EUMETSAT

ROM SAF

RADIO OCCULTATION METEOROLOGY

ROM SAF CDOP 4

Product Requirements Document

Version 1.1

22 November 2022

ROM SAF Consortium
Danish Meteorological Institute (DMI)
European Centre for Medium-Range Weather Forecasts (ECMWF)
Institut d'Estudis Espacials de Catalunya (IEEC)
Met Office (METO)
University of Graz, Wegener Center (UG-WEGC)

Ref: SAF/ROM/DMI/MGT/PRD/004

DOCUMENT AUTHOR TABLE

	Author(s)	*Function*	*Date*
Prepared by:	Kent B. Lauritsen	ROM SAF Project Manager	22/11 2022
Reviewed by (internal):			
Approved by:	Kent B. Lauritsen	ROM SAF Project Manager	22/11 2022

DOCUMENT CHANGE RECORD

Version	*Date*	*By*	*Description*
1.0	15/5 2022	KBL	First version based on ROM SAF CDOP 4 Proposal
1.1	22/11 2022	KBL	Updated version: - Editorial corrections in reprocessing RE1, RE2, RE3 tables This version is submitted to CDOP 4 SG02. **Approved as: ROM-CDOP4-SG02-Dec-04**

ROM SAF

The Radio Occultation Meteorology Satellite Application Facility (ROM SAF) is a decentralised processing centre under EUMETSAT which is responsible for operational processing of radio occultation (RO) data from the Metop, Metop-SG and Sentinel-6 satellites and radio occultation data from other missions. The ROM SAF delivers bending angle, refractivity, temperature, pressure, humidity, and other geophysical variables in near real-time for NWP users, as well as reprocessed Climate Data Records (CDRs) and Interim Climate Data Records (ICDRs) for users requiring a higher degree of homogeneity of the RO data sets. The CDRs and ICDRs are further processed into globally gridded monthly-mean data for use in climate monitoring and climate science applications.

The ROM SAF also maintains the Radio Occultation Processing Package (ROPP) which contains software modules that aid users wishing to process, quality-control and assimilate radio occultation data from any radio occultation mission into NWP and other models.

The ROM SAF Leading Entity is the Danish Meteorological Institute (DMI), with Cooperating Entities: i) European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading, United Kingdom, ii) Institut D'Estudis Espacials de Catalunya (IEEC) in Barcelona, Spain, iii) Met Office in Exeter, United Kingdom, and iv) and Wegener Center, University of Graz, in Graz, Austria. To get access to our products or to read more about the ROM SAF please go to: http://www.romsaf.org

Intellectual Property Rights

List of Contents

Executive Summary

This document presents the product requirements of the EUMETSAT Satellite Application Facility (SAF) on Radio Occultation Meteorology (ROM), hereinafter referred to as the ROM SAF.

The requirements expressed in this document represent the commitment of the ROM SAF Team for the development under the overall EPS, EPS-SG and Sentinel-6 end-user requirements within the Fourth Continuous Development and Operations Phase (CDOP 4) based on the cooperation agreement between the Leading Entity (DMI) and EUMETSAT. This document is under the authority of the Steering Group, which approves changes and modifications. Any changes substantially changing the product list or other major commitments would need the approval by EUMETSAT Delegate Bodies.

The Product Requirements Document (PRD) is the main reference document for all development related reviews (Requirements Reviews, Product Consolidation Reviews, Operational Readiness Reviews, and Delivery Readiness Reviews) and provides the end users of the ROM SAF with a vision of what can be expected at the end of the current ROM SAF phase.

1. Introduction

1.1 Purpose of the Document

This document presents the product requirements of the EUMETSAT Radio Occultation Meteorology (ROM) Satellite Application Facility (SAF), hereinafter referred to as the ROM SAF. The products requirements have been determined taking into consideration user-based requirements as specified in the GRAS SAF User Requirements Document [RD.1].

The requirements expressed in this document represent the commitment of the ROM SAF Team for the development under the overall EPS, EPS-SG and Sentinel-6 (previously known as Jason-CS) end-user requirements [AD.1, AD.2, AD.3] and within the Fourth Continuous Development and Operations Phase (CDOP 4) [AD.4] based on the Cooperation Agreement between the Leading Entity (DMI) and EUMETSAT [AD.5]. This document is under the authority of the Steering Group, which approves changes and modifications. Any changes substantially changing the product list or other major commitments would need the approval by EUMETSAT Delegate Bodies.

The Product Requirements Document (PRD) is the main reference document for all development related reviews (Requirements Reviews, Product Consolidation Reviews, Operational Readiness Reviews, and Delivery Readiness Reviews) and provides the end users of the ROM SAF with a vision of what can be expected at the end of the current ROM SAF phase.

The requirements stated in this document apply to the nominal mode of operations of the ROM SAF and/or central EUMETSAT ground segment. The nominal mode is characterised by the following:

- The EPS/Metop, EPS-SG, Sentinel-6 satellites and the ground segment are successfully commissioned and are in an operational status;
- The satellites are outside the outage periods related to manoeuvre and decontamination within its operational tolerances;
- The RO instruments are correctly functioning to requirements and is in its nominal operational mode;
- No satellite and ground segment anomaly impacts on the on-ground processing;
- The intra- and inter-SAF data flow and data production operate at the planned capacity and efficiency;

1.2 Applicable and Reference Documents

1.2.1 Applicable Documents

The following list contains documents with a direct bearing on the contents of this document.

[AD.1] EPS End-User Requirements Document; Ref: EPS/MIS/REQ/93001 Issue 4, Rev. 2, 13 October 1997 (also Annex I to EUM/C/36/97/DOC/54)

[AD.2] EPS-SG End User Requirements Document, Ref: EUM/PEPS/REQ/09/0151

[AD.3] Jason-CS/Sentinel-6 End-User Requirements Document, Ref: EUM/LEO-JASCS/REQ/12/0013

[AD.4] CDOP 4 Proposal: Proposal for the Fourth Continuous Development and Operations Phase (CDOP 4), Ref: SAF/ROM/DMI/MGT/CDOP4/001, Version 1.1, 5 April 2021, as approved by the EUMETSAT Council in document reference EUM/C/97/21/DOC/15

[AD.5] CDOP 4 Cooperation Agreement between EUMETSAT and DMI on the CDOP 4 of the ROM SAF (EUM/C/97/21/DOC/21), signed on 31 August and 15 September 2021

1.2.2 Reference Documents

The following documents provide supplementary or background information, and could be helpful in conjunction with this document.

[RD.1] GRAS SAF User Requirements Document Ref: SAF/GRAS/METOFFICE/RQ/URD/001, version 2.1, 5 November 2001

1.3 Acronyms and Abbreviations

BUFR	Binary Universal Format for the Representation of data (also FM94)
CDR	Climate Data Record
CGS	Core Ground Segment
DMI	Danish Meteorological Institute
ECMWF	The European Centre for Medium-range Weather Forecasts
EPS	EUMETSAT Polar satellite System)
EPS-SG	EUMETSAT Polar satellite System - Second Generation
EUMETSAT	European organisation for the exploitation of Meteorological Satellites
EURD	End Users Requirements Document
FM94	Form Number 94 (see BUFR)
GBGP	Ground Based GNSS Package
GLONASS	Globalnaya Navigatsionnaya Sputnikovaya Sistema
GM	Global Mission (for EPS-SG)
GNSS	Global Navigation Satellite Systems
GPAC	GNSS Processing and Archiving Center
GPS	Global Positioning System
GPS/MET	Global Positioning System/Meteorology Experiment on Microlab-1

GRAS	GNSS Receiver for Atmospheric Sounding
GRIB	Gridded Binary format
GTS	Global Telecommunication System
IEEC	Institut d'Estudis Espacials de Catalunya
LEO	Low Earth Orbit
Met Office	United Kingdom Meteorological Office
METOP	METeorological Operational Polar satellite
NetCDF	Network Common Data Form
NRT	Near-Real Time
NTC	Non Time Critical
NWP	Numerical Weather Prediction
POD	Precise Orbit Determination
RO	Radio Occultation
ROM SAF	Radio Occultation Meteorology SAF
ROPP	Radio Occultation Processing Package
RM	Regional Mission (for EPS-SG)
RMDCN	Regional Meteorological Data Communications Network
SAF	Satellite Application Facility
TBC	To Be Confirmed
TBD	To Be Determined or To Be Decided
VAR	Variational analysis (1D, 2D, 3D or 4D variants)
UG-WEGC	University of Graz, Wegener Center
WIS	World Information System
WMO	World Meteorological Organisation

1.4 Definitions

RO data products from the Metop, Metop-SG and Sentinel-6 satellites and RO data from other missions are grouped in data levels (level 0, 1, 2, or 3) and product types (NRT, Offline, NTC, CDR, or ICDR). The data levels and product types are defined below. The lists of variables should not be considered as the complete contents of a given data level, and not all data may be contained in a given data level.

Data levels:

Level 0: Raw sounding, tracking and ancillary data, and other GNSS data before clock correction and reconstruction;

Level 1A: Reconstructed full resolution excess phases, total phases, pseudo ranges, SNRs, orbit information, I, Q values, NCO (carrier) phases, navigation bits, scintillation parameters, and quality information;

Level 1B: Bending angles and impact parameters, tangent point location, total electron content, and quality information;

Level 2: Refractivity, geopotential height, "dry" temperature profiles (Level 2A), pressure, temperature, specific humidity profiles (Level 2B), surface pressure, tropopause height, planetary boundary layer height (Level 2C), ECMWF model level coefficients (Level 2D), electron densities, and quality information;

Level 3: Gridded or resampled data, that are processed from Level 1 or 2 data, and that are provided as, e.g., daily, monthly, or seasonal means on a spatiotemporal grid, including metadata, uncertainties and quality information.

Product types:

NRT: Data product delivered less than: (i) 3 hours after measurement (ROM SAF Level 2 for EPS); (ii) 150 min after measurement (ROM SAF Level 2 for EPS-SG Global Mission); (iii) 125 min after measurement (ROM SAF Level 2 for EPS-SG Regional Mission);

Offline, NTC: Data product delivered from about 5 days to up to 6 months after measurement, depending on the applicable requirements. The evolution of this type of product is driven by new scientific developments and subsequent product upgrades;

CDR: A (Fundamental or Thematic) Climate Data Record is generated from a dedicated reprocessing activity using a fixed set of processing software.[1] The data record covers an extended time period of several years (with a fixed end point) and constitutes a homogeneous data record appropriate for climate usage;

ICDR: An Interim Climate Data Record (ICDR) regularly extends in time a (Fundamental or Thematic) CDR using a system having optimum consistency with and lower latency than the system used to generate the CDR.[2]

[1] (i) GCOS 2016 Implementation Plan; (ii) http://climatemonitoring.info/home/terminology/

[2] http://climatemonitoring.info/home/terminology/ (the ICDR definition was endorsed at the 9th session of the joint CEOS/CGMS Working Group Climate Meeting on 29 March 2018)

1.5 Identification of Requirements

The requirements in this document are uniquely identified as follows:

PRD-mm-nn

where *mm* represents the requirements group identifier (deliverables) and *nn* is the group requirement number. The following group identifiers are used:

01 General, covering all products and services.
02 Near-real time sounding product
03 Offline, NTC and ICDR sounding product
04 Gridded products
05 Near-real time validation
06 Offline, NTC and ICDR validation
07 Gridded validation
08 Software deliverables
09 User and supporting services
10 Re-analysis dataset
11 Reprocessed data records

1.6 Overview of this document

The structure of the chapters of this document is as follows:

Chapter 1 contains the introduction and definitions.
Chapter 2 contains the list of all product requirements.
Chapter 3 contains the list of TBCs and TBDs.
Annex A contains tables with product requirements for all products.

2. Requirements

2.1 General

PRD-01-01 The ROM SAF shall have an operational capability to process EUMETSAT Secretariat CGS Level 1B data in near-real time from the RO instruments on Metop and Metop-SG to Level 2 products according to specifications in Annex A, Tables GRM-24, 24.1, 24.2, 26, 26.1, 26.2, 40 to 44, 60 to 64, 130 to 135, 150 to 155, 200.

PRD-01-02 The ROM SAF shall have an offline and NTC capability to process EUMETSAT Secretariat CGS Level 1A data from the RO instruments on Metop, Metop-SG and Sentinel-6 to Level 1B and Level 2 products according to specifications in Annex A, Tables GRM-24, 24.1, 24.2, 26, 26.1, 26.2, 46 to 51, 66 to 71, 103, 105, 117 to 122, 136 to 142, 156 to 162. This capability shall be used to regularly generate offline and NTC products and at certain key points, to re-process the complete Level 1B, 2, and 3 dataset up to that point to a common best-practice standard.

PRD-01-03 The ROM SAF shall have a capability to generate offline and NTC gridded products from data from the RO instruments on Metop, Metop-SG and Sentinel-6 for climate applications, according to the product specifications in Annex A, Tables GRM-53 to 59, 73 to 79, 83 to 89, 123 to 129, 143 to 149, 163 to 169, 183 to 189, 191 to 198.

PRD-01-04 The ROM SAF shall develop and maintain a software package (“ROPP”) to support user-assimilation of RO data in NWP models, according to specifications in Annex A, Table GRM-16, 16_v12, 16_v13.

PRD-01-05 ROM SAF near-real time, offline and climate data record products shall conform to netCDF standards for file formatting.

PRD-01-06 ROM SAF Level 2 products shall be made available to users within the timeliness requirements specified in the EPS and EPS-SG EURDs and via GTS and EUMETCast dissemination for NRT and via HTTP for offline.

PRD-01-07 All ROM SAF deliverables (products, datasets and software) shall be available to users according to EUMETSAT data policy.

PRD-01-08 An on-line catalogue of ROM SAF products shall be maintained as part of the EUMETSAT Data Centre to enable offline bulk data ordering.

PRD-01-09 ROM SAF shall archive its products for a period of no less than 10 years after the end of the EPS/Metop mission.

PRD-01-10 Archived products shall be capable of extraction, with no degradation to the original product quality, on user request, ordered via the EUMETSAT Data Centre.

PRD-01-11 Archived products shall be capable of extraction, with no degradation to the original product quality, on user request, ordered via the ROM SAF Product Archive.

PRD-01-12 Archived products shall be available to users in the same file formats as used for the original data.

PRD-01-13 The ROM SAF shall develop and maintain a software package (“GBGP”) containing tools for formatting of GNSS ground-based data, according to

specifications in Annex A, Table GRM-92.

2.2 Near-Real Time Sounding Products

PRD-02-01 NRT Sounding products shall contain all required Level 2 parameters (including date, time and geodetic location, error estimates and quality control flagging). Level 2 NRT product parameter specifications are as presented in Annex A, Tables GRM-24, 24.1, 24.2, 26, 26.1, 26.2, 40 to 44, 60 to 64, 130 to 135, 150 to 155, 200.

PRD-02-02 NRT Sounding products shall contain a sub-set of required Level 1 parameters selected from EUMETSAT Secretariat CGS NRT products (from which the Level 2 product are derived), including: thinned profiles of bending angle, impact parameters, geographical location, position and velocity data.

PRD-02-03 Of those Level 1B NRT products with correct instrument operation and available to the ROM SAF within: (i) 2h 15min (EPS), (ii) 70 min (EPS-SG GM), (iii) 30 min (EPS-SG RM), more than 95% shall be processed to Level 2 products and disseminated to users within the following SAF Level 2 breakthrough values calculated from end of sensing time: (i) 3 hours, (ii) 150 min, (iii) 125 min. This availability rate shall be calculated over a 1 month period.

PRD-02-04 NRT sounding products shall be disseminated via GTS, RMDCN and EUMETCast.

PRD-02-05 NRT sounding products disseminated via GTS or RMDCN shall use WMO FM94 (BUFR) encoded format. Dissemination over EUMETCast shall use BUFR or netCDF.

PRD-02-07 The near real-time sounding products shall be archived within the ROM SAF leading entity.

2.3 Offline and NTC Sounding Products

PRD-03-01 Offline and NTC products shall be generated to take advantage of RO NRT data not meeting the timeliness requirements for NRT products and with the offline and NTC products fulfilling Level 1B and 2 product parameter specifications as presented in Annex A, Tables GRM-24, 24.1, 24.2, 26, 26.1, 26.2, 46 to 51, 66 to 71, 103, 105, 117 to 122, 136 to 142, 156 to 162.

PRD-03-02 The ROM SAF shall have the capability to process data from RO instruments other than onboard EUMETSAT missions in order to generate offline and NTC Level 1B and Level 2 products to the same specification (within the limits of the available data) as the EUMETSAT missions RO products.

PRD-03-03 Offline and NTC products shall at least contain identical parameters to the near-real time products.

PRD-03-04 All available offline and NTC occultation events with correct instrument operation shall be processed to Level 1B and Level 2 sounding products and shall be available to users within 30 days to 6 months of observation time. This availability rate shall be calculated over a 1 month period.

PRD-03-05 Offline and NTC products shall be made available to users via HTTP using the file

formats netCDF and BUFR.

PRD-03-06 The offline and NTC sounding products shall be archived within the ROM SAF leading entity.

PRD-03-07 More than 95% of all generated Sentinel-6 Level 2 NTC products shall be available to users within 60 days of observation time. This availability rate shall be calculated over a 1-year period.

2.4 Gridded Products

PRD-04-01 Gridded products shall be generated from best-quality offline and NTC products from Metop/GRAS, Metop-SG, Sentinel-6 and other RO receivers that are readily available and have high enough quality. Gridded product parameter specifications are as presented in Annex A, Tables GRM-53 to 59, 73 to 79, 83 to 89, 123 to 129, 143 to 149, 163 to 169, 183 to 189, 191 to 198.

PRD-04-02 Gridded products shall contain gridded monthly means together with estimates of corresponding errors and contain meta-data providing traceability to the individual occultations and software versions.

PRD-04-03 Gridded products shall be made available to users via HTTP using the file format netCDF.

PRD-04-04 The gridded products shall be archived within the ROM SAF leading entity.

2.5 Near-Real Time Validation

PRD-05-01 The ROM SAF shall generate, and make publicly available, validation information supporting available RO NRT sounding products using information obtained from Met Office and ECMWF NWP fields and RO measurements from Metop, Metop-SG, Sentinel-6, COSMIC, COSMIC-2, CHAMP, GRACE, TanDEM-X, TerraSAR-X, FY-3 (GNOS).

PRD-05-02 The ROM SAF shall generate (for use only by team members and EUMETSAT) validation and monitoring information on the GPAC NRT product processing.

PRD-05-03 Validation shall include statistics on the quantity of products.

PRD-05-04 The validation domain shall be global and over the full vertical domain of the NRT products.

PRD-05-05 Validation statistics shall be generated with a time resolution of 1 day and 1 month, including Metop commissioning periods.

PRD-05-06 Metop/GRAS and Metop-SG NRT product validation information shall be made publicly available via the project's website.

PRD-05-07 The ROM SAF shall also validate data available in NRT from other available RO instruments and present the same information, and in the same way, as for Metop and Metop-SG.

PRD-05-08 The NRT product validation information shall be archived within the ROM SAF leading entity.

2.6 Offline and NTC Validation

PRD-06-01 The ROM SAF shall generate, and make publicly available, validation information supporting available RO offline and NTC sounding products using information obtained from NWP fields.

PRD-06-02 The ROM SAF shall generate (for use only by team members and EUMETSAT) validation and monitoring information on the GPAC offline and NTC product processing.

PRD-06-03 Validation shall include statistics on the quantity of products.

PRD-06-04 The validation domain shall be global and over the full vertical domain of the offline and NTC products.

PRD-06-05 Validation statistics shall be generated with a time resolution of 1 calendar month, excluding Metop commissioning periods.

PRD-06-06 Offline and NTC product validation information shall be made available via the project's website.

PRD-06-07 The offline and NTC product validation information shall be archived within the ROM SAF leading entity.

2.7 Gridded Validation

PRD-07-01 The ROM SAF shall generate, and make publicly available, validation information supporting gridded products.

PRD-07-02 The ROM SAF shall generate (for use only by team members and EUMETSAT) validation and monitoring information on the GPAC gridded product processing.

PRD-07-03 Validation shall include statistics on the quantity of products.

PRD-07-04 The validation domain shall be global and over the full vertical domain of the gridded products.

PRD-07-05 Validation statistics shall be generated with a time resolution of 1 calendar month and based on full length of data sets.

PRD-07-06 Gridded product validation information shall be made available via the project's website.

PRD-07-07 The gridded product validation information shall be archived within the ROM SAF leading entity.

PRD-07-08 The ROM SAF shall generate metrics to monitor the stability of gridded data in time.

PRD-07-09 The ROM SAF shall generate time series for the whole length of the data set and make it available at the web site.

2.8 Software Deliverables

ROM SAF deliverables include software to support user applications, such as 1D-Var code and RO observation operators for NWP assimilation, pre-processing algorithms and supporting code for interfacing with various standard file formats. Collectively, this deliverable is known as the 'Radio Occultation processing Package' (ROPP). The software deliverables also include tools for formatting Ground-based GNSS data; this deliverable is known as the "Ground Based GNSS Package" (GBGP).

PRD-08-01 The ROM SAF shall make available the ROPP software deliverable according to the specifications in Annex A, Table GRM-16, 16_v12, 16_v13. This package shall include key user documentation describing the software deliverable, and shall include: Release notes, User Guide and Reference Manual(s).

PRD-08-02 The ROM SAF shall support user assimilation in NWP models by the provision of associated observation error covariance matrices appropriate to the ROM SAF Level 2 products.

PRD-08-03 Software deliverables shall be coded in ISO-standard high-level languages (principally Fortran-95) and shall follow programming standards guidelines. The code shall be designed to be portable so as to be capable of being built, installed and run on a variety of different POSIX-compliant platforms and compilers.

PRD-08-04 The ROM SAF shall make the software deliverable and associated supporting documentation and datasets available (to registered users) for download from the project website.

PRD-08-05 The ROPP software deliverable shall continue to be developed and maintained by the ROM SAF. Maintenance activity shall include fixes to programming errors, improvements to code efficiency, and developments supporting improved scientific processing in response to evolving Product Requirements. Updates resulting from development & maintenance shall be released to users according to plans.

PRD-08-06 The ROM SAF shall make available the GBGP software deliverable according to the specifications in Annex A, Table GRM-92. This package shall include key user documentation describing the software deliverable, and shall include: Release notes, User Guide and Reference Manual(s).

PRD-08-07 The GBGP software deliverable shall continue to be maintained by the ROM SAF. Maintenance activity shall include fixes to programming errors.

PRD-08-08 The ROPP software shall contain low-level utility routines (geodesy calculations, date/time conversion, coordinate transformations, error messages).

PRD-08-09 The ROPP software shall contain I/O routines (support for intrinsic ROPP netCDF data structure, and its conversion to and from BUFR, tools to read UCAR, GFZ and EUMETSAT Leve1b data in their proprietary formats, ability to process data from the missions listed below, tool to extract background profiles from GRIB files, range-checking, profile thinning).

PRD-08-10 The ROPP software shall contain pre-processing routines (tools to generate L1 and L2 channel bending angles from excess phase and amplitude, and to compute ionospheric corrected bending angle and refractivity profiles from L1 and L2 bending angles, 1D and 2D wave optics propagation codes).

PRD-08-11 The ROPP software shall contain forward modelling routines (tools to generate

refractivities and bending angles from background profiles produced by ECMWF and Met Office models, 1D refractivity operator, 1D and 2D bending angle operators, routines to calculate electron density and L2-L1 bending angle profiles for idealised ionospheres, tangent linear and adjoint counterparts for use in 1D-Var).

PRD-08-12 The ROPP software shall contain 1D-Var routines (tools to retrieve solution profiles from ECMWF and Met Office models and refractivity and bending angle profiles, tools to retrieve electron density profiles from L2-L1 bending angle differences, quality control, minimisers, solution diagnostics).

PRD-08-13 The ROPP software shall contain applications routines (tools to diagnose tropopause height and boundary layer height from profiles of a variety of observational and model variables).

PRD-08-14 The ROPP software shall be tested on the following platforms and compilers:

(i) All 'compile', 'run' and 'regression' tests shall be carried out on one compiler (probably either gfortran or ifort).
(ii) All 'compile' and all 'run' tests must be performed with at least two compilers (probably ifort and gfortran).
(iii) All 'compile' tests must be performed on at least two platforms (probably linux and Cygwin).
(iv) All 'compile' tests must be performed with at least five compilers.

PRD-08-15 The ROPP software shall be tested through verification and validation methods (“Test Folder”) as follows:

(i) Coding and compilation testing (compliance to coding standards; tests of basic functionality ('core tests') on at least 6 commonly available compilers and at least two platforms);
(ii) Module testing for the I/O module (test reading and writing of data is within tolerances, test unit conversion);
(iii) Integration testing for the pre-processing module (test Abel transform, ionospheric correction, excess phase processing, wave optics propagators);
(iv) Integration testing for the forward modelling module (test computed refractivities and bending angles from ECMWF and Met Office background temperature, water vapour and pressure, against independently generated profiles, including at least one test of a full day of data);
(v) Integration testing for the 1D-Var module (test the propriety of the input data, sensitivity to assumed errors, retrievals using real observational data from a variety of sources, including at least one test of a full day of data);
(vi) Integration testing for the applications module (calculated TPH and PBLHs compared against independently calculated reference values);
(vii) Regression testing (for each module, the results of one test are closely compared against those of the immediately preceding ROPP release);
(viii) Portability testing (check that at least one compiler passes as many tests as the default compiler);
(ix) Timing testing (check that code runs in reasonable times on differer compilers and platforms);
(x) Documentation testing (check that user guides and reference manuals are clear and correct).

2.9 User and Supporting Services

ROM SAF deliverables include information services such as user documentation, education and Helpdesk and other web-based resources for SAF products, plus supporting users through holding workshops and providing opportunities under the SAF Visiting Scientist programme.

PRD-09-01 The ROM SAF shall establish and maintain a project website as a service to users. This user service shall include (but not be limited to) news and announcements about, and information and documentation on, ROM SAF products, validation, software and data sets; technical and scientific reports; announcements of seminars, workshops, and visiting scientist opportunities; information on how to contact the SAF; and shall allow a user to search the product catalogue for quick-view and to order products and data sets.

PRD-09-02 The ROM SAF website shall be hosted by the leading entity and shall be an operational element of the ROM SAF, with a maximum of one interruption per week and with an interruption time of one working day as a maximum.

PRD-09-03 The website shall implement a user interface function (Helpdesk) for users to report problems, request help or give other feedback. The Helpdesk facility shall track user interactions, and shall acknowledge receipt of a new contact by automated response. Helpdesk shall answer at least 90% of requests within 3 working days. Resolution of an issue depends on its complexity, and is thus not guaranteed.

PRD-09-04 Access to ROM SAF products (data, software) shall require the user to first register their details.

PRD-09-05 User Services shall include a User Notification service as an option for registered users to be notified by email of changes to operational or offline products, software or data sets or on their availability via the website, GTS/RMDCN or EUMETCast as appropriate to the user.

PRD-09-06 Access to ROM SAF software deliverables shall require the user to agree to a User Licence.

PRD-09-07 Information on the availability, quality and web access statistics, of ROM SAF deliverables shall be reported in a ROM SAF half-yearly Operations Report.

PRD-09-08 The ROM SAF shall organise and hold ROM SAF User and Training Workshop(s).

PRD-09-09 The ROM SAF shall encourage and conduct Visiting Scientist activities aimed at improving the information exchange between the ROM SAF team and the scientific community, and at improving the science in, and promoting the use of, ROM SAF deliverables.

2.10 Re-Analysis Dataset

PRD-10-01 With the ERA5 system, ECMWF generates a GNSS-RO global reanalysis dataset for the 2007-2015 period by assimilating reprocessed GNSS-RO measurements and conventional measurements that do not require bias correction. The reprocessed measurements is provided by ECMWF as part of the ERA CLIM project.

PRD-10-02 The processing uses the ECMWF reanalysis system run at T159 resolution, to

produce daily, gridded reanalyses at 00Z and 12Z. The daily reanalyses and the corresponding departure statistics of both active and passive observations are archived.

PRD-10-03 The quality of the dataset is monitored using the departure statistics with respect to both active and passive observations, and by comparison with other global reanalyses.

PRD-10-04 Three dimensional and zonally averaged Monthly Mean Climatologies (MMCs) of various variables, including temperature, humidity and geopotential height, is derived from the daily reanalyses. Time-series of climate indicators are computed, stored and made available to users.

PRD-10-05 The dataset and derived data are archived at ECMWF.

PRD-10-06 The dataset and derived data is made available to users in standard formats, such as GRIB fields, via appropriate links such as at the ROM SAF web site.

2.11 Climate Data Records

PRD-11-01 Reprocessed climate data records shall be generated to take advantage of improved algorithms not available at the original time of processing. Original products are the ROM SAF Offline and NTC Level 1B, 2 and 3 products. Product parameter specifications for reprocessed data records are as presented in Annex A, Tables GRM-28-R1, 29-R1, 30-R1, 32-R1, 33-R1; GRM-28-R2, 29-R2, 30-R2, 31-R2, 32-R2, 33-R2; GRM-28-R3, 29-R3, 30-R3, 31-R3, 32-R3, 33-R3, 34-R3, 35-R3.

PRD-11-02 The ROM SAF shall have the capability to reprocess data from RO instruments from COSMIC, COSMIC-2, GRACE, CHAMP to generate reprocessed Level 1B, 2, and 3 climate data records to the same specification (within the limits of the available data) as the Metop/GRAS products.

PRD-11-03 Reprocessed climate data records shall contain identical parameters to the original products.

PRD-11-04 Reprocessed climate data records shall be made available to users via appropriate links, channels or media using standard file formats such as netCDF and BUFR.

PRD-11-05 Reprocessed climate data records shall be archived within the ROM SAF leading entity.

PRD-11-06 Reprocessed climate data records shall be made available to users via HTTP using the file formats netCDF and BUFR.

PRD-11-07 The ROM SAF shall generate (for use only by team members and EUMETSAT) validation and monitoring information on the GPAC reprocessing.

PRD-11-08 Validation shall include statistics on the quantity of products and on their improvement with respect to the original products.

PRD-11-09 The validation domain shall be global and over the full vertical domain of the reprocessed climate data records.

PRD-11-10 Reprocessed climate data records validation information shall be made available

via the project's website.

PRD-11-11 Reprocessed climate data records validation information shall be archived within the ROM SAF leading entity.

PRD-11-12 Validation statistics for reprocessed climate data records shall be generated with a time resolution of 1 calendar month and based on full length of data sets.

PRD-11-13 The ROM SAF shall generate reprocessed time series for the whole length of the climate data records and make it available at the web site.

PRD-11-14 Reprocessed climate data records shall be extended in time using the same software as used in the generation of the CDRs and allow for the generation of Interim CDRs. Product parameter specifications for reprocessed data records are as presented in Annex A, Tables GRM-29-I1, 29-I2, 29-I3.

PRD-11-15 Interim CDRs shall be monitored similarly to the monitoring of Offline and NTC profile and gridded products as described in requirements PRD-06-01 to PRD-06-07 and PRD-07-01 to PRD-07-09.

3. List of TBDs and TBCs

Annex A, table GRM-26: PBLH requirements (TBD)

Annex A, table GRM-170 to 173: Ionosphere products for EPS-SG (TBD)

ANNEX A. Product Specifications

The following tables summarize the specifications for each ROM SAF deliverable product.

A1. Definitions:

Threshold Accuracy	The minimum accuracy limit which is needed, so that the product is considered being useful for some user groups
Target Accuracy	The product accuracy that is targeted in the development and the reference in product quality before the (pre-) operational product generation and dissemination.
Optimal Accuracy	The accuracy that can be reached under optimal conditions.

The interpretation, definition and validation approach of accuracy for a given product is described under the verification and validation method in the following tables.

A2. Product Levels and Groups:

ROM SAF products are divided into the following groups:

- Level 1B Bending Angle (GRM-46, 66, 136, 156)
- Level 2A Refractivity (GRM-40, 47, 60, 67, 117, 130, 137, 150, 157)
- Level 2A Dry temperature (GRM-103, 105)
- Level 2B, 2C Temperature, Pressure, and Humidity (GRM-41 to 44, 48 to 51, 61 to 64, 68 to 71, 118 to 121, 131 to 134, 138 to 141, 151 to 154, 158 to 161)
- Level 2C Tropopause Height (GRM-24, 24.1, 24.2)
- Level 2C Planetary Boundary Layer Height (GRM-26, 26.1, 26.2)
- Level 3 Gridded Data (GRM-53 to 59, 73 to 79, 83 to 89, 123 to 129, 143 to 149, 163 to 169, 191 to 198)
- Climate Data Records (GRM-28-R1, 29-R1, 30-R1, 32-R1, 33-R1; GRM-28-R2, 29-R2, 30-R2, 32-R2, 33-R2; GRM-28-R2, 29-R3, 30-R3, 31-R3, 32-R3, 33-R3, 34-R3, 35-R3)
- ICDR products (GRM-29-I1, 29-I2, 29-I3)
- ROPP software (GRM-16, 16_v12, 16_v13)
- GBGP software (GRM-92)
- Ionosphere products (GRM-170 to 173)
- Verification product (GRM-200)

A3. Overview list of sub GRM-ids for climate data records:

Product ID	*Product Name*	*Product Acronym*
GRM-28-R1 GRM-28-R2 GRM-28-R3	**Reprocessed Multi-Mission climate data record (Metop, COSMIC, CHAMP, GRACE L3)**	**REPMUL**
GRM-28-L3-B-R1/R2/R3	Reprocessed Bending Angle Grid	RBGMUL
GRM-28-L3-R-R1/R2/R3	Reprocessed Refractivity Grid	RRGMUL
GRM-28-L3-D-R1/R2/R3	Reprocessed Dry Temperature Grid	RDGMUL
GRM-28-L3-Y-R1/R2/R3	Reprocessed Dry Pressure Grid	RYGMUL
GRM-28-L3-Z-R1/R2/R3	Reprocessed Dry Geopotential Height Grid	RZGMUL
GRM-28-L3-T-R1/R2/R3	Reprocessed Temperature Grid	RTGMUL
GRM-28-L3-H-R1/R2/R3	Reprocessed Specific Humidity Grid	RHGMUL
GRM-28-L3-C-R1/R2/R3	Reprocessed Tropopause Height Grid	RCGMUL
GRM-28-L3-L-R2/R3	Reprocessed Planetary Boundary Layer Height Grid	RLGMUL
GRM-29-R1 GRM-29-R2 GRM-29-R3	**Reprocessed Metop dataset climate data record (Metop-A/B L1, L2, L3)**	**REPMET**
GRM-29-L1-B-R1/R2/R3	Reprocessed Bending Angle	RBAMET
GRM-29-L2-R-R1/R2/R3	Reprocessed Refractivity Profile	RRPMET
GRM-29-L2-D-R1/R2/R3	Reprocessed Dry Temperature Profile	RDPMET
GRM-29-L2-T-R1/R2/R3	Reprocessed Temperature Profile	RTPMET
GRM-29-L2-H-R1/R2/R3	Reprocessed Specific Humidity Profile	RHPMET
GRM-29-L2-P-R1/R2/R3	Reprocessed Pressure Profile	RPPMET
GRM-29-L2-S-R1/R2/R3	Reprocessed Surface Pressure	RSPMET
GRM-29-L2-C-R1/R2/R3	Reprocessed Tropopause Height	RCHMET
GRM-29-L2-L-R1/R2/R3	Reprocessed Planetary Boundary Layer Height	RLHMET
GRM-29-L3-B-R1/R2/R3	Reprocessed Bending Angle Grid	RBGMET
GRM-29-L3-R-R1/R2/R3	Reprocessed Refractivity Grid	RRGMET
GRM-29-L3-D-R1/R2/R3	Reprocessed Dry Temperature Grid	RDGMET
GRM-29-L3-Y-R1/R2/R3	Reprocessed Dry Pressure Grid	RYGMET
GRM-29-L3-Z-R1/R2/R3	Reprocessed Dry Geopotential Height Grid	RZGMET
GRM-29-L3-T-R1/R2/R3	Reprocessed Temperature Grid	RTGMET
GRM-29-L3-H-R1/R2/R3	Reprocessed Specific Humidity Grid	RHGMET
GRM-29-L3-C-R1/R2/R3	Reprocessed Tropopause Height Grid	RCGMET
GRM-29-L3-L-R2/R3	Reprocessed Planetary Boundary Layer Height Grid	RLGMET
GRM-30-R1 GRM-30-R2 GRM-30-R3	**Reprocessed COSMIC-1 climate data record (COSMIC-1 L1, L2, L3)**	**REPCO1**
GRM-30-L1-B-R1/R2/R3	Reprocessed Bending Angle	RBACO1
GRM-30-L2-R-R1/R2/R3	Reprocessed Refractivity Profile	RRPCO1
GRM-30-L2-D-R1/R2/R3	Reprocessed Dry Temperature Profile	RDPCO1
GRM-30-L2-T-R1/R2/R3	Reprocessed Temperature Profile	RTPCO1

Product ID	*Product Name*	*Product Acronym*
GRM-30-L2-H-R1/R2/R3	Reprocessed Specific Humidity Profile	RHPCO1
GRM-30-L2-P-R1/R2/R3	Reprocessed Pressure Profile	RPPCO1
GRM-30-L2-S-R1/R2/R3	Reprocessed Surface Pressure	RSPCO1
GRM-30-L2-C-R1/R2/R3	Reprocessed Tropopause Height	RCHCO1
GRM-30-L2-L-R1/R2/R3	Reprocessed Planetary Boundary Layer Height	RLHCO1
GRM-30-L3-B-R1/R2/R3	Reprocessed Bending Angle Grid	RBGCO1
GRM-30-L3-R-R1/R2/R3	Reprocessed Refractivity Grid	RRGCO1
GRM-30-L3-D-R1/R2/R3	Reprocessed Dry Temperature Grid	RDGCO1
GRM-30-L3-Y-R1/R2/R3	Reprocessed Dry Pressure Grid	RYGCO1
GRM-30-L3-Z-R1/R2/R3	Reprocessed Dry Geopotential Height Grid	RZGCO1
GRM-30-L3-T-R1/R2/R3	Reprocessed Temperature Grid	RTGCO1
GRM-30-L3-H-R1/R2/R3	Reprocessed Specific Humidity Grid	RHGCO1
GRM-30-L3-C-R1/R2/R3	Reprocessed Tropopause Height Grid	RCGCO1
GRM-30-L3-L-R2/R3	Reprocessed Planetary Boundary Layer Height Grid	RLGCO1
GRM-31-R3	**Reprocessed COSMIC-2 climate data record (COSMIC-2 L1, L2, L3)**	**REPCO2**
GRM-31-L1-B-R3	Reprocessed Bending Angle	RBACO2
GRM-31-L2-R-R3	Reprocessed Refractivity Profile	RRPCO2
GRM-31-L2-D-R3	Reprocessed Dry Temperature Profile	RDPCO2
GRM-31-L2-T-R3	Reprocessed Temperature Profile	RTPCO2
GRM-31-L2-H-R3	Reprocessed Specific Humidity Profile	RHPCO2
GRM-31-L2-P-R3	Reprocessed Pressure Profile	RPPCO2
GRM-31-L2-S-R3	Reprocessed Surface Pressure	RSPCO2
GRM-31-L2-C-R3	Reprocessed Tropopause Height	RCHCO2
GRM-31-L2-L-R3	Reprocessed Planetary Boundary Layer Height	RLHCO2
GRM-31-L3-B-R3	Reprocessed Bending Angle Grid	RBGCO2
GRM-31-L3-R-R3	Reprocessed Refractivity Grid	RRGCO2
GRM-31-L3-D-R3	Reprocessed Dry Temperature Grid	RDGCO2
GRM-31-L3-Y-R3	Reprocessed Dry Pressure Grid	RYGCO2
GRM-31-L3-Z-R3	Reprocessed Dry Geopotential Height Grid	RZGCO2
GRM-31-L3-T-R3	Reprocessed Temperature Grid	RTGCO2
GRM-31-L3-H-R3	Reprocessed Specific Humidity Grid	RHGCO2
GRM-31-L3-C-R3	Reprocessed Tropopause Height Grid	RCGCO2
GRM-31-L3-L-R3	Reprocessed Planetary Boundary Layer Height Grid	RLGCO2
GRM-32-R1 **GRM-32-R2** **GRM-32-R3**	**Reprocessed CHAMP climate data record (CHAMP L1, L2, L3)**	**REPCHA**
GRM-32-L1-B-R1/R2/R3	Reprocessed Bending Angle	RBACHA
GRM-32-L2-R-R1/R2/R3	Reprocessed Refractivity Profile	RRPCHA
GRM-32-L2-D-R1/R2/R3	Reprocessed Dry Temperature Profile	RDPCHA
GRM-32-L2-T-R1/R2/R3	Reprocessed Temperature Profile	RTPCHA

Product ID	*Product Name*	*Product Acronym*
GRM-32-L2-H-R1/R2/R3	Reprocessed Specific Humidity Profile	RHPCHA
GRM-32-L2-P-R1/R2/R3	Reprocessed Pressure Profile	RPPCHA
GRM-32-L2-S-R1/R2/R3	Reprocessed Surface Pressure	RSPCHA
GRM-32-L2-C-R1/R2/R3	Reprocessed Tropopause Height	RCHCHA
GRM-32-L2-L-R1/R2/R3	Reprocessed Planetary Boundary Layer Height	RLGCHA
GRM-32-L3-B-R1/R2/R3	Reprocessed Bending Angle Grid	RBGCHA
GRM-32-L3-R-R1/R2/R3	Reprocessed Refractivity Grid	RRGCHA
GRM-32-L3-D-R1/R2/R3	Reprocessed Dry Temperature Grid	RDGCHA
GRM-32-L3-Y-R1/R2/R3	Reprocessed Dry Pressure Grid	RYGCHA
GRM-32-L3-Z-R1/R2/R3	Reprocessed Dry Geopotential Height Grid	RZGCHA
GRM-32-L3-T-R1/R2/R3	Reprocessed Temperature Grid	RTGCHA
GRM-32-L3-H-R1/R2/R3	Reprocessed Specific Humidity Grid	RHGCHA
GRM-32-L3-C-R1/R2/R3	Reprocessed Tropopause Height Grid	RCGCHA
GRM-32-L3-L-R2/R3	Reprocessed Planetary Boundary Layer Height Grid	RLGCHA
GRM-33-R1 **GRM-33-R2** **GRM-33-R3**	**Reprocessed GRACE climate data record (GRACE L1, L2, L3)**	**REPGRA**
GRM-33-L1-B-R1/R2/R3	Reprocessed Bending Angle	RBAGRA
GRM-33-L2-R-R1/R2/R3	Reprocessed Refractivity Profile	RRPGRA
GRM-33-L2-D-R1/R2/R3	Reprocessed Dry Temperature Profile	RDPGRA
GRM-33-L2-T-R1/R2/R3	Reprocessed Temperature Profile	RTPGRA
GRM-33-L2-H-R1/R2/R3	Reprocessed Specific Humidity Profile	RHPGRA
GRM-33-L2-P-R1/R2/R3	Reprocessed Pressure Profile	RPPGRA
GRM-33-L2-S-R1/R2/R3	Reprocessed Surface Pressure	RSPGRA
GRM-33-L2-C-R1/R2/R3	Reprocessed Tropopause Height	RCHGRA
GRM-33-L2-L-R1/R2/R3	Reprocessed Planetary Boundary Layer Height	RLGGRA
GRM-33-L3-B-R1/R2/R3	Reprocessed Bending Angle Grid	RBGGRA
GRM-33-L3-R-R1/R2/R3	Reprocessed Refractivity Grid	RRGGRA
GRM-33-L3-D-R1/R2/R3	Reprocessed Dry Temperature Grid	RDGGRA
GRM-33-L3-Y-R1/R2/R3	Reprocessed Dry Pressure Grid	RYGGRA
GRM-33-L3-Z-R1/R2/R3	Reprocessed Dry Geopotential Height Grid	RZGGRA
GRM-33-L3-T-R1/R2/R3	Reprocessed Temperature Grid	RTGGRA
GRM-33-L3-H-R1/R2/R3	Reprocessed Specific Humidity Grid	RHGGRA
GRM-33-L3-C-R1/R2/R3	Reprocessed Tropopause Height Grid	RCGGRA
GRM-33-L3-L-R2/R3	Reprocessed Planetary Boundary Layer Height Grid	RLGGRA
GRM-34-R3	**Reprocessed Sentinel-6 climate data record (Sentinel-6 L1, L2, L3)**	**REPSEN**
GRM-34-L1-B-R3	Reprocessed Bending Angle	RBASEN
GRM-34-L2-R-R3	Reprocessed Refractivity Profile	RRPSEN
GRM-34-L2-D-R3	Reprocessed Dry Temperature Profile	RDPSEN
GRM-34-L2-T-R3	Reprocessed Temperature Profile	RTPSEN

Product ID	*Product Name*	*Product Acronym*
GRM-34-L2-H-R3	Reprocessed Specific Humidity Profile	RHPSEN
GRM-34-L2-P-R3	Reprocessed Pressure Profile	RPPSEN
GRM-34-L2-S-R3	Reprocessed Surface Pressure	RSPSEN
GRM-34-L2-C-R3	Reprocessed Tropopause Height	RCHSEN
GRM-34-L2-L-R3	Reprocessed Planetary Boundary Layer Height	RLGSEN
GRM-34-L3-B-R3	Reprocessed Bending Angle Grid	RBGSEN
GRM-34-L3-R-R3	Reprocessed Refractivity Grid	RRGSEN
GRM-34-L3-D-R3	Reprocessed Dry Temperature Grid	RDGSEN
GRM-34-L3-Y-R3	Reprocessed Dry Pressure Grid	RYGSEN
GRM-34-L3-Z-R3	Reprocessed Dry Geopotential Height Grid	RZGSEN
GRM-34-L3-T-R3	Reprocessed Temperature Grid	RTGSEN
GRM-34-L3-H-R3	Reprocessed Specific Humidity Grid	RHGSEN
GRM-34-L3-C-R3	Reprocessed Tropopause Height Grid	RCGSEN
GRM-34-L3-L-R3	Reprocessed Planetary Boundary Layer Height Grid	RLGSEN
GRM-35-R3	**Reprocessed FY-3 climate data record (FY-3 L1, L2, L3)**	**REPFY3**
GRM-35-L1-B-R3	Reprocessed Bending Angle	RBAFY3
GRM-35-L2-R-R3	Reprocessed Refractivity Profile	RRPFY3
GRM-35-L2-D-R3	Reprocessed Dry Temperature Profile	RDPFY3
GRM-35-L2-T-R3	Reprocessed Temperature Profile	RTPFY3
GRM-35-L2-H-R3	Reprocessed Specific Humidity Profile	RHPFY3
GRM-35-L2-P-R3	Reprocessed Pressure Profile	RPPFY3
GRM-35-L2-S-R3	Reprocessed Surface Pressure	RSPFY3
GRM-35-L2-C-R3	Reprocessed Tropopause Height	RCHFY3
GRM-35-L2-L-R3	Reprocessed Planetary Boundary Layer Height	RLGFY3
GRM-35-L3-B-R3	Reprocessed Bending Angle Grid	RBGFY3
GRM-35-L3-R-R3	Reprocessed Refractivity Grid	RRGFY3
GRM-35-L3-D-R3	Reprocessed Dry Temperature Grid	RDGFY3
GRM-35-L3-Y-R3	Reprocessed Dry Pressure Grid	RYGFY3
GRM-35-L3-Z-R3	Reprocessed Dry Geopotential Height Grid	RZGFY3
GRM-35-L3-T-R3	Reprocessed Temperature Grid	RTGFY3
GRM-35-L3-H-R3	Reprocessed Specific Humidity Grid	RHGFY3
GRM-35-L3-C-R3	Reprocessed Tropopause Height Grid	RCGFY3
GRM-35-L3-L-R3	Reprocessed Planetary Boundary Layer Height Grid	RLGFY3

A3. Overview list of all sub GRM-ids for ICDRs:

Product ID	*Product Name*	*Product Acronym*
GRM-29-I1 GRM-29-I2 GRM-29-I3	**Metop Interim Climate Data Record (Data Levels L1B, L2, L3)**	**ICDRMET**
GRM-29-L1-B-I1/I2/I3	ICDR Bending Angle	IBAMET
GRM-29-L2-R-I1/I2/I3	ICDR Refractivity Profile	IRPMET
GRM-29-L2-D-I1/I2/I3	ICDR Dry Temperature Profile	IDPMET
GRM-29-L2-T-I1/I2/I3	ICDR Temperature Profile	ITPMET
GRM-29-L2-H-I1/I2/I3	ICDR Specific Humidity Profile	IHPMET
GRM-29-L2-P-I1/I2/I3	ICDR Pressure Profile	IPPMET
GRM-29-L2-S-I1/I2/I3	ICDR Surface Pressure	ISPMET
GRM-29-L2-C-I1/I2/I3	ICDR Tropopause Height	ICHMET
GRM-29-L2-L-I2/I3	ICDR Planetary Boundary Layer Height	ILHMET
GRM-29-L3-B-I1/I2/I3	ICDR Bending Angle Grid	IBGMET
GRM-29-L3-R-I1/I2/I3	ICDR Refractivity Grid	IRGMET
GRM-29-L3-D-I1/I2/I3	ICDR Dry Temperature Grid	IDGMET
GRM-29-L3-Y-I1/I2/I3	ICDR Dry Pressure Grid	IYGMET
GRM-29-L3-Z-I1/I2/I3	ICDR Dry Geopotential Height Grid	IZGMET
GRM-29-L3-T-I1/I2/I3	ICDR Temperature Grid	ITGMET
GRM-29-L3-H-I1/I2/I3	ICDR Specific Humidity Grid	IHGMET
GRM-29-L3-C-I1/I2/I3	ICDR Tropopause Height Grid	ICGMET
GRM-29-L3-L-I2/I3	ICDR Planetary Boundary Layer Height Grid	ILGMET

A4. Product Requirements Tables

(On the following pages)

GRM-16	Radio Occultation Processing Package	ROPP	CDOP4-PRD-1.1

Type	Software Product
Applications and Users	NWP, RO data suppliers, scientific users
Characteristics and Methods	Routines for handling RO data: - Utilities module - Input/output module - Pre-processing module - Forward modelling module - 1D-Var module - Applications module
Operational Satellite Input Data	Metop (GRAS) Metop-SG COSMIC COSMIC-2 CHAMP GPS/MET GRACE TerraSAR-X TanDEM-X PAZ FY-3 (GNOS)
Other Operational Input Data	NWP model fields

Dissemination		
Format	Means	Timeliness
tarballs	Web	N/A

Accuracy		
Threshold	Target	Optimal
N/A	N/A	N/A
Notes		
Verification/Validation Methods	Test Folder	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
N/A	N/A	N/A	N/A

GRM-16_v11	**Radio Occultation Processing Package**	**ROPP_v11**	**CDOP4-PRD-1.1**
Type	Software Product		
Applications and Users	NWP, RO data suppliers, scientific users		
Characteristics and Methods	GRM-16; 1D-Var routines tools to retrieve electron density profiles from L2-L1 bending angle differences		
Operational Satellite Input Data	GRM-16		
Other Operational Input Data	GRM-16		

Dissemination		
Format	Means	Timeliness
tarballs	Web	N/A

Accuracy		
Threshold	Target	Optimal
N/A	N/A	N/A
Notes		
Verification/Validation Methods	Test Folder	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
N/A	N/A	N/A	N/A

GRM-16_v12	**Radio Occultation Processing Package**	**ROPP_v12**	**CDOP4-PRD-1.1**
Type	Software Product		
Applications and Users	NWP, RO data suppliers, scientific users		
Characteristics and Methods	GRM-16; Improved spline interpolation in forward operators; Updated 2D forward operator; Algorithms for EPS-SG Day 2 ionosphere products;		
Operational Satellite Input Data	GRM-16		
Other Operational Input Data	GRM-16		

Dissemination		
Format	Means	Timeliness
tarballs	Web	N/A

Accuracy		
Threshold	Target	Optimal
N/A	N/A	N/A
Notes		
Verification/Validation Methods	Test Folder	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
N/A	N/A	N/A	N/A

GRM-16_v13	**Radio Occultation Processing Package**	**ROPP_v13**	**CDOP4-PRD-1.1**
Type	Software Product		
Applications and Users	NWP, RO data suppliers, scientific users		
Characteristics and Methods	GRM-16; 2D airborne RO forward operator; 2D LEO-LEO forward operator;		
Operational Satellite Input Data	GRM-16		
Other Operational Input Data	GRM-16		

Dissemination		
Format	Means	Timeliness
tarballs	Web	N/A

Accuracy		
Threshold	Target	Optimal
N/A	N/A	N/A
Notes		
Verification/Validation Methods	Test Folder	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
N/A	N/A	N/A	N/A

GRM-24 **GRM-24.1** **GRM-24.2**	**Tropopause Height (EPS)** **Tropopause Height (EPS-SG Sat A1)** **Tropopause Height (EPS-SG Sat B1)**	**TPH**	**CDOP4-PRD-1.1**

Type	NRT Product Offline Product Reprocessed Product
Applications and Users	NWP, Climate and atmosphere researchers
Characteristics and Methods	One scalar value based on the dry temperature lapse rate
Operational Satellite Input Data	All ROM SAF RO products
Other Operational Input Data	ECMWF fields

Dissemination		
Format	Means	Timeliness
netCDF	Web	NRT: 80 min - 3 h Offline: 5 - 30 d

Accuracy		
Threshold	Target	Optimal
2 km	1 km	0.5 km
Notes		
Verification/Validation Methods	Standard deviation of (TPH product ERA Interim analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	Scalar	RO resolution

GRM-26 **GRM-26.1** **GRM-26.2**	**Planetary Boundary Layer Height (EPS)** **Planetary Boundary Layer Height (EPS-SG Sat A1)** **Planetary Boundary Layer Height (EPS-SG Sat B1)**	**PBLH**	**CDOP4-PRD-1.1**

Type	NRT Product Offline Product Reprocessed Product
Applications and Users	NWP, Climate and atmosphere researchers
Characteristics and Methods	TBD
Operational Satellite Input Data	All ROM SAF RO products
Other Operational Input Data	ECMWF fields

Dissemination		
Format	Means	Timeliness
netCDF	Web	NRT: 80 min - 3 h Offline: 5 - 30 d

Accuracy		
Threshold	Target	Optimal
TBD	TBD	TBD
Notes		
Verification/Validation Methods	TBD	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	Scalar	RO resolution

GRM-28-R1	Reprocessed Multi-Mission climate data record (Metop, COSMIC, CHAMP, GRACE L3)	REPMUL	CDOP4-PRD-1.1

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(a) Reprocessed level 1A Metop, CHAMP, GRACE, COSMIC from EUMETSAT Secretariat (CSDP: WP230, WP230C3S); (b) Reprocessed Level 1A data from CDAAC; CHAMP: 09/2001 – 10/2008 GRACE: 03/2007 – 12/2018 COSMIC: 07/2006 – 12/2018 COSMIC-2: TBD Metop: 10/2006 – 12/2018
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) ROM SAF CDOP-2 RR-RE1 Review Board Report (Ref: EUM/TSS/DOC/14/784725, 9 Dec 2014)	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-28-L3-B-R1 **GRM-28-L3-R-R1** **GRM-28-L3-D-R1** **GRM-28-L3-Y-R1** **GRM-28-L3-Z-R1** **GRM-28-L3-T-R1** **GRM-28-L3-H-R1** **GRM-28-L3-C-R1**	**Reprocessed bending angle grid** **Reprocessed refractivity grid** **Reprocessed dry temperature grid** **Reprocessed dry pressure grid** **Reprocessed dry geopotential height grid** **Reprocessed temperature grid** **Reprocessed specific humidity grid** **Reprocessed tropopause height grid**	**RBGMUL** **RRGMUL** **RDGMUL** **RYGMUL** **RZGMUL** **RTGMUL** **RHGMUL** **RCGMUL**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Reprocessed level 1a Metop, CHAMP, GRACE, COSMIC from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-002: GRAS L1 R1: 01/ 2007 – 05/2014; WG-DRG Plan CF-016: CHAMP L1 R1: 09/2001 - 09/2008; WG-DRG Plan CF-017: GRACE L1 R1: 01/2005 - 12/2014; WG-DRG Plan CF-018: COSMIC L1 R1: 07/2006 - 12/2014;
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a
Accuracy		
Threshold	Target	Optimal
Bending angle		
25 – 50 km: 0.4 % or 0.8 μrad*) 8 – 25 km: 0.4 % 0 – 8 km: 4 – 0.4 %	25 – 50 km: 0.2 % or 0.4 μrad*) 8 – 25 km: 0.2 % 0 – 8 km: 2.0– 0.20 %	25 – 50 km: 0.10 % or 0.2 μrad*) 8 – 25 km: 0.10 % 0 – 8 km: 1.0 – 0.10 %
Refractivity		
25 – 50 km: 0.16 % or 0.008 N-units*) 8 – 25 km: 0.16 % 0 – 8 km: 1.6 – 0.16 %	25 – 50 km: 0.08 % or 0.004 N-units*) 8 – 25 km: 0.08 % 0 – 8 km: 0.8 – 0.08 %	25 – 50 km: 0.04 % or 0.002 N-units*) 8 – 25 km: 0.04 % 0 – 8 km: 0.4 – 0.04 %
Dry temperature		
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: –	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: –
Dry pressure		
25 – 50 km: 0.16 – 0.80 % 8 – 25 km: 0.16 % 0 – 8 km –	25 – 50 km: 0.08 – 0.40 % 8 – 25 km: 0.08 % 0 – 8 km: –	25 – 50 km: 0.04 – 0.20 % 8 – 25 km: 0.04 % 0 – 8 km: –
Dry geopotential height		
25 – 50 km: 8 – 80 m 8 – 25 km: 8 m	25 – 50 km: 4 – 40 m 8 – 25 km: 4 m	25 – 50 km: 2 – 20 m 8 – 25 km: 2 m

0 - 8 km: –	0 – 8 km: –	0 – 8 km: –
Temperature		
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: 2.0 – 0.4 K	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: 1.0 – 0.2 K	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: 0.50 – 0.10 K
Specific humidity		
8 – 12 km: 6.0 % 0 – 8 km: 6.0 %	8 – 12 km: 3.0 % 0 – 8 km: 3.0 %	8 – 12 km: 1.5 % 0 – 8 km: 1.5 %
Tropopause Height		
0.2 km	0.1 km	0.05 km

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate. *) whichever is greater
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim. Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
global	5 deg latitude	200 m	1 month

GRM-29-R1	Reprocessed Metop climate data record (Metop L1, L2, L3)	REPMET	CDOP4-PRD-1.1

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(a) Reprocessed level 1A Metop from EUMETSAT Secretariat (CSDP: WP230, WP230C3S); (b) Reprocessed Level 1A data from CDAAC; Metop: 10/2006 – 12/2018
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) ROM SAF CDOP-2 RR-RE1 Review Board Report (Ref: EUM/TSS/DOC/14/784725, 9 Dec 2014)	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-29-L1-B-R1	Reprocessed bending angle	RBAMET	CDOP4-PRD-1.1

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Hi-res wave optics retrieval
Operational Satellite Input Data	Reprocessed level 1a Metop from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-002: GRAS L1 R1: 01/ 2007 – 05/2014;
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
35 – 60 km: 4 μrad 8 – 35 km: 4% 2 – 8 km: 20% - 4%	35 – 60 km: 2 μrad 8 – 35 km: 2% 2 – 8 km: 10% - 2%	35 – 60 km: 1 μrad 8 – 35 km: 1% 2 – 8 km: 5% - 1%

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate BA noise above 60 km is expected to be between 0.5 and 1.5 μrad;
Verification/Validation Methods	Standard deviation of (Product – ERA Interim forecasts) Comparison to EUMETSAT reprocessed bending angle

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
Global	RO resolution	Hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-29-L2-R-R1 **GRM-29-L2-D-R1**	**Reprocessed refractivity profile** **Reprocessed dry temperature profile**	**RRPMET** **RDPMET**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Hi-res wave optics retrieval
Operational Satellite Input Data	Reprocessed level 1a Metop from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-002: GRAS L1 R1: 01/ 2007 – 05/2014;
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
Refractivity profile		
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Dry temperature profile		
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K – 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K – 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K – 0.5 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Standard deviation of (Product – ERA Interim forecasts)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	Hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-29-L2-T-R1 **GRM-29-L2-H-R1** **GRM-29-L2-P-R1** **GRM-29-L2-S-R1**	**Reprocessed temperature profile** **Reprocessed specific humidity profile** **Reprocessed pressure profile** **Reprocessed surface pressure**	**RTPMET** **RHPMET** **RPPMET** **RSPMET**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	1D-Var algorithm on model levels, ERA Interim forecast as background
Operational Satellite Input Data	Reprocessed level 1a Metop from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-002: GRAS L1 R1: 01/ 2007 – 05/2014;
Other Operational Input Data	ECMWF ERA Interim fields.

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
Temperature profile		
30 – 50 km: 3 K – 6 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 2 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 1 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Specific humidity profile		
0 – 12 km: 1.8 g/kg or 30% *)	0 – 12 km: 0.6 g/kg or 10% *)	0 – 12 km: 0.3 g/kg or 10% *)
Pressure profile		
0 – 50 km: a) 0.03 hPa 0 – 50 km: b) 0.75% 0 – 50 km: c) 2.4 hPa **)	0 – 50 km: a) 0.01 hPa 0 – 50 km: b) 0.25% 0 – 50 km: c) 0.8 hPa **)	0 – 50 km: a) 0.005 hPa 0 – 50 km: b) 0.1% 0 – 50 km: c) 0.7 hPa **)
Surface pressure		
2.4 hPa	0.8 hPa	0.7 hPa

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate *) Whichever is greater **) Whichever is greatest of (a) and (b) but not greater than (c);
Verification/Validation Methods	Standard deviation of (1D-Var solution – ERA Interim analysis)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	model levels	RO resolution

GRM-29-L2-C-R1	Reprocessed tropopause height	RCHMET	CDOP4-PRD-1.1

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Dry temperature lapse rate
Operational Satellite Input Data	Reprocessed level 1a Metop from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-002: GRAS L1 R1: 01/ 2007 – 05/2014;
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy

Threshold	Target	Optimal
2 km	1 km	0.5 km

Notes	
Verification/Validation Methods	Standard deviation of (Product - ERA Interim analysis)

Coverage, Resolution

Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	scalar	RO resolution

GRM-29-L3-B-R1 **GRM-29-L3-R-R1** **GRM-29-L3-D-R1** **GRM-29-L3-Y-R1** **GRM-29-L3-Z-R1** **GRM-29-L3-T-R1** **GRM-29-L3-H-R1** **GRM-29-L3-C-R1**	**Reprocessed bending angle grid** **Reprocessed refractivity grid** **Reprocessed dry temperature grid** **Reprocessed dry pressure grid** **Reprocessed dry geopotential height grid** **Reprocessed temperature grid** **Reprocessed specific humidity grid** **Reprocessed tropopause height grid**	**RBGMET** **RRGMET** **RDGMET** **RYGMET** **RZGMET** **RTGMET** **RHGMET** **RCGMET**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Reprocessed level 1a Metop from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-002: GRAS L1 R1: 01/ 2007 – 05/2014;
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a
Accuracy		
Threshold	Target	Optimal
Bending angle		
25 – 50 km: 0.6 % or 1.2 μrad*) 8 – 25 km: 0.6 % 0 – 8 km: 6 – 0.6 %	25 – 50 km: 0.3 % or 0.6 μrad*) 8 – 25 km: 0.3 % 0 – 8 km: 3 – 0.3 %	25 – 50 km: 0.15 % or 0.3 μrad*) 8 – 25 km: 0.15 % 0 – 8 km: 1.5 – 0.15 %
Refractivity		
25 – 50 km: 0.24 % or 0.012 N-units*) 8 – 25 km: 0.24 % 0 – 8 km: 2.4 – 0.24 %	25 – 50 km: 0.12 % or 0.006 N-units*) 8 – 25 km: 0.12 % 0 – 8 km: 1.2 – 0.12 %	25 – 50 km: 0.06 % or 0.003 N-units*) 8 – 25 km: 0.06 % 0 – 8 km: 0.6 – 0.06 %
Dry temperature		
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: –	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: –	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: –
Dry pressure		
25 – 50 km: 0.24 – 1.20 % 8 – 25 km: 0.24 % 0 – 8 km –	25 – 50 km: 0.12 – 0.60 % 8 – 25 km: 0.12 % 0 – 8 km: –	25 – 50 km: 0.06 – 0.30 % 8 – 25 km: 0.06 % 0 – 8 km: –
Dry geopotential height		
25 – 50 km: 12 – 120 m 8 – 25 km: 12 m 0 - 8 km: –	25 – 50 km: 6 – 60 m 8 – 25 km: 6 m 0 – 8 km: –	25 – 50 km: 3 – 30 m 8 – 25 km: 3 m 0 – 8 km: –
Temperature		
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: 2.0 – 0.6 K	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: 1.0 – 0.3 K	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: 0.50 – 0.15 K

Specific humidity		
8 – 12 km: 8.0 % 0 – 8 km: 8.0 %	8 – 12 km: 4.0 % 0 – 8 km: 4.0 %	8 – 12 km: 2.0 % 0 – 8 km: 2.0 %
Tropopause height		
0.4 km	0.2 km	0.1 km

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate. *) whichever is greater
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim. Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
global	5 deg latitude	200 m	1 month

GRM-30-R1	Reprocessed COSMIC-1 climate data record (COSMIC-1 L1, L2, L3)	REPCO1	CDOP4-PRD-1.1

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(a) Reprocessed level 1A COSMIC-1 from EUMETSAT Secretariat (CSDP: WP230, WP230C3S); (b) Reprocessed Level 1A data from CDAAC; COSMIC: 07/2006 – 12/2018
Other Operational Input Data	(1)

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy

Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) ROM SAF CDOP-2 RR-RE1 Review Board Report (Ref: EUM/TSS/DOC/14/784725, 9 Dec 2014)	
Verification/Validation Methods	(1)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-30-L1-B-R1	Reprocessed bending angle	RBACO1	CDOP4-PRD-1.1
Type	Reprocessed Data Set		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Hi-res wave optics retrieval		
Operational Satellite Input Data	Reprocessed level 1a COSMIC from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-018: COSMIC L1 R1: 07/2006 -12/2014		
Other Operational Input Data	ECMWF ERA Interim fields		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
35 – 60 km: 4 μrad 8 – 35 km: 4% 2 – 8 km: 20% - 4%	35 – 60 km: 2 μrad 8 – 35 km: 2% 2 – 8 km: 10% - 2%	35 – 60 km: 1 μrad 8 – 35 km: 1% 2 – 8 km: 5% - 1%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate BA noise above 60 km is expected to be between 1 and 2.5 μrad;	
Verification/Validation Methods	Standard deviation of (Product – ERA Interim forecasts) Comparison to EUMETSAT reprocessed bending angle	

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
Global	RO resolution	Hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-30-L2-R-R1 **GRM-30-L2-D-R1**	**Reprocessed refractivity profile** **Reprocessed dry temperature profile**	**RRPCO1** **RDPCO1**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Hi-res wave optics retrieval
Operational Satellite Input Data	Reprocessed level 1a COSMIC from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-018: COSMIC L1 R1: 07/2006 -12/2014
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
Refractivity Profile		
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Dry temperature Profile		
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K – 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K – 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K – 0.5 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Standard deviation of (Product – ERA Interim forecasts)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	Hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-30-L2-T-R1 **GRM-30-L2-H-R1** **GRM-30-L2-P-R1** **GRM-30-L2-S-R1**	**Reprocessed temperature profile** **Reprocessed specific humidity profile** **Reprocessed pressure profile** **Reprocessed surface pressure**	**RTPCO1** **RHPCO1** **RPPCO1** **RSPCO1**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	1D-Var algorithm on model levels, ERA Interim forecast as background
Operational Satellite Input Data	Reprocessed level 1a COSMIC from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-018: COSMIC L1 R1: 07/2006 -12/2014
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
Temperature Profile		
30 – 50 km: 3 K – 6 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 2 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 1 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Specific Humidity Profile		
0 – 12 km: 1.8 g/kg or 30% *)	0 – 12 km: 0.6 g/kg or 10% *)	0 – 12 km: 0.3 g/kg or 10% *)
Pressure Profile		
0 – 50 km: a) 0.03 hPa 0 – 50 km: b) 0.75% 0 – 50 km: c) 2.4 hPa **)	0 – 50 km: a) 0.01 hPa 0 – 50 km: b) 0.25% 0 – 50 km: c) 0.8 hPa **)	0 – 50 km: a) 0.005 hPa 0 – 50 km: b) 0.1% 0 – 50 km: c) 0.7 hPa **)
Surface Pressure		
2.4 hPa	0.8 hPa	0.7 hPa

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate *) Whichever is greater **) Whichever is greatest of (a) and (b) but not greater than (c);
Verification/Validation Methods	Standard deviation of (1D-Var solution – ERA Interim analysis)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	model levels	RO resolution

GRM-30-L2-C-R1	Reprocessed tropopause height	RCHCO1	CDOP4-PRD-1.1

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Dry temperature lapse rate
Operational Satellite Input Data	Reprocessed level 1a COSMIC from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-018: COSMIC L1 R1: 07/2006 -12/2014
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
2 km	1 km	0.5 km

Notes	
Verification/Validation Methods	Standard deviation of (Product - ERA Interim Analysis)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	scalar	RO resolution

GRM-30-L3-B-R1 **GRM-30-L3-R-R1** **GRM-30-L3-D-R1** **GRM-30-L3-Y-R1** **GRM-30-L3-Z-R1** **GRM-30-L3-T-R1** **GRM-30-L3-H-R1** **GRM-30-L3-C-R1**	**Reprocessed bending angle grid** **Reprocessed refractivity grid** **Reprocessed dry temperature grid** **Reprocessed dry pressure grid** **Reprocessed dry geopotential height grid** **Reprocessed temperature grid** **Reprocessed specific humidity grid** **Reprocessed tropopause height grid**	**RBGCO1** **RRGCO1** **RDGCO1** **RYGCO1** **RZGCO1** **RTGCO1** **RHGCO1** **RCGCO1**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Reprocessed level 1a COSMIC from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-018: COSMIC L1 R1: 07/2006 -12/2014
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a
Accuracy		
Threshold	Target	Optimal
Bending angle		
25 – 50 km: 0.4 % or 0.8 μrad*) 8 – 25 km: 0.4 % 0 – 8 km: 4 – 0.4 %	25 – 50 km: 0.2 % or 0.4 μrad*) 8 – 25 km: 0.2 % 0 – 8 km: 2.0– 0.20 %	25 – 50 km: 0.10 % or 0.2 μrad*) 8 – 25 km: 0.10 % 0 – 8 km: 1.0 – 0.10 %
Refractivity		
25 – 50 km: 0.16 % or 0.008 N-units*) 8 – 25 km: 0.16 % 0 – 8 km: 1.6 – 0.16 %	25 – 50 km: 0.08 % or 0.004 N-units*) 8 – 25 km: 0.08 % 0 – 8 km: 0.8 – 0.08 %	25 – 50 km: 0.04 % or /0.002 N-units*) 8 – 25 km: 0.04 % 0 – 8 km: 0.4 – 0.04 %
Dry temperature		
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: –	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: –
Dry pressure		
25 – 50 km: 0.16 – 0.80 % 8 – 25 km: 0.16 % 0 – 8 km –	25 – 50 km: 0.08 – 0.40 % 8 – 25 km: 0.08 % 0 – 8 km: –	25 – 50 km: 0.04 – 0.20 % 8 – 25 km: 0.04 % 0 – 8 km: –
Dry geopotential height		
25 – 50 km: 8 – 80 m 8 – 25 km: 8 m 0 - 8 km: –	25 – 50 km: 4 – 40 m 8 – 25 km: 4 m 0 – 8 km: –	25 – 50 km: 2 – 20 m 8 – 25 km: 2 m 0 – 8 km: –
Temperature		
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K

0 – 8 km: 2.0 – 0.4 K	0 – 8 km: 1.0 – 0.2 K	0 – 8 km: 0.50 – 0.10 K
Specific humidity		
8 – 12 km: 6.0 % 0 – 8 km: 6.0 %	8 – 12 km: 3.0 % 0 – 8 km: 3.0 %	8 – 12 km: 1.5 % 0 – 8 km: 1.5 %
Tropopause Height		
0.2 km	0.1 km	0.05 km

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate. *) whichever is greater
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim. Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
global	5 deg latitude	200 m	1 month

GRM-32-R1	Reprocessed CHAMP climate data record (CHAMP L1, L2, L3)	REPCHA	CDOP4-PRD-1.1

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(a) Reprocessed level 1A CHAMP from EUMETSAT Secretariat (CSDP: WP230, WP230C3S); (b) Reprocessed Level 1A data from CDAAC; CHAMP: 09/2001 – 10/2008
Other Operational Input Data	(1)

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy

Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) ROM SAF CDOP-2 RR-RE1 Review Board Report (Ref: EUM/TSS/DOC/14/784725, 9 Dec 2014)	
Verification/Validation Methods	(1)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-32-L1-B-R1	Reprocessed bending angle	RBACHA	CDOP4-PRD-1.1

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Hi-res wave optics retrieval
Operational Satellite Input Data	Reprocessed level 1a CHAMP from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-016: CHAMP L1 R1: 09/2001-09/2008
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy

Threshold	Target	Optimal
35 – 60 km: 4 μrad 8 – 35 km: 4% 2 – 8 km: 20% - 4%	35 – 60 km: 2 μrad 8 – 35 km: 2% 2 – 8 km: 10% - 2%	35 – 60 km: 1 μrad 8 – 35 km: 1% 2 – 8 km: 5% - 1%

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate; BA noise above 60 km is expected to be about 4 μrad; Product may have reduced information content below 8–10 km due to limitations in the CHAMP closed loop data;
Verification/Validation Methods	Standard deviation of (Product – ERA Interim forecasts) Comparison to EUMETSAT reprocessed bending angle

Coverage, Resolution

Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
Global	RO resolution	Hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-32-L2-R-R1 **GRM-32-L2-D-R1**	**Reprocessed refractivity profile** **Reprocessed dry temperature profile**	**RRPCHA** **RDPCHA**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Hi-res wave optics retrieval
Operational Satellite Input Data	Reprocessed level 1a CHAMP from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-016: CHAMP L1 R1: 09/2001-09/2008
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
Refractivity Profile		
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Dry temperature Profile		
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K – 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K – 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K – 0.5 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate; Product may have reduced information content below 8–10 km due to limitations in the CHAMP closed loop data;
Verification/Validation Methods	Standard deviation of (Product – ERA Interim forecasts)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	Hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-32-L2-T-R1 **GRM-32-L2-H-R1** **GRM-32-L2-P-R1** **GRM-32-L2-S-R1**	**Reprocessed temperature** **Reprocessed specific humidity** **Reprocessed pressure** **Reprocessed surface pressure**	**RTPCHA** **RHPCHA** **RPPCHA** **RSPCHA**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	1D-Var algorithm on model levels, ERA Interim forecast as background
Operational Satellite Input Data	Reprocessed level 1a CHAMP from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-016: CHAMP L1 R1: 09/2001-09/2008
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
Temperature Profile		
30 – 50 km: 3 K – 6 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 2 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 1 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Specific Humidity Profile		
0 – 12 km: 1.8 g/kg or 30% *)	0 – 12 km: 0.6 g/kg or 10% *)	0 – 12 km: 0.3 g/kg or 10% *)
Pressure Profile		
0 – 50 km: a) 0.03 hPa 0 – 50 km: b) 0.75% 0 – 50 km: c) 2.4 hPa **)	0 – 50 km: a) 0.01 hPa 0 – 50 km: b) 0.25% 0 – 50 km: c) 0.8 hPa **)	0 – 50 km: a) 0.005 hPa 0 – 50 km: b) 0.1% 0 – 50 km: c) 0.7 hPa **)
Surface Pressure		
2.4 hPa	0.8 hPa	0.7 hPa

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate; Product may have reduced information content below 8–10 km due to limitations in the CHAMP closed loop data; *) Whichever is greater **) Whichever is greatest of (a) and (b) but not greater than (c);
Verification/Validation Methods	Standard deviation of (1D-Var solution – ERA Interim analysis)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	model levels	RO resolution

GRM-32-L2-C-R1	Reprocessed tropopause height	RCHCHA	CDOP4-PRD-1.1

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Dry temperature lapse rate
Operational Satellite Input Data	Reprocessed level 1a CHAMP from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-016: CHAMP L1 R1: 09/2001-09/2008
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy

Threshold	Target	Optimal
2 km	1 km	0.5 km

Notes	
Verification/Validation Methods	Standard deviation of (Product - ERA Interim Analysis)

Coverage, Resolution

Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	scalar	RO resolution

GRM-32-L3-B-R1 **GRM-32-L3-R-R1** **GRM-32-L3-D-R1** **GRM-32-L3-Y-R1** **GRM-32-L3-Z-R1** **GRM-32-L3-T-R1** **GRM-32-L3-H-R1** **GRM-32-L3-C-R1**	**Reprocessed bending angle grid** **Reprocessed refractivity grid** **Reprocessed dry temperature grid** **Reprocessed dry pressure grid** **Reprocessed dry geopotential height grid** **Reprocessed temperature grid** **Reprocessed humidity grid** **Reprocessed tropopause height grid**	**RBGCHA** **RRGCHA** **RDGCHA** **RYGCHA** **RZGCHA** **RTGCHA** **RHGCHA** **RCGCHA**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Reprocessed level 1a CHAMP from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-016: CHAMP L1 R1: 09/2001-09/2008
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a
Accuracy		
Threshold	Target	Optimal
Bending angle		
25 – 40 km: 0.8 % or 1.6 μrad*) 8 – 25 km: 0.8 % 0 – 8 km: –	25 – 40 km: 0.4 % or 0.8 μrad*) 8 – 25 km: 0.4 % 0 – 8 km: –	25 – 40 km: 0.20 % or 0.4 μrad*) 8 – 25 km: 0.20 % 0 – 8 km: –
Refractivity		
25 – 40 km: 0.4 % or 0.016 N-units*) 8 – 25 km: 0.4 % 0 – 8 km: –	25 – 40 km: 0.20 % or 0.008 N-units*) 8 – 25 km: 0.20 % 0 – 8 km: –	25 – 40 km: 0.10 % or 0.004 N-units*) 8 – 25 km: 0.10 % 0 – 8 km: –
Dry temperature		
25 – 40 km: 0.8 – 8 K 8 – 25 km: 0.8 K 0 – 8 km: –	25 – 40 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 40 km: 0.20 – 2.0 K 8 – 25 km: 0.20 K 0 – 8 km: –
Dry pressure		
25 – 40 km: 0.4 – 2.0 % 8 – 25 km: 0.4 % 0 – 8 km –	25 – 40 km: 0.2 – 1.0 % 8 – 25 km: 0.2 % 0 – 8 km: –	25 – 40 km: 0.10 – 0.50 % 8 – 25 km: 0.10 % 0 – 8 km: –
Dry geopotential height		
25 – 40 km: 16 – 160 m 8 – 25 km: 16 m 0 - 8 km: –	25 – 40 km: 8 – 80 m 8 – 25 km: 8 m 0 – 8 km: –	25 – 40 km: 4– 40 m 8 – 25 km: 4 m 0 – 8 km: –
Temperature		
25 – 40 km: 0.8 – 8 K 8 – 25 km: 0.8 K 0 – 8 km: –	25 – 40 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 40 km: 0.20 – 2.0 K 8 – 25 km: 0.20 K 0 – 8 km: –

Specific humidity		
8 – 12 km: 12 % 0 – 8 km: –	8 – 12 km: 6.0 % 0 – 8 km: –	8 – 12 km: 3.0 % 0 – 8 km: –
Tropopause Height		
0.6 km	0.3 km	0.15 km

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate; Product may have reduced information content below 8–10 km due to limitations in the CHAMP closed loop data; *) whichever is greater
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim. Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
global	5 deg latitude	200 m	1 month

GRM-33-R1	**Reprocessed GRACE climate data record (GRACE L1, L2, L3)**	**REPGRA**	**CDOP4-PRD-1.1**
Type	Climate Data Record		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	(1)		
Operational Satellite Input Data	(a) Reprocessed level 1A GRACE from EUMETSAT Secretariat (CSDP: WP230, WP230C3S); (b) Reprocessed Level 1A data from CDAAC; GRACE: 03/2007 – 12/2018		
Other Operational Input Data	(1)		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) ROM SAF CDOP-2 RR-RE1 Review Board Report (Ref: EUM/TSS/DOC/14/784725, 9 Dec 2014)	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-33-L1-B-R1	Reprocessed bending angle	RBAGRA	CDOP4-PRD-1.1

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Hi-res wave optics retrieval
Operational Satellite Input Data	Reprocessed level 1a GRACE from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-017: GRACE L1 R1: 2007-2018
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy

Threshold	Target	Optimal
35 – 60 km: 4 μrad 8 – 35 km: 4% 2 – 8 km: 20% - 4%	35 – 60 km: 2 μrad 8 – 35 km: 2% 2 – 8 km: 10% - 2%	35 – 60 km: 1 μrad 8 – 35 km: 1% 2 – 8 km: 5% - 1%

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate; BA noise above 60 km is expected to be about 4 μrad; Product may have reduced information content below 8–10 km due to limitations in the CHAMP closed loop data;
Verification/Validation Methods	Standard deviation of (Product – ERA Interim forecasts) Comparison to EUMETSAT reprocessed bending angle

Coverage, Resolution

Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
Global	RO resolution	Hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-33-L2-R-R1 **GRM-33-L2-D-R1**	**Reprocessed refractivity profile** **Reprocessed dry temperature profile**	**RRPGRA** **RDPGRA**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Hi-res wave optics retrieval
Operational Satellite Input Data	Reprocessed level 1a GRACE from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-017: GRACE L1 R1: 2007-2018
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
Refractivity Profile		
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Dry temperature Profile		
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K – 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K – 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K – 0.5 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate; Product may have reduced information content below 8–10 km due to limitations in the CHAMP closed loop data;
Verification/Validation Methods	Standard deviation of (Product – ERA Interim forecasts)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	Hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-33-L2-T-R1 **GRM-33-L2-H-R1** **GRM-33-L2-P-R1** **GRM-33-L2-S-R1**	**Reprocessed temperature** **Reprocessed specific humidity** **Reprocessed pressure** **Reprocessed surface pressure**	**RTPGRA** **RHPGRA** **RPPGRA** **RSPGRA**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	1D-Var algorithm on model levels, ERA Interim forecast as background
Operational Satellite Input Data	Reprocessed level 1a GRACE from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-017: GRACE L1 R1: 2007-2018
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
Temperature Profile		
30 – 50 km: 3 K – 6 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 2 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 1 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Specific Humidity Profile		
0 – 12 km: 1.8 g/kg or 30% *)	0 – 12 km: 0.6 g/kg or 10% *)	0 – 12 km: 0.3 g/kg or 10% *)
Pressure Profile		
0 – 50 km: a) 0.03 hPa 0 – 50 km: b) 0.75% 0 – 50 km: c) 2.4 hPa **)	0 – 50 km: a) 0.01 hPa 0 – 50 km: b) 0.25% 0 – 50 km: c) 0.8 hPa **)	0 – 50 km: a) 0.005 hPa 0 – 50 km: b) 0.1% 0 – 50 km: c) 0.7 hPa **)
Surface Pressure		
2.4 hPa	0.8 hPa	0.7 hPa

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate; Product may have reduced information content below 8–10 km due to limitations in the CHAMP closed loop data; *) Whichever is greater **) Whichever is greatest of (a) and (b) but not greater than (c);
Verification/Validation Methods	Standard deviation of (1D-Var solution – ERA Interim analysis)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	model levels	RO resolution

GRM-33-L2-C-R1	Reprocessed tropopause height	RCHGRA	CDOP4-PRD-1.1

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Dry temperature lapse rate
Operational Satellite Input Data	Reprocessed level 1a GRACE from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-017: GRACE L1 R1: 2007-2018
Other Operational Input Data	ECMWF ERA Interim fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
2 km	1 km	0.5 km

Notes	
Verification/Validation Methods	Standard deviation of (Product - ERA Interim Analysis)

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
global	RO resolution	scalar	RO resolution

GRM-33-L3-B-R1 **GRM-33-L3-R-R1** **GRM-33-L3-D-R1** **GRM-33-L3-Y-R1** **GRM-33-L3-Z-R1** **GRM-33-L3-T-R1** **GRM-33-L3-H-R1** **GRM-33-L3-C-R1**	**Reprocessed bending angle grid** **Reprocessed refractivity grid** **Reprocessed dry temperature grid** **Reprocessed dry pressure grid** **Reprocessed dry geopotential height grid** **Reprocessed temperature grid** **Reprocessed humidity grid** **Reprocessed tropopause height grid**	**RBGGRA** **RRGGRA** **RDGGRA** **RYGGRA** **RZGGRA** **RTGGRA** **RHGGRA** **RCGGRA**	**CDOP4-PRD-1.1**

Type	Reprocessed Data Set
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Reprocessed level 1a GRACE from EUMETSAT CF, cf. Refs.: CSDP WP230 (EUM/STG/65/14/DOC/18); WG-DRG Plan CF-017: GRACE L1 R1: 2007-2018
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a
Accuracy		
Threshold	Target	Optimal
Bending angle		
25 – 40 km: 0.8 % or 1.6 μrad*) 8 – 25 km: 0.8 % 0 – 8 km: –	25 – 40 km: 0.4 % or 0.8 μrad*) 8 – 25 km: 0.4 % 0 – 8 km: –	25 – 40 km: 0.20 % or 0.4 μrad*) 8 – 25 km: 0.20 % 0 – 8 km: –
Refractivity		
25 – 40 km: 0.4 % or 0.016 N-units*) 8 – 25 km: 0.4 % 0 – 8 km: –	25 – 40 km: 0.20 % or 0.008 N-units*) 8 – 25 km: 0.20 % 0 – 8 km: –	25 – 40 km: 0.10 % or 0.004 N-units*) 8 – 25 km: 0.10 % 0 – 8 km: –
Dry temperature		
25 – 40 km: 0.8 – 8 K 8 – 25 km: 0.8 K 0 – 8 km: –	25 – 40 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 40 km: 0.20 – 2.0 K 8 – 25 km: 0.20 K 0 – 8 km: –
Dry pressure		
25 – 40 km: 0.4 – 2.0 % 8 – 25 km: 0.4 % 0 – 8 km –	25 – 40 km: 0.2 – 1.0 % 8 – 25 km: 0.2 % 0 – 8 km: –	25 – 40 km: 0.10 – 0.50 % 8 – 25 km: 0.10 % 0 – 8 km: –
Dry geopotential height		
25 – 40 km: 16 – 160 m 8 – 25 km: 16 m 0 - 8 km: –	25 – 40 km: 8 – 80 m 8 – 25 km: 8 m 0 – 8 km: –	25 – 40 km: 4– 40 m 8 – 25 km: 4 m 0 – 8 km: –
Temperature		
25 – 40 km: 0.8 – 8 K 8 – 25 km: 0.8 K 0 – 8 km: –	25 – 40 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 40 km: 0.20 – 2.0 K 8 – 25 km: 0.20 K 0 – 8 km: –

Specific humidity		
8 – 12 km: 12 % 0 – 8 km: –	8 – 12 km: 6.0 % 0 – 8 km: –	8 – 12 km: 3.0 % 0 – 8 km: –
Tropopause Height		
0.6 km	0.3 km	0.15 km

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate; Product may have reduced information content below 8–10 km due to limitations in the CHAMP closed loop data; *) whichever is greater
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim. Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
global	5 deg latitude	200 m	1 month

GRM-28-R2	**Reprocessed Multi-Mission climate data record (Metop, COSMIC, CHAMP, GRACE L3)**	**REPMUL**	**CDOP4-PRD-1.1**
Type	Climate Data Record		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	(1)		
Operational Satellite Input Data	Reprocessed level 1A Metop, CHAMP, GRACE, COSMIC from EUMETSAT Secretariat		
Other Operational Input Data	(1)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE2	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-29-R2	**Reprocessed Metop climate data record (Metop L1, L2, L3)**	**REPMET**	**CDOP4-PRD-1.1**

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	Reprocessed level 1A Metop, CHAMP, GRACE, COSMIC from EUMETSAT Secretariat
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE2	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-30-R2	**Reprocessed COSMIC-1 climate data record (COSMIC-1 L1, L2, L3)**	**REPCO1**	**CDOP4-PRD-1.1**

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	Reprocessed level 1A Metop, CHAMP, GRACE, COSMIC from EUMETSAT Secretariat
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE2	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-32-R2	**Reprocessed CHAMP climate data record (CHAMP L1, L2, L3)**	**REPCHA**	**CDOP4-PRD-1.1**

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	Reprocessed level 1A Metop, CHAMP, GRACE, COSMIC from EUMETSAT Secretariat
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE2	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-33-R2	Reprocessed GRACE climate data record (GRACE L1, L2, L3)	REPGRA	CDOP4-PRD-1.1

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	Reprocessed level 1A Metop, CHAMP, GRACE, COSMIC from EUMETSAT Secretariat
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE2	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-28-R3	**Reprocessed Multi-Mission climate data record (Metop, COSMIC, CHAMP, GRACE L3)**	**REPMUL**	**CDOP4-PRD-1.1**

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(1)
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE3	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-29-R3	Reprocessed Metop climate data record (Metop L1, L2, L3)	REPMET	CDOP4-PRD-1.1

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(1)
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE3	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-30-R3	**Reprocessed COSMIC-1 climate data record (COSMIC-1 L1, L2, L3)**	**REPCO1**	**CDOP4-PRD-1.1**

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(1)
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE3	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-31-R3	**Reprocessed COSMIC-2 climate data record (COSMIC-2 L1, L2, L3)**	**REPCO2**	**CDOP4-PRD-1.1**
Type	Climate Data Record		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	(1)		
Operational Satellite Input Data	(1)		
Other Operational Input Data	(1)		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE3	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-32-R3	Reprocessed CHAMP climate data record (CHAMP L1, L2, L3)	REPCHA	CDOP4-PRD-1.1

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(1)
Other Operational Input Data	(1)

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy

Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE3	
Verification/Validation Methods	(1)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-33-R3	**Reprocessed GRACE climate data record (GRACE L1, L2, L3)**	**REPGRA**	**CDOP4-PRD-1.1**

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(1)
Other Operational Input Data	(1)

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE3	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-34-R3	**Reprocessed Sentinel-6 climate data record (Sentinel-6 L1, L2, L3)**	**REPSEN**	**CDOP4-PRD-1.1**
Type	Climate Data Record		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	(1)		
Operational Satellite Input Data	(1)		
Other Operational Input Data	(1)		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy		
Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE3	
Verification/Validation Methods	(1)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-35-R3	Reprocessed FY-3 climate data record (FY-3 L1, L2, L3)	REPFY3	CDOP4-PRD-1.1

Type	Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	(1)
Operational Satellite Input Data	(1)
Other Operational Input Data	(1)

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	n/a

Accuracy

Threshold	Target	Optimal
(1)	(1)	(1)
Notes	(1) Baseline determined at RR for RE3	
Verification/Validation Methods	(1)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
(1)	(1)	(1)	(1)

GRM-40	NRT Refractivity Profile	NRPMEB	CDOP4-PRD-1.1
Type	NRT Product		
Applications and Users	NWP		
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 0.09 N-units 5 – 30 km: 1.8% 0 – 5 km: 6% – 1.8%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	GRAS resolution

GRM-41	NRT Temperature Profile	NTPMEB	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-B/GRAS
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy

Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-42	NRT Specific Humidity Profile	NHPMEB	CDOP4-PRD-1.1
Type	NRT Product		
Applications and Users	NWP		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy		
Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-43	NRT Pressure Profile	NPPMEB	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-B/GRAS
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy

Threshold	Target	Optimal
a) 0.03 hPa b) 0.75% c) 2.4 hPa *	a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *
Notes	* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-44	**NRT Surface Pressure**		**NSPMEB**	**CDOP4-PRD-1.1**
Type		NRT Product		
Applications and Users		NWP		
Characteristics and Methods		Scalar at surface		
Operational Satellite Input Data		Metop-B/GRAS		
Other Operational Input Data		GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		
Dissemination				
Format		Means	Timeliness	
BUFR/netCDF		GTS EUMETCast Web	3 h	
Accuracy				
Threshold		Target	Optimal	
2.4 hPa		0.8 hPa	0.7 hPa	
Notes				
Verification/Validation Methods		Standard deviation of (1D-Var solution – ECMWF analysis)		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	GRAS resolution	Scalar at surface	GRAS resolution	

GRM-46	Offline Bending Angle	OBAMEB	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
35 – 60 km: 4 murad 8 – 35 km: 4% 2 – 8 km: 20% - 4%	35 – 60 km: 2 murad 8 – 35 km: 2% 2 – 8 km: 10% - 2%	35 – 60 km: 1 murad 8 – 35 km: 1% 2 – 8 km: 5% - 1%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate BA noise above 60 km is expected to be between 0.5 and 1.5 (rad;	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	GRAS resolution

GRM-47	Offline Refractivity Profile	ORPMEB	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	GRAS resolution

GRM-48	Offline Temperature Profile	OTPMEB	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-49	Offline Specific Humidity Profile	OHPMEB	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-50	Offline Pressure Profile	OPPMEB	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-B/GRAS
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
a) 0.03 hPa b) 0.75% c) 2.4 hPa *	a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *
Notes	* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-51	Offline Surface Pressure	OSPMEB	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Scalar at surface		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
2.4 hPa	0.8 hPa	0.7 hPa
Notes		
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	Scalar at surface	GRAS resolution

GRM-53	**Offline Bending Angle Grid**		**OBGMEB**	**CDOP4-PRD-1.1**
Type		Offline Product		
Applications and Users		Climate and atmosphere researchers		
Characteristics and Methods		Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data		Metop-B/GRAS		
Other Operational Input Data		ECMWF ERA Interim (validation, sampling error estimation)		
Dissemination				
Format		Means	Timeliness	
netCDF		Web	30 d	
Accuracy				
Threshold		Target	Optimal	
25 – 50 km: 0.6 % or 1.2 murad *) 8 – 25 km: 0.6 % 0 – 8 km: 6 – 0.6 %		25 – 50 km: 0.3 % or 0.6 murad*) 8 – 25 km: 0.3 % 0 – 8 km: 3 – 0.3 %	25 – 50 km: 0.15 % or 0.3 murad*) 8 – 25 km: 0.15 % 0 – 8 km: 1.5 – 0.15 %	
Notes		* whichever is greater An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate		
Verification/Validation Methods		Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	5 deg latitude	200 m	1 month	

GRM-54	**Offline Refractivity Grid**		**ORGMEB**	**CDOP4-PRD-1.1**
Type		Offline Product		
Applications and Users		Climate and atmosphere researchers		
Characteristics and Methods		Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data		Metop-B/GRAS		
Other Operational Input Data		ECMWF ERA Interim (validation, sampling error estimation)		
Dissemination				
Format	Means		Timeliness	
netCDF	Web		30 d	
Accuracy				
Threshold	Target		Optimal	
25 – 50 km: 0.24 % or 0.012 N-units*) 8 – 25 km: 0.24 % 0 – 8 km: 2.4 – 0.24 %	25 – 50 km: 0.12 % or 0.006 N-units*) 8 – 25 km: 0.12 % 0 – 8 km: 1.2 – 0.12 %		25 – 50 km: 0.06 % or 0.003 N-units*) 8 – 25 km: 0.06 % 0 – 8 km: 0.6 – 0.06 %	
Notes	* whichever is greater ; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate			
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.			
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	5 deg latitude	200 m	1 month	

GRM-55	**Offline Temperature Grid**	**OTGMEB**	**CDOP4-PRD-1.1**

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-B/GRAS
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: 2.0 – 0.6 K	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: 1.0 – 0.3 K	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: 0.50 – 0.15 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-56	**Offline Specific Humidity Grid**	**OHGMEB**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
8 – 12 km: 8.0 % 0 – 8 km: 8.0 %	8 – 12 km: 4.0 % 0 – 8 km: 4.0 %	8 – 12 km: 2.0 % 0 – 8 km: 2.0 %
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-57	Climate Dry Geopotential Height	OZGMEB	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-B/GRAS
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 12 – 120 m 8 – 25 km: 12 m 0 - 8 km: –	25 – 50 km: 6 – 60 m 8 – 25 km: 6 m 0 – 8 km: –	25 – 50 km: 3 – 30 m 8 – 25 km: 3 m 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-58	Offline Dry Temperature Grid	ODGMEB	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-B/GRAS
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: –	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: –	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-59	**Offline Dry Pressure Grid**	**OYGMEB**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.24 – 1.20 % 8 – 25 km: 0.24 % 0 – 8 km –	25 – 50 km: 0.12 – 0.60 % 8 – 25 km: 0.12 % 0 – 8 km: –	25 – 50 km: 0.06 – 0.30 % 8 – 25 km: 0.06 % 0 – 8 km: –
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-60	NRT Refractivity Profile	NRPMEC	CDOP4-PRD-1.1
Type	NRT Product		
Applications and Users	NWP		
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 0.09 N-units 5 – 30 km: 1.8% 0 – 5 km: 6% – 1.8%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	GRAS resolution

GRM-61	NRT Temperature Profile	NTPMEC	CDOP4-PRD-1.1
Type	NRT Product		
Applications and Users	NWP		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-62	NRT Specific Humidity Profile	NHPMEC	CDOP4-PRD-1.1
Type	NRT Product		
Applications and Users	NWP		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy		
Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-63	NRT Pressure Profile	NPPMEC	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-C/GRAS
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy

Threshold	Target	Optimal
a) 0.03 hPa b) 0.75% c) 2.4 hPa *	a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *
Notes	* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-64	NRT Surface Pressure	NSPMEC	CDOP4-PRD-1.1
Type	NRT Product		
Applications and Users	NWP		
Characteristics and Methods	Scalar at surface		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	3 h

Accuracy		
Threshold	Target	Optimal
2.4 hPa	0.8 hPa	0.7 hPa
Notes		
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	Scalar at surface	GRAS resolution

GRM-66	Offline Bending Angle	OBAMEC	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
35 – 60 km: 4 murad 8 – 35 km: 4% 2 – 8 km: 20% - 4%	35 – 60 km: 2 murad 8 – 35 km: 2% 2 – 8 km: 10% - 2%	35 – 60 km: 1 murad 8 – 35 km: 1% 2 – 8 km: 5% - 1%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate BA noise above 60 km is expected to be between 0.5 and 1.5 (rad;	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	GRAS resolution

GRM-67	Offline Refractivity Profile	ORPMEC	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-C/GRAS
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy

Threshold	Target	Optimal
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	GRAS resolution

GRM-68	Offline Temperature Profile	OTPMEC	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-69	Offline Specific Humidity Profile	OHPMEC	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-70	Offline Pressure Profile	OPPMEC	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-C/GRAS
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
a) 0.03 hPa b) 0.75% c) 2.4 hPa *	a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *
Notes	* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	model levels (with interpolation); interpolated to 247 fixed levels	GRAS resolution

GRM-71	**Offline Surface Pressure**	**OSPMEC**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Scalar at surface		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
2.4 hPa	0.8 hPa	0.7 hPa
Notes		
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	Scalar at surface	GRAS resolution

GRM-73	**Offline Bending Angle Grid**	**OBGMEC**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.6 % or 1.2 murad *) 8 – 25 km: 0.6 % 0 – 8 km: 6 – 0.6 %	25 – 50 km: 0.3 % or 0.6 murad*) 8 – 25 km: 0.3 % 0 – 8 km: 3 – 0.3 %	25 – 50 km: 0.15 % or 0.3 murad*) 8 – 25 km: 0.15 % 0 – 8 km: 1.5 – 0.15 %
Notes	* whichever is greater An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-74	**Offline Refractivity Grid**	**ORGMEC**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.24 % or 0.012 N-units*) 8 – 25 km: 0.24 % 0 – 8 km: 2.4 – 0.24 %	25 – 50 km: 0.12 % or 0.006 N-units*) 8 – 25 km: 0.12 % 0 – 8 km: 1.2 – 0.12 %	25 – 50 km: 0.06 % or 0.003 N-units*) 8 – 25 km: 0.06 % 0 – 8 km: 0.6 – 0.06 %
Notes	* whichever is greater ; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-75	**Offline Temperature Grid**	**OTGMEC**	**CDOP4-PRD-1.1**

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-C/GRAS
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: 2.0 – 0.6 K	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: 1.0 – 0.3 K	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: 0.50 – 0.15 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-76	**Offline Specific Humidity Grid**	**OHGMEC**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
8 – 12 km: 8.0 % 0 – 8 km: 8.0 %	8 – 12 km: 4.0 % 0 – 8 km: 4.0 %	8 – 12 km: 2.0 % 0 – 8 km: 2.0 %
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-77	**Climate Dry Geopotential Height**	**OZGMEC**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 12 – 120 m 8 – 25 km: 12 m 0 - 8 km: –	25 – 50 km: 6 – 60 m 8 – 25 km: 6 m 0 – 8 km: –	25 – 50 km: 3 – 30 m 8 – 25 km: 3 m 0 – 8 km: –
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-78	**Offline Dry Temperature Grid**	**ODGMEC**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: –	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: –	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: –
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-79	**Offline Dry Pressure Grid**	**OYGMEC**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-C/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.24 – 1.20 % 8 – 25 km: 0.24 % 0 – 8 km –	25 – 50 km: 0.12 – 0.60 % 8 – 25 km: 0.12 % 0 – 8 km: –	25 – 50 km: 0.06 – 0.30 % 8 – 25 km: 0.06 % 0 – 8 km: –
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-83 **GRM-84** **GRM-85** **GRM-86** **GRM-87** **GRM-88** **GRM-89** **GRM-194**	**Offline bending angle grid** **Offline refractivity grid** **Offline dry geopotential height grid** **Offline temperature grid** **Offline specific humidity grid** **Offline dry temperature grid** **Offline dry pressure grid** **Offline tropopause height grid**	**RBGMET** **RRGMET** **RZGMET** **RTGMET** **RHGMET** **RDGMET** **RYGMET** **RCGMET**	**CDOP4-PRD-1.1**

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Offline Level 1A Metop (Multimission Metop)
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a
Accuracy		
Threshold	Target	Optimal
Bending angle		
25 – 50 km: 0.4 % or 0.8 μrad*) 8 – 25 km: 0.4 % 0 – 8 km: 4 – 0.4 %	25 – 50 km: 0.2 % or 0.4 μrad*) 8 – 25 km: 0.2 % 0 – 8 km: 2.0– 0.20 %	25 – 50 km: 0.10 % or 0.2 μrad*) 8 – 25 km: 0.10 % 0 – 8 km: 1.0 – 0.10 %
Refractivity		
25 – 50 km: 0.16 % or 0.008 N-units*) 8 – 25 km: 0.16 % 0 – 8 km: 1.6 – 0.16 %	25 – 50 km: 0.08 % or 0.004 N-units*) 8 – 25 km: 0.08 % 0 – 8 km: 0.8 – 0.08 %	25 – 50 km: 0.04 % or 0.002 N-units*) 8 – 25 km: 0.04 % 0 – 8 km: 0.4 – 0.04 %
Dry temperature		
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: –	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: –
Dry pressure		
25 – 50 km: 0.16 – 0.80 % 8 – 25 km: 0.16 % 0 – 8 km –	25 – 50 km: 0.08 – 0.40 % 8 – 25 km: 0.08 % 0 – 8 km: –	25 – 50 km: 0.04 – 0.20 % 8 – 25 km: 0.04 % 0 – 8 km: –
Dry geopotential height		
25 – 50 km: 8 – 80 m 8 – 25 km: 8 m 0 - 8 km: –	25 – 50 km: 4 – 40 m 8 – 25 km: 4 m 0 – 8 km: –	25 – 50 km: 2 – 20 m 8 – 25 km: 2 m 0 – 8 km: –
Temperature		
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: 2.0 – 0.4 K	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: 1.0 – 0.2 K	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: 0.50 – 0.10 K

Specific humidity		
8 – 12 km: 6.0 % 0 – 8 km: 6.0 %	8 – 12 km: 3.0 % 0 – 8 km: 3.0 %	8 – 12 km: 1.5 % 0 – 8 km: 1.5 %
Tropopause Height		
0.2 km	0.1 km	0.05 km
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate. *) whichever is greater	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim. Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
global	5 deg latitude	200 m	1 month

GRM-183 **GRM-184** **GRM-185** **GRM-186** **GRM-187** **GRM-188** **GRM-189** **GRM-198**	**Offline bending angle grid** **Offline refractivity grid** **Offline dry geopotential height grid** **Offline temperature grid** **Offline specific humidity grid** **Offline dry temperature grid** **Offline dry pressure grid** **Offline tropopause height grid**	**RBGMES** **RRGMES** **RZGMES** **RTGMES** **RHGMES** **RDGMES** **RYGMES** **RCGMES**	**CDOP4-PRD-1.1**

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Offline Level 1A Metop (Multimission Metop-SG)
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination		
Format	Means	Timeliness
netCDF	Web	n/a
Accuracy		
Threshold	Target	Optimal
Bending angle		
25 – 50 km: 0.4 % or 0.8 μrad*) 8 – 25 km: 0.4 % 0 – 8 km: 4 – 0.4 %	25 – 50 km: 0.2 % or 0.4 μrad*) 8 – 25 km: 0.2 % 0 – 8 km: 2.0– 0.20 %	25 – 50 km: 0.10 % or 0.2 μrad*) 8 – 25 km: 0.10 % 0 – 8 km: 1.0 – 0.10 %
Refractivity		
25 – 50 km: 0.16 % or 0.008 N-units*) 8 – 25 km: 0.16 % 0 – 8 km: 1.6 – 0.16 %	25 – 50 km: 0.08 % or 0.004 N-units*) 8 – 25 km: 0.08 % 0 – 8 km: 0.8 – 0.08 %	25 – 50 km: 0.04 % or 0.002 N-units*) 8 – 25 km: 0.04 % 0 – 8 km: 0.4 – 0.04 %
Dry temperature		
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: –	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: –
Dry pressure		
25 – 50 km: 0.16 – 0.80 % 8 – 25 km: 0.16 % 0 – 8 km –	25 – 50 km: 0.08 – 0.40 % 8 – 25 km: 0.08 % 0 – 8 km: –	25 – 50 km: 0.04 – 0.20 % 8 – 25 km: 0.04 % 0 – 8 km: –
Dry geopotential height		
25 – 50 km: 8 – 80 m 8 – 25 km: 8 m 0 - 8 km: –	25 – 50 km: 4 – 40 m 8 – 25 km: 4 m 0 – 8 km: –	25 – 50 km: 2 – 20 m 8 – 25 km: 2 m 0 – 8 km: –
Temperature		
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: 2.0 – 0.4 K	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: 1.0 – 0.2 K	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: 0.50 – 0.10 K

Specific humidity		
8 – 12 km: 6.0 % 0 – 8 km: 6.0 %	8 – 12 km: 3.0 % 0 – 8 km: 3.0 %	8 – 12 km: 1.5 % 0 – 8 km: 1.5 %
Tropopause Height		
0.2 km	0.1 km	0.05 km
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate. *) whichever is greater	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim. Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
global	5 deg latitude	200 m	1 month

GRM-92	Ground Based GNSS Package		GBGP	CDOP4-PRD-1.1
Type		Software Product		
Applications and Users		Analysis Centres and NWP		
Characteristics and Methods		Routines for handling ground-based GNSS (ZTD, IWV)		
Operational Satellite Input Data		Output of ground-based GNSS processing		
Other Operational Input Data				
Dissemination				
Format		Means	Timeliness	
tarballs		Web	N/A	
Accuracy				
Threshold		Target	Optimal	
N/A		N/A	N/A	
Notes				
Verification/Validation Methods		Test Folder		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
N/A	N/A			

GRM-103	Offline Dry Temperature Profile	ODPMEB	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-B/GRAS
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination		
Format	Means	Timeliness
BUFR netCDF	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K - 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K - 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K - 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	GRAS resolution

GRM-105	Offline Dry Temperature Profile	ODPMEC	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-C/GRAS
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR netCDF	Web	5 - 30 d

Accuracy

Threshold	Target	Optimal
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K - 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K - 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K - 0.5 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	GRAS resolution

GRM-107	Offline Bending Angle Grid	OBGCO2	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	COSMIC-2 Post-processed data
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 - 180 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.4 % or 0.8 murad*) 8 – 25 km: 0.4 % 0 – 8 km: 4 – 0.4 %	25 – 50 km: 0.2 % or 0.4 murad*) 8 – 25 km: 0.2 % 0 – 8 km: 2.0– 0.20 %	25 – 50 km: 0.10 % or 0.2 murad*) 8 – 25 km: 0.10 % 0 – 8 km: 1.0 – 0.10 %

Notes	* whichever is greater; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-108	Offline Refractivity Grid	ORGCO2	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	COSMIC-2 Post-processed data
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 - 180 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.16 % or 0.008 N-units*) 8 – 25 km: 0.16 % 0 – 8 km: 1.6 – 0.16 %	25 – 50 km: 0.08 % or 0.004 N-units*) 8 – 25 km: 0.08 % 0 – 8 km: 0.8 – 0.08 %	25 – 50 km: 0.04 % or 0.002 N-units*) 8 – 25 km: 0.04 % 0 – 8 km: 0.4 – 0.04 %
Notes	* whichever is greater ; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-109	**Offline Temperature Grid**	**OTGCO2**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	COSMIC-2 Post-processed data		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 - 180 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: 2.0 – 0.4 K	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: 1.0 – 0.2 K	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: 0.50 – 0.10 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-110	**Offline Specific Humidity Grid**	**OHGCO2**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	COSMIC -2Post-processed data		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 - 180 d

Accuracy		
Threshold	Target	Optimal
8 – 12 km: 6.0 % 0 – 8 km: 6.0 %	8 – 12 km: 3.0 % 0 – 8 km: 3.0 %	8 – 12 km: 1.5 % 0 – 8 km: 1.5 %
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-111	Climate Dry Geopotential Height	OZGCO2	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	COSMIC-2 Post-processed data
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 - 180 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 8 – 80 m 8 – 25 km: 8 m 0 - 8 km: –	25 – 50 km: 4 – 40 m 8 – 25 km: 4 m 0 – 8 km: –	25 – 50 km: 2 – 20 m 8 – 25 km: 2 m 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-112	**Offline Dry Temperature Grid**	**ODGCO2**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	COSMIC-2 Post-processed data		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 - 180 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.4 – 4 K 8 – 25 km: 0.4 K 0 – 8 km: –	25 – 50 km: 0.2 – 2 K 8 – 25 km: 0.2 K 0 – 8 km: –	25 – 50 km: 0.10 – 1.0 K 8 – 25 km: 0.10 K 0 – 8 km: –
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-113	Offline Dry Pressure Grid	OYGCO2	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	COSMIC-2 Post-processed data
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 - 180 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.16 – 0.80 % 8 – 25 km: 0.16 % 0 – 8 km –	25 – 50 km: 0.08 – 0.40 % 8 – 25 km: 0.08 % 0 – 8 km: –	25 – 50 km: 0.04 – 0.20 % 8 – 25 km: 0.04 % 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-117	NTC Refractivity Profile	ORPS6	CDOP4-PRD-1.1

Type	NTC Level 2 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Sentinel-6 series (EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational fields

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	60 d

Accuracy

Threshold	Target	Optimal
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-118	NTC Temperature Profile	OTPS6	CDOP4-PRD-1.1

Type	NTC Level 2 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	NWP model levels
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational fields

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	60 d

Accuracy

Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	NWP model levels	RO resolution

GRM-119	NTC Specific Humidity Profile	OHPS6	CDOP4-PRD-1.1

Type	NTC Level 2 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	NWP model levels
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational fields

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	60 d

Accuracy

Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	NWP model levels	RO resolution

GRM-120	NTC Pressure Profile		OPPS6	CDOP4-PRD-1.1
Type		NTC Level 2 Product		
Applications and Users		Climate and atmosphere researchers		
Characteristics and Methods		NWP model levels		
Operational Satellite Input Data		Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)		
Other Operational Input Data		ECMWF NWP operational fields		
Dissemination				
Format		Means	Timeliness	
netCDF BUFR		Web	60 d	
Accuracy				
Threshold		Target	Optimal	
a) 0.03 hPa b) 0.75% c) 2.4 hPa *		a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *	
Notes		* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered		
Verification/Validation Methods		Standard deviation of (1D-Var solution – ECMWF analysis)		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	RO resolution	NWP model levels	RO resolution	

GRM-121	**NTC Surface Pressure**	**OSPS6**	**CDOP4-PRD-1.1**
Type	NTC Level 2 Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Scalar at surface		
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)		
Other Operational Input Data	ECMWF NWP operational fields		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	60 d

Accuracy		
Threshold	Target	Optimal
2.4 hPa	0.8 hPa	0.7 hPa
Notes		
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	Scalar at surface	RO resolution

GRM-122	NTC Dry Temperature Profile	ODPS6	CDOP4-PRD-1.1

Type	NTC Level 2 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	60 d

Accuracy		
Threshold	Target	Optimal
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K - 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K - 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K - 0.5 K
Notes		
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-123	**NTC Bending Angle Grid**	**OBGS6**	**CDOP4-PRD-1.1**
Type	NTC Level 3 Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Sentinel-6 series (EUMETSAT Secretariat Level 1B Bending Angle Data)		
Other Operational Input Data	ECMWF NWP operational and reanalyses fields		

Dissemination		
Format	Means	Timeliness
netCDF	Web	60 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.6 % or 1.2 murad*) 8 – 25 km: 0.6 % 0 – 8 km: 6.0 – 0.6 %	25 – 50 km: 0.3 % or 0.6 murad*) 8 – 25 km: 0.3 % 0 – 8 km: 3.0 – 0.30 %	25 – 50 km: 0.15 % or 0.3 murad*) 8 – 25 km: 0.15 % 0 – 8 km: 1.5 – 0.15 %
Notes	* whichever is greater; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-124	NTC Refractivity Grid	ORGS6	CDOP4-PRD-1.1

Type	NTC Level 3 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination

Format	Means	Timeliness
netCDF	Web	60 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.24 % or 0.012 N-units*) 8 – 25 km: 0.24 % 0 – 8 km: 2.4 – 0.24 %	25 – 50 km: 0.12 % or 0.006 N-units*) 8 – 25 km: 0.12 % 0 – 8 km: 1.2 – 0.12 %	25 – 50 km: 0.06 % or 0.003 N-units*) 8 – 25 km: 0.06 % 0 – 8 km: 0.6 – 0.06 %

Notes	* whichever is greater ; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-125	NTC Temperature Grid	OTGJA!	CDOP4-PRD-1.1

Type	NTC Level 3 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination

Format	Means	Timeliness
netCDF	Web	60 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: 2.0 – 0.6 K	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: 1.0 – 0.3 K	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: 0.50 – 0.15 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-126	NTC Specific Humidity Grid	OHGS6	CDOP4-PRD-1.1

Type	NTC Level 3 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination

Format	Means	Timeliness
netCDF	Web	60 d

Accuracy

Threshold	Target	Optimal
8 – 12 km: 8.0 % 0 – 8 km: 8.0 %	8 – 12 km: 4.0 % 0 – 8 km: 4.0 %	8 – 12 km: 2.0 % 0 – 8 km: 2.0 %
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-127	NTC Dry Geopotential Height Grid	OZGS6	CDOP4-PRD-1.1

Type	NTC Level 3 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination

Format	Means	Timeliness
netCDF	Web	60 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 12 – 120 m 8 – 25 km: 12 m 0 – 8 km: –	25 – 50 km: 6 – 60 m 8 – 25 km: 6 m 0 – 8 km: –	25 – 50 km: 3 – 30 m 8 – 25 km: 3 m 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-128	NTC Dry Temperature Grid	ODGS6	CDOP4-PRD-1.1

Type	NTC Level 3 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination

Format	Means	Timeliness
netCDF	Web	60 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: –	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: –	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-129	NTC Dry Pressure Grid	OYGS6	CDOP4-PRD-1.1

Type	NTC Level 3 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination

Format	Means	Timeliness
netCDF	Web	60 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.24 – 1.20 % 8 – 25 km: 0.24 % 0 – 8 km –	25 – 50 km: 0.12 – 0.60 % 8 – 25 km: 0.12 % 0 – 8 km: –	25 – 50 km: 0.06 – 0.30 % 8 – 25 km: 0.06 % 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-130	NRT Refractivity Profile	NRPMA1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy

Threshold	Target	Optimal
30 – 50 km: 0.09 N-units 5 – 30 km: 1.8% 0 – 5 km: 6% – 1.8%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-131	NRT Temperature Profile	NTPMA1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy

Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-132	NRT Specific Humidity Profile	NHPMA1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy		
Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-133	NRT Pressure Profile	NPPMA1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy

Threshold	Target	Optimal
a) 0.03 hPa b) 0.75% c) 2.4 hPa *	a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *
Notes	* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-134	NRT Surface Pressure	NSPMA1	CDOP4-PRD-1.1
Type	NRT Product		
Applications and Users	NWP		
Characteristics and Methods	Scalar at surface		
Operational Satellite Input Data	Metop-SG A1		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy		
Threshold	Target	Optimal
2.4 hPa	0.8 hPa	0.7 hPa
Notes		
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	Scalar at surface	RO resolution

GRM-135	NRT Dry Temperature Profile	NDPMA1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy

Threshold	Target	Optimal
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K - 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K - 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K - 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-136	Offline Bending Angle	OBAMA1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy

Threshold	Target	Optimal
35 – 60 km: 4 murad 8 – 35 km: 4% 2 – 8 km: 20% - 4%	35 – 60 km: 2 murad 8 – 35 km: 2% 2 – 8 km: 10% - 2%	35 – 60 km: 1 murad 8 – 35 km: 1% 2 – 8 km: 5% - 1%

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate BA noise above 60 km is expected to be between 0.5 and 1.5 (rad;
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-137	Offline Refractivity Profile	ORPMA1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-138	Offline Temperature Profile	OTPMA1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-139	Offline Specific Humidity Profile	OHPMA1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-140	Offline Pressure Profile	OPPMA1	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-SG A1		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
a) 0.03 hPa b) 0.75% c) 2.4 hPa *	a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *
Notes	* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-141	**Offline Surface Pressure**		**OSPMA1**	**CDOP4-PRD-1.1**
Type		Offline Product		
Applications and Users		Climate and atmosphere researchers		
Characteristics and Methods		Scalar at surface		
Operational Satellite Input Data		Metop-SG A1		
Other Operational Input Data		GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		
Dissemination				
Format		Means	Timeliness	
netCDF BUFR		Web	5 - 30 d	
Accuracy				
Threshold		Target	Optimal	
2.4 hPa		0.8 hPa	0.7 hPa	
Notes				
Verification/Validation Methods		Standard deviation of (1D-Var solution – ECMWF analysis)		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	RO resolution	Scalar at surface	RO resolution	

GRM-142	Offline Dry Temperature Profile	ODPMA1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy

Threshold	Target	Optimal
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K - 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K - 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K - 0.5 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-143	Offline Bending Angle Grid	OBGMA1	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-SG A1		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.6 % or 1.2 murad *) 8 – 25 km: 0.6 % 0 – 8 km: 6 – 0.6 %	25 – 50 km: 0.3 % or 0.6 murad*) 8 – 25 km: 0.3 % 0 – 8 km: 3 – 0.3 %	25 – 50 km: 0.15 % or 0.3 murad*) 8 – 25 km: 0.15 % 0 – 8 km: 1.5 – 0.15 %
Notes	* whichever is greater; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-144	**Offline Refractivity Grid**		**ORGMA1**	**CDOP4-PRD-1.1**
Type		Offline Product		
Applications and Users		Climate and atmosphere researchers		
Characteristics and Methods		Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data		Metop-SG A1		
Other Operational Input Data		ECMWF ERA Interim (validation, sampling error estimation)		
Dissemination				
Format		Means	Timeliness	
netCDF		Web	30 d	
Accuracy				
Threshold		Target	Optimal	
25 – 50 km: 0.24 % or 0.012 N-units*) 8 – 25 km: 0.24 % 0 – 8 km: 2.4 – 0.24 %		25 – 50 km: 0.12 % or 0.006 N-units*) 8 – 25 km: 0.12 % 0 – 8 km: 1.2 – 0.12 %	25 – 50 km: 0.06 % or 0.003 N-units*) 8 – 25 km: 0.06 % 0 – 8 km: 0.6 – 0.06 %	
Notes		* whichever is greater ; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate		
Verification/Validation Methods		Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	5 deg latitude	200 m	1 month	

GRM-145	**Offline Temperature Grid**	**OTGMA1**	**CDOP4-PRD-1.1**

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: 2.0 – 0.6 K	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: 1.0 – 0.3 K	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: 0.50 – 0.15 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-146	Offline Specific Humidity Grid	OHGMA1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
8 – 12 km: 8.0 % 0 – 8 km: 8.0 %	8 – 12 km: 4.0 % 0 – 8 km: 4.0 %	8 – 12 km: 2.0 % 0 – 8 km: 2.0 %
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-147	Climate Dry Geopotential Height	OZGMA1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 12 – 120 m 8 – 25 km: 12 m 0 - 8 km: –	25 – 50 km: 6 – 60 m 8 – 25 km: 6 m 0 – 8 km: –	25 – 50 km: 3 – 30 m 8 – 25 km: 3 m 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-148	Offline Dry Temperature Grid	ODGMA1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: –	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: –	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-149	**Offline Dry Pressure Grid**	**OYGMA1**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-SG A1		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.24 – 1.20 % 8 – 25 km: 0.24 % 0 – 8 km –	25 – 50 km: 0.12 – 0.60 % 8 – 25 km: 0.12 % 0 – 8 km: –	25 – 50 km: 0.06 – 0.30 % 8 – 25 km: 0.06 % 0 – 8 km: –
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-150	NRT Refractivity Profile	NRPMB1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy

Threshold	Target	Optimal
30 – 50 km: 0.09 N-units 5 – 30 km: 1.8% 0 – 5 km: 6% – 1.8%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-151	NRT Temperature Profile	NTPMB1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy

Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-152	NRT Specific Humidity Profile	NHPMB1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy		
Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-153	NRT Pressure Profile	NPPMB1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy

Threshold	Target	Optimal
a) 0.03 hPa b) 0.75% c) 2.4 hPa *	a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *
Notes	* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-154	NRT Surface Pressure	NSPMB1	CDOP4-PRD-1.1
Type	NRT Product		
Applications and Users	NWP		
Characteristics and Methods	Scalar at surface		
Operational Satellite Input Data	Metop-SG B1		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy		
Threshold	Target	Optimal
2.4 hPa	0.8 hPa	0.7 hPa
Notes		
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	Scalar at surface	RO resolution

GRM-155	NRT Dry Temperature Profile	NDPMB1	CDOP4-PRD-1.1

Type	NRT Product
Applications and Users	NWP
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
BUFR/netCDF	GTS EUMETCast Web	Global: Th: 150 min (90%) B: 80 min (95%) Regional: TBD

Accuracy

Threshold	Target	Optimal
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K - 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K - 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K - 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global, Regional (TBD)	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-156	Offline Bending Angle	OBAMB1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy

Threshold	Target	Optimal
35 – 60 km: 4 murad 8 – 35 km: 4% 2 – 8 km: 20% - 4%	35 – 60 km: 2 murad 8 – 35 km: 2% 2 – 8 km: 10% - 2%	35 – 60 km: 1 murad 8 – 35 km: 1% 2 – 8 km: 5% - 1%

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate BA noise above 60 km is expected to be between 0.5 and 1.5 (rad;
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-157	Offline Refractivity Profile	ORPMB1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy

Threshold	Target	Optimal
30 – 50 km: 0.06 N-units 5 – 30 km: 1.2% 0 – 5 km: 4% – 1.2%	30 – 50 km: 0.03 N-units 5 – 30 km: 0.6% 0 – 5 km: 2% – 0.6%	30 – 50 km: 0.02 N-units 5 – 30 km: 0.3% 0 – 5 km: 1% – 0.3%

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-158	Offline Temperature Profile	OTPMB1	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-SG B1		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
30 – 50 km: 3 K – 30 K 5 – 30 km: 3 K 0 – 5 km: 6 K – 3 K	30 – 50 km: 1 K – 10 K 5 – 30 km: 1 K 0 – 5 km: 2 K – 1 K	30 – 50 km: 0.5 K – 5 K 5 – 30 km: 0.5 K 0 – 5 km: 1 K – 0.5 K
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-159	Offline Specific Humidity Profile	OHPMB1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy

Threshold	Target	Optimal
1.8 g/kg 30% *	0.6 g/kg 10% *	0.3 g/kg 10% *
Notes	* whichever is greater; The interval 0 – 12 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-160	**Offline Pressure Profile**	**OPPMBA1**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	model levels (with interpolation); interpolated to 247 fixed levels		
Operational Satellite Input Data	Metop-SG B1		
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy		
Threshold	Target	Optimal
a) 0.03 hPa b) 0.75% c) 2.4 hPa *	a) 0.01 hPa b) 0.25% c) 0.8 hPa *	a) 0.005 hPa b) 0.1% c) 0.7 hPa *
Notes	* whichever is greatest of (a) and (b) but not greater than (c); The interval 0 – 50 km is considered	
Verification/Validation Methods	Standard deviation of (1D-Var solution – ECMWF analysis)	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	model levels (with interpolation); interpolated to 247 fixed levels	RO resolution

GRM-161	**Offline Surface Pressure**		**OSPMB1**	**CDOP4-PRD-1.1**
Type		Offline Product		
Applications and Users		Climate and atmosphere researchers		
Characteristics and Methods		Scalar at surface		
Operational Satellite Input Data		Metop-SG B1		
Other Operational Input Data		GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN		
Dissemination				
Format		Means	Timeliness	
netCDF BUFR		Web	5 - 30 d	
Accuracy				
Threshold		Target	Optimal	
2.4 hPa		0.8 hPa	0.7 hPa	
Notes				
Verification/Validation Methods		Standard deviation of (1D-Var solution – ECMWF analysis)		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	RO resolution	Scalar at surface	RO resolution	

GRM-162	Offline Dry Temperature Profile	ODPMB1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	hi-res wave optics sampling; interpolated to 247 fixed levels
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	GPS orbits (EUM) Metop orbits (EUM) ECMWF FC, AN

Dissemination

Format	Means	Timeliness
netCDF BUFR	Web	5 - 30 d

Accuracy

Threshold	Target	Optimal
20 – 40 km: 2 K – 20 K 5 – 20 km: 2 K 0 – 5 km: 4 K - 2 K	20 – 40 km: 1 K – 10 K 5 – 20 km: 1 K 0 – 5 km: 2 K - 1 K	20 – 40 km: 0.5 K – 5 K 5 – 20 km: 0.5 K 0 – 5 km: 1 K - 0.5 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Standard deviation of (Product – ECMWF forecasts)

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO resolution	hi-res wave optics sampling; interpolated to 247 fixed levels	RO resolution

GRM-163	Offline Bending Angle Grid	OBGMB1	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-SG B1		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.6 % or 1.2 murad *) 8 – 25 km: 0.6 % 0 – 8 km: 6 – 0.6 %	25 – 50 km: 0.3 % or 0.6 murad*) 8 – 25 km: 0.3 % 0 – 8 km: 3 – 0.3 %	25 – 50 km: 0.15 % or 0.3 murad*) 8 – 25 km: 0.15 % 0 – 8 km: 1.5 – 0.15 %
Notes	* whichever is greater; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-164	**Offline Refractivity Grid**	**ORGMB1**	**CDOP4-PRD-1.1**
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-SG B1		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
25 – 50 km: 0.24 % or 0.012 N-units*) 8 – 25 km: 0.24 % 0 – 8 km: 2.4 – 0.24 %	25 – 50 km: 0.12 % or 0.006 N-units*) 8 – 25 km: 0.12 % 0 – 8 km: 1.2 – 0.12 %	25 – 50 km: 0.06 % or 0.003 N-units*) 8 – 25 km: 0.06 % 0 – 8 km: 0.6 – 0.06 %
Notes	* whichever is greater ; An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-165	Offline Temperature Grid	OTGMB1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: 2.0 – 0.6 K	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: 1.0 – 0.3 K	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: 0.50 – 0.15 K

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-166	Offline Specific Humidity Grid	OHGMB1	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-SG B1		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
8 – 12 km: 8.0 % 0 – 8 km: 8.0 %	8 – 12 km: 4.0 % 0 – 8 km: 4.0 %	8 – 12 km: 2.0 % 0 – 8 km: 2.0 %
Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate	
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-167	Climate Dry Geopotential Height	OZGMB1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 12 – 120 m 8 – 25 km: 12 m 0 - 8 km: –	25 – 50 km: 6 – 60 m 8 – 25 km: 6 m 0 – 8 km: –	25 – 50 km: 3 – 30 m 8 – 25 km: 3 m 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-168	Offline Dry Temperature Grid	ODGMB1	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-SG B1
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
25 – 50 km: 0.6 – 6 K 8 – 25 km: 0.6 K 0 – 8 km: –	25 – 50 km: 0.3 – 3 K 8 – 25 km: 0.3 K 0 – 8 km: –	25 – 50 km: 0.15 – 1.5 K 8 – 25 km: 0.15 K 0 – 8 km: –

Notes	An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	200 m	1 month

GRM-169	**Offline Dry Pressure Grid**		**OYGMB1**	**CDOP4-PRD-1.1**
Type		Offline Product		
Applications and Users		Climate and atmosphere researchers		
Characteristics and Methods		Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data		Metop-SG B1		
Other Operational Input Data		ECMWF ERA Interim (validation, sampling error estimation)		
Dissemination				
Format		Means	Timeliness	
netCDF		Web	30 d	
Accuracy				
Threshold		Target	Optimal	
25 – 50 km: 0.24 – 1.20 % 8 – 25 km: 0.24 % 0 – 8 km –		25 – 50 km: 0.12 – 0.60 % 8 – 25 km: 0.12 % 0 – 8 km: –	25 – 50 km: 0.06 – 0.30 % 8 – 25 km: 0.06 % 0 – 8 km: –	
Notes		An accuracy interval means a linearly changing quantity between the two values over the given vertical coordinate;		
Verification/Validation Methods		Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	5 deg latitude	200 m	1 month	

GRM-170	Electron Density Profile	EDPMA1	CDOP4-PRD-1.1

Type	TBD
Applications and Users	Space weather and ionosphere researchers
Characteristics and Methods	
Operational Satellite Input Data	Metop-SG A1
Other Operational Input Data	

Dissemination		
Format	Means	Timeliness
TBD	TBD	TBD

Accuracy		
Threshold	Target	Optimal
TBD	TBD	TBD
Notes		
Verification/Validation Methods	TBD	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	GRAS-SG resoltuion		

GRM-171	Electron Density Profile		EDPMB1	CDOP4-PRD-1.1
Type		TBD		
Applications and Users		Space weather and ionosphere researchers		
Characteristics and Methods				
Operational Satellite Input Data		Metop-SG B1		
Other Operational Input Data				
Dissemination				
Format		Means	Timeliness	
TBD		TBD	TBD	
Accuracy				
Threshold		Target	Optimal	
TBD		TBD	TBD	
Notes				
Verification/Validation Methods		TBD		
Coverage, Resolution				
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution	
Global	GRAS-SG resoltuion			

GRM-172	**Scintillation Index**			**SINMA1**	**CDOP4-PRD-1.1**
Type		TBD			
Applications and Users		Space weather and ionosphere researchers			
Characteristics and Methods					
Operational Satellite Input Data		Metop-SG A1			
Other Operational Input Data					
Dissemination					
Format		Means		Timeliness	
TBD		TBD		TBD	
Accuracy					
Threshold		Target		Optimal	
TBD		TBD		TBD	
Notes					
Verification/Validation Methods		TBD			
Coverage, Resolution					
Spatial Coverage	Horizontal Resolution		Vertical Resolution		Temporal Resolution
Global	GRAS-SG resoltuion				

GRM-173	**Scintillation Index**			**SINMB1**	**CDOP4-PRD-1.1**
Type		TBD			
Applications and Users		Space weather and ionosphere researchers			
Characteristics and Methods					
Operational Satellite Input Data		Metop-SG B1			
Other Operational Input Data					
Dissemination					
Format		Means		Timeliness	
TBD		TBD		TBD	
Accuracy					
Threshold		Target		Optimal	
TBD		TBD		TBD	
Notes					
Verification/Validation Methods		TBD			
Coverage, Resolution					
Spatial Coverage	Horizontal Resolution		Vertical Resolution		Temporal Resolution
Global	GRAS-SG resoltuion				

GRM-192	Offline Tropopause Height Grid	OCGMEB	CDOP4-PRD-1.1
Type	Offline Product		
Applications and Users	Climate and atmosphere researchers		
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids		
Operational Satellite Input Data	Metop-B/GRAS		
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)		

Dissemination		
Format	Means	Timeliness
netCDF	Web	30 d

Accuracy		
Threshold	Target	Optimal
2 km	1 km	0.5 km
Notes		
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude		1 month

GRM-193	Offline Tropopause Height Grid	OCGMEC	CDOP4-PRD-1.1

Type	Offline Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 200 m x 5 deg grids
Operational Satellite Input Data	Metop-C/GRAS
Other Operational Input Data	ECMWF ERA Interim (validation, sampling error estimation)

Dissemination

Format	Means	Timeliness
netCDF	Web	30 d

Accuracy

Threshold	Target	Optimal
2 km	1 km	0.5 km
Notes		
Verification/Validation Methods	Statistics of differences relative to ECMWF ERA Interim.Resampling statistics: inter-comparison of RO data subsets.	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude		1 month

GRM-195	NTC Tropopause Height Grid (Sentinel-6)	OCGS6	CDOP4-PRD-1.1

Type	NTC Level 3 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 5 deg grids
Operational Satellite Input Data	Sentinel-6 series (ROM SAF Level 2 product derived from EUMETSAT Secretariat Level 1B Bending Angle Data)
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination

Format	Means	Timeliness
netCDF	Web	60 d

Accuracy

Threshold	Target	Optimal
0.4 km	0.2 km	0.1 km
Notes		
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.	

Coverage, Resolution

Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	Scalar	1 month

GRM-196 **GRM-197**	**NTC Tropopause Height Grid (EPS-SG Sat A1)** **NTC Tropopause Height Grid (EPS-SG Sat B1)**	**OCGMA1** **OCGMB1**	**CDOP4-PRD-1.1**

Type	NTC Level 3 Product
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	Zonal monthly means on 5 deg grids
Operational Satellite Input Data	EPS-SG mission Level 1A from EUMETSAT Secreatariat
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination		
Format	Means	Timeliness
netCDF	Web	60 d

Accuracy		
Threshold	Target	Optimal
0.4 km	0.2 km	0.1 km
Notes		
Verification/Validation Methods	Statistics of differences relative to ECMWF operational data within 9 broad latitude-height regions (low, middle, and high latitudes; low, middle, and high altitudes). Compliance requires that 60% of the absolute differences are smaller than the corresponding accuracy value.	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	5 deg latitude	Scalar	1 month

GRM-200	NRT Verification Product	NVPMET	CDOP4-PRD-1.1

Type	NRT demonstration product
Applications and Users	NWP and atmosphere researchers
Characteristics and Methods	- Temperature and geopotential height datasets twice per day, valid at the times of 00Z and 12Z. - Each dataset will contain batched GNSS-RO data from the 6 hour time interval spanning ±3 hours of the validity time. - The GNSS-RO data, which has passed the ROM SAF QC, will be interpolated onto a set of fixed pressure levels, from 100 hPa up to 5 hPa (Possibly 100, 70, 50, 30, 20, 10, and 5 hPa, TBD).
Operational Satellite Input Data	Metop and Metop-SG
Other Operational Input Data	ECMWF NWP operational and reanalyses fields

Dissemination		
Format	Means	Timeliness
TBD	TBD	TBD

Accuracy		
Threshold	Target	Optimal
TBD	TBD	TBD
Notes		
Verification/Validation Methods	TBD	

Coverage, Resolution			
Spatial Coverage	Horizontal Resolution	Vertical Resolution	Temporal Resolution
Global	RO	Fixed pressure levels (TBD)	RO

GRM-29-I1	**Metop Interim Climate Data Record (Data Levels L1B, L2, L3)**	**ICDRMET**	**CDOP4-PRD-1.1**
GRM-29-L1-B-I1	**ICDR Bending Angle**	**IBAMET**	
GRM-29-L2-R-I1	**ICDR Refractivity Profile**	**IRPMET**	
GRM-29-L2-D-I1	**ICDR Dry Temperature Profile**	**IDPMET**	
GRM-29-L2-T-I1	**ICDR Temperature Profile**	**ITPMET**	
GRM-29-L2-H-I1	**ICDR Specific Humidity Profile**	**IHPMET**	
GRM-29-L2-P-I1	**ICDR Pressure Profile**	**IPPMET**	
GRM-29-L2-S-I1	**ICDR Surface Pressure**	**ISPMET**	
GRM-29-L2-C-I1	**ICDR Tropopause Height**	**ICHMET**	
GRM-29-L3-B-I1	**ICDR Bending Angle Grid**	**IBGMET**	
GRM-29-L3-R-I1	**ICDR Refractivity Grid**	**IRGMET**	
GRM-29-L3-D-I1	**ICDR Dry Temperature Grid**	**IDGMET**	
GRM-29-L3-Y-I1	**ICDR Dry Pressure Grid**	**IYGMET**	
GRM-29-L3-Z-I1	**ICDR Dry Geopotential Height Grid**	**IZGMET**	
GRM-29-L3-T-I1	**ICDR Temperature Grid**	**ITGMET**	
GRM-29-L3-H-I1	**ICDR Specific Humidity Grid**	**IHGMET**	
GRM-29-L3-C-I1	**ICDR Tropopause Height Grid**	**ICGMET**	

Type	Interim Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	1) Regularly extends in time CDR GRM-29-R1 using a system having optimum consistency with the system used to generate CDR GRM-29-R1; 2) The extension in time will continue until the release of CDR GRM-29-R2 which will cover both the GRM-29-R1 and GRM-29-I1 time periods;
Operational Satellite Input Data	Operational Level 1A/1B Metop files from EUMETSAT Secretariat
Other Operational Input Data	ECMWF ERA Interim fields and ERA5 fields

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	Two months

Accuracy		
Threshold	Target	Optimal
GRM-29-R1	GRM-29-R1	GRM-29-R1

Notes	
Verification/Validation Methods	Same methods as used for CDR GRM-29-R1

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
GRM-29-R1	GRM-29-R1	GRM-29-R1	GRM-29-R1

GRM-29-I2	Metop Interim Climate Data Record (Data Levels L1B, L2, L3)	ICDRMET	CDOP4-PRD-1.1
GRM-29-L1-B-I2 GRM-29-L2-R-I2 GRM-29-L2-D-I2 GRM-29-L2-T-I2 GRM-29-L2-H-I2 GRM-29-L2-P-I2 GRM-29-L2-S-I2 GRM-29-L2-C-I2 GRM-29-L2-L-I2 GRM-29-L3-B-I2 GRM-29-L3-R-I2 GRM-29-L3-D-I2 GRM-29-L3-Y-I2 GRM-29-L3-Z-I2 GRM-29-L3-T-I2 GRM-29-L3-H-I2 GRM-29-L3-C-I2 GRM-29-L3-L-I2	ICDR Bending Angle ICDR Refractivity Profile ICDR Dry Temperature Profile ICDR Temperature Profile ICDR Specific Humidity Profile ICDR Pressure Profile ICDR Surface Pressure ICDR Tropopause Height ICDR Planetary Boundary Layer Height ICDR Bending Angle Grid ICDR Refractivity Grid ICDR Dry Temperature Grid ICDR Dry Pressure Grid ICDR Dry Geopotential Height Grid ICDR Temperature Grid ICDR Specific Humidity Grid ICDR Tropopause Height Grid ICDR Planetary Boundary Layer Height Grid	IBAMET IRPMET IDPMET ITPMET IHPMET IPPMET ISPMET ICHMET ILHMET IBGMET IRGMET IDGMET IYGMET IZGMET ITGMET IHGMET ICGMET ILGMET	

Type	Interim Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	1) Regularly extends in time CDR GRM-29-R2 using a system having optimum consistency with the system used to generate CDR GRM-29-R2; 2) The extension in time will continue until the release of CDR GRM-29-R3 which will cover both the GRM-29-R2 and GRM-29-I2 time periods;
Operational Satellite Input Data	Operational Level 1A/1B Metop files from EUMETSAT Secretariat
Other Operational Input Data	ECMWF ERA5 fields and TBD

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	Two months

Accuracy		
Threshold	Target	Optimal
GRM-29-R2	GRM-29-R2	GRM-29-R2

Notes	
Verification/Validation Methods	Same methods as used for CDR GRM-29-R2

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
GRM-29-R2	GRM-29-R2	GRM-29-R2	GRM-29-R2

GRM-29-I3	**Metop Interim Climate Data Record (Data Levels L1B, L2, L3)**	**ICDRMET**	**CDOP4-PRD-1.1**
GRM-29-L1-B-I3	**ICDR Bending Angle**	**IBAMET**	
GRM-29-L2-R-I3	**ICDR Refractivity Profile**	**IRPMET**	
GRM-29-L2-D-I3	**ICDR Dry Temperature Profile**	**IDPMET**	
GRM-29-L2-T-I3	**ICDR Temperature Profile**	**ITPMET**	
GRM-29-L2-H-I3	**ICDR Specific Humidity Profile**	**IHPMET**	
GRM-29-L2-P-I3	**ICDR Pressure Profile**	**IPPMET**	
GRM-29-L2-S-I3	**ICDR Surface Pressure**	**ISPMET**	
GRM-29-L2-C-I3	**ICDR Tropopause Height**	**ICHMET**	
GRM-29-L2-L-I3	**ICDR Planetary Boundary Layer Height**	**ILHMET**	
GRM-29-L3-B-I3		**IBGMET**	
GRM-29-L3-R-I3	**ICDR Bending Angle Grid**	**IRGMET**	
GRM-29-L3-D-I3	**ICDR Refractivity Grid**	**IDGMET**	
GRM-29-L3-Y-I3	**ICDR Dry Temperature Grid**	**IYGMET**	
GRM-29-L3-Z-I3	**ICDR Dry Pressure Grid**	**IZGMET**	
GRM-29-L3-T-I3	**ICDR Dry Geopotential Height Grid**	**ITGMET**	
GRM-29-L3-H-I3	**ICDR Temperature Grid**	**IHGMET**	
GRM-29-L3-C-I3	**ICDR Specific Humidity Grid**	**ICGMET**	
GRM-29-L3-L-I3	**ICDR Tropopause Height Grid**	**ILGMET**	
	ICDR Planetary Boundary Layer Height Grid		

Type	Interim Climate Data Record
Applications and Users	Climate and atmosphere researchers
Characteristics and Methods	1) Regularly extends in time CDR GRM-29-R3 using a system having optimum consistency with the system used to generate CDR GRM-29-R3; 2) The extension in time will continue until the release of CDR GRM-29-R4 which will cover both the GRM-29-R3 and GRM-29-I3 time periods;
Operational Satellite Input Data	Operational Level 1A/1B Metop files from EUMETSAT Secretariat
Other Operational Input Data	ECMWF ERA5 fields and TBD

Dissemination		
Format	Means	Timeliness
netCDF BUFR	Web	Two months

Accuracy		
Threshold	Target	Optimal
GRM-29-R3	GRM-29-R3	GRM-29-R3

Notes	
Verification/Validation Methods	Same methods as used for CDR GRM-29-R3

Coverage, Resolution			
Spatial Coverage	Spatial Resolution	Vertical Resolution	Temporal resolution
GRM-29-R3	GRM-29-R3	GRM-29-R3	GRM-29-R3