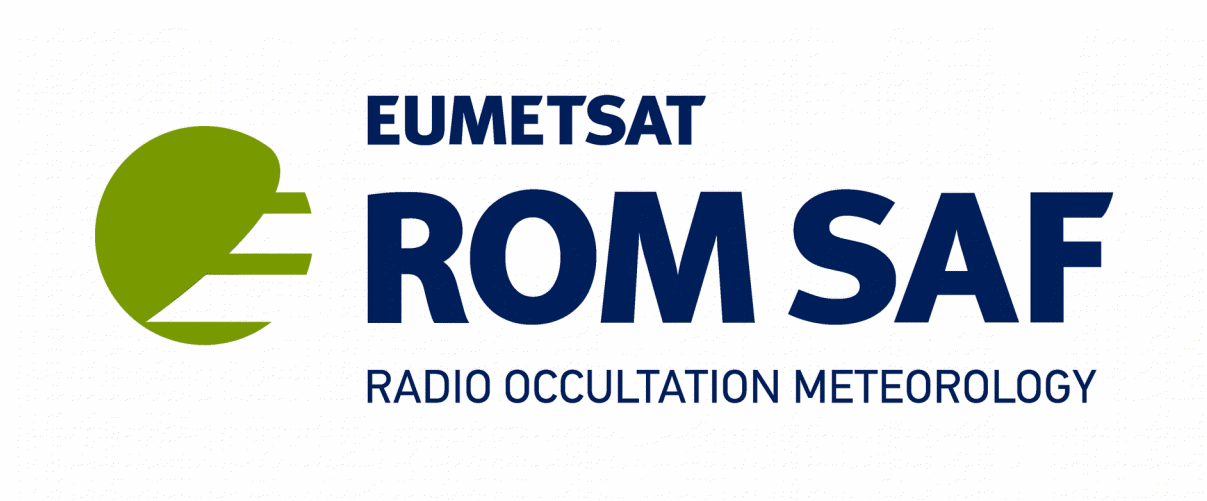

GBGP Change Log: v1.0

Version 1.0

31 March 2019

Danish Meteorological Institute (DMI)
European Centre for Medium-Range Weather Forecasts (ECMWF)
Institut d'Estudis Espacials de Catalunya (IEEC)
Met Office (METO)

Ref: SAF/ROM/METO/CL/GBGP/001

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DOCUMENT CHANGE RECORD

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1.0	31/03/2019	DO	1st Release version GBGP-1 (V1.0)

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 GRAS radio occultation data from the Metop satellites and radio occultation (RO) data from other missions. The ROM SAF delivers bending angle, refractivity, temperature, pressure, and humidity profiles in near-real time and off-line for NWP and climate users. The off-line profiles are further processed into climate products consisting of gridded monthly zonal means of bending angle, refractivity, temperature, humidity, and geopotential heights together with error descriptions.

The ROM SAF also maintains the Radio Occultation Processing Package (ROPP) which contains software modules that will aid users wishing to process, quality-control and assimilate radio occultation data from any radio occultation mission into NWP and other models, and the Ground-Based GNSS Package (GBGP) which provides format conversion with quality-checking for processed ground-based GNSS data prior to dissemination to, and use by, NWP centres.

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, and iii) Met Office in Exeter, United Kingdom. To get access to our products or to read more about the ROM SAF please go to: http://www.romsaf.org

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List of Contents

Executive Summary

This document summarizes the significant differences between the first full release of the Ground-Based GNSS Package (GBGP) Version 1.0 and the previous public Prototype release (Version 1.0-proto), including changes before and since the Beta package (Version 1.0-beta) released to cooperating beta-testers only.

1. Introduction

1.1 Purpose of the document

This document summarizes the significant differences between the first full release of the Ground-Based GNSS Package (GBGP) Version 1.0 and the previous public Prototype release (Version 1.0-proto), including changes before and since the Beta package (Version 1.0-beta) released to cooperating beta-testers only.

For guidance on downloading and installing the GBGP software, and the available documentation, please refer to the GBGP Release Notes [RD.1]. All comments on the GBGP software should, in the first instance, be reported via the ROM SAF Helpdesk at http://www.romsaf.org.

1.2 Reference documents

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

[RD.1] GBGP Release Notes
Ref: SAF/ROM/METO/RN/GBGP/001

[RD.2] GBGP User Guide
Ref: SAF/ROM/METO/UG/GBGP/001

[RD.3] 'COST-format' file specification for ground-based GNSS delay and water vapour data
Ref: E-GVAP/METO/FMT/COST/001

[RD.4] WMO FM94 (BUFR) specification for ground-based GNSS delay and water vapour data
Ref: E-GVAP/METO/FMT/BUFR/001

[RD.5] NetCDF (Unidata) website
URL: http://www.unidata.ucar.edu/software/netcdf/

[RD.6] NOAA/Earth Systems Resreach Laboratory GPSNet website
URL: http://gpsmet.noaa.gov/

[RD.7] UCAR/COSMIC Programme Office SuomiNet/CONUS website
http://www.suominet.ucar.edu/

1.3 Acronyms and abbreviations

API	Application Programming Interface
BUFR	Binary Universal Form for the Representation of data (also: FM94) (WMO)
CDOP-2	Second Continuous Development and Operations Phase (EUMETSAT)
CSV	Comma-Separated Value
DMI	Danish Meteorological Institute; ROM SAF Leading Entity
ECMWF	The European Centre for Medium-range Weather Forecasts
EUMETSAT	EUropean organisation for the exploitation of METeorological SATellites
GB-GNSS	Ground-Based GNSS
GBGP	Ground-Based GNSS Package
GCC	GNU Compiler Collection (not to be confused with **gcc**, the GCC C-compiler)
GNU	GNU's Not Unix
GNSS	Global Navigation Satellite System

GPS	Global Positioning System
GTS	Global Telecommunications System (WMO)
HDF5	Hierarchical Data Format version 5
IWV	Integrated Water Vapour
Met Office	Meteorological Office of the United Kingdom
MetDB	Meteorological DataBase (Met Office)
netCDF	Network Common Data Format
NRT	Near Real Time
OS	Operating System
POSIX	Portable Operating System Interface
RHEL	Red Hat Enterprise Linux
RO	Radio Occultation (also: GPS-RO, GNSS-RO)
ROM SAF	Radio Occultation Meteorology SAF (formerly GRAS SAF)
ROPP	Radio Occultation Processing Package
SAF	Satellite Application Facility (EUMETSAT)
UCAR	University Center for Atmospheric Research (Boulder, CO, USA)
USP	Unique Selling Point
WMO	World Meteorological Organisation
ZHD	Zenith Hydrostatic Delay
ZTD	Zenith Total Delay
ZWD	Zenith Wet Delay

1.4 Definitions

GB-GNSS data products under the the E-GVAP project and other data suppliers (such as NOAA and UCAR) of NRT or offline products:

Data levels:

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

Level 1a: Reconstructed full resolution excess phase, SNR, amplitude, orbit information

Level 1b: Zenith total delay, timestamped and annotated with GNSS station location, metadata and quality information;

Level 2: Zenith wet delay, integrated water vapour, ancillary meteorological data

Level 3: Gridded Level 1 and 2 offline products in the form of, e.g., hourly time series, daily or longer means, metadata, and quality information.

Product types:

NRT product:	data product delivered less than 1.5 hours after measurement;
Offline product:	data product delivered greater than 1 day after measurement;
Reprocessed product:	data product processed consistently over a long dataset.

File format Types:

COST-format: Text-based format defined by E-GVAP and used for general exchange of GB-GNSS Level 1/2 data. This format is defined in [RD.3];

BUFR: WMO binary format for dissemination of NRT observational data on the GTS. For GB-GNSS details, see [RD.4];

netCDF: Unidata binary format for general data storage and exchange. [RD.5]. For GB-GNSS data and documentation on this format, see [RD.6] and [RD.7];

CVS: A simple text-line-based flat-format. For GB-GNSS data and documentation on this format, see [RD.6].

Note that the ROM SAF does not itself process or provide any GB-GNSS data products; it only maintains the GBGP software to assist in disseminating and using this data type.

2. List of changes

This list documents the most significant differences from the previous *prototype* release. Minor bug fixes and typographical corrections are not included here.

1. **Various** : Character string variables used for file names (including paths) have been consistently set to 256 characters. In the prototype, various lengths between 100 and 256 characters were declared; the lower lengths proved to be be too short, in some cases resulting in truncated file path+names.
2. **`gbcost.f90`** : Quality control flagging has been relaxed for 'optional' observational sample parameters often not having valid values (such as ZHD, IWV and TEC); if such parameters have the recommended default 'missing data' value, the Q/C will no longer flag a warning.
3. **cost2bufr.f90** : The string variable holding the encoded BUFR bit stream has been increased from 20,000 to 30,000 bytes (characters). The old size had been more than adequate to hold data for up to the maximum of 500 ZTD observations per message, but we had noted recently two extreme examples detected as marginally exceeding this length by 8 and 302 bytes and thereby not encoded. The new value should never be exceeded unless the maximum number of observations is also raised.
4. **`noaa2cost.f90`** : NOAA's Earth Systems Research Laboratory no longer process the 'NOAA' GPSIPW network – this has been contracted out to a commercial company – so the 'ESRL' ID has been removed from the COST-format headers converted from the GPSPWV CVS or netCDF files, and the default output COST-format file status is changed from **`OPER`** to **`TEST`**. This tool is still included in GBGP-1 for converting legacy files, but may be removed in a future release.
5. **`noaa2cost.f90`** : Q/C-based rejection of *vfiles* mapped from NOAA netCDF are now treated the same (i.e. more relaxed about certain non-critical observational data being missing/invalid) as when mapped from CVS files.
6. **`gbuildpack`** : The netCDF-C core package tarball can be named **`netcdf-<ver>.tar.gz`** or **`netcdf-c-<ver>.tar.gz`** depending on the download source. The GBGP package build script will now try the second form if the first is not present.
7. **`gbgp_updsdb.sh`** : The script to download the latest database dump has been simplified by removing the option to also download station maps and listings files. This option was originally designed to support the CGI browser, and is not necessary for GBGP. The **User Manual** has been amended accordingly.
8. **User Manual** : At the suggestion of a Beta tester, we note the existence of the generic BUFR decoding tool **`decbufr`** which is installed as part of the MetDB BUFR library package. This tool, not being part of GBGP, is not documented in any detail here, but it has been found useful to check the content of any properly encoded BUFR message including GB-GNSS data encoded with **`cost2bufr`**. While there are many such generic decoders (and there is a simple one included in the base MetDB kernel library package), the key advantage of **`decbufr`** is that it maps code values to interpreted, human-readable text equivalents for all BUFR header Section 1 as well as for data Section 4 and can decode a sub-set of multiple BUFR messages within a single file.
9. **gbgp_test.sh** : The decbufr function only can take file name lengths of 100. gbgp_test.sh was passing whole directory paths through to decbufr which can be longer then this 100 character limit. To solve this gbgp_test.sh changes directory to the folder which contains the file being passed through to decbufr.
10. **mkreffiles.sh and autogen.sh** : The calling of mkreffiles.sh each time a distribution is built has been stopped. There are problems when an FTP server is not available, such as NOAA no longer being available. Set data files are now included in the package. These set files can be updated using a new command line option in autogen.sh which will call mkreffiles.sh. Get noaa_from_server function has been commented out so it is not removed and the deletion of current CSV files has also been commented out.

11. **utils/files.f90** : Removed use of the generic Fortran function RENAME. Replaced this with a CALL SYSTEM command which uses a bash mv command to rename the file.
12. **setgbgpenv.sh** : A new script has been added in response to the beta review. A setgbgpenv.sh script will set up the required environment variables that are needed for using the GBGP package executables.