# WORKSHOP PROCEEDINGS

GRAS SAF Workshop

Applications of GPS radio occultation measurements

16-18 June 2008



European Centre for Medium-Range Weather Forecasts
Europäisches Zentrum für mittelfristige Wettervorhersage
Centre européen pour les prévisions météorologiques à moyen terme

Series: ECMWF Proceedings

A full list of ECMWF Publications can be found on our web site under:

http://www.ecmwf.int/publications/

Contact: library@ecmwf.int

### © Copyright 2008

European Centre for Medium Range Weather Forecasts Shinfield Park, Reading, RG2 9AX, England

Literary and scientific copyrights belong to ECMWF and are reserved in all countries. This publication is not to be reprinted or translated in whole or in part without the written permission of the Director. Appropriate non-commercial use will normally be granted under the condition that reference is made to ECMWF.

The information within this publication is given in good faith and considered to be true, but ECMWF accepts no liability for error, omission and for loss or damage arising from its use.

## Proceedings of the GRAS SAF Workshop

on

### Applications of GPS radio occultation measurements

16 - 18 June 2008

European Centre for Medium-Range Weather Forecasts Shinfield Park, Reading, Berkshire, UK

December 2008



### GRAS SAF Workshop on Applications of GPS radio occultation measurements, 16 - 18 June 2008

Introductioniii
Working Group Reportsv
General issues
J.R. Eyre An introduction to GPS radio occultation and its use in numerical weather prediction
K. B. Lauritsen, H. Gleisner, M. E. Gorbunov, F. Rubek, S. Syndergaard and M. B. Sørensen  GRAS SAF project and products
Status of Missions
Ying-Hwa Kuo, Hui Liu, Zaizhong Ma, Sergey Sokolovskiy, Peng Guo, Richard A. Anthes, Nick Yen, and Jiun-Jih Miau
COSMIC status and prospects for COSMIC-2
Axel Von Engeln, Yago Andrew, Cristian Marquardt and Francisco Sancho GRAS status and future European GPS radio occultation missions
J. Wickert, C. Arras, C.O. Ao, G. Beyerle, C. Falck, L. Grunwaldt, S.B. Healy, S. Heise, A. Helm, C.Y. Huang,, N. Jakowski, R. K"onig, T. Mannucci, C. Mayer5, G. Michalak, P. Poli, M. Rothacher, T. Schmidt, R. Stosius, and B. Tapley CHAMP, GRACE, SAC-C, TerraSAR-X/TANDEM-X: Science results, status and future prospects
E. R. Kursinski, D. Ward, A. Otarola, K. Sammler, R. Frehlich, D. Rind, C. Groppi, S. Albanna, M. Shein, W. Bertiger, H. Pickett and M. Ross  The Active Temperature Ozone and Moisture Microwave Spectrometer (ATOMMS)
Assimilation of GPS Radio Occultation Measurements
Lidia Cucurull Assimilation of GPS radio occultation measurements at NCEP
P. Poli, G. Beyerle, T. Schmidt and J. Wickert Assimilation of GPS radio occultation measurements at Météo-France
M.P. Rennie  The assimilation of GPS radio occultation measurements at the Met Office
Josep M. Aparicio, Godelieve Deblonde and Stephane Laroche Assimilation of GPS radio occultation measurements at the Meteorological Service of Canada

#### **CONTENTS**

Sean Healy	
Assimilation	of GPS radio occultation measurements at ECMWF99
Fang-Ching Anisetty S. K	Huang, Ying-Hwa Kuo, Shu-Ya Chen, Mien-Tze Kueh, Pai-Liam Lin, Chuen-Tsyr Terng, Chien, Ming-Jen Yang, Song-Chin Lin, Kuo-Ying Wang, Shu-Hua Chen, Chien-Ju Wang, and A. V. Prasad Rao PS radio occultation measurements on severe weather prediction in Asia
PBL and	Altimetry Applications
C.O. Ao, T.K Planetary bo	C. Chan, B.A. Iijima, JL. Li, A.J. Mannucci, T. Teixeira, B. Tian and D.E. Waliser undary layer information from GPS radio occultation measurements
E. Cardellac Applications	h, S. Oliveras and A. Rius of the reflected signals found in GNSS radio occultation events
Climate/	Reanalysis Applications
Stephen S. L. Testing clim	eroy and James G. Anderson ate models with GPS radio occultation measurements
	G. Kirchengast, M. Borsche, B. Pirscher, and A. K. Steiner
Creating a co	onsistent radio occultation data base for climate studies in the upper troposphere ratosphere
D. Dee, S. U Reanalysis a	Appala, S. Kobayashi, S. Healy, and P. Poli applications of GPS radio occultation measurements
Annex 1	Poster presentations
Annex 2	List of participants
Annex 3	Workshop Programme

#### Introduction

The three day workshop on "Applications of GPS radio occultation measurements" took place on June 16-18, 2008. The workshop was co-sponsored by the EUMETSAT GRAS Satellite Application Facility (SAF) and ECMWF, and organised by ECMWF. The workshop brought together many of the world's leading experts in the use of GPS radio occultation measurements in both operational NWP and climate studies, with the aim of producing a set of recommendations that would inform the future work at ECMWF, the GRAS SAF and the broader community.

The workshop began with a series of invited lectures which covered the following:

- An introduction to the measurement technique and the work of the GRAS SAF.
- The status of current and future missions.
- Assimilation of GPS radio occultation measurements at the NWP centres.
- Planetary boundary layer and altimetry applications.
- Climate and reanalysis applications.

The presentations are available at:

http://www.ecmwf.int/newsevents/meetings/workshops/2008/GPS\_radio\_occultation/

The lectures were followed by discussions in three work groups and the workshop concluded with a plenary session. The working groups discussed Future Missions, NWP applications and Climate applications. The discussions and recommendations of the working groups are summarised in the following three reports.

This was a very successful and stimulating workshop and ECMWF thanks all the participants for their contribution.

The *papers* contained in these proceedings can also be found on our website http://www.ecmwf.int/publications/