SCOPE·CM

Sustained Coordinated Processing
of Environmental Satellite Data
for Climate Monitoring

SCM-08
Radio Occultation based gridded Climate Data Sets - (RO-CLIM Project)

RO-CLIM Project Team

Outline

- RO Background
- RO Constellation
- ROTrends Background
- SCOPE-CM RO-CLIM

Background RO

- Radio occultation (RO) has several features which make it an ideal climate monitoring data set:
    - essentially a measurement of time;
    - requires no external calibration, benchmark capability;
    - ideal to generate long term data sets, no issues with combining different satellites, e.g. < 0.05K bias for CHAMP to COSMIC, processing should ideally be by one S/W setup;
    - all weather capability;
    - high vertical resolution in the upper troposphere, lower stratosphere, high sensitivity between ~5km to ~40km;
    - "random sampling" in space and time;
    - provides "anchor" point in NWP analysis, re-analysis

(Current) GNSS-RO Constellation
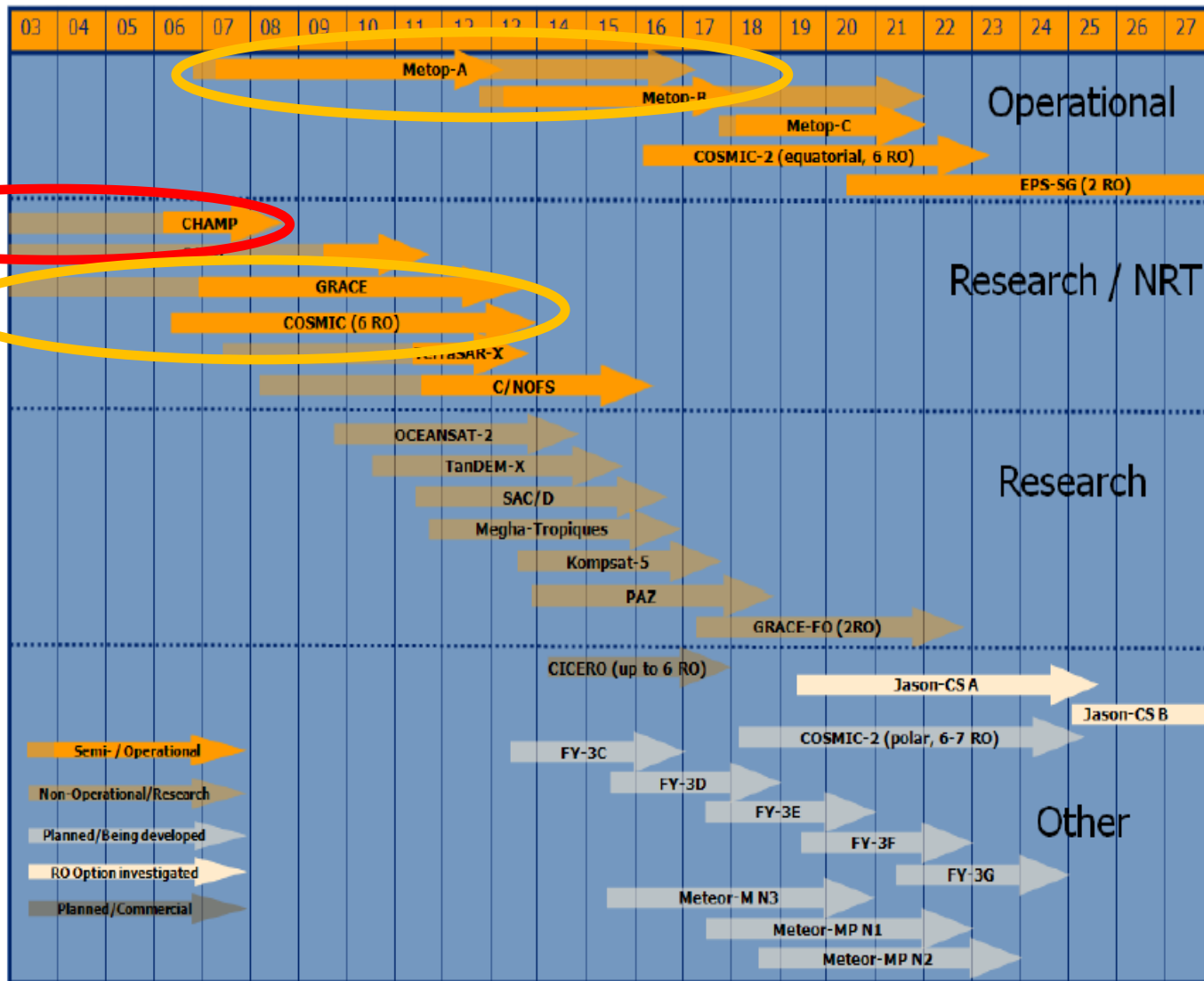
Initial RO-CLIM Focus
Extended RO-CLIM Focus
> 12 years of coverage

Note: Figure from proposal, now outdated for dates > 2013!

See also:

Status of the Global Observing System for Radio Occultation (Update 2013), IROWG/DOC/2013/02, available at:

http://irowg.org/workshops/irowg-3/

Background ROTrends Project

RO community started comparison of different processing centres in 2006 (ROTrends). Main aim is to validate RO as a climate benchmark, initially by identifying the impact of processing assumptions (structural uncertainty). Note: unfunded, best effort

- Initial ROTrends participants: JPL, GFZ, UCAR, WEGC
- 1st Round: CHAMP Monthly Mean Climatology of refractivity (found ±0.03%/5 yrs trend uncertainty)
- 2nd Round: Profile by profile comparisons, extension to include bending angles, dry temperature & pressure, … - ROM SAF, EUMETSAT also joined - (found trend uncertainty <0.03%/7yrs for bending angle, refractivity, pressure; <3m/7yrs geop. height of pressure levels, <0.06K/7yrs temperature. SU lowest within 50°S to 50°N at 8 km to 25 km)

See also: http://irowg.org/projects/rotrends/

RO-CLIM: Aim

- builds upon ROTrends, by including SCOPE-CM provides:
    - more visibility;
    - clear maturity levels;
    - forward guidance, 1 year plan (ROTrends rounds were agreed on the spot at telecons, or splinter meetings);
    - should (hopefully) open other funding options to participants
- in addition:
    - number of participating centres extended to include NWP, re-analysis, climate models

- answered SCOPE-CM 2013 Call for Letters of Intent (Phase 2)

RO-CLIM: Summary of Project

c. Summary of proposed project

While ROTrends provided a very valuable data set over the CHAMP period, an extension of that initial period to include the most recent radio occultation observations and build up a long term climate data record is one focus of this project. It will in addition also make use of the more dense coverage of recent satellites, to provide a shorter duration, higher resolution data set. By including model data from both ECMWF and the Met Office Hadley Centre an assessment of the model performance against radio occultation data is also possible. The SCOPE-CM used maturity matrix provides a very valuable reference for the currently available ROTrends data set, this set will be evaluated and "matured" against that matrix.

From RO-CLIM Project Description, available at:
http://irowg.org/projects/ro-clim-under-scope-cm/

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RO-CLIM: Project Partners

3. Composition of the project team for this project:

Name and title	Institute	Address
K. Lauritsen, H. Gleisner, S. Syndergaard	DMI	Danish Meteorological Institute, Copenhagen, Denmark
S. Healy	ECMWF	European Centre for Medium Range Weather Forecasts, Reading, UK
C. Marquardt, R.A. Roebeling	EUMETSAT	EUMETSAT, Eumetsat Allee 1, Darmstadt, Germany
T. Schmidt, J. Wickert	GFZ	GeoForschungsZentrum, Helmholtz Centre Potsdam, Germany
C. Ao, T. Mannucci	JPL	Jet Propulsion Laboratory/NASA, Pasadena, California, US
M. Ringer	Met Office	Met Office, Exeter, UK
R. Kursinski	Moog	Moog Broad Reach, Boulder, USA
B. Schreiner, S.-P. Ho, D. Hunt	UCAR	COSMIC Program Office, University Corporation for Atmospheric Research, Boulder, Colorado, USA
A. Steiner, U. Foelsche, G. Kirchengast	WEGC	Wegener Center for Climate and Global Change, University of Graz, Graz, Austria

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RO-CLIM: Processing Setup / Partner Start Level

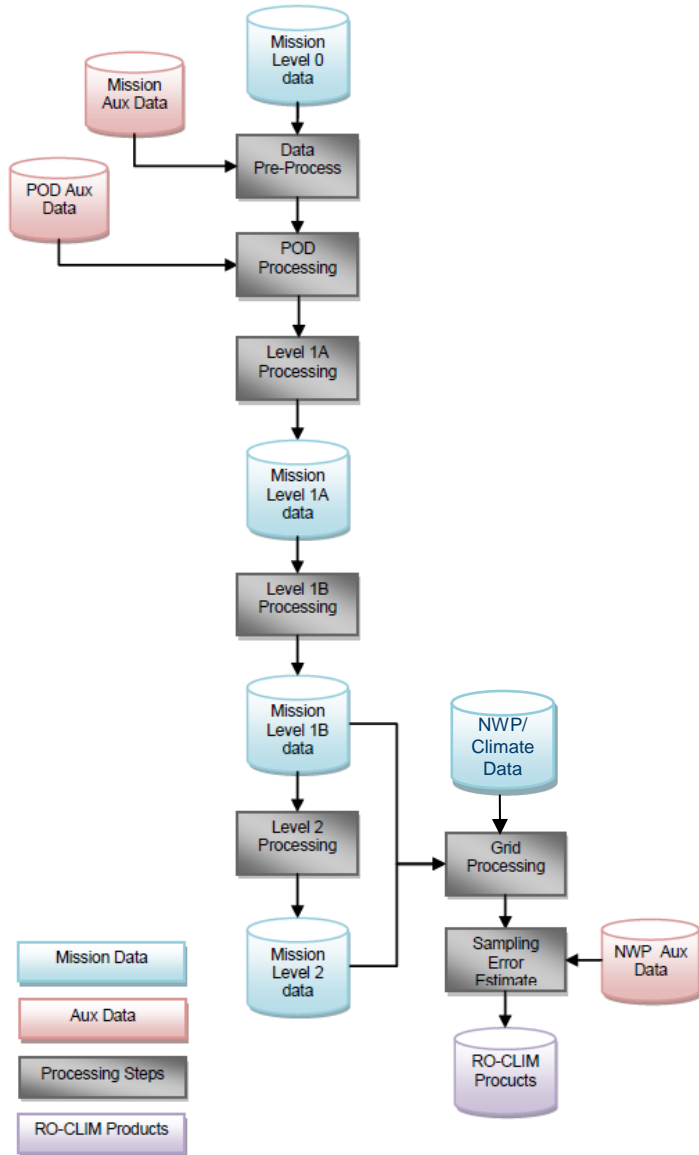

Figure 2 Generic processing flow to generate gridded RO-CLIM products.

Institute	Starting Point for Level 1B, 2 Generation
DMI	Level 1A generated at UCAR or EUMETSAT
ECMWF	not applicable
EUMETSAT	Level 0 or Level 1A generated at UCAR
GFZ	Level 0 or Level 1A generated at UCAR, EUMETSAT
JPL	Level 0 or Level 1A generated at EUMETSAT
Met Office	not applicable
Moog	not applicable
UCAR	Level 0 if possible
WEGC	Level 1A generated at UCAR or EUMETSAT

Generation of FCDRs and ECVs

From RO-CLIM Project Description, available at:
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RO-CLIM: Targeted Maturity Level

	Software Readiness	Meta Data	Docu- mentation	Validation	Public Access	Societal Impacts
1. ROTrends Maturity level	5	4	3	5	3	3
Targeted 1 Maturity level	6	6	5	6	6	5
2. Extended ROTrends Maturity level	2	3	3	4	2	3
Targeted 2 Maturity level	5	6	5	5	6	5

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RO-CLIM: 2014 Project Plan / Status

5. Annual Project Plans

a. 2014

The following development steps are foreseen for the 1st year, the lead institute/scientist is given in brackets:

- Increase maturity level of CHAMP ROTrends data set by:
  - re-assess implemented processing software at center, in particular with respect to the initialization of bending angles at higher altitudes, re-process data set if required, investigate outlier statistics (all centres);
  - cross-check data set against radio occultation data from more recent missions that overlap with CHAMP, such as COSMIC, GRACE, GRAS (WEGC);
  - provide information on the structural uncertainty of the CHAMP data set in form of tables (Andrea Steiner);
  - generate an ensemble of products, i.e. RO data are provided by each centre, including uncertainty information (representative of each centre);
  - generate a re-analysis based data set that uses the same processing and gridding setup as the instrument one, using e.g. ERA-Interim data or ERA-CLIM if available (Sean Healy, Axel von Engeln, Hans Gleisner);
  - improve documentation of data set (representative of each centre);
  - make information publicly available through http://www.scope-cm.org, pointing to a dedicated project page at http://www.irowg.org which includes links to the individual centres. The download data will be hosted at http://www.romsaf.org. (Andrea Steiner, Ben Ho, Hans Gleisner, Axel von Engeln).

Start the generation of the extended ROTrends data set that includes more recent missions and will be updated throughout the project:
  - develop a common Level 1A format that can be used across the different centers (Christian Marquardt, Doug Hunt, DMI, representative of each centre);
  - develop capability at the different centers to ingest this format into their processing (representative of each centre)

- Ongoing
- Ongoing
- Ongoing
- Not yet started
- Ongoing
- Not yet started
- Started

- Started
- Not yet started

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