Key Outcomes of the Symposium on Climate Research and Earth Observation from Space

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Outcome of Climate Symposium 2014

- Darmstadt 13 – 17 October 2014
- Programme organised around WCRP Grand Challenges
- 500 participants (science leaders) + 500 followers on web streaming
- More information available on www.theclimatesymposium2014.org
- Conclusions available: http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-15-00003.1

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WCRP Grand Challenges

CliC	CLIVAR		GEWEX	SPARC
Cryosphere-Climate Interactions	Ocean-Atmosphere Interactions	Regional Climate Information	Land-Atmosphere Interactions	Troposhere-Stratosphere Interactions
		Sea-Level Rise and Regional Impacts		
		Cryosphere in a Changing Climate		
		Changes in Water Availability		
		Clouds, Circulation and Climate Sensitivity		
		Climate Extremes		

Climate Symposium – Major Outcomes

- Consensus that the thermodynamic aspects of the Grand Challenges are generally better understood than the dynamic aspects: circulation is a common uncertainty across several Grand Challenges;

- The broad range of needs and priorities formulated by the research community for space-based observations can only be fulfilled through international cooperation, in particular through the Architecture for Climate Monitoring from Space coordinated by the CEOS-CGMS WG on Climate.

Climate Symposium – Major Outcomes

- Links between Grand Challenges and their needs/ priorities for space-based observations and Climate Data Records should be further developed
- Grand Challenges need to be more explicitly traced to associated Societal Benefits
- This could support decisions on the funding of new observation systems

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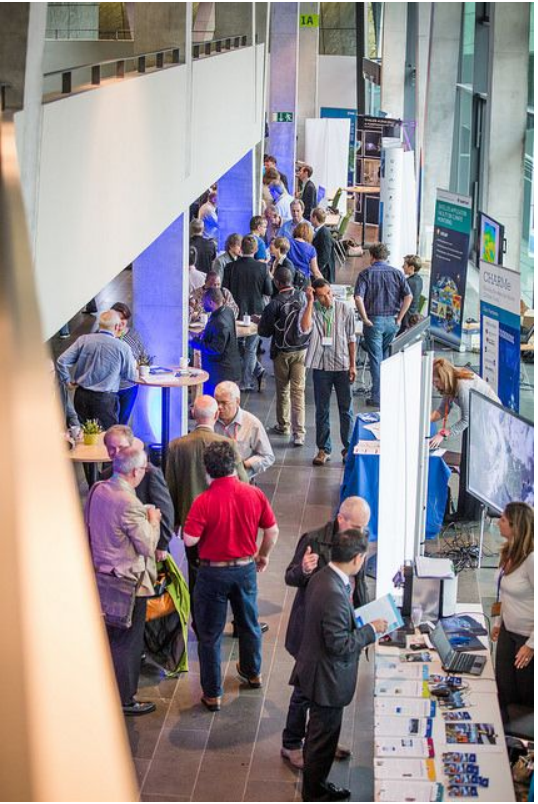
Climate Symposium – Major Outcomes

- The unique potential of the combination of multi-satellite operational programmes and research missions was highlighted, noting that:
  - The continuation of the high precision ocean altimetry measurements, expected from the Sentinel-6/Jason-CS mission, is a top priority of several Grand Challenges;
  - Some research missions (e.g. GRACE, Active atmospheric sounding, GPM…) need to be continued beyond one single satellite to consolidate understanding of key climate processes or brought to operational status.

Need for improved observations



- Progress on Grand Challenges will require improved observations of water vapour, clouds and winds, especially in the lower troposphere and at a higher vertical resolution than is available from most of the current sensors;
- Space-based observations of clouds and water vapour, together with measurements of their three-dimensional distribution and temporal variation, may be good proxies for circulation. Understanding circulation changes and the processes driving climate sensitivity requires coincident observations of clouds and their environment, as well as better estimates of surface evaporation;
- A combination of instruments flown on satellites in different orbits can provide powerful observations that assist in the evaluation of changes in water vapour, cloud formation/dissipation and convective processes, and their relationship to atmospheric circulation;
- Sustained and improved observations of precipitation and snow and their variability are needed to understand the changes in the water cycle and to close the surface energy balance;

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Analysis of archived data

- To enhance the value of existing observations records for climate research and applications, operational and research space agencies should put a sustained effort into re-processing and re-analysing existing archived data to increase their quality and record length;
- Accuracy and in-orbit verification are important attributes of a climate observing system, and help to advance the understanding of the physical processes in the Earth's climate system.

Impact of GSICS correction Infra-red channel (10.8 μm)

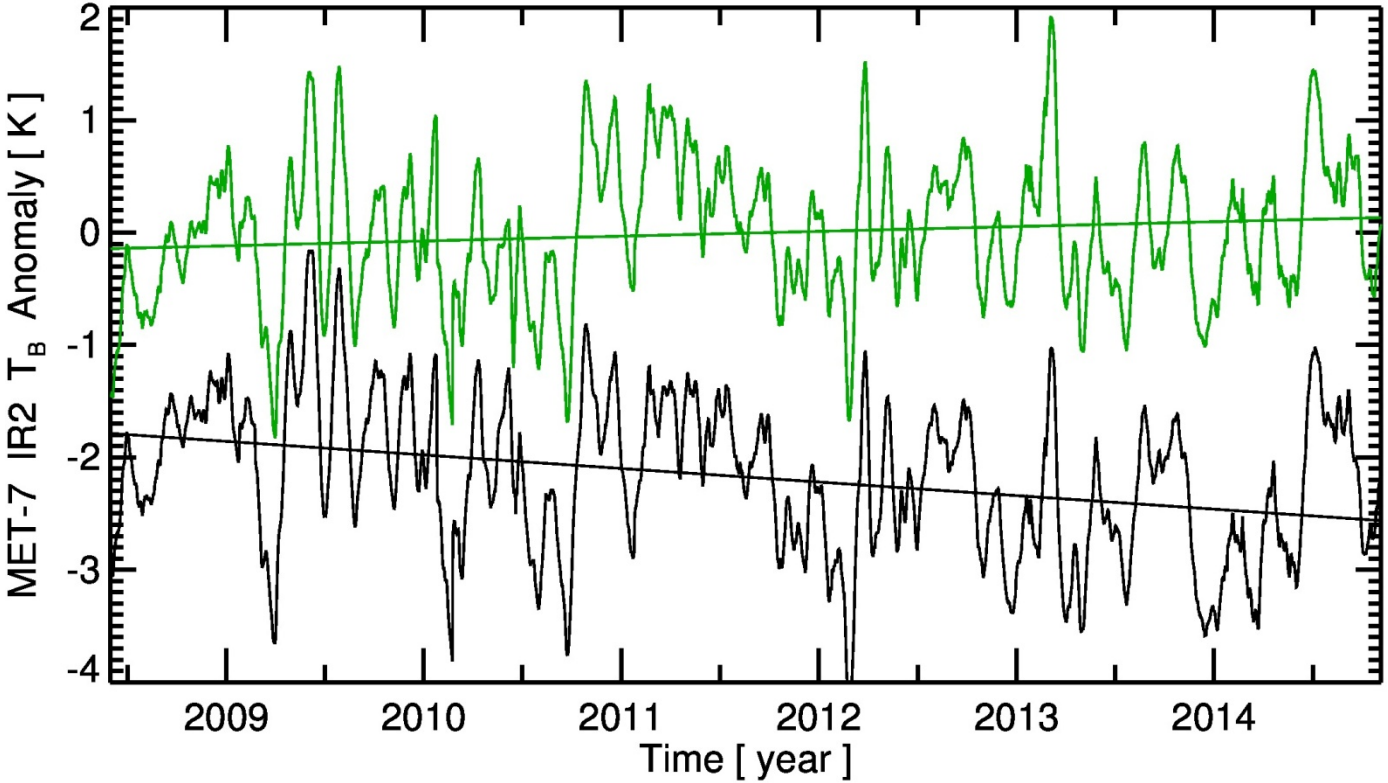

Fig: MET-7 Infrared (IR) channel brightness temperature daily anomalies for the original time series and corrected time series using GSICS inter-calibration method. IASI instrument on board Metop-A is used as the reference instrument. Time series is smoothed to remove variability on time scales shorter than a month.

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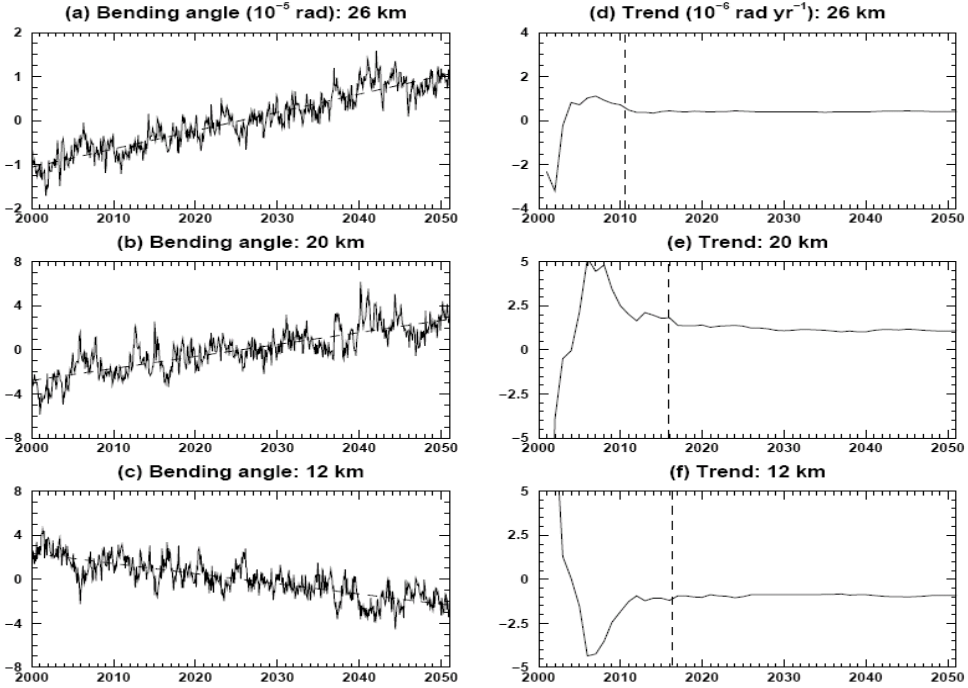
Benchmark Measurements

- GNSS radio occultation observations have very desirable properties (e.g. stability, homogeneity, high vertical resolution) that result in improvements in our understanding of atmospheric variability and the detection of climate change. It is important that their continuity is ensured with optimum global coverage;



Ringer and Healy (2008) http://onlinelibrary.wiley.com/doi/10.1029/2007GL032462/abstract

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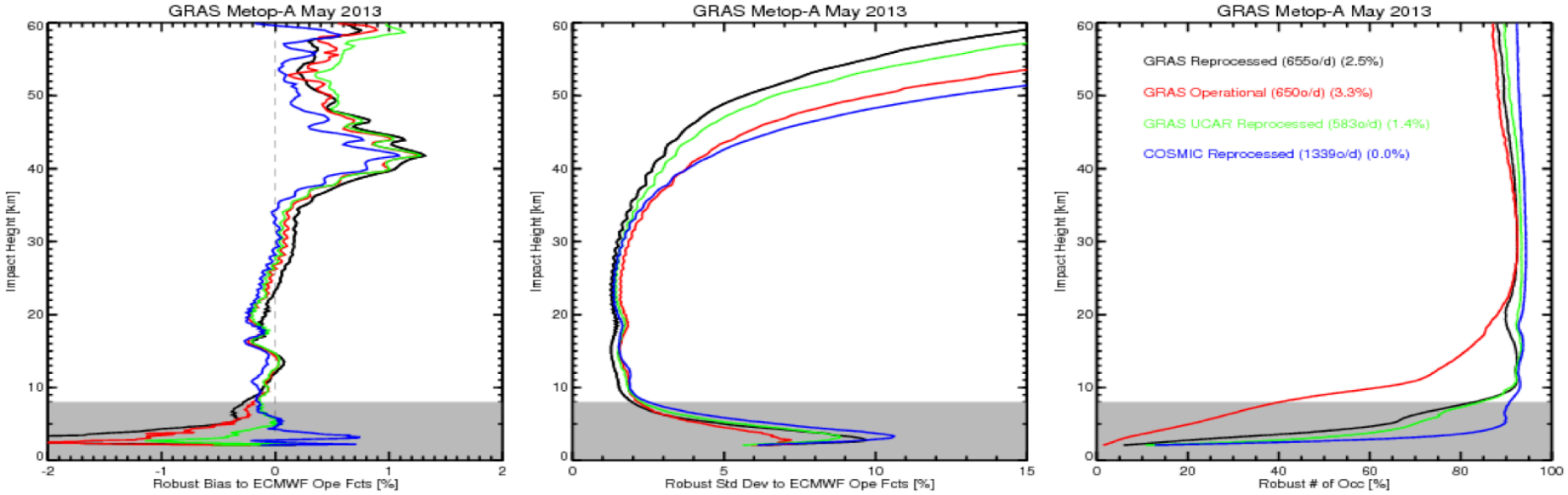
Where are we today (in reprocessing & operations)?



- Comparison of GRAS operational (red) and reprocessed (black) geometrical optics data as well as UCAR/COSMIC (blue) and UCAR/GRAS (green) wave optics data against co-located ECMWF

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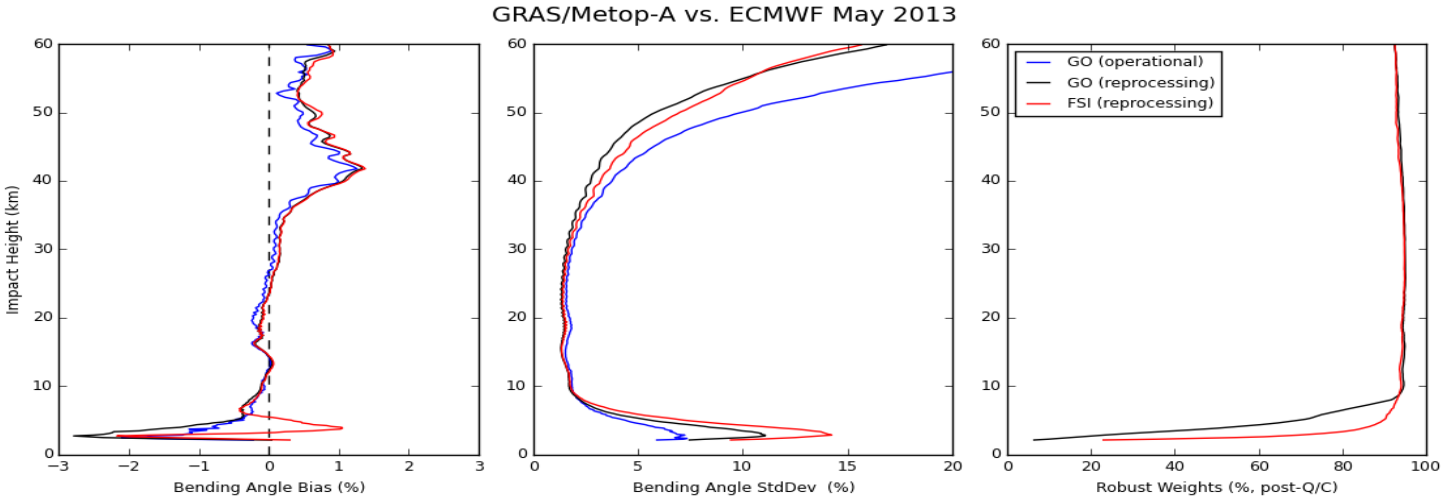
Wave Optics provides reasonable statistics against ECMWF



Stratosphere, upper troposphere	Mid and lower troposphere
• comparable w/ reprocessed geometrical optics	• improved bias structure / more similar to UCAR/GRAS
• remains significantly better compared to operational products	• Stddev. still slightly larger, but more profiles reaching down that far
• wave optics to the top.	

Continuity and combined use of observations

- Active remote sensing has revolutionised our understanding of processes involving clouds, precipitation, aerosols and their detailed vertical structure. In view of its importance for the understanding of physical processes, the continuity of the active remote sensing record needs to be maintained;
- There is an unequivocal need for sustained long-term space-based observing systems provided by operational satellites that are primarily used for weather observations. It is recommended that ‘science theme’ oriented space missions proposed by the research agencies take benefit from the core observations produced by these operational satellites;

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Ultimate Ambition

- There is a need for an integrated observational approach. One that is strategically designed to be cost effective and sustained over decades, yet remains targeted on key challenges and promotes the fusion of theory, models and observations. Where relevant, this approach should also address the linkages to societal benefits, as this could facilitate the funding of new observation systems.