Met Office plans for the development of a climate record from HIRS and IASI

Mark McCarthy, Simon Tett, Roger Saunders, Nigel Atkinson, Karsten Fennig

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Why observe climate?

- Providing evidence (or not) for policy action (or not)
- Assessing current climate for infrastructure planning.
- Assessing climate variability and change including climate change detection and attribution
- Developing and validating climate models
- Validating long range/short term climate forecasts
- Assessing climate impacts
1979 - 2004

Temperature trends

Source: CCSP Synthesis and Assessment Product 1.1
Objectives

- Provide >30 years of homogenised all-sky IR radiances to:
  - Quantify and reduce uncertainty in temperature and humidity changes aloft.
  - Assess model simulations of recent climate accounting for both model and observational uncertainty.
  - Estimate all-sky (and clear-sky) long-wave feedbacks.
  - Contribute to the next generation reanalysis projects (e.g. ERA-70)
Given a possible resource of at least 4.5 person years between 2007-2009:

- Is it worth doing? Yes
- What lessons have we learnt from previous efforts?
- How should it be done for maximum benefit?

Last two questions to direct methodology.
- **Climate sensitive parameters**
  - Cloud properties (fraction, temperature)
  - Relative Humidity
  - Atmospheric and surface temperature
  - Surface properties
  - Greenhouse Gases
  - Aerosols

- **Measurement sensitive parameters**
  - Spectral response
  - Radiometric response (gain)
  - Pre and post-launch calibration
  - Fov response (+spatial sampling)
  - Viewing geometry
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**Interpretation through appropriate use of climate models and reanalyses and less reliance on geophysical retrieval and cloud-clearing.**

CO, etc. etc.
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Challenge is to create a data record with static observational properties. E.g. Spectral response, spatio-temporal sampling etc. This requires some “correction” of all observations to a pre-defined standard.
IASIPP for climate
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Pre-processing at NWP Centre:
(Quality control, surface type and altitude, Map AMSU and MHS)

Uncompressed Level 1c

Spatial and Spectral thinning for NWP

Spatial thinning for Climate

"Level 1d" NWP product

1. 1 in 4 fov – to local data storage available for reprocessing
2. 5 spectra every 3 scan lines – Super-thinned for fast processing

Day 2 Cloud detection tests (TBC – but requirement for consistent cloud detection back to 1979)

1. All-sky and clear-sky only radiance products for climate monitoring
2. Super-thinned product for research

Disseminate to user community
- Climate requirement for continuity of observations.

- MetOp provides opportunity for integration of IASI with the legacy HIRS instrument.

- Provide equivalent HIRS radiance.
  - Comparison to in-orbit HIRS/4.
  - Quantify historical HIRS SRF bias and uncertainty.
  - Maintain continuity of observations 1979-20??
HIRS reprocessing
Some existing methods for calibration:

1. Forward model the bias from the given HIRS SRF.
   - Fails when SRF poorly characterised.

2. Compare radiances from GOES and Meteosat.
   - Must account for sampling errors and different SRF.

3. Calibrate to AIRS/IASI radiances
   - Lack of historical observations and same problems as 1.

4. SNO
   - Mostly arctic atmospheres used – N8-N9 difficult

5. Correct bias in aggregated values.
   - Mask non-linear effects. Too crude for some applications?
Level 1b with consistent calibration. Cloud detection consistent with IASIPP both all-sky and clear-sky only radiances to be considered.

Step 1 – Estimation of known biases

- Spectral Response – Using given instrument specifications.
- Orbit decay – Affecting off-nadir views, simulate radiance and correct as function of viewing geometry.
- Orbit drift – Requires good estimate of diurnal cycle. Use Geo’s and models.
- Changing FOV
- Others (e.g. SSU interference)
**Step 2 – Residual biases**

- Utilise satellite overlaps to quantify remaining biases (e.g. SNO)
- Attribution of remaining biases:
  - Poor calibration
  - Poorly defined SRF
  - Inadequate bias correction
  - Others…

**Challenges:**
- HIRS/2 to /3 to /4 channel reassignment
- N8 to N9 transition (Reanalysis or Geos as bridge?)
- Comprehensive uncertainty estimates on climatology and trends.
IR sounders have already proven themselves as a valuable resource for climate research both directly, and through reanalyses.

Homogenisation of historical data needs to be an evolving process in order to capture structural uncertainty.

Methodological choices hinge on the research objectives of the resultant dataset.

Aim to provide 30 year record of IR brightness temperatures from HIRS and IASI, corrected to a consistent spatio-temporal and spectral sampling.
Where possible apply all bias adjustments that can be analytically determined (the knowns).
- SRF, Orbit drift, Orbit decay, fov characteristics

Biases must be functions of atmospheric state and viewing geometry with comprehensive uncertainty estimates.

Unknown biases to be treated separately
- e.g. SRF drift or poor characterisation.
- SNO

Details are still to be confirmed – Close collaboration with ECMWF, NCDC, and others with expert knowledge essential.

Feedback and comments are welcomed…This project must meaningful contribute to international climate research and extend our current understanding of these data.
GCOS Climate monitoring principle:

“Use of Functioning baseline instruments…should be maintained for as long as possible, even when these exist on de-commissioned satellites.”

NOAA-14 SSU and HIRS/2 overlap with ATOVS and potentially MetOp.