Met Office

Satellite radiance bias monitoring

Roger Saunders, Brett Candy, Pete Francis
(Met Office) and Tim Hewison (EUMETSAT)

Rationale: It is crucial for climate and very desirable for NWP that we understand the characteristics of satellite radiance biases. Simultaneous Nadir Overpasses (SNOs) have a limited time and space sampling. By comparing measured radiances with those simulated from a NWP model more can be learnt about the nature of the biases, as the space and time matchup window can be relaxed using double differences with the NWP model as a transfer standard. In addition the dependence of the biases on scan angle, scene temperature, time of day can also be investigated. The Met Office global Unified Model 6 hour forecast fields are used for this study. The plots below show some examples from the first year of data collection in 2009.

1. Methodology

Measured radiances from a variety of sensors (see panel to right) are compared with radiances computed from the model 6 hour forecast profile ***x*** at the same location using the RTTOV fast radiative transfer model ***H(x)***. The differences ***DBT(n)*** and ***DBT(m)*** for two sensors can then be compared (double difference). If the frequency of the channels are similar it is a reasonable assumption the biases will be the same from the simulated radiances and so any variations in bias between instruments are due to calibration problems.

For channel n
Sensor 1: $DBT(n) = \text{mean}\{y_n - H_n(x_i)\}$, $i=1$ to k obs

For channel m
Sensor 2: $DBT(m) = \text{mean}\{y_m - H_m(x_i)\}$, $i=1$ to l obs

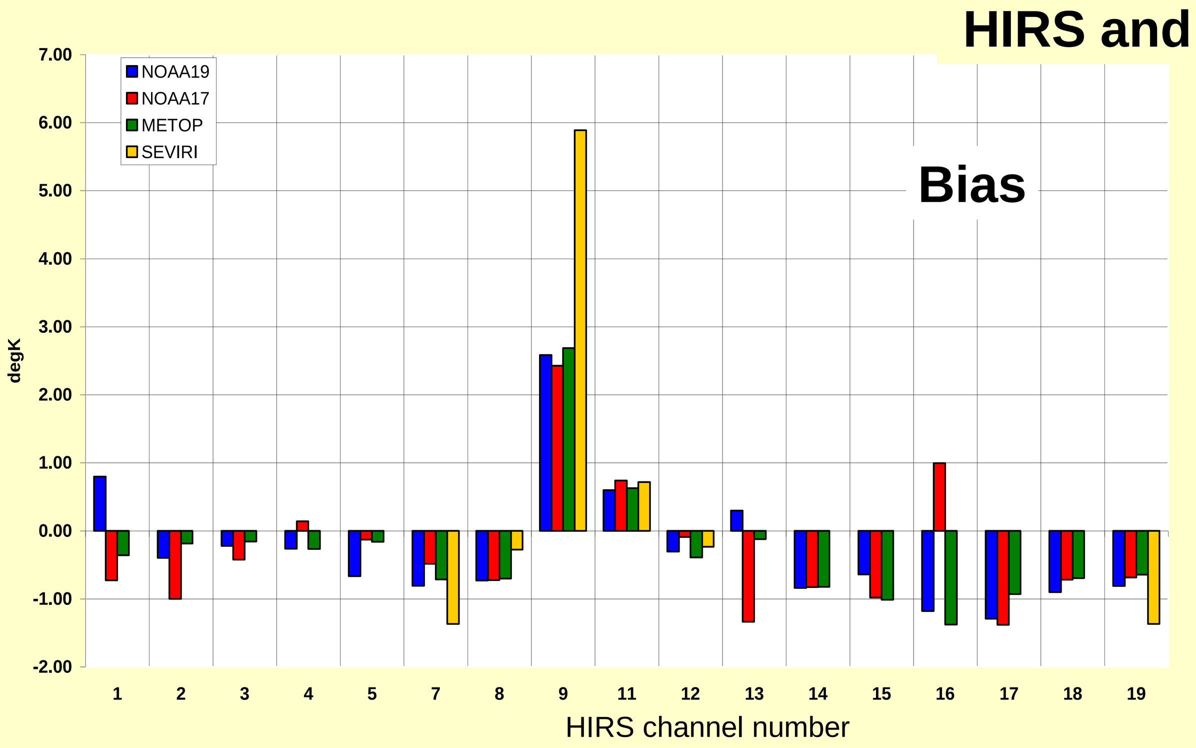
Monitor DBT(n) – DBT(m)

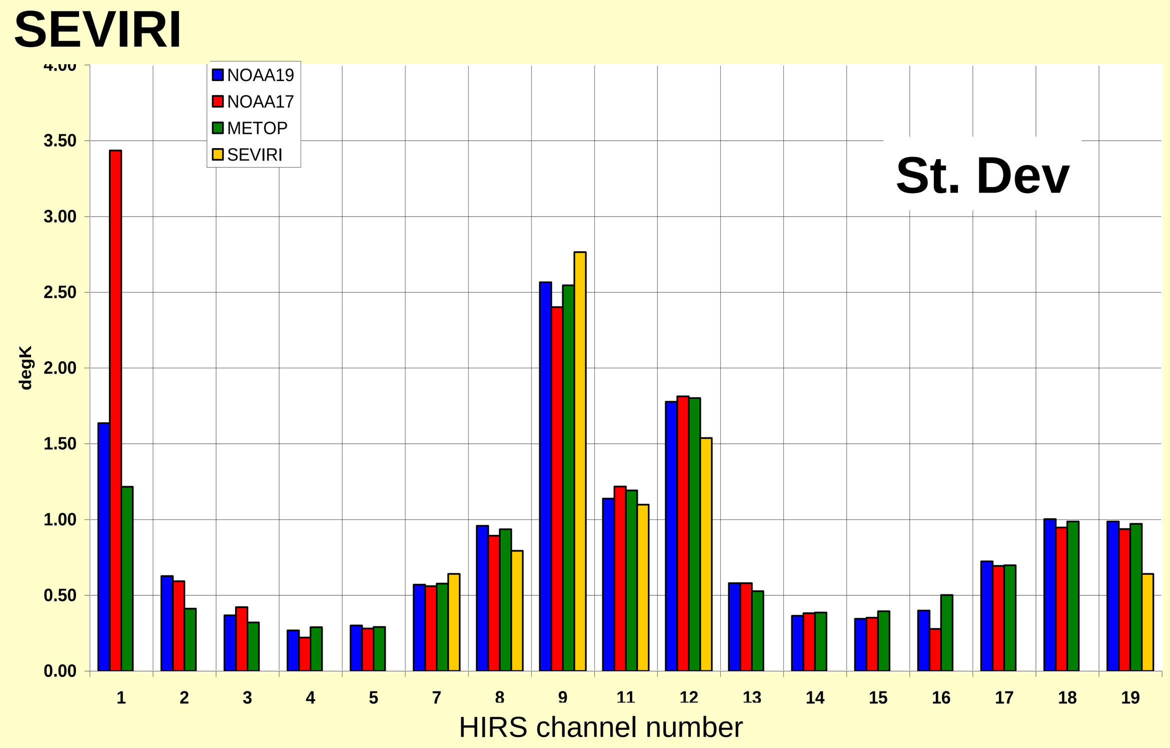
2. Sensor data used

Geostationary satellite	Instrument	Channels	Source	Comments
Meteosat-8	SEVIRI	8 IR	EUMETCAST	Only when Met-9 is unavailable
Meteosat-9	SEVIRI	8 IR	EUMETCAST	
Polar-orbit satellite	**Instrument**	**Channels**	**Source**	**Comments**
METOP-A	IASI	35 IR	EUMETCAST	
	HIRS	19 IR	EUMETCAST	
Aqua	AIRS	35 IR	NESDIS	Occasional outages
NOAA-17	HIRS	19 IR	NESDIS	Gap after mid Dec 2009
NOAA-19	HIRS	19 IR	NESDIS	From August 2009

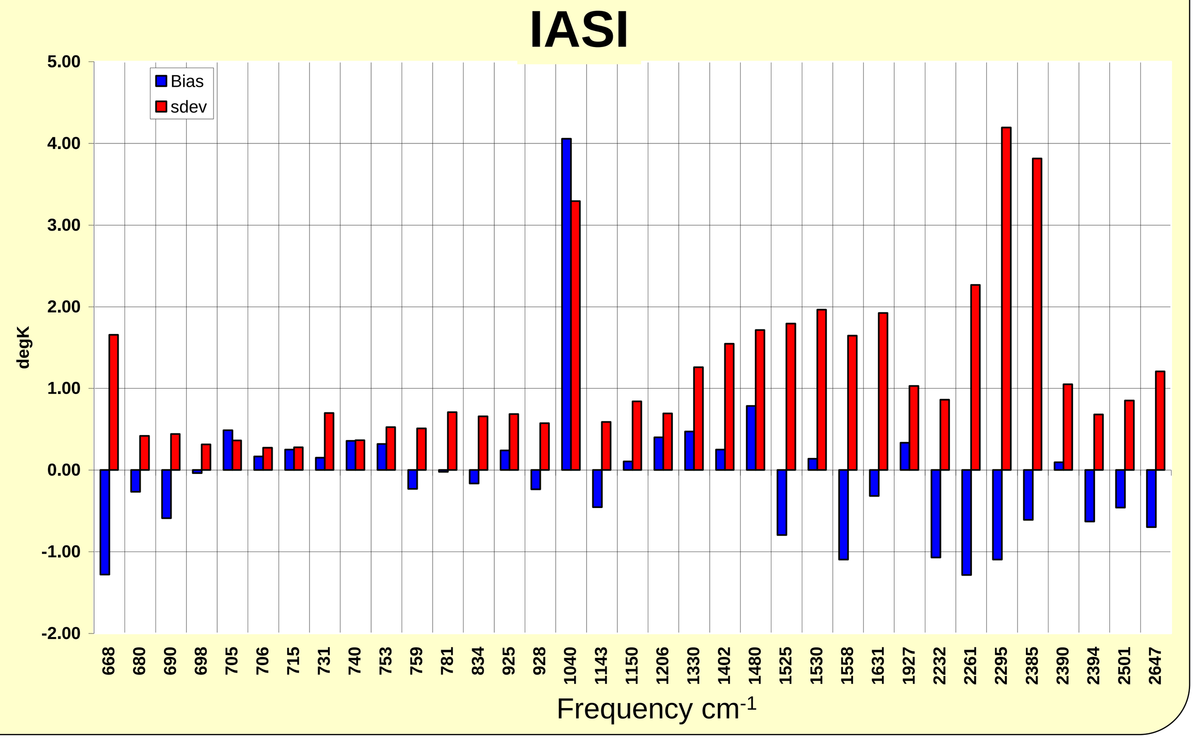
3. Global mean statistics observed-background for 2009

HIRS and SEVIRI

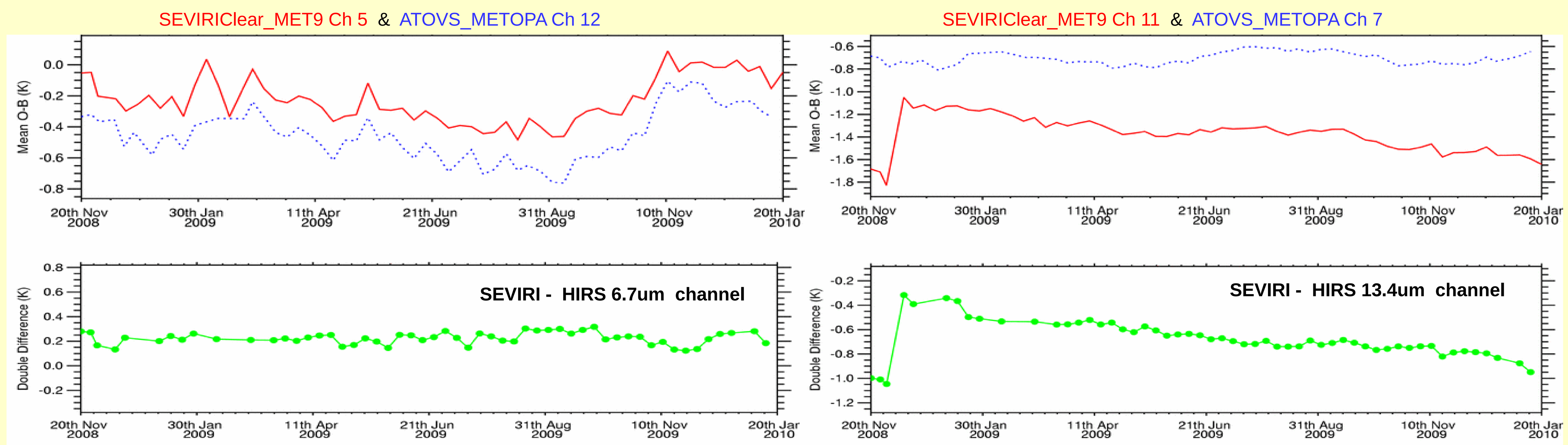




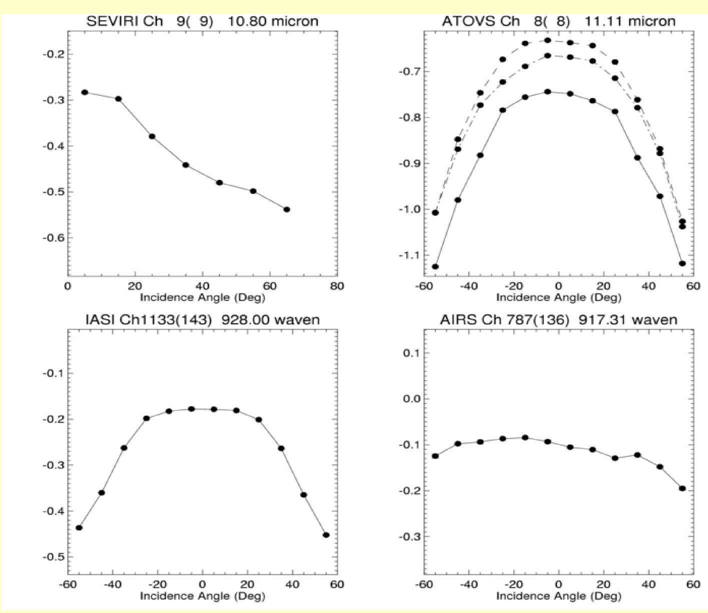
IASI



4. Observed-background and double difference plots



5. Scan biases



6. Geographical distribution of 13.4µm biases

7. Main conclusions from this preliminary analysis are:

- Changes in NWP model affect the sensor biases but the double difference is unaffected.
- The radiance drift seen in SNOs of the SEVIRI 13.4µm channel is confirmed in this study.
- All other SEVIRI channels appear to be stable over the period of this study (2009).
- Comparisons of SEVIRI and HIRS channels are more consistent than for SEVIRI and single channels of IASI/AIRS. It is important to convolve the IASI/AIRS channels over the SEVIRI spectral response.
- Biases of the 13.4µm channels on SEVIRI, IASI and HIRS are all different from each other.
- The 6.2µm water vapour channels have similar biases due to uncertainty in the model water vapour.
- The sensor bias becomes more positive with increasing scene temperature for all instruments.
- The biases of all 3 HIRS sensors on METOP, NOAA-17 and NOAA-19 are similar in behaviour.
- The change in bias across a scan is small for IASI/AIRS but significant for HIRS in some channels.
- For SEVIRI there is a peak in the negative bias around incidence angles of 45° for some channels.

Met Office FitzRoy Road, Exeter, Devon, EX1 3PB United Kingdom
Tel: 01392 886295 Fax: 01392 885681
Email: roger.saunders@metoffice.gov.uk

International TOVS Study Conference, 17th, ITSC-17, Monterey, CA, 14-20 April 2010. Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center, Cooperative Institute for Meteorological Satellite Studies, 2011.