HIRS Inter-satellite Bias from the Simultaneous Nadir Overpass Observations

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HIRS Instrument

- 12 longwave (6.5-15 µm)
- 7 shortwave (3.7-4.6 µm)
- 1 visible (0.69 µm)

- Onboard calibration for IR channels
  - Space View
  - Blackbody View
HIRS Historic Dataset

[Graph showing equator crossing times over time for different satellites and instruments such as HIRS/2, HIRS/2I, HIRS/3, N06, N08, N10, N12, N15, N17, TIROS-N, N07, N09, N11, N13, N14, N16, with years ranging from 1978 to 2005.]
Inter-satellite Bias

- **Type 1 – Related to instrument itself** (HIRS instruments are not exactly identical)
  - SRF difference
  - Instrument degradation
  - Change of calibration algorithm

- **Type 2 – Different observation time**
  - Diurnal variation of HIRS observations
  - Orbit drift of satellite

- Climate analysis: Both are important
  - Data assimilations: Type 1

- The inter-satellite bias from the SNO observations can only resolve Type 1 inter-satellite bias
Simultaneous Nadir Overpass (SNO)

- Polar orbiting satellites intersect each other at high latitudes.

- When the SNO occurs, the radiometers from both satellites view the Earth and the atmosphere at the same place and same time but from different altitudes.

- It greatly reduces the comparison uncertainties related to satellite observational time and viewing geometries.
Example of SNO events
- HIRS ch2 between NOAA12 and NOAA14

Observational time difference: < 40 seconds

Pixel size: 17.2 km (HIRS/2)
20.4 km (HIRS/2I HIRS/3)

Orbit for satellite 1
SNO pixels: 4X5
Orbit for satellite 2
SNO detected BT range

Cover the lower to upper-mid range of the HIRS measured brightness temperature but miss the upper range for some channels.
All the SNO data on website

http://www.orbit.nesdis.noaa.gov/smcd/spb/calibration/icvs/hirs_historic/
HIRS Inter-satellite Bias for Ch2
(70hPa Temperature)
Scene-Temperature Dependent Bias

Channel 2 for NOAA14 – NOAA15
The biases can not be totally explained by the SRF difference.
Inter-satellite Bias for Ch12 (Upper Troposphere Humidity)
The SRF change resulted in the larger inter-satellite bias between NOAA14 and NOAA15.
Inter-satellite Bias for Ch8 (Window channel; ISSCP reference)
HIRS inter-satellite bias have been analyzed using SNO observations for all HIRS instruments from 1980-2005. All the data are on-line now.

We demonstrate the inter-satellite bias for channels 2, 8 and 12.

We also found that the bias can not be totally explained by the difference of the HIRS SRFs. Other factors may also be involved.

We are now investigating the root-causes for the HIRS inter-satellite bias channels by channels. We will focus on developing a algorithm to account for the inter-satellite biases in the future.
Inter-satellite Bias for ch8

Bias (K)

Actic Summer Actic Winter NCEP Profile at 80N SNO Bias

[Graph showing bias values for different satellites across Actic Summer, Actic Winter, NCEP Profile at 80N, and SNO Bias.]
Inter-satellite bias for ch12
How does scene homogeneity effects on results?

Mean Value

Mean Value
Two phases of this study

- Phase 1: Focus on the Inter-satellite biases between HIRS
  - Completed

- Phase 2: Develop an algorithm to account for the inter-satellite biases.
  - Working on
Example of results: channel 2
Inter-satellite Bias for ch8

![Diagram showing inter-satellite bias for ch8]