Introduction

In order to accommodate climate change monitoring and improved weather forecasting, there is an established need for higher accuracy and more refined error characterization of radiance measurements from space and the corresponding geophysical products. This need has been emphasized through its influence on validation of climate change observations.

Currently, validation typically involves (1) collecting high-quality reference data from airborne and/or ground-based instruments during the satellite overpass, and (2) a detailed comparison between the satellite-based radiance measurements and the corresponding high-quality reference data.

Additionally, for future mission technology advancements, the University of Wisconsin Space Science and Engineering Center (UW-SSEC) have led to the development of an on-orbit absolute radiance reference utilizing miniature phase change cells to provide direct on-orbit traceability to International Standards (IEEE 512, Std. 2).

The NASA’s National Aeronautics and Space Administration (NASA) has sponsored a variety of intercalibration campaigns that have been utilized for CrIS validation efforts. This includes the NPOESS Atmospheric Sounder (NAST-I) and Microwave Spectrometer (NAST-M), the NASA MODIS/ASTER airborne simulator (MASTER), and the NPOESS Atmospheric Sounder (NAST-I). The University of Wisconsin's Scanning-High resolution Interferometer validation campaign, the NASA ER-2 aircraft instrument payload was conducted May 2013 with a primary objective of providing detailed, validation typically involves (1) collecting high quality reference data from airborne and/or ground-based instruments during the satellite overpass, and (2) a detailed comparison between the satellite-based radiance measurements and the corresponding high quality reference data.

Double Obs-CalC Comparison Methodology

1. Spatial colocation is achieved by selecting scenes with low variability and covering the selected CrIS FOVs with S-HIS observations.

2. Compare residuals from calculations:
   - S-HIS and CrIS FOVs are each completed at correct altitudes, view angles, spectral resolution and sampling.
   - Wavelength retrieval calculations are compared using same forward model, atmospheric state, and surface property inputs.

3. Difference residuals from CrIS to S-HIS instruments include:
   - The full double obs-calC method accounts for altitude and view angle differences and differences in instrument linekhepes.

Double Obs-CalC Comparison Results with Radiometric Uncertainty (RU) Estimate

**Calibration Verification Results**

- Excellent radiance validation results: high-sensitivity, great spatial and temporal co-location for 2013-05-15, 2013-05-30, and 2013-06-01. Results significantly improved compared to CrIS and S-HIS field of view fingerprint as orbitally better aligned.

**S-HIS**

Aircraft based Scanning High-resolution Interferometer Sounder (S-HIS)

Infrared Fourier-transform spectrometer with 1305 spectral channels; produces high-resolution, three-dimensional temperature, pressure, and moisture profiles. Designed to give scientists more refined information about Earth’s atmosphere and improve weather forecasts and our understanding of climate.

**CrIS**

Spectral Coverage:
- 3 spectral bands
- 8 cm clear aperture
- Modular Construction
- Anti-sun

**Calibration, Calibration Verification, and Traceability**

- Pre-integration calibration of on-board Blackbody references at sub-system level
- On-orbit radiometric and spectral calibration verification
- Periodic radiometric and spectral calibration verification
- Periodic pre-integration calibration under flight-like conditions with NIST transfer standards

**Single CrIS Scan Line (full sweep, 30 FORs)**

**Double Obs CalC Comparison Results**

- Observed CrIS: 895-900 cm−1 Brightness Temperature
- S-HIS: 895-900 cm−1 Brightness Temperature