

NOAA Calibration/Validation Update

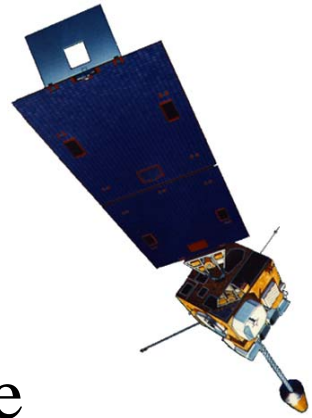
Presented by Changyong Cao
NOAA/NESDIS/STAR

With contributions from NOAA/NESDIS Scientists

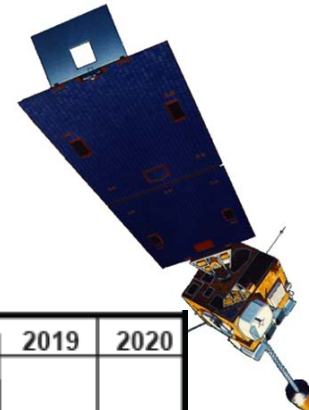
Presented at the WGCV30, Brazil, May 24-39, 2009



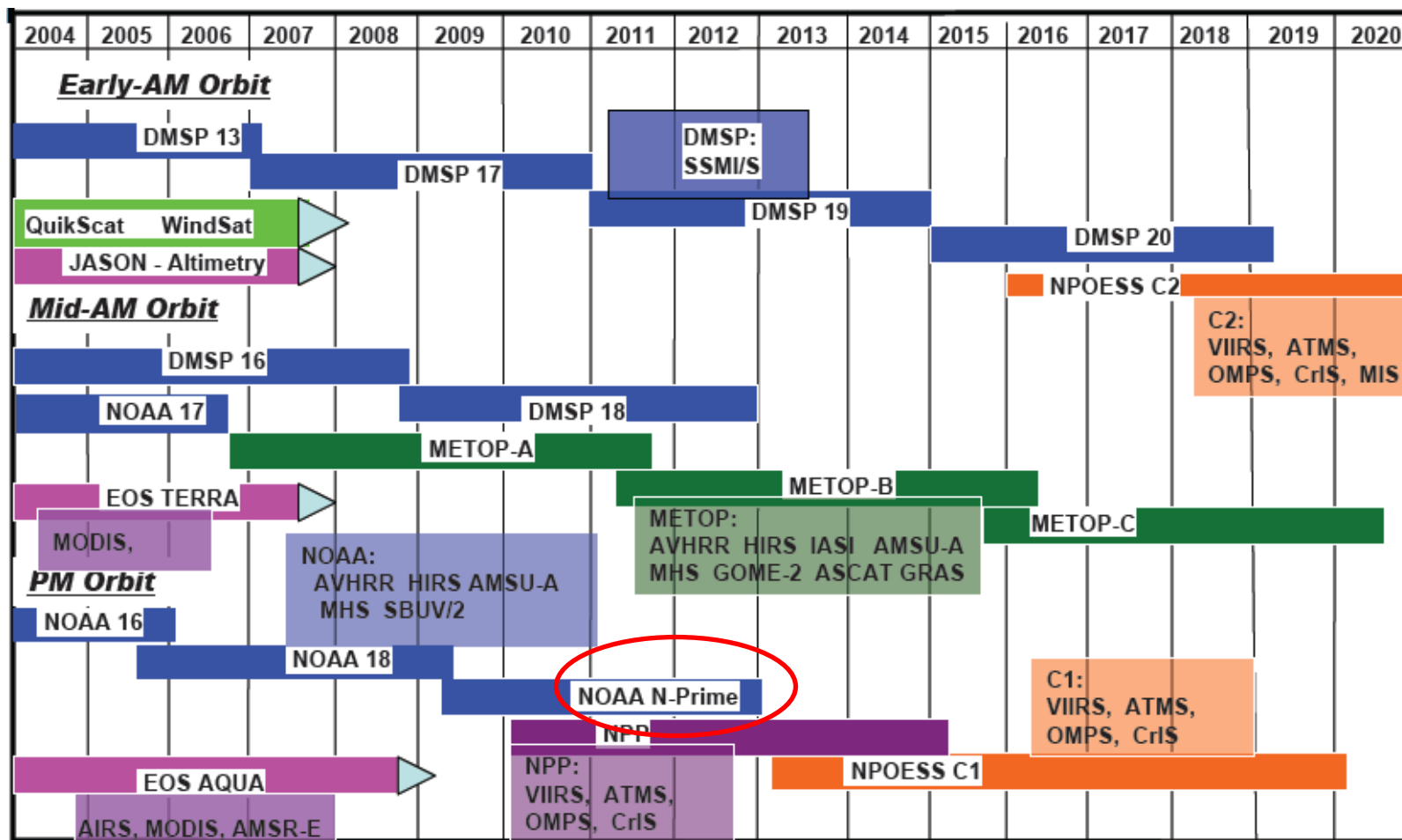
Outline



- NOAA polar-orbiting & geostationary satellite programs
- NOAA-N (19) successful launch and on-orbit verification
- Climate quality calibration and the Scientific Data Stewardship Project
- NPP/NPOESS & GOES-R calibration support
- Other cal/val activities

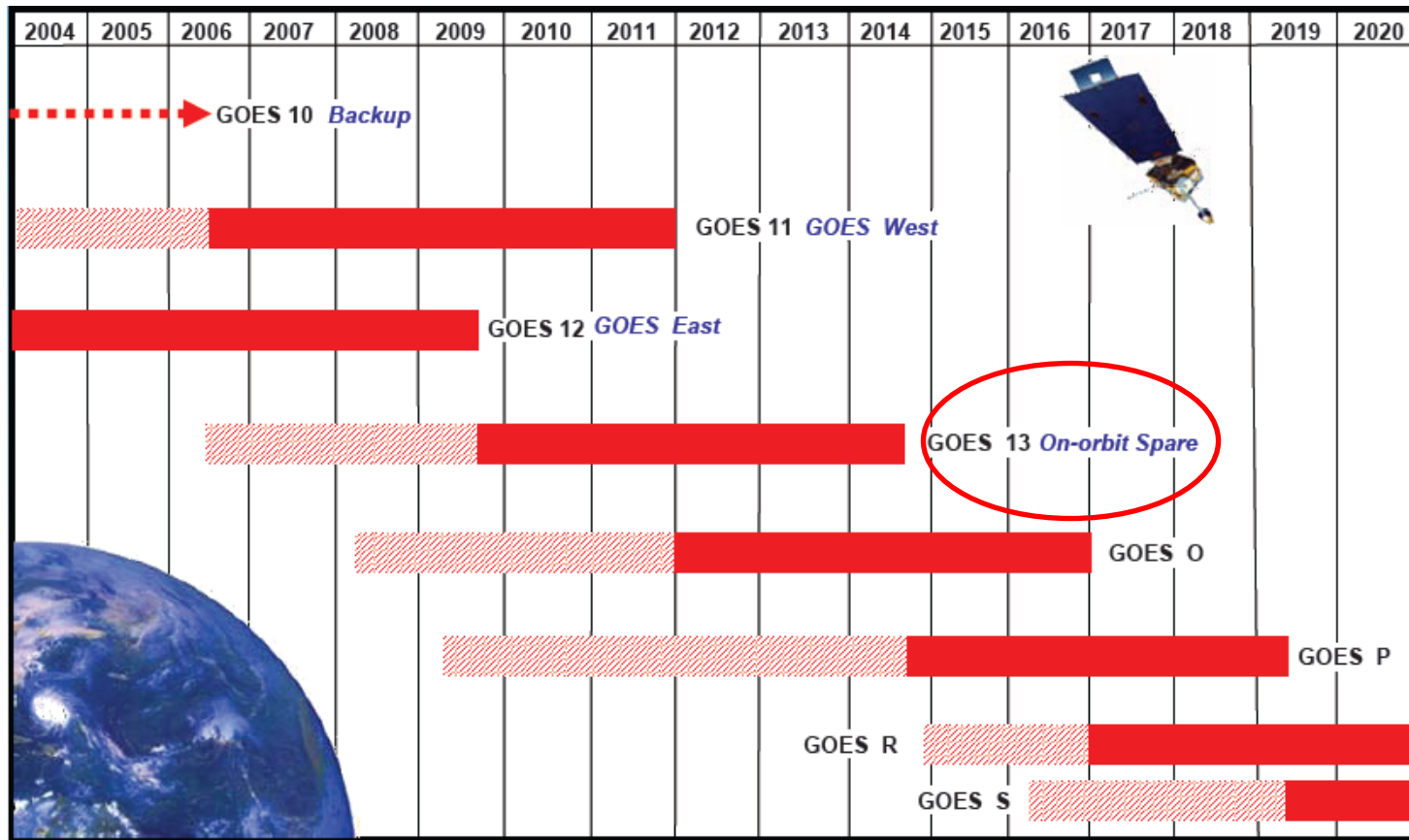


Polar-orbiting Satellites



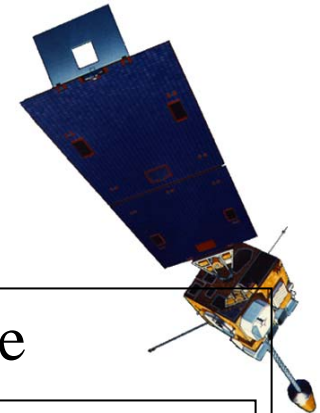


Geostationary Satellites





NOAA Cal/Val Programs



Future

NPOESS (IPO)

GOES-R (GPO)

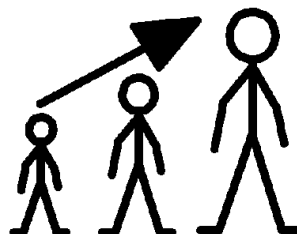
Past and present

POES

GOES

Common themes:

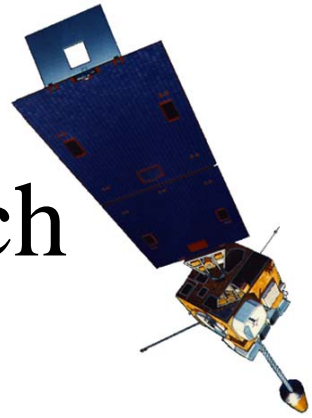
- Operational calibration support
- Data quality assurance
- Calibration for climate
- Cal/val sites
- R2O (NASA)
- SI traceability (NIST)



transition



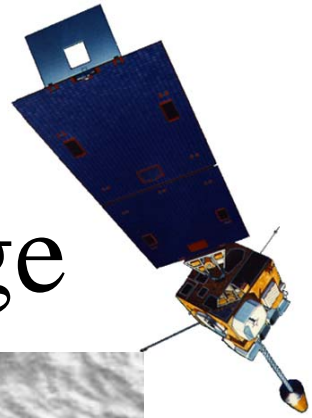
NOAA-N'(19) Successful Launch



- PM orbit (MetOP in AM orbit)
- Instruments:
AVHRR/AMSU/HIRS/MHS/SBUV
- Launch very successfully (Feb. 6, 2009)
 - The last in the NOAA POES series since 1978, with 14 satellites;
 - Completed on-orbit verification;
 - All instruments performing very well;
 - Will become operational around June, 2009.



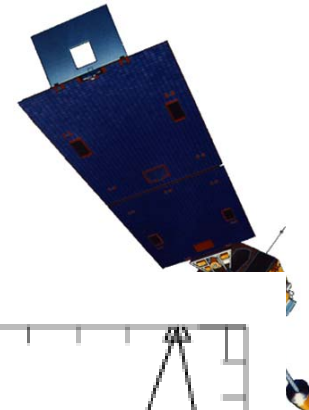
NOAA-19 First Visible Image



First NOAA-19
AVHRR visible
image with
adequate sunlight
over Wallops VA
on Feb. 6, 2009

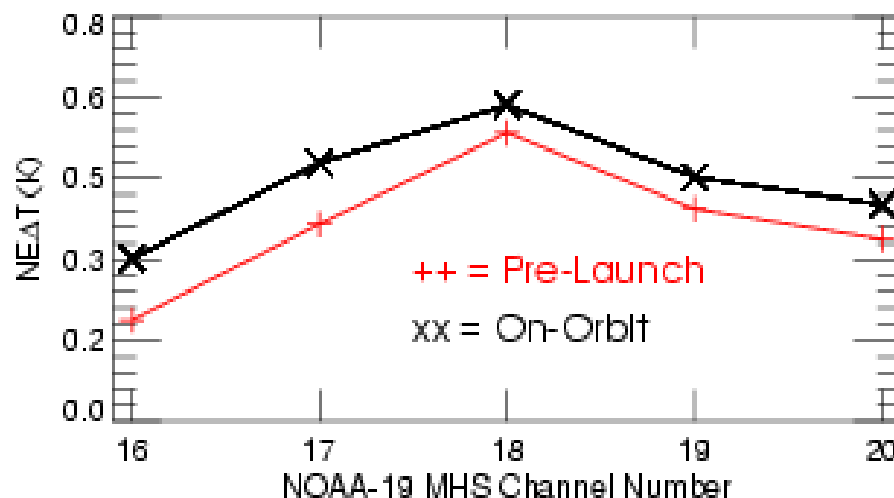
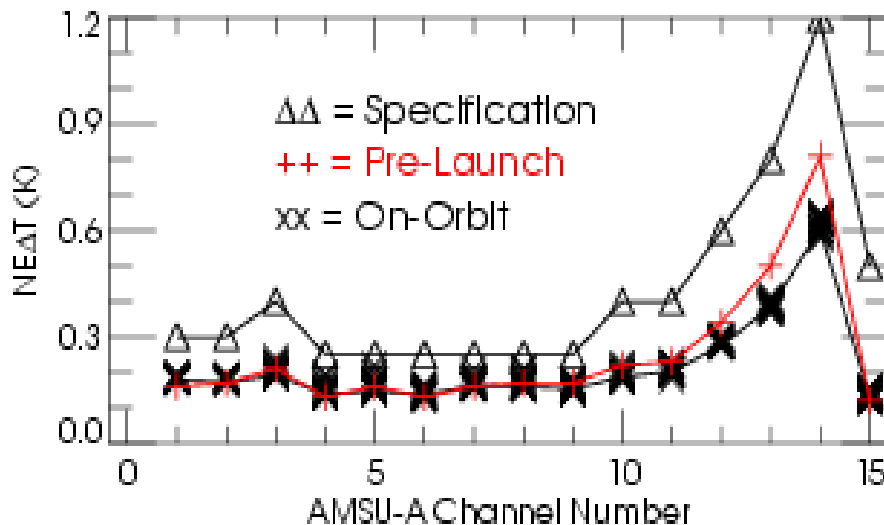


Courtesy of Wrublewski



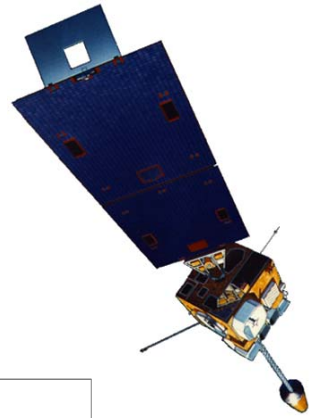
AMSU/MHS Performance

- All NOAA-19 AMSU-A and MHS systems function normally
- On-orbit AMSU-A and MHS NE Δ Ts at all channels meet specs
- Overall calibration is good with quality control flags set properly
- Optimal Space Views for AMSU-A1 and -A2 are determined
- Antenna Power Parameters for Correction of Lunar Contamination in Space View Counts: TBD in Early April
- *Concern: Sudden jumps in calibration counts at AMSU-A Ch. 7*

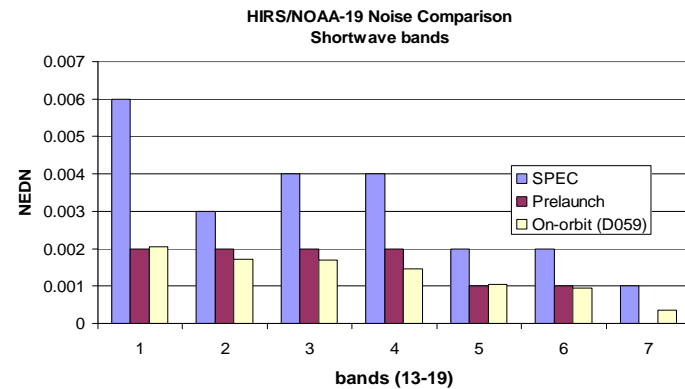
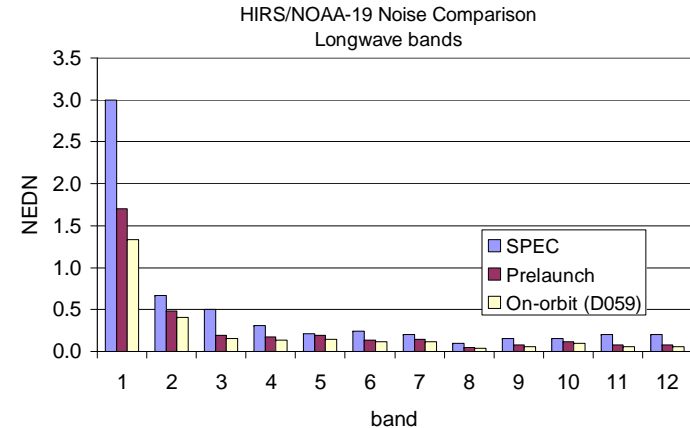


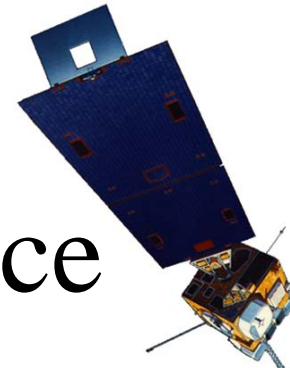


HIRS Performance



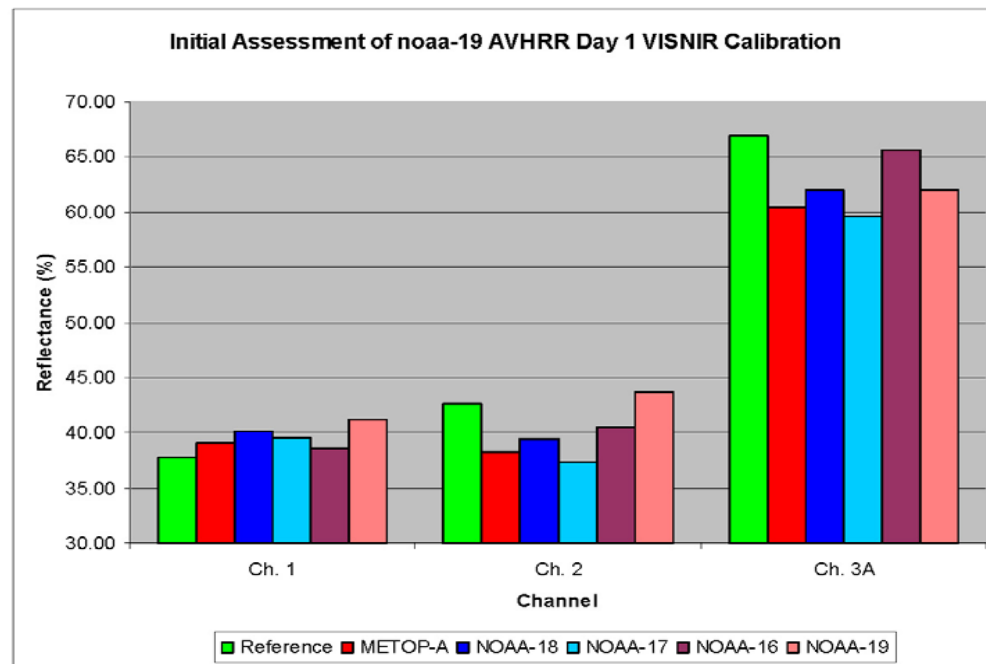
- HIRS/NOAA-19 is performing well. Noise meet specification,
- Coherent noise found for some longwave channels at low temperatures,
- Filterwheel temperature slowly increasing, and longwave channel gain change noted, we are monitoring closely,
- Preliminary SNO analysis results are available.





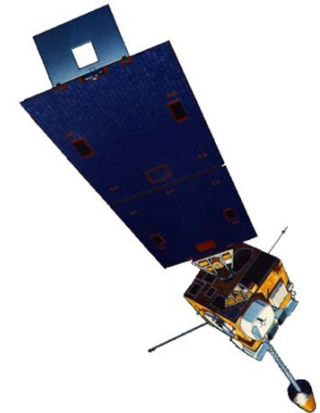
AVHRR VIS/NIR Performance

- Space view count jumps by 2 count after thermal channels turn on, while blackbody count is steady
- Using Libyan Desert, a traditional target for the operational calibration of the AVHRR solar reflectance channels (Ch. 1, 2, & 3A).
- It is recommended to multiply 0.9169, 0.9739, and 1.0801 to the pre-launch calibration results for NOAA-19 AVHRR Channel 1, 2, and 3A, respectively

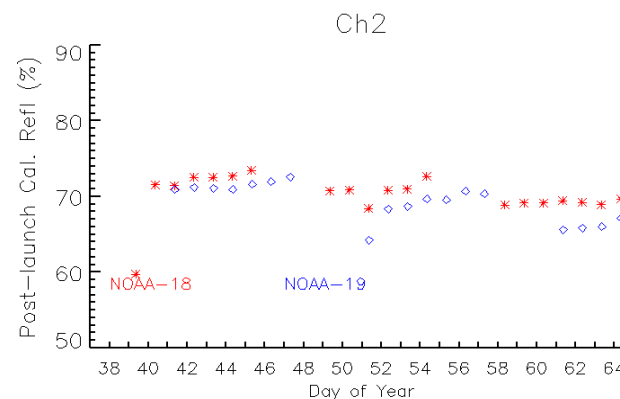
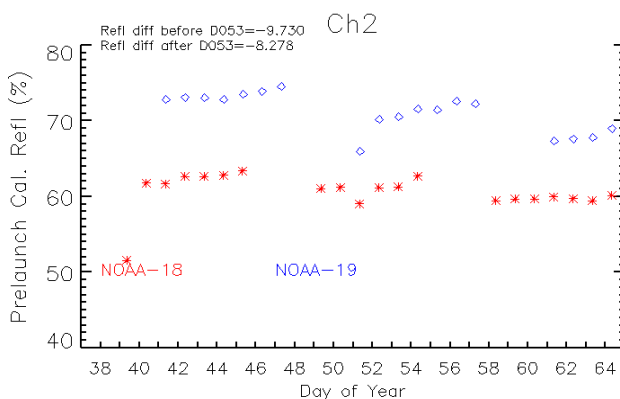
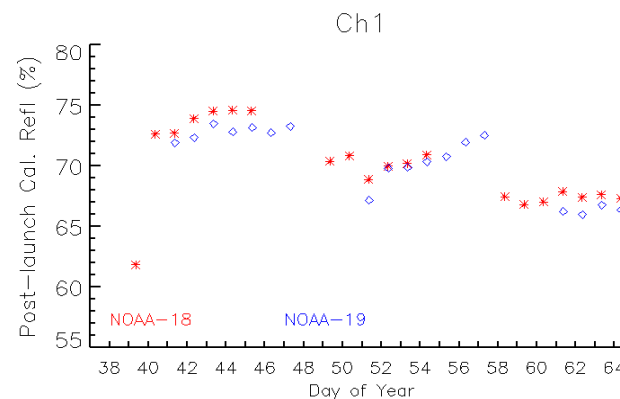
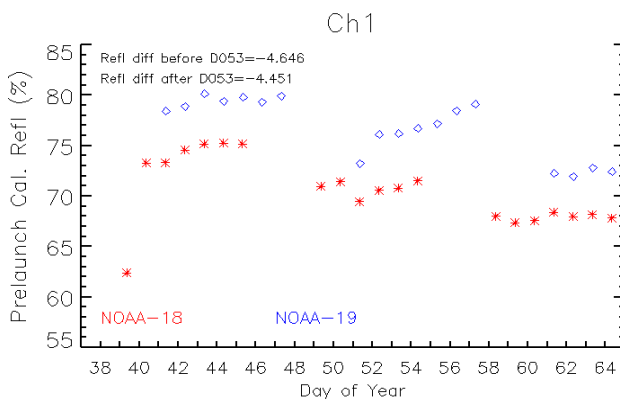




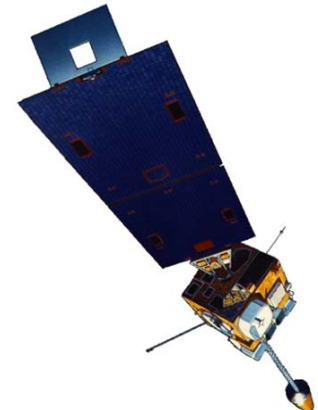
Inter-comparison between NOAA-18 and -19 AVHRR at Dome C



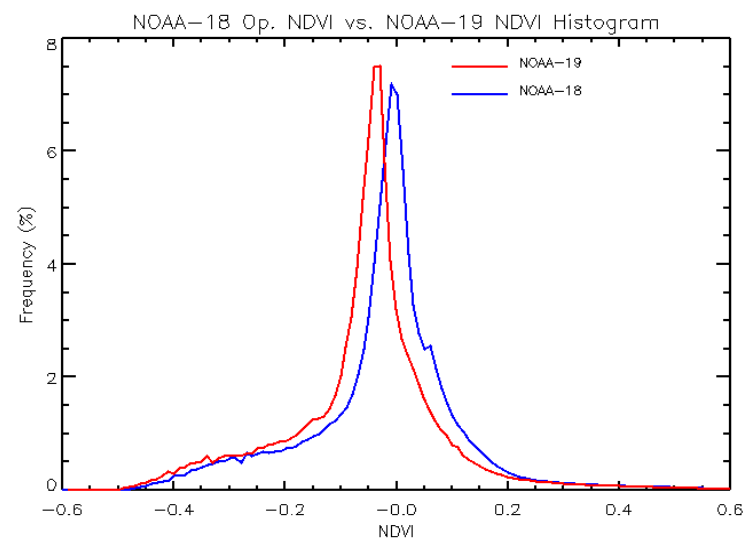
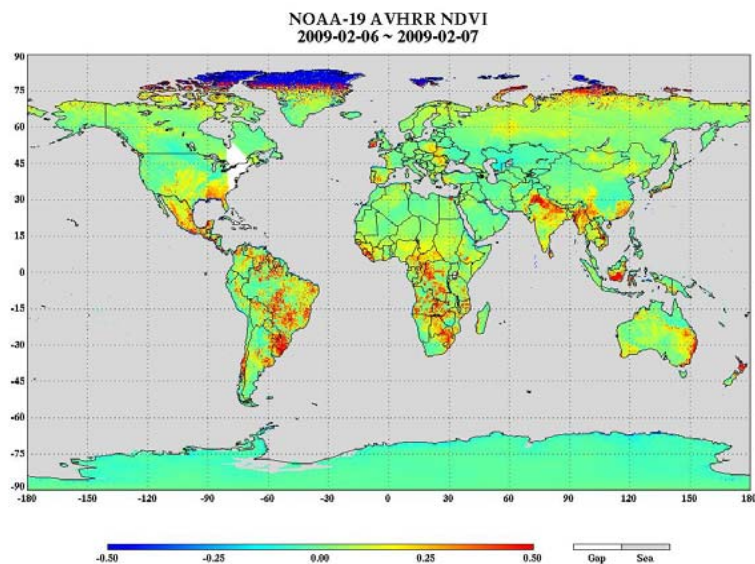
Nadir observations of Dome C, Pre- and Post-launch (Libyan)
calibration w/o BRDF correction



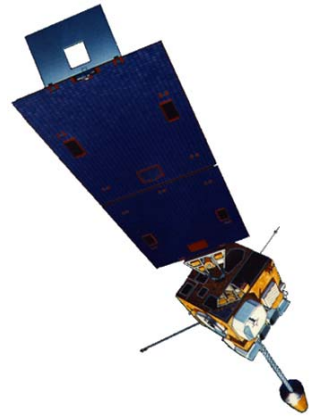
Courtesy of Wu and Yu



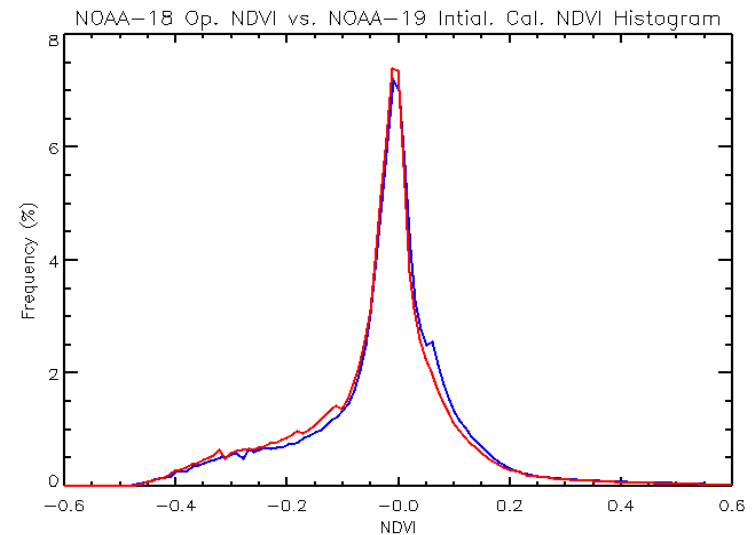
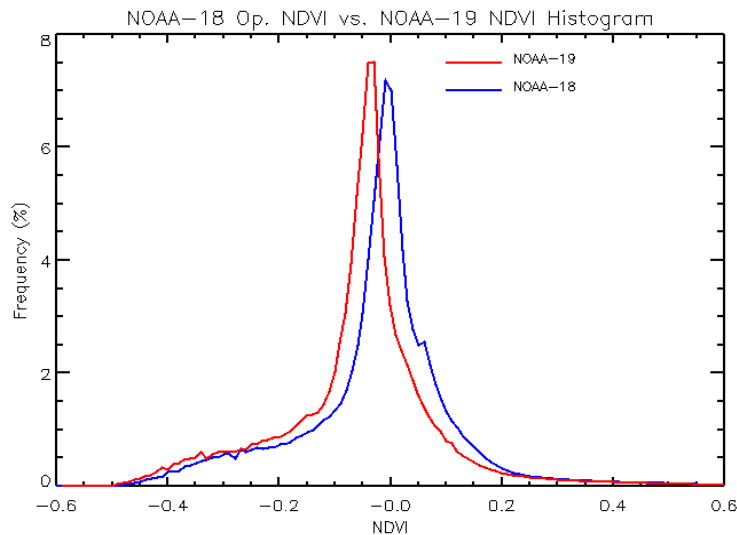
Calibration Bias Evaluation with NDVI



Courtesy of Wu & Yu



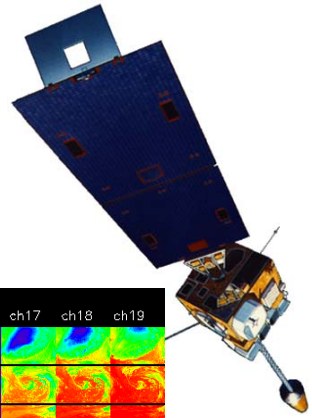
NDVI Histogram Before and After Bias Correction



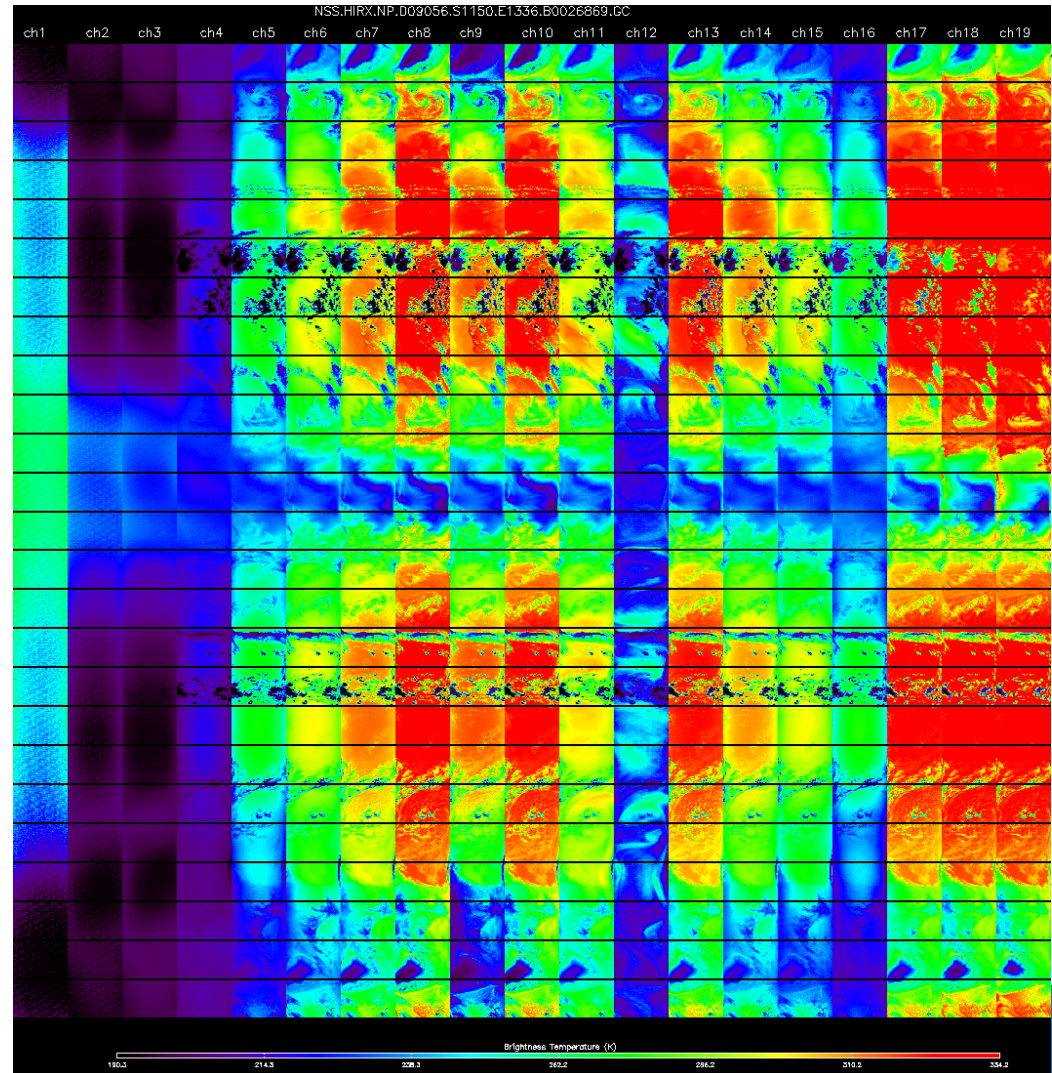
Courtesy of Wu & Yu



NOAA-19/HIRS Data Quality

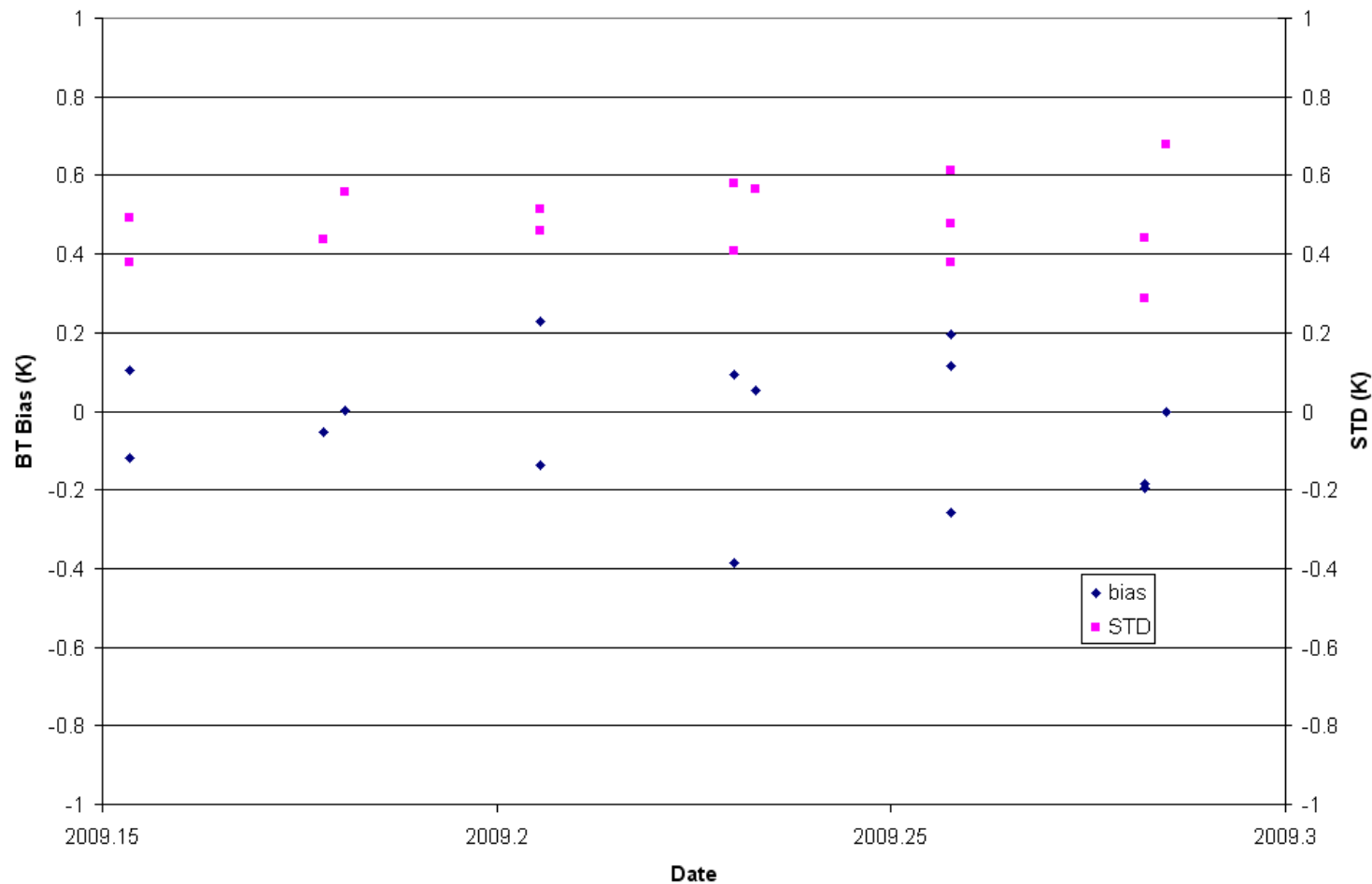
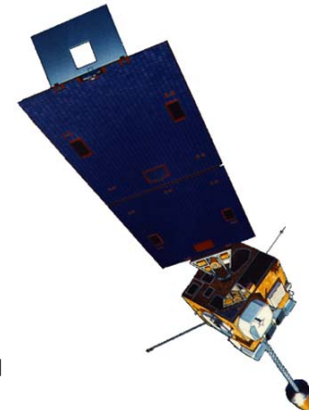


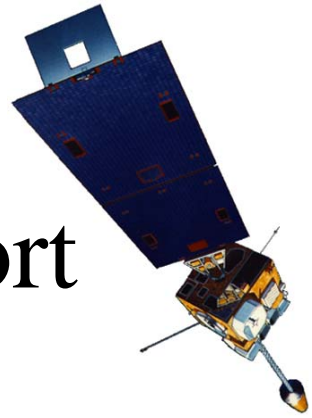
- Overall, data quality is very good;
- Small coherent noise in the longwave channels at low temperatures;
- Figure show one orbit for all IR channels.





NOAA-19 vs. MetOP HIRS Comparison at SNOs Band 2 at 50 hPa



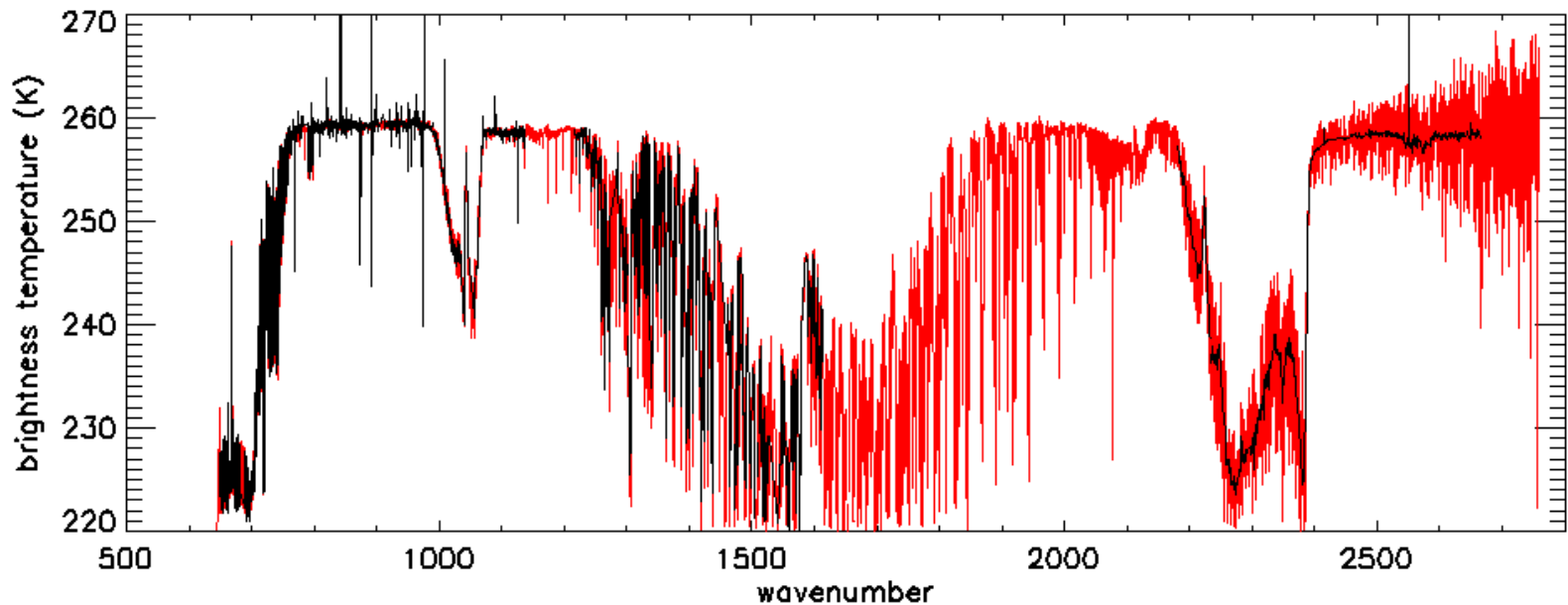
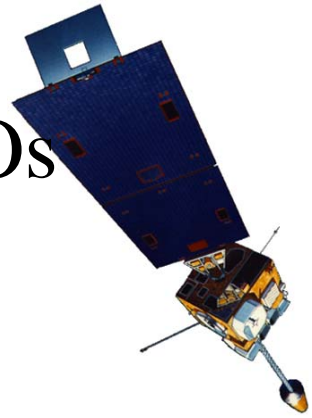


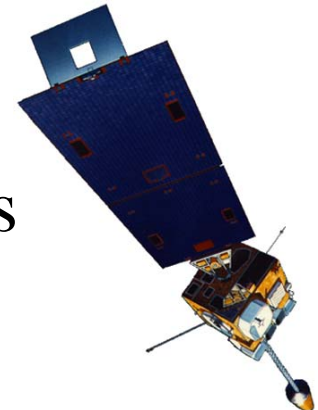
NPP/NPOESS calibration support

- Developed integrated cal/val system for
 - Inter-calibrating CrIS with IASI and AIRS using SNOs
 - Inter-calibrating VIIRS with MODIS and AVHRR using SNOs
 - Inter-calibrating reflective solar bands at Dome C and other sites
- Currently under development
 - Calibration transfer using GOES imagers and sounders in the low latitudes;
 - Double differencing at ocean sites;
 - Spectral calibration using IASI;
 - Spatial calibration for geolocation and co-registration evaluation.

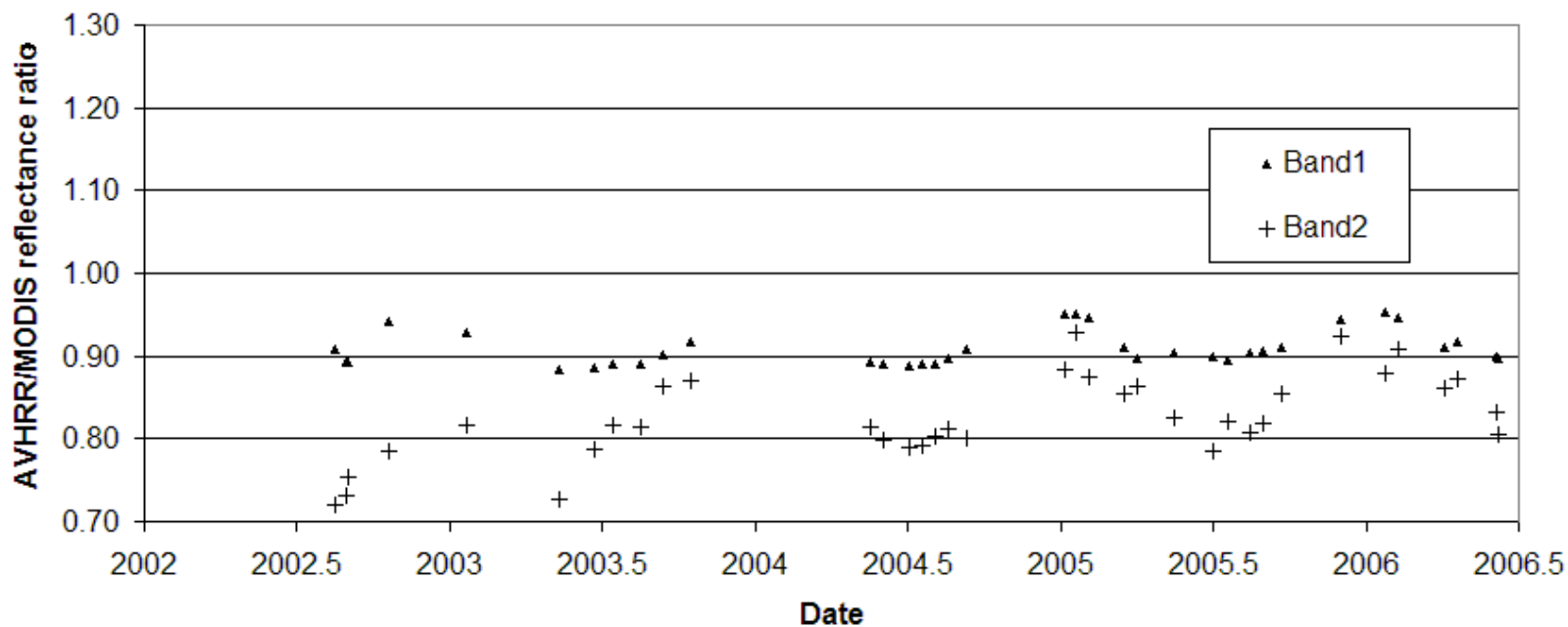


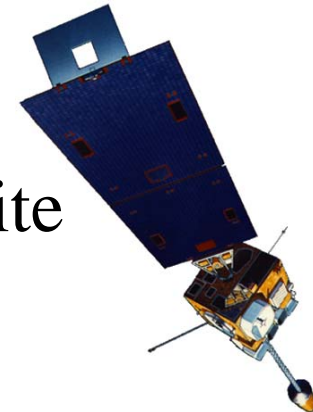
IASI vs. AIRS inter-comparison at SNOs in preparation for CrIS



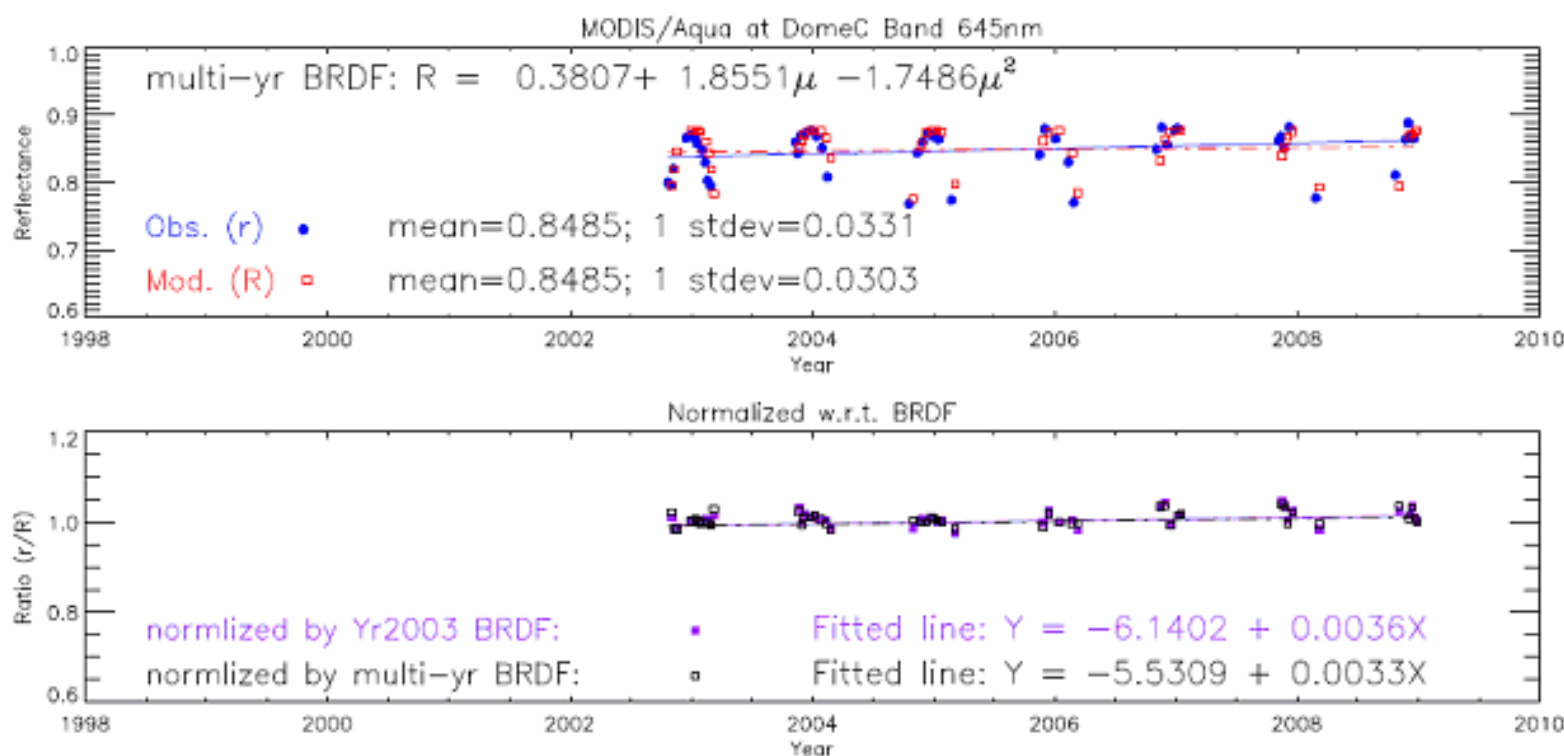


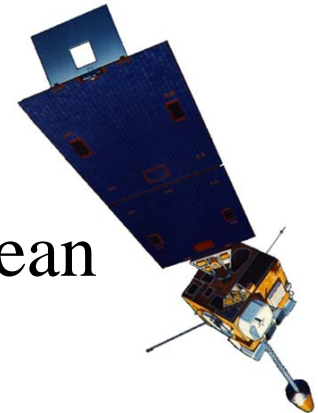
MODIS/AVHRR inter-comparison at SNOs in preparation for VIIRS



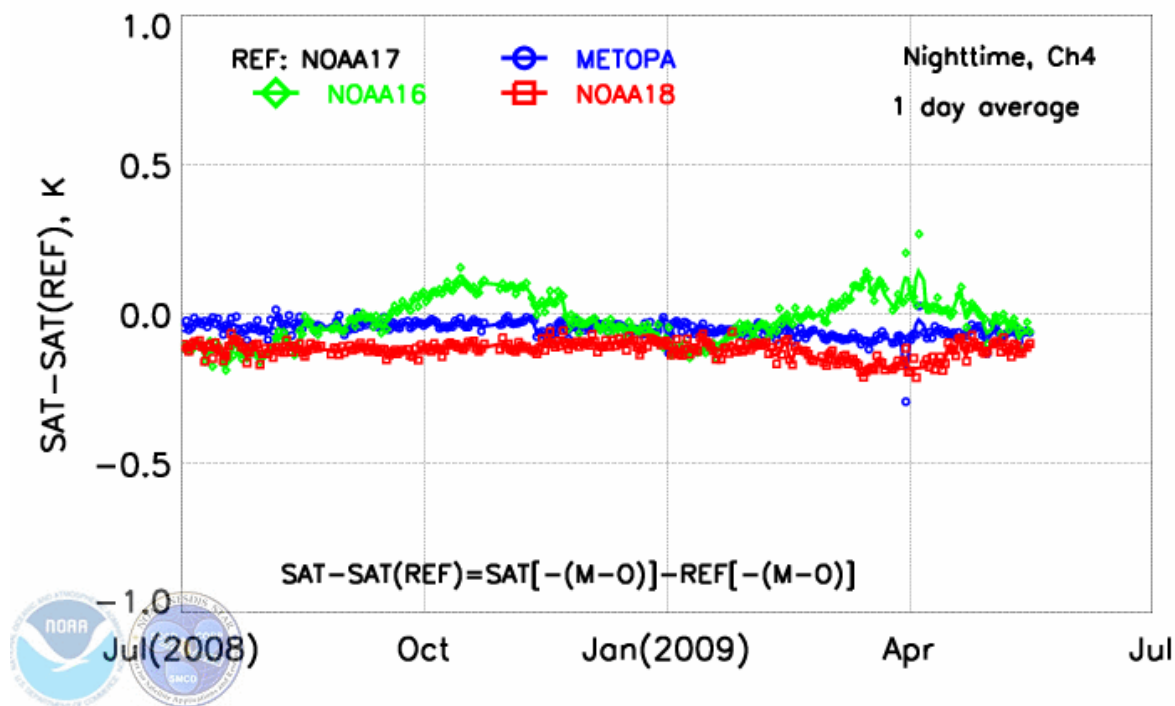


MODIS/Aqua Observations at the Dome C site in preparation for VIIRS

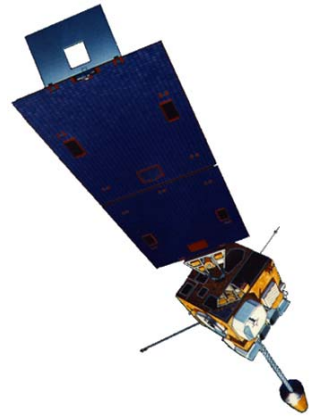




Double Differencing Method using Clear Sky Ocean

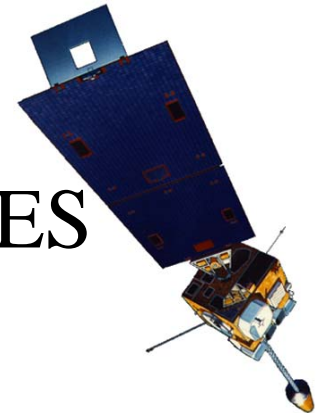


Courtesy of A. Ignatov



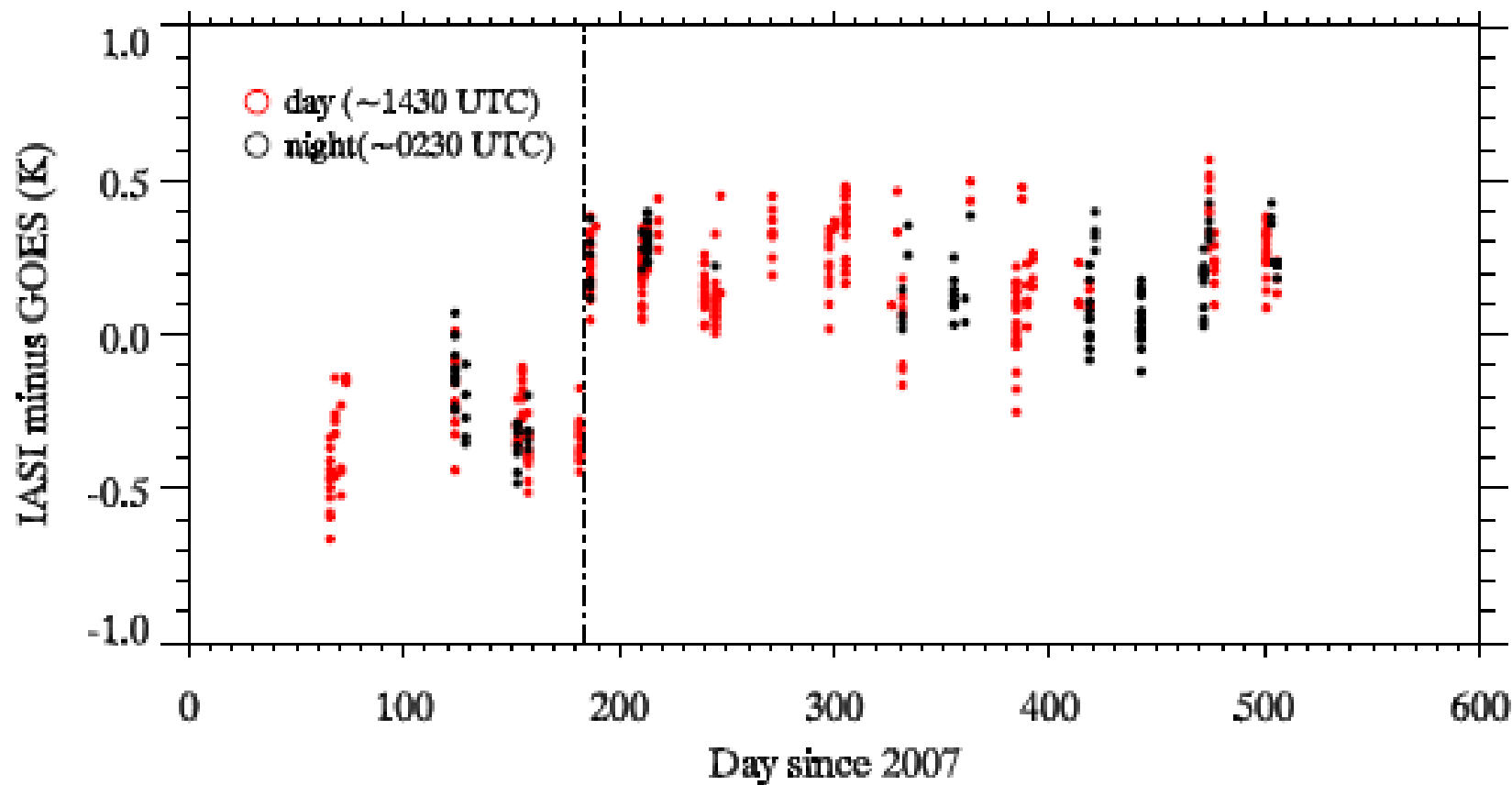
GOES-R calibration support

- Cal/val plan development
- Prelaunch calibration
- Postlaunch capability development
- Longterm monitoring capability development
- Special sessions at the Utah calibration conference in August.



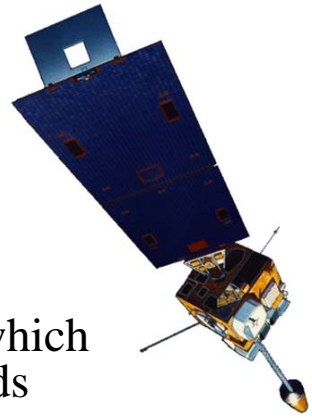
Inter-comparison between IASI and GOES

Cal/Val capability development for GOES-R





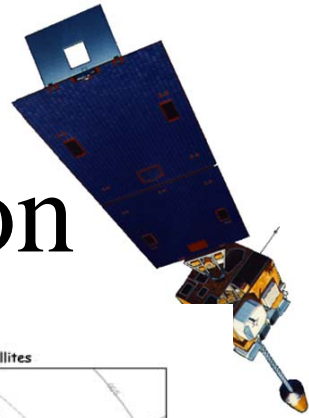
Science Data Stewardship (SDS) Project and Climate Quality Calibration



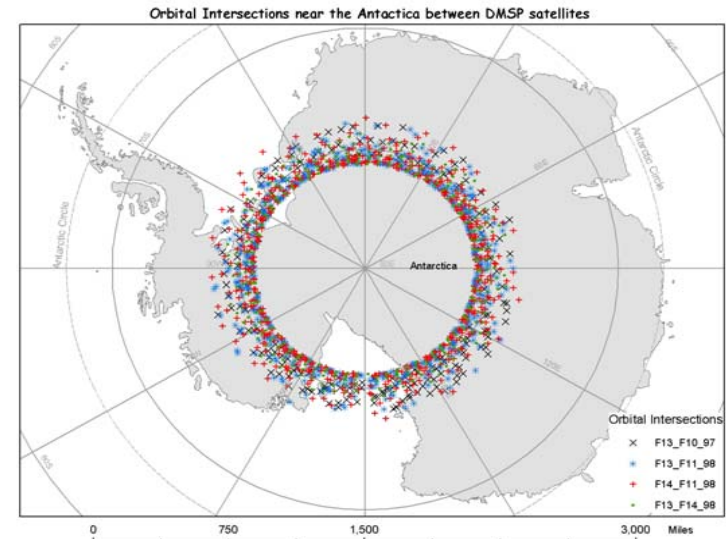
- NOAA/NCDC is leading the Scientific Data Stewardship (SDS) Project which seeks to support the development and stewardship of Climate Data Records (CDRs) for the atmosphere, cryosphere, oceans, and land surface.
- Initially focused on Fundamental CDRs (FCDRs, i.e., calibrated and quality-controlled long term sensor data records that have been improved over time).
- Initial Priority FCDR Parameter Sets:
 - Multispectral Imager(s) Solar Reflective SDR
 - Mutispectral Imager(s) Thermal Emissive SDR
 - Total Ozone Sensor(s) (Nadir) SDR
 - Ozone Profile Sensor(s) (Limb) SDR
 - Microwave Sounder(s) SDR
 - Thermal Infrared Sounder(s) SDR
 - Radiation Budget Sensor(s) SDR
- Note: SDR=Sensor Data Record, or climate-quality calibrated and geo-located radiances, reflectances, temperatures and/or radar return, as appropriate for the sensing technology.



SSM/I Intersensor Calibration

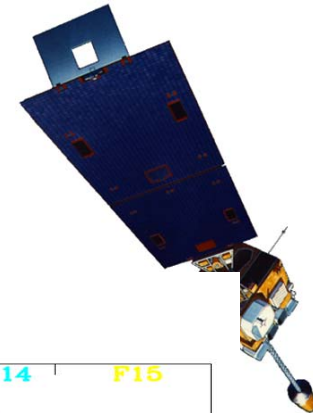


- **NOAA: Developed unique technique for matching SSM/I obs from two DMSP satellites**
 - Simultaneous conical over-passing
 - Characterize biases according to surface type
- **CM-SAF**
 - Statistical intercalibration (histogram equalisation)
 - Intercomparison
- **Work with CSU (Kummerow/Berg) and RSS (Wentz)**
 - Independent calibration approach
 - Intercomparison
- **Work with NASA GPM Cross-Calibration team**
 - TMI and SSM/I
 - Windsat and SSM/I



**Simultaneous observations from
DMSP F10 and F11 satellites
over Antarctic continent**

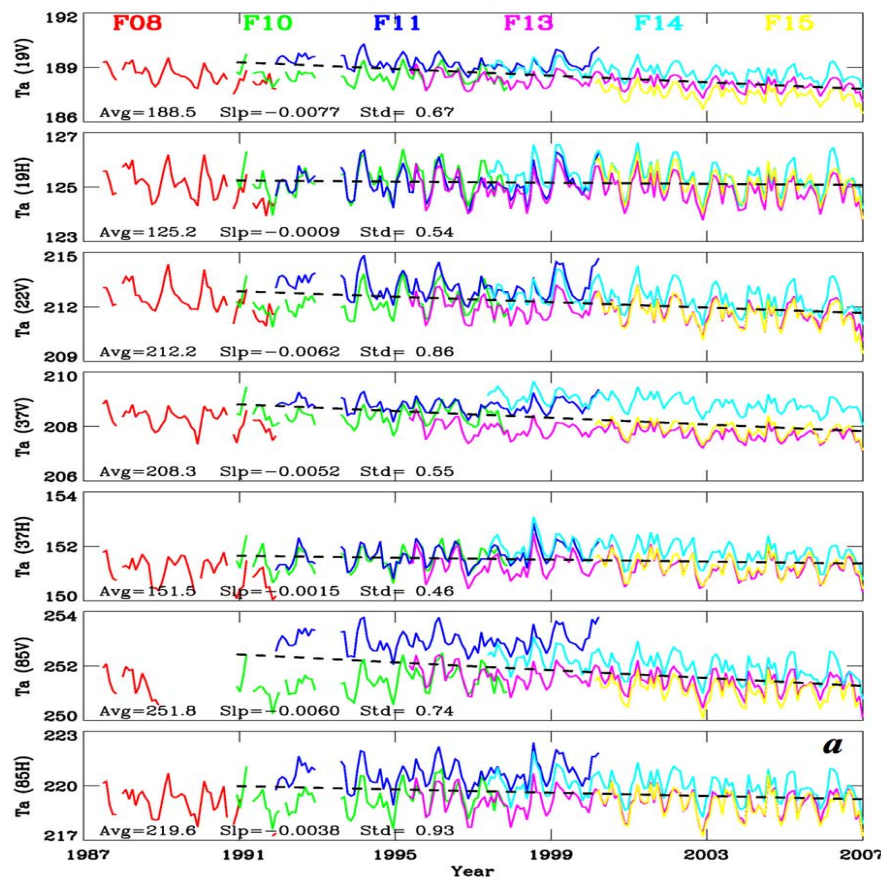
Courtesy of F. Weng



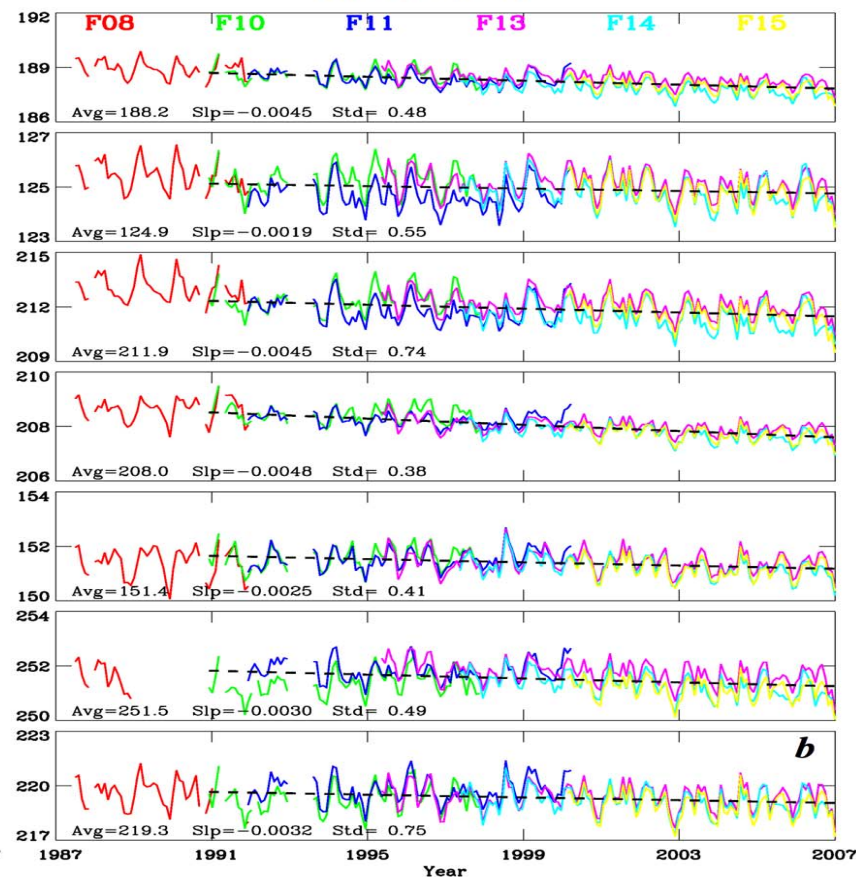
Preliminary Results: SSM/I TDR Trend

Comparison of Rain-Free Monthly T_a Trend (Ocean)

Before Calibration



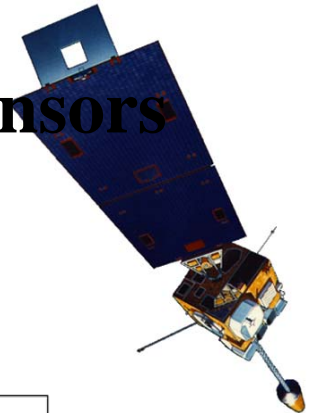
After Calibration



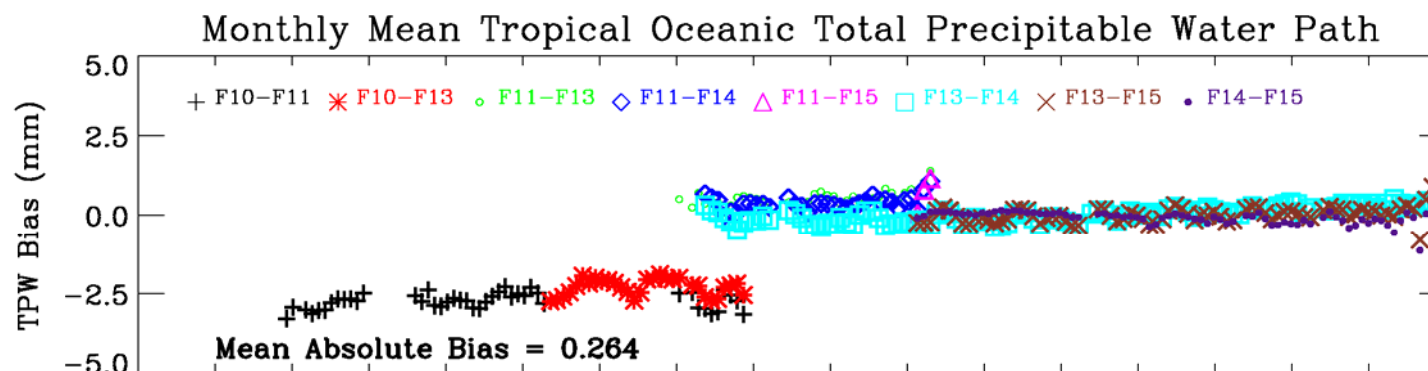
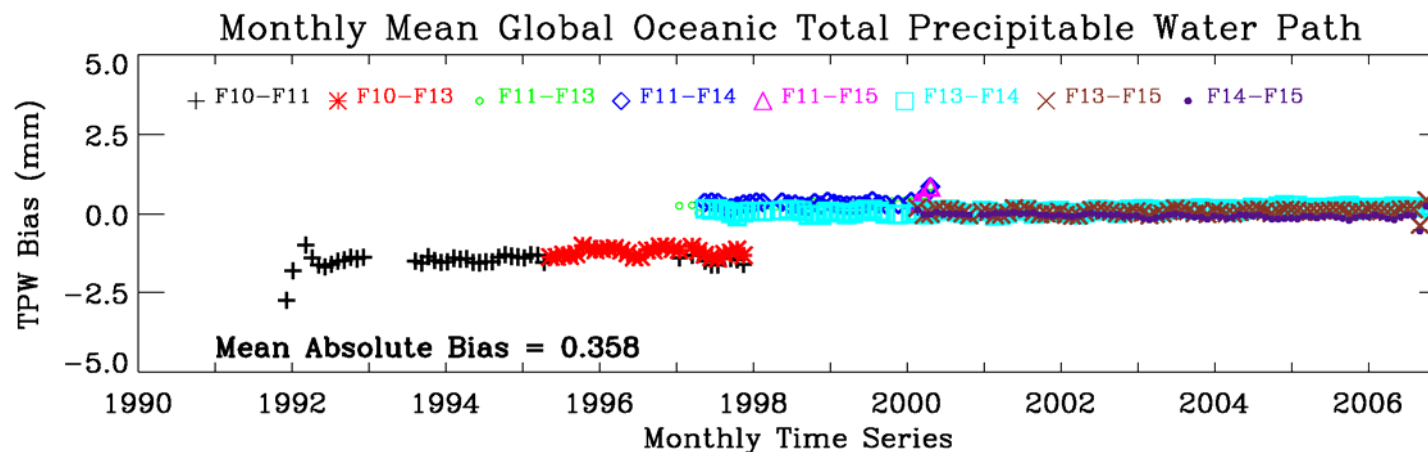
Comparison of SSM/I Monthly Oceanic Rain-free TDR Trend using F13 satellite as a reference. The trend at TDR level from all satellites are more consistent after calibration



Monthly TPW Bias between Overlapped Sensors



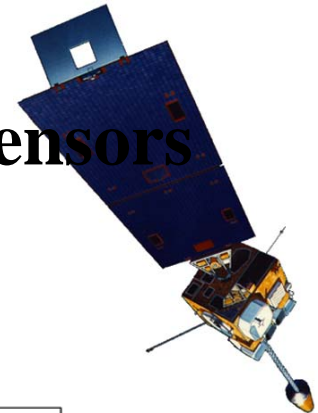
Before Intercalibration



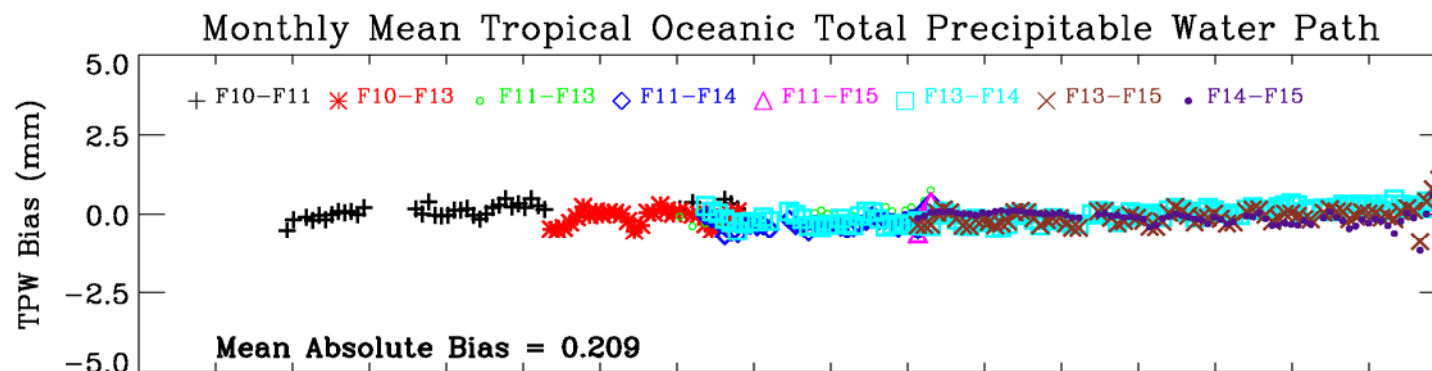
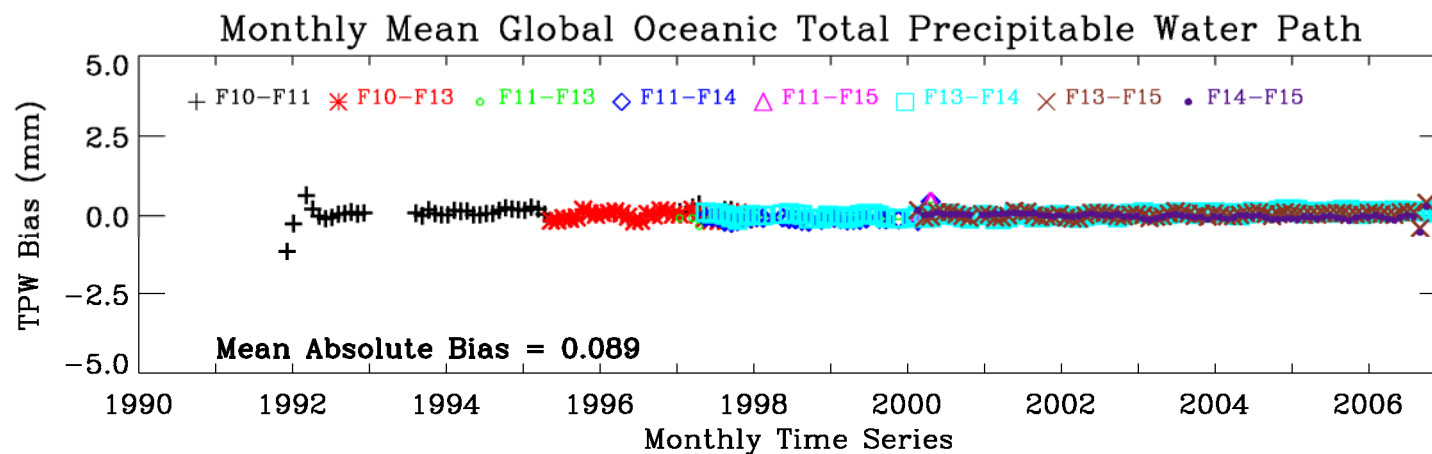
Monthly total precipitable water path (TPW) bias between any overlapped SSM/I sensors for F10, F11, F13, F14, and F15. Large biases between F10-F11 and F10-F13 are obvious. Since $TPW = 232.89 - .1486 * TV19 - .3695 * TV37 - (1.8291 - .006193 * TV22) * TV22$, (Alishouse et al., 1991), any radiance biases in lower SSM/I frequencies will be directly translated into TPW biases



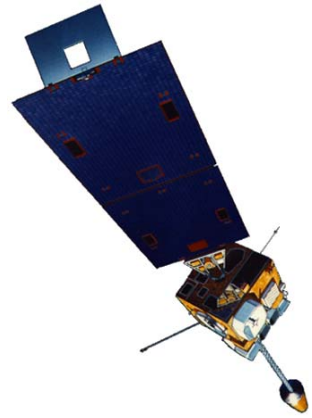
Monthly TPW Bias between Overlapped Sensors



After Intercalibration

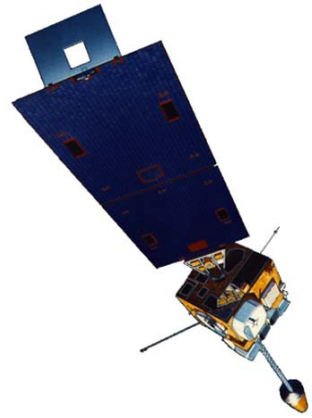


The inter-sensor TPW biases become much smaller and consistent between different sensors. The averaged absolute bias after calibration is reduced by **75%** and **21%** over global ocean and over tropical ocean, respectively .



Other Cal/Val Activities

- Jason Cal/Val Support
 - Altimeter for ocean surface topography
 - Research to Operations (CNES, EUMETSAT, NASA, NOAA)
 - Microwave radiometer calibration & water vapor correction
 - Sea-level rise & climate change detection
- CLARREO Science Team Meeting
- GSICS activities (reported separately)
- Dome C study (reported separately)



Summary

New progress since last meeting

- NOAA-N' successful launch and OV
- Continue developing cal/val infrastructure for NPP/NPOESS and GOES-R cal/val
- Continue calibration research and development
- Climate quality calibration for FCDRs
- JASON cal/val support