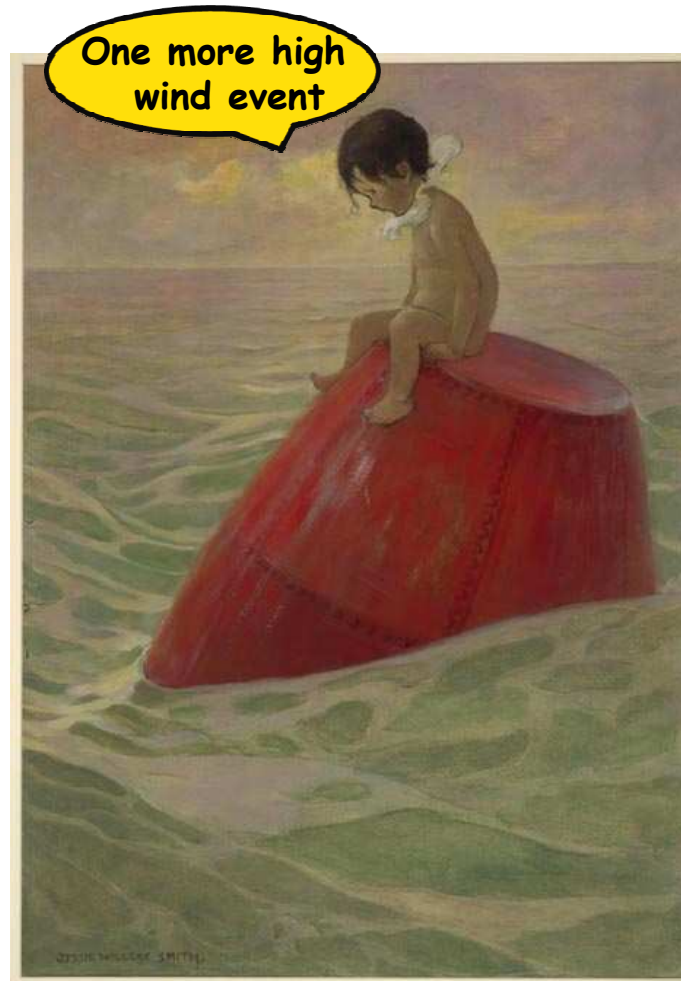




# Improving Satellite Wind Measurements

Frank J. Wentz, Deborah Smith, Lucrezia Ricciardulli



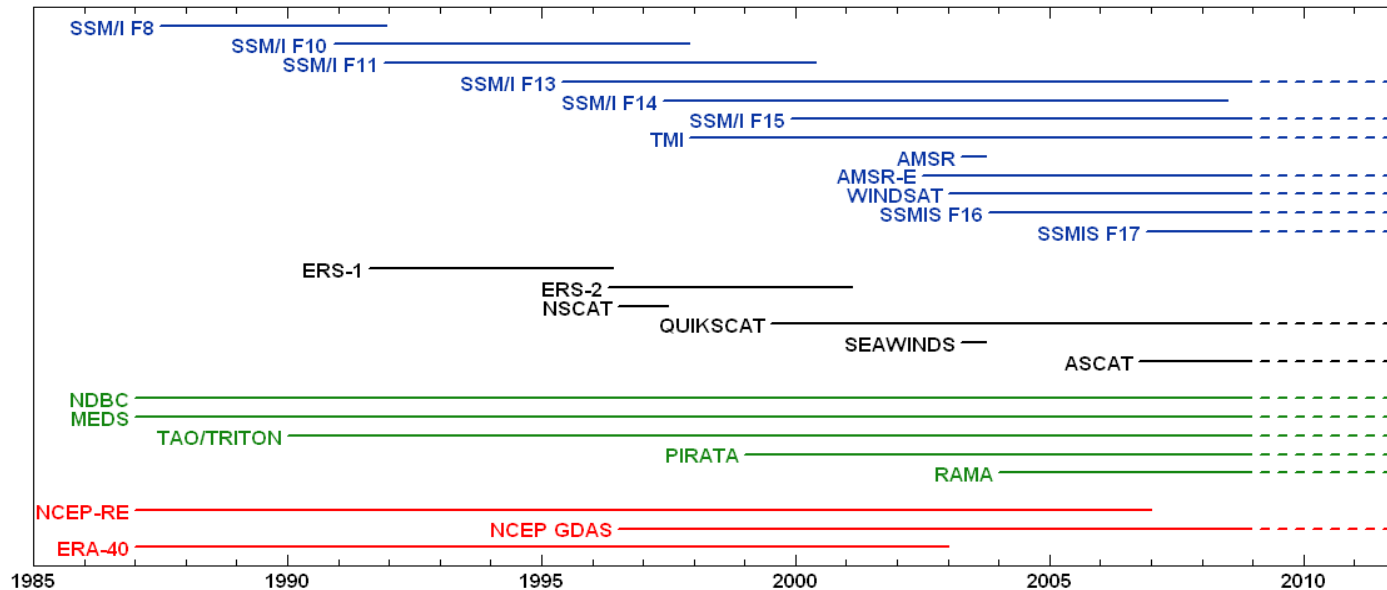
Presented at the OVWST Meeting, Seattle, WA November 2008



## Winds for Climate Research

### Climatology of Vector Winds from 1987 to Present

- RSS does intersatellite calibration and wind retrievals
- Atlas & Ardizzone assimilate RSS wind products into numerical model and generate 6-hour wind vector maps for 1987 to present



Last year saw a major Improvement in SSM/I Wind (V6 winds) (Global Evaporation = Precipitation)

This year (and this talk):

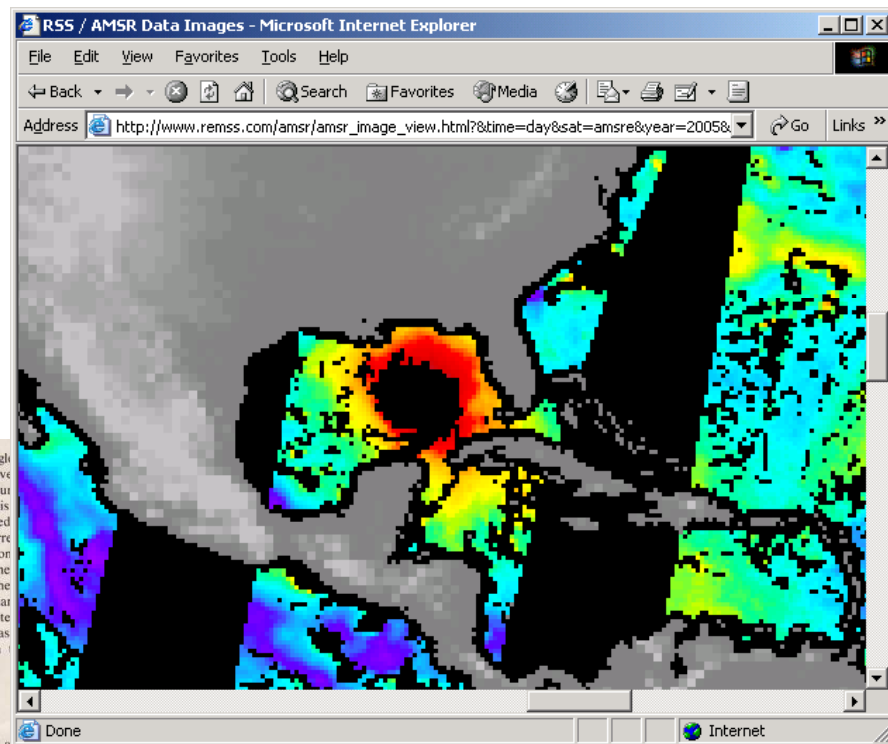
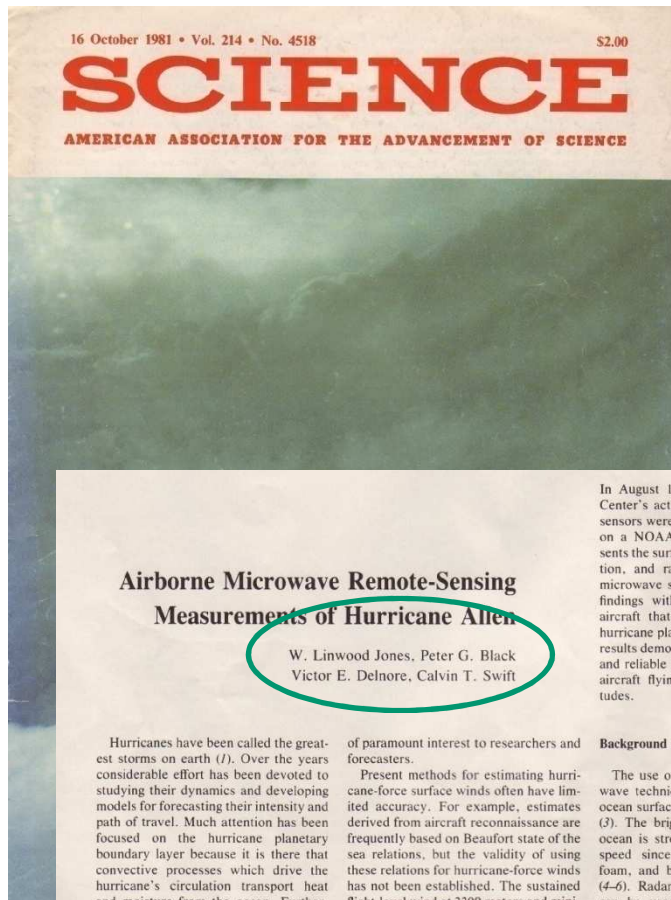
- New retrieval algorithm for conventional radiometers (i.e., SSMI and AMSR) for providing useful wind speed measurements in storms and hurricanes
- Updating the Geophysical Model Function (GMF)  $\sigma_o = f(u_*, \phi_r, \theta_i)$
- Precise calibration and optimum interpolation of WindSat observations



## Can Microwave Radiometers Measure Wind in Rain?

Yes, SFMR

No, Satellite Retrievals are Bad





## Time to Refresh the Geophysical Model Function

Much more Data and in New Locations (Atlantic and Indian Oceans)

A merger of 3 data sets: **One Model Function that Fits All**

- a. Buoy (absolute calibration for 0 to 20 m/s)
- b. NCEP (wind direction)
- c. H\*winds (20-40 m/s)

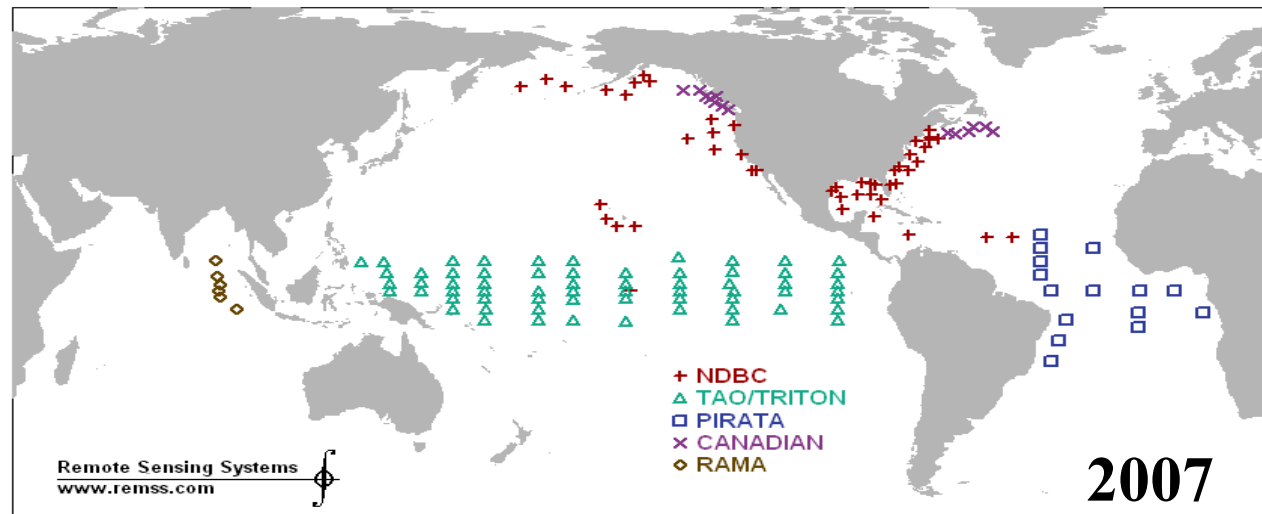
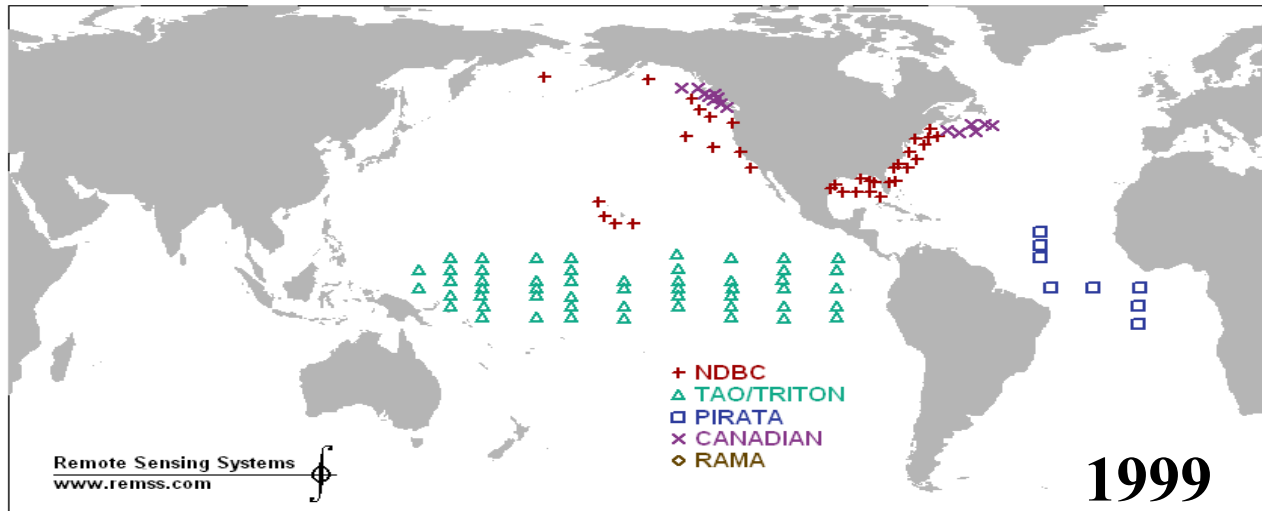
More reliance on Buoys

Ocean Current Effect taken into account

Literature Review, Analysis, and Intercomparison of Previous Works

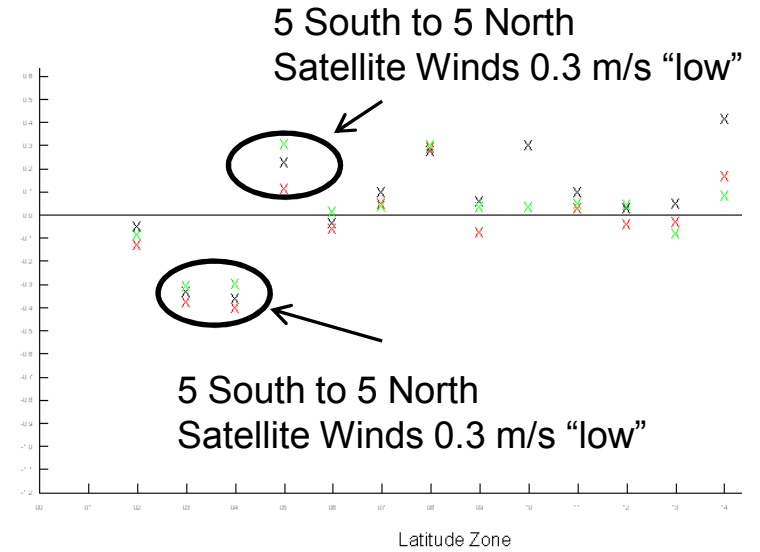
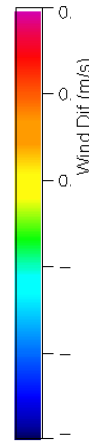
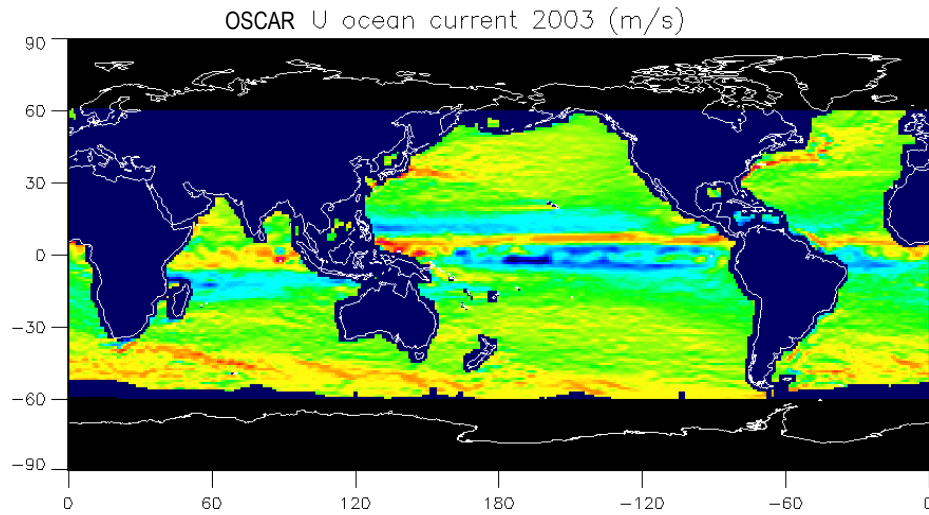


## More Buoy Data in Atlantic and Indian Oceans

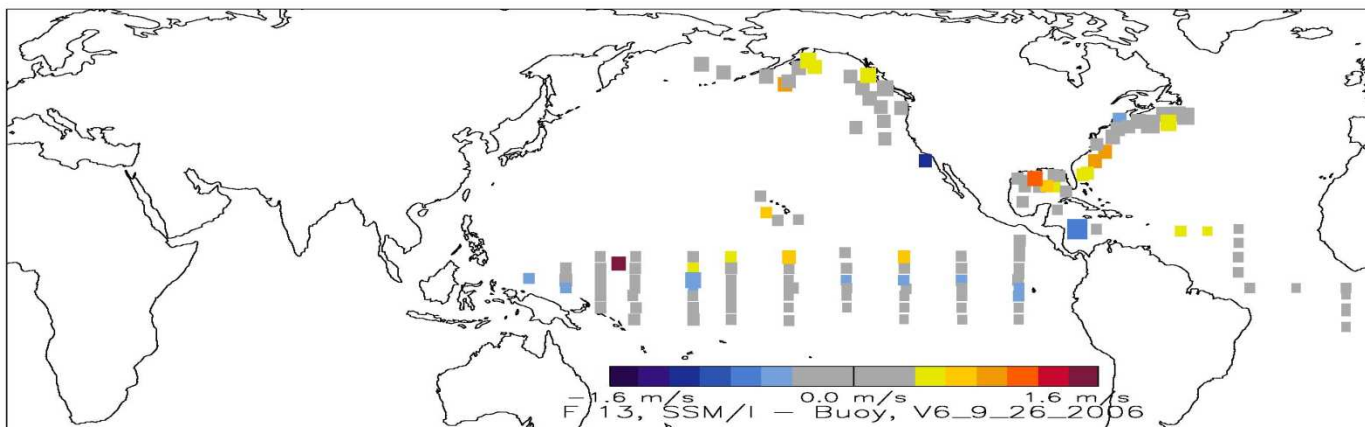


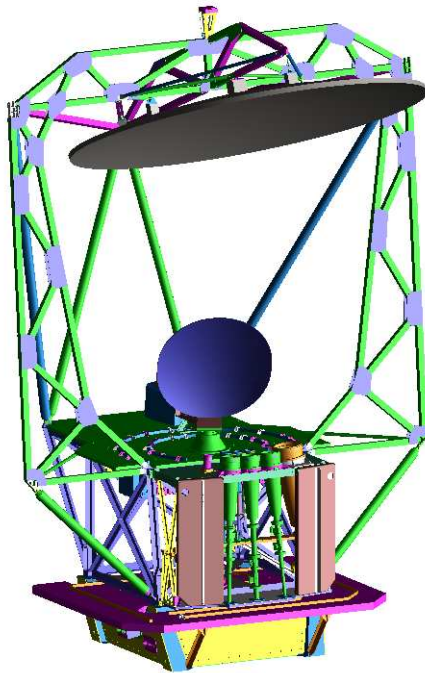


## Ocean Currents: A Small but Persistent Effect



Map of SSM/I Minus Buoy Wind Bias





## How Good is WindSat, Really?

### Everything about WindSat is Complicated

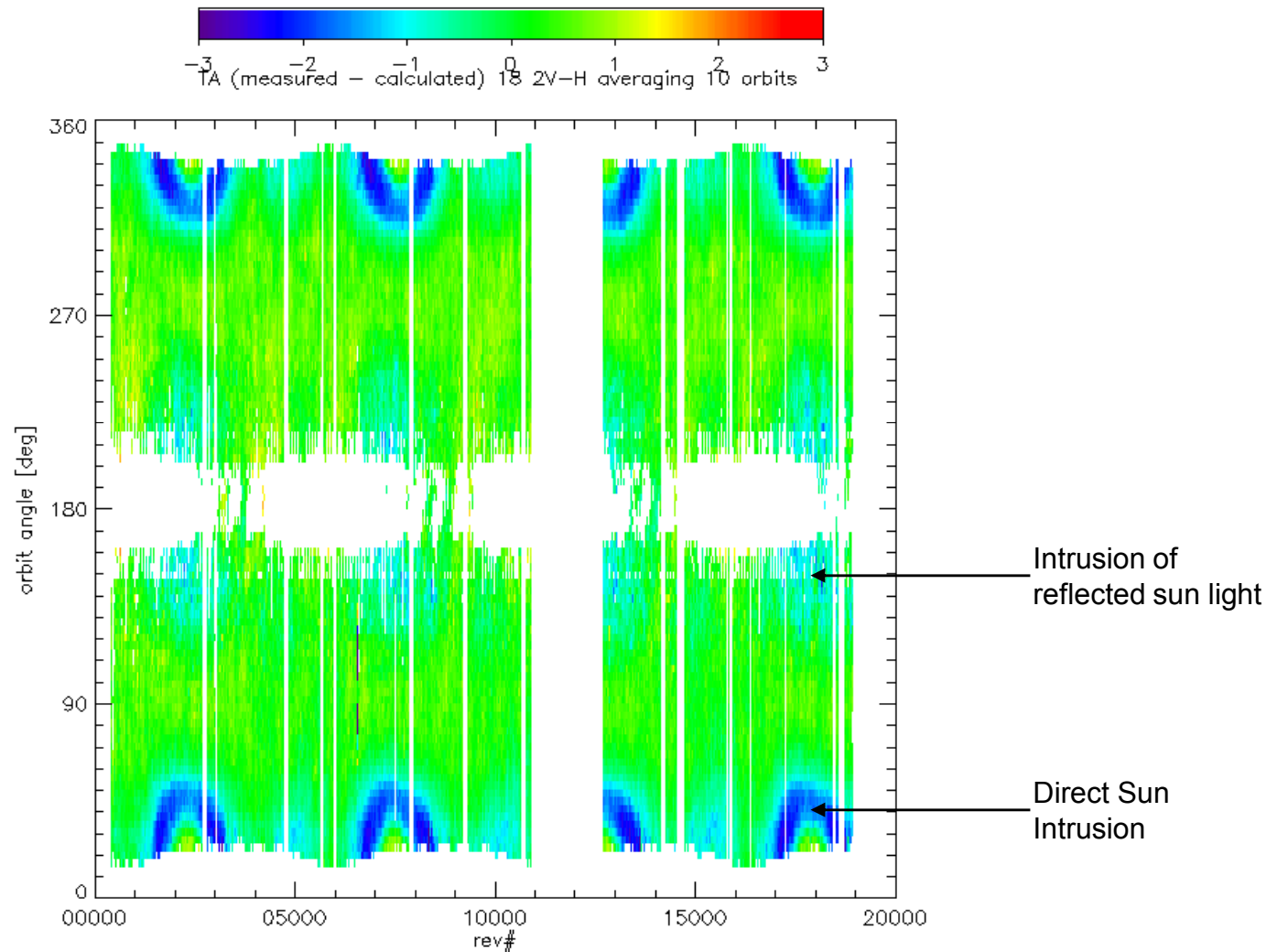
- Large Data Volumes
- Fully Polarimetric
- 11 Feedhorns– 22 channels
- 3 Scan lines (i.e., 3 nadir angles)
- Fore and Aft Looks
- Sun Intrusion in the Hot Load
- RFI, both in cold counts and earth counts

### True Assessment of Capabilities Requires A Rigorous Treatment of these Complexities

- Complex Algorithms
- High CPU and Memory Requirements  
32 Processors (3.5 GHz each), 64 GB RAM



## WindSat Hot Load Anomaly at 19 GHZ

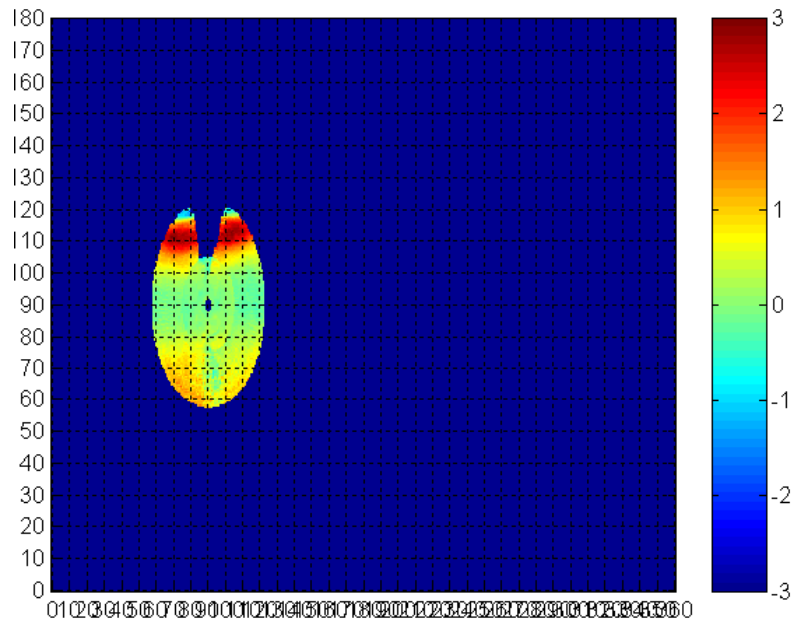


Measured minus simulated TA as function of time and orbit position

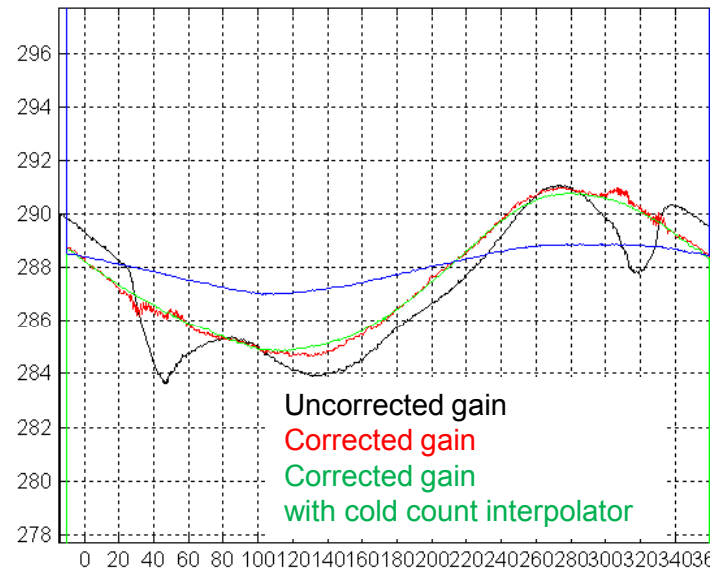




## WindSat Hot Load Anomaly at 19 GHZ, continued



Error in Reported Hot Load Temperature  
Versus Sun Zenith and Azimuth Angles



Effect of Correction to Radiometer Gain  
X-axis = orbit angle (0 deg = south pole)  
Y-axis = gain \* mean(hot-cold count)

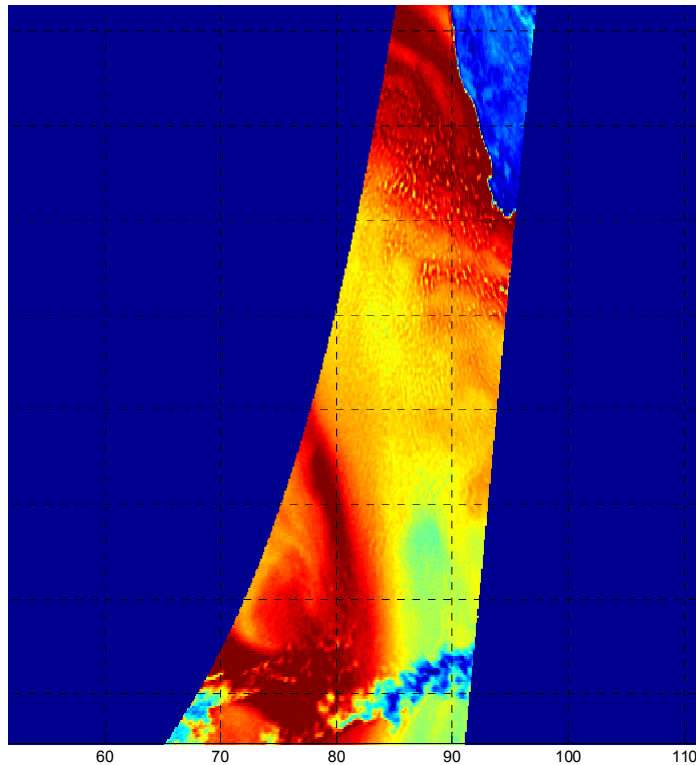


## Optimum Resampling for WindSat

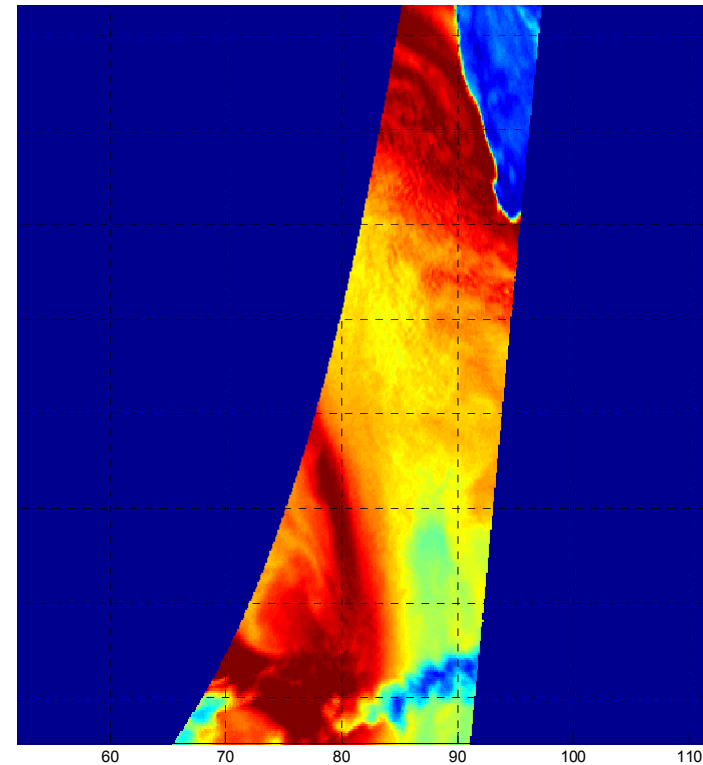
22 Channels: 11 separate feedhorns, each with two polarizations  
3 scan lines (i.e., 3 different incidence angles)  
Fore and Aft looks  
Resampling to swath reference target a nightmare (Earth rotation etc.)  
New Solution: Resample directly to a earth-fix grid (grid points every 1/8 deg)

**A problem requiring a lot of head beating:** Figures show 24 GHz minus 19 GHz TA off of Africa.

Using original NRL value for 24 GHz footprint size

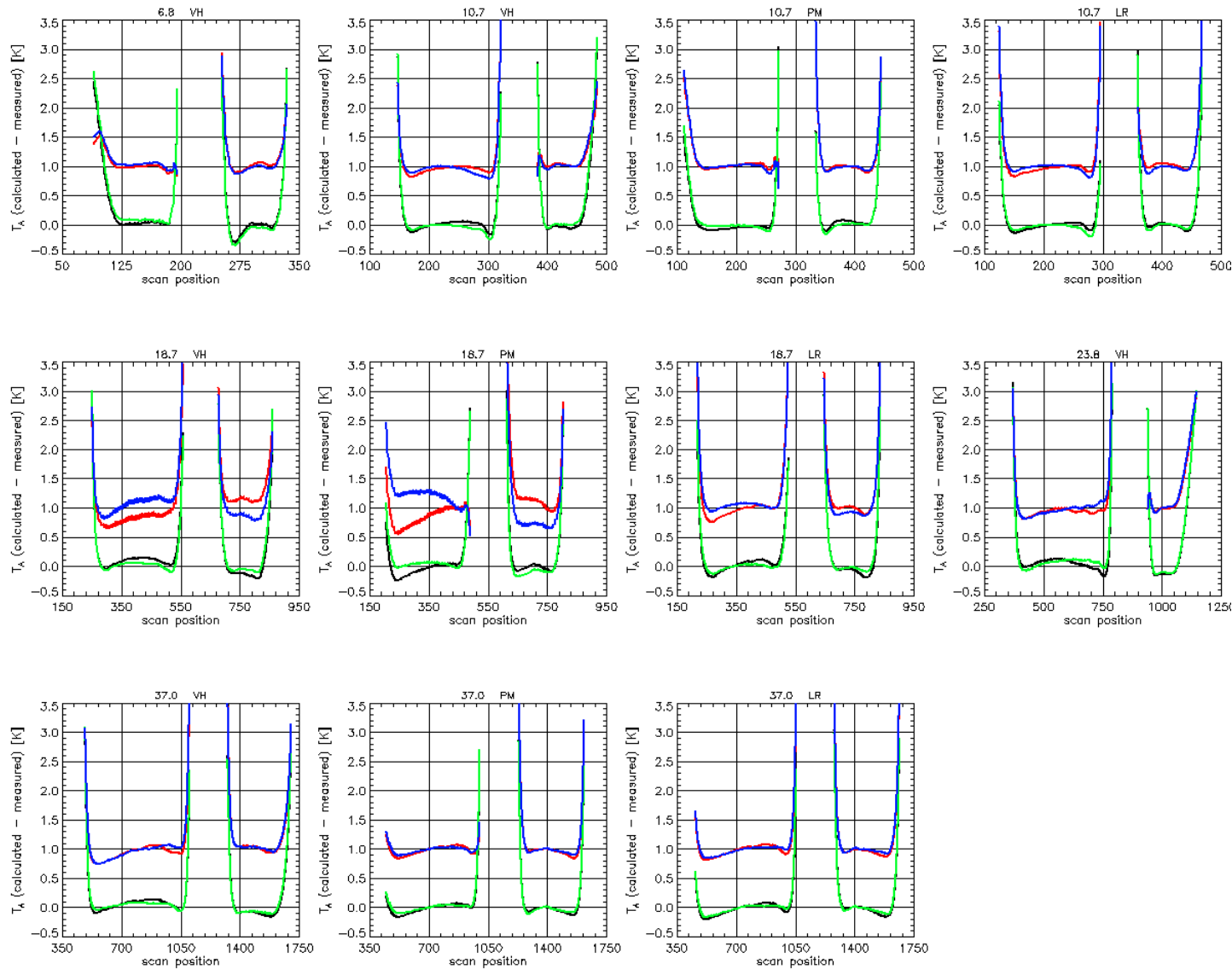


Using revised NRL value for 24 GHz footprint size





## Along-Scan Biases for WindSat's 22 Channels



WindSat: VH PM LR

ASC V P L (1<sup>st</sup> channel)

DSC V P L (1<sup>st</sup> channel)

ASC H M R (2<sup>nd</sup> channel)

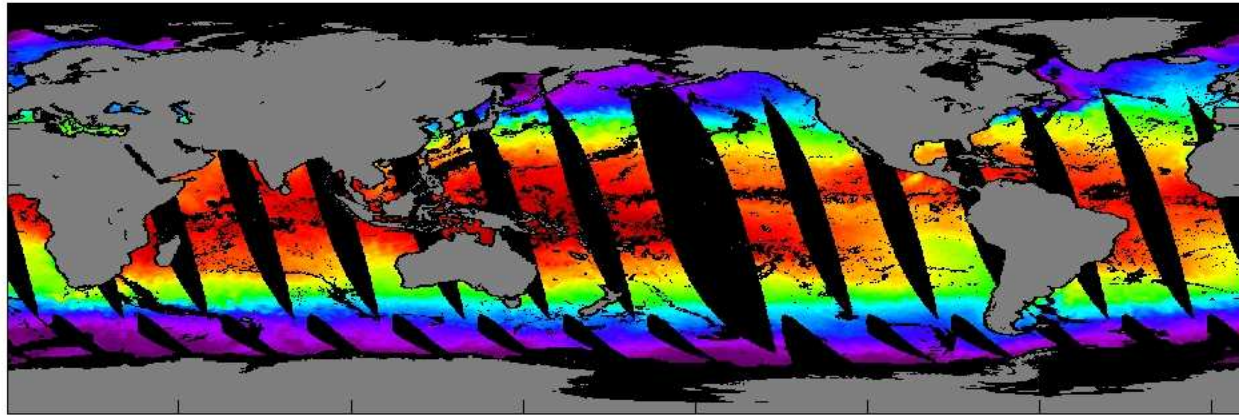
DSC H M R (2<sup>nd</sup> channel)

V P L curves are  
visually shifted by + 1 K



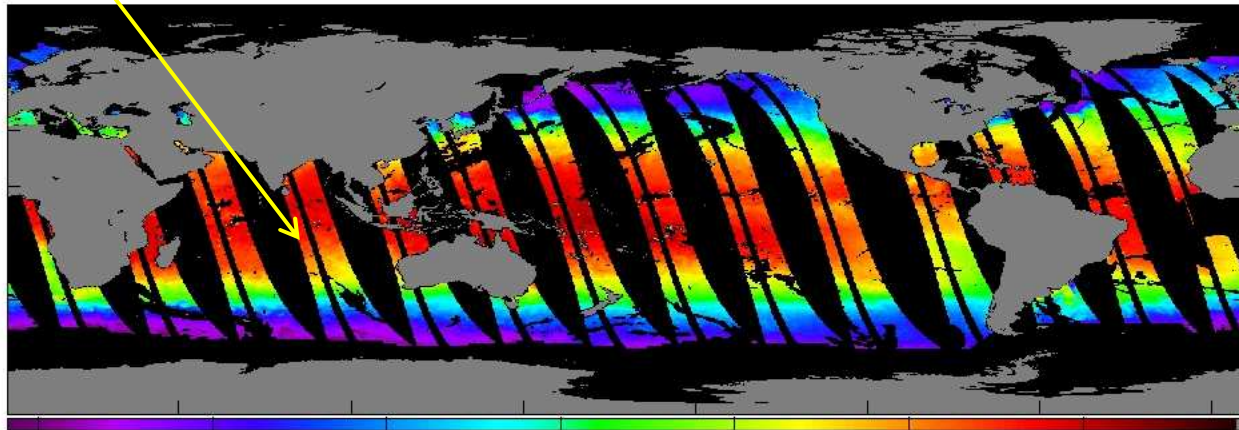
## Resampling and Along-Scan Correction Maximizes Swath Width

AMSR-E SST



Combining fore and aft obs. gives additional swath

WindSat SST





## Current Status

### Wind in Rain:

- Paper completed and is being submitted for publication
- Some final testing still needs to be done
- Implementation into standard RSS processing code

### Geophysical Model Function

- Initial phase (methodology and datasets) completed
- Expect new GMF early 2009
- Will be made available to all

### WindSat

- Ocean Data Set produced for 2003-2008  
(but has 24 GHz resampling problem)
- Currently reprocessing data
- New dataset should be available first quarter of 2009:
  - SST
  - Vector Wind
  - Water Vapor
  - Cloud Water
  - Rain