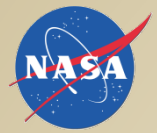


Remote Sensing Systems
www.remss.com

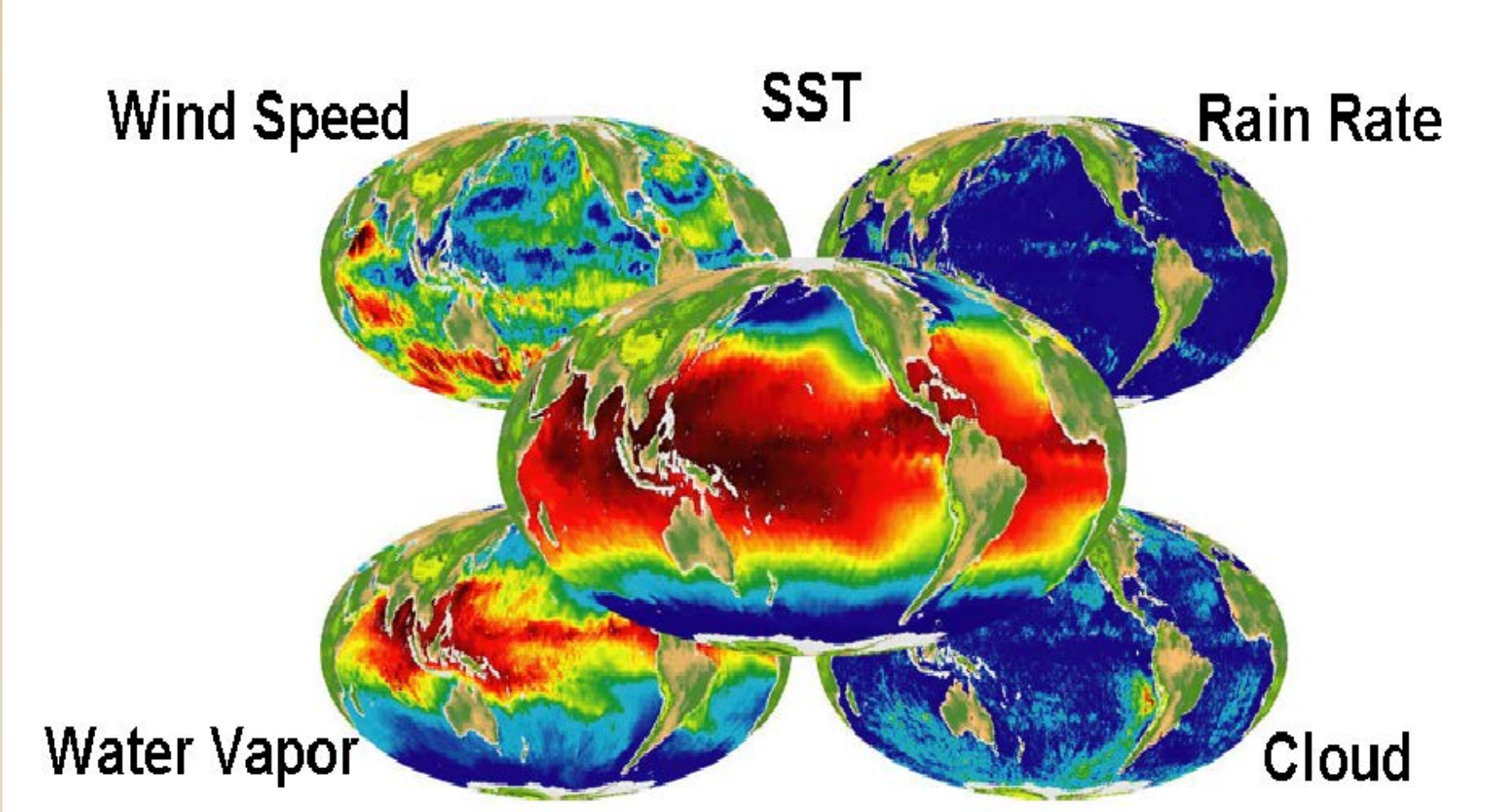
Communicating Satellite Microwave Ocean Product Errors to a Variety of Users

Deborah K Smith, Frank J. Wentz, Kyle Hilburn, Carl A. Mears
Remote Sensing Systems, Santa Rosa, CA

This research is support by NASA's Earth Science Division under the MEaSUREs Program

Presented at: AMS Annual Meeting, Seattle WA, January 27, 2011
Paper Number J8.5 in themed joint session "

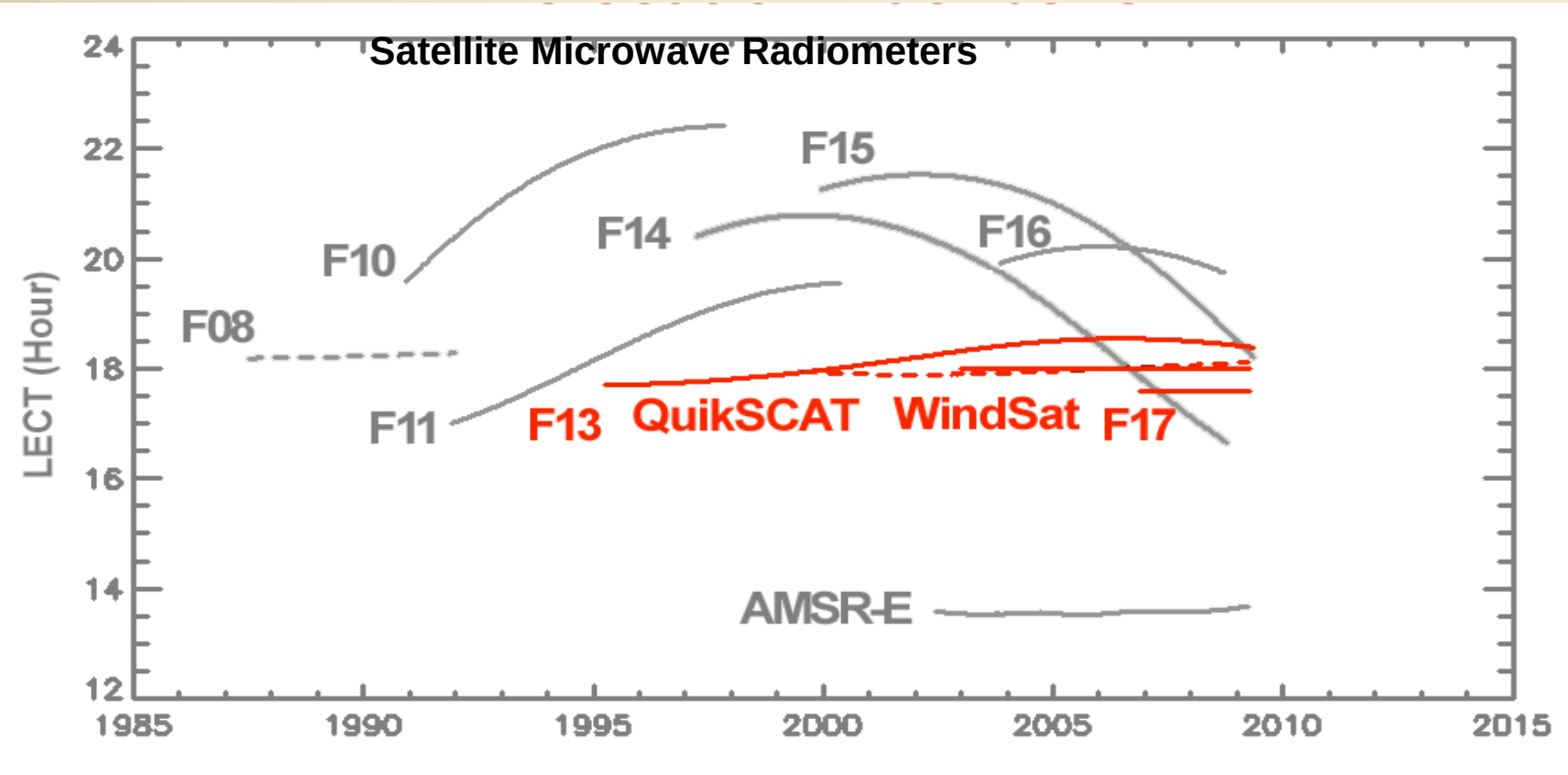
DISCOVER Provides Critical Environmental Parameters



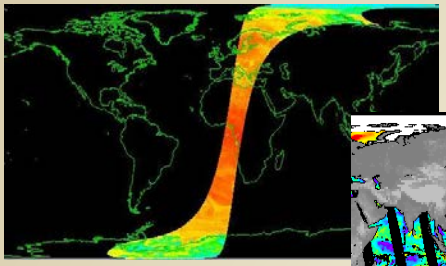
The Data

Remote Sensing Systems
www.remss.com

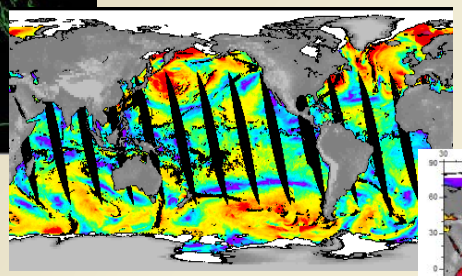
Volume: Nearly 100 satellite-years of observations from Microwave Radiometers.
Calibration: Each sensor has its own unique set of Sensor Calibration Problems
Precision: High precision required for Climate Studies



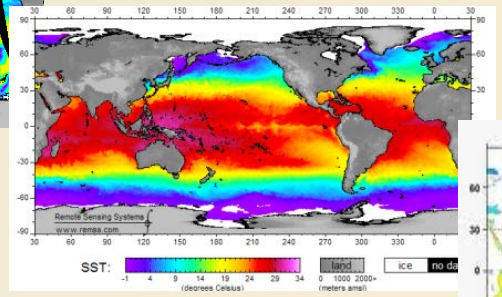
Products and Users



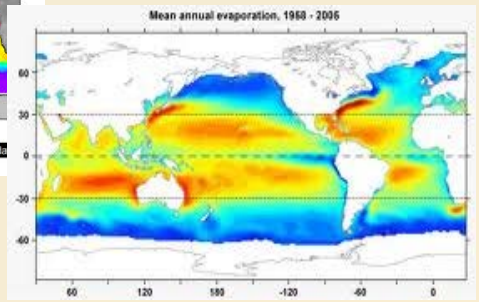
Brightness Temperatures



Gridded Data



Merged Data



Derived Products

- Instrument Scientists
- Modelers
- Redistributors
- Application/Regional Scientists
- Students
- Public

Traditional Approach to Error Assessment

A typical error is associated with each **type** of retrieval.

Error is based comparisons with in situ, other satellite retrievals, and numerical weather models.

For the AMSR-E ocean products, we have

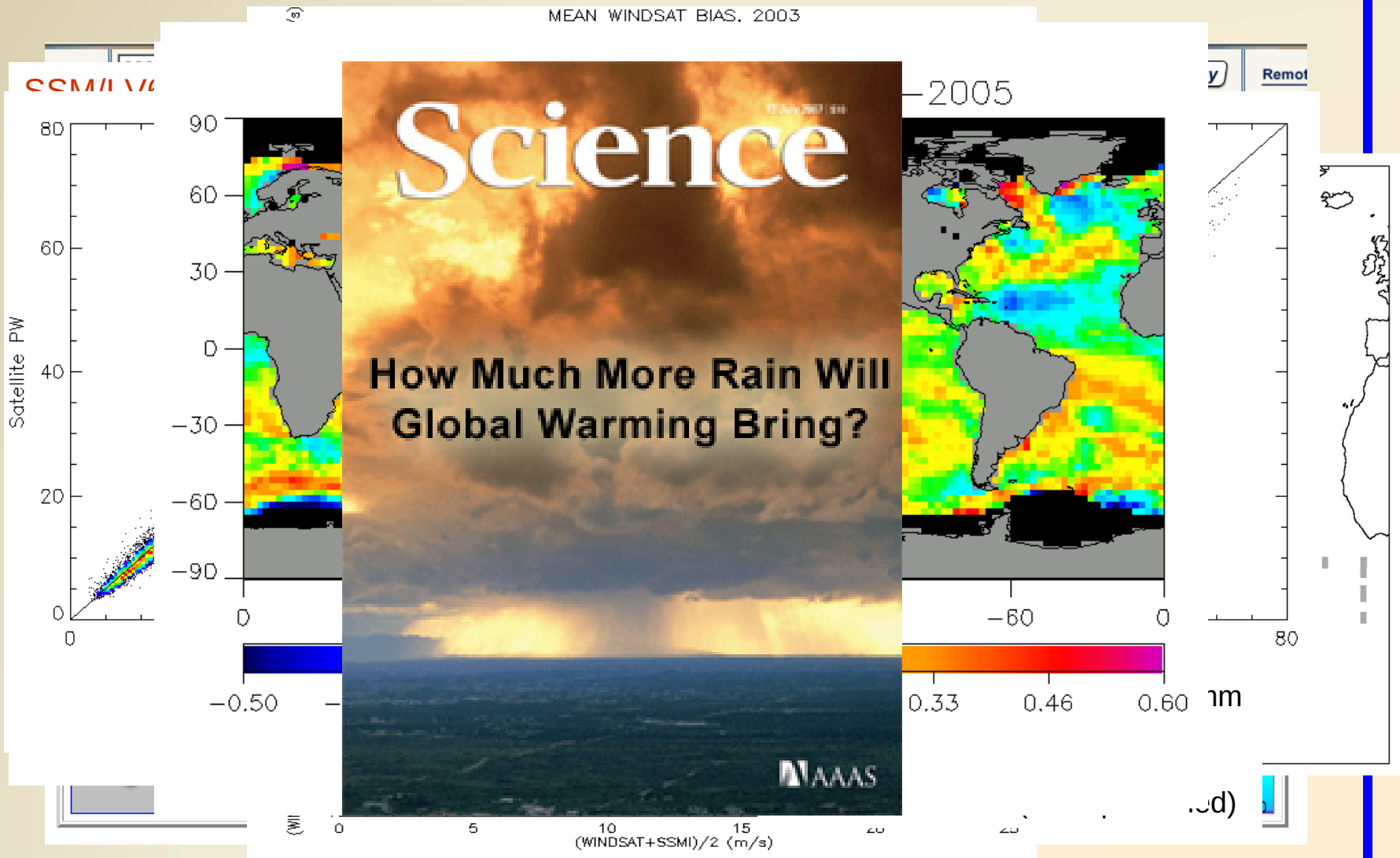
1. Moored ocean buoy measurements of SST and wind speed
2. Drifting buoys and floats measurements of SST
3. Radiosonde and GPS measurements of columnar water vapor
4. Satellite scatterometer wind retrievals
5. Satellite IR retrievals of cloud water and rain

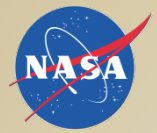
Errors are incorrectly assumed to be static and due to the instrument

Retrieval accuracy for the AMSR-E Ocean Products

Ocean Parameter	Spatial Resolution	ATBD Accuracy Requirement (Single Obs.)	Post-Launch Validation (Single Obs.)	Accuracy 3-day Average
Sea-surface temperature SST	56 km	0.5°C	0.5°C	0.25°C
Near-surface wind speed W	21 km	1 m/s	1.0 m/s	0.5 m/s
Columnar water vapor V	21 km	1 mm	1.6 mm	1 mm
Columnar cloud water L (no rain)	12 km	0.02 mm	0.02-0.04 mm	0.01 mm
Rain Rate	12 km		tbd	tbd

Error Information Currently Provided





Retrieval errors are NOT static.

They depend on:

- Environmental scene
- Regional anomalies
- Algorithm assumptions and deficiencies
- Choice of methods for constructing multi-decadal time series

They have spatial and temporal characteristics.

Some advanced Users want details, while more general Users do not.

As ***DATA PRODUCERS***, we are well situated to communicate data quality and error assessments to data users as we understand all the warts and bumps of our production process and have insight into all the contributing factors to the error budget.

But how do we more effectively communicate errors to each User group?

Unique Challenges of Satellite Data

Mis-specification of pointing geometry

Satellite attitude problems, orbital drift/decay

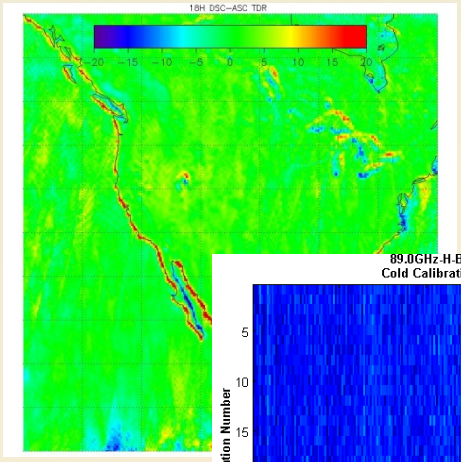
Emissive antenna

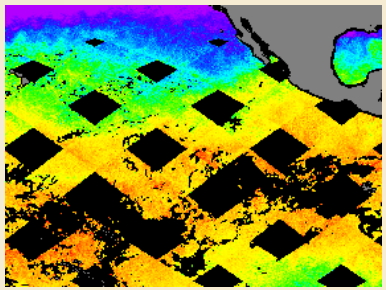
Gradients in the hot load, moon reflection in cold mirror

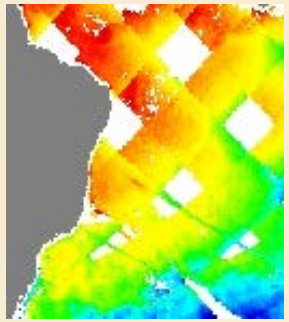
Radio Frequency Interference reflected off sea surface

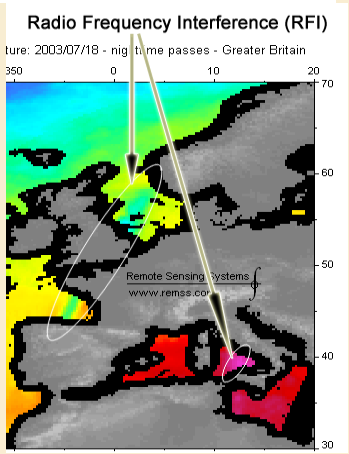
Sun glitter on the sea surface

Cross-scan biases





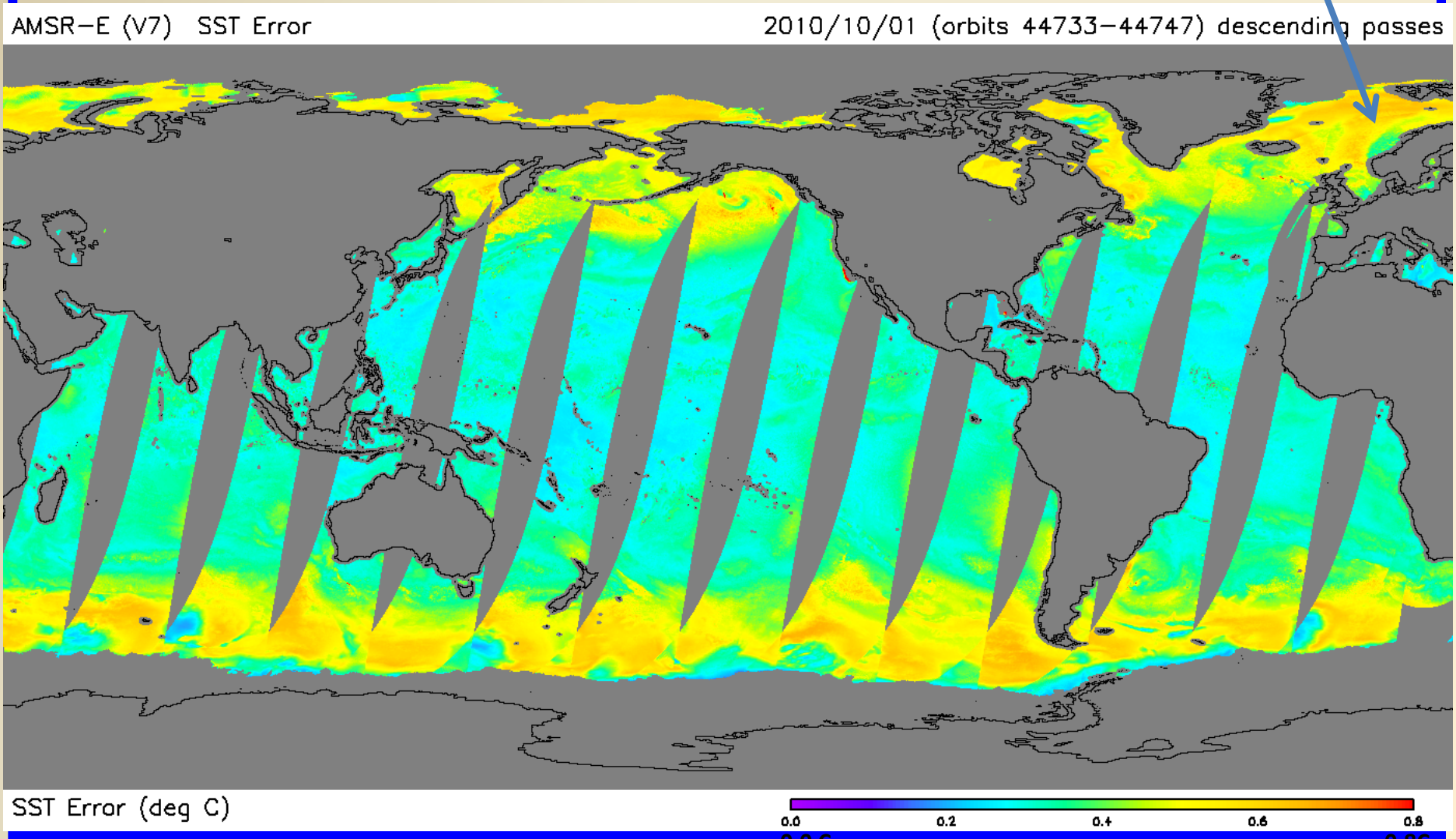




SST Retrieval Error

Remote Sensing Systems
www.remss.com

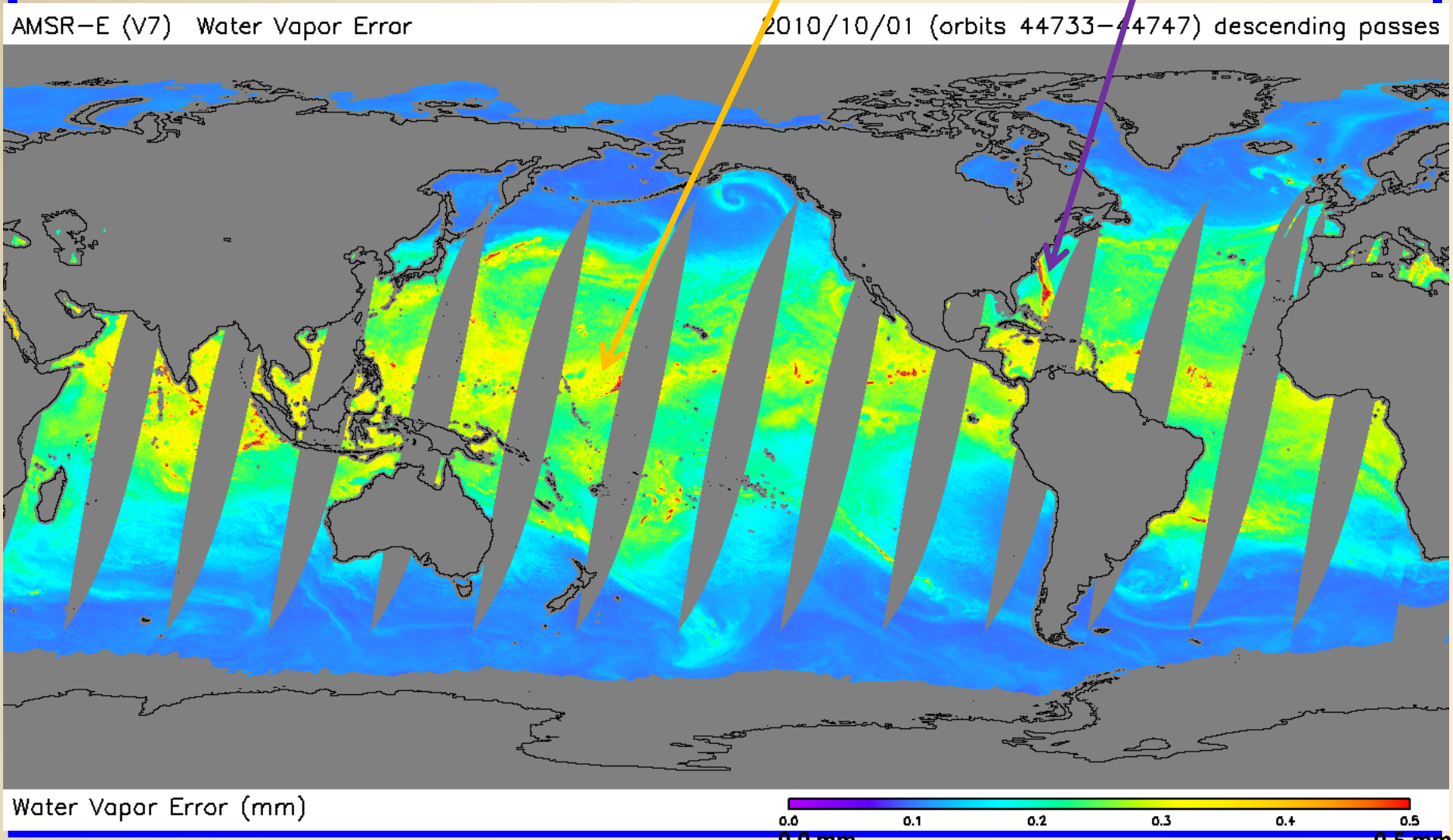
SST derived from 11-37 GHz channels (no 7 GHz). Sensitivity diminishes in cold water



Water Vapor Retrieval Error

Remote Sensing Systems
www.remss.com

Sensitivity diminishes in very moist air and also in heavy rain.



Retrieval Error Due to Anomalous Regional Effects

Some of the Anomalous Regional Effects that Degrade Accuracy

1. Proximity to land or sea ice
2. Solar radiation reflecting off the sea surface (sun glitter)
3. Radio frequency interference (RFI) often due to satellite TV signals
4. Rain

Can these effects be automatically detected by monitoring the difference between the measurements and the ocean radiative transfer model (RTM) ?

$$\Delta T_{Bi} = T_{Bi} - RTM\left(T_S, W, V, L, R\right)$$

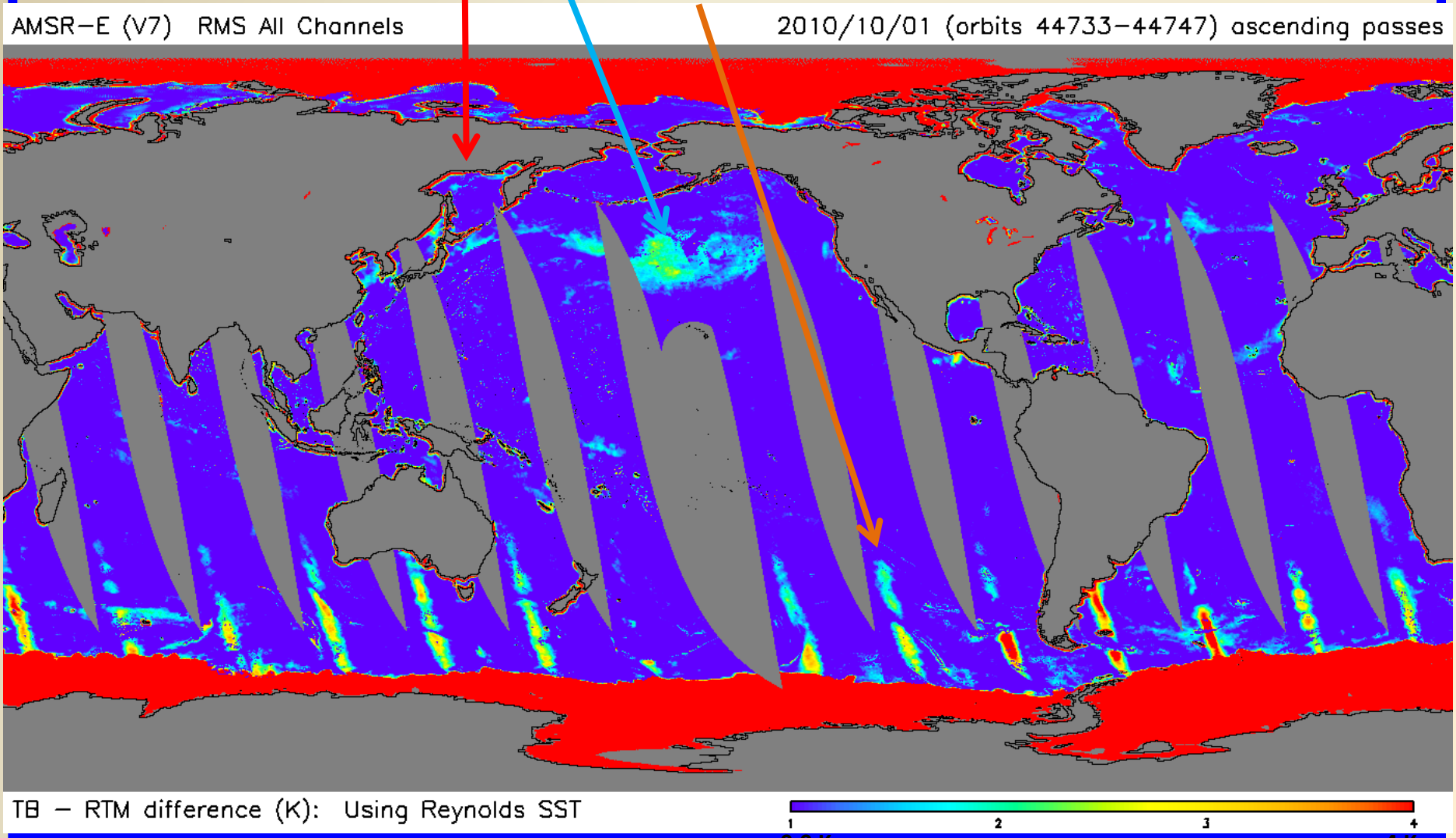
Retrievals: SST, wind, vapor, cloud, and rain

Chi-Squared Test: $$\chi^2 = \sum_{n=1}^{10} \frac{\Delta T_{Bi}^2}{\sigma_i^2}$$

Chi-Squared Detection of Coast, Rain, and Sun Glitter

Remote Sensing Systems
www.remss.com

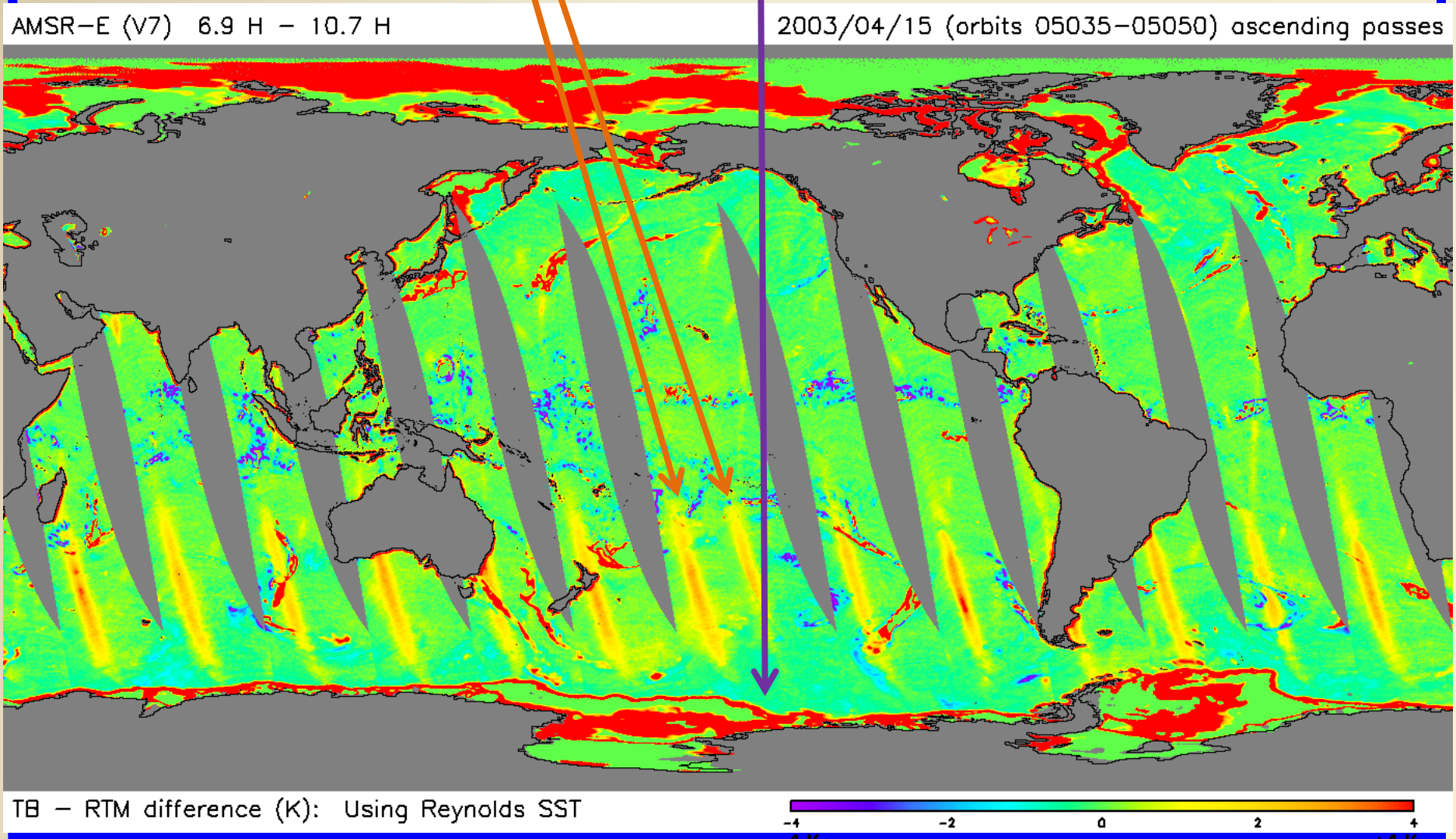
Land, Rain and Sun Glitter Detected



Difference Detection of Sun Glitter and Sea Ice: ΔTB_7H minus ΔTB_11H

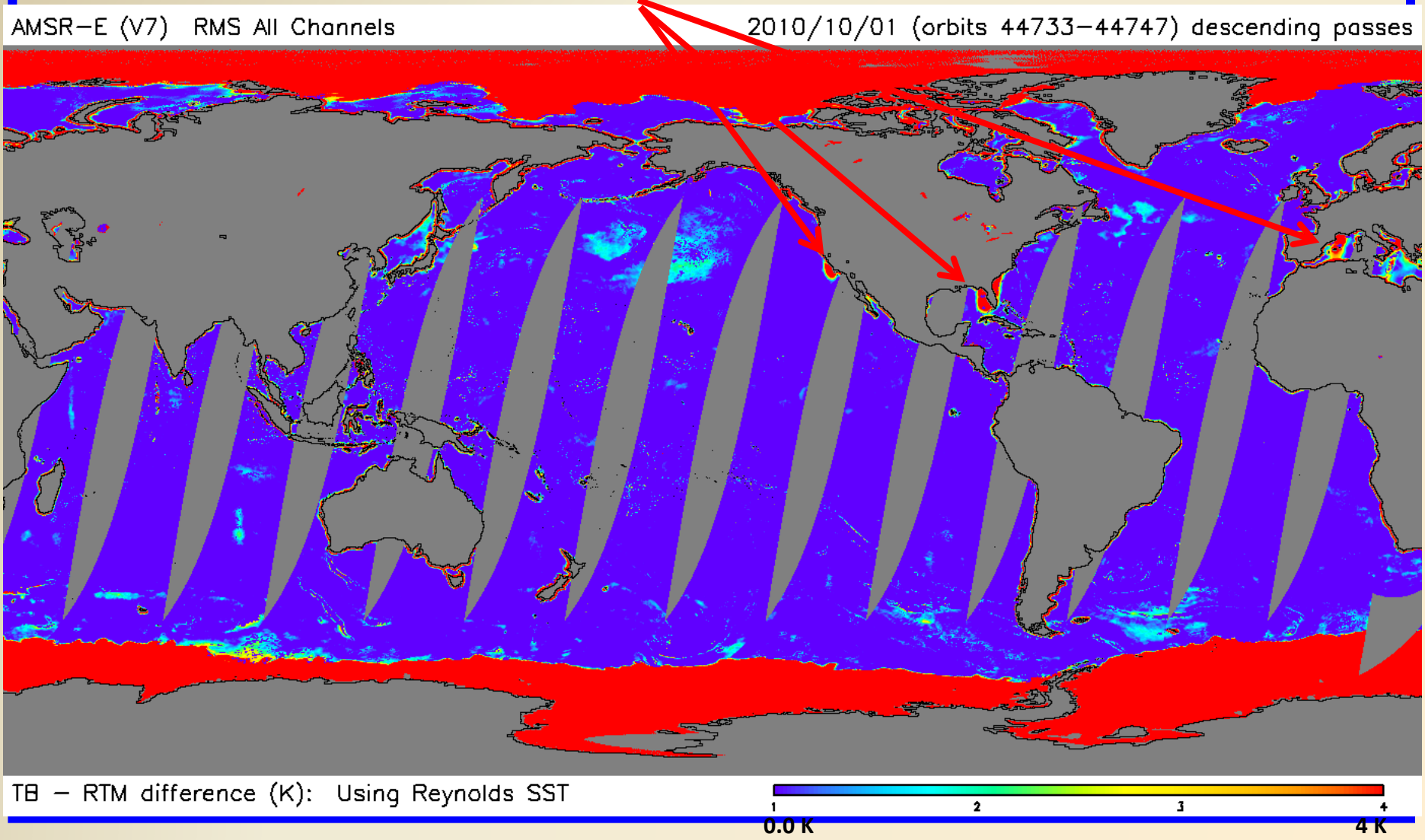
Remote Sensing Systems
www.remss.com

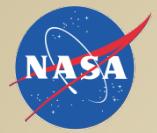
Sun Glitter and Sea-Ice Edge Detected



Chi-Squared Detection of Radio Frequency Interference

Remote Sensing Systems
www.remss.com





Errors in Microwave Products

Calibration Errors
Algorithm Sensitivity Errors
Measurement Noise Errors

Validation Source Errors
Differences between insitu data and instrument observations (mismatch)

Contamination Effects (RFI, Land, Ice)
Geophysical Effects

Errors Inherent in Supplemental Data Required for processing

Overall Error Determined By Validation

Future Plans

We will continue providing our Users with validation results, access to publications, plots of parameter differences.

We are developing an automated means for determining error for a given 0.25 deg grid cell using Monte Carlo simulations and knowledge derived from previous validations, understanding of the instrument, and error budgeting.

Those Users needing to access only high quality data will have a simple means to locate it. Those Users needing more error information to use in determining which data they want to use, will have error maps.

Parting Thoughts

It is difficult to satisfy all our Users needs through one product/ set of products.

Do we resort to multiple products or do we limit what information is included?

We have decided to add the error layer to our data files providing means for Users to access error information we obtain as part of our routine analysis.

We expect this process will involve iterations between User groups as we discover how they use the information.

Contact For More Information

www.remss.com

support@remss.com