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With contributions from many others –
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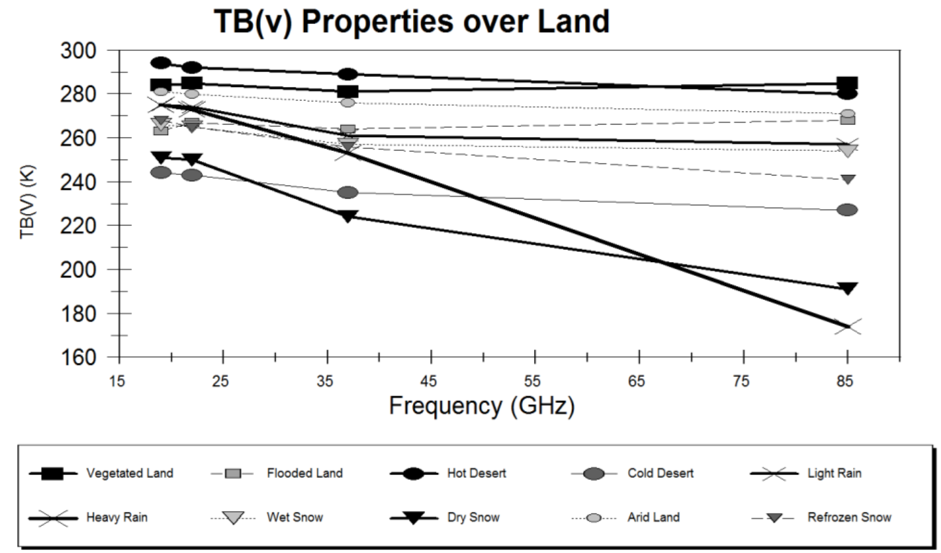
THE IMPORTANCE OF AND USE OF SNOW PRODUCTS IN PRECIPITATION RETRIEVALS

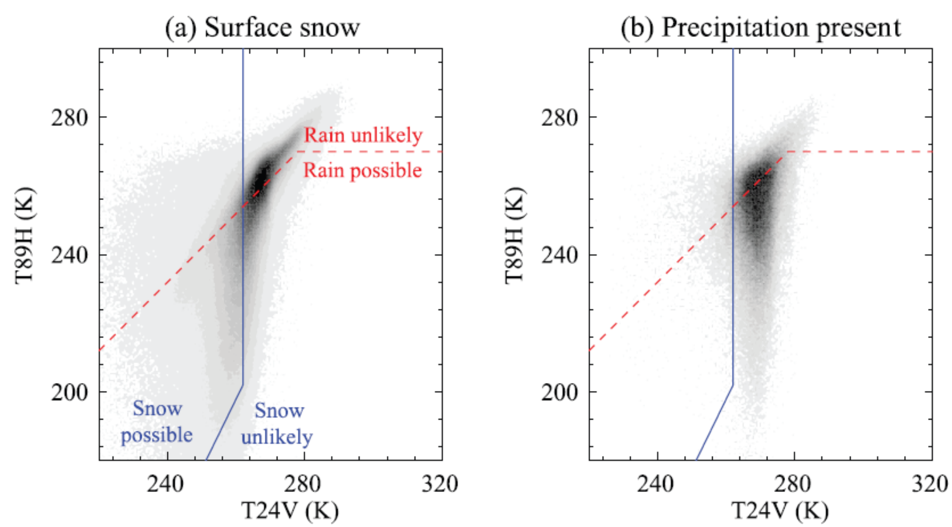
OUTLINE

- Scientific Issue
- Historical perspective
- Current status
- What was requested and done for NASA
- Impacts
- What are future plans for GCOM precipitation EDR at NOAA

Scientific Issue

- Precipitation has a similar signal to surface snow and arid surfaces in the microwave spectrum
  - Also impacted by diurnal variations
- Many measurements are correlated, so not enough unique information to separate **all signals all of the time**
  - Impact of misclassification can be quite dramatic (next slide)



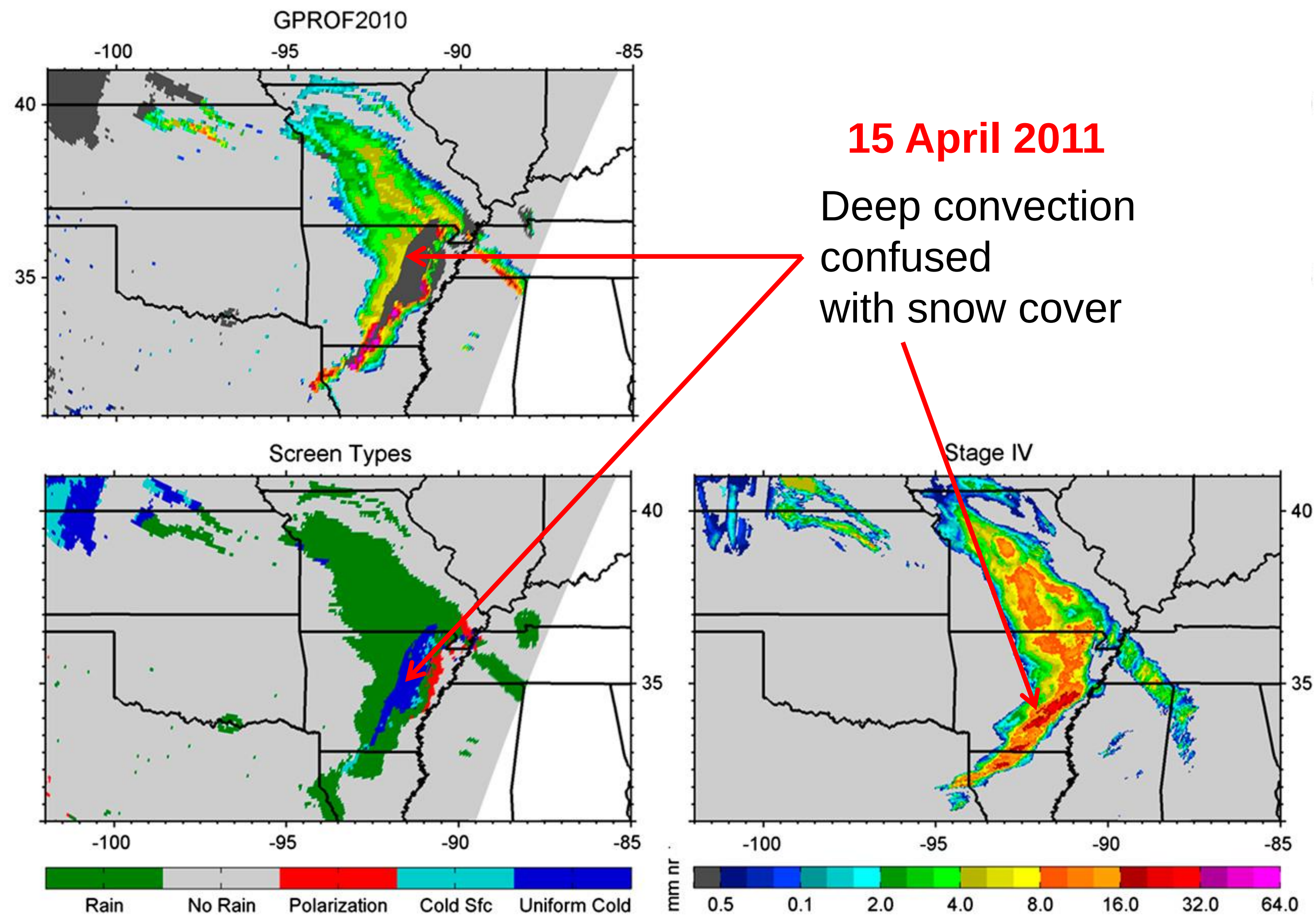


Meyers and Ferraro, 2015 – AMSR-2

![JPSS NOAA NASA]

Example of Misclassification using radiometric screening

Meyers et al 2015 – AMSR-2



Historical Perspective

Grody 1991 - SSMI

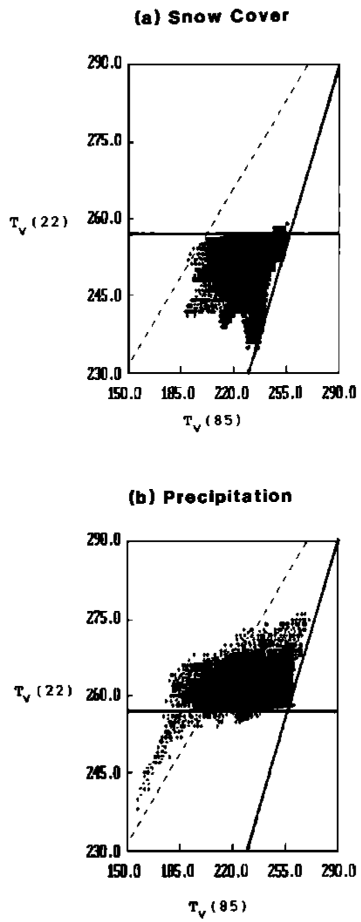
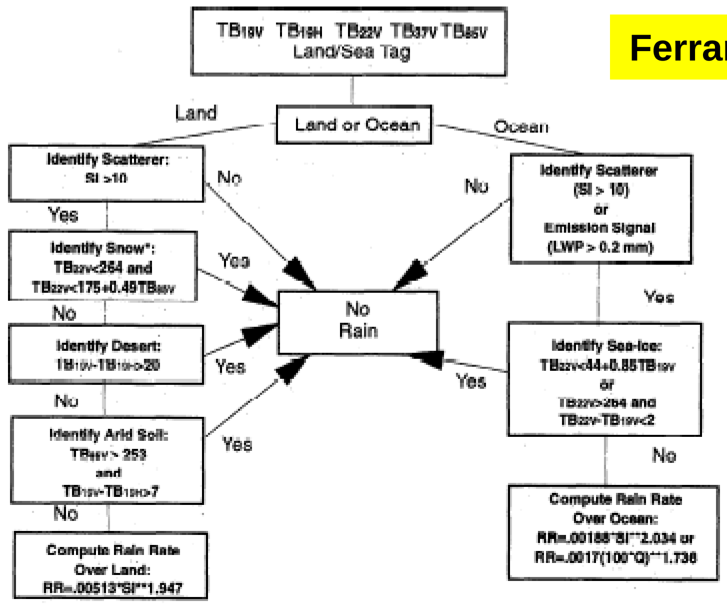


Fig. 5. SSMI measurements at 22 GHz plotted against the 85-GHz vertically polarized measurements for (*a*) snow cover and (*b*) precipitation over land. The dashed sloping line is given by equation (3*b*), and the horizontal line is given by equation (3*a*) of the text. Also shown is the line of perfect agreement.

- Restricted to just MW satellite data and static data bases – stove pipes, lack of data interoperability, etc.

- Need for simple approaches for operational use – shared computer resources, etc.

Ferraro 1997 - SSMI



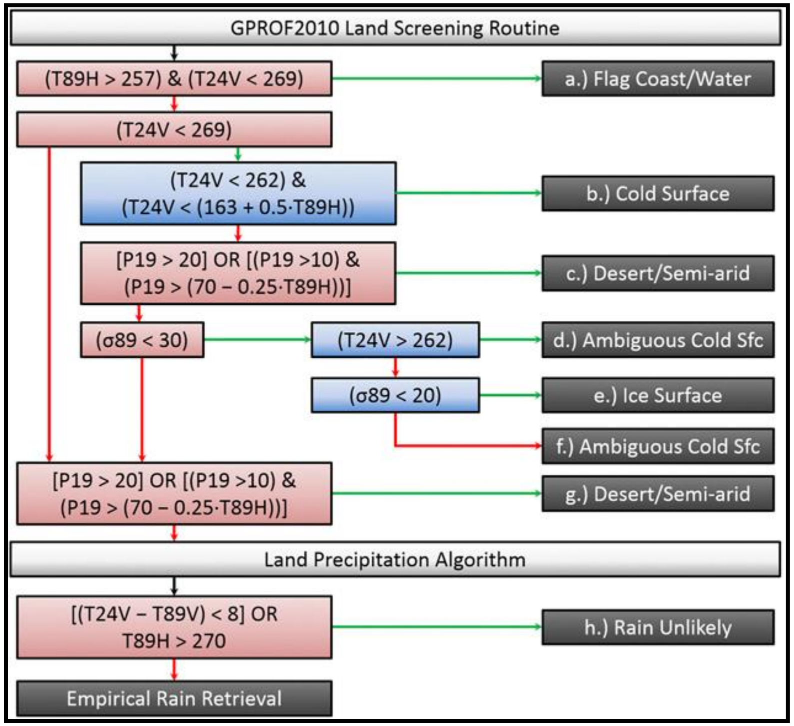
* An additional check is made for refrozen snow when for the following regions: January-March [Latitudes 25-90], April-May [Latitudes 40-90], June [Latitudes 60-90]

Refrozen snow is flagged if SI<60 and 264≤TB(22V)≤268

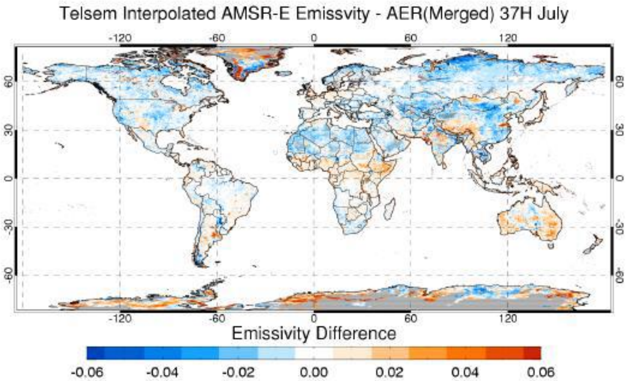
Incremental Progress & Paradigm Shift

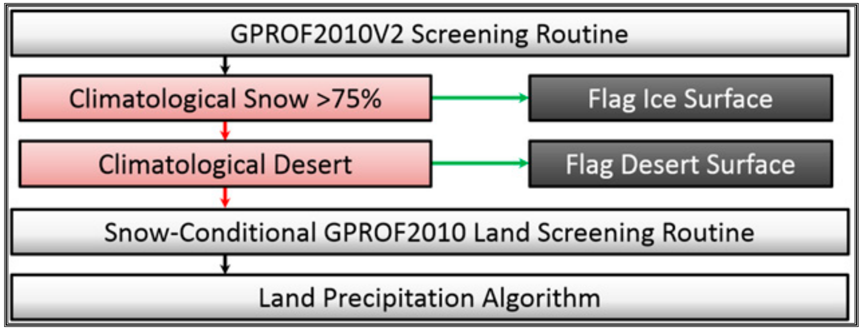
- Additional MW sensors followed SSM/I
  - Better spatial resolution
  - MW sounders/additional channels
  - Better ability to separate surfaces
- Access to other real-time, dynamic data sources become a reality
  - NWP model fields
  - Other satellite and in-situ data
  - Climatological data sets
- Physical retrievals developed and now feasible for operational use
  - Leverage off of other disciplines
    - Land sfc. Emissivty (TELSEM)
    - RTM community (RTTOVS, CRTM)
  - Examples – GPROF, MiRS

Meyers et al 2015 – AMSR-2

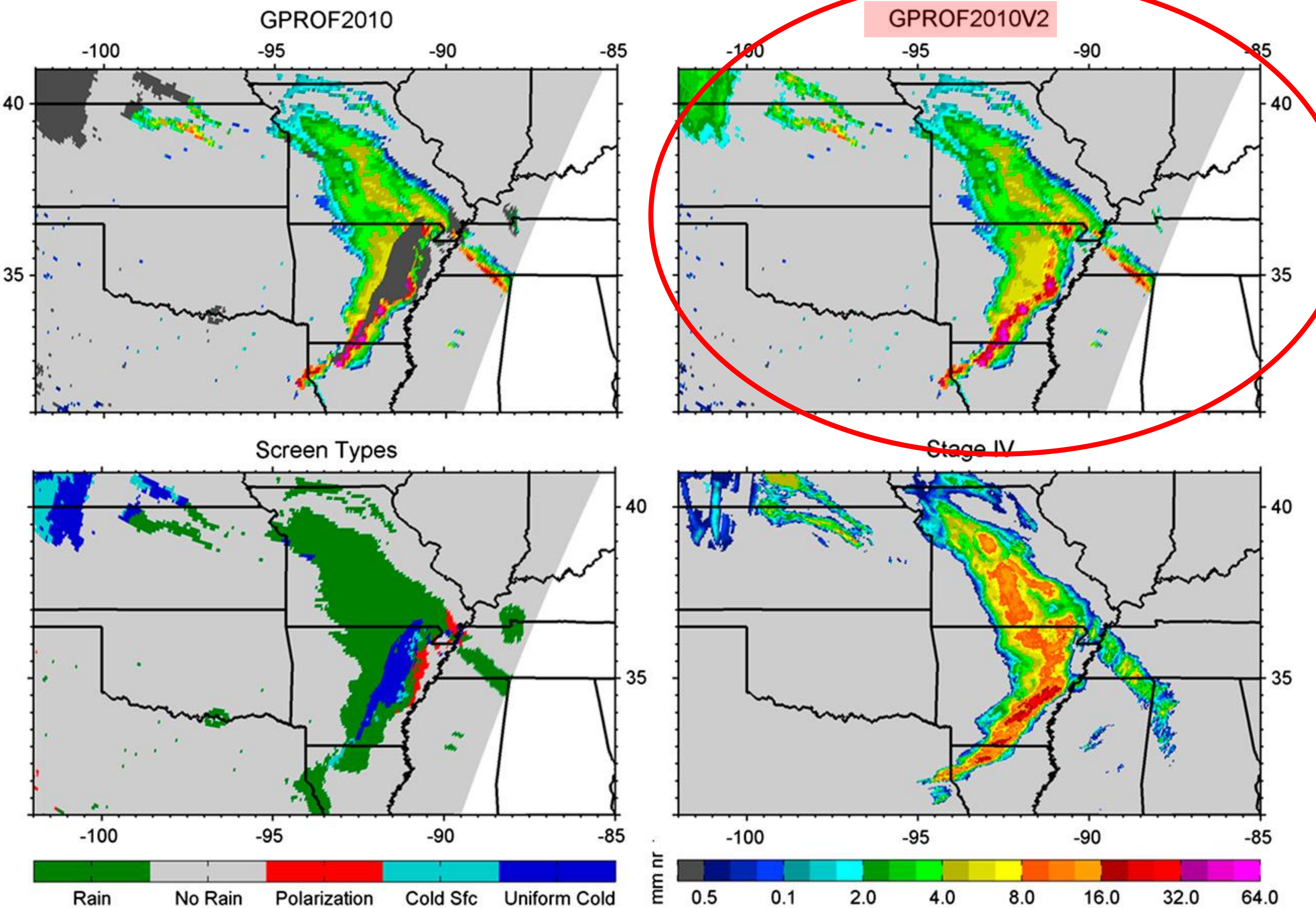


Aires et al 2011 – AMSR-E





Impact of using climatology

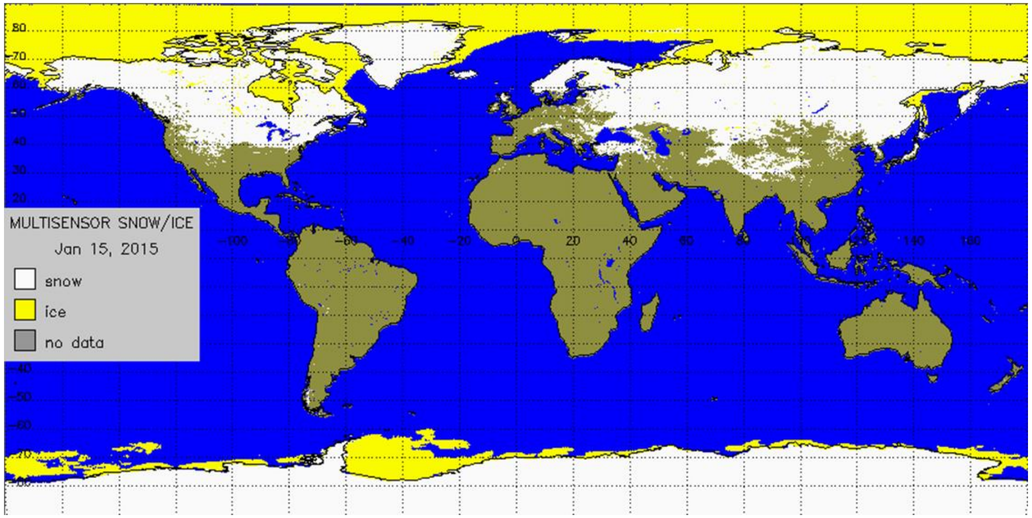


Current Status/Needs by NASA and Community

Via Peter Romanov

- A global, high resolution daily snow cover field for as long as a time period as possible – back to 1998/TRMM era

- The best NOAA candidate – The Global Multisensor Automated Snow/Ice (GMASI-Autosnow) Mapping System
  - Produces daily spatially-continuous (gap-free) global snow/ice cover maps ~4 km for use in operational applications
  - Synergy of satellite snow/ice retrievals from observations in the Vis/IR and passive microwave
  - Operational since 2006….



Autosnow Reprocessing: Sensors used

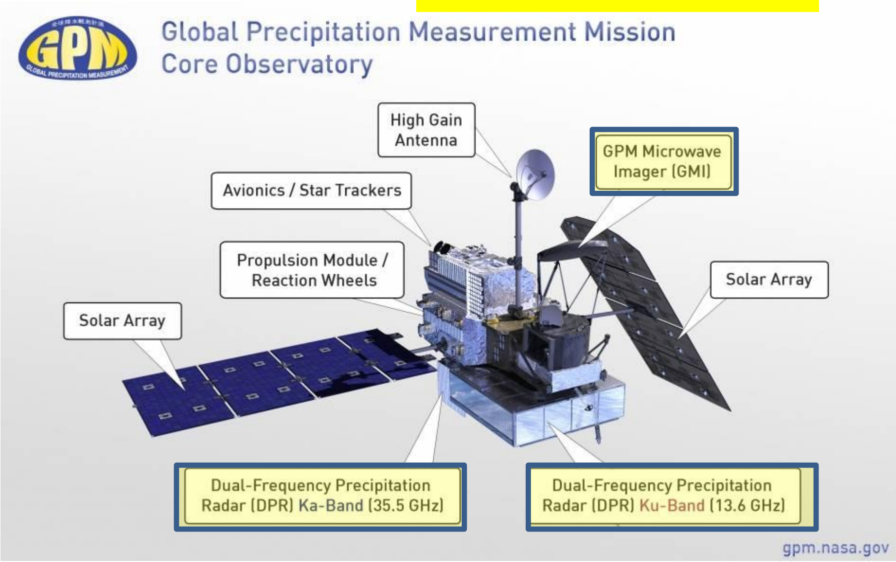
Year	Primary AVHRR carrier	Number of SSMI(S)	F-11	F-13	F-14	F-15	F-16	F-17	F-18	F-19
1998	NOAA-14	3								
1999		3								
2000		3								
2001	NOAA-16	3								
2002	NOAA-17	3								
2003		3								
2004		3								
2005		3								
2006		4								
2007	METOP-A	4								
2008		4								
2009		4								
2010		3								
2011		4								
2012		4								
2013		4								
2014		4								
2015		5								
2016		5								
2017		4								

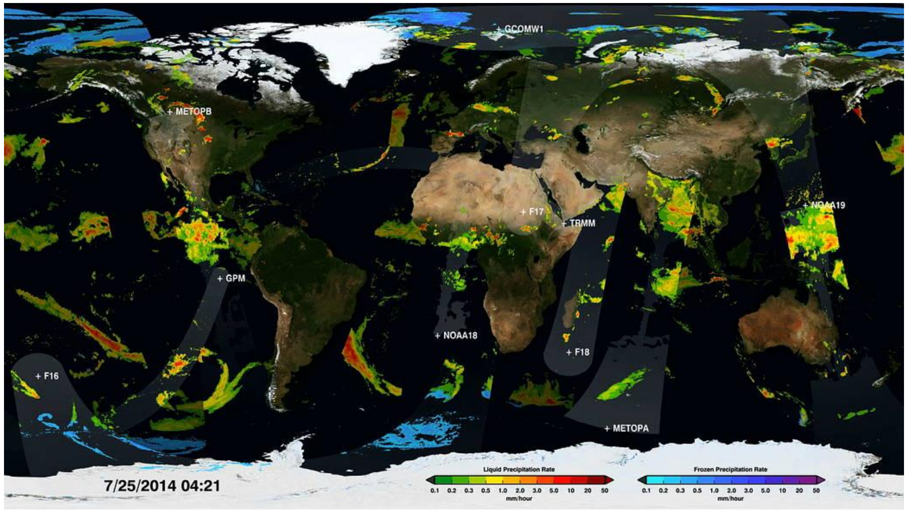
Many thanks to CREST for supporting this activity!

Which NASA Products use the Autosnow?

Via Erich Stocker/GSFC

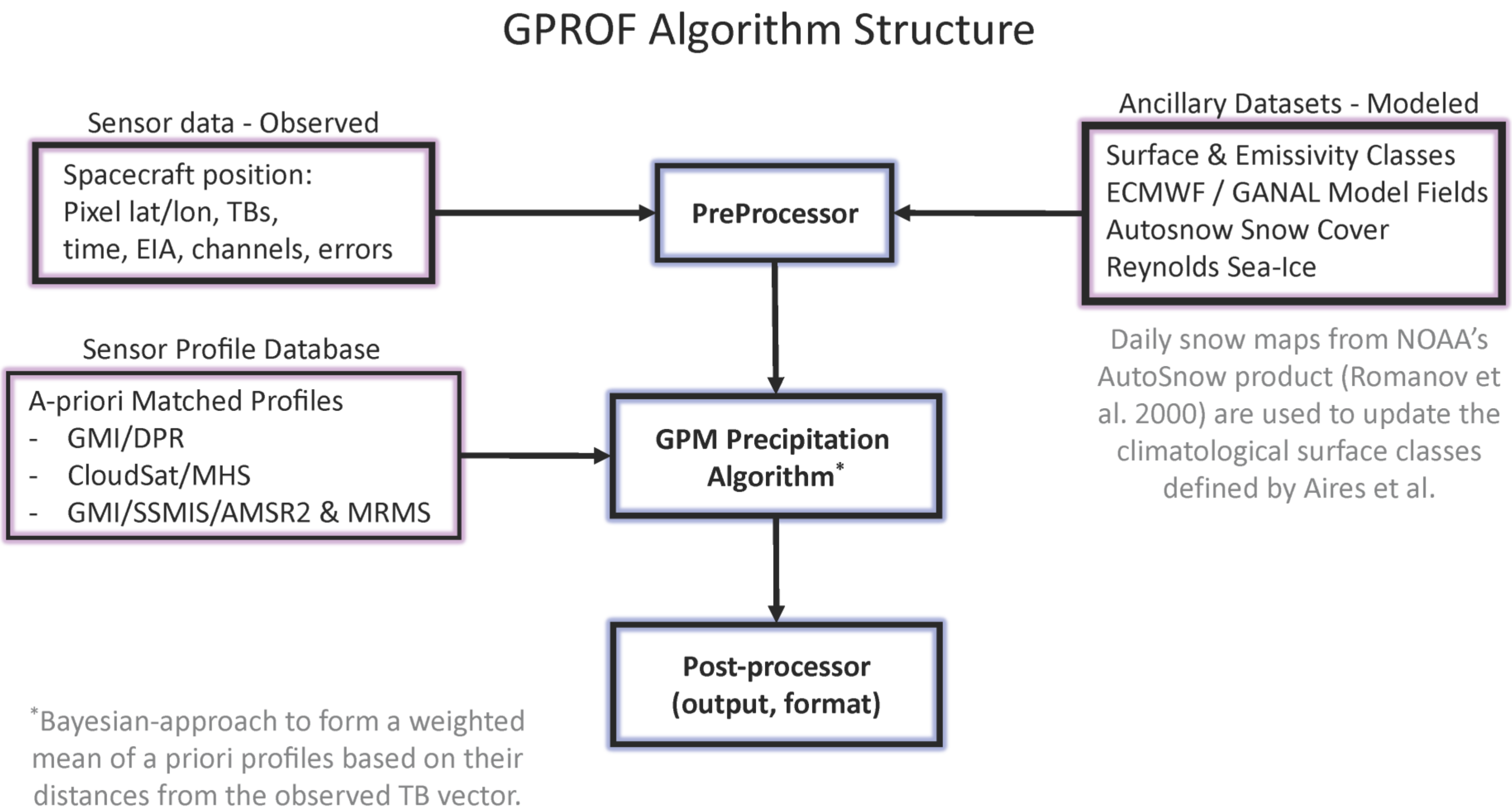
- All **GPM** GPROF (GMI, AMSR2, SSMIS, MHS, ATMS) use the autosnow product to produce the retrievals
- **GPM** Radar L2 Ku/Ka/DPR uses the autosnow data for retrieval and stored in ENV file.
- Combined **GPM** GMI/DPR L2 uses the autosnow information that the radar L2 put into the ENV file
- **GPM** IMERG half-hourly uses the autosnow file for its retrievals.
- **TRMM** PR/Ku does not use autosnow files but the **TRMM** TMI GPROF retrievals do use the autosnow.



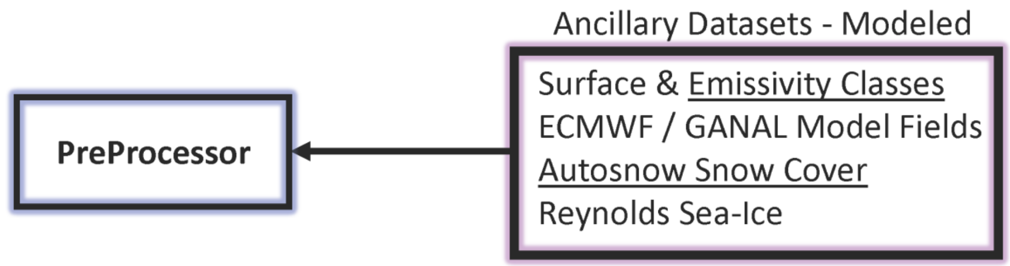


GPROF Algorithm Structure

Via Veljko Petkovic



Snow surface type in GPROF Algorithm

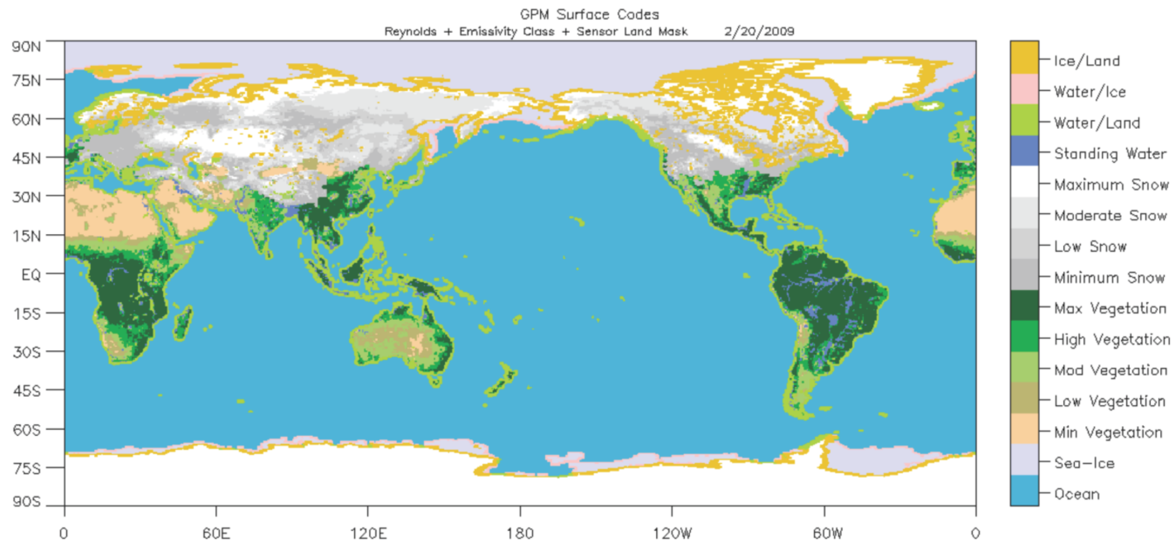


Step 1 in preprocessor:

- Emissivity Class from TELSEM – monthly climatology
- Four snow categories (min, low, moderate, max)

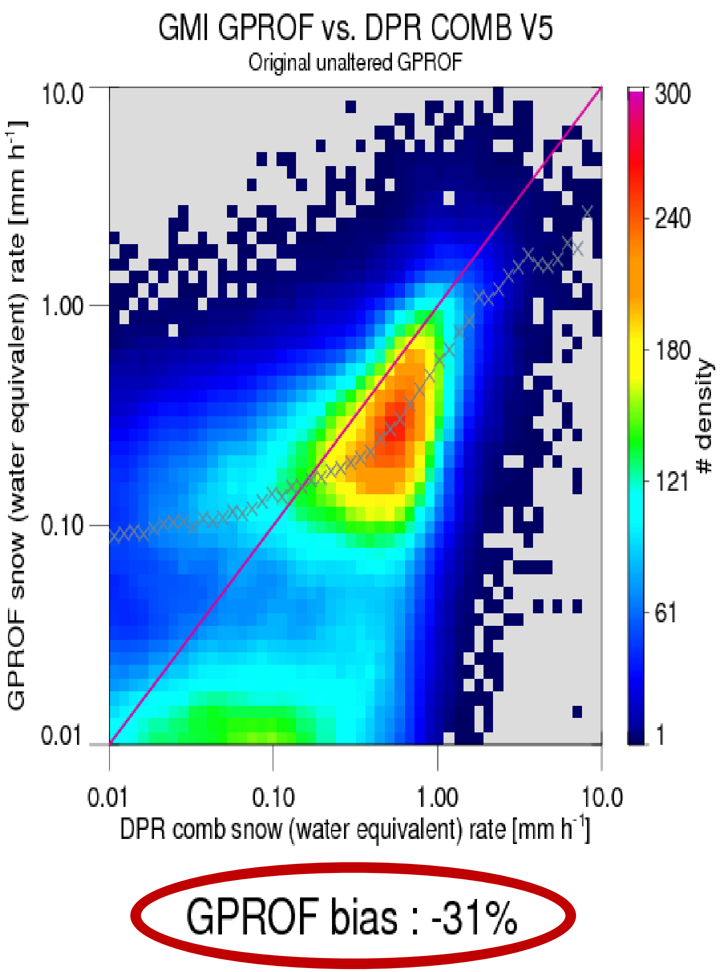
Step 2 in preprocessor:

- Autosnow Snow Cover
- TELSEM category is adjusted to match Autosnow product
- If TELSEM snow is to be removed, the closest (in time) non-snow surface type for a given pixel is assigned



Effect of adding Autosnow surface type information to the Bayesian averaging

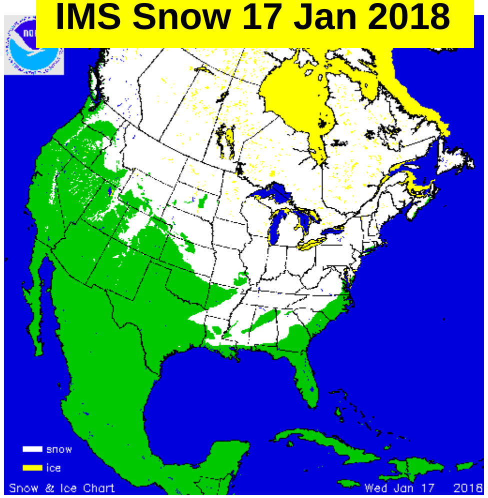
- Operational PPS GPROF V5 precipitation retrieval using both monthly TELSEM climatology and daily Autosnow surface type information.
- In the plot: snowing pixels only; globally; over land; October – April 2017.
- Overall bias: -31 %
- When Autosnow is **EXCLUDED**, bias increases by 15% (to -35%)



Via Pat Meyers

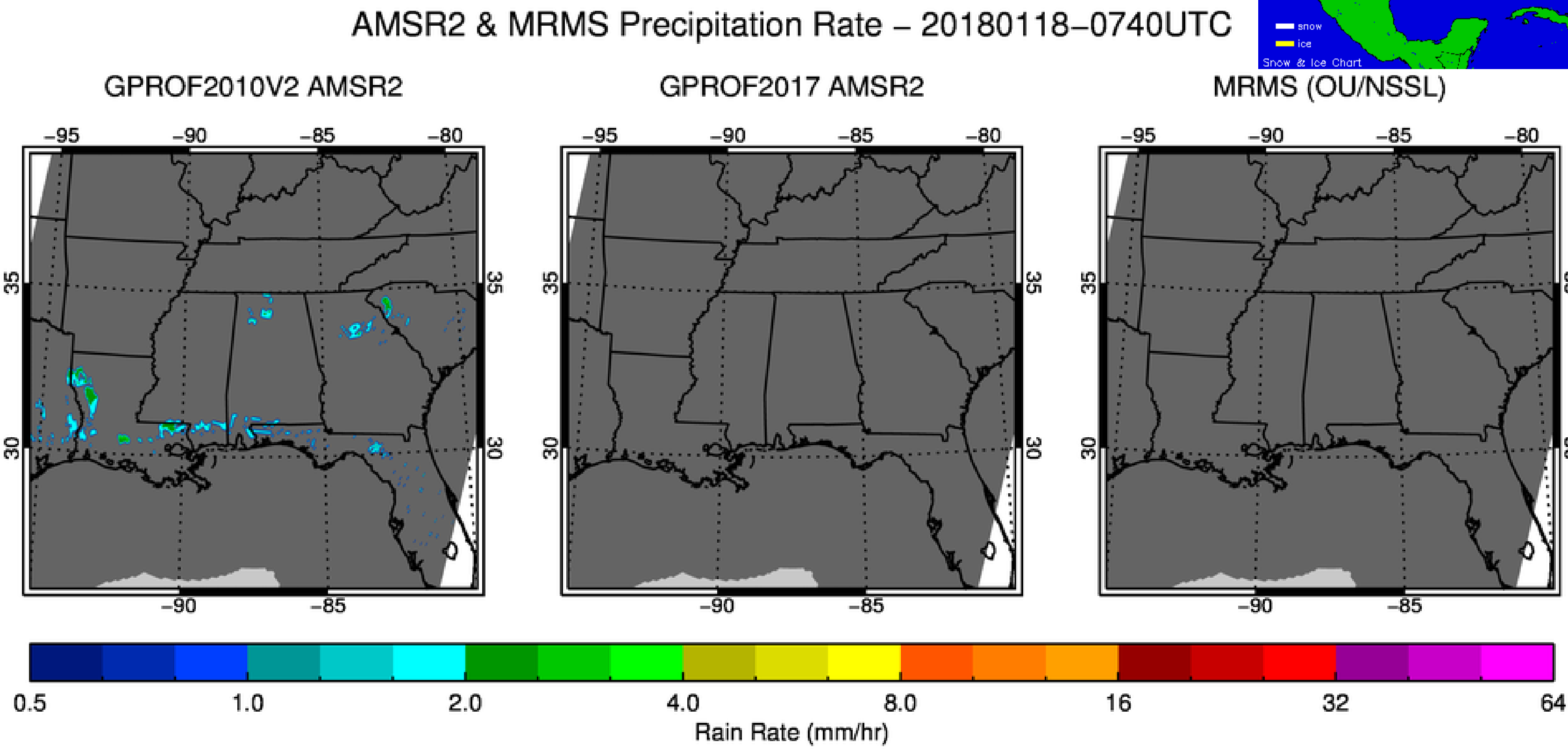
Example of current NOAA GCOM vs. GPM GCOM

IMS Snow 17 Jan 2018



False rain retrievals due to confusion with snow on ground and outside of climatology

Accurate "no rain" retrieval via dynamic use of Autosnow in GPROF retrieval



Summary and looking ahead

- Accurate snow cover information is critical for passive microwave precipitation retrievals
  - Lack of unique radiometric information to delineate "scattering" surfaces
  - Even using ancillary data and full physical retrievals does not work 100% of time
- Autosnow provides global, high spatial resolution information that is compatible with passive MW sensors and provides complimentary information
- NOAA GCOM project is evaluating latest NASA GPM passive MW retrieval (GPROF2017) for future implementation
  - Anticipated for sometime in 2019