Improvement to Rainfall Over Land - Next generation of GPROF2010 Adopted for AMSR-E

Ralph Ferraro[1,2], Patrick Meyers[2], Nai-Yu Wang[2], Chris Kummerow[3], Dave Randel[3]

[1]NOAA/NESDIS

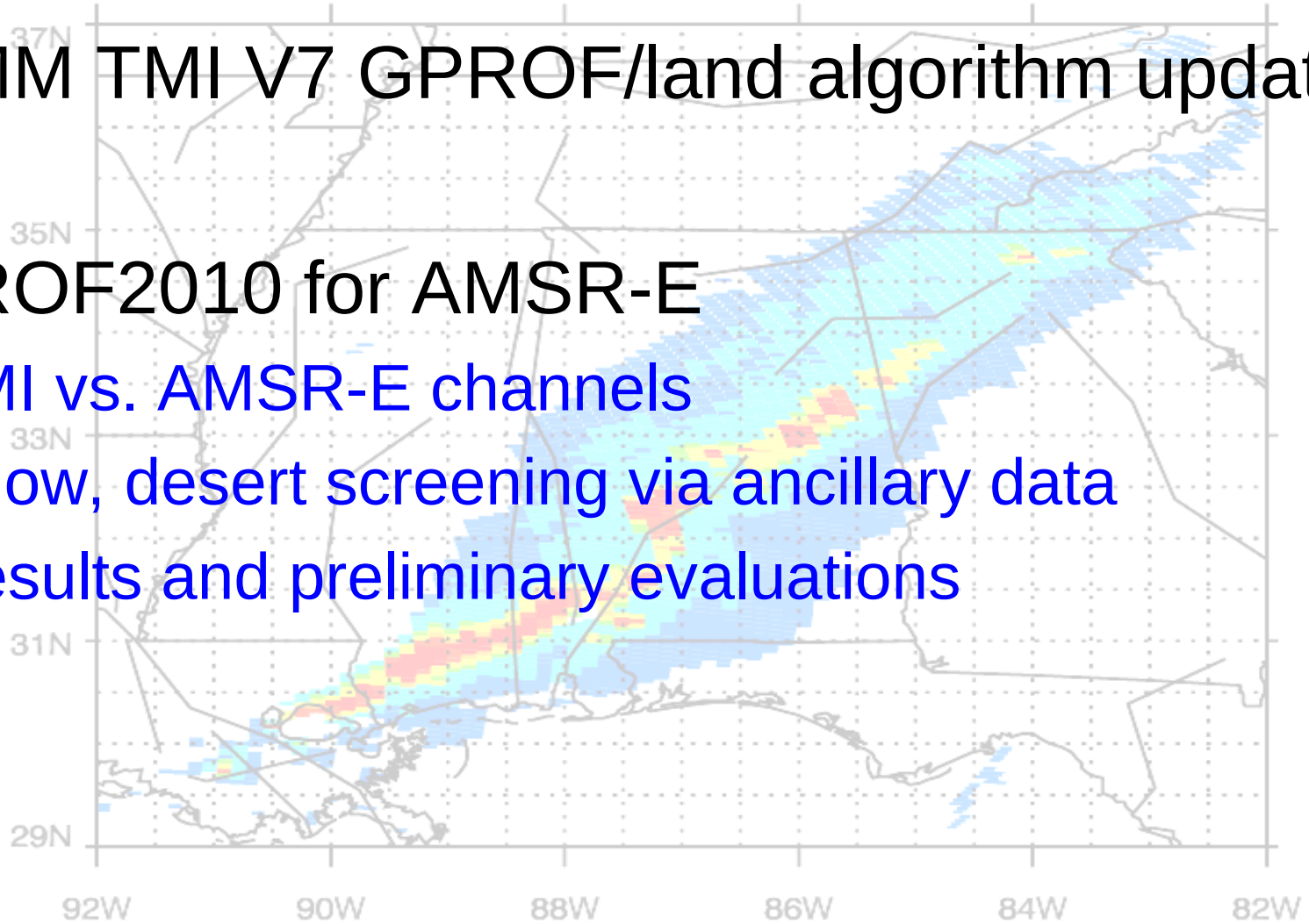
[2]Cooperative Institute for Climate and Satellites (CICS), University of Maryland
College Park, MD

[3]Cooperative Institute for Research in the Atmosphere (CIRA)
Colorado State University
Fort Collins, CO

AMSR-E Science Team Meeting – Portland, OR

Outline

- TRMM TMI V7 GPROF/land algorithm update
- GPROF2010 for AMSR-E
  - TMI vs. AMSR-E channels
  - Snow, desert screening via ancillary data
  - Results and preliminary evaluations

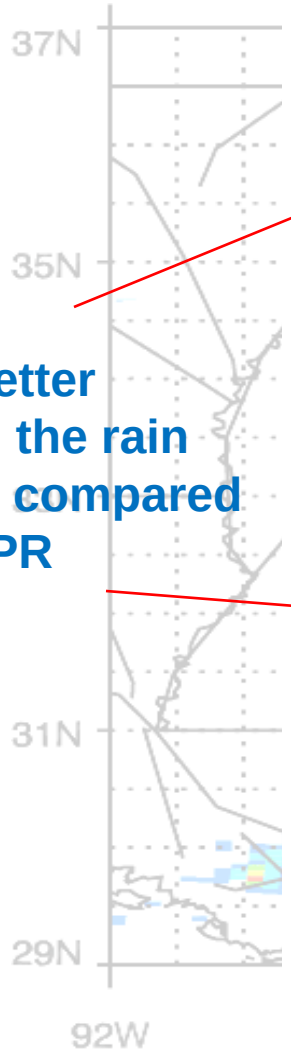


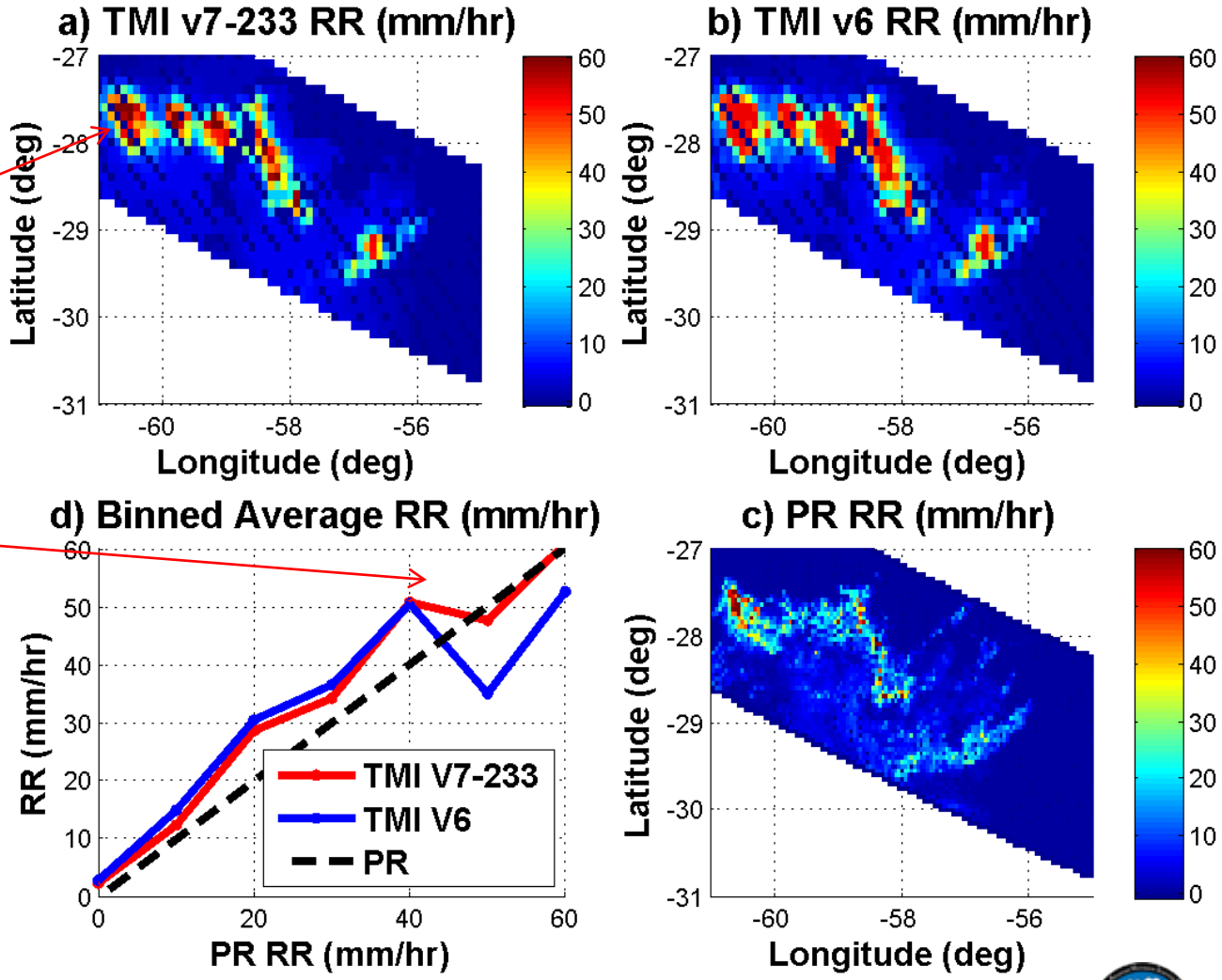
Update on TMI 2A12 Land – V7 (a.k.a. GPROF2010) (Nai-Yu Wang)

- Main focus of effort - make improvements over V6
  - Improve Convective-Stratiform separation and TB85V-RR relationships to remove warm season bias
- Redone **several times** due to lack of convergence of PR V7, but ultimately, used PRV7 "ITE233"
  - Results in slightly higher TMI rain than tuning that was done with PR V6
    - But substantially lower than TMI V6
    - Makes "sense" in terms of proper synergy using PR V7 for TMI V7
- We did not specifically address regional artifacts
  - However, V7 does use improved land/sea tag (mostly to improve ocean retrievals)
- **V7 was implemented at PPS in July 2011**

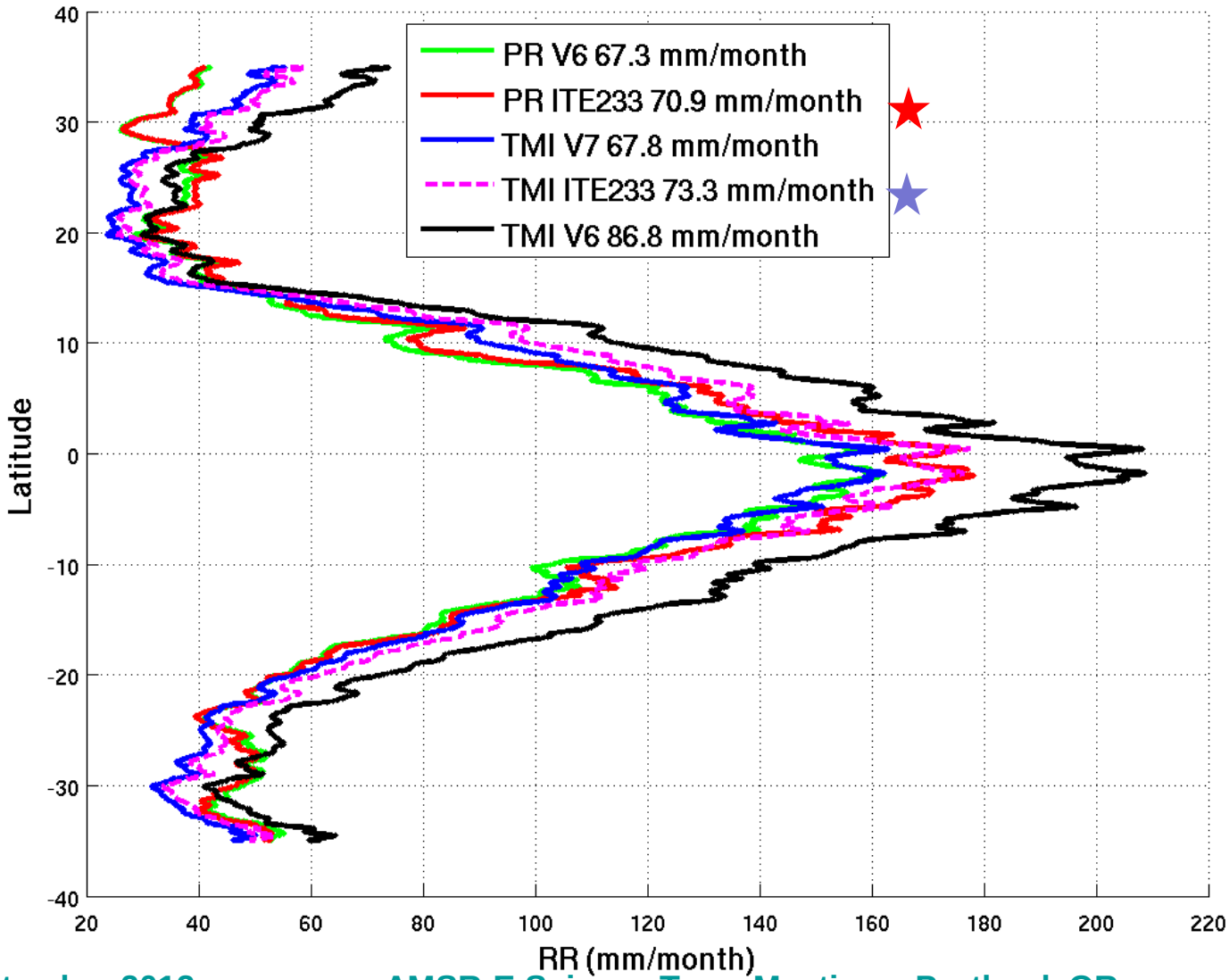
An Example

Note the better gradient in the rain rates in V7 compared to V6 and PR

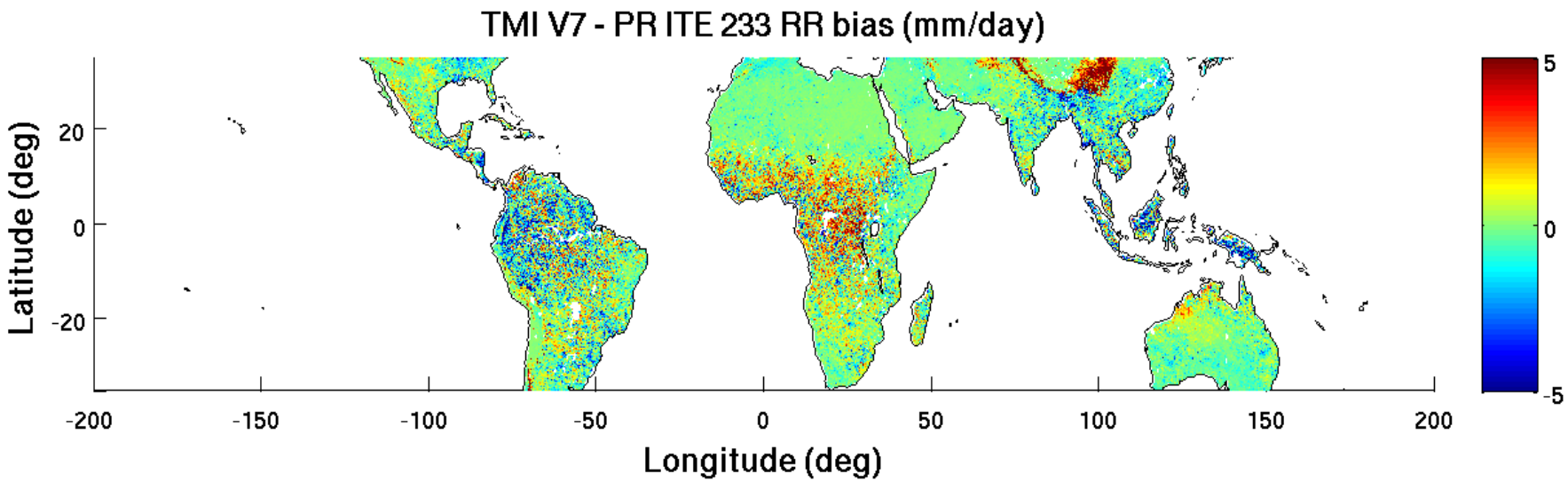


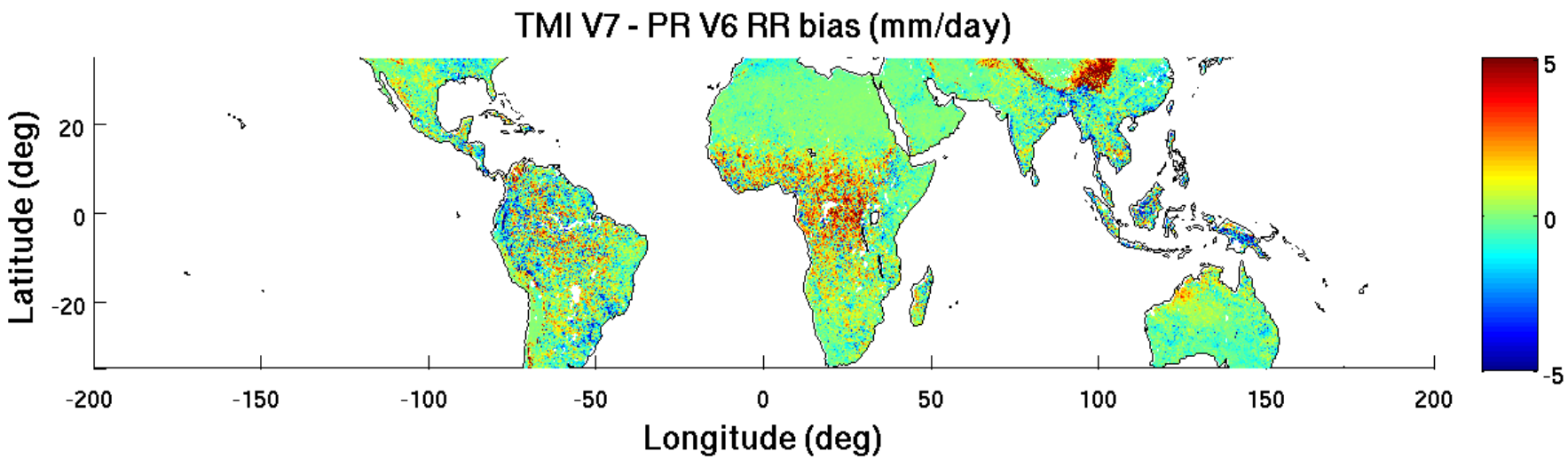


TMI and PR Global Land comparison Data from Jan 2008-Dec 2009

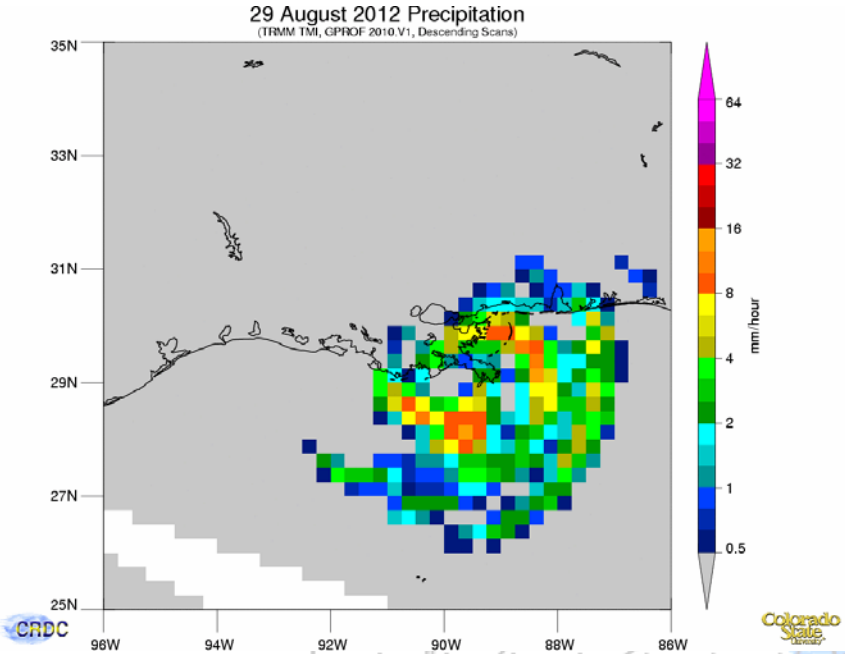


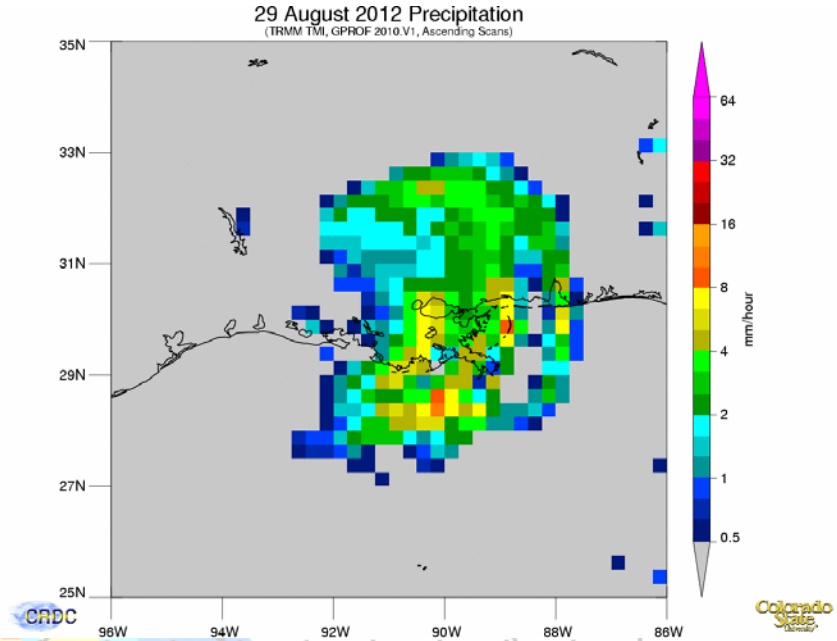
Global Evaluations: TMI - PR

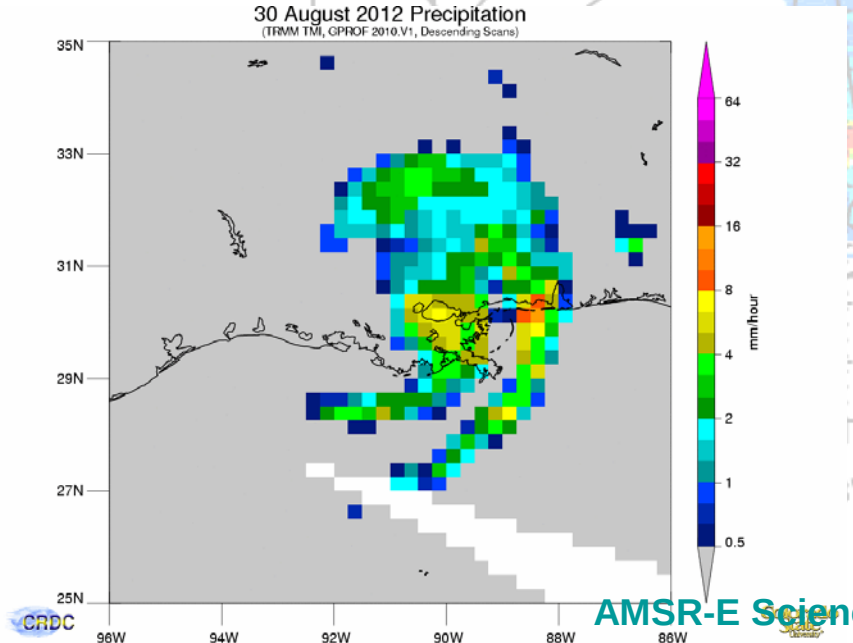


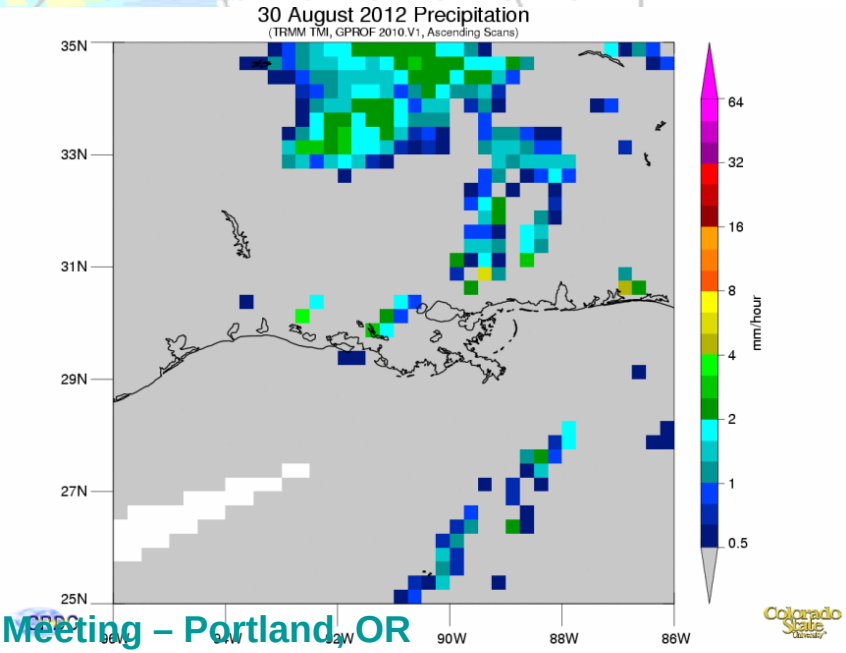


Hurricane Isaac w/TMI

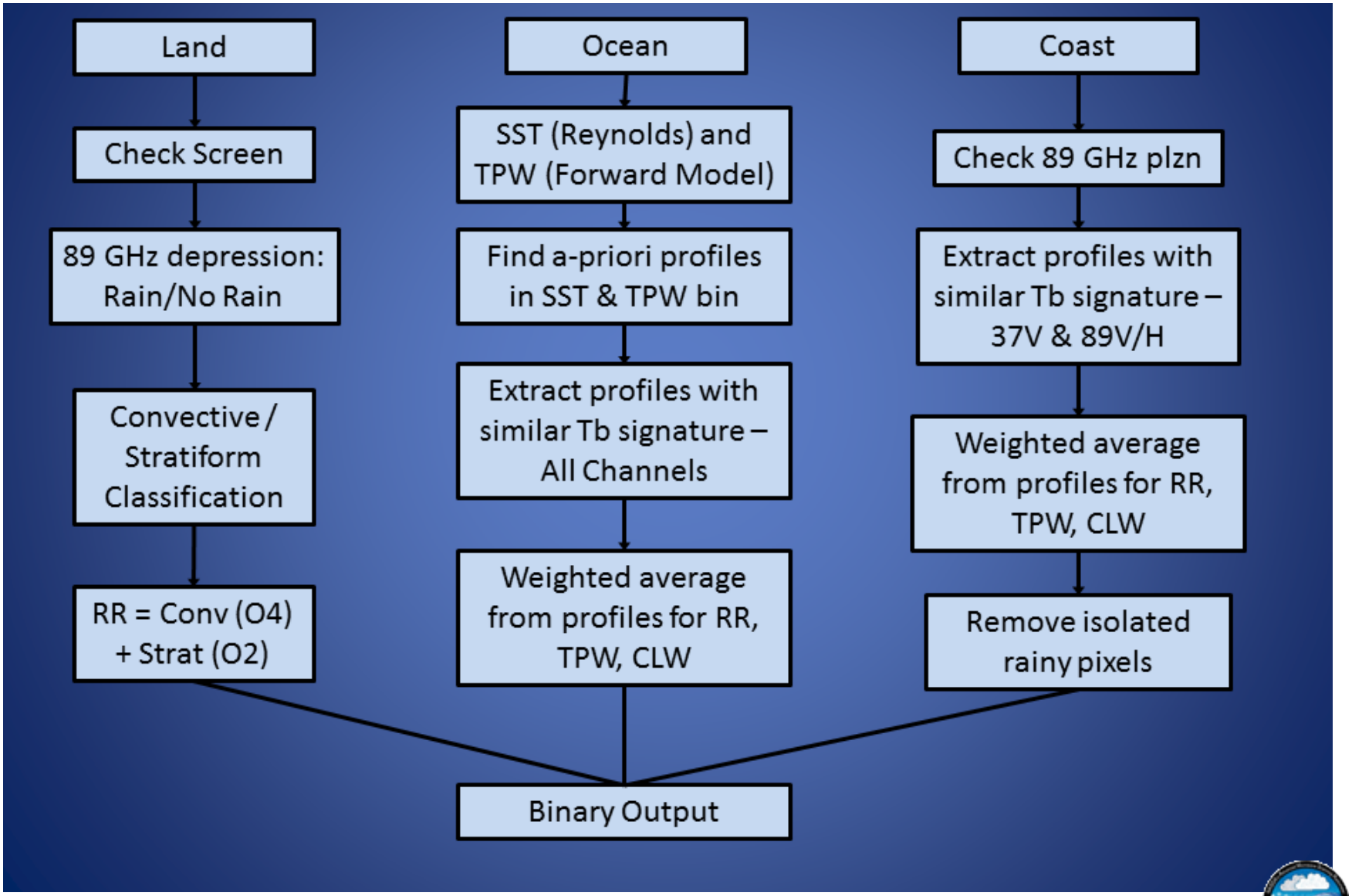






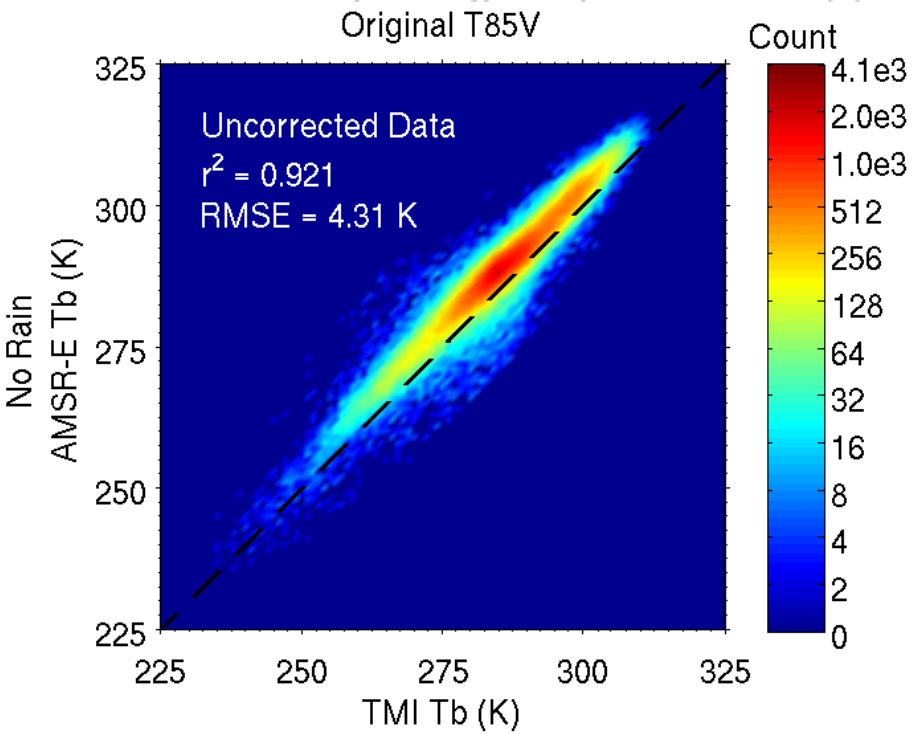


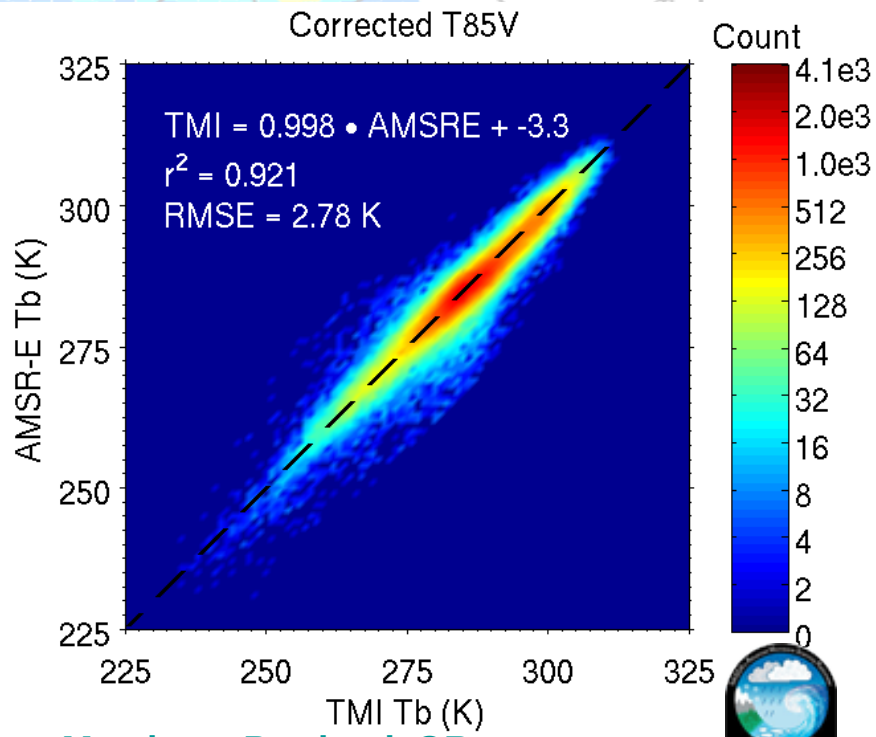
GPROF Schematic



Brightness Temperature Correction : TMI 85 V to AMSR-E 89 V

- RTM and GPM X-Cal L1C methods attempted…but did not produce any beneficial results…
- So…brute force method….Collocated TMI & AMSR-E data (1.5 km & 30 minutes)
- Correlation coefficients computed
- Adjusts brightness temperatures by over 3.5 K





Original GPROF Land Screening

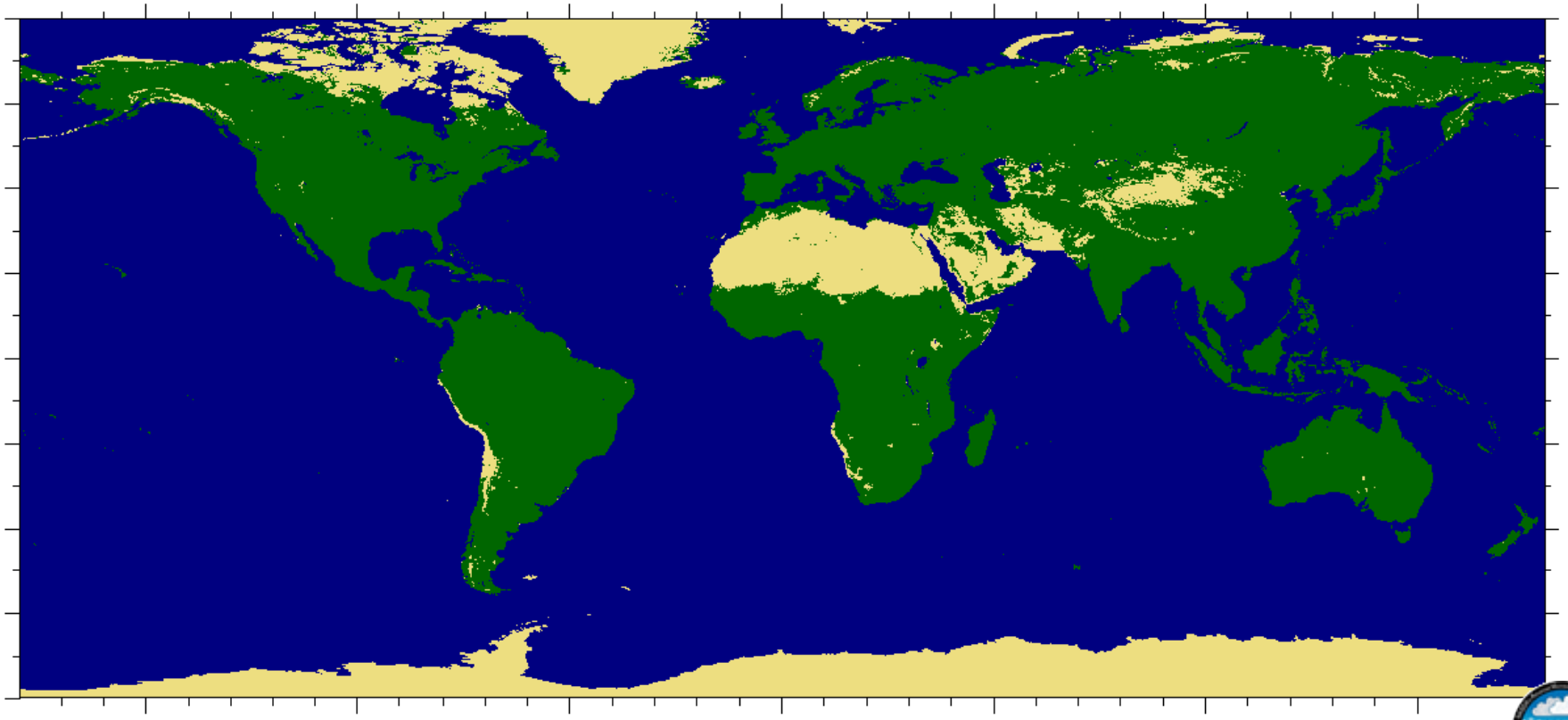
- Snow/Ice/Desert/Sand
- Incremental patchwork
  - If … Then …;Threshold TB's, TB_V-TB_H, TB_{v1} – TB_{V2}
  - Goal – Simplify!

```
      if ((T85H .gt. WARM85_LN).and.(T22V .lt. AMB_HI)) then
         rain_status(pix,lin) = MASKO

      !  If 85H is not as warm, then a series of other test
      !  are needed to determine if pixel must be screened

      elseif (T22V  .lt. AMB_HI) then

      !  Use grody criteria to screen for ice surfaces

         if ((T22V .lt. AMB_LO) .and.
     >              T22V .lt. (AMB_INT + 0.49*T85H) ) then
            rain_status(pix,lin) = MASKI

         !  Check for large polrization at 19 GHz

         elseif (DT19 .gt. POL ) then
            rain_status(pix,lin) = MASKP

         !  Check a second polarization criteria for
         !  possible ice background contamination.

         elseif ((DT19 .gt. ((55.+POL)-0.25*T85H)) .and.
     >               (DT19 .gt. (POL-10.))) then
            rain_status(pix,lin) = MASKP

         elseif (landretsat(1:1).eq.'F' .and. DT19.gt.7 .and.
     >              T85V .gt. 253) then
            rain_status(pix,lin) = MASKP
```

```
                sig85h = sqrt((N2*sumxx - sumx*sumx)/N2N21)

                if (sig85h .le. 30. ) then
                   !  First case if for ambiguous T22V
                   if ( T22V .ge. AMB_LO ) then
                      rain_status(pix,lin) = 13
                   !  Unambiguous cold surface
                   elseif (sig85h .le. 20. ) then
                      rain_status(pix,lin) = MASKI
                   !  The rest is ambiguous
                   else
                      rain_status(pix,lin) = 14
                      acnt(4) = acnt(4) + 1
                    end if
                !  The rest is probably raining
                else
                   rain_status(pix,lin) = 0
                end if
             end if
          end if
       !  Grody "sand" polarization test when 22V > 262
          rain_status(pix,lin) = MASKP
       !  Check a second polarization criteria for
       !  possible ice background contamination.
       elseif ((DT19 .gt. ((55.+POL)-0.25*T85H)) .and.
     >               (DT19 .gt. (POL-10.))) then
          rain_status(pix,lin) = MASKP
       else
          rain_status(pix,lin) = 0
       end if
```

Climatological Desert Screening

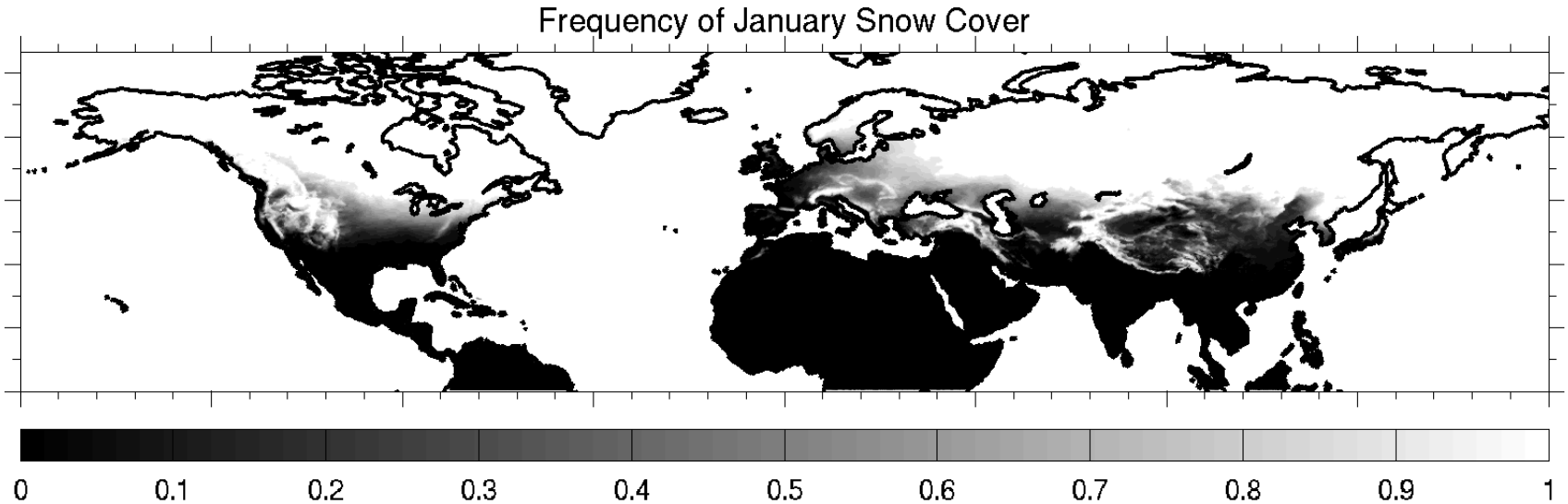
– International Geosphere/Biosphere Programme 1/12° scene types

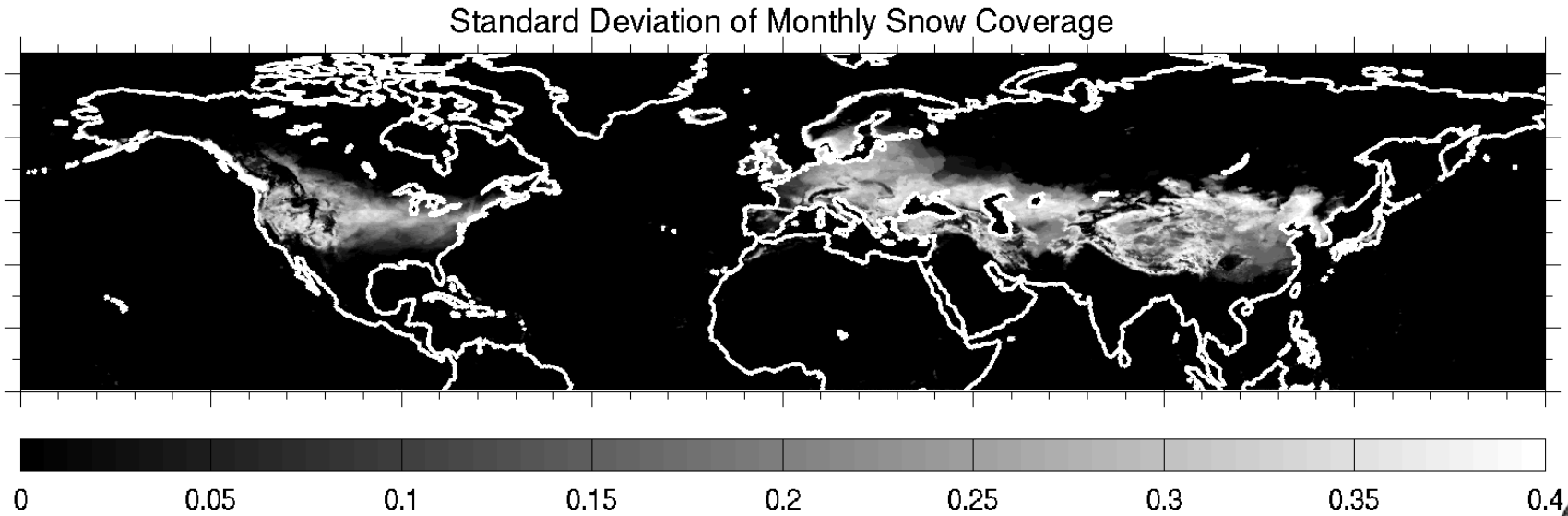


Climatological Snow Screening

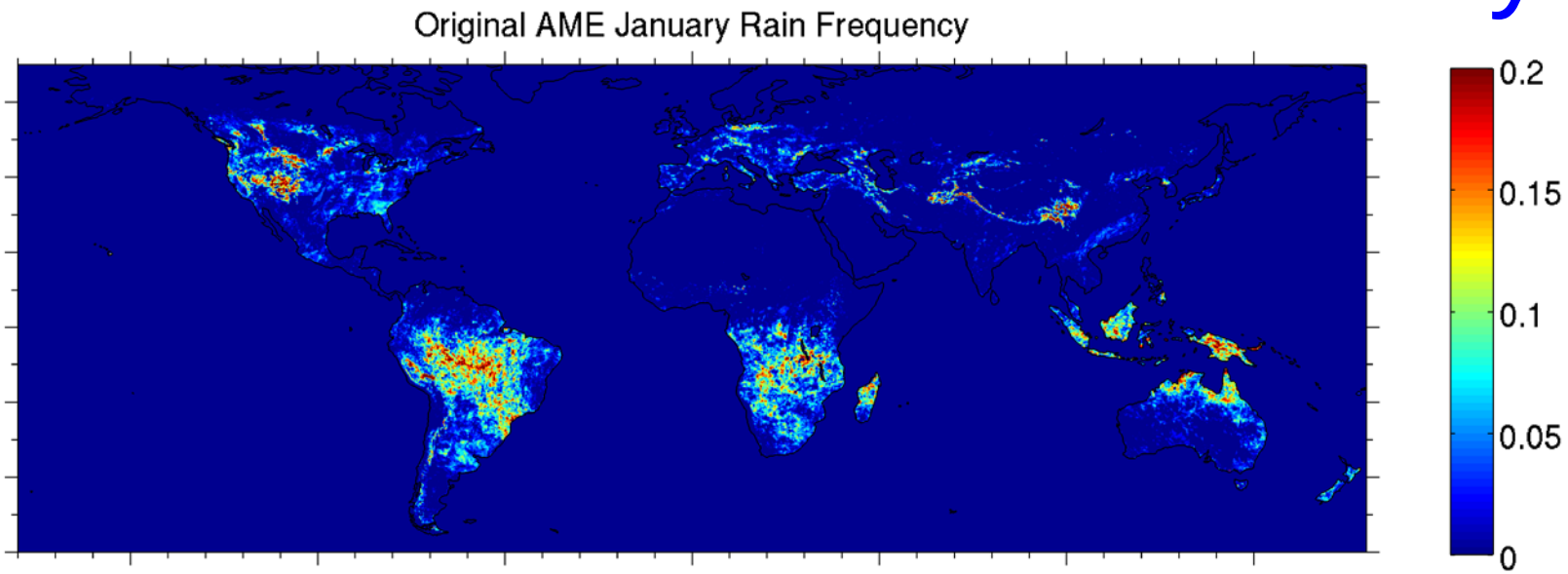
- Interactive Multisensor Snow and Ice Mapping System (IMS)
  - Northern Hemisphere
  - Multisensor (AVHRR, SSM/I, GOES, AMSR-E)
  - Human in the loop
  - Daily 24 km snow product 1997-present
- AMSR-E Monthly Snow Product
  - Southern Hemisphere
  - L3 25km Snow Water Equivalent
- Global 1/4° map of likelihood of snow coverage
  - If (p > 75%), snow likely, pixel flagged

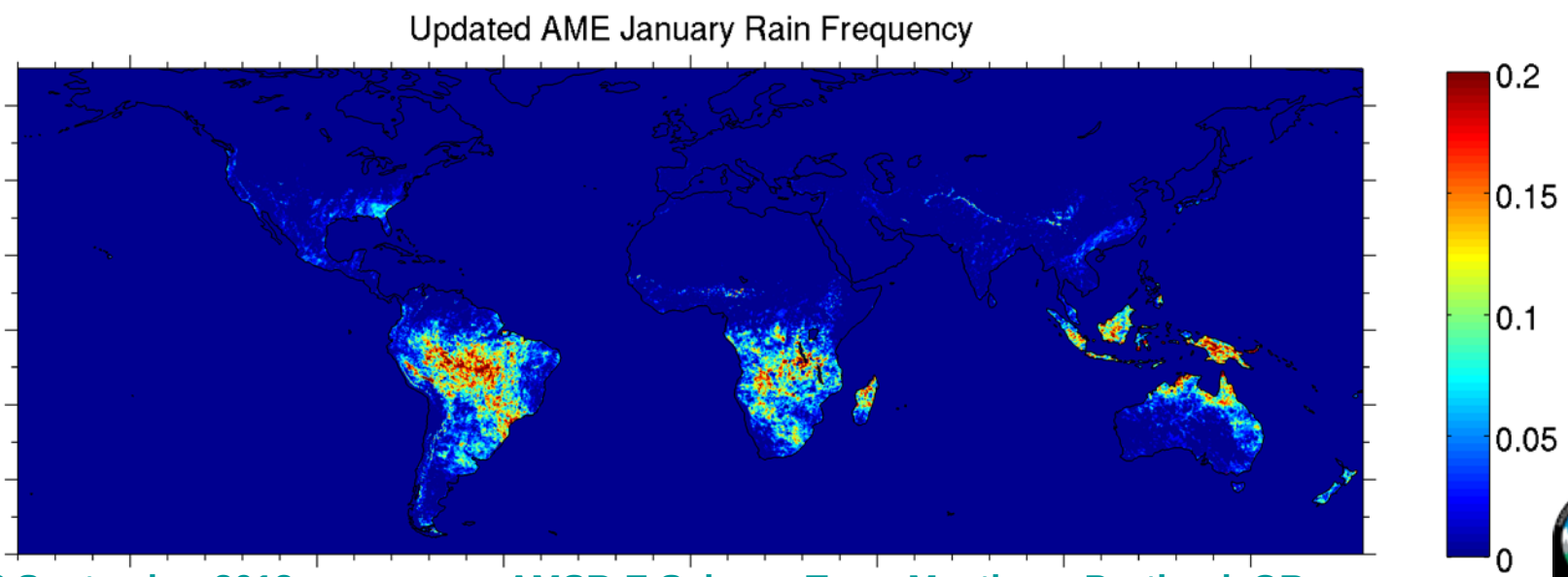
Climatological Snow Screening



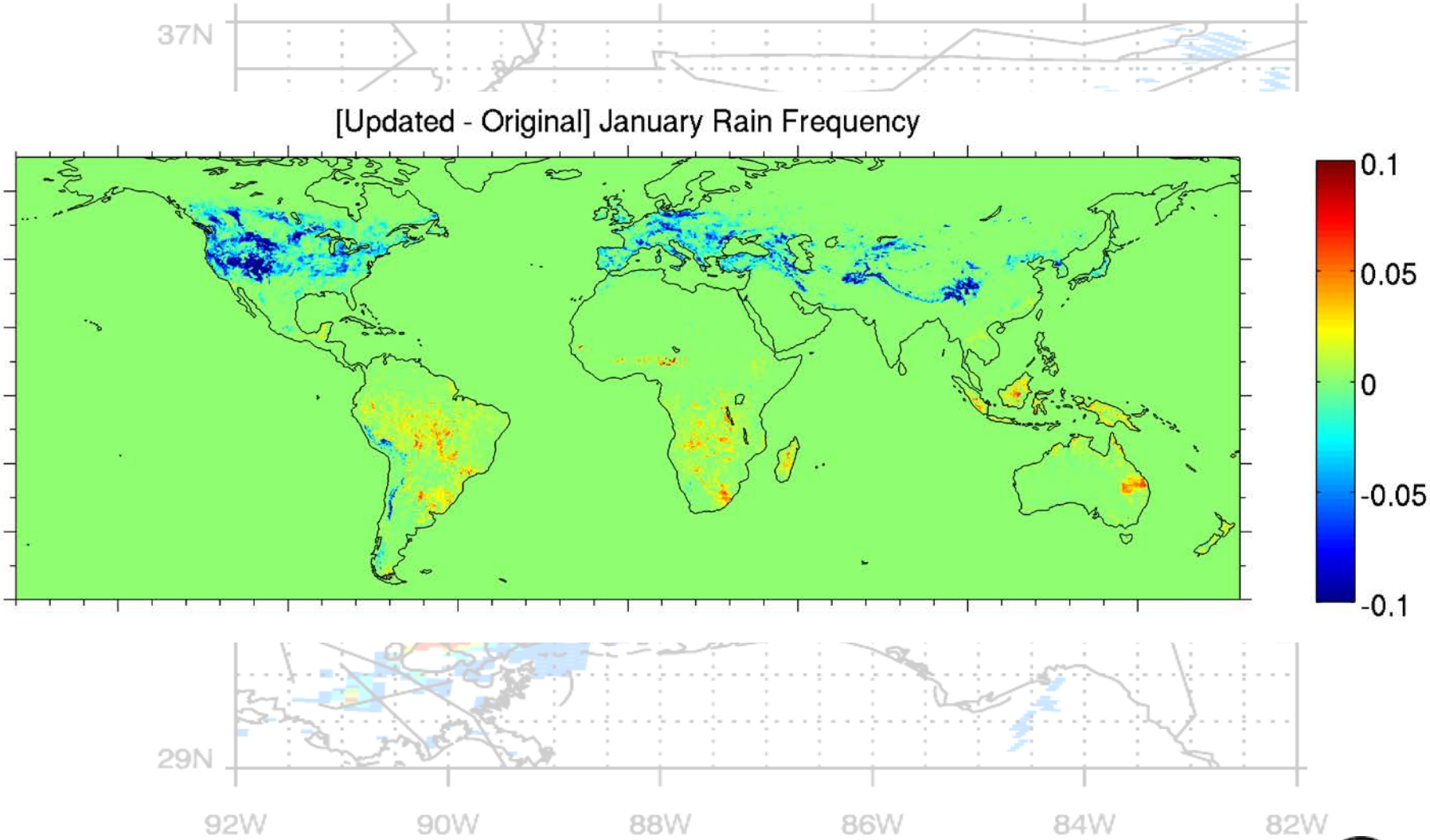


Occurrence of Rain - January

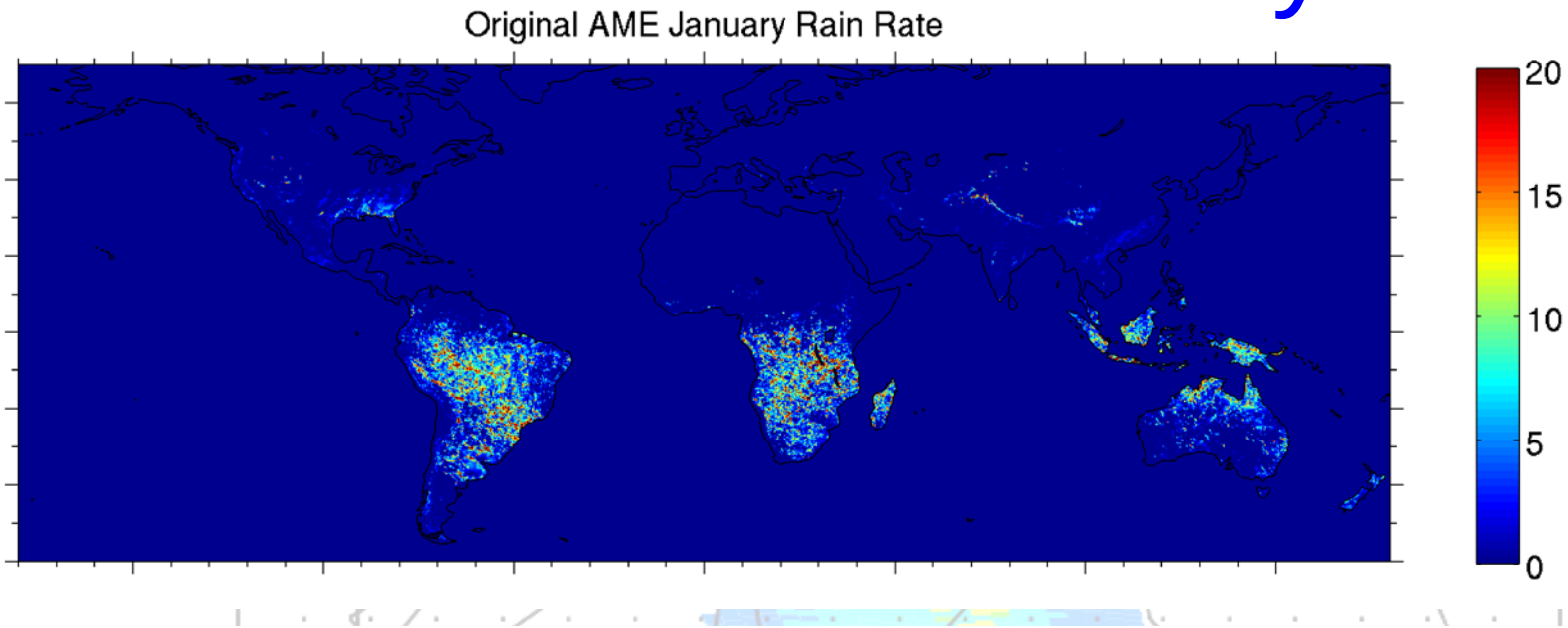


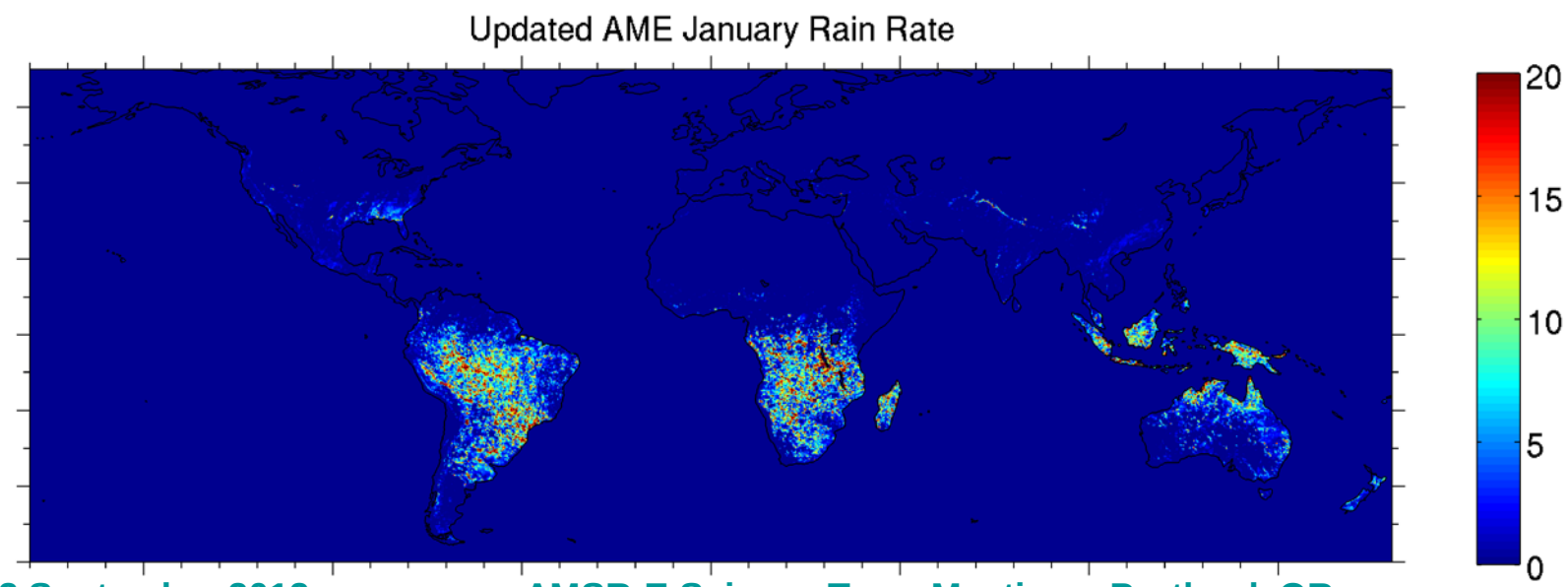


Occurrence of Rain - January

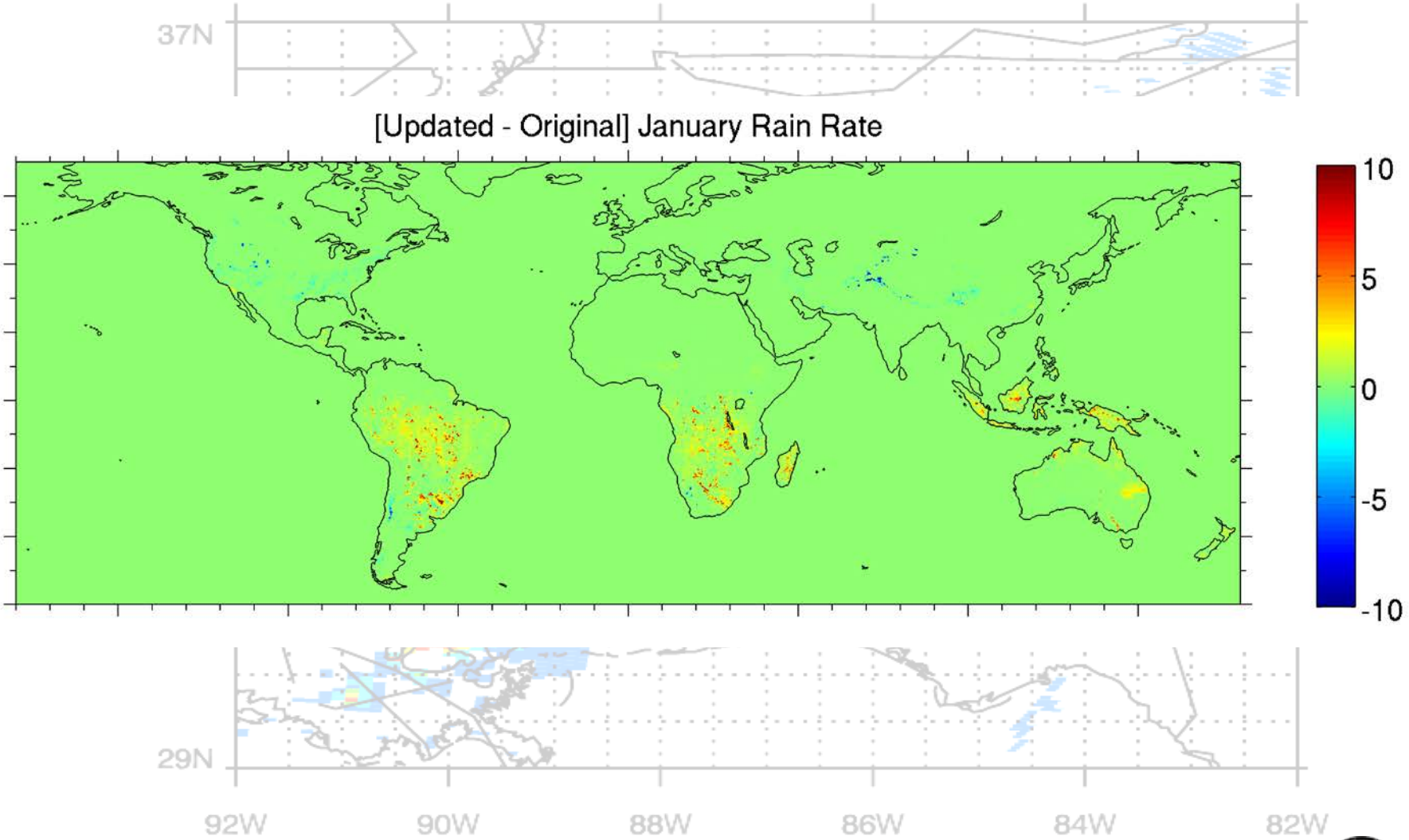


Rain Rate - January

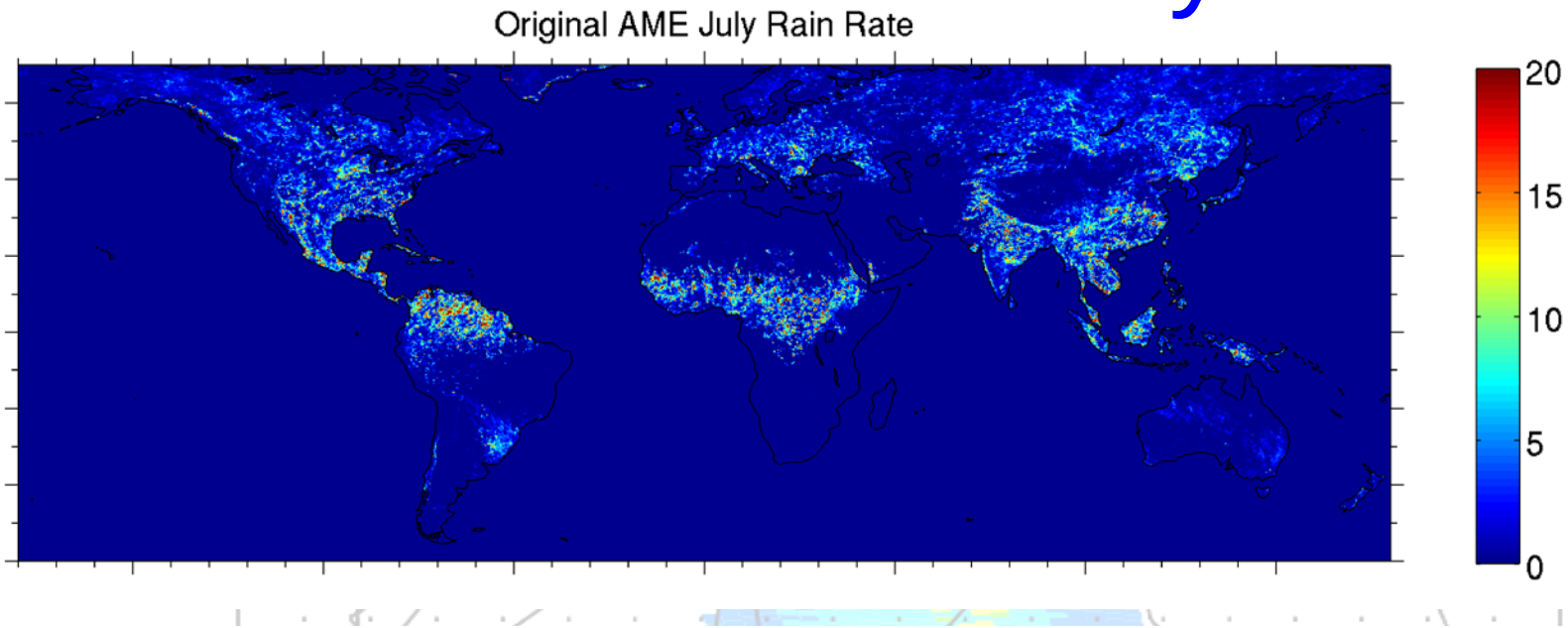


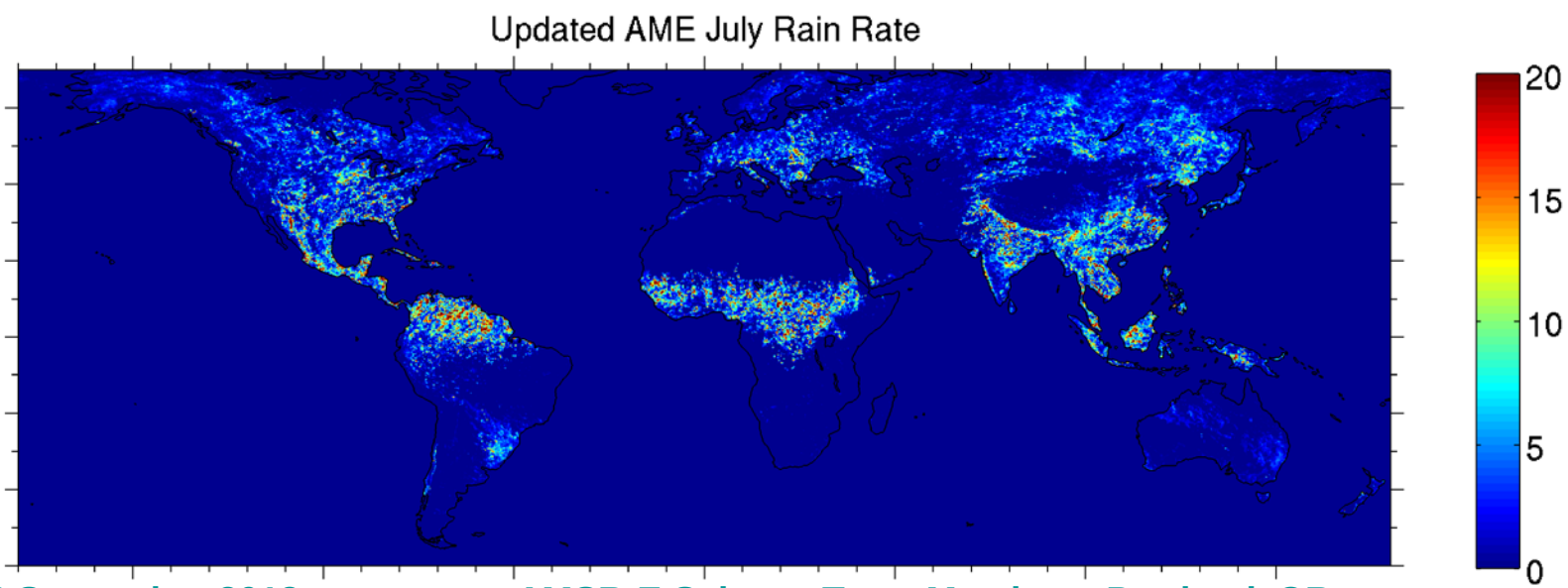


Rain Rate - January

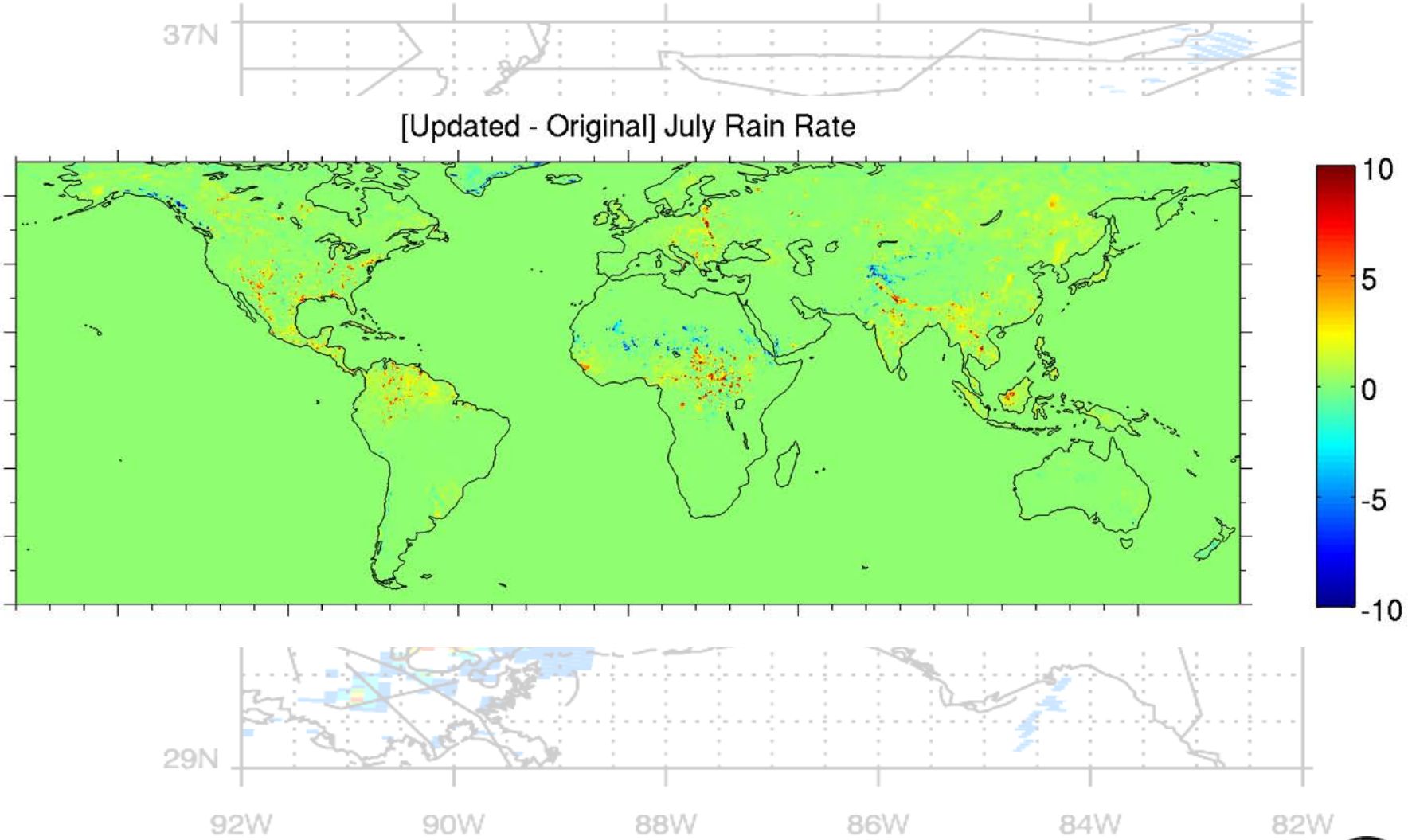


Rain Rate - July

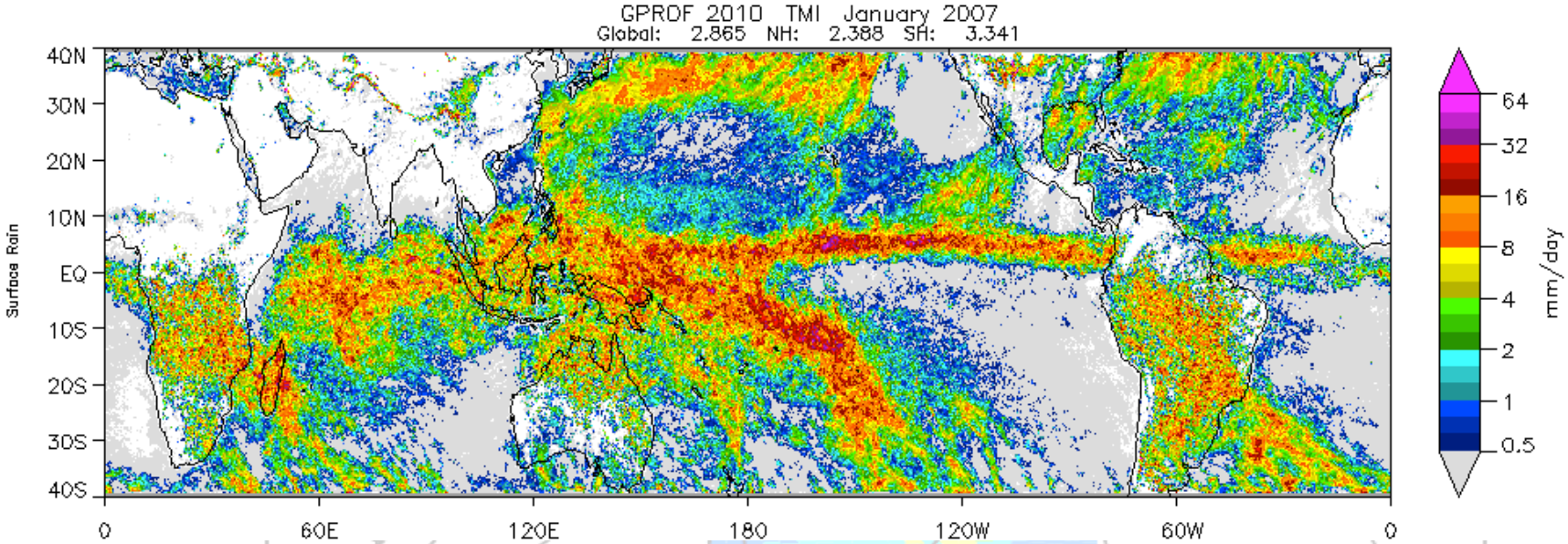


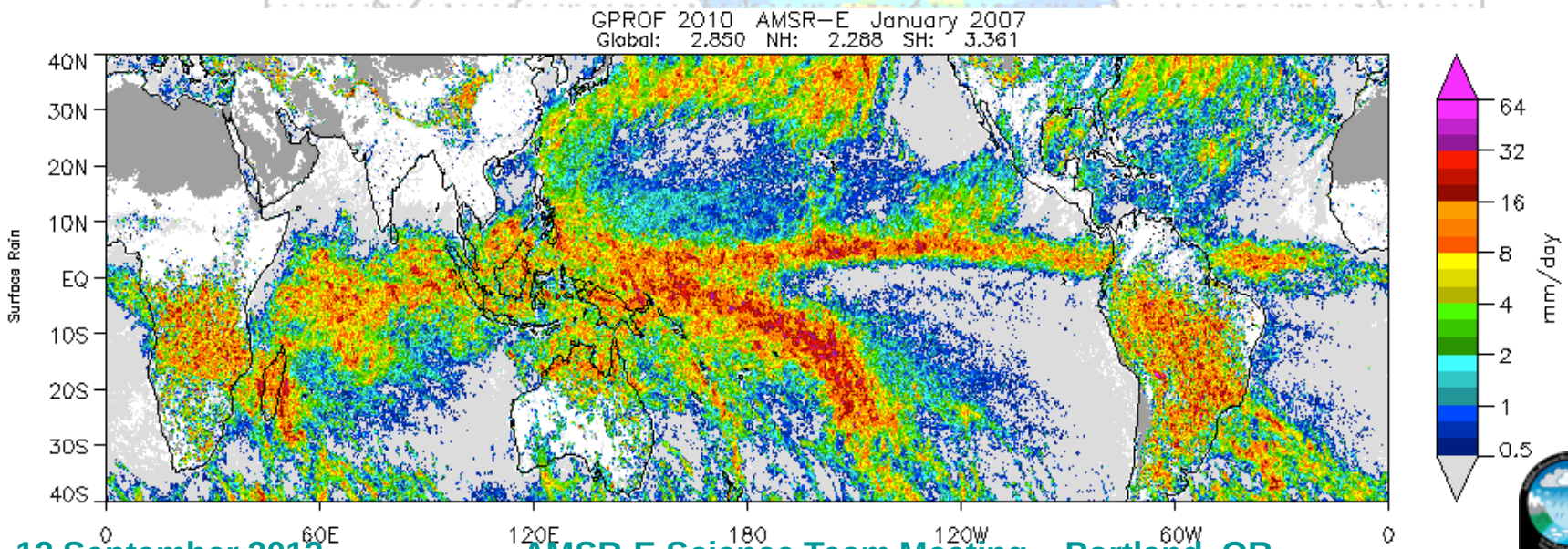


Rain Rate - July



TMI /AMSR-E Comparison

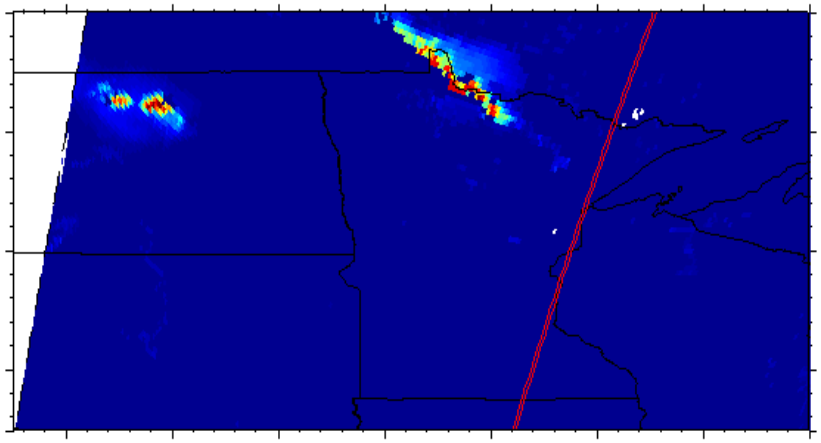




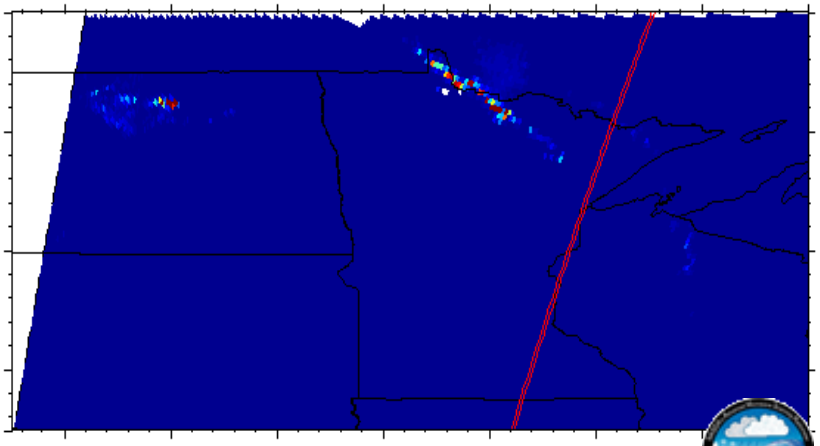
NMQ-Q2 Validation

- National Mosaic & Multi-Sensor QPE
  - 3-D Blend of radar, satellite, model, and surface obs
  - Developed by NOAA/NSSL team – (Howard, Gourley, et al.)
- GPROF typically has broader rain field
- GPROF doesn't estimate high rain rates in NMQ
- Why? Mostly resolution

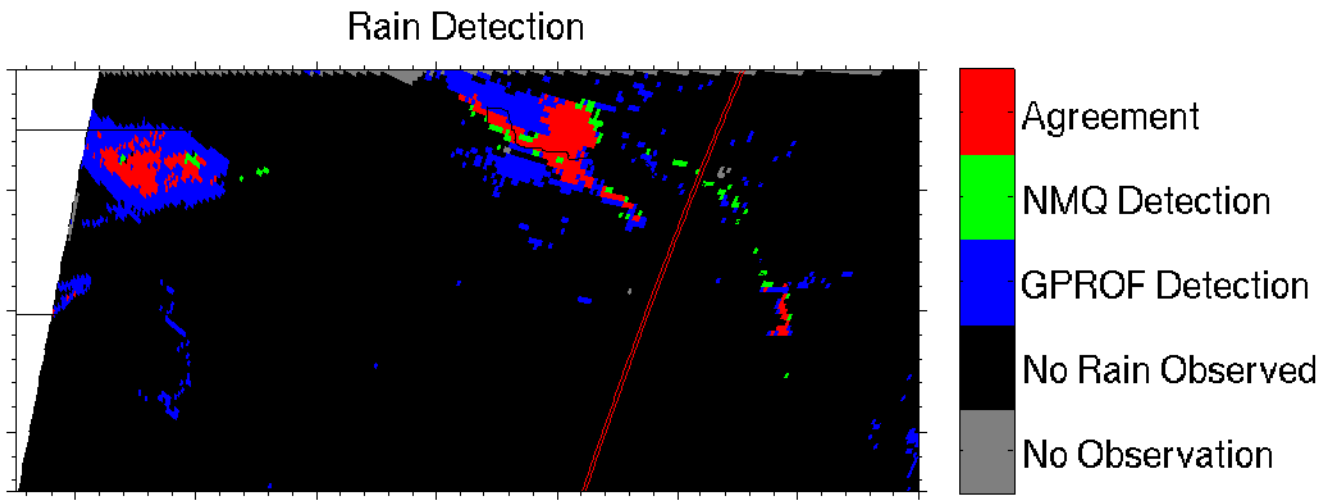
GPROF Swath Data

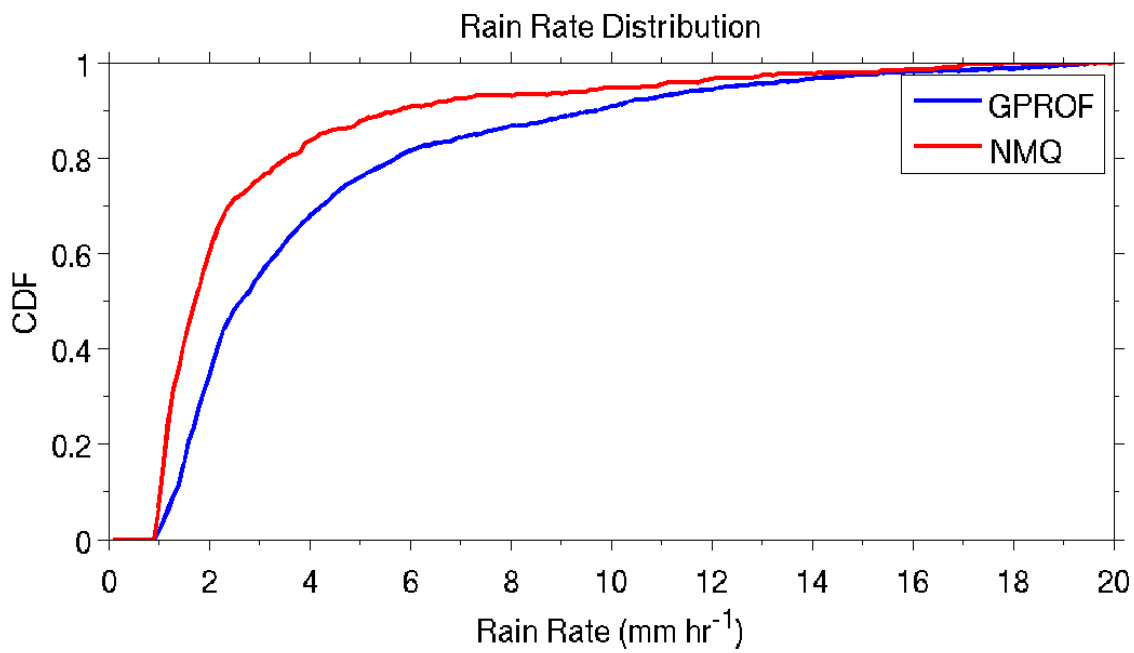


NMQ Matched Swath



NMQ-Q2 Validation (con't)





Summary & Future Plans

- Attributes of GPROF2010-b (for AMSR-E)
  - Utilizes improved CSI and TB to RR from TMI V7
  - Reduces frequency of rain due to misclassification of snow and desert
    - Use of climo. not perfect but a step in the right direction
    - A good intermediate algorithm prior to GPROF2014
      - Could serve as "benchmark" approach for GPM era
  - Brings back intense convective cores filtered out by snow check
- Code undergoing final check out, will be handed over to MSFC for reprocessing in near future
- NOAA will also utilize for AMSR-2
  - Strive for consistency across as many platforms and systems as possible to benefit user community