# Global Precipitation Measurement

## A Comparison of the GPROF Algorithm Results in the 2A-CLIM and 2A Data Products


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*9 April 2019*

# Why this Presentation

- GPM provides 2 types of GPROF radiometer retrieval products
- Users have asked why 2 (3) GPROF products
- Given there are 2 (3) GPROF products how do they differ
- Which do I use?????????

# Introduction

- GPM provides 3 types of GPROF radiometer retrieval products
  - All three use exactly the same algorithm and the same precipitation databases
  - They differ in latency (input and ancillary data) availability
- Ancillary Data used
  - Near-realtime GPROF uses JMA Forecast data
  - Standard production GPROF uses JMA GANAL data
  - Long term research GPROF uses ECMWF ERA-Interim
- Latencies achievable
  - Near-realtime within 30 mins of data collection)
  - Standard within 24 hours of data collection)
  - Long term research within 2/3 months of data collection
- With the exception of the ancillary data the GPROF algorithm producing the products are exactly the same.

# Programmatic Reasons

- During development phase a science review team advocated that radar and radiometer retrievals use the same ancillary data when possible
  - The radar team had committed to using JMA GANAL data
  - The radiometer team indicated that they would use this for GPM-era GPROF
  - While GANAL was only available from 2013 onward, still felt comparable use in radar and radiometer retrievals important
- GPROF products would be produced back to 1987 but GANAL not available back to that period
  - Decided that for a consistent GPROF data set (from 1987-the ongoing GPM era) ECMWF ERA-I based GPROF would also be produced
  - The 2/3 month lag was not acceptable for many researchers who wanted a research quality GPROF within 48 hours of data production. GANAL used for this.
  - The requirement for same ancillary products also fulfilled by producing 2 products
- Neither GANAL or ERA-I available in time for NRT requirement so JMA forecast file used

# Variables from Ancillary Products used in GPROF

- Ancillary data needed to subset a-priori precipitation profile database into manageable sectors.
  - Total Precipital Water (TPW)
  - Two-meter temperature (T2M)
- Each ancillary product has slightly different values for these parameters
  - The JMA GANAL and Forecast are similar
  - Therefore this presentation only looks at the difference between GANAL and ECMWF ERA-I GPROF
- ECMWF ERA-I is consistent back to 1987
- GANAL had a discontinuity for which the GPROF algorithm needs to account even within the 2013-present timeframe

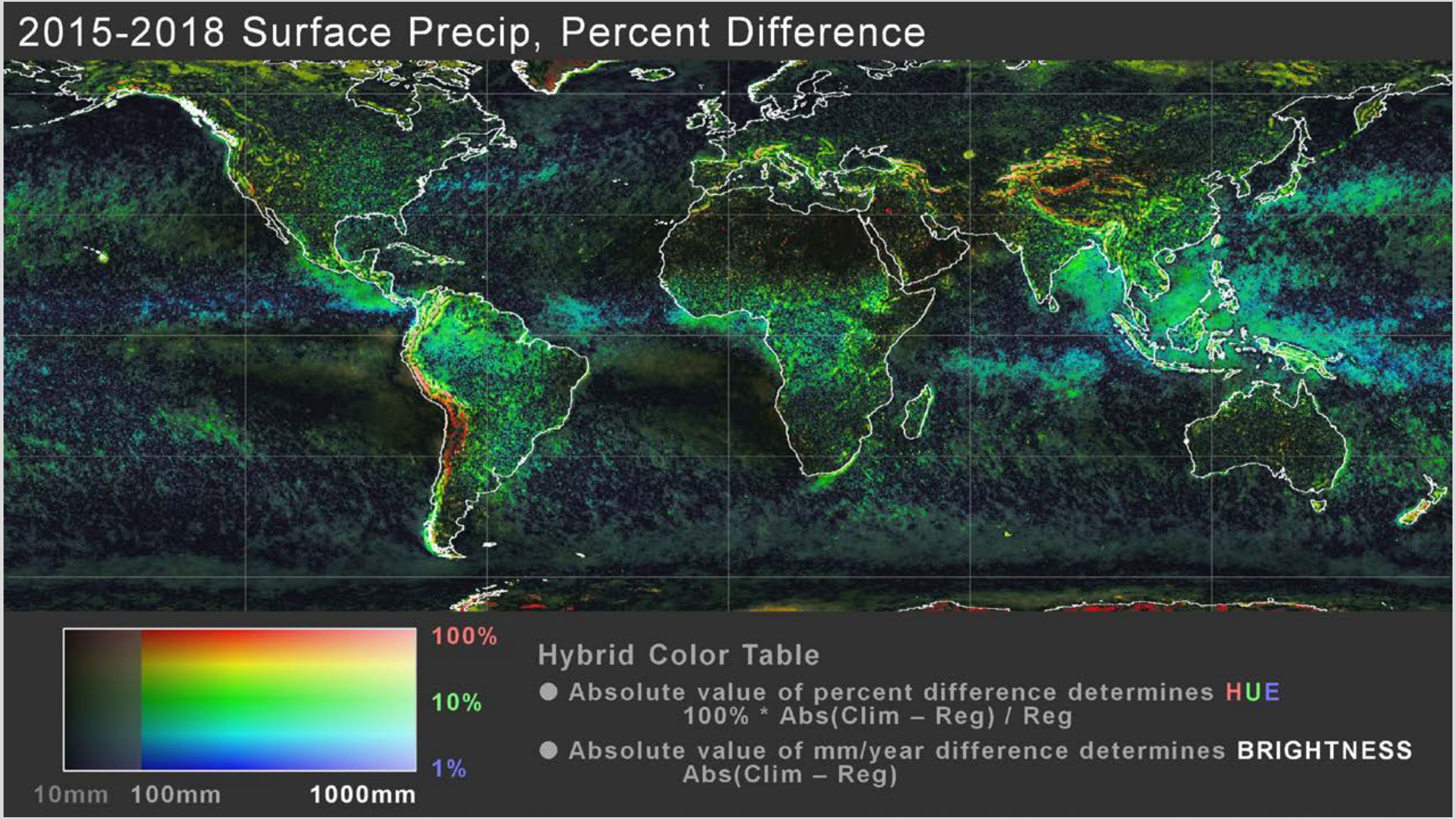
# Conclusions

- Differences exist between the ERA-I and GANAL GPROF
  - In extreme cases up to 25%
  - Generally the differences are much less than this
- The origin of the difference is due to the different TPW and T2M that the ancillary data provide
  - This can lead to the counts within subset of the database being different between the two
  - This can lead to the precipitation rate within subset of the database being different between the two
  - Could be a combination of both
  - Colder-wetter ancillary values will generally lead to more precipitation.
- For long term studies must use GPROF 2A-CLIM as it provides a consistent retrieval back to 1987 but there is a 3 month lag for present data
- If doing research that requires more recent (less latency) and only interested in GPM era then use GPROF 2A
- Don't mix the 2A-CLIM and 2A GPROF products if one wants to ensure consistent values

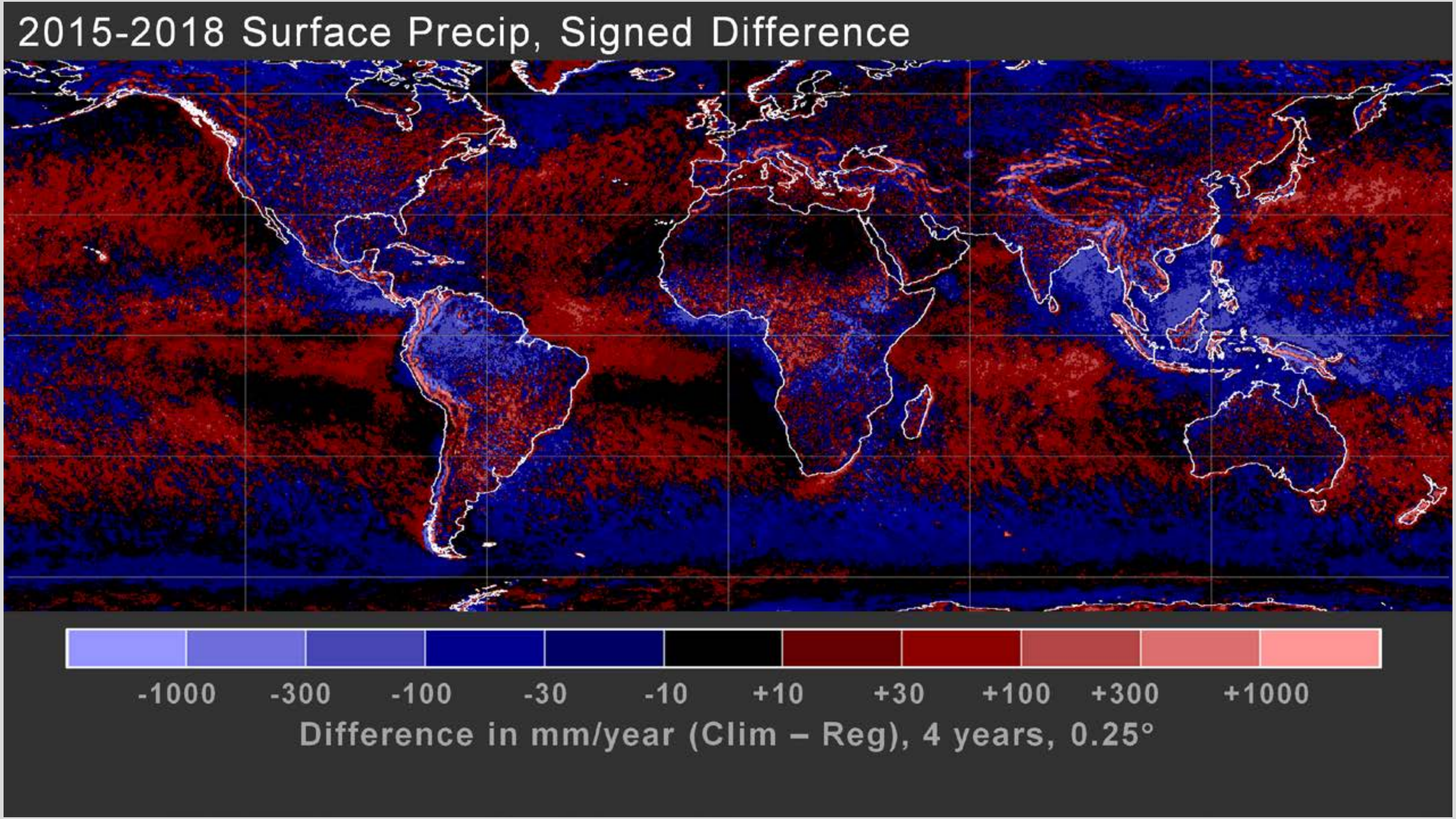
# Probabilistic vs non-Probabilistic Retrievals

- During TRMM version 7 products the GPROF algorithm (Probabilistic Approach)
  - Provided precipitation values with a probability attached
  - This seemed to show very light precipitation everywhere and such precipitation had very low probability
  - GPROF team believed this was more accurate because they had no additional measurements to indicate that precipitation was not occurring
  - Many users did not want to make the determination of precip/no-precip and wanted the GPROF team to make that determination
- For GPM the GPROF algorithm is making a determination of precipitation (Non-probabilistic Approach)
  - Requires use of an additional auxiliary dataset to help make the determination
  - The dataset provides global expected precipitation values.
  - However, GPROF must apply these over regional surface types.
  - This non-probabilistic approach also affects the amount of precipition reported as well as the counts.

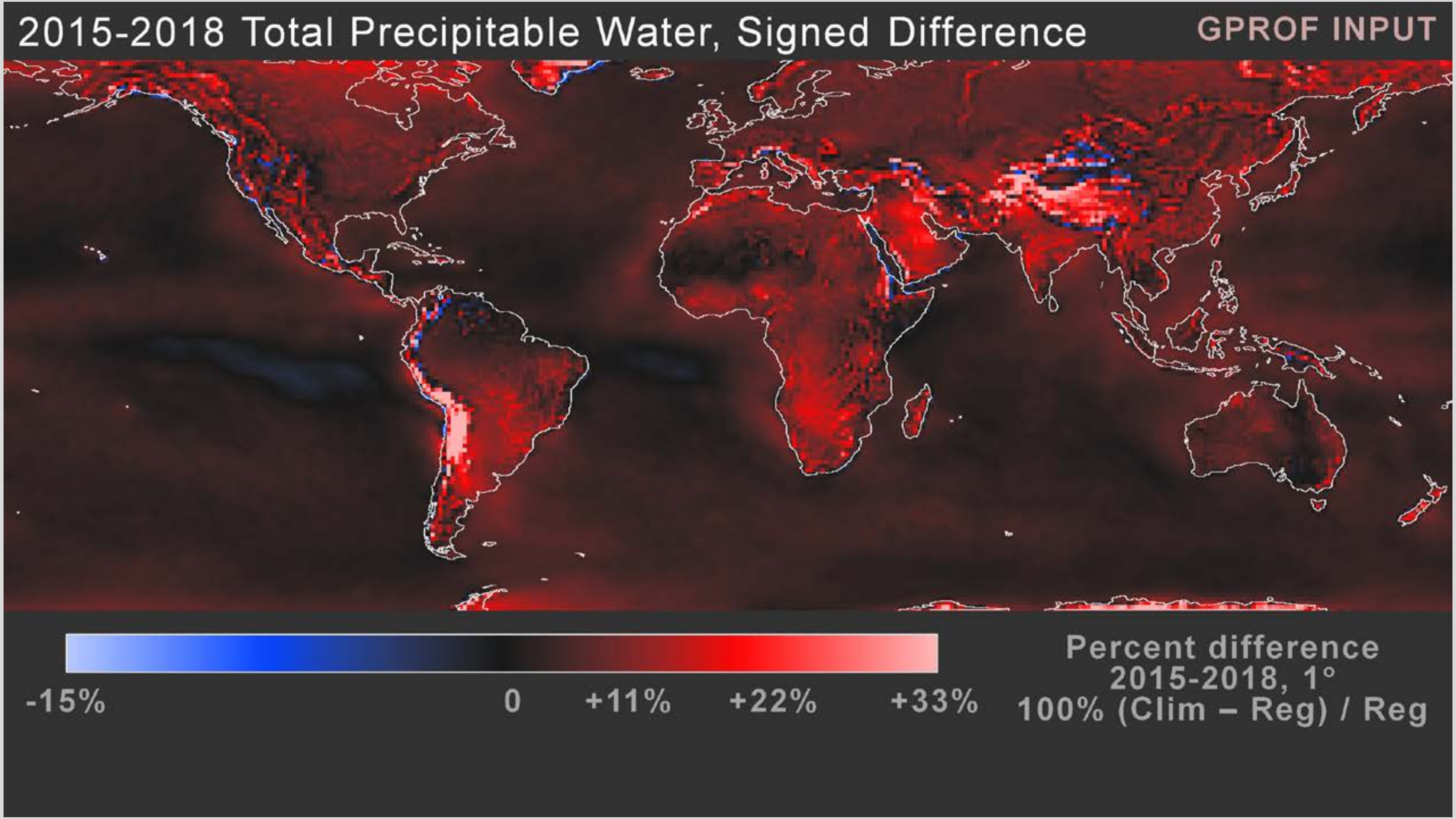
# Surface Precip



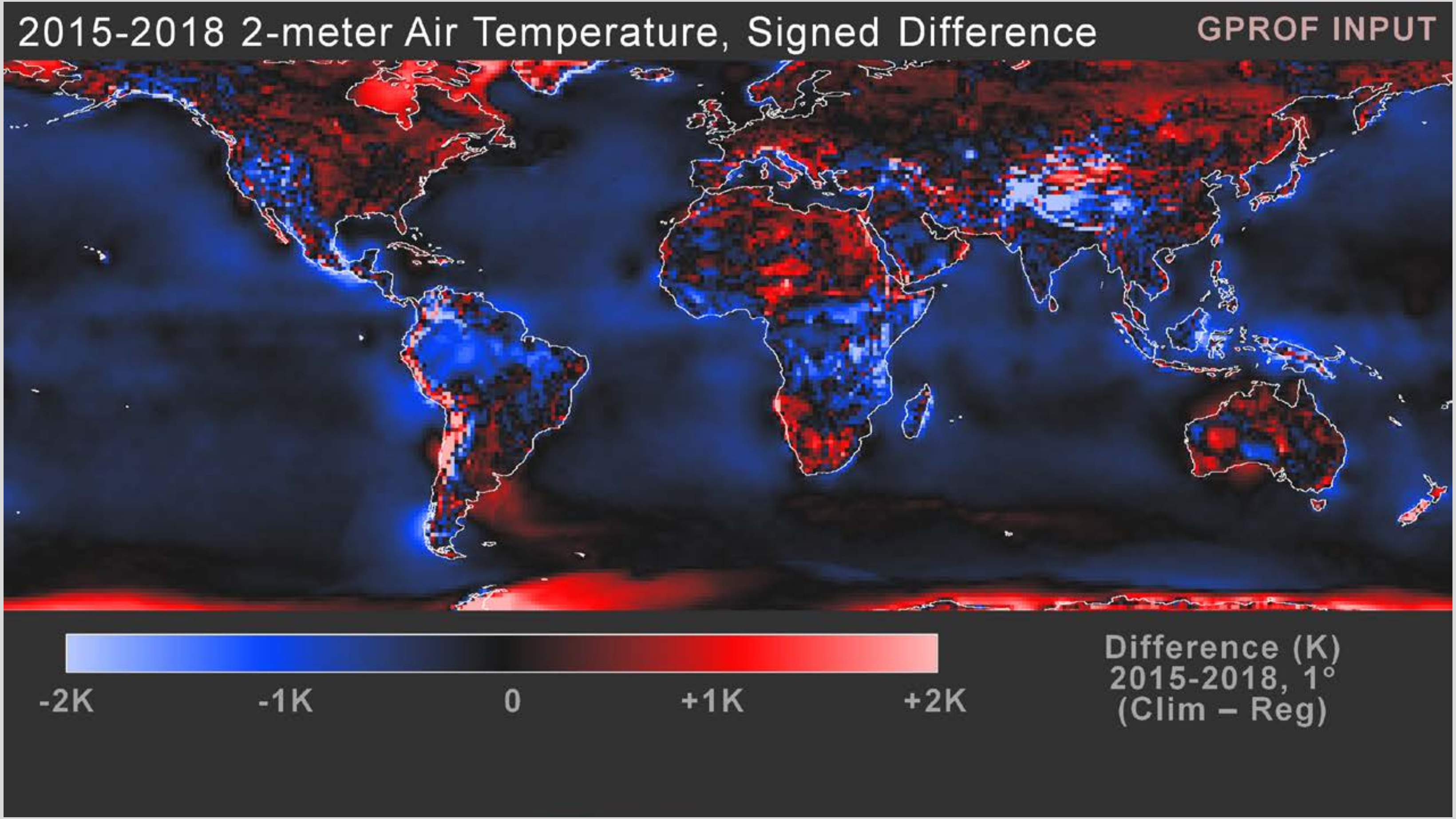
# Surface Precip - Sign

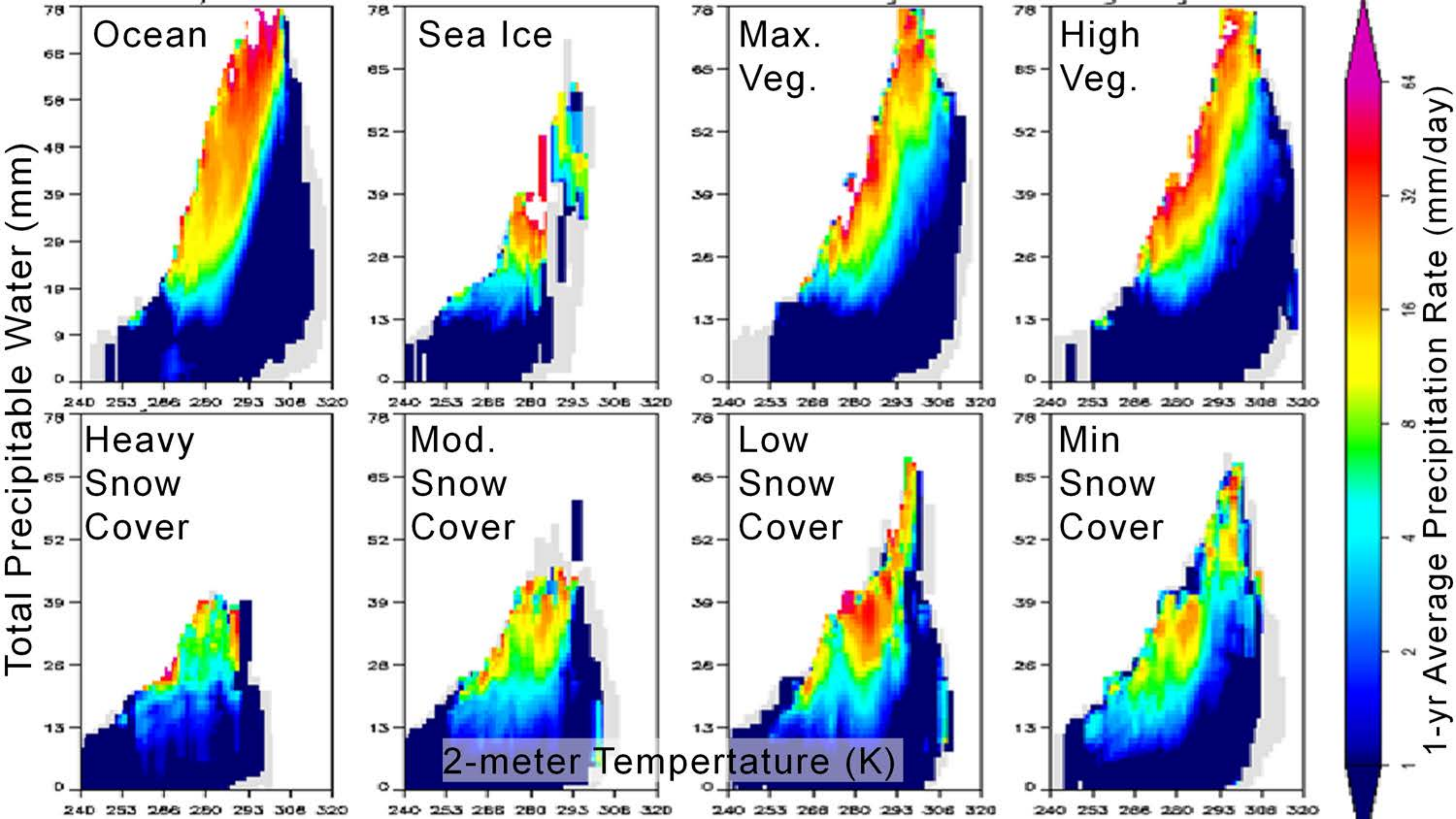


# Total Precipitable Water

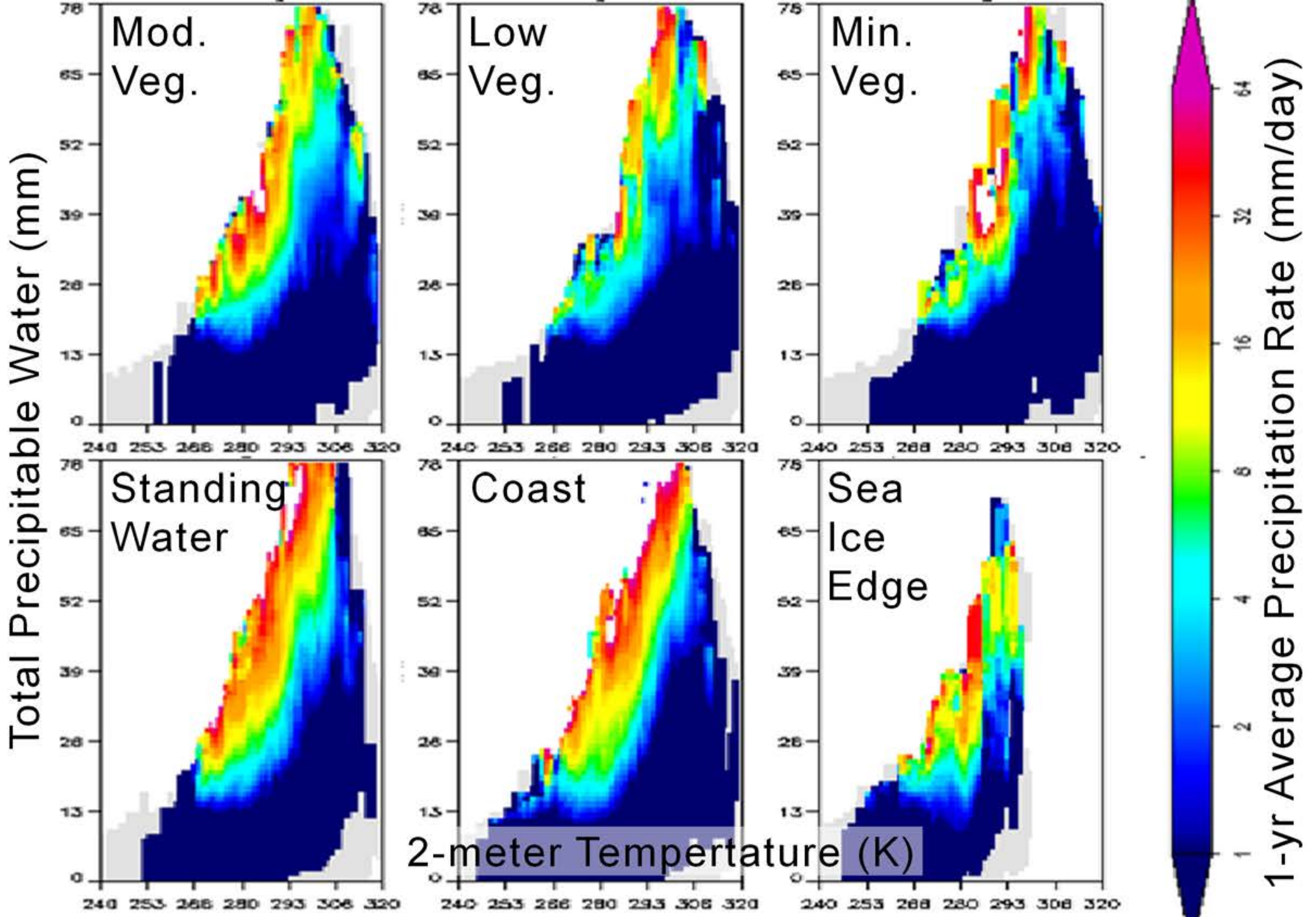


# 2-meter Temperature

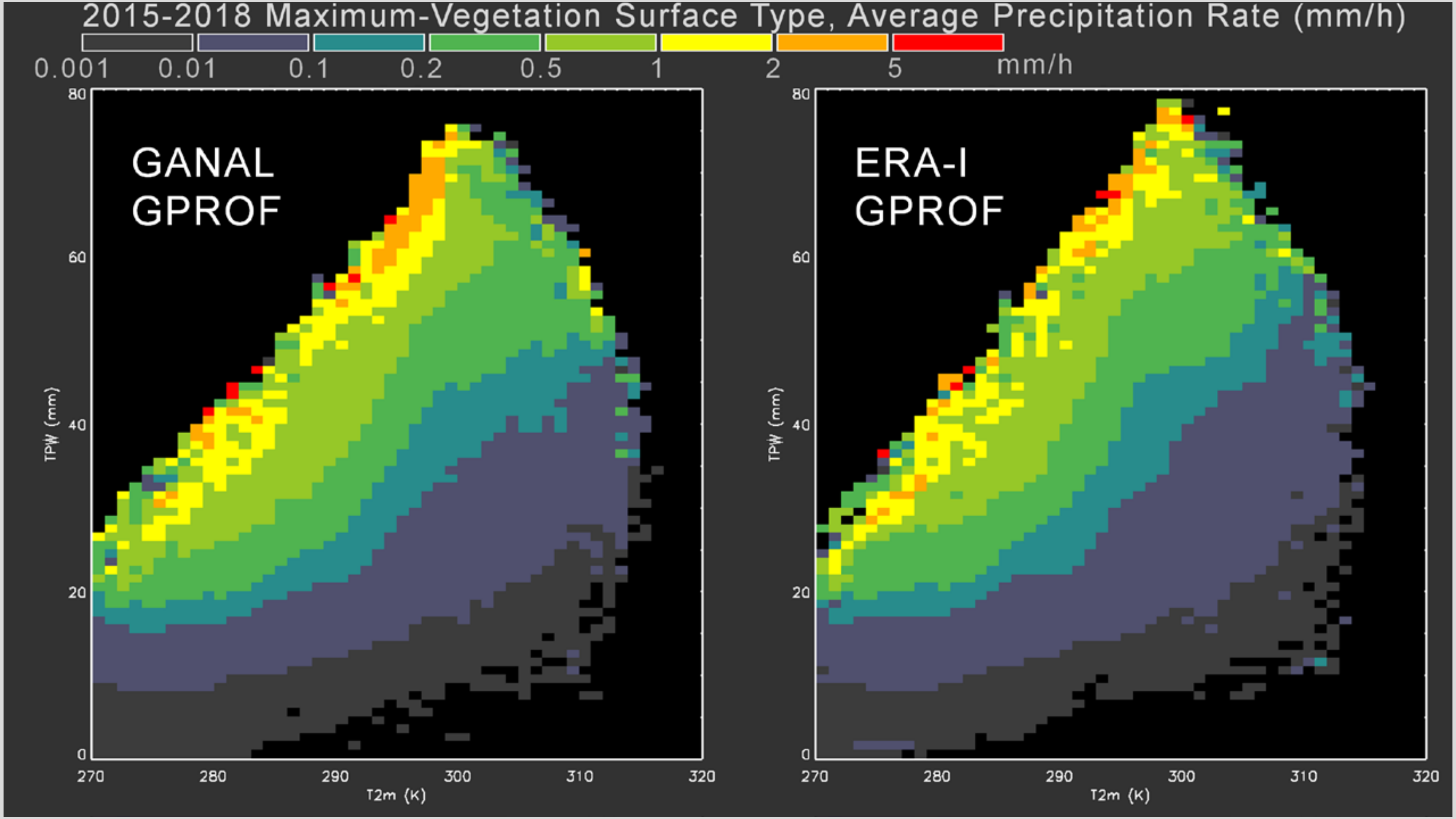


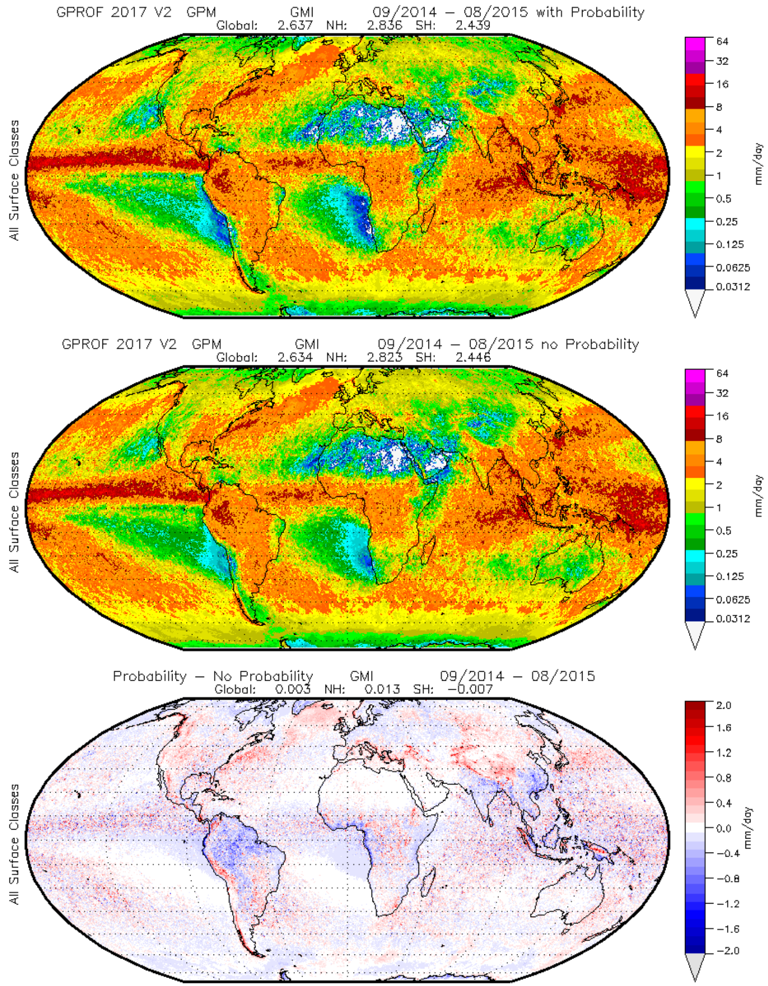


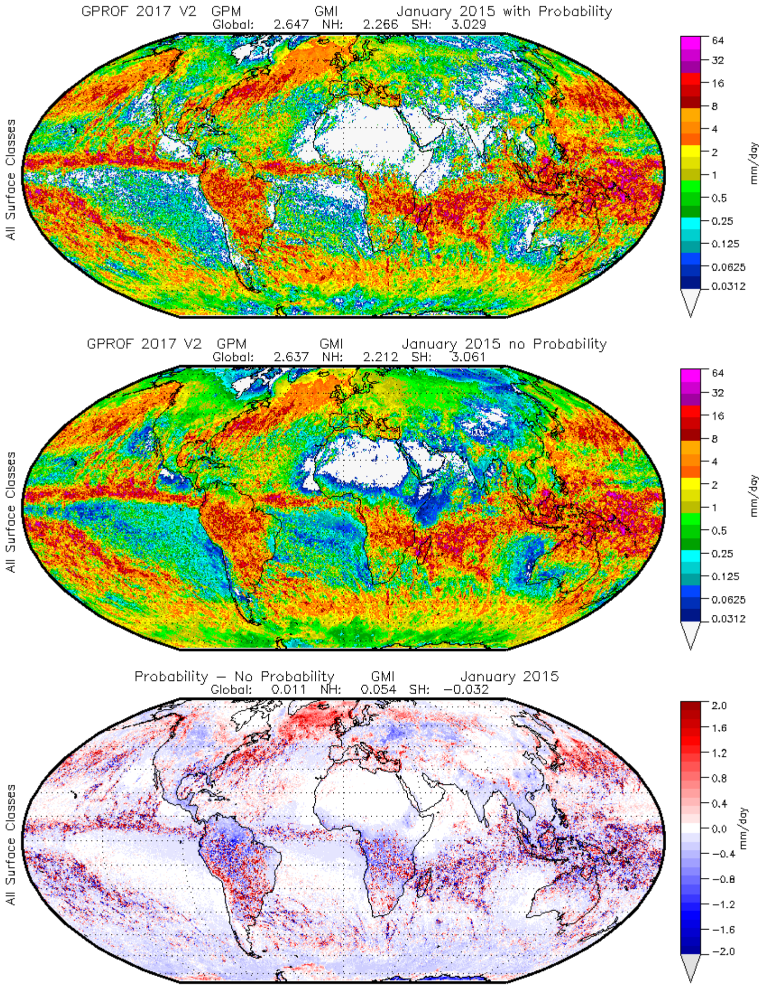
Ocean
Sea Ice
Max. Veg.
High Veg.
Heavy Snow Cover
Mod. Snow Cover
Low Snow Cover
Min Snow Cover
Total Precipitable Water (mm)
2-meter Tempertature (K)
1-yr Average Precipitation Rate (mm/day)

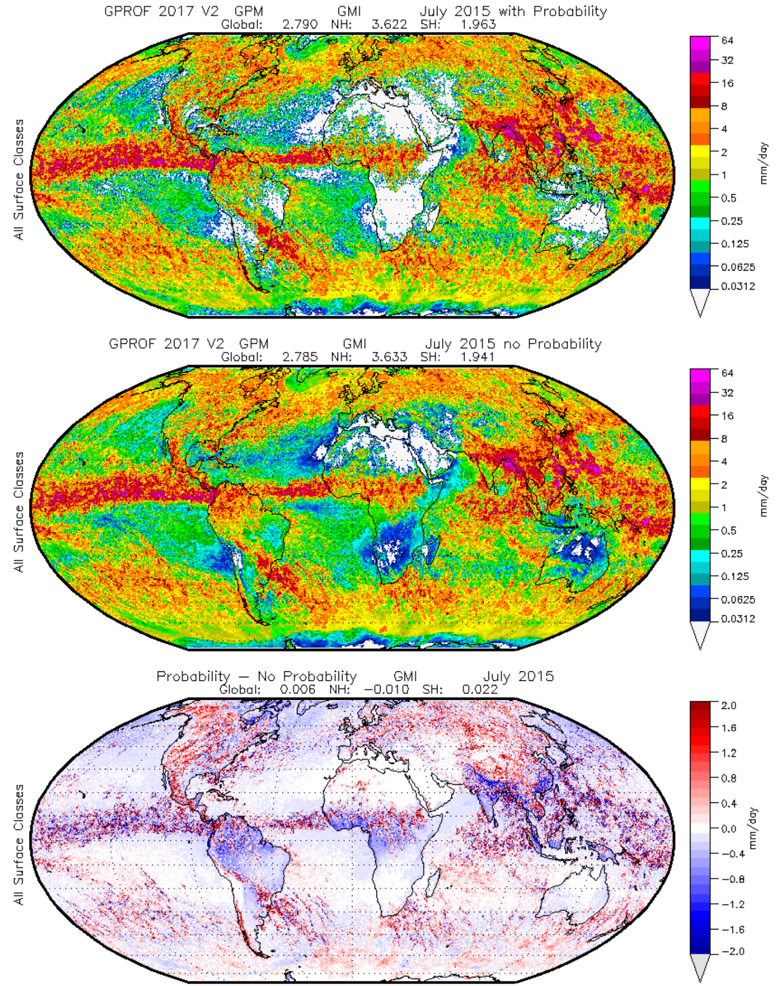

Mod. Veg.
Low Veg.
Min. Veg.
Standing Water
Coast
Sea Ice Edge
Total Precipitable Water (mm)
2-meter Tempertature (K)
1-yr Average Precipitation Rate (mm/day)
0
13
26
39
52
65
78
240
253
266
280
293
306
320
1
2
4
8
16
32
64

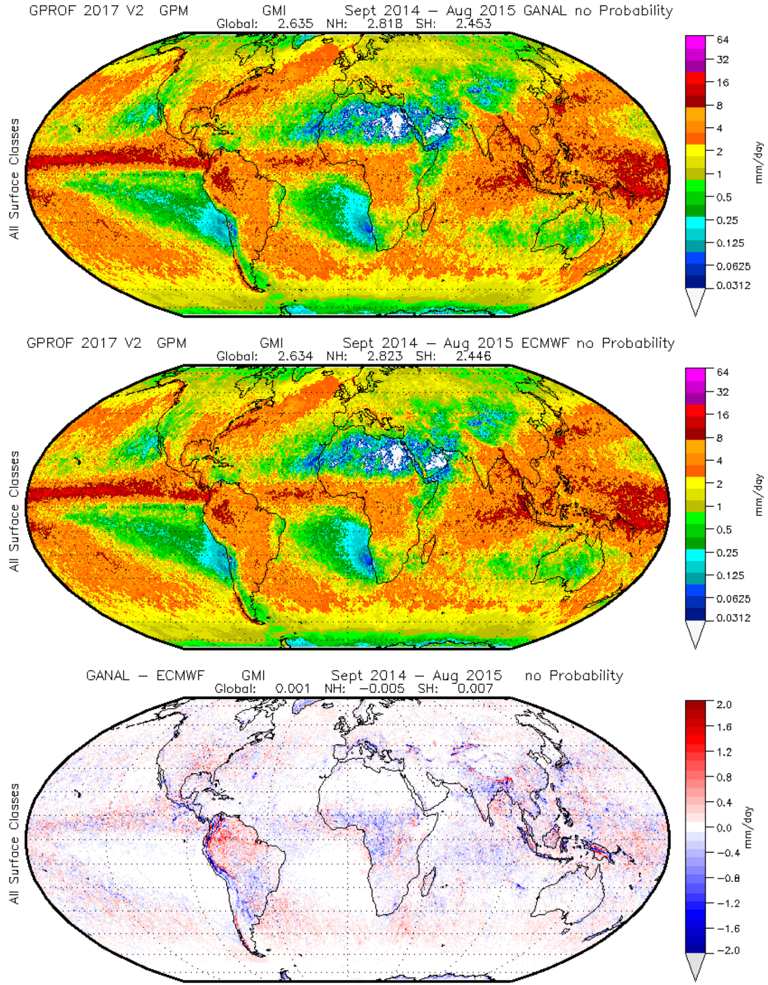
# Max Vegetation

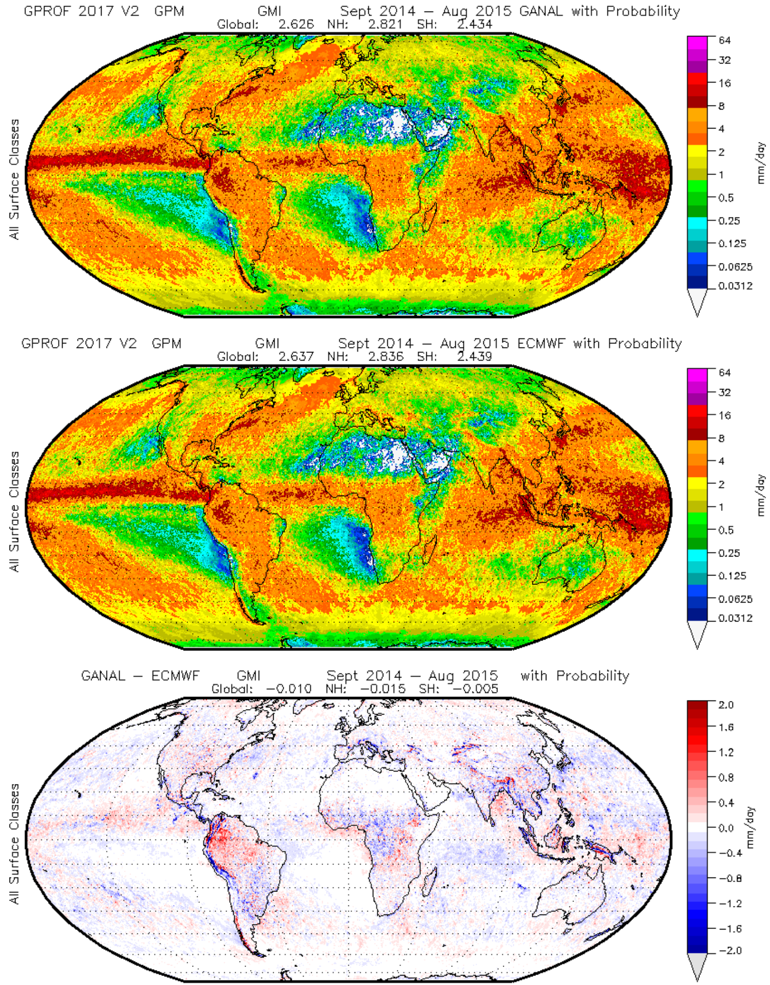


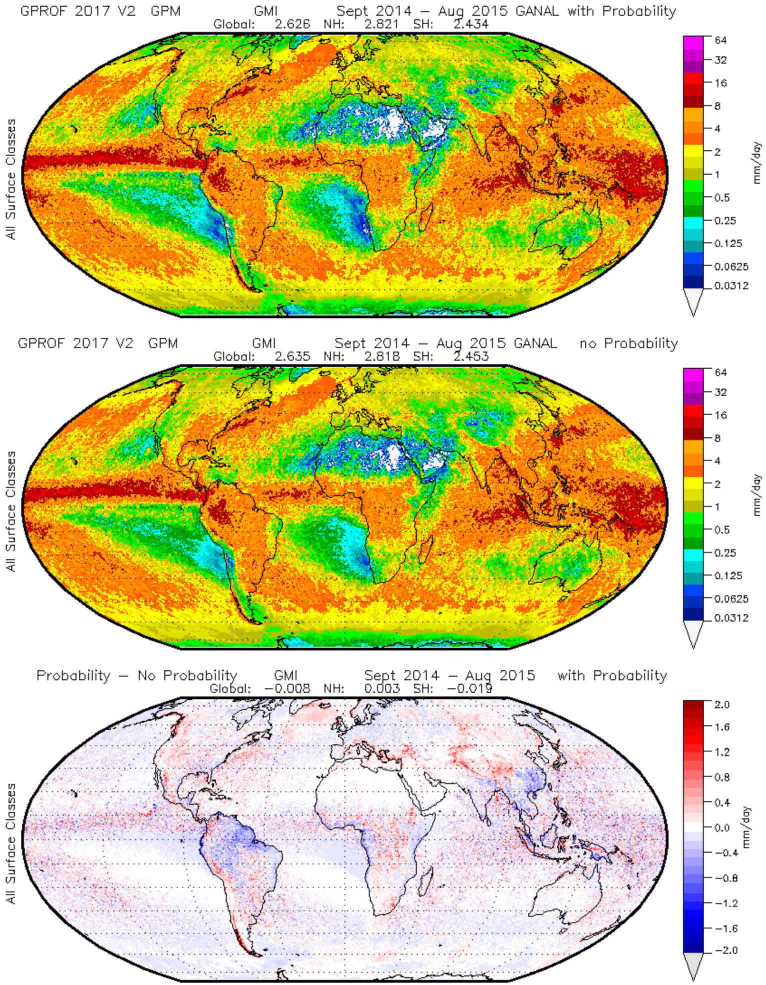

GPROF 2017 V2 GPM GMI 09/2014 – 08/2015 with Probability
Global: 2.637 NH: 2.836 SH: 2.439
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
GPROF 2017 V2 GPM GMI 09/2014 – 08/2015 no Probability
Global: 2.634 NH: 2.823 SH: 2.446
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
Probability – No Probability GMI 09/2014 – 08/2015
Global: 0.003 NH: 0.013 SH: -0.007
All Surface Classes
2.0
1.6
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.6
-2.0
mm/day


GPROF 2017 V2 GPM GMI January 2015 with Probability
Global: 2.647 NH: 2.266 SH: 3.029
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
GPROF 2017 V2 GPM GMI January 2015 no Probability
Global: 2.637 NH: 2.212 SH: 3.061
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
Probability – No Probability GMI January 2015
Global: 0.011 NH: 0.054 SH: −0.032
All Surface Classes
2.0
1.6
1.2
0.8
0.4
0.0
−0.4
−0.8
−1.2
−1.6
−2.0
mm/day


GPROF 2017 V2 GPM GMI July 2015 with Probability
Global: 2.790 NH: 3.622 SH: 1.963
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
GPROF 2017 V2 GPM GMI July 2015 no Probability
Global: 2.785 NH: 3.633 SH: 1.941
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
Probability – No Probability GMI July 2015
Global: 0.006 NH: –0.010 SH: 0.022
All Surface Classes
2.0
1.6
1.2
0.8
0.4
0.0
–0.4
–0.8
–1.2
–1.6
–2.0
mm/day


GPROF 2017 V2 GPM GMI Sept 2014 – Aug 2015 GANAL no Probability
Global: 2.635 NH: 2.818 SH: 2.453
All Surface Classes
mm/day
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
GPROF 2017 V2 GPM GMI Sept 2014 – Aug 2015 ECMWF no Probability
Global: 2.634 NH: 2.823 SH: 2.446
All Surface Classes
mm/day
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
GANAL – ECMWF GMI Sept 2014 – Aug 2015 no Probability
Global: 0.001 NH: –0.005 SH: 0.007
All Surface Classes
mm/day
2.0
1.6
1.2
0.8
0.4
0.0
–0.4
–0.8
–1.2
–1.6
–2.0


GPROF 2017 V2 GPM GMI Sept 2014 – Aug 2015 GANAL with Probability
Global: 2.626 NH: 2.821 SH: 2.434
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
GPROF 2017 V2 GPM GMI Sept 2014 – Aug 2015 ECMWF with Probability
Global: 2.637 NH: 2.836 SH: 2.439
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
GANAL – ECMWF GMI Sept 2014 – Aug 2015 with Probability
Global: –0.010 NH: –0.015 SH: –0.005
All Surface Classes
2.0
1.6
1.2
0.8
0.4
0.0
–0.4
–0.8
–1.2
–1.6
–2.0
mm/day


GPROF 2017 V2 GPM GMI Sept 2014 – Aug 2015 GANAL with Probability
Global: 2.626 NH: 2.821 SH: 2.434
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
GPROF 2017 V2 GPM GMI Sept 2014 – Aug 2015 GANAL no Probability
Global: 2.635 NH: 2.818 SH: 2.453
All Surface Classes
64
32
16
8
4
2
1
0.5
0.25
0.125
0.0625
0.0312
mm/day
Probability – No Probability GMI Sept 2014 – Aug 2015 with Probability
Global: −0.008 NH: 0.003 SH: −0.019
All Surface Classes
2.0
1.6
1.2
0.8
0.4
0.0
−0.4
−0.8
−1.2
−1.6
−2.0
mm/day

The next 6 slides are the GPROF GPM V5 GMI surface rain plots for:

1) Sep 2014 – Aug 2015 (annual average) for Probability added (this is the Operational GPROF product), no Probability, and the difference. By algorithm design the annual averages should be VERY close, and they are. But regional differences can be seen in the difference plot.

2) January 2015 for the same as in 1)
3) July 2015 for the same as in 1)
4) Sep 2014 - Aug 2015 (GANAL – ECMWF) no probability

# Patterns and Cautions

## Patterns:

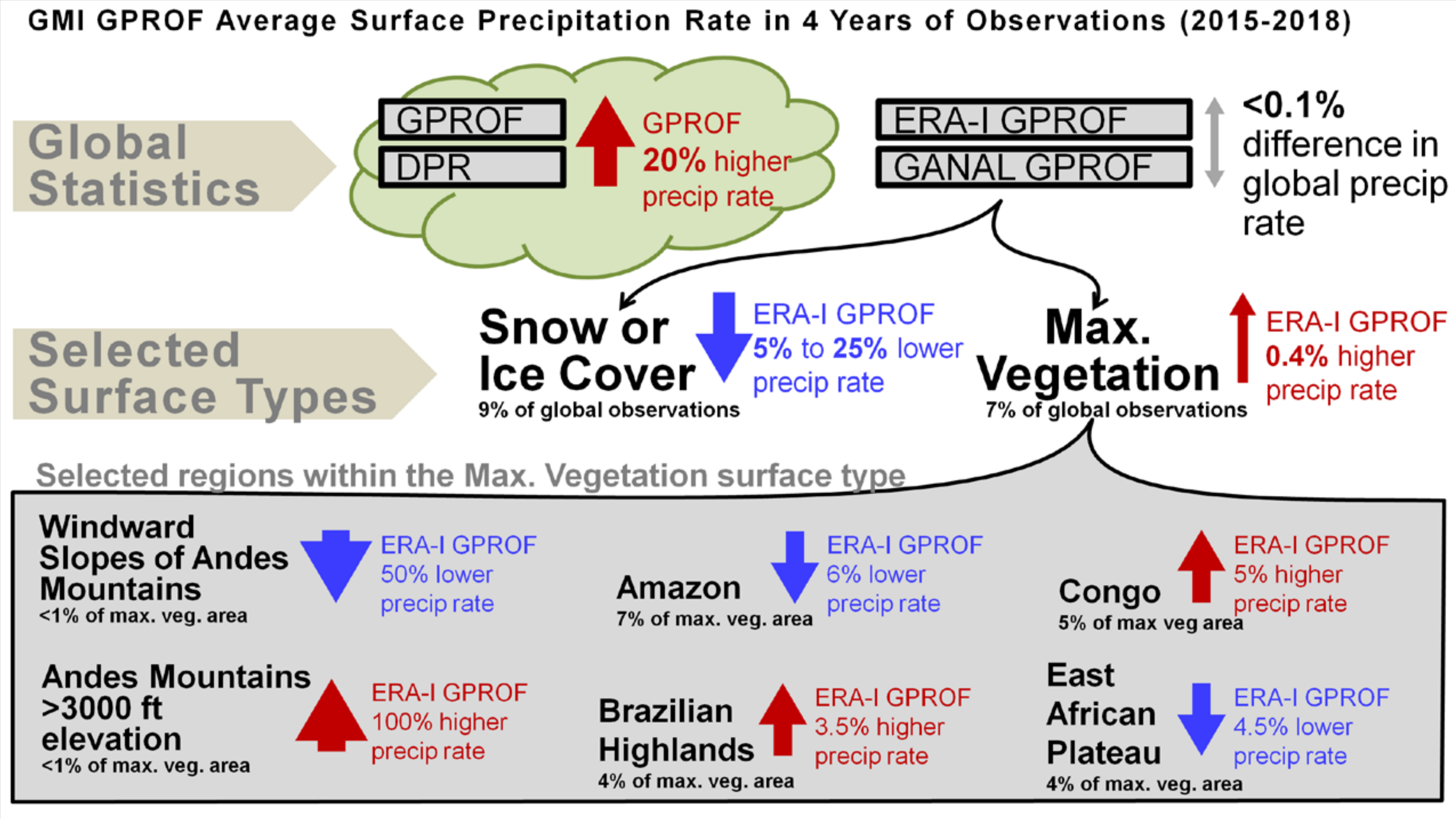
- The 4-year global average precipitation rate is almost identical in the ERA-I and GANAL runs of the 2A-GPROF-GMI precipitation estimation algorithm: <0.1% difference in average precip rate.
- Larger precipitation-rate differences occur in difficult-to-retrieve regions: snow-covered areas (up to 25% difference in 4-year avg precip rate) or mountains (factor of 2 differences in avg precip rate).

## Cautions:

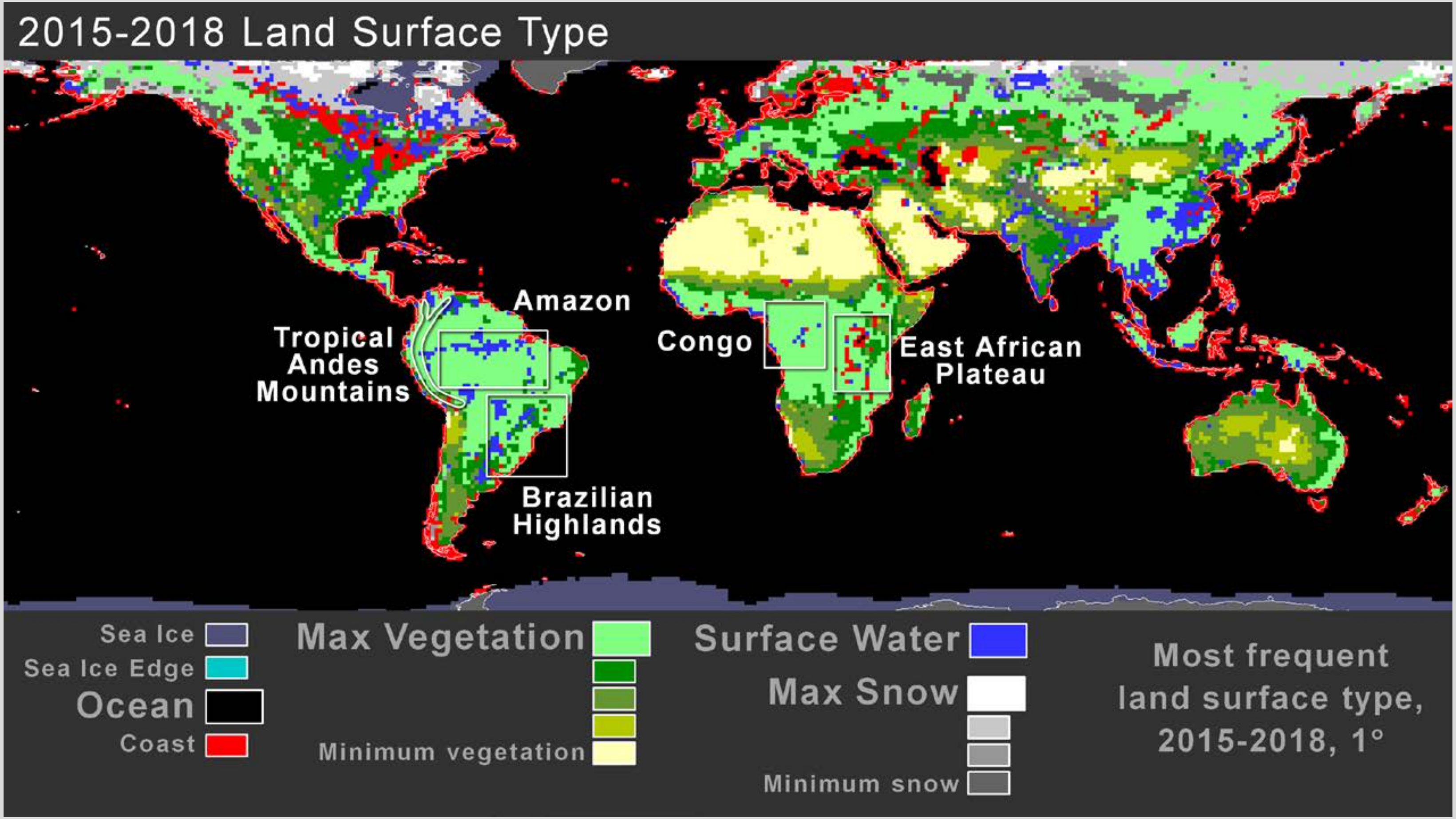
- Researchers should stick to one run of GPROF in their analysis: do NOT mix ERA-I and GANAL runs.
- Researchers should use caution over regions of the world where microwave precipitation retrievals face challenges.

# Extra Slides

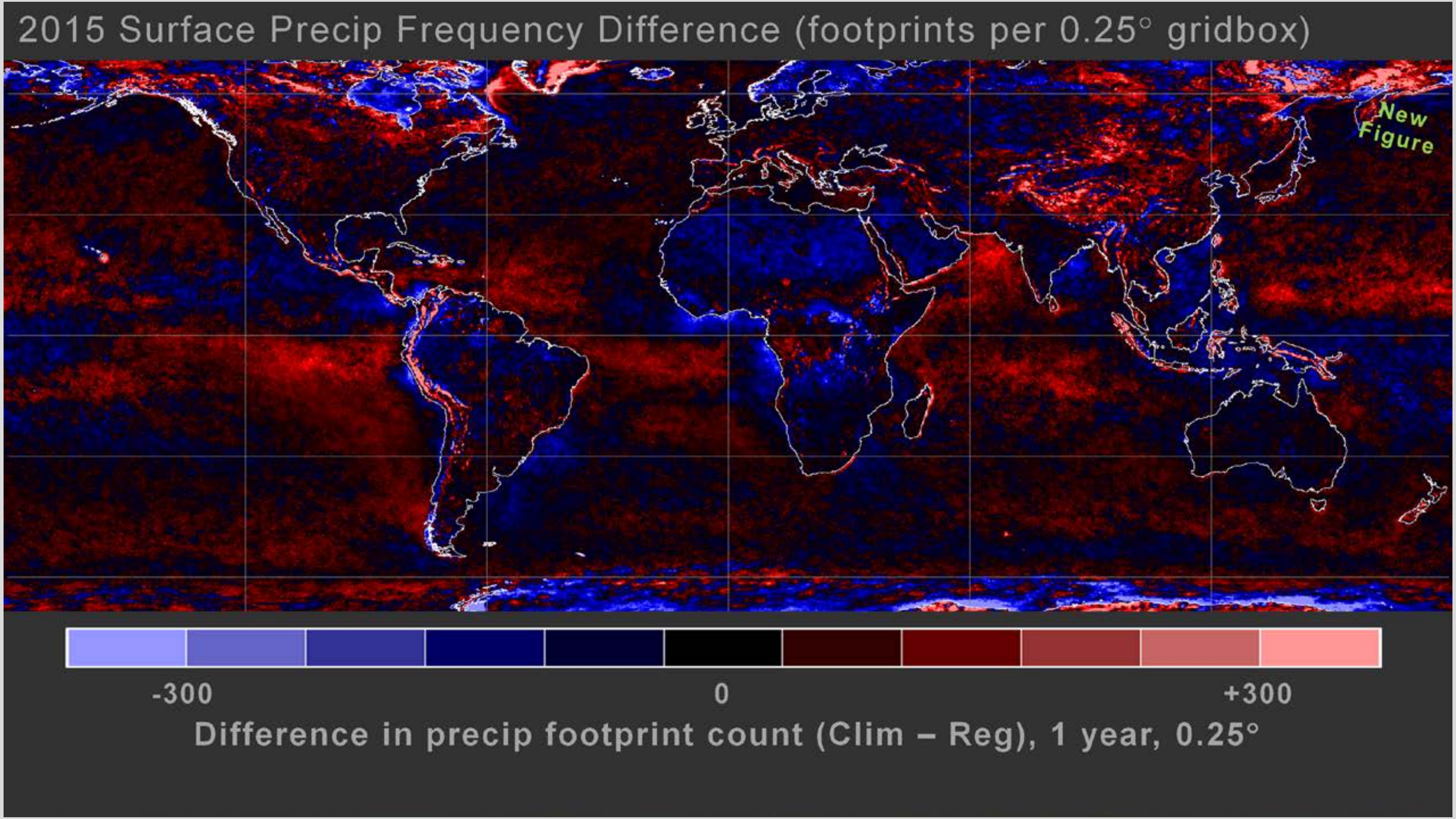
# Global vs. Regional Differences



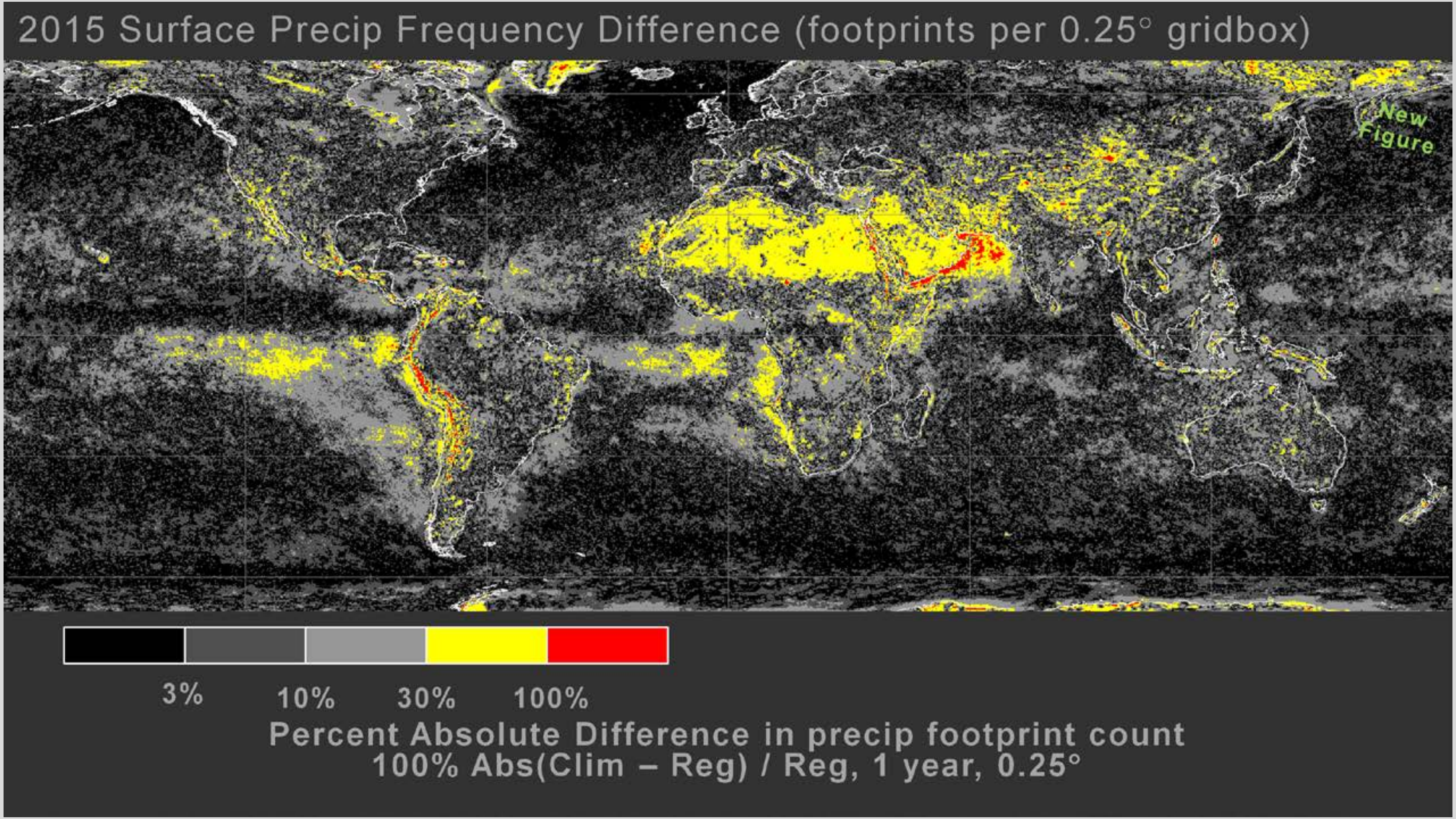
# Surface Type



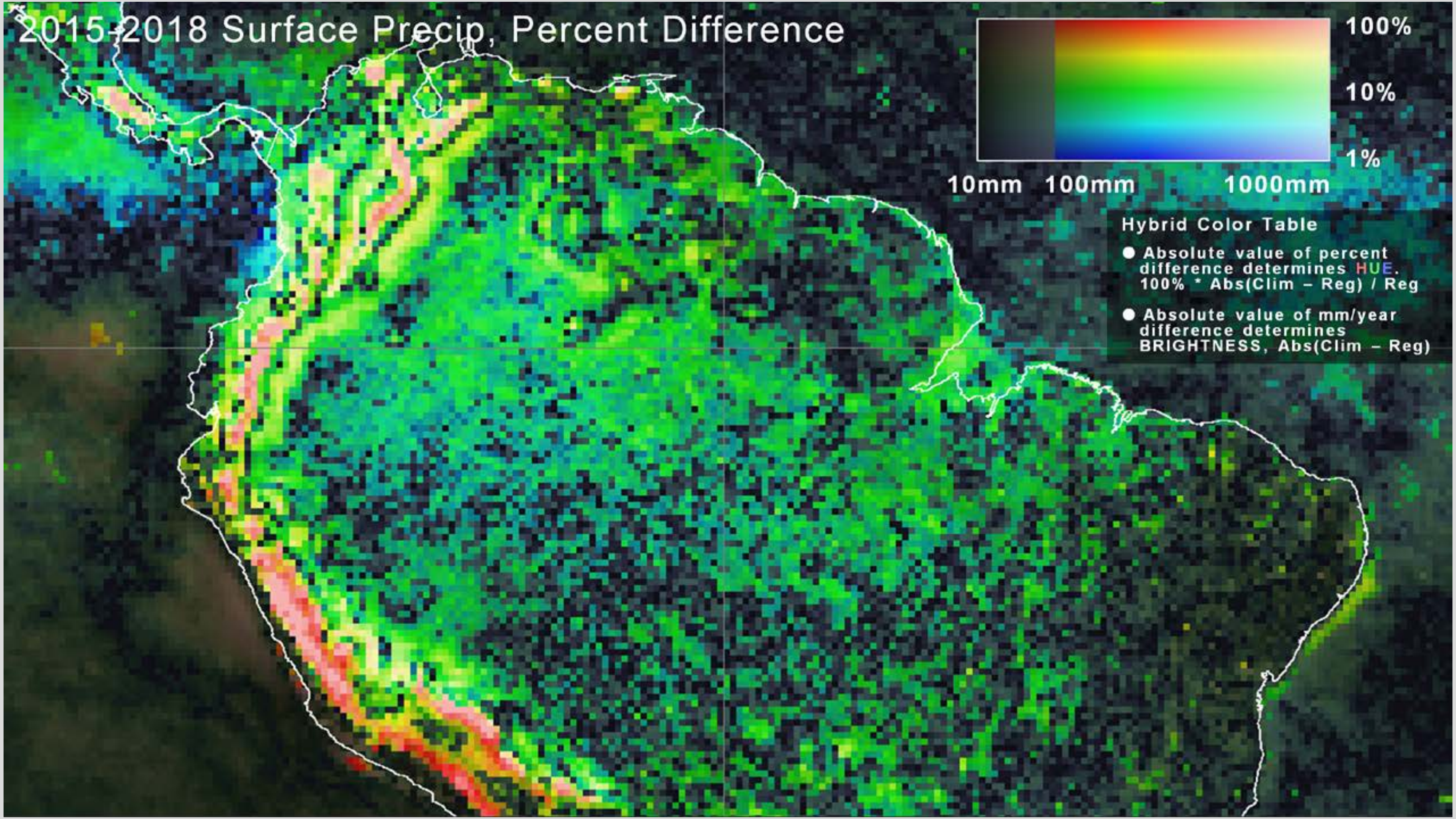
# Precip Frequency Difference



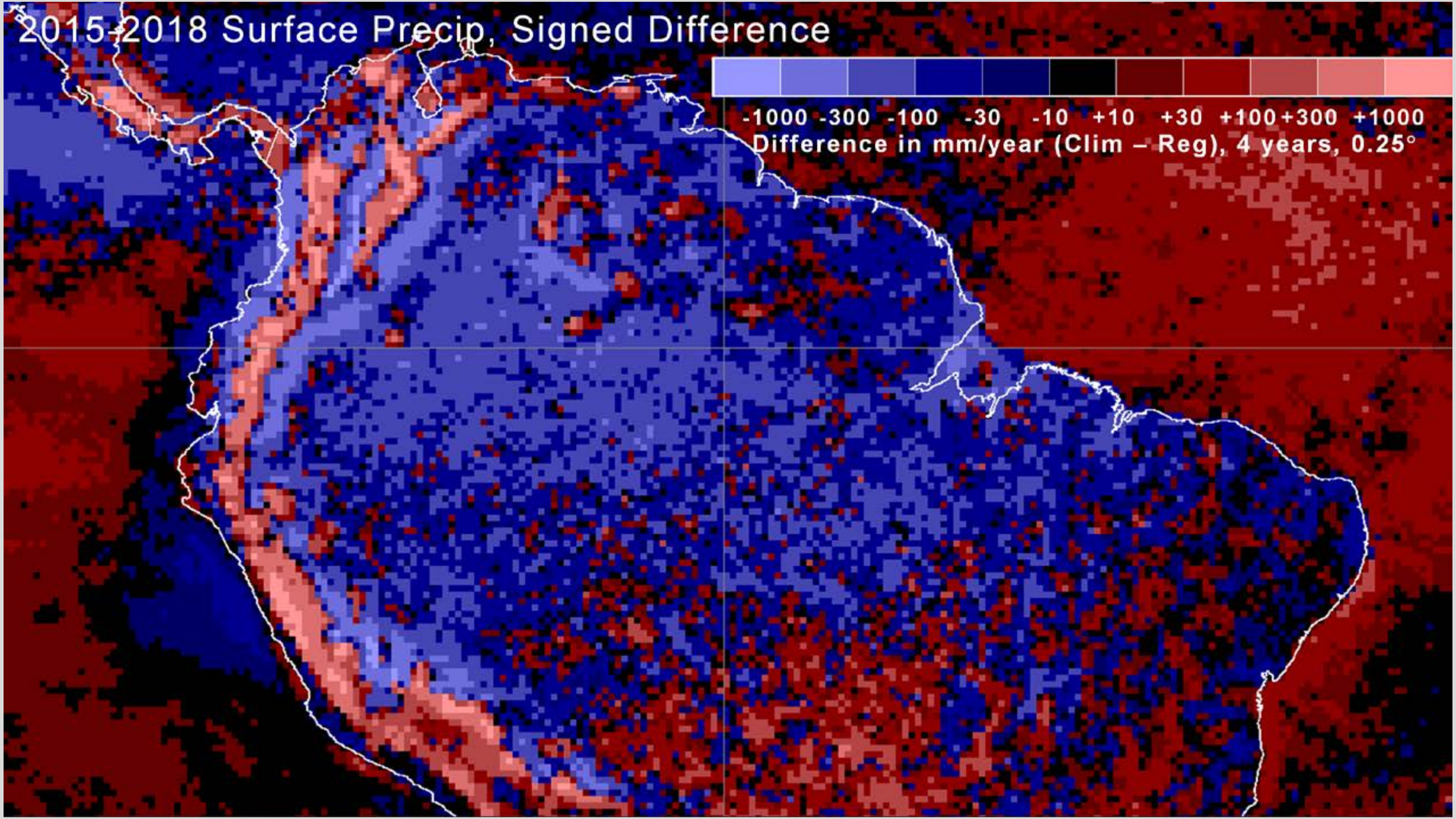
# Precip Frequency Difference



# Amazon


2015-2018 Surface Precip, Percent Difference
100%
10%
1%
10mm 100mm 1000mm
Hybrid Color Table
Absolute value of percent difference determines HUE. 100% * Abs(Clim – Reg) / Reg
Absolute value of mm/year difference determines BRIGHTNESS, Abs(Clim – Reg)

# Amazon


2015-2018 Surface Precip, Signed Difference
-1000 -300 -100 -30 -10 +10 +30 +100 +300 +1000
Difference in mm/year (Clim – Reg), 4 years, 0.25°

# Amazon