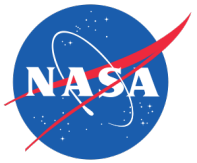
IMERG Evaluation at Pixel Level by Sensor and Surface Types for GPM Ground Validation

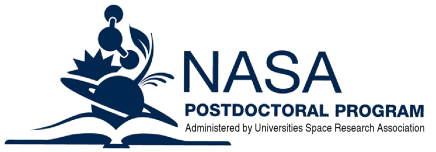
Jackson Tan

NASA Postdoctoral Fellow

GSFC / USRA

Walter Petersen and Pierre Kirstetter





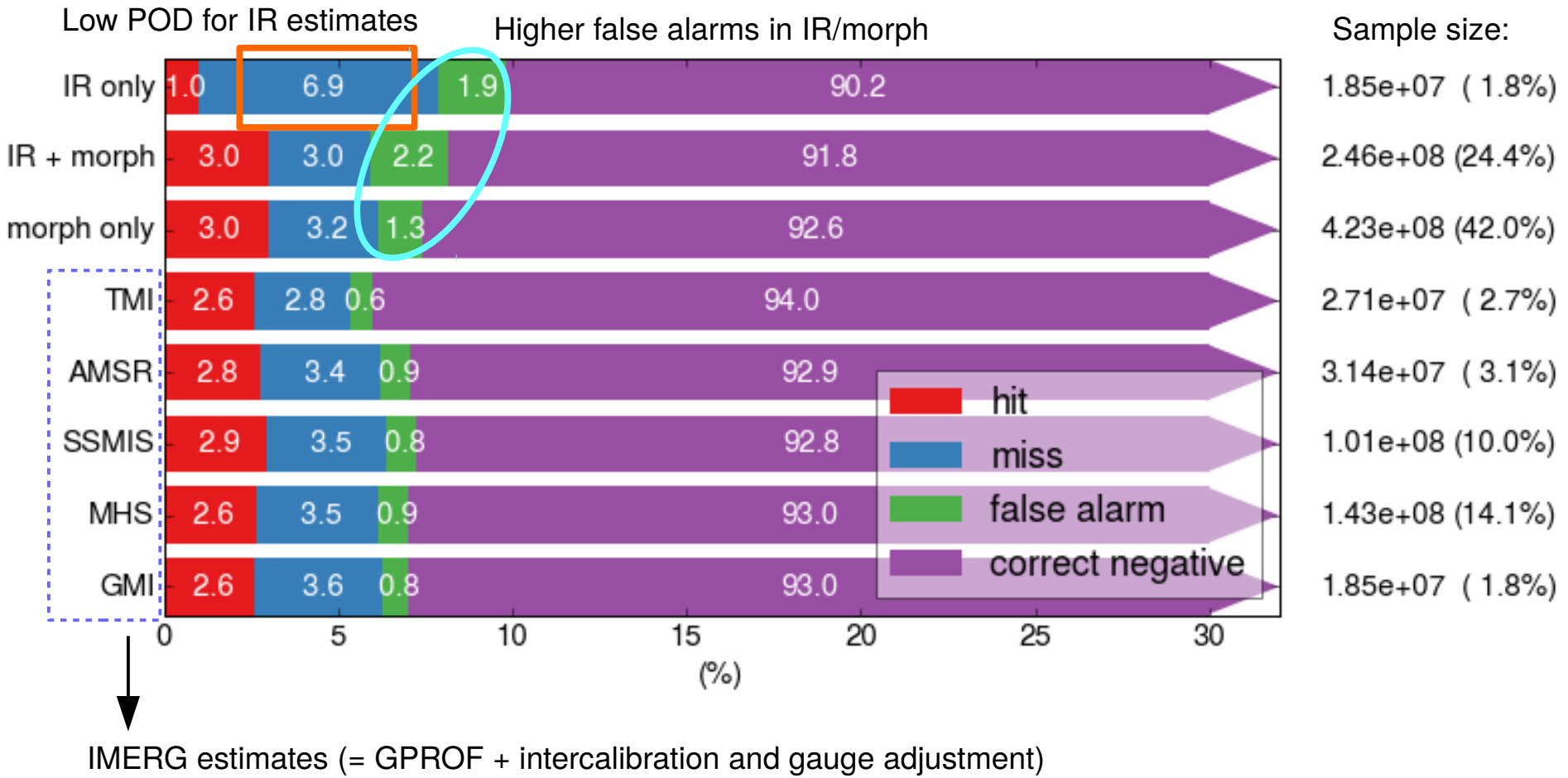
Data & Approach

- Compare IMERG to MRMS over one year (Apr 2014 to Mar 2015) at pixel level, separated by categories of sensor/algorithm type (`HQprecipSource` and `IRkalmanFilterWeight`) and surface type (derived from GPROF).
- IMERG Final run (`precipitationCal`):
  - Level 3 GPM rainfall estimate (V3)
  - gridded PMW estimates (GPROF) + propagation using cloud top motion vectors (CMORPH) + IR precipitation through Kalman filter (PERSIANN) + GPCC gauge adjustment (TMPA)
  - 0.1° between ±60° latitudes at 0.5 h
- MRMS:
  - mosaic of gauge-calibrated surface precipitation from the WSR-88D network; using Level 3 dataset produced for GPM GV (see Pierre's presentation in June)
  - 0.01° over CONUS at 1 h (0.5 h currently in reprocessing)
  - coarsen to IMERG grids, assume same rain rate for both half-hours and selecting the best estimates (no missing values, perfect RQI, no snow)

Comparisons by Sensor/Algorithm

Contingency Table by Sensor

Rain/no-rain threshold = 0.2 mm / h

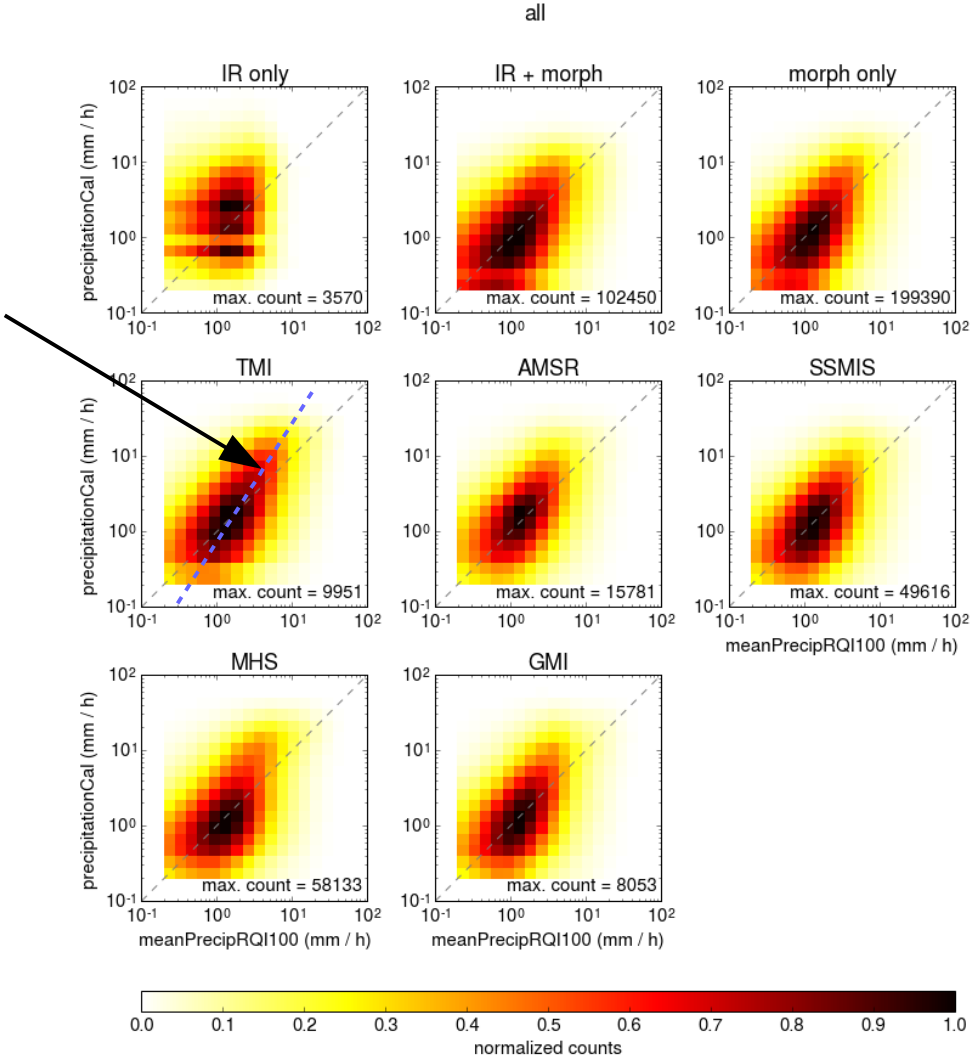


IMERG estimates (= GPROF + intercalibration and gauge adjustment)

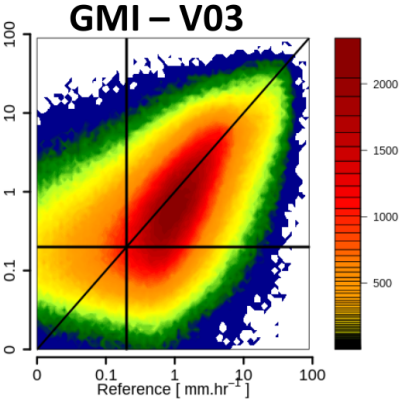
Density Diagram by Sensor

PMW/morphed estimates have a tendency to underestimate low values and overestimate high values.

Note log-log axes

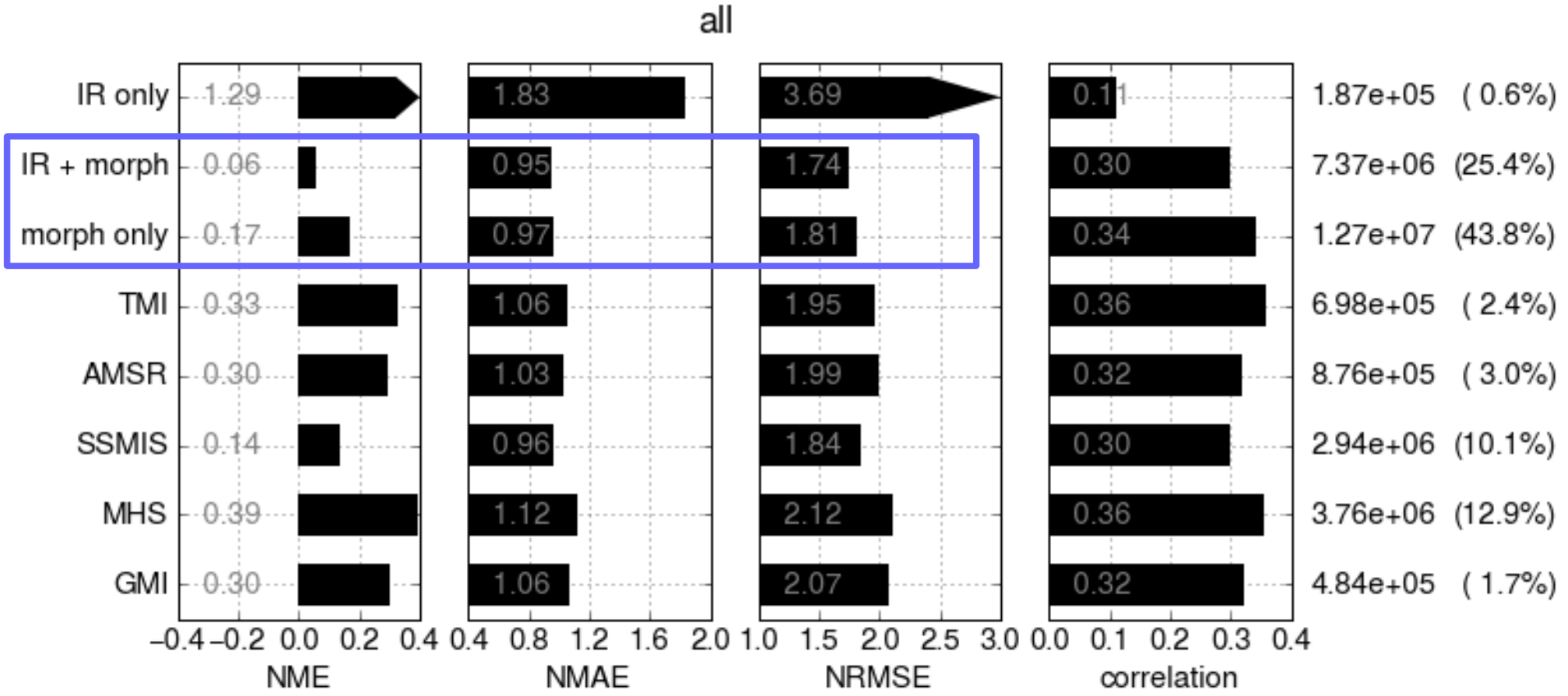


From Pierre's presentation in June:



Error/Correlation by Sensor

Morphed estimates actually outperform PMWs... effect of averaging?

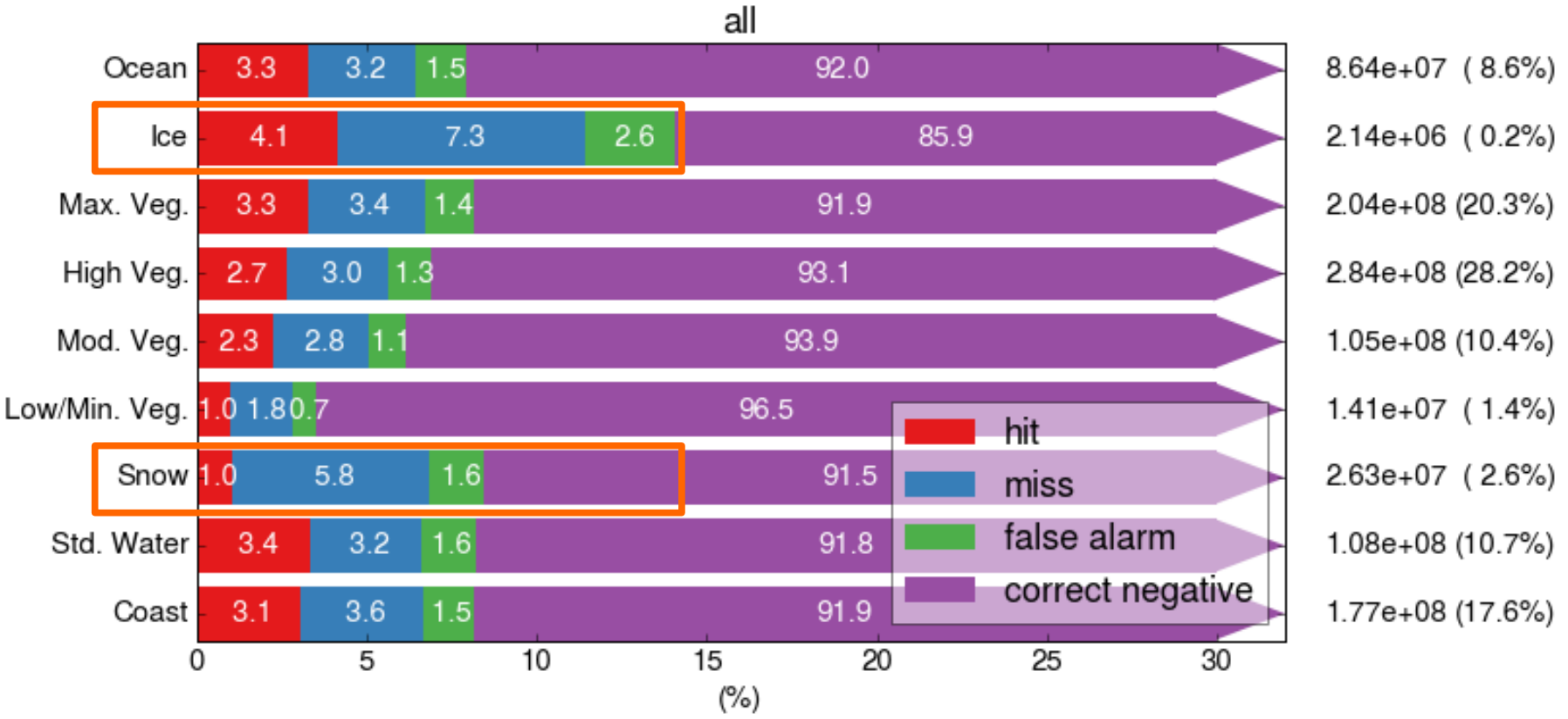


$$\frac{\frac{1}{N}\sum_i (y_i - x_i)}{\bar{x}} \qquad \frac{\frac{1}{N}\sum_i |y_i - x_i|}{\bar{x}} \qquad \frac{\sqrt{\frac{1}{N}\sum_i (y_i - x_i)^2}}{\bar{x}}$$

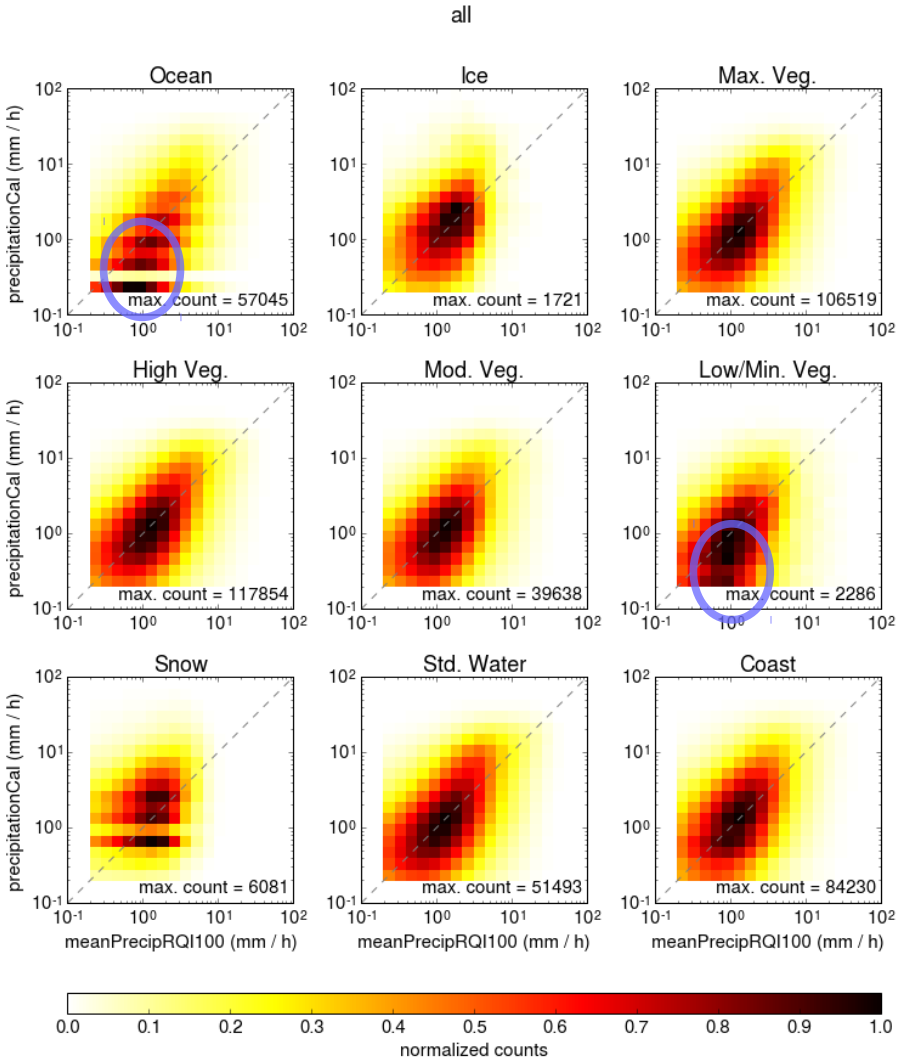
(calculated using only the hits)

Comparisons by Surface

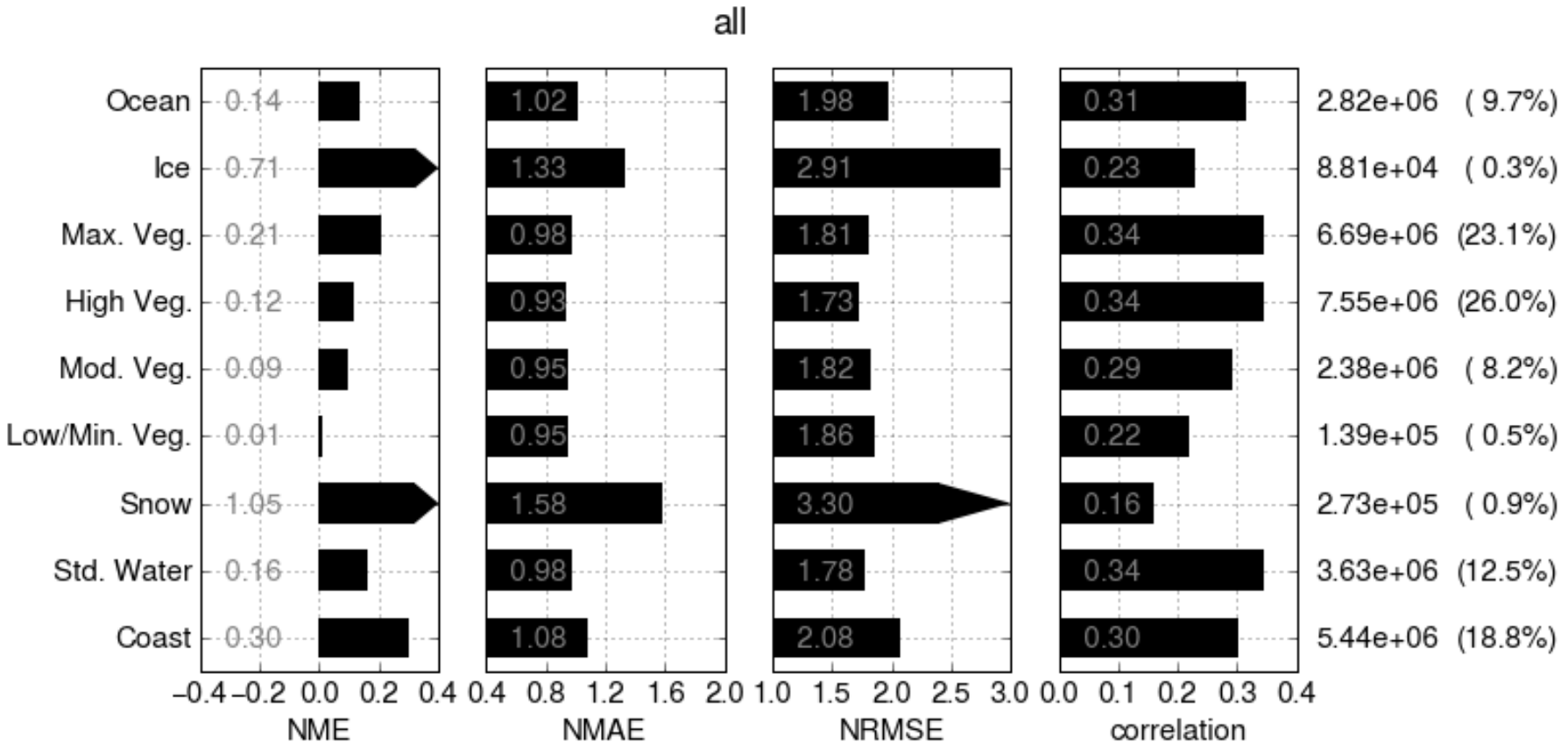
Contingency Table by Surface



Density Diagram by Surface

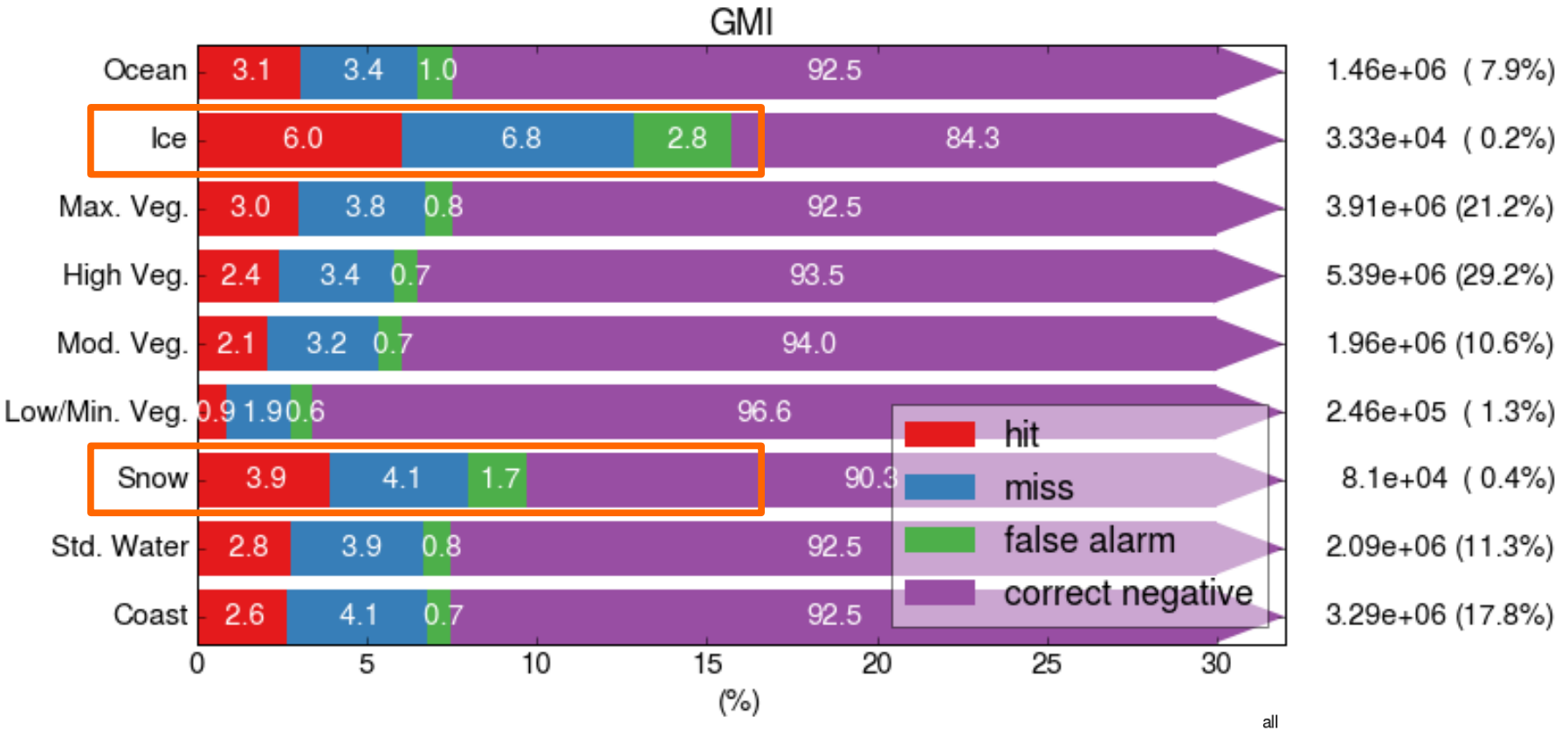


Error/Correlation by Surface

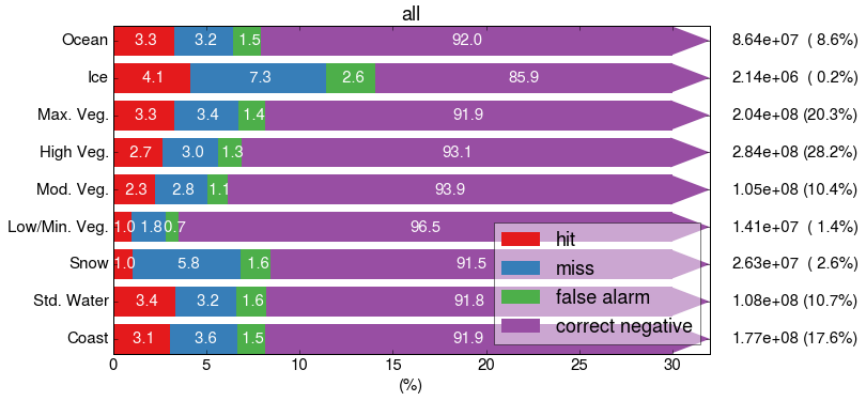


Comparisons for GMI

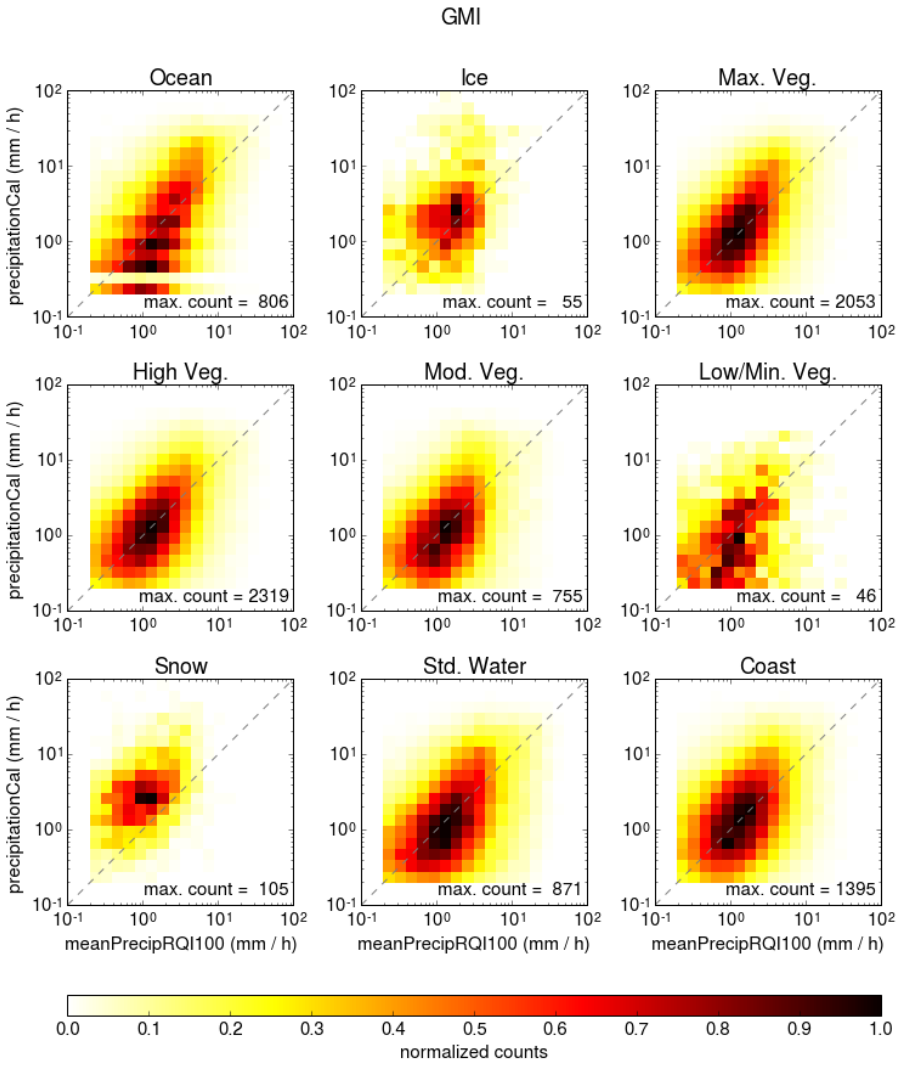
Contingency Table for GMI

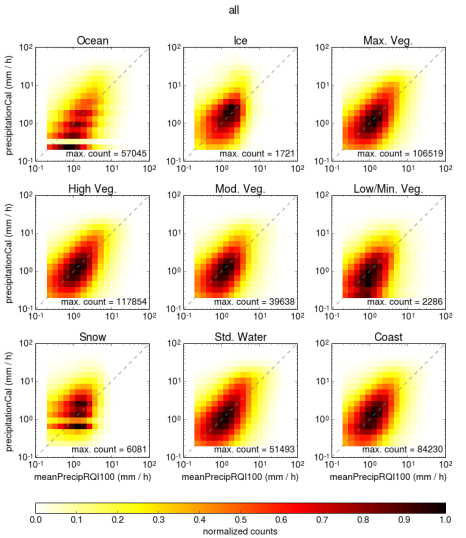


Detection over ice and snow is better,
but slightly worse over other surfaces.

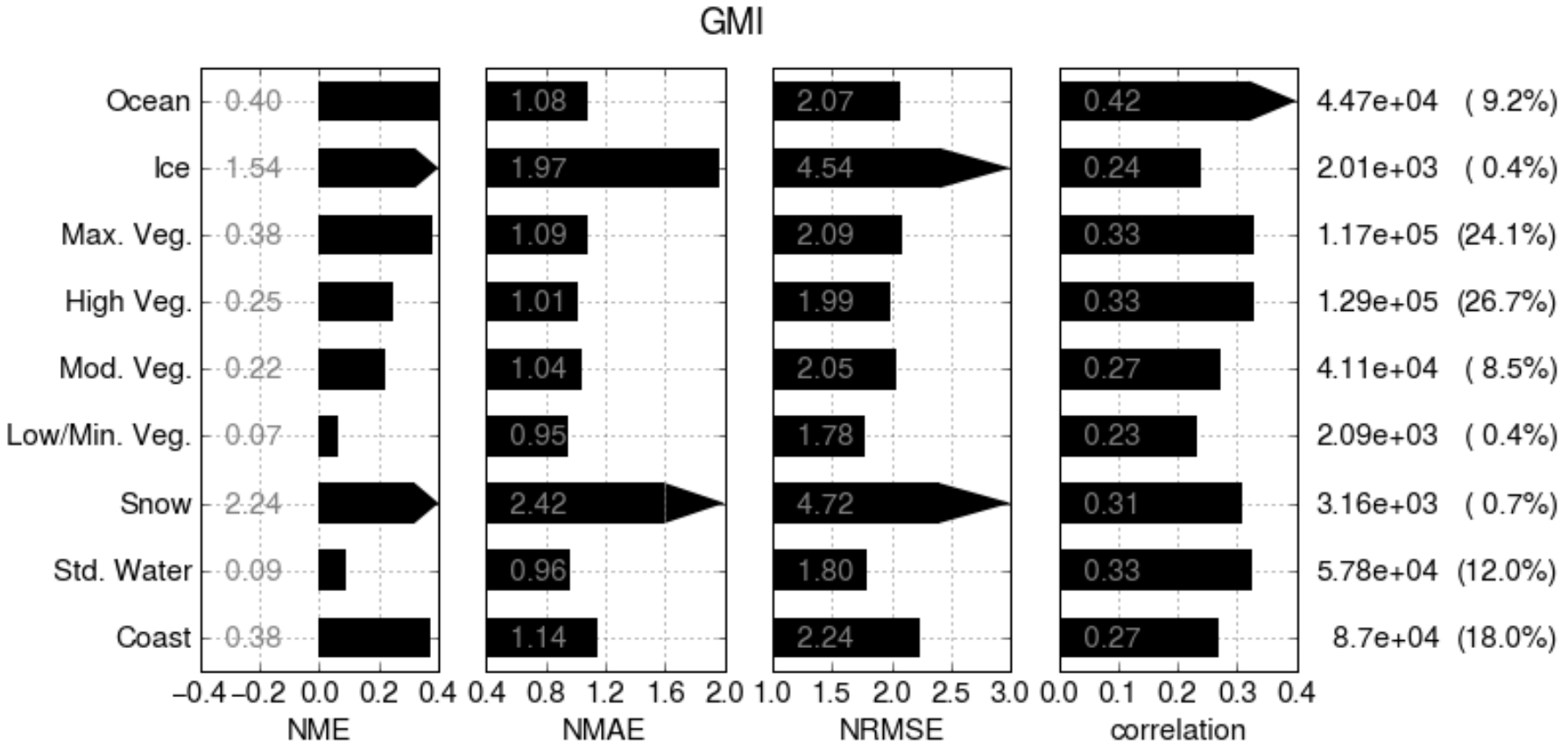


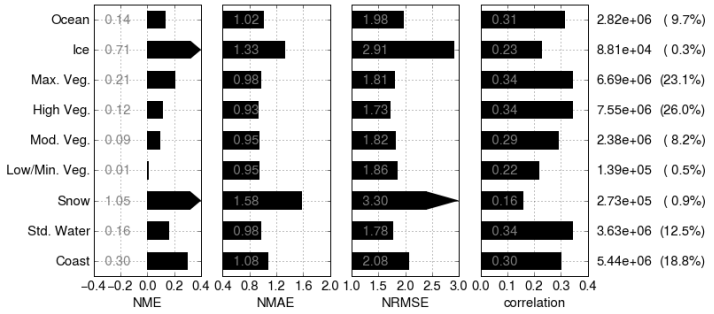
Density Diagram for GMI





Error/Correlation for GMI

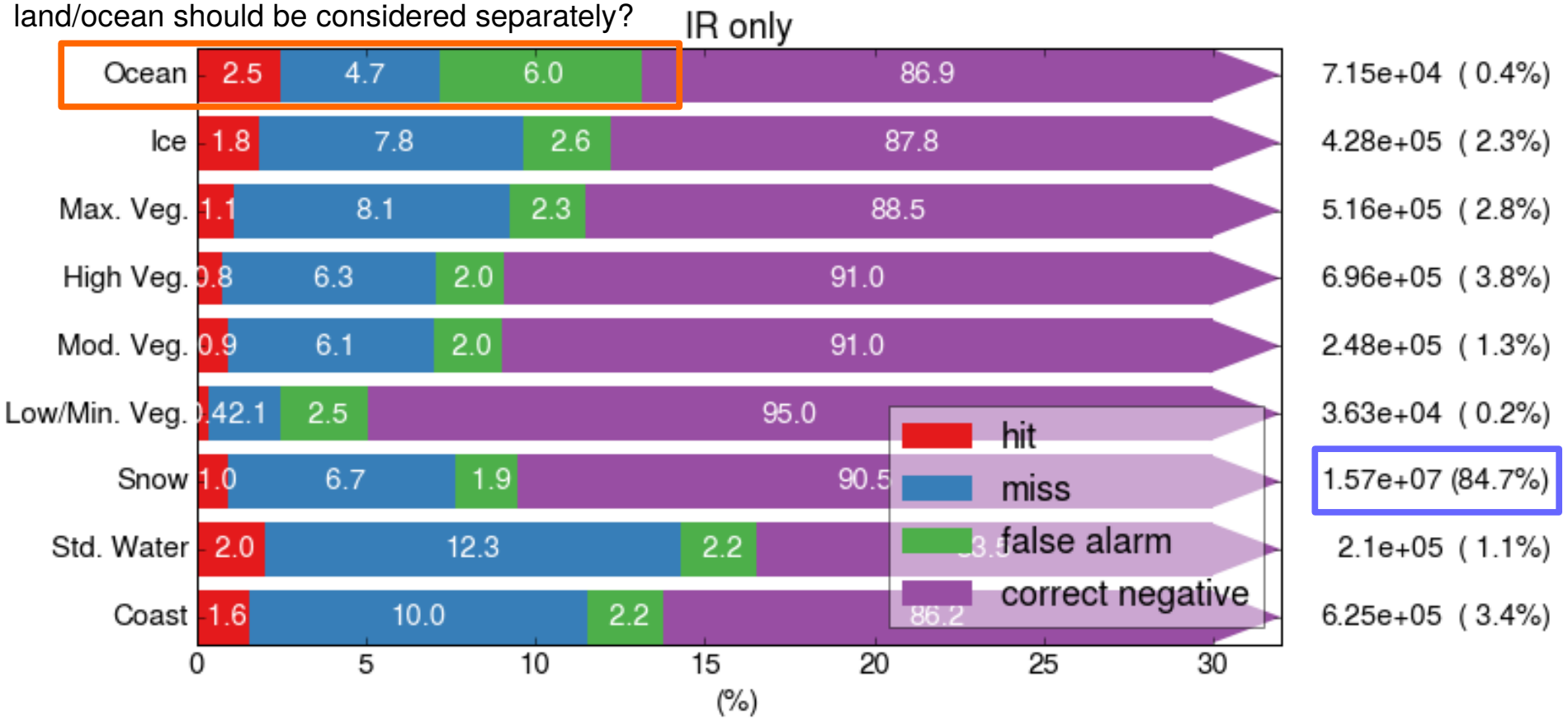




The Really Bad Categories

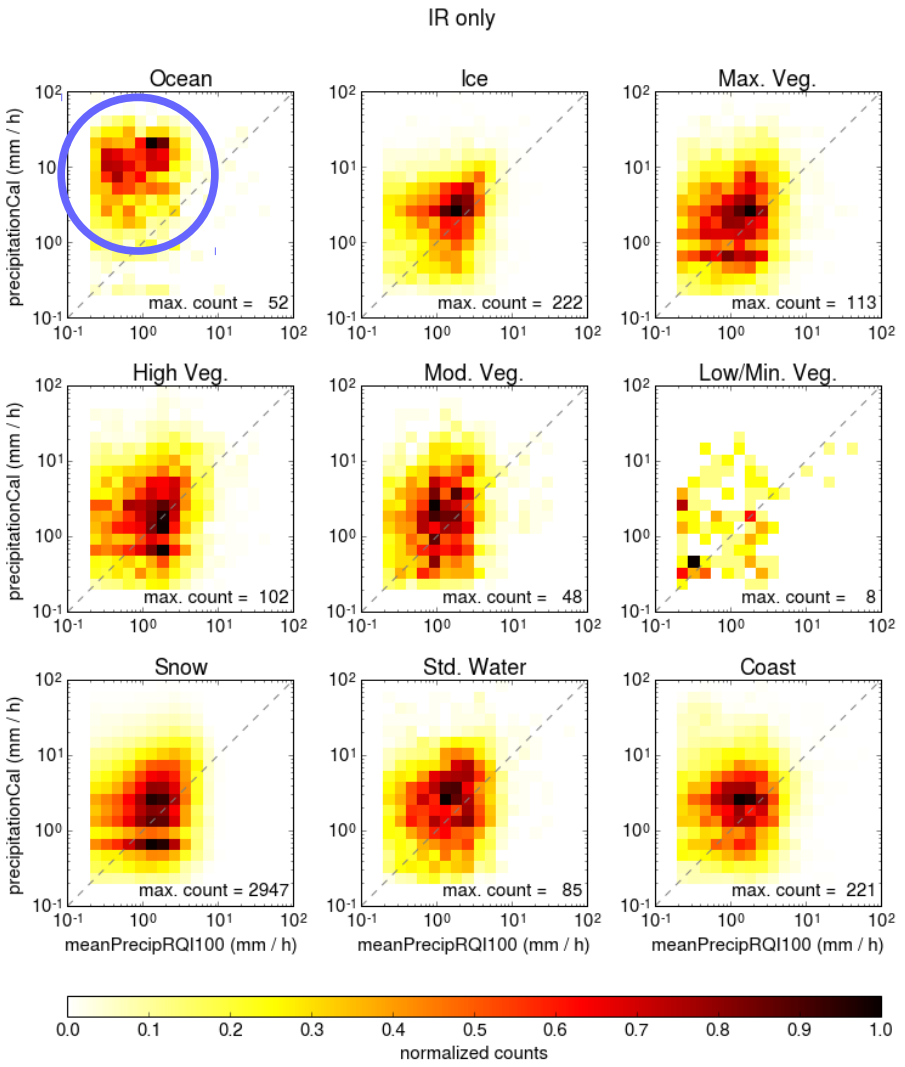
Contingency Table for IR Only

land/ocean should be considered separately?



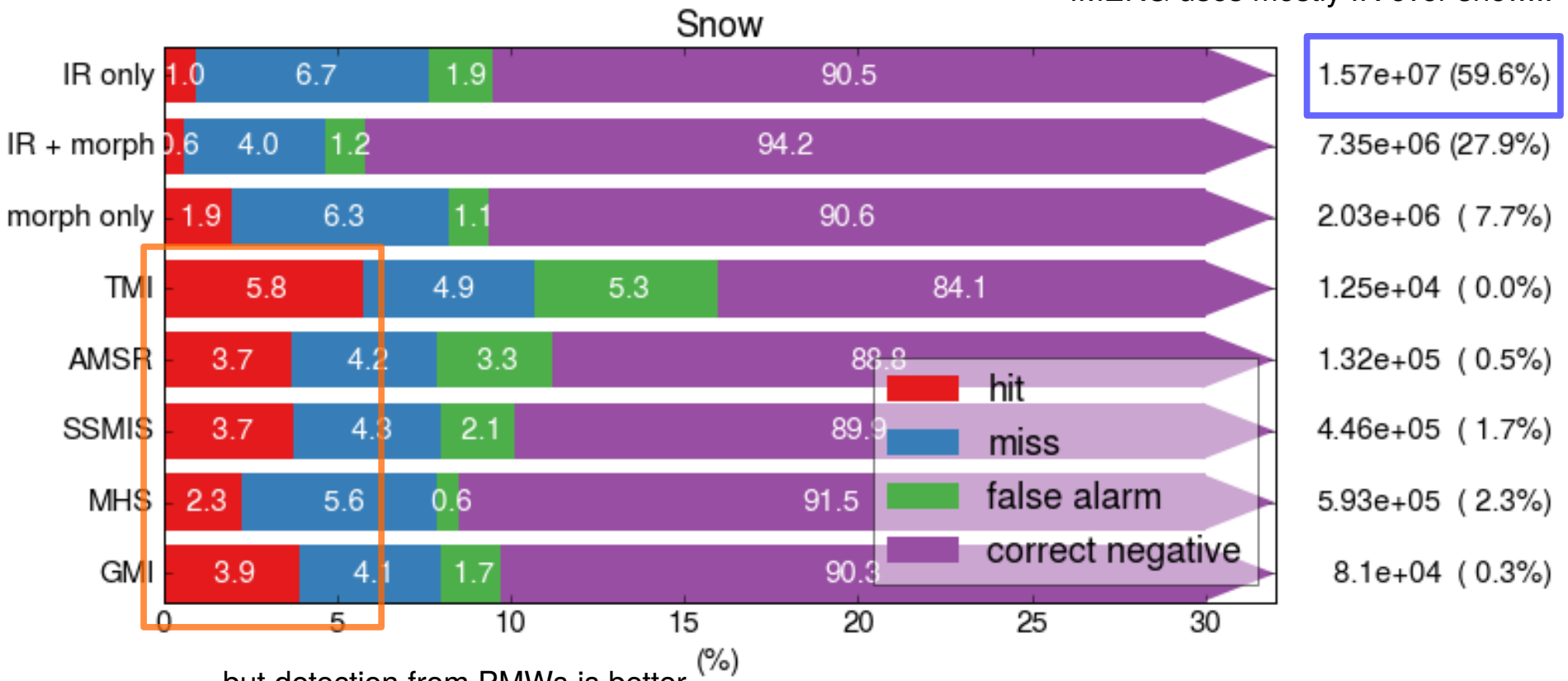
IR precipitation misses a lot of precipitation…

Density Diagram for IR Only



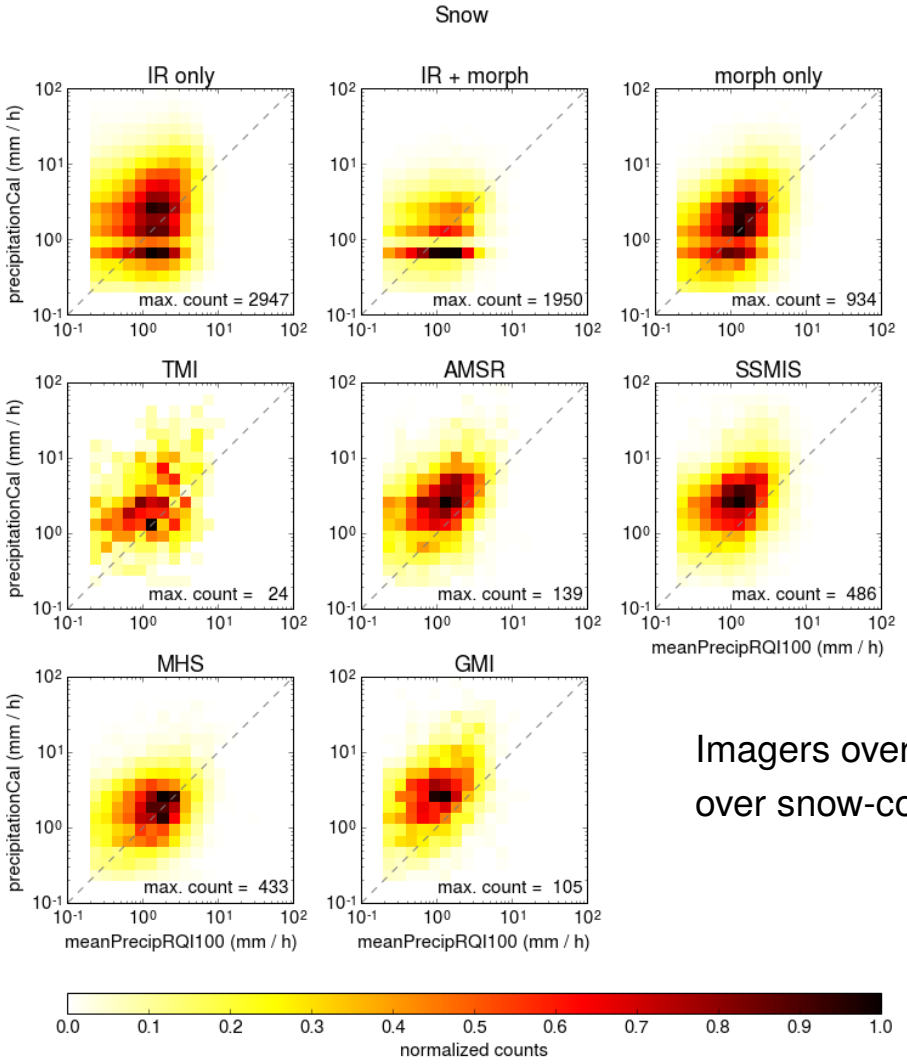
Contingency Table for Snow

IMERG uses mostly IR over snow...



… but detection from PMWs is better.

Density Diagram for Snow



Imagers overestimate rain rate over snow-covered surfaces.

Summary and Future Work

- Statistically robust, pixel-level comparisons of IMERG and MRMS by sensor and surface types:
  - estimates from IR only and estimates over snow are bad
  - slight tendency for underestimation of low values and overestimation of high values across all PMWs, prominent over ocean and low/min vegetation
  - GMI has better detection over ice, snow but slightly worse detection over other surfaces
- Next:
  - 30-min MRMS, IMERG V4
  - other variables (`precipitationUncal`) or runs
  - break down by season
  - case studies of major discrepancies to investigate physical causes
- The match-up between IMERG and MRMS are available in HDF5 files (similar to IMERG files).