Investigating the Seasonal and Diurnal Cycles of Ocean Vector Winds, Precipitation, and Lightning near the Philippines

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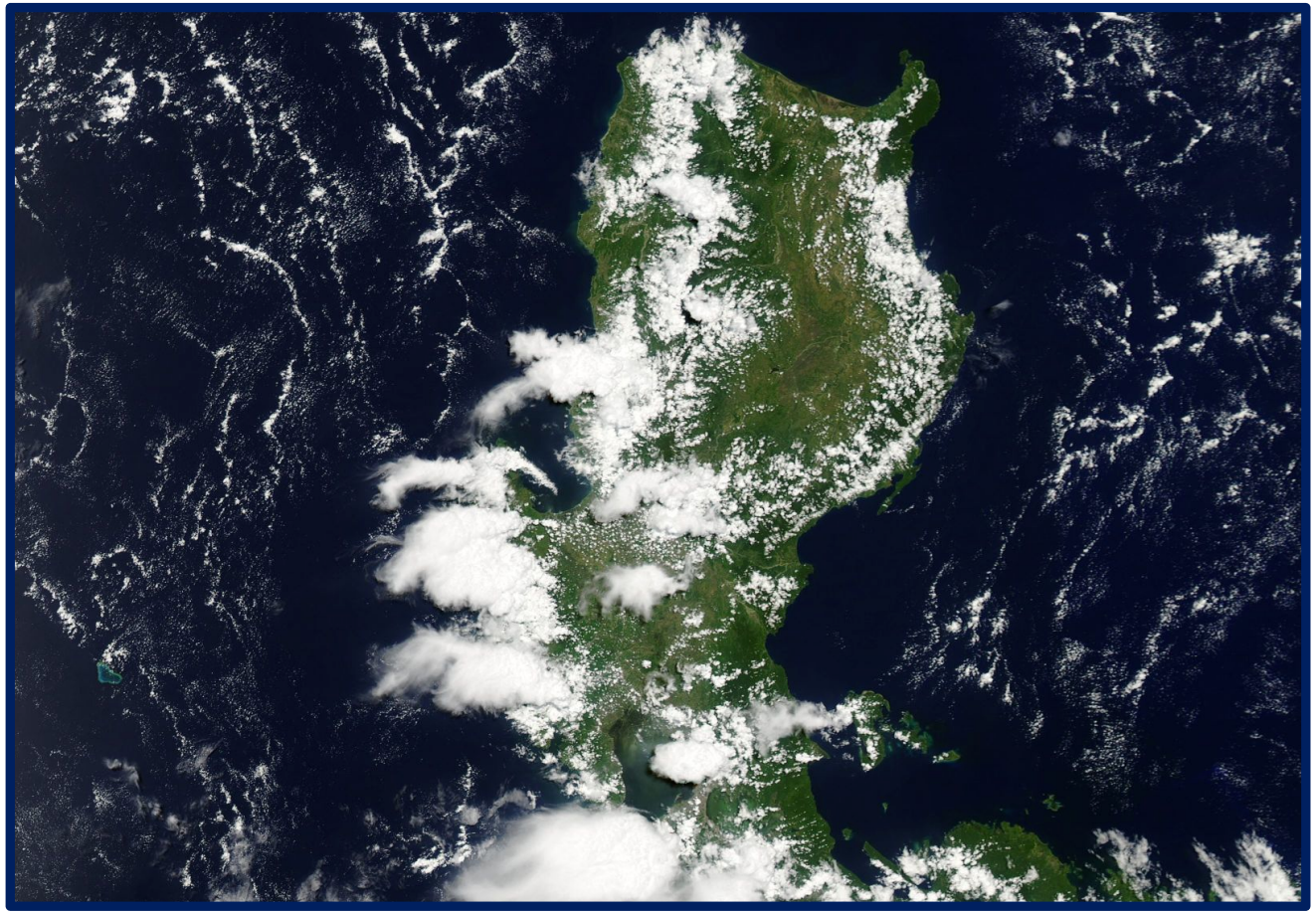
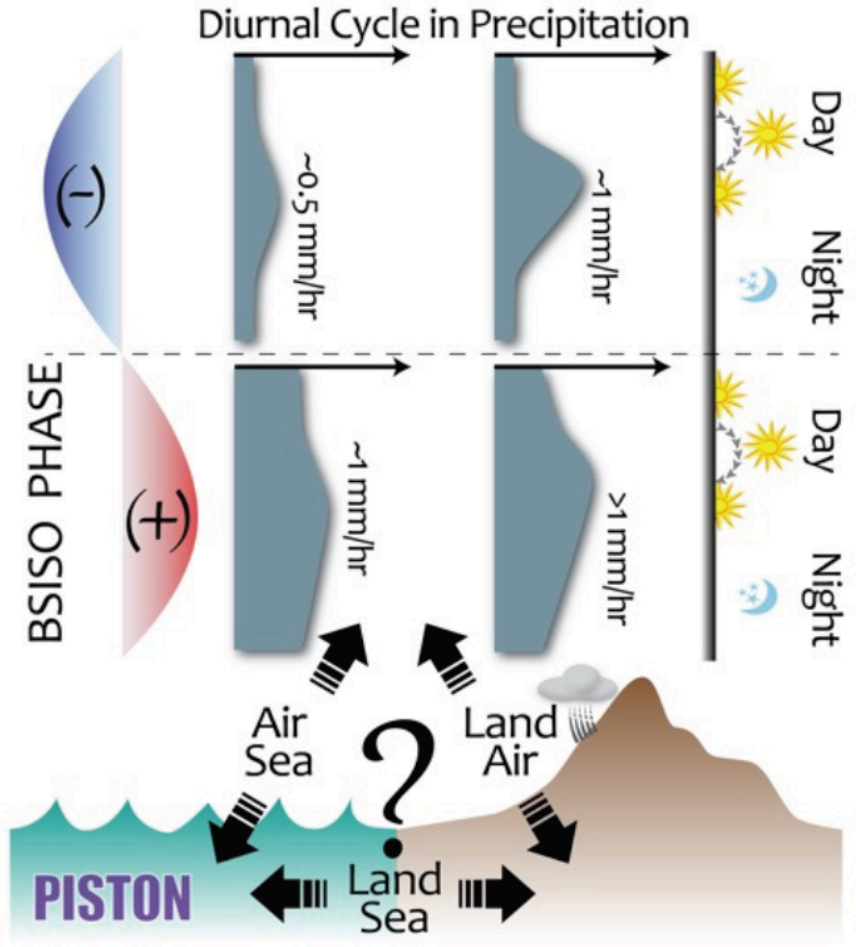


Background

Boreal Summer Intraseasonal Oscillation (BSISO) creates northeastward-moving disturbances, which interact with the strong diurnal cycle of the Maritime Continent, complicating sub-seasonal forecasts.

<u>Key Questions</u>

- Can we characterize the diurnal cycle of vector winds near the west coast of Luzon using satellite-based datasets?
- How does the BSISO affect the intraseasonal variability and diurnal cycle of winds, precipitation, and lightning near the Philippines?



http://onrpiston.colostate.edu

Datasets and Methodology

RapidScat 12.5-km Climate V1.0

- Each relevant swath binned to 0.25-degree, 2-hourly grid
- Diurnal harmonic fit to dataset

Cross-Calibrated Multi-Platform (CCMP) Winds V2.0

- Includes ASCAT-A, WindSat, GMI, AMSR-2, SSMI/S, Buoys assimilated into model
- 0.25-degree, 6-hourly grid

Tropical Rainfall Measuring Mission (TRMM)

- 3B42 Rainfall Product
- Lightning Imaging Sensor (LIS) Flashes

Primary Domain of Interest – 5 °S to 20 °N, 110-130 °E

https://eol.jsc.nasa.gov/

Seasonal Results

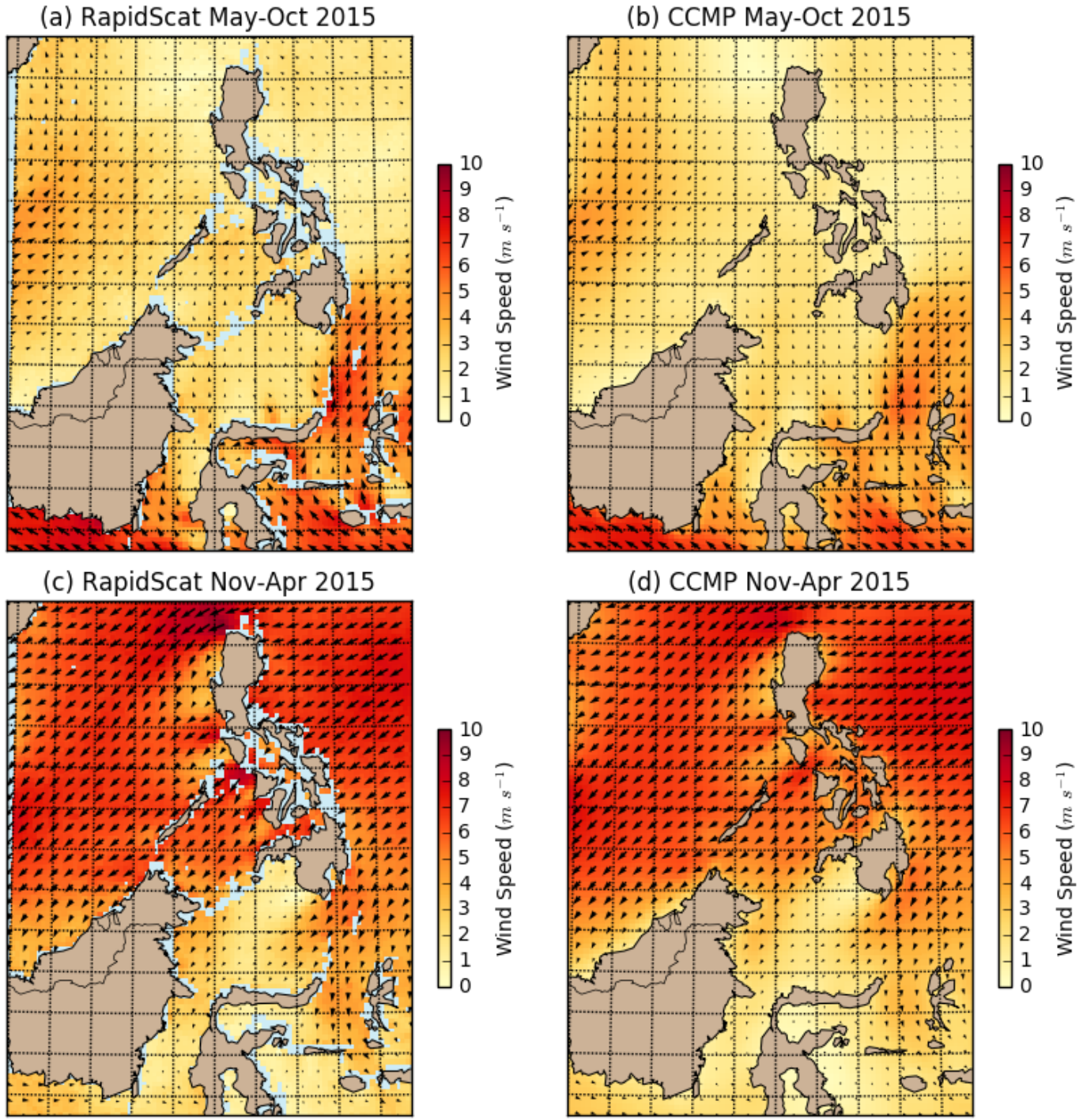
May-Oct: “Monsoon”
Nov-Apr: Trade wind regime

Relatively good agreement between RapidScat and CCMP

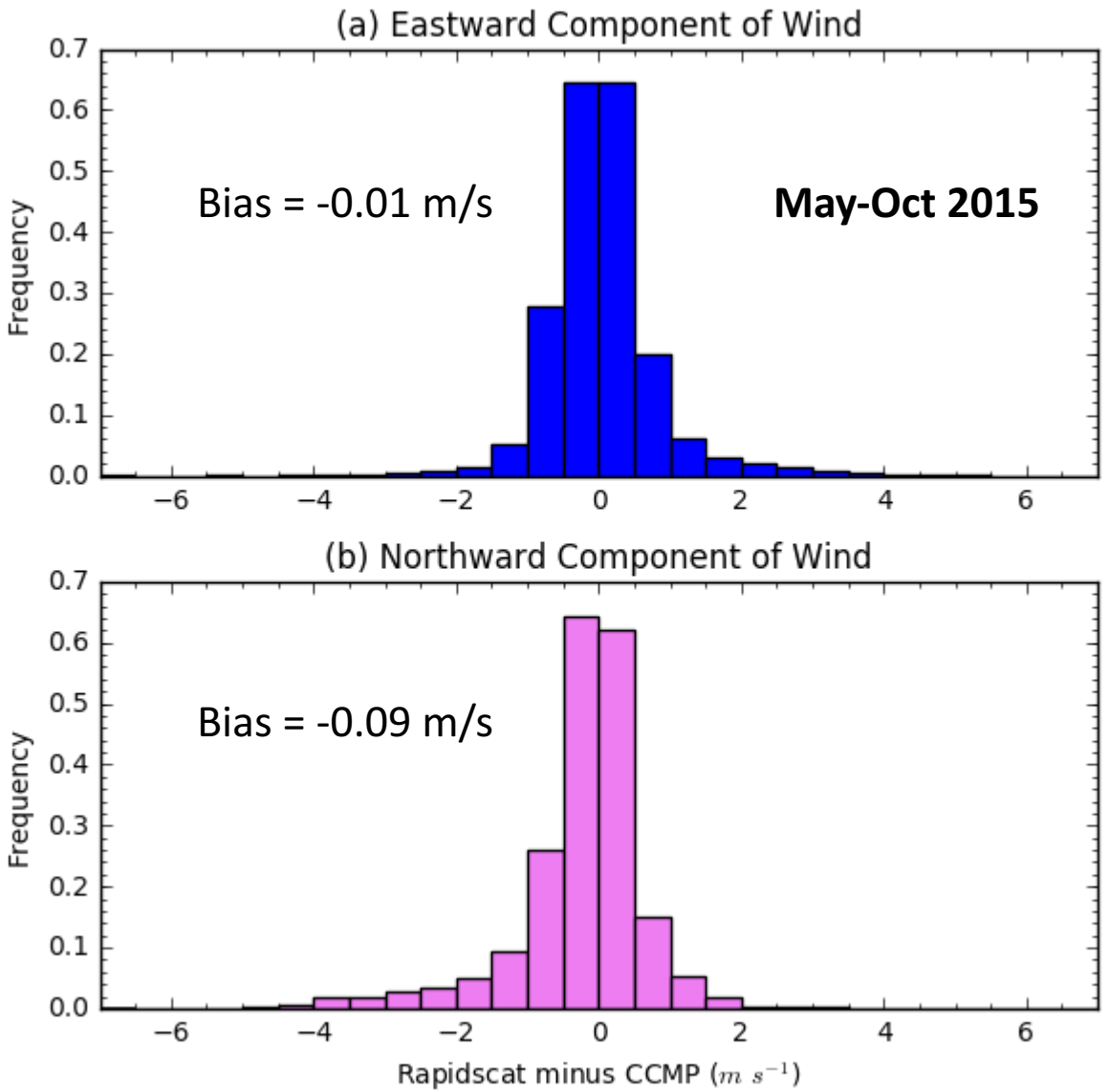
West of Luzon is region of relatively weak mean winds

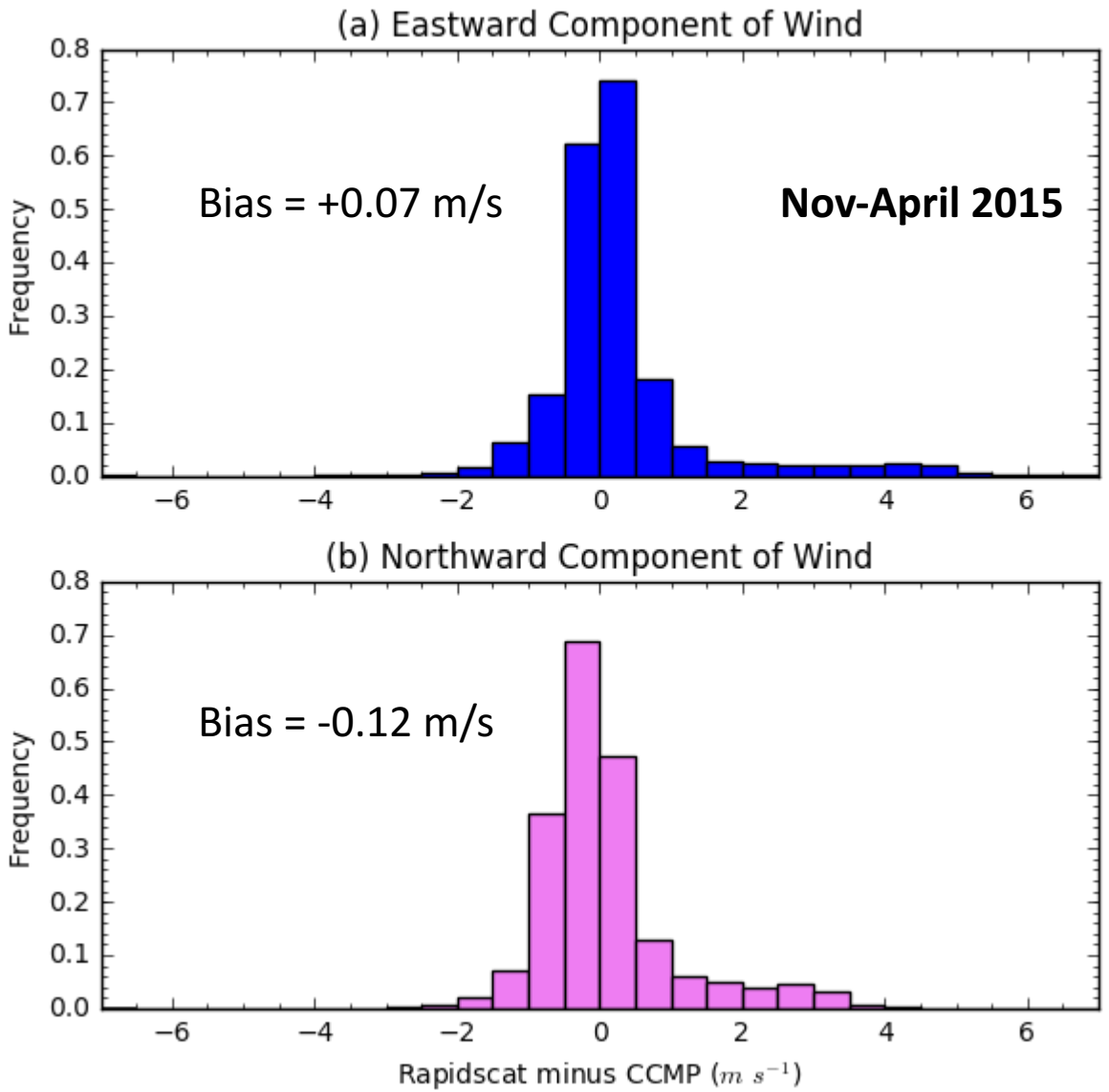
Several gap flows observed in both datasets

(RapidScat filtered to remove grid boxes with < 400 samples 2014-2016)

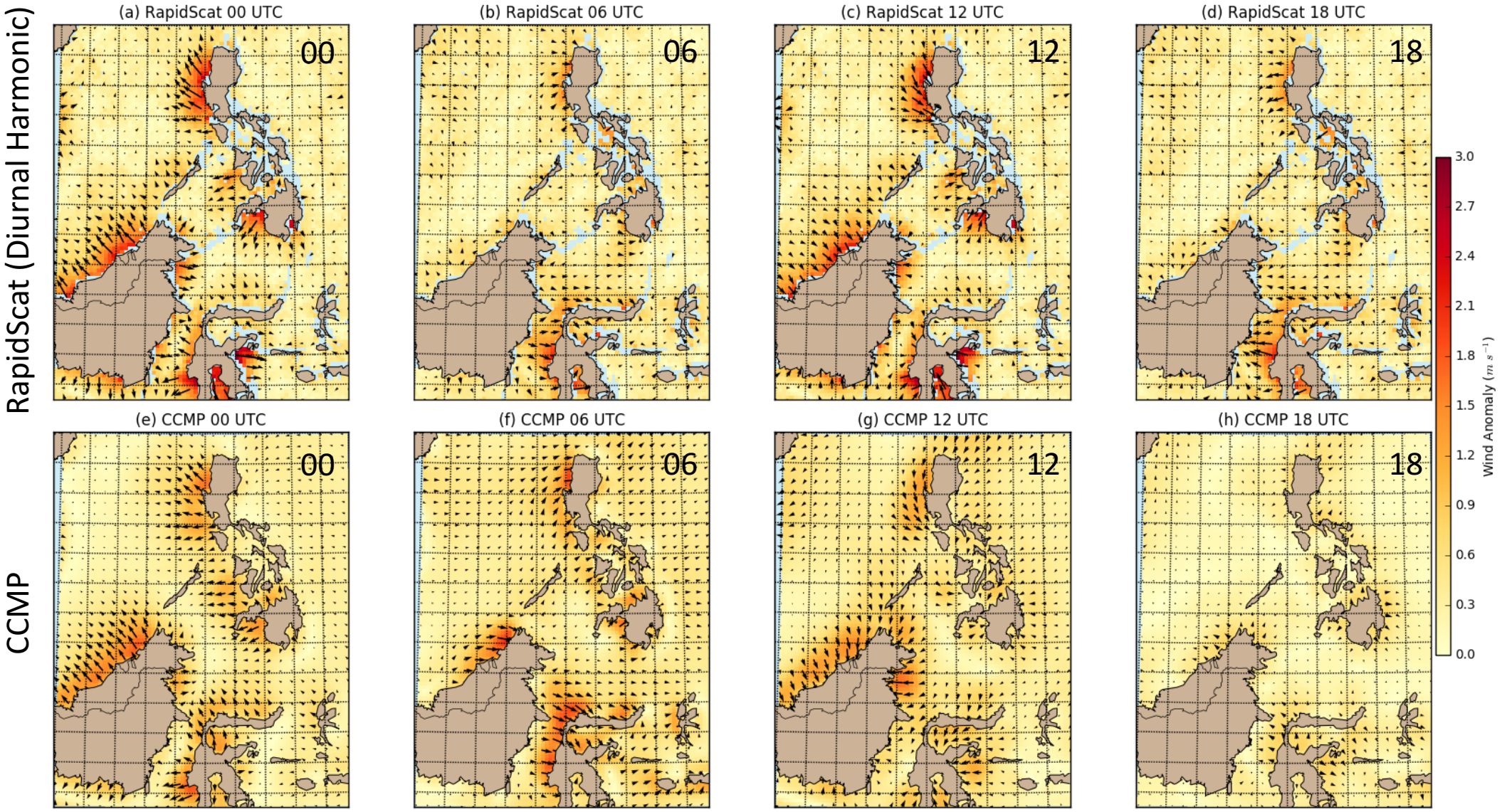


RapidScat – CCMP, Seasonal Means, Whole Domain





Diurnal Cycle – 2014-2016

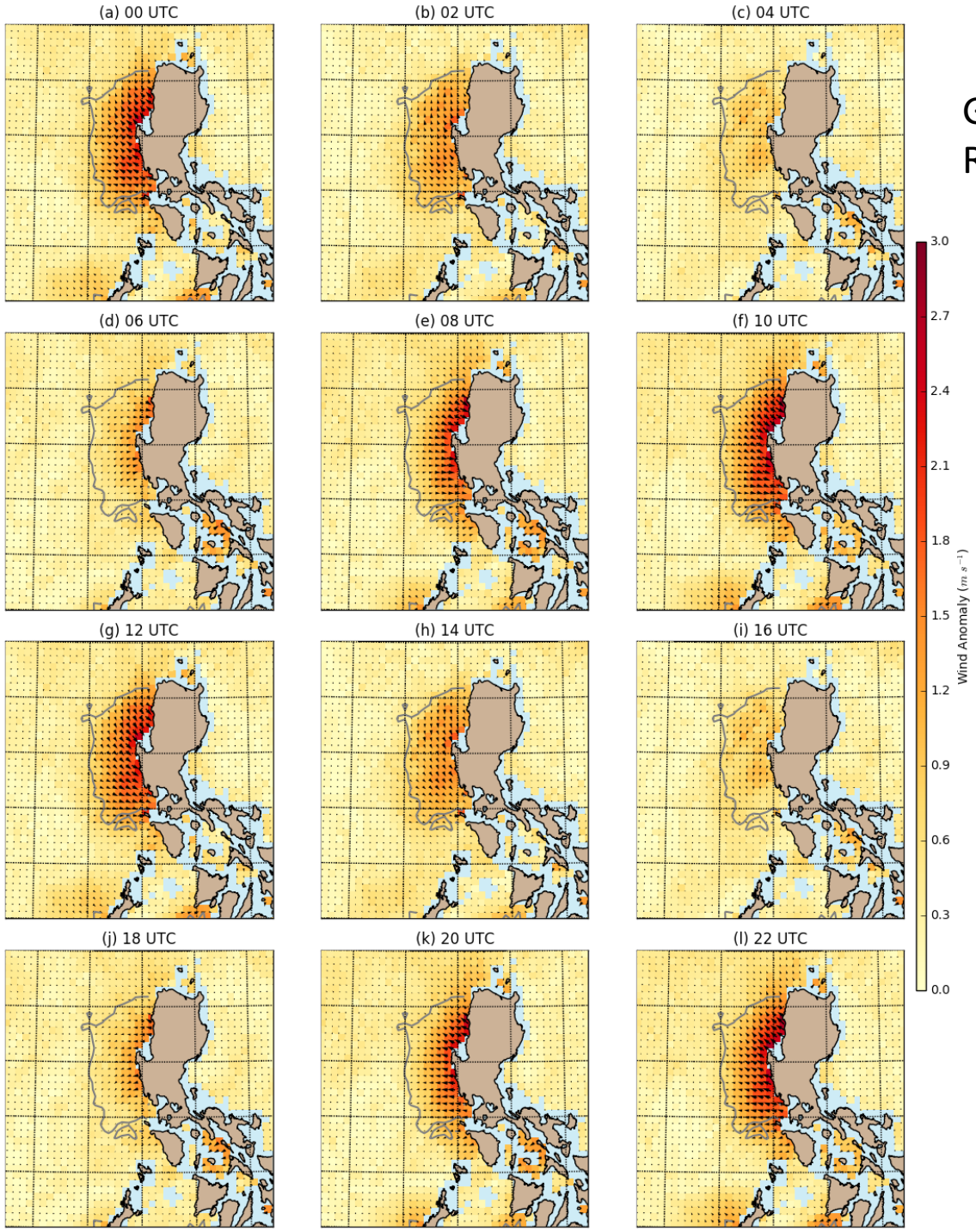


RapidScat 2-hourly Diurnal Harmonic

Oct 2014 - August 2016

Peak winds closer to 10 (onshore) and 22 UTC (offshore) than 00/12

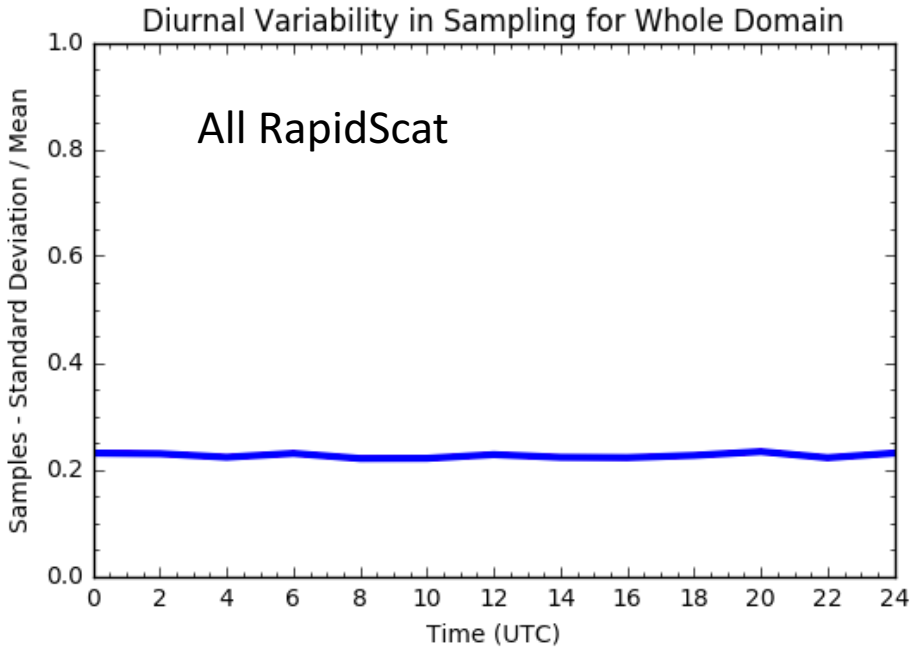
Diurnal influence extends ~200 km west

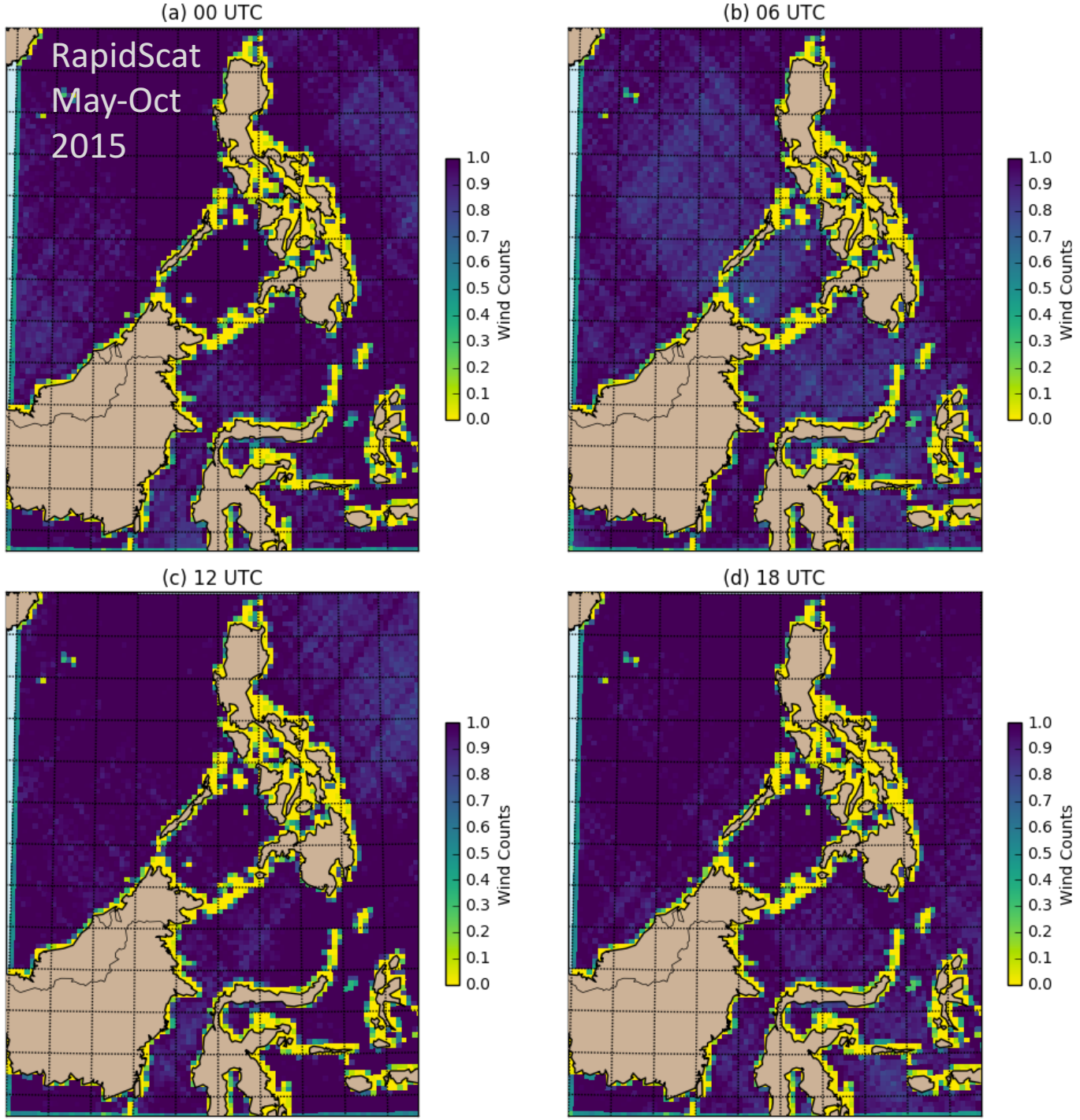


Grey curve:
$R^2 = 0.5$

Sampling Considerations

- Binning and averaging non-optimal; more sophisticated methods being explored
- However, near Philippines there does not appear to be a major diurnal bias in sampling



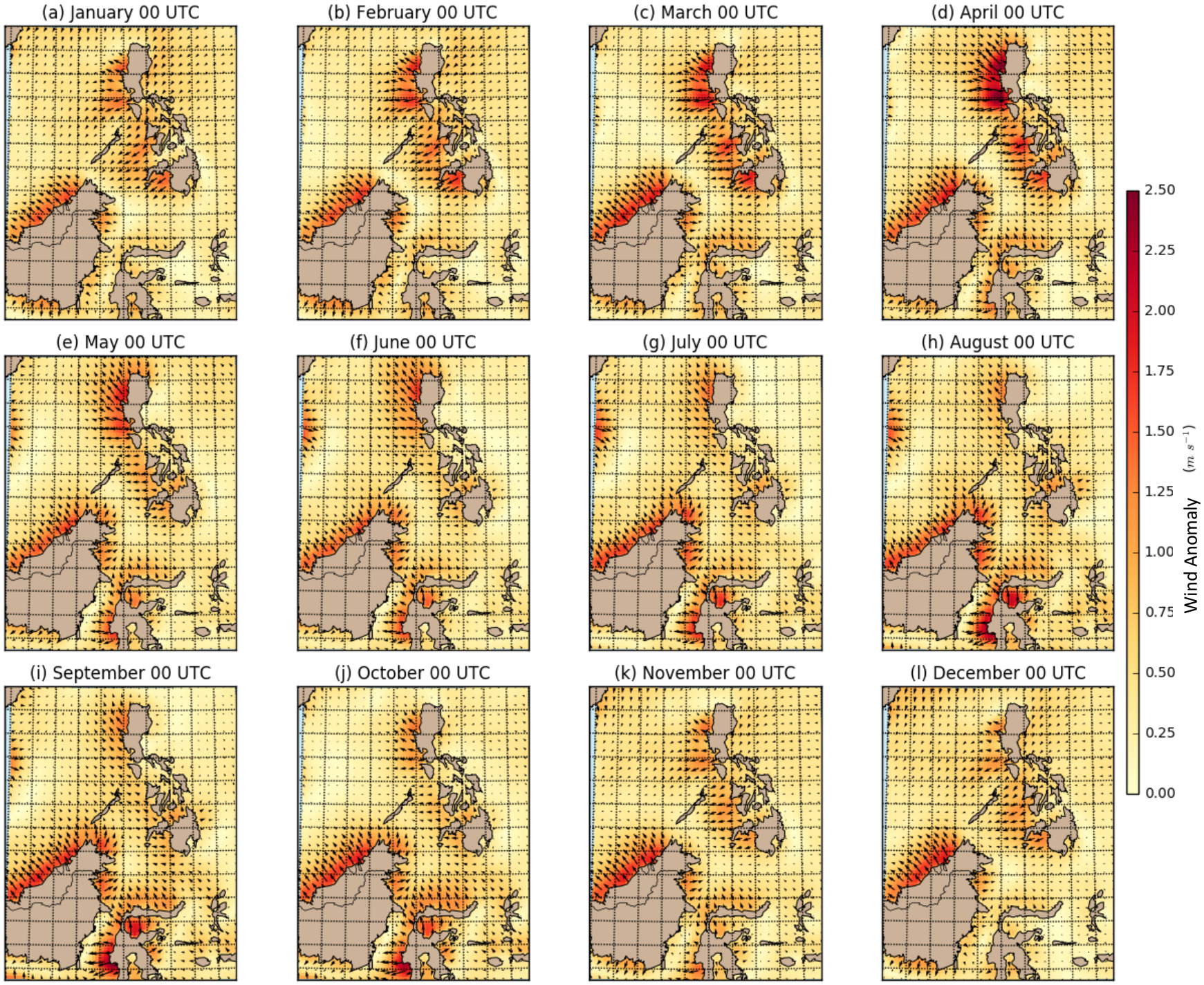


CCMP Diurnal Cycle

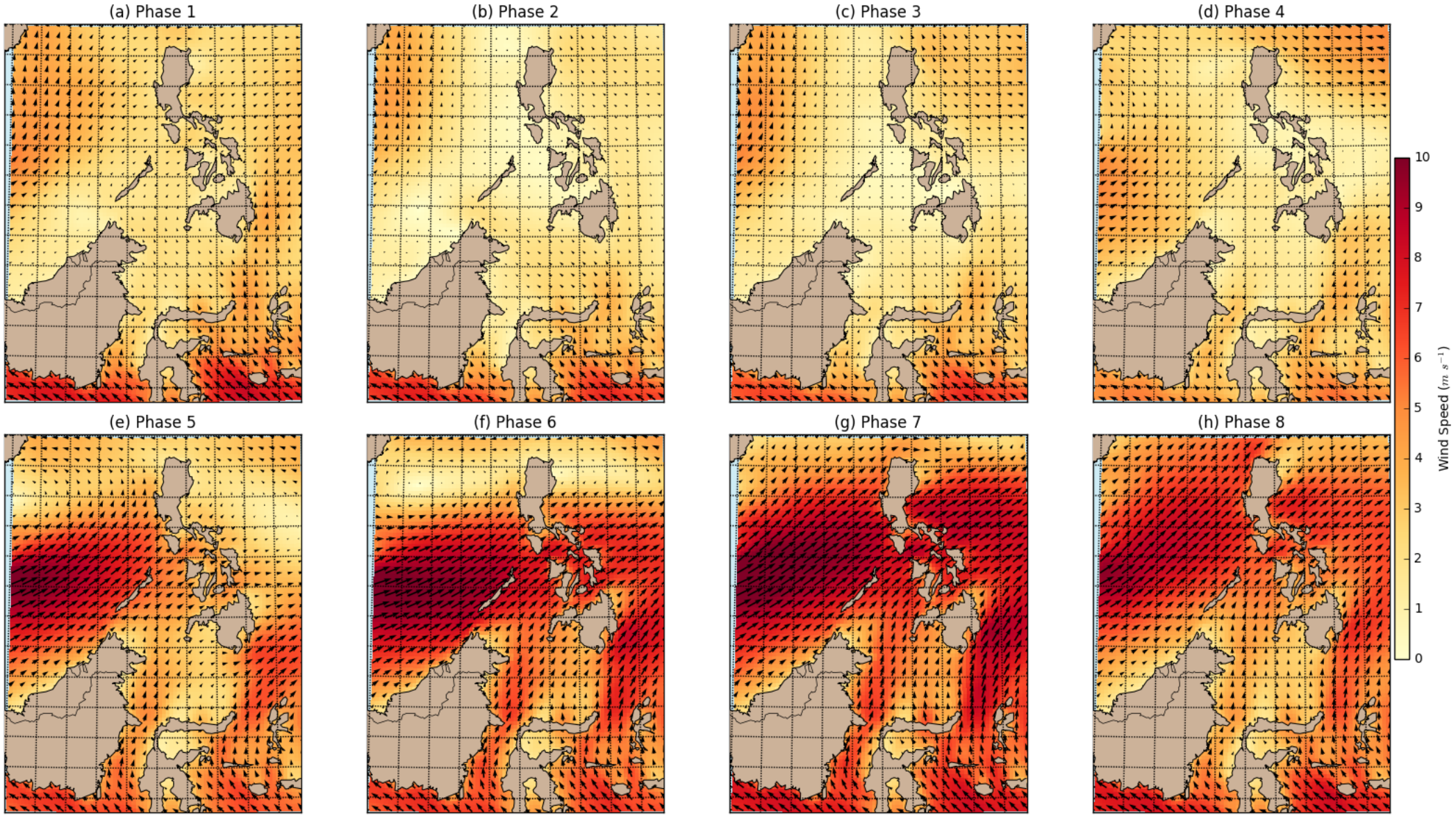
Monthly 1997-2016

00 UTC

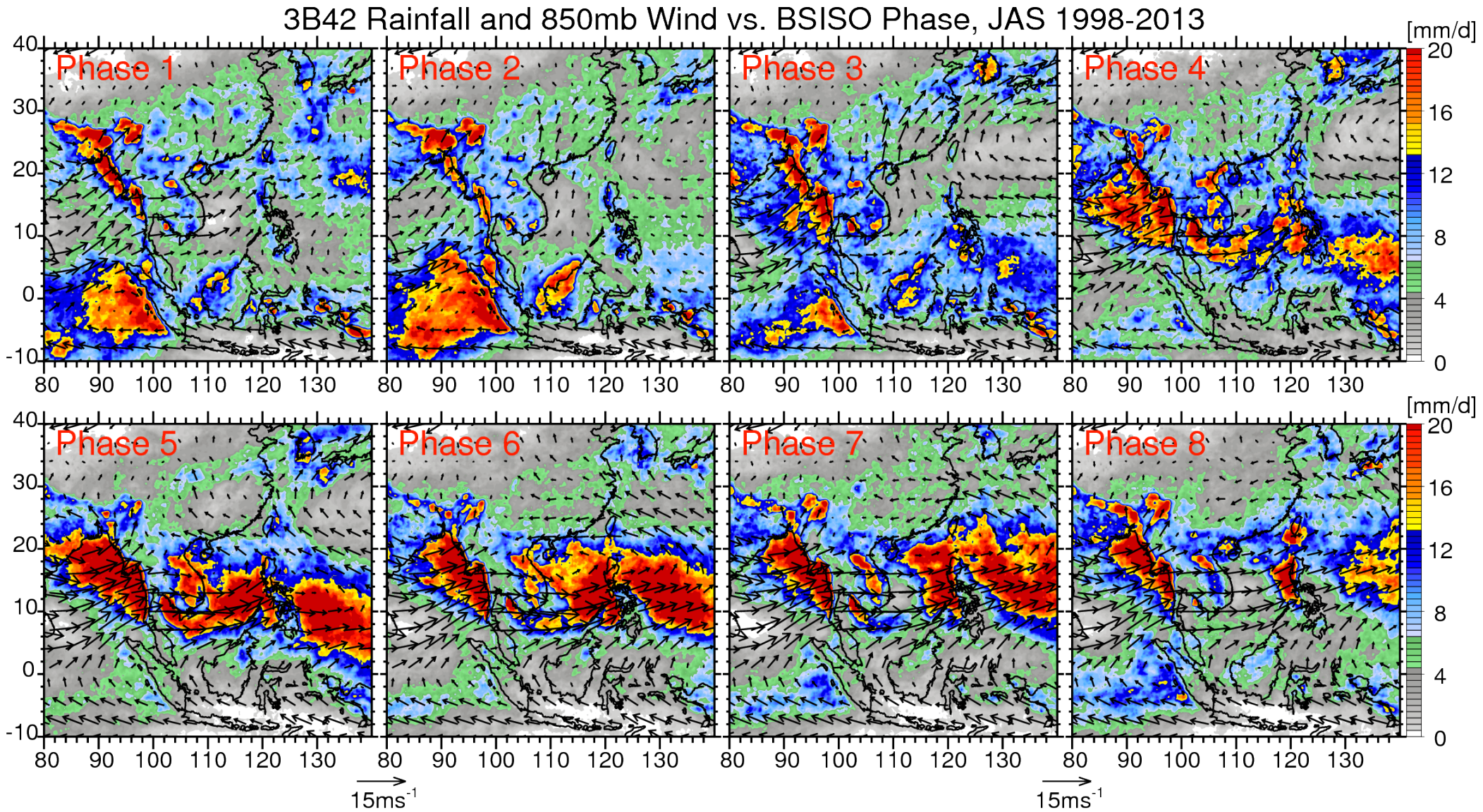
Amplitude peaks in April



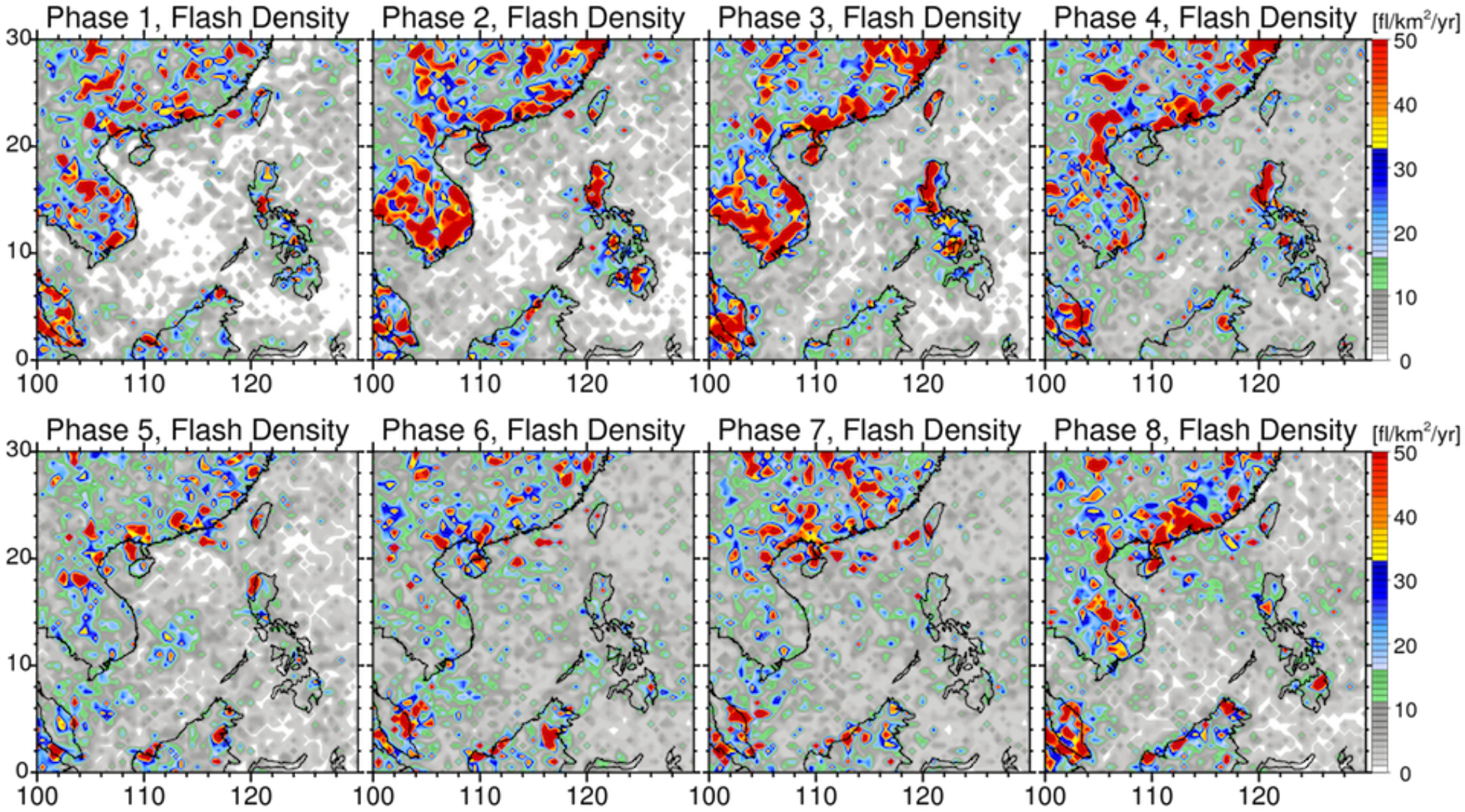
CCMP Winds by BSISO Phase – July-September 1997-2013, Magnitude > 1



TRMM and ECMWF



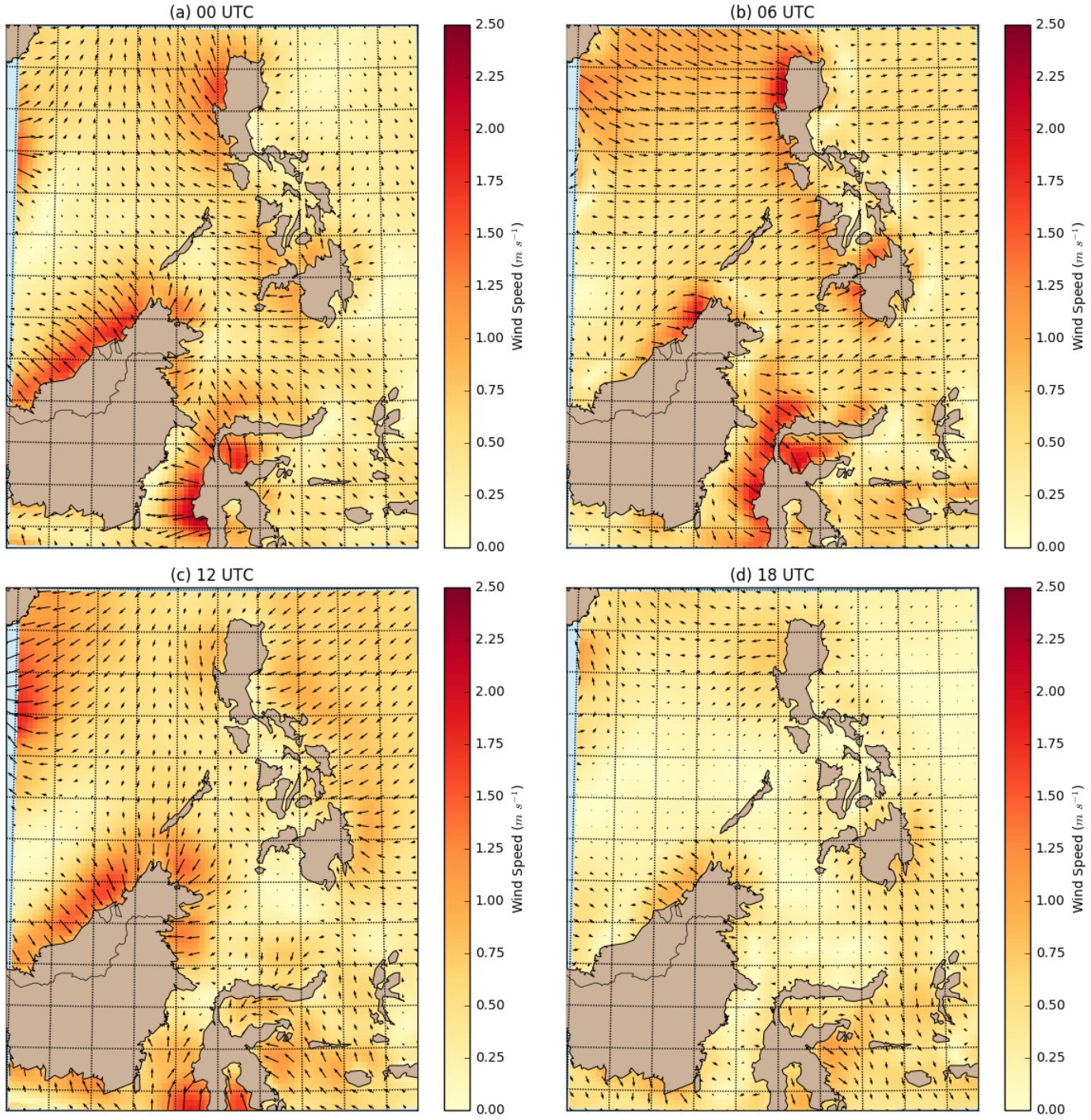
TRMM LIS Flash Density by BSISO Phase, JAS



Inactive BSISO

Phases 1-3
Magnitude > 1

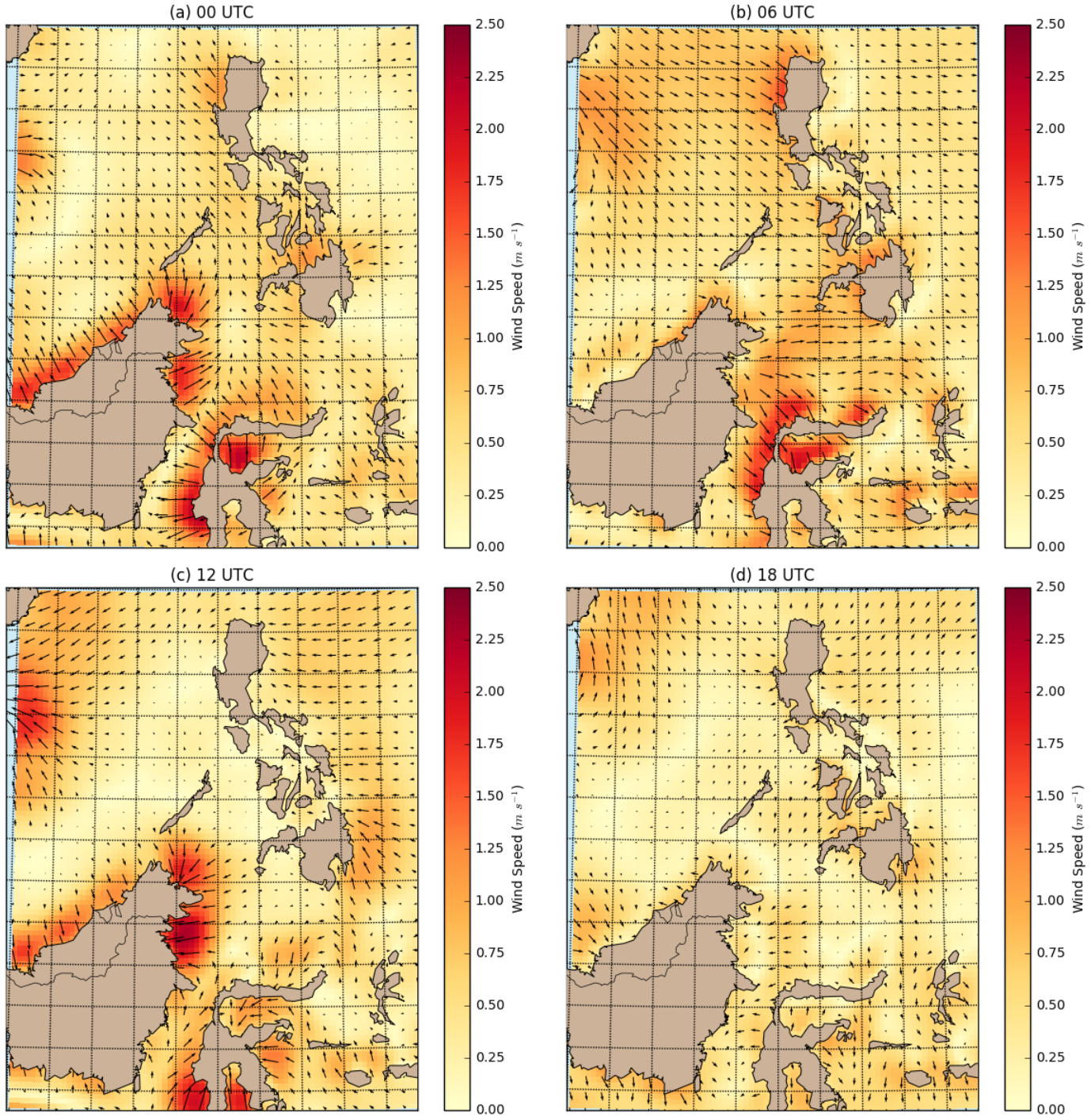
CCMP
JAS 1997-2013



Active BSISO

Phases 5-7
Magnitude > 1

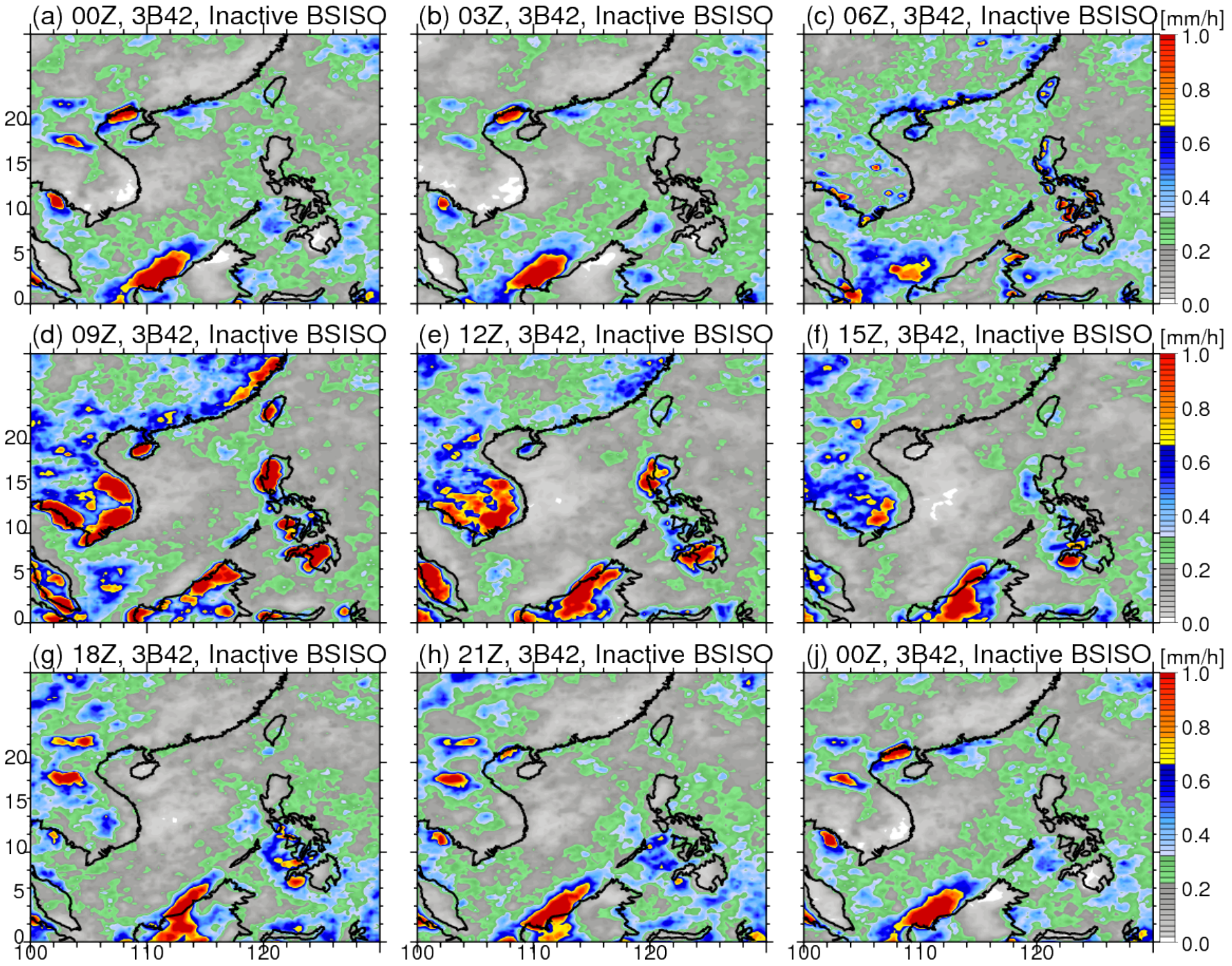
CCMP
JAS 1997-2013



Inactive BSISO

Phases 1-3
Magnitude > 1

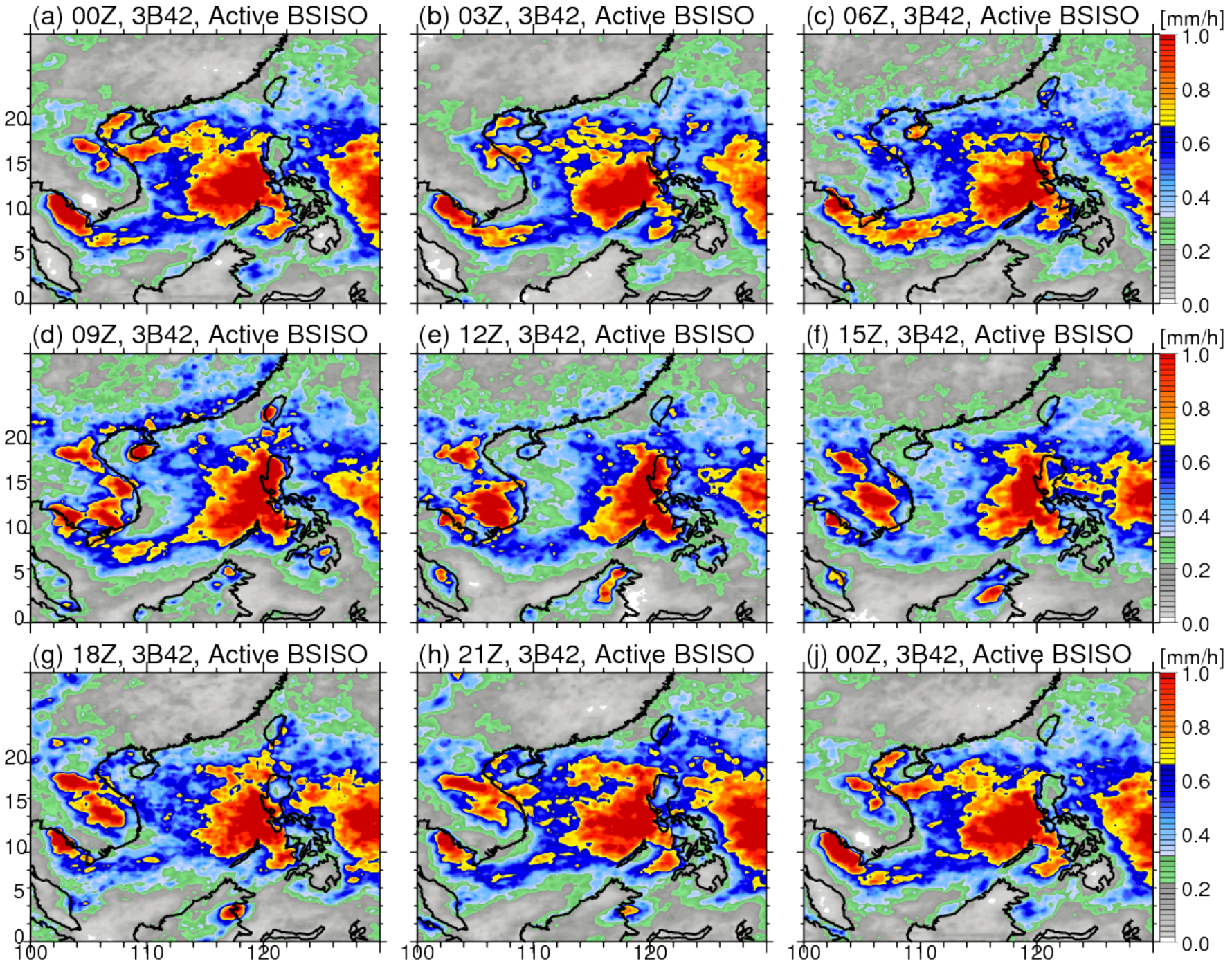
TRMM 3B42
JAS 1997-2013



Active BSISO

Phases 5-7
Magnitude > 1

TRMM 3B42
JAS 1997-2013



Inactive BSISO

Phases 1-3
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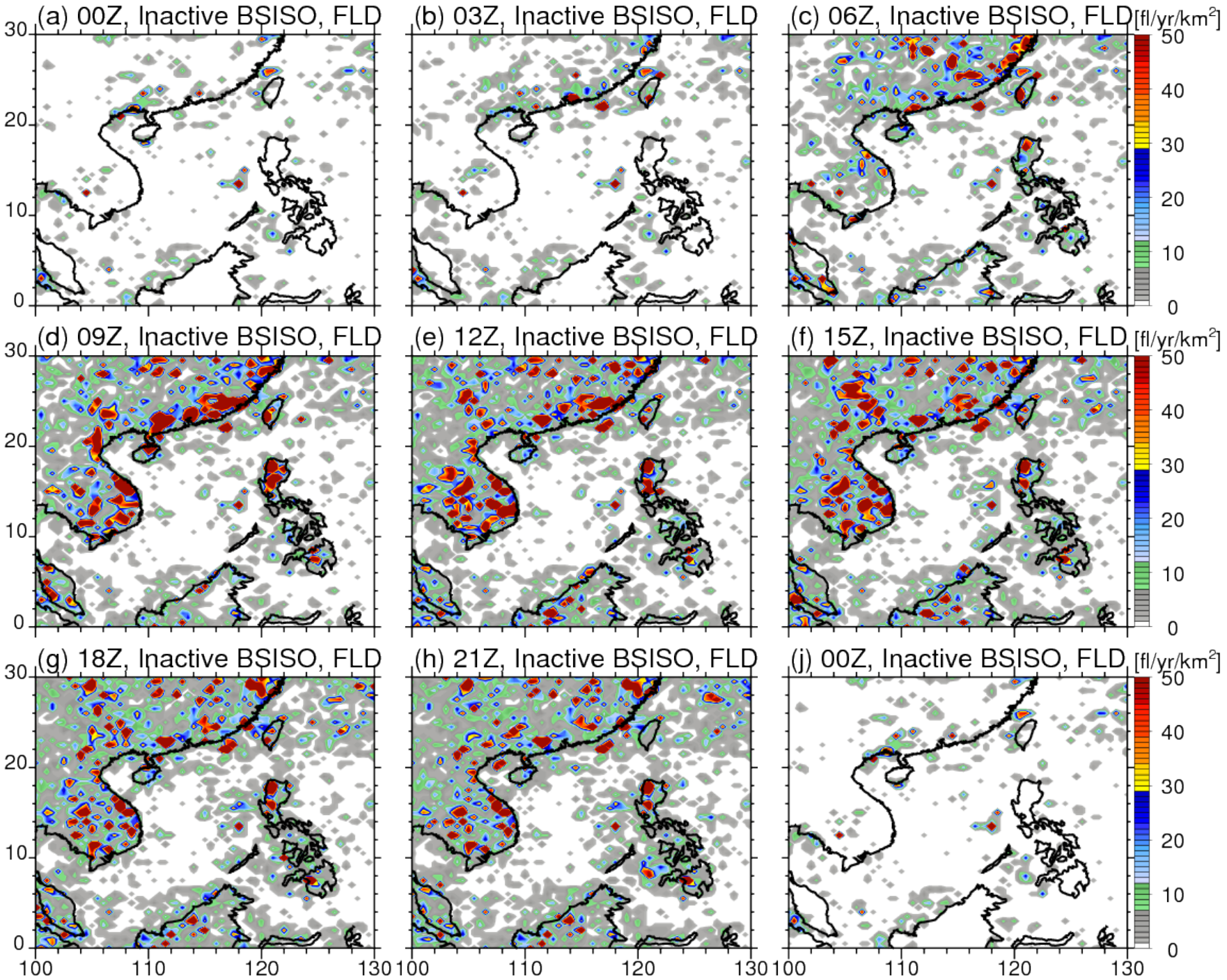
TRMM LIS Flash Density
JAS 1997-2013



Active BSISO

Phases 5-7
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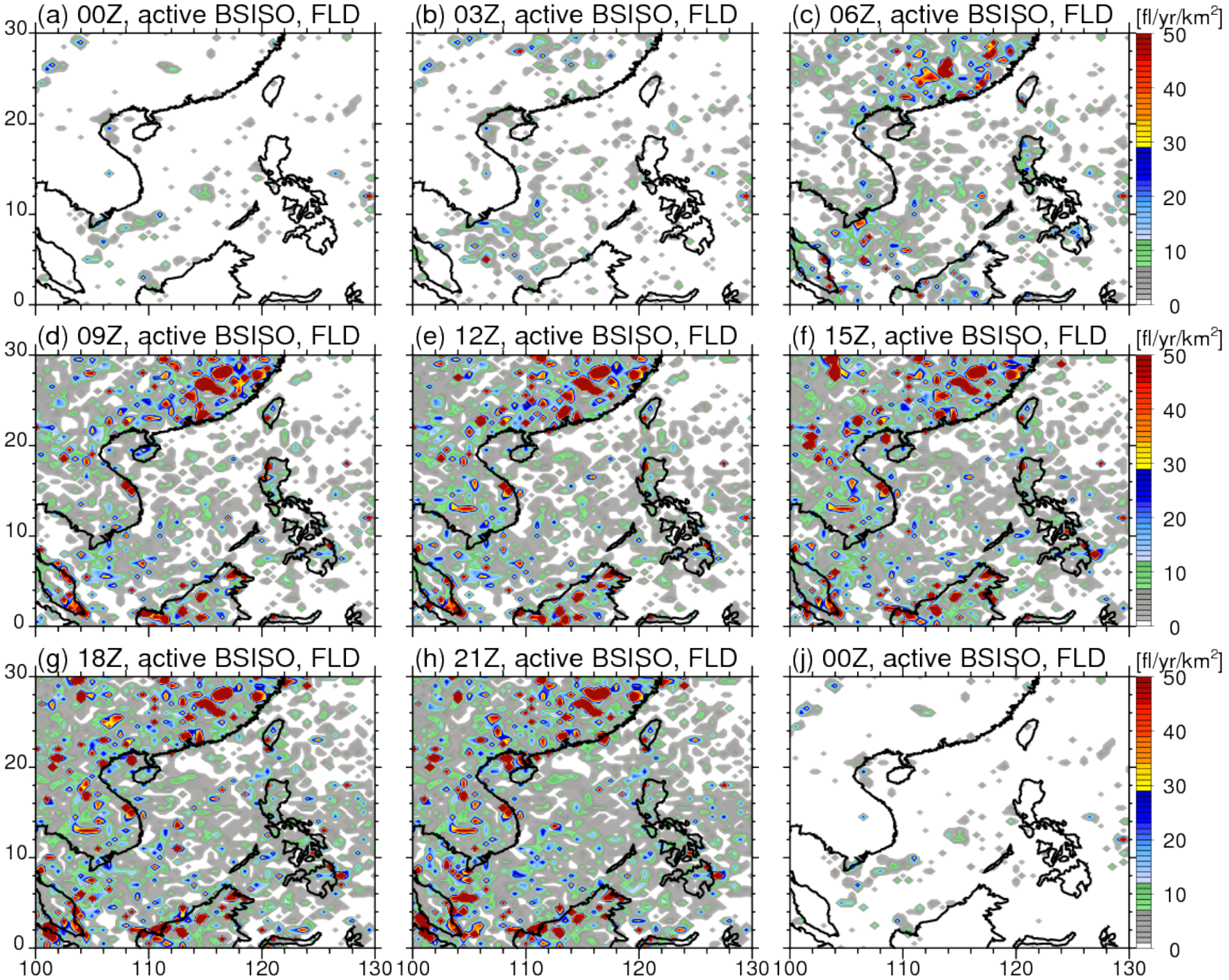
TRMM LIS Flash Density
JAS 1997-2013



Conclusions

CCMP and RapidScat agree on many basic characteristics of the seasonal and diurnal cycle of ocean vector winds near the Philippines

Offshore flow near Luzon peaks at 22 UTC (06 L), and onshore flow peaks at 10 UTC (18 L) – Corresponds well to behavior of precipitation and lightning

CCMP shows diurnal cycle amplitude near Luzon peaks in April, as trade wind regime is transitioning to monsoonal flow

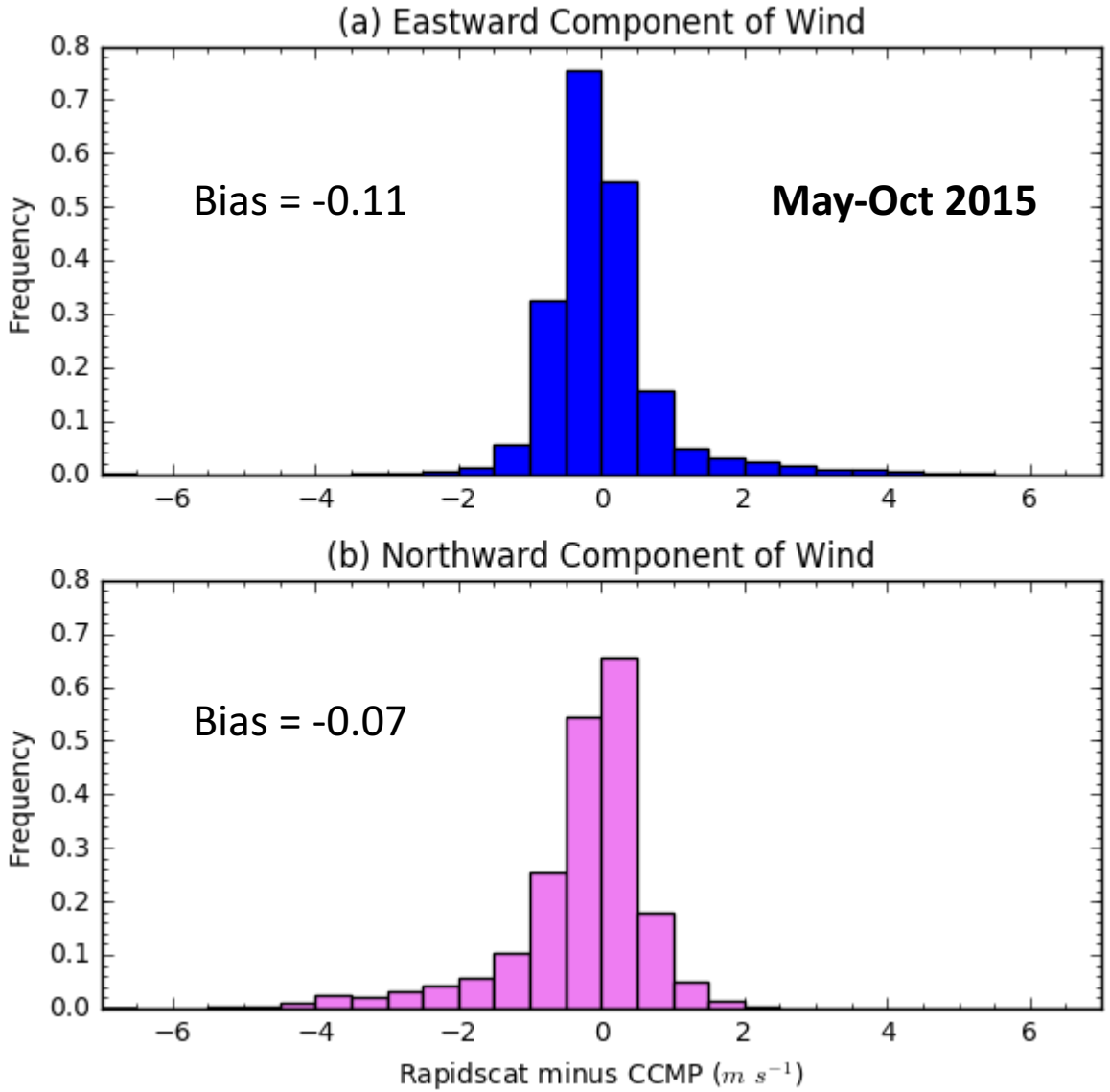
Active BSISO phases associated with weaker diurnal cycle of ocean vector winds – Consistent with more cloud cover/precipitation suppressing sea breeze

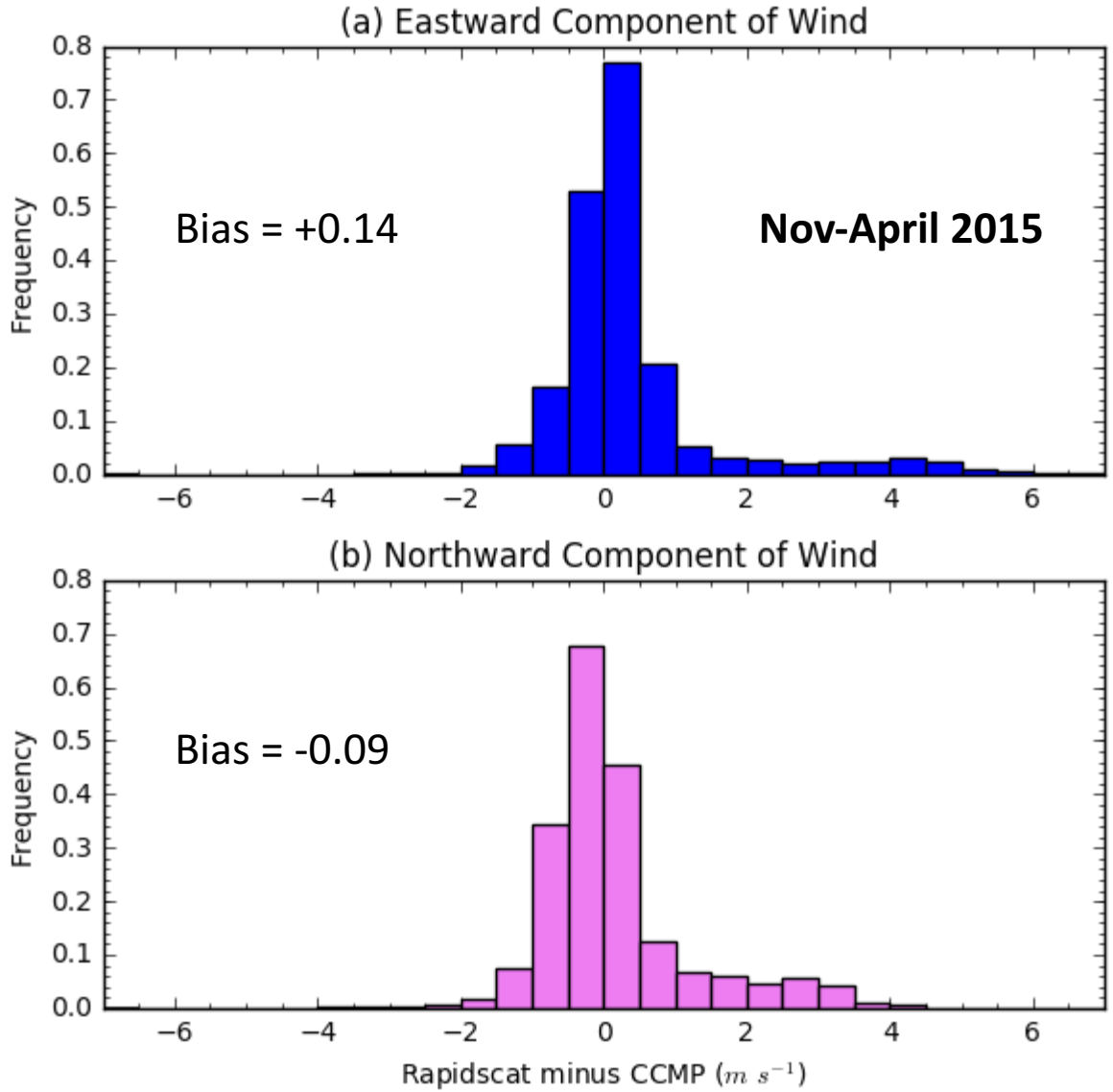
“In situ” study of winds/precipitation will occur during PISTON 2018

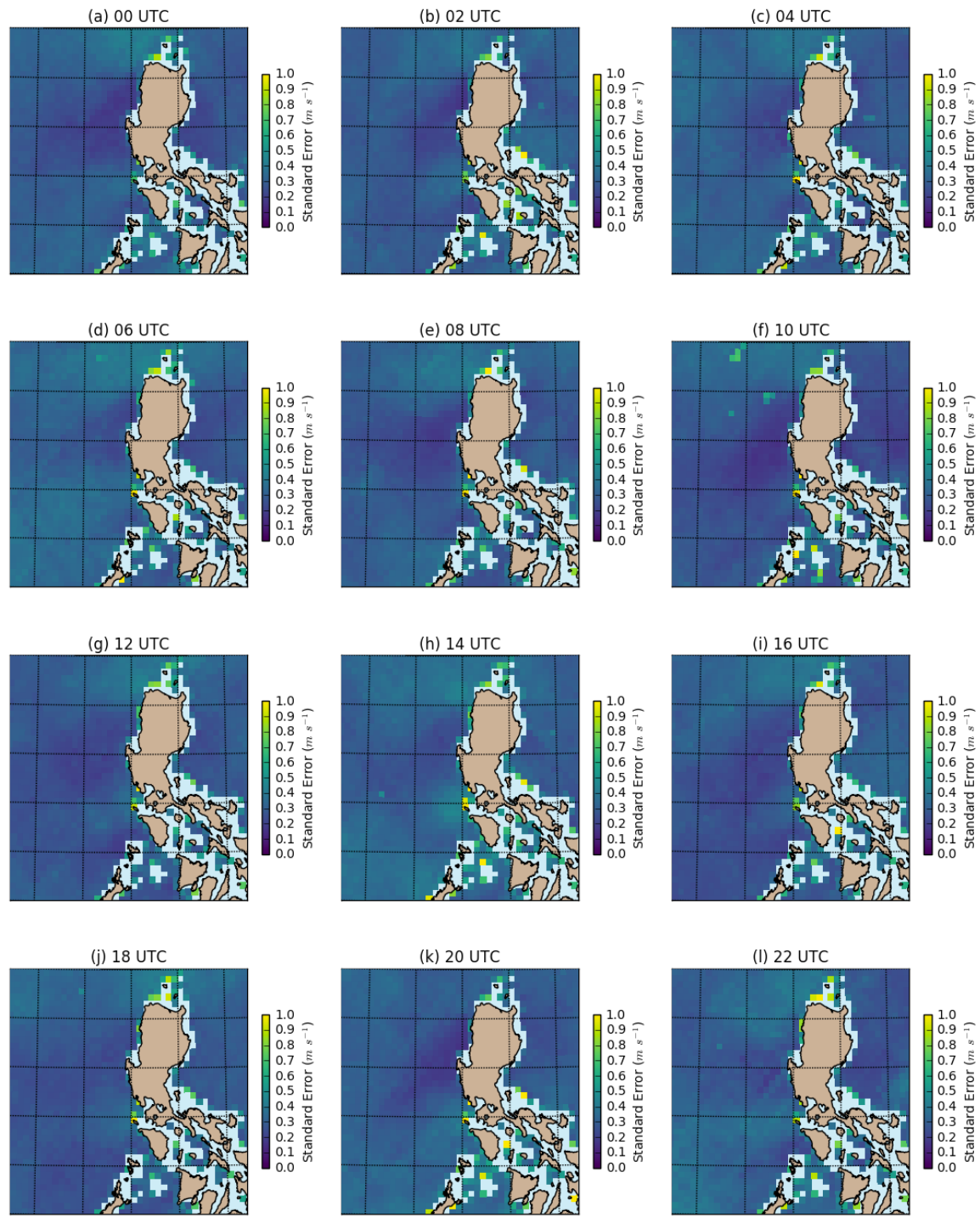
Funded by:

BACKUP SLIDES

RapidScat – CCMP, Seasonal Means, Whole Domain (rain flagged removed)

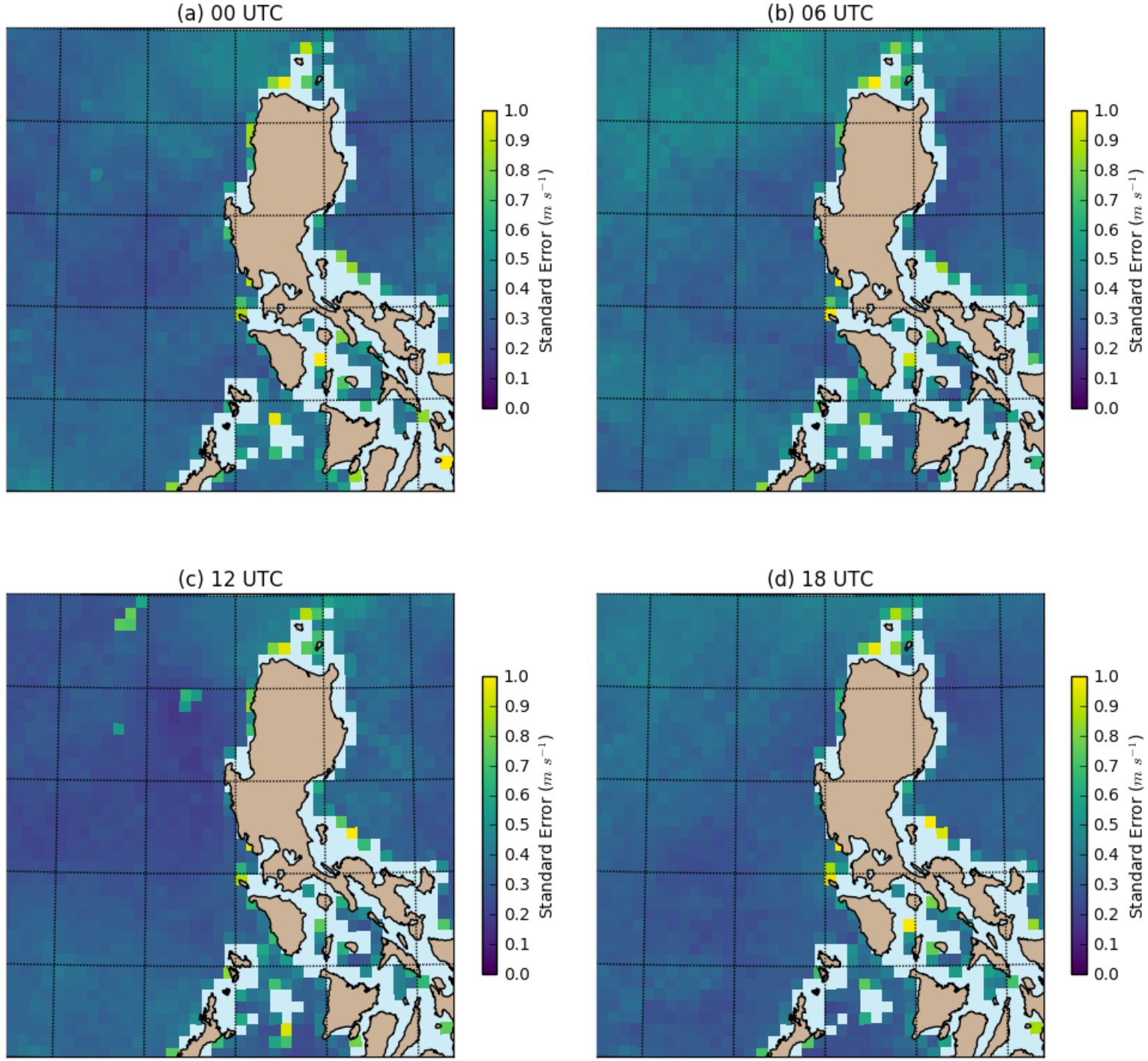






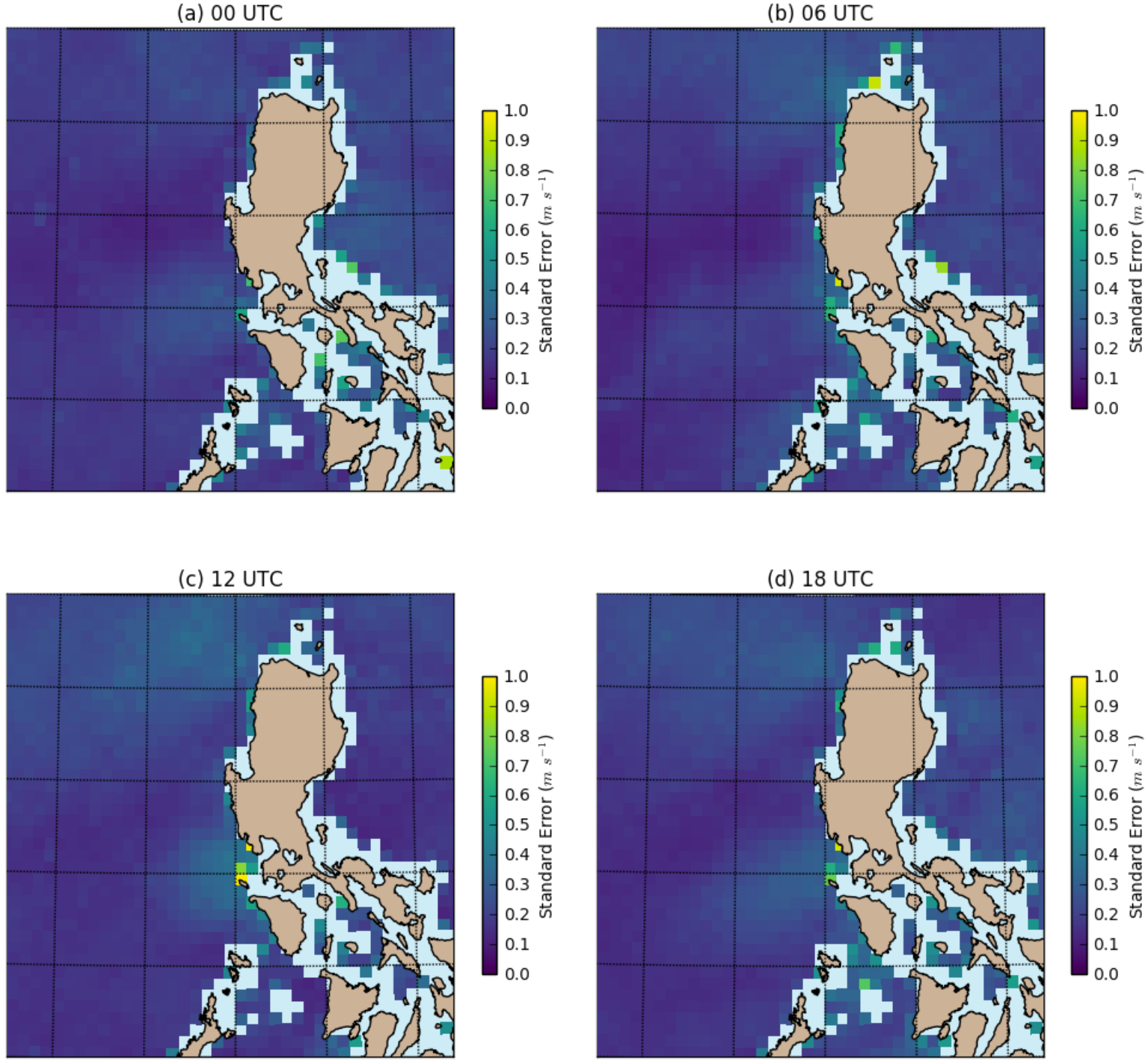
Entire RapidScat Dataset

U component



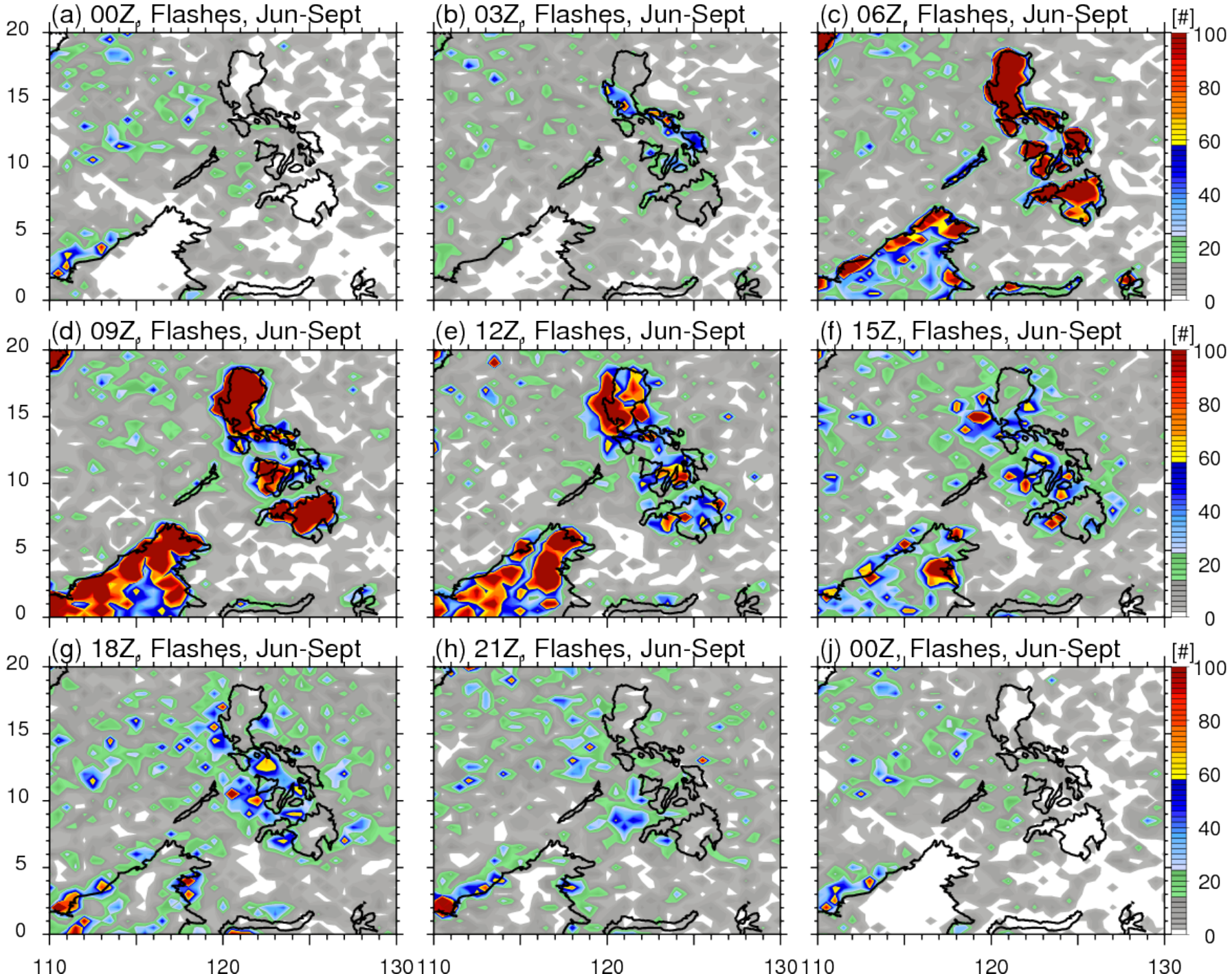
May-Oct 2015

U component



Nov-Apr 2015

U component


(a) 00Z, Flashes, Jun-Sept
(b) 03Z, Flashes, Jun-Sept
(c) 06Z, Flashes, Jun-Sept
(d) 09Z, Flashes, Jun-Sept
(e) 12Z, Flashes, Jun-Sept
(f) 15Z, Flashes, Jun-Sept
(g) 18Z, Flashes, Jun-Sept
(h) 21Z, Flashes, Jun-Sept
(j) 00Z, Flashes, Jun-Sept
[#]
100
80
60
40
20
0
20
15
10
5
0
110
120
130