Contribution of Oceansat-2 to Vector Wind Constellation in Characterizing Diurnal Cycle

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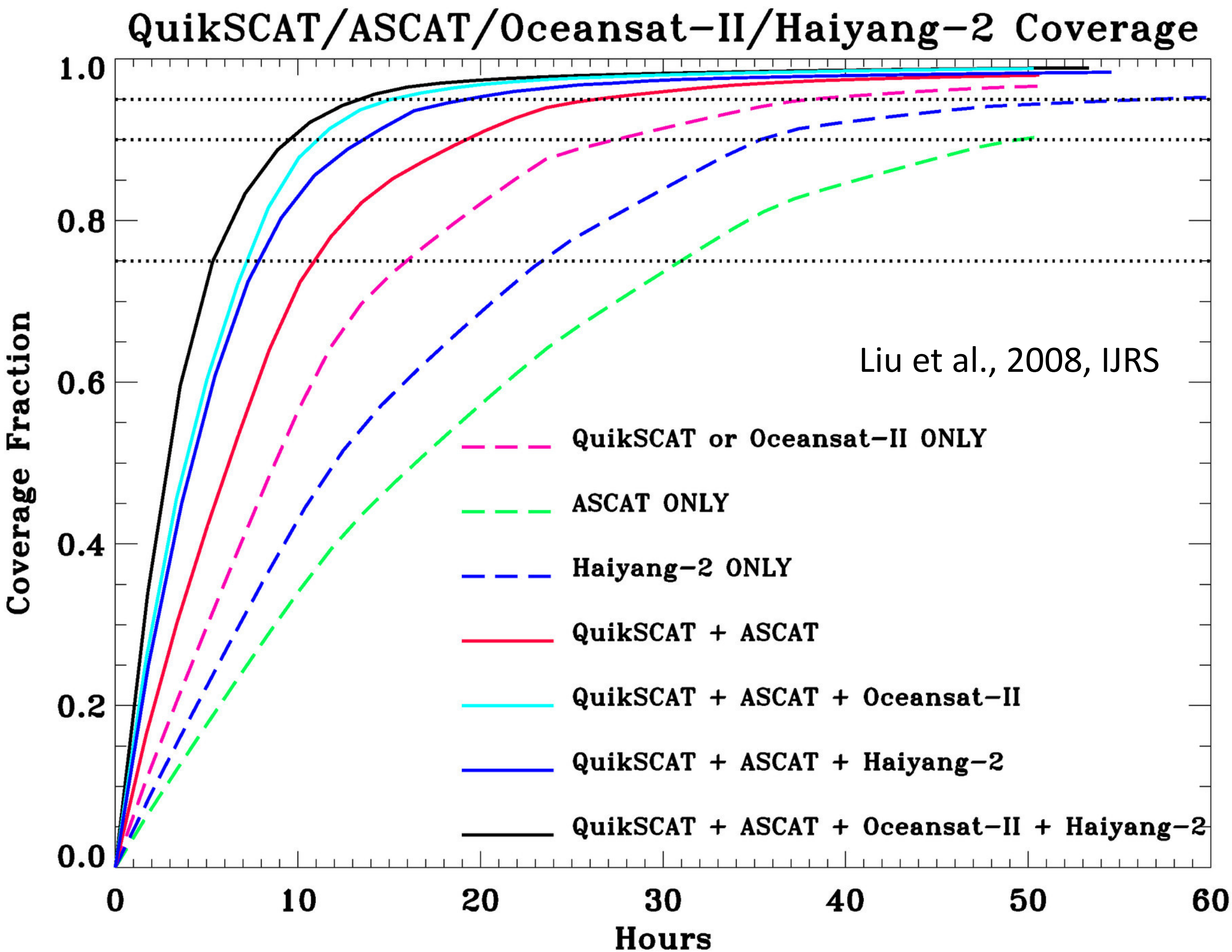
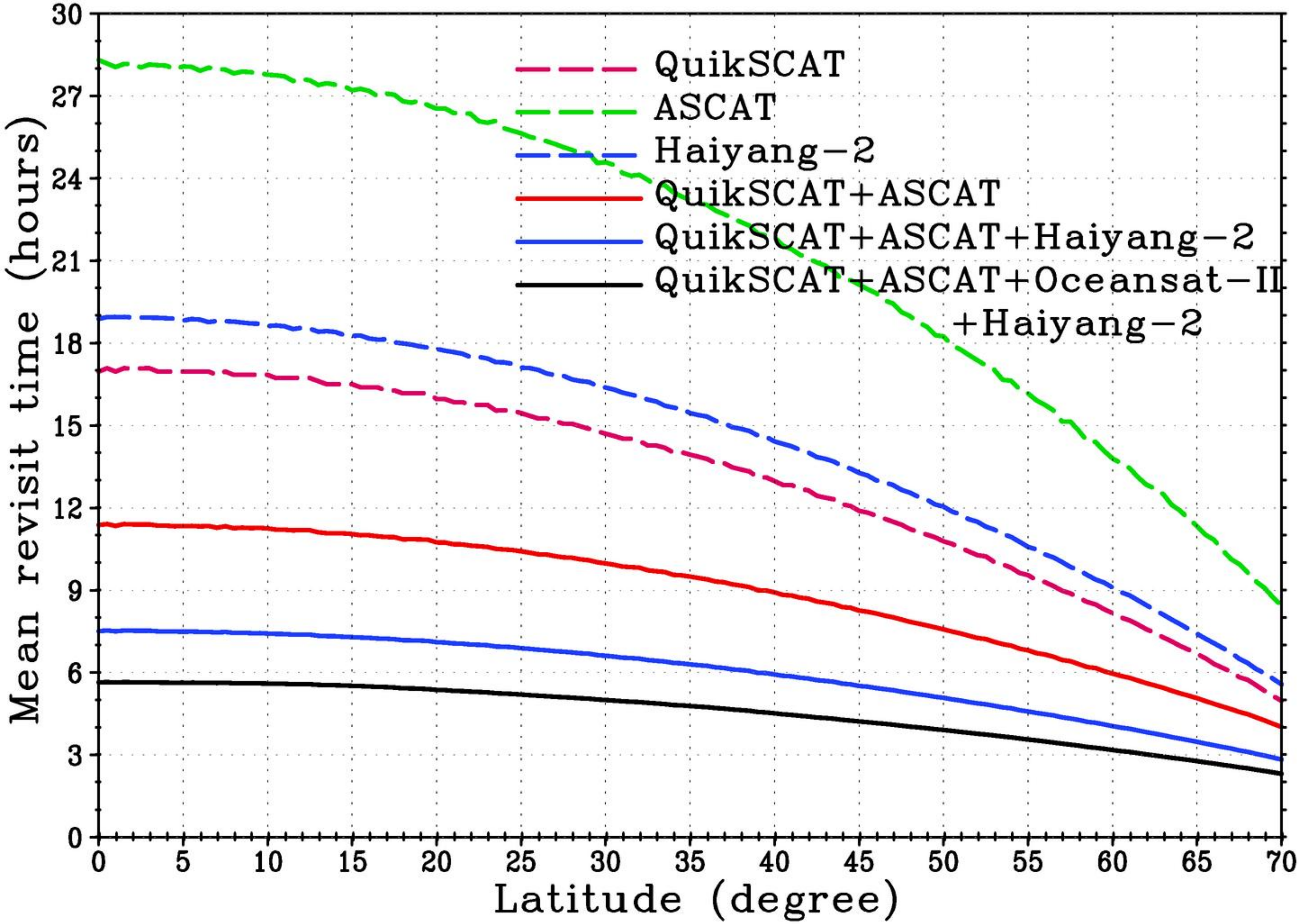
(part in IJRS 2013, in press)

SAMPLING IMPROVEMENT





Scatterometer constellation will provide less than 6-hour revisit interval for all latitudes, meeting operational weather forecast requirement

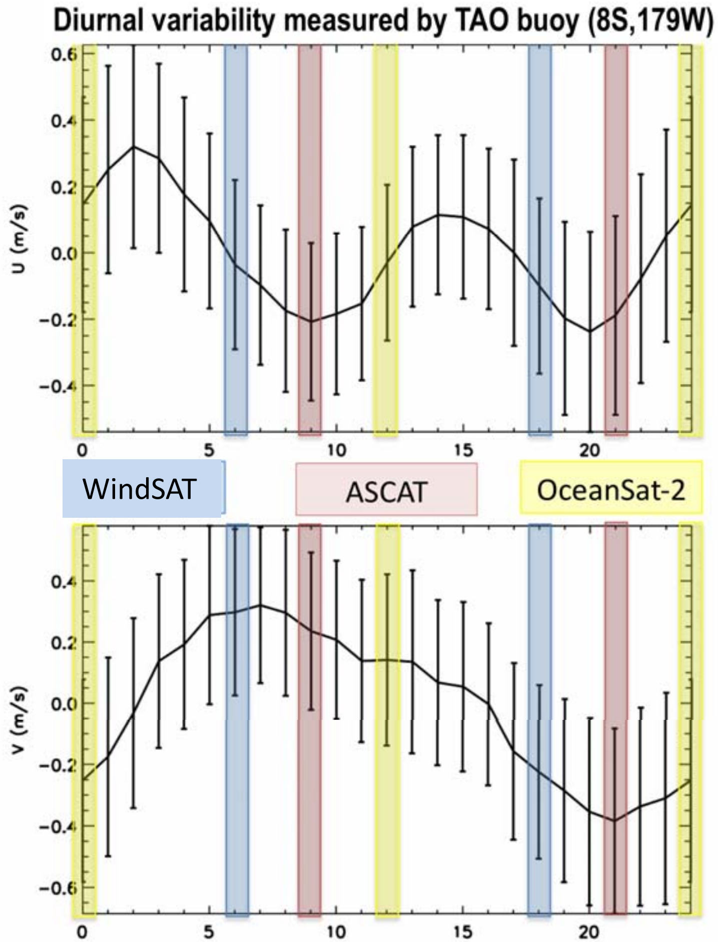
One scatterometer, like QuikSCAT, can sample a location at most twice a day.

NASA tandem scatterometer mission SeaWinds on QuikSCAT and ADEOS-II (2003) with 4 observations everyday provides a global view of diurnal, but only for 6 months

The constellation of OceanSAT-2, ASCAT and WindSAT, provides opportunity to construct the amplitude and phase of the large spatial pattern diurnal variabily with full annual cycle over global ocean.

It is assumed that instrument bias do not have a diurnal cycle. We only used deviations of ascending and decending passes from daily mean for each sensor.

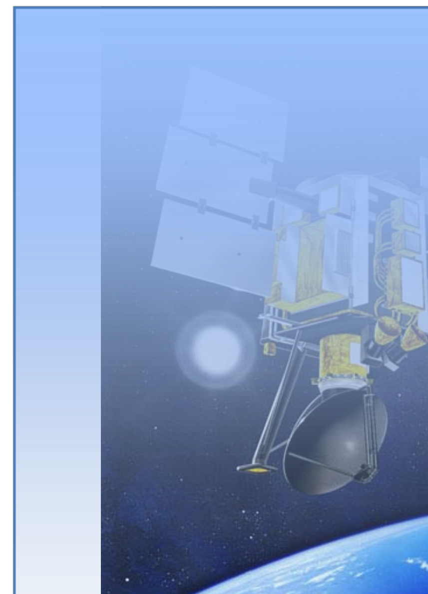
OceanSAT-2/ISRO
Sep. 23, 2009-present



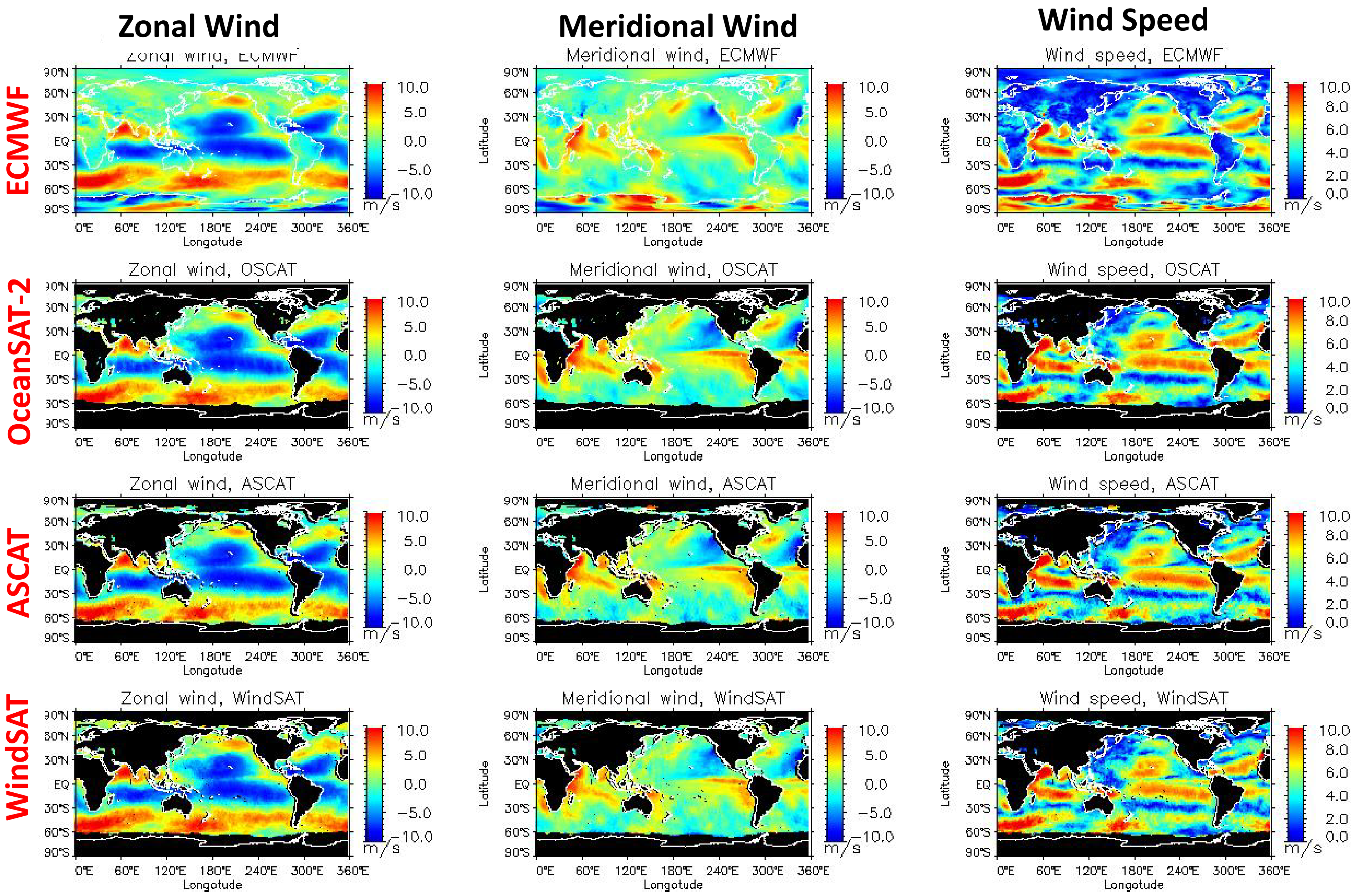
Local time of satellite passing

ASCAT/EUMETSAT M
Oct. 19, 2006-prese

WindSAT/NPOESS Coriolis
Jan 6, 2003-present

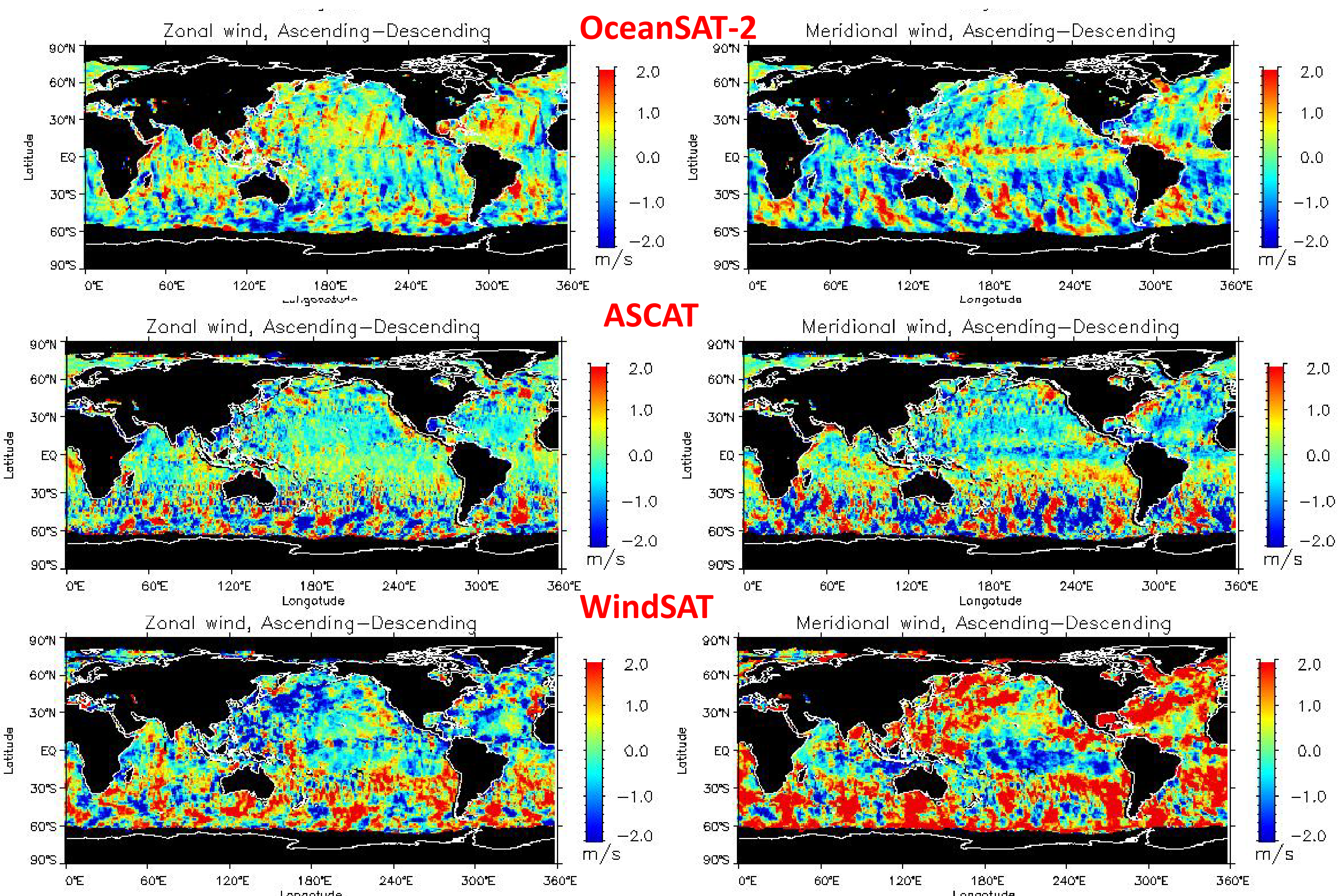


SeaWinds/NASA Quik
June 19, 1999-Nov. 23



Main feature of ocean vector winds are consistently observed by OceanSAT-2, ASCAT and WindSAT.

Observing Diurnal Variability of Ocean Wind from Space



Deviations from the daily means observed by ascending/descending passes provide possibility to derive the diurnal cycle over global ocean

Fitting the harmonics

$$X(t) = A_1 \sin(2\pi t / 24 + P_1) + \varepsilon$$

Uncertainty estimated via Monte Carlo simulation

(1) Perturb the original 6 data values by random numbers with a Gaussian distribution and a variance equivalent to the standard error of the time-averaged means; and re-derive A_1, P_1

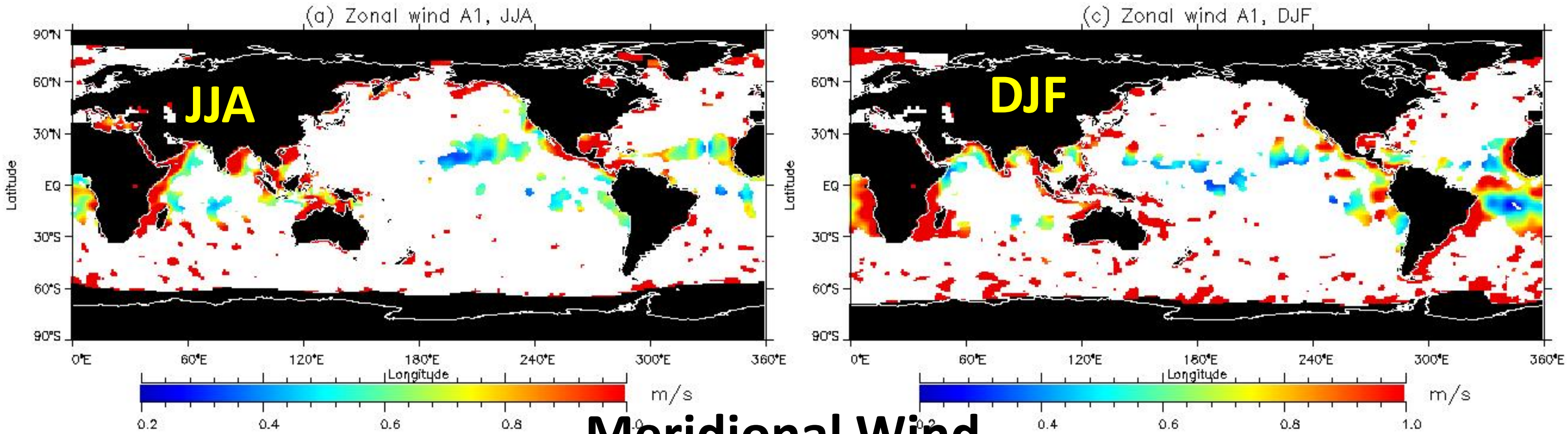
(2) Repeat (1) 100 times for the Monte Carlo simulation of uncertainty analysis;

(3) Uncertainties of A_1, P_1 are determined from the standard deviation of the 100 realizations

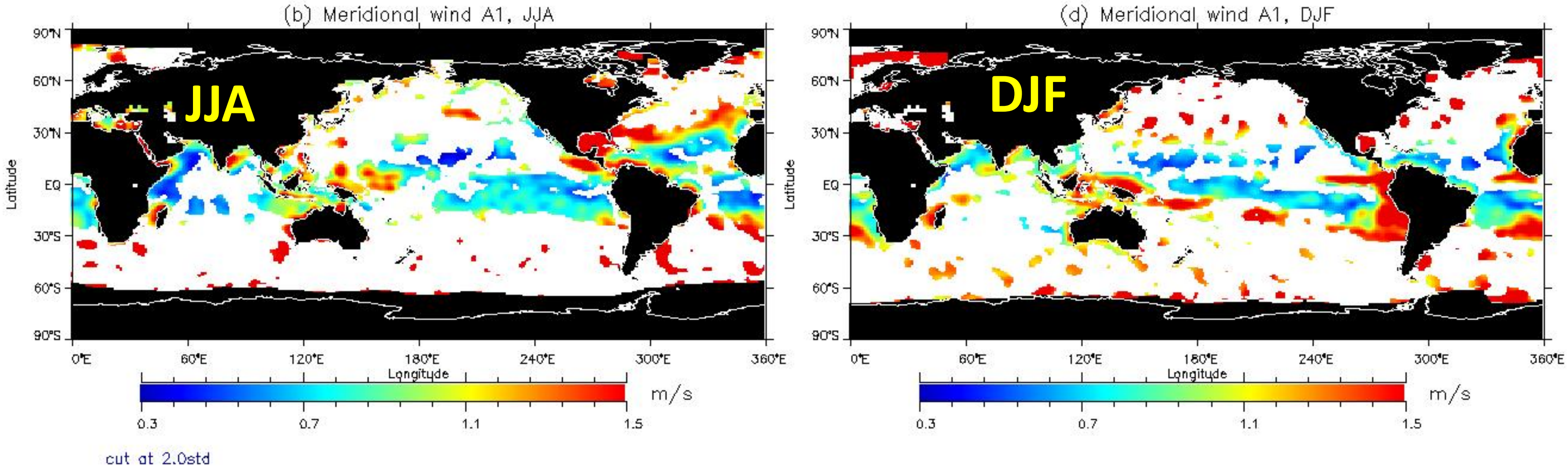
Global

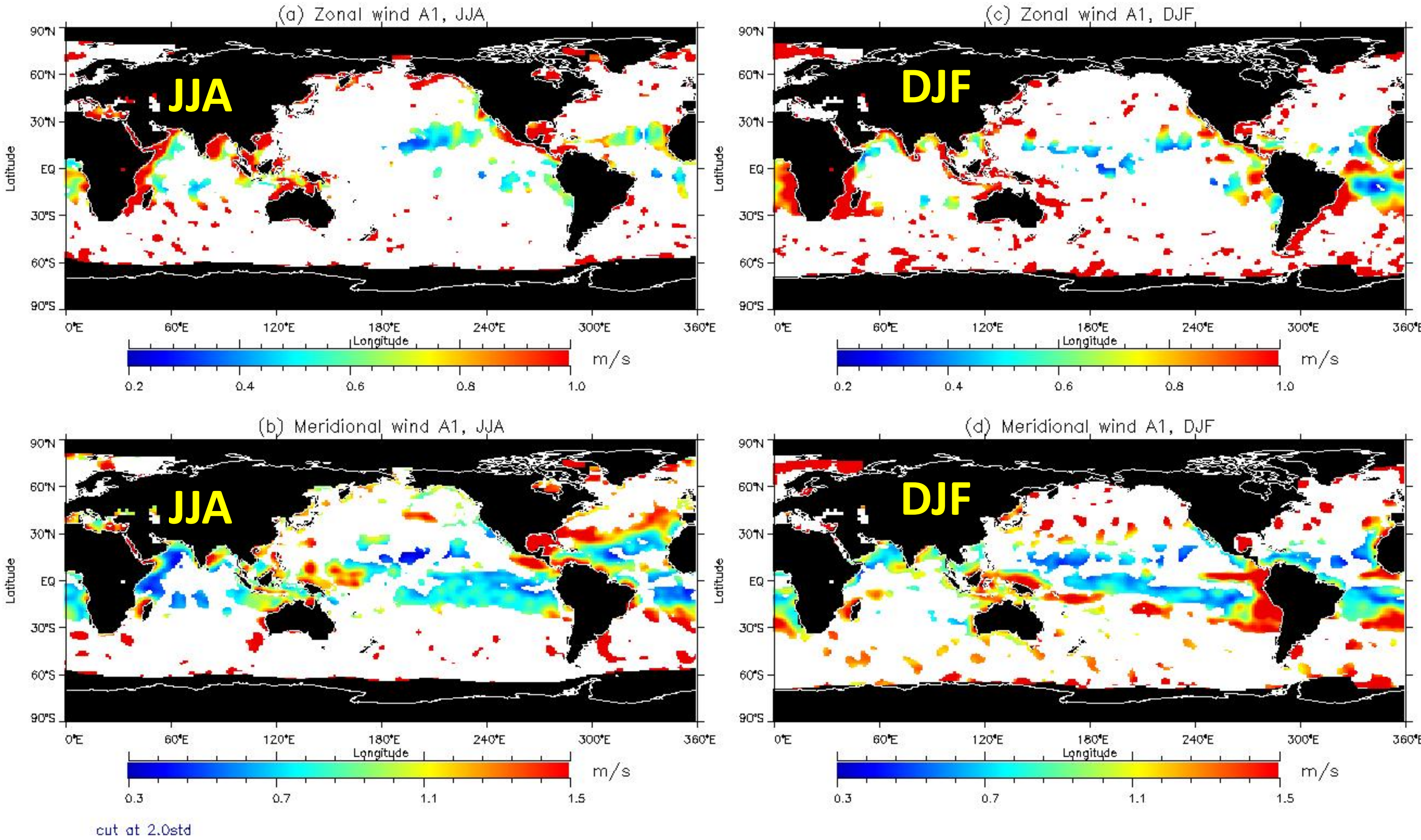
A_1

Zonal Wind



Meridional Wind

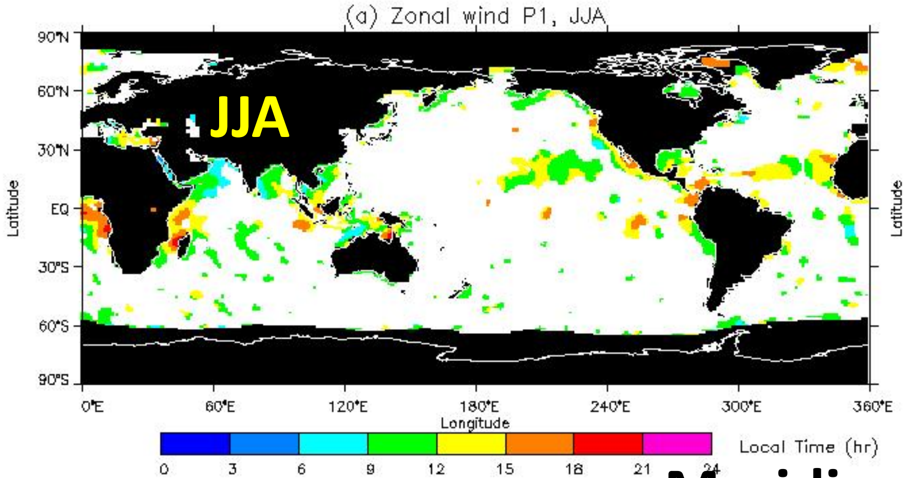


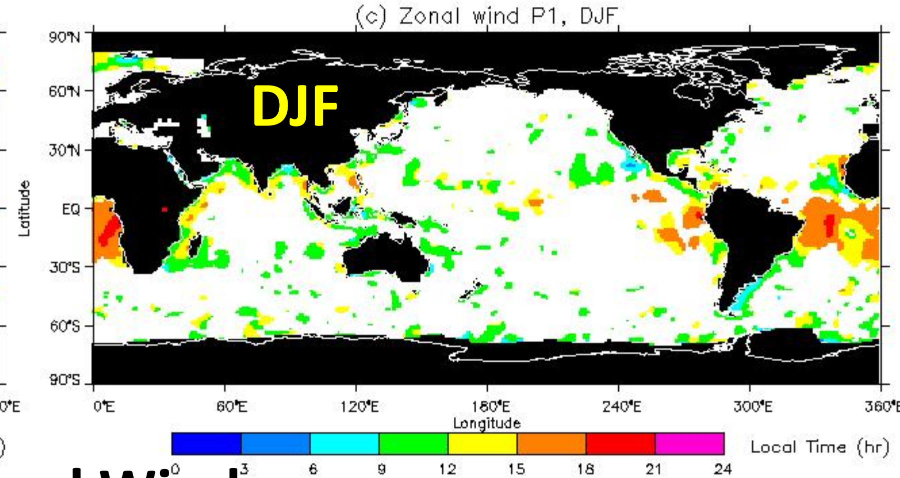

(a) Zonal wind A1, JJA
(b) Meridional wind A1, JJA
(c) Zonal wind A1, DJF
(d) Meridional wind A1, DJF
JJA
DJF
90°N
60°N
30°N
EQ
30°S
60°S
90°S
Latitude
0°E
60°E
120°E
180°E
240°E
300°E
360°E
Longitude
m/s
0.2
0.4
0.6
0.8
1.0
0.3
0.7
1.1
1.5
cut at 2.0std

Global

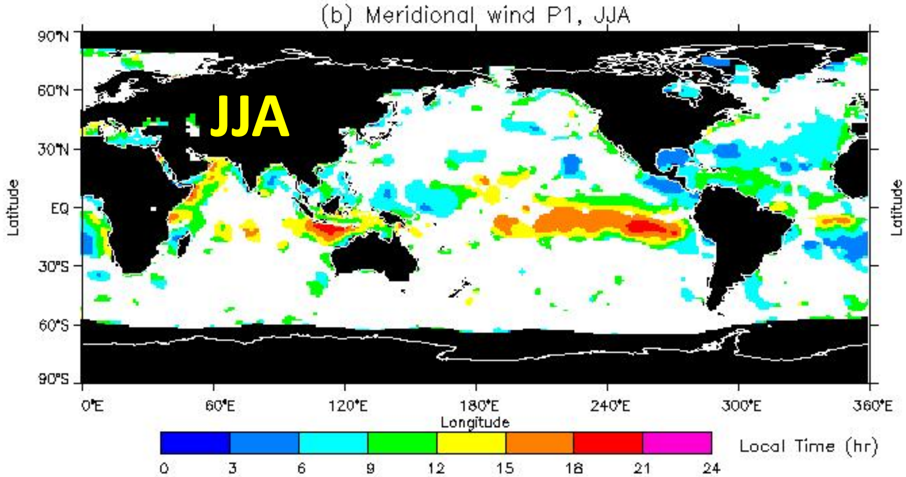
P_1

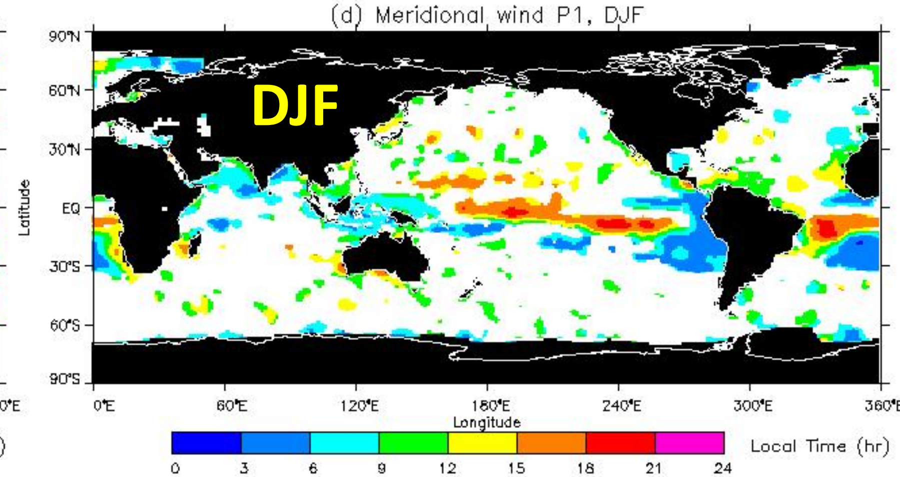
Zonal Wind





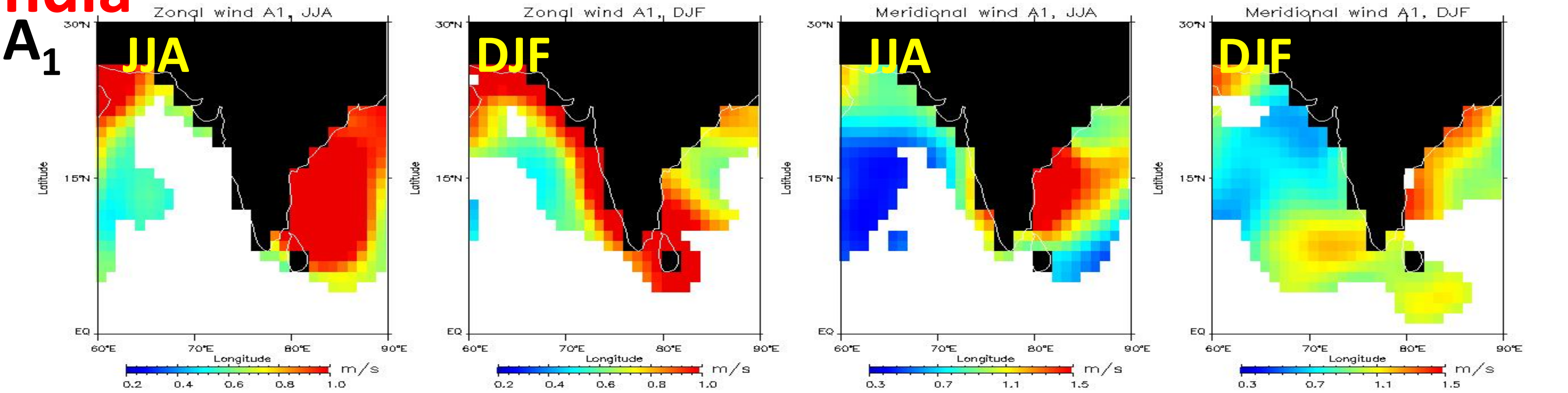
Meridional Wind





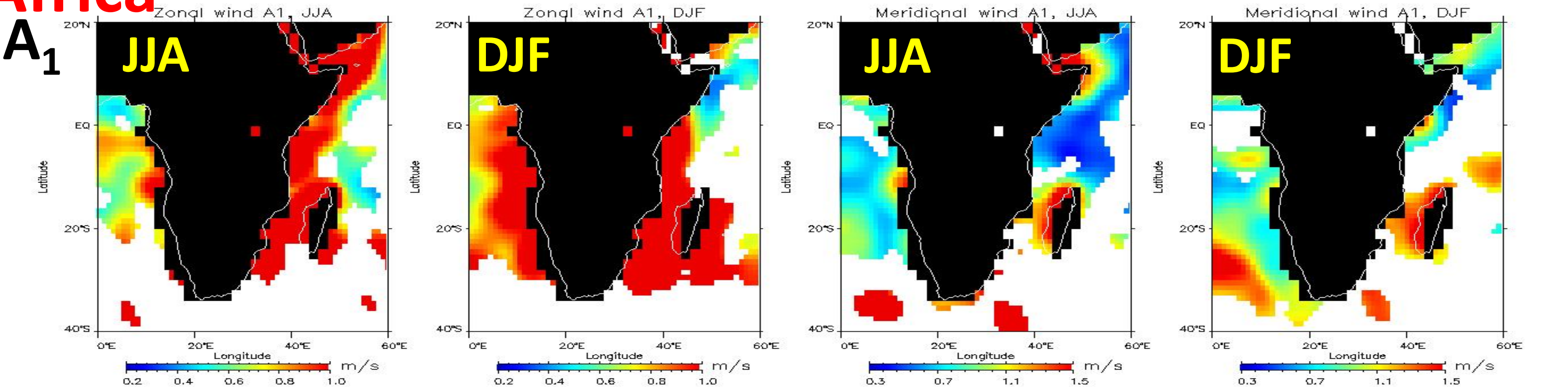
India

Zonal Wind **Meridional Wind**



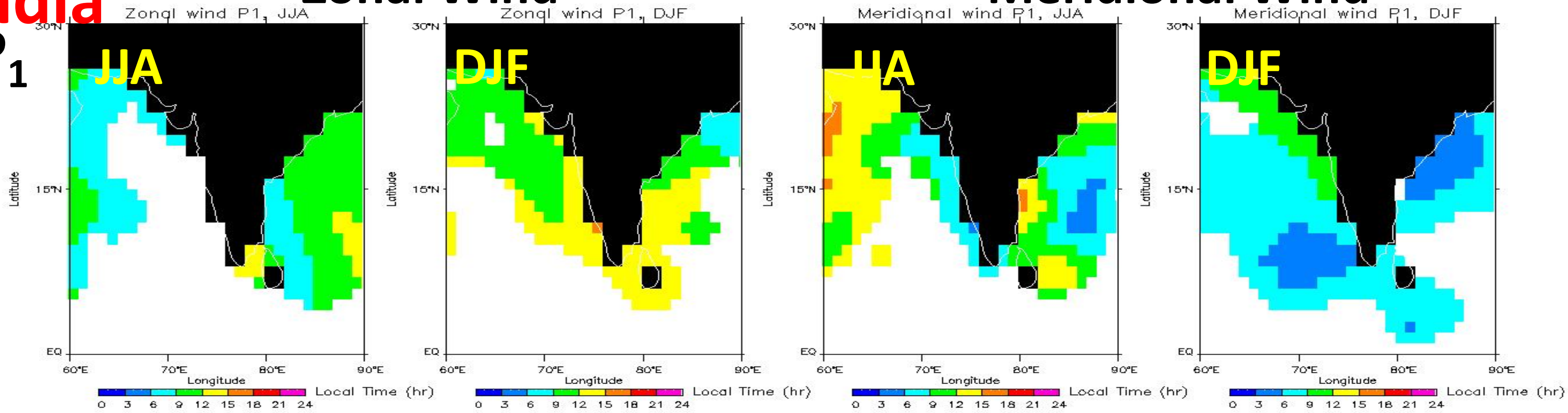
Africa

Zonal Wind **Meridional Wind**



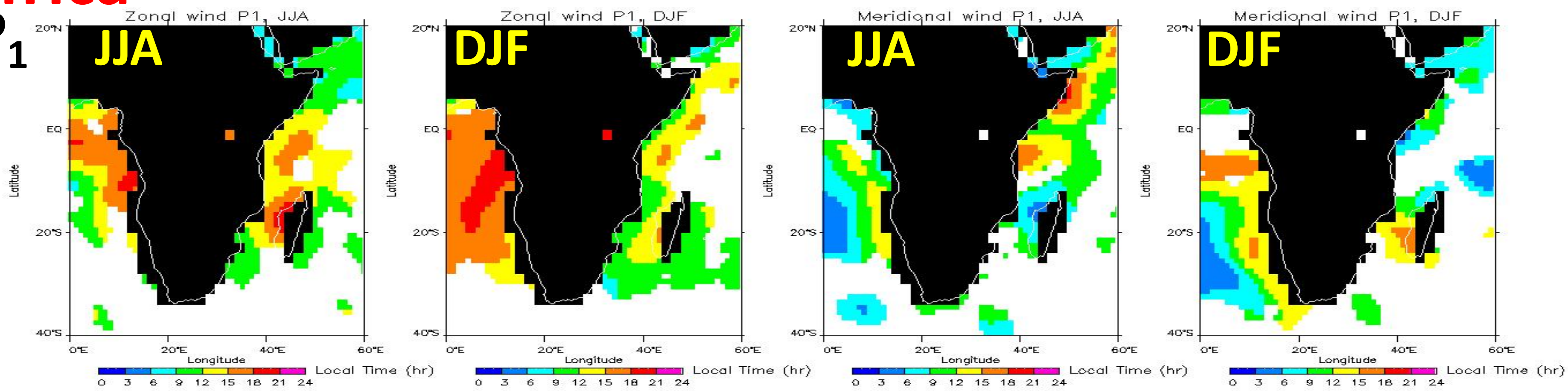
India P_1

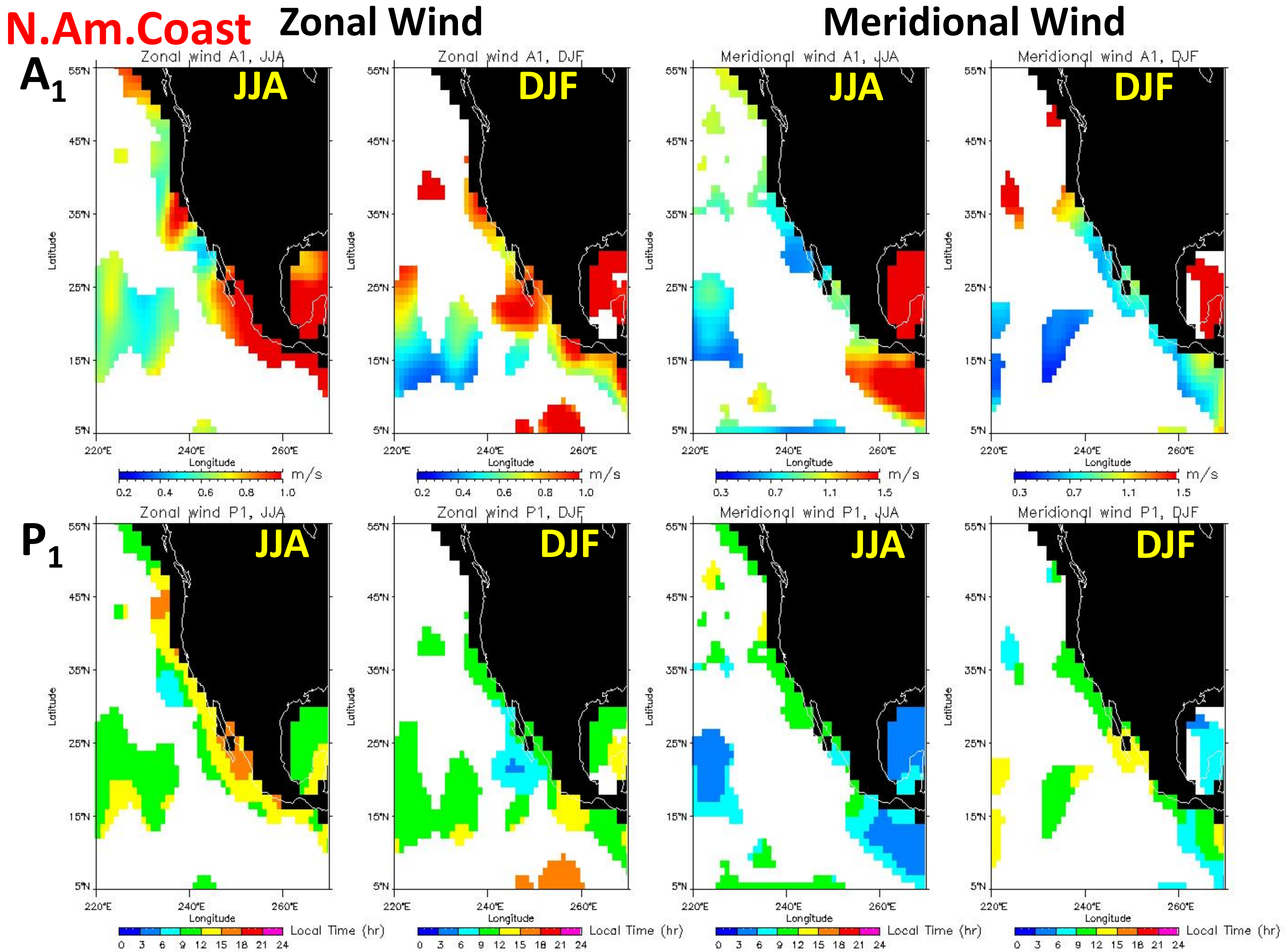
Zonal Wind **Meridional Wind**



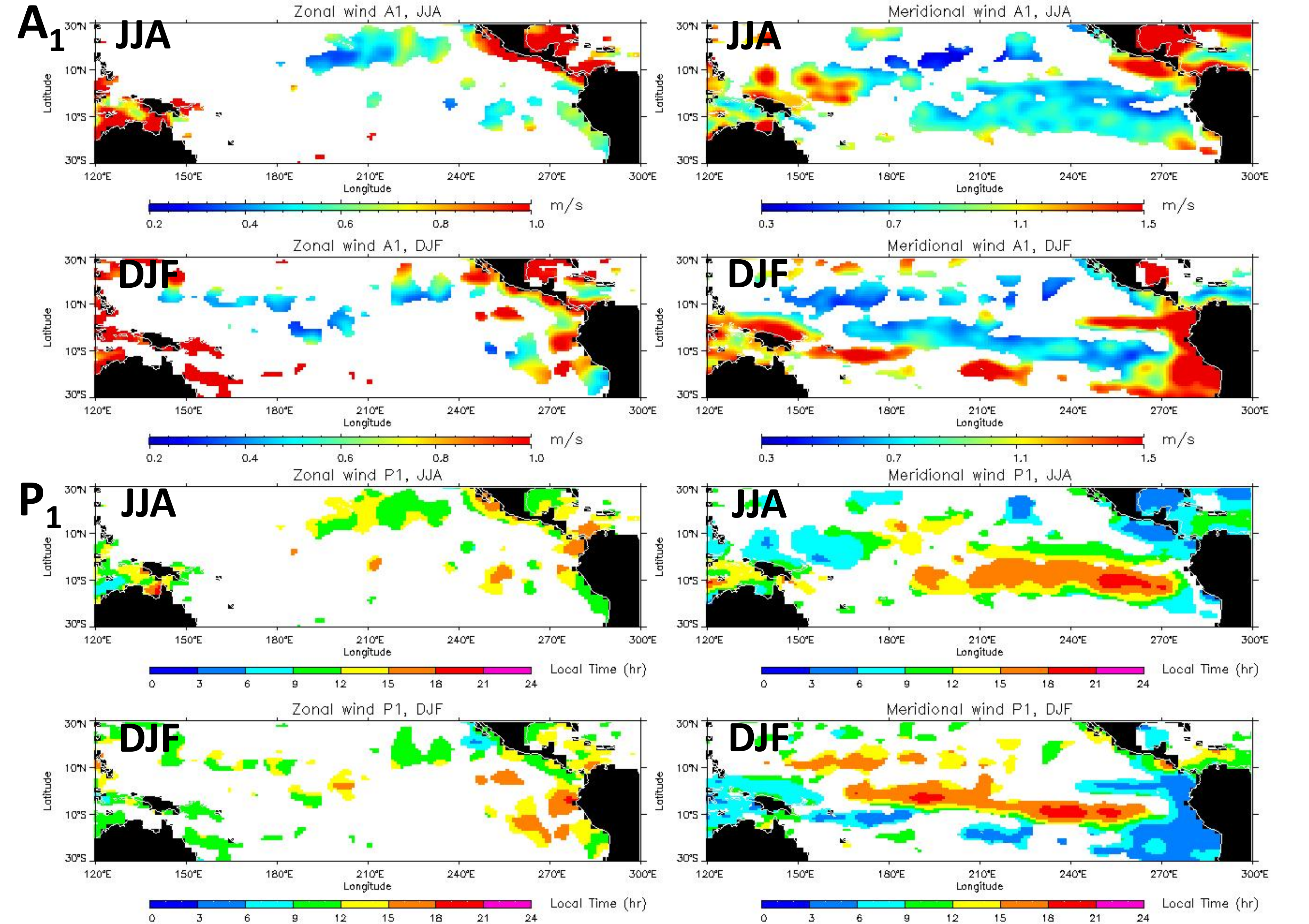
Africa P_1

Zonal Wind **Meridional Wind**




N.Am.Coast
Zonal Wind
Meridional Wind
A1
P1
Zonal wind A1, JJA
Zonal wind A1, DJF
Meridional wind A1, JJA
Meridional wind A1, DJF
Zonal wind P1, JJA
Zonal wind P1, DJF
Meridional wind P1, JJA
Meridional wind P1, DJF
JJA
DJF
Latitude
Longitude
55°N 45°N 35°N 25°N 15°N 5°N
220°E 240°E 260°E
m/s
0.2 0.4 0.6 0.8 1.0
0.3 0.7 1.1 1.5
Local Time (hr)
0 3 6 9 12 15 18 21 24

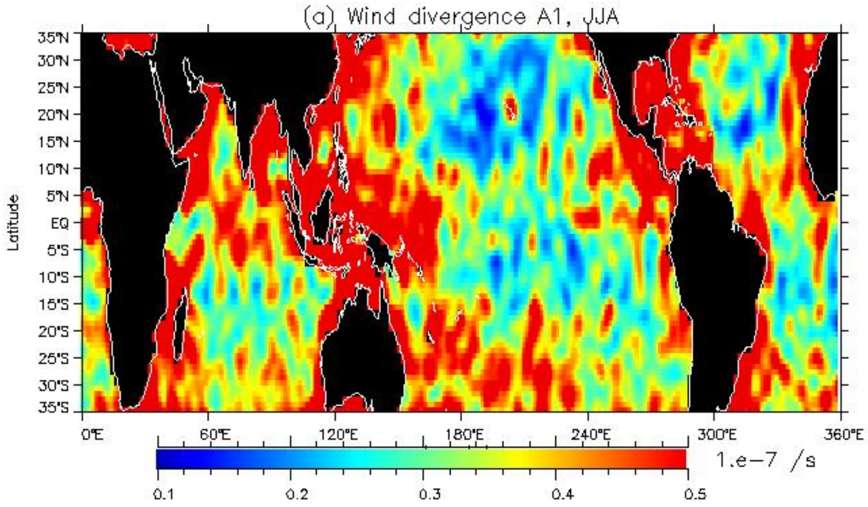
Pacific


Zonal Wind
Meridional Wind
A1
JJA
Zonal wind A1, JJA
Meridional wind A1, JJA
DJF
Zonal wind A1, DJF
Meridional wind A1, DJF
P1
Zonal wind P1, JJA
Meridional wind P1, JJA
Zonal wind P1, DJF
Meridional wind P1, DJF
Latitude
Longitude
30°N
10°N
10°S
30°S
120°E
150°E
180°E
210°E
240°E
270°E
300°E
m/s
0.2
0.4
0.6
0.8
1.0
0.3
0.7
1.1
1.5
Local Time (hr)
0
3
6
9
12
15
18
21
24

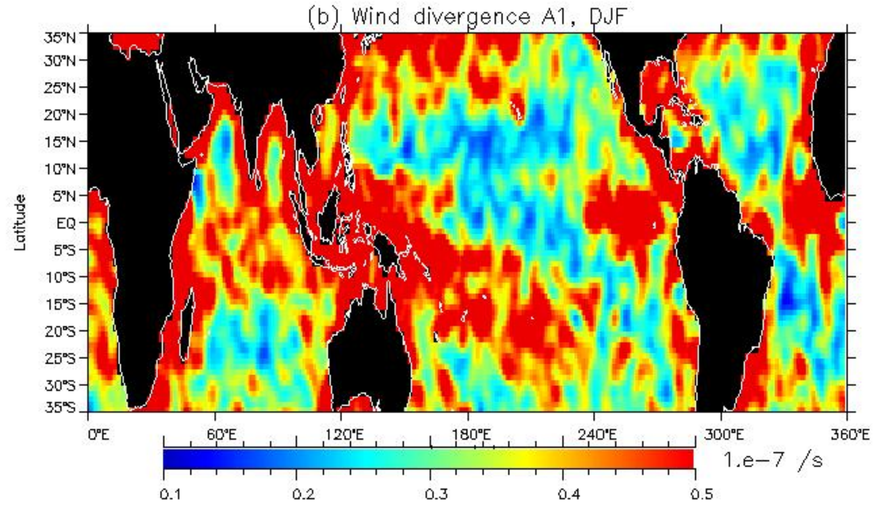
Observing Diurnal Variability of Ocean Wind from Space

Amplitude of wind divergence diurnal cycle

June, July, Aug.

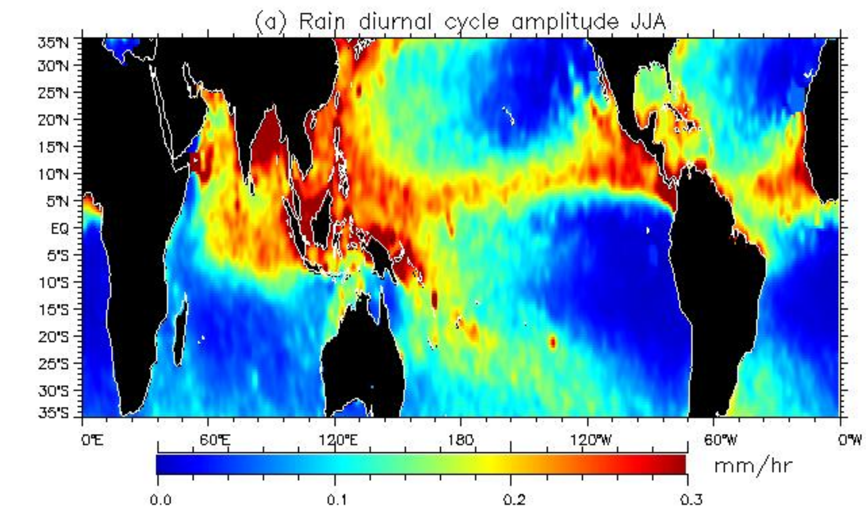


Dec., Jan., Feb.

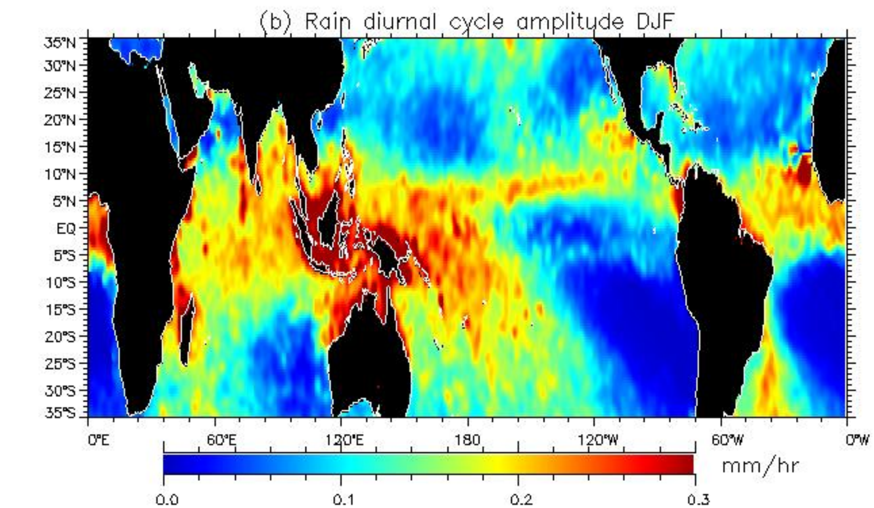


Amplitude of rain diurnal cycle (TRMM/TMI)

June, July, Aug.



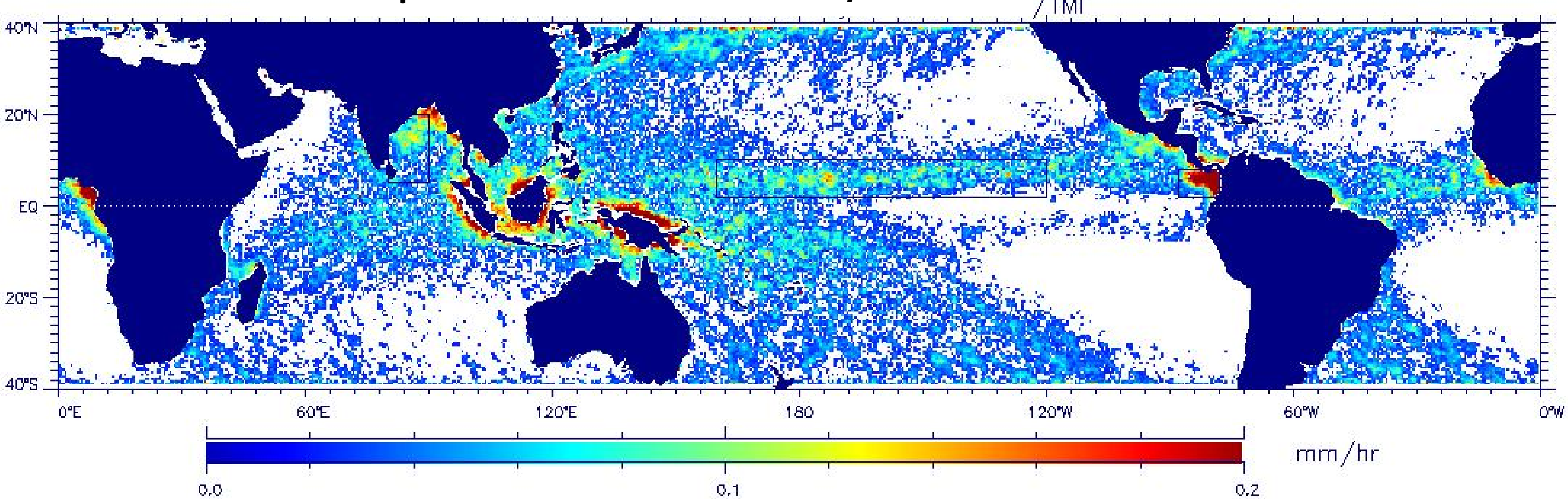
Dec., Jan., Feb.



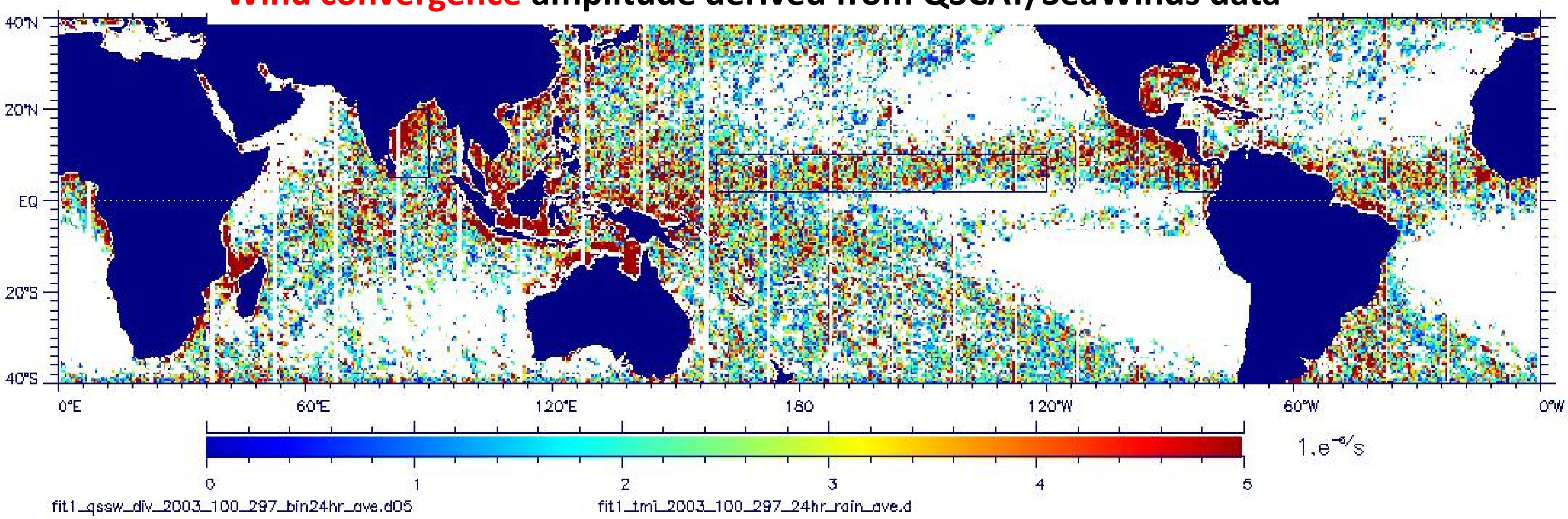
Amplitude of surface rain / wind convergence diurnal cycle

Rain amplitude derived from TRMM/TMI data

Rain ampli. > 0.02 mm/hr



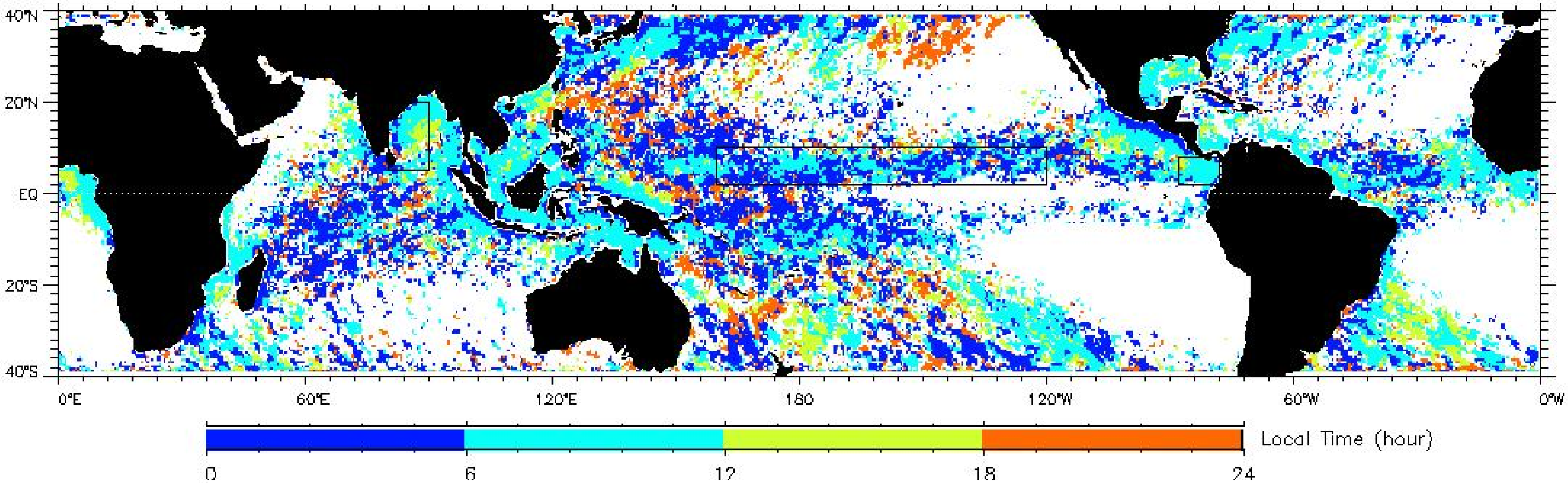
Wind convergence amplitude derived from QSCAT/SeaWinds data



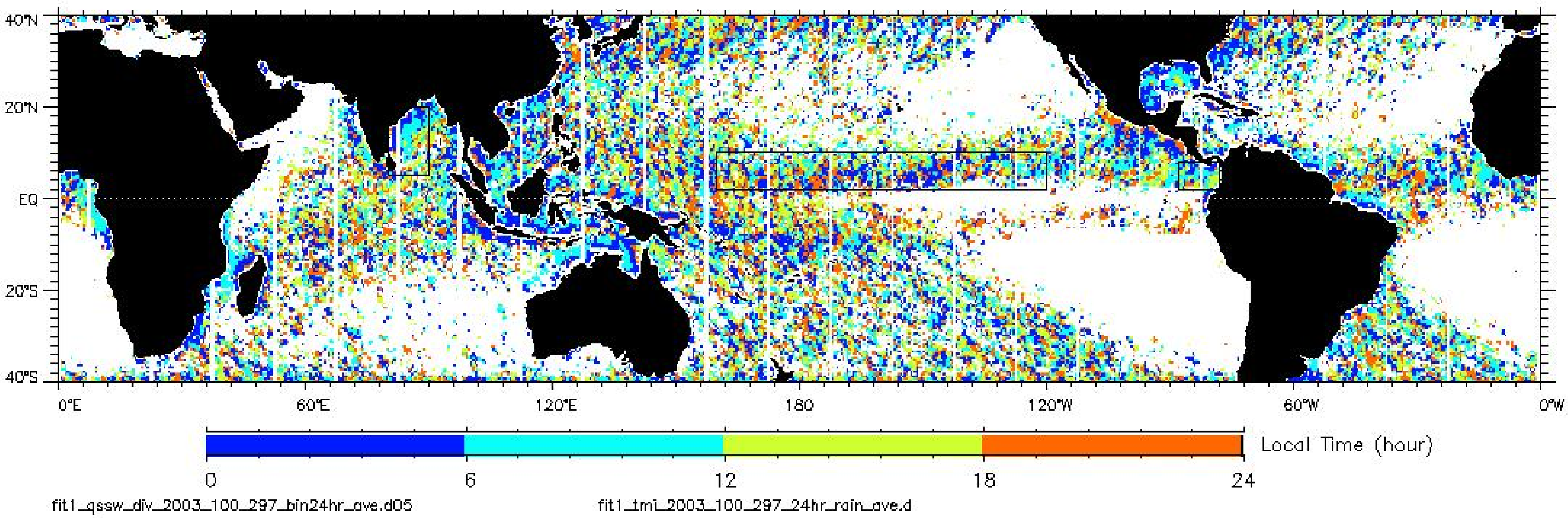
Both constructed over QuikSCAT/SeaWinds tandem mission period of April 10 to Oct. 24, 2003.

Phase of surface rain / wind diurnal cycle

Rain Tmax1 (peak time) derived from TRMM/TMI data Rain ampli. > 0.02 mm/hr

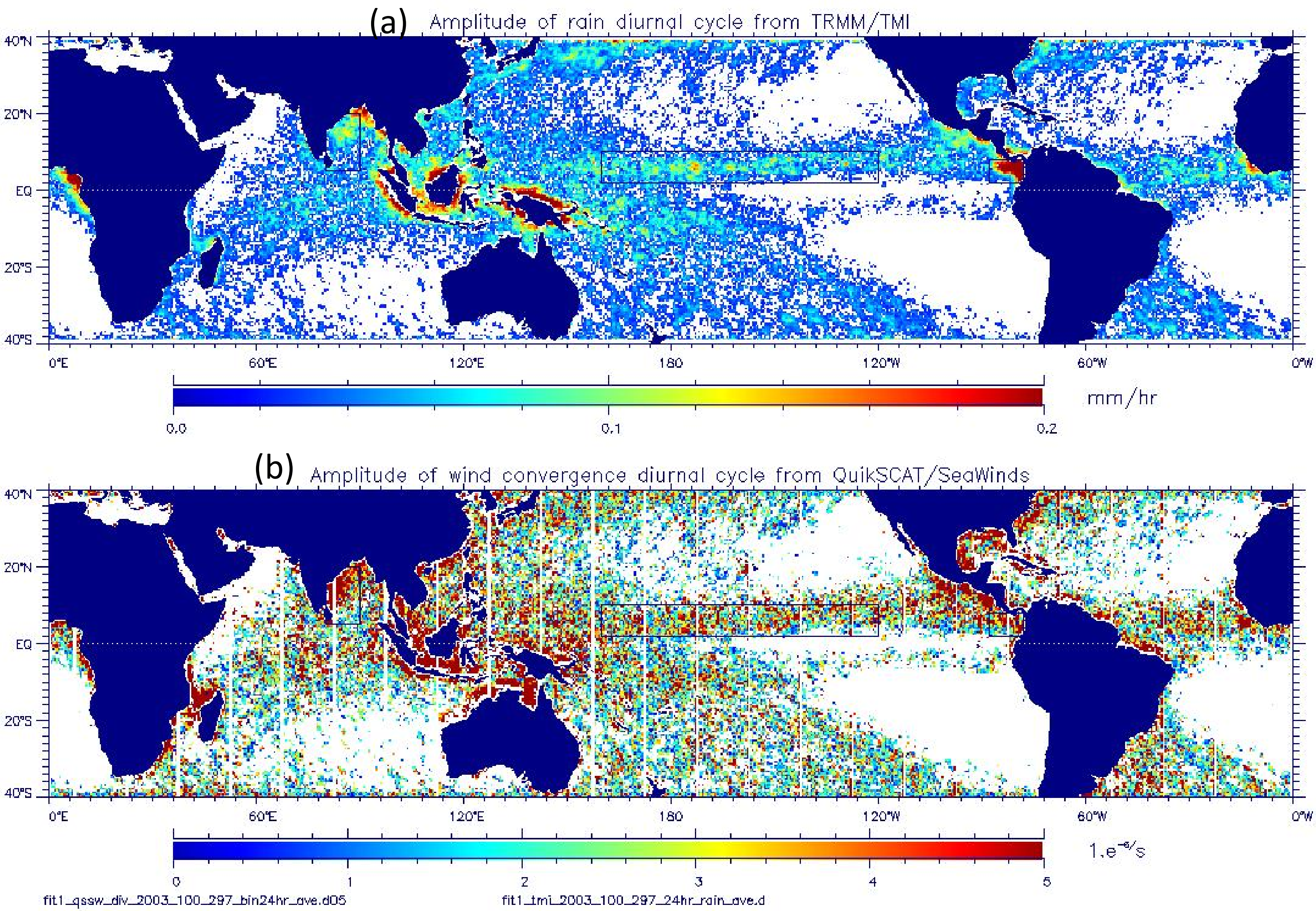


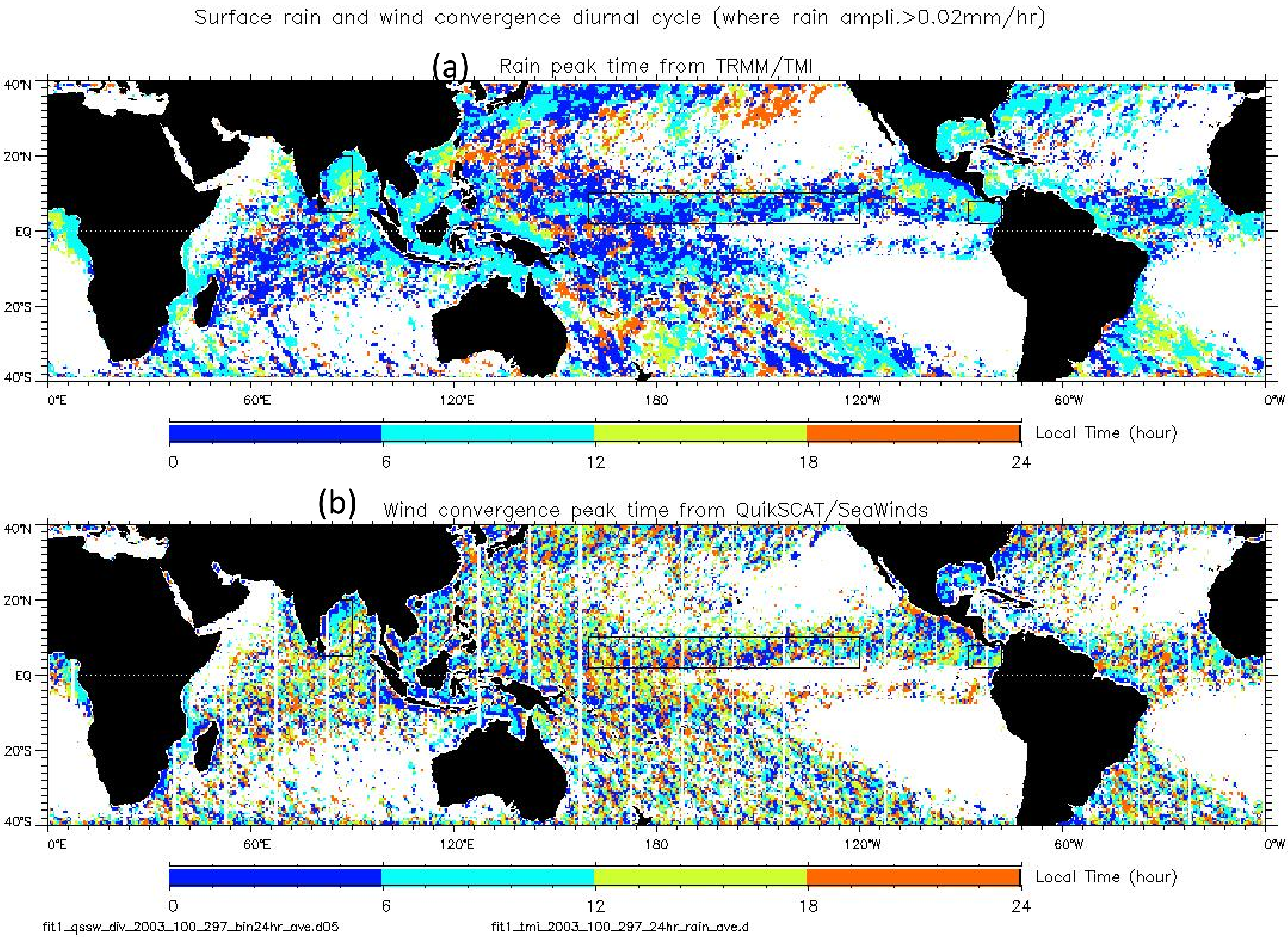
Wind convergence Tmax1 (peak time) derived from QSCAT/SeaWinds data



Both constructed over QuikSCAT/SeaWinds tandem mission period of April 10 to Oct. 24, 2003.

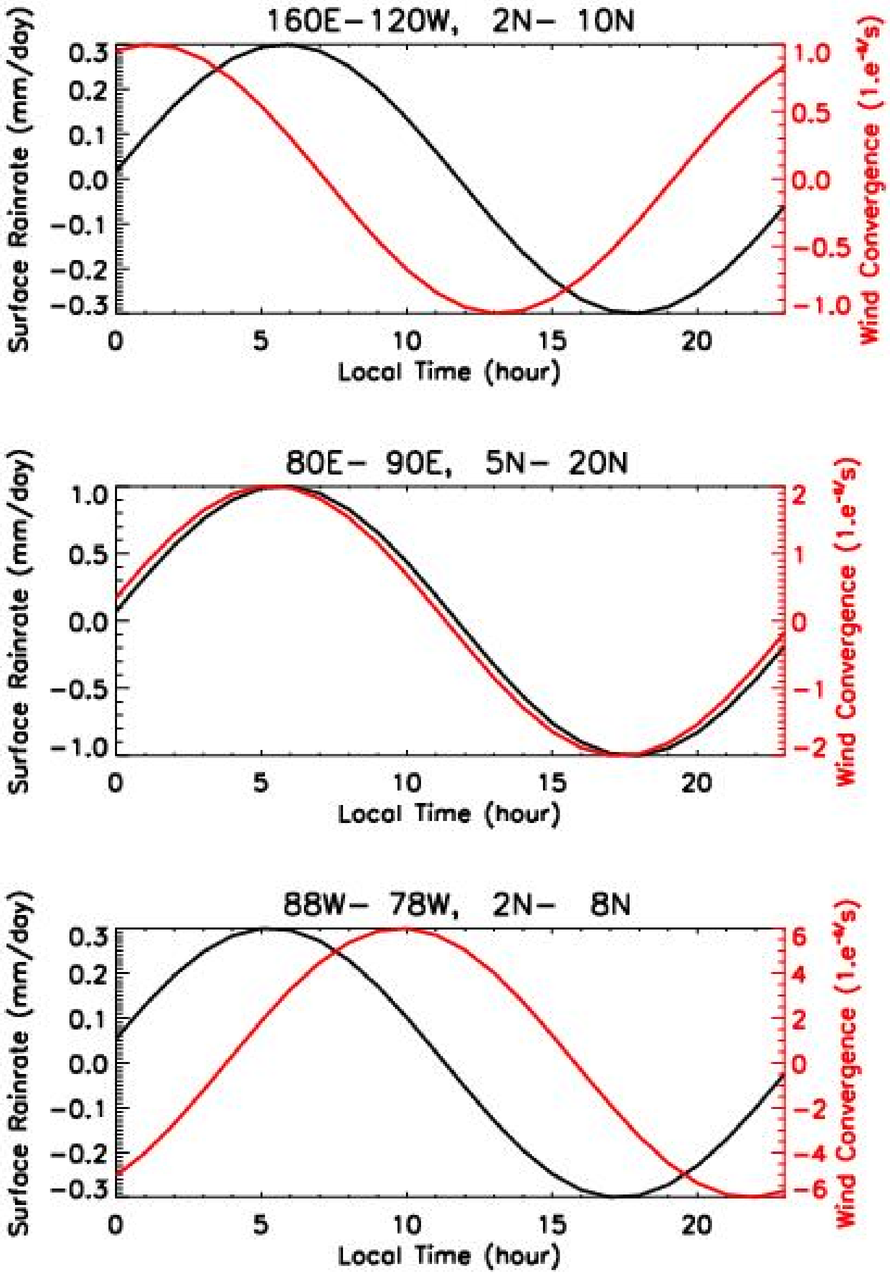
Surface rain and wind convergence diurnal cycle (where rain ampli.>0.02mm/hr)





Surface rain and wind convergence diurnal cycle (where rain ampli.>0.02mm/hr)
(a) Rain peak time from TRMM/TMI
40°N
20°N
EQ
20°S
40°S
0°E
60°E
120°E
180
120°W
60°W
0°W
Local Time (hour)
0
6
12
18
24
(b) Wind convergence peak time from QuikSCAT/SeaWinds
40°N
20°N
EQ
20°S
40°S
0°E
60°E
120°E
180
120°W
60°W
0°W
Local Time (hour)
0
6
12
18
24
fit1_qssw_div_2003_100_297_bin24hr_ave.d05
fit1_tmi_2003_100_297_24hr_rain_ave.d

Diurnal Cycle of rain and wind convergence for the period of QuikSCAT/SeaWinds tandem mission



Boxed area in maps for amplitude/phase

- OSCAT is a critical component of a wind constellation to satisfy ocean requirement of inertial frequency and operational weather requirement of 6 hourly repeat.
- The compiled diurnal cycle reveals, for the first time, seasonal and regional changes over global oceans
- Strong diurnal signal along coast regions is associated with sea breeze and in tropical oceansis associated with deep convections