



# ***The Global and Seasonal Variability of Ocean Winds and Derivatives from Multiple Scatterometers***

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and J. Turk**

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California Institute of Technology**



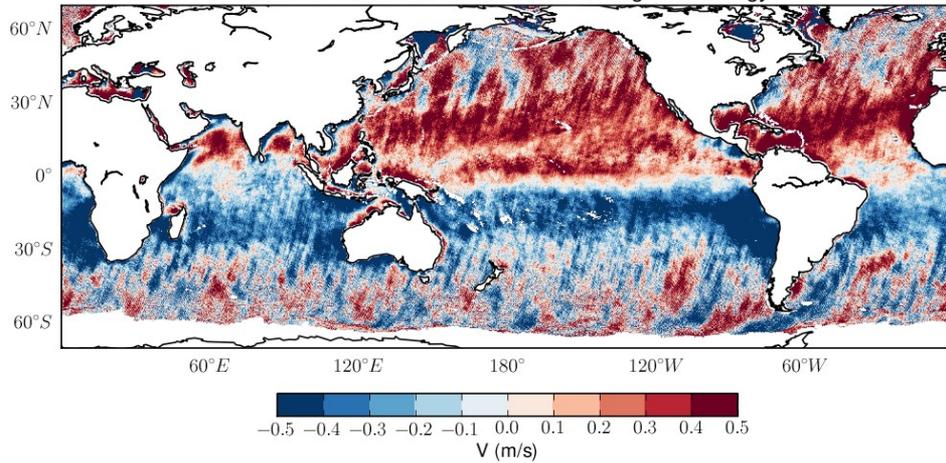
- Diurnal and semi-diurnal wind observations have been observed in buoy and models
  - A. Dai and C. Deser, “Diurnal and semidiurnal variations in global surface wind and divergence fields,” *Journal of Geophysical Research*, vol. 104, no. 31, pp. 109–31, 1999.
  - C. Deser and C. Smith, “Diurnal and semidiurnal variations of the surface wind field over the tropical pacific ocean,” *Journal of Climate*, vol. 11, no. 7, pp. 1730–1748, 1998.
- These variations cannot be resolved by a single scatterometer, but can be resolved by a constellation of scatterometer. This has previously been done with Qscat and SeaWinds on ADEOS-2
  - S. Gille, S. Smith, and N. Statom, “Global observations of the land breeze,” *Geophys. Res. Lett.*, vol. 32, no. 5, 2005.
  - R. Munoz, “Diurnal cycle of surface winds over the subtropical southeast pacific,” *Journal of Geophysical Research*, vol. 113, no. D13, p. D13107, 2008.
  - R. Wood, M. Kohler, R. Bennartz, and C. O’Dell, “The diurnal cycle of surface divergence over the global oceans,” *QJR Meteor. Soc.*, 2009.



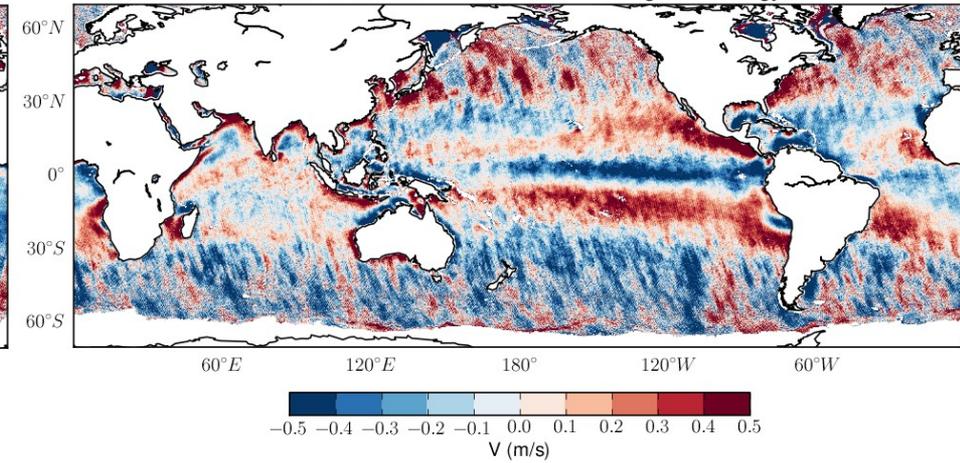
- QuikSCAT and SeaWinds L2B data from PODAAC for 2003, 2008, 2009
- ASCAT 25 km netcdf data from PODAAC for 2008, 2009
  - Wind speeds prior to December 2008 corrected by 0.2 m/s to match CMOD5.N applied after that date
- CCMP data from 2008, 2009 from PODAAC
  - R. Atlas, R. Hoffman, J. Ardizzone, S. Leidner, J. Jusem, D. Smith, and D. Gombos, “A cross-calibrated, multi-platform ocean surface wind velocity product for meteorological and oceanographic applications,” *Bulletin of the American Meteorological Society*, pp. 157–174, February 2011.

# Ascat V Component Morning-Evening Differences

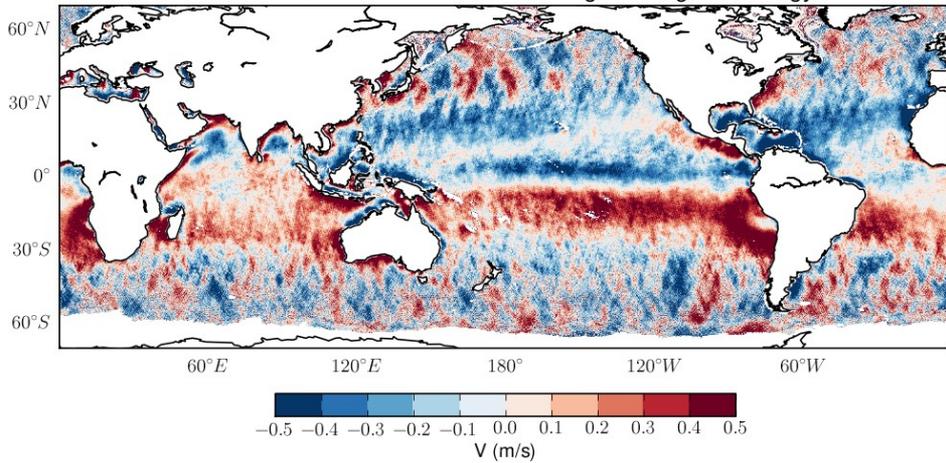
Ascat no-correction 2008-2009 Morning Climatology



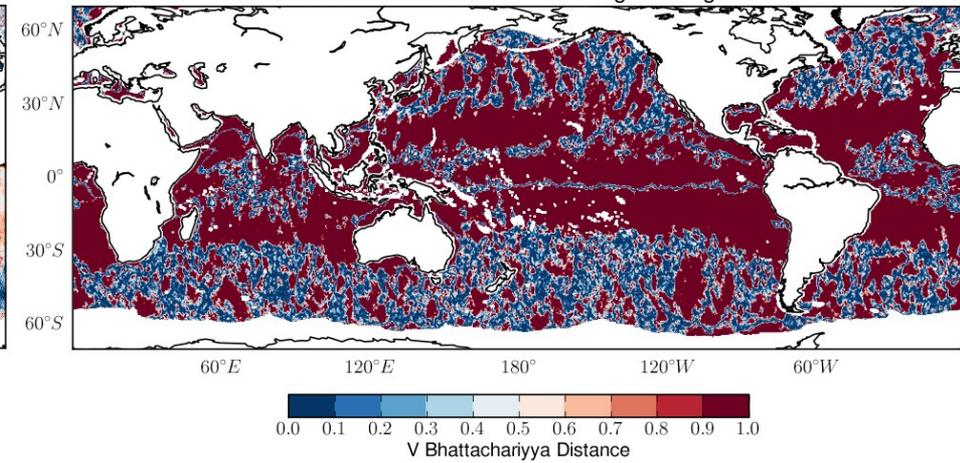
Ascat no-correction 2008-2009 Evening Climatology



Ascat no-correction 2008-2009 Evening-Morning Climatology



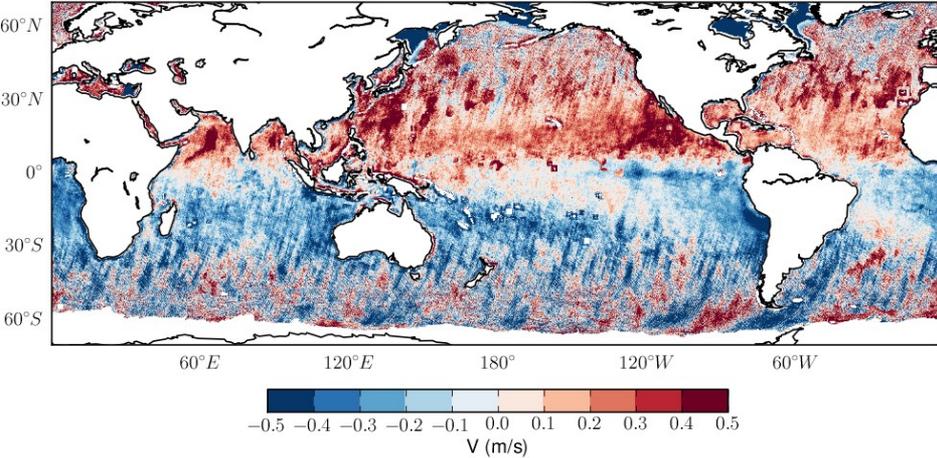
Ascat no-correction 2008-2009 Morning/Evening Distance



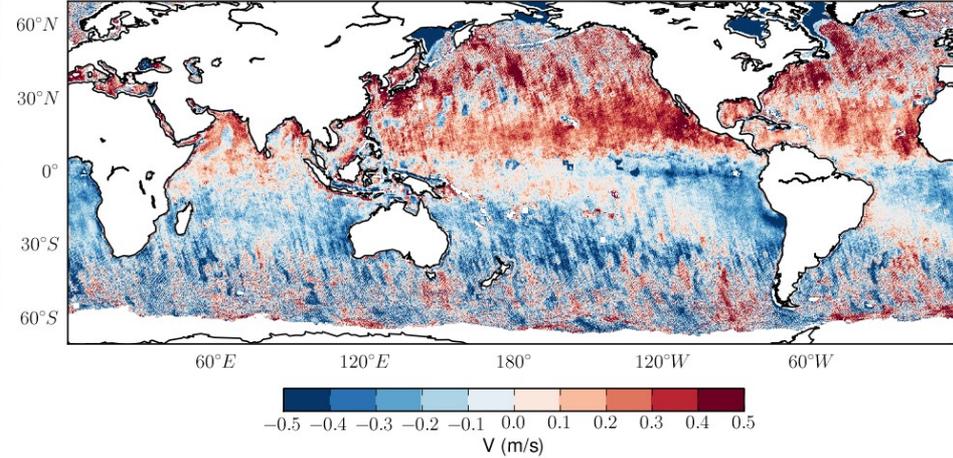


# Ascat V component after diurnal correction Morning Evening Differences

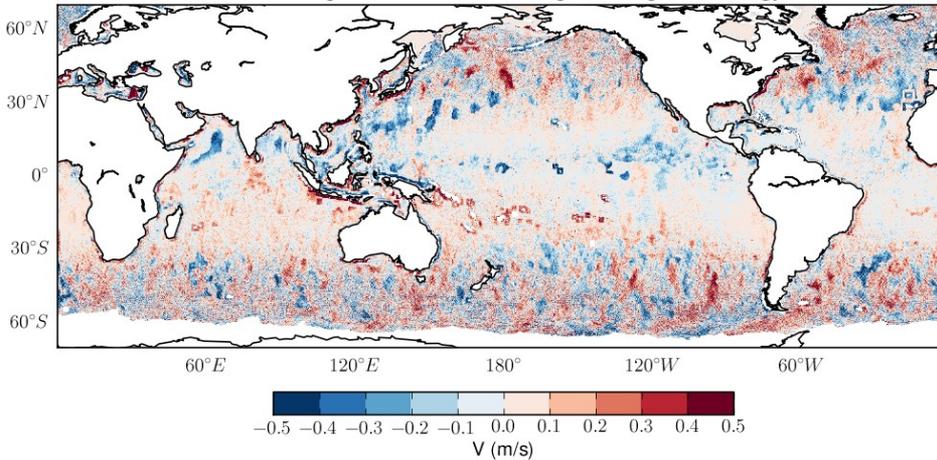
Ascat merged 2008-2009 Morning Climatology



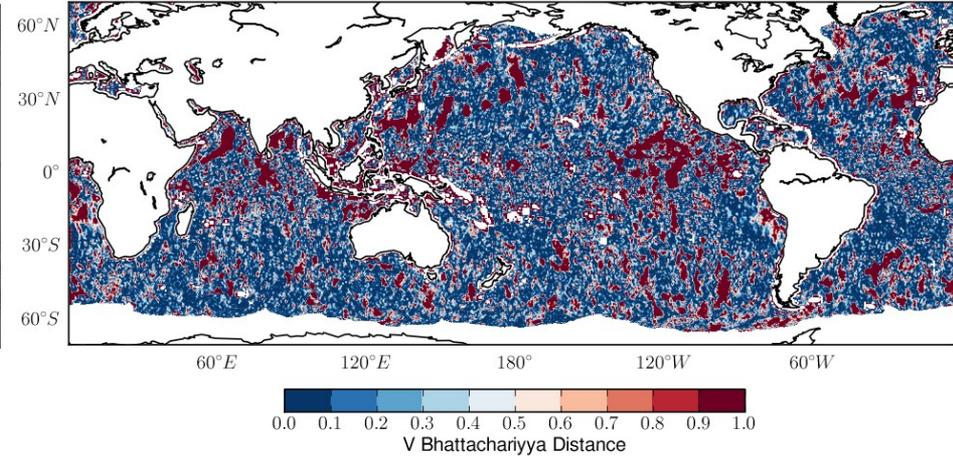
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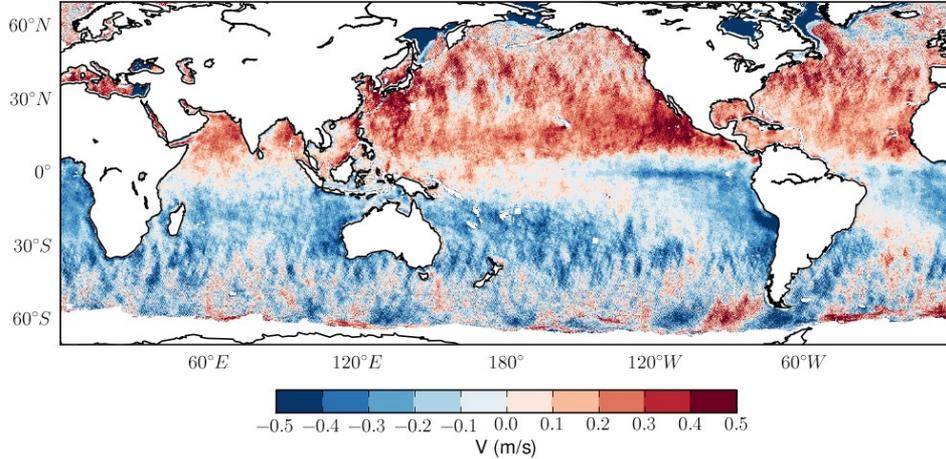
Ascat merged 2008-2009 Evening-Morning Climatology



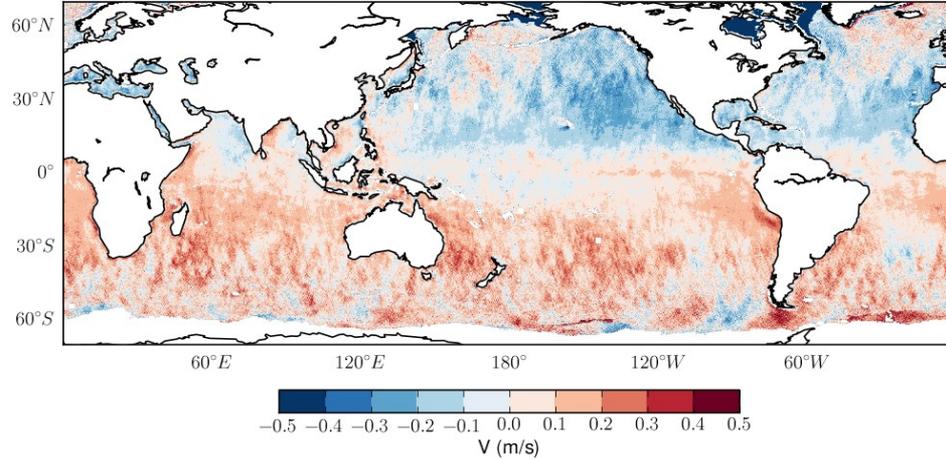
Ascat merged 2008-2009 Morning/Evening Distance



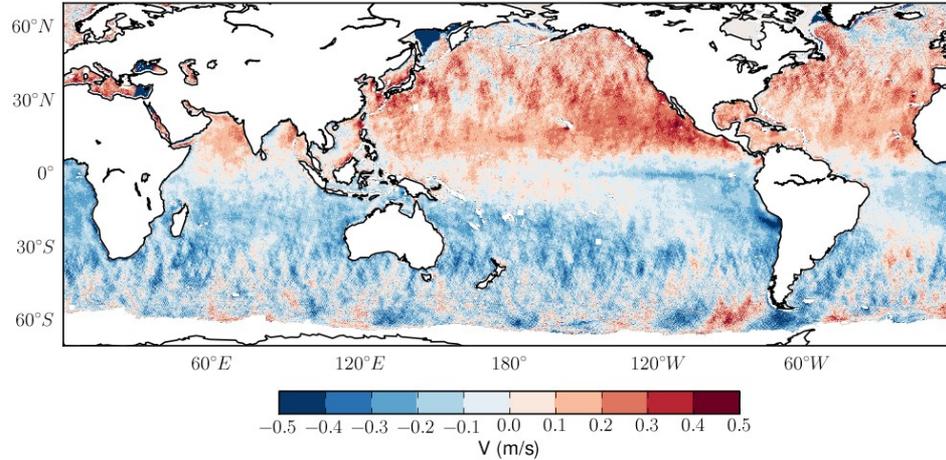
Ascat merged 2008-2009 Morning+Evening Climatology



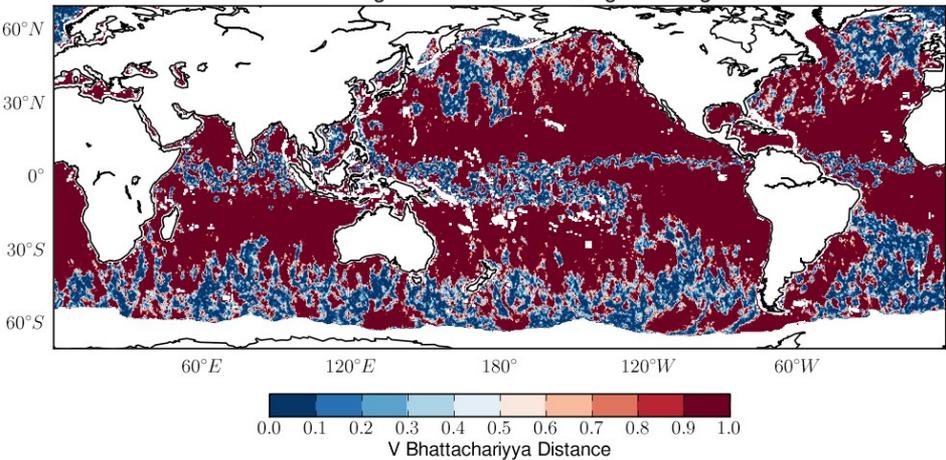
Qscat merged 2008-2009 Morning+Evening Climatology

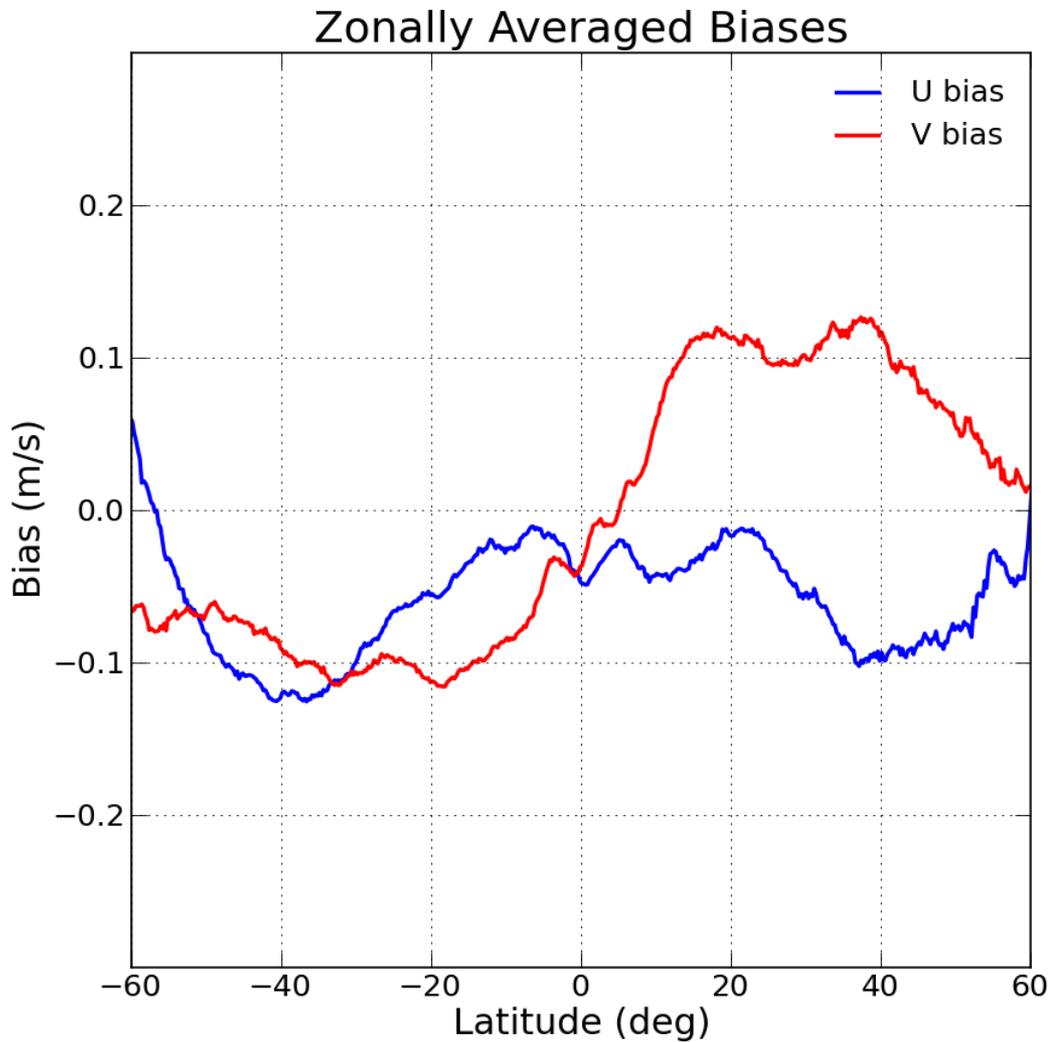


Ascat - Qscat merged 2008-2009 Morning+Evening Climatology



Ascat - Qscat merged 2008-2009 Morning+Evening Distance

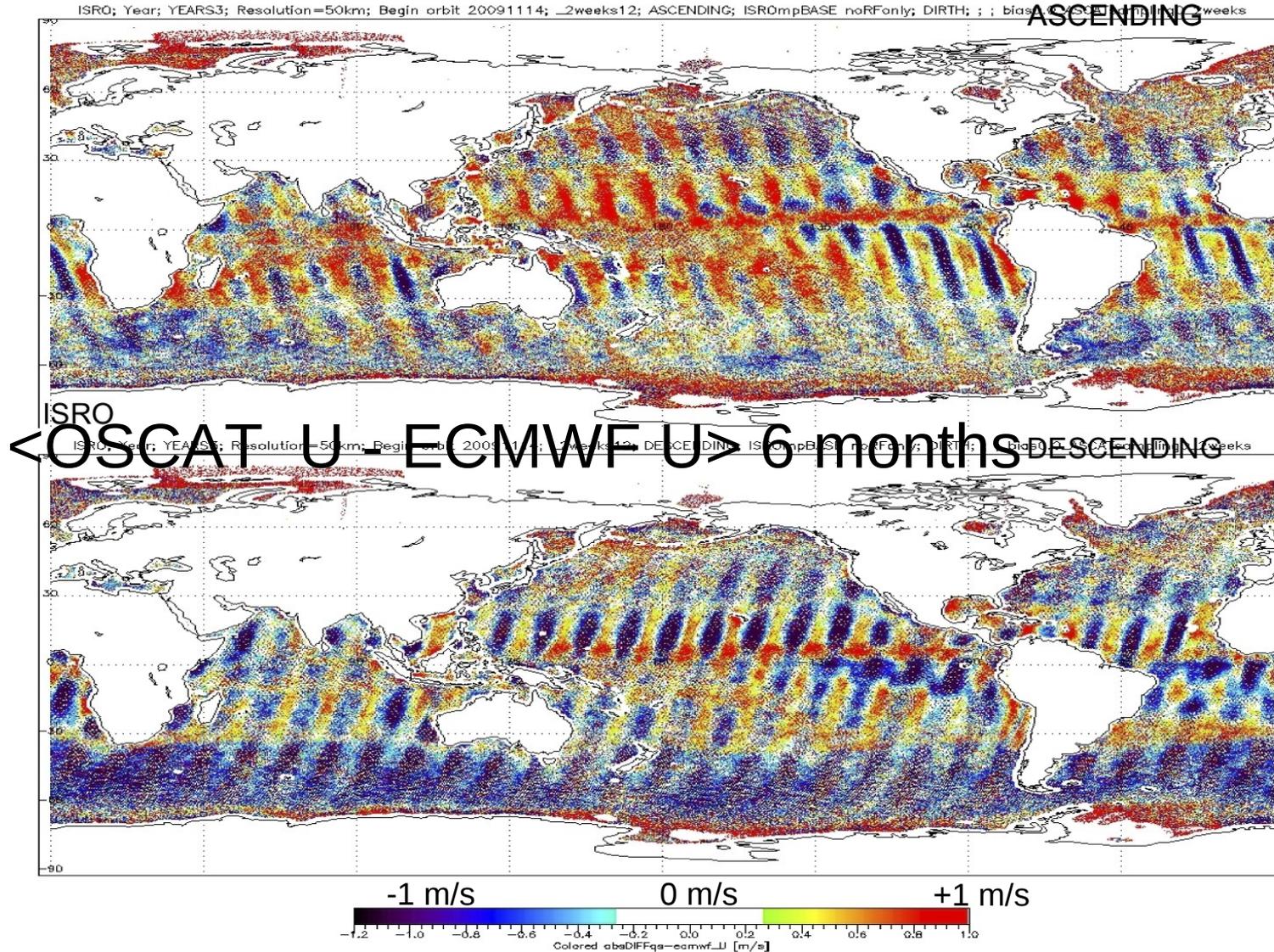


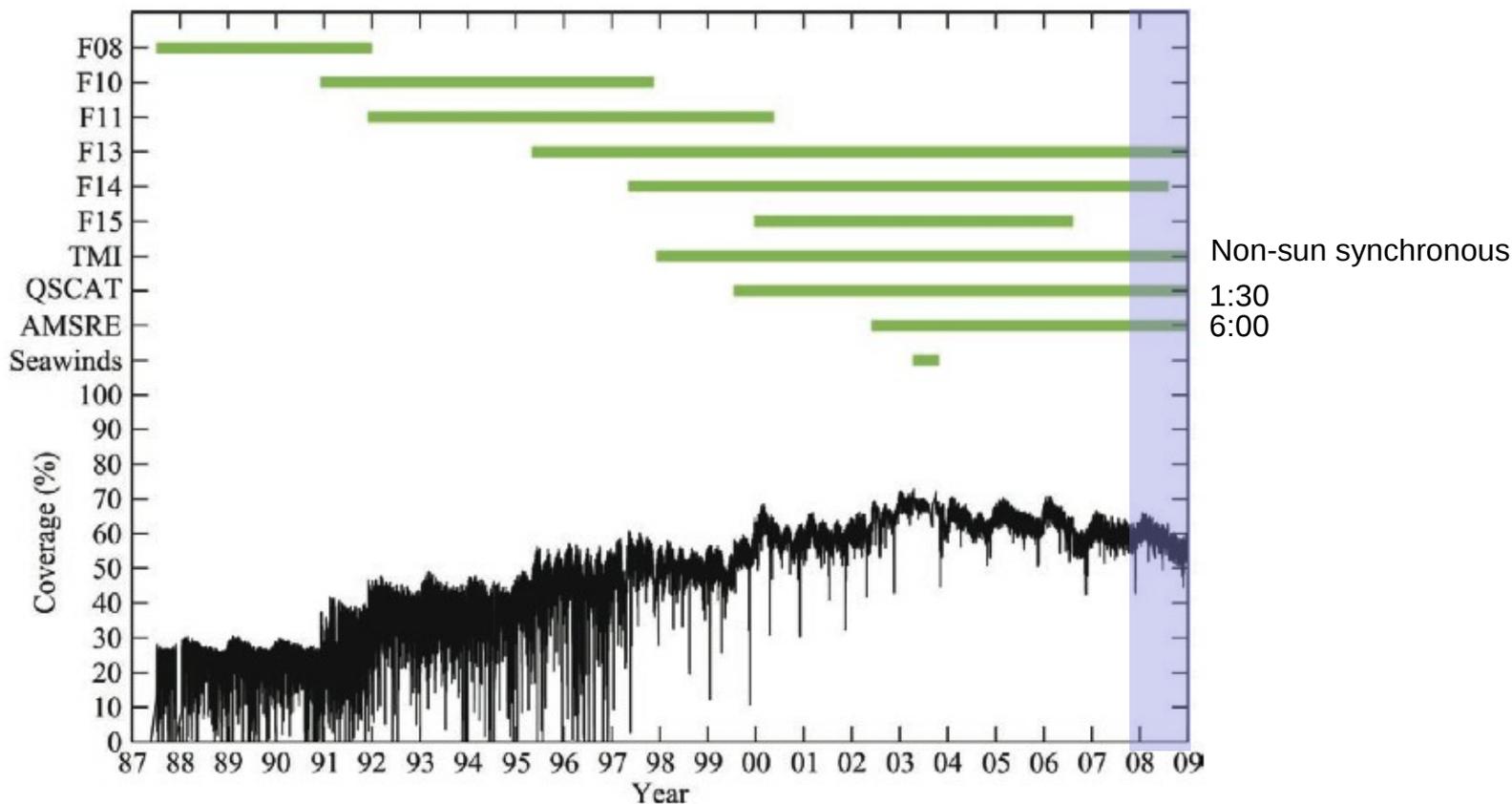




JPL

# OSCAT Ascending/Descending Systematic Differences are Unacceptable for Diurnal Variations





**FIG. 3. Time availability of satellite surface wind datasets analyzed by the VAM. The SSM/I instruments are denoted F08–F15. The percentage of the global oceans observed by these missions in a 6-h period is shown in the bottom portion of the graph.**

R. Atlas, R. Hoffman, J. Ardizzone, S. Leidner, J. Jusem, D. Smith, and D. Gombos, "A cross-calibrated, multi-platform ocean surface wind velocity product for meteorological and oceanographic applications," *Bulletin of the American Meteorological Society*, pp. 157–174, February 2011.



- Bin wind components into 0.5 hour local time bins
- Estimate fitting weights from the data standard error (STD/sqrt(N))
- Fitting model (t is local time in fractions of a day):

$$U(t) = \bar{U} + U_s \sin(2\pi t) + U_c \cos(2\pi t)$$

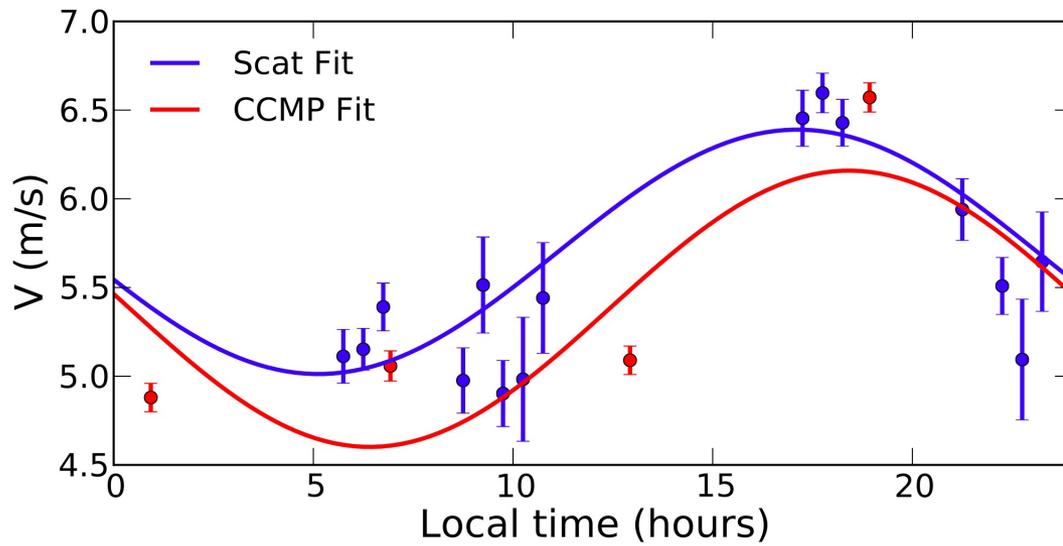
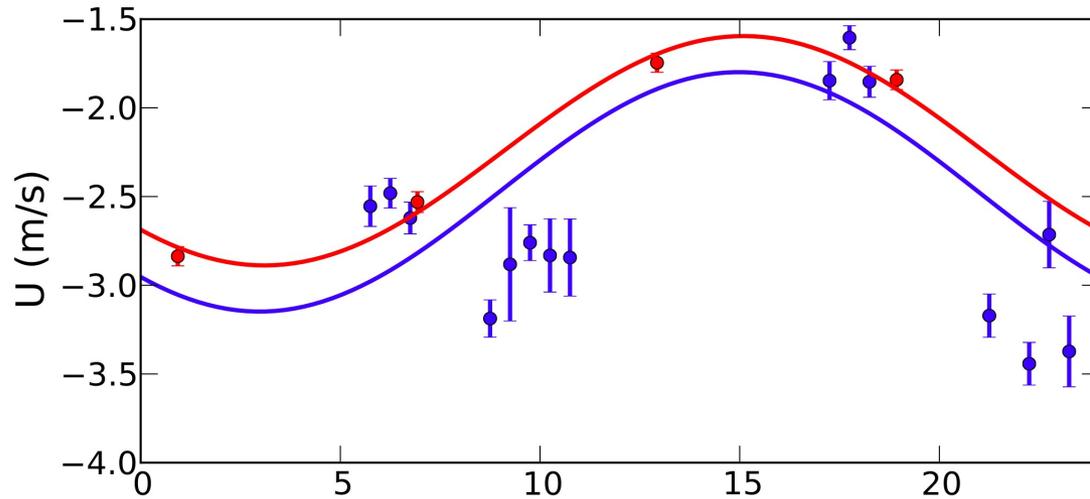
- Component errors estimated from weighted LS covariance
- Amplitude and phase errors estimated by Monte Carlo simulation (Nrealizations = 1000)

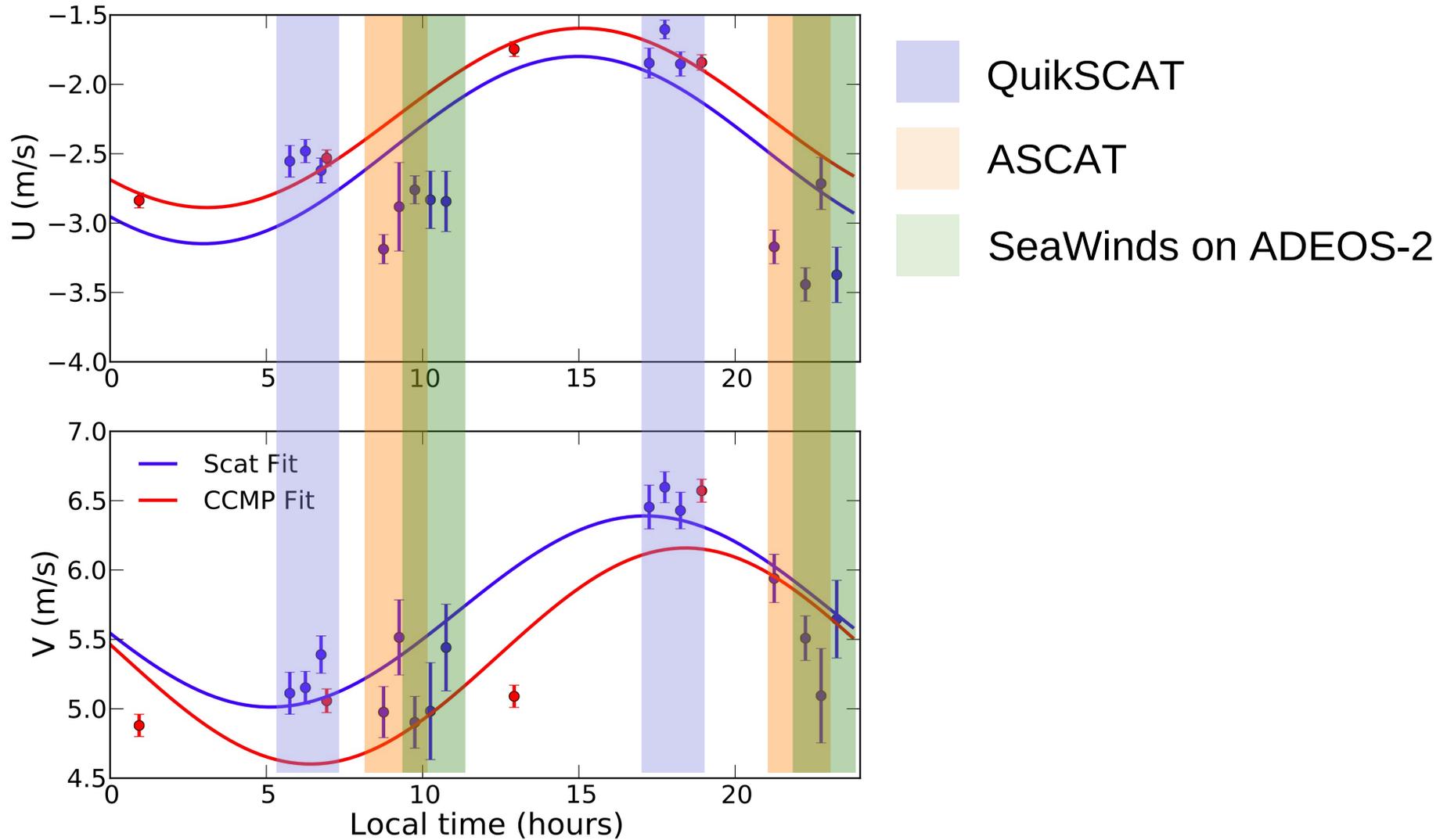
$$U(t) = \bar{U} + A_U \sin(2\pi t + \Phi_U)$$

- Relative **constant** biases between the two instruments alias into the **semi-diurnal**, not the diurnal signature, since the same biases are seen twice per day (no phase flip)
- Residual bias differences make semi-diurnal fits questionable



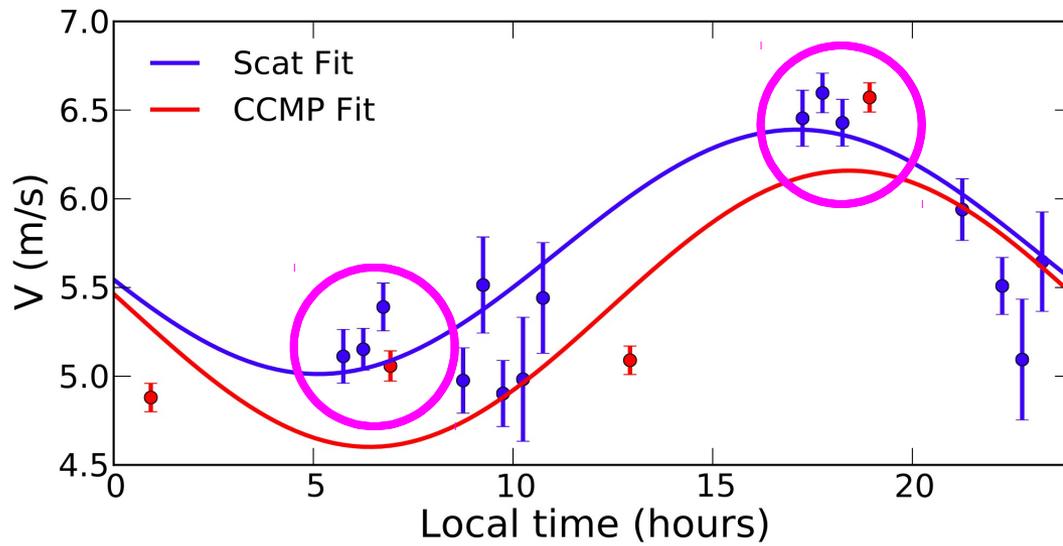
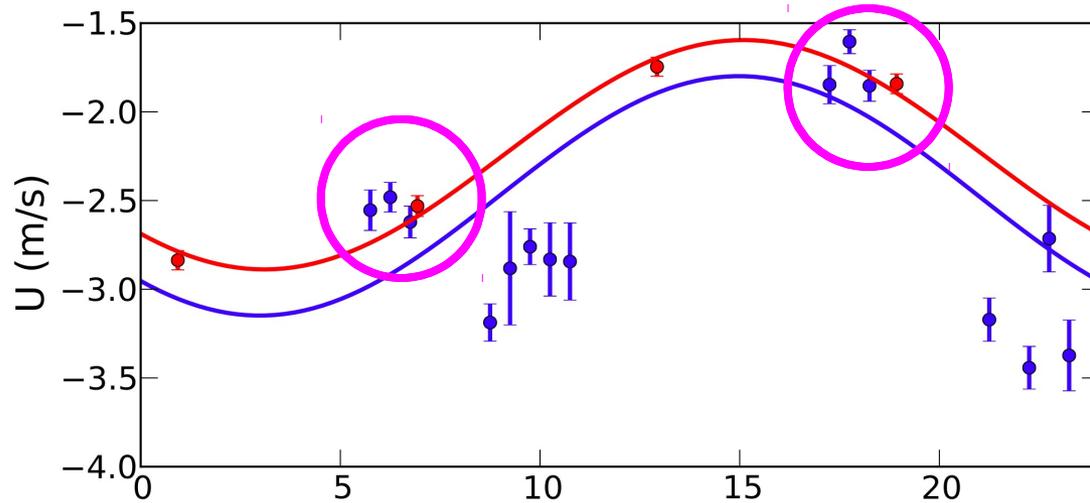
# Scat vs CCMP Fitting Example





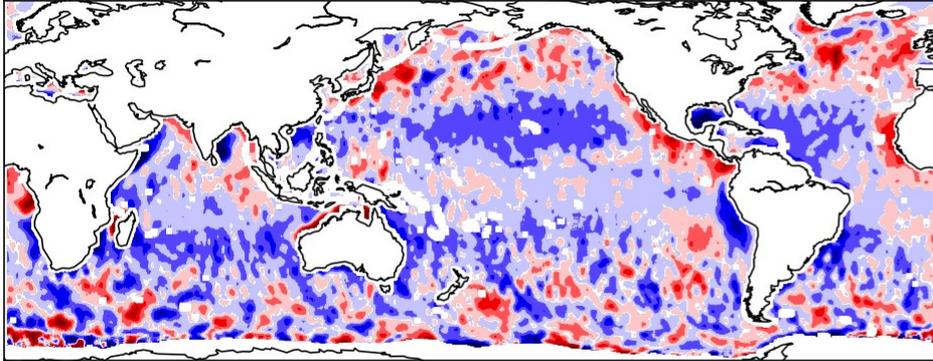


# Scat vs CCMP Fitting Example

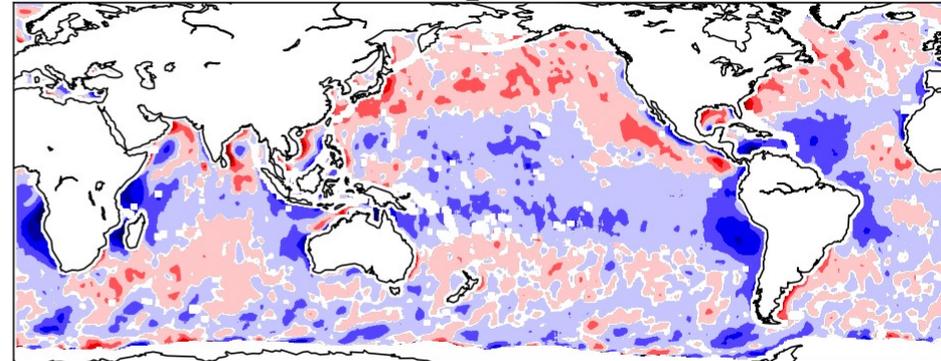


# QuikSCAT/SeaWinds vs QuikSCAT/ASCAT U Component Diurnal Variability

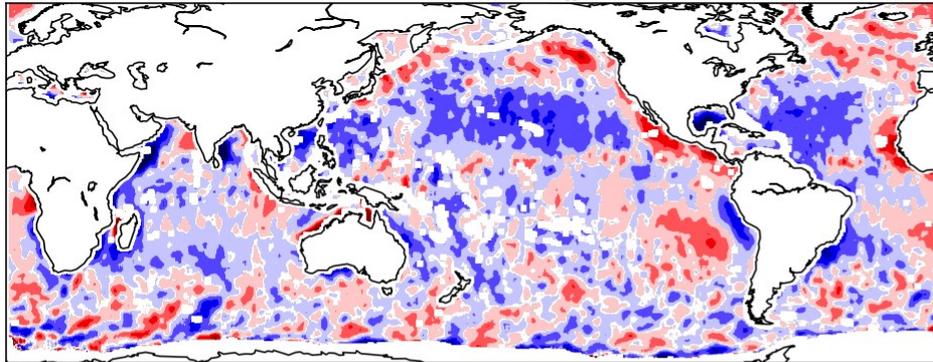
Qscat-Ascet Diurnal 2008 2009 AMJJASO Nwindow: 9



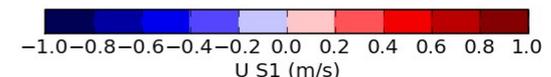
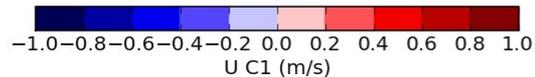
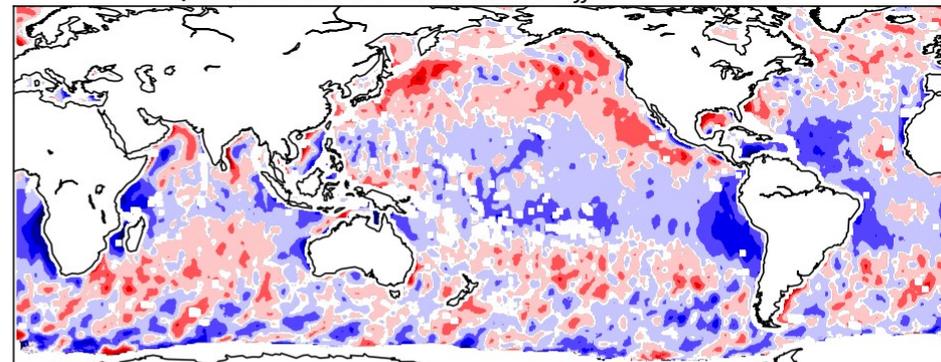
Qscat-Ascet Diurnal 2008 2009 AMJJASO Nwindow: 9



Qscat-SeaWinds Diurnal 2003 AMJJASO Nwindow: 9



Qscat-SeaWinds Diurnal 2003 AMJJASO Nwindow: 9

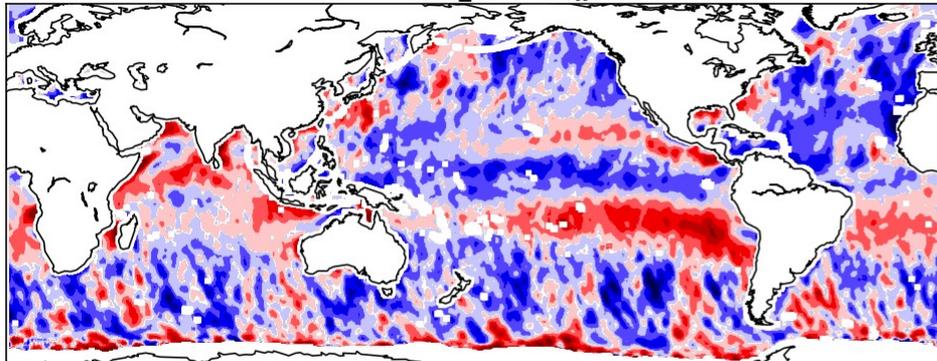


Cosine: peaks at midnight

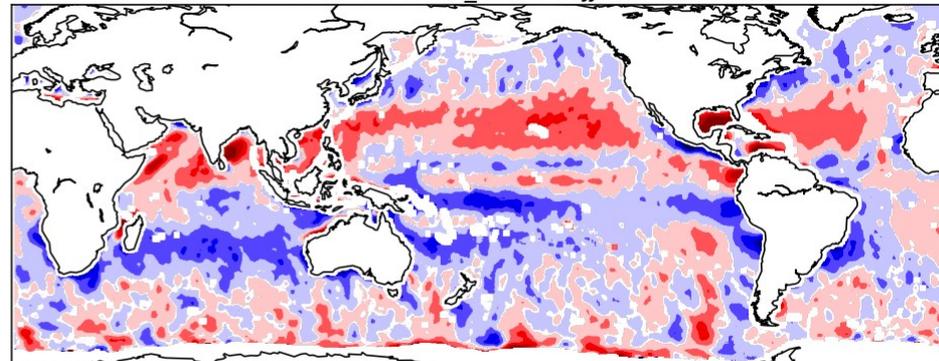
Sine: peaks at 6am

# QuikSCAT/SeaWinds vs QuikSCAT/ASCAT V Component Diurnal Variability

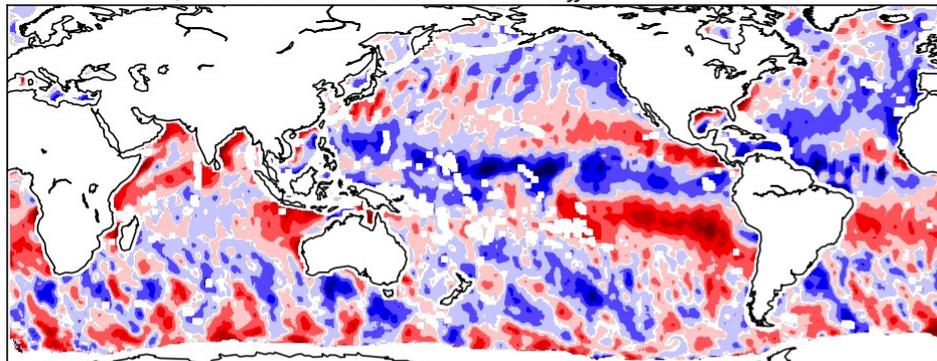
Qscat-Ascat Diurnal 2008\_2009 AMJJASO Nwindow: 9



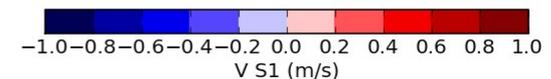
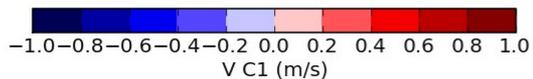
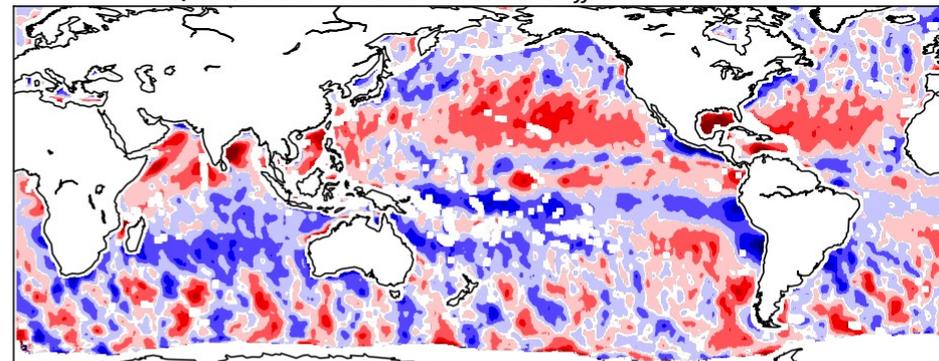
Qscat-Ascat Diurnal 2008\_2009 AMJJASO Nwindow: 9



Qscat-SeaWinds Diurnal 2003 AMJJASO Nwindow: 9

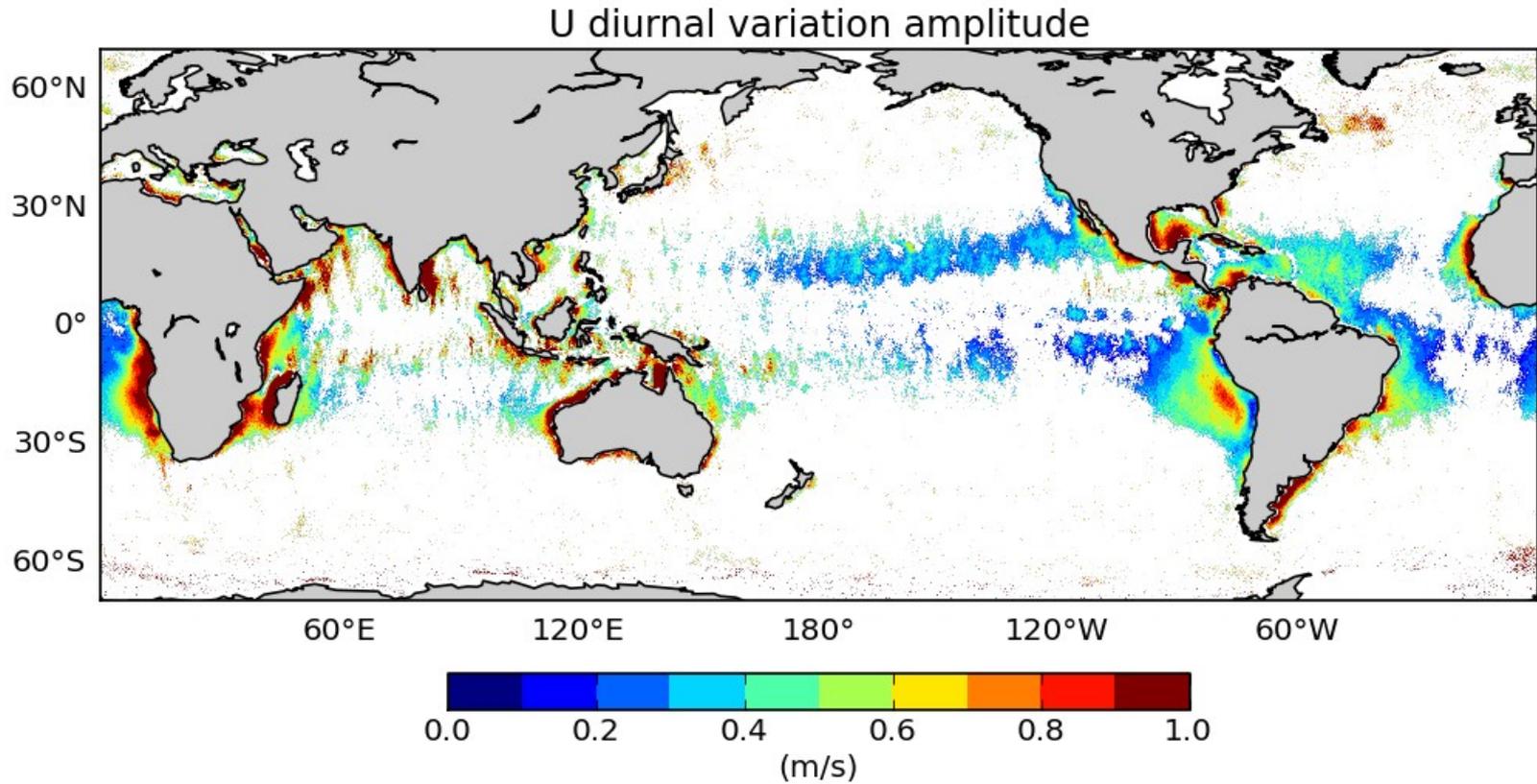


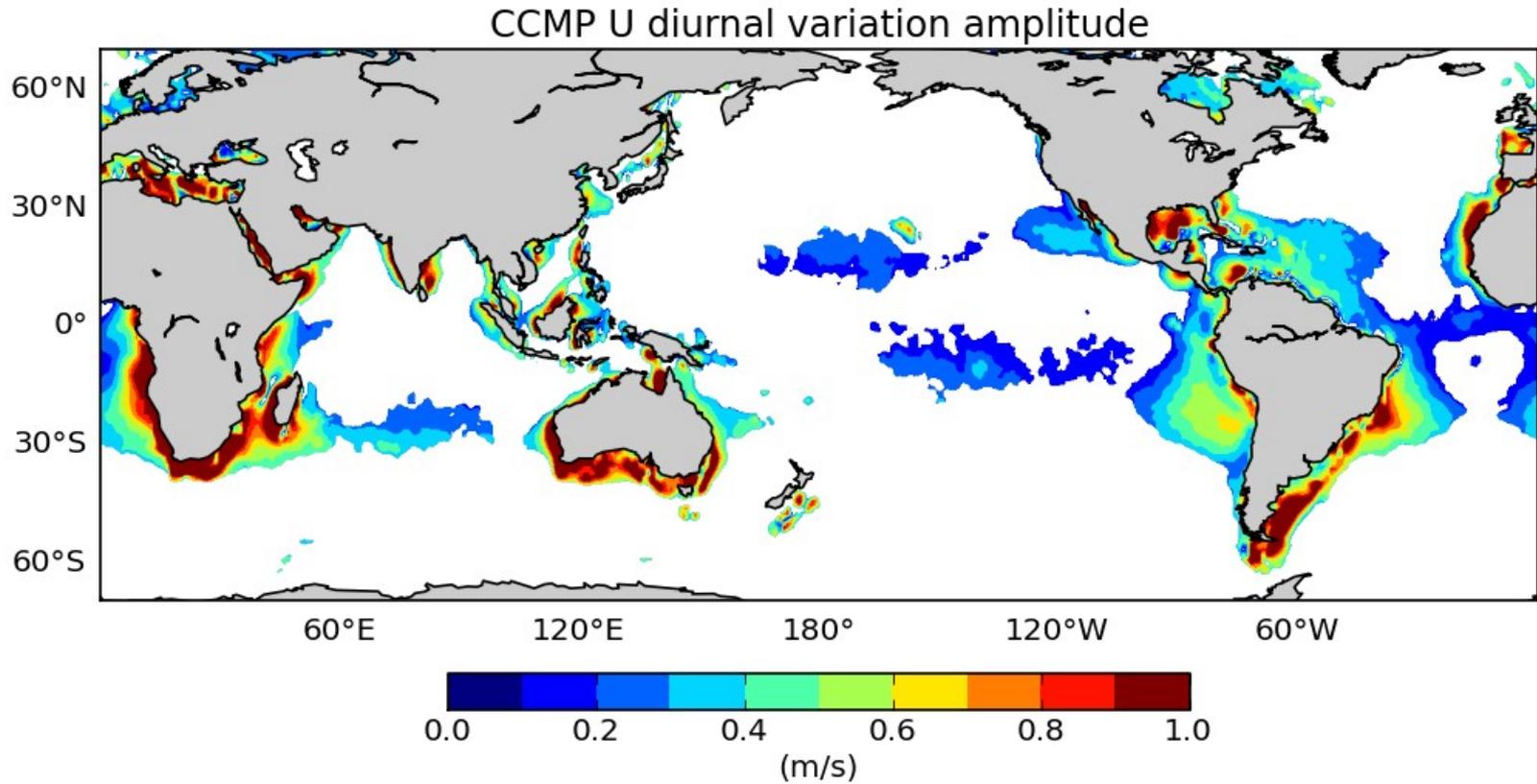
Qscat-SeaWinds Diurnal 2003 AMJJASO Nwindow: 9

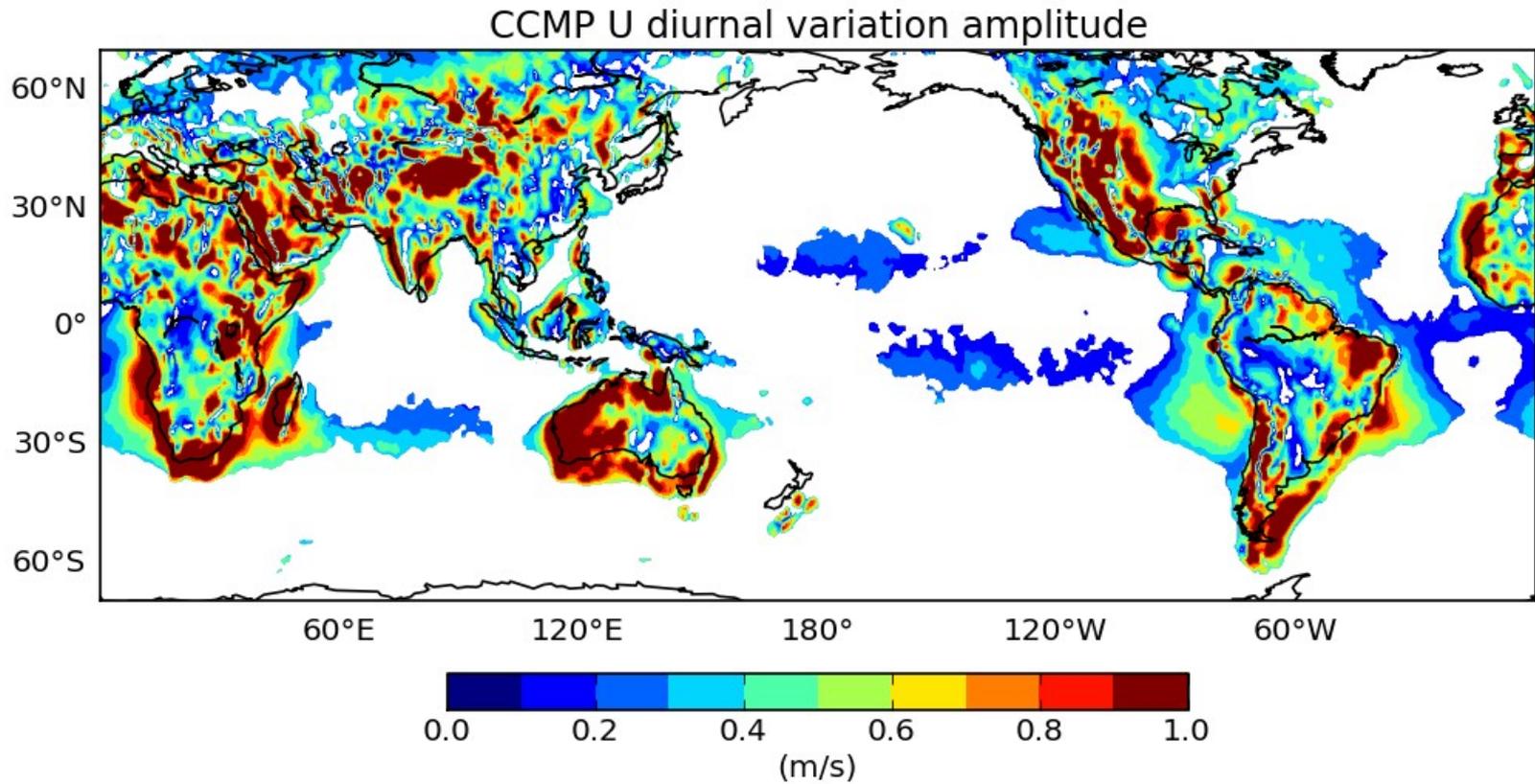


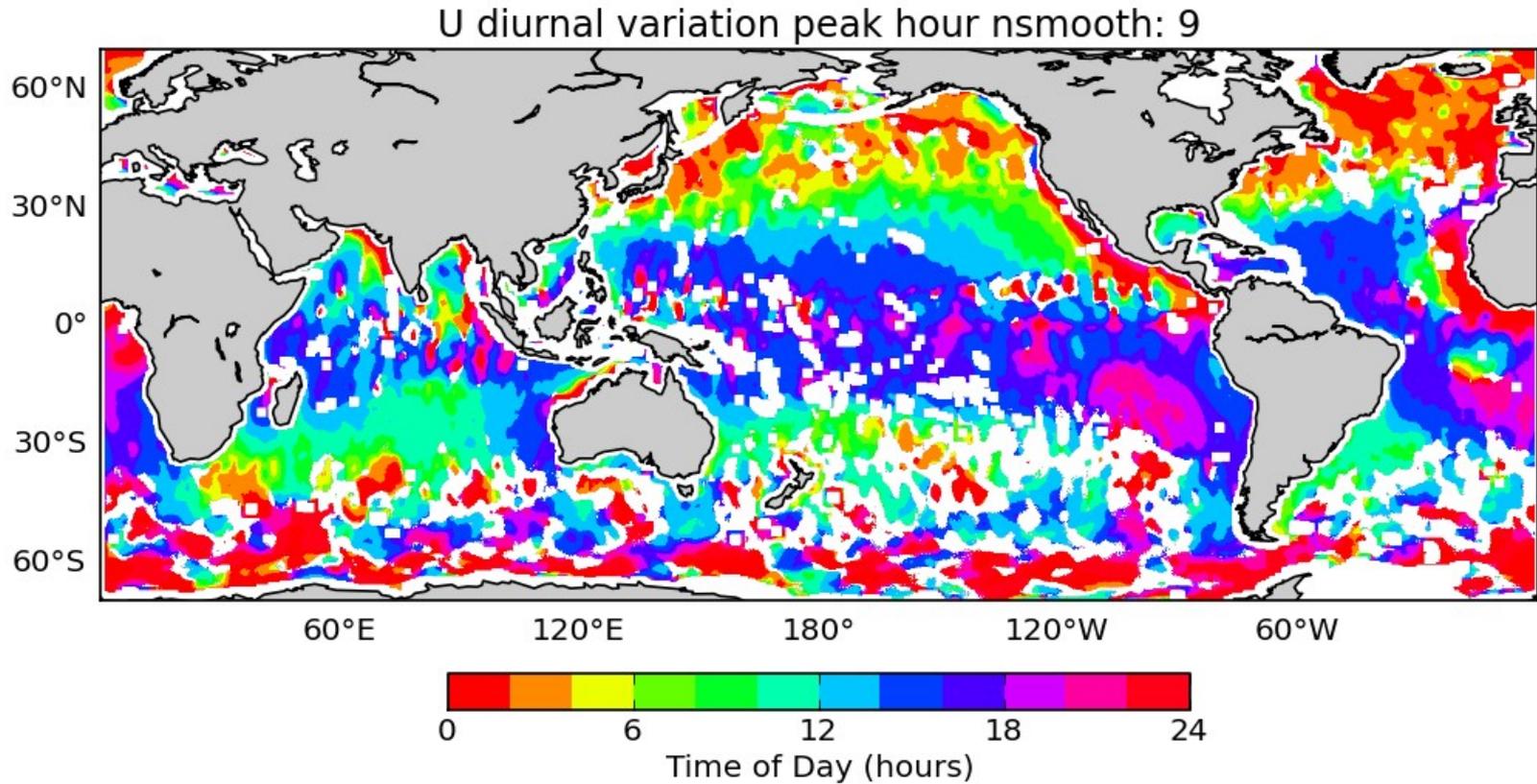
Cosine: peaks at midnight

Sine: peaks at 6am



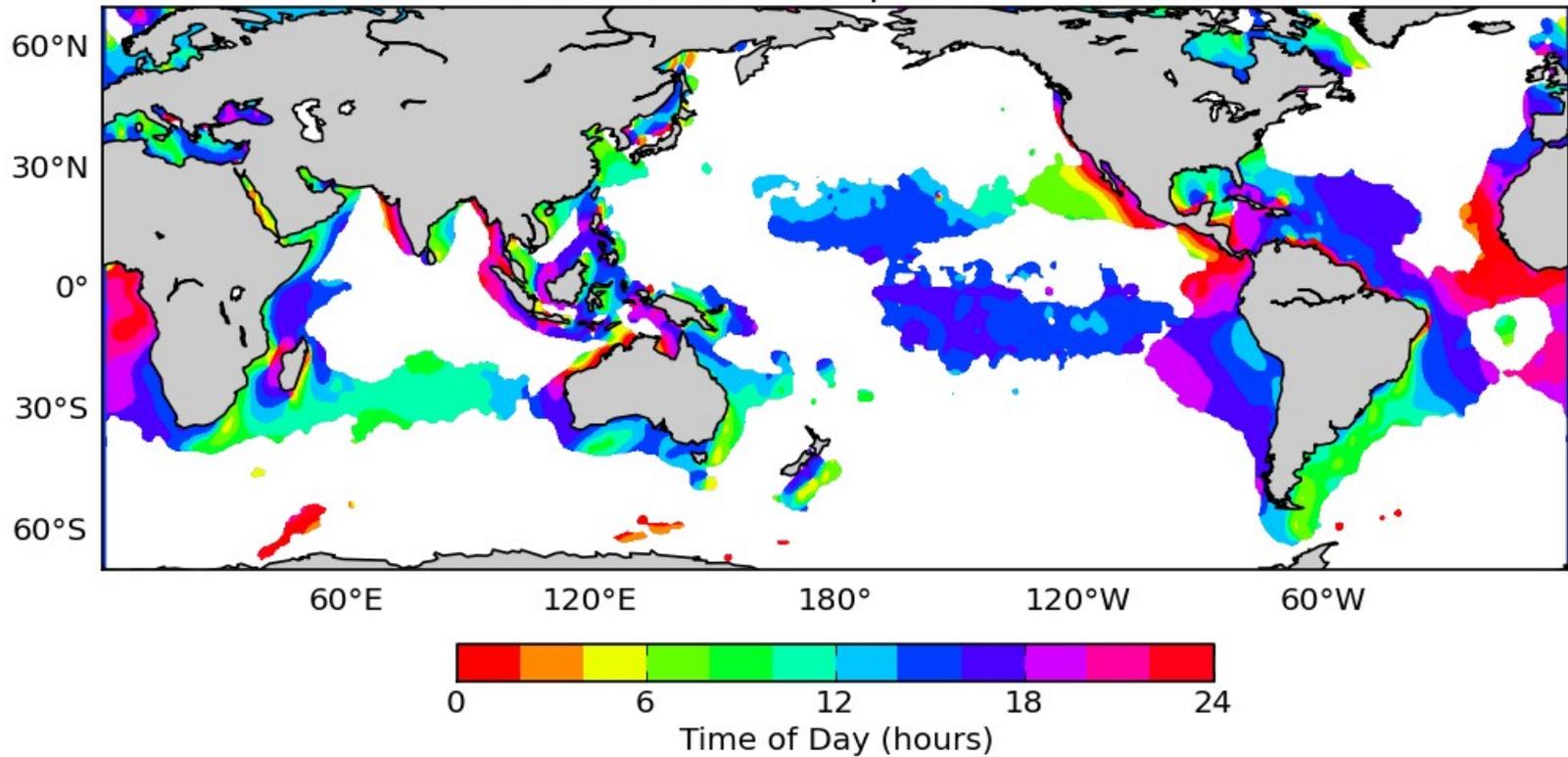


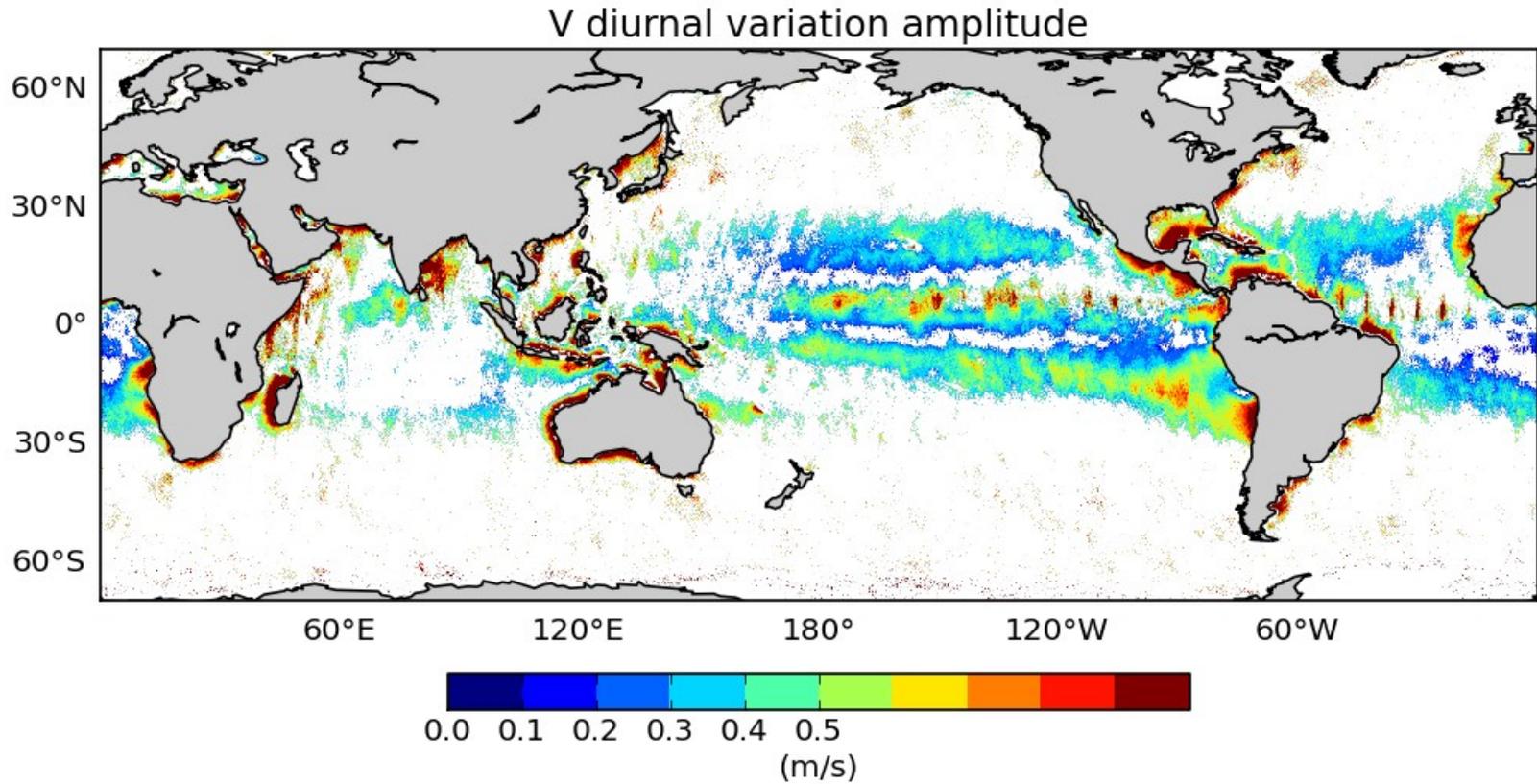


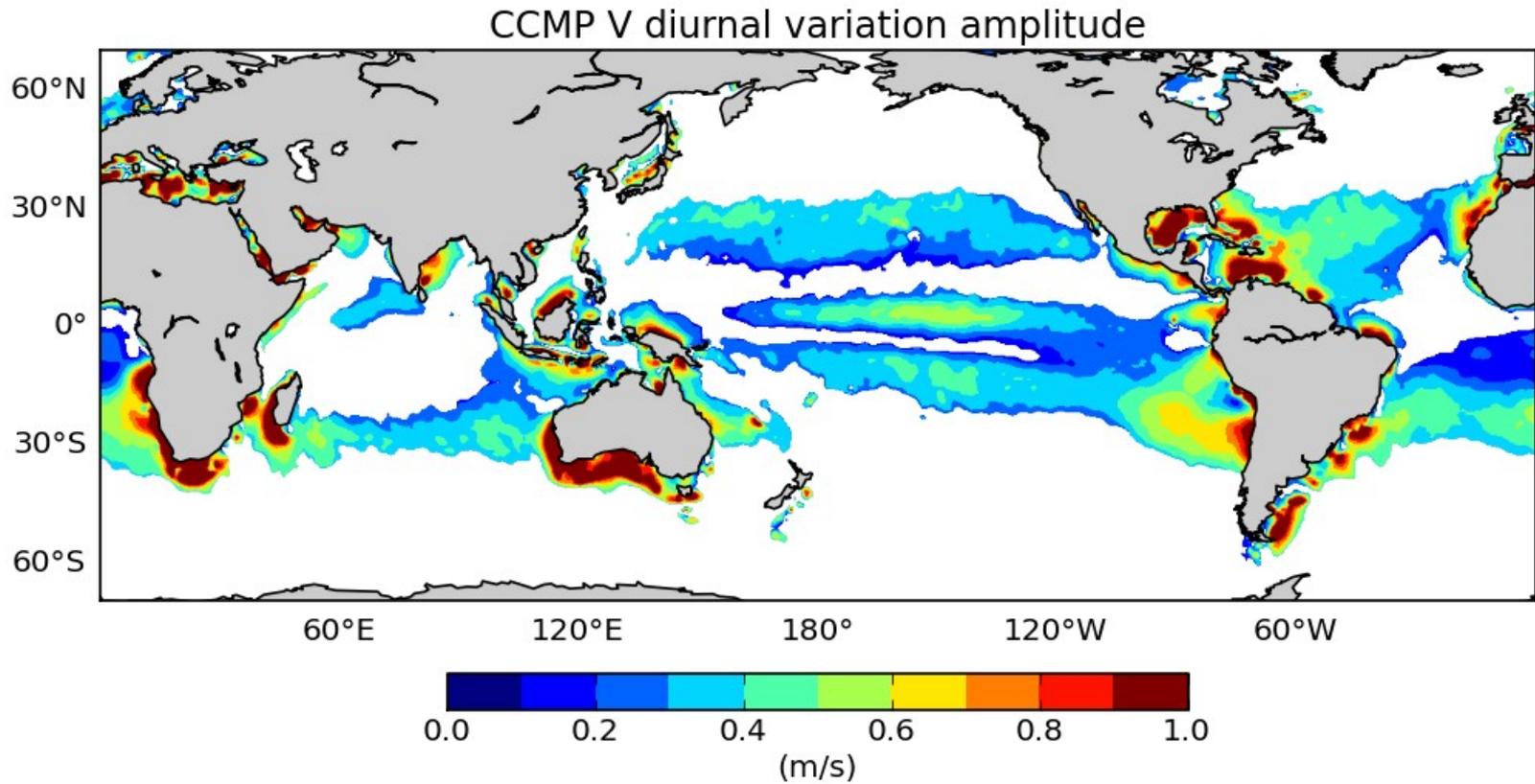




CCMP U diurnal variation peak hour nsmooth: 9

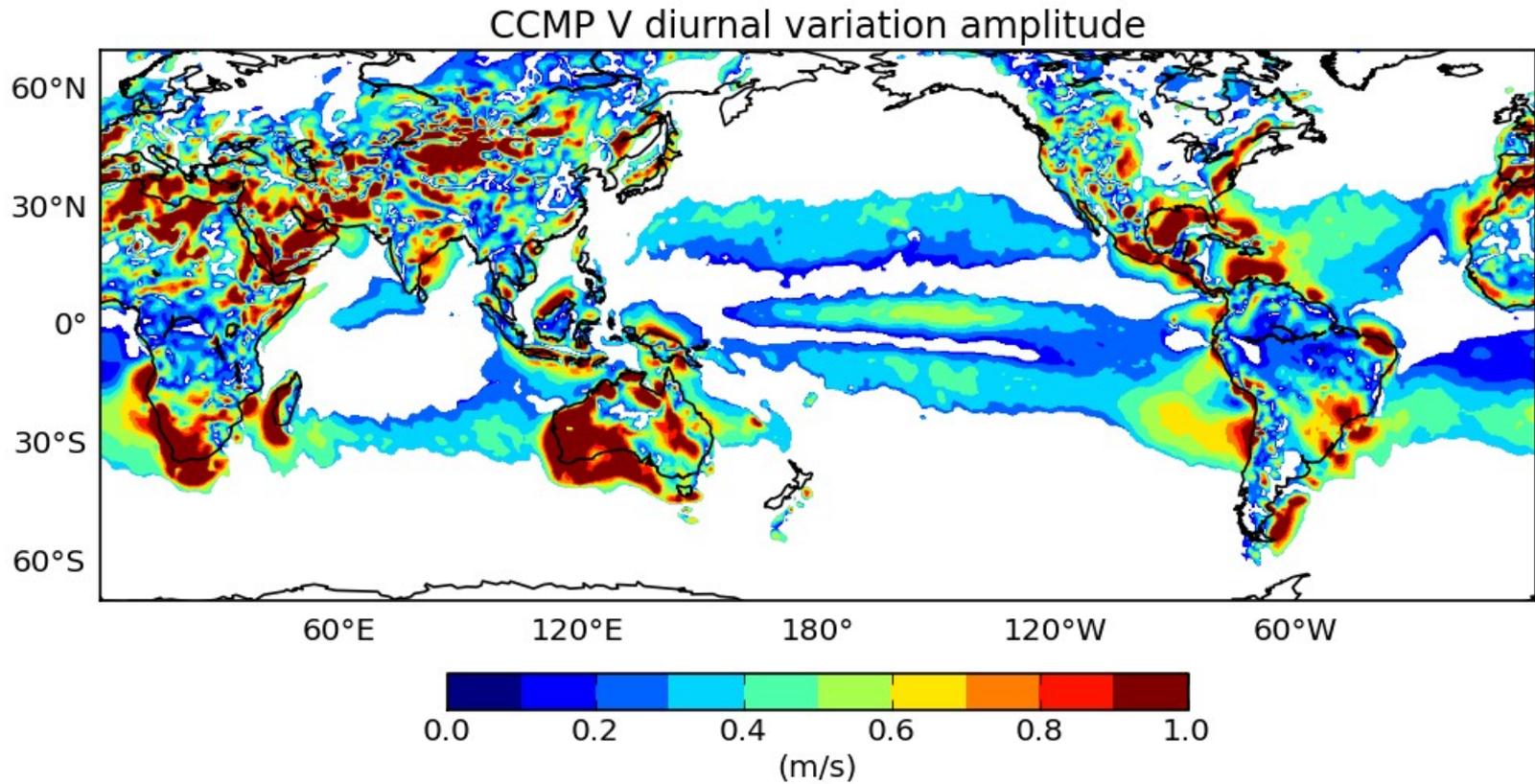






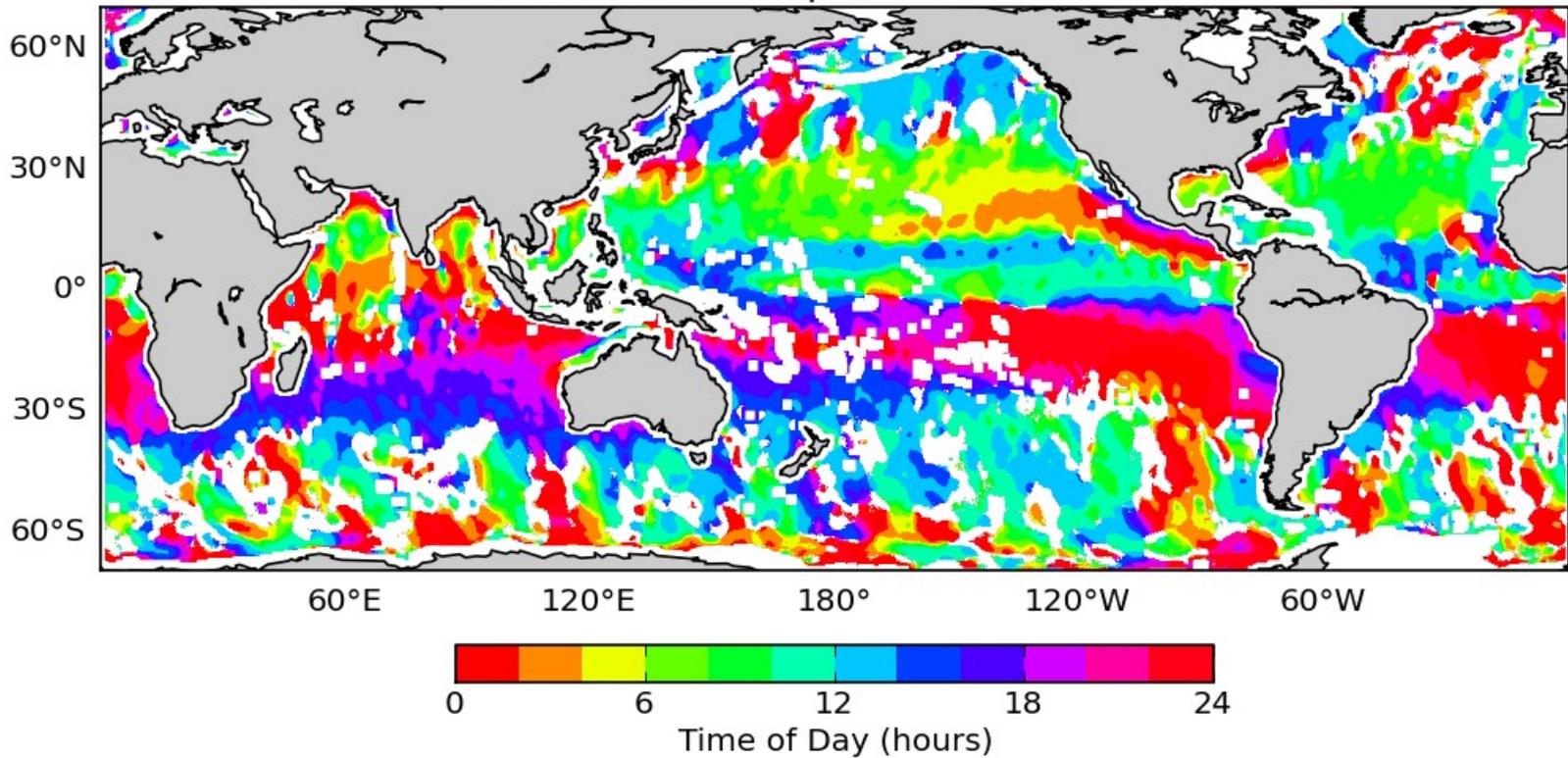


# CCMP 0.25 deg V Diurnal Amplitude



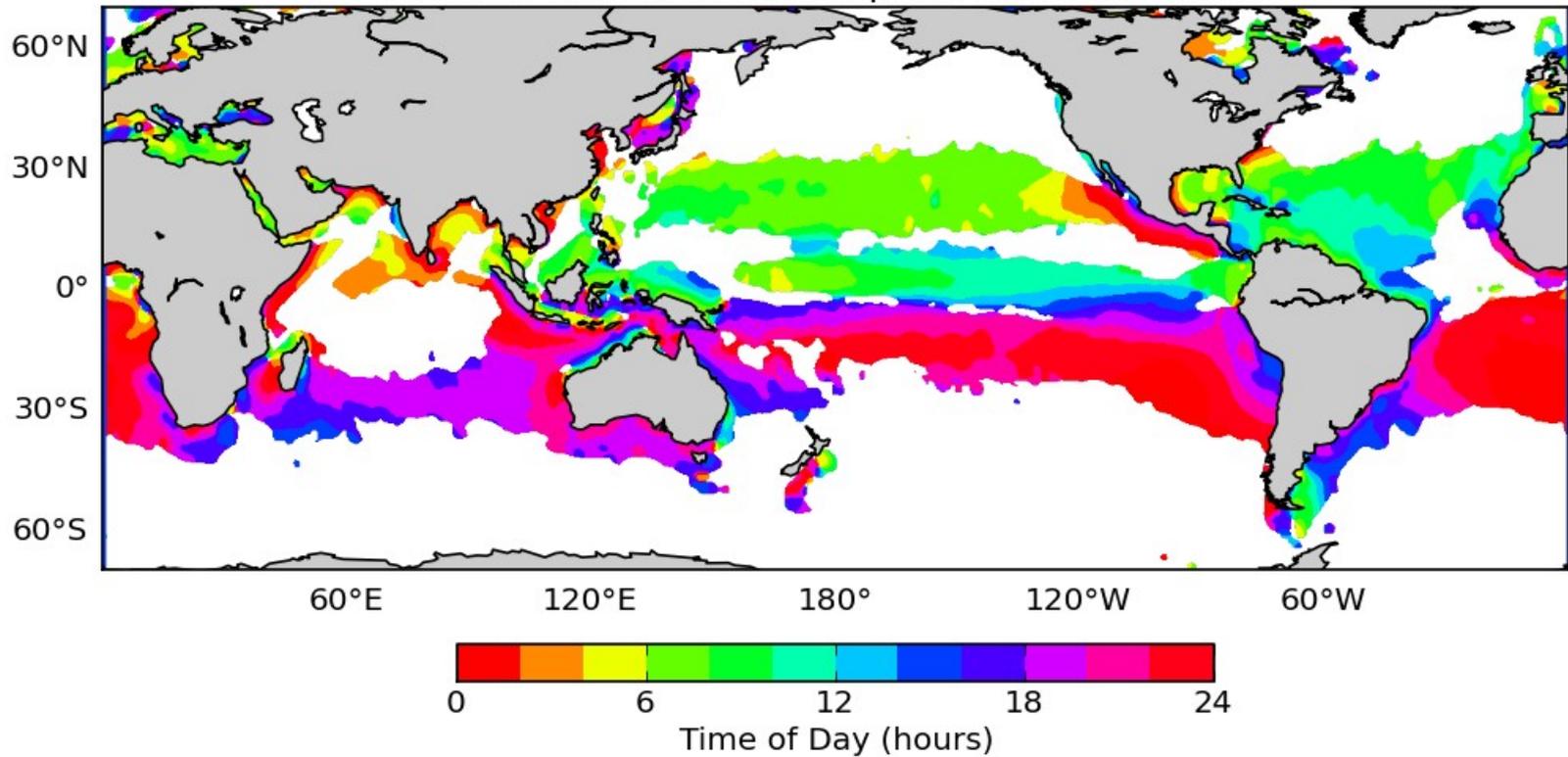


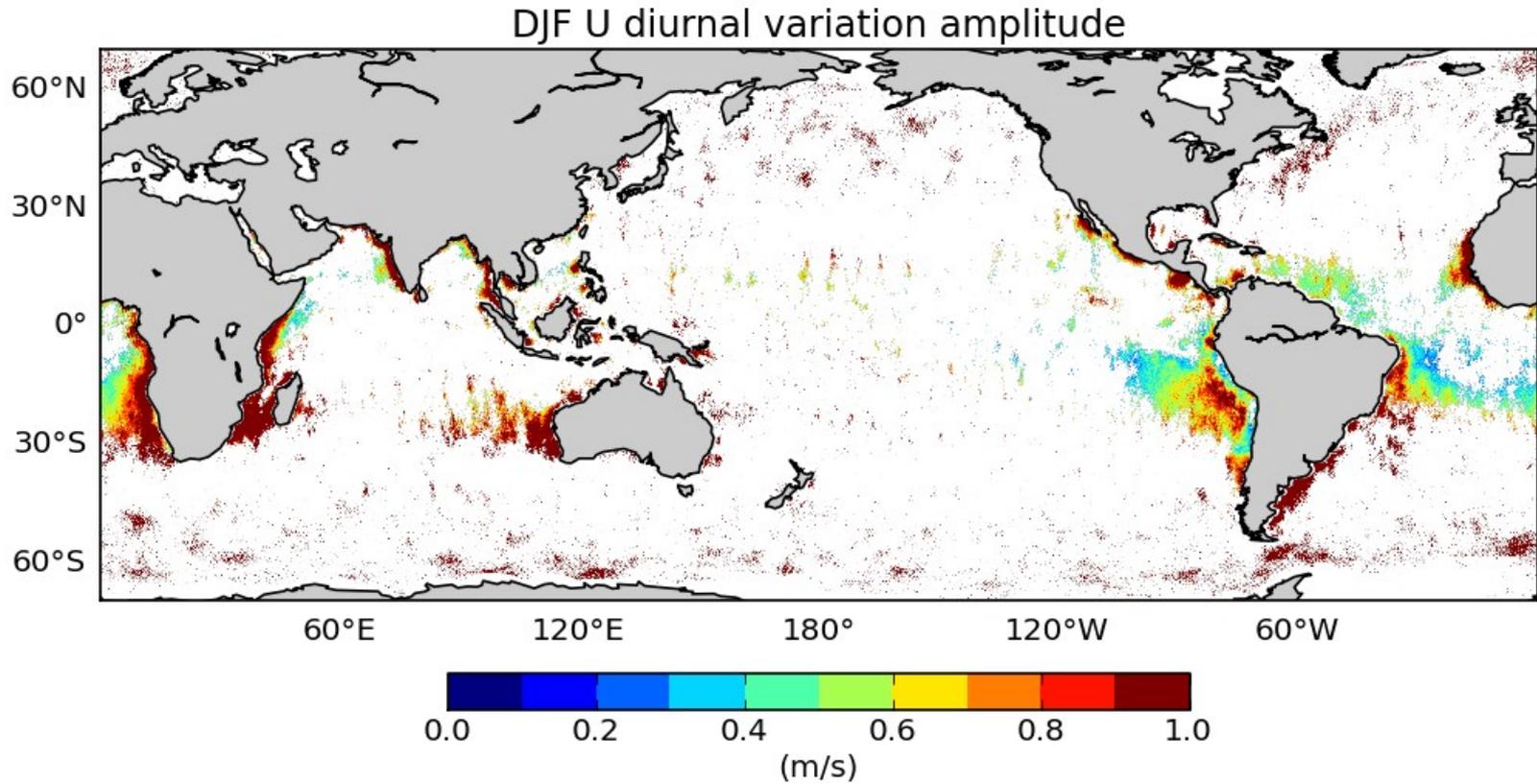
V diurnal variation peak hour nsmooth: 9

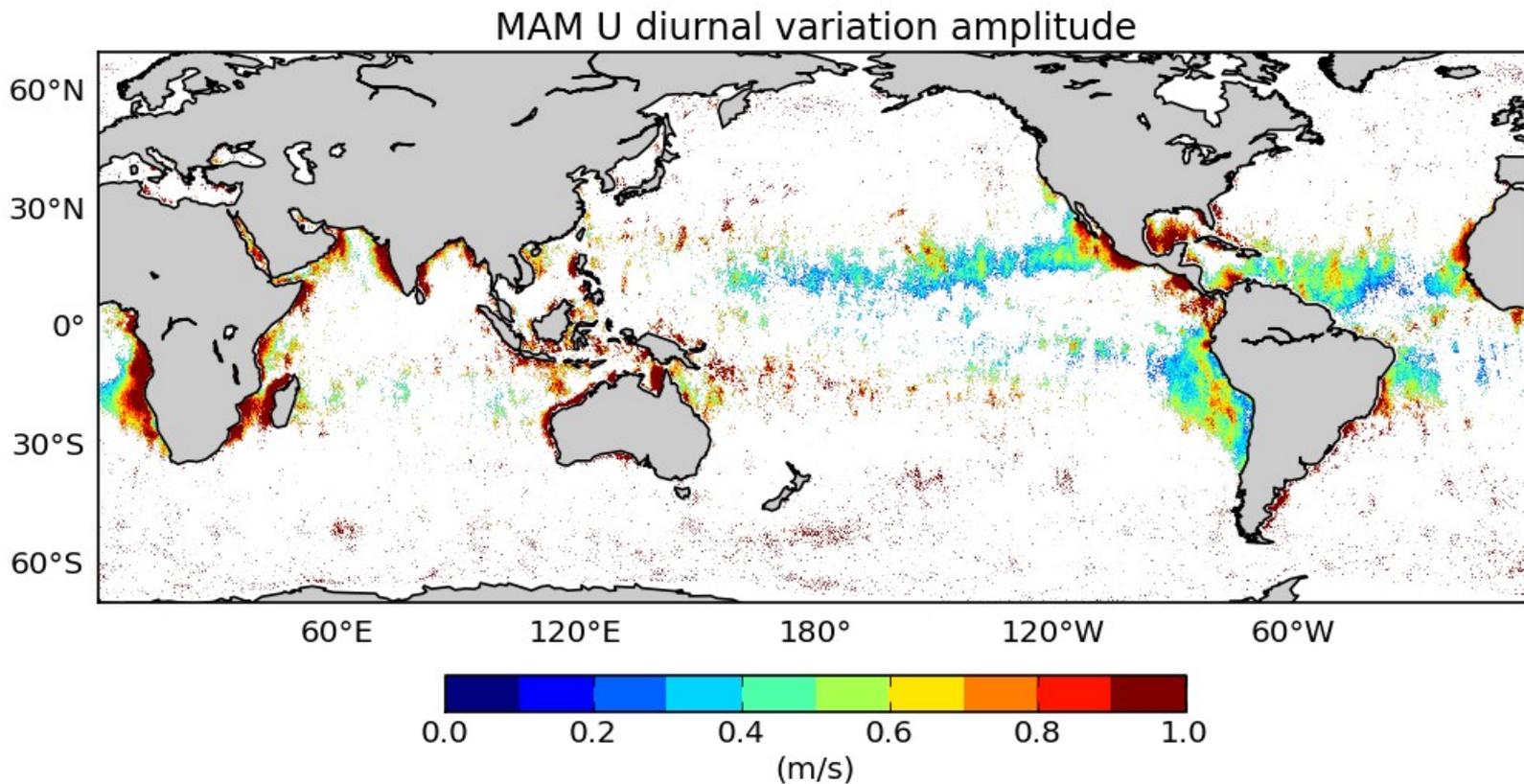


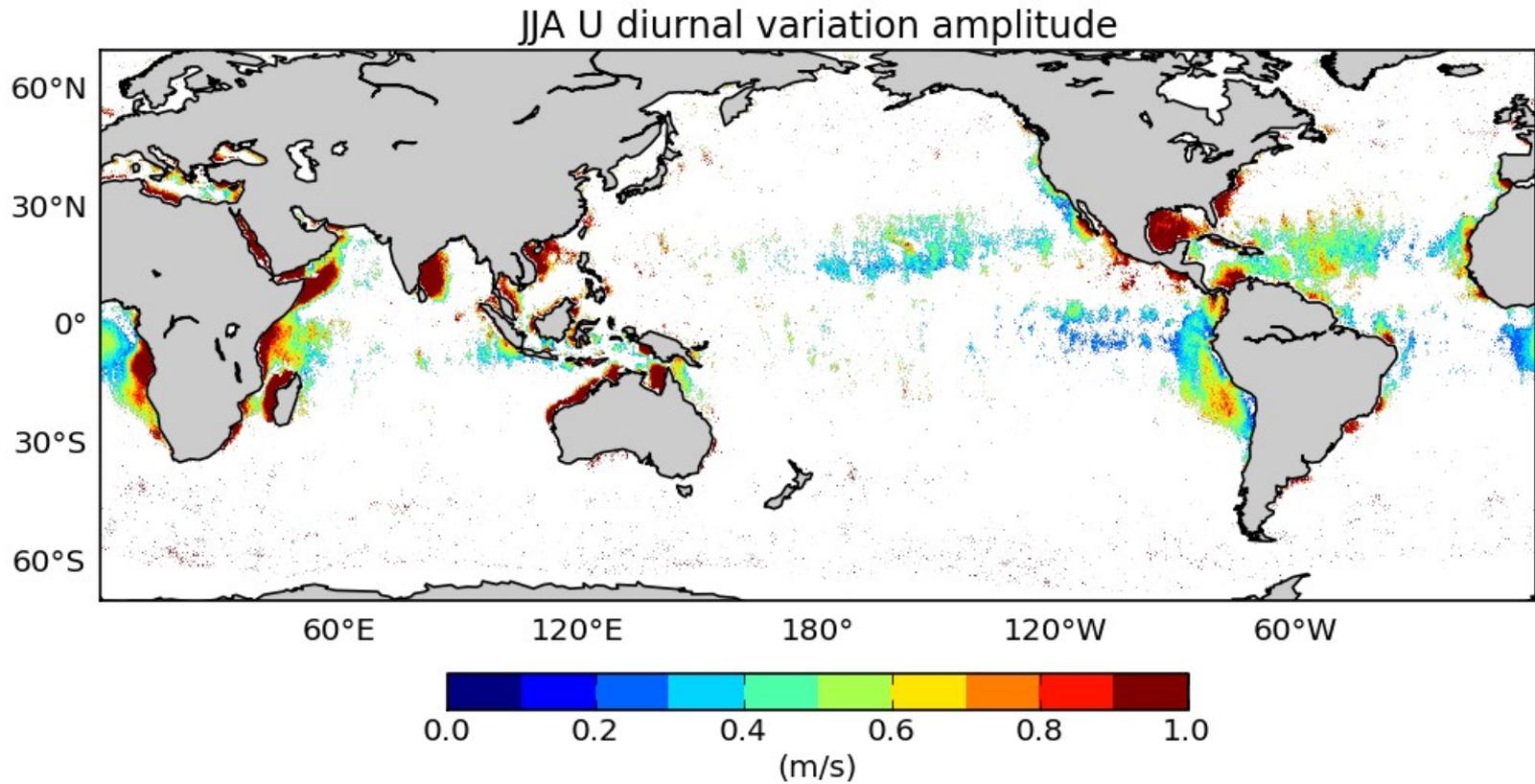


CCMP V diurnal variation peak hour nsmooth: 9



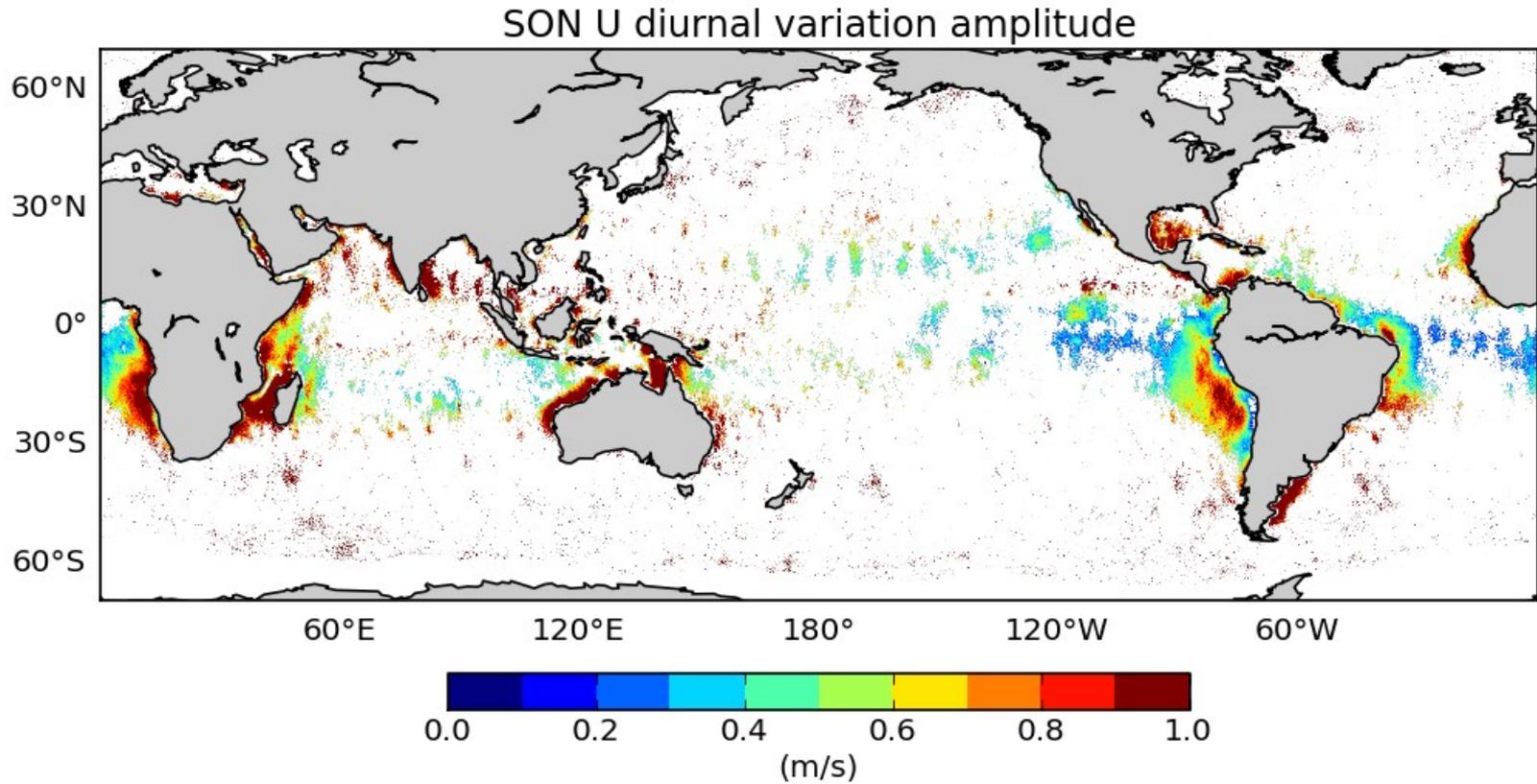


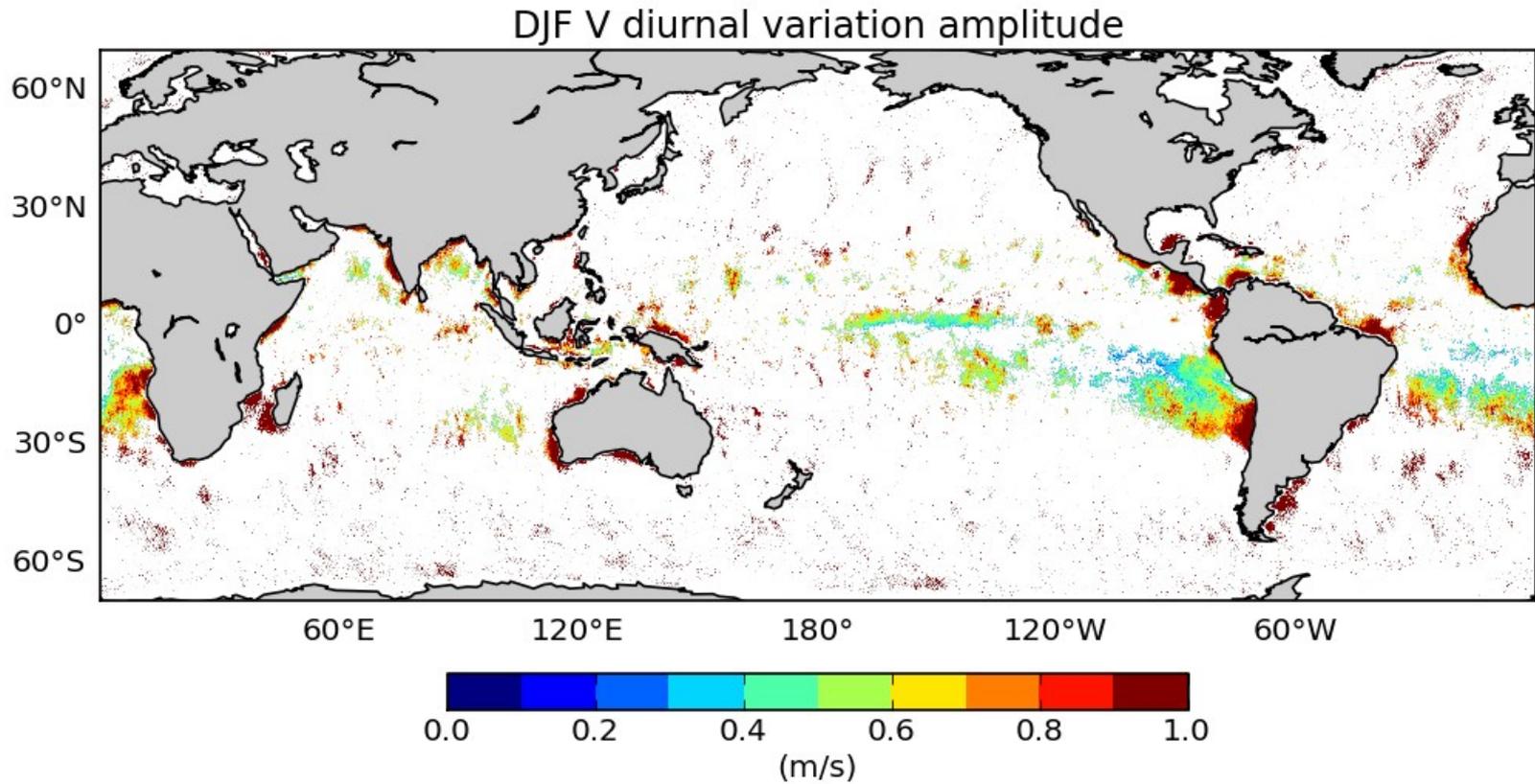


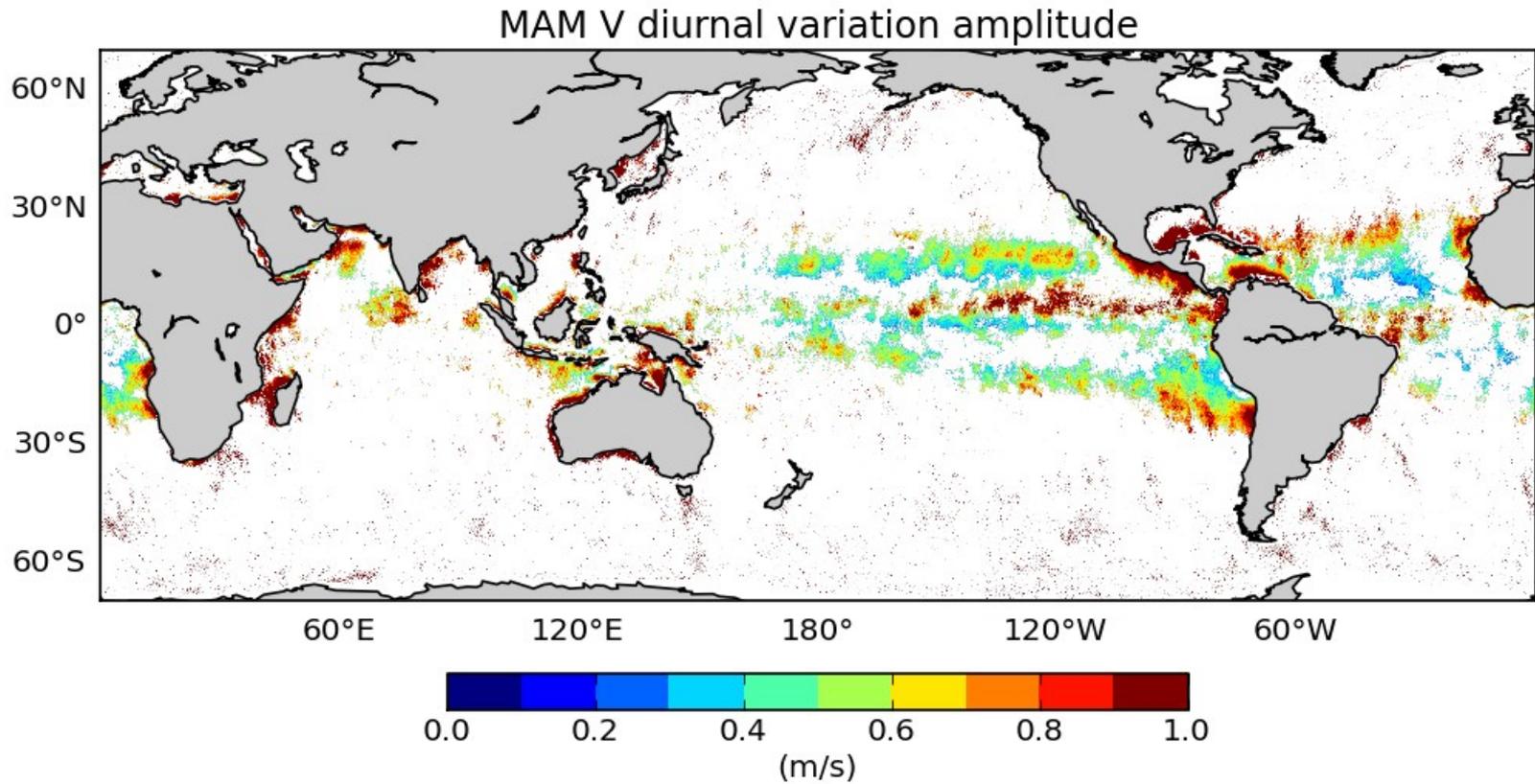


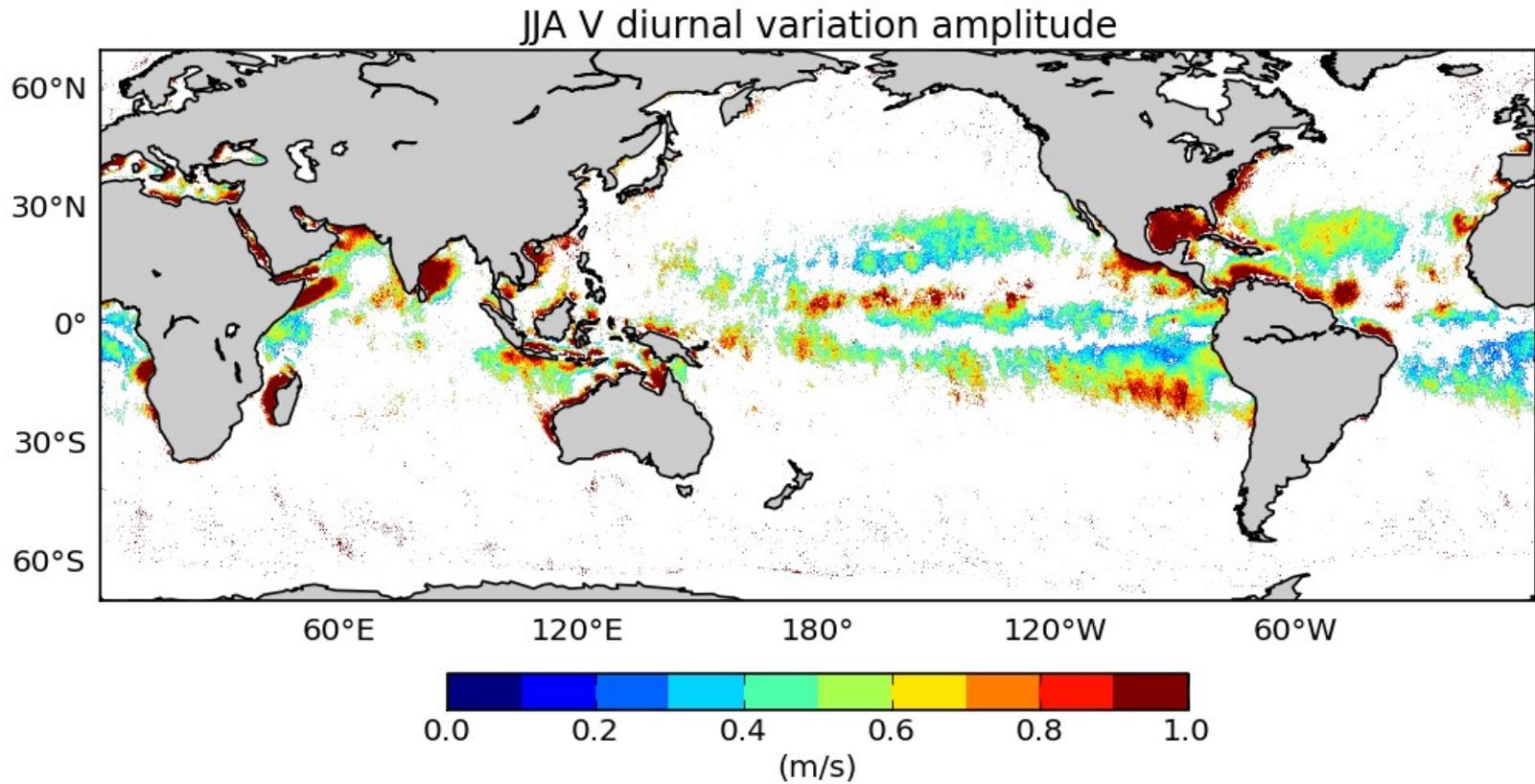


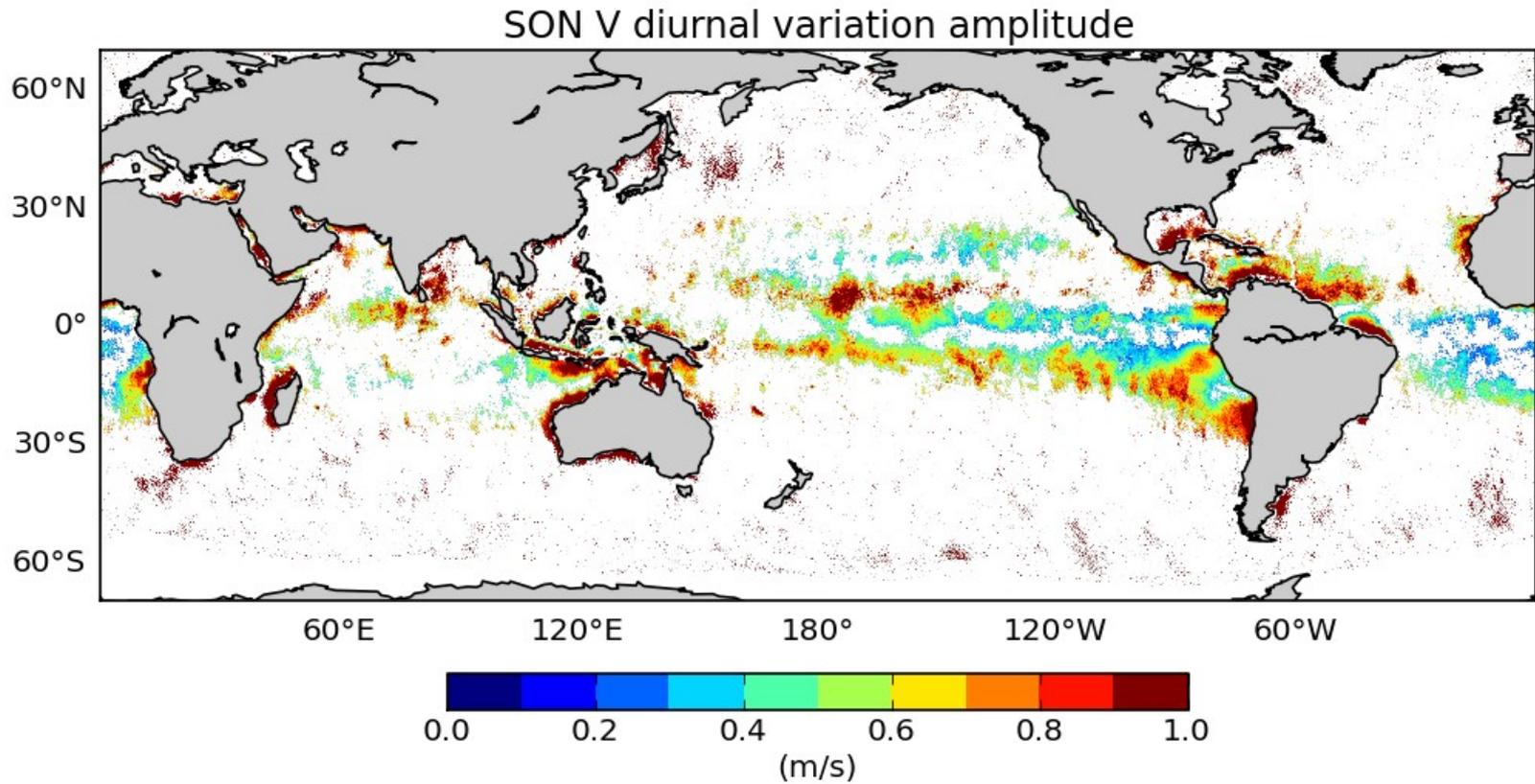
# Scat SON U Diurnal Amplitude

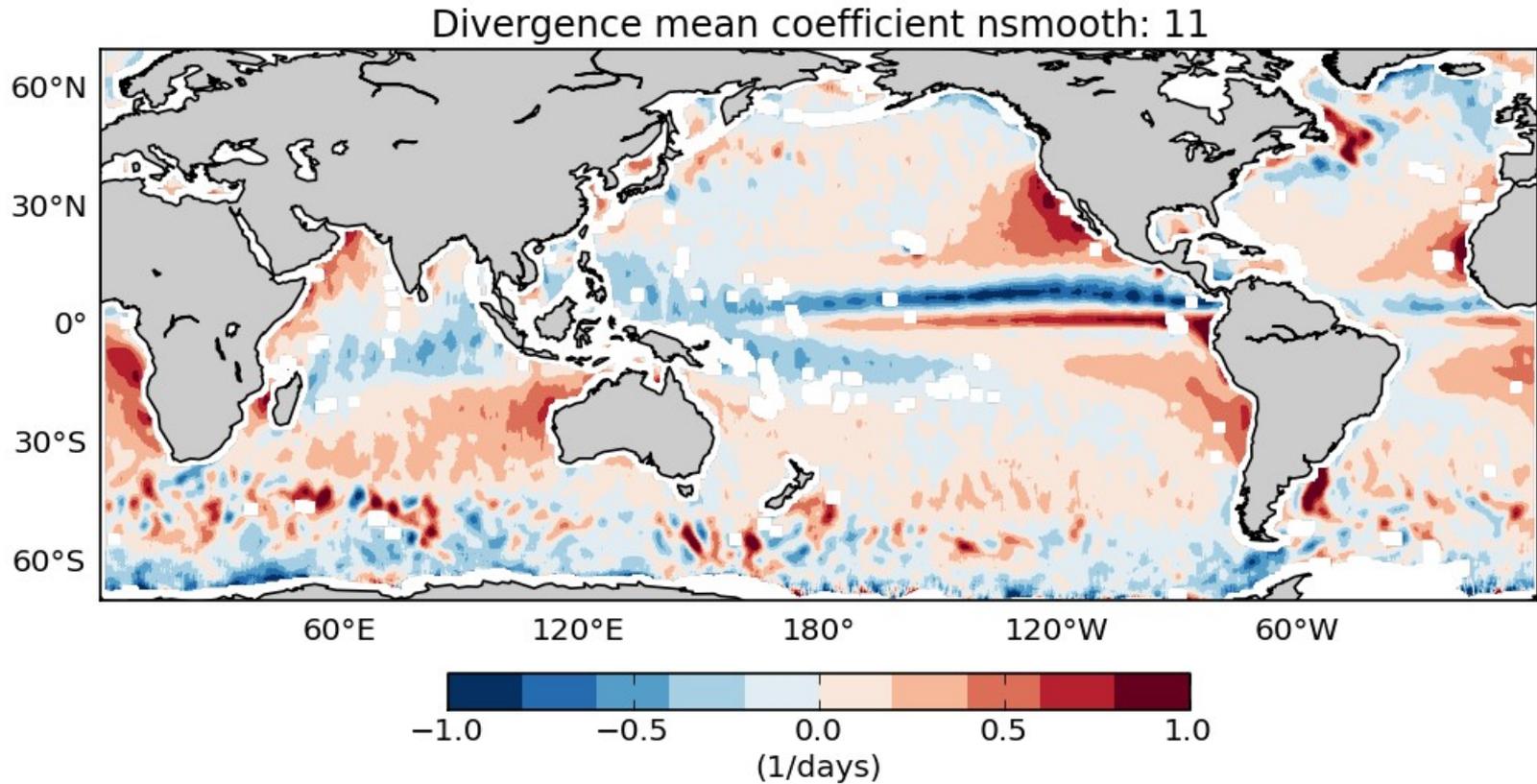




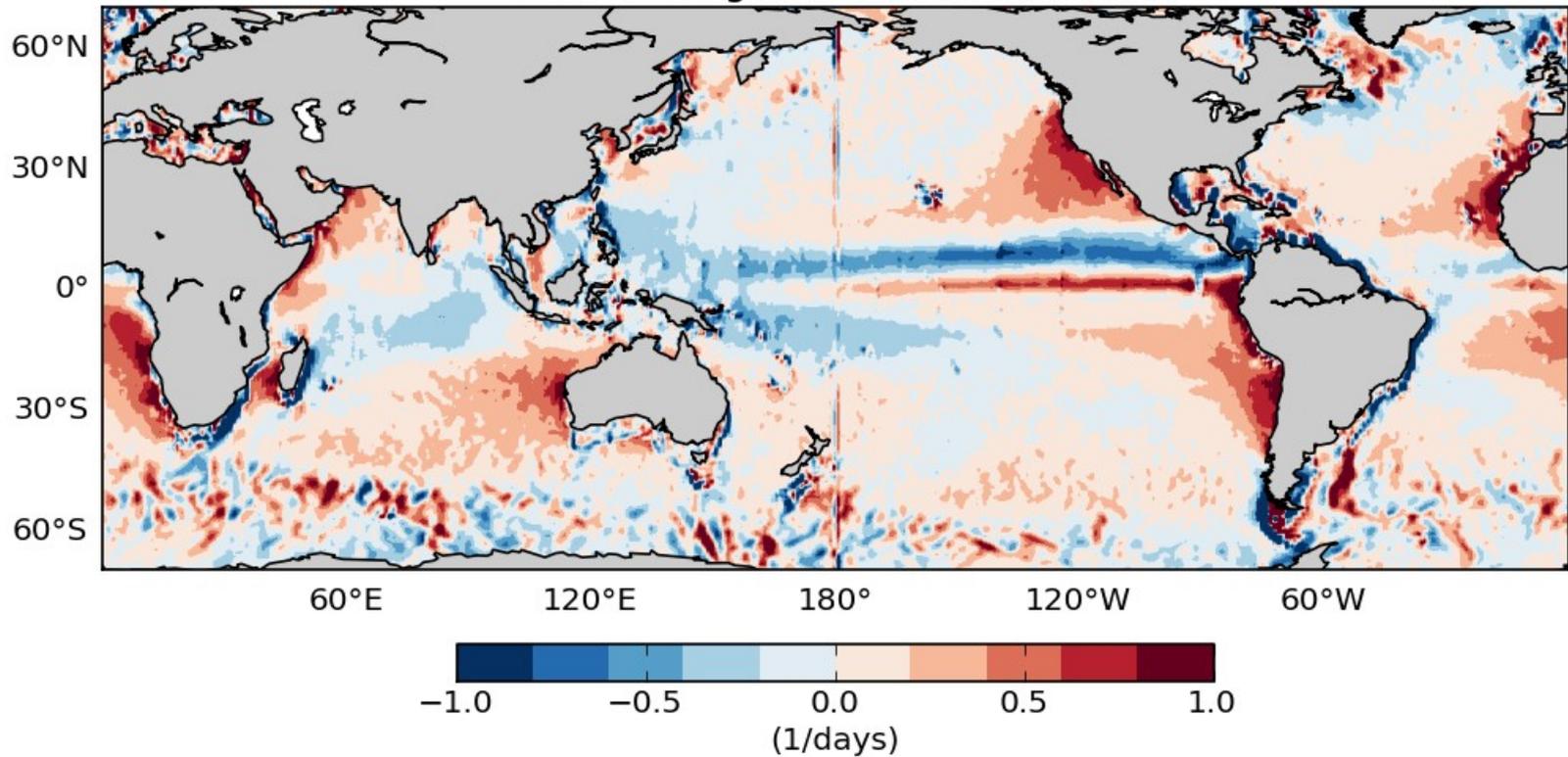








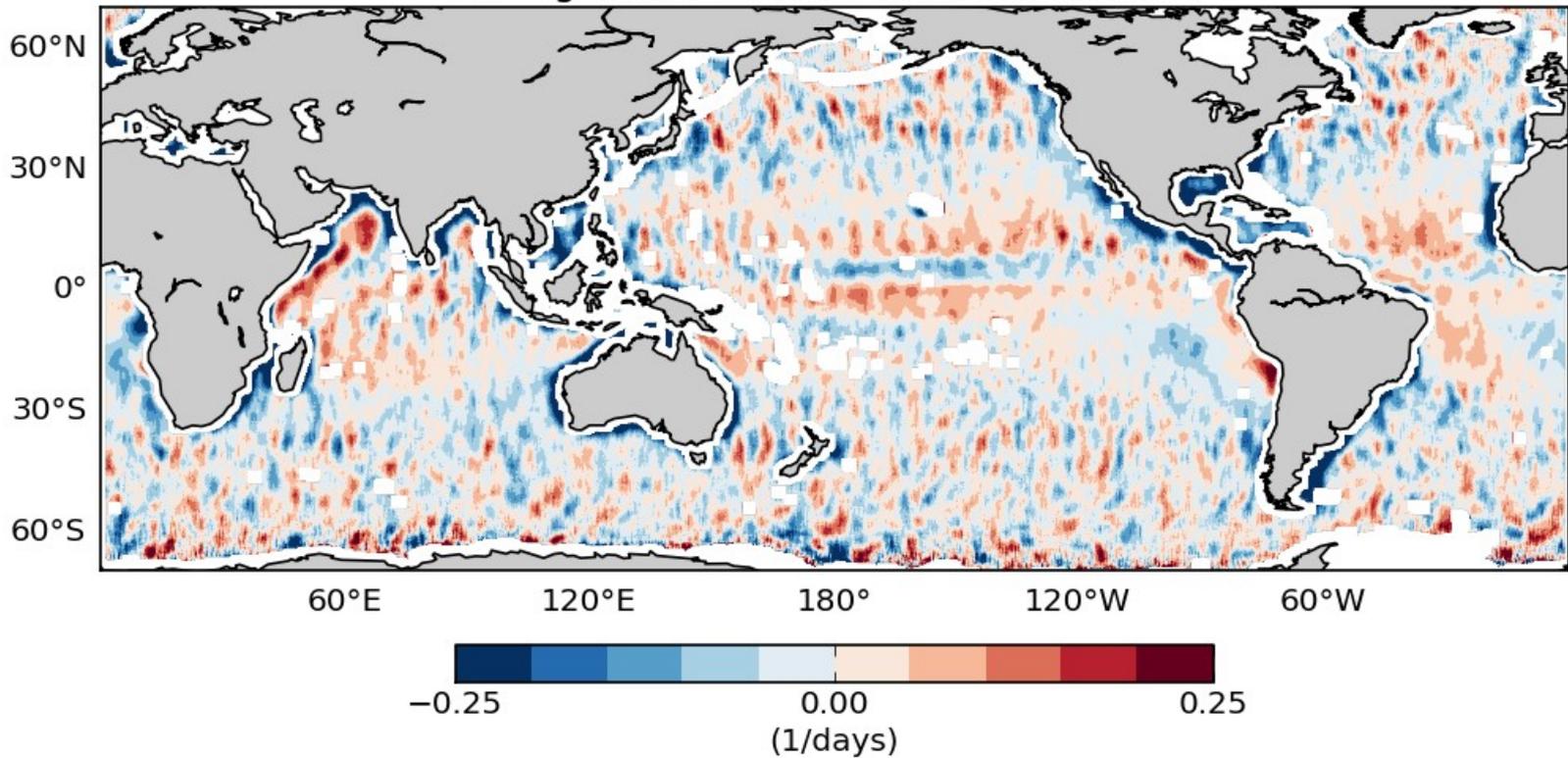
CCMP Divergence mean coefficient

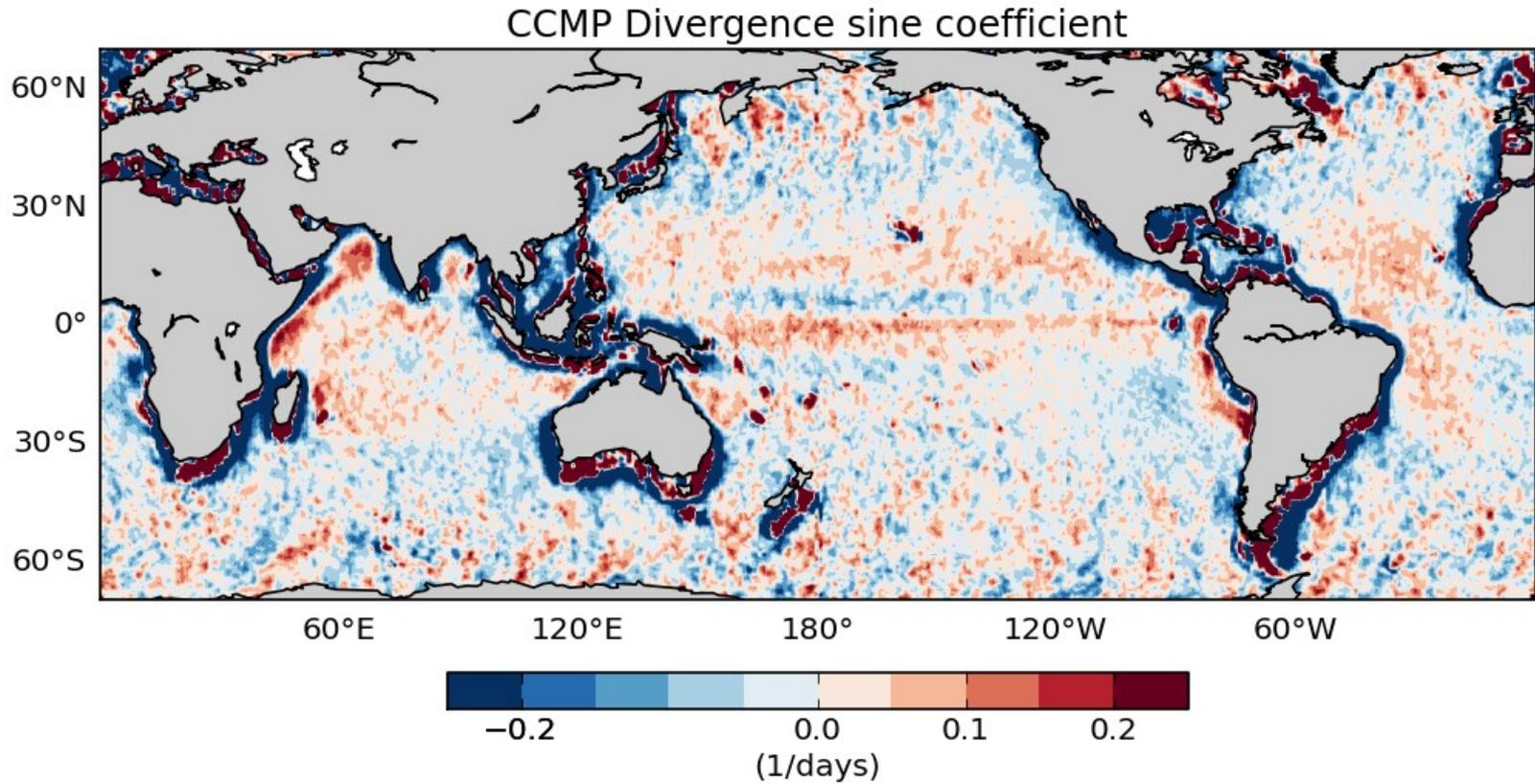




# Scat 6am/6pm Max Divergence Component

Divergence sine coefficient nsmooth: 11

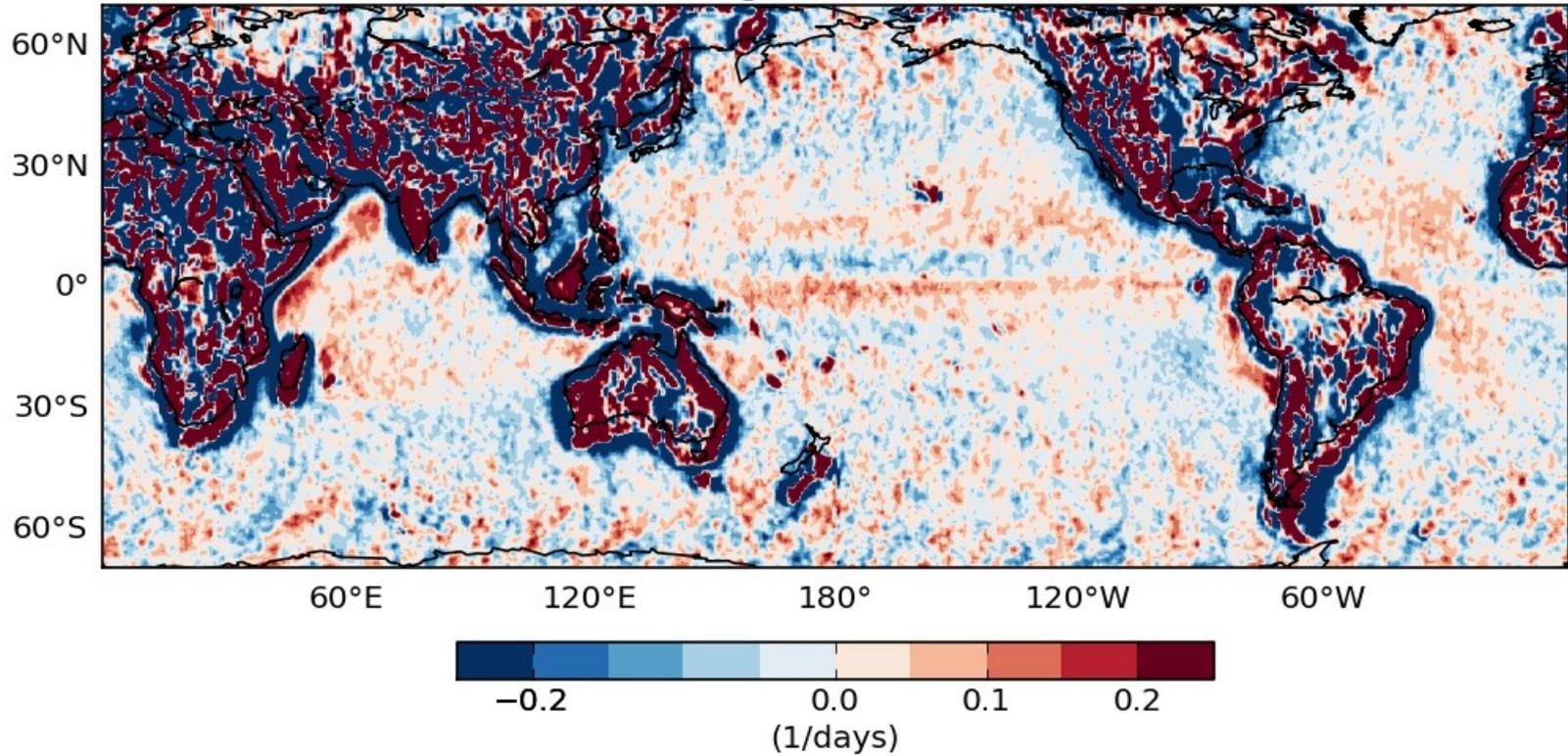






# CCMP 6am/6pm Max Divergence Component

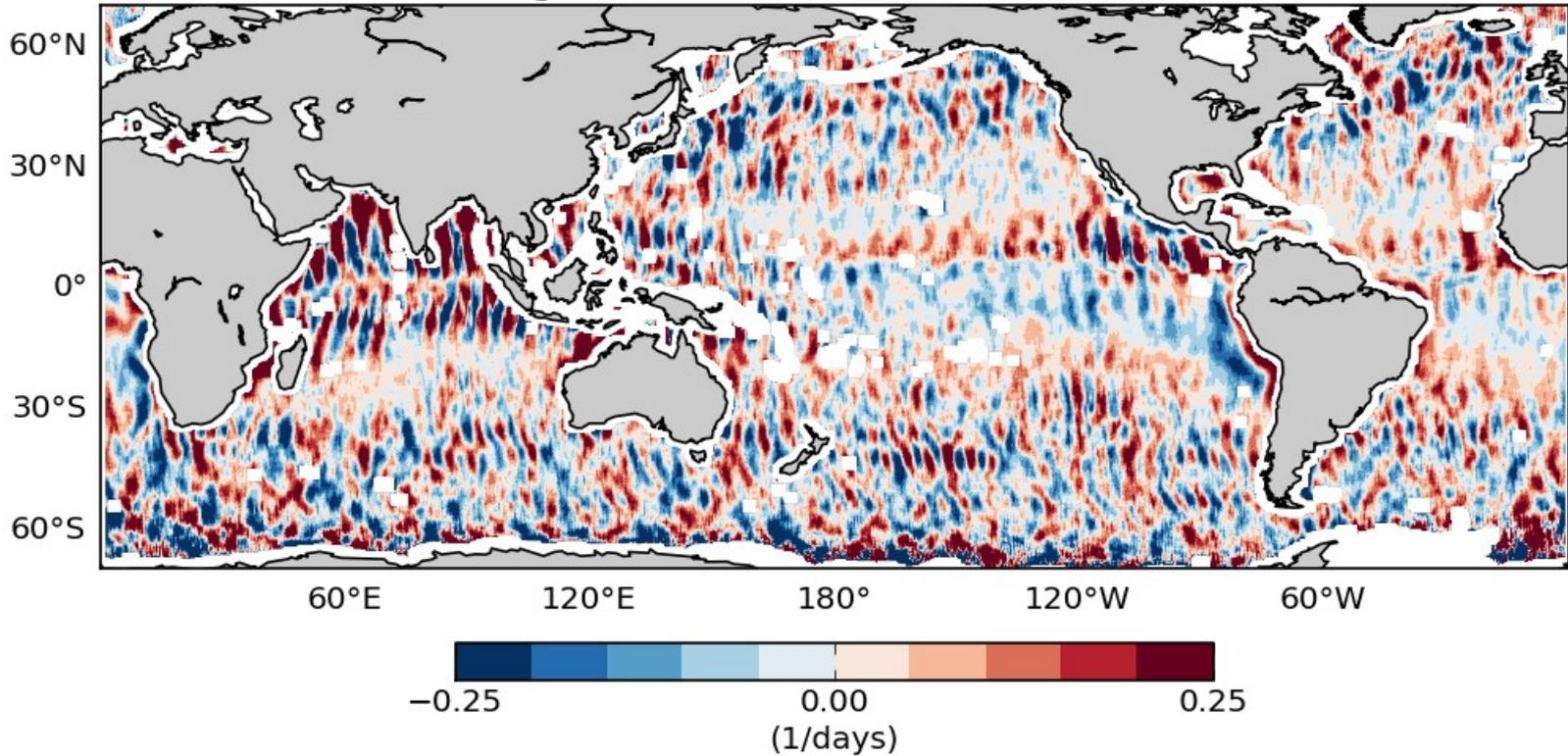
CCMP Divergence sine coefficient





# Scat 12am/12pm Max Divergence Component

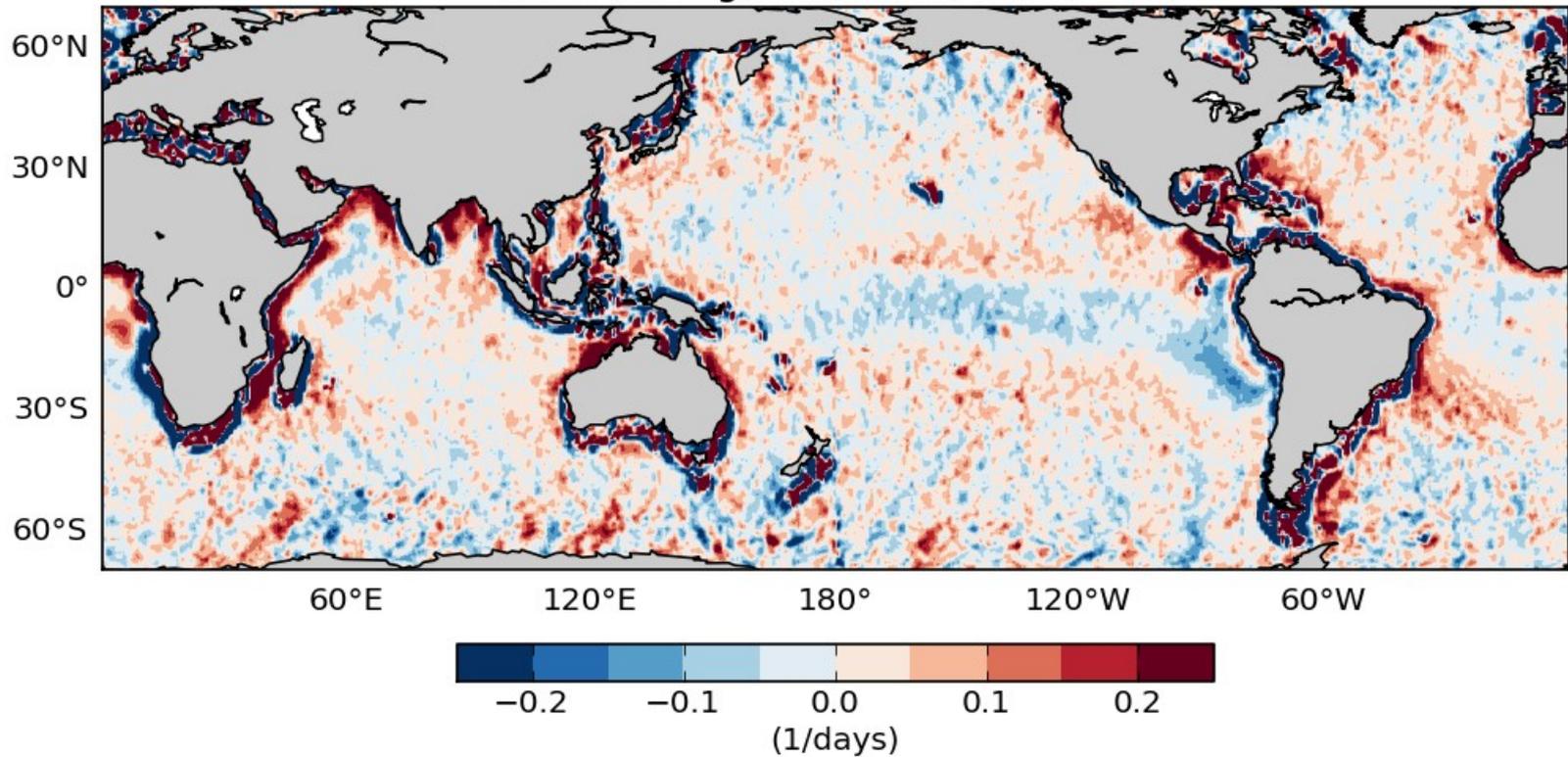
Divergence cosine coefficient nsmooth: 11





# CCMP 12am/12pm Max Divergence Component

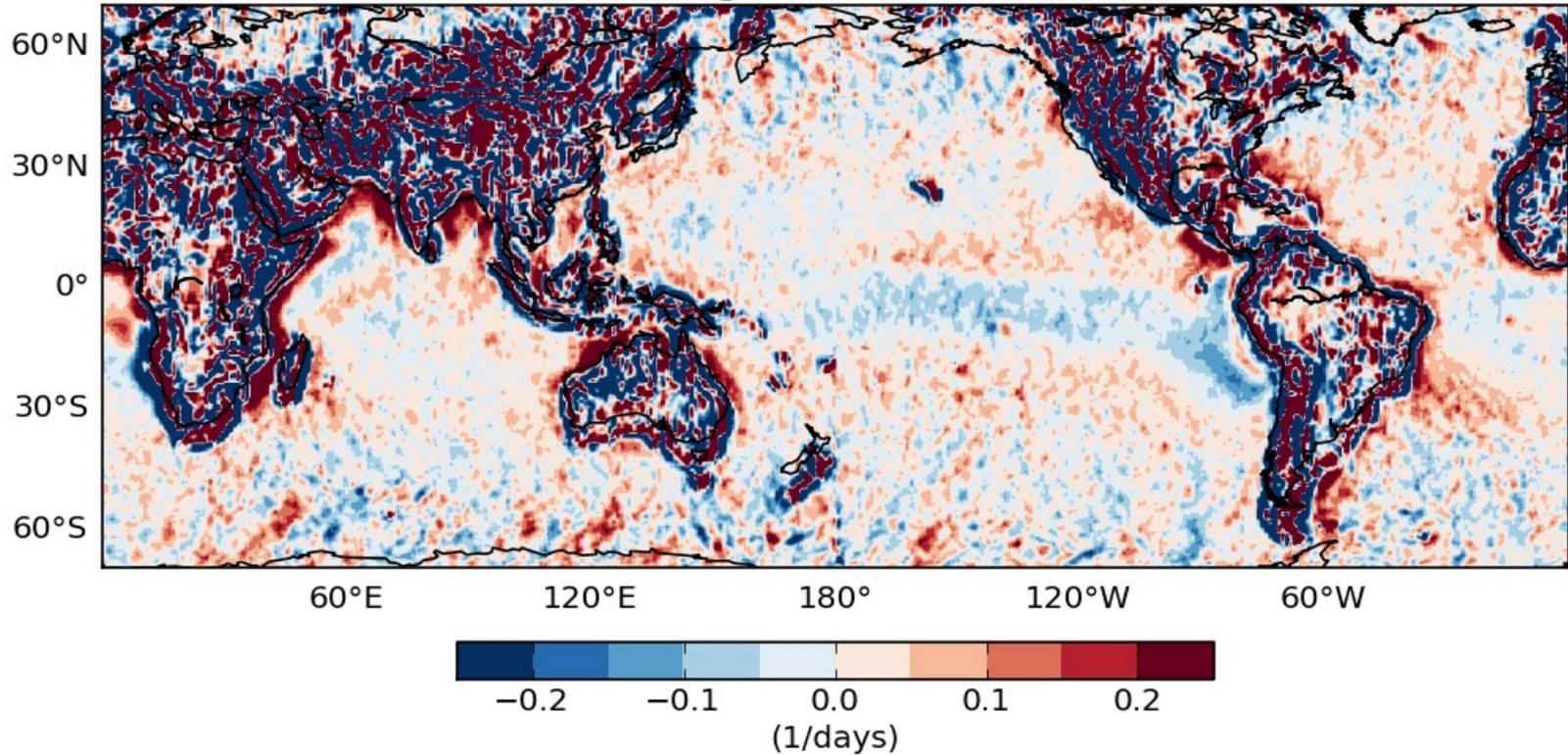
CCMP Divergence cosine coefficient

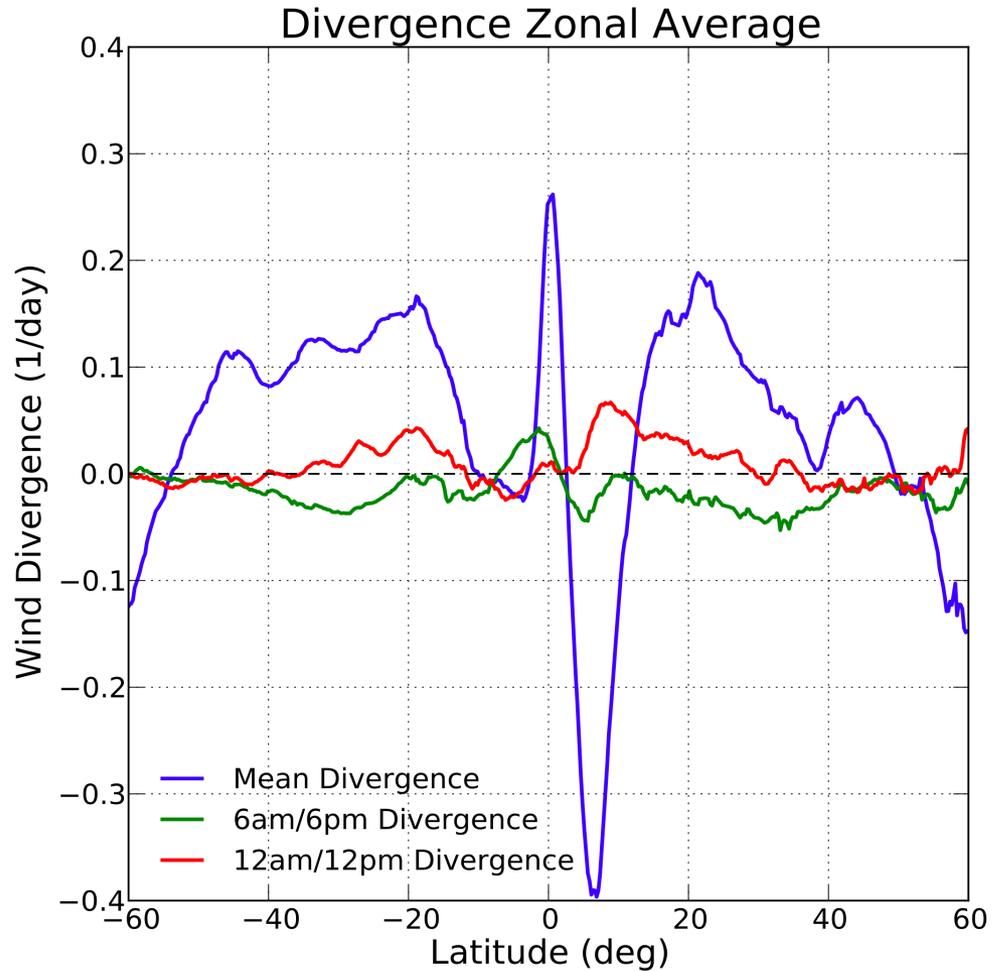




# CCMP 12am/12pm Max Divergence Component

CCMP Divergence cosine coefficient







- QuikSCAT and ASCAT seem to generate robust signatures for diurnal variations that are broadly consistent with QuikSCAT-SeaWinds
- The composite mission data set can be used to characterize the seasonal variability of the diurnal component
- CCMP data has significantly higher diurnal variability close to the coast
  - ECMWF influence
- There is a global meridional dependence on the wind divergence field that is broadly consistent between the scatterometer and CCMP data
  - However, the high frequency behavior and the behavior near the coasts is quite different between the two data set
  - ECMWF influence?
  - Residual scatterometer track effects? Real?

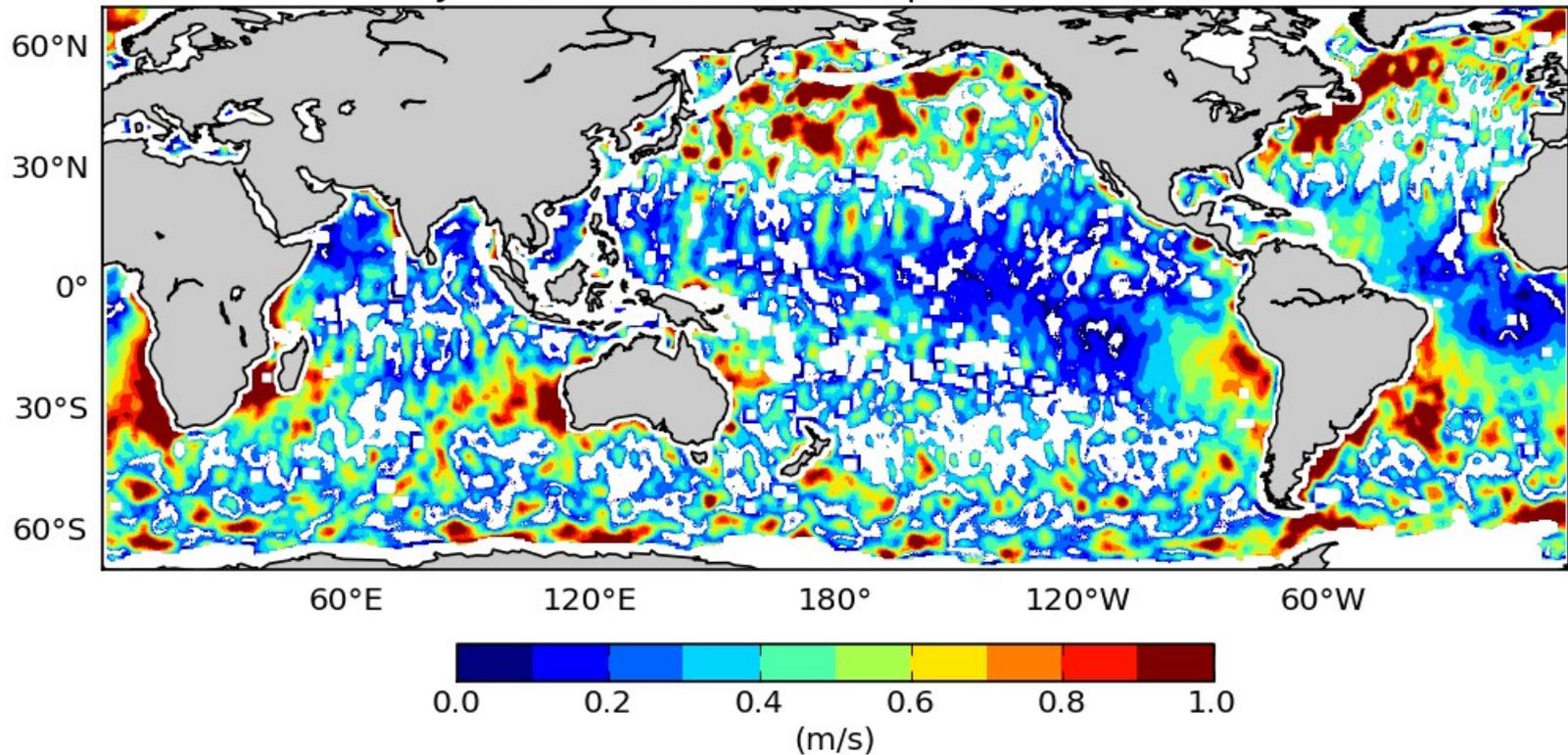


**JPL**

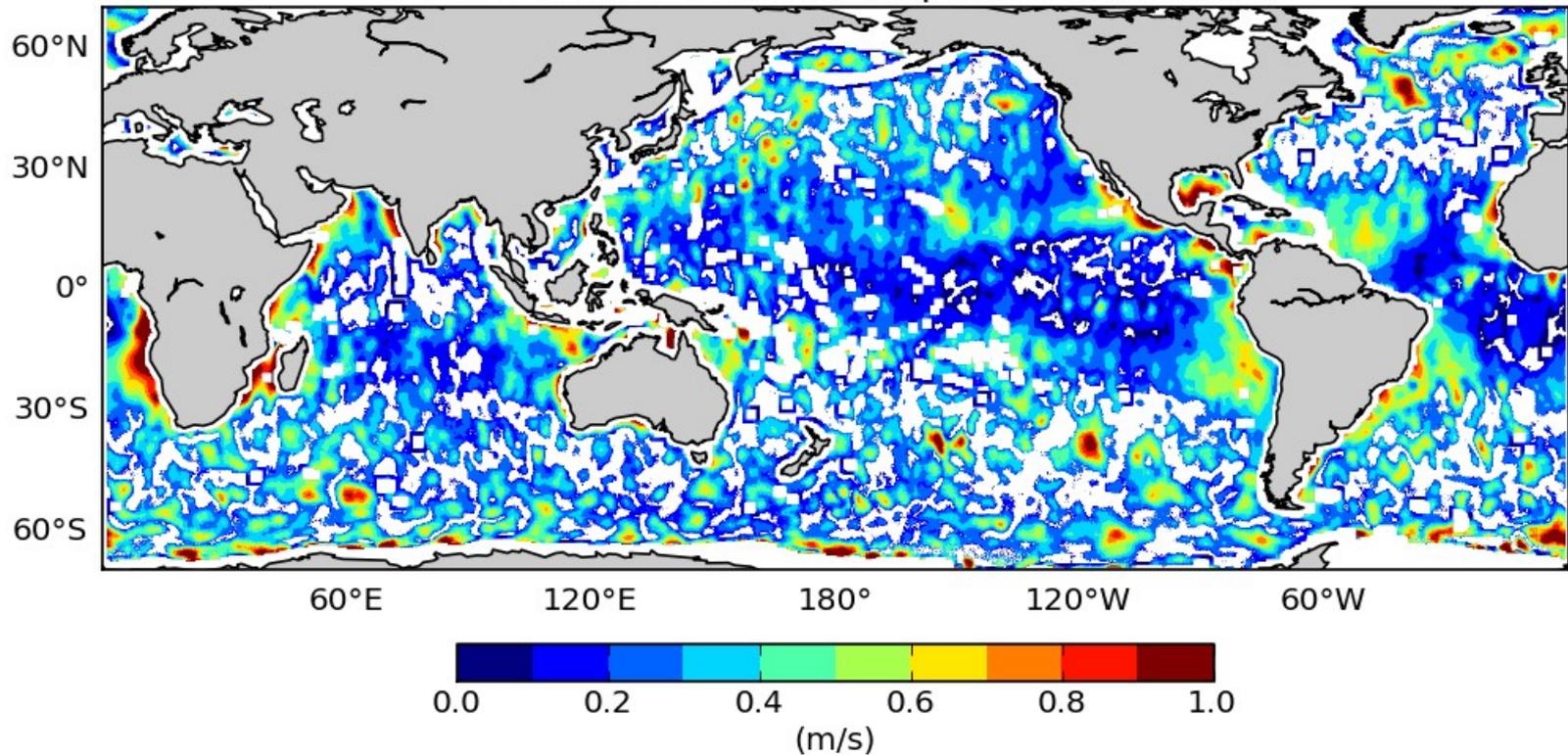
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# ***BACKUPS***

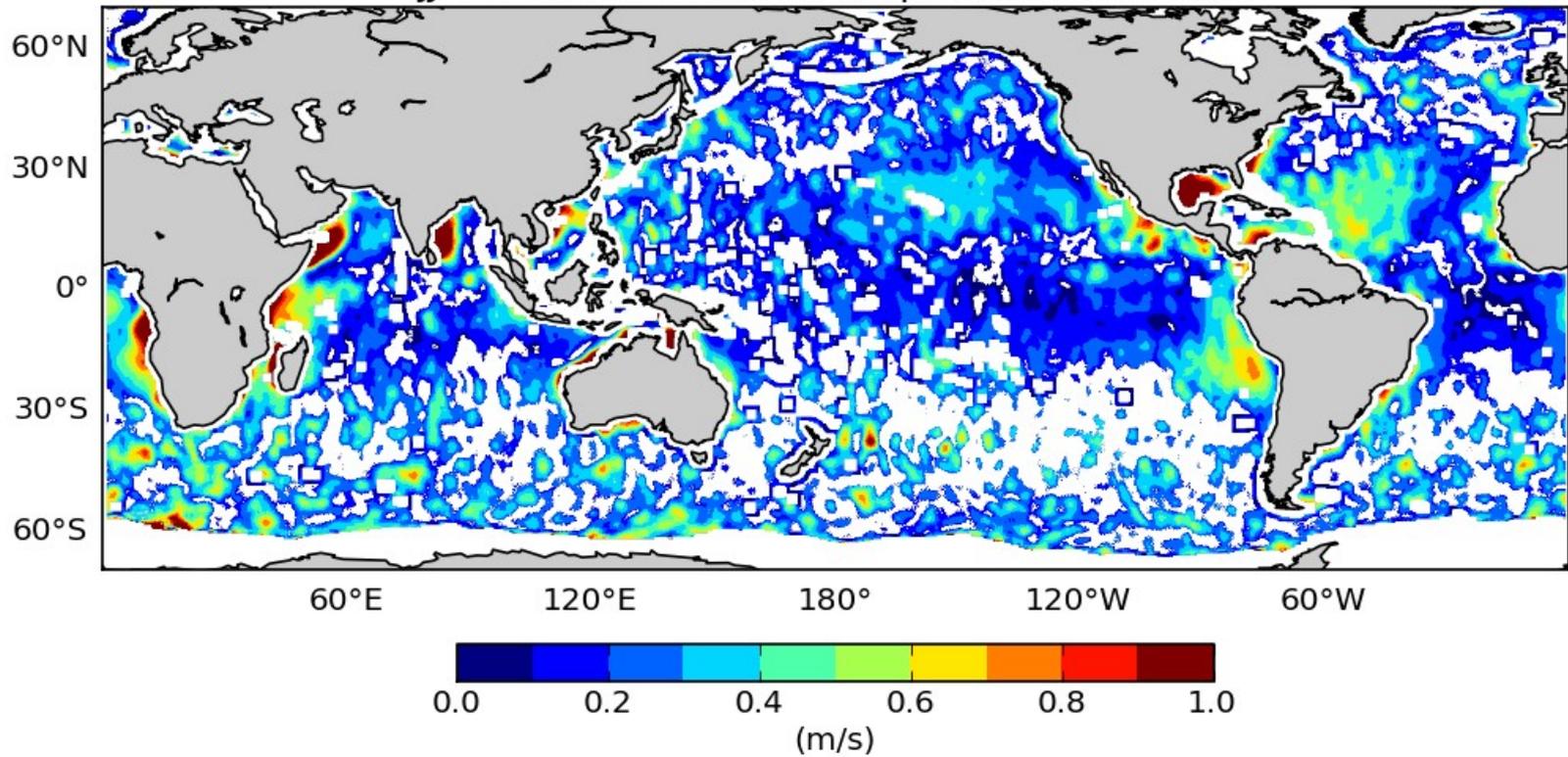
DJF U diurnal variation amplitude nsmooth: 9



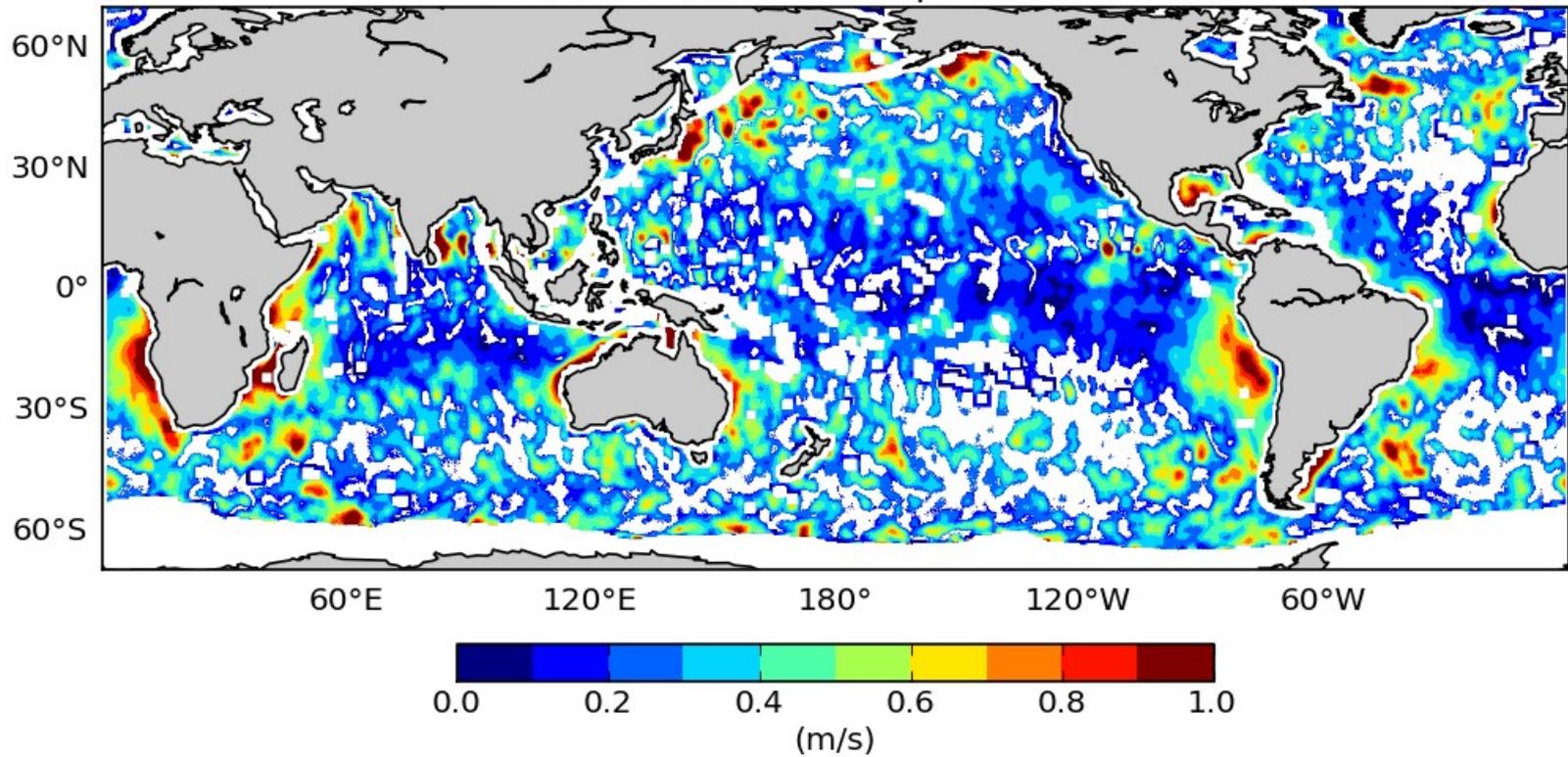
MAM U diurnal variation amplitude nsmooth: 9



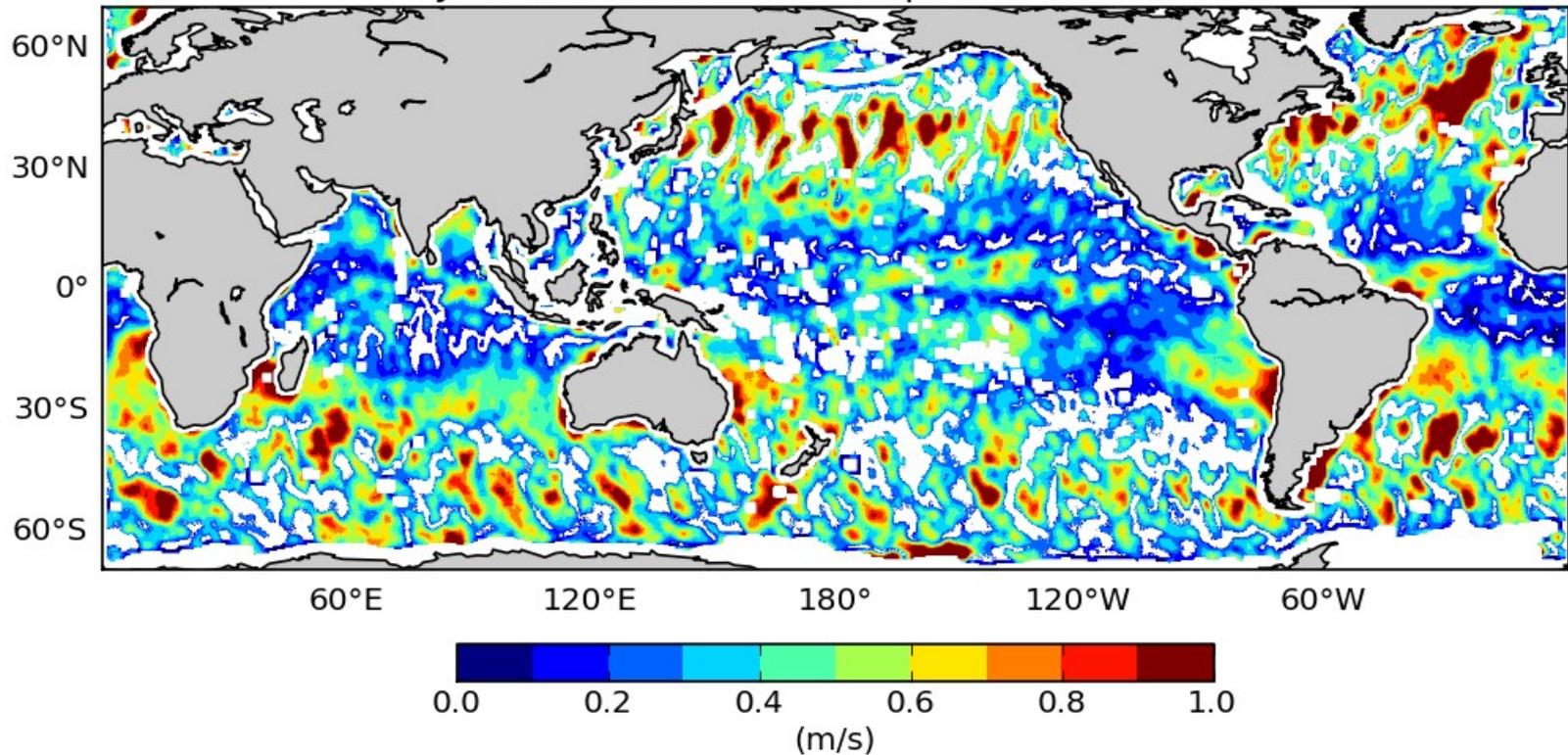
JJA U diurnal variation amplitude nsmooth: 9



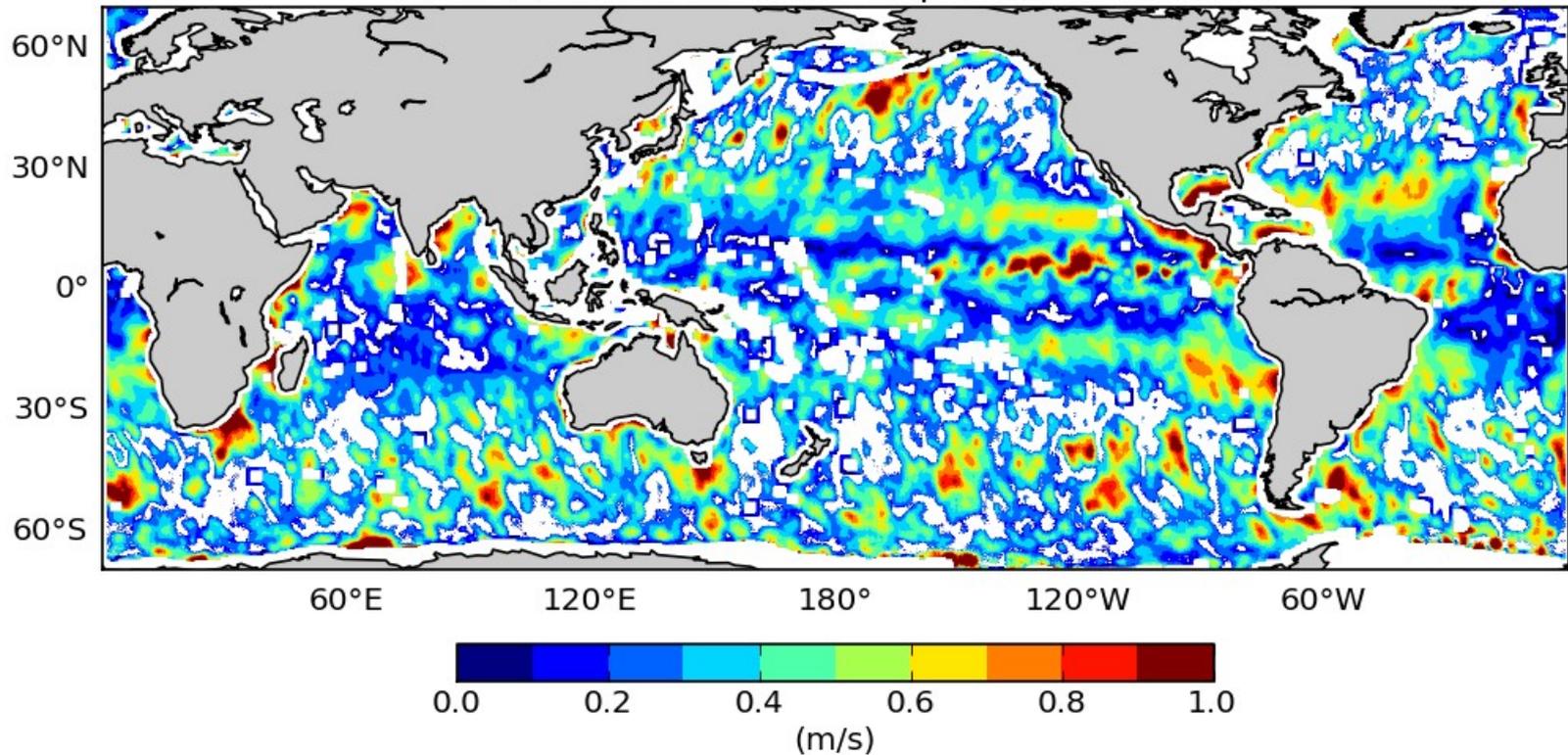
SON U diurnal variation amplitude nsmooth: 9



DJF V diurnal variation amplitude nsmooth: 9

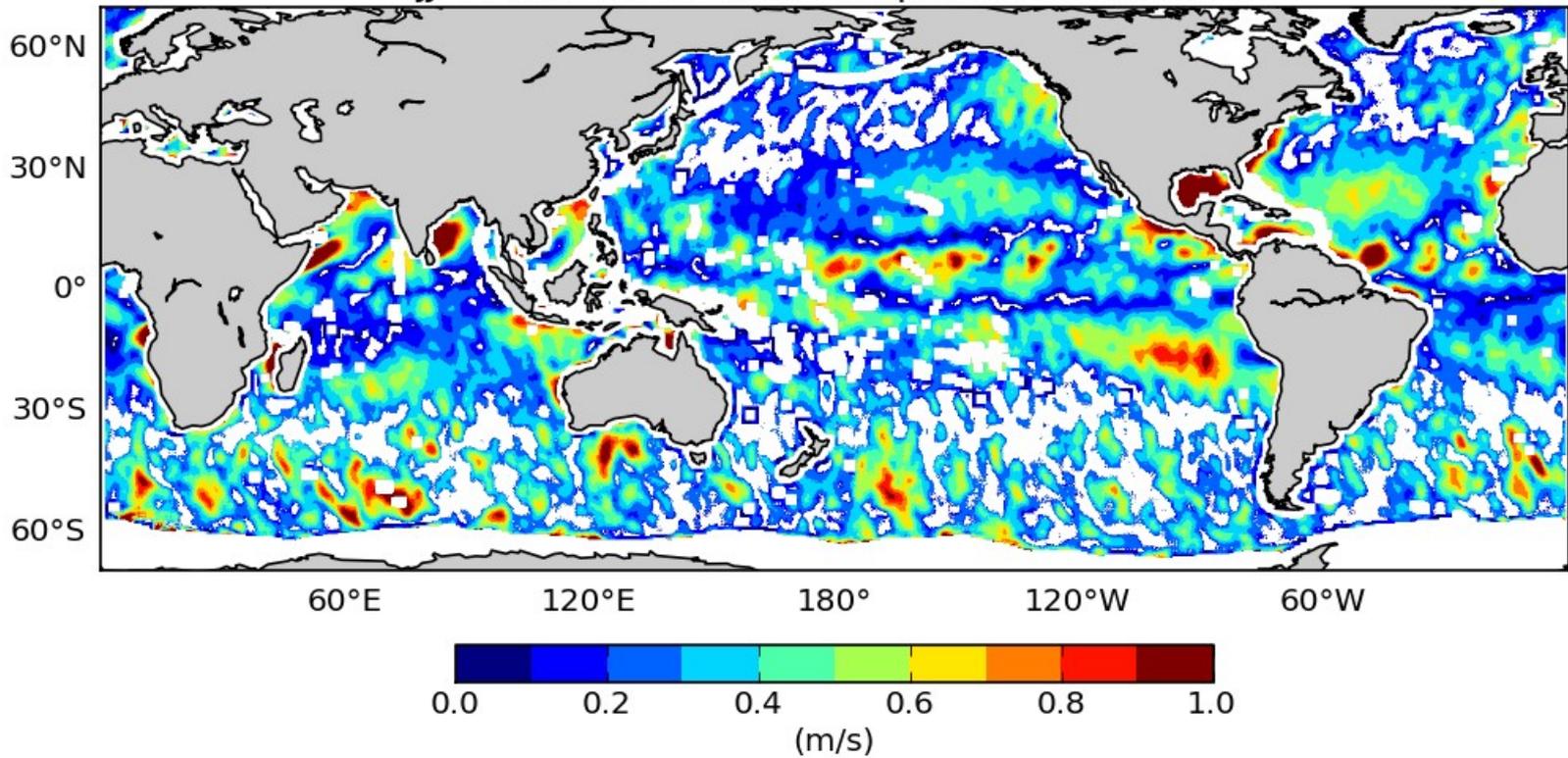


MAM V diurnal variation amplitude nsmooth: 9

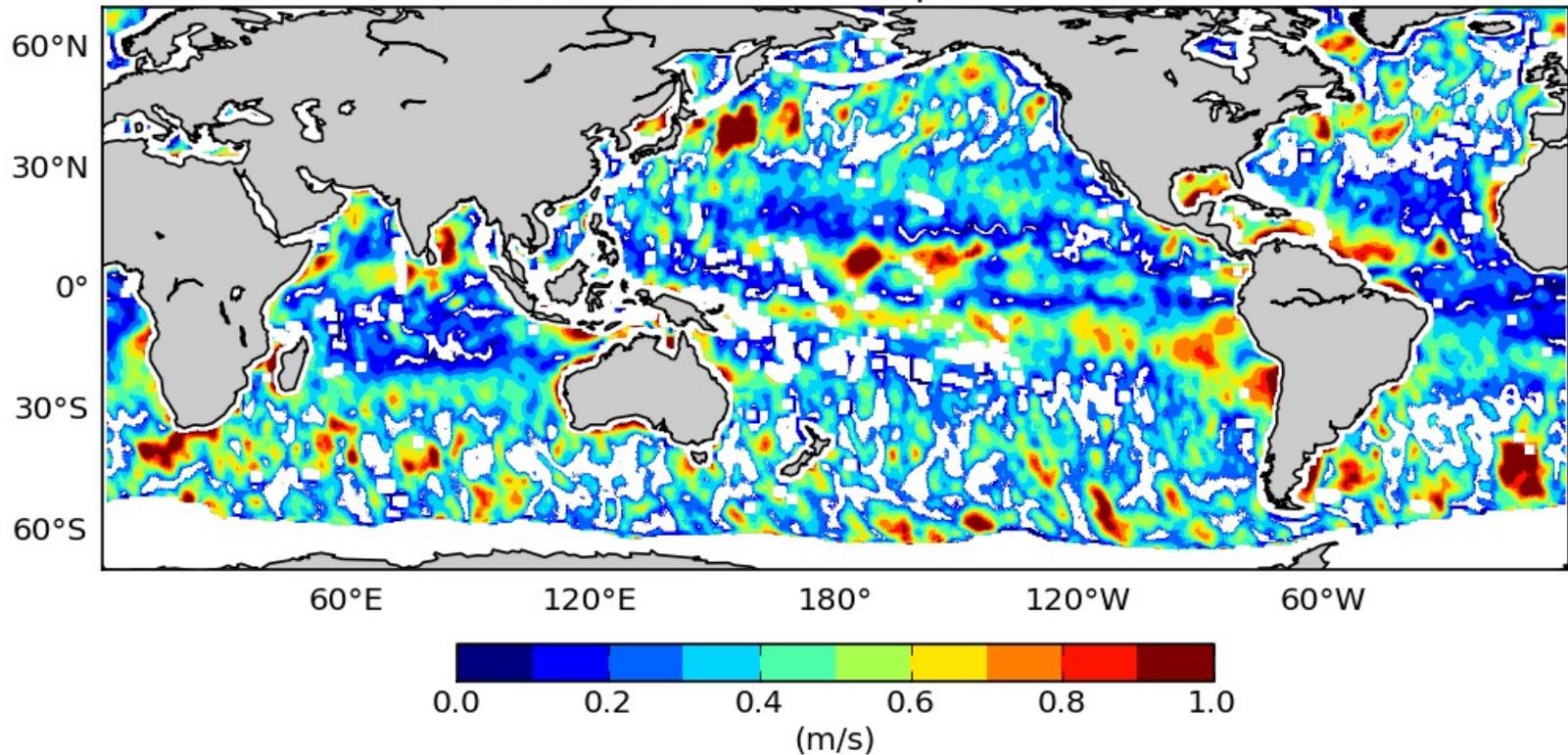




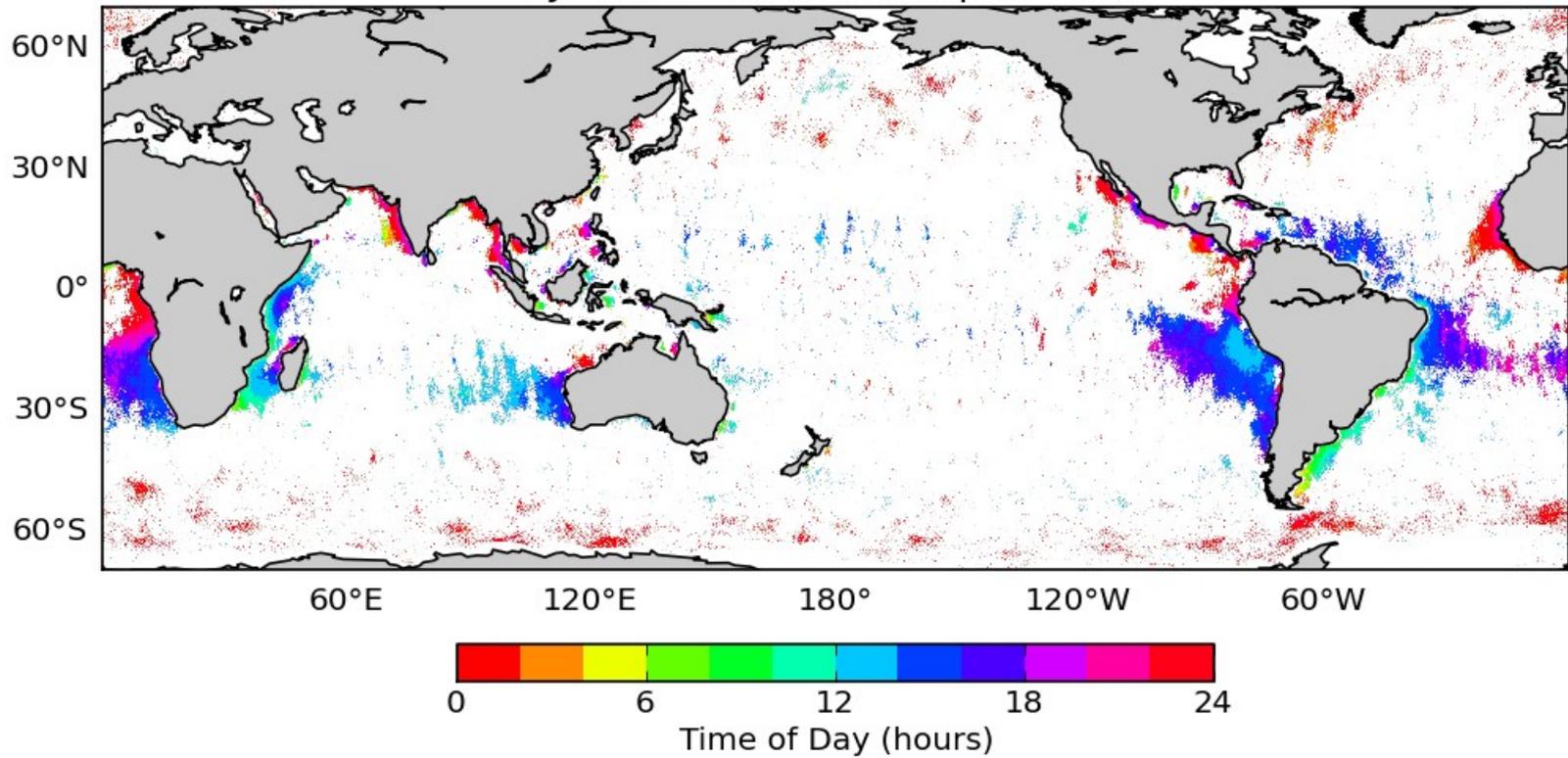
JJA V diurnal variation amplitude nsmooth: 9



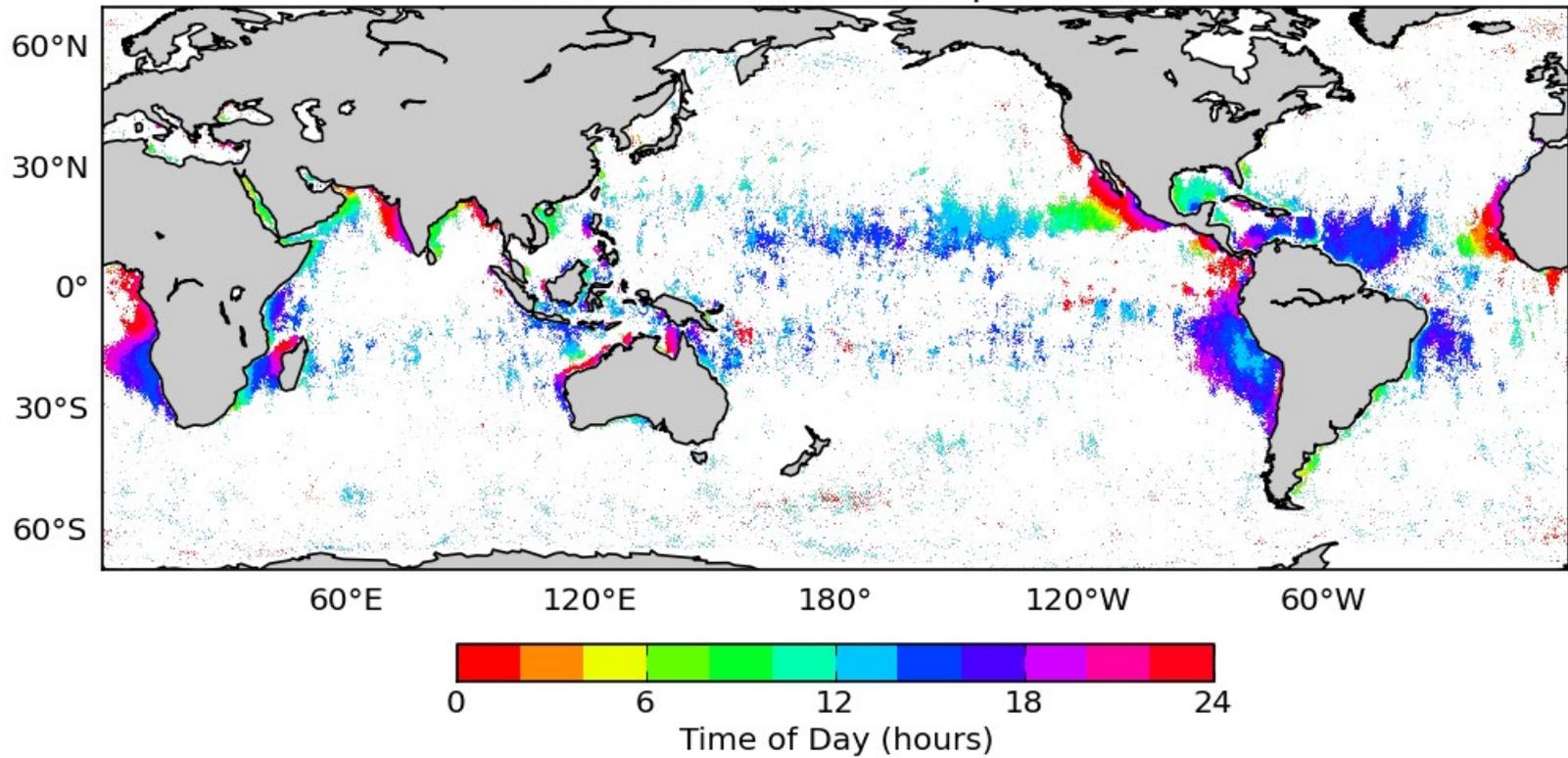
SON V diurnal variation amplitude nsmooth: 9



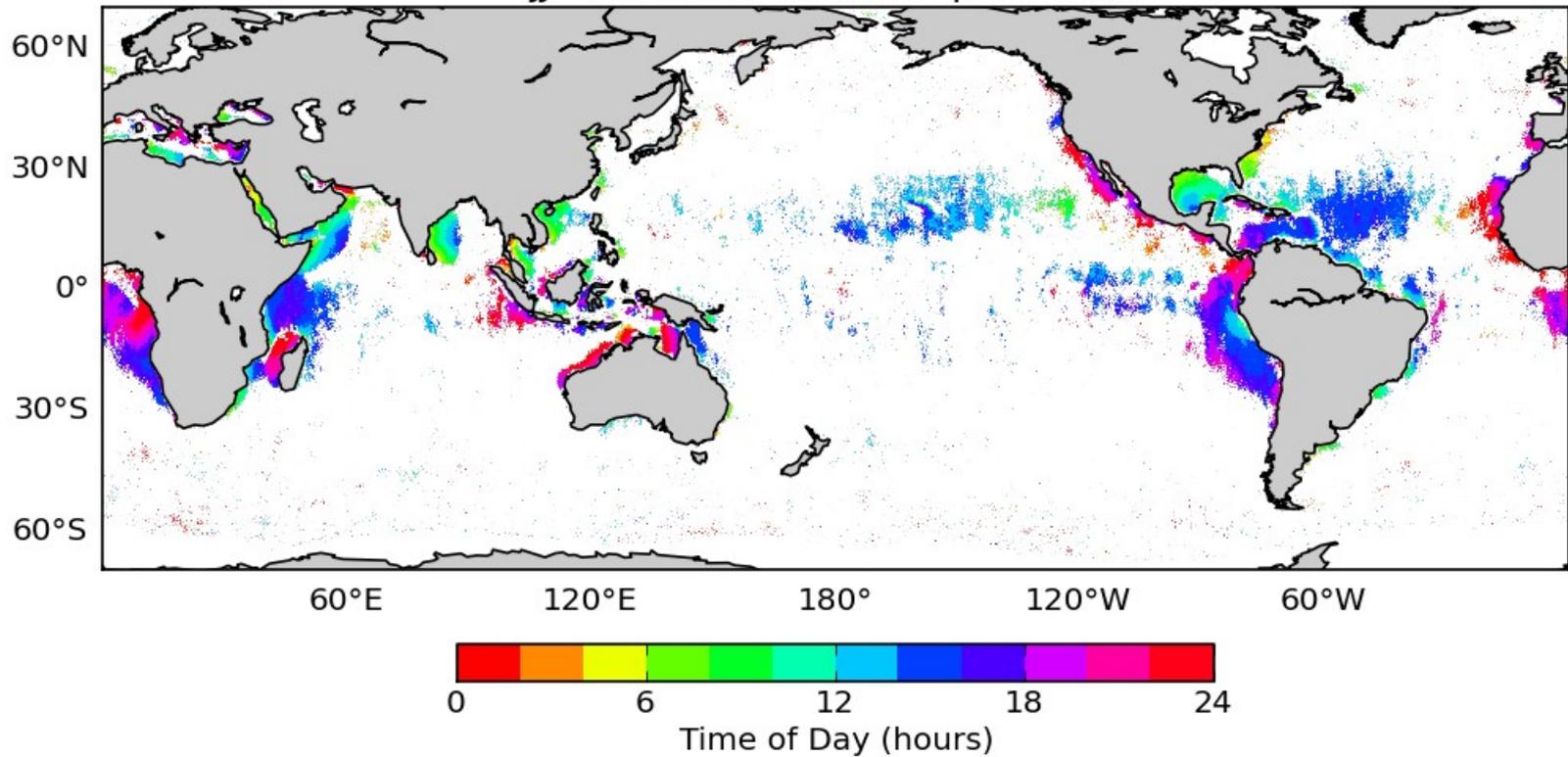
DJF U diurnal variation peak hour



MAM U diurnal variation peak hour



JJA U diurnal variation peak hour



### SON U diurnal variation peak hour

