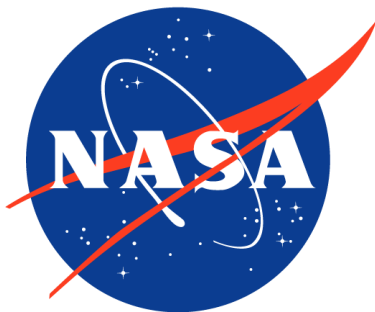


# **Air-Sea Coupling and Fluxes: Wind-Wave-Current in High-Impact Weather and Implications for Earth System Modeling and Prediction**

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**Shuyi S. Chen, Ben Barr, Milan Curcic and Brandon Kerns**  
**Department of Atmospheric Sciences**  
**University of Washington, Seattle, WA 98195**



(IOVWST, Barcelona, Spain, 25 April 2018)

## **Main objectives:**

- To develop accurate and integrated impact forecasts of extreme wind, rain, waves, and storm surge in hurricanes, to meet societal needs as coastal population and built environment expand worldwide
- To better represent air-sea fluxes (sea spray) and aerosol (sea salt) in global coupled models for weather-climate prediction

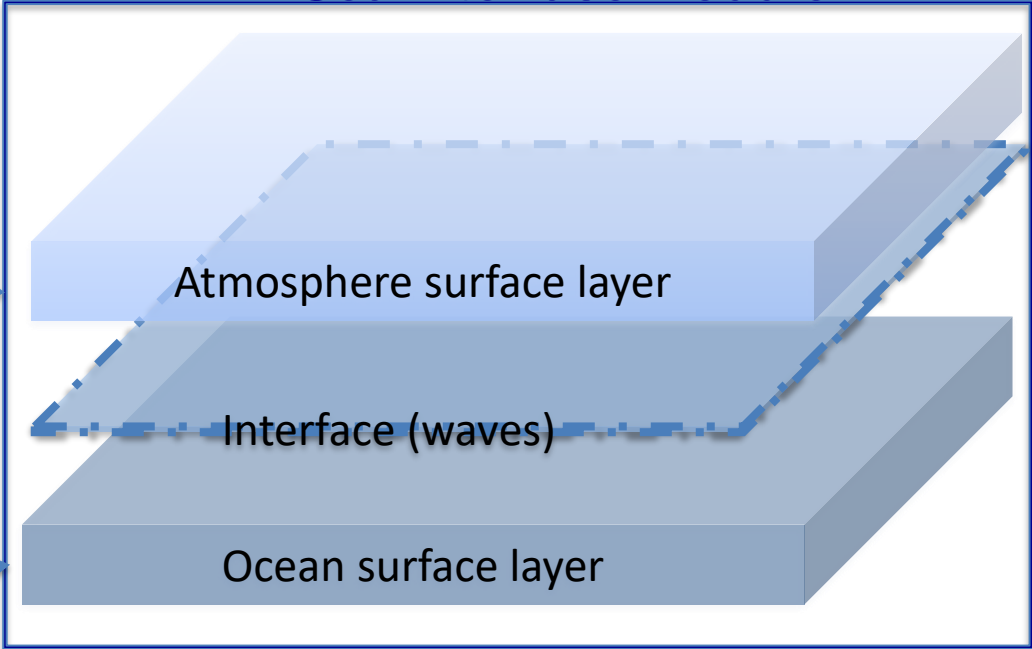
## **Results:**

- 1) Unified Wave INterface (UWIN) and its applications in fully coupled atmosphere-wave-ocean model (WRF-UMWM-HYCOM) predictions of hurricanes and coastal winter storms
- 2) Implementation of UWIN in the NASA GMAO GEOS

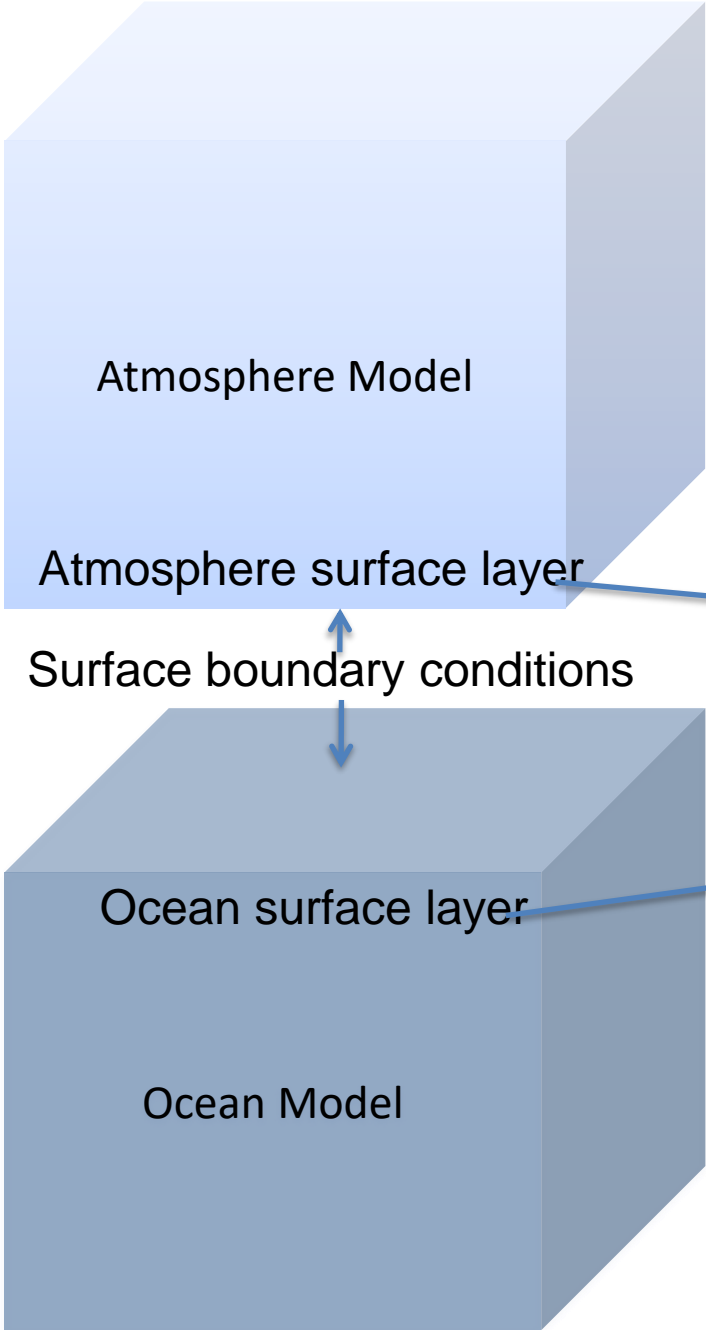
# Coupled Models

**Unified Wave Interface (UWIN)  
for Coupled Models (CM)**  
Chen et al. (2013), Chen & Curcic 2016)

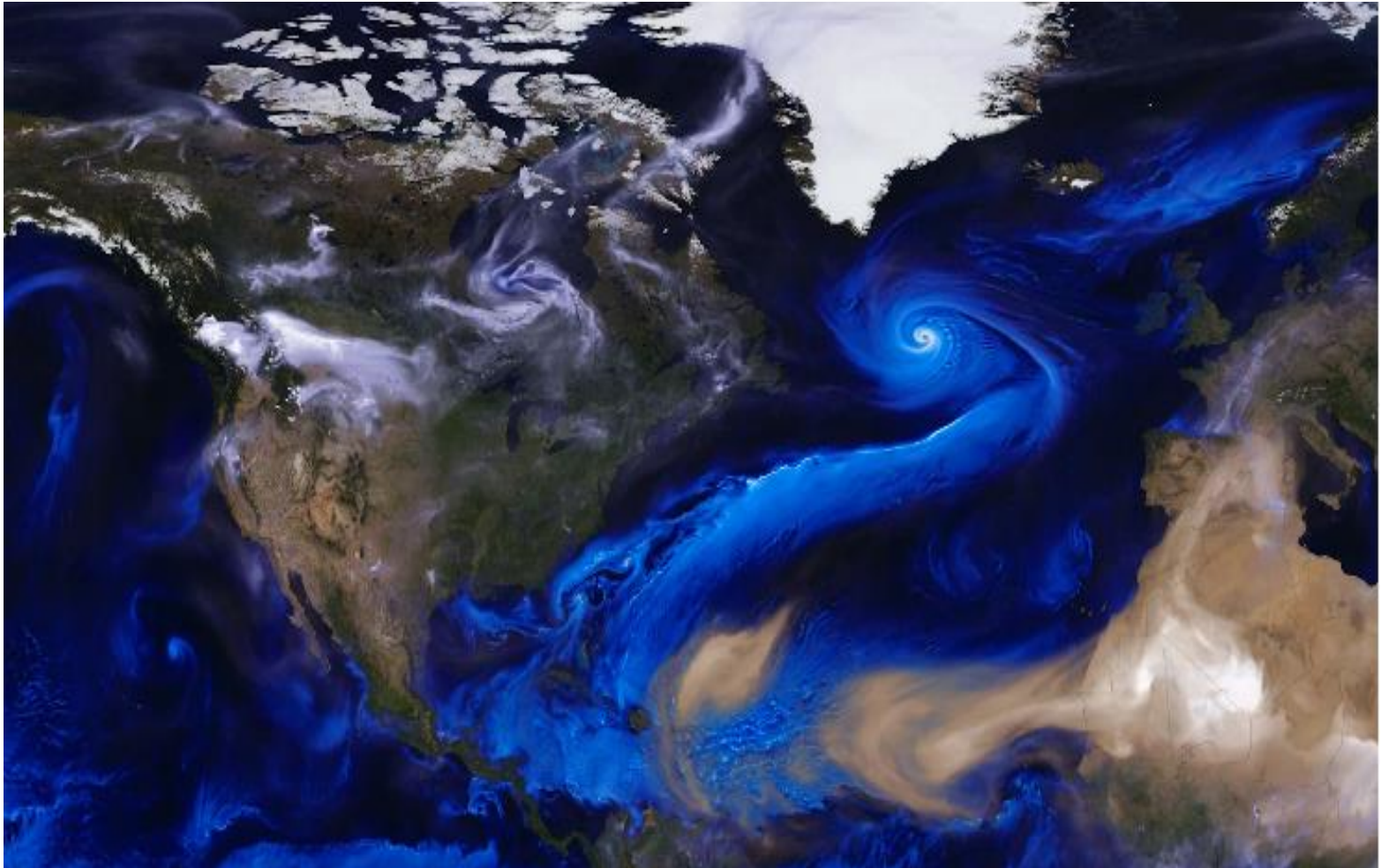
## Air-Sea Interface Module

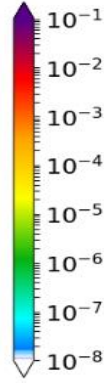
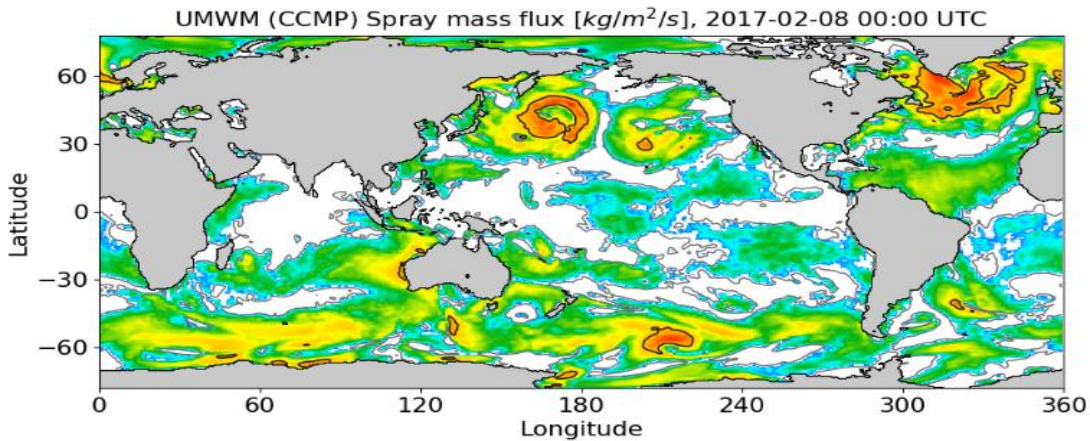
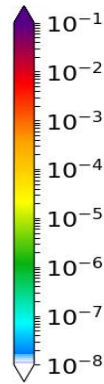
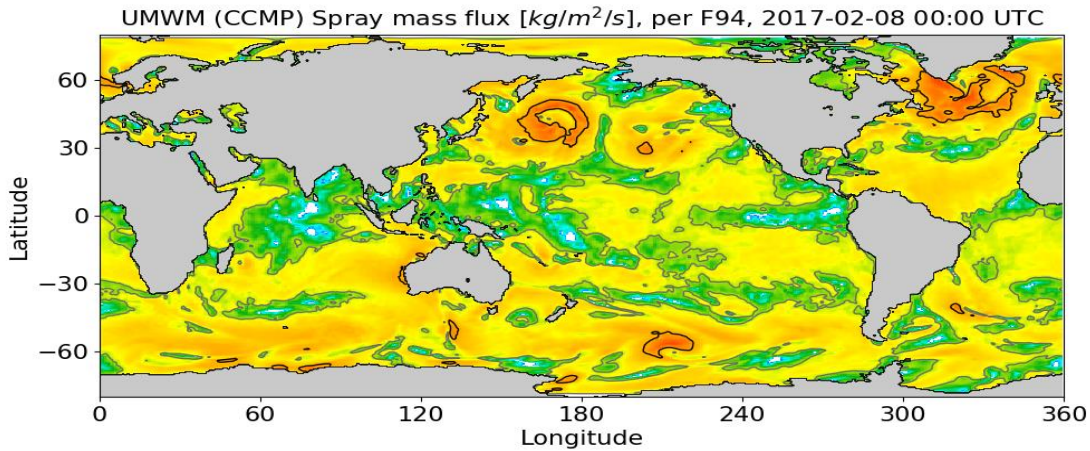
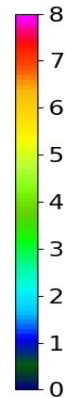
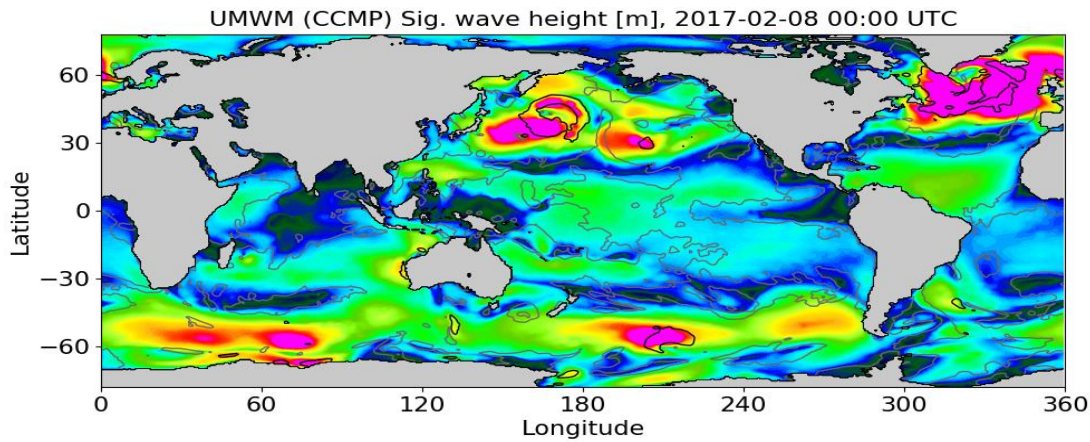


**Coupled observations and  
data assimilation**

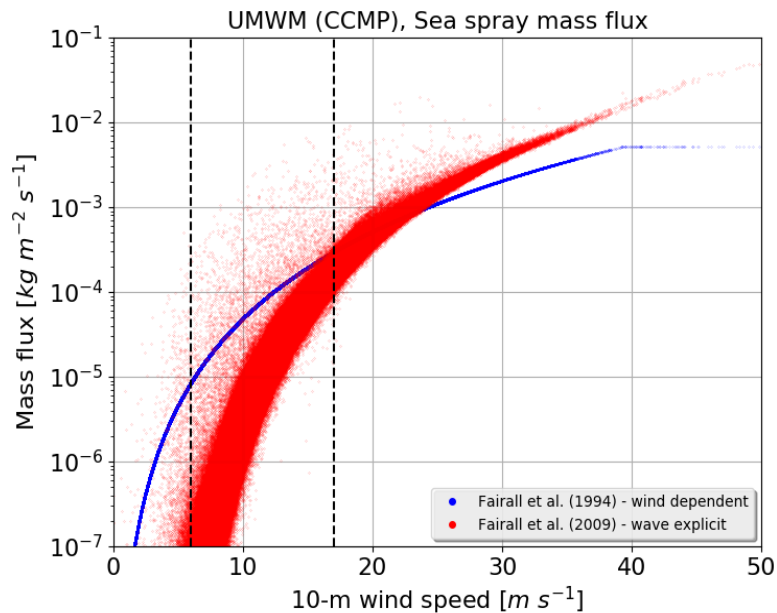
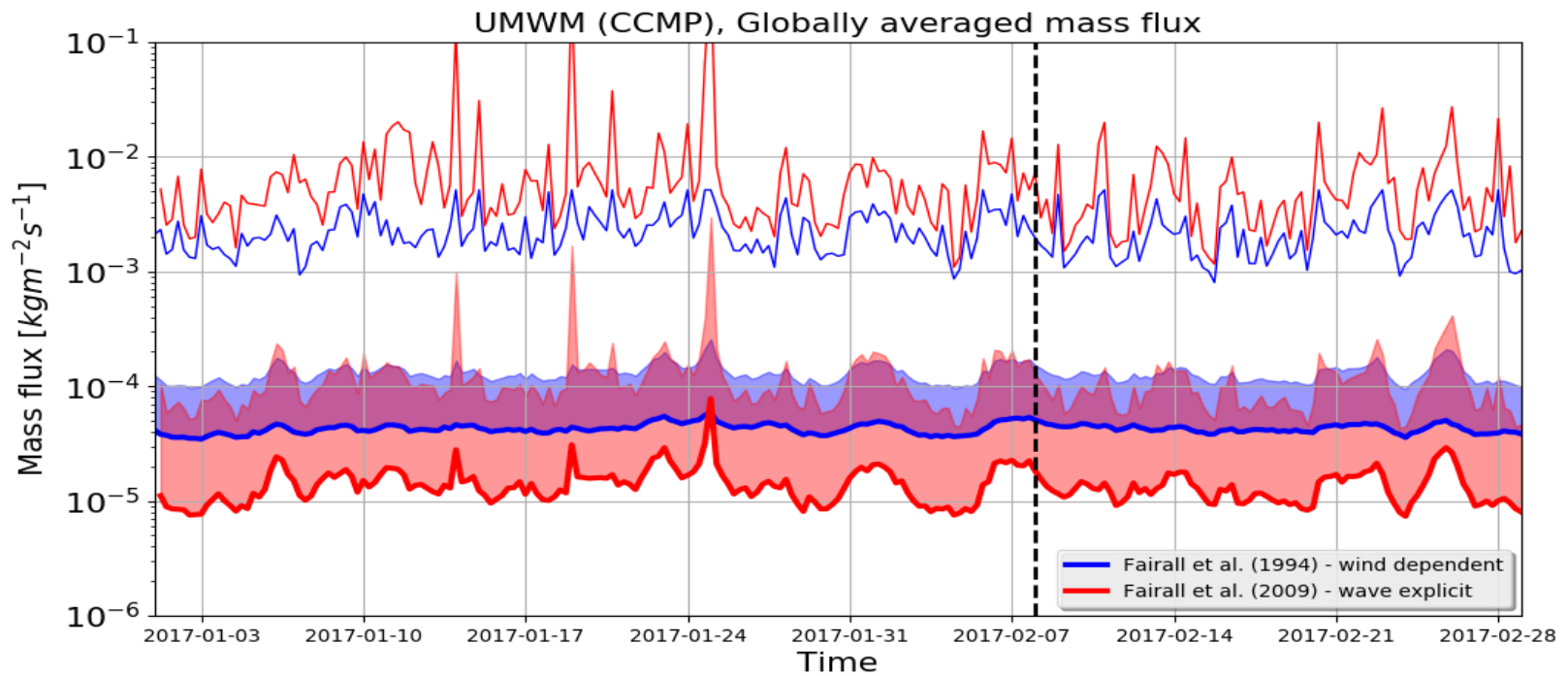


**NASA GMAO GEOS-5 model simulation of aerosol (dust-brown, sea salt-blue, and smoke-white) production and transport by weather systems on August 1, 2017.**





Significant wave height (top) and calculated spray mass flux per F94 (middle) and F09 (bottom) formulations. CCMP 10-m wind speed contours for  $6 \text{ m s}^{-1}$  (grey) and  $17 \text{ m s}^{-1}$  (black) shown on all plots.

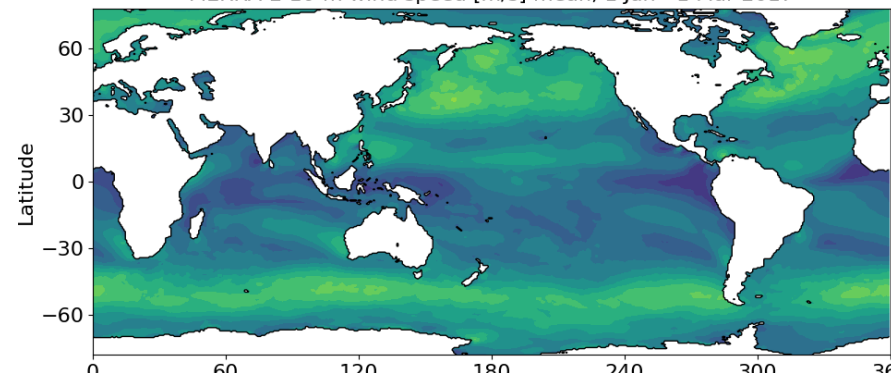


Top: Time series of globally-averaged sea spray mass flux for F94 and F09 formulations. Thick lines show average fluxes, shaded regions represent one standard deviation above the average, and thin lines represent the maximum flux out of all grid points.

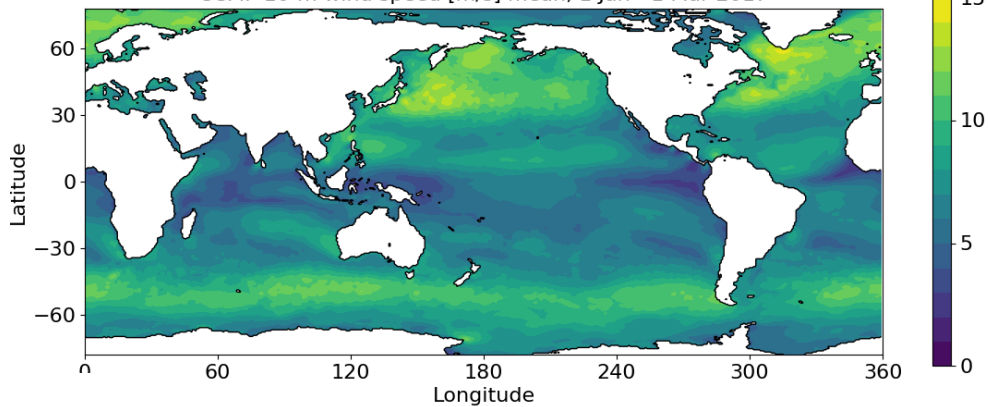
Left: Scatter plot of sea spray mass flux for F94 and F09 formulations (all gridpoints and timesteps from Jan-Feb 2017). Vertical dashed lines indicate  $6 \text{ m s}^{-1}$  and  $17 \text{ m s}^{-1}$  wind speeds.

# MERRA-2 and CCMP Winds 1 Jan-1 Mar 2017

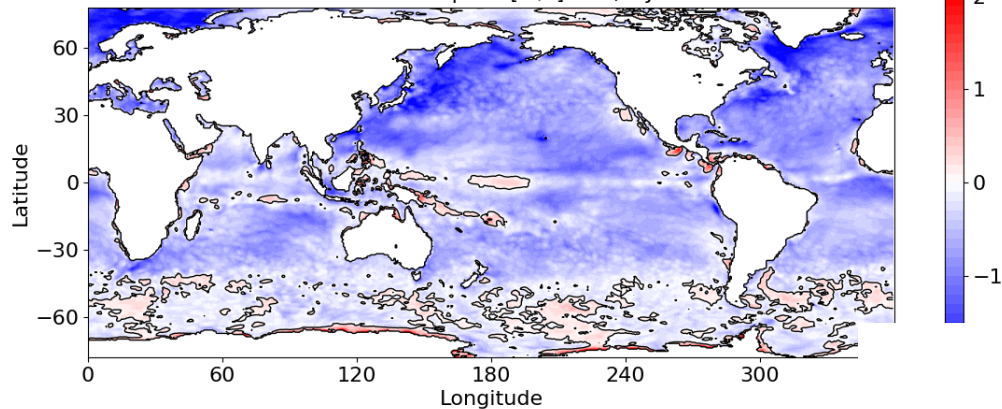
MERRA-2 10-m wind speed [m/s] mean, 1 Jan - 1 Mar 2017



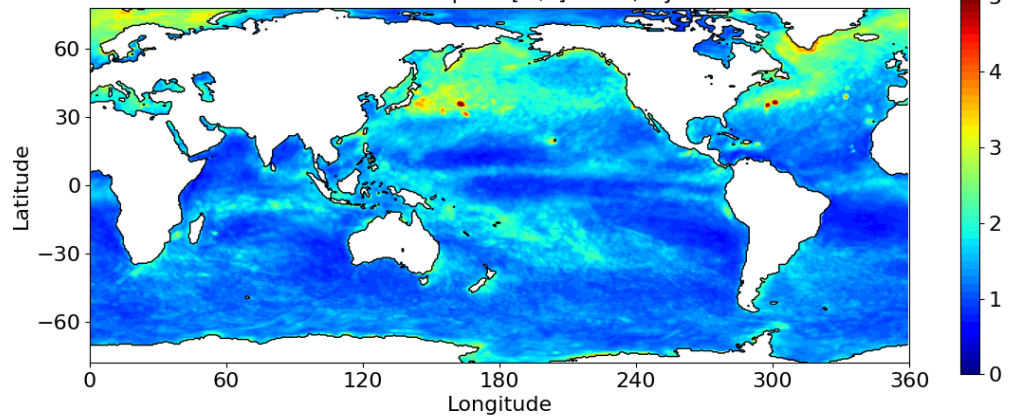
CCMP 10-m wind speed [m/s] mean, 1 Jan - 1 Mar 2017



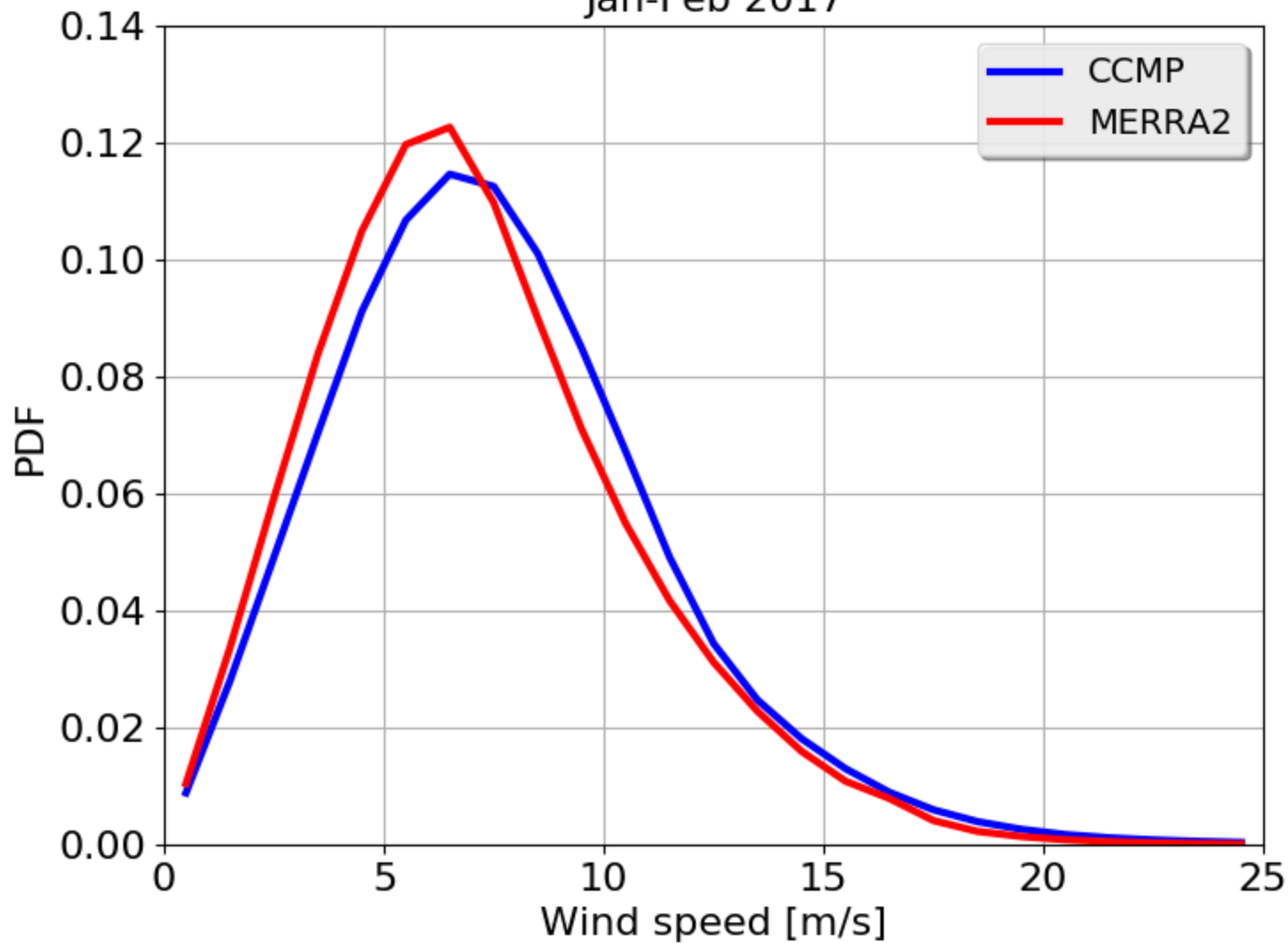
MERRA2-CCMP 10-m wind speed [m/s] bias, 1 Jan - 1 Mar 2017



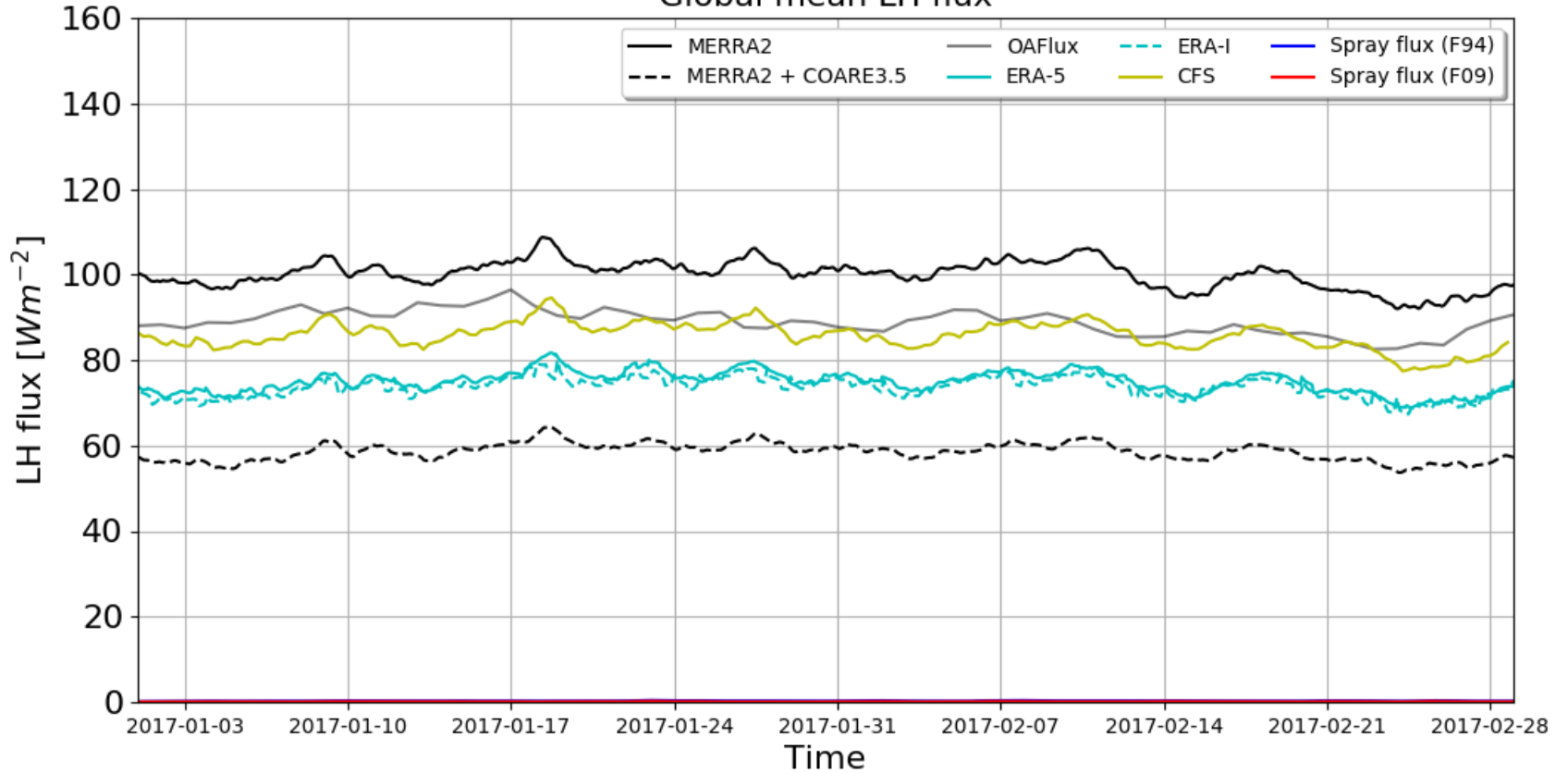
MERRA2-CCMP 10-m wind speed [m/s] RMSE, 1 Jan - 1 Mar 2017



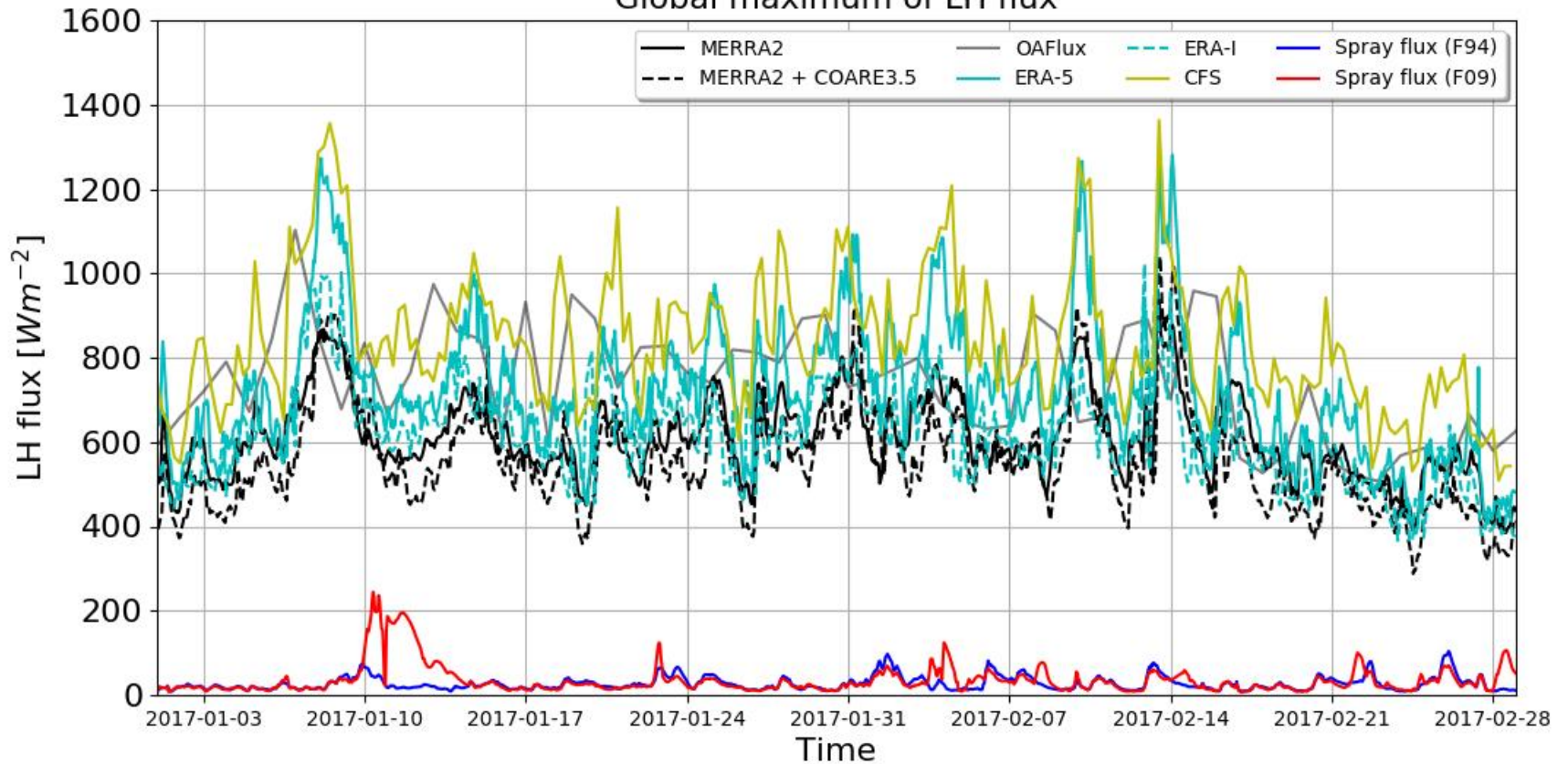
Jan-Feb 2017



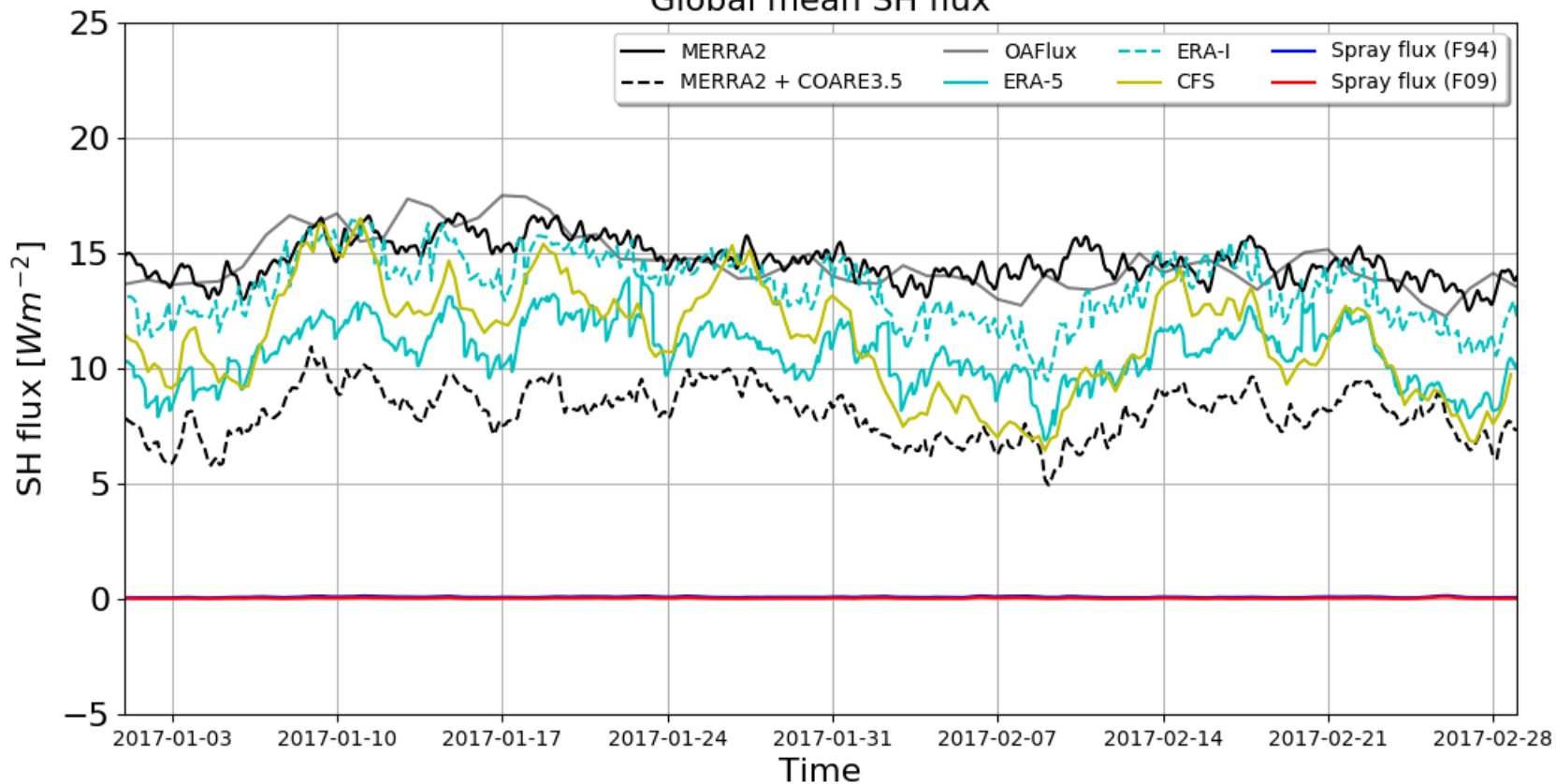
Global mean LH flux



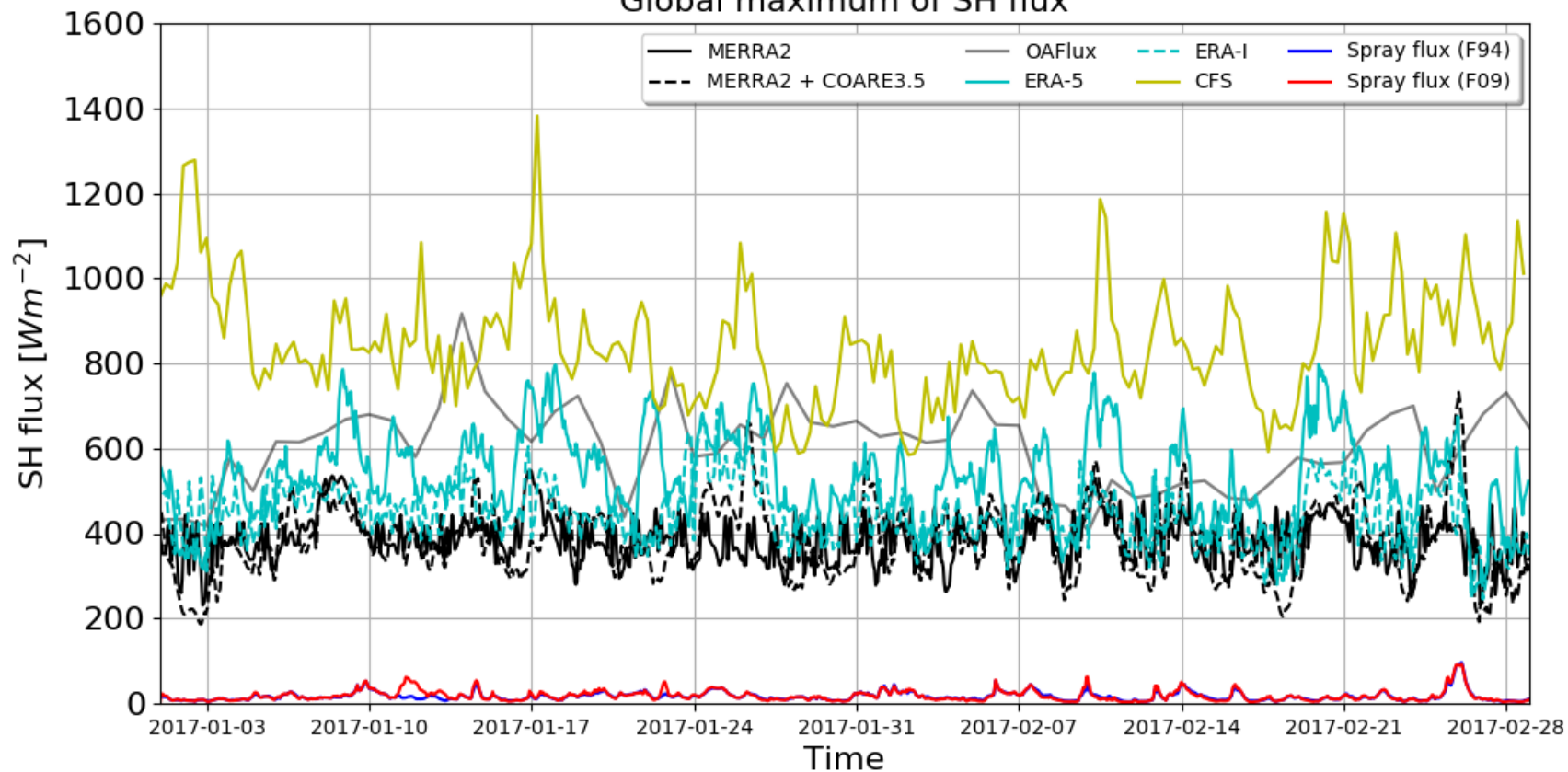
Global maximum of LH flux



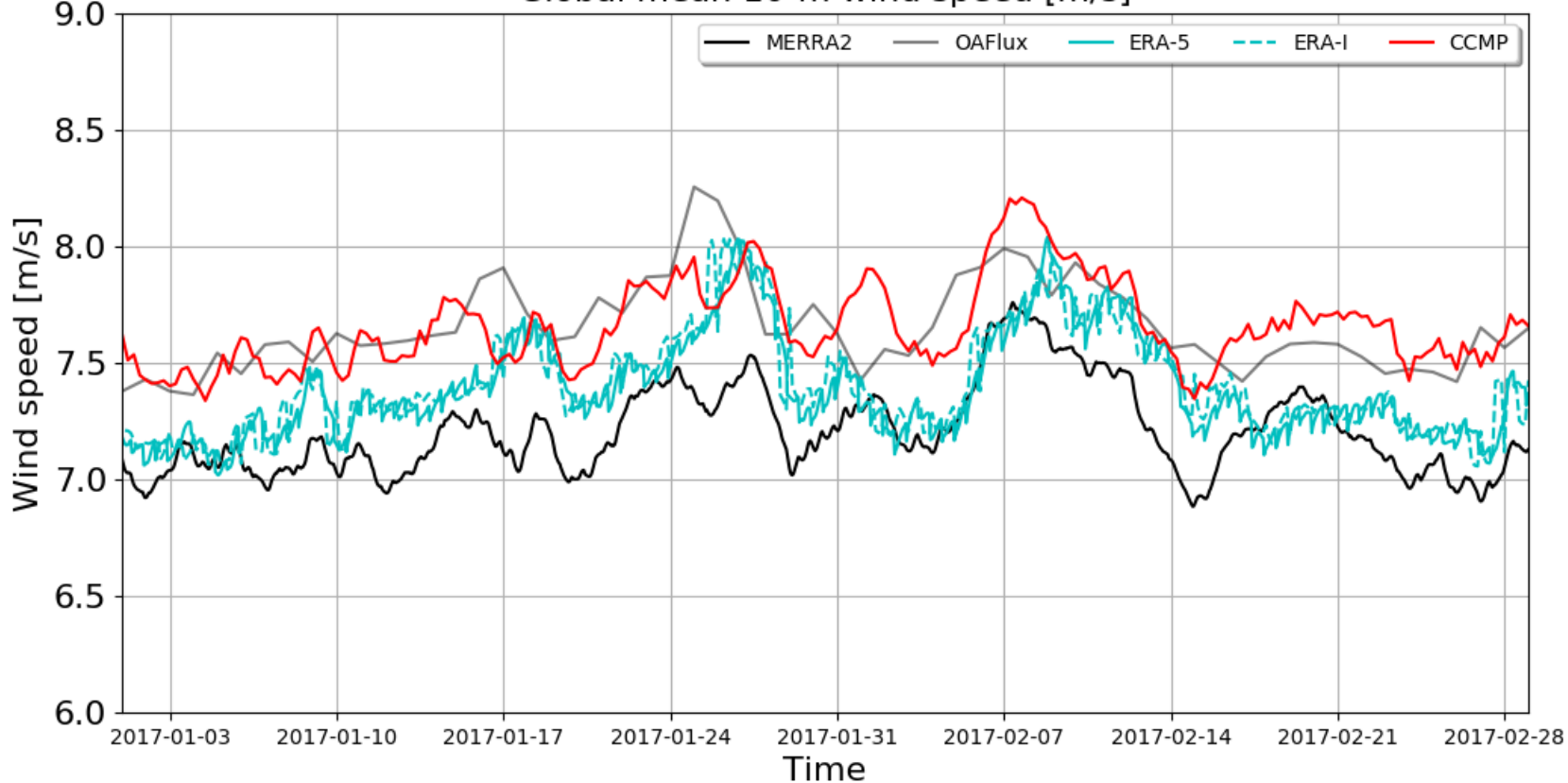
Global mean SH flux



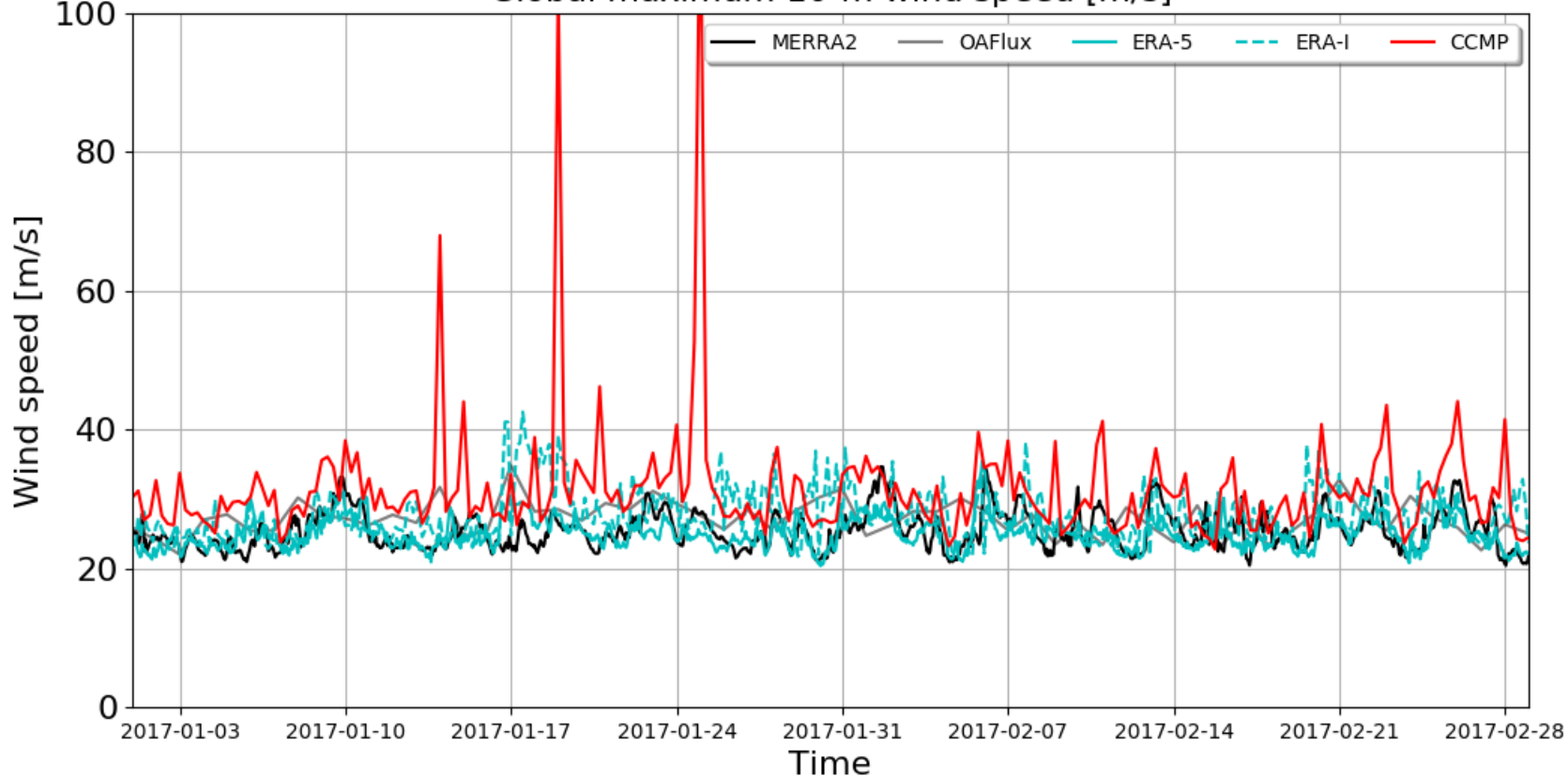
Global maximum of SH flux



Global mean 10-m wind speed [m/s]



Global maximum 10-m wind speed [m/s]



# Latent Heat Fluxes

