MODELED AIR-SEA HEAT FLUX vs IN-SITU DATA: Statistical Comparison

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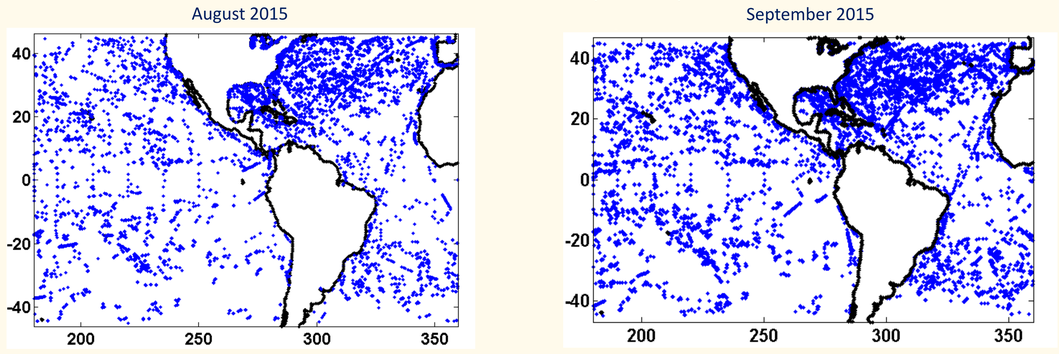
Many physical phenomena occurring at or near the ocean surface (such as upwelling, dense water formation, hurricanes, etc.) are particularly sensitive to small variations in air-sea heat flux. The parameterization of these fluxes in coupled models is then crucial to obtain accurate forecasts in both surface and subsurface events. In our case, differences in the horizontal resolution and pixel position between the NAVGEM (atmospheric) and the HYCOM (oceanic) components of the Earth System Prediction Capability System (ESPC) makes this comparison a rare challenge. Here we present a validation of global heat fluxes derived from the ESPC through a comparison with heat fluxes obtained from in-situ data during two months of 2015 as an example.

ICOADS and ESPC

We compared the ESPC-derived heat fluxes with those calculated with the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) for 2015. These sets contain individual observations of meteorological and oceanographic variables, such as wind, mean sea level pressure, surface temperature, cloudiness, etc. The ESPC fluxes used here are from a single 60-day forecast run started in July 31st.

Observations location (ICOADS)



APPROACH

We computed the normalized error and mean bias monthly average between the ESPC turbulent heat fluxes (HF) and the observations-derived fluxes for August and September, 2015. Values on the tables indicate ESPC-HF minus observations-HF differences, in W/m². Hourly bias are represented in the figures below as a function of time. Daily mean bias were also computed (not represented here).

RESULTS

LATENT HEAT FLUX

	Aug	Sep
Mbias	0.03	-0.48
NRmse	0.76	0.97
Nobs	433696	329926

Latent Heat Flux (Left)

The mean monthly bias between observations-HF and model-derived HF is slightly warm in august, and cold in September, increasing the magnitude about 10 times.

We can observe during August apparent weekly 'cycles', which are the subject of our current research. The minimum value is -4 and the maximum is 8 W/m², with a normalized average of about -0.4 W/m², an extremely low value considering that the Latent HF average is about 800 W/m². For September, the bias varies between -5 and 15 W/m². Note that the global time series are bulk values that give insight into the model-HF validity.

The heightening of bias coincides with the decrease of observations available (see below), and the normalized error lays between the limits expected.

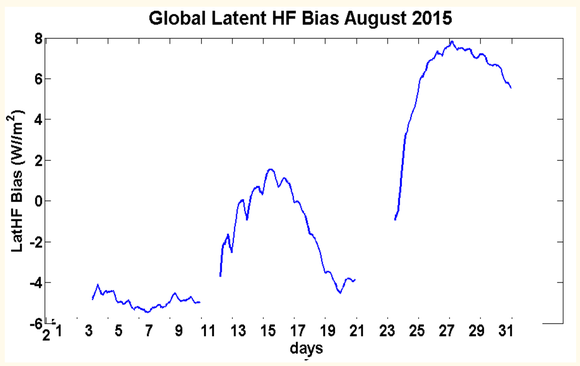
Sensible Heat flux (Right)

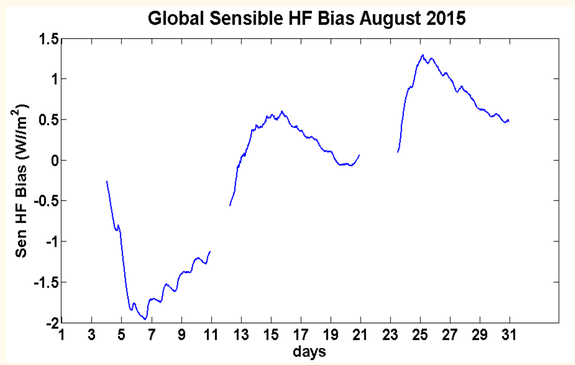
The model fluxes show a lower bias during August than September as in the previous case. However, the model slightly underestimate the sensible HF during August, and more largely overestimate it during September. In any case, the bias for September is still very reduced.

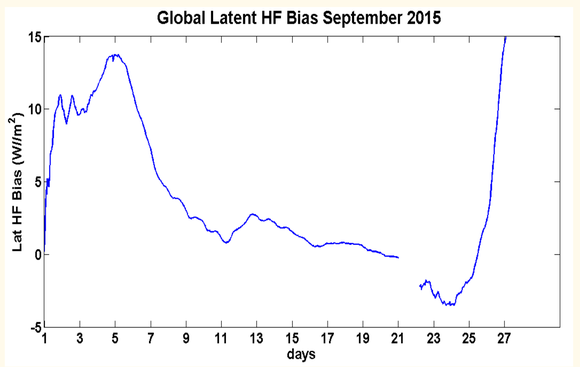
Note that the number of observations available are lower during September (see tables Nobs).

SENSIBLE HEAT FLUX

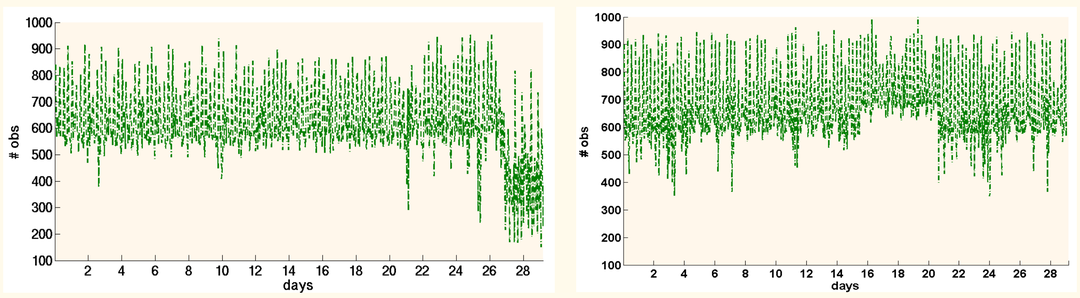
	Aug	Sep
MBias	-0.10	0.83
NRmse	0.78	0.90
Nobs	433696	329926

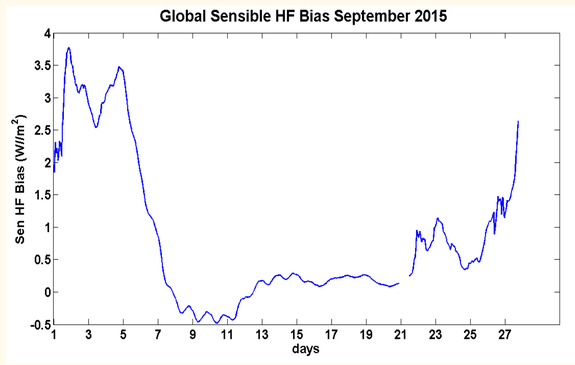






Number of observations available per hour





CONCLUSIONS

For the months analyzed, the model fluxes seem to have values between the limits indicated by in-situ observations. Previous comparisons with MERRA and NFLUX showed higher biases throughout the same period. This shows a promising starting point for the extensive tests required to arrive to a robust conclusion on the behavior of these heat fluxes.

DATA CITATION: RDA/CISL/NCAR/UCAR, PSD/ESRL/OAR/NOAA/U.S. DCCIRES/UCO, NOC/U. SOTON, Met. Off./MOD/UK, Deutscher Wetterdienst (German MS.)/Germany, DAS/UWA, COAPS/ FSU, and NCEI/NESDIS/NOAA/U.S. DOC, 2016. Updated monthly. "International Comprehensive Ocean-Atmosphere Data Set (ICOADS) Release 3, Individual Observations". RDA at NCAR CISL. https://doi.org/10.5065/D6ZS2TR3. Accessed 06/15/2017.