Validation of Heat fluxes Derived from the Earth System Prediction Capability (ESPC) Project

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OBJECTIVE

We present here a study of the air-sea heat fluxes for the global ocean during fall 2015 within the Earth System Prediction Capability (ESPC) project. In particular, we compared the ESPC-derived heat fluxes with fields derived by the Naval Research Laboratory Ocean Surface Flux (NFLUX) System, and the Modern Era Retrospective-Analysis for Research and Applications (MERRA).

Motivation

The numerical representation of physical properties and their exchange at the boundaries in circulation models are the key factors in determining the proper functioning of air-sea coupled models and in defining the accuracy of the output forecast. Given the potential applications of the ESPC coupled models, we have a strong interest in testing the ***validity of the flux exchange*** at the surface, and in particular the surface heat fluxes (HF). Here we present an example of the turbulent heat flux global variability during the transition summer-to-fall, 2015 and compare them versus two known data sets, the NFLUX and MERRA heat fluxes.

ESPC Model

Oceanic component

HYbrid Coordinate Ocean Model (HYCOM): Global circulation model with hybrid coordinates, that is, isopycnal in the open stratified ocean, terrain-following coordinates in shallow coastal regions, and z-level coordinates in the mixed layer and/or unstratified seas.

Atmospheric component

U.S. Navy Global Environmental Model (NAVGEM): High resolution weather prediction model, which provides synoptic forcing at the ocean surface in 3hs-intervals. It replaces the Navy Operational Global Atmospheric Prediction System (NOGAPS) due to improvements in its capabilities.

MEDIATOR

Interpolates between model grids and fills gaps, to and from both model components. In our case, it provides the surface variables to calculate HF with COARE3.0 .

Data

Naval Research Laboratory Ocean Surface Flux (**NFLUX**) System: is a modular system that provides all heat fluxes components, using NAVGEM forecast fields as the background and assimilating various polar-orbiting satellite streams (for details see May et al., 2017). The regular-gridded HF products have spatial resolution of 8 km, and temporal resolution of 3hs.

Modern Era Retrospective-Analysis for Research and Applications (**MERRA**): is a NASA data base (GMAO group) based on the GEOS-5 atmospheric data assimilation system. The data used here were produced hourly on a 0.5° × 0.66° grid with 72 layers and are available at the GES DISC database (http://disc.gsfc.nasa.gov/data collection/MERRA-2.html).

Approach

The COARE3.0 algorithm was applied to Mediator files, to calculate latent and sensible HF components. Monthly-averaged mean bias and RMSE distribution are shown in the figures below, and the global statistics in Table 1. The statistics are calculated hourly for ESPC-MERRA and every 3hs for ESPC-NFLUX.

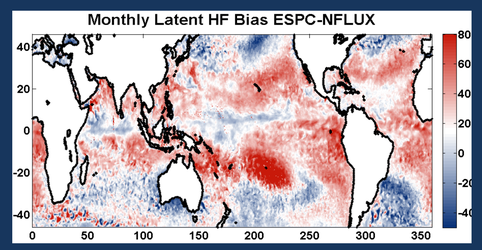
Results

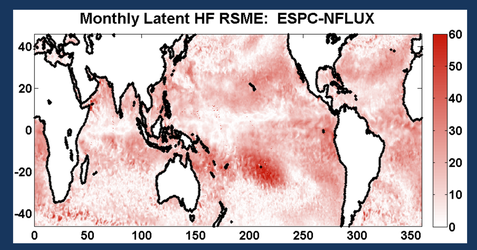
The statistical comparison with NFLUX shows minor monthly biases, < 1%, for the Latent HF and slightly higher for the Sensible HF. Bias with the MERRA reanalysis, instead, appear to be smaller and/or change sign, specially in areas of high kinetic energy (like boundary currents.)

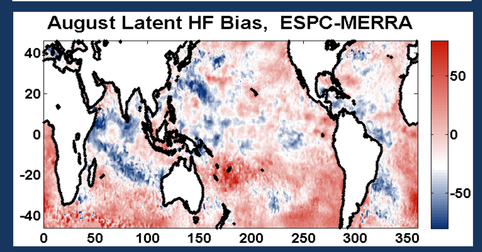
HF	MO	NFLUX		MERRA	
		B	RMSE	B	RMSE
LATENT	Aug	6.7	4.1	-4.1	1.3
	Sep	6.1	4.0	-4.0	1.2
SENSIBLE	Aug	1.9	1.2	0.9	0.3
	Sep	1.6	1.1	0.8	0.3

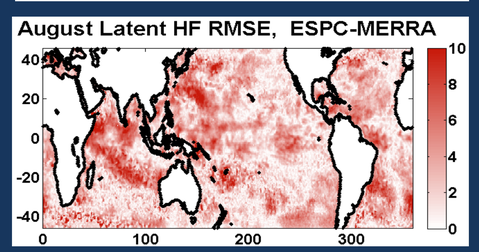
Table 1 : Bias and RMS error between data sets for Aug and Sep 2015

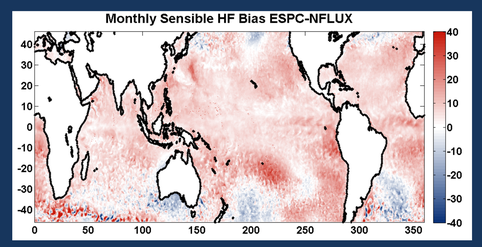
August

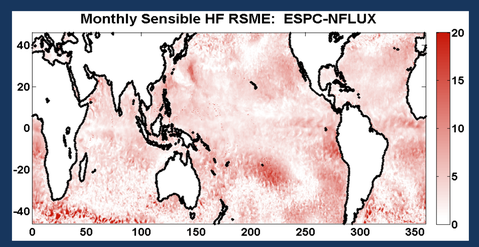


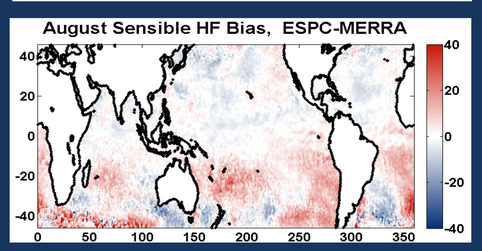


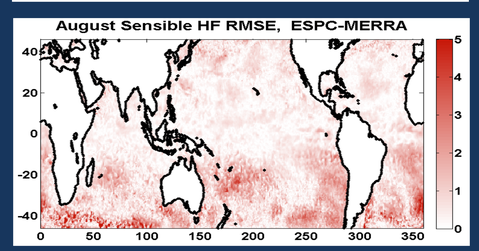












September