Tropical Pacific wind comparisons: objective FSU versus NCEP reanalysis products

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Global reanalysis projects at NCEP and ECMWF have provided the researchers investigating climate change and ocean-atmosphere modeling with uniformly assimilated data sets. The surface air-sea flux fields from reanalyses are now widely used to force models. Since air-sea fluxes play a critical role in ocean variability, quality estimates of these parameters are essential to numerical simulations of the ocean-atmosphere system. Comparing flux fields from reanalysis products to products derived from other data sources, and using different parameterizations, can provide estimates of the uncertainties in the reanalysis fields.

The Center for Ocean-Atmospheric Prediction Studies has developed and made operational a new objective procedure to create monthly mean turbulent flux fields over the ocean (Bourassa et al. 2001). The input data are all in-situ and include ships of opportunity and buoys (both moored and drifting). Buoy and ship observations are independently weighted and background fields are based on the observations. A variational method utilizes several constraints to maximize similarity to observations, minimize non-geophysical features in the spatial derivatives (e.g., the observational patterns), and accomplishes these goals with the minimum smoothing necessary. Weights are objectively determined using cross validation (Pegion et al. 2000).

Comparisons over the tropical Pacific Ocean are made between the objective FSU winds and the wind fields from the first and second NCEP reanalysis (NCEPR1 and NCEPR2 respectively). Monthly wind averages over the equatorial Pacific (11N - 11S, 122 - 290E) reveal large differences in the three products (Figure 1). When comparing long term means, the FSU winds are stronger (5.6 ms^{-1}) than either the NCEPR1 (4.1 ms^{-1}) or the NCEPR2 (4.6 ms^{-1}). The 1.5 ms^{-1} difference in means between FSU and NCEPR1 is consistent with Smith et al. (2001), in which they compared wind observations from research vessels (R/V) to the NCEPR1 and found the NCEPR1 winds in the tropics to be consistently lower (mean bias 0.7 ms^{-1}) than the R/V winds. Since the R/V winds are rarely included in the NCEPR1 and are not used in the FSU products, they provide a pseudo-independent reference for the FSU and NCEP wind fields. The difference between the NCEPR2 and FSU is smaller (1.0 ms^{-1}) than for NCEPR1 and the reduction may be due to either improvements in the data inputs to NCEPR2 or changes in the NCEPR2 flux parameterization. The authors plan to investigate the differences between the NCEPR1 and NCEPR2 parameterizations to determine what role they play in reducing the NCEP versus FSU differences.

In contrast to the monthly wind averages, the monthly standard deviation in the equatorial Pacific wind speeds are similar for the FSU and NCEP reanalyses. Long term mean standard deviations are 0.59 ms^{-1} for the FSU product and 0.54 ms^{-1} for both the NCEPR1 and NCEPR2. This implies that all three products capture a similar level of monthly wind variability, while the mean winds differ greatly for each product.

These results, though preliminary in nature, imply that improvements in near surface winds have been made in NCEPR2 for the tropical Pacific. The authors analysis will continue and will be expanded to include momentum and heat fluxes in the near future.

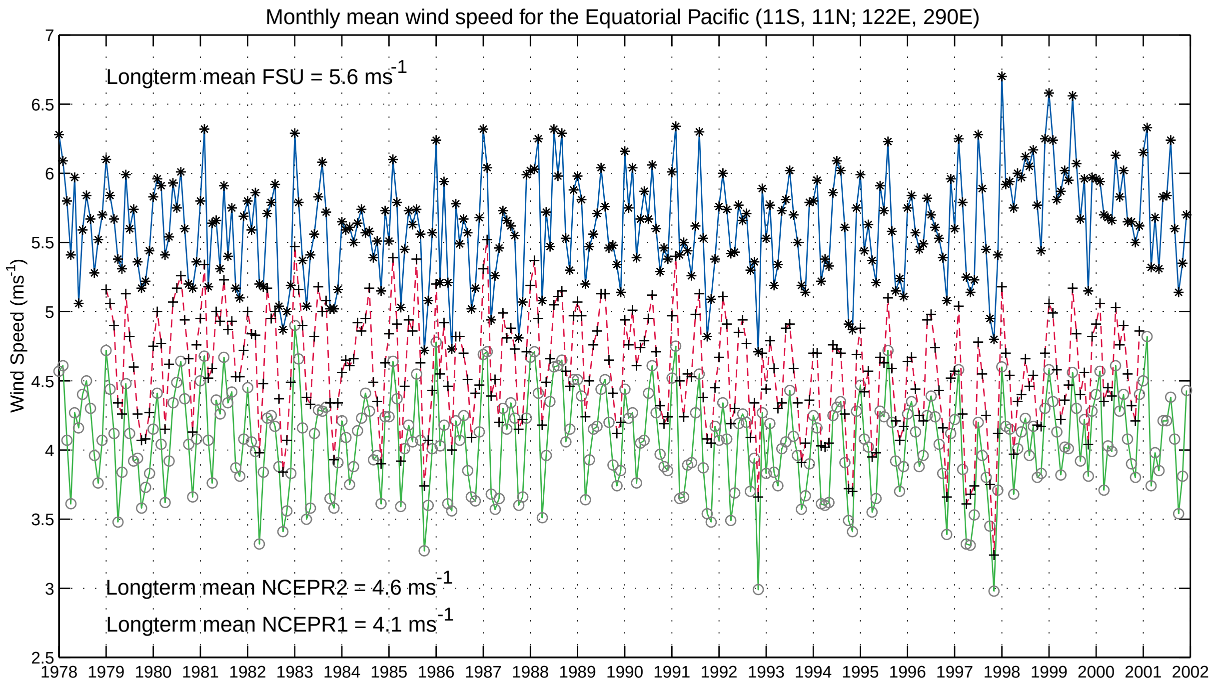

Figure 1: Monthly mean wind speed (ms^{-1}) averaged over the Equatorial Pacific from 11°S to 11°N, 122 to 290°E for the objective FSU (*, blue solid line), NCEP Reanalysis 1 (○, green solid line), and NCEP Reanalysis 2 (+, red dashed line).

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