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Title

Characterization of turbulent latent and sensible heat flux exchange between the atmosphere and ocean in MERRA

Abstract

Turbulent fluxes of heat and moisture across the atmosphere-ocean interface are fundamental components of the Earth's energy and water balance. Characterizing both the spatiotemporal variability and the fidelity of these exchanges of heat and moisture is critical to understanding the global water and energy cycle variations, quantifying atmosphere-ocean feedbacks, and improving model predictability. This study examines the veracity of the recently completed NASA Modern-Era Retrospective analysis for Research and Applications (MERRA) product with respect to its representation of the surface turbulent heat fluxes.

A validation of MERRA turbulent heat fluxes and near-surface bulk variables at local, high-resolution space and time scales is achieved by making comparisons to a large suite of direct observations. Both *in situ* and satellite-observed gridded surface heat flux estimates are employed to investigate the spatial and temporal variability of the surface fluxes with respect to their annual mean climatologies, their seasonal covariability of near-surface bulk parameters, and their representation of extremes. The impact of data assimilation on the near-surface parameters is assessed through evaluation of incremental analysis update tendencies produced by the assimilation procedure.

It is found that MERRA turbulent surface heat fluxes are relatively accurate for typical conditions but have systematically weak vertical gradients in moisture and temperature and have a weaker covariability between the near-surface gradients and wind speed than found in observations. This results in an underestimate of the surface latent and sensible heat fluxes over the western boundary current and storm track regions. The assimilation of observations mostly acts to bring MERRA closer to observational products by increasing moisture and temperature near the surface and decreasing the near-surface wind speeds. The major patterns of spatial and temporal variability of the turbulent heat fluxes produced by MERRA compare favorably to observationally based estimates. However, MERRA is distinct in terms of amplitude. These results suggest that MERRA is likely to be a valuable resource for a number of research applications though, as with all turbulent flux estimates, systematic issues should be taken into account.