Why do oceanic heat flux estimates over the Atlantic Ocean differ?

T. Santorelli, A. Bentamy (2), J. Carton (1), W. Drennan(3), S. Grodsky (1),
A. Mestas-Nuñez (4), K. Katsaros (3), R. T. Pinker (1)

1. Department of Atmospheric and Oceanic, University of Maryland, College Park, MD 20742
2. Institut Francais de Recherche pour l'Exploitation de la Mer (IFREMER), France.
3. RSMAS/University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149
4. Department of Physical & Environmental Sciences, Texas A&M University-Corpus Christi, Corpus Christi, TX 78412-5869

Abstract

We explore why oceanic heat flux estimates differ by conducting an indepth evaluation of two recent global products (from the Woods Hole Oceanographic Institution (WHOI) and from the French Research Institute for Exploitation of the Sea (IFREMER)). One is based on a combination of inputs from assimilation of buoy and ship data and model analyses and the other on satellite observations. The objective of the present study is to understand the reasons for existing differences so that future flux estimates can be reconciled. The focus is on the Atlantic sector (70W-30E, 45S-45N) during 1996-2005 and on the annual, seasonal and monthly mean differences in latent and sensible heat fluxes. The parameters that enter the bulk formulae for computing these fluxes, including wind speed, sea surface and air temperature, and specific humidity are also evaluated. Where possible, each component is compared to independent "ground truth" such as buoy observations. It was found that over the basin except in the Gulf Stream region and poleward of 30S, IFREMER turbulent fluxes are larger than those from WHOI. It is shown that the differences in latent heat flux estimates are likely due to differences in specific humidity while differences in sensible heat fluxes are likely due to differences in air temperature. When the products are compared to the Prediction and Research Moored Array in the Atlantic (PIRATA) buoys, both flux components for the two products exhibit a positive bias. It was found that air temperature and specific air humidity used by IFREMER and WHOI were negatively biased when compared to buoy data, and wind speeds from both analyses were positively biased, more so for WHOI. When using buoy observations from the FETCH Experiment which are independent from PIRATA, the WHOI latent and sensible heat fluxes were both negatively biased, likely due to a negative bias in wind speed and sea surface temperature, respectively. IFREMER latent heat fluxes also exhibited a negative bias due to a positive bias in specific humidity. IFREMER sensible heat fluxes were positively biased due to a negative bias in air temperature.