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New approach for the development of global fields of air-sea turbulent fluxes based on probability distributions

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One of the major problems of the development of surface flux fields is a sampling problem which inhomogeneously affects different ocean areas. Direct averaging of flux-related variables and fluxes for the further development of climatological fields results in sampling biases, which are quite large in the areas of poor sampling and high synoptic variability of fluxes. In this study we suggest a new approach for the development of flux climatologies. This approach is based on the use of probability density functions for the averaging of fluxes within particular boxes and time periods (e.g. months, seasons). We developed a new probability density function (PDF), which belongs to the family of the so-called double-exponential distributions and is very effective for the description of the distributions of turbulent fluxes of sensible and latent heat. This PDF allows to explicitly account for the extreme flux values and synoptic variance even if the sampling is poor. Moreover, application of this method to the relatively large areas helps to quantify the energy balances of different ocean basins. We use in our analysis voluntary observing ship (VOS) data form ICOADS (International Comprehensive Ocean-Atmosphere Data Set) and different reanalyses (ERA-40 and NCEP/NCAR) for the period from 1948 to 2004. On the basis of different data we build up double-exponential PDFs for the 2-degree boxes and derive new climatological flux fields and their variability. Our estimates are very close to the widely used climatologies (e.g. SOC) in well sampled regions, but exhibit significant differences in the areas of poor sampling, showing more realistic climatological values, less affected by the sampling problem. Different applications of the method proposed are presented. In particular, we show the possibility of its use for the derivation of variability patterns and the reduction of the imbalances associated with sampling uncertainties in highly variable ocean regions.