Sampling errors in VOS-based sea-air flux climatologies: impact on climate means and variability patterns

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Analysis of sampling errors in the global fields of sea-air turbulent and radiative heat fluxes and flux-related parameters is performed using VOS (Voluntary Observing Ship) observations from COADS (Comprehensive Ocean-Atmosphere Data Set) and NCEP/NCAR Reanalysis for the period from 1948 to 2000. In order to estimate sampling errors, we simulated VOS-like sampling density in the 6-hourly NCEP/NCAR Reanalysis flux data. Random simulation accounts for the so-called random representativeness errors in flux fields. Simulation, which takes into account the actual time of VOS observations, allows also for estimation of the fair-weather biases in flux fields. Global maps of different sampling errors are presented for flux-related individual quantities and different flux components. The largest climatological effect is observed in poorly sampled subpolar areas of the North Atlantic and North Pacific and in the Southern Ocean. Locally high time-dependent sampling uncertainties ranging from 50 to 200 W/m^2 are observed in Labrador Sea and some other regions. They may seriously affect long-term variability patterns in the flux fields. Impact of sampling on climate variability is quantified using EOF analysis of fluxes, derived from VOS and Reanalyses. Finally, a simple procedure is proposed to minimize the impact of sampling onto climate variability characteristics. This procedure can be effectively used for estimation of the area-integrated fluxes for relatively large areas.