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Establishing more truth in space-time integration of surface turbulent heat fluxes

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Space-time integration of surface turbulent heat fluxes is important for obtaining area-averaged budget estimates and for producing climatologies of surface fluxes. Uncertainty of the integration or averaging of fluxes in space and in time are especially high when the data are sparse as in the case of the use of information from Voluntary Observing Ships (VOS) which are characterized by inhomogeneous sampling density in contrast to NWP products and satellite data sets. In order to minimize sampling impact onto local and larger scale surface flux averages we suggest an approach based upon analysis of surface fluxes in the coordinates of steering parameters (vertical surface temperature and humidity gradients on one hand and wind speed on the other). These variables are distributed according to the Modified Fisher-Tippett (MFT) distribution (temperature and humidity gradients) and Weibull distribution (wind speed) which imply a 2-dimentional distribution for the fluxes. Since the fluxes in these coordinates are determined in a unique manner (within a chosen bulk transfer algorithm), they can be easily integrated in the space of 2-dimentional distribution in order to get the averaged values dependent on the parameters of the MFT and Weibull distributions. Conceptually, the approach is similar to that oceanographers apply for analysing volumetric T,S-diagrams of water mass properties. We developed an algorithm for applying this approach and also provided the analysis of integrated surface fluxes for different regions of the North Atlantic for which heat flux estimates can be obtained from oceanographic cross-sections. Analysis was performed for the last 5 decades. 2-dimensitonal diagrams also make it possible to analyse temporal variability of integrated surface fluxes in the dimension of steering parameters and to further compare estimates with changes in the ocean heat content.