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Characterization of extreme air-sea turbulent fluxes

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Extreme ocean-atmosphere turbulent fluxes play a critical role in the convective processes in the mid and subpolar latitudes and may also affect a variety of atmospheric processes, such as generation and re-intensification of extreme cyclones in the areas of the mid latitude storm tracks. From the ocean dynamics perspective, specifically for quantifying extreme vertical mixing, characterization of the extreme fluxes requires, besides estimation of the extreme events, also consideration of the relative extremeness of surface fluxes and their timing, e.g. the duration of periods of high surface fluxes. In order to comprehensively characterize extreme turbulent fluxes at sea surface we propose a formalism based upon probability density distributions of surface turbulent fluxes and flux-related variables. Individual absolute flux extremes were derived using Modified Fisher-Tippett (MFT) distribution of turbulent fluxes. Then, we extend this distribution to the fractional distribution, characterizing the fraction of time-integrated turbulent heat flux provided by the fluxes exceeding a given percentile. Finally, we consider the time durations during which fluxes of a given intensity provide extreme accumulations of heat loss from the surface. For estimation of these characteristics of surface fluxes we use fluxes recomputed from the state variables available from modern era reanalyses (ERA-Interim, MERRA and CFSR) for the period from 1979 onwards. Applications of the formalism to the VOS (Voluntary Observing Ship) – based surface fluxes are also considered. We discuss application of the new metrics of mesoscale and synoptic variability of surface fluxes to the dynamics of mixed layer depth in the North Atlantic.