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Association of synoptic variability in surface turbulent fluxes with cyclone characteristics in the Northern hemisphere midlatitudes

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Surface turbulent heat fluxes are primarily responsible for variability of surface ocean heat budget on synoptic and interannual scales. On synoptic time scale they are highly variable in time ranging from hundreds to thousands W/m2. This variability is primarily driven by variations of near surface atmospheric characteristics controlled in midlatitudes by atmospheric cyclones. We focus on understanding the mechanisms of synoptic variability of surface turbulent fluxes and particularly on the origins of extreme turbulent fluxes and their further impact on the atmospheric and oceanic dynamics. The main questions addressed in this study are (i) what are the large scale atmospheric conditions associated with extreme ocean surface fluxes and to what extent they are related to cyclones, (ii) what is the role of extreme surface fluxes in the variability of oceanic heat content, and (iii) which characteristics of atmospheric cyclones are most sensitive to the surface ocean flux signals? To answer these questions, we analyse statistical characteristics of surface turbulent heat fluxes and cyclone characteristics over the midlatitudinal North Atlantic and North Pacific. Further we investigate links of cyclones and surface fluxes with each other focusing on cyclone life cycle characteristics such as deepening rates, propagation velocities, life time and clustering. We derived characteristics of the extreme surface fluxes from the empirical probability distributions of surface fluxes from the NCEP-CFSR reanalysis for the period 1979-onwards. Cyclone tracking for the same period has been performed using state of the art numerical tracking algorithm applied to the reanalysis SLP at 6-hourly resolution. We argue that the presence of the high pressure system following to the rare part of propagating cyclone is a critical condition for the formation of extreme surface ocean fluxes which are associated with the cyclone-anticyclone interaction zone rather than with cyclone per se. We also demonstrate that the fraction of oceanic heat loss due to extreme fluxes linked to the atmospheric circulation characteristics. This fraction is highly variable over the ocean and can be locally as large as 50%. We also show that considerable part of extreme surface flux cases is associated with cyclone generation stage. For instance, over the Gulf Stream more than 60% of cyclogenesis events were associated with extreme surface fluxes.