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Impacts of mesoscale SST anomalies on atmospheric mid-latitude storms

Riwal Plougonven (1), Guillaume Lapeyre (2), and Xavier Perrot (2)

(1) Ecole Polytechnique, Laboratoire de Meteorologie Dynamique / IPSL, Palaiseau, France, (2) Ecole Normale Supérieure, Laboratoire de Meteorologie Dynamique / IPSL, Paris, France

Idealized simulations of a mid-latitude storm track are investigated to quantify the atmospheric response (heat and moisture fluxes, surface winds) to mesoscale SST anomalies.

Analysis of satellite observations have revealed, in the past decade, that surface winds over the ocean exhibit spatial variations that are strongly correlated to underlying SST anomalies. Two different mechanisms have been proposed to explain how the SST influences the Marine Atmospheric Boundary Layer: the momentum mixing mechanism (emphasizing cross-wind SST gradients), and the pressure adjustment mechanism (emphasizing the Laplacian of the SST, and hence smaller scales). Complementary work (Perrot et al) shows that the atmospheric response transitions from the latter response in the case of weak winds to the former in the case of stronger winds.

In the present study we investigate the impacts of the SST anomalies on a mid-latitude storm-track. Specific questions include the mechanisms for atmospheric response in different regions of the flow, and the depth of the influence of the SST anomalies :

- how much does the spatial organisation of the SST anomalies constrain the fluxes from the ocean to the atmosphere?
- how are the spatial patterns of surface winds correlated to those of the SST anomalies, in regions of strong winds and in regions of weak winds?
- does the influence of the SST anomalies reach beyond the Boundary Layer, ie is their impact visible in the free troposphere? Can they influence (at least sporadically) developping storms?

Simulations of an idealized storm track in aquaplanet configuration are carried out with the Weather Research and Forecast Model, in a zonally periodic channel with two different underlying SST spatial organisation. A reference simulation consists in a zonally uniform SST field with a smooth meridional gradient whereas an "eddying" version additionally includes typical mesoscale (200km) SST anomalies.

It is found that mesoscale SST anomalies organize much of the lower level flow, in particular the sensible and latent heat surface fluxes. They also influence the amplitude of precipitations and part of the tropospheric flow, such as the Eliasen-Palm fluxes. Sensitivity to choices of parameterizations, in particular for moist processes, and to resolution will be discussed.