Atmospheric response to sea surface temperature mesoscale structures

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Recent studies have revealed that strong Sea Surface Temperature (SST) fronts, on the scale of a Western Boundary Current, significantly affect not just the Marine Boundary Layer but the entire troposphere. This has aroused renewed interest in air-sea interactions. The present study investigates the atmospheric response to fixed SST anomalies associated with mesoscale oceanic eddies and submesoscales filaments, using idealized simulations. Our main result is that in weak wind conditions, the vertical velocity in the planetary boundary layer (PBL) is linearly proportional to the SST Laplacian, in agreement with the 'pressure adjustment' mechanism. This is established by a quantitative analysis in the spatial space as well as in the spectral space. Comparing the responses to two different SST fields shows that vertical velocities are much more intense when the submesoscales are more energetic. These results hold for different configurations of the atmospheric large scale state and for different PBL parameterizations. To our knowledge, this study is the first to clearly reveal the high impact of submesoscales on the atmospheric boundary layer at midlatitudes, as well as the direct link between the vertical velocity and the SST Laplacian.

In parallel to these simulations investigating the atmospheric response to SST anomalies on small-scales and short timescales, simulations are being set up in a larger domain and including moisture in order to study the impact of meso- and submesoscale anomalies on the storm-tracks. Preliminary results on this ongoing work and perspectives will be discussed.

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