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Planetary boundary layer response to surface temperature anomalies forcing

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Recent studies showed that strong sea surface temperature (SST) fronts, on the scale of the western boundary currents, strongly affect the planetary boundary layer (PBL) but also all the troposphere. This renewed the interest of air-sea interactions at oceanic meso-scales. Mainly two mechanisms are proposed in the literature, the first one (due to Wallace et al 1989) is based on the destabilization of the PBL above SST anomalies, the second one (Lindzen and Nigam 1987) is based on the pressure anomalies linked to the atmosphere temperature adjustment to the SST. These two mechanisms predict different responses of the PBL to the SST.

We did numerical simulations with a meso-scale atmospheric model (WRF) with the same configuration as the one described in Lambert et al 2013. The model is forced by a SST anomaly which is first a zonally or meridionally constant field and secondly a field of meso-scale structures. Firstly we studied the influence of the initial wind strength on the PBL response for the two different types of SST anomalies. We showed that the dominant mechanism can change according to weak or strong wind and to the orientation of the SST anomaly. Secondly after considering a dry atmosphere we switched on the humidity in our configuration. We studied how it influences the PBL response and whether the mechanism driving the PBL response is still the same as in the dry case.