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An energetic study of Northern hemisphere storm-tracks under 4xCO2 conditions in two ocean-atmosphere coupled models

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We consider different possible behaviours of the northern hemisphere storm-tracks under 4xCO2 forcing by analysing the response of two of the ocean-atmosphere coupled models participating to the fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-AR4), namely IPSL-CM4 and CNRM-CM3. These models are interesting to compare due to their very different responses, especially concerning the North Atlantic storm-track.

We perform a complete local energetic study of the synoptic variability in both models, derived from the eddy energy equations in a quasigeostrophic framework, including diabatic terms. The ability of both models to simulate the present-day eddy energetics is considered, indicating no major discrepancies.

Both models indicate that the primary cause for synoptic activity changes at the western end of the storm-tracks is related to baroclinic conversion process, due to mean temperature gradient changes in some localized regions of the western oceanic basins but also resulting from changes in the eddy efficiency to convert energy from the mean flow. Farther downstream, latent heat release during the mature stage of perturbations becomes the dominant eddy energy source in terms of absolute values and anomalies. This diabatic process amplifies the upstream synoptic (hence usually baroclinic) anomalies, more and/or stronger storms implying more latent heat being released (and

inversely for weaker synoptic activity). This amplification

is asymmetrical under the simulated 4xCO2 conditions, due to a greater amount of water vapour contained in warmer air and hence potentially condensated for a given synoptic activity. Negative diabatic anomalies are attenuated, whereas positive anomalies are enhanced.