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A prominent role for the low latitude oceans in sustaining carbon-climate feedbacks under future climate change

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The ocean is the principal integrator in the climate system on multi-decadal to centennial timescales, modulating anthropogenic climate change by absorbing approximately 30% of anthropogenic carbon (Cant) emissions. Under global warming, coupled climate model simulations and theoretical arguments indicate that the capacity of the ocean to absorb Cant will be reduced relative to what would be absorbed for an unperturbed physical state of the ocean, with this constituting a positive ocean carbon-climate feedback. Recent studies emphasize the importance of the North Atlantic and/or the Southern Ocean in sustaining such feedbacks.

Here we use a suite of simulations with an Earth system model (GFDL's ESM2M) under a “business-as-usual” (historical/RCP8.5) concentration pathway for 21st century climate projections to test the hypothesis that the coupling of heat and carbon in surface waters of the low-latitude shallow overturning circulation structures plays a first-order role in sustaining global ocean carbon-climate feedbacks. In particular, we use a new set of model runs with ESM2M that exploit the "data override" feature in ESM2M to tease out the direct versus direct effects of the invasion of anthropogenic heat perturbations by isolating the impact of surface warming on the carbonate buffering capacity of seawater. Our preliminary findings indicate that perturbations to the carbonate buffering capacity of seawater do in fact offer a first-order contribution to ocean carbon-climate feedbacks over the low latitudes. This stands in contrast to the drivers of carbon-climate feedbacks over the high latitudes, which tend to be driven by ocean circulation changes perturbing the natural carbon cycle.