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Is the Eocene's climate affected by ocean tides?

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Global ocean models can generally be divided into Ocean General Circulation and tidal models. Paleoclimate simulations consider dynamics due to the ocean's general, i.e. thermohaline, wind and pressure driven circulation, while tidal dynamics most commonly are neglected due to their strict periodicity and high frequencies. Nevertheless, it could be demonstrated that transport ellipses and energy fluxes are being deformed over shelf areas due to tidal induced friction thus altering ocean circulation and energy fluxes on longer timescales. This makes tides not only an interesting subject of investigation of present-day dynamics, but also of paleo time slices, when both different celestial constellations and geometric shapes of ocean basins affected tidal waves.

Using the coupled atmosphere-ocean general circulation model ECHAM5/MPIOM with an integrated tidal module based on luni-solar ephemerides, we simultaneously simulate circulation and tidal dynamics for the Early Eocene (50Ma) and a pre-industrial control run. Major changes in ocean circulation cannot only be observed in shelf areas, but also in the open ocean, for example the Indian and North Atlantic Oceans. Especially the opening of the Tethys Sea alters ocean basin geometry and hereby the dissipation of tidal waves. The southern position of Australia allows resonance between the Indian and Pacific Ocean and leads to high amplitudes in the M2 tide that dominate the Western Pacific and Eastern Indian Oceans. Including tidal dynamics in the ocean model also affects climate by decreasing global mean temperature.