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## A process model for Deep-ocean exoplanet long-term evolution

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Ocean planets with deep oceans may have ocean bottom pressures of 1-3 GPa (Léger et al. (2004), Küchner et al. (2003)), with ice floors rather than rock. In addition, such planets can have double-diffusivly convective regimes, inhibiting heat transport vertically similar to Vance and Brown (2005).

An EOS has been developed for oceans under high pressure (to 5 GPa), with high  $CO_2$  and CH4 molalities due to dense atmospheres. This is then used in a process model to study the long-term evolution of ocean thermal gradients due to heating and cooling, and ocean heat transport.

An ocean of up to 2 mol/L salts with a surface temperature 0-100  $^{\circ}$ C is modelled. In the absence of simple convection, the heat and salinity in the lower part of the ocean may rise leading to the ocean deepening as the ice floor melts downwards.

Looking at the case of super Earths around M-dwarf stars, tidal locking results with heating and cooling of the ocean in sub- and anti-stellar hemispheres respectively. A long-term box model over several hundred-thousand year timescales demonstrates multiple climate states develop.