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Simulating Late Ordovician deep ocean O_2 with an earth system climate model. Preliminary results.

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The geological record provides several lines of evidence that point to the occurrence of widespread and long lasting deep ocean anoxia during the Late Ordovician, between about 460-440 million years ago (ma). While a series of potential causes have been proposed, there is still large uncertainty regarding how the low oxygen levels came about. Here we use the University of Victoria Earth System Climate Model (UVic ESCM) with Late Ordovician paleogeography to verify the impacts of paleogeography, bottom topography, nutrient loading and cycling and atmospheric concentrations of O_2 and CO_2 on deep ocean oxygen concentration during the period of interest. Preliminary results so far are based on 10 simulations (some still ongoing) covering the following parameter space: CO_2 concentrations of 2240 to 3780 ppmv ($\sim$8x to 13x pre-industrial), atmospheric O_2 ranging from 8% to 12% per volume, oceanic PO4 and NO_3 loading from present day to double present day, reductions in wind speed of 50% and 30% (winds are provided as a boundary condition in the UVic ESCM). For most simulations the deep ocean remains well ventilated. While simulations with higher CO_2, lower atmospheric O_2 and greater nutrient loading generate lower oxygen concentration in the deep ocean, bottom anoxia – here defined as concentrations <10 μmol L-1 – in these cases is restricted to the high-latitue northern hemisphere. Further simulations will address the impact of greater nutrient loads and bottom topography on deep ocean oxygen concentrations.