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Simulating physical and biogeochemical dynamics of the Arctic Ocean (w21_arcticbgc)

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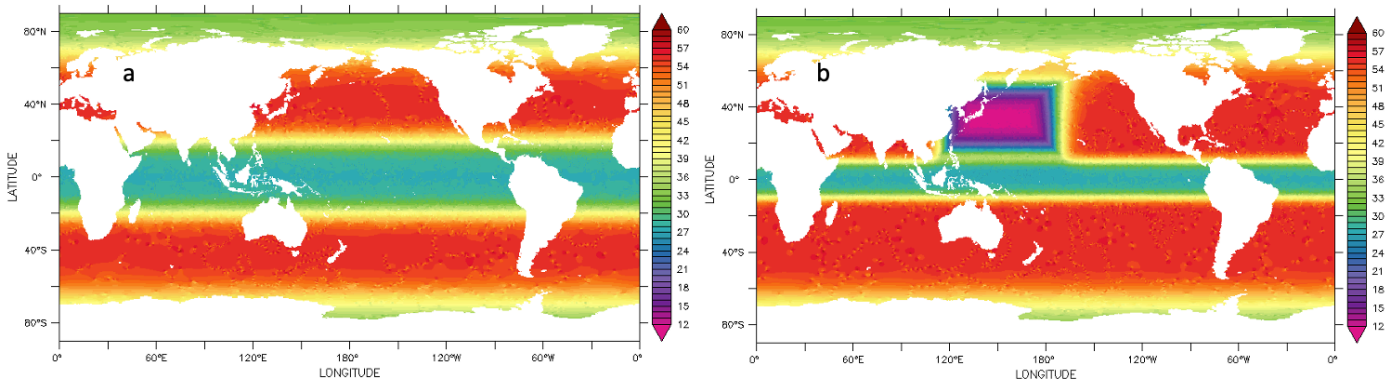
- Ocean physics (currents, mixing, air-sea transfer of heat and gases) and biogeochemistry (carbon and oxygen cycles, ecosystem dynamics, nutrient distributions) are tightly coupled.

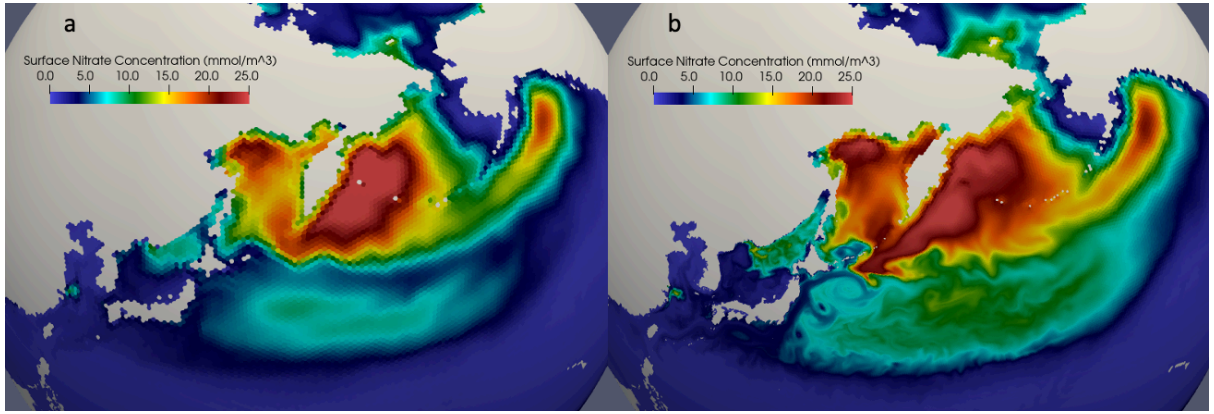
- We used the DOE-developed Energy Exascale Earth System Model (E3SM) to simulate physical and biogeochemical dynamics of the global ocean, with an emphasis on the western North Pacific.

- In particular, we used the grid refinement capability of E3SM's ocean component (LANL-developed MPAS-Ocean) to quantify the effect of model resolution on the carbon and oxygen cycles using a pair of century-long simulations that differ only in the western North Pacific grid.

- Regional grid refinement has a noticeable impact on biogeochemistry. Distribution of important nutrients (such as nitrate) changes the amount of photosynthesis by phytoplankton, which in turn affects air-sea transfer of CO2 and the local carbon cycle.



Cell-averaged grid length (km) of (a) the standard mesh and (b) the Kuroshio-focused mesh showing enhanced resolution (minimum of 12 km) resolution in the North Pacific



Surface NO_3 concentration (mmol/m^3) at the same model time for (a) the standard mesh and (b) the Kuroshio-focused mesh. The size of the grid cells can be seen in the coarse resolution regions of both grids.

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