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## BIOPERIANT12, a regional high-resolution model configuration towards developing the South African VrESM Earth System Model

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In understanding and predicting a changing global climate system, the representation of ocean-biogeochemistry processes in the Southern Ocean is particularly important because of the key role it plays in global carbon-climate feedbacks. To date, Earth System Models (ESMs) do not adequately resolve important ocean dynamics (e.g., mesoscale processes), features that are critical in Southern Ocean heat and CO<sub>2</sub> fluxes and storage. Therefore high resolution ocean biogeochemical models provide essential constraints to the medium resolution (100km) global ESMs.

The South African ESM, VrESM, comprises of globally coupled atmosphere, ocean, ice, land-surface, atmospheric chemistry, and ocean-biogeochemistry models. Building and running the ESM is therefore a huge task: both scientifically and computationally. Several numerical models, each discretized on a global grid need to be integrated in space and time, while additionally passing information to each other. As part of a multi-institution and multi-year goal of building South Africa's first Earth System Model, which will be run at the CHPC, we have been developing the ocean-biogeochemistry component of the VrESM (PISCES-SOCCO). BIOPERIANT12 is a critical platform in this development.

We present the NEMO v3.4 regional model configuration BIOPERIANT12, our most computationally-challenging model to date and run on CHPC's Lengau cluster. BIOPERIANT12 simulates ocean, ice, biogeochemistry of the circumpolar Southern Ocean (south of 30°S) from 1989 to 2009, prescribed by ERA-interim atmospheric forcing. BIOPERIANT12 is high resolution at a mesoscale-resolving 8 km in the horizontal and in the vertical: ranges from 6 m resolution at the surface to 250 m at the ocean bottom over 46 vertical levels.

In addition to the technical aspect of developing the PISCES-SOCCO source code for VrESM, we have to configure VrESM for an improved representation of the Southern Ocean. BIOPERIANT12, thus serves in multiple ways: (1) as a comparison for ocean biogeochemistry in the ESM, (2) as a large test case for ocean-biogeochemical evaluation metrics for the ESM, (3) as an experimental platform for understanding processes which influence atmosphere-ocean carbon exchange in the Southern Ocean, which additionally helps improve the ESM. We discuss PISCES-SOCCO development progress as well as the building and evaluation of BIOPERIANT12.

### Supported Student

**Primary authors:** Dr CHANG, Nicolette (Ocean Systems and Climate, CSIR); Prof. ENGELBRECHT, Francois (Global Change Institute, WITS ); Dr NICHOLSON, Sarah-Anne (Ocean Systems and Climate, CSIR); Dr DU PLESSIS, Marcel (Ocean Systems and Climate, CSIR; UCT); Dr LEBÉHOT, Alice (Ocean Systems and Climate, CSIR; UCT); Dr MONTEIRO, Pedro M.S. (Ocean Systems and Climate, CSIR)

**Presenter:** Dr CHANG, Nicolette (Ocean Systems and Climate, CSIR)

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