Exploring Southern Ocean ecosystem change through the use of a statistical sea ice emulator

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The development end-to-end (E2E) models for Southern Ocean ecosystems has become a priority in order to evaluate the potential impacts of climate change in the region. These models aim to satisfactorily include all ecosystem processes, from interactions of top predators to the physical environment. A key driver of change in these models is the projected changes to sea ice cover. Effective modelling of all changes to sea ice cover that are relevant for ecosystem function is an essential component of any Southern Ocean end-to-end ecosystem model.

The interaction between sea ice and Southern Ocean ecosystems is complex (Massom and Stammerjohn, 2010). Most obviously the timing of the seasonal advance and retreat of the pack, as well as the overall areal-extent plays a major role in controlling biological and biogeochemical variability. However other crucial factors include concentration, ice and snow cover properties, floe-size, ice-type distribution, drift and degree of deformation. Also, the ice-edge is rarely a clear-cut boundary; instead a diffuse zone of mixed ice and water, dominated by wave-ice interaction usually exists.

Ocean models used for climate runs typically estimate ice thickness and percentage cover. This is insufficient information with which to model the full range of ecosystem responses to changing sea ice cover. One-dimensional sea ice models have been developed that incorporate more complicated interactions between sea ice and biological processes (Saenz *et al*. 2012, Vancoppenolle *et al.* 2012), but these models are limited to providing information on primary production in the ice and are of limited use for capturing features that are important in a habitat context for zooplankton or higher trophic levels.

If we are to investigate regional-scale changes to ecosystem function of the Southern Ocean under climate change scenarios then a more complete representation of the status of sea ice needs to be developed (Massom *et al.* 2006). The development of a statistical sea ice emulator that combines satellite observations (or climate model output) with *in situ* observations is one method of improving this situation. This emulator could provide insight into changes to primary productivity, but also the productivity of higher trophic levels that are also dependent on sea ice. This presentation outlines the development of such an emulator.

References

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