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Real time forecasting of the ecosystem dynamics during the CROZEX experiment and the roles of the light, iron, silicate and circulation

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Real time coupled physical and biological forecasting was conducted prior to and during the CROZEX (CROZet natural bloom and Export experiment) program in Southern Ocean between November 2004 and January 2005. The program was aimed at investigating, through both measurements and modelling, the origin and fate of an intense and long lasting phytoplankton bloom that was unusual for the otherwise high-nutrient low-chlorophyll conditions that characterise the Southern Ocean.

Regular 14 day forecasts and reanalysis of the biogeochemical fields were issued on a weekly basis using a 3D primitive equation model coupled with an 11 component ecosystem model, along with assimilation of the remotely sensed and in situ data. A final reanalysis run covered the period from the start of the bloom at the end of winter convection at the beginning of September until the decline of the bloom at the end of January. This run indicated that the complex interplay between light, iron and silicate limitations on primary production, and grazing control, determined the spatial extent and dynamics of the phytoplankton bloom. The model indicated that natural fertilisation of the area by dissolved iron was insufficient on its own to initiate a phytoplankton bloom. The persistence of deep mixing in the southern part of the iron-enriched waters was delaying or in some areas preventing the development of the phytoplankton bloom.

The real time modelling assisted not only in optimisation of the cruise strategy, but also provided an ongoing synthesis of observations and test of the working hypotheses proposed to explain the bloom dynamics of the study area.