



Atmospheric response to a realistic coastal polynya in Terra Nova Bay (Antarctica) simulated by ETA model.

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Coastal polynyas are areas of open water (and/or very thin ice) which form adjacent to coasts or blocking feature in polar regions during the wintertime, when the sea water is expected to be ice covered. They are thought to be maintained by strong offshore winds blowing over these area and/or by ocean currents. Sea ice is removed as it forms and drifted offshore. In polynya areas a direct contact is established between the relatively warm sea water and the cold, dry atmosphere. As a consequence, the physical characteristics of the atmospheric boundary layer change.

The work presented here concerns a real polynya event in the region of Terra Nova Bay (TNB), Antarctica, where a recurring coastal polynya occurs nearby the Italian Antarctic Base. The aim is the study of atmospheric response to the presence of a open water area of realistic size by three-dimensional numerical simulations. Atmospheric numerical modelling is a fundamental tool for the study of air - polynya interactions in the remote polar regions, where observational data are difficult. The numerical model used for the simulations is a recent version of ETA model (Mesinger et al., 2006), with the addition of a piecewise linear advection for the wind field. ECMWF and NCEP data provided the initial and boundary conditions. A previous version of the model had already been successfully used in the Antarctic area (De Carolis et al, 2006, Casini and Morelli, 2007).

As a first step to analyze the polynya event, numerical simulation was performed for the period from 12 to 17 July 2006 in order to study the development of the katabatic wind (Morelli and Casini, 2008; Morelli, 2008). Daily satellite images, concerning the period, display that a sea ice free area formed on 15 and 16 July, reaching its maximum extension of about 4000 km² on 16 July (Morelli et al., 2007). In order to gain insight on the atmospheric response to open water area within a sea ice field, ETA model runs were carried out from 15 to 17 July 2006 both with and without the polynya (as derived by satellite image) included in the initial conditions. Results from these experiments will be presented. Simulations were performed with 50 layers in the vertical from sea surface to 25 hPa, with higher resolution near the bottom of the domain. Horizontal resolution was 0,125x0,125 transformed degrees (about 20kmx20km). Numerical simulations show that the polynya had significant effects on temperature, specific humidity, vertical velocity and horizontal wind speed throughout the boundary layer. The effects are found over and downwind the sea ice free area. The presence of polynya produced significant thermal modifications in atmosphere. Turbulent kinetic energy also responded to its presence and the low level wind speed changed over the open water area.

References:

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