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Antarctic katabatic winds and their interaction with a coastal polynya in Terra Nova Bay, studied by Eta model simulations and satellite images.

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Coastal polynyas are areas of partially or totally ice free water which form in coastal regions during the wintertime in spite of the low air temperatures. Coastal polynyas are often referred to as 'latent heat polynyas' .They are thought to be opened and maintained by strong offshore winds blowing over the area, and by the curvature of the coastline. Sea ice is removed by the wind and new ice is constantly formed and exported (Smith et al, 1990) with a consequent release of latent heat . Atmospheric numerical modelling and satellite observations are fundamental tools for the analysis of winter polynya events occurring over remote and often data sparse polar regions.

This study concerns the region of Terra Nova Bay (TNB) in Antarctica, where a recurring coastal polynya occurs offshore the Italian Antarctic Base 'Mario Zucchelli Station' (MZS). The aim is the study of a real event of TNB polynya and the two way interaction between strong katabatic winds, blowing from the coast, and development of the polynya. The atmospheric circulation of the area is studied by simulations performed with ETA model in its last version (Mesinger et al., 2006), also with a piecewise linear advection for the wind field. A previous version of the model was yet successfully used for simulations in the Antarctic area (De Carolis et al, 2006, Casini e Morelli, 2007). Satellite images from AMSR-E (Morelli et al, 2007) and AVHRR and observational data integrate the analysis.

The presented case study is a polynya event happened during the period 12-17 July 2006. AMSR-E images displayed the presence of a sea ice free area, that reached an

extension of 4000 km^2 on 16 July 2006. 72 hours simulations were carried on in order to study the atmospheric circulation of the period over a large area; ECMWF analyses provided the initial and boundary conditions. Furthermore, ETA simulations, nested in the previous domain, were performed with a finer resolution. To gain some insight on atmospheric response to open water within a sea ice field, simulations were carried on both with and without a prescribed open polynya (derived by AMSR-E images) forced in the initial conditions .

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 15kmx15km) for the coarser grid, and 0,05x0,05 transformed degrees for the finer grid (about 8kmx8km), respectively.

Numerical simulations show that cyclonic structures were moving over the Ross Sea, and that the polynya development, displayed by satellite images, was related to the katabatic wind field blowing from the Reeves glacier. ETA simulations performed with an realistic open water region in the initial conditions show a strengthening of the surface wind field over the ice free area.

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