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Meteorological impact of realistic Terra Nova Bay polynyas.

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The energy exchange between the ocean and the atmosphere in the Antarctic marginal sea ice zone is influenced by the extent of sea-ice cover. In areas of open water, a direct contact is established and intense energy exchanges occur, due to the large difference of temperature between the water and the air above it. This implies that the polynyas are areas where the ocean exchanges energy with the atmosphere and as a result they have an effect on the polar meteorology/climate.
The work presented here concerns real polynya events 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 the impact of polynyas on the atmosphere by three-dimensional numerical simulations. The ETA model (Mesinger et al., 2006) was used and ECMWF and NCEP data provided the initial and boundary conditions. The model had already been successfully used in the Antarctic area (Casini and Morelli, 2007) A polynya of realistic size (as observed by satellite image) was included in the initial conditions for the simulations and a study of the air circulation during the events is found in Morelli et al. (2007), Morelli and Casini (2008), Morelli et al. (2009). The Eta Model reproduced the evolution of upper and mod-level conditions in good agreement with AVHRR observations (Morelli, 2008, Morelli and Parmiggiani, 2009). Also, the simulated 10 m wind was well correlated with the observed extension of the polynya.
In order to isolate the effect of the presence of the open water area on the structure of the atmospheric boundary layer and on the atmospheric circulation, further simulations were performed without the presence of the polynya, i.e. with its extent covered with sea ice.
The numerical simulations show that the polynyas act to increase the speed of the air above them and generate strong heat fluxes that warm the air. The effects are found over and downwind the sea ice free area.
Results from the Eta Model runs show that a polynya modifies the atmosphere up to a height of several hundred meters and over a long distance from its location. A structure, as a thermal cyclone, develops over the eastern side of the polynyas. This structure is embedded in the pressure field simulated also without taking into account the polynya.

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