Final project report

Project ID: 2003/6.06
Title: *Surface turbulent fluxes in conditions of katabatic winds over the Nansen Ice Sheet in the Terra Nova Bay region*

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Duration: 2 years
Assigned funding: € *60,000.00*

Activities and results

Aim of the project is the presentation of in-situ observations, with the realisation of a data base, the data analysis and the formulation of parameterisations of exchange processes, and finally the realisation of numerical simulations of the atmospheric circulation in the Baia Terra Nova region.

The observations have been critically analysed in order to put into evidence possible instrumental errors related to the misalignement of the sonic anemometers, mainly produced by oscillations of the mast due to the strong wind and/or by the melting of the ice. A correction method has been suggested and implemented for a subset of the available observations (Richiardone et al., 2008).

Similarity relationships for one-point first and second moments of velocity and temperature have been evaluated against the data, with special attention to the surface layer. Also power spectra have been investigated, looking for 1/k slopes (being k the wavenumber), which are signatures of large scale effects (especially evident in the horizontal component spectra). Literature parameterisations for the variances have been tested and new ones proposed, based on the data and recent theories. The main results are reported in Mammarella et al. (2005), Tampieri et al. (2008), Tampieri et al. (2009) and were presented in national and international meetings.

Physical and numerical simulations have been performed in the Torino rotating tank and at the UNIMORE research unit. The rotating tank experiments allowed to investigate in particular the non-Gaussian nature of the turbulence in the planetary boundary layer. The numerical simulations, made using the ETA model, allowed to test different formulations of the lower boundary conditions and their impact on the simulation of katabatic winds. The results have been presentd at different meetings (Morelli e Parmiggiani, 2005; Morelli et al., 2005; De Carolis et al, 2005; De Carolis et al., 2006; Morelli, 2007; Casini e Morelli, 2007; Morelli e Casini, 2007; Morelli et al., 2007; Morelli e Casini, 2008).

Products

A – papers in scientific magazines

1. Mammarella I., Tampieri F., Tagliazucca M., Nardino M. (2005) Turbulence perturbations in the neutrally stratified surface layer due to the interaction of a katabatic flow with a steep ridge. Environm. Fluid Mechanics, 5 (3), 227-246.

2. Richiardone R., Giampiccolo E., Ferrarese S., Manfrin M. (2008) Detection of Flow Distortions and Systematic Errors in Sonic Anemometry using the Planar Fit Method. Boundary-Layer Meteorology, 128, 277-302.
3. Tampieri F., A.Maurizi (2008) . A re-evaluation of surface layer turbulence from Antartic data. Il Nuovo Cimento C, 31, 711-722.
4. Tampieri, F., Maurizi A., Viola A. (2009). An Investigation on Temperature Variance Scaling in the Atmospheric Surface Layer. Boundary-Layer Meteorol., 132, 31-42

B – book chapters

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C - proceedings of international conferences

1. Maurizi A., Tampieri F., Viola A. (2008). Similarity relationships for velocity and temperature moments in the atmospheric boundary layer. Oral communication, NP6.05, EGU General Assembly 2008, Vienna, 13-18 April 2008.
2. Tampieri F., Maurizi A., Viola A. (2008b). An investigation on temperature variance scaling in the atmospheric surface layer. International Workshop on Environmental Turbulence, Baeza, Spain, 23-25 June 2008.
3. Casini G., Morelli S. (2007). Katabatic wind and Terra Nova Bay polynya: a study using two different versions of the Eta model, European Geophysical Union General Assembly, Vienna, Austria, April 2007.
4. Morelli S., Casini G.. (2008) Antarctic katabatic winds and their interaction with a coastal polynya in Terra Nova Bay, studied by ETA model simulations and satellite images. EGU General Assembly 2008, Vienna, 13-18 April 2008.
5. Morelli S., Casini G., Parmigiani F. (2007). Wintertime katabatic event and polynya at Terra Nova Bay: a study by Eta model simulation and AMSR-E images, 2nd Antarctic Meteorological Observation, Modeling, and Forecasting Workshop. Roma, 26-28 June 2007
6. De Carolis G., Morelli S., Parmiggiani F. , Casini G. (2006). Terra Nova Bay Polynya: a study by satellite microwave observations and Eta model simulations. European Geophysical Union General Assembly, Vienna, Austria, April 2006.
7. De Carolis G., Morelli S. , Parmiggiani F. (2005). Synergic use of Asar wide swath observations and limited area model simulations to study Terra Nova Bay polynya. 3rd International Conference on the Oceanography of the Ross Sea Antarctica, 10 - 14 October 2005, Venice, Italy
8. Morelli S., Parmiggiani F. (2005). Numerical simulations of a winter polynya event. 10th European Polar Lows Working Group Workshop, Tromso, Norway, 1–2 Sept. 2005
9. Morelli S., Parmiggiani F., Casini G. (2005) Impact of Terra Nova Bay polynya on katabatic wind development: Eta Model simulations and satellite microwave observations. Inviato per la pubblicazione su Journal of Marine Systems, special issue from the 3rd International Conference on the Oceanography of the Ross Sea Antarctica, 10-14 October 2005, Venice, Italy.

D – proceedings of national meetings and conferences

1. Barberis E., Maurizi A., Tampieri F. (2007). Analisi della relazione skewness-kurtosis in funzione della stabilita' nello strato limite atmosferico. XCIII Congr. Nazionale SIF, Pisa, 24-29 sett. 2007, Volume dei Sommari, pag.53.
2. Morelli S., Casini G. (2007) Low level wind and coastal Terra Nova Bay polynya: a study by Eta Model simulations. Inviato per la pubblicazione su gli atti del XI Workshop "Fisica e Chimica dell'Atmosfera Antartica". Roma, 10-12 April 2007
3. Morelli S. (2007) Low level wind and coastal Terra Nova Bay polynya: a study by Eta model simulations, XI Workshop " Fisica e Chimica dell'Atmosfera Antartica". Roma, 10-12 April 2007.

E – thematic maps

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F – patents, prototypes and data bases

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G – exhibits, organization of conferences, editing and similar

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H - formation (PhD thesis, research fellowships, etc.)

1. Villani M. G. (2005) Mechanims of exchange and transport in the atmosphere. Two aspects considered: exchanges at the surface and transport in the troposphere. PhD thesis, Environmental Sciences, Urbino University.

Research units

CNR ISAC Bologna and Roma
UNITO Physics Dept.
UNIMORE Physics Dept.
