Final conference, Rome October 11, 2016

Atmospheric Observations at Amundsen Nobile Climate Change Tower

"The integrated atmosphere-hydrosphere-cryosphere system : radiation ,energy budgets, fluxes of mass, heat and momentum at the air-snow-ground interface"

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The Amundsen-Nobile Climate Change Tower (CCT) is one of the important scientific platforms operating in Ny-Alesund, Svalbard.
The CCT is equipped with a consistent set of meteorological sensors installed at different heights to provide continuous measurements of the atmospheric parameters that affect the climate and its variability. In the following table the list of sensor installed is presented.

• K&Z CNR 1 Net radiometer	**[33 m]**
• K&Z CM11 and CGR4 upwelling radiometers	**[25 m]**
• Young propeller anemometer	**[34m ,10m, 5m and 2m]**
• Vaisala HMP45 Thermo-hygrometers,	**[34m ,10m, 5m and 2m]**
• Campbell CSAT3 sonic anemometers	**[21 m]**
• Campbell EC150 fast hygrometer	**[21 m]**
• Gill R50 Solent sonic anemometer	**[7.5 m]**
• Campbell Kh-20 fast hygrometer	**[7.5 m]**
• Gill R50 Solent sonic anemometer	**[3.7 m]**
• Campbell Kh-20 fast hygrometer	**[3.7 m]**
• IR120 infrared sensor for snow skin temperature	**[5m]**
• SR50 sonic range sensor for the snow height	**[5m]**
• Flux plate at the interface soil-snow	**[at surface]**
• Temperature sensor in snow layer agl	**[5 cm , 15 cm]**

The data are continuously collected since November 2009 and stored in a dedicated built-in digital infrastructure (IADC) that allows users to visualize, access and download the data.
The atmospheric characteristics at the site are used to describe the thermodynamic structure of the lower layers of the atmosphere and provide an overview of the phenomenology occurring in the Kongsfjord area, useful to proceed with further analysis of the arctic climatic system.

The numerous and complex interactions between atmosphere, ocean, cryosphere and biosphere on a broad spectrum of temporal and spatial scales, are largely responsible for the phenomenon that goes under the name of "arctic amplification" and requires a detailed knowledge of the atmospheric processes at different scales. In this frame a climatological analysis of the atmospheric parameters is important to proceed with detailed studies the exchange processes and energy balance at the surface.

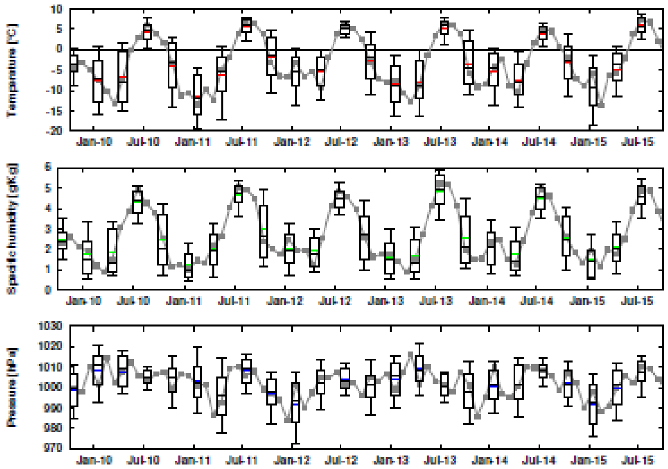

Fig 1 temperature time series at CCT

The time series are not long enough to assess the variability of parameters on a climatological scale, but useful assumptions can be made for detailed analysis concerning turbulence studies, data intercomparison at different time and space scales, validation of theory and numerical model results (Mazzola et al. 2016).

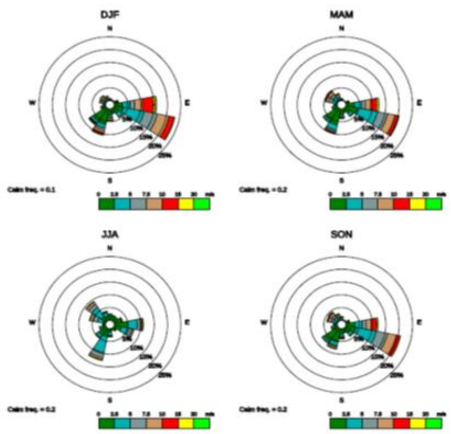

Fig. 2 Seasonal Wind field distribution at 10 m at the CCT

In particular the identification of the phenomena occurring in the Kongsfjord area helps also to evaluate the turbulent characteristics of the atmosphere and validate the Monin-Obukov similarity theory as function of the environmental condition.

The data set collected at the Climate Change Tower installed in Ny Alesund, Svalbard allows to test similarity predictions and address some questions for quasi neutral, convective and stable boundary layer in the Arctic environment.

An attempt to answer to questions about the transition from dynamic to free convection for the Convective Boundary Layer, the recognition of the structure of the Stable Boundary Layer (traditional and up-side down) as well as the evaluation of the Von Karman constant in the quasi-neutral conditions have been studied. In the analysis the four conventional anemometers and Vaisala thermos-hygrometers, and three lined up sonic anemometers, installed on the CCT have been used.

For the unstable and stable atmospheric conditions the main similarity functions have been calculated and the results are in according with the literature. The study of the influence of critical conditions in stable cases has been initiated.

For tSBL cases the fitting procedure suggested by Mazzola et al. (2016) allows to evaluate the SBL depth. It results that this depth is approximately consistent with the value derived from equilibrium formulas (Zilitinkevich et al, 2013). Stable ABL are often characterized by lowwind conditions (i.e. wind velocity below about 1 m/s). Also this aspect is under investigation, especially is connection with the mean profile variability associated with large flux Richardson numbers, following a suggestion by Grachev et al, (2013).

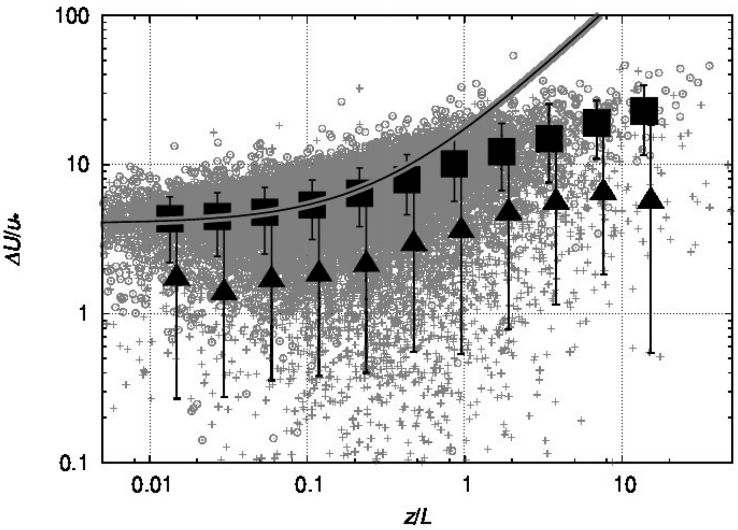

Fig 3 The wind velocity difference from 10 and 2 m normalized over the friction velocity measured at 7.5 m

The example in Figure 3 shows the wind velocity difference from 10 and 2 m normalized over the friction velocity measured. It is evident that the log-linear relationship is a good approximation of the high wind data for moderate stability, while for large stability the data are lower than the theoretical curve (Yague et al, 2006).

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