EMS Annual Meeting Abstracts
Vol. 16, EMS2019-723, 2019
© Author(s) 2019. CC Attribution 4.0 License.

Synoptically driven regimes of the Atmospheric Surface Layer over Dronning Maud Land, Antarctica

Gabin Urbancic (1,2), Irene Suomi (1), and Timo Vihma (1)

(1) Finnish Meteorological Institute , Helsinki, Finland , (2) Geophysical Institute, University of Bergen, Bergen, Norway

The coastal Antarctic surface climate is dependent on both katabatic and synoptic forcing. The closer to the Antarctic plateau, the weaker is the synoptic influence. The interaction between katabatic and synoptic forcing is not always a simple superposition, but often analogous to a supply-and-demand system with strong katabatic outflow occurring with coastal low-pressure systems. The katabatic influence is decreased in the Austral summer months, when only night-time inversions are observed and the diurnal cycle resembles that at mid-latitudes.

Using eddy-covariance data from three field campaigns near the Finnish Aboa Station, in Dronning Maud Land, we found that the regimes of the Atmospheric Surface Layer (ASL) are dependent on synoptic pressure systems travelling across the Weddell Sea. Unlike many coastal stations where the climatological wind-field is bi-modal, the area around Aboa Station shows alignment of the katabatic and synoptic forcing, resulting in a high directional constancy of wind.

The remote influence of the synoptic conditions of the Weddell Sea allows categorization of the ASL turbulence and provides a basis for a phenomenological analysis of the area, considering among others, convection, surface based inversions, low-level jets, wind-meandering, and surface decoupling. Furthermore, this approach contextualizes the validity and failure of Monin-Obukhov Similarity Theory (MOST) and other ASL parameterizations.

During weak synoptic conditions, strong night-time inversions are formed and the resulting gentle slope flow is deflected almost perpendicular from the fall line by the Coriolis force. The wind maxima can occur at heights as low as 5 m and the vertical wind profile exhibits considerable wind-turning. For this regime, called the Intermittently Turbulent Ekman Layer, MOST is invalid and standard Ekman theory must be extended for the synoptic and katabatic influence.