Geophysical Research Abstracts
Vol. 21, EGU2019-7775, 2019
EGU General Assembly 2019

Large-Eddy Simulations of the Steady Wintertime Antarctic Boundary Layer

Steven van der Linden (1), John Edwards (2), Chiel van Heerwaarden (3), Etienne Vignon (4), Christophe Genthon (5), Igor Petenko (6,7), Peter Baas (1), Harm Jonker (1), and Bas van de Wiel (1)

(1) Geoscience and Remote Sensing, Delft University of Technology, Netherlands (s.j.a.vanderlinden@tudelft.nl), (2) Met Office, Exeter, United Kingdom, (3) Meteorology and Air Quality, Wageningen University and Research, Wageningen, Netherlands, (4) Environmental Remote Sensing Laboratory, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, (5) Laboratoire de Météolorogie Dynamique, CNRS, Paris, France, (6) Institute of Atmospheric Sciences and Climate, National Research Council, Rome, Italy, (7) A.M. Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences, Moscow, Russia

Observations of two typical contrasting weakly and very stable boundary layers from the winter at Dome C, Antarctica, are used as a benchmark to set up two centimetre-scale resolution Large-Eddy Simulation cases. By taking the Antarctic winter, the effects of the diurnal cycle are eliminated enabling the study of the long-lived steady stable boundary layer. With its homogeneous, flat snow surface, and extreme stabilities, Dome C is a natural laboratory for studies on the long-lived stably stratified boundary layer. The two simulation cases differ only in the imposed geostrophic wind speed which is identified as the main deciding factor for the resulting regime. In general, a good correspondence is found between observed and simulated profiles of mean wind speed and temperature. Discrepancies in the temperature profiles are likely due to the lack of radiative transfer in the current simulations. The extreme stabilities result in a considerable contrast between the stable boundary layer at Dome C and those found at typical mid-latitudes. The boundary-layer height is found to range from approximately fifty to just five metres in the most extreme case. Remarkably, heating of the boundary layer by subsidence may result in thermal equilibrium of the boundary layer in which the associated heating is balanced by the turbulent cooling toward the surface. Using centimetre-scale resolutions, accurate Large-Eddy Simulations of the extreme stabilities encountered in Antarctica appear to be possible. However, future simulations should aim to include radiative transfer and subsurface heat transport to increase the degree of realism of this type of simulations.