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Influence of the optically-active turbulence on astronomical seeing at Concordia station - Dome C, Antarctica

Igor Petenko (1,2), Eric Aristidi (3), Karim Agabi (3), Guillaume Bouchez (3), Erick Bondoux (3), Ilaria Pietroni (1), Stefania Argentini (1), Angelo Viola (1), Giampietro Casasanta (1), and Giangiuseppe Mastrantonio (1)

(1) Institute of Atmospheric Sciences and Climate, Italy (g.casasanta@isac.cnr.it), (2) Obukhov Institute of Atmospheric Physics/RAS, Pyzhevsky per. 3 – 119017 Moscow, Russia, (3) LUAN, University of Nice, Parc Valrose, 06108 Nice Cedex 2, France

The study of the distorting action of the atmospheric turbulence is important to understand the reason of the astronomical seeing variability, and to propose reliable methods to estimate the seeing quality. The influence of the atmospheric surface layer thermal turbulence on distortion of astronomical images is investigated. During a campaign carried out at Concordia station at Dome C, East Antarctica in winter 2012, an experiment was carried out to determine the behaviour and the contribution of the optically-active atmospheric turbulence in the lowest tens meters. The surface layer in the interior of Antarctica during winter is extremely stably stratified with the difference of temperature between the surface and the top of the inversion reaching 30-40 °C. Direct optical measurements of the seeing made by differential image motion monitors (DIMM) at two levels, 8 and 20 m, were made simultaneously with turbulence observations in the near-surface atmospheric layer. The intensity of the thermal turbulence was detected and evaluated using both a specially designed high-resolution sodar, and sonic anemometer measurements. The statistics of some meteorological variables, including long-wave downwelling radiation, characterising the presence of cloudiness are obtained. Typical patterns of the turbulence shown by sodargrams are analysed and classified. The statistics of the heights of the surface-based turbulent layer and of the seeing quality values are presented. A correlation exists between the seeing quality and the intensity of turbulence measured by sodar. Statistics of turbulent optical factor (TOF) for different layers within the surface layer are analysed for the total period and for clear sky conditions to give recommendations on how to choose an optimal height for the installation of the astronomical instrumentation.