Identification of extreme dry atmospheric flow events at the VLT site from analysis of the near surface weather parameters database

Angel Otarola\(^1\), Florian Kerber\(^2\), Roberto Rondanelli\(^3\)

\(^1\)TMT Observatory, Pasadena, USA
\(^2\)European Southern Observatory, Garching, Germany
\(^3\)Universidad de Chile, Santiago, Chile

Observations in the mid-infrared (mid-IR) bands from ground based astronomical observatories can be possible only in very dry conditions. VISIR is a mid-IR imager and spectrograph located in the Cassegrain focus of the UT3 (Melipal) telescope at the European Southern Observatory (ESO)’s Very Large Telescope (VLT), and has been in operations since 2004. VISIR supports observations in the N-band (8 um to 13 um) and Q-band (16.5 um to 24.5 um). Of these two bands, Q-band specially is very sensitive to water vapor in the Earth’s atmosphere through added atmospheric thermal background noise as well as attenuation of the signals from the cosmic sources in this band.

Upgrades of the VISIR instrument, intended to further increase its performance, triggered the need to continuously monitor the PWV field at the VLT site. This has been done by adding the Low Humidity and Temperature Profiling microwave radiometer (LHATPRO), manufactured by Radiometer Physics GmbH (RPG), to monitor the atmospheric water vapor field from its thermal emission in the 183 GHz band (Kerber et al., 2012). On July 5\(^{th}\) 2012 LHATPRO recorded an extremely dry, persistent and stable event with a Precipitable Water Vapor (PWV) level of about 0.1 mm (Kerber et al, 2014). This even lasted for about 12 hours and was explained to have source in a very cold, and consequently dry mass of air, advected from the Antarctic region.

The scientist that researched and published on the extreme dry event detected by LHATPRO also stated that statistical analysis of science measurements conducted with the UVES and CRIRES instrument, spanning more than a decade, show that dry events with inferred PWV levels lower than 0.2 mm occur about 1% of the nights while PWV levels less than 0.5 mm are encountered on 6-7 nights per year (~ 2% of the year). In this work, we analyzed the archive of near surface weather parameters, specifically near surface absolute humidity, as to confirm the probability of occurrence of these extreme dry events in the period 1999-2014. The analysis includes the use of the VLT site weather parameters archive as well as the database of surface weather data observed during the site testing campaign of the Thirty Meter Telescope in three sites in the Atacama Desert region. A few selected cases are studied with the help of mesoscale analyses databases as to learn the source of the very dry air advected into the Atacama region.