Paper ID: 41380
oral

EARTH OBSERVATION SYMPOSIUM (B1)
Interactive Presentations (IP)

Author: Dr. Balthasar Indermuehle
CSIRO Astronomy & Space Science, Australia

PREDICTING ANOMALOUS TROPOSPHERIC RADIO PROPAGATION CAUSED BY LOW LEVEL INVERSION LAYERS USING NEAR REAL-TIME SATELLITE DATA

Abstract

One of the challenges of operating low frequency (20 MHz - 2 GHz) radio telescopes is in avoiding radio frequency interference (RFI) which is ubiquitous in populated areas in those frequencies. For this reason, these types of facilities are built as far away from population centres as possible in order to be able to receive unencumbered astronomical signal. During commissioning of the Australian Square Kilometre Array Pathfinder (ASKAP) telescope in remote West Australia's Murchison Radio Observatory (MRO) - an area specifically protected from RFI - we have discovered that on occasion, signal from transmitters that are a few hundred kilometres away were visible, and very occasionally we even detected signal from as far away as Perth, some 550km away. One of the anomalous radio propagation effects in the troposphere is the well understood mechanism of "tropospheric ducting". This occurs when the refractive index of the atmosphere at radio wavelengths matches that of the curvature of the earth, leading to radio signals bouncing back and forth in a "duct" like channel only a few hundred meters in height, leading to essentially lossless propagation over vast distances. The creation of such ducts is a function of the refractivity lapse rate, which, to meet the right conditions, requires a low level inversion layer to be present, i.e. the temperature of lower altitude air must be cooler than that of higher altitude air leading to a sharp increase in the refractivity of the atmosphere as the altitude increase, the opposite of the normal condition. This readily occurs over arid areas such as West Australia when the soil rapidly cools after sunset. Normally these conditions can be measured using radio sondes to provide vertical atmospheric profiles. However, this is not a practical approach to obtain data over vast areas. We present the results of our investigation into deriving soil cooling rates from data obtained by the Advanced Himawari Imager (AHI) deployed on the Japanese Meteorological Agency's (JMA) Himawari 8 satellite and correlate this to the likelihood of low level inversion rates forming, providing us with the unique opportunity to adaptively schedule observations so that the data obtained from the radio telescopes will not be affected as severely if ducting conditions are predicted to form during the night. This will be of eminent importance for other large scale facilities such as the Square Kilometre Array (SKA) telescope currently being built in South Africa and Australia.