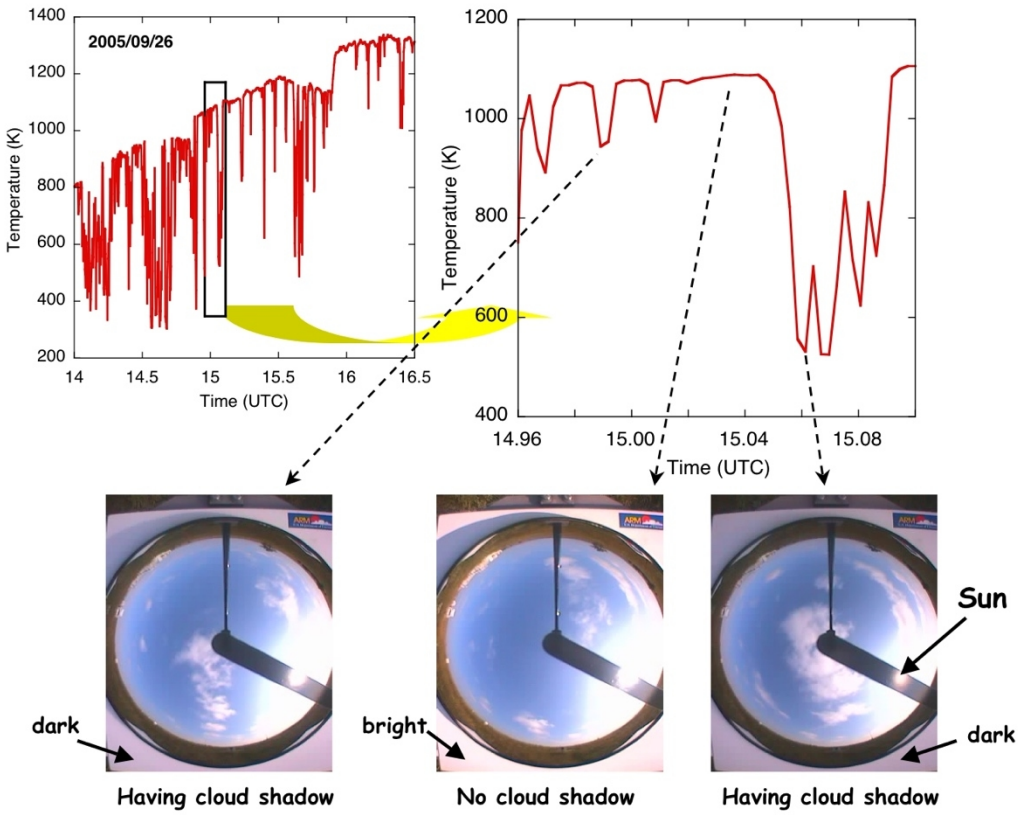
# Measuring low liquid water paths from an Infrared Thermometer




This image shows measurements of the sky temperature from the new Atmospheric Radiation Measurement ARM Program Infrared Thermometer (IRT) at the Southern Great Plains (SGP) site in Oklahoma on September 26, 2005. This customized IRT looks toward the Sun and measures solar radiation with a narrow field of view of 1.1 degree at the wavelength spectrum of 10.5 – 11.5 microns. This wavelength region is in the most transparent part of the atmospheric window (8 – 12 microns), since it radiates the least IR radiation and avoids strong ozone absorption at 9.6 microns. When clouds block the scene in the field of view of the IRT, the solar beam is attenuated, and thus a lower temperature (less radiation) is measured (as shown by many dips in the temperature time series). We enlarge the plot around 15 UTC and show it on the right panel along with images from the ARM Total Sky Imager TSI. Clearly, when a decrease in the IRT temperature occurs, we see a dark background (due to cloud shadows) in the corresponding TSI image as well, indicating that the sun is blocked. This IR Thermometer is designed to measure low liquid water paths (LWP). Laboratory experiments and theoretical calculations have confirmed that the transmission of the solar beam in this window around 11 microns gives direct information on LWP. However, this idea works only when clouds contain low LWP. Clouds having high LWP emit significant IR radiation. If the solar radiation (i.e., signal) is drowned by the cloud-emitted thermal radiation (i.e., noise), the signal-to-noise ratio is not sufficiently large to retrieve liquid water path accurately. It has been found that half the clouds observed at the ARM SGP site have low liquid water paths below 100 g/m2. These types of clouds are important from a climate sensitivity point of view, but unfortunately it is often not accurately detected by microwave radiometers. The new customized IRT has the ability to provide accurate liquid water path for such clouds. Long-term measurements of the IRT will be very valuable for the climate community in order to better understand the feedback of clouds on global radiation budget.

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