DYNAMO role of U of Miami scanning radiometer   Oct. 8 2011 report

Since 6 October, the UM radiometer has been running continuously using the scanning strategy outlined below. The 89 Ghz channel is not working and will not be used for the duration of DYNAMO. Science objectives for which the 89 GHz radiances are valuable can make use of data from the DOE site and its 3-channel radiometer. The UM and DOE 3-channel radiometers are the same model (if applied differently). [1]
The 15-minute scanning sequence begins ~ 20-30 seconds after each 15-minute mark, and in 15 minutes completes a 1) composite scan, 2) zenith-pointing scan, and 3) 9 tipping calibrations, detailed further below.

1) This 4 minute, 28 second composite scan at 23.834 and 30.0 Ghz frequency is designed to complement the low-elevation radar scans tasked for humidity and liquid water retrievals.
The composite scan covers azimuth angles between -50 to 150 sampled every 8 degrees. Two azimuths at 70 and 110 degrees coincide with lightning protection rods and are not sampled. The elevation angles coincide with those of the radar: 5, 7, 9, and 11 degrees. The radar does PPI constant-elevation 360-degree scans (red lines in Fig. 1), whereas the radiometer does RHIs, sampling the 4 elevations at one azimuth, then moving to the next azimuth (blue lines in Fig. 1). The 2 frequencies sampled, (one is primarily for water vapor absorption (23.834 GHz), and the other for liquid water absorption/emission (30 GHz)) correspond to those used by standard 2-channel 'mailbox' microwave radiometers, and as such their behavior is well-documented in the literature.

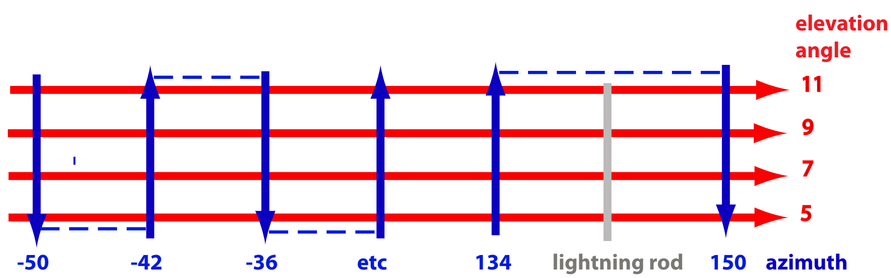

Fig. 1: Schematic of low-elevation scanning pattern by S-PolKa (red lines) and the radiometer (blue lines). The azimuth scanning sector spans from -50 degree to +150 degrees with two azimuths, coinciding with lightning rods, removed.

The two radiometer channels have a beamwidth of 3.0-3.3 degrees, and surface emission may impact the measured radiances at the lower elevation angles. This was investigated by comparing brightness temperatures measured over land to those measured over water. The coastline is oriented approximately due north at the S-Pol site, and is slightly to the site's east. The azimuth scans at -50 (land) and +54 (ocean) were chosen for the comparisons shown in Fig. 2, one at each elevation angle. The plot also includes values calculated using a TOGA-COARE mean sounding and a microwave radiative transfer model adapted from that of Schroeder and Westwater (1991).

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[1] The DOE 3-channel radiometer is also able to blow and evaporate rain off of its antenna. The DOE radiometer is being used for vertical scans and tipping calibrations at 23.834, 30, and 89 GHz frequencies alone, creating a consistent dataset to that from other ARM sites.

Fig. 2 shows that the 30 GHz Tbs are brighter over land than over ocean at elevation angles of 5 and 7 degrees, with the offset decreasing at 9 and 11 degrees. The 23 GHz Tbs agree better,

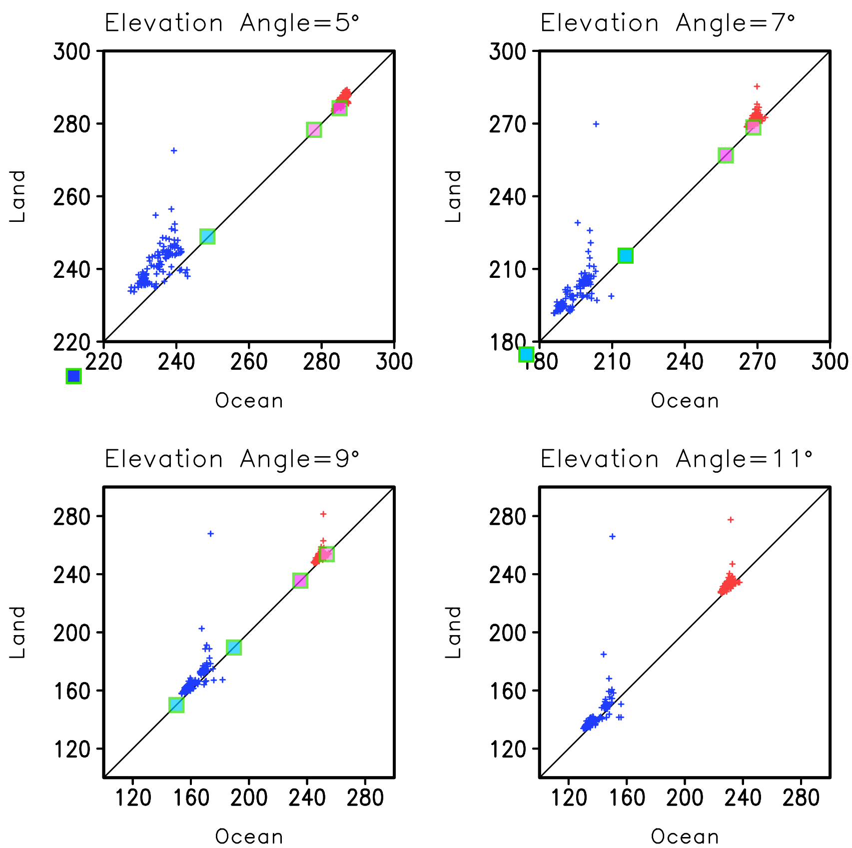

Fig. 2: 23.834 and 30 Ghz measured Tbs (blue and red points respectively) at four elevation angles and two azimuth angles representative of land and ocean. The squares indicate forward-calculated values using the TOGA-COARE mean sounding in clear-sky and cloudy (LWP=120 g/m^2) conditions, at both frequencies. Plot made with help from Daehyun Kim and David Zermano.

perhaps because stronger water vapor absorption at that frequency attenuates the surface signal. The comparison to the forward-calculated values, which relied on the TOGA-COARE mean sounding as input, suggests that either the boundary layer at Gan was more moist than that of the TOGA-COARE mean sounding (i.,e the red points tend to have larger values than the nearby squares), or, the current radiometer calibration is a bit off (it has not yet calibrated itself for typical Gan conditions). The WVPs at Gan have fluctuated between 4.4-4.7 cm, while the TOGA-COARE mean sounding WVP is approximately 4.5 cm. The forward-calculated values include a clear and a cloudy (LWP=120 g/m^2) value for each frequency. The agreement between the measurements and the calculation is not bad given the 2 caveats.

2) zenith-pointing scan at the frequencies of a microwave profiler (22.234, 23.034, 23.834, 26.234 and 30 GHz) if lacking the 60 Ghz channel. This scan also collects MET and IRT (downwelling infrared Tb, primarily used to determine cloud base temperature) data. The scans takes ~ 25 seconds. The zenith scans are used to determine WVP and LWP to first-order, but

also to derive a moisture profile, using an a-priori temperature profile. The goal here is not to supplant the radiosondes (the anticipated moisture profile will have a vertical resolution of 2 km at best), but rather, provide greater temporal resolution to changes in atmospheric humidity profiles, and assess dominant modes of variability. The moisture retrievals will also be based on the Schroeder and Westwater (1991) model, but this model will need to be updated and the retrieval developed.

3) Tipping calibration scans (“tip cals”) at the above 5 frequencies. These occur at (az, el) pairs of (-40,30), (-40,45), (-40, 90), (140, 45) and (140,30). The number of tip cals were chosen to fill the remaining time within the 15-minute time interval, or about 10 minutes 7 seconds. Column-integrated WVPs and LWPs, and column-resolved moisture profiles, will be garnered from the vertical stares.

References

J. A. Schroeder and E. R. Westwater, 1991: User’s guide to WPL microwave radiative transfer software. *NOAA Tech. Memo., ERL WPL-213*, NOAA ERL Wave Propagation Lab., Boulder, CO.