MAGIC

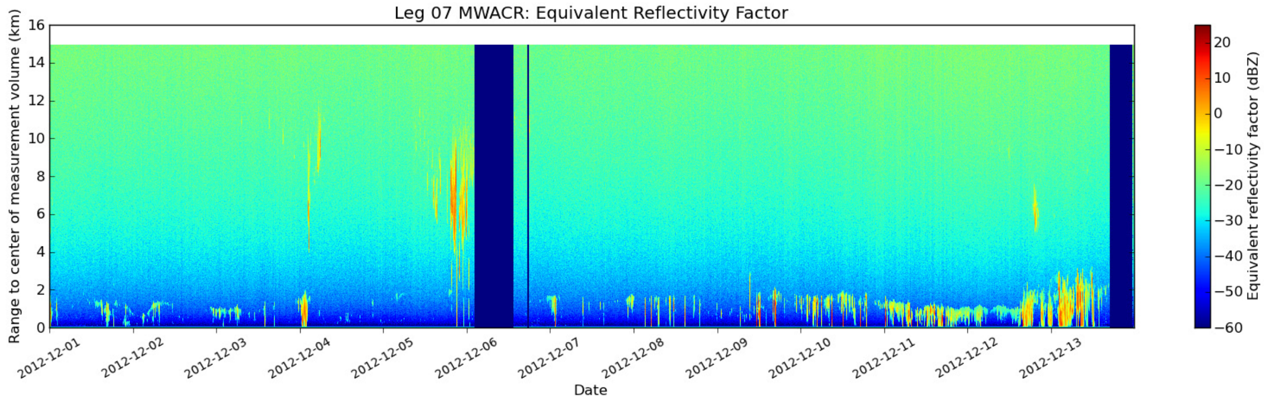
2013-01-07

The *Spirit* is currently on its way from Honolulu to Los Angeles on Leg09B. I fly to Los Angeles Wednesday to meet it when it arrives Thursday. Tom and Mark, the two techs who have been on the ship for the last two round trips (including Christmas and New Years' Day) will be getting off, and Pat and Brett will be replacing them for the next two round trips. I will ride the *Spirit* to Hawaii, and Mike Reynolds ride it back to Los Angeles. Trevor Ferguson, a graduate student at University of Utah, will be riding both ways. I don't think he's been on a ship before, so he might be a bit anxious, but I'm confident he'll have a great time. I'm certainly looking forward to my voyage!

This next round trip is an Intensive Observational Period, or IOP, during which we will launch weather balloons every three hours instead of every six hours as we do now; that's eight launches per day. This intensive coverage will provide an even more detailed picture of the structure of the atmosphere (temperature, relative humidity, wind speed and direction) than what we are getting now. Trevor and I (and Mike when he gets on) will do the night shift so the techs can keep to their regular schedule. It should be fun.

Many people are already looking at MAGIC data, and I will present a few graphs of results from the MWACR, one of the radars. These were made by Karen Johnson, who also works at Brookhaven National Laboratory (thanks Karen!). MWACR stands for Marine W-band ARM Cloud Radar. W-band radars are designed to detect cloud drops. They also detect rain, but their signal doesn't don't penetrate too far into heavy rain, so they are often used with other radars that are specifically designed to study precipitation (radars were discussed in previous MAGIC updates; see http://www.bnl.gov/envsci/ARM/MAGIC/docs/updates/MAGIC%20Update%202012-03-20.pdf).

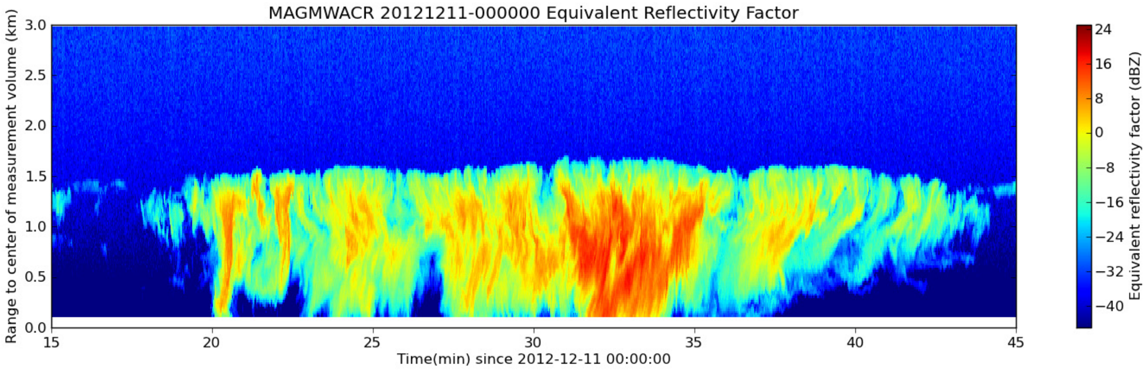
The first graph below shows the MWACR reflectivity for Leg07, which took place in December of 2012. The bottom axis shows the date, and the left vertical axis shows the height in the atmosphere. The numbers on the right show the reflectivity; hotter colors (reds and yellows) correspond to greater reflectivity, meaning there was more "stuff" that reflected back the signal that the radars sent vertically. This "stuff" would be mainly cloud drops, rain drops, and ice particles, although birds, planes, and anything else would also show up too.



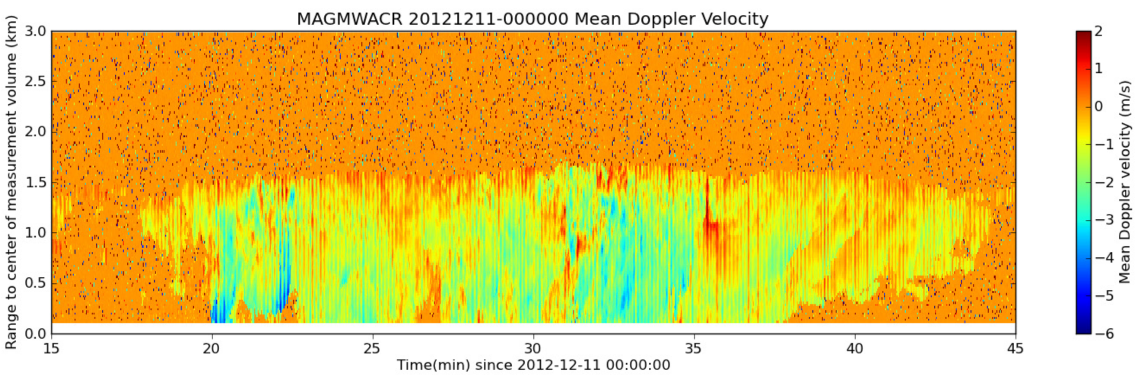
Moving from the left of the graph to the right corresponds to the trip from Los Angeles to Honolulu and back (the *Spirit* left Los Angeles on Dec 1, arrived in Honolulu on Dec 6, left the next day, and arrived back in Los Angeles Dec 13). Solid blue regions mean that the radar was turned off (probably for servicing); the one on December 6 occurred when the radar was in Honolulu, and the one on December 13 when it was in Los Angeles. A vertical line at any time shows the reflectivity as a function of height; this would look like a snapshot of the atmosphere at the given time.

For an example, on December 4 there is one bright area (yellow or red color) from 0 to about 1.5 km (the lowest mile or so of the atmosphere), and another one from around 8 to around 11 km (about 5 to 7.5 miles). The reflectivity in the lower region results from clouds and/or precipitation, and that in the upper region is almost certainly due to cirrus clouds, which are composed of ice crystals. These are often faint and difficult to see with the naked eye, but at the temperatures at these heights there wouldn't be liquid water. Much of the time during this leg appeared to be cloud-free, especially on the trip to Hawaii, and most of the clouds are restricted to the lowest 1.5 km. This region is known as the marine boundary layer, or MBL. Toward Los Angeles on the return there appears to have been "some weather" (as they say), as evidenced by the bright areas on Dec. 13.

Multiple radars, and multiple instruments, looking at the same region of the sky, can provide information that will tell what is responsible for the reflectivities that are observed, and can also be used to discern what processes are occurring. The two graphs below cover a shorter time period (30 minutes on December 11) and show only the lowest 3 km (about 2 miles) of the atmosphere. The first, which shows the reflectivity from the MWACR, is a blow-up of the above graph and shows more clearly that the reflectivity is largely contained in the lowest 1.5 km (i.e., in the MBL). It also shows high reflectivity (bright red) at 32-34 minutes that extends all the way to the surface.



Such a bright region could correspond to heavy clouds, fog, or rain, but additional information from our radar will help determine which it is: Doppler velocities (these were discussed in several updates in August, 2012; http://www.bnl.gov/envsci/ARM/MAGIC/updates.php has all updates). These are shown in the figure below for the same time period and same region. The bottom axis is again the date, the left axis shows the height, and the numbers (and colors) shown on the right are the Doppler velocities. Negative values (green and blue) correspond to objects moving downward, and positive values (red) correspond to objects moving upward.



There are a few areas that are red, corresponding to updrafts, but for most of the region that had the high reflectivity (32-34 minutes), the Doppler velocities were negative at around -2 to -3 meters per second. This means that objects were moving *downward* at this speed, and this behavior continued all the way to the surface. Thus we can conclude that this region was experiencing precipitation from clouds that were within the lowest mile or so of the surface. Also, based on the values of the velocities, we can conclude that the sizes of the drops responsible for most of the reflectivity were between 6/10 and 8/10 of a millimeter in diameter. Thanks again Karen!

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Please address any questions or comments to elewis@bnl.gov.
All updates and other MAGIC information can be found at http://www.ecd.bnl.gov/MAGIC.html.