MAGIC

2013-03-28

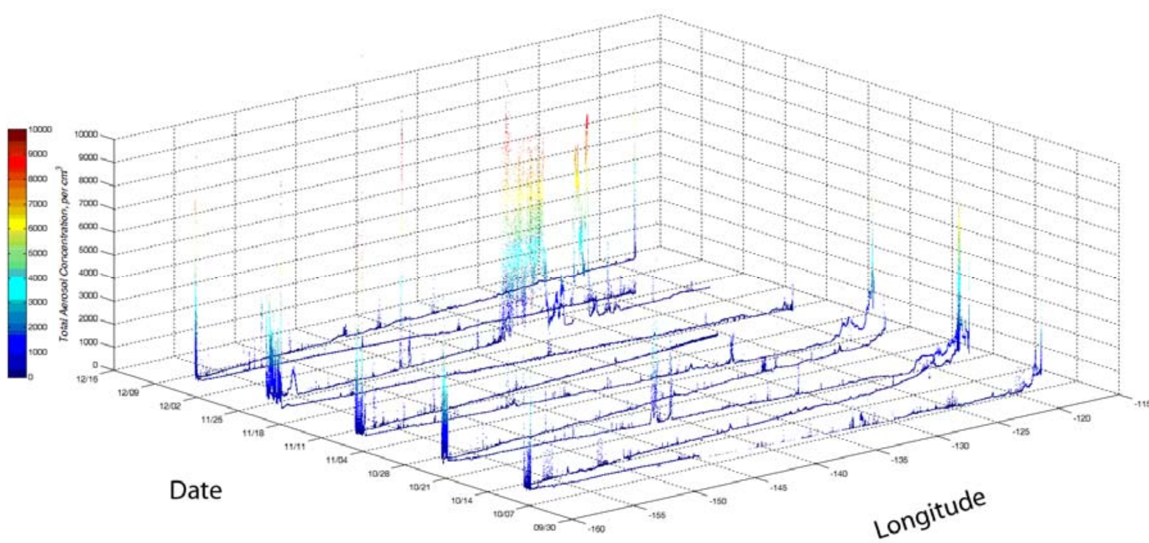
The purpose of this update is to provide information on the MAGIC deployment, and to learn a bit of science along the way. If this is your first MAGIC update then you are receiving it because your name appeared on my distribution list (probably because I added it, thinking that you would be interested in MAGIC). These updates are designed for non-scientists and scientists alike, and all previous updates, and additional information on MAGIC, can be found on the website listed at the bottom of this page. If you do not want to receive these updates, please let me know and I will remove your name from the distribution list.

I spent last week with a few hundred other scientists at the Atmospheric System Research (ASR) Science Team Meeting, which was held near Washington, DC. ASR is the science partner to ARM (which deploys the instruments on MAGIC), and its goal is “to quantify the interactions among aerosols, clouds, precipitations, radiation, dynamics, and thermodynamics to improve fundamental process-level understanding…” Quite a mouthful, to be sure, but in essence it means we want to really understand–at a basic level–what goes on in the atmosphere and how the atmospheric system works. The meeting had sessions scheduled from 8:00 am until nearly 9:00 pm at night, after which we would meet colleagues in the lounge to informally discuss future plans and collaborations, catch up with other news, etc. As you can imagine, the week was exhausting. However, it was also exhilarating! There were many exciting presentations, information on future deployments already scheduled or being planned (Finland, Brazil, and more marine deployments), and great conversations on fun science. I caught up with friends, collaborators, and other MAGIC people, met some scientists from Brazil (where I hope to visit next summer), and discussed possibilities of including additional instruments on MAGIC when we re-install in May of this year.

There was a lot of interest in MAGIC among the attendees at the conference, and I chaired a session on MAGIC that was well-attended and which had some very interesting presentations. Among these were one by Nicki on how the deployment itself was carried out, two on how we can correct the radar signals for ship motion, several on preliminary data that have resulted from MAGIC so far, and one on another instrument that might be included when we go out again in May. I also discussed future MAGIC plans that I alluded to in the last update.

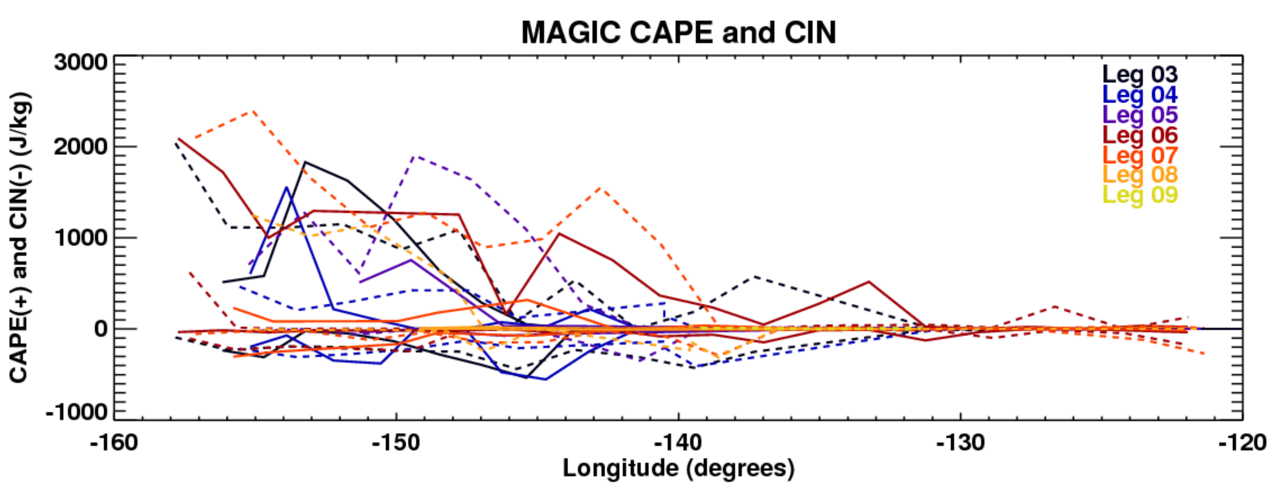
Correction of radar signals from a moving ship provides a challenging problem. One of the radars is on a stable table so that it always looks at the vertical. I saw a preliminary report on how well this table performed during the first part of the deployment, and it was able to correct for ship motion to the extent that the average deflection from the vertical was 1/10 of a degree (0.1°); this corresponds to a horizontal distance of 8 feet per mile, which is exceptionally good (great job Rich!). The other radars are fixed so that they point upward but move when the ship pitches and rolls, complicating interpretation of the data streams that they provide. The average ship motion is such that the deviation from vertical is often only a few degrees, but removing this motion would yield information that we couldn't otherwise obtain. There were several creative suggestions for making these corrections, and I look forward to hearing more about these as they are developed.

As discussed in the last update, we scientists are constantly looking for ways to visualize data that not only make it easier to understand what they can tell us, but also can aid in illuminating patterns and trends. The graph below is provided by Gunnar, who is in the office next door to mine (sometimes to his detriment, as it's harder for him to escape my queries), and shows the aerosol number concentration (i.e., how many particles are there in a certain volume of air) for each leg. The lower axis is longitude, with Los Angeles on the right and Honolulu on the left, and the left axis is the date, with older to the front, and more recent to the back. The graph starts in the lower right (corresponding to Los Angeles) and moves to the left and slightly farther back, where it turns around (at Hawaii) and moves back to the right (still moving a bit farther back), and so forth as the ship travels back and forth between LA and Hawaii. The colors, and the height of the graph, represent the concentration–yellow and red colors (and greater heights) corresponding to higher concentrations.

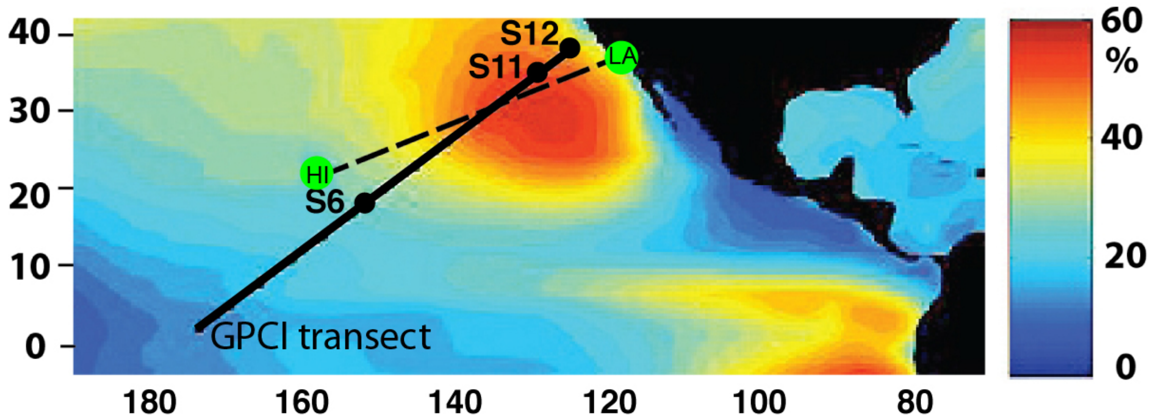


The numbers are a bit small to be easily read, but the point is to illustrate this means of presenting data for multiple legs in a way that maximizes information content. Values are generally quite low (deep blue), but on the far left and right edges the graph jump up somewhat (blue-green). These regions correspond to when the ship was in port, and with tug boats and other ships around emitting particles it makes sense that particle number concentrations would be higher there. During the last leg there were some high values (yellows and reds, which are much higher than normal), but these were probably caused when we were encountering exhaust from our ship. Certainly more work needs to be done to investigate these high values (checking wind direction for those times, etc.), and other instances when the concentrations increased, but the preliminary results that number concentrations are generally low is in and of itself quite interested. Thanks Gunnar!

I also wanted to give some explanation of what was displayed on the graph I presented (in multiple versions) in the last update (shown again below in the final form). Los Angeles is on the right and Honolulu on the left–in the same relative locations they would be on a map. The quantity plotted is CAPE, if the value is positive, and CIN, if it is negative. CAPE stands for **C**onvective **A**vailable **P**otential **E**nergy, and true to its name, CAPE is the energy available for convection. A good way to think of CAPE is that it is the severe weather potential–a larger value of CAPE means that there is more energy available to the atmosphere, making it more unstable, and thus more likely to produce severe weather, (e. g., a thunderstorm). Conversely, CIN, which stands for **C**onvective **IN**hibition, is a measure of how much energy must be added to the atmosphere before it can begin to form convective motions; thus it is a measure of the inhibition of convection. There appears to be some sort of transition at approximately 140°W longitude; to the east of that CAPE is essentially zero, but to the west it generally increases and takes on much greater values.



I want to show one final graph. The colors in the graph below represent the average low cloud cover for June, July, and August. The dashed line is the MAGIC transect, and the solid line corresponds to an imaginary transect (the GPCI transect) along which atmospheric scientists compare their computer programs (this activity provides the "G" in MAGIC, as described in the update on 2011-12-15). There is clearly a transition at approximately longitude 140°W along the MAGIC transect, at approximately the same location as the transition in CAPE in the graph above. As the purpose of MAGIC is to study this transition from high cloud cover to low cloud cover, and to provide data that will help atmospheric scientists to better understand it and thus make better computer programs describing how the atmosphere behaves, this graph (at least in my mind) is pretty much the iconic image of MAGIC.



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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.bnl.gov/envsci/ARM/MAGIC/.