Shipboard Tilt Corrections for More Accurate Broadband Radiation Data
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Moving Platform Radiometry
- Tilt from horizontal on moving platforms can result in substantial downwelling shortwave (SW) and longwave (LW) errors
- ARM has developed shipboard radiation packages (ShipRad) similar to that designed for the ARM Aerial Facility G-1 aircraft
- The ShipRad set of instruments provides all the information that is needed to apply the correction for tilt from horizontal orientation developed by Long et al. (2010) to the downwelling SW measurements, as well as screen the longwave measurements for data likely contaminated by too large tilt.
- Three ShipRad systems were assembled affording one each on the starboard and port sides of the ship, and one spare system in case of failures.

Correcting Tilt from Horizontal
For modest tilt, only the direct part of downwelling SW should be corrected for tilt. Thus a-priori knowledge of the direct and diffuse partitioning is required along with navigation latitude, longitude, pitch, roll, and heading. Given these parameters, and the assumption that the tilted diffuse is nominally equal to the horizontal diffuse, the Long et al. (2010) technique is applied.

Example Shipboard Data
These examples are from the Measurements of Aerosols, Radiation, and Clouds over the Southern Ocean (MARCUS) campaign.

Example of tilt correction, Dec. 14, 2017:
A brief nearly clear-sky period (dashed circle) shows the effectiveness of the preliminary tilt correction. As the zoom plot shows, even without refined detector angular offset from nav correction, the noise in the 1-second samples is decreased from a spread of 30-40 Wm⁻² to only a few Wm⁻². This despite the rapidly changing tilt from horizontal (black) shown in the right hand plot.

Usefulness of port and starboard systems:

ShipRad Intercomparison

Summary
Making accurate downwelling shortwave irradiance measurements on moving platforms such as ships and aircraft requires correction of the data for tilt from horizontal orientation. ARM has developed ship-board radiation systems (ShipRad) similar to the radiation package developed for the AAF G-1 aircraft.

The maiden deployment of the ShipRad systems is for the MARCUS campaign with both a port and a starboard system to help mitigate shading by the ship structure and other close-by obstructions.

Preliminary data indicate the systems are functioning reasonably well after a few initial hiccups, and will provide more accurate, tilt corrected data for use in developing a “best estimate” radiation product for ship campaigns.