A-TRAIN instruments characteristics' influence on derived Cloud Radiative Effect

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Satellite observations are indispensable for providing information on clouds on a global scale. However, due to their instrumental limitations and relatively coarse resolution compared to cloud scales, these datasets do have deficiencies.
Here, we focus on A-TRAIN measurements, especially by CLOUDSAT and CALIOP, which provide unique information on the vertical structure of clouds.
Nevertheless, depending on footprint, resolution and sensitivity, these satellite products of cloud properties show systematic biases.

We compare A-TRAIN measurements by CLOUDSAT, CALIOP and MODIS with a relatively similar set up of instrumentation on board of the Arctic research aircraft POLAR 5 (cloud radar, lidar and multispectral imager).

Thus, we are able to compare the satellite dataset with finer resolving, higher sensitivity co-located measurements over the Atlantic Arctic in the vicinity of Svalbard.
Complex, partly multi-layered, mixed-phase cloud structures allow to exemplarily show the differences in the measurements during direct underflight: Optically thin and very low clouds are missed by the satellite, ice and water layers are differently located in the respective measurements and signal intensities differ. Although some of these differences are not unexpected, they lead to different interpretations of the very same clouds, leading to further implications on atmospheric radiative fluxes and heating rates.

In order to asses this impact we use cloud properties from these diverging measurements to constrain idealized cloud profiles for RRTMG.

Simple Abstract:

Satellite measurements give information on where clouds are located and give and idea about of how many droplets or ice crystals there are and what size they have. However, this information is not always perfectly precise.

With an aircraft we made comparable measurements and show how the same cloud could be interpreted a bit differently, depending which measurement we use.

To evaluate these differences we use a model to investigate how the atmosphere warmed or cooled differently if one or the other measured cloud composition were true.