# Collocating satellite-based radar and radiometer measurements – methodology and usage examples

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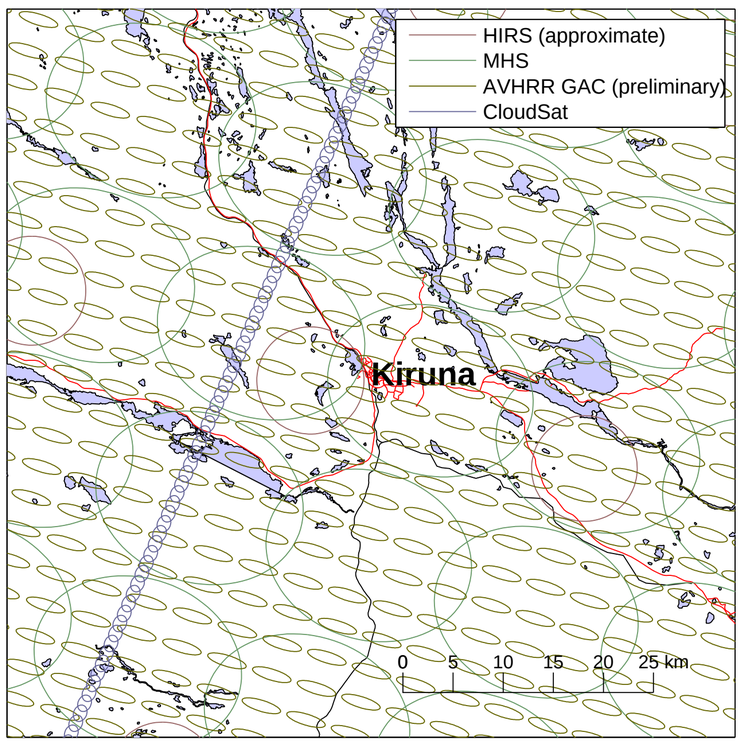
## Motivation

- Cloud Ice is important [1] but poorly understood [2, 3].
- CloudSat has an accurate Ice Water Path (IWP) measurement with poor spatial coverage.
- AMSUB/MHS has a less accurate IWP measurement with a much better spatial coverage.
- Combine the benefits through collocations between CloudSat and NOAA or MetOp satellites.

## Idea

Different instruments have different footprint sizes. We define collocations as max. 15 km, 15 minutes between footprint centerpoints.

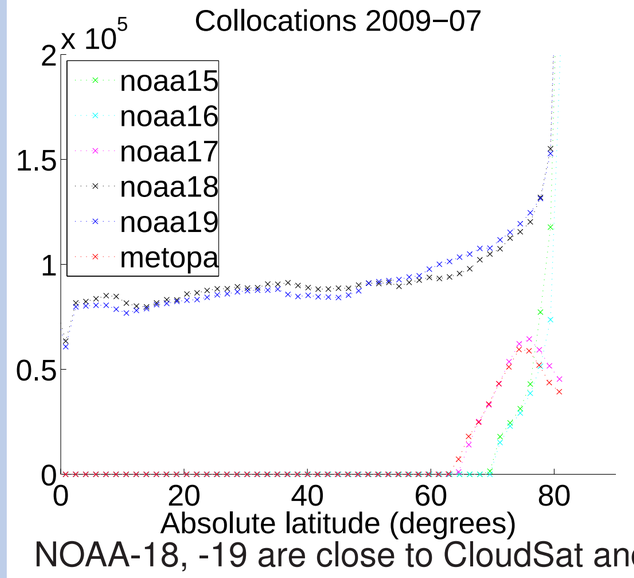
Illustration of sensor footprints over the Kiruna region

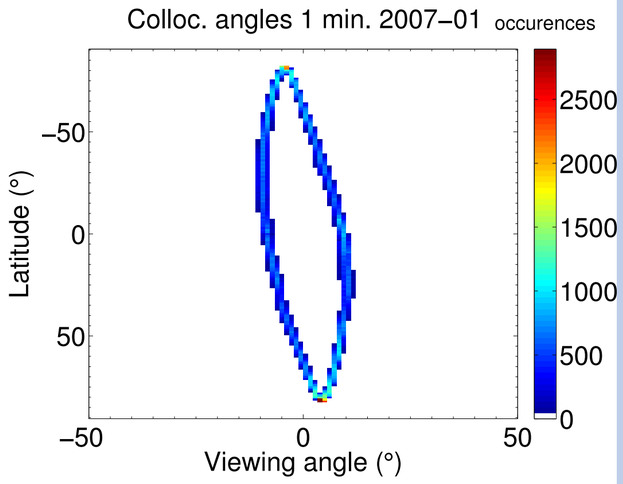



Map data ©OpenStreetMap contributors, CC-BY-SA.

MHS is a scanning instrument but CloudSat measures only the nadir. HIRS/4 scans but has no full coverage. Global AVHRR data is available only at a reduced resolution.

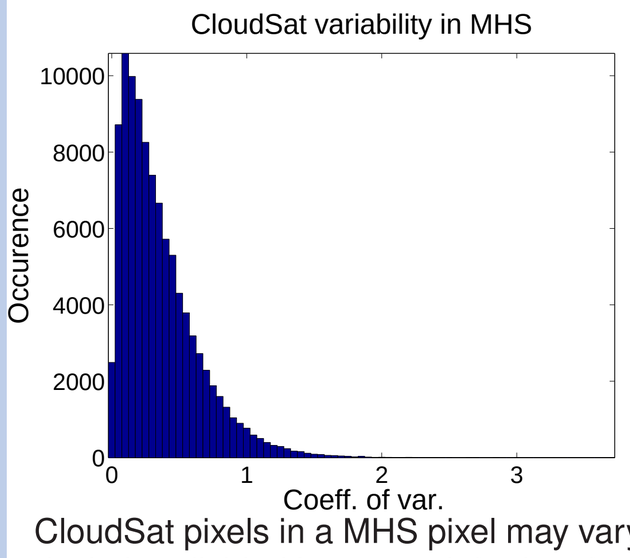
## Statistics

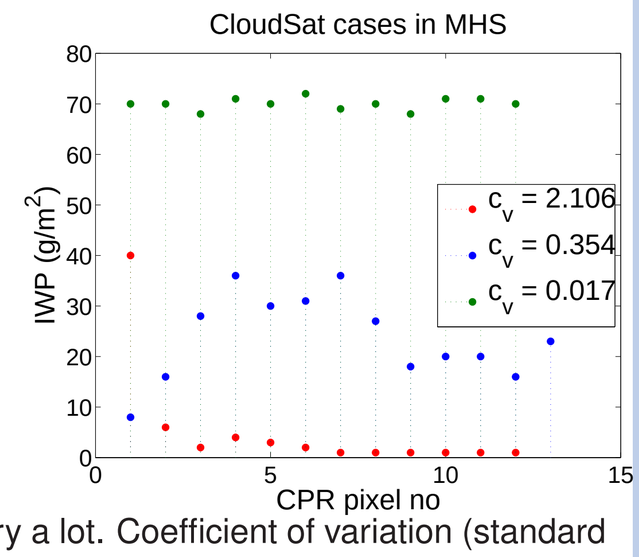



NOAA-18, -19 are close to CloudSat and collocate globally (left) but with latitude-dependent viewing angles (right). The other Polar Orbiting Environmental Satellites (POES) collocate only with CloudSat near the poles.

Unless otherwise mentioned, statistics refer to CloudSat/NOAA-18 collocations.

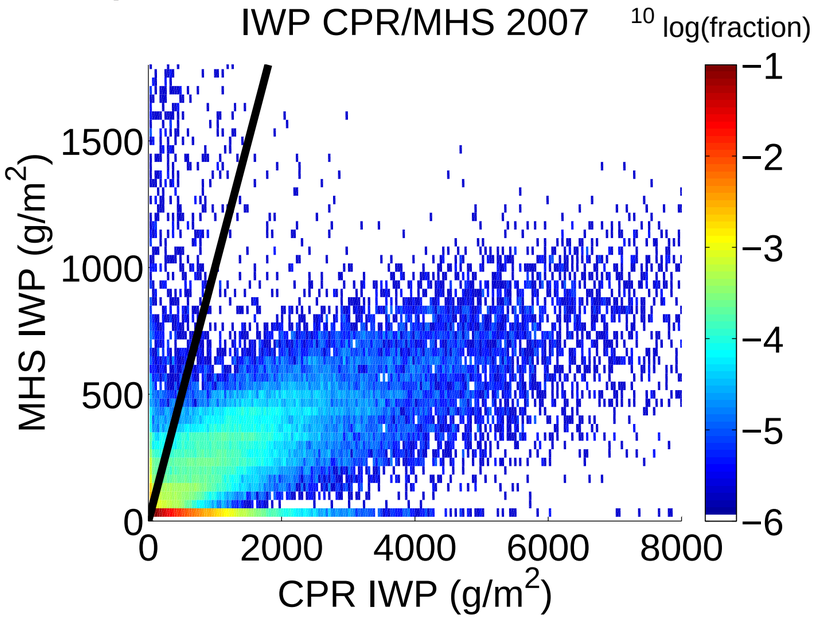



CloudSat pixels in a MHS pixel may vary a lot. Coefficient of variation (standard deviation divided by mean, left, data for 2008) and three specific cases (right).

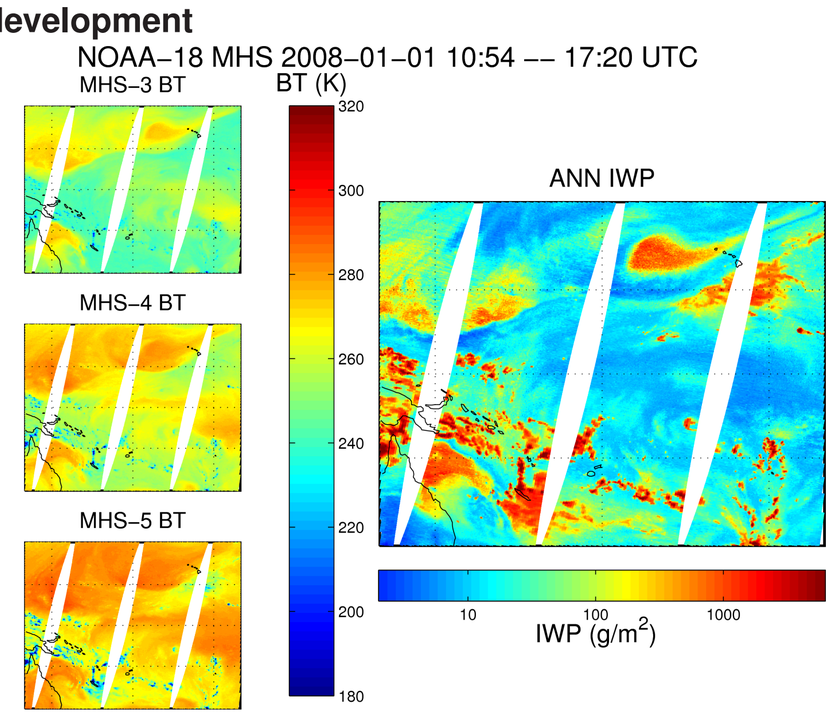
## Applications

- **Product intercomparison**



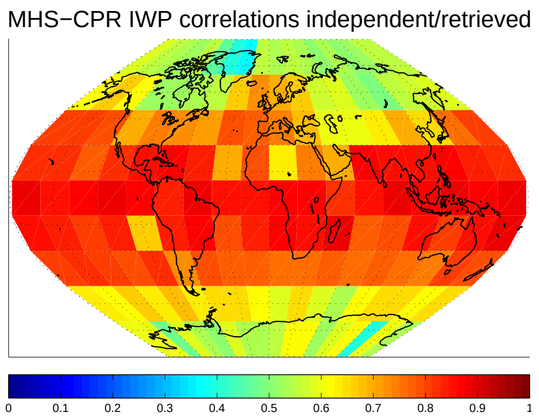

NOAA NESDIS MSPPS IWP is much drier than CloudSat IWP.

- **Product development**

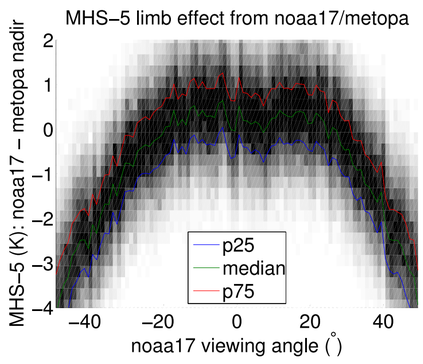



A new MHS-CPR IWP product can be developed by setting up a neural network that learns the mapping between the MHS radiances (training inputs) and the CloudSat IWP (training targets).

## Future work




CPR-MHS IWP correlated with indendent CPR IWP. Goal: make good and global




With MHS/AMSUB-collocations and (later) simulations, quantify the limb-effect for various scenarios (figure: tropical clearsky from Metop-A/NOAA-17 collocations)

The code is easily extended for other pairs of collocations: CPR with AVHRR, (collocated) MHS with AVHRR, HIRS (clear-sky) with MHS, Calipso with HIRS, and others. Applications are numerous.

## More information/References

An article was recently published [4]. For more information and access to code and data, please contact Gerrit Holl at `gerrit.holl@ltu.se`.

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