Coupling GPROF precipitation estimates and DPR reflectivity profiles over the Netherlands to (reflectivity) observations obtained from ground-based dual-polarization radars.

Linda Bogerd[1], Hidde Leijnse[2], Aart Overeem[2], and Remko Uijlenhoet[3]

[1]Wageningen University and Research Center
[2]Royal Netherlands Meteorological Institute
[3]Wageningen University and Research

November 22, 2022

Abstract

Radiance measurements from several types of passive microwave (PMW) sensors are combined in the Global Precipitation Measurement mission (GPM) to increase the temporal and spatial coverage of precipitation observations. The measurements of these sensors are converted to precipitation estimates by the GPM Profiling Algorithm (GPROF). High frequency PMW-channels are used to retrieve precipitation estimates over land, as these frequencies can measure the radiance scattered by ice particles in rain clouds. Scattering related to shallow and low-intensity precipitation events, however, is limited. Hence, radiometric signals associated with these events are hard to distinguish from the naturally emitted radiation from the Earth's surface, especially since this so-called background radiation is dependent on the surface type. A better understanding of the physical processes that occur during precipitation events can help to identify possible weaknesses in the GPROF algorithm. Hence, this study couples overpasses of GPM radiometers over the Netherlands to two dual-polarization radars from the Royal Netherlands Meteorological Institute (KNMI) in 2019. All rainy overpasses (>0.1 mm/hr) within a 75 km radius around one of the radars are selected. This coupling provides the opportunity to relate GPROFs performance to physical characteristics of precipitation events, such as the vertical reflectivity profile and dual-polarization information on the melting layer. Additionally, simultaneous observations from both the PMW sensor and the dual-frequency precipitation radar (DPR, used as a-priori database in GPROF) aboard the GPM core satellite are available. Hence, space-based and ground-based reflectivity profiles can be compared and coupled to discrepancies of the GPROF algorithm.

Unravel the contribution of different frequency PMW-channels during rainfall events.

Aim: *to explore this contribution even further by taking into account the weather type.*

Study area and period:

Overpasses of GPM constellation conical scanners during 2019 over the Netherlands.

<u>Satellite observations:</u>
GPROF precipitation estimates.
Level 1 brightness temperatures.

<u>Ground-based radar:</u>
Gauge-adjusted radar estimates.
Radar reflectivities.

Study outline:

Step 1
Match footprint of conical sensors with ground-based radar grid

Step 2
Regress brightness temperatures against reference precipitation estimates

Step 3a
Is their any weather-type dependency?

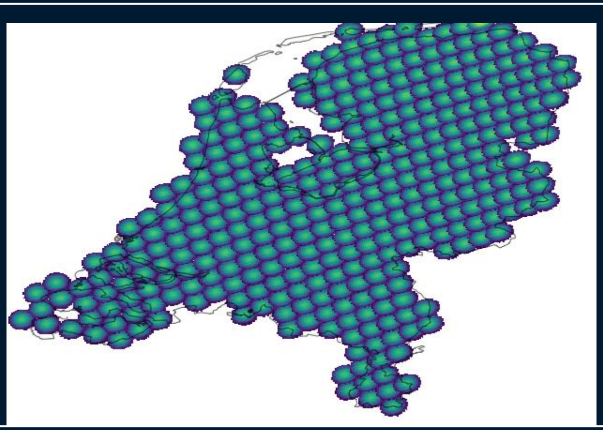
Step 3b
Select overpasses to study in depth with profiles (cases)

Matching:

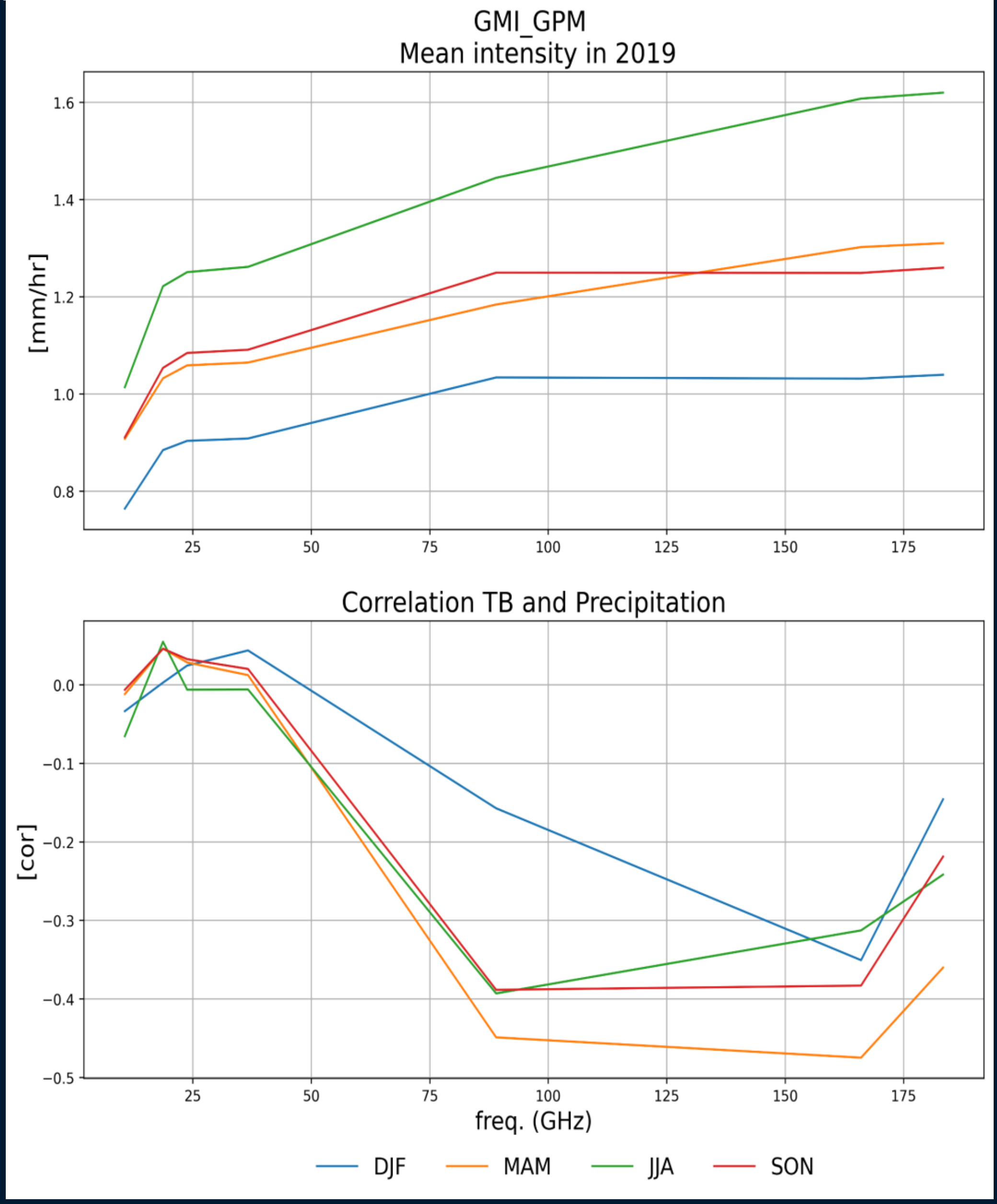
Gaussian weighted ellipses.

Footprint specifications are frequency dependent.

Example simulated footprints:



Preliminary results overpasses GMI over the Netherlands in 2019 (intensity is the reference precipitation resampled at GMI footprint)



AGU poster session 2021

Linda Bogerd, PhD candidate (Wageningen University and Research, The Netherlands). Linda.Bogerd@wur.nl
Supervisors: Hidde Leijnse, Aart Overeem, Remko Uijlenhoet

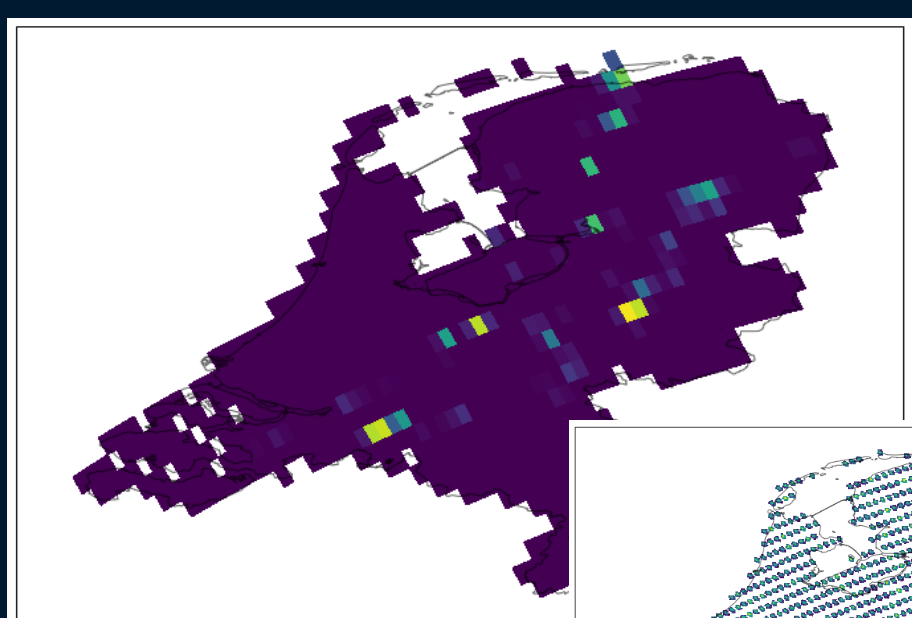
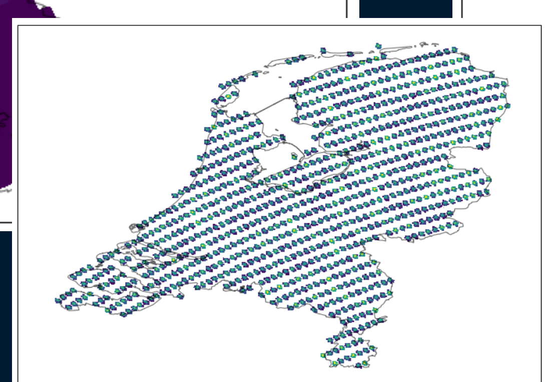
First, one step back: how do different footprint sizes and the way of coupling affect the satellite observations

Aim: *to unravel how different footprint sizes and way of matching a ground-based profile affect GPROF its performance statistics.*

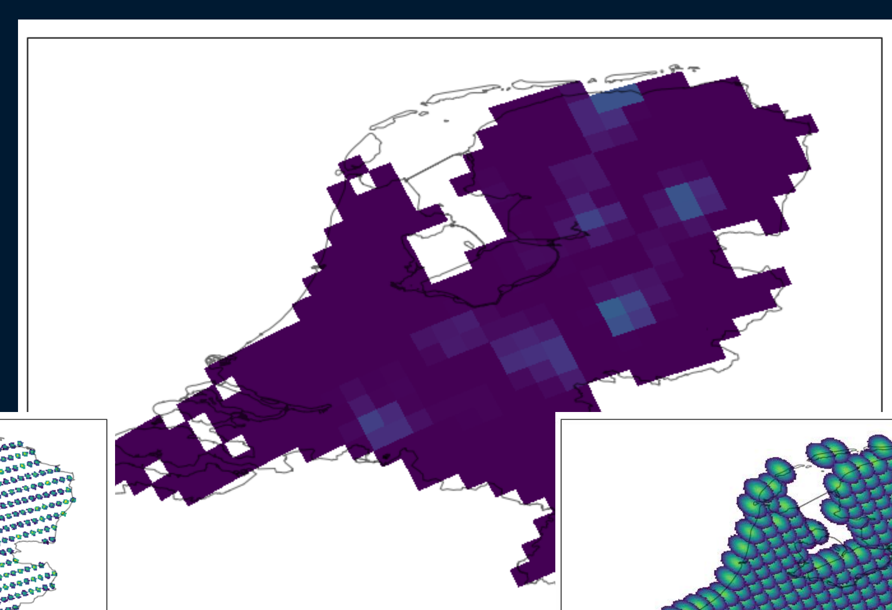
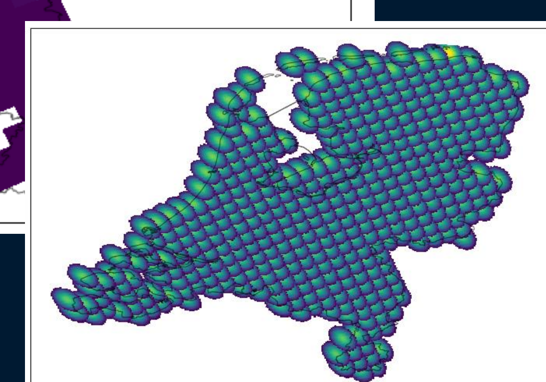
Study outline:

Study area, period and data:	Step 1 (same)	Step 2	Step 3	Step 4
Same	Match footprint of conical sensors with ground-based radar grid	Quantify effect footprint size on reference precipitation estimate	Validate use of ground-based radar: compare profiles of ground- vs satellite-based radar	Compare coupling slanted and straight vertical radar profile.

Example of effect footprint size on intensity reference precipitation estimates (AMSR-2)

Simulated footprints: Left, AMSR-2 10 GHz

Right: AMSR-2 89 GHz

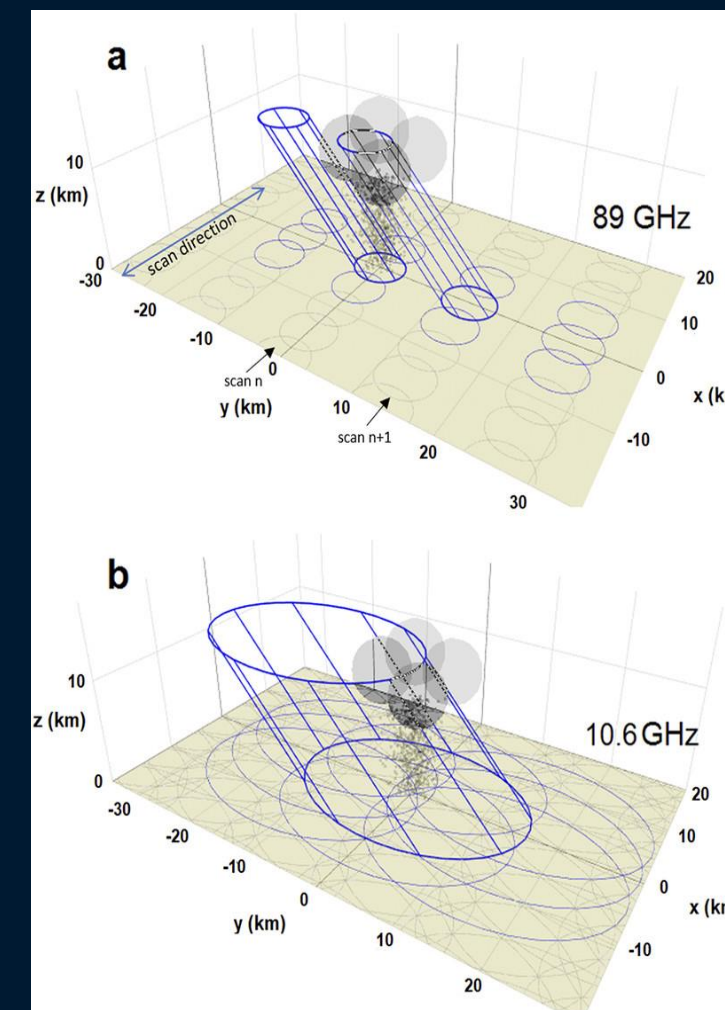


Illustration step 4

Retrieved from C. GUILLOTEAU and E. FOUFOULA-GEORGIOU (2019). *Beyond the Pixel: Using Patterns and Multiscale Spatial Information to Improve the Retrieval of Precipitation from Spaceborne Passive Microwave Imagers*

AGU poster session 2021

Linda Bogerd, PhD candidate (Wageningen University and Research, The Netherlands). Linda.Bogerd@wur.nl
Supervisors: Hidde Leijnse, Aart Overeem, Remko Uijlenhoet