Barreyat, M., P. Chambon, J.-F. Mahfouf, G. Faure, and Y. Ikuta, 2021: A 1D Bayesian inversion applied to GPM Microwave Imager observations: Sensitivity studies. *J. Meteor. Soc. Japan*, **99**, 1045−1070.
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Plain Language Summary:
The assimilation of cloudy and rainy microwave observations is under investigation at Météo-France with a method called '1D-Bay+3D/4D-Var'. This method consists of two steps: (i) a Bayesian inversion of microwave observations and (ii) the assimilation of the retrieved relative humidity profiles in a 3D/4D-Var framework. In this paper, two estimators for the Bayesian inversion are used: either a weighted average (WA) or the maximum likelihood (ML) of a kernel density function. Sensitivity studies over the first step of the method are conducted for different degrees of freedom: the observation error, the channel selection and the scattering properties of frozen hydrometeors in the observation operator. Observations over a two-month period of the Global Precipitation Measurement (GPM) Microwave Imager (GMI) on-board the GPM-Core satellite and forecasts of the convective scale model Application of Research to Operations at Mesoscale (AROME) have been chosen to conduct these studies.

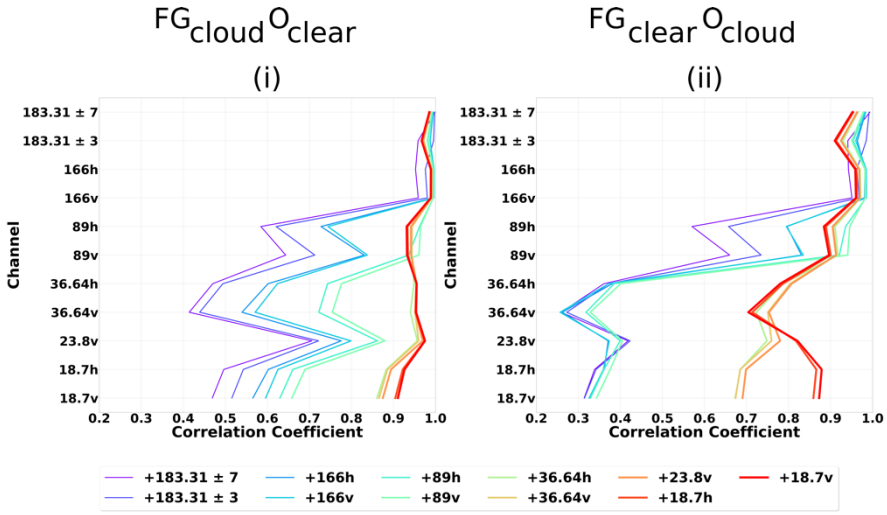

Figure 1. Correlation coefficient between the observations (GMI brightness temperatures) and the Bayesian inversion using the ML experiments for which channels have been progressively added within the inversion from 183±7 GHz to 18.7V GHz. Figure (i) shows the results for the samples FGcloudOclear (cloudy profiles in the First-Guess but clear in the observations) and column (ii) those for FGclearOcloud (clear profiles in the First-Guess but cloudy in the observations). Curves are drawn thicker with the number of channels increasing and statistics are computed over a two-month period. The correlations are low for the channels not used in the inversion and high for the other ones. When adding the low frequencies within the inversion the correlations increase progressively for both samples. In summary, the channels can be split in two sets having contrasted behaviors: the frequencies below 37 GHz and those above.

Highlights:

- Low observational errors tend to be associated with the retrieved profiles with the highest consistency with the observations.
- The validity of the retrieved profiles varies vertically with the set of channels used.
- The radiative properties of hydrometeors used in the radiative transfer simulations have a strong influence on the retrieved atmospheric profiles.
- The ML estimator provide retrievals which do not depend on the observation error but which are less constrained than the WA estimator when only few frequencies are considered in the inversion.