EGU24-8065, updated on 04 Oct 2024
https://doi.org/10.5194/egusphere-egu24-8065
EGU General Assembly 2024

Measuring dynamical properties of atmospheric convection using C2OMODO: a tandem of microwave radiometers

Thomas Lefebvre[1], Helene Brogniez[2], Laura Hermozo[3], and Frédéric Chevalier[4]
[1]LATMOS, Université Paris-Saclay, Guyancourt, France (thomas.lefebvre@latmos.ipsl.fr)
[2]LATMOS, UVSQ, Guyancourt, France (helene.brogniez@latmos.ipsl.fr)
[3]CNES, Toulouse, France (Laura.Hermozo@cnes.fr)
[4]LSCE/IPSL, Gif sur Yvette, France (frederic.chevallier@lsce.ipsl.fr)

Convective clouds serve as a primary mechanism for the transfer of thermal energy, moisture, and momentum through the troposphere. The lack of understanding of the convective updraft properties and their relationship to environmental factors limit our ability to represent deep convection and its feedbacks in large-scale circulation models. Satellites are the only viable means of efficiently sampling tropical convective clouds, predominantly found in ocean-covered regions.

The C2OMODO Project, proposed by CNES as contribution to the AOS NASA program scheduled for 2029, aims to target the vertical development of deep convective cells. The proposed concept is a tandem of identical microwave radiometers aboard two different satellites in the same orbit, separated by a small-time delay, between 1 and 2 minutes. Each radiometer will measure at 89 GHz, 183 GHz (6 Channels) and 325 GHz (6 Channels), with footprints of 10, 5, and 3 km, respectively. These observations inform about the vertical distribution of ice, thanks to the scattering of radiation (in the line of ICI, STERNA, SAPHIR instruments). The derivative-time measurements of the C2OMODO tandem will provide information on the updraft dynamics of growing convective cells. Furthermore, C2OMODO will contribute to enhance the understanding of the life cycle of convective systems and improve the representation of deep convection in both weather prediction and climate models.

The aim of the presented study is to introduce the inversion method developed to estimate convective mass flux of ice from C2OMODO measurements, based on the variational approach (1D-VAR). Assimilation approaches, based on Bayesian theory, are commonly applied to the inversion of satellite observations. To simulate C2OMODO measurements, the radiative transfer model, RTTOV, serves as the forward operator while the mesoscale model MESO-NH is used as nature-like representation for atmospheric state. Only growing convective cells are selected in this work. The general 1D-VAR approach is adapted to integrate derivative-time measurements, thereby directly incorporating the dynamical properties in the restitution process. In this presentation, we describe the ongoing development of the variational approach. Additionally, the restitution of vertical ice mass flux and the performance of the 1D-VAR be discussed.

The ongoing development of this method has yielded promising preliminary results, instilling

optimism about the wealth of information that will be accessible through C2OMODO.