International Master 2 Atmospheric Sciences: Research Training 2022-2023

Laboratory: LOA

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Collaborator:

Eventually,

CaPPA Work Package:

Quantitative study of water vapor field evolution in the vicinity of clouds.

Atmospheric water vapor plays a major role in the Earth-Atmosphere energy balance and in the hydrological cycle. Indeed, it is the primary greenhouse gas in the Earth's atmosphere, contributing to the absorption of solar and terrestrial radiation. In addition, atmospheric water vapor is essential to cloud formation, development and dissipation. So, improving our knowledge about water vapor content spatial and temporal variability around clouds is of primary importance. Moreover, the latent heat released during phase changes is affecting the vertical structure of the atmosphere and water vapor content can vary rapidly with altitude. Despite this primary importance, it still remains a challenge to precisely quantify water vapor variation around clouds.

The aim of this internship will be to investigate and quantify the variability of water vapor around clouds using Large Eddy Simulations (i.e. high resolution numerical simulations with a spatial resolution of 100 m and a temporal resolution of 1 minute) obtained with the RAMS-CSU numerical model. More precisely, the first step will be to quantify the integrated water vapor content variation around clouds as a function of the life cycle (variation of horizontal gradients), and in a second step to investigate the water vapor content vertical variability. The detailed analysis of these 2D and 3D effects will give insights on how entrainment (mixing of cloudy and environmental air at cloud edges) and detrainment (cloudy air left in the environment) affect the whole cloud life cycle and how it could be studied and inferred from space measurements.

This study will be a complementary part of a current PhD work focusing on the water vapor retrieval around clouds for future space missions such as 3MI (Multi-viewing Multi-channel Multi-polarization Imager which launch is planned on 2023) or C^3IEL (Cluster for Cloud evolution, Climate and Lightning). It will give some constrains on what is possibly retrievable from space and what is below the instrument and/or algorithm sensitivity.

Key words: Water vapor content, cloud formation/dissipation, cloud entrainment / detrainment, high resolution numerical simulations, satellite retrievals.