

## International Master 2 Atmospheric Environment: Research Training 2018-2019

Laboratory: LOA

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CaPPA Work Package: WP-5 Cloud-aerosol interactions

### Oscillations and collective behavior of cloud-rain interaction

Oscillators abound in nature. Indeed, they appear in areas ranging from the study of biological populations to quantum mechanics. While the behavior of individual oscillators is well understood, new effects arise when many oscillators are coupled together, such as collective synchronization of the individual oscillators. These effects constitute an ongoing and active branch of research in physics, but with limited results across the atmospheric sciences.

However, it has recently been observed that marine stratocumulus cloud-precipitation systems also undergo periodic oscillations. For instance, according to some recent bibliographic references, observations of quasi-periodic oscillations in the precipitation rate have been observed in the Atlantic and Pacific Oceans as well as modeled theoretically.

A goal of this Master 2 internship will be to examine the oscillations and the interactions of many clouds. A novel modeling framework through which to examine these oscillations is the Kuramoto model, which is used to study the synchronization and collective behavior of many individual oscillators. In particular, the student will use a new model of cloud-rain interaction and the Kuramoto approach to examine how precipitation generated oscillations of the cloud field can be understood as a collective behavior of many coupled oscillators.

Skills: Python, understanding of statistical and theoretical physics

**Key words:** Cloud-rain interaction, oscillation, Kuramoto model