Ecole Doctorale des Sciences Fondamentales

Title of the thesis:

Study of the precipitation structure modifications in view of the atmospheric aerosol content variability: observations and modelling.

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Summary :

At the processes scale, clouds and precipitation life cycle are controlled by the prevailing meteorology and aerosol particles available in the atmosphere, particularly the presence of cloud condensation and/or ice nuclei (CCN/IN). For liquid clouds it is well-established that an excess in atmospheric dust concentration can suppress cloud precipitation capability. Indeed, an excess of CCN causes an increase in the number of droplets but of smaller sizes which in turn lower the collection of small drops by significantly larger ones therefore preventing the mechanism that triggers precipitation. However, this argument does not consider that dust particles can also act as ice nuclei and provoke rainfall such that this hypothesized regional "desertification feedback loop" remains an open issue that needs to be addressed. Hence, one of the objectives of this work is to use a bin microphysical model (DESCAM) coupled with a meso-scale circulation model (WRF) to assess the importance of the ice phase for triggering the precipitation and more precisely how the ice nucleating properties of dust particles can reinforce or weaken precipitation.

Likewise, the other underlying goal of the project is to validate the capacity of the models to provide reliable precipitation field estimates at different spatial and temporal scales in order to investigate the impact of aerosols on precipitation yields, both in intensity and geographical distribution, and, thus estimate the climate change impact on precipitation and, hence, water resources. To do so, it is necessary to confront model outputs with extensive and accurate precipitation observations for an ensemble of events in different meteorological conditions. Then, both the dynamical and temporal evolution of the precipitation system and the instantaneous and cumulated rain estimates can be assessed between observations and simulations.

To provide the necessary data fort such a study on a key climatic region such as the Eastern Mediterranean basin under the influence of Saharan dust episodes, an international campaign is designed to take place in Crete over the winter/spring period of 2017-2018, where LaMP will field its mobile high time and space resolution X band precipitation radar together with vertically pointing Micro Rain Radars to monitor the precipitation patterns and rain structure.