UNIVERSITE BLAISE PASCAL
CLERMONT-FERRAND
34, avenue Carnot
63006 Clermont-Ferrand
Cedex 1 - France
www.univ-bpclermont.fr

Chimie
Mathématiques
Sciences de l'Univers
Physique

Ecole Doctorale des Sciences Fondamentales

Title of the thesis: Microphysical, optical and radiative properties of Arctic mixed phase clouds

Supervisor : SZCZAP Frédéric
Laboratory : LaMP
University : Université Blaise Pascal
Email and Phone : szczap@opgc.univ-bpclermont.fr, 04 73 40 73 57
Possible co-supervisor : JOURDAN Olivier
Laboratory : LaMP
University : Université Blaise Pascal

Summary :
Clouds have a significant effect on the Earth radiation budget. They reflect the solar radiation and reduce the warming of the Earth (albedo effect). They also create a greenhouse effect by trapping the thermal radiation emitted from the Earth surface, reducing the radiative cooling of the Earth. Cloud feedback remains however the largest uncertainty in the study of climate sensitivity for almost twenty years. Arctic region is more sensitive to climate change than any other regions of the world. Clouds and in particular mixed-phase clouds remain one of the greatest sources of uncertainties in the modelling of the Arctic response to climate change due to an inaccurate representation of their variability and their quantification. In addition, the Arctic is known for the frequent occurrence of mixed-phase clouds especially near the surface, wherein liquid droplets and ice crystals coexist.

In the first step, the Phd student will analyze ground and airborne “in situ” measurements in order to characterize the horizontally and vertically thermodynamical phase as a function of averaging scale for different large scale meteorological conditions. He will focus on effects of ice crystal shape and the ice/liquid partition on cloud optical properties. He will provide a phase function model, from visible to thermal wavelengths.

In the second step, the Phd student will modify the 3DCLOUD generator in order to simulate Arctic mixed phase cloud sharing statistical properties observed in “in situ” measurements.

In a third step, the Phd student will perform a sensitivity study of ground heating rate and satellite cloud properties retrievals in relation with inhomogeneity of microphysical and optical properties of 3DCLOUD mixed phase clouds, with the help of 3D radiative transfer code (SHDOM, 3DMCPOL) and the McRALI lidar/radar simulator. At last, the Phd student should provide optical and radiative model of mixed phase cloud pertinent for global climatic model and for satellite cloud remote sensing algorithms (RADAR and LIDAR especially).

Key words : cloud, Arctic, mixed phase, microphysic, optic, phase function, satellite, inhomogeneity, radiative transfer, “in situ” measurements, sensitivity study

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