Post doctoral or research associate fellowship at CNRM-GAME (Météo-France CNRS), Toulouse, France

Turbulence modelling inside and near convective clouds: development and validation of a new parameterization at hectometre and kilometre scales
24 months

Acknowledged as one of the leading international laboratory in matter of meteorological research, CNRM is the main Météo-France lab in R&D, in partnership with CNRS under the label GAME. Its main missions are:
- to have a better understanding not only of the atmosphere and its interfaces (soil, vegetation, snow cover, ocean) and the processes governing their interactions,
- but also of atmospheric models: weather forecasting in general but also of severe events, climate changes, seasonal forecasting, peaks of pollution, avalanche occurrences, floods …

The CNRM-GAME is involved in the Multiscale process studies of intense convective precipitation events in Mediterranean (MUSIC) project funded by the French national research agency (ANR). This project contributes to the Hydrological cycle in Mediterranean experiment (HyMeX) Program (http://www.hymex.org/).

As part of this ANR MUSIC project, the CNRM-GAME offers a 24-month post-doctoral or research engineer position to work on parameterization of turbulence in and near convective clouds, starting in June 2015 or as soon as possible after this date.

Context:

The Mediterranean region is frequently affected by heavy precipitation events (HPE) that produce flash-floods and landslides. They are the most damaging natural risk in the Mediterranean region that costs each year several billions euros of damages and fatalities. Mesoscale convective systems that stay over the same area during several hours are the main responsible for high rainfall totals that produce flash-flooding. The MUSIC project strongly relies on the two-month HyMeX field campaign that provides a novel and unique dataset of observations within about twenty convective systems and of their ambient flow.

The overarching objective of the MUSIC project is to provide a better understanding and modelling of convective HPE in order to improve their forecast by state-of-art kilometre and sub-kilometre scale Numerical Weather Prediction (NWP) models. The project firstly concentrates on the key physical parameterizations that strongly influence the forecasts of deep convection at kilometre and sub-kilometre scales (microphysical processes modelling, turbulence modelling in its “grey zone”).

In the last years, the “grey zone” for turbulence has been studied for the boundary layer with the aim to improve the turbulence parameterization in this intermediate range. The representation of turbulence inside and near the clouds needs also special attention as the turbulent mixing inside convective systems and the exchanges with the environmental air are insufficient at kilometre resolution.

Description of work:

In recent studies at CNRM-GAME, to address the turbulence parameterization inside or near convective clouds, a LES (Large Eddy Simulation) in simplified atmospheric conditions has been performed with the Meso-NH model to serve as a reference simulation of deep convection. By comparing parameterized fluxes with the reference fluxes at coarser resolutions (500m, 1km, and 2km) it has been shown that the current turbulence scheme used in the Meso-NH model is deficient inside convective clouds. Alternative approaches have been explored to improve the turbulence parameterization and show promising results.

The main objective of this work is to continue this study and lead to a new turbulence parameterization valid for sub-kilometre and kilometre resolutions and for different weather conditions.

The first step is to generalize the modified parameterization to different hectometre and kilometre resolutions in the LES framework. The analysis will be conducted using appropriate diagnostics to characterize the mixing with the environment.

In a second step, some convective cases will be selected from the twenty IOPs sampled during the HyMeX field campaign and the modified turbulence scheme will be tested for these real cases. For that, simulations with 500m, 1km and 2km horizontal grid spacings will be performed and compared with observations of HyMeX IOPs, including with the in-cloud turbulence observations.

Supervision team: The work will be conducted under the main supervision of Didier Ricard and Christine Lac from CNRM-GAME (http://www.cnrm-game.fr/gmme) in Toulouse, with the possibility of accommodation on site (basic student rooms) for the first months.

Required qualifications: The candidates should have either a PhD or an engineer diploma in atmospheric, environmental sciences or computational fluid dynamics and should speak English fluently. Experience in mesoscale modelling or knowledge on turbulence processes would represent considerable additional skills. Good programming skills (Fortran, Unix/linux shell scripts) are required.

Duration and salary: The successful applicant will be recruited for 24 months with a net monthly salary between 1600 and 2700 euros, commensurate with experience and qualifications. This includes social services and health insurance.

Contact for applications: Application should be done by e-mail to Didier Ricard (didier.ricard@meteo.fr) and Christine Lac (christine.lac@meteo.fr) by sending a CV, a statement of research interests and the names of at least two referees including e-mail addresses and telephone numbers before **31 March 2015**.