

**CALL FOR APPLICATION**  
**15-MONTH POST-DOCTORAL FELLOWSHIP AT CNRM**  
**(TOULOUSE, FRANCE)**

*Applications are invited for a 15-month post-doctoral position starting early January 2018, in the climate research group of the CNRM in Toulouse, France (<http://www.cnrm.meteo.fr/>) to work on the following subject: "Parameterization of sub-grid-scale effects on surface fluxes over ocean using high-resolution simulations." The deadline for application is **30 September 2017**.*

*Context and objectives:*

The representation of air-sea interactions is a fundamental aspect of climate modelling, and controls many features of the climate mean state and its variability, especially over the tropical oceans. It includes a wide range of issues: parameterizations of atmospheric and oceanic boundary layers, estimation of air-sea fluxes, time-space numerical schemes, matching of different grids at the interface, coupling algorithms... Most climate models use bulk aerodynamic methods to compute turbulent fluxes of momentum, energy and water vapour at the air-sea interface (e.g., Fairall et al. 1996, 2003). Such methods are mostly based on local measurements and assume horizontally homogeneous parameters over the grid scale of a climate model. This is a strong assumption: over a domain as large as a climate model grid cell, the occurrence of boundary layer thermals and deep convection updrafts or downdrafts can generate strong sub-grid-scale variability of wind, temperature and moisture which impacts surface fluxes averaged over the whole grid cell. Some formulations to account for these effects, often known as gustiness effects, have been proposed in the literature (e.g., Redelsperger et al. 2000), but are rarely used in climate models.

The present post-doctoral fellowship seeks to address this important topic by developing a parameterization of these effects to be tested and implemented in the atmospheric component of the CNRM climate model. The post-doctoral fellow will analyse the sub-grid-scale variability of surface wind, temperature and moisture fields in high-resolution simulations (convection-permitting and large-eddy simulations) available at the CNRM in the context of other activities. He/she will document how the sub-grid-scale variability of surface turbulent fluxes of momentum, energy and water vapour can be related to the climate model grid-scale fields. He/She will then develop a parameterization of these sub-grid-scale effects on surface turbulent fluxes, using the large-scale properties of the flow and/or the thermal/convection properties as computed internally in the model by the convection parameterization. Finally, he/she will independently evaluate these developments and their impacts in the context of the Cindy-Dynamo field campaign, using both in-situ observations and convection-permitting simulations as references.

This position is funded by the French National Agency for Research (ANR) through the COCOA (Comprehensive Coupling approach for the Ocean and the Atmosphere) project (<http://www.agence-nationale-recherche.fr/?Projet=ANR-16-CE01-0007>).

*Required qualifications:*

- 1) *A Ph.D. in atmospheric sciences obtained before the starting date of the contract.*
- 2) *An expertise in modelling of turbulent surface fluxes, in convection processes or convection parameterization, analysis of high-resolution simulations (convection-permitting of large-eddy simulations)*
- 3) *An expertise in Fortran and Unix, and an experience in high computing.*
- 4) *A good command of English.*

Practical information:

The successful applicant will be contracted by Météo-France and will be based at the “Centre National de Recherches Météorologiques” (Toulouse, France; <http://www.cnrm.meteo.fr/>) within the climate research group. The opened position will start as soon as possible, possibly as early January 2018 for a 15-month duration. The net salary is commensurate with qualifications and experience, ranging from 2500€ to 3500€, after most of the taxes and health insurance premiums have been deducted. Note there might be an additional income tax on top of that, but depending on nationality.

*For full consideration, applicants are asked to submit a curriculum vitae (including research experience, publications and conferences, and computing skills), an application letter including a detailed statement of research interest and the names, phone and email address of 2 referees. Applications should be sent by email before 30 September 2017 to: romain.roehrig@meteo.fr with copy to aurore.voltaire@meteo.fr*

For more details about this call, please contact:

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Bibliography:

Fairall C. W. et al., 1996: Bulk parameterization of air-sea fluxes for Tropical Ocean-Global Atmosphere Coupled-Ocean Atmosphere Response Experiment. *J. Geophys. Res.*, **101**, 3747-3764.  
Fairall C. W. et al., 2003: Bulk parameterization of air-sea fluxes: updates and verification for the COARE algorithm. *J. Climate*, **16**, 571-591.  
Redelsperger J.-L., F. Guichard and S. Mondon, 2000: A parameterization of mesoscale enhancement of surface fluxes for large scale models. *J. Climate*, **13**, 402-421.