H2020-MSCA European Training Network

Cloud-MicroPhysics-Turbulence-Telemetry: An inter-multidisciplinary training and research network for enhancing the understanding and modeling of atmospheric clouds ”

14 PhD positions in the EU Horizon 2020 Marie Skłodowska-Curie ACTION ITN ETN Project COMPLETE

Applications are invited for **14 PhD** positions (“Early Stage Researchers”) to be funded by the Marie-Skłodowska-Curie Innovative Training Network “**COMPLETE – Cloud-MicroPhysics-Turbulence-Telem**etry: **An inter-multidisciplinary training network for enhancing the understanding and modeling of atmospheric clouds** within the Horizon 2020 Programme of the European Commission. **COMPLETE** is a consortium of high profile universities, research institutions and companies located in **Italy, France, Germany, Israel, Poland and UK**.

Number of positions available
14 PhD positions

Research Fields
Turbulence, Atmospheric physics and dynamics, Environmental monitoring, Scientific computing and data processing

Keywords
Warm clouds, turbulent entrainment, remote sensing, radiosondes, LIDAR, aerosol spectrometers, Lagrangian tracking, droplet generators, in-situ experiments, laboratory experiments

Career Stage
Early Stage researcher (ESR)

Benefits and salary
The successful candidates will receive an attractive salary in accordance with the MSCA regulations for Early Stage Researchers. The exact salary will be confirmed upon appointment and is dependent on the country correction factor (to allow for the difference in cost of living in different EU Member States). The salary includes a living allowance, a mobility allowance and a family allowance (if already married). The guaranteed PhD funding is for 36 months. In addition to their individual scientific projects, all fellows will benefit from further continuing education, which includes internships and secondments, a variety of training modules as well as transferable skills courses and active participation in workshops and conferences.

Eligibility criteria
Applicants need to fully satisfy three eligibility criteria:

- **Early-stage researchers** (ESR) are those who are, at the time of recruitment by the host, in the first four years (full- time equivalent) of their research careers. This is measured from the date when they obtained the degree which formally entitles them to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the research training is provided, irrespective of whether or not a doctorate was envisaged.
- **Conditions of international mobility of researchers:** Researchers are required to undertake transnational mobility (i.e. move from one country to another) when taking up the appointment. At the time of selection by the host organization, researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organization for more than 12 months in the 3 years immediately prior to their recruitment. Short stays, such as holidays, are not taken into account.
- **English language**: Network fellows (ESRs) must demonstrate that their ability to understand and express themselves in both written and spoken English is sufficiently high for them to derive the full benefit from the network training.

A more detailed information on the eligibility criteria can be found in t**he Marie Skłodowska-Curie Actions** H2020

Guide for Applicants.

General contact persons for COMPLETE

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Recruitment procedure

Description of the available positions is listed below. All candidates are invited to get in touch with the host institution contact persons. As above specified, applicants will need to prove that they are eligible according to the ESR definition, international mobility requirement and English language proficiency.

Project Abstract: Clouds are the largest source of uncertainty in weather prediction, climate science, and remain a weak link in modeling atmospheric circulation. This is rooted in the fact that clouds depend on the physical and chemical processes over a huge range of scales, from the collisions of micron-sized droplets and particles to the airflow dynamics on the scales of thousands of meters. Since ambiguities related to representation of clouds in climate models prevail, explorative observations are still needed. The challenge is on the one hand to establish connections across this range of scales, from aerosol and particle microphysics to macro-scale turbulent dynamics in clouds, and on the other to combine knowledge and training across vastly different scientific and engineering disciplines. The aim of COMPLETE is to develop an inter/multidisciplinary training network that will prepare high-potential early stage researchers (ESRs) with both scientific and industrially-oriented skills that will advance our understanding in these multi-scale complex natural phenomena. COMPLETE will vastly improve Europe's position as a global leader in technology, science and innovation to address climate change challenges. The training programme will combine the scientific investigation of specific aspects of cloud physics and related turbulent dynamics with training in key professional skills. This comprises an exceptional experimental programme that includes field experiments, laboratory and numerical simulations, the design and development of advanced fast temperature probes, velocity MEMS and innovative atmospheric mini radio-sondes; all aimed at the production of new, Lagrangian based, cloud fluctuation datasets, required to reduce the fragmentation of results and knowledge in this field.

Beneficiaries: *Politecnico di Torino, Imperial college London, Max Planck Institut für Dynamik und Selbstorganisation, Universytet Warszawski, Tel Aviv University, CNRS, Envisens, Pentalum, Sitael*

Partner organizations: *Max Planck Institut für Meteorologie, Istituto per le Scienze dell'Atmosfera e del Clima/CNR, Bayerische Forschungsallianz, Umweltforschungsstation Schneefernerhaus, MTF z.o.o., I3P, Ramot, Regione Piemonte*

The 14 available positions

ESR 1: Transport across warm turbulent cloud interfaces.

Objectives: Numerical analysis by using Lagrangian Turbulence spectral solvers of the transport of energy, water vapor and droplets across the interface warm cloud/clear air in a stably and non-stably stratified environment. Lagrangian analysis of small inertial water droplets in suspension (1 - 100 μm) across turbulent-non turbulent cloud interfaces and inside warm clouds. The system includes effects associated to buoyancy and condensation/evaporation.
Expected Results: Measure of the spreading rate of the vapor across the interface and of the entrainment of dry air or detrainment of moisture. Determination of the flow rates and their modelling. Creation of a Lagrangian database for dispersed small water droplets.
Host: Politecnico di Torino, Italy
Contact person: Prof.Daniela Tordella (daniela.tordella@polito.it), Dr. Michele Iovieno (michele.iovieno@polito.it)

ESR 2: Floating cloud radiosonde data analysis from infield and laboratory experiments.

Objectives: Analysis of data produced by innovative expendable bio-compatible radio-probes released and floating in warm clouds. Comparison of field data with numerical simulations
Expected Results: Advanced spectral and statistical data from such observation. Contribution to shaping our understanding of microphysical processes in clouds. Generation of a Lagrangian data base for pressure, temperature,

humidity, aerosol concentration, velocity and acceleration fluctuations inside warm clouds over lands and alpine environment.
Host: Politecnico di Torino, Italy
Contact person: Prof.Daniela Tordella (daniela.tordella@polito.it), Dr. Michele Iovieno (michele.iovieno@polito.it)

ESR 3: Interfacial dynamics of aerosols and droplets.
Objectives: Study of particles (aerosols/droplets) in interfacial dynamics either in shear-free mixing layers where the interface is between two different turbulent intensity fields or in cases where the interface will be between a turbulent and a non-turbulent field. Study of interfaces as they appear in wakes and jets to simulate in the laboratory and the computer the kind of turbulent/non-turbulent interfacial physics which may be found in clouds under certain conditions. In all these flows, entrainment of inertial particles but also the effect of entrainment and of the presence of the interface on turbulence dynamics will be a focus of research.
Expected Results: A model for how the interface modulates the acceleration field, the behaviour of swarms of droplets/particles.
Host: Imperial College London, UK
Contact persons: Prof. J.Christos Vassilicos (j.c.vassilicos@imperial.ac.uk), Prof. Maarten van Reeuwijk (m.vanreeuwijk@imperial.ac.uk)

ESR 4: The effect of buoyancy on the dynamics of aerosols and particles.
Objectives: Numerical study (Direct Numerical Simulation) of the interaction between the flow interface and an approximately collocated buoyancy interface. Influence of the nonlinear dependence of buoyancy on mixing fraction in clouds, and how these enhance/reduce turbulent exchange. Dynamics of buoyant inertial particles.
Expected Results: Parameterisations of the dynamics of aerosols/droplets for incorporation into GCMs and atmospheric dispersion models;- Turbulence models for LES/RANS.
Host: Imperial College London, UK
Contact persons: Prof. J.Christos Vassilicos (j.c.vassilicos@imperial.ac.uk), Prof. Maarten van Reeuwijk (m.vanreeuwijk@imperial.ac.uk)

ESR 5: Drop dynamics in turbulent flows.
Objectives: Experimental measurement of the acceleration and relative velocity of micrometric droplets in warm clouds in situ at the research station Schneefernerhaus (WP 3,4). Numerical scheme capable of reproducing the experimental results (WP 3,4).
Expected Results: New experimental data on the dynamical behaviour of drops in turbulent flows found in warm clouds. Simultaneous development of a numerical model that would examine the same system, but over a larger range of relevant parameters, in order to better assess the importance of the critical environmental variables on the process.
Host: Max Planck Institut für Dynamik und Selbstorganisation, Germany
Contact person: Prof. Eberhard Bodenschatz (eberhard.bodenschatz@ds.mpg.de)

ESR 6: Development of a droplet generator, drop collision measurement.
Objectives: To develop a drop generator capable of rapid creation of liquid droplets of sizes 5-50 μm, similar to those typically found in warm clouds. To control also the initial velocity of the created drops, both in magnitude and direction. Experimental measurement of the coalescence rate of droplets generated with the device.
Expected Results: Design, prototyping, calibration and testing of a new droplet generator, with drop size and drop velocity control. The drop generator can then be used to calibrate other equipment (e.g. particle-tracking systems, interferometers) and to speed up and refine other experiments. Using two such devices, experimental results on the drop collision and coalescence rate can be obtained, leading to a better understanding of their dependence on the relative velocity, size and angle of impact of the drops.
Host: Max Planck Institut für Dynamik und Selbstorganisation, Germany
Contact person: Prof. Eberhard Bodenschatz (eberhard.bodenschatz@ds.mpg.de)

ESR 7: Lagrangian properties of aerosol parcels at the turbulent/non-turbulent interfaces with density jumps.
Objectives: Experimental and numerical based estimates of "apparent diffusivity" of particles and fluid parcels crossing the turbulent/non-turbulent interfaces with density jumps.
Expected Results: Parameterisation and a model of the spreading rate and "apparent diffusivity" constants as a function of density jump, and particle-related parameters (Reynolds, Stokes).
Host: Tel Aviv University, Israel
Contact person: Prof. Alex Liberzon (alexlib@eng.tau.ac.il)

ESR 8: Development of the multi-MEMS-sensor-probe for the three dimensional turbulent velocity and vorticity measurements at sub Kolmogorov scales in atmospheric turbulent flows and clouds.
Objectives: Design and development of a multi-sensor probe based on the unique MEMS-based technology, providing multi-component measurements of turbulent properties in atmospheric turbulent flows and in clouds.

Expected Results: A set of MEMS-based probes based on different design with adaptation for in-flight vs stationary measurements, hardware and software development for the rapid probe deployment.
Host: Tel Aviv University, Israel
Contact person: Prof. Alex Liberzon (alexlib@eng.tau.ac.il)

ESR 9: Small-scale turbulence and spatial distribution of droplets in clouds.
Objectives: The project is aimed at joint investigation of droplet spatial distribution and small-scale turbulence in clouds. We plan measure positions and velocities of cloud droplets in a two-dimensional plane enlightened by a laser sheet technique. We will build a device allowing for uniform illumination of cloud volume of the area ~50x50 cm^2 and of variable thickness (~1 mm to ~2 cm). This will allow for visualization of cloud droplets within this volume and quantitative multi-scale (from below Kolmogorov scale to Taylor microscale) measurements of droplet clustering and small scale turbulence. We will test a prototype of this instrument in a laboratory cloud chamber at UW and in wind tunnels at MPG. We will use the instrument to measure properties of clouds in a mountain laboratory (preferably Schneefernenhaus at Zugspitze). We will perform collocated measurements of temperature fluctuations in cloud with our Ultra-Fast Thermometer and/or turbulence measurements with a fine instrument by TAU and PTL in order to investigate small-scale effects of inhomogeneous/homogeneous turbulent mixing in clouds.
Expected Results: Quantitative information about droplet spatial distribution and small-scale turbulent mixing in clouds disseminated in scientific publications, increased experience in development of new sensors.
Host: Uniwersytet Warsawski, Poland
Contact person: Prof. Szymon Malinowski (malina@fuw.edu.pl),
Dr. Marta Waclawczyk (marta.waclawczyk@igf.fuw.edu.pl)

ESR 10: Sub-grid scale modelling of particle transport in Large Eddy Simulations of fluid flows.
Objectives: The project is aimed at numerical modelling of transport and interactions of Stokes particles, such as cloud droplets and other aerosols. In high Reynolds number flows, say in a cumulus cloud, there is a gap of 2-4 decades between the Kolmogorov scale and the size of transported droplets. Therefore, even Direct Numerical Simulations of the flow require sub-grid scale (SGS) modelling to account for droplet transport and interactions within one grid cell. In DNS, although not straightforward, this modelling is conceptually tractable as the SGS flow is laminar and, essentially, linear. The SGS modelling of Stokes particles in LES is a major theoretical challenge as the SGS flow, unlike in the DNS, is complex and multi-scale. The project will concern theoretical and numerical modelling of the dispersed phase dynamics in LES simulations of the continuous phase flow. We will focus on the correct modelling of collisions and coalescence of Stokes particles in turbulent flows comparing SGS models in true LES with filtered DNS simulations (a priori LES analysis) as the reference results.
Expected Results: Improved numerical model of droplet coalescence in Large Eddy Simulations. Qualitative understanding of the dependence of particle coalescence rate on the details of the SGS model.
Host: Uniwersytet Warsawski, Poland
Contact person: Prof. Szymon Malinowski (malina@fuw.edu.pl),
Dr. Marta Waclawczyk (marta.waclawczyk@igf.fuw.edu.pl)

ESR 11: Lagrangian estimates of entrainment rates in clouds.
Objectives: Computing balloon Lagrangian trajectories from LES outputs in shallow cumulus and stratocumulus conditions. Comparison with data from mini radioprobes. Specific adjustment to Lagrangian trajectories will have to be implemented to take into account balloon dynamics. Rates of mixing will be estimated at the interfaces of cloudy and clear air.
Expected Results: Transfer of knowledge from microprobes to the weather/climate modelling community.
Host: Laboratoire de Meteorologie Dynamique, CNRS, France
Contact person: Dr. Fabio D'Andrea (dandrea@lmd.ens.fr), Dr. Jean-Pierre Duvel (jpduvel@lmd.ens.fr)

ESR 12: Disposable radio-probes.
Objectives: Testing on the field of the sensing probes. Pre-processing of data acquired by the ground station.
Expected Results: Design, prototyping, calibration and testing in laboratory and simulating environment of new disposable radio-probes released by airplanes or UAV. Design and prototyping of an adequate ground station able to receive the data. The testing on the field of the probes previously realized will be performed. The whole data acquisition system (from the probes to the ground station) will be fully tested on the field. A pre-processing of the acquired data will be performed, too.
Host: Envisens Technologies S.r.L., Italy
Contact person: Dr. Marco Allegretti (amministrazione@envisens.com)

ESR 13: Research and investigation of the performance limits of a direct detection Lidar system developed at PTL, in highly turbulent atmosphere and in real and artificial turbulent environment.
Objectives: Experimental and theoretical research on ways to improve the performance of a wind and aerosols Lidar in highly turbulent environment, and inside or in the vicinity of clouds and fog at different density levels.
Expected Results: Algorithms and software tools to handle accurate wind measurement and aerosols density in high turbulent flow and high density environment such as fog and clouds. These algorithms and software tools will be implemented and tested in Pentalum's SpiDAR technology and potentially in other Lidar systems.

Host: Pentalum Ltd, Israel
Contact person: Dr. Sagie Tsadka (Sagie.Tsadka@pentalum.com), Dr. Nathan Sela (nathan.sela@pentalum.com)

ESR 14: Microelectronic systems for innovative sensors control. Innovative sensors for the measurement of concentration of the chemical species.
Objectives: Design and Development of microelectronic systems for innovative sensors control: feasibility studies, die size estimation, power and package definition, application circuit study, breadboard implementation, electrical specifications definition, testing-oriented design definition, optimization of system dimensions and weight, identification of materials with low environmental impact.
Expected Results: Design, prototyping and test of microelectronic systems for acquisition and processing of temperature, humidity, pressure, speed, acceleration, vorticity, concentration values.
Host: Sitael SpA, Italy
Contact person: Ing.Matteo Angarano (matteo.angarano@sitael.com),
Dr. Patrizia Sferza (patrizia.sforza@sitael.com)