AEROSPACE ENGINEERING

MUR DM 118 - End to end simulator for spaceborne atmospheric radars for the validation of the new generation Earth system models

Funded By	DIATI - Progetti Ministero dell'Università e della Ricerca - MUR [P.iva/CF:96446770586]
Supervisor	BATTAGLIA ALESSANDRO - alessandro.battaglia@polito.it
Contact	STESINA FABRIZIO - fabrizio.stesina@polito.it GRAF VON HARDENBERG JOST-DIEDRICH - jost.hardenberg@polito.it
Context of the research activity	All major weather forecasting and climate prediction centres are currently developing a new generation of km-scale global models with explicit representation of convection that should be operational by 2030. Current and new spaceborne atmospheric radars can be exploited to evaluate and validate the representations of cloud, precipitation and convection in these NWP and climate models via forward model simulations. Progetto finanziato nell'ambito del PNRR – DM 118/2023 - CUP E14D23001660006
	Spaceborne radars offer a unique three-dimensional view of the atmospheric components of the Earth's hydrological cycle. Existing and planned spaceborne radar missions provide cloud, precipitation and convection information over the oceans and over land difficult to access in remote areas. Examples of such systems are provided by the NASA-JAXA Global Precipitation Measuring mission (https://www.nasa.gov/mission_pages/GPM/main/index.html) dual-frequency Ku-Ka band radar, the ESA-JAXA EarthCARE (Cloud, Aerosol and Radiation Explorer, https://earth.esa.int/eogateway/missions/earthcare) Cloud Profiling radar, the WIVERN Doppler radar (www.wivern.polito.it) , the INCUS (https://incus.colostate.edu/) and the Tomorrow.IO (https://www.tomorrow.io/space/) Ka-band radars. The hydrometeor vertical structure information provided by such systems are critical for evaluating and validating how the next generation of weather forecasting and climate prediction models represent cloud and precipitation related processes, which is paramount to properly model the Earth's radiation budget and water cycle. The simulator will have to simulate the

Objectives	radar observables (reflecitivities and Doppler velocities) accounting for the satellite orbit, the radar observation geometry and the radar specs (e.g. antenna pattern, point target response, noise level). The model should be able to run on the fly on outputs of global models of the Earth like those provided by the project Destination Earth or the MPI ICON model and produce statistics of radar observables on the same atmosphere sampled by the radars. This will allow to statistically validate the realism of the vertical distribution of clouds, precipitation and atmospheric winds of these models. This work will be done in strict collaboration with the NASA and ESA science teams of the above-mentioned missions and with numerical modelling groups (under the leadership of Prof. von Hardenberg). The project will contribute to improve the forecasting capability considering various temporal and spatial scales and promoting the seamless prediction concept, from Nowcasting to Numerical Weather Prediction (NWP), Global Circulation Models (GCM), and Convection-Permitting Models (CPM), with the aim to advance from the early warning up to the future projections in climate change scenarios. These objectives are also included in the National Recovery Plan of Italy (PNRR), Mission 2 – Component 4 aimed at the safeguard of the national territory and water resources. In this frame there is an explicit call for actions intended to strengthening predictive capacity of climate change effects through advanced and integrated monitoring and analysis systems and prevention and contrast of the consequences of climate change on hydrogeological instability phenomena and the vulnerability of the territory.

Skills and competencies for the development of the activity	The student will be trained in a wide range of topics including radar meteorology and precipitation remote sensing. Applicants should have a science or engineering Laurea magistrale degree. Excellent knowledge of English is required. Knowledge of radar theory, meteorology would be beneficial. Programming skills in matlab/Python/C/Java/C++, knowledge of signal propagation and numerical modelling, cloud resolving models, ability to analyze big data using HPC could also be advantageous.