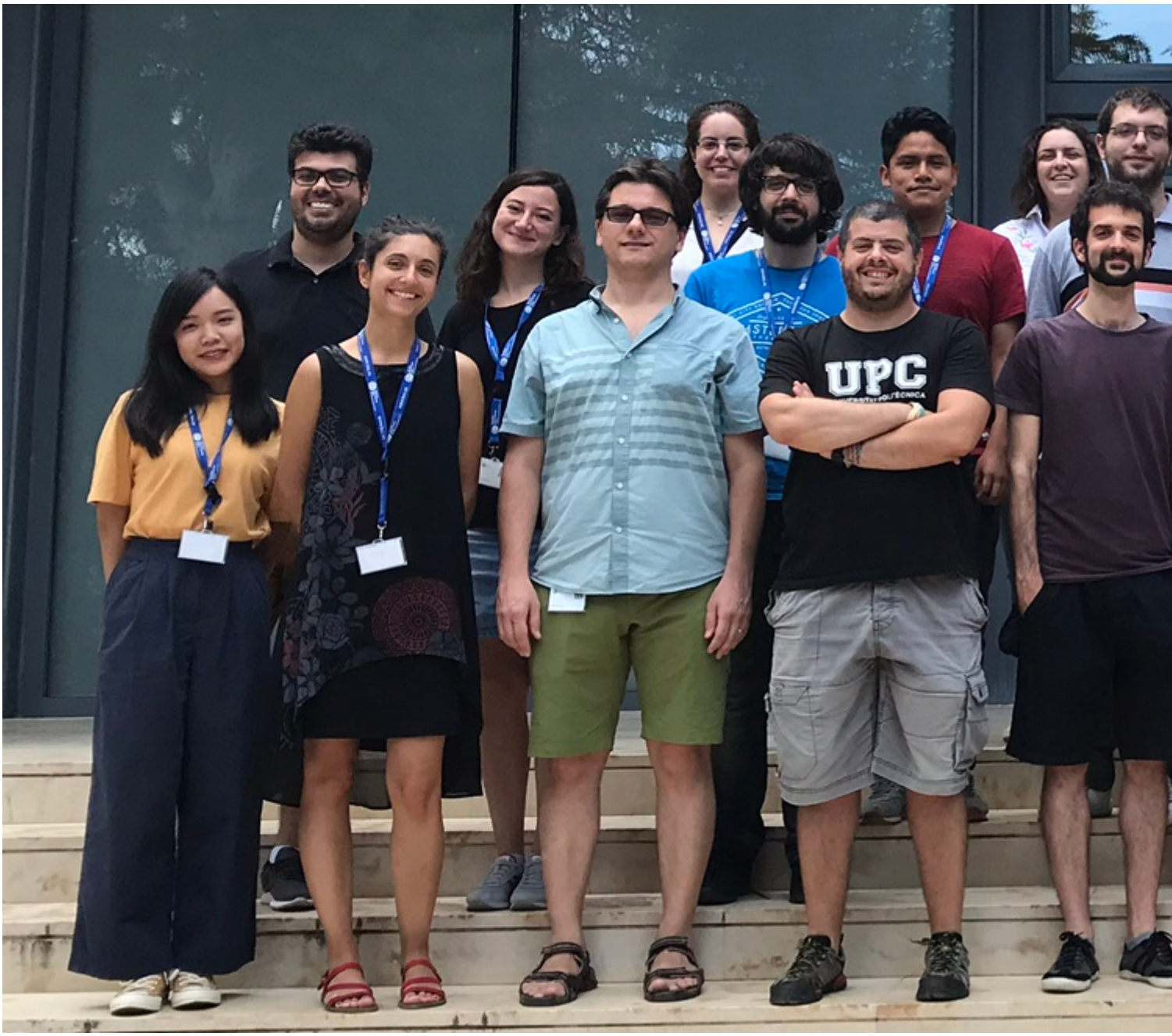
Computational Earth Sciences



The Computational Earth Sciences (CES) group is a multidisciplinary team with different IT profiles that interacts closely with all the other groups of the Department. The group provides help and guidance to scientists on the technical issues relating to their work and develops a framework for the most efficient use of HPC resources. In order to improve the use of the variety of computing resources available at the BSC and in other HPC institutions, a solid software development, profiling and optimisation area will be created for Earth system model codes towards exascale computing, and we will provide feedback on this to modellers around Europe. Last but not least, the development of a framework to disseminate the outputs

generated by BSC-ES among the research and service community will be pursued. This area will take advantage of BSC's unique environment where research in Big Data is already a priority that will be extended in the coming years.

Big Data and Climate Change

Objectives

Efficient use of the computational resources by the research groups

- *Provide HPC services such as performance analysis to identify bottlenecks and apply optimisations*

Collaborate with other BSC departments, especially Computer Sciences, to use state-of-the-art programming models and profiling tools to prepare earth sciences models to run on next generation exascale HPC systems. Also improve the efficiency of existing models and postprocessing tools, interacting with developers and users during all stages of software development life cycle.

- *Research on new computational methods to apply on Earth Sciences models*

Collaborate with external earth system modelling teams to implement and test new computational methods that allow the use of new platforms such as heterogeneous architectures.

Development of HPC user-friendly software framework for Earth system modelling and the management of operational systems

- *Support the development of atmospheric research software and contribute to its maintenance*

Interact with model developers and HPC support teams to develop and deploy a software stack to run generic earth system models on a wide range of HPC facilities.

- *Maintain and improve operational systems*

Collaborate with the other three other groups to satisfy their needs for the development and efficient running, including the design of appropriate workflows, of the BSC-ES operational air quality, weather and climate forecast systems.

Data and Diagnostics

- *Develop, manage and maintain a common data service framework*

Develop, manage and maintain a common data service framework to collect, standardize and distribute climate and atmospheric data to both internal departmental and external users of the research and services community. Setting up an ESGF Datanode will be a priority of the team to give international visibility to the centre.
Implement locally and contribute to the development of international standards for data storage and exchange, with special interest in data in NetCDF and GRIB formats.

- *Deploy an infrastructure ready to overcome the Big Data challenge in Earth sciences*

Improve the capability for processing Big Data volumes for the analysis of Earth system simulation using the latest technologies both at hardware and software levels.

Improve the outcome to society of user-friendly data visualization products
Study new approaches to address the I/O challenges of the new generation of high-resolution, highly parallelized Earth system models.

Guidance on the use of IT resources

- *Design and maintain an IT infrastructure allowing the research teams the accomplishment of their objectives*

Maintain an IT infrastructure that ensures an efficient working environment for the development of the BSC-ES research and services, including the provision of sufficient storage to reduce this specific vulnerability of the department.
Provide and guide the department groups to use a collaborative framework and good coding practices (code version control, testing suites, style guides) to improve the work efficiency, the integration of newcomers and the sharing of tools.
Develop and ensure a continuous training to IT members and earth sciences users to use resources in the most efficient way.

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