New CORDEX Flagship Pilot Study on Island processes in the Macaronesian Archipelagos (FPS-I-Mac): Objectives and challenges

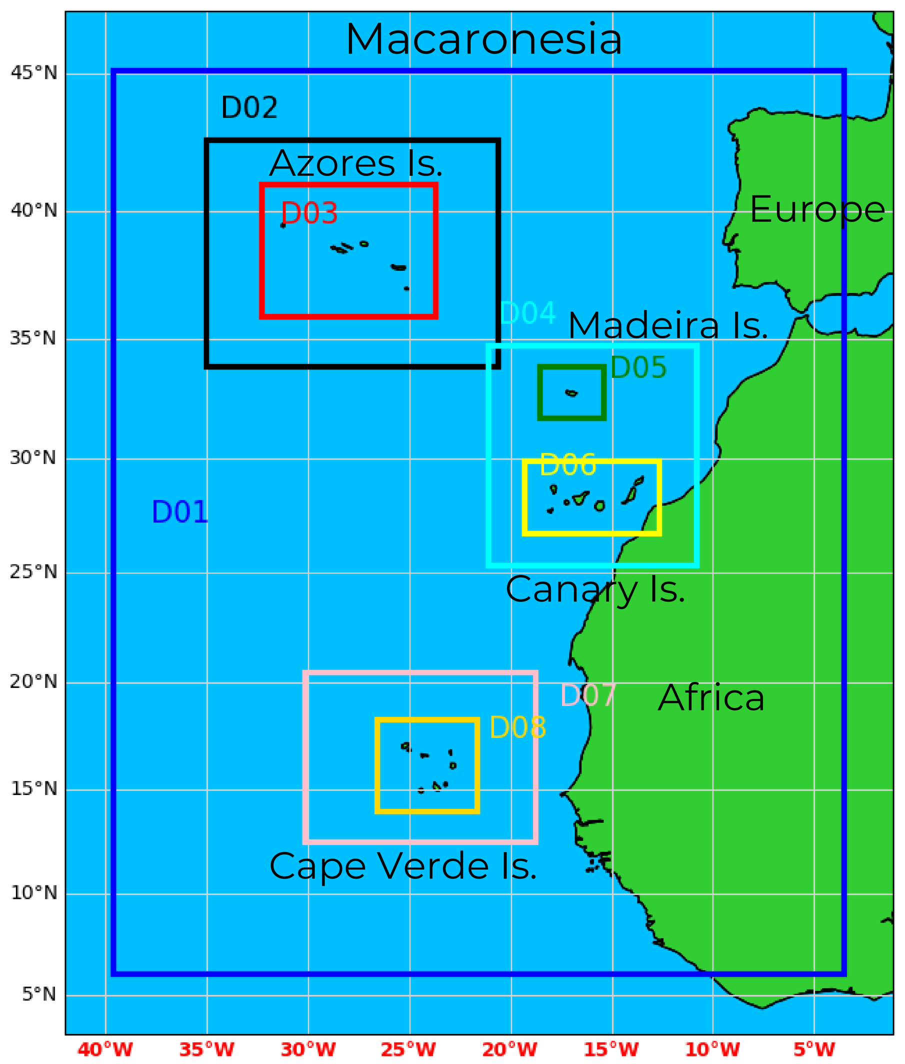
Juan P. Díaz[1], Esteban Rodríguez-Guisado[2], Maialen Iturbide[3], Jesús Fernández[3], Marianna Adinolfi[4], Helena Vasconcelos[5], Maria Meirelles[5], Enrique Sánchez[6], Miguel Angel Gaertner[6], Daniel Argüeso[7], and Pedro M.M. Soares[8]

[1]Departamento de Física, Universidad de La Laguna, La Laguna, Spain; [2]Agencia Estatal de Meteorología, Madrid, Spain; [3]Instituto de Física de Cantabria (IFCA), CSIC-Universidad de Cantabria, Santander, Spain; [4]CMCC Foundation - Euro-Mediterranean Center on Climate Change, Caserta, Italy; [5]Universidade dos Açores, Ponta Delgada, Portugal; [6]Universidad de Castilla-La Mancha, Toledo, Spain; [7]Departamento de Física, Universitat de les Illes Balears, Palma, Spain; [8]Instituto Dom Luiz, Faculty of Sciences of the University of Lisbon, Lisbon, Portugal

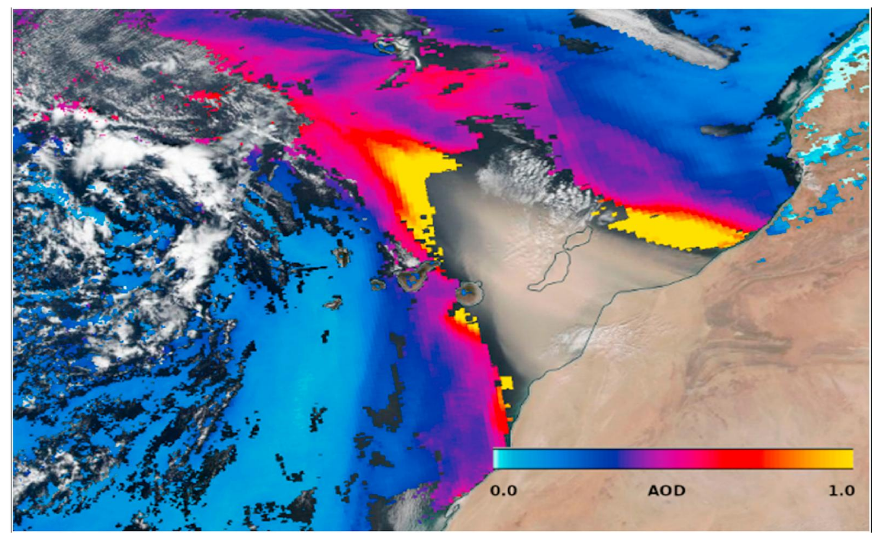
Islands are particularly vulnerable to climate change, facing threats such as sea-level rise, cyclones, and changes in temperature and precipitation. However, global climate models (GCMs) struggle to represent the small-scale processes that are critical for these regions. This study focuses on Macaronesia (Azores, Madeira, Canary Islands and Cape Verde) and aims to analyze climate variables and extreme events using regional climate models (RCMs), statistical techniques, and hybrid approaches to enhance simulation resolution. In collaboration with meteorological services and local researchers, the project seeks to deliver high-resolution climate data to support adaptation strategies in the region.

• Objectives

- Investigate multiscale processes and their interactions to improve climate modeling in Macaronesia.
- Assess the influence of sea surface temperature on climate patterns in these oceanic regions.
- Evaluate the benefits of convection-permitting (CP) simulations over lower-resolution RCMs, and explore the potential of empirical-statistical downscaling (ESD) and emulators for capturing key processes.
- Compile existing observational databases, including satellite data, suitable for validating the main climate processes.
- Foster synergies between the modeling and user communities.
- Generate a multi-source, multi-model ensemble of climate projections to support decision-making in climate-sensitive sectors such as agriculture and food security, water resources, energy, disaster risk reduction and health, in connection with VIA communities.
- Create a shared database with results from the coordinated FPS-I-Mac experiments.
- Provide realistic extreme climate indices for small islands to support policy-making and facilitate comparisons with other regions.



How can future dust emission predictions be improved?

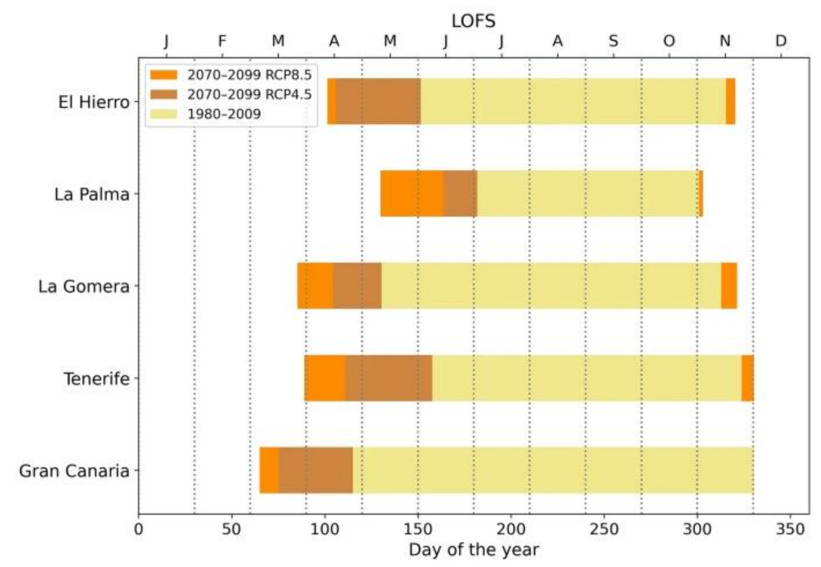


Aerosol Optical Depth (AOD) obtained by MODIS radiometer onboard terra and Aqua satellites on 22 February 2020. The true-color image corresponds to the sensor SEVIRI of Meteosat satellite.

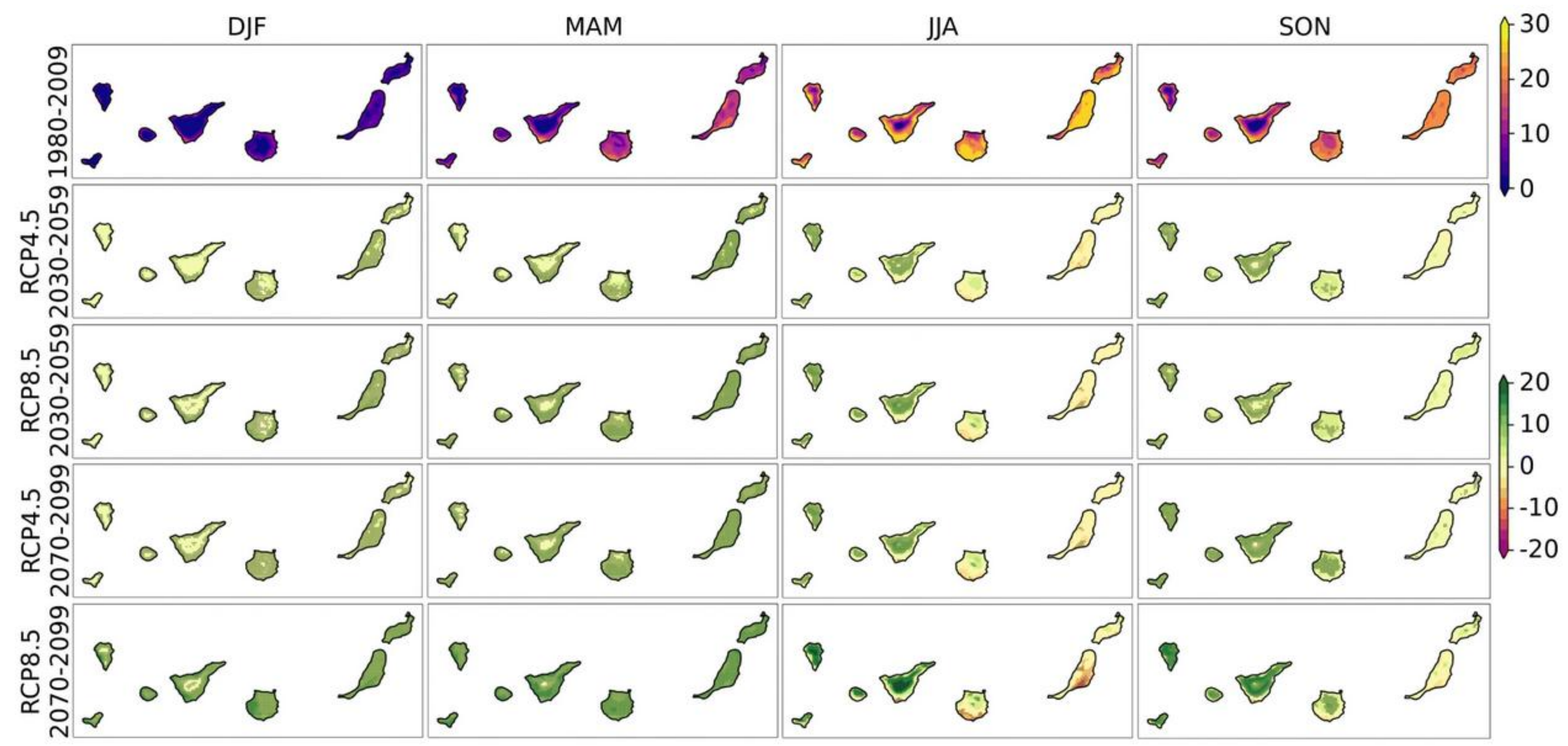
• Experimental strategy

- Process-oriented simulations:
  - Modeling of sub-daily precipitation regimes.
  - Simulation of extreme precipitation events.
  - Coupled atmosphere-land-ocean simulations, including the impact of AMOC weakening in the region.
  - Modeling of dust outbreak events.
- Climate projections simulations
  - ERA5-driven simulations covering a 30-year recent past period
  - Climate projections generated using a high-resolution ensemble

How can coordination with the Vulnerability, Impact and Adaptation (VIA) community be strengthened?

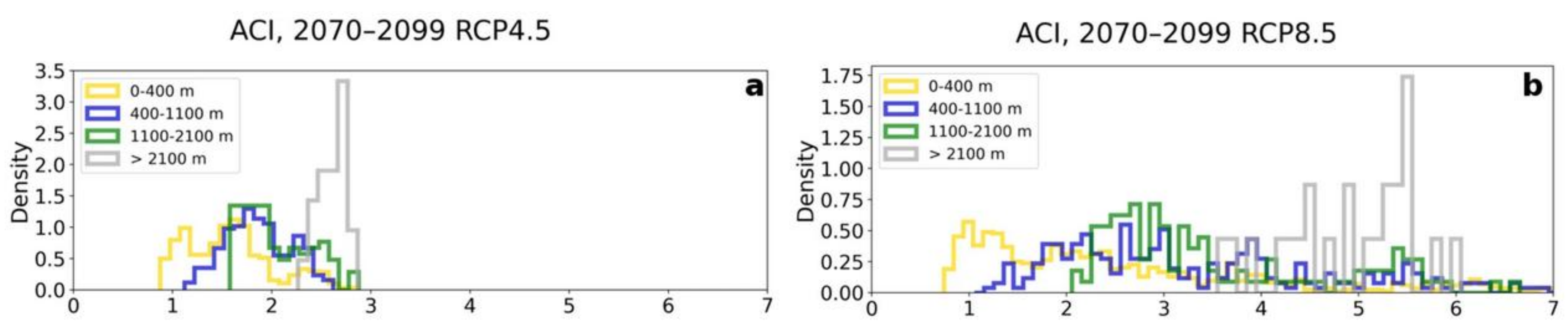


Length Of Fire Season (days) for different islands, indicated by the length of the horizontal bars. The vertical grid lines facilitate the identification of the initial and final day of the season in each period: recent past, 1980-2009 (beige), and future, 2070-2099, RCP4.5 (brown), 2070-2099, RCP8.5 (orange).



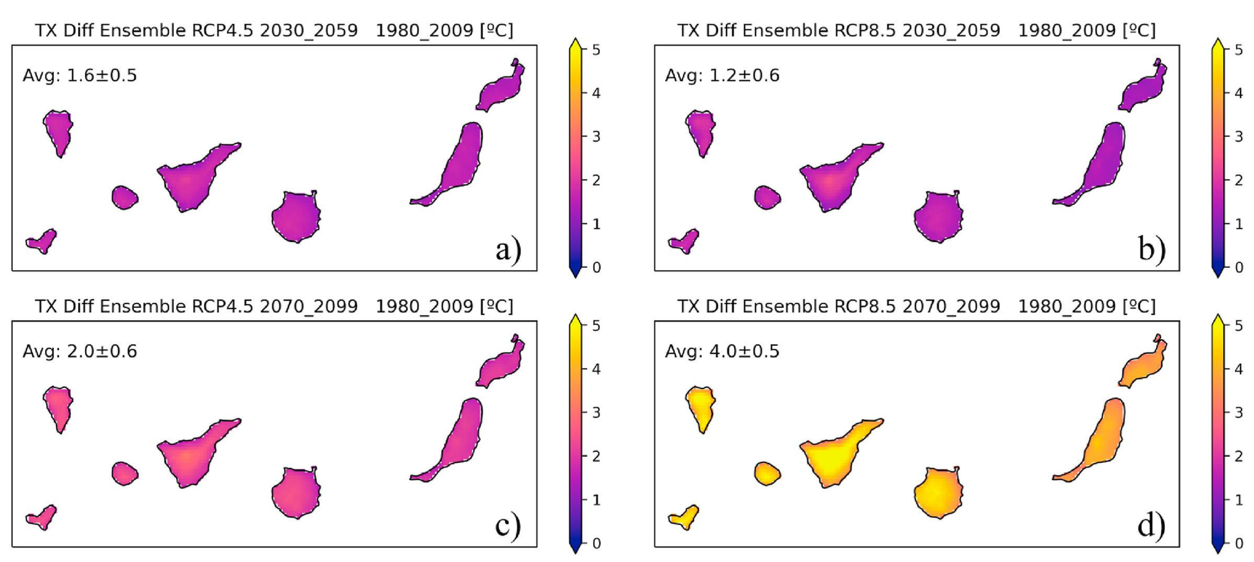
Projected changes of HCI80 (days per month) for 2030-2059 (2nd and 3rd rows) and 2070-2099 (4th and 5th rows) compared to 1980-2009 (1st row), for RCP4.5 and RCP8.5 emission scenarios. Data has been seasonally analyzed (columns), including boreal winter (DJF), spring(MAM), summer (JJA) and autumn (SON). Hatched areas indicate robust and statistically significant change.

What methodology should be adopted to enhance the study of the hydrological cycle?



Aridity Change Index (ACI) for 2070-2099 RCP(4.5) (**a**) and RCP8.5 (**b**) expressed as histograms. The altitude levels are indicated in the legend of histograms.

In what ways will coupled ocean-atmosphere models improve future extreme predictions?



Average differences for the maximum temperature (TX) variable (ºC) between the simulations for the future projections (MID and END of the century) and the recent past (HIS). They correspond to the greenhouse emission scenarios RCP4.5 (left column) and RCP 8.5 (right column). All the values are statistically significant to a 95% level of confidence.

• References

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Contact information:
Juan P. Díaz
jpdiaz@ull.es

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