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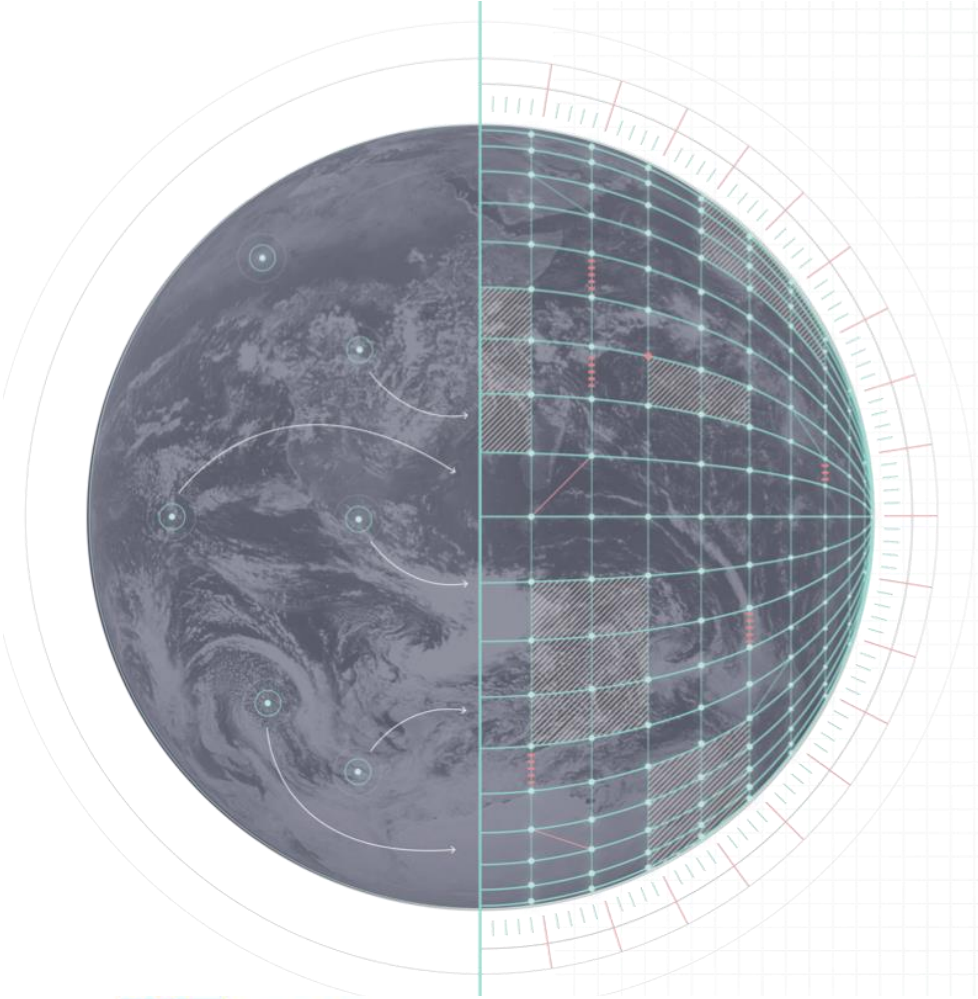

Equitable climate projections for small island climates

Kat Grayson, Jan Wehner, Marc Batlle, Kai Keller, Matías Olmo, Pierre-Antoine Bretonnière, Aina Gaya, Rachel Lowe, Daniel Klocke, Jost Von Hardenberg, Francisco Doblas-Reyes

and many more in the ClimateDT who have made this information system possible

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Destination Earth
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Climate Adaptation Digital Twin (ClimateDT)

New type of climate information system **to assess impacts of climate change and adaptation strategies** at local and regional levels over multiple decades.

Climate DT key features:

- **User-oriented** approach focused on **user interactivity**
- **Global climate simulations** at high horizontal **resolution**
- Novel approach with **streaming of climate model output to impact models**
- **Quality assessment and uncertainty quantification**
- **Integration of relevant European research** (Horizon programmes, national, private)

Climate DT information page

DestinE platform

Climate DT paper

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High-resolution global models

- ClimateDT employs **three climate models**: **ICON** and **IFS-NEMO/FESOM**, also involved in EERIE (HighResMIP2).
- The production focuses on **multi-decadal simulations (climate projections) on a 10-5 km global mesh** and **storyline simulations with different GWLs** for the recent past.

These simulations enable:

- **fine-scale** (storm resolving, eddy permitting) **processes** described
- **regional information sources** at global scales
- systematic **comparison with observational references**

ECMWF
Integrated **F**orecasting **S**ystem (IFS)

NEMO
Nucleus for **E**uropean **M**odelling of the **O**cean

FESOM
Finite **E**lement **S**ea-ice **O**cean **M**odel

ICOsahedral **N**on-hydrostatic model (ICON)

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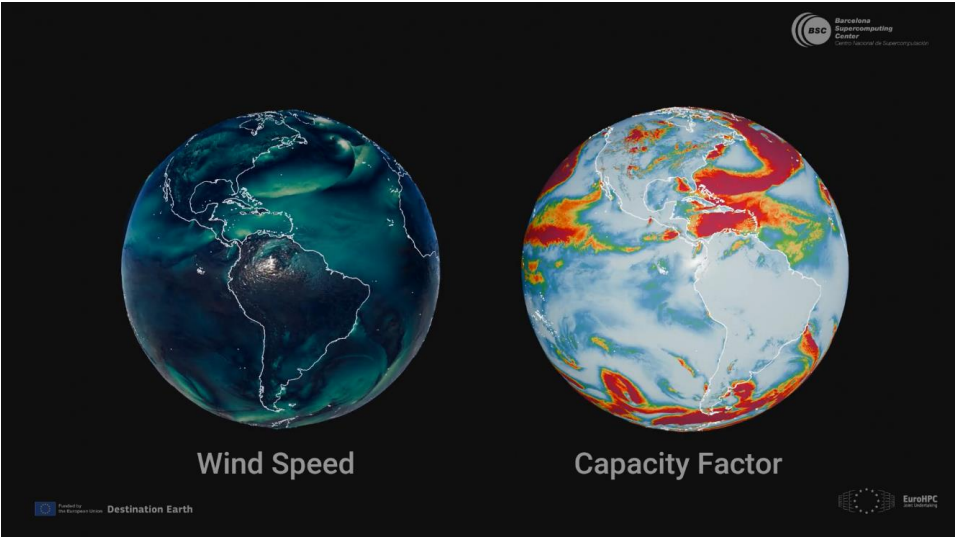
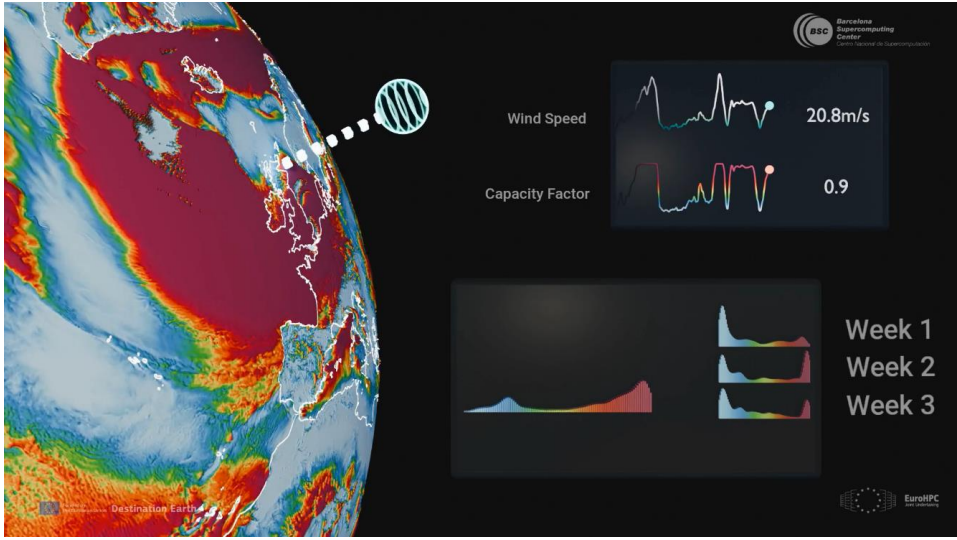
At a global scale...





And at a local scale...

nature climate change

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Comment | Published: 10 July 2024

Higher-resolution projections needed for small island climates

Jason P. Evans, Ali Belmadani, Christophe Menkes, Tannecia Stephenson, Marcus Thatcher, Peter B. Gibson & Alexandre Peltier

Nature Climate Change **14**, 668–670 (2024) | Cite this article

1570 Accesses | **2** Citations | **33** Altmetric | Metrics

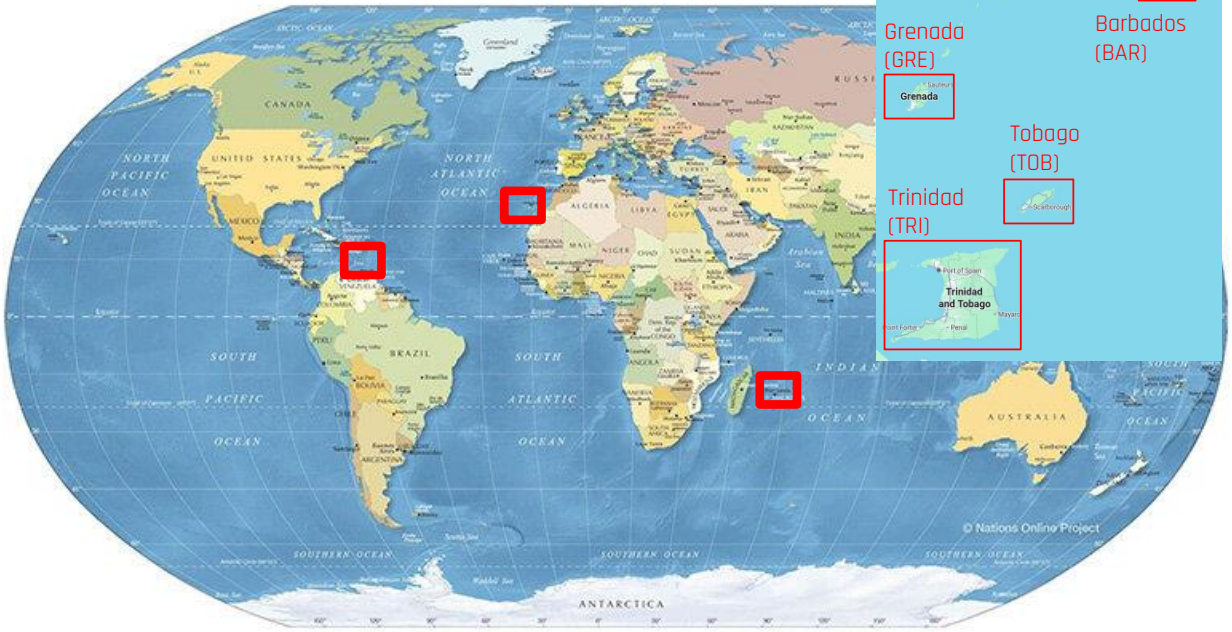
Projections of the future climate of small island states and territories are currently limited by the coarse resolution of models. We call for rapid global and regional cooperation to develop projections compatible with small island scales, providing relevant local information and decision-making tools.

Small islands are particularly vulnerable to climate change:

- Droughts
- Heatwaves (also marine)
- Floods
- Hurricanes & cyclones
- Sea level rise
- + much more

This is coupled with increase in exposure to risks and geographical isolation

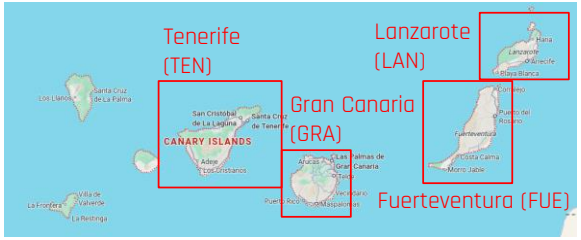
Which islands?



Caribbean Islands

We focus on the three regions for illustration purposes:

- Canary islands
- some Caribbean islands
- one of the Mascarene islands



Canary Islands

Réunion Island

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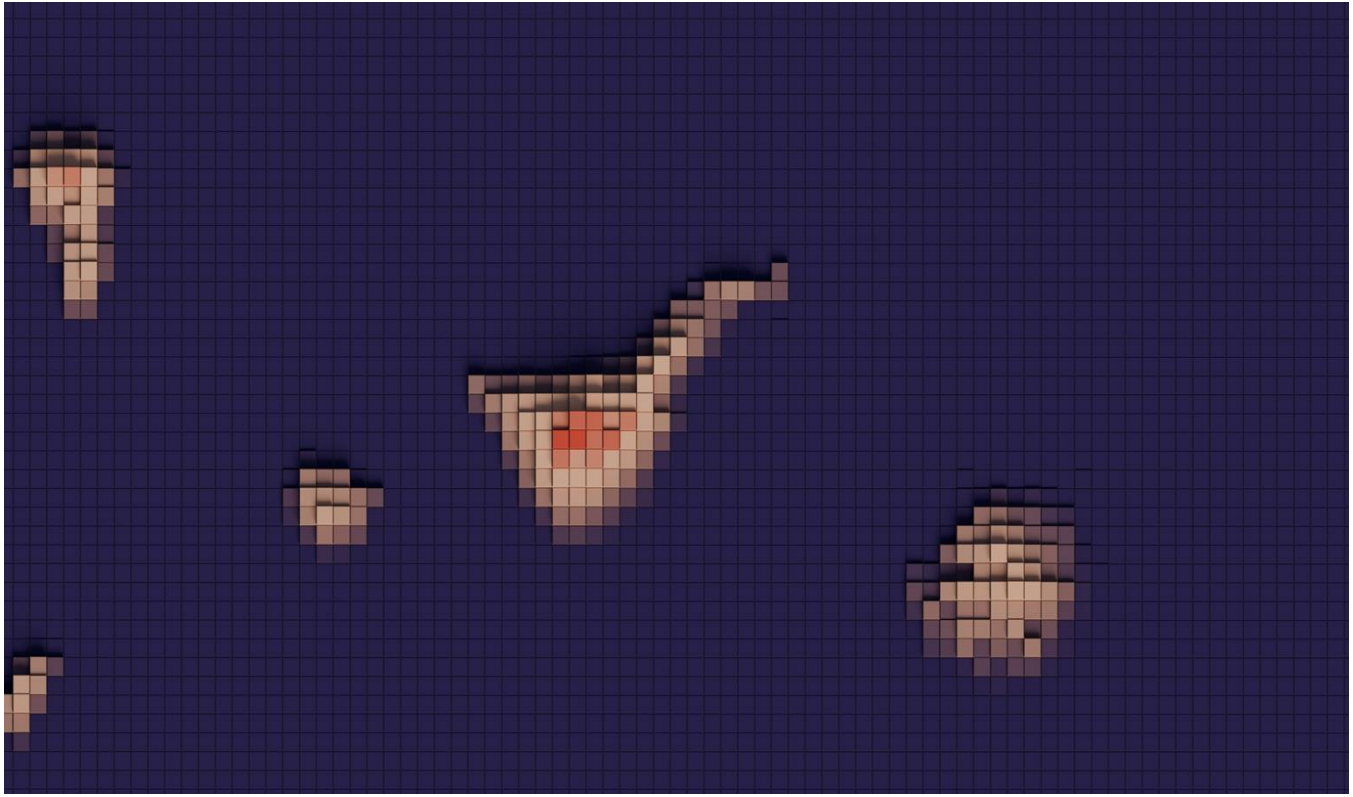
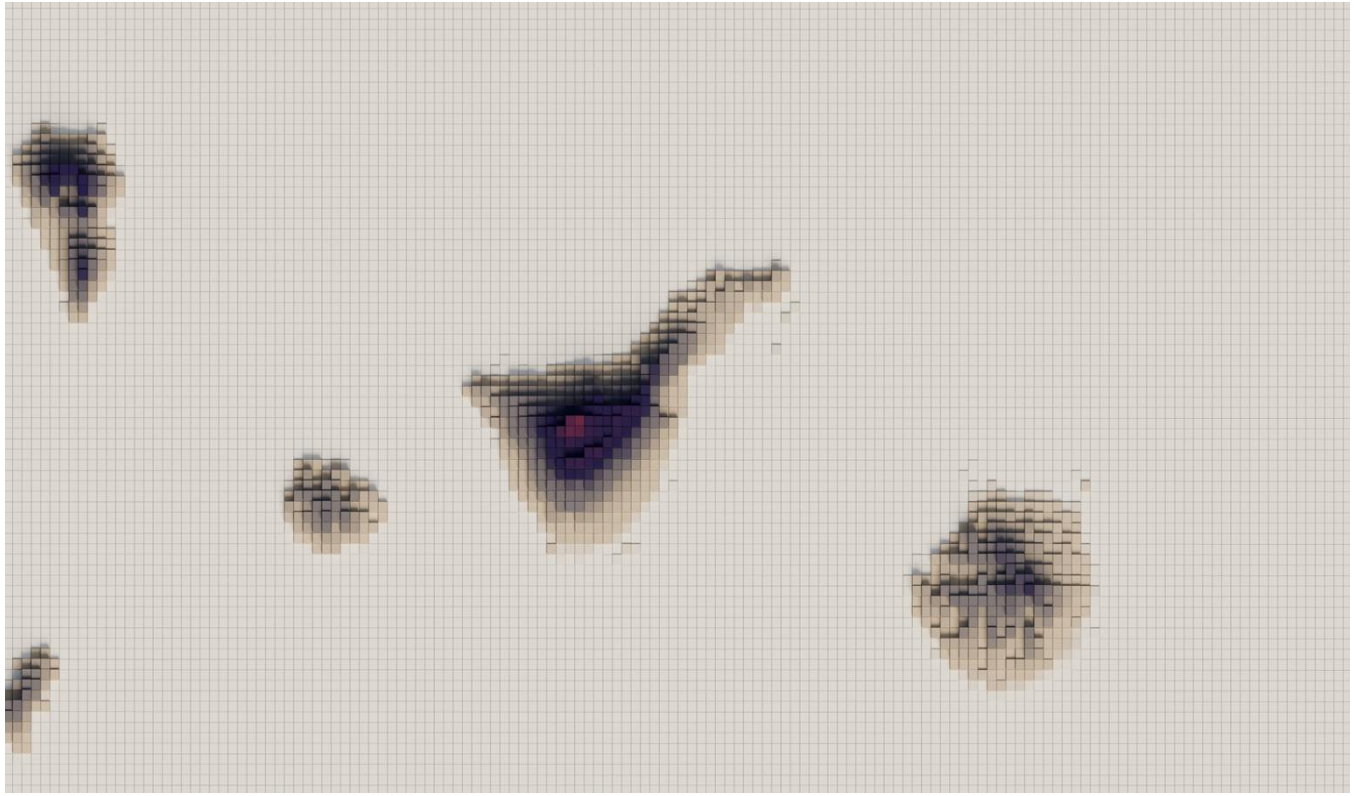
Island resolution



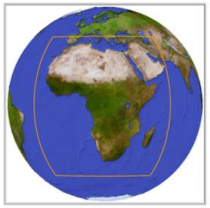
Impact of resolution images produced by Jan Wehner (AWI)

Island resolution



Impact of resolution images produced by Jan Wehner (AWI)

Which datasets? Canary and Mascarene islands - Temperature and precipitation 1990-2015



	CORDEX Africa								ClimateDT						
Island	MOHC-HadGEM2-ES-CCLM 25 km	MPI-ESM-LR-CCLM 25 km	NorESM1-M-CCLM 25 km	MOHC-HadGEM2-ES REMO 25 km	MPI-ESM-LR-REMO 25 km	NorESM1-M-REMO 25 km	ERA5 Land 10 km	MSWEP 10 km	IFS-NEMO freeze - 10 km	IFS-NEMO 3 member ensemble 10 km	IFS-NEMO o-suite - 5 km	IFS-FESOM o-suite - 5 km	IFS-ICON o-suite - 5 km	Observations - gridded	Observations - stations
Tenerife (TEN)				Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5		Precipitation only							Limited
Gran Canaria (GRA)				Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5		Precipitation only							Limited
Fuerteventura (FUE)				Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5		Precipitation only							Limited
Lanzarote (LAN)				Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5		Precipitation only							Limited
La Reunion (REU)				Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5	Missing 2005-15 rcp 8.5		Precipitation only							

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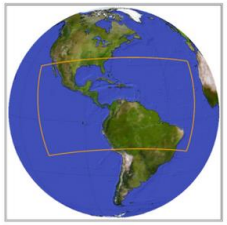
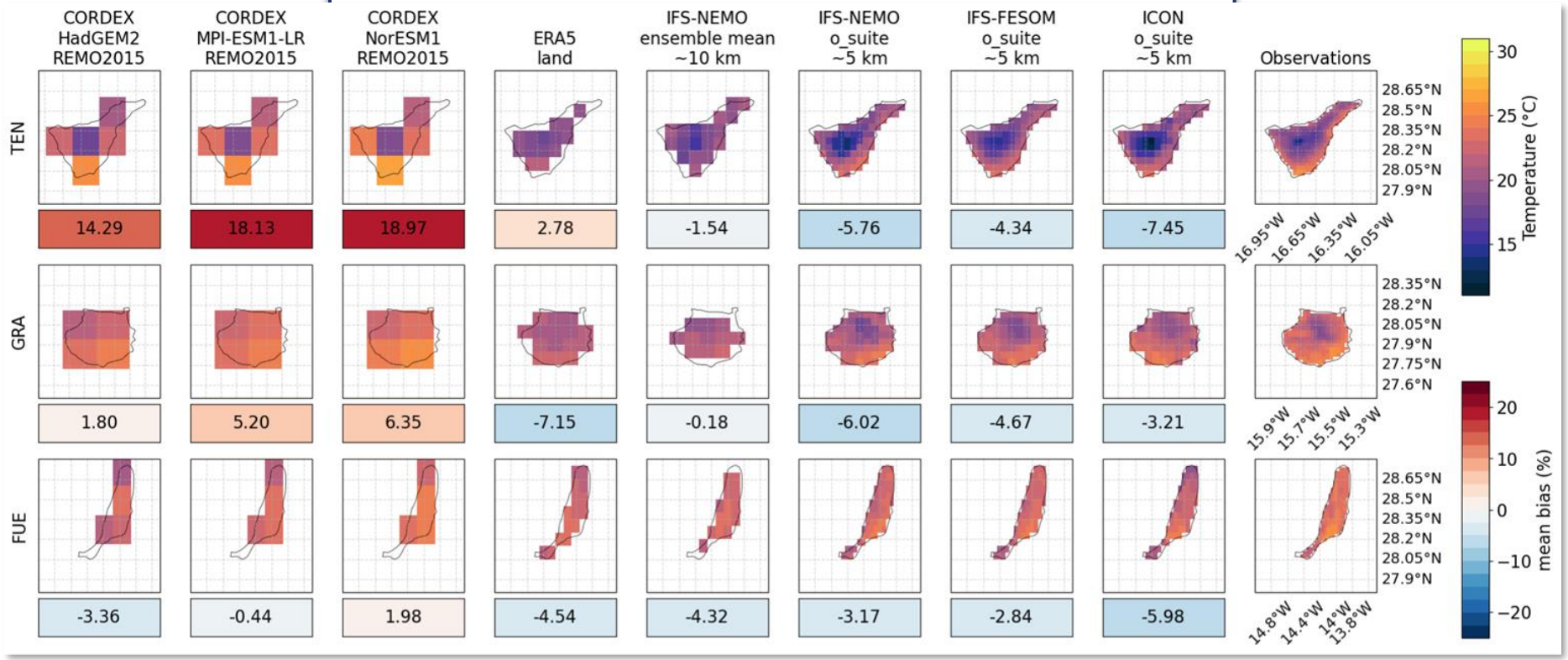
Which datasets? Caribbean islands - Temperature and precipitation 1990-2015



	CORDEX Central America					ClimateDT			
Island	CNRM-CERFACS-CM5-CRCM5 25 km	NOAA-GFDL-ESM2M-CRCM5 25 km	CCCma-CanESM2-CRCM5 25 km	ERA5 Land 10 km	MSWEP 10 km	IIFS-NEMO o-suite - 5 km	IFS-FESOM o-suite - 5 km	ICON o-suite - 5 km	Observations - stations
Saint Lucia (LUC)					Precipitation only				Missing tas 1 station
Barbados (BAR)					Precipitation only				Missing tas 1 station
Grenada (FUE)					Precipitation only				Missing tas 1 station
Trinidad (TRI)					Precipitation only				Missing tas 1 station
Tobago (TOB)					Precipitation only				Missing tas 1 station

Mean maximum daily temperature 1990-2014

Method for temperature heatmap

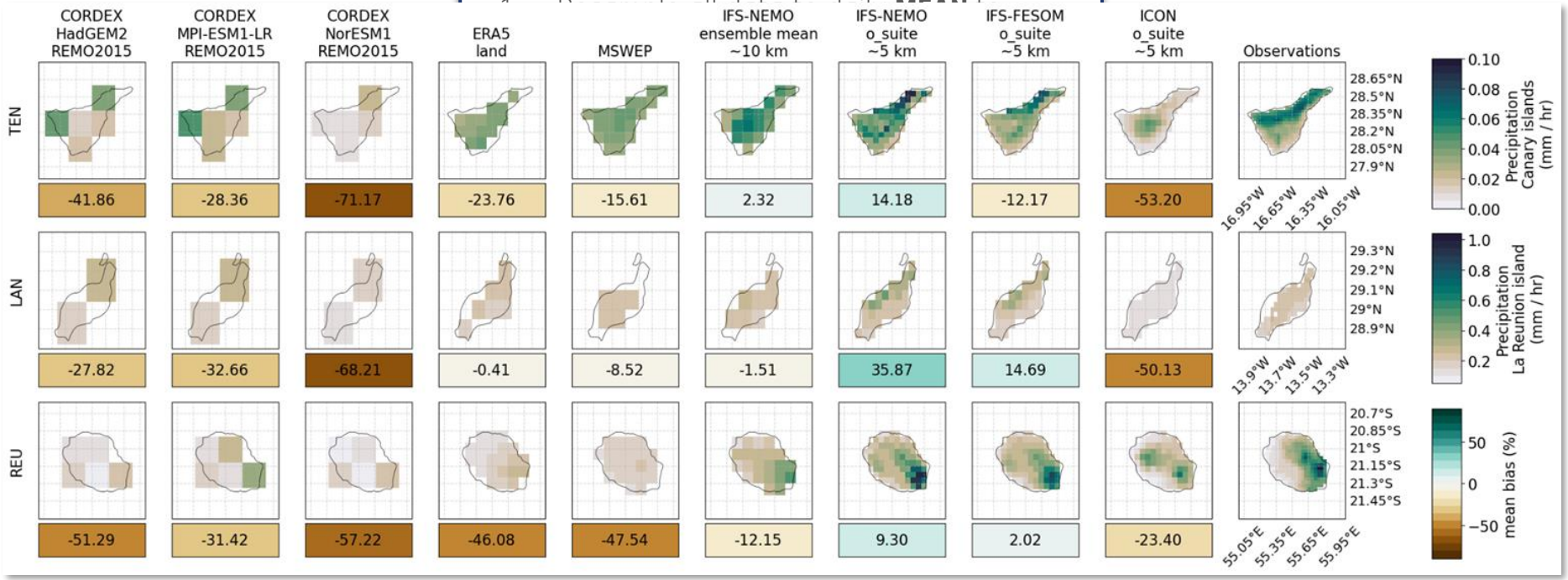


P99 of maximum daily temperature 1990-2014

Method for temperature heatmap

Mean daily precipitation rate 1990-2014

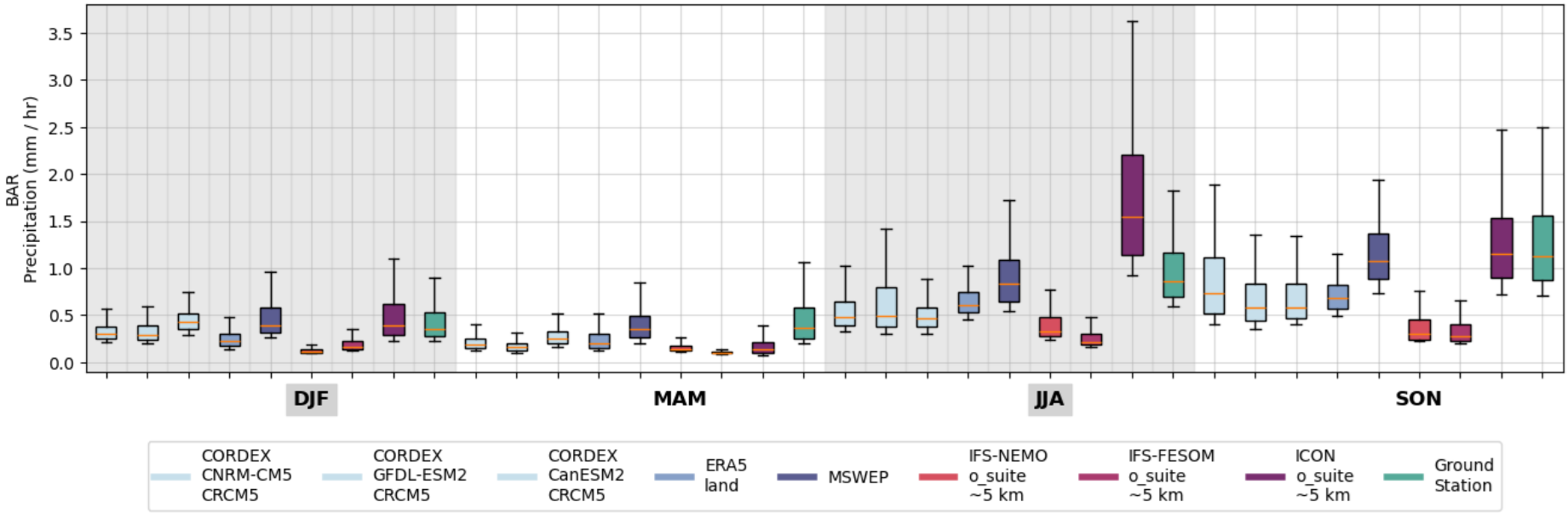
Method for precipitation heatmap



Distribution of 90th-99th percentile of daily precipitation 1990-2014

Method for extremes box plots

1. Resample all data to **DAILY MEAN** to match resolution of stations
2. **Match each model to the closest location of the stations** (nearest-neighbour) and extract time series from that location
3. Take 90th - 99th percentile over time
4. If multiple stations available for an island, average over stations
5. Box plots show distribution of 90th - 99th percentile.



Some take-home messages

- Global high-resolution climate simulations by the Climate DT offer an **opportunity** to, among other sectors, small islands to access climate-projection data in equal conditions as other better-catered regions.
- There have been opportunities to bring together **CORDEX** and high-resolution global model simulations since **HighResMIP**, with relatively little success.
- **Observational uncertainty** and discrepancies among reference products complicate model inter-comparisons, especially in small island. Co-developing solutions with local scientists is fundamental to achieve meaningful results.
- Global high-resolution coupled models do **not guarantee** to reproduce satisfactorily all user-relevant climate characteristics.

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