

# High-resolution Regional Palaeoclimate Simulations for the Last 2000 Years

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## Overview and Objectives

### Project PRIME 2

The objective of the **PRIME2** project (Precipitation in last millennia, funded by the German Research Foundation in the framework of the priority program INTERDYNAMIK) is to gain insight in the evolution of the climate over Europe during the last two millennia. The project aims to develop a set of **climate simulations** and **reconstructions**, combining both approaches to assess the skill and uncertainties of these methodologies. The project objectives also include extending the knowledge up to Roman times and to emphasise the added value of high resolution climate model simulations.

### Simulations

A number of regional climate simulations were performed using the **DKRZ** supercomputer.

Two simulations were carried out, both driven by the GCM **ECHO-G**:

#### “OETZI2”

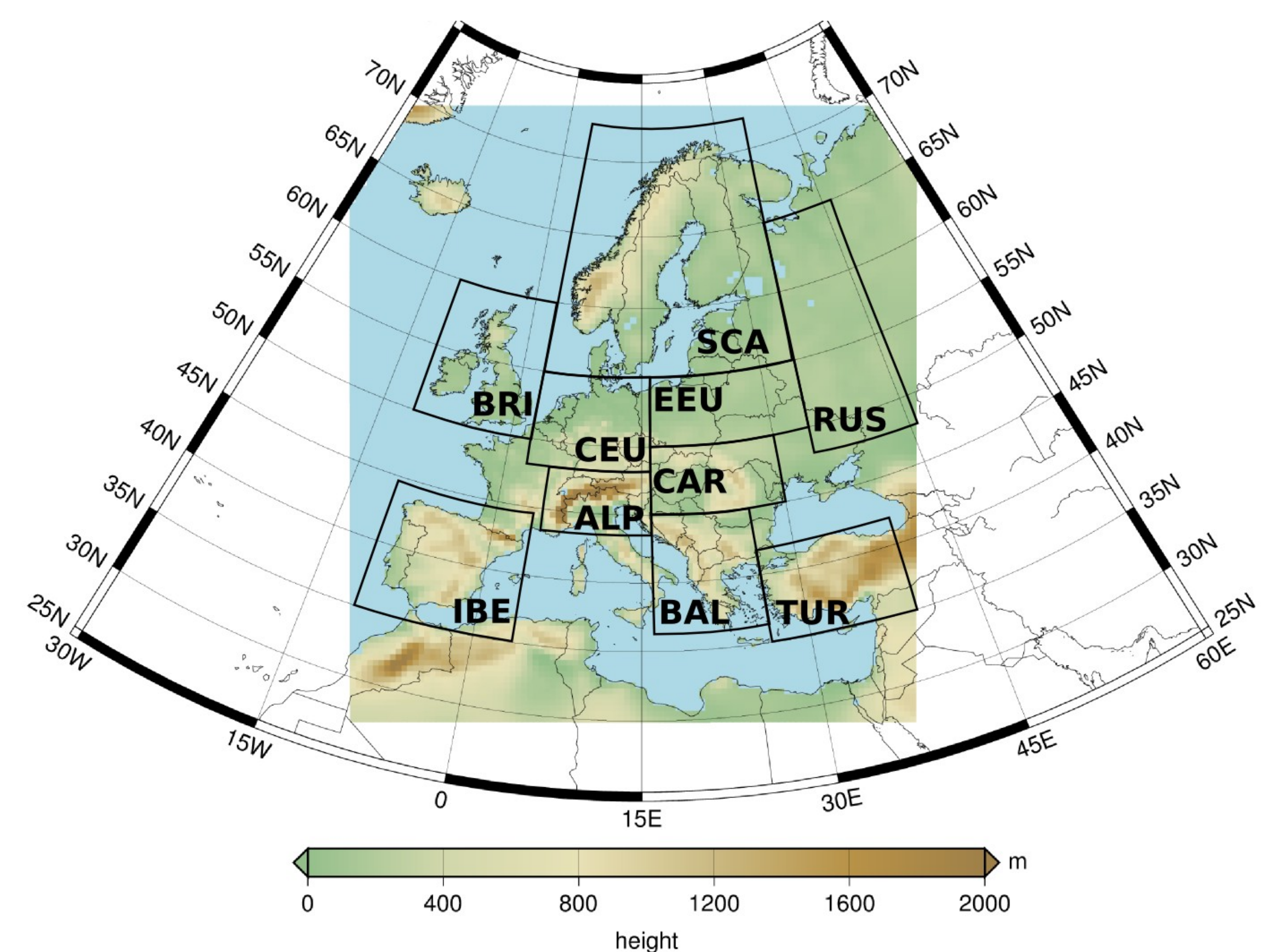
- period 1–1998 AD
- solar and **orbital forcing**
- greenhouse gases
- no volcanoes

#### “ERIK2”

- period 1001–1990 AD
- solar forcing
- greenhouse gases
- **volcanoes**

## Regional Model Setup

- Regional climate model **MM5**
- Two two-way nested domains of 135 and **45 km**
- Time step of **405 seconds**
- Parametrizations:
  - Cumulus: Grell
  - Radiation: Rapid Radiation Transfer Model
  - Microphysics: Simple Ice
  - Planetary Boundary Layer: Medium Range Forecast
  - Noah land soil model
- Driven by **ECHO-G**
- Boundaries updated every 12 hours
- **No nudging**
- Run in parallel in periods of 50 years



**Domain setup.** The simulation domain covers the European region including the Mediterranean. Two two-way nested domains are implemented in the regional model with a resolution of 135 and 45 km, respectively. The Figure shows the terrain and land-sea mask for the model using the 45 km horizontal resolution.

## Technical properties and results

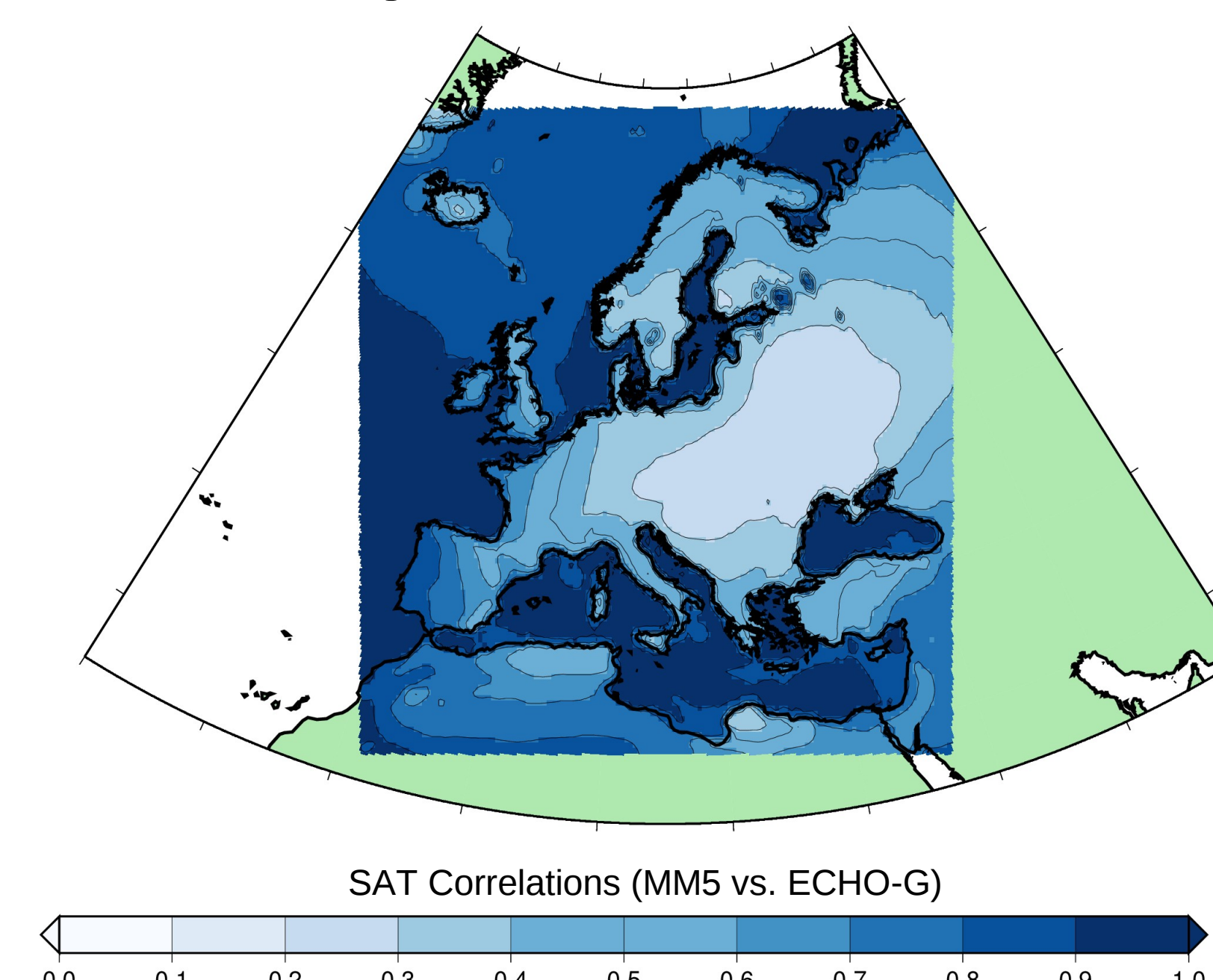
### Technical issues:

- Simulations are broken in 50-year “chunks”
- Up to 10 jobs running at the same time
- Every “chunk” is run in a node with **64 mpi processes** (hyperthreading)
- Every year takes ~ 5 hours (real time)
- consumption of ~ **220 000 CPUh** per 1000 years
- model output is post-processed and only **daily resolution** is archived at HPSS (compressed **netCDF** files to facilitate data exchange)
- Final format data weights ~ 2 Tb/1000 years

### Outlook:

- Simulation with **15 km horizontal resolution** for selected climatic anomalous periods

### Preliminary results: Added value of the RCM



**Temporal (dis)agreements.** Although the general behaviour of the RCM follows the global model, around 1200 AD a period with large deviations over eastern Europe is evident, which could represent an important added value of the regional simulation in addition to the GCM.

**Temporal correlations.** Although the driving GCM model has an important impact on the evolution of surface temperatures (SAT) in the regional model, some regions in its interior can deviate profoundly from the GCM. The reasons for this disagreement are currently investigated.

