



# Land use and soil texture effects on WRFv4.3

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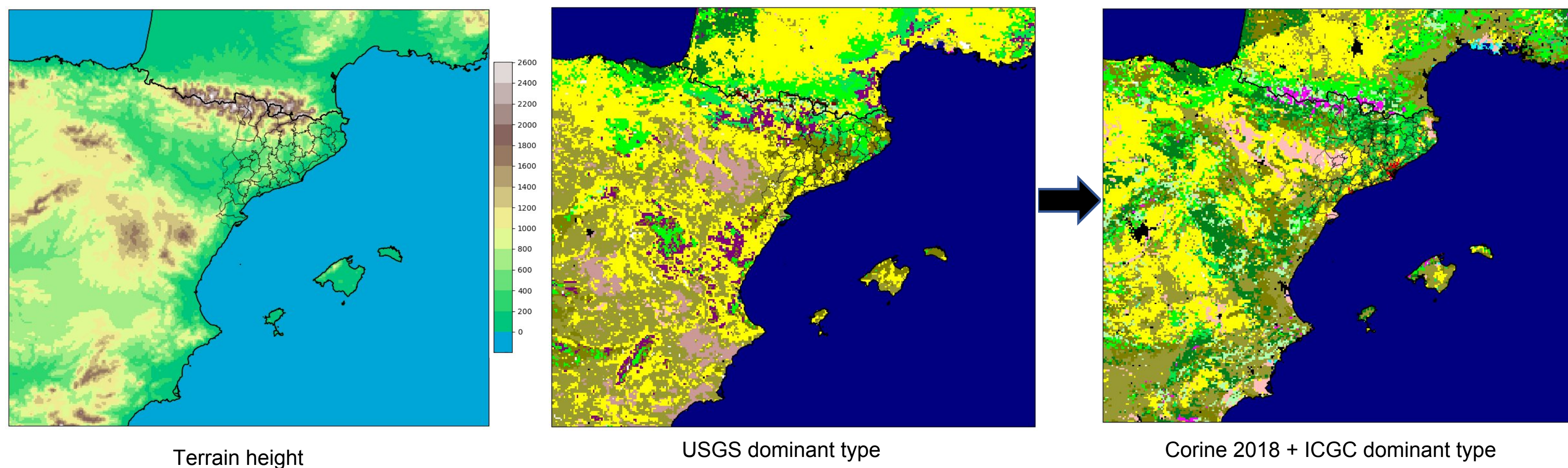
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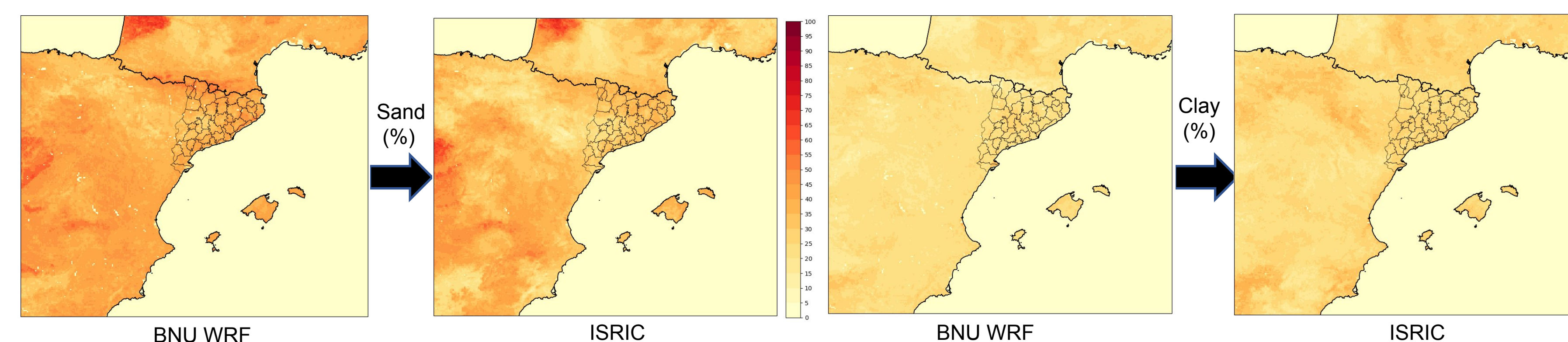
## Motivation

The SMC forecast for the maximum temperature during the 2022 summer, coming from the operational WRFv4.3 model, had a consistent cold bias, especially during the daytime. In order to address this shortcoming, a sensitivity study was done to identify the causes. A change in the selected parameterizations has been proposed as a new operational version, along with changes to the surface parameterization (NoahMP) code to take into account land use fraction and background albedo. Land use cover, soil moisture and the soil database were identified as sensitivity points to study in this new set of parameterizations.

### Land use database



### Soil composition database



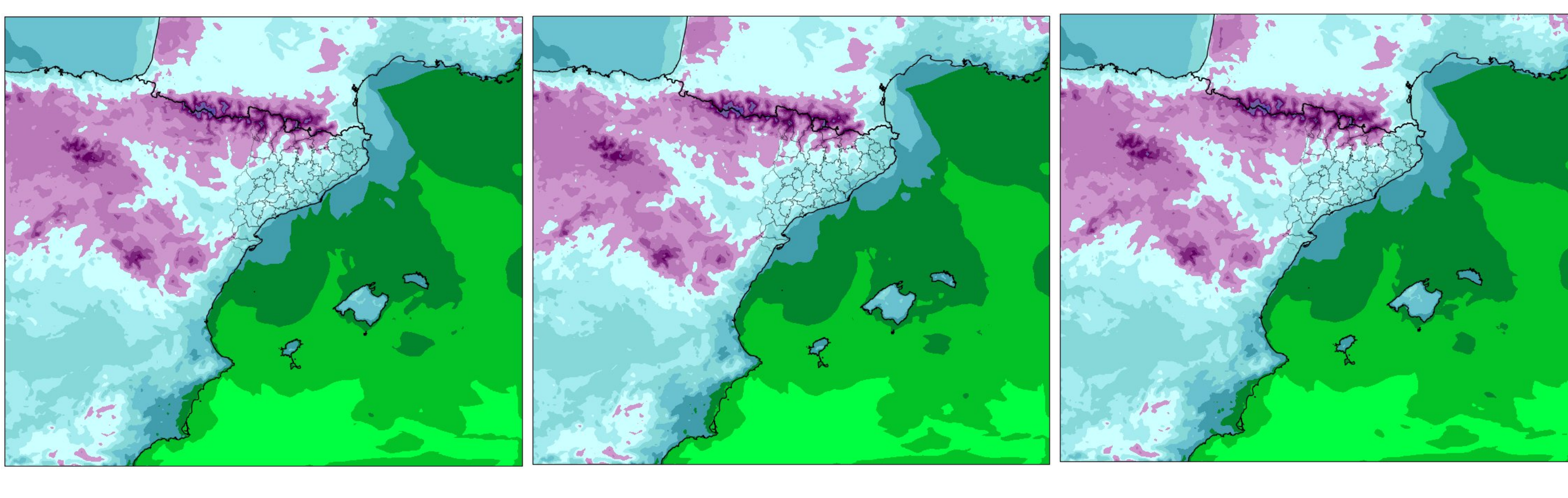
## Examples

Minimum Temperature 2m (°C) — 10/01/2024 — +48h

Control

Landuse

Soil+Landuse

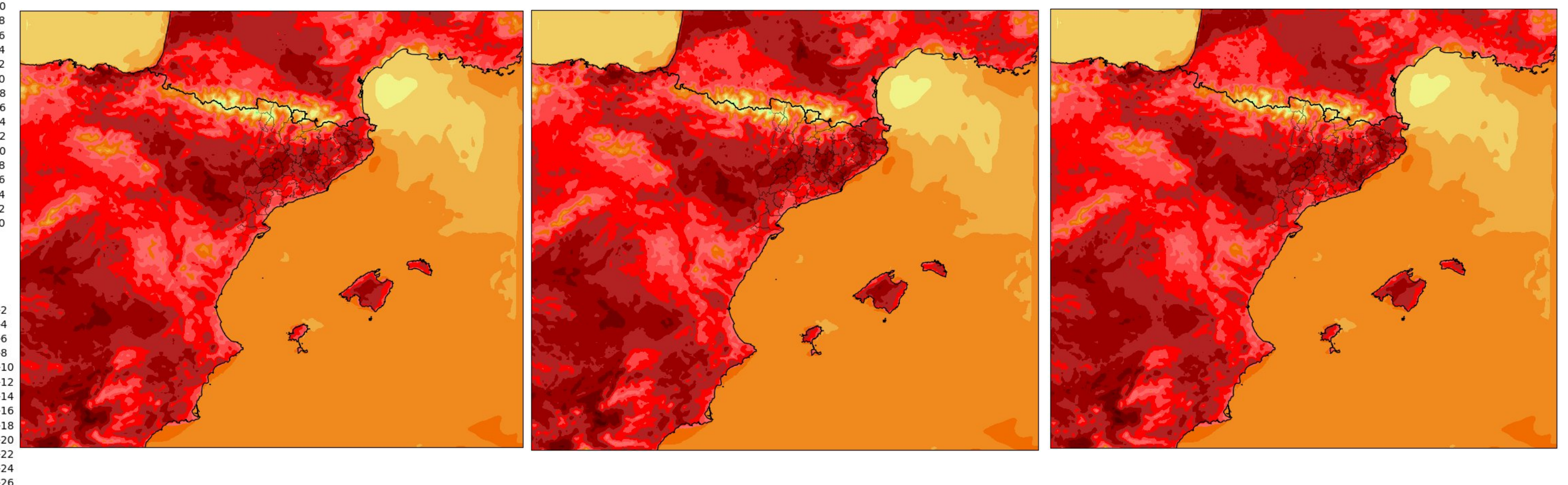


Maximum Temperature 2m (°C) — 29/07/2024 — +48h

Control

Landuse

Soil+Landuse

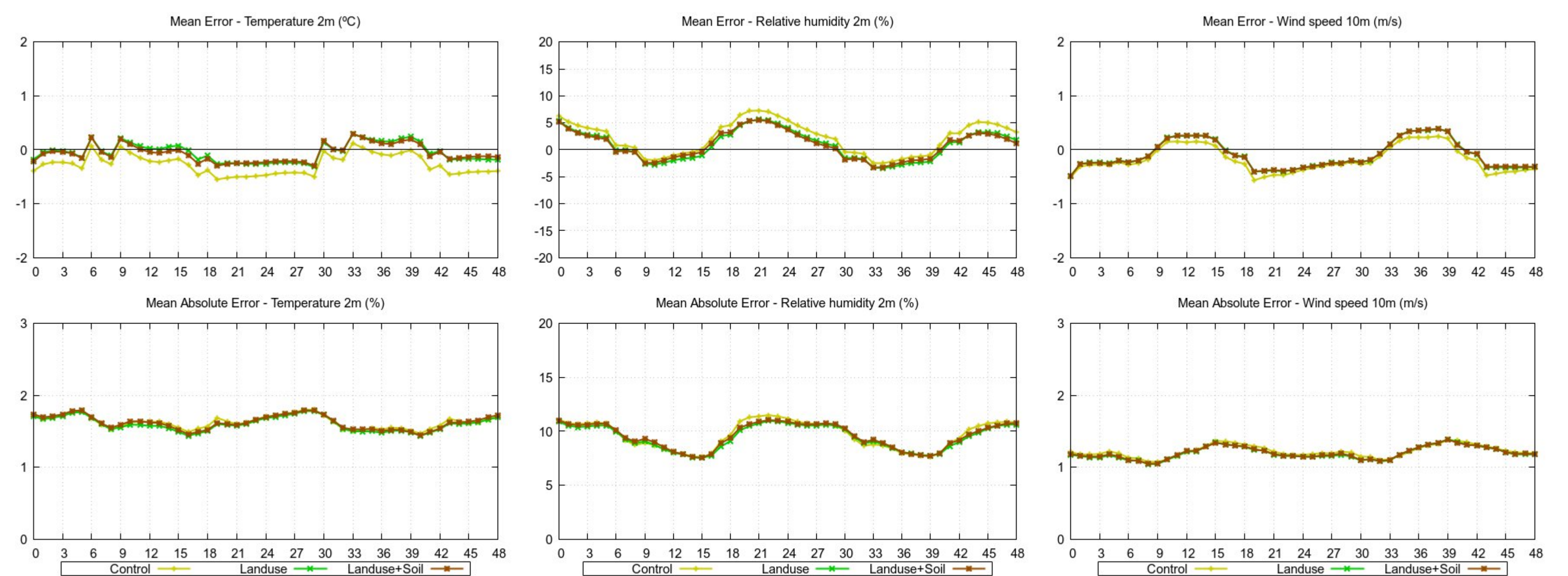


## Objective verification and discussion

The three experiments data come from 15 winter and 15 summer days, during the coldest and hottest spells of 2024. They have been verified against the SMC surface automatic weather station network (XEMA), with 189 stations in Catalonia.

Land use is the driving factor of the observed differences in the verification plots. However, maximum soil moisture content, derived from soil composition, has also been identified as a sensitive component regarding the forecast of surface parameters (not shown)

The different selection of parameterizations, the change in code, and table parameters produce bigger impact than land use and soil composition sources.



## Conclusions

- Code modification and debugging are necessary to understand the effects.
- Differences between experiments are small.
- Temperatures are increased, relative humidity decreases.
- Land use is the main driver, soil composition is on a different order.

## Further work

- Dynamic initialization of soil moisture and temperature.
- Leaf Area Index, Vegetation Fraction, Albedo initialization with observations.
- Activate irrigation and urban parameterizations.
- Update WRF version and test different pedotransfer functions.

## WRFv4.3 control configuration

- Microphysics: WSM5
- Cumulus: Kain-Fritsch
- Radiation: RRTMG
- Surface Layer: Monin-Obukhov
- PBL: YSU
- Surface Physics: **Noah-MP**
- Horizontal resolution: 3 km
- Vertical levels: 33
- Domain size: 300x260

## Changes in NOAHMP code

- Add pedotransfer functions options
- Mosaic land use option
- Changes in MPTABLE parameters
- Updated background albedo from ECOCLIMAP
- Inland water effects on evaporation

A mosaic representation of land use is used in all experiments.

A comparison between the USGS (1 km) database and a composite of CORINE v2018 100 m (Europe) and ICGC v2018 1 m (Catalonia) has been made. The last one with more forested areas and irrigated fields and general heterogeneity.

A comparison between the BNU-WRF and ISRIC soil grids has been made. A decrease in sand percentage in favour of clay and silt appears to be the main characteristic.

ISRIC soil grids add information for silt, organic matter, density and gravel composition. The Saxton and Rawls pedotransfer functions have been updated to take into account this new information.

The three experiments are:

Control

USGS Landuse + BNU Soil composition

Landuse

CORINE-ICGC Landuse + BNU Soil composition

Soil+Landuse

CORINE-ICGC Landuse + ISRIC Soil composition

Acknowledgements: Teammates of the Applied Research and Modelling Area of the SMC