SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year	2020…………………………………………………………
Project Title:	Convective phenomena at high resolution over Europe and the Mediterranean………………………………….
Computer Project Account:	spptsoar………………………………………………….
Principal Investigator(s):	Pedro Matos Soares …….………………………………….
Affiliation:	Portuggal………………………………………….……
Name of ECMWF scientist(s) collaborating to the project (if applicable)	……………………………………………………….…… ……………………………………………………….……
Start date of the project:	2020/01/01………………………………………………..
Expected end date:	2022………………………………………………….……

Computer resources allocated/used for the current year and the previous one
(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)			9 500 000	6816410.38
Data storage capacity	(Gbytes)			1000	

Summary of project objectives (10 lines max)

The main goal of this study is the analysis of the sensitivity of different surface model options in the Weather Research and Forecasting (WRF) model. Four experiments are being performed in the ECMWF high performance computing Center, driven by ERA5 reanalysis spanning from 2004-2006 over the European domain at 0.11o horizontal resolution. We will investigate the transition from wet and dry regimes through the analysis of the soil moisture – temperature and soil moisture – precipitation interactions. Also, the response of the surface climate to different model options will be explored.

Summary of problems encountered (10 lines max)

……..

Summary of plans for the continuation of the project (10 lines max)

Four simulations with the WRF model are being carried out with different land surface model schemes for the 2004-2006 period, driven by ERA5 reanalysis. The WRF model version 4.2 is used for the simulations over the European domain with a horizontal resolution of 0.11o and 50 vertical levels, which follows the CORDEX guidelines (Giorgi et al. 2009). A more detailed view of the parametrizations used will be given in the result sections. Finally, after these simulations are concluded, it is projected to run the same model at an higher horizontal resolution (3km) over the Iberian Peninsula

Giorgi, F., Jones, C., & Asrar, G. R. (2009). Addressing climate information needs at the regional level: the CORDEX framework. *World Meteorological Organization (WMO) Bulletin*, *58*(3), 175.

List of publications/reports from the project with complete references

………

Summary of results

The following physical parameterisations are used in the WRF setup for the four simulations (Table 1): the rapid radiative transfer model for global circulation models scheme for longwave and shortwave radiation; the planetary boundary layer Yonsei University scheme; the Grell-Freitas (GF) cumulus scheme; the GRIMS (Global/Regional Integrated Modelling System) shallow convection scheme; the microphysics Thompson aerosol-aware scheme; and the revised MM5 surface layer scheme. For the first experiment, the Noah land surface model was used. For the remaining simulations, the Noah-MP (multi-physics) land surface model was used with different runoff and groundwater options: (1) original surface and subsurface runoff (free drainage), (2) TOPMODEL with groundwater and (3) Miguez-Macho & Fan groundwater scheme. The other Noah-MP options used are described in Table 2.

Table 1. A list of the four simulations containing the physic parameterization options.

Schemes \ Experiment	WRF_NOAH	WRF_NOAH-MP_1	WRF_NOAH-MP_2	WRF_NOAH-MP_3
Radiation	RRTMG			
PBL	YSU			
Cumulus	Grell-Freitas			
Shallow convection	GRIMS			
Microphysics	Thompson 28			
Surface layer	Revised MM5			
LSM	NOAH	NOAH-MP	NOAH-MP	NOAH-MP

Table 2. NOAH-MP LSM configuration used in three simulations.

	Options \ Experiment	WRF_NOAH-MP_1	WRF_NOAH-MP_2	WRF_NOAH-MP_3
NOAH-MP Options	Dynamic vegetation	Off; use input LAI; calculate FVEG		
	Runoff and groundwater	Original surface and subsurface runoff (free drainage)	TOPMODEL with groundwater	Miguez-Macho & Fan groundwater scheme
	Stomatal resistance	Ball-Berry		
	Surface layer drag coefficient	Monin-Obukhov		
	Soil moisture factor for stomatal resistance	CLM		
	Supercooled liquid water	No iteration		
	Soil permeability	Koren's iteration		
	Radiative transfer	Two-stream applied to vegetation fraction		
	Ground surface albedo	CLASS		
	Precipitation partitioning between snow and rain	Snow when SFCTMP<TFRZ		
	Soil temperature boundary condition	TBOT at 8m from input file		
	Snow/soil temperature time	Semi-implicit		
	Glacier treatment	Includes phase change		
	Surface evaporation resistence	Sakaguchi and Zeng 2009		
	Defining soil properties	Use input dominant soil texture		
	Crop model	No crop model, will run default dynamic vegetation		

Preliminary Results

Evaluation of the Experiments

The results presented in this report are preliminary and are only referents to 2004 year and for three simulations (WRF_NOAH, WRF_NOAH-MP_1, WRF_NOAH-MP_2). The first step of this work is the evaluation of the simulations against the observations. The new version of the Europe-wide E-OBS temperature and precipitation data set is used to compare with the output of the simulations performed. This dataset has a regular grid with 0.1o spatial resolution. The Figures 1, 2 and 3 displayed the spatial pattern of the yearly precipitation, maximum and minimum temperature for the E-OBS dataset and the three simulations. Also, the differences between the simulations and the observations are also displayed. An extensive evaluation will be performed when all the simulations are finished. For each grid point and time scales [daily, monthly, seasonal and yearly], the following standard statistics will be computed:

bias, normalized bias, mean absolute error, mean absolute percentage error, root mean square error, standard deviation for the RCMs and evaluation data, normalized standard deviation, spatial correlation and the Willmott – D Score. Additionally, the probability density Function matching scores will be also computed, as well as the Yule-Kendall skewness measure.

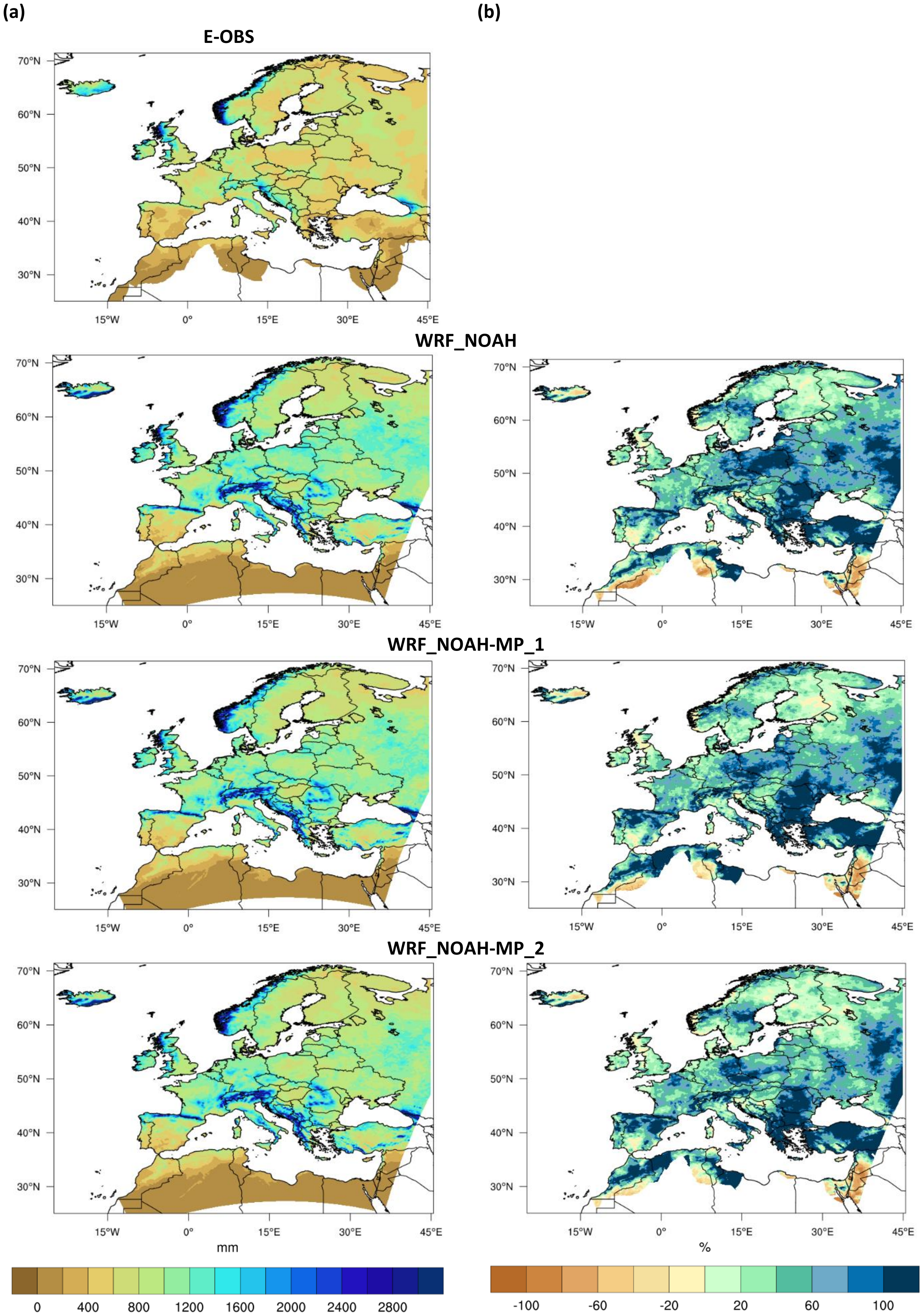

Figure 1. (a) Yearly precipitation (2004) from gridded observations at 0.1º (E-OBS) and from three simulations (WRF_NOAH, WRF_NOAH-MP_1, WRF_NOAH-MP_2) interpolated for the E-OBS grid. (b) Relative differences of yearly precipitation between the simulations and the E-OBS dataset (2004).

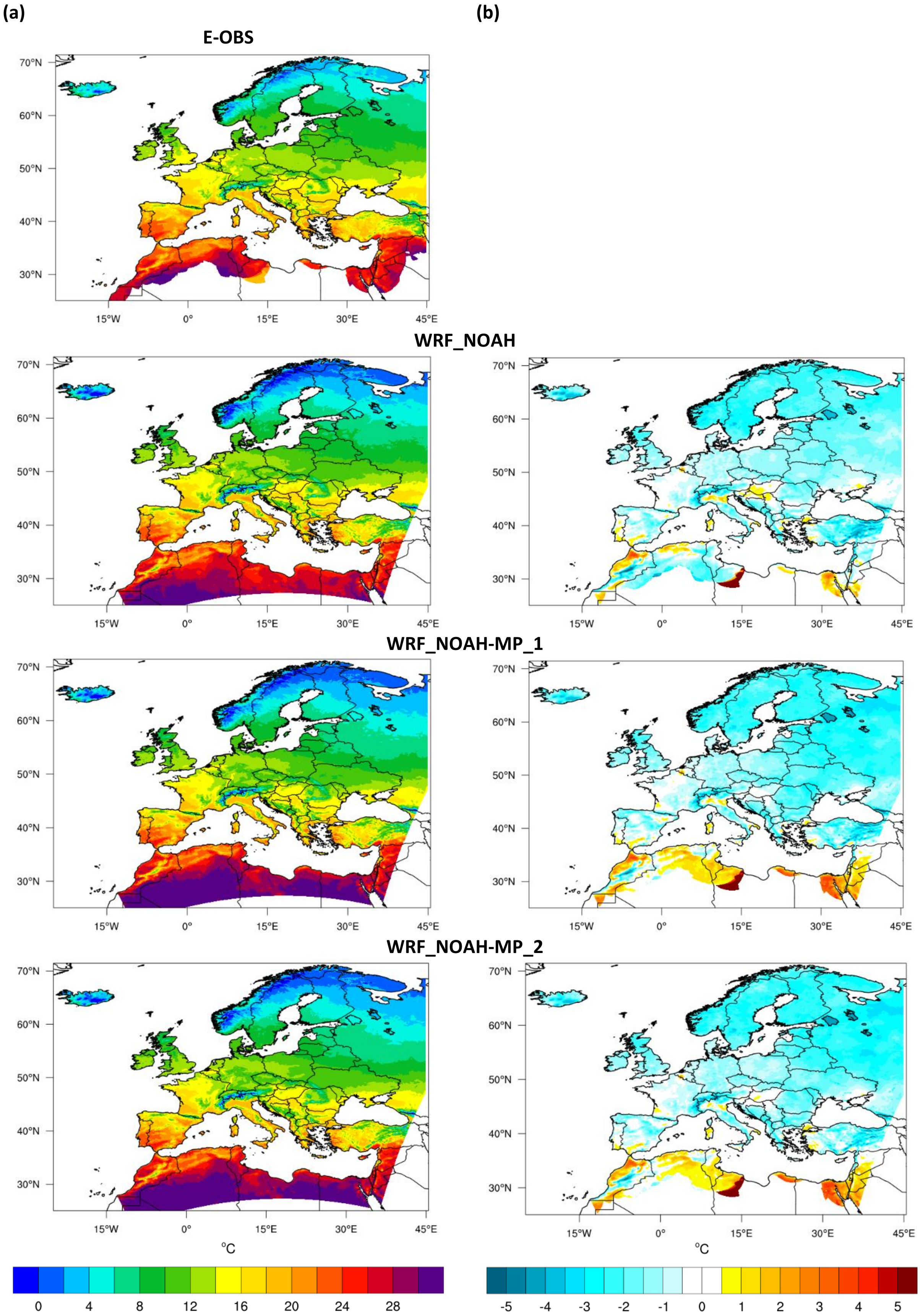

Figure 2. (a) Yearly mean maximum temperature (2004) from gridded observations at 0.1° (E-OBS) and from three simulations (WRF_NOAH, WRF_NOAH-MP_1, WRF_NOAH-MP_2) interpolated for the E-OBS grid. (b) Differences of yearly mean maximum temperature between the simulations and the E-OBS dataset (2004).

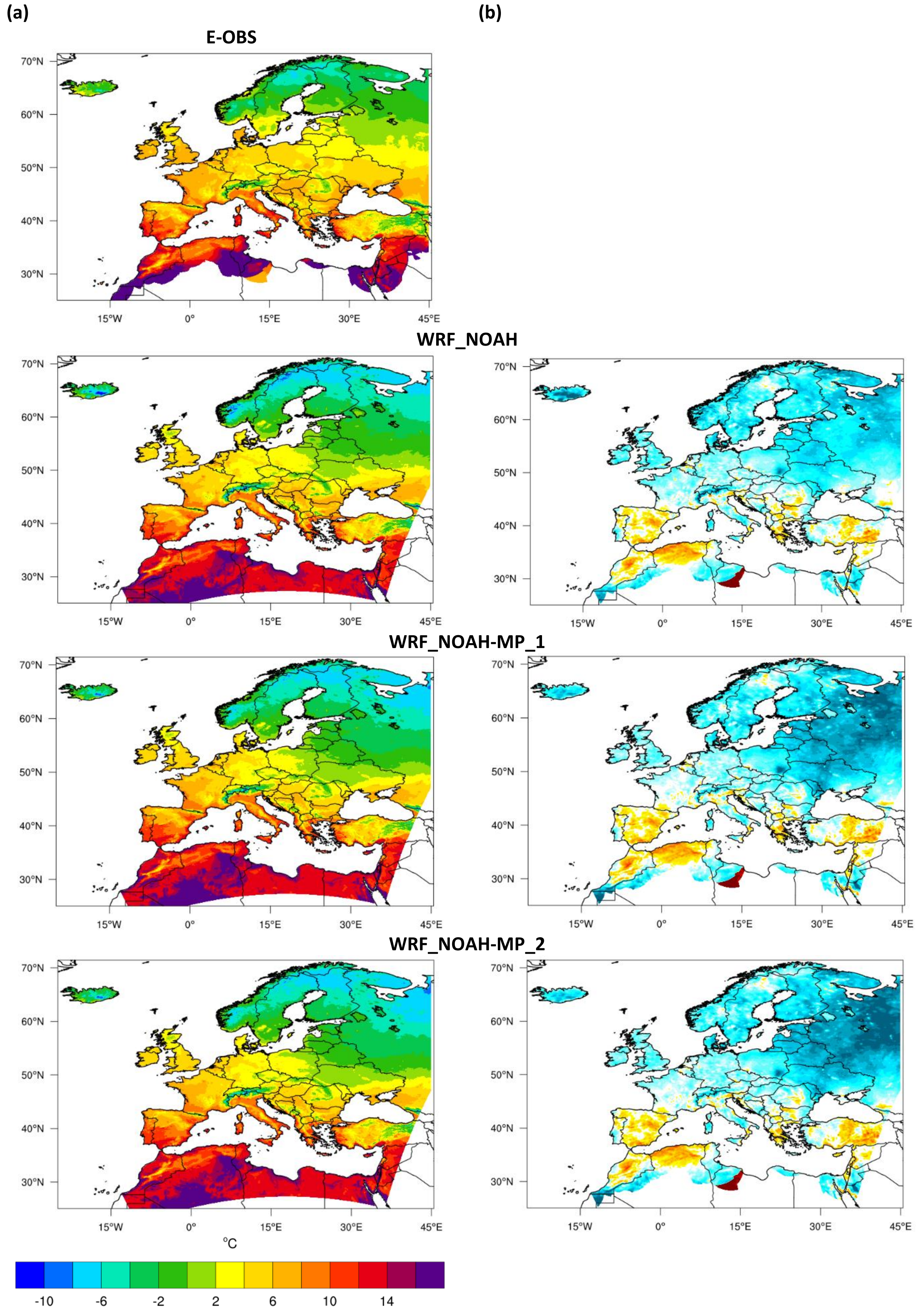

Figure 3. (a) Yearly mean minimum temperature (2004) from gridded observations at 0.1^{o} (E-OBS) and from three simulations (WRF_NOAH, WRF_NOAH-MP_1, WRF_NOAH-MP_2) interpolated for the E-OBS grid. (b) Differences of yearly mean minimum temperature between the simulations and the E-OBS dataset (2004).