Recent advances in climate modelling for impacts studies

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What would we like for our impact models?

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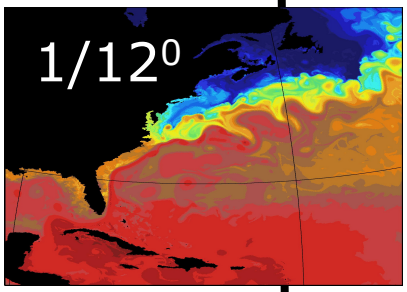
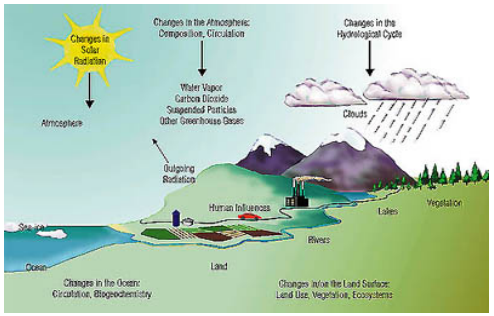
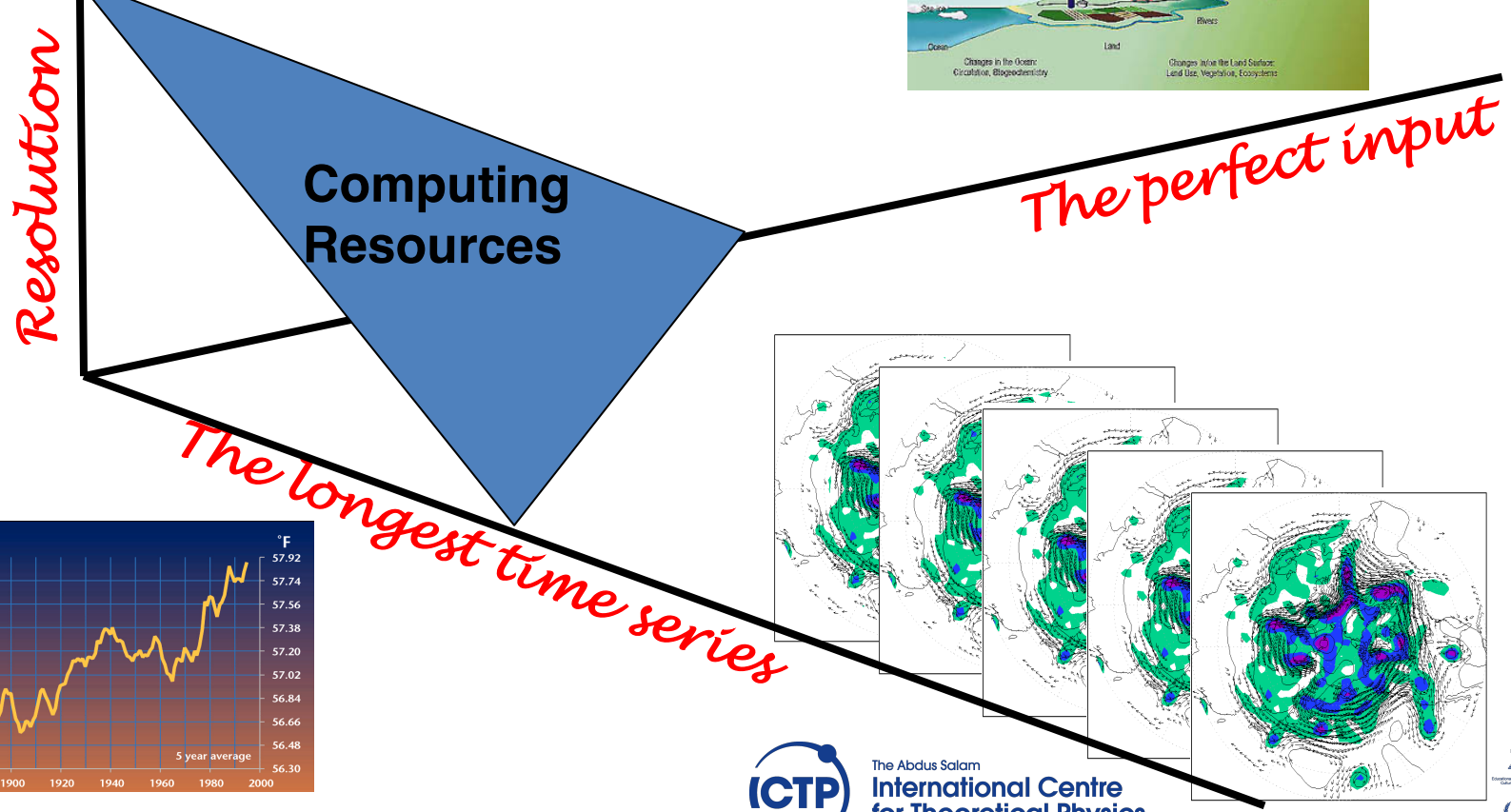
Shopping list:

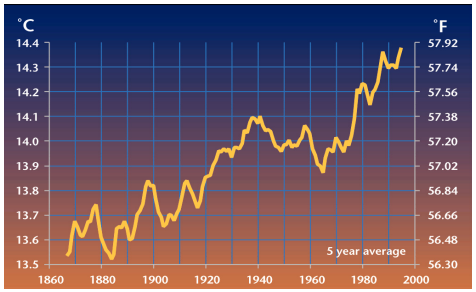
- The highest resolution
- The perfect input
- The longest time series

Context: *competing demands to improve climate prediction - resolution, complexity and ensemble size*









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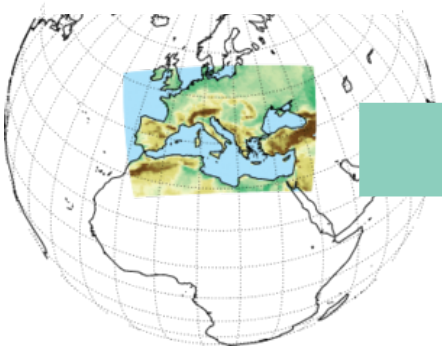
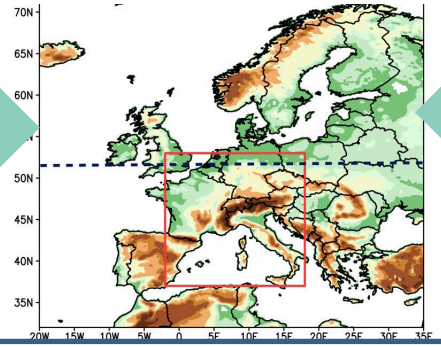
Coordinated European on-going project

WCRP CORDEX
FLAGSHIP PILOT STUDIES

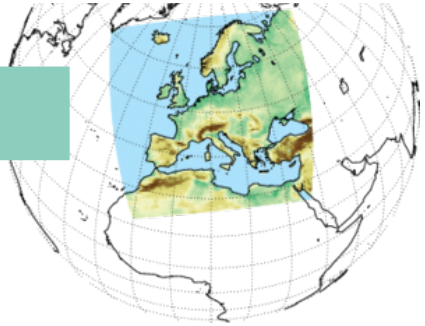
Med-CORDEX



FPS-CORDEX on CP

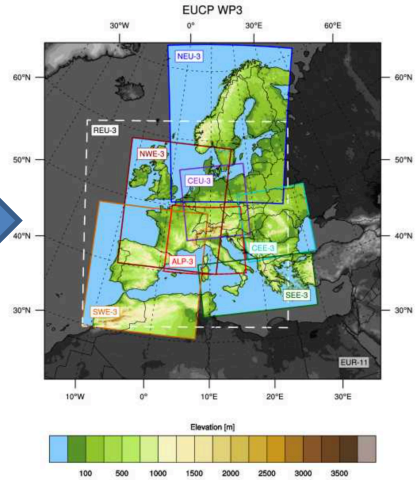


EURO-CORDEX



#H2020

EUCP
European Climate Prediction system



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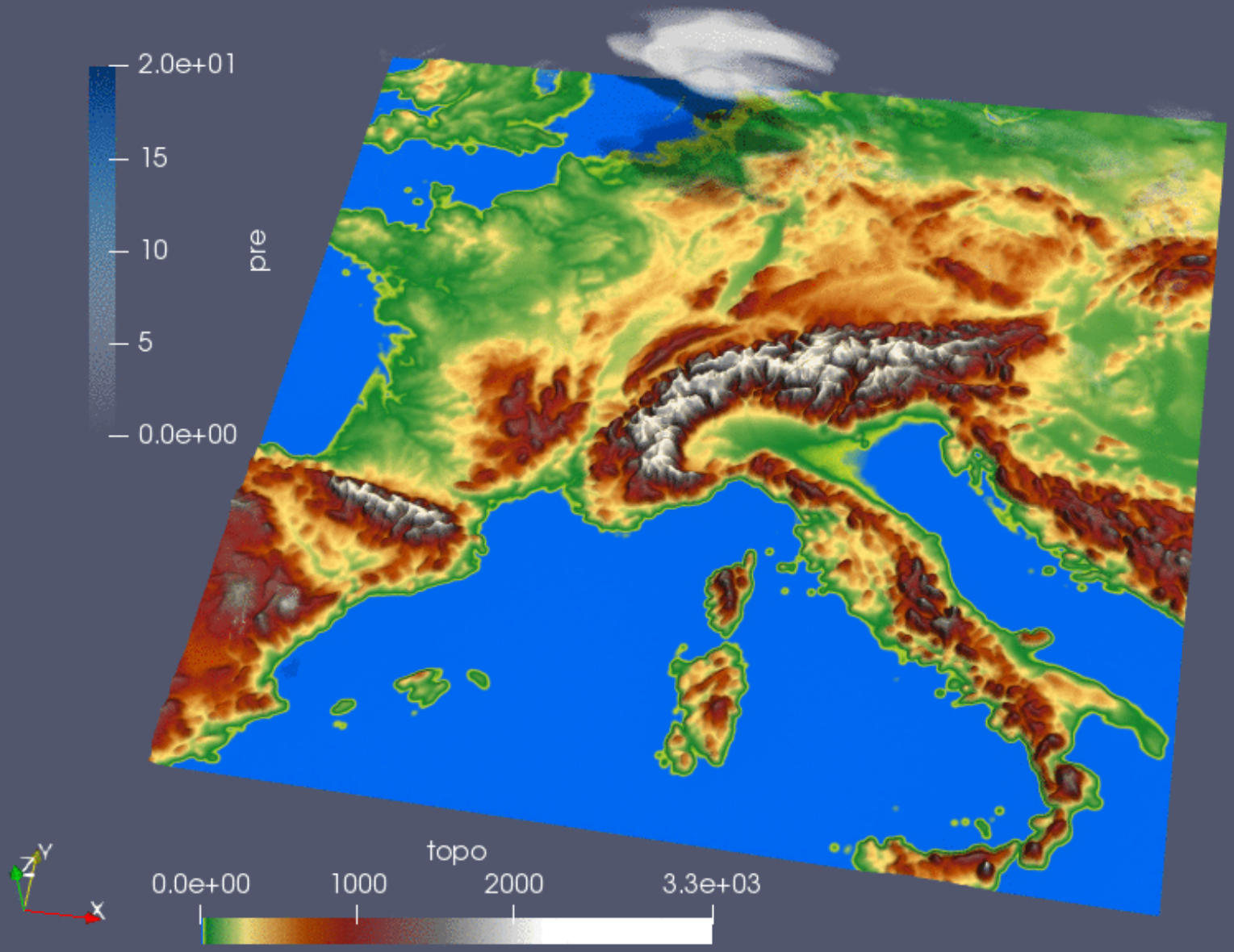
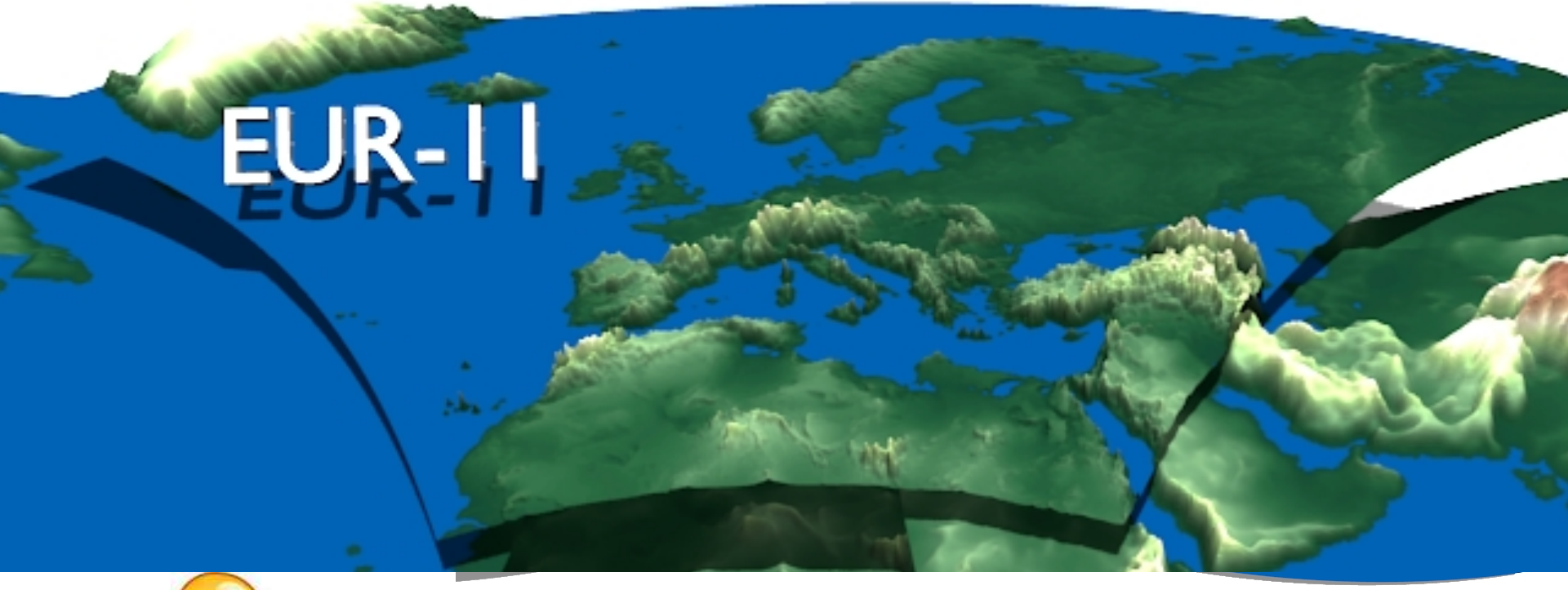

2.0e+01
15
10
5
0.0e+00
pre
topo
0.0e+00
1000
2000
3.3e+03
Y
Z
X

Computational Resources



- 54 member ensemble
- 150 years lenght
- 2 scenarios RCP2.6 and RCP8.5
- all simulation available on ESGF archive

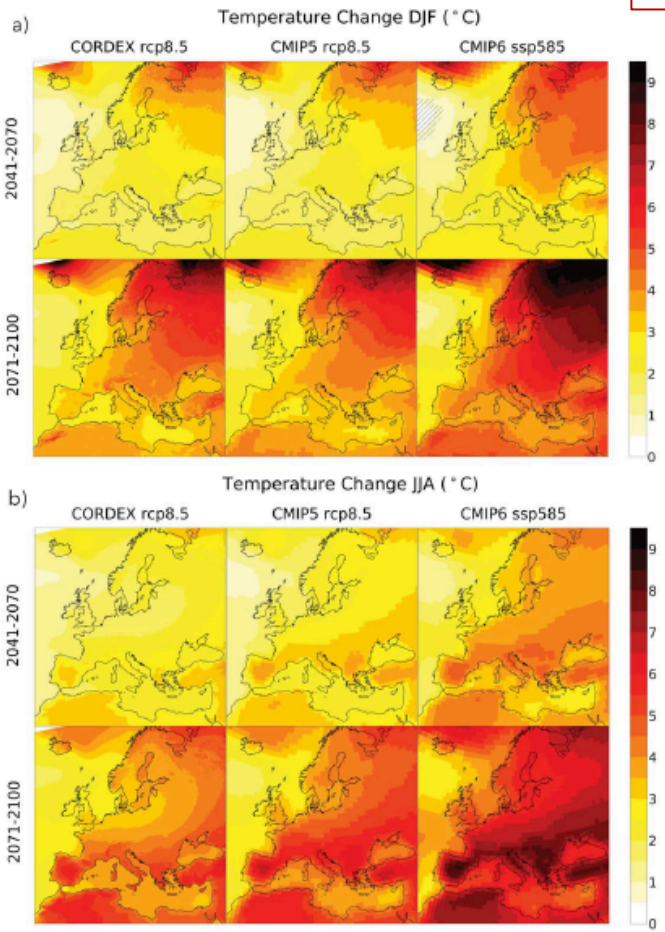
High resolution convection permitting models ~3km

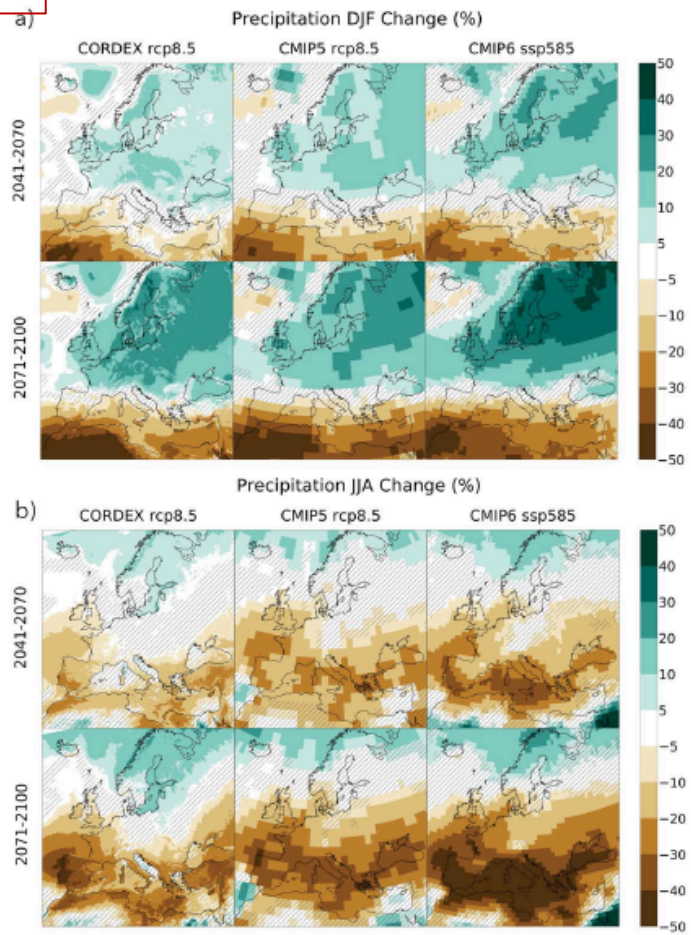
INSTITUTE	CP-RCM	Resolution (km)	Driving RCM	Resolution (km)	GCM
KNMI (**) The Royal Netherlands Meteorological Institute	HCLIM38-AROME	2.5	RACMO	12	EC-Earth
ICTP (**) Abdus Salam Internatinal Centre for Theoretical Physics	RegCM4	3	RegCM4	12	HadGEM
CNRM (**) Centre National de Recherches Meteorologique	CNRM-AROME41t1	2.5	CNRM-ALADIN63	12	CNRM-CM5
KIT Karlsruhe Institute of Technology	CCLM5	3	CCLM4	12	MPI-ESM-LR
BTU Brandenburg University of Technology					CNRM-CM5
ETHZ (**) (a) Federal Institute of Technology, Institute for Atmospheric and Climate Science					MPI
ETHZ (**) (b) Federal Institute of Technology	CCLM	2.2	CCLM	12	pgw
FZJ-IBG3-IDL Research Centre Julich Institute Dom Luis	WRF3.8	3	WRF3.8.1CA	15	EC-EARTH
DMI- MET Norway- SMHI (**) HARMONIE-Climate community	HCLIM38-AROME	3	HCLIM38-ALADIN	12	EC-EARTH
UNIGRAZ-WEGC Wegener Center for Climate and Global Change, University of Graz	WEGC-CCLM5	3	WEGC-CCLM5	12	MPI-ESM-LR
UK Met OFFICE (**) Met Office Hadley Centre Exeter	UM	2.2	No intermediate RCM		HadGEM
BCCR The Bjerknes Centre for Climate Research	WRF3.8	3	WRF3.8.1CA	15	NorESM1

- **12 member ensemble**
- **3x10 years lenght**
- **1 scenarios RCP8.5**

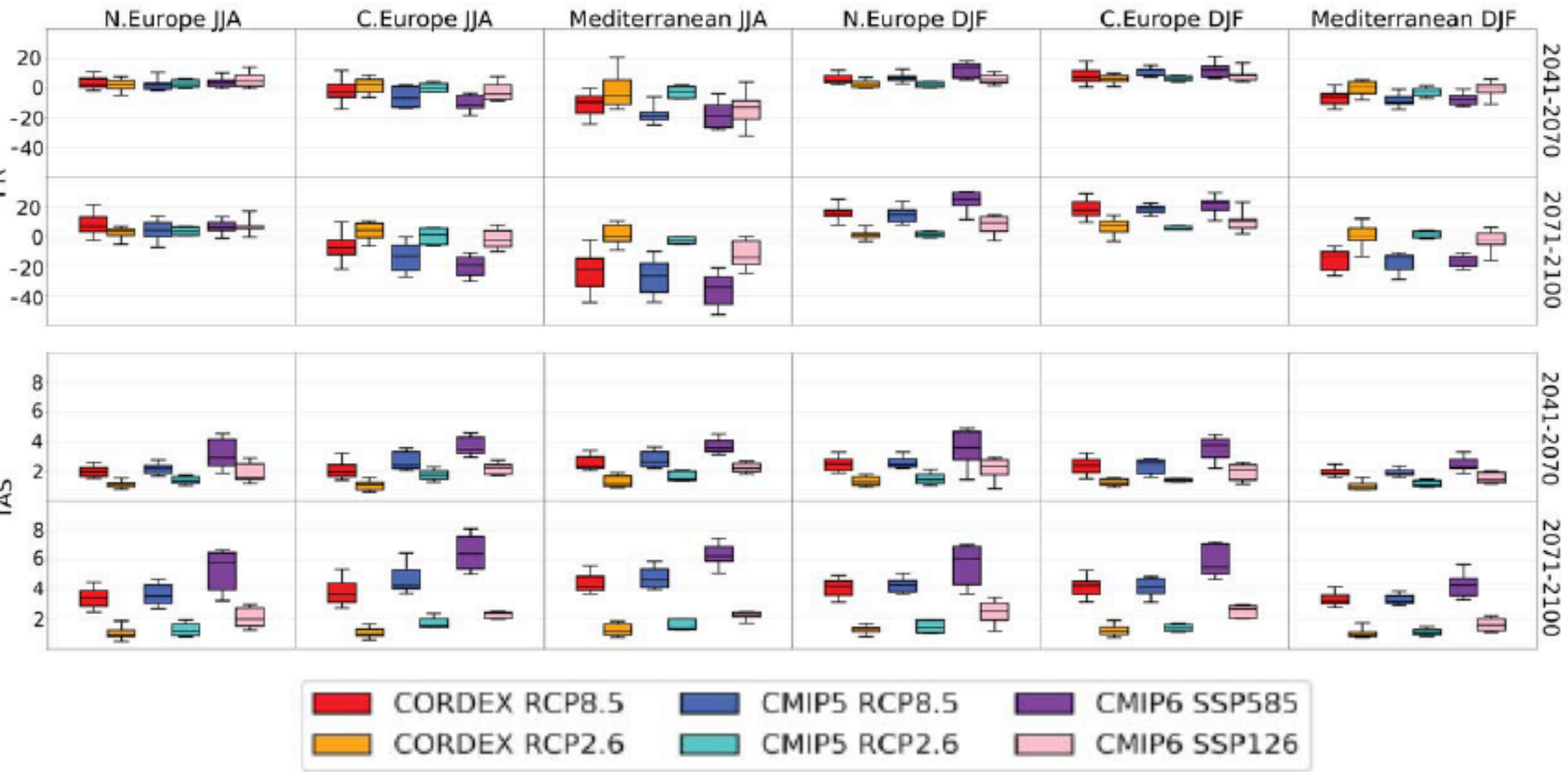
The first of this size European Regional Climate Model ensemble

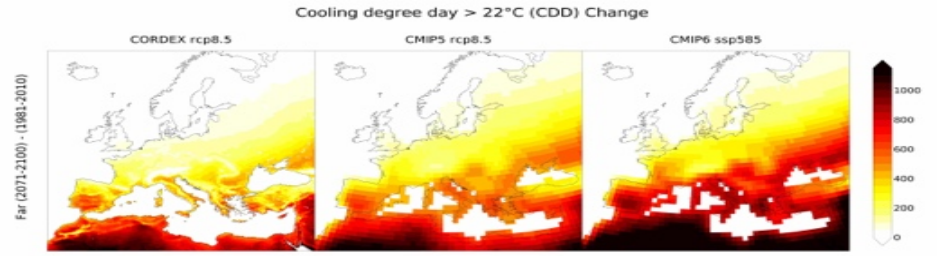
Mean climate

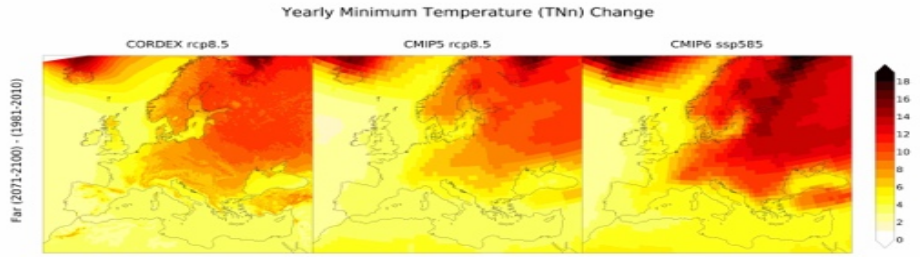


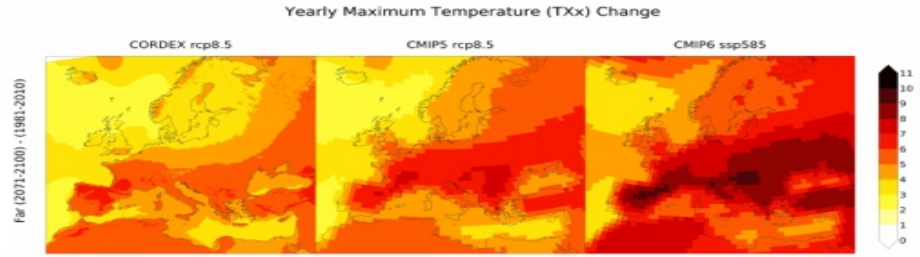


Coppola, E., Nogherotto, R., Ciarlo, J. M., Giorgi, F., van Meijgaardm, E., Iles, C., et al. (2020). Assessment of the European climate projections as simulated by the large EURO-CORDEX regional climate model ensemble. *J. Geophys. Res. - Atmos.* DOI: 10.1029/2019JD032356

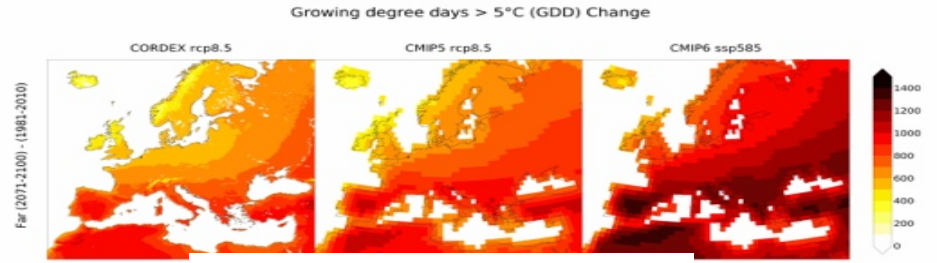

N.Europe JJA
C.Europe JJA
Mediterranean JJA
N.Europe DJF
C.Europe DJF
Mediterranean DJF
2041-2070
2071-2100
TAS
CORDEX RCP8.5
CORDEX RCP2.6
CMIP5 RCP8.5
CMIP5 RCP2.6
CMIP6 SSP585
CMIP6 SSP126

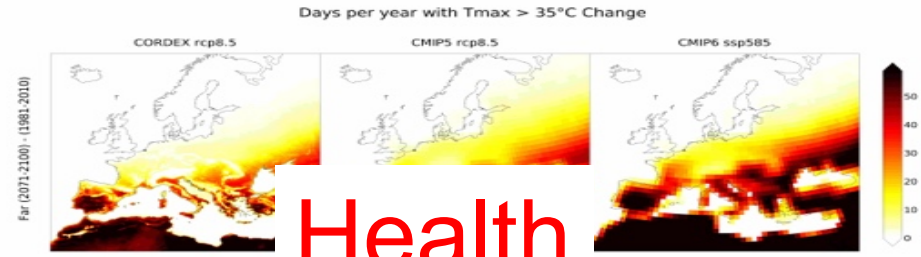






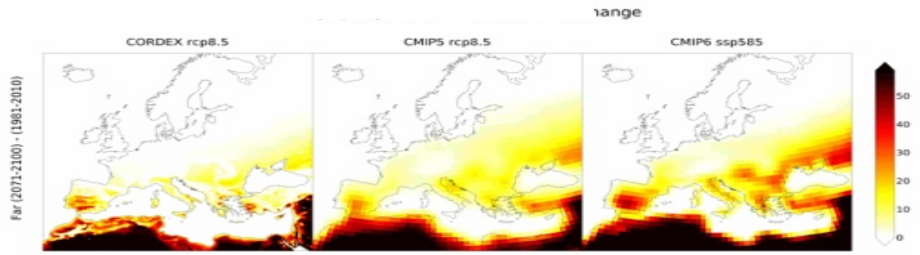
Energy consumption

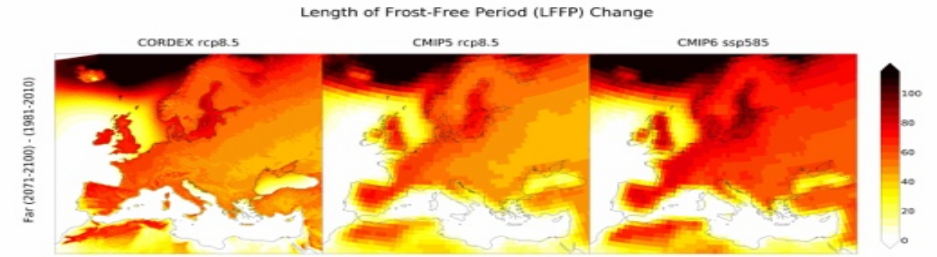


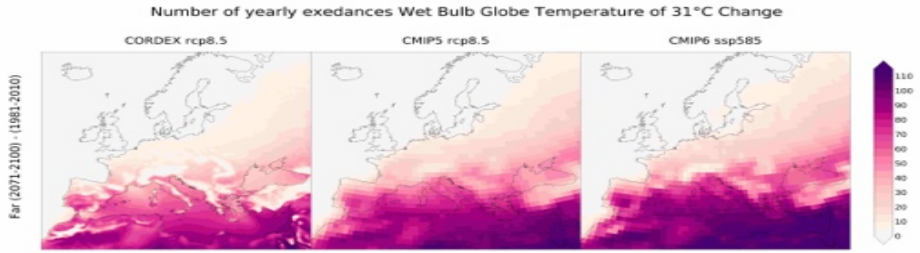


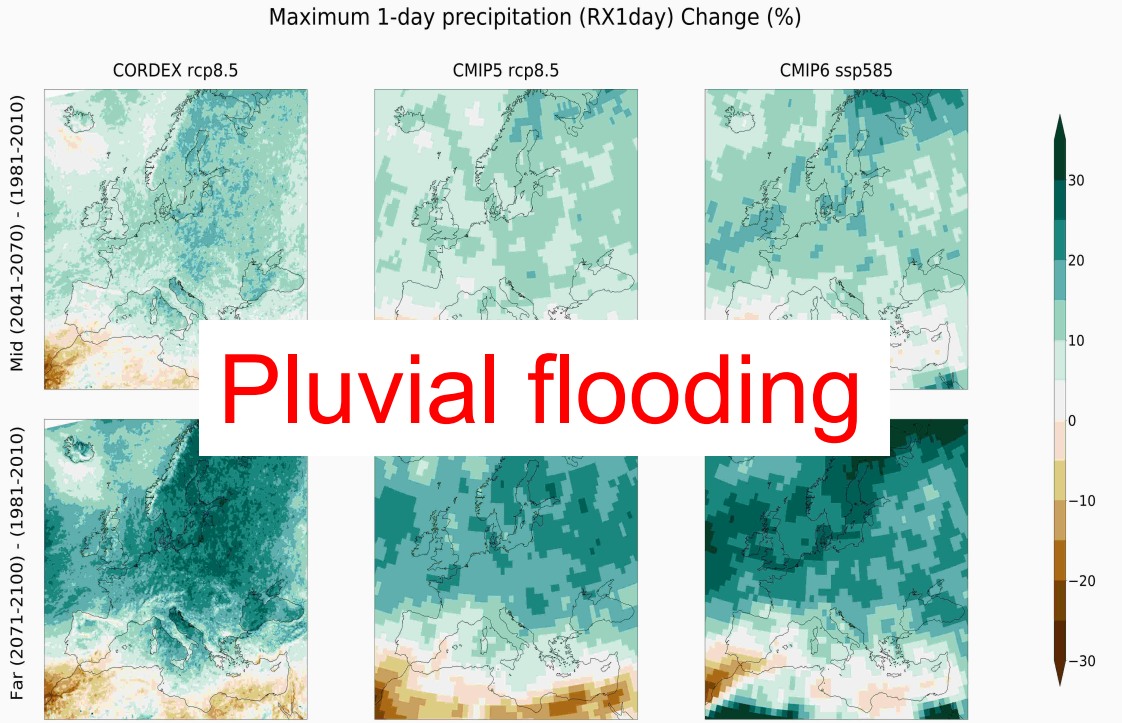
Health

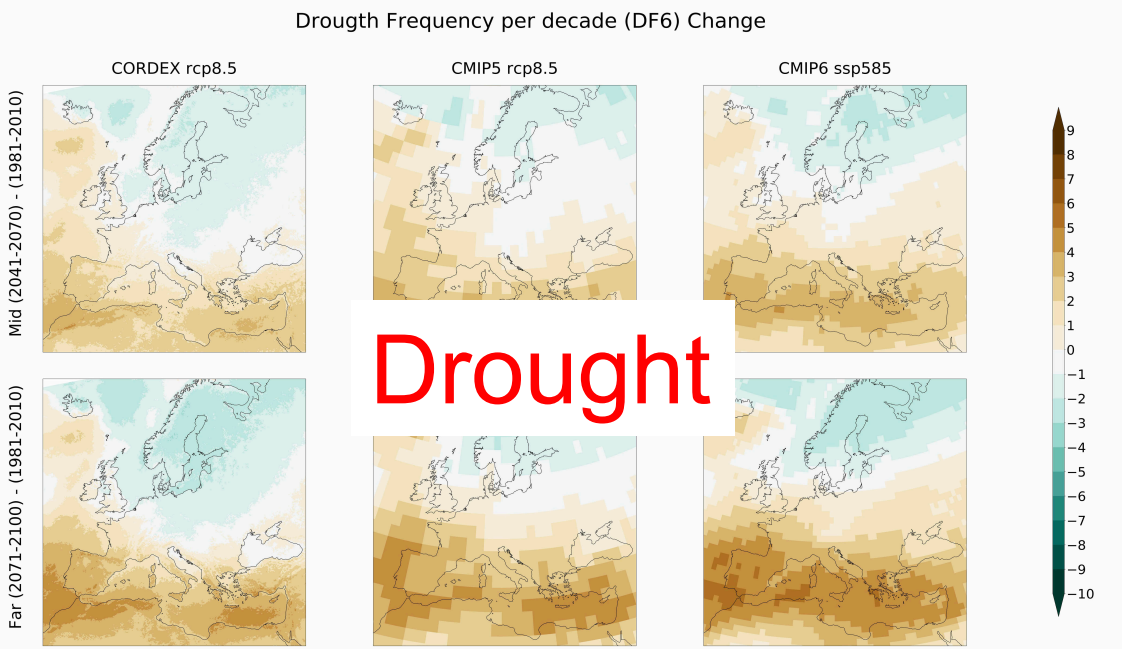
Agriculture





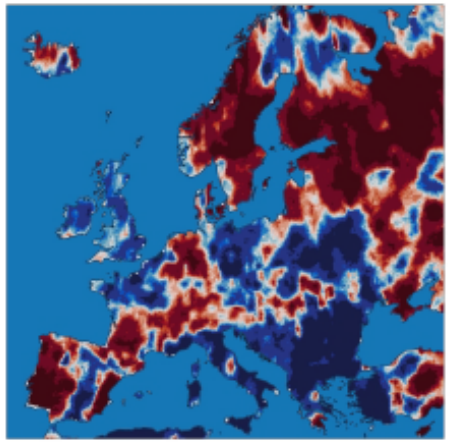



Maximum 1-day precipitation (RX1day) Change (%)
CORDEX rcp8.5
CMIP5 rcp8.5
CMIP6 ssp585
Mid (2041-2070) - (1981-2010)
Far (2071-2100) - (1981-2010)
30
20
10
0
−10
−20
−30
Pluvial flooding

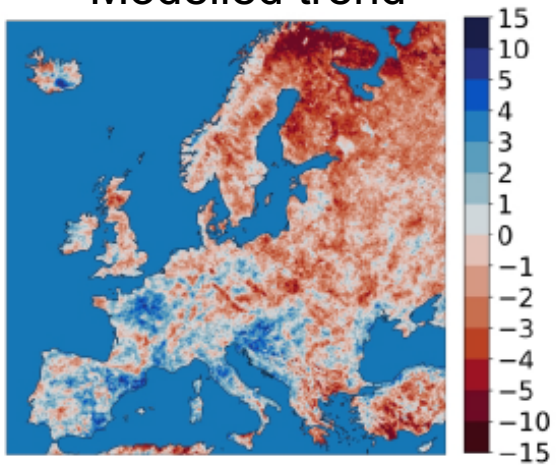

Drougth Frequency per decade (DF6) Change
CORDEX rcp8.5
CMIP5 rcp8.5
CMIP6 ssp585
Mid (2041-2070) - (1981-2010)
Far (2071-2100) - (1981-2010)
9
8
7
6
5
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−7
−8
−9
−10
Drought

Hydrological model ensemble driven by Euro-CORDEX 0.11

Observed trend

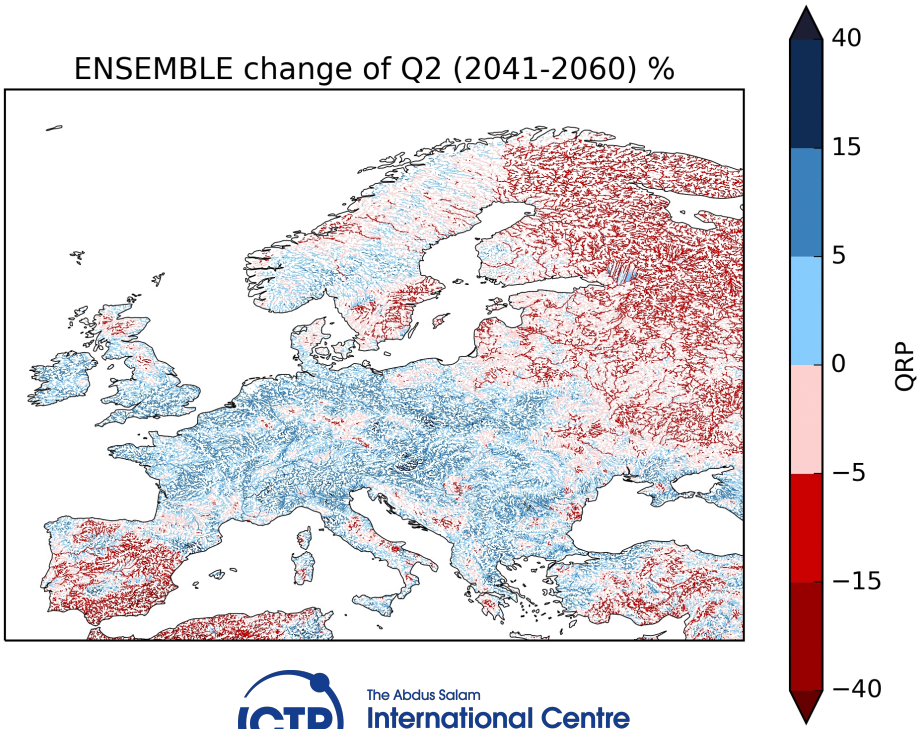


Modelled trend



- 44 member ensemble
- 150 years lenght
- 2 scenarios RCP2.6 and RCP8.5

ENSEMBLE change of Q2 (2041-2060) %



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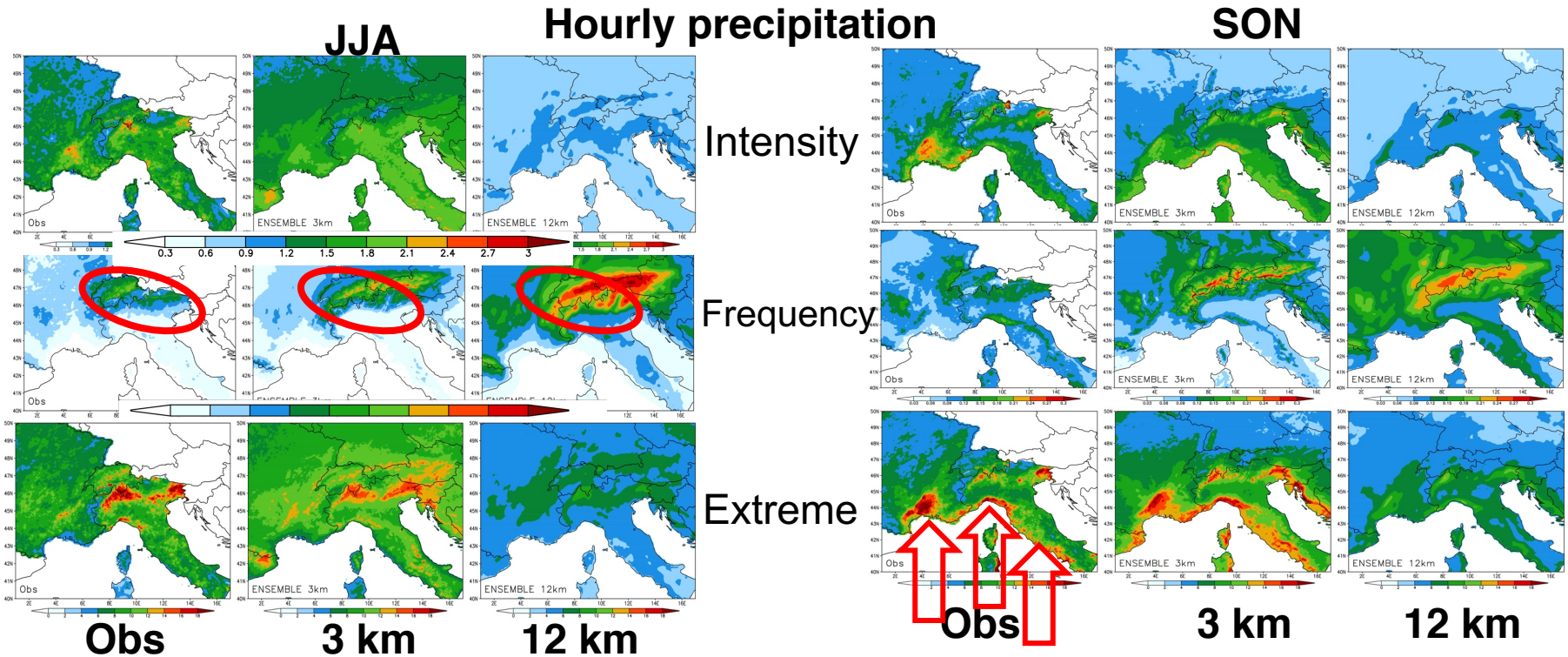
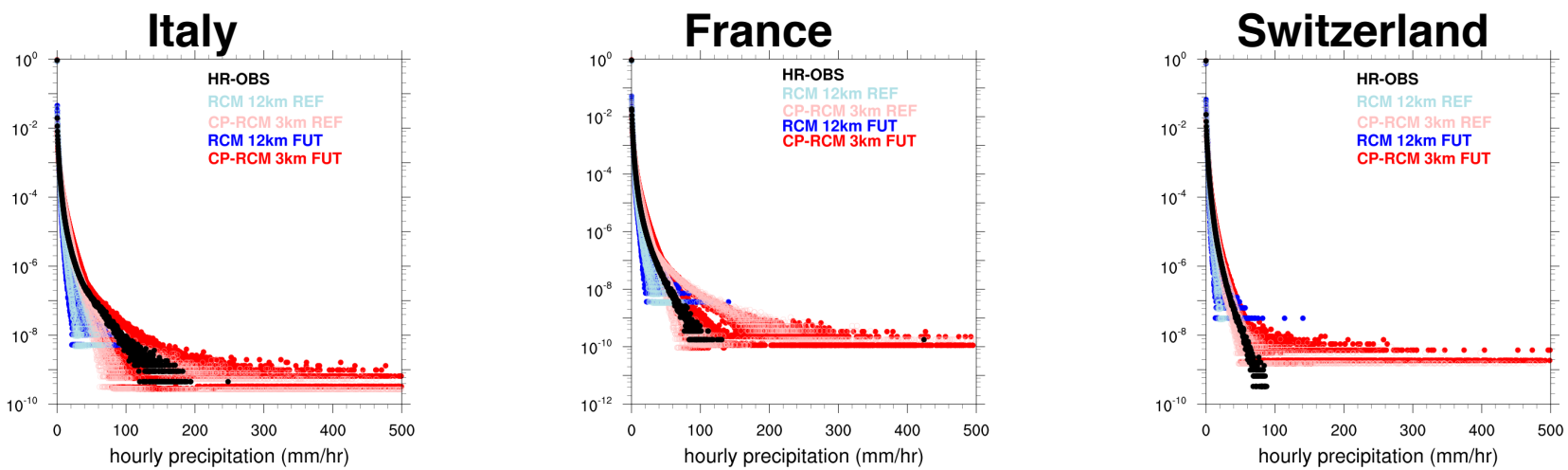
Di Sante, F., Coppola, E., and Filippo, G. (2020). Future projections of river floods over the European region using EURO-CORDEX simulations. *Int. J. Climatol.* (submitted).

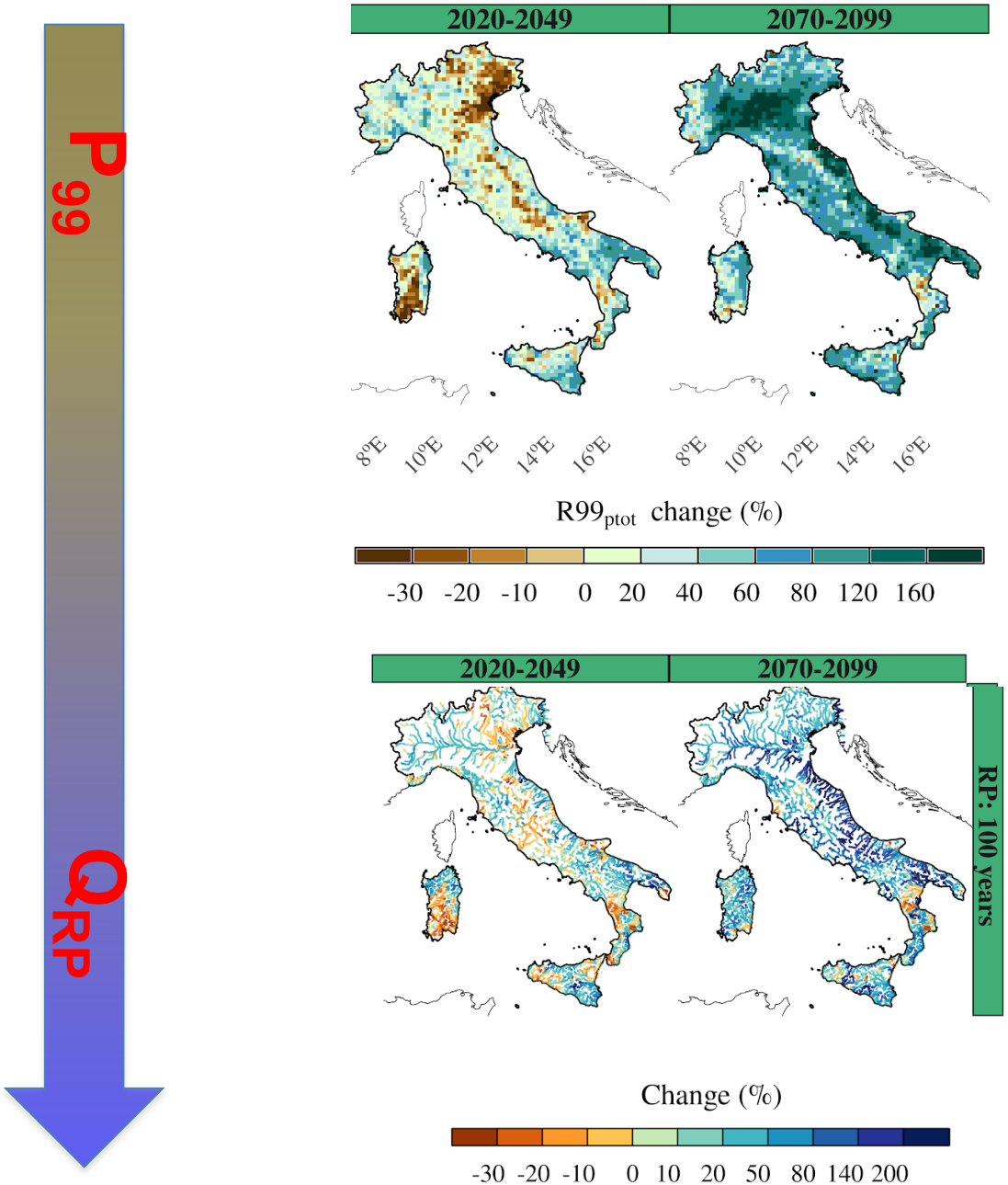
The Convection Permitting Ensemble





Pichelli, E., Coppola, E., Sobolowski, S., Ban, N., Giorgi, F., Stocchi, P., et al. (9999). The first multi-model ensemble of regional climate simulations at

From high resolution climate projections to the flood hazard map

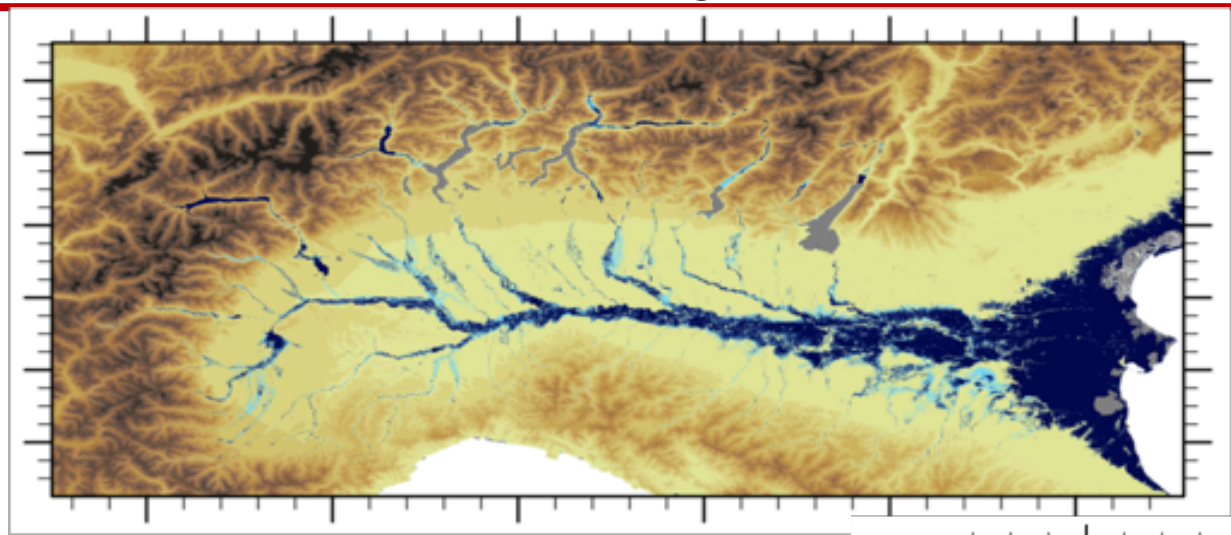


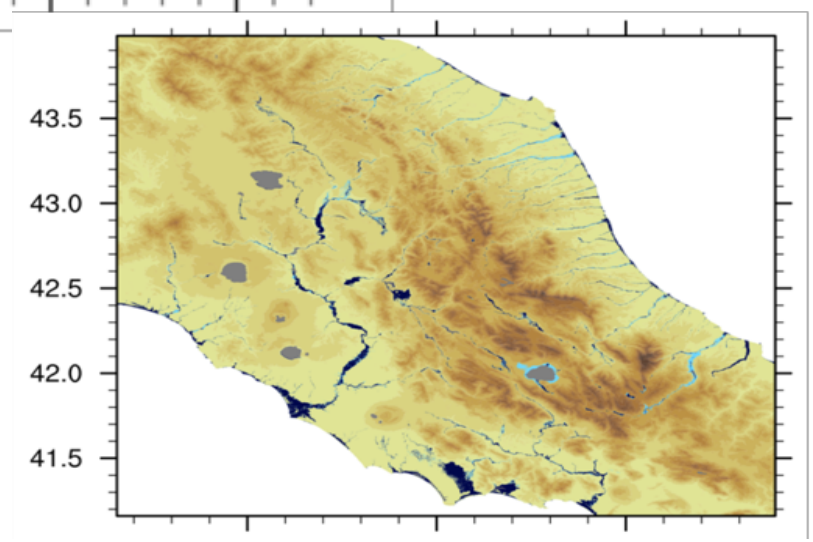
Fantini, A. (2019). Climate change impact on flood hazard over Italy Ph.D. thesis, University of Trieste, 2019.

We performed the flood extent simulation for a range of return periods using both **historical** and **RCP8.5** data to estimate **the flood change**.

For **T=500 yr, flooded area increases by 18%** in the North of Italy.

Central Italian **flood extent will increase in the eastern coast**, in line with the increase of maximum discharges.





RP = 500 yr

Historical

RCP8.5

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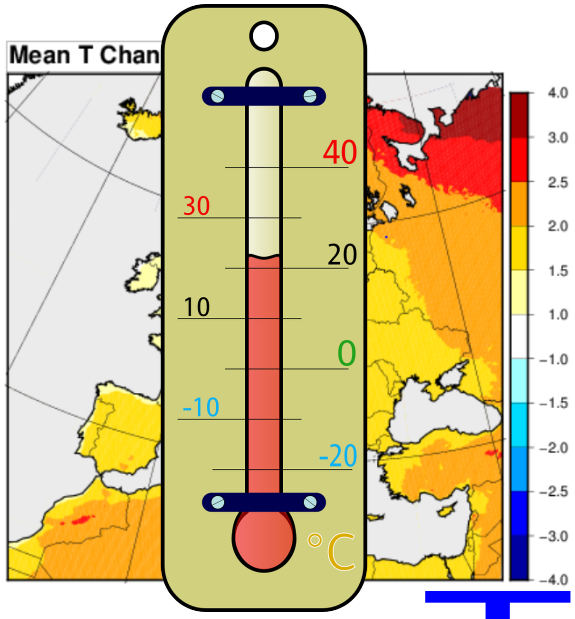
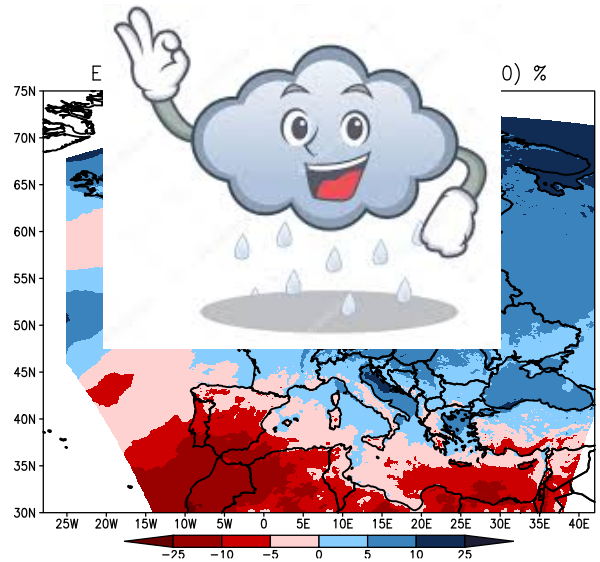
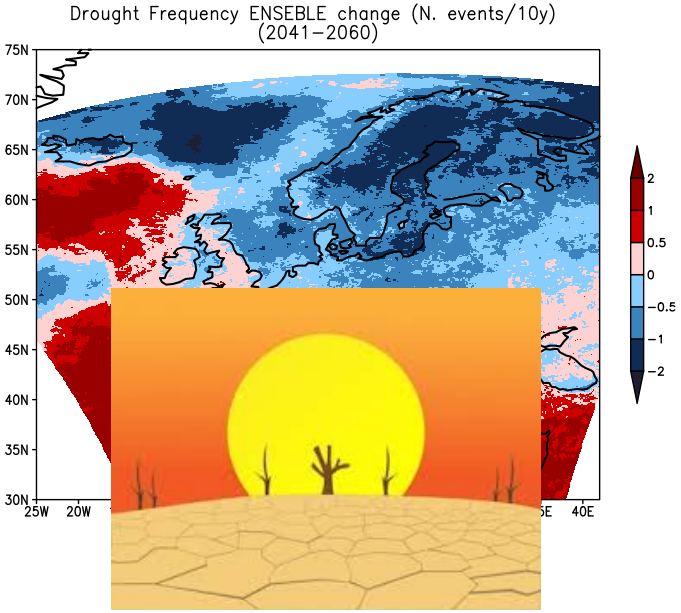
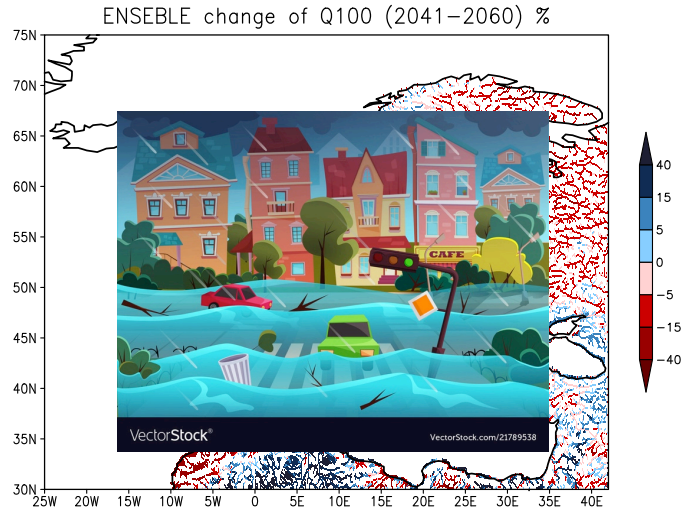
Nogherotto R. et al., An integrated hydrological and hydraulic modelling approach for the flood risk assessment over Po river basin, Journal of Flood Risk Management, Submitted


Mean T Chan
40
30
20
10
0
-10
-20
°C
4.0
3.0
2.5
2.0
1.5
1.0
−1.0
−1.5
−2.0
−2.5
−3.0
−4.0


E
0) %
75N
70N
65N
60N
55N
50N
45N
40N
35N
30N
25W 20W 15W 10W 5W 0 5E 10E 15E 20E 25E 30E 35E 40E
−25 −10 −5 0 5 10 25

Thanks!


Drought Frequency ENSEBLE change (N. events/10y)
(2041−2060)
75N
70N
65N
60N
55N
50N
45N
40N
35N
30N
25W 20W
40E
2
1
0.5
0
−0.5
−1
−2


ENSEBLE change of Q100 (2041−2060) %
75N
70N
65N
60N
55N
50N
45N
40N
35N
30N
25W 20W 15W 10W 5W 0 5E 10E 15E 20E 25E 30E 35E 40E
CAFE
VectorStock
VectorStock.com/21789538
40
15
5
0
−5
−15
−40