The Abdus Salam
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IAEA
International Atomic Energy Agency

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Fifth ICTP Workshop on the Theory and Use of Regional Climate Models

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Verification, climate change and variability of European temperature and precipitation: Focus on Croatia and the first CORDEX results

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Zagreb
CROATIA

5th ICTP Workshop on the
Theory and Use of Regional Climate Models

Verification, climate change and variability of **European** temperature and precipitation: focus over **Croatia** and the first **CORDEX** results

Ivan Güttler, Mirta Patarčić, Lidija Srnec, Čedo Branković
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Trieste, 2 June 2010

DHMZ

www.meteo.hr

Experiment 1: Downscaling global climate model simulations

Near-present climate
- T2m and total precipitation bias
- T2m and total precipitation variability: EOF1
- T2min, T2m, T2max
- Focus over Croatia: climatology and *number of days*

Near-future climate
- T2m and total precipitation change
- Change in variability patterns

Experiment 2: Downscaling ERA-Interim

Default simulation
- T2m and total precipitation bias

ERAInterim vs CRU
Sensitivity of the warm bias to changes in PBL scheme

New simulation
- T2m and total precipitation bias

Summary

Experiment 1: Downscaling global climate model simulations

GCM: EH5OM
3 ens. members
T63/L31

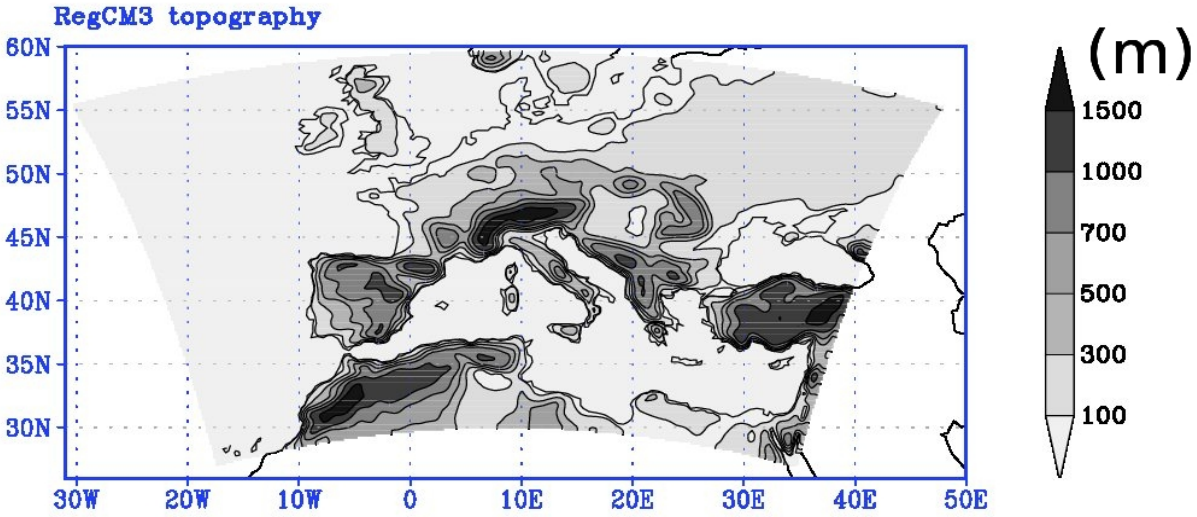
RCM: RegCM3
3 ens. members
35 km/L23

P0: 1961-1990

P1: 2011-2040

SRES A2

(a)



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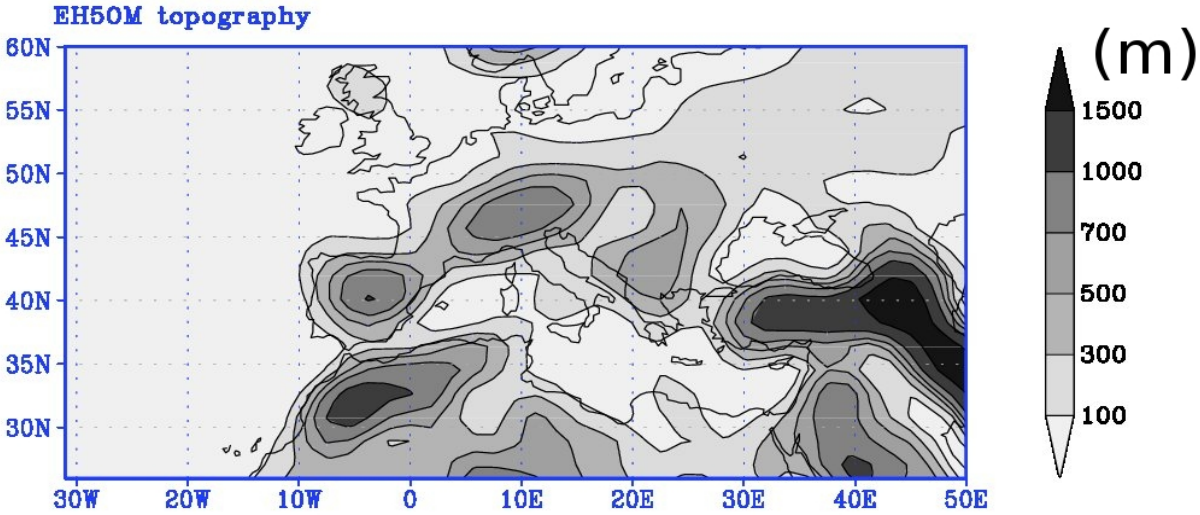


Winter and summer T2m bias

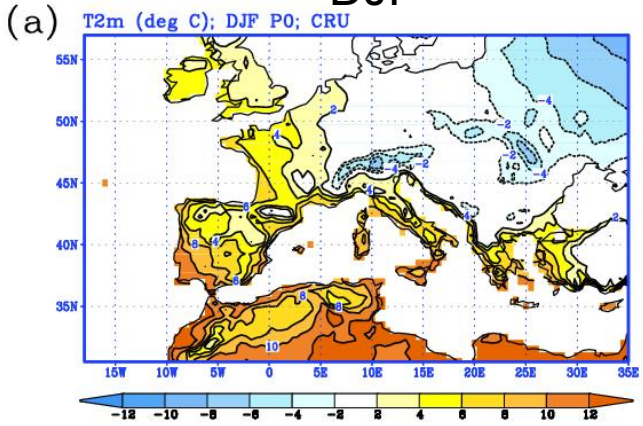
DJF

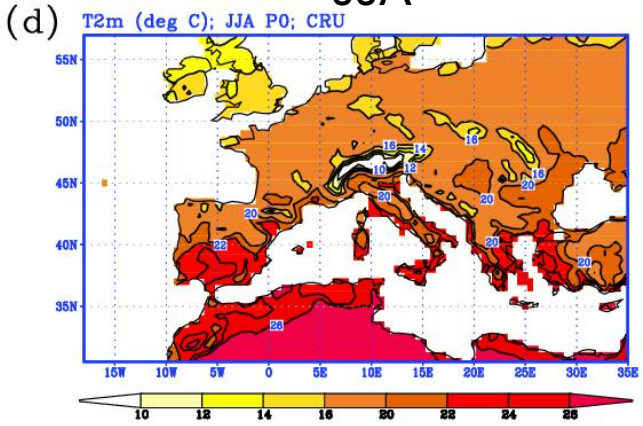
JJA

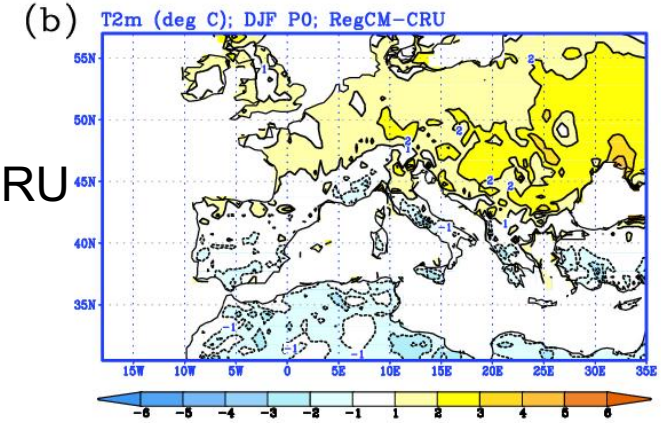
CRU

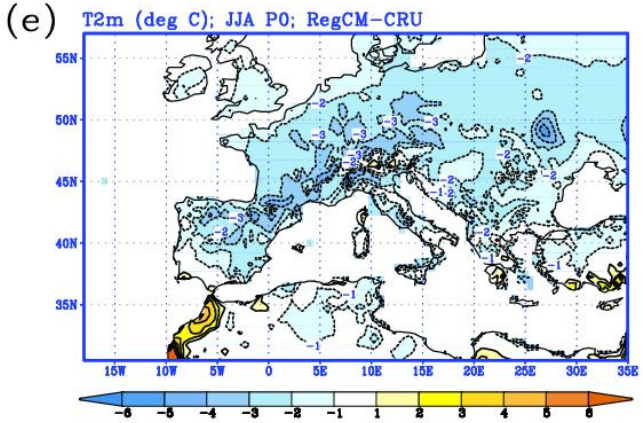
RegCM-CRU

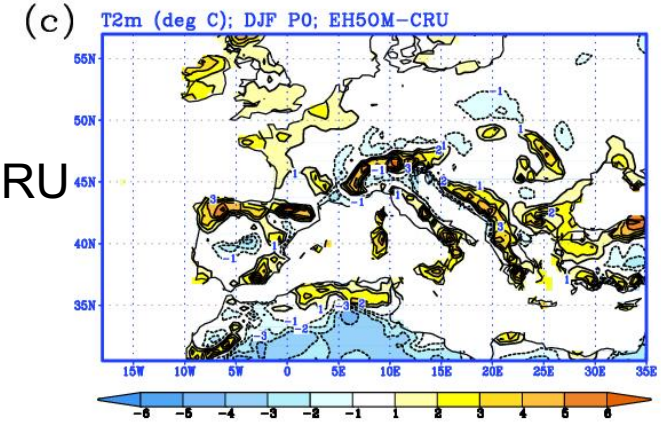
EH5OM-CRU

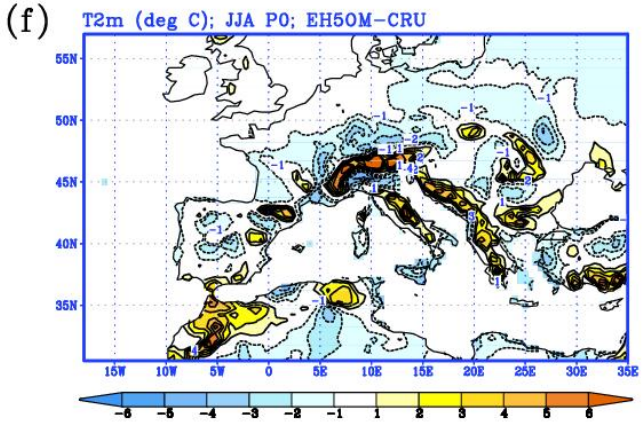












Winter and summer total precipitation bias

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JJA

CRU

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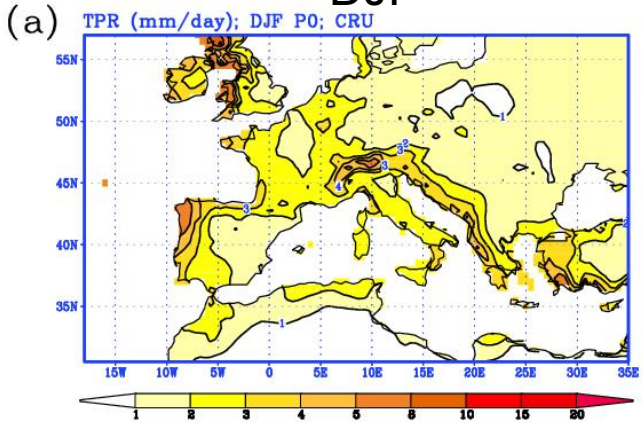
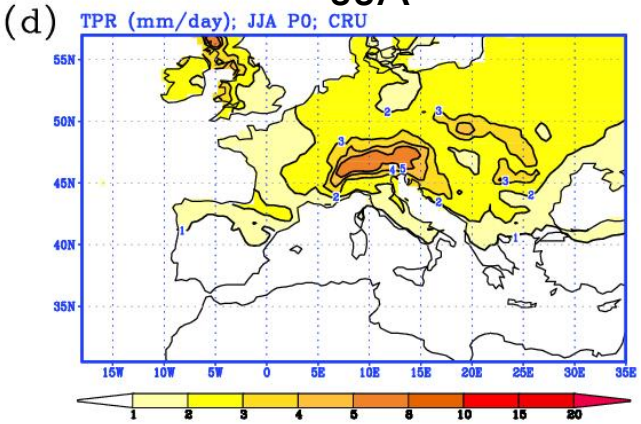
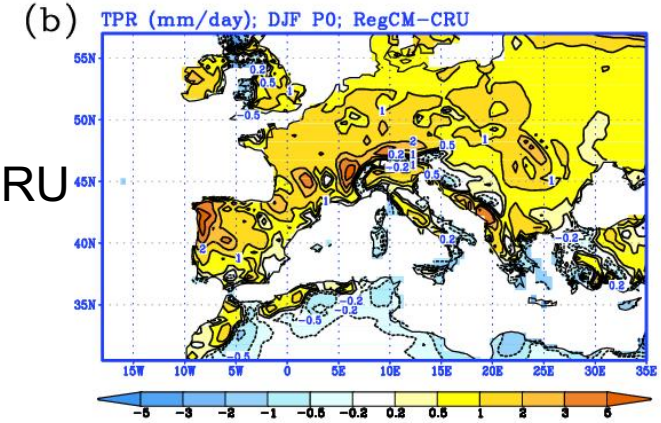
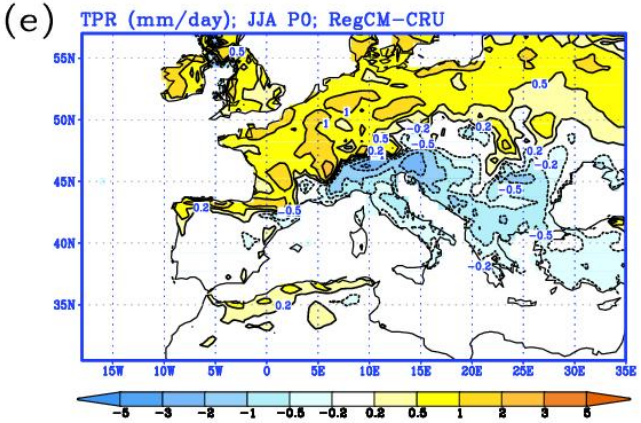
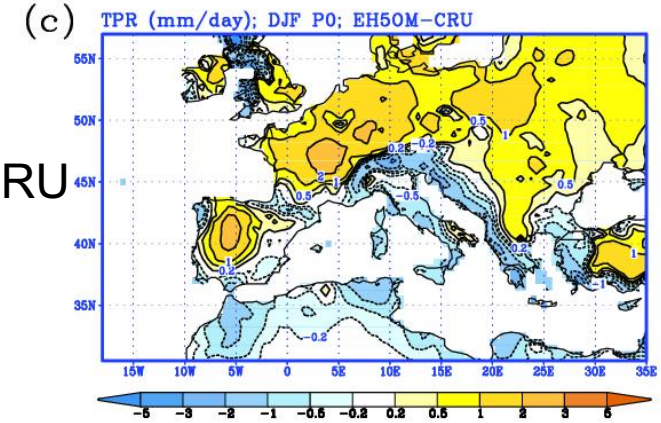
EH5OM-CRU

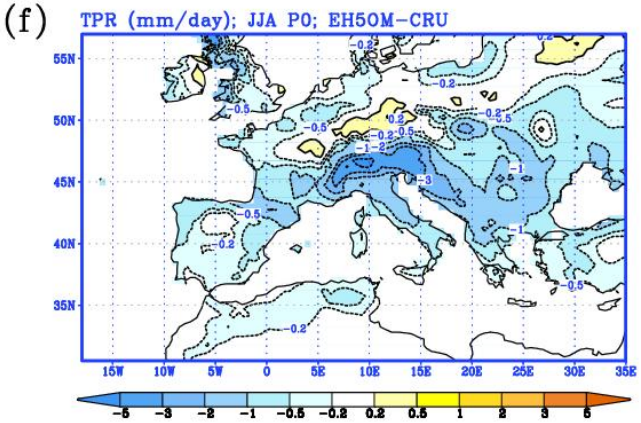












Winter and summer T2m variability: EOF1

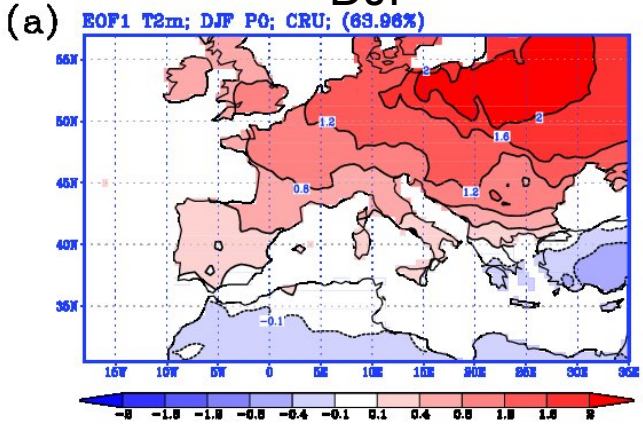
DJF

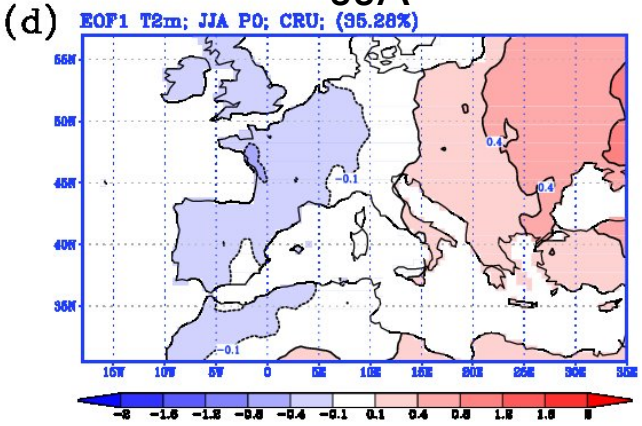
JJA

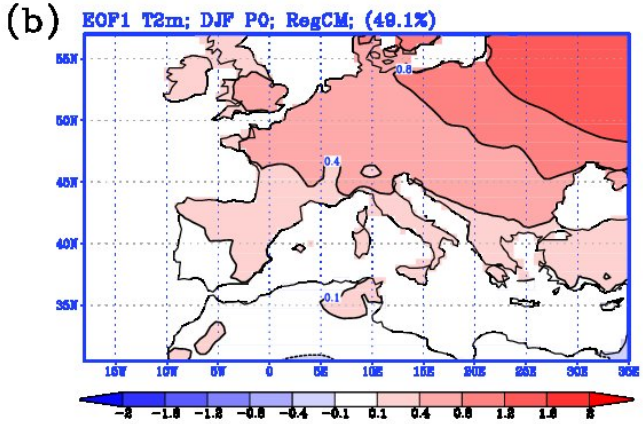
CRU

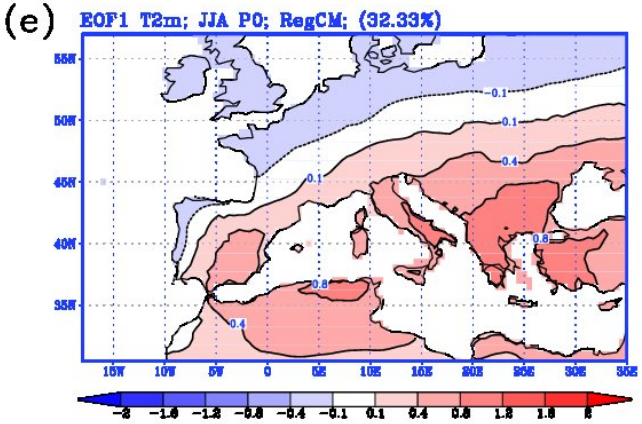
RegCM

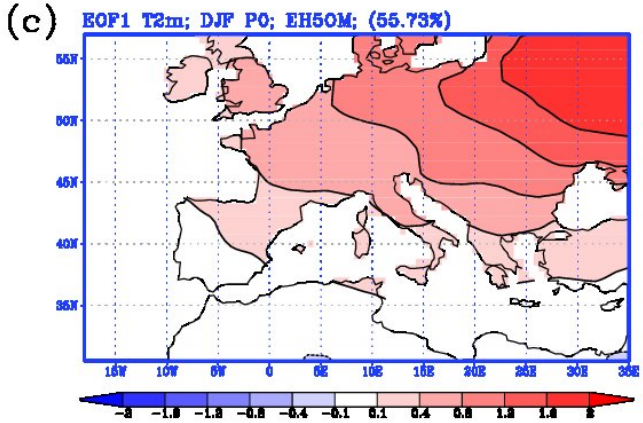
EH5OM

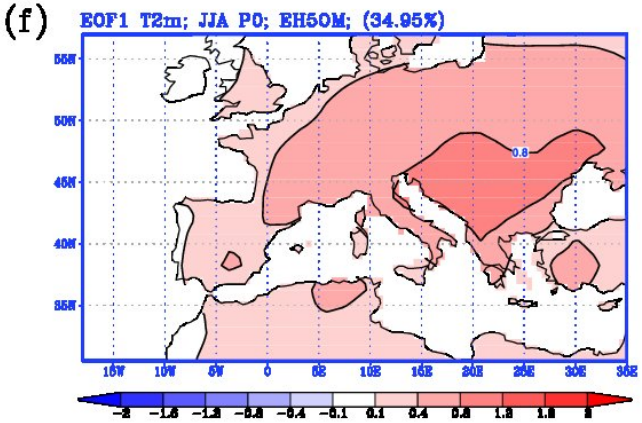












Winter and summer total precipitation variability: EOF1

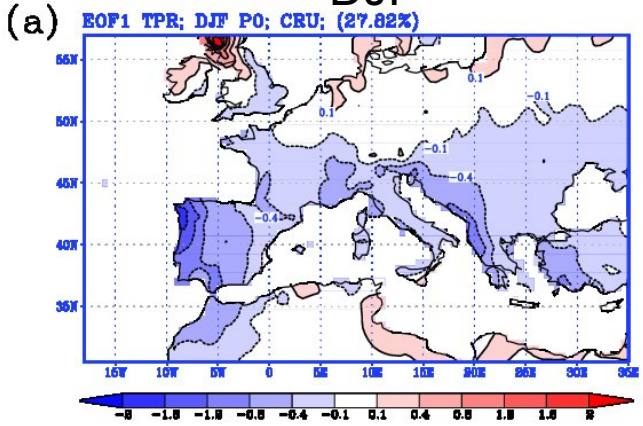
DJF

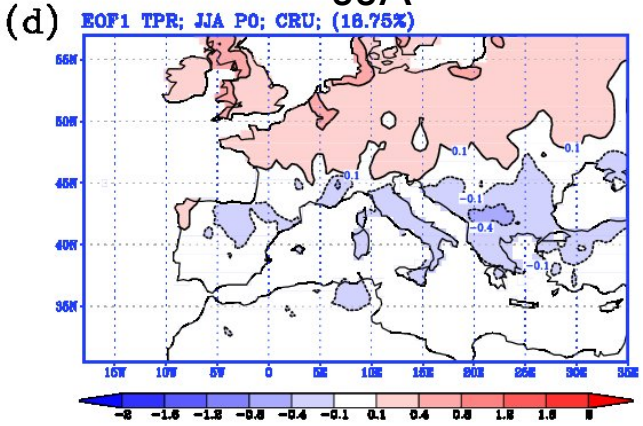
JJA

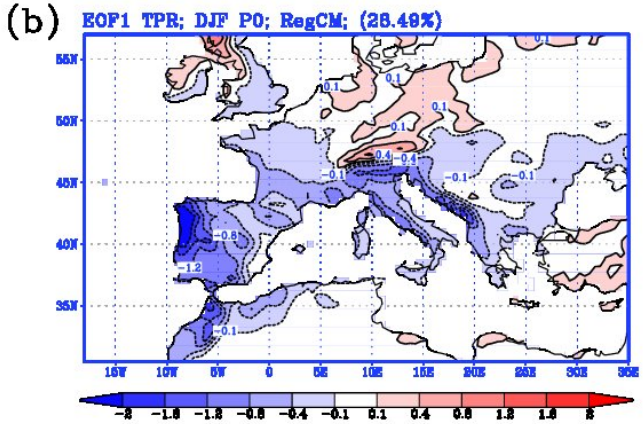
CRU

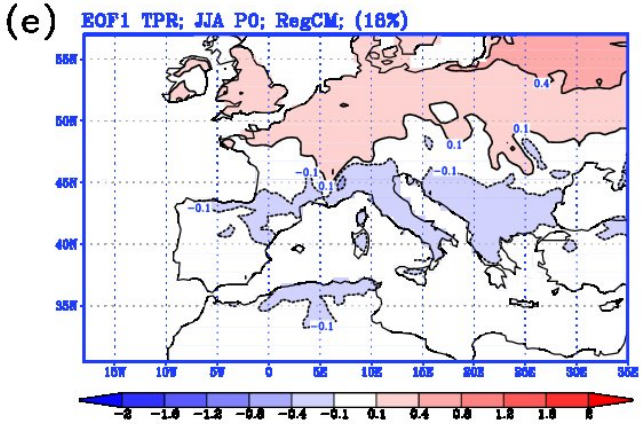
RegCM

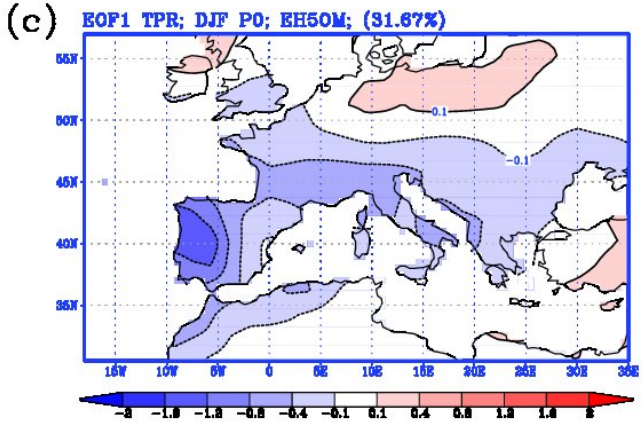
EH5OM

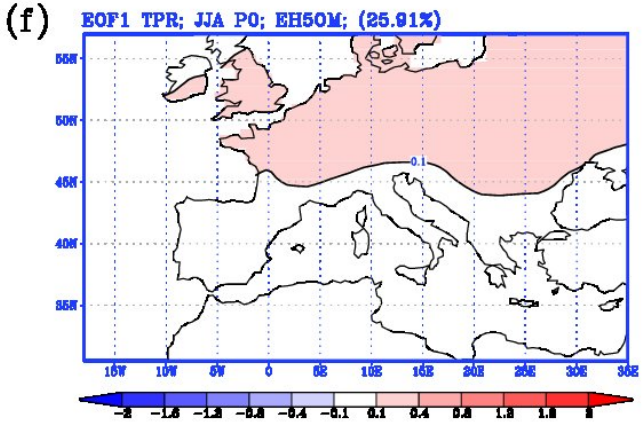










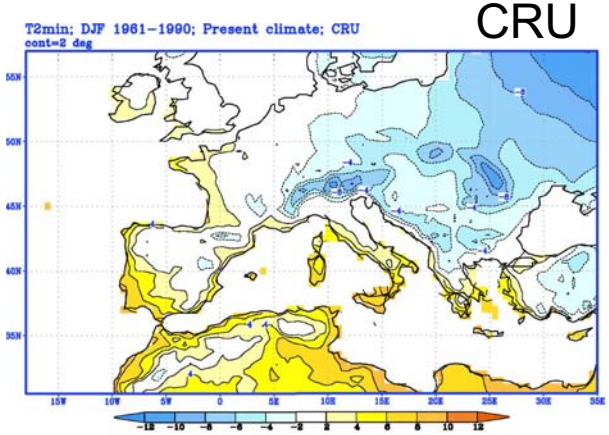


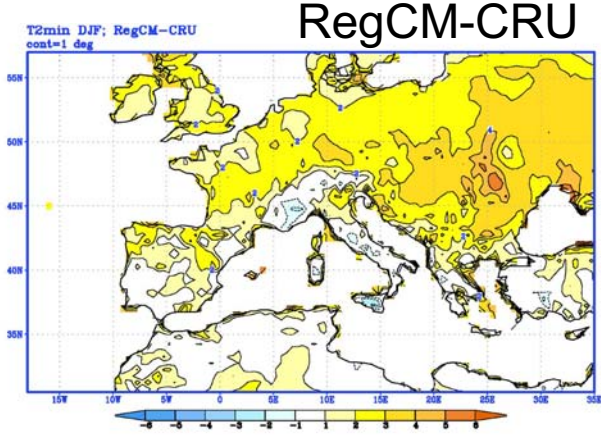
Winter T2min, T2m, T2max: RegCM3 vs CRU

CRU

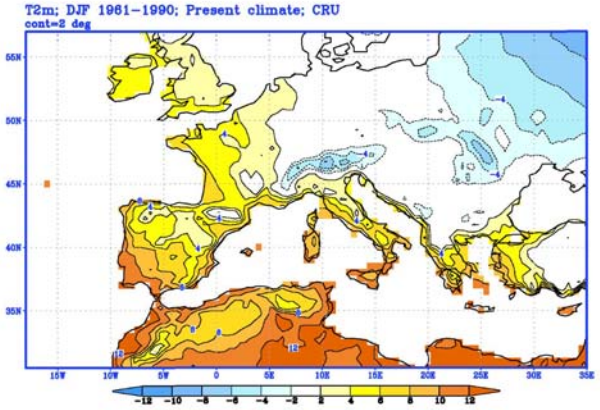
RegCM-CRU

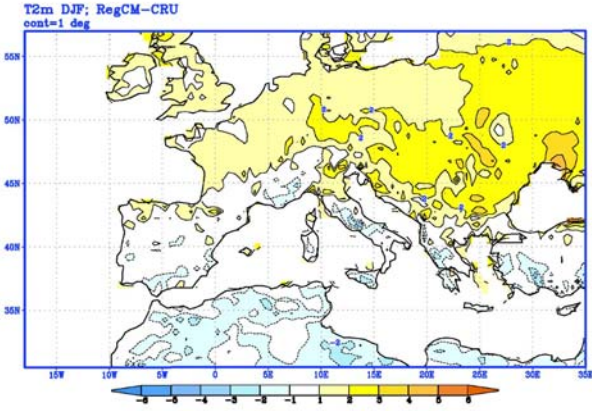
T2m min



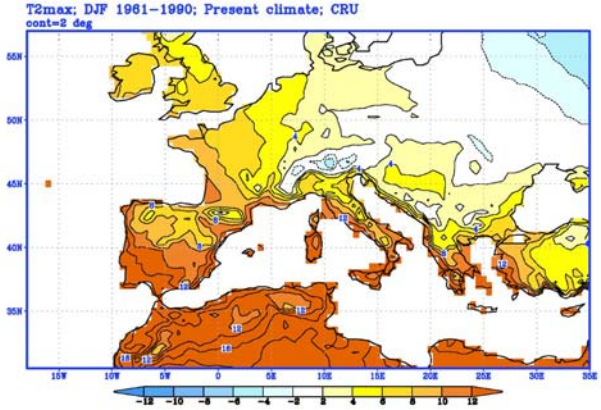


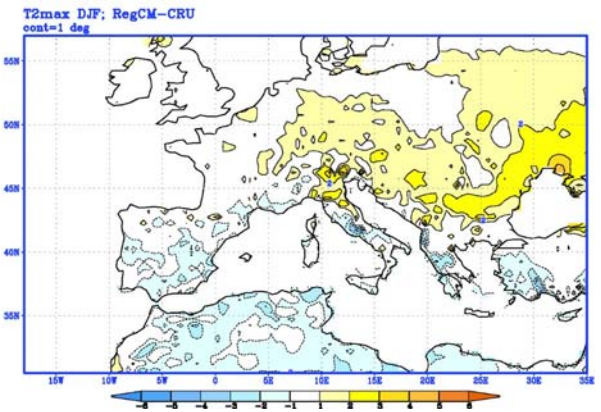
T2m





T2m max



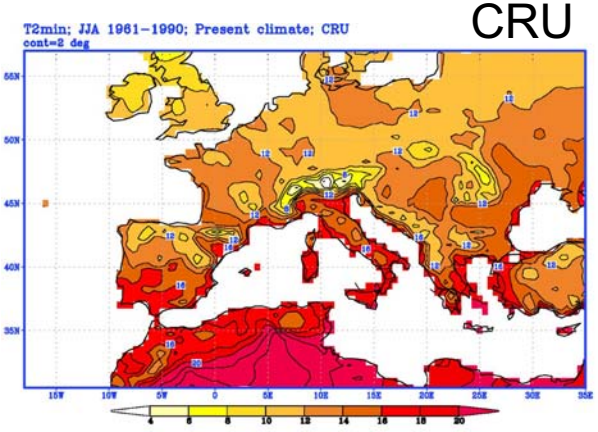


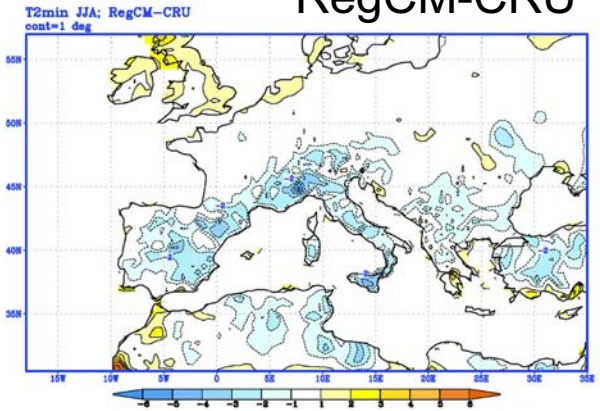
Summer T2min, T2m, Tmax: RegCM3 vs CRU

CRU

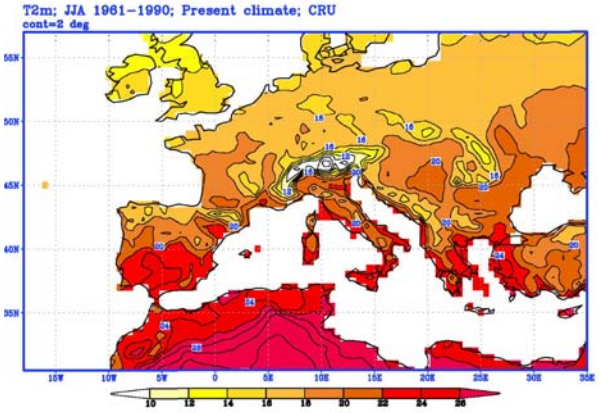
RegCM-CRU

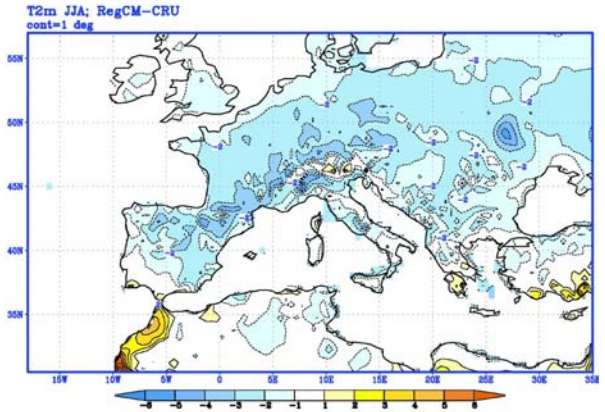
T2m min



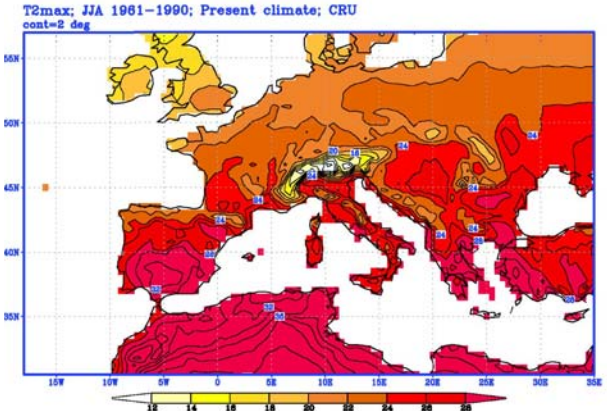


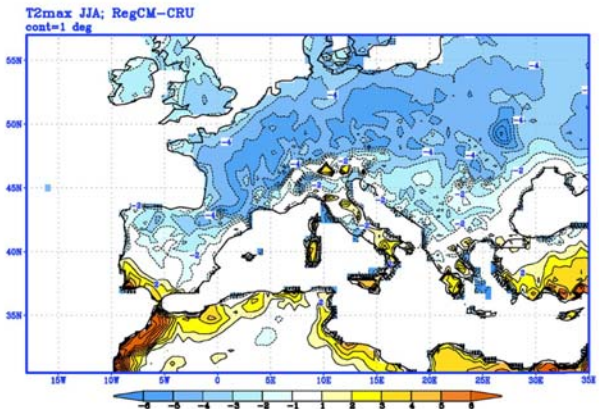
T2m



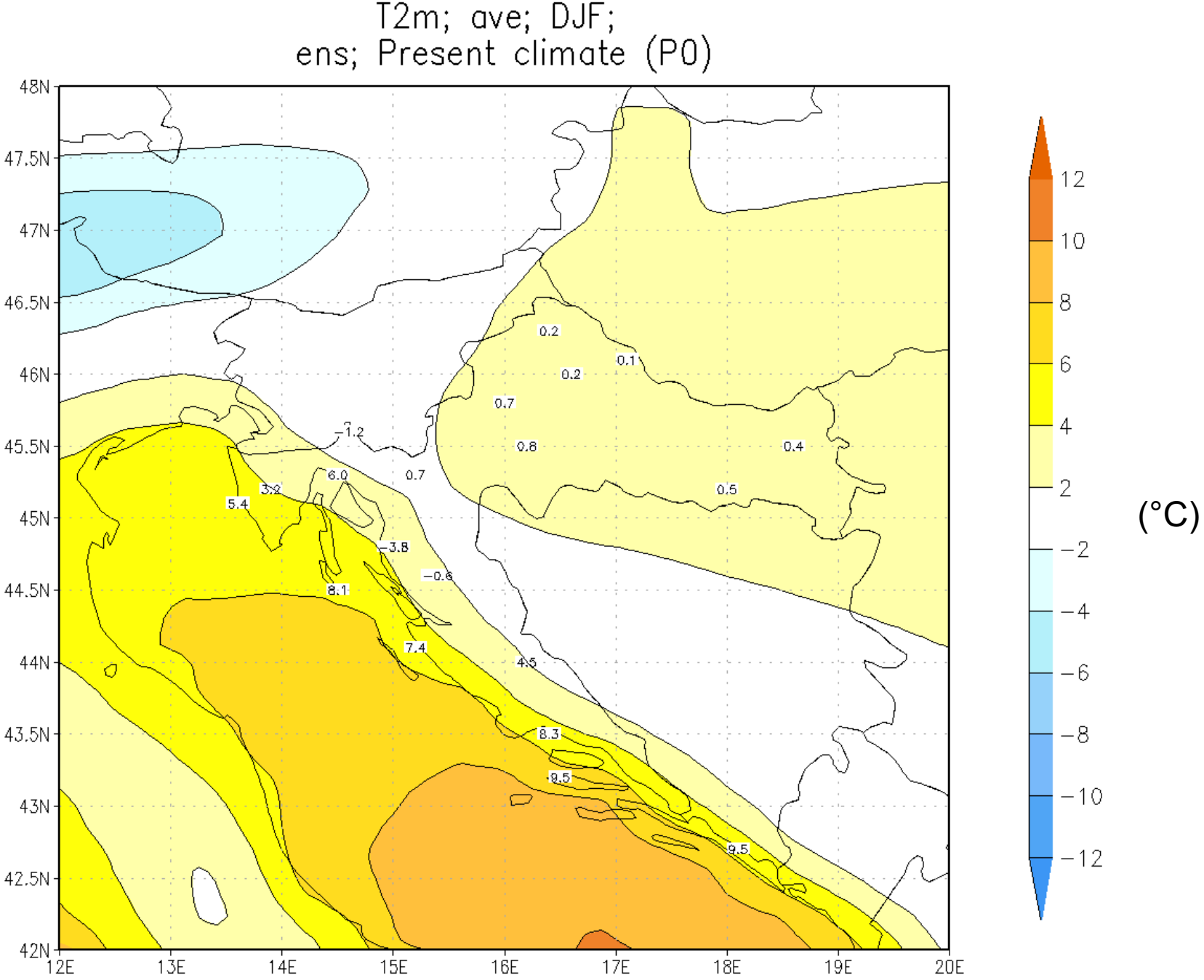


T2m max





RegCM3 vs station data: climatology



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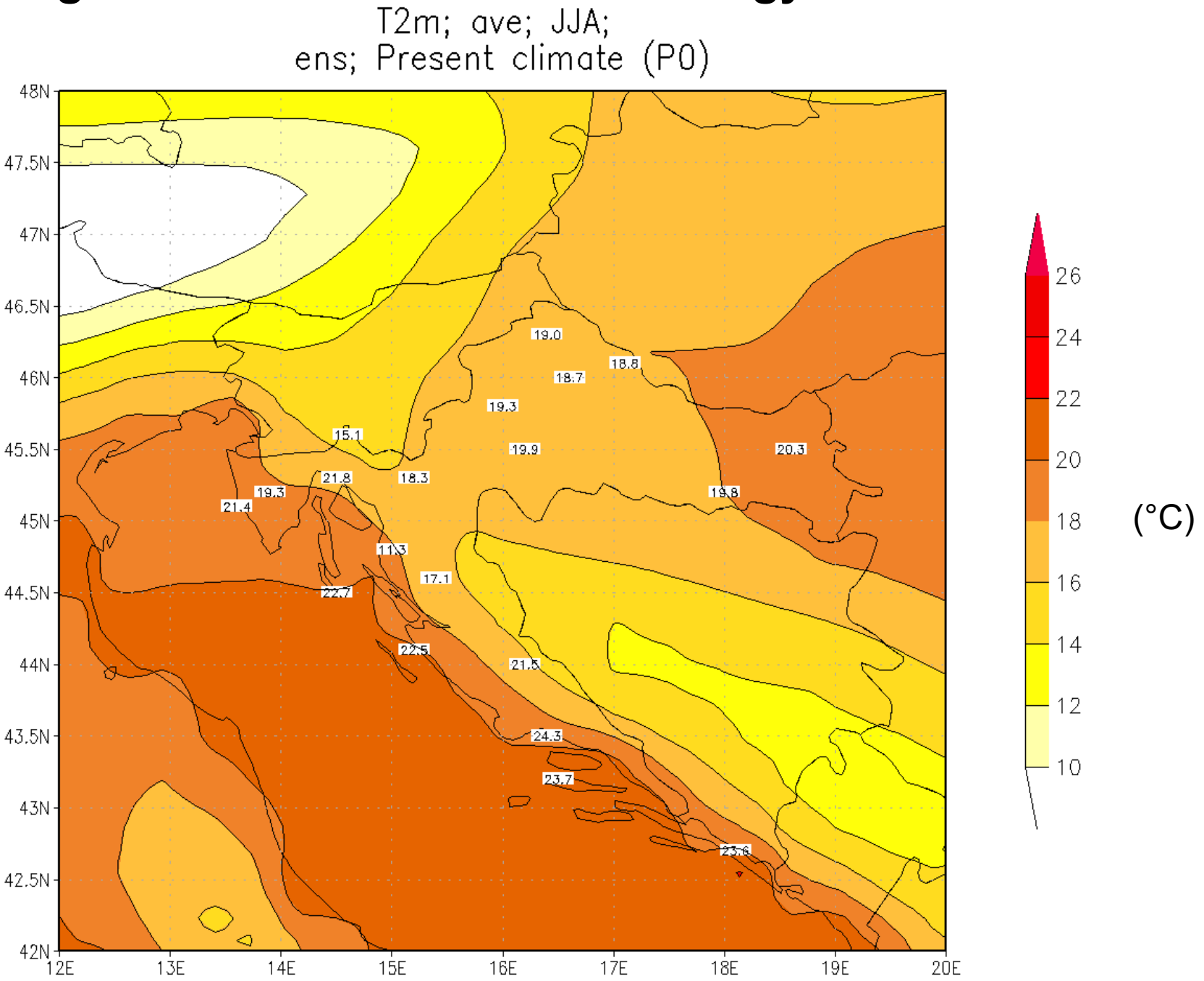

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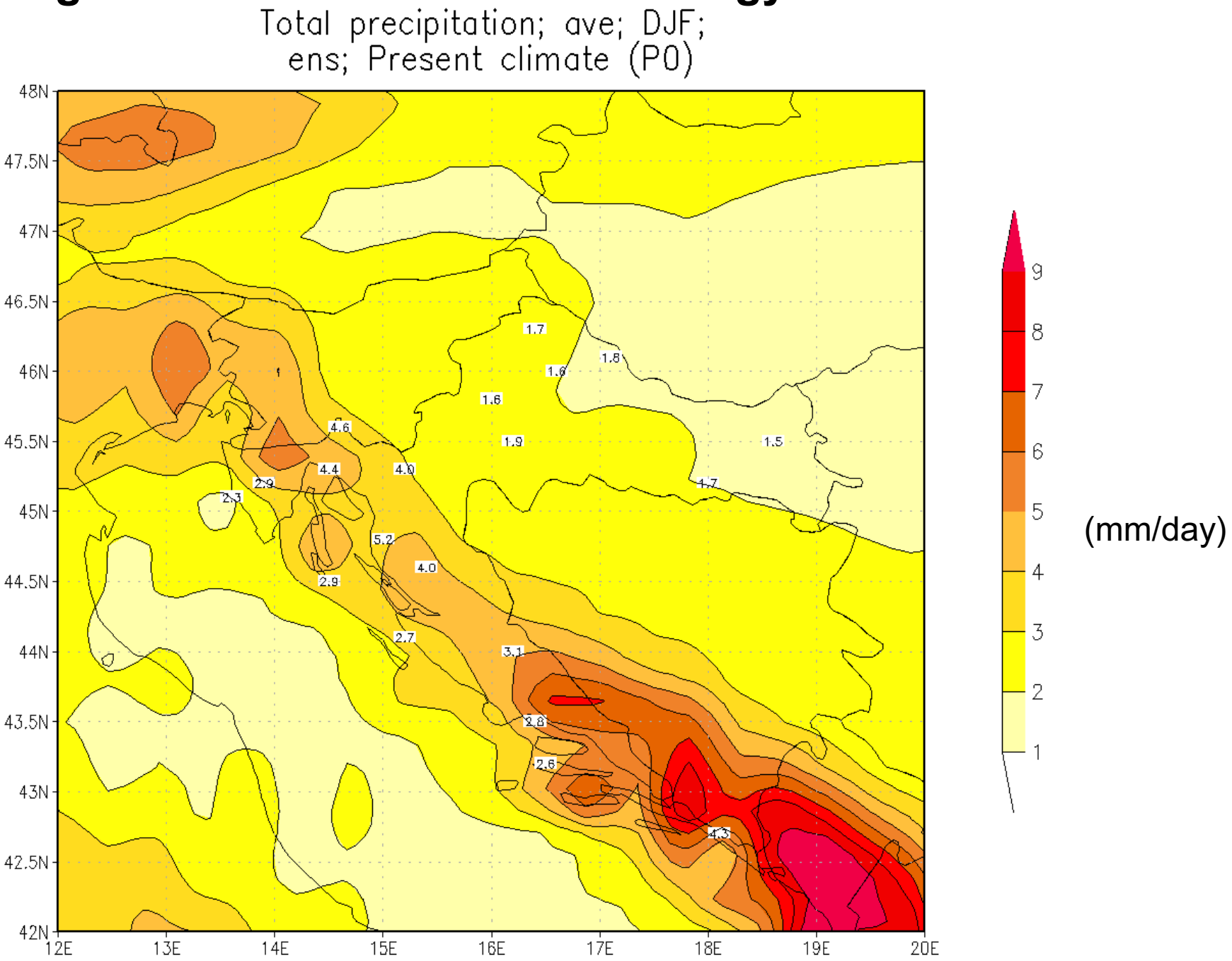

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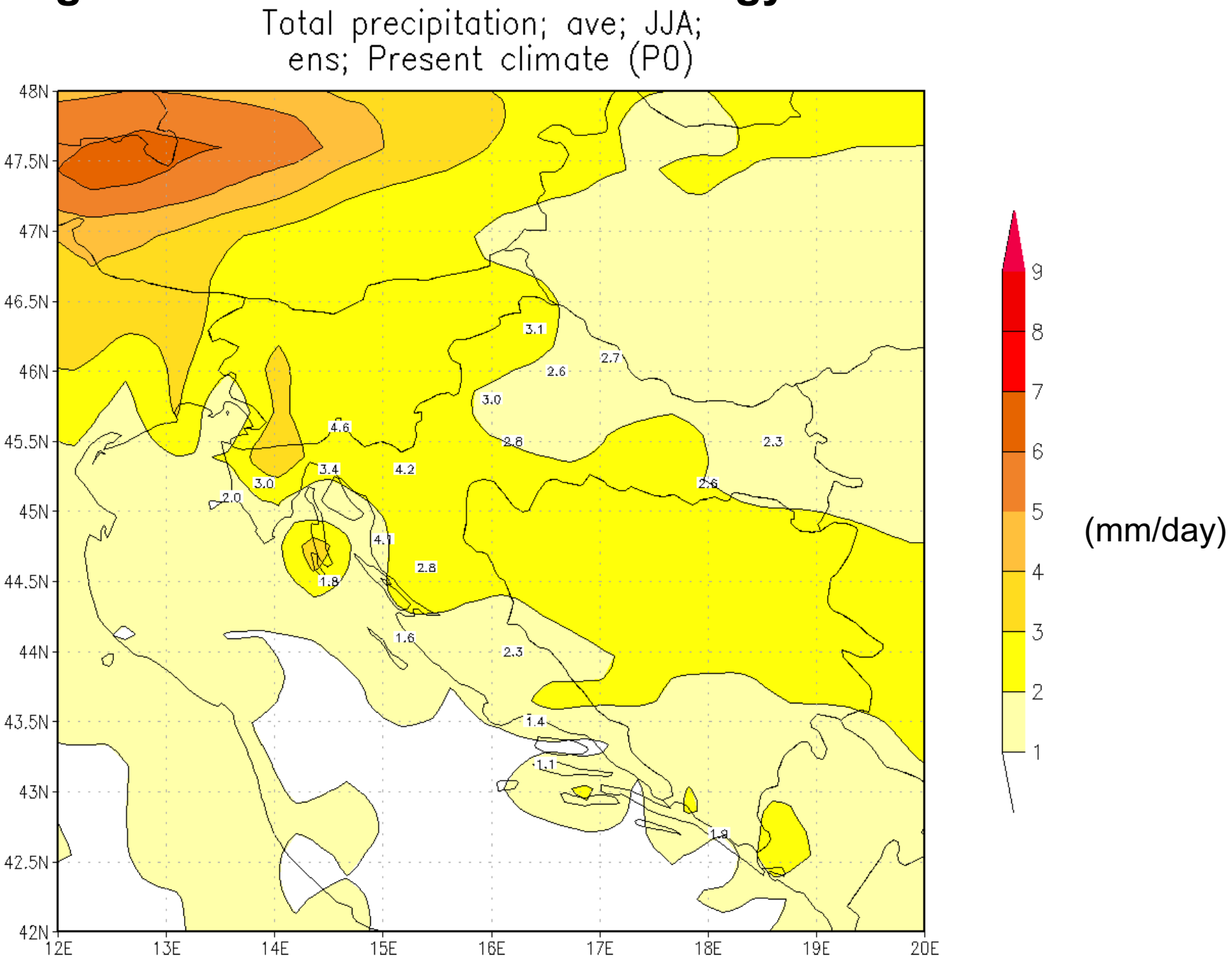
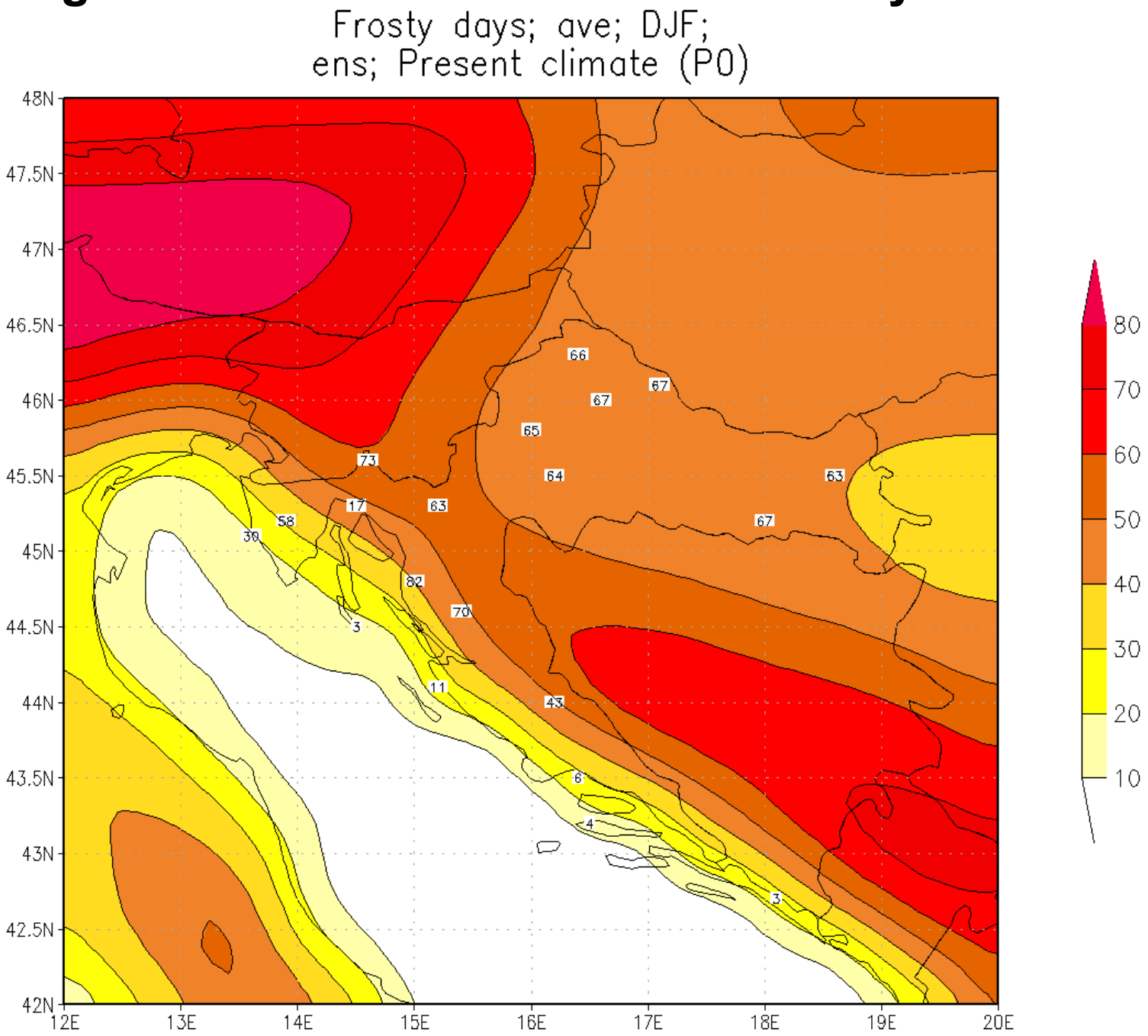
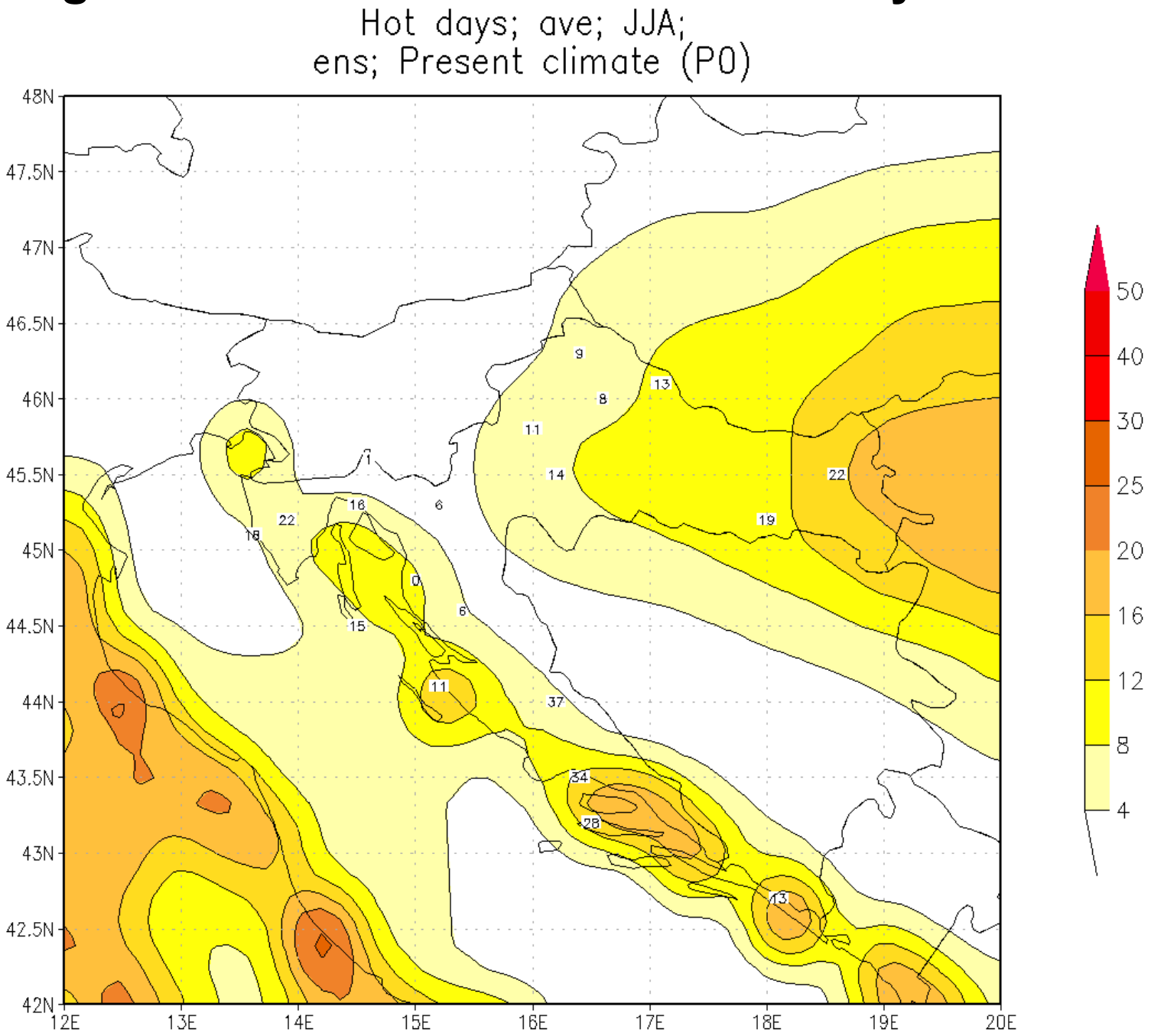


RegCM3 vs station data: number of days



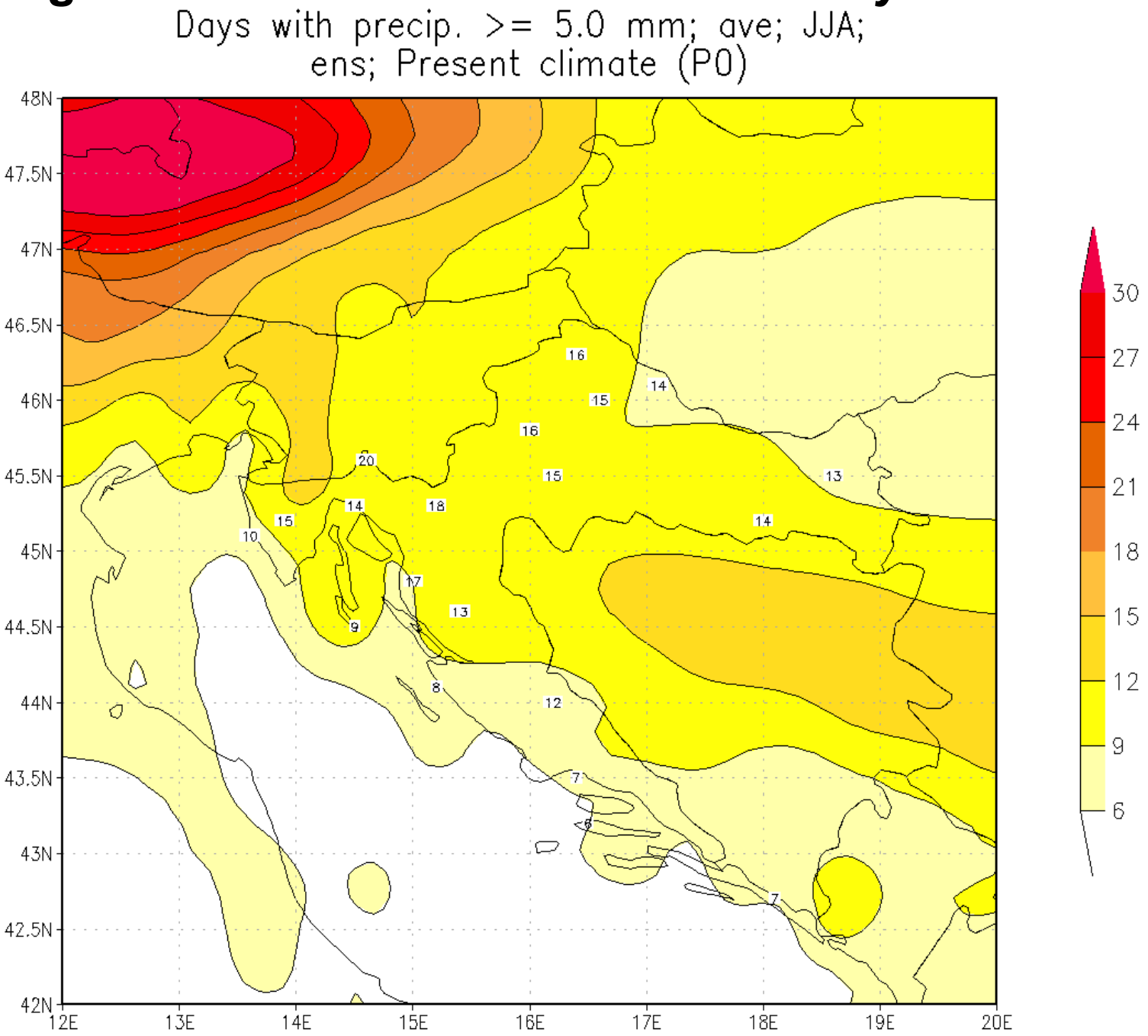
Frosty day:
T2min < 0°C

RegCM3 vs station data: number of days



Hot day:
T2max ≥ 30°C

RegCM3 vs station data: *number of days*



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New simulation
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Summary

T2m change

DJF

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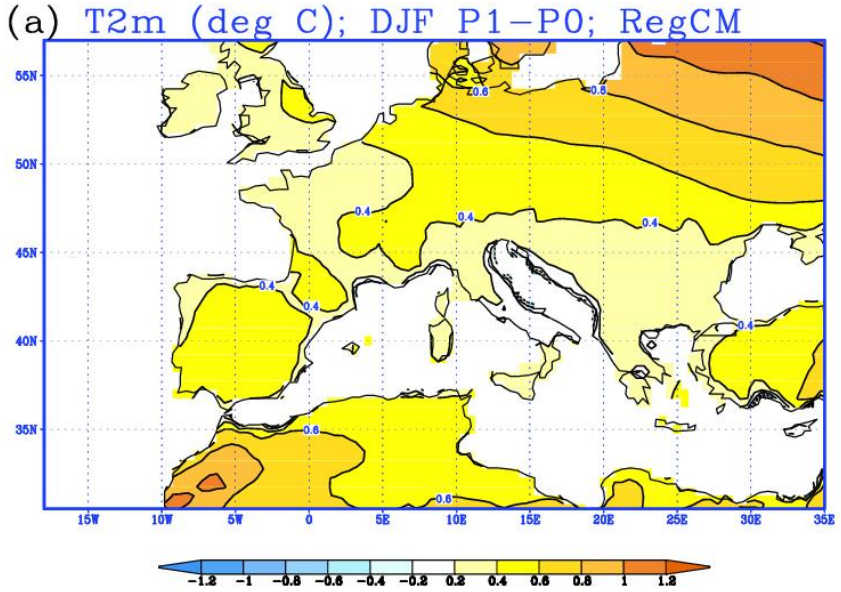
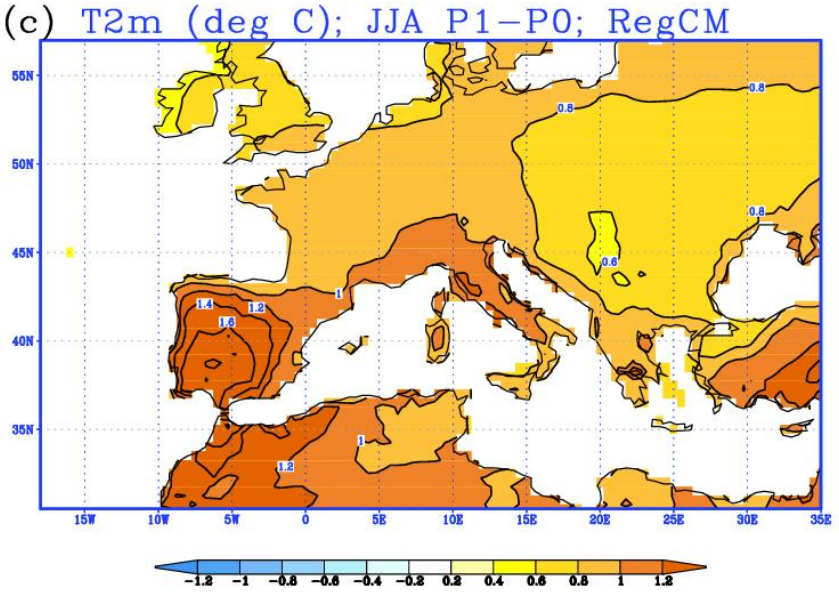
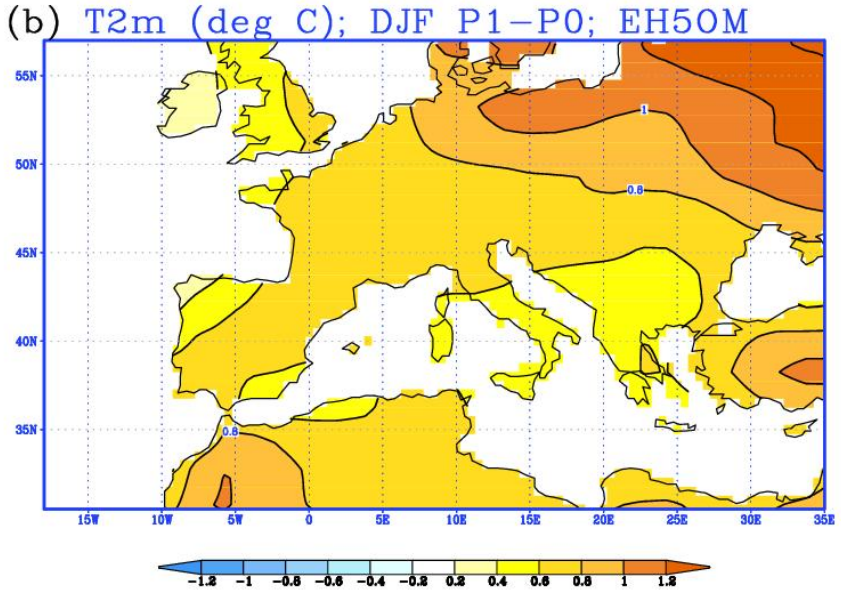
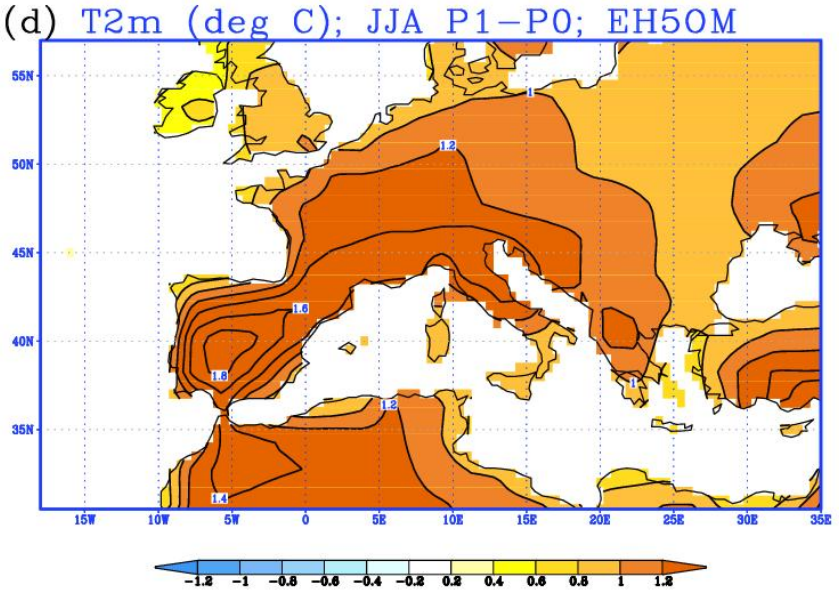
EH5OM









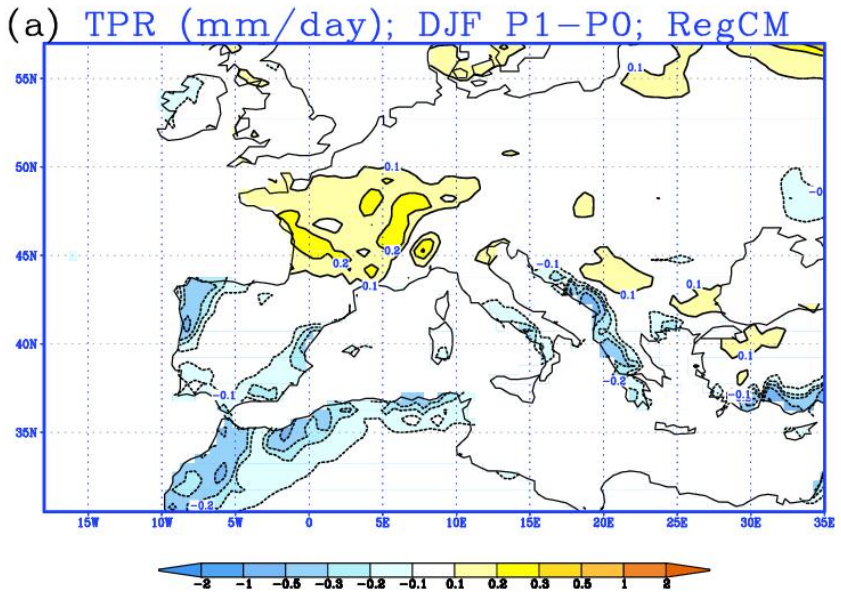
Total precipitation change

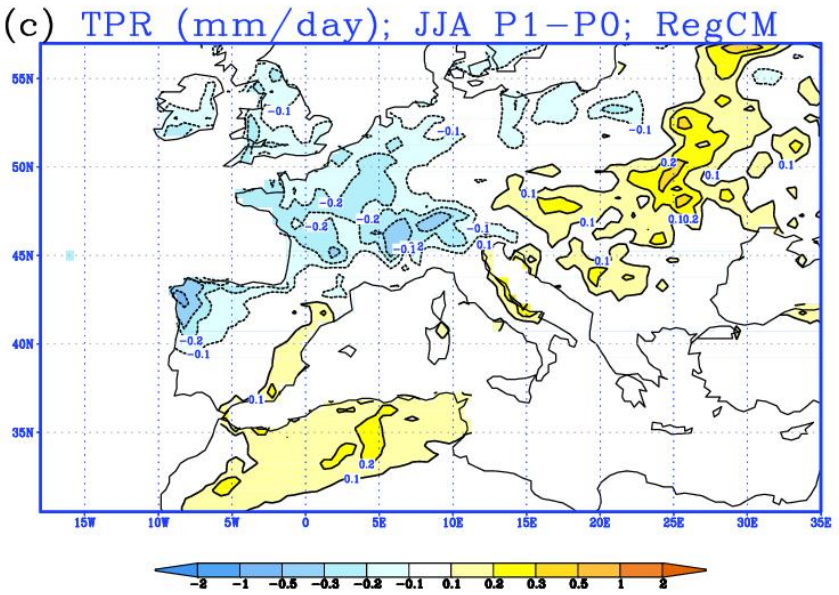
DJF

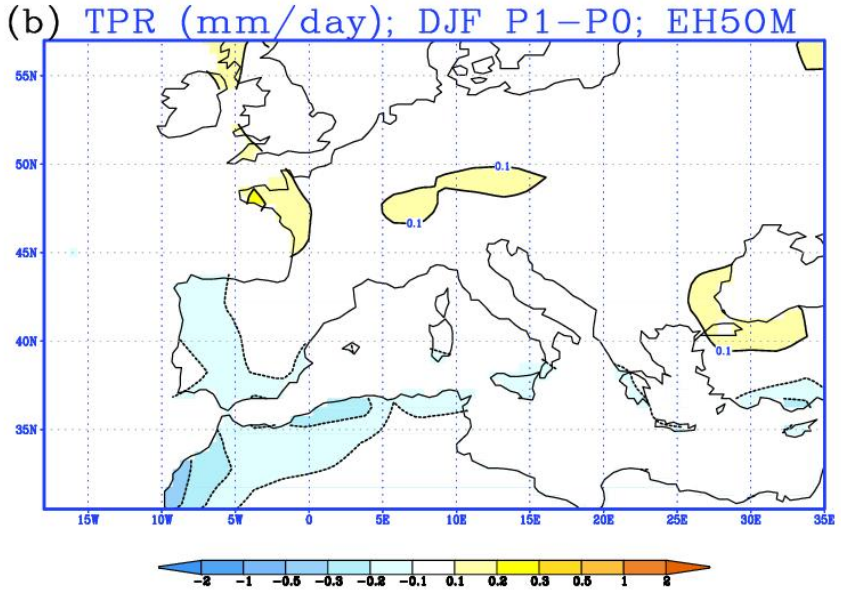
JJA

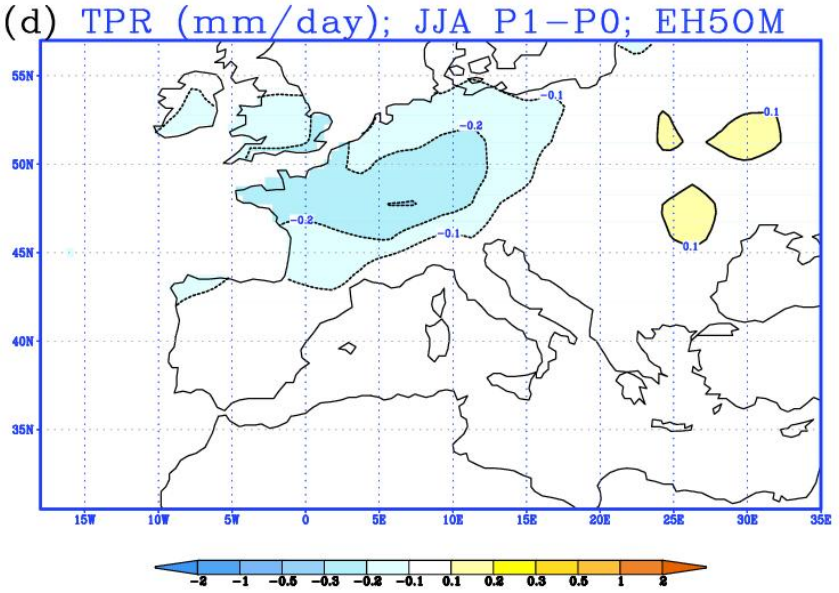
RegCM

EH5OM

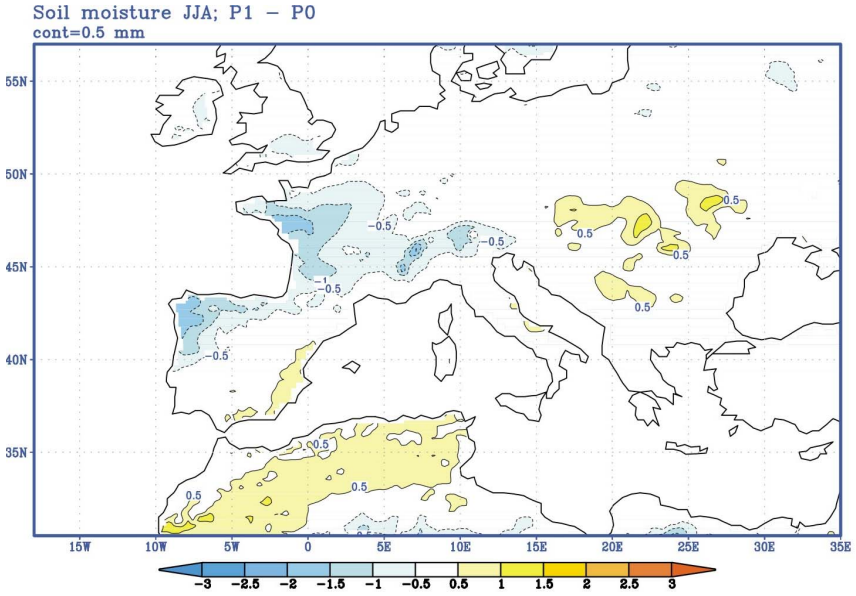


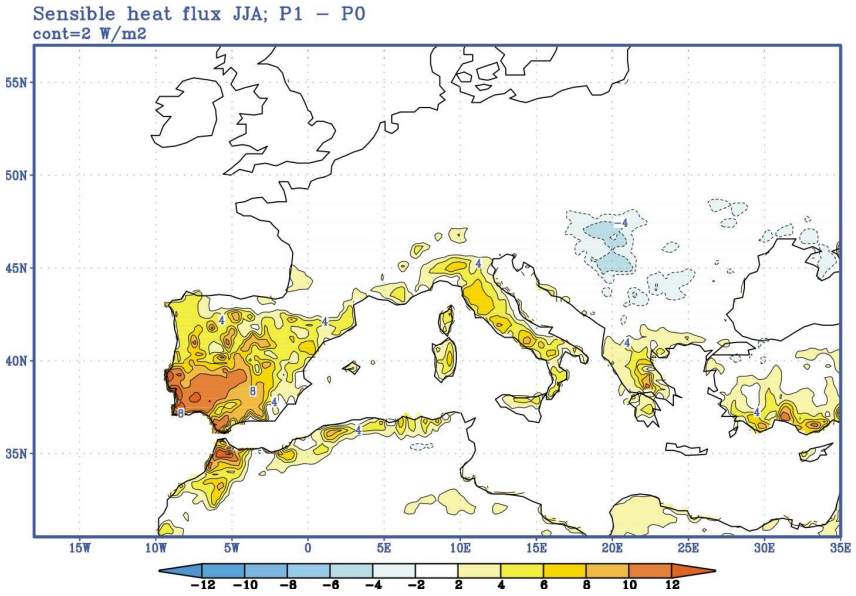


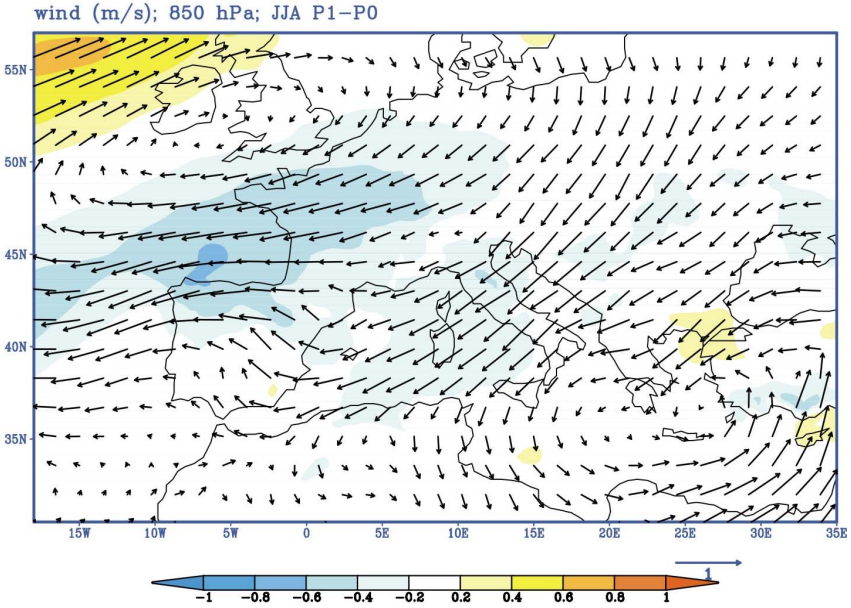




Soil moisture, sensible heat flux and wind 850hPa change







Change in variability patterns

Cumulative (first 3 EOFs) explained variance (%)		T2m P0	T2m P1	TPR P0	TPR P1
	CRU	87.53		58.03	
DJF	RegCM	81.14	86.33	54.00	55.53
	EH5OM	83.81	88.47	61.96	64.21
	CRU	68.60		45.07	
JJA	RegCM	70.19	69.14	35.13	32.60
	EH5OM	72.37	72.14	52.75	49.00

Experiment 1: Downscaling global climate model simulations

Near-present climate
- T2m and total precipitation bias
- T2m and total precipitation variability: EOF1
- T2min, T2m, T2max
- Focus over Croatia: climatology and *number of days*

Near-future climate
- T2m and total precipitation change
- Change in variability patterns

Experiment 2: Downscaling ERA-Interim

Default simulation
- T2m and total precipitation bias

ERAInterim vs CRU

Sensitivity of the warm bias to changes in PBL scheme

New simulation
- T2m and total precipitation bias

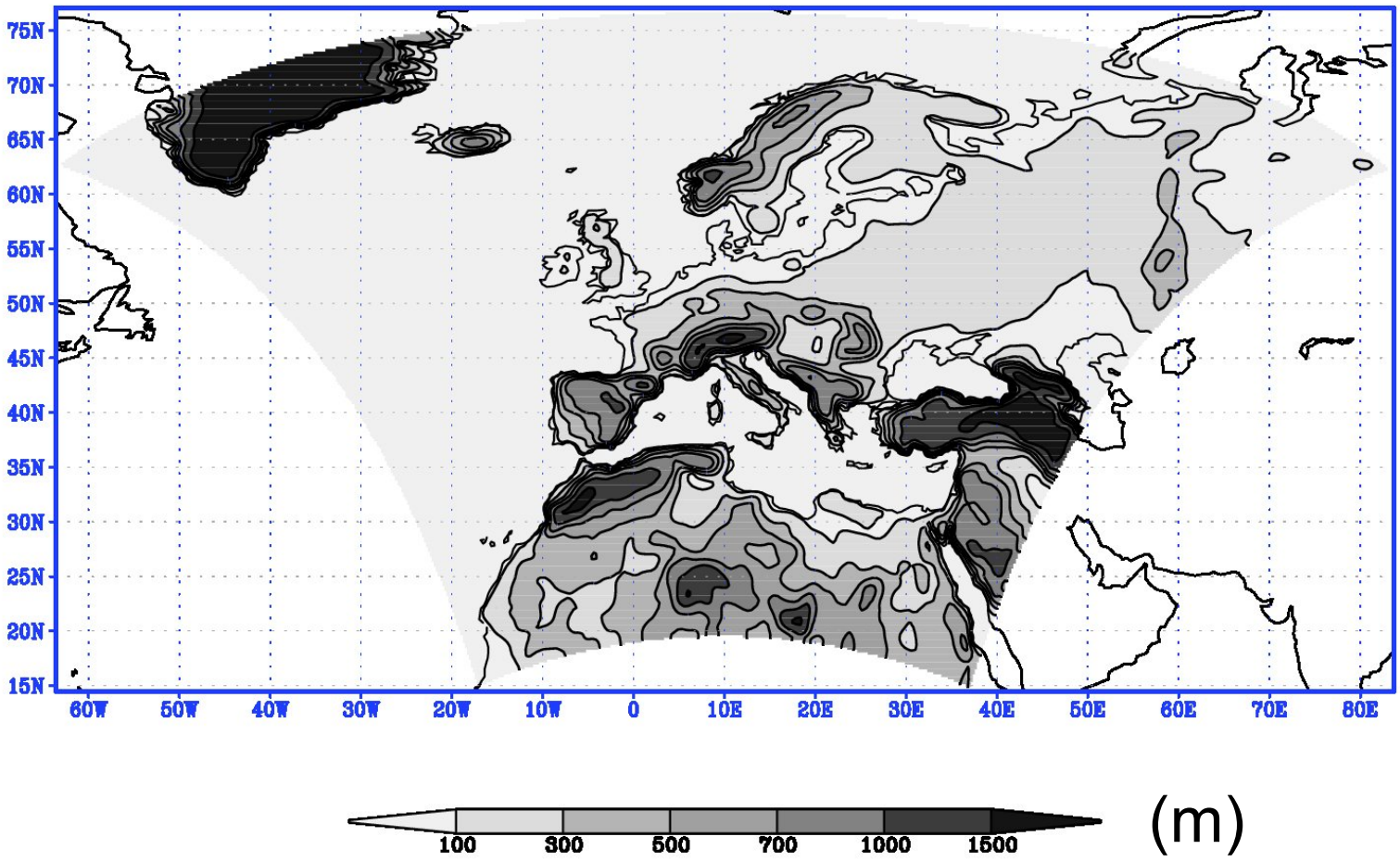
Summary

Experiment 2: Downscaling ERA-Interim

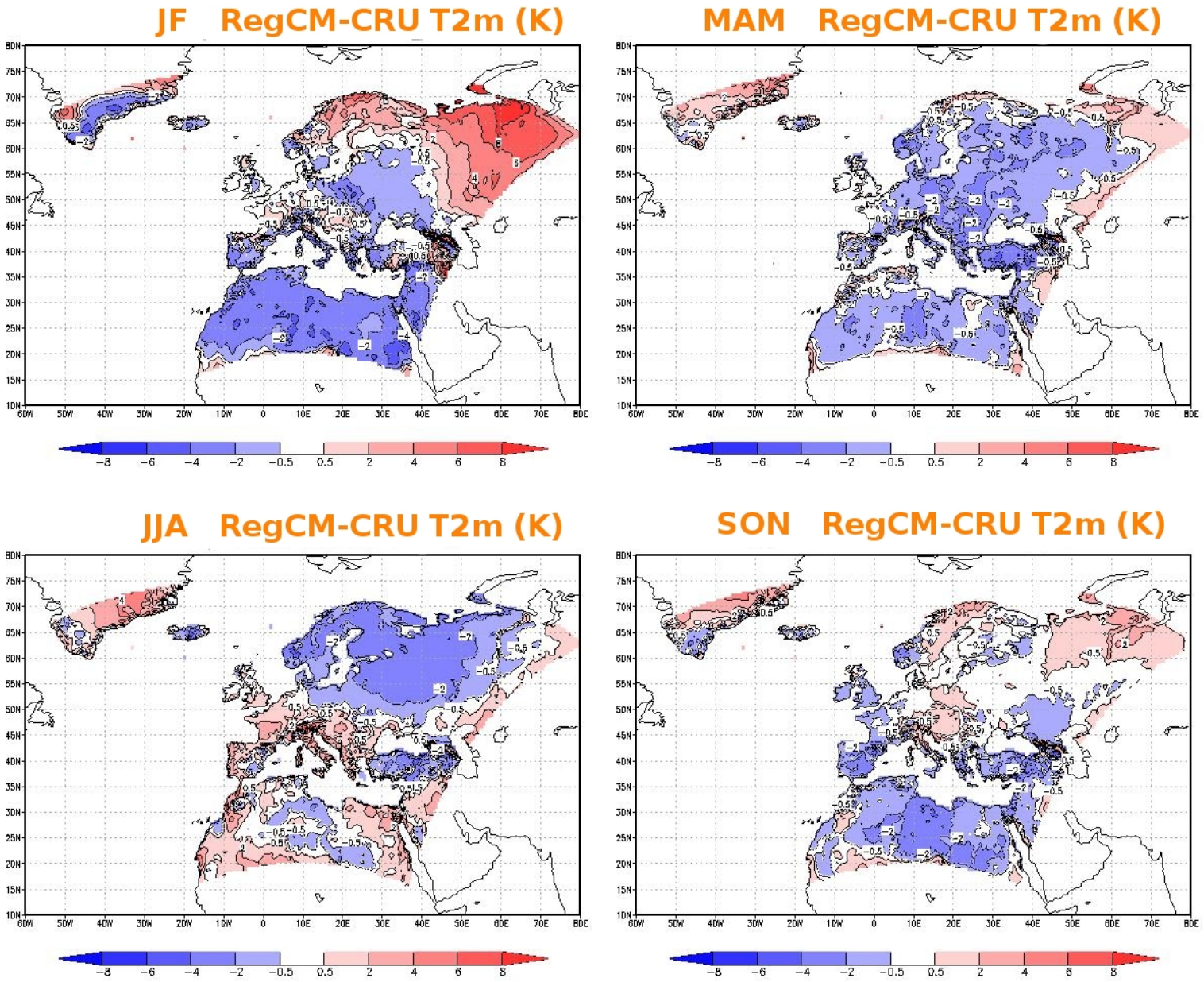
ICBC: ERA-Interim
weekly OISST

RCM: RegCM3
50 km/L18

Period: 1989(-2009)

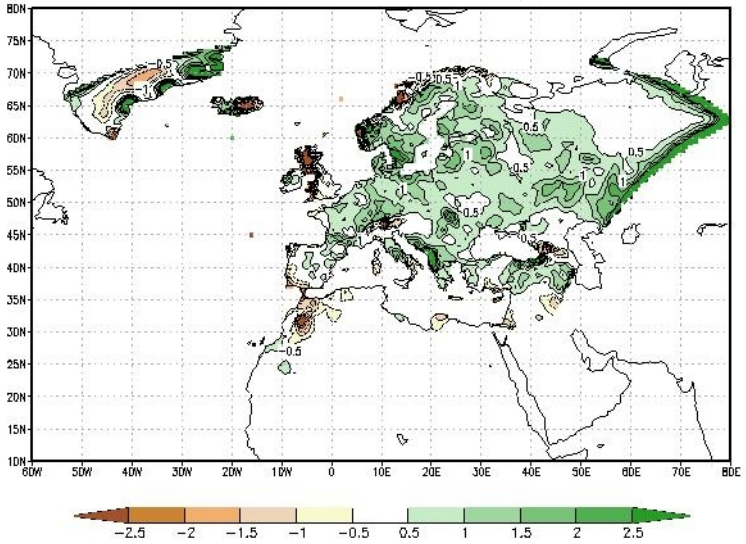


T2m bias: 1989

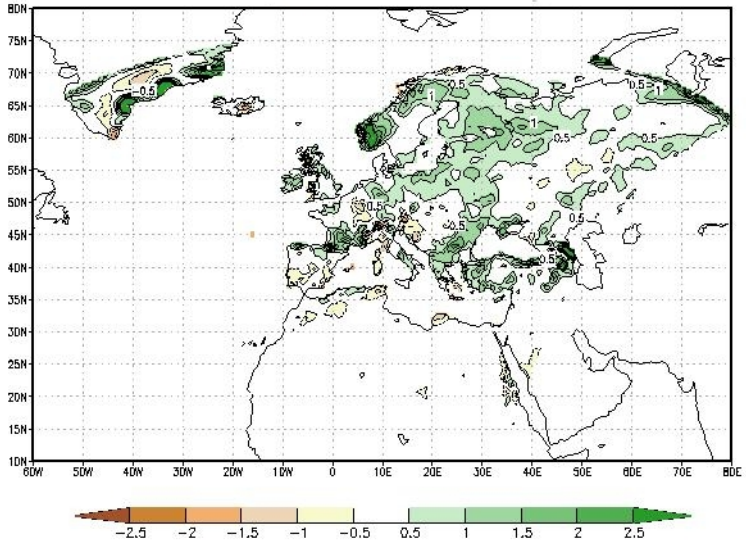


Total precipitation bias: 1989

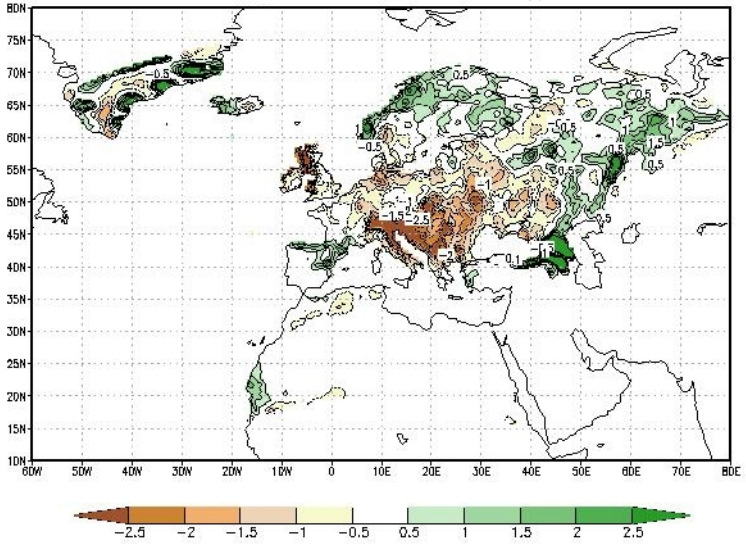
JF RegCM-CRU TPR (mm/day)



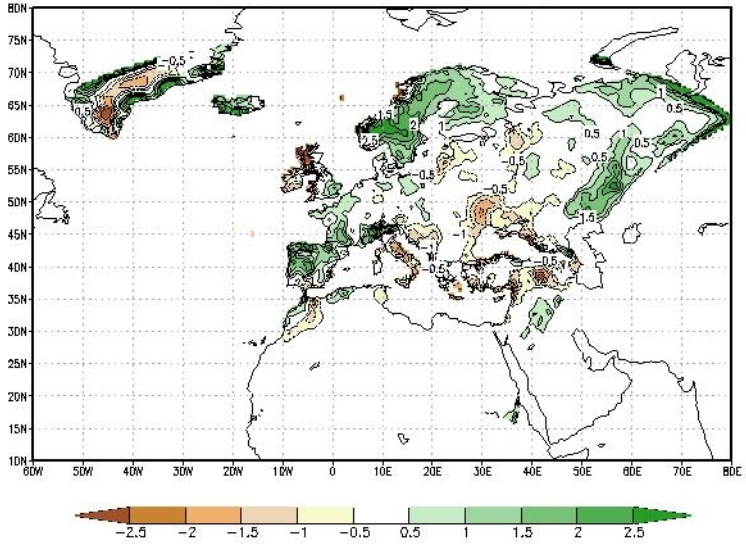
MAM RegCM-CRU TPR (mm/day)



JJA RegCM-CRU TPR (mm/day)



SON RegCM-CRU TPR (mm/day)



Experiment 1: Downscaling global climate model simulations

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- T2m and total precipitation change
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Experiment 2: Downscaling ERA-Interim

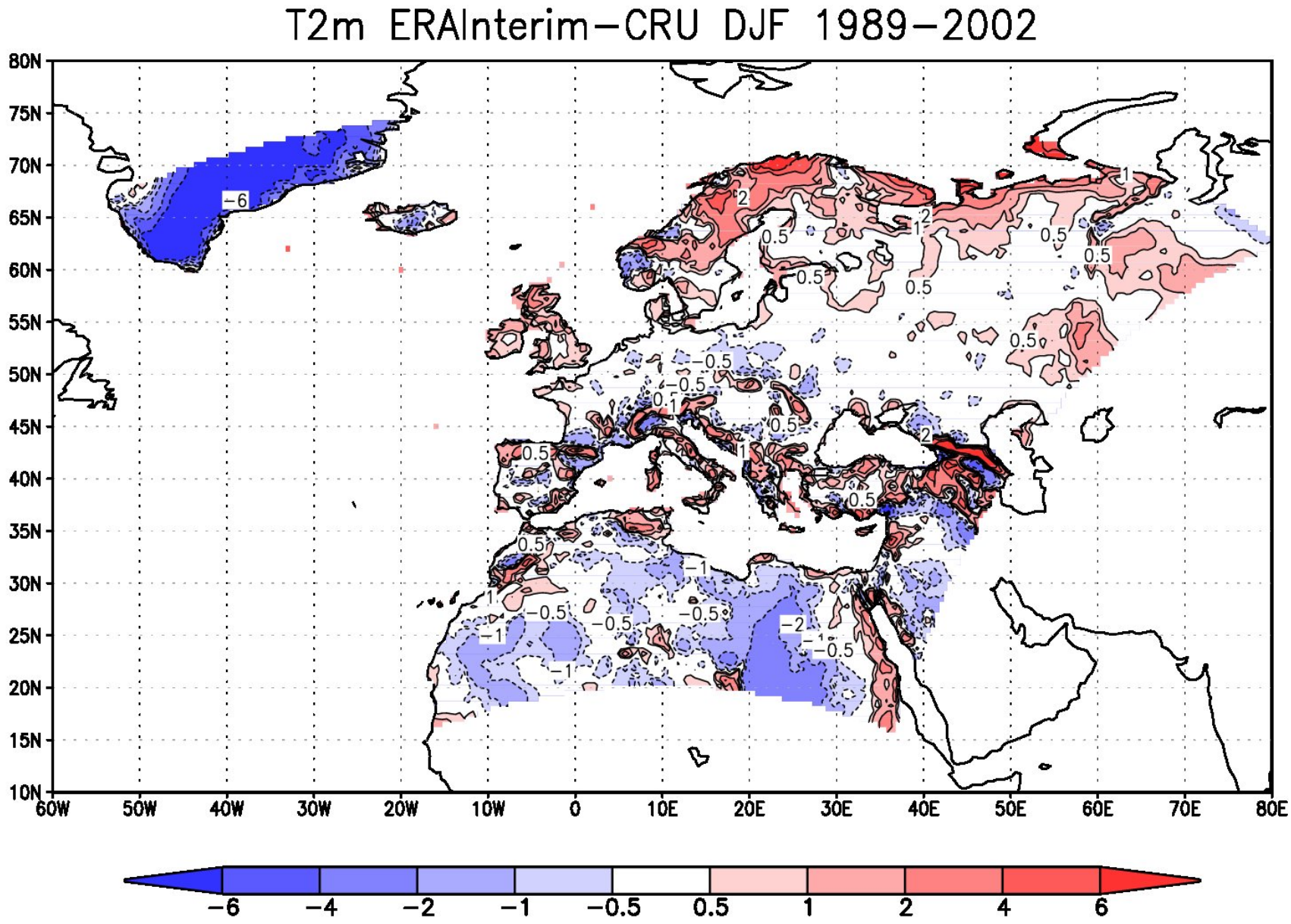
Default simulation
- T2m and total precipitation bias

ERAInterim vs CRU
Sensitivity of the warm bias to changes in PBL scheme

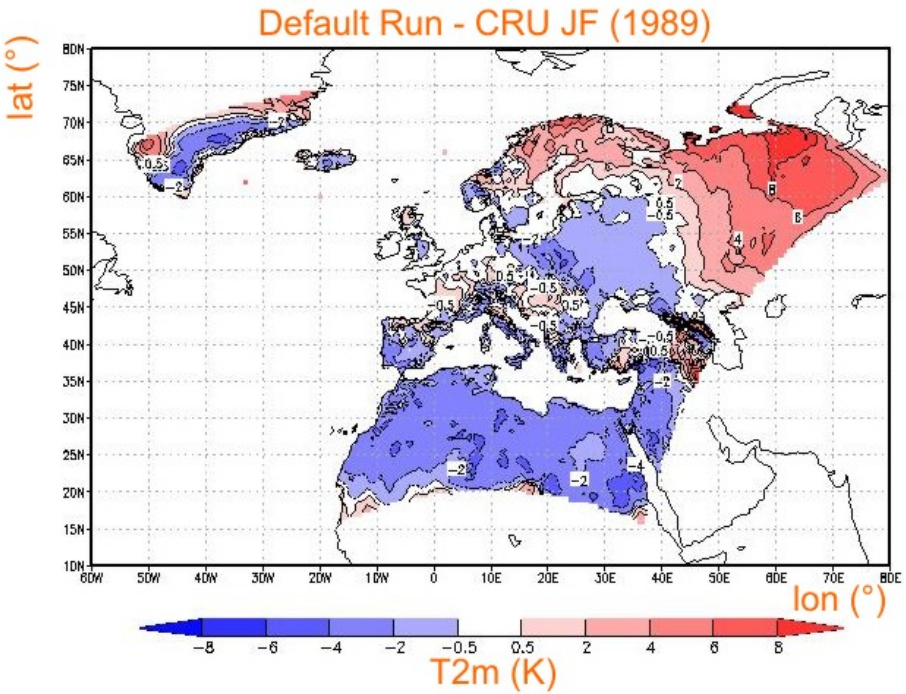
New simulation
- T2m and total precipitation bias

Summary

ERAInterim vs CRU: T2m

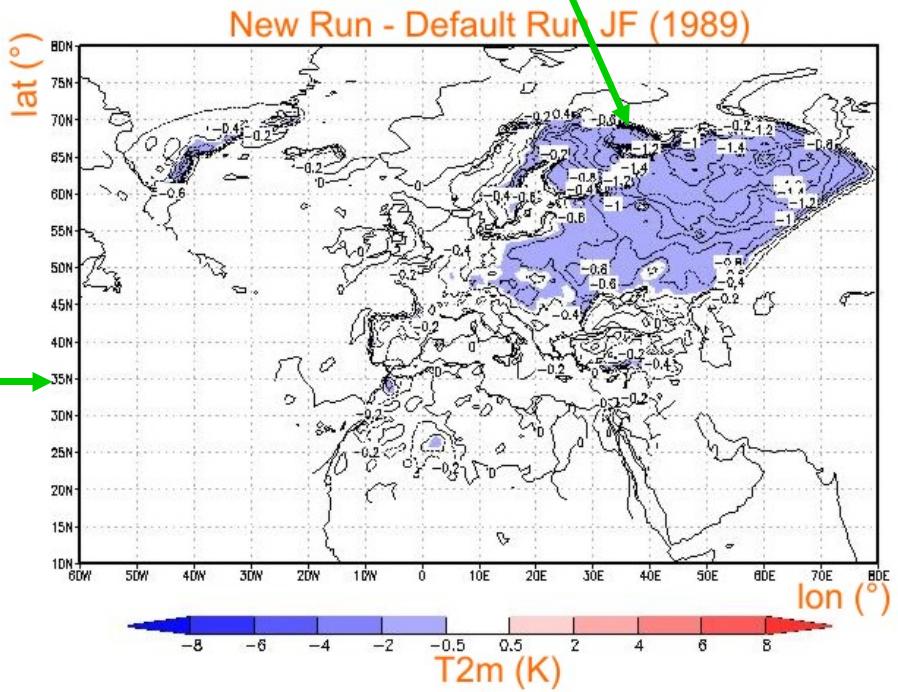


Sensitivity of the warm bias to changes in PBL scheme



~1 K reduction in bias

$$h < 600 \text{ m}$$
$$L > 100 \text{ m}$$
$$K_h = 0 \text{ m}^2/\text{s}$$



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Experiment 2: Downscaling ERA-Interim

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- T2m and total precipitation bias

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Sensitivity of the warm bias to changes in PBL scheme

New simulation
- T2m and total precipitation bias

Summary

Changes in the new simulation

(1) albedov.F
Over the desert, solour=0.16 **>** DJF solour=0.12; MAM solour=0.14; JJA solour=0.16; SON solour=0.14

(2) blhnew.F

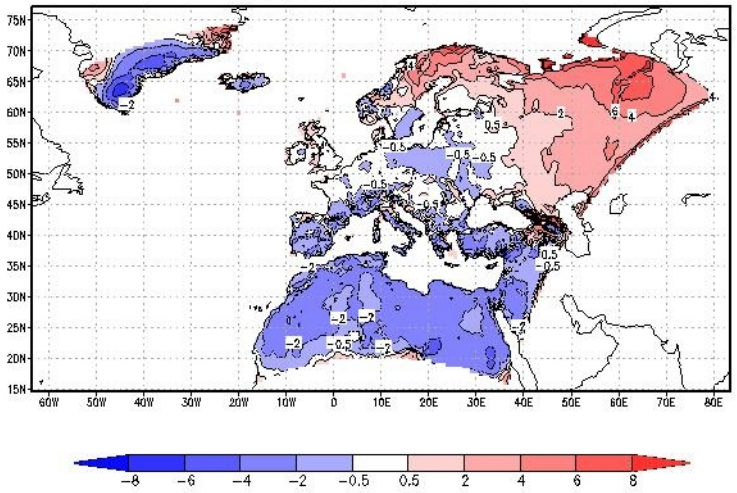
(3) cldefr.F
(3 a) Minimum effective liquid radius over land is 10 μm **>** 12 μm
(3 b) Maximum effective ice radius is 30 μm **>** 25 μm

(4) param.F
(4 a) The number of bottom levels without clouds in radiation calculation is 1 **>** 3
(4 b) Relative humidity thresholds for ocean and land are 0.90 **>** 0.95, and 0.80 **>** 0.85
(4 c) Raindrop evaporation rate coefficient is 1.0E-3 [$(kg\ m^{-2}\ s^{-1})^{-1/2}$] /s **>** 1.0E-5

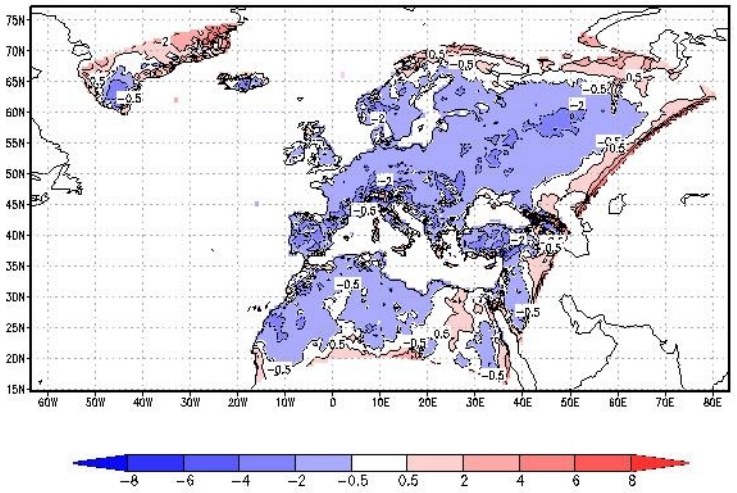
(5) zengocn.F
zo=0.0065 ustar^2/g **>** zo=0.0013 ustar^2/g

T2m bias: 1989-2002, new simulation

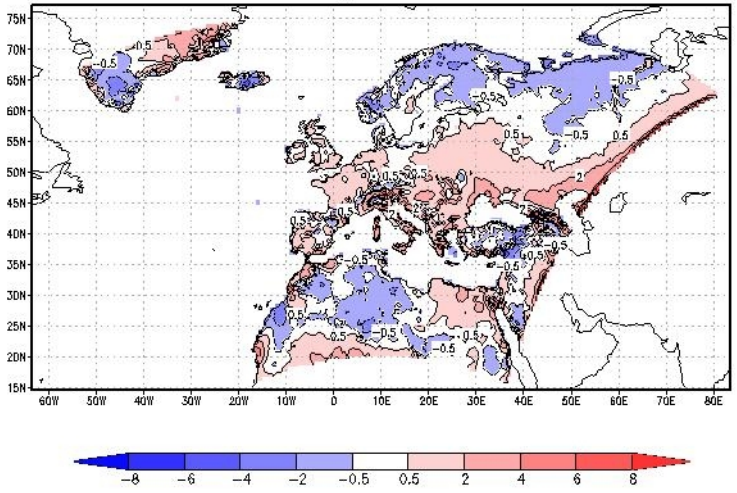
JF RegCM-CRU T2m (K)



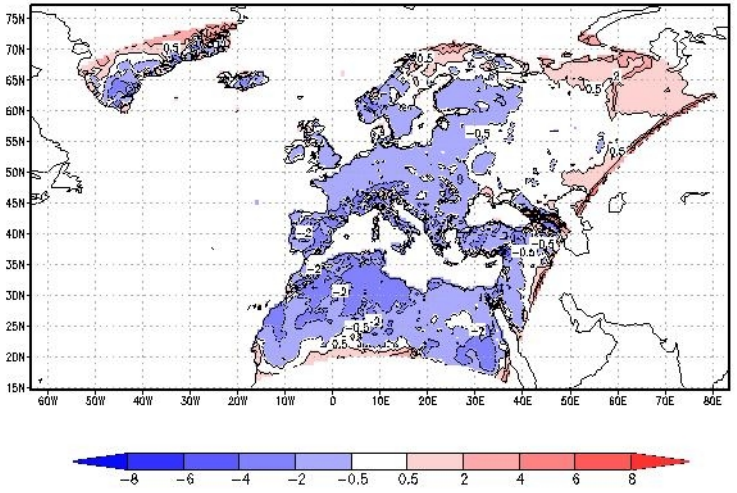
MAM RegCM-CRU T2m (K)



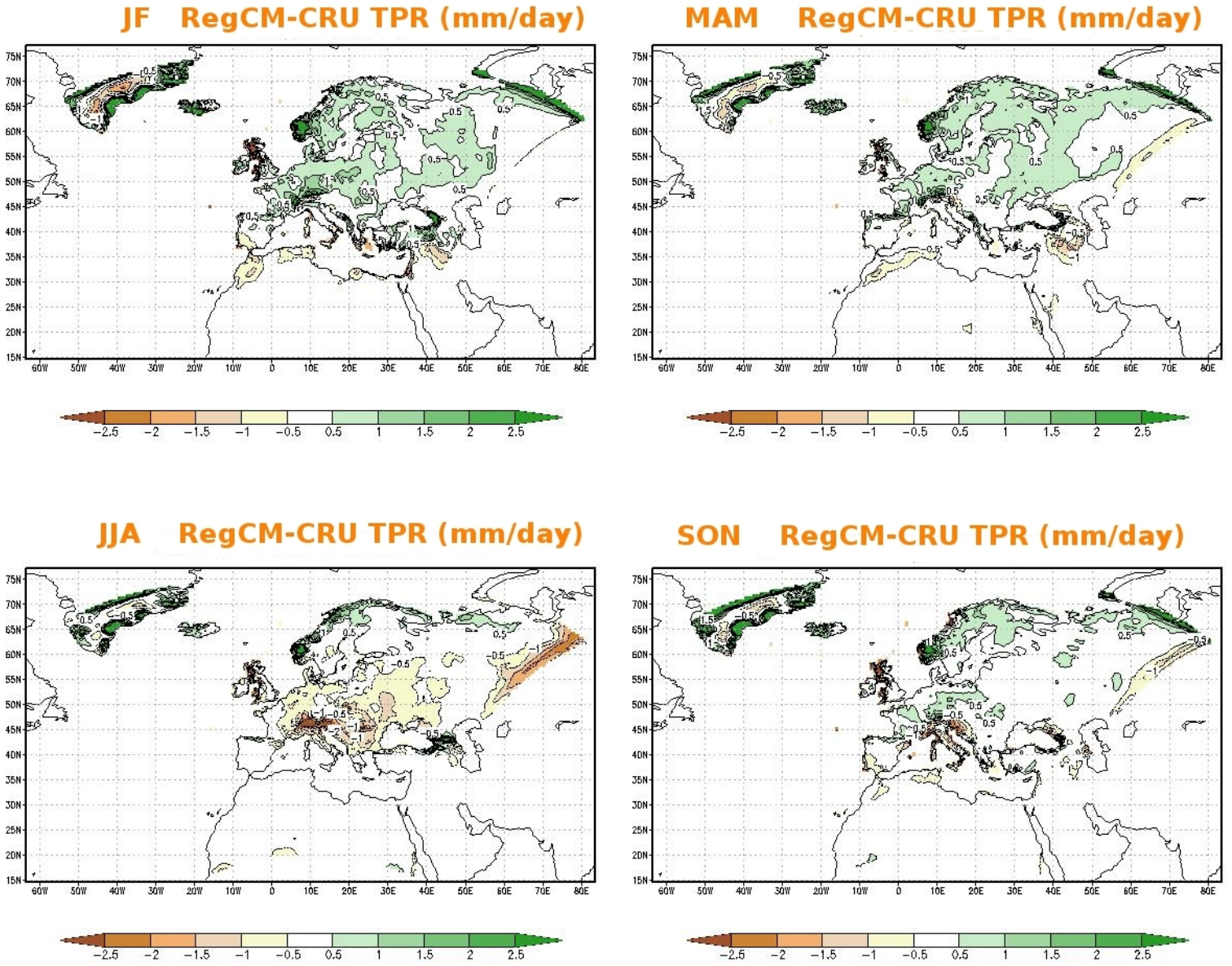
JJA RegCM-CRU T2m (K)



SON RegCM-CRU T2m (K)



Total precipitation bias: 1989-2002, new simulation



Summary

Experiment 1: Downscaling global climate model simulations

Near-present climate

- RegCM: warm bias in DJF, cold bias in JJA.
- EH5OM: smaller T2m bias (!) than in RegCM.
- Same sign of precipitation bias in RegCM and EH5OM.
- Similar T2m EOF1 mode during DJF, and precipitation for both DJF and JJA.
- Depatures of T2min in DJF and T2max in JJA.
- RegCM reproduces differences between Croatian coastal and continental parts.

Near-future climate

- Increase in T2min, T2m and T2max.
- Drying over western Europe during JJA.

Experiment 2: Downscaling ERA-Interim

- Warm bias during DJF sensitive to PBL scheme.
- Difference between forcing and validation data might explain part of biases.