Variability of precipitation in Romania: recent trends and projected changes in climate

scenarios

M. Caian, F. Georgescu, A. Dobre, P. Neague
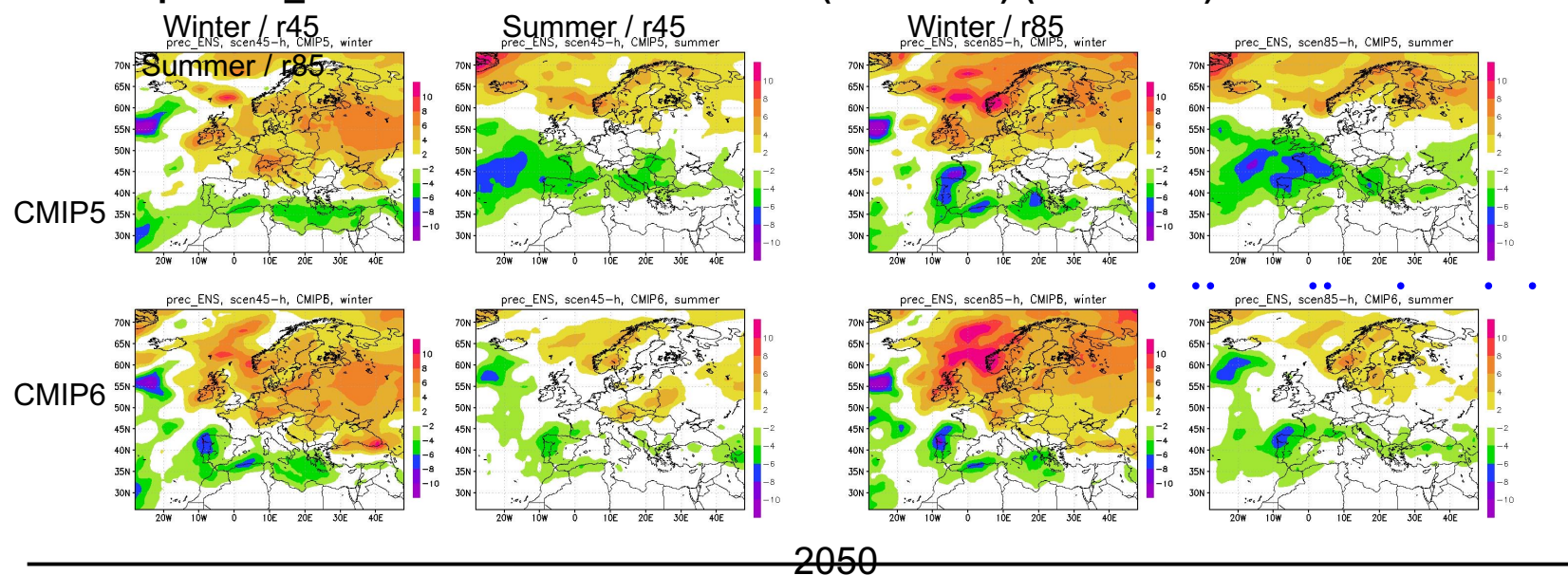
WeADL 2021 Workshop

*) Projected changes in CMIP6 and CMIP5 for Romania

*) Changes in regional extremes

*) Regional drivers of extreme variability

*) Projected changes in CMIP6 and CMIP5 for Romania

Precipitation_ENS: differences mean 30 ani: (2021-2050)-(1971-2000)

Winter / r45   Summer / r45   Winter / r85
Summer / r85

CMIP5

CMIP6

2011   2050   2070

RCP4.5   **2011-2040**   RCP8.5   RCP4.5   **20401-2070**   RCP8.5

nr. wet days
(prec > 1mm)

**CORDEX
(10km)**

Total precip.

CMIP6 vs. CMIP5:
Winter: Westard tripole, more precip

Summer: less precip. CMIP6 vs. CMIP5 (at high lat)

RO – more precipitation in CMIP6 vs. CMIP5 in both scenarios, both seasons
**(source: Atl+Med in RCP45; Atl. in RCP85)**
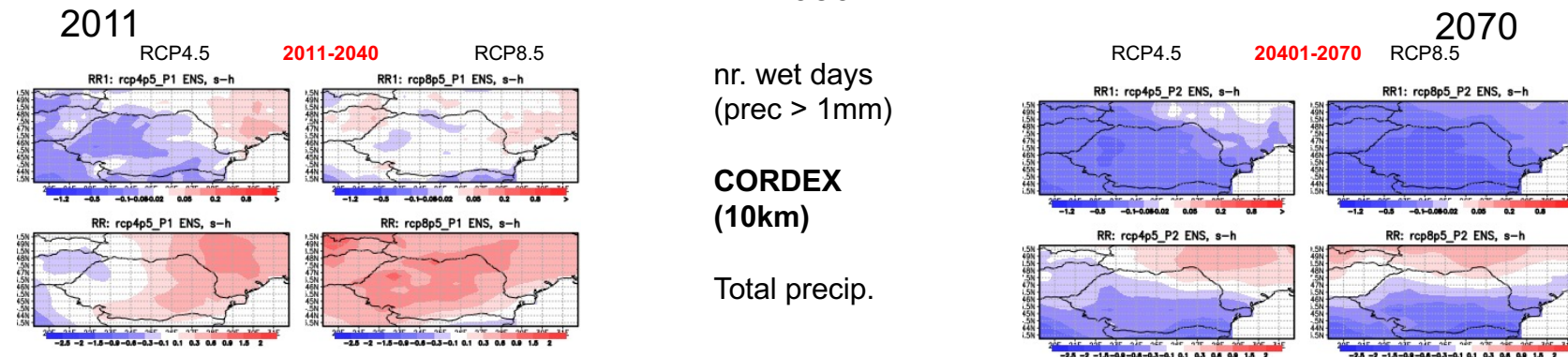
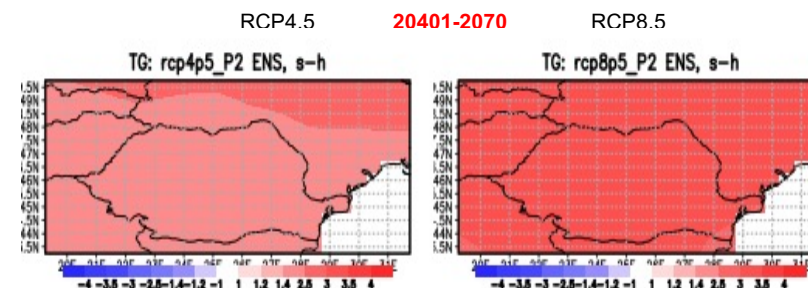=> Increase appears mainly due to extremes after 2040

[Figs. slides 3-8: Caian M. Dobre A., Mihailescu D., Sesiune Stiintifica ANM Nov. 2021]

Winter / r45   Summer / r45   Winter / r85

Summer/ r85

CMIP5

CMIP6

2050

2011   2070
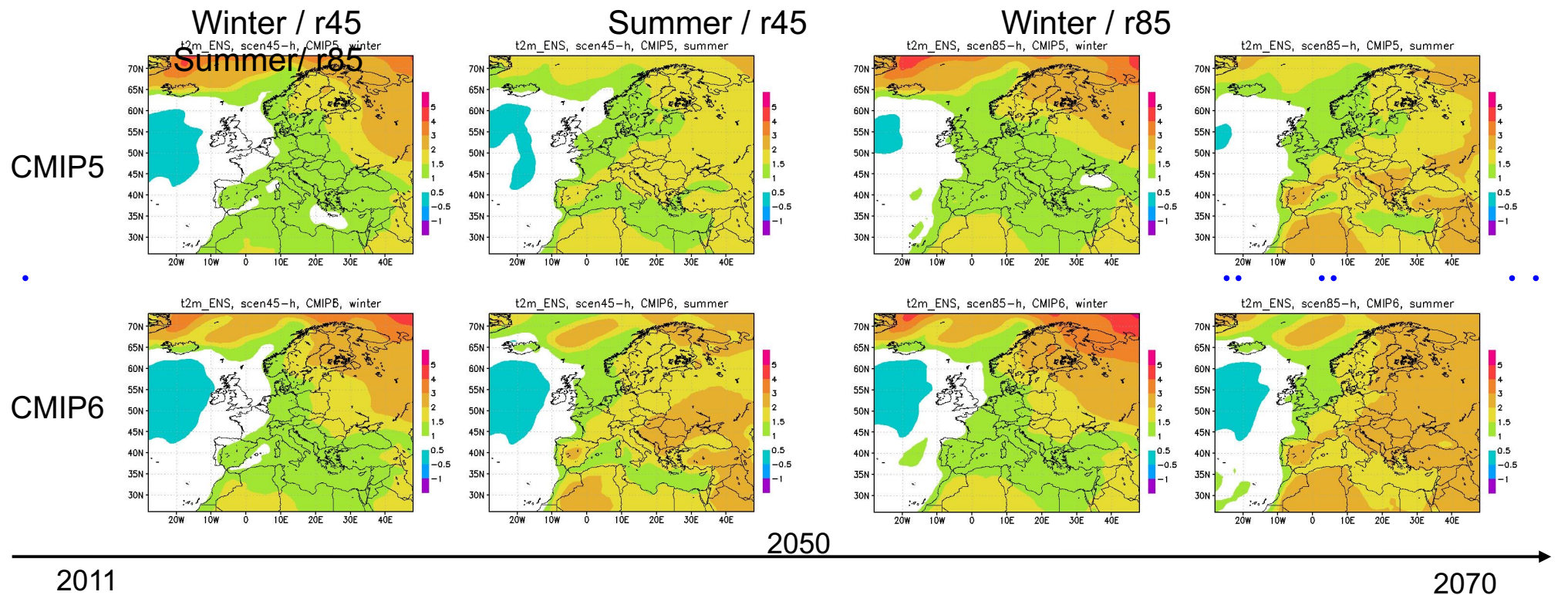
Temperature2m_ENS: Mean differences 30 years: (2021-2050)-(1971-2000)
- up to 1C warmer CMIP6
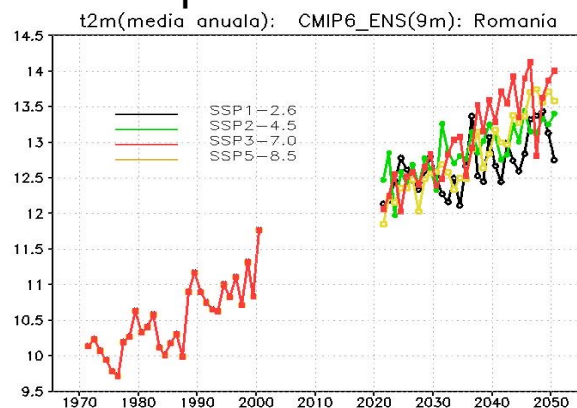- enhanced gradt(T) SV/NE
- SE-EU/ RO hot-spot

RCP4.5   **2011-2040**   RCP8.5   RCP4.5   **20401-2070**   RCP8.5
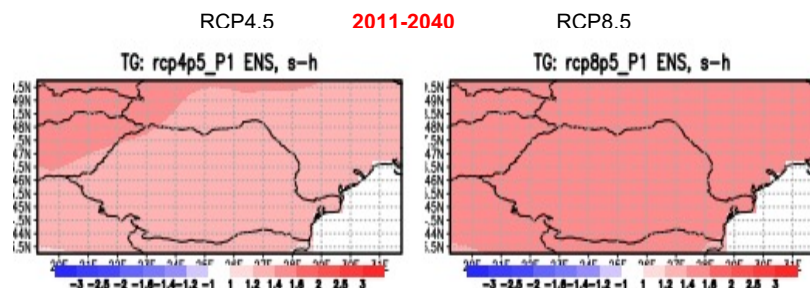
Diurnal mean T2m
(diff.: scen-hist)
CORDEX (10km)

Trends: season ROMANIA scenarios SSP/ CMIP6
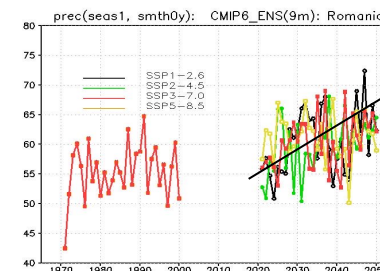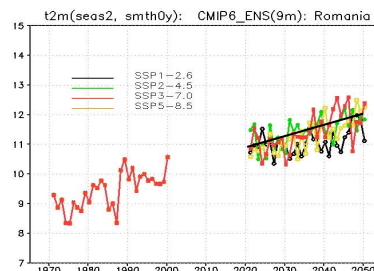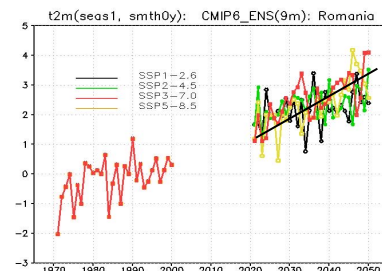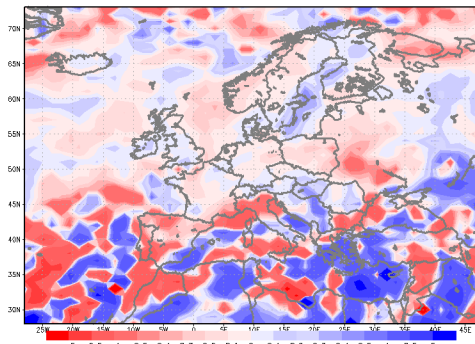
Temperature 2m

Precipitation

Working together for a green, competitive and inclusive Europe

Norway grants

Unitatea Executivă pentru
Finanțarea Învățământului Superior,
a Cercetării, Dezvoltării și Inovării

WeaMyL

METEO
ROMANIA

UNIVERSITAS NAPOCENSIS
1581
BABEŞ-BOLYAI

Norwegian
Meteorological
Institute
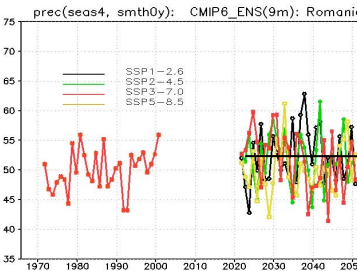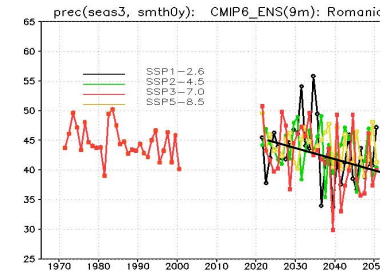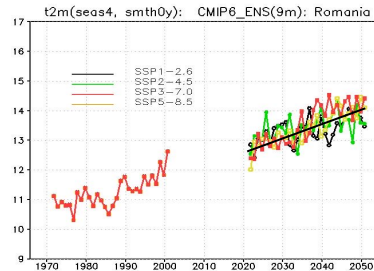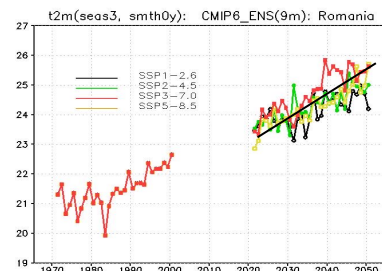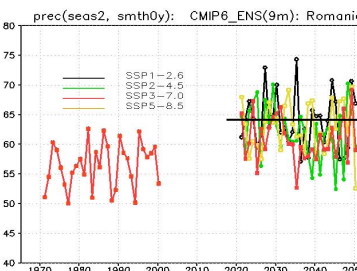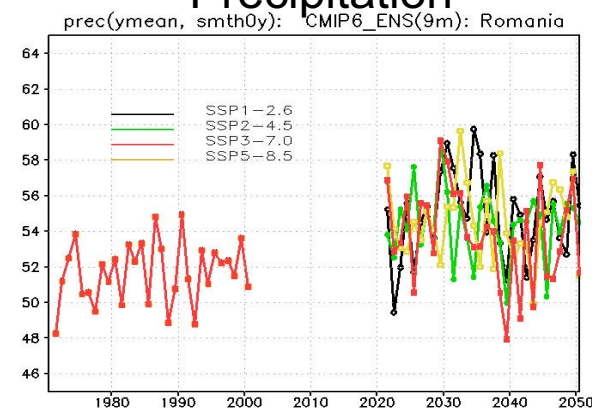
Intercomparare tendencies ROMANIA
In SSPs / CMIP6
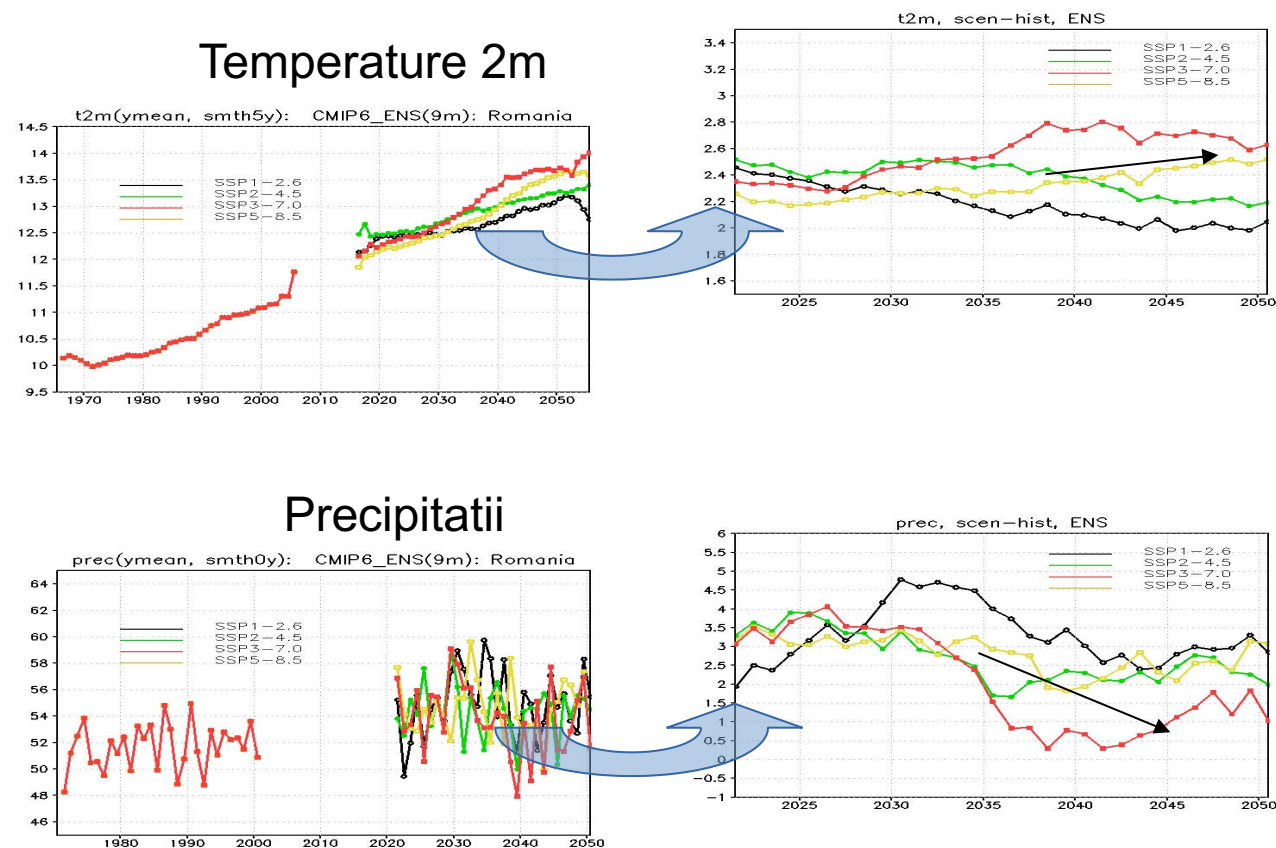
Temperature 2m

Precipitatii

Main spread
after 2030

RCP4.5 RCP8.5

SPEI_ENS: mean **differences**
30years: (2021-2050)-(1971-2000)
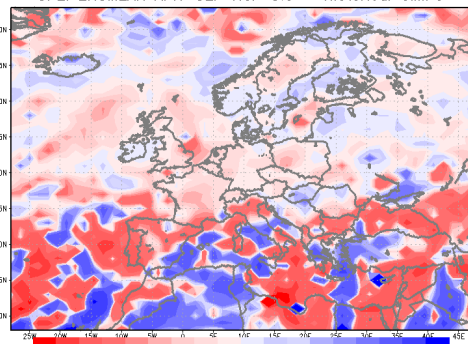
CMIP5
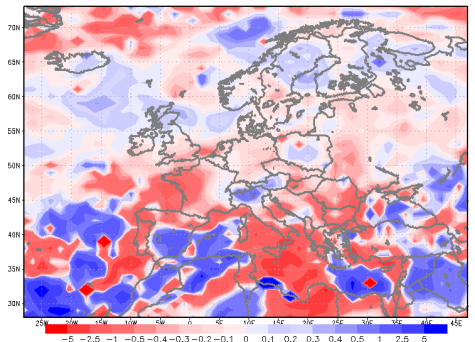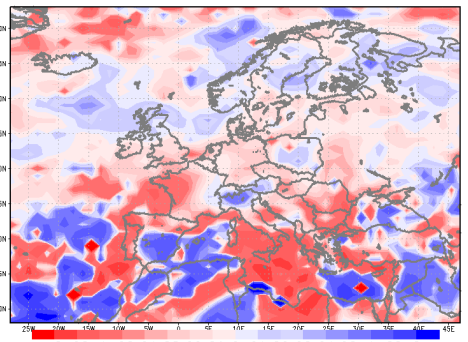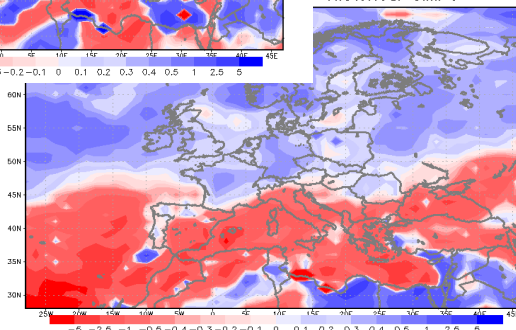
CMIP6

SPEI_ENS APRIL – SEPTEMBER: **CMIP6**

HISTORICAL   **SSP2 4.5**   **SSP 5 8.5**
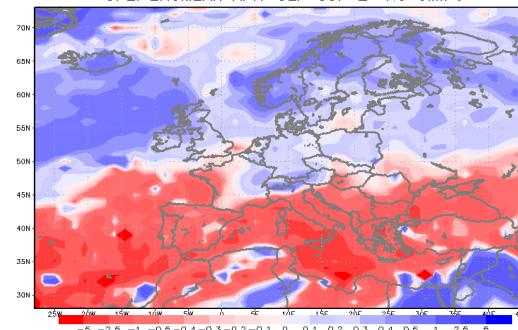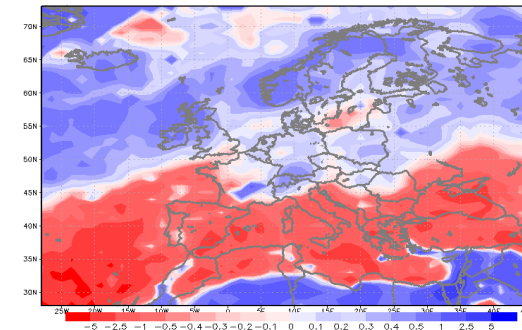
ΔPrec > 10 mm ⬈in NV, V Ⓧ 1.5 < ΔTxx < 4

Δhumdity ⬊(in S) Ⓧ 1.5 < ΔTmax < 4

2011-2040
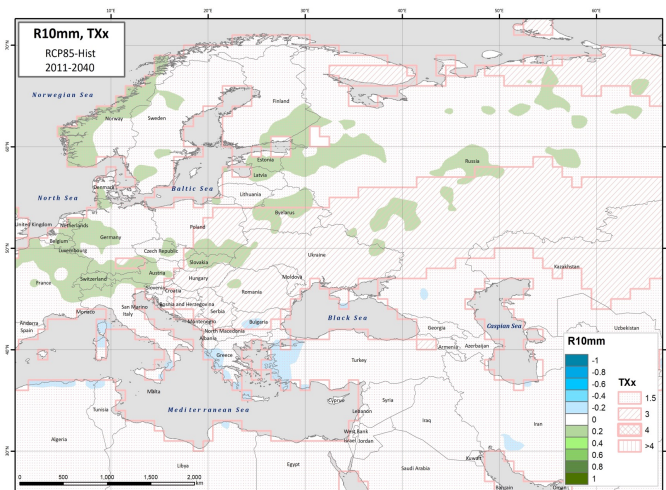
2011-2040
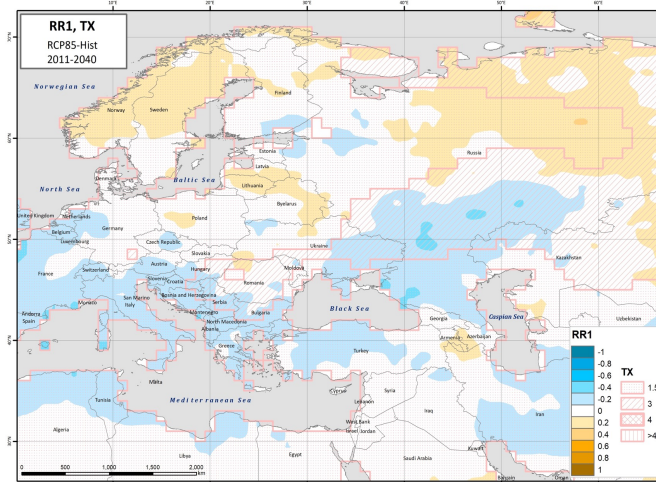
2041-2070

2041-2070

Multiple hazard collocated: Extreme Precip.; heat waves; drought

RCP4.5   2011-2040   RCP8.5   RCP4.5   20401-2070   RCP8.5
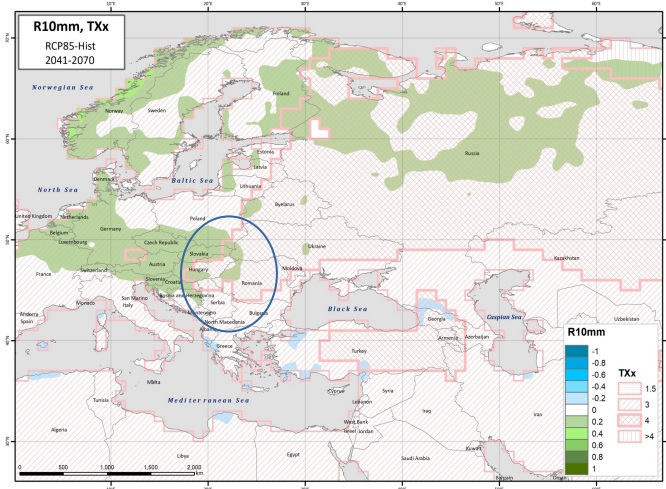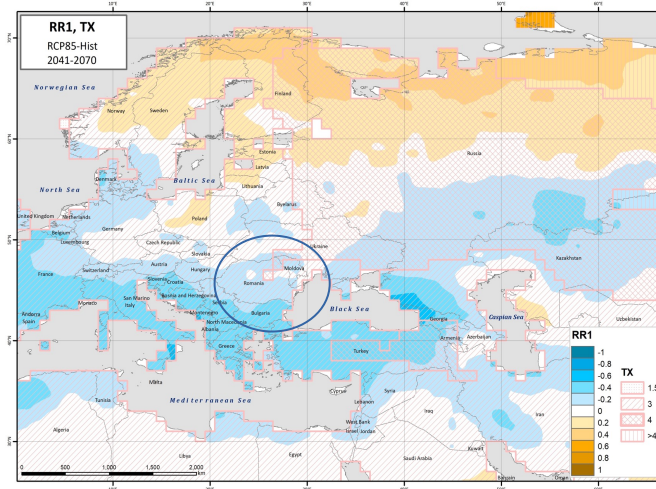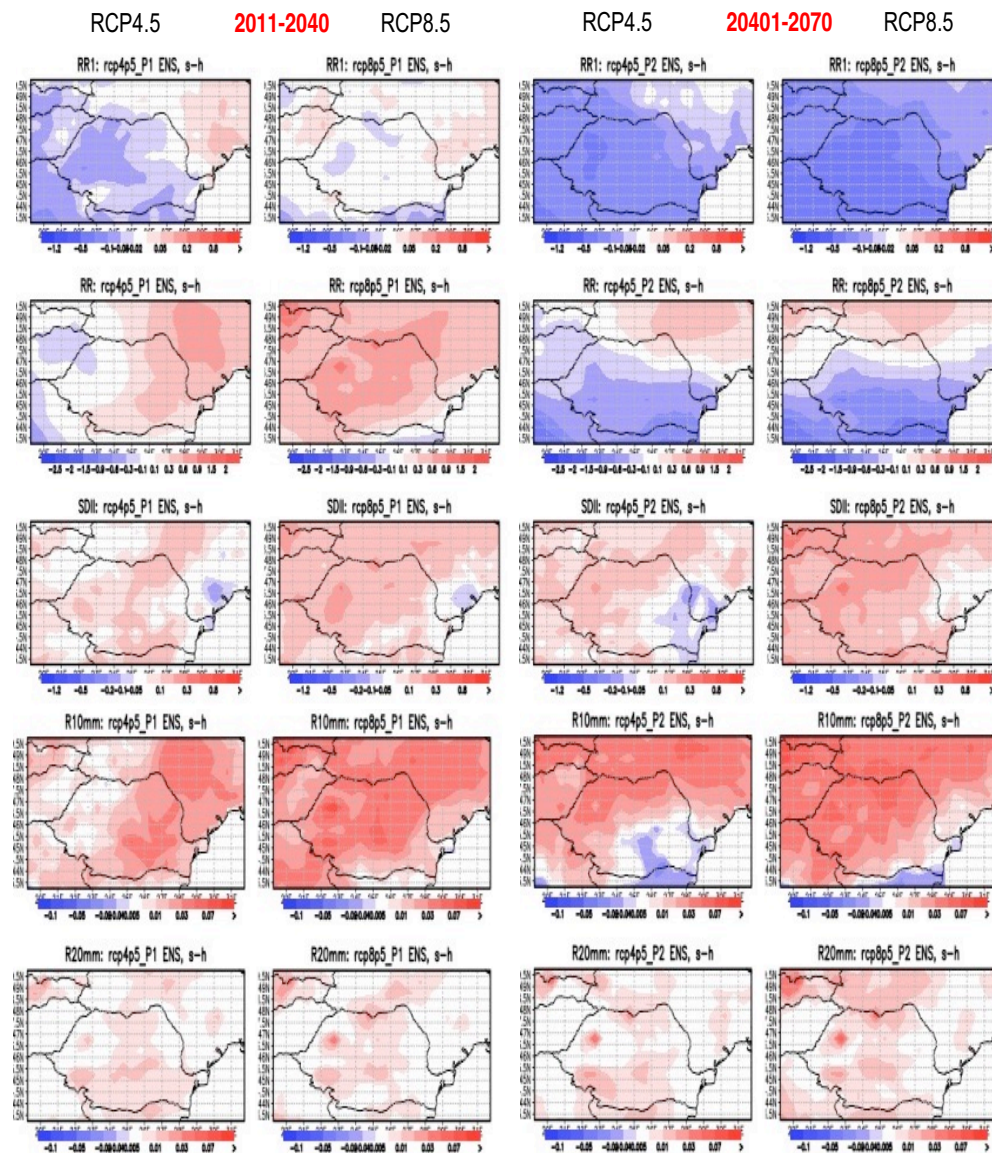
Wet days (precipitation >= 1mm)

Precipitation sum

Daily intensity index (mm/wet day)

Heavy precip days (precip >=10mm)

Very heavy precip days (precip >=20m

*) Changes in regional extremes

Caian M., Lazar C., Chitu Z, Dobre A, Amihaesei V., RAR Journal, 2021
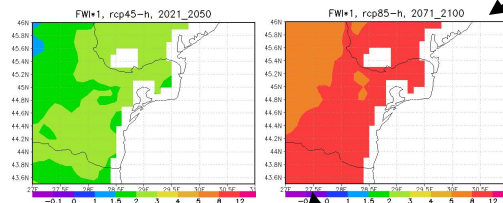
Example: Interacting hazards under climate change for SE Romania
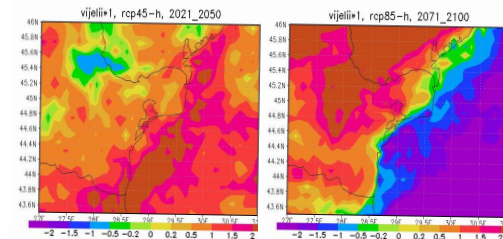 (from Projections CORDEX (11km) / CMIP5)
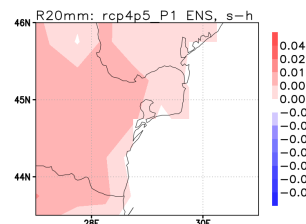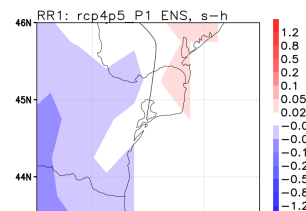
Temperature increase
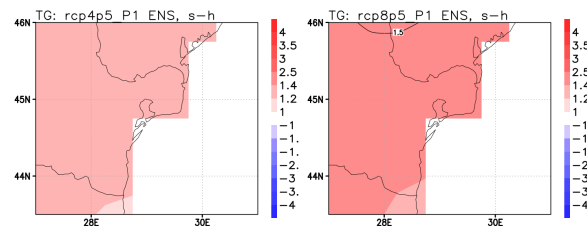
Fire index increase

Wind gust increase and shift
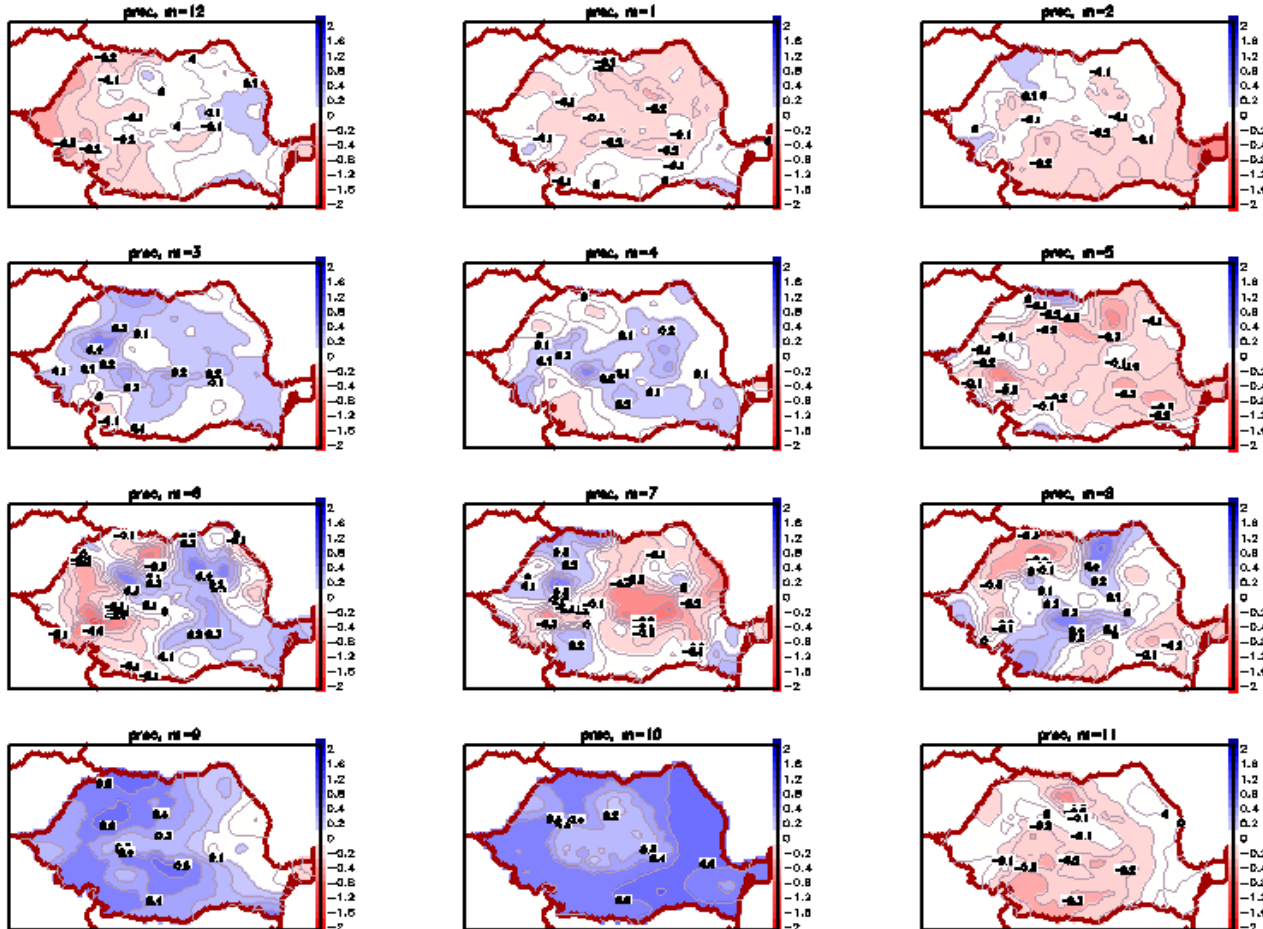
Precip

Wet days
 decrease

Heavy
Prec.
 increase

*) Drivers of regional and extreme variability

- > proxies for seasonal prediction
- > potential drivers in learning process AI/ML

Precipitation trend - monthly 1961-2016

[Dobre A, Caian M, Sesiune stiintifica ANM, 2020]

Origins Extr.CT: E+S, dom6, winter

Origins Extr.CT: E+S, dom3, summer

wind300,w trends 42y

wind300,s trends 42y
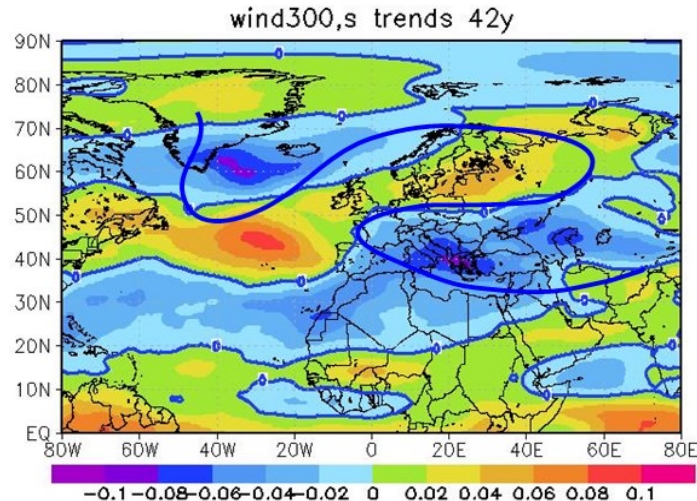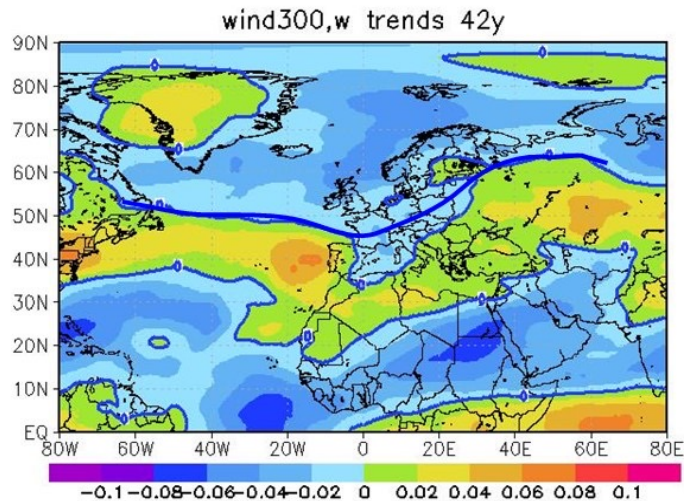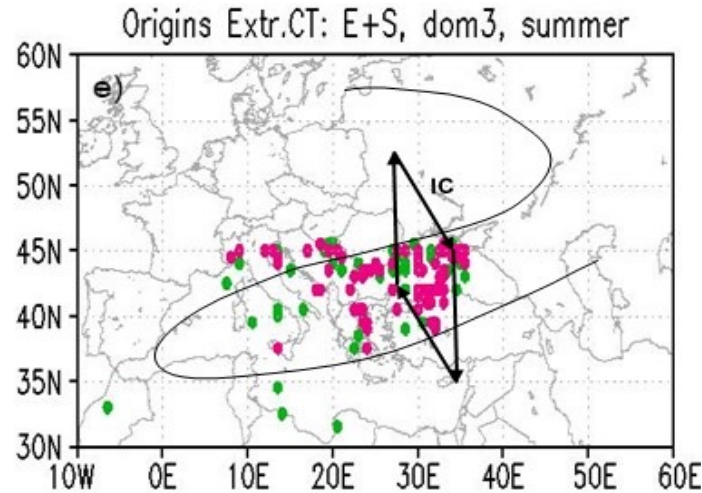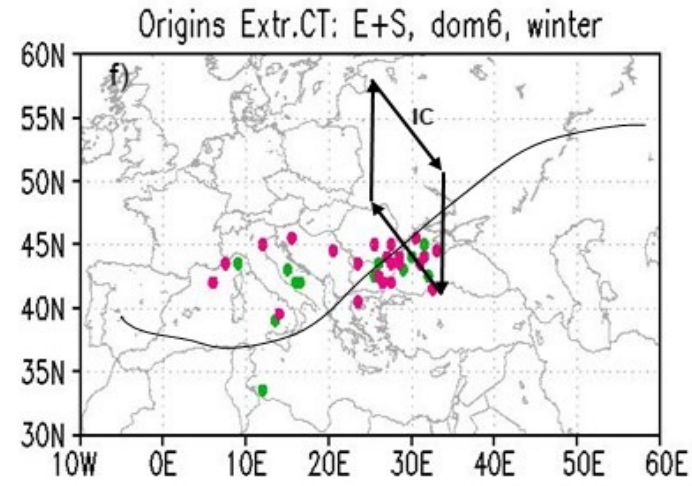
*) jet streack variability under warmer climate controls extremes shifts

ERAINT, S, EU

P2−P1 S,(w)
P2−P1 S,(s)

Caian M., Georgescu F., Pietrisi M, Catrina O, Atmosphere, 2021
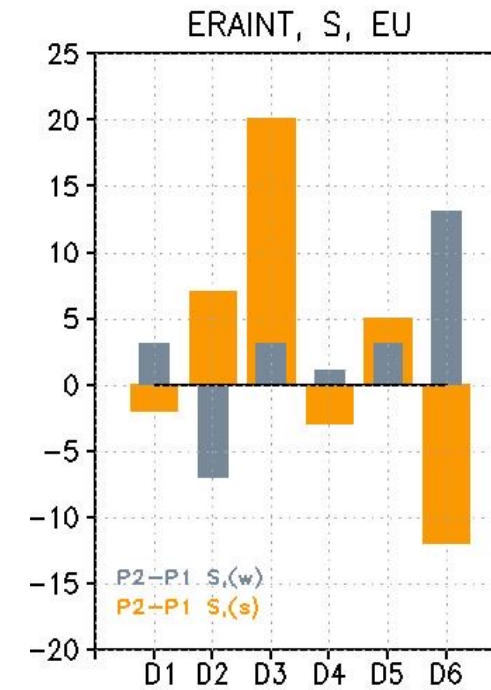
Storm tracks in climate scenarios: extreme cyclones crossing Romania: RCP*-HIST

a)Frequency
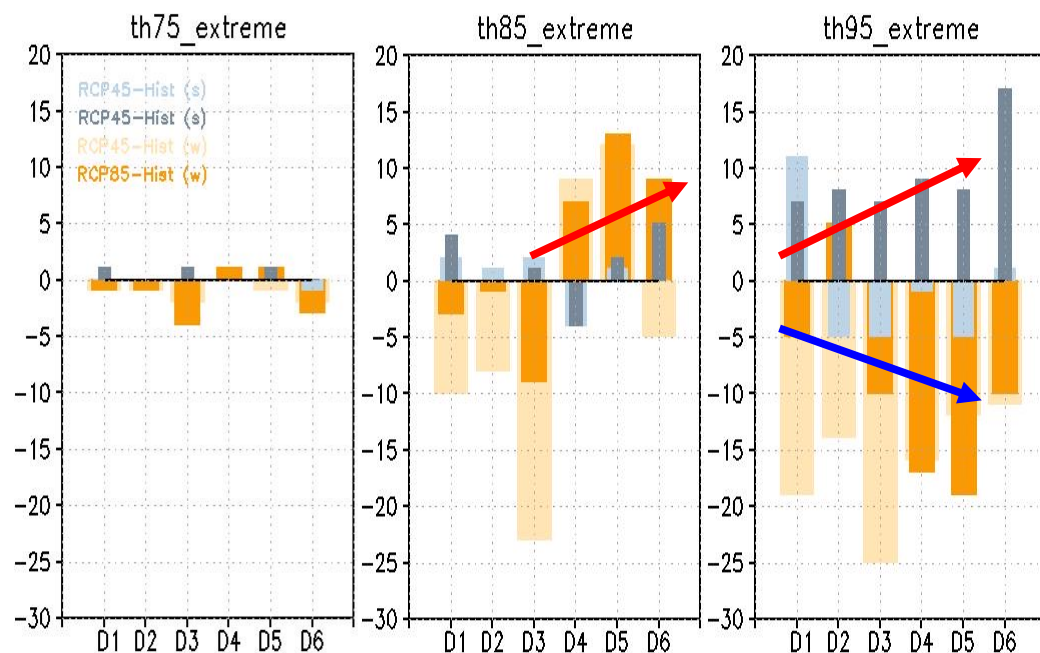
b) Persistence

Changes in the frequency and persistence of extreme cyclones over Romania for seasons: winter (grey); summmer (orange), RCP45 (light(; RCP85 (dark); [sursa: *Caian M. and Boroneant C. – in prep., 2022*]

Blizzard case-study

high resolution impact: conditions - present for April 2022 (left); signal persists on Mai

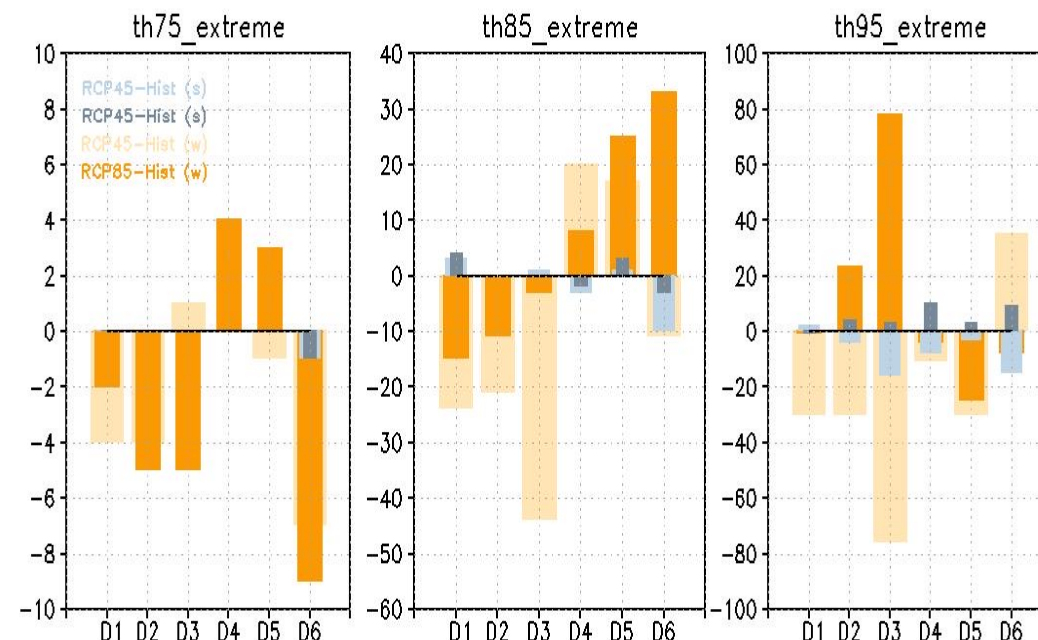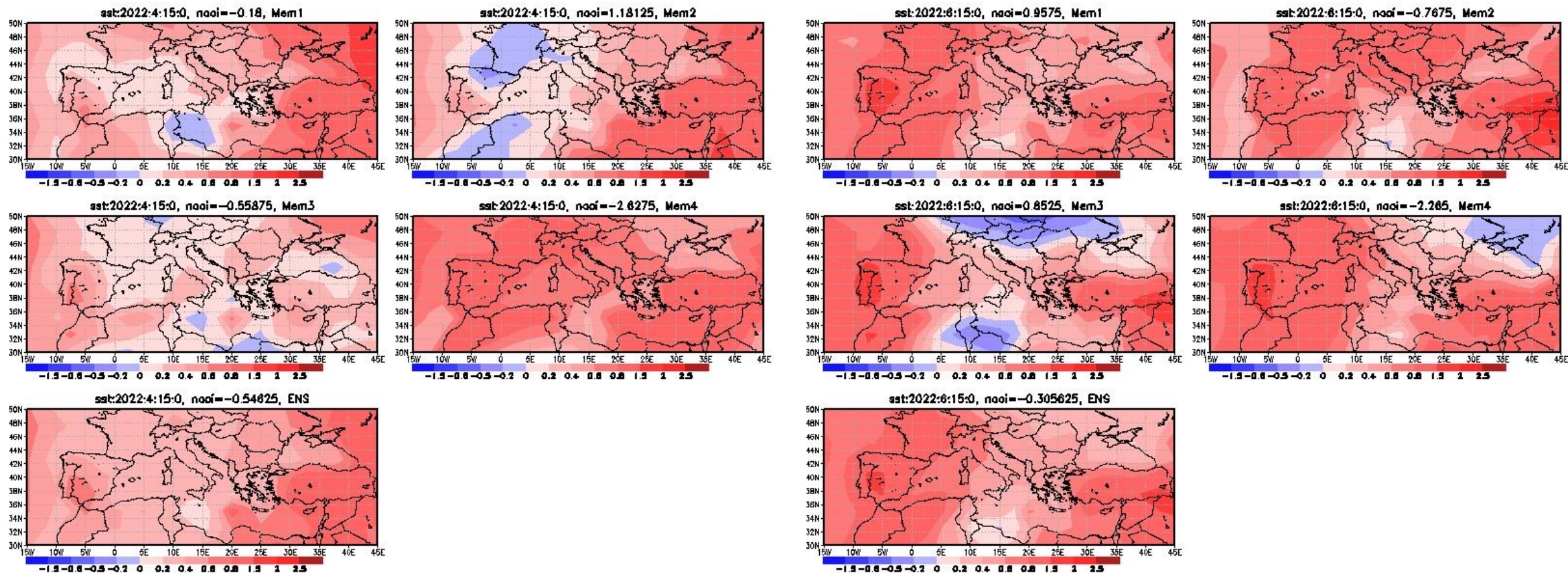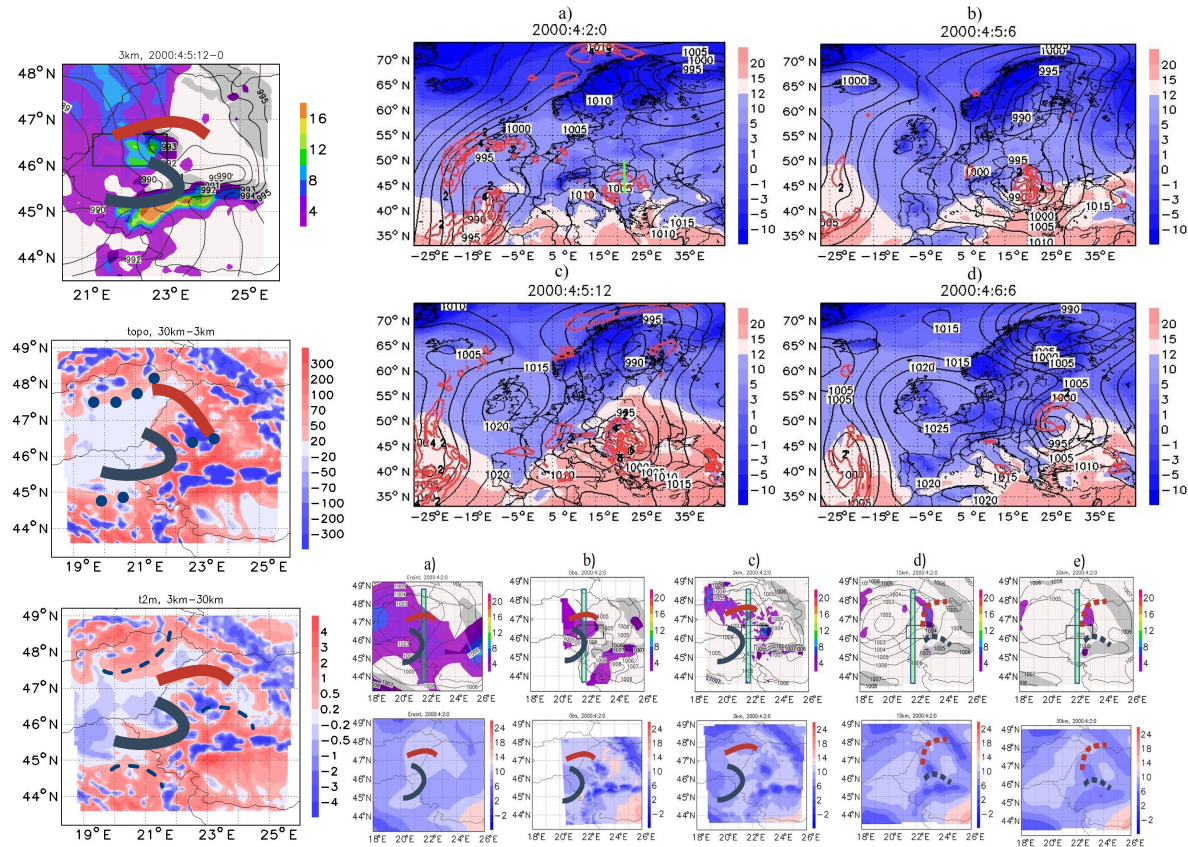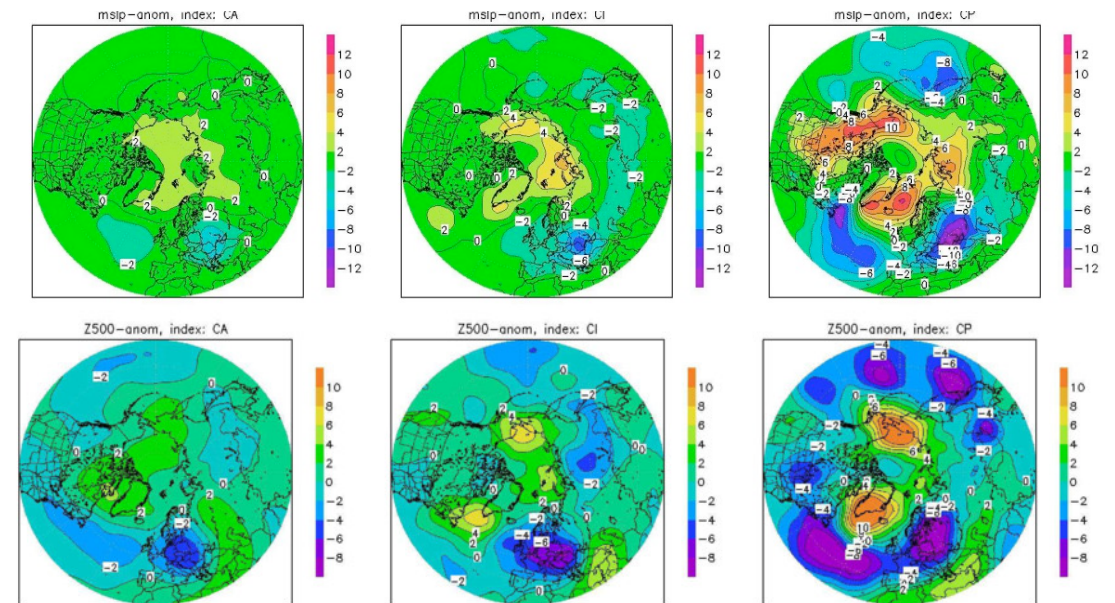**Flood** Case-study

*) flood preconditions index

*) high resolution impact

Driving modes (flood, West Romania, Cris Basins)

Summary

- Changes in precipitation indicate in climate projections an increase in winter and decrease in summer for RO; the winter increase is related mostly to extreme precipitation (with strength index increase, number of wet days decrease);

- Changes indicated by the most recent models and scenarios CMIP6 enhance the previous signal found in CMIP5: a stronger increase in temperature (up to $\delta T \sim 1C$) and in winter precipitation (mainly in the N-NE EU)

- drivers of regional extreme variability identified in the actual climate appear to preserve the remote connections => these links provide useful proxies to be used in climate prediction and AI/ML methods

- enhanced resolution is required for local extremes and AI/ML downscaling of extended range forecast (month, season) could be a solution