Primes: "*Preventing flooding risks by making resilient communities*"

Action A1: Designing integrated baseline scenarios

28/09/2016

Expected results of A1:

- Common observed data set of meteorological , marine, oceanografic variables and **climate indices;**
- Common **climate scenarios** of the same variables;
- Inter-regional modelling systems representing the wave motion, storm surge, costal effects;
- Hydrological model scenarios for small basin

Indicators of progress:

- N°1 report summarizing the state of the art of the climate (observed and future scenario) by using common data and common models **(REPORT A);**
- - N°1 report summarizing the main impacts of climate change on hydrological and coastal sectors nge using common data and common models **(REPORT B);**

- - N°1 Atlas visualizing climatologic parameters on common layouts (maps/plots from REPORT A) ;
- - N°1 Atlas visualizing hydraulic and coastal risk in the three Regions (maps/plots from REPORT B).

… a seguito dello slittamento della scadenza per la presentazione del progress report al **31/10/2016,** L'AGGIORNAMENTO DELLA RENDICONTAZIONE sia delle attività svolte che delle spese sostenute deve essere AL 30 SETTEMBRE 2016 pertanto la SCADENZA PER LA TRASMISSIONE DI TALE DOCUMENTAZIONE DA PARTE DEI BENEFICIARI È FISSATA AL **10 OTTOBRE 2016.**

Decisions from last meetings as regards the work to be done on A1

Hydro-meteo-climatological indices based on precipitation

REPORT	Index	Description
A	Amount of precipitation	Total amount of precipitation
A	Extreme precipitation	95thpercentile of daily precipitation
A	Frequency of extreme precipitation	Number of days when the daily precipitation exceed 95th daily percentile
?	Frequency of intense precipitation events	Number of events when a given threshold is exceeded (30mm/hourly). Significant durations for flooding purposes are 1h, 3h, 6h.
	Areal intense precipitation	Deviation of mean areal daily precipitation from the warning threshold (example 50mm/24hours)
A	Frequency of areal intense precipitation	Number of days when areal daily precipitation exceed warning threshold, computed at seasonal/annual level (threshold of 50mm/day).
B	Hydrometric level	Exceed hydrometric level threshold in significative river sections
A	WET days	Maximum number of consecutive wet days(rain>1mm) on season/year
A	DRY days	Maximum number of dry days
B	Trend of location and/or scale parameter	Trend of location and scale parameter of GEV distribution.
B	Parameter of GEV distribution	Comparison of GEV distribution's parameters in two or more periods
B	Antecedent Soil Moisture (AMS)	Includes: soil type , land cover, 5 days precipitation before the event events.

Meteo-climatological indices based on temperature

Report	Index	Description
A	Seasonal minimum and maximum temperature	Mean minimum and maximum seasonal values
A	Heat wave duration (HWD)	The maximum number of consecutive days with maximum temperature greater then 95th daily percentile

Index	**Description**
Amount of precipitation	Total amount of precipitation
Extreme precipitation	95^{th}percentile of daily precipitation
Frequency of extreme precipitation	Number of days when the daily precipitation exceed 95th daily percentile
Frequency of areal intense precipitation	Number of days when areal daily precipitation exceed warning threshold, computed at seasonal/annual level (threshold of 50mm/day).
WET days	Maximum number of consecutive wet days on season/year
DRY days	Maximum number of consecutive dry days

Marine and costal indices

Report	Index	
B	Storms surge frequency	
B	Wave storms frequency	
B	Combined surge-wave storms frequency of storms with combination of surge and wave	
B	Wind storminess	
B	Frequency of events of combined surge and river flood wave	

+

Impact indices

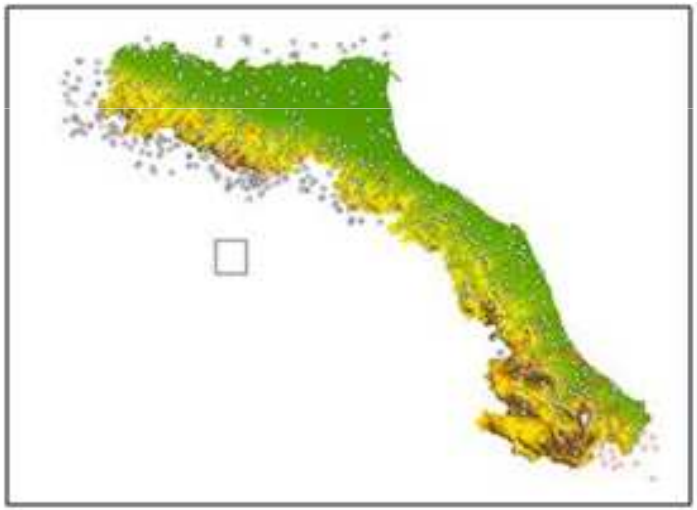
(see materials from Patrizia Ercoli on DROPBOX)

Fattori ambientali correlati	Indicatore di contesto	Indicatore di contributo al processo	Indicatore di processo
B **Popolazione e Salute Umana**	Popolazione totale (IC1)	Variazione percentuale di popolazione in aree a pericolosità idraulica a seguito di azioni di piano (ICP1)	Interventi finalizzati a ridurre la pericolosità idraulica (IP1)
	Popolazione esposta ad eventi alluvionali di diversa entità (IC2).		Interventi e azioni di delocalizzazione (IP2)
			Attuazione di azioni e regole di governo del territorio (IP3)
	Numero di ospedali in aree a pericolosità molto elevata (IC3)	Numero di ospedali interessati da interventi di piano (ICP2)	Interventi finalizzati a ridurre la pericolosità idraulica (IP1)
			Interventi di riduzione di vulnerabilità (IP4)
			Attuazione di azioni e regole di governo del territorio (IP3)
	Numero di scuole in aree a pericolosità molto elevata (IC4)	Numero di scuole interessate da interventi di piano (ICP3)	Interventi finalizzati a ridurre la pericolosità idraulica (IP1)
		Numero di scuole delocalizzate (ICP4)	Interventi e azioni di delocalizzazione (IP2)
			Attuazione di azioni e regole di governo del territorio (IP3)
Acqua	Stato ecologico dei corpi idrici superficiali interni (IC5)	Modifica di pressioni idromorfologiche dovute ad interventi di piano (ICP5)	Numero di interventi di ripristino di aree di naturale espansione dei fiumi e dei laghi, di recupero di aree golenali, di riqualificazione fluviale e di azioni gestionali (ad esempio contratti di fiume e di lago) (IP5)
	Stato di qualità ecologico delle acque marino costiere (IC6)		Numero di interventi di difesa a mare, di ripascimento, di difese costiere (IP6)
	Stato quantitativo dei corpi idrici sotterranei (IC7)		Numero di interventi di ripristino del rapporto falda fiume, interventi di riduzione della pericolosità che comportano ricarica della falda (IP7)

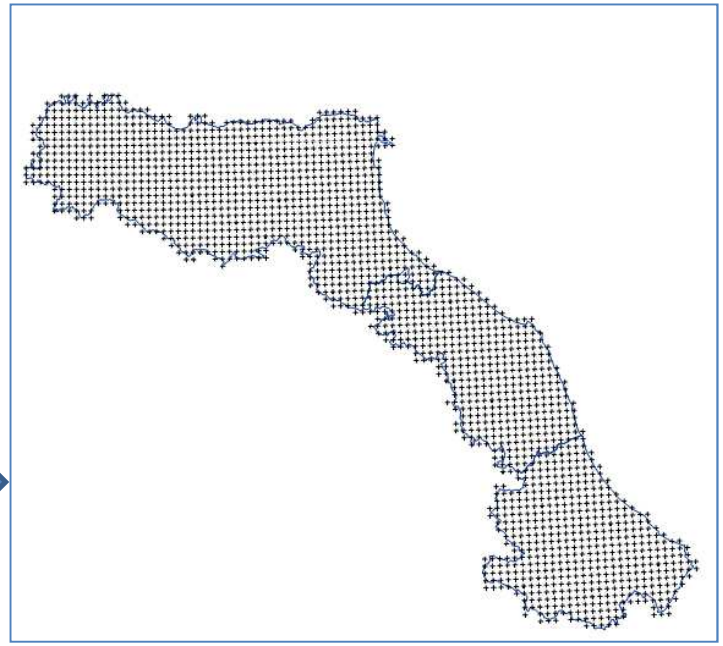
Report A: Common Data set

1.Precipitation

Daily precipitation data have been interpolated over the whole PRIMES domain using the Shepard scheme with the distances between stations computed using the topographic distance as in Antolini et al (2015).

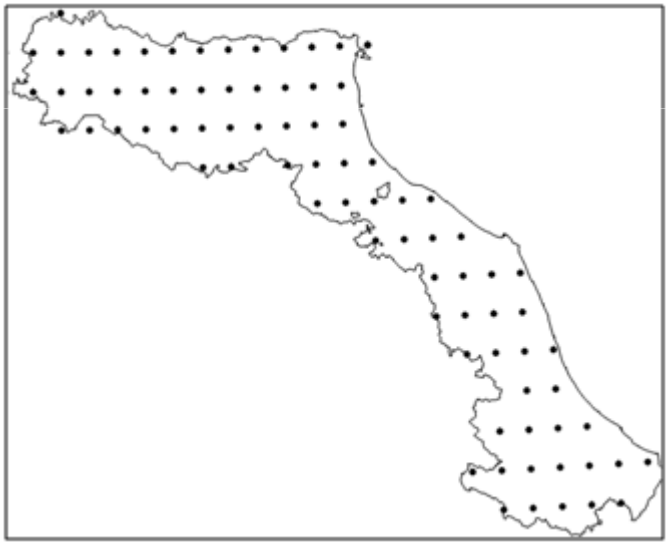


analysis at 5 Km
over 1961-2015



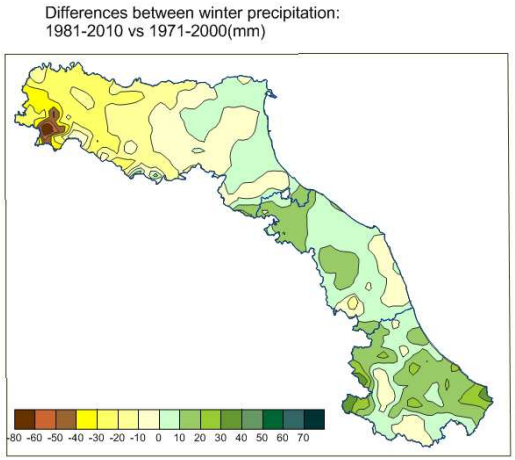
2. Temperature:

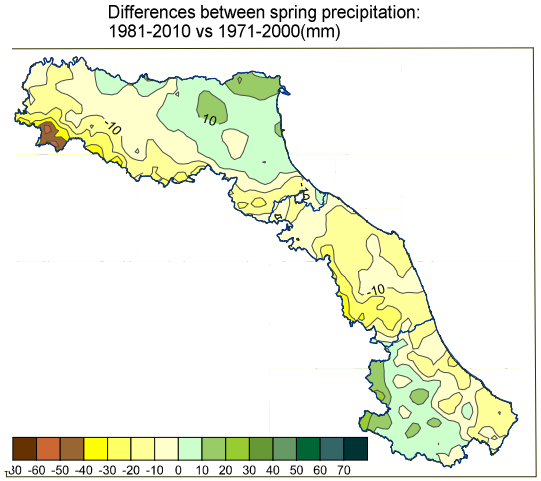
E-OBS daily gridded data set with a spatial resolution of 0.25°x0.25° (Version 12) (http://www.ecad.eu/download/ensembles/ensembles.php)

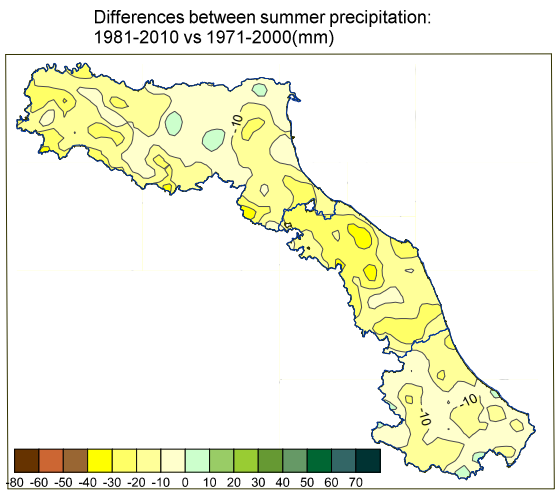


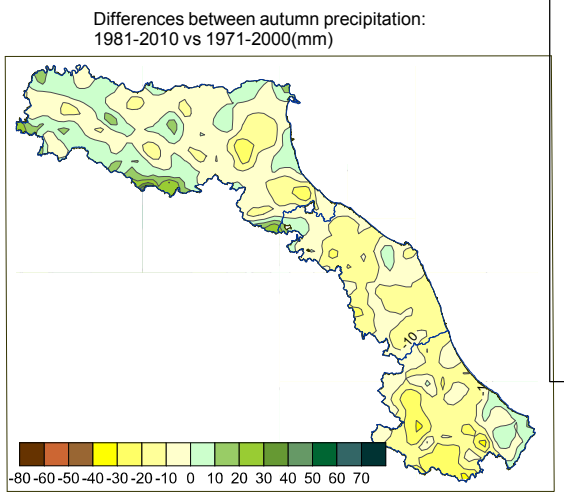
state of the art of the observed climate

Amount of precipitation: 1981-2010 v.s 1971-2000









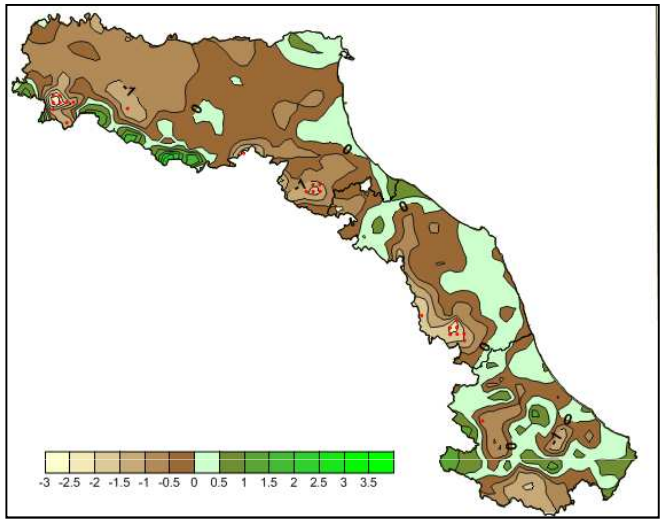
<u>Summary 1981-2010 v.s 1971-2000</u>

- Winter = 1981-2010 was "Wetter" for Marche and Abruzzo and costal area of ER, while great part of ER was "drier"
- Spring = 1981-2010 was "Wetter" in Ferrara and Appennino Aburzzeze , while the rest of area was "drier"
- Summer= 1981-2010 was "drier" everywhere than 1971-2000
- Autumn= 1981-2010 was "drier" in Marche and Abruzzo

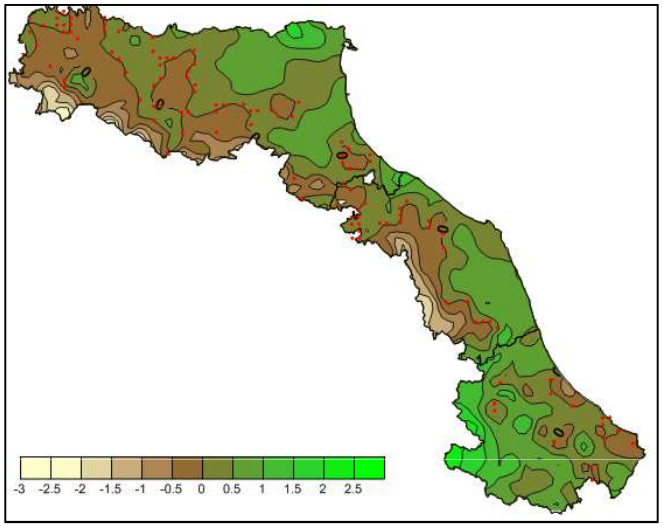
Differences between 1981-2010 and 1971-2000 : between-30 and 30mm,except Liguria area where the diff. is greater for winter and spring.

2 . Trends over 1961-2015 of seasonal precipitation(mm/yr)& significance in red (90%)

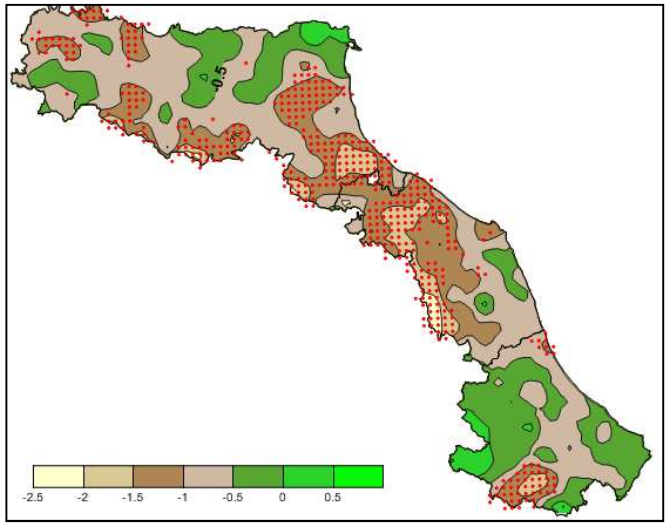
DJF



MAM



JJA



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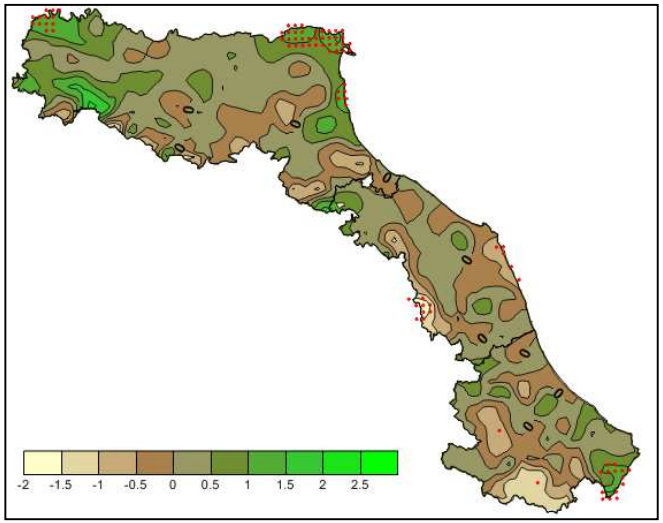
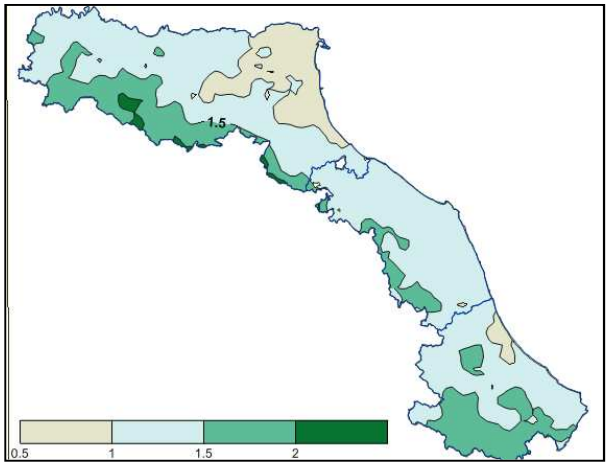


Summary:

- Winter presents negative trends over great part of ER;
- Spring presents negative trends over great part of Emilia , Apennino Umbro Marchigiano, and costal area of Abruzzo positive over rest of area
- Summer presents significant negative trends over ER, MA and parts of AB;
- Autumn postive and significant over Ferrara and isolated area

Pnl95-spatial distribution of the index

DJF



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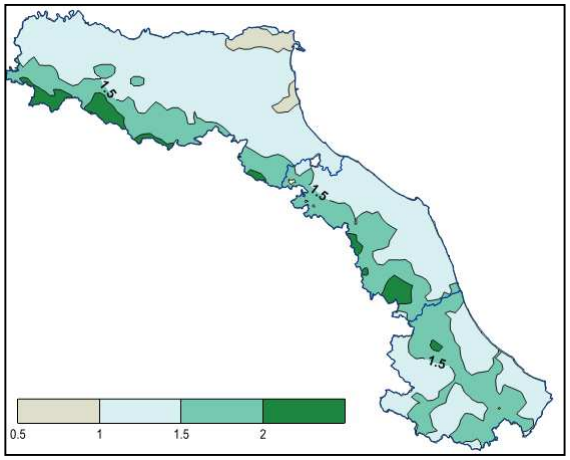

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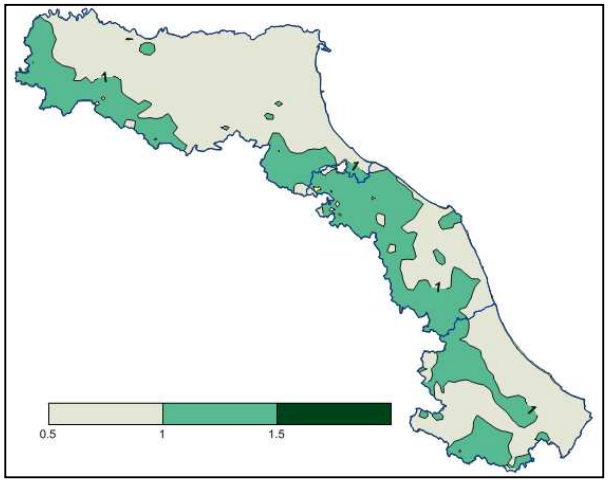

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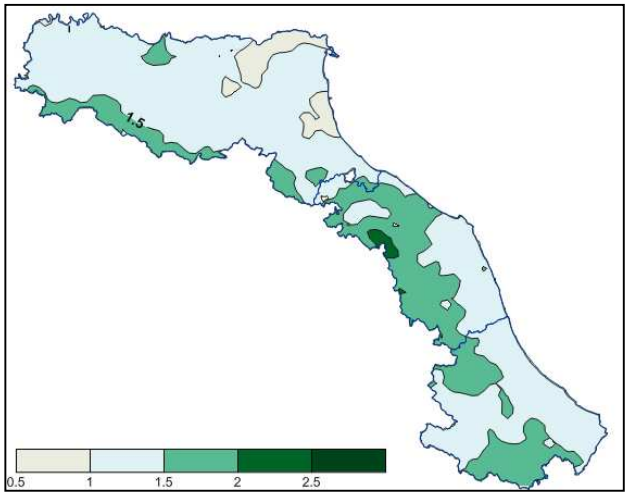
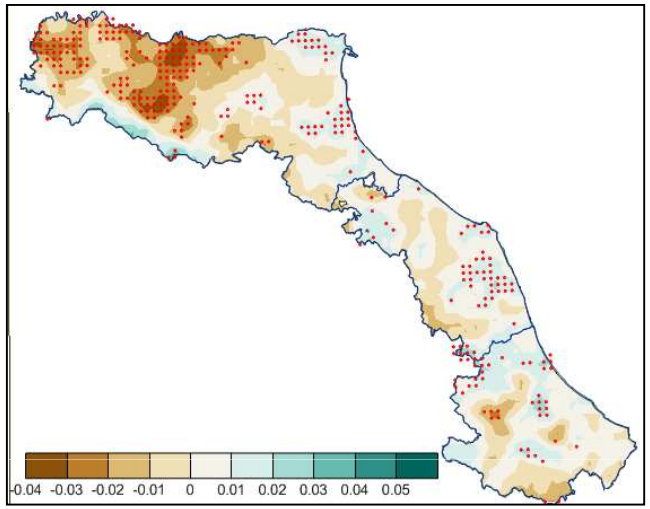


Summary:

•The index vary between 0.5-3 days;
• high values especially in the Apennine

PNL95 - trends over 1961-2015& significance in red (90%)

DJF



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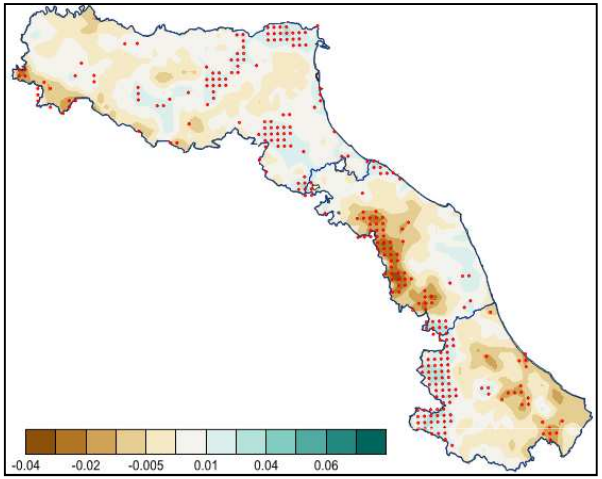

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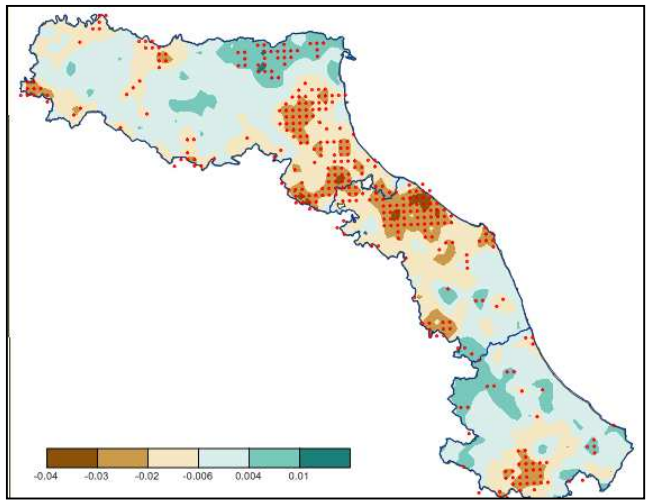

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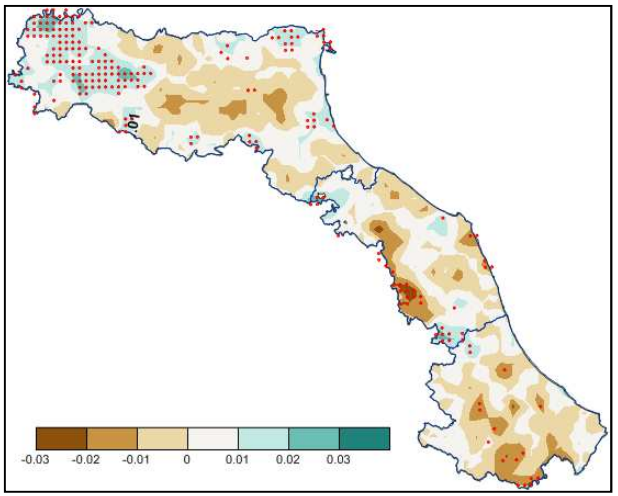
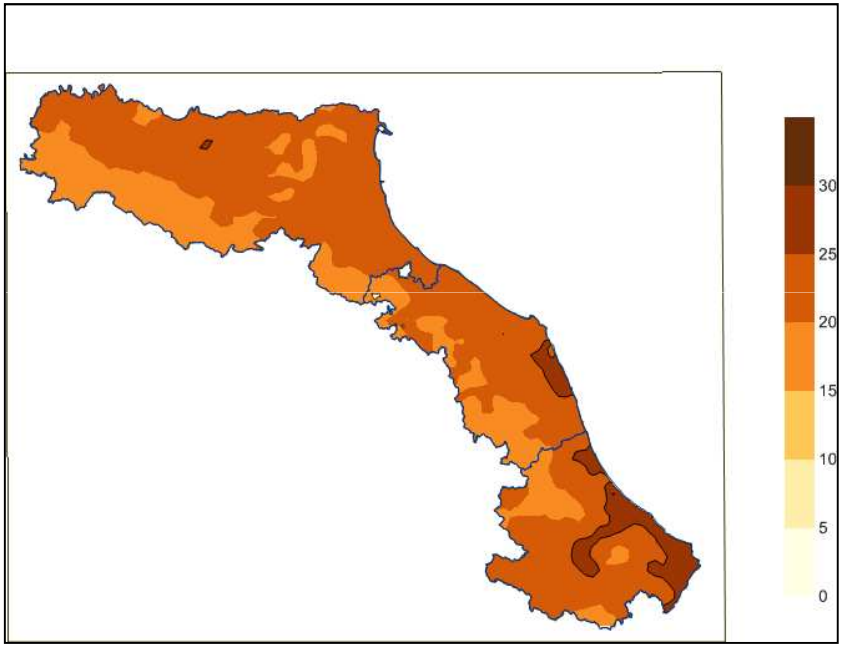


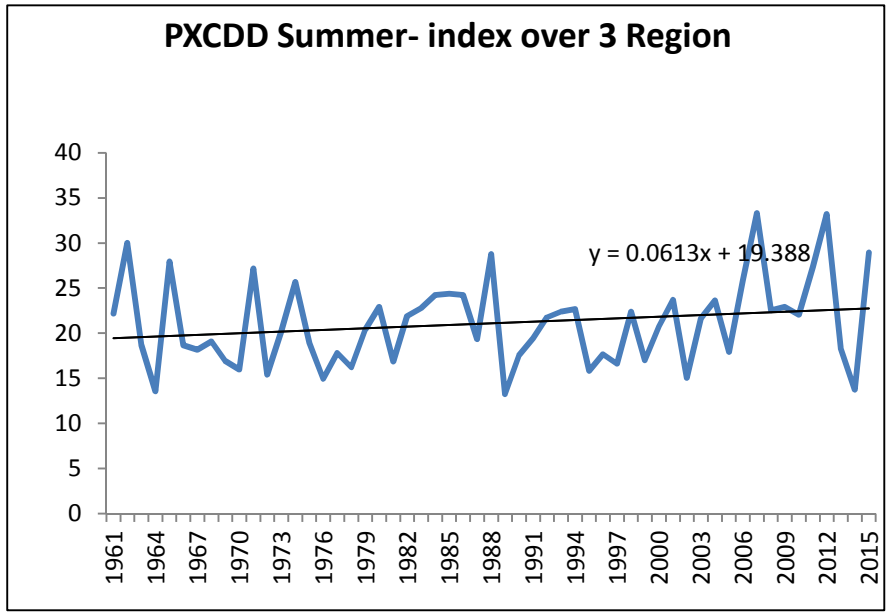
Summary:

- Winter and Spring =negative trend
- Summer and Autumn= mixed signal of trend

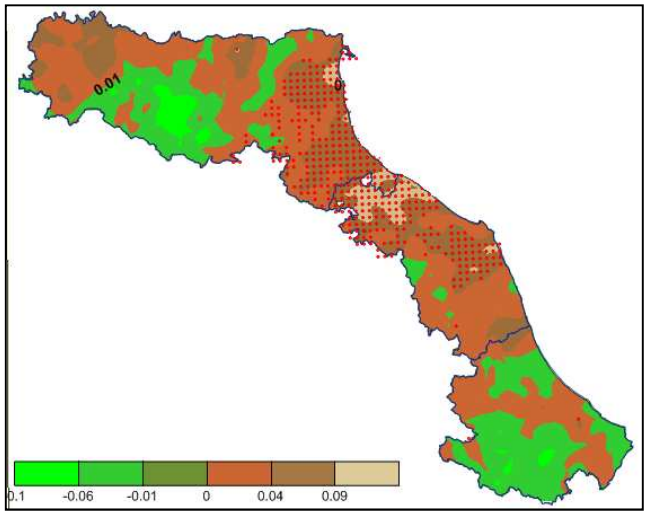
Pxcdd –spatial distribution during summer

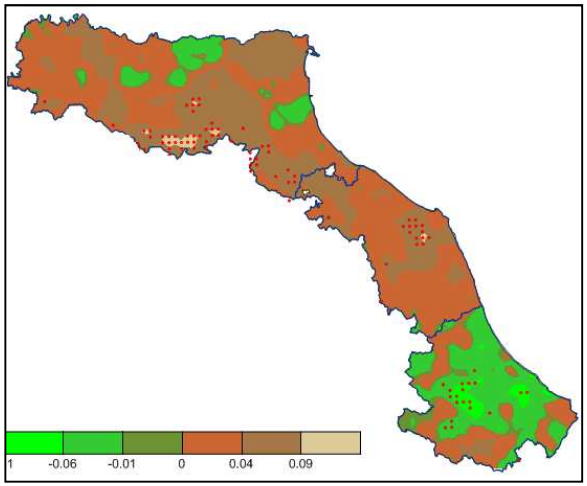
Pxcdd Summer

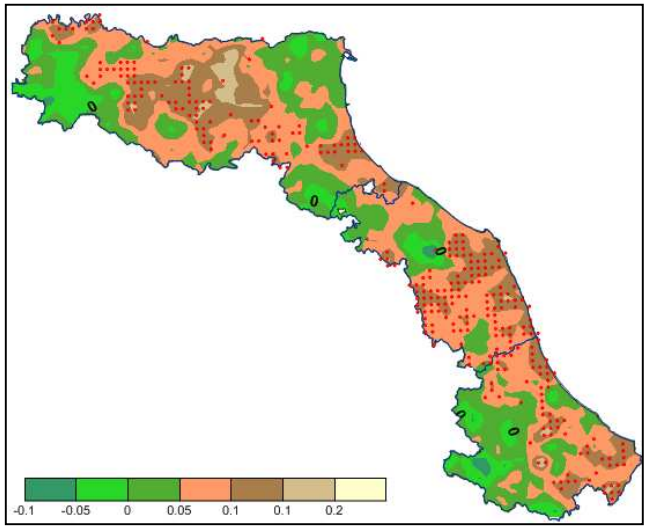


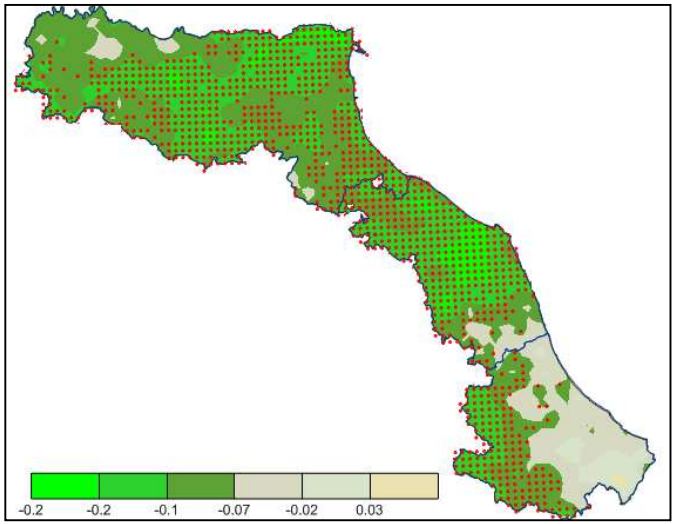


Pxcdd trends over 1961-2015& significance in red (90%)









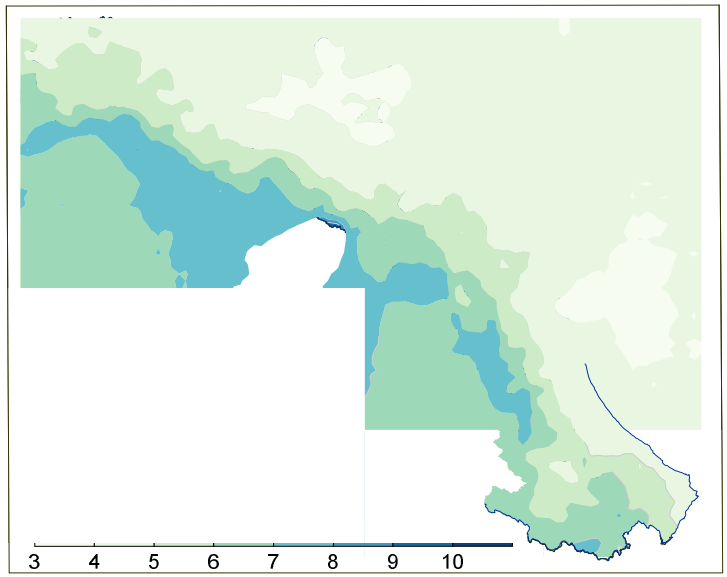
Summary:

Winter , Spring and Summer presents significant positive trends

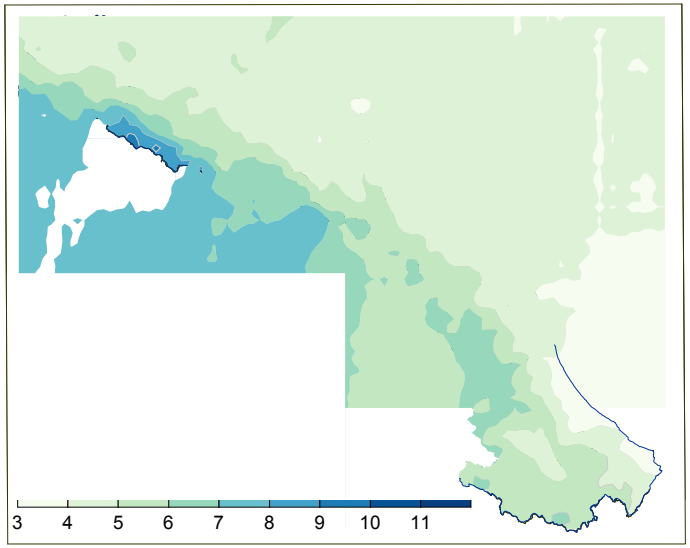
•Autumn negative significant over great part of the cases

WET DAYS- PXCWD index

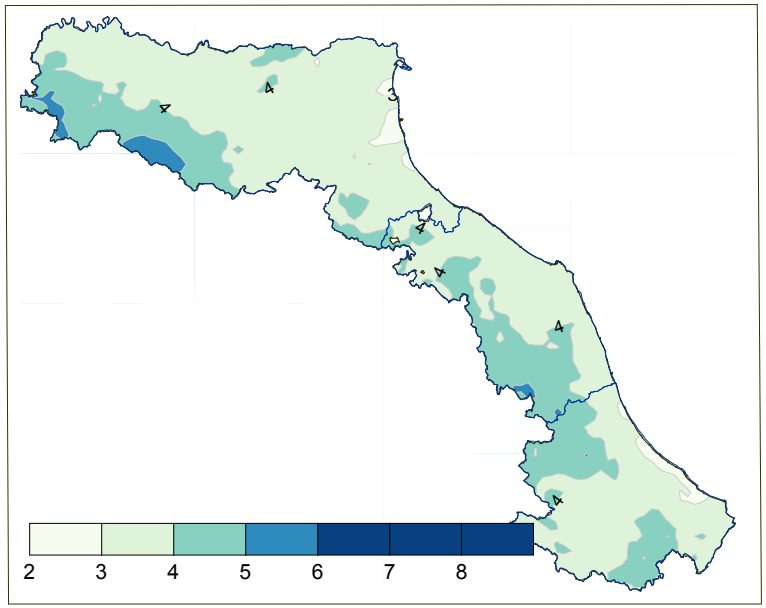
Maximum number of consecutive WET days-
WINTER 1981-2010



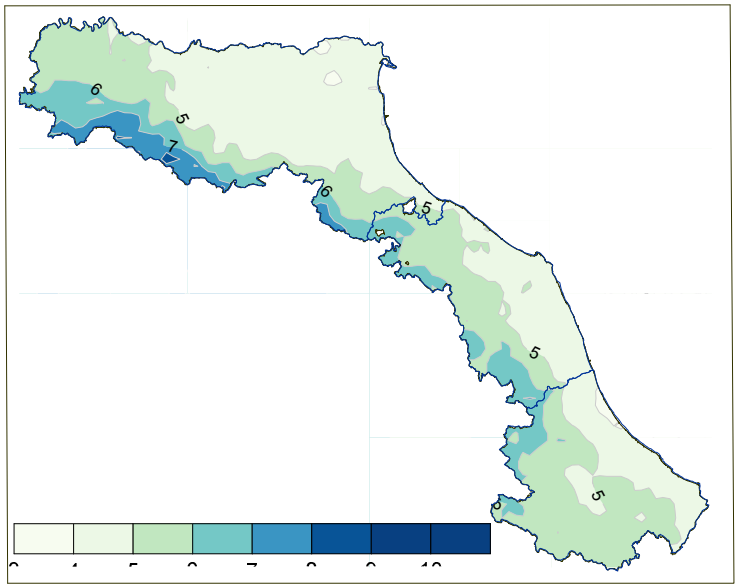
Maximum number of consecutive WET days-
SPRING 1981-2010



Maximum number of consecutive WET days-
SUMMER 1981-2010

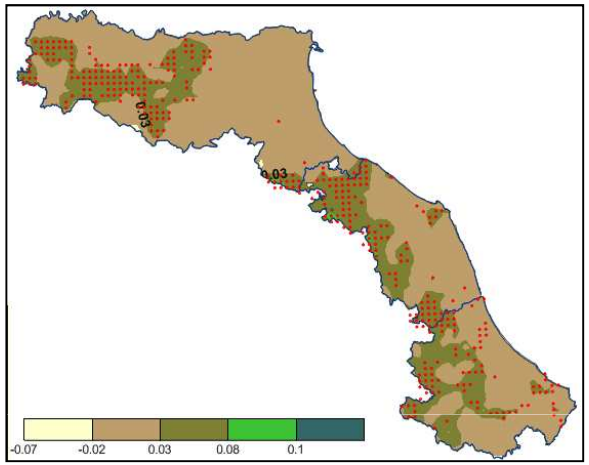


Maximum number of consecutive WET days-
AUTUMN 1981-2010

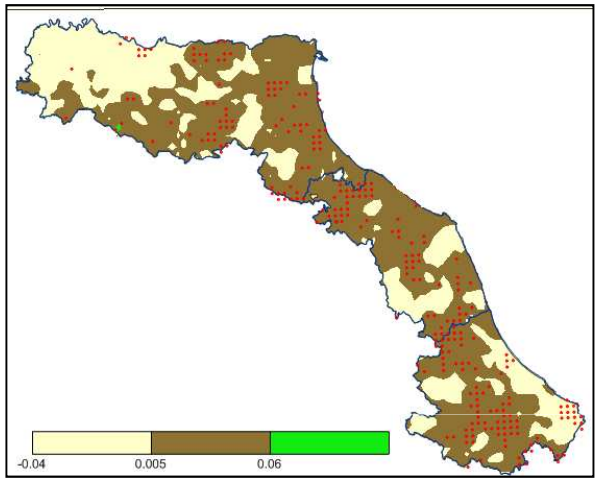


PXCWD Trends over 1961-2015)& significance in red (90%)

DJF

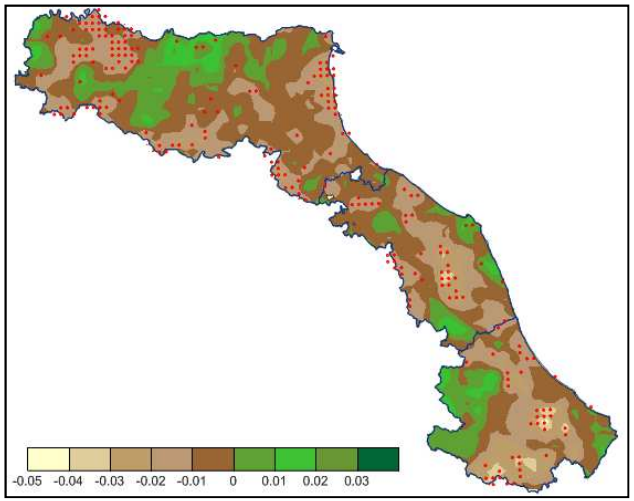


MAM



Summary:
•Summer presents significant negative trends over ER, MA and parts of AB;
•Autumn positive and significant over Ferrara and isolated area

JJA



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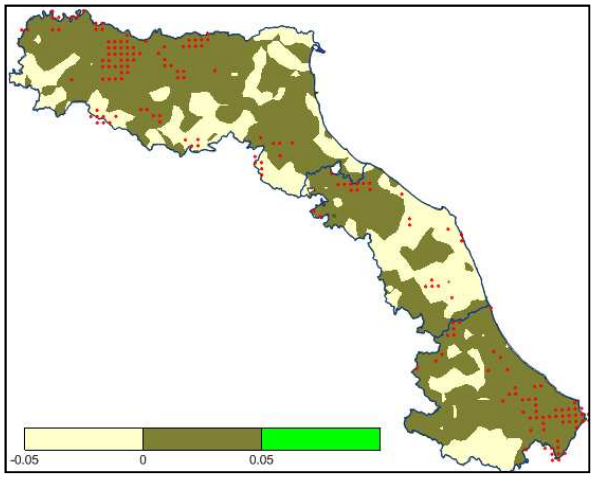
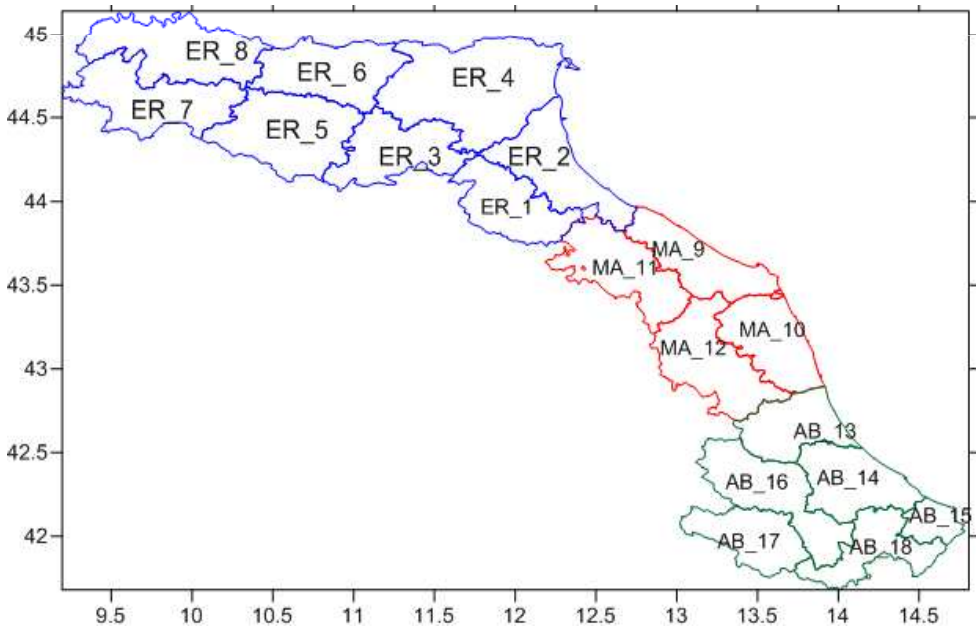
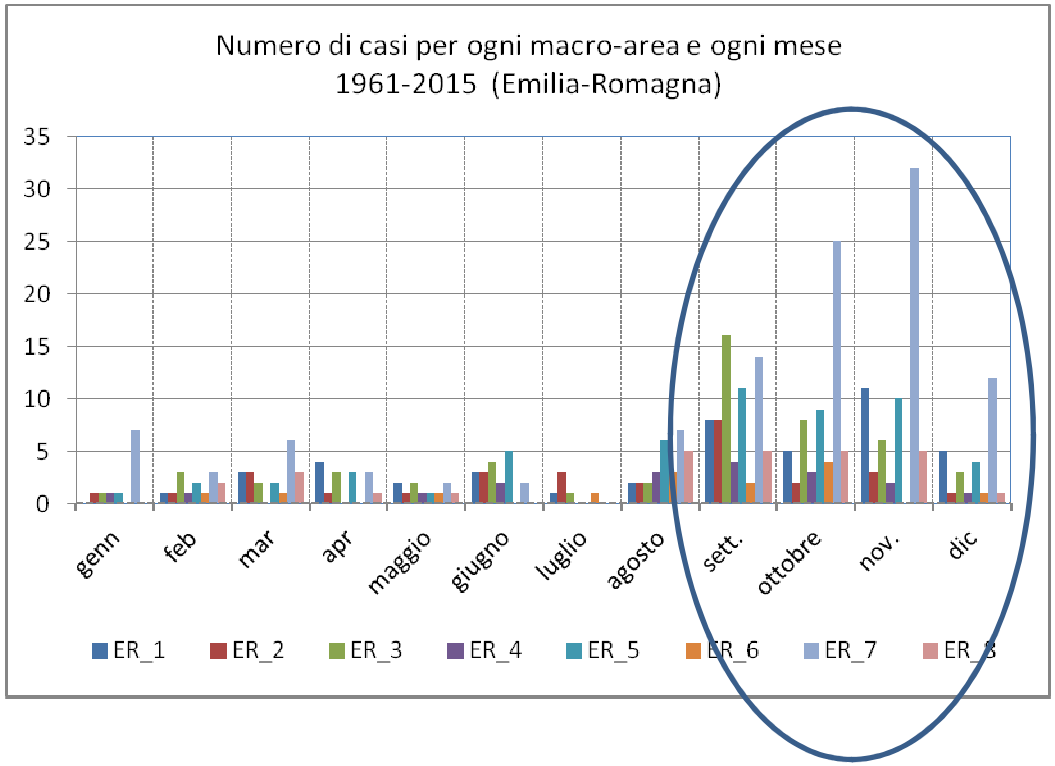


Areal Index Precipitation (AIP)

- AIP= *the number of days* in which the areal average precipitation exceeds 50 mm in 24 hours. In Emilia-Romagna region this quantity of precipitation corresponds to an events with around 2-years return period.
- The index is computed at monthly, seasonal and annual level and results are described below. The period take into analysis is from 01/01/1961 to 31/12/2015.

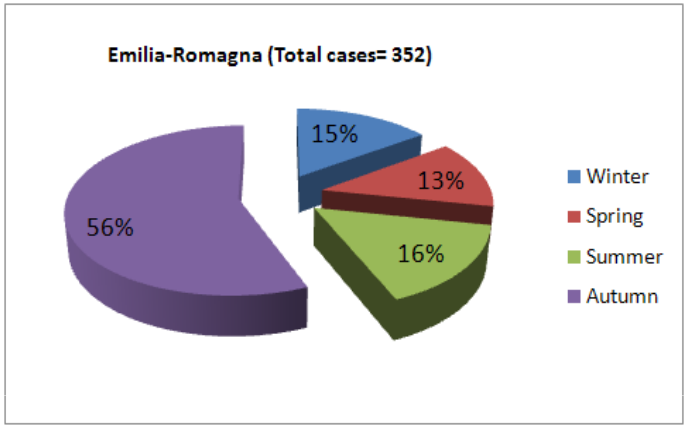


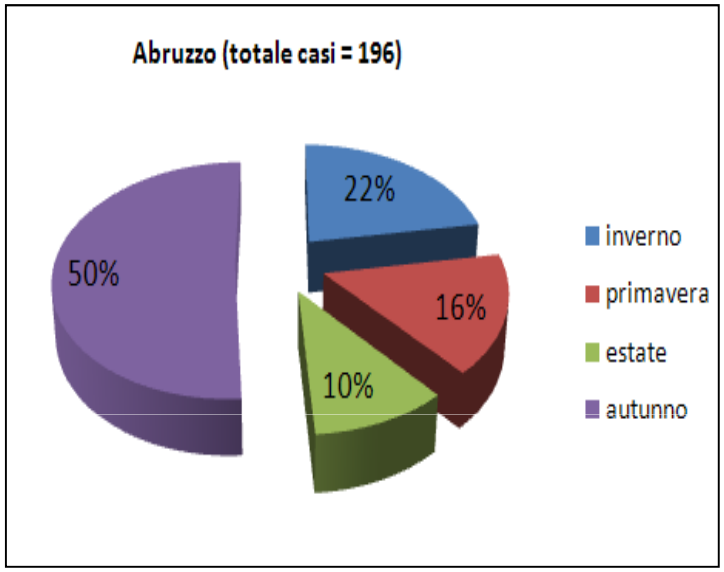
AIP-ER , monthly analysis 1961-2015

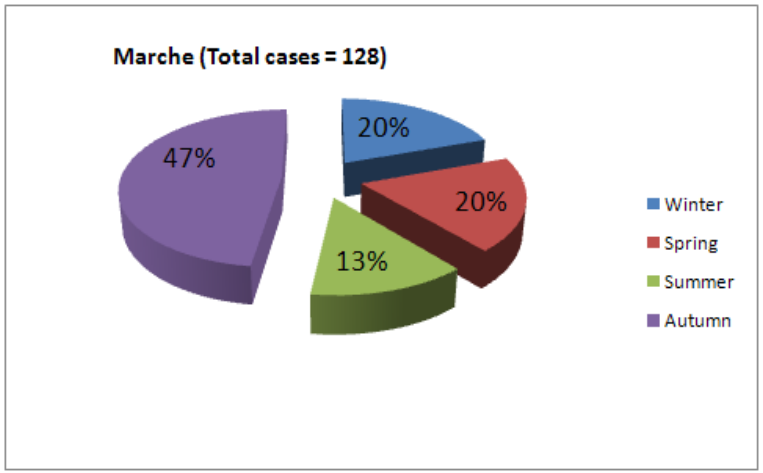


More cases in the second part of the year

Seasonal distribution of AIP frequency, computed over 1961-2015 period (region level)



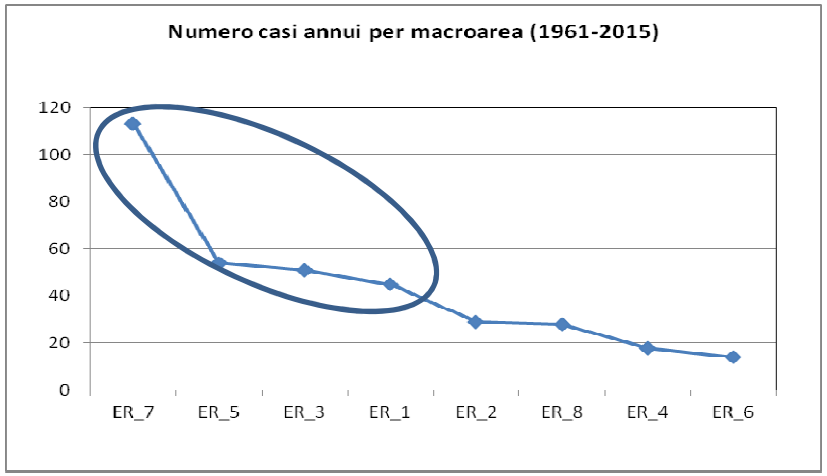




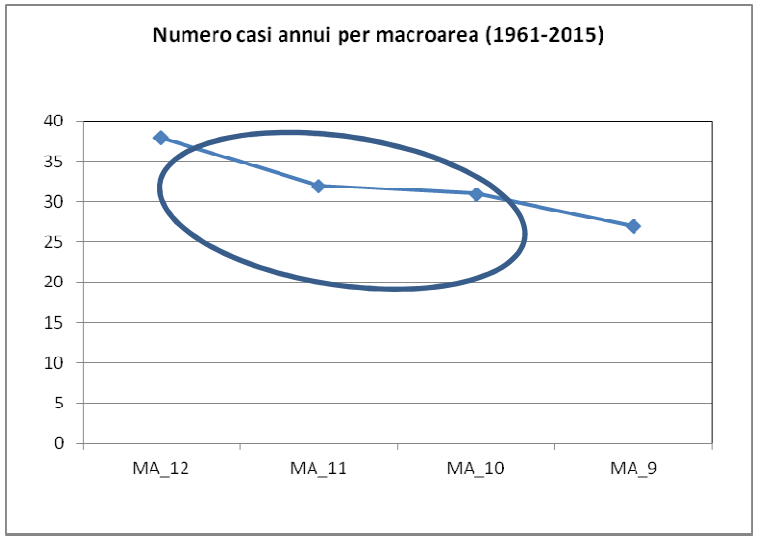
•Great part of cases during autumn

Annual distribution of the number of cases of AIP for each region

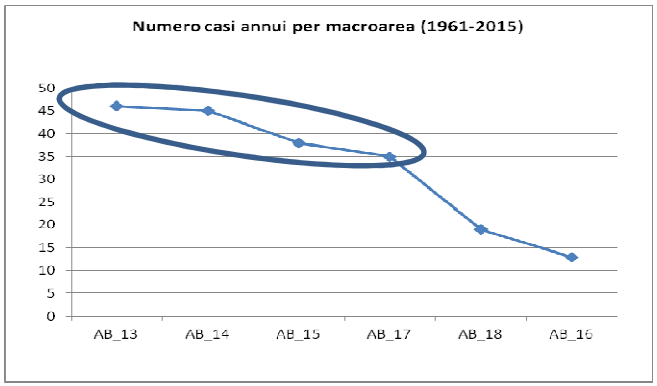
ER

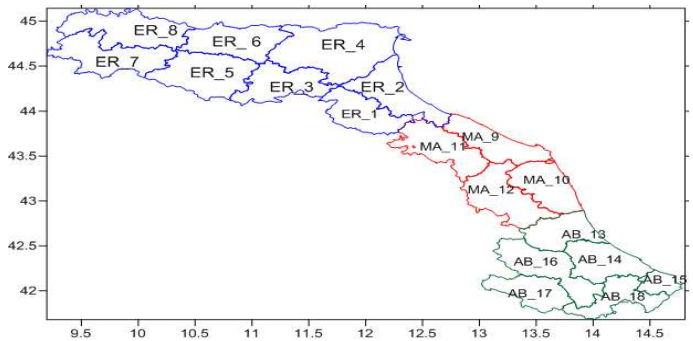


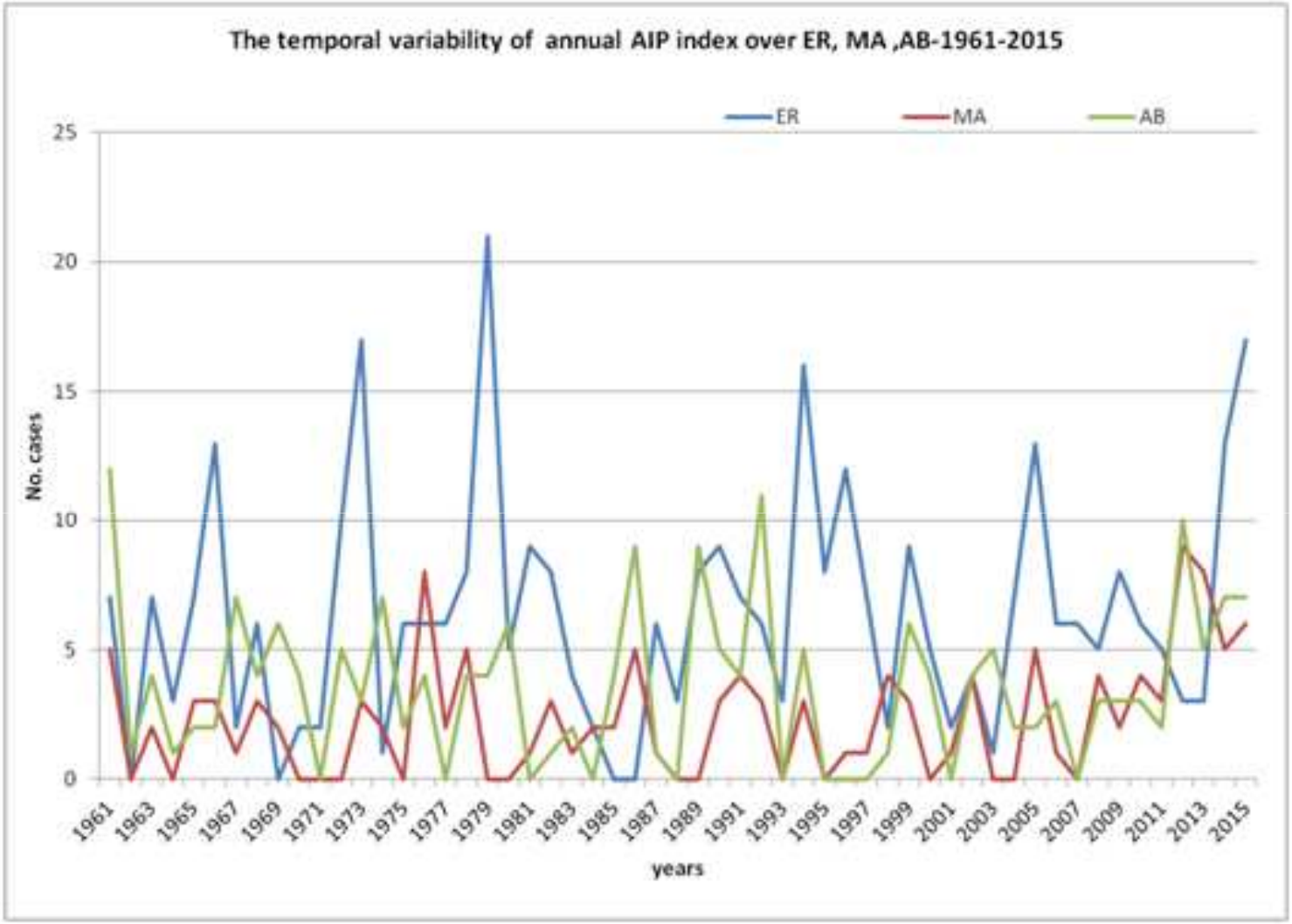
MA



AB






The temporal variability of annual AIP index over ER, MA ,AB-1961-2015
ER
MA
AB
No. cases
years
0
5
10
15
20
25
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
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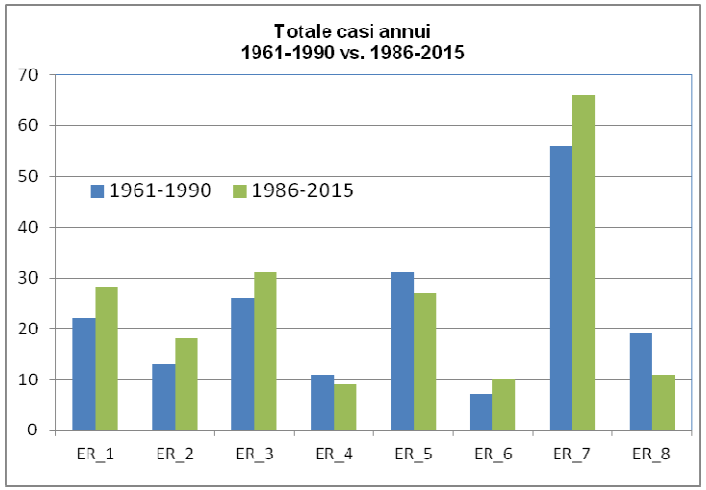
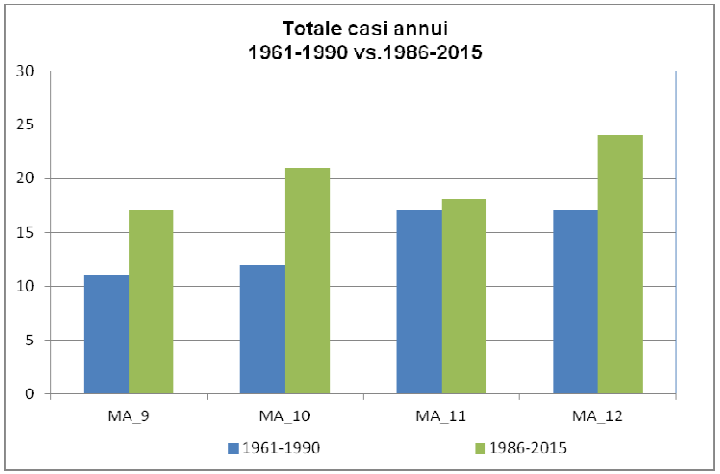
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015

Changes in AIP 1961-1990 &1986-2015

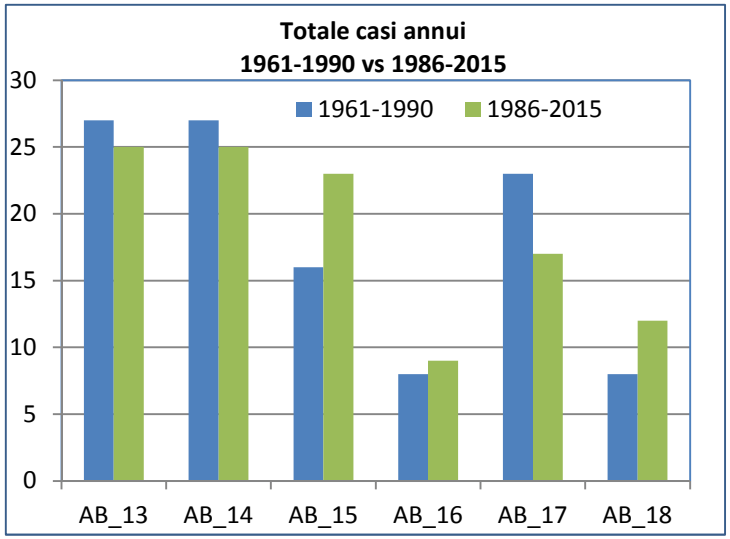
ER

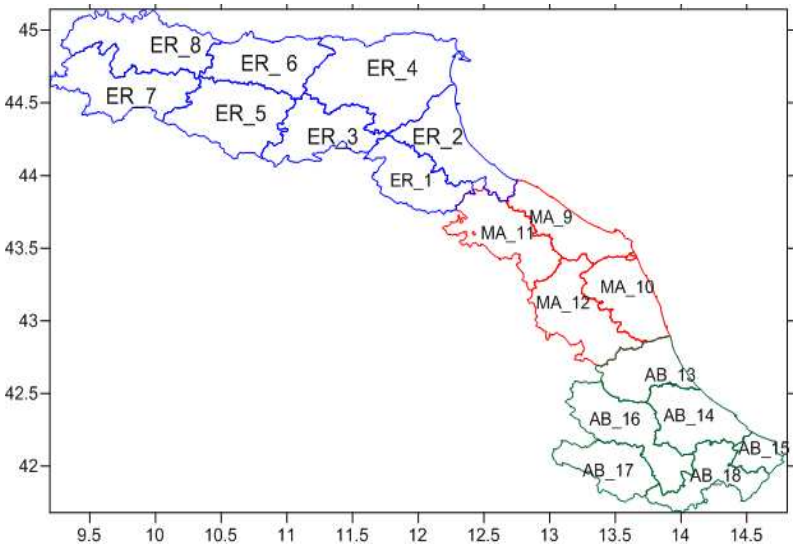


MA



AB





Temperature…(Eobs data set)

The trend coefficient(°C/decade) of seasonal Tmin(left) and Tmax (right)1960-2015 of the time series averaged over all regions Emilia-Romagna, Marche and Abruzzo.

Tmin

Season	Trends(℃/decade)
DJF	0.2
MAM	0.3
JJA	0.4
SON	0.3

Tmax

Season	Trends(℃/decade)
DJF	0.3
MAM	0.4
JJA	0.6
SON	0.3

Conclusions over 1961-2015

- **Precip** Summer presents significant negative trends over ER, MA and parts of AB ; Autumn positive and significant trends in precip. over Ferrara and isolated area;

- **Pnl95**: Winter and Spring =negative trend; Summer and Autumn= mixed signal of trend;

- **Pxcdd** Winter , Spring and Summer presents significant positive trends ; Autumn negative significant;

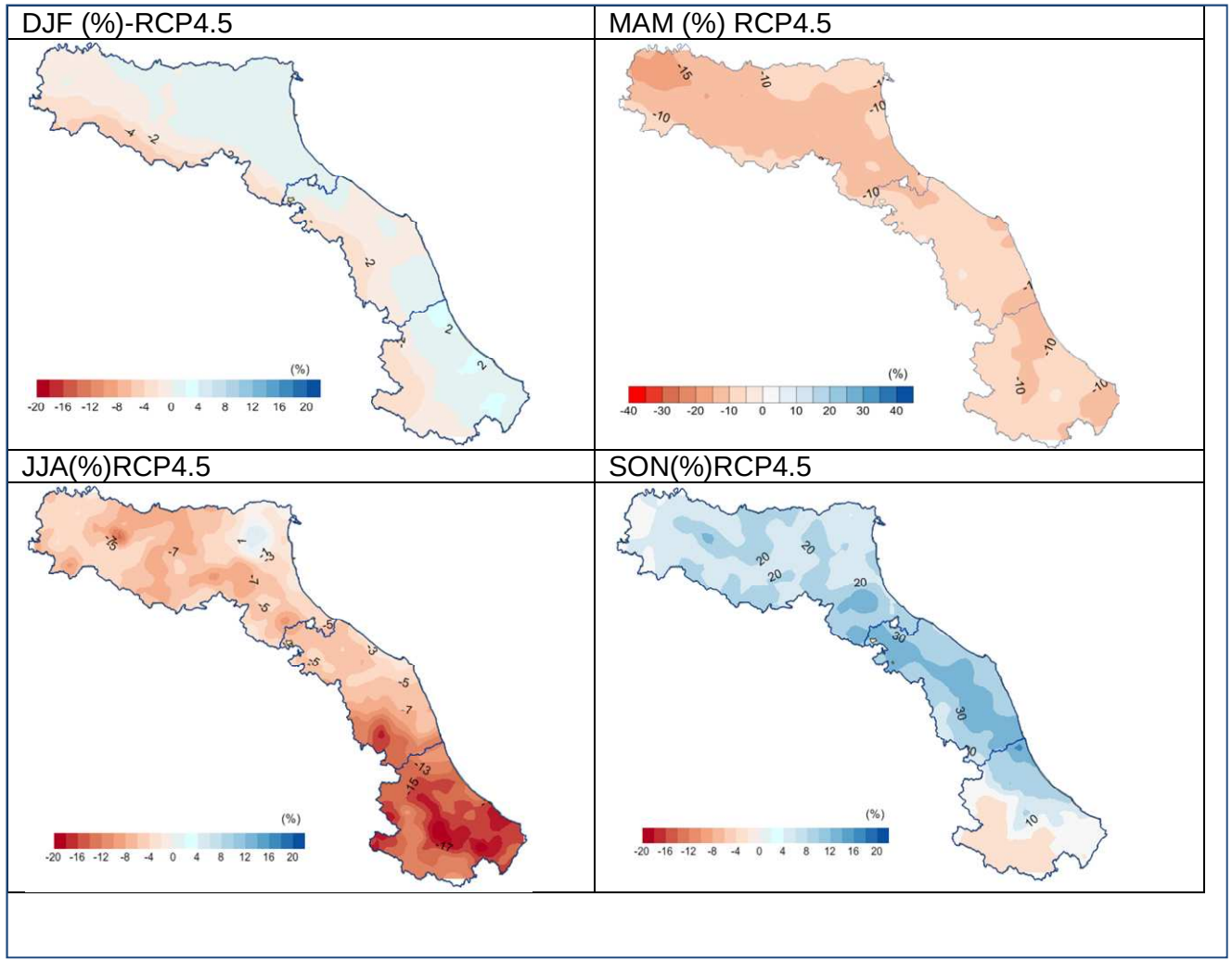
- **AIP :** great part of cases were registered during autumn; Areas with higher variability : Appenine for ER and MA , costal area for AB;

- **Temp:** positive trend over all season, more significant during summer

Projections of precipitation performed through SD applied to CMCC-CM model

(scheme based on Perfect Prog approach, under work EM &MOS)

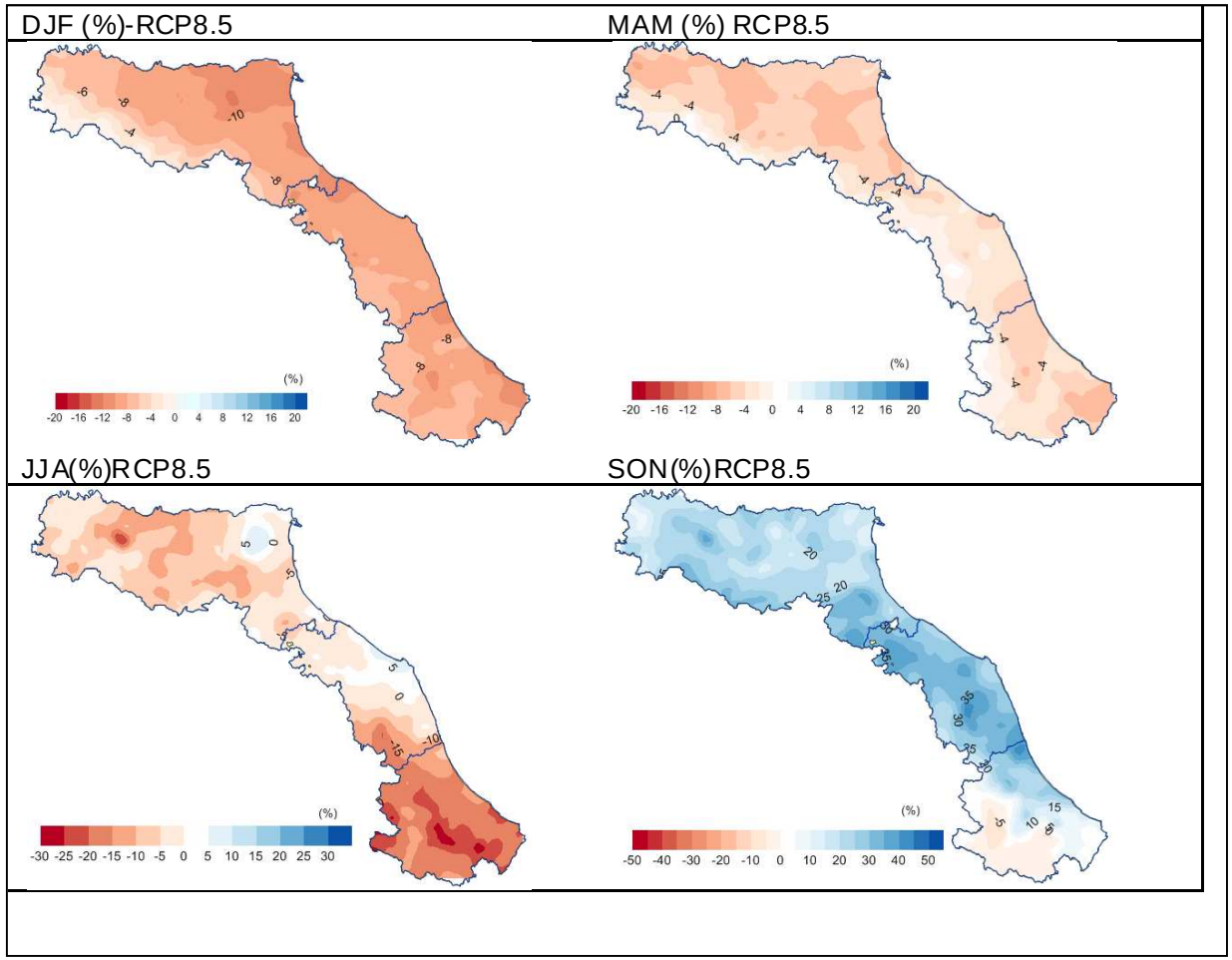
Precipitation 2021-2050 vs 1971-2000 RCP4.5



- WINTER: low signal of changes that consists in: light increase over Romagna and coastal areas from Abruzzo and Marche (isolated areas), and slightly Apennine mountains that lies over the three regions (up to 5%).
- SPRING and SUMMER a decrease is projected more (up to - 20%).

- AUTUMN: an increase of precipitation over the whole area of study, with peaks of 30%, exception done the mountains area of Abruzzo region while a slightly decrease is projected.

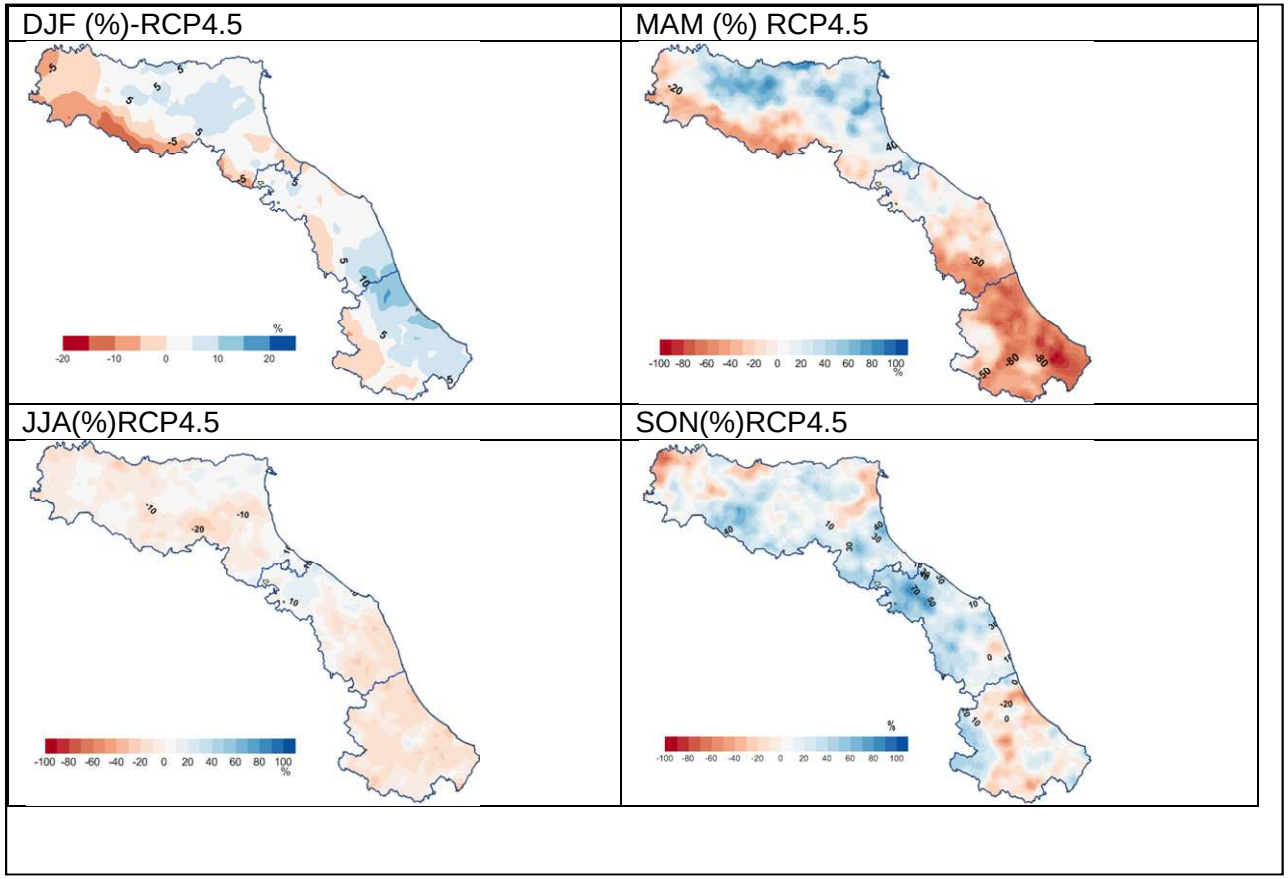
Precipitation 2021-2050 vs 1971-2000 RCP8.5



- WINTER, SPRING and SUMMER: a decrease is projected more (up to -20%).

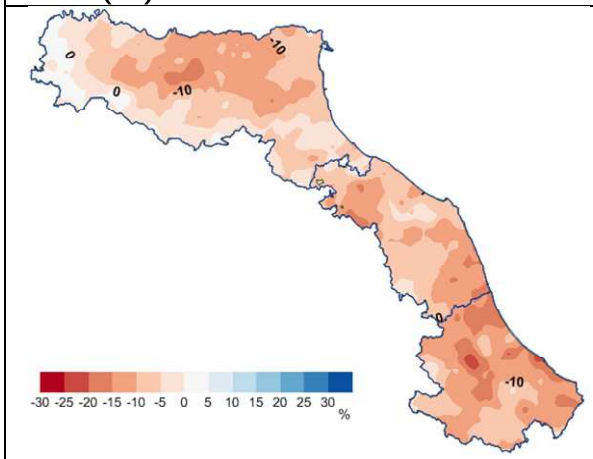
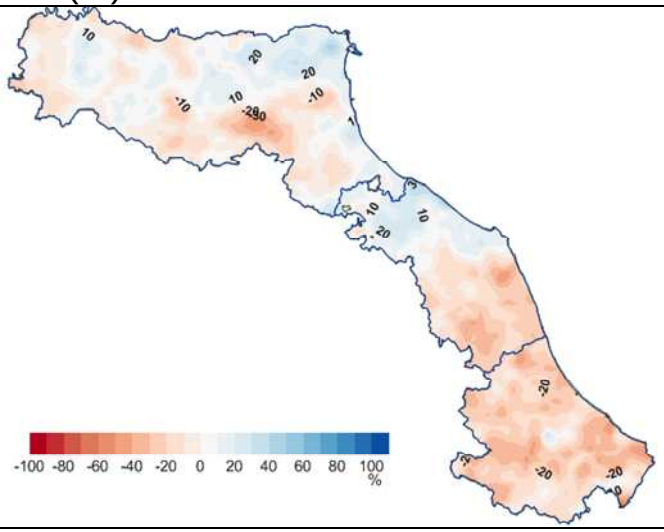
- AUTUMN: an increase of precipitation over the whole area of study, with peaks of 30%, exception done the mountains area of Abruzzo region while a slightly decrease is projected.

Frequency of extreme precipitation 2021-2050 v.s. 1971-2000 RCP4.5



- WINTER a slightly increase over great part of areas (around - 5%) exception is doing the mountain areas where a decrease is projected up to 10%.
- SPRING even if the skill of the model is low, the pattern of changes emphasis an increase of the frequency over plain and hill area of Emilia Romagna and a decrease on the rest of area;
- SUMMER: low signal of changes
- AUTUMN: an increase of the number of extremes over quite all the regions, up to 30%

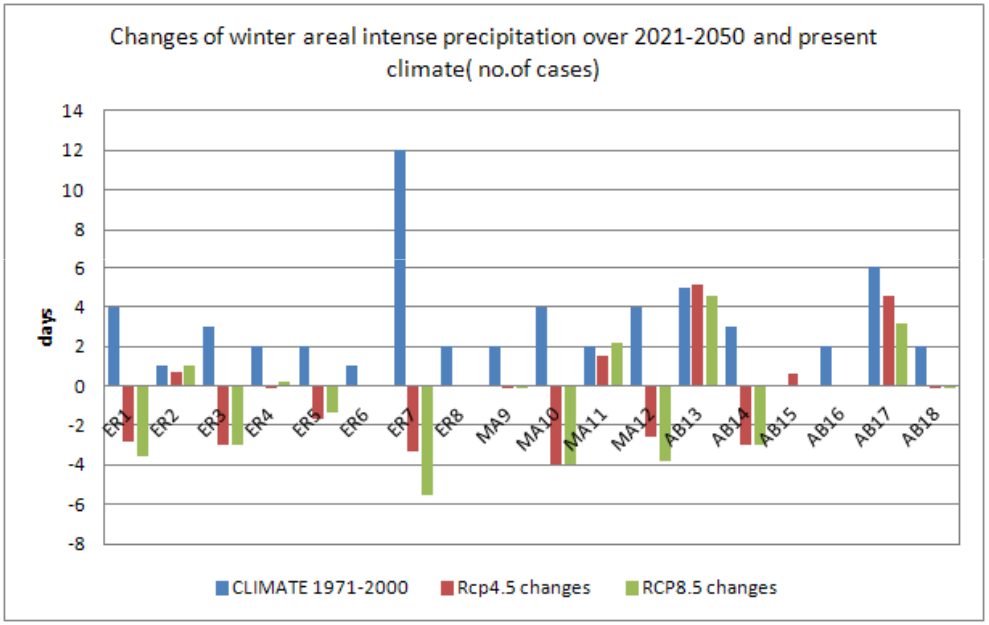
Frequency of extreme precipitation 2021-2050 v.s. 1971-2000 RCP8.5

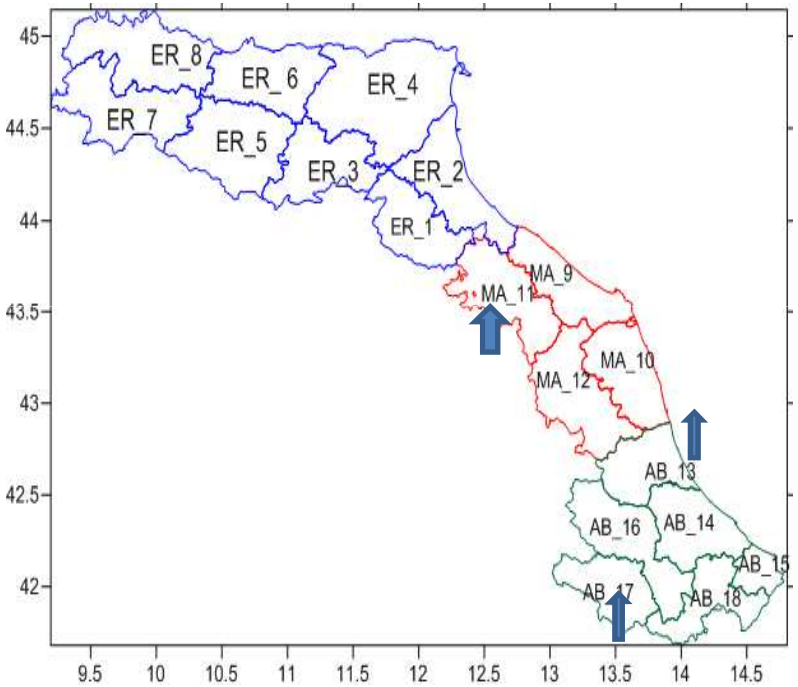
DJF (%)-RCP8.5	JJA (%) RCP8.5
	

•Similar pattern during SPRING and AUTUMN

Frequency of Areal Intense Precipitation (AIP) 2021-2050 v.s.1971-2000, RCP 4.5 and RCP8.5

WINTER

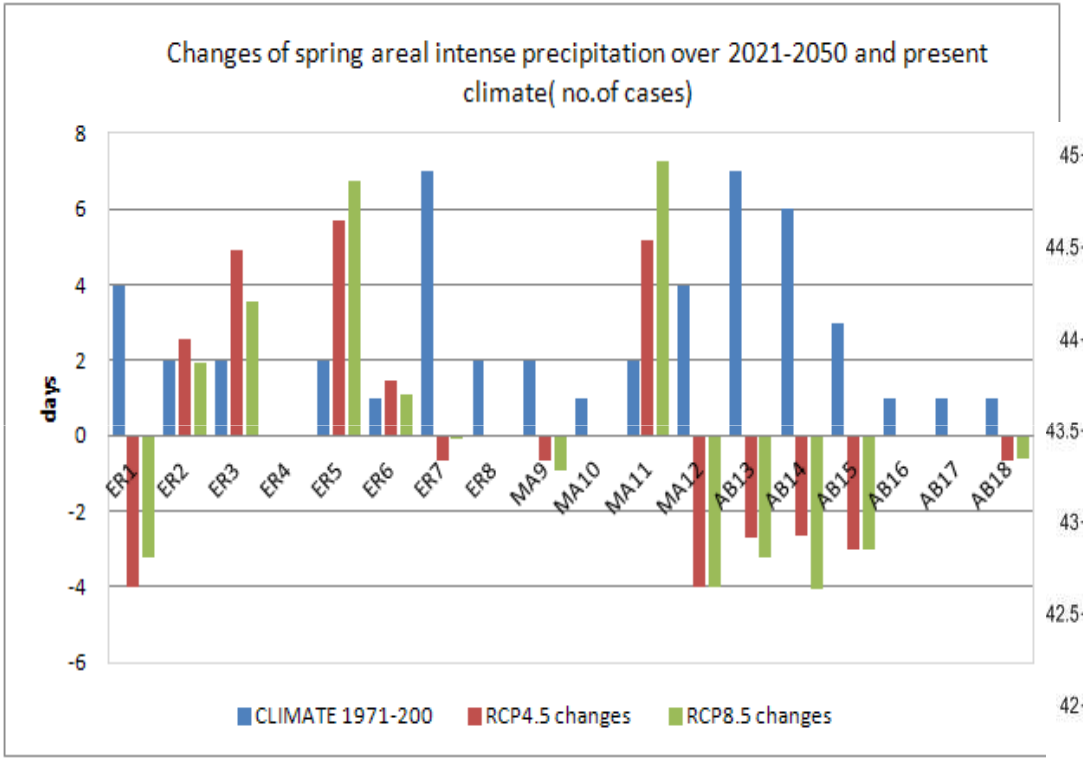


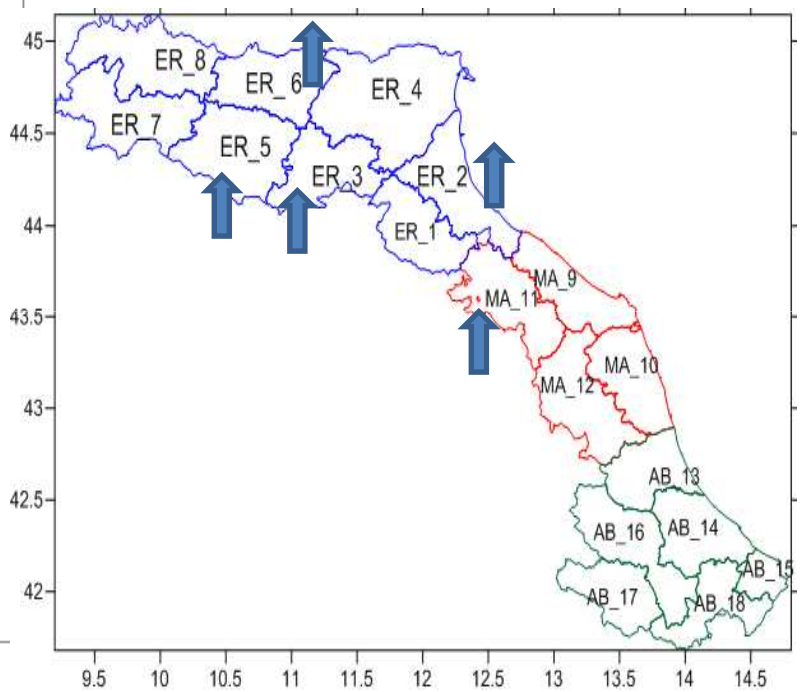


increase

decrease

SPRING

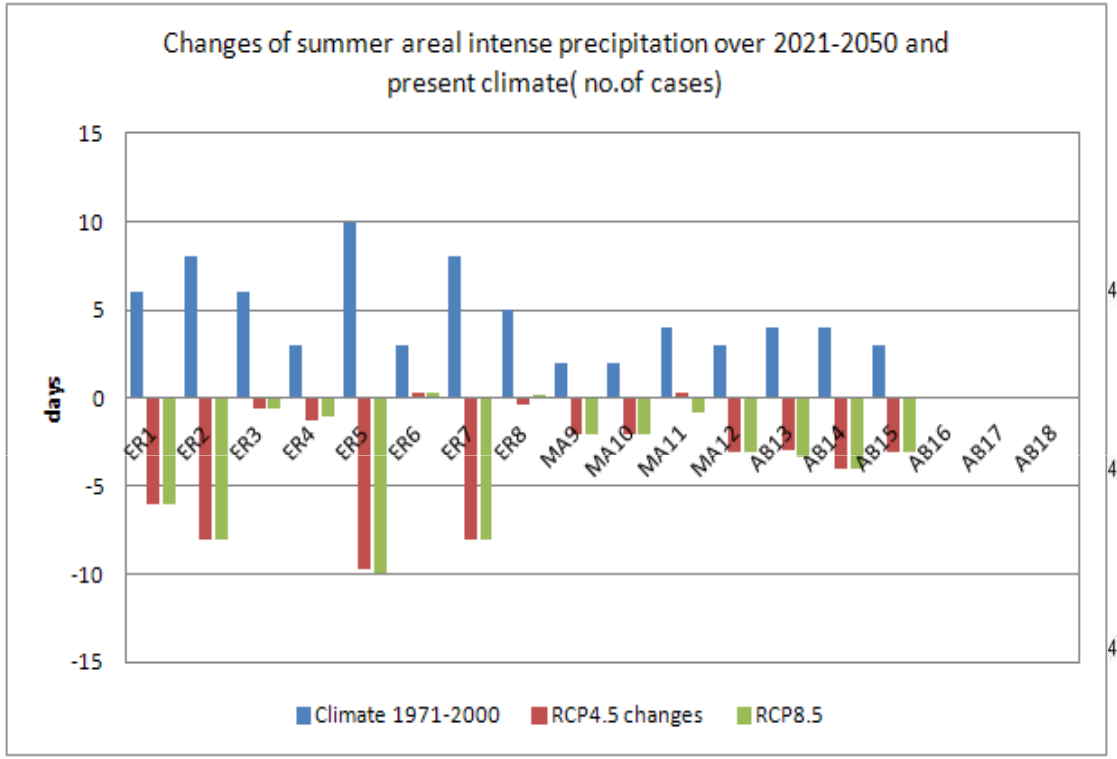


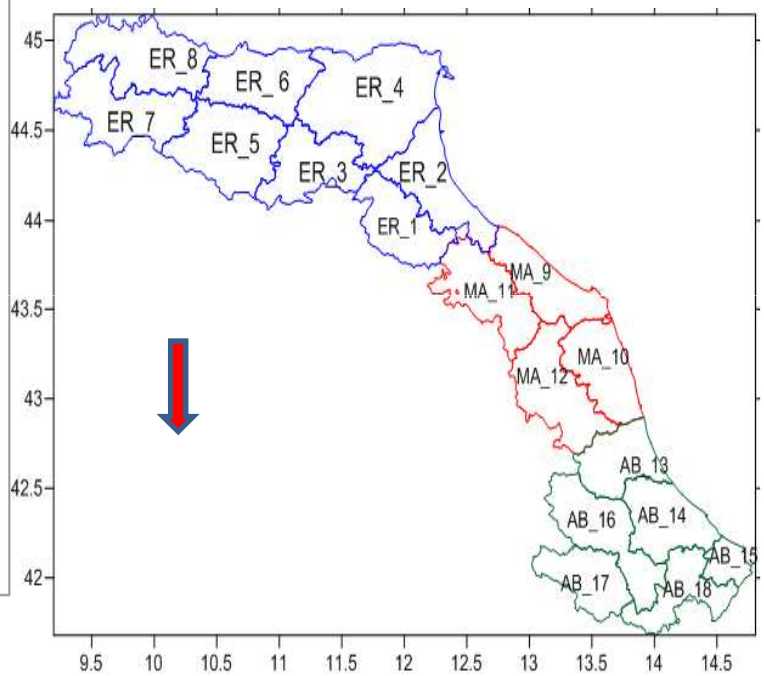


increase

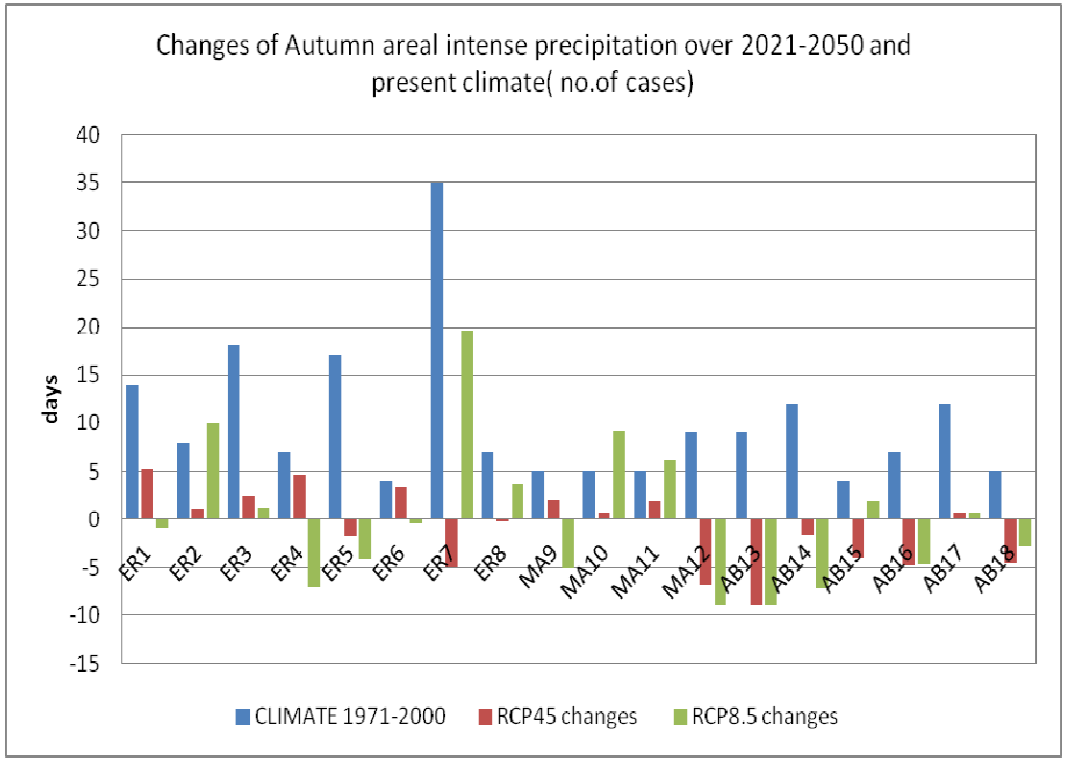
decrease

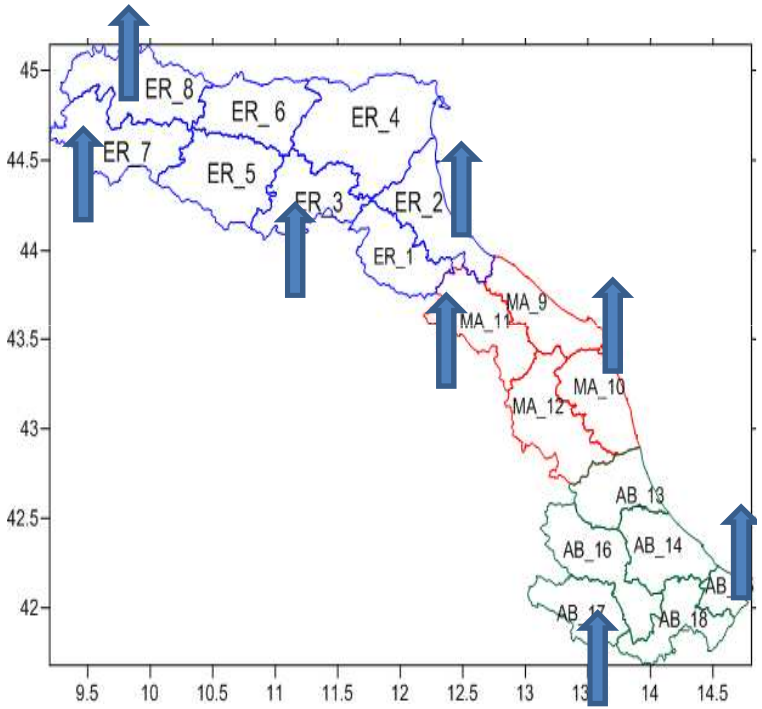
SUMMER


Changes of summer areal intense precipitation over 2021-2050 and present climate(no.of cases)
days
15
10
5
0
-5
-10
-15
ER1
ER2
ER3
ER4
ER5
ER6
ER7
ER8
MA9
MA10
MA11
MA12
AB13
AB14
AB15
AB16
AB17
AB18
Climate 1971-2000
RCP4.5 changes
RCP8.5


ER_8
ER_6
ER_4
ER_7
ER_5
ER_3
ER_2
ER_1
MA_9
MA_11
MA_10
MA_12
AB_13
AB_16
AB_14
AB_15
AB_17
AB_18
45
44.5
44
43.5
43
42.5
42
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5

AUTUMN



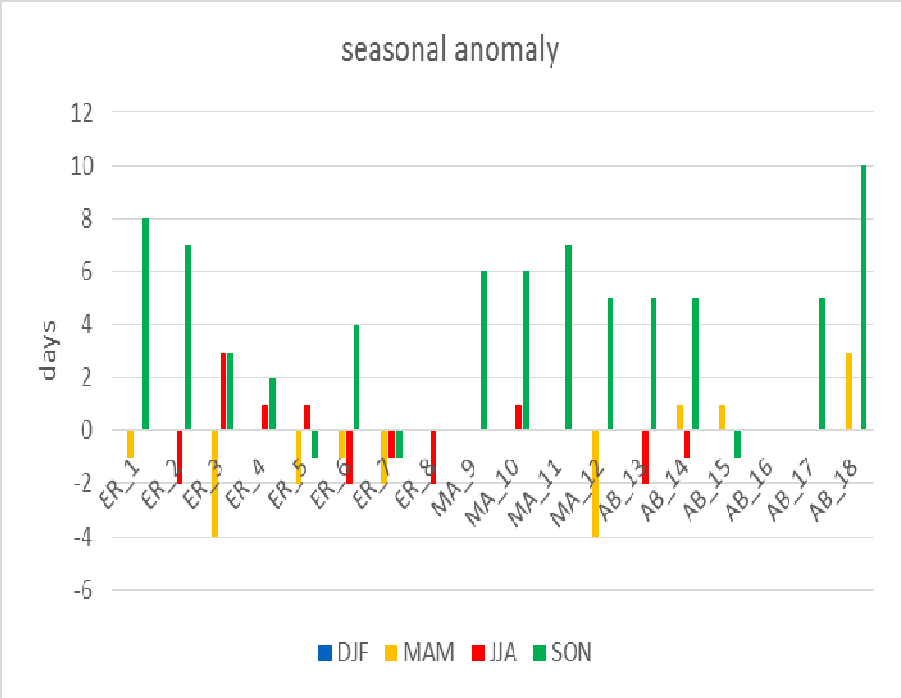


increase

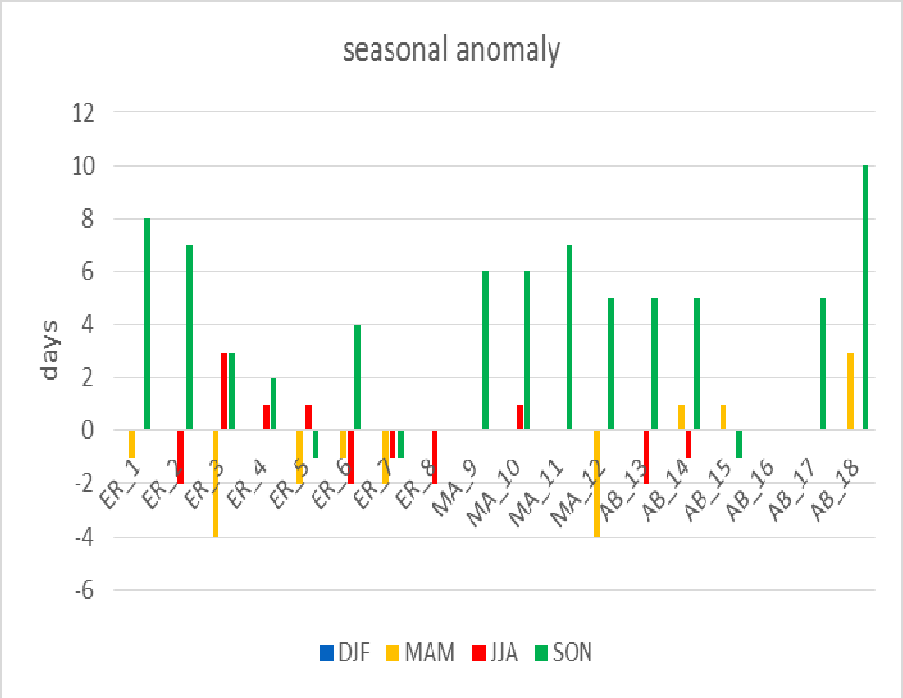
decrease

COSMO –CLM 2021-2050 v.s. 1981-2010

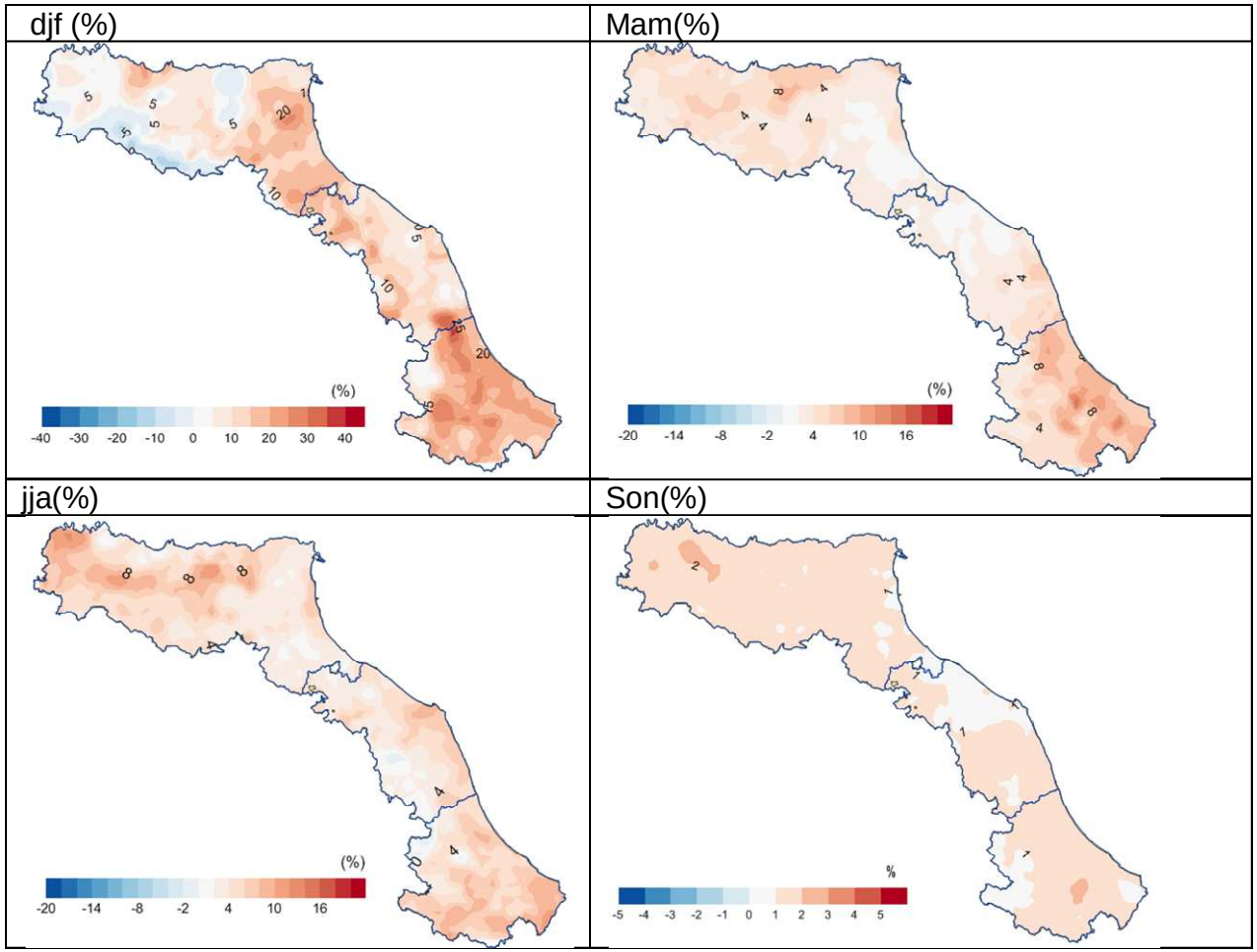
RCP 4.5



RCP 8.5



Consecutive dray days 2021-2050 vs 1971-2000 RCP4.5



- WINTER, SPRING and SUMMER: an increse is projected more during winter (up to - 20%).

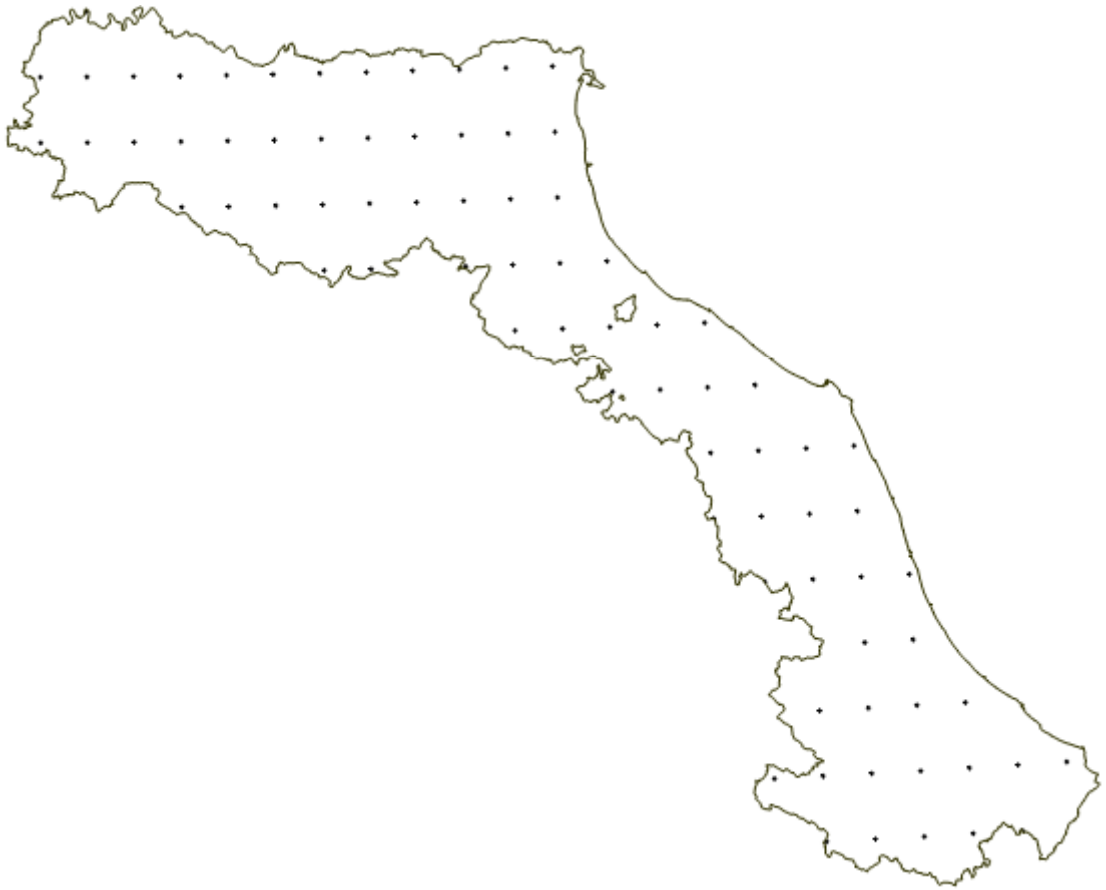
- AUTUMN: no signal of change.

Projections seasonal Tmin &Tmax based on E-Obs data set, RCP45 and RCP85, 2021-2050

Nota :

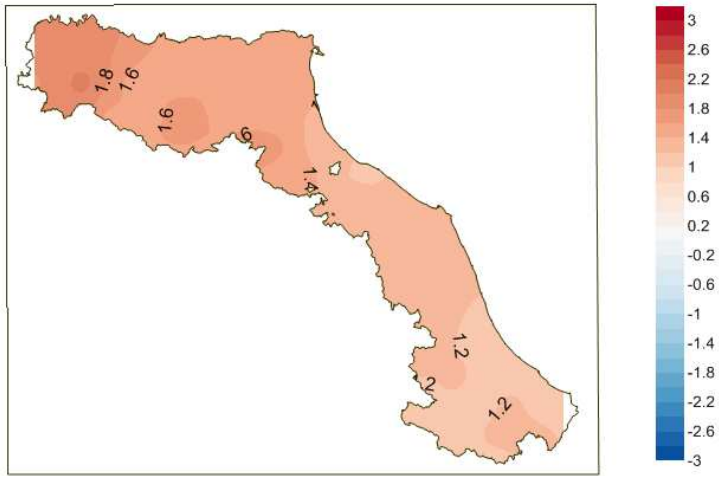
- projections for Eobs version 12 data set;
- changes respect to climate 1971-2001;

Eobs Grid points

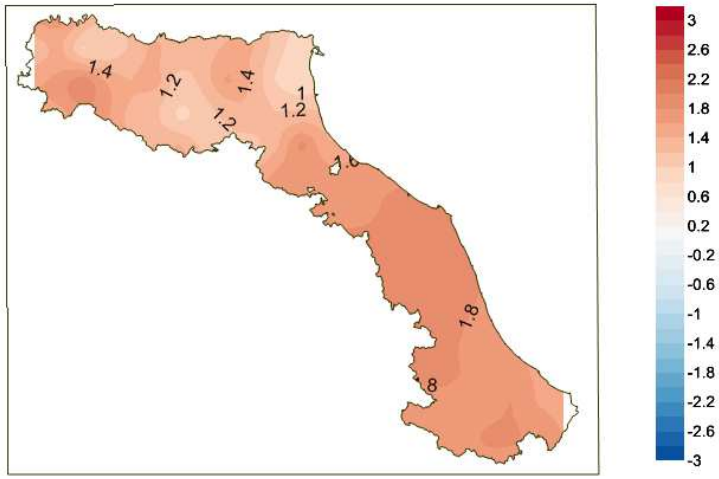


Tmin 2021 :2050-1975:2005
(Eobs_v.12)

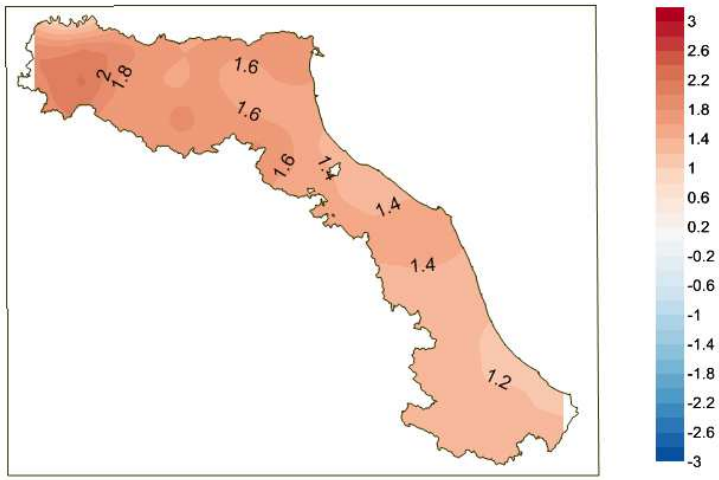
RCP4.5 DJF



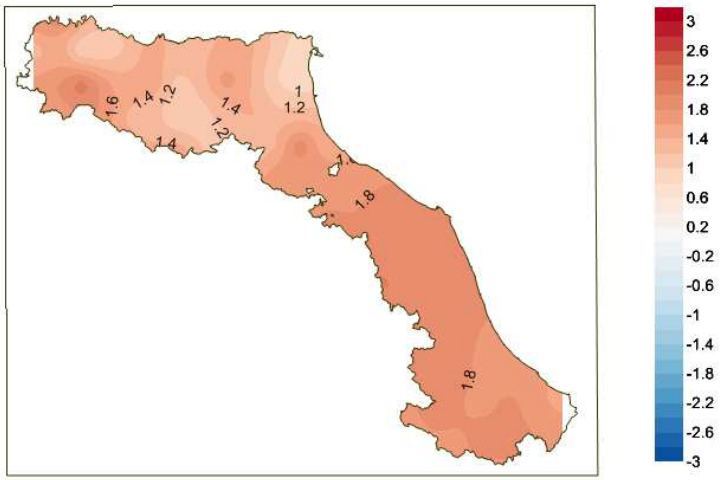
RCP4.5 MAM



RCP8.5 DJF



RCP8.5 MAM

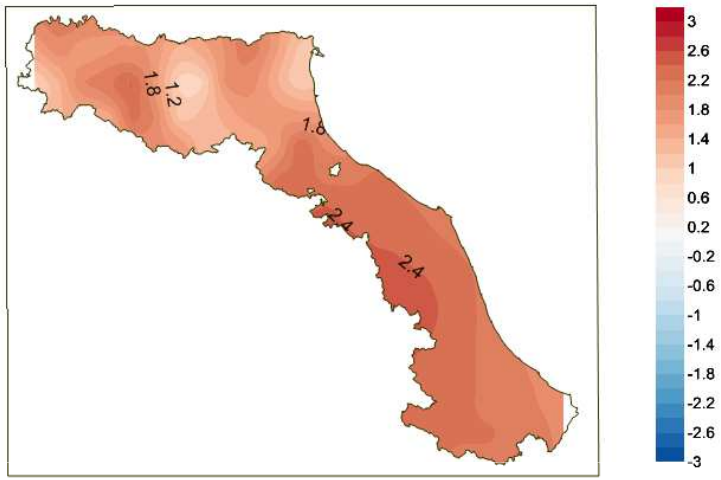


Nota: positive changes between 1.2-2°C, more intense in ER (Emilia) ; Small diff between RCPs

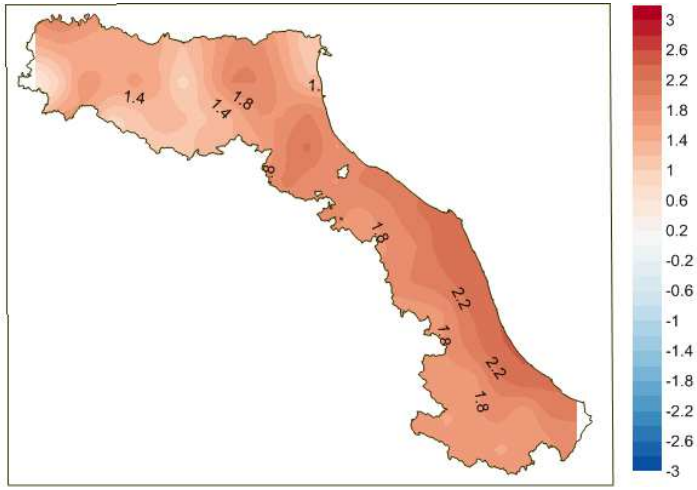
Nota: positive changes between 1-2°C, more intense in MA and AB Small diff between RCPs

Tmin 2021 :2050-1975:2005
(Eobs_v.12)

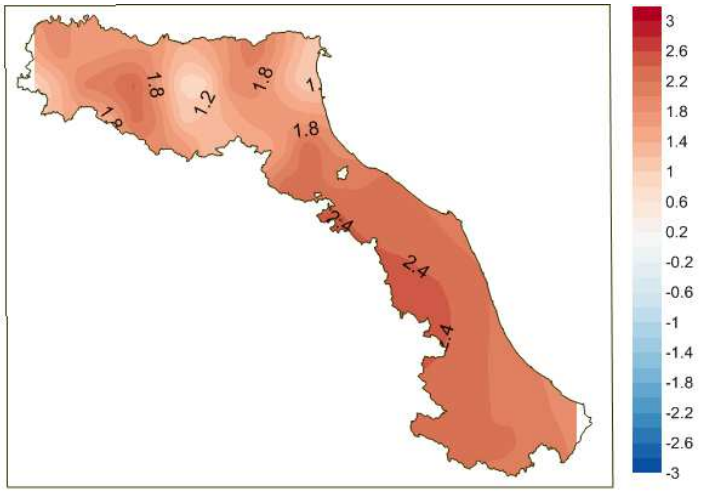
RCP4.5 JJA



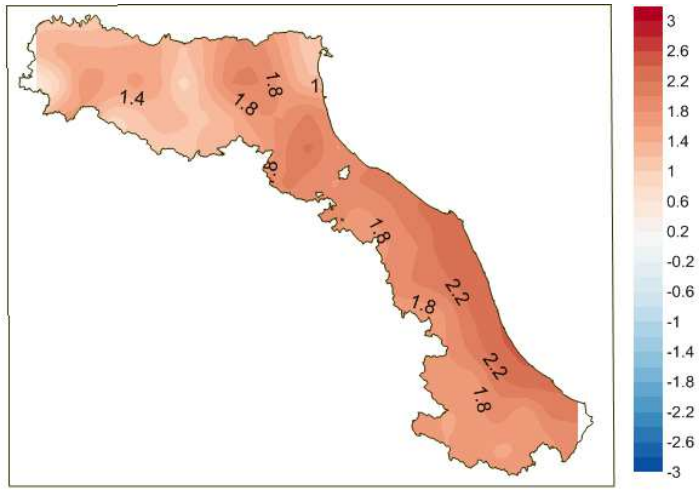
RCP4.5 SON



RCP8.5 JJA



RCP8.5 SON

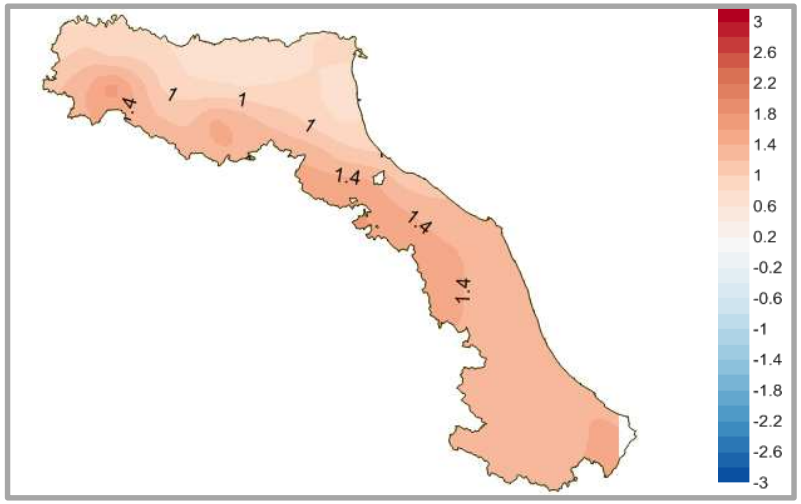


Nota: positive changes between 1.0 -2,6°C, more intense over MA and AB (internal areas) ; No diff between RCPs

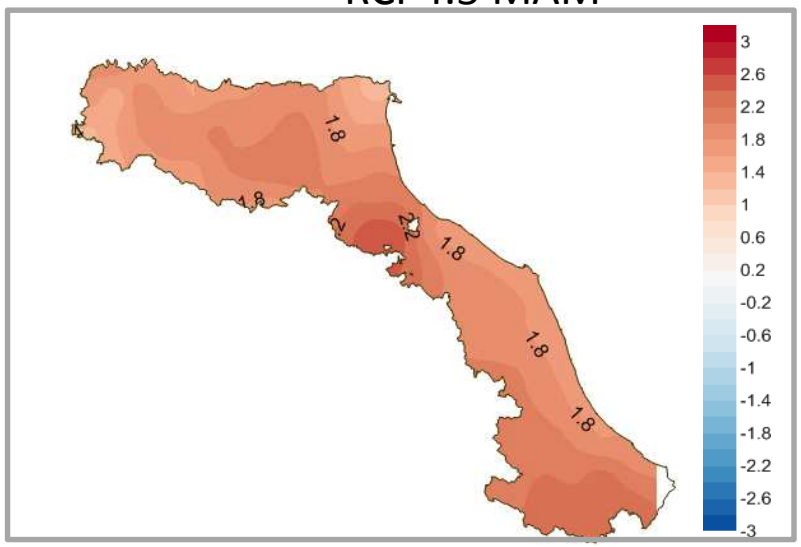
Nota: positive changes between 0.5-2.5°C, more intense over MA and AB (costal areas); No diff between RCPs

Tmax 2021 :2050-1975:2005
(Eobs_v.12)

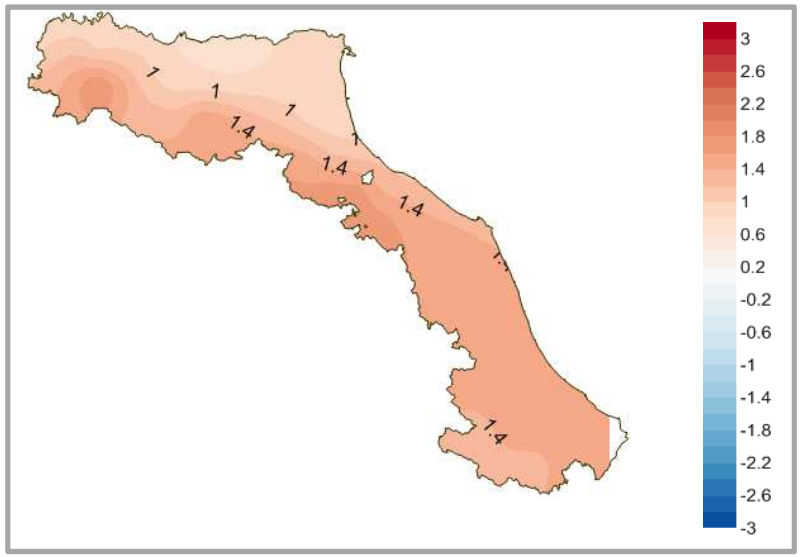
RCP4.5 DJF



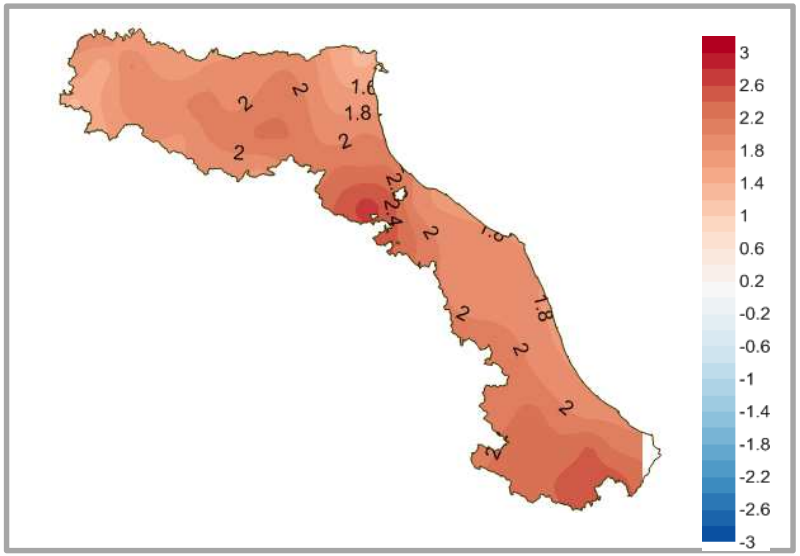
RCP4.5 MAM



RCP8.5 DJF



RCP8.5 MAM

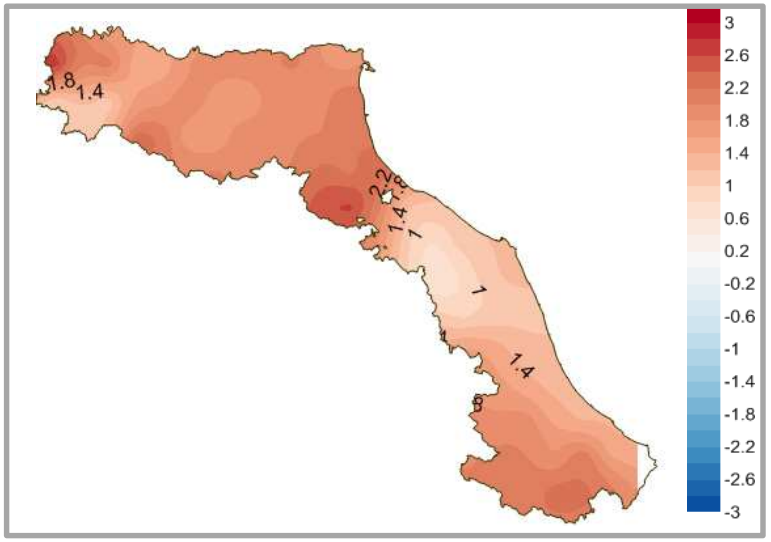


Nota: positive changes between 1-1.5°C, more intense in MA and AB8, ER Apennine: No diff between RCPs

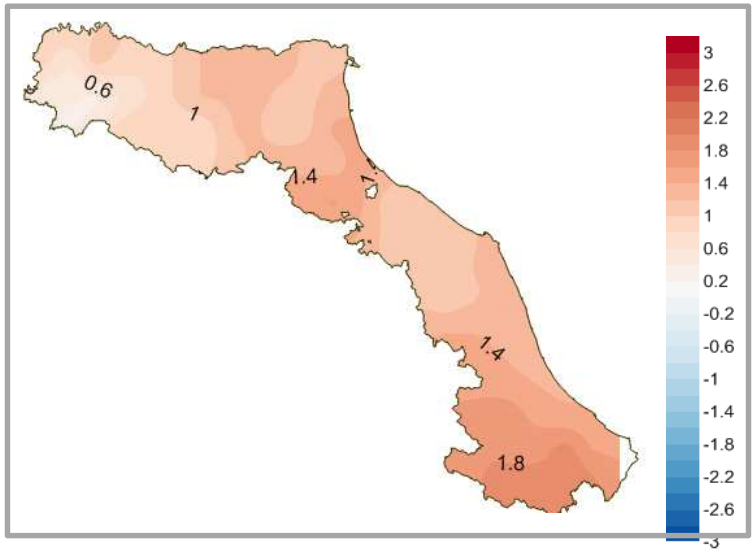
Nota: positive changes between 1.4-2.6°C, more intense over Romagna, MA and AB: Small diff between RCPs

Tmax 2021 :2050-1975:2005
(Eobs_v.12)

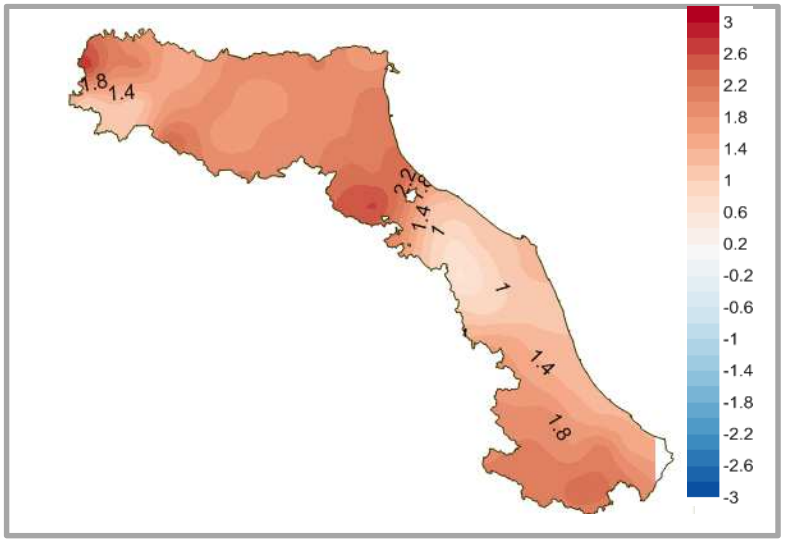
RCP4.5 JJA



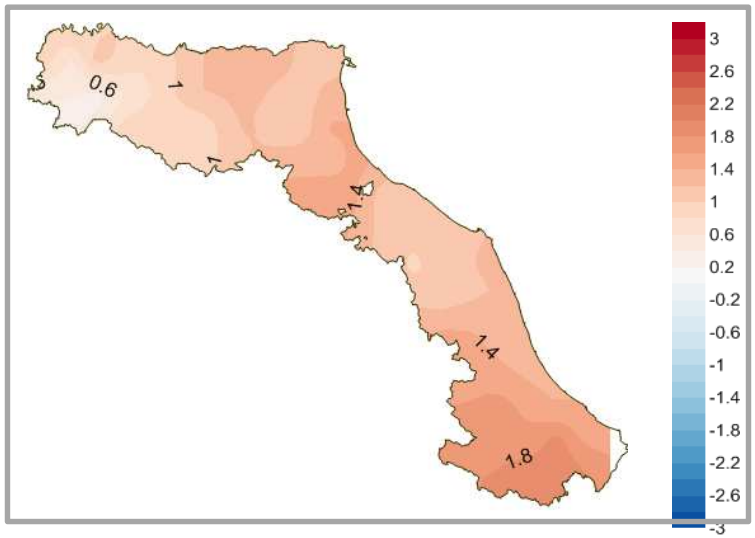
RCP4.5 SON



RCP8.5 JJA



RCP8.5 SON



Nota: positive changes between 1-2.8C, more intense over ER (Romagna, Piacenza) and AB; No diff between RCPs

Nota: positive changes between 0.6-2°C, more intense in AB; No diff between RCPs

Conclusions-projections 2021-2050

Precip:

- Increase in precipitation during autumn and in extreme events; decrease in precipitation during spring and summer

Tmin:

- Positive changes in all seasons, up to 2°C during DJF and MAM ; up to 2.5°C during JJA and SON

Tmax :

- Positive changes in all seasons, more intense during MAM and JJA up to 2.5°C: up to1.5 °C during DJF and 2°C during SON;
- small differences between RCP4.5 and RCP8.5 (up to 0.2°C)