



CHANGES
IN PRECIPITATION EXTREMES
IN HIGH RESOLUTION SIMULATIONS OF
COSMO-CLM DRIVEN BY MPI-ESM-LR
UNDER RCP8.5 SCENARIO
OVER WESTERN TURKEY

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Outline

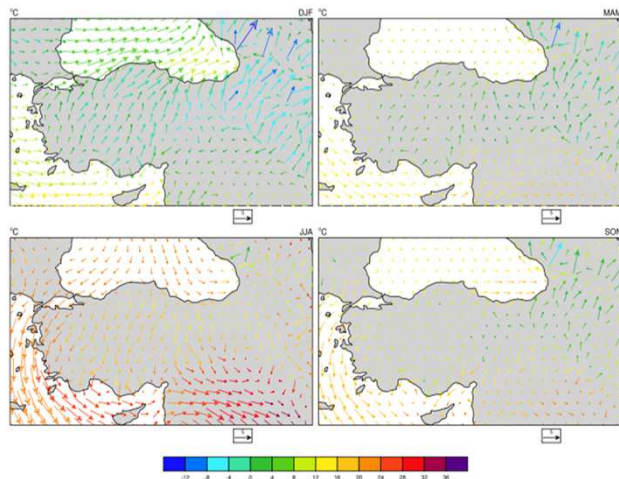
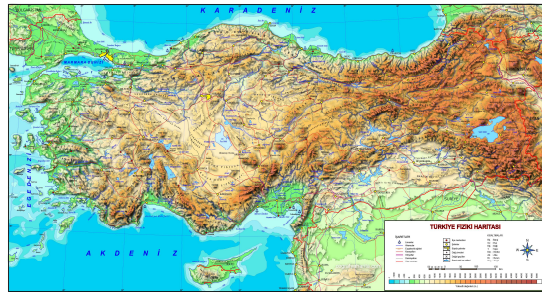
- ❖ Objectives
- ❖ Introduction
- ❖ Regional Climate Model CCLM
 - Model Domain and Topography
 - Model Configuration
- ❖ Analysis and Results
- ❖ Conclusion

Objectives

- ❖ To evaluate the performance of COSMO-CLM (CCLM) coupled with the Earth System Model MPI-ESM-LR to simulate the climate over Turkey.
- ❖ To investigate the projected impacts of climate change on the extreme precipitation for 21st century under RCP8.5 scenario.

Introduction

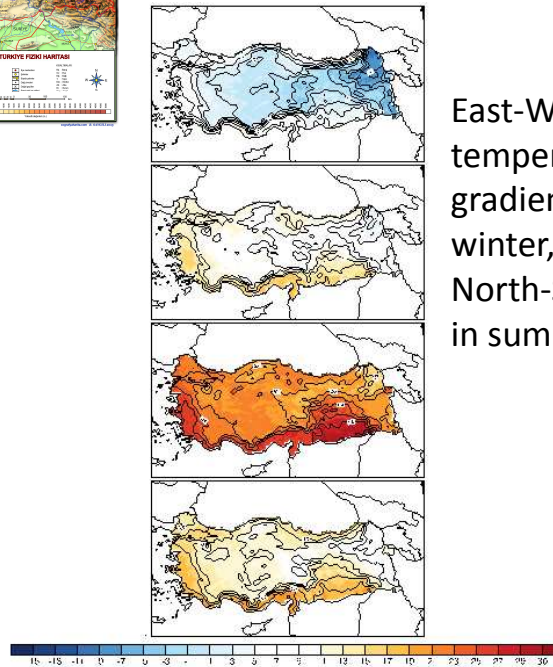
Complex topography



Winter and summer prevailing winds are NE and SW and high on the western Turkey.

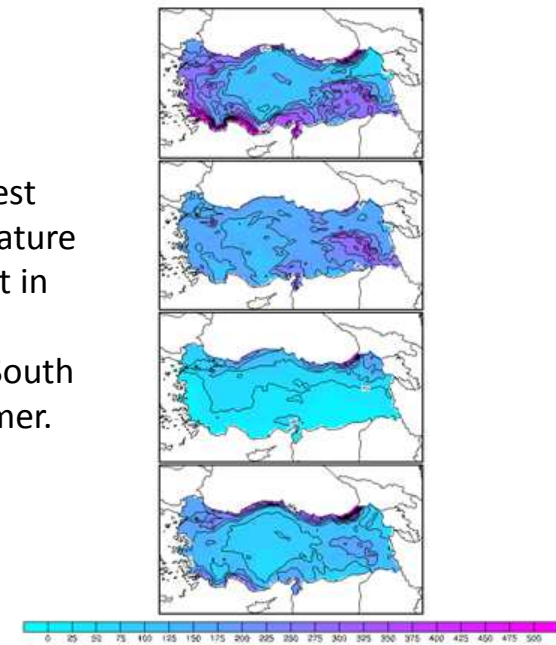
Land sea contrast

Temperature 1970-2000



East-West temperature gradient in winter, North-South in summer.

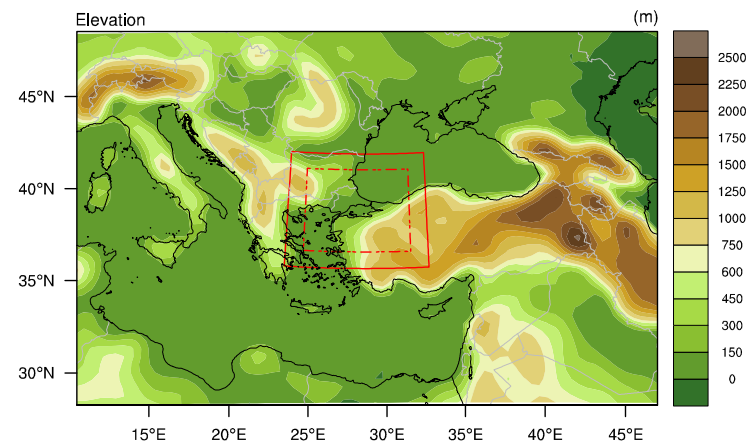
Precipitation 1970-2000



High along the sea shores and over the higher altitudes.

MODEL DOMAINS & TOPOGRAPHY

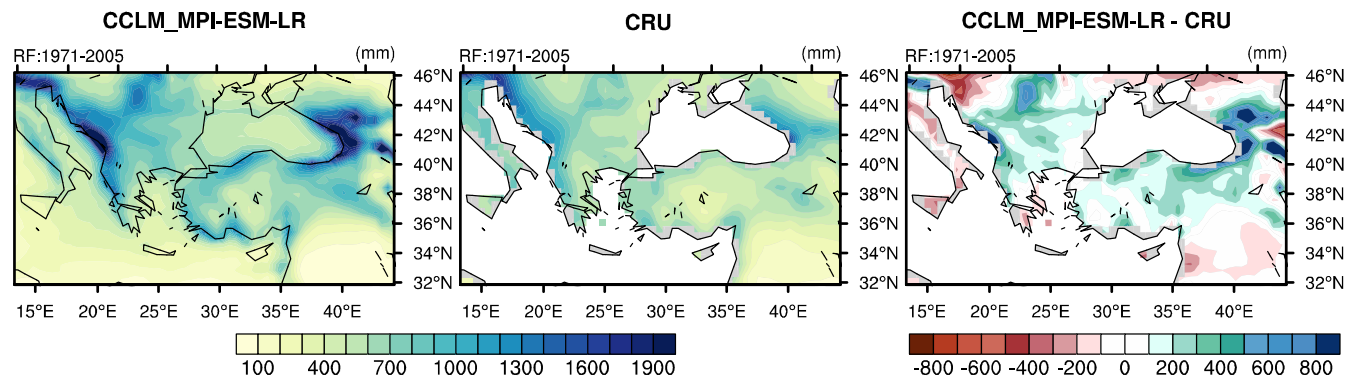
- ❖ Elevation is given in meters
- ❖ 10 grid wide relation zone
- ❖ Mother Domain $\rightarrow 0.44^\circ$
 - Turkey and vicinity
- ❖ Nested Domain $\rightarrow 0.11^\circ$
 - Northwestern Turkey



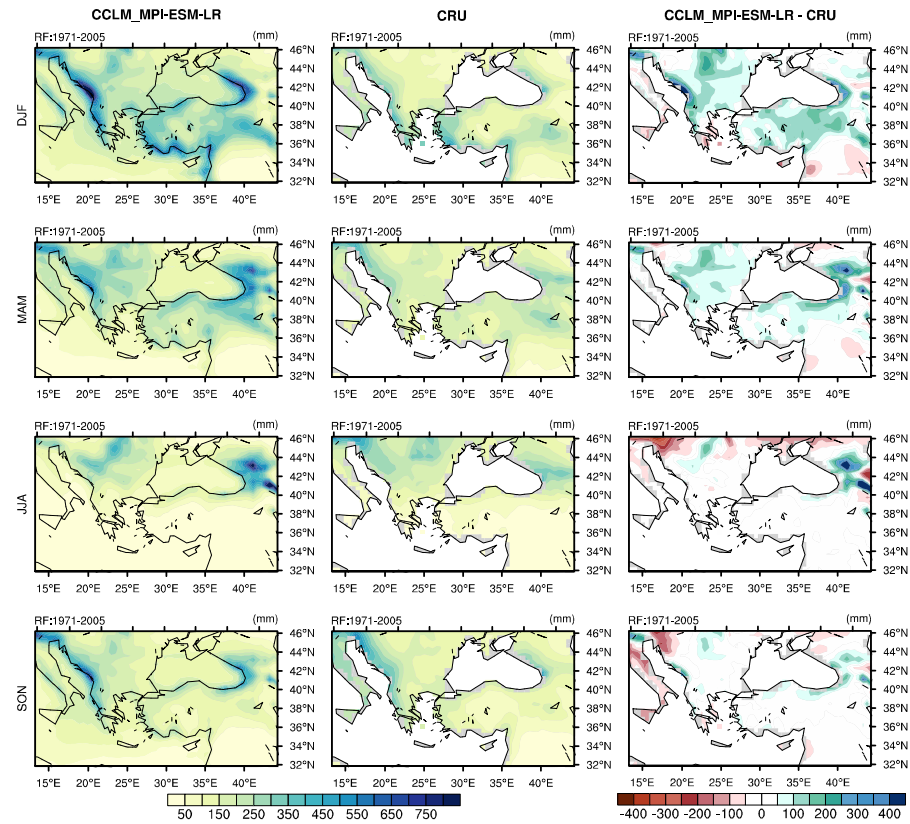
Model Configuration

CONTENT	DOMAINS	
Horizontal Resolution	0.44°	0.11°
Grid Cell	ie=77, je=50	ie=70, je=60
Vertical Levels	40 μ level	40 μ level
Time Interval	240 sec	120 sec
SST Type	MPI-ESM-LR	FNEST
Data Set Type	MPI-ESM-LR	FNEST
Microphysics Scheme	Two-category Ice Scheme	Two-category Ice Scheme
Convection Scheme	(Tiedtke, 1989)	(Tiedtke, 1989)
Radiation Scheme	(Ritter and Geleyn, 1992)	(Ritter and Geleyn, 1992)
Vertical Turbulent Diffusion Scheme	1D TKE: (Sommeria and Deardorff, 1977)	1D TKE: (Sommeria and Deardorff, 1977)
Surface Transfer Scheme	Diagnostic TKE	Diagnostic TKE
Land Surface Scheme	TERRA-ML	TERRA-ML
Land Use	GLC2000: (Joint Research Centre, 2003)	GLC2000: (Joint Research Centre, 2003)
Periods	RF: 19710101 – 20051231 RCP8.5: 20110101 – 21001231	

Annual Precipitation RF:1971-2005 – 0.44°

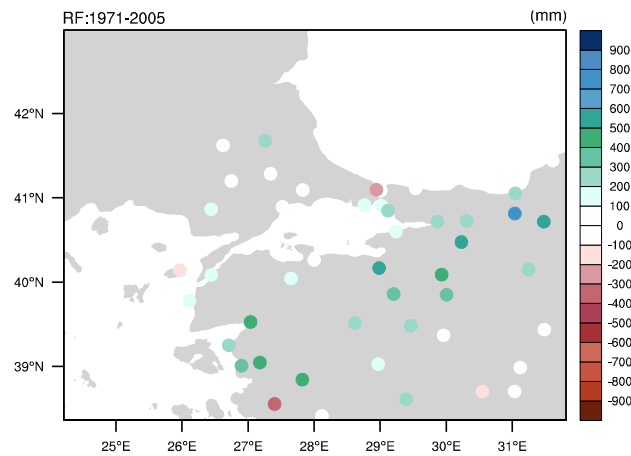


Seasonal Precipitation RF:1971-2005 – 0.44°

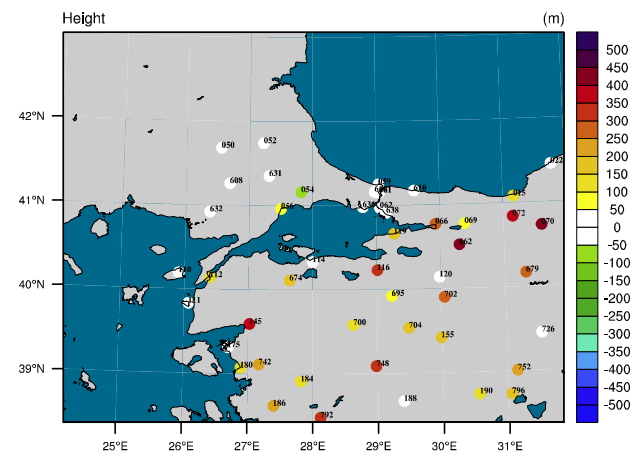


Annual Precipitation Biases

RF:1971-2005 – 0.11°



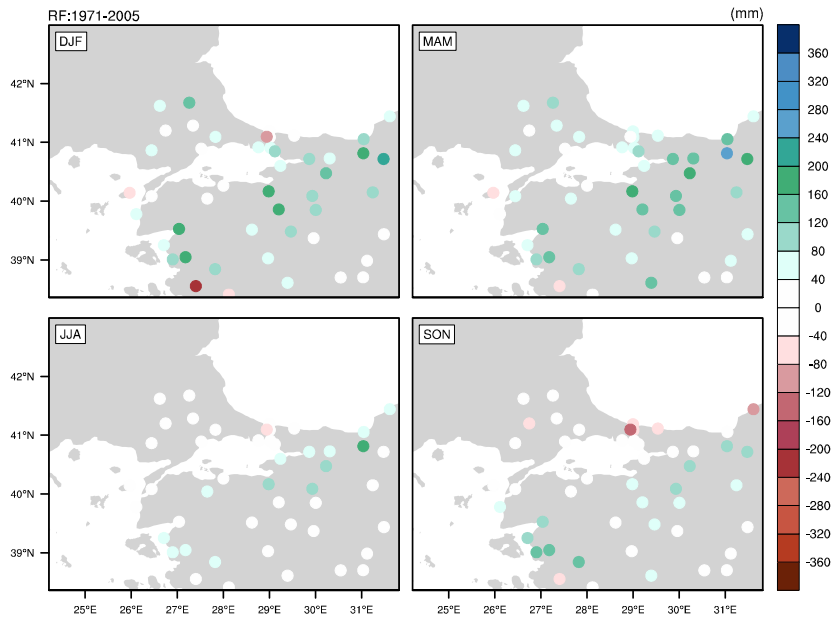
- ❖ AVERAGE → 177.8 mm
- ❖ STANDARD DEVIATION → 215.9 mm



- ❖ Maximum at 17072 Duzce station with 758.3 mm

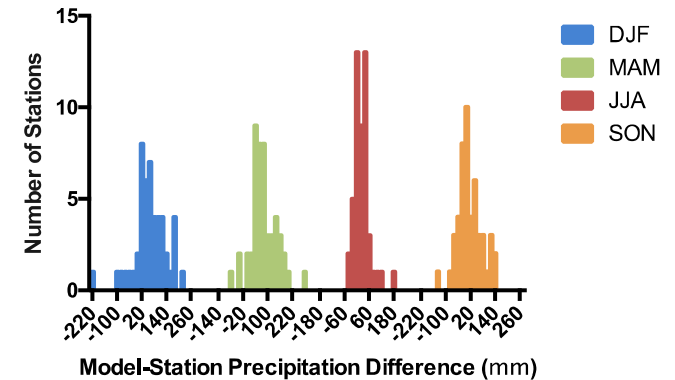
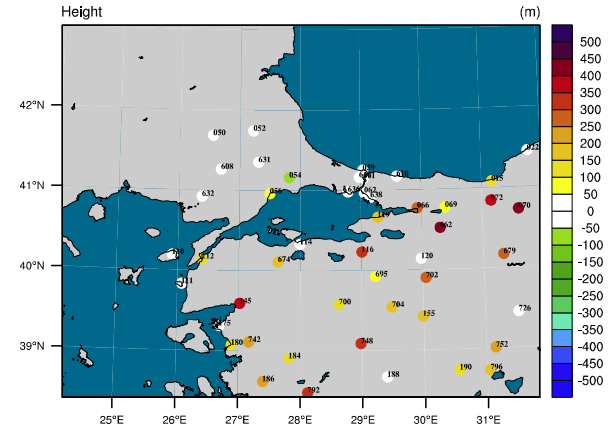
Seasonal Precipitation Biases

RF:1971-2005 – 0.11°



- ❖ AVERAGES → DJF:58, MAM:79.5, JJA:24, SON:15.2 mm
- ❖ S. DEVIATIONS → DJF:78.9, MAM:64.6, JJA:39.4, SON:59.1 mm

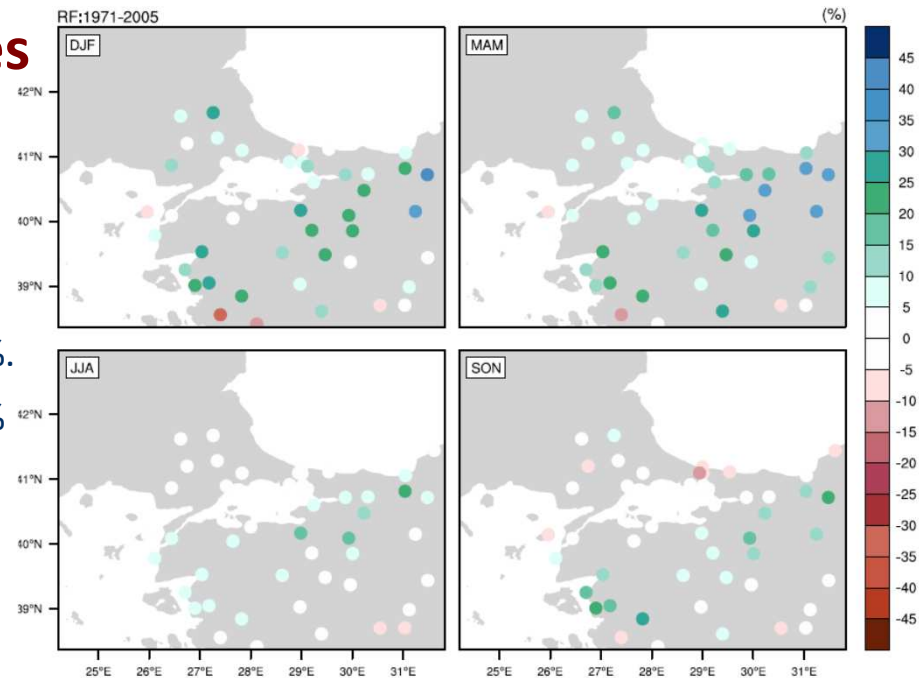
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Offenbach



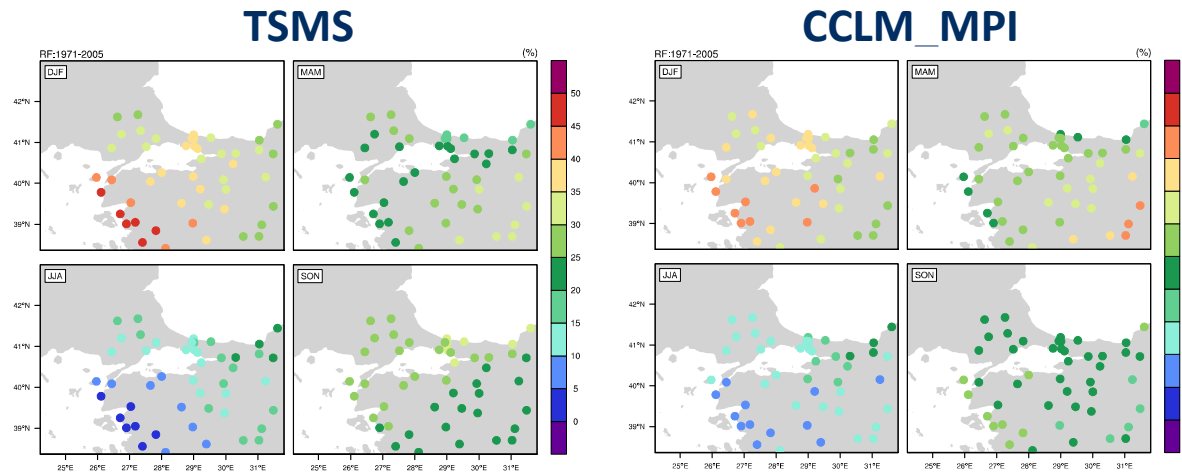
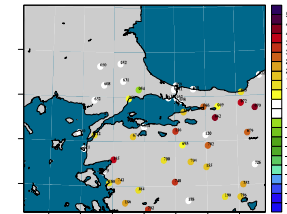
- ❖ Wide range in winter and spring

Seasonal Precipitation Biases in %

- ❖ Over estimation in every season.
- ❖ The winter and spring season biases reach to 35%.
- ❖ Dry summer season, 5-10% more precipitation over high altitudes.
- ❖ Underestimation in the northern latitudes.

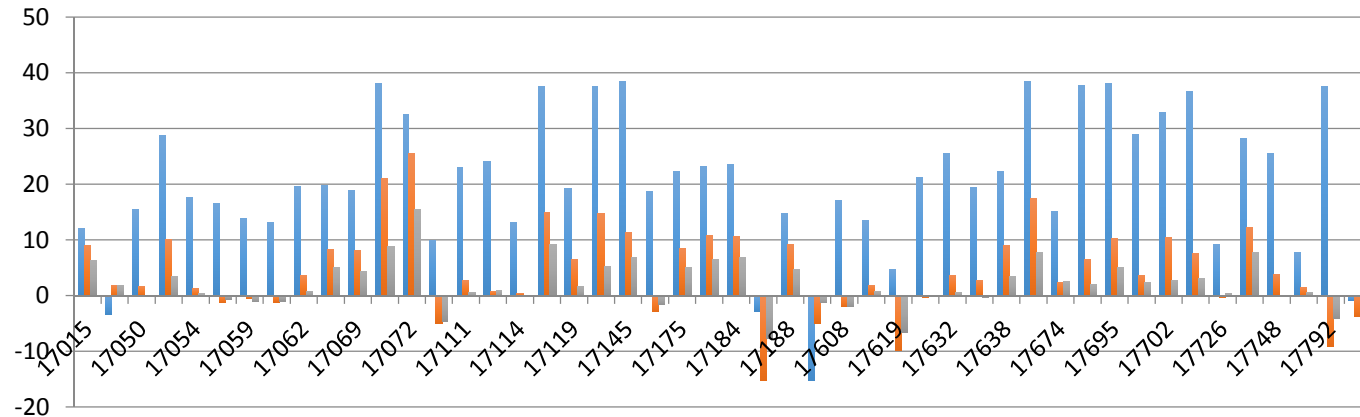


Contribution of Seasonal to Total Year Precipitation 1971-2005 Period – 0.11°

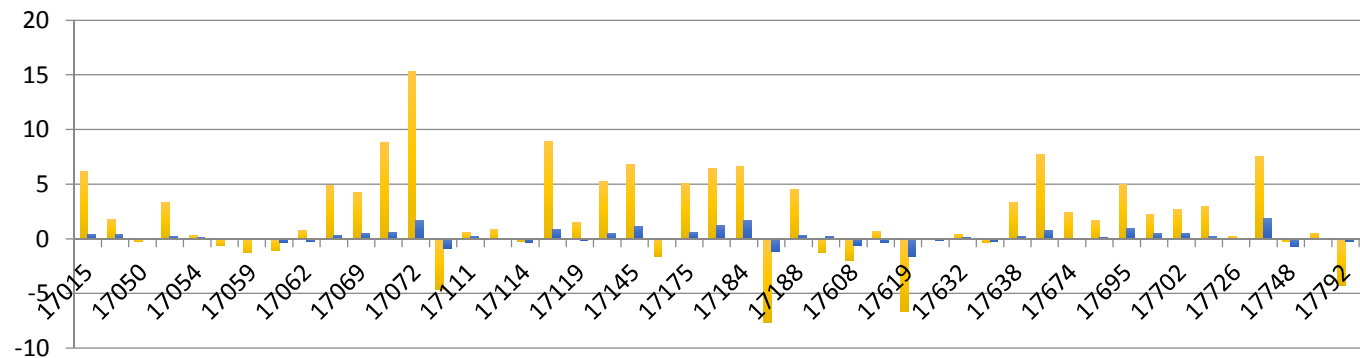


- ❖ 30-50% of precipitation on winter season.
- ❖ Dry summer season on the Aegean coast, 10-15% on the North and over high altitudes.

Climate Indices for the Reference Period



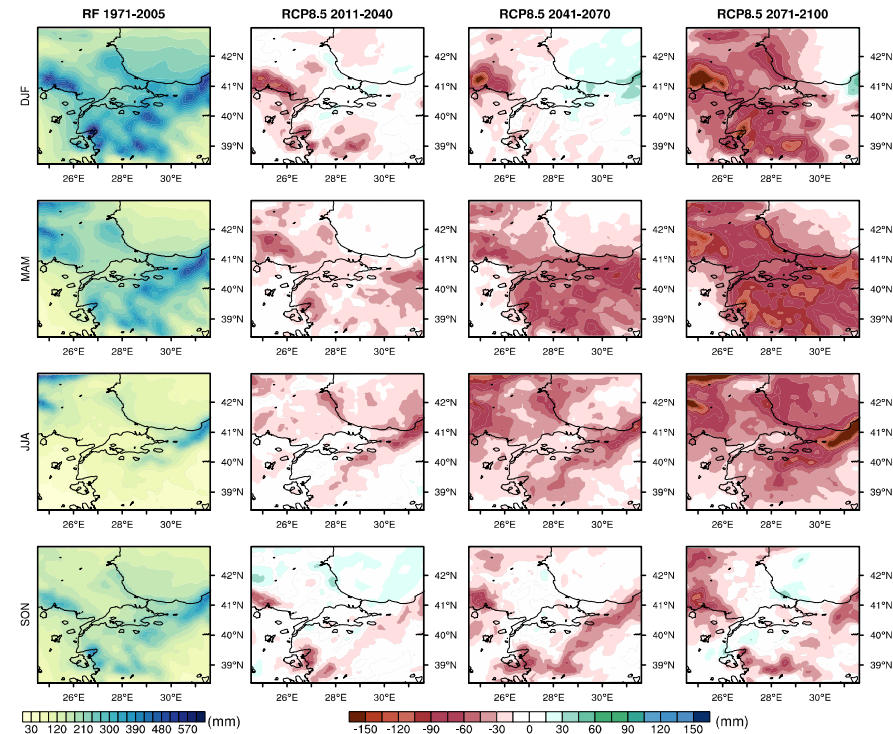
	Av. Bias days
RR1	20.6
RR10	4.5
RR20	2.1
R90p	2.0
R99p	0.2



CCLM_MPI	90p=20 mm
	99p=52.3 mm
OBS	90p=19.9 mm
	99p=48.7 mm

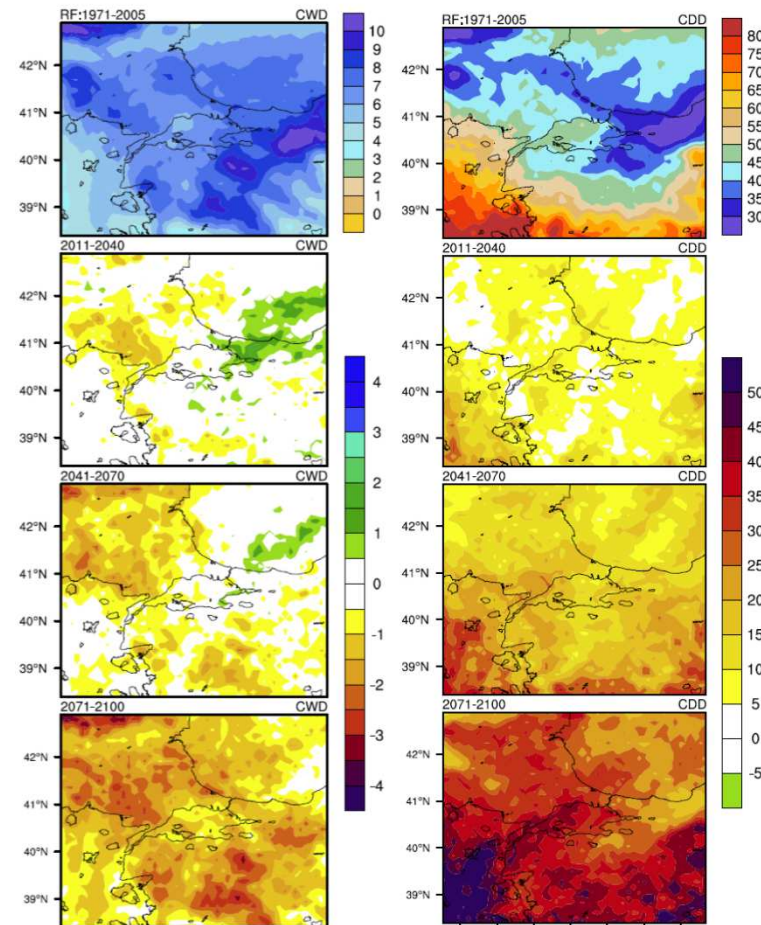
Projected Changes for Precipitation

- ❖ Extreme precipitation reduction is over mountainous regions in the last period.
- ❖ The most pronounced changes in the precipitation patterns are in spring and summer seasons.



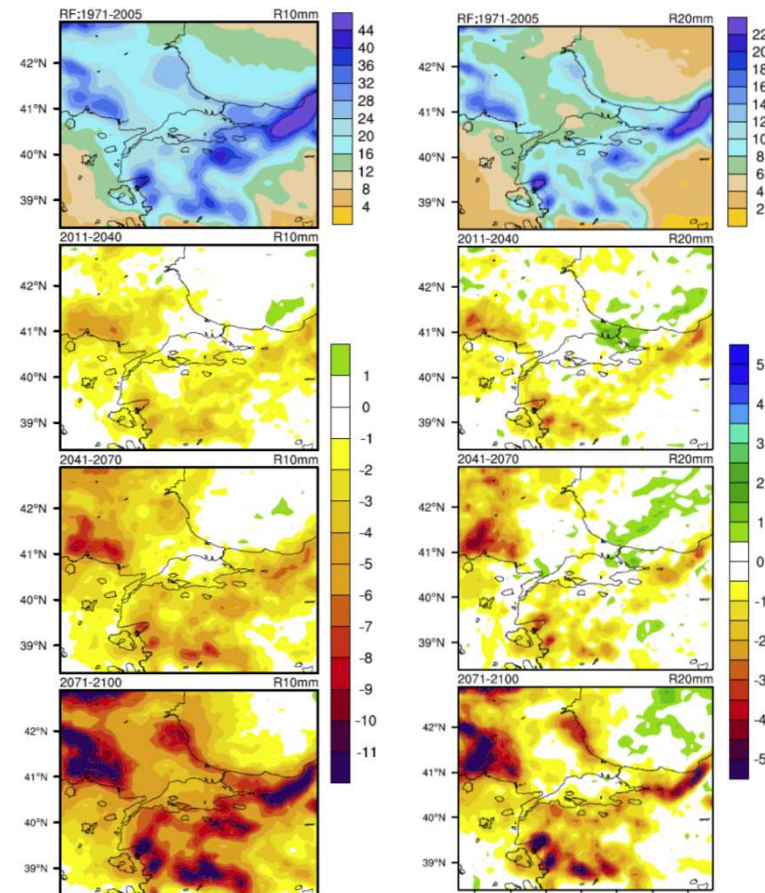
CWD and CDD for the periods of 2011-2040, 2041-2070 and 2071-2100

- ❖ The number of consecutive wet days decreasing every periods except the Marmara Region in the first 30 years.
- ❖ The number of consecutive dry days increasing every periods and reaches up to a month in the mid-Aegean region.

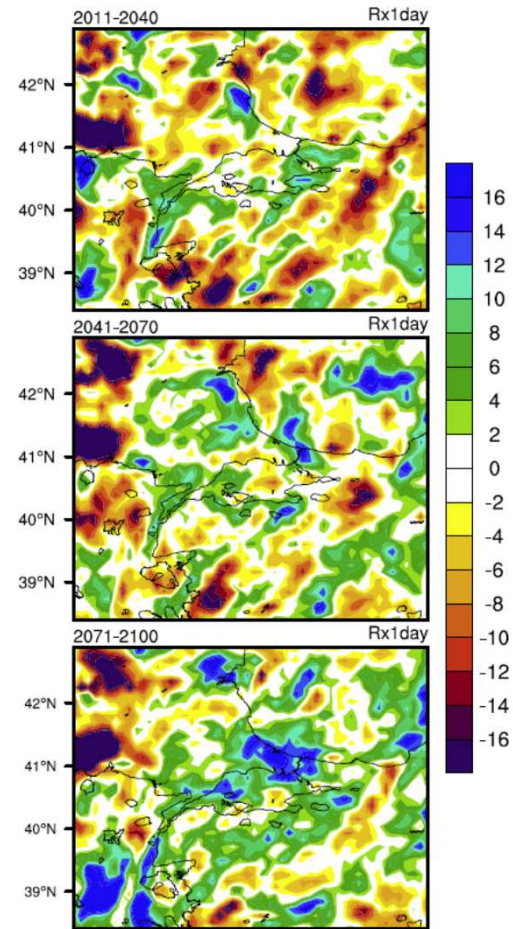
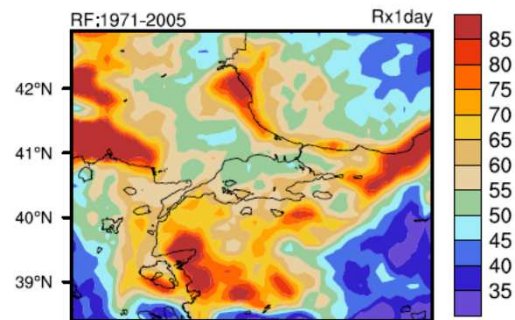


R10mm and R20mm for the periods of 2011-2040, 2041-2070 and 2071-2100

- ❖ The number of days which has larger than 10 mm precipitation decreasing up to 10 days in the last 30 years over high topography regions which have more than 40 days in the reference period.
- ❖ The number of days which has larger than 20 mm precipitation is increasing for a few days along Bosphorus but in general similar to R10mm they are also decreasing at similar locations of R10mm.



Rx1day for the periods of 2011-2040, 2041-2070 and 2071-2100



Conclusions

- ❖ CCLM driven by MPI-ESM-MR produces reasonable climatology over Turkey.
- ❖ Increase of resolution from 0.44° to 0.11° results in improvement of precipitation climatology.
- ❖ For the reference period, the annual precipitation biases wrt to the station observations are around 20%. Winter and spring seasons biases are larger than the other seasons.
- ❖ Seasonal partitionings of the precipitation are similar to the observations.
- ❖ For RCP8.5 scenario, more dry conditions are expected on the western part through the end of century.
- ❖ The largest precipitation changes are expected first on spring season, then winter and summer.
- ❖ The number of CWD decreases every period while the number of CDD increases and reaches up to a month in the mid-Aegean region.
- ❖ The number of days which has larger than 10 mm precipitation decreasing up to 10 days in the last 30 years over high topography regions which have more than 40 days in the reference period.
- ❖ The number of days which has larger than 20 mm precipitation is increasing for a few days along Bosphorus but in general similar to R10mm they are also decreasing at similar locations of R10mm.

Thank you...

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