

# **PERFORMANCE EVALUATION OF COSMO-CLM (CCLM) OVER ISTANBUL**

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# OUTLINE

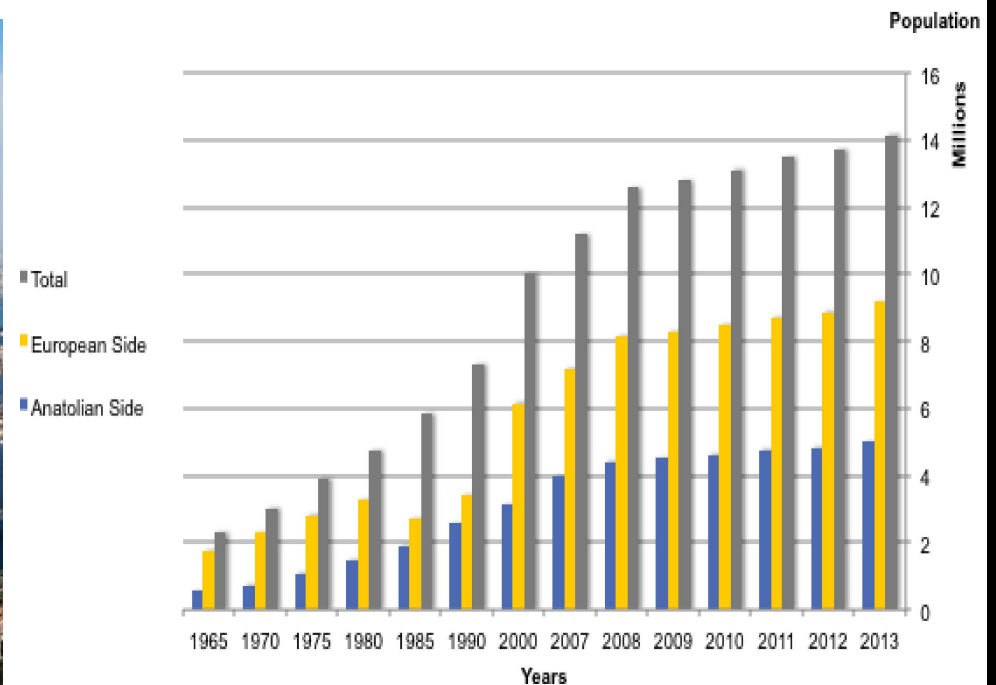
- ✧ Objectives
- ✧ Introduction
- ✧ Regional Climate Model CCLM
  - Model Domain and Topography
  - Model Configuration
- ✧ Analysis and Results
- ✧ Conclusion

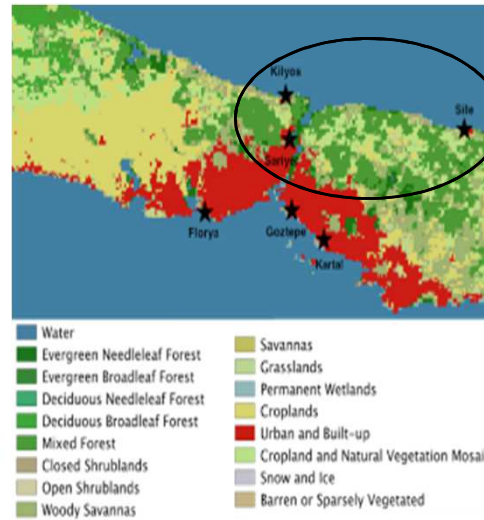
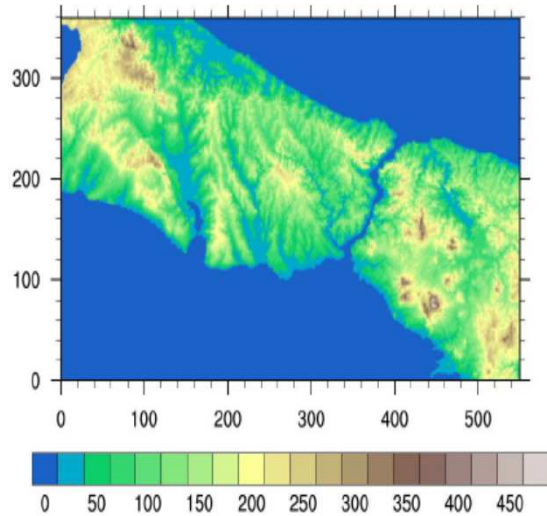
# THE OBJECTIVES

- ✧ LOCLIM3 is a part of the EU project ERAfrica
  - ✧ Investigate local climate change in 3 cities (Cairo, Nairobi, Istanbul)
  - ✧ Conducting Istanbul simulations
- ✧ To explore the performance of the COSMO-CLM to simulate climate over Istanbul, Turkey.

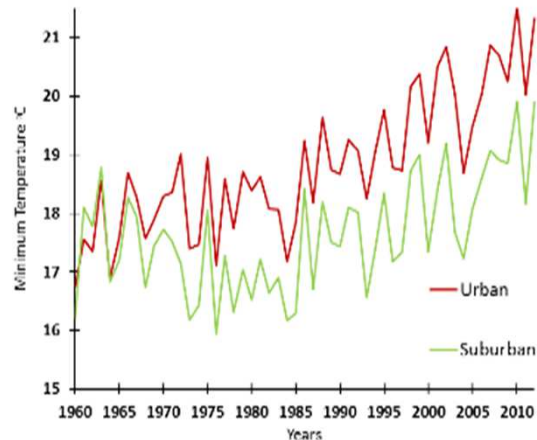
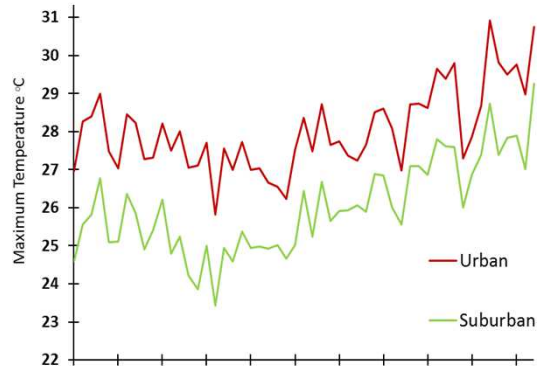
# INTRODUCTION

- ✧ The most of the world population lives in the cities so that the majority of the people is under the treat of climate change.
  - ✧ Example: The mega city Istanbul → The fastest growing city with its economy and dense population in Turkey and Europe

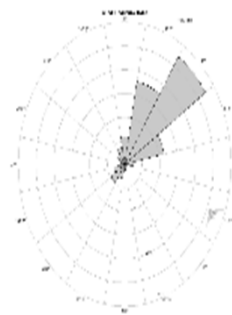




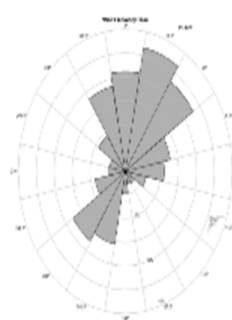
	Maximum Temperature					Minimum Temperature				
	Average °C					Average °C				
	Winter	Spring	Summer	Fall	Annual	Winter	Spring	Summer	Fall	Annual
Kilyos	9.54	15.32	26.43	19.66	17.74	3.44	7.51	17.79	12.11	10.21
Sarıyer	9.21	15.38	25.96	19.14	17.46	3.87	8.02	18.66	12.88	10.89
Göztepe	9.80	16.71	27.95	20.29	18.75	4.08	8.46	18.52	12.39	10.90
Şile	9.67	15.23	25.50	19.24	17.41	3.32	7.51	17.44	11.87	10.03
Florya	9.38	16.13	27.63	20.01	18.34	3.96	8.42	18.56	12.72	10.91
Kartal	10.12	17.07	28.54	20.49	19.09	4.75	9.39	19.61	13.51	11.83



### SUMMER



### WINTER



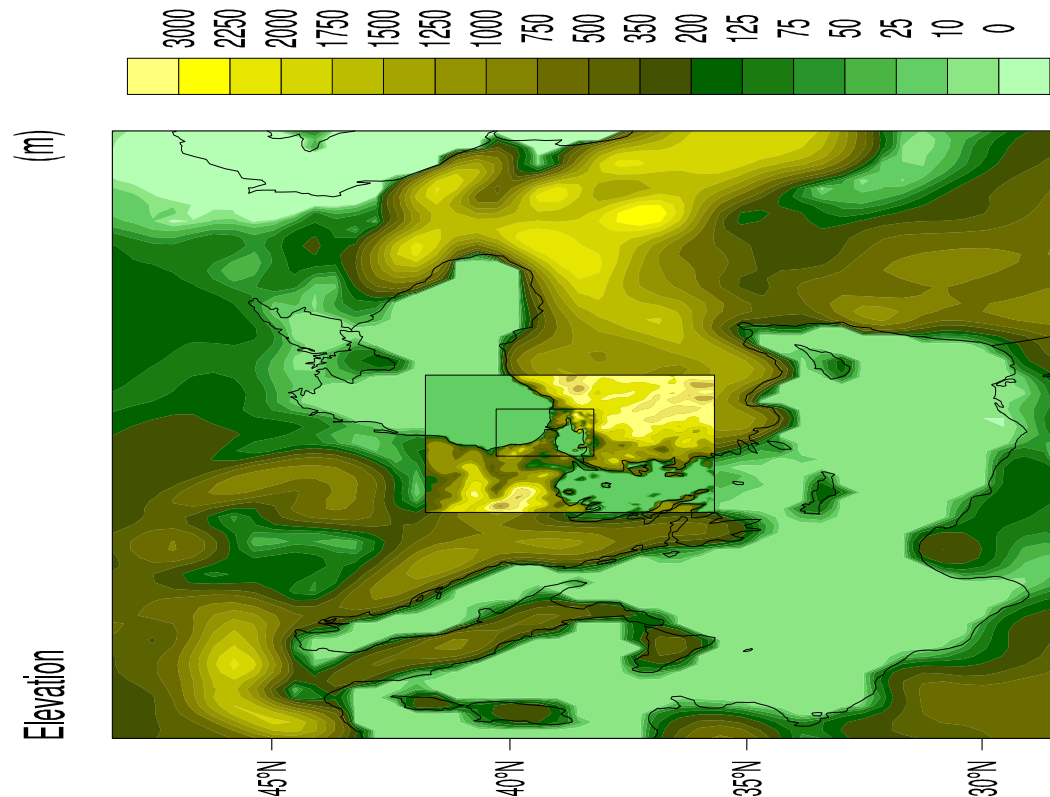
✧ Every season

✧ Highest precipitation in northern part

✧ Maximum cloud cover in northern part

	Cloud Cover ( out of 10)				Wind Speed (m/sec)				Precipitation (mm/day)			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Kilyos	7.20	5.98	3.52	5.41	5.28	3.68	3.44	4.30	3.28	1.71	1.13	2.76
Sarıyer	6.96	5.55	3.21	5.06	3.08	2.74	3.23	3.05	3.44	1.63	1.21	2.79
Göztepe	6.85	5.26	2.74	4.71	3.15	3.36	4.00	3.07	2.97	1.55	0.81	2.20
Şile	7.31	6.02	3.45	5.44	3.99	3.10	3.03	3.58	3.33	1.65	1.30	3.02
Florya	6.74	5.08	2.48	4.56	3.06	2.51	2.67	2.55	2.81	1.50	0.79	2.01
Kartal	6.95	5.26	2.68	4.69	1.93	1.74	1.98	1.75	2.79	1.58	0.80	2.06

# MODEL DOMAINS AND TOPOGRAPHY



✧ 3 sets of simulations with Cosmo\_5.0

✧ Mother domain  $\rightarrow 0.44^\circ$

✧ Turkey and its vicinity

✧ Nested domain  $\rightarrow 0.11^\circ$

✧ Northwestern Turkey

✧ Nested domain  $\rightarrow 0.0275^\circ$

✧ Istanbul and its vicinity

✧ 10 grid wide sponge zone

✧ 2 years for spin up time

# MODEL CONFIGURATION

CONTENT	DOMAINS	
Horizontal Resolution	0.44° / 0.11°	0.0275°
Grid Cell	ie=77, je=50 / ie=70, je=60	ie=95, je=80
Vertical Levels	40 $\mu$ levels	50 $\mu$ levels
Time Interval	240 sec / 120 sec	30 sec
Initial and Boundary Data	NCEP1 / FNEST	FNEST
Microphysics Scheme	2-category Ice Scheme	3-category Ice (Graupel) Scheme
Convection Scheme	Moist Convection (Tiedtke, 1989)	Shallow Convection
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	TKE-based Scheme	TKE-based Scheme
Soil Scheme	TERRA-ML	TERRA-ML
Land Use	GLC2000: (Joint Research Centre, 2003)	GLC2000: (Joint Research Centre, 2003)
Periods	RF: 19710101 – 20051231	RF: 19710101 – 20051231

# OBSERVATIONAL DATA SET

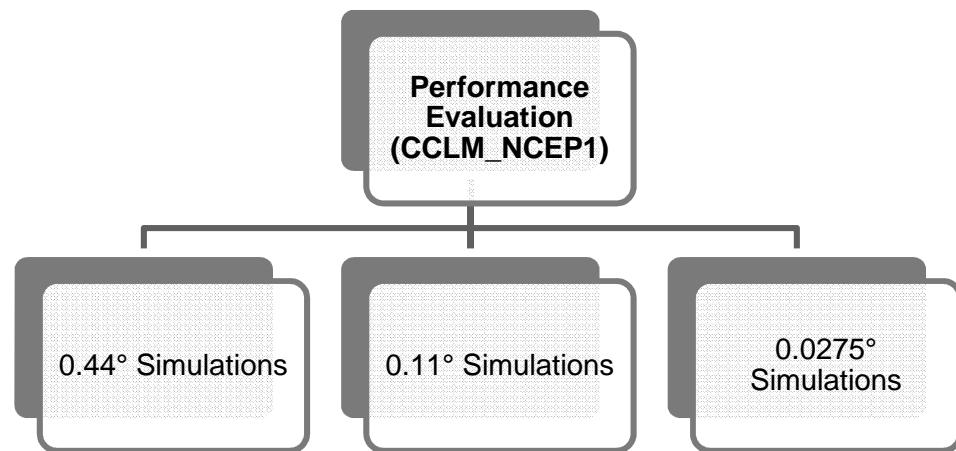
## Meteorological Observations

- ✧ Temperature data were provided from 217 stations out of overall 372 Turkish State Meteorological Service (TSMS) stations in Turkey.
  - ✧ 80% non-missing values
  - ✧ 12 of them falls into the  $0.0275^\circ$  computational domain
- ✧ For the precipitation data 212 stations were chosen from 283 TSMS stations.
  - ✧ 80% non-missing values
  - ✧ 12 of them falls into the  $0.0275^\circ$  computational domain

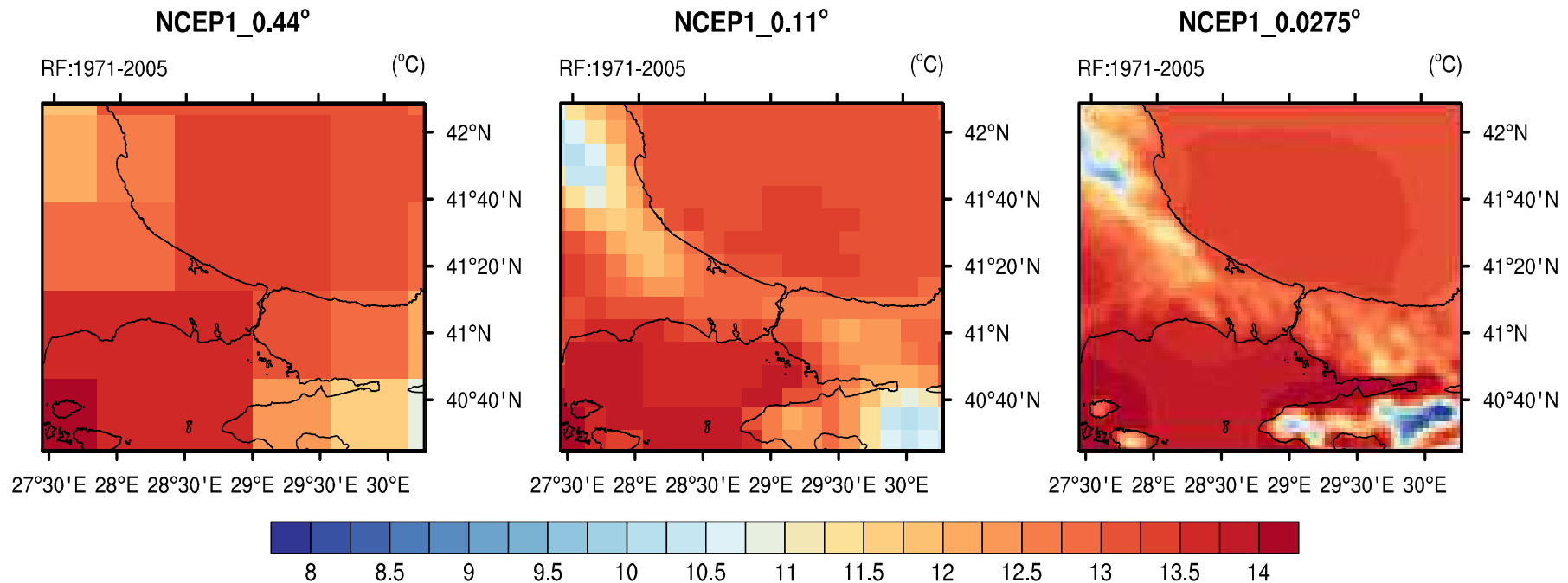


# ANALYSIS AND RESULTS

- ✧ Simulated values were interpolated to closest TSMS station point using the bilinear interpolation method
- ✧ Evaluation is performed on annual and seasonal basis

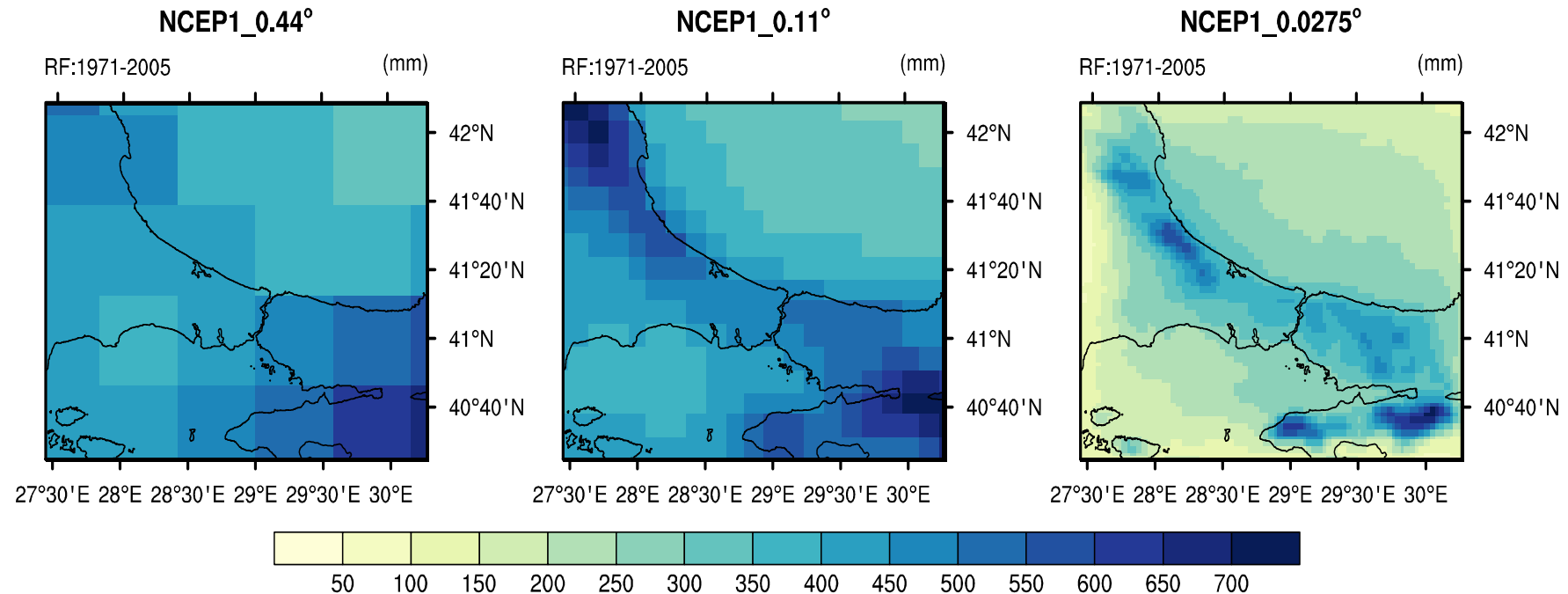


# ANNUAL MEAN TEMPERATURE DISTRIBUTIONS FOR 1971-2005 REFERENCE PERIOD



- ✧ Hard to resolve climate variations in regional scale and assess these regional impacts with coarse spatial resolution.
- ✧ Obtained fine scale information influenced by surface heterogeneities such as coast lines.

# ANNUAL TOTAL PRECIPITATION DISTRIBUTIONS FOR 1971-2005 REFERENCE PERIOD

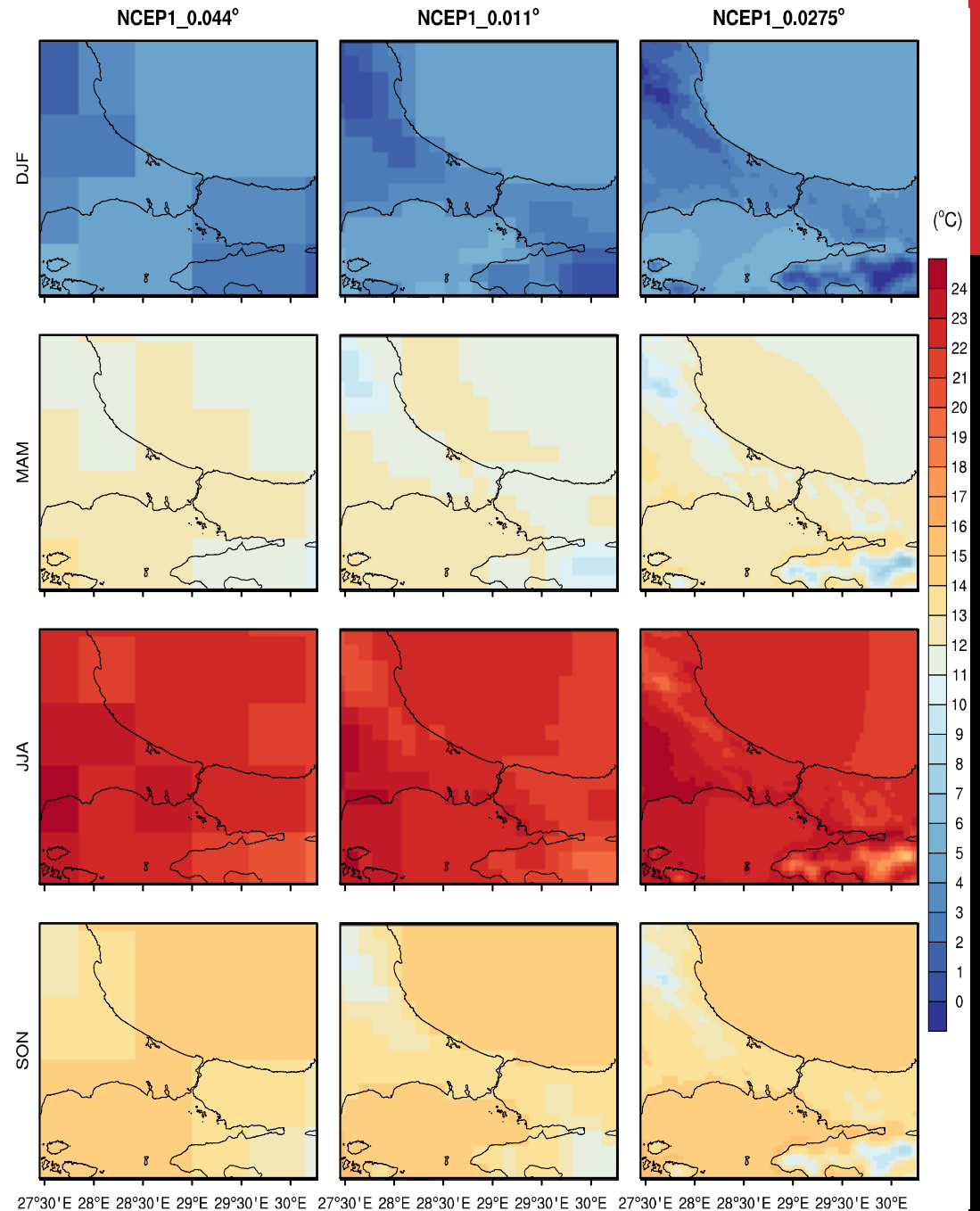


✧ Catches the north – south contrast in the precipitation pattern with increasing resolution

# SEASONAL MEAN TEMPERATURE DISTRIBUTIONS FOR 1971-2005

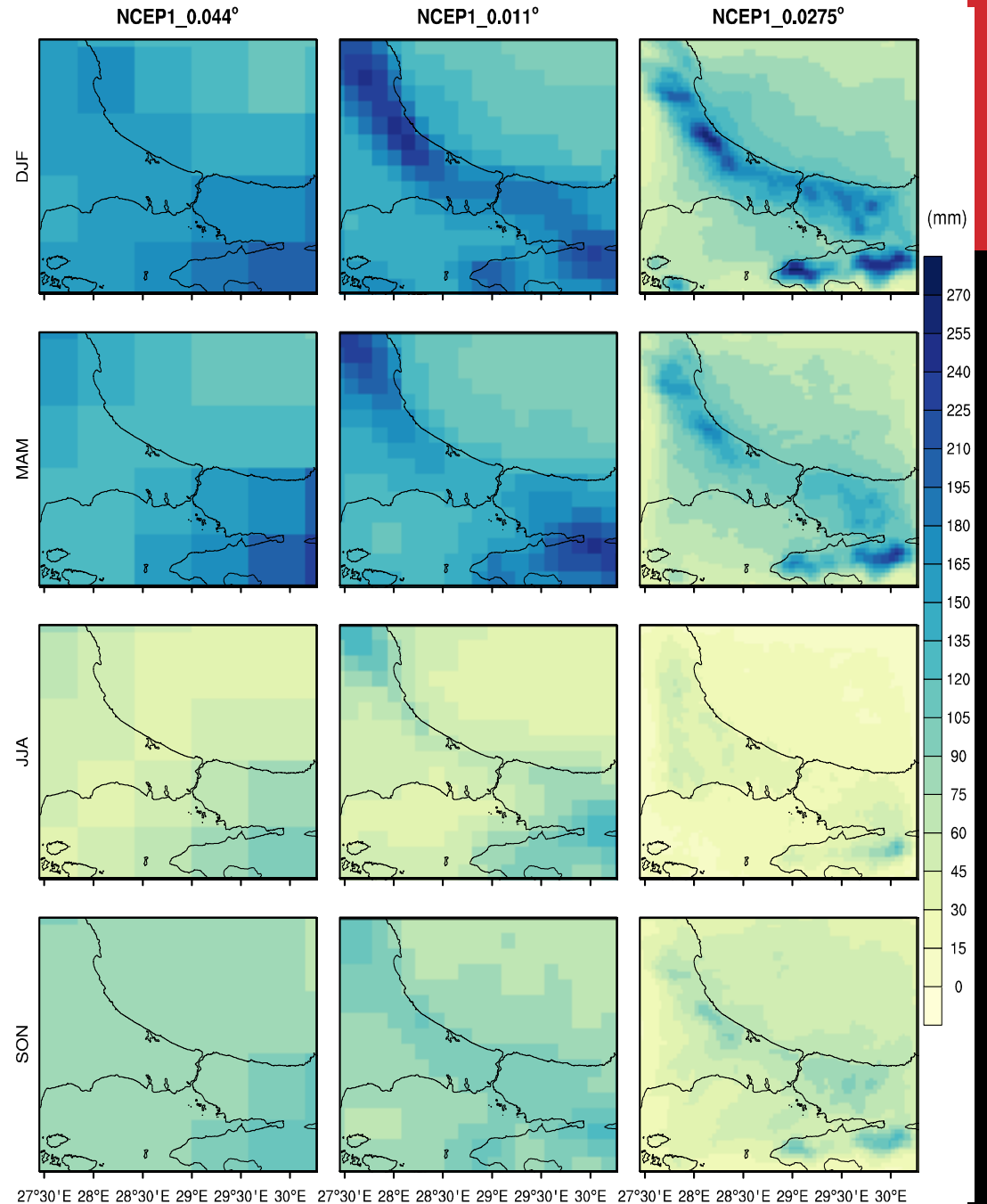
✧ NCEP1\_0.44°

- ✧ Istanbul is represented with few grids
- ✧ Hard to distinguish land-sea warming



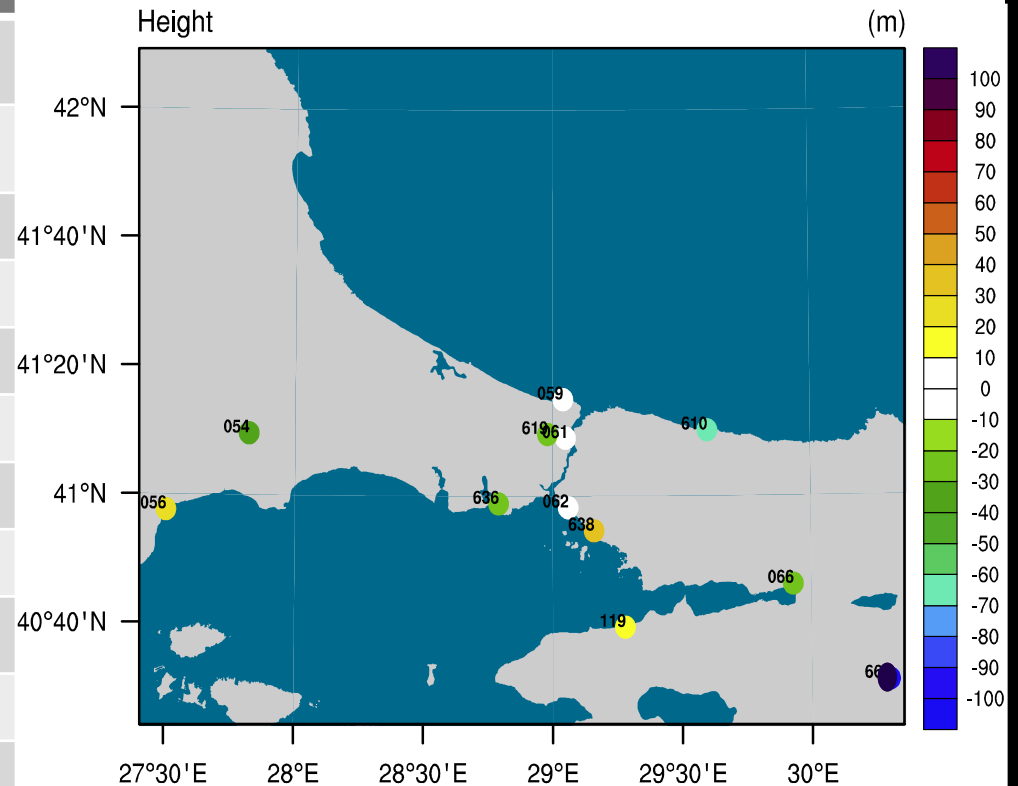
# SEASONAL TOTAL PRECIPITATION DISTRIBUTIONS FOR 1971-2005

✧ NCEP1\_0.0275 → Not able to capture north-south precipitation pattern in summer



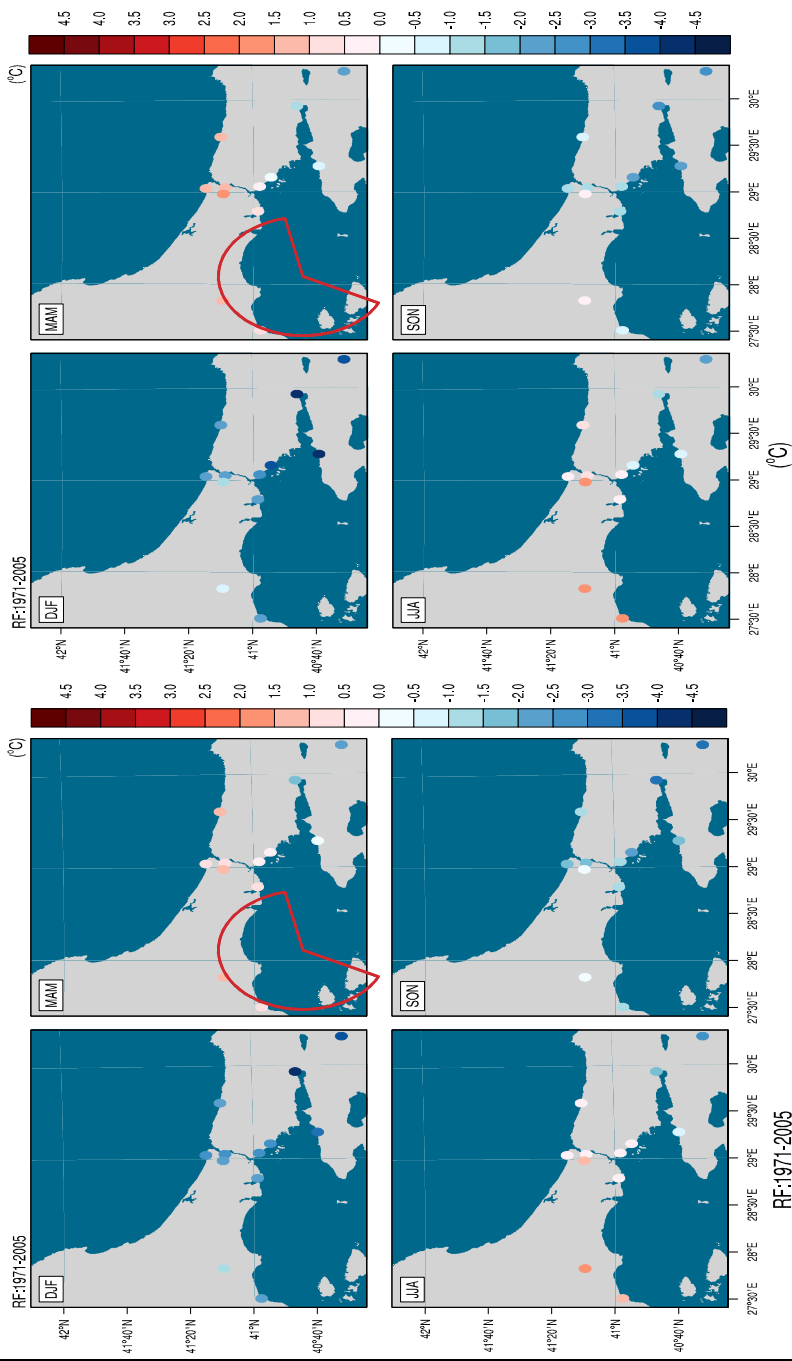
# ELEVATION DIFFERENCE BETWEEN CCLM & TSMS

Sta No	Sta Name	0.44	0.11	0.0275
17054	CORLU	-100.9	-74.6	-37.7
17056	TEKIRDAG	73.5	77.6	24.3
17059	KUMKOY	-18.5	29.9	-0.7
17061	K.BURNU	-35.8	33.3	1.3
17062	GOZTEPE	24.0	9.9	0.3
17066	KOCAELI	165.3	256.8	-24.6
17119	YALOVA	180.1	150.9	10.5
17610	SILE	-43.3	-19.1	-62.9
17619	BAHCEKOY	-107.2	-42.5	-20.1
17636	FLORYA	-9.5	-6.5	-20.4
17638	KARTAL	49.4	-15.9	38.7
17662	GEYVE	407.2	425.9	180.8

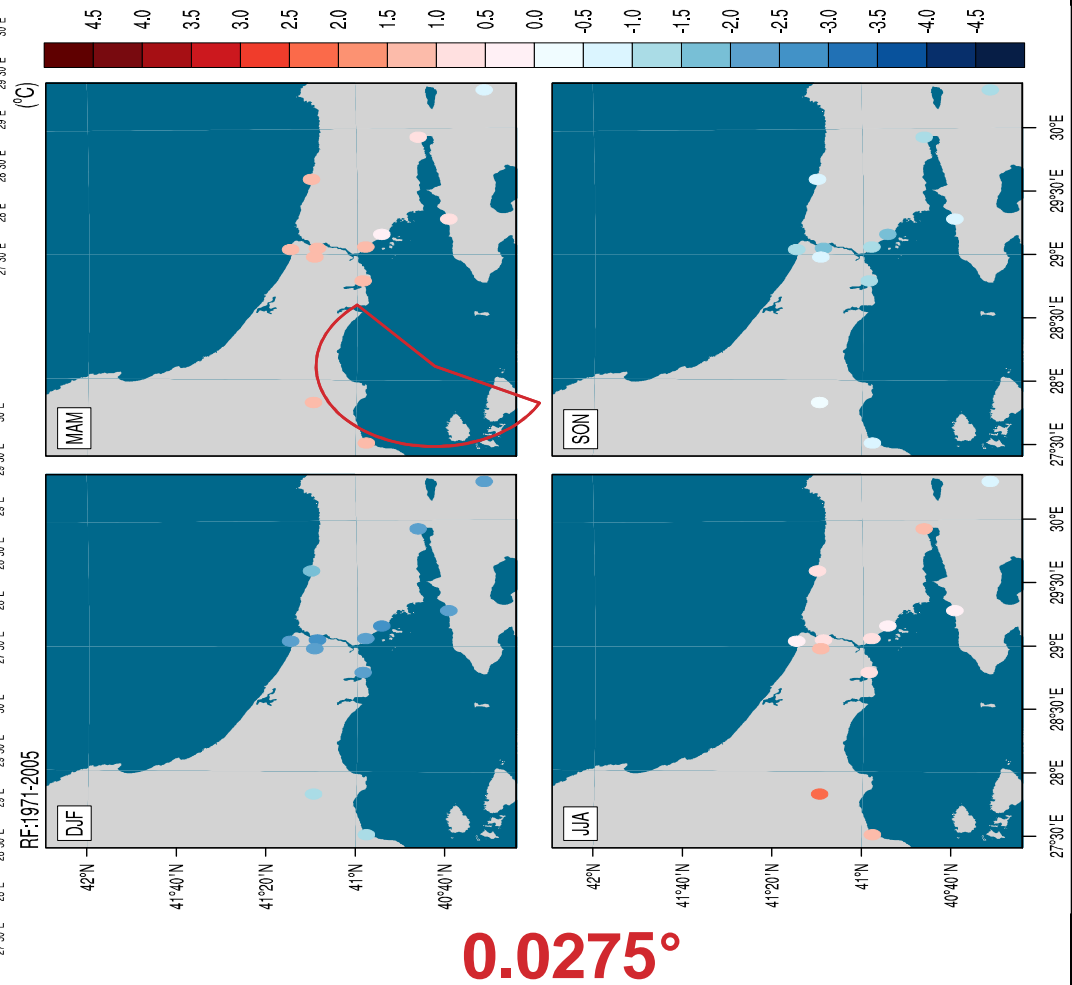


Only last three digits of the station numbers are shown.

0.11°



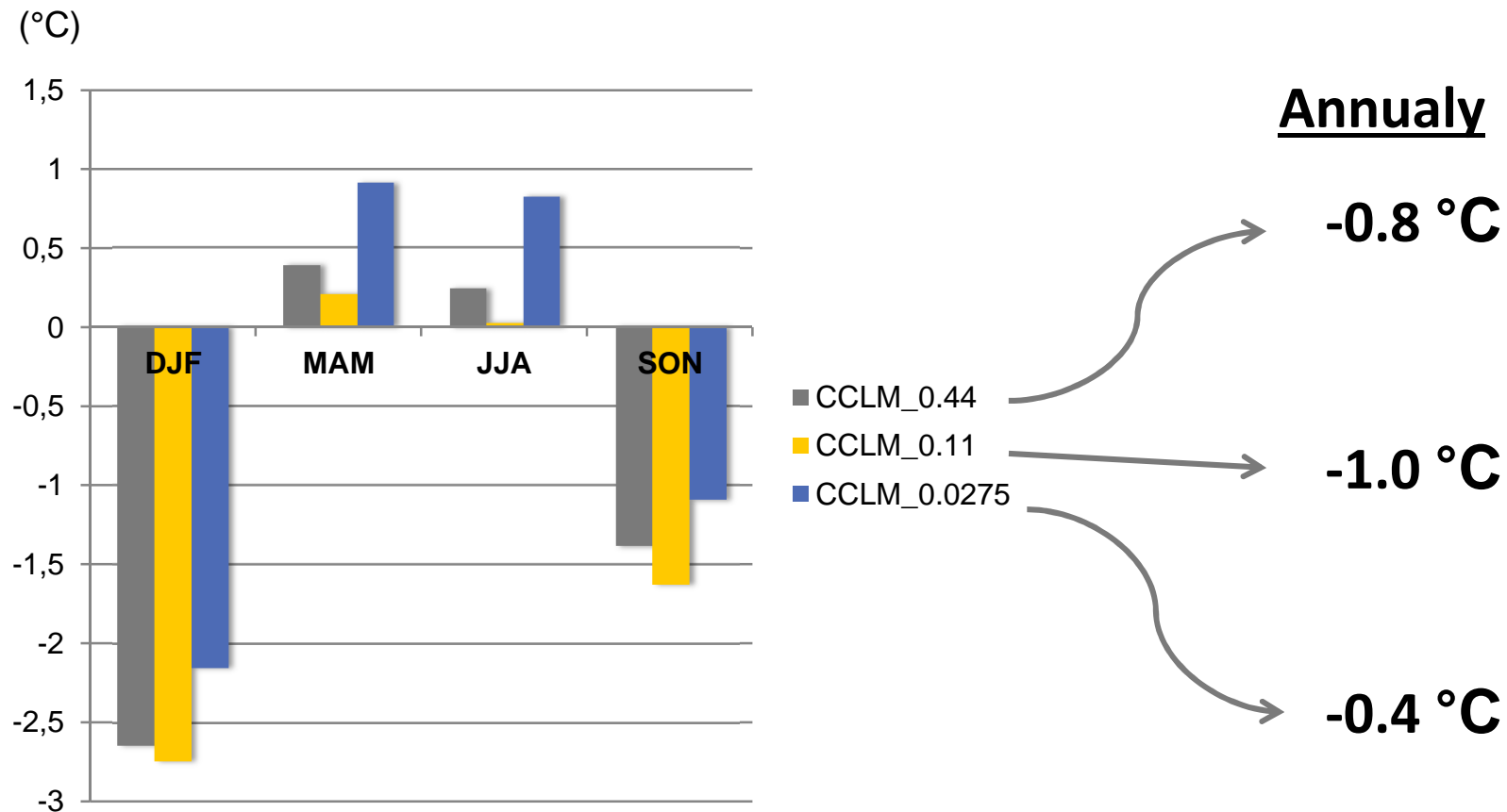
0.44°



# SEASONAL MEAN TEMPERATURE DIFFERENCES

0.0275°

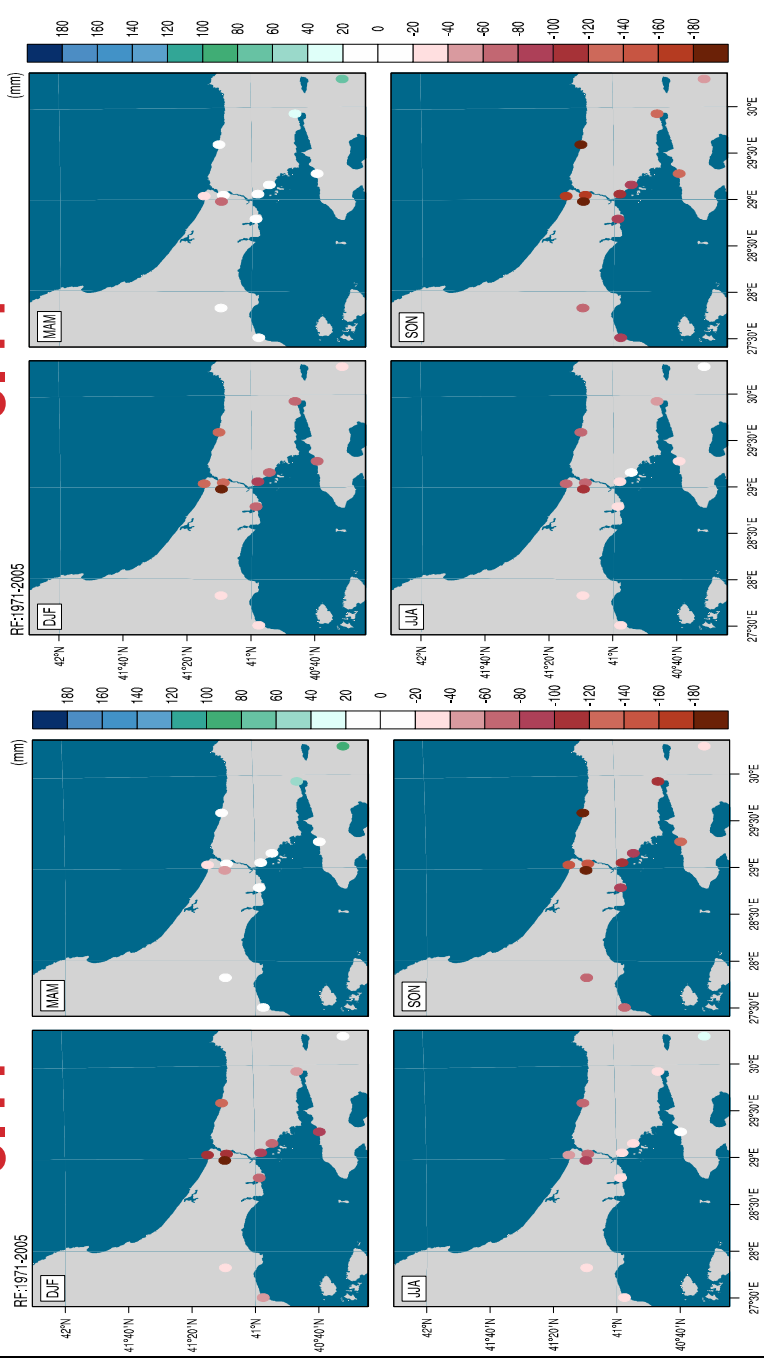
# SEASONAL MEAN TEMPERATURE BIASES



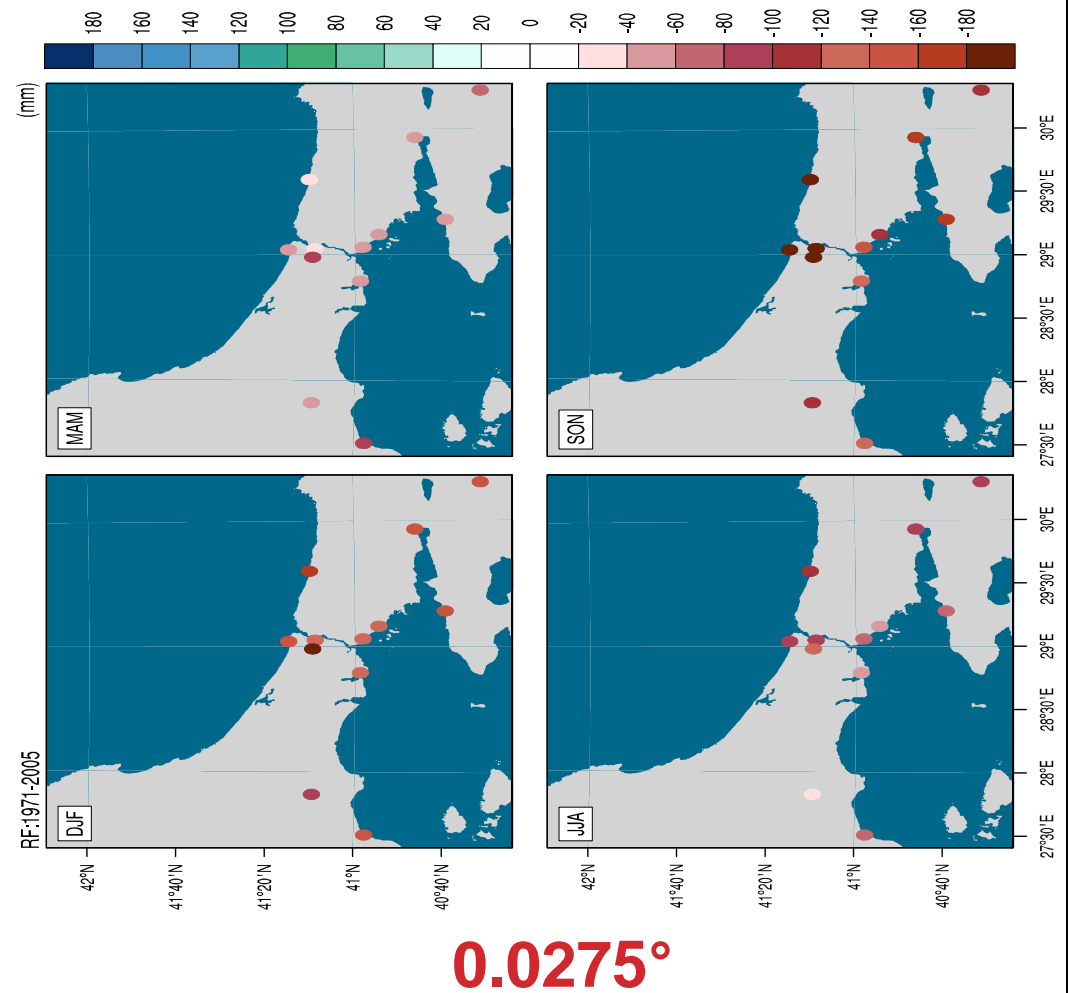
✧ High inconsistency in DJF & SON



0.11°



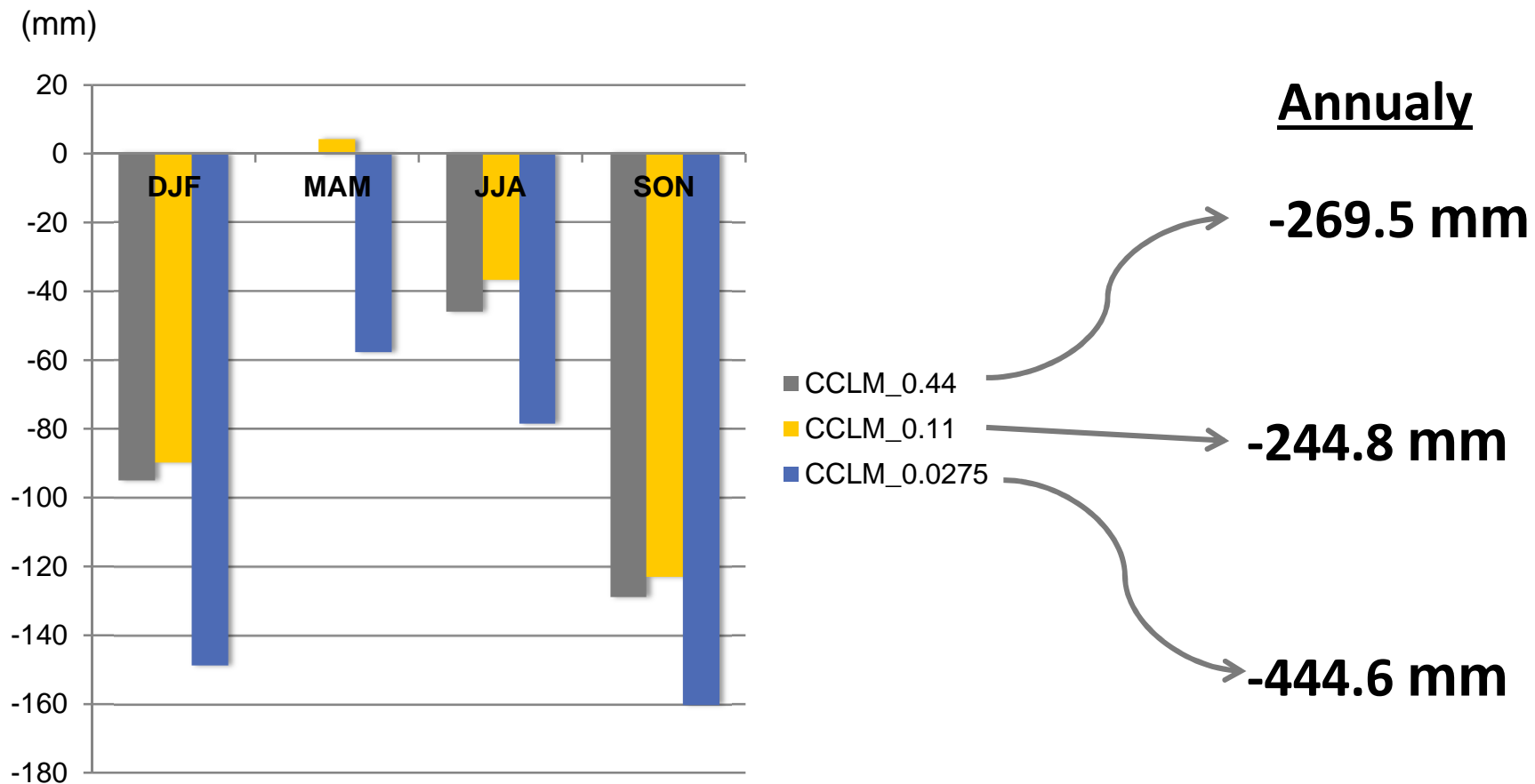
0.44°



# SEASONAL TOTAL PRECIPITATION DIFFERENCES

0.0275°

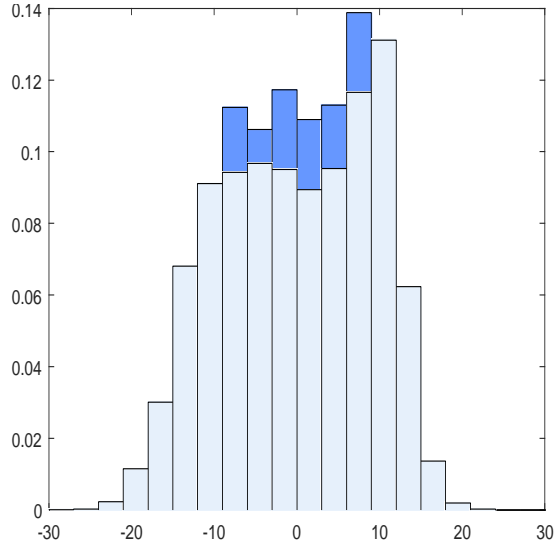
# SEASONAL TOTAL PRECIPITATION BIASES



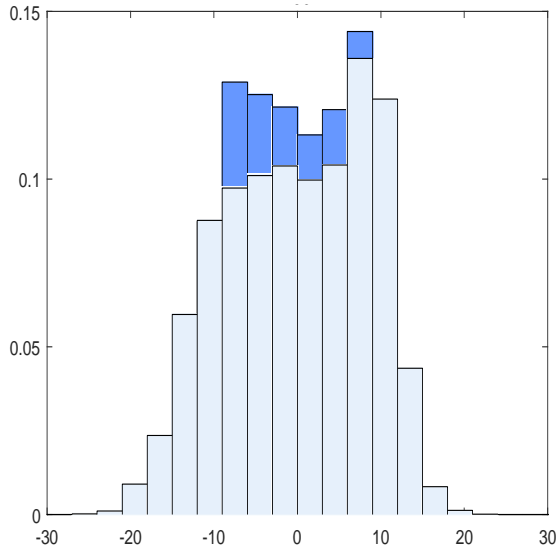
✧ High inconsistency in DJF & SON

# PDF OF DAILY TEMPERATURE

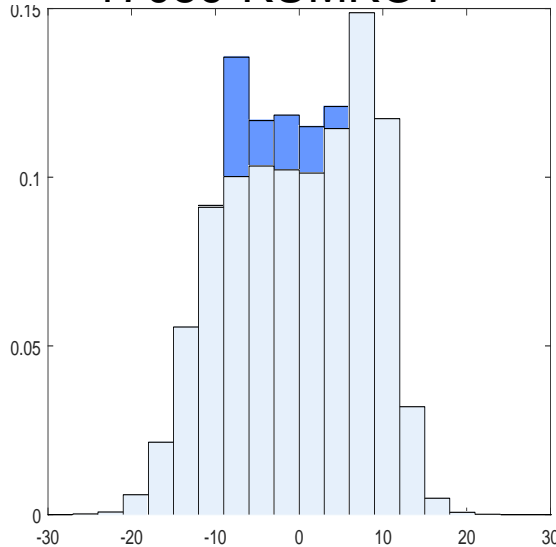
17054-CORLU



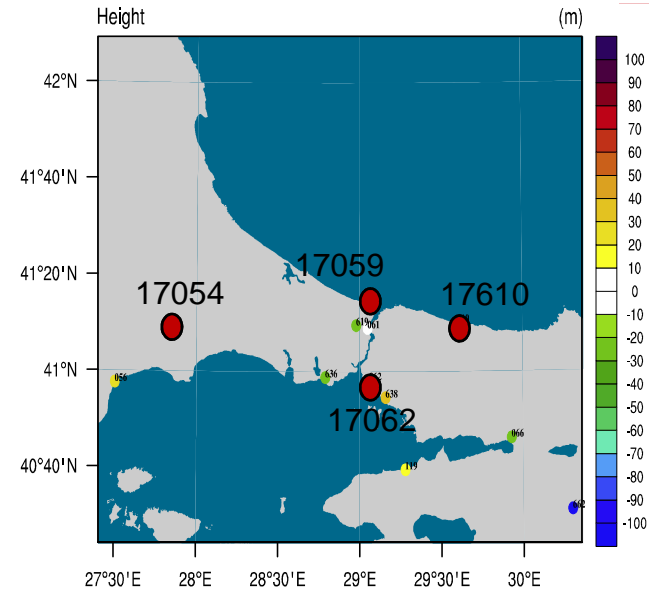
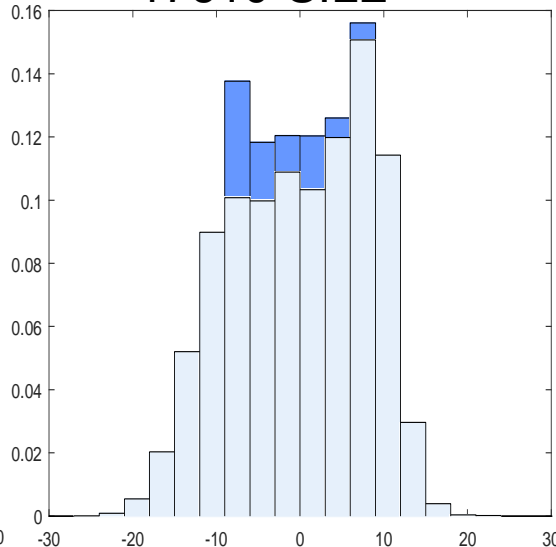
17062-GOZTEPE



17059-KUMKOY

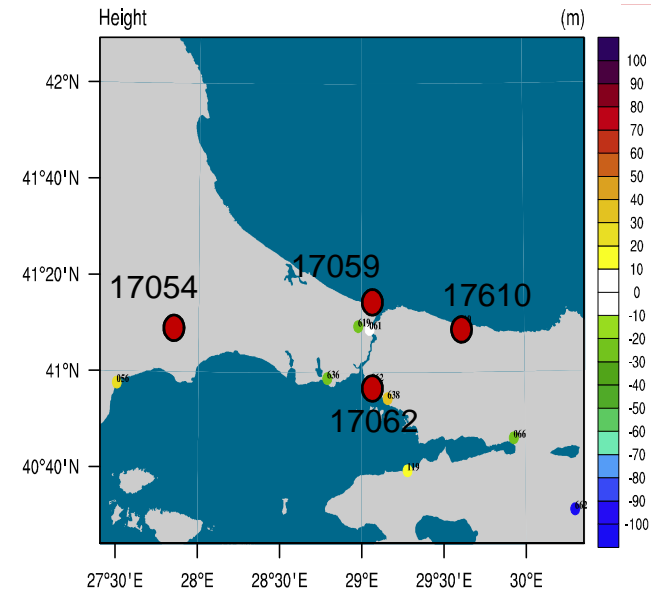
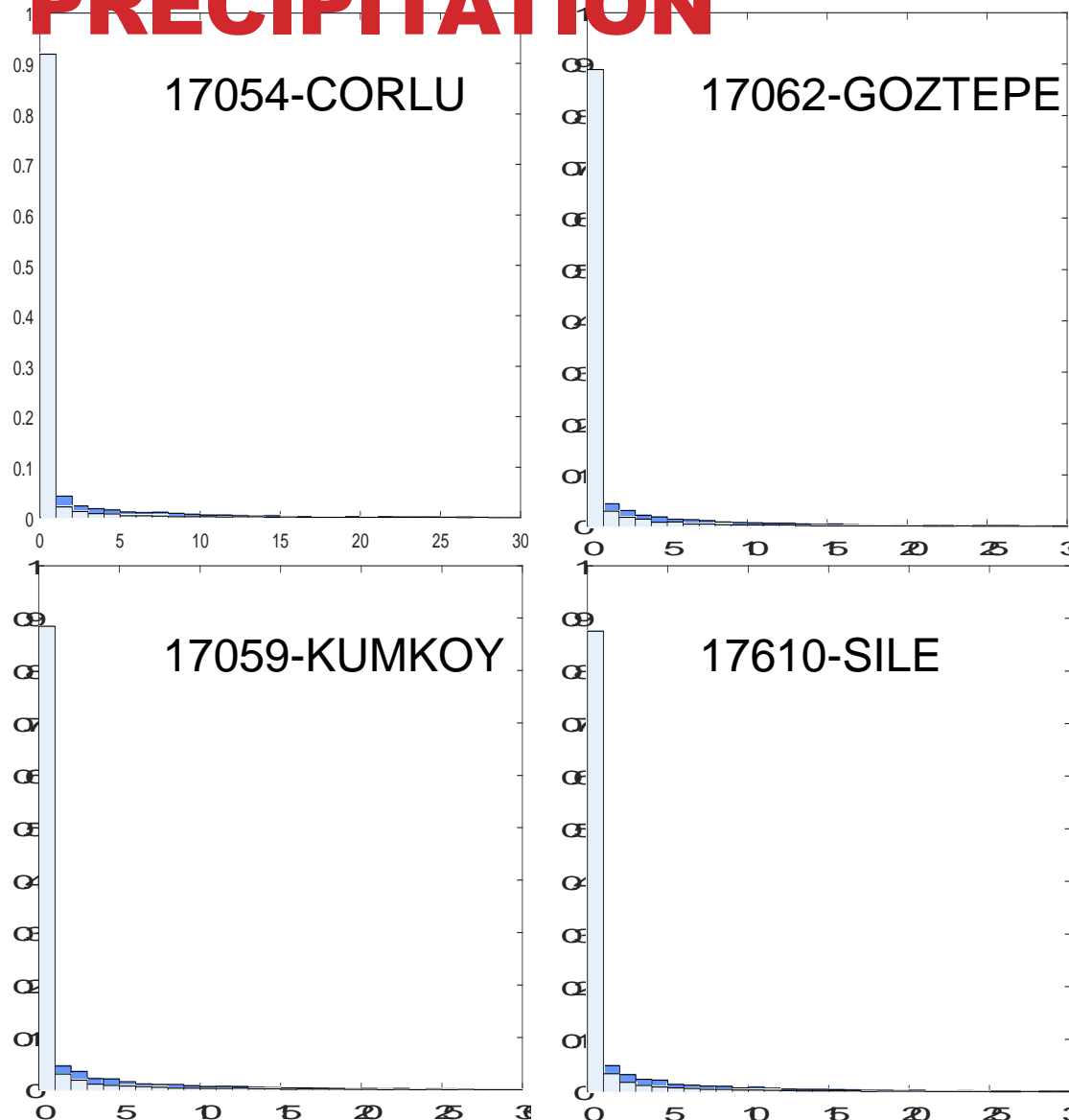


17610-SILE



✧ The model overestimates high temperatures

# PDF OF DAILY PRECIPITATION



- ✧ The model produces less rainy days (<1mm) than observations ~10% dry
- ✧ The model underpredicts extreme precipitations

# CONCLUSION

- ✧ 2-m Temperature
  - ✧ The best agreement is obtained for 0.0275° resolution.
  - ✧ CCLM + NCEP1 has tendency to underestimate winter and fall temperatures while overestimating spring and summer temperatures.
  - ✧ Model overpredicts high and low temperatures.
- ✧ Total Precipitation
  - ✧ The best agreement is obtained for 0.11° resolution.
  - ✧ However, high resolution simulations reveal more systematic biases over Istanbul.
  - ✧ CCLM + NCEP1 underestimates precipitation in the smaller domain, especially in winter and autumn seasons.
  - ✧ The model produces less rainy days.

# THANK YOU...

## Acknowledgements

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We would like to thank to

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- ✓ Turkish State Meteorological Service (TSMS) for sharing data with us and
- ✓ National Center for High Performance Computing (UHeM) for providing us supercomputing .