

A comparative analysis of CMIP and MedCORDEX output for Mediterranean SSTs

Are the statistical properties of observed SSTs captured in the historical runs of CMIP and MedCORDEX models?

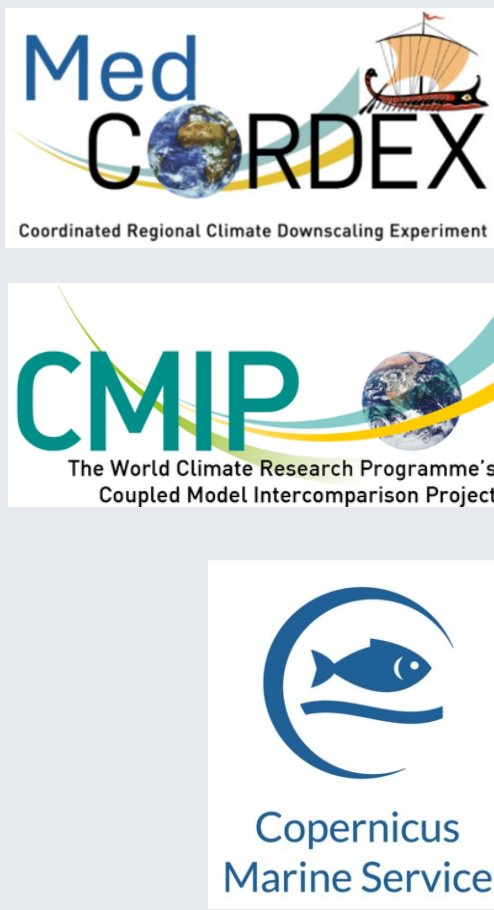
BACKGROUND

Why focus on SSTs?

Our work is the initial step towards a better understanding of the representation of Marine Heat Wave (MHW) events in models, as MHW indicators are largely based on SST observations/outputs.

Do state-of-the-art models accurately represent Med SSTs?

We compare Global Climate Model (GCM) outputs from the Coupled Model Intercomparison Project (CMIP, phases 5 and 6), and the Coordinated Regional Climate Downscaling Experiment (CORDEX) for the Mediterranean domain against SST observations from the Copernicus Marine Service (CMS) L4 reprocessed data. Our target is to evaluate the representation of historical and future SST. Our choice of the models is based on the availability of daily sub-surface temperature outputs in MedCORDEX products.



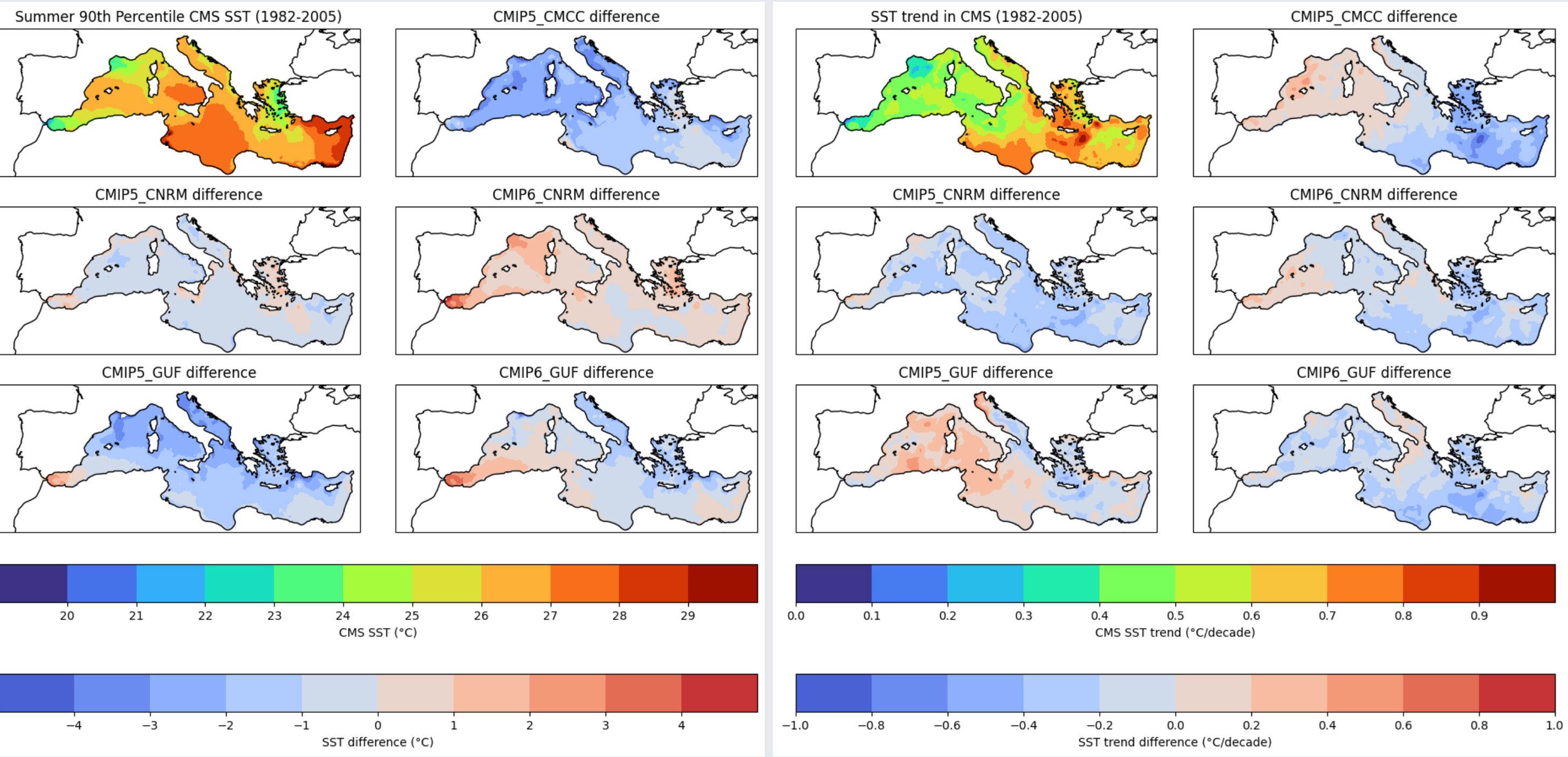
List of models and experiments:

MedCORDEX model (and nickname)	Parent GCM and experiments
CMCC COSMOMED (CMIP5 CMCC)	CMCC-CM, historical/rcp45/rcp85, r1i1p1
CNRM RCSM4 (CMIP5 CNRM)	CNRM-CM5, historical/rcp45/rcp85, r1i1p1
CLMcom-GUF-CCLM5-0-9-NEMOMED12-3-6 (CMIP5 GUF)	EC-Earth, historical/rcp85, r1i1p1
CNRM RCSM6 (CMIP6 CNRM)	CNRM-ESM2-1, historical/ssp585, r1i1p1f2
CLMcom-GUF-CCLM5-0-9-NEMOMED12-3-6 (CMIP6 GUF)	EC-Earth3-Veg, historical/ssp585, r12i1p1f1

MedCORDEX VALIDATION

MedCORDEX models show different skills in representing historical Med SST

MedCORDEX underestimate average SST (except CMIP6 CNRM) and SST trend (except CMIP5 GUF) in the historical period (1982-2005).

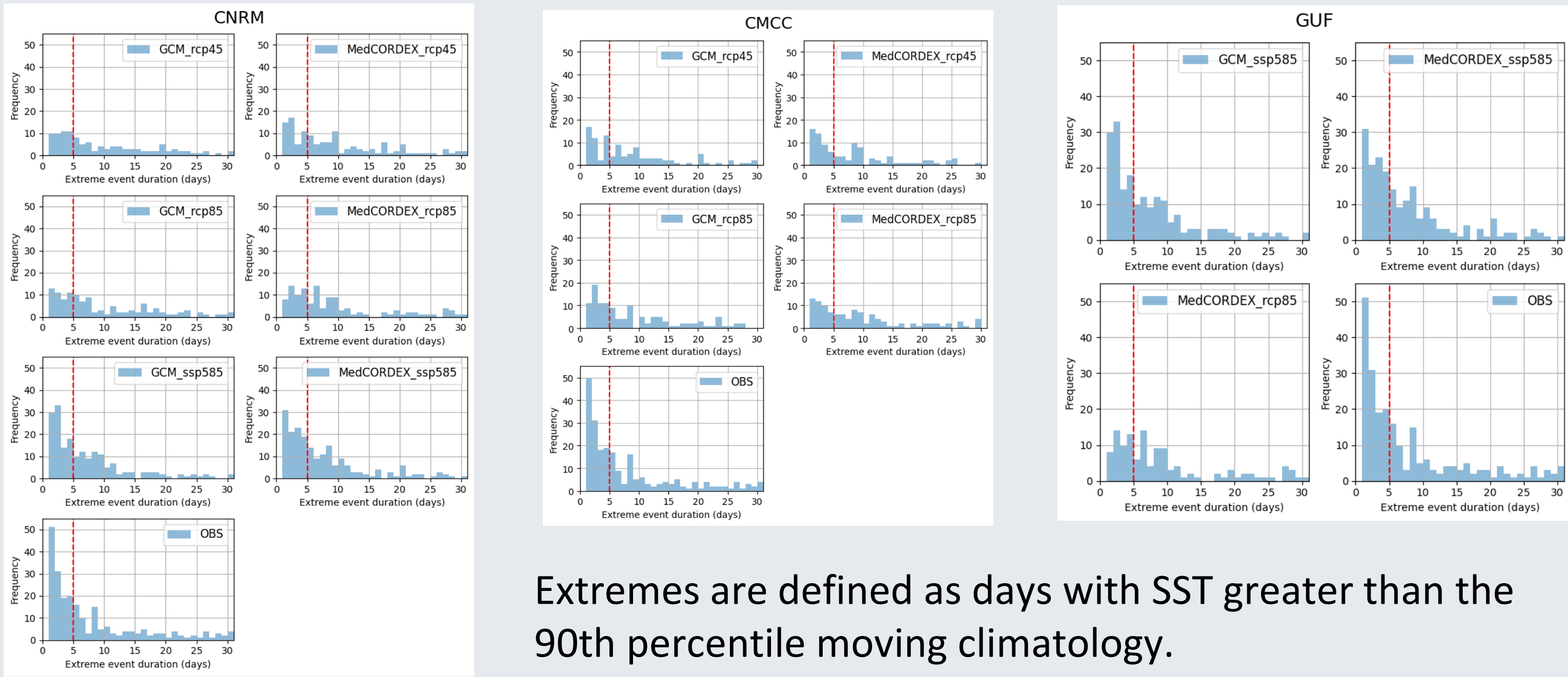
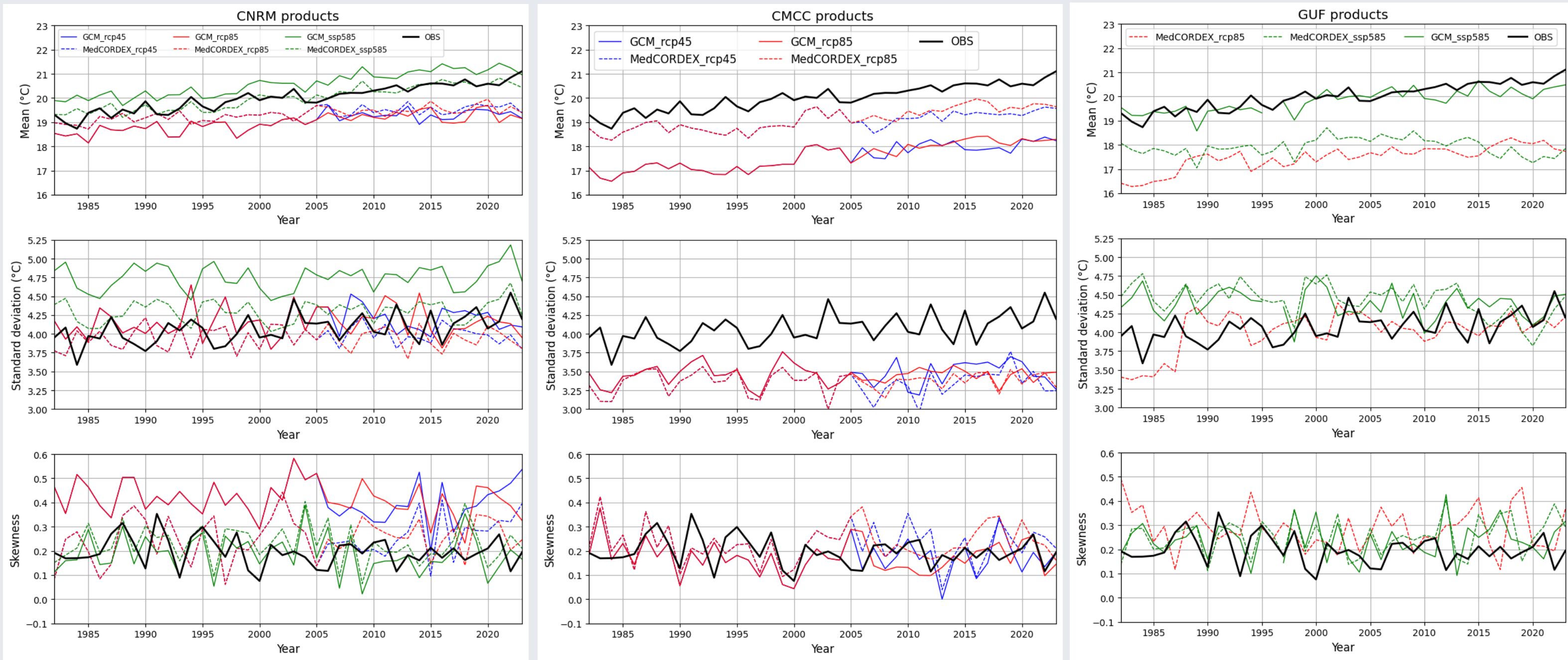


Model	Average (°C)	Summer 90th percentile (°C)	Trend (°C/decade)	Standard deviation (°C)
CMIP5 CNRM	19.18 (-0.45)	25.65 (-0.49)	0.19±0.05 (-0.25)	3.94 (-0.08)
CMIP5 CMCC	18.83 (-0.81)	24.24 (-1.9)	0.3±0.09 (-0.14)	3.38 (-0.65)
CMIP5 GUF	17.19 (-2.44)	24.27 (-1.86)	0.51±0.1 (+0.07)	4.0 (-0.03)
CMIP6 CNRM	19.65 (+0.01)	26.54 (+0.41)	0.31±0.06 (-0.14)	4.28 (+0.26)
CMIP6 GUF	17.91 (-1.72)	25.38 (-0.76)	0.26±0.09 (-0.19)	4.52 (+0.49)
CMS (Observations)	19.63	26.14	0.45±0.07	4.03

All statistics refer to area-averaged Med SST in 1982-2005. Difference from CMS is reported in ().

COMPARISON OF CMIP, MedCORDEX AND OBSERVATIONS

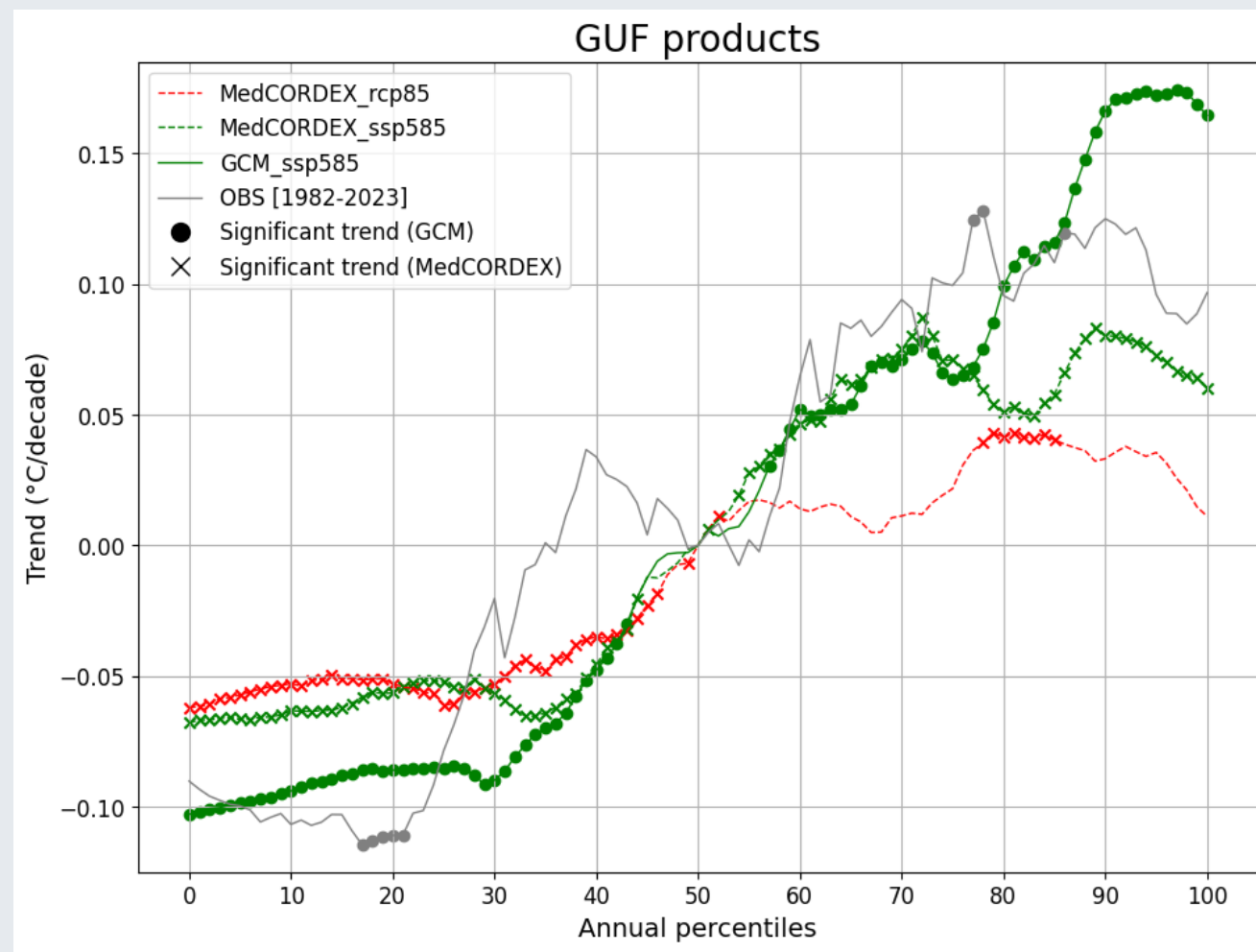
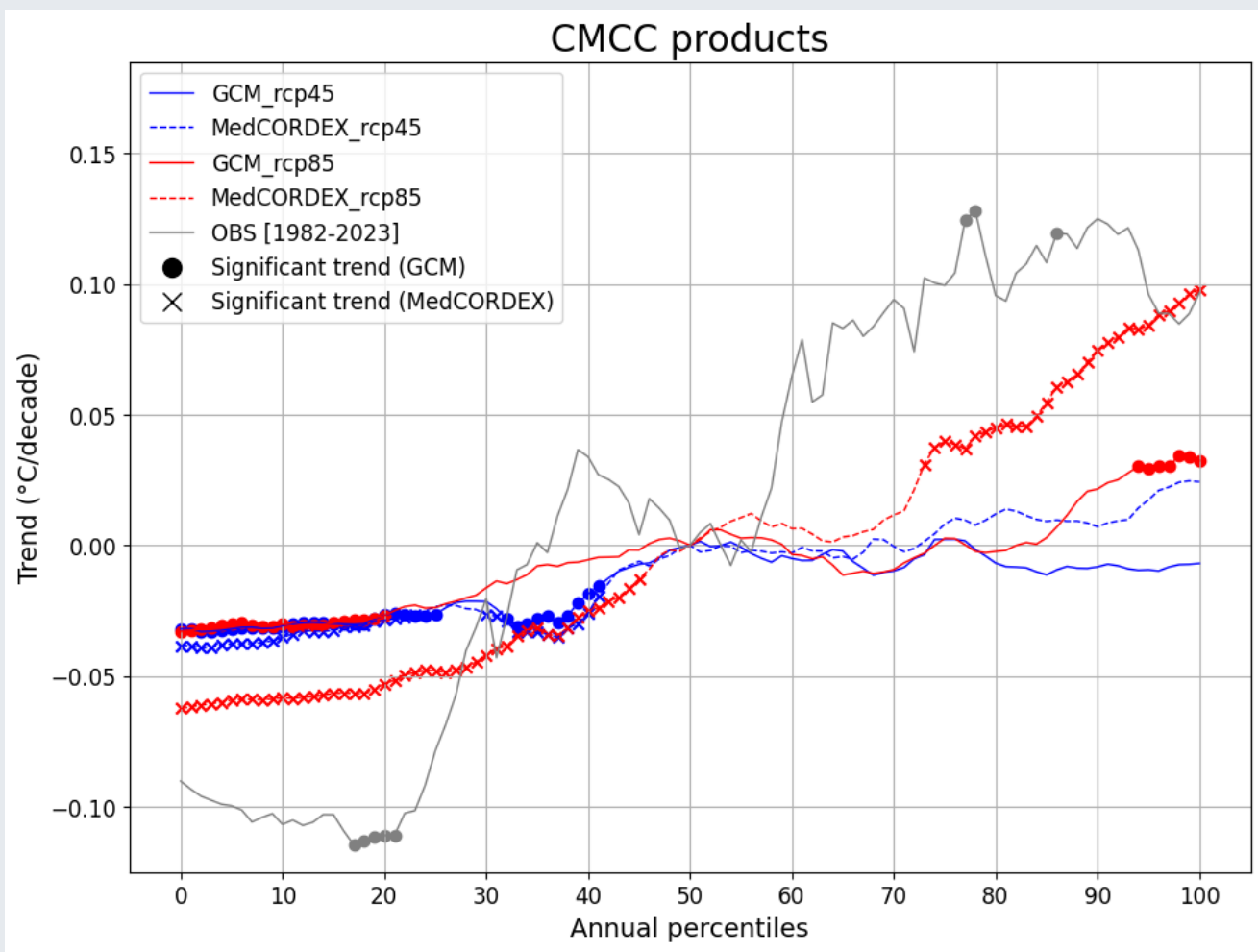
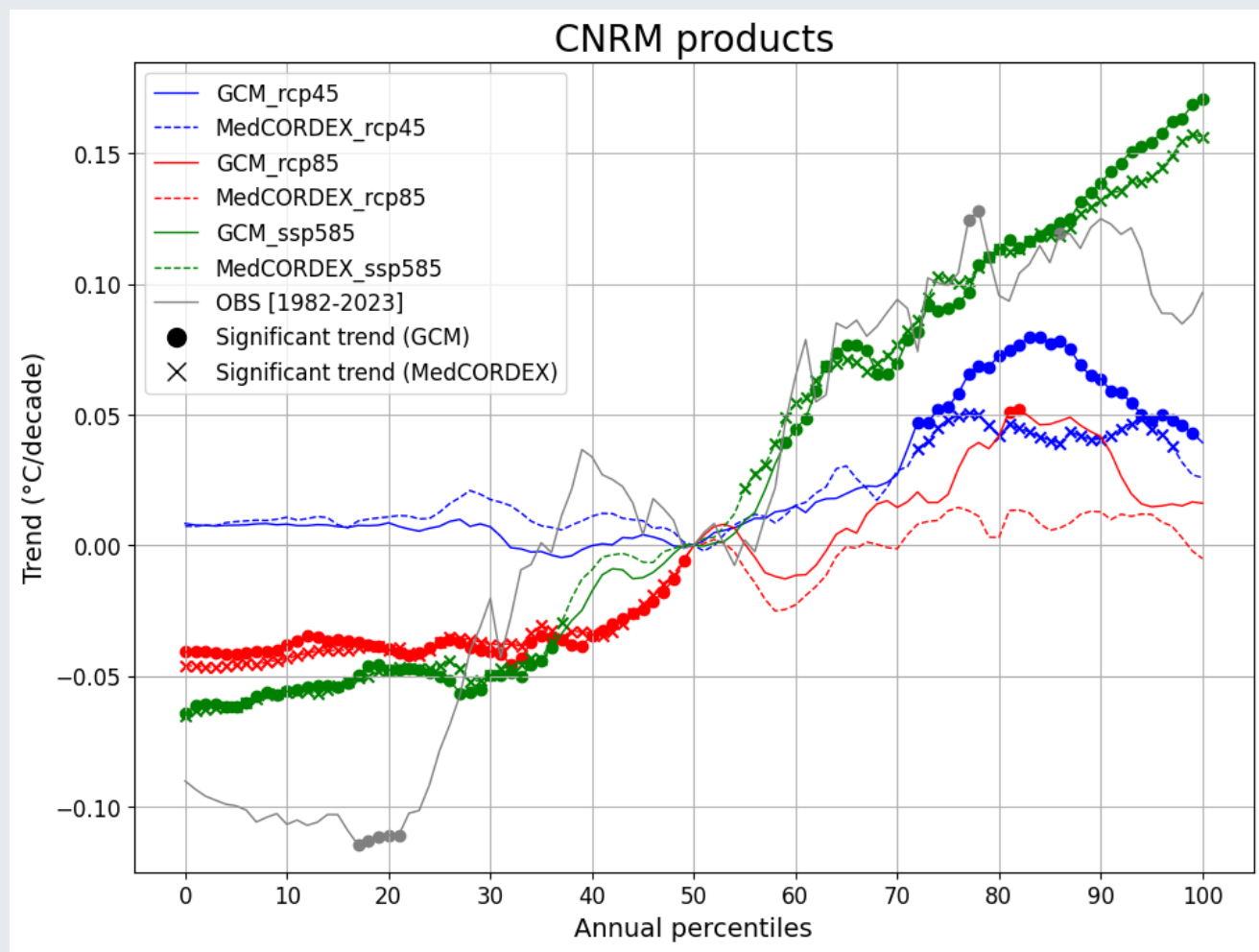
Do MedCORDEX models better represent area-averaged Med SST properties over GCMs?



Extremes are defined as days with SST greater than the 90th percentile moving climatology.

Expanding area-averaged Med SST distributions in future projections

Median-removed annual percentiles exhibit positive (negative) trends in larger (lower) percentiles over 2000-2100, suggesting that the annual area-averaged SST distribution around the median will be broader in the future, with implications for future extremes.



Future directions

- What are the implications of an expanding SST distribution for MHW studies?
- Compare surface MHW properties among CMIP, MedCORDEX and observations
- Assess sub-surface MHWs at a daily resolution in MedCORDEX products



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