

# Variability in solar based power generation at the Eastern Mediterranean

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ΑΚΑΔΗΜΙΑ



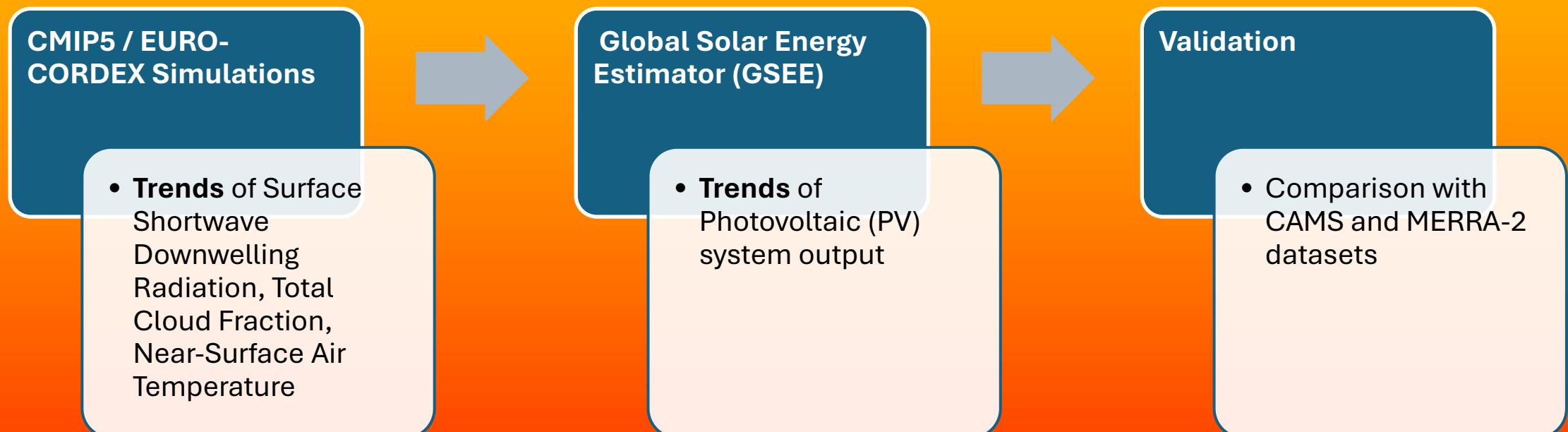
ΑΟΗΝΩΝ



HARMONIA



# Introduction



# CMIP / EURO – CORDEX Simulations

## ❖ Temporal Coverage

Historical (1951-2005), Representative Concentration Pathways (RCP) 2.6, 4.5, and 8.5 [low, moderate, and very high future emissions] (2006-2100)

## ❖ Climate Models

Global Climate Model (GCM): CNRM-CERFACS-CM5

Regional Climate Model (RCM): CNRM-ALADIN63 → Aerosol scheme (TACTIC) (Nabat *et al.*, 2020)

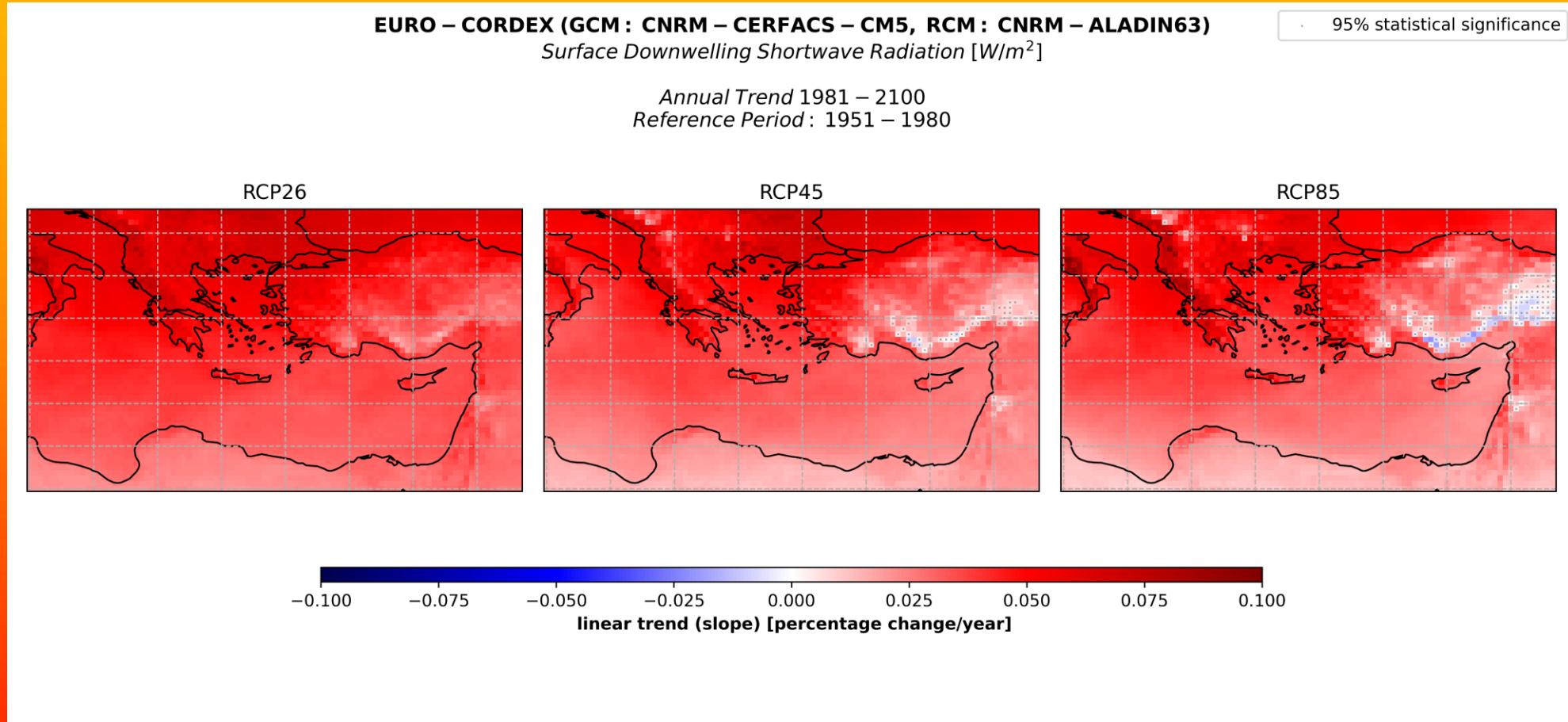
## ❖ Variables

Surface Shortwave Downwelling Radiation (rsds), Total Cloud Fraction (clt), Near-Surface Air Temperature (tas)

## ❖ Region

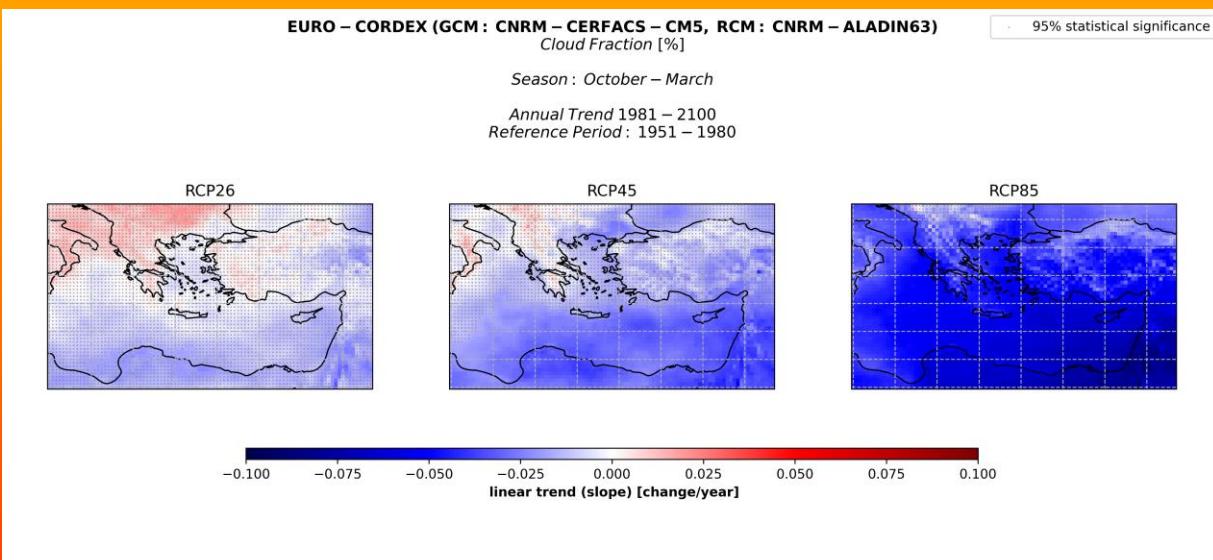
Eastern Mediterranean

# Surface Downwelling Shortwave Radiation (rsds)

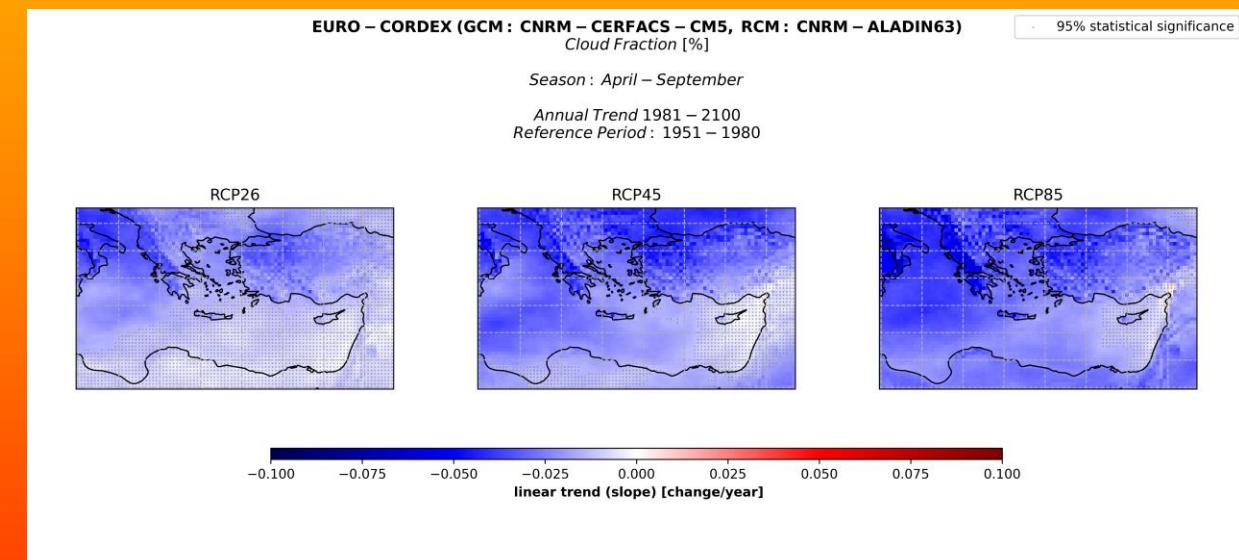


# Total Cloud Fraction (clt)

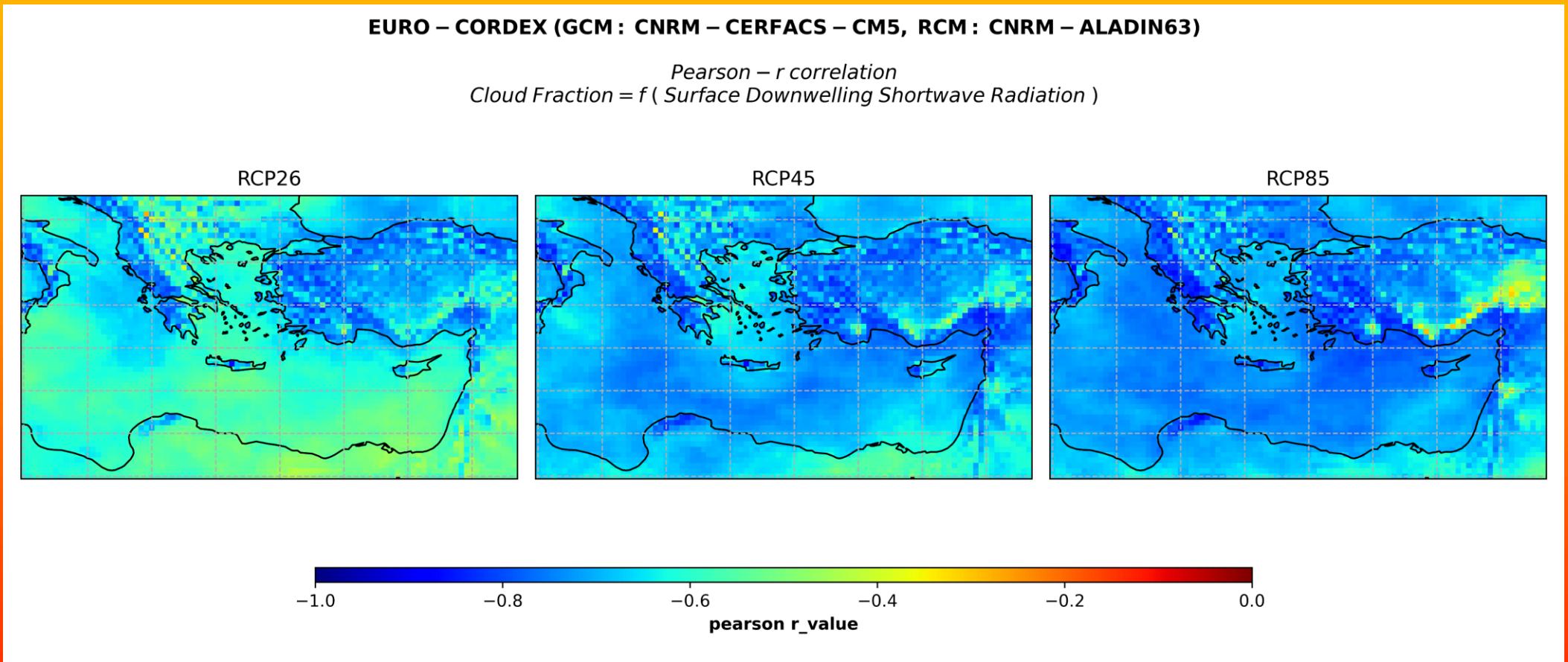
**October – March (Winter period)**



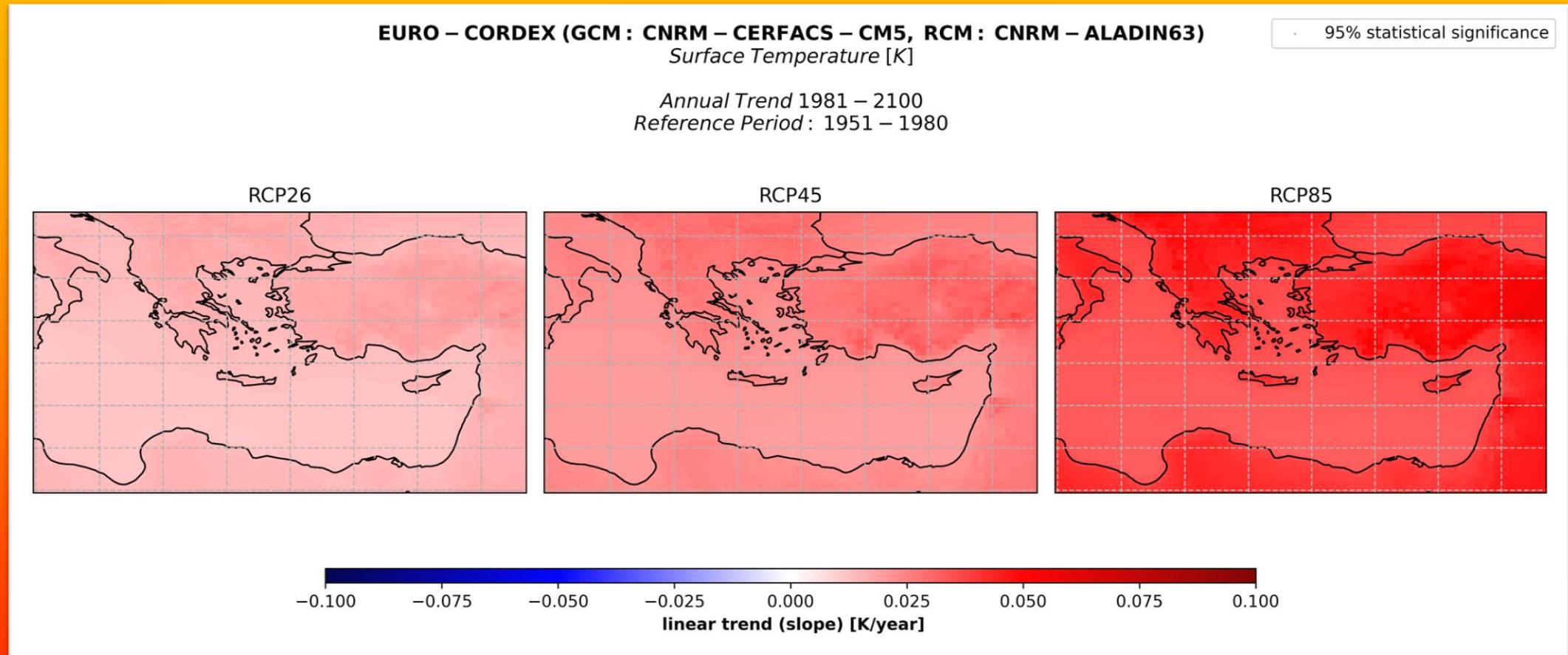
**April – September (Summer period)**



# $\text{clt} = f(\text{rsds})$ Pearson – r correlation



# Near-Surface Air Temperature (tas)



# Global Solar Energy Estimator (GSEE)

(Pfenninger & Staffell, 2016)



## Photovoltaic (PV) system simulating model

is a solar energy simulation library designed for rapid calculations and ease of use

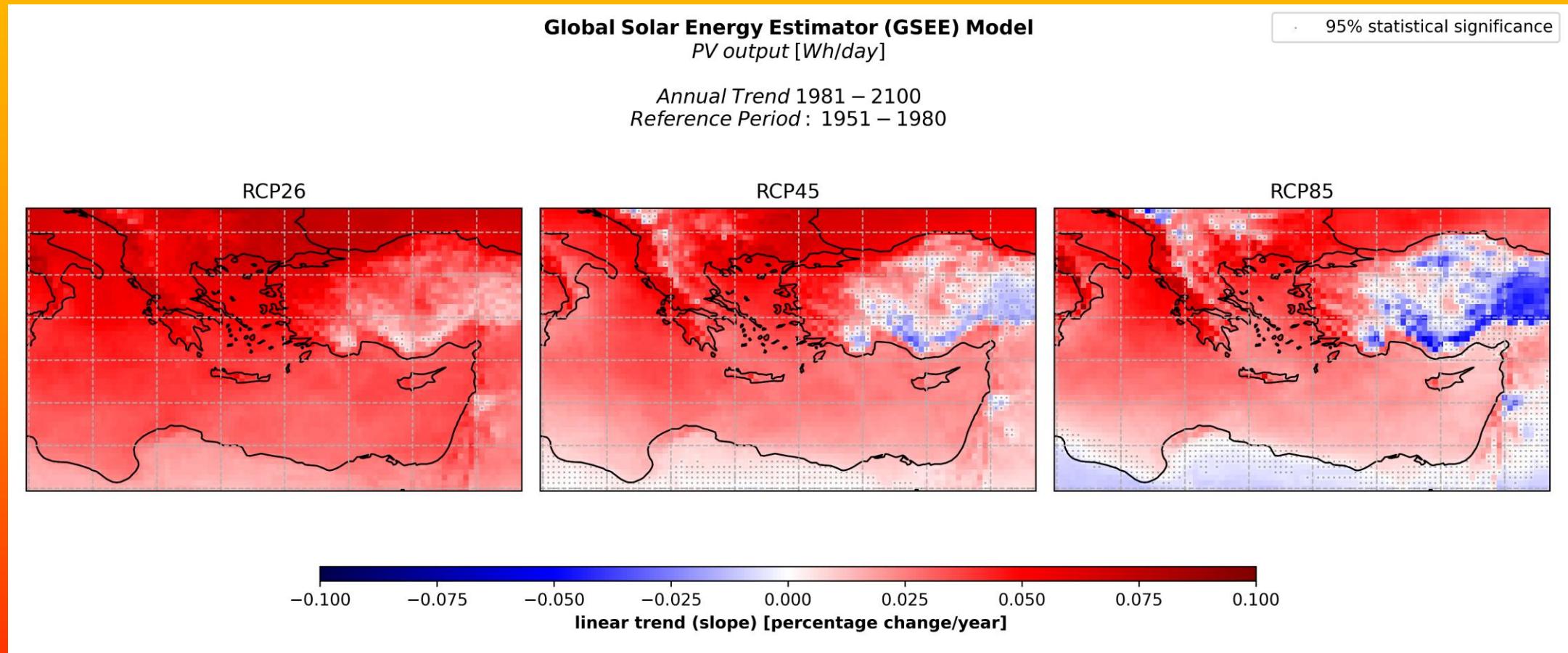
## Climate Data Interface submodule

**Input Data**  
netCDF: Global Horizontal Irradiance =  $f(\text{time}, \text{lat}, \text{lon})$   
Optionally: Diffuse Irradiance and Ambient Temperature

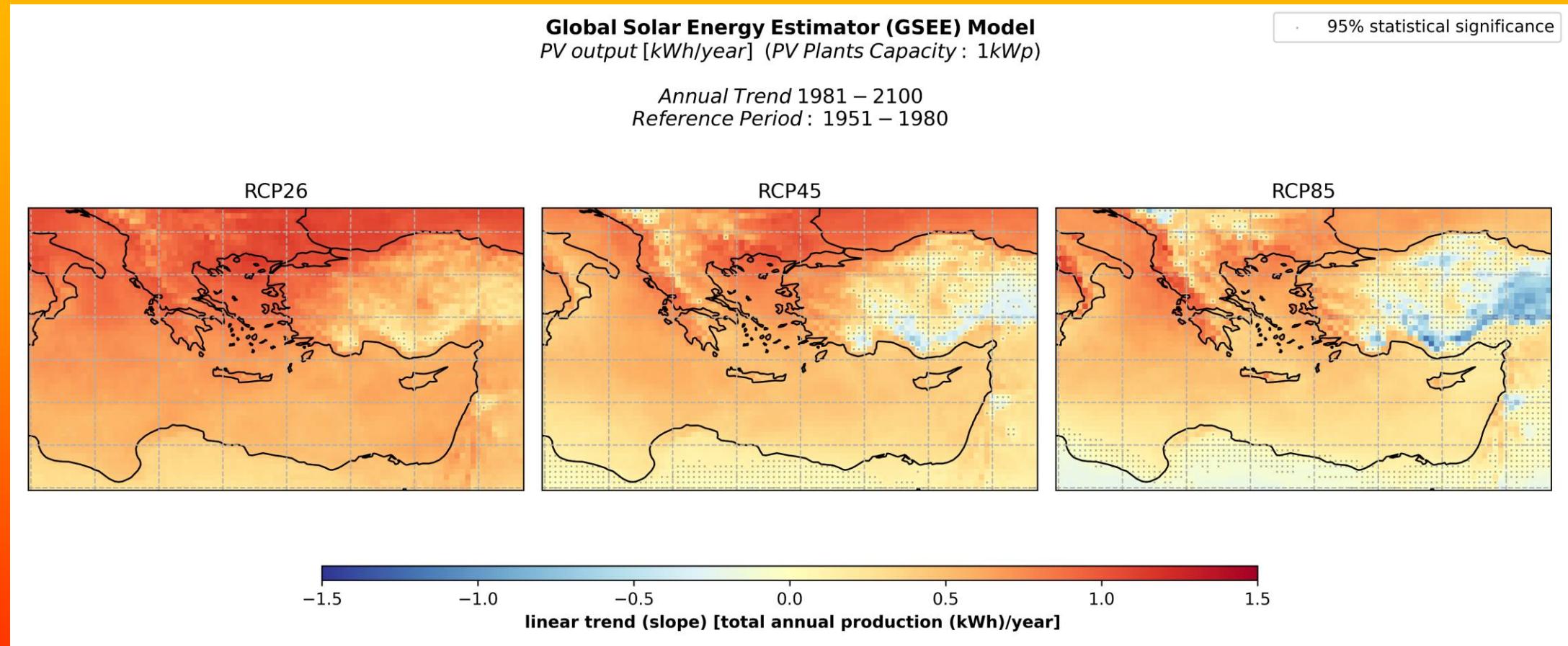
**Input  
Parameters**  
Tilt, capacity, orientation, tracking

**Output**  
PV out (kWh)

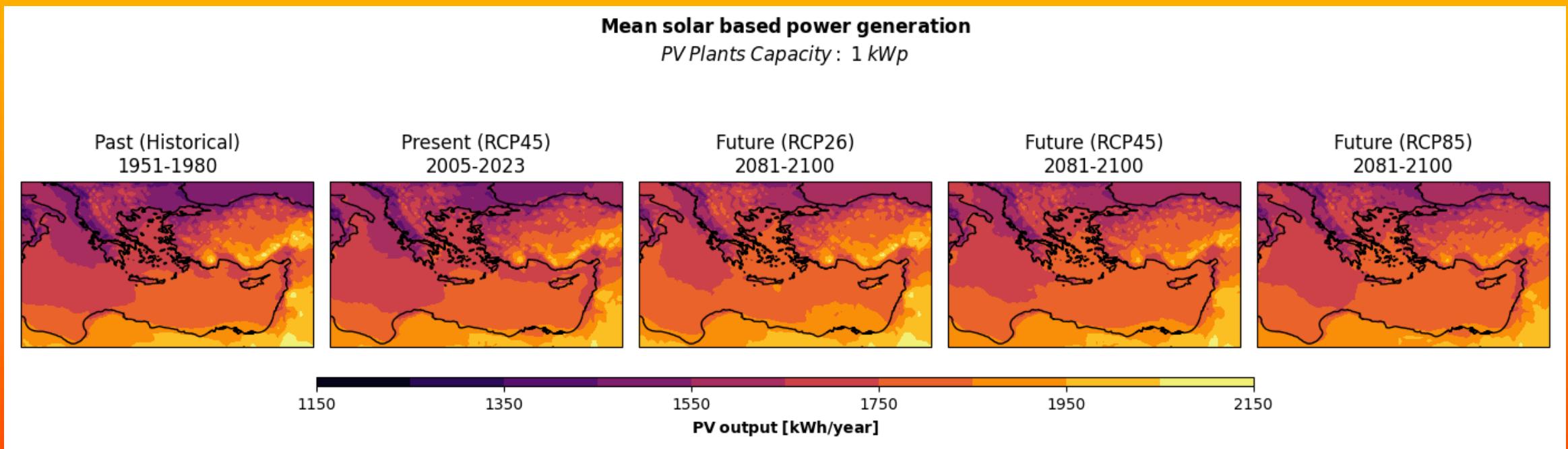
# Solar Based Power Generation



# Solar Based Power Generation (2)



# Solar Based Power Generation (3)



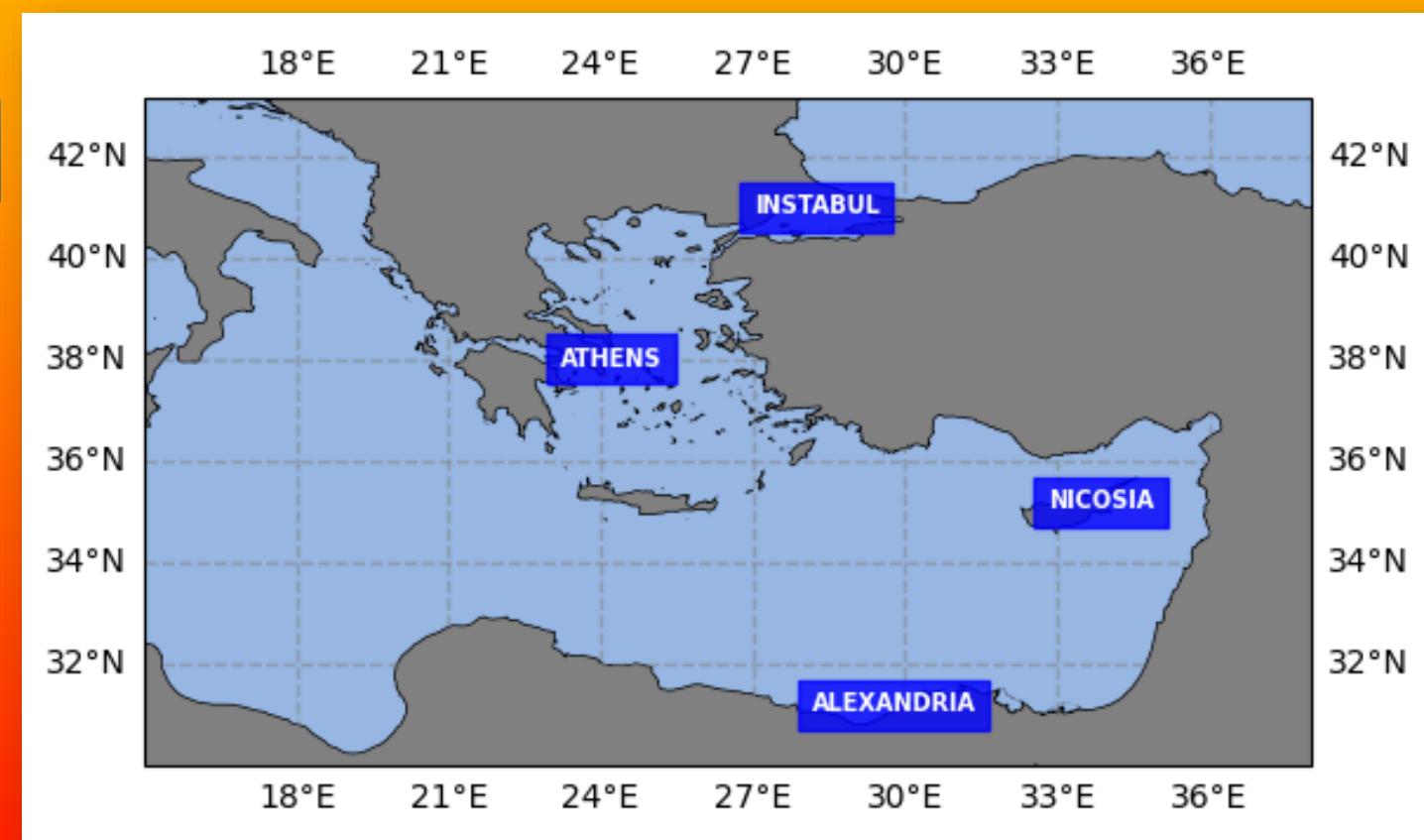
# Regional Climate Model validation

## CAMS

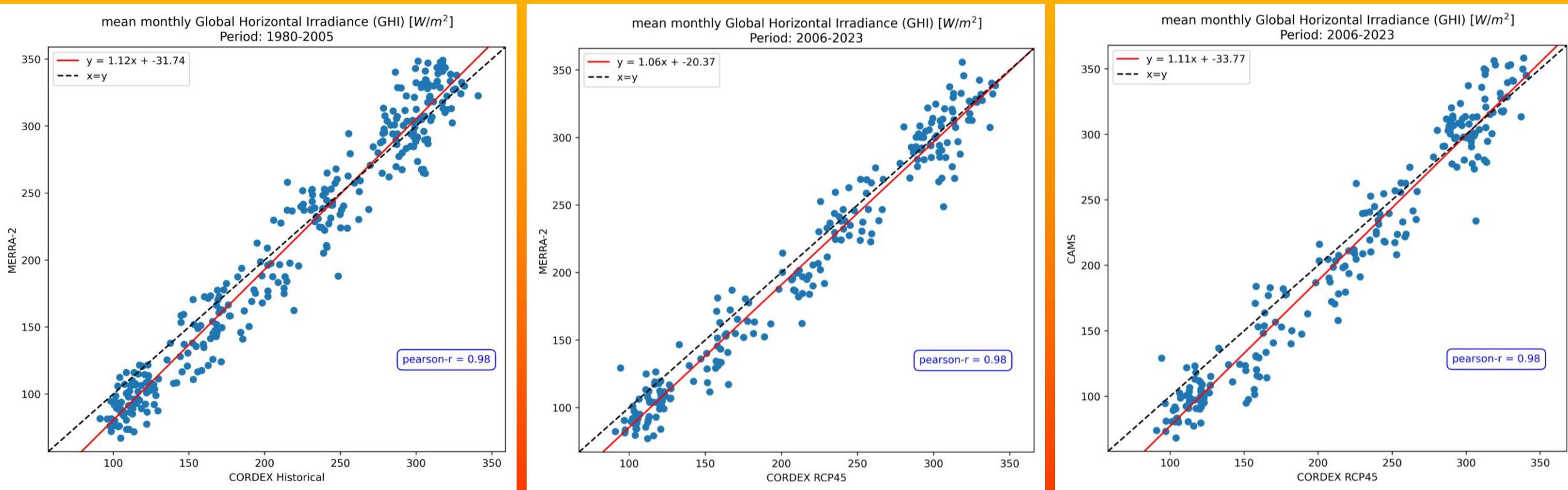
- 2006-2023 with CORDEX RCP45

## MERRA-2

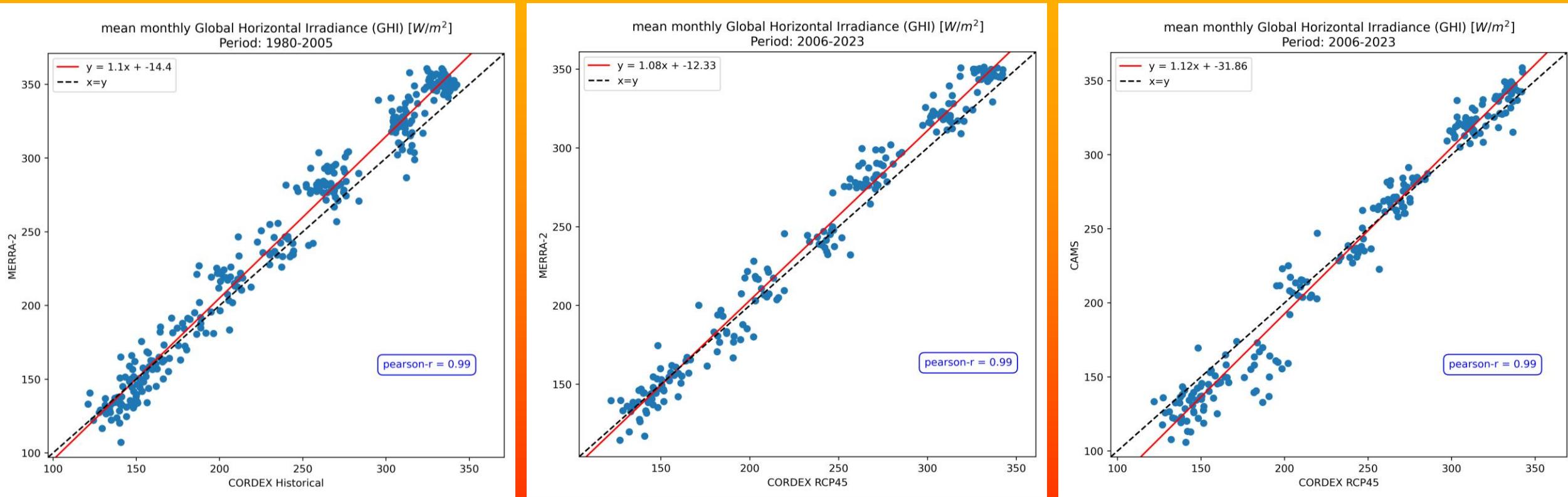
- 1980-2005 with CORDEX Historical
- 2006-2023 with CORDEX RCP45



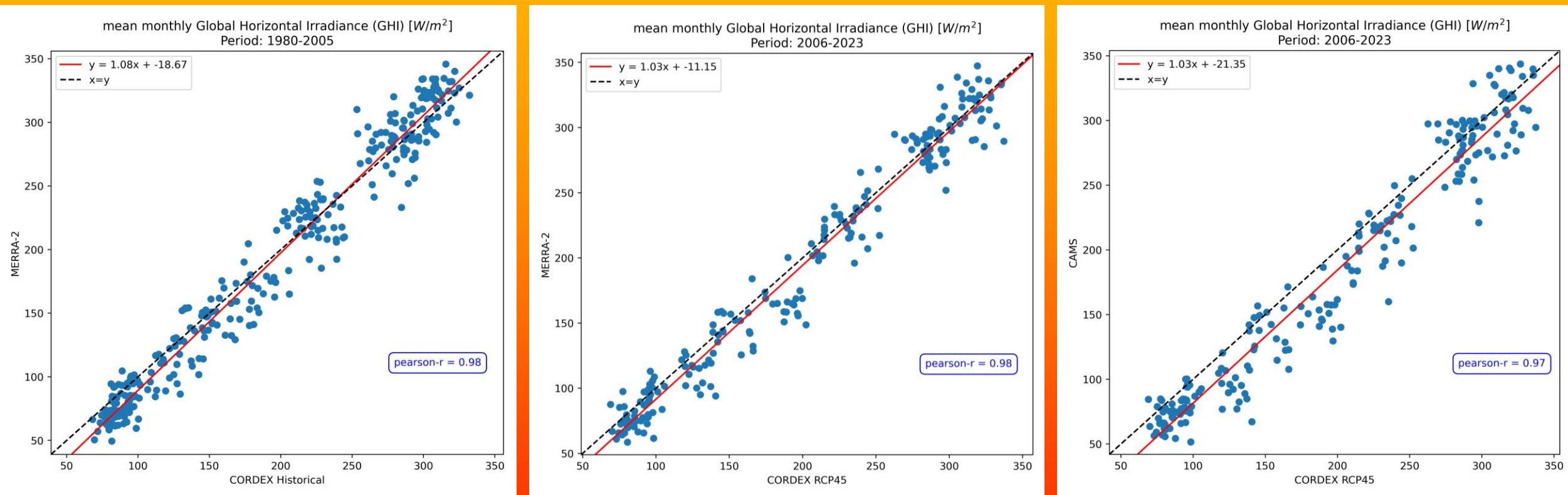
# Regional Climate Model validation - Athens



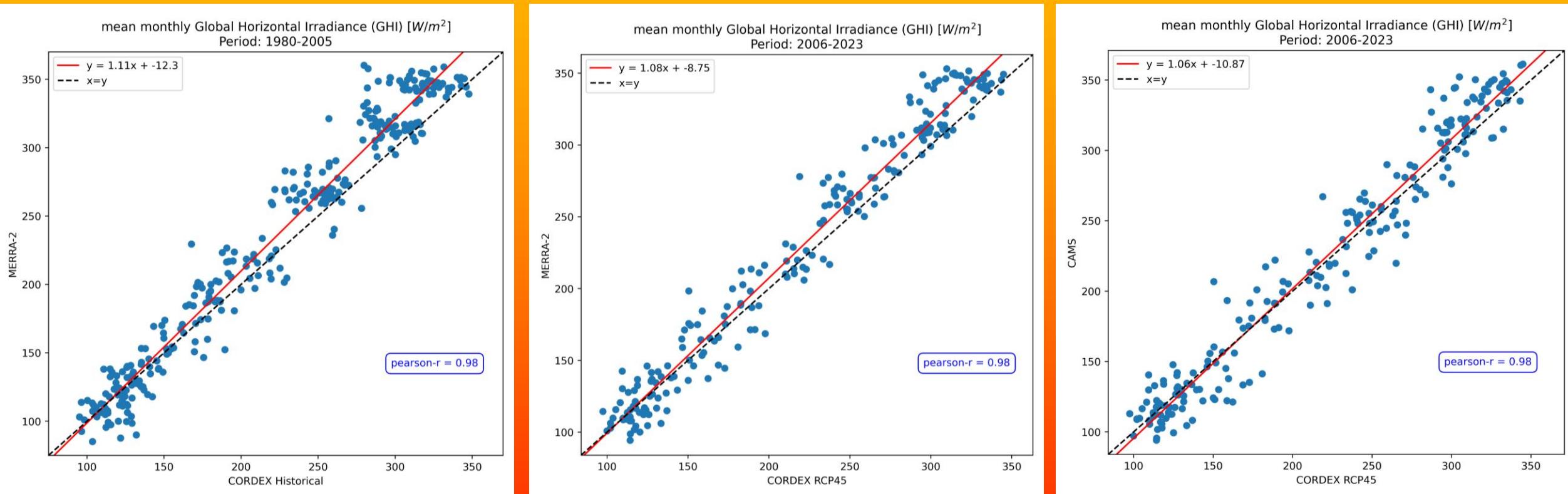
# Regional Climate Model validation - Alexandria



# Regional Climate Model validation - Istanbul



# Regional Climate Model validation - Nicosia



# Future work

- ❖ Simulations with GSEE for Global Climate Models (CMIP5)
- ❖ Simulations with GSEE for Regional Climate Models (CMIP6) ~ when they will be available

# References

1. Nabat, P., Somot, S., Cassou, C., Mallet, M., Michou, M., Bouniol, D., ... Saint-Martin, D. (2020). Modulation of radiative aerosols effects by atmospheric circulation over the Euro-Mediterranean region. *Atmospheric Chemistry and Physics*, 20(14), 8315–8349. doi:10.5194/acp-20-8315-2020
2. Pfenninger, S., & Staffell, I. (2016). Long-term patterns of European PV output using 30 years of validated hourly reanalysis and satellite data. *Energy (Oxford, England)*, 114, 1251–1265. doi:10.1016/j.energy.2016.08.060

Thank you!