# Projecting the Potential Evapotranspiration of Egypt using a high-resolution regional climate model (RegCM4)

By

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# Motivation

- Calculating potential Evapotranspiration (PET) is important especially for long term of water management on a regional scale.
- Penman-Monteith (PM) is the best method to calculate PET as recommended by Food and Agriculture Association (FAO). However it requires a large number of meteorological input (which can amplify the error of the simulated PET).
- Instead, Hargreaves-Samani (HS) was selected because it is recommended by the FAO as the best alternative method after the PM and it only requires global incident solar radiation and mean air temperature (available from the regional climate model; RegCM4).

# TARGET OF STUDY

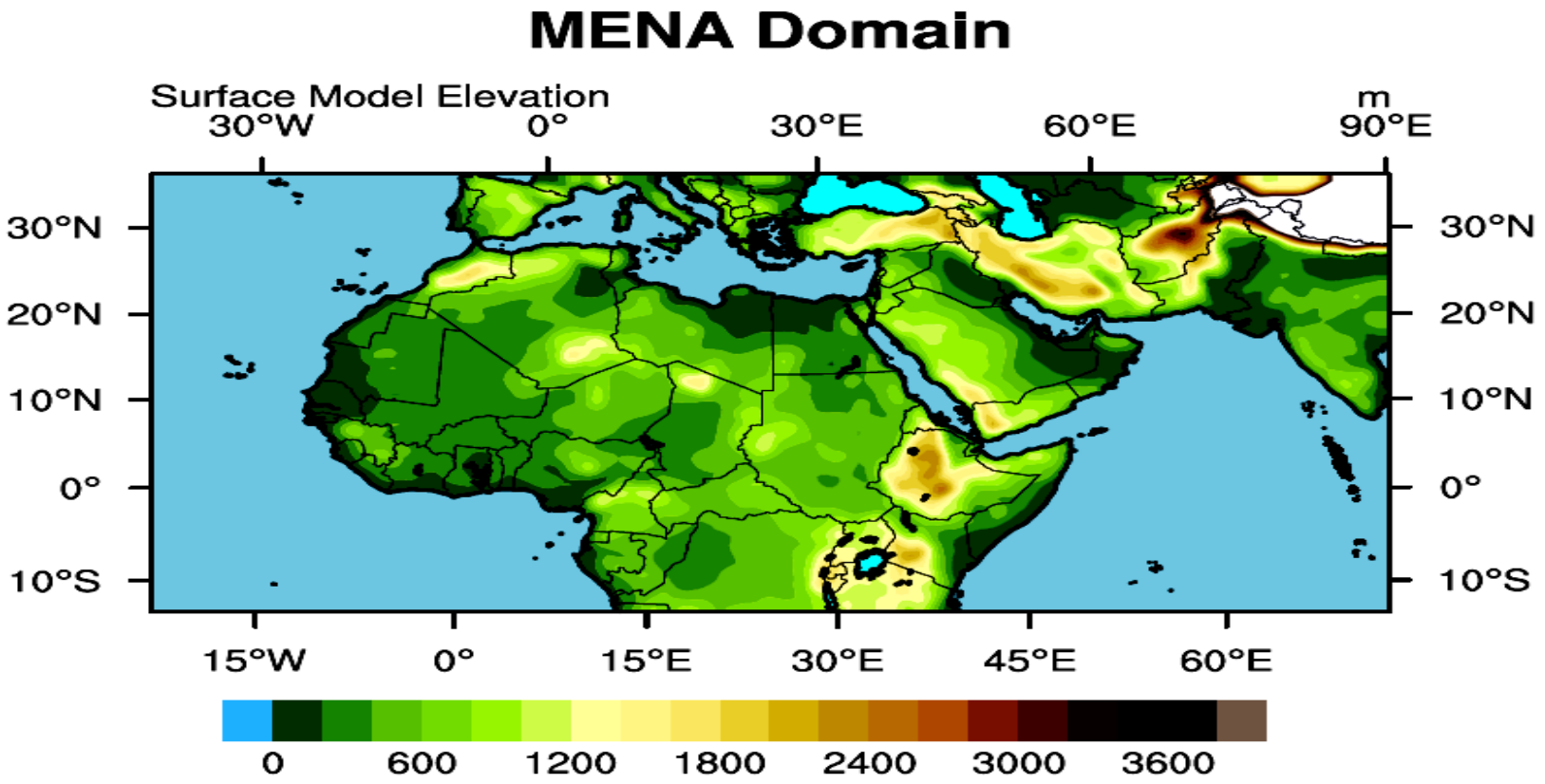
1. Examine the regional future PET changes under the two future scenarios RCP4.5 and 8.5.
2. At a point scale, the capability of the RegCM4 model was evaluated in comparison with the CRU product in the historical period 1981-2005.
3. Correct the projected PET under the two future scenarios using the LRM approach between the RegCM4 and CRU of the historical period.

# EXPERIMENT DESIGN : 1 – PHYSICAL CONFIGURATION

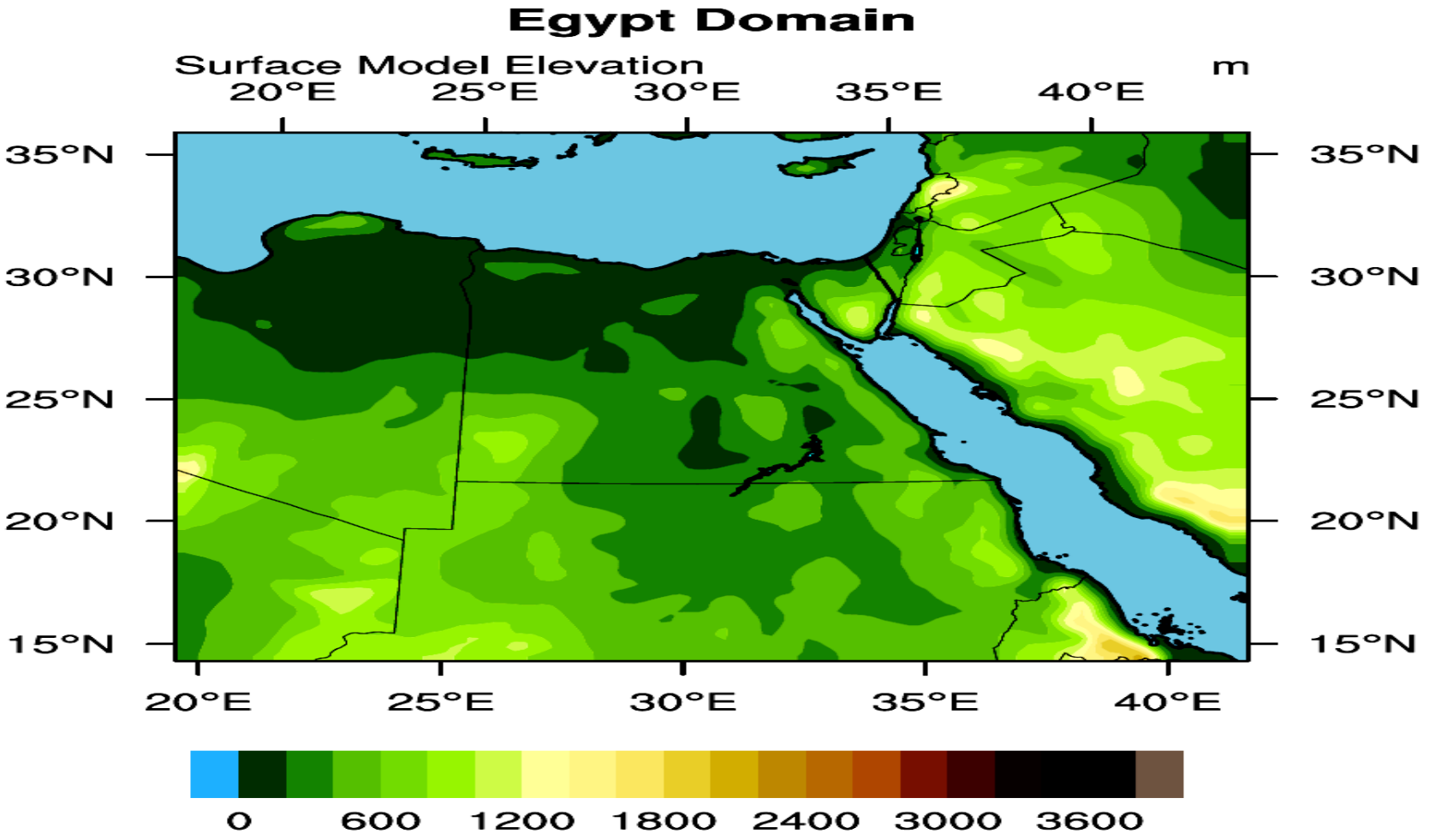
| | |
|---|---|
| Domain Dimension | Coarse domain (50 km with 235 grid points in the zonal direction and 121 grid points in the meridional direction, clat = 19.5, clon = 24.5); Nested domain (20 km with 121 in zonal and meridional direction, clat = 25.5, clon = 30.5) |
| Model Projection | Lambert-conformal |
| Lateral Boundary condition and SST | Max Planck Institute (MPI) with resolution 1.8 x 1.8 degrees<br>Historical : 1981-2005<br>RCP45 and 85 : 2006-2100 |
| Convection scheme | Grell over land and Emanuel over ocean |
| Radiation scheme | Community Climate Model version 3 (CCM3) |
| Land surface scheme | Biosphere Atmosphere Transfer System (BATS) |

# Experiment design: 2 – Domain configuration

## A – Coarse Domain

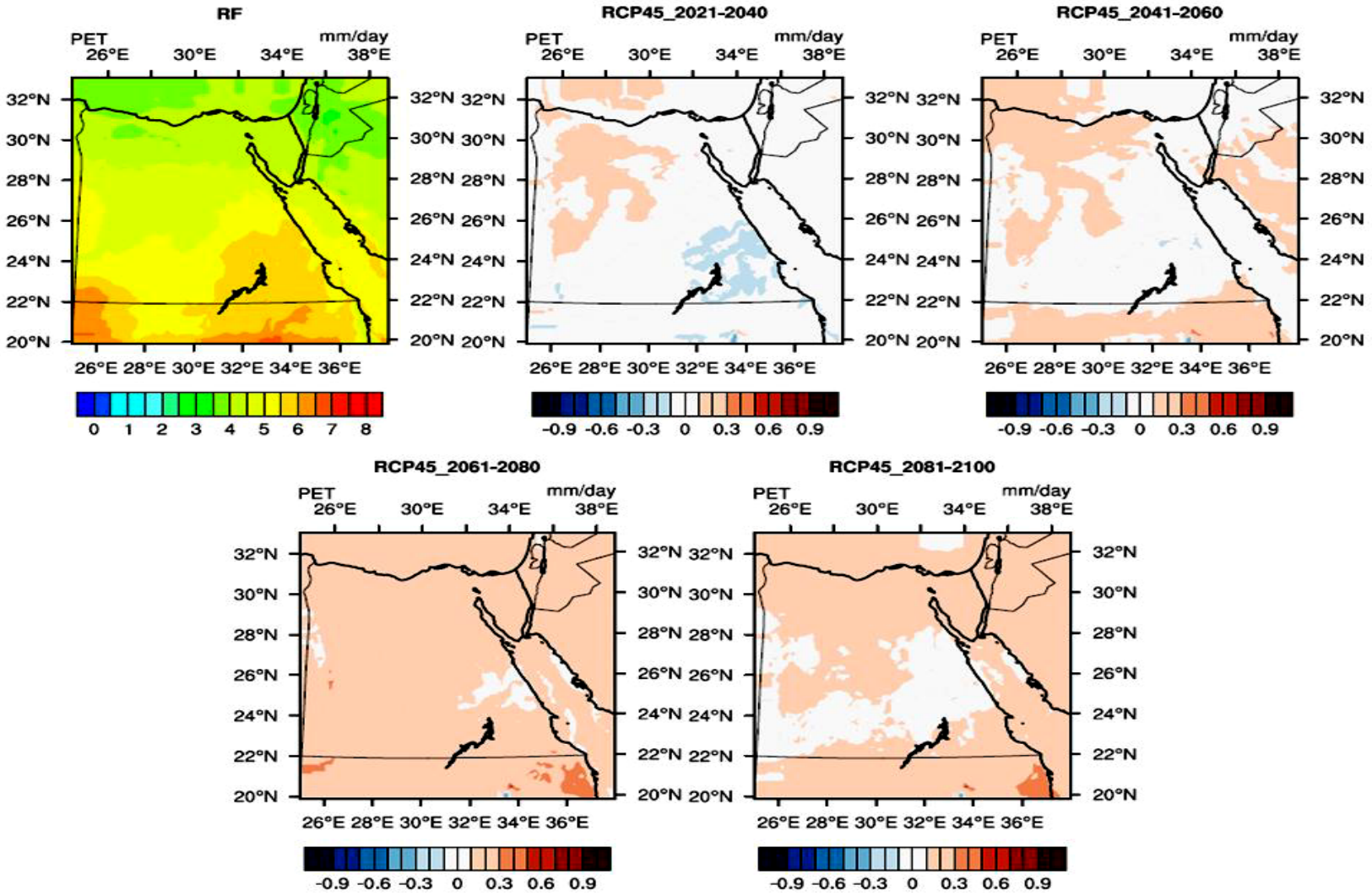


# B – Nested Domain

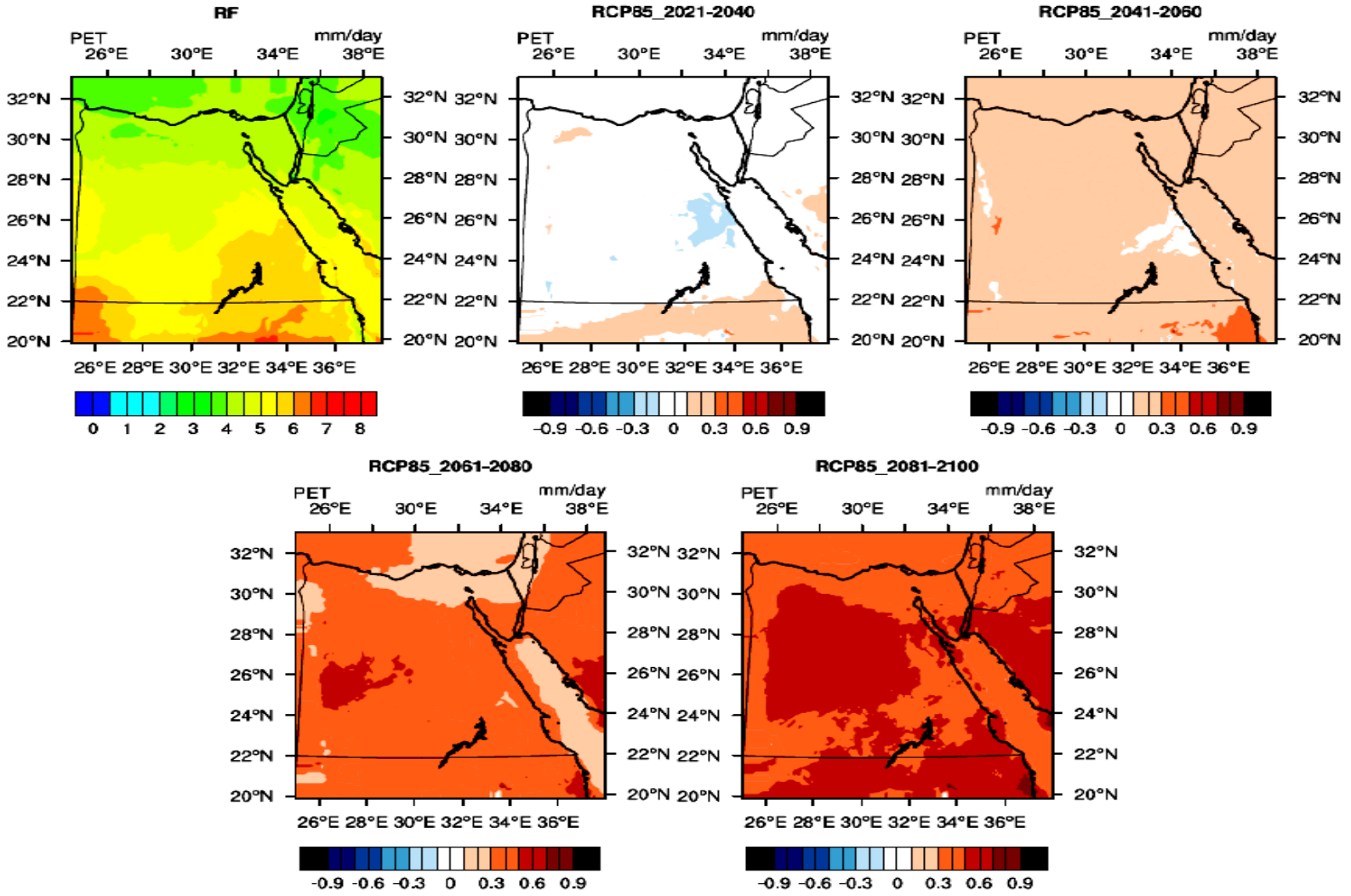


# Observed data: Climate Research Unit (CRU)

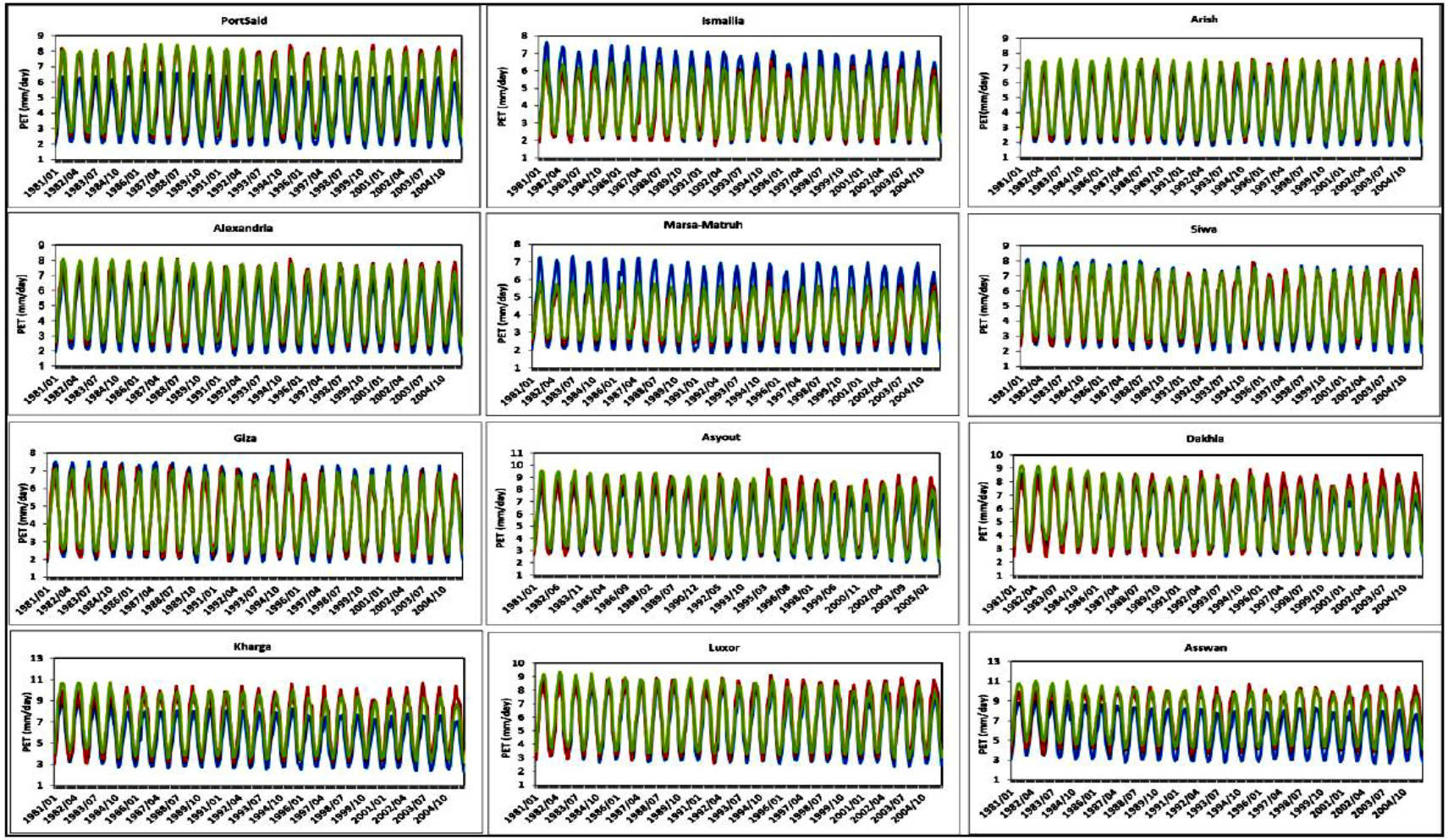
1. The gridded Climatic Research Unit (CRU) Time-series (TS) data version 4.05 data are month-by-month variations in climate, provided on high-resolution (0.5 x 0.5 degree) grids, produced by CRU at the University of East Anglia. CRU product covers the period of 1901-2020.
2. It is considered as one of the best available global reference PET dataset (Mitchell and Jones 2005; Droogers and Allen 2002; IPCC 2007).



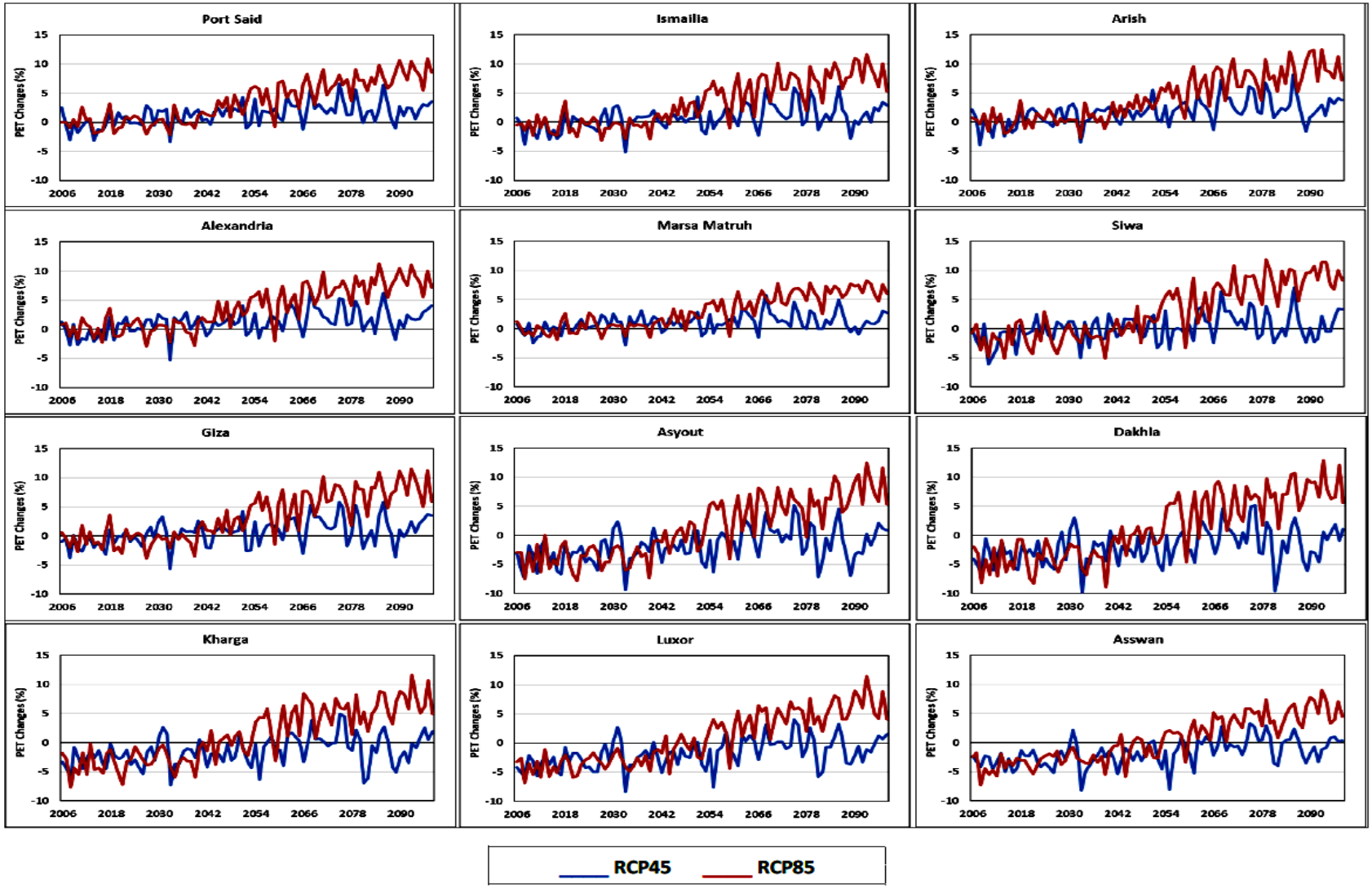

**Average evapotranspiration (mm/day) over Egypt during 1986-2005 (RF) (a) and potential change during the period 2021-2040 (b), the period 2041-2060 (c), the period 2061-2080 (d), period 2081-2100 (e) according to the RCP4.5 scenario**




**Average evapotranspiration (mm/day) over Egypt during 1986-2005 (RF) (a) and potential change during the period 2021-2040 (b), the period 2041-2060 (c), the period 2061-2080 (d), period 2081-2100 (e) according to the RCP8.5 scenario**




**Monthly times series of Potential Evapotranspiration (PET; in mm/day) of by the RegCM4 in the historical period (1981-2005) of the twelve locations in comparison with the CRU product (in red), before applying the linear regression model (RegCM; in blue) and after applying the linear regression model (RegCMnew; in green)**




**Future corrected PET changes (in %) under the two future scenarios (RCP45; in blue) and (RCP85; in red) for the twelve locations**

# Conclusion

- The RegCM4 projects the largest increase of the PET in the time segments 2061-2080 and 2081-2100, it is higher under scenario RCP8.5 than 4.5.
- At station level, the RegCM4 shows a good performance for simulating the PET with respect to the CRU when the LRM approach is used.
- Downscaling multi-GCMs participated in the CMIP6 to examine the potential influence of meteorological forcing on the simulated global incident solar radiation (RSDS), 2-m mean air temperature (T2M) and eventually PET.