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Estimating the Potential Evapotranspiration of Egypt Using a Regional Climate Model and a High-Resolution Reanalysis Dataset

Samy Ashraf Anwar[1] and Irida Lazić[2]

[1]Egyptian Meteorological Authority, Qobry EL-Kobba, Cairo P.O. Box 11784, Egypt

[2]Faculty of Physics, Institute for Meteorology, University of Belgrade, Dobračina 16, 11000 Belgrade, Serbia

❖ Motivation and Experiment Design:

• There is an urgent need to find a promising tool to daily predict/project the PET in locations where station observation is not available.

• The regional climate model (RegCM4) was used to compute the PET using the Hargreaves–Samani method (HS; **Hargreaves, Allen 2003**). ERA-Interim reanalysis of 1.5 degrees (EIN15) was used to downscale the RegCM4 with 25 km grid spacing over Egypt for the period 1979-2017.

• Calibrating the coefficients of the HS equation over Egypt and role of lateral boundary condition (used to downscale the RegCM4) in simulating the PET weren't conducted till present day.

• To evaluate the RegCM4 performance; a new high-resolution global gridded PET (hPET) product was developed (**Singer et al. 2021**). This product adopts the Penman-Monteith (PM; **Allen et al. 1998**) equation to compute the PET and it is integrated over the period 1981-2021 in 0.1 degree grid spacing over the global land area.

• The present study aims to: 1) Address the added value of the calibrated HS equation (relative to the original version) in comparison with the ERA5 reanalysis product and 2) Validate the calibrated HS equation (versus the original version) by examining the climatological annual cycle of the simulated PET with respect to ERA5 at locations defined by **Anwar et al. (2022)**.

❖ Results and Conclusion:

• Results showed that calibrating the HS coefficients indicates a considerable improvement in estimating the PET (relative to the original equation) when it is compared with ERA5. Such improvement is confirmed by a significant low mean bias particularly in the summer season (Figure 1).

• On a point-scale, the HS/HSnew performance varies with location and month (Supplementary file) Yet, the RegCM4 shows a good performance using the calibrated HS equation. Therefore, the RegCM4 can be used to estimate the PET using a calibrated version of the HS equation either for making a daily forecast or projecting the future PET under different global warming scenarios.

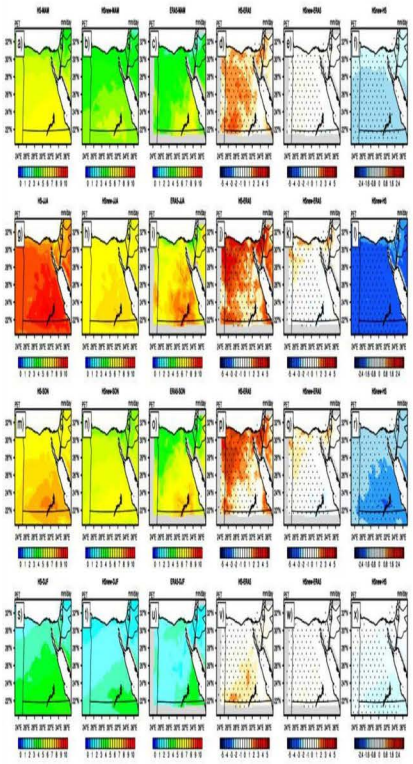

Figure 1. The figure shows the potential evapotranspiration over the period 1981–2017 (PET; in mm day^{-1}) for: MAM season in the first row (a-f); JJA in the second (g-l); SON in the third (m-r), DJF in the fourth (s-x). For each row, HS is on the left, followed by HSnew. ERA5 is in the third from left, HS minus ERA5, HSnew minus ERA5 and the difference between HSnew and HS. Significant difference/bias is indicated in black dots using student t-test with alpha equals to 5%.

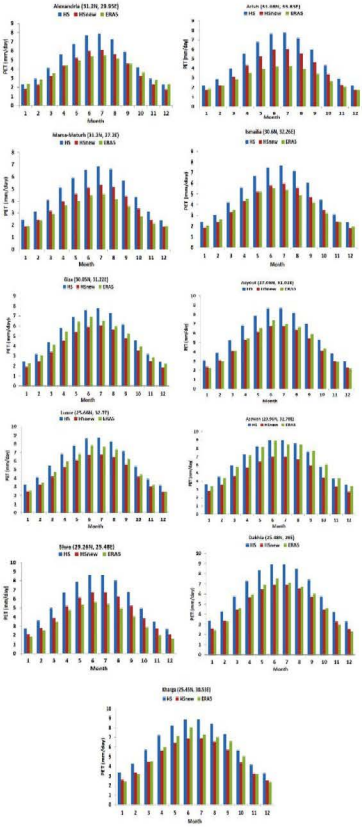

Figure 2. The figure shows the climatological annual cycle of the simulated PET for HS, HSnew compared to ERA5 for different cities in Egypt

References:

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