The Impact of Biases in Precipitation and Evapotranspiration on Aridification Assessment over the Mediterranean Region

Hossein Abbasizadeh[1], Vishal Thakur[1], Akbar Rahmati Ziveh[1], Arnau Sanz i Gil[1], Martin Hanel[1], Petr Maca[1], Rakovec Oldrich[1&2], Yannis Markonis[1]

[1] Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Praha-Suchdol 16500, Czech Republic

2 Helmholtz Centre for Environmental Research GmbH - UFZ, CHS, Germany

Contact emails: abbasizadeh@fzp.czu.cz (Hossein Abbasizadeh), thakur@fzp.czu.cz (Vishal Thakur)

Abstract

Aridification is one of the growing concerns in the Mediterranean region. The estimation of water availability (**precipitation minus evaporation; P-E**), has been widely used to assess aridification. However, the values of P and E are always associated with uncertainties due to different methodological and observational approaches.

Objective of this research

- To investigate the **impact of uncertainties** in assessing the aridification in the **Mediterranean region**.
- To understand the ability of datasets to represent the hydroclimatic regime of the Mediterranean region.

Outcome of the research

The result reveals a high level of variability in the estimated water availability, aridity, and evaporative indices when using satellite and reanalysis datasets, whereas the observational datasets exhibit a comparatively lesser degree of variability.

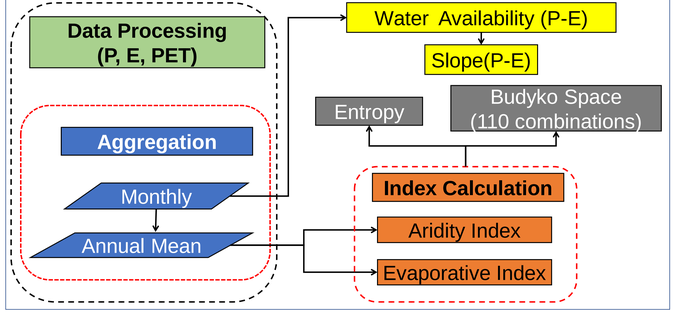
Data

Precipitation (P)		
Observational	**Reanalysis**	**Satellite-Based**
TerraClimate	MERRA-2	CMORPH CDR
EM-Earth	JRA-55	PERSIANN-CDR
GPCC	NCEP-NCAR	CHIRPS
	ERA5	
	MSWEP	

Potential Evapotranspiration (PET)	
Combinational Type	**Temperature Based**
GLEAM (Prientley Taylor)	EM-EARTH (Oudin)
TerraClimate (Penman Montieth)	EM-EARTH (Hargreve Samani)
	EM-EARTH (McGuinness Bordne)

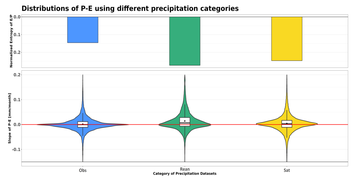
Evaporation (E)	
GLEAM	TerraClimate

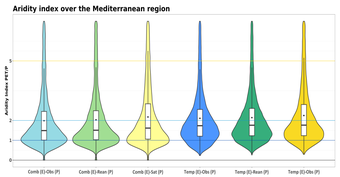
Methodology

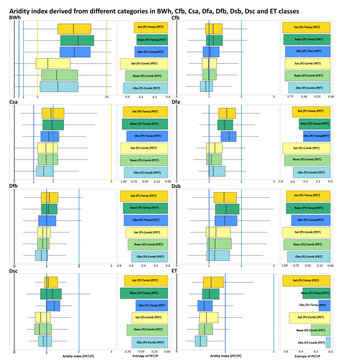


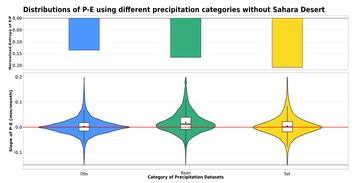
Results

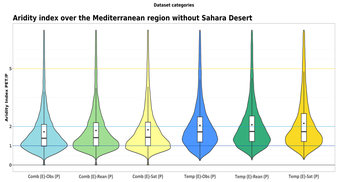
The study's outcomes for the time frame spanning from 2000 to 2020



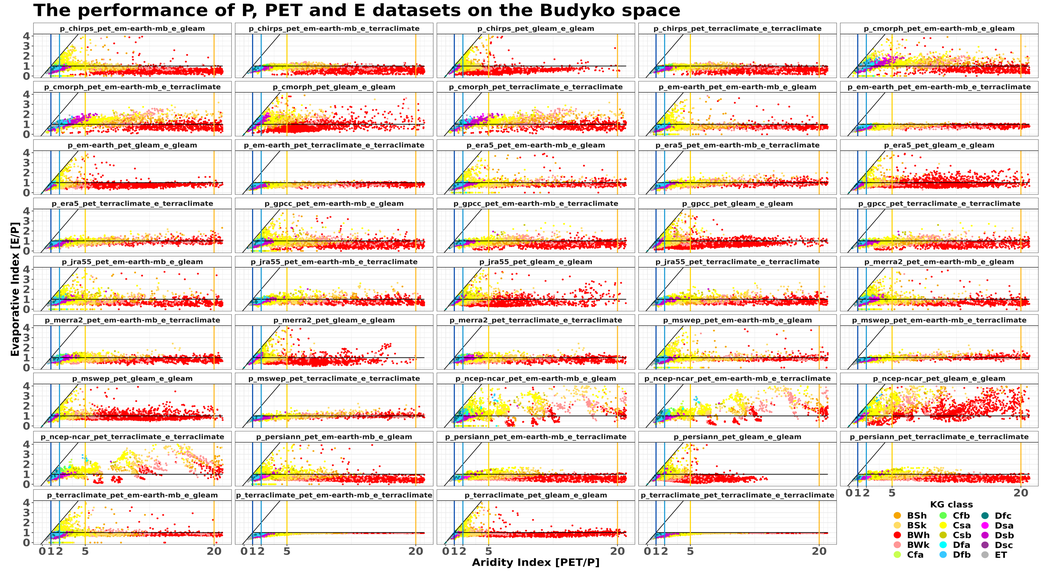




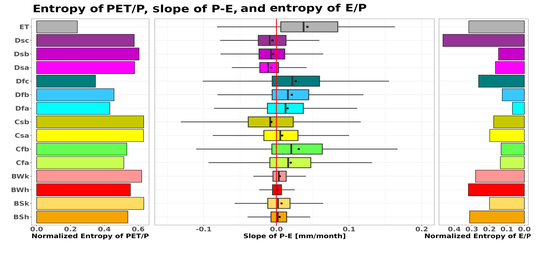


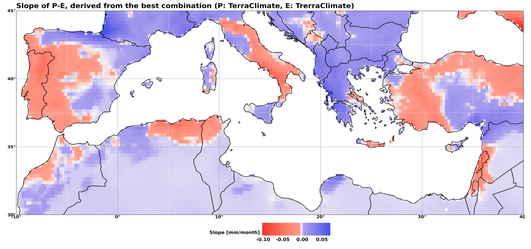


The performance of P, PET and E datasets on the Budyko space



Entropy of PET/P, slope of P-E, and entropy of E/P





Conclusion

- The analysis of **observational P** datasets indicates a reduced level of uncertainty in estimating **P-E**, when compared to **reanalysis** and **satellite-based datasets**, regardless of the presence of the Sahara desert.
- Using **temperature-based PET** results in higher mean **aridity index** compared to **combinational type PET** methods.
- Exclusion of Sahara desert has a negligible impact on the mean values of **aridity index** derived from **temperature-based PET**.
- The utilization of **observational P data** in calculating the **aridity index** is associated with reduced uncertainty across all **KG classes**, emphasizing the significance of incorporating observational data in achieving precise estimates of aridity.
- Out of fifteen KG classes, only **four classes** demonstrate a **negative trend** in the **P-E** value, which are associated with a **high entropy of aridity index**.

KG Climate Classes

BSk: Arid,steppe, hot	**BWk:** Arid, desert, cold	**Csa:** Temperate, dry summer, hot summer	**Dfb:** Cold, no dry season, warm summer	**Dsb:** Cold, dry summer, warm summer
BSh: Arid, steppe, cold	**Cfa:** Temperate, no dry season, hot summer	**Csb:** Temperate, dry summer, warm summer	**Dfc:** Cold, no dry season, cold summer	**Dsc:** Cold, dry summer, cold summer
BWh: Arid, desert, hot	**Cfb:** Temperate, no dry season, warm summer	**Dfa:** Cold, no dry season, hot summer	**Dsa:** Cold, dry summer, hot summer	**ET:** Polar, frost

References

- Konapala G., Mishra A K., Wada Y., Mann M E. 2020. Climate change will affect global water availability through compounding changes in seasonal precipitation and evaporation. *Nature Communications.* 3044.
- Greve P., Orlowsky B., Mueller B., Sheffield J., Reichstein M., Seneviratne S I. Global assessment of trends in wetting and drying over land. 2014. *Nature Geoscience*. 7,716–721.
- Mishra A K., Özger M., Singh V P. 2009. An entropy-based investigation into the variability of precipitation. *Journal of Hydrology*. 370, 139-154.

Faculty of Environmental Sciences

ITHACA

This presentation participates in OSPP

Outstanding Student & PhD candidate Presentation contest