

Independent validation of daily precipitation in the Ukrainian gridded climate dataset ClimUAd

Vladyslav Sidenko^{1*}, Olesya Skrynyk^{2,1}, Liudmyla Palamarchuk¹, Dmytro Oshurok¹, Ihor Kravchenko¹, Oleg Skrynyk¹
¹Ukrainian Hydrometeorological Institute, Kyiv, Ukraine
²National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine
 *vladyslavsidenko@gmail.com

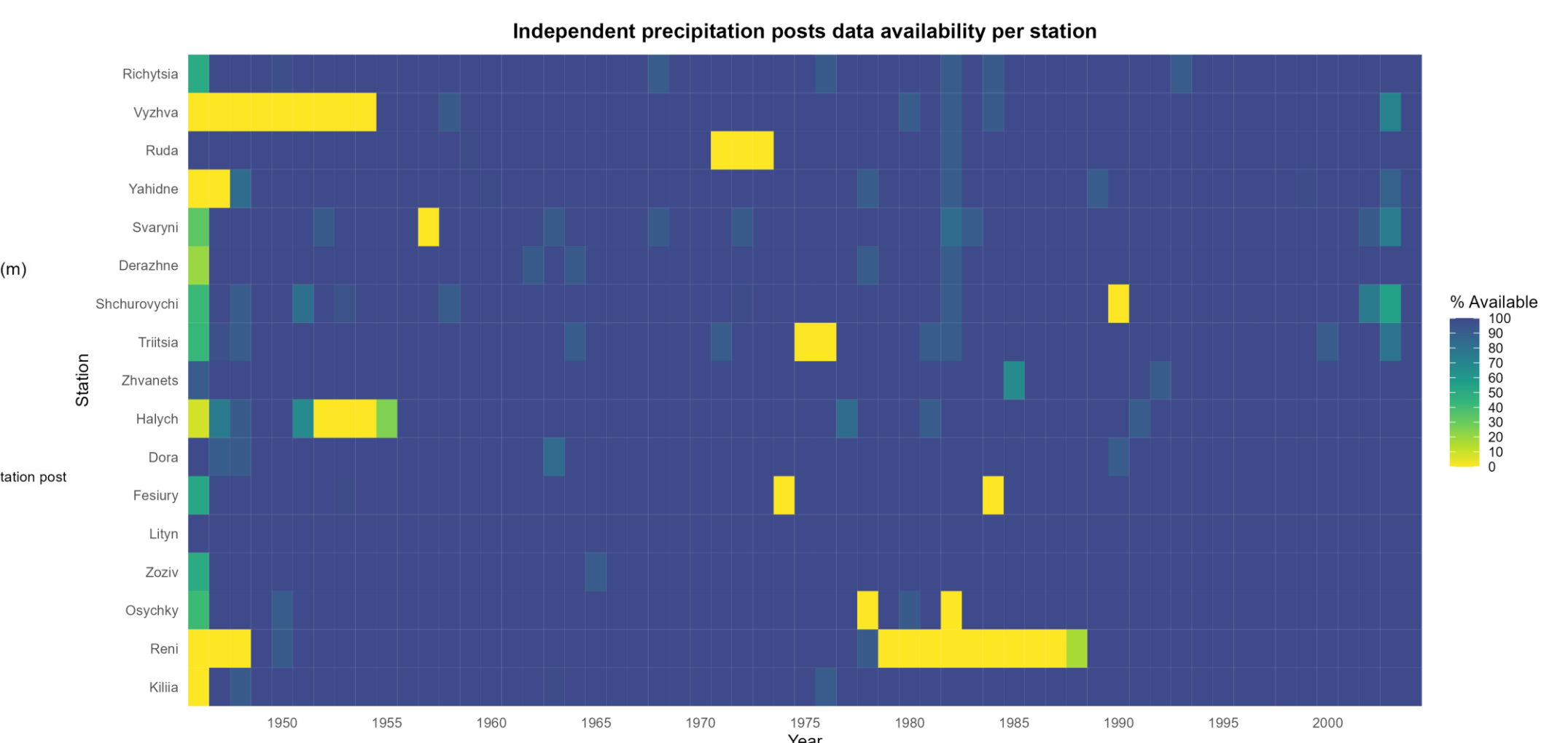
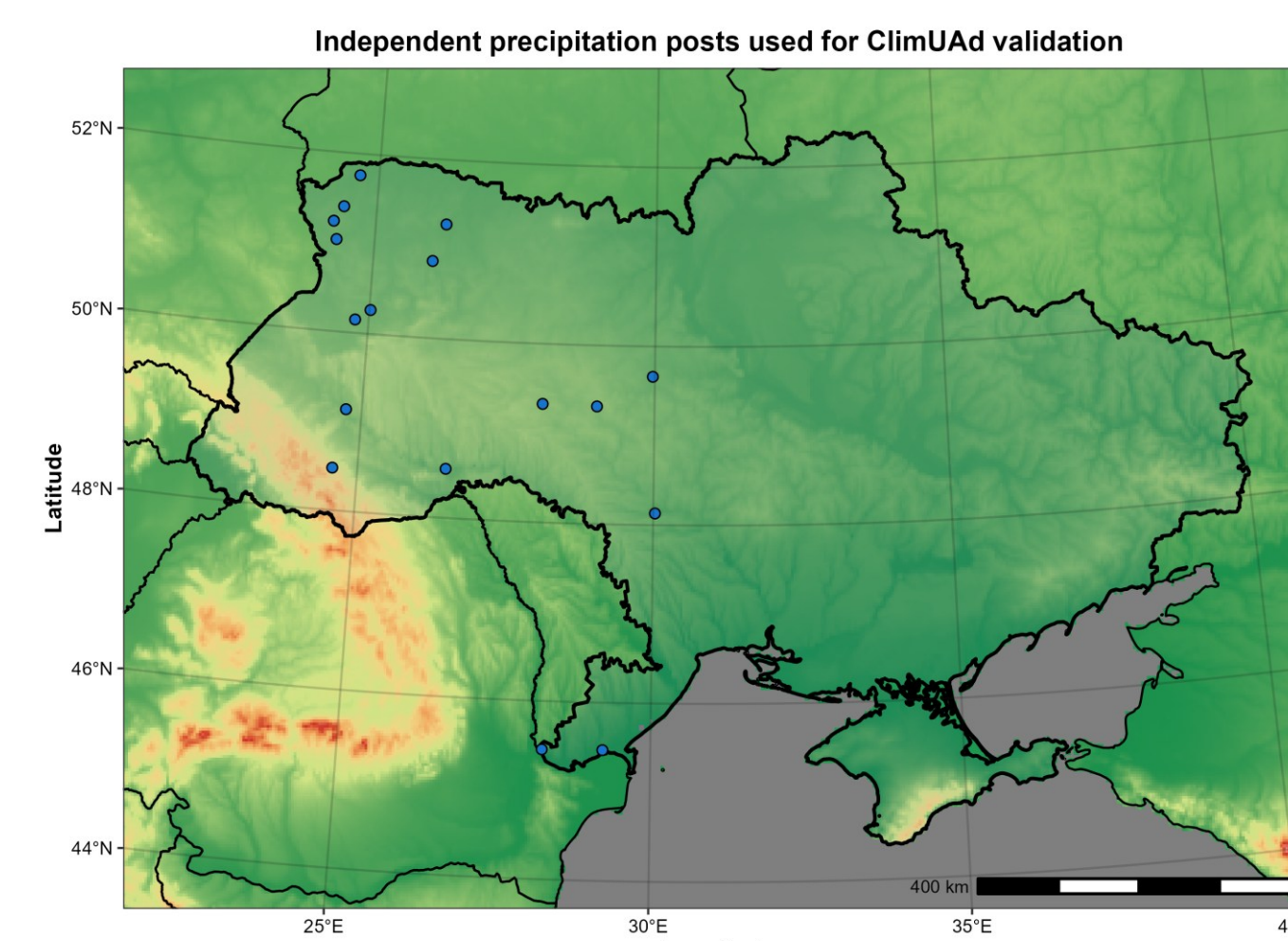
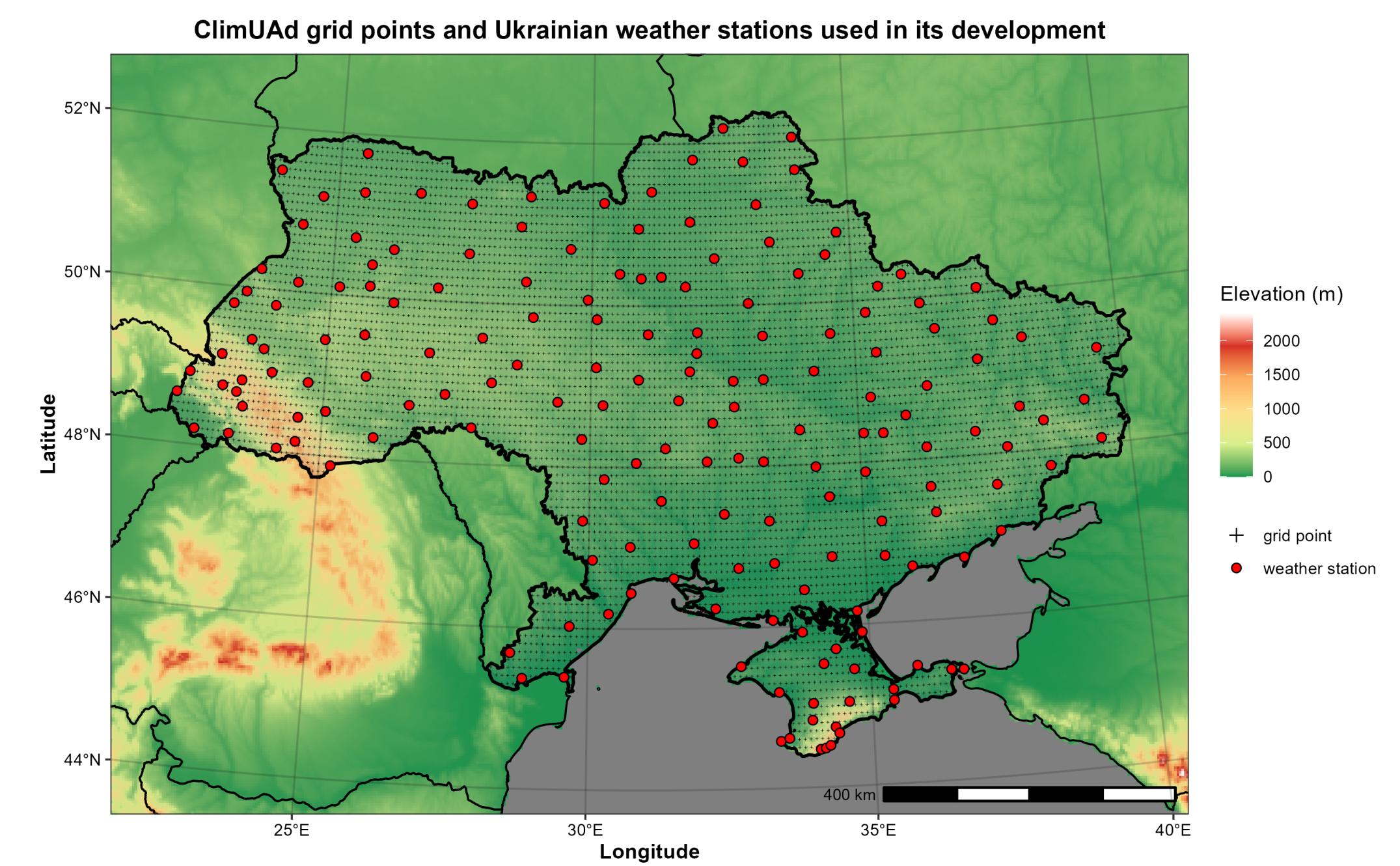
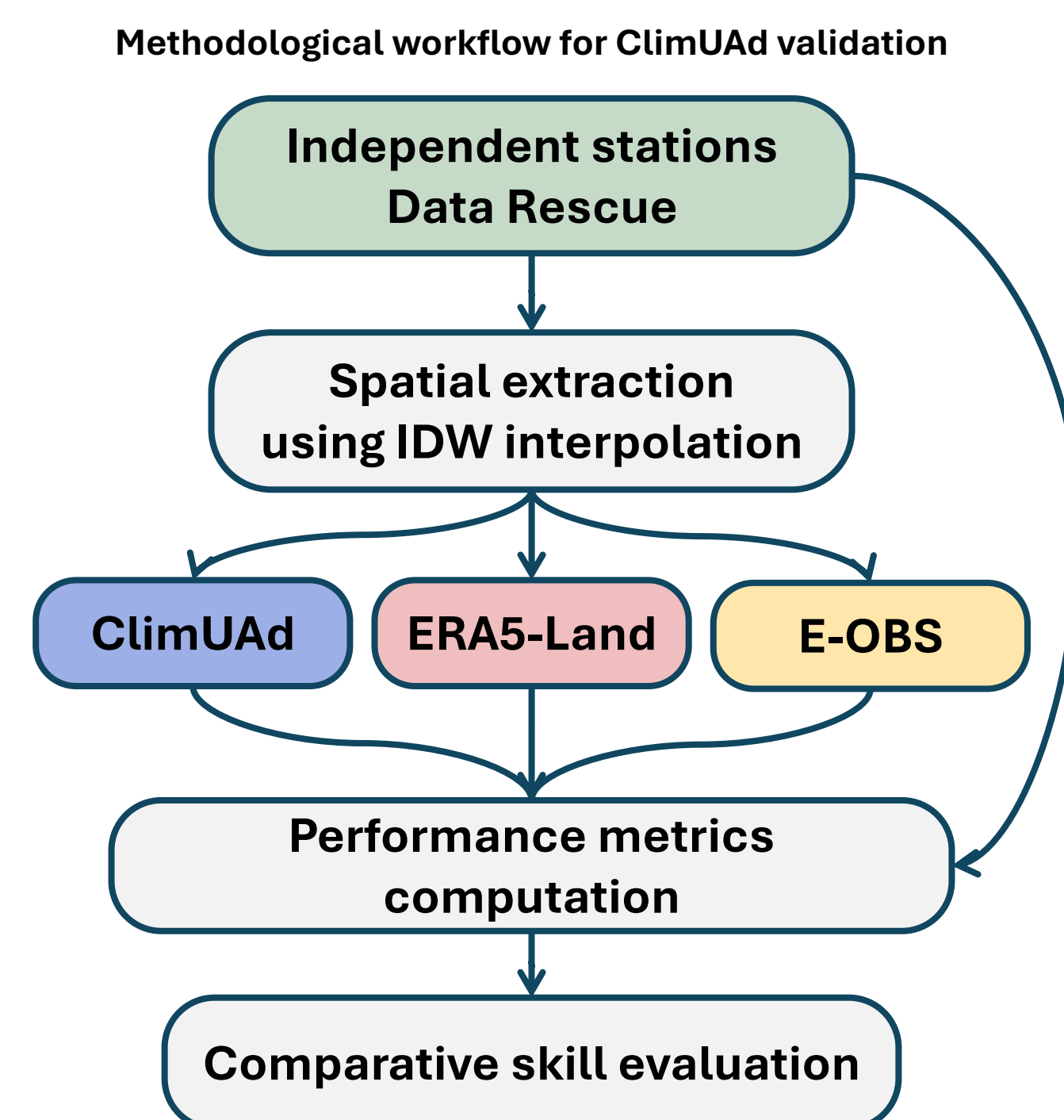
BACKGROUND

- High-resolution gridded precipitation datasets are key inputs for climate monitoring, impact and sectoral studies.
- ClimUAd** is a gridded climate dataset for Ukraine (1946–2020), which provides high-resolution (0.1°×0.1°, ~10 km) daily data, including four essential climate variables: **minimum, mean, maximum air temperatures and precipitation totals**. It was developed from **178 meteorological station records**, with quality control performed using **INQC**, homogenization with **Climatol** and spatial interpolation by means of the **MISH** method.
- ClimUAd was previously statistically compared to ERA5-Land and E-OBS, demonstrating good overall agreement. Due to the **inherently high spatial and temporal variability** of precipitation, the reliability of gridded products **requires assessment against observations that are independent** of the stations used in their construction.
- ClimUAd can be freely accessed for research via following QR code:**

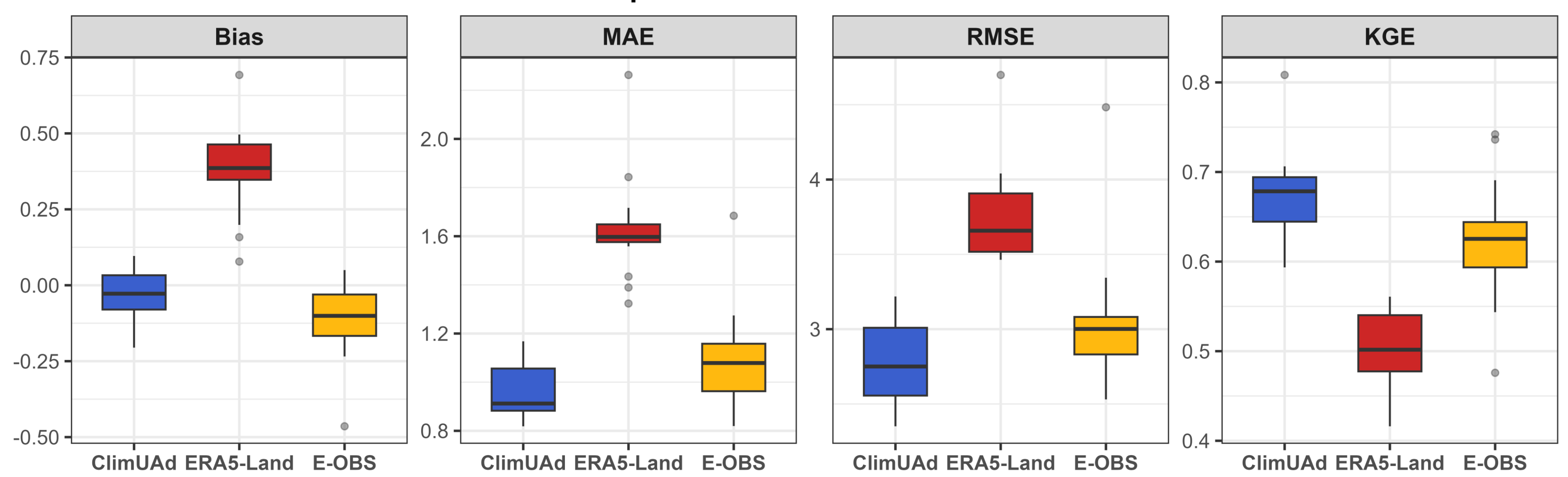


DATA & METHODS

- This study presents an additional **validation** of the ClimUAd precipitation data **against fully independent in-situ observations from 17 long-term stations** (precipitation posts) located mainly in the western part of Ukraine that were not involved in the gridding procedure.
- The raw daily precipitation records at these stations were manually digitized from historical hardcopy sources.
- For each location, daily gridded precipitation values were extracted via inverse distance weighting from the four nearest grid points.
- Performance was assessed at the daily scale using
 - Continuous **statistical metrics**:
 - bias, relative bias,
 - mean absolute error (MAE),
 - root mean square error (RMSE),
 - Pearson correlation,
 - coefficient of determination (R^2),
 - standard deviation ratio,
 - Kling–Gupta efficiency (KGE)
 - Categorical event detection scores** (at a 1 mm threshold):
 - probability of detection (POD),
 - false alarm ratio (FAR)
 - critical success index (CSI).
- Monthly and annual aggregations** were additionally evaluated to assess the temporal-scale dependence of skill.
- An **identical evaluation** framework was applied to **ERA5-Land** and **E-OBS** (v31.0e) to enable direct and consistent comparison of performance across datasets.



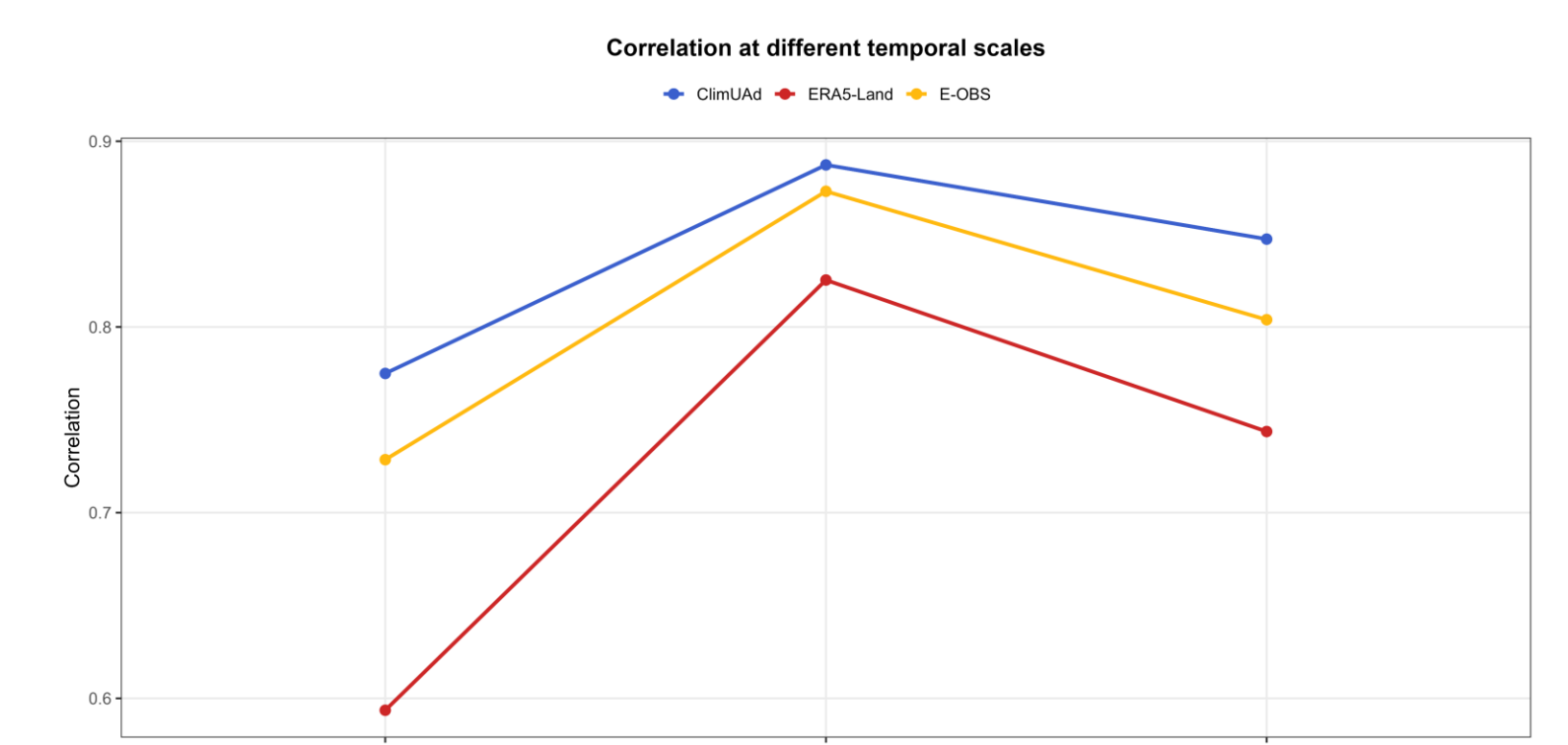
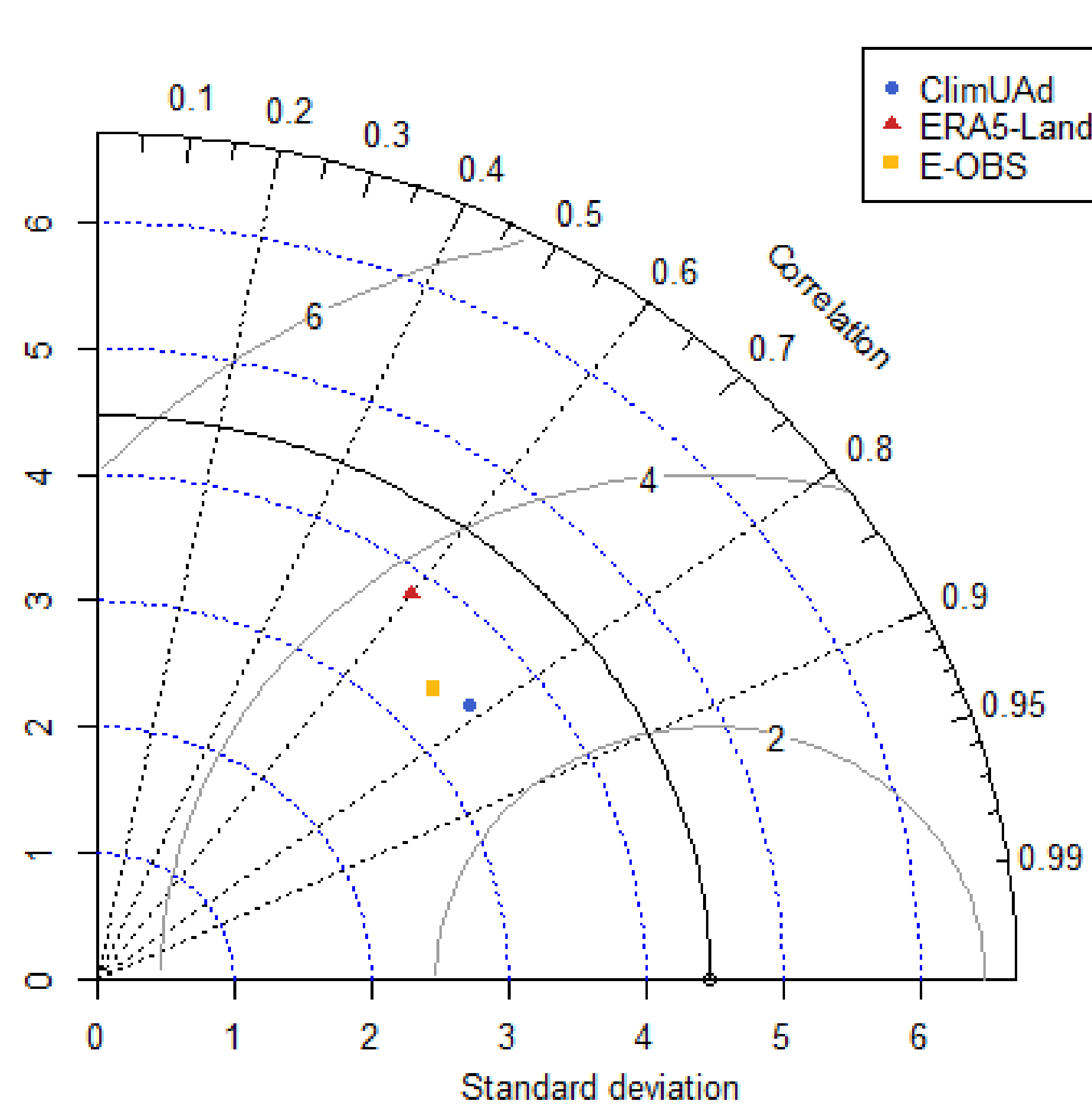
Error and performance metrics across stations



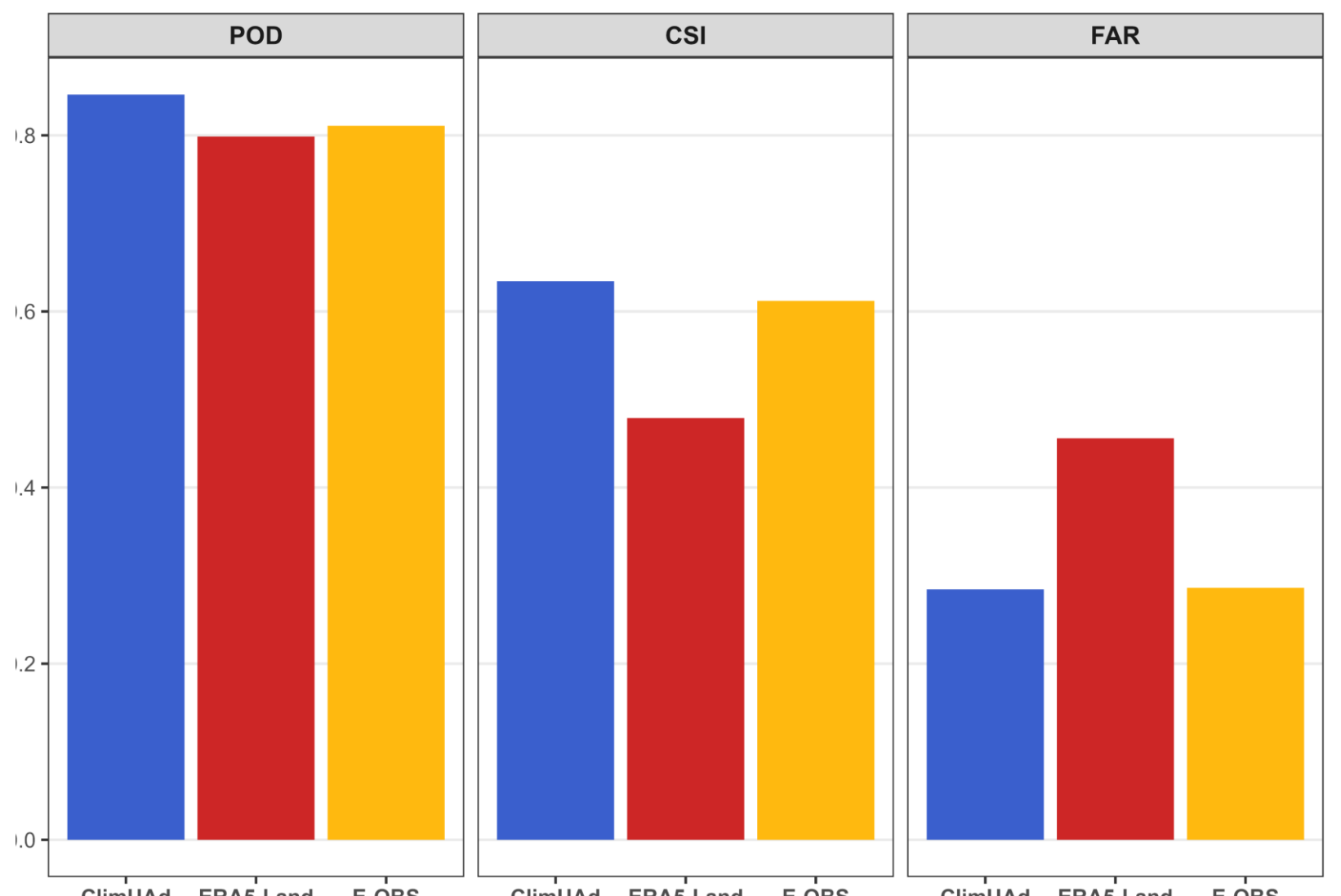
RESULTS

- ClimUAd shows strong daily performance across stations:**
 - Mean correlation: **0.77 ± 0.05**
 - Mean KGE: **0.67 ± 0.05**
 - Minimal bias: **-0.04 mm**
 - Robust event detection: **POD ≈ 0.85, CSI ≈ 0.63**
- Performance improves with temporal aggregation:**
 - Monthly correlation: **≈ 0.89**
 - Annual correlation: **≈ 0.85**
- Comparative evaluation:**
 - ClimUAd **clearly outperforms ERA5-Land**
 - ClimUAd **moderately but consistently surpasses E-OBS**
 - Higher **correlation and KGE**
 - Lower **bias, MAE, RMSE**
 - Higher **CSI**
 - Comparable or stronger performance at monthly and annual scales

Taylor Diagram – Daily Precipitation



Event detection performance



CONCLUSIONS

- ClimUAd reliably captures both the variability and magnitude of precipitation across temporal scales in Ukraine**, supporting its use for:
 - climatological monitoring
 - regional diagnostics
 - impact assessments
- Independent observations are critical for rigorous validation of gridded climatological datasets.