



S2S Extreme Weather Featurization: A Global Skill Assessment Study

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Introduction and Methodology

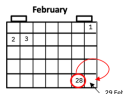
Objectives

- 1) To compare the skill of S2S ECMWF forecasts and S2S ML-based forecasts [1] in producing extreme indices.
- 2) To correlate ECMWF-derived extreme indices with the impact of extreme events to evaluate the relevance of these extreme indices.

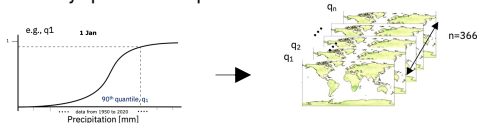
Methodology: skill assessment

For each dataset – CPC, ECMWF and ML-based forecasts, the following steps were performed:

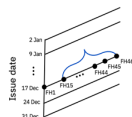
- 1) Data preparation.



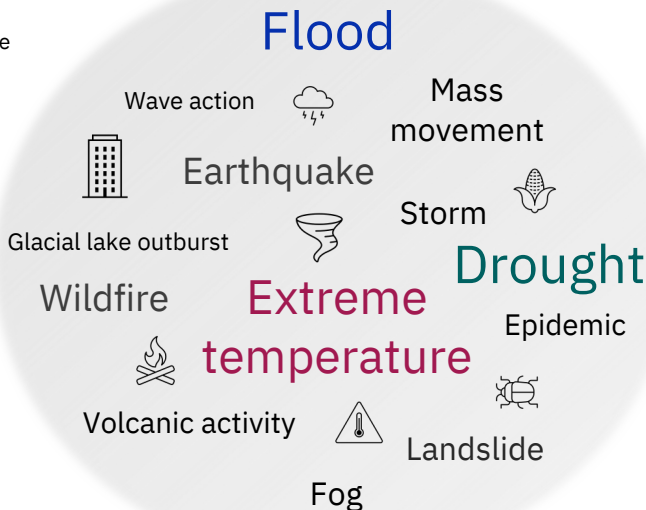
- 2) Daily quantile maps.



- 3) Index calculation, redefined over the S2S horizon.



- 4) Evaluation metrics - PCC and MAE of indices derived using forecasts and ground truth data.

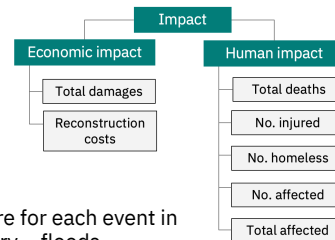


ETCCDI indices

A set of temperature- and precipitation-based extreme indices. Examples are:

- 1) CDD - consecutive dry days - maximum annual number of consecutive dry days.
- 2) WSDI - warm spell duration indicator - annual number of days with at least 6 consecutive days when $T_{\max} > 90^{\text{th}}$ percentile.
- 3) Rx5day – max 5-day precipitation - maximum 5-day precipitation total.

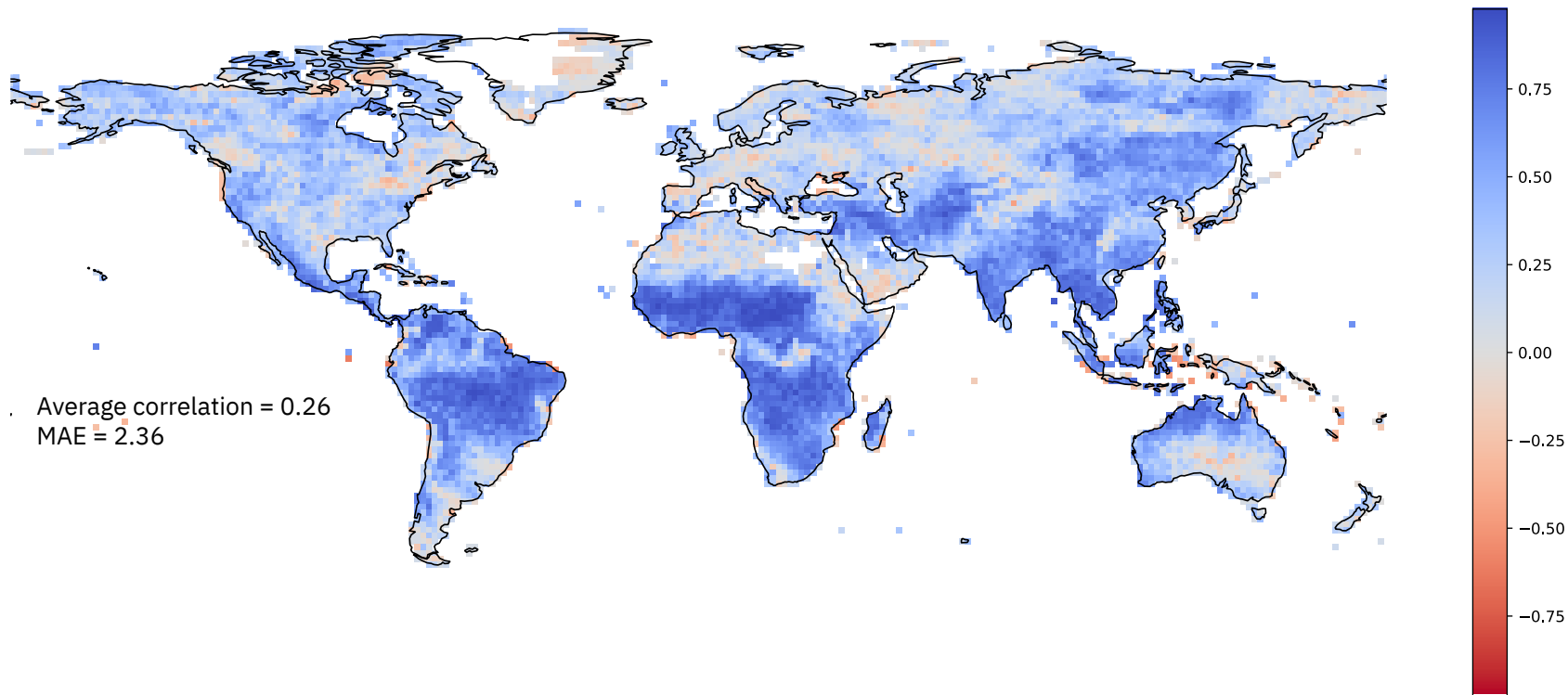
Methodology: impact analysis



- 1) Develop an impact score for each event in each respective category – floods, droughts and heat waves – using data from EM-DAT [2].
- 2) Correlate each event with the relevant extreme index.

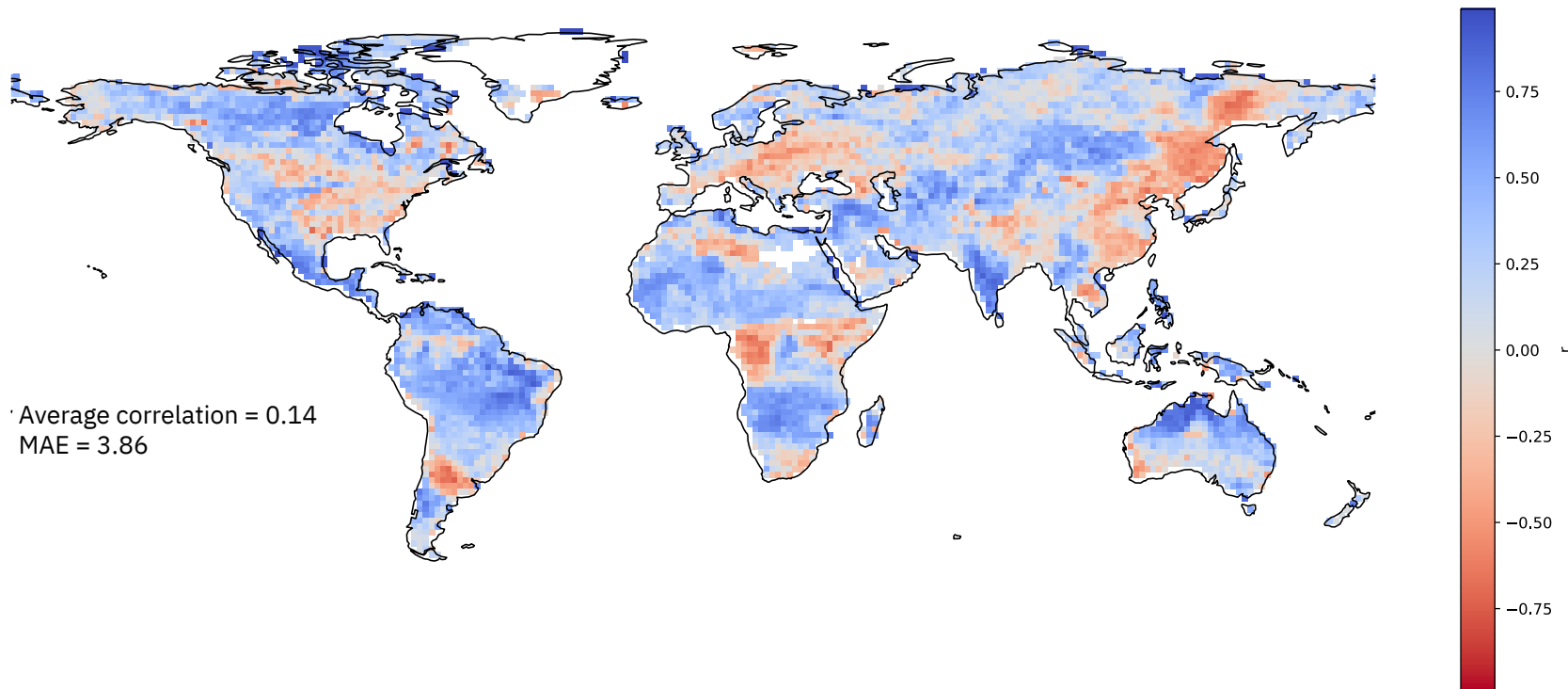
Skill Assessment

CDD - PCC: ECMWF vs. CPC



Skill Assessment

CDD - PCC: ML-Based Forecasts vs. CPC



Impact Analysis

Table 1: PCC: Economic Impact vs. ECMWF-derived Extreme Indices

	Floods	Droughts	Heat waves
CDD	-0.21	0.60	-
CWD	0.21	-0.53	-
Rnnmm	0.16	-0.21	-
SDII	0.18	-0.39	-
Rx5day	0.35	-0.34	-
Rx1day	0.23	-0.17	-
R95p	0.061	-0.28	-
R90p	0.12	-0.31	-
R85p	0.15	-0.35	-
R70p	0.18	-0.44	-
TR	-	-	0.075
TX90p	-	-	0.31
WSDI	-	-	0.32
TXx	-	-	-0.12
TXn	-	-	0.28

Conclusion

- 1) In most regions of the globe, the ECMWF forecasts produce relatively accurate extreme indices.
- 2) The indices defined over the S2S horizon show significant relevance to the economic impact of extreme events.
- 3) Rx5day, CDD and WSDI are found to be the best indicators of the impact of floods, droughts and heat waves, respectively.

References

- [1] Zaytar, M. A., Zadrozny, B., Watson, C., Salles Civitarese, D., Eben Vos, E., Michael Mathonsi, T., and Lukhetho Mashinini, T.: ML-based Probabilistic Prediction of 2m Temperature and Total Precipitation, EGU General Assembly 2022, Vienna, Austria, 23–27 May 2022, EGU22-11063, <https://doi.org/10.5194/egusphere-egu22-11063>, 2022.
- [2] D. Guha-Sapir, R. Below, Ph. Hoyois - EM-DAT: The CRED/OFDA International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.