

Towards Subseasonal-to-Seasonal Drought-to-Flood Prediction



Decarb AI
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Introduction

Floods and droughts can occur in sequence — a **drought-to-flood transition (D2F)**. Globally, **~25% of floods are preceded by drought** [1], and socio-economic losses can be up to **8x greater** than from isolated hazards [2]. Forecasting D2Fs at subseasonal-to-seasonal lead times could support early action, but 2 research gaps remain →

No catalogue of D2F events exists for Ireland
Subseasonal-to-seasonal forecast skill over Ireland has not been assessed

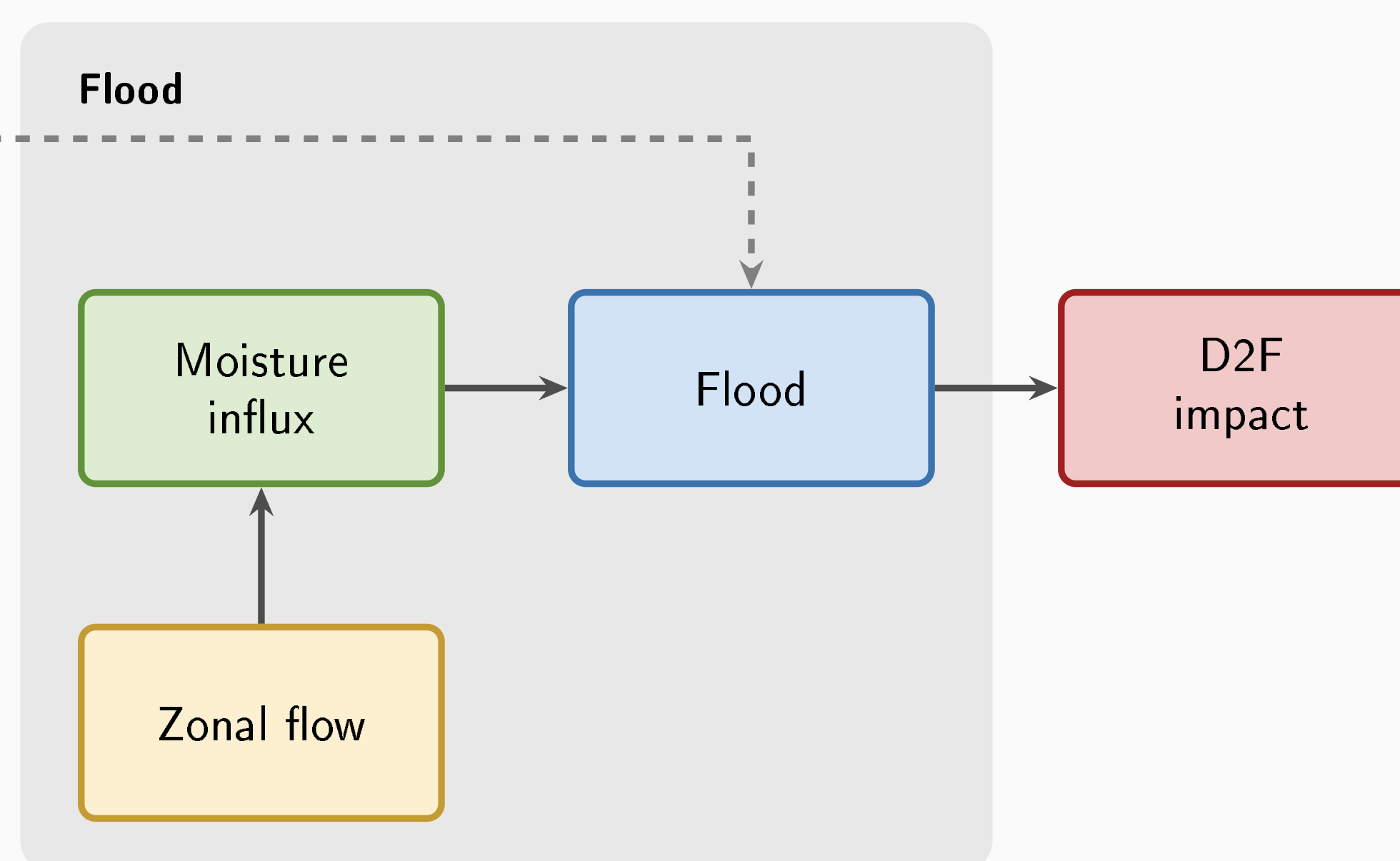
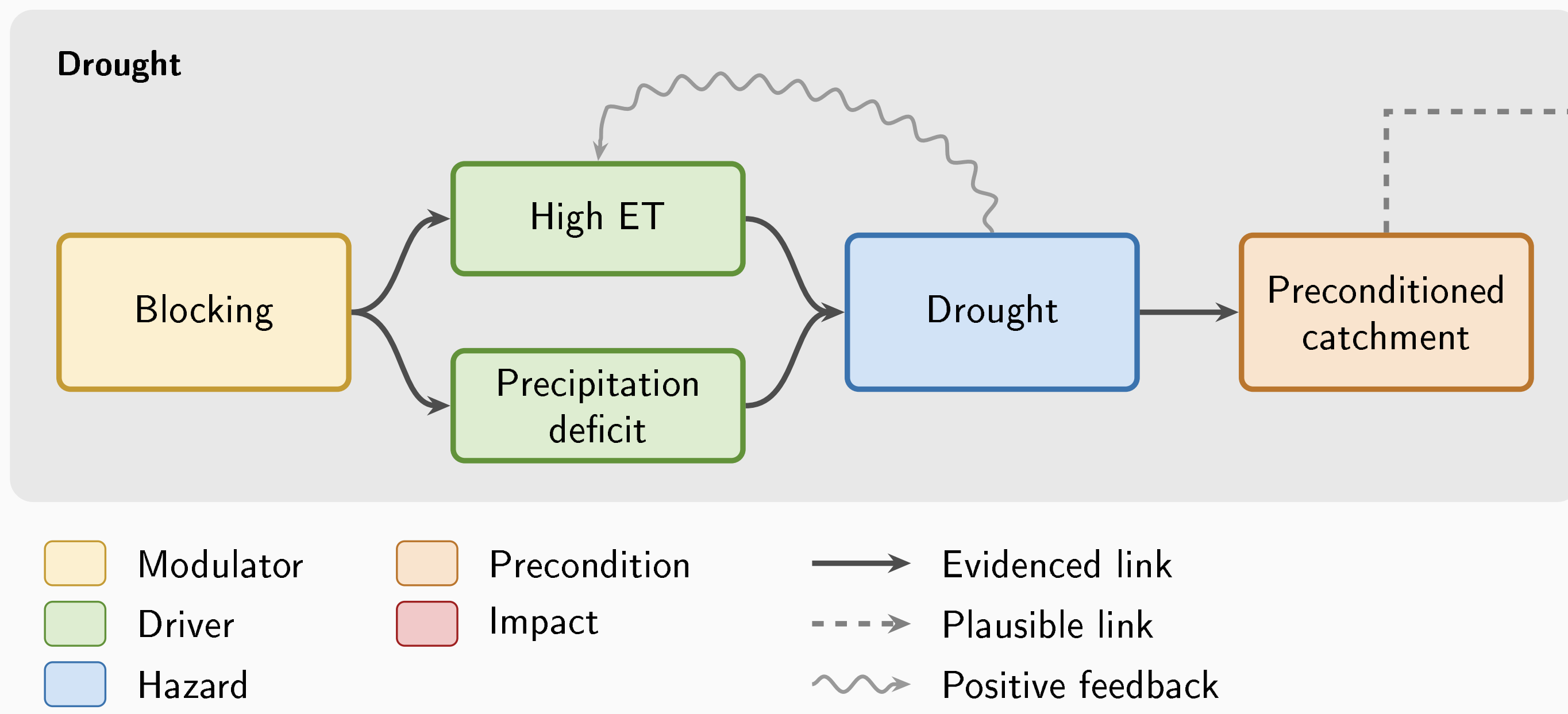
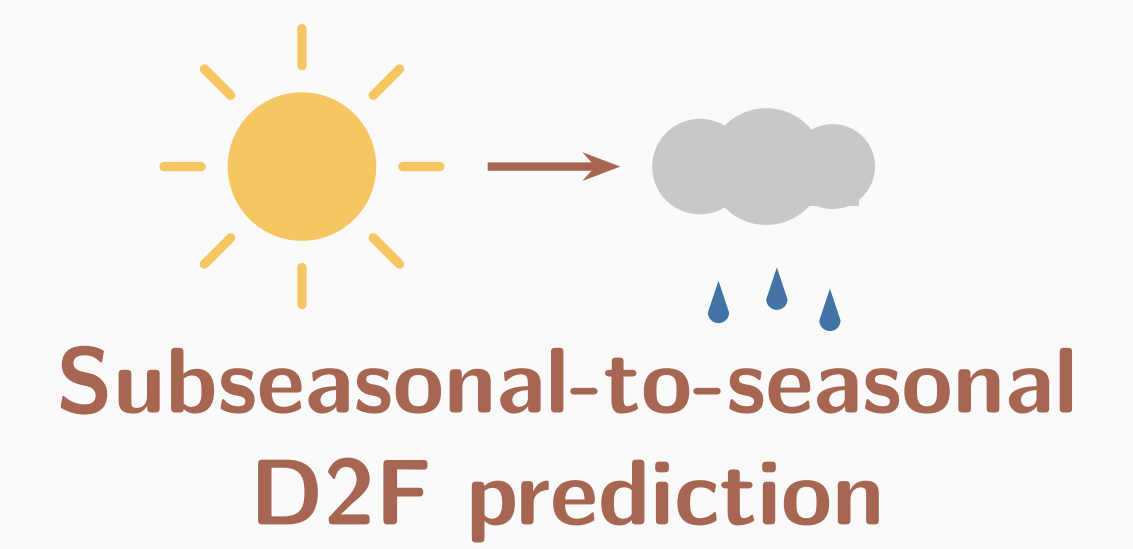


Fig. 1: Physical pathway for D2F events, after the framework of Bevacqua et al. [3].

Methods

As a first step towards D2F prediction, we verify **2 m temperature** reforecasts from the ECMWF sub-seasonal ensemble at **weeks 2–6** over Ireland on the native grid, stratified by season. Temperature anomalies are computed relative to separate climatologies: a 1991–2020 ERA5 baseline (± 15 -day window), interpolated from its native grid, and a 2006–2016 hindcast climatology for the forecast. Skill is assessed on ensemble-mean anomalies over land grid points using deterministic metrics: **bias**, **centred ACC**, and **RMSE** [4].

Data

ECMWF ENS sub-seasonal (CY49R1)
11 members ■ init. every 2 days ■ weeks 2–6
2 m temperature ■ O320 grid ■ 2006–2016
Reference data
ERA5 reanalysis ■ Met Éireann observations

Results

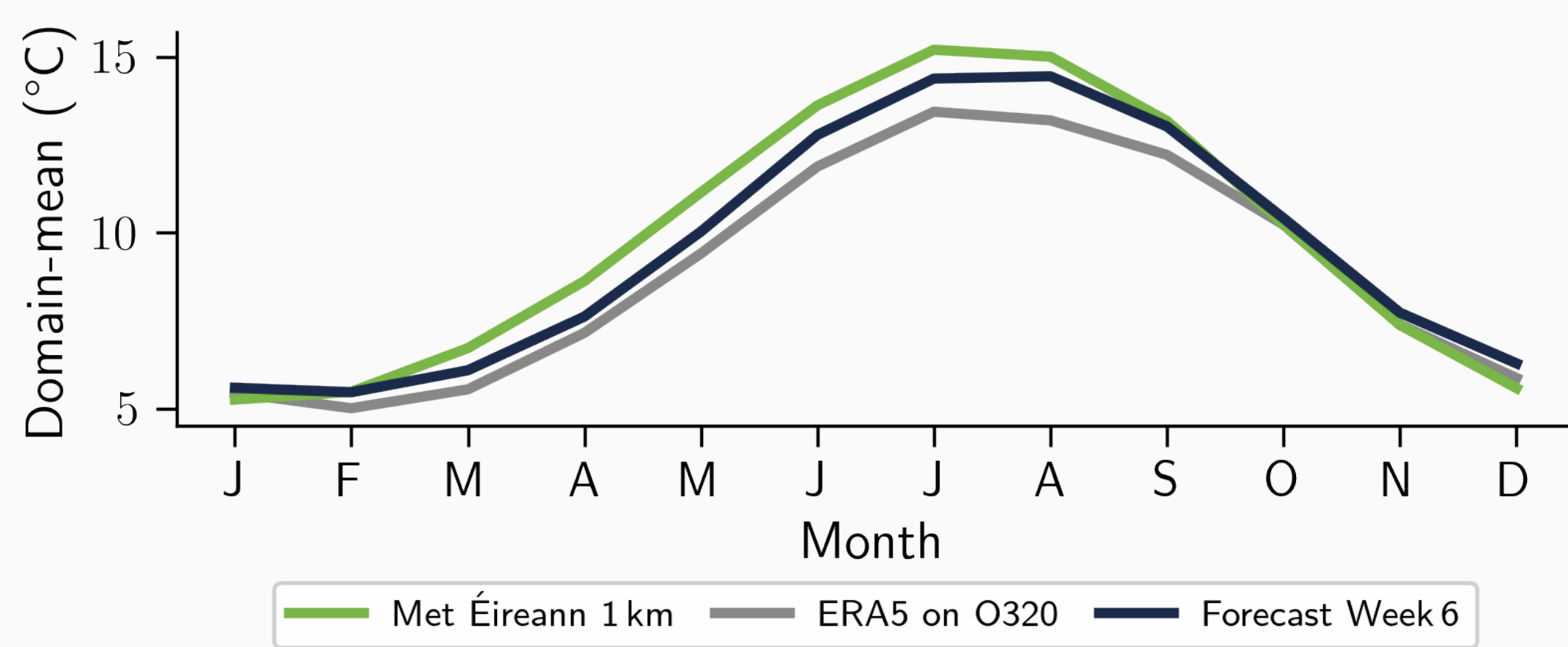


Fig. 2: Domain-mean seasonal cycle of raw 2 m temperature. ERA5 is $\sim 1.5^\circ\text{C}$ colder than both Met Éireann and the forecast in summer, motivating separate climatologies.

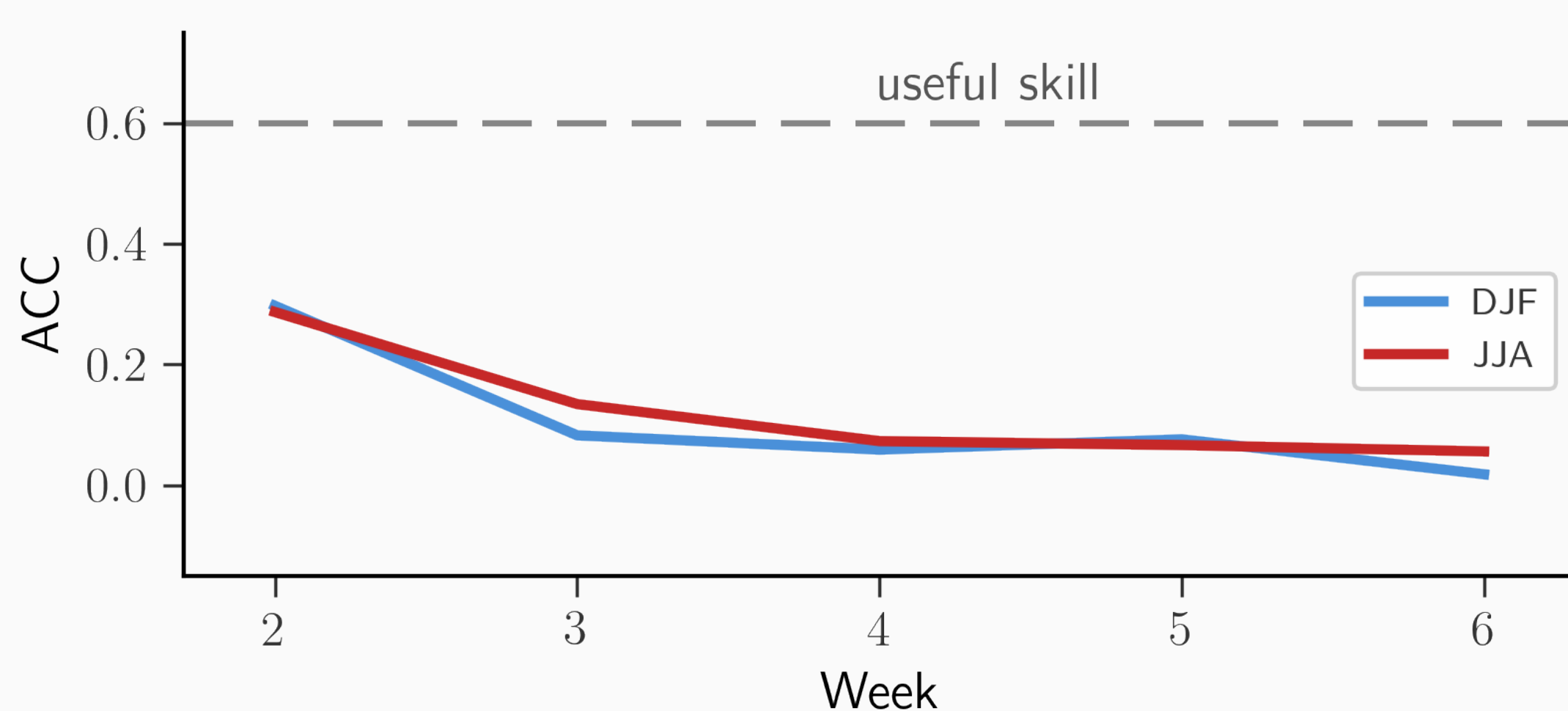


Fig. 3: Centred ACC by lead week. Positive skill persists for both seasons but remains below the 0.6 useful skill threshold.

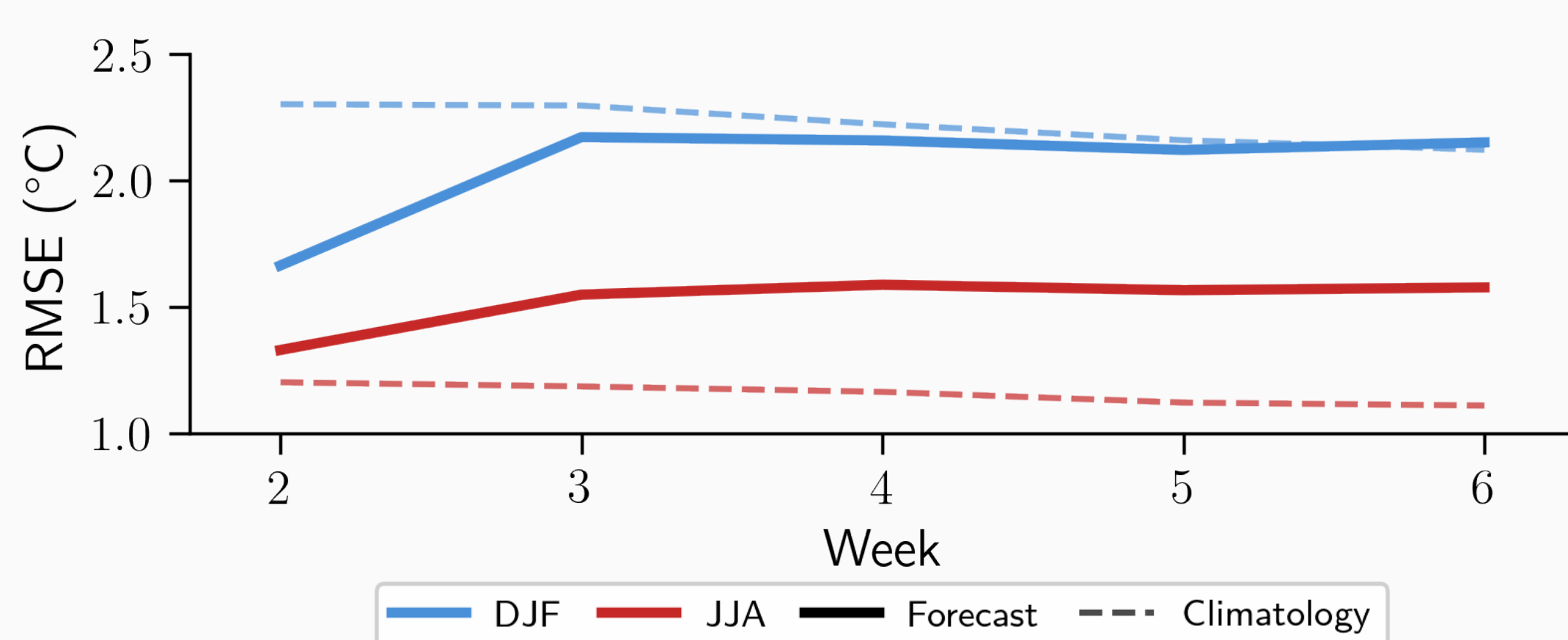


Fig. 4: Anomaly RMSE by lead week. DJF forecast outperforms climatology until week 5; JJA never does.

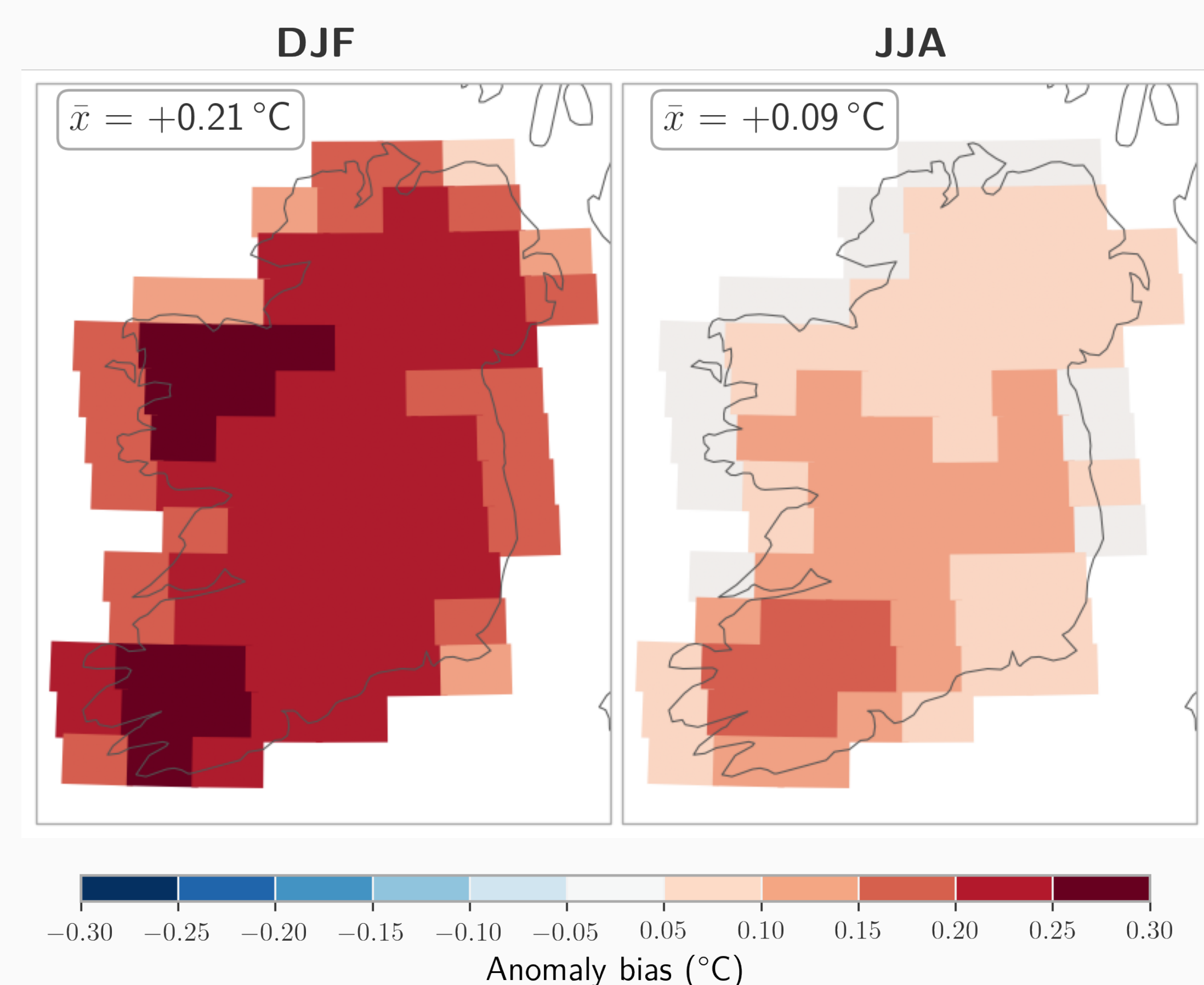
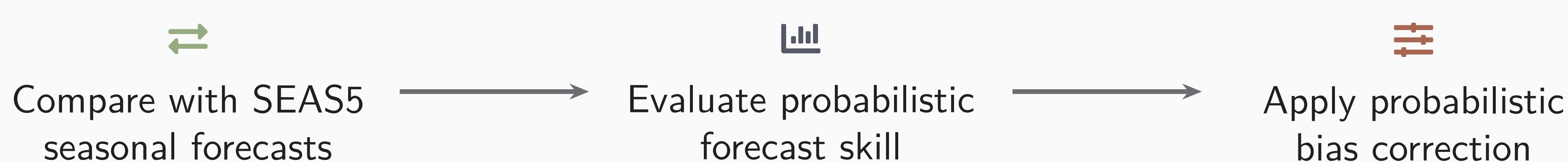


Fig. 5: Anomaly bias composited across lead weeks 2–6. DJF shows strong uniform warm bias; JJA is weaker. Both seasons show enhanced bias, particularly in the southwest.

- DJF forecast **outperforms climatology** in RMSE to week 5, while JJA **does not** at any lead, as **higher winter variability** makes climatology a weaker baseline
- A residual **warm anomaly bias** persists in both seasons, possibly due to smoothed model orography and forecast–ERA5 model cycle differences [5], motivating **bias correction** as a next step

Future Work



References

- [1] Matanó et al. (2024). *Environ. Res. Lett.*, 19, 064048. [2] Worou & Messori (2025). *Environ. Res. Lett.*, 20, 104024. [3] Bevacqua et al. (2021). *Earth's Future*, 9, e2021EF002340. [4] Wilks (2011). *Statistical Methods in the Atmospheric Sciences*, 3rd ed. [5] Ingleby et al. (2024). *ECMWF Newsletter*, No. 178.