Land-Surface Initialisation Affects Indian Monsoon Predictability

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Results
Conclusion

Netherlands Organisation for Scientific Research

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Rationale: dry bias for Indian monsoon

- Most climate and S2S models have a dry bias for Indian summer monsoon precipitation
- Previous work showed the importance of the land surface in India
- Is the land surface initialization important for the monsoon prediction?

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The land surface matters in India

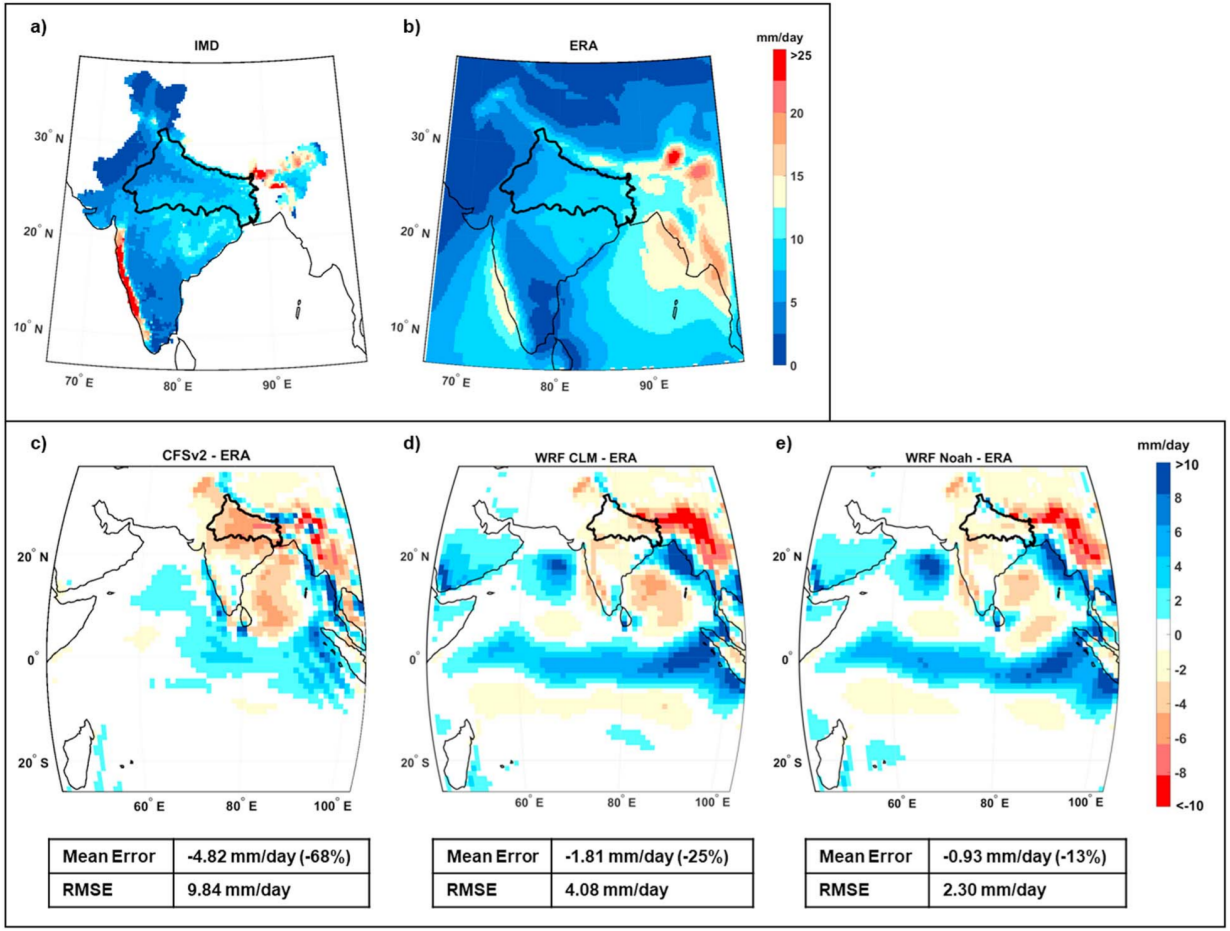

Figure 1. Biases in model simulations of mean seasonal (June–September, JJAS) rainfall. (a, b) JJAS rainfall climatology (mm/d) from India Meteorological Department (IMD) data and ERA-Interim reanalysis data. (c–e) Biases in mean JJAS rainfall (mm/d) from Climate Forecast System version 2 (CFSv2), Weather Research and Forecasting model (WRF)-Community Land Model (CLM), and WRF Noah. Ganga basin is marked on the map. The error statistics are for seasonal rainfall over the Ganga basin. RMSE = root-mean-square error.

- Decreased bias due to more realistic land surface model
- Moisture from both land and ocean sources

Devanand et al., 2018 (GRL)

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Irrigation leads to more northeastward flow

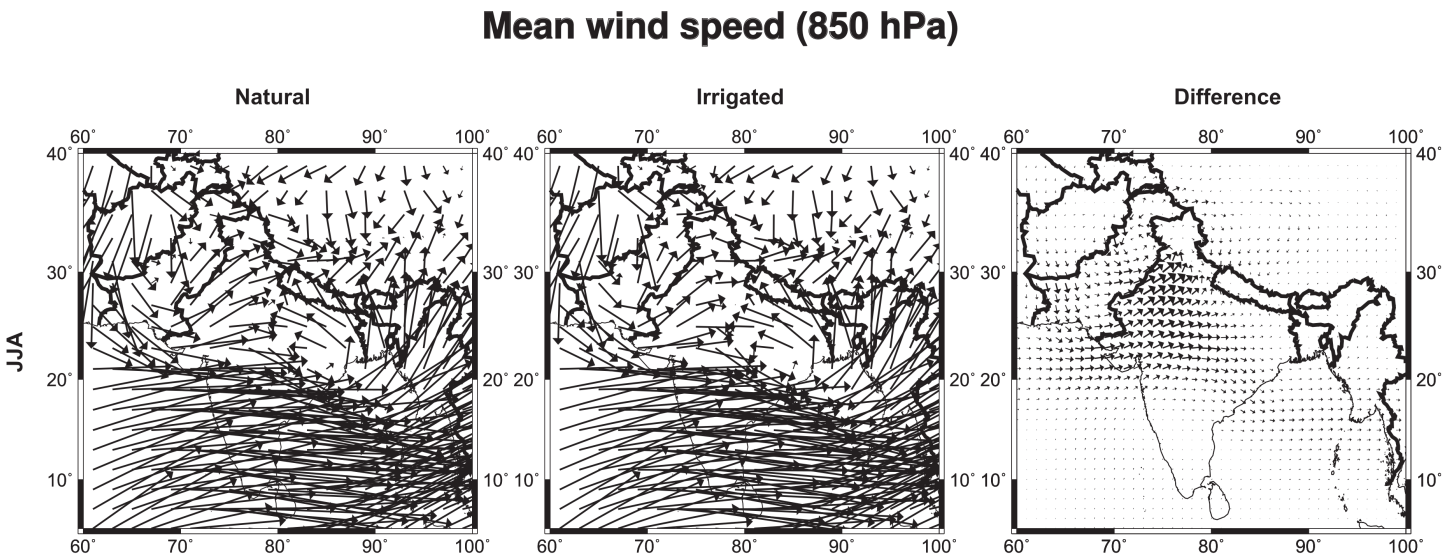

FIG. 12. Wind direction (850 hPa) in the natural and irrigated runs and their difference per season; shown is the mean over ECHAM, RAMS, and HIRHAM5

Tuinenburg et al., 2014 (JHM)

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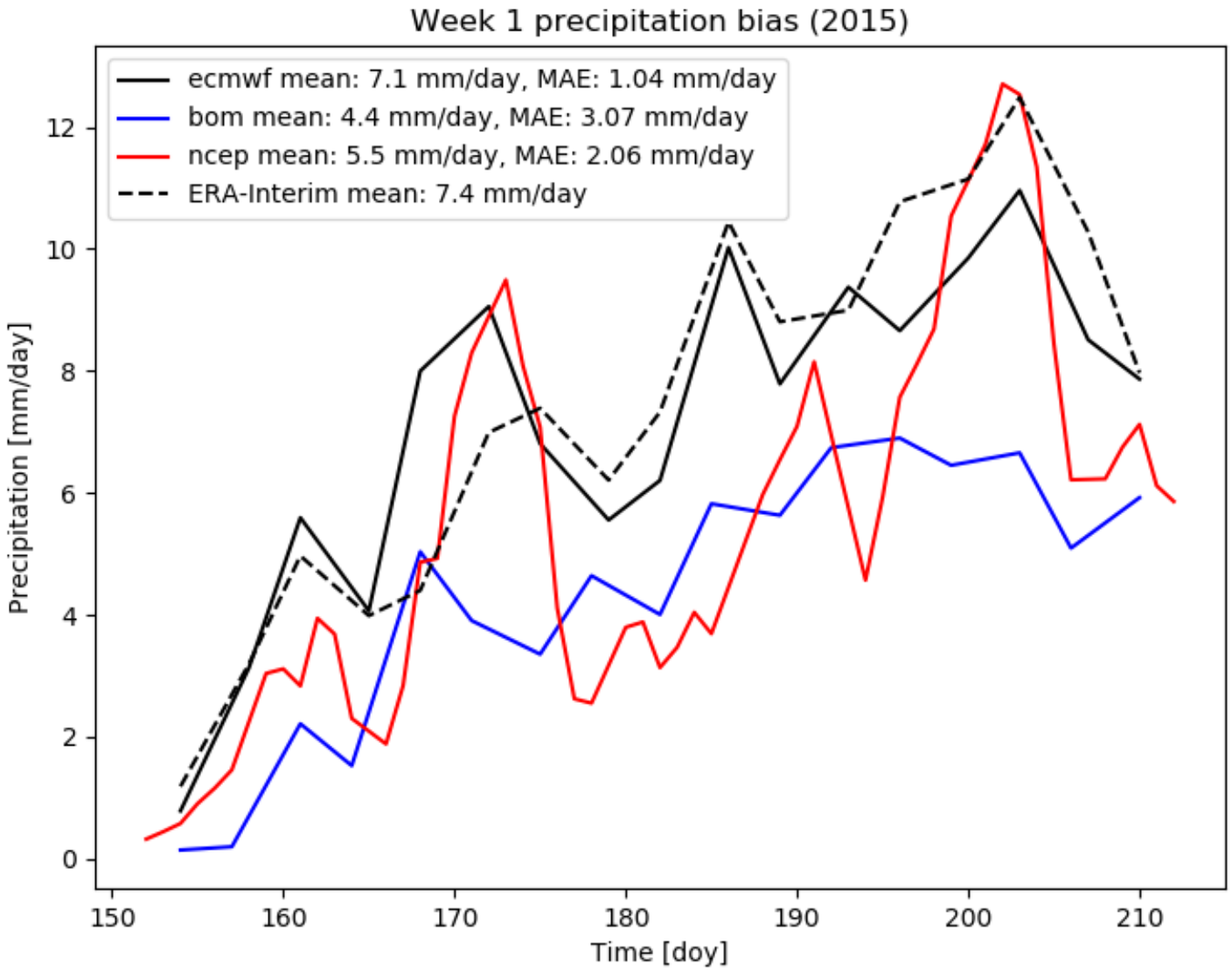
S2S monsoon precipitation bias



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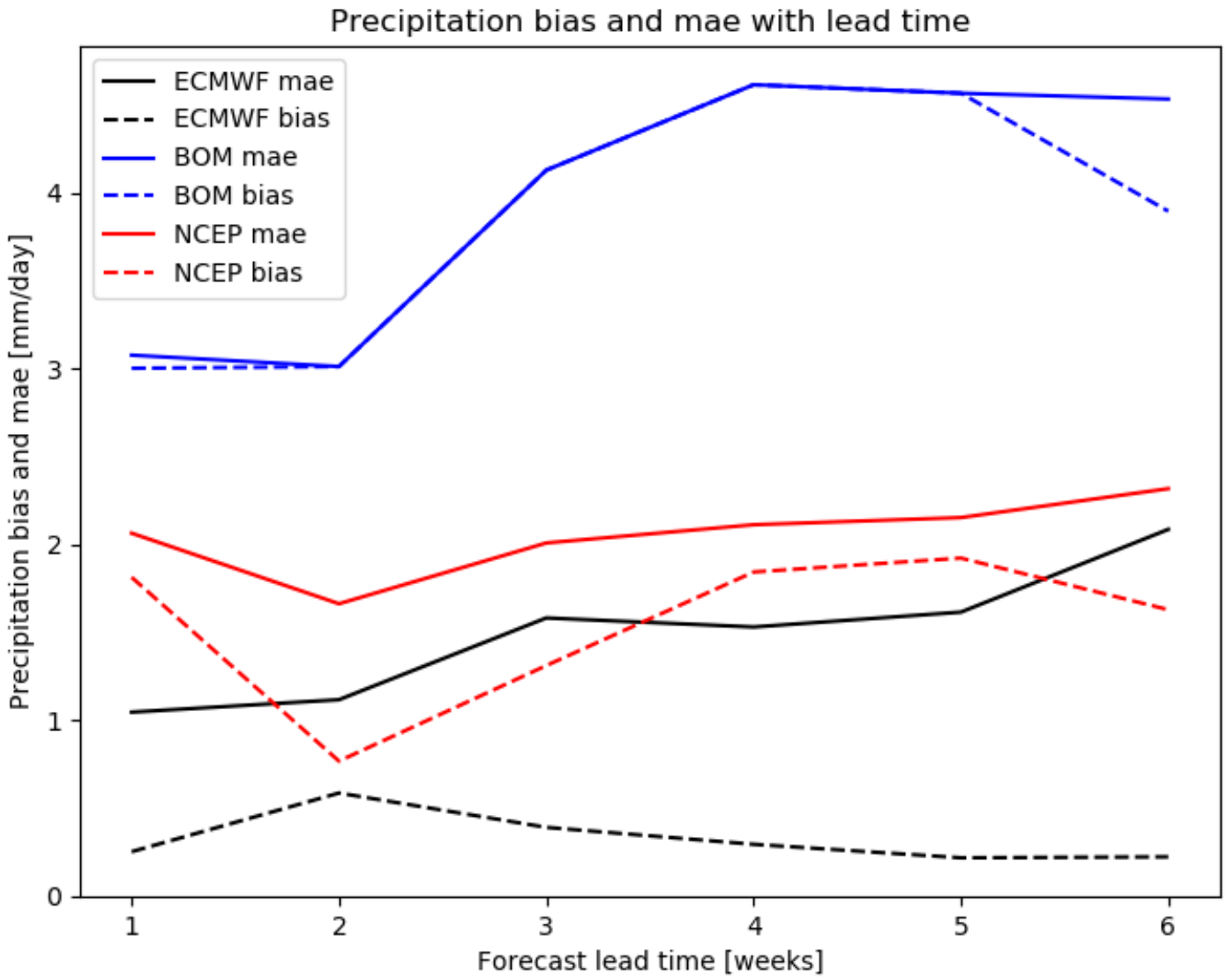
S2S monsoon precipitation bias



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Questions

1. Does the land surface wetness affect the Indian monsoon in S2S models?
2. Do we get a better monsoon prediction if the initialisation is more accurate?

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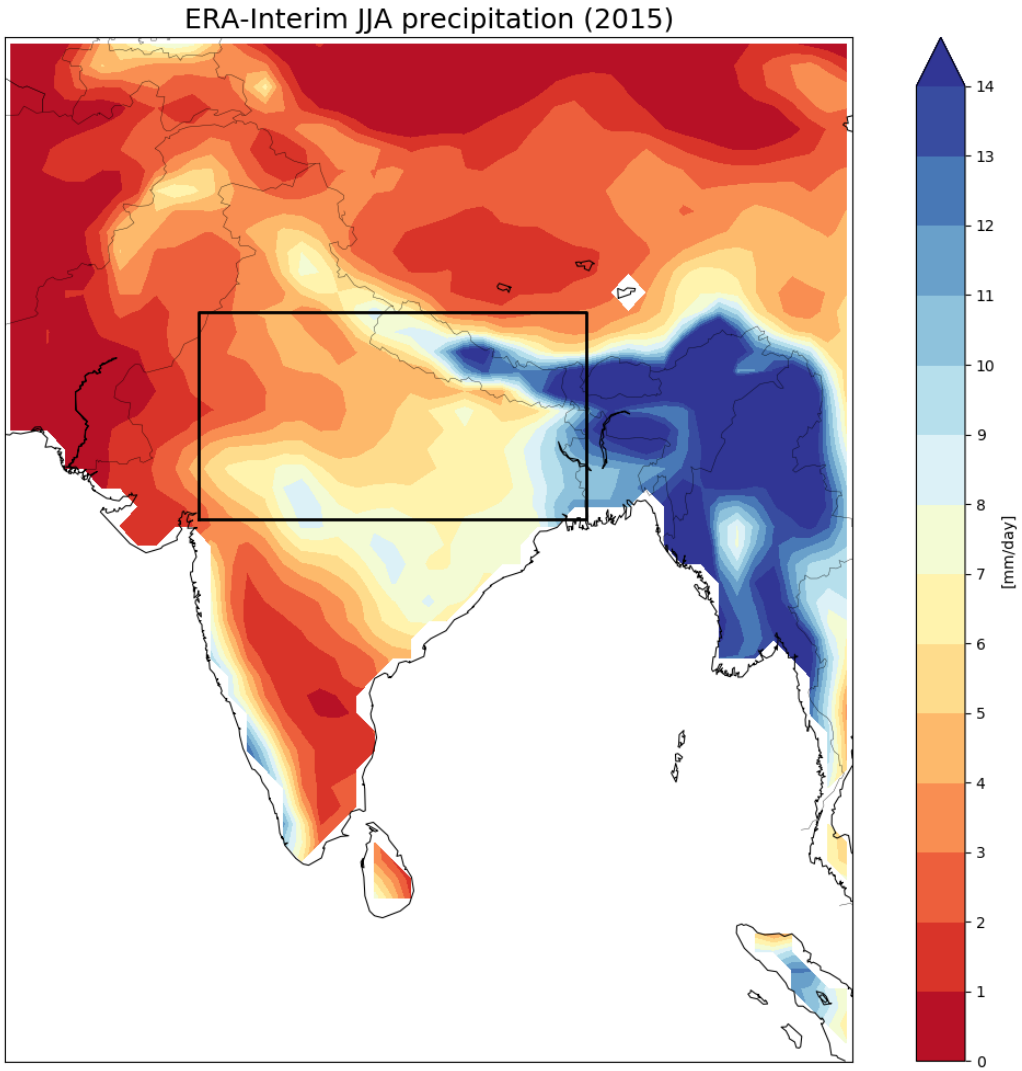
Focus area and JJA precipitation



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Differences between ensemble members

Input data:

- Use ECMWF, BoM and NCEP from S2S archive
- JJA period, for 2015-2017 forecasts

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Differences between ensemble members

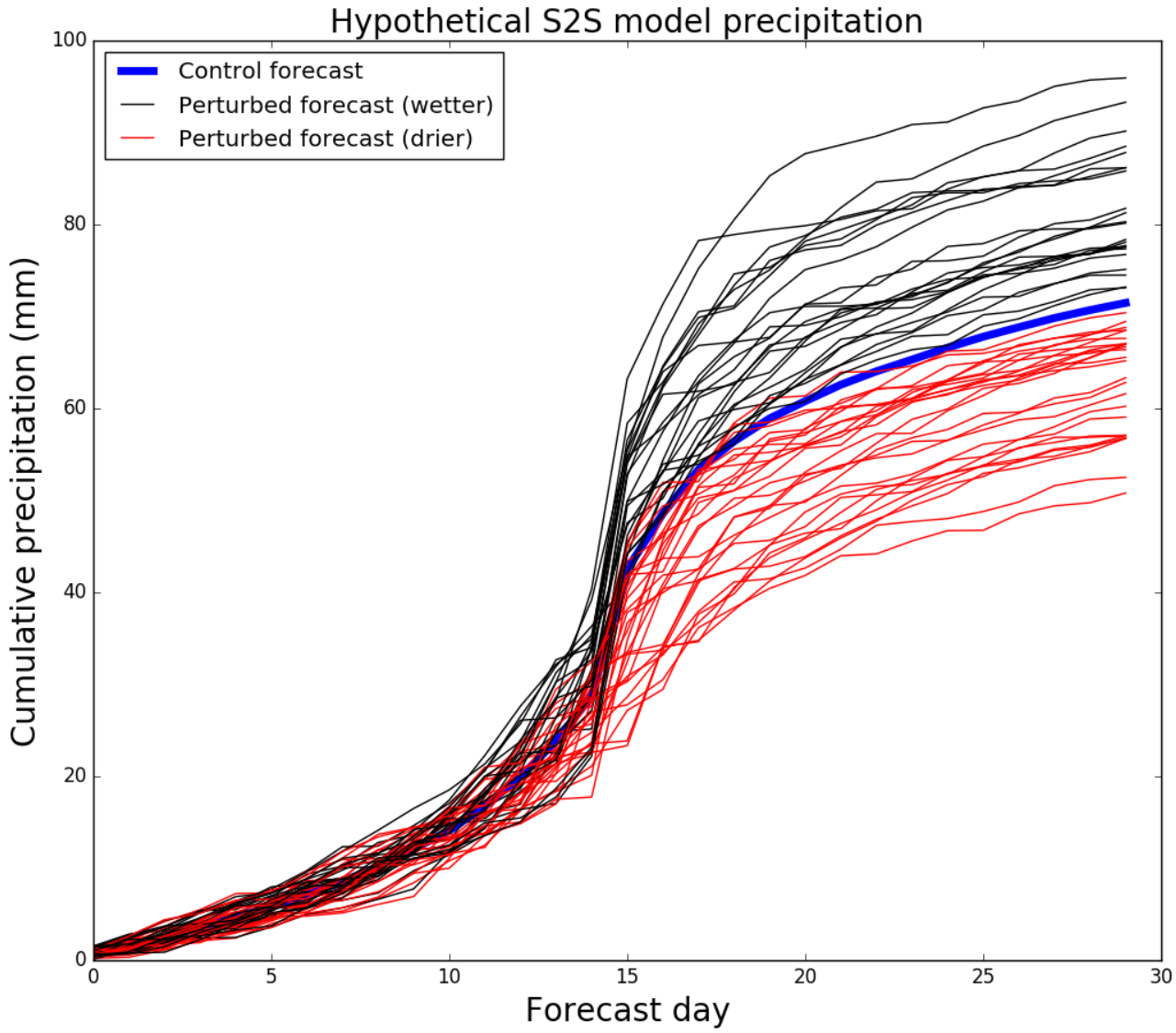
Input data:

- Use ECMWF, BoM and NCEP from S2S archive
- JJA period, for 2015-2017 forecasts

Approach:

1. Determine surface wetness using Bowen ratio ($LH/(LH + SH)$) on first day
2. Compare the initialisation to the **control forecast** and to **ERA-Interim** Bowen ratio
3. Determine differences in **precipitation** and **northward IWV transport**

Initialization difference between ensemble members



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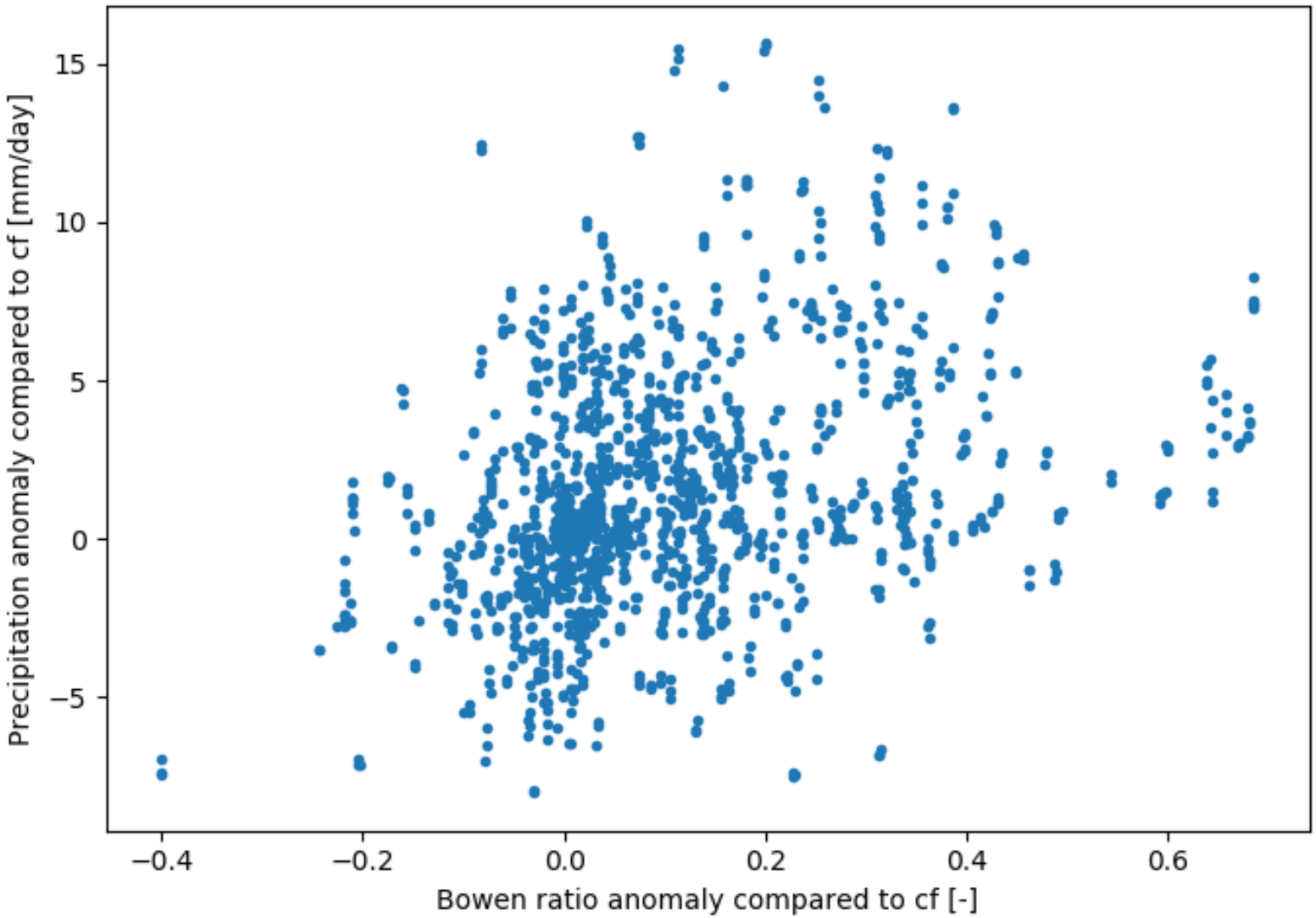

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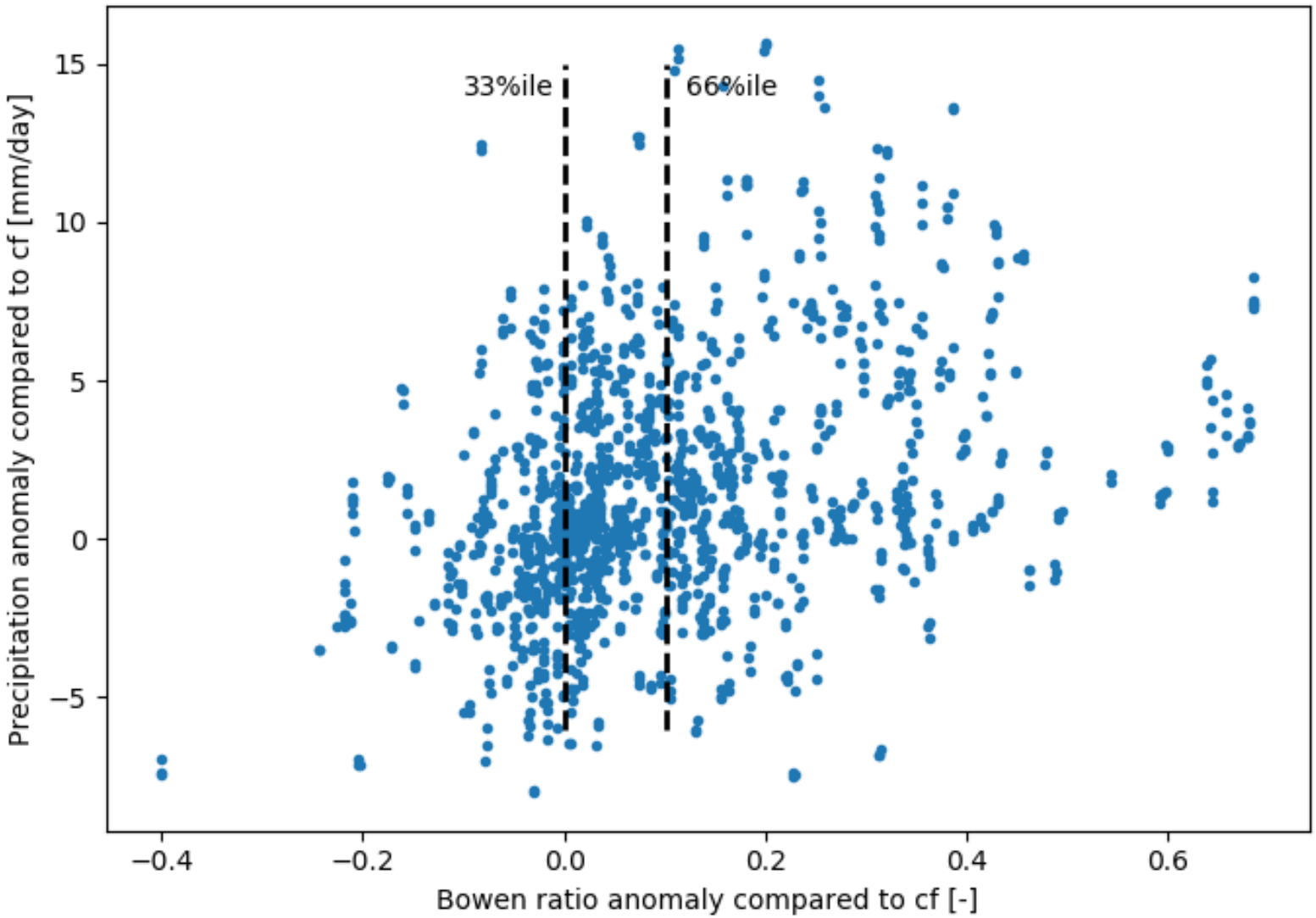

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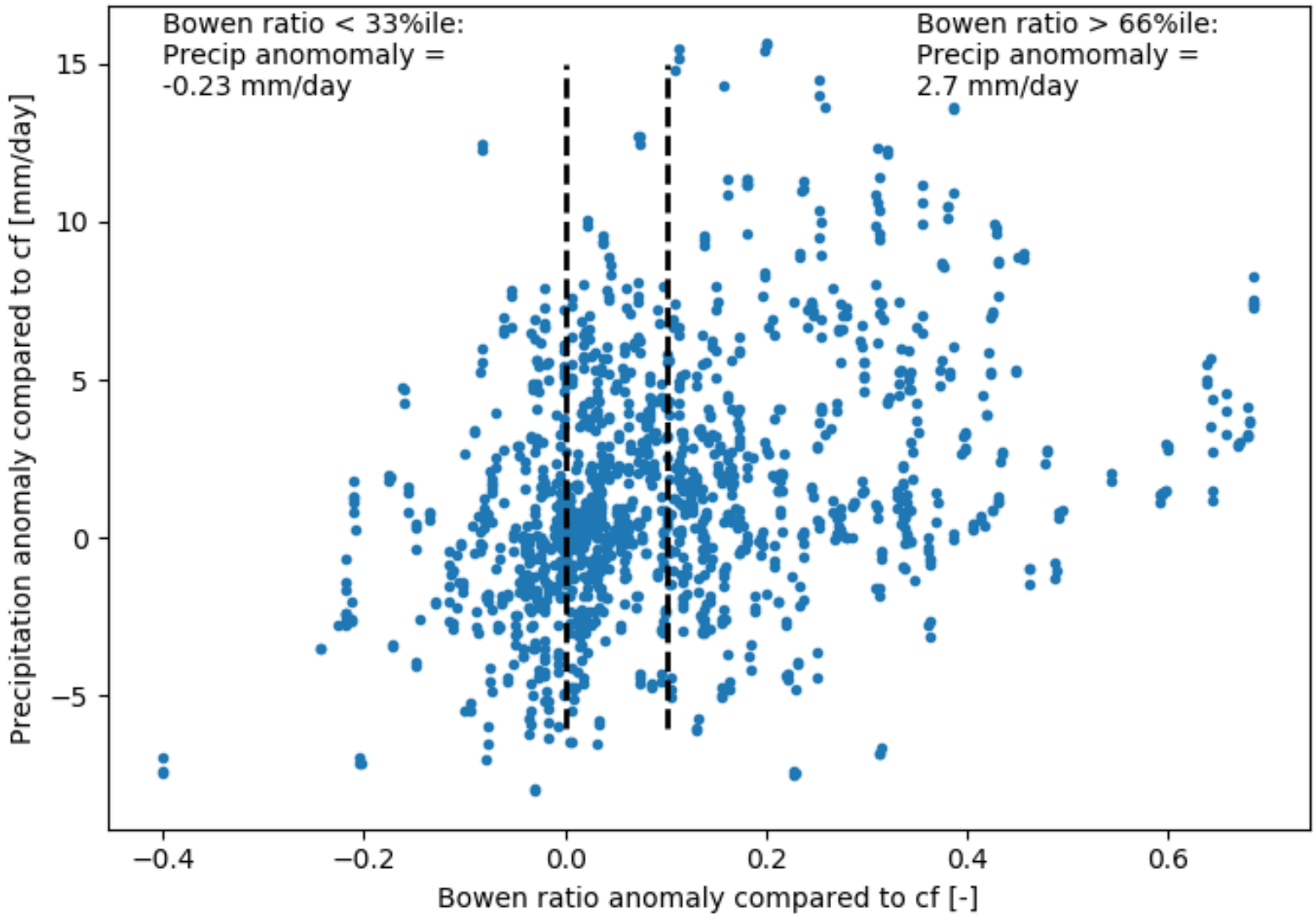

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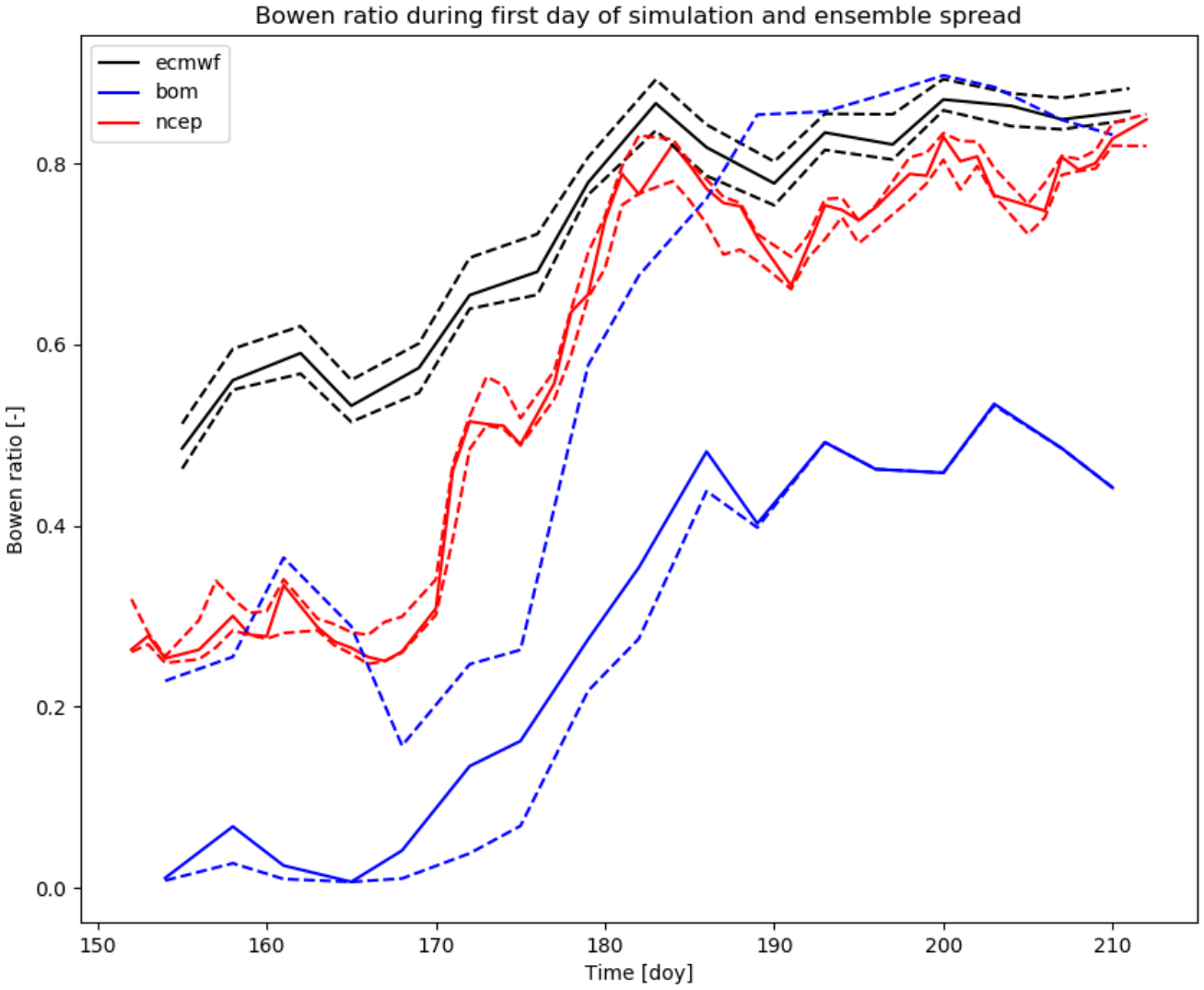
Different S2S model initialisation systems



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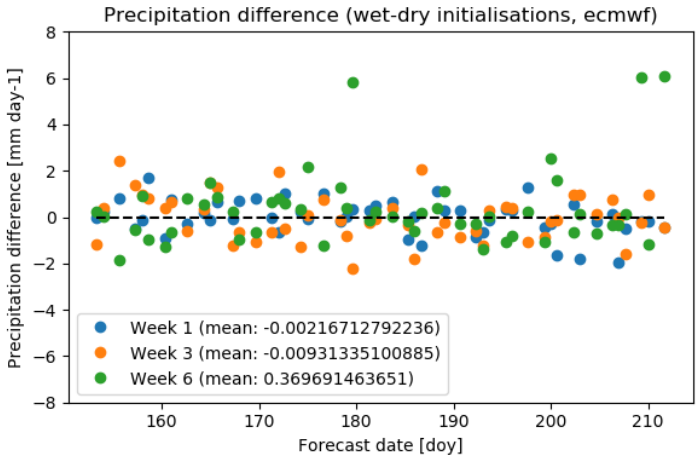
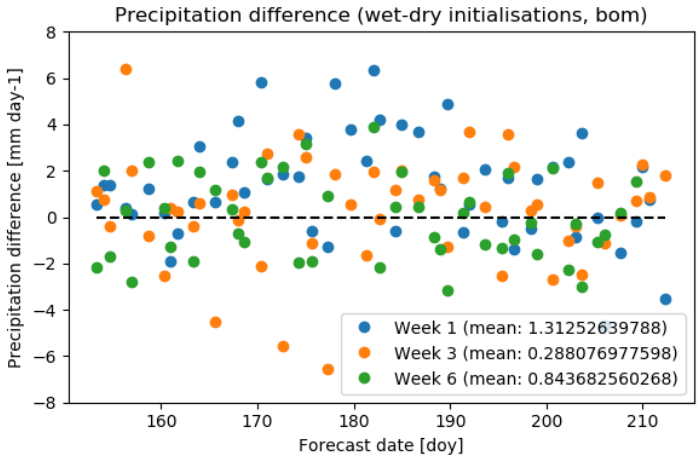
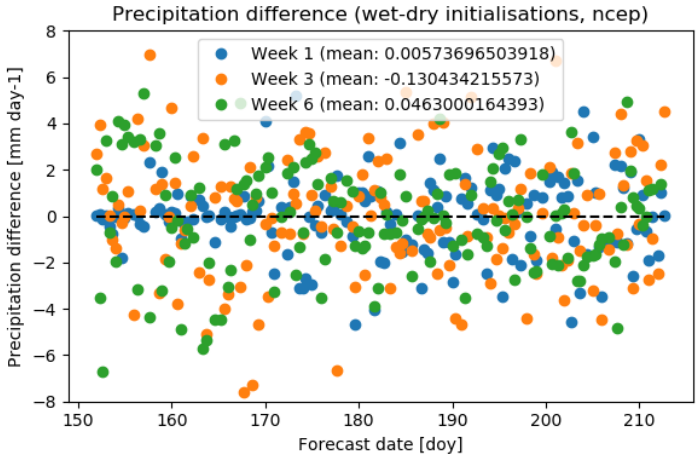
Wet initializations: more precip?







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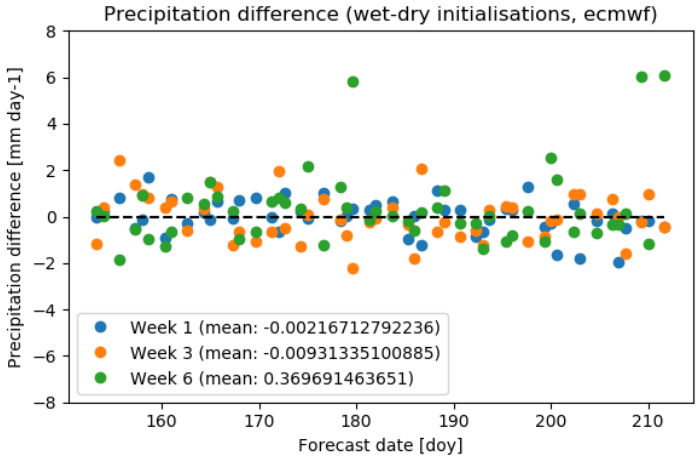

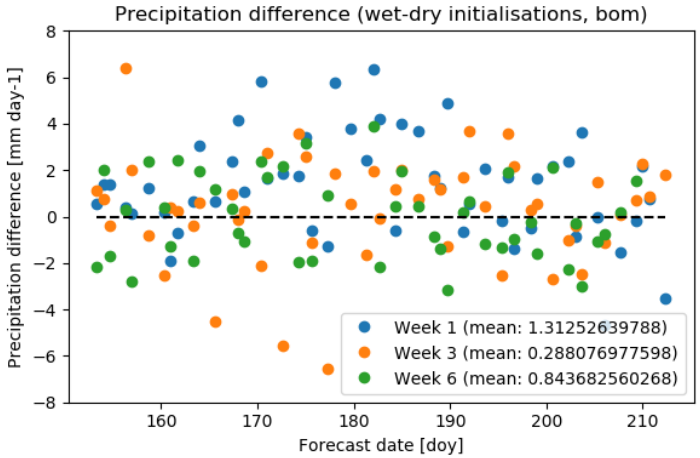

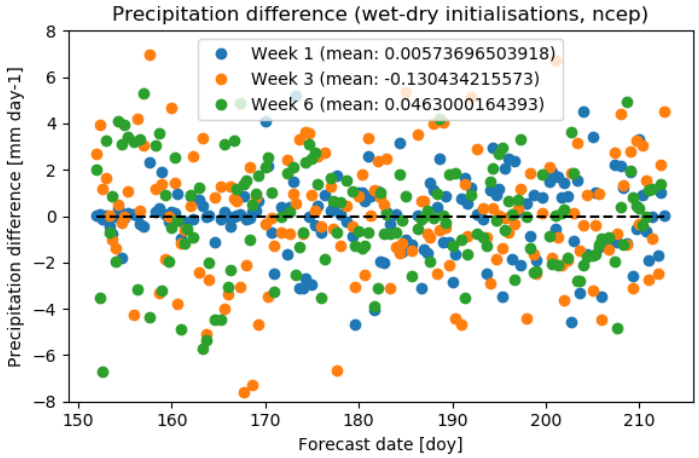

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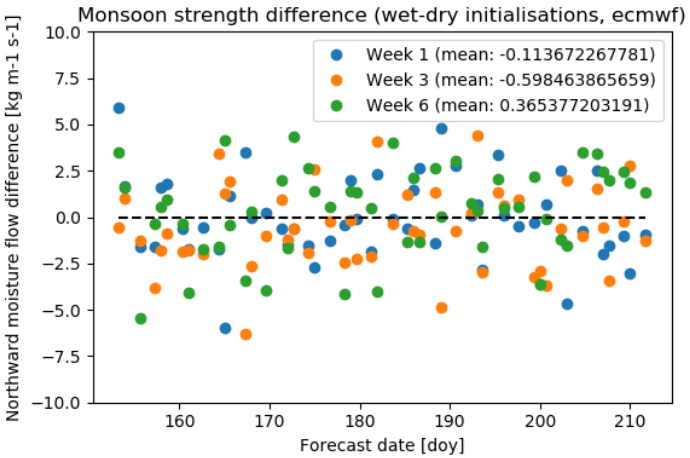
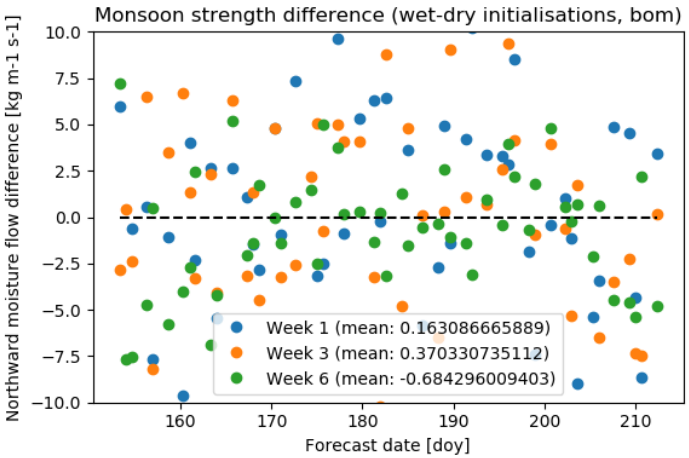
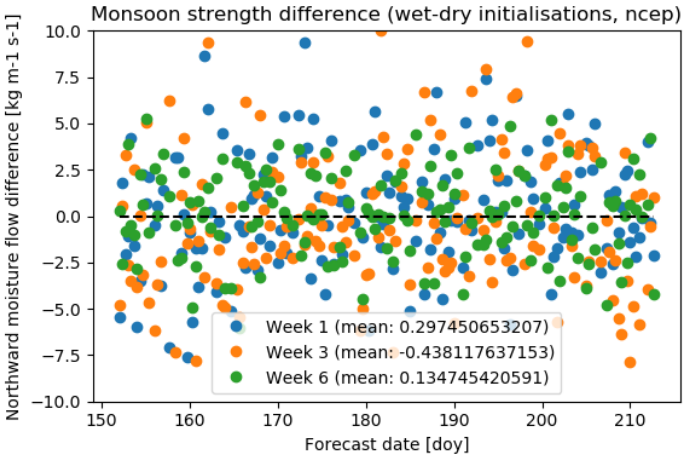
Wet initializations: stronger monsoon flow?







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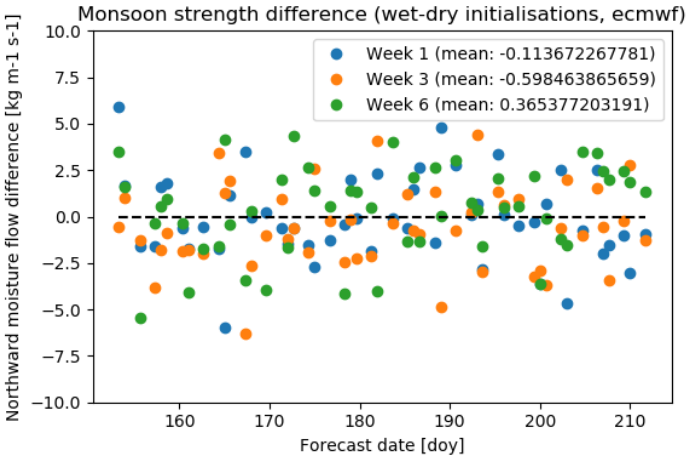

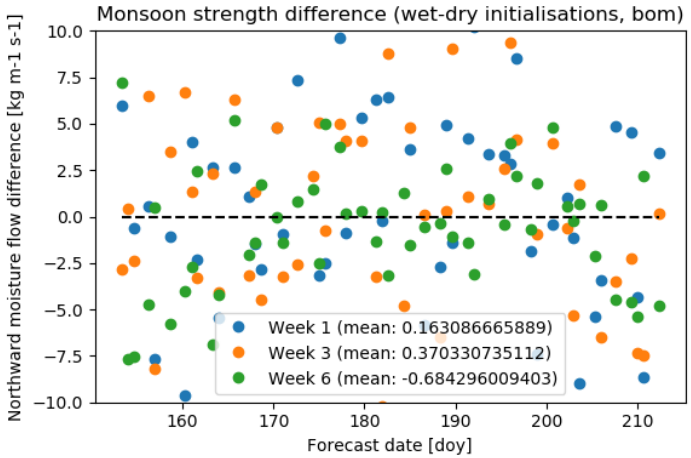

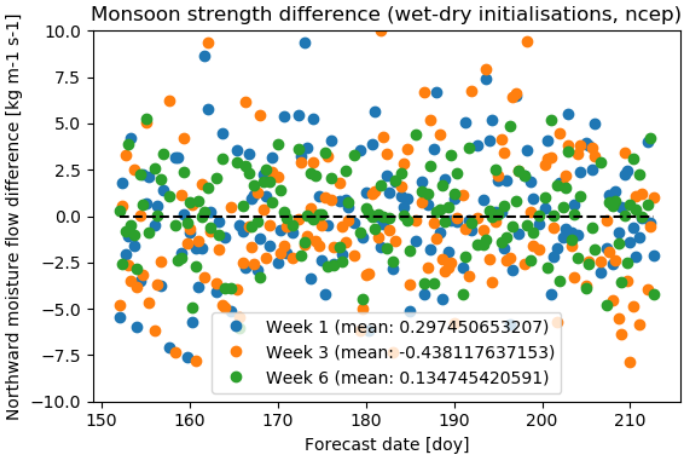

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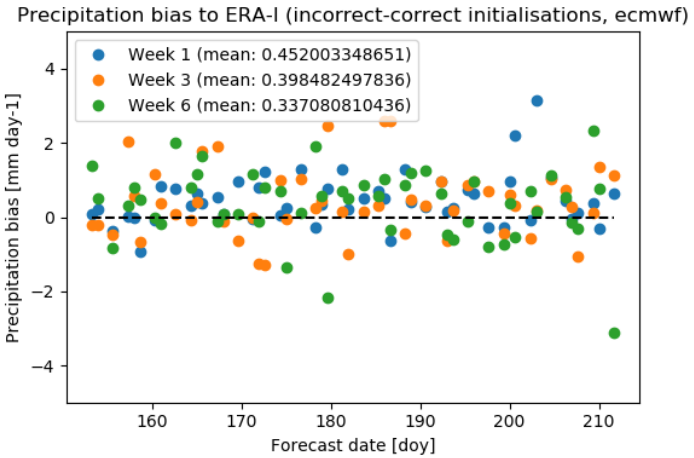
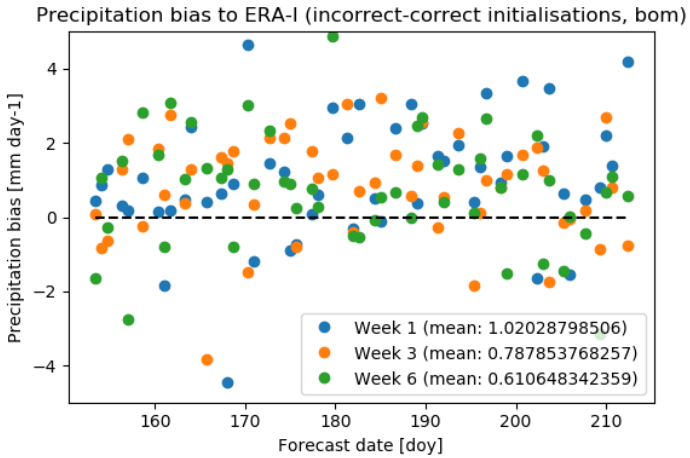
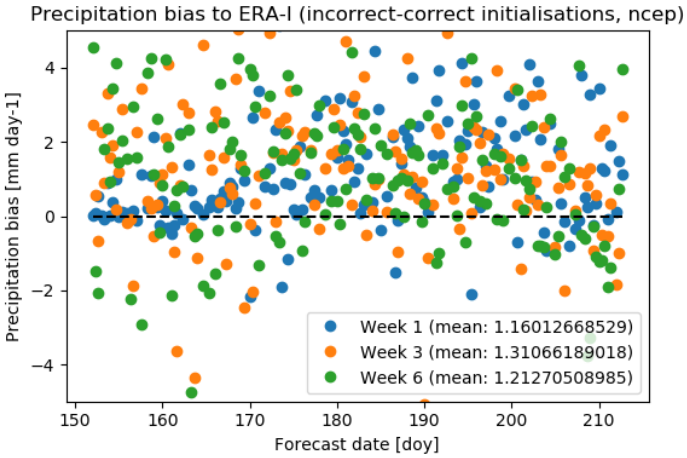
Correct initializations: smaller P bias?







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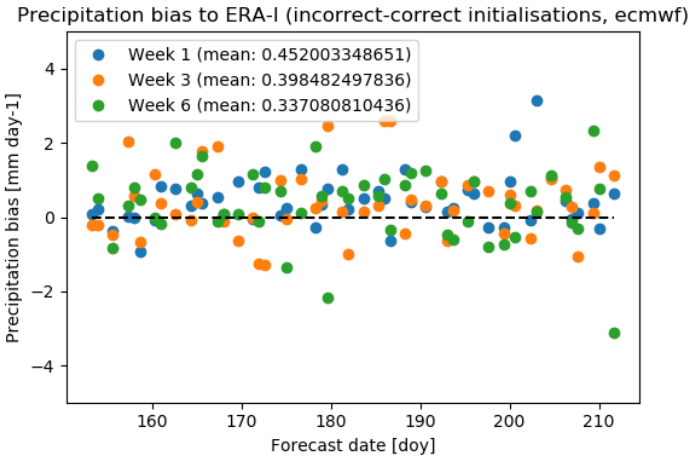

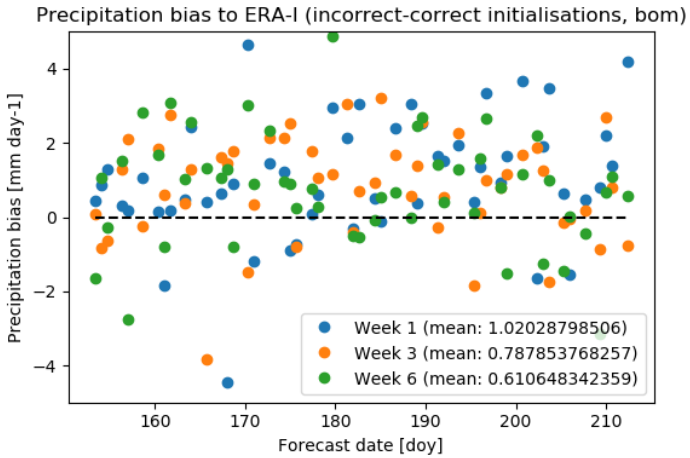

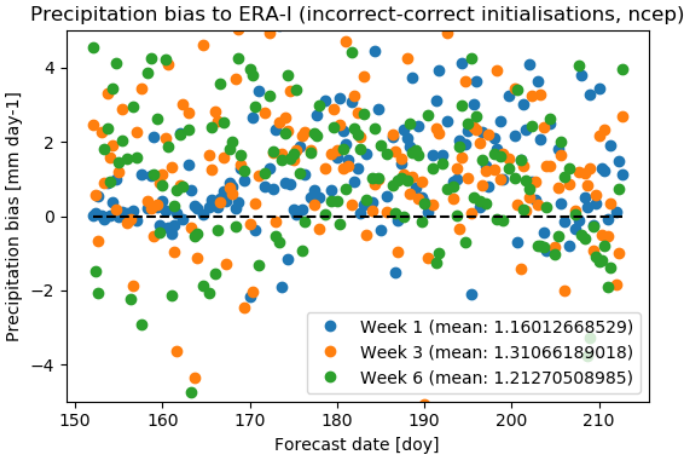

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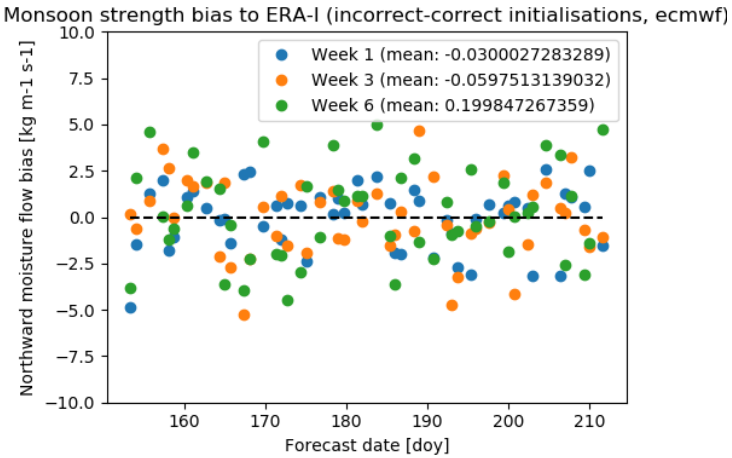
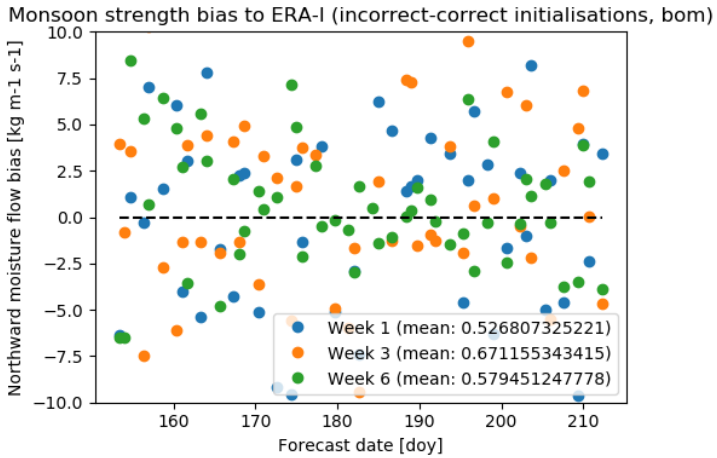
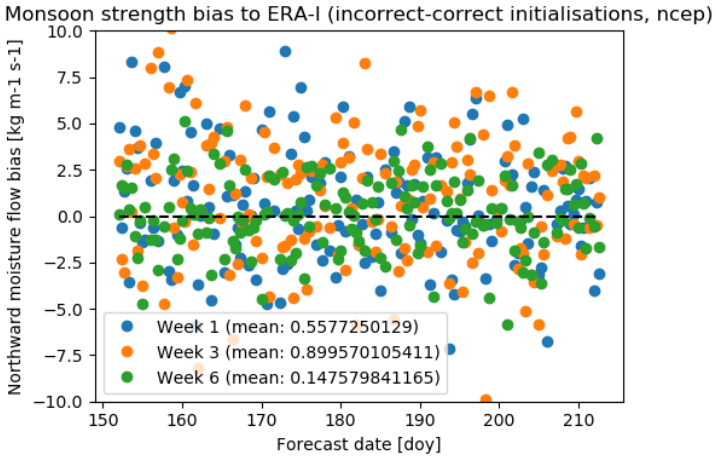
Correct initializations: smaller flow bias?







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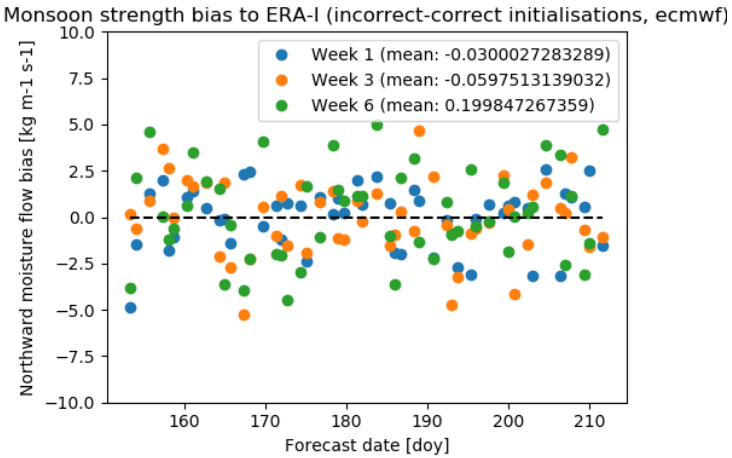

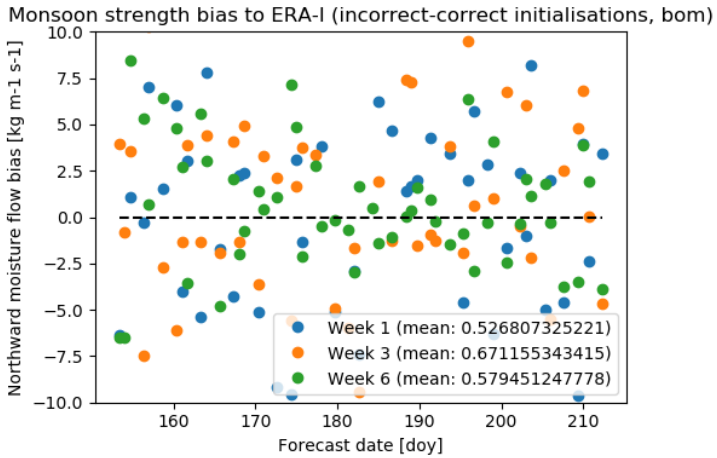

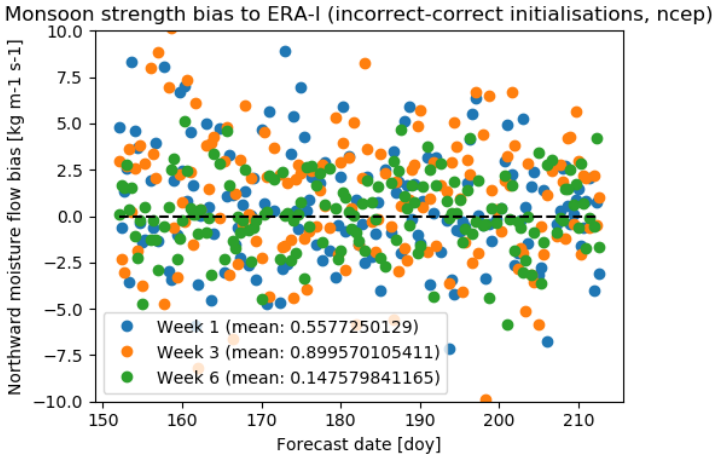

For some models.

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Conclusions

1. The spread of the Bowen ratio within the S2S ensemble varies strongly across S2S models
2. Wetter initializations do not necessarily lead to more precipitation
3. More realistic initialization (compared to ERA-Interim) improves the prediction of Indian summer monsoon precipitation
4. However, the mechanism by which this occurs (stronger monsoon flow or more local evaporation) is different for the models

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