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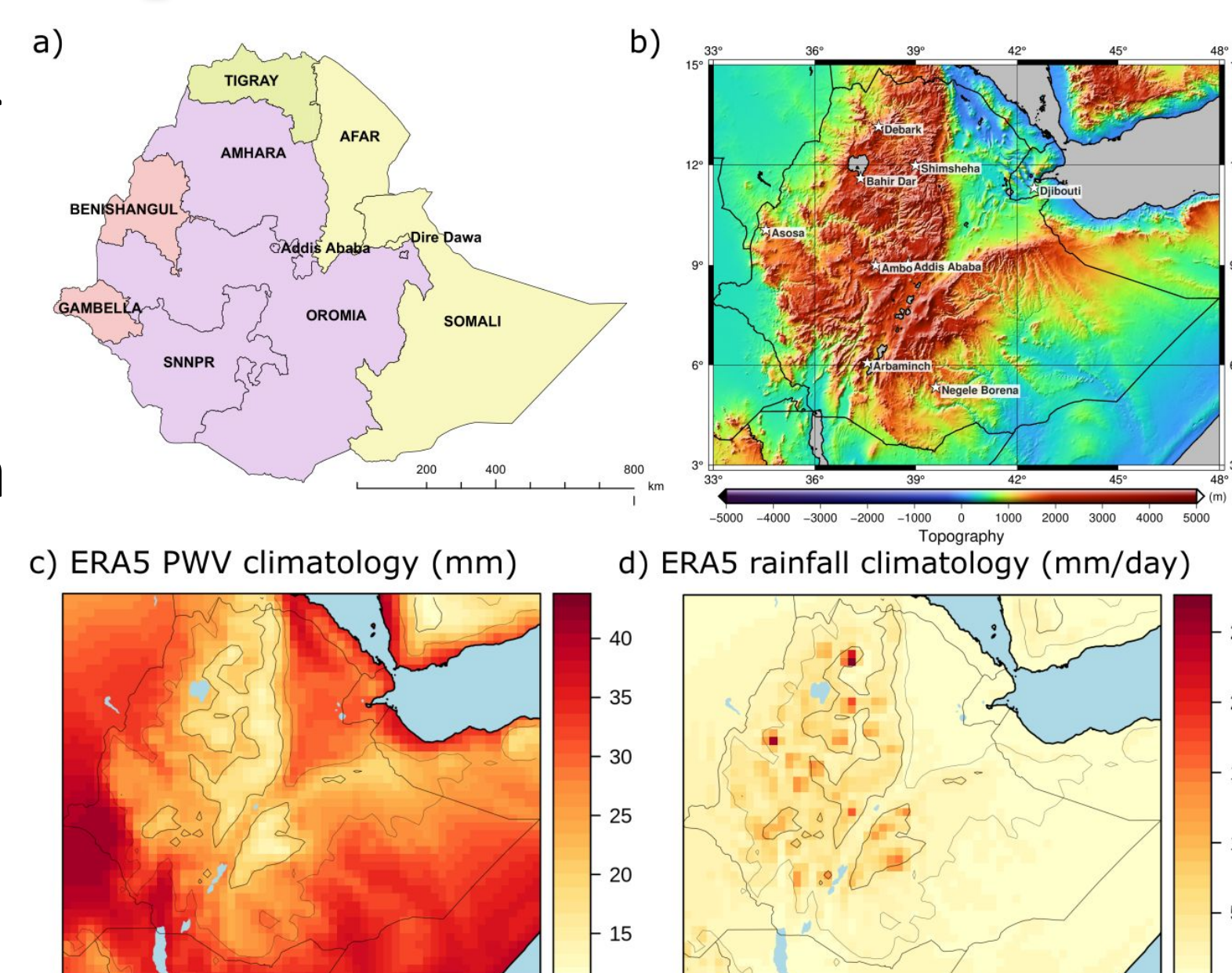
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Research Questions

- How do Regional Climate Models (RCMs) reproducing Precipitable Water Vapor (PWV) in a mountainous tropical region of Ethiopia?
- What is the relation between PWV and heavy rainfall over Ethiopia and how is that reproduced by the RCMs?
- What is the impact of climate change on PWV and how does it relate to the changes in temperature and heavy rainfall?

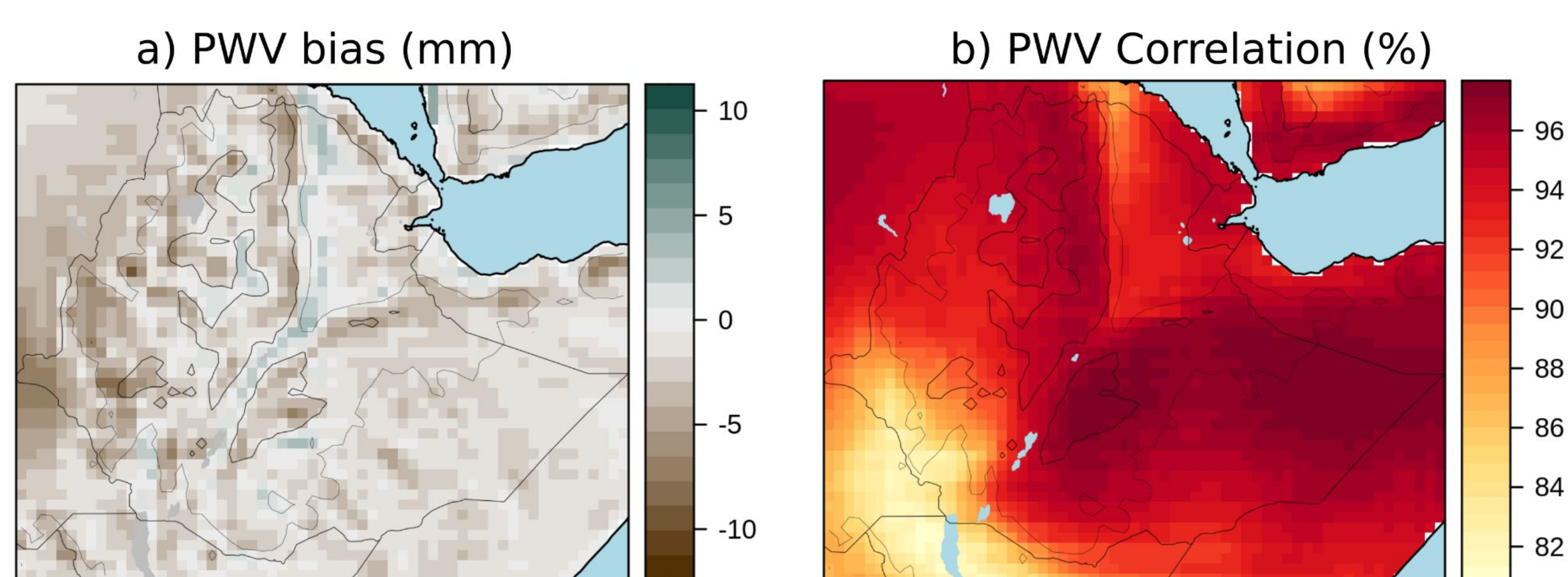
Region

Ethiopia covers diversity of climate zones: tropical (wet, red in panel a), dry (yellow), and temperate climate with a single dry season and a warm summer (purple). Mountains exceed 4000m in elevation (see panel b)



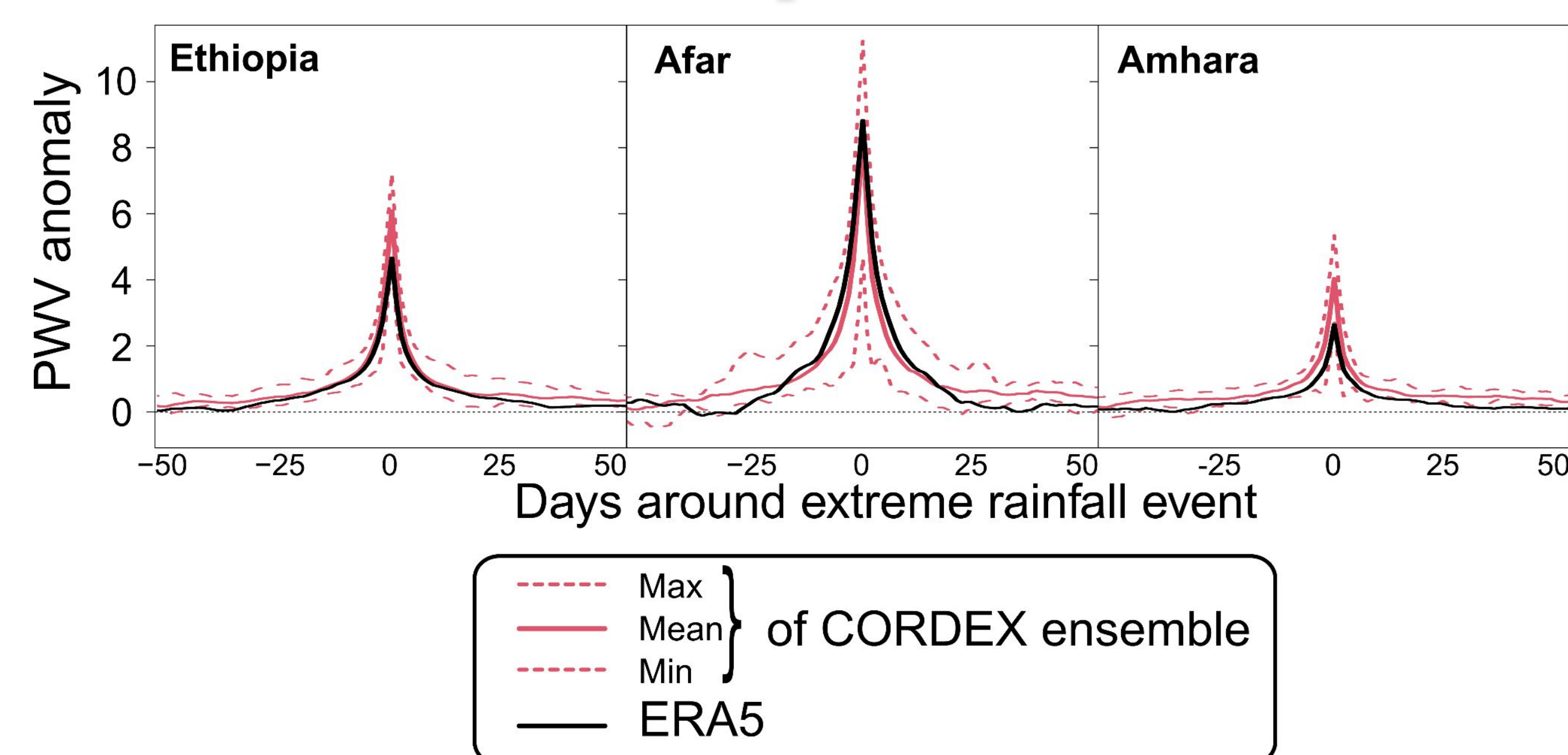
PWV bias & correlation of CORDEX models with ERA5

CORDEX ensemble mean wrt ERA5



Wet and dry PWV biases are present at high and low elevations, respectively. Correlations are highest in the highlands and lowest in southwest.

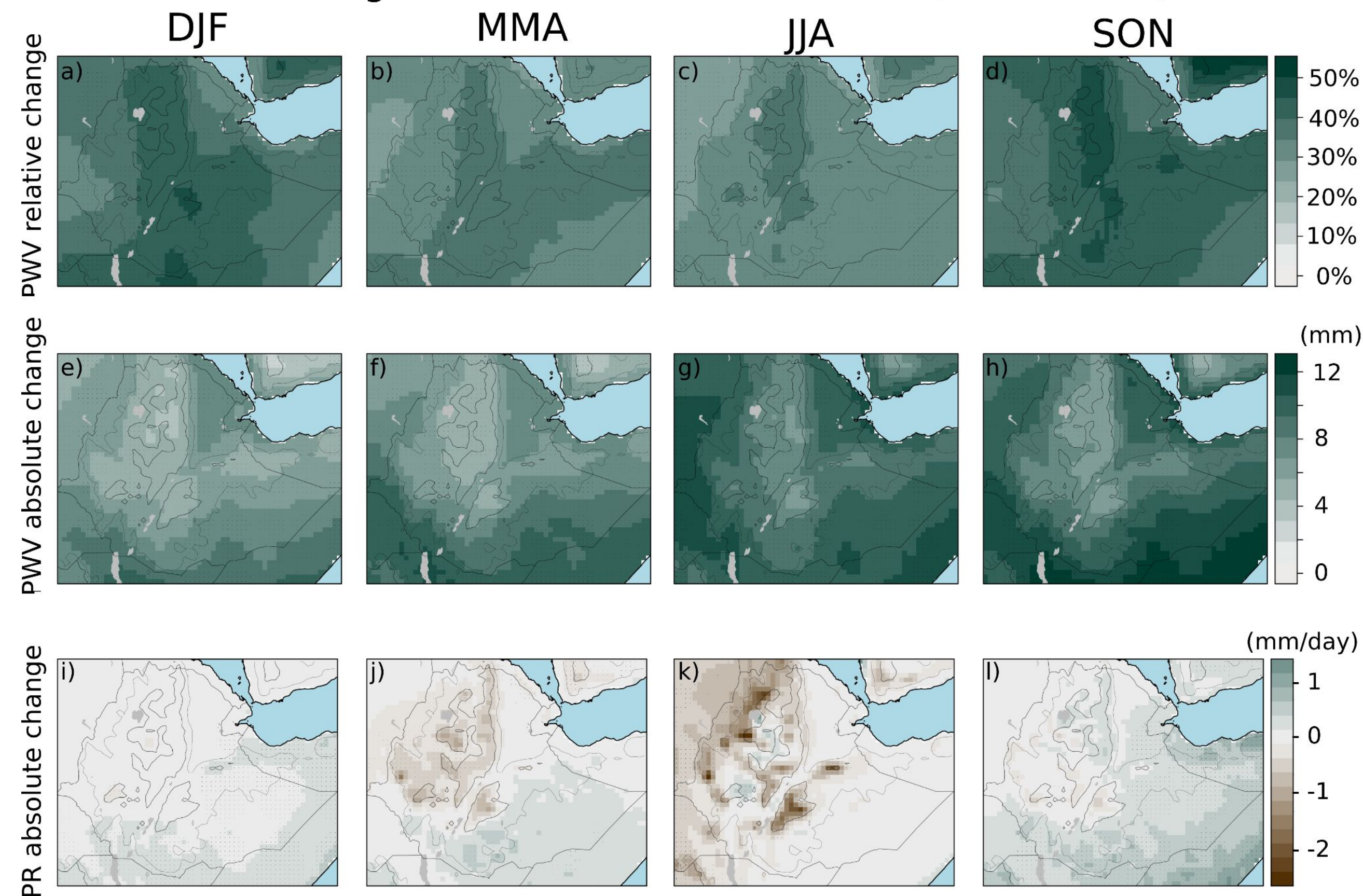
Relation PWV with heavy rainfall



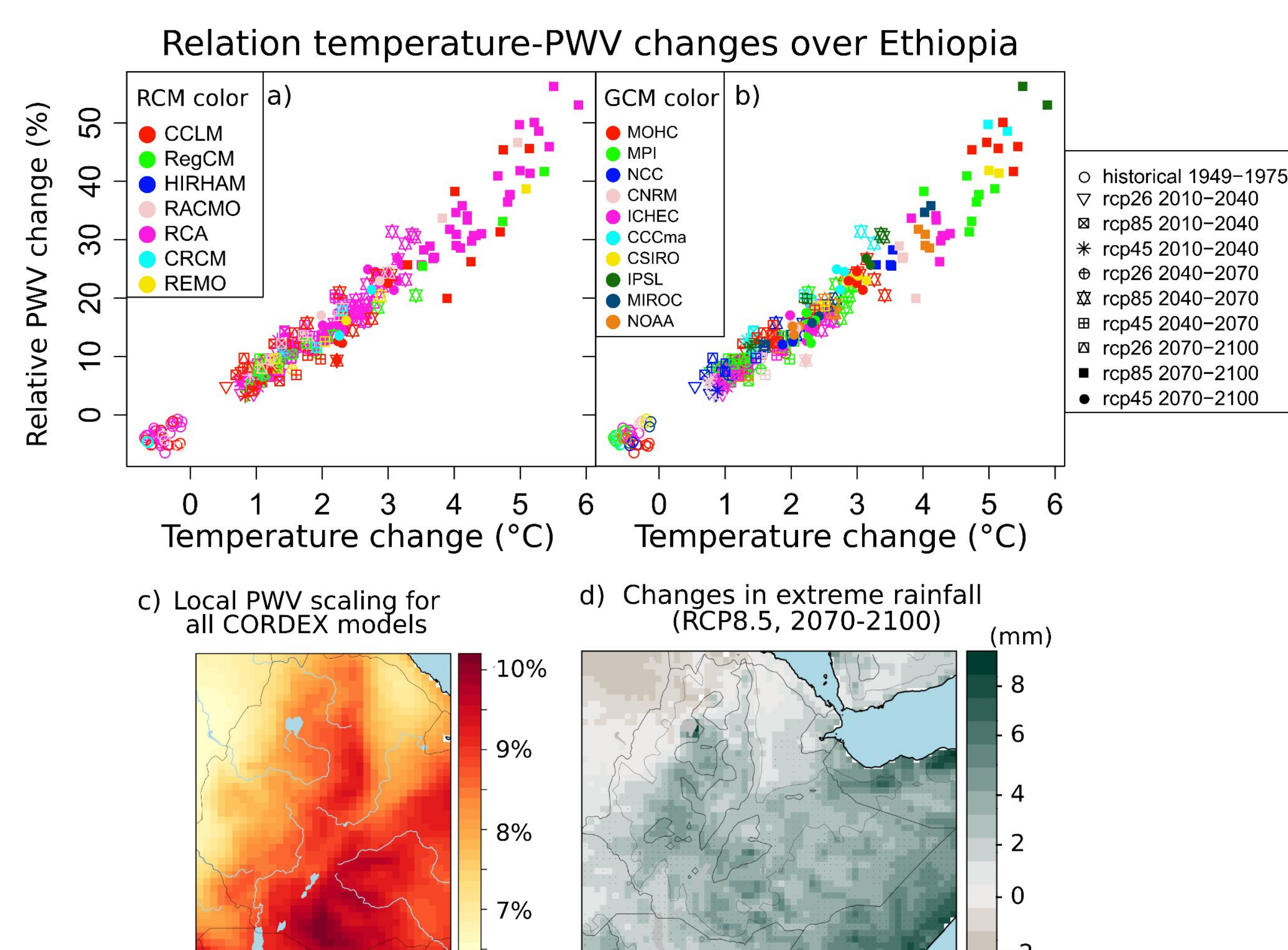
PWV anomalies before and after the occurrence of heavy rainfall events. These peaks are highest in the driest regions (e.g. Afar). CORDEX captures overall spatial patterns but overestimates the lowest and underestimates the highest PWV anomalies.

Climate Change: average PWV and rainfall

Change of PWV and PR for RCP8.5 (2070-1200)



Climate Change: PWV and heavy rainfall



Conclusions

- CORDEX RCMs reproduce well the PWV annual cycle but substantial biases appear in the very dry and in the tropical climate zones. Also wet and dry biases exist at high and low elevations, respectively.
- CORDEX models simulate well the peak in PWV anomalies at the day of a heavy-rainfall event but strongly overestimate the timescales of buildup and decline.
- Future scenarios point towards a PWV increase up to 40% for end-of-the-century RCP8.5 with limited spatial and seasonal variations.
- PWV changes align with near-surface temperature changes at a rate of 7.7% per degree warming.
- Changes in daily rainfall extremes are lower especially in northwestern Ethiopia potentially caused by an overall drying.