

# PROCESS-BASED ASSESSMENT OF CLIMATE MODEL PROJECTIONS

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# Application to West Africa

 AGU PUBLICATIONS

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### RESEARCH ARTICLE

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#### Key Points:

- Circulation changes associated with modeled precipitation change are identified
- Modeled processes are similar for future change and historical variability
- Contrasts to variability in reanalyses bring these models' futures into question

#### Supporting Information:

- Figures S1–S9

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## Process-based assessment of an ensemble of climate projections for West Africa

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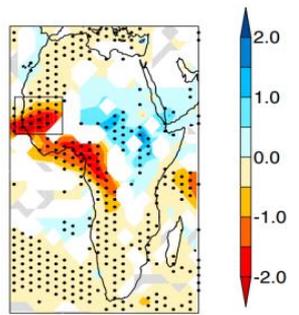
**Abstract** Determining the level of confidence in regional climate model projections could be very useful for designing climate change adaptation, particularly for vulnerable regions. The majority of previous research to evaluate models has been based on the mean state, but for confidence in projections the plausibility of the mechanisms for change is just as, if not more, important. In this study we demonstrate a methodology for process-based assessment of projections, whereby circulation changes accompanying future responses are examined and then compared to atmospheric dynamics during historical years in models and reanalyses. We apply this methodology to an ensemble of five global and regional model experiments and focus on West Africa, where these models project a strong drying trend. The analysis reveals that this drying is associated with anomalous subsidence in the upper atmosphere, and large warming of the Saharan heat low region, with potential feedback effects via the African easterly jet and West African monsoon. This mode occurs during dry years in the historical period, and dominates in the future experiments. However, the same mode is not found in dry years in reanalysis data, which casts doubt on the reasons for strong drying in these models. The regional models show a very similar response to their driving global models, and are therefore no more trustworthy in this case. This result underlines the importance of assessing model credibility on a case-by-case basis and

# Framework applied in James et al. 2015 (JGR-A)

Examine future projections

*How do GCMs and RCMs project precipitation will change in future?*

GCM  
future



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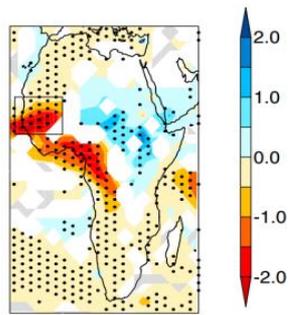
Examine future projections



Analyse modelled circulation responses in future

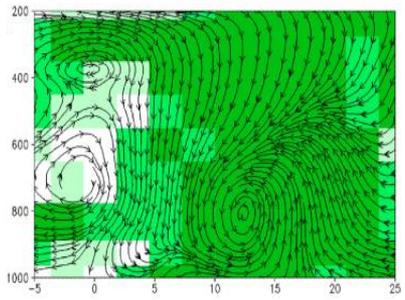
*How do GCMs and RCMs project precipitation will change in future?*

GCM future



*Is it possible to infer potential mechanisms for precipitation change?*

GCM future



# Framework applied in James et al. 2015 (JGR-A)

Examine future projections

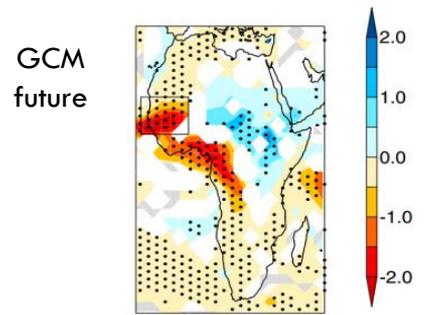


Analyse modelled circulation responses in future

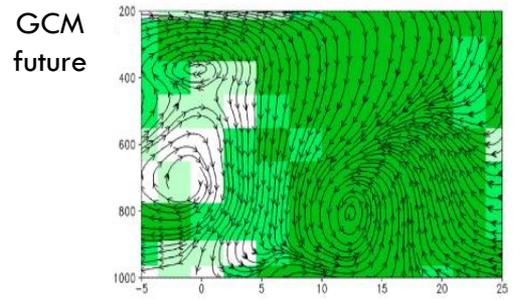


Investigate composites of historical wet and dry years

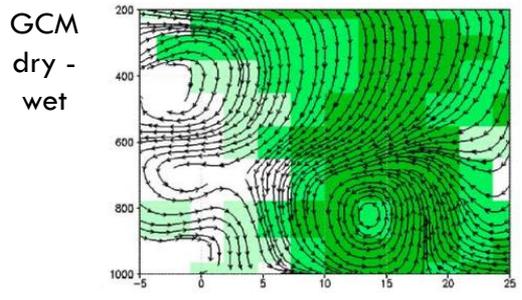
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*Are the drivers of change similar for future projections and interannual variability?*



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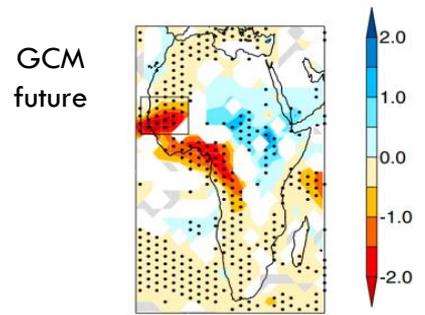


Investigate composites of historical wet and dry years

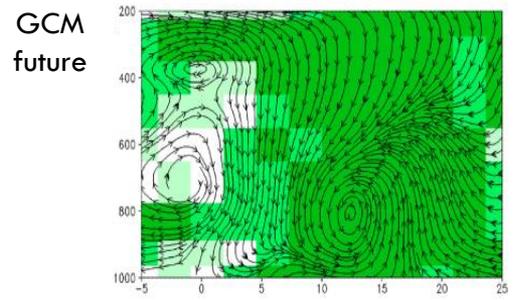


Compare modelled composites to reanalysis

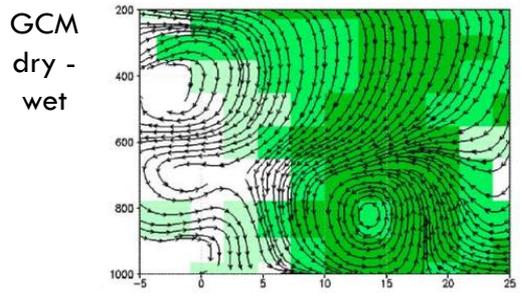
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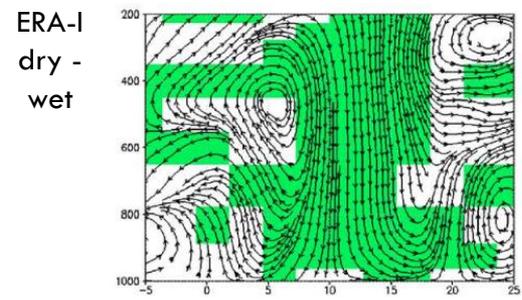
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*Are the drivers of change similar for future projections and interannual variability?*



*Are interannual circulation responses similar in models and reanalysis?*



# Conclusions: West Africa

- Important difference in magnitude of GCM and RCM projections
- But character of response very consistent
  
- Both GCMs and RCMs show distinct circulation mode during 20<sup>th</sup> century dry years, and this dominates in response to global warming
- This mode is not found in reanalysis
  
- Findings cast doubt on strong drying of West Sahel
- RCM no more trustworthy than GCM in this case

**→ Need for assessment of modelled signals before they are used to provide data for decision-making**