

Crop-climate ensemble scenarios to narrow uncertainty in the evaluation of climate change impacts on agricultural production

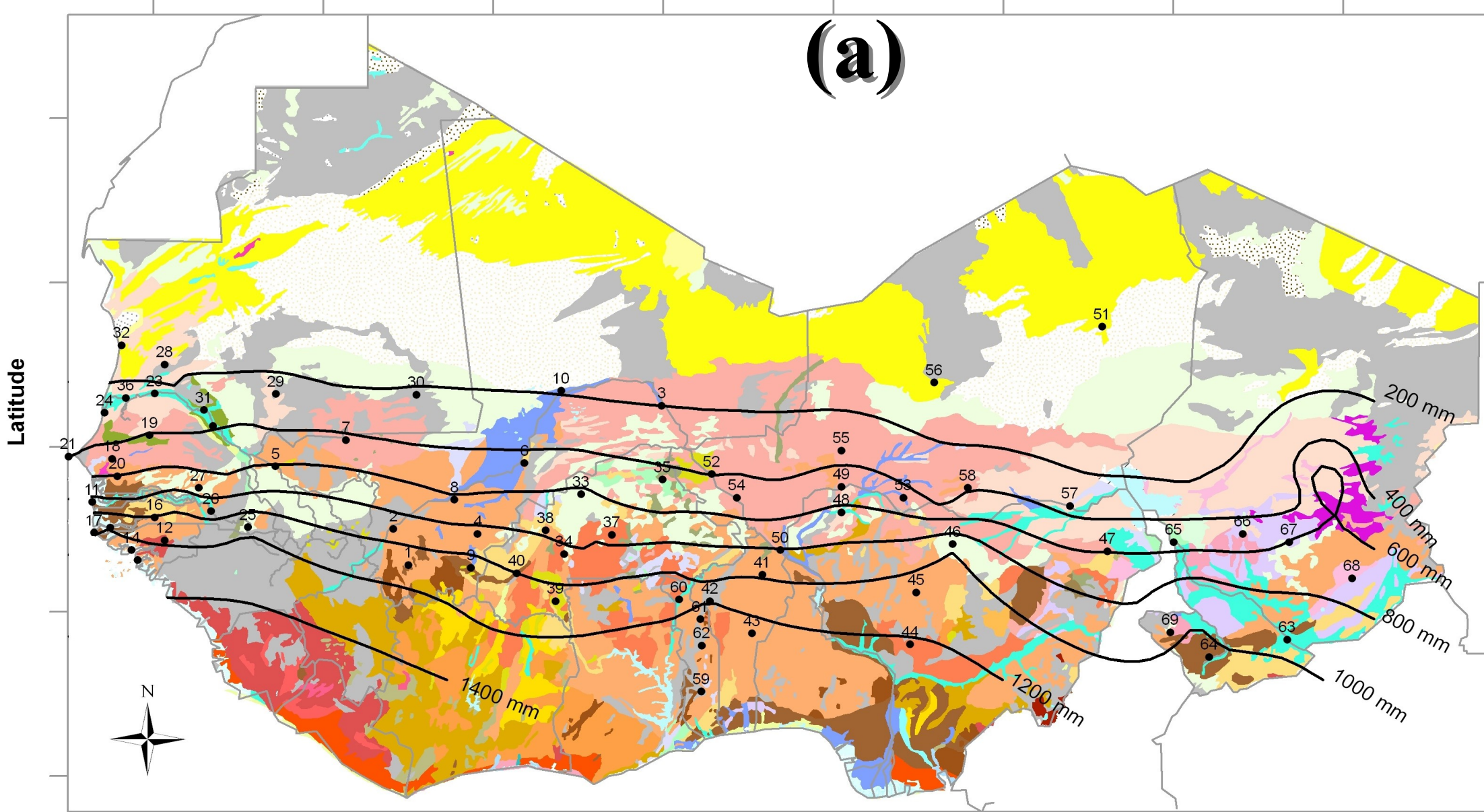
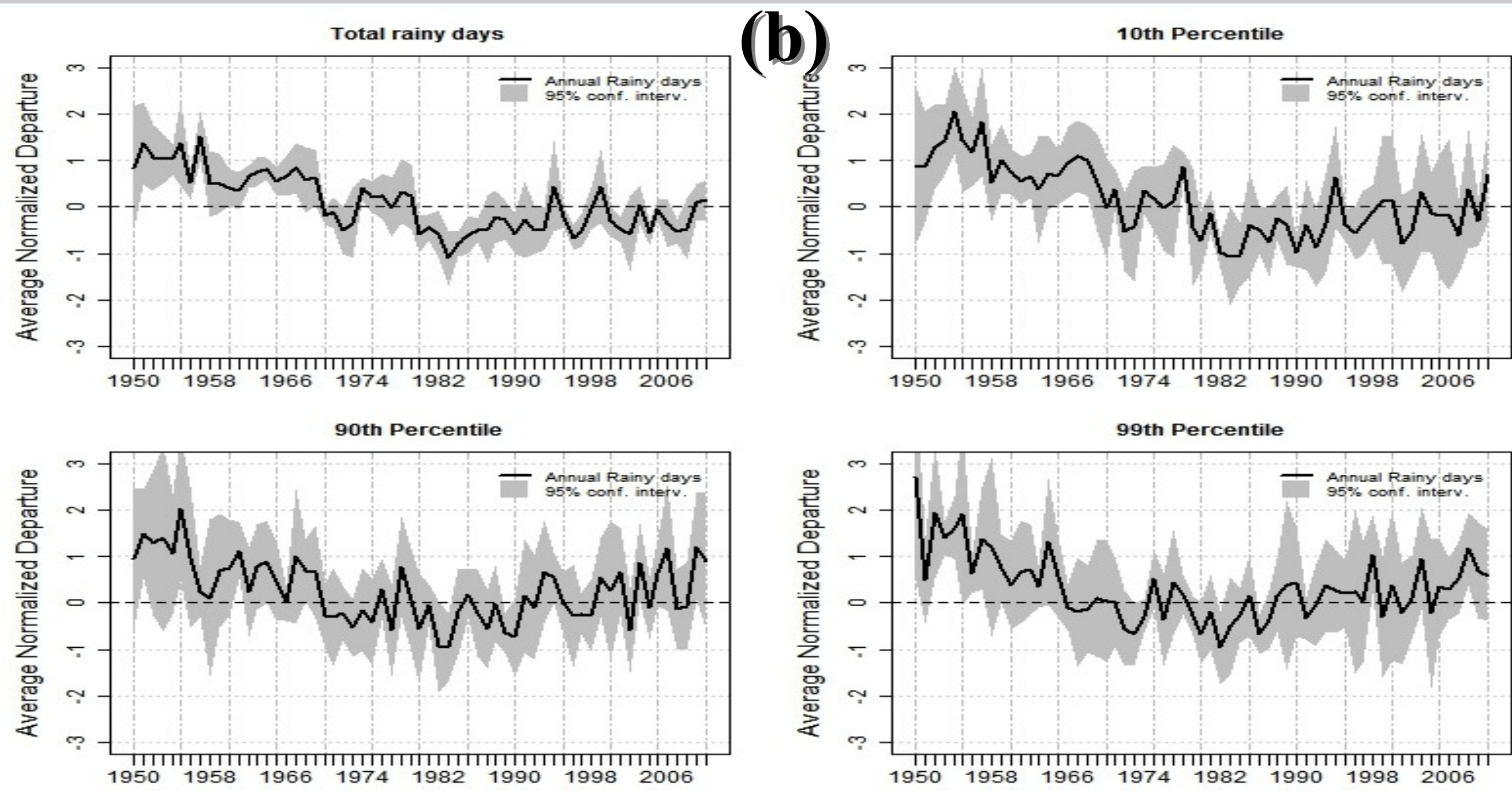
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The impacts of climate variability and change are still full of discrepancies due to cascades of uncertainties from *i*) lack of accurate crop-soil management information, *ii*) crop model sensitivity, *iii*) divergence of climate models on rainfall distribution, *iv*) linear bias transfer between climate/crop models. In order to reduce these uncertainties in the evaluation of climate change impacts on cereals (millet, maize), legumes (groundnut, cowpea), coherent methodology of plausible crop-climate ensemble scenarios are developed in a multidisciplinary teamwork. They underpin the impact assessment studies over West Africa.

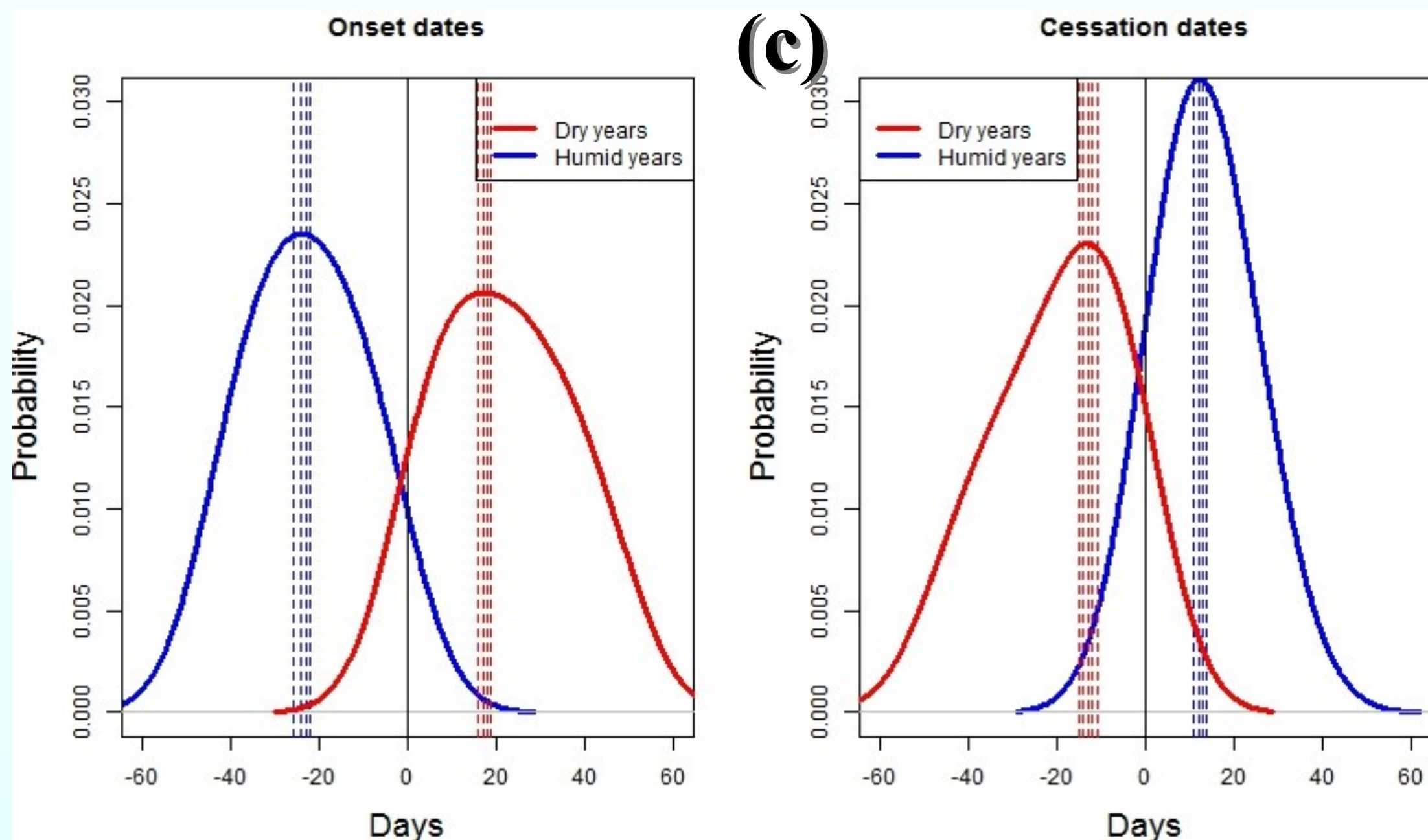
1. Agro-climatic risks assessments (Historical & Baseline) (Figures (a), (b), (c))

- 👉 Diagnostics of soil-atmospheric-crop management factors of high agricultural impacts.
- 👉 Historical evolution of factors and rating their influence on crops in the *Baseline* period.

(b) Evolution of Frequency of extreme rainy days. Annual totals (top left), light (top right), heavy (bottom left), very heavy (bottom right) rainy days.



(a) Soil types, reference stations and rainfall climatology of 1981-2010



(c) Relationship between quality of rainy seasons, extreme dry spells occurrence and length of cropping seasons at onset (left) and Cessation (right) periods.

2. Families of climate change scenarios for impact assessments (Table 1)

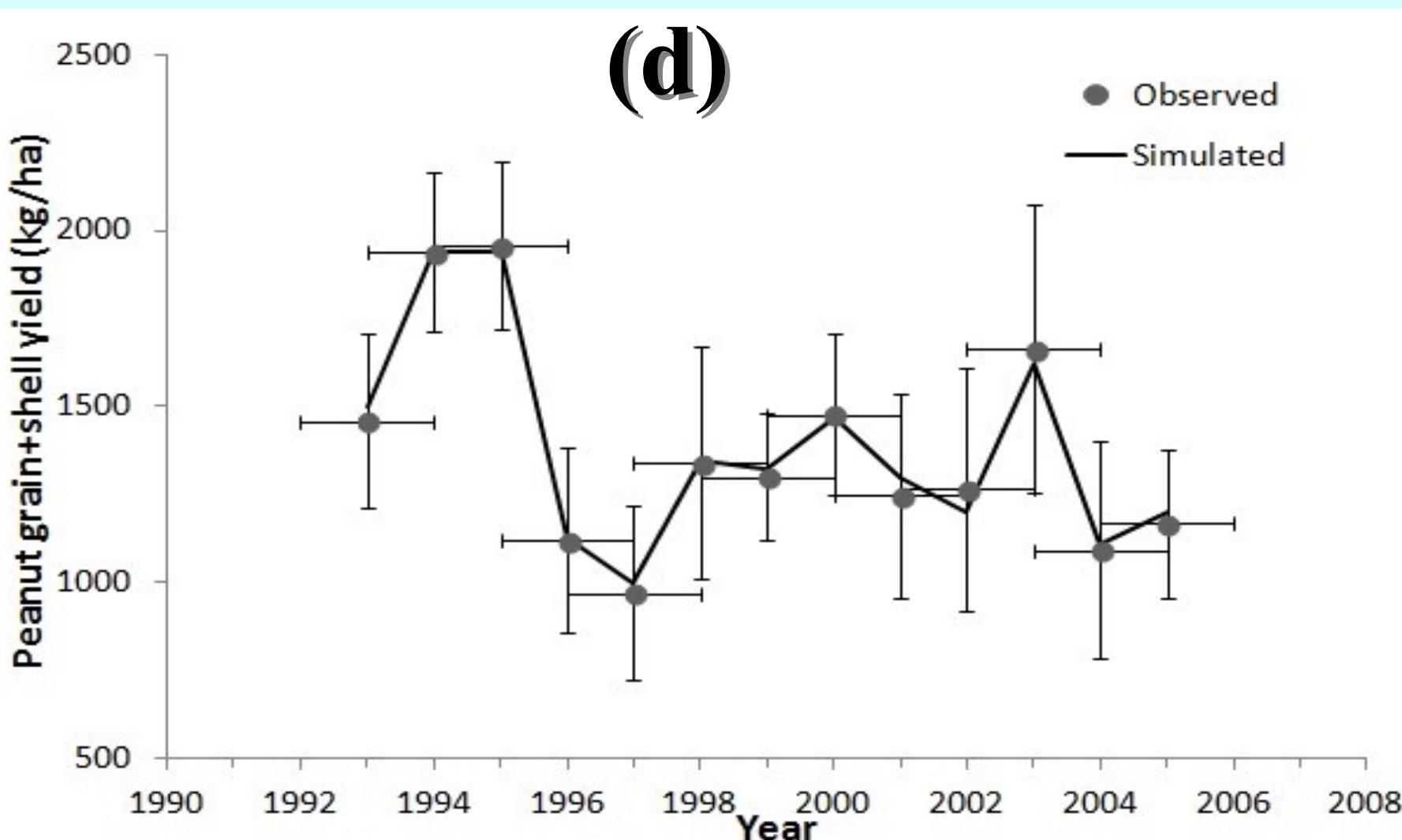
- 👉 Manage the dispersion of climate models with respect to projected future climate
- 👉 Reduce linear bias transmission from climate model to crop model
- 👉 Diversify rainfall/temperature intraseasonal distributions

Table 1: Summary of climate ensemble scenarios for impact assessments over West Africa

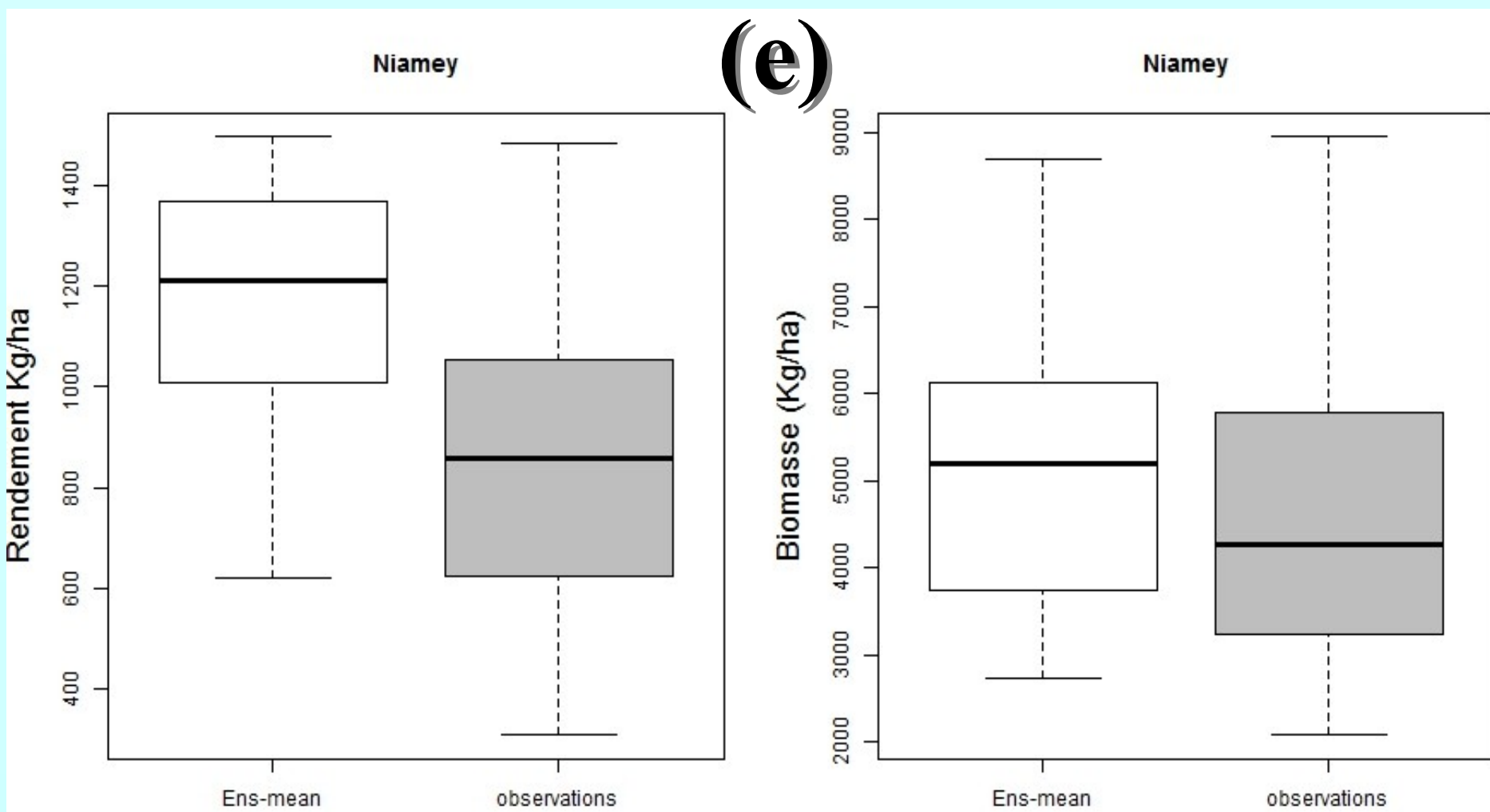
Family of scenario	Data source	Projection type	Precipitation	Temperature	Time series
Direct forcing	ENSEMBLES RCM data (SRES* A1b)	Warmest/coldest RCM**	Stationary/decreasing	Warmest/coldest	1981-2050 (daily)
Synthetic scenario	Weather Generators (Probability distributions)	Stochastic distribution of rainfall, Tmax, Tmin	Frequency of dry/wet days, mean/variance of rain	Frequency of thresholds, mean/variance tmax, tmin	1981-2050 (daily)
Incremental scenario	Perturbation of Baseline observations	— RCM consensus (A1b)	— +5 & -7% for A1b scenario	— +0.6 & +1.4 °C	— 2011-2030 & 2026-2050 (averages)
		— GCM consensus (RCP8.5)***	— Awaiting results for RCP8.5	— Awaiting results for RCP8.5	— 2006-2050 (Monthly averages)

3. Multiple crop management practices to test crop model sensitivity and robustness (Figures (d), (e))

- 👉 Experimental and on-farm surveys data for calibration and validation of crop models DSSAT, SARRAH, APSIM.
- 👉 Five treatments of practical on-farm crop management practices (sowing dates, fertility levels, seedling density).
- 👉 Actual and recommended fertilization, soil profiles and land use changes.



(d) APSIM crop model performance on groundnut yield relative to some crop management practices in Burkina faso.



(e) CERES-millet crop model performance relative to an ensemble of crop management practices observed at 10 villages around Niamey in 2004, 2005, 2006.

4. Preliminary Results

- 👉 Agro-climatic driving factors and risks diagnostics are published in peer reviewed papers (see references).
- 👉 Robust calibration/validation of crop models are achieved
- 👉 Near future impact evaluations resulting from these scenarios exhibit consistency and convergence of rate/signs over the 2011-2050 assessment period. Some of these results are exposed in Sangare *et al.*, Poster.

Acknowledgements

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References:
1. Salack S, Sarr B, Ly M *et al.*: Rainfall distribution hazards threaten agricultural production in semi-arid West Africa. *Geo. Res. Let.* (Manuscript under revision)
2. Alhassane A, Salack S, Ly M *et al.* (2013): Evolution of agro-climatic risks related to the recent trends of the rainfall regime over the Sudan-Sahel region of West Africa. *Secheresse*. (Accepted)
3. Sangare SK, Bilgo A, Salack S, *et al.* (ACC-2013): Modeling the impacts of Climate change on agricultural production in the CILSS/ECOWAS region: Preliminary results. (Poster).