AFRICA CLIMATE CONFERENCE 2013 (ACC-2013)
(15-18 OCTOBER 2013, ARUSHA, TANZANIA)
CONFERENCE SESSION: MODELLING AND PREDICTING CLIMATE IMPACTS
(ESTIMATING CLIMATE VARIABILITY AND CHANGE; CLIMATE IMPACTS PREDICTION SYSTEMS)

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

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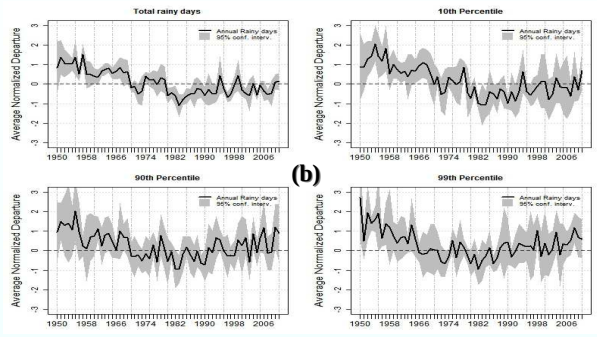
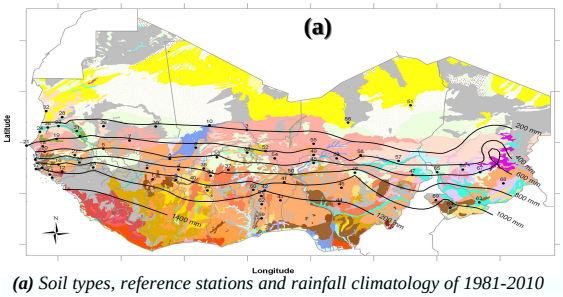
The impacts of climate variability and change are still full of discrepancies due to cascades of uncertainties from ***i)*** lack of accurate crop-soil management information, ***ii)*** crop model sensitivity, ***iii)*** divergence of climate models on rainfall distribution, ***iv)*** linear bias transfer 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)*)

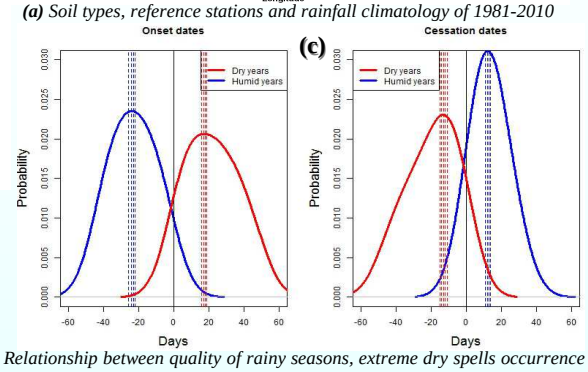
- **Diagnostics of soil-atmospheric-crop management factors of high agricultural impacts.**
- **Historical evolution of factors and rating their influence on crops in the *Baseline* period.**



(b) *Evolution of Frequency of extreme rainy days.* Annual totals (top left), light (top rigth), 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*)

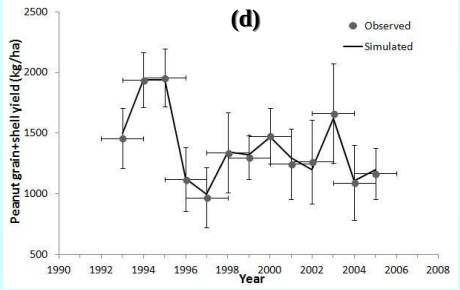
- **Manage the dispersion of climate models with respect to projected future climate**
- **Reduce linear bias transmission from climate model to crop model**
- **Diversify rainfall/temperature intraseasonal distributions**

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

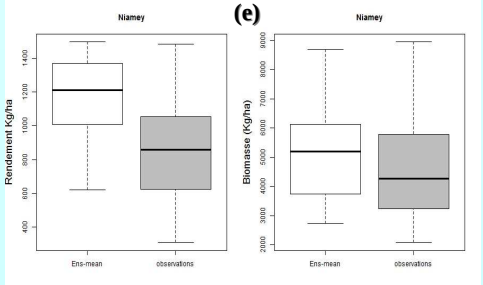
Family of scenario	Data source	Projection type	Precipitation	Temperature	Time series
Direct forcing	ENSEMBLES RCM data (SRES* A1b)	Warmest/coldest RCM**	Stationary/decreasing	Warmest/coldest	1981-2050 (*daily*)
Synthetic scenario	Weather Generators (Probability distributions)	Stochastic distribution 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) —GCM consensus (RCP8.5)***	— +5 & -7% for A1b scenario — Awaiting results for RCP8.5	— +0.6 & +1.4 °C — Awaiting results for RCP8.5	— 2011-2030 & 2026-2050 (*averag.*) — 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*



(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 is 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
*The Global Climate Change Alliance (**GCCA**) is an initiative of African Carbbean Pacific group of states (**ACP**) and funded by the **European Union**.*

References:
1. Salack S, Sarr B, Ly M *et al.*: Rainfall distribution hazards threathen 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).*

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