**Forest-Savanna Transitions in West-Africa: The climatic imprint of bimodal distributions in vegetation cover**

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**Introduction**

- Land-atmosphere feedbacks can generate sudden shifts in the vegetation state.
- Bimodal distributions of woody cover with mean annual precipitation provide evidence that alternative stable states may exist.2.
- Understanding clearly the climate conditions behind this bimodality is important to predict crucial transitions due to climate change.

**Results from Satellite (Modis) data²**

- Bimodality also found with Mean Annual Radiation (Fig.1)
- Cell by cell analyses show only bimodality at boundaries between grassland-savanna and savanna-forest (Fig.2)
- Best prediction of Land Cover is with a combination of Mean Annual Precip, dry season length, and seasonality (Fig. 3)

**How do global models represent savannas?²**

- Three Dynamic-Global Vegetation Models are used to model savanna-forest systems
- Ecological theory: grass-fire feedback is able to simulate bimodality
- Tree-grass fire feedback are differently included in the model

**Conclusions**

- Bimodality is not observed in current data of woody cover and biomass per grid cell
- Bimodality found with precipitation, radiation and other forcings due to strong correlation between forcing data
- Seasonality is important to predict bimodality
- A bimodal systems can be bistable due to the mechanisms at play: Tree-Grass fire feedback and seasonality are important

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**Figure 1** a) Map of Woody Cover (W) and b. above ground biomass (B). c,d,e Histograms of W, B and mean annual radiation

**Figure 2** Observed bimodality in Woody Cover per gridcell

**Figure 3** Prediction Land-cover

- a. Prediction only with mean annual Precipitation (P)
- b. Prediction with P and length dry season (LD)
- c. Prediction with P, LD, Entropy monthly precip
- d-f. Difference between 3c and 1a

E, F, G are resp Forest, Savanna and Grass. s means stable, b means bistable

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**Figure 4** Model results of JSBach, LPJ-Guess, aDGVM. All models show water-limitation. Due to negative grass-fire feedbacks, only aDGVM show bistability.

**Figure 5** Positive grass-fire feedback (a) explaining observed bimodality in Modis tree cover data (b).

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**References**