**1. INTRODUCTION**

- Smallholder farming systems are characterized by poor soil fertility and low agricultural input use; process-based crop growth models can help quantifying the potential impact of climate change on productivity in these systems.
- With limiting conditions (water and nutrients), crop models need to rigorously account for soil water, nutrient, CO₂, and temperature interactions when simulating climate change effects.

We performed a crop model intercomparison including 29 different maize models:

1) How accurately can these models simulate observed yield in diverse smallholder cropping systems?
2) How uncertain are the model responses to changes in CO₂, temperature and water?

**2. METHODS**

Five contrasting experimental sites across sub-Saharan Africa (OPV: Open Pollinated Variety):

<table>
<thead>
<tr>
<th>SOIL</th>
<th>ETHIOPIA</th>
<th>RWANDA</th>
<th>GHANA</th>
<th>MALI</th>
<th>BENIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Texture</td>
<td>clay</td>
<td>sandy loam</td>
<td>clay</td>
<td>loamy sand</td>
<td>loamy sand</td>
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<tr>
<td>SOC (%) (0-30cm)</td>
<td>0.65</td>
<td>1.65</td>
<td>0.57</td>
<td>0.20</td>
<td>0.28</td>
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**CLIMATE (baseline 1980-2010)**

- Type of rainy season: unimodal
- Temperature (°C): 20.6
- Rainfall (mm): 938
- OPV: Open Pollinated Variety

<table>
<thead>
<tr>
<th>MANAGEMENT</th>
<th>Cultivar</th>
<th>N fertilizer (kg/ha)</th>
<th>Hybrids</th>
<th>OPV</th>
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<td></td>
<td>87</td>
<td>64</td>
<td>80</td>
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FAO Agro-ecological zones:
- Cool sub-humid
- Warm sub-humid
- Warm semi-arid

29 soil-crop models (some with different soil or crop models):
- AGRO-WG, APSIM, CRESS, SOIL, CROPSYST, DNDC, EPIC, EXPERT-N, GLAM, Hire ME, INFOCROP, MAIZSIM, MOCCA - MAIZE, MOCCA - PIGEASUS, ROOTZONE, SABLE, SARRA-H, SIMPLACE-LUNTIL, STICS, SWEAT

**1) Model calibration:** two experimental years per site

- Partial calibration: crop phenology only
- Full calibration: experimental yields, in-season biomass, leaf area index and soil water content provided

**2) Model sensitivity to climate change:** climate change

- Increased [CO₂]: 450, 540, 630 and 720 ppm
- Increased temperature: +2, +4 and +6 °C
- Modified rainfall: 50, 75, 125 and 150% of current

**3. RESULTS**

**1) MODEL SIMULATION OF OBSERVED YIELD**

- Observed
- Partially calibrated
- Fully calibrated

**2) MODEL SENSITIVITY TO CLIMATE CHANGE**

- Double [CO₂]
- Temperature +4°C
- 150% of current rainfall
- 50% of current rainfall

- Simulated grain yield varied widely among models with partial calibration (coefficients of variation (CV) from 51% to 77% depending on site) (Fig.1)
- Full calibration greatly reduced uncertainty (CV 12-31% depending on site)
- Simulation accuracy increased with full calibration for other maize growth variable (biomass, max., LAI) but not for Crop N content at maturity and in-season soil water contents (Fig.2)

**3) CONCLUSION**

- Although model simulations of water – and nutrient-limited yield in low input conditions greatly improved after full calibration, models response to changes in climate factors, especially rainfall, remained highly uncertain.
- This questions our ability to derive robust recommendations for decision-making using modelling on adaptation to climate change in sub-Saharan Africa.
- Further analysis will address the impact of model structure and calibration procedure on response to changes in temperature and rainfall.