AGMIP protocol to test the effect of temperature, CO2 and N

Sensitivity analysis on temperature, CO2 and N
Use of as default the management practices given in the experiments.

Main assumptions
Consider the same initial soil water and sowing date as in the experimental dataset for the scenario analysis (testing effect of temperature, CO2 and N).

- No irrigation in USA and Brazil.
- Irrigation in France and Tanzania.

Questions
1. Why not using the soil water dynamics simulated within the model, rather than a fixed soil initial water?
2. By not irrigating, we might introduce water stress. What effect does it have on our simulations?
3. If we want to capture realistic management practices, should we not consider sowing date according to previous rain, to optimize crop emergence?

**Methodology**
- Use the soil water dynamics from SARRA-H to test the impact initial soil water on simulations for the different sites.
- Use of automatic irrigation to determine the potential simulation of water stress in non irrigated situation.
- Use of the potential sowing date routine from SARRA-H to test the impact of the sowing date defined according to previous rain.

**Analysis**
- Use the soil water dynamics from SARRA-H to test the impact of initial soil water on simulations for the different sites.

**Impact on yield**

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>BRAZIL</th>
<th>FRANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline*</td>
<td>7.5 (4.0)</td>
<td>7.40 (4.0)</td>
<td>9.10 (4.0)</td>
</tr>
<tr>
<td>Simulating initial soil water non irrigated</td>
<td>5.40 (4.0)</td>
<td>7.50 (4.0)</td>
<td>2.80 (4.0)</td>
</tr>
<tr>
<td>Simulating sowing date non irrigated</td>
<td>5.30 (4.0)</td>
<td>7.50 (4.0)</td>
<td>2.80 (4.0)</td>
</tr>
<tr>
<td>Simulating initial soil water irrigated</td>
<td>9.60 (4.0)</td>
<td>8.10 (4.0)</td>
<td>9.10 (4.0)</td>
</tr>
<tr>
<td>Simulating sowing date irrigated</td>
<td>10.60 (4.0)</td>
<td>8.40 (4.0)</td>
<td>10.01 (4.0)</td>
</tr>
</tbody>
</table>

- Irrigation: Yield in the USA is impacted by water stress.
- Sowing date: in potential growth conditions, defining an potential sowing date slightly increase yield. The potential sowing date is on average 1 month before the defined sowing date (as in the experiment) in USA, Brazil instead of May in France.

**WATER BALANCE**

<table>
<thead>
<tr>
<th></th>
<th>Initial soil water</th>
<th>Irrigation</th>
<th>Transpiration</th>
<th>Drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>no irrigation</td>
<td>205 (3)</td>
<td>65 (0)</td>
<td>95 (7)</td>
</tr>
<tr>
<td>Simulating initial soil water</td>
<td>non irrigated</td>
<td>195 (3)</td>
<td>75 (0)</td>
<td>95 (7)</td>
</tr>
<tr>
<td>Simulating initial soil water</td>
<td>non irrigated</td>
<td>76 (3)</td>
<td>65 (0)</td>
<td>95 (7)</td>
</tr>
<tr>
<td>Simulating initial soil water</td>
<td>irrigated</td>
<td>235 (3)</td>
<td>45 (3)</td>
<td>95 (7)</td>
</tr>
<tr>
<td>Simulating sowing date</td>
<td>irrigated</td>
<td>275 (3)</td>
<td>45 (3)</td>
<td>95 (7)</td>
</tr>
</tbody>
</table>

**USA**
- We reproduce the experiment (irrigation vs. no irrigation, sowing date) if we want to simulate growth potential conditions.
- Rain: seem to be enough; less than 100mm of irrigation is needed for potential growth conditions.

**France**
- Automatic irrigation, we reproduce the average irrigation needed, as done in the experiment used for calibration.

Table 2: Main water balance component for (a) USA; (b) Brazil; and (c) France

**Discussions**
- US: not potential production, experiences water stress.
- FR. Br: enough rain or irrigation.
- Water dynamics: If we want to capture the water dynamics and its impact of crop yield, would not it better to simulate the soil water dynamics considering the rain before the cropping season (without irrigation)?
- If we can, to decouple the water stress effect on the temperature effect tested in the scenario?
- Sowing date: If we represent the inter-annual variability by considering rain (without irrigation), it seems important to simulate variable sowing date corresponding to the right initial conditions (Fig. 2).

**Perspectives**
- Should we really consider fixed management practices, as defined in the experimentation (irrigation vs. no irrigation, sowing date) if we want to capture annual variability?
- Tanzania: not shown in this analysis as maize appears to be mostly planted during the long rainy season in Morogoro (Tumbo et al., *to discuss with experts*), while our data are on the short rainy season. How well do we want to represent farmers’ practices?