CLIMATE-SMART Agriculture 2015

Global Science Conference

March 16-18, 2015
Le Corum, Montpellier France

[How precisely do maize crop models simulate the impact of climate change variables on yields and water use ?]

[Durand Jean-Louis et al.]

[AgMIP]

Montpellier

March 16-18, 2015

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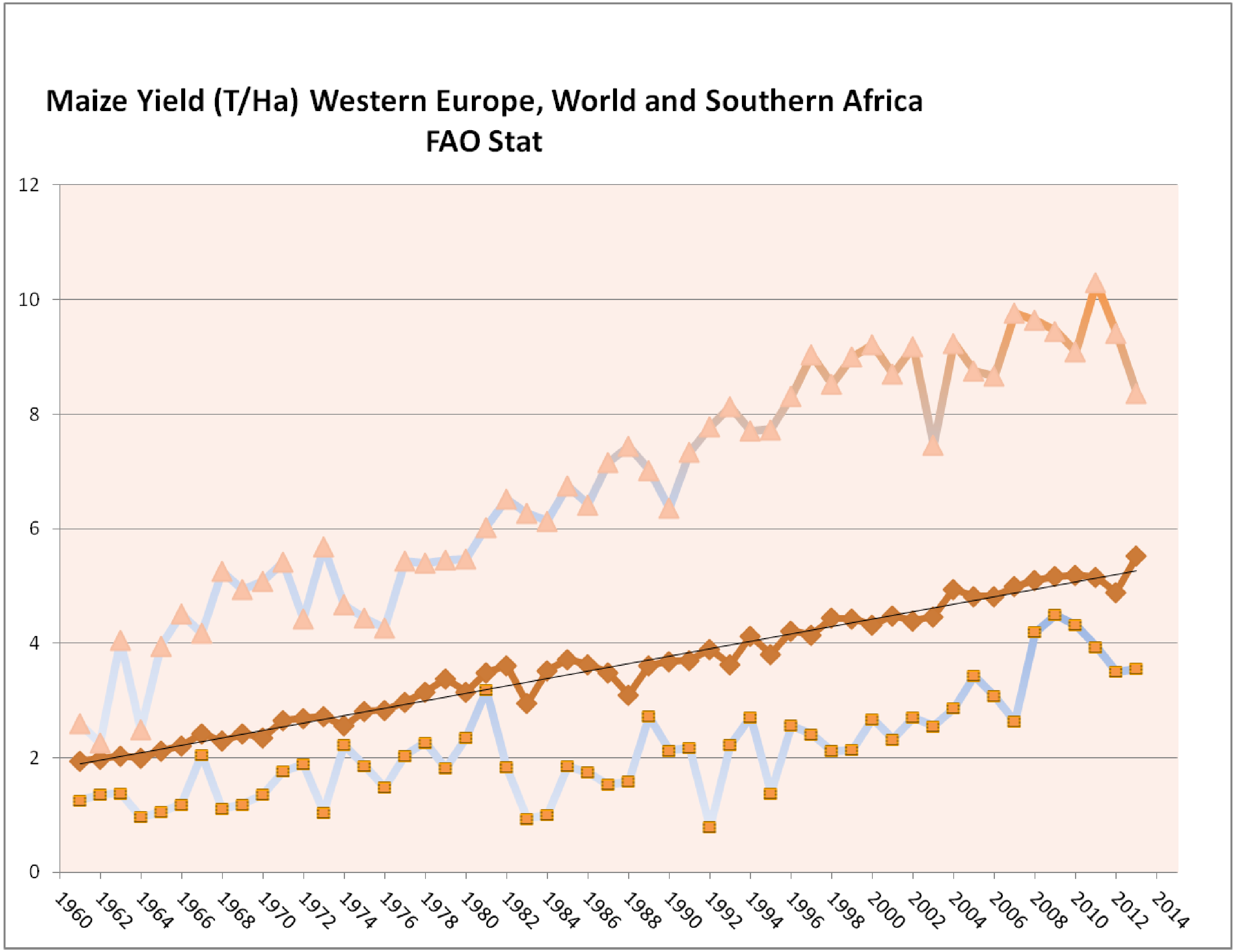
AgMIP The Agricultural Model Intercomparison and Improvement Project

The Agricultural model intercomparison and improvement project for maize

1. Catches more aspects of real crops
2. Brings together more scientists from a larger area
3. Helps communicating between scientists and improves knowledge
4. More convincing results
5. Easier to share conclusions and questions

Why Maize ?

- Widely croped.
- Large interest in improving that crop (genetics and management).
- Model for other C4 species in terms of response to climate change.
- Many models of maize productivity allowing for proper incertitude analysis.



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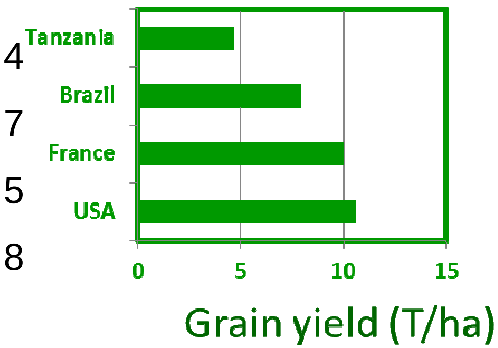
0,07 T/Ha/year. More than 184 M Ha in 2013

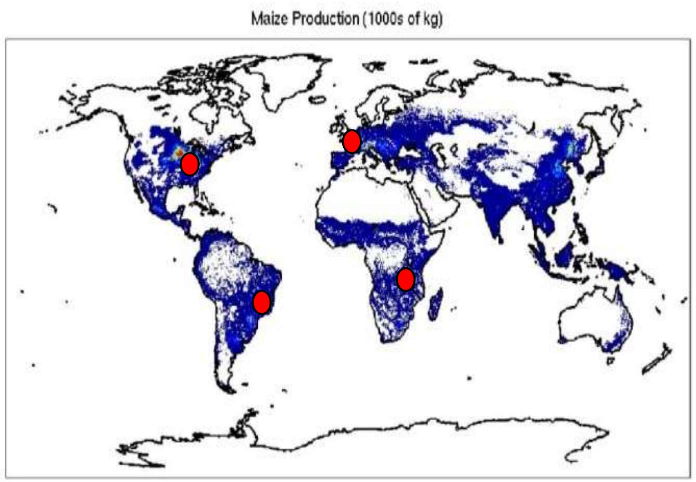
Specific Objectives

- Intercompare maize models relative to yield and water use across multiple locations with contrasted potentials under <u>well watered conditions</u>.
- **Evaluate the response of the ensemble of models to <u>level of knowledge about the site</u>.**
- **Utilize the models to <u>evaluate projected production</u> under climate change and variability, and especially high T and [CO2].**
- Improve models.

AgMIP Maize models sites used to test models

- High input calibration maize simulations vs. climate factors
  - 19 models for temperature
  - 15 models for CO_2
- 4 contrasting field experiments
  - Morogoro, Tanzania (06.50°S; 37.39°E) Tavg. 22.5 ° C st.dev.1.4
  - Rio Verde, Brazil (17.52°S; 51.43°W) Tavg. 23.3 °C st.dev.1.7
  - Ames, Iowa, USA (42.01°N; 93.45°W) Tavg. 20.6 °C s t.dev.4.5
  - Lusignan, France (46.25°N; 00.07°E) Tavg. 16.8 °C st.dev.3.8





Bassu et al, 2014. How do various maize crop models vary in their responses to climate change factors? Global Change Biology, 20, 2301–2320..

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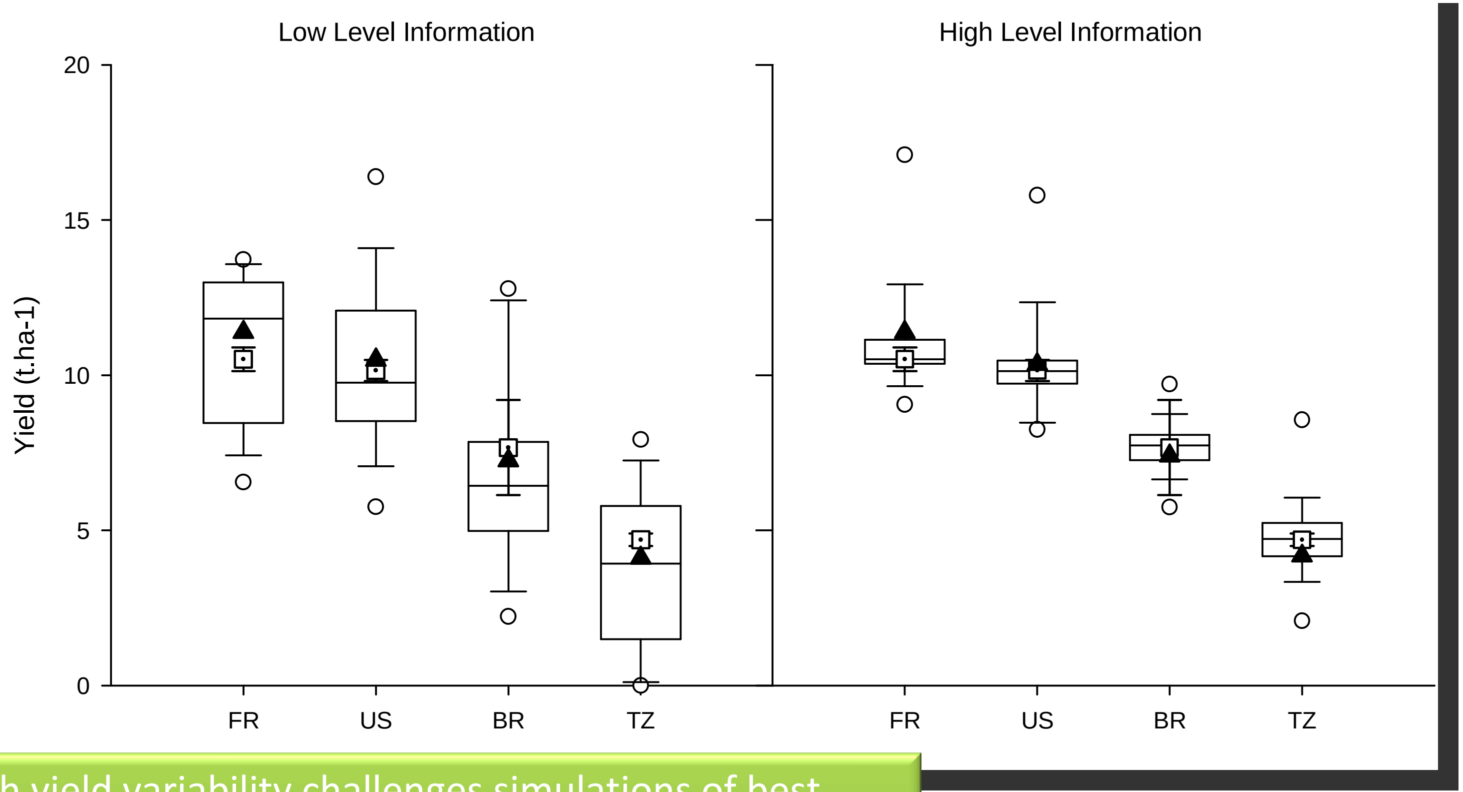
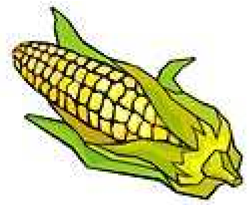
Simulation protocoles

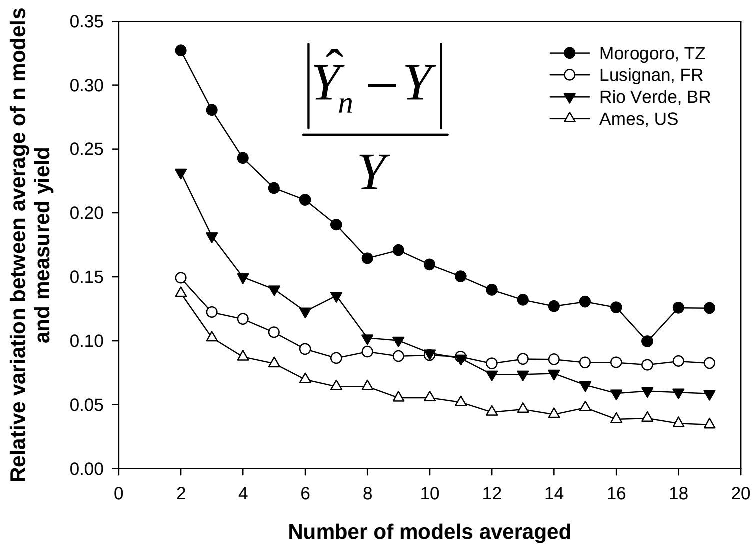
Each model under the responsability of one particular team with 3 successive tasks.

1. Simulate observed yields and water use at 4 sites with a minimum of local data: cv phenology, soil, weather, techniques.
2. Adjust parameters with all experimental data on yields, LAI, nitrogen etc…
3. Simulate the ΔCO_2 * ΔT responses over 30 years.





High yield variability challenges simulations of best models.
Ensemble 23 models simulated yields accurately with a low level of input information (weather, soil and techniques).
The minimum number appears linked to the site[2].



Also read : Martre et al. 2015. Multimodel ensembles of wheat growth: many models are better than one. Global Change Biology.

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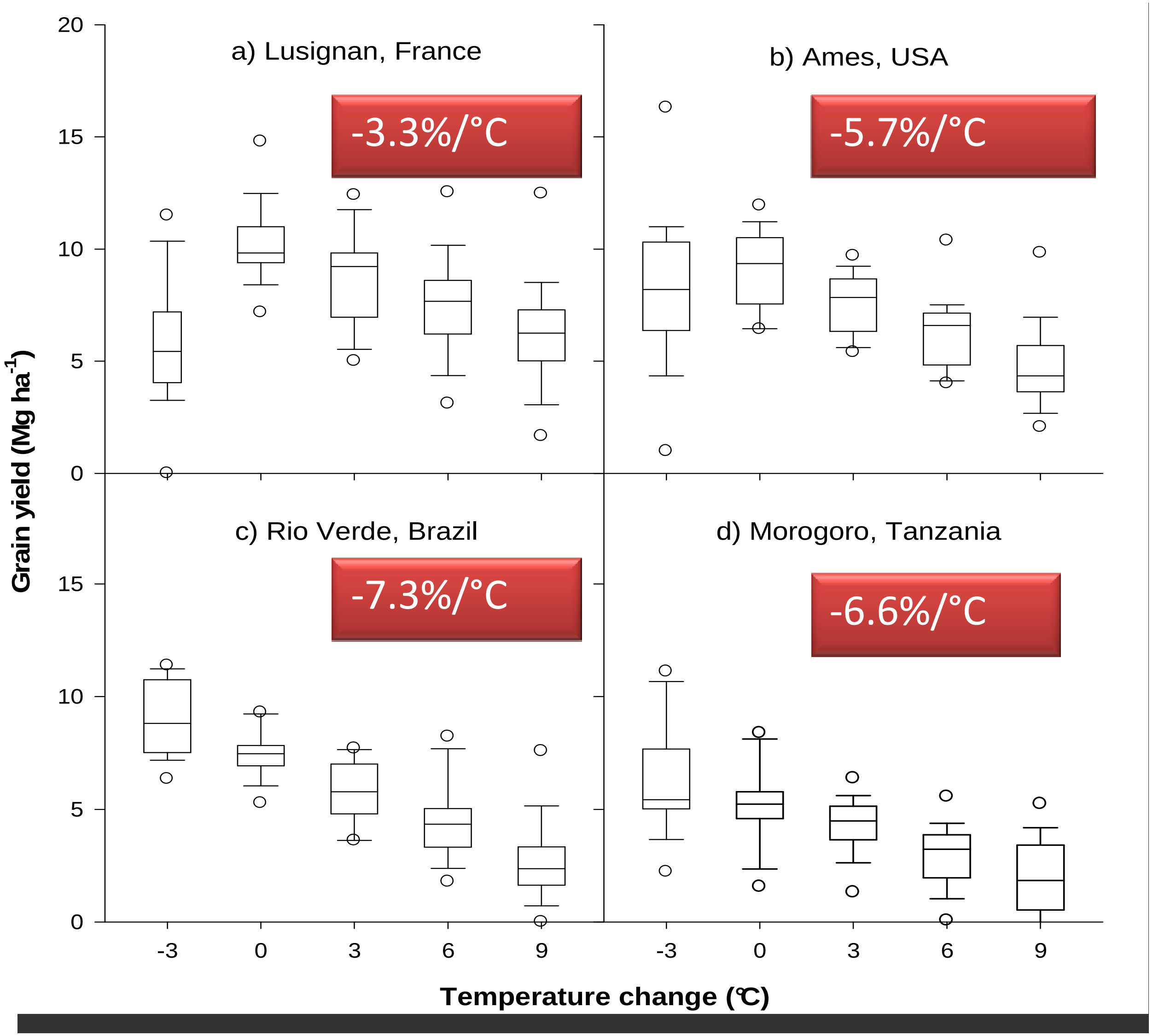
Most models: maize yield declines in response to temperature increase



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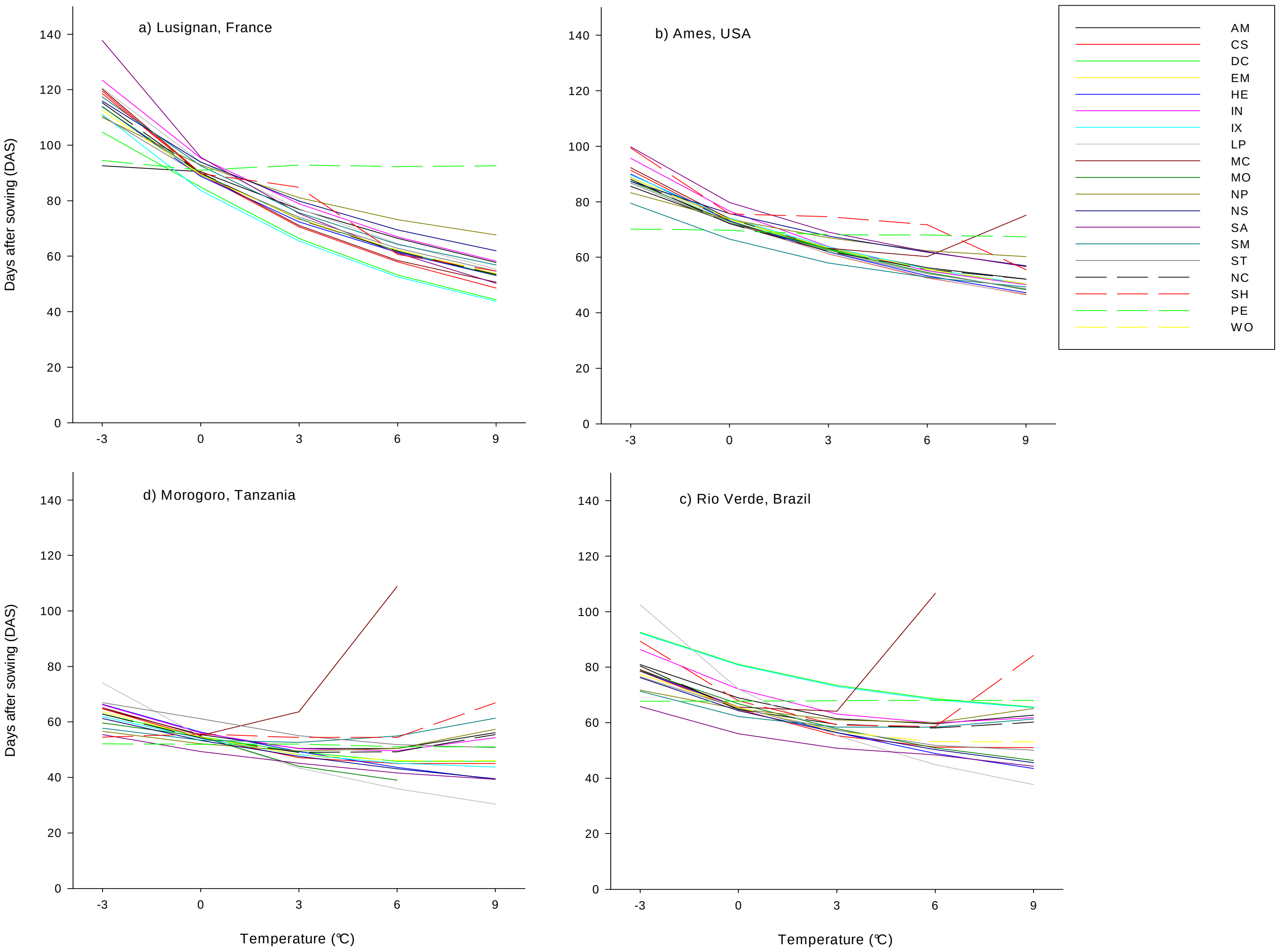
Models agree about the response of phenology to temperature increase:



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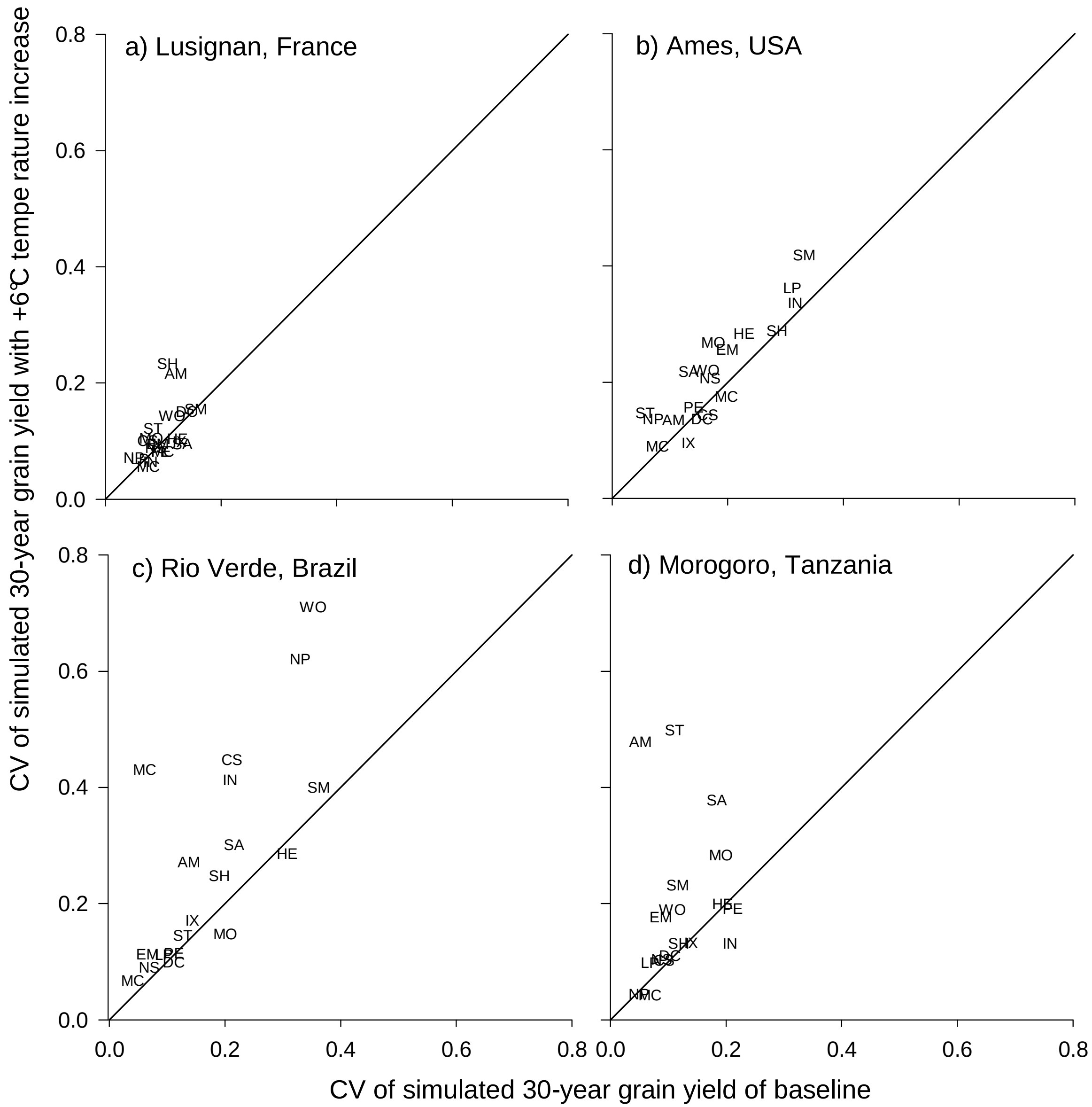
For most of models, a 6°C temperature increase, will not increase the simulated interannual variability.



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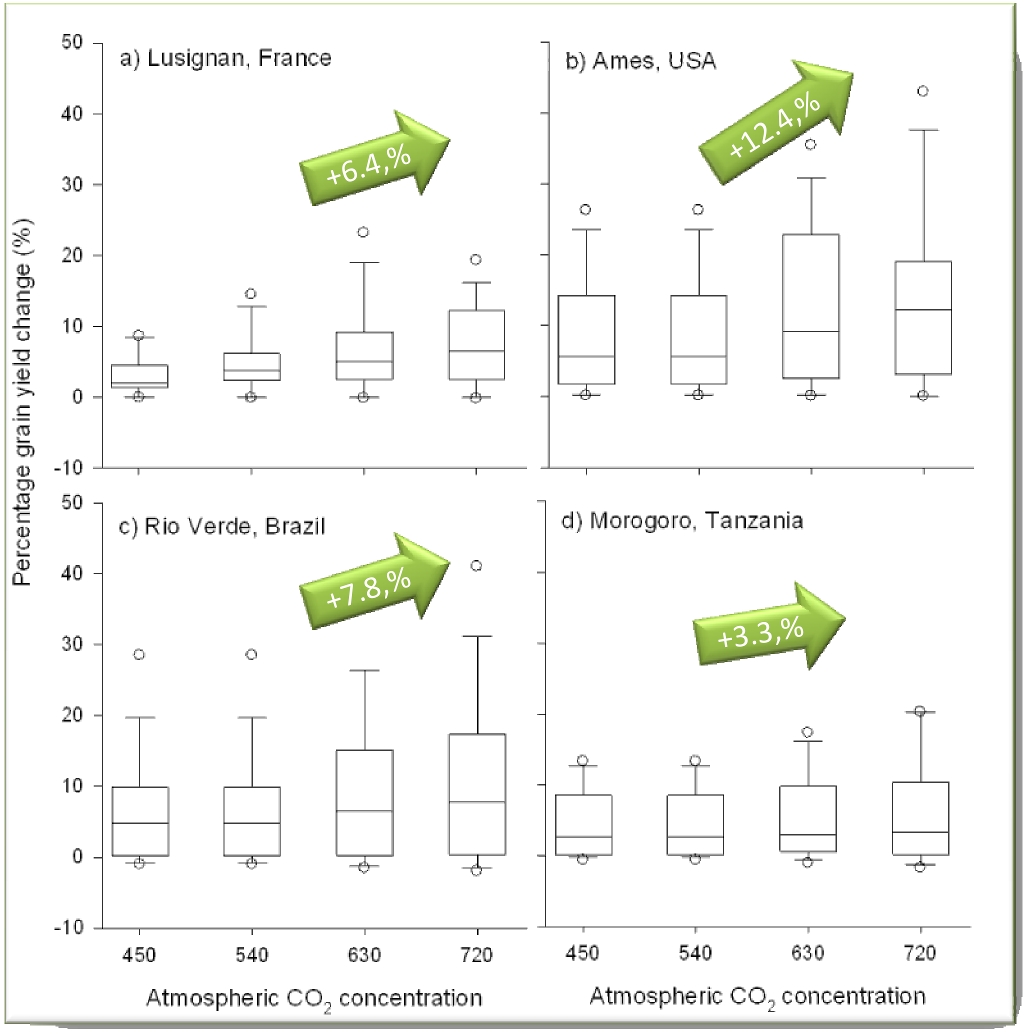
% yield increase with doubling [CO_2]



Slight **positive** impact of [CO_2] but with **high variability**:

- **Reliable ?**
- **How is it related to water use?**

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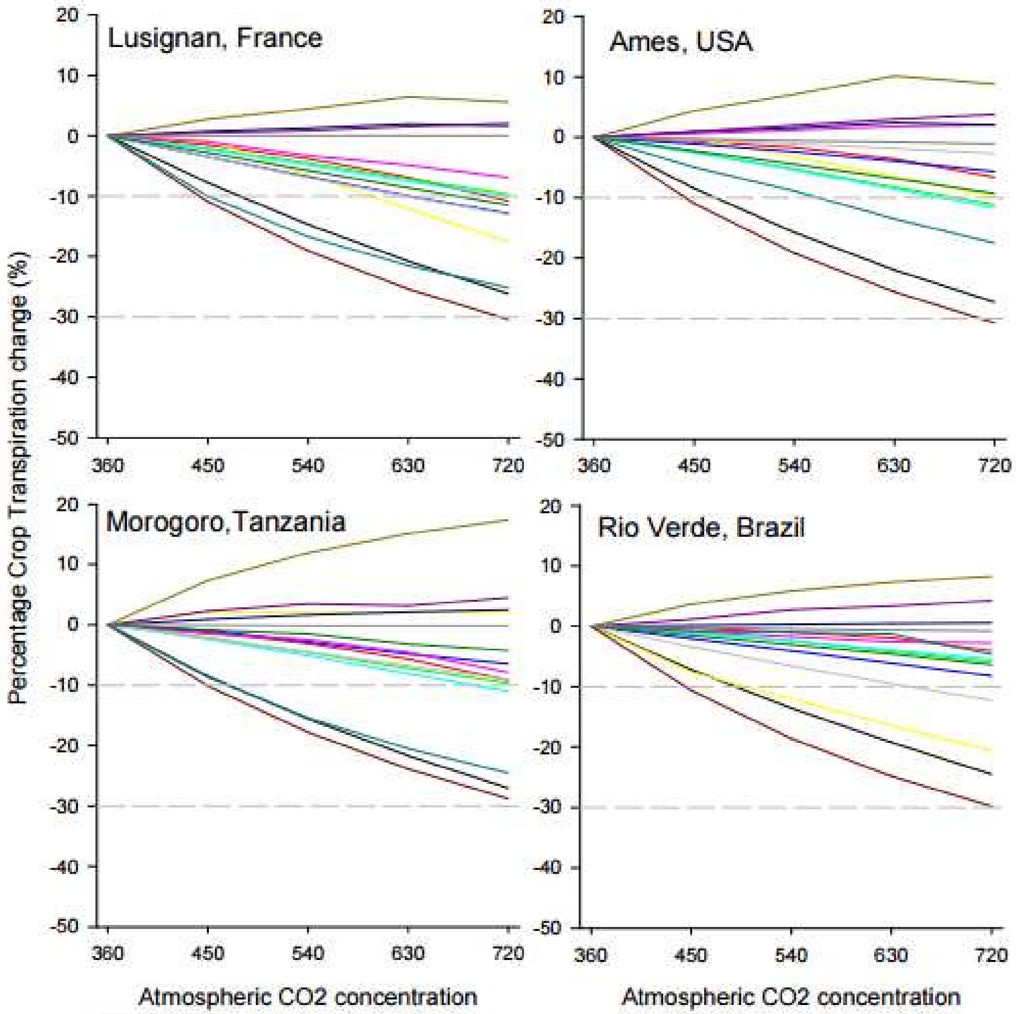
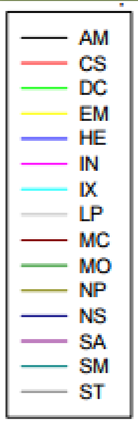
Simulated crop transpiration response to CO2 (15 models)





Slight **negative** impact of [CO_2] but even **higher variability**:

- **Reliable ?**
- **How is it related to conductance or leaf area ?**

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Conclusions

- Agreement between model teams about T impacts.
- Temperature increase tends to reduce maize yields through shortening of the growth cycle.
- Simulated relative interannual variability not sensitive to T increase.
- Water use remains unchanged.. But
- Maintaining the yield increase is possible only where enough water is available.
- Very large incertitude about the CO_2 impacts.
- Need to test CO_2 response of models simulations against real data: currently in construction in AgMIP.
- Too large incertitude in water use by crops: need to check water use routines in models for taking CO_2 impacts into account.