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

AgMIP The Agricultural Model Intercomparison and Improvement Project

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

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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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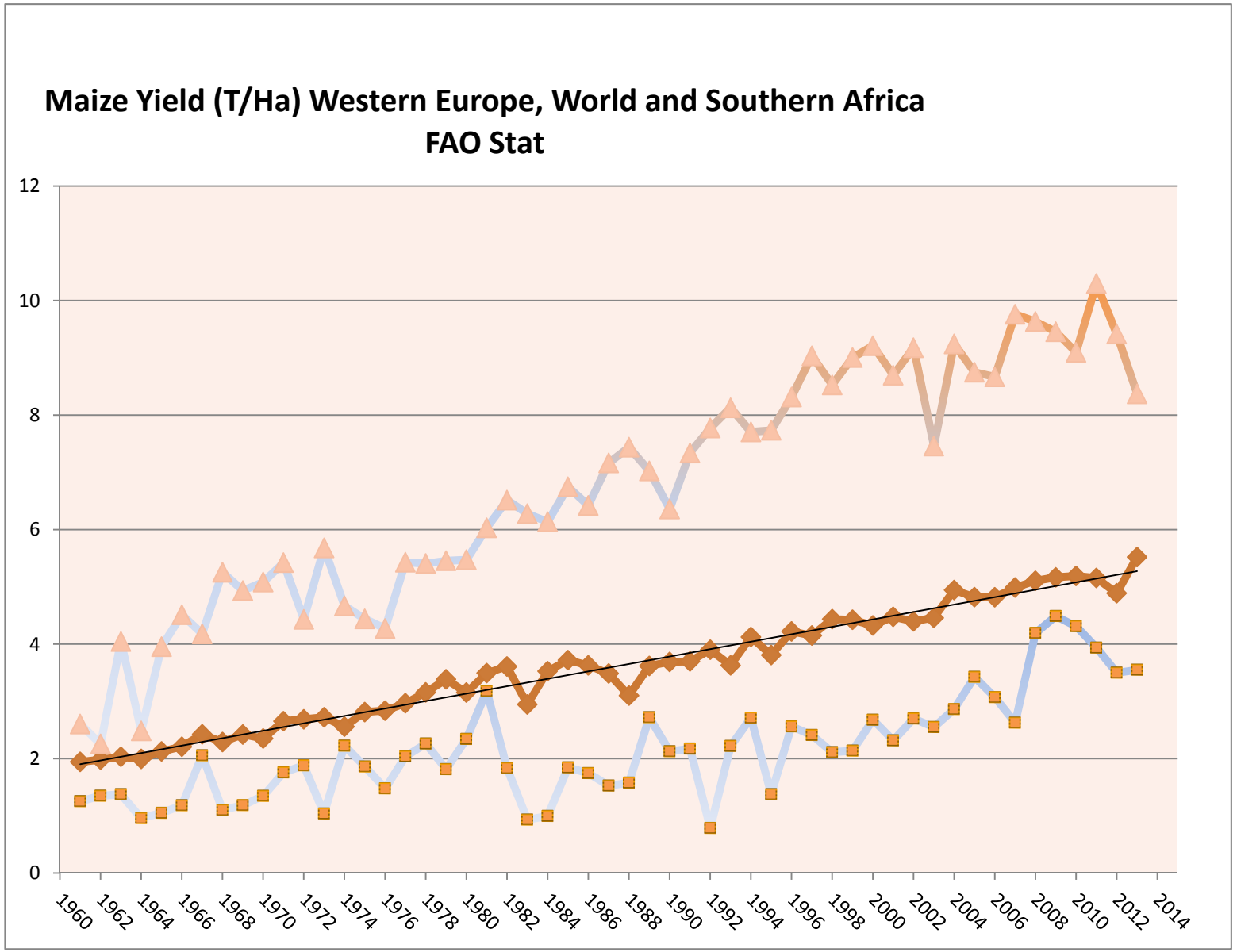

0,07 T/Ha/year. More than 184 M Ha in 2013

Specific Objectives

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

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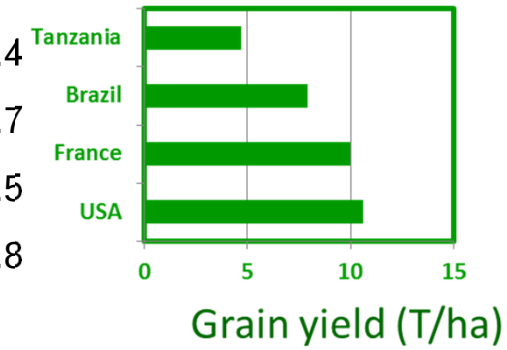
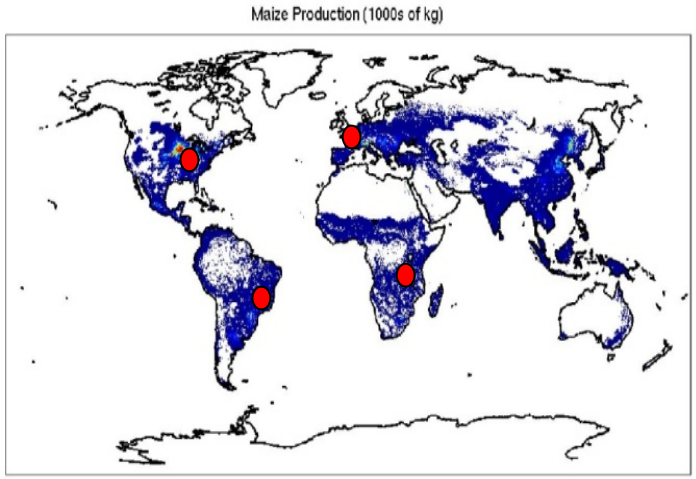
AgMIP Maize models sites used to test models

- 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 st.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 $\Delta CO2 * \Delta T$ responses over 30 years.

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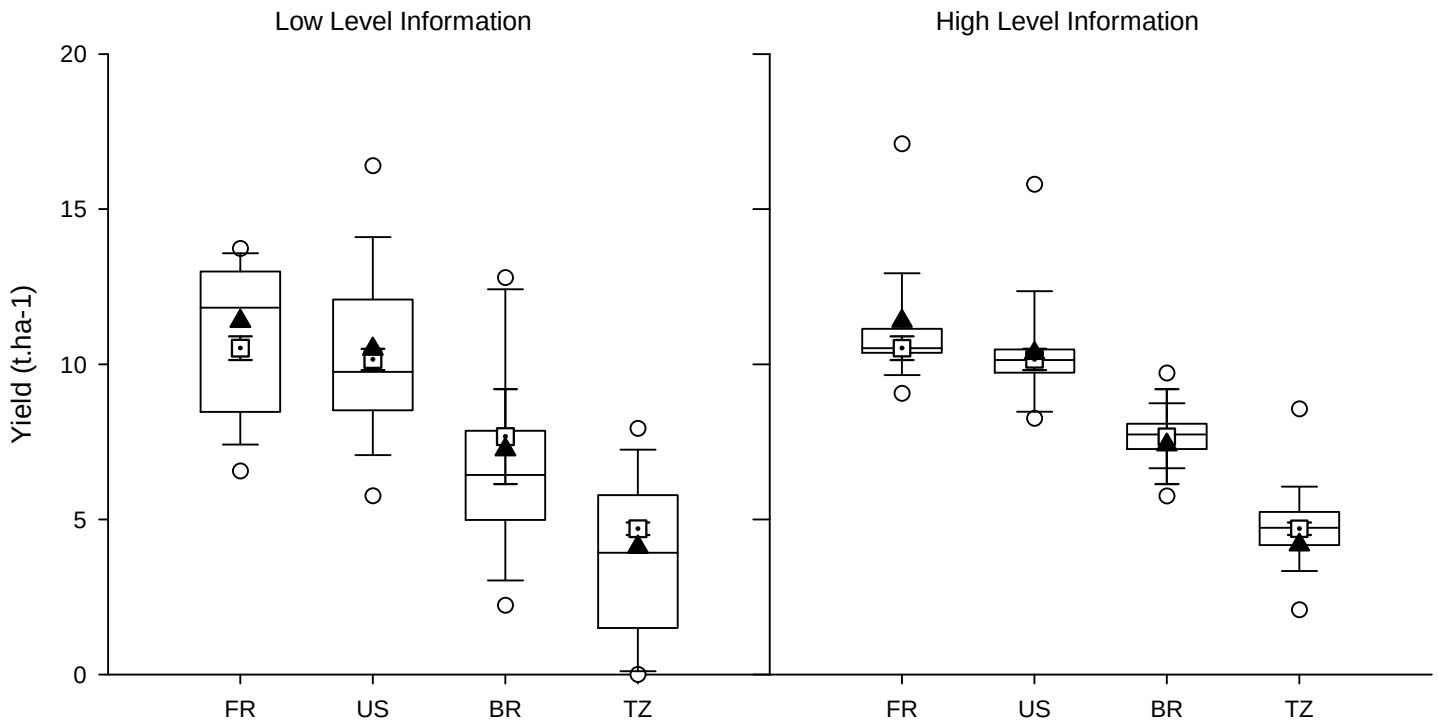
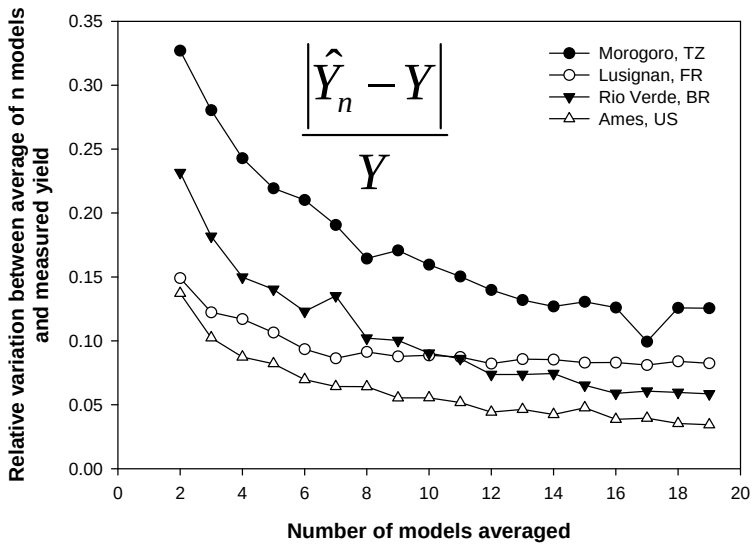


High yield variability challenges simulations of best models.
Ensemble 23 models simulated yields accurately with a low level of input information (weather, soil and techniques).
The minimum number appears linked to the site[2].



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

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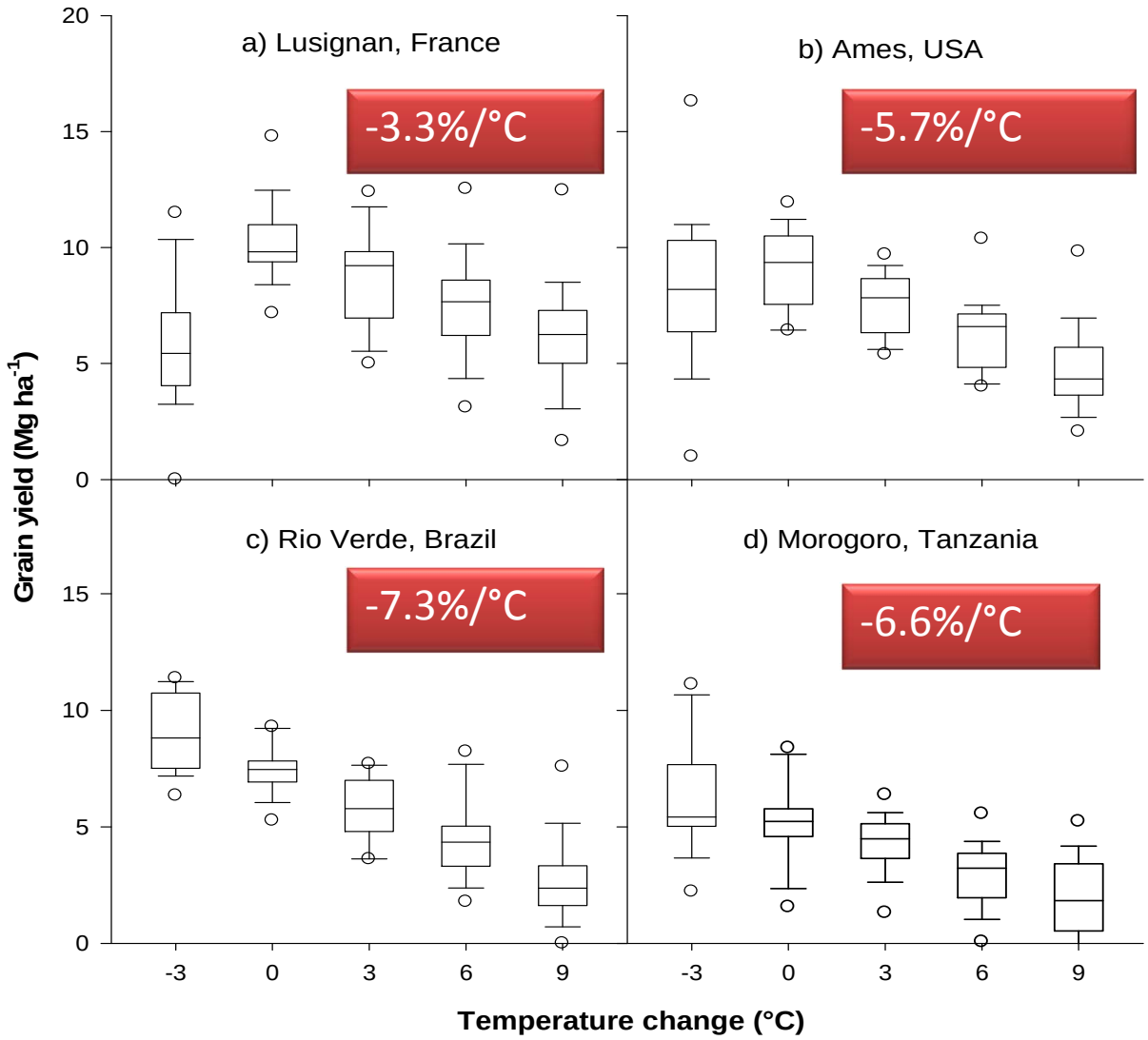
Most models: maize yield declines in response to temperature increase



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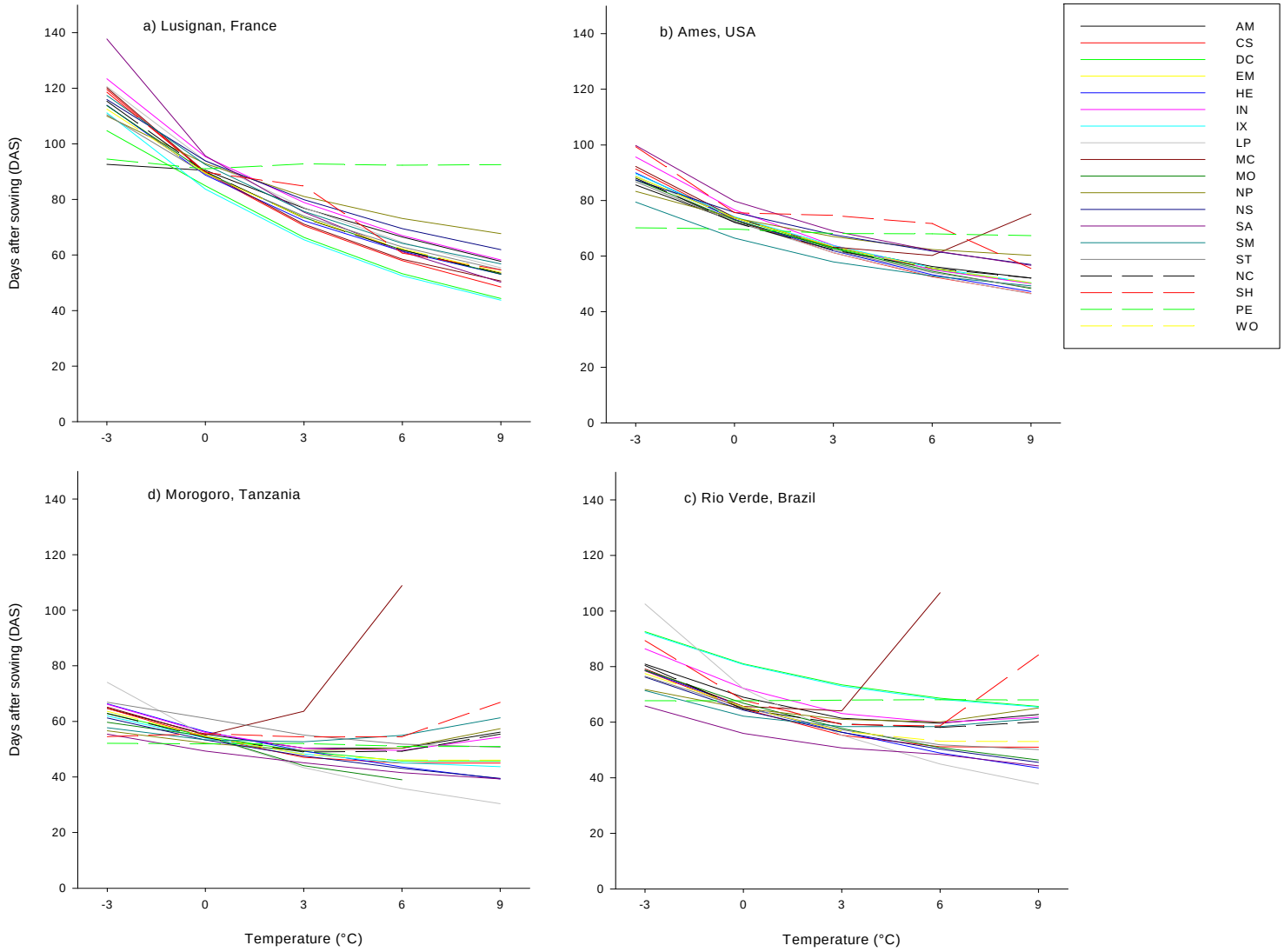
Models agree about the response of phenology to temperature increase:



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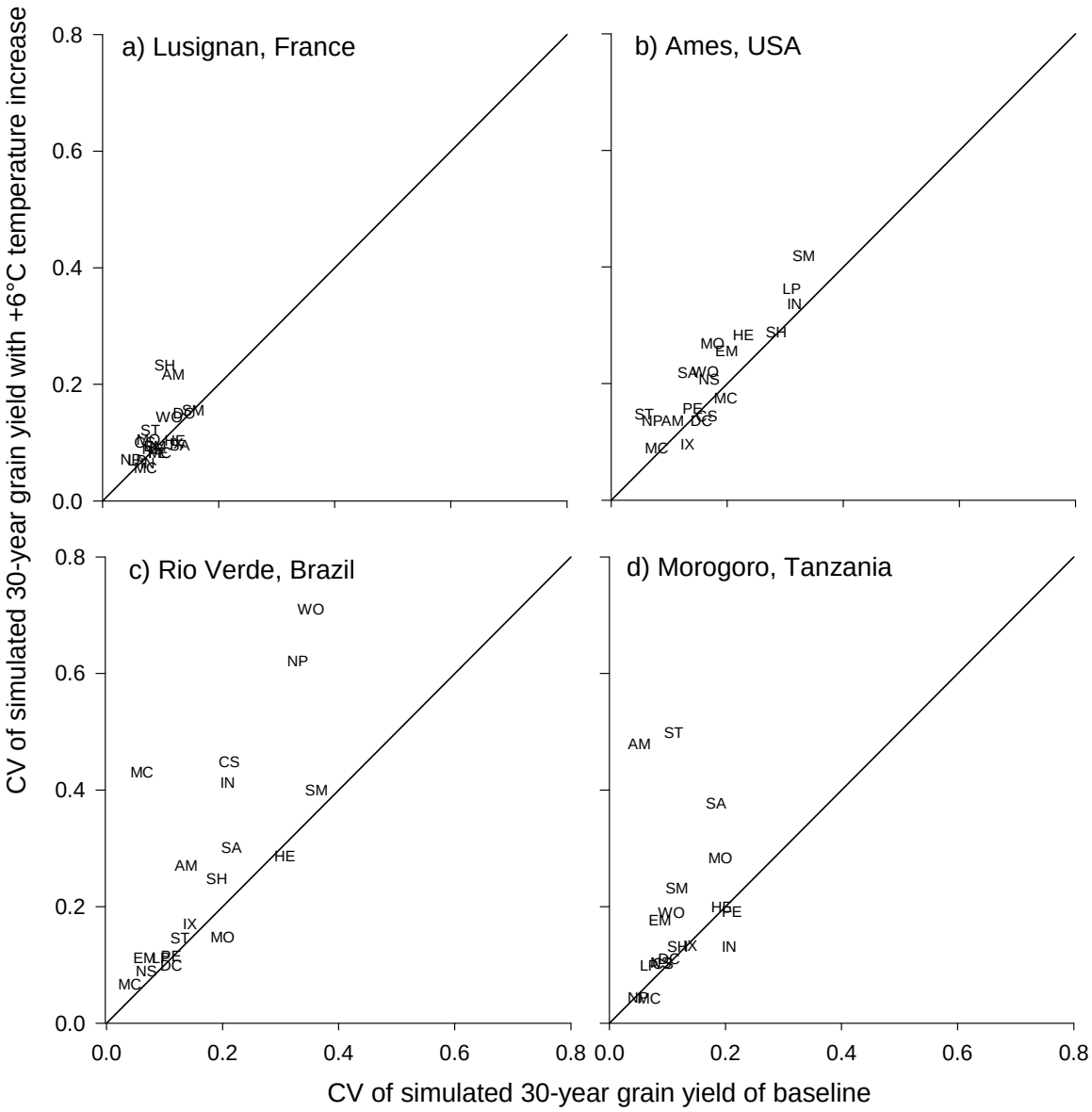
For most of models, a 6°C temperature increase, will <u>not</u> increase the simulated interannual variability.



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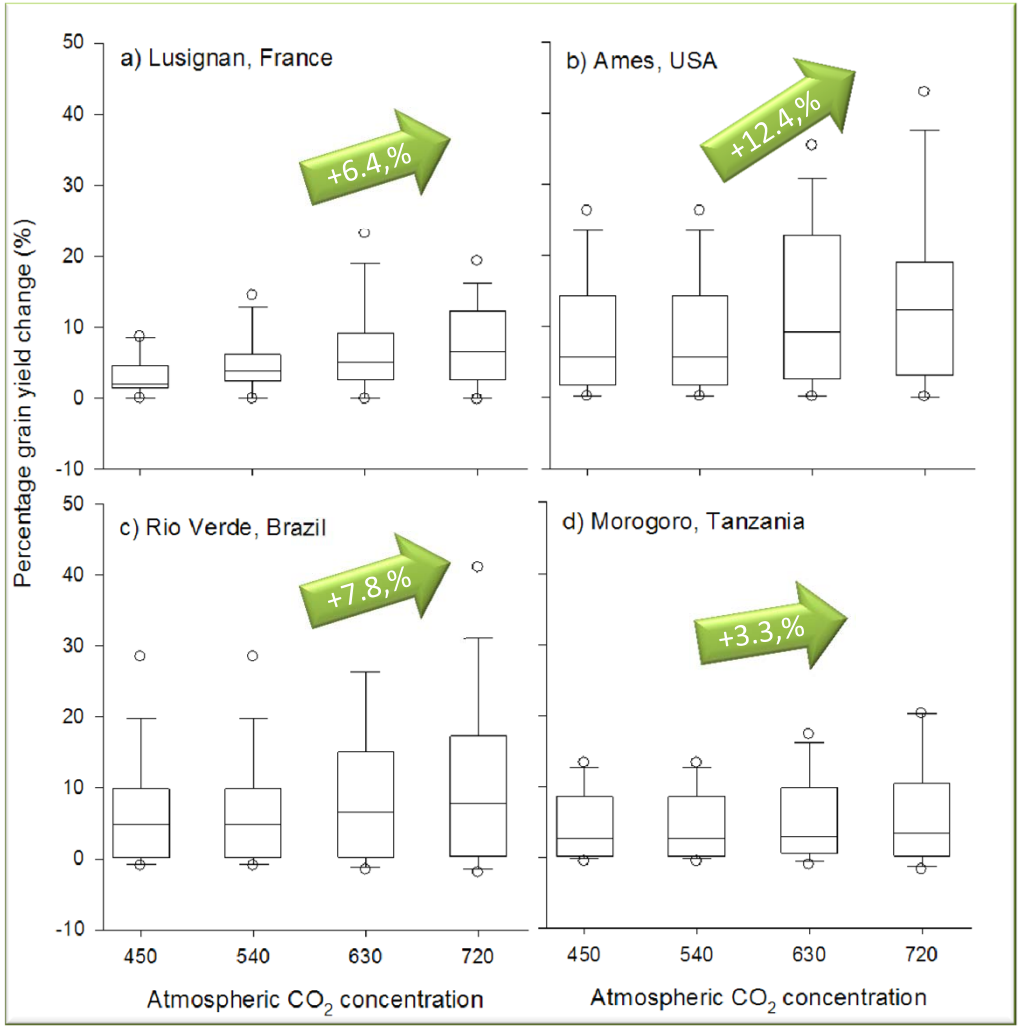
% yield increase with doubling [CO2]



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

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

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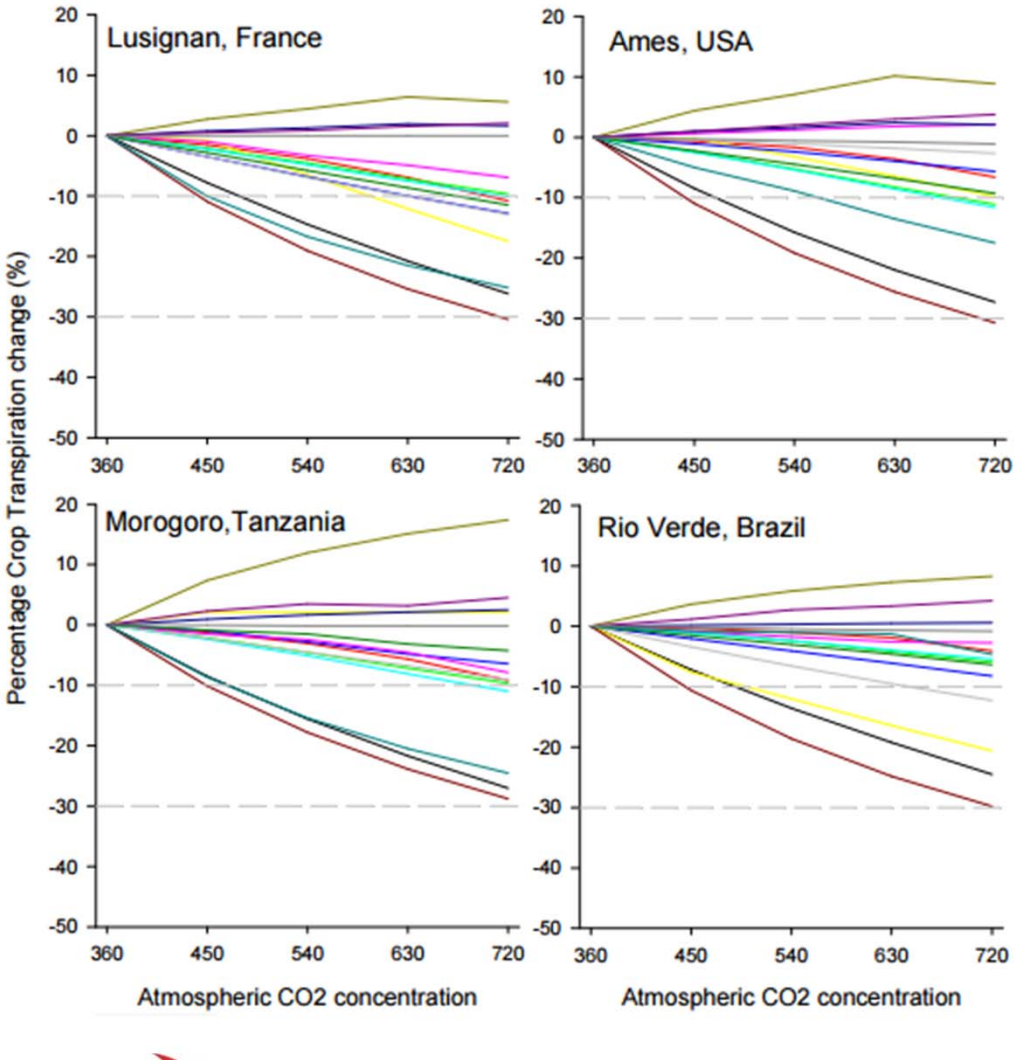
Simulated crop transpiration response to CO2 (15 models)



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 CO2 impacts.
- Need to test CO2 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 CO2 impacts into account.

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