ARE OUR MODELLING TOOLS READY TO COPE WITH AGRICULTURAL SYSTEMS EVOLUTION?

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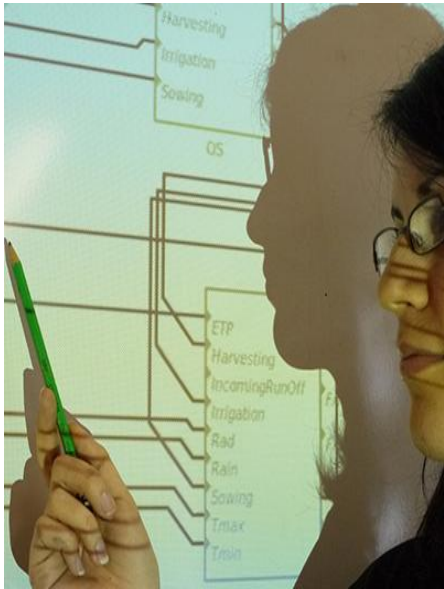
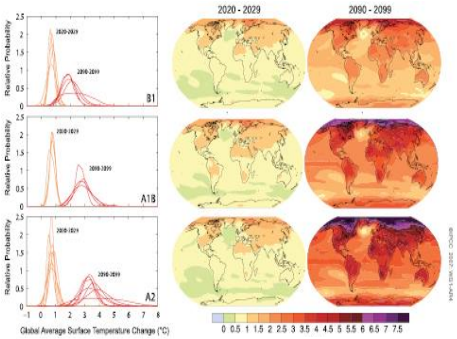


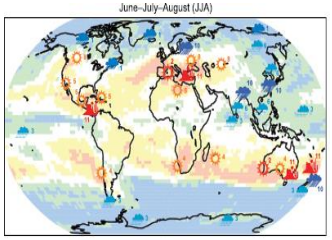
Outline

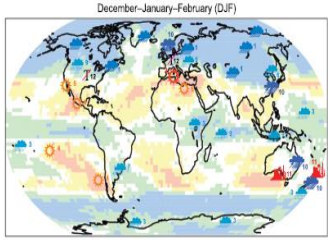
1. A changing world
2. Scientific challenges
3. Computing issues
4. Concluding remarks

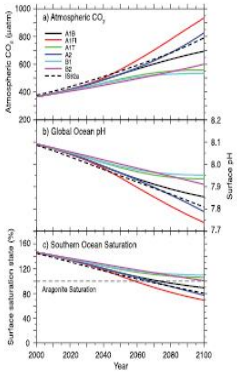
A changing world: climate change

- Trends and variability
- New interactions
- Dynamic integration of crops with pests, diseases and weeds









IPCC, 2007

C. Guevar, Reuters

A changing world: societal changes

- New production systems/agricultural practices, agroecology, organic farming

INRA

- Stakeholders and growers are IT literate and want improved decision support systems

blog.ecocert.com

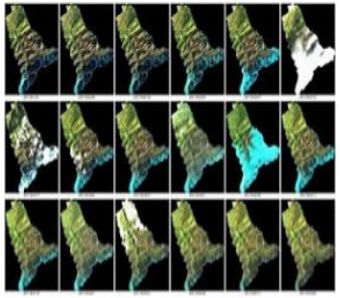
- Participatory sciences

- Society/policy foresight, simulation

http://bovins-viande.reussir.fr

A changing world: technical changes

- Data acquisition: continuous flow at different scales (temporal and spatial)



Working with simulated Sentinel-2, SPOT4 and RapidEye Take 5 data

- Improved sensors

http://www.shop-wifi.com/

- Computation power

http://unt-ori2.crihan.fr

→ Precision agriculture

http://www.agriavis.com/

Scientific Challenges - 1

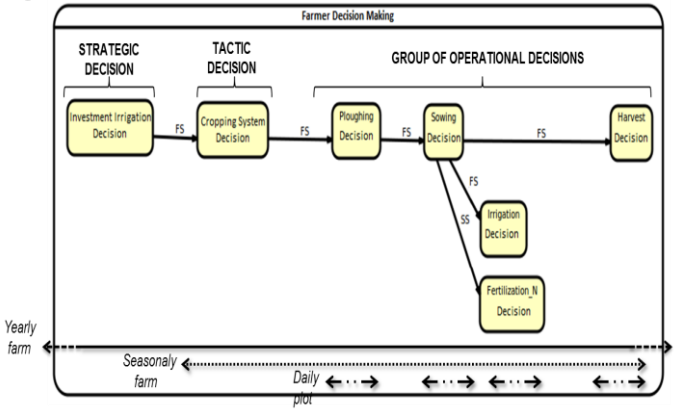
1. Integrating new processes
   - Biophysical processes
   - Multi entities interactions

$$\Delta TT(j) = \max\left[\frac{TMIN(j) + TMAX(j)}{2} - T_{base}, 0\right] \quad (4)$$

$$\begin{cases} \Delta B(j) = RUE\,(1-e^{-K\,LAI(j)})I(j) & TT(j) \le TT_M \\ \Delta B(j) = 0 & TT(j) > TT_M \end{cases} \quad (5)$$

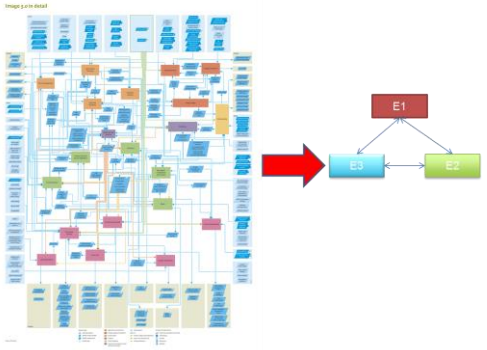
$$\begin{cases} \Delta LAI(j) = \alpha \Delta TT(j) LAI(j) \max[LAI_{max} - LAI(j), 0] & TT(j) \le TT_L \\ \Delta LAI(j) = 0 & TT(j) > TT_L \end{cases} \quad (6)$$

2. Integrating complex management options
   - Individual based modelling
   - Events modelling



Scientific Challenges - 2

3. Crossing spatial and temporal scales
   - Metamodelling
   - Multi-clocks

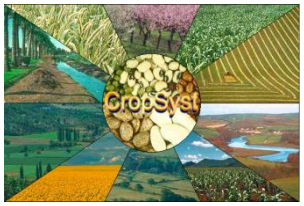


4. Enabling participatory modelling and simulation
   - Library of modules
   - On-site parametrisation
   - Multi-assessment possibilities
   - User-friendly interfaces

Existing modelling and simulation f-works

Agricultural Production Systems Simulators, Australian community, contains a suite of modules

Biophysical Models Applications, MARS unit at JRC, software framework designed and developed for parameterizing and running modelling solutions.



Multi-year, multi-crop daily time step simulation model, developed at the Washington State University

Decision Support System for Agrotechnology Transfer, American Universities and ICASA, software application program

Box and arrow modelling and simulation framework, French community, multiformalisms, focus on decision,

Model development platform for simulations of crop productivity, U of Bonn.

Computing Issues - 1

1. Links with statistical packages
   - –Stochasticity
   - –Meta-modeling
   - –Real-time data assimilation

2. Optimizing codes
   - –Cloud/grid simulation
   - –Multi thread

Computing Issues - 2

3. Multi formalisms/multi clock
   - –Differential equation
   - –Difference equation
   - –Discrete events
   - –Agent based modeling
   - –Petri networks

4. Natural language pseudo-coding
   - –Participatory
   - –Exchange between platforms

5. Standardisation input/output
   - –Links between platform

Some concluding remarks

- Evolution is good for challenges
- Compatibility between platforms might happen at different levels: modules (wrapping) but quite often binary problems, pseudo-codes that formalize knowledge
- There is already a lot of technical possibilities from different application domains
- More and more need to cross disciplines research
- Complexity → Time → Resources

Thank you for your attention

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