AgreenSkills Annual Meeting
Toulouse, 27th-29th October 2014

INRA
SCIENCE & IMPACT

INSIDE

UNCERTAINTY OF PROCESS-BASED WHEAT MODELS UNDER CLIMATE CHANGE

Andrea Maiorano

Tolouse, 28 / 10 / 2014

Background

Background in Agronomy, University of Turin, Italy

Started PhD in 2004 University of Turin, Italy

Relationships between agronomic techniques and mycotoxin contamination in maize kernels
Development of decision support systems to guide maize management (safety)

Started taking interest in development of process-based models

Why process-based models??

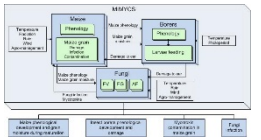
→ Overview of biological system processes involved and their relationships
→ Tools to better understand effects of complex systems
→ Tools to better understand emerging properties of biological systems
→ Can help and improuve agricultural system management (different objectives)

4 months training on system analysis and model development at Wageningen University, The Netherlands

Marie Curie IEF Fellowship at EC Joint Research Centre – 2010-2012

Project MIMYCS

Development of a framework of process-based models dealing with the complex system formed by maize crop-insect borers-toxigenic fungi responsible for mycotoxin contamination in maize kernels. Overview of different modelling techniques and approaches, analyse different biological systems and their interconnexions, climate change impact studies, development of model independent software components.



2014 Agreenskills Fellowship

LEPSE, INRA-SupAGRO in Montpellier
Supervisor Dr. Pierre Martre

Crop models??

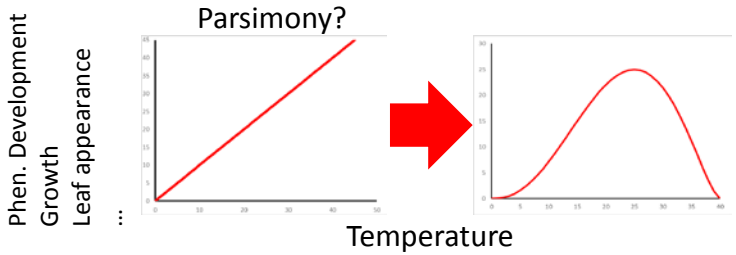
→ Cost-effective information to maintain a quality food supply for the nation and the world
→ Data on weather, soil, and crop management are processed to predict crop yield, maturity date, efficiency of fertilizers and other elements of crop production
→ Existing knowledge of the physics, physiology and ecology of crop responses to the environment.

INSIDE Project

Uncertainty of process-based wheat models under climate change

Current state of development of most crop models do not incorporate knowledge about how crops respond to changing climate and extreme weather events.

Inadequate to describe extreme events and climate change impact on crops and agricultural systems



INSIDE project focuses on extreme high temperatures

Extreme event	Main physiological processes	INSIDE Project
Severe drough (weeks)	Tillering, leaf expansion and senescence, vernalization, rate development, canopy senescence, C and N assimilation and partitioning, grain development	NO
Heavy rains and storms (days,weeks)	Stem lodging, water logging-oxygen stress, post-maturity losses from delayed harvest, disease losses (wet conditions)	NO
Chronic high temperature (weeks, months)	Tillering, leaf expansion and senescence, phenology (lack of vernalization, winter wheat), accelerated rate of development, canopy senescence, C and N assimilation and partitioning, grain development	**YES**
Short heat spells (hours, days)	Floret mortality, pollen viability, potential grain size, canopy senescence, grain C (starch) and N (gluten proteins) polymers accumulation and size distribution	**YES**
Short and chronic low temperature	Cold hardening (winter wheat), ear mortality, leaf senescence	NO

INSIDE project:
- Review available knowledge about impacts of climate variability and extreme temperature events
- Incorporate the knowledge in SiriusQuality2 wheat model (INRA)
- Compare and evaluate improvements of 30 different wheat crop models
- Assess climate change impact on wheat crop using model ensemble simulations
- Estimate climate change impacts and simulation uncertainties

The AgMIP Project

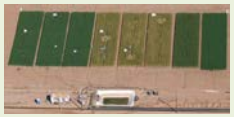
AgMIP The Agricultural Model Intercomparison and Improvement Project

Member organizations of AgMIP Wheat

Around 30 crop models → 30 international teams collaborating to improve crop models and ensemble simulations and estimate/reducing uncertainties under climate change impact studies

Extreme temperature experimental datasets

HSC Experiment
USDA Arizona



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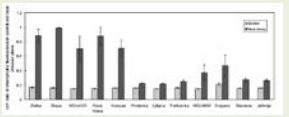
Kansas SU
Heat Shock Field



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USDA-ARS SPAR

INSIDE
Uncertainty of process-based wheat models under climate change

Thanks to AgreenSkills team:
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Thank you!!