Le Corum Conference Centre - Montpellier, France

February 3-5, 2020

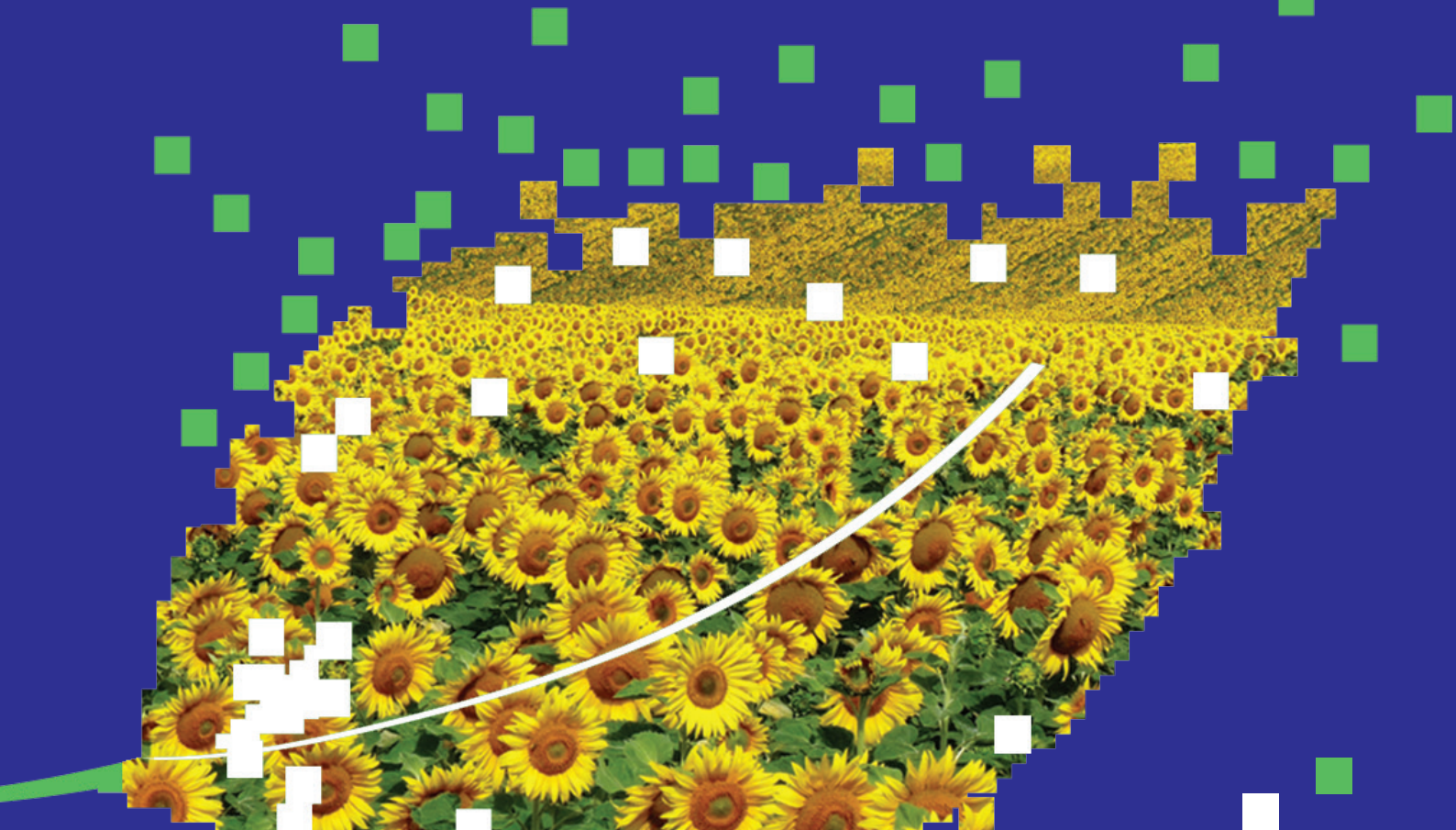
iCROPM 2020

Crop Modelling for the Future

Book of Abstracts

Second International

Crop Modelling Symposium



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WELCOME ADDRESS

Welcome to iCROPM 2020

Crop Modelling for the Future

On behalf of the Scientific and Organizing Committees, it gives us great pleasure to welcome you to **the International Crop Modelling symposium** (iCROPM 2020) dedicated to ***'Crop modelling for Agriculture and Food Security under Global Change'***.

Four years after the first International Crop Modelling symposium in Berlin (iCROPM 2016), crop modelers from around the world are meeting in Montpellier (France) from 3 to 5 February 2020 at the Corum conference center in Montpellier.

The city of Montpellier is home to one of the oldest European and French Universities and hosts research units from such institutes as **CIRAD**, **INRAE** and **INRIA**, which are proud to host the iCROPM 2020 symposium. The recently formed 'Montpellier University of Excellence' (**MUSE I-Site**) brings together 19 institutions to create a thematic research-intensive institution that is internationally engaged and recognised in the fields of agriculture, ecology, environment and health.

Global agriculture faces multiple crucial challenges. Achieving food security in the face of growing global population and increasing resource scarcity remains a central priority. Additional pressures from heating of the climate and other global drivers and the demand that agriculture contributes to net climate mitigation require innovative approaches to growing crops. In strong complementarity with experimentation in agronomy, crop models are increasingly called upon to understand and disentangle the environmental factors driving crop production and to support the design of improved genotypes and new cropping systems. While the development of connected sensors and the 'Internet of Things' offer opportunities it also necessitates novel crop modelling approaches.

Researchers and students participating in the iCROPM 2020 symposium are meeting to exchange on recent scientific advances related to model improvement, development and the use of experimental data for modelling, as well as on advancements in model applications considering new methods of model intercomparison, uncertainty propagation and scaling. While the main focus is on arable and grassland crops and crop-soil interactions, progress in related topics, like intercropping, agroforestry, agroecology, and integrated assessment modelling is also addressed. Digital farming and efforts to integrate crop and plant modelling with high-throughput phenotyping, remote sensing, and genetic improvement are also considered, as well as new modelling approaches and links to big data methods facilitated by innovative software technologies.

This iCROPM 2020 symposium gathers about 400 participants from 48 countries, representing 5 continents. We are sure that iCROPM 2020 will be a comprehensive and inspiring conference that will stimulate innovations to address both local and global challenges faces by agriculture. All types of crops and cropping systems and world regions will be considered, including high and low input systems, with relevance for large agricultural firms as well as for smallholder farmers.

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In addition, **side-events** are organized on 6 and 7 February 2020 (at Agropolis International and at CIRAD), allowing participants to continue to interact for a further two days in workshops. Activities of AgMIP -the Agricultural Model Inter-comparison and Improvement Project- and of other crop modelling research groups, such as the STICS model biannual workshop, will complete this Montpellier crop modelling week.

We wish you all a fascinating, successful, inspiring and enjoyable iCROPM 2020 symposium and we look forward to strengthening both the scientific community and the community of practice in crop modelling!

We warmly thank the Alpha Visa Congrès team for their professional and efficient support for organizing the logistics. We also greatly thank all sponsors that generously support us to make iCROPM 2020 a success!

Enjoy your scientific stay in Montpellier and also take the time to discover a modern but 1,000 year-old beautiful city!

Eric Justes and Christophe Pradal (CIRAD, France)
Pierre Martre and Marie Launay (INRAE, France)
Senthod Asseng (Univ. Florida, USA)
Frank Ewert (ZALF, Germany)
On behalf of the Organising and Scientific Committees

Crop modelling for Agriculture and Food Security under Global Change

iCROPM 2020

Crop Modelling for the Future

COMMITTEES

International Organising Committee

- Eric Justes, *CIRAD, France*
- Senthold Asseng, *University of Florida, USA*
- Frank Ewert, *ZALF, Germany*
- Marie Launay, *INRAE, France*
- Pierre Martre, *INRAE, France*
- Christophe Pradal, *CIRAD & Inria, France*

Scientific Committee

- **Karine Chenu (Chair)**, *UQ, Australia*
- **Roberto Confalonieri (Chair)**, *UNIMI, Italy*
- **Marc Corbeels (Chair)**, *CIMMYT & CIRAD, Kenya*
- **Elisabeth Pattey (Chair)**, *AAFC, Canada*
- **Reimund Rötter (Chair)**, *UG, Germany*
- **Heidi Webber (Chair)**, *ZALF, Germany*
- Ioannis Athanasiadis, *WUR, The Netherlands*
- Kenneth Boote, *UFL, USA*
- Jochem Evers, *WUR, The Netherlands*
- Gerrit Hoogenboom, *UFL, USA*
- Françoise Lescourret, *INRAE, France*
- Guillaume Lobet, *UCL, Belgium*
- Delphine Luquet, *CIRAD, France*
- Dilys MacCarthy, *UG, Ghana*
- Charlie Messina, *Corteva Agriscience, USA*
- Christoph Müller, *PIK, Germany*
- Claas Nendel, *ZALF, Germany*
- Jørgen Olesen, *UA, Denmark*
- Cheryl Porter, *UFL, USA*
- Vittorio Rossi, *UCSC, IT*
- Alex Ruane, *NASA, USA*
- Claudio Stöckle, *WSU, USA*
- Peter Thorburn, *CSIRO, Australia*
- Vincent Vadez, *IRD, France*
- Xiaogang Yin, *CAU, China*
- Xinyou Yin, *WUR, The Netherlands*
- Yan Zhu, *NAU, China*

ORGANISERS

- **CIRAD**
  Centre de coopération internationale en recherche agronomique pour le développement
  https://www.cirad.fr/en/

- **INRAE**
  Institut national de recherche pour l'agriculture, l'alimentation et l'environnement
  https://www.inrae.fr/

- **INRIA**
  Institut national de recherche en sciences et technologies du numérique
  Inria Sophia Antipolis - Méditerranée
  https://www.inria.fr/en/

PARTNERS

Duration	Time	Monday 3 February		
00:10	09:00	**Welcome by the Symposium Chairs** Eric Justes & Frank Ewert		
00:35	09:10	**Welcome by the Organizing Institutions** Senthold Asseng - AgMIP Patrick Caron - Montpellier University of Excellence Michel Eddi - CIRAD Philippe Hinsinger - INRAE		
		Plenary Keynotes Chair: John R. Porter		
00:30	09:45	**Bruno Basso -** Integrating crop models, AI, and sensing for scaling sustainable agricultural systems		
00:30	10:15	**Amy Marshall-Colon** - Integrative modeling and visualization for the development of in silico crops		
00:45	10:45	**Break**		
		Session V Chair: Heidi Webber	**Session I** Chair: Reimund Rötter	**Session VI** Chair: Roberto Confalonieri
00:15	11:30	**Keynote Session V** **Frank Dentener** - Risks and opportunities for the European agricultural sector under 2050 climate change conditions	**Simone Bregaglio** - Methodological advances to incorporate damage mechanisms from diseases in crop models	**Keynote Session VI** **Pierre Martre** - Crop2ML: A Crop Modelling MetaLanguage shared between different crop simulation platforms
00:15	11:45		**Sotirios Archontoulis** - Modeling shallow water table and impacts on soil, root, and plant processes using APSIM	
00:15	12:00	**Andy Challinor** - Crop modelling for sustainable nutrition security: lessons from UK Climate Change Risk Assessment and Africa projects	**Jan Graefe** - A new efficient method for upscaling soil water flow to randomly dispersed or clustered roots	**Kyungdahm Yun** - Design of Declarative Crop Modeling Framework
00:15	12:15	**Alex Ruane** - Historical climate uncertainty in the AgMIP GGCMI ensemble of agricultural models	**Montse Salmeron Cortasa** - Soybean multi-model sensitivity analysis for prediction of seed nitrogen, biological N fixation, and N cycling	**Meagan Lang** - yggdrasil: A Python package for connecting models across programming languages in support of model reuse and modularity
00:15	12:30	**Taru Palosuo** - Combining stakeholder views and simulations to boost sustainable intensification of cereal production in North Savo	**Sibylle Dueri** - Evaluation of a new nitrification/denitrification/N_2O emission model in three different crop models	**Cheryl Porter** - New sources of data for crop model evaluation and improvement: recycling existing agronomic data using AgMIP protocols
00:15	12:45	**Stewart Jennings** - AFRICAP diets, impacts, mitigation modelling for climate smart food security in sub-Saharan Africa	**Tobias Weber** -Soil hydraulic properties matter: A physically comprehensive model for improving crop model simulations	**Hélène Raynal** - AgGlob: Workflow for simulation of agronomic models at a global scale
01:30	13:00	**Lunch**		
		Plenary Model & Software Presentations Chair: Christophe Pradal		
00:10	14:30	**Gerrit Hoogenboom** - Overview of the Decision Support System for Agrotechnology Transfer (DSSAT)		
00:10	14:40	**Greg McLean** - Overview of the Agricultural Production Systems sIMulator (APSIM) platform for modelling and simulation of agricultural systems		
00:10	14:50	**Samuel Buis & Marie Launay** - Overview of STICS (Simulateur mulTIdisciplinaire pour les Cultures Standard), a generic crop growth model		
00:10	15:00	**Claudio Stöckle** - Overview of CropSyst, a user-friendly multi-year and multi-crop growth model		
		Session V Chair: Jørgen Olesen	**Session III** Chair: Karine Chenu	**Session VI** Chair: Cheryl Porter
00:15	15:20	**Marco Carozzi** - Potential GHG mitigation and carbon sequestration from European cropland by modelling crop residues management	**Keynote Session III** **Jana Kholova** - Utilization of crop modelling tools as a guiding principles in crop improvement programs; current status at CG-system	**Hendrik Boogaard** - Application of the crop simulation model WOFOST at parcel scale through distributed cloud computing
00:15	15:35	**Zhan Tian** - Balancing rice production and greenhouse gas mitigation in China		**Bahareh Kamali** - Future of permanent grasslands in Germany: implications for grassland management
00:15	15:50	**Jose Guarin** - Impacts of tropospheric ozone and climate change on Mexico wheat production	**Sandra Truong** -Adaptive landscapes to explore genetics and environment	**Hussein Kanso** - Reducing a model of sugar metabolism in peach fruit to explore genetic diversity
00:15	16:05	**Alan Robock** - Modeling the response of crops to rapid cooling from stratospheric aerosols	**Pierre Casadebaig** - Optimized cultivar deployment improves the efficiency and stability of sunflower crop production at national scale	**Livia Paleari** - Genotype-specific parameterization of functional-structural models using smart technologies: rice and leaf architecture
00:45	16:20	**Break**		
		Session V Chair: Dilys MacCarthy	**Session III** Chair: Vincent Vadez	**Session VI** Chair: Xiaogang Yin
00:15	17:05	**Claas Nendel** - Future soybean productivity in Europe	**Karine Chenu** - Integrating crop modelling, physiology and genetics to aid crop improvement in changing environments	**Michelle Viswanathan** - Bayesian sequential updating for crop yield prediction in soil-crop-atmosphere systems
00:15	17:20	**Jonathan Ojeda** - Multi-resolution analysis of aggregated spatial data to simulate yield and irrigation water demand at regional scales	**Yutaka Tsutsumi-Morita** - Yield prediction based on QTLs for component traits in yield dissection models	**Daniel Wallach** - The AgMIP crop model calibration activity: documenting, evaluating, improving calibration techniques
00:15	17:35	**Rettie Fasil Mequanint** - Climate change impact on crop yield in Ethiopia: A multi-model uncertainty analysis	**Boris Parent** - A phenomics-based model to identify achievable ideotypes of leaf growth in the diversity of European environments	**Samuel Buis** - A new method for sensitivity analysis of models with dynamic and/or spatial outputs
01:00	18:00	**Poster Session - Model & Software Demonstrations**		
	19:00	**End of the Day**		

Tuesday 4 February

Plenary Keynotes
Chair: Marie Launay

00:30 09:00 **Graeme Hammer -** On the nature of crop models (and modellers) needed to advance crop adaptation and improvement
00:30 09:30 **Kerstin Wiegand -** Integrated modelling of ecological and socioeconomic functions of perennial tree crops at the landscape scale

		Session V Chair: Alex Ruane	Session I Chair: Kenneth Boote	Session II Chair: Marc Corbeels
00:15	10:10	**Babacar Faye** - Climate change impact on European crop yields: sensitivity to rotations and residue management	**Delphine Luquet** - Why and how crop models should account for C source-sink relationships better to address future agro-climatic challenges	**Keynote Session II** **Philippe Tixier** - Modelling in agroecology: from simple to complex models, and vice versa
00:15	10:25	**Dilys MacCarthy** - Impact of Climate scenarios on the yields of cereals among farms in Nioro, Senegal and Navrongo, Ghana, West Africa	**Sylvie Sabatier** - Modelling the Guayule plant growth and development with a Functional Structural Plant Model	
00:15	10:40	**João Vasco Silva** - Using farmer's field data and crop modelling to benchmark resource use efficiencies of arable crops in The Netherlands	**Christopher Bahr** - Shedding light on virtual Riesling canopies (*Vitis vinifera* L.)	**Laurène Perthame** - Which nitrogen fertilization techniques and crop traits to promote biological weed regulation by competition?
00:45	10:55	Break		
		Session V Chair: Alex Ruane	**Session I** Chair: Kenneth Boote	**Session II** Chair: Françoise Lescourret
00:15	11:40	**Jawoo Koo** - El Niño–Southern oscillation impacts on agriculture and the national economy in Ethiopia	**Ambra Tosto** - Developing a functional-structural plant model of cocoa to explore the interaction between pruning and shading	**Amos Ngwira** - Improving the productivity and resilience of smallholder farmers with maize-legume and legume-legume systems in Malawi
00:15	11:55	**Hermine Mitter** - Efficient land and water use under stochastic climate scenarios and groundwater restrictions in a semi-arid region	**Yi-Chen Pao** - Coordination between dynamics in canopy structure and photosynthetic acclimation strategy optimizes canopy productivity	**Meixiu Tan** - Modelling crop growth and water use in relay strip intercropping
00:15	12:10	**Davide Cammarano** - Response of grain yield and nitrogen to climate change in Scotland	**Shouyang Liu** - Improving the estimation of canopy light interception in wheat	**Frédéric Boudon** - Modelling of the mango tree – blossom gall midge system: in silico assessment of its functioning
00:15	12:25	**Paresh Shirsath** - Crop-loss Assessment Monitor (CAM): A Web based integrated platform to monitor yield losses for agricultural insurance	**Thuy Huu Nguyen** - Crop modelling of maize growth and gas fluxes considering plant hydraulic conductance	**Rasche Livia** - EPIC-GILSYM: Modelling crop-insect interactions and pest management with a novel coupled crop-insect model
00:15	12:40	**Peter Thorburn** - Can insurance help farmers mitigate nitrogen pollution from intensive cropping?	**Jonas Coussement** - Modelling maize leaf expansion under water limitations	**Zvi Hochman** - Ecological intensification of rainfed cropping systems in Australia's subtropical grain zone
01:30	12:55	**Lunch**		

Plenary Model & Software Presentations
Chair: Eric Justes

00:10 14:25 **Marcello Donatelli** - Overview of the Biophysical Model Applications (BioMA): engineering components and services
00:10 14:35 **Hélène Raynal** - Overview of the RECORD platform for modeling and computer simulation of farmning and agro-ecosystems
00:10 14:45 **Sabine Seidel** - Overview of SIMPLACE: a platform for advanced crop and ecosystem management
00:10 14:55 **Christophe Pradal** - Overview of OpenAlea: a visual programming and component-based software platform for plant modelling

		Session IV Chair: Elisabeth Pattey	Session III Chair: Xinyou Yin	Session II Chair: Vittorio Rossi
00:15	15:20	**Keynote Session IV** **Harry Vereecken** - Managing agricultural fields: from observation to prediction	**Livia Paleari** - Crop model-aided genomic prediction: a multi-model study on rice phenology	**Guillaume Jégo** - Challenges for simulating the long term effects of complex agroecological systems to support innovation in Canada
00:15	15:35		**Zhigan Zhao** - Predicting flowering time of wheat genotypes across diverse environments in Australia	**Lalaina Ranaivoson** - Can legume crop residues contribute to sustainable intensification of rainfed rice production in Madagascar?
00:15	15:50	**Yvette Everingham** - A cybernetic precision sugarcane irrigation system informed by the IrrigWeb crop model	**Florian Larue** - Comparison of estimation methods to capture better the genetic variability within crop growth model parameters	**Kurt Christian Kersebaum** - Effects of climate change on crop rotations and their management across the Federal state of Brandenburg, Germany
00:15	16:05	**Christian Fournier** - Fitting a dynamic structural maize model on thousands of plants imaged in a high throughput phenotyping platform	**Chetan Deva** - Cool beans: modelling leaf temperature and breeding for heat avoidance	**Yin Xiaogang** - Uncertainties in simulating N uptake, net N mineralization, soil mineral N and N leaching in European crop rotations
00:45	16:20	**Break**		
		Session IV Chair: Yan Zhu	**Session III** Chair: Charlie Messina	**Session II** Chair: Gerrit Hoogenboom
00:15	17:05	**Luisa Leolini -** UNIFI.GrapeML: new capabilities for the simulation of vineyard systems	**Alex Wu** - Cross-scale modelling connecting photosynthesis with crop models to support yield improvement	**Nicolas Beaudoin** - Long term modelling of crop biomass, N fate and GHG balance of organic cropping systems with a research version of STICS
00:15	17:20	**Jean-Christophe Soulié** - Coupling of cropping system models with the AEGIS platform	**Scott Chapman** - Extending the phenotype - combining proximal sensing with crop models to characterise radiation use efficiency	**Max De Antoni** - Soybean fallows and nitrification inhibitors to reduce N_2O emission intensities in Australian sugarcane cropping systems
00:15	17:35	**Ryan McCormick** - Transcontinental prediction of soybean phenology via hybrid ensemble of knowledge-based and data-driven models	**Tom De Swaef** - Drought tolerance screening of soybean genotypes using UAV imagery and Functional-Structural Plant Modelling	**Nicolas Meyer** - Management of cover crops has to be climate and soil specific. A simulation approach
01:30	18:00	**Poster Session and Drinks**		
03:30	19:30	**Symposium Dinner**		

		Wednesday 5 February		
		Plenary Keynotes Chair: Senthold Asseng		
00:30	09:00	**Mark Cooper** - Connecting quantitative genetics with crop models to enhance prediction of long-term grain yield trends		
00:30	09:30	**Joanna Linnerooth-Bayer** - Crop insurance for the most vulnerable: Can it equitably address climate loss and damage?		
		Session V Chair: Christoph Müller	**Session I** Chair: Delphine Luquet	**Session IV** Chair: Peter Thorburn
00:15	10:10	**Heidi Webber** - Drought not heat stress driving yield losses in extreme years under climate change	**Keynote Session I** **Claudio Stöckle** - On the urgent need for improvement of crop models	**Tobias Weber** - Impact of pedotransfer functions on simulated crop growth in SW Germany with ExpertN-GECROS
00:15	10:25	**Benjamin Sultan** - Evidence of crop production losses in West Africa due to historical global warming in two crop models		**Enli Wang**- Process-based crop modelling enables inverse prediction of plant available water holding capacity across farm with yield
00:15	10:40	**Bahareh Kamali** - Spatio-temporal dynamic of crop drought vulnerability in Sub-Saharan Africa	**Gatien Falconnier** - Modeling of climate change impacts on maize yields in low-nitrogen conditions in Africa	**Karen Lammoglia** - Coupling Sentinel-2 images and STICS crop model to map soil hydraulic properties
00:45	10:55	**Break**		
		Session V Chair: Christoph Müller	**Session I** Chair: Delphine Luquet	**Session IV** Chair: Claas Nendel
00:15	11:40	**Budong Qian** - Quantifying the uncertainty introduced by internal climate variability in the projected Canadian crop yield changes	**Enli Wang -** Challenges and new opportunities for crop-soil systems modelling	**Joost Wellens** - Processing chain for parcel and regional crop monitoring (PROCCY): Open Data, Sentinel-2, AquaCrop and sugar cane
00:15	11:55	**Tommaso Stella** - Patterns and drivers of the risk of crop failure across Europe	**Kirsten Paff** - A new crop simulation model in DSSAT for Tef	**Christian Baron** - Remote sensing contributions to crop-yield simulation: bias and scarcity VS scale and predictive capacity issues
00:15	12:10	**Dorothée Kapsambelis** - Modelling drought and wetness events in 2050 and their impacts on agricultural yield losses	**Kenneth Boote** - Improving the CROPGRO perennial forage model for ability to simulate fall dormancy classes of Alfalfa cultivars	**Qingling Wu** - Regional yield prediction by assimilating Sentinel-2 reflectance into crop model with cloud platform
00:15	12:25	**Marc Corbeels**- Challenges of modeling climate change impact on smallholder agricultural systems in Africa	**Albasha Rami** - When would simulating temperature at the leaf-layer scale improve crop model performance? Conclusions from a wheat model	**Pepijn van Oort** - Calibration of the Tipstar potato model using remote sensing data
00:15	12:40	**Jonas Jägermeyr** - CMIP6 climate and crop model ensemble estimates of future extreme event impacts on crops	**Gabriela Naves Maschietto** - Phosphorus calibration in Century model in a French agricultural context	**Benoît Piquemal** - Data assimilation and sensor fusion in the CHN crop model for integrated monitoring of nitrogen fertilization in cereals
01:30	12:55	**Lunch**		
		Session V Chair: Dilys MacCarthy	**Session I** Chair: Claudio Stöckle	**Session II** Chair: Jochem Evers
00:15	14:25	**Ehsan Eyshi Rezaei** - Impact of changes in climate and cultivars on winter wheat phenology in Germany	**Xinyou Yin** - Can we learn from experiences in physics to improve crop models?	**Herman Berghuijs** - A minimalist mixture model for cereal-legume intercropping
00:15	14:40	**Ahmad Manschadi** - Integrating crop modelling in the smart farming project Farm/IT in Austria: Achievements and challenges	**Fulu Tao** - Why do crop models diverge substantially in climate impact projections?	**Rémi Vezy** - Implementation of new formalisms in STICS for intercropping modeling
00:15	14:55	**Morteza Mesbah -** Precipitation deficit indicators for rainfed crops; a revisit using model-based evapotranspiration	**Michael Dingkuhn** - Towards Simulation-Modeling of Rice Crop Lodging	**Gaëtan Louarn** - Individual-based modelling as a tool to identify combinations of traits promoting overyielding in grass-legume mixtures
00:15	15:10	**Folorunso Akinseye** - Predicting sorghum performance from big on-farm data in the savannah zone of northern Nigeria	**Madina Diancoumba** - Characterization of spatiotemporal changes in drought occurrence over Mali sorghum growing areas using modeling approach	**Emmanuelle Blanc** - WALTer: modeling the impact of competition for light on the regulation of tillering in wheat cultivar mixtures
01:00	15:25	**Break & Poster Session**		
		Plenary Keynotes Chair: Frank Ewert		
00:30	16:25	**François Tardieu -** Modelling the consequences of the genetic variability on yield: which scales, methods and degrees of abstraction?		
00:30	16:55	**Ken Giller -** Grand challenges for the 21st Century: What crop models can and can't (yet) do		
00:20	17:25	**Final plenary** Chair: Pierre Martre		
	17:45	**End of the Symposium**		

Monday 3 February

08:00 **Congress check-in & Poster installation** — Espace Joffre, level 1

Pasteur auditorium, level 1

09:00 **Welcome by the Symposium Chairs**

- **Eric Justes & Frank Ewert**

09:10 **Welcome by the Organizing Institutions**

- **Senthold Asseng** - AgMIP
- **Patrick Caron** - Montpellier University of Excellence
- **Michel Eddi** - CIRAD
- **Philippe Hinsinger** - INRAE

Plenary Keynotes

Chair: John R. Porter

09:45 • **Bruno Basso** - Integrating crop models, AI, and sensing for scaling sustainable agricultural systems

10:15 • **Amy Marshall-Colon** - Integrative modeling and visualization for the development of *in silico* crops

10:45 **Coffee break** — Espace Joffre, level 1

PARALLEL SESSIONS: V, I, VI

Pasteur auditorium, level 1

Session V: Crop modelling for risk and impact assessment

Chair: Heidi Webber

Keynote

11:30 • **Frank Dentener** - Risks and opportunities for the European agricultural sector under 2050 climate change conditions

Presentations

12:00 • **Andy Challinor** - Crop modelling for sustainable nutrition security: lessons from UK Climate Change Risk Assessment and Africa projects

12:15 • **Alex Ruane** - Historical climate uncertainty in the AgMIP GGCMI ensemble of agricultural models

12:30 • **Taru Palosuo** - Combining stakeholder views and simulations to boost sustainable intensification of cereal production in North Savo

12:45 • **Stewart Jennings** - AFRICAP diets, impacts, mitigation modelling for climate smart food security in sub-Saharan Africa

Barthez room, level 2

Session I: Improvement of crop models

Chair: Reimund Rötter

Presentations

11:30 • **Simone Bregaglio** - Methodological advances to incorporate damage mechanisms from diseases in crop models

11:45 • **Sotirios Archontoulis** - Modeling shallow water table and impacts on soil, root, and plant processes using APSIM

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12:00 • **Jan Graefe** - An new efficient method for upscaling soil water flow to randomly dispersed or clustered roots

12:15 • **Montse Salmeron Cortasa** - Soybean multi-model sensitivity analysis for prediction of seed nitrogen, biological N fixation, and N cycling

12:30 • **Sibylle Dueri** - Evaluation of a new nitrification/denitrification/N_2O emission model in three different crop models

12:45 • **Tobias Weber** -Soil hydraulic properties matter: A physically comprehensive model for improving crop model simulations

Rondelet room, level 2

Session VI: Methods and software to support modelling activities

Chair: Roberto Confalonieri

Keynote

11:30 • **Pierre Martre** - Crop2ML: A Crop Modelling MetaLanguage shared between different crop simulation platforms

Presentations

12:00 • **Kyungdahm Yun** - Design of declarative crop modeling framework

12:15 • **Meagan Lang** - yggdrasil: A Python package for connecting models across programming languages in support of model reuse and modularity

12:30 • **Cheryl Porter** - New sources of data for crop model evaluation and improvement: recycling existing agronomic data using AgMIP protocols

12:45 • **Hélène Raynal** - AgGlob: Workflow for simulation of agronomic models at a global scale

13:00 **Lunch** Espace Joffre, level 1

Pasteur auditorium, level 1

Plenary Model & Software Presentations

Chair: Christophe Pradal

14:30 • **Gerrit Hoogenboom** - Overview of the Decision Support System for Agrotechnology Transfer (DSSAT)

14:40 • **Greg McLean** - Overview of the Agricultural Production Systems sIMulator (APSIM) platform for modelling and simulation of agricultural syste

14:50 • **Samuel Buis & Marie Launay** - Overview of STICS (Simulateur mulTIdisciplinaire pour les Cultures Standard), a generic crop growth model

15:00 • **Claudio Stöckle** - Overview of CropSyst, a user-friendly multi-year and multi-crop crop growth model model

PARALLEL SESSIONS: V, III, VI

Pasteur auditorium, level 1

Session V: Crop modelling for risk and impact assessment

Chair: Jørgen Olesen

Presentations

15:20 • **Marco Carozzi** - Potential GHG mitigation and carbon sequestration from European cropland by modelling crop residues management

15:35 • **Zhan Tian** - Balancing rice production and greenhouse gas mitigation in China

15:50 • **Jose Guarin** - Impacts of tropospheric ozone and climate change on Mexico wheat production

16:05 • **Alan Robock** - Modeling the response of crops to rapid cooling from stratospheric aerosols

Barthez room, level 2

Session III: Linking crop/plant models and genetics

Chair: Karine Chenu

Keynote

15:20 • **Jana Kholova** - Utilization of crop modelling tools as a guiding principles in crop improvement programs; current status at CG-system

Presentations

15:50 • **Sandra Truong** - Adaptive landscapes to explore genetics and environment

16:05 • **Pierre Casadebaig** - Optimized cultivar deployment improves the efficiency and stability of sunflower crop production at national scale

Rondelet room, level 2

Session VI: Methods and software to support modelling activities

Chair: Cheryl Porter

Presentations

15:20 • **Hendrik Boogaard** - Application of the crop simulation model WOFOST at parcel scale through distributed cloud computing

15:35 • **Bahareh Kamali** - Future of permanent grasslands in Germany: implications for grassland management

15:50 • **Hussein Kanso** - Reducing a model of sugar metabolism in peach fruit to explore genetic diversity

16:05 • **Livia Paleari** - Genotype-specific parameterization of functional-structural models using smart technologies: rice and leaf architecture

16:20 **Coffee break** Espace Joffre, level 1

PARALLEL SESSIONS: V, III, VI

Pasteur auditorium, level 1

Session V: Crop modelling for risk and impact assessment

Chair: Dilys MacCarthy

Presentations

17:05 • **Claas Nendel** - Future soybean productivity in Europe

17:20 • **Jonathan Ojeda** - Multi-resolution analysis of aggregated spatial data to simulate yield and irrigation water demand at regional scales

17:35 • **Rettie Fasil Mequanint** - Climate change impact on crop yield in Ethiopia: A multi-model uncertainty analysis

Barthez room, level 2

Session III: Linking crop/plant models and genetics

Chair: Vincent Vadez

Presentations

17:05 • **Karine Chenu** - Integrating crop modelling, physiology and genetics to aid crop improvement in changing environments

17:20 • **Yutaka Tsutsumi-Morita** - Yield prediction based on QTLs for component traits in yield dissection models

17:35 • **Boris Parent** - A phenomics-based model to identify achievable ideotypes of leaf growth in the diversity of European environments

Rondelet room, level 2

Session VI: Methods and software to support modelling activities

Chair: Xiaogang Yin

Presentations

17:05 • **Michelle Viswanathan** - Bayesian sequential updating for crop yield prediction in soil-crop-atmosphere systems

17:20 • **Daniel Wallach** - The AgMIP crop model calibration activity: documenting, evaluating, improving calibration techniques

17:35 • **Samuel Buis** - A new method for sensitivity analysis of models with dynamic and/or spatial outputs

18:00 **Poster Session - Model & Software Demonstrations** Espace Joffre, Level 1

19:00 **End of the Day**

Tuesday 4 February

08:00 **Welcome desk opening** — Espace Joffre, level 1

Pasteur auditorium, level 1

Plenary Keynotes

Chair: Marie Launay

09:00 • **Graeme Hammer** - On the nature of crop models (and modellers) needed to advance crop adaptation and improvement

09:30 • **Kerstin Wiegand** - Integrated modelling of ecological and socioeconomic functions of perennial tree crops at the landscape scale

PARALLEL SESSIONS: V, I, II

Pasteur auditorium, level 1

Session V: Crop modelling for risk and impact assessment

Chair: Alex Ruane

Presentations

10:10 • **Babacar Faye** - Climate change impact on European crop yields: sensitivity to rotations and residue management

10:25 • **Dilys MacCarthy** - Impact of Climate scenarios on the yields of cereals among farms in Nioro, Senegal and Navrongo, Ghana, West Africa

10:40 • **João Vasco Silva** - Using farmer's field data and crop modelling to benchmark resource use efficiencies of arable crops in The Netherlands

Barthez room, level 2

Session I: Improvement of crop models

Chair: Kenneth Boote

Presentations

10:10 • **Delphine Luquet** - Why and how crop models should account for C source-sink relationships better to address future agro-climatic challenges

10:25 • **Sylvie Sabatier** - Modelling the Guayule plant growth and development with a Functional Structural Plant Model

10:40 • **Christopher Bahr** - Shedding light on virtual Riesling canopies *(Vitis vinifera L.)*

Rondelet room, level 2

Session II: Crop modelling for ecological intensification

Chair: Marc Corbeels

Keynote

10:10 • **Philippe Tixier** - Modelling in agroecology: from simple to complex models, and vice versa

Presentation

10:40 • **Laurène Perthame** - Which nitrogen fertilization techniques and crop traits to promote biological weed regulation by competition?

10:55 **Coffee break** — Espace Joffre, level 1

PARALLEL SESSIONS: V, I, II

Pasteur auditorium, level 1

Session V: Crop modelling for risk and impact assessment

Chair: Alex Ruane

Presentations

11:40 • **Jawoo Koo** - El Niño–Southern oscillation impacts on agriculture and the national economy in Ethiopia

11:55 • **Hermine Mitter** - Efficient land and water use under stochastic climate scenarios and groundwater restrictions in a semi-arid region

12:10 • **Davide Cammarano** - Response of grain yield and nitrogen to climate change in Scotland

12:25 • **Paresh Shirsath** - Crop-loss Assessment Monitor (CAM): A Web based integrated platform to monitor yield losses for agricultural insurance

12:40 • **Peter Thorburn** - Can insurance help farmers mitigate nitrogen pollution from intensive cropping?

Barthez room, level 2

Session I: Improvement of crop models

Chair: Kenneth Boote

Presentations

11:40 • **Ambra Tosto** - Developing a functional-structural plant model of cocoa to explore the interaction between pruning and shading

11:55 • **Yi-Chen Pao** - Coordination between dynamics in canopy structure and photosynthetic acclimation strategy optimizes canopy productivity

12:10 • **Shouyang Liu** - Improving the estimation of canopy light interception in wheat

12:25 • **Thuy Huu Nguyen** - Crop modelling of maize growth and gas fluxes considering plant hydraulic conductance

12:40 • **Jonas Coussement** - Modelling maize leaf expansion under water limitations

Rondelet room, level 2

Session II: Crop modelling for ecological intensification

Chair: Françoise Lescourret

Presentations

11:40 • **Amos Ngwira** - Improving the productivity and resilience of smallholder farmers with maize-legume and legume-legume systems in Malawi

11:55 • **Meixiu Tan** - Modelling crop growth and water use in relay strip intercropping

12:10 • **Frédéric Boudon** - Modelling of the mango tree – blossom gall midge system: in silico assessment of its functioning

12:25 • **Livia Rasche** - EPIC-GILSYM: Modelling crop-insect interactions and pest management with a novel coupled crop-insect model

12:40 • **Zvi Hochman** - Ecological intensification of rainfed cropping systems in Australia's subtropical grain zone

12:55 **Lunch** Espace Joffre, Level 1

Pasteur auditorium, level 1

Plenary Model & Software Presentations

Chair: Eric Justes

14:25 • **Marcello Donatelli** - Overview of the Biophysical Model Applications (BioMA): engineering components and services

14:35 • **Hélène Raynal** - Overview of the RECORD platform for modeling and computer simulation of farmning and agro-ecosystems

14:45 • **Sabine Seidel** - Overview of SIMPLACE: a platform for advanced crop and ecosystem management

14:55 • **Christophe Pradal** - Overview of OpenAlea: a visual programming and component-based software platform for plant modelling

PARALLEL SESSIONS: IV, III, II

Pasteur auditorium, level 1

Session IV: Linking crop models to data stream systems in the digital age

Chair: Elisabeth Pattey

Keynote

15:20 • Harry Vereecken - Managing agricultural fields: from observation to prediction

Presentations

15:50 • Yvette Everingham - A cybernetic precision sugarcane irrigation system informed by the IrrigWeb crop model

16:05 • Christian Fournier - Fitting a dynamic structural maize model on thousands of plants imaged in a high throughput phenotyping platform

Barthez room, level 2

Session III: Linking crop/plant models and genetics

Chair: Xinyou Yin

Presentations

15:20 • Livia Paleari - Crop model-aided genomic prediction: a multi-model study on rice phenology

15:35 • Zhigan Zhao - Predicting flowering time of wheat genotypes across diverse environments in Australia

15:50 • Florian Larue - Comparison of estimation methods to capture better the genetic variability within crop growth model parameters

16:05 • Chetan Deva - Cool beans: modelling leaf temperature and breeding for heat avoidance

Rondelet room, level 2

Session II: Crop modelling for ecological intensification

Chair: Vittorio Rossi

Presentations

15:20 • Guillaume Jégo - Challenges for simulating the long term effects of complex agroecological systems to support innovation in Canada

15:35 • Lalaina Ranaivoson - Can legume crop residues contribute to sustainable intensification of rainfed rice production in Madagascar?

15:50 • Kurt Christian Kersebaum - Effects of climate change on crop rotations and their management across the Federal state of Brandenburg, Germany

16:05 • Yin Xiaogang - Uncertainties in simulating N uptake, net N mineralization, soil mineral N and N leaching in European crop rotations

16:20 **Coffee break** Espace Joffre, Level 1

PARALLEL SESSIONS: IV, III, II

Pasteur auditorium, level 1

Session IV: Linking crop models to data stream systems in the digital age

Chair: Yan Zhu

Presentations

17:05 • **Luisa Leolini** - UNIFI.GrapeML: new capabilities for the simulation of vineyard systems

17:20 • **Jean-Christophe Soulié** - Coupling of cropping system models with the AEGIS platform

17:35 • **Ryan McCormick** - Transcontinental prediction of soybean phenology via hybrid ensemble of knowledge-based and data-driven models

Barthez room, level 2

Session III: Linking crop/plant models and genetics

Chair: Charlie Messina

Presentations

17:05 • **Alex Wu** - Cross-scale modelling connecting photosynthesis with crop models to support yield improvement

17:20 • **Scott Chapman** - Extending the phenotype - combining proximal sensing with crop models to characterise radiation use efficiency

17:35 • **Tom De Swaef** - Drought tolerance screening of soybean genotypes using UAV imagery and Functional-Structural Plant Modelling

Rondelet room, level 2

Session II: Crop modelling for ecological intensification

Chair: Gerrit Hoogenboom

Presentations

17:05 • **Nicolas Beaudoin** - Long term modelling of crop biomass, N fate and GHG balance of organic cropping systems with a research version of STICS

17:20 • **Max De Antoni** - Soybean fallows and nitrification inhibitors to reduce N_2O emission intensities in Australian sugarcane cropping systems

17:35 • **Nicolas Meyer** - Management of cover crops has to be climate and soil specific. A simulation approach

18:00 **Poster Session and Drinks** Espace Joffre, Level 1

19:30 **Symposium Dinner** Salon central, level 3

Wednesday 5 February

08:30 **Welcome desk opening** — Espace Joffre, level 1

Pasteur auditorium, level 1

Plenary Keynotes

Chair: Senthold Asseng

09:00 • **Mark Cooper** - Connecting quantitative genetics with crop models to enhance prediction of long-term grain yield trends

09:30 • **Joanne Linnerooth-Bayer** - Crop insurance for the most vulnerable: Can it equitably address climate loss and damage?

PARALLEL SESSIONS: V, I, IV

Pasteur auditorium, level 1

Session V: Crop modelling for risk and impact assessment

Chair: Christoph Müller

Presentations

10:10 • **Heidi Webber** - Drought not heat stress driving yield losses in extreme years under climate change

10:25 • **Benjamin Sultan** - Evidence of crop production losses in West Africa due to historical global warming in two crop models

10:40 • **Bahareh Kamali** - Spatio-temporal dynamic of crop drought vulnerability in Sub-Saharan Africa

Barthez room, level 2

Session I: Improvement of crop models

Chair: Delphine Luquet

Keynote

10:10 • **Claudio Stöckle** - On the urgent need for improvement of crop models

Presentation

10:40 • **Gatien Falconnier** - Modeling of climate change impacts on maize yields in low-nitrogen conditions in Africa

Rondelet room, level 2

Session IV: Linking crop models to data stream systems in the digital age

Chair: Peter Thorburn

Presentations

10:10 • **Tobias Weber** - Impact of pedotransfer functions on simulated crop growth in SW Germany with ExpertN-GECROS

10:25 • **Enli Wang** - Process-based crop modelling enables inverse prediction of plant available water holding capacity across farm with yield

10:40 • **Karen Lammoglia** - Coupling Sentinel-2 images and STICS crop model to map soil hydraulic properties

10:55 **Coffee break** — Espace Joffre, level 1

PARALLEL SESSIONS: V, I, IV

Pasteur auditorium, level 1

Session V: Crop modelling for risk and impact assessment

Chair: Christoph Müller

Presentations

11:40 • **Budong Qian** - Quantifying the uncertainty introduced by internal climate variability in the projected Canadian crop yield changes

11:55 • **Tommaso Stella** - Patterns and drivers of the risk of crop failure across Europe

12:10 • **Dorothée Kapsambelis** - Modelling drought and wetness events in 2050 and their impacts on agricultural yield losses

12:25 • **Marc Corbeels** - Challenges of modeling climate change impact on smallholder agricultural systems in Africa

12:40 • **Jonas Jägermeyr** - CMIP6 climate and crop model ensemble estimates of future extreme event impacts on crops

Barthez room, level 2

Session I: Improvement of crop models

Chair: Delphine Luquet

Presentations

11:40 • **Enli Wang** - Challenges and new opportunities for crop-soil systems modelling

11:55 • **Kirsten Paff** - A new crop simulation model in DSSAT for Tef

12:10 • **Kenneth Boote** - Improving the CROPGRO perennial forage model for ability to simulate fall dormancy classes of Alfalfa cultivars

12:25 • **Albasha Rami** - When would simulating temperature at the leaf-layer scale improve crop model performance? Conclusions from a wheat model

12:40 • **Gabriela Naves Maschietto** - Phosphorus calibration in Century model in a French agricultural context

Rondelet room, level 2

Session IV: Linking crop models to data stream systems in the digital age

Chair: Claas Nendel

Presentations

11:40 • **Joost Wellens** - Processing chain for parcel and regional crop monitoring (PROCCY): Open Data, Sentinel-2, AquaCrop and sugar cane

11:55 • **Christian Baron** - Remote sensing contributions to crop-yield simulation: bias and scarcity VS scale and predictive capacity issues

12:10 • **Qingling Wu** - Regional yield prediction by assimilating Sentinel-2 reflectance into crop model with cloud platform

12:25 • **Pepijn van Oort** - Calibration of the Tipstar potato model using remote sensing data

12:40 • **Benoît Piquemal** - Data assimilation and sensor fusion in the CHN crop model for integrated monitoring of nitrogen fertilization in cereals

12:55 **Lunch** Espace Joffre, level 1

PARALLEL SESSIONS: V, I, II

Pasteur auditorium, level 1

Session V: Crop modelling for risk and impact assessment

Chair: Dilys MacCarthy

Presentations

14:25 • **Ehsan Eyshi Rezaei** - Impact of changes in climate and cultivars on winter wheat phenology in Germany

14:40 • **Ahmad Manschadi** - Integrating crop modelling in the smart farming project Farm/IT in Austria: Achievements and challenges

14:55 • **Morteza Mesbah** - Precipitation deficit indicators for rainfed crops; a revisit using model-based evapotranspiration

15:10 • **Folorunso Akinseye** - Predicting sorghum performance from big on-farm data in the savannah zone of northern Nigeria

Barthez room, level 2

Session I: Improvement of crop models

Chair: Claudio Stöckle

Presentations

14:25 • **Xinyou Yin** - Can we learn from experiences in physics to improve crop models?

14:40 • **Fulu Tao** - Why do crop models diverge substantially in climate impact projections?

14:55 • **Michael Dingkuhn** - Towards simulation-modeling of rice crop lodging

15:10 • **Madina Diancoumba** - Characterization of spatiotemporal changes in drought occurrence over Mali sorghum growing areas using modeling approach

Rondelet room, level 2

Session II: Crop modelling for ecological intensification

Chair: Jochem Evers

Presentations

14:25 • **Herman Berghuijs** - A minimalist mixture model for cereal-legume intercropping

14:40 • **Rémi Vezy** - Implementation of new formalisms in STICS for intercropping modeling

14:55 • **Gaëtan Louarn** - Individual-based modelling as a tool to identify combinations of traits promoting overyielding in grass-legume mixtures

15:10 • **Emmanuelle Blanc** - WALTer: modeling the impact of competition for light on the regulation of tillering in wheat cultivar mixtures

15:25 **Coffee break and Poster Session** Espace Joffre, Level 1

Pasteur auditorium, level 1

Plenary Keynotes

Chair: Frank Ewert

16:25 • **François Tardieu** - Modelling the consequences of the genetic variability on yield: which scales, methods and degrees of abstraction?

16:55 • **Ken Giller** - Grand challenges for the 21st Century: What crop models can and can't (yet) do

17:25 **Final plenary**

Chair: Pierre Martre

17:45 **End of the Symposium**

ABSTRACTS PARALLEL SESSIONS

SESSION I

IMPROVEMENT OF CROP MODELS

While crop models have advanced considerably during the past five decades, their capability for assessing the current and future performance of crops and cropping systems under variable environmental conditions has sometimes been debated. Model improvement is certainly closely related to the availability and quality of data from experimentation and (remote/nearby) monitoring, although questions also exist on how to exactly measure model improvement. Process-based crop simulation models (CSMs) that aim to quantify current, and explore future genotype by environment by management (GxExM) interactions are in the focus here. Major challenges in improving description of the underlying mechanisms relate to predicting crop impacts caused by agro-climatic extremes and biotic stresses, in particular, interactive effects of drought and heat stress, biotic stresses, and their modification under enhanced atmospheric CO_2 concentration. Likewise, challenges exist to improve process descriptions regarding nutrient dynamics including soil water and nutrient uptake, especially for (sub-) tropical cropping systems. In order to improve crop models, it will also be necessary to judiciously assimilate different data types and consider the complementarity of CSMs with statistical/machine learning approaches to feed or substitute some parts of the CSMs in the era of big data.

The session invites papers that address the above-mentioned issues.

S4-O.09

Processing chain for parcel and regional crop monitoring (PROCCY): Open Data, Sentinel-2, AquaCrop and sugar cane

Wellens Joost[1] (joost.wellens@uliege.be), Sall Mor Talla[2], Ville Anouk[3]

[1] *Environmental Sciences and Management, University of Liège, Arlon, Belgium*; [2] *Compagnie Sucrière Sénégal, Richard Toll, Senegal*; [3] *Spacebel, Liège, Belgium*

Introduction

FAO's crop growth model, AquaCrop, helps the "Compagnie Sucrière Sénégalaise" (CSS) monitor and manage its +/- 13.000 ha of irrigated sugar cane. Field, satellite and open data are linked to a crop growth model. A processing chain with dashboard was developed to asses irrigation calendars and estimate final biomass.

Materials and Methods

To facilitate the batch-processing of 1.000s of fields, the AquaCrop stand-alone version (Raes et al., 2012) has been integrated in an R environment (Figure 1). The resulting software tool has been baptized '*PROCCY*'; for '*Processing Chain for Regional & Parcel Crop Yield modelling*'. Soil physical characteristics for the region are automatically retrieved from SoilGrids and soil-hydraulic properties calculated using Saxton pedo-transfer functions. Meteorological data are downloaded from NASA's POWER project. Time series of median satellite fractional green vegetation cover (fCover) values are calculated for each field. A double sigmoidal function is fitted through the fCover data and phenological key data are assimilated into AquaCrop. Irrigation calendars are read from CSS' data base. A dashboard assists the graphical assessment of the simulation results.

Results and Discussion

AquaCrop's most important crop parameters were adjusted until a minimal error was obtained between observed and simulated biomass (R^2 0,6; nRMSE 9,1 %). Some detailed simulation results are presented in Figure 1. Figure 1.A represents simulated (black line) and satellite fCover (grey dots). Soil water depletion rates are depicted in Figure 1.B in black. Dashed grey lines represent field capacity and permanent wilting point. Irrigation events are in blue. If depletion rates drop below certain thresholds, water stresses affect: canopy development (green), stomatal closure (orange) and early senescence (red). Figure 1.C also shows eventual water stresses negatively impacting biomass production. Relative (green area), cumulative (blue line) and observed (red point) biomass are given in Figure 1.D. The observed biomass is only depicted for calibration and validation purposes.

The dashboard considerably enhances calibration and validation, and forms the core of the decision support tool. A straightforward overview is given of the interconnected simulation processes. An example of under- and over-irrigation are given in Figure 1. Observed vs simulated fCover values in Figure 1.A function as a sort of indicator light that simulations correspond to observed realities. The water balance (column B) of field one shows few irrigation events (bleu lines) and severe water stresses; field two intensive irrigation and a soil water content continuously above saturation. More details on these stresses are explained in column C: canopy expansion stress for the upper case and stomatal closure due to anaerobia for the lower case. Both type of stresses results in reduced biomass (column D). The dashboard serves to monitor actual irrigation calendars, but can also be used to develop and test new schedules.

Conclusions

The main strength of PROCCY is its generic approach combining free data and software. Presently show-cased for sugar-cane in Senegal, PROCCY is also being implemented for other crops in other regions (e.g. Mohammed Sallah *et al.*, 2019).

Acknowledgments

The authors thank CSS for the field data and NADiRA (EU H2020 grant No 776309) for the scientific assistance.

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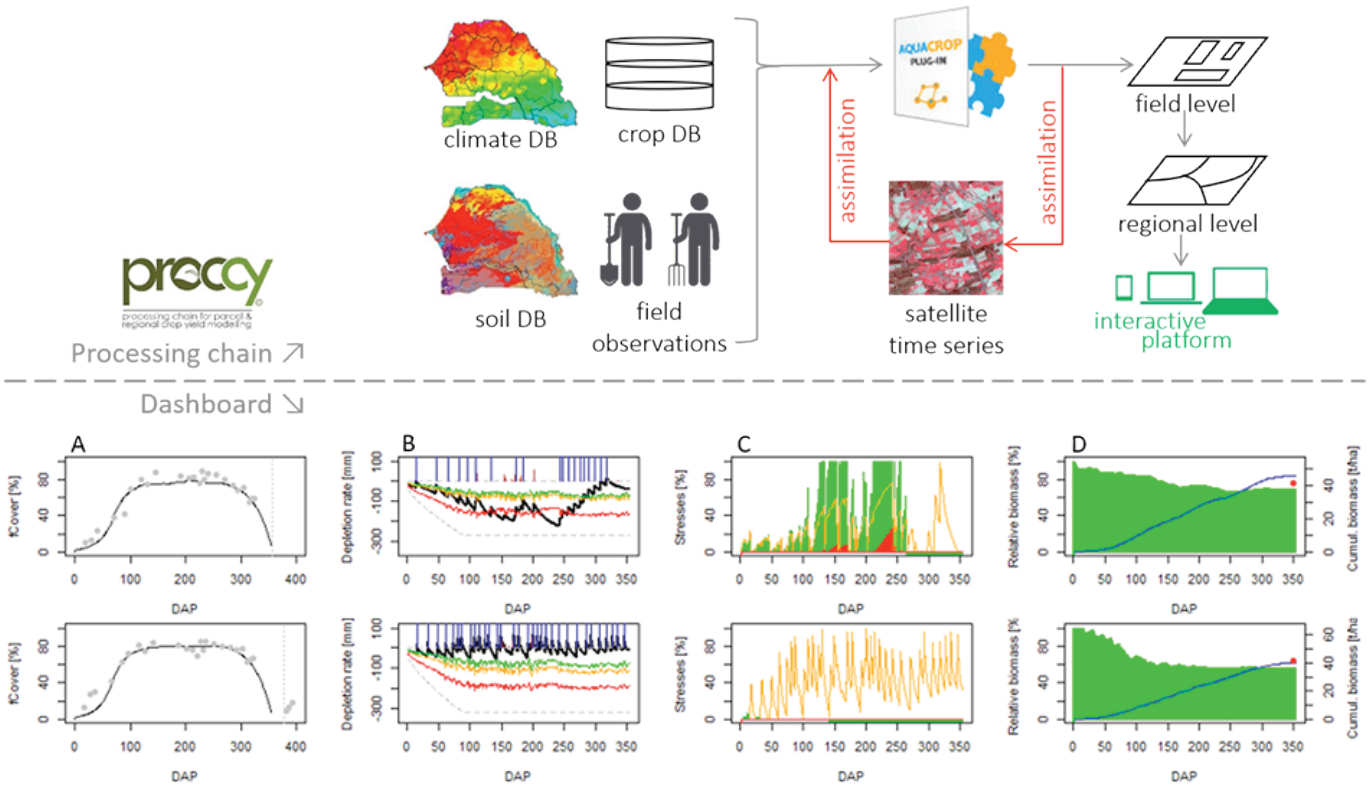

PROCCY workflow and dashboard (based on Wellens et al., 2017).

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1. Mohamed Sallah, A.H., Tychon, B., Piccard, I., Gobin, A., Van Hoolst, R., Bakary, D., Wellens, J., 2019. Batch-processing of AquaCrop plug-in for rainfed maize using satellite derived fractional vegetation cover data. Agric. Water Manag., 217, 346-355.
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S5-O.31

Predicting sorghum performance from big on-farm data in the savannah zone of northern Nigeria

Akinseye Folorunso[1] (f.akinseye@cgiar.org), Ajeigbe Hakeem A.[1], Ahmed Mohammed I.[2], Traore Pierre C. Sibiry[3], Tabo Ramadjita[4], Whitbread Anthony Michael[2]

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Introduction

Smallholder farming systems in semi-arid regions are characterized by poor soil fertility and low agricultural input use. Sorghum production in tWest Africa is mainly rain-fed with many smallholder farmers dependent on it for their livelihoods. Process crop models serve as powerful tools for evaluating different cropping systems and for devising strategic and tactical decisions therein. The Agricultural Production Systems sIMulator (APSIM) is widely used to test the many combinations of production options and interventions under current and future climatic conditions, and to identify main constraints to sorghum production. Our study explores the adaptation and performance of contrasting sorghum cultivars ranging from early to late maturing, low to high photoperiod sensitivity over a wide range of sorghum production environments. It aims to combine simulation and field experimentation to evaluate crop response to variable climate risk and management practices, across different soil types and climate scenarios.

Materials and Methods

Two datasets provided calibration and validation for five contrasted sorghum varieties. Calibration data came from 2016-2018 on-station field experiments conducted in the Savannah and Sudano-Sahelian agro-ecological zones. Validation data came from 2013-2017 on-farm measurements of the impacts of various improved agronomic practices including: seed treatment, minimum tillage and fertilization strategies. A total of 3,266 yield data points spread from Southern Guinea Savannah to the Sudano-Sahelian zone were assembled that included basic management data (sowing date, fertilizer application rate) and approximative location for each farm. APSIM was used to simulate crop grain yields under two different weather scenarios (historical and future) and three fertility levels (low, medium and high). Spatial information was normalized across scales to match with modelling outputs. Soil maps from FAO, agroecological zones from the national agencies, national and CHIRPS data, observed yield from the multilocal trials were used to understand the connectivity to markets and credit was compiled and used in a mapping framework to generate zones of adaptation.

Results and Discussion

Our results showed that APISM produced robust predictions of phenology (flowering and maturity) captured with high accuracy (MBE: 1-4 days; normalized RMSE < 10%). The prediction of grain yield (GY) and total biomass (TB) ranged from accurate RMSEn (SK5912: 9.2% for GY; 6.9% for TB) to low RMSEn (34.5% for GY; 36.8 % for TB) of the observed mean across the sorghum variety. Being able to accurately predict crop performance over widely differing agro-ecologies and soil types, is the basis for applying such tools for management. Simulated grain yield varied widely among cultivars CV varying from 12 - 31% depending on variety.The spatial dimension to this type of study will add value to predictions by providing a basis for scaling-out over larger areas.

Conclusion

This study is expected to strengthening digital farming solutions towards improving management practices and risk management strategies to cope with uncertainties and benefits African smallholder farmers productivity and financial security .

Acknowledgement

The authors thank the donor for the funding of the study.The study is part of the NADiRA project, which has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 776309.

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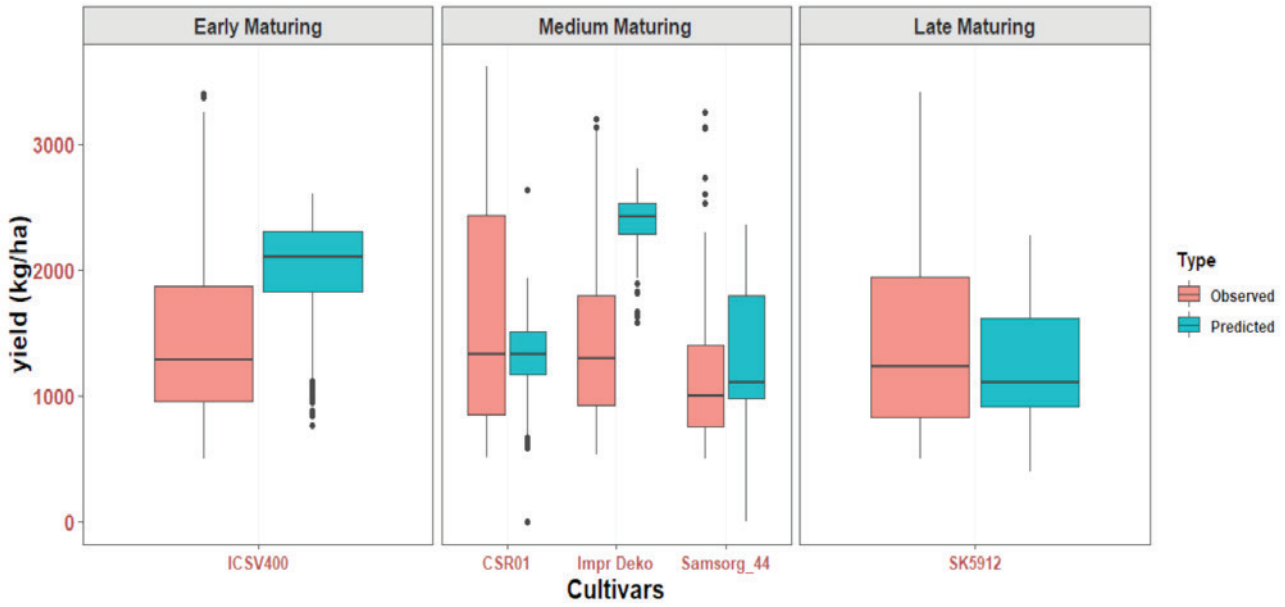

Figure 1: Yield of (observed and simulated) using on-farm data sets from 2013-2017 growing seasons from contrasting environment for five (5) sorghum cultivars ranged from early to late maturing.
ICSV-400 (N=1192; MBE = 535 kgha-1;RMSE =971kgha-1); Improved Deko (N=300; MBE= -960 kgha-1,RMSE = 1169 kgha-1); Samsorg-44 (N=100; MBE= 102 kgha-1;RMSE = 912 kgha-1);CSR01 (N=944; MBE= -228kgha-1,RMSE = 867 kgha-1); SK5912 (N=731; MBE= -219 kgha-1;RMSE = 839 kgha-1. Coefficients of variation (CV) ranged from 12 - 31% depending on variety, N= number of observation

Keywords: Sorghum, Nigeria, APSIM, big data, NADiRA.

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