FAO-MOSAICC

Modelling System for Agricultural Impacts of Climate Change

EU/FAO Programme on Improved Global Governance for Hunger Reduction (GCP/INT/130/EU)

MOSAICC Trainings in Morocco

Technical report

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Contents

1. Introduction

In the framework of the EU/ FAO Programme on improve global governance for hunger reduction[1], the NRC division is developing a server-based tool aimed at providing information to support decision making in the area of climate change and agriculture called MOSAICC (Modelling System for Agricultural Impacts of Climate Change)[2]. As part of the development Morocco has been identified as a pilot country to deploy the system, to train users and to carry out a reference impact study at national level.

The activities in Morocco are taking place under the framework of a Memorandum of Understanding (MOU) signed with national and regional institutions in January 2013. The MOU fixes the roles and responsibilities of each institution and outlines the main activities related to MOSAICC in Morocco. The signatory parties are:

- The FAO of the UN
- The National Institute for Agronomic Research (INRA)
- The Direction of National Meteorology (DMN)
- The Direction of Strategy and Statistics of the Ministry of Agriculture and Sea Fisheries (DSS)
- The Direction of Water Research and Planning of the Ministry of Energy, Mines, Water and Environment (DRPE)
- The Hydraulic Basin agency of Oum Er Rbiâ (ABHOER)
- The Hydraulic Basin agency of Loukkos (ABHL)
- The Hydraulic Basin agency of Sebou (ABHS)
- The Hydraulic Basin agency of Moulouya (ABHM)
- The Hydraulic Basin agency of Tensift (ABHT)
- The Hydraulic Basin agency of Souss Massa and Drâa (ABHSM)
- The Hydraulic Basin agency of Bouregreg and Chaouia (ABHBC)

A working group with national experts has been established to manage the system and to define study projects at national level. The members of the working group are listed in Table 1. Mr Balaghi (INRA), in addition to being in charge of the crop modelling component of MOSAICC, coordinates the working group and represents the focal points to the FAO staff involved in the project, at the representation in Morocco and at the Head-Quarters in Rome.

Table 1 Working group MOSAICC Morocco

MOSAICC component	Focal points		
	Name	**Institution**	**E-mail**
System administration	Ms. Meriem Alaouri	DMN	meriemalaouri@gmail.com

[1] More info: www.foodsec.org/
[2] More info: www.fao.org/climatechange/mosaicc

Climate	Mr. Tarik ElHairech	DMN	tarik.elhairech@gmail.com
Crop	Mr. Riad Balaghi	INRA	riad.balaghi@gmail.com
Hydrology	Ms. Soudouce Moutaouakkil	DRPE	soundouce.moutaouakkil@gmail.com
Economics	Mr. Redouane Arrach	DSS	r.arrach@gmail.com

The trainings took place in a sequence of activities defined with the national institutions. Following on from the signature of the agreement document, a server containing the software has been installed in the host institution (DMN) and connected to the network in March 2013. The working group start carrying out a climate change impact study at national level using the different models in MOSAICC after the trainings. Results will be publicly presented to end-users in April 2014. The pilot installation of MOSAICC in Morocco will lead to the definition of the first stable version of the system (MOSAICC v1.0)

In order to cover the expenses incurred during the training (catering, accommodation, logistics), a budget of 10,810USD has been transferred to and managed by INRA through a letter of agreement (LOA). These expenses include:

- Training organization logistics (accommodation, catering, conference room, training material)
- The logistic costs (transportation, catering) pertaining to the training evaluation meeting and the progress meetings during the climate change impact study
- The logistic costs (transportation, catering) for the final workshop.

The objective of this report is to document the training sessions in Morocco for the records and draw lessons and recommendations for future deployment of the system.

2. Organisation

2.1 Trainers

The trainings were organized by the project officer in HQ, the international consultant at the FAO representation for Morocco and the coordinator of the national working group. All trainers but one (WABAL) were experts involved in the development of the models integrated in MOSAICC and had therefore a full mastery of the models and good knowledge about MOSAICC. The list of trainers is given in Table 2.

Table 2 Trainers

Training	Trainer	Institution

System administration	Mr. Mauro Evangelisti	FAO NRC
Introduction	Mr. Francois Delobel	FAO NRC
Statistical downscaling	Mr. Jose Manuel Gutierrez	Santander Meteorology Group, University of Cantabria
Interpolation	Mr. Francois Delobel	FAO NRC
STREAM	Mr. Ate Poortinga Mr. Francois Delobel	University of Wageningen, Water Insight FAO
WABAL	Mr. Riad Balaghi	INRA Morocco
AQUACROP	Mr. Dirk Raes Ms. Patricia Mejìas Moreno Mr. Francois Delobel	Catholic University of Leuven FAO NRL FAO NRC
CGE	Mr. Onno Kuik Mr. Francois Delobel	IVM, Free University of Amsterdam FAO NRC

2.2 Trainees

The training participants were designated by the focal points according to their qualifications and their responsibilities in their respective institutions. They will be involved in the subsequent MOSAICC activities, among which the integrated climate change impact study.

Due to unforeseen events in their institutions, experts from Hydraulic Basins Agencies of Oum Er Rbia and Sebou were not able to attend but they will still be involved in the project. The complete list of participants is available in Annex 2: Participants (page 19).

2.3 Venue and equipment

The training on System administration, Interpolation and Statistical downscaling were given in the meeting room at the DMN (Casablanca). All the other trainings were given in the large ADIC meeting room at the INRA Regional Office in Rabat.

Both rooms at the DMN and at INRA were equipped with projector, screen, wi-fi and power supply for computers. The ADIC meeting room also had a flipchart, which turned out to be useful for the training on AQUACROP, and microphones.

The trainees were responsible for bringing their own laptops.

2.4 Training calendar

The trainings were stretched over 8 weeks (Table 3). Scheduling the training in sequence allowed to keep a relative close match between the chronology and the dataflow, to make sure that bugs arising during the exercises could be addressed, and users to attend to different modules. Two weeks were left empty (April 29-May 3 and May 20-24) to incorporate data to the system for the trainings, to fix possible bugs, and, for the latter, to prepare the WABAL training.

An official opening by Mr. Michael Hage, FAO representative in Morocco, and Mr. Mohamed Badraoui, Director of INRA, was scheduled on May 14th at INRA, Rabat.

Table 3 Training calendar

Date	Training module (location)
April 24-26	System administration (DMN, Casablanca)
May 7	Interpolation (DMN, Casablanca)
May 8-10	Statistical Downscaling (DMN, Casablanca)
May 14	Introduction to MOSAICC (INRA, Rabat)
May 15-17	STREAM (INRA, Rabat)
May 27-31	WABAL (INRA, Rabat)
June 3-7	CGE (DSS, Rabat)
June 10-13	AQUACROP (INRA, Rabat)

2.5 Language

According to the language skills of the trainers and the participants, the language was either English or French. The following trainings were taught in English: System administration, Interpolation, Statistical Downscaling, Introduction to MOSAICC, STREAM and CGE. The trainings on WABAL and AQUACROP were given in French.

2.6 Technical support during the trainings

Data collection, formatting and import and model testing were made by the focal points, the project officer, the IT consultant and the trainers prior to the training sessions in order to run them smoothly. Translation of training material and interpretation during group discussions turned out to be necessary for some of the training taught in English: STREAM and CGE. Facilitation of the training sessions was ensured by the project officer and the national coordinator. Finally, technical adjustments to the system and fixes of the bugs arising during the practical exercises were made in collaboration with the MOSAICC IT consultant.

Figure 1 MOSAICC STREAM training participants, 17 May 2013, Rabat

3. Feedbacks on the training

3.1 Survey

A survey was given to the participants of the following trainings: statistical downscaling, interpolation, STREAM, WABAL, AQUACROP and CGE. The objective of the survey was to gauge the reception of the trainings and their opinion about the models and their utilization during the project and in their regular activities.

As a corollary the answers to the surveys are useful indicators to evaluate the selection of the participants and the relevance of a system for the regular work in the partner institutions.

For each training, participants were asked 10 questions:

1. In the perspective of an autonomous utilization of MOSAICC for climate change studies in Morocco, what is your overall rating of the training? (1 = very bad, 10 = excellent)

2. What would you suggest to improve the training programme on [name of the model]?

The items listed below were to evaluate. The possible answers were: more, less, as it was.

- *Theoretical background on climate change and agriculture*
- *Theoretical background on MOSAICC*
- *Theoretical background on the model*
- *Practicals with the model (on the laptop)*
- *Practicals with MOSAICC interfaces*
- *Manipulation of the data (input data preparation etc.)*
- *Overall length of the training (number of days)*

3. Do you have any other comment on the content of the training? Topics covered, level of prerequesite, teaching style etc. (Open question)

4. What is your overall rating on the relevance of [name of the model] to climate change impact studies in Morocco? (1 = the model is not appropriate, 10 = the model is very appropriate)

5. According to you, what feature, characteristic or functionality would you suggest to develop to increase the relevance of the model to carry out climate change impact studies in Morocco? (Open question)

6. What is your overall rating of the integration of the model within MOSAICC? (1 = very poor, 10 = excellent)

7. What are the advantages? What are the inconvenients? (Open question)

8. How relevant MOSAICC and [name of the model] are with respect to your regular work? (1 = not relevant, 10 = very relevant)

9. To what scale MOSAICC and [name of the model] meet your personal interest? (1 = not in my area of interest, 10 = very much in my interest)

10. Would you use MOSAICC or [name of the model] in activities other than the MOSAICC project? If yes, which ones? (Open question)

Of a total of 42 of possible answers, 19 were received, distributed as following (Table 4):

Table 4 Surveys completed per training module

Training	Number of answers/maximum possible (%)
Statistical downscaling	3/7 (42.9 %)
Interpolation	3/8 (37.5 %)
STREAM	6/12 (50 %)
WABAL	1/3 (33.3 %)
AQUACROP	3/7 (42.9 %)
CGE	3/5 (60 %)

The highest number of answers received was for STREAM (6), the lowest for WABAL (1). The highest rate of reply was for CGE (60 %), the lowest for WABAL (33.3 %). As a consequence, the results for WABAL are not sufficiently representative to draw sound conclusions.

The questions were grouped into 3 themes: evaluation of the training and improvements, evaluation of the model and the system and potential user take-up and system sustainability. An analysis of the result is given in the next paragraphs while the detailed answers are available in the Annex 3: Survey results (page 20).

3.2 Training evaluation

A large majority of survey respondents expressed overall satisfaction with the training they received. Indeed the average rating on the training as a preparation for an autonomous utilization (question 1) reaches 8.11/10. Satisfaction appears to be highest with statistical downscaling, interpolation and AQUACROP trainings (plus WABAL, but the single answer is not sufficient to be representative). CGE training scores the lowest (6.67 on average).

The second question gave the users the possibility to evaluate the topics usually addressed in the trainings: theoretical background on climate change and agriculture, on MOSAICC and on the model, practical exercises with the model on the desktop and within MOSAICC and data manipulation. Whereas most participants both on average and for all models agree that the background given on climate change and agriculture (13/18) and on MOSAICC (14/20) was sufficient, a slight majority of them (10/19) think that theoretical background on the models was lacking. 8 of them were attended to the interpolation (2/3), STREAM (4/6) and CGE (2/3) trainings.

As far as practical exercises are concerned, the majority of participants would have liked more sessions with the model desktop versions for all models except for statistical downscaling. These desktop were not scheduled for the sessions on interpolation, STREAM and WABAL, as these models are fully integrated in the system. Similarly more practicals would have been welcome with the MOSAICC interfaces for most WABAL, AQUACROP and CGE users as well as for 50% of the hydrologists. All participants to the statistical downscaling training and most participants to the interpolation training (2/3) indicated that the amount of practical exercises was sufficient.

In addition, data manipulation seemed to be too shallow. Indeed for each training a majority of respondents (15/19 or 79% aggregated) thinks that more practical exercises on the input data would have been useful.

Finally as far as the length is concerned, most respondent who attend to the trainings on statistical downscaling (3 days), interpolation (1 day) and AQUACROP (4 days) believe that the trainings were too short. Conversely, most hydrologists (66,7%) and all economists who replied to the survey claimed to be satisfied with the length of the training.

In question 3 respondents had the opportunity to provide additional comments on the classes. 7 answers were collected, giving an appreciation on the training and the trainer (1, statistical downscaling and 1, STREAM), asking for more theoretical background (1, interpolation), balancing out theory for more hands-on exercises (1, CGE), adapting the exercises to local cases and giving more time to the model calibration (1, STREAM). More focus on input data preparation was also suggested once for AQUACROP.

3.3 Model and system evaluation

In question 4 respondents evaluated the relevance of the models for impact studies in agriculture in Morocco. Models scored high on average (7.58/10) however there are some disparities among models. Whereas statistical downscaling and interpolation scored the highest (9.33 and 8.67 respectively), AQUACROP and CGE were perceived as the least suitable (6.67 and 6). Respondents could develop their opinion on the model relevance in question 5 however many of the replies actually refer to the integration of the models (e.g. data exchange, interfaces etc.).

Among the relevant answers, one suggests working with appropriate data (use of a “real” land use map of Morocco in STREAM) and another one proposes to calibrate first the model (STREAM) to local conditions. A participant to AQUACROP training proposes to simulate no-till system as it is one of the climate change mitigation options implemented in the country.

The scores were on average higher and more uniform when participants rated the integration of the models within the system (question 6). The average is 8.16/10, only one respondent gave a score lower than 7/10 (5/10, for STREAM). The averages per model range from 7.33 (CGE) to 9.67 (Interpolation). In question 7, eight replies were obtained: 2 for Statistical Downscaling and interpolation, 3 for STREAM and 1 for CGE. The respondents generally pointed out pros and cons of the integration of the models and their installation on the server. Among the advantages: connections between models (STREAM), simplicity to operate (interpolation, STREAM) while the drawbacks emphasized the impression of black box process regarding to data upload and the execution of models and scripts (CGE, Interpolation, Statistical downscaling). In addition, among the answers to question 5, respondents suggested to improve the data upload for statistical downscaling, interpolation and AQUACROP and to allow the CGE modellers to work with multiple versions of the model (which is in fact operational already).

3.4 Sustainability

The sustainability of the system was assessed through the relevance of the system to the users' regular activities (question 8) and to their personal interest (question 9). In the first question the models usually score rather high: 7.63 on average, with minimum of 6 (STREAM) and a maximum of 9 (Interpolation). Individual answers spread from 3 (once, for STREAM) to 10 (1 for CGE). The relatively low scores of STREAM may be due to the fact that some hydraulic basin agencies already run similar models. In addition, some experts attended trainings that were different to their usual field of work.

In the second question, the training and the models appear to match well with most respondents' personal interest (8.05/10 on average), which is also an important factor for the sustainability of the system. The highest scores were given to the modules and Statistical Downscaling and Interpolation. Indeed the participants from the DMN are already very familiar with this kind of models and indicated that the models in MOSAICC were good complements to what is already available in the institution.

Finally, in the last question the participants were asked on the possible further utilization of the system (question 10). Among the 12 answers received, 11 are positive and 1 is negative. Cited applications include other impact studies, crop yield monitoring and forecasting, river flow modeling and agricultural economics.

3.5 Additional feedback

Some additional feedback was also collected during the training. On the system administration module, participants indicated that some of them were not fully comfortable with the language (English) and that the training was too short.

It was also suggested that in some cases two short sessions of a couple of days scheduled a month or so one after the other is favourable in order to give the users the time to ingest and carry out some practical exercises on their own between the two sessions. This way the second session can be deeper and better suited to the users' needs.

Participants to the training on the economic model (CGE) requested further general training on general equilibrium theory and modeling, in order to brush up their knowledge and get a fuller ownership of the model in MOSAICC.

Finally bugs and improvements for the system have been listed during the training sessions (see Annex 5: Bugs and suggestion for improvements on page 27).

3.6 Conclusion

In conclusion, the training and the system seems well received by the future users. Some adjustments can be made to improve the trainings (e.g. emphasize on the utilization of the desktop version of the model and on input data manipulation) with possible extension of the duration or scheduling them in 2 steps according to the needs.

Beside the bug fixing, the system can be further improved notably regarding the Integration of the CGE and STREAM models, and increasing the transparency of data upload and management functions.

In the end, because of the appropriateness of the trainings and the models, conditions are favorable to the sustainability of the system in the country.

4. Opportunities and follow-up

In the perspective of enhancing the institutions capacities to investigate potential impacts of climate change in agriculture in Morocco, the effort made during the training sessions can be complemented with additional workshop organized in collaboration with the World Bank, with possible extension to other institutions. Further training on CGE modelling and STREAM could be useful for the project. In the view of spreading the information to relevant actors (decision makers, educational institutions) the organization of the final workshop in April 2014 is key. Definition of the agenda and selection of the invitees will have to be handled with care.

In the perspective of improving and consolidating MOSAICC the already existing capacities and data in the institutions are an asset. Possibilities of undertaking comparison and validation experiments have to be discussed with the partners.

Similarly the experience of the national institutions with international organizations and international projects can be an asset in the perspective of disseminating MOSAICC to other countries in the region. Regional organization such as ICARDA and ESCWA could collaborate as well in such endeavours.

In order to ensure the performance of the system a number of following-up activities are necessary. Firstly, the bugs detected but not solved yet during the training, whether related to the system, or to the models, have to be fixed. The continuous development of the system, including the development of the end-user interface, will be undertaken in collaboration with the users in Morocco. Working groups for each model will be constituted, where they have been made yet, to facilitate the coordination of the modelling activities. User support will be ensured by the system development team, including the model developers. Support will be also provided to the preparation of the final reports and workshop foreseen in April 2014. Finally a page on the activities in Morocco will be added to the MOSAICC website to increase the visibility of the project.

Annex 1: training programmes

FAO-MOSAICC
Modelling system for Agricultural impacts of climate change

Training Programme for MOSAICC in Morocco
System Administration

April 24 to 26, DMN Casablanca

Final

Date	April 24	April 25	April 26
Title	*System Administration (1/3)*	*System Administration (2/3)*	*System Administration (3/3)*
Trainer	M. Evangelisti	M. Evangelisti	M. Evangelisti
Morning 9.00-12.00	Introduction DB management, focusing on backup and restore of the PostgreSQL DB using the command line versions of the programs, e.g. "psql" and "pg_dump"	GIS, focusing on PostGIS (the open source software program that adds support for geographic objects to the PostgreSQL)	MOSAICC management and maintenance, including: • data management, such as preparation and upload of the user data • module installation • module configuration • module execution • troubleshooting
Afternoon 13.00-16.00	CMS, focusing on Drupal 6 used as framework of the user interface of FAO-MOSAICC, that can be classified as a web-application	GDAL (the open source library designed for processing raster geospatial data formats)	

Training Programme for MOSAICC in Morocco
Interpolation and Statistical Downscaling

May 7 to 10, DMN Casablanca

Final

Date	May7	May 8	May 9	May 10
Title	*Interpolation (1/1)*	*Statistical Downscaling (1/3)*	*Statistical Downscaling (2/3)*	*Statistical Downscaling (3/3)*
Trainer	F. Delobel	JM. Gutierrez	JM. Gutierrez	JM. Gutierrez
Morning 9.00-12.00	Introduction to interpolation techniques Kriging AURELHY Interpolation in MOSAICC PET calculation	Concept and evolution of climate models Global climate change projections From IPCC-AR4 to AR5 Introduction to downscaling methods and its advantages and limitations	Elements of SD Methods: Predictors and predictands. Sensitivity to the choice of reanalysis and predictors Validation of GCMs for downscaling purposes Validation of SD methods for climate change studies.	Hand On Work in Groups: Downscaling in Morocco
Afternoon 13.00-16.00	Hands-on practicals	Dynamical Downscaling: The CORDEX Initiative Statistical Downscaling (SD): Standard Methodologies.	Hands On Exercise: Using the Statistical downscaling Portal	

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Modelling system for Agricultural impacts of climate change

Training Programme for MOSAICC in Morocco
Introduction to MOSAICC and Hydrological modelling

May 14 to 17, INRA Rabat

Tentative

Date	**May14**	**May 15**	**May 16**	**May 17**
Title	*Introduction (1/1)*	*Hydrological Modelling (1/3)*	*Hydrological Modelling (2/3)*	*Hydrological Modelling (3/3)*
Trainer	F. Delobel	A. Poortinga, F. Delobel	A. Poortinga	Ate Poortinga
Morning 9.00-12.00	Welcome from the Director of INRA Mr. Badraoui Introduction from the FAO Representative Mr. Hage General introduction to the system: models, integration and study design Hands-on practicals: log-in, user profiles and user account, uploading data, creating a study area, data and experiment management	General Introduction DEM preparation with QGIS Introduction to STREAM	Assignment 2 – the first simulations Reflection assignment 2 Model calibration	STREAM history STREAM automatic calibration Assignment 5 – model calibration
Afternoon 13.00-16.30	Data for hydrological modelling	Assignment 1 – getting to know stream Reflection assignment 1	Assignment 3 – model calibration part 1 Reflection assignment 3 Technical aspects of STREAM	Feedback session Assignment 5 + presentation preparation 3 slide presentation

Training Programme for MOSAICC in Morocco
Introduction to WABAL and crop yield projections under climate change scenarios

May 29 to 31, INRA Rabat

Final

Date	May 29	May 30	May 31
Title	*WABAL (1/3)*	*WABAL (2/3)*	*WABAL (3/3)*
Trainer	Riad Balaghi	Riad Balaghi	Riad Balaghi, Francois Delobel
Morning 9.00-12.00	A general introduction to Crop Models Trends, detrending, retrending and trend projection	WABAL one of the two crop model engines in MOSAICC and PLD	Utilisation of WABAL in MOSAICC: output variables signification Bug diagnosis Climate data quality check Yield projection
Afternoon 13.00-16.30	Practicals: crop yield data analysis and manipulation, trend detection and removal	Practicals: crop water balance modelling with WABAL in MOSAICC Crop parameters	Wrap up

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Modelling system for Agricultural impacts of climate change

Training Programme for MOSAICC in Morocco
Introduction to CGE modelling

June 3 to 7, INRA Rabat

Final

Date	**June 3**	**June 4**	**June 5**	**June 6**	**June 7**
Title	*CGE Modelling (1/5)*	*CGE Modelling (2/5)*	*CGE Modelling (3/5)*	*CGE Modelling (4/5)*	*CGE Modelling (5/5)*
Trainer	O. Kuik, F. Delobel	O. Kuik	O. Kuik	O. Kuik, F. Delobel	O. Kuik, F. Delobel
Morning 9.00-12.00	Le projet MOSAICC General introduction to computable general equilibrium (CGE) modelling	Presentation of the script	Social Accounting Matrices and other data input	Hands-on exercises with the model (tax changes, productivity shocks, etc.)	Uploading a new CGE model to MOSAICC Preparing and uploading input data files (shocks) Running simulations in MOSAICC
Afternoon 13.00-16.30	General introduction to MOSAICC CGE	Dynare and Octave, simple hands-on practices	Hands-on practices with standard model	Presentation of the MOSAICC interfaces and practical with own data	Retrieving outputs Questions and answers

Training Programme for MOSAICC in Morocco
Introduction to AQUACROP

June 10 to 13, INRA Rabat

Final

Date	June 10	June 11	June 12	June 13
Title	*AQUACROP (1/4)*	*AQUACROP (2/4)*	*AQUACROP (3/4)*	*AQUACROP (4/4)*
Trainer	D. Raes, P. Mejias	D. Raes, P. Mejias	P. Mejias, F. Delobel	F. Delobel
Morning 9.00-12.00	Introduction/overview of AQUACROP (desktop version) Soil and crop characteristics	Yield response and Management (Irrigation	Applications and climate change Preparation of climate data files with ETo_calculator	Trend in statistical statistics: detection and removal (exercise) Crop files in MOSAICC AQUACROP Simulation in MOSAICC (exercise)
Afternoon 13.00-16.30	Exercises on AQUACROP (desktop version): Climatic, crop and soil characteristics	Exercises on AQUACROP (desktop version): Simulation of irrigation	Implementation of AQUACROP in MOSAICC Data in MOSAICC: soil map and climate grids	Retrieving outputs and definition of yield function (exercise)

Annex 2: Participants

First name	Surname	Organization	E-mail	System Administration	Introduction to the system	Interpolation	Statistical downscaling	STREAM	WABAL	AQUACROP	CGE
Meriem	Alaouri	DMN	meriemalaouri@gmail.com	■		■	■				
Mohamed	AMGHAR	ABHSMD	amgharmoh@yahoo.fr		■			■			
Redouane	Arrach	DSS	r.arrach@gmail.com								■
Wafae	Badi	DMN	wafae.badi@gmail.com			■	■				
Riad	Balaghi	INRA	riad.balaghi@gmail.com		■	■			■	■	
Tarik	Benabdelouahab	INRA	bentas01@yahoo.fr		■			■			
abdelkader	benjebara	ABHL	benjebaray@yahoo.fr		■			■			
Adil	EL KHANDOUKI	ABHBC	elkhandouki.abhbc@gmail.com		■			■		■	
Fatima	ElGuelai	DMN	faty.elguelai@gmail.com			■	■				
Tarik	ElHairech	DMN	tarik.elhairech@gmail.com	■		■	■				
Sliman	ElHani	INRA	sliman_elhani@yahoo.fr						■	■	
Abdelhamid	Eljaouhari	ABHM	hamideljaouhari@gmail.com		■			■			
Khalid	ElRhaz	DMN	elrhazkhalid@gmail.com			■	■				
Rachid	Essail	DMN	ESSAIL.Rachid@marocmeteo.ma	■							
Aziz	Fadlaoui	INRA	azizfadlaoui@yahoo.fr								■
Yahya	Faress	DSS	faressyahya@gmail.com								■
Rachid	HADRIA	INRA	r.hadria@gmail.com		■			■		■	
Samira	ISMAILI	INRA	ismaili.samira@gmail.com		■			■	■	■	
Jalal	Jair	DMN	Jalal.jair@gmail.com	■							
Mohammed	Kamili	DSS	mohakamili@gmail.com								■
Rachid	MEJDOUL	DMN	rachidmejdoul@yahoo.fr		■	■	■	■			
Abderrafik	Moustafa	DSS	m.abderrafik@gmail.com								■
Soundouce	MOUTAOUAKKIL	DRPE	soundouce.moutaouakkil@gmail.com		■			■		■	
Mohamed	Oujida	DMN	m.oujadi@gmail.com							■	
Said	RACHIDI	ABHT	s.rachidi.r@gmail.com		■			■			
Youssef	Rahmouni	DMN	rayou72@yahoo.fr	■							
Amina	SAAIDI	DMN	saaidister@gmail.com		■	■	■	■			
Rachid	Sebbari	DMN	sebbari@gmail.com	■	■						
Debra	Turner	ICARDA	d.tuner@cgiar.org		■			■			

Annex 3: Survey results

Question 1: In the perspective of an autonomous utilization of MOSAICC for climate change studies in Morocco, what is your overall rating of the training? (1 = very bad, 10 = excellent)

	1	2	3	4	5	6	7	8	9	10	**Average**
Statistical downscaling									2	1	**9.33**
Interpolation								2	1		**8.33**
STREAM						1	1	2	2		**7.83**
WABAL									1		**9.00**
AQUACROP							1		2		**8.33**
CGE					1		1	1			**6.67**
All					1	1	3	5	8	1	**8.11**

Question 2: What would you suggest to improve the training programme on [name of the model]?

The items listed below were to evaluate. The possible answers were: More, less, as it was.

- Theoretical background on climate change and agriculture

	Less	As it was	More
Statistical downscaling		3	
Interpolation		2	1
STREAM	1	3	2
WABAL			1
AQUACROP	1	1	1
CGE		2	
Sum	2	11	5

- Theoretical background on MOSAICC

	Less	As it was	More
Statistical downscaling		2	1
Interpolation		2	1
STREAM		5	2
WABAL		1	
AQUACROP	1	1	1
CGE		2	1

Sum	1	13	6

- Theoretical background on the model

	Less	As it was	More
Statistical downscaling		2	1
Interpolation		1	2
STREAM		2	4
WABAL		1	
AQUACROP	1	1	1
CGE		1	2
Sum	1	8	10

- Practicals with the model (on the laptop)

	Less	As it was	More
Statistical downscaling		2	1
Interpolation			3
STREAM		1	5
WABAL			1
AQUACROP		1	2
CGE			3
Sum	0	4	15

- Practicals with MOSAICC interfaces

	Less	As it was	More
Statistical downscaling		3	
Interpolation		2	1
STREAM		3	3
WABAL			1
AQUACROP		1	2
CGE		1	2
Sum	0	10	9

- Manipulation of the data (input data preparation etc.)

Less	As it	More

	was		
Statistical downscaling		1	2
Interpolation		1	2
STREAM		2	4
WABAL			1
AQUACROP			3
CGE			3
Sum	0	4	15

- Overall length of the training (number of days)

	Less	As it was	More
Statistical downscaling		1	2
Interpolation		1	2
STREAM		4	2
WABAL			1
AQUACROP		1	2
CGE		3	
Sum	0	10	9

Question 3: Do you have any other comment on the content of the training? Topics covered, level of prerequesite, teaching style etc. (Open question)

	# of replies	Replies
Statistical downscaling	1	c'était très intéressant, et le formateur a été excellent
Interpolation	1	expliquer plus la théorie d'Aurlehy
STREAM	2	Baser les exercices pendant les formations sur des études de cas ; c'est à dire choisir un bassin pilote , acquérir toutes les données qui le concernent et travailler sur le système MOSAICC à travers tous ses modèles de A à Z. The training is very interesting except that it should be given more time to the part of model calibration.
WABAL	0	
AQUACROP	1	More focus must be on the process of the input data
CGE	2	training was too theoretical. lack paratique exercises No

Question 4: What is your overall rating on the relevance of [name of the model] to climate change impact studies in Morocco? (1 = the model is not appropriate, 10 = the model is very appropriate)

	1	2	3	4	5	6	7	8	9	10	**Average**
Statistical downscaling									2	1	**9.33**
Interpolation								1	2		**8.67**
STREAM						1	3	1	1		**7.33**
WABAL								1			**8.00**
AQUACROP					1		1	1			**6.67**
CGE					1	1	1				**6.00**
All					2	2	5	4	5	1	**7.58**

Question 5: According to you, what feature, characteristic or functionality would you suggest to develop to increase the relevance of the model to carry out climate change impact studies in Morocco? (Open question)

	# of replies	Replies
Statistical downscaling	1	input data upload in the downscaling portal
Interpolation	1	data upload and the structure of the Database
STREAM	4	Calibrate the model first for Moroccan context. La calibration manuelle et automatique For the visualization of simulation results at a point defined by the geographic coordinates the model does not give the possibilty to enter the XY coordinates automatically, and it is interesting to use the data of stations ABHs in place of those of the DMN For more accuracy. integration of real land use map of Morrocco in the model
WABAL	0	
AQUACROP	2	i^nput data regarding precipitations Simulating no-till system would be of great interest especially for mitigation options and its impact on CC
CGE	2	rework application interface to make application easily usable to work with version. I supose that the one we get is the simple one but some improvement by future could be better like impact on household's revenu by categories.

Question 6: What is your overall rating of the integration of the model within MOSAICC? (1 = very poor, 10 = excellent)

	1	2	3	4	5	6	7	8	9	10	**Average**
Statistical downscaling								1	1	1	**9.00**
Interpolation									1	2	**9.67**
STREAM					1		2	1	2		**7.50**
WABAL								1			**8.00**
AQUACROP								3			**8.00**

CGE					2	1					**7.33**
All				1		4	7	4	3		**8.16**

Question 7: What are the advantages? What are the inconvenients? (Open question)

	# of replies	Replies
Statistical downscaling	2	inconvénient: ne pas pouvoir travailler directement sur les scripts afin de pouvoir mieux étudier le cas du Maroc Advantages: 1-robust Analog approach to generate climate projection 2- Rich theoritical backgroung for predicor selection Inconvenients: 1- upload data in the portal is a black box process 2- processing is heavy and time consuming
Interpolation	2	Nous n'avons pas la main sur les programmes et les scripts pour pouvoir étudier (tester, modifier adapter) au cas du Maroc The major advantage is that aurelhy interpolation is now easy to use and its processing is available inconvenients: cross validation is not yet implemented
STREAM	3	Advantage: work at the the spatial level. Inconvenient: learn the preparing data required. l'intégration permet la connexion avec les autres modèles The advantage is that The Model is very simple to operate. -The disadvantage is that The Model is installed on a server and sometimes simulations require enough time.
WABAL	0	
AQUACROP	0	
CGE	1	the model is easy to understand and easy to run. So it's easy to upgrade. the inconvenient is that model is key on hand. hypothesis used must be more explained to users

Question 8: How relevant MOSAICC and [name of the model] are with respect to your regular work? (1 = not relevant, 10 = very relevant)

	1	2	3	4	5	6	7	8	9	10	**Average**
Statistical downscaling								1	2		**8.67**
Interpolation									3		**9.00**
STREAM			1		2		1	2			**6.00**
WABAL									1		**9.00**
AQUACROP							1	1	1		**8.00**
CGE					1			1		1	**7.67**
All			1		3		2	5	7	1	**7.63**

Question 9: To what scale MOSAICC and [name of the model] meet your personal interest? (1 = not in my area of interest, 10 = very much in my interest)

	1	2	3	4	5	6	7	8	9	10	**Average**
Statistical downscaling									1	2	**9.67**
Interpolation									2	1	**9.33**
STREAM					1	2	1	2			**6.67**
WABAL									1		**9.00**
AQUACROP					1			1		1	**7.67**
CGE						1		1		1	**8.00**
All					2	3	1	4	4	5	**8.05**

Question 10: Would you use MOSAICC or [name of the model] in activities other than the MOSAICC project? If yes, which ones? (Open question)

	# of replies	Replies
Statistical downscaling	2	oui, les scripts d'Aurelhy other impact studies
Interpolation	3	Oui, Aurehly no Agrometeorological Monitoring and yield forecast
STREAM	3	Yes. Research. oui, pour la simulations des débits Certainly in the future after a good mastery of the Model
WABAL	0	
AQUACROP	3	yes, especially STREAM. In the modelisation of the river basin's flow probably yes in yield estimation in Morocco Using AQUACROP for studing the CC on Crops yields
CGE	1	Yes not defined at this moment but the Tools have a wide range of use in agriculture economics

Annex 4: Logistics

Catering:

- Number of person.day: 85
- Unit cost: 329 MAD (40 USD)
- Total cost: 27,980 MAD (3,368 USD)

DSA (accommodation and transportation):

- Number of person.day: 9
- Unit cost: 2,064 MAD (248 USD)
- Total cost: 18,576 MAD (2,236 USD)

Annex 5: Bugs and suggestion for improvements

Bugs

Interpolation	Missing PCA maps in PCA experiment management – outputs map display (#1 to #4 and maybe others).
Interpolation	PET calculation: the time step switch is not changed according to the data temporal resolution
WABAL	Invert Excess and deficit in the column names in the outputs
WABAL	Display the year with NA instead of hiding it in the output when data is missing or the model produced no output
WABAL	Make sure the outputs are associated with the harvest year and displayed accordingly
WABAL	Winter crops can't be simulated from the last year of the climate time series. In MOSAICC there are results produced with climate data from the last year repeated for the second year
AQUACROP	AQUACROP stops when an experiment has some gaps in the climate data (maybe a mismatch in coding nodata between MOSAICC and AQUACROP). Eg exp 2876. Harmonize nodata coding may be needed
AQUACROP	A number of experiment on MOSAICC produced no output: 2848, 2861, 2865, 2866, 2877, 2882. Maybe linked to user rights.
STREAM	Automatic calibration: testing and bug fixing needed
STREAM	One month is missing (the first one of the time series) in the detailed result for the outlets
STREAM	The outlet coordinates in DD (lon lat) are missing in the result summary of STREAM experiments and in the detailed result for the outlets
STREAM	The utilization of a soil water holding capacity map is not operational
CGE	In the CGE data template, some columns appear at times to be missing. For instance compare the template “CGE FD 0607 Agrozone” and “CGE FD 0607 Agrozone test 3”. Both are generated with the same model (CGE FD 0607). In the first one WHT, OTH and AGR are missing.
CGE	Output 1st year and last year are not for use (model initialization) and can be taken off in output display

Improvements (interface/shell only)

Interpolation	Coherence check when selecting another preliminary analysis for PET calculation in interpolation
WABAL	Allow the user to work with a fixed WHC (value defined with the user). Soil map and intersection with administrative boundaries are skipped, simulation run direclty on the latter.
WABAL/ AQUACROP	*Allow display of results on maps (administrative polygons with values of a selected output variable)*
WABAL/ AQUACROP	Distinguish AQUACROP and WABAL crop parameter files
WABAL/ AQUACROP	Enable the use of masks
AQUACROP	*Make possible to display climatic stations and provinces on a same map, with their names*
AQUACROP	Save as button in the crop library to save modifications under different names (also WABAL)
AQUACROP	Direct download of AQUACROP outputs to excel, as for WABAL
AQUACROP	Add a check on the initial dekad for the simulation (range: 0-36)
AQUACROP	GDD crop files are yet to be tested in MOSAICC (adapt crop files accoringly)
AQUACROP	Add save as button in crop files, force save as if the file being modified has been already used
PET	Use the term Eto instead of PET (harmonization with AQUACROP and FAO standards)
STREAM	*Upload of hydraulic stations shapefile, display and association with the streamlines, display observation points in stream simulation window*
STREAM	Download of the discharge time series to Excel
STREAM	*Display all the input files (especially the maps) on click in the experiment page*
STREAM	Check the overlap between climate grids and river basins by overlay (climate coverage must be larger)
STREAM	Allow the user to choose the units: m3 per second or per time step (10D, month)
CGE	Allow the user to generate a template without selecting any administrative units. The template would only contain the columns for the aggregated units from the model and would not be linked to anything in the database but it could be useful for testing.
CGE	Allow the user to use a mask (for cultivated areas or for anything else) to refine the weighted average in the simulations.
Interface	Decrease institution logo size, add focal point contacts and MOSAICC_MOROCCO logo
Interface	Filter for data management

Improvements (require some development on model side)

Interpolation	AURELHY and kriging: statistics on the variance (prelim, interpolation)
Interpolation	Implementation of cross-validation utilities
Interpolation	Prelim: distinguish the procedure for kriging and aurelhy
WABAL	Add ETP and rainfall by phase in the outputs
WABAL	Add a radiation calculation module using hargreaves, reading development phases parameters from WABAL
AQUACROP	Integrate AQUACROP version 4.1
AQUACROP	AQUACROP plug-in version does not provide feedback on errors and crashes, e.g. due to wrong parameter value or missing data. A log file with error messages would be useful.
AQUACROP	Include tools for statistical processing of yield observations and create yield functions (also WABAL)
PET	Include two options: Hargreaves and Penman Monteith
PET	Allow tuning of all parameters for each method with default values
STREAM	Inter-basin transfer of water (to be discussed if of any relevance)
STREAM	Utilization of the CROPF parameter to calibrate the evapotranspiration when PET grids are used
STREAM	Additional outputs are needed to understand the result more clearly and improve the simulations more effectively: statistics on the precipitations, surface of the basin etc.
CGE	*Allow the user to visualize and download the yield data simulated from other models in their data management page*

Display functions: harmonization

Table

Points

Grids — Display of individual maps in gridded climate data (data management) and Download enabled for anyone if shared

Polygons

Additional functionalities:

Aggregation

Extraction

Info on click

Overlay

Upload

Table

Points

Grids

Polygons