



INTERNATIONAL ADVANCED SCHOOL IN AGRICULTURAL  
METEOROLOGY

SECOND EDITION

Bologna

5-9 September 2022



# AGRICULTURAL METEOROLOGY

FOR SUSTAINABLE  
WATER MANAGEMENT  
IN AGROECOSYSTEMS

## COURSE REPORT



Organized by AIAM  
<http://www.agrometeorologia.it/en/>



National Research  
Council of Italy  
Institute of BioEconomy

In collaboration with WMO-RTC  
<https://climateservices.it/rtc-italy/>

*The report was prepared by:*  
Marina Baldi, CNR-IBE and WMO-RTC, Italy  
*with the contribution of:*  
Marco Simonetti, CNR-IBE, Italy

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**Table of Contents**

1. Background .....	4
2. Objectives and Expected Learning Outcomes.....	4
3. Training approach .....	5
4. Delivery of the course .....	5
4.1 Participants .....	5
4.2 Trainers .....	6
4.3 Practical Sessions and field visit .....	7
5 Course Evaluation .....	8
6. Certificate of attendance.....	10
8. Conclusions and recommendations.....	11
Appendix 1. List of Participants .....	13
Appendix 2. Programme .....	14
Appendix 3. Responses to question [5]: Do you think the acquired knowledge will help you during the everyday job activities?.....	17
Appendix 4, Responses to question [29]: If you have any suggestion to improve the program for future training activities, please, write it here. ....	18

**List of figures**

Figure 1, Group photo.....	5
Figure 2, Opening Session .....	6
Figure 3, During the sessions .....	7
Figure 4, Visit to CER - Acqua Campus .....	8
Figure 5, Perception of participants of the course (left) and course meeting the objectives (right) .....	9
Figure 6, Quality of training material.....	10
Figure 7, Certificate of attendance - Template.....	10
Figure 8, Group photo with Certificate!.....	11



## 1. Background

Since its foundation in 1997, AIAM (<http://www.agrometeorologia.it>) has been involved in enhancing and promoting agrometeorological research through conferences, seminars, and training courses. It also acts as a link between the services and research activities. This connection has the result of promoting researches on relevant agrometeorological themes, which are internationally disseminated through the Italian Journal of Agrometeorology.

As part of its mission, AIAM is proud to launch the Second Edition of the International Advanced School in Agricultural Meteorology, aiming to build up knowledge about the use of integrated tools and advanced technologies for a sustainable management of agroecosystems.

The 2022 edition, co-organized with WMO-RTC (<https://training.climateservices.it/>) and with the technical cooperation of FAO (<http://www.fao.org/home/en/>), is focused on the role of Agricultural Meteorology for a Climate Smart Agriculture (CSA), and wants to provide young researchers and professionals with high-level innovative knowledge and skills on the most advanced technologies for the agrometeorological analysis and monitoring applied to a sustainable agricultural development under climate change

A Scientific Committee was in charge to design and plan the course, evaluate applications, and appoint the Trainers. The Committee was composed by: Filiberto Altobelli (CREA-PB), Anna Dalla Marta (University of Florence-DAGRI), Federica Rossi (CNR-IBE), Marina Baldi (WMO-RTC, CNR-IBE), Federica Matteoli (FAO).

The colleagues Guido Righini (CNR-IC) and Marco Simonetti (CNR-IBE) ensured the management of the Moodle platform used by the WMO-RTC, while Giovanni Maria Poggi from Bologna University provided technical support in the classroom during online lectures and facilitated access where internet connection issues arose.

## 2. Objectives and Expected Learning Outcomes

The course was designed with the aim to facilitate participants to increase their knowledge of novel scientific results, and advanced technologies for the agrometeorological analysis and monitoring applied to agricultural water management under present and future climates. The school included theoretical activity and practical/demonstration sessions to allow the direct application of theory through the use of advanced tools. The active participation of the trainees contributed to facilitate the realization of interdisciplinary networking among experts and attendees.

Expected attendees to the course were professionals from National Agro-Meteorological Services and other technical Services involved in climate change adaptation in agriculture, but was also open to young researchers, scientists and PhD students, engaged and interested in application of advanced agrometeorological methodologies and techniques.

The course has been realized in presence, with only some lectures from remote, hosted by the University of Bologna, from the **5<sup>st</sup> to the 9<sup>th</sup> of September 2022**

The full programme of the school was very dense as it is reported in Appendix 1. Following is the list of the main topics covered by the school:



- Relations between hydrological cycle, agriculture, and climate change
- Water harvesting, research, and implementation
- Modelling of crop yield response to water under conditions in which water is a key limiting factor in crop production – the AquaCrop system
- Satellite products and tools for sustainable water management
- Field visit to Acqua Campus (CER) and Decision support systems

### 3. Training approach

The training course was implemented in presence, but all the educational material has been stored on the platform Moodle used as a learning management system. Moreover, the platform was used to foster discussion and included a forum on the topics covered by the Lecturers.

For this edition of the school, the organizers decided not to register all the lectures, since the school was in presence, apart from some classes offered online, synchronous, using the Microsoft “Teams” tool and registrations stored by the University, with the intention to be shared with the WMO-RTC.

### 4. Delivery of the course

#### 4.1 Participants

The number of applications received was very high for this course: 119, from 54 Countries. The Applicants were all well motivated to take the course and the selection that was carried out by the members of the scientific committee was very complex. The Committee evaluated, for each candidate, the application, the motivation, and profile, and selected twenty-eight people coming from 14 Countries which enrolled in the course, as listed in the Appendix 2. Two of them, unfortunately were not able to participate, because their VISA was not delivered on time



*Figure 1, Group photo*



A registration fee of 400€ has been charged to the selected participants, including access to the School, Course material, Coffee breaks, Visit to Acqua Campus – CER, however, a tuition fee waiver was offered to some applicants in order to favour participation from Low Income Countries.

## 4.2 Trainers

The school opening session included welcome address from the President of AIAM, Prof Francesca Ventura, the Director of the hosting Department, Prof Rosalba Lanciotti, the Director of WMO-RTC in Italy, Dr Marina Baldi. The school was then declared officially opened by the B. Gen Luca Baione, Permanent Representative of Italy with WMO.



*Figure 2, Opening Session*

We involved 20 trainers during the 5 days of the school, all world-class experts from University of Florence (DAGRI), University of Milan, Council for Agricultural Research and Economics (CREA), Sicily Region, National Research Council of Italy, and International Agencies: Food and Agriculture Organization of United Nations - FAO, CGIAR / Alliance of Bioversity International and CIAT, CGIAR/IWMI.





Figure 3, During the sessions

### 4.3 Practical Sessions and field visit

Some hands-on sessions were delivered by the Trainers, and students were able to follow step-by-step the demonstration.

The practice in all disciplines is crucial to better understand the theory and to acquire knowledge on how the theory can be implemented in specific services, however the limited amount of time available can represent a big obstacle.



The presence of the trainer in the class was very well appreciated, and amiable and useful discussions were undertaken on the topic addressed during and after the lectures.

More practical sessions, and group work might be planned in future editions of the school, maybe cutting the number of topics covered.

A full day visit to the Acqua Campus facility took place on the Wednesday. It was a good time to have a break from the theory and in class sessions. The visit included a general introduction to the facility, and some talks on

- Flux measurements eddy covariance
- Satellite and sensors use for in-farm irrigation
- Use of big data for DSS

The second part was a field demonstration. The trainers were experts from CER, the Consortium operating the Campus, and from the Institute of BioEconomy of CNR.



*Figure 4, Visit to CER - Acqua Campus*

## 5 Course Evaluation

As a final task to complete the course the participants were asked to respond to the evaluation questionnaire on the Moodle platform. Not all of them filled the questionnaire, but only 21 over 26. The general participants' perception of the course is positive with 80% evaluating the initiative very



successful or excellent, and for about 65% of the participants had the right duration (1 week), and 22% a little short. In terms of meeting the objectives, about 39% of the participants evaluated the course to fully meet them, and 35% very well, while 17% evaluated the course to nearly meet the objectives.



Figure 5, Perception of participants of the course (left) and course meeting the objectives (right)

Concerning the problems faced during the course the main issue was related to their job activities during the school: they had to suspend their everyday duties (35%), or had to manage their duties while attending the course (43%).

Most of the participants gave the perception to have good ability to use the internet at a level between intermediate and expert, and only few problems occurred in the first access to the Moodle platform and to the webinars.

Despite the practical sessions, some of the participants (36%) considered the course too theoretical and suggest more practical parts to be included in the future. This is a comment often received during classroom courses, and even more true when the school is fully online, and new solutions must be considered in future both for in presence and online courses. One possibility is to cover a fewer number of topics, and, for the online, to adopt other tools.

Concerning the topics covered and the knowledge acquired during the course, all the respondents believe the acquired knowledge will help during their everyday job activities. The appreciation was also well described by the answers to the specific question [5] reported in the Appendix 3.

Participants are aware the course offered the opportunity to know tools and methods to be applied in their daily job, and they express the intention to contact the trainers in the future when more questions will arise on the use of the tools. The topics that stimulated most interest were:

- Modelling of crop yield response to water – The AquaCrop system,
- Relations between hydrological cycle, agriculture, and climate change
- Copernicus and ESA, contribution to hydrology and water management

The field visit to CER-Acqua Campus was very well appreciated by almost 80%, despite the very hot and long day (weather conditions in Bologna during the school were very hot).

Participants evaluated positively the Trainers in terms of preparation, their ability to motivate/stimulate the class, and to respond and interact with learners. More than 80% of the trainees felt that the trainers were able to stimulate/motivate interest in the subject presented, and available and comprehensive when asked for clarification. They only suggest to invite all trainers to participate in person, and minimize the lectures from remote.

The material distributed by the trainers was considered comprehensive for the theoretical lectures, and the practical sessions for 90% of respondents, but the quality of training materials could be improved distributing additional case studies and exercises. Additional support, not better specified, after the training could improve the training itself.

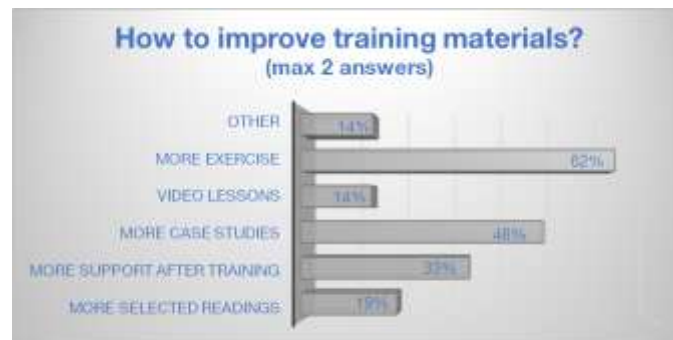


Figure 6, Quality of training material

## 6. Certificate of attendance

This course included the release of a certificate of attendance.

The picture shows a sample certificate with the logo of the contributors to the realization of the Course: AIAM, and WMO-RTC, and signed by the respective representatives:



Figure 7, Certificate of attendance - Template

As for the previous edition of the school, no final test was planned, and the certificate of participation was issued to participants attending to all the classroom sessions.



*Figure 8, Group photo with Certificate!*

## 8. Conclusions and recommendations

The survey distributed via the Moodle allowed to collect participants' opinions and impressions on the course. The surveys' questions were designed in order to get information on the efficacy of the course, on the tools used and the subject matters, as well as on the duration and structure of the course. The purpose of the survey was also to get suggestions for future courses of distance learning.

We believe that participants were generally satisfied by the course. Also, from our point of view, it was a positive experience and surely a valuable experience for the future.

Some consideration not in order of importance, reflecting the comments on possible improvements for future course (see Appendix 4), can be summarized as follows:

- The topic: Agricultural Meteorology and Water Resources is a very wide topic and can be declined in different ways and presented at different levels of complexity. Some of the major aspects have been touched during the school, by international experts. A school one week long is probably not the better approach to deliver it, and more time is needed to explore these topics in more detail. The participants' suggestions for future training initiatives underline the desire for more in-depth study of some topics, but also the need for more practice in small working groups.
- Engagement: for the classroom course a selection process was carried out, and this selection made it possible to have a class with a fairly homogeneous background, and the differences due to different experiences in different countries can be on the one hand a difficulty, because the interests are different, but also a mutual enrichment. All the students were strongly motivated to participate and this resulted also in starting new relationships, sharing knowledge and experience, setting up networking among participants and with trainers.
- Technical issues: enlarge the practical part is the leit motiv common to most of the participants. They also suggested some ideas about practical exercise like assign a test to be completed in small groups at the end of sessions; organize a wrap-up session at least for some of them; leave more time for the discussion in a plenary session.



- Human interaction: Another suggestion is related to communication among participants and with trainers. Having participants and trainers at hand in a classroom, to discuss and interact is still considered an added value that can positively impact on a course. Few solutions to be considered for next editions of the school are:
  - For next events, avoid as much as possible lectures from remote and encourage all the instructors to be present physically, although this requires an added cost to the management to bring them to the venue.
  - Offer the possibility to lodge in a single place (as the WMO-RTC did for past courses in Florence)
  - Organize one or two “social events”



## Appendix 1. List of Participants

<b>Country</b>	<b>Nr of Trainees</b>
Argentina	1
Belgium	1
Botswana	1
Czech Republic	1
Germany	2
Indonesia	1
Iran	1
Ireland	1
Italy	8
Kazakhstan	1
Kenya	2
Nigeria	1
Philippines	2
Switzerland	1
UK	1
USA	1



## Appendix 2. Programme

### 5 September Monday

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09:00 —10:00 Opening Session

Francesca Ventura, AIAM

Rosalba Lanciotti, Director DISTAL - Univ Bologna

Federica Matteoli, FAO

Marina Baldi, WMO-RTC

B.Gen. Luca Baione, WMO PR - Italy

10:00 —12:40 Keynote

Climate change, Agriculture and water: the Sicilian experience - *Antonino Drago, Department of Agriculture of Sicily Region*

14:00 —17:00 Session 1

Relations between hydrological cycle, agriculture and climate change - *Marco Acutis, University of Milan - DiSAA*

*Short comfort break*

Climate change and the hydrological cycle. Effects on agriculture – *Petra Schmitter, CGIAR/IWMI*

### 6 September Tuesday

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09:00 —12:30 Session 2

Copernicus and ESA contributions to hydrology and water management – *Espen Volden, ESA*

*Short comfort break*

High-Resolution Earth Observation for Understanding the Water Cycle: Recent Advances and Future Opportunities – *Luca Brocca, CNR-IRPI*

*Coffee break*

Runoff and river discharge – *Angelica Tarpanelli and Luca Brocca, CNR IRPI*

*Short Comfort break*

High-resolution evapotranspiration – *Radoslaw Guzinski, DHI GRAS*



14:00 —17:00 Session 2 *cont.*

Using satellite data for crop water management: from the farm to the district scale. The operative approach of irrisat® - *Carlo De Michele, ARIESPACE*

*Short Comfort break*

Sharing experiences from Europe to Australia: the H2020 Coala project - *Carlo De Michele, ARIESPACE*

## 7 September Wednesday

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*All day* Session 3

Field visit to Acqua Campus (CER), and Decision support systems (DSSs) <https://consorzioцер.it/it/>

## 8 September Thursday

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*All day* Session 4

Modelling of crop yield response to water under conditions in which water is a key limiting factor in crop production – the AquaCrop system (FAO) - *Dirk Raes, KU Leuven University*

## 9 September Friday

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09:00 —10:40 Session 5

Water harvesting, research, and implementation – *Elena Bresci, University of Florence – DAGRI*

11:00 —12:40 Session 6

Use of marginal quality water for agriculture, *CGIAR/IWMI*

Introduction, *Javier Mateo-Sagasta*

Use of marginal quality water in agriculture: opportunities and risks for climate change mitigation, *Pay Drechsel*

Regulations and policy on water reuse in MENA, *Marie Helene Nassif*

Waterborne AMR: development, spread and risks along the food chain, *Mahesh Jampani*

Q/A from the public, *Moderated by Marie Helene Nassif*

Closing and takeaways, *Javier Mateo-Sagasta*



14:00 —15:00 Session 7

Collaborative innovation in agrometeorology: tools and applications to improve crop production sustainability (Precision farming) – *Gianpiero Menza, CGIAR/Alliance of Bioversity International and CIAT*

15:00 —16:00 Session 8

The potential role of neglected species in water scarce production systems – *Carlo Fadda, CGIAR/Alliance of Bioversity International and CIAT*

*Wrap-up Session and closing remarks*





### Appendix 3. Responses to question [5]: Do you think the acquired knowledge will help you during the everyday job activities?

I will apply AquaCrop to teaching and research I will also design better projects on biodiversity and climate change

AquaCrop is a suitable tool that I will be incorporating into my integrated assessment modelling exercises to study irrigation as an adaptation strategy.

My PhD work is related to water management and crop water use. Thus, this advanced school is relevant in expanding my knowledge about my research project.

The content and experts was of very high level. Perhaps some concepts were not entirely new to me but applying the same tools in different contexts and situations is really inspiring. I believe that re-inventing the wheel is not that fruitful but thinking of new ways of using is much more enriching.

I have learned about current practices for water requirement estimation by crops and will be able to use them whenever I am involved in a decision about irrigation.

The course was well conceived to provide participants with inspirational, tangible and concrete examples of how to enhance water management sustainability in agro-ecosystems. The information will provide me ideas and approaches to solve development challenges. I will use the information for the development of project proposals on climate information services. I will also use tools such as Aquacrop for technical assistance purposes

Insights on agrometeorology enhanced my knowledge in the field and will enhance my working climate risk management in Eastern Africa, particularly in the agriculture and food security sector where I coordinate

new insight on water harvesting, irrigation, as well as the discussion between participants is very well beneficial

The sessions helped increase my knowledge on theory on agromet analysis in its many dimensions and also improved my understanding of the application of theory and scientific studies in real life scenarios and projects. These are valuable for my job in formulating development projects.

During this training, I succeeded to improve my knowledge on sustainable water management practices under the climate change context, and explore (or develop) many ideas of future research project that could be conducted starting from tomorrow.

Correct water management through decision support systems and proper assessment of crop water requirements are necessary tools for those working in agriculture and research. It gave me an overview of different analysis and further tool to improve my work and knowledge

I manage to understand better the Hydrological cycle of Agroecosystem and learn new way to estimate reference ET and actual ET to compare with the traditional approach. Now I can define more accurate irrigation schedule. I had insight on the AquaCrop Model which will be useful for my thesis work.

I will use the approaches presented during the School and compare the results

The knowledge in agronomy and different ways to use remote sensing data for precision agriculture will help me a lot as that's my area of focus in my work.

The course content was relevant to my daily needs at work



Appendix 4, Responses to question [29]: If you have any suggestion to improve the program for future training activities, please, write it here.

More coordination in logistics.
Since the course participants are from different parts of the world, I think a socio-cultural night would be a meaningful experience. I believe that lunchtime is an excellent opportunity to engage with co-participants. Thus, setting-up lunch in one area for all the participants would allow for more interaction or discussion.
Maybe more activities in which the students can interactively be more involved would improve the course even more. Students were very actively asking after the talks ... but maybe some activities involving the students would be good after each day of class. For example, at the end of each day some time can be assigned for either some practical activity in which students (individually or in groups) have to apply some of the learned tools to their day to day activities... or a wrap up short session in which students can discuss about take home messages from the daily presentations.
<ul style="list-style-type: none"> <li>- include participation and presentation of private business to get a more practical perspective of the use of research findings.</li> <li>- provide more case studies about uptake/dissemination of research findings in developing countries</li> <li>- check presentations of speakers in advance to avoid duplication and redundancy of contents</li> <li>- reduce length of some presentations to promote more interactions by allocating time for a 2 hour set of discussions within the group of participants.</li> </ul>
<ol style="list-style-type: none"> <li>1. Tailor case studies to cover all regions, for instance, have some contexts for Africa</li> <li>2. If it is fully physical, encourage all the instructors to be present physically</li> </ol>
Some small group exercises may be helpful to have a semi-structured discussion among participants. AquaCrop was also very interesting and it may merit a hands-on session where students can investigate their own cases. On the administrative organization, it might have helped many if lunch were served even for a small additional fee.
Add more days to the training, maybe two weeks could be a good duration to more exploring more knowledge
I would add a day in the course were participants can show their own research or situations in their own countries to create a more and strong network and involvement
Maybe dedicating some afternoon to some workshop activities can be a way to avoid
The field visit was an excellent experience for me. But the experience is not relevant to the context of small-scale agriculture in developing countries. In my opinion, it would be great if the field additional field visit that fit the context of small-scale agriculture is added to the course.
I think it would be ideal to house or give the students an alternative to lodge in a single place to make facilitation of other things easier.

