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MED-GOLD

Turning climate-related information into added value for traditional **MED**iterranean **G**rape, **OL**ive and **D**urum wheat food systems

D 6.5.

Compilation of Publications Abstracts no. 1

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Disclaimer

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EXECUTIVE SUMMARY

This deliverable compiles 26 abstracts submitted by Med-Gold partners between April 2018 and September 2019.

The abstracts covered topics of interest for the targeted sectors (climate, grapes/wine, olives/olive oil, agriculture in general), as well as for the engagement with end-users of climate information and services.

With this deliverable, the project has contributed to the achievement of the following objectives (DOA, PartB Table1.1):

No.	Objective	Yes
1	To co-design, co-develop, test, and assess the added value of proof-of-concept climate services for olive, grape, and durum wheat	
2	To refine, validate, and upscale the three pilot services with the wider European and global user communities for olive, grape, and durum wheat	
3	To ensure replicability of MED-GOLD climate services in other crops/climates (e.g., coffee) and to establish links to policy making globally	
4	To implement a comprehensive communication and commercialization plan for MED-GOLD climate services to enhance market uptake	
5	To build better informed and connected end-user communities for the global olive oil, wine, and pasta food systems and related policy making	X

1. INTRODUCTION

1.1. PURPOSE

This deliverable compiles 26 abstracts submitted by Med-Gold partners between April 2018 and September 2019.

The abstracts covered topics of interest for the targeted sectors (climate, grapes/wine, olives/olive oil, agriculture in general), as well as for the engagement with end-users of climate information and services.

1.2. DEFINITIONS AND ACRONYMS

1.2.1.ACRONYMS

Acronyms used in this document and needing a definition are included in the following table:

Table 1-1 Acronyms

Acronym	Definition
AEC	Spanish Association of Climatology
AFTA	Association for Temperate Agroforestry
A_n	Daily Net Photosynthesis
BSC	Barcelona Supercomputing Center
COP	Convention on Climate Change
ECCA	European Climate Change Adaptation
ENEA	Agenzia Nazionale per le Nuove tecnologie, l'Energia e lo Sviluppo Economico Sostenibile
ENSO	El Nino-Southern Oscillation
EMS	European Meteorological Society
ETCCDI	Expert Team on Climate Change Detection and Indices
EURO-CORDEX	Coordinated Regional Climate Downscaling Experiment
IMSC	International Meeting on Statistical Climatology
JRC	Joint Research Centre – European Commission
MED-GOLD	Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems
MERRA	Modern-Era Restrospective Analysis for Research and Applications
NOA	National Observatory of Athens
RCM	Reliability Centred Maintenance
RCP	Representative Concentration Pathway
RUE	Radiation Use Efficiency
SOGRAPE	SOGRAPE Vinhos S.A
SPEI	SPEI Standardized Potential Evapotranspiration Index
SPI	Standardized Potential Index)
UNIVLEEDS	UNIVERSITY OF LEEDS
VISCA	Vineyards' Integrated Smart Climate Application

2. REFERENCES

2.1. REFERENCE DOCUMENTS

The following documents amplify or clarify its contents. Reference documents are referenced in this document in the form [RD.x]:

Table 2-1 Reference Documents

Ref.	Title	Code	Version	Date
[RD.1]	Dell'Aquila A., Ponti L., Calmanti S., and De Felice M., 2018. "Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems: the MED-GOLD project". *EMS Annual Meeting Abstracts, Vol. 15* : Abstract EMS2018-183	-	-	-
[RD.2]	Dell'Aquila A., Ponti L.,Calmanti S., and De Felice M., 2018. "Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems: the MED-GOLD project". *Geophysical Research Abstracts, Vol. 20* : Abstract EGU2018-6430	-	-	-
[RD.3]	Ponti L., Gutierrez A.P., Cure J.R., Rodríguez D., Caboni F., Boggia A., and Neteler M., 2019. "Bioeconomic analogies as a unifying paradigm for modeling agricultural systems under global change in the context of geographic information systems". *Geophysical Research Abstracts, Vol. 21* : Abstract EGU2019-13677	-	-	-
[RD.4]	Dell'Aquila A., Ponti L., Calmanti S., De Felice M., S"anderson M., Giannakopoulos C., Gonzalez-Reviriego N., Toreti A., and Bruno Soares M., 2018. "Voices from the field: climate prediction requirements in the agricultural sector from the MED-GOLD initiative". *EMS Annual Meeting Abstracts, Vol. 15* : Abstract EMS2018-180.	-	-	-
[RD.5]	Ponti L., Gutierrez A.P., Boggia A., and Neteler M., 2018. "Analysis of grape production in the face of climate change". *Climate,* 6: 20. doi:10.3390/cli6020020	-	-	-
[RD.6]	Graça A. and The MEDGOLD Consortium. 2018. "The MEDGOLD project: advanced user-centric climate services for higher resilience and profitability in the grape and wine sectors". *Proceedings of the 41st World Congress of Vine and Wine* (Ed. Aurand, J.-M.): Abstract 2018-1741	-	-	-
[RD.7]	Marta Teixeira, Natacha Fontes, Cátia Costa, and António Graça. 2019. "Resiliência e adaptação: uso de informação histórica para prever a qualidade de uvas e vinhos numa determinada propriedade da região demarcada do Douro", 11º Simpósio de vitivinicultura do Alentejo, May, Évora, Portugal	-	-	-
[RD.8]	Konstantinos V. Varotsos, Christos Giannakopoulos, Myrto Gratsea, Vasilis Tenentes, and the MED-GOLD TEAM. 2019. "Mediterranean agro-climate projections and the case of olives inAndalucia: results from the MED-GOLD project." *EMS Annual Meeting Abstracts*, Vol. 16: Abstract EMS2019-609	-	-	-
[RD.9]	C Giannakopoulos, KV Varotsos, A Karali, and M Gratsea. 2018. "Evaluation of various bias correction methods for Mediterranean agro-climate projections: first results from the MED-GOLD project". *MEDCLIVAR 2018 Book of abstracts (Eds. J. Lukovic, P. Lionello)*, page 121	-	-	-

Ref.	Title	Code	Version	Date
[RD.10]	Calmanti S., Dell'Aquila A., Ponti L., Monotti C., Bruno Soares M., De Felice M., Graça A., Fontes N., Teixeira M., López-Nevado J., Marcos-Matamoro R., Terrado M., Soret A., Pasqui M., Sanderson M., and MED-GOLD Team, 2019. "Development of climate services from the user perspective: the MED-GOLD experience". *EMS Annual Meeting Abstracts, Vol. 16*: Abstract EMS2019-526	-	-	-
[RD.11]	Mihailescu E., Bruno Soares M., Lopez-Nevado J., Graca A., Fontes N., Teixeira M., Monotti C., Terrado M., Gonzalez-Reviriego N., Marcos R., Arjona R., Dell'Aquila A., Ponti L., Calmanti S., Sanderson M.G., Giannakopoulos C., Zamora-Rojas E., Maglavera S., Toreti A., 2019. "Co-development of tailored climate services for adding value to olives, grapes and durum wheat production systems". *European Climate Change Adaptation conference book* : Abstract: SS046-OC273	-	-	-
[RD.12]	Jaroslav Mysiak, Stefano Bagli, Elisa Delpiazzo, Ghislain Dubois, Isadora Jimenez, Adriaan Perrels, **Marta Bruno Soares,** Alberto Troccoli, Giulio Zuccaro, and Filip Lefebre. 2019. "Unfolding the potential of climate services for climate change adaptation", *European Climate Change Adaptation conference book*: Abstract: SP004	-	-	-
[RD.13]	Elena Mihailescu. 2018 and the MED-GOLD team "The MED-GOLD Project : "Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems". *Agrisource European workshop: Agriculture & Climate Change: How can we encourage collaborations? How can we involve territorial players, farmers, businesses?* Agricsource workshop book of contributions 9Ed. Marc Nougier) : page 8	-	-	-

3. DOCUMENT CONTENT

The submitted abstracts are presented in chronological order, per sector, in Table 3-1.

The abstracts were grouped per sector based on their main theme.

Table 3-1. Abstract titles, type of event/publication, year and location, name of partners, and sectors

No	Title	Type of event/ publication	Year/ Location	Submitting partner	Sector
1	Multi-year prediction of European summer drought conditions for the agricultural sector	Conference	June 2019/ Touluse, France	BSC	Climate
2	Multi-year prediction of European summer drought conditions for the agricultural sector	Journal article	2019	BSC	Climate
3	How climate services can help key sectors of society	Side event	Dec. 2018/ Katowice, Poland	BSC	Climate
4	Climate services for the Mediterranean food security	Conference	Oct. 2018/ Cartagena,Spain	BSC	Climate
5	Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems: the MED-GOLD project	Conference	Sept. 2018/ Budapest, Hungary	ENEA	Climate
6	Assessing the added-value of near-term decadal climate information for decision making in the agricultural sector	Conference	Sept. 2018/ Boulder,USA	BSC	Climate
7	Helping to ensure the future of the Mediterranean diet with climate services	Conference	May 2018/ Barcelona , Spain	BSC	Climate
8	Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems: the MED-GOLD project.	Conference	April 2018/ Vienna, Austria	ENEA	Climate
9	Agroforestry models overestimate photosynthesis of understory crops	Conference	June 2019/ Corvallis, USA	ENEA	Agriculture in general
10	Do agroforestry models overestimate photosynthesis and RUE of understory crops?	Conference	May 2019/ Montpellier, France	ENEA	Agriculture in general
11	Bioeconomic analogies as a unifying paradigm for modeling agricultural systems under global change in the context of geographic information systems	Conference	Apr. 2019/ Vienna, Austria	ENEA	Agriculture in general
12	Modeling light below tree canopies overestimates A_n and RUE in understory crops by averaging light in space and time	Journal article	2019	ENEA	Agriculture in general
13	Voices from the field: climate prediction requirements in the agricultural sector from the MED-GOLD initiative	Conference	Sept. 2018/ Budapest, Hungary	ENEA	Agriculture in general
14	Climate services in the wine industry: promises from project MED-GOLD	Conference	May 2019/ Athens, Greece	SOGRAPE	Grapes/wine
15	Analysis of grape production in the face of climate change	Journal article	2018	ENEA	Grapes/wine
16	The MEDGOLD project: advanced user-centric climate services for higher resilience and profitability in the grape and wine sectors	Conference	Nov. 2018/ Punta del Este, Uruguay	SOGRAPE	Grapes/wine
17	Resiliência e adaptação: uso de informação histórica para prever a qualidade de uvas e vinhos numa determinada propriedade da região demarcada do Douro	Conference	May 2019/ Évora, Portugal	SOGRAPE	Grapes/wine

No	Title	Type of event/ publication	Year/ Location	Submitting partner	Sector
18	Mediterranean agro-climate projections and the case of olives in Andalucia: results from the MED-GOLD project	Conference	Sept. 2019/ Copenhagen, Denmark	NOA	Olives/olive oil
19	Climate change impacts in the Mediterranean food system: Results of the MED-GOLD project for the case of olive oils in Andalusia	Conference	June 2019/ Crete, Greece	NOA	Olives/olive oil
20	Evaluation of various bias correction methods for Mediterranean agro-climate projections: first results from the MED-GOLD project	Conference	Sept. 2018/ Belgrade, Serbia	NOA	Olives/olive oil
21	Development of climate services from the user perspective: the MED-GOLD experience	Conference	Sept. 2019/ Copenhagen, Denmark	ENEA	User engagement
22	Il concetto di valore delle previsioni climatiche dalla prospettiva dell'utente: l'esperienza del progetto MED GOLD	Conference	June 2019/ Bologna, Italy	ENEA	User engagement
23	Co-development of tailored climate services for adding value to olives, grapes and durum wheat production systems	Conference	May 2019/ Lisbon, Portugal	UNIVLEEDS	User engagement
24	Unfolding the potential of climate services for climate change adaptation	Conference	May 2019/ Lisbon, Portugal	UNIVLEEDS	User engagement
25	The MED-GOLD Project : Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems	Workshop	Dec. 2018/ Paris,France	UNIVLEEDS	User engagement
26	Communicating, engaging and clustering: the MED-GOLD approach to provide climate services for Mediterranean grape, olive and durum wheat	Festival	Oct. 2018/ Belgrade,Serbia	BSC	User engagement

3.1. ABSTRACTS SUBMITTED FOR CLIMATE SECTOR

To date, there were 8 abstracts submitted for the Climate sector, by ENEA, BSC. And UNVILEEDS (Table 3-1).

The main themes dealt with included the general presentation of the tools under development within MED-GOLD project, types of climate services (such as near-term decadal climate prediction), and the availability of climate information.

1. **B. Solaraju-Murali, N. González-Reviriego, L.P. Caron, A. Soret, and F.J. Doblas-Reyes (BSC). 2019. "Multi-year prediction of European summer drought conditions for the agricultural sector". *International Meeting on Statistical Climatology (IMSC),* Toulouse, France, 24-28 June 2019**

Near-term decadal climate prediction represents a source of information that has the potential to improve climate-related decisions in key societal sectors such as agriculture up to a decade in the future. Predicting the variations in climate at this timescale is of great interest for decision makers, as it this time horizon coincides with the strategic planning of many stakeholders. However, up to now, very little effort has been put into using near-term decadal climate predictions for adaptation and mitigation purposes. This could be partially linked to the lack of illustrations showcasing the skill and the limited knowledge on how to use this climate information by the stakeholders. This work aims to illustrate the usability of decadal predictions for building a climate service for agricultural needs. In particular, we assess the forecast quality of multi-model ensemble mean temperature, precipitation and user-relevant agro-climatic indices such as SPEI (Standardized Potential Evapotranspiration Index) and SPI (Standardized Potential Index) over Europe at the multi-annual timescale. In addition, an assessment of the added value of near-term decadal climate information with respect to standard non-initialized climate projections will be shown.

2. **B. Solaraju-Murali et al. "Multi-year prediction of European summer drought conditions for the agricultural sector". *Environmental Research Letters* (under revision)**

Decadal climate prediction, where climate models are initialized with the contemporaneous state of the Earth system and run for a decade into the future, represents a new source of near-term climate information to better inform decisions and policies across key climate-sensitive sectors. This paper illustrates the potential usefulness of such predictions for building a climate service for agricultural needs. In particular, we assess the forecast quality of multi-model climate predictions in estimating two user-relevant drought indices, SPEI (Standardized Precipitation Evapotranspiration Index) and SPI (Standardized Precipitation Index), at multi-annual timescales during European summer. In addition, an assessment of the added value of near-term climate information with respect to standard uninitialized climate projections is presented. We obtain a high skill for predicting five-year average (forecast years 1-5) SPEI across Southern Europe, while for the same forecast period SPI exhibits high and significant skill over Scandinavia and its surrounding regions. The model initialization improves the forecast skill over Central Europe, the Balkan region and Southern Scandinavia. Most of the increased skill found with initialization seems to be due to the climate forecast systems ability to improve the extended summer precipitation and potential evapotranspiration forecast, and as well as their ability to adequately represent the observed effects of these climate variables on the drought indices.

3. **A. Soret (BSC). 2018. "How climate services can help key sectors of society". *Side event 'Harnessing the potentials of climate services to deliver on objectives of the Paris Agreement' of the 24th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP) 24*, Katowice, Poland, 5 December 2018**

Climate services hold great promises for harnessing the values of ever better information on past, present and future climate variability and change, and advising public and private decision and policy making so as to deliver on the pledges of the Paris Agreement on Climate Change. This side event will (i) provide a snapshot overview about the cutting-edge advancements in climate projection and (seasonal to decadal) forecasting; (ii) explore the fast evolving landscape and variety of climate services in various sectors (e.g. agriculture, energy, disaster risk reduction, water management); and (iii) convey insights from recent market intelligence analysis with respect to the users' needs, strengths and pitfalls of contemporary climate services, as well as future prospects.

4. **N. González-Reviriego, M. Terrado, R. Marcos, B. Solaraju, A. Manrique, A. Soret, and F.J. Doblas-Reyes (BSC). 2018. "Climate services for the Mediterranean food security". *11 Congreso internacional of the Spanish Association of Climatology (AEC),* Cartagena, Spain, 17-19 October 2018**

Grapes, olives and durum wheat are typical crops of the Mediterranean region. They lead to the production of wine, olive oil and pasta, which are considered staples of the Mediterranean diet. These crops are highly sensitive to heat, solar radiation and water availability and, therefore, very sensitive to climate variability, extremes and the impacts of climate change. Hence, a big challenge for the Mediterranean agricultural sector is to increase the resilience of this ecological, economic and cultural heritage by minimizing climate-driven risks through a better use of climate information.

In this climate-vulnerable context, seasonal forecasts offer valuable information for action-oriented decision-making. This contribution presents the climate services developed by the Earth System Services group at the Barcelona Supercomputing Center (BSC) within the framework of the European projects VISCA (Vineyards' Integrated Smart Climate Application) and MEDGOLD (turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems). Both projects aim to make European food systems more competitive and resilient to climate change and variability, while minimizing risks and costs through the improvement of the production management.

Our aim is to illustrate the approaches applied to engage with users from the agriculture sector, their climate information needs and the co-development of relevant climate services in suitable formats to be applied to their key operational and strategic decision-making processes. We also explain the importance of seasonal forecast quality assessments, which are essential to ensure an adequate use of seasonal prediction as a relevant source of information for users.

5. **Dell'Aquila A., Ponti L., Calmanti S., and De Felice M., 2018. "Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems: the MED-GOLD project". *European Meteorological Society (EMS) Annual Meeting*, Budapest, Hungary, 3-7 September 2018. *EMS Annual Meeting Abstracts*, Vol. 15: Abstract EMS2018-183 [RD.1]**

MED-GOLD is a four-year research and innovation project, started the 1 december 2017, funded by Horizon 2020.

The MED-GOLD project will demonstrate the proof-of-concept for climate services in agriculture by de- veloping case studies for three staples of the Mediterranean food system: grape, olive and durum wheat. Agriculture is primarily driven by weather and climate, and future climatic conditions will further increase its vulnerability to crop failure and pest damage.

Nowhere in the globe will this have consequences as dramatic as in the Mediterranean Basin - a hot spot of global change where higher than average projected climate change threatens an extremely rich and intertwined biological and cultural diversity, and will increase its vulnerability to natural hazards including biological invasions. The challenge for this region is how to increase the resilience of this complex ecological, economic, and cultural heritage of global relevance in an era of decreasing resources and climate change.

Climate services, understood as the transformation of climate-related data and other information into customised products (e.g., projections, trends, advice on best practices, and any other climate-related service that may be of use for the society), have the potential to support the transition towards a climate-resilient and low-carbon society. Developing a capacity for climate services that can inform decision-making in agriculture is therefore a priority both in Europe and worldwide, as agriculture is directly affected by climate variability and change. The long-term goal of this project is to make European agriculture and food systems more competitive, resilient, and efficient in the face of climate change.

The cumulative added value of MED-GOLD will range from enhancing agricultural management to supporting and informing policy-making at the Mediterranean, European and global levels. This is because olive, grape, and durum wheat are grown across the globe and produce the raw materials for global food commodities such as olive oil, wine and pasta. These in turn, are key staple foods of the Mediterranean diet with demonstrated potential for contrasting the increasing homogeneity in global food supplies with important food security implications and significant health benefits, and for reducing the ecological footprint of the global food system.

The diverse, multidisciplinary MED-GOLD partnership enables suppliers/purveyors and users to develop climate services jointly in close collaboration — a key challenge for achieving climate services with high added-value. Project partners that are world leaders in the wine, olive oil, and pasta sectors will lead the three Mediterranean case studies. Extension of the MED-GOLD approach will be tested for coffee — the world's most important agricultural commodity.

6. **B. Solaraju-Murali, N. González-Revieriego, L.P. Caron, A. Soret, A. Toreti, A. Ceglar, M. Zampieri, and F.J. Doblas-Reyes (BSC, JRC). 2018. "Assessing the added-value of near-term decadal climate information for decision making in the agricultural sector", *Second International Conference on Seasonal to Decadal Prediction,* Boulder, USA, 17-21 September 2018. Abstract book for poster presentations: Poster number: P-B4-09**

Near-term decadal climate prediction represents a source of information that has the potential to improve decision-making and strengthen the resilience of a wide range of socio-economic sectors heavily influenced by climate variability and change. However, up to now, very little effort has been put into using near-term decadal climate forecasts for adaptation and mitigation purposes. This is probably linked, at least partially, to knowledge constraints and lack of illustrations on how to use this data by the stakeholders and a lack of applied studies illustrating how the skill can be transformed into value. This work aims to tackle some of these aspects for the agricultural sector in a context of climate services. Starting from the forecast quality assessment of multi-year averages of temperature and precipitation, we also provide the skill assessment of key agroclimatic indices resulted from the co-development with final agricultural users. Some of those indices are the standardised precipitation evapotranspiration Index (SPEI) and the heating degree days (HDD), which are strongly linked to crop yield variability. The added value of near-term decadal climate information will be shown with respect to standard non-initialized climate simulations and will demonstrate the potential applicability of these forecasts at global spatial scales, to enhance the adaptation and mitigation activities in the agricultural sector.

7. **M. Terrado, M. Badal, I. Christel, N. González-Reviriego, R. Marcos, B. Solaraju-Murali, A. Soret, and F.J. Doblas-Reyes. 2018. "Helping to ensure the future of the Mediterranean diet with climate services", *VIIth Jornada Ambiental (Bodegas Torres),* Barcelona, Spain, 30 May 2018**

Climate change is a global threat on food security. The Mediterranean region is and will be one of the more affected areas by climate change worldwide. Observations from the last decades show a trend towards warmer conditions as well as changes in the seasonal distribution of precipitation in the Mediterranean, which compromise crop production objectives. Studies using climate projections point at a warmer situation by the end of the century. However, the effects of climate change will be already perceived in the near future, meaning that businesses such as agriculture will need to

adapt promptly. Having climate information in advance on how the next season, year or decade will be, can help the agriculture sector to adapt to the effects of climate change in the near future.

8. **Dell'Aquila A., Ponti L.,Calmanti S., and De Felice M., 2018. "Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems: the MED-GOLD project". *European Geophysical Union General Assembly 2018*, Vienna, Austria, 8-13 April 2018. *Geophysical Research Abstracts,* Vol. 20 : Abstract EGU2018-6430 [RD.2]**

MED-GOLD is a four-year research and innovation project, started the 1 December 2017, funded by Horizon 2020, the European Union's Framework Programme for Research and Innovation.

The project is led by ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development), and the project partnership includes Barcelona Supercomputing Center (Spain), Barilla (Italy), BeeToBit (Italy), National research Council (Italy), DCOOP (Spain), GMV Aerospace (Spain), Horta (Italy), Joint Research Centre (European Commission), Met Office (UK), National Observatory of Athens (Greece), Sogrape Vinhos (Portugal), Universidad Militar Nueva Granada (Colombia), University of Leeds (United Kingdom), University of Thessaly (Greece).

The MED-GOLD project will demonstrate the proof-of-concept for climate services in agriculture by developing case studies for three staples of the Mediterranean food system: grape, olive and durum wheat. Agriculture is primarily driven by weather and climate, and future climatic conditions will further increase its vulnerability to crop failure and pest damage.

Nowhere in the globe will this have consequences as dramatic as in the Mediterranean Basin — a hot spot of global change where higher than average projected climate change threatens an extremely rich and intertwined biological and cultural diversity, and will increase its vulnerability to natural hazards including biological invasions. The challenge for this region is how to increase the resilience of this complex ecological, economic, and cultural heritage of global relevance in an era of decreasing resources and climate change.

Climate services, understood as the transformation of climate-related data and other information into customised products (e.g., projections, trends, advice on best practices, and any other climate-related service that may be of use for the society), have the potential to support the transition towards a climate-resilient and low-carbon society. Developing a capacity for climate services that can inform decision-making in agriculture is therefore a priority both in Europe and worldwide, as agriculture is directly affected by climate variability and change. The long-term goal of this project is to make European agriculture and food systems more competitive, resilient, and efficient in the face of climate change.

The cumulative added value of MED-GOLD will range from enhancing agricultural management to supporting and informing policy-making at the Mediterranean, European and global levels. This is because olive, grape, and durum wheat are grown across the globe and produce the raw materials for global food commodities such as olive oil, wine and pasta. These in turn, are key staple foods of the Mediterranean diet with demonstrated potential for contrasting the increasing homogeneity in global food supplies with important food security implications and significant health benefits, and for reducing the ecological footprint of the global food system.

The diverse, multidisciplinary MED-GOLD partnership enables suppliers/purveyors and users to develop climate services jointly in close collaboration — a key challenge for achieving climate services with high added-value. Project partners that are world leaders in the wine, olive oil, and pasta sectors will lead the three Mediterranean case studies. Extension of the MED-GOLD approach will be tested for coffee — the world's most important agricultural commodity.

3.2. ABSTRACTS SUBMITTED FOR AGRICULTURE IN GENERAL SECTOR

To date, there were 5 abstracts submitted for the Agriculture in general sector, by ENEA (Table 3-1).

The main themes dealt with included solar radiation use efficiency, changes in agricultural systems caused by global change (i.e., change in agro-technical inputs, invasive species, and climate change), and general presentation of the MED-GOLD project.

9. **Rosati A., Wolz K.J., Murphy L., Ponti *L., and Gold M., 2019.* "Agroforestry models overestimate photosynthesis of understory crops". *16th AFTA (Association for Temperate Agroforestry) Biennial Conference*, Oregon State University, Corvallis, Oregon, USA, 24-27 June 2019. *Book of abstracts (Ed. Kate MacFarland)* : page 14.**

No biophysical agroforestry model predicts the exact light pattern available under the trees in each point in time and space. Being averaged in time and/or space, modelled light is less variable than in reality. We tested whether using the

more uniform light patterns predicted by models results in overestimation of crop photosynthesis and radiation use efficiency.

We measured the light pattern every minute for several days in 24 positions under chestnut orchard canopies of various ages and tree spacings. We also created a spatially explicit, ray-tracing canopy light model and used it to estimate the light pattern under the trees with a time resolution of one minute. We then used the modelled vs. measured light patterns to estimate the daily photosynthesis of an understory wheat leaf.

The porosity of the tree canopies in the model was calibrated to match the daily light totals measured with the sensors. Despite this, the modelled light patterns under the tree canopies were substantially different from the measured ones, being much more uniform. This was due to the fact that the model assumes a canopy of uniform porosity, while, in reality, sun rays pass through a complex heterogeneous canopy. Using the more uniform modelled light overestimated daily photosynthesis by about 40%, even when calculating photosynthesis using the light pattern at a minute scale. Averaging light in time increased the overestimation even further. We conclude that, by predicting overly uniform sub-canopy light patterns, current agroforestry models likely overestimate photosynthesis and radiation use efficiency of understory crops.

10. **Rosati A., Wolz K.J., Murphy L., Ponti L., and Gold M., 2019. "Do agroforestry models overestimate photosynthesis and RUE of understory crops*?" 4th World Congress on Agroforestry*, Montpellier, France, 20-22 May 2019 (keynote talk) Dupraz, C., Gosme, M., Lawson, G. (Editors) Book of Abstracts, 4th World Congress on Agroforestry. Agroforestry: strengthening links between science, society and policy. Montpellier: CIRAD, INRA, World Agroforestry. 933 pages.**

The light distribution under trees and available for understory crops has been examined with biophysical agroforestry models of various levels of complexity (for a review see Malézieux *et al.*, 2009). No model, however, predicts the exact light pattern available under the trees in each point in time and space, as this would require detailed knowledge of the spatial arrangement of leaves and large computing effort (Lamanda *et al.* 2008). By averaging in time and/or space, the light predicted by models is less variable than in reality. Under variable light, photosynthesis (and crop growth) is reduced compared to more uniform light (Poorter *et al.*,2016; Vialet-Chabrand *et al.*, 2017). Here, we tested whether using the more uniform light patterns estimated with models significantly affects the estimation of photosynthesis and radiation use efficiency compared to using measured light patterns.

We measured the light pattern using PAR photosensors every minute for several days in 24 positions under chestnut orchard canopies of various ages and tree spacings. We also created a spatially explicit, ray-tracing canopy light model and used it to estimate the light pattern under the trees at a one-minute resolution. We then compared the measured and modelled light patterns at the minute scale, as well as with half-hourly, hourly, and daily averages. Finally, we used the measured, modelled, minutely, and averaged light patterns to estimate the daily photosynthesis of an understory wheat leaf using its photosynthetic light response curve. Despite calibrating tree porosity in the model to yield the same daily light total as measured with the sensors, the modelled light patterns under the tree canopies differed substantially from the measured one, being much more uniform. This was due to the fact that the model assumes a canopy of uniform porosity, while, in reality, sun rays pass through a complex heterogeneous canopy. Using the more uniform modelled light overestimated daily photosynthesis by about 40%, even when calculating photosynthesis using the light patter at a minute scale. Averaging light in time increased the overestimation even further.

We conclude that, by predicting overly uniform sub-canopy light patterns, current agroforestry models likely overestimate photosynthesis and radiation use efficiency of understory crops. Finding ways to account for the actual variability in light patterns under trees could improve model predictions of understory crop performance.

11. **Ponti L., Gutierrez A.P., Cure J.R., Rodríguez D., Caboni F., Boggia A., and Neteler M., 2019. "Bioeconomic analogies as a unifying paradigm for modeling agricultural systems under global change in the context of geographic information systems". *European Geophysical Union General Assembly 2019*, Vienna, Austria, 7-12 April 2019. *Geophysical Research Abstracts*, *Vol. 21* : Abstract EGU2019-13677 [RD.3]**

Global change in agro-technical inputs, invasive species, and climate change disrupts and increases the time- varying complexity of the ecological roots of agricultural and natural systems. These systems are inherently complex as each of the interacting species of plants, animals and diseases have unique requirements for growth, survival, and reproduction in response to weather and abiotic factors that determine their geographic distribution, abundance, and interactions. Global change affects each species directly (e.g., climate favourability) and indirectly by altering biotic interactions with other species (e.g., predation, parasitism, competition for food). Determining the direction and magnitude of changes in agricultural and natural systems caused by global change is a major challenge for developing sustainable management solutions, and requires deconstructing system complexity by separating the core ecological issues from climatic and impinging economic components. However, deconstructing and analysing the complex tripartite ecological, economic, and social effects of global change is largely unexplored, and is a major constraint to achieving sustainability.

A bioeconomic approach using physiologically-based demographic models (PBDMs) in the context of a geo- graphic information system (GIS) is an important step in examining the complexity of agricultural systems under global change. PBDMs are mechanistic descriptions (i.e. models) of the field biology, and are based on the unifying paradigm that all organisms including humans acquire and allocate resources by analogous processes (the paradigm of ecological analogies, see http://www.casasglobal.org/). PBDMs are built around the notion that analogous weather-driven sub-models for resource acquisition and birth-death dynamics can be used to predict explicitly the biology and dynamics of heterotherm species across trophic levels, including the economic level. PBDMs may include bottom-up effects of plant growth and development on herbivore dynamics, and the top-down action of natural enemies. PBDMs predict the weather-driven phenology, age structure and abundance dynamics, and the distribution of the interacting species across wide geographic areas using weather data from various sources including satellite remote sensing (RS) and climate change projections. The open source GIS software GRASS (http://grass.osgeo.org/) has been used to perform geospatial analysis and mapping of results. A number of factors affecting species distribution and abundance may also be integrated into PBDMs as digital data layers using GIS (see the Copernicus program https://www.copernicus.eu/). Realistic PBDMs can be used as the production function in bioeconomic analyses in agriculture at various spatial scales, and levels of renewable resource exploitation.

In summary, physiological, ecological, and economic analogies in PBDMs bring realism that help bridge the gap between bottom-up (primarily physiological and population dynamics) and top-down (climatological) GIS approaches for assessing critical/emerging ecosystem problems linked to global change such as agricultural pests, invasive species, and vector-borne diseases. The bioeconomic analogies of PBDMs provide a sound basis for developing a modelling platform with high level of generalization and abstraction. This platform would make the PBDM/GIS methods widely accessible with minimal expertise and infrastructure requirements, and would have immense long-lasting potential for helping solve critical environmental, agricultural, and health problems globally.

12. **Rosati A., Wolz K.J., Murphy L., Ponti L., Jose S., 2019. Modeling light below tree canopies overestimates A_n and RUE in understory crops by averaging light in space and time. *Agricultural and Forest Meteorology* (submitted)**

By averaging in time and/or space, models predict less variable light patterns under tree canopies than in reality. We measured light every minute in 24 positions in a grid under different chestnut orchards, for several clear and overcast days. We also modelled this light with a purposely created 3D, spatially explicit, ray-tracing light interception model, where canopy porosity was calibrated to match measured daily light. Finally, we used both the measured and modelled light patterns transmitted under the tree canopies to estimate the daily net photosynthesis (An) and radiation use efficiency (RUE) of an understory wheat leaf. As expected, modelled light was more uniform than measured light, even at equal daily light. This resulted in large overestimation of daily An and RUE of the understory leaf. Averaging light in time increased the overestimations even further. A sensitivity analysis showed that this overestimation remained substantial over the range of realistic values for leaf photosynthetic parameters (i.e. Vc,max, Jmax, Rd) of the understory crop.

13. **Dell'Aquila A., Ponti L., Calmanti S., De Felice M., S"anderson M., Giannakopoulos C., Gonzalez-Reviriego N., Toreti A., and Bruno Soares M., 2018. "Voices from the field: climate prediction requirements in the agricultural sector from the MED-GOLD initiative". *European Meteorological Society (EMS) Annual Meeting,* Budapest, Hungary, 3-7 September 2018. *EMS Annual Meeting Abstracts, Vol. 15* : Abstract EMS2018-180 [RD.4]**

The EU funded Horizon 2020 MED-GOLD project (https://www.med-gold.eu/) will demonstrate the proof-of- concept for climate services in agriculture by developing case studies for three staples of the Mediterranean food system: grape, olive and durum wheat.

MED-GOLD benefits from the contribution of world leaders in the production of wine, olive oil and pasta (SOGRAPE, DCOOP, and Barilla, respectively) who are playing the role of problem-holders in the co-design of climate services for the three pilot services. The participation of those three champions in the co-design process will also catalyse and speed up the engagement of a wider community of users in these sectors across Europe. Initial hypotheses of each sectorial needs have already been identified in the proposal phase in cooperation with the industrial partners. MED-GOLD adopts a seamless approach whereby innovative climate service tools for the management of climate risks build upon existing ones, and will benefit from the existence of seasonal climate predictions and long-term climate change projections. The new climate service tools will first be evaluated by applying them retrospectively to recent adverse climate events for testing their added value to the users' decision-making processes.

Each pilot service will deal with specific questions and associated decisions identified with the MED-GOLD industrial partners. A coordinated and crosscutting mapping of the overall agricultural sector will allow the consortium to identify, from the outset of the project, the more representative players to be engaged in the MED-GOLD community for the validation and upscaling of the pilot services. A key aspect in the co-development of the pilot services is to manage the expectation of end-users.

A user-driven methodological framework has been developed in the early stages of the project and is being adopted to co-develop the MED-GOLD pilot services for the three main crops of interest. In particular, a preliminary analysis of each pilot will be pursued through scoping workshops as well as interviews, starting from the specific needs of the MED-GOLD industrial partners and the assessment of vulnerability and opportunities for each specific MED-GOLD pilot service. Particular attention will be devoted to key decision-making processes that underlie each case, to better identify how and when the outcomes of the pilot services to be developed can better support and inform those decisions

Subsequently, the methodological issues for each of the MED-GOLD pilot services will be addressed by: (i) collecting the various data required; (ii) analysing the climate data of interest from available data stores and from the concomitant initiatives through the MED-GOLD Information and Communications Technology (ICT) platform ; (iii) assessment of the quality of the observational data available along with the skills of climate predictions/projections required for the variables of interest.

3.3. ABSTRACTS SUBMITTED FOR GRAPES/WINE SECTOR

To date, there were 4 abstracts submitted for the Grape/Wine sector, by ENEA and SOGRAPE (Table 3-1).

The main themes dealt with included climate change impacts on grape and wine production and the climate services developed for grapes/wine sector within MED-GOLD project, and the relationship between grape maturation and the annual local climatic indexes.

14. **Graça A. and The MEDGOLD Consortium. 2019. "Climate services in the wine industry: promises from project MED-GOLD". *8th Symposium of the Oenoviti International network*, Athens, Greece, 13th-14 May 2019**

Within the Mediterranean region, climate change presents an important potential for change on the quality and style of wines that have historically gained market acceptance and become important sources of revenue for their origin areas. Those changes will mean increased costs of production to keep the wine style true to the preference of its consumer base and may ultimately result in need for structural changes requiring adaptation of policies, rural administration and business models. Learning in timely advance when climate will impose a disruptive pressure upon wine production systems offers stakeholders a chance to act proactively both at seasonal (operational campaign planning) and decadal (strategic business planning) time-scales. Coordinated and supported by climatology, modelling and social science researchers, project MED-GOLD joins the wine sector together with the olive oil and pasta sectors for joint development of better seasonal and long-term climate forecasts in the Mediterranean basin. For the wine sector, the project objective is to use the most recent advances in climate science and datasets to create prediction models that will produce specific forecasts of climate and bioclimatic variables and indices which are relevant for viticulture, making them readily available for users in the grape and wine sector under formats and visualizations making for easy, quick and seamless integration in critical decision-making.

15. **Ponti L., Gutierrez A.P., Boggia A., and Neteler M., 2018. "Analysis of grape production in the face of climate change". *Climate*, 6: 20. doi:10.3390/cli6020020 [RD.5]**

Grape, olive, and wheat are traditional Mediterranean Basin crops that have immense cultural, economic, and ecological importance, and are the basis for producing wine, olive oil, and pasta and bread products. Of fruit crops, grape has the largest area and the highest economic importance globally. These traditional Mediterranean crop systems and related food products have global relevance, and yet globally, all regions with Mediterranean climate are especially vulnerable to climate change that threatens this Mediterranean bio-cultural heritage. However, how to analyse the complex tripartite ecological, economic, and social effects of climate change on these systems has been vexing and largely unexplored. Here we review how a bioeconomic approach using physiologically-based demographic models in the context of geographic information systems may be an important step in examining the complexity of these factors on grape. We show that with relatively modest data and funding, regional bioeconomic analysis of grape production under present weather and climate change is possible, and that management-relevant complexity can be included in a mechanistic way.

16. **Graça A. and The MEDGOLD Consortium. 2018. "The MEDGOLD project: advanced user-centric climate services for higher resilience and profitability in the grape and wine sectors". 41st World Congress of Vine and Wine, 19-23 November 2018, Punta del Este, Uruguay**. ***Proceedings of the 41st World Congress of Vine and Wine*** *(Ed. Aurand, J.-M.):* **Abstract 2018-1741 [RD.6]**

Agriculture is primarily driven by weather and climate, and future climatic conditions will further increase its vulnerability to crop failure and pest damage. Nowhere in the globe will this have consequences as dramatic as in the Mediterranean Basin — a hot spot of global change where higher than average projected climate change threatens an extremely rich and intertwined biological and cultural diversity and will increase its vulnerability to natural hazards including biological invasions. The challenge for this region is how to increase the resilience of this complex ecological, economic, and cultural heritage of global relevance in an era of decreasing resources and climate change.

Climate services, understood as the transformation of climate-related data and other information into customised products (e.g., projections, trends, advice on best practices, and any other climate-related service that may be of use for the society), have the potential to support the transition towards a climate-resilient and low-carbon society. Developing a capacity for climate services that can inform decision-making in agriculture is therefore a priority both in Europe and worldwide, as agriculture is directly affected by climate variability and change. The long-term goal of this project is to make European agriculture and food systems more competitive, resilient, and efficient in the face of climate change.

The MED-GOLD project will demonstrate the proof-of-concept for climate services in agriculture by developing case studies for three staples of the Mediterranean food system: grape, olive and durum wheat.

The new type of climate services for agriculture developed by MED-GOLD will provide targeted information to companies that will allow them to act over longer time periods (months, seasons or even decades into the future) that go beyond the traditional 2-5 days provided by current weather forecasts. For example, knowing in advance if the next season will be warmer and drier or milder and wetter than normal, will allow wine producers to put in place the necessary measures to counteract the effects of climate change (choosing the ideal pest treatment, deciding on harvest or pruning dates, or choosing more suitable varieties).

The cumulative added value of MED-GOLD will range from enhancing agricultural management to supporting and informing policy-making at the Mediterranean, European and global levels. This is because olive, grape, and durum wheat are grown across the globe and produce the raw materials for global food commodities such as olive oil, wine and pasta.

The MED-GOLD project is coordinated by the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA). Three world leading companies are partners in MED-GOLD: the Portuguese winery Sogrape Vinhos, the Spanish olive oil cooperative DCOOP and the Italian food company Barilla. It is funded with 5 million euros by the European Union with the aim to turn climate-related information into added value for those sectors.

17. **Marta TEIXEIRA, Natacha FONTES, Cátia COSTA, and António GRAÇA. 2019. "Resiliência e adaptação: uso de informação histórica para prever a qualidade de uvas e vinhos numa determinada propriedade da Região Demarcada do Douro. 11º Simpósio de vitivinicultura do Alentejo, Évora, Portugal, May 2019 [RD. 7]**

O clima é um dos principais fatores que afetam a qualidade das uvas e dos vinhos com elas produzidos. As alterações climáticas recentes são cada vez mais evidentes, condicionando a composição e qualidade das uvas. Conseguir estabelecer relações entre a evolução do clima e da qualidade das uvas no passado, poderá permitir prever a qualidade das uvas a produzir no futuro, em função dos cenários de projeções climáticas disponíveis e, assim, analisar qual a resiliência do «terroir» numa região vitícola. O objetivo deste trabalho foi comprovar se existe uma relação próxima entre a maturação da uva de diferentes castas em parcelas de uma propriedade da Região Demarcada do Douro e índices bioclimáticos observados localmente. Para o estudo foram usados dados históricos, meteorológicos, e de maturação da uva de diferentes castas, no período entre 1991 a 2017. Verificou-se a existência de correlações significativas entre índices bioclimáticos e índices de extremos climáticos, bem como entre os índices climáticos e a qualidade das uvas à maturação. Usando estas correlações, juntamente com projeções climáticas de alta resolução, realizamos uma reflexão sobre a resiliência da qualidade das uvas e sua adequação aos vinhos nos próximos 60 anos, para prever eventuais medidas de adaptação.

3.4. ABSTRACTS SUBMITTED FOR OLIVES/OLIVE OIL SECTOR

To date, there were 3 abstracts submitted for the olives/olive oil sector, by NOA (Table 3-1).

The main themes dealt with related to the impacts of climate change on olives and the olive oil sector.

18. **Konstantinos V. Varotsos, Christos Giannakopoulos, Myrto Gratsea, Vasilis Tenentes, and the MED-GOLD TEAM. 2019. "Mediterranean agro-climate projections and the case of olives inAndalucia: results from the MED-GOLD project."** ***European Meteorological Society (EMS) Annual Meeting,*** **Copenhagen, Denmark, 9-13 September 2019.** ***EMS Annual Meeting Abstracts*****,** ***Vol. 16:*** **Abstract EMS2019-609 [RD. 8]**

Horizon 2020 Med-Gold is an EU funded project which aims to make European agriculture and food system more competitive, resilient, sustainable and efficient in the face of climate change, by using climate services to minimizeclimate-driven risks/costs and seize opportunities for added-value. The ongoing project aims to demonstrate the proof-of-concept for climate services in the agriculture sector by developing case studies for three staples of the Mediterranean food systems: grape, olive and durum. In this study we examine the impact of climate change on olives and the olive oil sector in general, in Andalucia, combining different information compiled during the early stages of the project. To this aim, daily data for temperature and precipitation from a five member ensemble of Regional Climate Models from the Euro-Cordex database are used. The data cover the period 1971-2100 under two RCP emission scenarios, namely RCP4.5 and RCP8.5. The analysis is performed on three periods: the 1971-2000 which is used as a reference period and two future periods, the 2031-2060 and the 2071-2100. In addition, daily data from the E-OBS database are used to evaluate the climate models during the period 1971-2000. Regarding the models' performance against E-OBS, the analysis revealed both cold (wet) and warm (dry) biases for temperature (precipitation), depending on the model. Therefore, we opted to perform bias adjustment to the models' output. Moreover, a number of climate threshold indices specifically tailored within the project and based on the analysis of the good and the bad years as derived from the different phenological stages of the olives, olive production and crop quality as well as from olive's survival, are examined. The results on both the return periods as well as the changes between the two future periods and the reference period for the various indices, indicate that future higher temperatures and decreased precipitation poses a negative impact on the olives with the most pronounced evidence towards the end of the century and under RCP8.5 future emission scenario.

19. **Varotsos,K. V., Giannakopoulos, C., and Gratsea M. 2019. "Climate change impacts in the Mediterranean food system: Results of the MED-GOLD project for the case of olive oils in Andalusia*". Adapt2clima Conference*. Heraklion, Crete, Greece, 24-25 June 2019.**

Horizon 2020 Med-Gold is an EU funded project which aims to make European agriculture and food systems more competitive, resilient, sustainable and efficient in the face of climate change, by using climate services to minimize climate-driven risks/costs and seize opportunities for added-value. The ongoing project aims to demonstrate the proof-of-concept for climate services in the agriculture sector by developing case studies for three staples of the Mediterranean food system: grape, olive and durum. In this study we examine the impact of climate change on olives and the olive oil sector in general, in Andalusia, combining different information compiled during the early stages of the project.

20. **C Giannakopoulos, KV Varotsos, A Karali, and M Gratsea. 2018. "Evaluation of various bias correction methods for Mediterranean agro-climate projections: first results from the MED-GOLD project".** ***MEDCLIVAR 2018 - Bridging the Mediterranean climates.*** **Belgrade, Serbia, 18-21 September 2018.** ***MEDCLIVAR 2018 Book of abstracts (Eds. J. Lukovic, P. Lionello), page 121*** **[RD. 9]**

Horizon 2020 Med-Gold is an EU funded project which aims to make European agriculture and food systems more competitive, resilient, sustainable and efficient in the face of climate change, by using climate services to minimize climate-driven risks/costs and seize opportunities for added-value. The ongoing project aims to demonstrate the proof-of-concept for climate services in the agriculture sector by developing case studies for three staples of the Mediterranean food system: grape, olive and durum. One of the early tasks of the project is the quantification of the uncertainty and the skill of climate data. In this study we focus on the climate change impacts on the olive sector using a set of four RCM simulations carried out in the framework of EURO-CORDEX (Coordinated Regional Climate Downscaling Experiment) under the RCP4.5 and RCP8.5 future emissions scenarios were used. However, the initial evaluation analysis revealed high deviations between the simulations and the available gridded reference data set (ERA-40, UERRA reanalysis and/or AgMERRA) for temperature (both daily maximum and daily minimum) and precipitation. Therefore, a set of different bias correction techniques were analysed for the aforementioned variables. The evaluation analysis between the bias corrected timeseries and the reference data set revealed that not all

techniques can adequately capture the annual cycle and interannual variability of temperature and precipitation. Moreover, a number of climate threshold indices specifically tailored, within the LIFE Adapt2clima project, for the different phenological stages of the olives, olive production and crop quality as well as olive's survival were examined. For instance, for temperature (both daily maximum and daily minimum) only two out of the four examined bias corrected techniques were capable to capture the mean number of days with daily maximum temperature higher than 30oC which is related to the olive's flowering and the number of days with daily maximum temperature lower than -3 which is related to the late frost especially during spring. In addition, the higher the interannual variability of the observed variables the lesser the raw model output seems to be corrected.

3.5. ABSTRACTS SUBMITTED FOR USER ENGAGEMENT TOPIC

To date, there were 6 abstracts submitted for the user engagement topic, by ENEA, UNIVLEEDS, and BSC (Table 3-1).

The main themes dealt with included effective communication practices with end users of climate services, lessons learned from engaging with European end users of climate information, the process of co-developing climate services within MED-GOLD project, the roles of MED-GOLD community in co-developing climate services, and the engaging and clustering activities undertaken within MED-GOLD project.

21. **Calmanti S., Dell'Aquila A., Ponti L., Monotti C., Bruno Soares M., De Felice M., Graça A., Fontes N., Teixeira M., López-Nevado J., Marcos-Matamoro R., Terrado M., Soret A., Pasqui M., Sanderson M., and MED-GOLD Team, 2019. "Development of climate services from the user perspective: the MED-GOLD experience". *European Meteorological Society (EMS) Annual Meeting*, Copenhagen, Denmark, 9-13 September 2019. *EMS Annual Meeting Abstracts, Vol. 16*: Abstract EMS2019-526 [RD. 10]**

Transforming climate-related information into added (economic) value requires a suitable language for a precise quantitative definition of technical concepts that are rather vague for non-experts. While the scientific (climate modelling) community has developed a set of formal definitions for concepts such as skill and reliability of climate predictions, those are not always equally understood by the potential end-users in many sectors.

The project MED-GOLD is addressing the lack of a common and agreed terminology between users and providers of climate information in the context of the agri-food industry of traditional Mediterranean products, including grapes/wine, olives/olive oil, and durum wheat/pasta, as a fundamental factor to generate trust in climate services among the user community.

Rather than sticking to the technical concepts used by scientists, a common terminology is being co-developed between users and scientists to allow a shared understanding of the key concepts relevant to users' decision- making, and thus fostering essential trust in the resulting services.

During a recent participatory workshop, with contributions from climate scientists and experts from the agri-food industry, a set of guidelines has been identified in order to develop quantitative definitions of the value of climate information. This has been done by linking the occurrence of false alarms and hit rates to information associated with specific users' actions.

On the basis of these outcomes, the first release of the tools tailored to the agri-food systems of interest for MED-GOLD (grapes/wine, olives/olive oil, and durum wheat/pasta) has been recently done, and the tools are now in the testing phase through close interaction with the users. Here we present the most recent advancements and propose a bottom-up approach to the definition of the reliability of climate information.

22. **A. Dell'Aquila, S. Calmanti, L. Ponti, I.Cionni, F.Catalano, M. Petitta e il Team MED-GOLD " Il concetto di valore delle previsioni climatiche dalla prospettiva dell'utente: l'esperienza del progetto MED GOLD " , *Prima Conferenza Nazionale sulle Previsioni Meteorologiche e Climatiche* (in Italian). Bologna, Italy, 17-18 June 2019.**

Il Laboratorio di Modellistica Climatica e Impatti dell'ENEA affianca alle attività di sviluppo di codici numerici integrati per la previsione della circolazione atmosferica ed oceanica su diverse scale temporali un consistente impegno nella progettazione di servizi climatici, utili alla pianificazione strategica ed economica a medio e lungo termine.

L'interesse nei confronti della variabilità climatica e delle sue mutazioni anche su scala locale, negli ultimi anni, si è allargato ben oltre la comunità scientifica, per coinvolgere in maniera sempre più diretta le amministrazioni, i decisori politici e gli stakeholder locali.

Questo ha comportato la sempre più pressante necessità di trasformare il dato climatico in un'informazione autorevole, credibile e certificata, che possa essere compresa ed utilizzata come supporto per il processo decisionale in comunità diverse da quelle scientifica (utenti istituzionali, compagnie private, amministrazioni locali).

Tale attività prevedono la trasformazione delle variabili meteo-climatiche climatiche (temperature, precipitazione, vento, ecc..) prodotte dalle previsioni climatiche in indicatori quantitativi ed infine in informazioni trasparenti, autorevoli e comprensibili che permettano agli utenti di prendere decisioni in cui la variabilità climatica possa essere presa in adeguata considerazione.

Tutto questo richiede un linguaggio comune adeguato a definire in modo comunque preciso e quantitativo concetti tecnici che possono apparire vaghi e qualitativi. Mentre la comunità scientifica ha sviluppato un set di definizioni formali per concetti come affidabilità e accuratezza delle previsioni climatiche, tali nozioni non sono interpretate allo stesso modo dai potenziali utenti.

Riporteremo qui come il progetto Europeo MED-GOLD, a guida ENEA, sta affrontando il problema della mancanza di un gergo comune e condiviso tra utenti dell'industria agro-alimentare tradizionale nel Mediterraneo e comunità scientifica attraverso l'introduzione, di concerto con le due comunità, di una terminologia che permetta una comprensione condivisa dei concetti rilevanti ai fini dei processi decisionali e che consenta quindi di alimentare la fiducia nei risultati ottenuti dai servizi climatici in sviluppo.

23. **Mihailescu E., Bruno Soares M., Lopez-Nevado J., Graca A., Fontes N., Teixeira M., Monotti C., Terrado M., Gonzalez-Reviriego N., Marcos R., Arjona R., Dell'Aquila A., Ponti L., Calmanti S., Sanderson M.G., Giannakopoulos C., Zamora-Rojas E., Maglavera S., Toreti A., 2019. "Co-development of tailored climate services for adding value to olives, grapes and durum wheat production systems*". European Climate Change Adaptation (ECCA) conference*, Lisbon, Portugal, 28-31 May 2019. *European Climate Change Adaptation conference book:* Abstract SS046-OC273 [RD. 11]**

Managing impacts of climate change is critical in the most climate-sensitive agricultural areas. Information about climate variability can inform and support decision-making for adaptation to these impacts and help optimisation of crop production activities. In this light, tailored climate services, shaped by end-users' needs (Bruno Soares *et al.*, 2018), can provide customized climate-related knowledge and information that can be used to reduce climate-related losses (Vaughan and Dessai, 2014) and associated costs. With the aim of developing effective climate services to support and inform the decision-making processes of end-users operating in the production of olives, grapes and durum wheat, the objectives of this work are twofold: identify the climate change impacts, and associated farming and socio-economic decisions, on the production of these crops; and assess the climate information needs in order to contribute to the effective co-development of tailored climate services.

To examine the impacts and related decisions across European countries and to engage end-users in knowledge co-production, a systematic literature review was carried out in combination with participatory methodologies. The systematic literature review followed a protocol including eligibility search criteria, screening of search results, data abstraction, encoding, and analysis. Focus group discussions and participatory workshops were conducted with key stakeholders for olives, grapes and durum wheat production in the Douro region in Portugal, Andalusia in Spain, and Emilia Romagna region in Italy, respectively.

The main impacts of climate variability and change on these three crops, and associated decisions, relate to a decreased suitability of southern cultivation areas, changes in phenology, alteration of fruit quality (olives, grapes), increased pest incidence, and increased regional yield variability. Key socio-economic decisions differ in terms of operational planning (all crops), changes in processing chain (durum wheat) and meeting market demand (grapes). The climate information needs across the three crops commonly relate to access to reliable climate information such as temperature and precipitation forecasts, in both short-term (seasonal) and long-term (decadal), and differ in terms of predictions of water balance (durum wheat).

These combined findings represent the first stage of the ongoing process of co-designing tailored climate services, for the three case studies, in the project MED-GOLD (Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems). Next steps include the co-development, co-validation, and co-assessment of the value of the climate services developed for each of these crops together with their respective end-users.

24. **Jaroslav Mysiak, Stefano Bagli, Elisa Delpiazzo, Ghislain Dubois, Isadora Jimenez, Adriaan Perrels, *Marta Bruno Soares*, Alberto Troccoli, Giulio Zuccaro, and Filip Lefebre. 2019. "Unfolding the potential of climate services for climate change adaptation", *European Climate Change Adaptation (ECCA) conference*, Lisbon, Portugal, 28-31 May 2019. *European Climate Change Adaptation conference book:* Abstract SP004 [RD. 12]**

Climate variability and change pose sizeable economic, social and environmental risks. Climate services (CSs) catalyse economic and societal transformations that not only reduce these risks and/or improve societal resilience, but also unlock Europe's innovation potential, competitiveness and economic growth. Over the past several years, climate services have grown in numbers, quality and sophistication, stimulated not at least by the EU Research programmes (FP7 and H2020), Copernicus Climate Change Services (C3S), and the World Meteorological Organisation's Global Framework for Climate Services (GFCS). The European Union made sizeable investments in frontline systems enabling modern meteorological services as a contribution to the Europe 2020 strategy for smart, sustainable and inclusive growth.

As a part of European efforts to catalyse the potential of climate services for more efficient natural resource management and improved disaster risk management and resilience, the development of climate services has been promoted through H2020 Research programme. Climate services hold promise for better informed and evidence-based management of climate risks, i.e. better adaptation and disaster risk reduction. To live up to these expectations, climate services need to be based on thorough understanding of and respond to the needs and requirements of decision and policy makers who cope with and adapt to climate variability and change. The most successful climate services are those that have been co-designed and co-developed with the intended users, galvanising mutually beneficial learning.

Business viability of climate services is boosted by making explicit the value or benefits drawn from their use. This is not an easy task and no single, one-size-fitsall methodology exists to reveal the value of the information embedded in climate services. In this session we will summarise the results and expected impacts of the frontline climate services developed in the context of more than ten H2020 funded research and innovation projects. It also sets out to summarise the insights gained and identify good practice examples for co-development and co-assessment of climate services, formulation of viable business and marketing strategies, and communication of uncertainty and risk.

25. **Elena Mihailescu and the Med-Gold team. 2018. "The MED-GOLD Project : Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems". "*Agrisource European workshop: Agriculture & Climate Change: How can we encourage collaborations? How can we involve territorial players, farmers, businesses?"* Paris, France, 12 December 2018, *Agrisource workshop book of contributions (Ed. Marc Nougier):* page 8 [RD. 13]**

The summary of the online presentation is included below.

The MED-GOLD Project is an H2020 program with a number of partners from both public and private European organisations. MEDGOLD will demonstrate the proof-of-concept for climate services in the agricultural sector by developing tailored climate services for three hallmarks of the Mediterranean food system: grapes, olives and durum wheat. Dr. Mihailescu explains that the project focusses on co-development of pilot climate services for the three food chains. Therefore, the MED-GOLD community is formed of European actors inside (producers, processors, input manufacturers) and outside (researchers, NGOs, regulatory bodies, agricultural and climate service suppliers, policy makers) the grape-wine, olive-olive oil, and durum wheat-pasta food chains, as well as from food chains other than the three targeted ones. The members of MED-GOLD community are end-users of the pilot climate services, which will be developed during the project. The roles of MED-GOLD community entail testing, validation and potential upscaling of the pilot climate services to other European crops and potentially to non-European crops (e.g. coffee). In the light of its roles, the development of MED-GOLD community is and remains critical for the duration of the project. Additional information on MED-GOLD project and updates can be found here (in English OR Italian, Spanish, French, Portuguese, and Greek): https://www.med-gold.eu/ Those interested in joining MED-GOLD community can do so here (in English OR Italian, Spanish, French, Portuguese, and Greek): https://www.med-gold.eu/participate/. Any questions about the project can be sent to med-gold.project@enea.it.

26. **Marta Terrado (BSC), Helen Hanlon, Nube González-Reviriego, Antonio Graça, Raül Marcos, Ilaria Vigo, Eduardo Zamora-Rojas, Marta Bruno-Soares, Elena Mihailescu, Sandro Calmanti, Luigi Ponti and Alessandro Dell'Aquila. 2018. "Communicating, engaging and clustering: the MED-GOLD approach to provide climate services for Mediterranean grape, olive and durum wheat", *Climateurope Festival 2018*, Belgrade, Serbia, 17-19 October 2018**

A brief introduction to the MED-GOLD pilot services for grape, olive and durum wheat will be provided. Focus put on the importance of user-engagement activities (workshops, focus groups), communication activities (importance of language, be at the place of the user) and clustering (interactions with other projects/initiatives).

4. CONCLUSION

To date, there were 26 abstracts submitted by MED-GOLD partners, between April 2018 and September 2019.

The abstracts covered topics of interest for the targeted sectors (climate, grapes/wine, olives/olive oil, agriculture in general), as well as for the engagement with end-users of climate information and services.

The next step will be the compilation of abstracts no. 2, in month 36 of the project.

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