VISCA

VINEYARDS´ INTEGRATED
SMART CLIMATE APPLICATION

VISCA Project Results

WWW.VISCA.EU

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The unprecedented impacts of climate change are severely affecting the agriculture sector and grapes are no exception to other crops. Wine-grapes are especially sensitive to microclimatic changes where variations modify grapes' quality (acidity-, sugar-, alcoholic levels) and quantity. Such changes directly affect the European wine industry which encompasses some of the most recognised wine regions worldwide. That's why the consortium of Vineyards´ Integrated Smart Climate Application (VISCA) project has been on a mission to provide climate services and a decision support system (DSS) to support viticulturists and workers in this field in adapting to climate change and in preserving their crops

WHAT IS VISCA?

44 MONTHS *(2017-2020)*

11 PARTNERS *(5 EU COUNTRIES)*

3,2 M€ *(H2020)*

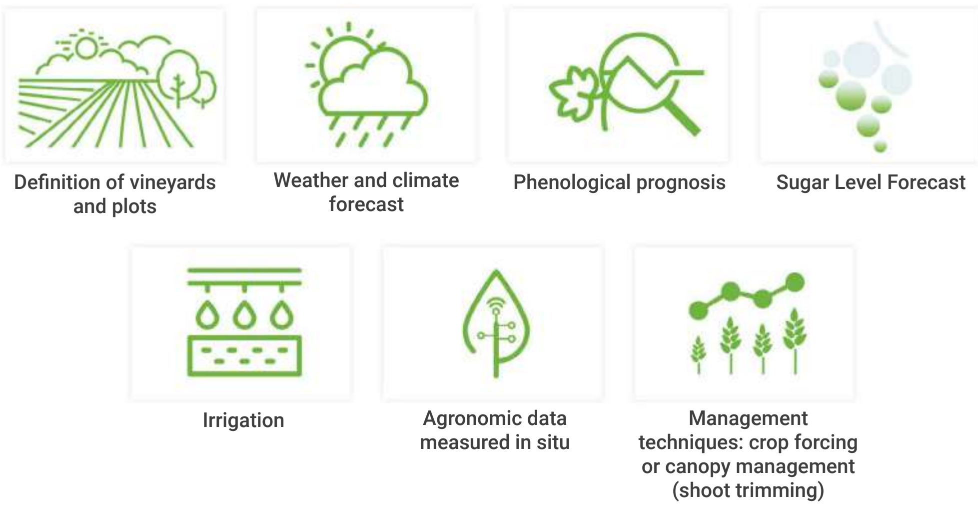
3 DEMONSTRATION SITES

CS, DSS & AGRONOMIC TECHNIQUES

VISCA 'Vineyards´ Integrated Smart Climate Application' is a research & innovation project co-funded under the Horizon 2020 programme with a total budget of 3.2M euros. The project started officially in May 2017 and it ends in December 2020. VISCA consortium is led by Meteosim and it is composed of 11 members from different fields including 3 end-users (Codorniu, Mastroberardino and Symington).

VISCA aims to meet the need of climate change adaptation in viticulture by providing a decision support system (DSS) offering several climate services which integrate climate, agricultural and farmers specifications. In addition to the DSS and climate services, VISCA consortium has tested 2 adaptation agronomic techniques (crop forcing and shoot trimming) which are considered in the DSS predictions and recommendations. VISCA services and techniques are validated by real demonstrations with end users, who are part of the consortium, in three demo sites in Spain (Codorniu), Italy (Mastroberardino) and Portugal (Symington).

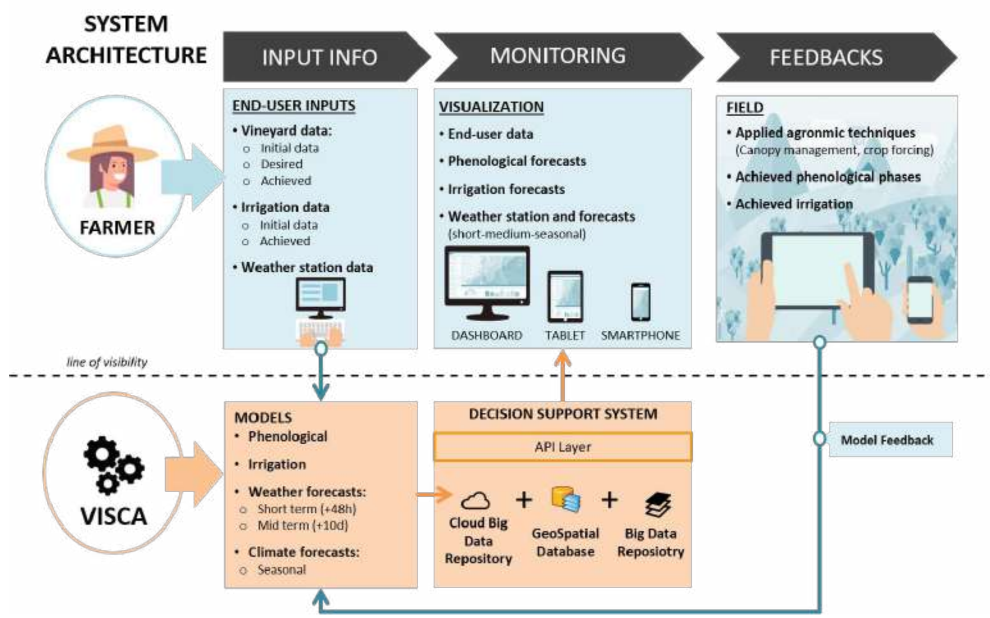
VISCA FUNCTIONALITIES



VISCA Functionalities

VISCA Services

VISCA DSS: AN INTEGRATED PLATFORM PROVIDING CLIMATE, PHENOLOGY AND IRRIGATION SERVICES



INPUT INFO: REQUIRED INFORMATION FROM FARMERS

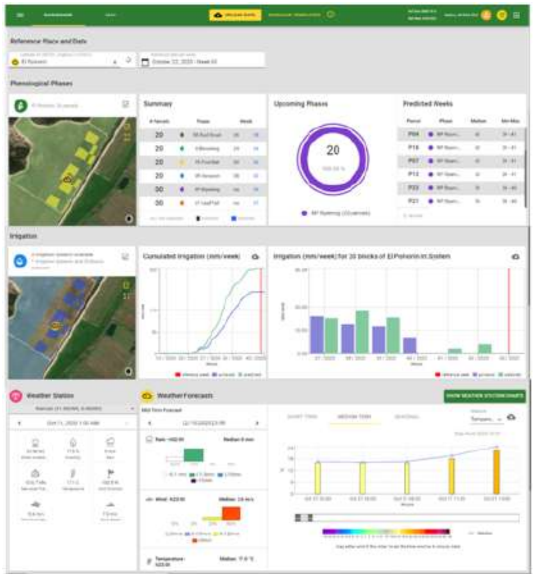
To start using VISCA DSS, a viticulturist has to upload essential data about his vineyard, in terms of parcel location and size, desired sugar level at harvest, aimed water stress level at the different phenological stages, grape variety and the cultivation interventions he performs.

In addition, the grower needs to upload irrigation data,he can also connect the DSS to a local weather station which will feed the tool automatically with weather information inputs. This allows the DSS to adapt the phenological development model not only according to the climate projections, but also according to the performed cultivation interventions which facilitate the decision-making skills of the users.

Accordingly, the viticulturist applies different actions in the field, in terms of irrigation, planting, harvest, etc. VISCA DSS proposes 2 agronomic techniques for climate change adaptation. One is crop forcing which is based on shifting the grape-ripening period from hot summer months to cooler months later in the growing season. The other is shoot trimming which is a pruning technique for vineyards to decrease leaf to fruit yield ratio to slow down carbon partitioning to berries and therefore sugar accumulation.

MONITORING: VISCA DSS COMPONENTS AND VISUALISATION

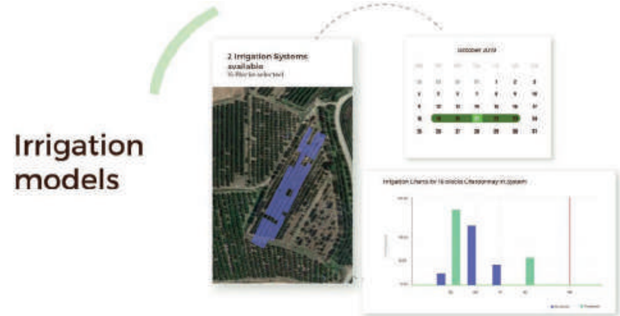
The main part of VISCA DSS user interface is an integrated dashboard which includes the vineyard details (location, a map, the parcels and reference dates) and the 3 main layers (phenology, irrigation and weather information widgets). The provided information supports farmers to set smart strategies to take on climate change:



VISCA DSS Dashboard

1) Phenology widgets: The phenology forecast represents the date of phenological phases predicted by the model and actual (observed by the farmer). The end-users can obtain details on a phenological phase: the probability given by the model to reach this phase at a specific period and a photo with an explanation to support the observation of the achieved phenological phase.

2) Irrigation widgets (water requirements): Irrigation forecasts display both applied irrigation and recommended irrigation for the incoming weeks. The histogram presents applied irrigation in purple and forecast in green for the weeks around the currently selected date. Irrigation forecasted is on a weekly basis



3) Weather forecasts (Short-, medium and seasonal): Several details are presented in the weather information widgets such as global irradiation, humidity, rain, sea level pressure, temperature, wind direction, wind gust speed and wind speed. Weather Forecast layer has three options: **short-term forecasts** (2 days ahead), **mid-term forecasts** (10 days ahead) and **seasonal-term forecasts** (6 months ahead).

FEEDBACKS: PROVIDING FEEDBACK BY FARMERS ON THE APPLIED AGRONOMIC TECHNIQUES AND ACHIEVED PHASES

After the field actions based on the weather data and suggestions of the DSS, the end-users mustprovide their feedback about the applied agronomic techniques as well as the achieved phases (phenology, irrigation) into the tool in order to increase its precision of forecasts and recommendations. For that, the end-users are supported by user-friendly interfaces with photos and descriptions or massive upload of data file

VISCA AGRONOMIC TECHNIQUES

In addition to VISCA DSS, VISCA consortium have tested two agronomic techniques which are demonstrated as ways to adapt to climate change in vineyards. These techniques are also taken into account by VISCA DSS.

CROP FORCING

Crop forcing is based on shifting the grape ripening period from hot summer months to a cooler month later in the growing season. This is achieved by pruning the shoots and removing the remaining leaves and bunches to "force" a restart of the phenology. To apply this technique, it is

SHOOT TRIMMING

Shoot trimming is a post-veraison summer pruning techniques for vineyards to decrease leaf to fruit yield ratio and to slow down carbon partitioning rate to berries and therefore sugar accumulation (responsible of the increase in alcohol concentration in the wine).

VISCA STAKEHOLDERS (DIRECT & INDIRECT)

- **FARMERS (VITICULTURISTS) AND FARMING ASSOCIATIONS**
- **AGRICULTURE AND WINE INDUSTRIES**
- **TECHNOLOGY PROVIDERS**
- **SCIENTIFIC COMMUNITY**
- **POLICY MAKERS**
- **CONSUMERS**

	WHO	WHAT
Direct beneficiaries	Farmers (end-users)	Farm management with climate variability (VISCA DSS and Agronomic techniques).
Direct beneficiaries	Agriculture and wine industry (value chain)	Enhancing the resiliency to climate change (preserving the actual production) while minimizing costs and risks
Direct beneficiaries	Technology, integrators, providers of platforms for farmers	Plugin services for integration in their commercial platform (stand-alone or integrated data forecasts services: short-, medium- and long term weather forecast, phenology, irrigation, grapes quality)
Indirect beneficiaries	Scientific Community	New knowledge on climate services, agronomic techniques and improved models' forecasts considering climate variability.
Indirect beneficiaries	Policy Makers	Contributing in the acquisition and dissemination of climate data which influence policies and funding opportunities.
Indirect beneficiaries	Wine Consumers	Getting wine with high quality and productivity.

ADDED VALUE OF VISCA

- Supply information to help farmers make well-founded decisions of specific aspects of crop planning (budburst, harvesting, defoliation, pruning, etc.).
- Plan for the irrigation frequency and amount according to plant needs .
- Consult integrated information of weather forecasts (short, medium & seasonal) into phenological, sugar content evolution and irrigation prediction.
- Support European wine industries in being resilient to climate changes while minimizing costs and risks.

TESTIMONIES FROM VISCA DSS USERS

“VISCA tool is useful to our viticulture management because it combines different information such as weather forecast, climatic data, phenological stages forecast as well as pest and diseases development cycles. It has allowed us to implement an Integrated Conduction Management for early alerts as well as for allowing high efficiency and savings. Such tools can be successfully integrated further in the value chain to reduce emissions and water use, improve energy efficiency, optimise distribution and achieve sustainable management,”

Dr. Antonio Dente,
Agronomist, Viticulture Manager
at Mastroberardino,
Italy

“I think VISCA’s most powerful strength is the information it provides about what will happen in the vineyard in the near future in terms of plant physiology and climate conditions as well as the different decisions that can be taken from it regarding vineyard management,”

Xavier Bordes Aymerich,
Viticulture Projects Technician
at Codorniu,
Spain.

“Climate change is one of the main challenges for viticulture especially in the southern regions of Europe. Modern viticulture needs to rely on decision-making tools for medium and long-term strategies but above all on short-term management to deal with the impacts that may arise from the changing climate trend. Currently, multiple tools are available to the grower, but none offer the ability of VISCA DSS combining climate, phenology and water stress management in assessing the techniques and strategies used by the grower. Herein lays one of the main potentialities of VISCA.”

Fernando Alves,
R&D Viticulture
at Symington Family Estates,
Portugal.

VISCA DEMONSTRATION SITES

Spain (Codorniu)

Location: Costers del Segre region, the southwest slope of Raimat hills

Size: 7 ha (demo area)

Climate: Annual rainfall (300 - 450mm) - continental climate (av. 15°C)

Grape variety: Chardonnay and Tempranillo

Soil composition: lutites with sandstone.

Agronomic technique used: Crop Forcing

Italy (Mastroberardino)

Location: Campania region, Mirabella Eclano Estate

Size: 1 ha (demo area)

Climate: Annual rainfall 750 mm -

continental climate (up to 20 °C).

Grape variety: Aglianico

Soil composition: deep soil of volcanic origin

with layers of clay and traces of limestone.

Agronomic technique used: Shoot trimming

Portugal (Symington)

Location: Douro Valley, Porto

Size: 1 ha (demo area)

Climate: Annual rainfall (50.6 - 6.9 mm) -

continental climate (11.8 -16.5º C)

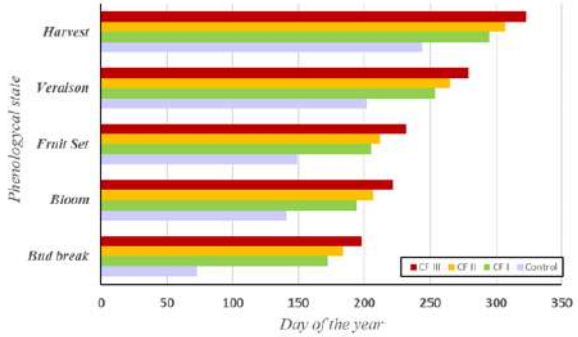
Grape variety: Touriga Nacional

Soil composition: Sandy-loam and loam

Agronomic technique used: Crop Forcing

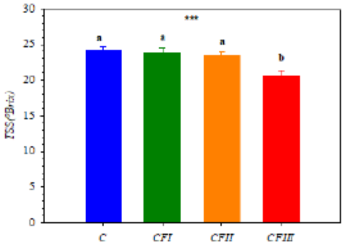
SUCCESS CASES FROM VISCA DEMONSTRATION SITES

At the three demonstration sites included in VISCA (Codorniu in Spain, Mastroberardino in Italy, and Symington in Portugal) we have been testing, on the one hand, different management strategies to cope with the negative effects of climate change, and on the other hand, the ability of the DSS to provide accurate predictions that can be integrated into the cellars' decision-making process.Results on the implementation of crop forcing can be observed in the figures below.

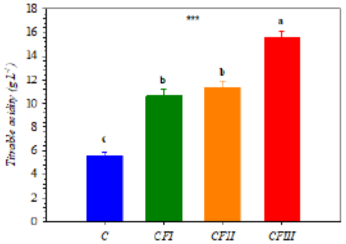


Phenology evolution for the Control and the three crop forcing treatments (CFI, CFII and CFIII)

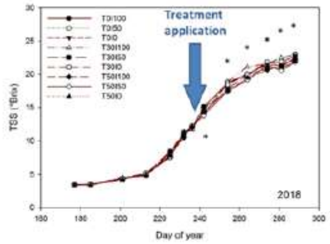
The crop forcing allowed a significant delay on the harvest, which varied between 21 and 77 days depending on the crop forcing date. The shift of harvest date had a direct effect on the berry quality traits, with a positive correlation between the increase in acidity and the delay on harvest -without compromising the sugar content in the berry. For the trimming technique we found similar results. The application of trimming resulted in a reduction on sugar accumulation rate which induced a differential in quality traits as shown in the following figures.



Total soluble solids in control (C) crop forcing one (CFI), crop forcing two (CFII) and crop forcing three (CFIII) treatments.

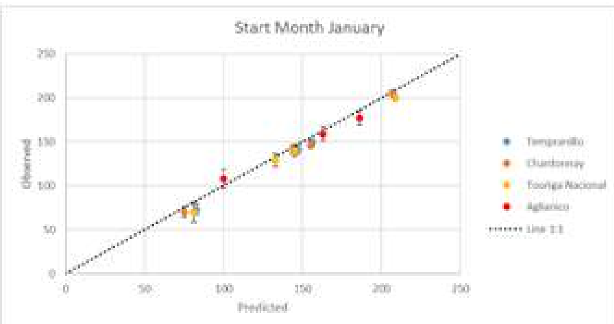


Tritable acidity content in control (C) crop forcing one (CFI), crop forcing two (CFII) and crop forcing three (CFIII) treatments.

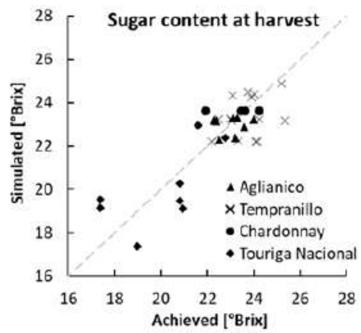


Sugar accumulation rate at the different trimming treatments. Asterix indicates a significance of p<0.05.

During the last year of the project, we fine-tuned the phenology and sugar accumulation models. The major deviations observed in the phenology predictions on previous years have been solved and now the tool is able to provide accurate forecasts of the different phenological phases (see the figure below: predicted vs observed day of year of the different phenology events). The average deviation in days for the phenology forecasts varies between 6 and 8 days, depending on the initial simulation month. The closer to the real event, the better the model will perform. In addition to the phenological model, the sugar accumulation rate module can now provide forecasts even when management techniques are implemented in the grapevines (figure: Relation between observed and predicted sugar accumulations). The irrigation module was fine tuned in the previous years. The weather information widgets also provided some promising results of accuracy between 60 and 90% for short-term predictions depending on the meteorological field, the forecast horizon and the demosite location (according to international standard accuracy limits). On the other hand, for the mid-term forecasting widget provides a probabilistic forecast with promising levels of accuracy. Regarding the seasonal forecasts, the obtained results show there is some degree of skill in the three demo-sites that can provide value beyond the customary use of climatology, but it depends on the month and start date.



Predicted vs observed day of year of the different phenology events

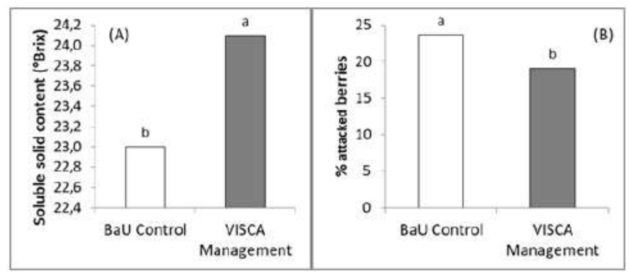


Relation between observed nd predicted sugar accumulations

During the last year of the project, we decided to test the performance of the DSS in a real situation. The objective of this test was, to study the ability of the DSS to enhance grapevine management by improving the use of resources and increasing the profits. To do so, we designed some experiments based on a decision tree. This decision tree was the results of discussions between the end-users and the researchers to provide actions based on predictions. The above picture illustrates the relation between observed and predicted sugar accumulations for three different varieties. The ripening model, successfully predicted the accumulated sugar of different varieties. The model gives forecasts 15 days in advance, allowing to establish the ideal moment for harvest, without the necessity of continuous samplings in the field.

The below figure (Effect of Control disease management (business as usual, BaU) and VISCA-assisted disease management (VISCA management) treatment) provides an example of one of the experiments performed at Mastroberardino. In this experiment, the end-user took advantage of the medium and seasonal weather forecasts to adjust the spraying calendar for disease control. The experimental design compared two treatments. The two treatments were: (a) a Control treatment (business as usual, BaU) that managed diseases according to the common company practice (b) a treatment where the decision on the disease control strategy was following the indications provided by the VISCA tool (VISCA management). The rest of the management practices remained the same for the two treatments. In BaU, the disease control included the application of regular sprayings with a frequency of 12 days from May to July (in 2020 it resulted in a total of 7 sprayings), whereas the in the VISCA management treatment, there were two main differences in the spraying calendar. The spraying scheduled on June 1st was anticipated three days (May 28th), because the VISCA weather service (short-term forecasts) correctly predicted two days of consecutive rains (between 29 and 31 May). After that, in the VISCA management treatment, sprayings were done every 12 days until the end of July (remaining always anticipated of 2-3 days compared to BaU). In addition, since the VISCA seasonal weather service (seasonal and mid-term forecasts) forecasted a summer drier than normal (conditions that may favour powdery mildew attacks), two applications of sulfur dust where carried out on June 30th and July 9th, these applications were not done in BaU.

The soluble solids content was around 1 °Brix higher in vines of the VISCA management treatment compared to business as usual (A). The VISCA management also allowed to improve the sanity of the grapes at harvest (B).No difference was found between the two vineyard management practices (BaU and VISCA management) in fruit yield (on average 1.71 kg/vine) and in berry juice pH and titratable acidity at harvest (on average 3.20 and 9.4 g/L tartaric acid, respectively). The use of the VISCA service allowed to modify the protocol used by the company for spraying and this induced an improvement of grape sanity and in soluble solids content. This can result in an increase of product value from 0.8 to 1.0 euro/kg. The profits improvement justified the increase in costs due to the two extra applications of sulfur dust suggested by the VISCA tool.



Effect of Control disease management (business as usual, BaU) and VISCA-assisted disease management (VISCA management) treatments on (A) soluble solids content and (B) grape sanity (percent of attacked berries) at harvest at Mirabella Eclano (Mastroberardino)

REPLICABILITY OF VISCA: WINE-GRAPES, OLIVES, CEREALS & RICE

The possible options for farmers (end-users) to replicate the services provided by VISCA DSS can be based on the points below:

- Replicability of DSS on specific grapevine cultivars (Tempranillo, Chardonnay, Aglianico, Touriga Nacional)
- Replicability of the DSS on other grapevine cultivars These options can be available in VISCA
- VISCA Replicability of the tool on other crops (e.g. olives, cereals and rice)

To understand the potential of VISCA DSS replicability, VISCA consortium has been assessing the required adaption of the DSS or its further development based on the main components (phenology widgets, irrigations widgets and weather information forecasts widgets). Depending on the type of crop, and location of the replicability site(s), different actions will be required to adjust the DSS. Full assessment of the possible replicability options of VISCA is provided in 'Deliverable 5.4: Report on replicability and associated funding mechanisms' available on VISCA website (Dissemination: Scientific Publication and Deliverables)

THE WAY FORWARD

To facilitate the uptake of the VISCA developed solution in the market, we envision the exploitability of all of the developed components and services, as the following:

VISCA DSS, including the:

- Data Access Layer (i.e. the Back end);
- Presentation layer (i.e. the Front end);

VISCA Services:

- Phenology forecast;
- Irrigation forecast (water requirements); and
- Weather (short and medium term) and climate forecasts (seasonal).

In such way, VISCA can meet a multitude of needs of its customers, from small to big wine-grape producers. In particular, this approach was suggested by the end-users as, on one side, there are companies willing to invest in a comprehensive VISCA solution (comprising all of its components); while, on the other side, there are companies that already have their own platform tool and are interested in having only VISCA services. METEOSIM will take the lead in bringing VISCA to the market, acting as reseller of the solution. In this sense, partnerships among VISCA consortium partners are being set in place in view of the commercial exploitation.

Moreover, given the raised interest in the developed solution during the projectand the need of the agricultural market to be more resilient to climatic changes, the engagement with third parties already present in market for possible synergies (possibly leveraging 3rdparty marketplace) and with winegrowing companieswill be continued, setting the path to afurther uptake of the VISCA overall solution. Additionally, the evaluation other markets outside the agricultural market such as the Insurance and Reinsurance market as well as the flood and fire emergency management market has been foreseen to exploit the climate services and risk models. Finally, the possibility to replicate VISCA to other types of cultivations or sectors heavily impacted by climate change (e.g., olives, cereals, forestry,...)could be envisaged. In this sense, project replicability could be foreseen with the possibility to leverage the opportunities provided by various funding schemes at EU/international/national level in order replicate VISCA to other varieties and/or to other crops.

For exploitation potentials, please contact Mr. Josep Maria SOLE, VISCA Project Coordinator (METEOSIM), at jmsole@meteosim.com

VISCA PARTNERS

VISCA PARTNER	ROLE IN THE PROJECT
METEO SIM	**Coordinator and climate models provider (short-term, mid-term and climate projections)**
BSC Barcelona Supercomputing Center	**Climate models provider (seasonal)** BSC coordinates the model chain workflow from the seasonal forecast predictions to the phenologicaland irrigation models. Produce real-time seasonal forecast predictions
Codorníu	**End-user** Codorniu provides the Spanish demo site and validation and development of models.
IRTA	**Irrigation and phenology models provider and scientific and technical support** IRTA contributes in the implementations of the DSS and the main developer of irrigation and phenology models. IRTA is also the coordinator of all the scientific work at the 3 demo sites included in the project. It also gives support to all the tasks that is performed by the partner Codorniu. These includes the collection and analysis of data, elaboration of reports and dissemination of results, either in a form of scientific or technical documents."
LINKS	**VSS System development** LINKS is responsible of the development of several system components, namely the centralized that will collect and aggregate all the data sources involved, and the visualization of the DSS
Dipartimento di Agraria	**Developer of the sugar forecasts model and scientific and technical support** This support is linked to all tasks that will be performed by the partner Mastroberardino, it includes the collection and analysis of data, elaboration of reports and dissemination of results, either in a form of scientific either technical documents.
Mastroberardino	**End-user** Mastroberardino provides the Italian demo site and validation and development of models.
SYMINGTON	**End-user** SYMINGTON provides the Portuguese demo site and validation and development of models.
U.PORTO FC	**Scientific and technical support** This support is linked to all tasks that will be performed by the partner SYMINGTON, it includes the collection and analysis of data, elaboration of reports and dissemination of results, either in a form of scientific either technical documents.
SEMIDE EMWIS	**Dissemination & Replicability Leader, also leading the 'data management'**
AlphaConsult	**Exploitation Leader, also leading the 'innovation management'**

Contact

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