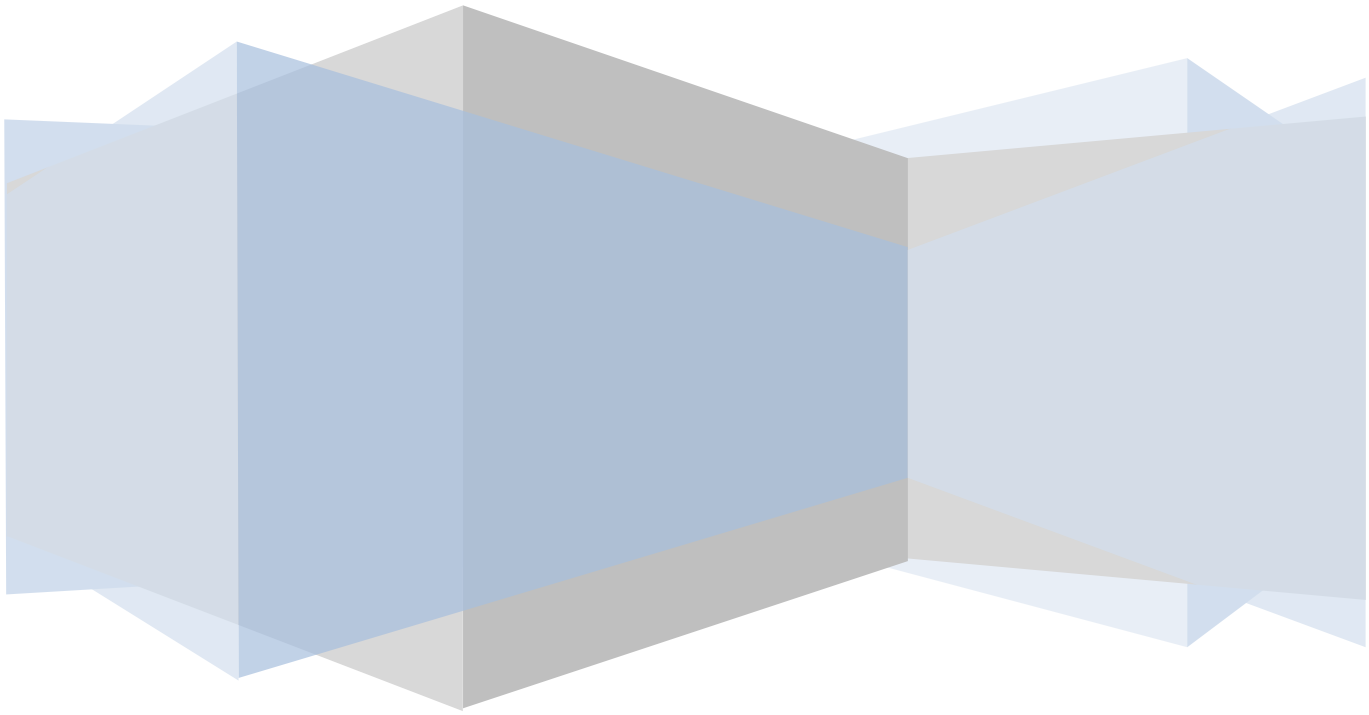
Template of Mid-Term Progress Report

Water Joint Programming Initiative 2018 Joint Call

Closing the water cycle gap - Sustainable management of water resources

This Template should be used by the Project Coordinator for the reporting of the project.

This template does not substitute national regulations



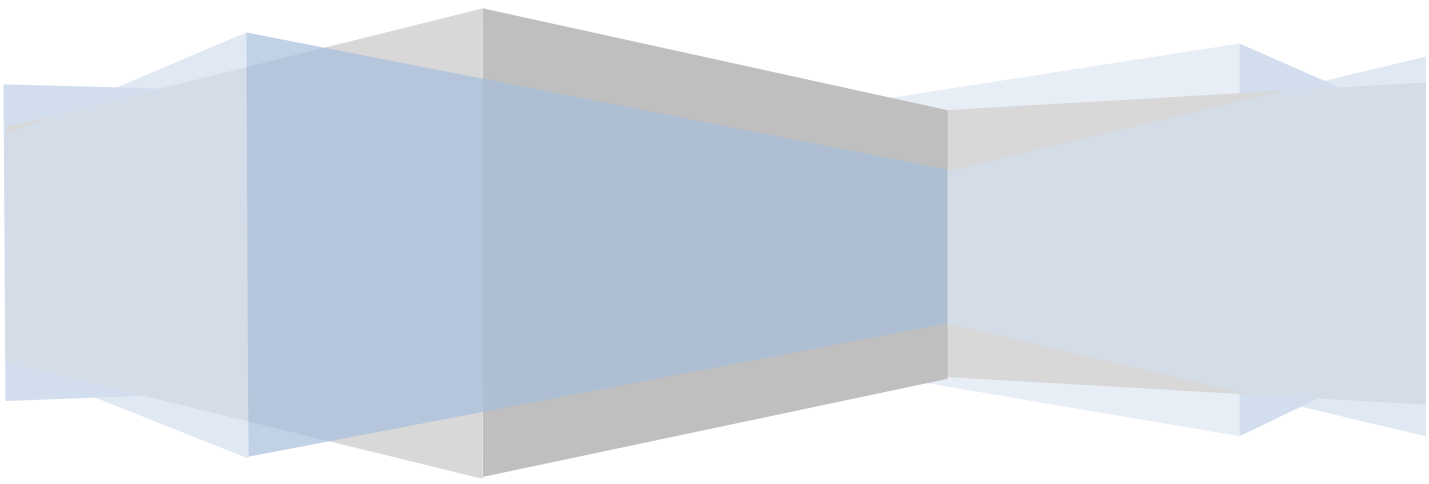
2018 Joint Call
Mid-Term Progress Report
Closing the water cycle gap - Sustainable management of water resources

"Strategies for increasing the water use efficiency of semi-arid mediterranean agrosilvopastoral systems under climate change"

"FLUXMED"

This document must be filled in by the project coordinator with the help of its project partners and must be sent to the WaterWorks2017 Follow-up Secretariat by **31/10/2020** (for Consortium FLUXMED).

The WaterWorks2017 Follow-Up Secretariat will ensure distribution to the concerned national funding agencies. The project coordinator is responsible for sending a copy of the report to its partners.



STRATEGIES FOR INCREASING THE WATER USE EFFICIENCY OF SEMI-ARID MEDITERRANEAN AGROSILVOPASTORAL SYSTEMS UNDER CLIMATE CHANGE

"FLUXMED"

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Project Website: www.fluxmed.eu
Project code: WaterWorks2017-FLUXMED

Duration of project: 30 months
Start date: 01/01/2020 End date: 30/06/2022

Period covered by this report: 01/01/2020 – 31/10/2020

1. Publishable Summary

Maximum 1 page

The overarching goal is to develop and apply innovative methodologies to increase the social-ecological WUE of managed ecosystems along the Mediterranean biome and climate types. Case studies will examine the Mediterranean Sea basin from west to east providing the exceptional opportunity to develop and compare water resources management and planning strategies, and develop a wide monitoring network for contrasting climate conditions (mean annual rain from 35 to 780 mm/y) in the Mediterranean region. The specific objectives are:

OB1: to develop and implement innovative methodologies for evapotranspiration measurements and estimate in typical heterogeneous Mediterranean agrosilvopastoral systems;

OB2: to improve the eco-hydrologic monitoring in ephemeral rivers and wadis along the Mediterranean biome and climate types, establishing a transnational Mediterranean watershed monitoring system;

OB3: to develop data assimilation systems for assimilating remotely sensed and field data into ecohydrological models at the watershed or agricultural district scales for optimal characterization of soil water balances;

OB4: to identify the impacts of contrasting vegetation and crop types on the soil water balance, surface runoff, and water use under current and past Mediterranean climates;

OB5: to predict the impact of future climate scenarios on soil water balance, runoff, and water use;

OB6: to develop a set of land cover change strategies for climate change scenarios that optimize the water uses and increase system resilience;

OB7: to improve the multipurpose and multiuser water resources management and planning systems for the optimization of the water infrastructure under current and future climate change scenarios.

Research activities have been delayed due to SARS-Cov-2. However, the hydrologic basin monitoring systems started in each project case study, ecohydrologic models have been developed and tested, and remote sensing images of Sardinian and Tunisian case studies have been acquired and analysed. The project will have positive social and economic impacts. The project objectives respond to priorities of H2020 Societal Challenge 5, Call topic SC5-11-2016 because the project results will allow to increase the efficiency of Mediterranean water resources and innovate the approach for water resources planning and management for both current and future climate change scenarios. The project supports the requests of innovative solutions of the UN SDG 6, providing new techniques and methodologies for increasing the water-use efficiency of water-limited Mediterranean regions. The results of the research project will allow to combat climate change impacts, supporting the UN SDG 13, because future climate change scenarios are predicting a decrease in water resources availability. As consequence existing water resources plans are wrong, because these are based on water input (surface and groundwater) that will not be any longer available. At the same time environmental plans need to consider the climate change effect on both CO2 budget and water resources use of vegetation and water resources availability to vegetation growth, which can impact on species type (in drier climate more resistant species should survive) and their spatial distribution (less water implies less density). Instead, our proposed methodology is strongly innovative and integrate new knowledge, allowing to adequately develop water resources and environmental planning also for future climate change scenarios. The project economic impact will be significant for agricultural development and its sustainability because the project aims to increase the system efficiency and decrease the costs. The project will provide the stakeholders the scientific approach and results for defining the planning and management strategies for both current and future climates.

Website

www.fluxmed.eu

2. Work Performed and the Results achieved during the reporting period

Deliverable attached

- D1.1 - Kick-off meeting and its minutes
- D1.2.1 - Data management plan (DMP)
- D7.1.1 - Dissemination and communication plan (DCP)
- D7.2.1 - Project web site www.fluxmed.eu

a. Scientific and technological progress

The project started on 1 January 2020, due to the delay on fund availability of few partners. The SARS-Cov-2 pandemic and the related restrictions affected and delayed the activities of FLUXMED from March 2020. The main issue concerns the restrictions on people mobility and the new rules on the way of working of different categories of worker and administrations (Universities, public agencies, other administrations, private suppliers, etc.). Each country, also those interested by FLUXMED Project, has faced the Covid-19 pandemic differently, according to different times: total lockdown, partial lockdown, temporary suspension of specific economic activities, teleworking, shifting of workers, for instance. These changes required some time to come into effect and it has had some effect on the planned progress of the FLUXMED activities.

Following the description of scientific and technological progress achieved so far of WPs from 2 to 5 (WP 6 is going to start in November 2020). The description is listed according the WP/Task and the partner.

WP2 - Task 2.1: monitoring of experimental fields
WP2 - Task 2.2: monitoring of hydrologic basins

UNICA (Italy)
The monitoring of hydrological basins has been slowed considerably due to the Covid-19 pandemic. The limits imposed to the mobility had the effect to lose the first field campaign, whichwas planned to be done in the Flumendosa basin and in the Marganai park during the period of vegetation growth (spring and summer seasons).
The Flumendosa basin is located in central-eastern Sardinia and Flumendosa is the second longest river of the region with a length of 127 km. The northern part of the basin is mountainous with steep hill slopes and higher rain compared to the southern part. Two large dams, the Flumendosa dam at Nuraghe Arrubiu (reservoir capacity of 300 × 106 m3) and the Mulargia dam at Monte Su Rei, (reservoir capacity of 320 × 106 m3), collect runoff from a basin area of 934 km2. Due to its key role in the Sardinian water resources system, the Flumendosa basin became an experimental basin of the University of Cagliari, resulting in an extensive hydrological database.
The climate regime is typically Mediterranean. The mean annual precipitation (1922-2007) is 819 mm with strong seasonality and interannual variability: the mean historical monthly precipitation ranges from 9 mm in July to 124 mm in December. The mean historical monthly temperature ranges from a minimum of 7.1 °C in January to a maximum of 23.7 °C in July. Daily precipitation data from 31 rain gauge stations in and surrounding the Flumendosa basin and monthly runoff data at the basin outlet were collected for the period 1923 – 2020.
In the Flumendosa basin site, we have installeda10 m micrometeorological tower from September 2020. The tower includes a Campbell Scientific CSAT-3 sonic anemometer and a Licor-7500 CO2/H2O infrared gas analyzer at 10 m above ground to measure velocity, temperature and gas concentrations at 10 Hz for the estimation of latent heat, and sensible heat fluxes through standard eddy-correlation methods. Skin

temperature of the tree canopy and grass/bare soil patches (using IRTS-P by Apogee Instrument), incoming and outgoing shortwave and longwave radiation to derive net radiation (using CNR-1 by Kipp&Zonen), and soil heat flux and temperature (using HFT3 REBS) at two locations close to the eddy-covariance tower, combined to generate the energy budget, were monitored and half-hourly means were recorded. Precipitation was measured using a PMB2 CAE rain gauge. Seven frequency domain reflectometer probes (FDR, Campbell Scientific Model CS-616) were inserted in the soil close to the tower (3.3-5.5 m away) to estimate moisture at half-hourly intervals A hydrometric station for discharge measurements at the Mulargia section (area of about 65 km2) has been also installed in October 2020.
We also acquired and tested in the lab the 7 m tower and sensors that will be installed in the Marganai Park, as it was planned in the project proposal.

Cyl (Cyprus)

Adjustment of the case study research site: The Peristeronariver flows from its highest elevation at 1540 m above sea level along the northern slopes of the Troodos Mountains (750 mm annual average precipitation) to the Mesaoria plain, with its lowest elevation at 175 m above sea level (average annual precipitation of 270 mm). The main focus of the FLUXMED project research is on the Mesaoria plain, where rainfed agriculture is expected to become very marginal under climate change. For the scientific requirements of the Eddy Covariance system(relatively flat area with homogeneous land use) and our long-term monitoring objectives, we identified the Athalassa Forest park, 30 km east of the Peristerona Watershed, as a representative research site for the Mesaoria Plain. The selection of the site was made in consultation with the Ministry of Agriculture, Rural Development and Environment.
The Athalassa site has two different land covers next to each other: (i) agricultural site with rainfed barley with a legume rotation every 3rd or 4th year (20 ha) and (ii) a re-forested crop-field, planted with mixed, indigenous, drought-tolerant trees and shrubs (10 ha). Evapotranspiration and carbon fluxes from the agricultural field will be monitored with an Eddy Covariance system (partly funded through FLUXMED) and evapotranspiration from the forested site will be monitored with sapflow sensors, soil moisture sensors, rainfall/throughfall gauges and a meteorological station.

Design and acquisition of flux tower components: After identifying required technical specifications of the flux tower, the following scientific equipment has been purchased, which was partly funded by the FLUXMED project (15k): IRGASON open-path H20 and CO2 gas analyser with 3D sonic anemometer (Campbell Scientific), CR1000X data logger (Campbell Scientific), 3 soil heat flux sensors (Hukseflux), soil moisture sensors with loggers (Truebner), NR01 4-component net radiation sensor (Hukseflux), Hygroclip2 temperature and relative humidity probe (Rotronic) and 4-m tall aluminium tower (Campbell Scientific). The design of the tower has been completed and a location has been decided in collaboration with the Ministry of Agriculture. A detailed (cm accuracy) terrain digital elevation model has been created with structure-from-motion method, using a drone. The surrounding area of the tower (3m by 3.6 m) will be fenced with a 1.8-m tall chain-link fence. The tower is expected to be erected and be in full operation before the end of November 2020.

Methodological design and acquisition of scientific equipment for the Athalassa forested site: The detailed methodology and a plan of the research have been completed, with cooperation from the Forestry Department. Field surveys were performed for recording tree/shrub species, their stem characteristics and their locations in February and March 2020. A total of 2,400 trees/shrubs have been recorded. Biomass samples were collected in May 2020, to assess the seasonal undergrowth. A 3D digital surface model of the site was constructed from areal images taken with an Unmanned Aerial Vehicle (UAV) in August. Stomatal conductance and water potential measurements were made on different species for assessing the plant water stress in October 2020, after a 7-month long drought period. A total of 12 sapflow sensors, 45 soil moisture sensors and 12 dendrometers will be installed before the end of November 2020.

UNIAS (Egypt)

The study field was shifted to the North West coast area due to accessibility limitation and limited available ground data. The new site was presented in the Kick off Meeting and a site visit was carried out to the site to check the current condition and the available information.

CESBIO (France)

The rainfed Olive Tree site (Taous flux tower site) and remote data access are operational: is http://130.120.117.103/~incamadmin/Snapshot/TEST/SFAX.html ; a first batch of flux data (all 2019) has been processed and is currently used by a companion project (SEN-ET). Due to the COVID crisis, the auxiliary equipment scheduled to be installed in spring 2020 within the frame of FLUXMED could not be installed (low cost Thermal Infra Red cameras, sapflow sensors in the main roots).
Within the frame of Nesrine Farhani's PhD (CESBIO/INAT), ERA5 climate forcing for the whole 2000-2020 period (coincident with the MODIS remote sensing data availability) has been projected on the local Kaiouran plain using an original statistical weather generator (https://cran.r-project.org/web/packages/MetGen/MetGen.pdf; https://meetingorganizer.copernicus.org/Plinius16/Plinius16-21.pdf), and is used to produce evapotranspiration ET and water stress S using the SPARSE energy budget model.

INRGREF (Tunisia)

Eddy covariance observations on citrus orchards in Tunisia were recorded continuously. In the frame of FLUXMED, a teletransmission station at the site to remotely control the transmission of the eddy covariance data was installed. Also, in collaboration with a young innovative company, have installed new low cost soil moisture sensors (HS-BWS sensors) and compared them with (Campbell CS616). Gravimetric soil measurements are taken and are compared to those measured by the humidity sensors in order to calibrate the measurements. More sampling points are taken at short intervals (one each week) to distinguish the temporal variability of soil moisture.
Geophysical methods were used (electrical and ERT methods) associated with traditional methods of Soil Science for studying the spatial and temporal variability of soil moisture. The results provided us information on the:
- Spatial variability of the soil properties;

- Existence of a perched aquifer and on its geometrical characteristics in the depth;

- Depth and the preferential pathways of the irrigation water infiltration;

- Temporal variations of soil humidity related to evapotranspiration and weather conditions.

A research work was applied in order to provide a tool for spatio-temporal analysis and reconstruction of climate data, in order to obtain a uniform and complete series of data. This methodology is based on the statistical analysis of data observed at agro-climatic stations and re-analysis data (ERA5).

- Rain and stream flow are monitored, and we are collecting the data that will be checked for the accuracy; then uploaded to the FLUXMED on line database;

- we are collecting historical data of precipitation and temperature from European Center for Medium-Range Weather Forecasts

WP2 - Task 2.3: analysis of field observation data

UNICA

Using observed data from 2003 to 2018 in the Orroli site, we combined eddy-covariance estimates of evapotranspiration (ET) with sap flux and energy balance estimates of wild-olive tree transpiration. Proper accounting for heterogeneity of sources within the eddy covariance footprint seems to have overcome potential errors from not preserving an important assumption of the method, the land-surface homogeneity, highlighting the methods reliability in such inhomogeneous ecosystem. Compared to ET, transpiration of wild olives was nearly constant over the hydrologic year, insensitive to variation in soil moisture and atmospheric conditions. Under favourable spring environmental conditions, the pasture area transpires at high rates, contributing to, and dominating the high ET during that season. Conversely, in dry periods, when evapotranspiration from the grass cover is dominated by low evaporation from the, principally, bare soil, tree transpiration dominants ecosystem ET.
Because transpiration of wild olives was nearly constant during the observed period, including during the dry period, and the soil layer was thin, tree water requirement must be satisfied by another source of water, presumably the water in the underlying fractured rocks. Future efforts should investigate the role of water uptake by tree roots penetrating the rocks, its importance during the dry periods, and its impact on the seasonal and annual water balance.

INRGREF (Tunisia)

-We are following the vegetation growth at the watershed scale and the soil moisture changes, which will be compared to remote sensing observations.

- Analysis and data elaboration are performed for: control and quality check of data; estimation of ET components in agricultural plots and the estimation of relationships between ET and soil moisture.

WP 3 – Task 3.1 LSM-VDM calibration and validation at field scale

UNICA

The model was calibrated and validated for the Orroli field site using data of the eddy covariance tower collected during the 2003-2018 period. The calibrated soil water balance model well predict soil moisture and the evapotranspiration, with the evapotranspiration ranging from 4 mm/d in spring to less than 1 mm/d in summer. The other two modules of the model, vegetation dynamic model and energy balance module, allowed to well predict the other main ecohydrologic variables (net radiation, sensible heat flux, LAI).

UNIAS (Egypt)

Data collection from previous works carried out in the field area has already started.

CESBIO (France)

Within the frame of Wafa Chebbi's PhD (CESBIO/INAT, https://labo.obs-mip.fr/wp-content-labo/uploads/sites/20/2019/10/Th_Chebbi_2019.pdf) the ISBA Land Surface Model has been applied and confronted to the Nasrallah Site flux tower with a set-up identical to the Taous site (https://hess.copernicus.org/preprints/hess-2020-104/)

WP 3 – Task 3.2: Distributed ecohydrologic model at basin scale

UNICA

A new distributed ecohydrologic model has been developed, which coupled a distributed hydrologic model and a vegetation dynamic model (VDM). Three principal components can be identified in all models (Figure 6): 1) the flow paths and channel network definition, 2) the runoff computation, and 3) the overland flow and base flow routings. In the first component the flow path network is automatically derived from the DEM using the algorithm designated D8 (eight flow directions). In the second component, the runoff is computed for each elementary cell, using a land surface model (LSM), which includes one soil layer and computes surface runoff through Philip's infiltration excess mechanism. The third component performs the runoff routing throughout the hill slope and the river network, and the base flow routing. The runoff routing throughout the hill slope and the river network is performed via a diffusion wave scheme based on the Muskingum-Cunge method in its non-linear form with the time variable celerity. The VDM computes change in biomass over time from the difference between the rates of biomass production (photosynthesis) and loss, such as occur through respiration and senescence. VDM provides LAI values of WV and grass daily, which are then used by the LSM for computing the evapotranspiration estimate, energy flux and the soil water content in the root-zone.

CESBIO (France)
ET has been simulated using MODIS and Landsat8 remote sensing data with both EVASPA and SPARSE energy budget models over the Kairouan plain within the frame of Jordi Etchanchu's PhD (https://tel.archives-ouvertes.fr/tel-02459812/document) as well as Emilie Delogu's CNES sponsored research contract ; ET has also been simulated using the SEN_ET algorithm (combination of Sentinel 2 and 3 remote sensing data) over the Taous flux tower site for the year 2019 (https://www.mdpi.com/2072-4292/12/9/1433/htm; see https://www.mdpi.com/2072-4292/12/9/1433/s1 Figure S10)

WP 4 – Task 4.1 Acquisition of satellite images

UNICA
For the two sites, Flumendosa basin and Marganai park, the following satellite multispectral images for surface temperature and leaf area index (LAI) estimates have been acquired:
- Landsat: spatial resolution 30 m, temporal resolution 16 days
- SENTINEL 2: spatial resolution 10 m, temporal resolution 3 days
- NOAA AVHRR: 1spatial resolution 1 km, temporal resolution 1 day
- SEVIRI: spatial resolution 1 km, temporal resolution 15 min
- MODIS: spatial resolution 250 m, temporal resolution 1-2 day

UNIAS (Egypt)
RS data for the meteorological condition has already started.

CESBIO (France)
Landsat8 and MODIS remote sensing time series have been downloaded, as well as Sentinel 1 and 2 data, which complement the existing database (which includes land use maps and biophysical variables derived from remote sensing data such as leaf area index and surface soil moisture).

WP 4 – Task 4.2: estimation and validation of Ts and LAI

UNICA
For the two experimental sites, we have started to estimate LAI from NDVI using satellite near-infrared and visible bands, and Ts from satellite thermal infrared bands.

CESBIO (France)
The necessary biophysical parameters used as inputs in SPARSE and EVASPA (LAI, NDVI, fraction cover, surface temperature, emissivity, vegetation height) have been produced at L8 and MODIS overpass times.

WP 4 – Task 4.3: development of a data assimilation system

UNICA
The Ensemble Kalman filter (Enkf) has been implemented in the ecohydrologic model for assimilating LAI observations obtained from remote sensors. We are performing a sensitivity analysis of the data assimilation system to frequency of assimilation and to spatial resolution of satellite images.

CESBIO (France)
Chloe Ollivier has started on the 5th of October, 2020, a FLUXMED sponsored postdoc in order to assimilate ET generated with SPARSE and EVASPA from MODIS and L8 data into the SAMIR water budget and irrigation scheduling model.

WP5 – Task 5: analysis of historical hydrologic data(Leader: UNIAS)

UNICA
Daily precipitation data from 31 rain gauge stations in and surrounding the Flumendosa basin and monthly runoff data at the basin outlet were collected for the period 1923 – 2007. Air temperature data of 8 stations are available at the monthly scale, but only 4 stations are included because only these stations exhibit continuous observations for a time period greater than 50 years. Statistics were computed and analyzed on the annual and monthly series of precipitation, runoff and temperature. Spatially mean rainfall data were estimated using the Thiessen method. Temporal trends were estimated using the non-parametric Mann-Kendall test (MK). The Theil-Sen approach, a common non parametric method, is used for estimating the slope of the trend line. We also used the non parametric Pettitt's test for estimating potential change points of the annual runoff time series. We use the monthly NAO index time series of Hurrell (1995) available from 1864 onward. Hence, we explored the climate tendencies over this area. The historical yearly runoff decrease has been more pronounced than the yearly precipitation decrease, highlighting a high elasticity of stream flow of 2.18. Indeed from 1975 a sequence of dry periods has affected the Flumendosa basin. The changes of yearly runoff in the Flumendosa basin cannot be explained due to changes in climate through a first order Taylor approximation alone, because of the importance of inter annual variability in rainfall seasonality. The precipitation mainly decreased during the winter months when the wet soil humidity conditions and the atmospheric conditions (lower evaporative demand) generally produce high surface runoff. A significant negative correlation was found between winter precipitation and NAO, when the NAO has a strong impact on Mediterranean climate. The results confirm the sensitive of this Mediterranean local area to global climate changes and that the Mediterranean climate is one of the "hot spots" of future climate change.

Cyl (Cyprus)
We prepared a manuscript on the analysis of long-term throughfall data from the pine forest (2008-2019) and the application of different rainfall interception models.

b. Collaboration, coordination and mobility

UNICA

Collaboration

Despite the Covid-19 pandemic related issues, the collaboration between Partners is still effective, although the restrictions on people mobility make the activity slower and, in part, more difficult. If mobility restrictions hadn't been adopted, the collaboration would have been faster and smoother thanks to the possibility for the researchers involved to travel between Partners' countries, meet each others in presence, visit experimental fields. The Covid-19 Pandemic forces so far to exchange information between Partners only by video conference and on line tools such as cloud space, for data and documents sharing, and communication platforms. However, the collaboration is still effective, regular and continuous.
Regardless of slowdown in some first activities, the Project is progressing according to the tasks allocation among Partners described in the approved proposal. In addition to the usual communication activities between individual partners by skype call and e-mail, the two first Partners meetings were the opportunity to check each Partner contribution and the progress of activities assigned to each one.
Despite all of these, the Project is still meeting its transnational nature.

Coordination

The coordination and the overall organization of the Project is efficient, although some measures linked to the Covid-19 Pandemic, in particular those related to the reorganization of the Public Administrations offices (University included), have slowed down some activities.
During the total lockdown in Italy (March – May 2020), the Administration of the University of Cagliari (UNICA) had to adapt the general work organization of their offices and employees. This took some time and a delay in some management activities of the FLUXMED Project has been the consequence. Specifically, the competition for the engagement of the Assistant Project Manager (APM) was published in March 2020 and the selection process ended in June 2020. The APM started to work in July 2020.Because of this delay: the Data Management Plan (Deliverable 1.2.1),originally planned in June 2020, was drafted in August 2020 in a first version; the Deliverable D7.1.1 Dissemination and Communication Plan was prepared (Version 1.0) in September 2020 instead of June as planned.
The Kick-off meeting, originally planned in month 1 (January), took place in month 7 (July), and it was on line(video-conference) due to the travel restrictions.

UNICA is one of the Partner of Altos and SWATCH projects funded by PRIMA.

Regarding the mobility within the Consortium, unfortunately the Covid-19 pandemic didn't allowed researchers to travel abroad. Researchers interactions so far can only be only virtual through by web based channels.

Cyl (Cyprus)
As requested by the Cyprus Research and Innovation Foundation, the Cyprus Institute started the FLUXMED project contract on 1 October 2019. We will be able to request a no-cost extension, as needed, during the second halve of the project.
For the technical requirements and selection of the Eddy Covariance system components we received the scientific support from the Italian and French FLUXMED teams.
The Peristerona Watershed was identified both by the FLUXMED and the PRIMA-funded SWATCH Project (2020-2022), as a case study research site for Cyprus. The focus of the SWATCH Project research will remain on the Peristerona Watershed, especially the forested midstream and upstream area.

UNIAS (Egypt)
Due to the Covid-19 pandemic, meetings and site visits were limited and conducted only if necessary and could not be avoided.
No mobility abroad (outside Egypt) took place during this period of the project due to the mobility restriction caused by the Covid-19 pandemic. Yet the PI have conducted a trip to the new proposed field area to investigate the availability of data on site.
A meeting was held with a team from another Egyptian research institute working in the same area for experience transfer regarding the planned filed measurements campaign.

CESBIO (France)
We have discussed with Rim Zitouna from INRGREF the observation protocol for the Cap Bon Citrus flux site managed by INRGREF and CTA. We have bought and sent (with financial support from the MISTRALS SICMED2 program) 4 sapflow measuring devices, but the latter have not yet been installed due to the COVID sanitary crisis.
We have asked for Giuseppe Murrocu from UNICA an ERASMUS+ training mobility grant (1/02/2021 till 1/05/2021) in to CESBIO lab to complete the collection and analysis of high resolution remote sensing data for the Sardinia sites as well as the processing of those data to produce ET maps.
The Taous flux site and related scientific work is also sponsored by ALTOS PRIMA, TRISHNA CNES and MISTRALS SICMED2 projects

INRGREF (Tunisia)
Unfortunately, thefield activities were stopped during the lock down period. Also, some difficulties with administrative issues were occurred due to the COVID-19 situation.

c. *Impact and knowledge output*

As outlined above, since some partners obtained late the funding from the respective National Funding Authorities, the FLUXMED Project started late. Moreover, the restrictions on people mobility has delayed some of the scheduled activities. Hence, the Project hasn't yet achieved its impact so far.

3. Table of Deliverables

Please indicate whether the planned deliverables are completed, delayed or readjusted. Explain any changes/difficulties encountered and solutions adopted. Please add/delete rows, as necessary in the table below.

Deliverable name	**Lead partner (country)**	**Date of delivery (dd/mm/yyyy)**	**Changes, difficulties encountered and new solutions adopted**

Deliverable name	Lead partner (country)	Date of delivery (dd/mm/yyyy)	Changes, difficulties encountered and new solutions adopted
WP1			
D1.1 - Kick-off meeting and its minutes	UNICA (Italy)	31/01/2020	The Kick-off meeting was planned in January 2020, but it took place in July on line due to the travel restrictions. However, a preliminary video conference between Partners was held in order to discuss the first activities and plan the Kickoff Meeting that should have been in Cyprus.
D1.2.1- Data management plan(DMP)	UNICA (Italy)	30/06/2020	Because of the delay in the engagement of the Assistant Project Manager (APM), due to the slowdown of administrative activities linked to the lockdown in Italy, the DMP, originally planned in June, 2020, was drafted in August 2020.
WP7			
D7.1.1 - Dissemination and communication plan (DCP)	UNICA (Italy)	30/06/2020	Because of the delay in the engagement of the Assistant Project Manager (APM), due to the slowdown of administrative activities linked to the lockdown in Italy, the DCP, originally planned in June 2020, was drafted in September 2020.
D7.1.2 - Reports from participatory workshops	UNICA (Italy)	31/07/2020	Because of the restrictions on the people mobility and the organization of public events, it has not yet been possible to hold participatory workshops. All Partners are evaluating possible alternatives way, such as video conferences, on the basis of the evolution of the Pandemic.
D7.2.1- Project web site	UNICA (Italy)	*31/03/2020*	The project web site went on line in February 2020. The web site structure, already defined in the Dissemination and Communication Plan, will be implemented as soon as public tender (ongoing) to select the external professional is concluded.

4. Budget review

		PERSONNEL (Non permanent position) €			
Partner	Organization	Original	Spent	Spent/Original (%)	Remaining
Coordinator	UNICA	95000,00	12458,58	13,1%	82541,42
Partner 1	Cyl	115800,00	30000,00	25,9%	85800,00
Partner 2	UNIAS	24000,00	0,00	0,0%	24000,00

Partner 3	CESBIO	70614,60	4000,00	5,7%	66614,60
Partner 4	INRGREF	0,00	0,00		
	Total	**305414,60**	**46458,58**	**15,2%**	**258956,02**

			Equipement (€)		
Partner	Organization	Original	Spent	Spent/Original (%)	Remaining
Coordinator	UNICA	10000,00	10000,00	100,0%	0,00
Partner 1	Cyl	15000,00	15000,00	100,0%	0,00
Partner 2	UNIAS	10000,00	0,00	0,0%	10000,00
Partner 3	CESBIO	25000,00	0,00	0,0%	25000,00
Partner 4	INRGREF	0,00	0,00		
	Total	**60000,00**	**25000,00**	**41,7%**	**35000,00**

			Travel &Subsistence (€)		
Partner	Organization	Original	Spent	Spent/Original (%)	Remaining
Coordinator	UNICA	20000,00	0,00	0,0%	20000,00
Partner 1	Cyl	10000,00	0,00	0,0%	10000,00
Partner 2	UNIAS	6000,00	0,00	0,0%	6000,00
Partner 3	CESBIO	25000,00	0,00	0,0%	25000,00
Partner 4	INRGREF	6000,00	0,00	0,0%	6000,00
	Total	**67000,00**	**0,00**	**0,0%**	**67000,00**

			Consumables (€)		
Partner	Organization	Original	Spent	Spent/Original (%)	Remaining
Coordinator	UNICA	2000,00	51,24	2,6%	1948,76
Partner 1	Cyl	2000,00	0,00	0,0%	2000,00
Partner 2	UNIAS	1000,00	0,00	0,0%	1000,00
Partner 3	CESBIO	0,00	0,00		
Partner 4	INRGREF	5000,00	649,07	13,0%	4350,93
	Total	**10000,00**	**700,31**	**7,0%**	**9299,69**

			Sub contracting (€)		
Partner	Organization	Original	Spent	Spent/Original (%)	Remaining
Coordinator	UNICA	0,00	0,00		
Partner 1	Cyl	0,00	0,00		
Partner 2	UNIAS	5000,00	0,00	0,0%	5000,00
Partner 3	CESBIO	0,00	0,00		
Partner 4	INRGREF	18000,00	7358,37	40,9%	10641,63
	Total	**23000,00**	**7358,37**	**32,0%**	**15641,63**

			Other Costs (€)		
Partner	Organization	Original	Spent	Spent/Original (%)	Remaining
Coordinator	UNICA	800,00	286,00	35,8%	514,00
Partner 1	Cyl	3000,00	0,00	0,0%	3000,00
Partner 2	UNIAS	3000,00	0,00	0,0%	3000,00
Partner 3	CESBIO	0,00	0,00		
Partner 4	INRGREF	6000,00	0,00	0,0%	6000,00
	Total	**12800,00**	**286,00**	**2,2%**	**12514,00**

			Overheads (€)		

Partner	Organization	Original	Spent	Spent/Original (%)	Remaining
Coordinator	UNICA	22000,00	0,00	0,0%	22000,00
Partner 1	Cyl	29160,00	0,00	0,0%	29160,00
Partner 2	UNIAS	0,00	0,00		
Partner 3	CESBIO	9649,17	0,00	0,0%	9649,17
Partner 4	INRGREF	0,00	0,00		
	Total	**60809,17**	**0,00**	**0,0%**	**60809,17**

		Total with Overheads (€)			
Partner	Organization	Original	Spent	Spent/Original (%)	Remaining
Coordinator	UNICA	149800,00	22795,82	15,2%	127004,18
Partner 1	Cyl	174960,00	45000,00	25,7%	129960,00
Partner 2	UNIAS (a)	49000,00	0,00	0,0%	49000,00
Partner 3	CESBIO	130263,77	4000,00	3,1%	126263,77
Partner 4	INRGREF	35000,00	8007,44	22,9%	26992,56
	Total	**539023,77**	**79803,26**	**14,8%**	**459220,51**

Note
(a) The project fund was transferred to the project account by April 2020. The main expenses till date were made for personnel (permanent position) working in data collection and report and presentation preparing). Minor part of the fund was also spent on consumables for office work.
The process of equipments' purchasing has already started, yet a lot of paper work should be made and already ongoing before paying to the supplier and receiving the equipments.

5. Consortium Meetings

Please list below the Consortium meetings which took place during the reporting period, by filling in the table below. Add/delete rows as necessary in the table below.

N°	Date	Location	Attending partners	Purpose/ main issues/main decisions?
1	18/02/2020	On line	All the partners	- Planning of the Kickoff Meeting - Discussion on project web site structure and contents - Coordination about activities on field activities - Discussion on Ecohydrological models, remote sensing and data assimilation
2	08/07/2020	On line	All the partners	- Introduction by Partner Coordinator (meeting presentation and project schedule) - Presentation by each partner on WP activities and contents (description on ongoing and oncoming activities) related to: case studies, experiments, databases, models; contract staffs, partnerships; work trips, calendar; links with other projects - Discussion on milestones and deliverables - Discussion on issues related to the Covid-19 Pandemic

6. Stakeholder/Industry Engagement

Maximum 1 page

UNICA (Italy)

A main part of the proposed project is the dissemination and exploitation activities to stakeholders (ENAS and FORESTAS) and scientific community. In particular UNICA started to organize start-up stakeholder meetings in all case studies to tap into the knowledge and experience of all local stakeholders and fine-tune the planning of the monitoring and modelling activities, and identify acceptable scenarios in view of simulated impacts

Cyl (Cyprus)
We have explained the objectives of the FLUXMED project and discussed the research in a meeting with the Chief Forester of the Forestry Department, Ministry of Agriculture, Rural Development and Environment. After the meeting, we shared a detailed written methodology, which included data on the species and biomass of annuals collected by us at the Athalassa research site, and a time plan for the research. We also met with officers from the Forestry Department and Agriculture Department on site three times for sharing research ideas and knowledge and for improving the research design. Through these exchanges, we obtained permissions for installing the equipment at the site.

The Cyprus Institute is in close collaboration with governmental authorities for the exchange of data and knowledge, including the Department of Forests, Department of Agriculture, Water Development Department, Geological Survey Department and Department of Meteorology.

An invited presentation on the long-term monitoring on the evapotranspiration of a Pinus brutia forest was made by the Cyprus Institute's Marinos Eliades at the 2nd meeting of Cyprus Association of Professional Foresters in November 2019.

UNIAS (Egypt)
During the site visit of the planned experimental field area, meeting was held with the Sustainable Development Centre in the area and a Memorandum of Understanding is planned to be signed with them for future cooperation during the project period.
No dissemination activities were conducted due to the Covid-19 Pandemic.

CESBIO (France)
The Taous Flux Tower site is managed together with the Institut de l'Olivier in Sfax, which beneficits from its research outputs on the quantification of water use.

INRGREF (Tunisia)
We have established an agreement with CTA and the Bewireless solution start-up company. This latter is a Tunisian company specializing in the field of IOT (Internet of Things). It offered us a range of wireless soil moisture sensors(HS-BWS) which allowed to take automatic measurements that were remotely transmitted to a central server. The measurements can then be viewed on the "Bewireless Solutions" application developed by the same company. This application provides several features:

- Provide an overview of the plots and the sensors installed.
- Real-time data visualization.
- Data extraction in different formats (Excel).
- low cost

They also offered us a teletransmission of the data from the eddy covariance station.

So far, we have realised a training session in "downloading and processing ERA5 data". The session was carried out at 28/08/2020 in the agroclimatic laboratory (INRGREF),that lasts 4 hours with the presence of 8 young researchers. The main goal was to learn how to download ERA5 data using multiple methods (Copernicus Climate Data Store, Toolbox Editor, and CDS API), and then read and process these data using R software.

7. List of Publications produced by the Project - Open Access

International	Peer-reviewed journals	**Partner: CESBIO (France)** 1.Chebbi, W., Rivalland, V., Fanise, P., Boone, A., Jarlan, L., Chehab, H., Chabaane, Z. L., Le Dantec, V., and Boulet, G.: *Modelling of water and energy exchanges over a sparse olive orchard in semi-arid areas*, Hydrol. Earth Syst. Sci. Discuss., in review, 2020. Website: https://doi.org/10.5194/hess-2020-104, **Partner: UNICA (Italy)** Montaldo, N., Curreli, M., Corona, R., Oren, R., Fixed and variable components of evapotranspiration in a Mediterranean wild-olive - grass landscape mosaic, *Agricultural and Forest Meteorology*, Volume 280, 15 January 2020, Article number 107769, 10.1016/j.agrformet.2019.107769 Montaldo, N., Curreli, M., Corona, R., Saba, A., Albertson, J.D., Estimating and modeling the effects of grass growth on surface runoff through a rainfall simulator on field plots, *Journal of Hydrometeorology*, Volume 21, Issue 6, 2020, Pages 1297-1310, 10.1175/JHM-D-20-0049.1
	Books or chapters in books	**Partner: CESBIO (France)** 1.Boulet G., JarlanL., OliosoA., Nieto H., *Evapotranspiration in the Mediterranean region* in Zribi M., Brocca L., Tramblay Y., Molle F. "Water Resources in the Mediterranean Region, 1st Edition", chapter 2 (pp 23-49), May 2020 (ISBN: 9780128180860) Website: https://www.elsevier.com/books/water-resources-in-the-mediterranean-region/zribi/978-0-12-818086-0
	Communications (presentations, posters)	1. 2. 3.
National (separate lists for each nationality)	Peer-reviewed journals	1. 2. 3.
	Books or chapters in books	1. 2. 3.
	Communications (presentations, posters)	1. 2. 3.
Dissemination initiatives	Popular articles	1. 2.

		3.
	Popularconferences	**Partner: Cyl (Cyprus)** 1.Long-term monitoring on the evapotranspiration rates of a Pinusbrutia forest, Marinos Eliades. Presentation at 2nd meeting of Cyprus Association of Professional Foresters, November 2019
	Others	1. 2. 3.

8. Knowledge output transfer

INRGREF (Tunisia)

Short Title	meteorological data and time series of energy fluxes observations
Knowledge Output Description	The meteorological data (precipitation, global radiation, wind speed, and both air temperature and air humidity) are measured by the climatic station installed in CTA on a hourly basis. The energy fluxes allow us to observe the annual variations of actual evapotranspiration from the eddy covariance station. And to assess irrigation scheduling especially at dry seasons..
Knowledge Type	* data
Link to Knowledge Output	

Sectors & Subsectors	• Basin Management
	• Flood Risk Management
	• Water Scarcity and Droughts
	• Others
	  ○ Agriculture
	  ○ Modelling & Prediction
	  ○ Socio-Economics

End User *Choose as many options as required* *Per identified End User, please identify possible applications of the Knowledge Output.*	oEducation & Training o Environmental Managers & Monitoring o Policy Makers / Decision Makers o Scientific Community
IPR .	
Policy-Relevance	
Status	The knowledge outputs are generated as thing progress

Short Title	Soil water content measurements and irrigation data

Knowledge Output Description	Periodically gravimetric soil moisture measurements are affected and then compared to soil moisture results obtained from the humidity sensors in order to obtain a calibration equation that will help us correct the errors generated during the measurements. Soil samples were collected within the horizons for the determination of bulk density, soil water retention at field capacity and permanent wilting point . These measurements will help us to manage the water consumption for the irrigation especially with water resources scarcity.
Knowledge Type	* data
Link to Knowledge Output	
Sectors & Subsectors	• Flood Risk Management • Water Scarcity and Droughts • Others o Agriculture o Socio-Economics
End User Choose as many options as required Per identified End User, please identify possible applications of the Knowledge Output.	o Education & Training o Environmental Managers & Monitoring o Policy Makers / Decision Makers o Scientific Community
IPR .	
Policy-Relevance	
Status	The knowledge outputs are generated as thing progress

Short Title	Vegetation growth and biomass
Knowledge Output Description	To adapt to climate changes we are testing intercropping as agricultural practices, we installed forage crop (vetch, oat, and triticale) between citrus and calculating their biomass.
Knowledge Type	* data
Link to Knowledge Output	
Sectors & Subsectors	• Water Scarcity and Droughts • Adaptation to Global Change • Others o Agriculture
End User *Choose as many options as required* *Per identified End User, please identify possible applications of the Knowledge Output.*	o Education & Training o Environmental Managers & Monitoring o Policy Makers / Decision Makers o Scientific Community
IPR	

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Policy-Relevance	
Status	The knowledge outputs are generated as thing progress

9. Open Data

In relation to Open Data, the funded projects will be requested to submit metadata on all the resources directly generated by the project, as well as additional information on how these data will be exploited, if and how data will be made accessible for verification and re-use, and how it will be curated and preserved. Metadata on all project resources are required to be submitted as part of the final reporting. This will be done via the **Open Data & Open Access platform**, available at: http://opendata.waterjpi.eu/ (also accessible from the bar menu of the Water JPI website).

10. Problems Encountered during Project Implementation

UNICA (Italy)

Overall, the mains problems are related to the restrictions from Covid-19. Restrictions that:

- delayed some activities, such as: the monitoring of hydrological basins, the engagement of the Assistant Project Manager, the carrying out of the Kickoff Meeting, the production of some deliverable (Data Management Plan, Dissemination and Communication Plan)
- didn't allowed other activities, such as: the possibility to attend the partners meeting in presence, the organization of workshops and, in general, the possibility of travel abroad

Cyl (Cyprus)

Lock-down due to Covid-19 delayed field data collection, research design and installation of instrumentation approximately by three months.

UNIAS (Egypt)

The Covid-19 Pandemic affected the work progress due to the shutdown period of the governmental institutes then the work with limitation (only online). This have also minimized the outdoor activities such as site visit and field data collection.

CESBIO(France)

Mobility has been hindered in 2020 from March on.

INRGREF (Tunisia)

unfortunately we have faced multiple problems that impeded the progress of the project:

-The COVID-19 pandemic that hindered the researchers mobility and the realisation of seminars, aseveral workshops, and the meetings with the farmers.

-Problems with finance : all the finance were allocated to consumables (problem recently resolved).

-Problems with field and administration procedures (lockdown of field missions)

11. Suggestions for improvement regarding project implementation?