



*European Research Area
for Climate Services*

SERV_FORFIRE

Report on the Case study demonstration

M.5

Issued on 31/10/2019

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1. Fire risk estimation: pre-fire phase

1.1 Demonstration of the six-week forest fire danger outlooks in Finland

Contribution by FMI: Vajda A, Wolff C., Hyvärinen O.

The statistical model developed in the first phase of the project to predict the seasonal and sub-seasonal (six week) forest fire danger have been first evaluated for Finnish conditions followed by a demonstration of the sub-seasonal forest fire risk outlook prototype with users during the summer season 2019.

The model was evaluated using re-forecast data from ECMWF's extended range forecast system (EPS) and seasonal forecast system (SEAS5) (ECMWF 2016, 2018) for the time period 2008 to 2016. The predicted FFI and the input parameters were verified against observations using standard verification methodologies. The predicted potential fire risk (FFI>4.0) was underestimated by the model for both sub-seasonal and seasonal scale. On sub-seasonal scale temperature had the highest skill of the parameters, but the skill of both and RH was lower consisting of a significant drop after the first lead week (Fig. 1). Following the evaluation, model improvements have been done, e.g. including an adjustment period of one week from observations, thus the model is initialized with the current soil conditions which fosters the stabilization of model.

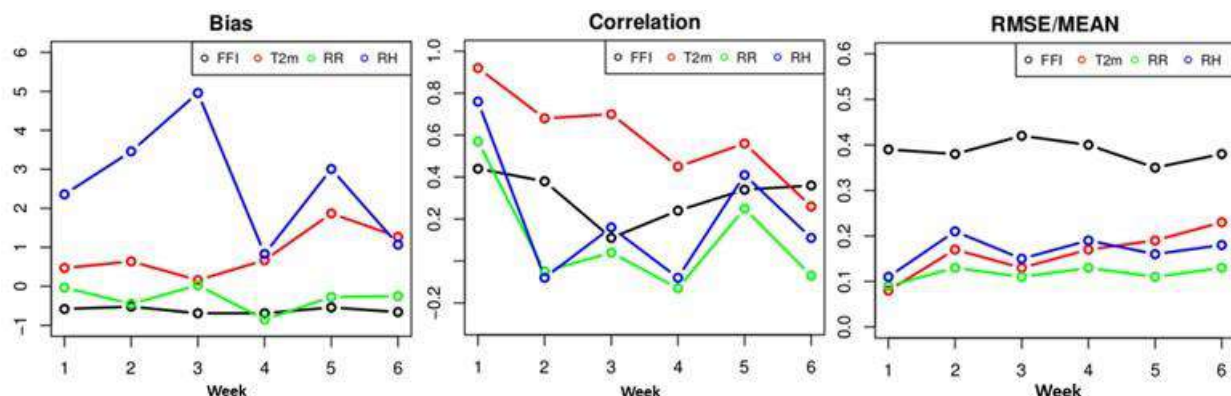


Figure 1 - Verification metrics (bias, correlation and RMSE/MEAN) for predicted FFIs and the input parameters (T, RR and RH). The weekly mean metric is calculated for various lead weeks (weeks 1 to 6) for the time period 2008-2016.

The developed statistical model was used in the production of sub-seasonal forest fire risk outlooks prototype, which is being piloted with end-users during summer season 2019. The users testing the prototype were the Regional State Administrative Agency from Northern Finland, Finnish Rescue Services - North Karelia and Department for Rescue Services from the Ministry of the Interior. The use of sub-seasonal forest fire risk outlook would allow Rescue Services to prepare in advance and plan the fire survey flights according to the expected risk.

The six-week (sub-seasonal) fire risk outlooks were produced operationally and delivered twice a week to the Rescue Services during June–September. The outlooks expressed the probability forecast of forest fire risk for Finland. For the production and dissemination of the six week outlooks the operational service set-up earlier in FMI within the SA CLIPS project for the extended-range forecast products was utilized which implies a fully operational and automatized

run. A detailed description of the operational service is given in Vajda et al. (submitted), the schematic diagram of the production flow and data processing steps used in the operational production and dissemination of the outlooks are presented in Figure 2.

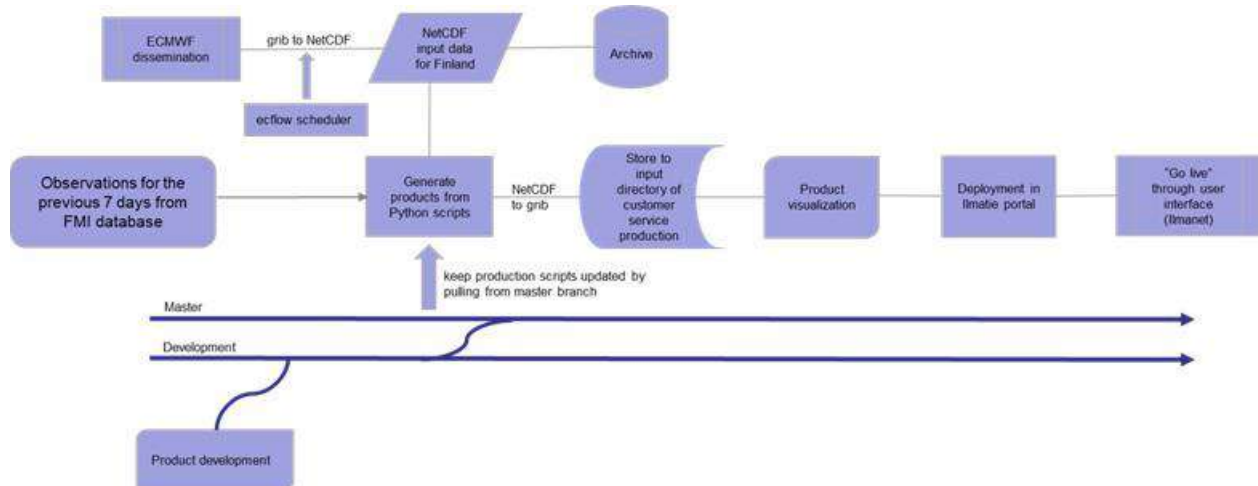


Figure 2 - The schematic diagram of the production flow and data processing steps used in the operational service of the six week fire risk outlooks (modified from Vajda et al. submitted).

The “real-time” forecast of 2 m temperature, total precipitation and relative humidity were extracted from ECMWF EPS system. The retrieval of parameters was automatized using the dissemination stream from FMI’s operational system. A typical production run begun after a new forecast has been disseminated to FMI, i.e., every Monday and Thursday. The climate outlooks were communicated with the pilot users through an online user interface implemented by the research team. Once the updates of the climate outlook were brought into production, the produced weekly maps were exported first to an internal management tool (Ilmatie) where the product and its content was organized and the finalized sub-seasonal fire risk outlooks were displayed on the user interface, i.e., the Ilmanet service platform, which end-users have had access to. The climate outlooks displayed included six static weekly maps presenting the predicted forest fire risk conditions for Finland during the forecast week expressed as probability and an animated runs of the weekly maps showing fire weather conditions during the weeks 1-6 (Fig. 3). Daily probabilities were defined as the percentage of forecast ensemble members indicating a fire risk, i.e. $FFI \geq 4$. Weekly probabilities were defined as the weekly mean of daily probabilities. Finally, these probabilities were expressed as probability categories between 5% and 95%. The updated climate outlooks were available for the users every Tuesday and Friday. The first climate outlooks were released in June and the run continues until the end of fire season (September).

Following the release of first six week forest fire risk outlook informational material was provided and a guiding session was organized for the users in order to facilitate the use and interpretation of forecasts.

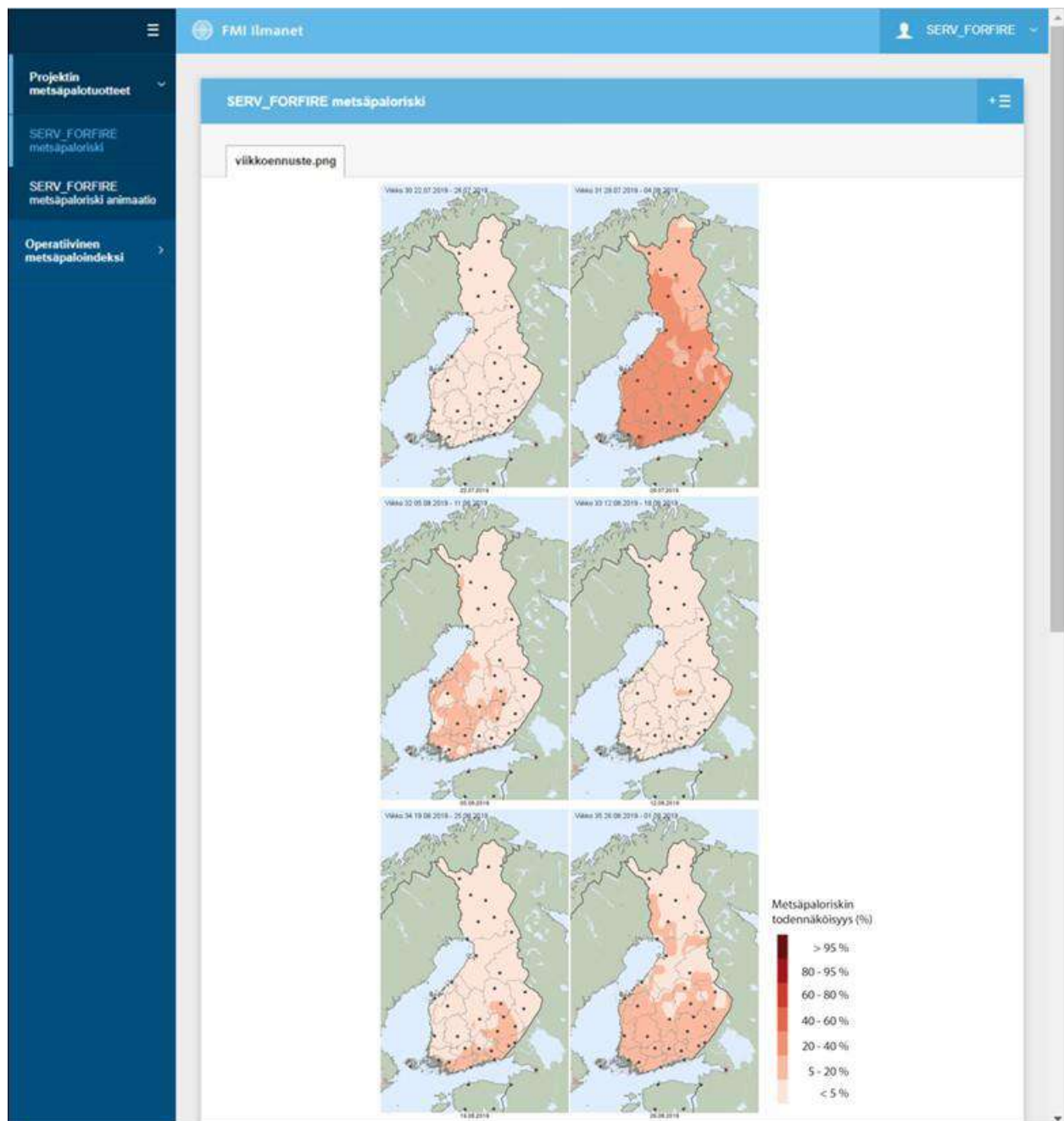


Figure 3 - The sub-seasonal forest fire risk outlooks and the user interface of the operational service; here presenting an example issued on July 19, 2019, the maps express the weekly probabilities of fire risk weather for the upcoming six weeks.

Although a detailed verification of the fire season 2019 forecasts was not possible due to the low sample of forecasts available a simple verification test was run to examine the performance of six week outlooks. The FFI forecasts for the weeks 1...3 have during May-August 2019 have been tested against observed weekly FFI values (Fig. 4) for two regions: south and north of 65° latitude (Southern and Northern Finland). The correspondence between predicted and observed forest fire risk indicates that forecasts tended to underestimate the forest fire risk for both regions, very high fire risk (FFI>5) has not been forecasted at all. The accuracy of forecasts is lower after the first week.

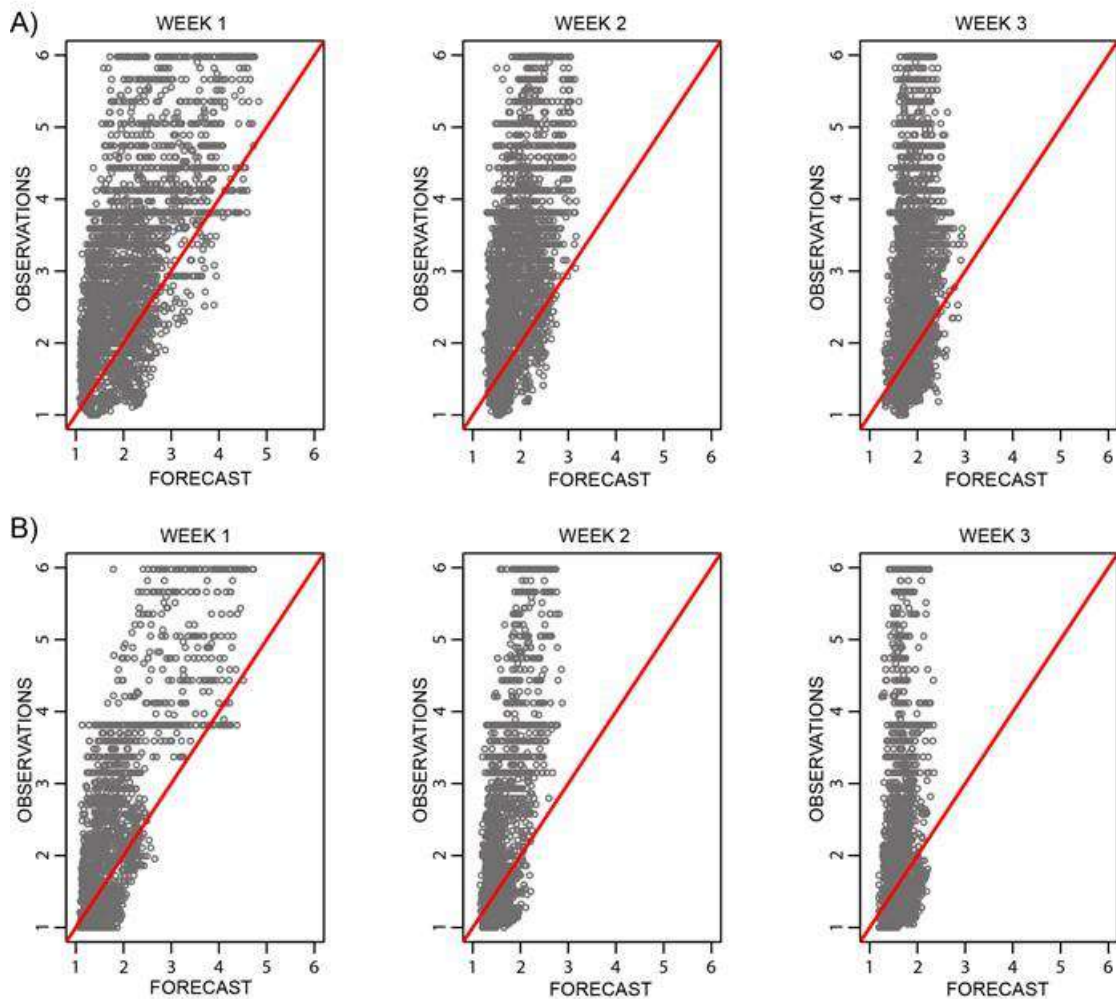


Figure 4 - Scatter-plots of observed and forecasted weekly mean FFIs for weeks 1...3 for (A) Southern Finland and (B) Northern Finland during May-August 2019.

The input parameters of the model, e.g. weekly means of 2m temperature, precipitation and relative humidity were also tested against observed values as shown in Fig. 5 (here shown the results for Southern Finland).

In summary to increase the reliability of developed and piloted sub-seasonal forest fire risk forecasts prototype for Finland further post-processing of the input variables is required, i.e. bias adjustment of input variables is needed to improve the skill of the model data. As the verification tests indicated the prediction skill of relative humidity is very low, thus for an improved version of statistical model we consider not using the relative humidity at all. Also, the comparison of weekly forecasted and observed FFI indicated an oversized role of temperature in the statistical model compared to precipitation, which should be equilibrated.

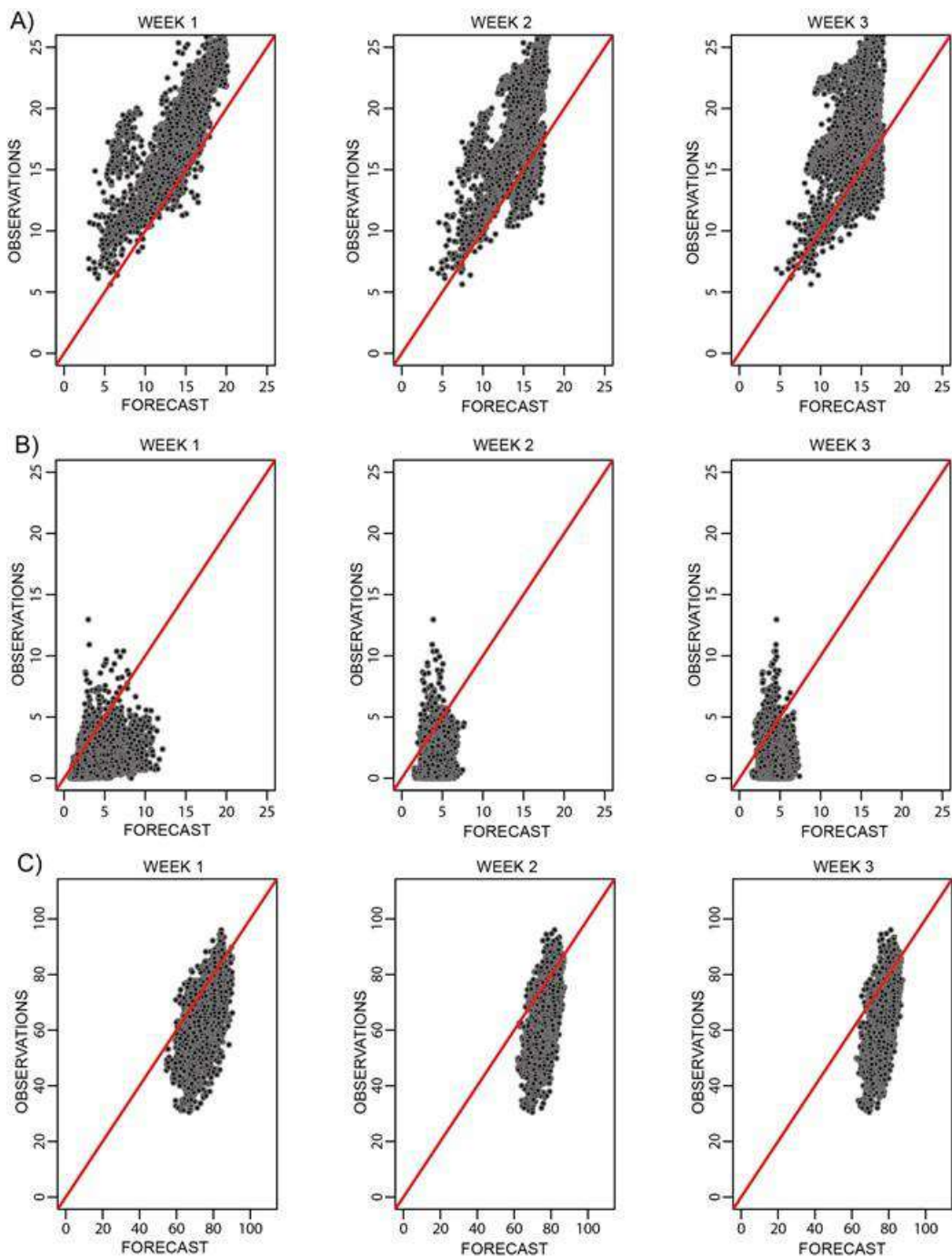


Figure 5 - Scatter-plots of observed and forecasted weekly mean (A) temperature, (B) precipitation and (C) relative humidity values for weeks 1...3 during May-August for Southern Finland.

The experience and value of six week forest fire risk outlooks for stakeholders is tested through a feedback survey at the end of the season; the surveys have not been returned by stakeholders yet.

1.2 Iberian Wildfires during Hurricane Ophelia in October 2017

Contribution by FMI: Partanen T., Sofiev M.

In our case study, we examine Iberian forest fires during tropical storm Ophelia which took place in October 2017. Ophelia formed over the eastern Atlantic Ocean on the 9th of October and dissipated over Europe on the 17th of October. Already-burning forest fires in Iberia accompanied by hot and dry air were further aggravated by Ophelia as it passed by off the coast of Portugal on the 15th of October. High winds from Ophelia fed and quickly spread wildfires resulting in an exceptional firestorm and devastation in Portugal and Spain. Figure 6 illustrates a snapshot of a data animation of the forest fires in Portugal, Spain, and North Africa during the storm Ophelia roughly when it was closest to Portugal. The particularly strong and intensive forest fires in Portugal can be seen in the figure. The storm induced and carried a great deal of air pollutants in the form of a mixture of dust from the Saharan Desert, sea-salt from the Atlantic Ocean, and smoke from the Iberian forest fires into Europe and beyond. The pollutants worsened visibly the air quality in Europe, especially in the UK. We studied two aspects of the Iberian wildfires during Ophelia, namely the evolution of the emitted fire radiative power (FRP) and the dispersion of particulate matter (PM) emissions from the fires.

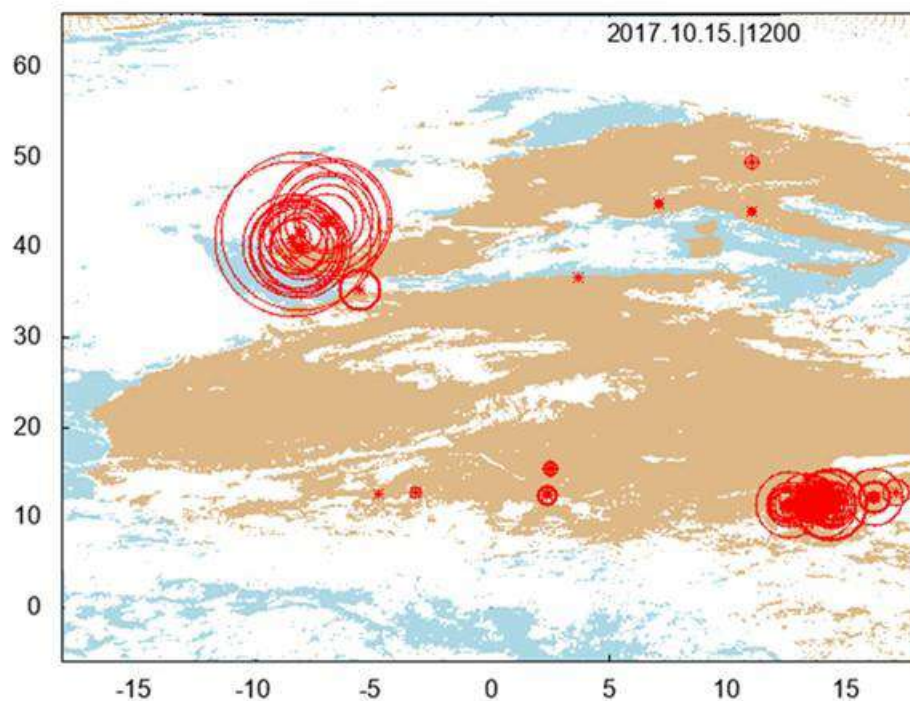


Figure 6 - Wildfires detected by SEVIRI on the 15th of October in 2017 at 12:00 UTC. The size of the red circle represents the amount of FRP a fire emits.

In one of our two cases, we split Portugal into areas of size $1.44^\circ \times 1.44^\circ$ and investigated in detail the evolution of FRP emitted by each area. Our interest in this case lies in the possibility to forecast future wildfires in Portugal by appropriately parameterizing for this purpose our developed fire prediction method that already shows promise in predicting African grassland fires reasonably well. As an example, Fig. 7 shows FRP from fires over the period of Ophelia in one of the areas located roughly in the center of Portugal. The FRP patterns in the figure resemble

the ones that arise from the African grassland fires, which makes us cautiously optimistic that predicting Portuguese forest fires may be doable at least in extreme cases like Ophelia.

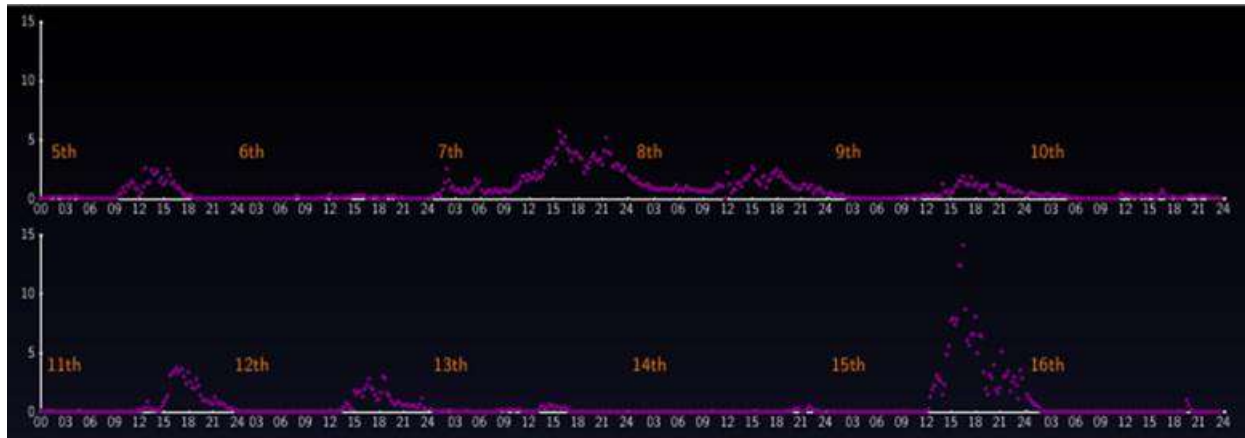


Figure 7 - FRP emitted by the 1.44°×1.44° sized area at 7.92W 41.04N in Portugal between the 5th and 16th of October 2017 observed by SEVIRI. The vertical axis is in units of GW and the horizontal one is the local time of Portugal in the 24-hour clock format. The days from the 13th to the 16th are cloudy and the rest of the days either a little bit cloudy or cloudless. Notice the strong power peak on the 15th day despite the area is heavily covered by clouds.

In the other case, we made two simulation runs by using the SILAM dispersion model with two different fire datasets: one for SEVIRI instrument and one for MODIS one. Figures 8 and 9 illustrate snapshots of a fire-induced particulate matter (PM) concentration simulation over Europe. The simulation exploited SEVIRI FRP data and were performed by using the SILAM model. The figures represent, respectively, the concentration distributions on the day Ophelia hit the coast of Portugal and two days later after it had subsided over Norway. Ophelia transported the smoke plumes from the fires in Iberia towards northwest Europe in the direction of its trajectory. Plumes with relatively high PM concentrations were quickly transported over large distances across Europe all the way far to Russia. The total disagreement between the simulated emissions is about 20 % between the two sets of fire sources, SEVIRI and MODIS. The discrepancy may be explained by the differences between the two instruments in their temporal resolutions and sensitivities to detect fires. The simulated PM emissions may be too low, since many of the fires are covered by clouds and thus undetected by satellites.

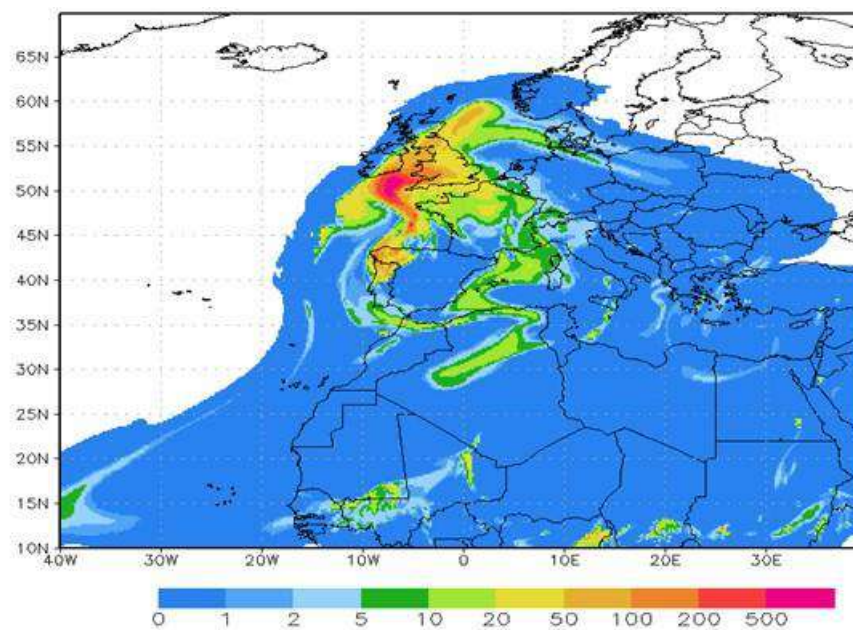


Figure 8 - Concentration of PM 0.05 - 20 μm in units of $\mu\text{g}/\text{m}^3$ based on FRP observed by SEVIRI on the 15th of October in 2017 at 12:00 UTC.

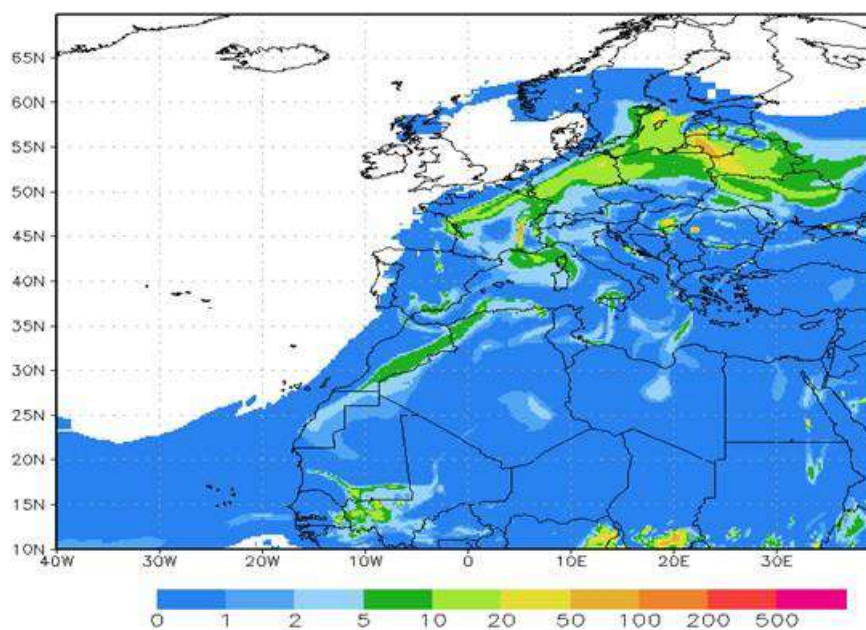


Figure 9 - Same as Fig. 1, but for the 17th of October in 2017 at 1200 UTC.

1.3 Trend Assessment of Drought Condition for the Tuscany region pilot area

Contribution by CNR-IBE: Pasqui M.

We propose a trend test for the different classes of drought risk based on the Poisson process (Di Giuseppe et al., 2019). In the framework of the time series of SPEI values calculated at a specific time scale and for a given month, we can consider the inter-arrival times—years in this case—between drought episodes as independent and identically distributed. Consequently, the point process becomes a counting process and the natural distribution used to describe such a counting process is the Poisson distribution. Furthermore, if the arrival rate does not remain constant through time, then it follows a Non-Homogeneous Poisson Process (NHPP). We consider the use of a special case of the NHPP: the power law process.

An advantage of using a counting process approach for testing the trend, in the case of those drought indexes that allow for thresholds definition, is the possibility of distinguishing the results among different classes of risk. This is particularly useful for risk management, such as the management of water resources. Thus, the characterization of the type of drought risk, that is to know whether in a specific area the increasing of drought episodes regards the extreme or the moderate ones, is intrinsically important. We also compare the NHPP method with a standard one: the Mann-Kendall.

We used the CRU TS v.4.03 gridded time-series dataset, released by Climatic Research Unit, University of East Anglia and applying a dry mask with a 3 mm monthly threshold that guarantees from errors in the SPEI computation.

The phase of data preparation for trend analysis is composed of two parts: (1) the computation of SPEI time series from precipitation and evapotranspiration data at 3-, 6-, 12- and 24-month scale of aggregation; and (2) the sub-setting of SPEI time series for each month of the year. The final output of this phase is represented by 48 time series resulting from the 4 aggregation scales (3-, 6-, 12- and 24-month) multiplied by the 12 months of the year (Figure 10). Thus, for each month, we have a time series of 118 values corresponding to the number of years in the time window 1901–2018. Let us label the SPEI time series as SPEI-3, SPEI-6, SPEI-12, and SPEI-24 according to the scale of aggregation such that, for example, the time series of SPEI at 6-month for March is briefly indicated as SPEI-6 March.

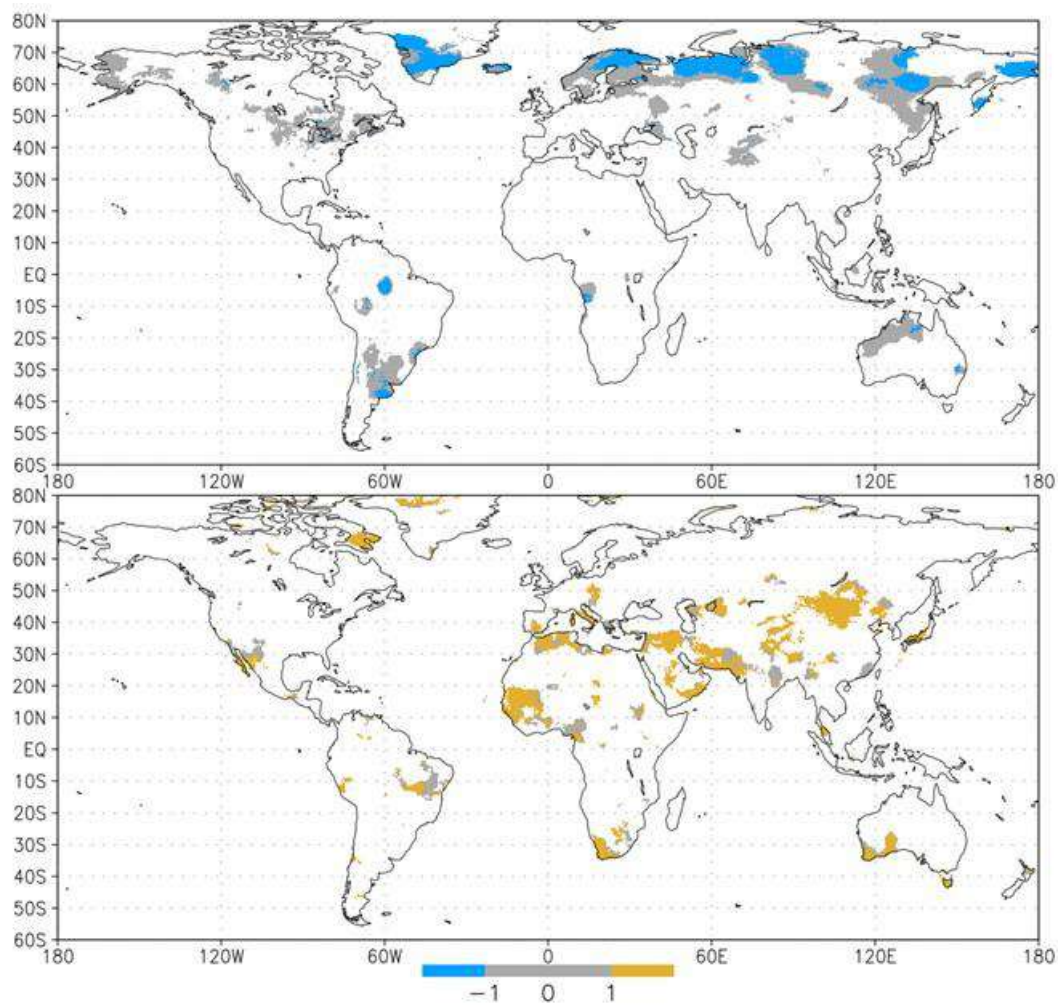


Figure 10 - Spatial distribution of cases where the M-K gives a negative (top) and positive trend (bottom) and the response of the NHPP test on the same areas for SPEI-6 March: In the top panel, the M-K negative trend cases are blue and grey, while the NHPP non-significant trends are in grey. In the bottom panel, the M-K positive trend cases are yellow and grey, while the NHPP non-significant trends are in grey.

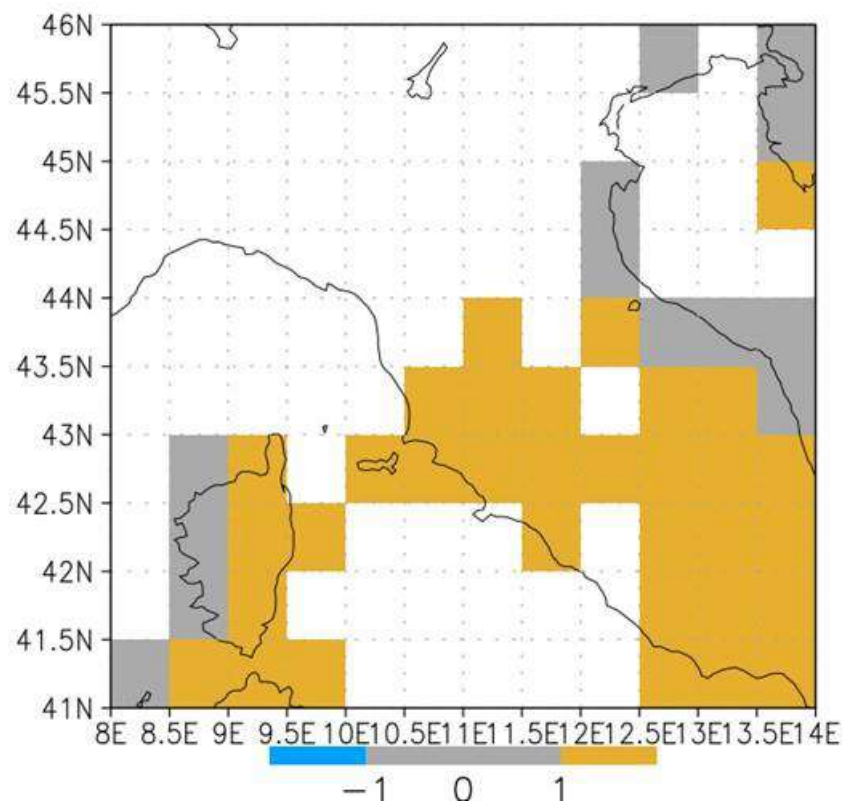


Figure 11 - Same as Fig.1-bottom, but for the pilot target area of Tuscany region.

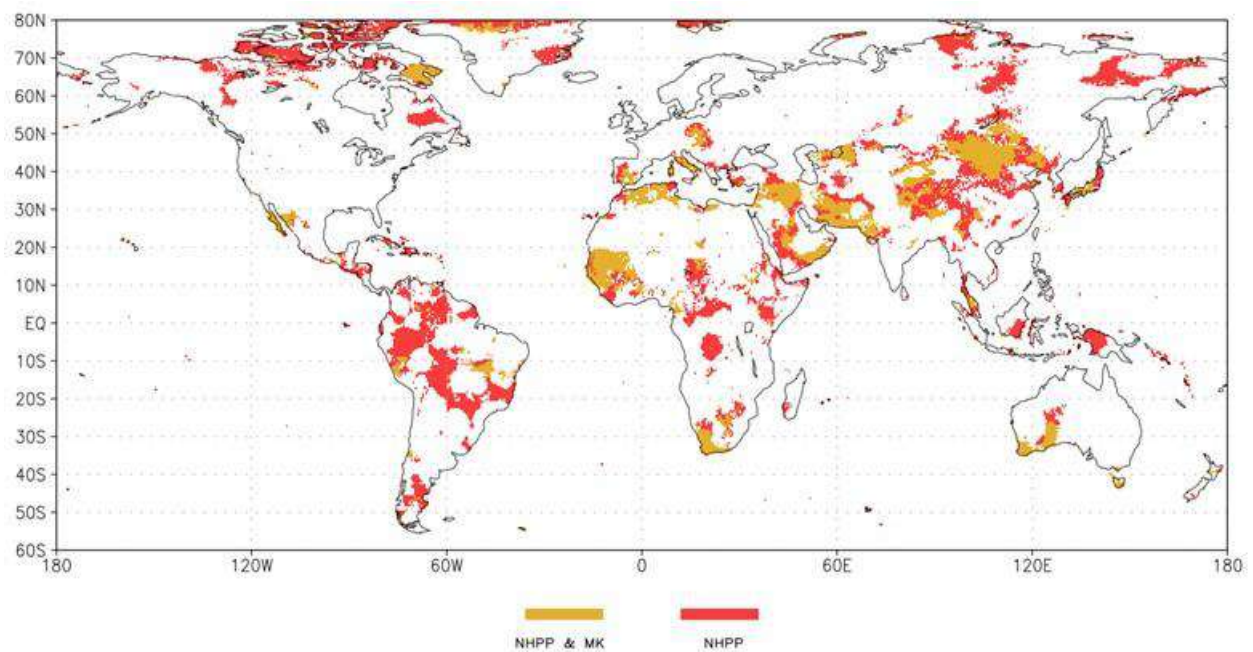


Figure 12 - Areas of the globe interested by an increasing trend of drought episodes identified by SPEI-6 for the month of March. Significant positive trend: (1) only for NHPP (red areas); and (2) for NHPP and M-K (yellow areas).

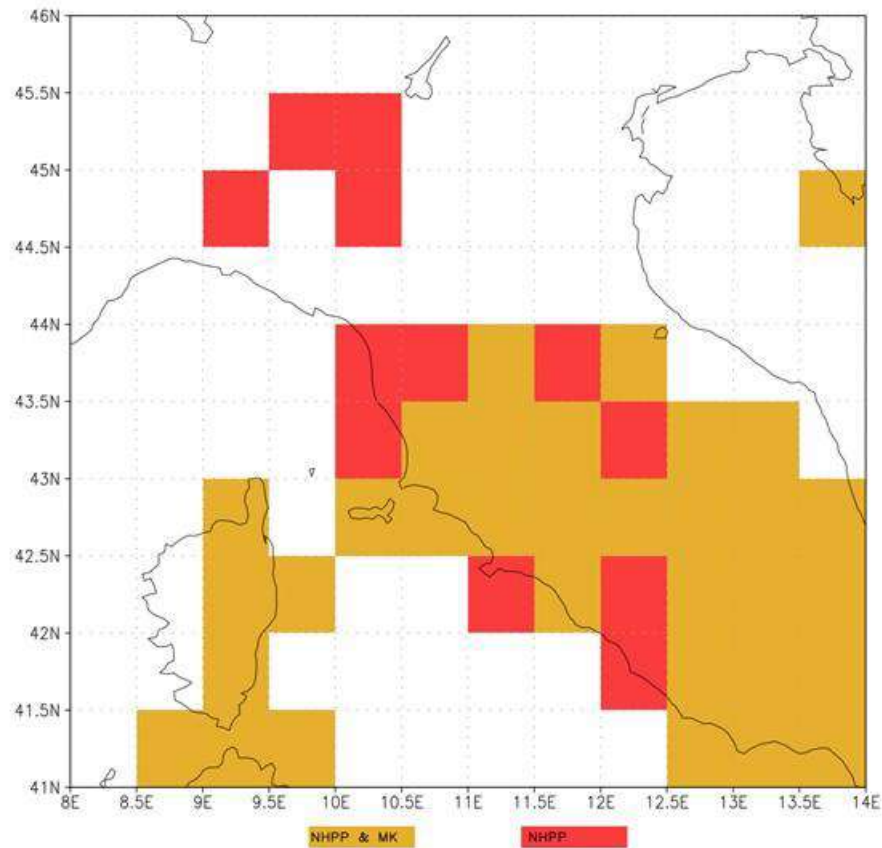


Figure 13 - Same as in Fig.3, but for the pilot target area of Tuscany region.

1.4 A drought empirical forecasting system for the Mediterranean basin.

Contribution by CNR-IBE: Pasqui M.

A drought-monitoring and forecasting system, developed for the Tuscany region, was improved in order to provide a semi-automatic, more detailed, timely and comprehensive operational service for decision making, water authorities, researchers and general stakeholders.



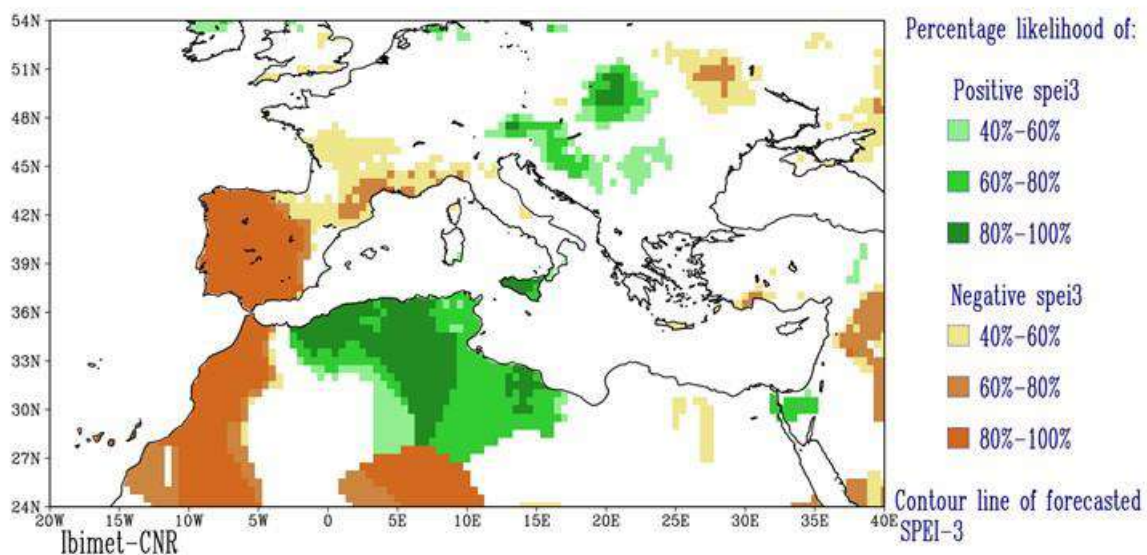
Figure 14 - An example of the Drought Observatory web GIS portal available via:
<https://drought.climateservices.it/en/>.

The forecasting system is based on an empirical approach to predict meteorological drought using the SPI 3, a few months in advance from large-scale observed climate indices. The forecast's window (25°–65° N; 20° W–45° E) has a spatial resolution of 0.5°. This seasonal forecast empirical system adopts a physically based statistical approach which uses a multivariate regression (MR) model to estimate future anomalies. The entire structure is extensively described in Magno et al., 2018. As an example, here the last issued forecast of SPEI index for OND 2019 season.

December 2019

Most likely category for SPEI-3months [CRU Dataset]
Forecast issued on 26/09/2019

Ibimet-CNR Seasonal Forecast
multi-regressive model
www.climateservices.it



Based on CRU Dataset at 0.5x0.5 spatial resolution with 1980–2010 climatological reference

Figure 15 - An example of the empirical seasonal forecast of SPEI index issued in late September for OND 2019, available via: <https://drought.climateservices.it/en/>.

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- Di Giuseppe, E., Pasqui, M., Magno, R., & Quaresima, S. (2019). A Counting Process Approach for Trend Assessment of Drought Condition. *Hydrology*, 6(4), 84.
- Magno, R., De Filippis, T., Di Giuseppe, E., Pasqui, M., Rocchi, L., & Gozzini, B. (2018). Semi-automatic operational service for drought monitoring and forecasting in the Tuscany region. *Geosciences*, 8(2), 49.

1.5 Emission factors on the case study “Metaponto Natural Reserve”

Contribution by CNR-IRET: Calfapietra C., Guidolotti G., Enrica Nestola

Monitoring ecosystem properties in relation to the fire occurrence and measuring vegetation fire emission were the main activities carried out by CNR IRET.

The case study area was located at the Metaponto Natural Reserve, Basilicata Region, South of Italy. The site was selected for both its proneness to fire and its proximity to a burned area, similar in both vegetation and topographic complexity. Five plots were sampled for the field campaign on 3th and 4th August 2019 (Fig. 16).

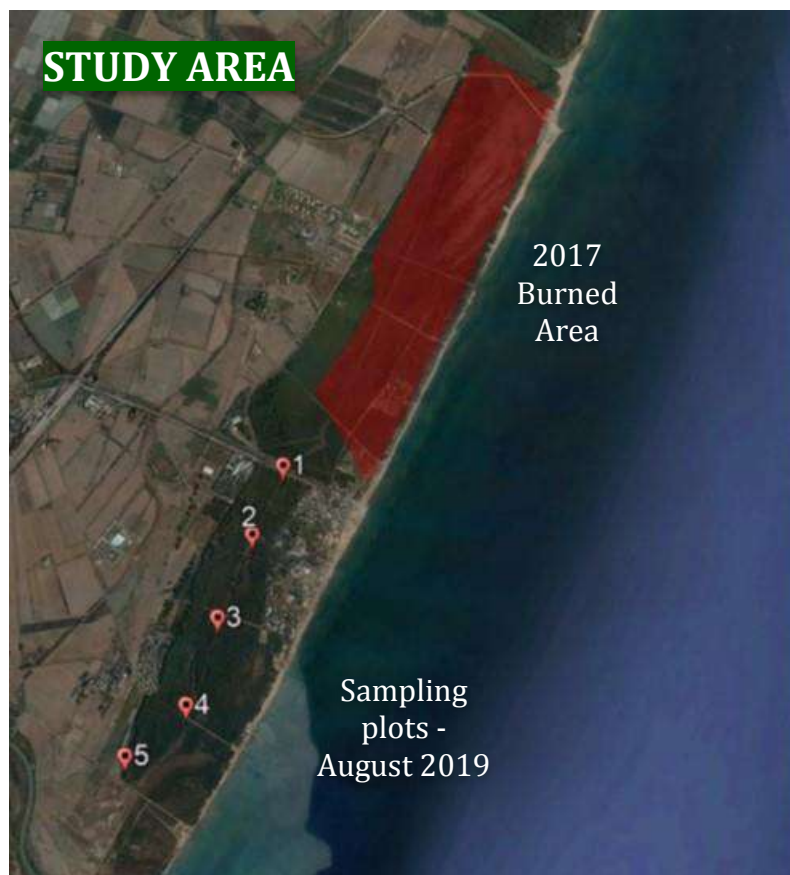


Figure 16 - Study area, Metaponto Natural Reserve, Basilicata Region (Italy). Field sampling locations are displayed in red.

The field campaign was aimed to:

- Characterize the case study area, in terms of plant specific composition and abundance
- Collect biomass samples for the analysis of the emission during the fire.

Regarding the characterization of the area, parameters as woody species, mean height, mean diameter and plot density were quantified (Fig.17).

Sampling Plot	Woody Species	Mean height	Mean diameter	Plot Density
1	Dominant Layer			980 trees/ha
	<i>Pinus halepensis</i>	9 m	20 cm	
	<i>Ecualyptus camaldulensis</i>	9 m	10 cm	
	Understory			
	<i>Juniperus communis</i>	Rare		
	<i>Pistacia lentiscus</i>	Rare		
2	Dominant Layer			477 trees/ha
	<i>Casuarina equisetifolia</i>	3.5 m	5 cm	
	Understory			
	<i>Juncus acutus</i>	Rare		
	<i>Pistacia lentiscus</i>			
3	Dominant Layer			980 trees/ha
	<i>Pinus halepensis</i>	3 m	12 cm	
	Understory			
	<i>Pistacia lentiscus</i>	Rare		
4	Dominant Layer			1000 trees/ha
	<i>Pinus halepensis</i>	2.5 m	3.5 cm	
	<i>Acacia farnesiana</i>	3 m	5 cm	
	Understory	Missing		
5	Dominant Layer			490 trees/ha
	<i>Pinus halepensis</i>	10 m	30 cm	
	Understory	Missing		

Figure 17 - Characterization of the study area at Metaponto Natural Reserve, Basilicata Region (Italy).

The studied species were two trees (*Pinus halepensis* and *Eucalyptus camaldulensis*) and one shrub (*Pistacia lentiscus*). Needles/leaves, small woody branches and needle/leaf litter were separately collected at the 5 sampling plots in the study area.

During the next months, the experiments will be carried out using a combustion chamber, which continuously samples emissions throughout the different phases of a fire (pre-ignition, flaming and smoldering). The aim is an accurate determination and parameterization of the emission factors of various compounds such as CO₂, CO, CH₄, particulate matter (PM) and volatile organic compounds (VOCs), allowing the analysis of the different combustion phases of various plant tissues in different species. Within ServForFire project, the speciation profile of emission will contribute to the effective quantification of biomass-burning impacts on atmospheric composition and, thus, to the assessment of wildland fires impact on carbon cycle at local scale.

1.6 Fire emission Estimation using Landsat TM: the case study studies of 2011 fires occurred in the Ionian coast (southern Italy)

Contribution by CNR-IMAA: Cardettini G., Aromando A., Proto M., Lasaponara R.

Fires are considered as one of the most important causes of degradation being that they induce significant alterations not only on the vegetation cover but also on fauna, soil, atmosphere thus producing high direct and indirect damages including economic ones. At a global scale, yearly 50 million hectares of forest are burnt producing a significant impact on global atmospheric

pollution, being that biomass burning contributes to the global budgets of greenhouse gases, like carbon dioxide, etc. Actually, wildfires contribute to carbon emissions and human-induced climate change, a process that is likely to cause progressive aridness of parts of Europe with increased risk for wild fire and subsequent secondary disasters such as erosion, floods and landslides. At a global scale forest fires produce a remarkable amount of greenhouse gases and solid particulate matter.

Current and future challenges of wildfire contrast and governance, oriented to a comprehensive approach to limit fire incidence, can be addressed creating a system focused on social and ecological resilience and based on reliable and update information on fire occurrence and characteristics, including the assessment of fire damage with specific reference to the missions from forest fires which depend on (1) the duration and intensity of the fire, (2) the total area burnt by the fire, and (3) the type and amount of the burnt vegetation generally referred to as fuel load. In our study case, we used the fuel load mapping developed for the Basilicata region in the framework of FIRESAT project based on Landsat TM data and assessed the burnt areas using Landsat TM data acquired before and after the fire event. The assessment of the emission is based on the formula:

$$E_x = F(A, B, C, E)$$

Where: - E_x emission of compound x –

A burnt area (m²) – estimated from landsat

B fuel load (g dry matter m⁻²) – estimated from Landsat (in terms of Fuel load as developed for the Basilicata in the framework of FIRESAT project)

C burning efficiency – estimation from, landsat (in terms of fire severity)

E emission factor (g g⁻¹ dry matter burnt) for which we used CO, CH₄, VOC, NO_x, N₂O and SO_x taken from the current state of the art as available in Miranda et al. (2005).

1.7 Case study demonstration on Eastern Attika

Contribution by NCRSD: Varela V.

Eastern Attika is an area with Frequent forest fire incidents with special features (Wildland-Urban Interface, touristic areas, intense human presence and activity, high density of infrastructure and networks, etc.)

Spatial and regional planning in the area began solely with economic development criteria and at a later stage environmental protection and sustainable development criteria were incorporated.

The wildland fire events of the last 10 years show that safety and protection of citizens and properties is a priority in the area and evacuation plans should be integrated into the spatial and development plans in areas with natural vegetation.

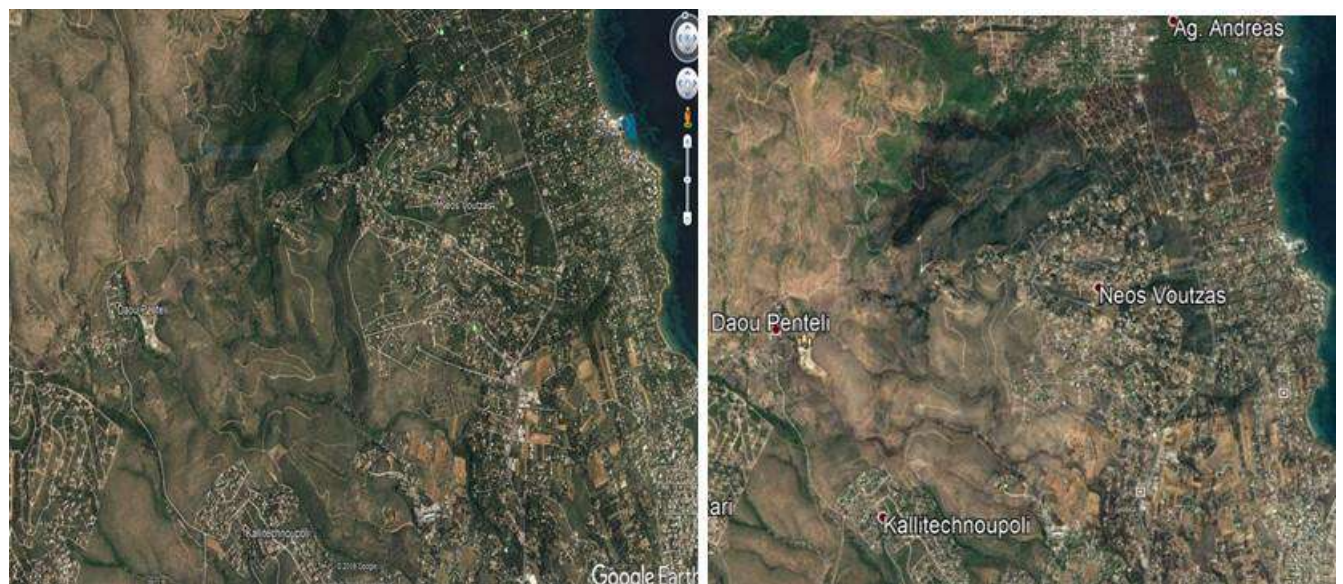


Figure 18 - The area of Eastern Attika before (left) and after (right) the fire in Mati in July 2018 (source : Google Earth)



Figure 19 - View of the WUI area before the fire in Mati in July 2018 (Source : https://upload.wikimedia.org/wikipedia/commons/4/40/2014-10-22_11-32-46_Greece_Attika_-_Raf%C3%ADna.jpg)

The recent decades of fire incidents including the fire in Mati, Attika on 23rd of July 2018, are determined by:

- timely differentiation of forest fire behaviour at local level
- the large increase in spatial exposure to fire risk: of life, property and critical infrastructure

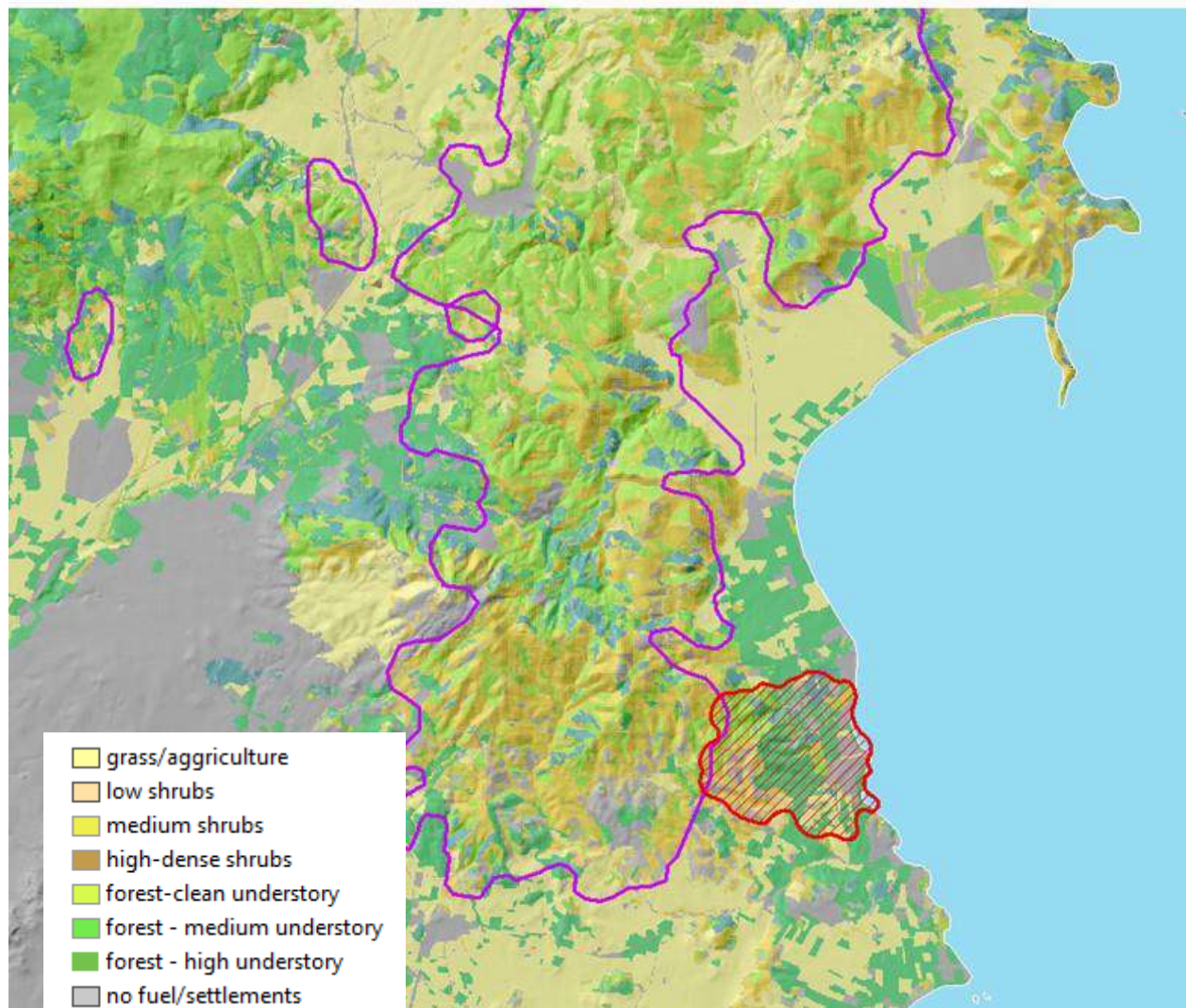


Figure 20 - Fuel Map and burned areas during the last 20 years. The fire in Mati in July 2018 is shaded in red colour.



Figure 21 - View of the WUI area after the fire in Mati in July 2018 (Source : <https://www.bbc.com/news/world-europe-44968581>)

Pre-fire phase risk estimation and its change in the future for Eastern Attica, is based on the estimation and mapping of a number of FWI system components, on a daily basis for the fire seasons (1st May- 31th October) of a historical and a future time period. More particularly, FWI system parameters and maps have been calculated for the study area using high resolution climatic for a historical time period (2006-2015) and a near future time period (2036-2045) datasets for 4.5 RCP scenario , which is built on specific assumptions of socioeconomic and land-use changes projections. The climate model data were obtained from EURO-CORDEX climate model and consist of atmospheric variables, such as temperature, relative humidity, wind speed and wind direction at 12:00 hr as well as and total 24hr precipitation at 12.5 km spatial resolution. The final datasets of the above mentioned variables used for the study were processed with 5 km spatial resolution for the domain of interest after applying regridding based on the nearest neighbour interpolating process. The following maps were calculated and are presented below:

- Seasonal Fire Severity Rating (Fig. 22)
- Number of days per year with Fire Weather Index greater than 50 (Fig. 23)
- Mean fire-season Initial Spread Index (Fig. 24)

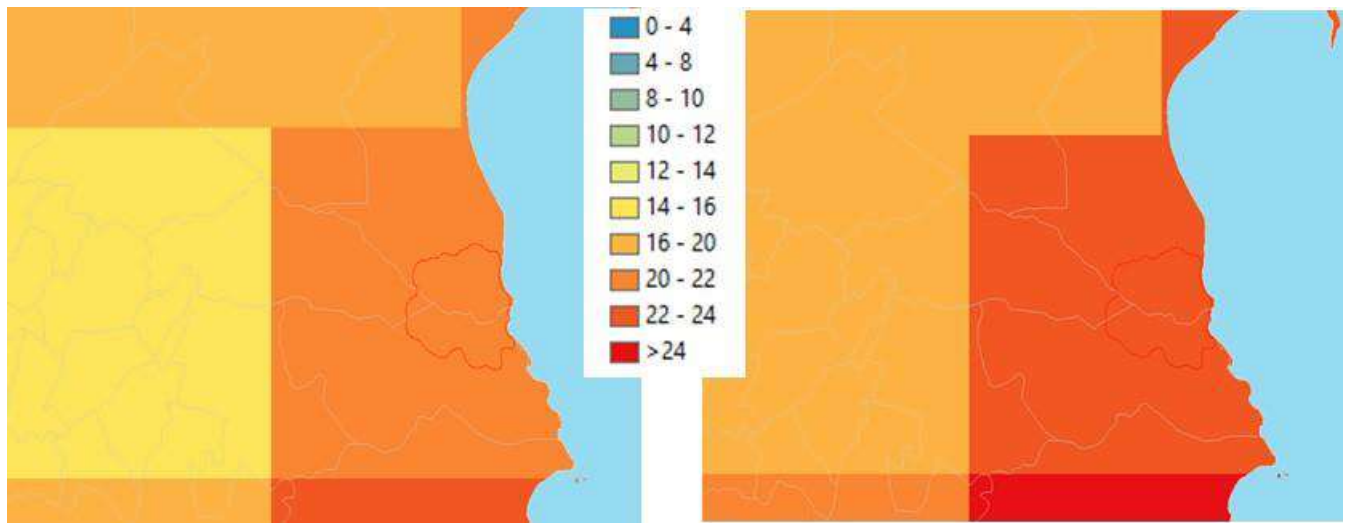


Figure 22 - Seasonal Severity Rating for a. historic (2006-2015) and b. near future period (2036-2045).

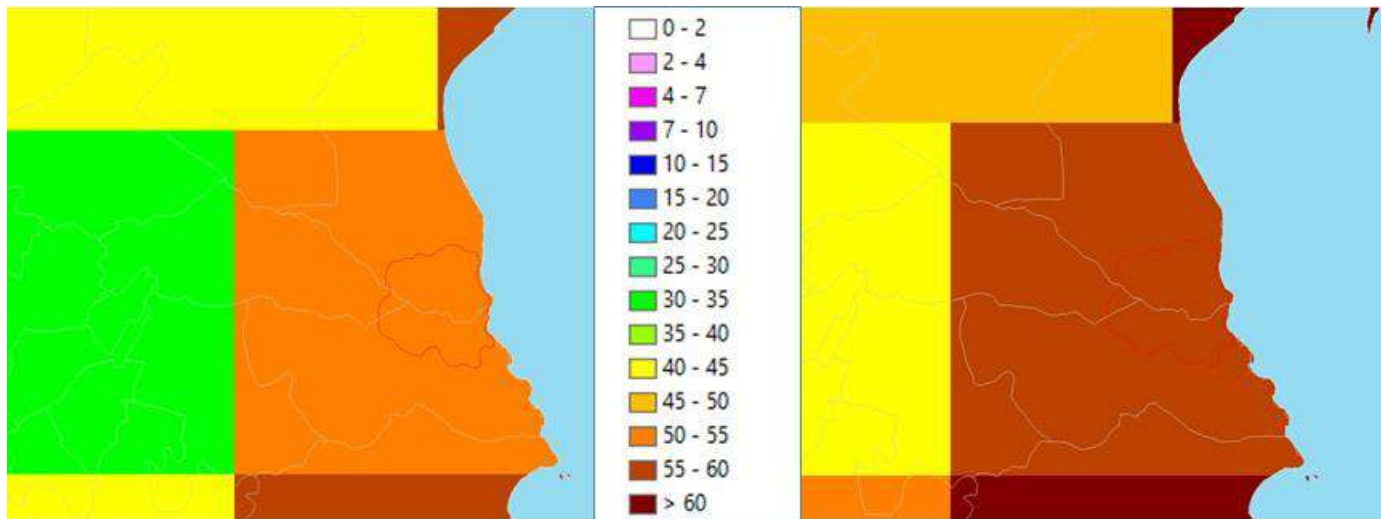


Figure 23 - Number of days/year with FWI > 50 a. for historic (2006-2015) and b. near future period (2036-2045).

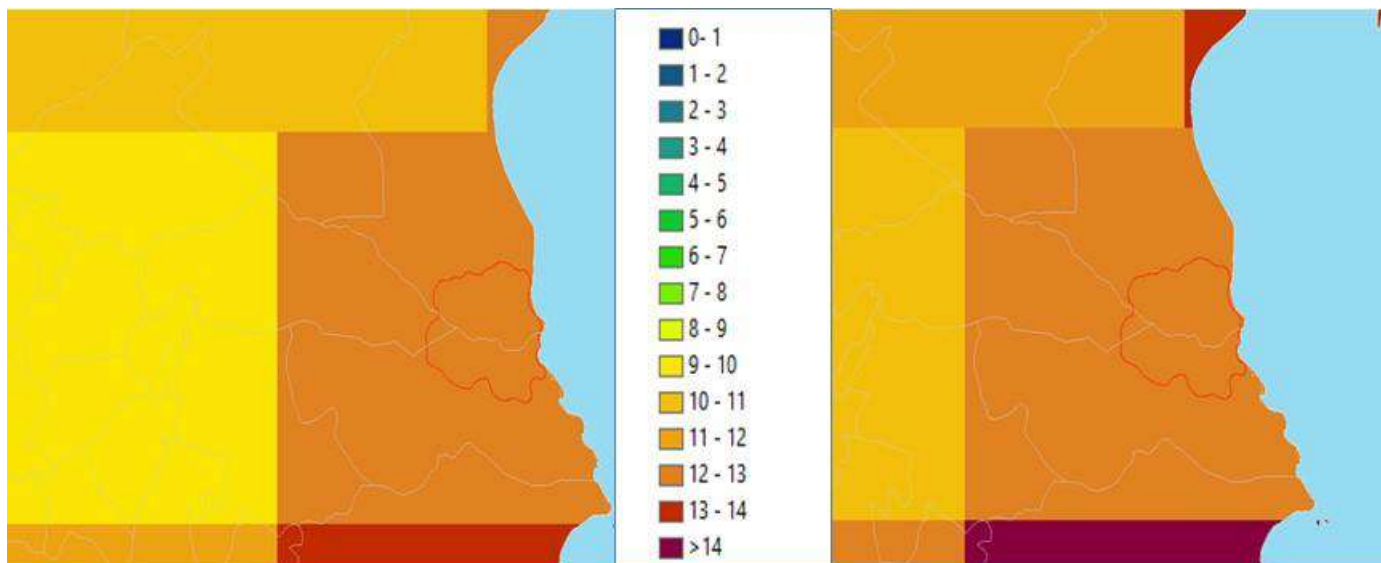


Figure 24 - Mean fire-season ISI a. for historic (2006-2015) and b. near future period (2036-2045)

1.8 Climate attribution study of the forest fires in Portugal 2017

Contribution by KNMI: Krikken F., van Oldenborgh G.J., van Velthoven P.

Climate attribution studies for recent extreme forest fires are the main activities carried out by KNMI, apart from seasonal forecasts of fire weather.

The forest fires in Portugal 2017 were selected as a case study because of the severity of the fires and the impact it had on society, specifically the large number of casualties.

We follow the same method previously applied to the climate attribution of the forest fires in Sweden 2018 (Krikken et al., in review). We use Canadian fire weather index (FWI) to quantify the fire weather risk. We construct the FWI using ERA5 reanalysis data and two climate models (EC-Earth and CESM). The former is used to get an observational estimate, while the latter is used to get an estimate of past, present and future fire weather risk.

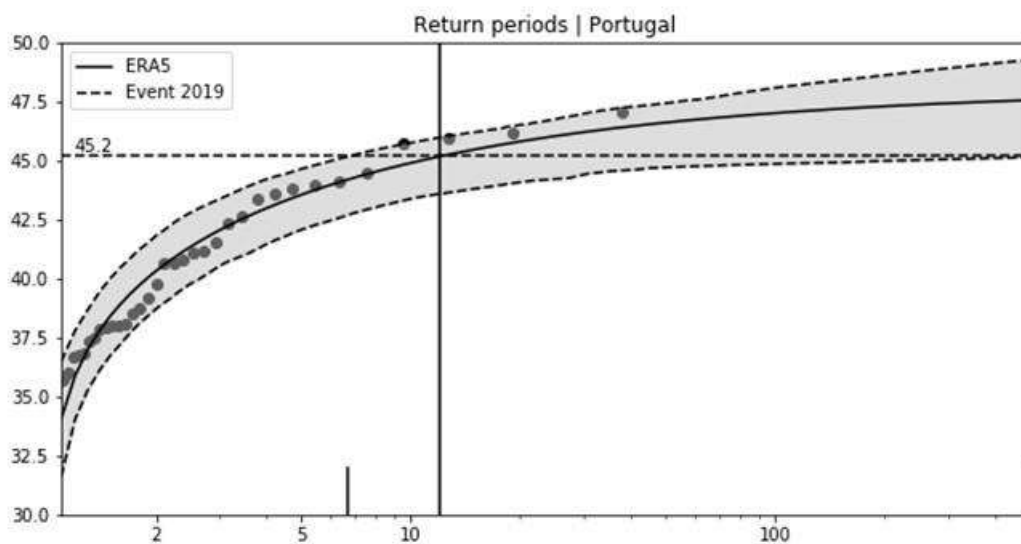


Figure 25 - Return times of the 2017 forest fire event, based on ERA5 reanalysis data

Figure 25 shows the return time of the 2017 forest fire event, defined as the maximum FWI during the fire season, averaged over Portugal, with a 7-day rolling mean applied. The return time of ~11 years indicate that based on only the fire weather, it was indeed a rare event but not unprecedented over the last 40 years.

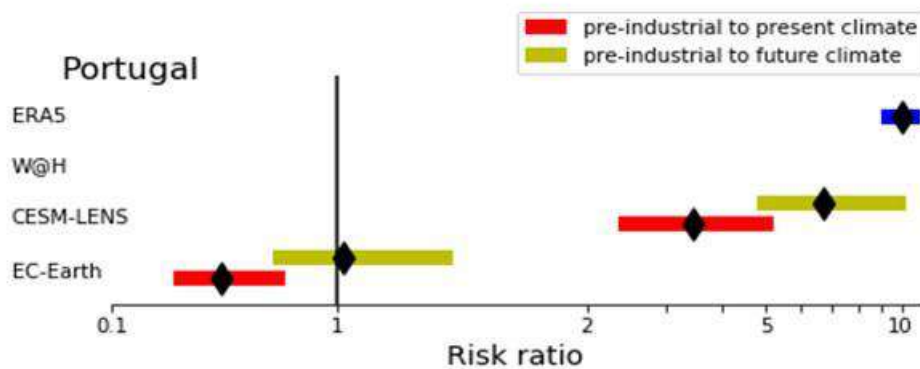


Figure 26 - Risk ratios of the Portugal 2017 forest fires, for ERA5 (reanalysis) and CESM and EC-Earth (climate models). The risk ratios are given relative to pre-industrial climate.

Figure 26 illustrates the risk ratios, i.e. how much more or less likely such an event has become relative to pre-industrial climate. We can see that based on ERA5, the event has become ~10 times more likely. Both climate models show distinct different responses, where CESM gives a large increased risk for such event both for current and future climate. EC-Earth however shows decreased risk for such an event for the present climate and the same risk for future climate.

Our aim is to continue this analysis with more reanalysis products and climate models, and to better understand the distinct different behavior between the climate models used, in order to give accurate projections of future fire weather risk in the Mediterranean region.

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1.9 The use of Random Forest classifier for the mapping of burnt areas based on satellite data Sar (Sentinel1) and optical data (Sentinel 2). The case study: fire in the South of Portugal in 2018"

Contribution by CNR-IMAA: Fattore C., Lasaponara R.

In the recent years, forest fires in Portugal have become a serious environmental problem. According to the 2017 annual report issued by EFFIS (European Forest Fire Information System), the number of fires occurred was about 21002 for a burnt area of about 540630 hectares; in 2018 the burnt areas decreased, but 37436 hectares were affected.

The study area is located in Southern Portugal, particularly in the Algarve region. The event, which took place in August 2018, damaged the city of Monchique and burned about 27,000 hectares. The satellite data used for mapping the burnt areas are the Optical images and the SAR

images (respectively Sentinel 2 and Sentinel 1 of the ESA Copernicus program), which have different resolutions, to better understand how the two sensors return different information based on data processing. The Sentinel-2 used has a resolution of 10 m while the Sentinel-1 has a resolution of 5 m. The choice to use such high resolutions is due to the large size of the event to be investigated, in order to better detect the burn severity. The identification and mapping of the surfaces affected by the fire is based on the recognition of the spectral response of the burnt vegetation, i.e. different from the response of the unburned surface. The identification and mapping of the areas affected by the fire are based on the recognition of the spectral response of the burnt vegetation, i.e. different from the response of the unburned surface. In this case we used spectral vegetation indices such as the NDVI (Normalized Difference Vegetation Index) and the NBR (Normalized Burn Ratio). The first was selected to estimate the moisture level in the vegetation, as the fire causes a significant decrease in the humidity level of the plants and the soil. The second index, however, is designed to highlight burnt areas and estimate the severity of the fire. The formula is similar to NDVI, except that it uses near infrared (NIR) and shortwave (SWIR) wavelengths.

A comparison was made between the limit values of the normalised combustion ratio (dNBR) and the normalised differential vegetation index (dNDVI) (from pre- and post-fire images). However, dNBR could present problems in areas with low pre-fire vegetation cover, where the absolute variation between pre-fire and post-fire NBR is not significant. For this reason we have applied an additional spectral index such as RBR (Relativized Burn Ratio), which allow us to isolate the burned area from the unburned context (Fig. 27). Spectral indices provide information on risk assessment, severity of fire and burns, characterizing the extent of damage but they are not sufficient for discriminating burned area, so it was necessary to create a supervised classification, through the application of a special classifier such as the to the Random Forest.

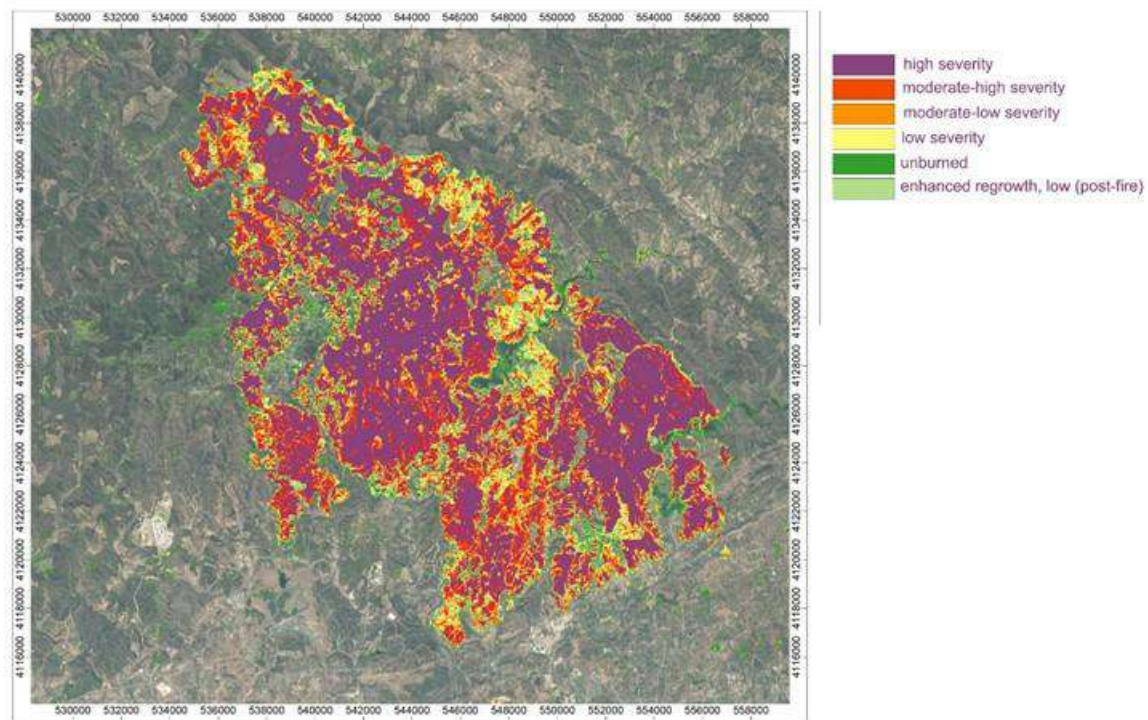


Figure 27 - Sentinel-2 RBR (Relativized Burn Ratio) index on the area affected by the fire. The legend clearly shows the most damaged areas thanks to the discrimination of fire severity.

The random forest classifier consists of a combination of tree classifiers where each classifier is generated using a random vector sampled independently from the input vector, and each tree casts a unit vote for the most popular class to classify an input vector (Breiman, 1999).

This procedure resulted in better classification accuracy.

It is important to carefully choose the attributes to be provided to our classifier because as they must be as meaningful as possible. In this case, our characteristics are determined by the results obtained by mapping the burned area using the spectral index RBR (Relativized Burn Ratio). The different levels of fire severity produced were also compared with the levels catalogued by the United States Geological Survey (USGS), which proposed a classification table to evaluate the severity of the fire.

The next objective is to estimate the damage after the fire in terms of burnt vegetation, damaged soil, and carbon monoxide emissions after an accurate definition of the degree of burn.

2. Fire risk estimation: post-fire phase

2.1 Post-fire phase for the area of eastern Attika

Contribution by NCSR D: Varela V.

The fire risk estimation of the post-fire phase for the area of eastern Attika is based on the simulation of fire behaviour of the fire in Mati. More particularly, G-FMIS fire simulator, which is based on BEHAVE/Rothermel's equations, was used for the calculation of fireline intensity map of the area of interest, based on the weather conditions during the fire. Fireline intensity parameter is the rate of energy or heat release per unit time per unit length of fire front (kW/m).



The overlay of the final burned area on the fireline intensity map (Fig. 28-29), depicts the fire line intensity conditions for every point within the burned area and is a good indicator of fire severity and expected post-fire effects for the particular fire.

Figure 28 - Simulated fire propagation of Mati Fire, for the first three hours.

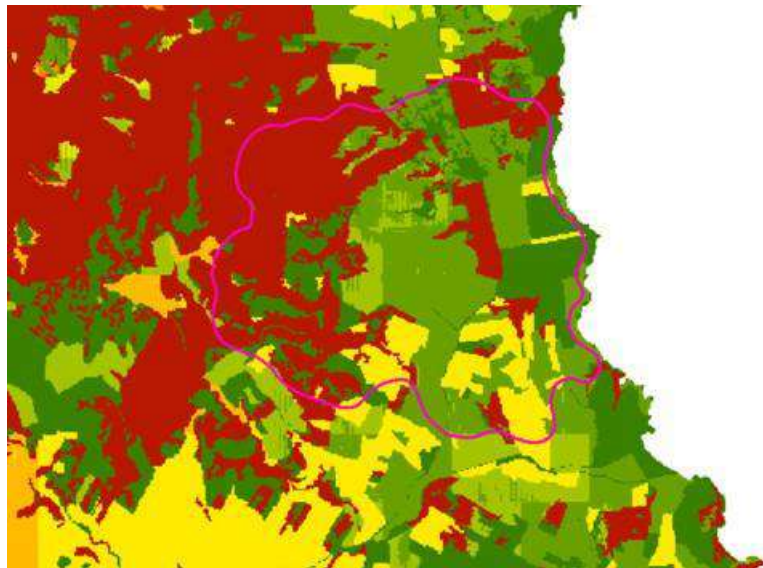


Figure 29 - Calculated map of Fireline intensity in kW/m for the weather conditions of the fire in Mati. .

2.2 Post risk assessment- Model development and setup at different temporal and spatial scales: the study area of the Celone River Basin

Contribution by CNR-IRSA and BRGM: Anna Maria De Girolamo (CNR-IRSA), Antonio Lo Porto (CNR-IRSA) Rosalie Vandromme (BRGM) Olivier Cerdan (BRGM)

This chapter summarizes the research activities developed within the WP4 to assess the climate change impact on flow regime in a Mediterranean basin (Celone, S-E Italy) characterized by a river system with an intermittent flow. The assessment was based on climate change forecasted by different combinations of global and regional models (GCMs and RCMs).

The three different future scenarios showed an increase in mean temperature for all months between 0.5–2.4°C and a reduction in precipitation (by 4–7%) for the period 2030-2059 (MPI, KNMI, SMHI).

The results of the present work show that climate change will bring a reduction of water resource availability and some alterations in the hydrological regime. The SWAT model, which proved to be a valuable operational tool for evaluating the potential impact of climate change on water resources, estimates a reduction of total water yield and a shift of the flow regime towards drier conditions, although the river type classification will probably remain essentially unvaried. A sever reduction of snowfall in the mountainous part of the basin was also estimated that is expected to impact the flow regime. However, it is important to take into account that several sources of uncertainties, which depend both on the used hydrological models and on the climate change scenarios, affect the predictions of the hydrological response of a river basin under climate change. In addition, some of the assumptions made (i.e. that land use does not change in the future) could be incorrect as climate change could also result in a significant alteration of land cover. Hence, we have to consider projections not as a predictive method, but as a tool that may be used to assess changes in process dynamics.

The Case Study

The study area is the Celone River Basin (Puglia, Italy), a typical Mediterranean area under water shortage (Fig. 30).

The Soil and Water Assessment Tool, SWAT2005 version with Arcgis interface (Arnold et al., 1998), was used to evaluate current and predicted future water balance and streamflow regimes (De Girolamo et al., 2017).

Climate change scenarios (A1B storyline, Van Meijgaard et al., 2008; Roeckner et al., 2003) used in the present study are the following:

- KNMI_RACMO_ECHAM5
- SMHI_RCA_ECHAM5
- MPI_REMO_ECHAM5.

Data were obtained by the ENSEMBLES project, funded by the European Commission (EC) (contract number GOCE-CT-2003-505539). The current conditions (1980-2009) and future condition (2030-2059) were simulated.

A number of Hydrological Indicators of Alterations (IHAs) were used to estimate changes in flow regime (such as magnitude of monthly discharge, magnitude and duration of peak discharge, timing of annual peak discharge, frequency and duration of high and low discharge, and rate and frequency of discharge changes). The IHAs were evaluated using daily flow data. Comparing these hydrological indicators, calculated for current and the future scenarios, it is possible to assess changes in the river flow regime caused by anthropogenic pressures and climate change.

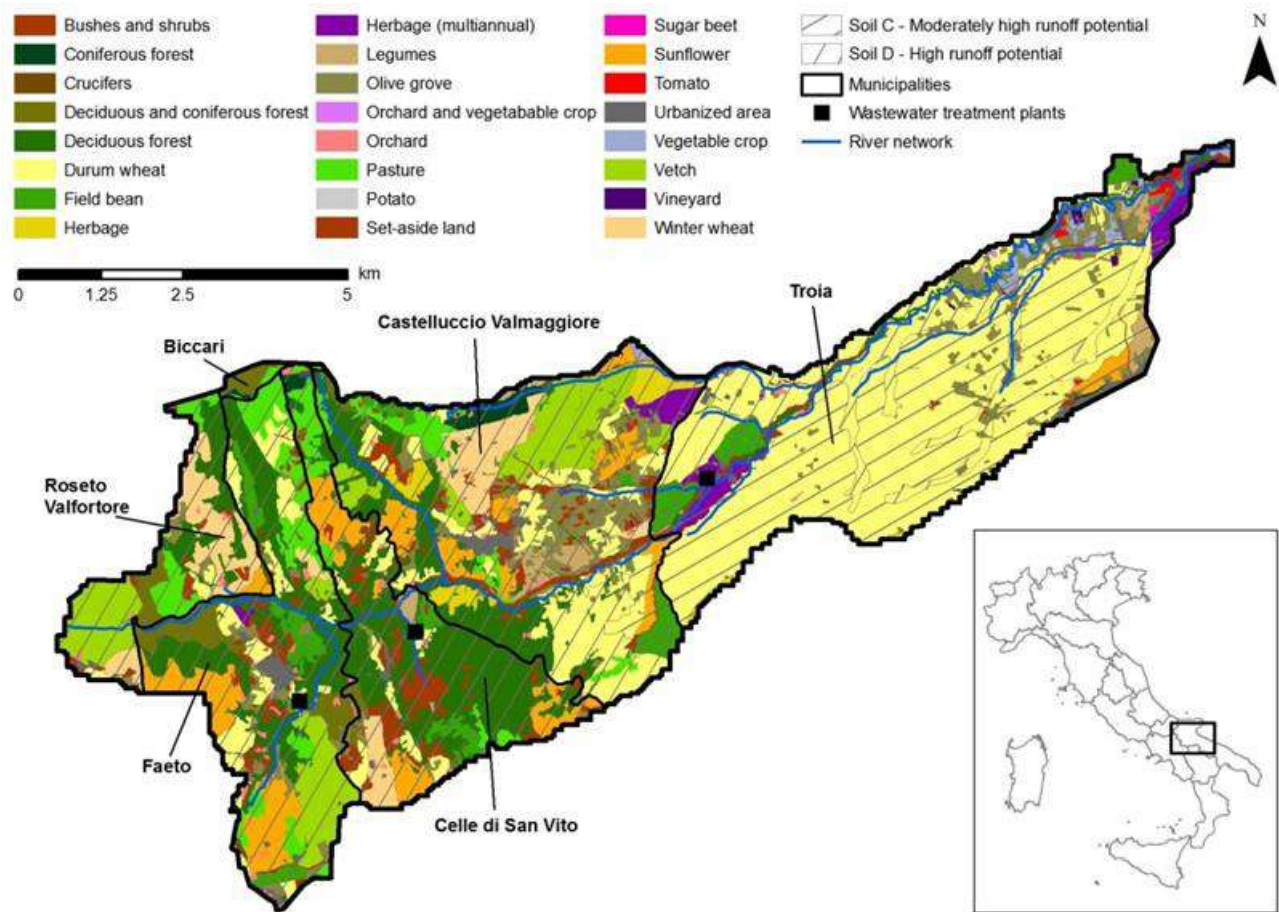


Figure 30 - Study area: Celone catchment

Results: potential impact of climate change on water balance and flow regime

Hydrology

The performance of the model simulations was evaluated by using the Nash and Sutcliffe efficiency (NSE) and correlation coefficient (R²) and the percent bias (PBIAS). The model was calibrated over the period 1990-92 (Fig. 31), the NSE at the outlet was 0.74, the R² values were 0.89 and PBIAS was -25%. In the validation period (1995-1996), NSE was 0.47, R² was 0.77 and PBIAS was 26%.

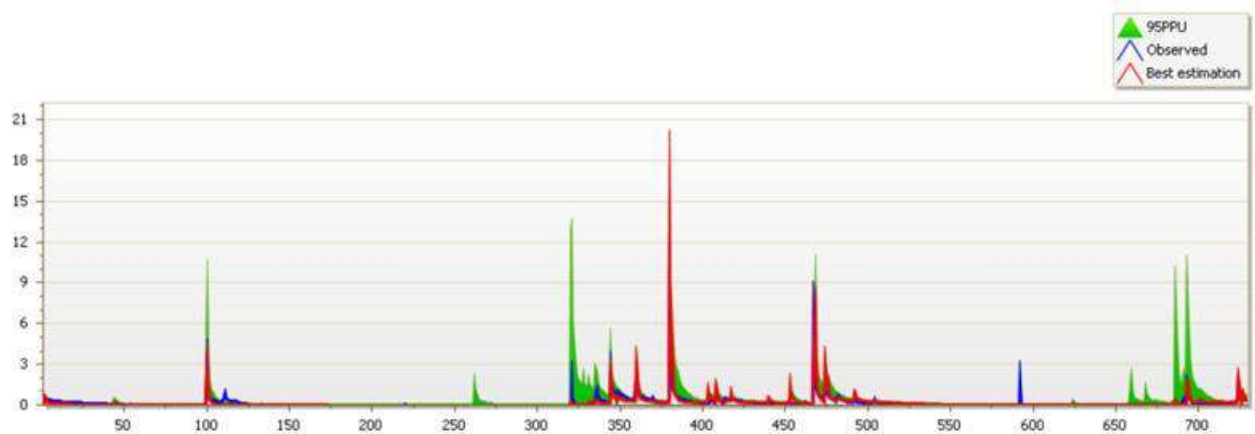


Figure 31 - Measured and simulated streamflow at the outlet and the 95% uncertainty predictions (P-Factor = 0.28; R-Factor = 0.20). Calibration (1990-91).

Downscaling climate variables

All the scenarios show an increase of temperature for all months: maximum temperature varies between 0.5–2.4°C in different scenarios, with the highest in September for the MPI scenario. Minimum temperature varies between 0.3–2.1°C, with the highest in the wet area in February (Fig. 31). The increase in minimum temperature, which is forecasted for the winter months, will bring a different type of precipitation with a reduction of snowfall in the mountainous part of the basin during the period 2030–2059.

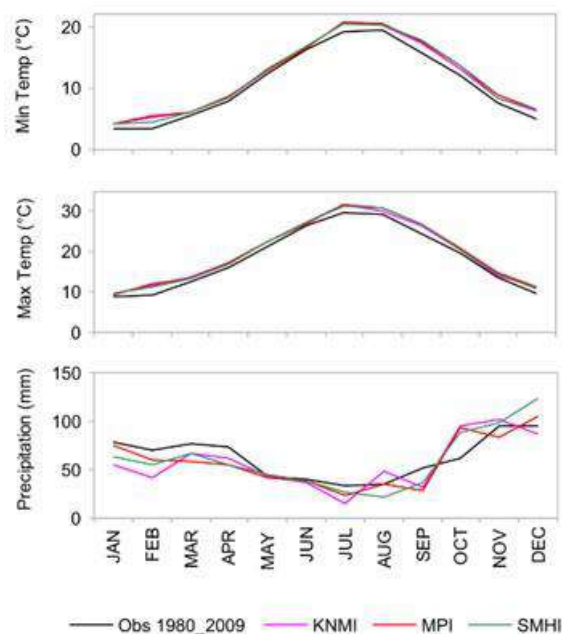


Figure 32 - Comparison of the historical measured data and downscaled average monthly maximum and minimum temperature for the future scenarios (2030–2059). Comparison of historical measured precipitations (1980–2009) and downscaled precipitation for the future scenarios (2030–2059) in a gauging station (Biccare).

All the scenarios predict for the period 2030–2059 a decrease in annual precipitation and a different distribution through the year with a major decrease from January to May (Fig. 32).

Impact of climate change on water balance

The ability of statistical downscaled GCMs to predict water balance was performed comparing the components simulated with observed climatic data (1990–2009) to those simulated with GCM downscaled data for the period 1990–2009. As the downscaling was performed over a different time period (calibration: 1990-2000; validation 2001-2009), the predicted water balance components with GCMs data do not replicate exactly those with measured data. However, a good agreement was found for all the variables. Change in a modelled factor was considered acceptable if the difference from the observed variable is less than the absolute sum of standard errors (De Girolamo et al., 2017).

The impact of climate change on water balance was evaluated at the basin scale (Table 1). As a result of CC, a reduction of rainfall between 3% and 6% was forecasted.

Table 1. Effect of climate change on the water balance components for the Celone basin at the basin scale.

	Current scenarios GCM_RCMs (baseline 1980-2009)			Future scenarios GCM_RCMs (2030-2059)		
	MPI	KNMI	SMHI	MPI	KNMI	SMHI
Rainfall (mm/y)	741	792	738	699	753	719
Diff in rainfall (%)	-			-6	-5	-3
Snowmelt (mm/y)	45	42	12	18	16	4
Diff in snowmelt (%)				-60	-63	-65
PET (mm/y)	968	967	964	1015	1012	1009
Diff in PET (%)				5	5	5
Eta (mm/y)	459	463	474	460	459	460
Diff in Eta (%)				0	-1	-3
TWY (mm/y)	155	178	138	126	160	135
Diff in TWY (%)				-19	-10	-2

The reduction of total water yield (TWY), which is the sum of surface runoff, lateral flow and baseflow, was estimated in 19% for the MPI scenario, 10% for the NMI and 2% in the SMHI scenario. Although an increase of potential evapotranspiration is expected for all the studied scenarios (5%), only a modest change in actual evapotranspiration was forecast (1% and 3% for KNMI and SMHI scenarios, respectively). This is due to the fact that actual evapotranspiration depends not only on the air temperature but also on water into soil. In this study, no land use changes were assumed for the future scenarios and an increase of 4% in irrigation was considered only for the areas where crops are actually irrigated in the basin.

As a result of the increase in temperature, the model simulates a reduction of snowfall that is 60% for MPI, 63% for KNMI and 65% for SMHI.

A reduction of the total inflow into the “Capaccio” reservoir was predicted between 8% and 9%.

Assessment of climate change impact on the flow regime

By using simulated daily streamflow as input in the IHA software (IHA version 7.1) the changes in streamflow regime and Environmental Flow Components (EFCs) were evaluated. Actually, the general reliability of the hydrological indicators evaluated by using simulated data instead of measured flow data was verified by De Girolamo et al. (2017b).

At yearly basis, a reduction of mean annual flow was predicted. Indeed, over the period 1990 to 2009 it was $0.37 \text{ m}^3\text{s}^{-1}$, meanwhile it was estimated in $0.26 \text{ m}^3\text{s}^{-1}$, $0.29 \text{ m}^3\text{s}^{-1}$ and $0.35 \text{ m}^3\text{s}^{-1}$ for MPI, SMHI and KNMI, respectively.

At monthly time scale, a reduction was predicted in all scenarios in the wet season (Fig. 33). For the scenario MPI, a reduction of the mean flow in all months, especially in winter and spring, was predicted. An increase in autumn was predicted for the KNMI scenarios that showed a slightly different distribution through the year. MPI resulted the worst scenario in terms of reduction of water resources.

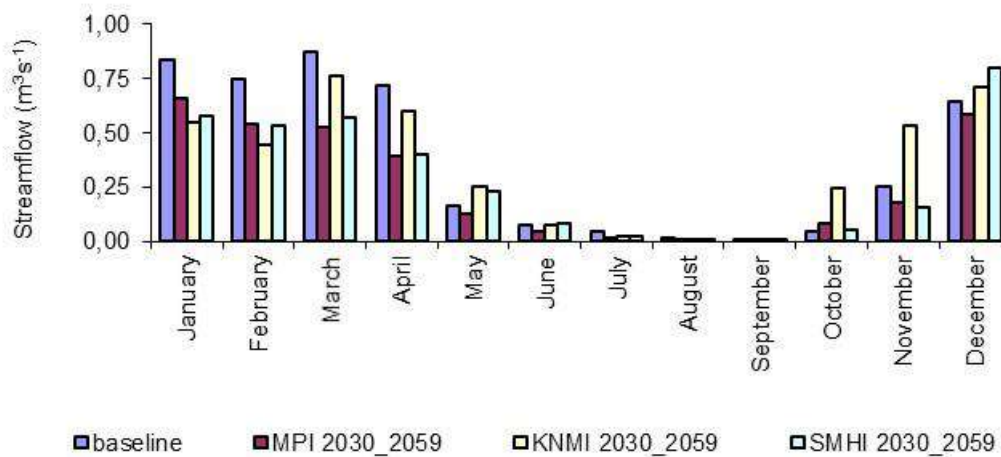


Figure 33 - Comparison of the historical monthly mean flow and monthly mean flow for the future scenarios in the Celone basin.

The duration of the extreme low flow it is expected to change in the future scenarios, as well as the extension of the dry season. As Figure 5 shows an increase of the number of days without flow is forecasted for the MPI and SMHI scenarios.

A reduction was predicted for the IHA that represent the magnitude of minimum annual flow of 1-, 3-, 7-, 30-, 90-consecutive days. MPI resulted the worst scenario in terms of reduction of water resources. Indeed, MPI presented an extreme low flow lower than 1 Ls^{-1} over the 90-consecutive days and zero for the other durations (Fig. 34).

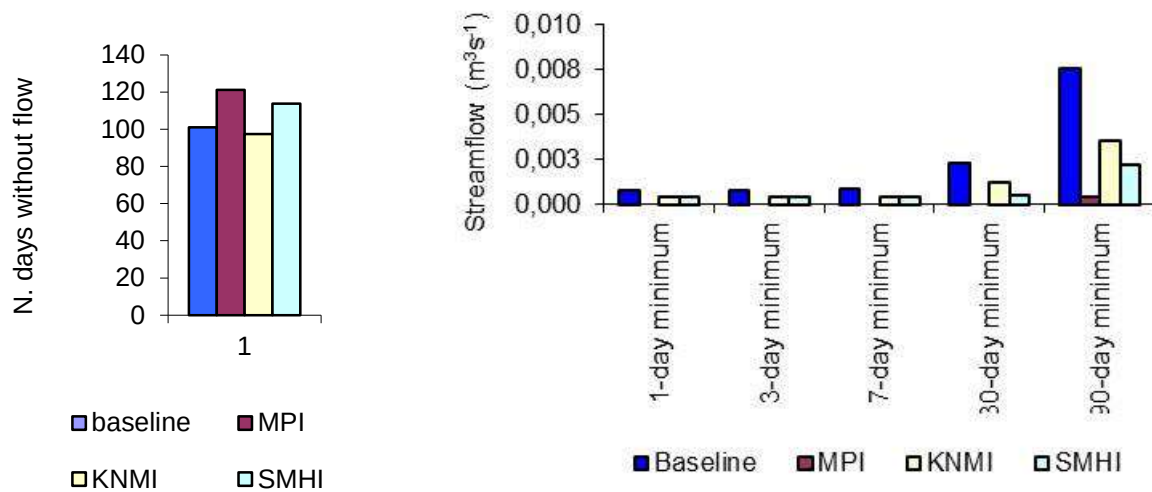


Figure 34 - Comparison of the number of days without flow for historical future scenarios (on the left). Comparison of magnitude of minimum annual flow of 1-, 3-, 7-, 30-, 90-consecutive days for the baseline and future scenarios in the Celone basin.

Analogously a decrease of the high flow magnitude of maximum annual flow of 1-, 3-, 7-, 30-, 90-consecutive days was predicted.

The base flow Index estimated in $0.002 \text{ m}^3\text{s}^{-1}$ for the baseline scenarios it was predicted to be zero for the future in all the analysed scenarios. Concerning the timing of the extreme low flow conditions, it was predicted to remain the same for the MPI scenario, meanwhile a shift was predicted for the other two scenarios (Table II). The timing of maximum flow for the MPI future scenario was ahead of the baseline, meanwhile remain the same for the KNMI and SMHI scenarios.

Table II. Effect of climate change on the timing of extreme low and high flow conditions in the Celone basin..

	baseline	MPI	KNMI	SMHI
Julian date of minimum	165	168	176	192
Julian date of maximum	42	23	43	46
High pulse duration	1.7	1.99	1.96	1.76

Perspectives

During the first period of the, BRGM has tested the possibility to use its erosion and runoff modelling tool (WATERSED, Landemaine 2016) in post-fire context. These tests were carried out on a Corsican site because of an urgent request of the local authorities following several fires of summer 2016. WATERSED has been calibrated with the Curve Number approach, which is often used to characterize runoff coefficient for a given soil, its land use and fire severity. Based on this calibration, the WATERSED model was used to test the effect of a moderate rainfall event before

and after a fire. This first exercise proves the ability of the model to reproduce the effect of fire on soil erosion processes. Nevertheless, only qualitative data were used.

The next step will consist in further calibrating the model with the use of quantitative data from a monitored study site. This will be done in the Celone river basin using the CNR-ISRA dataset. Hence, a set of scenarios including reforestation and wildfires of different severity and location will be simulated in order to analyze the impact on water balance, sediment detachment and delivery in the study area. The results will be compared to the SWAT modelling approach of CRN-ISRA.

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2.3 On the impacts that fire on soil and hydrogeological risk: the case study of Basilicata Region

Contribution by CNR: Lasaponara R. (IMAA), Danese M. (IBAM)

Managers need to be aware of the impacts that fire can have on soil systems, and how these impacts can lead to undesired changes in site productivity, sustainability, biological diversity, and watershed hydrologic response. For this reason, providing reliable and qualified information on the impact of fire on vegetation and soil and related changes is crucial to maximize post fire risk prevention and related potential damage.

In this paper, we present outputs from research activities we conducted in the framework of the FIRESAT project (funded by the Office of Civil Protection of the Department of Infrastructure of the Basilicata Region) in the context of burn severity mapping addressed to the estimation of post fire damage mainly for the (i) assessment of the impact of fire on soil and hydrological risk and (ii) to support the definition of mitigation strategy.

At local scale, managers need to be aware of the impacts that fire can have on soil systems, and how these impacts can lead to undesired changes in site productivity, sustainability, biological

diversity, and watershed hydrologic response. For this reason, the availability of reliable and timely information on fire affected areas and burn severity (and expected changes) is crucial to mitigate post fire damage and optimize strategies related to post fire damage management. The full exploitation of data provided by the diverse satellite sensors (MODIS, TM, ASTER; Sentinel 1 and 2), ancillary information and data base, with specific reference to the landslides catalogues, are integrated with all the available information (in digital and non digital format) within a GIS environment for the elaboration, integration and publication (via a webgis. Statistical analysis on the co-occurrence of fires and landslides enable us to assess the impact of fire events on the landslide susceptibility and to provide useful information for improving landslides risk estimation and mitigation strategies. As an example, Figure 35 and 36 show the co-occurrence of fires and landslides as assessed for the 2011 and 2012 in the Basilicata Region.

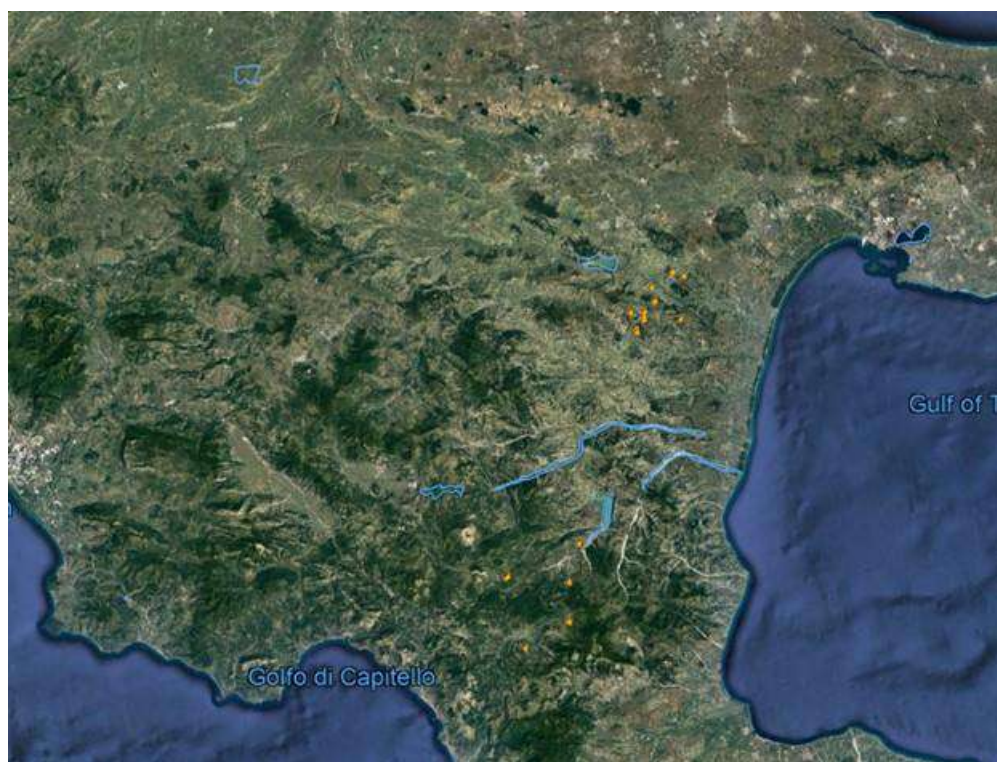


Figure 35- Co-occurrence of fires and landslides (orange dots in the figure) as assessed for the 2011 events in the Basilicata Region



Figure 36- - Co-occurrence of fires and landslides (red dots in the figure) as assessed for the 2012 events in the Basilicata Region

3. Publications

- Carmen Fattore, Rosa Lasaponara. Analysis, interpretation and discussion on mismatch of Fire severity mapping from UAV, Sentinel -2 and EFFIS: case studies in the Basilicata Region. 12th EARSEL Forest Fires SIG Workshop “Remote sensing of forest fire data, science and operational applications” Conference, 3-5 October 2019 - Rome, ITALY
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- Gianfranco Cardettini, Angelo Aromando, Rosa Lasaponara. Fire emission Estimation using Landsat TM: the case study studies of 2011 Fires occurred in the Ionian coast (southern Italy). 12th EARSEL Forest Fires SIG Workshop “Remote sensing of forest fire data, science and operational applications” Conference, 3-5 October 2019 - Rome, ITALY
- Hamid Reza Pourghasemi, Rosa Lasaponara. Forest fire susceptibility modelling using boosted regression tree data mining technique. 12th EARSEL Forest Fires SIG Workshop “Remote sensing of forest fire data, science and operational applications” Conference, 3-5 October 2019 - Rome, ITALY
- Karlsson C., Vajda A., Hyvärinen O.: Forest fire risk prediction on sub-seasonal and seasonal timescale in Finland, Poster presentation, EGU2019, Vienna, 7-12 April 2019
- Marco Turco, Jost von Hardenberg, Amir AghaKouchak, Maria Carmen Llasat, Antonello Provenzale & Ricardo M. Trigo (2017). On the key role of droughts in the dynamics of summer fires in Mediterranean Europe. *Nature, Scientific Reports* 7:81, DOI: DOI:10.1038/s41598-017-00116-9
- Marco Turco, Juan José Rosa-Cánovas, Joaquín Bedia, Sonia Jerez, Juan Pedro Montávez, Maria Carmen Llasat & Antonello Provenzale. Exacerbated fires in Mediterranean Europe due to anthropogenic warming projected with nonstationary climate-fire models (2018) *Nature Communications* 9:3821, DOI: 10.1038/s41467-018-06358-z
- Maria Danese, Gianfranco Cardettini, Angelo Aromando and Rosa Lasaponara. On the impacts that fire on soil and hydrogeological risk: the case study of Basilicata Region. 12th EARSEL Forest Fires SIG Workshop “Remote sensing of forest fire data, science and operational applications” Conference, 3-5 October 2019 - Rome, ITALY
- Nicola Masini, Rosa Lasaponara. Archaeology on fire. Remote sensing base approach for the damage analysis: the case of Ventarron in Peru. 12th EARSEL Forest Fires SIG Workshop “Remote sensing of forest fire data, science and operational applications” Conference, 3-5 October 2019 - Rome, ITALY

- Partanen T., Sofiev M.: A weather based prediction method to forecast regional emissions from wildfires in African grassland, Oral presentation, 12th EARSeL Fire Workshop 2019, Rome, 3-5 October 2019
- Partanen T.: A method to forecast regional emissions from wildfires in African grasslands, Oral presentation, 37th ITM Conference Hamburg, Germany, Sept. 23-27, 2019
- R. Lasaponara, M Proto CNR-IMAA, A. Aromando, G. Cardettini, V. Varela, M. Danese. On the mapping of burnt areas and burn severity using Self Organizing Map and Sentinel 2 data (in press IEEE)
- Rosa Lasaponara, Andrea Vajda, Cerdan Oliver, Vassiliki Varela, Peter Van Velthoven, Mirek Trnka, Massimiliano Pasqui, Carlo Calfapietra, Antonio Lo Porto, Brunella Rago, Emanuele Pallozzi, Nicola Afflitto, Angelo Aromando, Gianfranco Cardettini, Carmen Fattore, Monica Proto, Ari Venalainen, Cecilia Karlsson, Tero Partanen, Mikhail Sofiev, Rostislav Kouznetsov, Rosalie Vandromme, Baptiste Vignerot, Geert Jan van Oldenborgh, Folmer Krikken. Integrated services and approaches for assessing effects of climate change and extreme events for fire and post fire risk prevention. 12th EARSEL Forest Fires SIG Workshop "Remote sensing of forest fire data, science and operational applications" Conference, 3-5 October 2019 - Rome, ITALY
- Rosa Lasaponara, Angelo Aromando, Gianfranco Cardettini, Carmen Fattore, Monica Proto. Satellite based burnt areas and burn severity mapping: preliminary results in the framework of SERV-FORFIRE project. 12th EARSEL Forest Fires SIG Workshop "Remote sensing of forest fire data, science and operational applications" Conference, 3-5 October 2019 - Rome, ITALY
- Rosa Lasaponara, Angelo Aromando, Gianfranco Cardettini, Monica Proto (2018). Fire Risk Estimation at Different Scales of Observations: An Overview of Satellite Based Methods Computational Science and Its Applications – ICCSA 2018 (2018)
- Rosa Lasaponara, Biagio Tucci and Luciana Ghermandi (2018). On the Use of Satellite Sentinel 2 Data for Automatic Mapping of Burnt Areas and Burn Severity, Sustainability 2018, 10(11), 3889; <https://doi.org/10.3390/su10113889>
- Sofiev M., Kouznetsov R., Partanen T., Vira J., Prank M., Soares J., Tarvainen V., Vankevich R., Kukkonen J.: Finnish experience in fire smog emission estimation and pollution prediction, Oral presentation, 7th International Wildland Fire Conference Campo Grande, Brazil, 28 Oct. - 1 Nov. 2019
- Vajda A., Karlsson C., Hyvärinen O.: Sub-seasonal predictability of forest fire danger in Finland, Oral presentation, 12th EARSeL Fire Workshop 2019, Rome, 3-5 October 2019
- Vassiliki Varela, Diamando Vlachogiannis, Athanasios Sfetsos, Stelios Karozis, Rosa Lasaponara Projection of forest fire danger due to climate change in Greece. 12th EARSEL Forest Fires SIG Workshop "Remote sensing of forest fire data, science and operational applications" Conference, 3-5 October 2019 - ROME, ITALY
- Wolff C., Vajda A., Hyvärinen O.: Developing a model for forest fire risk forecast at sub-seasonal scale in Finland, Short paper submitted to FMI Climate Bulletin Research Letter

Meetings with the Regional State Administrative Northern Finland Agency and Rescue Services, presenting the prototype developed in the ERA4CS SERV_FORFIRE project.

4. Divulagation

EARSeL Workshop “Remote sensing of forest fire: Data, science and operational applications” – Rome, 3-5 October 2019

Sala Marconi, CNR, Piazzale Aldo Moro 7, 00185 Roma, Italy

The workshop, organized by the European Association of Remote Sensing Laboratories “EARSEL” was held in Rome at CNR headquarter from 3 to 5 October 2019. It was the 12th EARSeL Forest Fires SIG Workshop. It was chaired by Rosa Lasaponara (CNR-IMAA), Lead Principal Investigator of SERV_FORFIRE project and by Ioannis Gitas, Aristotle University of Thessaloniki, and has benefited from the presence of all the principal investigators of the project and other well-known experts, who are part of the Workshop’s Scientific Committee.



Figure 37 - EARSeL Workshop “Remote sensing of forest fire: Data, science and operational applications” – Rome, 3-5 October 2019

The Workshop topic was the “Remote sensing of fire: Data, science and operational applications”. The workshop has brought together experts in remote sensing, forest managers, researchers, local governments and global organizations to address the key strategic issues of fire data science, modelling, management, and monitoring. Among the invited speakers, it is worth noted, Emilio Chuvieco, Professor of Geography and director of the Environmental Ethics chair at the University of Alcalá (ES), Antonello Provenzale, Director of the Institute of Geosciences and Earth Resources, CNR (IT) and Jesus S. Miguel, Senior researcher at the European Commission Joint Research Centre.

The thematic session has included presentations and poster on the use of historical archives and data delivered by the most recent satellite missions, employing big data and time-series for:

- Dynamic modelling fire occurrence, fuel structure and fuel moisture models
- Application of image processing techniques and machine learning to support fire management
- Integration of satellite, airborne, and field sensor for wildfire management
- Fire detection and monitoring on multiple scales

- Fire behaviour and fire impacts
- Burned area, severity estimation and ecological impacts,
- Fuel consumption and fuel load estimation
- Laboratory and field studies of fire and post-fire residues
- Fire emissions estimation and air quality monitoring
- wildfire impacts and post-fire treatments.
- Exploitation of Big Earth Data and satellite time-series for fire disturbance monitoring
- Studies on the impact of climate change on forest fires occurrence and severity;
- Contribution of Sentinel missions on forest fire research;
- Improved methods of modelling post-fire vegetation trends;
- Modelling and Monitoring post fire vegetation recovery

SERV_FORFIRE project was presented by the contribution “INTEGRATED SERVICES AND APPROACHES FOR ASSESSING EFFECTS OF CLIMATE CHANGE AND EXTREME EVENTS FOR FIRE AND POST FIRE RISK PREVENTION”, with the participation of all partner.

Conference website: <https://cnrfire2019.eu/#organizers>

Training on forest fire organized by ESA, EARSel CNR | ESA ESRIN Frascati 30 Sep-1 Oct 2019

Training Room 9007 (Building 9), ESA ESRIN, Largo Galileo Galilei, 1, 00044 Frascati RM, Italy

On the occasion of the 12th EARSel Forest Fires SIG Workshop, a training course was organized on the application of active and passive remote sensing techniques for fire research. The training course was held from 30 September to 1 October in Rome at European Space Agency building. The course was focused on the use of active and passive Earth Observation (EO) Technologies for fire monitoring.

EO has long been considered as a key tool for fire data, science, modelling, management, and monitoring. The most recent developments in computer technology, data processing, artificial intelligence (AI), deep learning approaches, and geospatial data mining techniques, enable advanced dynamic modelling, tools, data integration, and assimilation schemes, and are expected to significantly support and improve fire science and operational applications. Recently, the availability of new sensors from satellite, aerial, drone, and ground, along with the free access to large archives of data, has opened new perspectives for both fire science and applications.

The training was addressed to early career researchers, students, PhD students and young professionals from European institutions and Canada with background in Remote Sensing and working in topics related to wildfire. 26 Applicants from other countries have participated. The official language of the training course was English.



Figure 38 - Training on forest fire organized by ESA, EARSEL CNR / ESA ESRIN Frascati 30 Sep-1 Oct 2019

Training course website: <https://cnrfire2019.eu/#training>

Presentation of SERV_FORFIRE at the European Researchers' Night – Matera (Italy), 27 September 2019

The project SERV_FORFIRE was shown at the European Researchers' Night, held in Matera (Italy) on 27 September 2019, within the BRAINCITIES project, which was acknowledged as Associated Event to the European Researchers' Night. The project was shown both as a video and a panel at the European Corner, set up in the square of the University of Basilicata, where the core of the activities of the project have been realized.



Figure 39 – SERV_FORFIRE at the European Researchers' Night, Matera (Italy), 27 September 2019