SERV_FORFIRE ERA 4CS

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SERV_FORFIRE
Integrated services and approaches for Assessing effects of climate change and extreme events for fire and post fire risk prevention

Project Management Plan
Milestone M.1

http://www.jpi-climate.eu/nl/25223459-SERV_FORFIRE.html

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Authors

Rosa Lasaponara, Consiglio Nazionale delle Ricerche – Istituto di Metodologie per l’Analisi Ambientale (CNR –IMAA)

Monica Proto, Consiglio Nazionale delle Ricerche – Istituto di Metodologie per l’Analisi Ambientale (CNR –IMAA)

Massimiliano Pasqui CNR-IBIMET

Carlo Calfapietra CNR-IBAF

Antonio Loporto CNR-IRSA

Brunella Raco CNR-IGG

Andrea Vajda, Finnish Meteorological Institute (FMI)

Olivier Cerdan and Rosalie Vandromme, Bureau de Recherches Géologiques et Minières (BRGM)

Vassiliki Varela, National Center for Scientific Research "Demokritos" (NCSRD)

Mirek Trnka, CzechGlobe - Global Change Research Institute of the Czech Academy of Sciences (GCRI)

Peter Van Velthoven, The Royal Netherlands Meteorological Institute (KNMI)

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1 Project abstract

Fire represents one of the main disturbances for vegetation, causing profound transformations at different temporal and spatial scales which affect ecosystems, landscapes and environments. Climate change is expected to bring increased forest fire risk by altering the water cycle at seasonal time scale, by increasing the occurrence of prolonged droughts and heat waves in the Mediterranean basin, as well as in Alpine ecosystems and boreal forests, with severe environmental and economic consequences. This project aims at creating an international collaborative community , expert in remote sensing soil and vegetation, risk management and mitigation, to provide climate information along with decision makers and planning authorities in order to:• increase efficiency of decision and policy makers authorities response, to improve the preparedness level of our societies and to limit the high economic cost of climate variability impact on fire and post fire risks, develop methods and specific procedures within the framework of fire and post fire risk management in Europe at climatic time scales (from seasonal to longer time scales),• strengthen the science-policy-society nexus using a participatory approach, by improving already operational or experimentally tested climate services in Europe, tailoring relevant information for decision and policy makers through a participatory and circular approach, capacity building user-based tools, specific training programs, dissemination activities,• increase the information regarding the drought conditions on wildfire and post fire risks management at climatic time scales (from seasonal to longer time scales) for national and local authorities decision-making procedures and planning activities,• collect scenarios on the effects of climate change on vegetation and fire occurrence,• investigate adaptation strategies and approaches to deal with future fire occurrence.

Partners

Consiglio Nazionale delle Ricerche, Dipartimento Scienze del Sistema Terra e Tecnologie per l'Ambiente Terra (Italy)

Finnish Meteorological Institute (Finland)

Bureau de Recherches Géologiques et Minières (France)

National Center for Scientific Research "Demokritos" (Greece)

CzechGlobe - Global Change Research Institute of the Czech Academy of Sciences, (Czech Republic)

The Royal Netherlands Meteorological Institute (Netherlands)

Associate partners

Dipartimento Presidenza della Protezione Civile della Regione Basilicata (Italy)

Municipality of Vironas, Attika (Greece)

Comision Nacional de Activitidades Espaciales, CONAE (Spain)

International Centre on Space Technologies for Natural and Cultural Heritage, HIST under the auspices of UNESCO

EuroAqua

Forest Directorate of Chania

Departamento del Geologia, Geografiay Medio Ambiente, Universidad de Alcalà

JOINT RESEARCH CENTRE, EUROPEAN COMMISSION

2 Project Overview

Recognizing the scale and complexity of wild fires the network of the research Institutions involved will assure a comprehensive investigations devised for the different phases of fire management (pre and post fire) and for the different ecosystems and geographic areas ranging from Southern to Northern Europe. The first steps and (WPs) of the project will be focalised on creating an international collaborative community of research Institutions with climate information providers to share experiences, data, data format and meta data, scientific and technical language, approaches, methods and specific procedures within the framework of fire and post fire risk management in Europe. Moreover, all partners will involve decision makers and planning authorities at diverse levels from the municipality to national levels. This will be a significant test procedure for climate service that will also stimulate additional cooperation beyond the project itself.

Our goal is the effective institutional integration of the research component of national CS that will be achieved by (i) conducting quality and innovativeness cutting-edge research and develop services and tools useful for fire and post fire seasonal estimation risks (ii) leading to an improved fire risk management and to a more efficient and safer control of forest fires (iii) developing knowledge and tools that will help to reduce the negative impacts of fire while enhancing its beneficial effects for society and the environment, (iv) helping stakeholders, users and land managers to better understand and manage fire.

The project activities, listed below, will strongly contribute to the effective institutional integration. Advances in knowledge and information availability generated in the course of the project will be captured, stored and managed following the recommendations and the indications available in JPI Climate Guidelines on Open Knowledge. Plans for long-term archiving and meta-description of data will be managed to ensure the reuse and the easy and open access to knowledge and data generated by SERV_FORFIRE activities. Suitable communication and access plans will be carefully defined.

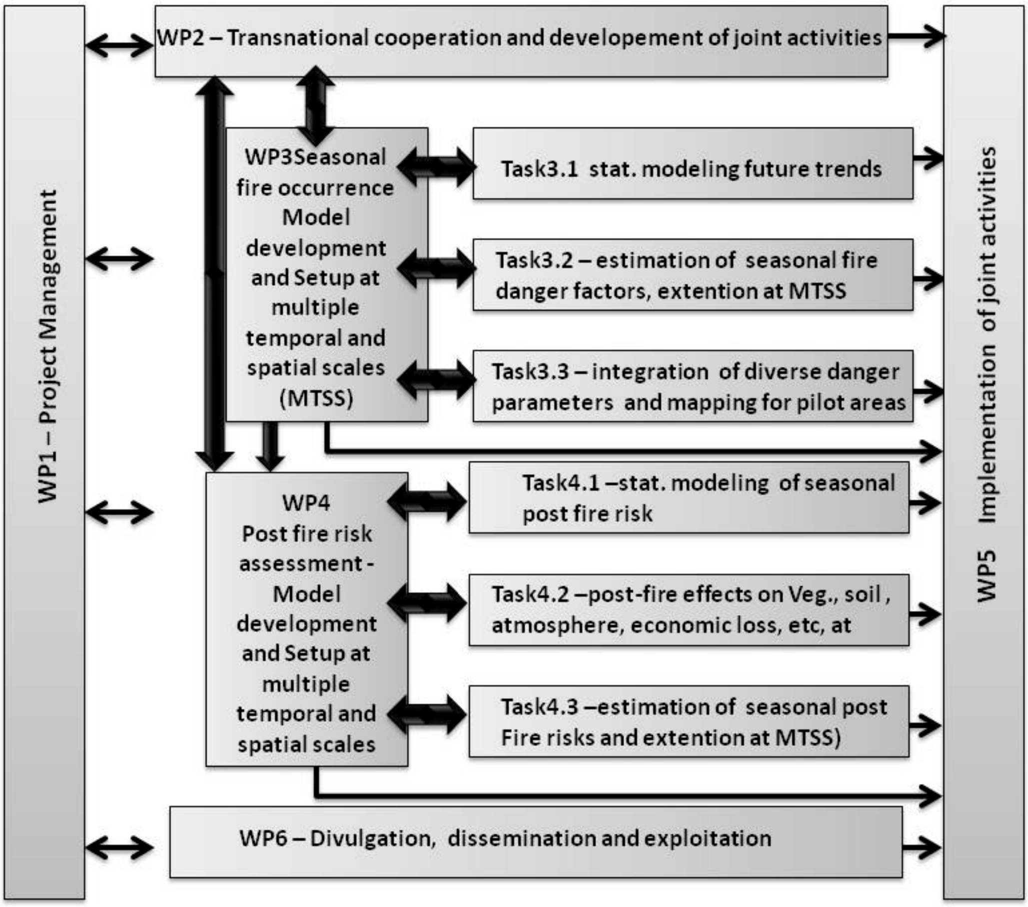
3 SERV_FORFIRE Work Packages

The SERV_FOR FIRE activities will be carried out according to the diverse Work Packages below described. Table 1 provides the time schedule of the Work Packages and Figure 1 shows and marks their interrelations.

Table 1 provides the time schedule of the Work Packages

WP No	WP Title	Lead	participants	Start month	End Month
WP 1	Project Management	CNR Italy	All partners	1	36
WP 2	Transnational cooperation and development of joint activities	NCSRD Greece	All partners	1	12
WP 3	Seasonal fire occurrence Model development and Setup at different temporal and spatial scales	FMI Finland	All partners	6	27
WP 4	Post fire risk assessment - Model development and Setup at different temporal and spatial scales	BRGM – France	All partners	10	36
WP 5	Implementation of joint activities	GCRI Czech Republic	All partners	6	36
WP 6	Dissemination and exploitation	CNR-ITALY	All partners	9	36

Figure 1 Work Packages interrelation



WP description

WP 1 project management

The Institute of Methodologies for Environmental Analysis (IMAA) is part of the Department of Earth and Environment of the National Council of Research (CNR). IMAA/CNR has performed and managed many research and innovation activities. The diverse Institutes of the CNR-DTA involved in the project have significant expertise in EU/INTERREG/National project coordination. Using this experience we can plan the necessary steps for a successful and effective team collaboration. The main tasks of CNR as Project coordinator are:

(i) To ensure the project's proper management and the achievement of its objectives in accordance with its time schedule and budget; (ii) to monitor the progress and the quality of all deliverables and assure deadlines; (iii) to guarantee all contractual, legal, ethical, security, society and gender equality issues; to give precise instructions about the PM rules, eligibility and implementation rules and to facilitate administrative issues; (iv) to update the activities and objectives by e-mails and by organizing Skype meetings and report regularly; (v) to assure the Quality Control of results and processes; (vi) finally coordinator will assure a systematic day-to-day management, supported by communication also via Skype within the partnership. Periodically reporting and evaluation procedures will be arranged with a monthly schedule. The overall coordination and monitoring of the project will be implemented on the basis of the organizational structure of the Consortium

Quantification of Main results : involvement **of at least** 15 **stakeholders and end users.**

WP 2 Transnational cooperation and development of joint activities

WP 2 will be aimed at creating an international collaborative community of research Institution, decision makers and planning authorities along with climate information providers to share experiences, data, data format and meta data, scientific and technical language, approaches, methods and specific procedures within the framework of fire and post fire risk management in Europe and the Mediterranean basin.

- Refine and improve the joint activities already identified in sections 9.2.1 and 9.2.2.
- Share and exchange among all the partners of experiences, data, data format and meta data, scientific and technical language, approaches, methods and specific procedures
- Defining possible schemes and barriers for the joint activities
- Preparing an action plan the for implementation of joint activities as in WP5
- Identifying of potential additional pilot areas where share the joint activities

The diverse phases of the WP2 will be supported by a systematic dialogue among all the partners. This action will begin with the start of the project, although have been already done during the project preparation. A relevant key task is creating a taxonomy of stakeholders and analysing their relative motivations (i.e., their interests, needs and drivers) to join SERV_FORFIRE community.

Quantification of Main results: N:1 protocol and standard for data exchange and metadata; N1 questionarie for stakeholders and end users

WP3 Seasonal fire occurrence Model development and Setup at Multiple Temporal and Spatial Scale (MTSS)

- Statistical analysis and modeling of fire occurrence
- Making better use of available climate information and knowledge for fire and post fire monitoring
- Increasing the information relevance of fire risk management, from weekly, seasonal up to the climatic time scales, for national and local authorities
- Refining climate change simulations by modeling activities,
- Collecting scenarios on the effects of climate change on vegetation and on fire occurrence

- Investigating adaptation strategies and options to deal with future fire occurrence.
- Estimation of seasonal fire danger factors, extension at MTSS
- Integration of physical and socioeconomic data and information
- Demonstration Pilot areas and definition of Standards and protocols

<u>Quantification of Main results</u>: N 4 pre- operational tools suitable at European and local level for (i) drought monitoring and forecasting, (ii) fire risk estimation at seasonal scales.

WP4 Post fire risk assessment -Model development and Setup at different temporal and spatial scales

- Statistical analysis and modeling of seasonal post fire risk
- Making better use of available climate information and knowledge for post fire monitoring
- increasing the information relevance of fire and post fire risk management, up to the climatic time scales, for national and local authorities decision-making procedures and planning activities;
- Assessing post fire risk (erosion, landslide, environmental degradation, atmospheric contaminations)
- Effect of fire on vegetation and biogeochemical cycles
- Refine climate change simulations by modeling activities,
- Quantify in physical terms, and value as economic costs, the effects of future climate change
- Integrate with physical and socioeconomic data and information
- Demonstration Pilot areas and Develop standards and protocols

<u>Quantification of Main results</u>: 3 pre- operational tools suitable for multiscale application from local, to landscape (promptly up-scalable to European level) for (i) N1 tool for land degradation monitoring, (ii) N1 tool fire-induced erosion and landslide, N 1 tool for atmospheric contamination

WP5 Implementation of joint activities

- Co-design, co-develop and co-evaluate the improvements and innovations needed
- Drawing on and integrating the physical, land-use, socio-economic and other non-physical data and information and framing them to support decision-making processes
- Including appropriate framing of the associated uncertainties
- Improve modelling and predictive capabilities at various space/time scales (wide R&I agenda)
- Make results and information more understandable and usable

<u>Quantification of Main results</u>: Definitions of Standards and protocols at European and local scale (N 2 for drought monitoring and forecasting, 2 fire risk estimation at seasonal scales)

WP6 Dissemination and exploitation

The dissemination and exploitation of the project results to relevant stakeholders and the identification of target groups as well, is going to be implemented, in order to maximize the impacts of the project on specific target audiences. One of the main **goal is to communicate and share results and transfer knowledge gained by this project at the local, regional, national, international level.** All potential end-users will be informed about the project subjects, timeline, and results, via: (i) Creation of the project website, (ii) Digital activities including social media and multimedia for a wider communication strategy. Social networks (Linkedin, Twitter) to actively involve the target audiences; (iii) Creation of promotional material such as: e-Poster of the project, e-Flyers of the project, Eco-Bags to make the project distinctive and widely recognizable; (iv) Participation to the main international conferences (v) Organization of dedicated workshops.

Quantification of main results: N 1 Project web site. N 6 Project electronic newsletter (every six months) N 1 Project forum /blog. N 6 Press releases and articles on sectorial magazines and newspapers. N.5 Videos for general public.

Overall coordination, monitoring and evaluation of the project

The project management will be mainly addressed to the coordination , the monitoring and the evaluation of the project during the overall project life cycle, in order to ensure the successful implementation of the individual activities in compliance with its objectives and timeline. The Coordinator (LPI) Dr. Rosa Lasaponara will assure a systematic day-to-day management, supported by frequent meetings and constant communication within the partnership, using video-conference devices (for example Skype) in order to optimize time and costs. She has to guarantee:

- the communication between the project team and the EU
- the communication among partners
- the correct implementation of the project, ensuring that the project objectives are addressed
- the resolution of any critical problem or delay
- the quality of the deliverables in compliance with the deadlines
- the organisation of the coordination meetings
- the finalization of all financial and administrative obligations
- the preparation of the Consortium Agreement in compliance with ERA4CS guidelines

Periodically reporting and evaluation procedures will be arranged with a monthly schedule. A feedback with all the partners will assure high quality management and timely risk estimation. The overall coordination and monitoring of the project will be implemented on the basis of the organisational structure of the Consortium that shall comprise the following Consortium Bodies:

- General Assembly (GA) as the ultimate decision-making body of the consortium
  (GA shall consist of one representative of each partner and it shall also take decisions on dissemination and exploitation, open access issues and intellectual property rights, etc).
- Executive Board Team (EBT) as the supervisory body for the execution of the Project EBT will consist of the Coordinator (LPI) and the partner representatives appointed by the General Assembly and shall report to and be accountable to the General Assembly

Both GA and EBT will be nominated during the Kick off meeting (not later than one month after the start of the project).
Moreover, three specific Committees will be nominated to assist both the Executive Board and the Coordinator (LPI):
--Steering Committee (SC)

--Advisory Committee (AC)

-- Intellectual Property Right Committee (IPRC)

The strategic management level includes the main decision-making role: The Steering Committee (SC), the Executive Board (EBT) and the Project Coordinator (LPI). The LPI will be assisted by the Advisory Committee (AC) and by Intellectual Property Right Committee (IPRC), as will be defined in the Consortium Agreement.

The EBT represents the operational decision level within the SERV_FORFIRE management organisation. According to the strategy decided by the SC, the EBT makes decisions regarding the management and the project's coordination. More precisely, the operational level within the SERV_FORFIRE management organisation is performed by the LPI and the WP Leaders.

The GA represents the ultimate decision-making body of the consortium. It will be made up by senior researches. Both GA and EBT persons make decisions regarding the technical and management issues including implementing the overall project strategy fixed by the SC (e.g. project re-organisation, dissemination and exploitation). The EBT will meet at least once every six months or more often when required under the chairing of the LPI (via teleconference and constant communication also via Skype). The EBT will inform the SC on the progress of the SERV_FORFIRE project.

The EBT is the structure through which the day-to-day operational management of the different processes is implemented.

Information flow and communication will be enhanced within the project, as follows:

- ✓ A systematic day-to-day management, supported by communication also via Skype within the partnership, will be assured.
- ✓ Periodically reporting and evaluation procedures will be arranged with a monthly schedule.
- ✓ A feedback with all the partners will assure high quality management and timely risk estimation.
- ✓ Temporary placement of project participants at other partner institutions. In particular, young researchers will be strongly involved

The EBT is responsible for deploying the necessary procedures and the planning, monitoring and controlling the necessary actions to make sure that the different WPs are well consolidated. The EBT will monitor and manage the project according to all requirements given, including ethical, gender, and other social related issues.

Following the Kick-off meeting held in Rome, on 9 and 10 October 2017, the project management structure has been discussed and all partners agree with a easier and simpler governance for managing the project. The final decision has been to associate the General Assembly to the Executive Board Team, by appointing the Principal Investigators already involved and nominated in the proposal. So the EBT is consistuted by:

Rosa Lasaponara (CNR)

Andrea Vajda (FMI)

Olivier Cerdan (BRGM), deputy Rosalie Vandromme

Varela Vassiliki (NCSRD)

Miroslav Trnka (GCRI)

Geert Jan Van Oldenborgh (KNMI)

Members of Steering Committee, Advisory Committee and Intellectual Property Right Committee will be appointed in the next steps.

Figure 2 briefly shows the schedule of the project activities

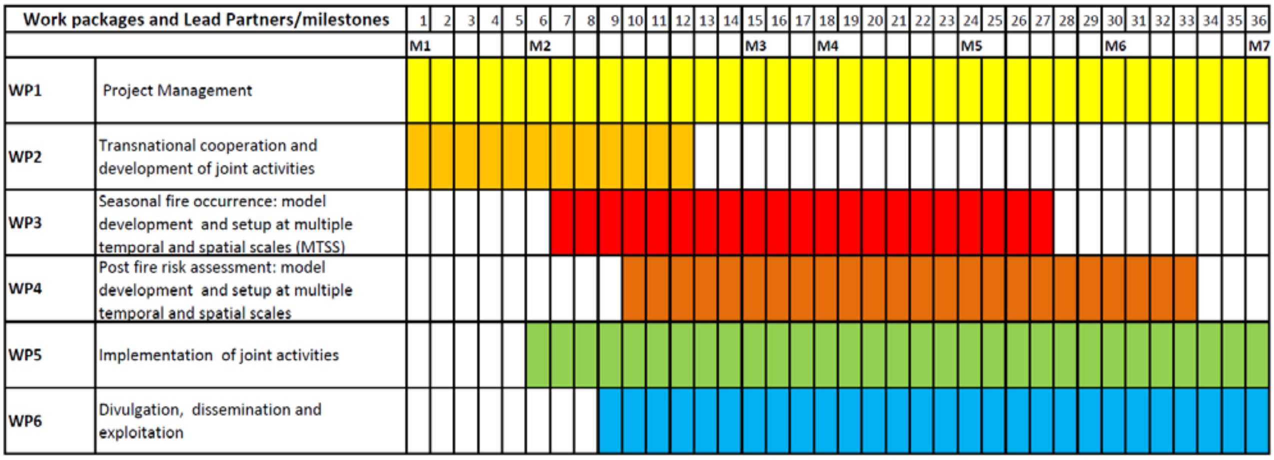


Table 2 briefly shows the milestones

#	Name	Task	date	Comments
M.1	Kick-off meeting	1	M1	Discussion on the Project Management Plan. I Report released.
M.2*	1st Progress Meeting	1,2,3,4,5,6	M6	WP 1 provides the guideline for the implementation of joint activities. II Report released. Begin of WP 5.
M.3	Mid-term Meeting	All	M15	Modeling concluded Start of the case study applications III Report released. 1st Newsletter released
M.4*	1st Progress Meeting on the Case study demonstration	All	M18	All Partners IV Report released. (also via Teleconference)
M.5	2 Progress Meeting on the Case study demonstration	All	M 24	All Partners V Report released. (also via Teleconference 2st Newsletter released
M.6	3 Progress Meeting on the Case study	All	M 30	All Partners VI Report released.

	demonstration			(also via Teleconference
M.7	Final Meeting	All	M 36	All Tasks and demonstration event concluded 3rd Newsletter and Final VII Report released.

Table 2 briefly shows the milestones where important goals will be reached and decisions on further

4 Research plans and Activities

4. 1 Statistical Estimation, Analysis and Modeling of future trends on fire occurrence and fire danger

Statistical Estimation, Analysis and Modelling of future trends on fire occurrence will be performed at diverse temporal and spatial scales exploiting as much as possible all the information available from European level down to a local scale using as reference cases the test areas selected in diverse geographical areas. Maps of monthly and seasonal fire danger forecasts based on long-term weather forecasts will be obtained also using DEM and fuel characteristics (by using European Fuel Map). Integration with social factor and evaluation of economic loss will be performed. In detail:

Statistical Estimation, Analysis and Modeling of future trends on fire occurrence at European level and downscaling to test areas.

<u>Statistical estimation will be made by the Italian CNR (IGG) and Netherlands KNMI</u> using data available from JRC public catalogues and other reliable "official" data source.

In particular, the CNR-IGG will arrange statistical assessments using time series of forest fires occurred in the Mediterranean Basin. KNMI will made available for SERV_FORFIRE activities the KNMI Climate Explorer (http://climexp.knmi.nl), that is a well-established web service that acts as an international repository for climate data at a range of time scales and as a tool for climate analyses. In SERV-FORFIRE it will be extended with already established fire risk prognostics as well as with new ones developed within this project. New climate explorer applications providing analyses, forecasts and future scenarios of fire risk on seasonal to long-term time scales will be implemented. These will be based on climate data already included in the Climate Explorer as well as on vegetation, land cover data sets and fuel map (as available from JRC) yet to be included therein. Observational fire data from the Copernicus Atmosphere Monitoring Service Global Fire Assimilation System (CAMS-GFAS) and from the European Forest Fire Information System (EFFIS) will be used for evaluation of the fire risk data. Once validated, the fire risk data will be made publicly available on the KNMI Climate Explorer website. It will also be used in attribution and projection studies.

4.2 Drought monitoring and fire risk estimation using Different climatic scenarios

Maps of probabilistic forecasts of drought over the Europe using different climatic scenarios and forecasts provided by **FMI at diverse time scales (weekly, monthly and**

seasonal) will be provided by CNR- (IBIMET and IRSA) using the Standardized Precipitation Index (SPI; 3, 6, 9, or 12-month accumulation periods) in future months based upon forecast precipitation and Palmer Drought Severity Index (PDSI) based on precipitation and temperature data

To describe in more detail the spatial characteristics of temporal drought dynamics, CNR- (IBIMET and IRSA) will also provide maps of probabilistic forecasts of drought for several significant test sites as the Tuscany and Basilicata Region (characterized by complex topography, mountain areas, fragmented ecosystems and land covers). These maps will be obtained using different climatic scenarios made available by FMI at diverse time scales (weekly, monthly and seasonal) and the Diverse Drought indices

- ✓ the Standardized Precipitation Index (SPI), which provides multiple time scale drought occurrence and detects its variation and duration;
- ✓ the Effective Drought Index (EDI) computed on a daily basis and is thus more effective to spatially recognize the onset of a drought episode.
- ✓ (Palmer Drought Severity Index (PDSI) based on precipitation and temperature data.

The Greek NCSRD will refine climate change simulations for forest fire risk areas by modeling activities, providing to this aim for different climatic scenarios **made available by the FMI** the following.:Calculation (daily) of Fire weather Index) , Drought Code (Canadian System). Analysis of the Comparison of the results and study of the changes at the fire risk/danger level. Relation with the fire regime/fire occurrence will be investigated as well. The analysis will be performed at both Regional and National level (i.e spatial resolution 12km – 1 km).

Additionally, detailed analysis will be performed for the test sites selected in South and North geographical region : (A) **Czech Republic,** (B) Attika and **Cyprus,** **(C) Basilicata Region (South of Italy)**

(A) The **whole Czech Republic will be considered as a test site** and to this aim **GCRI will arrange the following analyses :**

- ✓ Comparison and testing of various fire danger monitoring methods over the whole Czech Republic (and Slovakia) at 500 m resolution for period 1961-present and assessment of trends,
- ✓ Implementation of ensemble of weather forecasting models (presently GFS, UKM, IFS and up to 3 more) and testing its performance over +10day period;
- ✓ Studies of forest fire risk change for 1961-present and 2016-2100 using large ensemble of Global and Regional climate model
- ✓ Trends in soil moisture, temperatures and wind speed over period 1961-present and their role in change of forest fire risk with possibility to conduct attribution analysis and comparison with actual occurrence of forest fires;
- ✓ Investigation of volatile organic compound fluxes in forest and agricultural ecosystem and comparison of volatile organic compounds in air sampled under different climatic conditions and fire occurrence.

(B) in Cyprus as well as in the Eastern Attika Prefecture (Greece) NCSRD will perform detailed analysis namely Simulation at local spatial level of wild fire behaviour under various weather (eg. selected weather scenarios representative of the climatic scenarios) and vegetation/fuel conditions. Study of the fire behaviour parameters/maps(Fireline Intensity, Rate of Spread) that are considered as important for impact on landscape, erosion etc. The simulations of the fire behaviour will run with G-FMIS Fire Simulation software which is based on BEHAVE system. This type of simulations will be applied at local spatial level (eg. Area of a Municipality or smaller). The spatial resolution for these analyses will be 50-100 m

(C) For the whole Basilicata Region (South of Italy) that is characterized by small fires and a significantly high hydrological risk (one of the highest in Europe) CNR-IMAA will:

- ✓ perform statistical analysis on the fire catalogues available for the region since 1998,
- ✓ carry out the future fire occurrence projections that will be made focusing **on the interface fires (urban-forest vegetated areas),fragmented ecosystems and mountain regions, with particular reference to the Pollino national park recently listed in the UNESCO Geopark (2016).**
- ✓ Perform simulations at local spatial level of wild fire behaviour under various different climatic scenarios using both FIRESA tools (developed by researchers of IMAA) and FIRESITE (developed by the USA USGS). This will support the study of the fire behaviour parameters/maps.

Moreover, estimation of changes in vegetation status will be made (by **GCRI and CNR-IBAF)** using different climatic scenarios and long term weather forecasts (weekly, monthly and seasonal) provided by the FMI. Moreover, several well recognized satellite derived indicators will be adopted. Integration with social factors and evaluation of economic losses will **be carried out involving all the partners**.

4.3 Assessment of post-fire risk: erosion, landslide risk, environmental deterioration, and atmospheric contamination

Post-fire erosion and landslide hazard assessment by using historical landslide occurrence and magnitude data, rainfall conditions, terrain and soils information and burn-severity data from burned areas.

This estimation will be based exploiting model and all the data sets available at different scales, from local (plot) up to the catchment scale and landscape level

4.4 Statistical Estimation, Analysis and Modeling of future trends on post -fire erosion and landslide risk at Multiple Spatial and Temporal Scales.

Statistical estimation will be made by the Italian CNR (IGG), Netherlands KNMI and French BRGM using all the available data including JRC public catalogues and other reliable “official” data source. In synergy and with the cooperation of all the other partners involved in the SER-FORFIRE BRGM will carried out analysis is several test areas already selected for activities 9.2.1 located in Greece, Basilicata region, **Czech Republic plus additional others in Finland.**

Analysis and results collected at the plot scale for the selected test cases will permit to quantify the increase in erosion rates after a fire (and after a recurrence of fire as in the case of Greek test case) and also the evolution over time (e.g. Cerdan et al., 2010) also considering different climatic scenarios that will be provided by FMI. Moreover, remote sensing data acquired from MODIS, LandSat TM ; Sentinel 1 and 2 will be also used for the development of ad hoc vegetation indices for the monitoring of landscape changes during post-fire restoration.

- **Assessment of future trends on fire emission and atmospheric contamination at Multiple Spatial and Temporal Scales.**

The landscape soil and atmospheric system tends to react nonlinearly to changes induced by forest fire Actually , wild fires 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.

FMI and CNR with the cooperation of all the partners will estimated the fire emission and atmospheric contamination for selected test areas on the basis of the outputs from the activities related to the estimation and forecasting of wild fire occurrence in a context of climate change (9.2.1). The currently available models will be adopted and the expected modifications in vegetation and in fuel will be therein incorporated.

- **Assessment of future trends on post -fire land degradation at Multiple Spatial and Temporal Scales.**
  - ✓ CNR-IBAF and **GCRI** will estimate the Effect of wild fires on vegetation and biogeochemical cycles at a “local scale” in a context of climate change under different climatic conditions provided by FMI and fire occurrence.
  - ✓ CNR-IMAA will perform Analysis of large fires using satellite time series data to assess the fire resilience and the vegetation recovery capability under diverse climatic scenarios
  - ✓ Integration physical and socioeconomic data (including local land use land cover) and information will **be carried out involving all the partners**

The activities conducted over the Demonstration Pilot areas will be used as reference for the Development of standards and protocols for data and methods , for post-fire vulnerability and risk assessment decision support as well a sfor the estimation of environematl and socioeconomivcal impat. All partner will b einvolved

5 Detail activities for each institution

5.1 CNR activities as defined in the framework of the SERV_FORFIRE PROJECT

The following five Institutes of DTA are involved in the SERV_FOR FIRE. (i) IMAA scientific mission is the integration of analysis and modeling for risk monitoring will be responsible for the management and dissemination (WP 1 and WP6) and will contribute to all WPs; (ii) IBAF scientific mission is the forestry and vegetation monitoring will provide contribution on the assessment of the impact of climate change on vegetation proneness to fire and on effects of fire itself on the ecosystem processes and biogeochemical cycles (particularly WP3 and WP4); (iii) IBIMET will mainly focus on drought forecasting at seasonal up to climatic scale (WP2, WP5); (iv) IRSA will mainly focus on Drought monitoring (WP3); (v) IGG will implement statistical investigation on fire catalogues and landslide catalogues (WP3 and WP4IMAA whose main scientific mission is the integration of analysis and modeling for environmental monitoring and risk in the project will be responsabile for the managemet and dissemination (WP 1 and WP6) and will actively contribute to all WPs with particular emphasis to WP3 and WP4.In Detail

5.1.1 IMAA

CNR-IMAA is responsible for the management and dissemination and will contribute to all WPs. In particular the Analysis of extreme events as occurred in summer 2017 in the Basilicata Region

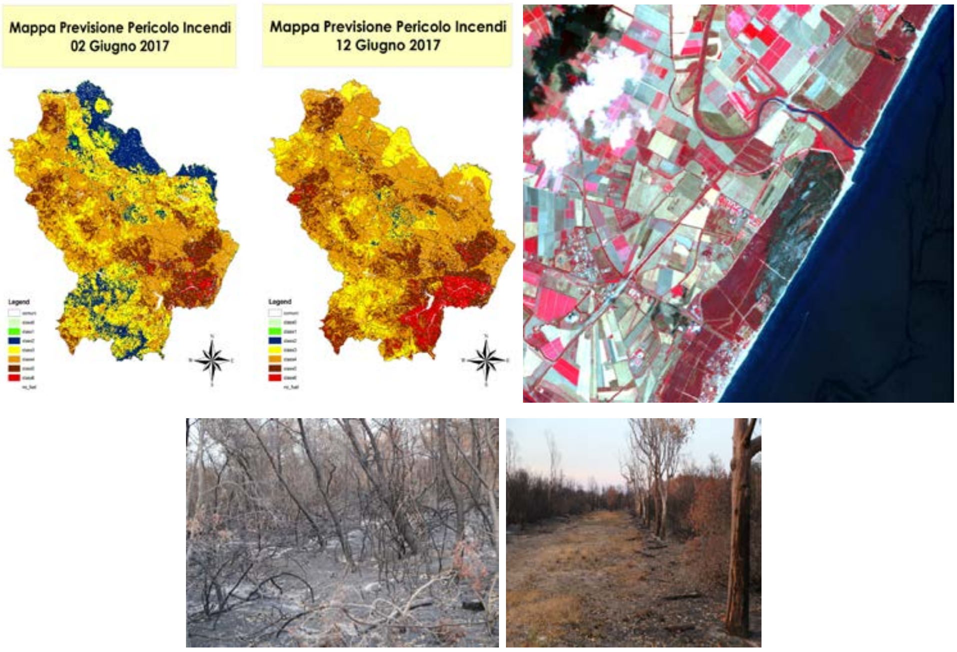


Figure 1: Examples of operational fire risk maps provived by IMAA to protezione civile , Sentinel 2 RGB of burned areas and in situ analysis (Metaponto fire, July 2017)

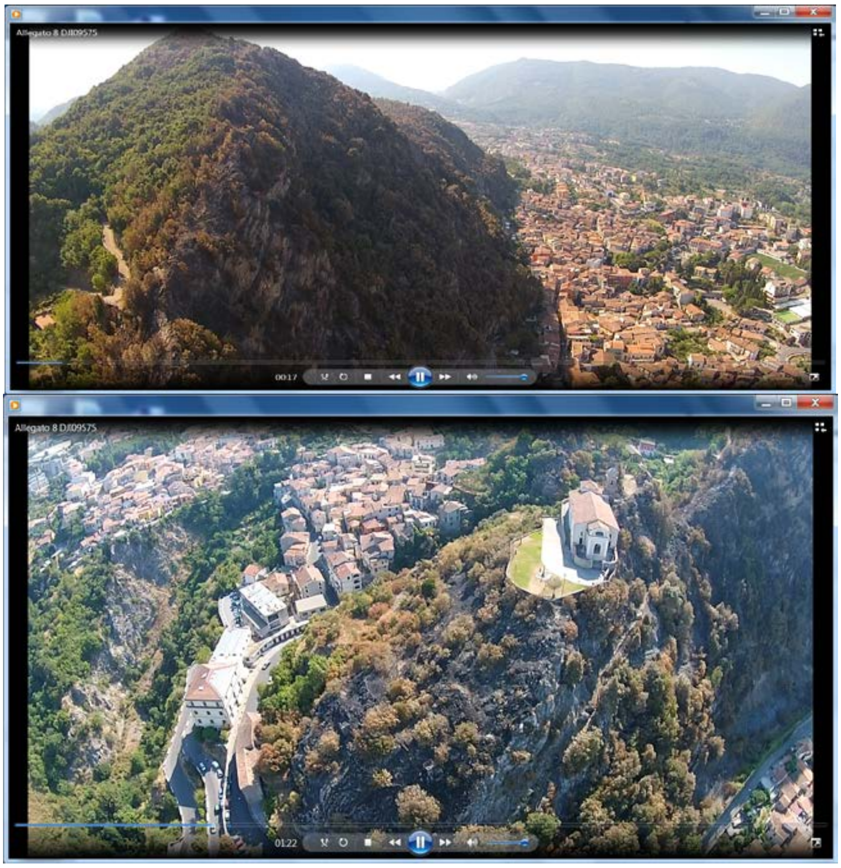


Figure 2 Pollino National Park: interface Fires occurred on 13 July 2017, drone acquisition

For the whole Basilicata Region (South of Italy) that is characterized by small fires and a significantly high hydrological risk (one of the highest in Europe) CNR-IMAA will:

- ✓ perform statistical analysis on the fire catalogues available for the region since 1998,
- ✓ carry out the future fire occurrence projections that will be made focusing on the interface fires (urban-forest vegetated areas),fragmented ecosystems and mountain regions, with particular reference to the Pollino national park recently listed in the UNESCO Geopark (2016).
- ✓ Perform simulations at local spatial level of wild fire behaviour under various different climatic scenarios using both FIRESA tools (developed by researchers of IMAA) and FIRESITE (developed by the USA USGS). This will support the study of the fire behaviour parameters/maps.

Moreover, estimation of changes in vegetation status will be made using different climatic scenarios and long term weather forecasts (weekly, monthly and seasonal). Moreover, several well recognized satellite derived indicators will be adopted. Moreover, remote sensing data acquired from MODIS, LandSat TM ; Sentinel 1 and 2 will be also used for the development of ad hoc vegetation indices for the monitoring of landscape changes during post-fire restoration.

Analysis on Post-fire erosion and landslide hazard assessment by using historical landslide occurrence and magnitude data, rainfall conditions, terrain and soils information and burn-severity data from burned areas.

Integration with social factors and evaluation of economic damage will be performed

5.1.2 IBIMET

CNR-IBIMETwill provide maps of the probabilistic forecasts of drought related indexes over the whole European area at seasonal time scale and estimates of drought indexes occurrence in future climate scenarios. The seasonal forecasts of drought conditions will be computed using several modeling system chains which provide the climate variables needed, in open-access mode and from different sources: the FMI modeling system, the Copernicus Climate Change Service – Climate Data Store (C3S-CDS) and the World Meteorological Organization Sub-Seasonal to Seasonal project data portal**.**

These forecasts and climate change scenarios information will be obtained by computing the Standardized Precipitation Index (SPI; 3, 6, 9, or 12-month accumulation periods) based on forecasted precipitation and Standardized Precipitation Evapotranspiration Index (SPEI) based on precipitation and temperature forecasted data.

Moreover, to describe with finer details the spatial characteristics of temporal drought dynamics, CNR-IBIMET will also provide calibrated maps of probabilistic seasonal forecasts of drought for several significant test areas such as Tuscany and Basilicata regions (characterized by complex topography, mountain areas, fragmented ecosystems and land covers). These seasonal information will be obtained using different forecasts systems available through the above mentioned data-information portals and the several drought indices:

✓·the Standardized Precipitation Index (SPI), which provides multiple time scale drought occurrence and detects its variation and duration;

✓·the Effective Drought Index (EDI) computed on a daily basis and is thus more effective to spatially recognize the onset of a drought episode.

✓·the Standardized Precipitation Evapotranspiration Index (SPEI) based on precipitation and temperature data.

CNR-IBIMET will also contribute to organize training events for professional and early career climate scientists in the area of climate science and stakeholder application for the seasonal forecasts and future climate scenarios. These training events will be open to participants within and outside SERV_FORFIRE, in order to train in the multidisciplinary arena of climate services science. This will develop and train new research expertise in the interface between climate variability and stakeholder application. Each training events will cover specific applications issues related to the SERV_FORFIRE sectors and beyond. These activities will contribute to the dissemination and communication plan of the project.

5.1.3 IBAF

CNR-IBAF will monitor a number of properties of the ecosystem in situ for a proper characterization of the study area in relation to the fire occurrence: i) the level of topographic complexity as one of the principal factors affecting microclimatic conditions; ii) the ecosystem characterization in terms of plant specific composition and abundance; iii) the morphological traits of the vegetation such as: surface/volume ratio, rooting depth and re-sprouting capacity; iv) the biomass and dead-mass amounts and their spatial distributions.

A Proximal sensing level index, based on hyperspectral bands, such the Photochemical Reflectance Index (PRI) will be measured using an ASD Fieldspec Spectroradiometer to monitor the variations in the excess energy dissipation pathways occurring when photosynthesis declines. PRI is using two wavelengths: 531 nm, which is affected by xanthophyll de-epoxidation, and 570 nm which is the reference waveband. The PRI can be used as a reliable water stress index.

The ecosystem characterization data, together with the results obtained by PRI and by ecophysiological surveys, will be combined with the forecasted climatic scenarios by IBIMET and the well-known indices based on multispectral imagery from satellites carried out by IMAA to monitor and forecasting the vegetation dynamics of post-fire restoration. Beyond the indices that use the reflectance of red and near infrared bands such the NDVI (Normalized Difference Vegetation Index) and the IRI (Infrared Index) other indices will be adopted as the NBR (Normalized Burned Ratio), based on red and SWIR bands, and the NBRT that account also for the “scaled brightness temperature” of the thermic band.

In order to assess the impact of wildland fires on carbon cycle at local scale, CO2, CO, CH4, particulate matter (PM) and volatile organic compounds (VOCs) emission during the fire will be measured by a recently combustion chamber collecting the material in the field. The chamber is equipped with a thermocouple, a high resolution balance, an epiradiometer and different sampling lines connected to a number of analyzers to measure the above mentioned gases and particles. In addition, the combustion chamber will allow to identify the contribution of the different plant tissues and the different plant species (leaf and branch biomass as well the dead-mass) to the emissions occurring during the different combustion phases.

5.1.4 IRSA

IRSA-CNR will implement in the test area of the Capitanata valley (Apulia Region, South Italy), in the Candelaro River basin, the hydrological management model SWAT (Soil and Water Assessment Tool).

The model operates at the river basin scale, at sub-daily/daily time scale, using as input a detailed description of physical settings (DTM, landuse, soil types and parameters), weather (rainfall, temperature, wind, solar radiation), human activities (land cover, management practices, urbanization). Output data are water balance at the Hydrological Response Unit (HRU, section of the subbasin sharing the same slope, land cover, soil), river flow, nutrient and other pollutant load and delivery, soil erosion and sediment transport and deposition.

The model will be used firstly to develop the baseline situation in the test site (actual land cover and climate) leading to the assessment of the current water balance and sediment transport/deposition. Then, different scenarios will be developed using changed climate time series (after check for consistency; to account for expected climate change situations), changed land cover (to set scenarios of wildfires of different severity and location), changed soil parameters to take into account modifications occurring in post-fire conditions, singling out effects of climate change, fires, possible adapted management practices.

The model will then allow to assess changes in sediment detachment and transportation/delivery and in the water balance, allowing to quantify the impact of forest/agricultural fires on the water resources in the area and on the upper soil horizon.

This exercise is made furthermore interesting because in the test area an artificial reservoir exists that drains the Celone subcathment: it will be possible then to evaluate impacts of wild fires on sedimentation and usable life in a reservoir.

5.1.5 IGG

Statistical Estimation, Analysis and Modelling of future trends on fire occurrence will be performed at diverse temporal and spatial scales exploiting as much as possible all the information available from European level down to a local scale using as reference cases the test areas selected in diverse geographical areas.

5.2 FMI activities as defined in the framework of the SERV_FORFIRE PROJECT

WP 2: Transnational cooperation and development of joint activities

FMI will continue dialogue concerning forest fire mitigation possibilities with the key Finnish stakeholders like Rescue Services and research institutes (Natural Resources Institute Finland, University of Eastern Finland, and University of Helsinki). This dialogue contributes to targeting of research activities optimal way for the boreal forest zone. As well, FMI will contribute to joint activities of SERV_FORFIRE community. FMI will seek new openings in forest fire related research and will share the outputs with other project partners.

WP3 and WP4

FMI’s activities in these work packages consist of two parts: (i) provision of meteorological information for the needs of other partners, (ii) research activities with fire risk and short-term fire forecasting.

For the fire forecasting model development at all timescales FMI will provide the meteorological and climatological data on different time scale, including short-term forecast data for the period 2005-2015, reforecasts or hindcast data for extended range forecast (ERL) for 2005-2015 and long range or seasonal forecast (LRF) for 1981-2015 and climate scenario data for the future-climate fire risk evaluation.

Re-forecast data is used for the evaluation of the sub-seasonal and seasonal forecast system (ECMWF_SEAS5, released in autumn 2017) and for testing the applicability of products in drought and forest fire assessment model. Using the hindcast data drought maps and forest fire risk climatology for selected test sites (defined and run by the other partner) on weekly, monthly and seasonal scale can be produced and validated against observed climatology.

FMI will test and evaluate the applicability of the extended range (6-week) and seasonal forecasting system for estimation of fire danger in Finland using Finnish Forest Fire Index (Vajda et al. 2014) and re-forecast data from the ECMWF model. The development of the fire forecasting model will be performed over the fire season of 2010-2016 for which both meteorological and fire observation data is available. Validation of the results will be done using standard verification methodology. The fire seasons of 2017-2018 will be used for the models evaluation with the corresponding meteorological data from FMI.

The demonstration case of developed models using forecasted meteorological information at all scales will be performed for the fire season of 2019. For that real-data case, FMI will provide 6-days meteorological forecasts with daily update, thus covering short- and weekly forecasting periods. Seasonal weather forecasts will be post-processed and provided with monthly updates.

Climate scenario data will be provided to the partners for the selected test sites (or Europe) the refinement of future climate forest fire risk modelling. For this purpose a set of post-processed variables from an ensemble of CMIP5 general circulation models for RCP 4.5 and

RCP8.5 scenario (Ruosteenoja et al. 2016) will be provided for the partners. The spatial resolution of the data is 2.5°, covering the whole Europe with daily time resolution.

Fire forecasts for a time period of a few days can be based on deterministic meteorological forecasts (or the corresponding climate predictions) and include the full set of variables driving the fire probability. There is however a strong evidence that fires are mostly induced by humans, either deliberately or accidentally -induced - see (Sofiev, 2013) and references therein. Therefore, accurate prediction of the fires occurrence has to account for the local habits and regulations. Certain information about those can be derived from the actual fires and their relation to the environmental conditions. A statistical short-term fire forecasting model will be built using the analysis of multi-annual fire observations by MODIS and SEVIRI, combined with the ERA-Interim meteorological re-analysis data. Possibility of the model application over longer periods – up to the whole fire season – will be considered.

In addition FMI will coordinate the activities among the partners in WP 3 - Seasonal fire occurrence, Model development and Setup at Multiple Temporal and Spatial Scale.

Deliverables:

Fire risk estimation at seasonal scale on European and local scale

Short-term fire forecasting model.

References:

Sofiev M., 2013: Wildland Fires: Monitoring, Plume Modelling, Impact on Atmospheric Composition and Climate. Chapter 21 in Matyssek, R., Clarke, N., Cudlin, P., Mikkelsen, T.N., Tuovinen, J.-P. Wieser, G., Paoletti, E. Climate Change, Air Pollution and Global Challenges. Series: Developments in Environmental Science, vol. 13. ISBN: 978-0-08-098349-3 ISSN: 1474-8177, Elsevier & Book Aid Intern., pp.451-474.

Vajda A., Venäläinen A., Suomi I., Junila P. and Mäkelä H.M, 2014: Assessment of forest fire danger in a boreal forest environment: description and evaluation of the operational system applied in Finland, Meteorological Applications, Volume 21, Issue 4, pp 879–887

Ruosteenoja, K., K. Jylhä and M. Kämäräinen, 2016: Climate projections for Finland under the RCP forcing scenarios. Geophysica, 51, 17-50.

5.3 BRGM activities as defined in the framework of the SERV_FORFIRE PROJECT

Forest fire as a geomorphic agent

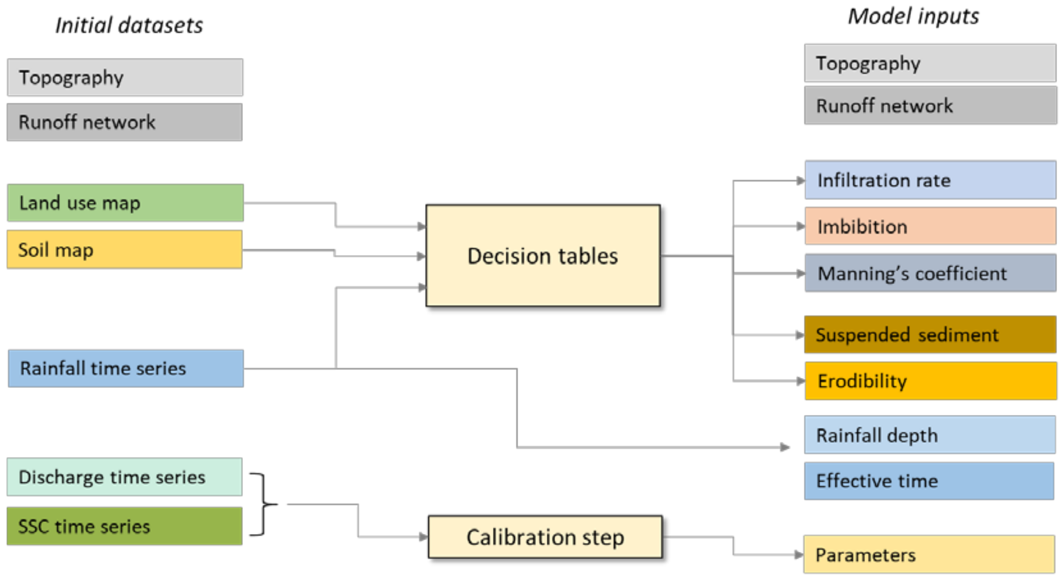
The landscape and the soil system tends to react nonlinearly to changes induced by forest fire, so that even modest rainfall events can result in dramatic increased rates of soil loss, especially if rainfall occurs on unprotected soil surface just after the occurrence of fire. Fires strongly disturb soil properties and composition during the event and modify vegetation itself, leaving large areas stripped of vegetation and prone to erosion. Wildfire is therefore regarded as a major agent of soil erosion and land degradation. It was suggested for some locations as the single most important agent of geomorphological change (Shakesby, 2011). Several studies were devoted to study the effect of fire on gravitational risks that have identified the main responsible processes. Firstly, there is a direct effect from the decrease of the percentage of vegetation cover. It increases the soil surface exposed to rainfall energy and/or overland flow shear stress. Secondly, fire may strongly affect soil surface properties (OM content, porosity, aggregate stability, water repellency), frequently inducing an increase in runoff and erosion rates. Experimental results collected at the plot scale permit to quantify the increase in erosion rates after a fire and its evolution with time (e.g. Cerdan et al., 2010). References at the catchment scale are lacking. However, to be able to develop integrated remediation studies, managers need to have an assessment at the catchment scale as the local effect can be propagated in vulnerable areas downstream depending on their location in the landscape. Modeling approaches incorporating the effect of the evolution of soil surface properties or of vegetation cover on soil erosion rates at the catchment scale (e.g. Landemaine et al., submitted; Le, 2012) were recently developed. These models are therefore potentially able to assess the effect of forest fire on erosion processes as well as the effect of remediation strategies. The BRGM objective in the SER_FORFIRE project is thus to adapt and apply a soil erosion model to the different test cases and climatic scenarios proposed in the project framework.

The Watersed soil erosion model

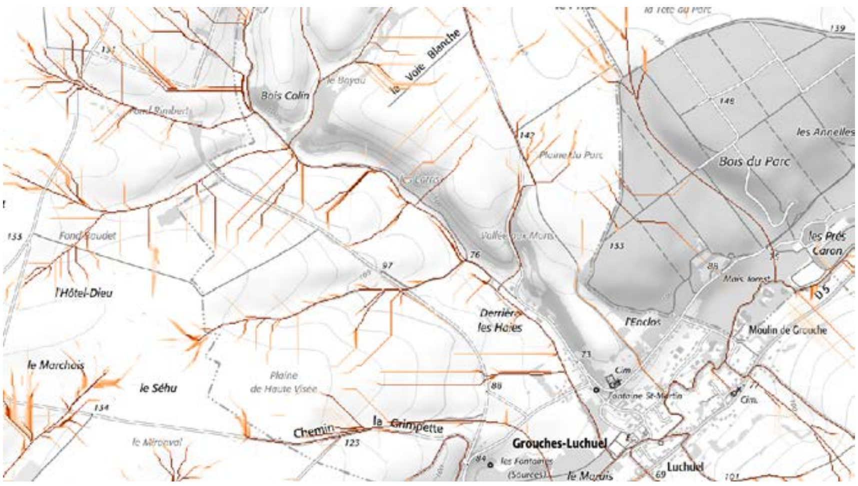
A distributed soil erosion hillslope model simulating water erosion generated by both Hortonian and saturation overland flow will be developed based on the existing STREAM expert-based model methodology (Cerdan et al., 2002a; Cerdan et al., 2002b). This upgrade of the STREAM model will provide a non-dynamic model using a raster-based distributed approach for predicting spatial distribution of runoff and soil erosion within a catchment for a given rainfall event (or a sequence of rainfall events) and will operate from the field scale to the large catchment scale (1000 km²). The WATERSED model (Surface and sub-surface water erosion modeling) will incorporate the same “expert system” approach as the STREAM model, which classifies and combines the dominant parameters driving runoff and soil erosion from a compilation of laboratory and field experimental references (Le Bissonnais et al., 2005). The major improvements of this version will be the inclusion of : (i) sub-surface runoff processes by taking into account percolation into the soil column, (ii) the use of topography, surface characteristics, and rainfall characteristics to discriminate the occurrence of sheet/interrill or concentrated erosion (rills, gullies) (Cerdan et al., 2002c;

Martin, 1999), (iii) the possibility to integrate soil and water conservation measures at the catchment scale.

The WATERSED model will be calibrated with existing monitored datasets of water and sediment fluxes in representative headwater catchments, available during the course of the project.



The WaterSed model requires seven datasets to compute runoff and erosion for any location within a catchment.



Example of output map of the Watersed model.

Expect results from the simulations

Statistical Estimation, Analysis and Modelling of future trends on fire occurrence will be performed by the project partners at diverse temporal and spatial scales. Information will be available from European level down to the local scale, using as reference cases several test areas selected in diverse geographical areas. Maps of monthly and seasonal fire danger forecasts based on long-term weather forecasts will be combined with the probability of occurrence of rainstorm. The expected outputs are:

- Definition of the periods and locations where the risk of intense rainfall after a fire are the highest in order to define priority remediation action plans
- Quantification of the potential impacts of rainstorm events after a fire on the landscape in terms of sediment yields
- Definition of optimum local management plan to prevent an increase in soil erosion risk according to different climatic scenarios.

5.4 NCSRD activities as defined in the framework of the SERV_FORFIRE PROJECT

CONTRIBUTION OF NCSRD (updated 25/9/2017)

WP2 Transnational cooperation and development of joint activities

NCSDR is the coordinator of WP2 which aims to the creation of an international collaborative community of decision makers and planning authorities along with climate information providers to share experiences, methods, specific procedures within the framework of fire risk management in Europe and the Mediterranean basin.

This action begins with the start of the project and lasts for 12 months.

✓ **Coordination of the following actions**

- define and agree upon community members categories. These categories will be updated and redefined as the project progresses.
- creating a taxonomy of stakeholders and analysing their relative motivations (i.e., their interests, needs and drivers) to join **SERV_FORFIRE community**
- organization of dedicated meetings by thelocal partners in their countries, aiming to inform the potential members of the community, analyse their needs and requirements, be informed about their expectations and role in the transnational cooperation scheme in order to maximize their involvement to the joint activities.

✓ **Collaboration with Greek end-users**

- Municipality of Vironas – Attika Greece
- Forest Service - Chania Krete

WP3 Seasonal fire occurrence Model development and Setup at Multiple Temporal and Spatial Scale (MTSS)

Analysis and Modeling of future trends on fire occurrence and fire danger. Seasonal & Climatic analyses.

NCSRD will refine climate change simulations for forest fire risk areas by modelling activities, providing to this aim for different seasonal & climatic scenarios. More particularly, NCSDR work for this WP includes the following tasks:

✓ Collaboration with FMI and the other partners for the precise definition of the seasonal and climatic data standards and requirements. NCSRD will use the Canadian FWI system as a basis for seasonal and climatic analyses.

✓ The data that will be available by_FMI, in an appropriate asccii format on a daily basis for the fire season (i.e May – October), both for the seasonal (past years) and climatic scenarios (up to 2100) will be elaborated by NCSRD for the Daily calculation of the Canadian FWI system parameters including : Daily Fire weather Index , Drought Code (Canadian System), FFMC, Fire Severity Index. The resulting map layers will be available in an asciiGrid format.

- ✓ Further processing of the resulting daily map layers. The spatial data will be further processed in a GIS using geostatistical and overlay analyses for studying Fire Risk/Fire Danger behaviour and trends both at the spatial and temporal level. The analysis will be performed at Regional and National level (i.e spatial resolution 12km – 5 km) depending on the spatial resolution and availability of data.
- ✓ Moreover, additional seasonal analysis for the fire season of the years of the Serv_ForFire project duration (2018-2020) will be performed using seasonal model and data of NCSRD at a 5 km spatial resolution.

- ✓ Relation with the fire regime/fire occurrence will be investigated for the Greek areas of Interest (Eastern Attika & Chania-Krete) , using historical data available by EFFIS database and National databases .

WP4 Post fire risk assessment -Model development and Setup at different temporal and spatial scales

The Contribution of NCSRD to this WP will be the Simulation of wildland fire behavior at a local level (50-100 m) under various weather (eg. selected weather scenarios representative of the climatic scenarios) and vegetation/fuel conditions. The simulations of the fire behavior will run with G-FMIS Fire Simulation software which is based on BEHAVE system. Fuel maps, topography and local meteorological data are the basic data requirements of the Fire Simulation Environment This work includes for this WP includes the following steps:

- ✓ Set up of the Simulation Environment for <u>Test Sites in Greece and Cyprus</u>. NCSRD will organize the spatial information for setting up the Simulation Environment for two Test Sites (in Greece and Cyprus) . Fuel classification and mapping will be based on European Fuel mapping and Corine Land Cover. Prometheus Fuel types and parameters will be used.
- ✓ Set up of the Simulation Environment for <u>two additional Test Sites</u> (in Italy and Portugal) that will be defined by the Serv_ForFire partners. NCSRD will provide the specifications for the creation of the required data layers (Fuel maps and parameters, Topography) and any other information required as input to the Fire Simulator.
- ✓ Collaboration with the partners for the definition of a number of representative weather scenarios for each test site. (up to 20 scenarios).
- ✓ Simulation of the Fire Behaviour for the whole area of interest and for each Fire Weather Scenario. Additionally, Fire propagation mapping scenarios can

be provided for selected ignition points and fire duration scenarios within the Test Sites.

- ✓ Elaboration of the resulting maps (fire line Intensity, Fire Rate of Spread and Fire Steps for particular ignition points) in order to be provided to the partners for further analyses.

5.5 - Global Change Research Institute of the Czech Academy of Sciences, activities as defined in the framework of the SERV_FORFIRE PROJECT

1. Comparison and testing of various fire danger monitoring methods over the whole Czech Republic (and Slovakia) at 500 m resolution for period 1961-present and assessment of trends;

2. Implementation of ensemble of weather forecasting models (presently GFS, UKM, IFS and up to 3 more) and testing its performance over +10day period;

3. Studies of forest fire risk change for 1961-present and 2016-2100 using large ensemble of Global and Regional climate model;

4. Trends in soil moisture, temperatures and wind speed over period 1961-present and their role in change of forest fire risk with possibility to conduct attribution analysis and comparison with actual occurrence of forest fires;

5. Application of airborne, aerial remote sensing optical sensors (thermal, hyperspectral, laser) and development of vegetation indices for the monitoring of landscape changes during postfire restoration;

6. Investigation of volatile organic compound fluxes in forest and agricultural ecosystem and comparison of volatile organic compounds in air sampled under different climatic conditions and fire occurance.

5.6 KNMI activities as defined in the framework of the SERV_FORFIRE PROJECT

The Royal Netherlands Meteorological Institute KNMI has extensive experience in the development of methods for projecting and attributing climate change as well as in weather forecasting. The KNMI Climate Explorer (http://climexp.knmi.nl) is a well-established web service that acts as an international repository for climate data at a range of time scales and as a tool for climate analyses. It provides statistical and visualization tools to handle already available or user supplied data. Resulting data and plots can be downloaded.

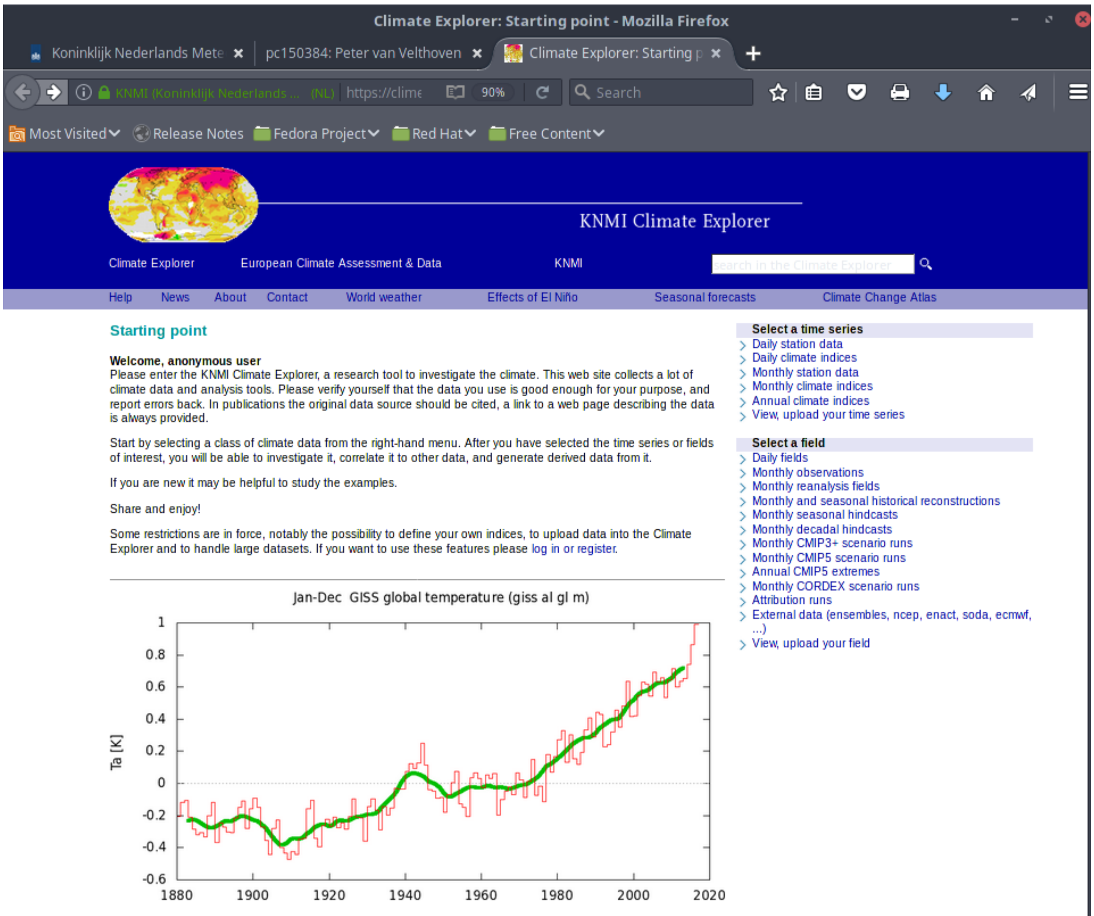


Figure 1: the KNMI Climate Explorer web service

In Serv-ForFire the KNMI Climate Explorer will be extended with already established fire risk prognostics such as the Monthly Drought Code (MDC) as well as with new ones developed within this project. New climate explorer applications providing empirical probabilistic forecasts and future scenarios of fire risk on seasonal to long-term time scales will be implemented. The fire risk forecasts to be developed will use the methodology designed by Eden et al. (2015) for the production of probabilistic forecasts of temperature and precipitation. They will make use of climate data already included in the Climate Explorer as well as on vegetation and land cover data sets yet to be included therein. Seasonal hindcasts from ECMWF from over about 5 decades will be used to select meaningful predictors of fire risk and to quantify the forecast skill. An example of the correlation with observations and the skill score of the probabilistic temperature forecasts for summer and winter is shown in figure 2.

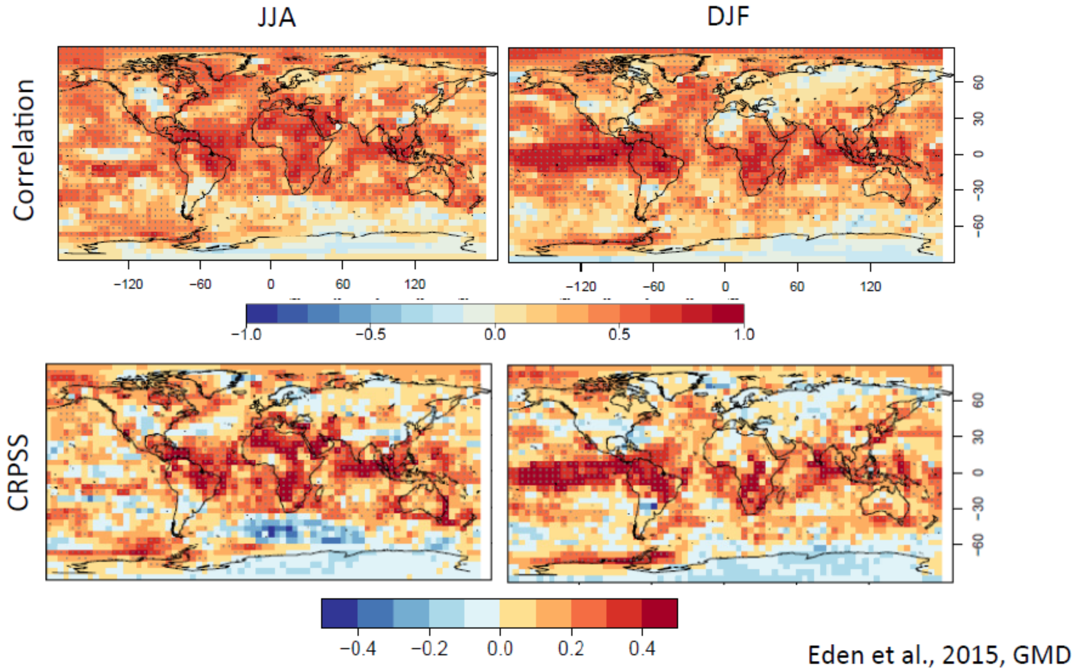


Figure 2 Correlation with observations (upper panels) and the continuous rank probability skill score (lower panels) of temperature forecasts for June-July-August (left) and December-January-February (right).

Observational fire data from the Global Fire Emissions Database (GFED, http://www.globalfiredata.org/), Copernicus Atmosphere Monitoring Service Global Fire Assimilation System (CAMS-GFAS, https://atmosphere.copernicus.eu/) and/or the European Forest Fire Information System (EFFIS, http://effis.jrc.ec.europa.eu/) will be used for evaluation of the fire risk forecasts. Once validated, the fire risk forecasts will be made publicly available as a service on the KNMI Climate Explorer website. The developed methodology and data will also be used in attribution and projection studies.

References

Eden, J.M., G.J. van Oldenborgh, E. Hawkins and E.B. Suckling: *A global empirical system for probabilistic seasonal climate prediction.* Geoscientific Model Development, **8**, 3947-3973, 2015, doi:10.5194/gmd-8-3947-2015.

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