



Forest Fire Management – FFM Geoportal

*A user friendly, state-of- technology Geo-Platform
for practitioners, decision-makers & scientists;
It delivers technology & services to analysing
Wildland & Forest Fires and respond to crises*

FFM Geoportal

**Forest Fire Simulation
& Management Geo-Portal**

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For practitioner, decision-makers & scientists:
It delivers technology & services to analyze
Wildland & forest fires & respond to crises*

Contributors:

EPSILON International SA

Contact Points

Prof. Markos BONAZOUNTAS	Mrs. Despina Kallidromitou	Mr. Anestis Trypitsidis
CTO/CMO	CEO	Technical Consultant
EPSILON International SA	EPSILON International SA	EPSILON International SA
Monemvasias 27	Monemvasias 27	Monemvasias 27
15125 Marousi, Greece	15125 Marousi, Greece	15125 Marousi, Greece
☎ +30 210 6898619	☎ +30 210 6898619	☎ +30 210 6898619
✉ +30 210 6821220	✉ +30 210 6821220	✉ +30 210 6821220
bonazountas@epsilon.gr	kallidromitou@epsilon.gr	rtd-projects2@epsilon.gr
www.epsilon.gr	www.epsilon.gr	www.epsilon.gr

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Nomenclature

AoI	Area of Interest
EGU	Elementary Geographical Unit
FAT	Fire Access Time
OWS	OGC Web Services
SDI	Spatial Data Infrastructure
TOC	Table of Contents
UM	User's Manual
WCS	Web Coverage Services
WFS	Web Feature Services
WMS	Web Map Services

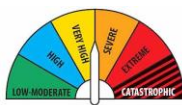
FFM GEOPORTAL™ ABSTRACT

Epsilon Group (2015). FFM Geoportal: Geo-portal for Forest Fire Simulation and Management Services. User's Manual, Draft Report. Epsilon International, SA, Monemvasias 27, GR-15125 MAROUSI, Greece, T: +30-210-6898619, F: +30-210-6821220, central@epsilon.gr, www.epsilon.gr

FFM (Forest Fire Management) Geoportal is web-based tool developed within the context of eENVplus (www.eenvplus.eu) providing access to three different modules:

- Risk Maps
- Fire Simulation
- Evacuation/Routing Service

FFM Geoportal builds upon ArcFIRE™ platform which is a market product. FFM Geoportal is a scalable, modular and customizable technology geo-portal that provides forest fire management solutions. It captures the two out of five stages of the Life Cycle via the following Modules:



Awareness Modules {A}: Analyzing national, regional & local situations, and to forecast short-term & long term circumstances and risks "prior to a fire". To this end it provides:

- Preemptive Methods & Tools for assessing & reducing risks based on maps, meteorological data, statistics and regional practices, and
- Key indices & maps on: meteo risks, FF risk out-breaking, danger indexing (e.g., CA, US, ES, PT, crown-fire), preparedness & prevention indexing.
- An integrated mapping system as visual guidance on "a day's" conditions.



Emergency Modules {E}: Dynamic integrated commutation, surveillance, modelling & information tools assisting planners-, decision makers- and fire fighters- in missions "during the fire". To this it provides synthesis of dynamic information & decision support services as:

- Fire evolution and behavior dynamics, based of fuel content, terrain features, real-time weather Forecasts/ Measurements.
- Dynamic Fleet Rooting linked to actual and forecasted fire-front evolution.
- Evacuation assistance to citizens.
- Dynamic Emergency monitoring and re-streamlining processes.

FFM Geoportal provides services as: stand-alone operational platform, tailored s/w solutions incorporating customers needs & endeavours via additional modules, integration of other third-party applications and services, delivery of custom made wildland & forestry modules as part of a civil protection platform, as fires. It can be simply replicated in any area of interest, only by using primary static (DEM, Slope, Aspect, FMO) and dynamic datasets (Meteo data).



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1 INTRODUCTION

1.1 WHAT IS FFMGEOPORTAL?

FFM GEOPORTAL is a geo-portal and it provides forest fire management solutions.

1.2 SERVICES OFFERED

FFM Geoportal offers:

1. Fire Assessment: Fire risk assessment, pre-preparedness evaluation of the civil protection mechanism and early warning tools for the phase "*prior-to-the-fire*".
2. Fire Management: Fire simulation, dynamic Rooting according to fire propagation, resources tracking & management for the "emergency" phase "*during the fire*" and other

1.3 BASIC TECHNOLOGY

Part of the FFM Geoportal platform is the [ArcFIRE^{TM1}](#) GIS s/w. The ArcFIRETM s/w technology is based on ESRITM.NET Technology, and implements a Service Oriented Architecture with a 3-Layer structure:

1. The Spatial Data Infrastructure (SDI) Layer that contains all GI Data necessary to run ArcFIRETM Modules & Operations (input or output).
2. The ArcFIRETM Client Layer that embeds all ArcFIRETM modules. The ArcFIRETM -Client is developed either on top of ESRITM-ArcMap plus Extensions ("heavy" client) or ESRITM ArcGIS Explorer ("thin" client to be implemented in next ArcFIRETM version).
3. The ArcFIRETM Server Layer that is an Interface between the Client and the SDI. It operates a list of Services that handle the Data-flow from the Data-Layer to the Application Layer and backwards.

1.4 PRODUCT DEVELOPMENT

ArcFIRETM origin dates back to 1999 with the FOMFIS project (EC/FOMFIS, 1999) and since then it integrates all the knowledge accumulated by more than 10 similar projects up to today (e.g., EC/SCIERS, 2009). Continuous improvement and extension is the mission of the development team, so to offer state-of-technology services and assistance upon demand.

ArcFIRETM has been selected by the Hellenic Government (2009) as the platform for the "Seix-Sou" Forest Management, Northern Greece, to be fully operational in the Fire Season of 2011. The Seix-Sou installation technologically delivers vision cameras for fire advanced monitoring, a CCC (control command centre), guidance to fire brigade facilities, and emergency management up to peoples' evacuation guidance and post fire impacts.

Within the context of BRISEIDE ²and based on ArcFIRETM spatial analysis WPSs were developed and integrated within existing open source frameworks (e.g. WPS extension of Sextante by 52°North). Spatio-temporal processing services were exposed via the web and are made available through compatible WebGIS applications. Newly developed or prototypical OWSs already made available by relevant INSPIRE-related EU projects and exposing standard services such as WMS, WCS and WFS, will be used to provide

¹ ArcFIRETM: http://de.epsilon.gr/imported/files/brochures/54_LIFE10_ENV_GR_617_ArcFIRE_brochure.pdf

² BRISEIDE: http://www.briseide.eu/joomla/docs/BRISEIDE_1st_newsletter.pdf

access to relevant geodatabases, enriched, when needed, with information, extracted from heterogeneous, distributed user operational databases. BRISEIDE services are accessible through a multi-platform 3D client, developed by Fondazione GraphiTech, invoked from a web page as a JavaWebStart application. The 3D client allows interactive orchestration of spatio-temporal WPSs providing support to chaining of required processing units. This ensures interactive access to datasets and a synchronous processing at the server side.

Leverage on all above mentioned technologies and within the context of eENVplus³ project EPSILON developed the FFM Geoportal⁴ based on the following services:

- Available Enterprise Service Oriented architecture where all pilot's data (static and dynamic) are stored (GeoServer): <http://epsilonportal.cloudapp.net/geoserver>
- Web-GIS application: <http://epsilonportal.cloudapp.net/portal/>
- Fire Simulation Service WPS: where the following parameters should be included: Aspect (ASP), Slope (SLO), Fuel Model (FMO), Wind Speed (WSP), Wind Direction (WDI), Dead Fuel Moisture (DFM), Ignition points (IGN), and several fire simulation parameters such as Simulation Time in minutes, Maximum number of simulated points, Fixed surface fuel model, Fixed dead fuel moisture in percentage etc.
- FTP Data Service for downloading meteorological data by the National & Kapodistrian University of Athens, School of Physics: <ftp://ftp.mg.uoa.gr/pub/data/epsilon/>

1.5 THIS USER'S MANUAL

This is the User's Manual (UM) for FFM Geoportal linked to the ArcFIRE™ theory documentation. It is addressed to "non-experts", though users who are familiar with the Web-Interfaces have a significant advantage. This manual contains the sections:

- Section 1: The general introduction
- Section 2: Definitions whilst going through the User's Manual
- Section 3: Spatial Data Infrastructure (SDI) to run ArcFIRE™ processes, toolbars, toolboxes
- Section 4: Functionalities

³ eENVplus: www.eenvplus.eu

⁴ FFM Geoportal: <http://epsilonportal.cloudapp.net/portal/>

2 DEFINITIONS

Selected major definitions are cited in this Section. These definitions are crucial to operating FFM Geoportal and the user is encouraged to return here each time an unknown term appears further in the UM.

Fire Simulation Calculates the fire-front spatiotemporal evolution, starting from one or more ignition points (initial conditions). Fire simulation implements an iterative algorithm based on Rothermel's propagation law. Rate of propagation depends on meteorological conditions (wind direction, wind speed) on terrain layout (slope, aspect) and fuel content of the fire propagation medium.

Fire Access Time Fire Access Time is the primary result of Fire Simulation. Fire Access Time is assigned per cell. It calculates the time a cell is burnt, with reference to the "Time the Fire Starts".

Fire Front Isochrones Fire Front Isochrones are the contours of Fire Access Time result. Isochrones capture a snapshot of Fire Front at a fixed time distance from the "Time the Fire Starts" (ignition of Fire).

Evacuation & Dynamic Rooting When Routing Fire Fighters towards the Fire-front or evacuating an area from civilians, it is important to consider Fire-Front evolution in order to avoid fatal events. This is called Dynamic rooting. The user chooses an "isochrone" he/she wants to avoid in minutes (e.g., 240 min). The edges of the Road Network affected by Fire (cross with the abovementioned isochrone) are considered non-traversable and routing is diverted accordingly.

Meteorologicals Maps Forecast Maps provide a spatio-temporal forecast of significant meteo parameters: wind speed, wind direction, temperature, relative humidity, mean sea level pressure, cloud coverage. Maximum spatial resolution is 2 km². Minimum spatial resolution 20 m. Temporal resolution is "per hour" for up to 120 hours (5 days).

Time of Meteo Forecast or Forecast Run Time (YYMMDD) Time of Meteo Forecast or Forecast Run Time (YYMMDD) is the time when the forecast engine runs the model to produce forecast meteo maps.

Forecast Horizon (HHH in hours) Forecast Horizon (HHH in hours) is the time distance between the "Time of Meteo Forecast" or "Forecast Run Time" and the Forecast Reference Time Stamp. HHH ranges from 000 to 120 with a "1 hour" temporal resolution, this means that we have a forecast for up to 5 days.

Time the Fire Starts Time the Fire Starts is the time stamp at which the simulated fire is supposed to start yyyyymmdd hh mm where yyyy:year, mm:month, dd:day, hh:hour, mm:minute).

Simulation Time Simulation Time is the duration of the Simulated Fire.

Time the Simulation is Triggered Time the Simulation is Triggered is the time stamp at which a user/stakeholder seats in front of the client to run a simulation. yyyy:year, mm:month, dd:day, hh:hour, mm:minute).

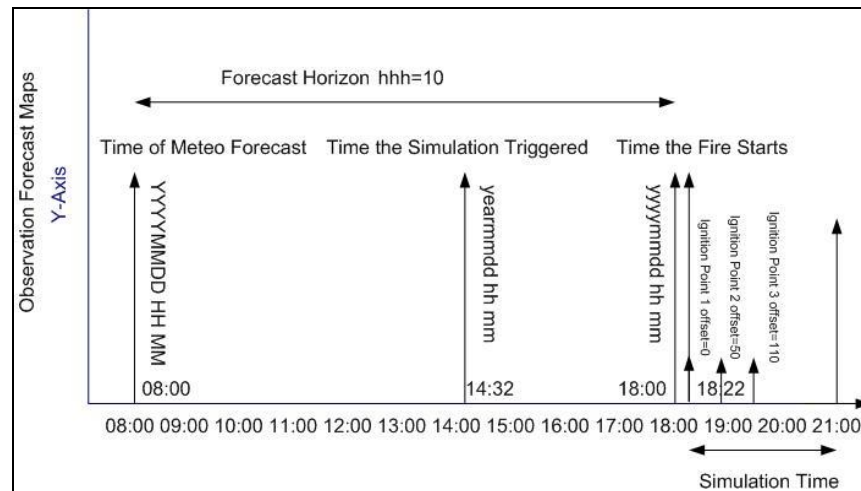


Figure 1: Forest Fire time Milestones

Forest Fuel Models Forest Fuel Models reproduce the Fire Propagation Medium (vegetation) properties. Fuel Models are an idealisation of the real vegetation layer. They always entail certain degree of inaccuracy in comparison to the actual situation. However they are of global use because they offer simplicity to non-experts. For higher accuracy at the local level, model-types should be refined and model-parameters should be re-calculated to match local conditions.

SCENE SCENE is a geographical rectangular area (Area of Interest). It is identified by a unique 3-digit number denoted by SSS (values: 1-999). Each scene (SSS) has a specific:

- Bounding Box (BBOX) i.e. geographical extent
 - resolution (size of Elementary Geographical Unit, EGU)
 - datum & projection system
- (For Seix Sou we have SSS=001)

Rate of Spread Rate of Spread is a vector value. Rate of Spread is the speed a Fire propagates

Fuel Moisture Fuel Moisture is the ratio of water content in grams per 1 gram of Fuel. Fuel Moisture for:

- Dead Fuel ranges from 5% to 30%
- Live Fuel ranges from 30% to over 300%

Fuel Moisture significantly affects the properties of the Fire Propagation medium. High Moisture results in Fuels of low flammability and a low Rate of Fire Spread.

Total Risk Map (TRS) Total Risk Map (TRS) assigns a Risk Value at the range 0-100% to each Elementary Geographical Unit (EGU) within an Area of Interest (AoI). TRS distinguishes: (i) Long-term or Static Fire Risk (SFR) (ii) Short-term or Dynamic Fire Risk (DFR). Both DFR and SFR are calculated as a multiplication of sub-indexes related to potential FF Ignition & Propagation Risk, Hazard Risk and Cost Risk.

3 SPATIAL DATA INFRASTRUCTURE (SDI)

3.1 AREA OF INTEREST (AoI)

The Area of Interest (AoI) is a Geographical Area always of rectangular shape and for whom a complete Spatial Data Infrastructure (Spatial Datasets) is available to run FFM Geoportal processes.

FFM Geoportal is operational for particular discrete AoIs. Each AoI is called "scene" and is identified by a unique 3-digit number denoted by SSS (e.g., the SEIX SOU is 001). Each scene (SSS) has a specific:

- Bounding Box (BBOX), i.e. geographical extent
- Resolution (size of Elementary Geographical Unit (EGU))
- Datum & projection system.

3.2 FFM GEOPORTAL SPATIAL DATA

Spatial Data used/produced by FFM Geoportal are of two types:

1. Static Data that bare some or no changes in the long-term; Static data are (i) either standard Spatial Data e.g. Terrain Maps such as the Digital Elevation Model (ii) or Spatial Data that require human interaction and pre-processing effort such as the Fuel Model Map/ Static Risk Maps etc.
2. Dynamic Data that bare significant changes in the short-term. Dynamic Data are further divided into three sub-Classes: (i) Meteorological maps e.g. Temperature (ii) Index Maps related to Forest Fire e.g. ,Probability of Ignition (iii) Fire Simulation Maps e.g. Fire Access Time and Alphanumeric Data (e.g. format ASCII Files with Ignition Points)

The following Tables (Table 1, Table 2, Table 3, Table 4) identify the abovementioned data.

Table 1: List of Static Data

XXX	Description	Units	Information
ASP	Aspect	Degrees	Clockwise, down slope, integer
DEM	Digital Elevation Model	Meters	Elevation
FMO	Surface fuel models	N/A	Models, as specified in XML file
SLO	Slope	%	Integer
VLU	Cost Risk	%	Float
TRS	Total Risk	%	Float

Table 2: List of Meteorological Maps

XXX	Description	Units	Comment
CLO	Cloud coverage	%	Integer
HRE	Air relative humidity	%	Integer
PPH	Precipitation in the last hour	mm	Float
TEM	Air temperature, dry bulb	°C	Float

WDI	Wind direction	Degrees	Wind vector, clock wise, 0 degrees North, 90 degrees East. Float
WSP	Wind speed	m/s	Integer
MSL	Mean Sea Level Pressure	Pa	Float

Table 3: List of Index Maps

XXX	Full Name	Metrics	Type
BYR	Fire Maximum Linear Intensity	KW/m	Float
DFM	Dead fine Fuel Moisture (1HR)	%	Integer
HPU	Heat Per Unit Area	KCal/m2	Float
PIG	Probability of Ignition	%	Integer
ROS	Fire Maximum Rate Of Spread	100*m/min	Integer

3.3 METADATA ARCHITECTURE

FFM Geoportal follows a specific naming-convention for SDI files (Maps & Alphanumeric Data). Self-explanatory labels for files are used to denote metadata information. Naming-convention entails metadata information in regards to the:

- Scene (all Static-Dynamic)
- Layer ID (all Static-Dynamic)
- "Time of Meteo Forecast" or "Forecast RunTime" (for Dynamic-> Meteo Forecasts & Indexes)
- "Forecast Horizon (for Dynamic-> Meteo Forecasts & Indexes)
- "Time the Fire Starts" (for Dynamic-> Simulation only)
- Session/scenario of simulation (for Dynamic-> Simulation only).

Although slightly different, the static and dynamic data follow these principles, and the structure for naming is similar. Name convention formats are given.

Table 4: FFM Geoportal name convention formats

Static Data	Naming Convention
Static Data	SSS_XXX
Dynamic Data	Naming Convention
Dynamic Folder, Meteorological Maps	SSS_YYYYMMDDHHNN_hhh_XXX
Dynamic Folder, Index Maps	SSS_YYYYMMDDHHNN_hhh_XXX
Simulation Data	Naming Convention
FAT	SSS_yyyymmdd_sss_nnn_XXX
Ignition Points	SSS_yyyymmdd_sss_nnn_XXX

Static Data		Naming Convention	
Static Data		SSS_XXX	
Dynamic Data		Naming Convention	
Dynamic Folder, Meteorological Maps		SSS_YYYYMMDDHHNN_hhh_XXX	
Dynamic Folder, Index Maps		SSS_YYYYMMDDHHNN_hhh_XXX	
Simulation Data		Naming Convention	
FAT		SSS_yyyymmdd_sss_nnn_XXX	
Ignition Points		SSS_yyyymmdd_sss_nnn_XXX	
SSS	Scene identifier (for example 001). All files that belong to the scene have the same geographical extent, resolution and co-ordinate system as specified in the metadata file of the scene.		
YYYY	Time of Meteo Forecasts: year		
MM	Time of Meteo Forecasts: month		
DD	Time of Meteo Forecasts: day		
hh	Time of Meteo Forecasts: hour		
mm	Time of Meteo Forecasts: minute		
HHH	Time of Meteo Forecasts: horizon. It measures the Forecast Horizon in hours i.e. the time distance between the "Time of Meteo Forecast" or "Forecast Run Time" and the Forecast Reference Time Stamp.		
yyyy	Time the Fire Starts: year		
mm	Time the Fire Starts: month		
dd	Time the Fire Starts: day		
sss	session only for simulation data		
nnn	Scenario/ session only for simulation data		
XXX	File ID according to the naming code convention		

4 FFM GEOPORTAL FUNCTIONALITIES

4.1 STATIC MAPS

In this functionality we can view Fire-Simulation and Risk-Map Static Layers in different areas of the Greek territory. First, we have to select the area of interest and the portal takes us directly to it. The area of interest is a geographical rectangular area. Each area has specific:

- Bounding Box (BBOX) i.e. geographical extent
- resolution (size of Elementary Geographical Unit, EGU)
- datum & projection system

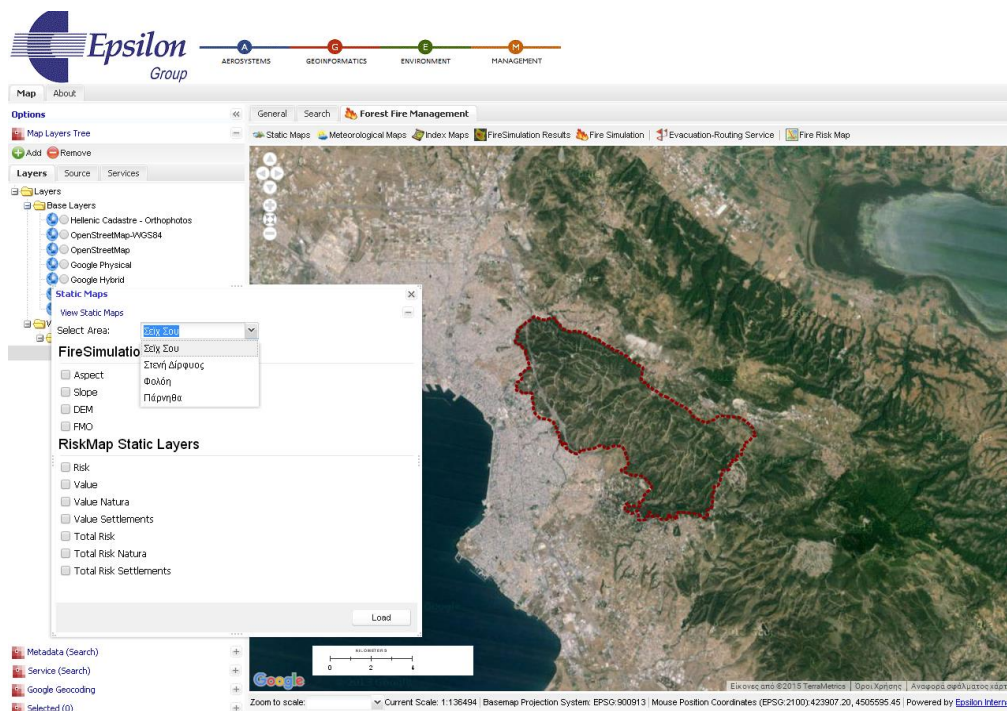


Figure 1: Select Area

There are available different types of static layers such as aspect and slope maps, DEM, risk layers etc. We can select the desired layer and load it to the base layer as presented below.

4.1.1 Fire-Simulation Static Layers

4.1.1.1 Aspect Layer

The aspect layer indicates the direction that slopes are facing. Aspect layers can be generated from continuous elevation surfaces.

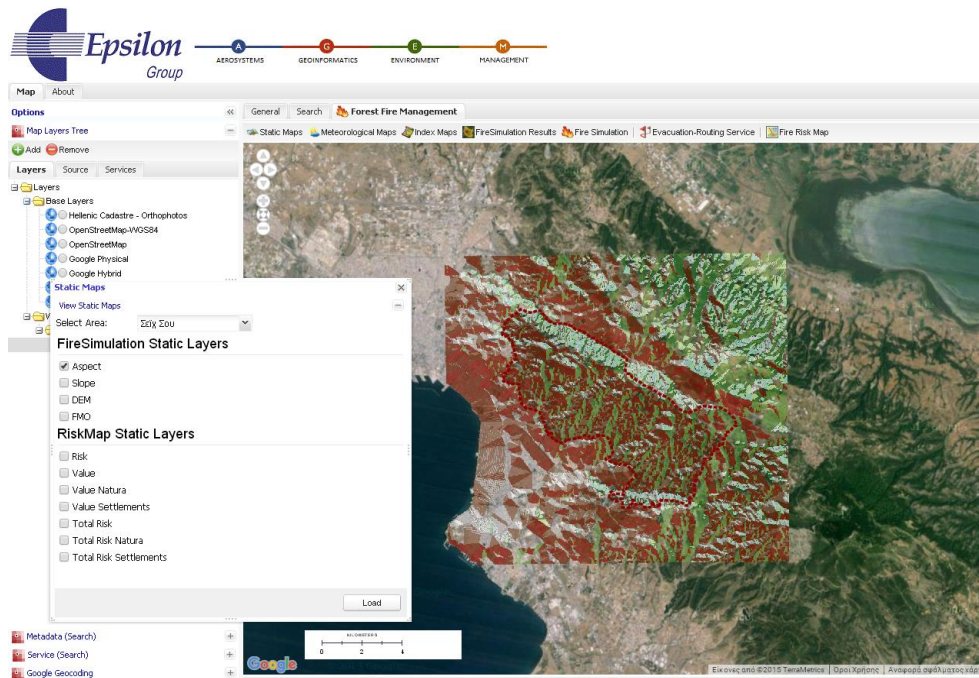


Figure 2: Aspect Layer

4.1.1.2 Slope Layer

The slope layer indicates the topography of an area.

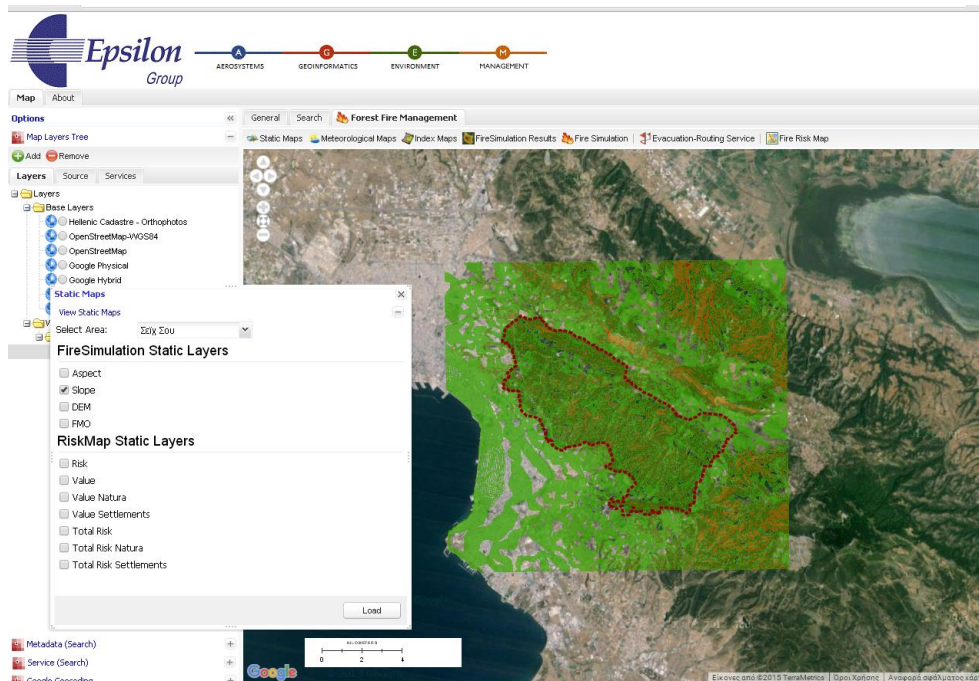


Figure 3: Slope Layer

4.1.1.3 DEM

The Digital Elevation Model (DEM) is a raster representation of a terrain's surface. It regards the representation of continuous elevation values over a topographic surface.

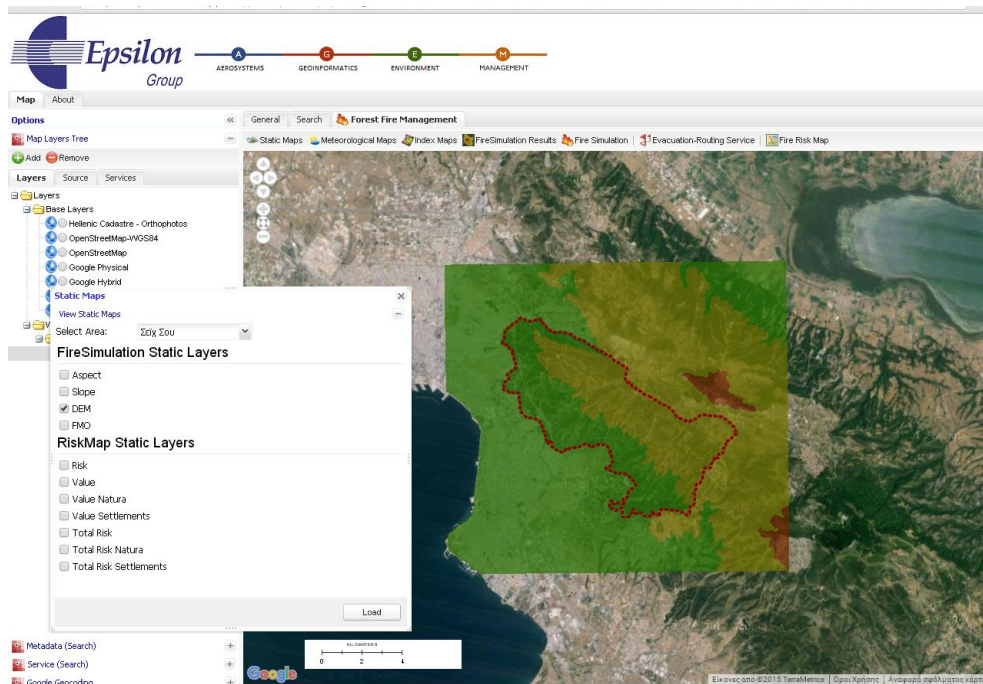


Figure 4: DEM Layer

4.1.1.4 FMO

This layer depicts various types of burning material.

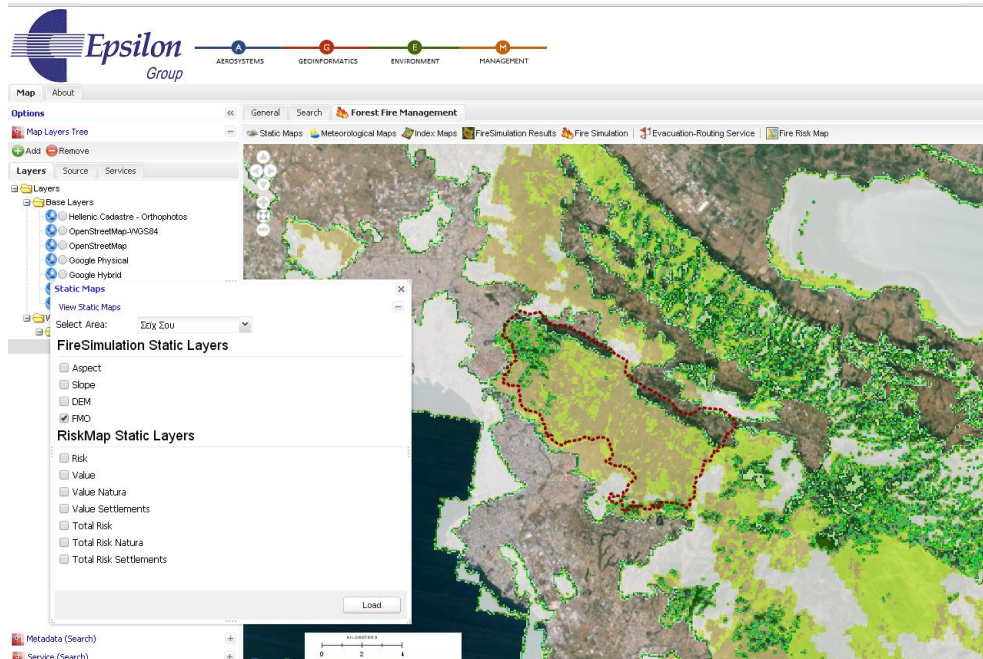


Figure 5: FMO Layer

4.1.2 Risk Map Static Layers

4.1.2.1 Risk Layer

This layer depicts the risk of fire in the area of interest based on the land use, the infrastructure associated with human activity, the power network, the accessibility and the probability of striking a lightning.

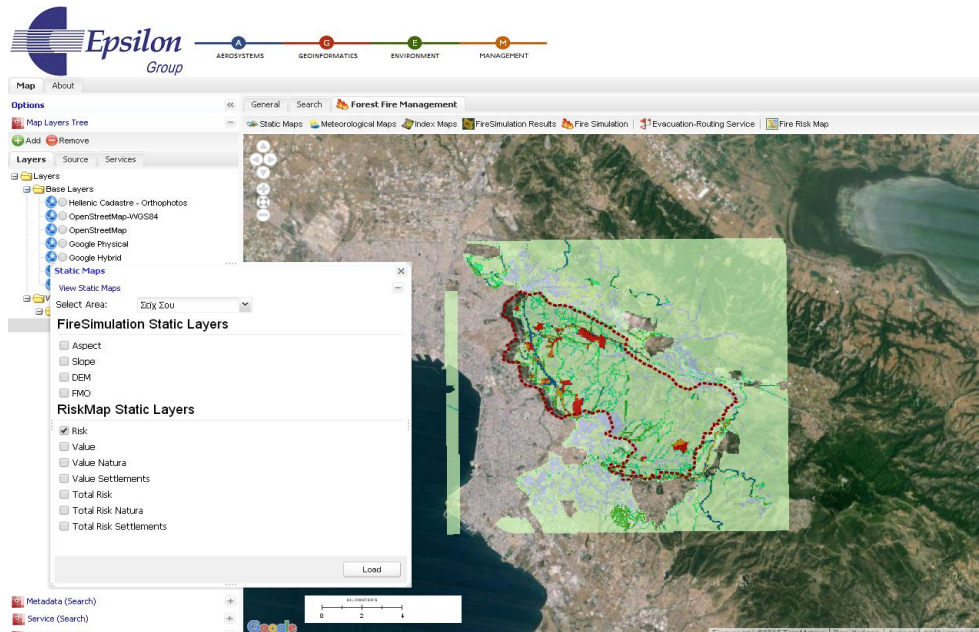


Figure 6: Risk Layer

4.1.2.2 Value Layer

This layer depicts the value of the induced destruction in case of fire, based on the individual characteristics of the area of interest such as settlements, protected areas etc.

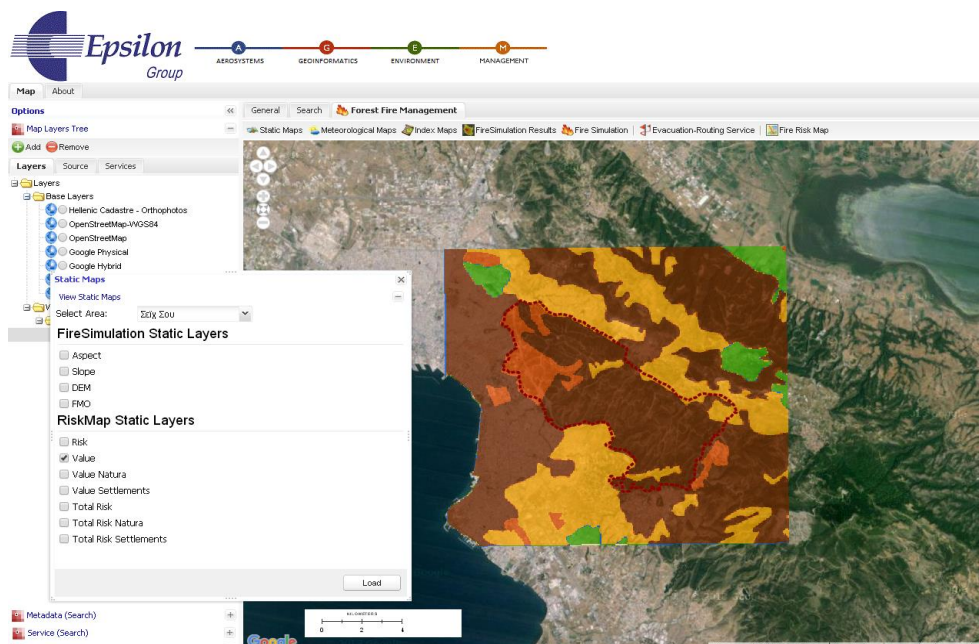


Figure 7: Value Layer

4.1.2.3 Value Natura Layer

This layer depicts the value of the induced destruction in case of fire, based on the existence of protected areas.

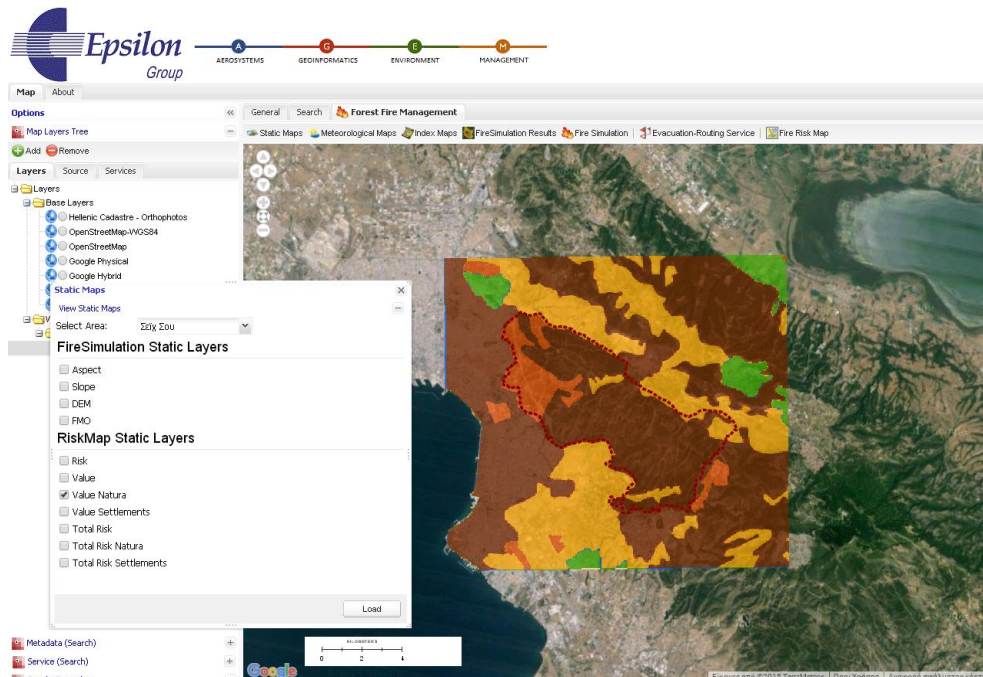


Figure 8: Value Natura Layer

4.1.2.4 Value Settlements Layer

This layer depicts the value of the induced destruction in case of fire, based on the existence of settlements.

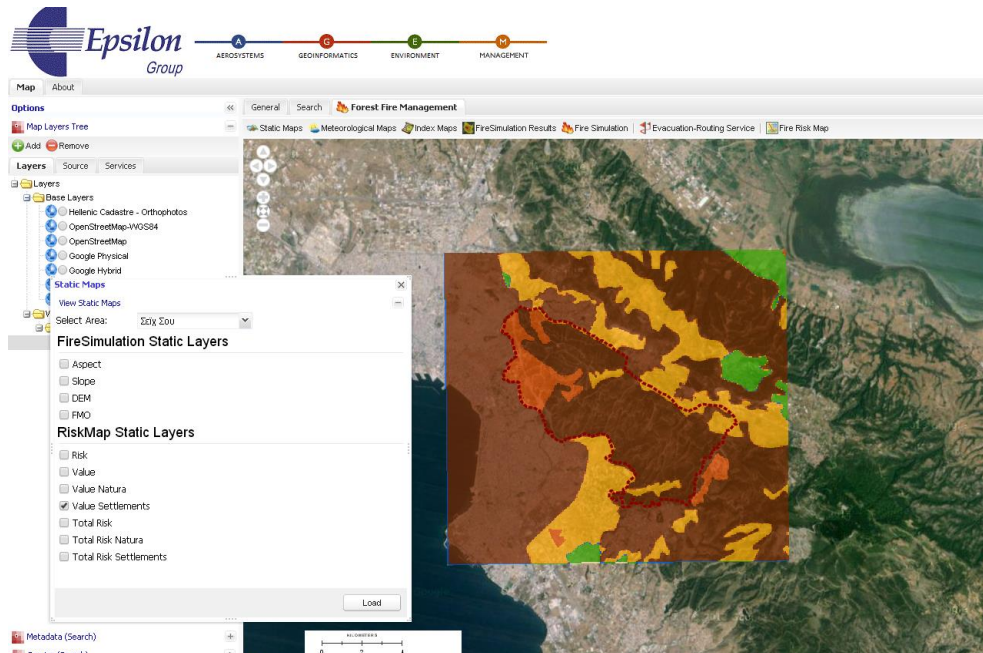


Figure 9: Value Settlements Layer

4.1.2.5 Total Risk Layer

This layer depicts the total risk associated with the fire in each elementary geographical unit. The total risk index, except from the parameters of risk index, is taking into account also the meteorological probability of fire ignition.

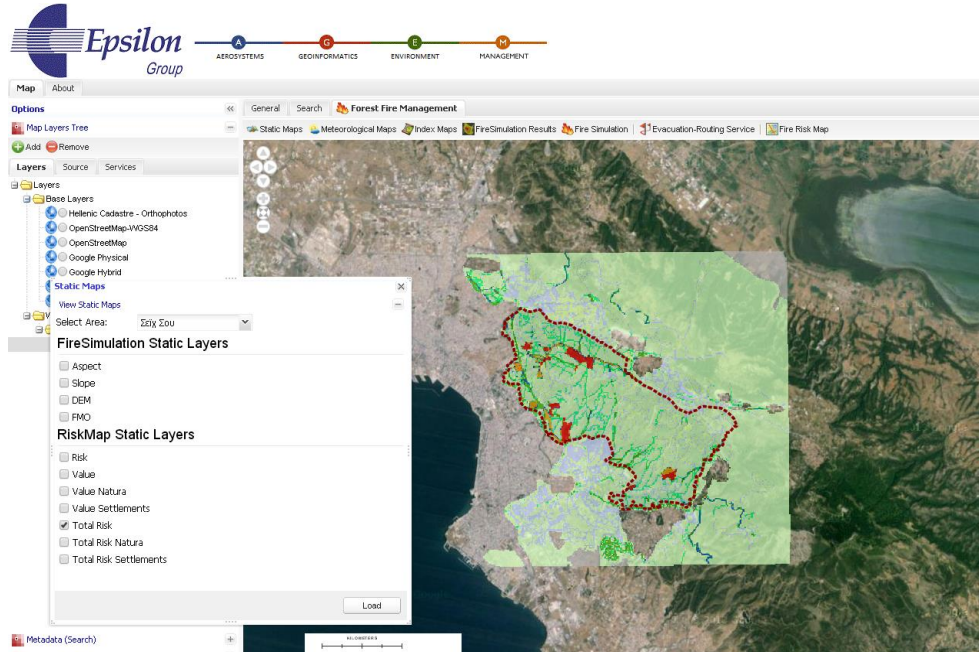


Figure 10: Total Risk Layer

4.1.2.6 Total Risk Natura Layer

This layer depicts the total risk of fire in the area associated with protected areas.

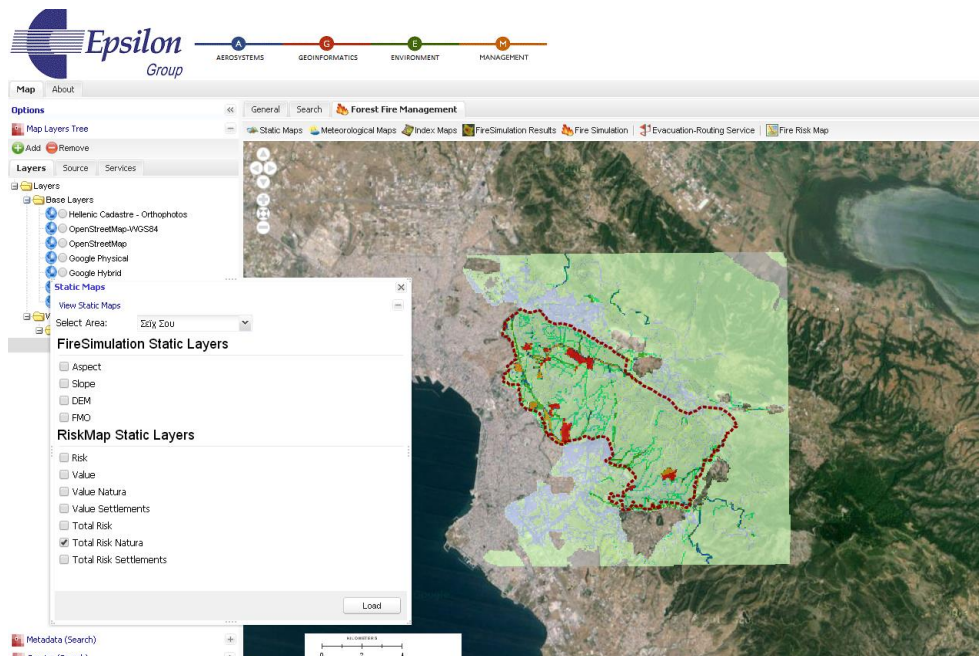


Figure 11: Total Risk Natura Layer

4.1.2.7 Total Risk Settlements Layer

This layer depicts the total risk of fire in the area associated with settlements.

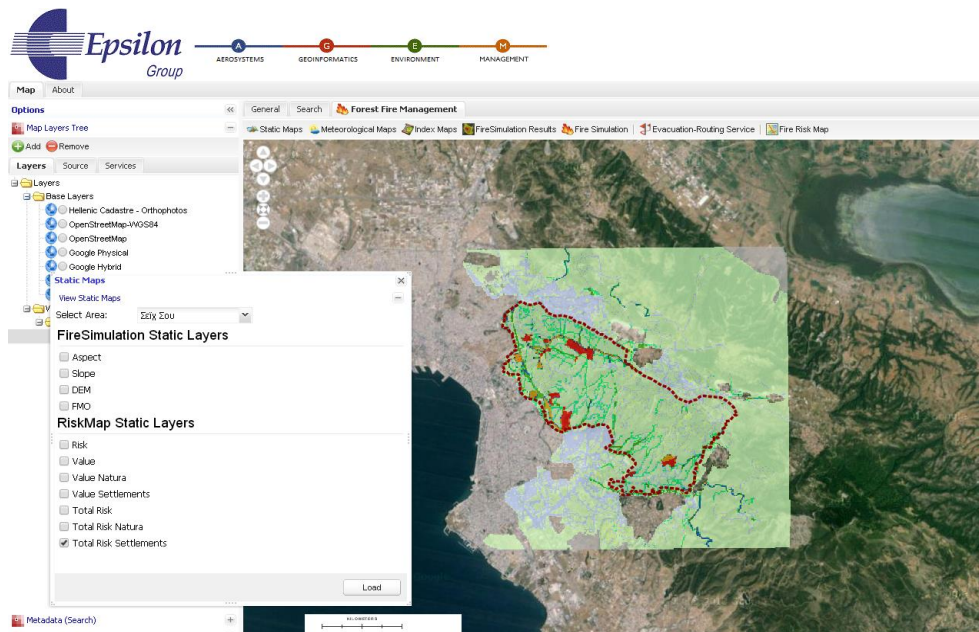


Figure 12: Total Risk Settlements Layer

4.2 METEOROLOGICAL MAPS

This function provides a spatio-temporal forecast of significant meteorological parameters. The parameters provided, are presented below. The maximum spatial resolution is 2km and the minimum is 20m. The temporal resolution is "per hour" for up to 120 hours (5 days). After selecting the area of interest and the date, we insert the Forecast Horizon. Forecast Horizon (HHH in hours) is the time distance between the "Time of Meteo Forecast" or "Forecast Run Time" and the Forecast Reference Time Stamp. For the Fire Simulation process HHH ranges from 000 to 120 with a "1 hour" temporal resolution, this means that we have a forecast for up to 5 days.

4.2.1 Cloud Coverage (%)

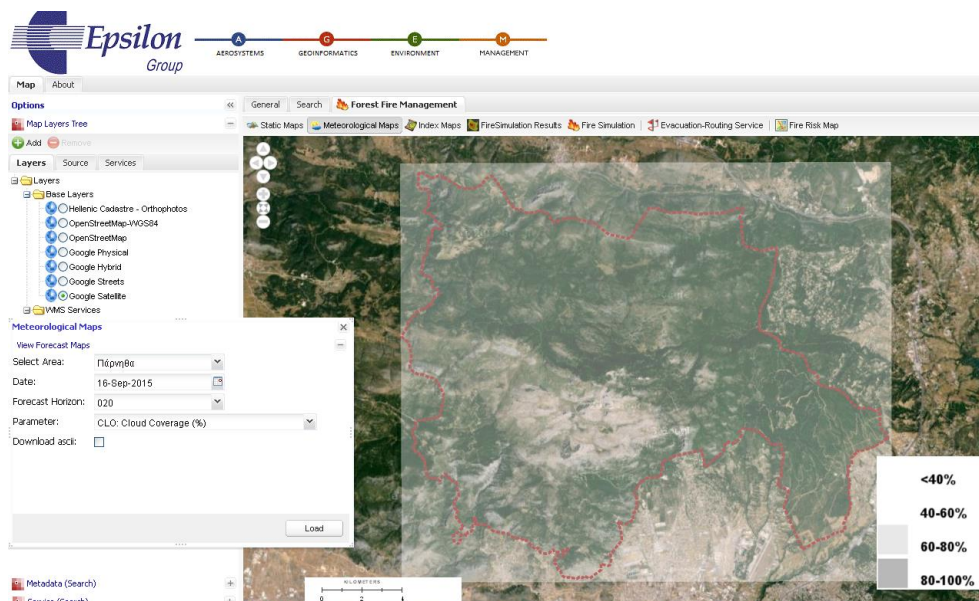


Figure 13: Cloud Coverage (%)

4.2.2 Air Relative Humidity (%)

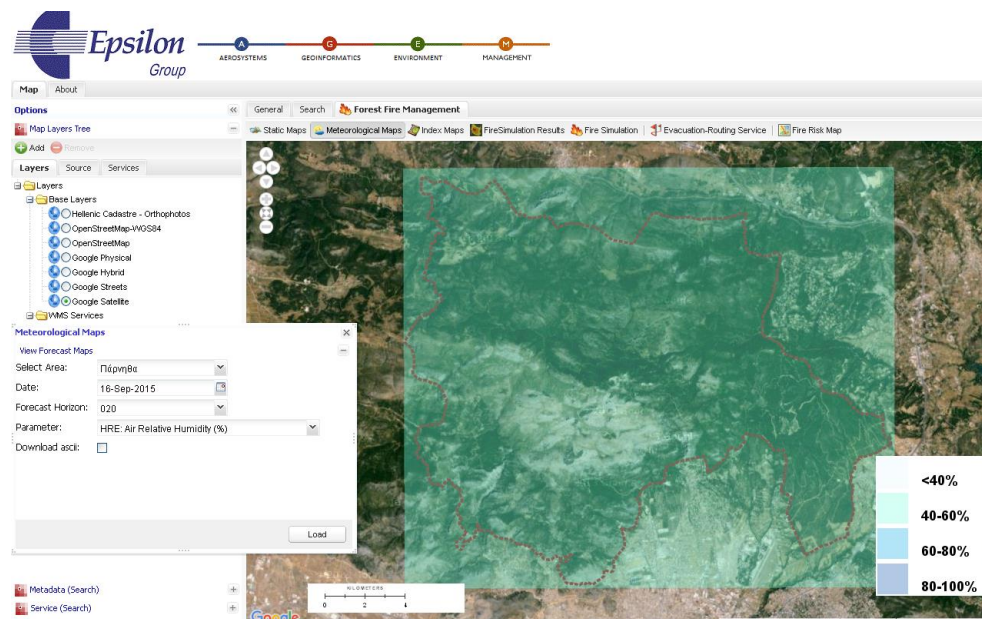


Figure 14: Air Relative Humidity (%)

4.2.3 Rain precipitation in the last Hour (in mm)

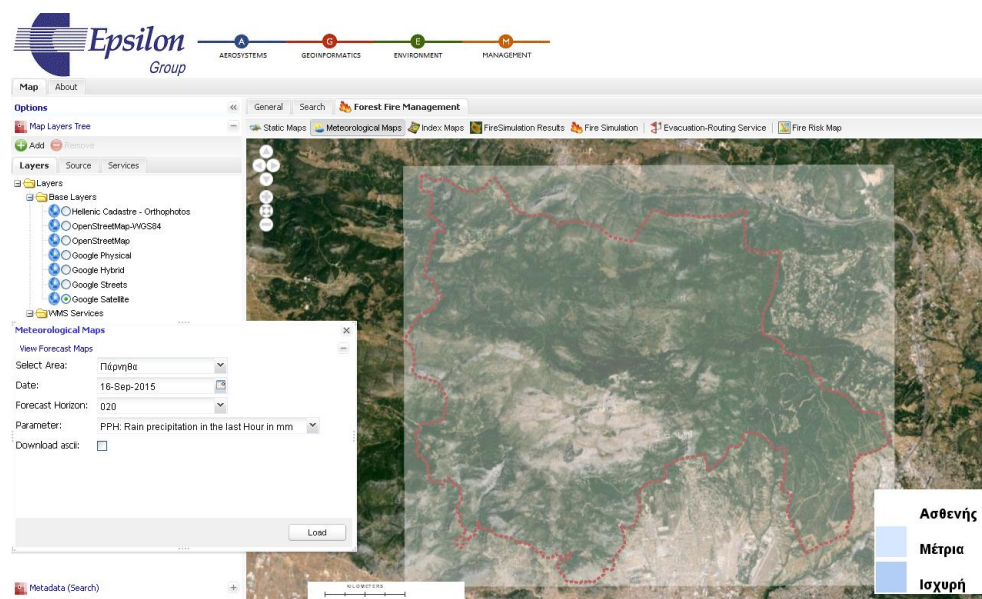


Figure 15: Rain precipitation in the last Hour

4.2.4 Air Temperature (dry bulb) in Celsius

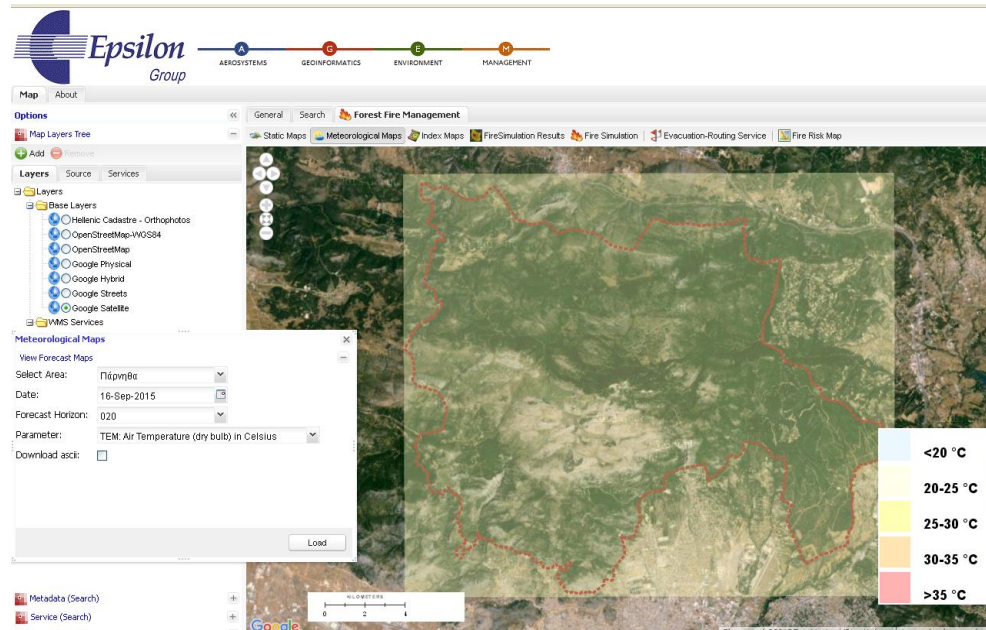


Figure 16: Air Temperature (Co)

4.2.5 Wind Direction in degrees

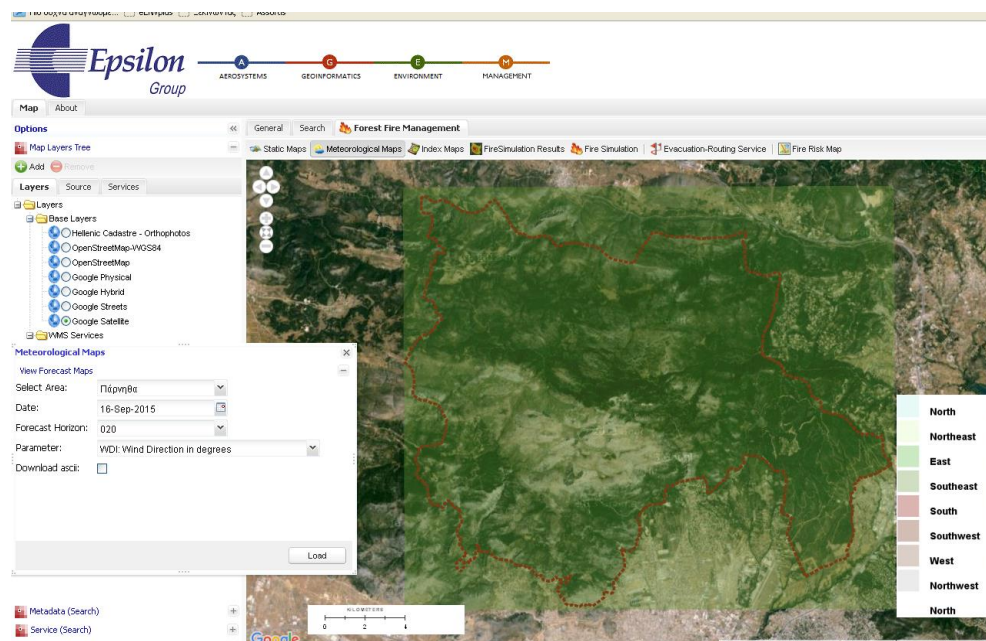


Figure 17: Wind Direction in degrees

4.2.6 Wind Speed (m/sec)

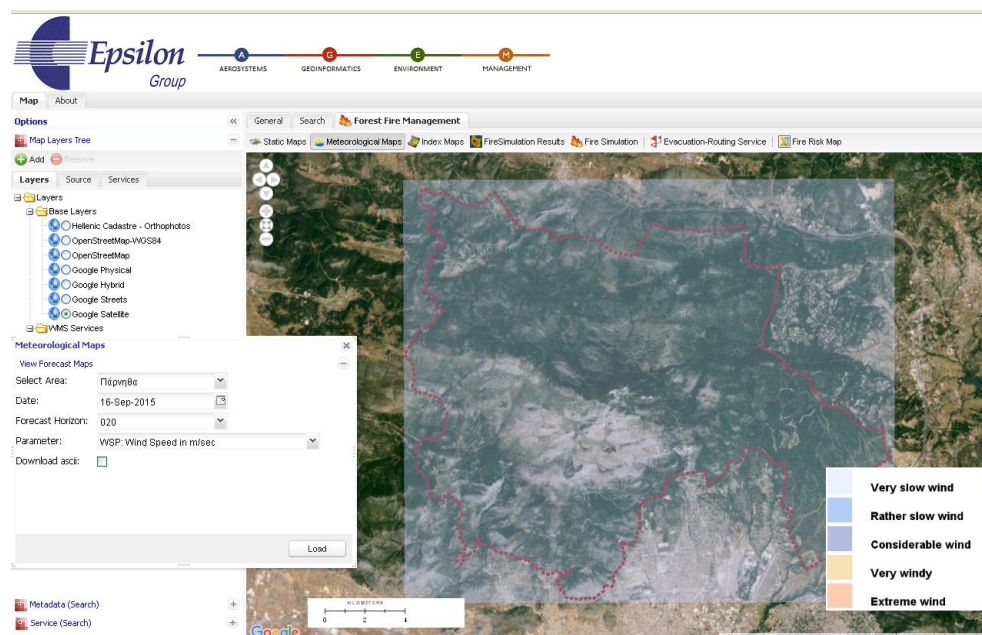


Figure 18: Wind Speed (m/sec)

4.2.7 Mean sea-level pressure in Pa

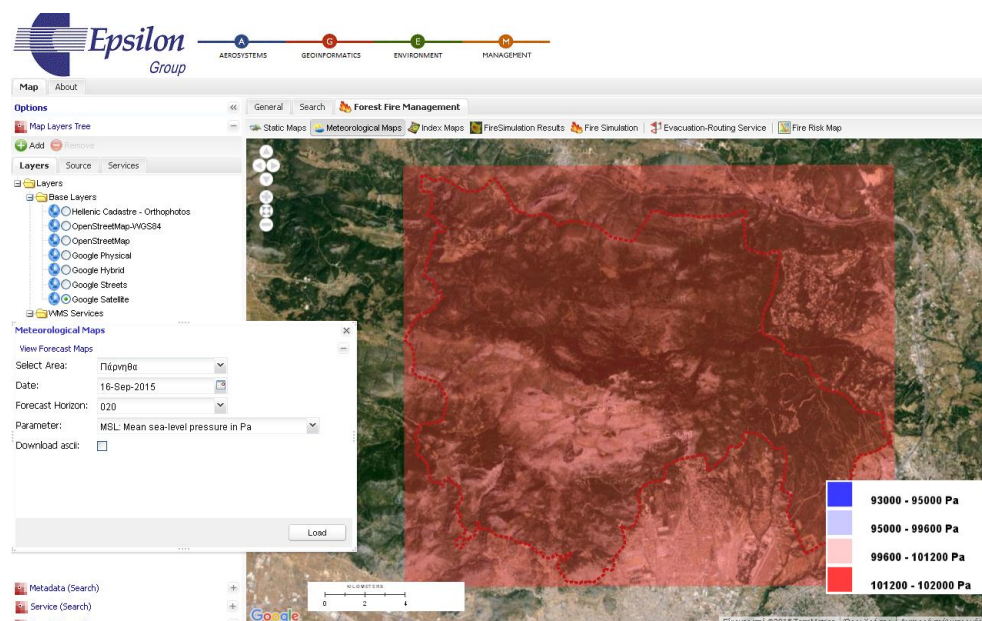


Figure 19: Mean sea-level pressure in Pa

4.3 INDEX MAPS

Index maps derived from a combination of static and meteorological maps. The parameters available in this module are the following:

4.3.1 Dead Fine Fuel Moisture Content

This map indicates the amount of grams of water enclosed in each gram of biomass. The dead fine fuel moisture content is calculated from the air relative humidity and the temperature during the day.

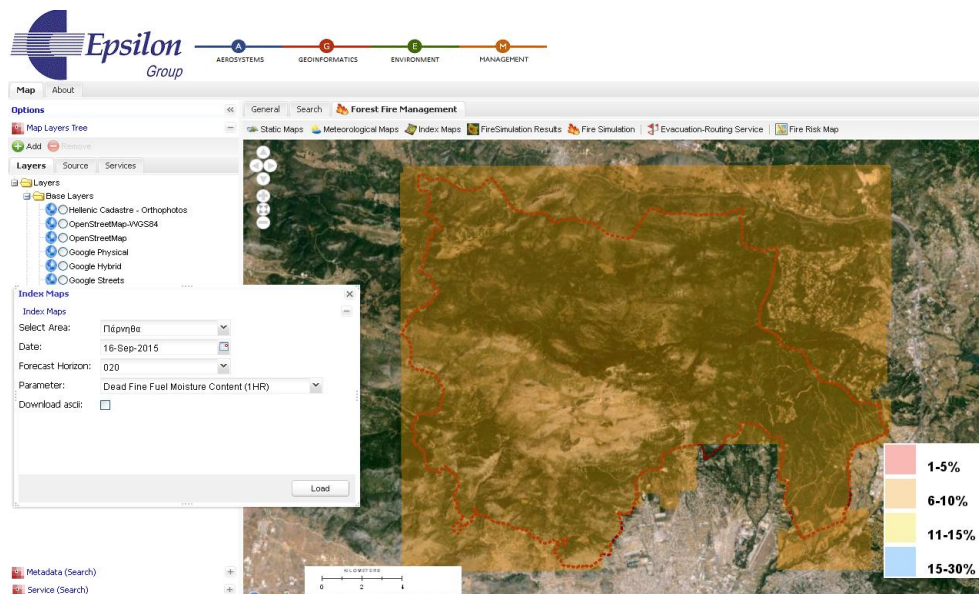


Figure 20: Dead Fine Fuel Moisture Content

4.3.2 Probability of Ignition

This map depicts the probability of fire ignition in the area of interest. For the calculation of the probability of ignition it is considered the land use, the fuel moisture and the meteorological elements (the degree of sun exposure).

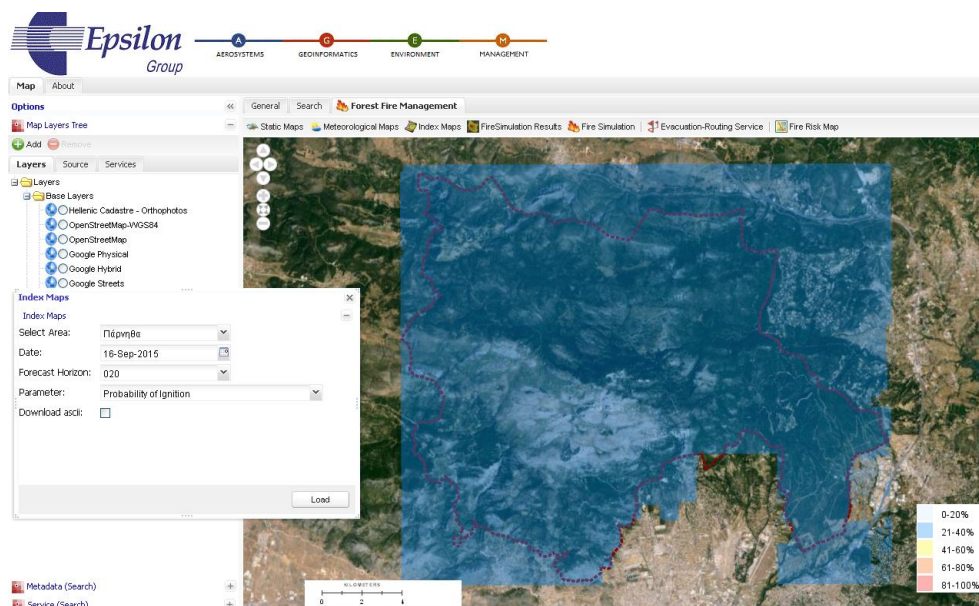


Figure 21: Probability of Ignition

4.3.3 Fire Maximum Linear Intensity

This map depicts the maximum intensity of fire propagation for four meteorological conditions.

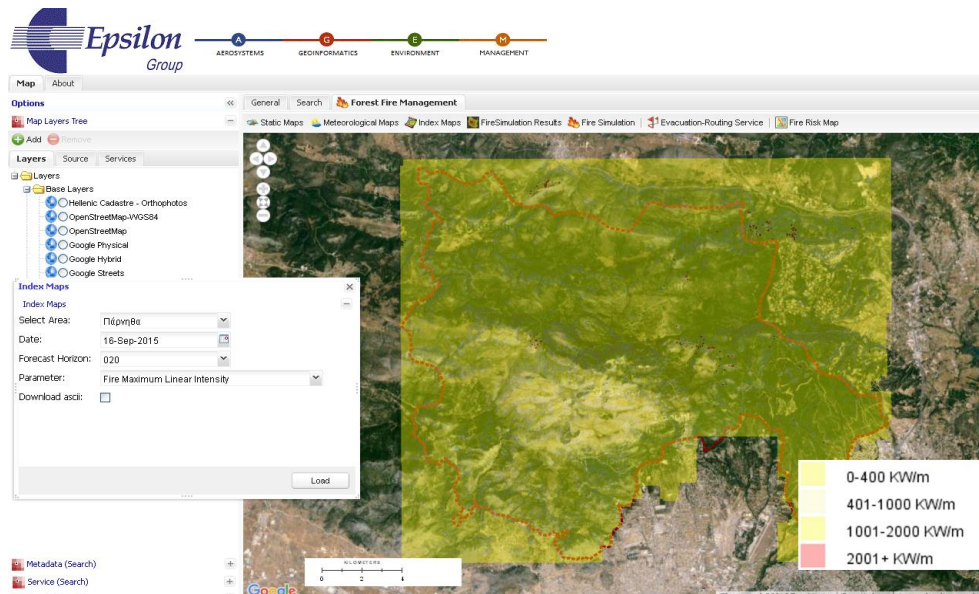


Figure 22: Fire Maximum Linear Intensity

4.3.4 Fire Maximum Rate of Spread

This map sets the direction and the magnitude of the rate of fire propagation.

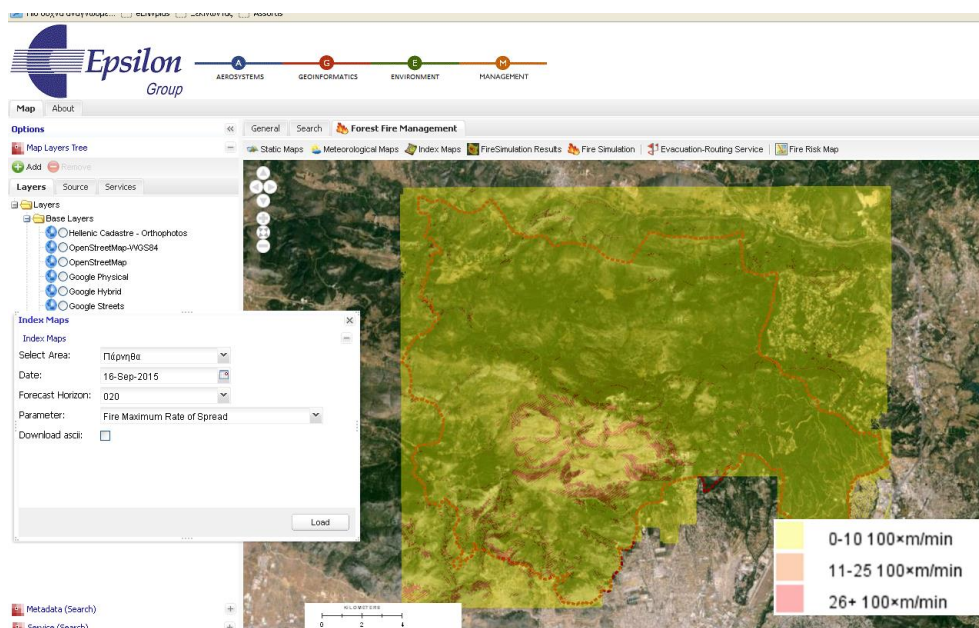


Figure 23: Fire Maximum Rate of Spread

4.3.5 Heat for Unit Area

This map depicts the amount of energy released in kcal per square meter.

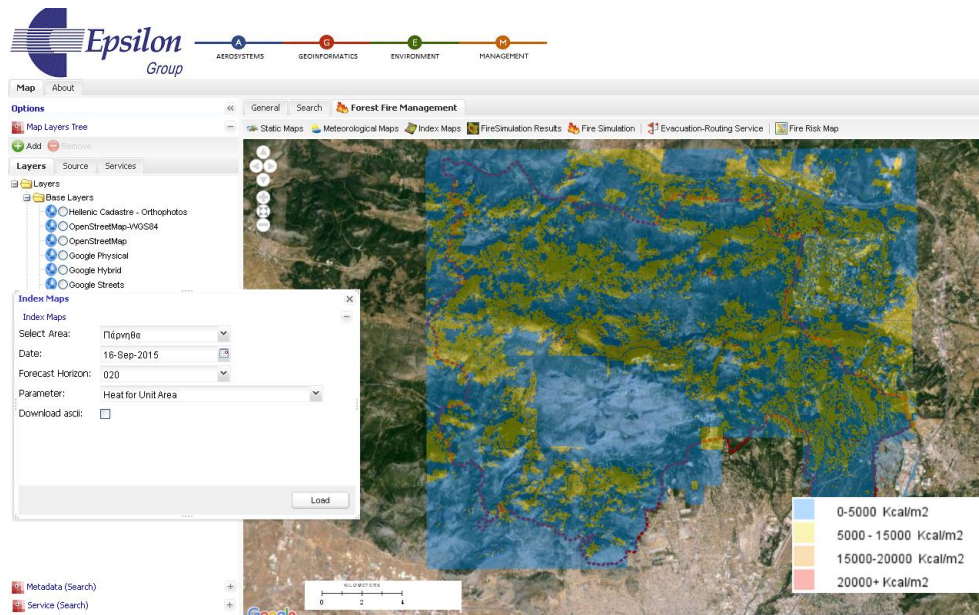


Figure 24: Heat for Unit Area

4.4 FIRE SIMULATION

Fire Simulation calculates the fire-front spatiotemporal evolution, starting from one or more ignition points (initial conditions). The rate of propagation depends on meteorological conditions (wind direction, wind speed) on terrain layout (slope, aspect) and fuel content of the fire propagation medium.

The user can insert the coordinates of the fire ignition point, the date and the hour in order to view the fire evolution.

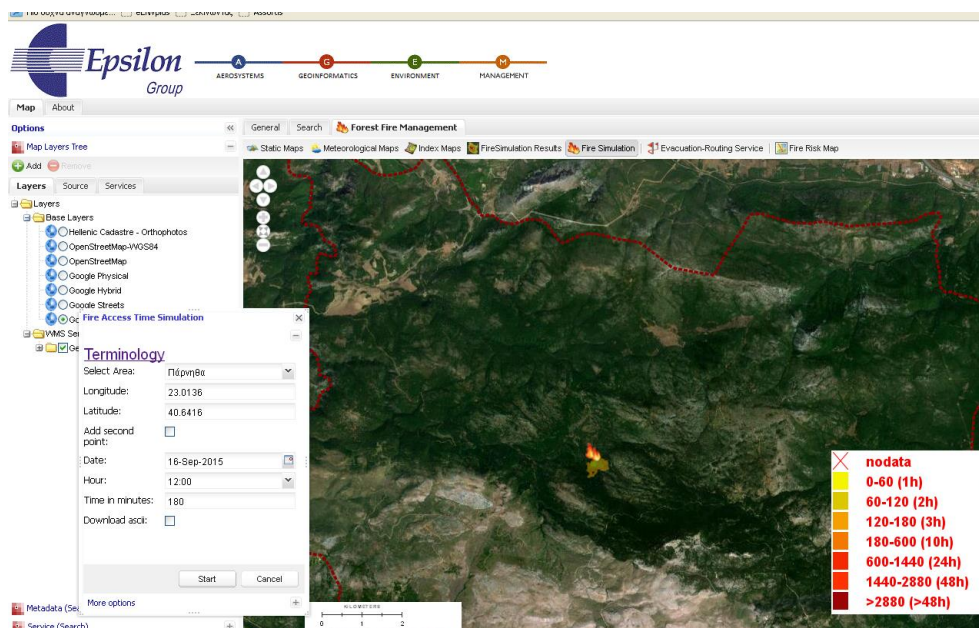


Figure 24a: Fire Simulation

Moreover, the module enables the user to enter further perimeters such as:

4.4.1 TS - Simulation time in minutes

We can insert the duration of the simulation in minutes

4.4.2 NS - Maximum number of simulated points

4.4.3 CB - Fixed Surface fuel model

The fixed surface fuel model, allows us to bypass the fuel map available in the spatial database with a default value for the entire area.

4.4.4 DM - Fixed dead fuel moisture (%)

The fixed dead fuel moisture, allows us to bypass the dead fuel map available in the spatial database. The values range between 0% and 30%.

4.4.5 LM - Fixed live fuel moisture (%)

The fixed live fuel moisture, allows us to set a default value for the live fuel moisture. The values range between 0% and 30%.

4.4.6 WS - Fixed wind speed (Km/h)

The fixed wind speed, allows us to bypass the wind intensity map by setting a default value for the entire area of interest.

4.4.7 WD - Fixed wind vector direction (degrees)

The fixed wind vector direction, allows us to bypass the wind direction map by setting a fixed value for the entire area of interest.

4.4.8 WR - Random wind aperture (degrees)

The random wind aperture, allows a stochastic simulation by giving an average wind aperture (in degrees).

4.4.9 RO – Wind vector rotation (degrees)

The wind vector rotation, allows a stochastic simulation by giving an average wind vector rotation

4.4.10 AS - Fixed down slope aspect (degree)

The fixed down slope aspect, allows us to bypass the aspect map by setting a default value for the entire area of interest.

4.4.11 SL - Fixed slope (%)

The fixed slope, allows us to bypass the slope map by setting a default value for the entire area of interest.

4.4.12 ST - Writes simulation statistics

It provides us with the simulation statistics.

4.4.13 CF - Enables simulation of crown fires

4.4.14 SP - Enables simulation of spotting

4.4.15 FL - Enables simulation of spotting

4.4.16 BY - Writes fire intensity results

It provides us with the linear intensity map.

4.4.17 XD - Writes direction of maximum spread results

It provides us with the direction of the maximum propagation

For example, if we set the Fixed wind speed in 20 Km/h and the Fixed wind vector direction in 90 degrees we can see a different spatio-temporal fire evolution.

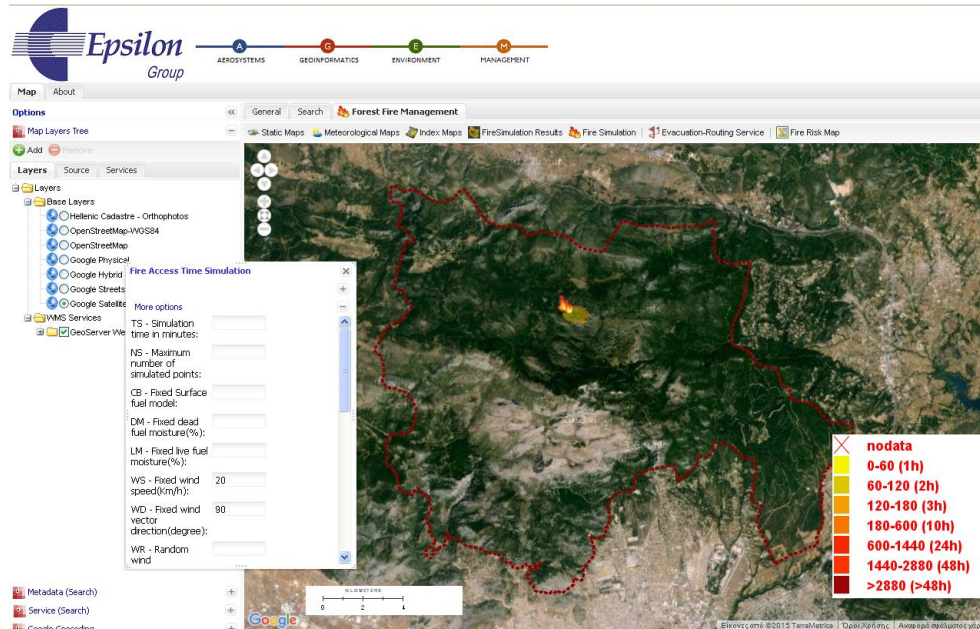


Figure 24b: Fire Simulation using more parameters

4.5 FIRE SIMULATION RESULTS

In this function, we can view the Fire Simulation maps created in Fire Simulation function.

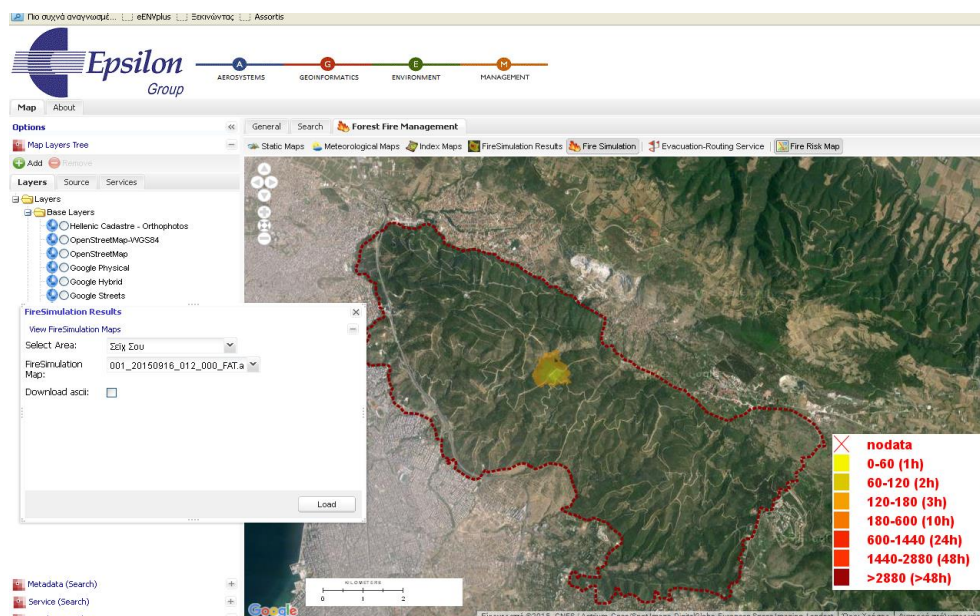


Figure 25: View Fire Simulation maps

4.6 EVACUATION – ROUTING SERVICE

This function enables the routing of Firefighting Forces towards the frond of the fire and the evacuation of the area of interest of citizens. First we select the area of interest and then we choose the desired simulation file and forecast. By selecting the option "Add points" we can set the starting point of the route by clicking on the map. The same process is followed in order to select the end of the route. Then the service generates the best available evacuation route. The optimum route is calculated dynamically based on (i) the nearest distance, and (ii) the fire's predicted evolution for the next few hours. Furthermore, we can draw the perimeter of the fire evolution with the option "Draw barrier".

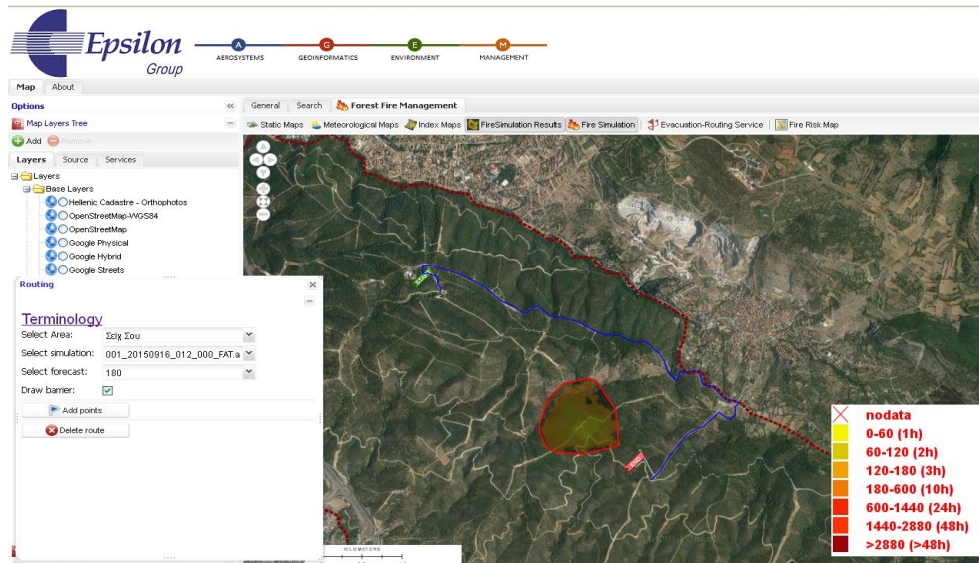


Figure 26: Evacuation – Routing

4.7 FIRE RISK MAPS

4.7.1 Risk Map

This map depicts the risk of fire in the area of interest based on the land use, the infrastructure associated with human activity, the power network, the accessibility and the probability of striking a lightning.

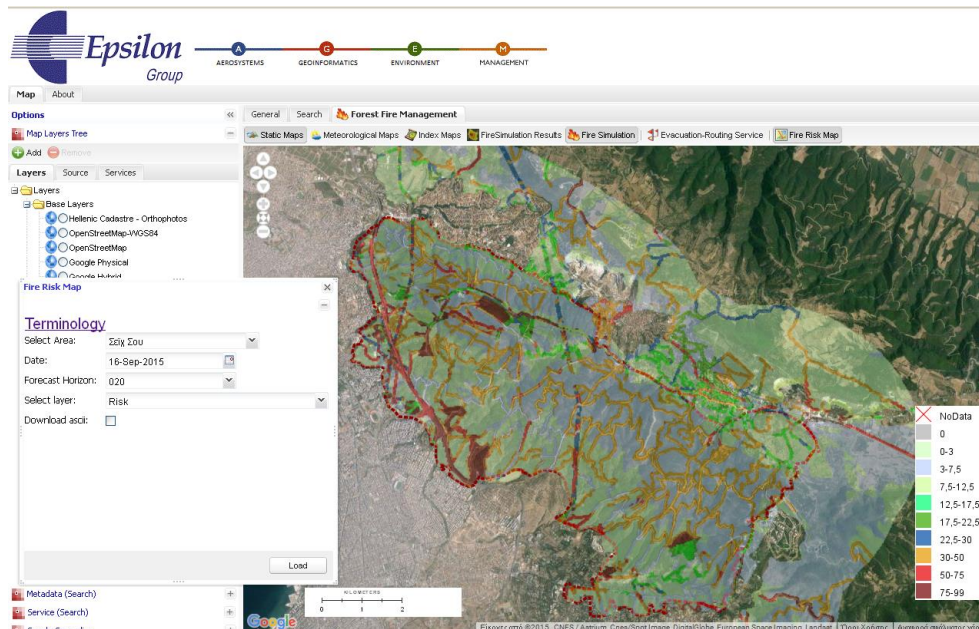


Figure 27: Fire Risk map

4.7.2 Total Risk Settlements Map

This map depicts the total risk of fire in the area associated with settlements.

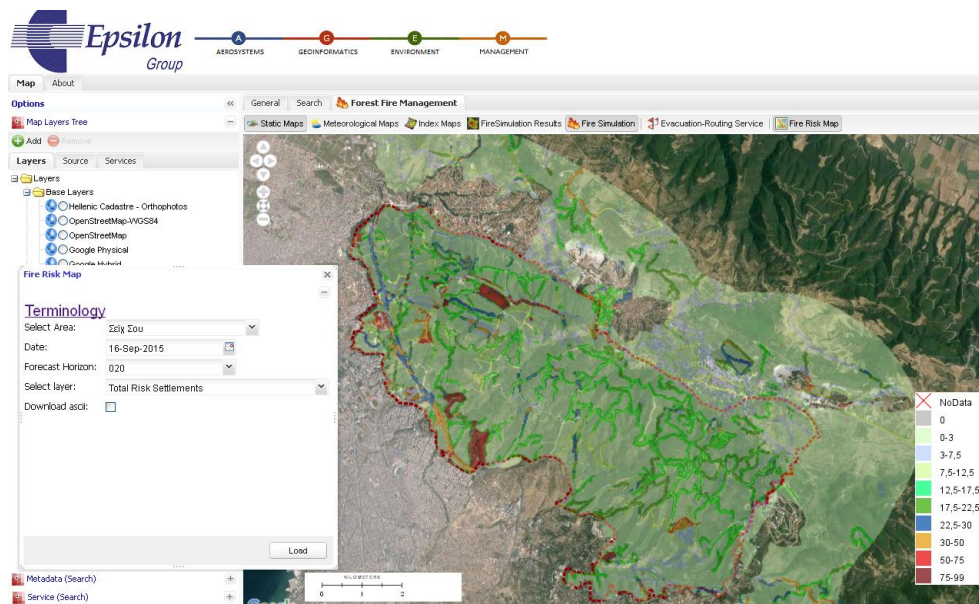


Figure 28: Total Risk Settlements map

4.7.3 Total Risk Natura Map

This layer depicts the total risk of fire in the area associated with protected areas.

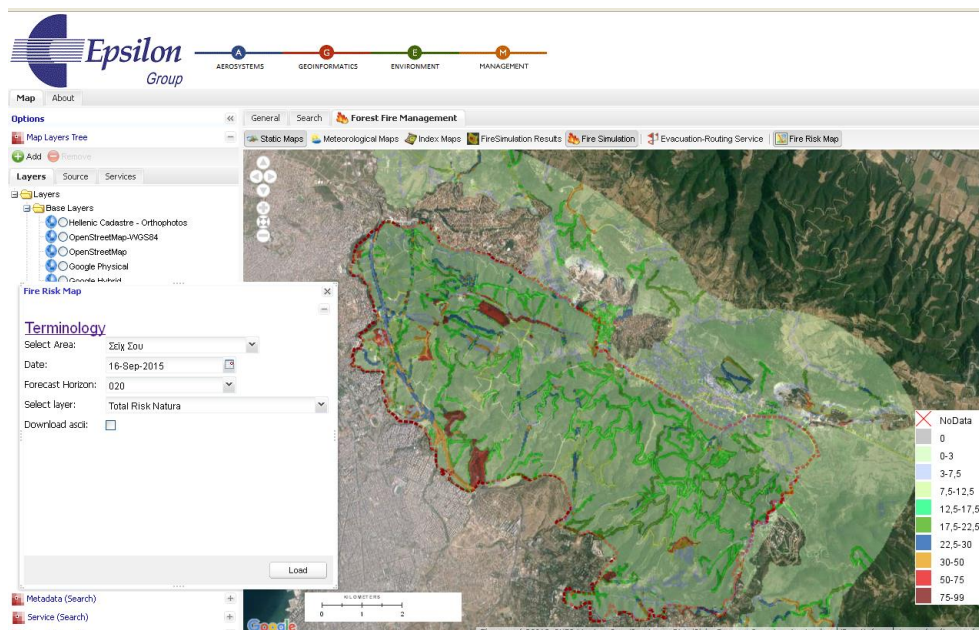


Figure 29: Total Risk Natura map

4.7.4 Total Risk Map

This layer depicts the total risk associated with the fire in each elementary geographical unit. The total risk index, except from the parameters of risk index, is taking into account also the meteorological probability of fire ignition.

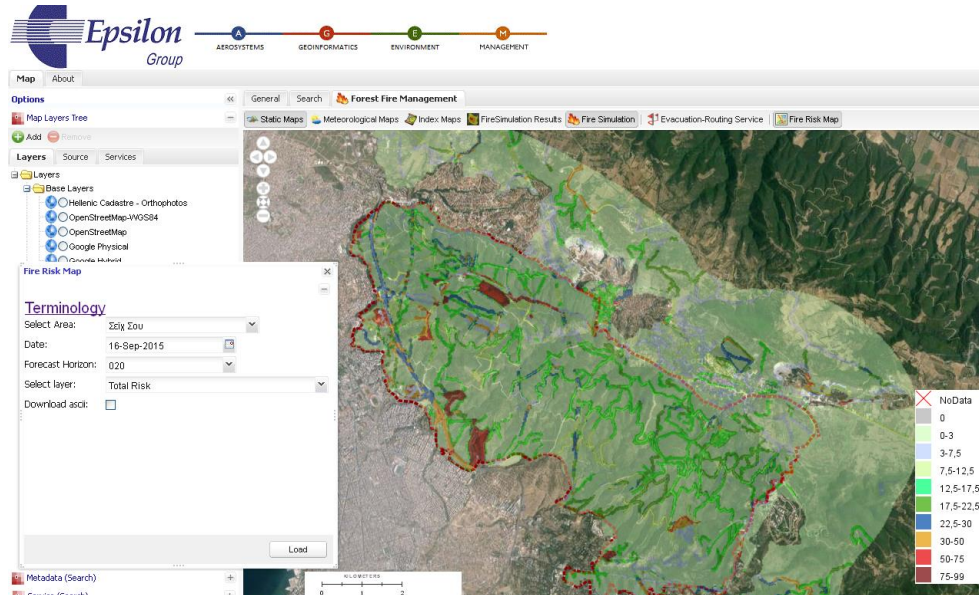


Figure 30: Total Risk map