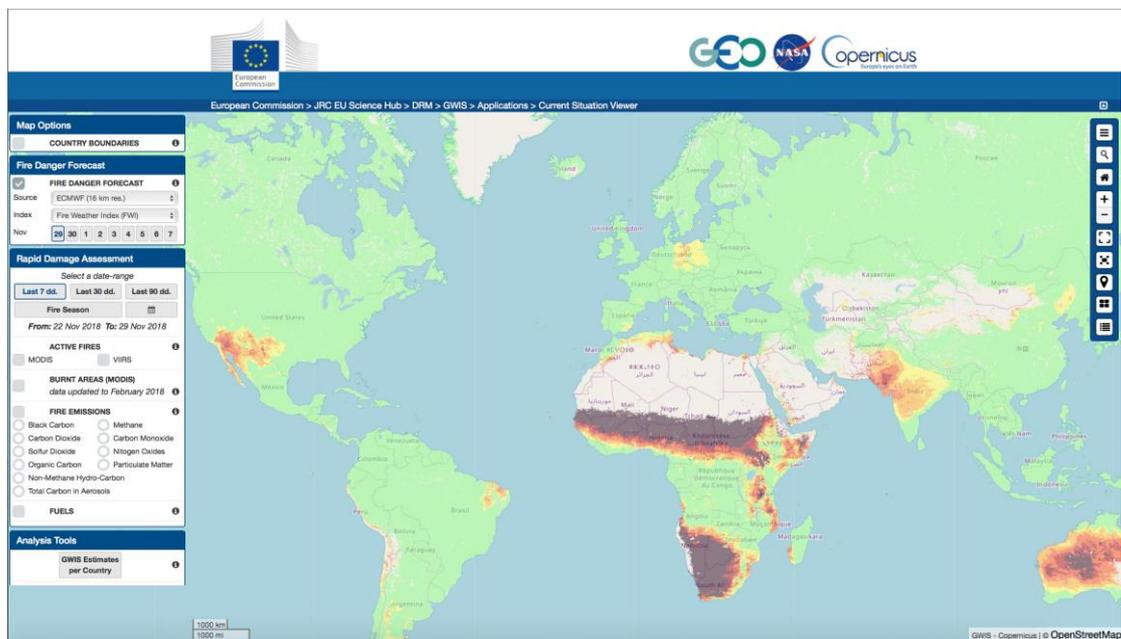


GEO Global Initiative

Global Wildfire Information System (GWIS)



Implementation Plan

February 20th, 2019

Table of Contents

1. Executive Summary	3
Overview	3
GWIS Planned Activities	4
Foreseen meetings in the WP 2020-2022.....	4
Point of Contact.....	4
Contributors.....	4
2. Purpose (3 pages).....	5
GWIS policy mandate	6
GWIS Outputs.....	7
GWIS Users	7
GWIS foreseen impacts and beneficiaries	8
3. Background and Previous Achievements (3 pages).....	8
Use of GWIS by end users	9
Impact on decision making by policy organizations.....	10
4. Relationship to GEO Engagement Priorities and to other Work Program Activities (3 pages)	10
Relationship with GEO Engagement Priorities.....	10
Relationship with other GEO Initiatives and Flagships	11
5. Stakeholder Engagement and Capacity Building	11
Key organizations and stakeholders.....	11
6. Governance	12
Coordination Board (CB).....	12
Advisory Board (AB).....	13
7. Resources (1 page).....	14
8. Technical Synopsis (2 pages)	15
Fire Danger.....	15
Active fire detection	15
Burned area mapping	15
Emissions assessment.....	16
Background and ancillary data.....	16
9. Data policy (2 pages).....	16
Table 1. Contribution of GWIS to SDGs	17
Annexes	19
I. Acronyms and abbreviations.....	19
II. List of key scientific references relevant for GWIS	19
Sample of references to GWIS by relevant institutions/organizations:.....	20
III. Brief CV of Project Leader(s).....	20

1. Executive Summary

Global Wildfire Information System (GWIS)

GEO Initiative

Overview

The Global Wildfire Information System – GEO Global Initiative builds on the work already performed in GEO GI-09 in the work program 2016 and the GWIS Initiative in the GEO WP 2017-19.

Wildfires are a global hazard that cause enormous environmental damage and economic losses and which continue to present a major risk in many countries. Wildfires, as opposed to controlled fires for agricultural and fuel reduction purposes, are a major threat to humans and the environment. Recent episodes in e.g. Indonesia (2015), Chile (2016), Canada (2016 & 2017), the USA (2017 & 2018) Europe (2017 & 2018), South Africa (2017 & 2018), among others, show that wildfires are far from diminishing in their size or intensity, but may be exacerbated by the already noticeable effects of climate change. It is estimated that about 450 Million ha of natural areas are burned every year causing large environmental and economic damage and contributing to the increase of carbon emissions worldwide. Wildfires have seasonal and regional patterns, which are reflected in different fire regimes across the globe. Several national and supranational organizations have established systems aiming at providing early warning for large fire events to minimize the effects of catastrophic fires, to monitor active fire distribution, and the post-fire accounting of burned area.

Despite the above, comprehensive and accurate ground-based inventories on wildfires at the global level do not exist, nor exists a global system that is able to provide in a synthesized way information on the evolution of fire regimes and fire impacts at national, regional and global levels. Efforts to collect information at local or national level have shown that this endeavor is very difficult, making it nearly impossible to collect such datasets at the global level. The existence of different definitions of forests or wildfires, different methods in the collection of information and different systems at the national or sub-national level, makes it impossible to gather global information through the aggregation of ground collected information. This information is essential to understand fire management from the local to national to regional and at a global scale, and the use of Earth Observation provides alternative ways to collect wildfire information.

Earth observations (EO) and information, derived both from space and surface networks, have demonstrated not only their maturity, but their critical role in supporting fire managers, first responders and risk managers by providing effective tools to predict severe fire danger conditions, rapidly map natural hazards, and assess impacts. Although there is an increasing amount of spatially explicit data and information on wildfires being derived from different sources and often collected at the national, regional and global levels, there is currently no international initiative to synthesize and harmonize such information, and to distribute it to users worldwide.

GWIS aims at providing a continuous and smooth platform of harmonized information on wildfires that could be used at different scales, from national to global. At the global level, where information on wildfires is scattered and not harmonized, GWIS will be a unique source of information for global initiatives and policies, while supporting the analysis of wildfire regimes at this scale. The calibration of the system and the validation of the different modules will require the close collaboration with regional and national partners. In countries that currently do not have a wildfire information system, GWIS will fill this gap and help countries engage in international collaboration. For countries and regions where wildfire information systems exist, GWIS will provide a complementary and independent source of harmonized information adding to the national/regional information sources. GWIS builds on the experience, achievements and networks established connection with the European Forest Fire Information System (EFFIS)¹ and the Global Observation of Forest Cover Global Observation of Land Dynamics (GOFC GOLD) Fire Implementation

¹ EFFIS <http://effis.jrc.ec.europa.eu>

Team and Fire Regional Networks². Engagement with wildfire managers at national and local scale will be channeled through the EFFIS network in Europe, Middle East and North Africa, and through the GOFC Fire IT networks in the rest of the world.

Additional work from 2019 will focus on the integration of wildfire data from regional and national fire information systems following GEOSS data sharing principles.

GWIS Planned Activities

1. Maintain and further develop the Global Wildfire Information System (GWIS), providing harmonized fire information e.g. fire danger, active fires, burned areas, emissions, as well as reports on wildfire regimes and statistics at national, regional and global level.
2. Integration of NASA Earth Science, Applied Science Program-supported GEO GWIS Project results into operation:
 - 2.1. Global Active Fire monitoring from geostationary satellites
 - 2.2. Fire danger prediction – specific calibration for regional scales
 - 2.3. National/regional/global GWIS services for fire managers and fire administrations.
3. Integration of global wildfire products from all sources, including e.g. results of the ESA Fire CCI products and Copernicus products from different services.
4. Networking of major national and regional fire information providers by organizing an annual workshop convening key international organizations and initiatives (e.g. GOFC-GOLD Fire IT) and national and regional providers, e.g. Australia, Canada, China, Central and South America and South Africa.
5. Keep the established operational links with other wildfire communities dealing with wildfire aspects at global scale (e.g. burned area assessment, emission estimation) and develop new links with other wildfire-related communities.
6. Further develop the GWIS by integrating and harmonizing as much as possible regional wildfire data and information sources.
7. Develop, implement and promote the establishment of mechanisms for interoperability and communication among national, regional and global wildfire information systems following OGC standards and guidelines, and the GEOSS Data Sharing Principles.
8. Develop methods for the global assessment of wildfire risk and implementation of this assessment at the global scale.
9. Coordinate and promote capacity building and training activities in close cooperation with the GOFC-GOLD Fire Implementation Team regional networks and the EFFIS network.
10. Promote dissemination of information and training on the use of GWIS methods and tools to the wildfire community and the general public, in cooperation with NASA ARSET, the Copernicus Communication Services and the GEO Secretariat.

Foreseen meetings in the WP 2020-2022

GWIS Annual meeting, Nov. 2020, Nov. 2021, Nov 2022

Contribution to the GEO Annual Symposium - 2020, 2021, 2022

Contribution to regional networks – Expert Group on Forest Fires (Europe, Middle East and North Africa), SAFNET, SEARRIN (Asia)

Contribution to wildfire related conferences & workshops such as the EARSEL Fire SIG, Wildfire, Forest Fire Research Conference series.

Point of Contact: Jesús San-Miguel-Ayanz, European Commission Joint Research Center (JRC)

Contributors: GTOS (GOFC-GOLD), NASA, Canada (CNR), NOAA, ESA, Brazil (INPE), China, South Africa (CSIR), Australia, New Zealand, NL, ES, UK, etc. Full list of contributors at <http://gwis.jrc.ec.europa.eu/partners/>

² <http://gofc-fire.umd.edu/RegNtwks/index.php>

2. Purpose (3 pages)

Wildfires are a global hazard that causes enormous environmental damage and economic losses and which continues to present a major risk in many countries. Recent episodes in Indonesia (2015), Chile (2016), Canada (2016 & 2017), the USA (2017 & 2018) Europe (2017 & 2018), South Africa (2017 & 2018), among others, show that wildfires, in numbers, size and intensity are not diminishing, and may be exacerbated by the already noticeable effects of climate change. It is estimated that nearly 400 Million ha of natural areas are burned every year causing large environmental and economic damage and contributing to the increase of carbon emissions worldwide. Economic direct losses from wildfires in Europe are estimated in about 3 billion Euro, annually. Reports from the European Forest Fire Information System (EFFIS) estimate over 54 billion Euro in losses in the period 2000-2017, with over 600 people killed as a direct consequence of the fires. Wildfires have seasonal and regional patterns, which are reflected in different fire regimes across the globe and several national and supranational organizations have established systems aiming at providing early warning for large fire events to minimize the effects of catastrophic fires.

Despite the above, comprehensive and accurate ground-based inventories on wildfires at the global level do not exist, nor does a global system exist that is able to provide in a synthesized manner information on the evolution of fire regimes and impact at national, regional and global levels. Efforts to collect information at local or national level have shown that this endeavor is very difficult, already at national and regional levels, making it nearly impossible at the global level. The existence of different definitions of forests or wildfires, different methods in the collection of information and different systems at the national or sub-national level, makes it impossible to gather global information through the aggregation of ground collected information. A coordinated effort in wildfire prevention and fighting requires harmonized information at the regional scale. This can only be achieved by a shared information system; the experience of EFFIS in Europe, which is shared by 43 countries, will thus be extrapolated to the global scale; critical fire events such as those in Indonesia in 2015 would potentially be managed more efficiently with the existence of a shared wildfire information system among the countries in the region.

Earth observations (EO) and information, derived both from space and surface networks, have demonstrated not only their maturity, but their critical role in supporting fire managers, first responders and risk managers by providing effective tools to rapidly map natural hazards and assess impacts. Although there is an increasing amount of spatially explicit data and information on wildfires being derived from different sources and often collected at the national, regional and global levels, an international initiative to pull the information together does not exist. GWIS intends to make a wide use of EO derived data, next to other sources of information on e.g. numerical weather predictions for fire danger, land cover and fuel information, as well as ground collected data, to provide a comprehensive view and input to understanding wildfires.

GWIS will thus provide a continuous and smooth platform of harmonized information on wildfires that could be used at different scales, from national to global. The calibration of the system and the validation of the different modules will require the close collaboration with national and regional partners. In countries that currently do not have a wildfire information system, GWIS will fill this gap and help countries engage in international collaboration. For countries and regions where wildfire information systems exist, GWIS will provide a complementary and independent source of harmonized information adding to the national/regional information sources. At the regional level, GWIS builds on the European Commission activities around the European Forest Fire Information System (EFFIS)³, which currently provides information for the pan-European territory, Middle East and North Africa, and its associated network of 41 countries in that region. At the global level, where information on wildfires is scattered and not harmonized, GWIS will be a unique source of information for global initiatives and policies.

³ San-Miguel-Ayanz, J., Schulte, E., Schmuck, G., Camia, A., Strobl, P., Libertà, G., Giovando, C., Boca, R., Sedano, F., Kempeneers, P., McInerney, D., Withmore, C., Santos de Oliveira, S., Rodrigues, M., Durrant, T., Corti, P., Oehler, F., Vilar L., Amatulli, G. (2012) Comprehensive monitoring of wildfires in Europe: the European Forest Fire Information System (EFFIS), in John Tiefenbacher (Ed.), *Approaches to Managing Disaster - Assessing Hazards, Emergencies and Disaster Impacts*, pp. 87-105, InTech, ISBN 978-953-51-0294-6.

GEO provides a unique platform for international cooperation. In the area of wildfires, the Global Wildfire Information System initiative aims at bringing together existing information sources at regional and national level in order to have a comprehensive view and evaluation of fire regimes and fire effects at global level. The task will build on the ongoing activities of the European Forest Fire Information System (EFFIS), the GTOS GOFC-GOLD Fire Implementation Team (GOFC Fire IT), and the associated Regional Networks, complementing existing and related activities that are ongoing around the world with respect to wildfire information gathering. Being the JRC co-chair of GOFC Fire IT, the collaboration with ongoing initiatives of the team is ensured. GWIS will thus be an asset built by and for the GWIS partners, including the GOFC Fire IT members, the EC and the regional partner networks.

The detailed schedule of annual activities and agreements among the partners is discussed at the yearly meeting of the GWIS network, such as the most recent that took place in October 2018 in the context of the ForestSAT conference in College Park (Maryland, USA). Workshops conclusions and recommendations are posted at the GWIS site and will be shared with other GEO communities for which the GWIS activities may be relevant. In addition to capacity building activities regarding the use of advance information systems such as GWIS by fire managers in the regions, additional actions will be taken to link GWIS to other GEO relevant initiatives and establish synergies with capacity building activities foreseen under those.

GWIS policy mandate

There are many UN policies that require information on wildfire regimes and impact at national, regional and global levels. At the regional level, a mandate to establish a decentralized database on forest fires was given by the Forest Europe - Strasbourg Resolution 3⁴, which is currently implemented by the European Commission Joint Research Centre in the context of EFFIS. It aims at assessing the impact of wildfires in the Forest Europe region, currently composed of 43 countries.

At the global level, the need for monitoring the effects of wildfires is linked to global commitments in the areas of adaptation and mitigation of climate change (Intergovernmental Panel on Climate Change and the latest Paris Agreement on Climate Change and recognized in the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) under the UNISDR (United Nations Office for Disaster Risk Reduction).

The Sendai Framework aims at achieving substantial reductions of damage caused by disasters and enhance international cooperation, increasing the availability and access to early warning systems and disasters risk information. In the area of wildfires, the GWIS components of fire danger and fire risk assessment contribute substantially to these actions. The JRC has been involved since 2017 in discussions with UNISDR for the inclusion of wildfire risk in the Global Assessment of Risk (GAR) report that is produced periodically. Furthermore, GWIS is engaged in the UN GRAF (Global Risk Assessment Framework), which analyzes potential contributions to the GAR reports in the coming years. In this context, GWIS will work on a global assessment of wildfire risk to be incorporated in the next GAR reports.

The UN Food and Agriculture Organization is currently collaborating with GWIS in two main aspects. The first aspect is the assessment of wildfire forest damage, which is essential for the Global Forest Resources Assessment 2020 (FAO produces the FRA every 5 years). Until recently the assessment of active fires and burned areas in the countries and the damage caused by these to forests was compiled through questionnaires that were filled in by the national authorities. However, there are many countries that do not routinely collect information on wildfires. In this context, GWIS will provide continuous reporting of fire regimes, burned areas and forest damage derived from the GWIS global fire database, which currently spans from 2000 to 2018. A second aspect, although not less important, is the estimation of emissions from wildfires, which is essential for the FAO global inventory on biomass Green House Gas emissions in the Land Use and Land Use Change (LULUCF) context. As in the case of burned areas, GWIS will provide country inventories of wildfire emissions which will contribute to the FAO global emission inventory. In this same context, the JRC collaborates internally with the EDGAR⁵ anthropogenic emissions database in order to build a

⁴ <https://foresteurope.org>

⁵ <http://edgar.jrc.ec.europa.eu>

comprehensive database of global emissions combining human sources and biomass burning emissions from wildfires.

GWIS Outputs

The scope of GWIS and its products is the global scale. GWIS generates harmonized wildfire information at the global scale and the access to the data is free under the European Commission license, based on the creative common attribution. Data are provided through Web Map Services (WMS) at the GWIS platform: <http://effis.jrc.ec.europa.eu/applications/global-viewer>.

GWIS is currently developed following the scheme of the European Forest Fire Information System (EFFIS), which provides information on the different phases of the wildfire cycle, supporting wildfire prevention and preparedness, active fire monitoring during the emergency phase, and post-fire damage assessments, quantifying the impact on human population, protected areas and land cover, soils and other assets, and estimating wildfire emissions.

In the area of fire danger, GWIS holds the current wildfire danger forecast database, which is available online. Additionally, in collaboration with the European Centre for Medium-Range Weather Forecast (ECMWF) a database of historical fire danger re-analysis has been generated and accepted for publication in Nature Scientific Data (reference). The database will be available through GWIS and in zenodo (<https://zenodo.org>). Under the area of fire danger forecast, GWIS will shortly provide access to the NASA Global Fire Weather Database GWFED database⁶.

GWIS holds active fire information with a database containing active fire data derived from MODIS sensors and retrieved from the NASA LANCE system for the period 2000-2017. Active fire data from VIIRS are also available for the period 2016-2018. Likewise, GWIS holds MODIS-derived burned area and active fire databases from 2001 to present, updated monthly. Within the section on burned area mapping, GWIS intends to incorporate and make available data/information from other global databases such as the ESA Fire CCI Burned Area products at 250 m, from 2001 to 2017 as well as the burned area product generated by the Copernicus Global Land Services.

Additionally, GWIS has generated a unique single event database on the basis of the MODIS burned area product that allows assessing wildfire duration, speed of the fire line as well as regimes of wildfires in terms of spatial and temporal distribution. This database is available in Pangea and its publication has been submitted to Nature Scientific Data. For the first time, national wildfire statistics are available for the period 2001-2017. Trends on the number of fires and area burned in the countries are provided as graphs in the GWIS analysis tools and downloadable from the site.

GWIS Users

The users of GWIS are wildfire managers, policy makers, environmental analysis and citizens that are interested in the assessment of wildfire regimes and/or seek information on the current situation of wildfires in their countries or elsewhere in the world.

GWIS will provide fire managers in the countries with data and information to support preparedness and mitigation actions to minimize the negative effects of wildfires. During the critical phase of ongoing fires, GWIS will provide information on the evolution of the fires and the potential of these to further spread into areas that may be of concern because of environmental values or because of presence of population and human infrastructures. Furthermore, GWIS will contribute to a global assessment of wildfire impacts and potential trends of fire regimes in different world regions, contributing to the assessment of the effects of climate change on wildfires.

⁶ <https://data.giss.nasa.gov/impacts/gfwed/>

The EFFIS and GOFc Fire IT networks will be used to reach out to wildfire management communities regarding training on the products and use of GWIS as well as cooperation in the calibration and validation of these products.

GWIS foreseen impacts and beneficiaries

Sound global policies and decisions regarding human wellbeing and the wellbeing of our planet require continuous and reliable information on global processes. Wildfires are currently the cause of about 20 to 25% of the CO₂ global emissions and one of the main causes of forest and environmental degradation worldwide. GWIS will thus provide the basis for evidence-based policies that will result in the reduction of losses due to increase preparedness and mitigation of wildfire effects. As mentioned in the above heading on policy mandate, the contribution of GWIS may be highly significant in the contribution to assessing the Sendai targets and enhancing the progress in many of the SDGs.

The analysis of GWIS data will allow characterizing fire regimes and assessing potential critical changes that some regions are already suffering due to climate change effects, allowing for both mitigation and adaptation measures. In the context of wildfire behavior, GWIS is working with world experts in the characterization and prediction of critical fires, those that are responsible for the largest number of casualties, and which are characterized by a dramatic speed and intensity.

3. Background and Previous Achievements (3 pages)

The GWIS services are available through its website: <http://effis.jrc.ec.europa.eu/applications/global-viewer>

In the period 2017-2019, the following GWIS activities were considered:

1. Establish and further develop a prototype Global Wildfire Information System (GWIS) providing harmonized fire information (e.g. fire danger) – building on initial activities of the European Commission in the European Forest Fire Information System and the Global Observation of Forest Cover-Global Observation of Land Dynamics Fire Implementation Team (GOFc-GOLD Fire IT).

State of implementation:

Work well in progress according to plan, with continuous development of the GWIS web services.

2. Promote the networking of major national and regional fire information providers by organizing an annual workshop convening key international organizations and initiatives (e.g. GOFc-GOLD Fire IT) and national and regional providers, e.g. Australia, Canada, China, Central and South America and South Africa.

State of implementation:

Activity implemented through the organization of GWIS/GOFc Fire IT meetings in London (2017) and Washington DC (2018) and the planned meeting in Frascati, Italy (2019).

3. Establish operational links and, if possible, arrangement with other wildfire communities dealing with wildfire aspects at global scale (e.g. burned area assessment, emission estimation).

State of implementation:

Links to the ECMWF were established and data on wildfire emission are published in GWIS. Ongoing work is ongoing with other emissions communities (e.g. GFED) to make the data available through GWIS.

The wildfire fuel map developed by the University of Alcala is displayed in the GWIS web site and the data available through appropriate links to the scientific article and datasets.

4. Further develop the GWIS by integrating and harmonizing regional wildfire data information sources.

State of implementation:

Only EFFIS is fully integrated with GWIS. Contact exist with other national/regional information services and data are shared with those, such as the Advance Fire Information System (AFIS; <https://afis.co.za/>) in South Africa.

5. Develop, implement and promote the establishment of mechanisms for interoperability and communication among national, regional and global wildfire information systems following OGC standards and guidelines, and the GEOSS Data Sharing Principles.

State of implementation:

Collaboration is ongoing with the GEOSS Portal in which GWIS data can be accessed and displayed.

6. Coordinate and promote capacity building and training activities in close cooperation with the GOFCC-GOLD Fire Implementation Team regional networks and the EFFIS network.

State of implementation:

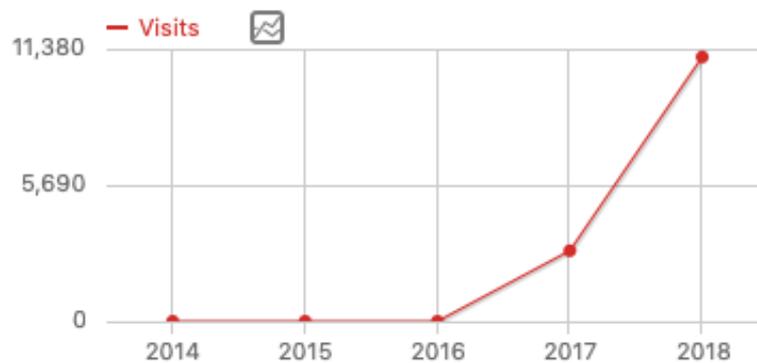
GWIS is funding the participation of the GOFCC Fire IT regional network representatives to the annual GWIS/GOFCC Fire IT meetings. Furthermore, when requested, GWIS contributes to the organization and funding of Regional Network meetings, such as that of SAFNET (South Africa) in April 2018.

Users are already incorporating GWIS products in the daily routine for wildfire management at national or regional scales. The graphic shows the geographical dispersion of the users. The collaboration with UN organizations such as FAO or ISDR can provide a large impulse to the usage of the system by national wildfire management administrations. The example of EFFIS in Europe, where most countries have a national wildfire management system, shows the potential of a regional or global system that provides information. EFFIS is currently used by 192 distinct countries worldwide and has about 300000 users. The potential use of GWIS worldwide is much greater than that of EFFIS, as it can support many countries that do not have a wildfire monitoring system in place.

Use of GWIS by end users

Below is the graph of usage of GWIS since 2017, when the first GWIS viewer was established. Although GWIS is not yet fully operational, the number of users has greatly increased during the last year.

Visits Overview (with graph)



In 2018, The number of unique visitors of the web site was above 11000, from 144 distinct countries. The figure below shows the spatial distribution of countries accessing GWIS in 2018.

11.0k visits



Impact on decision making by policy organizations

Decisions on intervention in relation to wildfires are taken at the European Response Coordinating Centre (ERCC) on the basis of available information in GWIS. Information from GWIS is routinely used for the production of the maps used by the European Commission Humanitarian Office, whose operational arm is the ERCC. The following link provides information on the use of GWIS by ERCC regarding fires in e.g. Australia, USA⁷. Daily maps are available for fires in e.g. USA (2016), Chile, Australia, California (USA), South Africa, Canada (2017), California (2018)⁸. In Europe, EFFIS, with the same scheme as GWIS, covers the operational needs of the wildfire management administrations and the ERCC.

As an example of the success in the initial development of the system, GWIS was included in the GEO Highlights 2016-2017 report⁹. Request for access to information and/or updates of the system are received by the JRC from nearly all locations worldwide, e.g. South Africa, Australia, USA (Pacific coast), Middle East countries, Chile, etc.

Although GWIS is not fully operational, it is routinely used by many administrations worldwide as shown by the number of countries that access its services. The next years will be decisive for the dissemination of information about the system and the strengthening of relations with final users via FAO and the GOFC Fire IT networks. Also, despite its novelty, either the GWIS data or the system itself have already been referred to in 35 scientific articles and literature.

4. Relationship to GEO Engagement Priorities and to other Work Program Activities (3 pages)

Relationship with GEO Engagement Priorities

Fire management plays an important role in realizing Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. The availability of consistent, reliable and independent data, analysis and products through GWIS directly supports and informs this SDG target. In addition to the above goal,

⁷ <https://erccportal.jrc.ec.europa.eu/About-us/Full-Text-Search?Search=gwis>

⁸ <https://erccportal.jrc.ec.europa.eu/Maps/Daily-maps> (search fire)

⁹ https://www.earthobservations.org/documents/geo_xiv/GEO%20Highlights%202016-2017.pdf

GWIS contributes directly to the implementation of other SDGs objectives as presented in Table 1, in the annex.

Wildfires are one of the main causes of deforestation and forest degradation in many regions of the world. Since, currently fire emissions are not fully considered in the IPCC reports, further efforts are required to characterize whether wildfires are carbon neutral or not. Obviously, deforestation caused by wildfires is not. Both activities are related to the REDD+ programs.

The strong emergence of Disaster Risk Reduction at global level has seen the Sendai Framework developed as the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. The Sendai Framework for Disaster Risk Reduction 2015 – 2030 (UN 2015a) has a strong emphasis on disaster risk management (before) as opposed to disaster management (during and after). The Sendai Framework is being linked to, and worked on, in the context of the Sustainable Development goals (SDGs), which are referred to in the above paragraphs.

The Sendai Framework articulates the following that should be considered in the context of wildfires: the need for improved understanding of disaster risk in all its dimensions of exposure, vulnerability and hazard characteristics; preparedness to “Build Back Better” (improved post-fire landscape management and use); recognition of stakeholders and their roles and strengthening of international cooperation and global partnership.

The Sendai Framework (UN 2015a) in relation to science and research notes the need to promote and improve dialogue and cooperation among scientific and technological communities, other relevant stakeholders and policymakers; to enhance the scientific and technical work on disaster risk reduction; promote scientific research on disaster risk patterns, causes and effects; identify research and technology gaps and set recommendations for research.

The concept, development, platform and products of the GWIS contribute directly to the efforts framed in the Sendai Framework.

Relationship with other GEO Initiatives and Flagships

The work in GWIS is related to several initiatives related to disaster risk management, such as the Global Drought Information System (GDIS), the Global Flood Alert System (GloFAS), GEODARMA and those dealing with human exposure to natural hazards, such as GEO Human Planet. Additionally, the work in GWIS is highly relevant for initiatives focusing on the observation of natural resources such as GFOI, GEO ECO and GEOBON and regional data sharing and networking initiatives such as AmeriGEOSS, AfriGEOSS, EuroGEOSS

5. Stakeholder Engagement and Capacity Building

Key organizations and stakeholders

FAO has identified that data on fire incidence, land area and biomass burned is weak in many countries and incomplete globally, and also that the combination of existing data sets, remote sensing data, historical information and emerging data sets and methods applied at national level will vastly improve understanding by countries of their wildfires, providing independent and verifiable assessment of where fires occur (fire detection – hotspots) and the landscapes, vegetation and communities impacted (burned area). This step of Research and analysis of fires is essential in planning for Risk Reduction, Readiness to fight wildfires, Response to wildfires and Recovery of the restoration of landscapes, livelihoods and assets impacted by wildfires. FAO is seeking to support collaboration and engagement among the remote sensing service providers, researchers and fire and land managers to enable the flow of data and information to countries and facilitate continuous improvement.

User and stakeholder engagement is already implemented through the networks of the European Forest Fire Information System and will be further expanded to the GOFI GOLF Fire Networks. However, up until

now, the above networks are a set of disconnected groups, and do not have a common information hub where wildfire information, expertise, and good practices could be shared. The establishment of GWIS will thus bring all networks to a higher level of networking, information sharing and collaboration that does not exist at the moment.

Stakeholders in the regional networks are already engaged in the co-development of GWIS, through the use of data and services and the support in the calibration and validation of these. GWIS, with the support of the EU Copernicus Program and NASA, intends to organize webinars and workshops in which GWIS will be presented and discussed. Support to regional networks took place already in 2018 through the SAFNET and EFFIS annual workshops.

Tools, services and data are freely available in GWIS, supporting national, regional and global agencies for informed decision making as regards wildfires. Additionally, the scientific community supporting GWIS (see partners) is in close cooperation with numerous networks of research centers and universities. A network of university centers involved in fire research would help to create a “fire virtual academy” that would help transferring knowledge on the generation and analysis of fire information. This network may be coordinated by GWIS, as part of a distribution list that includes fire managers, decision-makers, and academics involved in fire research.

Some of the current and/or planned activities to engage stakeholders and/or strengthen individual, organizational and/or institutional capacity and the expected outputs and outcomes of these activities are listed below:

- In late February FAO will undertake a training course on fire management concepts that will include a focus on the Review and Analysis of the fire situation, Fire reporting and recording, Damage and Loss Assessment, Data sources on fires, Supplementary information sources and Interpretation of the data and information and discuss the fire data needs and related requirement of the FAO Near East and North Africa Region.
- In April, JRC will meet with the Expert Group on Forest Fires (EFFIS network) to discuss on the assessment of wildfire risk at the pan-European level. The scope and methodology developed is envisaged to be applied at the global level.
- GEO GWIS side event at the Wildfire Conference, in Brazil, in October 2019, will reach out to the firefighting community and the fire research community gathered around the Conference.
- 4th Annual GWIS/GOFC Fire IT Workshop, at ESA headquarters, in Frascati, Italy, October 2019, with the participation of regional networks worldwide.

6. Governance

Coordination Board (CB)

GWIS is led by JRC and contributed by Canada, China, EC, Japan, South Africa, USA and ESA, ECWMF among others¹⁰. It is built on the experience on setting up the European Forest Fire Information System (EFFIS) and the collaboration of the GTOS Global Observation of Forest Cover Global Observation of Land Dynamics (GOFC-GOLD) Fire Implementation Team and its regional networks. A team of 12 staff in JRC works for GWIS. Coordination is made through meetings, in which JRC and the co-chairs of GOFC-GOLD Fire Implementation Team and other major contributions (e.g. NASA, Univ. Maryland) participate. An annual meeting with all partner organizations and contributions has been organized and held since 2016.

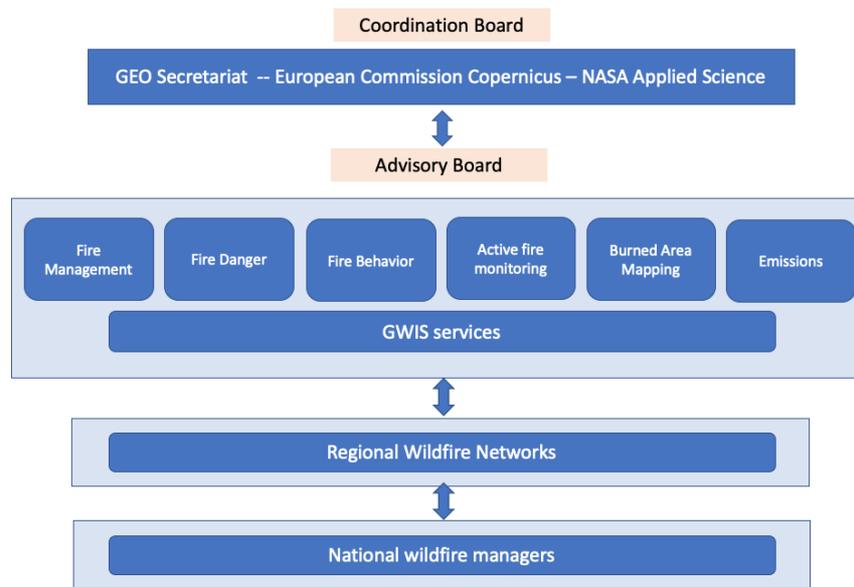
The proposed governance of GWIS includes the presence of a Coordination Board, composed of the three main organizations funding and/or coordinating the development of GWIS. Moreover, it is proposed that for the period 2020-2022, an Advisory Board (AB) would be set up. The AB would provide support to the Lead of the Initiative at the European Commission Joint Research Centre in several thematic aspects that are

¹⁰ Full list of partners at <http://gwis.jrc.ec.europa.eu/partners/>

essential in GWIS and would have a direct link to regional initiatives and networks and national wildfire management administrations.

Advisory Board (AB)

The AB is to be composed of relevant key persons in the relevant areas of wildfire science and management globally.



Indicatively, the AB could be composed of international scientists who are already members of the GOFC Fire IT such as those listed below in alphabetical order:

- Vincent Ambrosia, NASA Applied Science Program (USA)
- Luigi Boschetti, Univ. Idaho (USA) – Co-lead NASA ROSES project GWIS Services
- Marc Castellnou, Head of Forest Fire Fighting Operations, Catalonia (Spain)
- Emilio Chuvieco, Univ. of Alcalá (Spain) – Lead of ESA Fire CCI Burned Area Project
- Craig Clements, San Jose State University (CA USA)
- Robert Field, NASA & Columbia University (USA) – Lead NASA ROSES GWIS Fire Danger
- Mike Flannigan, Natural Resources Canada (Canada)
- Louis Giglio, Univ. Maryland (USA), Co-lead NASA ROSES GWIS Active Fire Detection
- Chris Justice, Univ. of Maryland, previous co-chair of GOFC GOLD Fire IT (2007-2016)
- Peter Moore, UN Food and Agriculture Organization (FAO)
- David Roy, Co-chair GOFC Fire Implementation Team
- Wilfrid Schroeder, NOAA, Co-lead NASA ROSES GWIS Active Fire Detection
- Guido van der Werf, Univ. of Amsterdam – Lead of GFED activities
- Krishna Vadrevu, GOFC Fire IT Network responsible.
- Martin Wooster, Co-chair GOFC GOLD Fire Implementation Team

The above members cover nearly all the phases of wildfire management, from science to operation and will support the development of GWIS in all aspects of wildfire monitoring. The AB would be flexible and able to incorporate additional members in relevant topics, as needed. The building blocks of a governance structure will include links to regional platforms and contact with national wildfire administrations. In addition to the AB, GWIS builds on the activities of the GOFC GOLD Fire IT and is supported by a series of partner staff and organizations. The full list of participating staff and organizations is available at <http://gwis.jrc.ec.europa.eu/partners/>.

Communication with the AB will be mainly through email and periodic Video Conferencing for assessment of progress in the work plan and setting of immediate objectives within it. Progress on the implementation of the Initiative will be done through the annual GWIS & GOFC Fire IT meeting and for intermediate thematic meetings in relation to GWIS activities. Progress on the GWIS activities will be posted at the GWIS home page, under the section news and events and shared periodically with the GEO Secretariat.

Given the collaborative basis of the GWIS maturation activities and the stable funding support of such by both the European Commission Copernicus Program and the NASA Earth Science, Applied Science Program, minimal risk is foreseen for the implementation of the GWIS work program. The development of the Global Wildfire Information System is supported by the European Copernicus program¹¹, which foresees the development of data sharing platforms and services in the GWIS. The Copernicus provides a stable development and funding platform until 2020, which is currently in process of renewal for the period 2021-2027. The NASA Applied Science Program provided funding for three investigator-led initiatives for the period 2018-2021. These three investigators are named on the Advisory Board, and supporting developments and enhancements of the GWIS.

7. Resources (1 page)

GWIS is supported by the European Commission Joint Research Centre activities on forest fire monitoring in the context of the extension of the European Forest Fire Information System to the global scale. The contribution of the EC Joint Research Centre includes the development and maintenance of a prototype Global Wildfire Information System as a potential component of the Copernicus EU Program.

Currently, the JRC EFFIS/GWIS team consists of 12 scientific staff with expertise on remote sensing, statistical and spatial analysis, information systems, web development and interoperability. This team will be supported by other JRC colleagues with specific expertise on data harmonization, data infrastructures and interoperability, who work on the implementation of the EU Directive INSPIRE¹² (that aims at creating a European Union (EU) spatial data infrastructure) and who are in close connection with GEO and GEOSS relevant initiatives in this field. The resources and expertise mentioned above ensure that GWIS is discoverable through the GEO Common Infrastructure (GCI).

Through its NASA Earth Science, Applied Science Program, NASA is currently investing in three projects to support the development of GWIS in the following aspects: (1) fire danger forecasting and support to regional networks, (2) development of new active fire detection global products and (3) customization and development of products and services aimed at end users, i.e. wildfire management administrations. In the period 2020-2022, these three NASA-supported efforts will enhance and expand the capabilities of GWIS

Furthermore, NASA supports the use and dissemination of information on GWIS through its ARSET program, which includes the preparation of training material and webinars. One ARSET webinar, focused on GEO-GWIS was developed in 2018¹³, and additional materials for training / webinars are being explored for 2020-2022.

The participants in the GWIS initiative provide in kind contribution through their participation in the meetings and teleconferences. The contributors are the owners of national and regional systems, who will contribute to the design and development of GWIS and the calibration and validation of the GWIS modules. Contributors to GWIS will provide support for the editing of documents and reports during the follow up of the Initiative in the WP2020-2022. The list of participants and their contribution will be regularly updated along the duration of the project. The networks will contribute to the development of GWIS by providing feedback on the use of GWIS in the different regions of the world.

¹¹ Regulation (EU) No 377/2014 of the European Parliament and of the Council of 3 April 2014 establishing the Copernicus Programme and repealing Regulation (EU) No 911/2010

¹² Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

¹³ https://arset.gsfc.nasa.gov/sites/default/files/land/webinars/18-advwild/AdvancedWildfires_Presentation2_Final.pdf

The European Commission Joint Research Centre, in the context of its activities within the Copernicus program, foresees the provision of financial resources for the organization of an annual workshop in the period 2020-2022, in addition to the resources on the development and maintenance of GWIS platform and web services. JRC will support the collaboration and organization of regional networks, as needed. No other specific financial support is provided by any of the Institutions participating in the task.

8. Technical Synopsis (2 pages)

This section describes the data sets used by GWIS. The principal datasets used in GWIS can be grouped according to the different phases of wildfire monitoring, from the pre-fire stage through active-fire detection, to the post-fire damage assessment. The following paragraphs describe the main sources of data in each stage and the scientific basis for the processing of the data by partner organizations.

Fire Danger

JRC uses Numerical Weather Predictions for fire danger prediction in GWIS. The Canadian Fire Weather Index is the default for the assessment of wildfire danger, while other fire danger indices such as the Haines or Mark 5 (Australia) are currently being tested for additional implementation into GWIS, where regionalized models have more scientific validity.

Historical reanalysis and real-time NWP forecasts come from the European Centre for Medium-Range Weather Forecasts (ECMWF) and from MeteoFrance FR. Fire danger from the NASA GFWED has fire danger computed from NASA Modern Era Retrospective Reanalysis version 2 (MERRA-2), Goddard Earth Observing System Model version 5 (GEOS-5) NWP, and Integrated Multi-satellite Retrievals for Global Precipitation Measurement (IMERG). The integration of GFWED data into GWIS will provide an additional forecast ensemble member, and strengthen operational use of global fire weather data at regional scales, for example through AFIS (<https://fdi.afis.co.za/>).

Seasonal fire weather predictions are derived by JRC from the ECMWF Seasonal System (S-4) and characterized for each world region. Currently, these only exist for Europe under EFFIS and have been prototyped for Indonesia using NOAA Coupled Forecast System Model (CFS) v2.

Seasonal Fire Danger Forecast is under development in collaboration with ECMWF and NASA (through the Applied Science Program-supported project developments).

For fire danger prediction, JRC uses the open-source method developed by Van Wagner for the Canadian FWI.

Active fire detection

Active fire information is provided in GWIS from MODIS¹⁴, VIIRS¹⁵, Sentinel-3 (not yet operational). A global Geostationary product will be developed in the context of the NASA ROSES project by University of Maryland & NOAA on the “Development of harmonized multi-sensor global active fire data set.”

Burned area mapping

¹⁴ MODIS Collection 6 NRT Hotspot / Active Fire Detections MCD14DL. Available on-line [<https://earthdata.nasa.gov/firms>]. DOI: 10.5067/FIRMS/MODIS/MCD14DL.NRT.006

¹⁵ NRT VIIRS 375 m Active Fire product VNP14IMG. Available on-line [<https://earthdata.nasa.gov/firms>]. DOI:10.5067/FIRMS/VIIRS/VNP14IMG.NRT.001.

Current burned area maps come from the MODIS (MCD64A1) product¹⁶, which is updated monthly. Current burned area maps are produced by JRC on the basis of the VIIRS active fire product to cover the time gap until the MODIS data are available. This later product allows to monitor ongoing fires and assess their spread in near real time.

As mentioned above, it is foreseen to include additional products such as the ESA Fire CCI and the Copernicus Global Land Product.

Emissions assessment

Current emissions in GWIS are available online and area provided by the Copernicus Atmospheric Monitoring service¹⁷.

Background and ancillary data

Currently GWIS is unable to display the Google background; given the high number of users, and although GWIS is operated by a research and non-profit organization like the JRC, this restriction persists.

Ancillary data for global fuel information is available in GWIS and provided by the University of Alcala¹⁸. Information on human infrastructure is provide by the Global Human Settlement Layer of JRC¹⁹, while vulnerability layers are currently under development.

9. Data policy (2 pages)

Policy of the Initiative regarding data availability, including degree of adherence to the GEOSS Data Sharing Principles and GEOSS Data Management Principles. Data are organized in a GWIS collection for which, currently, metadata are handled by the JRC Data Portal. The data are already discoverable through the GEOSS Platform.

All the data elaborated and synthesized in the GWIS web services are freely available to any type of users and are currently being inserted into commercial and non-commercial applications worldwide. Data sharing will follow the open data use and distribution, open data license, implemented already in EFFIS, following the GEOS data sharing principles.

Given the scientific and financial stability of GWIS in the coming years, due to the fact of being under the umbrella of two strong programs, the EU Copernicus Program and the NASA Advanced Science Program, continuity and reliability of data storage and access is guaranteed.

¹⁶ Giglio, L., Justice, C., Boschetti, L., Roy, D. (2015). MCD64A1 MODIS/Terra+Aqua Burned Area Monthly L3 Global 500m SIN Grid V006 [Data set]. NASA EOSDIS Land Processes DAAC. doi: 10.5067/MODIS/MCD64A1.006

¹⁷ <https://atmosphere.copernicus.eu/catalogue#/product/urn:x-wmo:md:int.ecmwf::copernicus:cams:prod:an:fire-radiative-power:pid324>

¹⁸ [Pettinari, M Lucrecia \(2015\): Global Fuelbed Dataset. Department of Geology, Geography and Environment, University of Alcala, Spain, doi:10.1594/PANGAEA.849808](#)

¹⁹ <https://ghsl.jrc.ec.europa.eu/index.php>

Annexes

Table 1. Contribution of GWIS to SDGs

GWIS & SDGs		
	<p>Goal 1. End poverty in all its forms everywhere</p> <p>1.5 By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters</p>	Better preparedness as regards wildfire exposure and vulnerability, building a more resilient society
	<p>Goal 3. Ensure healthy lives and promote well-being for all at</p> <p>3.d Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks</p>	Strengthen the capacity of the countries for early warning by adapting technologies and develop risk reduction strategies to
	<p>Goal 11. Make cities and human settlements inclusive, safe,</p> <p>11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations</p> <p>11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai</p>	<p>Contribution to early warning, climate change</p> <p>Contribution to early warning, climate change adaptation and resilience</p>
	<p>Goal 13. Take urgent action to combat climate change and its</p> <p>13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries</p> <p>13.2 Integrate climate change measures into national policies, strategies and planning</p> <p>13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning</p>	<p>Analysis of wildfire regimes and adaptation measures; training and capacity building</p> <p>current data supporting the planning and implementation of national and international policies</p> <p>Training and capacity building as regards wildfire prevention and early</p>
	<p>Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat</p> <p>15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and</p> <p>15.3 By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world</p> <p>15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened</p>	<p>Assessment of wildfire impacts, including deforestation and</p> <p>Assessment of wildfire impacts, including land degradation and</p> <p>Assessment of wildfire impacts on natural habitats and promotion of good</p>
	<p>Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development</p> <p>Technology</p> <p>17.6 Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge-sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the</p> <p>Capacity-building</p> <p>17.9 Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the Sustainable Development Goals, including through North-South, South-</p>	<p>Technology transfer and capacity building activities, training and networking, including transfer of knowledge on wildfires</p> <p>Technology transfer and capacity building activities, training and networking, including transfer of</p>

A. Individual Participants

Individual participants in GWIS are listed at the GWIS partner page: <http://gwis.jrc.ec.europa.eu/partners>. Temporarily, the names of the participants have been removed from the page.

B. Confirmed Contributions

Confirmed contributions are those described above, including resources from the European Commission Joint Research Centre, the EU Copernicus Program and the NASA Science Applied Program.

C. Task / Work Package Structure

Activities in the initiative are organized according to the fire cycle, following the scheme described in Section 8, above.

D. Deliverables / Milestones

Deliverables in the initiative are organized according to the fire cycle, following the scheme described in Section 8, above.

Annexes

I. Acronyms and abbreviations

AFIS Advanced Fire Information System
CNR Canada Natural Resources
ECMWF European Centre for Medium Range Weather Forecast
EDGAR – Emissions Database for Global Atmospheric Research
EFFIS European Forest Fire Information System
ESA European Space Agency
Fire CCI Fire Climate Change Initiative
GAR – Global Assessment of Risk
GEO Group on Earth Observations
GEOSS Global Earth Observation System of Systems
GFWED Global Fire Weather Database
GOFC GOLD Global Observation of Forest Cover Global Observation of Land Dynamics
GOFC Fire IT Global Observation of Forest Cover Fire Implementation Team
GRAF – Global Risk Assessment Framework
GTOS Global Terrestrial Observing System
GWIS Global Wildfire Information System
IMERG Integrated Multi-satellite Retrievals for Global Precipitation Measurement).
LULUCF - Land Use and Land Use Change
MERRA-2 Modern Era Retrospective Reanalysis version 2
MF MeteoFrance
MODIS Moderate Resolution Imaging Spectroradiometer
NASA National Aeronautics and Space Administration
NOAA – National Oceanic and Atmospheric Administration
SDGs – Sustainable Development Goals
UNISDR - United Nations Office for Disaster Risk Reduction
VIIRS Visible Infrared Imaging Radiometer Suite
WMS Web Map Services

II. List of key scientific references relevant for GWIS

(relative to the existing products and system). Additional information is provided in the text, as footnotes.

ESA Fire CCI project team; Chuvieco, E. (2016): ESA Fire Climate Change Initiative (Fire CCI) Dataset Collection. Centre for Environmental Data Analysis,
<http://catalogue.ceda.ac.uk/uuid/bcef9e87740e4cbabc743d295afbe849>

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T., Corti, P., Oehler, F., Vilar L., Amatulli, G. 2012. Comprehensive monitoring of wildfires in Europe: the European Forest Fire Information System (EFFIS), in John Tiefenbacher (Ed.), Approaches to Managing Disaster - Assessing Hazards, Emergencies and Disaster Impacts, , pp. 87-105, InTech, ISBN 978-953-51-0294-6

Van der Werf et al., 2017. Global fire emissions estimates during 1997-2016, Earth Syst. Sci. Data, 9, 697-720.

Wooster, M.J., Xu, W., Nightingale, T., Sentinel-3 SLSTR active fire detection and FRP product: Pre-launch algorithm development and performance evaluation using MODIS and ASTER datasets, Remote Sensing of Environment, 120, 236-254.

Sample of references to GWIS by relevant institutions/organizations:

WMO - https://library.wmo.int/doc_num.php?explnum_id=4519

EU Copernicus https://emergency.copernicus.eu/mapping/sites/default/files/files/EMS_FireEWS_A0_v2.pdf

UN SPIDER <http://www.un-spider.org/links-and-resources/data-sources/global-wildfire-information-system-gwis-effis>

NASA https://appliedsciences.nasa.gov/system/files/docs/262_Ambrosia_GEO-GWIS_170313030646.pdf

NASA https://arset.gsfc.nasa.gov/sites/default/files/land/webinars/18-advwild/AdvancedWildfires_Presentation2_Final.pdf

JRC Data catalogue <http://data.jrc.ec.europa.eu/dataset/603455f1-ab7d-485c-b10e-3d278c9579d9>

IUFRO/Worldbank - https://www.profor.info/sites/profor.info/files/IUFRO_op32_2018.pdf

III. Brief CV of Project Leader(s)

Leader on the development of the European Forest Fire Information System (EFFIS) and the Global Wildfire Information System (GWIS), Jesus San Miguel-Ayanz, is a Senior researcher at the European Commission Joint Research Centre. Until 2017, he led the development of other EU information systems such as the Forest Information System for Europe (FISE) and the European Forest Data Center (EFDAC), supporting EU Regulations on forest information and monitoring. He has a background on forestry research and remote sensing, including aspects of forest dynamics, inventory and disturbances, specifically on forest fires. He has wide experience in data handling and the development of information systems.

Education: PhD (1993) and MSc (1989) on Remote Sensing and GIS by University of California-Berkeley, Forest Engineering Degree (87) by Polytechnic Univ. of Madrid.

Professional experience: (95-97) Associate Professor of Forest Inventory, Forest Mensuration and Remote Sensing. (94-95) Assistant Professor same topics, University of Cordoba.

Research: Fulbright scholar at the Univ. California-Berkeley (1989); research fellow at the University of California-Berkeley (89-93), European Space and Technology Centre (ESTEC) of the European Space Agency (93-94), and Joint Research Centre (94-96).

List of publications available at: https://www.researchgate.net/profile/J_San-Miguel-Ayanz