



# Analysis and forecast of wildfires using ECMWF-Copernicus data and services



Claudia Vitolo<sup>1</sup>, Francesca Di Giuseppe<sup>1</sup>, Mark Parrington<sup>1</sup>

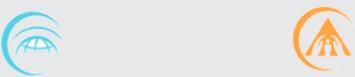
<sup>1</sup>Forecast Department, ECMWF, Reading, United Kingdom

@clavitolo  
claudia.vitolo@ecmwf.int

## Background

Copernicus is the European Union's Earth Observation programme aiming at monitoring and forecasting the state of the environment on land, sea and in the atmosphere, in order to support climate change mitigation and adaptation strategies, the efficient management of emergency situations and improve the security of every citizen.

Copernicus has created a wealth of datasets related to the forecasting of wildfire danger as well as the detection of wildfire events and related emissions in the atmosphere. These products contribute to the operational services provided by the Copernicus Emergency Management Service (CEMS) and the Copernicus Atmosphere Monitoring Service (CAMS) and consists of real time forecasts as well as historical datasets based on ECMWF reanalysis database ERA5. CEMS and CAMS data are under the Copernicus license, which provides users with free, full and open access to environmental data.



Global Fire monitoring

Global fire evolution forecasting (d+5)  
Global fire danger forecasting (d+10)

## Global ECMWF Fire danger Forecasts and Reanalysis

The European Centre for Medium-range Weather Forecasts (ECMWF) and CEMS produce daily fire danger forecasts and reanalysis products using the Global ECMWF Fire Forecast (GEFF) model (based on the Canadian Fire Weather index as well as the US and Australian fire danger systems). GEFF datasets are funded through a third-party agreement with the European Commission's Joint Research Centre (JRC).

### Data and services availability

- ▶ **GEFF-realtime** provides real-time high-resolution deterministic ( 9 Km) and lower-resolution probabilistic ( 18Km) fire danger forecasts up to 15 days ahead using weather forcings from the latest model cycle of the ECMWF's Integrated Forecasting System (IFS). Data can be requested through an online form and viewed using the following platforms:
  - ▷ The European Forest Fire Information System (EFFIS)
  - ▷ The Global Wildfire Information System (GWIS)
- ▶ **GEFF-reanalysis** provides historical records of global fire danger conditions from 1980 to the present day and it is made of four types of products: (i) deterministic model outputs, (ii) probabilistic model outputs (made of 10 ensemble members), (iii) ensemble mean and (iv) ensemble spread. It is updated as soon as new ERA-5 data becomes available ( 2 months behind real-time). Data are available through the
  - ▷ Copernicus Climate Data Store
- ▶ **Sample datasets**, for education purposes only, are available on the Zenodo wildfire community: <https://zenodo.org/communities/wildfire>.

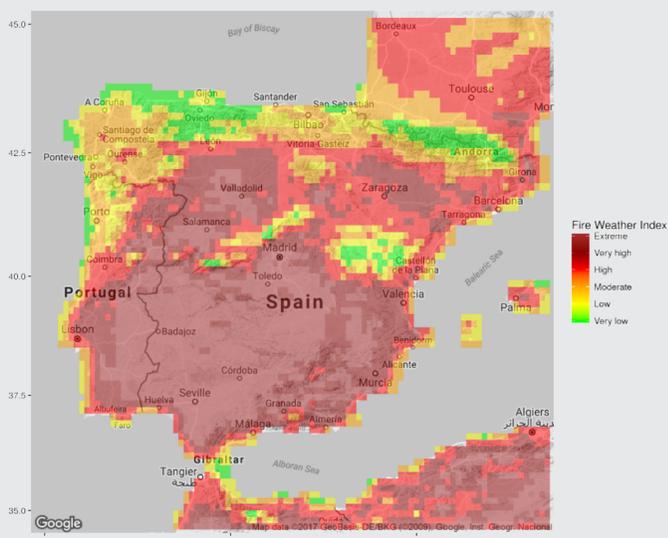


Figure: Example fire danger forecast (classified Fire Weather Index) in the Iberian Peninsula.

## CAMS Global Fire Assimilation (GFAS)

The Global Fire Assimilation System (GFAS) assimilates fire radiative power (FRP) observations from satellite-based sensors to produce daily estimates of emissions from wildfires and biomass burning. FRP is a measure of the energy released by the fire and is therefore a measure of how much vegetation is burned. FRP observations currently assimilated in GFAS are the NASA Terra MODIS and Aqua MODIS active fire products. The domain is global and the resolution is of 0.1 degrees on a regular lat-lon grid. The data covers the period from 2003 to present.

### Data and services availability

- ▶ CAMS main page
- ▶ CAMS Global Fire Assimilation (GFAS) data documentation
- ▶ Latest daily Fire Radiative Power (FRP) analysis
- ▶ Catalogue of archived GFAS products
- ▶ Questions/help:
  - ▷ E-mail: [copernicus-support@ecmwf.int](mailto:copernicus-support@ecmwf.int)
  - ▷ Twitter: @CopernicusECMWF

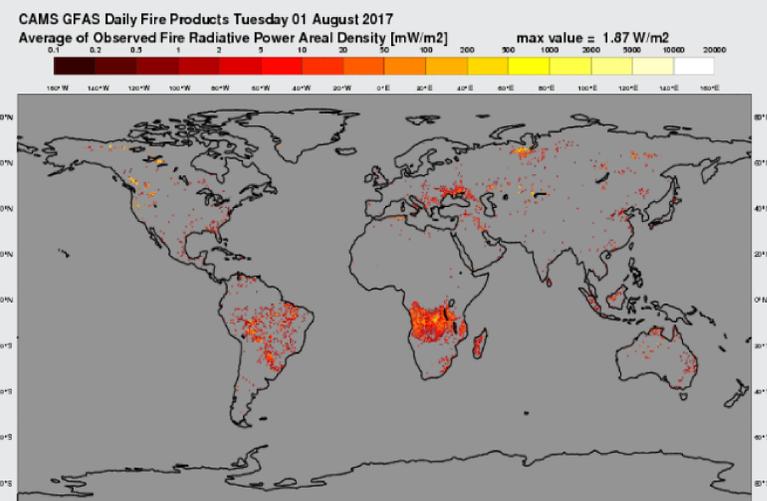
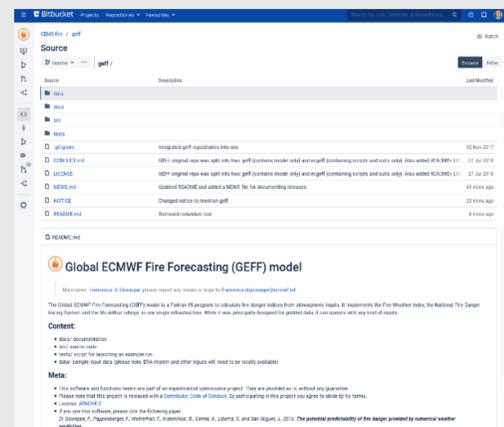


Figure: CAMS GFAS daily fire products.

## Software tools

- ▶ **GEFF model source code**  
<https://git.ecmwf.int/projects/CEMSF/repos/geff/browse>
- ▶ **Tools for data processing**
  - ▷ For Python3 users: collection of Jupyter notebooks: [https://github.com/cvitolo/GEFF\\_notebooks](https://github.com/cvitolo/GEFF_notebooks)
  - ▷ For R users: the R package "caliver" (open source under APACHE-2 license): <https://github.com/ecmwf/caliver>



## References

- [1] Claudia Vitolo, Francesca Di Giuseppe, Blazej Krzeminski, and Jesus San-Miguel-Ayanz. A 1980–2018 global fire danger re-analysis dataset for the Canadian fire weather indices. *Scientific data*, 6:190032, 2019.
- [2] Claudia Vitolo, Francesca Di Giuseppe, and Mirko D'Andrea. Caliver: an R package for calibration and verification of forest fire gridded model outputs. *PLOS ONE*, 13(1):1–18, 01 2018.
- [3] Francesca Di Giuseppe, Florian Pappenberger, Fredrik Wetterhall, Blazej Krzeminski, Andrea Camia, Giorgio Libertá, and Jesus San Miguel. The potential predictability of fire danger provided by numerical weather prediction. *Journal of Applied Meteorology and Climatology*, 55(11):2469–2491, 2016.