Development of Burned Area datasets based on Remote Sensing

E. Chuvieco[1], M. L. Pettinari[1], T. Storm[2], M. Böttcher[2], G. Kirches[2], C. Brockmann[2]
[1]Universidad de Alcalá, Alcalá de Henares, Spain; [2]Brockmann Consult GmbH, Hamburg, Germany
Contact: mlucrecia.pettinari@uah.es

Since 2010, the research group of the Universidad de Alcalá (UAH): Grupo de Investigación en Teledetección Ambiental (GITA, https://geogra.uah.es/gita) coordinates the Project **FireCCI**, of the European Space Agency (ESA) Climate Change Initiative (CCI, https://climate.esa.int).

And starting on 2018, the most mature global burned area (BA) products have been brokered to the Copernicus Climate Change Service (C3S, https://climate.copernicus.eu) for publication and further operational processing. C3S is managed by ECMWF (https://www.ecmwf.int), and the current contract **C3S2_313e_BC** is coordinated by the company Brockmann Consult GmbH (https://www.brockmann-consult.de/).

Aims of the FireCCI project

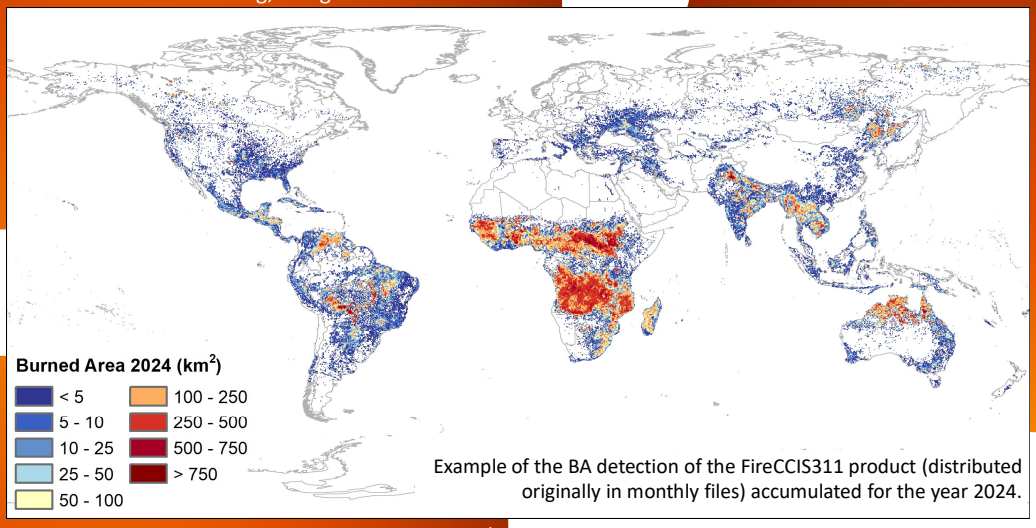
- ✓ Develop and validate algorithms to meet Essential Climate Variable (ECV) requirements for global satellite BA data products from multi-sensor data archives.
- ✓ Produce and validate the most complete and consistent possible time series of multi-sensor global satellite BA data products for climate research and modelling.
- ✓ Optimise the impact of ESA Earth Observation missions data on climate data records.

Development of BA algorithms

The **GITA team at UAH**, with the collaboration of researchers from different European institutions, has developed several algorithms for burned area detection based on remote sensing, using data from ESA and NASA sensors on board different satellites, including Terra & Aqua MODIS, Sentinel-2 MSI, Sentinel-3 OLCI & SLSTR, and Suomi-NPP & NOAA20 VIIRS.

Processing of BA maps

Brockmann Consult GmbH, as partner of the UAH in the FireCCI project, is in charge of processing the algorithms to obtain the burned area datasets. The most relevant datasets to date are FireCCI51 [1], based on MODIS surface reflectance (SR), FireCCIS311 [2], developed from Sentinel-3 SR, and FireCCISFD11/20 [3, 4], based on Sentinel-2 SR.



Example of the BA detection of the FireCCIS311 product (distributed originally in monthly files) accumulated for the year 2024.

Verification and validation

UAH, with the help of its partner CNR (Italian National Research Council), performs the verification and validation of the resulting maps.

Publication

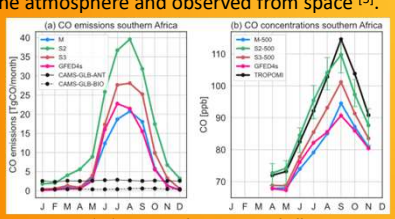
Two paths of publication of the BA datasets are followed, depending on the contract:

UAH, as prime contractor of the FireCCI project, publishes the FireCCI products in the CCI website.

Brockmann Consult GmbH, as prime contractor of the C3S project, publishes the FireCCI products in the C3S website.

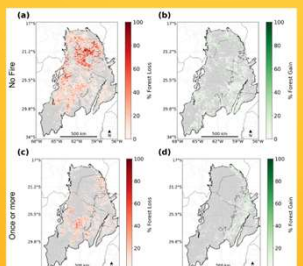
Examples of use of the BA datasets

Climate Modelling: researchers study the greenhouse gasses emissions from wildland fires and their contributions to climate change. The latest FireCCI products, and particularly the datasets based on Sentinel-2, allow to calculate emissions that are closer than previous products to the gasses present in the atmosphere and observed from space [5].



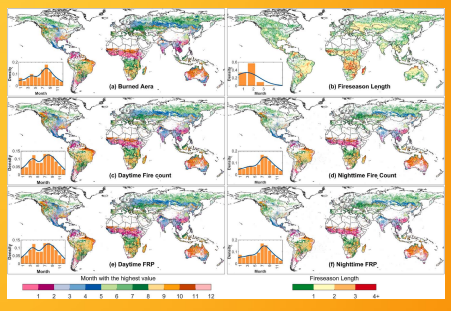
Carbon monoxide (CO) estimations from emissions of different BA products, and from those directly observed by the TROPOMI sensor. M-500: emissions derived from the NASA product MCD64A1; S3-500: derived from the FireCCIS311 product; S2-500: derived from FireCCISFD20 [5].

Land Cover change and deforestation: BA datasets can be used to analyse land cover dynamics, and how climate and fire occurrence affect deforestation processes [6].



Forest loss and gain maps for pixels without fire (a, b) and with one or more fires (c, d) between 2001 and 2019 in the Gran Chaco (Argentina) [6].

Fire dynamics and ecology: global BA datasets derived from satellite data allow to study the fire dynamics in different parts of the world, the changes of fire regimes through time, and the effects that fires can have on the ecosystems [7].



Spatial distributions of the months with the highest frequency of peak records in burned area (a), fire count during daytime (c) and nighttime (d), fire radiative power (FRP) during daytime (e) and nighttime (f), and the mean fire season length (b) over 2001–2020. The inset figures show the respective probabilistic density functions [7].

References:
[1] Lizundia-Loiola J. et al. (2020) A spatio-temporal active-fire clustering approach for global burned area mapping at 250 m from MODIS data. https://doi.org/10.1016/j.rse.2019.111493
[2] Lizundia-Loiola J. et al. (2022) Global burned area mapping from Sentinel-3 Synergy and VIIRS active fires. https://doi.org/10.1016/j.rse.2022.113298
[3] Roteta E. et al. (2019) Development of a Sentinel-2 burned area algorithm: Generation of a small fire database for sub-Saharan Africa. https://doi.org/10.1016/j.rse.2018.12.011
[4] Chuvieco E. et al. (2022) Building a small fire database for Sub-Saharan Africa from Sentinel-2 high-resolution images. https://doi.org/10.1016/j.scitotenv.2022.157139
[5] van der Velde I. et al. (2024). Small fires, big impact: Evaluating fire emission estimates in southern Africa using new satellite imagery of burned area and carbon monoxide. https://doi.org/10.1029/2023GL106122
[6] San-Martín, et al. (2023) Fires in the South American Chaco, from dry forests to wetlands: response to climate depends on land cover. https://doi.org/10.1186/s42408-023-00212-4.
[7] Yang, X. et al. (2023) Characterization of global fire activity and its spatiotemporal patterns for different land cover types from 2001 to 2020. https://doi.org/10.1016/j.envres.2023.115746

Universidad de Alcalá
Calle Colegios 2, 28801 – Alcalá de Henares, Madrid, Spain
www.uah.es

Brockmann Consult GmbH
Chrysanderstraße 1, 21029 - Hamburg, Germany
info@brockmann-consult.de