climate change initiative

→ FIRE NEWSLETTER

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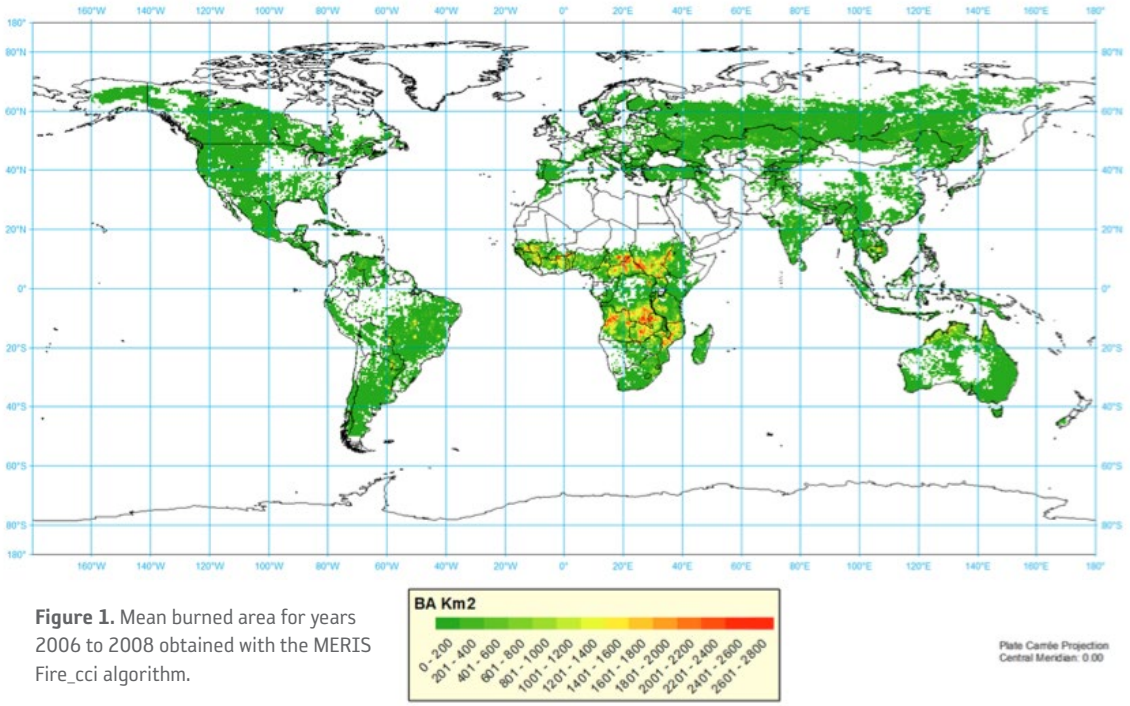

Figure 1. Mean burned area for years 2006 to 2008 obtained with the MERIS Fire_cci algorithm.

In this issue:

Overview of Fire_cci

The Fire_cci project aims to improve the consistency of the global Burned Area (BA) products using better algorithms for both pre-processing and burned area detection while incorporating error characterisation in the products.

The aims of the Fire_cci project are threefold.

- First, the objective is to obtain a product adapted to climate modellers' needs. For this, user requirements have been defined in terms of accuracy, bias, uncertainty, spatial consistency and stability.
- Second, the project aims to develop the methods to generate long and accurate BA time series from several European sensors.
- Finally, the improvements of climate vegetation carbon models with the new BA data are to be tested.

Results of Phase 1 of Fire_cci

During the first phase of the Fire_cci project several critical improvements over existing European Burned Area (BA) products were achieved. First, a detailed user requirement consultation was performed and used to tailor the products that would be obtained within the project. Following these user needs, products were offered in two formats: monthly pixel (300 m resolution) in continental tiles, and 15-day grids (0.5 degree) in global tiles, following international standard file formats (GEOTIFF and NETCDF, respectively).

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The algorithms were developed to obtain BA maps from European Medium Resolution sensors. Three years of global burned area estimates (2006-2008) were produced from MERIS FRS data (Figure 1). In parallel, a complete validation dataset was developed, following the CEOS Cal/Val protocol, together with new validation metrics to assess the accuracy of the Fire_cci BA products as well as other BA collections. Finally, the Climate Research Group evaluated the adequacy of the new BA datasets to model fire emissions and vegetation dynamics.

According to the accuracy assessment, the Fire_cci product was better balanced than existing BA products and showed less underestimation, although further efforts are necessary to improve BA accuracy, particularly in areas with low fire occurrence. Our product was also found to be significantly better than other European BA products. It also revealed a higher detection of smaller fires than previous BA collections.

Product intercomparison between Fire_cci and the Global Fire Emissions Database (GFED) showed similar global spatial and temporal patterns, however differences appeared when looking at regional scale. An example of these differences is shown in Figure 2, where an extreme fire event that took place in Eastern Europe during spring 2006 is represented. The Fire_cci product appears to capture this event more realistically than the standard version of GFED, most likely due to its enhanced ability to detect smaller fires.

The user assessment showed the potential to use this product to estimate GHG fire emissions and dynamic vegetation models (Figure 3).

The results obtained during the first phase of the Fire_cci project were considered promising, especially with the launch of OLCI, the follow up version of MERIS, and SLSTR, an optical and thermal sensor, both on board the Copernicus Sentinel 3.

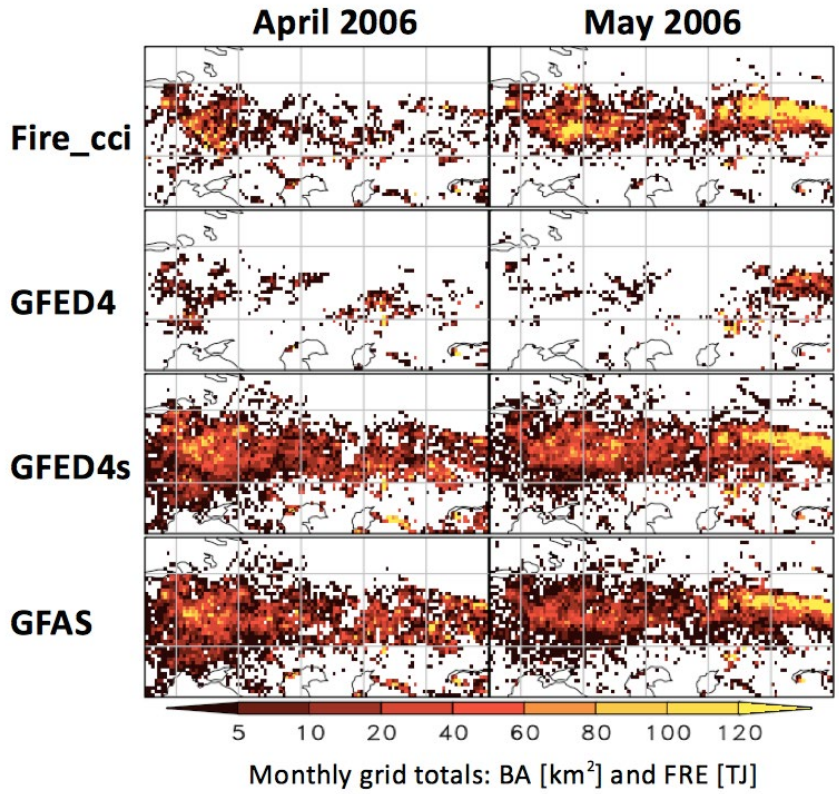

Figure 2: . Burned area in Eastern Europe detected by Fire_cci, GFED4 and GFED4s in April/May 2006. GFAS shows the spatial pattern of fire radiative energy (FRE) estimated from the MODIS active fire product. (Chuvieco et al. 2016).

Activities of Phase 2 of Fire_cci

In the second phase of the project major objectives are the processing of longer time series in order to obtain the needed data for climate studies and the generation of a small-fire database for the African continent, together with continuous improvement and development on the existing BA retrieval methods and climate assessment of the BA products.

The second phase of Fire_cci started in September 2015. Currently, the full MERIS archive (2002-2012) is being processed with the newest version of the algorithm.

The improvements made for this release will increase the number of perimeters detected compared to the previous version, as well as reducing omission errors. In parallel, the developed algorithms are being adapted to other sensors such as PROBA-V, OLCI and MODIS. Improvements on the uncertainty characterization and validation are also foreseen. The use of new sensors and methodologies will extend the time series (from 2000 to 2017) and improve the current results. This time series is of great interest for the users of the Fire_cci data.

Climate and vegetation modellers involved in the team will be testing the new products and extending their analysis for longer time series.

In addition, for the first time worldwide, a small fire database of a large continent (Africa) will be obtained based on Sentinel-2 MSI data.

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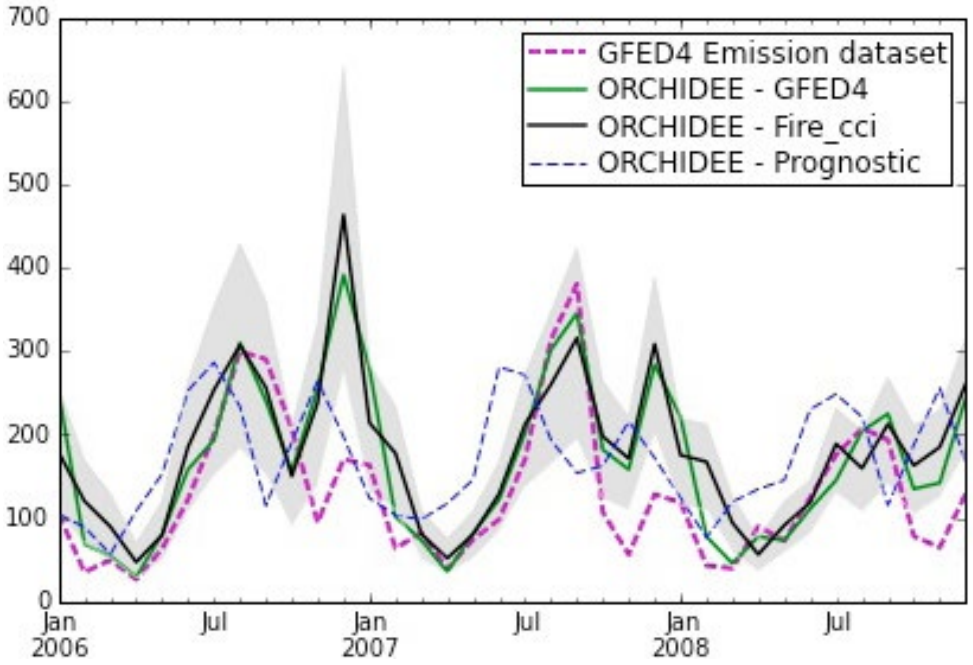

Figure 3: Global monthly fire emissions of carbon estimated with the ORCHIDEE global vegetation model using Fire_cci data from the first phase, compared to GFED 4 data (Chuvieco et al. 2016). Use of Fire_cci data in global vegetation and climate models is planned to be extended in the second phase of the project.

Access to data products

The current version of the Fire_cci Burned Area (BA) products is publicly available at www.esa-fire-cci.org

The products include BA pixels at full MERIS resolution with date of detection, confidence level and land cover burned in GeoTIFF format. The Grid products include total BA, standard error, fraction of observed area, number of burned patches and sum of BA for each land cover type, all in NETCDF format.

The products are available for years 2006 to 2008.

Forward look

The work from Phases 1 and 2 of the Fire_cci project implies a huge step forward on the characterization of the fire disturbance ECV. Additional future work on the Fire ECV that's not included in these two phases could build on the tools already established within the CCI and increase its relevance. In the framework of a climate change programme, progress in fire disturbance implies better characterization of the impact fire has in terrestrial and atmospheric domains.

Four major lines of research can be identified:

- Extending the small-fire database foreseen in Phase 2 for Africa to longer periods and to other fire sensitive regions, where deforestation fires are very critical, particularly to SE Asia (with a very important problem with peat fires) and Latin America. This small-fire database would greatly help to reduce current uncertainties in GHG derived from biomass burning. The contribution of small fires (<50 ha), is estimated to be 35% to the total burned area, with particular relevance in tropical regions.

- In terms of estimating emissions from fires, the generation of combustion completeness is of major relevance, as currently the amount of biomass consumed by the fire is estimated indirectly. In addition, a fire severity product would also help relevant ecological topics such as recovery, ecosystem resilience, land use changes, and post –management strategies.

- Further exploitation of European satellite capabilities: integration of the products developed with geostationary and polar-orbiting satellites would have a great impact on the way the different stages of a fire are characterised. Different quantities of gases and different gases and particles are released during the flaming and smouldering fire phases. Use of high temporal resolution information coming from geostationary satellites, combined with the existing fire products, will contribute to better characterize the duration of the different stages, therefore decreasing the uncertainty of the emissions estimations.

- Improvement of current dynamic vegetation models with better biomass burning information. Most current models greatly simplify the role of fire in emissions and vegetation regeneration, particularly in the case of deforestation fires. This has implications for the carbon cycle, so work still needs to be done on the use of carbon vegetation and dynamic vegetation models with the new products developed in the Fire_cci.

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Upcoming activities

The project will be represented at the following conferences and meetings:

- The European Geosciences Union (EGU) General Assembly 2016, Vienna (Austria), 17-22 April 2016.
- XXIII International Society for Photogrammetry and Remote Sensing (ISPRS) Congress, Prague (Czech Republic), 12-19 July 2016.
- XVII SELPER International Symposium, Puerto Iguazú (Argentina), 7-11 November 2016.
- ForestSAT 2016, Santiago (Chile), 14-18 November 2016.

Publications and presentations

The Fire_cci project has been presented at several international conferences and dedicated workshops. Key conferences have been the EGU in Vienna, GOFC-GOLD IT in Italy, Russia and the USA, the SELPER in Brazil, the International Forest fire Research Conference in Portugal, ISPRS conferences in Australia and South Africa, the EOGC conference in United Emirates, the EARSeL Fire Workshop in Cyprus and the GEIA Conference in China.

Peer-reviewed publications from the Fire_cci team include:

Alonso-Canas, I., & Chuvieco, E. (2015). Global Burned Area Mapping from ENVISAT-MERIS data, Remote Sensing of Environment, 163, 140-152.

Chuvieco, E., Yue, C., Heil, A., Mouillot, F., Alonso-Canas, I., Padilla, M., Pereira, J.M.C., Oom, D., & Tansey, K. (2016). A new global burned area product for climate assessment of fire impacts. Global Ecology and Biogeography, DOI: 10.1111/geb.12440

Hantson, S., Padilla, M., Corti, D., & Chuvieco, E. (2013). Strengths and weaknesses of MODIS hotspots to characterize global fire occurrence. Remote Sensing of Environment, 131, 152-159.

Mouillot, F., Schultz, M.G., Yue, C., Cadule, P., Tansey, K., Ciais, P., & Chuvieco, E. (2014). Ten years of global burned area products from spaceborne remote sensing—A review: Analysis of user needs and recommendations for future developments. International Journal of Applied Earth Observation and Geoinformation, 26, 64-79.

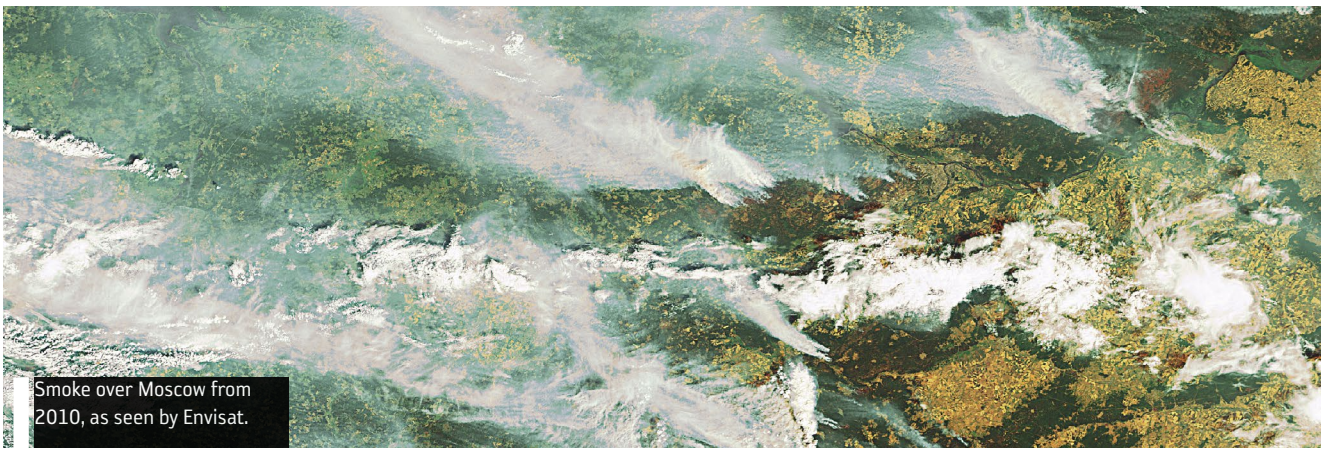
Padilla, M., Stehman, S.V., & Chuvieco, E. (2014a). Validation of the 2008 MODIS-MCD45 global burned area product using stratified random sampling. Remote Sensing of Environment, 144, 187-196.

Padilla, M., Stehman, S.V., Litago, J., & Chuvieco, E. (2014b). Assessing the Temporal Stability of the Accuracy of a Time Series of Burned Area Products. Remote Sensing, 6, 2050-2068.

Padilla, M., Stehman, S.V., Hantson, S., Oliva, P., Alonso-Canas, I., Bradley, A., Tansey, K., Mota, B., Pereira, J.M., & Chuvieco, E. (2015). Comparing the Accuracies of Remote Sensing Global Burned Area Products using Stratified Random Sampling and Estimation. Remote Sensing of Environment, 160, 114-121.

Yue, C., Ciais, P., Luyssaert, S., Cadule, P., Harden, J., Randerson, J., Bellassen, V., Wang, T., Piao, S. L., Poulter, B., and Viovy, N. (2013): Simulating boreal forest carbon dynamics after stand-replacing fire disturbance: insights from a global process-based vegetation model, Biogeosciences, 10, 8233-8252, doi:10.5194/bg-10-8233-2013,.

Yue, C., Ciais, P., Cadule, P., Thonicke, K., Archibald, S., Poulter, B., Hao, W. M., Hantson, S., Mouillot, F., Friedlingstein, P., Maignan, F., and Viovy, N. (2014): Modelling fires in the terrestrial carbon balance by incorporating SPITFIRE into the global vegetation model ORCHIDEE – Part 1: Simulating historical global burned area and fire regime, Geosci. Model Dev. Discuss., 7, 2377-2427, doi:10.5194/gmdd-7-2377-2014.



Smoke over Moscow from 2010, as seen by Envisat.

www.esa-fire-cci.org

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