INTRODUCTION

Vegetation fires are a major disturbance in the Earth System. Fires change the biophysical properties and dynamics of ecosystems and alter terrestrial carbon pools. Fire emissions affect the chemical composition and dynamics of the atmosphere and exert a significant climate forcing. To realistically simulate past and future changes of the Earth System, comprehensive models must take into account fire disturbances. The development and evaluation of process-based fire models requires consistent burned area observations covering at least 10 to 20 years, complemented by a set of ancillary information such as uncertainty, number of burn patches and land cover burn. Guided by the specific requirements of atmospheric and vegetation modellers, a new burned area product was developed, produced and evaluated during the first phase of the ESA Fire_cci project. It is now being extended during the second phase.

PRODUCT GENERATION

A new algorithm was developed combining temporal changes of MERIS near-infrared reflectances with MODIS active fire detections. More than 6000 MERIS full resolution images covering 2006 to 2008 were processed with this algorithm, amounting to more than 30 Tb of data. Two Fire_cci product types are generated to best meet the requirements of the user community: Pixel: monthly continental GeoTIFF files with ~300 m spatial resolution and pixel level information on the date of burning, confidence of burn detection, and the land cover burned. Fire_cci half-monthly netCDF files with 0.5 degree spatial resolution and grid level information on the area burned, the standard error of the burned area estimation, the observed area fraction, the number of burn patches, and the burned area by land class.

PRODUCT INTERCOMPARISON

Gridded Fire_cci burned area was compared with MODIS burned area used in the Global Fire Emissions Database (GFED). The GFED burned area and fire emission inventory is most widely used in global biogeochemical and atmospheric model studies.

Simulations with the ORCHIDEE model forced with the Fire_cci data yield comparable emissions to those of the GFED4 estimation (Fig. 6, Tab. 1), indicating that the Fire_cci product is well suited for modelling fire emissions and related downstream studies of climatic effects.

PRODUCT VALIDATION

Validation of the Fire_cci product was derived from multi-temporal pairs of Landsat images, following CEOS Cal-Val guidelines [1]. Reference fire perimeters were derived from a semi-automatic algorithm, and revised visually by two interpreters. At global scale, reference data were generated for the year 2008 from a stratified random sample of 105 sites. The temporal stability of the product was examined on five study sites where reference fire perimeters were generated annually for 2005 to 2009 [2].

The analysis revealed a very high overall accuracy (> 99%), but a modest accuracy of the burned category (DC = 29%) (Fig. 1). Comparison with MODIS burned area products (MCD45 and MCD64) showed that Fire_cci results have similar overall accuracy, but with higher commission and omission errors [2]. An overall trend towards underestimation was found (35%). The temporal stability assessment did not show any significant trends in accuracy levels (Fig. 2).

PRODUCT ASSESSMENT BY CLIMATE USERS

Fire patch analysis was carried out using burned area information from the Fire_cci pixel product. Burned patches were analysed in terms of patch size, elongation, orientation and/or omission errors [2]. An overall trend towards underestimation was found (35%). The temporal stability of the product was examined on five study sites where reference fire perimeters were generated annually for 2005 to 2009 [2].

Spatial distribution of fire patch indices across the globe indicated no major abrupt spatial bias in the Fire_cci pixel product. More elongated fire shapes were more frequent for larger fires in Northern latitudes, where fire prevention is more important and large fires only occur under extreme windy conditions. The patch metrics derived from the Fire_cci pixel product were in agreement with similar metrics produced by national forest services (Fig. 5).

Simulations with the ORCHIDEE model forced with the Fire_cci data yield comparable emissions to those of the GFED4 estimation (Fig. 6, Tab. 1), indicating that the Fire_cci product is well suited for modelling fire emissions and related downstream studies of climatic effects.

PHASE 1 ACHIEVEMENTS SUMMARY

- The first global burned area product based on Envisat-MERIS has been generated.
- Product validation with Landsat showed very high overall accuracy and temporal stability.
- Compared with MODIS-based burned area, the product showed high agreement in global spatial and temporal patterns, but a higher ability to detect small fires.
- Product assessment by climate users showed the usefulness of the product for calibrating fire models and fire emission studies.
- The Fire_cci product covering the years 2006 to 2008 can be freely downloaded from the fire_cci project web page at http://www.esa-fire-cci.org.

PLANS FOR PHASE 2 (Sep 2015 – Sep 2018)

- Processing the Fire_cci product over the full temporal coverage of MERIS (2002-2012).
- Extend the temporal coverage of the product using the best combination of satellite sensors. Particular attention will be paid to the integration of the data from the upcoming Sentinel series.
- Establish a small fire database using Landsat and Sentinel information.
- Full uncertainty characterisation of BA estimates at pixel level.
- Assessments of added value gained from using the products in various climate applications.

Please fill in the user questionnaire at http://www.esa-fire-cci.org to help us make the new products useful for you, too! 

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Most figures are created from a synthetic paper manuscript describing the Fire_cci project and products (Oliveira et al., submitted to Global Ecology and Biogeography in October 2013).


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