GLOBAL SCALE INVENTORY OF THE AREA BURNT IN THE YEAR 2000 THE GBA2000 DATASET

Over large regions of the globe, emissions from biomass burning are known to contribute significantly to the injection of pollutants into the atmosphere. Greenhouse gases and carbonaceous aerosols, emitted by the vegetation fires, impact on the radiation balance at the surface, on the acidification of precipitation, on air quality and human health. Vegetation fires act also as a direct disturbance to the terrestrial ecosystems, which play a role as sources or sinks of carbon at local, regional and global scales. For instance, biomass burning contributes up to 40%, 16% and 43% of the total emissions of anthropogenic origin for carbon dioxide, methane and carbon monoxide respectively [1]. Last but not least, vegetation fires are closely related to some of the degradation processes, which affect the terrestrial resources in certain global ecosystems.

Scientific communities addressing issues ranging from emissions from biomass burning to the interactions between vegetation fires and land cover - land use practices are requesting quantitative estimates of biomass burnt at a global scale. Previous work [2] have clearly demonstrated that satellite remote sensing is an efficient way, if not the only one, for the detection of fire occurrence over a range of temporal and spatial scales which allow a satisfactory characterization of seasonal and inter-annual patterns of fire activity (for example see, http://shark1.esrin.esa.it at ESA ESRIN). However, these fire inventories do not provide a means to quantify the area burnt and, consequently, the amount of biomass burnt in a specific region or vegetation type for a given period of time. Attempts have been made to quantify burnt areas at a continental scale [3], but only until recently, have products been available at a global scale and at a resolution of 1km (e.g. ESA GLOBSCAR product, see http://shark1.esrin.esa.it/ionia/FIRE/BS/ATSR/ for further information).

It is in this context that the European Commission Joint Research Centre (JRC) took the initiative to perform an inventory of the area burnt for the main vegetation cover types, during one year, over the entire globe. Started in January 2001, the Global Burnt Area 2000 (GBA2000) initiative [4] was carried through in partnership with nine research institutions from both European (Italy, Portugal, Russia, United Kingdom) and non-European countries (Australia, Canada). It involves also a direct cooperation with the United Nations Environmental Programme (UNEP) for the dissemination of the products to the user community.

A data set of 14 months of daily global imagery acquired by the VEGETATION (VGT) instrument, onboard the SPOT-4 satellite, was assembled in the context of the Millennium Ecosystem Assessment (MEA) operation. The acquisitions started on October 20th, 1999 and ended on December 31st 2000. The VGT-S1 product has been selected for this operation. It is composed of daily images that are calibrated, geo-referenced and corrected for atmospheric effects to surface reflectance in four spectral wavelengths (blue, red, near-infrared and short wave infrared), with a pixel size of approximately 1 km, and a multi-temporal registration accuracy better than 0.5 km.

The GBA2000 strategy uses a network approach for the development and testing of a series of regional algorithms for processing the daily VGT-S1 imagery into burnt area maps. This approach was adopted because the methods required to detect a burnt area differed from one ecosystem or climatic zone to another (e.g. boreal forest, tropical forest, grasslands). The JRC provided to each partner of the project a temporal and spatial subset of data from the global VGT S1 product that corresponded to their specific region of interest and expertise. Nine regional algorithms were developed by the GBA2000 partners [5-10]. Following a series of tests made over some experimental sites representative of the main land cover types of the globe, seven algorithms were selected for processing the entire year 2000 dataset and integrated into a global processing chain developed by the JRC [11].

The final version of the global burnt area map was completed in December 2002 and made accessible to the user community via the Internet http://www.gvm.jrc.it/fire/gba2000/index.htm, and through the UNEP-GRID web site at http://www.grid.unep.ch/activities/earlywarning/preview/ims/gba/. Please consult the GBA2000 websites for the latest information.

In its current version the GBA2000 dataset comprises three types of products:

- Non-accumulative, monthly maps and one annual synthesis (i.e. total burnt area in the year 2000) at a minimum mapping resolution of 1km^2 (= 100 hectares).
- Statistical datasets, such as the area burnt per type of vegetation cover and for geographical entities of particular interests (e.g. countries, protected areas)
- Statistical datasets that can better fulfill the requirements of the user communities, in particular the modelling community (e.g. extent of the area burnt, per type of vegetation cover, in 0.5^o and 1^o grids at global level).

Currently, the reference for the information layer used to derive statistical data of burnt areas per vegetation cover type is the University of Maryland Global Land Cover Product (http://www.geog.umd.edu/landcover/1km-map.html). The final GBA2000 product will include statistics based on both the University of Maryland land cover map and on the Global Land Cover 2000 (GLC2000) map under development JRC (http://www.gvm.jrc.it/glc2000/defaultGLC2000.htm).

Two examples of products derived from the GBA2000 dataset are presented. Figure 1 shows the seasonal distribution of burnt areas in the year 2000 at global scale. Burning activity is observed in Northern and Southern Hemisphere Africa at times corresponding to the dry season. This is also true for northern Australia, South America, Mexico and the Indian sub-continent. Biomass burning is detected in Russia during two seasons. Burning activity in April and May occur mainly in agricultural regions, whereas burning in June, July and August are mainly in forested or woodland areas. In North America, burning mainly occurs during Northern Hemisphere summer months. Figure 2 shows the percentage of the area within each one-half degree cell that has burnt in the year 2000 (including land, marine and inland waters). This map

highlights the regions where intense burning of vegetation occurs (e.g. northern and southern tropical Africa, northern Australia, Russia – Kazakhstan border) and regions where the burning density is lower (e.g. Europe, India, Mexico).

Validation of global products, such as GBA2000, is an important but inherently difficult task. This is because the methods available to undertake this task are not clearly defined and resources that go far beyond the limited network of the GBA2000 partners are required. However, the GBA2000 partners have agreed upon a common methodology to assess the accuracy of the final burnt area products, both in the training of the algorithms and in the evaluation of the burnt area maps. An initial visual inspection indicates any large-scale problems in the algorithm's ability to not detect or to over detect burnt areas. A second assessment evaluates quantitatively the performances of each regional algorithm by comparing the GBA2000 product with a supervised classification of burnt areas derived from Landsat TM data. Regression analysis is used to compare the proportion of burnt and not burnt areas in a 15 by 15 km grid randomly distributed within the area common to both sets of satellite sensor imagery. A third assessment that is to be implemented shortly is to evaluate the regional accuracy of the GBA2000 product in regions where a burnt area algorithm has been applied without any previous algorithm testing or development made over that particular region. Estimates of the regional accuracy of the global product will be made using Landsat TM data not used in previous validation exercises.

Future perspectives include a comparison of the GBA2000 maps with the GLOBSCAR product developed by ESA-ESRIN and the extension of the GBA analysis to one or two more years of SPOT-VGT data.

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Figure 1. Seasonal patterns of the distribution of burnt areas in the year 2000.

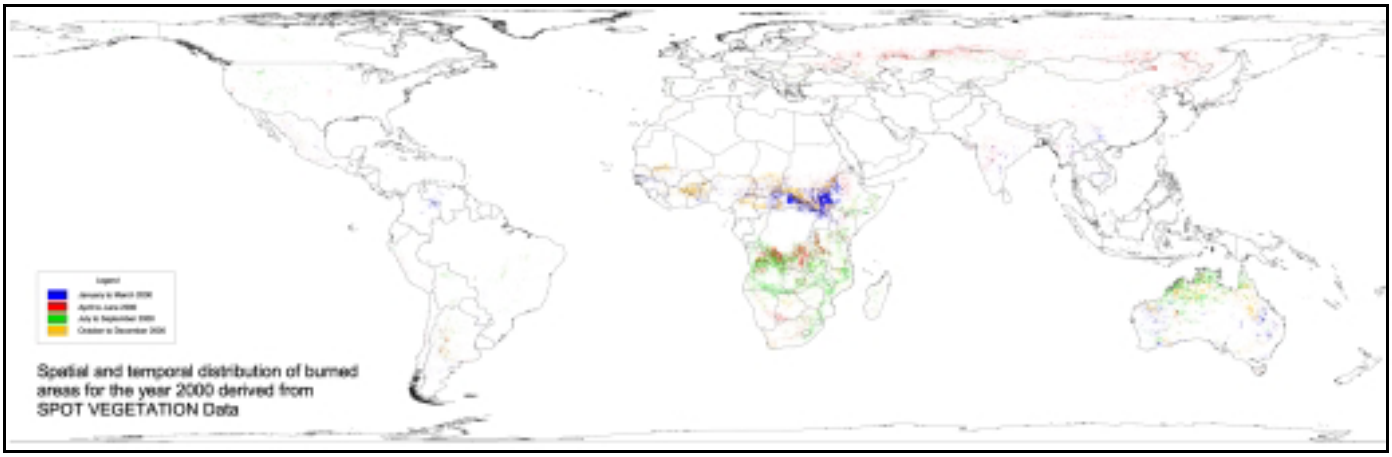
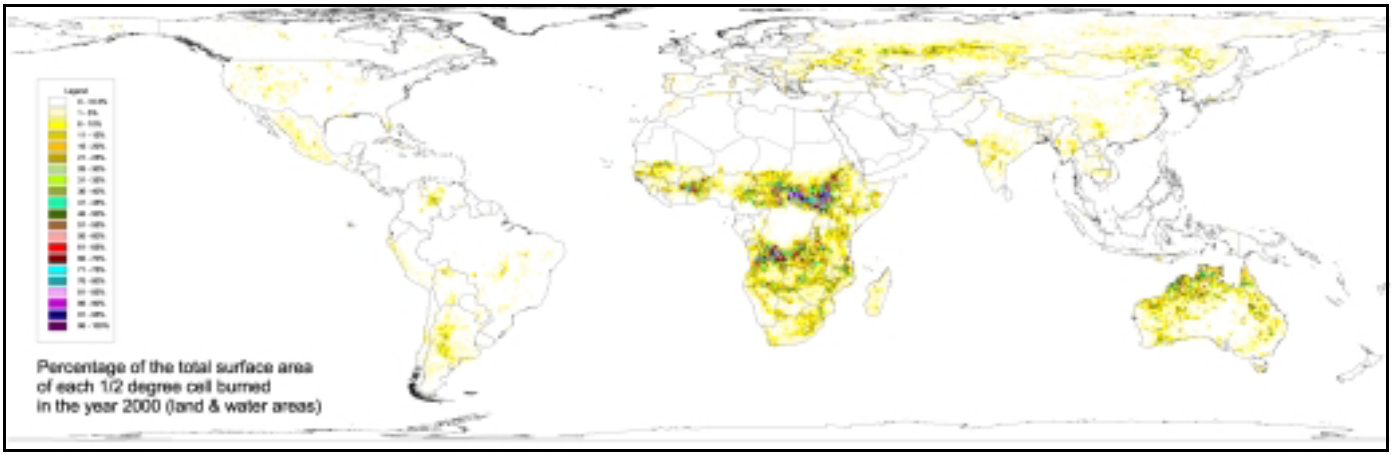


Figure 2. Burnt area density for each 1/2^o grid cell in the year 2000.



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