1997 AND 1998 WORLD ATSR FIRE ATLAS USING ERS-2 ATSR-2 DATA

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ABSTRACT

Data from the ERS-2 ATSR-2 instrument have been used to derive a world fire atlas for the year 1997 and 1998. The IGBP-DIS is currently co-ordinating the validation of this product. 36 scientists are taking part in the validation process over several representative areas of the world. This first data set once validated will be extended to the whole ATSR-2 data set from 1995 to now.

Keywords: ATSR, fire

INTRODUCTION

A long-term and frequently updated fire atlas is needed for land use, forestry, atmospheric chemistry, global climate, fire management studies and applications. The fire product has been identified by IGBP as an important input for global change analysis as underlined by *Malingreau*, (1990) and *Andreae et al.*, (1990). According to *Malingreau*, (1990) and *Hao and Liu*, (1994), the only solution for a rapid and efficient survey of biomass burning is the use of permanent operational satellite.

ATSR-2 INSTRUMENT CHARACTERISTICS

The Along Track Scanning Radiometer (ATSR) flying on-board ERS-2 has four visible and mid-infrared channels centred at 0.55, 0.67, 0.87 and 1.6 micrometers and three thermal-infrared channels centred at 3.7, 11.0 and 12.0 micrometers (Figure 1).

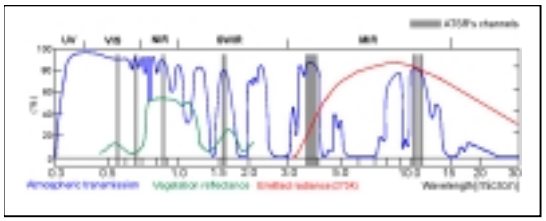


Figure 1.

It has been designed to produce a double view (forward view at 55 degree of the nadir) of the same surface at 1 kilometres resolution. The swath of 512 kilometres allows a revisiting period of 3 days at equator. The satellite cycle is 35 days.

FIRE ATLAS

Algorithm

ATSR data are well suited to identify hot spots on the earth surface (derived from *Dozier*, 1981). As seen in Figure 2 ATSR 3.7 channel is very sensitive to radiation emitted at temperature ranging from 500K to 1000K.

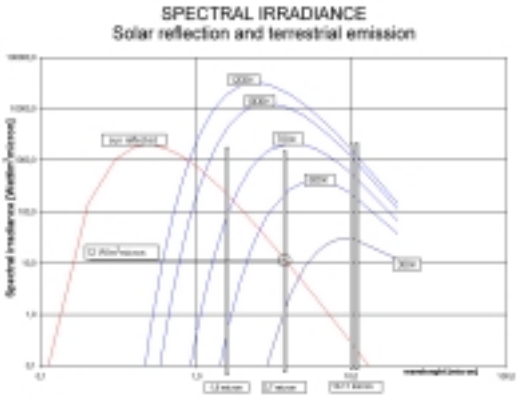


Figure 2.

Therefore, considering the absence of artefact due to the solar reflection during night time, the detection capabilities of ATSR can be estimated as follows: range from 0.1 ha at 600K, to 0.01 ha at 800K with a background temperature of 300K (Figure 3).

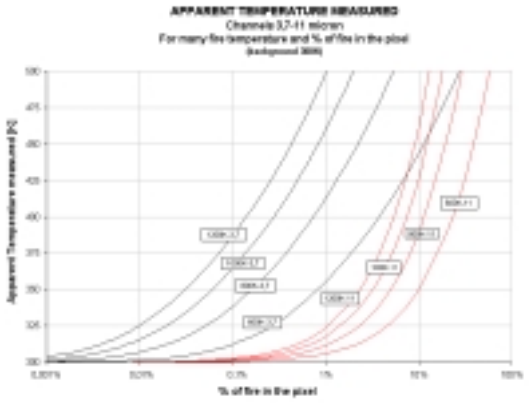


Figure 3.

The very good calibration of ATSR-2 Level 1B data (*Mason*, 1991, RAL, 1995, *Mutlow et al*., 1995) is achieved by the use of low noise infrared detectors, cooled to near-optimum temperature by a Stirling cycle mechanical cooler and by the continuous on-board radiometric calibration of the infrared channel against 2 blackbody targets. The stability of ERS-2 orbit along with the good orbit prediction algorithm ensure a precise geo-location (*Dow and al*., 1996).

Three algorithms are implemented (using night time data only):

- Algorithm 1: 3.7 microns > 312 K. (ATSR-2 saturation).
- Algorithm 2: 3.7 microns > 308 K.
- Algorithm 3: 3.7 - 11.0 > 10K and 11.0 > 283K.

These three algorithms use only the 3.7 and 11.0 microns channels, but 1.6 and 12.0 microns channels are also available in the ATSR Level 1B night data and can be use for future algorithm development (*Striker et al*., 1995).

Processing Facility

To create this 1997 fire atlas, more than 70000 ATSR-2 Level 1B products have been generated from Level 0 data. Each Level 1B product generated is systematically archived and can be retrieved to regenerate fire products with new algorithms. For this purpose, the processing facility has been designed to allow the generation of fire products from both ATSR-2 Level 0 data and ATSR-2 Level 1B data.

Product Description

The fire product gives for each hot spot detected, the following information:

- Date
- Time
- Precise location in Latitude/longitude

The frame-based products are merged on a monthly basis.

RESULTS

The three algorithms give the following results:

- Algorithm 1: (ATSR Saturation) gives good results. The hot spots distribution is coherent with the one obtained with AVHRR, DMSP and GOES data.
- Algorithm 2: (lowering of the threshold to 308 K) does not introduce a lot of obvious false alarms. Some false alarms (large area burning) occur on warm background surface (desert area). This algorithm will be improved using the 11.0 and 1.6 micrometers bands.
- Algorithm 3: Produces a lot of false alarms on water areas and need to be improved.

The fire distribution can be summarised as follow:

- Permanent hot spots over ocean and desert area. Most of them are gas flares (Gulf of Mexico, Gulf of Guinea, North Sea, Persian Gulf, Iran/Iraq, Algeria/Libya, Russia...).
- Exceptional fire event in Indonesia (August/ November 1997).
- Savannah seasonal fires. Southern hemisphere (June-October), Northern hemisphere (November-May).
- Other seasonal fires (Europe, Russia, southern Asia).

The user of the fire product should be aware of the algorithm limitations (e.g. coverage, cloud presence, atmospheric effects, bi-directionality of emissivity, fire temperature versus extension, background temperature...).

Figure 4 shows the ATSR-2 daily ascending coverage (night time).

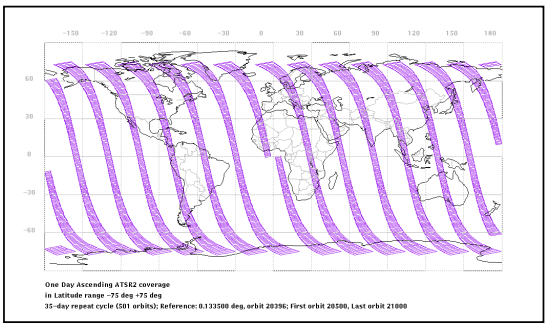
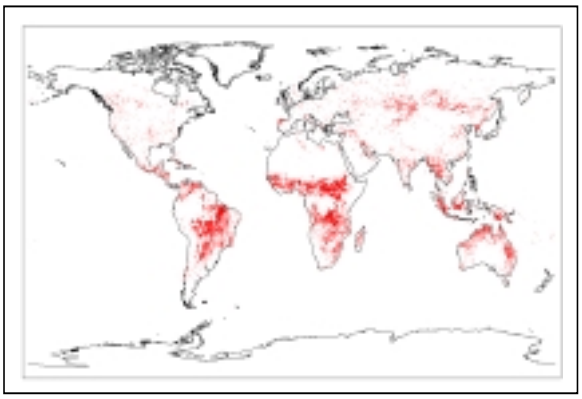


Figure 4.



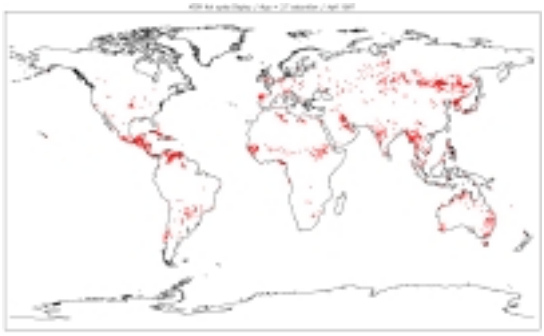
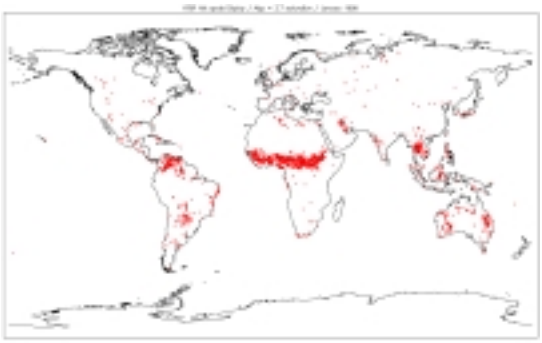


Figure 5. 1997 ATSR World Fire Atlas.



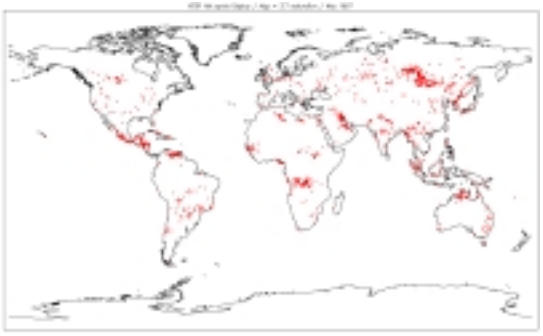
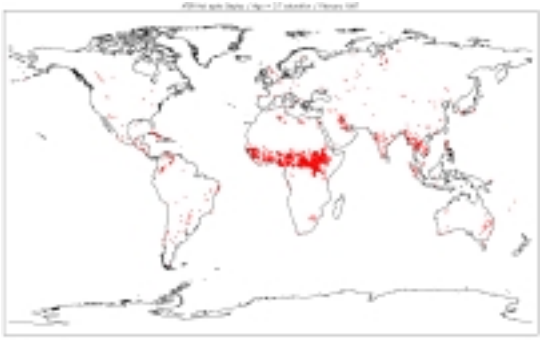
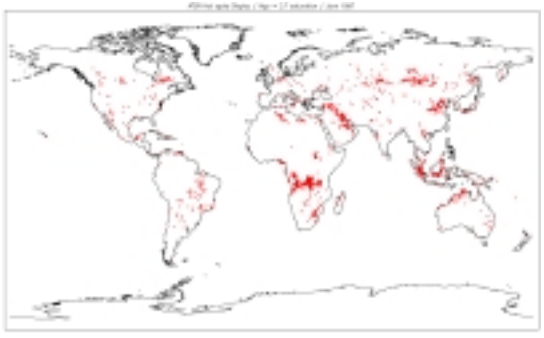
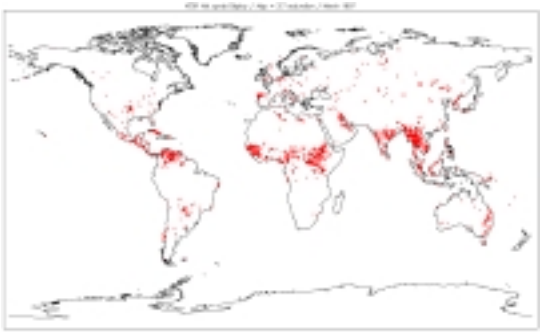
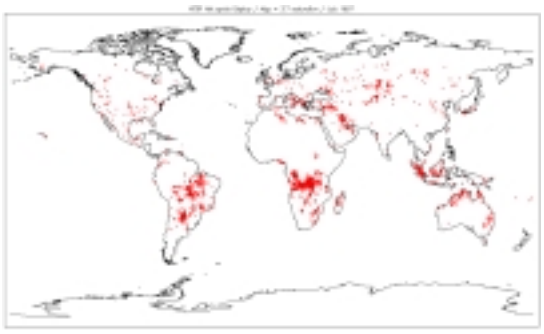


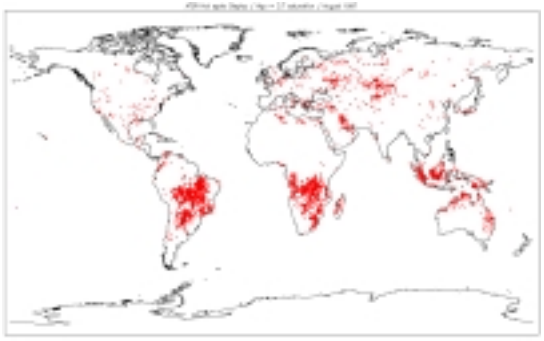
Figure 6. ATSR World Fire Atlas, Monthly Products (The one above and the next 11).

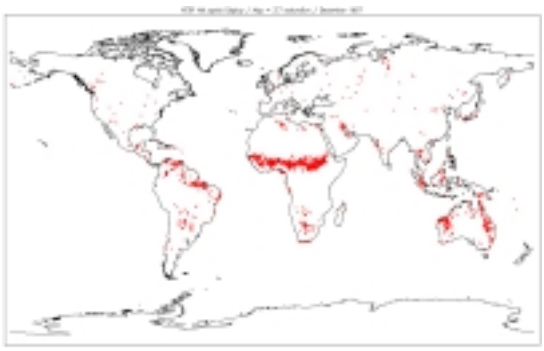


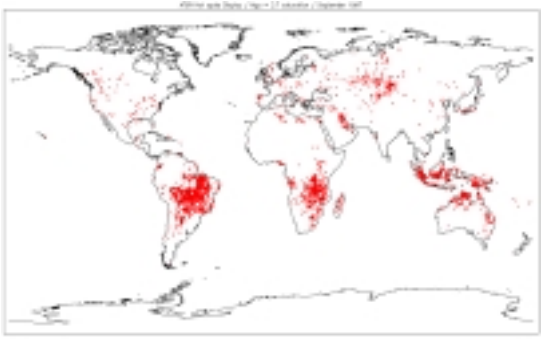


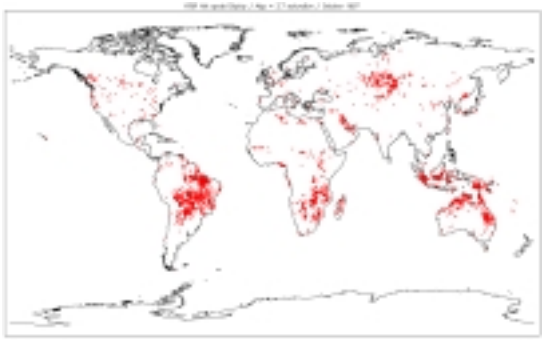


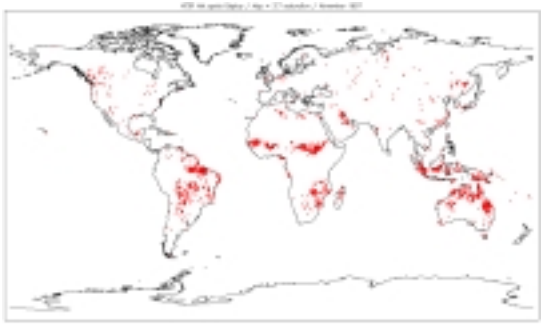












Months	Frames	Hot spots (Algo 1)	Hot spots (Algo 2)
January	6733	5088	8506
February	5907	4196	7363
March	6832	4273	7723
April	6260	4353	7051
May	5575	4657	8671
June	4813	4897	8901
July	5180	6034	13513
August	6025	13410	22479
September	6513	17403	29136
October	6560	16129	26394
November	6673	7816	13379
december	6908	6363	11811
Total	**73979**	**94619**	**164929**

Table 1.

Figure 5, 6 and table 1 show the 1997 fire distribution bounded at the 75 latitude in the Northern Hemisphere. All daytime ascending frames have been discarded from the processing.

Figures 7a and 7b show the pattern similarity across years, for January 1997/1998 and June 1997/1998.

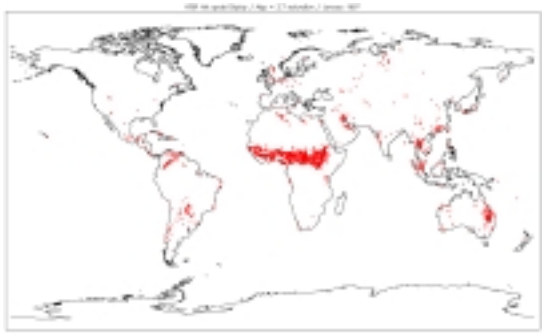
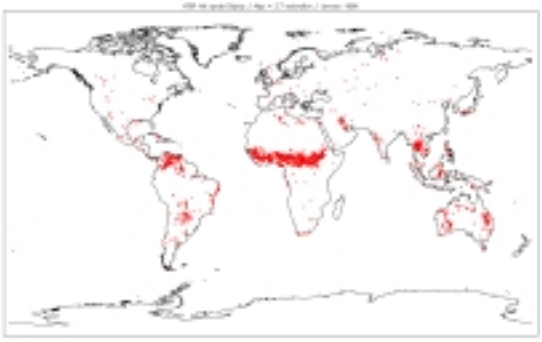


Figure 7a. Cross year comparison. Graphic above and the following one. (January 1997- January 1998).



Please note that for June the processing stop at 60 degrees north in June 1997 and 75 degrees north in June 1998. This explains why no hot spots are detected in Siberia in 1997.

Our results are consistent with those of Cahoon et al., (1992) and Arino and Melinotte, (1997). Feedback from the forestry, (Calvin, 1997) and the atmospheric

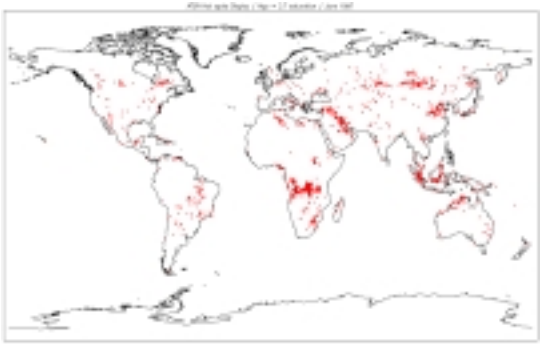
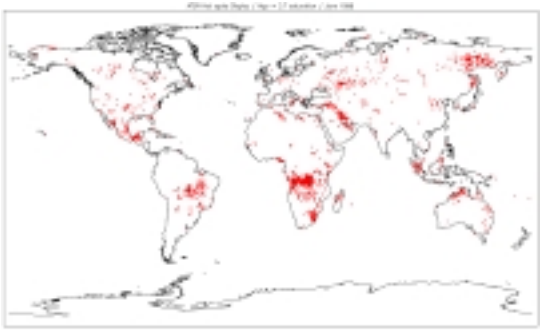


Figure 7b. Cross year comparison. Graphic above and the following one. (June 1997- June 1998).



community, (Jenkins et al., 1997) confirm the interest for their own field of research for that kind of products. The main requests were first to extend the coverage and second to ensure the continuity of the service across the years.

CONCLUSION

The 5 years ATSR global archive provides, thanks to the excellence of the satellite and the instrument, a unique opportunity to derive a global multi-year fire atlas not corrupted by environmental effects. This product will soon be available to the scientific community (As soon as the validation confirms the reliability of the product).

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World ATSR Fire Atlas
Information and access to the ATSR World Fire Atlas can be found at http://shark1.esrin.esa.it