# AVHRR Fire Product User's Guide

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## Abbreviations and Acronyms

AICC – Alaskan Interagency Coordination Center
AVHRR - Advanced Very High Resolution Radiometer
NDVI – Normalized Difference Vegetation Index
NOAA – National Oceanic and Atmospheric Administration
NRC – Natural Resources Canada

## 1.0 Introduction

This user guide provides information on the AVHRR Burned Area and Hotspot products. It is intended to provide the end user with detailed information, including caveats and known problems.

## 2.0 Product Description

The 12-year (1989 – 2000) AVHRR burned area and hotspot products were developed by Pu et al. (2007). The fire products were generated over the fire season (1st May – 31st October) for all years except 1994 when the period analyzed was between 1st May and 13th September. These products were developed using data acquired from two NOAA polar-orbiting satellites (NOAA-11 and NOAA-14) at 1-km resolution. Pu et al., (2007) developed a burned area algorithm using the Hotspot and NDVI Differencing Synergy (HANDS) mapping method (see Fraser et al., 2000 for more details). The algorithm incorporates pre- and post-burn hotspot detections and NDVI fluctuations to confirm the presence of a fire. Regional NDVI thresholds are applied to create burned scar patches. Any burn patches containing less than 5% of the confirmed hotspots are removed – this avoids any erroneous NDVI decreases caused by other factors including cloud cover, harvesting etc.

## 3.0 AVHRR Fire Products

The products are available as annual shapefiles (.shp):

- AVHRR burned area - in hectares (*Area_ha*) and acres (*Area_ac*)
- AVHRR hotspots (*YYYYMMDD* – date mapped)

### 3.1 Burned Area

- Date Range: 1989 – 2000
- Projection: Canada Albers Equal Area
- Naming Convention: YYYY_avhrr_ba.shp

  Where:

  YYYY = year mapped

## 3.2 Hotspots

- Date Range: 1989 – 2000
- Projection: Canada Albers Equal Area
- Naming Convention: YYYY_ avhrr_hs.shp

  Where:

  YYYY = year mapped

# 4.0 Product Assessment

An intercomparison of burned area ($km^2$) between the AVHRR burned area product and fire perimeter data obtained from the Alaskan Interagency Coordination Center (AICC; https://fire.ak.blm.gov/) and the Natural Resources Canada (NRC; https://www.nrcan.gc.ca/) was carried out to assess the performance of the AVHRR burned area algorithm. Yearly comparisons were undertaken between 1989 and 2000 (Figures 1a – 1l).

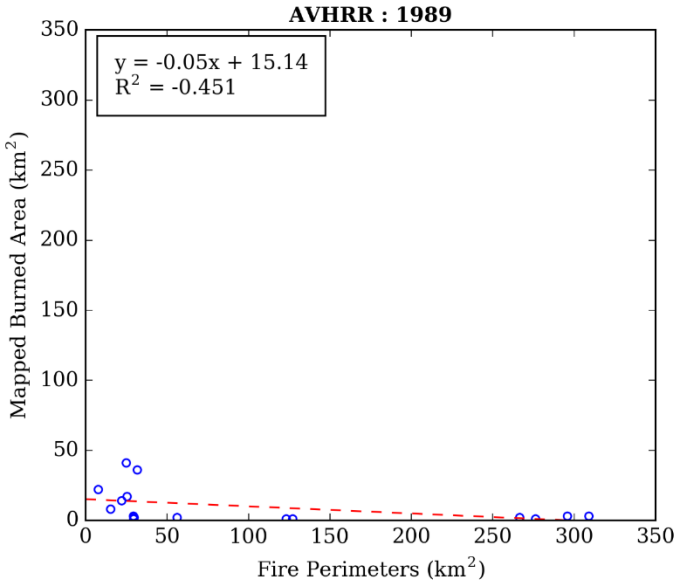


Figure 1a: 1989 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 5854 $km^2$ of cumulative burned area. These values were excluded from the analysis.

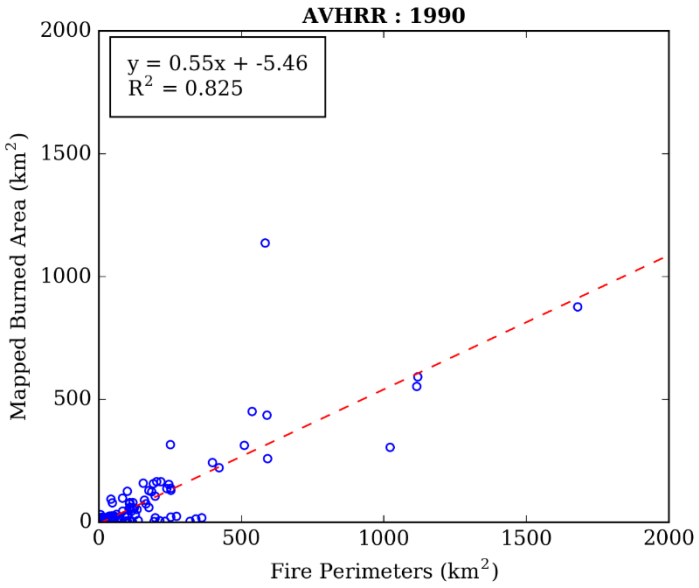


Figure 1b: 1990 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 1317 $km^2$ of cumulative burned area. These values were excluded from the analysis.

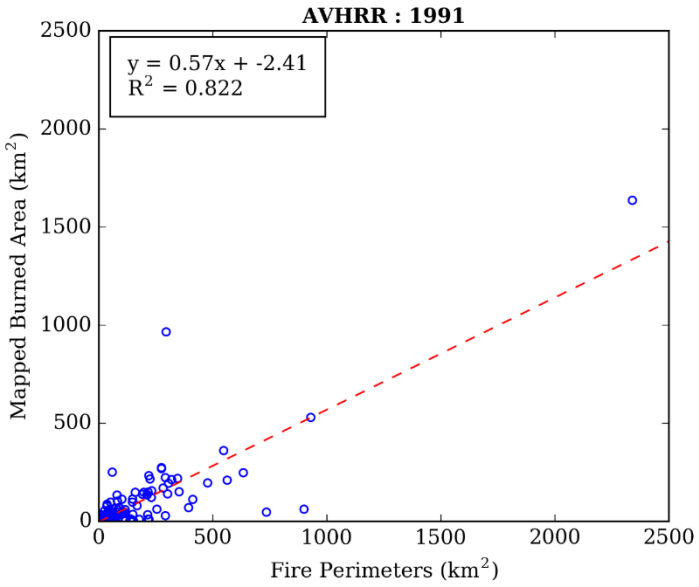


Figure 1c: 1991 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 3297 $km^2$ of cumulative burned area. These values were excluded from the analysis.

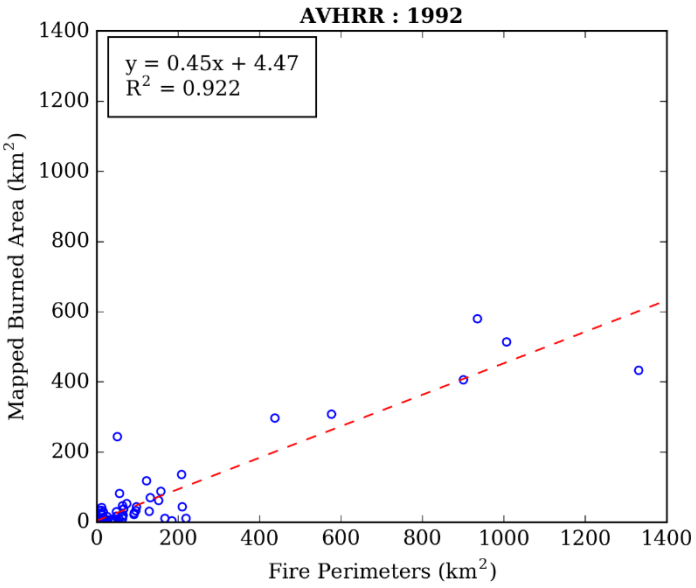


Figure 1d: 1992 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 522 $km^2$ of cumulative burned area. These values were excluded from the analysis.

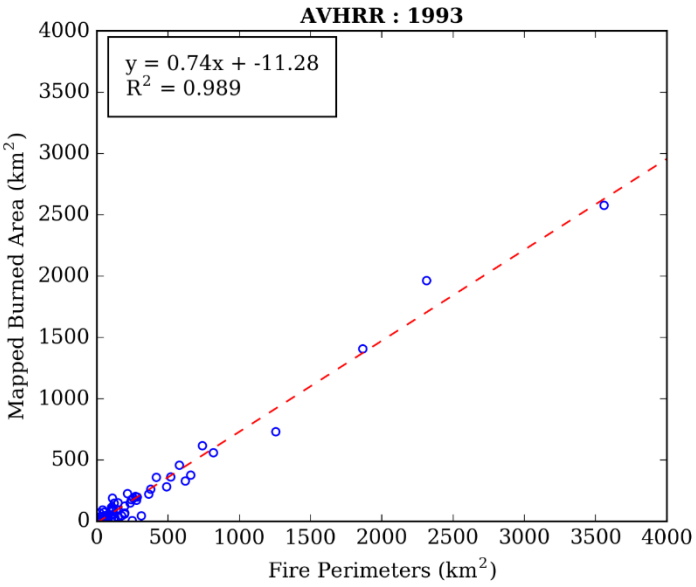


Figure 1e: 1993 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 763 $km^2$ of cumulative burned area. These values were excluded from the analysis.

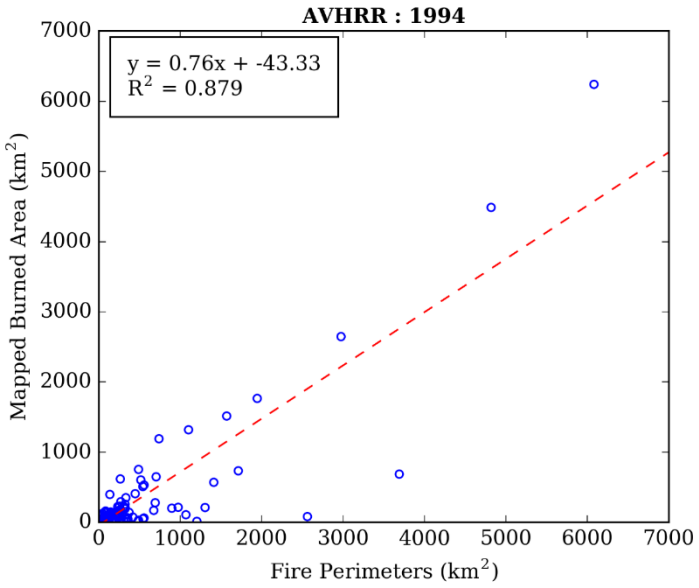


Figure 1f: 1994 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 1038 $km^2$ of cumulative burned area. These values were excluded from the analysis.

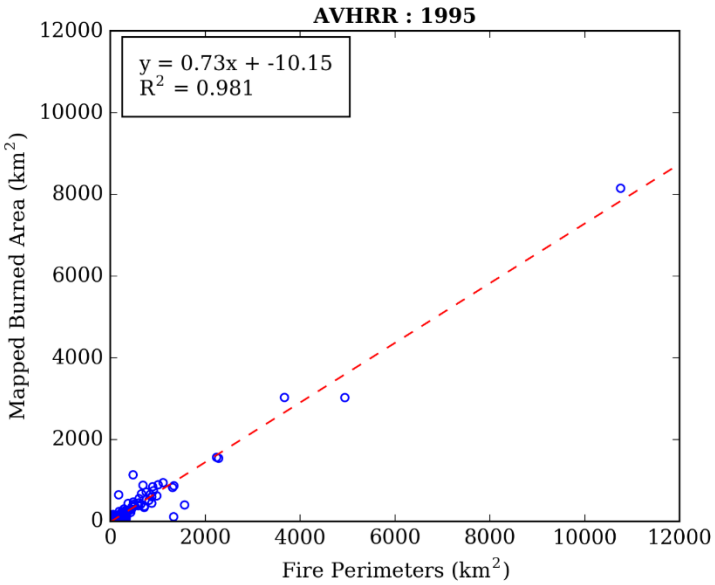


Figure 1g: 1995 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 4241 $km^2$ of cumulative burned area. These values were excluded from the analysis.

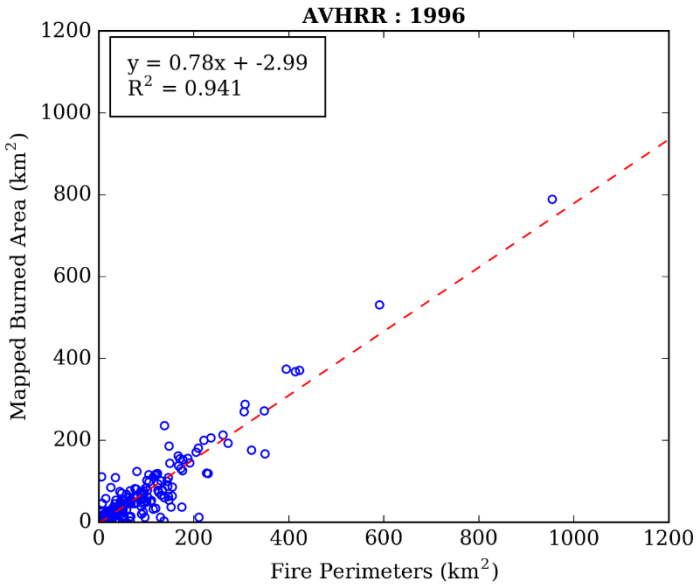


Figure 1h: 1996 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 3484 $km^2$ of cumulative burned area. These values were excluded from the analysis.

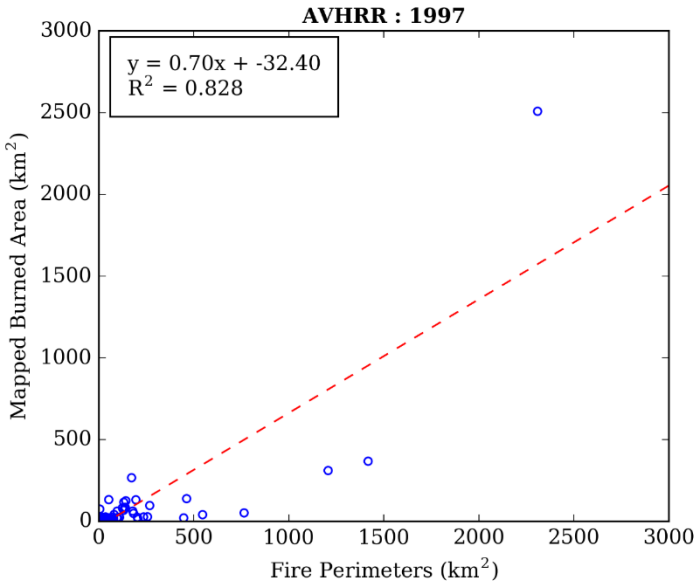


Figure 1i: 1997 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 7598 $km^2$ (includes anomalous striping) of cumulative burned area. These values were excluded from the analysis.

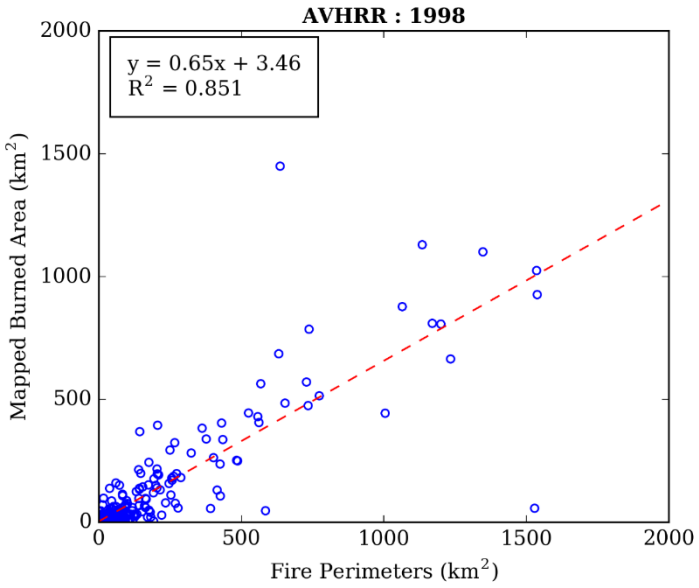


Figure 1j: 1998 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 4516 $km^2$ of cumulative burned area. These values were excluded from the analysis.

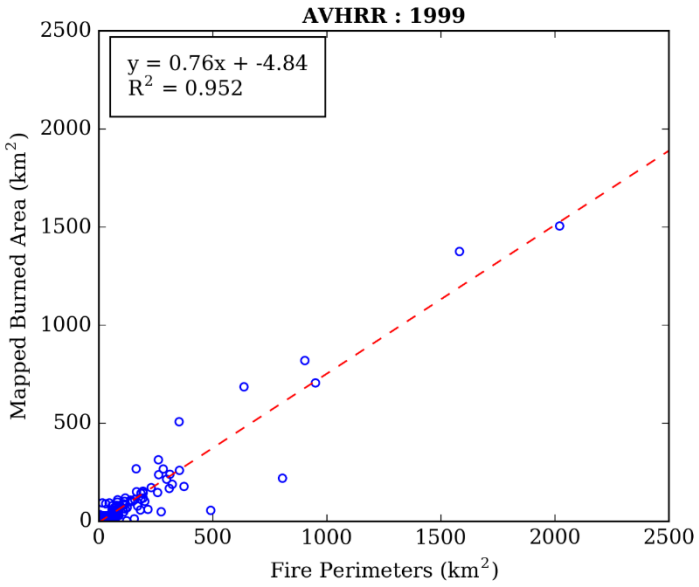


Figure 1k: 1999 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 3810 $km^2$ of cumulative burned area. These values were excluded from the analysis.

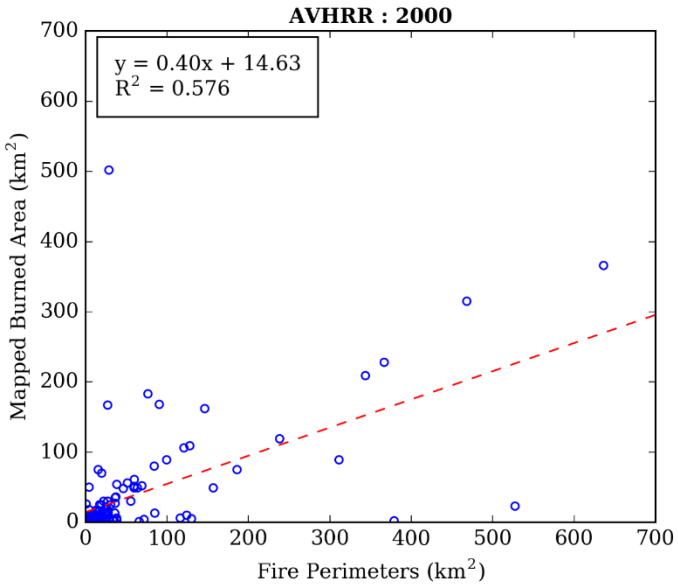


Figure 1l: 2000 burned area ($km^2$) comparison between the fire perimeters from AICC and NRC and the AVHRR burned area product. The AVHRR product mapped an additional 1950 $km^2$ of cumulative burned area. These values were excluded from the analysis.

Overall, the AVHRR burned area product provides a consistently reasonable estimate of area burned over Alaska and Canada both cumulatively (see Table A for results summary) and per individual burn scar with $R^2$ exceeding 0.8 in 10 out of 12 years. Although the AVHRR-based estimate of area burned are consistently lower than that reported by the AICC and NRC, the established statistical relationships allow for developing robust adjustment factors.

Table A: Summary of comparison between the AVHRR burned area product (1989 – 2000) and the AICC and NRC fire perimeter datasets. Small fire years (annual cumulative area < 25,000 $km^2$ are denoted with *) and large fire years (annual cumulative area ≥ 25,000 $km^2$ are denoted with a $^{\beta}$).

| Year | Cumulative Fire Database Area ($km^2$) | Cumulative Fire Database Area ($km^2$): Unmapped by AVHRR | AVHRR $R^2$ (slope) |
|---|---|---|---|
| 1989$^{\beta}$ | 79921 | 78280 | -0.451 (-0.05) |
| 1990* | 21556 | 3086 | 0.825 (0.55) |
| 1991* | 22672 | 3258 | 0.822 (0.57) |
| 1992* | 9677 | 769 | 0.922 (0.45) |
| 1993* | 23597 | 2666 | 0.989 (0.74) |
| 1994$^{\beta}$ | 60997 | 3214 | 0.879 (0.76) |
| 1995$^{\beta}$ | 68197 | 2514 | 0.981 (0.73) |
| 1996* | 20562 | 1248 | 0.941 (0.78) |
| 1997* | 13480 | 1698 | 0.828 (0.70) |
| 1998$^{\beta}$ | 44245 | 2536 | 0.851 (0.65) |
| 1999* | 21302 | 1893 | 0.952 (0.76) |
| 2000* | 8312 | 1195 | 0.576 (0.40) |

## 5.0 Caveats and Known Problems

- 1994 burned area comprises of data from 1st May – 13th September.
- 1997 hotspots and burned area contain anomalous stripes over eastern-central Canada leading to an overestimation in burned area.

## 6.0 References

Fraser, R. H., Li, Z., & Cihlar, J. (2000). Hotspot and NDVI differencing synergy (HANDS): A new technique for burned area mapping over boreal forest. Remote Sensing of Environment, 74(3), 362-376.

Pu, R., Li, Z., Gong, P., Csiszar, I., Fraser, R., Hao, W. M., Kondragunta & Weng, F. (2007). Development and analysis of a 12-year daily 1-km forest fire dataset across North America from NOAA/AVHRR data. Remote sensing of environment, 108(2), 198-208.