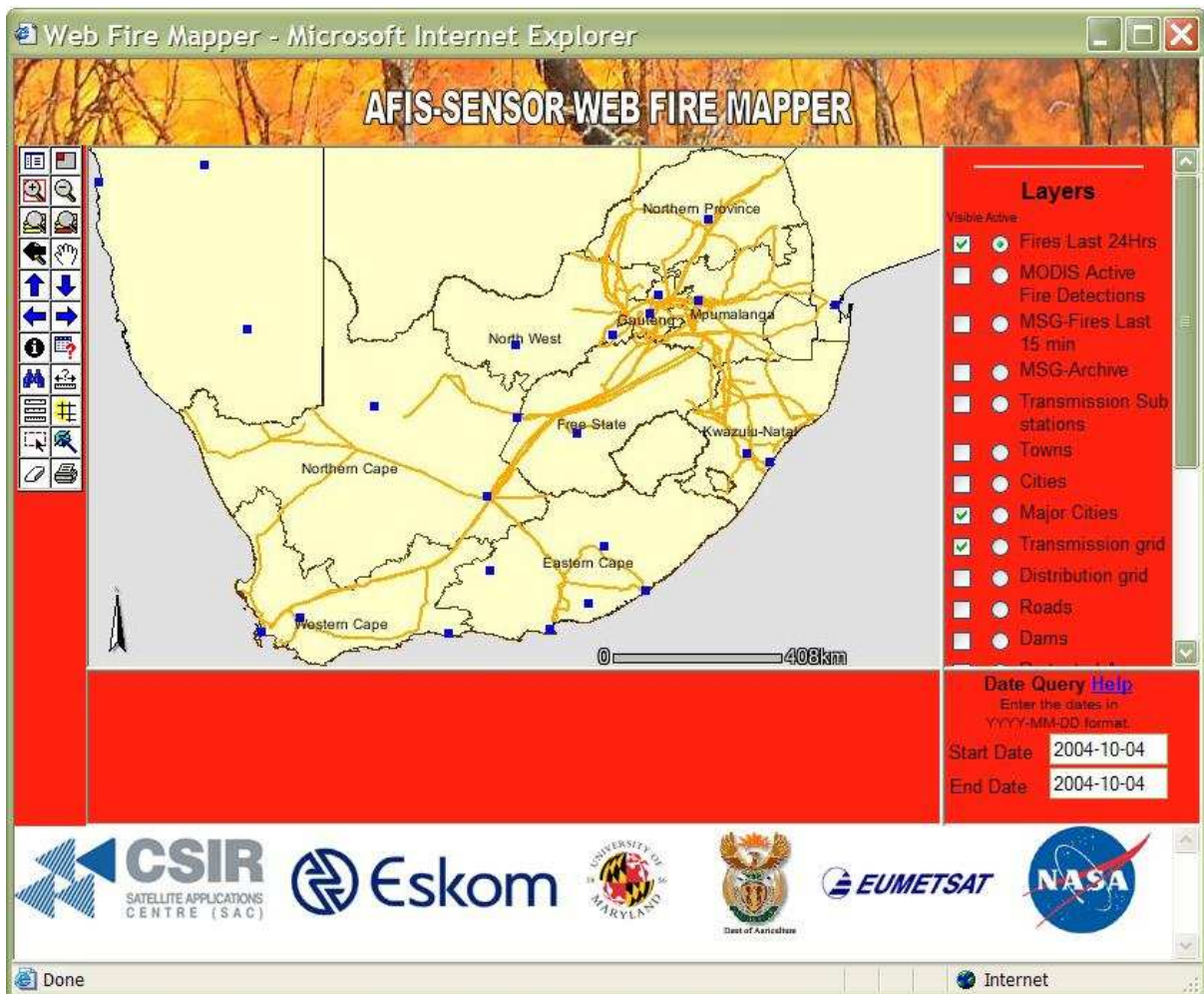


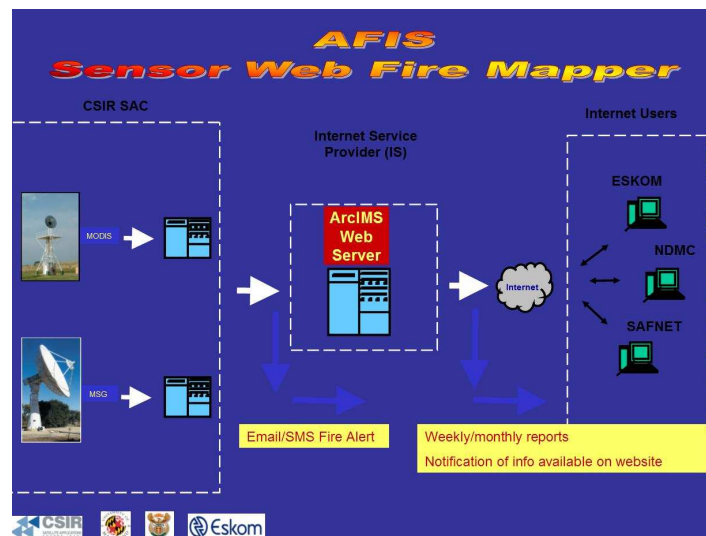
# AFIS User Guide



Produced by the CSIR Satellite Application Centre

## Introduction

The Advanced fire Information System (AFIS) is the first near real time operational satellite fire monitoring system in Southern Africa. The system is based on technology that has been developed at the University of Maryland and NASA over the last few years. Funding for the development, installation and operational running of the system has been made possible through ESKOM, Dept of Agriculture and the CSIR SAC. The CSIR Satellite Application Centre is in the process of customizing and further developing AFIS to enable not only the detection of fires but also the prediction and assessment of fire events in future.



AFIS Flow Diagram

## Frequently Asked Questions

- [What is the AFIS sensor web fire mapper, and at who is it aimed?](#)
- [How often are the active fires updated on AFIS?](#)
- [What size fires can be detected?](#)
- [If I see a fire on AFIS - what does that mean on the ground?](#)
- [Can I get information on burnt areas from Web Fire Maps?](#)
- [How are active fires detected?](#)
- [How do I know if a fire detection was missed due to clouds?](#)
- [What does the confidence value mean?](#)
- [What does scan and track mean?](#)

## What is AFIS, and who is it aimed at?

AFIS is an internet based mapping tool that delivers locations of active fires in near real time. For selected regions and countries you can view an interactive map showing active fires for a specified time period, combined with your choice of GIS layers and satellite imagery.

Each fire detection represents the center of a 1 km pixel flagged as containing one or more actively burning fires within that pixel. The active fires are detected using data from the MODIS (or Moderate Resolution Imaging Spectroradiometer) instrument, on board NASA's Aqua and Terra satellites as well as the Meteosat Second Generation (MSG) geostationary satellite from Eumetsat.

AFIS is primarily aimed at supporting natural resource managers, by helping them understand when and where fires occur. The system can answer the immediate question of where the fire is currently as well look at historical trends and fire frequency.

## How often are the active fires updated on AFIS?

The two MODIS satellites are polar orbiting, moving around the North and South Poles every 98 minutes while the earth is turning from west to east. Terra scans the Southern African region between 10 – 11:30 am while Aqua scans in the afternoons between 14:00 – 15:30 pm. Each satellite also scans the region once at night ( Terra @ 22:00 pm and Aqua @ 03:00 am). AFIS will be updated with MODIS fire locations about 35 minutes after a satellite overpass. Exact overpass times for Terra and Aqua can be found at:

<http://www.ssec.wisc.edu/datacenter/terra/>

Ps: first choose the African continent on the web page before opening a specific days overpass times, the global map is default and will show all passes for the entire world

MSG is a geostationary satellite that scans the African continent every 15 minutes in a south to north direction. MSG fire locations are displayed on AFIS every 15 minutes.

## What size fires can be detected?

In any given scene the minimum detectable fire size is a function of many different variables (satellite overpass time-MODIS, scan angle, biome, sun position, land surface temperature, cloud cover, amount of smoke and wind direction, etc.), so the precise value will vary slightly with these conditions.

MODIS fires

Validation results indicate that in many biomes the minimum flaming (~800-1000K) fire size typically detectable at 50% probability with MODIS is on the order of **100m<sup>2</sup>**. Under ideal conditions performance is somewhat better. Such conditions occur when a fire is observed at (or near) nadir on a fairly homogeneous surface, no other significant fires are nearby, and the scene is free of clouds, heavy smoke and sun glint. In these circumstances the smallest

flaming fire that can be routinely detected (i.e. near 100% probability of detection) is approximately 50 square meters in size.

## MSG fires

MSG is a coarse resolution satellite 36 000 km from earth. Validation of the minimum detectable fire size for MSG in Southern Africa is still research in progress. Validation in the USA on similar satellites have shown detectable sizes in the region of **500m<sup>2</sup>**, but once again scan angles, biome, sun position, land surface temperature, cloud cover, amount of smoke and wind direction will be the final determining factor.

### **If I see a fire on AFIS - what does that mean on the ground?**

A MODIS active fire (red pixels) displayed on AFIS represents a 1km<sup>2</sup> pixel on the ground; the fire "location" is the centre point of that pixel. This does not necessarily mean that the fire is 1km<sup>2</sup> in size (see: [What size fires can be detected?](#)). We are not able to determine the exact fire size, what we do know is that at least one fire is located within that 1km<sup>2</sup> pixel. Sometimes you will see several active fires in a line. This generally represents a fire front.

MSG active fires (purple pixels) displayed on AFIS represents a 1km<sup>2</sup> pixel which forms the centre of a MSG 5 km x 5 km pixel. Unlike MODIS which records images in 1km<sup>2</sup> pixels, MSG records imagery in 5 km<sup>2</sup> pixels. In order to limit confusion, only a 1 km x 1km area is represented by MSG. A fire detected on the ground with MSG should be within a 2km radius of the purple MSG pixel displayed on AFIS depending on the position of the fire within the 5 km x 5 km MSG pixel.

### **Can I get information on burned areas from AFIS?**

Not at the moment, but in the future we plan to include a MODIS 500m burned area product.

### **How are active fires detected?**

Fire detection is performed using a contextual algorithm that exploits the strong emission of mid-infrared radiation from fires.

The MODIS [algorithm](#) examines each pixel of the MODIS swath, and ultimately assigns to each one of the following classes: missing data, cloud, water, non-fire, fire, or unknown. The active fire detections are produced using the same algorithm as the standard MODIS [MOD14](#) fire and thermal anomalies product.

MSG fires are currently detected with a contextual algorithm based on a fixed threshold technique and statistical analysis of each potential fire pixels. Future detections will be based on change detection rather than fixed thresholds which should significantly improve the fire detection accuracy of MSG.

### **How do I know if a fire detection was missed due to cloud?**

An indication of cloud cover is not yet included in AFIS. If you want to know whether the MODIS Rapid Response system may have omitted to detect some fires due to cloud, you can look on the MODIS Rapid Response [Real-Time](#) website. There you can view the MODIS near-real-time level 2 browse images which clearly show cloud at the time of overpass.



## What does the confidence value mean?

A confidence value for each MODIS fire is stored in the attribute information and can be accessed using the Identify tool in AFIS. The confidence value (MODIS only) is based on a collection of intermediate algorithm quantities used in the detection process. The range of confidence is expressed between 0-100 (the values range from 0=very low to 100=very high). The confidence field is experimental and should be used with caution; it is likely that it will vary in meaning in different parts of the world. Nevertheless some of our end users have found such a field to be useful in excluding false positive occurrences of fire.

## What does scan and track mean?

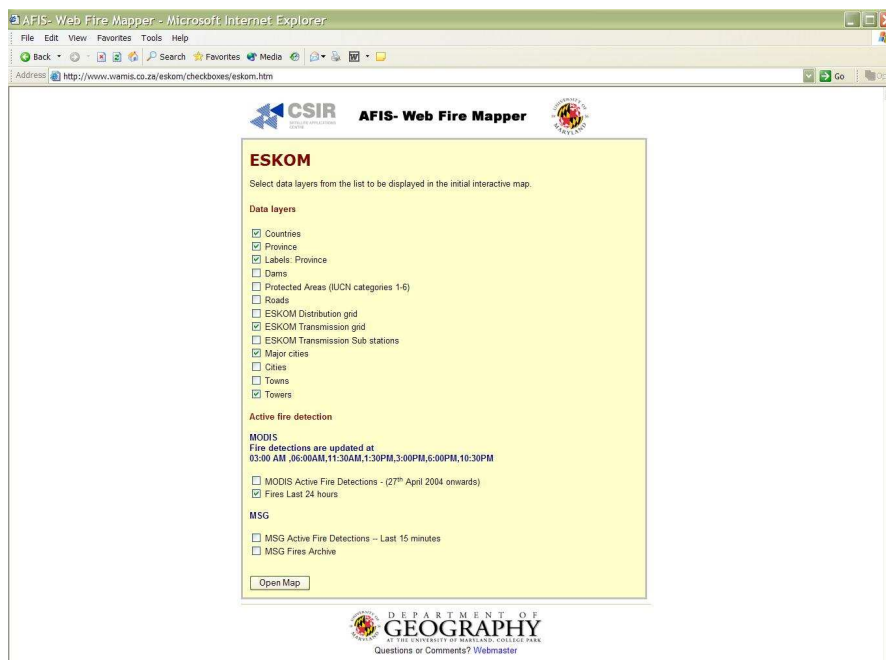
It should be noted that the pixel size of MODIS is not always 1km across the scan track. The pixels at the "Eastern" and the "Western" edges of the scan are bigger than 1km. It is 1km only along the Nadir (exact vertical from the satellite). Thus, the values shown for scan and track represent the actual spatial resolution of the scanned pixel. The scan value represents the spatial-resolution in the East-West direction of the scan and the track value represents the North-South spatial-resolution of the scan.

## • How to use AFIS online

### Step 1

Open the URL: [www.wamis.co.za/eskom/checkboxes/eskom.htm](http://www.wamis.co.za/eskom/checkboxes/eskom.htm)

### Step 2





This web page can be used to select or deselect data layers to be viewed as default when the AFIS page is opened.

### Step 3

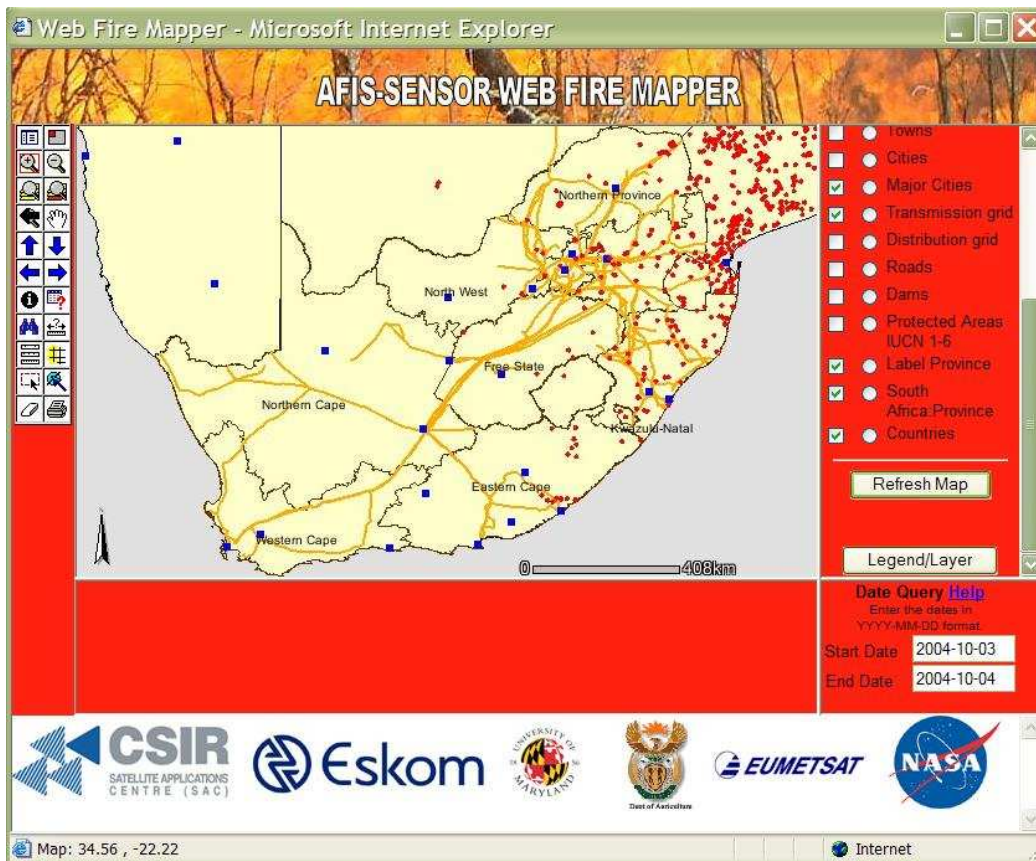
Click once on the Open Map box in the bottom left corner of the web page

### Step 4

Wait a few seconds for the web Geographic Information System (GIS) to open. **ps: the first time it will take a while to download all the information, but the next time the page is opened it should be much quicker.**

### Step 5

The AFIS web GIS should now be fully opened



- **System Components**

**Web Fire Mapper - Microsoft Internet Explorer**

**AFIS-SENSOR WEB FIRE MAPPER**

**Layers**

- Fires Last 24Hrs
- MODIS Active Fire Detections
- MSG Fires Last 15 min
- MSG Archive
- Transmission Sub stations
- Towns
- Cities
- Major Cities
- Transmission grid
- Distribution grid
- Roads
- Dams
- Protected Areas IUCN 1-6
- Label Province
- South Africa Province
- Countries

**Date Query Help**  
Enter the dates in YYYY-MM-DD format.

Start Date: 2004-10-04  
End Date: 2004-10-04

**Annotations:**

- Zoom function
- Info button used to query an object on the map, BUT only when both the Visible and Active boxes are activated for the particular layer
- Search function
- MODIS fires detected since 12:00 am
- MODIS fires in archive defined by Start and End Date in data Query window
- MSG fires detected in the last 15 minutes
- MSG fires in archive defined by Start and End Date in data Query window
- Town and City locations. Towns only viewable when zoomed in
- Main and secondary roads in SA
- Used to update map when changes such as time period is made.
- The Data Query window can be used to define the time period for view. Current archive goes back to 26 April 2004

**Logos:** CSIR, Eskom, University of Stellenbosch, Department of Agriculture, EUMETSAT, NASA

- **How to extract Information regarding an object**

**Example:** Retrieve information regarding a fire near Dullstroom

**Step 1**

Zoom in to the region of interested until the fire pixels are visible

**Step 2**

Activate all relevant data layers

In the example we zoomed into the Dullstroom area where a fire was detected on 4 October 2004. Four pixels are shown to contain fire

activity. We activated the flowing data layers by clicking on the **Visible** checkbox to the left of each layer:

- Fires last 24 Hours- MODIS fires
- Town data
- Cities
- ESKOM Transmission grid
- Roads
- Dams

Web Fire Mapper - Microsoft Internet Explorer

### AFIS-SENSOR WEB FIRE MAPPER

**Layers**

Visible Active

- Fires Last 24Hrs
- MODIS Active Fire Detections
- MSG-Fires Last 15 min
- MSG-Archive
- Transmission Sub stations
- Towns
- Cities
- Major Cities
- Transmission grid
- Distribution grid
- Roads
- Dams
- Protected Areas IUCN 1-6
- Label Province
- South Africa Province
- Countries

Refresh Map

Legend/Layer

Date Query [Help](#)  
Enter the dates in YYYY-MM-DD format:  
Start Date: 2004-10-04  
End Date: 2004-10-04

Map: 30.2, -25.3

Internet

Logos: CSIR SATELLITE APPLICATIONS CENTRE (SAC), Eskom, UNIVERSITY OF MARYLAND, EUMETSAT, NASA



### Step 3

Click the **Active circle** to activate the data layer for Information extraction



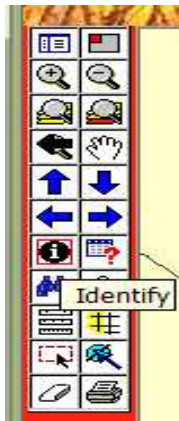
In this example we activate the **Fires last 24 Hrs** layer to view the information on the MODIS fires (red pixels). If we wanted to extract information regarding a road we would have activated the **Roads** layer.

**ps: many layers can be viewed at the same time (Visible checkbox on), but only one layer can be Active (circle) at a time.**

The **Active** option is used to activate that particular data layer to be interrogated by the Data Tools.

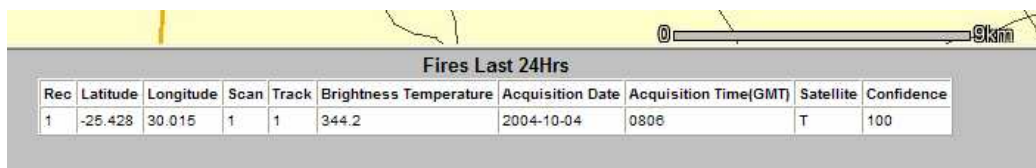
### Step 4

Active the Information tool by clicking on the “i” on the tool icon menu



### Step 5

Place the cursor now on top of the fire pixel and click once. The system will process for a few seconds and will then produce a table with information for the pixel that was chosen

A screenshot of a map interface. At the top, there is a scale bar showing 0 to 5 km. Below the map, a table titled "Fires Last 24Hrs" displays the following data:

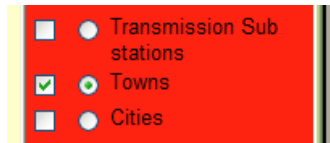
Rec	Latitude	Longitude	Scan	Track	Brightness Temperature	Acquisition Date	Acquisition Time(GMT)	Satellite	Confidence
1	-25.428	30.015	1	1	344.2	2004-10-04	0806	T	100

## How to search for a specific object

**Example:** Search for a town called Koekenaap

### Step 1

Activate both the **Visible and Active** checkboxes next to the Towns data layer



### Step 2

Active the Find tool by clicking on the  tool in the Tools icon menu



### Step 3

After activation of the Find tool a Find window will appear at the bottom of the page. The name of the town to be searched – Koekenaap must now be entered. Click on Find String to start the search



### Step 4

If the search is successful a window will appear with the results

Towns				
Rec	SDE.SDE.SOUTHAFRICA_TOWNS.OBJECTID_1	#SHAPE#	Name	Type
<u>1</u>	2881	[point]	Koekenaap	Settlement

## **Step 5**

Click on the 1 in the **Rec** column, this will move the map location to the town that was searched for.

## **Acknowledgements**

**MODIS related questions and answers based on the FAQ information page developed at the University of Maryland**

