1.1.1 Fire service products

_active Fire Products_

**FP 01: MODIS Active Fire Products**

The MODIS fire detection and characterisation techniques are fully automated for the production of daily, global fire information. In order to detect the presence of fire in a non-interactive fashion, a set of detection criteria different for the day and night fire observations are prescribed. These multispectral criteria are based on the apparent temperature of the fire pixel and the difference between the fire pixel and its background temperature.

The MODIS active fire product detects fires in 1km pixels that are burning at the time of overpass under relatively cloud-free conditions using a contextual algorithm, where thresholds are first applied to the observed middle–infrared and thermal infrared brightness temperature and then false detections are rejected by examining the brightness temperature relative to neighbouring pixels (Giglio, L. et al. 2003).

_product example_
This is not the standard Eumetsat product, but the WildFire_Automated Biomass Burning Algorithm (WF_ABBA) product generated by the University of Wisconsin Madison. The Wildfire Automated Biomass Burning Algorithm (WF_ABBA) provides fire detections and fire characteristics (instantaneous fire size, instantaneous fire temperature, and fire radiative power). The WF_ABBA has recently been upgraded to include improved metadata that allows for tracking when a specific place was observed by the satellite and why individual pixels were not labeled as fires, such as opaque clouds, block-out zones for sunglint, and disallowed surface types. This data allows for correction of the diurnal cycle of fire detections for places and times where fires could not be detected, which will enable the construction of high quality climatology of fires.

**Output Products**

- Parameter definition: WF_ABBA MSG
- Spatial coverage: Europe and Africa
- Frequency: 15 minute updates
- Geometric projection: 4 km
- Format Specification: ASCII
- Projection Information: WGS84
Product Usage (MODIS and MSG)

The MODIS active fire product provides the location of fires as the satellite passes over a specific region. It is a “snapshot” in time of active fires burning. The product has both a near real time application through the quick identification of fires to performing fire suppression as well as a longer term application looking at fire frequency and distribution through time. This product is also useful in studies involving the frequency and distribution of active fires within their area of interest. Historical active fire information from 2000 – 2010 will be available on the AMESD fire station.

FP 03: MODIS Burnt Area Products

This product is generated from the Burned Area algorithm, an automated algorithm for mapping post-fire burned areas using 500-m MODIS imagery coupled with 1-km MODIS active fire observations. The hybrid algorithm applies dynamic thresholds to composite imagery generated from a burn-sensitive vegetation index derived from MODIS channels 5 and 7, and a measure of temporal texture. Cumulative active fire maps are used to guide the selection of burned and unburned training samples and to guide the specification of prior probabilities. The combined use of active-fire and reflectance data enables the algorithm to adapt regionally over a wide range of pre- and post-burn conditions and across multiple ecosystems. In order to identify a pixel as burned or unburned the algorithm required 30 days of data before the event and 30 days after the event. This means that a 30 day product will only be available a month later.

Output Products

Parameter definition: MODIS Direct Readout Burned Area product

Spatial coverage: Southern Africa (Lat: 0°S - 36°S) Long: 12°E - 50°E

Frequency: Monthly

Resolution: 500m

Format Specification: GeoTIFF

Projection Information: Albert Equal area

Product example
The MODIS burned area product is a monthly summary of all areas affected by fire per pixel (500m x 500m). The product allows users to calculate area affected by fire. Such calculations can be done at administrative levels or based on landcover types as shown below.

<table>
<thead>
<tr>
<th>Country</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>20 000 ht</td>
<td>30 000 ht</td>
<td>45 000 ht</td>
<td>95 000 ht</td>
</tr>
<tr>
<td>Namibia</td>
<td>10 000 ht</td>
<td>15 000 ht</td>
<td>20 000 ht</td>
<td>45 000 ht</td>
</tr>
<tr>
<td>Zambia</td>
<td>45 000 ht</td>
<td>50 000 ht</td>
<td>70 000 ht</td>
<td>175 000 ht</td>
</tr>
<tr>
<td>Mozambique</td>
<td>55 000 ht</td>
<td>60 000 ht</td>
<td>70 000 ht</td>
<td>185 000 ht</td>
</tr>
</tbody>
</table>

Table 1: Burned Area Estimate per country

This product is also a critical parameter in various scientific research and application fields. It is a key input to estimate greenhouse gases and aerosols released from fires into the atmosphere, which have significant impacts on the global carbon cycle and air quality.
The model in the Canadian Forest Fire Danger Rating System (CFFDRS) has evolved and developed since the mid-1920s. The basis of this system has been extensive field experimentation and observation of fire behaviour. A wide range of vegetation types have been studied, but the most common forest types studied have been the Jack Pine and Lodgepole Pine forest which are widespread in Canada. These forests have been used as the standard fuel type in the calculation of the Fire Weather Index (FWI) and its component indices. The FWI was introduced in 1969 and is now applied nationally in Canada. The Canadian FFDRS model has been tested or adapted in New Zealand, Fiji, Alaska, Venezuela, Mexico, Chile, Argentina and Europe. The Fire Weather Index requires only daily temperature, relative humidity, rainfall, and wind speed inputs for its calculation. This is one of this system’s desirable traits. The Canadian FFDRS uses the FWI and its component parts as the basis for fire management. The FWI provides an indication of the ease of ignition, and should fires start, the potential spread and relative intensity of fires (Fig 31).

**Inputs**

![Diagram of Canadian Fire Weather Index](image)

**Output Product**

- Parameter definition: Canadian Fire Danger Index
- Spatial coverage: Southern Africa (Lat: 5°S - 36°S) Long: 14°E to 40°E
- Frequency: Daily for the next 3 days
- Geometric projection: 48 km
- Format Specification: ASCII file
- Projection Information: WGS84 Geographic
The Low veldt Fire Danger Index (LFDI) is an adaptation of the fire index model developed in Zimbabwe by Michael Laing (CSIR, 2001). The model uses the same inputs as MacArthur models, which are scaled to produce a simple model that can be used so that it can calculate numbers without needing any complex calculations. The index incorporates weather variables and fuel availability and condition to estimate difficulty of suppression of fire for early warning. This model has been widely applied in the low veldt region of South Africa and thus is often been referred to as the low veldt danger rating index (LFDI)(CSIR, 2001, Maathius et al., 2010).

The Burning index of this fire model employs a simple monogram, which uses temperature and relative humidity. The simple burning index once derived is then adjusted for wind by adding a value according to the prevailing wind conditions at 1400 hrs (CSIR, 2001). In order to account for the fine fuel
availability a rainfall correction factor based on past rainfall is used. The nomogram for the burning index calculation and the rainfall correction factor are shown in below

Figure 5: The Low Veldt Danger Rating Index (LFDI) Nomogram Used In the Burning Index, Source (CSIR, 2001)

Table 3: The Low Veldt Danger Rating Index (LFDI) Nomogram Used In the Burning Index, Source (CSIR, 2001)

Mathematically the Low veldt Fire Danger Index is expressed as;

\[ FDI = (BI + \text{Wind Factor}) \times \text{RCF}, \]

Where \( FDI \) = Fire Danger Index, \( BI \) is Burning Index, and the \( RCF \) is the rainfall correction factors as shown in figure (The Low Veldt Danger Rating Index) above.

According to Heine in (CSIR, 2001) another adjustment has been made to the model’s rainfall correction factor, such that if the temperature exceeds 23 \(^\circ\)C, and relative humidity is less than 50%, and the wind speed is greater than 20km/h then the latest rainfall event is moved back one day for every hour these conditions persists.

**Product usage (FP 05 and FP04)**

The Canadian FWI product is a 3 day forecast of fire danger that informs users where dangerous fires might occur due to dry, windy climatic conditions. The index can not confirm whether an ignition will occur but if an ignition occurs it can predict the difficulty of the resulting suppression. The product will be used by fire managers, fire suppression personnel and any person that wants to protect its land from dangerous fires.
**FP06: MODIS Daily True colour composites**

True-color imagery uses MODIS Bands 1, 4, and 3, respectively corresponding to the red, green, and blue range of the light spectrum, are assigned to the red, green, and blue channels of a digital image. These images are called true-color or natural color because this combination of wavelengths is similar to what the human eye would see. The data are first corrected for atmospheric molecular scatter effects using a radiative transfer model (without this correction, the product would assume a milky-white appearance especially near scan edge, when the sensor peers through a deeper layer of the atmosphere), and then combined to form a Red/Green/Blue composite image.

**Product usage**

The true colour product is a simple quick look of current conditions using the natural colours provided by the satellite. The product will be available every day around 17:00 and will represent a “snapshot” of the area as the satellite flew overhead. Users can use the imagery to identify burned areas and can spot smoke plumes as they burn.