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The Integration of an Operational Fire Hot Spots Processing Chain in a Multi-Hazard Emergency Management Service Platform (PHAROS)

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The aim of the project PHAROS - Project on a Multi-Hazard Open Platform for Satellite Based Downstream Services - is the design and development of a modular and scalable multi-hazard open service platform. It integrates space-based observation, satellite communications and navigation (Galileo/GNSS) in one system and provides sustainable (pre-operational) services for a wide variety of users. It covers the whole disaster cycle, such as risk preparedness and mitigation, prediction/early detection of emergencies, population alerting and environmental monitoring. This broad scale of potential applications involves consequently a large variety of users, such as crisis managers, operators of critical infrastructures, insurance companies and academic/research institutions. While the service platform is designed to be multi-hazard, the specific developments for the pre-operational system and pilot demonstration will be focused on the forest fire scenario. The platform will integrate data from EO satellites and in-situ sensors process it and provide the results to a series of key services for disaster management in its different phases.

Depending on the actual track, the scenes cover areas reaching from the Barents Sea in the north to the northern part of Africa in the south and from the Caspian Sea in the east to the Mid Atlantic in the west. The real-time data stream carries the data from all 36 spectral bands for the entire MODIS field of view (2330 km) whenever MODIS can be seen from the ground station at Oberpfaffenhofen or Neustrelitz.

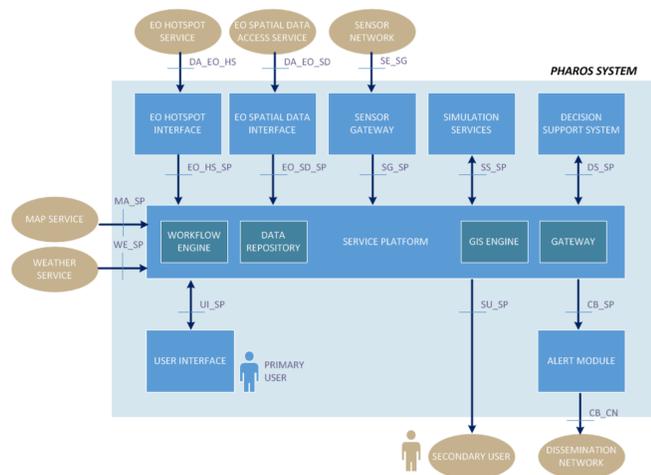


Figure 1: Pharos Overall System Architecture

One of the main concerns is to provide fire hot spots as an input for the PHAROS Simulation Service. For this purpose it is extremely important that the processing of the MODIS data takes place in near real time. This so-called NRT processing of the MODIS hotspots is possible because of two reasons:

- 1) The MODIS instruments on board of the Terra and Aqua satellites have the technical feature of Direct Broadcast capability together with an on board data storage and a transmission capability initiated by a ground command. This means that all raw data collected on board are immediately transmitted to ground.
- 2) The DLR has two ground stations for receiving MODIS data. One is located in Oberpfaffenhofen (Bavaria) in southern Germany and one in Neustrelitz (Mecklenburg-West Pomerania) in Northern Germany. The Terra and Aqua platforms have a sun-synchronous, near polar, circular orbit crossing the equator at 10:30 a.m. daily (descending mode for Terra) and crossing the equator daily at 1:30 p.m. as it heads north (ascending mode for Aqua). Both satellites have a typical flight height of 705 km. Both ground stations are receiving in average data from 3 to 4 daytime passes and 3 to 4 nighttime passes per day per satellite.

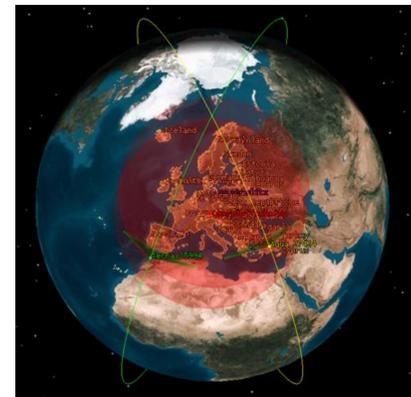


Figure 3: Five degree horizon mask for the ground stations in Neustrelitz and Oberpfaffenhofen

Subsequent to the MODIS pre-processing the fire hot spots (thermal anomalies) are derived automatically and also in NRT from the MODIS data. For the detection of high temperature events (HTE) the MOD14 algorithm is used. The algorithm is based on the shift of the radiances/reflectance to shorter wavelengths (middle infrared) with an increasing surface temperature. MOD14 is well documented and tested in operational services and guarantees comparability and reproducibility as well as a standardized international acknowledged product. The thermal information is collected at 1000 m spatial resolution twice daily by each sensor (Terra and Aqua) providing up to four thermal observations daily.

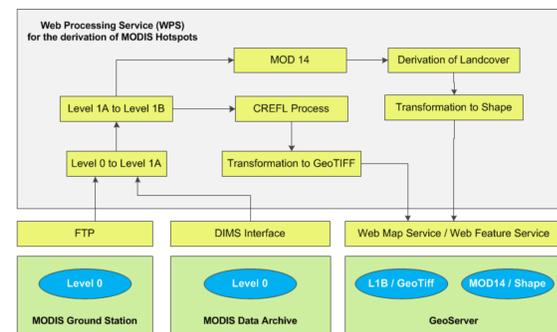


Figure 4: WPS Processing Chain for MODIS Hotspot Generation (MOD14)

The pre-processing of the MODIS data and also the derivation of the MOD14 hot spots is based on an OGC (Open Geospatial Consortium) compliant Web Processing Service (WPS). Also the interface for the MODIS products is OGC compliant:

- the MODIS hotspots are delivered as Web Feature Service (WFS)
- the MODIS scenes are provided for portrayal purposes as Web Mapping Service (WMS)

This assures the seamless integration of the MODIS processing results in the PHAROS system and furthermore in already existing applications of the potential end users.



Figure 2: The MODIS receiving capabilities at DLR a) MODIS antenna on the roof of DFD's building in Oberpfaffenhofen; b) MODIS antenna on the roof of DFD's building in Neustrelitz; c) MODIS X-band antenna