

FUSION

High Resolution
Land Monitoring by
Fusion of Optical and
Infrared Data

Technical Flyer

User Workshop
In Berlin
On May 19th, 2010



Bundesministerium
für Wirtschaft
und Technologie

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The FUSION system concept will combine the capabilities of a high resolution earth observation satellites constellation similar to RapidEye with an infrared sensor system based on BIRD.

The constellation of RapidEye satellites is comprised of five identical Earth Observation satellites. This system has daily revisit and multi-temporal imaging capabilities with 6.5 meter pixel spacing. The Bispectral InfraRed Detection (BIRD) satellite launched in 2001 allows for fire recognition and hot-spot detection through a combination of a capable infrared sensor system and advanced on-board data processing.

FUSION offers a valuable addition to the Sentinel Missions of GMES, as it holds the potential to **fill the infrared gap**, which exists for high resolution infrared imagery with a ground sampling distance (GSD) of around 100m. For day time observations the GSD can be improved to below 10 m using the Multi-sensor Multi-resolution Technique (MMT).

Applications

FUSION will be beneficial for the following fields of application:

- Terrestrial ecosystems and environment**
- Fires of forests and wild-land**
- Agriculture & Irrigation water management**
- Food security**
- Volcanology & geothermy**
- Inland water resource management**
- Geology**
- Land planning**
- Sea pollution & fishery**
- Desaster monitoring**
- Security and surveillence**



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System concept: outline and capabilities

Constellation

The FUSION space segment will be formed of a constellation of four to five LEO satellites. They will be able to point off-nadir and thus provide daily revisit of any point globally.

VIS/NIR sensor system

Based on the RapidEye heritage FUSION will carry a payload for the visible spectrum with a Ground Sampling Distance (GSD) of 6.5 m.

MIR/TIR sensor system

FUSION will build on the BIRD heritage and be equipped with an infrared payload delivering thermal imagery at 100 m GSD.

Image fusion

FUSION will provide high resolution infrared images through combination of VIS/NIR and MIR/TIR images which are fused using the Multi-sensor Multi-resolution Technique.

New products

FUSION will provide data with the same characteristics as the current RapidEye system supplemented by data of the MIR/TIR channels, thus enabling new types of Earth Observation products.

Hot spot detection

The FUSION satellites will be equipped with on-board hot spot detection software and will be able to directly extract fire parameters and calculate hot spot positions.

Direct user downlink

The FUSION satellites will provide a direct downlink possibility for users in fire affected regions. Fire data can thus be directly sent to the user during the satellite pass, providing the user with hot spot location and fire attributes in near real time.

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New Earth Observation products

FUSION sets out to provide data with the same characteristics as RapidEye data. Being a constellation and able to point off-Nadir, the FUSION space segment can reach any point on the globe at any given day. Additional channels in the infrared spectrum will allow for new products yielding extra information for Earth Observation data users.

Advantages of corregistered TIR and MIR data addition to pure VIS/NIR information are the following added capabilities:



Gulf of Malia, acquired by RapidEye 2

- The preferred IR bands allow measurements at day and night. Influence of air humidity is minimised since absorption bands are avoided.
- IR bands enable plant stress detection and determination of the hydrous and energetic state of vegetation. Vegetation and soil water content measurements are enabled.
- Surface temperatures of land and water can be estimated, which enables observation of normal temperature phenomena such as heat and water budgets, thermal pollution of rivers, lakes and coastal zones.

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Image fusion through MMT

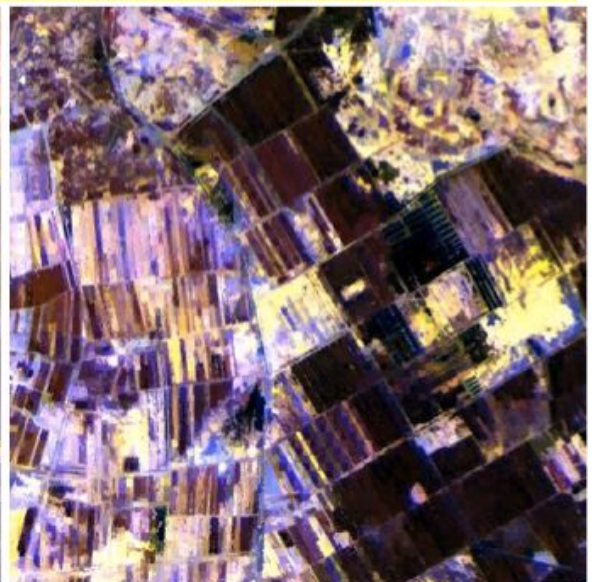
Fusion of multi-sensor imaging data enables a synergistic interpretation of complementary information obtained by sensors of different spectral range and spatial resolution. The Multi-sensor Multi-resolution Technique (MMT) can sharpen a lower resolution MIR/TIR image using the higher spatial resolution of the VIS/NIR channels.

FUSION will build on the experience and developments of the BIRD mission. MMT allows for improvement of the spatial resolution of IR images: Fused with VIS/NIR data a spatial resolution of below 10 m can be achieved for the infrared information. The images below exemplarily show the high resolution unmixing result of the lower resolution HSI image.

False color IR images: Initial (left) and MMT result (right)



Initial HSI image (90 m resolution) R: 1.6-1.7 μm , G: 2.24-2.29 μm , B: 10.3-11.0 μm



"Fused" HSI image (15m resolution) R: 1.6-1.7 μm , G: 2.24-2.29 μm , B: 10.3-11.0 μm

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Fire detection

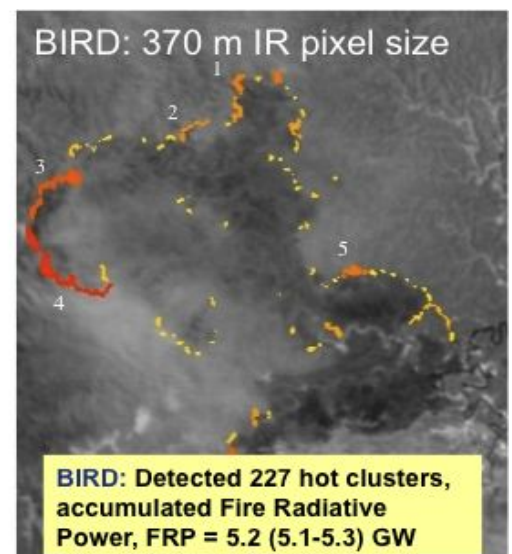
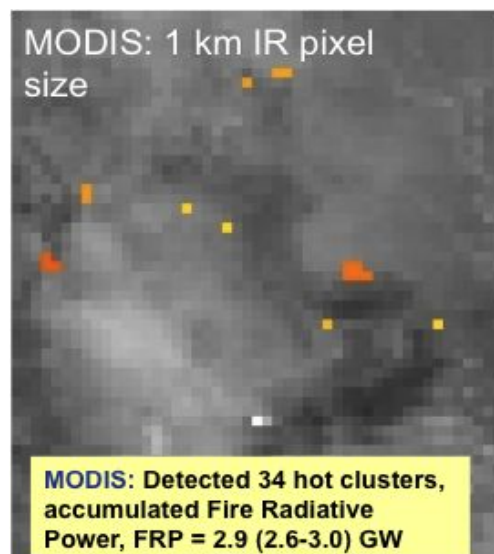
As identified by the Committee on Earth Observation Satellites, current and planned missions delivering active fire products, including Fire Radiative Power, do not deliver the 250 m resolution and daily observing cycle specified in the Global Climate Observation System (GCOS) Implementation Plan. Feeding off the Bispectral Infra-Red Detection (BIRD) mission and the RapidEye constellation, FUSION will fill this “infrared gap” with:

Active fire products in near-real time and low data rate

directly to the user yielding a considerable benefit for fire detection, monitoring and control.

A “Fire Zooming Service”

A “Fire Zooming Service” will be provided for validation of observations at local and regional-scale made by spatial coarser resolution systems such as geostationary sensors (providing hourly coverage), and MODIS- class instruments (providing sub-daily coverage).



Fragments of bush fire images in Australia obtained by MODIS and BIRD on 5 January, 2002. Colour coded Fire Radiative Power of hot spots is projected on the 0.9 μm NIR band images.

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Workshop scope

The FUSION user workshop is scheduled on May 19, 2010 in Berlin, Germany. The workshop gives future users the opportunity to get in touch with users and officials from numerous organisations and different fields of application. Participants will have the unique chance to learn about FUSION, the underlying technology and mission plans.

Within a dedicated session users are invited to discuss their requirements and outline their information needs. In that way the workshop allows future customers to influence the FUSION mission and it's system design right from the start.

Online Questionnaire

We kindly ask you take the FUSION user survey at
<http://fusion-workshop.questionpro.com>
before 12 May, 2010.
Thank you.

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