Detection of forest and peat fires using the German TET-1 satellite

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Vast and disastrous forest and peat fires are currently raging across Sumatra and Borneo putting Indonesia on track to be one of the world's largest carbon emitters this year (Global Emission Fire Database[1]). Peat fires burn smoldering and produce thick haze which drifts as far as to neighboring countries Malaysia, Singapore and Thailand (Figure 1,2).

NASA's two MODIS satellites Aqua and Terra make active fire data available every day by applying a fire and thermal anomalies algorithm (Giglio et al. 2003[2]). Thermal anomalies or active fires represent the center of a 1km pixel containing one or more fires within the pixel. Due to the sensitivity and the low spatial resolution of the thermal sensor only fires with more than 10 MW are detected (a flaming vegetation fire covering at least 200 m2). In combination with thick haze low energy smoldering peat fires may not be recorded by MODIS which in turn will result in underestimation of fire events and subsequent emission estimates.

The German fire detection system TET-1 acquires data in the thermal infrared with a much higher spatial resolution of 200 meters and a better sensitivity. The analysis of the high temperature events is based on a Bi- Spectral Method, which requires also an excellent characterization of the background temperatures. With this the TET-1 Infrared Instruments are also suitable to study fires with lower temperatures in the range of 1 MW to 10 MW. Figure 4 shows the swath of a TET acquisition taken the same day as the MODIS image (Figure 3). Yellow and red colors indicate high surface temperatures resulting from extensive peat and forest fires. Due to the higher sensitivity and better spatial resolution of the TET-1 instrument, these fires can be mapped in great spatial detail and accuracy. TET-1 is able to detect fires over a large range of temperatures and areas, in both day and night time conditions. Another unique feature is the real-time adjustment of sensor integration time: if the recorded onboard and processed data indicates a saturation of the signal a second exposure will be triggered with a shorter integration time. This technology resolves the problem of saturation in extremely hot fires.

Figure 3 shows a MODS image taken 1. October 2015. The area covers approx.. 7000 km2 in the lowlands of Southern Sumatra. Here the Merang REDD Pilot Project (MRPP) is located which was designed to prevent deforestation and degradation of the last remaining peat swamp forests in South Sumatra. Thick haze is obscuring the land surface, active fire detections by MODIS from the same day are shown as amber dots. The brownish color of the haze results from aerosols released by peat fires. Peat domes are indicated by brown outlines. Figure 4 shows a TET-1 acquisition taken the same day. Actively burning peat fires are shown in yellow to red colors. Figure 5 shows that several fires occur in very remote areas forested peatlands.

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[1] http://www.globalfiredata.org/updates.html

[2] http://www.sciencedirect.com/science/article/pii/S0034425703001846

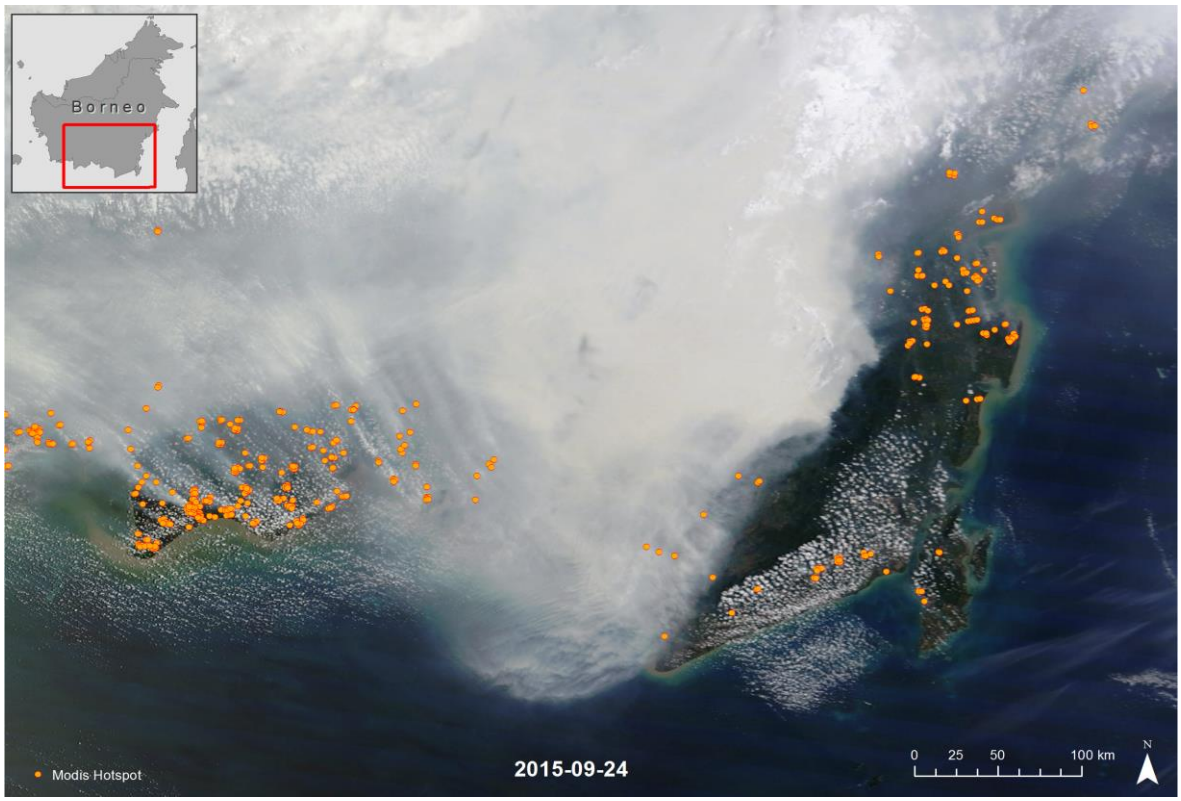

Figure 1: MODIS image acquired 24 September 2015. A blanket of thick haze obscures the detection of active fires (amber dots) by the MODIS instrument.

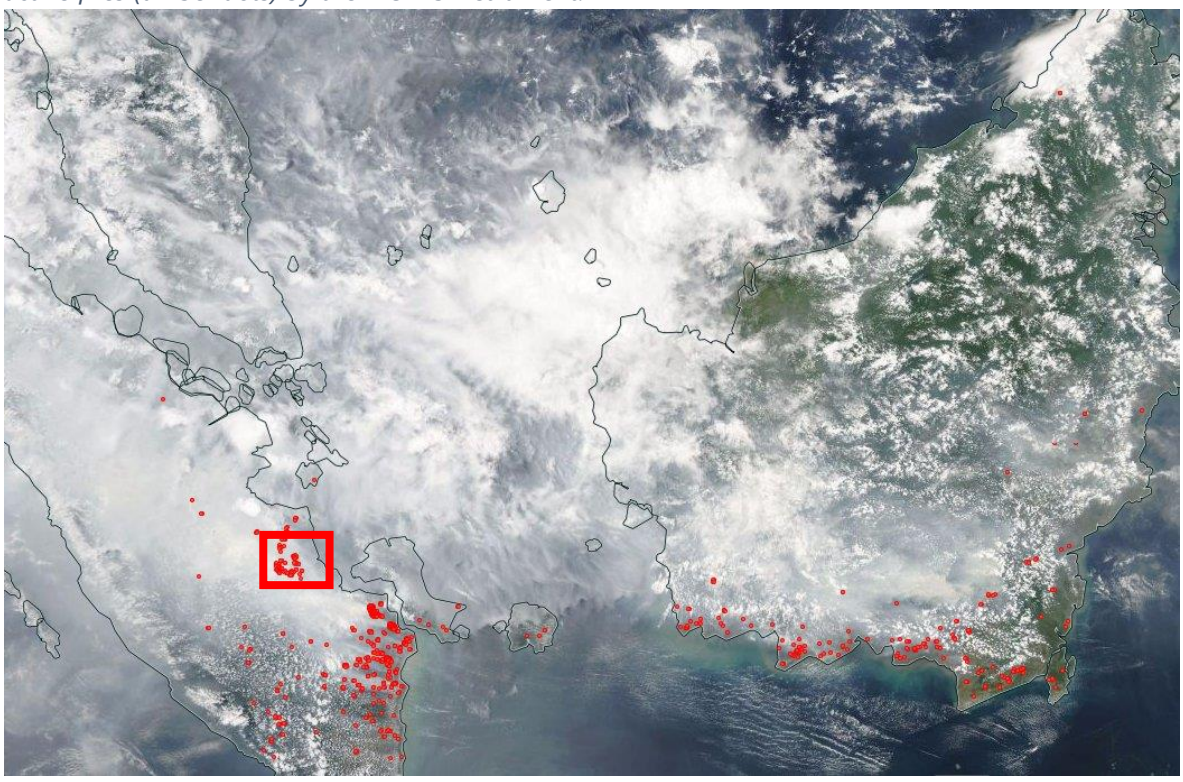

Figure 2: MODIS image acquired from 1 October 2015. Active fire detections by the MODIS instrument are shown in red

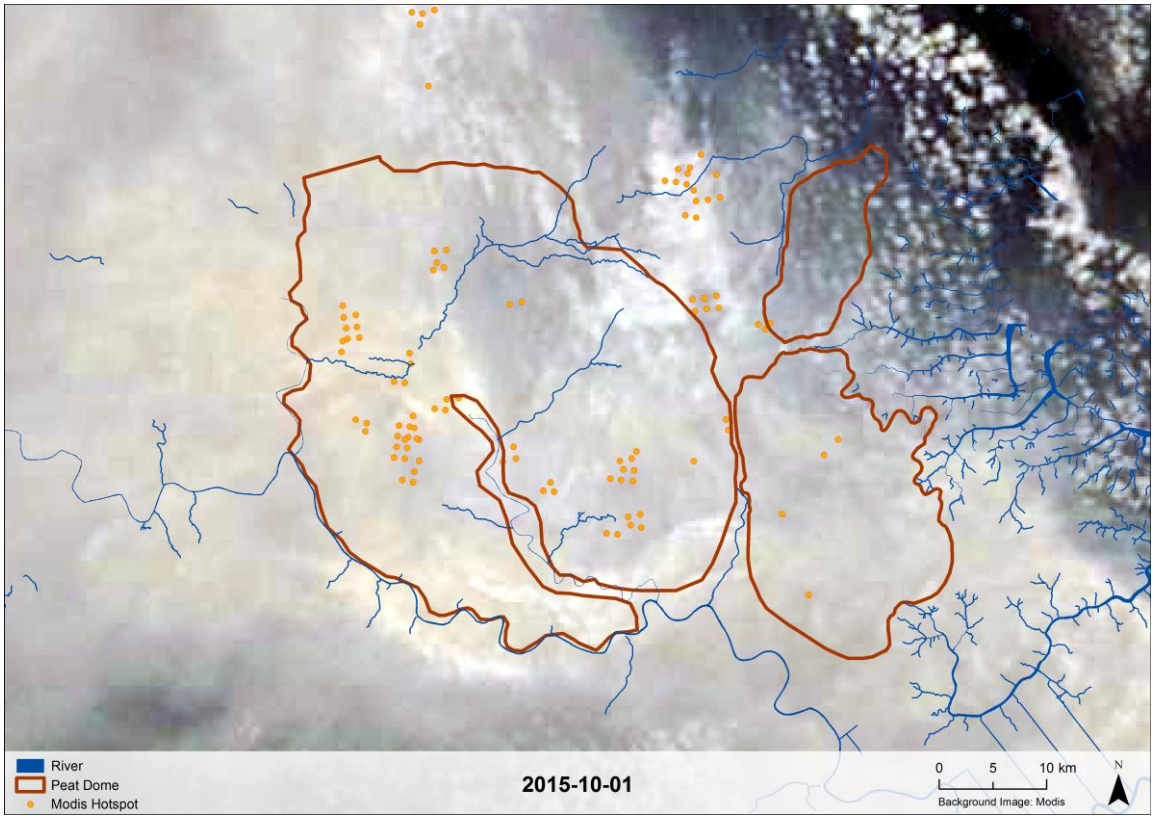

Figure 3: Close up of the Merang peatland area (rectangular region shown in figure 2). Haze is obscuring the land surface. The outline of the Merang peat domes is shown as brown outline. Active fire detections by MODIS from the same day are shown as amber dots.

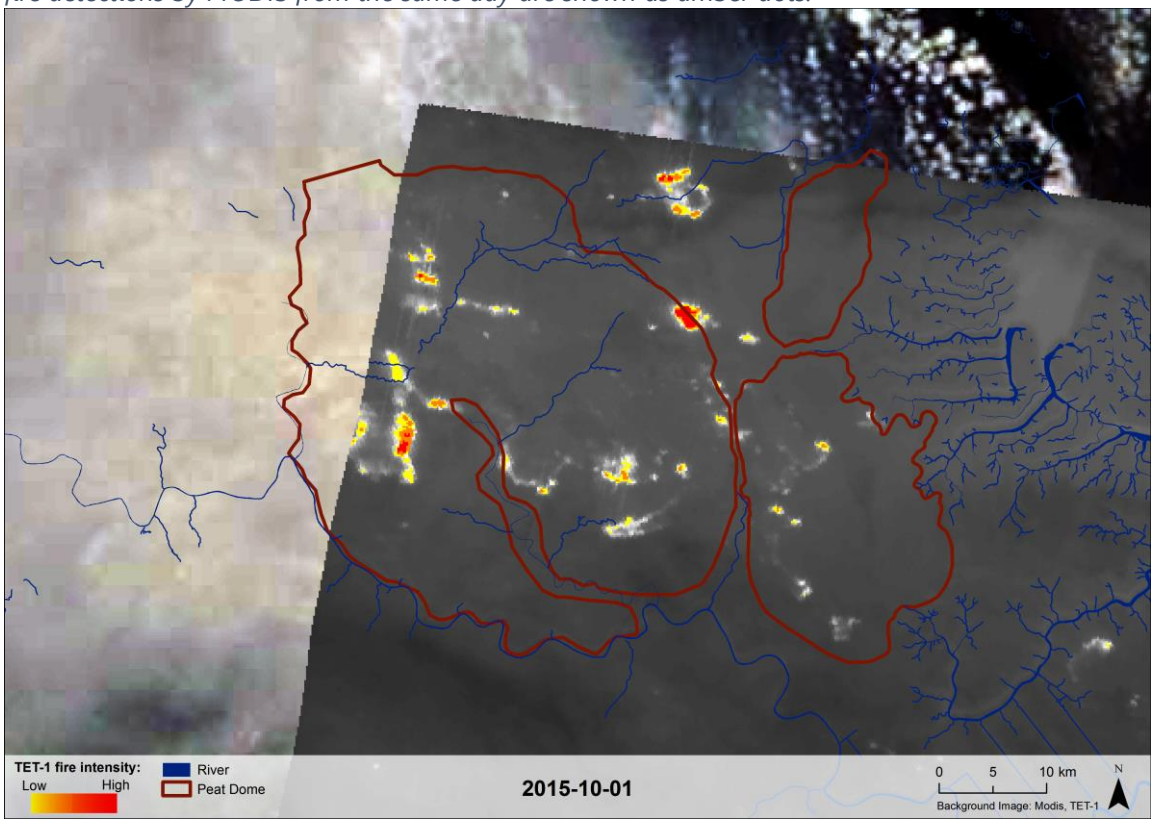

Figure 4: TET-1 image acquired the same day as the MODIS image (1 October 2015). Colors indicate actively burning peat fires.

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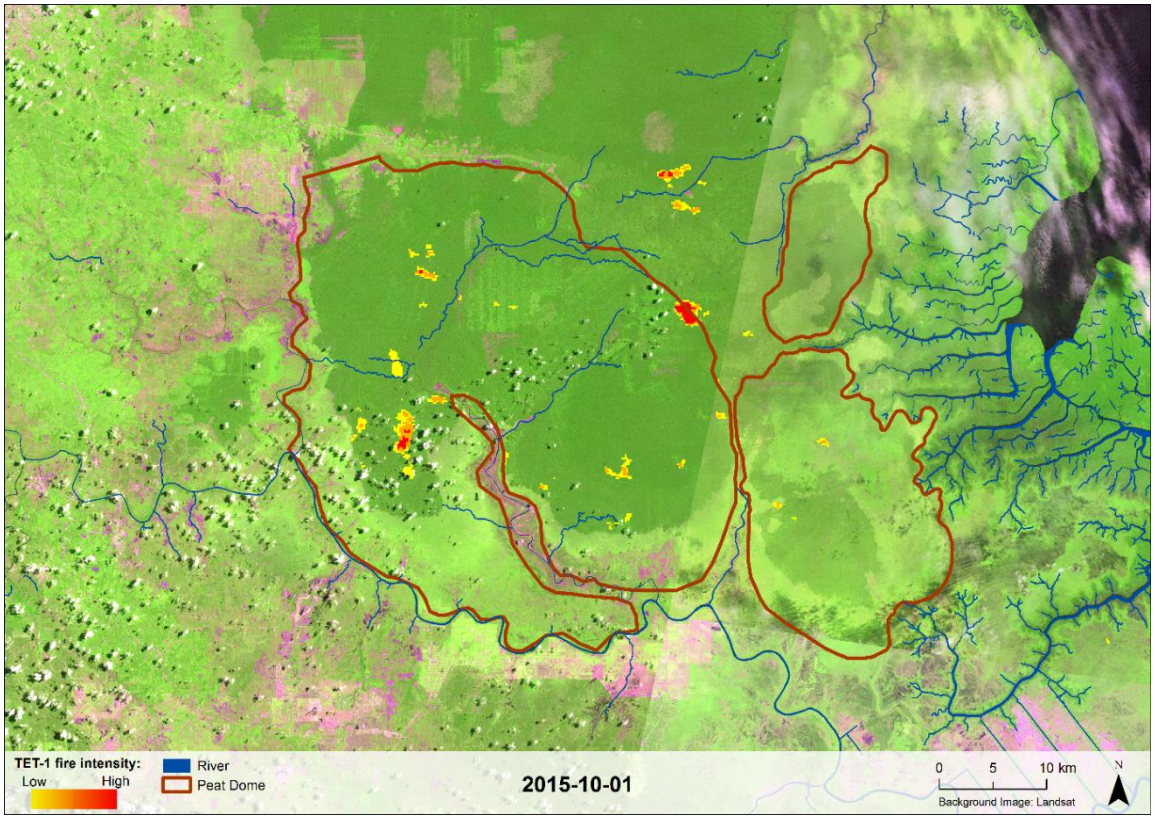

Figure 5: Landsat image superimposed with active fires detected by TET-1 (1 October 2015

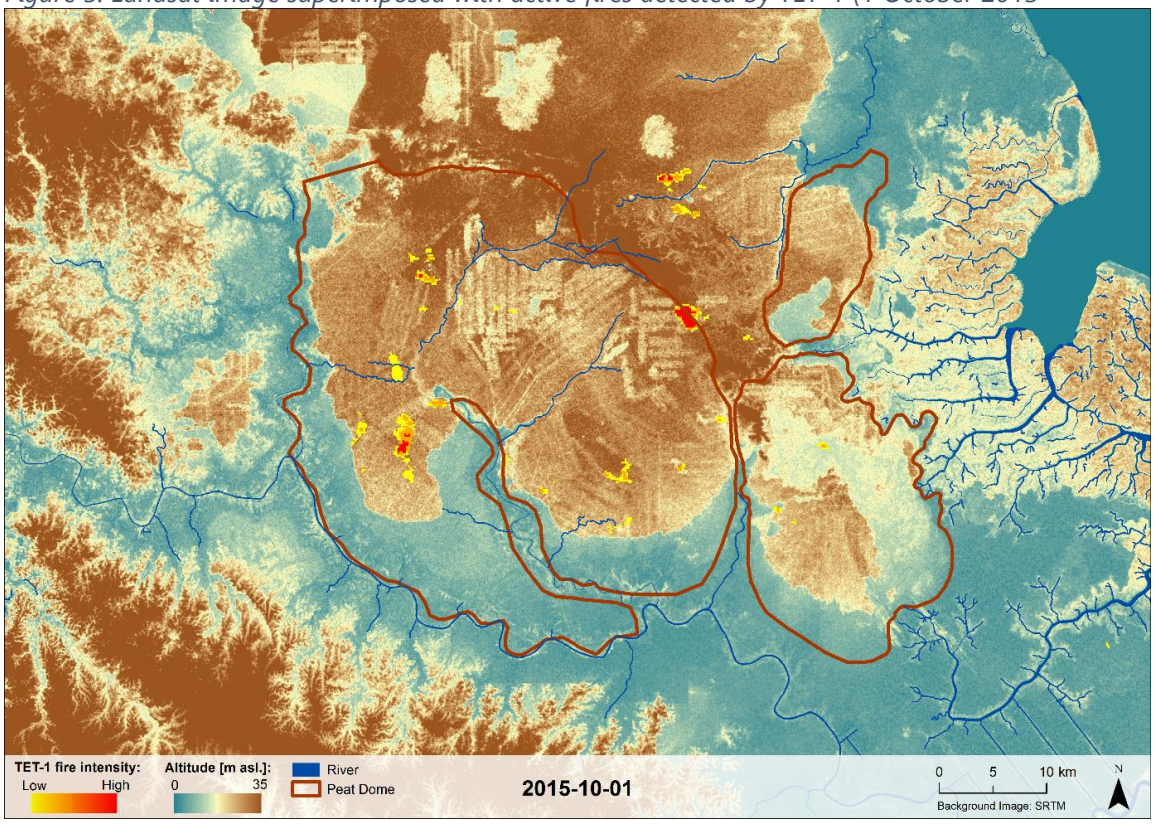

Figure 6: Digital surface model (SRTM DSM) superimposed with active fires detected by TET-1. Peat domes are visible as cloud shaped structures in brown color. It is evident that many fires burn on elevated peat domes. The linear structure in the DSM indicate logging operation in the years prior 2000.

About the authors

[a] **RSS - Remote Sensing Solutions GmbH** is one of the leading value-adding companies for earth observation in Germany. RSS is specialized in satellite image processing and interpretation, photogrammetry and geoinformation system (GIS) in the fields of environmental monitoring, nature conservation, forestry, REDD+ and carbon accounting and natural hazards. RSS is currently involved in various forestry and climate change mitigation projects in Eastern Europe, SE Asia, the Brazilian Amazon and Africa with special focus on REDD+, MRV, REL, and capacity building. Customers are national and international authorities, the GIZ (German international cooperation), the German space Agency (DLR), the European space agency (ESA), NGO's like WWF and FFI and private companies. RSS was responsible for data analysis.

For further information visit www.rssgmbh.de

[b] **GeoBio Center of Ludwig-Maximilians-University** (LMU) is a Munich-/Bavaria-based working group organisation of researchers, reflecting the fact that the understanding of the interactive System Earth demands a transdisciplinary approach. Shared focus of the research and educational activities is the analysis and understanding of mutual interactions of the geosphere and the biosphere. F.Siegert was responsible for data analysis.

[c] **DLR** is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency. The construction of the BIROS satellite was funded by the BMBF (FKZ 01LK0904A). The data are mainly received by the ground stations of the DLR in Neustrelitz and Weilheim and processed at the German Remote Sensing Data Center DLR, archived and made available to a worldwide scientific use. The satellites are operated and controlled by the German Space Operations Center (GSOC) of the DLR Space Operations facility in Oberpfaffenhofen. DLR was responsible for mission planning, data acquisition and preprocessing.