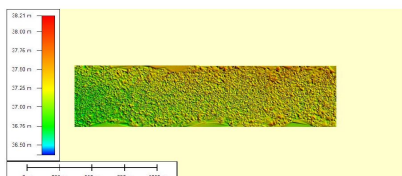
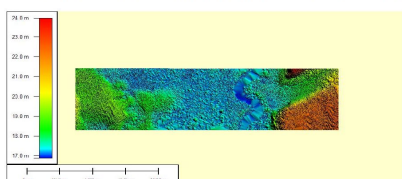




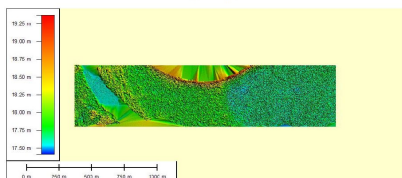
ALS-team in Rungan Sari: Juergen Frank, Detlef Klante, Suyud Paijan, Noor Alamsyah, Viktor Boehm, Jan Giehler, Mustafa Syafrudin



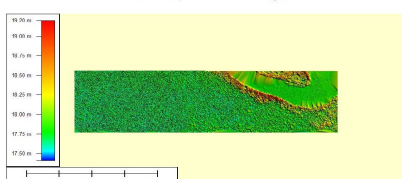
DTM846km-230km-Peatdome with 37.5m between Kahayan and Mangkatip



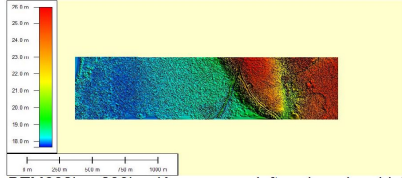
DTM864km-230km-Mangkatip, surface 17.0m and higher peat land



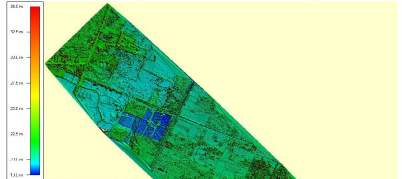
DTM878km230km-Kapuas bending, surface 17.6m on 7.8.2007



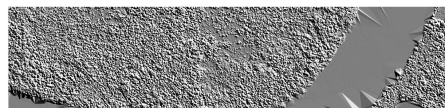
DTM880km-230km-Kapuas bending



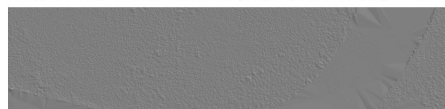
DTM882km-230km-Kapuas very left and road on higher peat land, all above figures are DTMs with a grid of 0.5km x 2km



DSM Spur 86 part, Kalampangan area with gravel lake



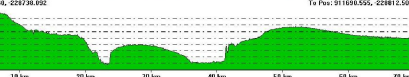
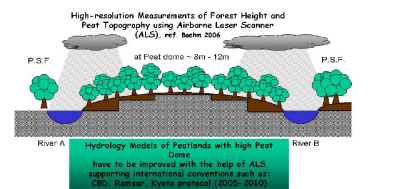
DSM 852km-262km with Kahayan, surface 16.3m; 0.5km x 2km



DTM 852km-262 km with Kahayan, surface 16.3m; 0.5km x 2km, black and white image as geo-tiff



Aerial photo Crossing Main Channel with river Putun, ALS-Spur 72



DTM-Cross-section showing peat topography in Block E

"Airborne Laser Scanning monitoring of Ex-MRP area to achieve high-resolution topographical maps of Peatlands in Central Kalimantan, contract between Kalteng Consultants, UNP-IR and Wetlands International"

by
Dr. H.-D.V. Boehm
Abstract

With a high-resolution Airborne Laser Scanner (ALS) the topography of peatlands was measured in Aug. 2007 by a helicopter to achieve a 3-dimensional Digital Elevation Model (DEM) for the CERP. The flight altitude was approx. 600m above ground. DEMs are divided into two types of groups. The Digital Surface Model (DSM) contains information by Laser Scanner with trees, bridges and houses and the Digital Terrain Model (DTM) is filtered using the DSM and shows the topography of landscapes without trees, bridges, houses etc.

With this type of information hydrology models of peatland and biomass of Peat Swamp Forest (PSF) can be analysed using this modern technology with an elevation resolution of $\approx 10\text{cm}$ e.g. in the Ex-MRP Rice Project (Ex-MRP) area of Blocks A, B, C, E and additionally in the Sebangau National Park (Sebangau Area is not part of this contract).

The different ground elevation was always referenced to the Palangkaraya airport reference point with 82m or approx. 26.5m.

From ALS-track on 7th Aug. 2007 with helicopter flight hours of 2.5 and approx. 280km length we achieved Spur 56 - 88 for this project with more than 14,000ha. The Laser pulses were processed to achieve a 6-60 geo-referenced corrected raw data in ASCII-format for each Spur 56 to 88, which were processed further to get first the DSMs and then by classification the DTMs in approx. 0.5km x 2km grids geo-coded with a strip width of 1m/m. Spur 88 was the ALS calibration flight over the Palangkaraya Tjilik River airport.

The DSM- and DTM-data can be visualised either with the SW Surfer or Global Mapper, which were delivered with the DVD-ASCII-package on 10.10.2007 and photos.

Additional to this KC delivered several maps (map of vegetation, map of fire prone area and map of peat thickness) to UNPAR of Block C-B-A on 3.8.2007. The ALS sensor, the flight management system, the INS, the HC-GPS, the ground DGPS and recorders had no problems during the 2.5 hours. The laser beam in the near infrared could penetrate the PSF with the divergence of 0.6mrad. The highest peat dome was found between rivers Kahayan and Mangkatip with 37.5m at the track approx. 22km south of the equator. Other ALS measurements are available from different areas of Ex-MRP for processing and analysis.

The preparation to get all equipment from Germany to Central Kalimantan, Indonesia, and back took several months including the temporary flight permits. The weather condition on the 7th August 2007 was very good. Also the helicopter in conjunction with the equipment worked properly including the qualified ALS-team.

FINDINGS

- Corrected ALS raw data (geo-coded) are available from the helicopter flight on 7.8.2007 with spur 56 - 88 from the Ex-MRP with an amount of 6.66 GB.

- Flight path spur 55 and 87 passed the runway of Palangkaraya airport two times, after 2.5 flight we received the same amount of 26.5m at the reference point, we needed the DGPS. The estimated flight track spur 88 continued the 25.0m. Every other flight on other days had the same elevation value of 25.0m.

- Precise ALS data with $\pm 0.5\text{m}$ resolution in x and y and $\pm 0.1\text{m}$ in z (vertical) were recorded for analysis of PSF-4m, mass estimation, topographical and hydrological. With the processed DSMs and DTMs the values can be determined very quickly, partly by subsetting. Classification was done automatically and using a manual control.

- The ALS is penetrating the PSF, which shows the very good results of the DTM for spur 56 to 88.

- The highest peat dome for the spur 56 to 88 was determined with 37.5m in Block E between rivers Kahayan and Mangkatip at the track 22km south of the equator. Manual analysis of the ALS data shows a similar result as the automatic DSM analysis.

- The visualisation of three-dimensional data is not so easy and needs specific SW and skills of the operator.

- Additional looks from the ALS flight, 5.8. and 6.8.2007, are available of the Ex-MRP to be processed and analysed, see Annex 2 + 3, and also one flight on the 7.8.2007 afternoon over peatland between Kahayan and Rungan, Annex 4.

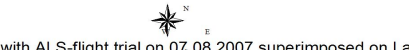
- The ALS campaign in the Ex-MRP August 2007 was a success. By integrals of the ALS and other measuring devices occurred during the complete flight path.

- Big Peat Layers are accumulated in Central Kalimantan between the rivers in the peatland (block E) in the Java Sea with up to 12m thickness in the Ex-MRP Rice Project (Ex-MRP) and in Sebangau National Park.

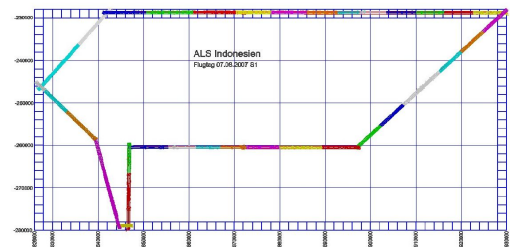
- A lot of caution is needed in Central Kalimantan;

- Degraded Peatland without trees are sensitive for burning in the dry season.

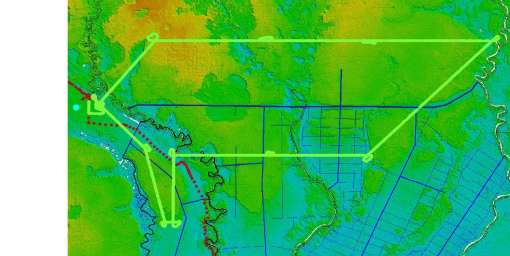
- The water level should be kept high in the peat area of Ex-MRP by blocking the many channels with different sizes and the area should be treated with korals, to avoid fire, and Bagan logging should kept very low.



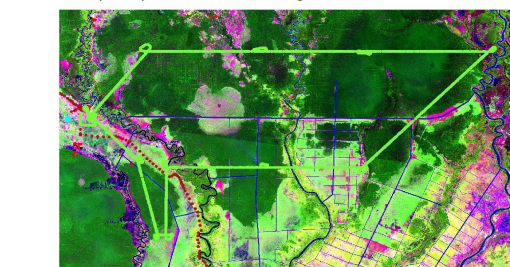
Laser beam reflections first-, second- and third-echo



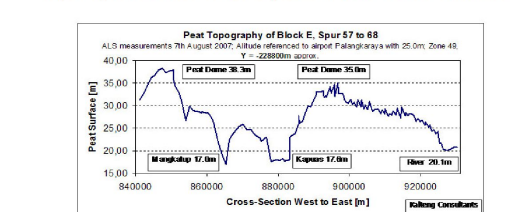
ALS-Flight path from 07.08.2007 with processed 2km x 2km grids and different spurs (ALS-tracks) in different colours



ALS-Flight path from 07.08.2007 with GPS-tracks superimposed on SRTM-image, turns for INS calibration



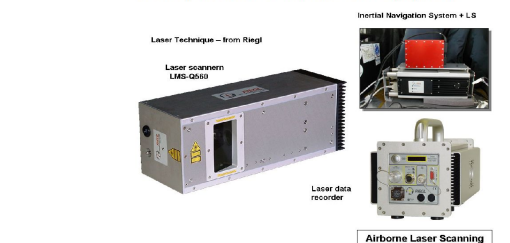
ALS-Flight path from 07.08.2007 with GPS-tracks superimposed on Landsat-image 2000, turns for INS calibration



Cross-section showing peat topography in Block E, visual filtering approx. -229 south of equator



Helicopter at MSC with the ALS equipment



Infra-red Laser Scanner with recorder and Inertial Navigation System



Palangkaraya airport (PKY) with runway and ground reference point of Spur 87 in an ALS-presentation

Ground reference station at PKY airport with 25.0m and DGPS