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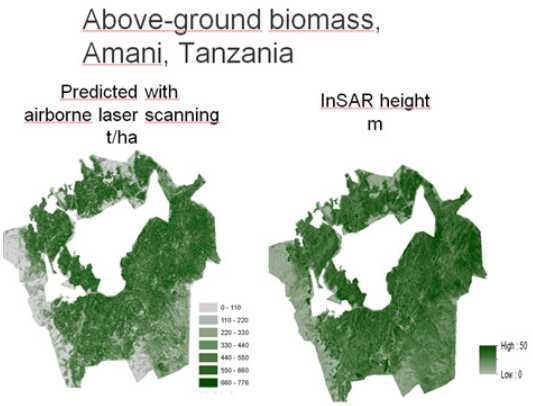
3D RADAR imagery for forest monitoring, for REDD-MRV

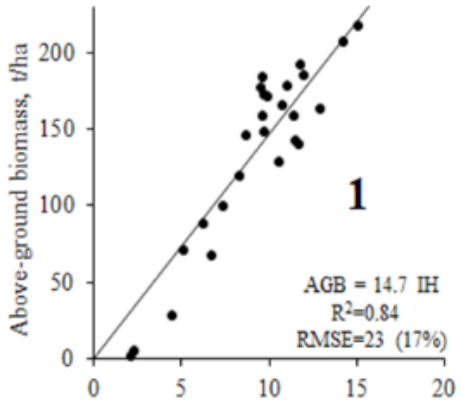
Interferometric RADAR imagery can play an important role in REDD (Reduced Emissions from Deforestation and Forest Degradation). Interferometric RADAR acquires stereo imagery from which we derive height data. The RADAR heights are located high up in the tree crowns. Height above ground is correlated to forest biomass. Height decreases represent logging, i.e. reduced carbon stock. Height increases represent tree growth, i.e. increased carbon stock.

The REDD initiative was presented at the UN-FCCC summit in Java, Indonesia in 2007. The idea is to pay tropical countries for their achievements in reducing deforestation and forest degradation. They shall be paid a price per ton carbon that is not emitted. In order to realize this idea there is a need for a monitoring method that can be used to document changes in forest carbon stocks, - on an annual basis. Satellite based 3D RADAR can do this job. This is contemporary technology that deserves attention in the REDD context. Today, the Tandem-X satellite mission is gathering 3D RADAR data that can be used for this purpose.

The Tandem-X mission acquires interferometric RADAR imagery globally.

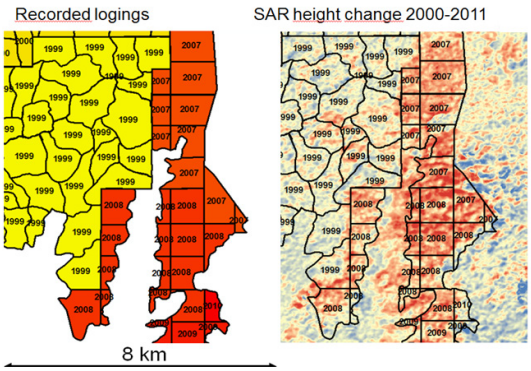


Testing Tandem-X in Tanzania. Amani is a forest reserve in a mountainous area with exceptionally high biomass density, due to its evergreen, dense forest with huge trees. We are testing Tandem-X in this area. The figure shows the distribution of forest biomass to the left mapped with airborne laser scanning (data: University of Life Sciences, Norway). To the right we have the Tandem-X heights above ground, which clearly reflects the spatial distribution of forest biomass.



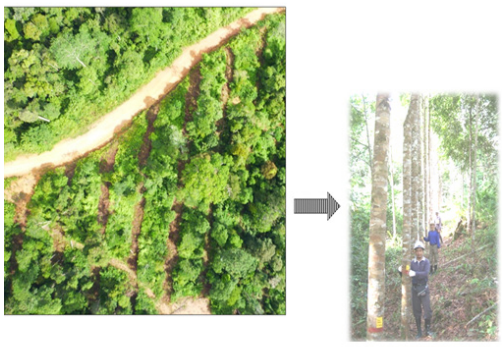
Testing has shown that forest biomass, and hence forest carbon, can be linearly related to the Tandem-X heights. For every meter we increase the height, the above-ground biomass is correspondingly increasing with about 14 tons per hectar. Note that there is no tendency of saturation. The relationship is straight linear.

Partially logged areas, Kalimantan, Indonesia



Loggings will be detected as decreases in height. This example is from Kalimantan, Indonesia. The left image shows areas that are recorded as logged by the forest logging company, and the colors indicate the year of logging (red is recent, yellow is older), which is also shown as labels. To the right we have the change in SAR height from 2000 to 2011. Recently logged areas show up with a decrease of about 30 m (red color).

Careful strip-logging on only 15% of the area can be detected



An important aspect of this method is that the loggings do not need to be clear-cuts. This image shows a sustainable and careful forest logging method which is carried out in this study area in Kalimantan, see above. As can be seen, only about 15% of the area is logged, and is soon replanted with high quality timber trees. Even though the logging is so careful, it is detected as decreased SAR heights. Hence, forest degradation can be detected, and this is difficult to see in commonly used satellite imagery, i.e. optical data. This result is from a spruce forest in Norway. 3D RADAR imagery should in this way be a valuable technical development for REDD.

SAR data are also superior by seeing through clouds.

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