

***Forest Resources Assessment  
using Synthetic Aperture Radar***

**FRASAR**

**2010**

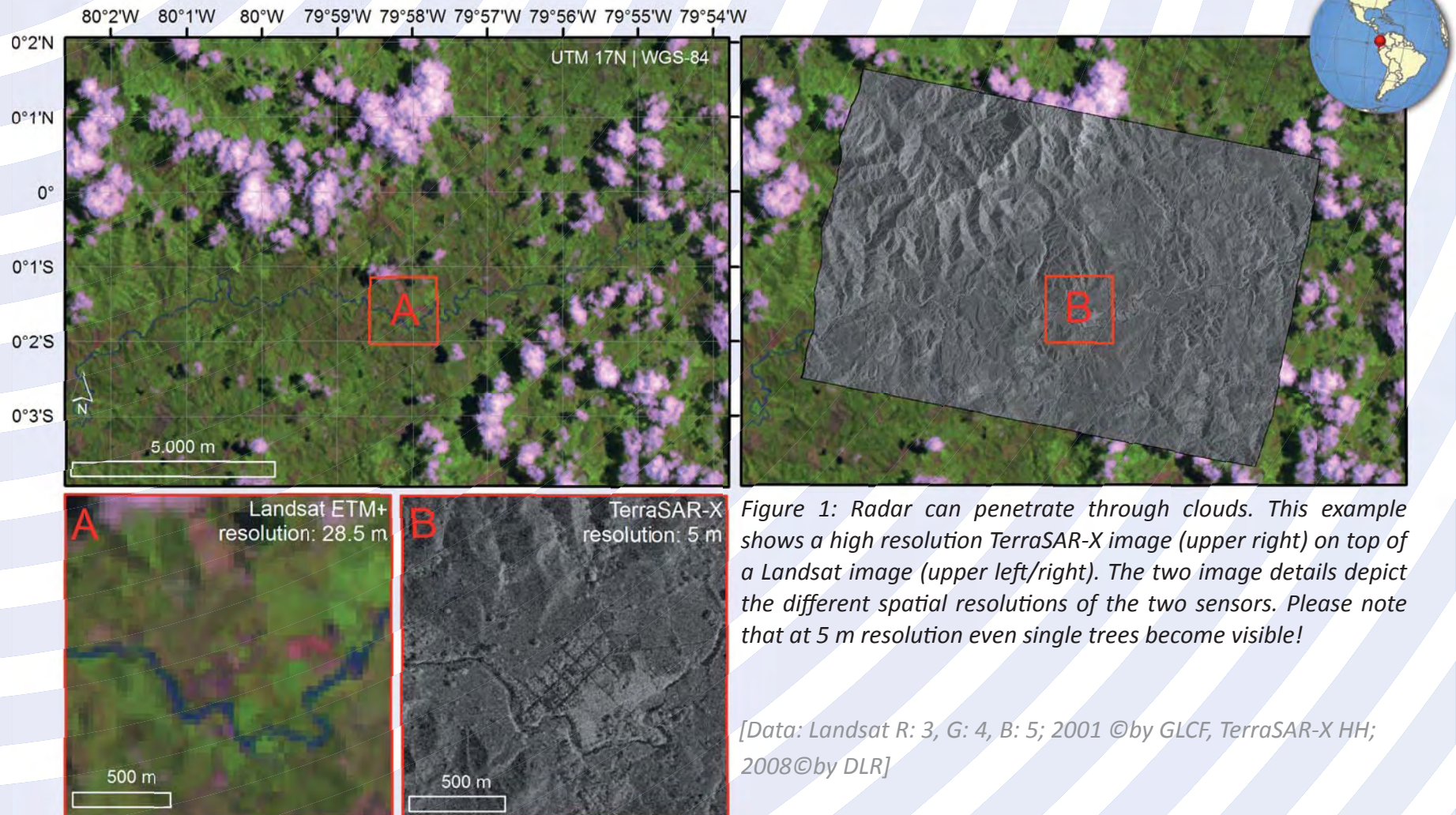


# Project Background

**F**RA-SAR 2010 was initiated to support the Forest Resources Assessment (FRA) of the United Nations Food and Agriculture Organization (FAO). An essential part of the present and all future FRAs is a global Remote Sensing Survey

(RSS) to estimate the world forest cover and trends using multispectral Landsat time series data. However, about 25 percent of the tropical RSS samples always exhibit a nearly persistent cloud cover (cf. Fig. 1, 2). To overcome the resulting limitations,

FRA-SAR 2010 uses space borne Synthetic Aperture Radar (SAR) with very high resolution. Because SAR sensors use much longer wavelengths, they can be applied to operate almost independently of any atmospheric condition.



# Investigation Areas

Based on cloud cover probability, about 300 test sites were spread across three major tropical regions, i.e. Central and

South America, tropical West-Africa and South-East Asia (cf. Fig 2). They have been selected in such a way to not only account

for cloud cover, but to include many different land cover types as well.

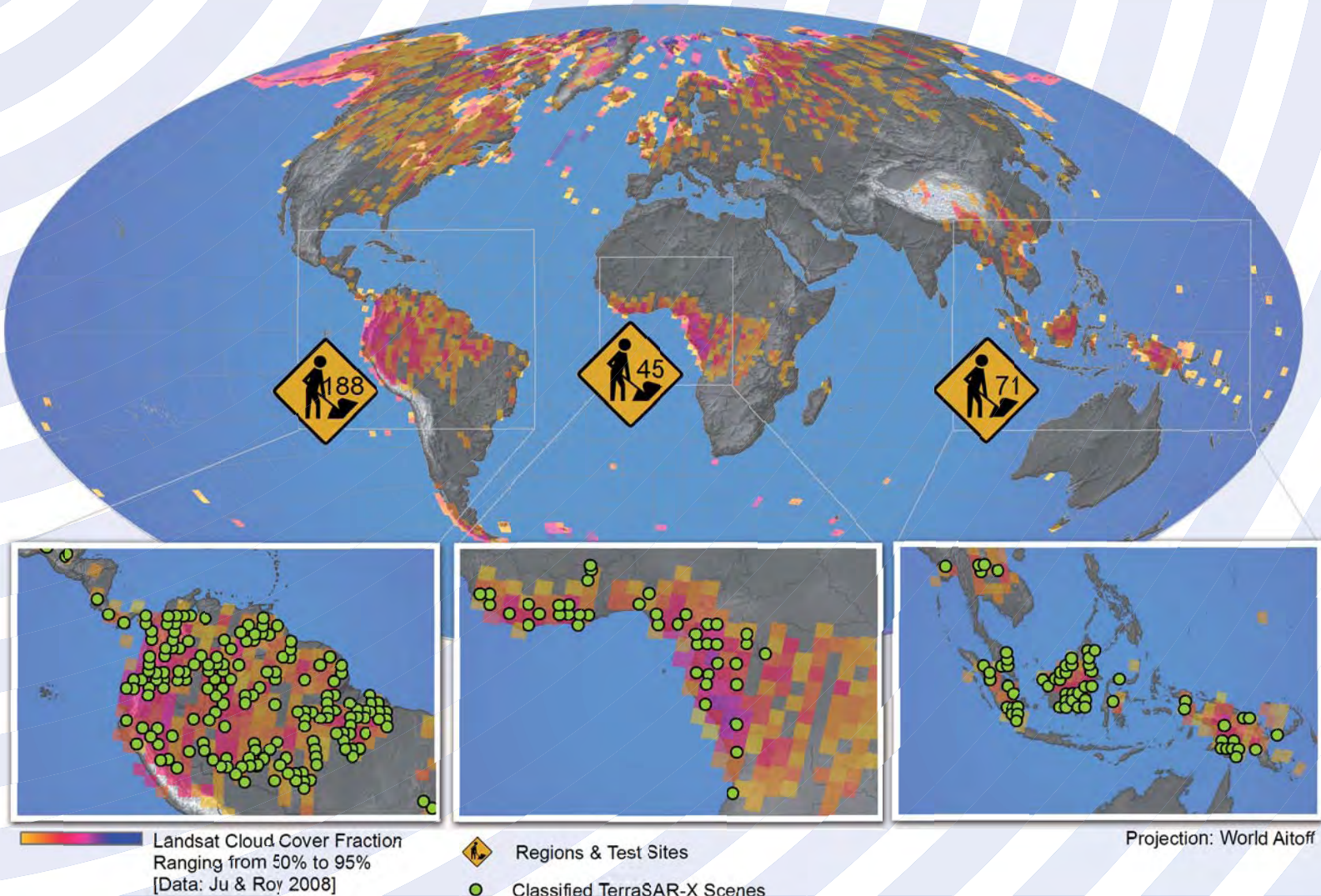
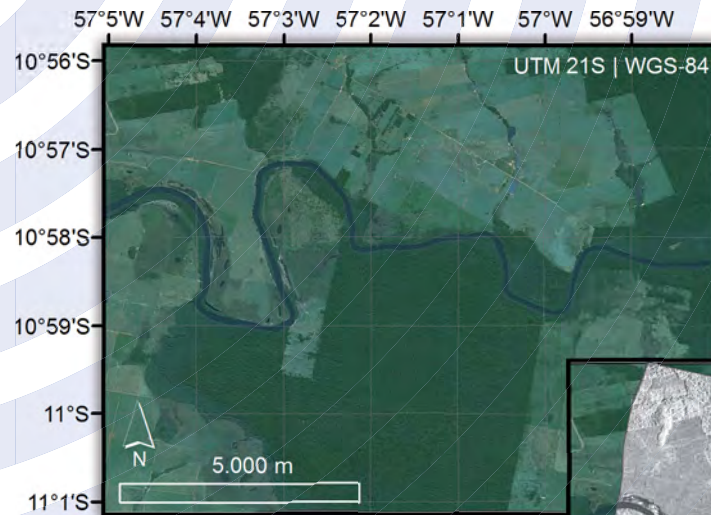


Figure 2: Persistent cloudy regions and the FRA-SAR 2010 test sites.



## Validation

Any mapping effort is incomplete without validation. Therefore, freely available optical reference images from Landsat and Quickbird were used



as source of reference in a stratified random sampling approach. The desired overall accuracy for our forest/non-forest classification is always better than 70 percent. Taking into account that the classification is derived from one band and single date imagery only, this really is a good result! In many scenes even more complex land cover classes have been picked up quite well by the developed algorithms (cf. Tab. 1).

## Classification

Between 2008 and 2011 more than 300 TerraSAR-X images with a spatial resolution of about 2 m have been acquired to derive forest cover maps. One primary goal in the mapping process was to develop automated algorithms. Consequently, the methodology can be described as a two stage process. Within the first step the images have been processed to various texture measures based on the very nice high geometric resolution. Afterwards, a complex feature selection procedure was applied to bring only the most useful textures into the second stage, where the land cover has been classified according to FAO needs using an object based methodology (cf. Fig. 3).

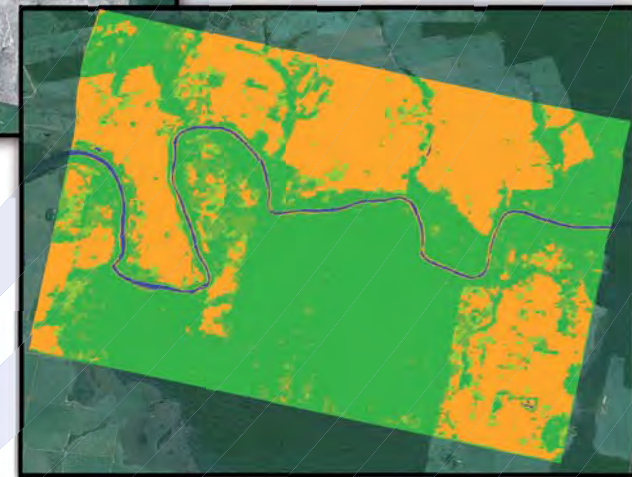


Figure 3: Qickbird image (upper left) with TerraSAR-X image overlay (middle) and FRA-SAR 2010 final classification (lower right).

# Accuracy

Table 1: Accuracy assessment results for the comparison with available Landsat data.

	Tree Cover 1-10%	Tree Cover 11-70%	Tree Cover 71-100%	Other Land	Water	No data	Totals
Tree Cover 1-10%	118	116	166	195	3	33	631
Tree Cover 11-70%	92	456	444	264	8	106	1370
Tree Cover 71-100%	110	499	1769	247	18	192	2835
Other Land	95	202	228	558	15	61	1159
Water	1	10	4	6	68	17	106
No data	0	0	0	0	0	0	0
Totals	416	1283	2611	1270	112	409	6101
<b>Overall accuracy =</b>							<b>0,49</b>
<b>Overall accuracy without „no data“ =</b>							<b>0,52</b>

	Tree Cover 1-10%	Tree Cover 11-100%	Other	Water	Totals
Tree Cover 1-10%	118	282	195	3	598
Tree Cover 11-100%	202	3168	511	26	3907
Other Land	95	430	558	15	1098
Water	1	14	6	68	89
Totals	416	3894	1270	112	5692
<b>Overall accuracy =</b>					<b>0,69</b>

	Forest	No Forest	Totals
Forest	3168	739	3907
No Forest	726	1059	1785
Totals	3894	1798	5692
<b>Overall accuracy =</b>			<b>0,74</b>

## Future Outlook

In the near future an aspired multi-temporal coverage will make these results even better! Because having images of two or more dates opens the door to other investigation methods, i.e. (i) coherence analysis helping to identify urban areas more precisely, (ii) interferometric

techniques making even height measurements possible. In addition, the availability of digital elevation models with a better resolution will enhance the classification, as well the accessibility of better training data provided by the results of FAOs present RSS will improve the classification

algorithms. Two or more images of the same area, better DEM and better training data, therefore, will provide an excellent investigation opportunity and consequently enhance the possibilities immensely.

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