ALOS K&C Activities in Sweden

Dr. Johan Fransson, Dr. Mattias Magnusson,
Prof. Håkan Olsson
Swedish University of Agricultural Sciences (SLU)

Prof. Lars Ulander, Dr. Leif Eriksson,
Klas Folkesson, Gustaf Sandberg
Chalmers University of Technology (Chalmers)

ALOS K&C Initiative – Meeting 9,
JAXA, RESTEC HQ, Roppongi, Japan,
21-24 January, 2008

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Outline

- Goals
- Local study and Prototype areas (regions)
- Time table
- Detection of forest changes
- Summary
- Estimation of forest stem volume
- Summary
- Cal/Val publications

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Goals

- Develop and evaluate methods for large-scale mapping and monitoring of forest change
- Main focus will be on detecting clear-cuts in boreal forest
- If successful for the Prototype areas (regions) the goal is to use the methodology operationally for the whole of Sweden

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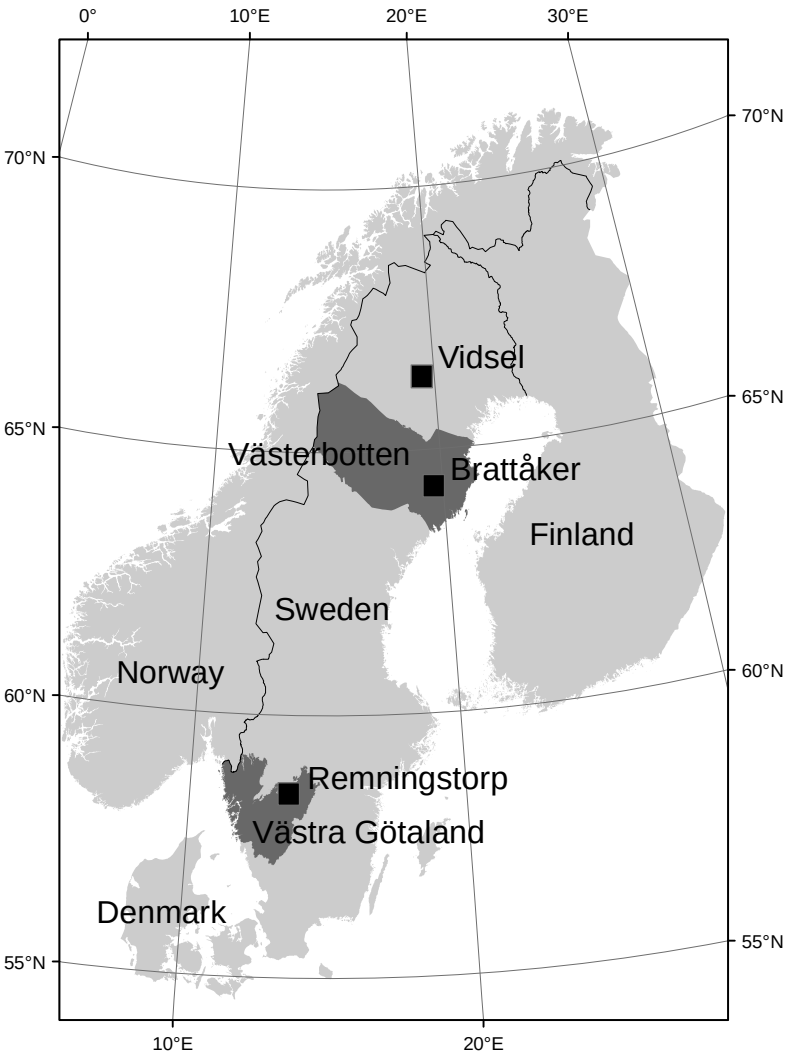
Local study and Prototype areas



Local study areas for methodology development

- Remningstorp
- Brattåker

Prototype areas (regions)

- Västra Götaland county
- Västerbotten county

Possible extension

- The whole of Sweden

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Time table – Swedish ALOS activities

- 2004-2005: Pre-ALOS studies with JERS-1 data
- Dec. 2005: Funding from the Swedish National Space Board for ALOS activities during 2006-2007
- Jan. 2006: ALOS launch
- Apr. 2006: Deployment of reflectors for ALOS Cal/Val
- Aug. 2006: Controlled cutting, wind-throw and thinning of forest stands
- Oct. 2006: ALOS declared operational
- Dec. 2006: Clearing of "simulated" wind-thrown forest
- 2007: Cal/Val and K&C methodology development
- 2008-2009: Main focus on K&C on a regional scale

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Data supply

- Local testsites (Remningstorp and Bråttaker)

Single images	Prototype area 1 Remningstorp		Prototype area 2 Brattåker
Mode	Ordered	Delivered	Ordered
PLR21.5	12	12	5 (PLR)
FBS21.5	3	2	19 (FBS)
FBS34.3	16	11	
FBD34.3	6	6	6 (FBD)
FBS41.5	5	1	
FBD41.5	4	2	
FBD50.8	2	2	
WB1 5Scan	6	4	2 (WB1)
	54	40	

- Prototype area (Västra Götaland and Västerbotten county)

Strip data	Prototype area 1 Västra Götaland county		Prototype area 2 Västerbotten County	
Cykle	RSP delivered	RSP missing	RSP delivered	RSP missing
9	627, 632, 633	628, 629, 630, 631, 634	611, 617, 621, 623	613, 615, 619
13	627, 628, 629, 630, 631, 632, 633	634	611, 613, 615, 617, 619, 621	623
14	627, 628, 629, 630, 631, 632, 634	633	611, 613, 615, 619, 621	617, 623

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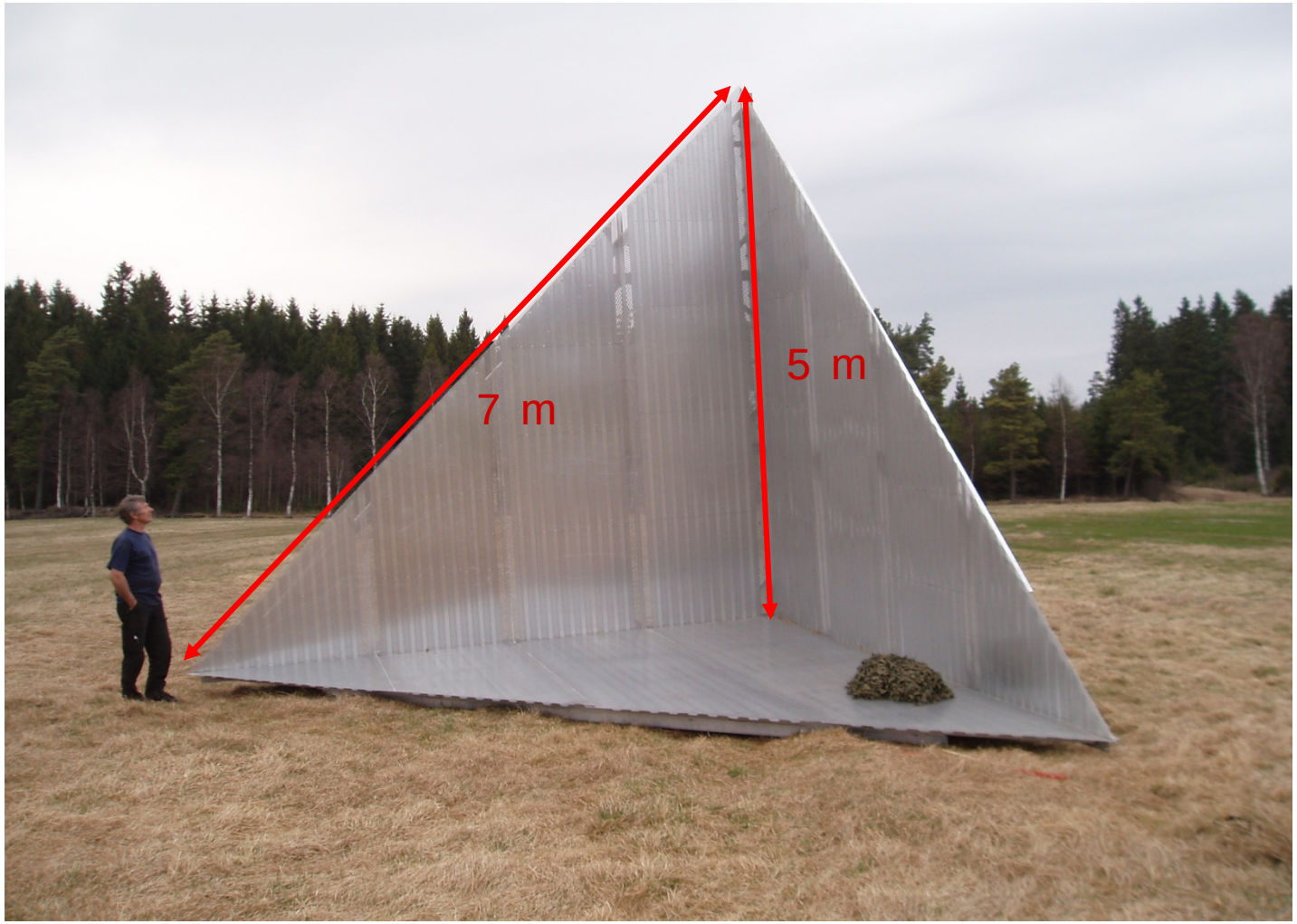
Four trihedral corner reflectors



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Directing the trihedrals

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Results from the local
study area Remningstorp

IGARSS07 - Barcelona

1. Fransson, J.E.S., Magnusson, M., Olsson, H., Eriksson, L.E.B., Sandberg, G., Smith-Jonforsen, G., and Ulander, L.M.H. 2007. Detection of forest changes using ALOS PALSAR satellite images. In Proceedings of IGARSS 2007 Symposium, Sensing and Understanding Our Planet, Barcelona, Spain, 23-27 July, 2007.

BioGeoSAR07- Bari

2. Eriksson, L.E.B., Fransson, J.E.S., Magnusson, M., Sandberg, G., Ulander, L.M.H., and Olsson, H. 2007. Detection of changes in boreal forest using SAR data from ALOS PALSAR and JERS-1. In Proceedings of Retrieval of Bio- and Geophysical Parameters from SAR Data for Land Applications, Bari, Italy, 25-28 September, 2007. Poster

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Remningstorp – FBS 34.3° HH

Acquisition Date	ALOS PALSAR FBS 34.3° HH		
	RSP number	***Orbit type***	***Season***
2006-06-08	304	Descending	Summer
2006-07-07	303	Descending	Summer
2006-09-08	304	Descending	Fall
2006-10-07	303	Descending	Fall
2006-12-31	630	Ascending	Winter
2007-01-29	629	Ascending	Winter
2007-02-15	630	Ascending	Winter

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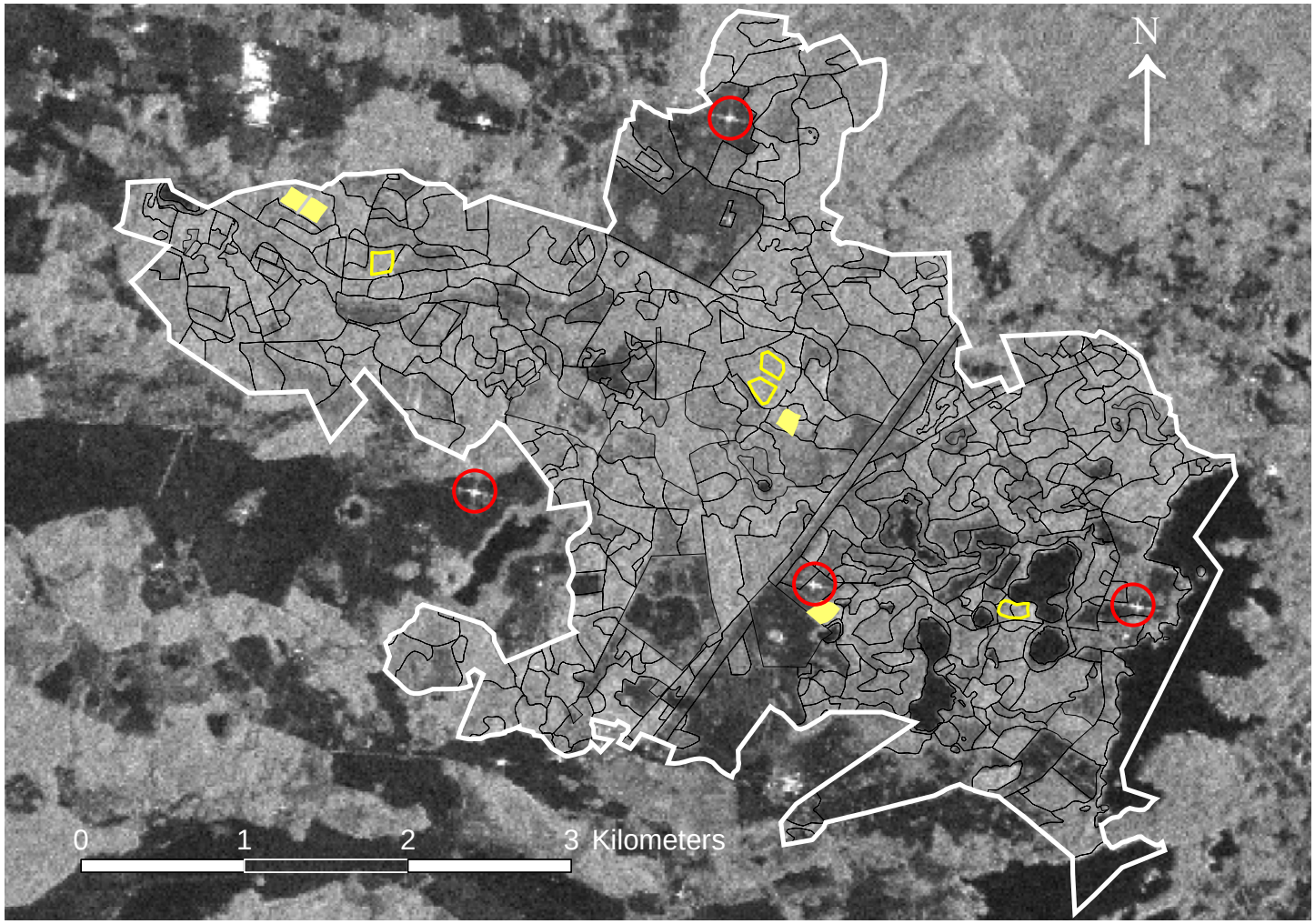
Remningstorp – FBS 34.3° HH



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Remningstorp – stands

4 reference forest stands

Old spruce forest stand prior to treatment

Artificially wind-thrown forest stand

4 treated forest stands

Clear-felled forest stand

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Artificially wind-thrown stand (UAV)

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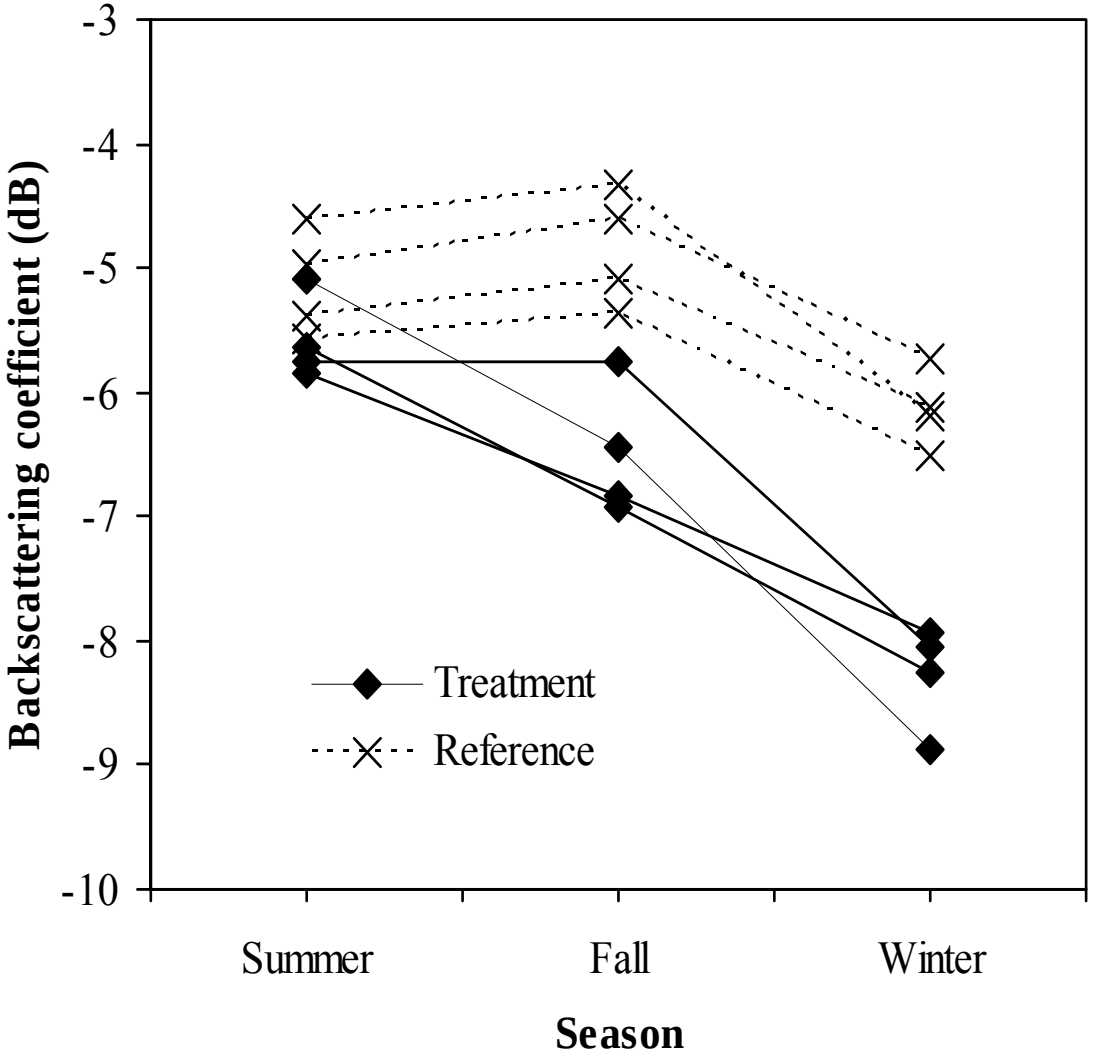
FBS 34.3° HH



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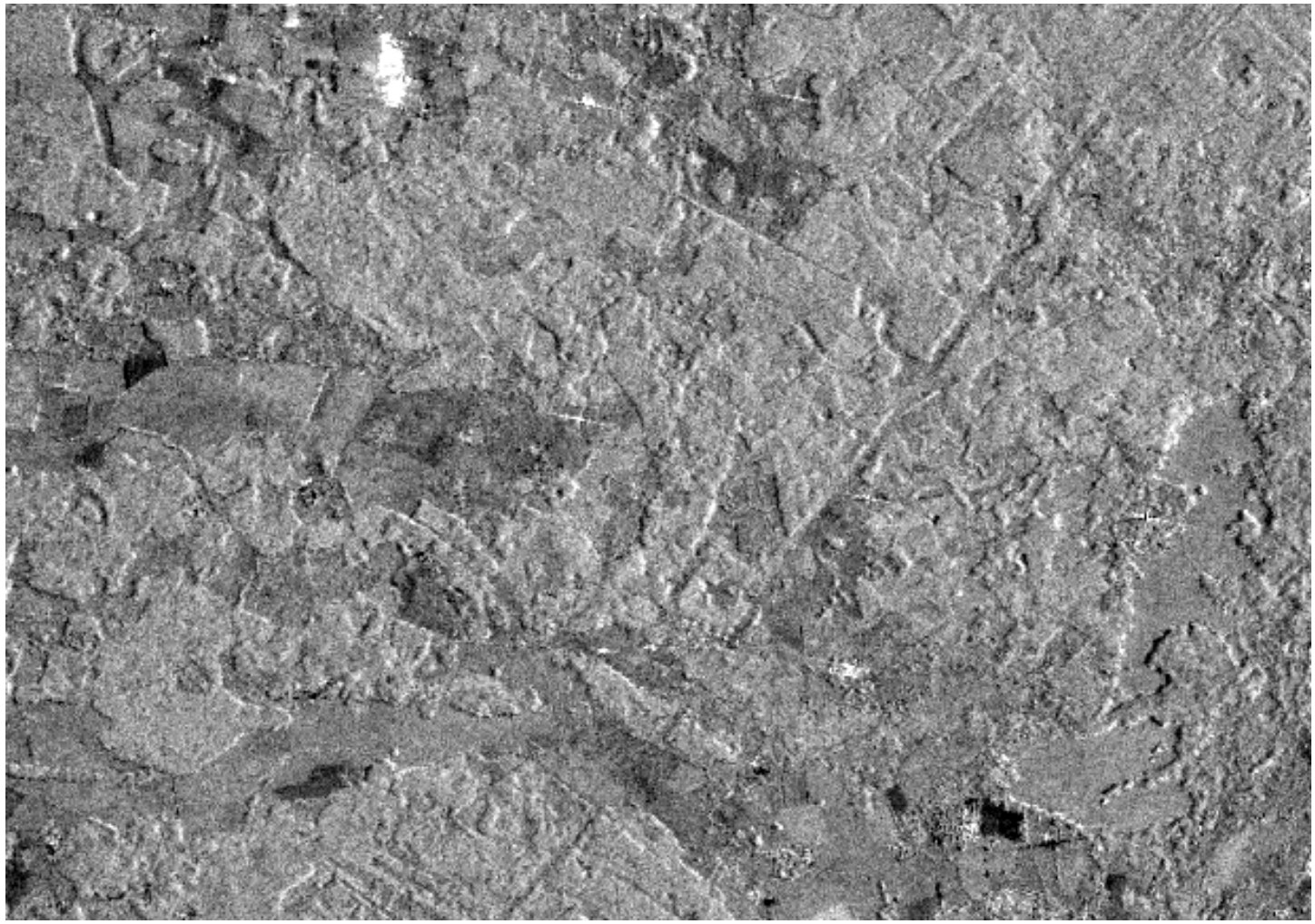
Diff. FBS 34.3° HH image (desc. – asc.)



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Summary – study 1 and 2

- The results indicate that FBS 34.3° HH images can be used for large-scale mapping of clear-felled stands ≥ 1.5 ha
- The difference in backscattering coefficient between the reference and the clear-felled stands during the winter season was calculated to 2.1 dB (2.7 dB)
- Ideally, change detection should be made using SAR images acquired with the same orbit type (ascending or descending) and hence radar imaging geometry

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Summary – study 1 and 2 (cont.)

- Even though a difference in backscattering coefficient between the reference and the artificially wind-thrown stands was observed, it is not likely that the investigated FBS images could be used for reliable mapping of small wind-thrown areas (about 1.5 ha)
- More stands and images together with meteorological data registered at the test site need to be analyzed

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IGARSS07 - Barcelona

3. Magnusson, M., Fransson, J.E.S., Eriksson, L.E.B., Sandberg, G., Smith-Jonforsen, G., and Ulander, L.M.H. 2007. Estimation of forest stem volume using ALOS PALSAR satellite images. In Proceedings of IGARSS 2007 Symposium, Sensing and Understanding Our Planet, Barcelona, Spain, 23-27 July, 2007.

BioGeoSAR07- Bari

4. Eriksson, L.E.B., Magnusson, M., Fransson, J.E.S., Sandberg, G., and Ulander, L.M.H. 2007. Stem volume estimation for boreal forest using ALOS PALSAR. In Proceedings of Retrieval of Bio- and Geophysical Parameters from SAR Data for Land Applications, Bari, Italy, 25-28 September, 2007.

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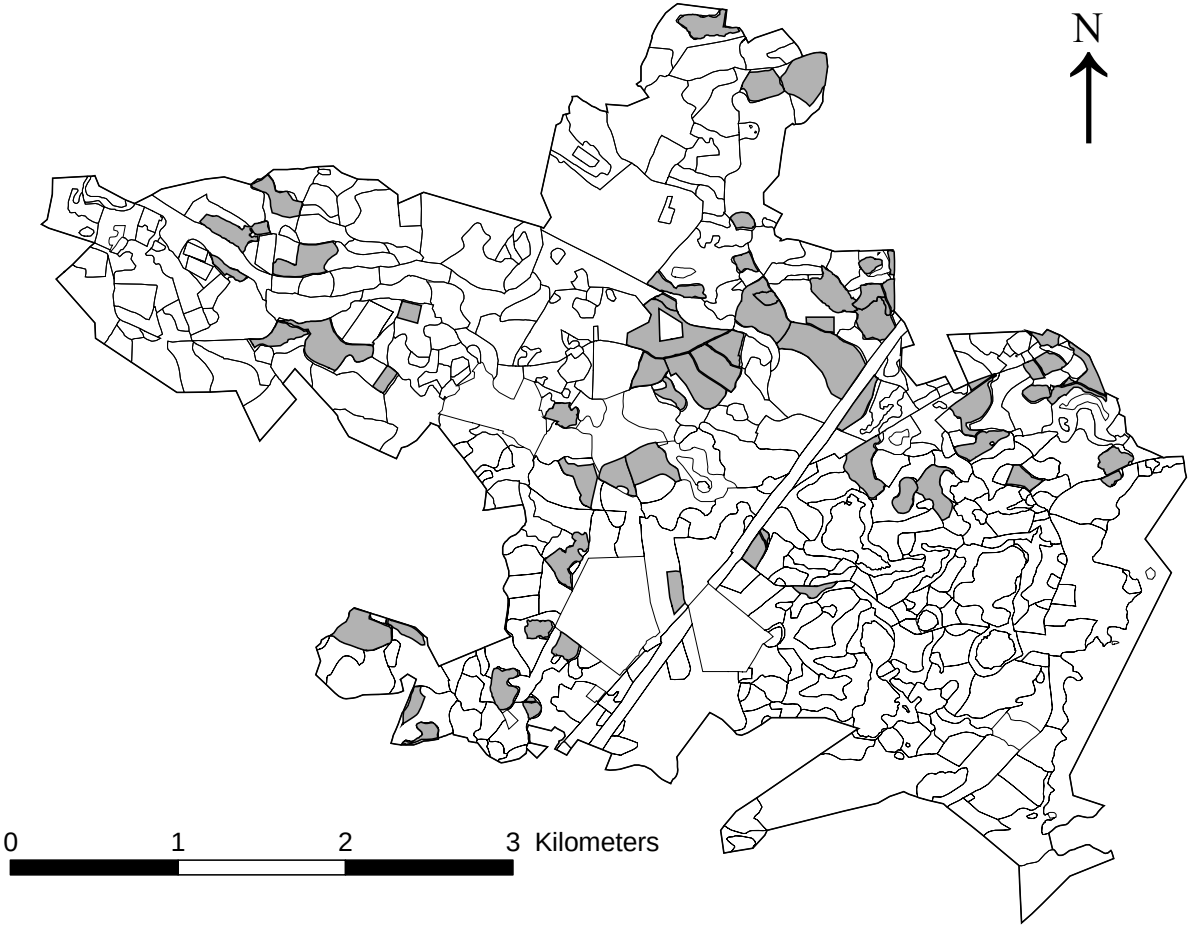
Remningstorp – 56 stands



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FBS 34.3° HH (study 1) + PLR 21.5°

Acquisition Date	ALOS PALSAR PLR 21.5° images		
	RSP number	***Orbit type***	***Season***
2006-05-20	311	Descending	Summer
2006-06-03	623	Ascending	Summer
2006-07-19	623	Ascending	Summer
2006-08-20	311	Descending	Summer
2007-10-05	311	Descending	Fall
2006-10-19	623	Ascending	Fall
2006-12-04	623	Ascending	Winter

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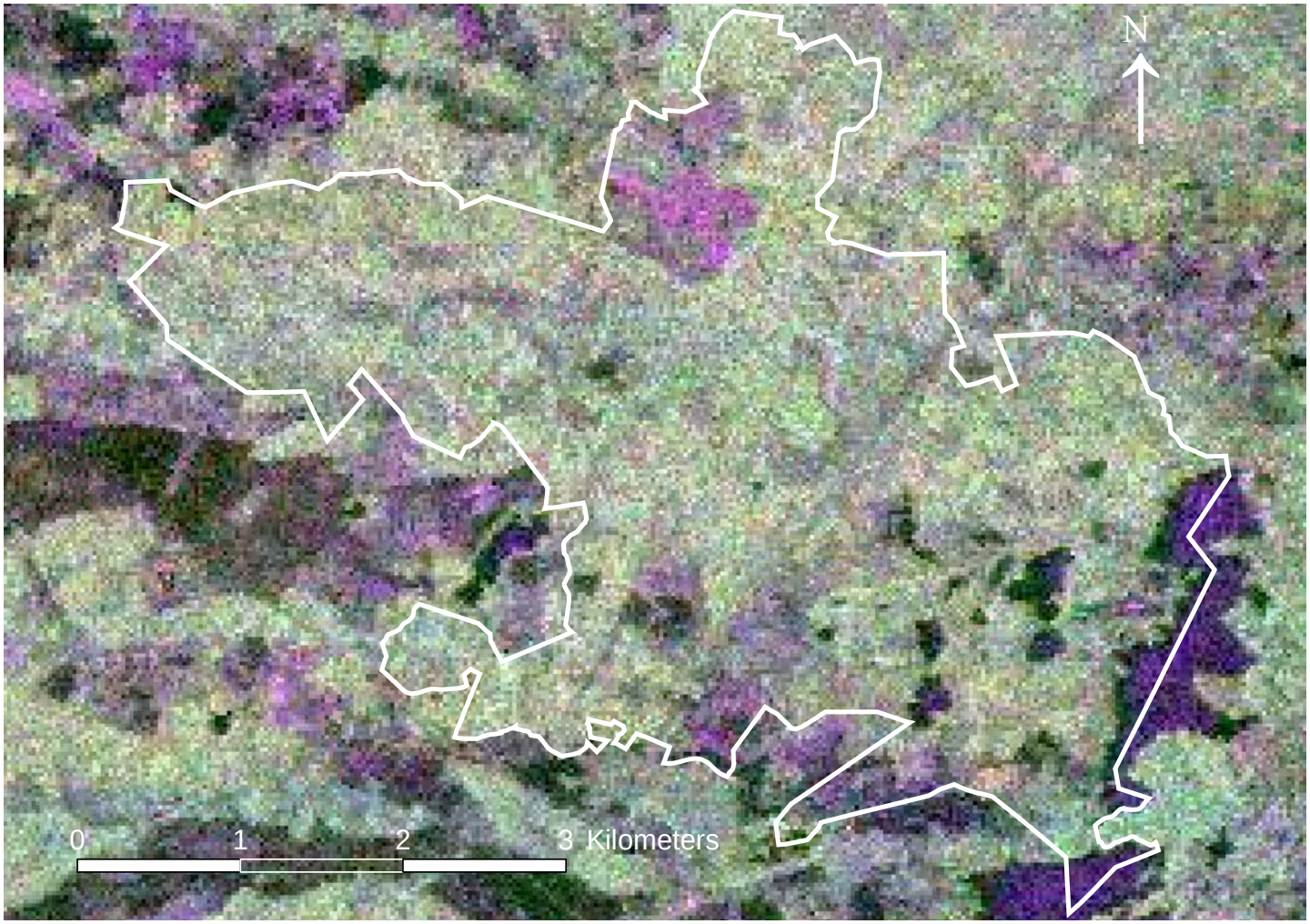
PLR 21.5° image (R,G,B – HH,HV,VV)



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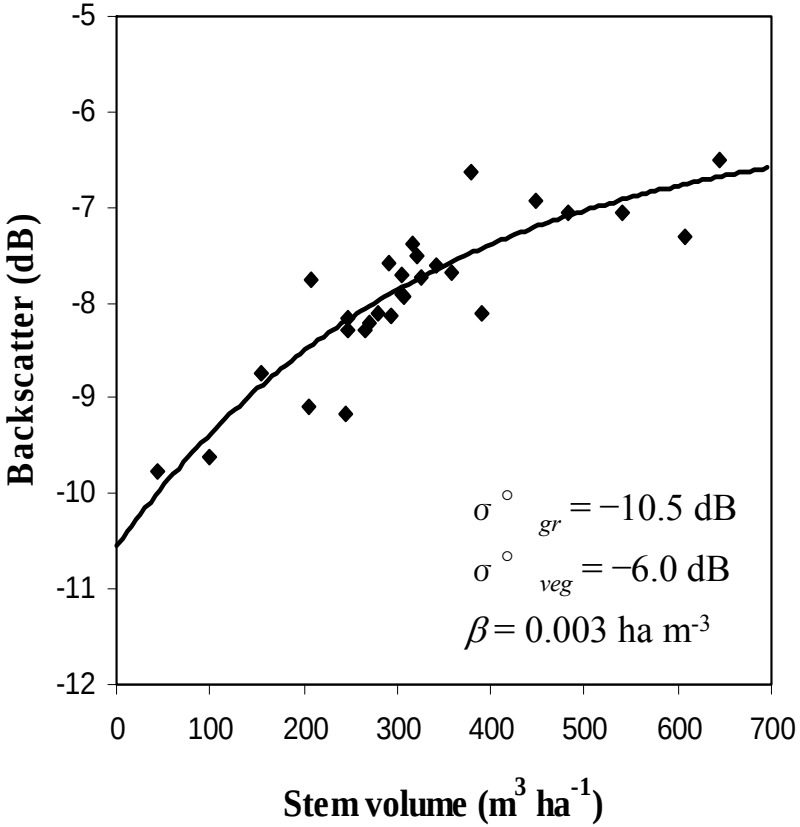
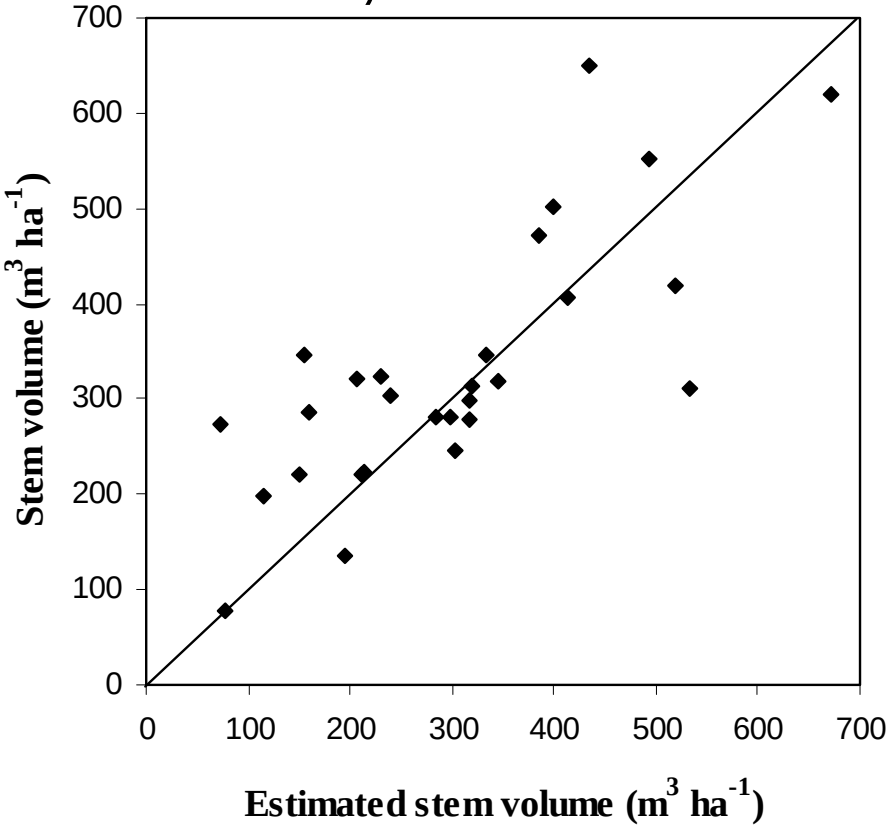
Standwise stem volume estimation

$$\sigma^{\circ}_{for} = \sigma^{\circ}_{gr} \times e^{-\beta V} + \sigma^{\circ}_{veg} \times (1 - e^{-\beta V})$$



$$\hat{V} = -\frac{1}{\beta} \times \ln\left(\frac{\sigma^{o}_{veg} - \sigma^{o}_{for,meas}}{\sigma^{o}_{veg} - \sigma^{o}_{gr}}\right)$$



FBS 34.3° HH, 2007-01-29 (best case)

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Standwise stem volume estimation

Mode and Look Angle	Best Case Investigated			
	Polari z-ation	***R^2 (%) from (1)***	***RMSE (%) from (2)***	***Number of stands that can not be estimated from (2) using the test dataset (28 stands)***
FBS 34.3°	HH	77	30	-
FBD 34.3°	HH	12	76	9
	HV	22	78	4
PLR 21.5°	HH	52	65	5
	HV	52	65	6
	VH	52	62	4
	VV	38	81	9

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Summary – study 3 and 4

- The results show that PALSAR data can be used for standwise stem volume estimation
- The difference in backscattering coefficient between the sparse and dense forest stands was found to be about 2-3 dB for the best case investigated (FBS 34.3° HH, 2007-01-29)
- The stem volume estimation accuracy for the best FBS image was found to be 30% (corresponding to 97 m^3 ha^{-1})

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Summary – study 3 and 4(cont.)

- The stem volume estimation accuracy for the best FBD and PLR images were found to be in the range of 62-81%
- The large variation in RMSE could probably be related to differences in season and weather conditions
- More stands and images together with meteorological data registered at the test site need to be analyzed

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IGARSS06/07 (Cal/Val)

- Ulander, L.M.H., Eriksson, L., Smith-Jonforsen, G., Fransson, J.E.S., and Olsson, H. 2006. ALOS calibration and validation activities in Sweden. In Proceedings of IGARSS 2006 Symposium, Remote Sensing: A Natural Global Partnership, Denver, Colorado, USA, 31 July-4 August, 2006, pp. 336-339.

- Eriksson, L.E.B., Sandberg, G., Ulander, L.M.H., Smith-Jonforsen, G., Hallberg, B., Folkesson, K., Fransson, J.E.S., Magnusson, M., Olsson, H., Gustavsson, A., and Flood, B. 2007. ALOS PALSAR calibration and validation results from Sweden. In Proceedings of IGARSS 2007 Symposium, Sensing and Understanding Our Planet, Barcelona, Spain, 23-27 July, 2007.

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ALOS PI-meeting07 (Cal/Val)

- Eriksson, L.E.B., Sandberg, G., Fransson, J.E.S., Magnusson, M., and Ulander, L.M.H. 2007. ALOS PALSAR calibration and validation activities in Sweden. In Proceedings of the First Joint PI Symposium of ALOS Data Nodes for ALOS Science Program, Kyoto, Japan, 19-23 November, 2007.

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Thank you!