ALOS K&C Activities in Sweden

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ALOS K&C Initiative – Meeting 8,
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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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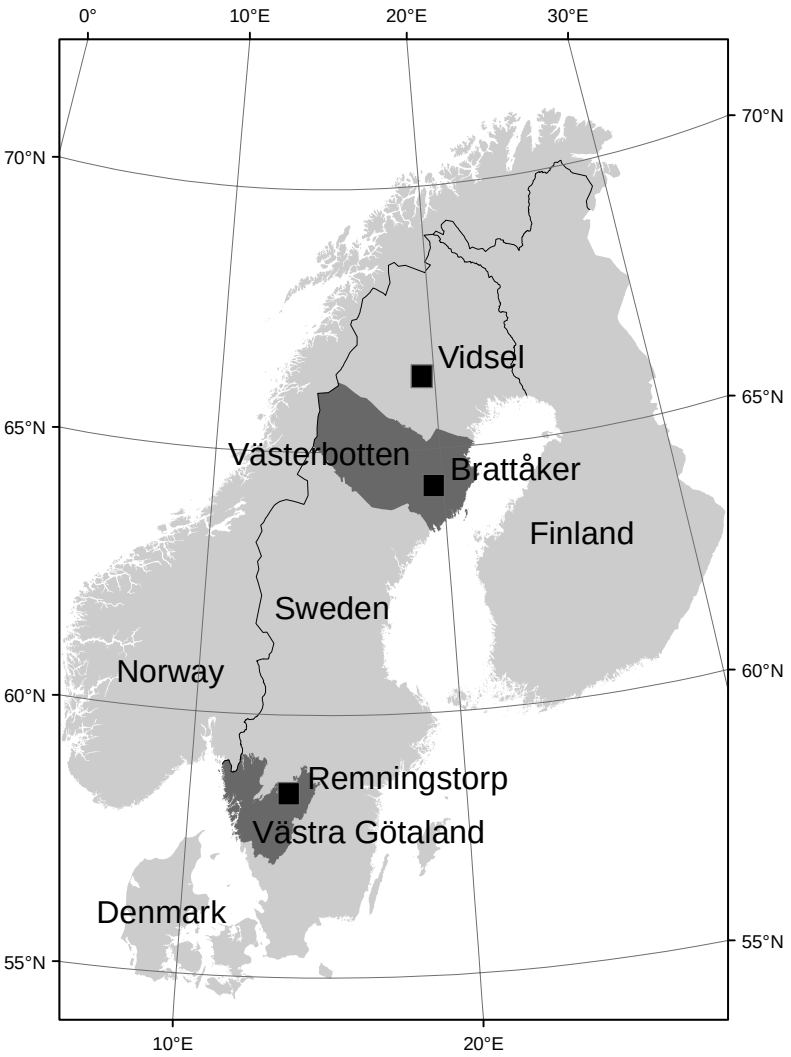
Local study and Prototype areas



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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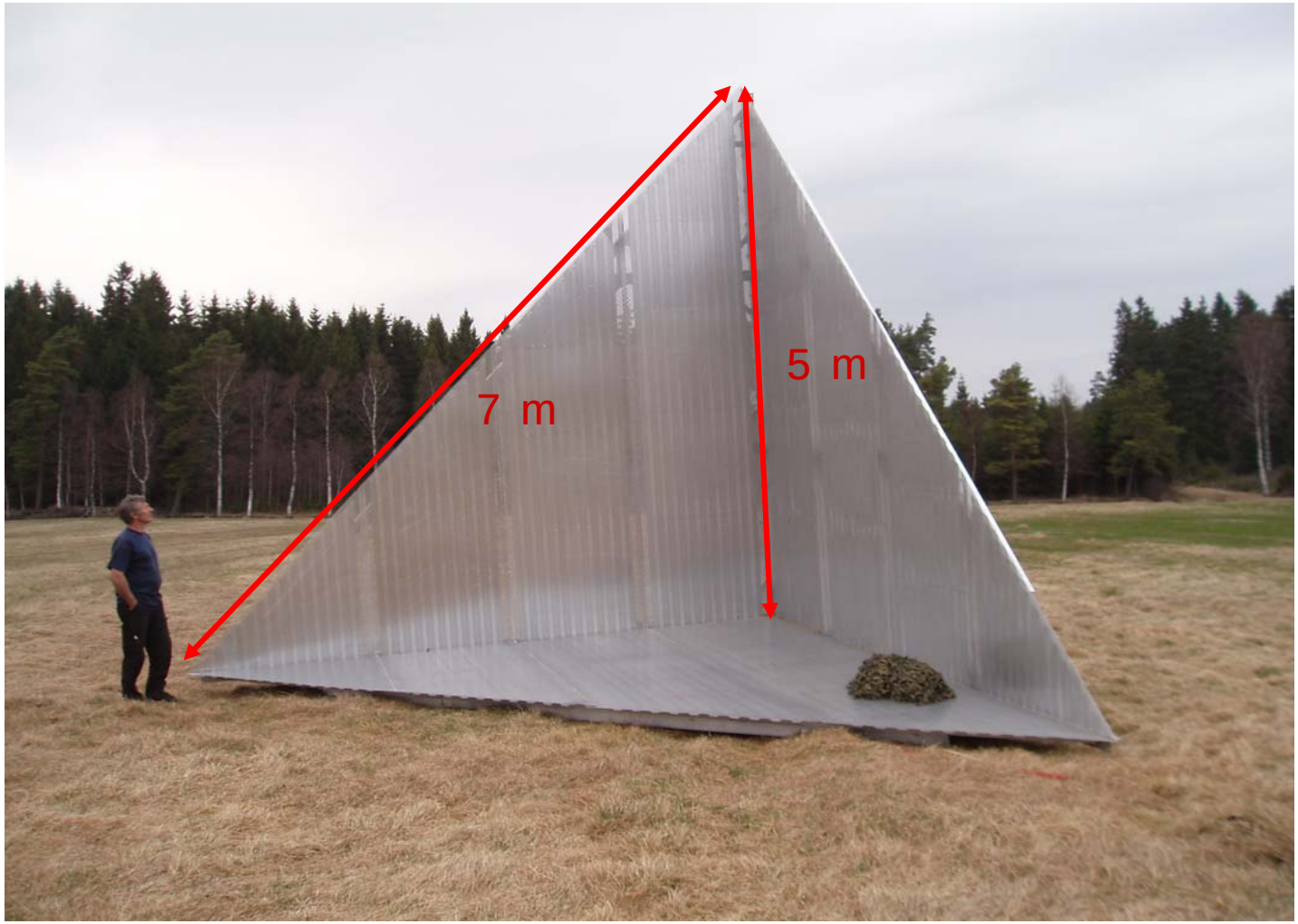
Four trihedral corner reflectors



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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.

2. 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.

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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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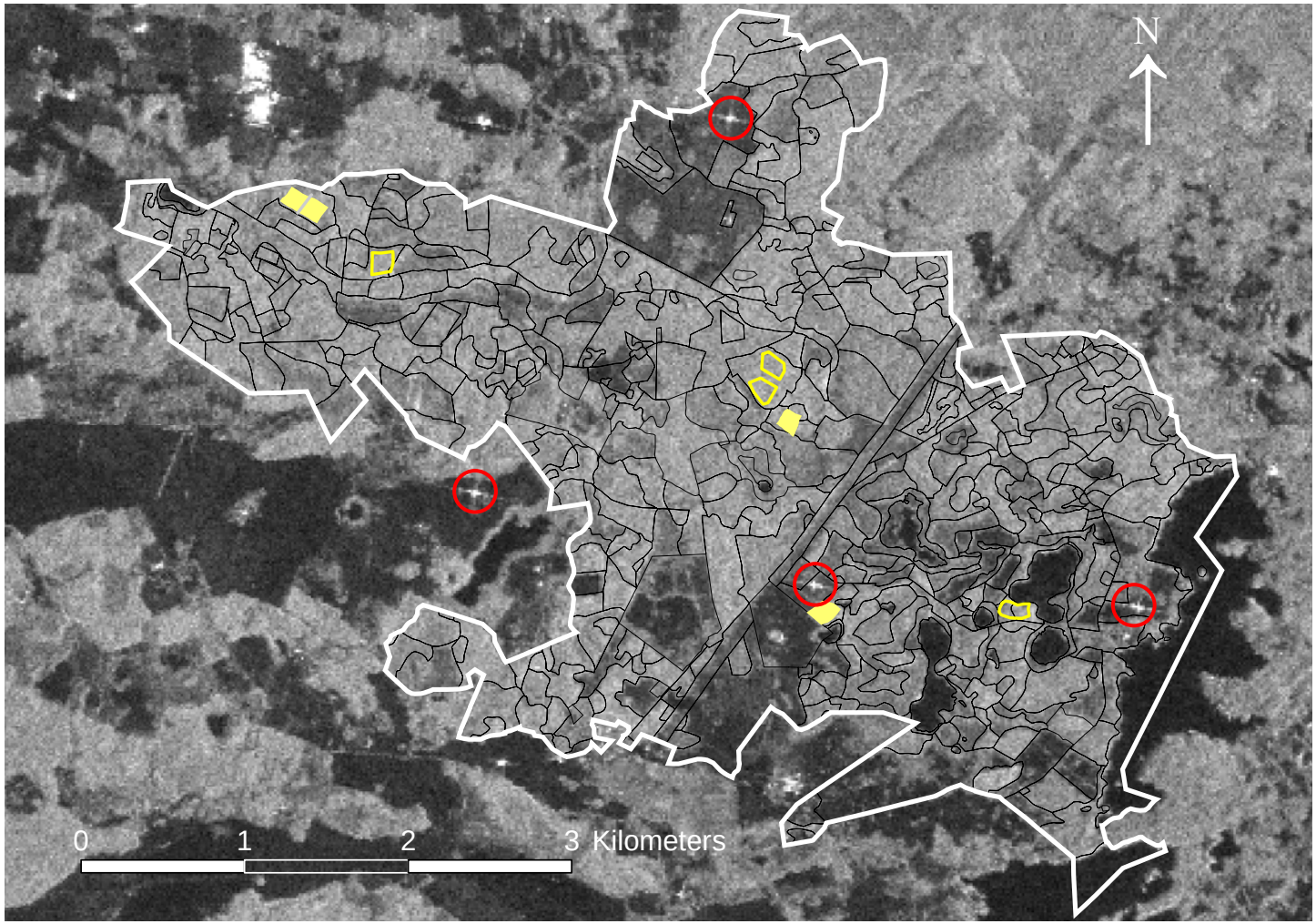
Remningstorp – FBS 34.3° HH



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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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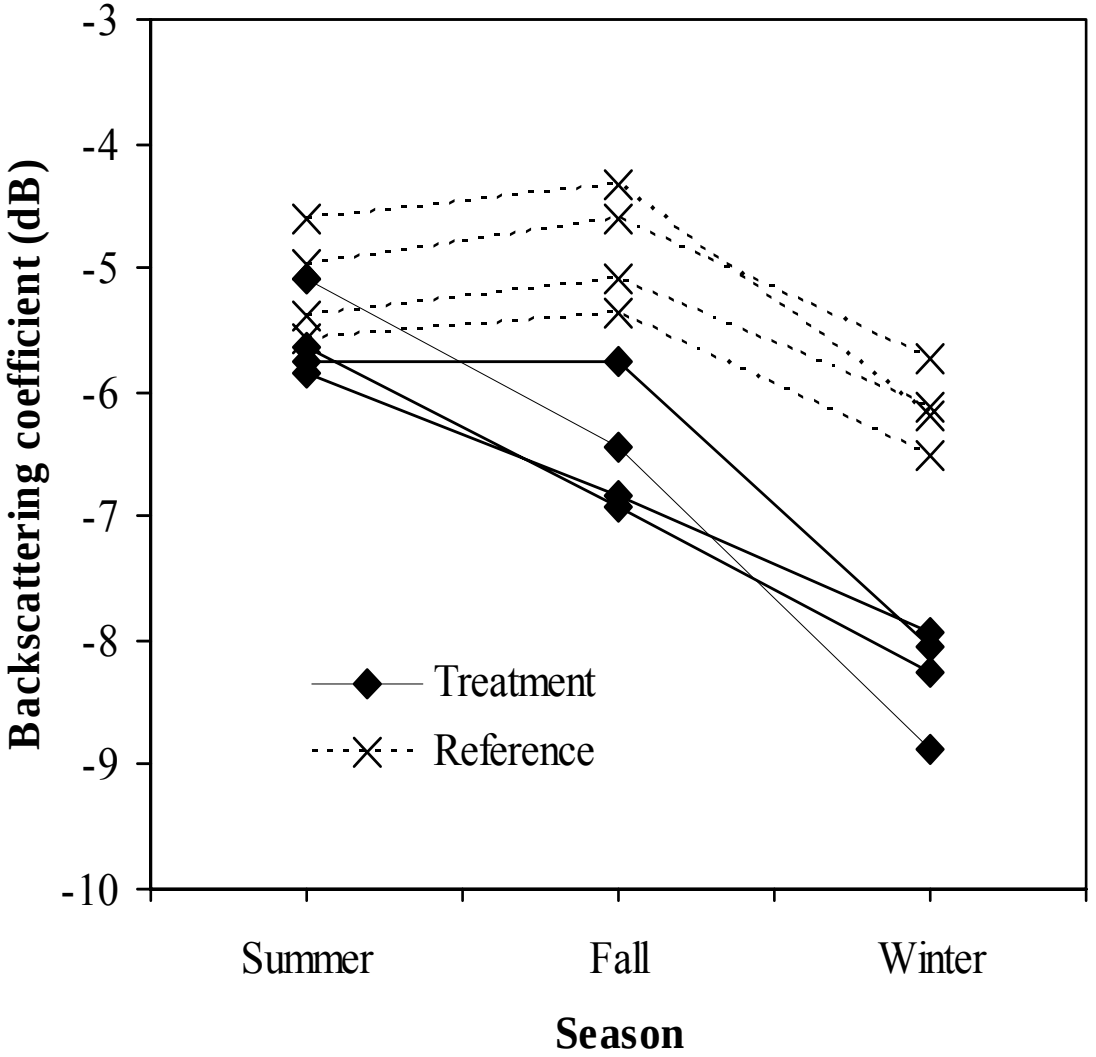
FBS 34.3° HH



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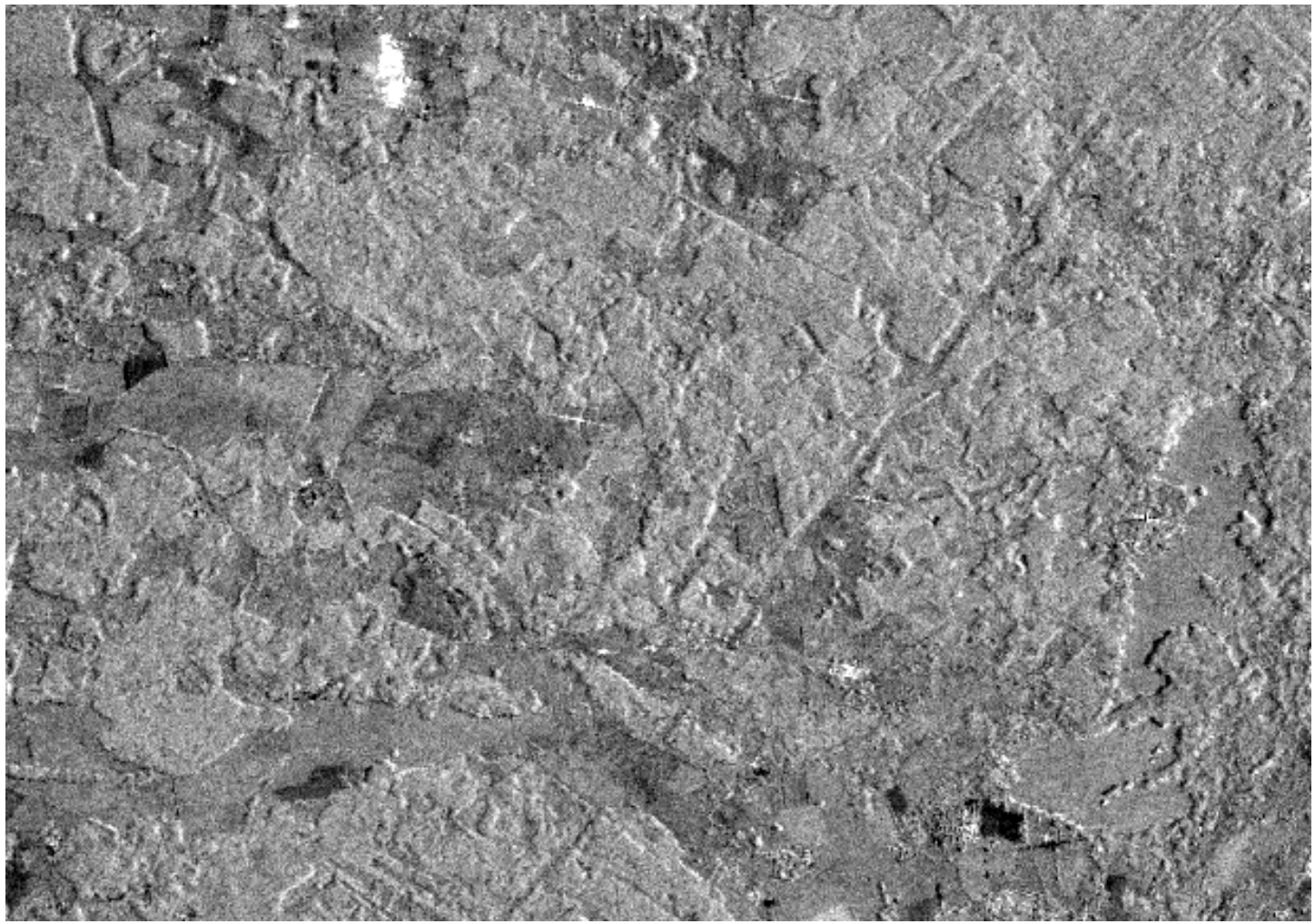
Diff. FBS 34.3° HH image (desc. – asc.)



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Summary – study 1

- 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 (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

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.

2. 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.

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Remningstorp – 58 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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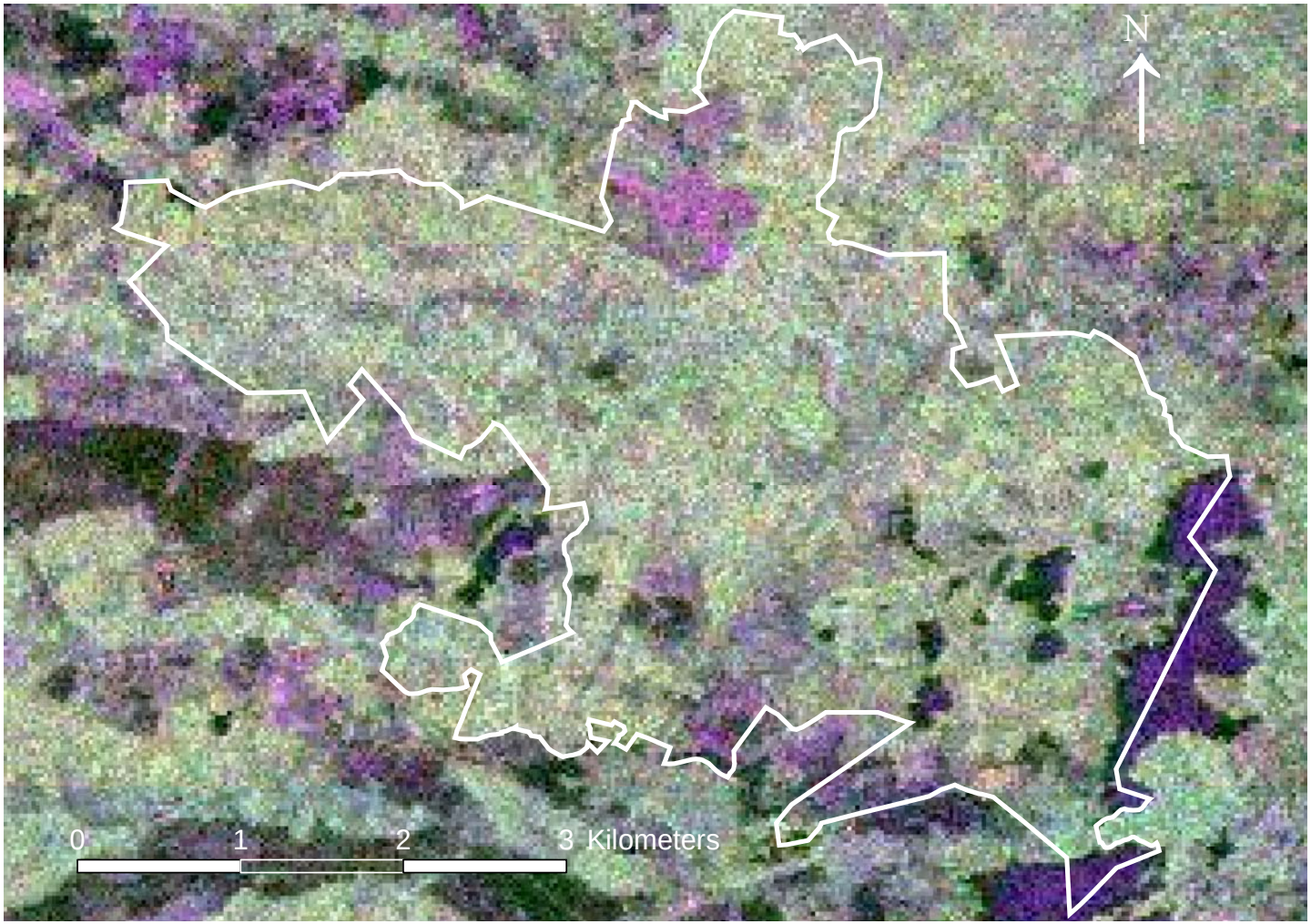
PLR 21.5° image (R,G,B – HH,HV,VV)



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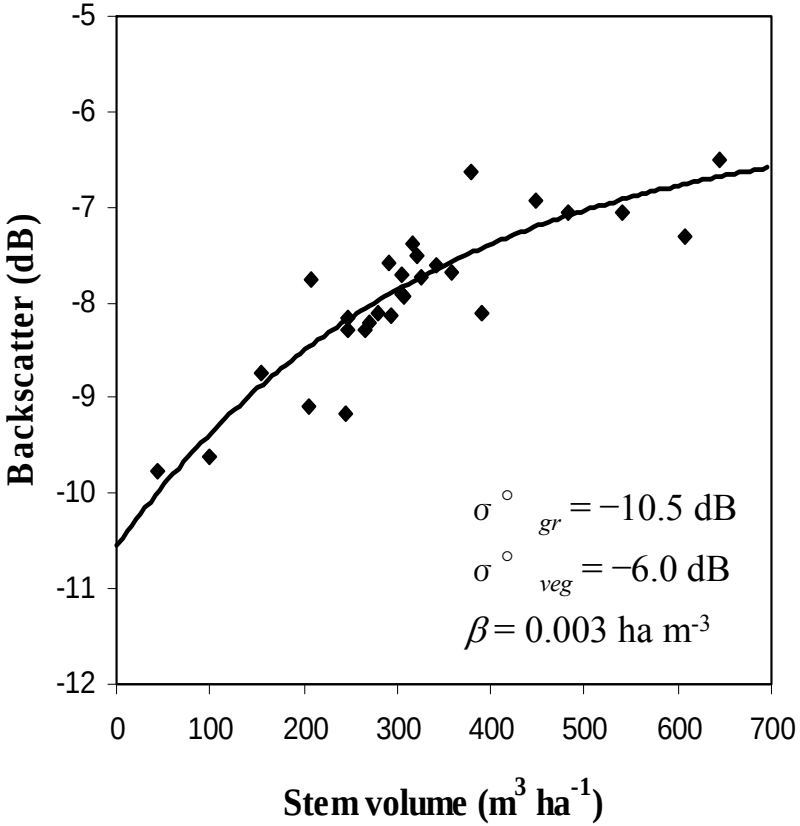
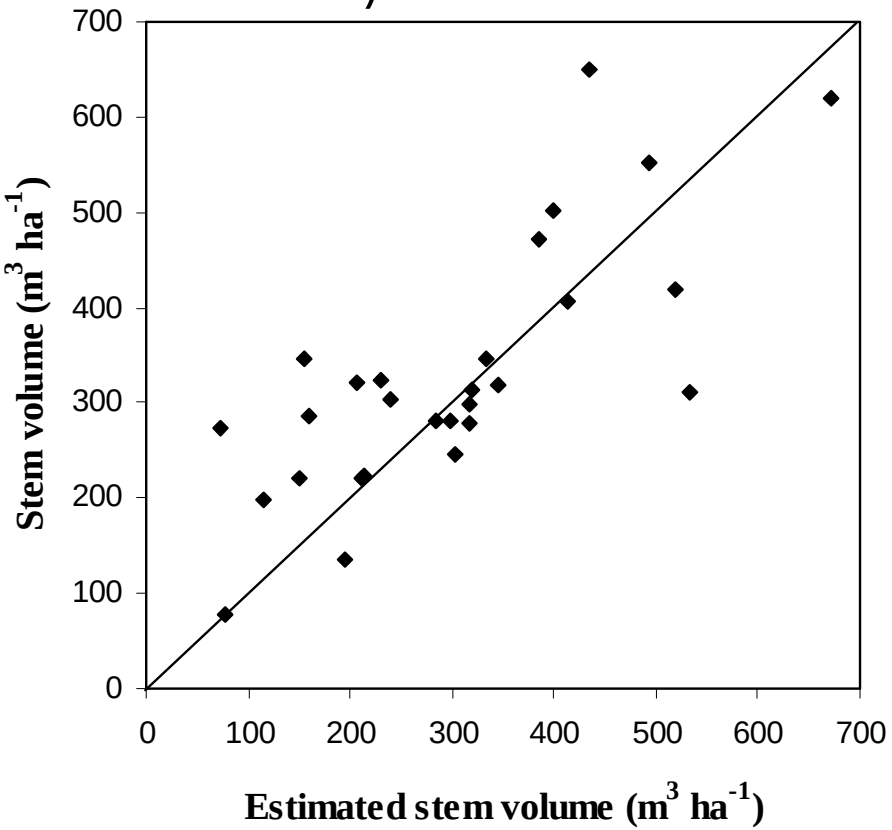
Standwise stem volume estimation

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



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



FBS 34.3° HH, 2007-01-29 (best case)

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Standwise stem volume estimation

Mode and Look Angle	Best Case Investigated			
	Polariz-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	-
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 2

- 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 2 (cont.)

- The stem volume estimation accuracy for the best 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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Thank you!