

Report on Kyoto & Carbon Initiative Project

Change detection in Swedish forest

Johan Fransson, Anders Krantz, Mattias Magnusson and Håkan Olsson

Swedish University of Agricultural Sciences, Sweden

Leif Eriksson and Lars Ulander

Chalmers University of Technology, Sweden

Maurizio Santoro

GAMMA Remote Sensing, Switzerland



Introduction

Project objective:

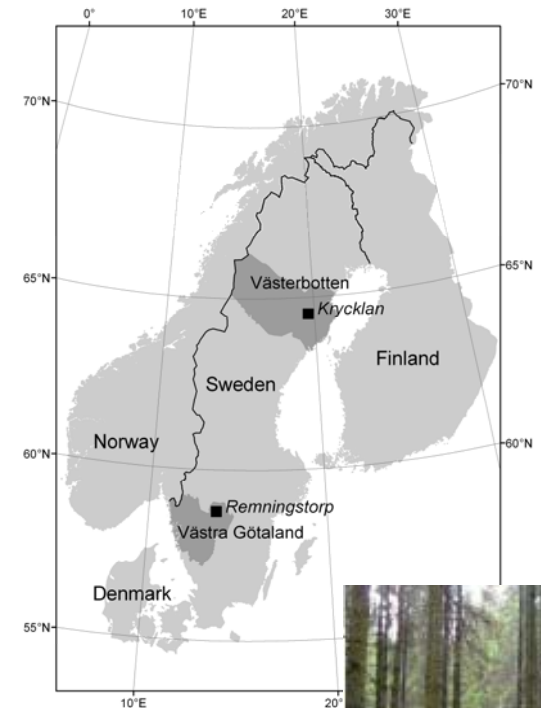
Develop and evaluate methods for large-scale mapping and monitoring of boreal forest with focus on clear-cut detection

Background:

L-band SAR data has potential for detection of forest cover changes, in particular HV-polarization

Project region:

Counties of Västerbotten and Västra Götaland, Sweden



Johan Fransson, Anders Krantz, Mattias Magnusson and Håkan Olsson, SLU, Sweden

Leif Eriksson and Lars Ulander, Chalmers University of Technology, Sweden

Maurizio Santoro, GAMMA Remote Sensing, Switzerland



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PALSAR dataset

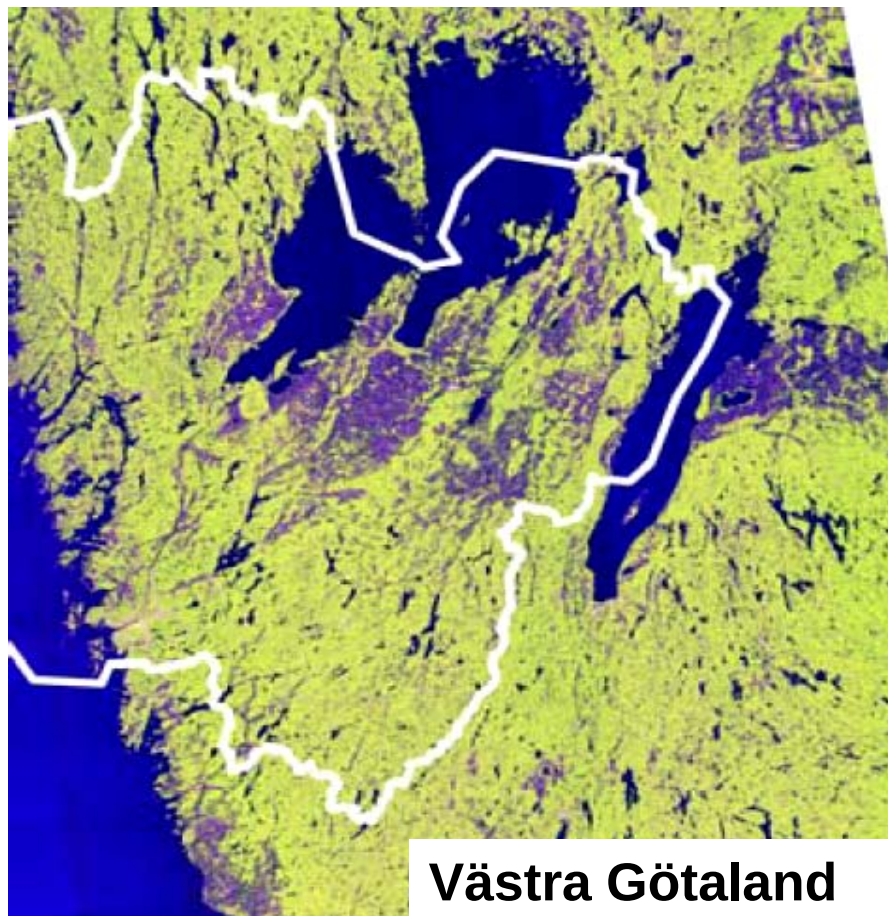
K&C data strips for the prototype areas

- FBS 34 HH mode during winter (1 cycle per year)
- FBD 34 HH and HV during summer/fall (2 cycles per year)
- Full coverage each season

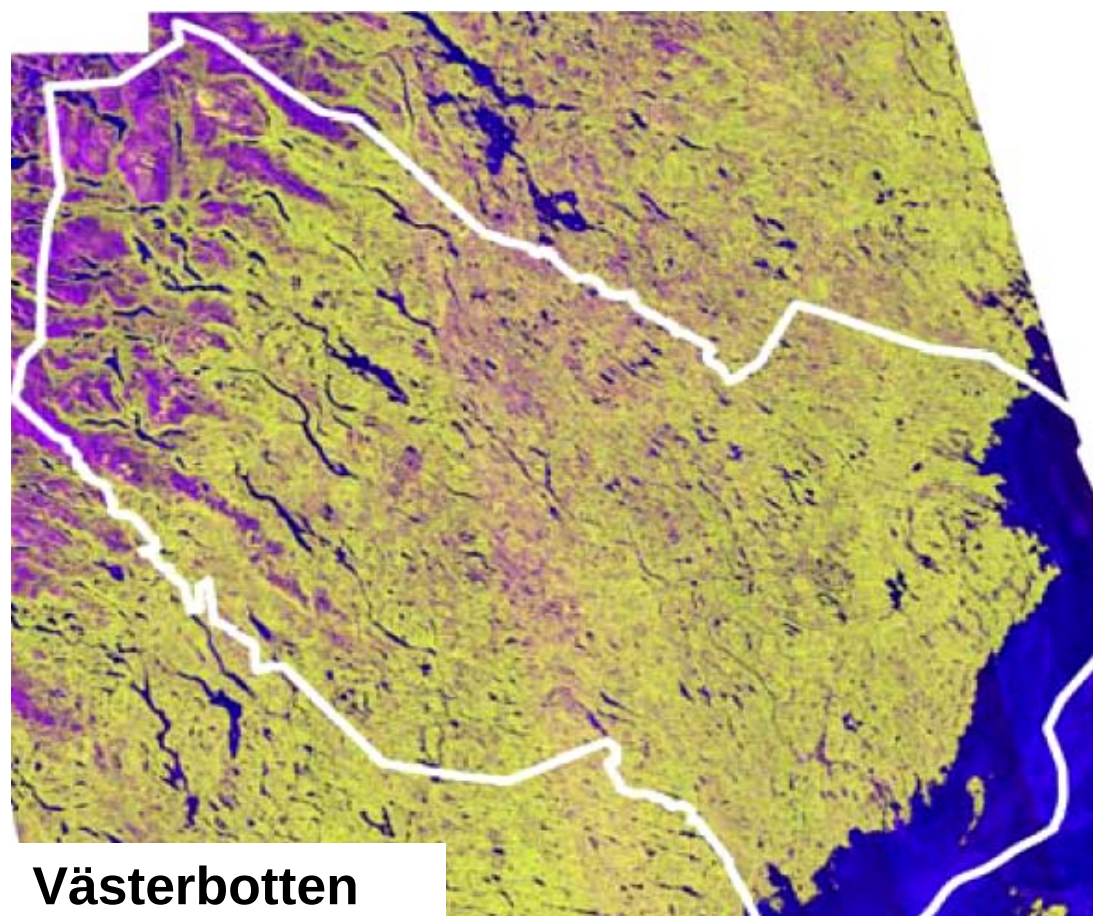


ALOS

K&C Initiative
An international science collaboration led by JAXA



Västra Götaland



Västerbotten

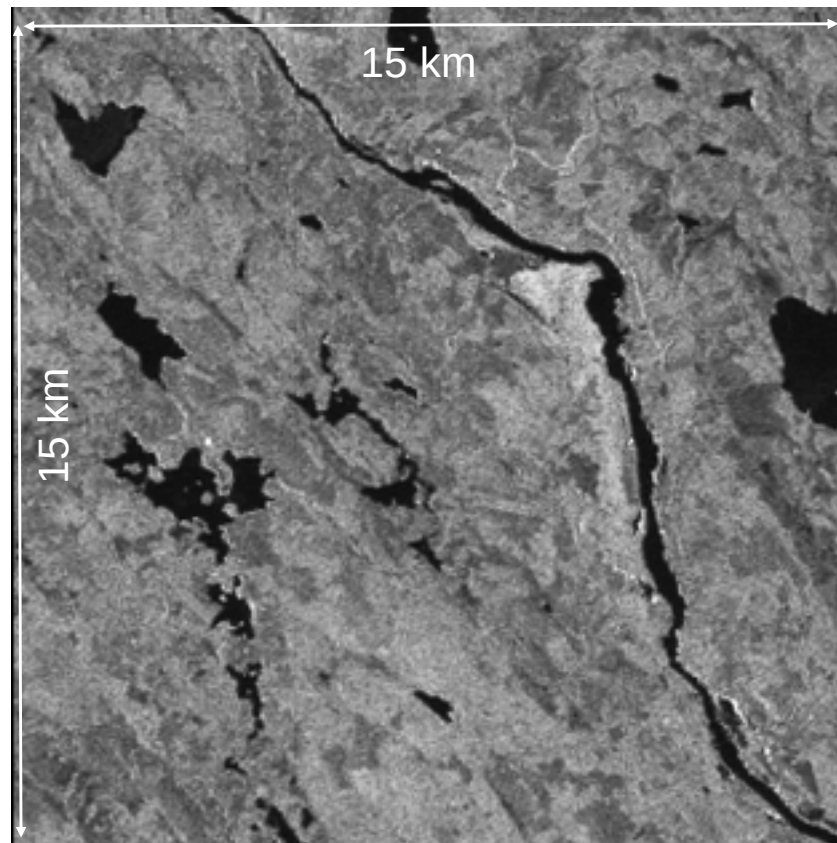
R = HH-pol, G = HV-pol, B = HH/HV ratio

Johan Fransson, Anders Krantz, Mattias Magnusson and Håkan Olsson, SLU, Sweden
Leif Eriksson and Lars Ulander, Chalmers University of Technology, Sweden
Maurizio Santoro, GAMMA Remote Sensing, Switzerland



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Time series of HH backscatter measurements



2007-01-21

2007-02-19

2007-07-24

2007-09-08

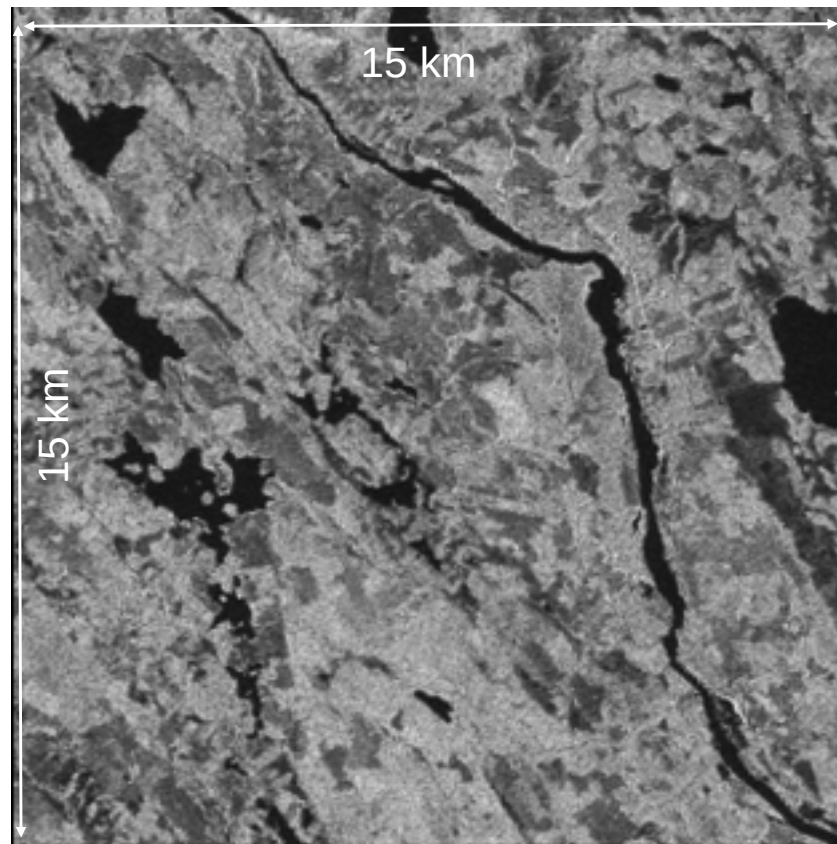
2007-09-25

2008-01-24

2008-07-26

2008-09-10

Time series of HV backscatter measurements



2007-07-24

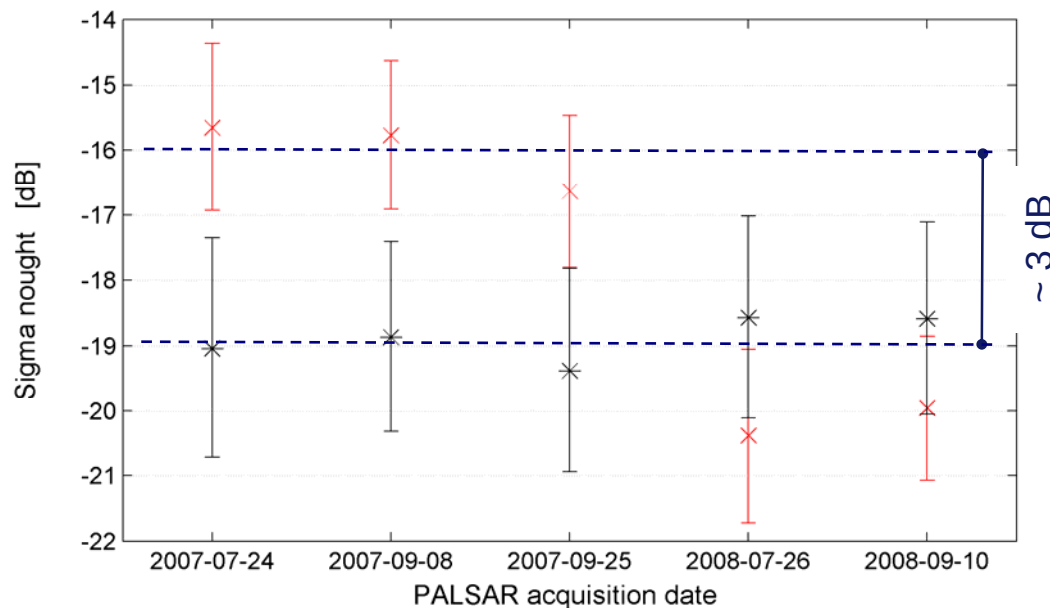
2007-09-08

2007-09-25

2008-07-26

2008-09-10

Change detection methodology



Clear-cut date and size

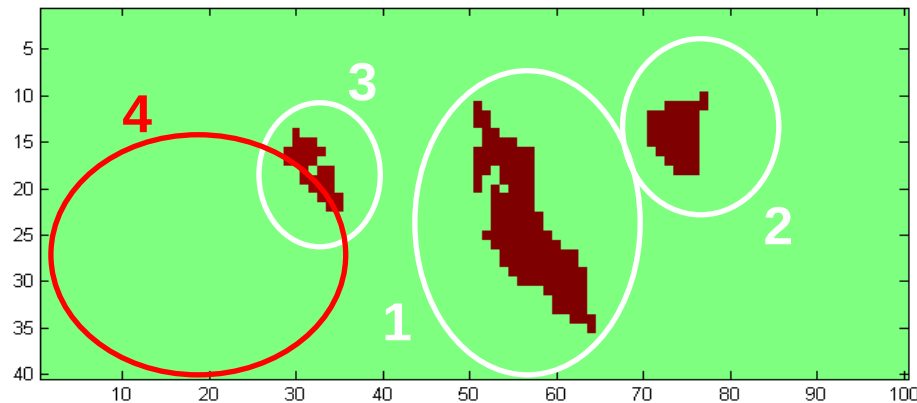
* 2007-01-02 (47 ha) x 2008-04-14 (28 ha)

- Threshold method applied to time series of HV backscatter values
- With 2 dB a lot of point-wise noise was retained, likely due to residual speckle
- With 2.5 and 3 dB less noise and still the detection of the (large) clear-cuts was not affected

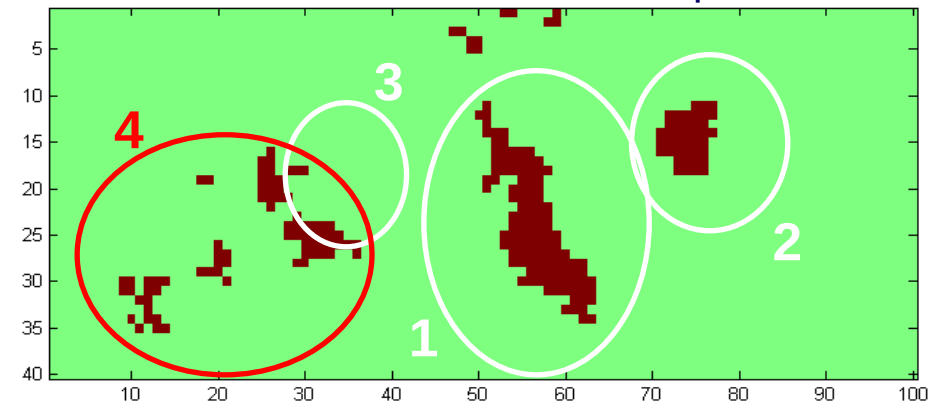
An example of changes detected with ALOS PALSAR

Example for a 2 km x 5 km area in the Västerbotten county

Clear-cut map from GIS layer



PALSAR-based clear-cut map



Cases 1 and 2: stands felled on 2007-11-02; PALSAR date: between 2007-09-25 and 2008-07-26

Case 3: stand felled on 2006-04-03, before all PALSAR data available for the area

Case 4: clear-cut detected between summers 2007 and 2008 but no evidence in the GIS: why?

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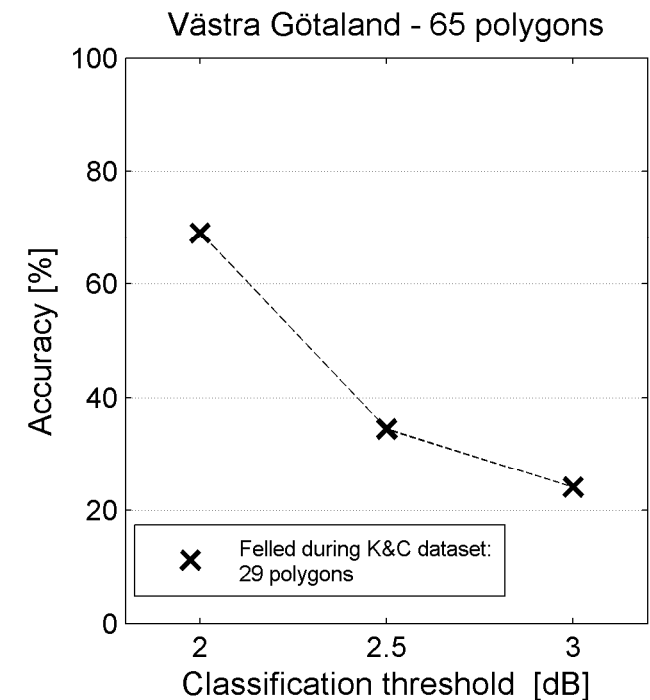
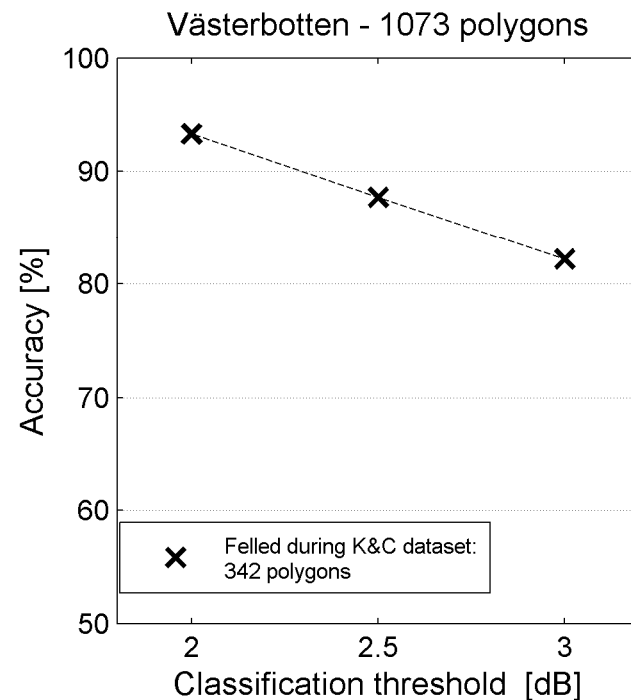
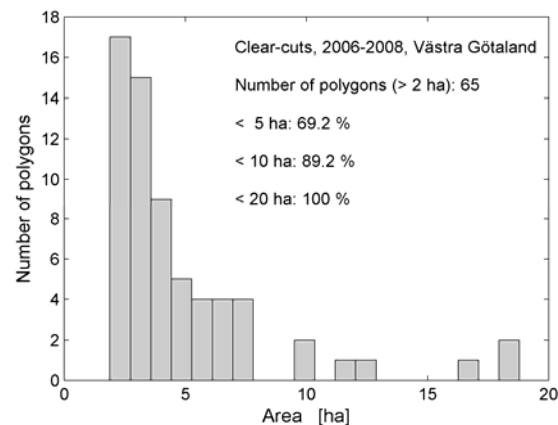
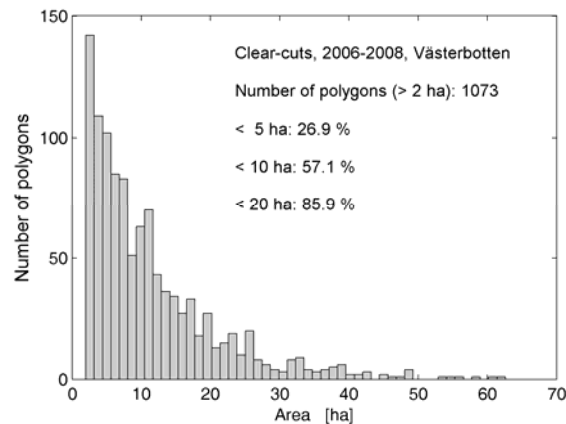
Leif Eriksson and Lars Ulander, Chalmers University of Technology, Sweden

Maurizio Santoro, GAMMA Remote Sensing, Switzerland



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Accuracy assessment



Johan Fransson, Anders Krantz, Mattias Magnusson and Håkan Olsson, SLU, Sweden
 Leif Eriksson and Lars Ulander, Chalmers University of Technology, Sweden
 Maurizio Santoro, GAMMA Remote Sensing, Switzerland

Conclusions

- The K&C PALSAR dataset is of high quality and has been timely delivered for the completion of the project tasks
- Signature analysis of PALSAR backscatter showed that L-band HV backscatter appears particularly suitable for detecting forest cover changes in Sweden
- A thresholding method applied to time series of HV backscatter data has been developed for detecting forest cover changes
- Maps of forest cover changes have been produced for the prototype areas
- Clear-cuts can be detected with high accuracy. Choice of threshold is crucial.
- Future research issues: understanding 1) the difference in accuracy assessment between the two prototype areas, 2) the scattered small-scale changes

List of publications

- Eriksson, L. E. B., Magnusson, M., Fransson, J. E. S., Sandberg, G., Ulander, L. M. H., "Stem volume estimation for boreal forest using ALOS PALSAR," Proceedings of 5th International Symposium on Retrieval of Bio- and Geophysical Parameters from SAR Data for Land Applications, Bari, 25-28 September, CD-ROM, 2007.
- 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., "ALOS PALSAR calibration and validation results from Sweden," Proceedings of IGARSS'07, Barcelona, 23-27 July, pp. 1589 - 1592, 2007.
- Eriksson, L. E. B., Sandberg, G., Fransson, J. E. S., Magnusson, M., Ulander, L. M. H., "ALOS PALSAR calibration and validation activities in Sweden," Proceedings of The First Joint PI Symposium of ALOS Data Nodes for ALOS Science Program, Kyoto, 19-23 November, CD-ROM, 2007.
- Eriksson, L. E. B., Santoro, M., Fransson, J. E. S., "Temporal decorrelation for forested areas observed in spaceborne L-band SAR interferometry," Proceedings of IGARSS'08, Boston, 6-11 July, in press, 2008.
- Fransson, J. E. S., Magnusson, M., Olsson, H., Eriksson, L. E. B., Sandberg, G., Smith-Jonforsen, G., Ulander, L. M. H., "Detection of forest changes using ALOS PALSAR satellite images," Proceedings of IGARSS'07, Barcelona, 23-27 July, pp. 2330-2333, 2007.
- Fransson, J. E. S., Magnusson, M., Olsson, H., Eriksson, L. E. B., Folkesson, K., Sandberg, G., Santoro, M., Ulander, L. M. H., "Detection of clear-cuts using ALOS PALSAR satellite images," Proceedings of EUSAR 2008, Friedrichshafen, 2-5 June, CD-ROM, 2008.
- Magnusson, M., Fransson, J. E. S., Eriksson, L., Sandberg, G., Smith-Jonforsen, G., Ulander, L. M. H., "Estimation of forest stem volume using ALOS PALSAR satellite images," Proceedings of IGARSS'07, Barcelona, 23-27 July, pp. 4343 - 4346, 2007.
- Santoro, M., Fransson, J. E. S., Eriksson, L. E. B., Magnusson, M., Ulander, L. M. H., Olsson, H., Krantz, A., "Investigations on forestry applications in Sweden using ALOS PALSAR," Proceedings of ALOS PI Symposium 2008, Rhodes, 3-7 November, in press, 2008.
- Santoro, M., Fransson, J. E. S., Eriksson, L. E. B., Magnusson, M., Ulander, L. M. H., Olsson, H., "Signatures of ALOS PALSAR L-band backscatter in Swedish forest," IEEE Transactions on Geoscience and Remote Sensing, submitted.
- Ulander, L. M. H., Eriksson, L., Smith-Jonforsen, G., Fransson, J. E. S., Olsson, H., "ALOS calibration and validation activities in Sweden," Proceedings of IGARSS'06, Denver, 31 July - 4 August, pp. 336-339, 2006.

Johan Fransson, Anders Krantz, Mattias Magnusson and Håkan Olsson, SLU, Sweden

Leif Eriksson and Lars Ulander, Chalmers University of Technology, Sweden

Maurizio Santoro, GAMMA Remote Sensing, Switzerland



List of publications

Krantz, A. H., Fransson, J. E. S., Olsson, H., Santoro, M., Eriksson, L. E. B., Sandberg, G., Ulander, L. M. H., "Mapping and monitoring clear-cuts in Swedish forest using ALOS PALSAR satellite images," Proceedings of IGARSS09, Cape Town, South Africa, 13-17 July, 2009. Submitted abstract.

Johan Fransson, Andreas Pantze and Håkan Olsson, SLU, Sweden
Leif Eriksson and Lars Ulander, Chalmers University of Technology, Sweden
Maurizio Santoro, GAMMA Remote Sensing, Switzerland



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- Swedish National Land Survey
- Sveaskog (Swedish forest company)

Johan Fransson, Anders Krantz, Mattias Magnusson and Håkan Olsson, SLU, Sweden
Leif Eriksson and Lars Ulander, Chalmers University of Technology, Sweden
Maurizio Santoro, GAMMA Remote Sensing, Switzerland



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