



ESA - MOST Dragon 2 Programme

**2011 DRAGON 2 SYMPOSIUM**

中国科技部-欧洲空间局合作“龙计划”二期

“龙计划”二期2011年学术研讨会

## **DRAGON 2 – Project ID5344**

# **Techniques for Deriving Land Cover and Earth Surface Deformation Information from Polarimetric SAR Interferometry**

**Eric POTTIER**

**I.E.T.R - Univ Rennes 1**

**Erxue CHEN**

**I.F.R.I.T – C.A.F**

## 4 Oral Presentations

### Forest Structure Information Extraction from PolinSAR / PolSAR Data

Erxue Chen, Zengyuan Li , Wen Hong, Eric Pottier, Shane Cloude

### First Studies of IECAS–X/P–SAR System

Wen Hong, Maosheng Xiang, Yang Li, Qiang Yin, Eric Pottier, Erxue Chen, Shane Cloude

### Forest Characterisation by Means of TerraSAR-X and TanDEM-X Polarimetric Interferometric Data

Florian Kugler, Irena Hajnsek, K. Papathanassiou, Shane Cloude

### Urban Impervious Surfaces Extraction from RADARSAT-2 PolSAR Data Using SVM Method

Xinwu LI, Huadong Guo, Zhongchang Sun

## 2 Poster Presentations

### Energy-Spectrum-Based Adaptive Windowing for Speckle Filtering of PolSAR Data

Wenlu Qi, Yang Li, Wen Hong, Qiang Yin



### Topographic Mapping with P-band SAR System of Wide Beam Width

Dongkun Xia, Yang Li, Wen Hong, Eric Pottier, Yirong Wu, Peng Wang, Maosheng Xiang, Yanping Wang, Weixian Tan



## WP 1

**Land Cover Analysis**

## WP 3

**Forest Vertical  
Structure Parameters  
Extraction**



## WP 2

**Earth Surface  
Deformation Monitoring  
and DEM Extraction**

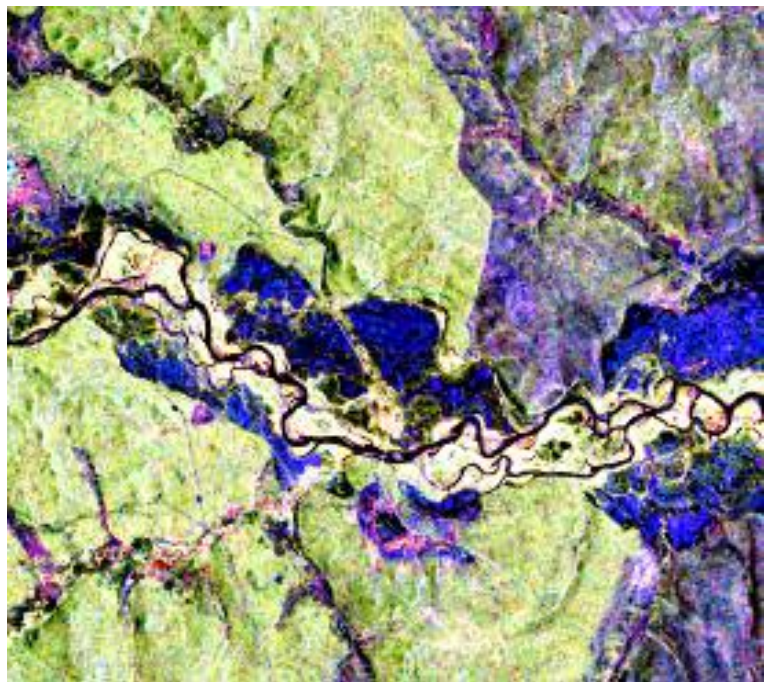
## WP 4

**PoSARpro Software  
Continued Development**

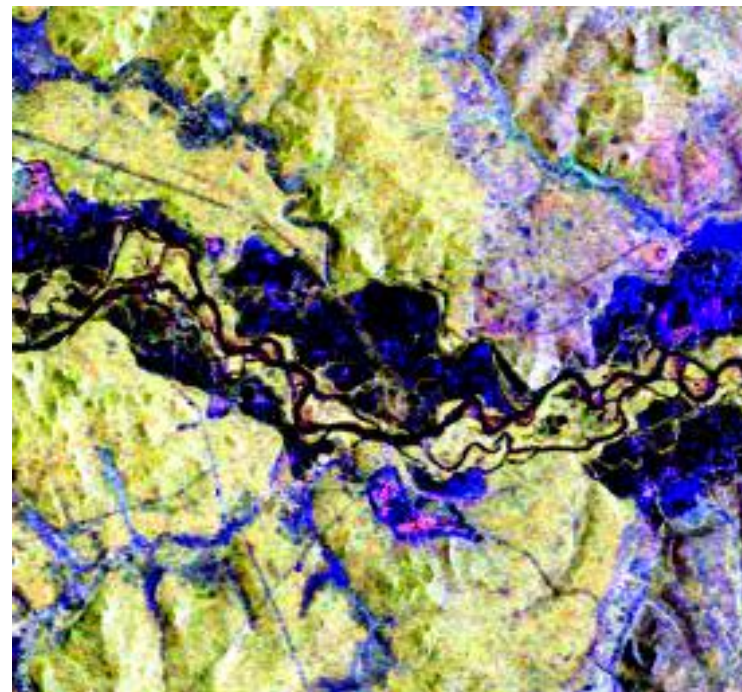




# Forest Fire Scar Mapping Using C- and L-band Polarmetric SAR

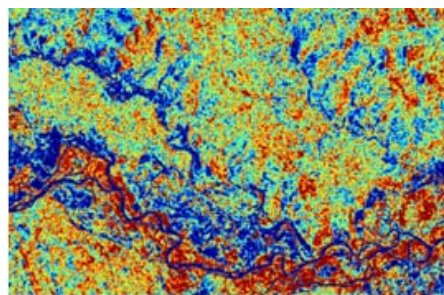


**Radarsat-2  
imaged in  
20091018**

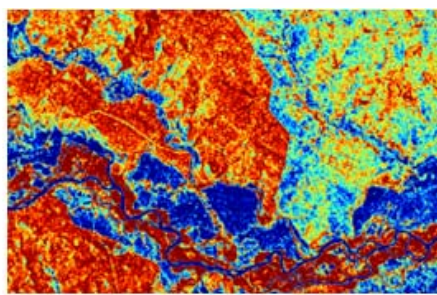


**ALOS  
PALSAR  
imaged in  
20080907**

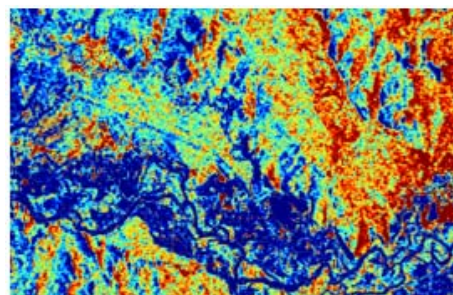




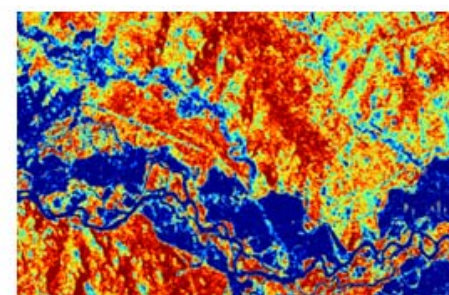
(a)  $\lambda_1$



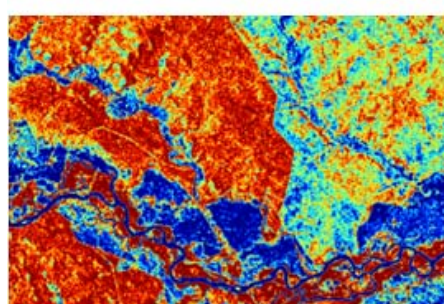
(b)  $\lambda_2$



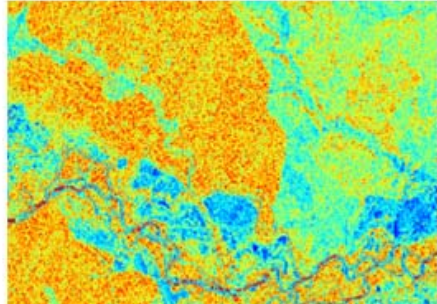
(a)  $\lambda_1$



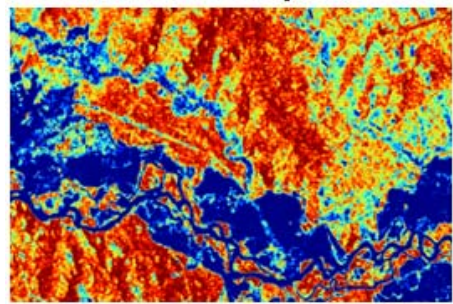
(b)  $\lambda_2$



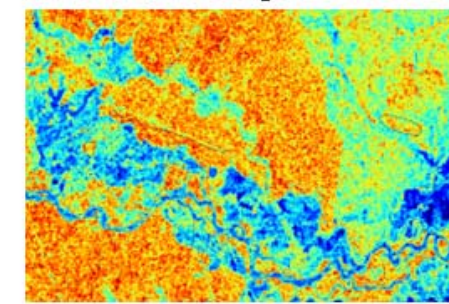
(c)  $\lambda_3$



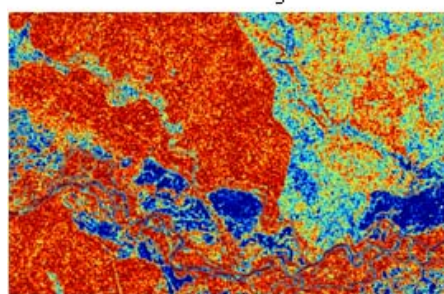
(d) *RVI*



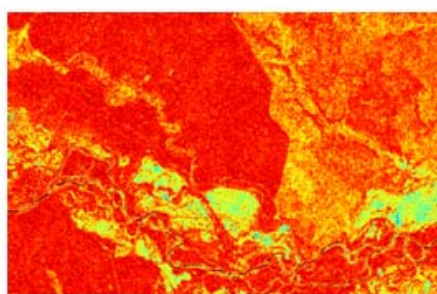
(c)  $\lambda_3$



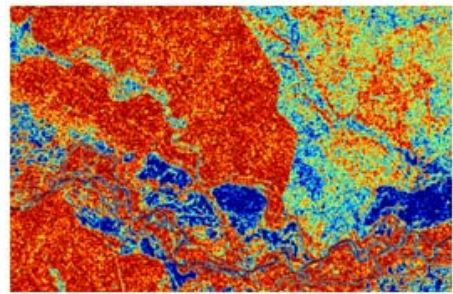
(d) *RVI*



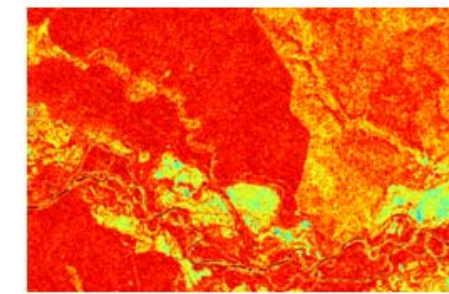
(e) *SEP*



(f) *H*



(e) *SEP*



(f) *H*

## Radarsat-2

## ALOS PALSAR



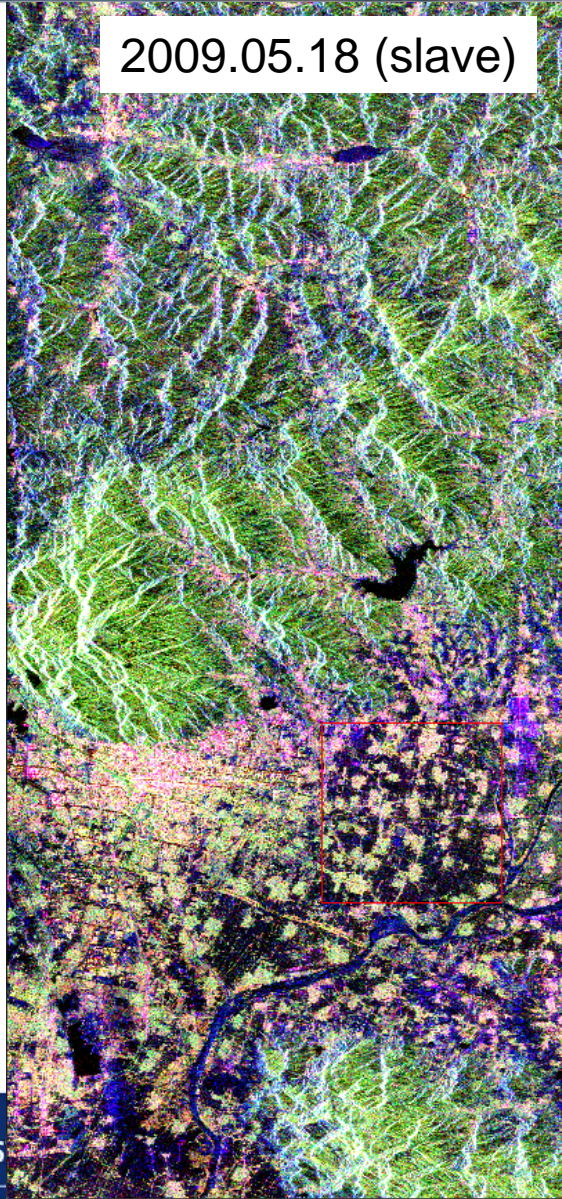
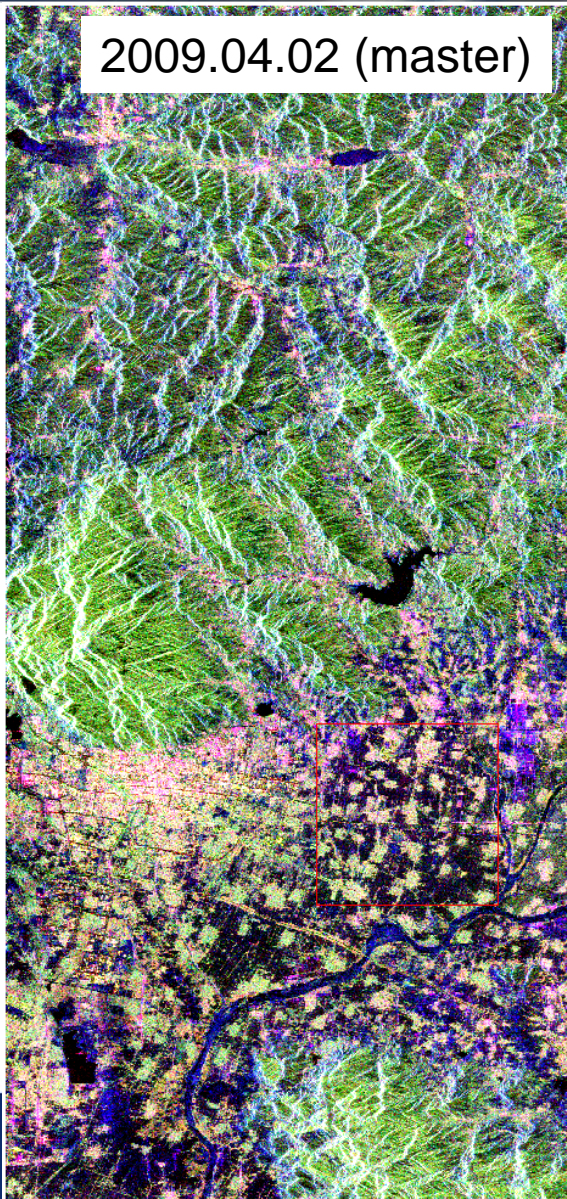


# Applying coherence optimization methods to DEM extraction from ALOS POLinSAR data



2009.04.02 (master)

2009.05.18 (slave)



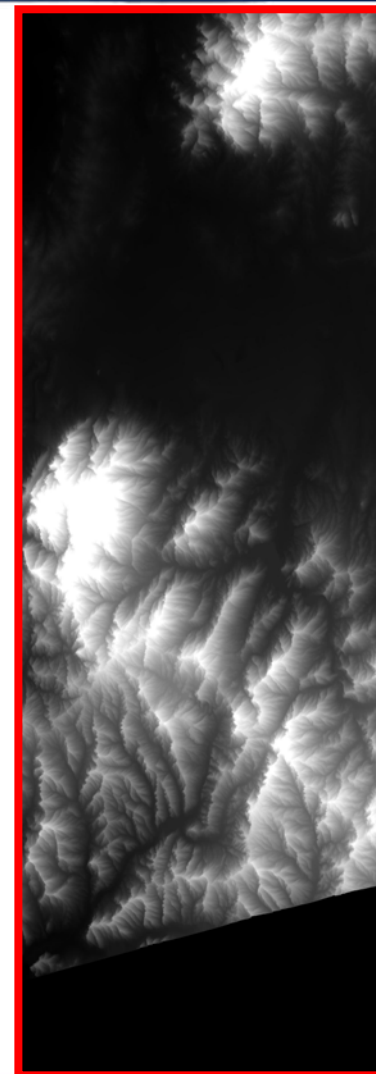
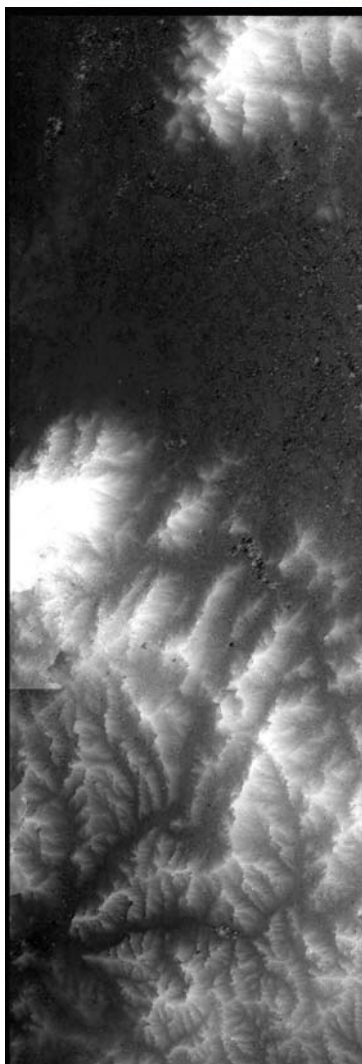
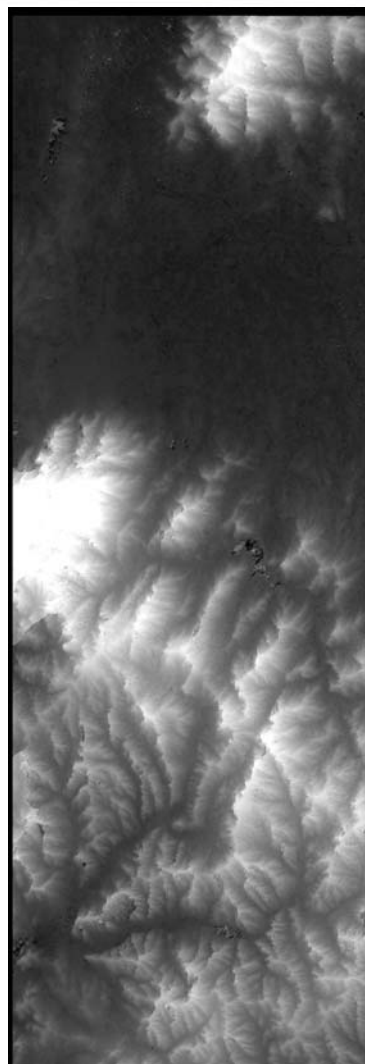
**Pauli RGB image:**  
[s2]→7looksAz\*1looksRg

Baseline (226.9m):

- Cross track: 206.1m
- Normal: 94.9m

- Parallel comp.: 163.5m
- Perpendicular: 157.3m



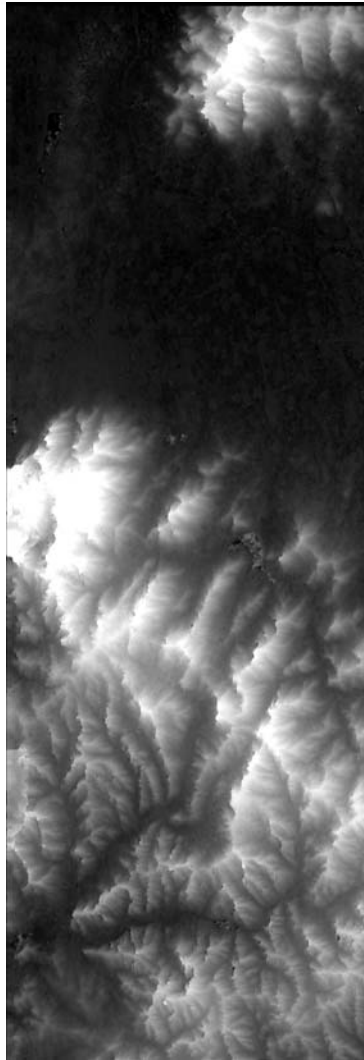


HH-HH DEM

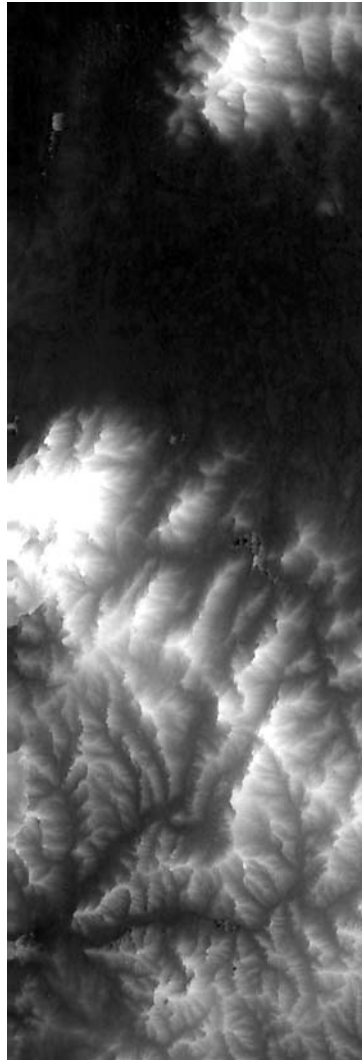
HV-HV DEM

VV-VV DEM

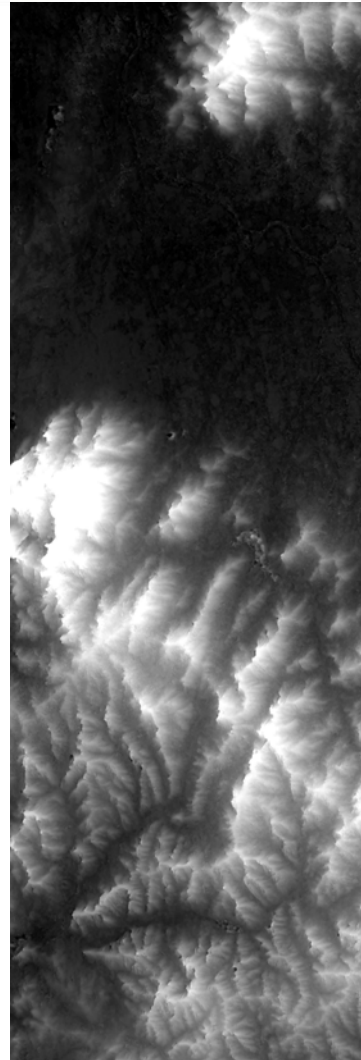
Reference DEM



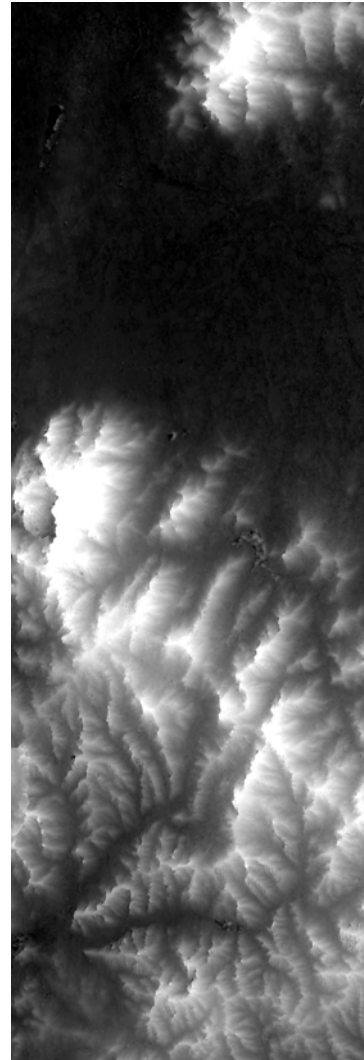
OPT1



NR1



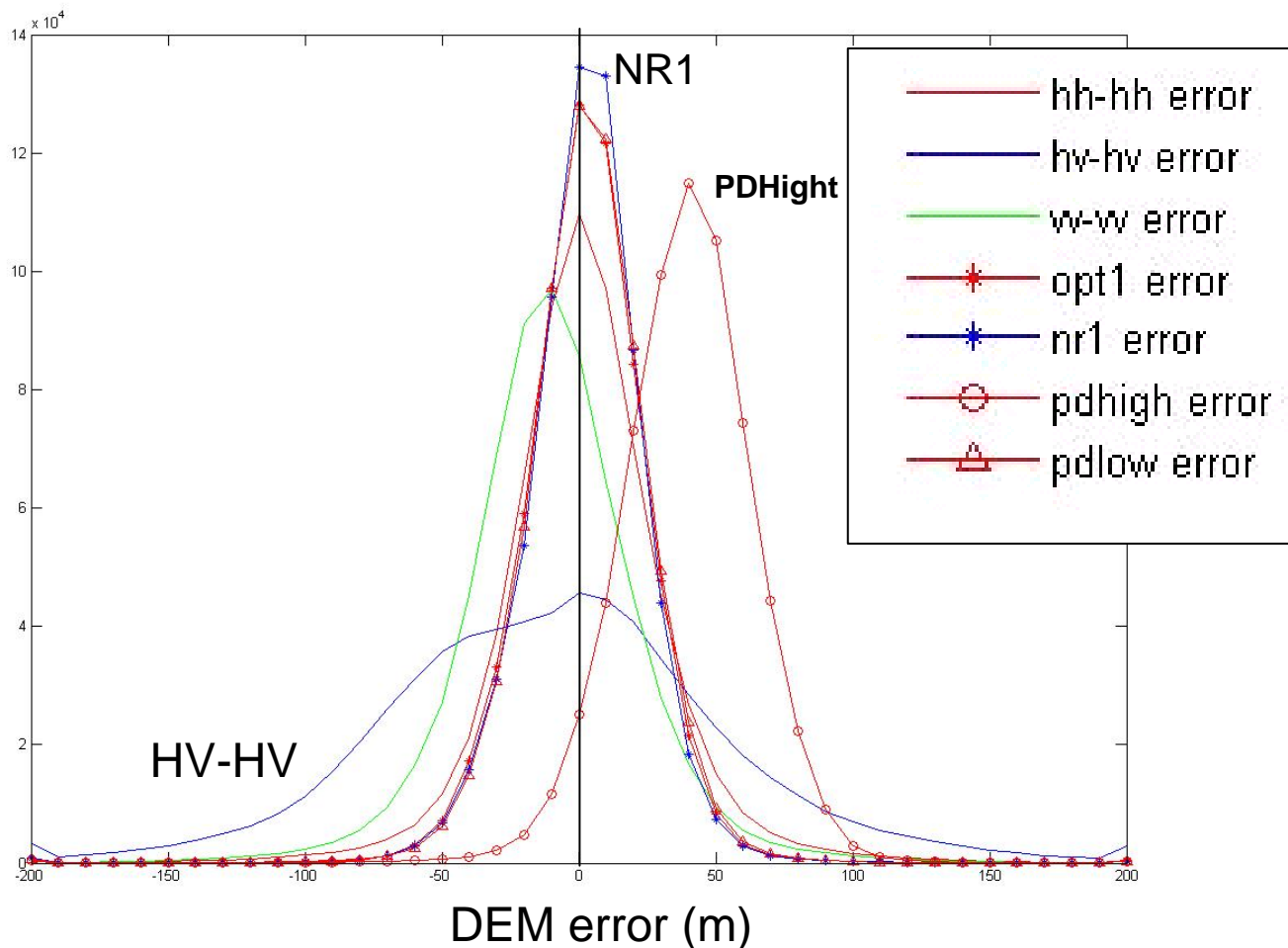
PDHigh



PDLow



## Quantitative validation results



RMSE (m):

NR1: 24.4242  
 PDLow: 24.7515  
 OPT1: 25.674  
 HH-HH: 31.985  
 VV-VV: 35.651  
 PDHigh: 46.8842  
 HV-HV: 64.9409





# Forest above Ground Biomass Estimation based on Polarization Coherence Tomography

Master

Slave

•POLinSAR data-SLC



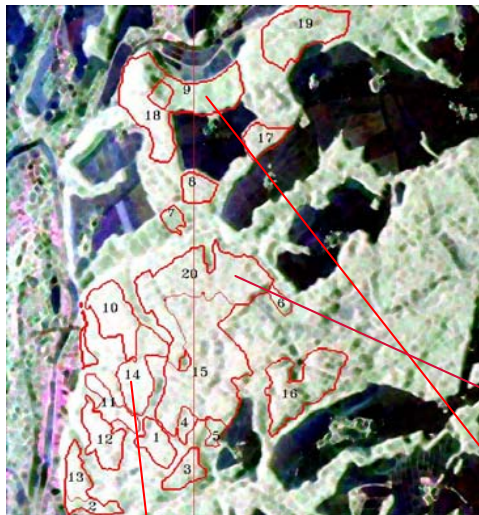
©DLR

1414width×4642lines

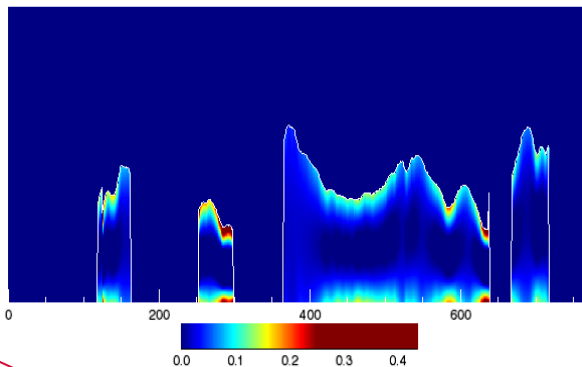
20031011, 9:00

20031011, 8:40

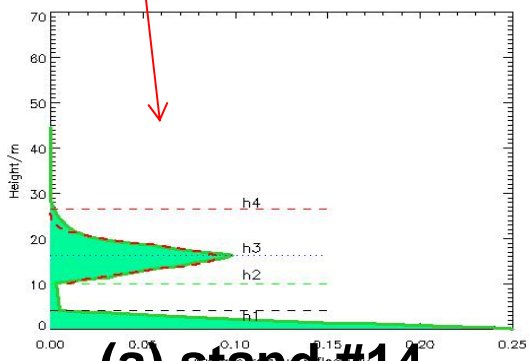




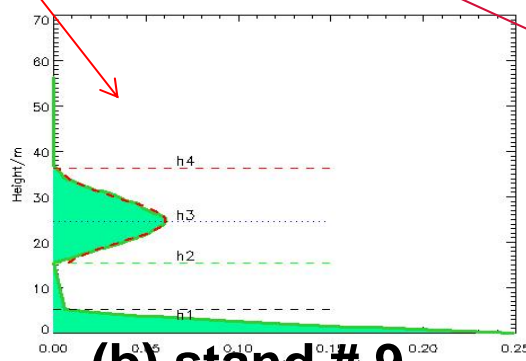
RGB composite image of the polarimetric SAR data of the Traunstein scene in the Pauli basis



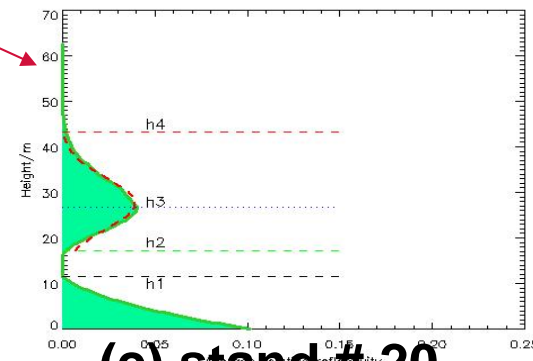
Vertical profile of the relative reflectivity function from PCT in the SAR azimuth direction (along the red line)



(a) stand #14

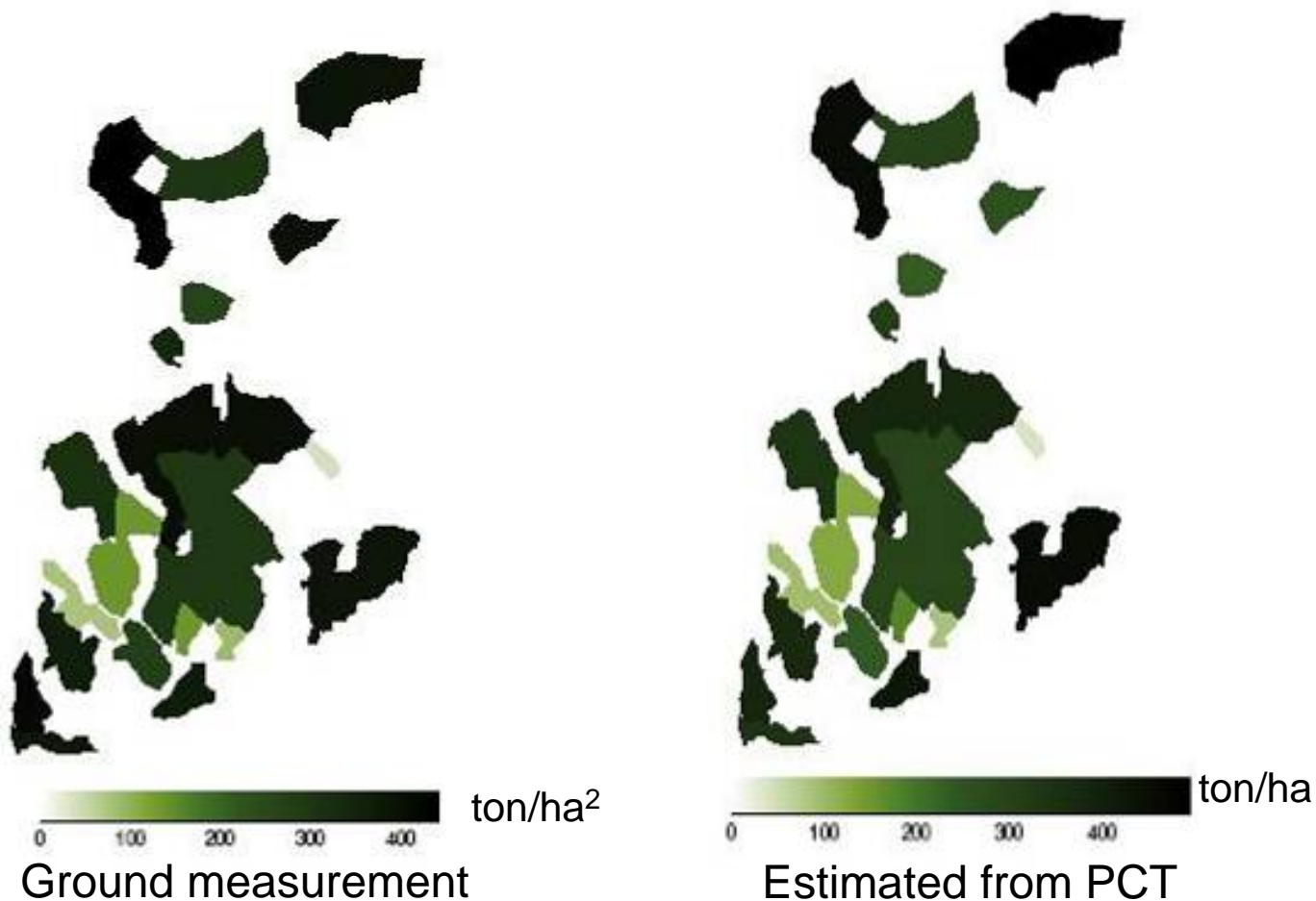


(b) stand #9



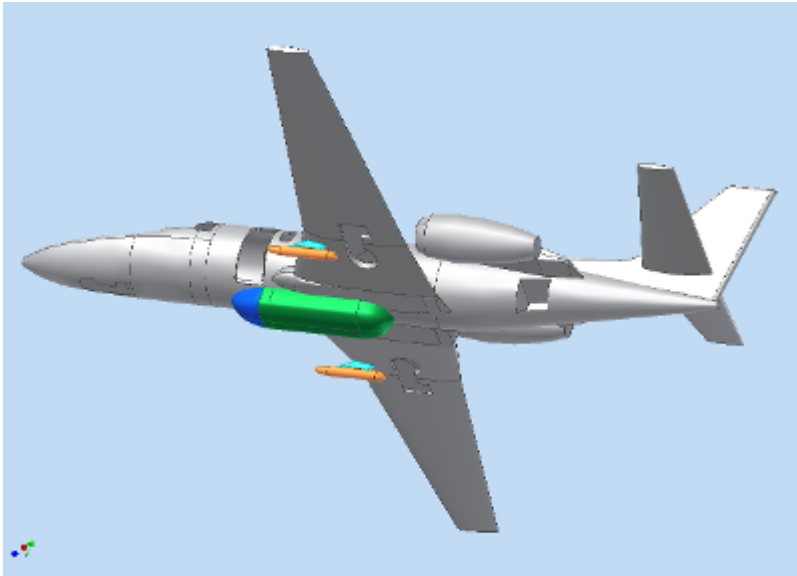
(c) stand #20

- Forest AGB map from PCT and from ground measurement





## IECAS-X/P-SAR System



Fully polarimetric SAR ,P-band



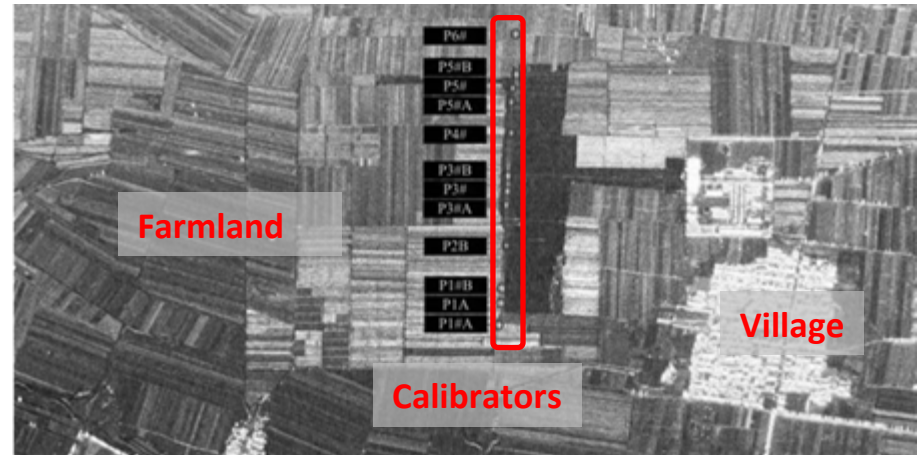
Single-pass InSAR, X-band



## □ Polarimetric Calibration

Test Site: Changzhi, Shanxi

- Calibration Site
  - Farmland
  - Runway
  - Viliage
- Calibrator
  - Three 0° dihedral corner reflectors
  - Three 45° dihedral corner reflectors
  - Six trihedral corner reflectors
- Calribration Methodology
  - [Ref]A. Fore etc. 2009\*



Corner Reflector 1.5m

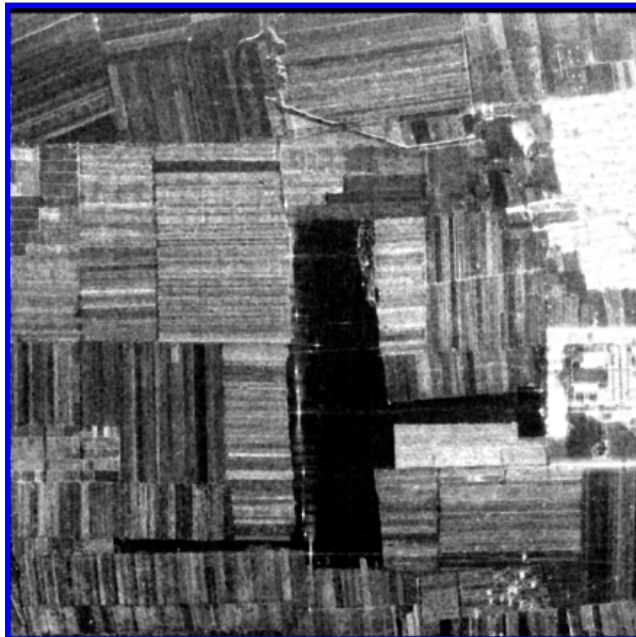


\* Alex Fore , Bruce Chapman , Scott Hensley .etc, UAVSAR Polarimetric Calibration

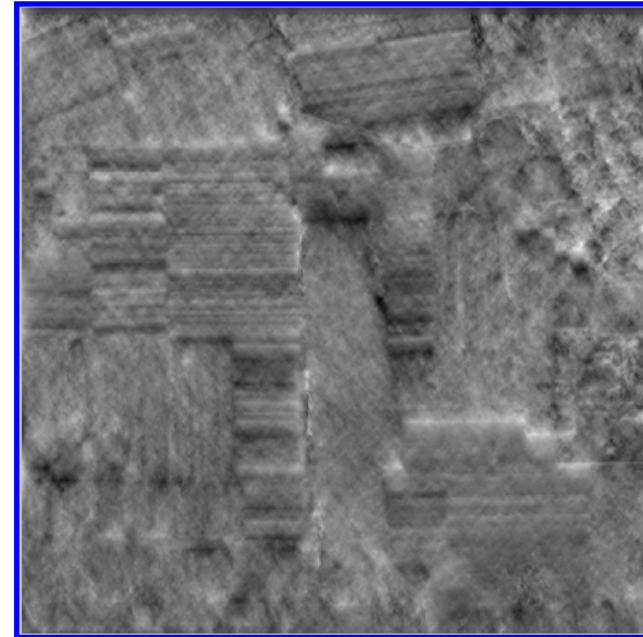


## □ Polarimetric Topography Estimation

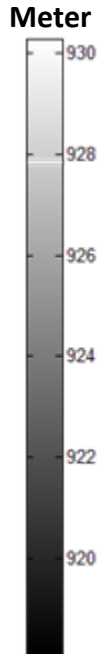
### Site 1: Mountain Area



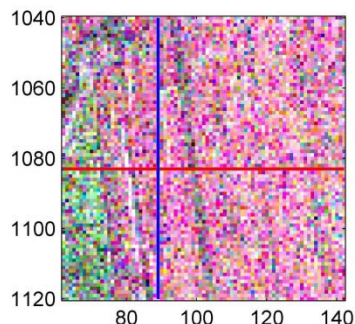
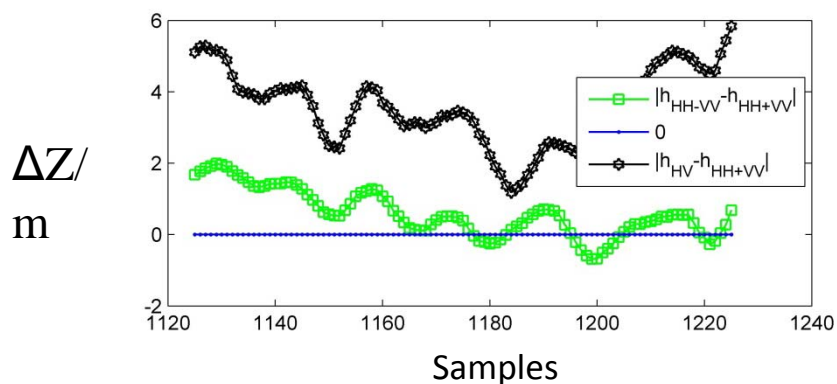
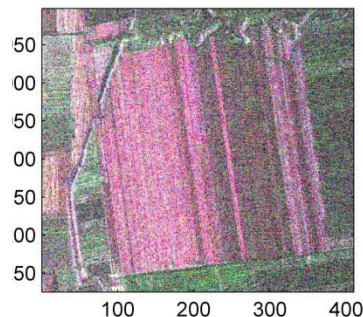
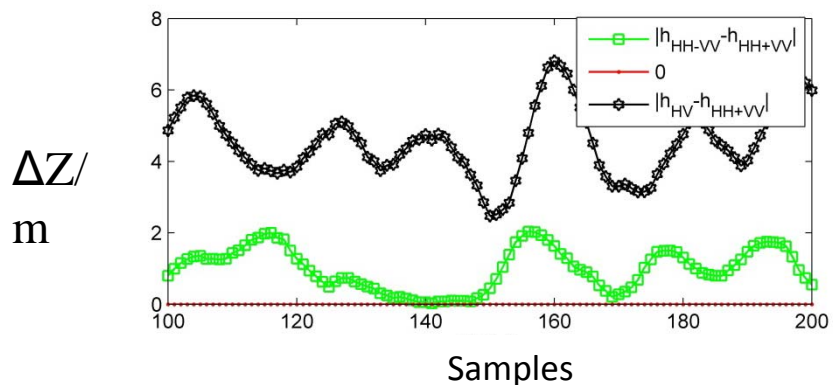
Intensity Map



Height Map



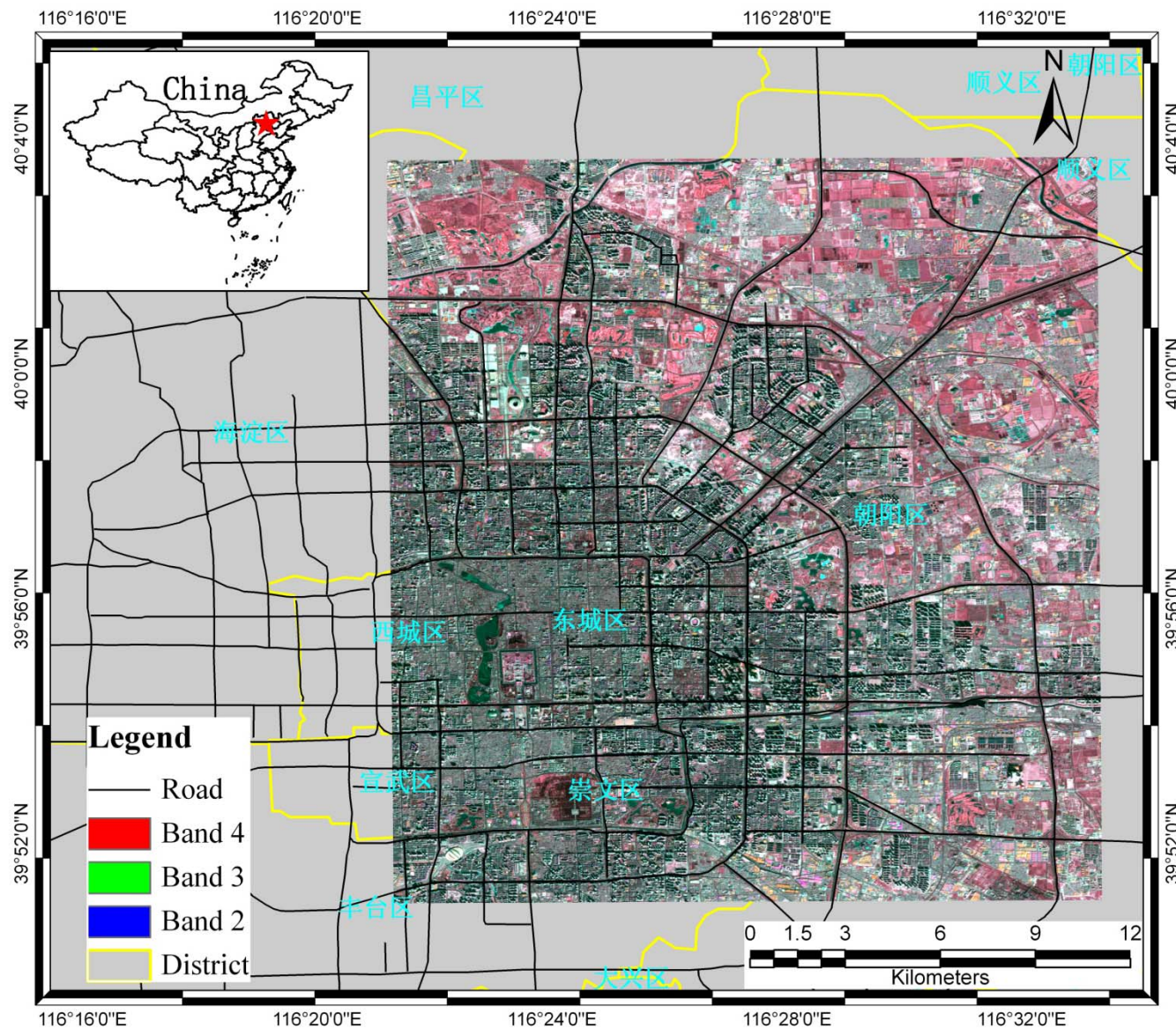
## Farmland Scattering Center Variation with Polarization







# Urban Impervious Surface Extraction from RADARSAT-2 PolSAR Data Using SVM Method

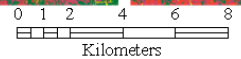
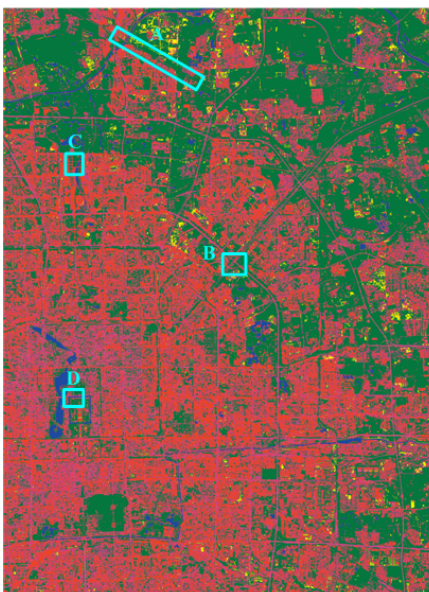
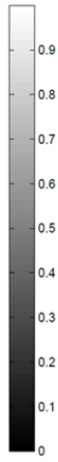
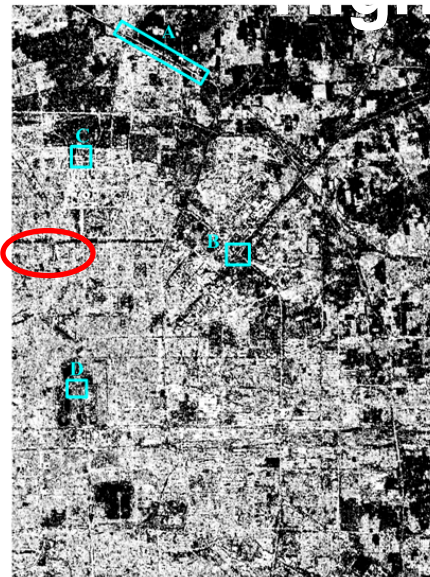
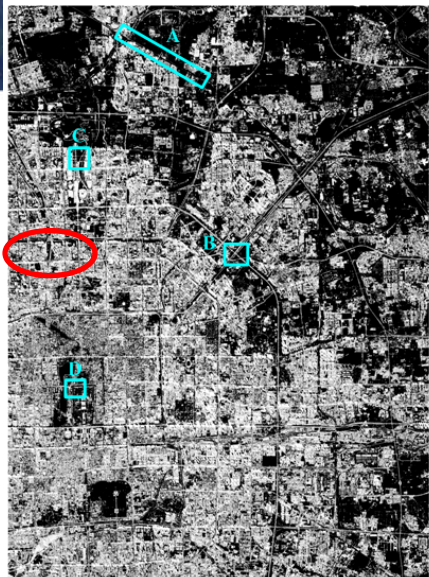






SPOT-5

RADARSAT-2



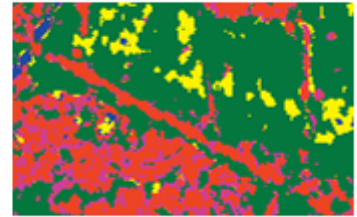
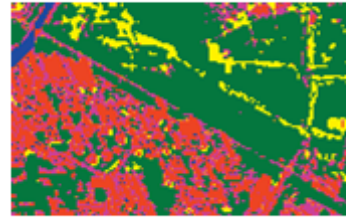
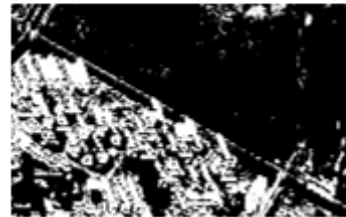
- High impervious surfaces
- Medium impervious surfaces
- Low impervious surfaces
- Soil
- Vegetation
- Water

# Highlights



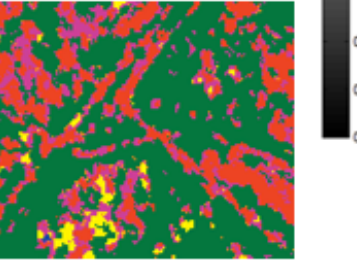
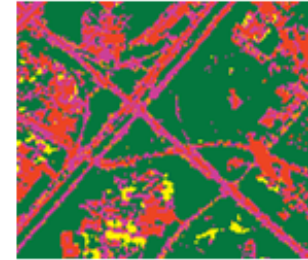
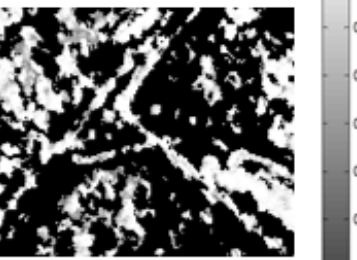
SPOT

RADARSAT-2



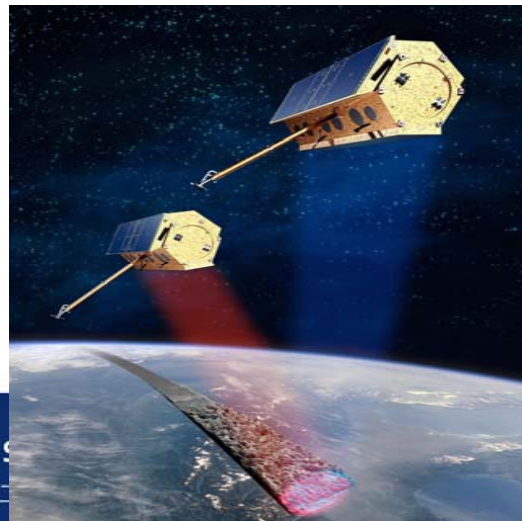
SPOT

RADARSAT-2





# Forest Characterisation by Means of TerraSAR-X and TanDEM-X Polarimetric Interferometric Data





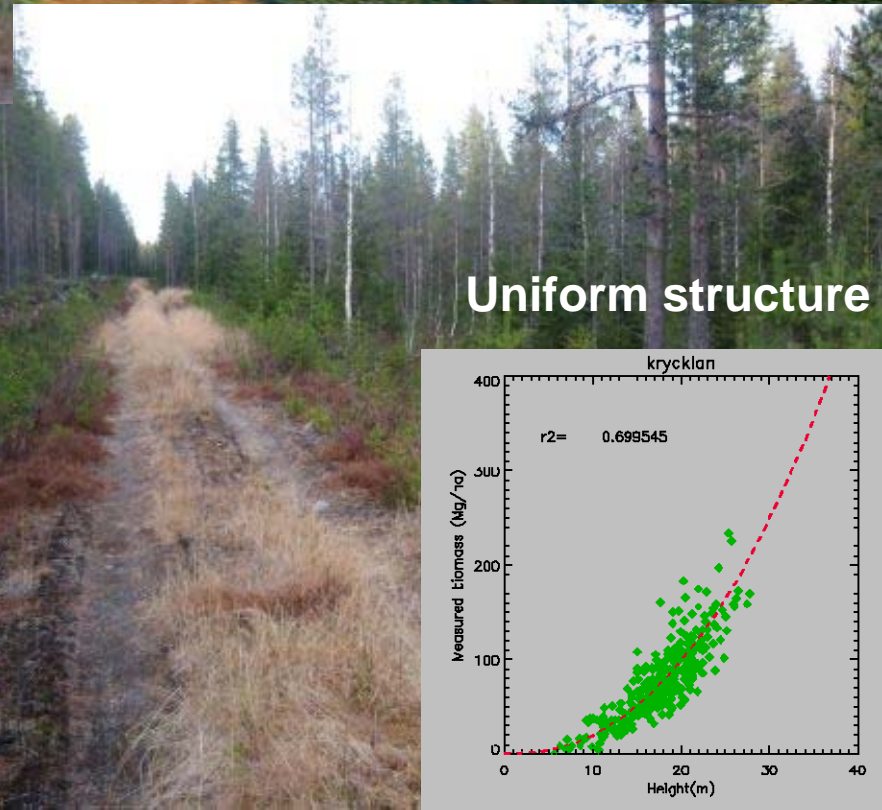
# Krycklan Test Site (Biosar II – Campaign 2008)



**Krycklan forest:**

**Location:**

- middle Sweden
- boreal forest
- hilly topography
- strong slopes

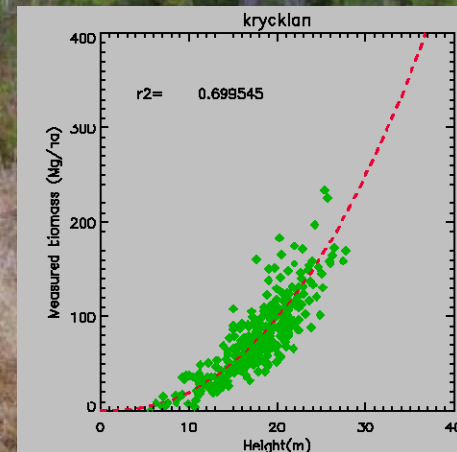


## Composition

- maximum forest height: ~ 30m
- mean forest height: 17m
- mean biomass: 90t/ha
- maximum biomass: 220 t/ha
- dominated by Coniferous trees

**Lidar Reference Measurements available (2008)**

**Uniform structure**





# Forest heights using Dual Pol-InSAR (HH & VV)

Low (unsensitive)  $K_z$  values (due to topography) are filtered out

Invalid points are filtered (21%)

$r^2 = 0.86$

RMSE = 2.02m

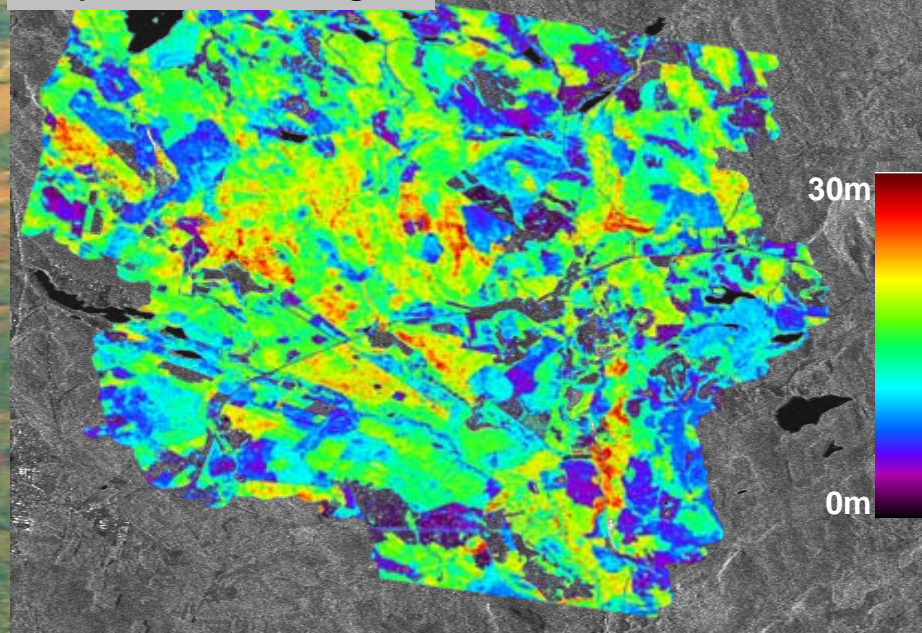
$r^2 = 0.90$  (without harvested areas)

Number of stands: 216

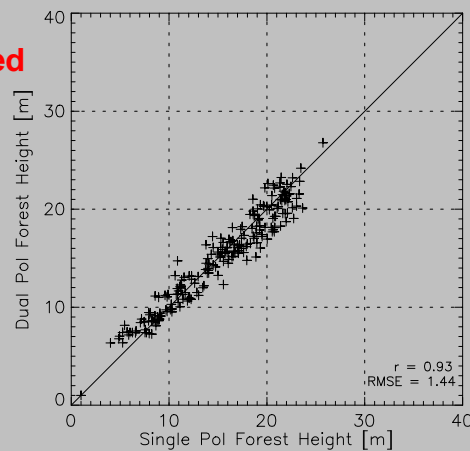
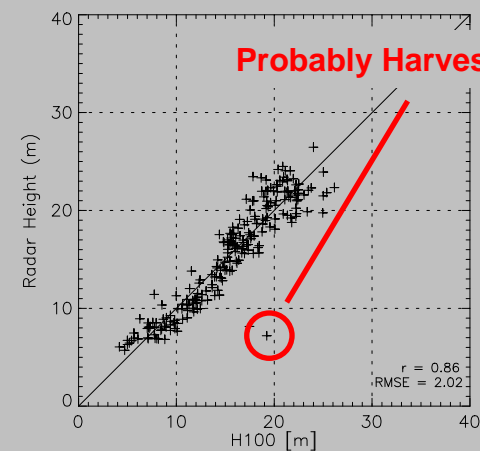
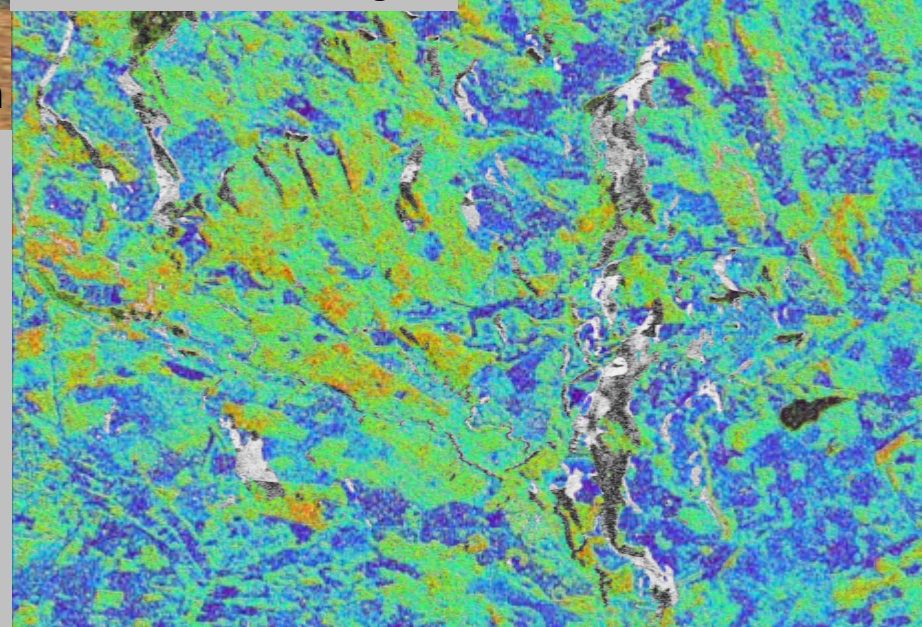
Validation Plot  
Lidar vs Radar:

Single-pol inversion  
vs Dual-pol inversion  
 $r^2=0.93$ , RMSE = 1.44m

Amplitude / Lidar Heights



Coherence / Radar Heights





## DRAGON 2 – Project ID5344



# Contribution and Training of Young Scientists



**Armando MARINO**  
**PhD Student**  
**(1/08/2009 – 31/07/2010)**



**Daniela ESPOSITO & Anna FONTANA**  
**MSc Students**  
**(2 x 6 Months)**



edinburgh  
earth  
observatory



**Support Training of Young European Scientists Working Within the  
Framework of the Dragon 2 Programme 2008 – 2010**

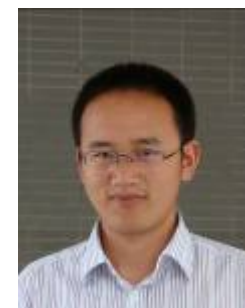




**Dr Xinwu LI**  
**Visiting Professor**  
 (1/10/2008 – 1/04/2009)

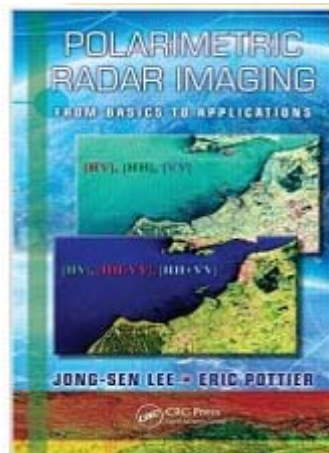


**Dr Fang CAO**  
**Visiting Researcher**  
 (1/10/2009 – 1/04/2010)



**Jian YAN**  
**Visiting PhD Student**  
 (1/03/2011 – 1/03/2012)





J.S. LEE – E. POTTIER (2009)

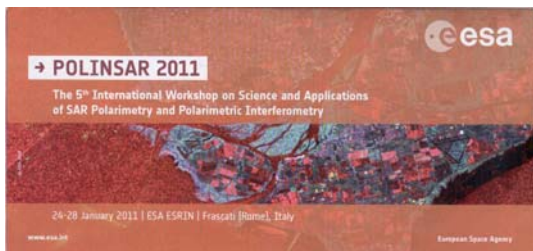
**2012**

**Chinese version: Pr-Dr. Wen HONG et al.**

**Proof Reading: Pr-Dr. Erxue CHEN**







## 3 Communications

### Energy-Spectrum-Based Adaptive Windowing for Speckle Filtering of PolSAR Data

Wenlu Qi, Yang Li , Wen Hong, Qiang Yin

### Topographic Mapping with P-band SAR System of Wide Beam Width

Dongkun Xia, Yang Li, Wen Hong, Eric Pottier, Yirong Wu , Peng Wang, Maosheng Xiang, Yanping Wang, Weixian Tan

### Forest above Ground Biomass Estimation based on Forest Vertical structure Information Extracted from POLInSAR Data

Luo, H.M, Chen, E.X., Li, Z.Y., Li, X.W.



## DRAGON 2 – Project ID5344



- **All 4 Work Packages in line with the proposed Time Schedule of the Project**
- **Contribution and Training of Young Scientist**
- **3 Communications: POLINSAR'11 (ESA - ESRIN)**





**SEE YOU NEXT YEAR**



**謝謝**

**THANK YOU**