

TANDEM-X: A New Era of Global Digital Elevation Data

PHOWO2011 – September 2011

M. Weber // September 07, 2011

All the space you need



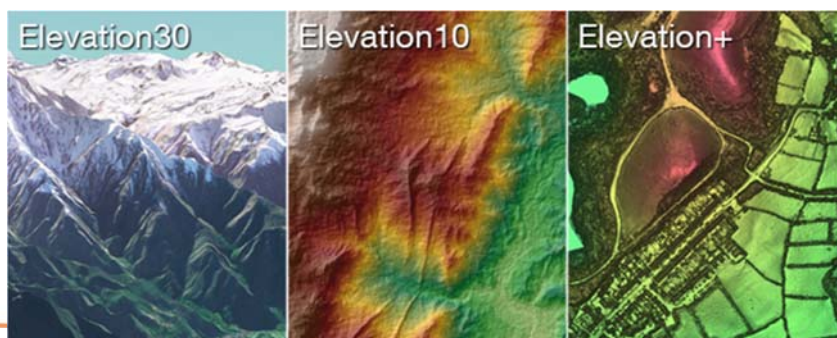
Infoterra and Spot Image are now

Astrium GEO-Information Services



Today's DEM

- **Elevation30**: unique worldwide 3D geographic reference database for all global coverage needs
- **Elevation10**: regional 10 m elevation models everywhere in the world whatever the relief and weather conditions
- **Elevation+**: high precision digital elevation modelling service providing 1 m DEM and beyond



GEO ELEVATION
SERVICES BY ASTRIUM

Highly Accurate Elevation
Data Worldwide

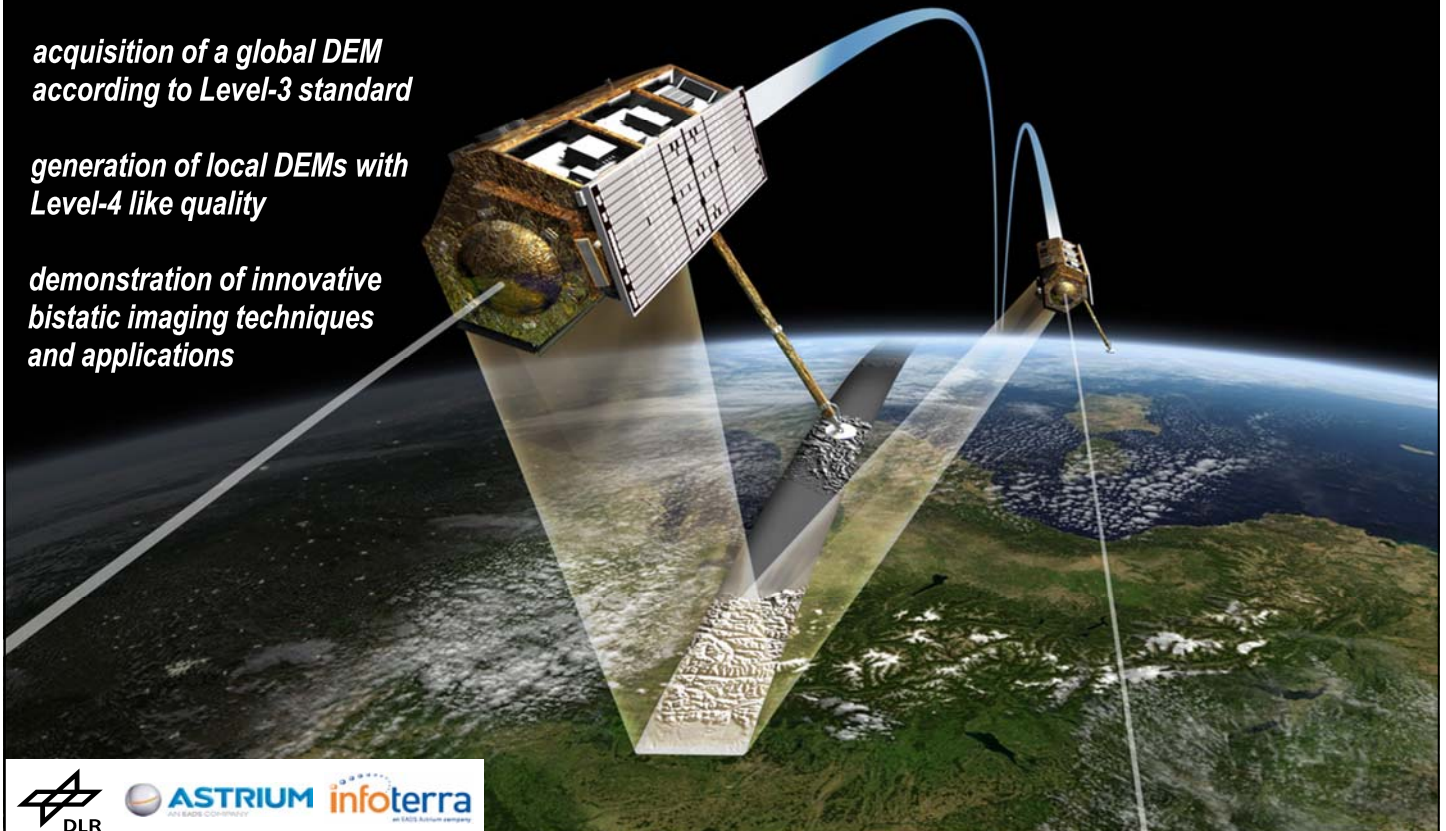
TerraSAR-X-add-on for Digital Elevation Measurements



*acquisition of a global DEM
according to Level-3 standard*

*generation of local DEMs with
Level-4 like quality*

*demonstration of innovative
bistatic imaging techniques
and applications*



Mission Goals



■ DEM Product

- Complete coverage of the entire landmass of the Earth without any voids
- Products according to NGA specifications (HRTI-3; $\Delta < 2\text{m}$)
- Additional acquisitions for higher quality DEM ($\Delta < 1\text{m}$), regional limited only

■ Image Products

- No impact on imaging missions
- Same image specification of TSX & TDX

■ Scientific applications



Key Features

- Close formation flight
- Both satellites serve two missions (TerraSAR-X & TanDEM-X) and are being operated jointly by one combined ground segment
- Globally oriented acquisition strategy for the global DEM
- Powerful processing chains to handle 1500 TByte of data

All the space you need

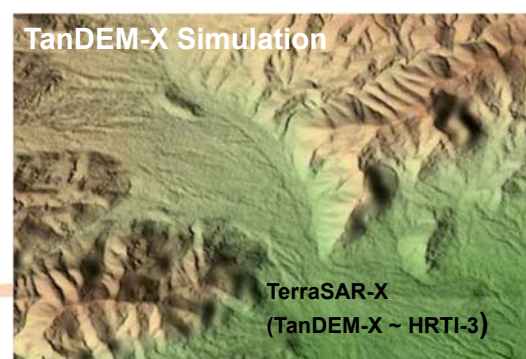
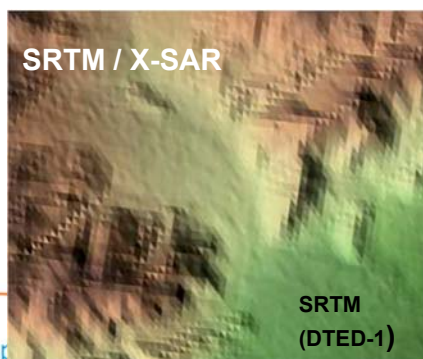


Date - 7

Primary Mission Objective: Global DEM

- Specifications at Mission Design (2005)

DEMs	Spatial Resolution	Absolute Vertical Accuracy (90%)	Relative Vertical Accuracy (point-to-point in 1° cell, 90%)
DTED-1	90 m x 90 m	< 30 m	< 20 m
DTED-2	30 m x 30 m	< 18 m	< 12 m
TDXDEM	12 m x 12 m	< 10 m	< 2 m
HRTI-4	6 m x 6 m	< 5 m	< 0.8 m



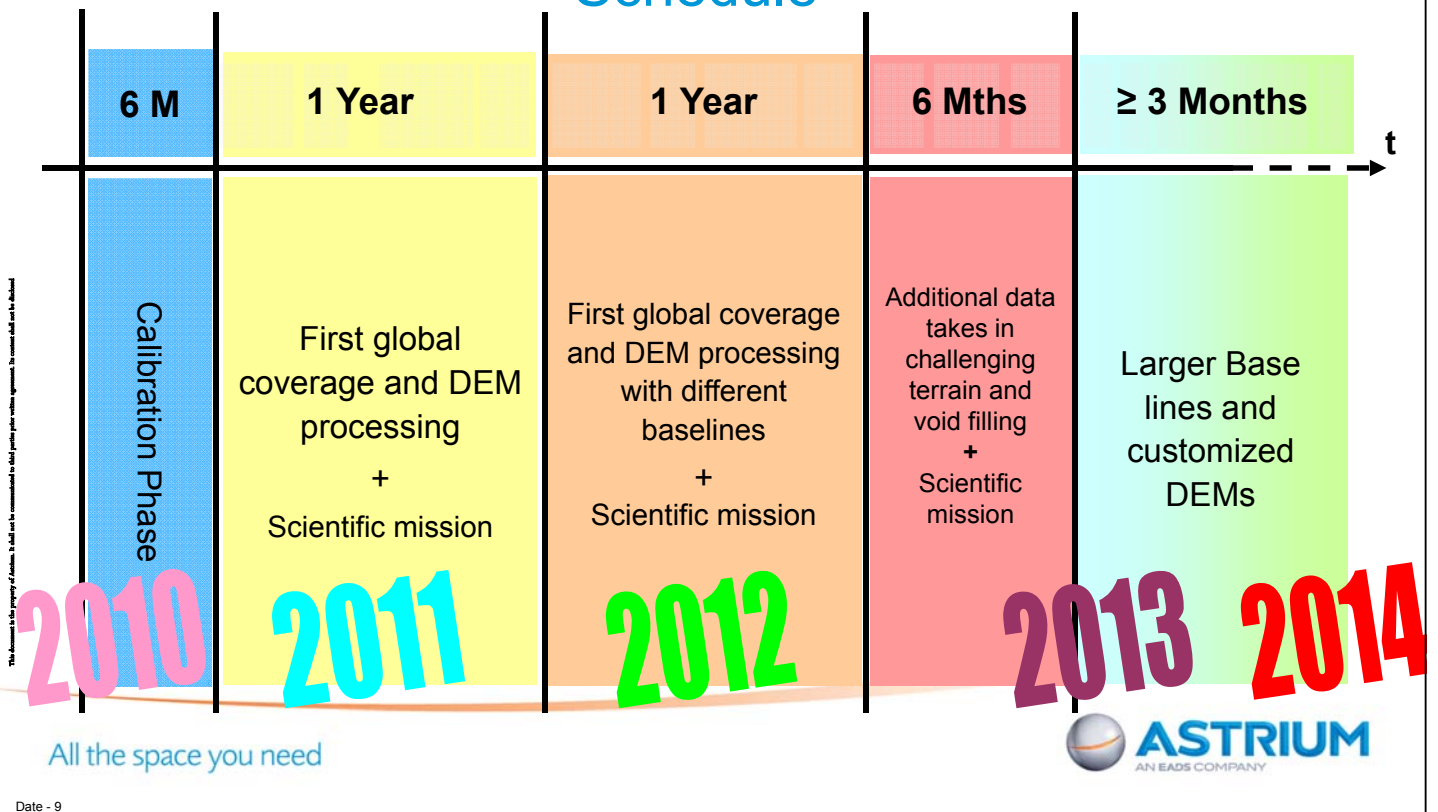
All the sp



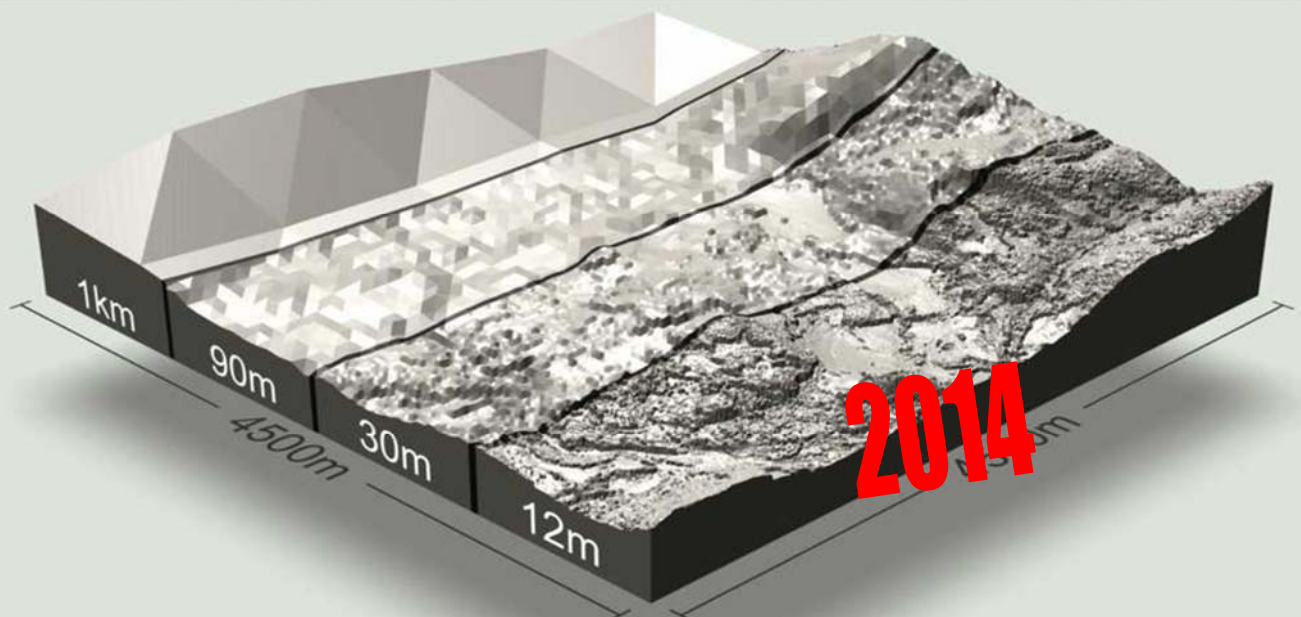
Date - 8



TanDEM-X Acquisition Schedule



New Class DEM



All the space you need



Status Acquisition

- Since December 12, 2010 DEM acquisition is operational and runs smoothly
- More than 5200 data takes have been acquired
- First global acquisition to be finished by the end of 2011 as planned
- Data-driven processing resumed mid August, free capacity used for re-processing of archived data
- Mosaicking & calibration processor to be made operational

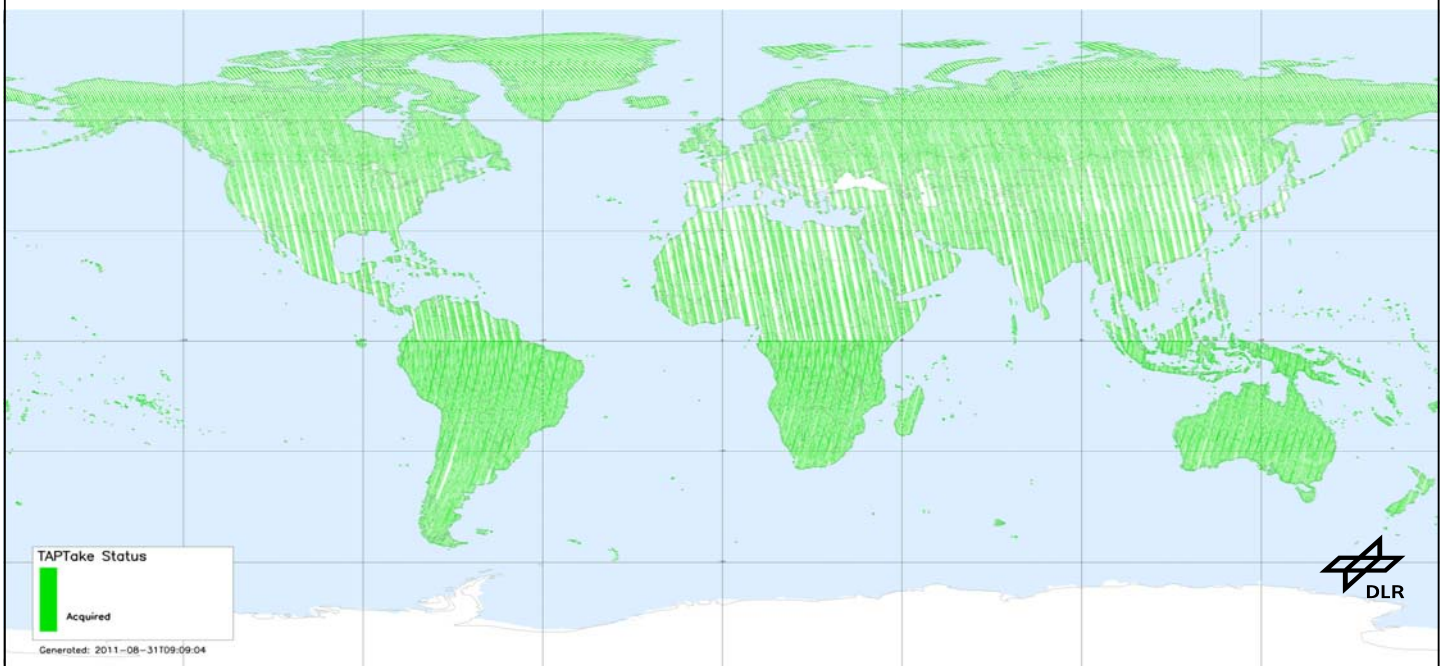
This document is the property of Astrium. It shall not be communicated to third parties prior to the agreement. Its content shall not be disclosed.

All the space you need



Date - 11

Completed Acquisitions



All the space you need



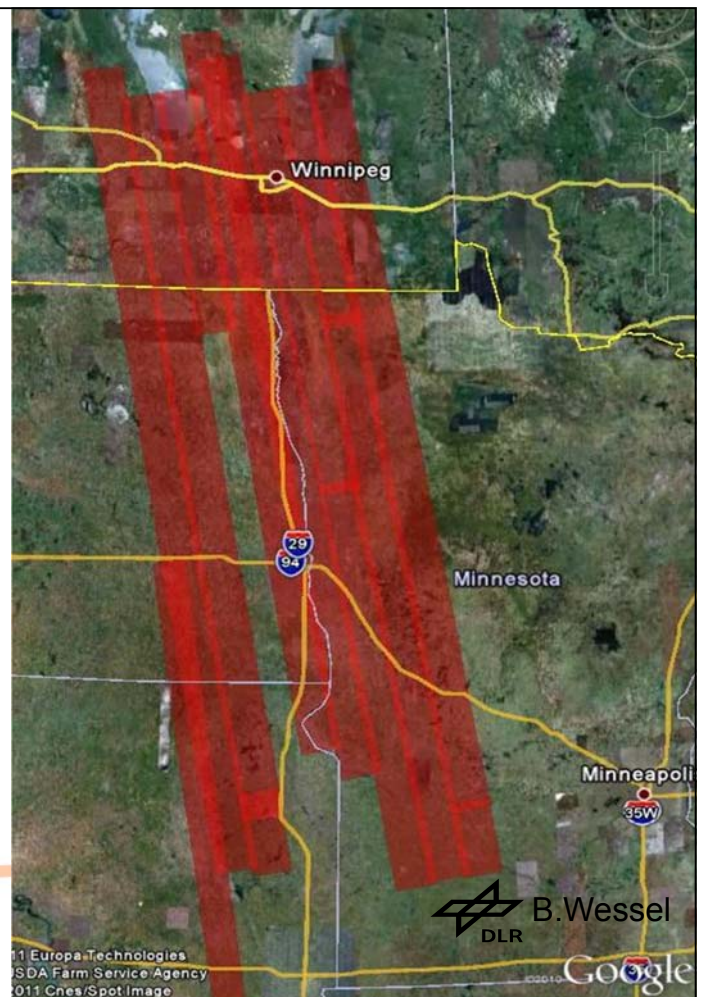
Date - 12

Test Site Minnesota/Manitoba

- 12 datatakes
- Reference data:
 - High resolution reference DEM
 - ICESat
 - SRTM
 - GPS track

All the space you need

Date - 13



W097_N47

DEM Mosaic

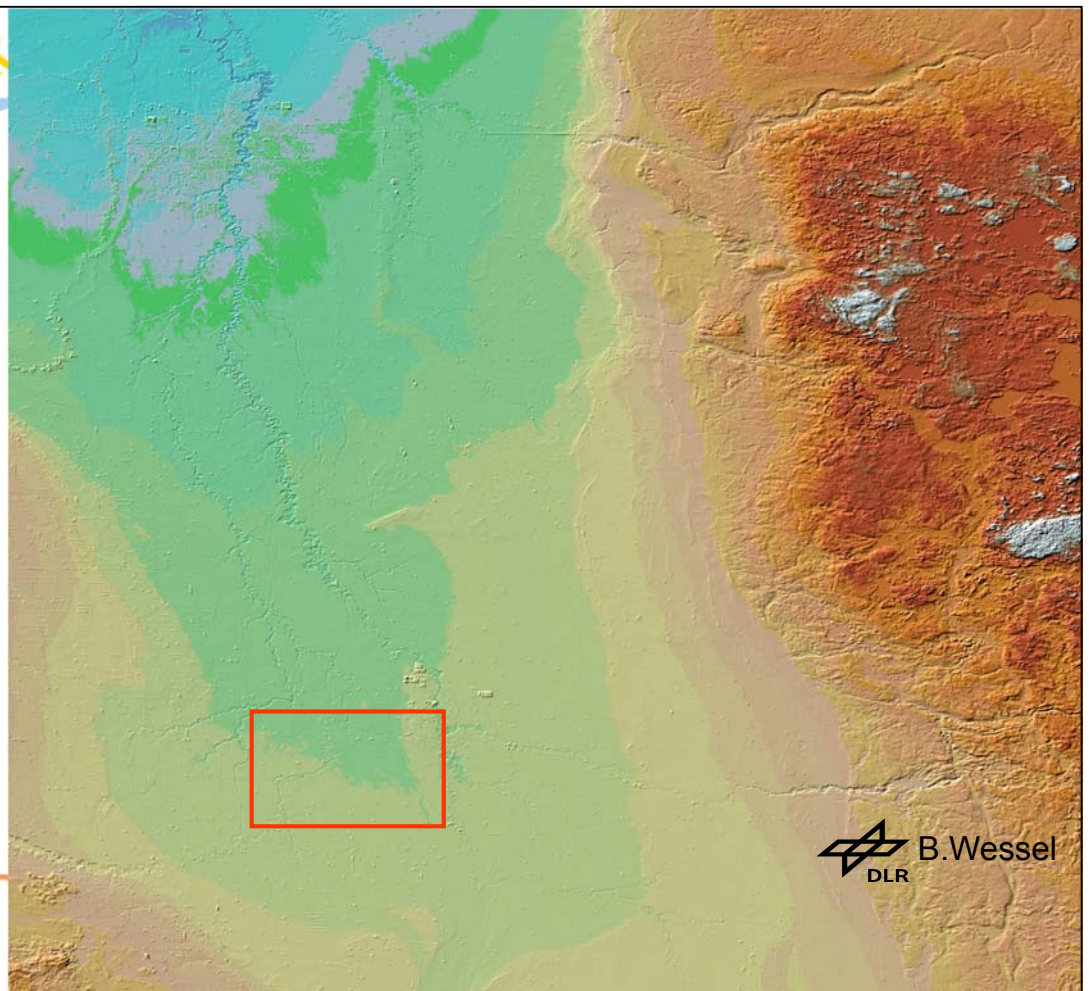
mean terrain

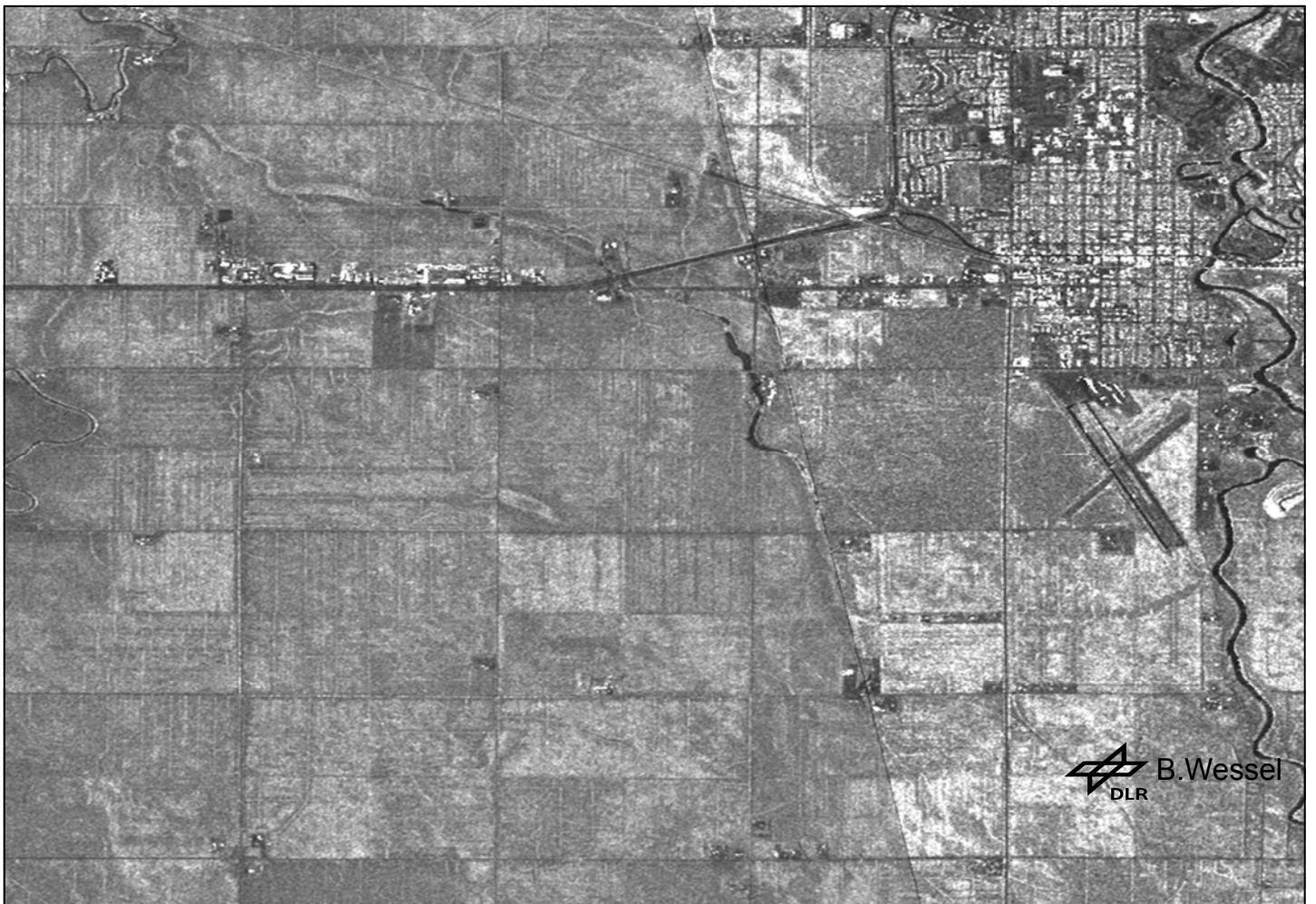
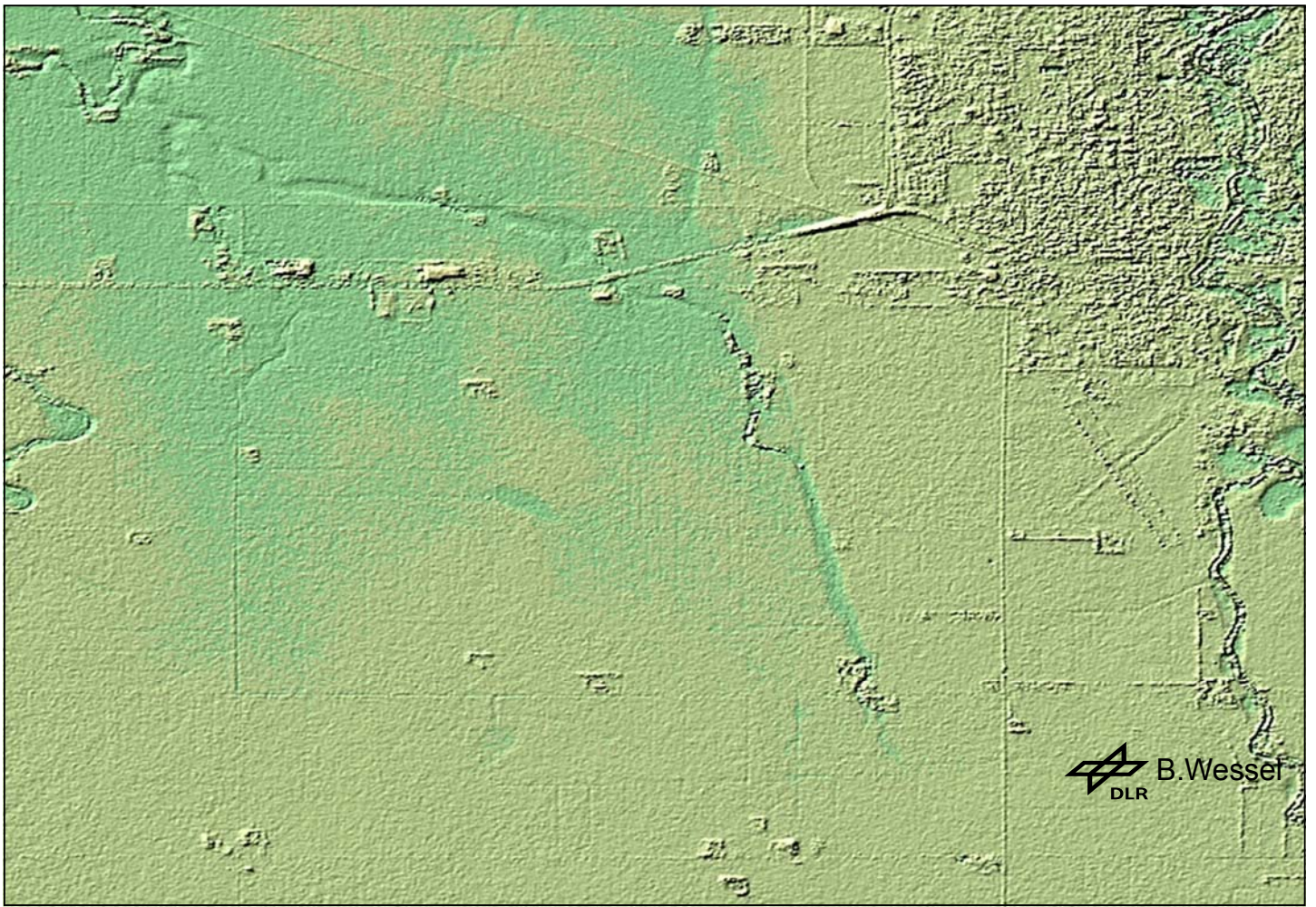
height:

294.5m

All the space you need

Date - 14





TANDEM

W097_N47

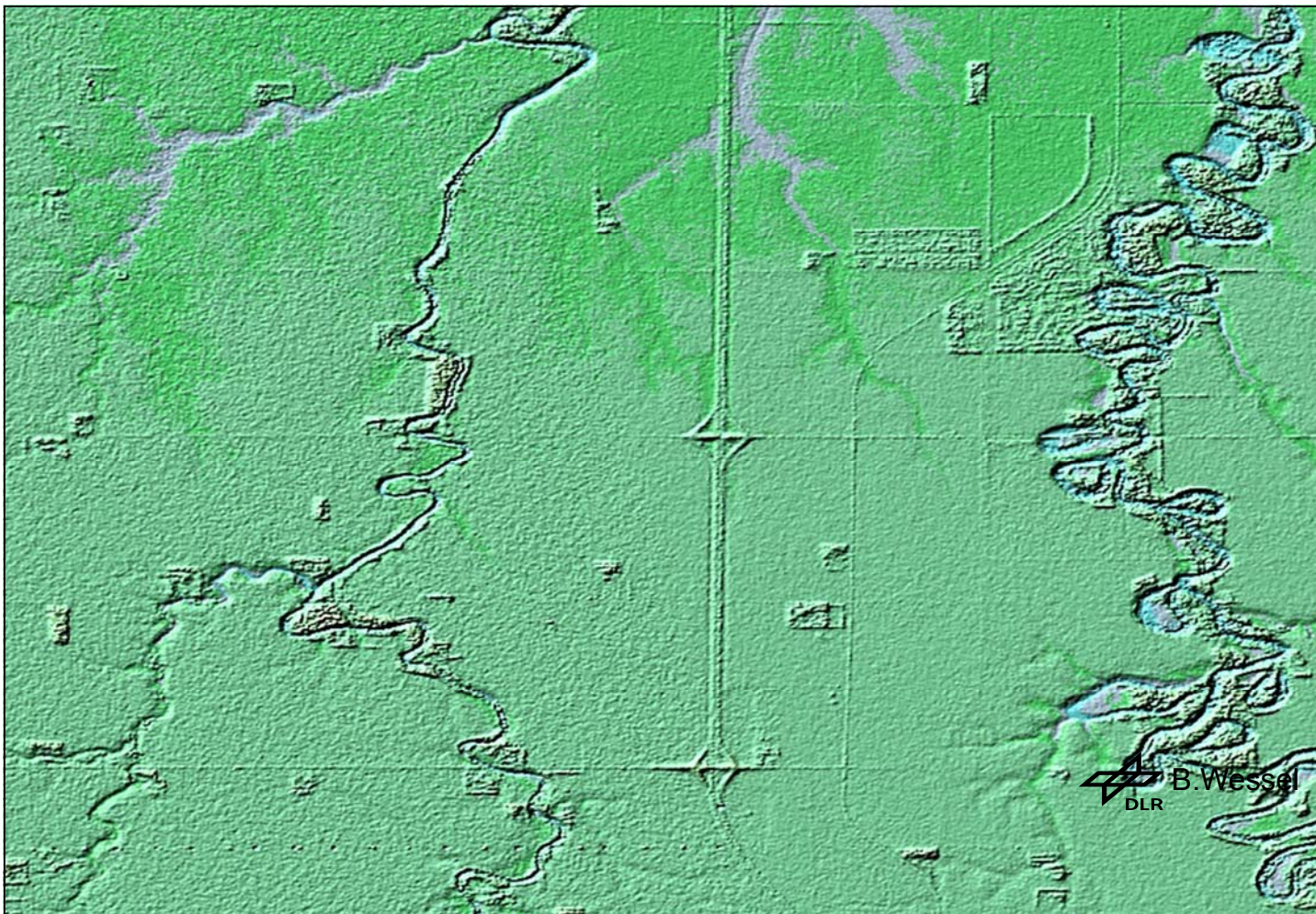
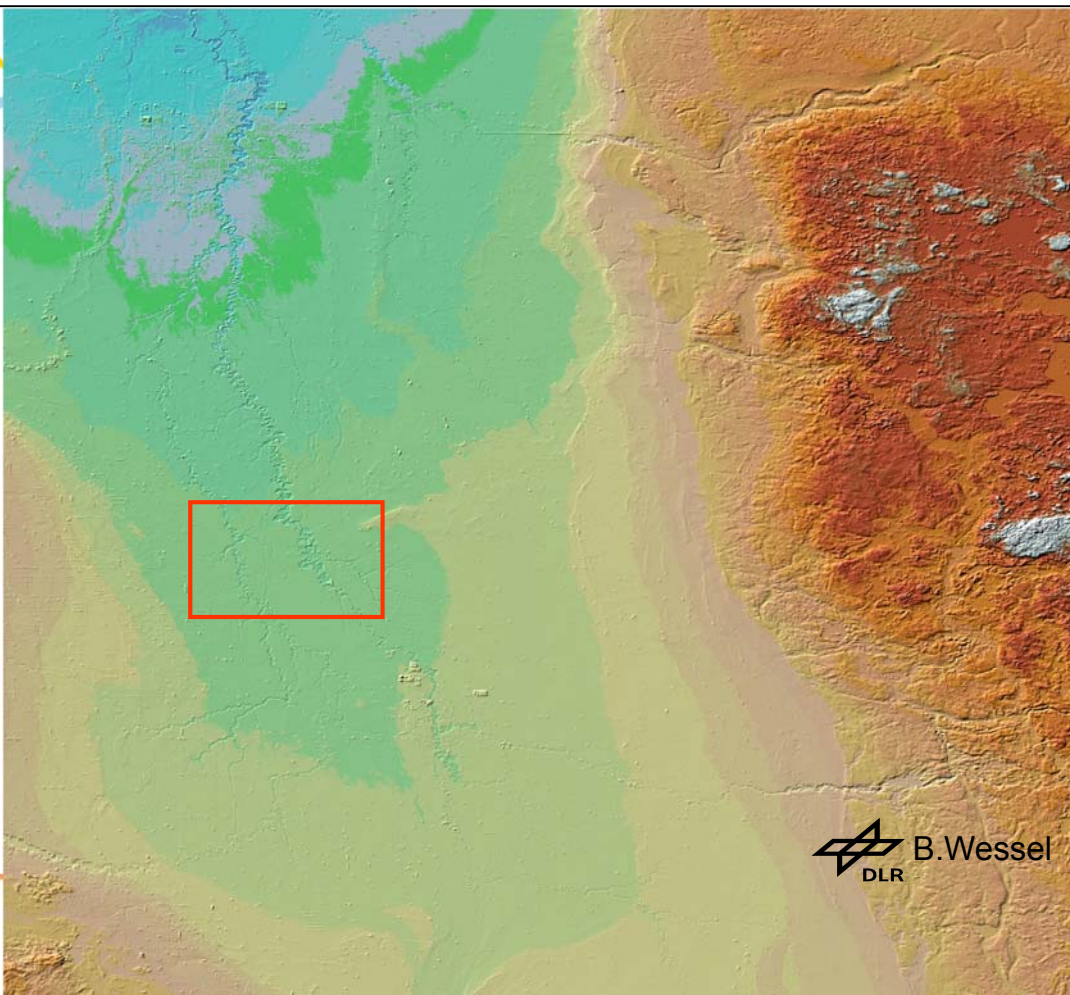
DEM Mosaic

mean terrain
height:
294.5m

This document is the property of DLR. It shall not be communicated to third parties without agreement. Its content shall not be released.

All the space you need

Date - 17





First Observations

- First block calibration Manitoba/Minnesota validates absolute vertical accuracy ~1-2m (LE90)
- Technical specification will be fulfilled (User Requirement Doc)
- Results will be better than expected

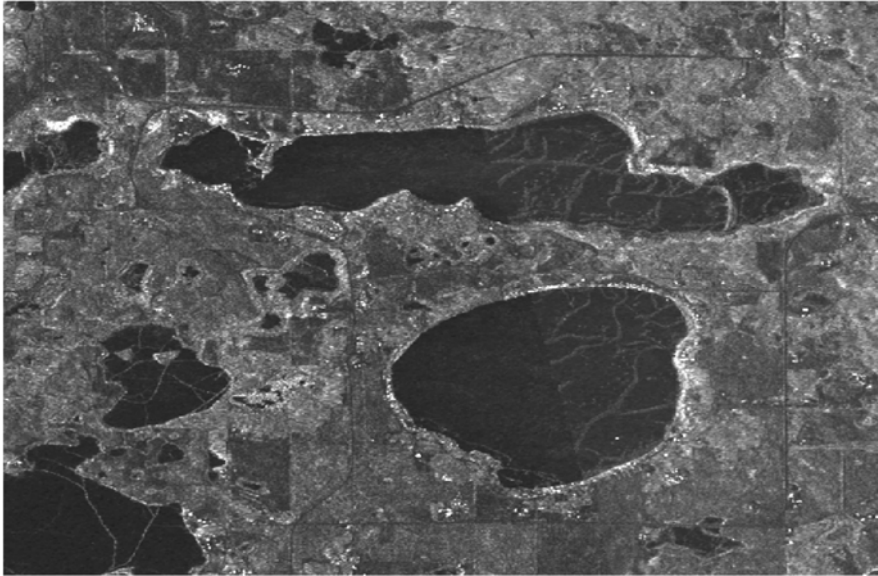
This document is the property of EADS. It shall not be communicated to third parties prior to the agreement. The content shall not be disclosed.

All the space you need

Date - 20



Editing Challenges



Radar image

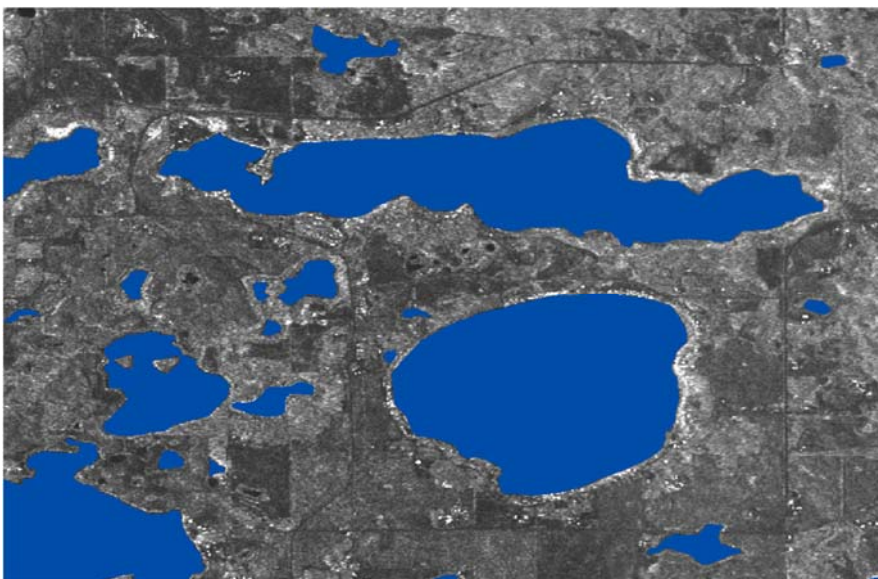
Minnesota USA

This document is the property of Astrium. It shall not be communicated to third parties prior to the agreement. The content shall not be disclosed.

All the space you need

Date - 21

Water Editing



Radar image with
water identified

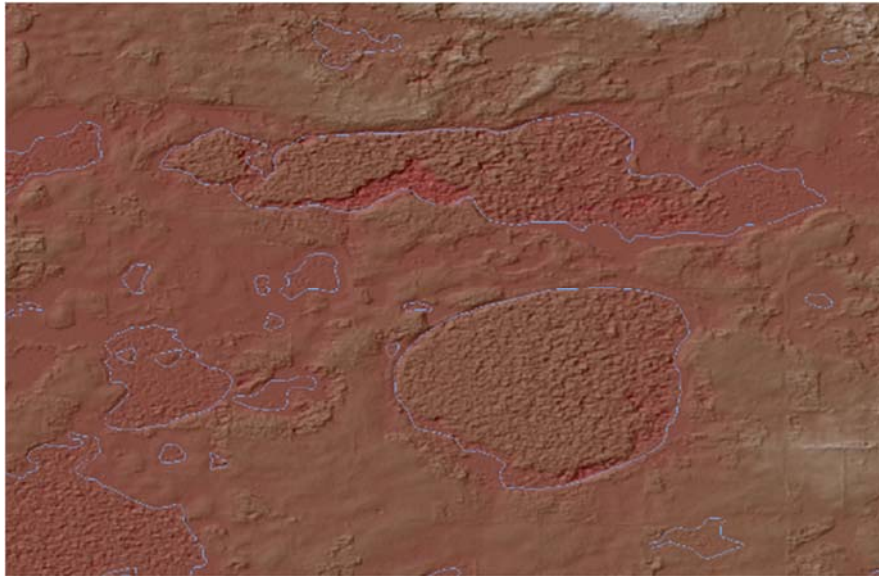
Minnesota USA

This document is the property of Astrium. It shall not be communicated to third parties prior to the agreement. The content shall not be disclosed.

All the space you need

Date - 22

Water Editing



Minnesota USA

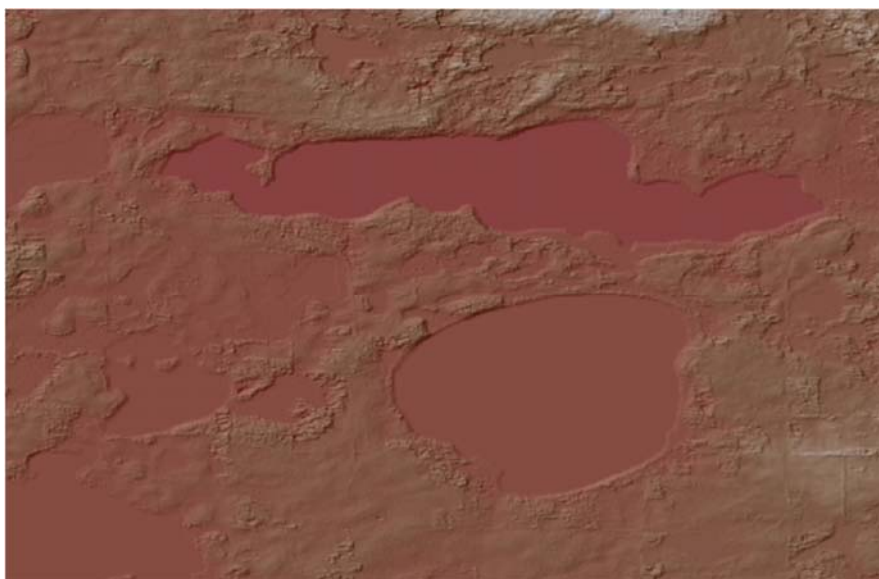
DSM elevation
model with water
identified

All the space you need



Date - 23

Water Editing



Minnesota USA

DSM elevation
model with water
flattened

All the space you need



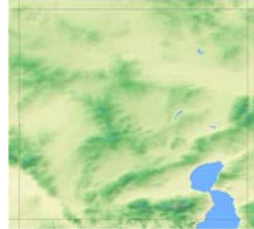
Date - 24

Classification of GeoCells

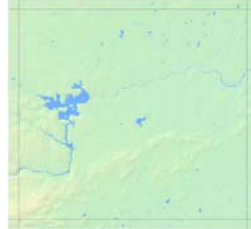
Very Easy



Easy



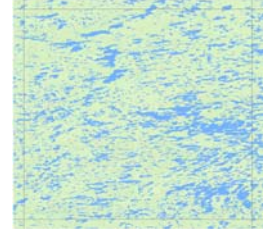
Medium



Difficult



Super
Difficult

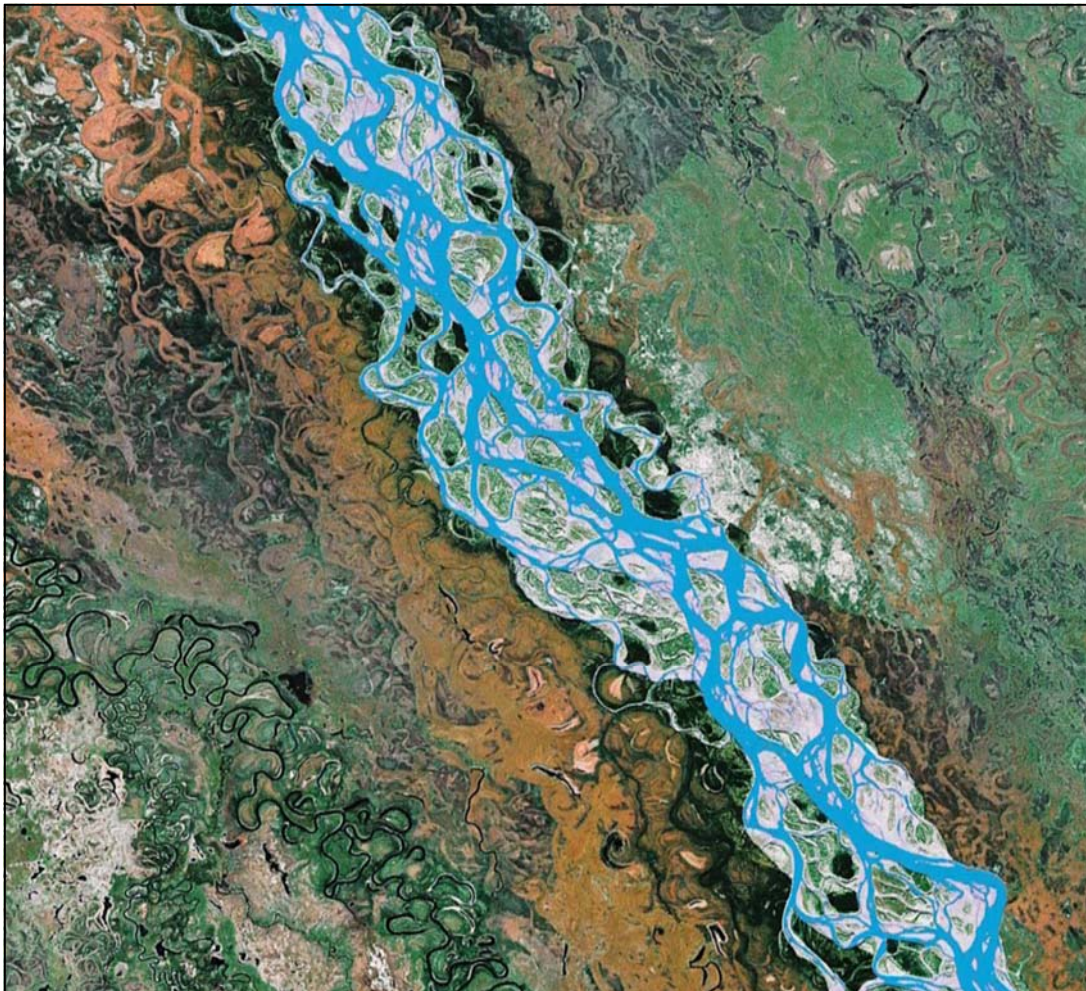


This document is the property of EADS. It shall not be communicated to third parties without agreement. Its content shall not be disclosed.

All the space you need



Date - 25

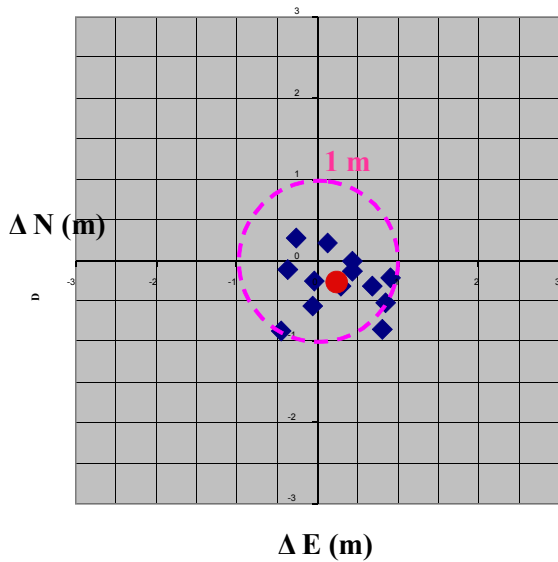


The Final
Slide
Geocell Hell:
Yukon River
Alaska



Geolocation Accuracy

TerraSAR-X-1 Spotlight Monoscopic Absolute Geolocation Accuracy (Rigorous Sensor Model Data)

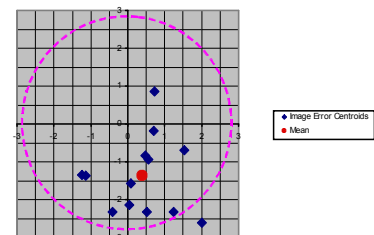


◆ Image Error Centroids
● Mean

The scatter plots show the mean displacements for each image in blue, and the associated centroid of all of the errors in red. The overall means are close to zero. The CE90 circles are shown in magenta.

Tom Ager, NGA, ASPRS 2009 Annual Conference

StripMap Monoscopic



All the space you need

Date - 27

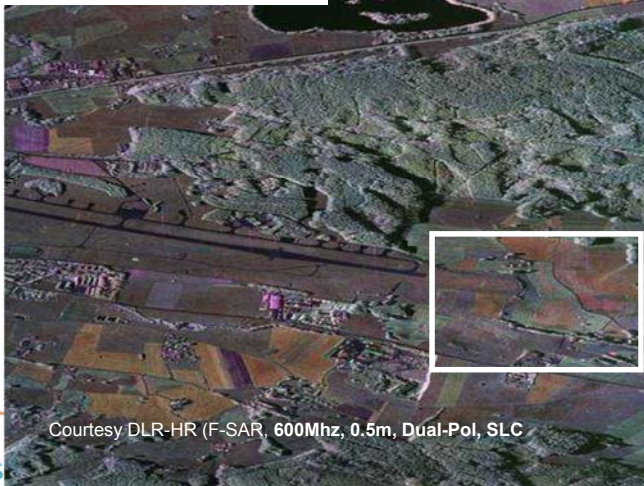


TerraSAR-X2

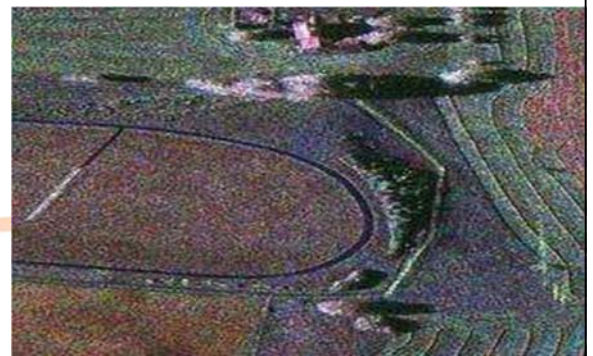
The next SAR Generation

The next SAR Generation

- TerraSAR-X2
- Resolution 0.5 m
- Dual Polarization



Courtesy DLR-HR (F-SAR, 600Mhz, 0.5m, Dual-Pol, SLC)



All the space you need

Date - 29

The next SAR Generation

- Heritage modes, INSAR continuity (as adopted)
- Enhanced collection capability
 - Zoom in: dual polarized 0.5 m (government: <0.5 m single pol.)
 - Zoom out: 500 km swath (50 m, dual pol.)
 - Overall capacity like first generation with increased flexibility: high local collection density for object patterns
 - AIS collects integral in local imagery
- Improvements in communication and downlinks
 - 800 Mbps (X-band); station compatibility
 - Relay link option based on LCT (EDRS)
- Constellation
 - 2 polar + 1 inclined
 - Average revisit below 10h
 - For most critical areas 24h revisit guaranteed at best resolution



All the space you need

Date - 30