

# 5<sup>th</sup> TerraSAR-X / 4<sup>th</sup> TanDEM-X Science Team Meeting

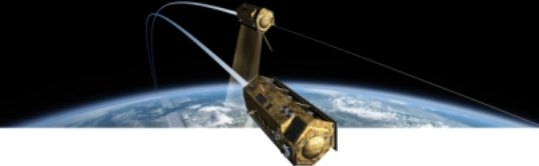
## TerraSAR-X Mission Status

**Stefan Buckreuss – Mission Manager**

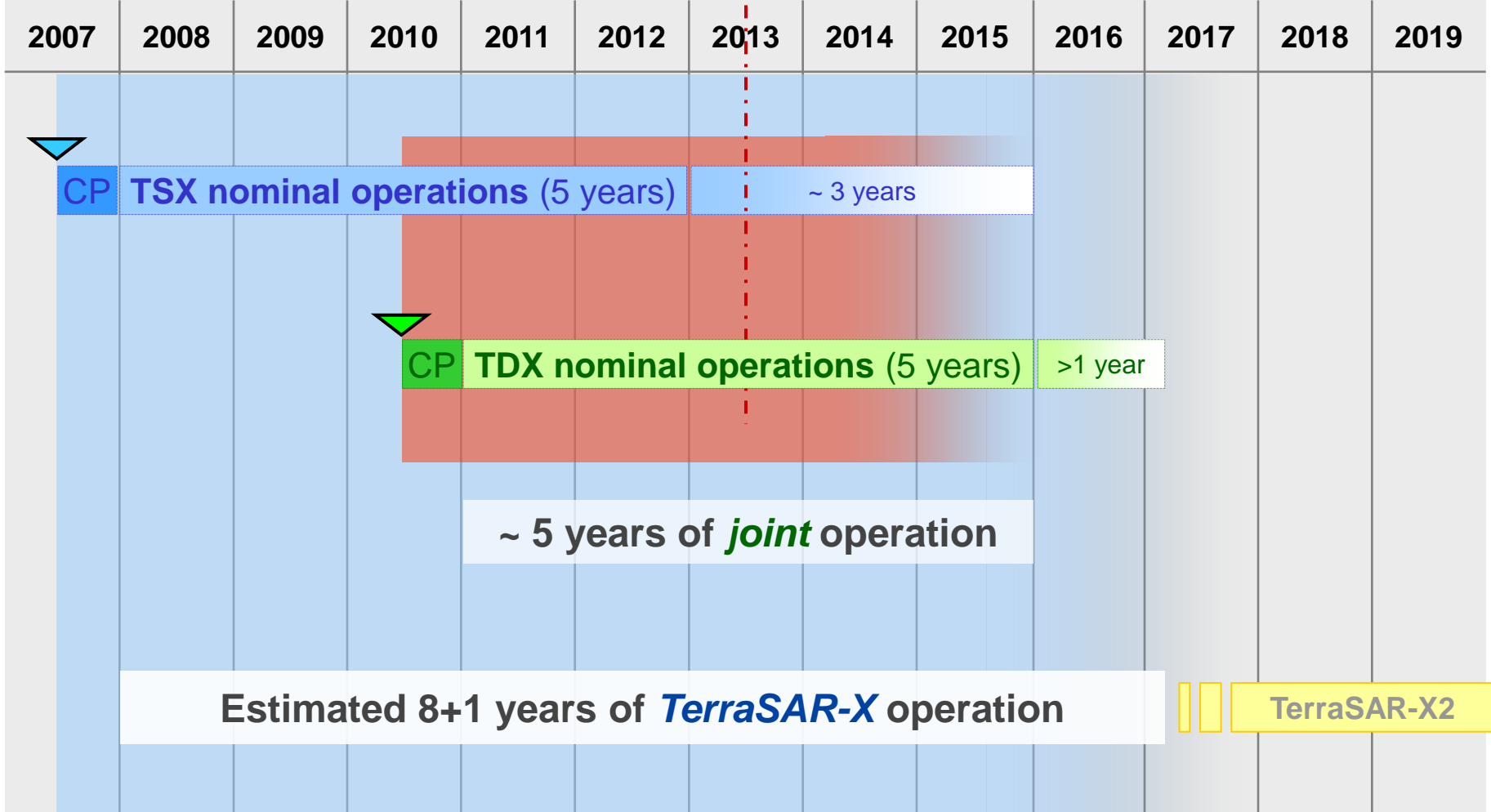


Deutsches Zentrum  
für Luft- und Raumfahrt e.V.  
in der Helmholtz-Gemeinschaft





# Timeline





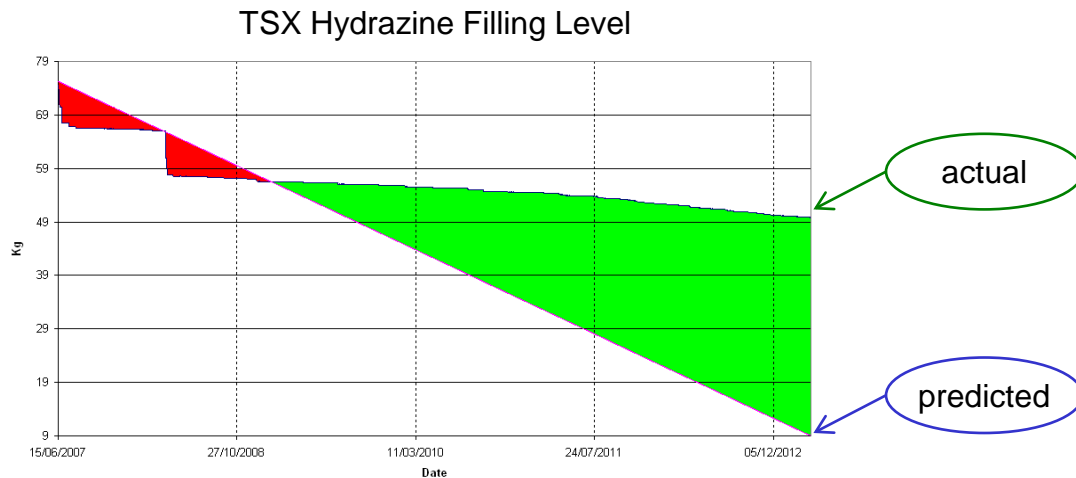
# Resources Status - Hydrazine

## TSX- Satellite

Hydrazine filling level

6 years after launch:

**ca. 65%**

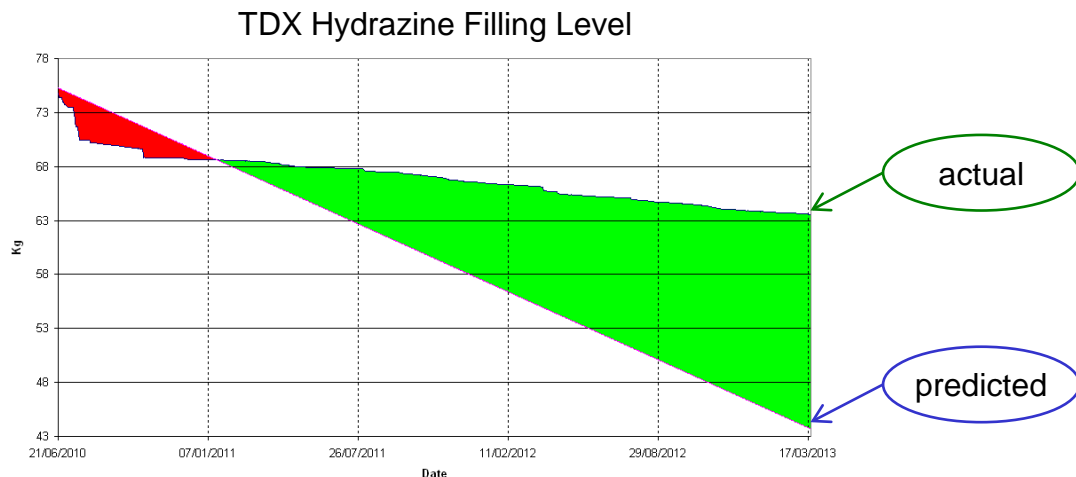


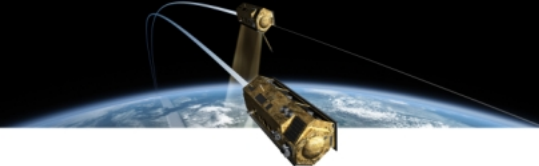
## TDX-Satellite

Hydrazine filling level

3 years after launch:

**ca. 86%**

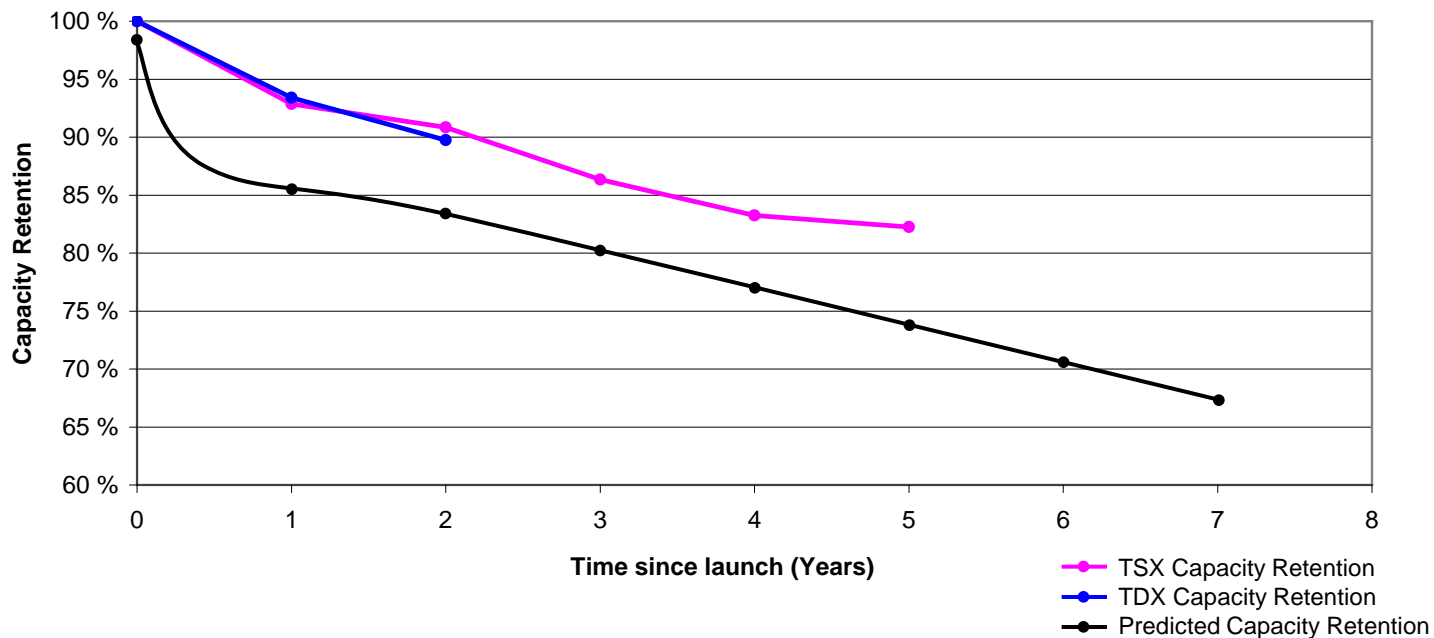




# Resources Status - Battery

- Retained TSX battery capacity is ~82 % and TDX battery capacity is ~90 %
- According to analysis batteries are in excellent health – exceeding original fade predictions

TSX vs. TDX Battery Capacity Retention





# Comparison of TerraSAR-X versus TanDEM-X

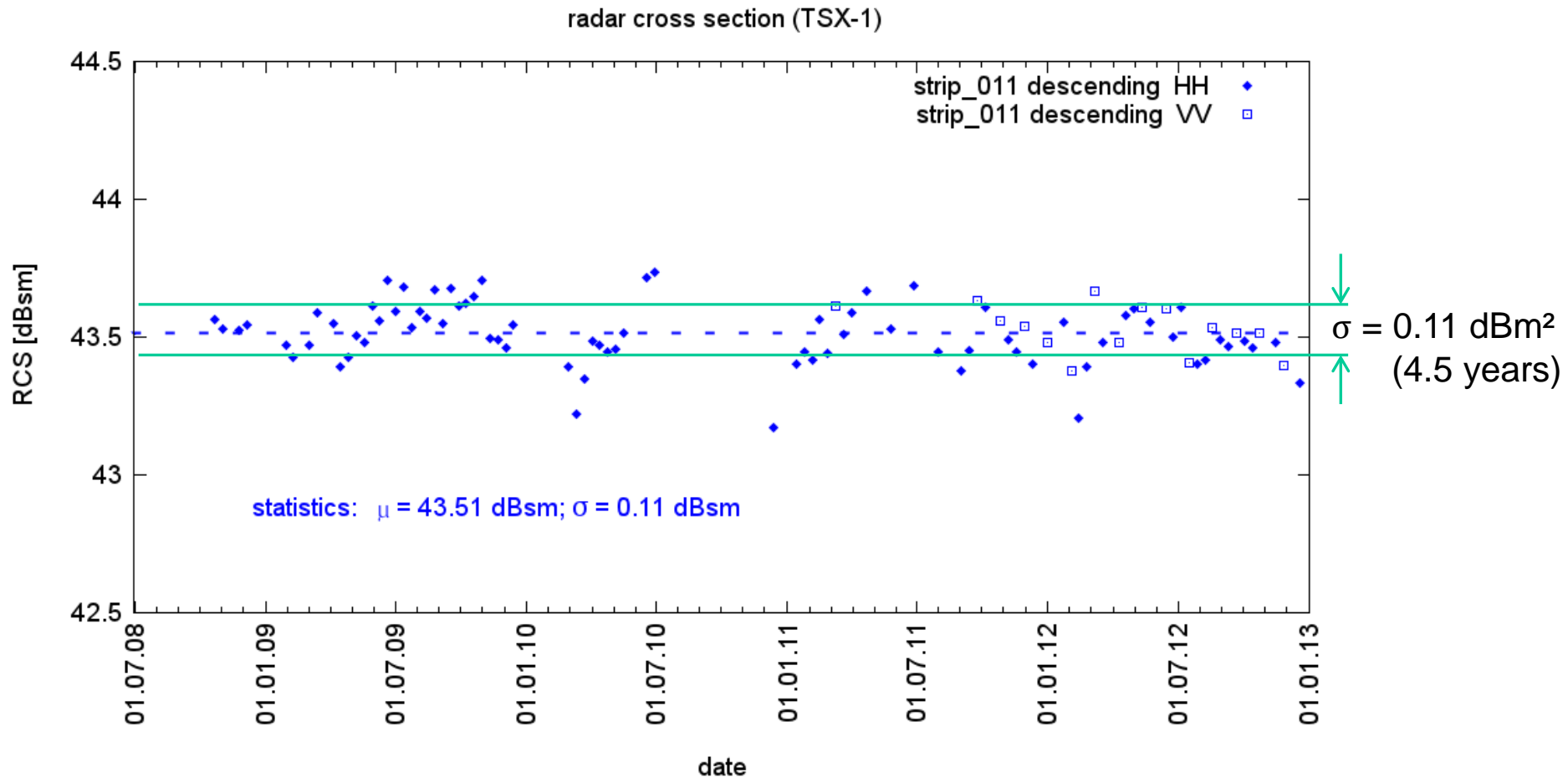
	TerraSAR-X	TanDEM-X
<b>Internal Calibration</b>		
✓ Instrument Drift (Ampl./Phase)	$\leq 0.15\text{dB} / \leq 0.5 \text{ deg}^*$	$\leq 0.1\text{dB} / \leq 0.85 \text{ deg}^{**}$
✓ TRM-Charact. (Ampl./Phase)	$< 0.2 \text{ dB} / < 2 \text{ deg}$	$< 0.2 \text{ dB} / < 2 \text{ deg}$
<b>Geometric Calibration</b>		
✓ Pixel Localisation Accuracy (az/rg)	12.1 cm / 10.7 cm	9.2 cm / 11.0 cm
<b>Antenna Pointing</b>		
✓ Azimuth / Elevation	1 mdeg / 4 mdeg	$< 2 \text{ mdeg} / < 2 \text{ mdeg}$
<b>Antenna Model</b>		
✓ Shape and Gain-Offset	$\leq \pm 0.2 \text{ dB}$	$\leq \pm 0.2 \text{ dB}$
<b>Radiometric Calibration</b>		
✓ Radiometric Stability	0.15 dB / (3 years)	0.15 dB / (3 years) ***
✓ Rel. Rad. Accuracy (Strip/Scan)	0.16 dB / 0.27 dB	0.2 dB / 0.3 dB
✓ Abs. Rad. Accuracy (Strip/Scan)	0.34 dB / 0.40 dB	0.48 dB / 0.52 dB

⇒ **TSX-1 and TDX-1 are almost not distinguishable**

\* 120 sec DT  
\*\* 320 sec DT  
\*\*\* TSX-1 experience



# Long-Term System Monitoring - RCS Measurement Example



# PN-Gating Results

1.10.2012 – 1.1.2013

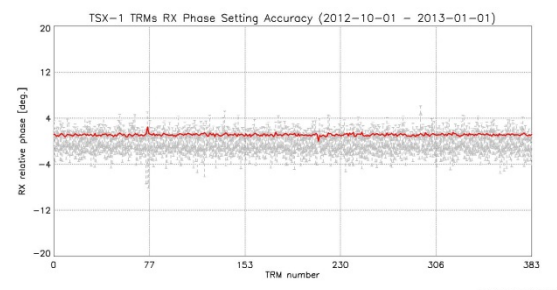
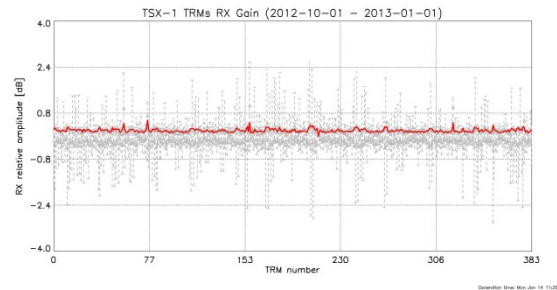
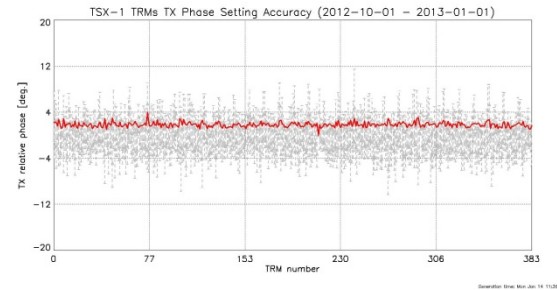
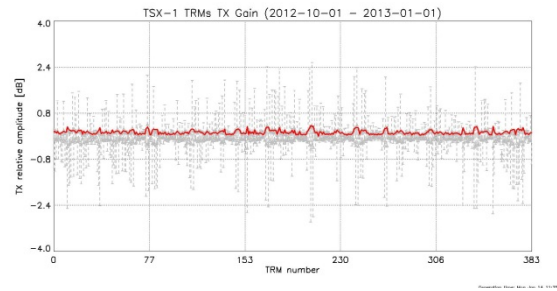
Transmit Gain:

Transmit Phase:

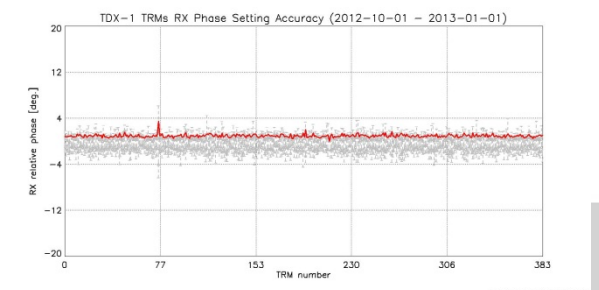
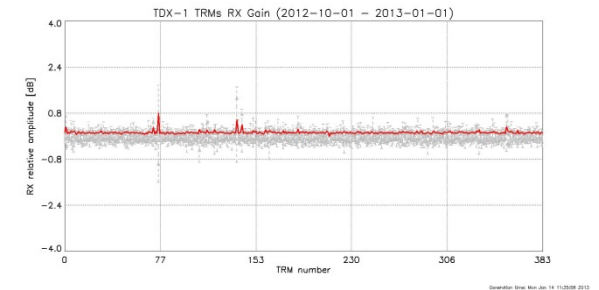
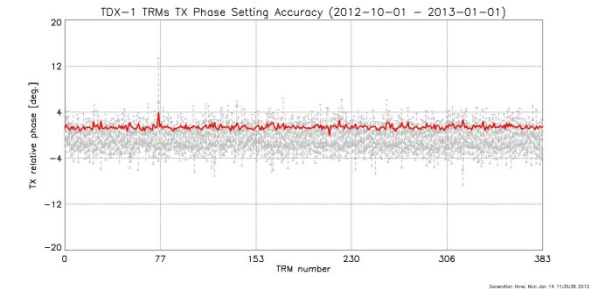
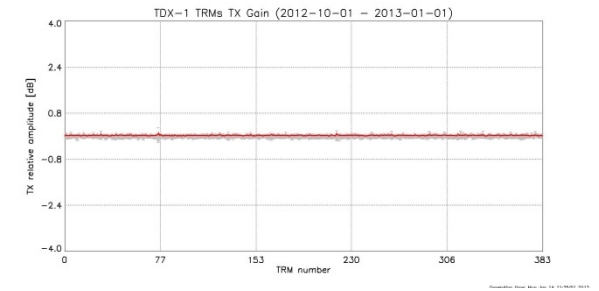
Receive Gain:

Receive Phase:

## TSX



## TDX





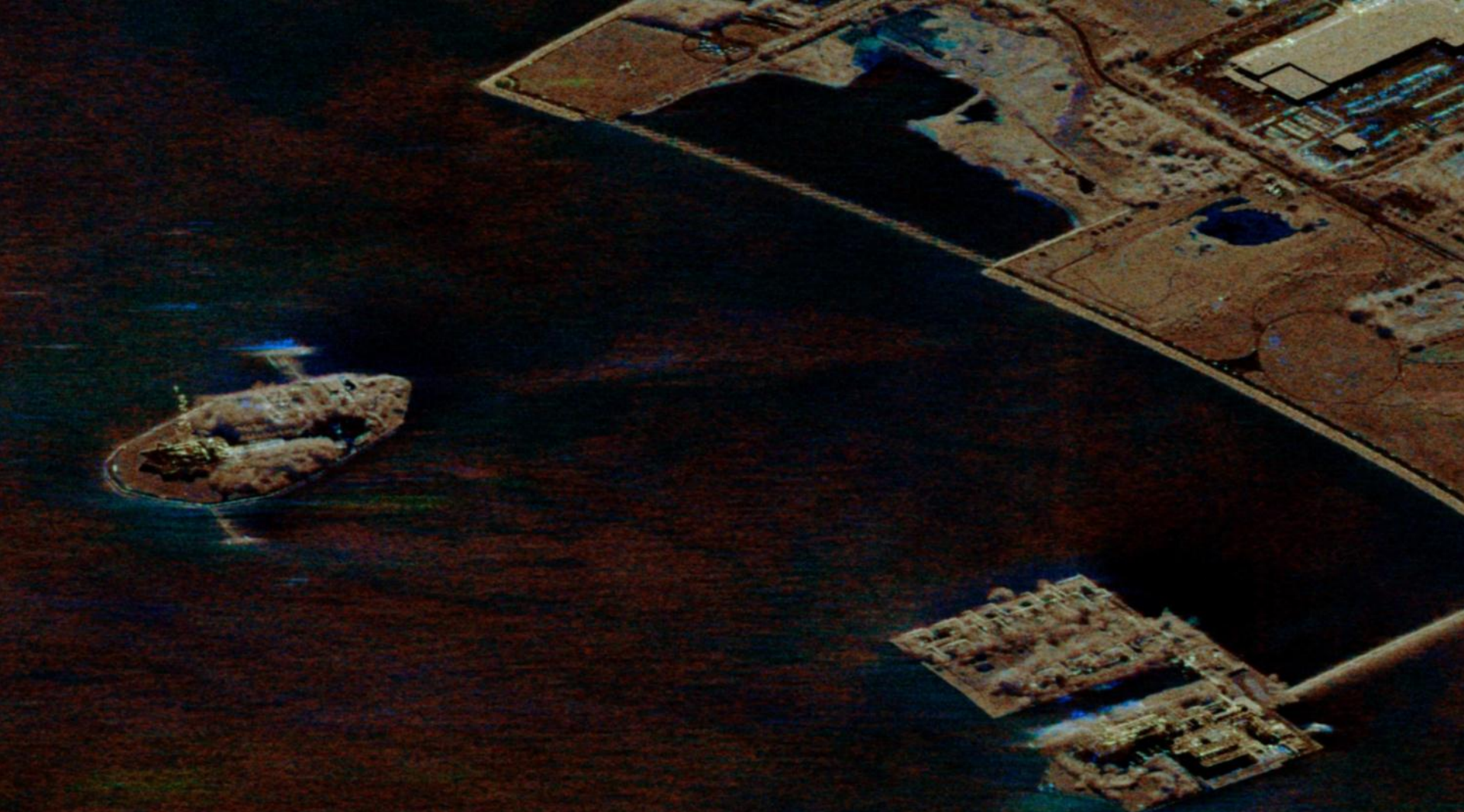
# Manhattan

Timeseries:  
4 images within  
21 months

- Speckle-Filtering
- Sidelobe Suppression
- Co-Registration

Blue: Changes  
Brown: Clutter  
Cyan: Robust Scatterers





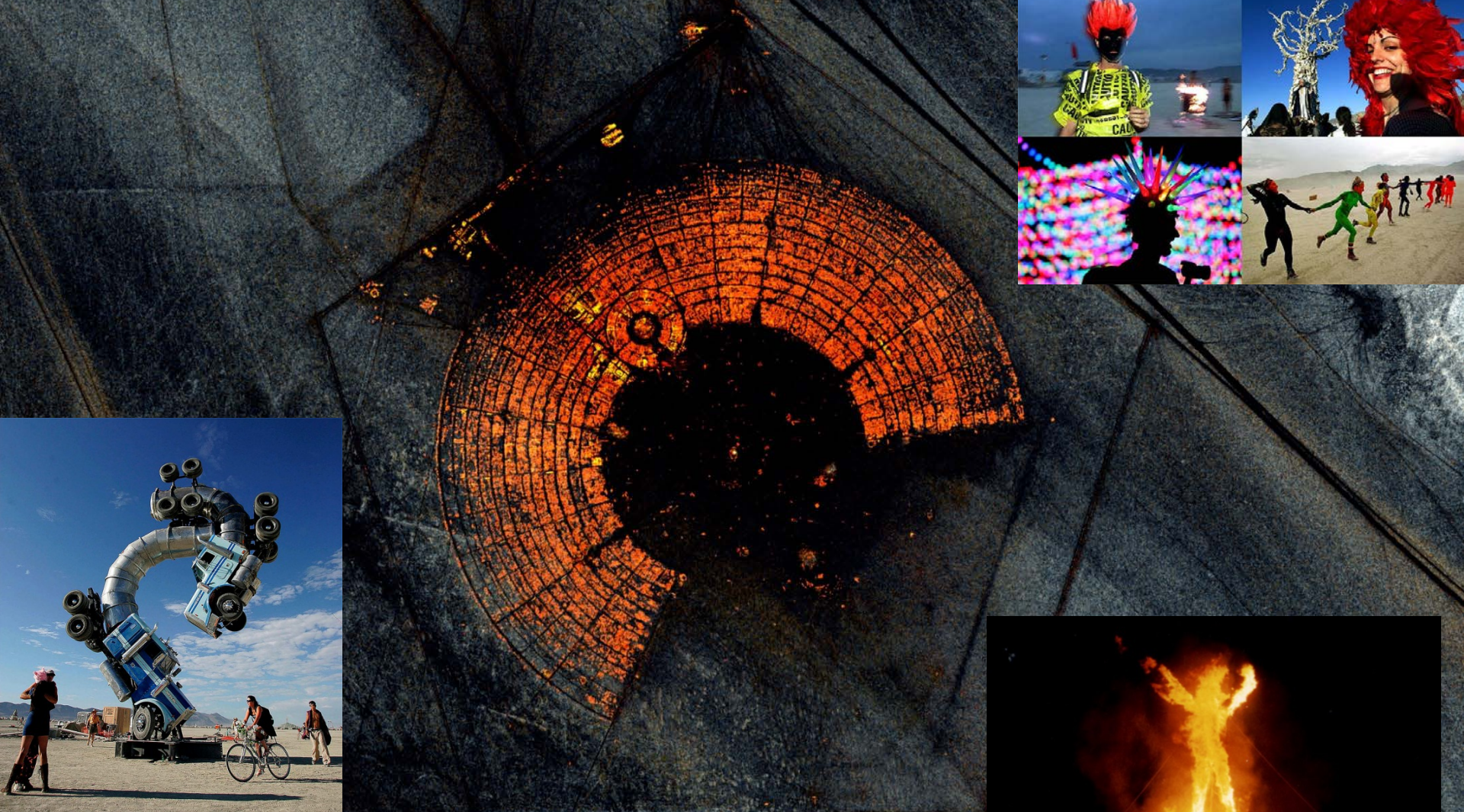
## Liberty Island

## Ellis Island

Timeseries:  
4 images within  
21 months

- Speckle-Filtering
- Sidelobe Suppression
- Co-Registration

Blue: Changes  
Brown: Clutter  
Cyan: Robust Scatterers



# Burning Man Festival

## Black Rock Desert, Nevada

Timeseries:  
4 images within  
1 month

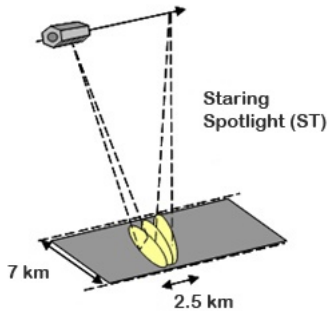
- Speckle-Filtering
- Sidelobe Suppression
- Co-Registration



Orange: Rare Appearance  
Yellow: Frequent Appearance  
Grey: Constant



# New SAR-Modes

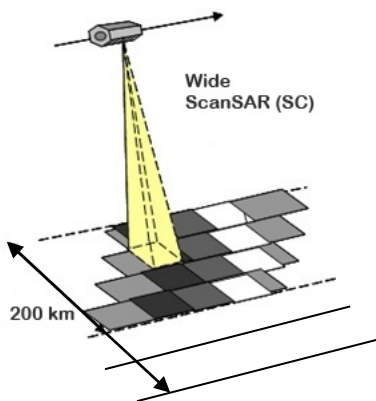


## Staring Spotlight Mode – Available October 2013

*Azimuth:*

*Range:*

- |                                |               |               |
|--------------------------------|---------------|---------------|
| ➤ Resolution:                  | <b>0.24 m</b> | 0.85...1.77 m |
| ➤ Scene Size:                  | 2.1...2.7 km  | 7.5...4.6 km  |
| ➤ Single Polarization (HH, VV) |               |               |



## Wide ScanSAR Mode – Available August 2013

*Azimuth:*

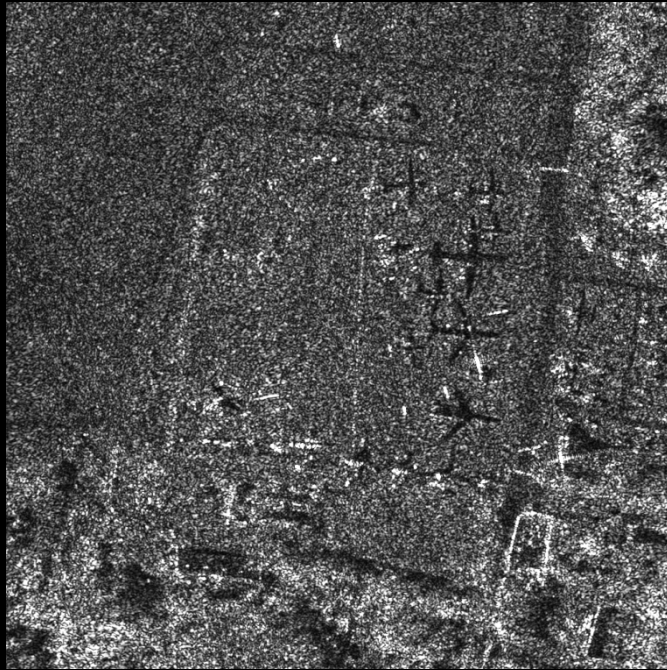
*Range:*

- |                                       |        |                     |
|---------------------------------------|--------|---------------------|
| - Resolution:                         | 40 m   | 6...10 m            |
| - Scene Size:                         | 200 km | <b>194...266 km</b> |
| - Single Polarization (HH, VV, HV/VH) |        |                     |

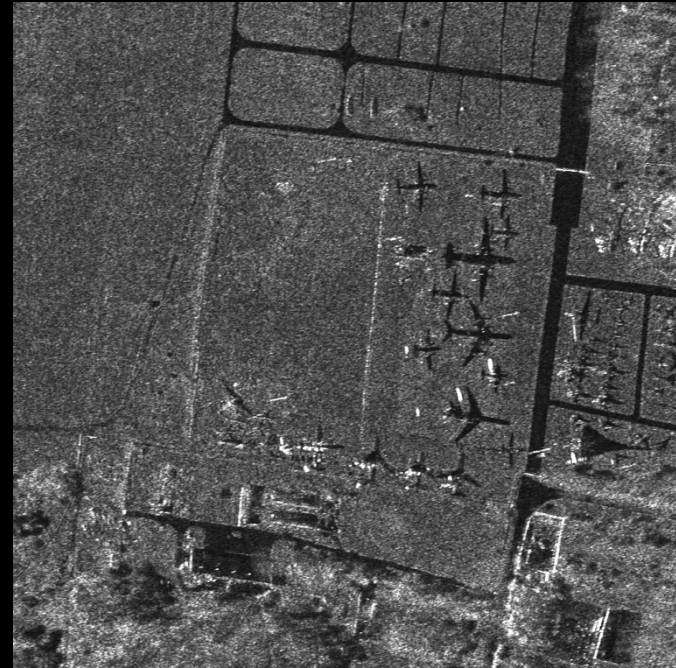


# Staring Spotlight Mode

**Spotlight Basic Product**



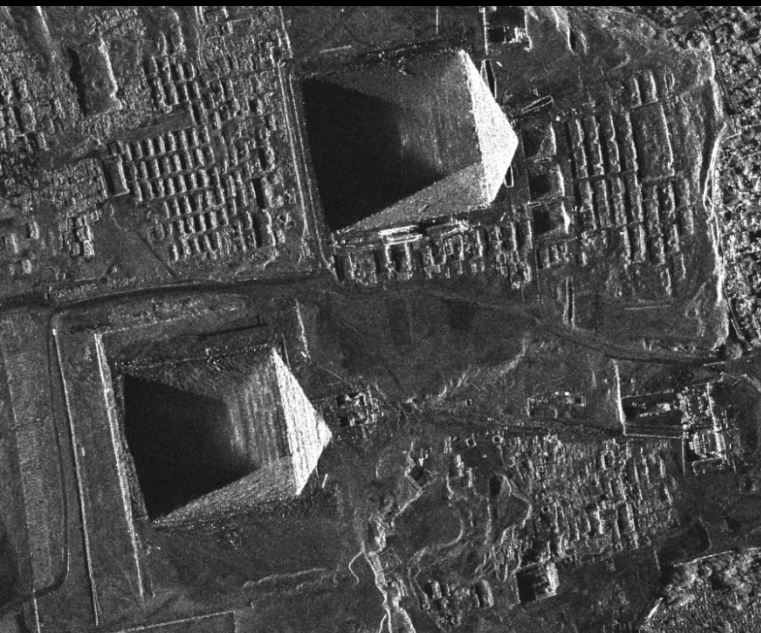
**Staring Spotlight Product**  
improved radiometric resolution



**Geometric Resolution:  $\sim 1 \text{ m} \times 1 \text{ m}$**



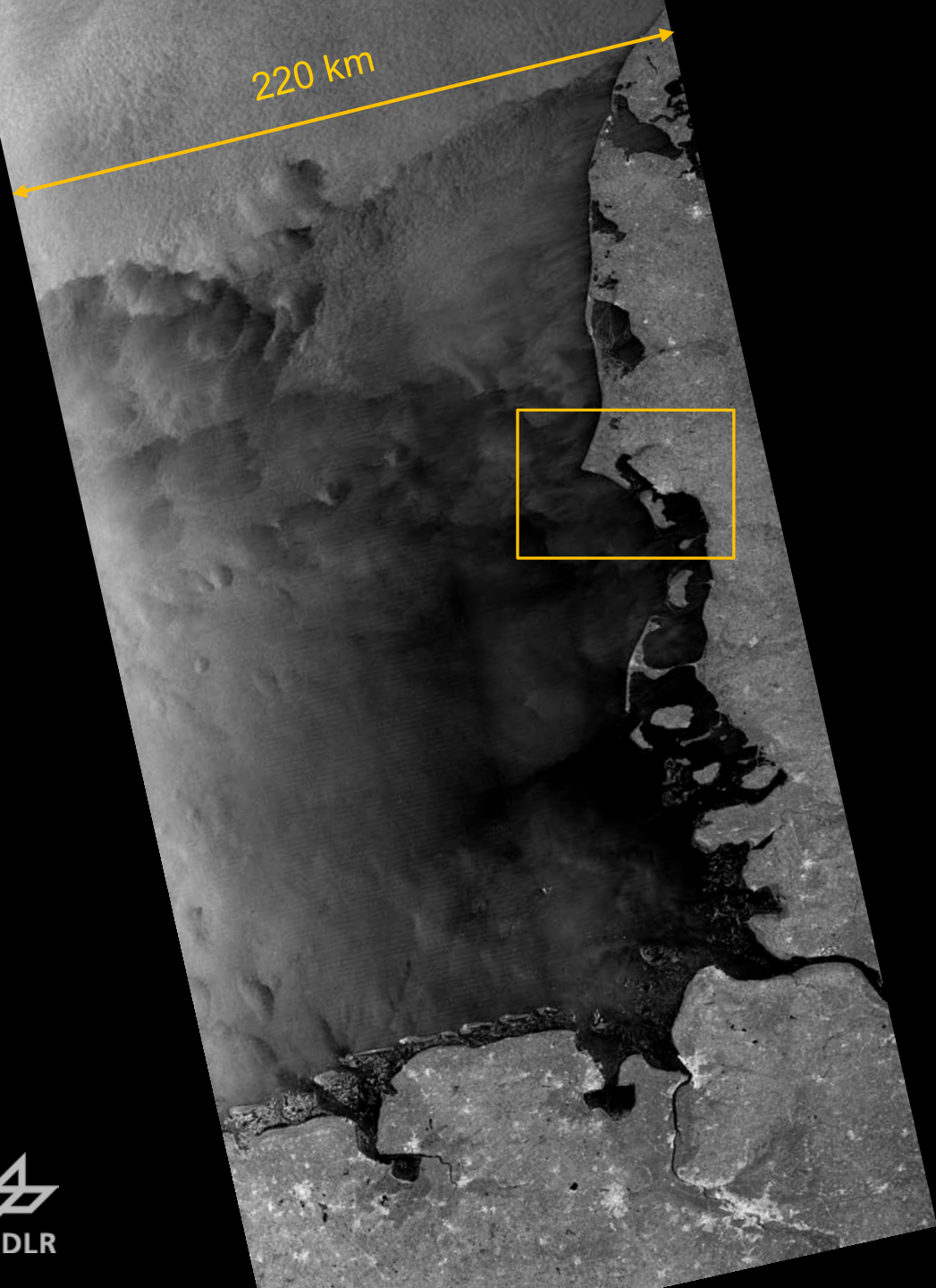
**Staring Spotlight Examples...**





# Preliminary Staring Spotlight Mode Characteristics

Parameter	Value
Scene extent for (20° - 45°)	[2.1 to 2.7 km] azimuth x [6 to 3.8 km] ground range - worst case x [7.5 to 4.6 km] ground range - typical case
Full performance incidence angle range	20° - 45°
Data access incidence angle range	15° - 60°
Number of elevation beams	58 (full performance) 122 (data access)
Number of azimuth beams	Depending on target area
Azimuth steering angle	± 2.2°
Azimuth resolution	0.24 m (single polarization)
Ground range resolution	0.85 m – 1.77 m (45°...20° at 300 MHz)
Polarizations	HH or VV (single)



# Wide ScanSAR

German Bight

220 km × 500 km



Offshore windfarm at the coast of Denmark

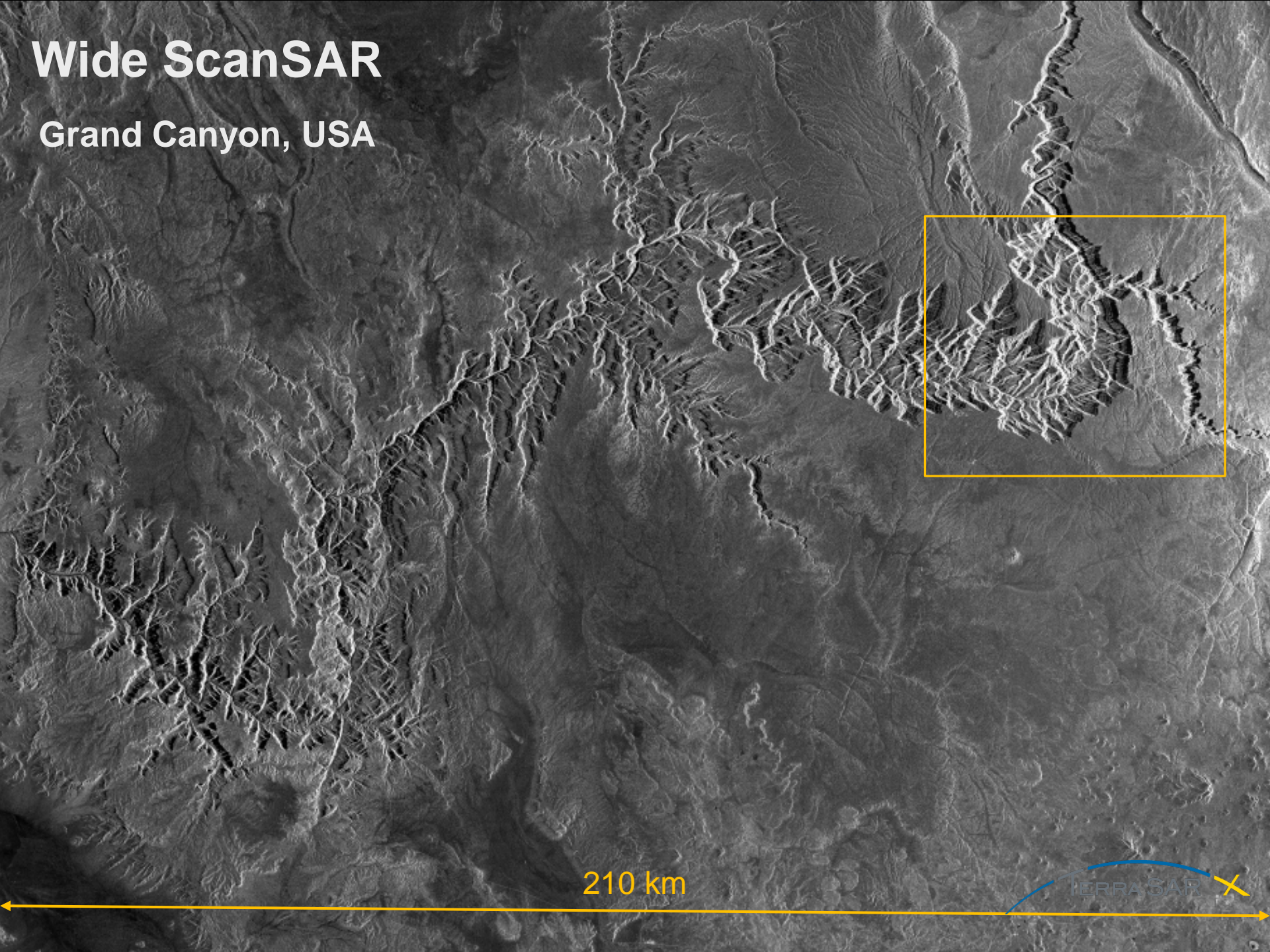
65 km





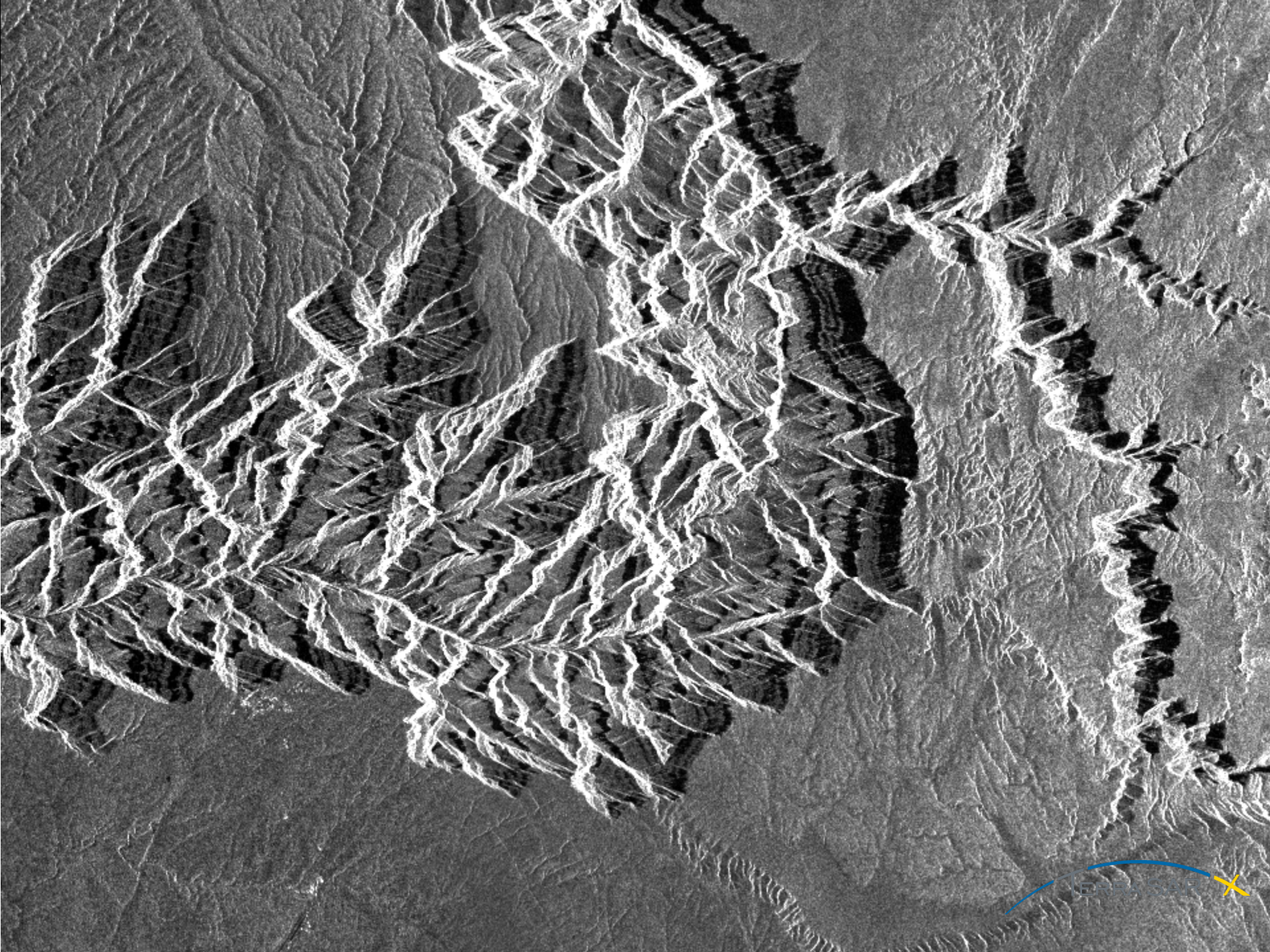
# Wide ScanSAR

Grand Canyon, USA



210 km

TERRA SAR X





# Preliminary Wide ScanSAR Mode Product Characteristics

Parameter	Four beam ScanSAR	Six beam ScanSAR
Number of sub-swaths	4	6
Swath width (ground range)	100 km	<b>266 to 194 km</b> (wide_001 to wide_005)
Nominal L1b product length	150 km	<b>200 km</b>
Full performance incidence angle range	20° - 45°	<b>15.6° - 49°</b>
Data access incidence angle range	15° - 60°	15.6° - 49°
Number of elevation beams	27 (9 x 4 stripmap beam combinations in full perf. range)	10 specific wide beams (5 x 6-beam combinations)
Azimuth resolution	18.5 m	<b>40m</b>
Range bandwidth	100 and 150 MHz	<b>81.25 to 31.25 MHz</b>
Ground range resolution	1.70 m - 3.49 m (@ 45°..20° incidence angle)	<b>6-10m</b> (projected slant range)
Polarizations	HH or VV (single)	HH or VV (single) or experimental HV or VH <b>TBC</b>



## TerraSAR-X Mission Status

- Nominal lifetime of TerraSAR-X satellite is exceeded, yet on-board resources allow operations for another 3 years (at least...)
- The TerraSAR-X mission will be continued until end of 2015 (at least...)
- Performance and calibration of the individual satellites within specification or better
- Exceptional stability of the radar instrument:
  - radiometric stability of 0.15 dB (3 years)
  - pixel location accuracy of ca. 10 cm
- Wide ScanSAR mode available summer 2013\*
- Staring Spotlight mode available autumn 2013\*

(\* ) Dedicated AO will be launched in autumn 2013

