

# TerraSAR Oceanography



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# Introduction

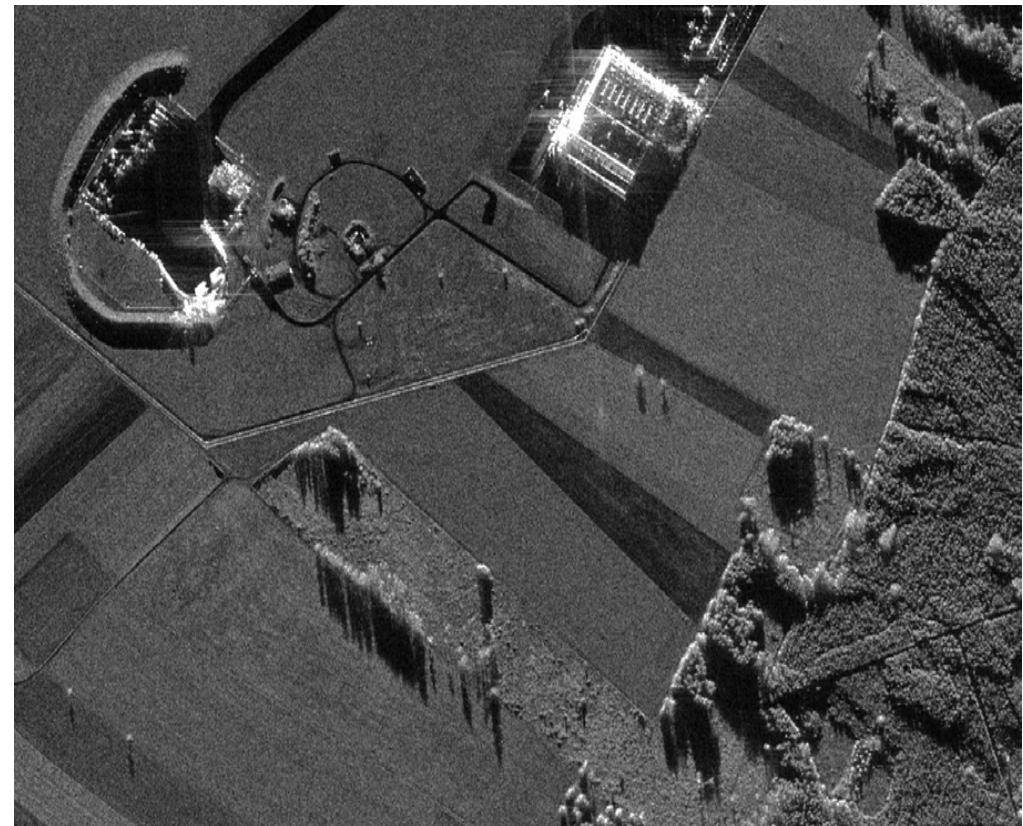
- TerraSAR-X: A high-resolution, next generation X-Band radar satellite
  - TerraSAR-X is the scientific/technological continuation of the highly successful missions X-SAR (1994) and SRTM (2000)
  - Continuation of ERS/ENVISAT/RADARSAT data (?)
  - launch planned for October 2005
- main mission goals are:
  - provision of TerraSAR-X data and products for scientific applications
  - commercial exploitation of remote sensing data
    - » Public Private Partnership (PPP)

# Simulated TerraSAR-X Image



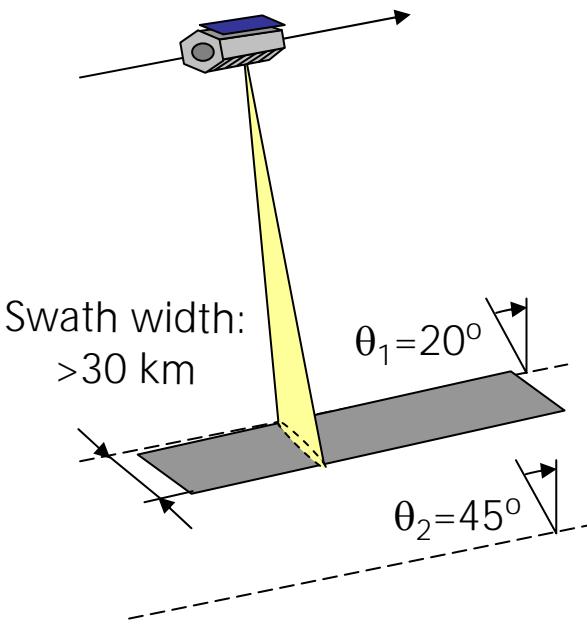
Testsite Oberpfaffenhofen (1,5 m resolution)

ESAR X-band data

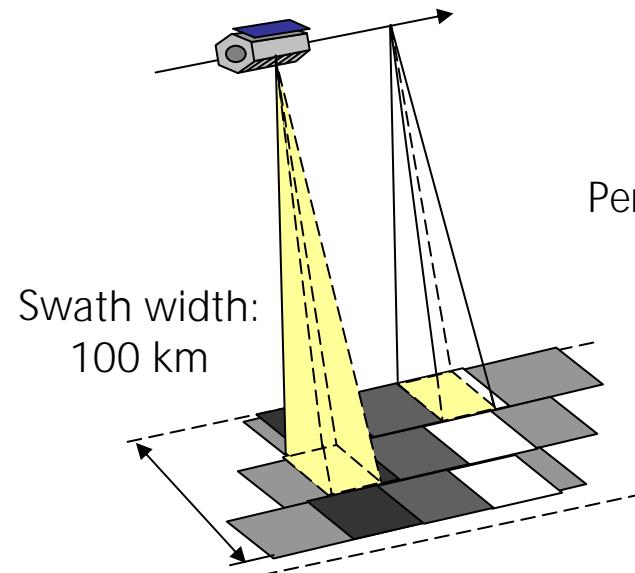


# TerraSAR-X Imaging Modes

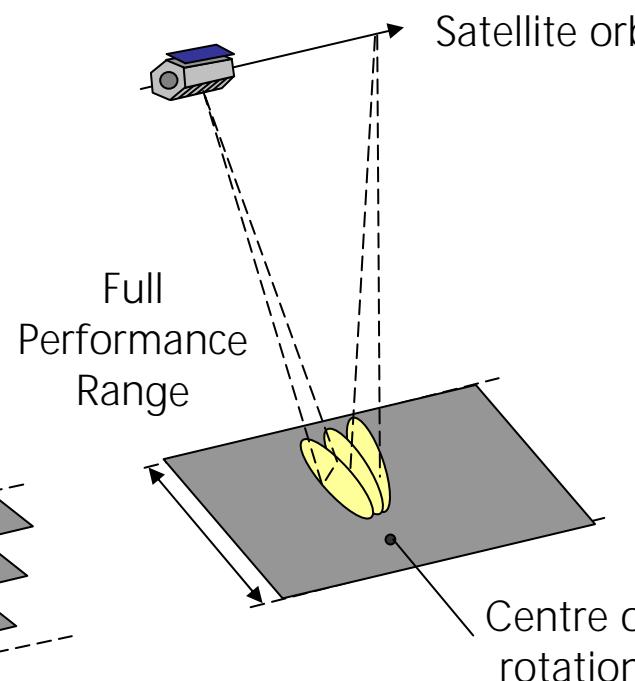
## StripMap



## ScanSAR



## Sliding SpotLight



# TerraSAR-X Products (Overview)

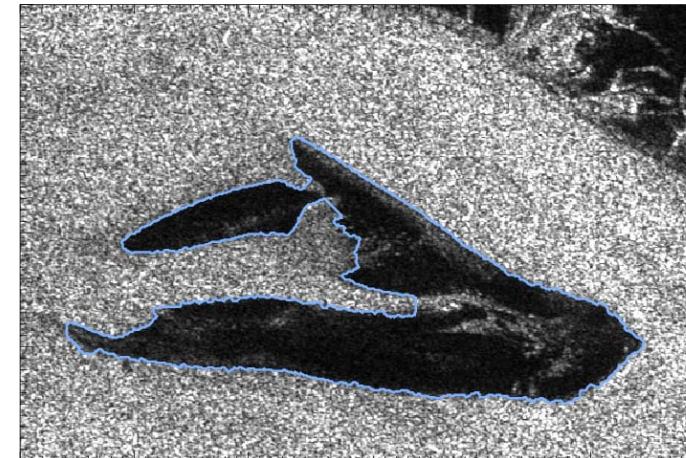
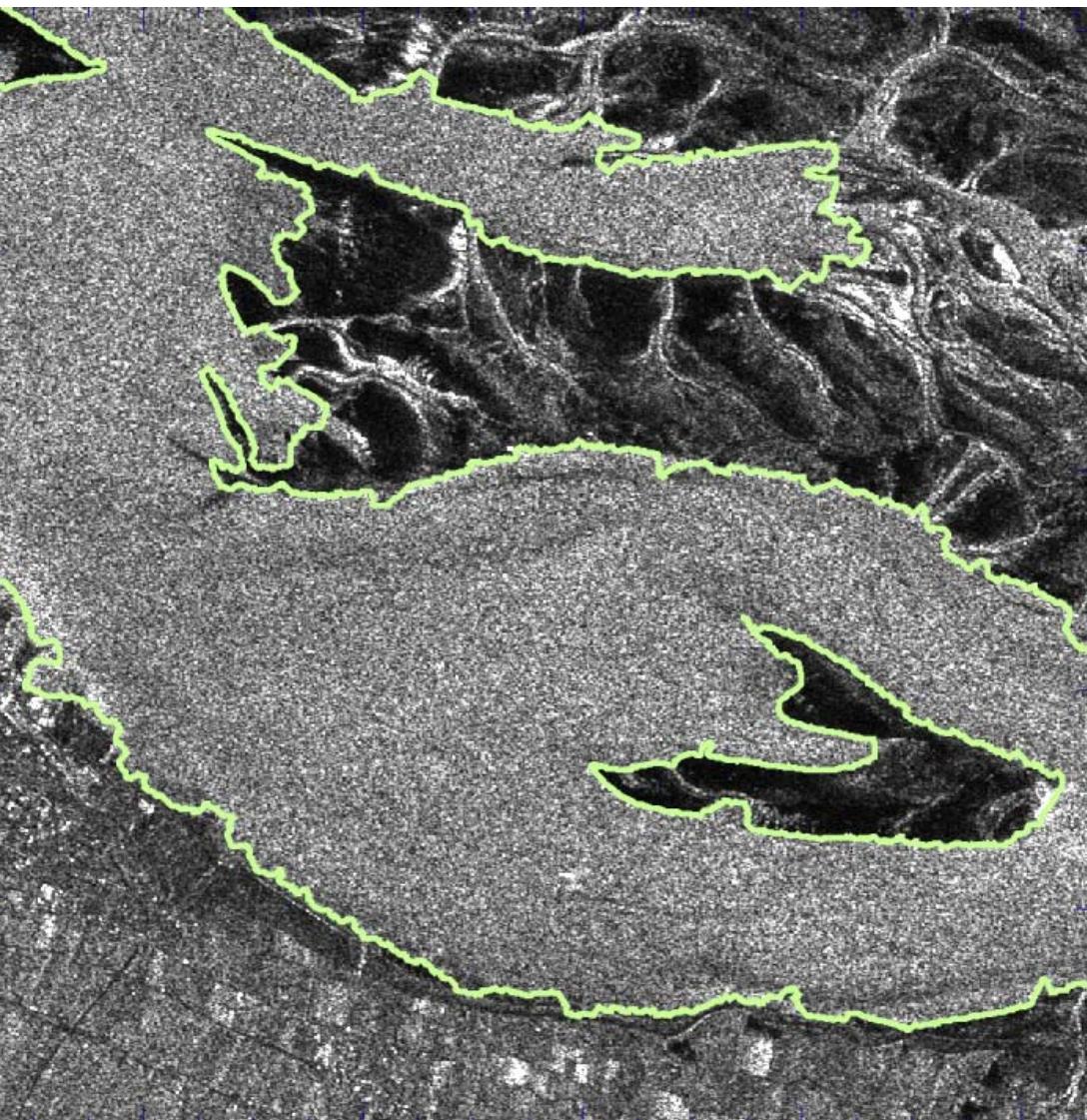
Product	Coverage [az x rg]	Resolution [az x rg]	Polarization	Full Performance Range
HR SpotLight	$5 \times 10 \text{ km}^2$	$1.0 \text{ m} \times (1.5 - 3.5 \text{ m})$	single, dual, <b>quad</b>	$20 - 55^\circ$
Spotlight	$10 \times 10 \text{ km}^2$	$2.0 \text{ m} \times (1.5 - 3.5 \text{ m})$	single, dual, <b>quad</b>	$20 - 55^\circ$
StripMap	$\leq 1650 \text{ km} \times 30 \text{ km}$	$3.0 \text{ m} \times (1.7 - 3.5 \text{ m})$	single	$20 - 45^\circ$
StripMap (polarimetric)	$\leq 1650 \text{ km} \times 15 \text{ km}$	$6.0 \text{ m} \times (1.7 - 3.5 \text{ m})$	dual, <b>quad</b>	$20 - 45^\circ$
ScanSAR	$\leq 1650 \text{ km} \times 100 \text{ km}$	$16.0 \text{ m} \times (1.7 - 3.5 \text{ m})$	single, dual, <b>quad</b>	$20 - 45^\circ$
300 MHz Exp.- Mode Spotlight	$5 \times 10 \text{ km}^2$	$1.0 \text{ m} \times (0.6 - 1.5 \text{ m})$	single, dual, <b>quad</b>	$20 - 55^\circ$
Dual Receive StripMap	$\leq 1650 \text{ km} \times 30 \text{ km}$	$1.5 \text{ m} \times (1.7 - 3.5 \text{ m})$	single, dual, <b>quad</b>	$20 - 45^\circ$
ATI		Acc. 15-60 km/h		

Experimental only

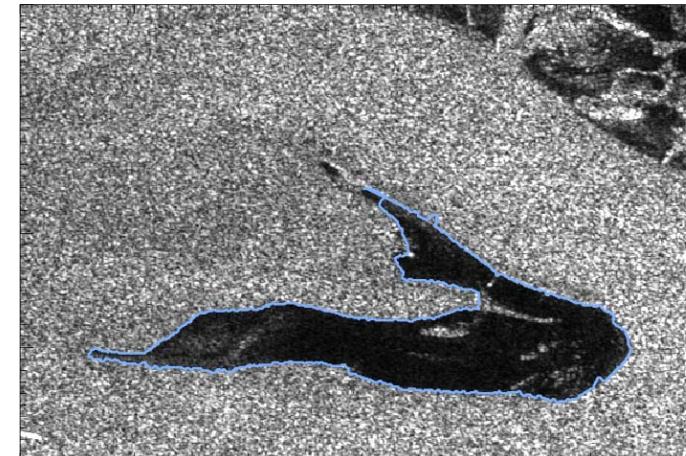
# TerraSAR-X: New Imaging Opportunities

- multi-mode observation capability
  - SpotLight
  - StripMap
  - ScanSAR
- look angles:
  - 20°-55° incidence angle
  - right/left looking
- polarization
  - Single, dual & quad (experimental)
- further experimental capabilities
  - 300 MHz mode for very high range resolution by doubling the chirp bandwidth
  - dual receive antenna mode (two independent antenna/receiver elements)
    - => Along Track Interferometry (ATI)
    - => Quad polarization
- R/V ratio = 80 sec (cf. ERS: 110 sec)

# Coastline Detection



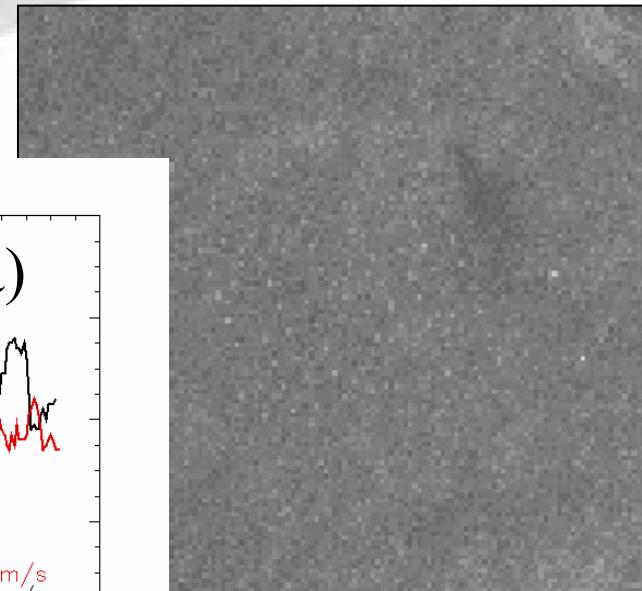
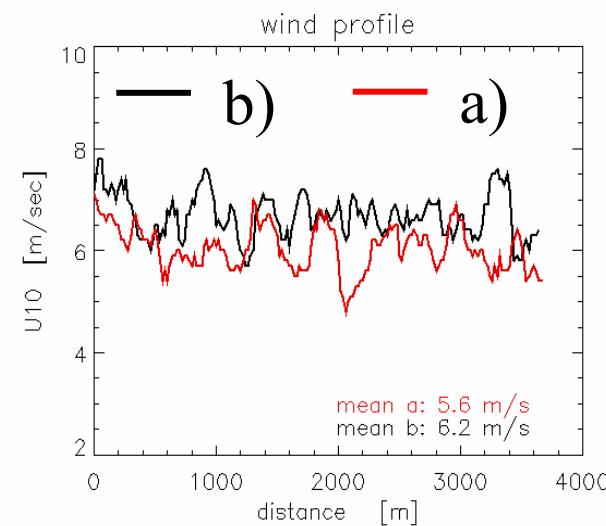
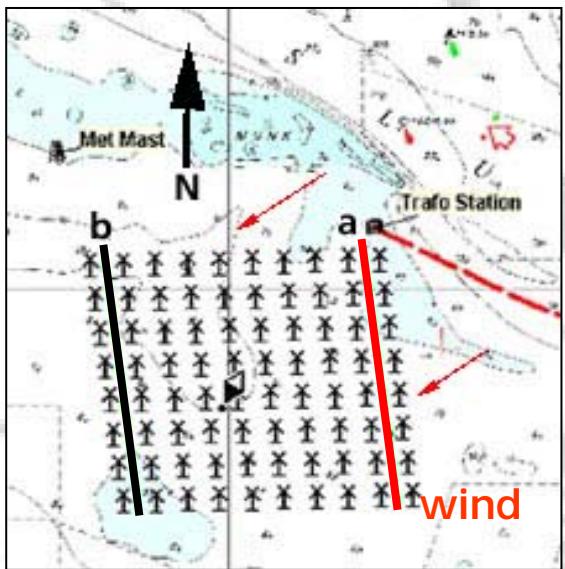
different tidal situations



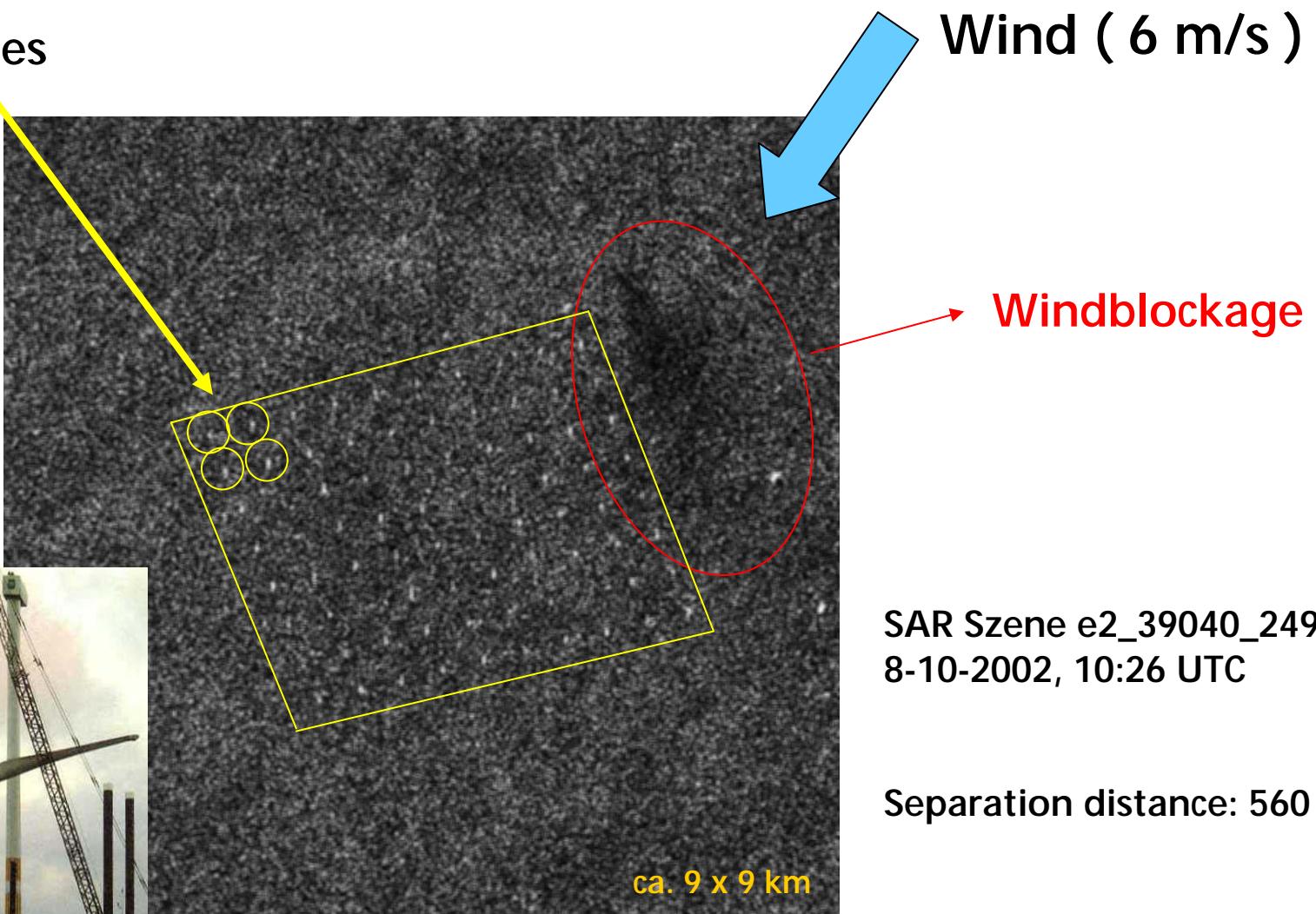
# Offshore Wind Farming

## Zoom from SAR scene

### Offshore wind park Horns Rev



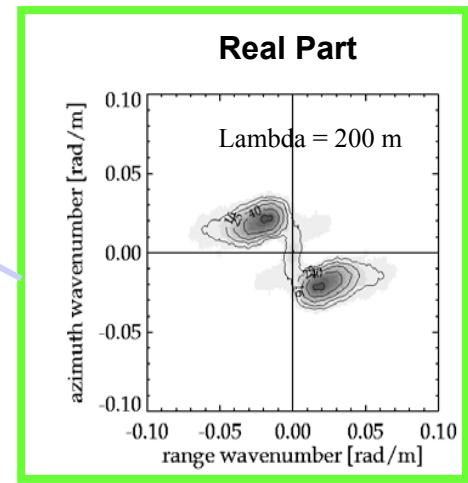
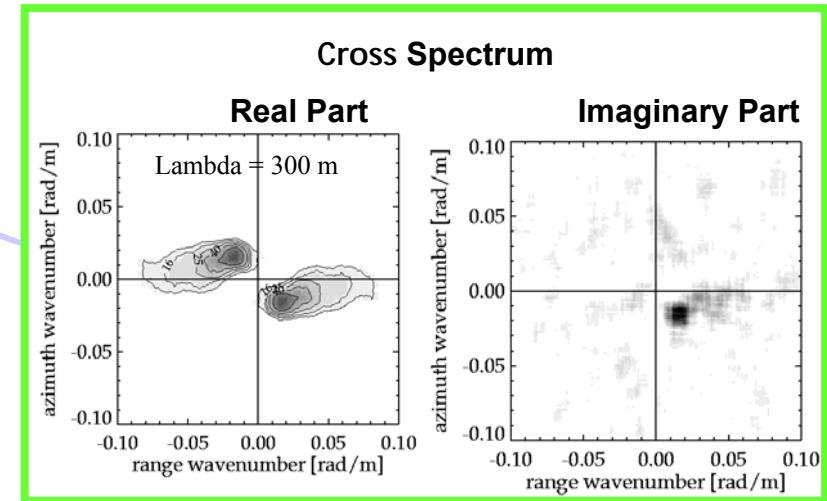
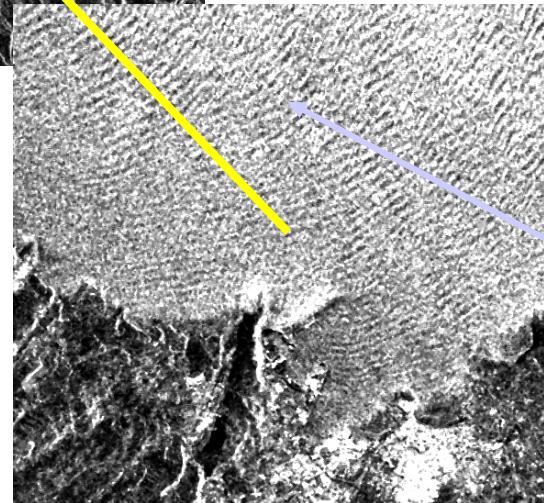
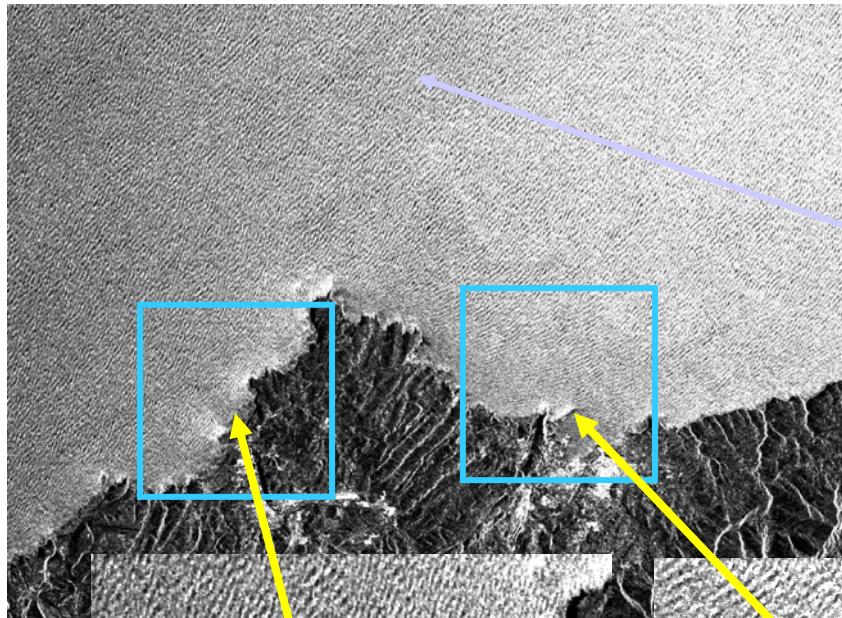
Turbines



Develop X Band Wind Algorithms

# Ocean Wave fields

35 x 20 km ERS-2 SAR image acquired on April 13, 1999, 11:11 UTC



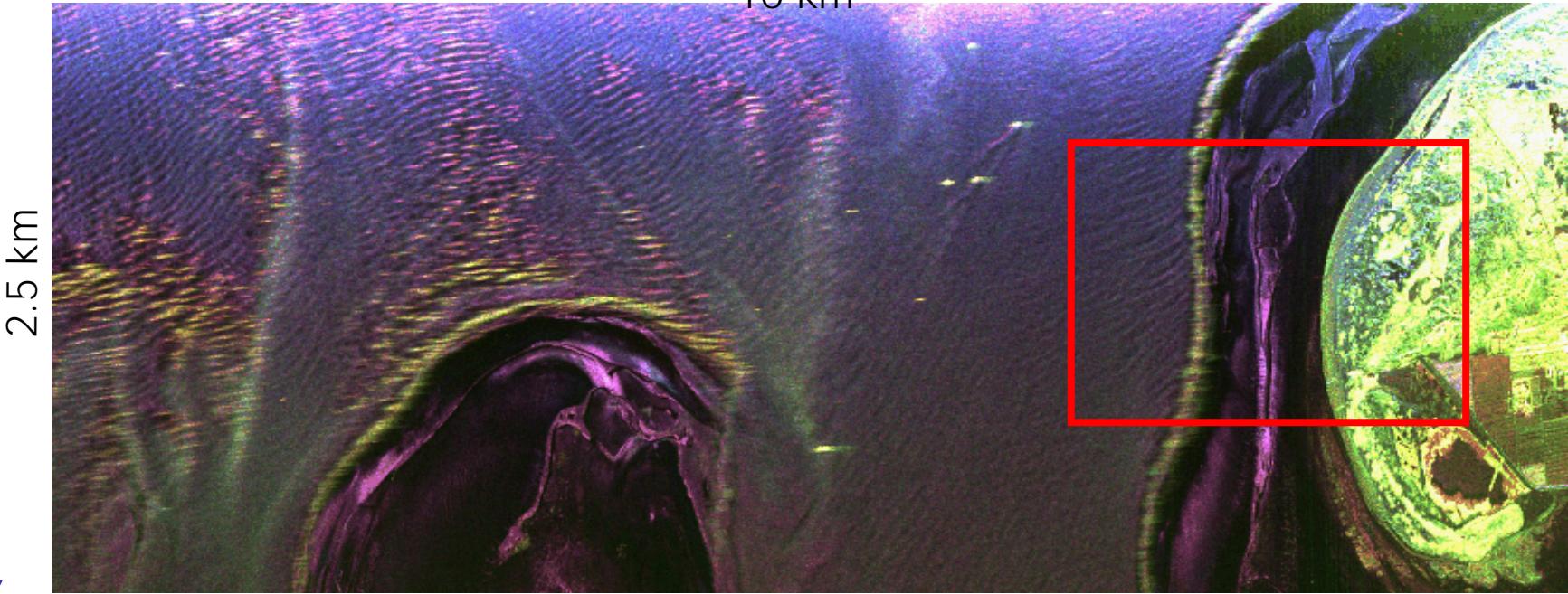
# But... So far no Wave Mode in TerraSAR-X!

163504	19970601163534	19970601163604	19970601163634	19970601163704	19970601163734	19970601163804	19970601163834	19970601163834
163935	19970601164005	19970601164035	19970601164105	19970601164135	19970601164205	19970601164235	19970601164305	19970601164305
164405	19970601164435	19970601164506	19970601164536	19970601164606	19970601164636	19970601164706	19970601164736	19970601164736
170235	19970601170305	19970601170335	19970601170405	19970601170435	19970601170505	19970601170536	19970601170606	19970601170606
170706	19970601170736	19970601170806	19970601170836	19970601170906	19970601170936	19970601171036	19970601171106	19970601171106
171207	19970601171237	19970601171307	19970601171337	19970601171407	19970601171437	19970601171507	19970601171537	19970601171537
171637	19970601171707	19970601171738	19970601171808	19970601171838	19970601171908	19970601171938	19970601172008	19970601172008
172108	19970601172138	19970601172208	19970601172238	19970601173817	19970601173847	19970601173917	19970601173947	19970601173947
174047	19970601174117	19970601174147	19970601174217	19970601174247	19970601174318	19970601174348	19970601174418	19970601174418
174518	19970601174548	19970601174618	19970601174718	19970601174748	19970601174818	19970601174849	19970601174919	19970601174919

RGB - Pauli components (*red*=HH-VV, *green*= 2HV, *blue*=HH+VV)

Flight Direction (Azimuth)

10 km

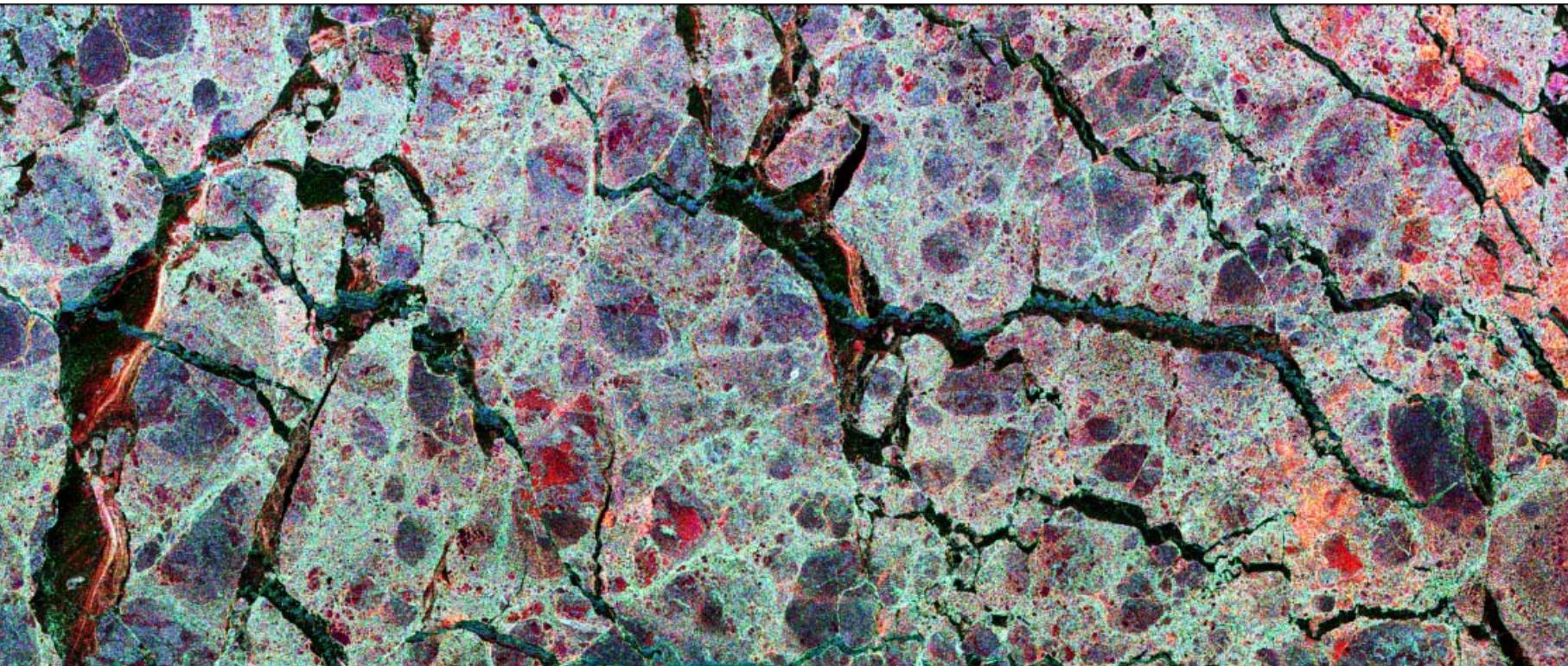


ESAR Aircraft Data, From I.Hajnsek, DLR

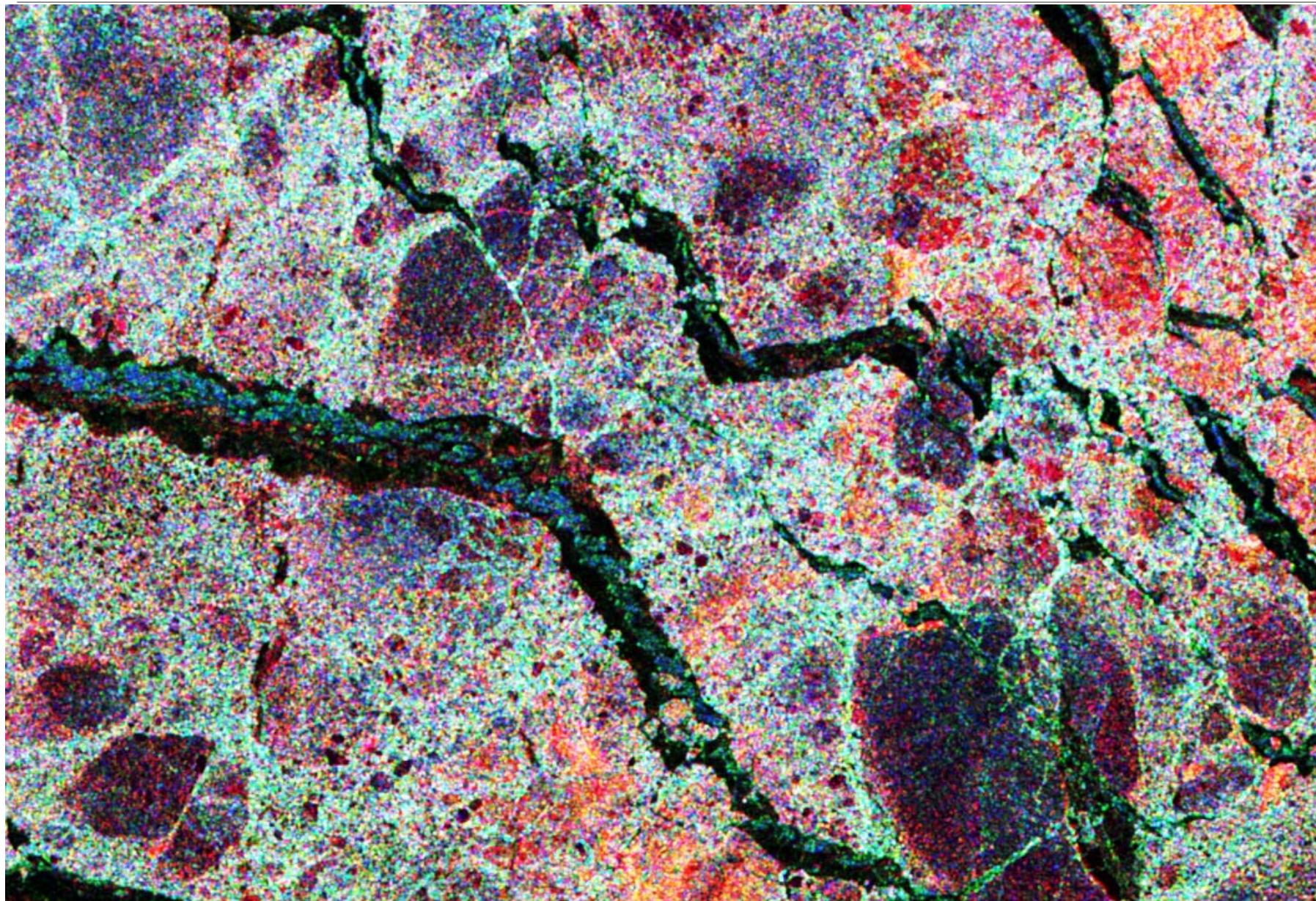
HR



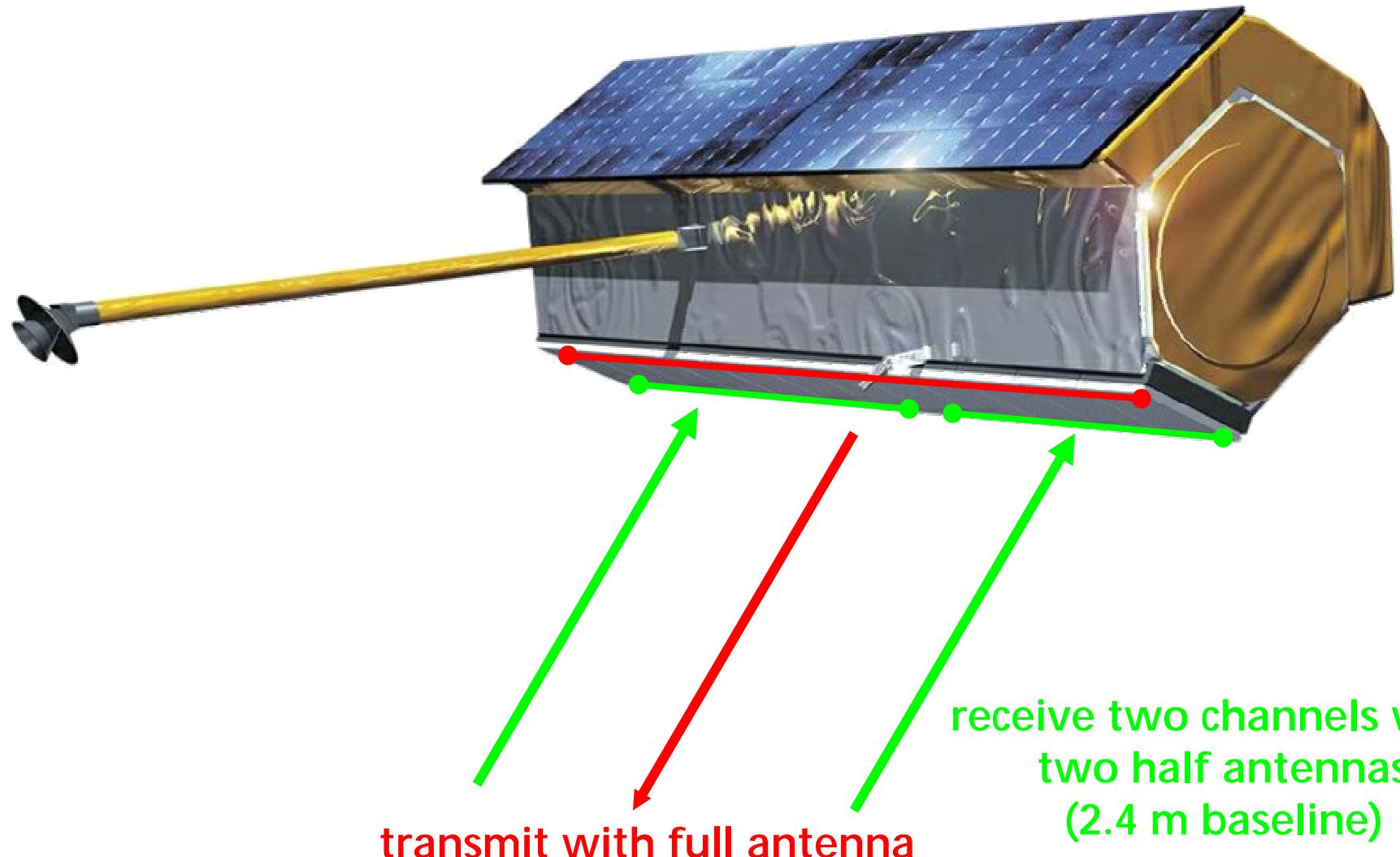
# SIR-C Quadpol Data of Weddell Sea Ice



## SIR-C Quadpol Data of Weddell Sea Ice, Full Resolution



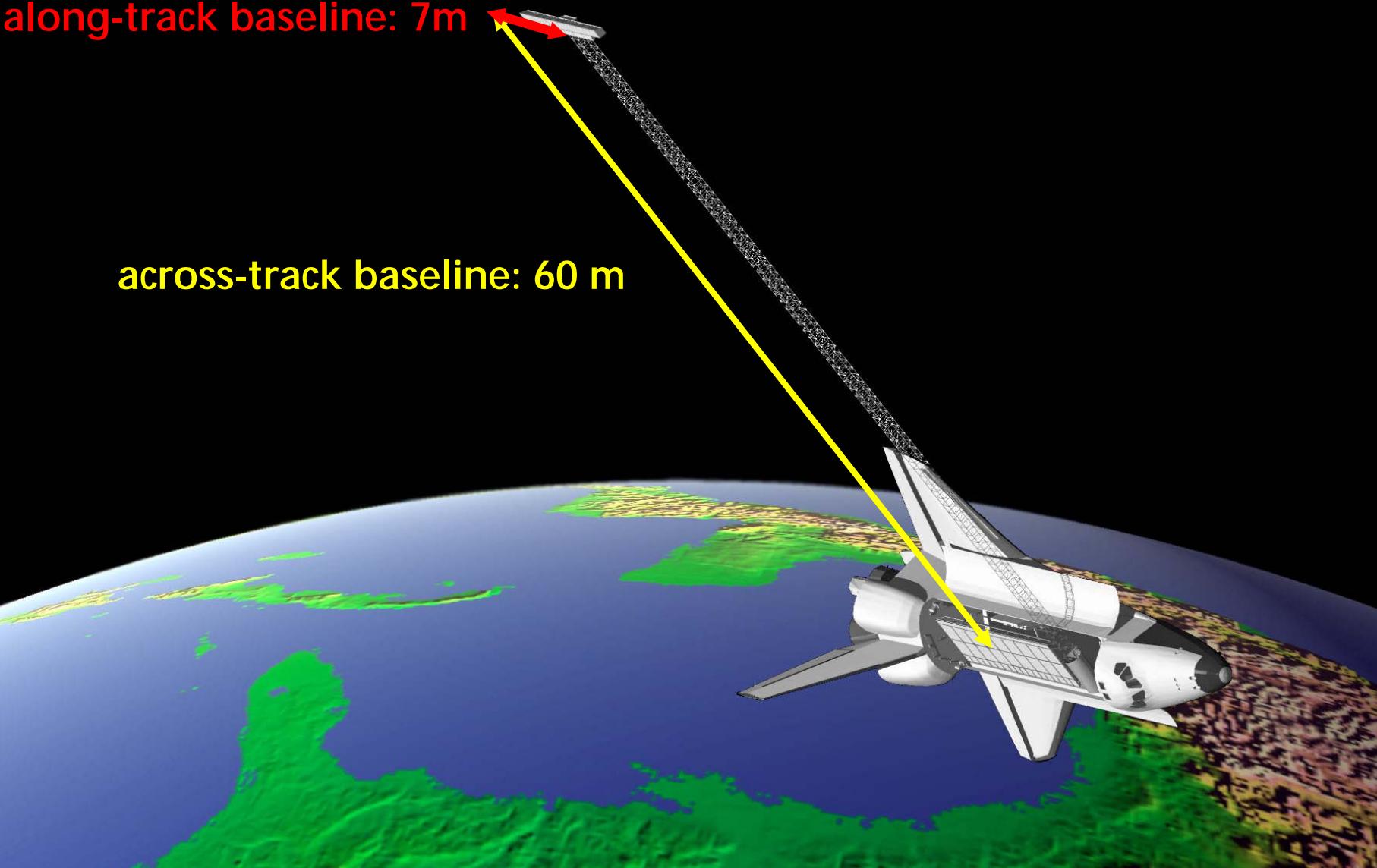
# TerraSAR-X – Dual Receive Antenna



# SRTM Geometry and Velocity Sensitivity

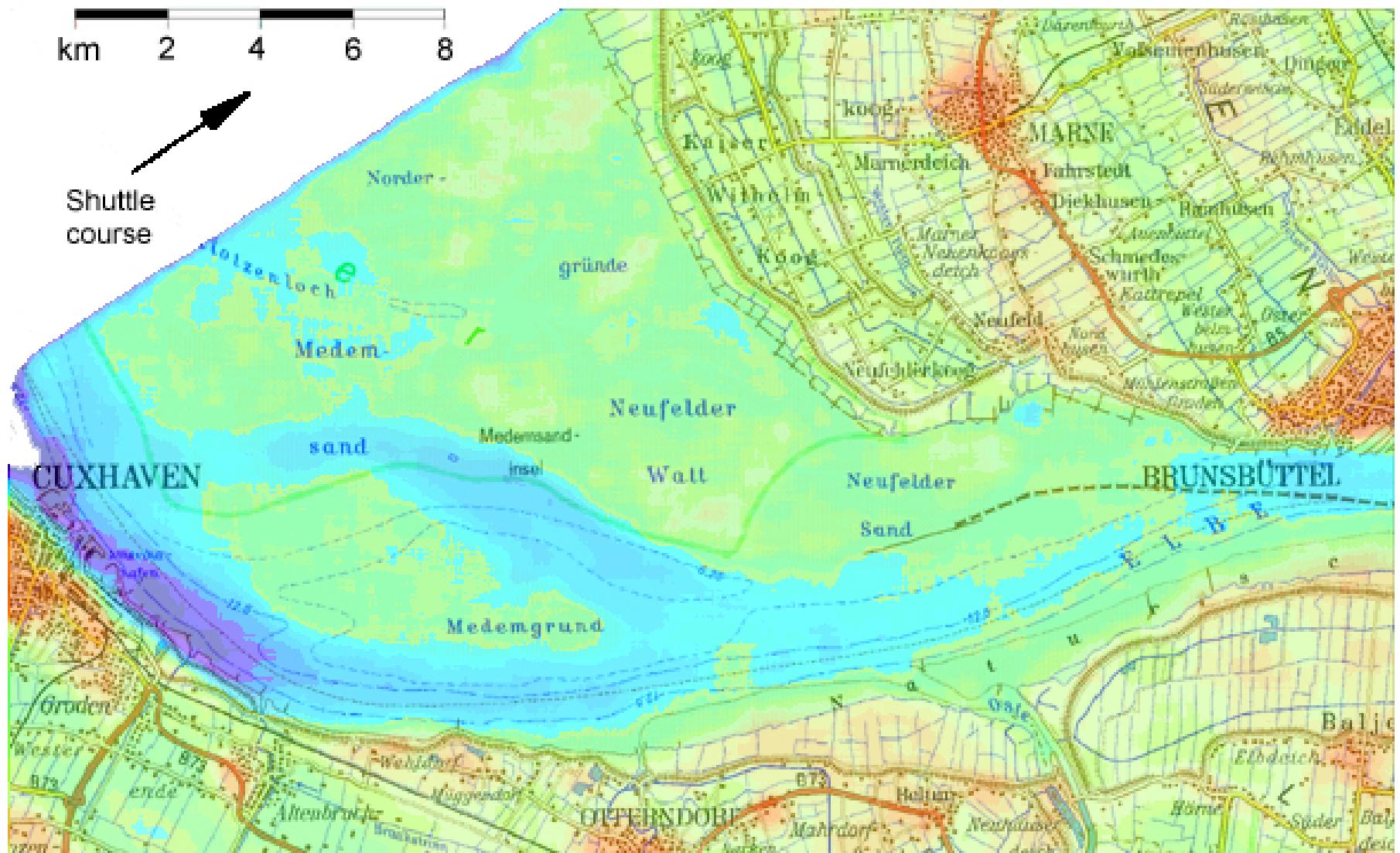
along-track baseline: 7m

across-track baseline: 60 m





## Current velocity measured from SRTM ATI



# Preparation of the Scientific Use

- 1st science team meeting December 2003
- implementation of the TX Science Plan June 2004
- Announcement of Opportunity September 2004
- proposal deadline December 2004
- proposal review March 2005
- 2nd Science Team Meeting June 2005
- launch October 2005

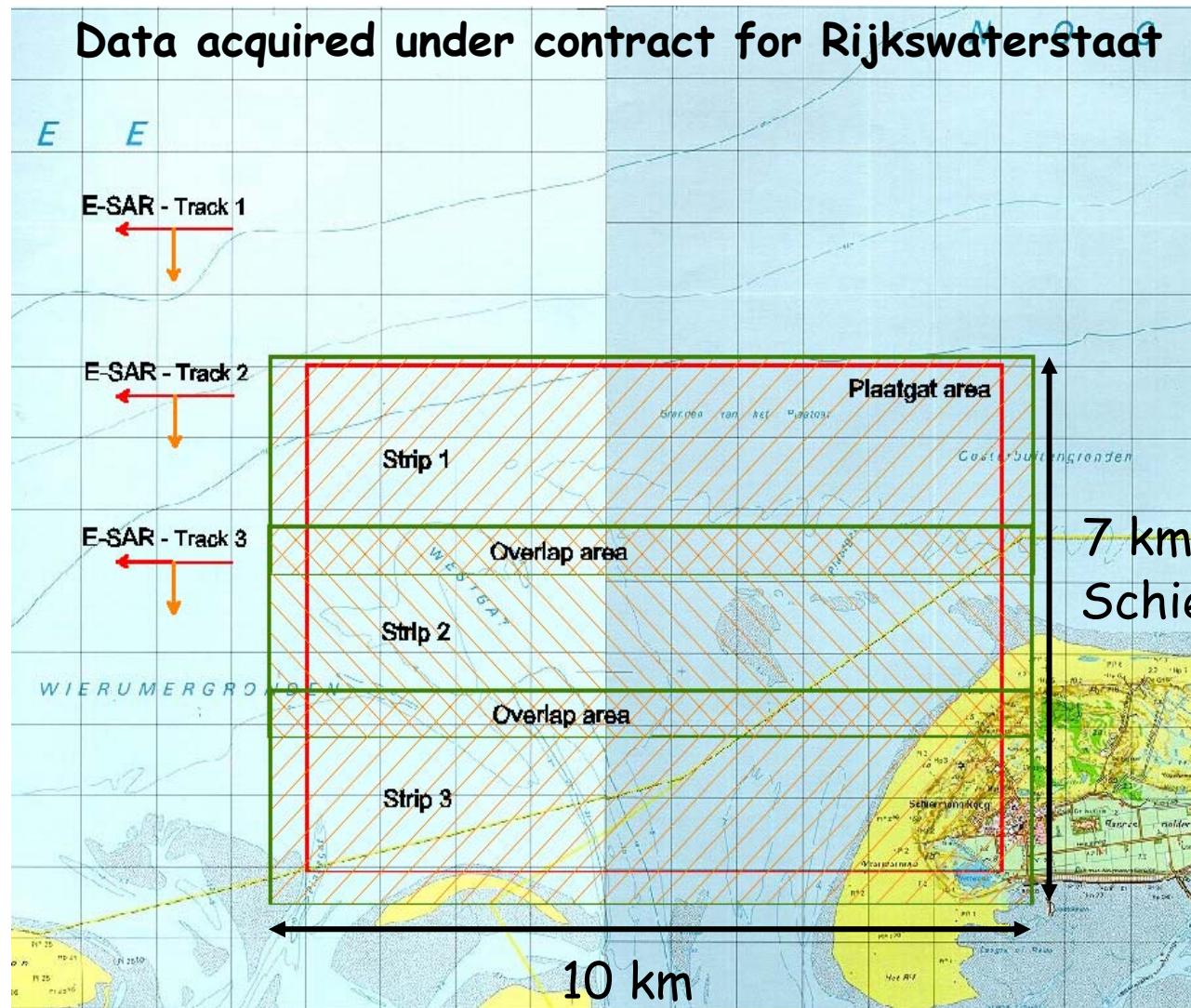
## Summary

- interesting features for oceanographic applications
    - high resolution
    - multi-polarization
    - different modes
    - short revisit time (double sided):

100%	4.5 days
95%	2.5 days
    - InSAR capability
    - important to create wave mode
  - launch planned for October 2005
  - first science team meeting planned for December 2003
  - AO in September 2004
  - migration of X/C/L band algorithms

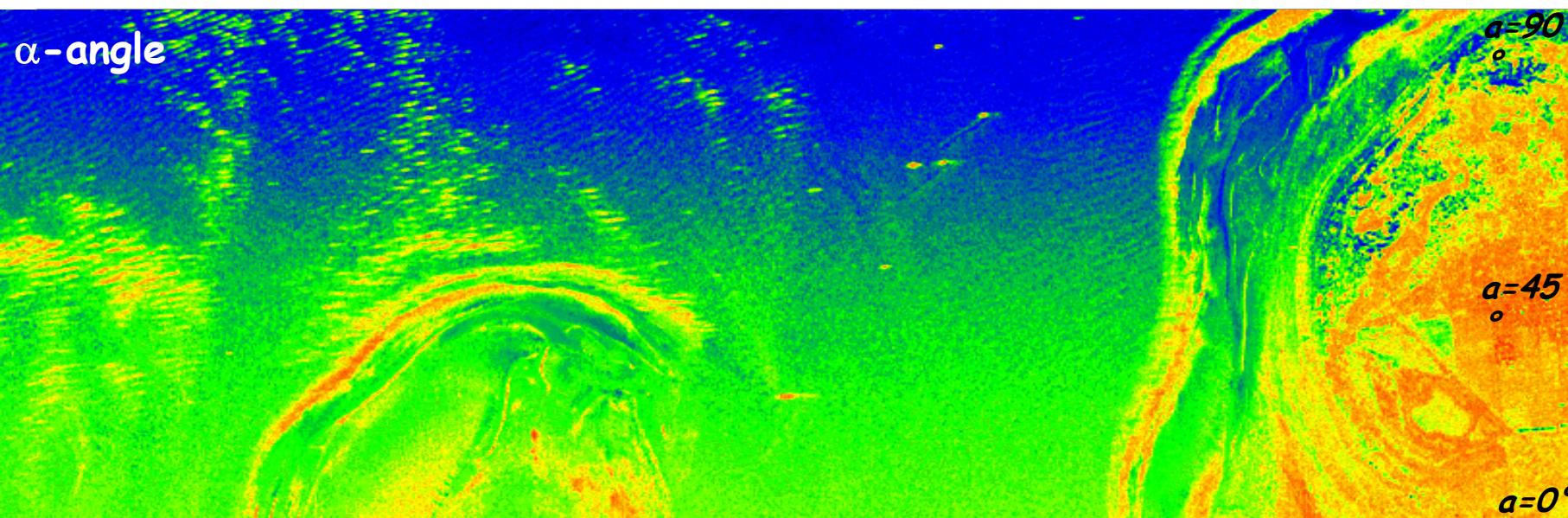


Weather condition: wind speed at 10 m height of 5-7 m/s



# *Alpha Angle / Entropy @ L-band*

$\alpha$ -angle



entropy



$H=$   
2