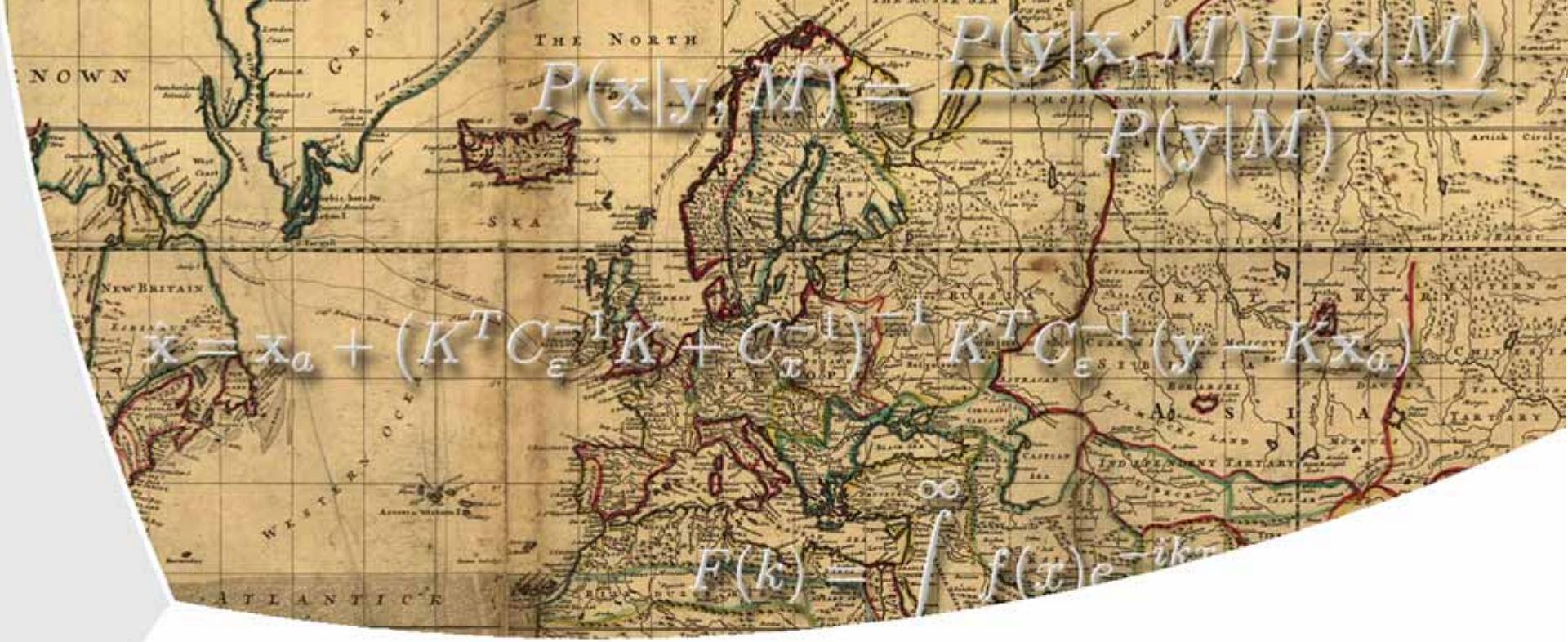


TerraSAR X Anwendungen Ozeanographie

Susanne Lehner

Institut für Methodik der Fernerkundung (IMF)

29. April 29 2008, Warnemünde

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

TerraSAR X - Ozeanographische Anwendungen

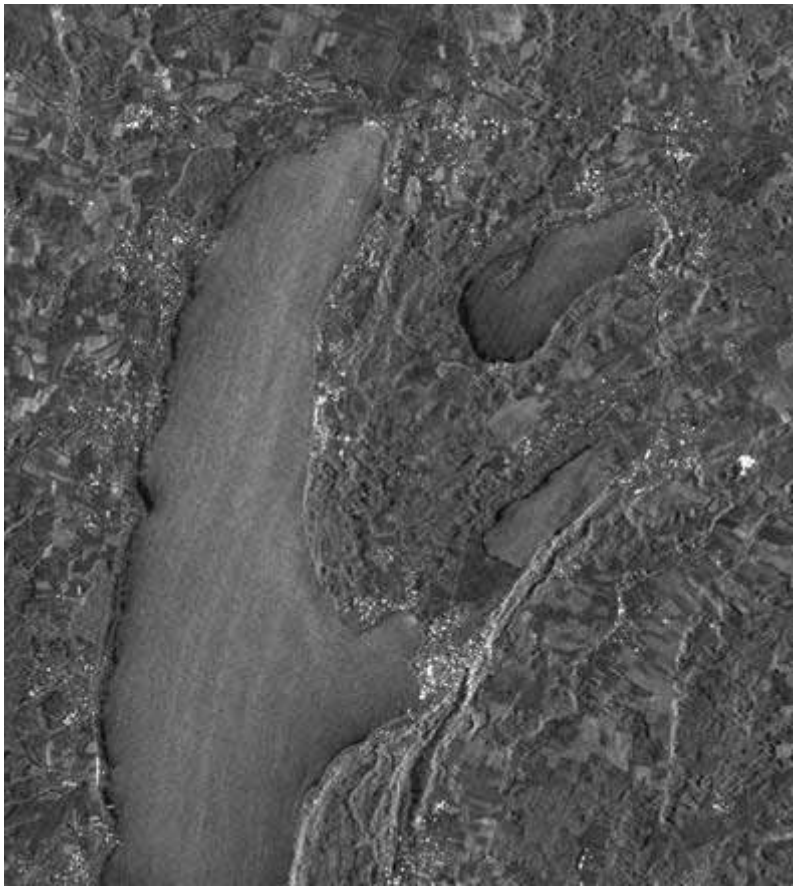
- **Algorithmen, Wind, Seegang, Strömung**
- **Offshore Windfarming – FiNO 2**
- **Seegangsmessungen**
- **Ölerkennung**
- **Schiffsdetektion – Galileo, AIS**
- **Küstennahe Unterwassertopografie**

Ammersee, Dec 1999

TerraSAR X Bilder des Ammersees

SM VV, 06.10.2007

SM VV, 25.09.2007



Beiträge zum Thema maritime Sicherheit

Verbesserte Wind- und Seegangsmodellierung durch Assimilation von Satellitendaten, Schiffsroutenoptimierung

- Windfeld vom aktiven Radar (ASCAT, Quikscat, SAR)
- Seegangsparameter (Altimeter, SAR)
- Extreme Einzelwellenhöhe (SAR)
- Küstennahe Wind- und Seegangsfelder in hoher Auflösung (TerraSAR X)

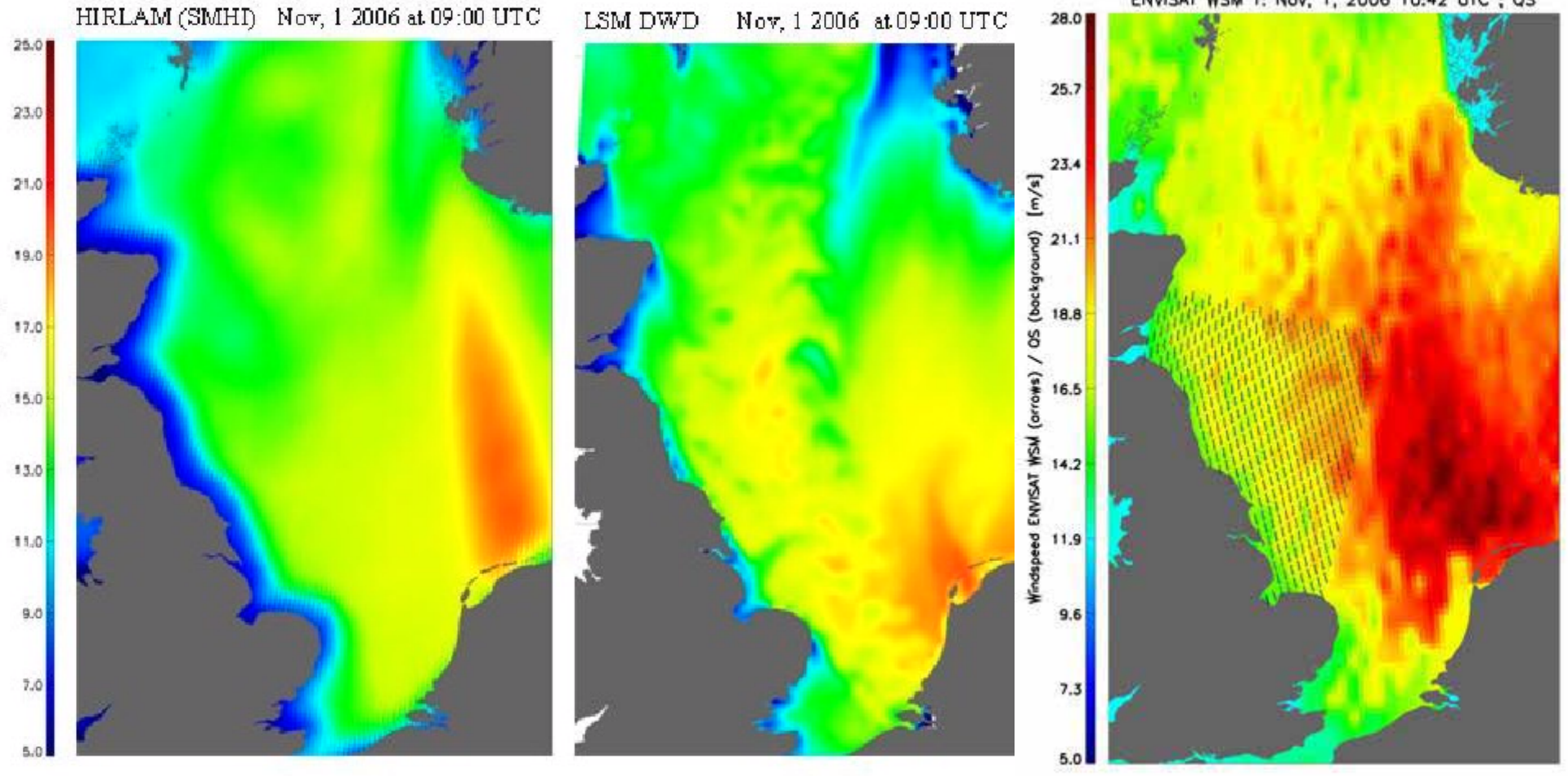
Hochaufgelöste Küstentopographie mit ASAR und TerraSAR X

- Küstenlinien
- Veränderung der Wattopographie, Morphodynamik
- Unterwassertopographie abgeleitet aus Brandungszone und Strömung

Schiffsdetektion

- Statistiken der Schiffsdichte
- Hafenbelegung
- Kollisionsvermeidung (Offshore Windfarmen, Fähren)
- Detektion von Schiffen, die kein AIS Signal aussenden

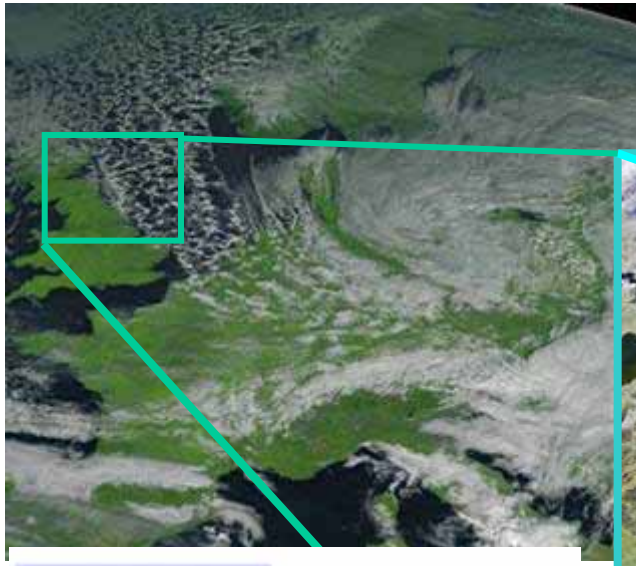
Vergleich Modell und Radar Windgeschwindigkeit U_{10}

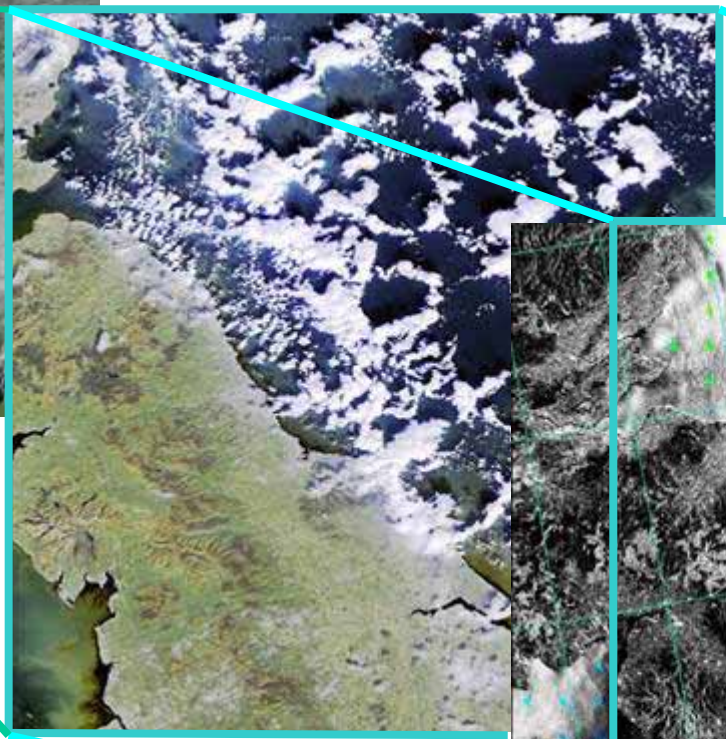


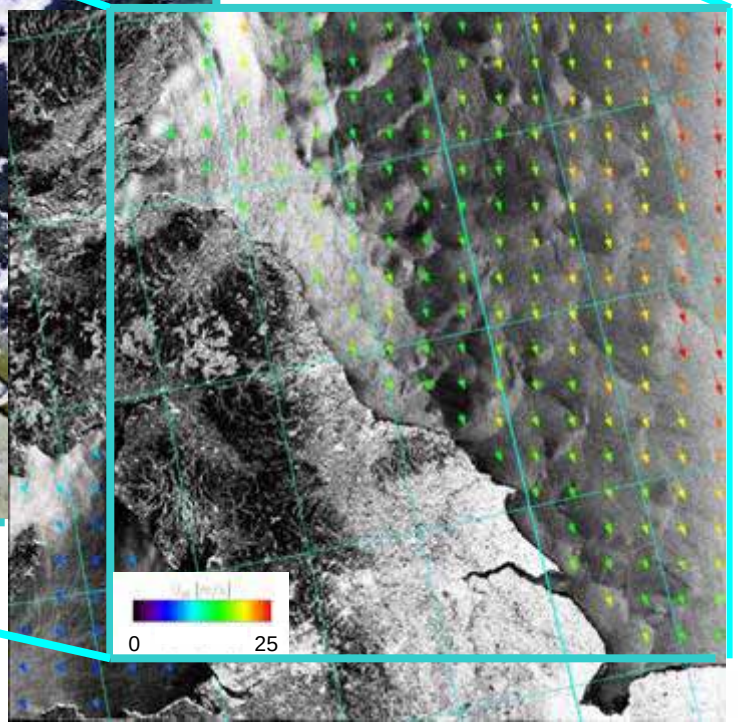
HIRLAM DWD SCAT, SAR

Kaltluftausbruch – FiNO 1 Seeschlag (Britta)

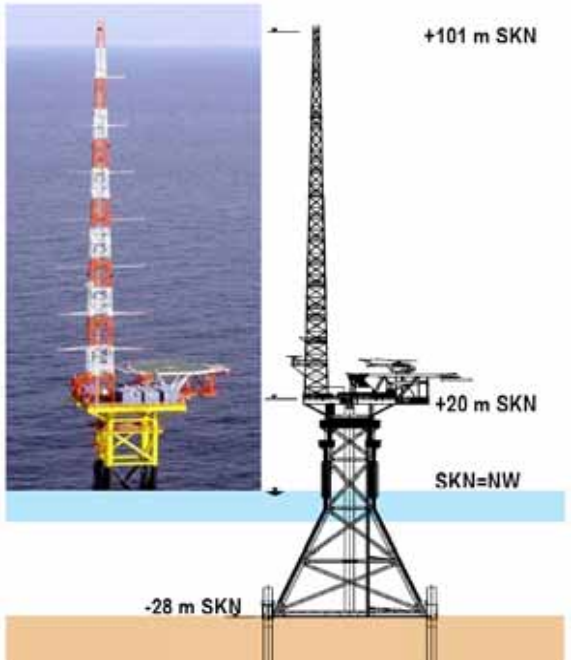
MERIS FR LEVEL 2
aquired on Nov 01, 2006







MS
20

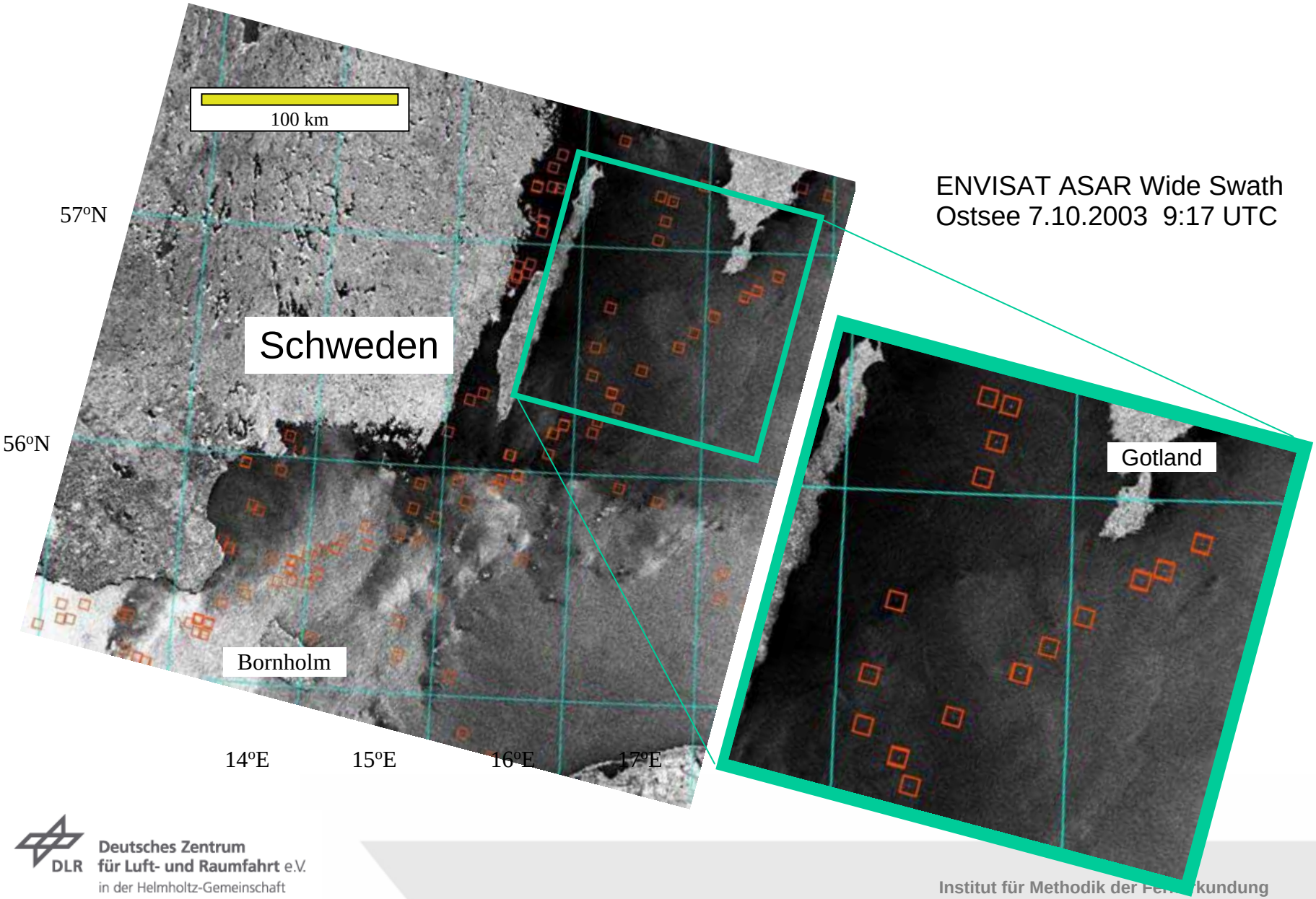


S.Brusch

IEEE TGARS

ASAR WSM acquired on Nov 1, 2006
10:26 UTC with overlayed windfield

Schiffsdetektion mit ENVISAT C-Band Daten

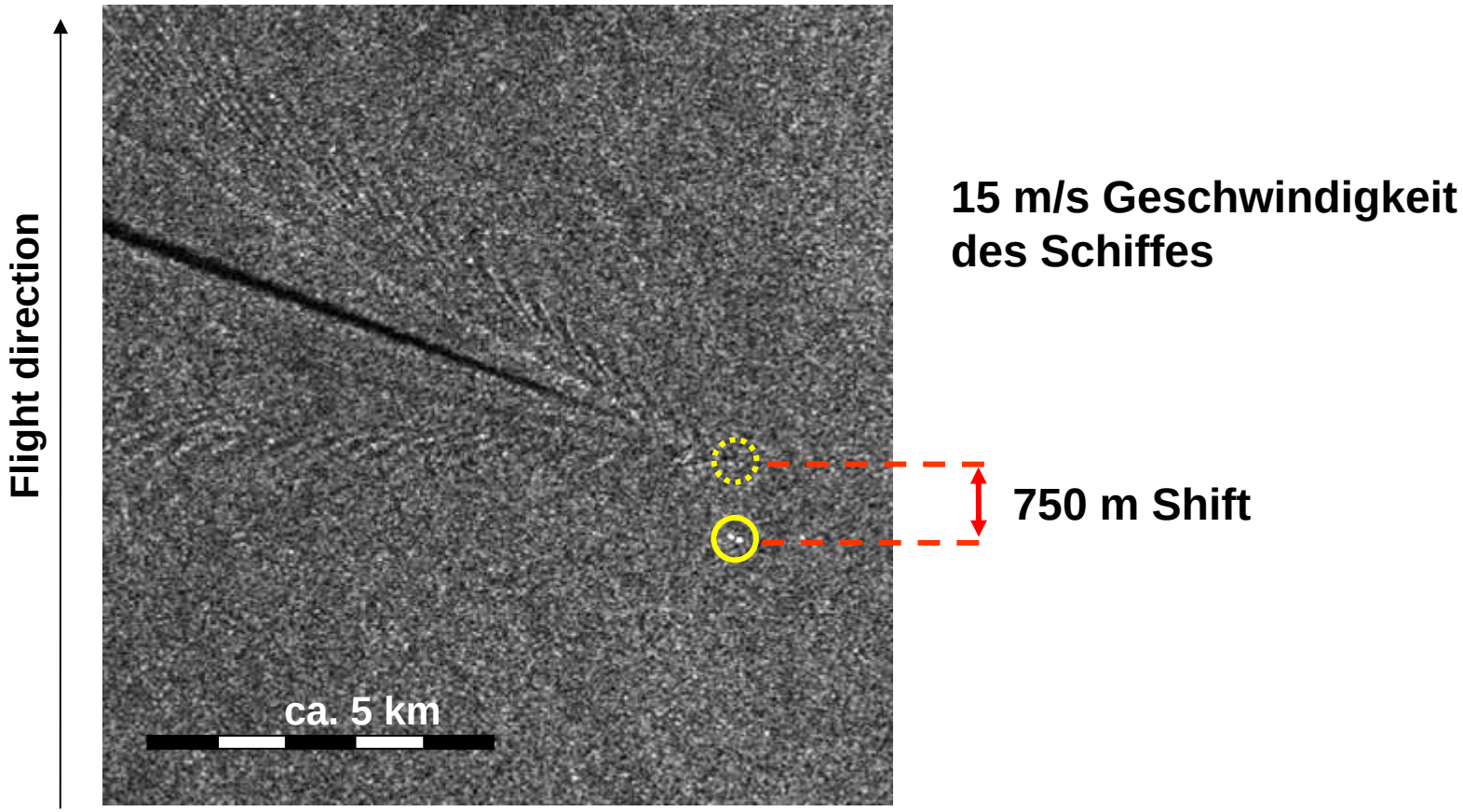


ENVISAT ASAR Wide Swath
Ostsee 7.10.2003 9:17 UTC

„Ship off the wake“

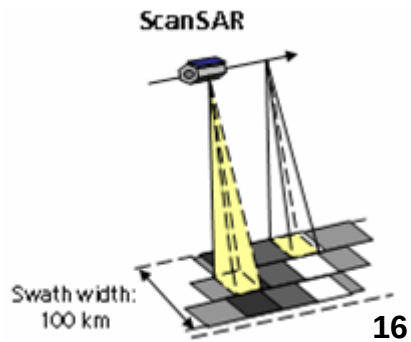
Bewegungseffekte führen zur Bildverzerrung

ERS-2-Szene vom 4.7.2001 (near Nizza):

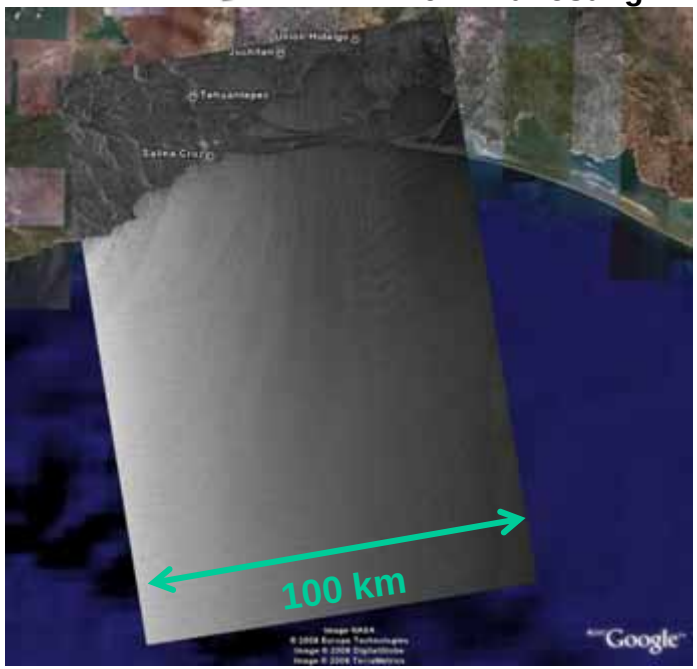


15 m/s Geschwindigkeit des Schiffes

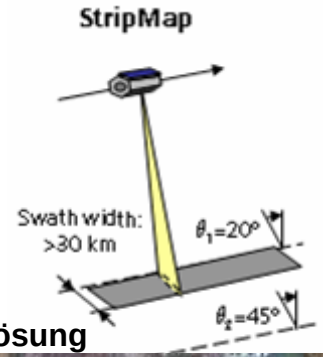
TerraSAR-X Aufnahme-Moden im Coastal Monitoring



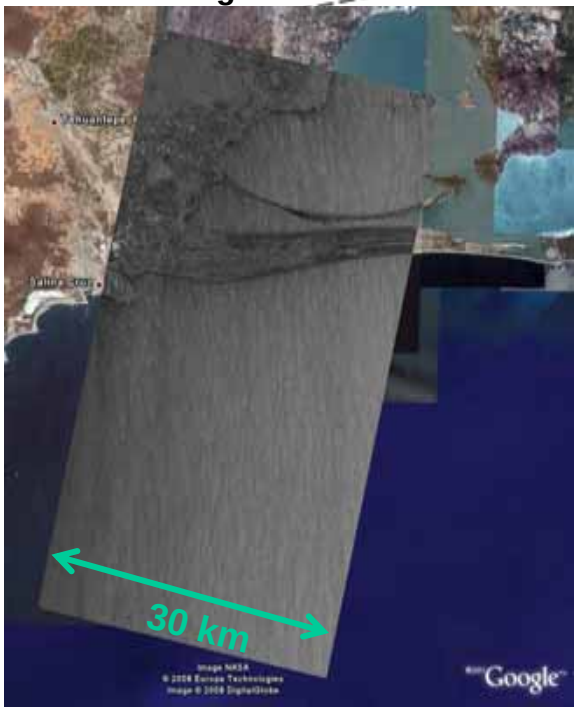
16 m Auflösung



Golf von Tehuantepec
Mar.1 2008 19:29 UTC.

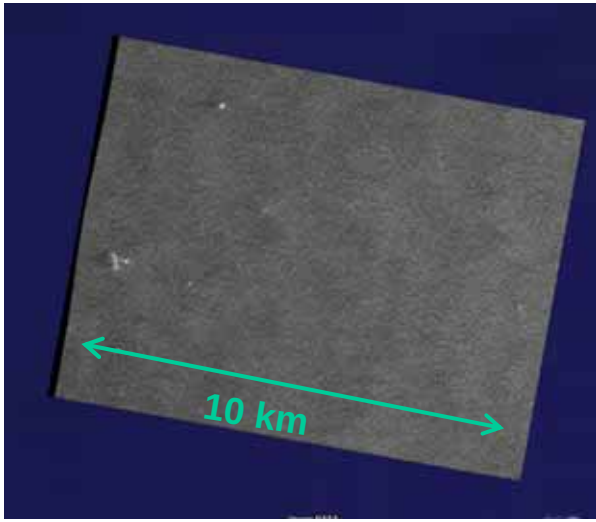


3 m Auflösung



Golf von Tehuantepec
Mar. 20 2008 12:19 UTC.

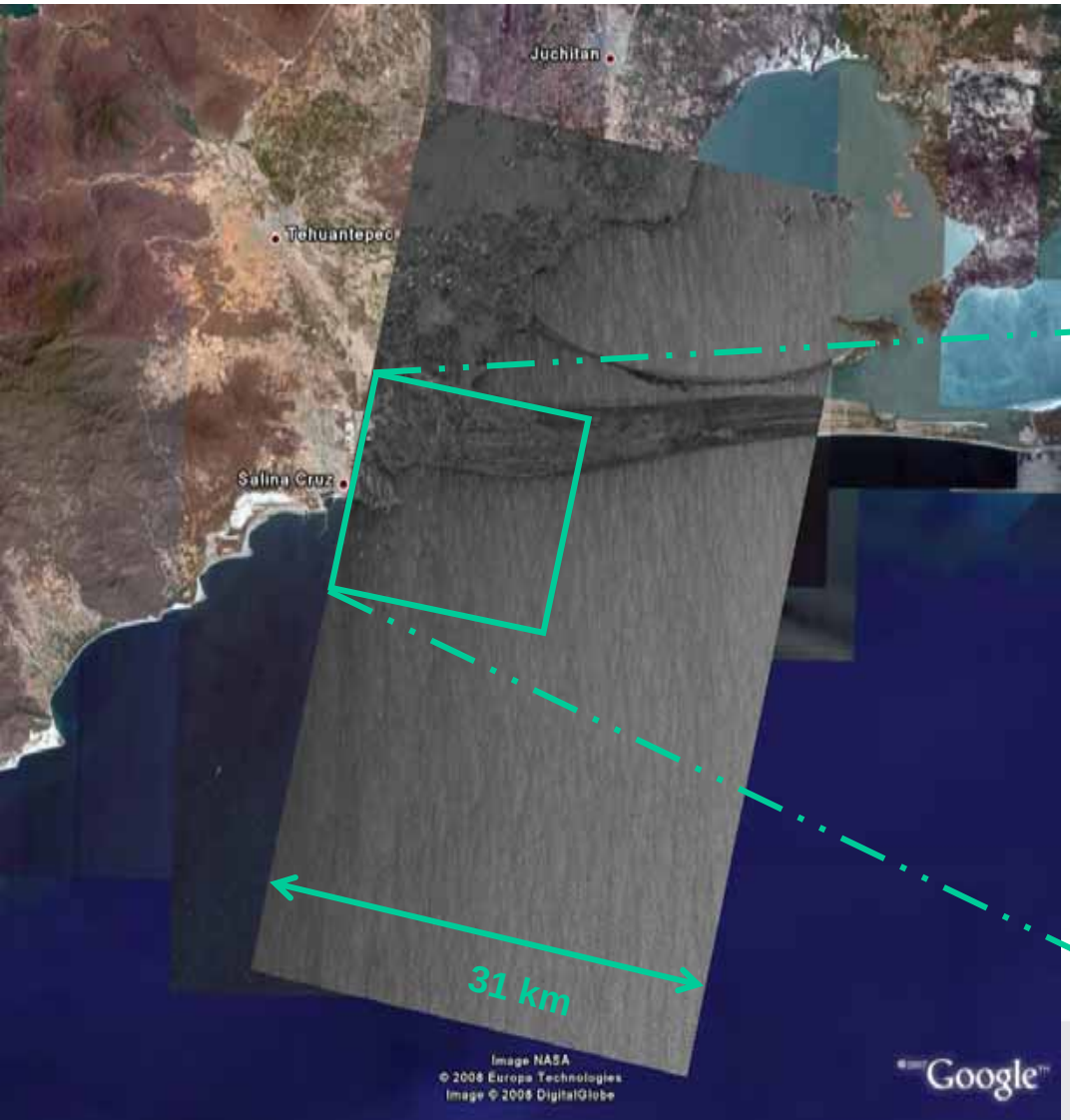
1,,,2 Auflösung

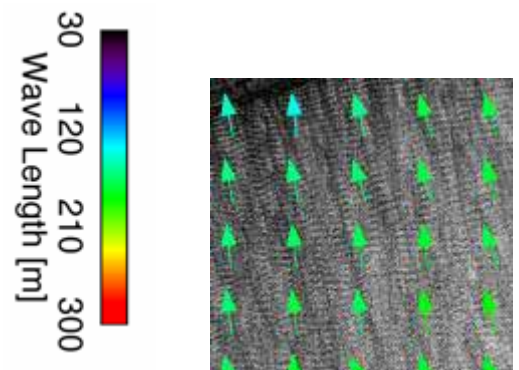


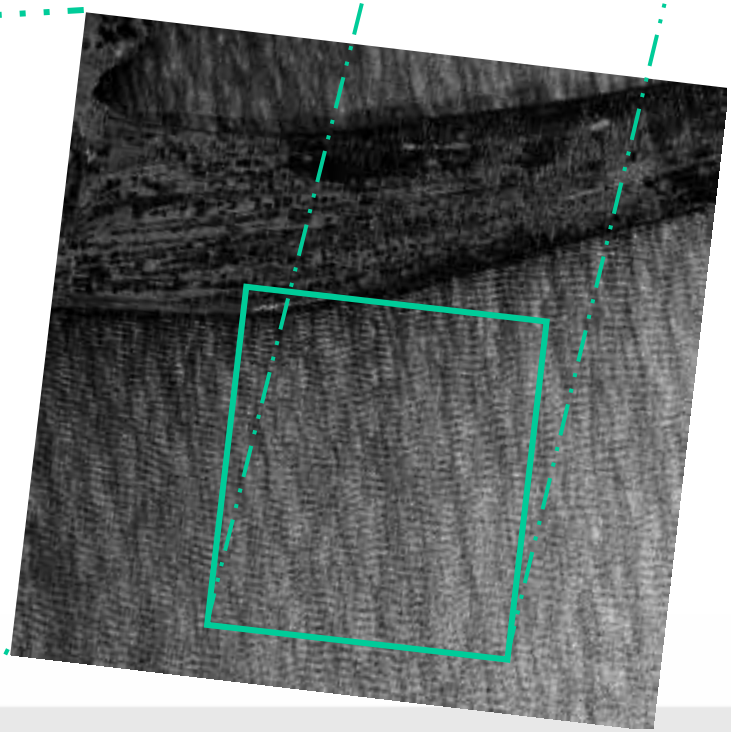
Bay of Campeche
Mar. 26 2008 12:10 UTC.

Seegang

TerraSAR-X Stripmap Mode aufgenommen über dem Golf von Tehuantepec 20. März 2008 04:40 UTC.

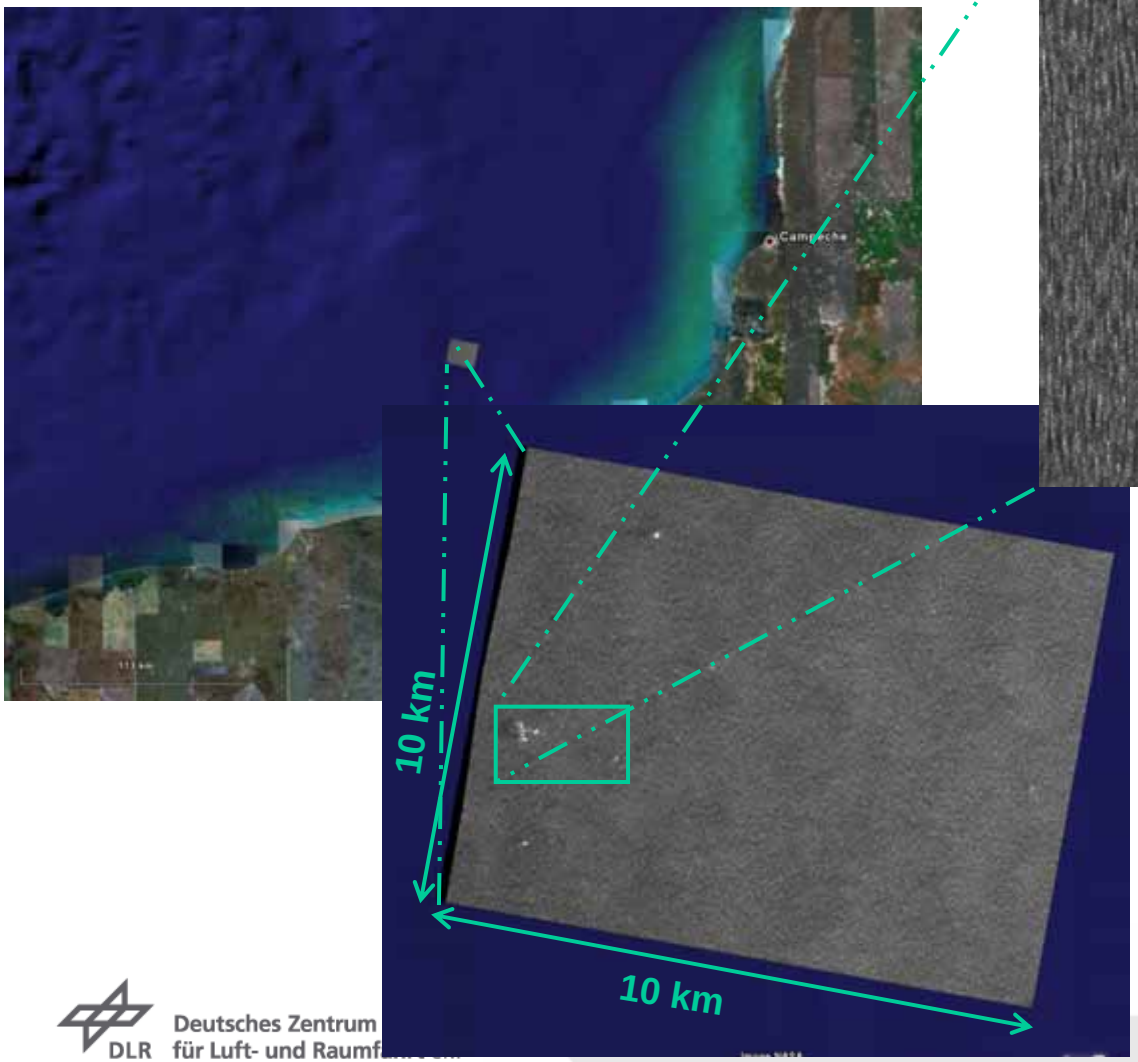


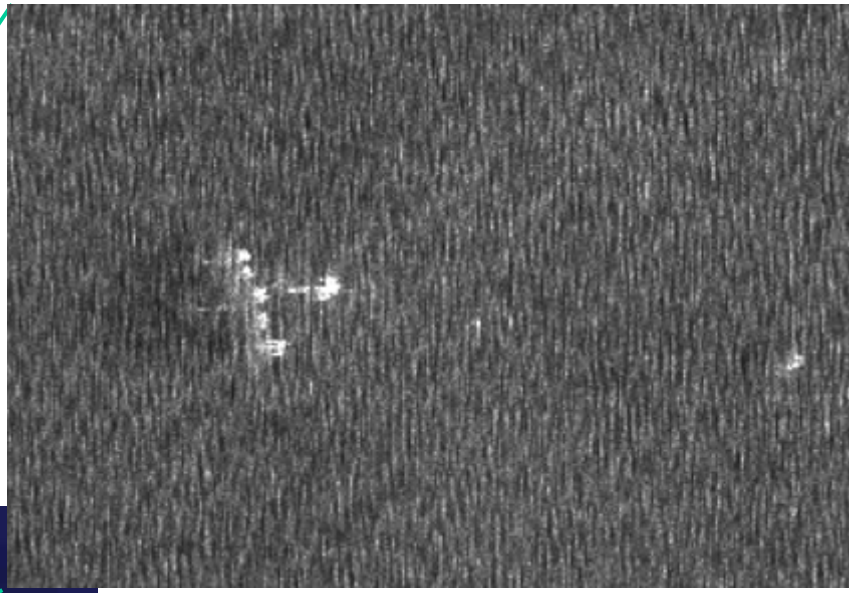




Cantarell Öl Feld

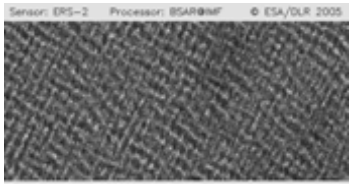
TerraSAR-X Spotlight Mode
Mar. 26 2008 04:40 UTC.



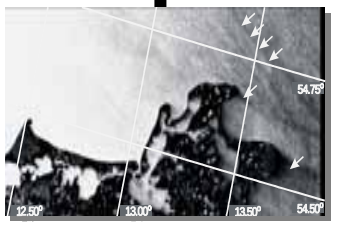


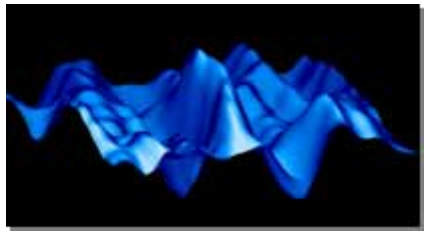
NOHOCH-A Plattform

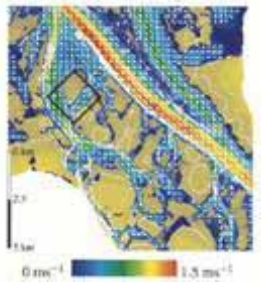
Fernerkundungs-Algorithmen

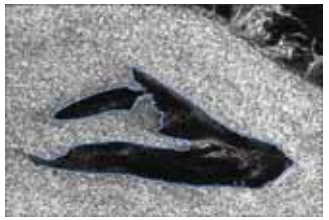


Windfelder <500m Auflösung	**Seegangs Parameter, H_s**	**Strömung**	**Morphodynamik**
Scatterometer Algorithmus	Empirischer Algorithmus	Along Track Interferometrie,	Wavelet

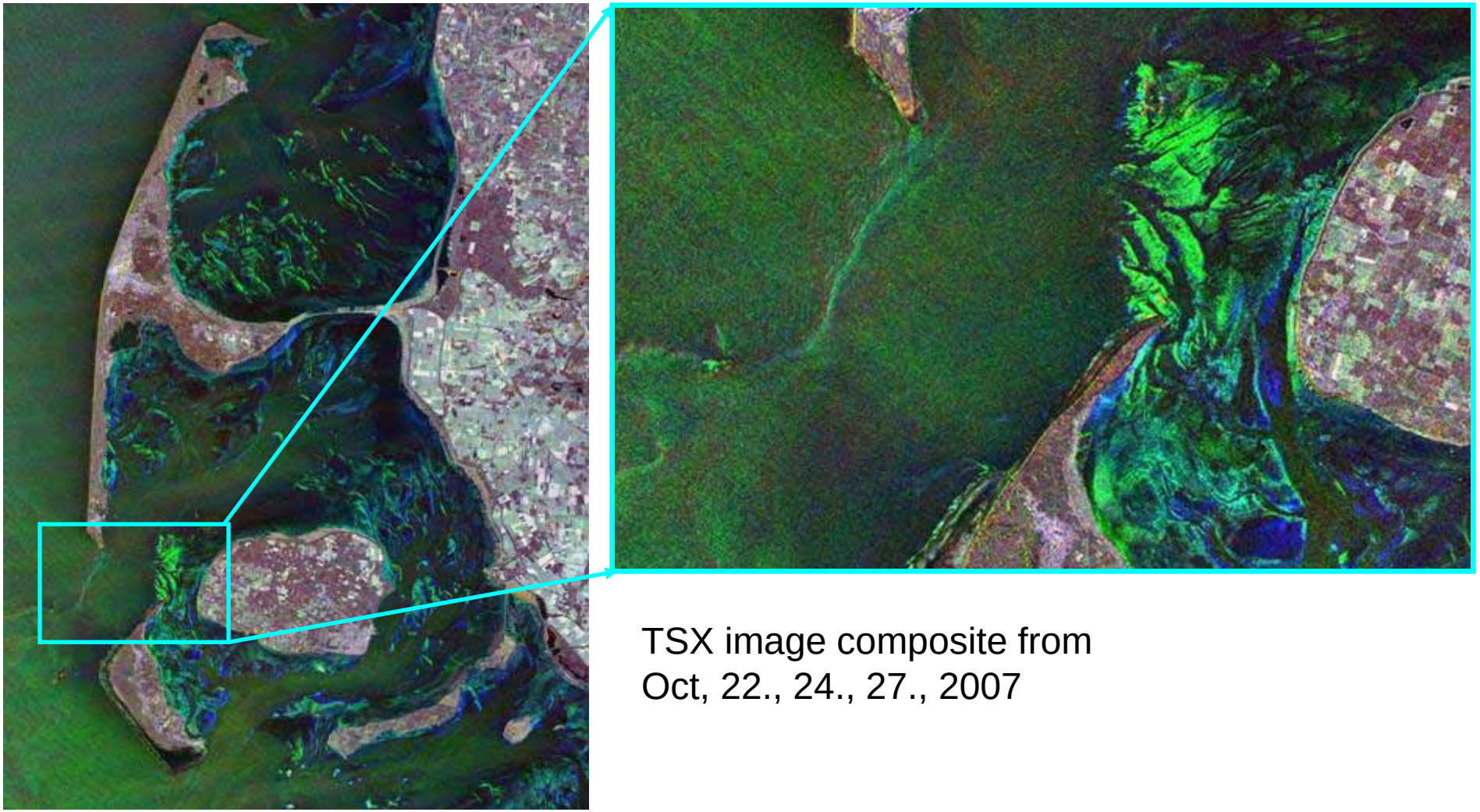






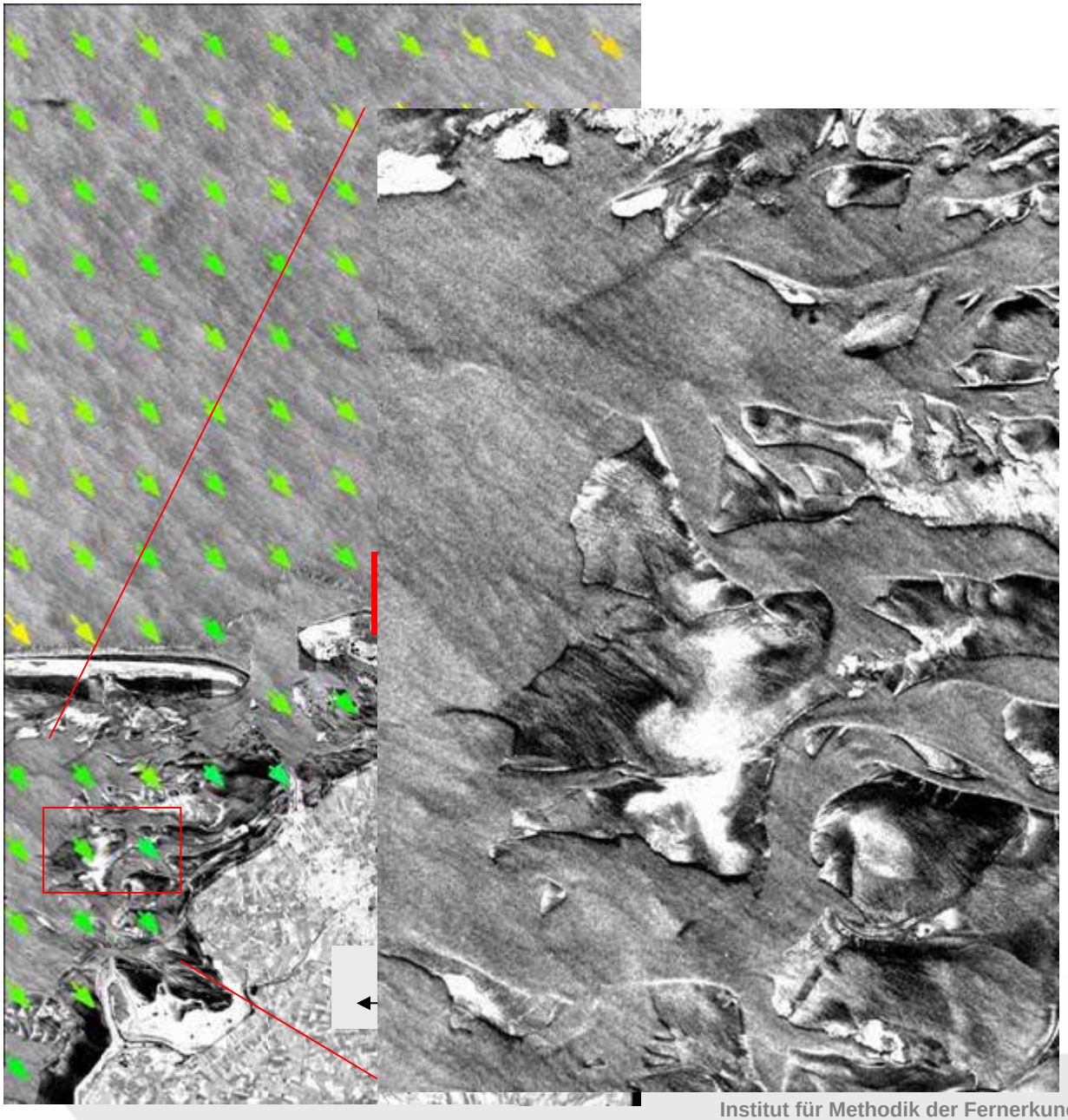


Scan SAR Mode Nordfriesisches Wattenmeer

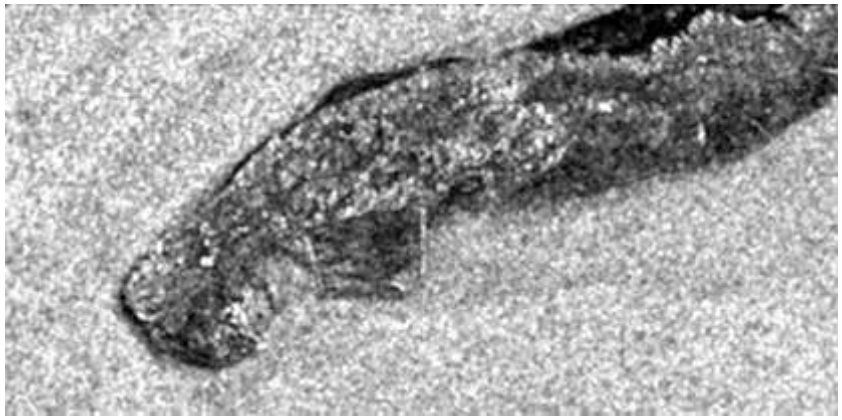


TSX image composite from
Oct, 22., 24., 27., 2007

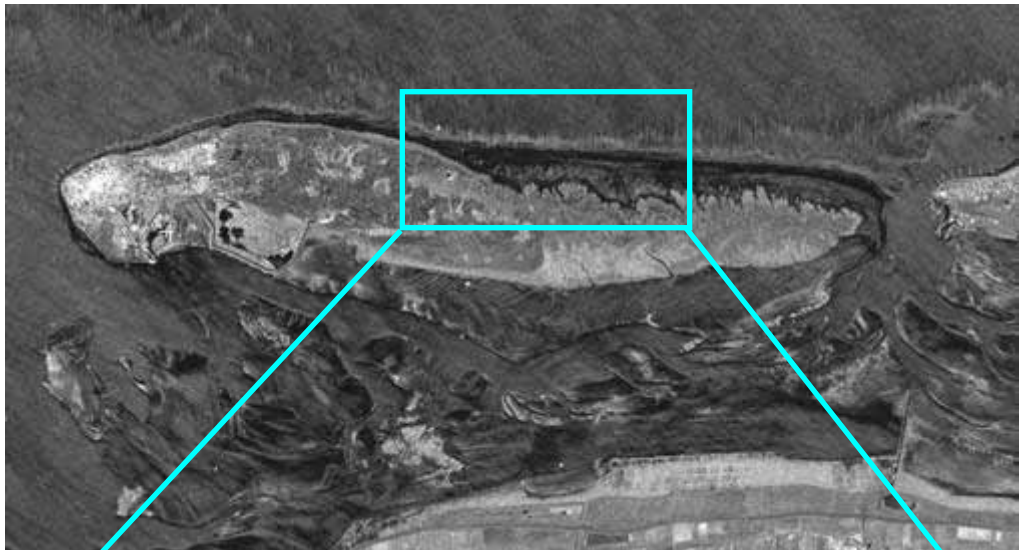
WATT-Topographie



TerraSAR X Stripmap
Norderney
28. Juli, 2007, 17:18 UTC

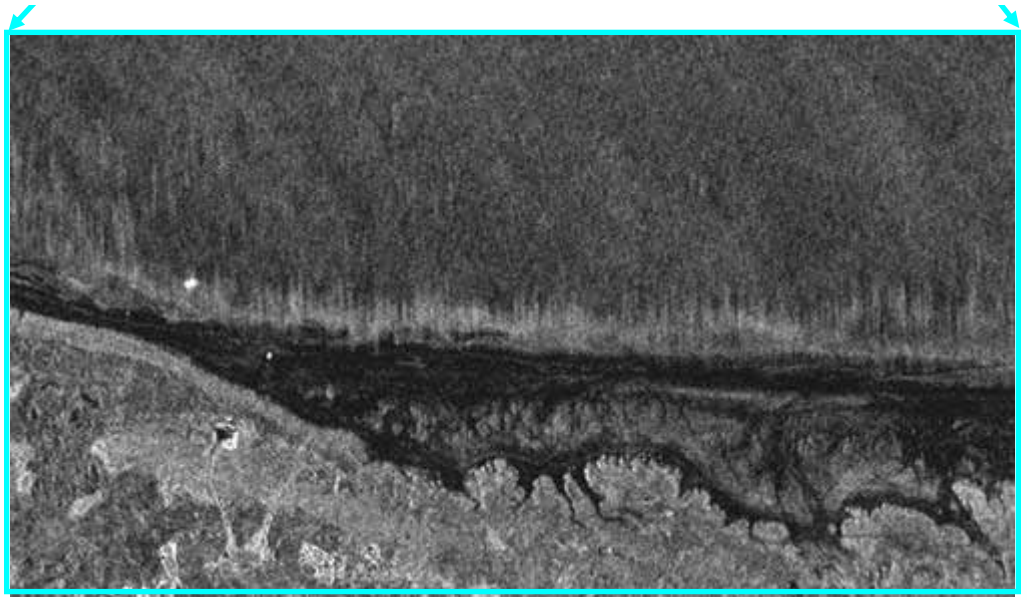


ENVISAT IMS Ausschnitt 4. April, 2004

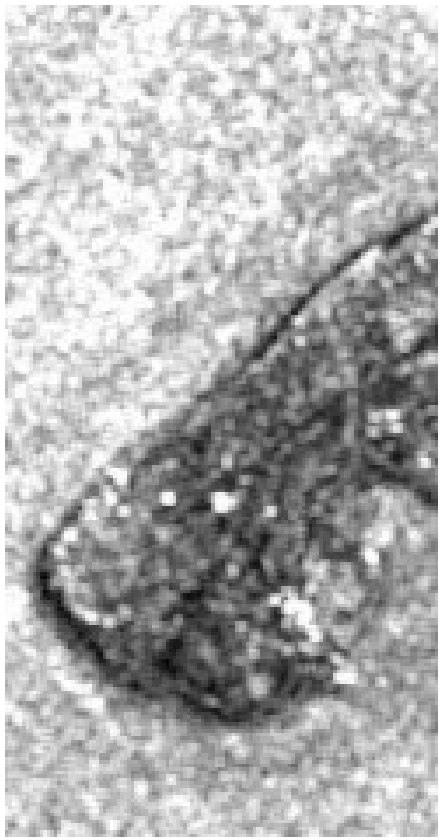


TSX Ausschnitt 27. August, 2007 (~17kmx7km)

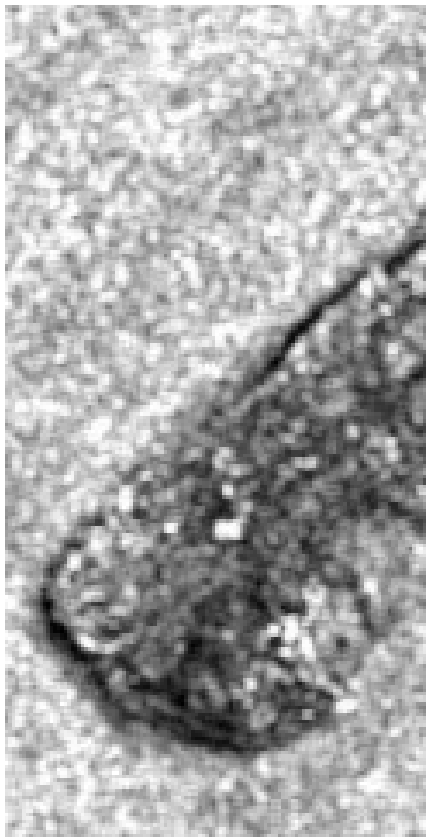
ERS-2 SLC Ausschnitt, 4. April, 2004



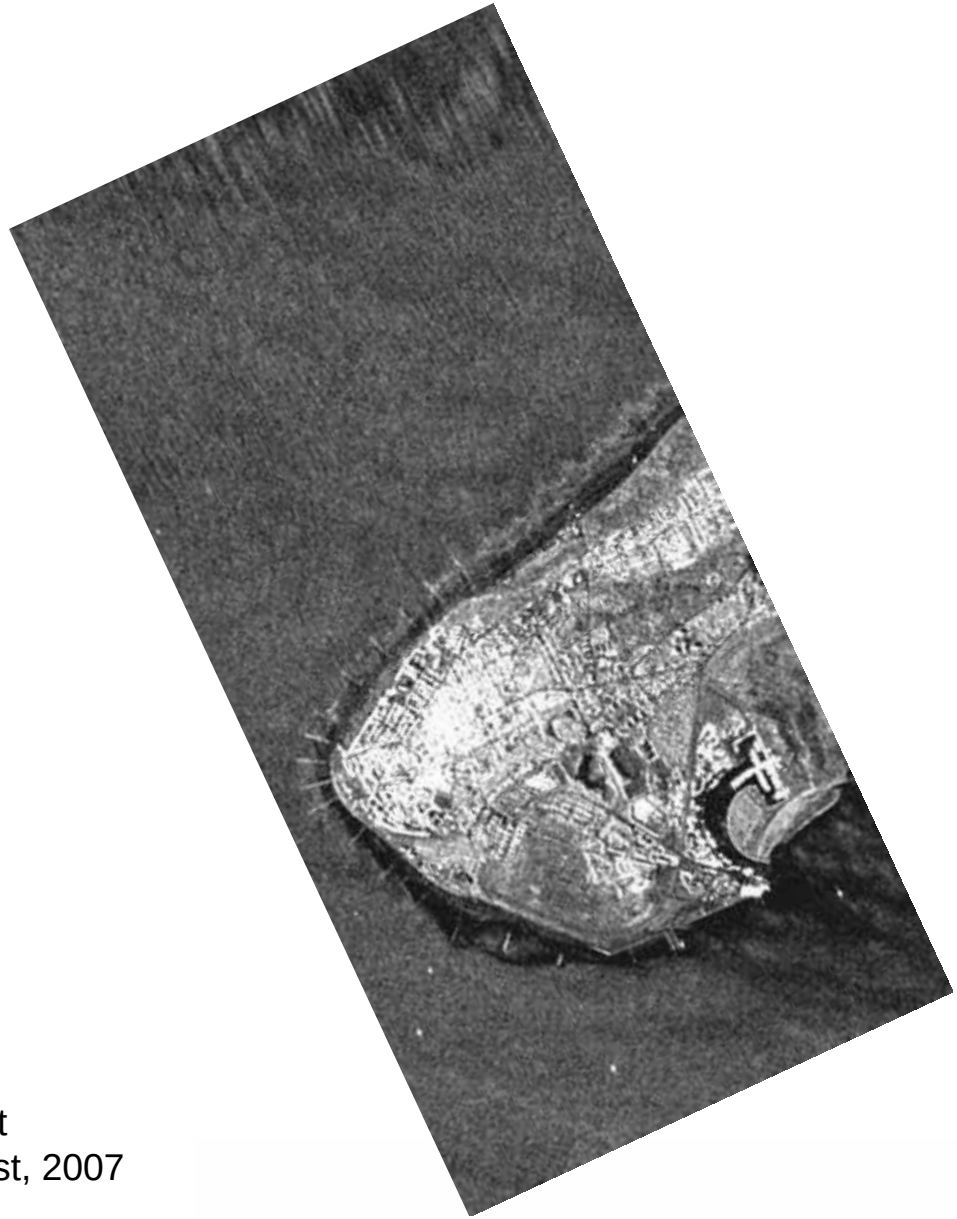
TSX Ausschnitt 27. August, 2007 (~6kmx1km)



ENVISAT IMS
Ausschnitt vom
4. April, 2004



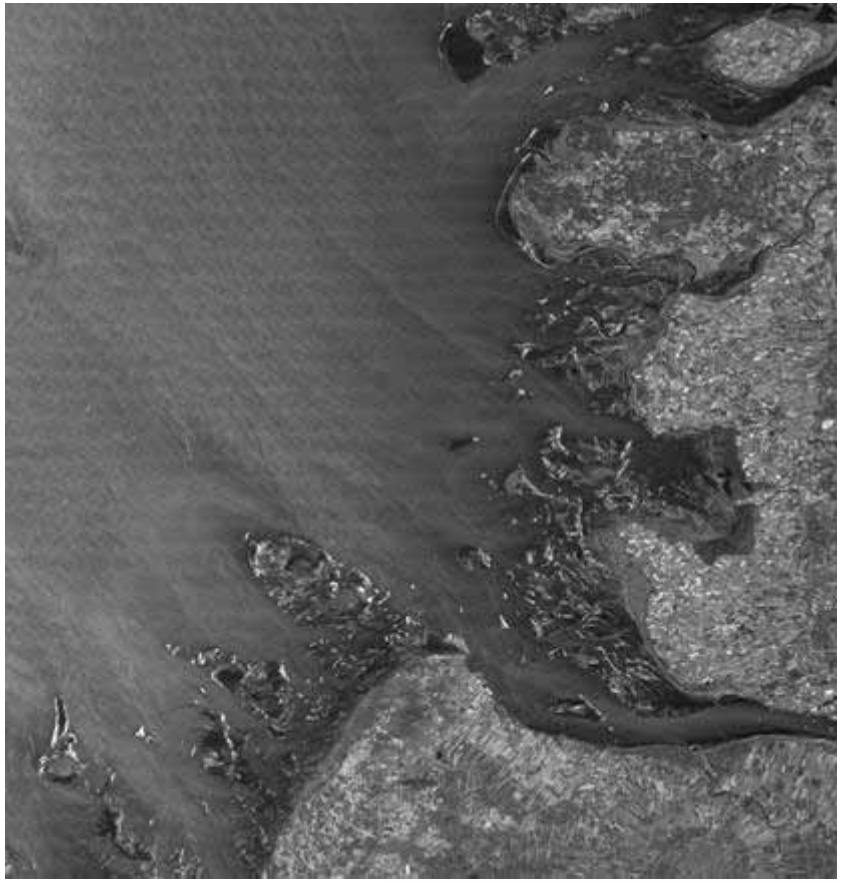
ERS-2 SLC
Ausschnitt vom
4. April, 2004



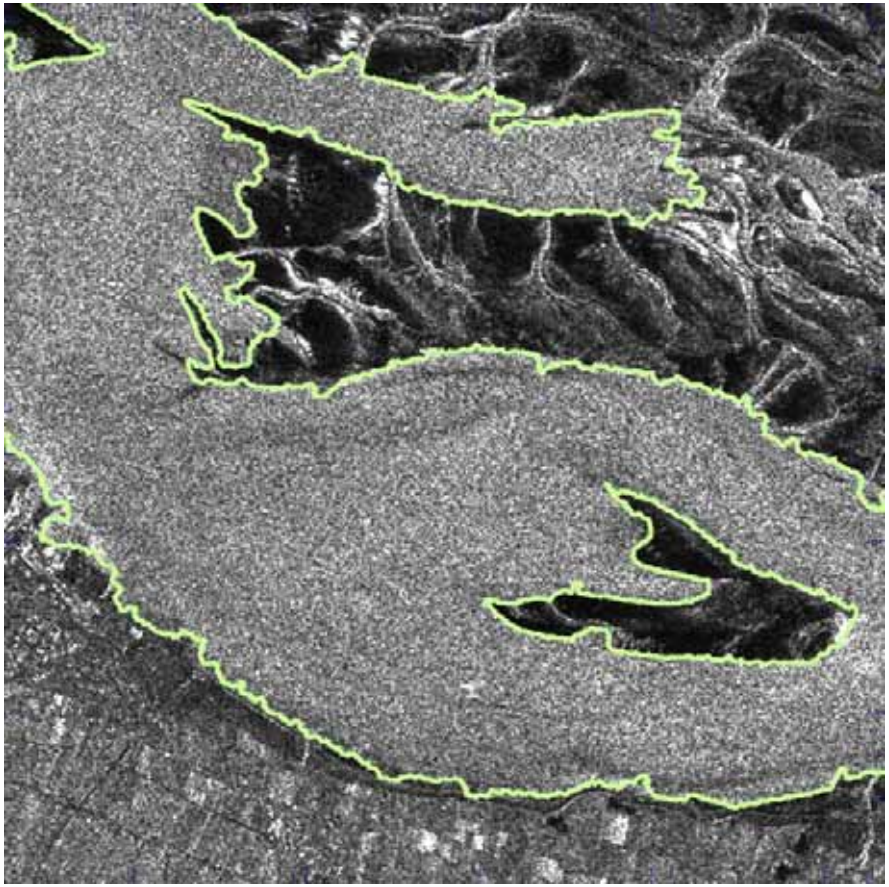
TSX Ausschnitt
vom 27. August, 2007
(~2kmx5km)

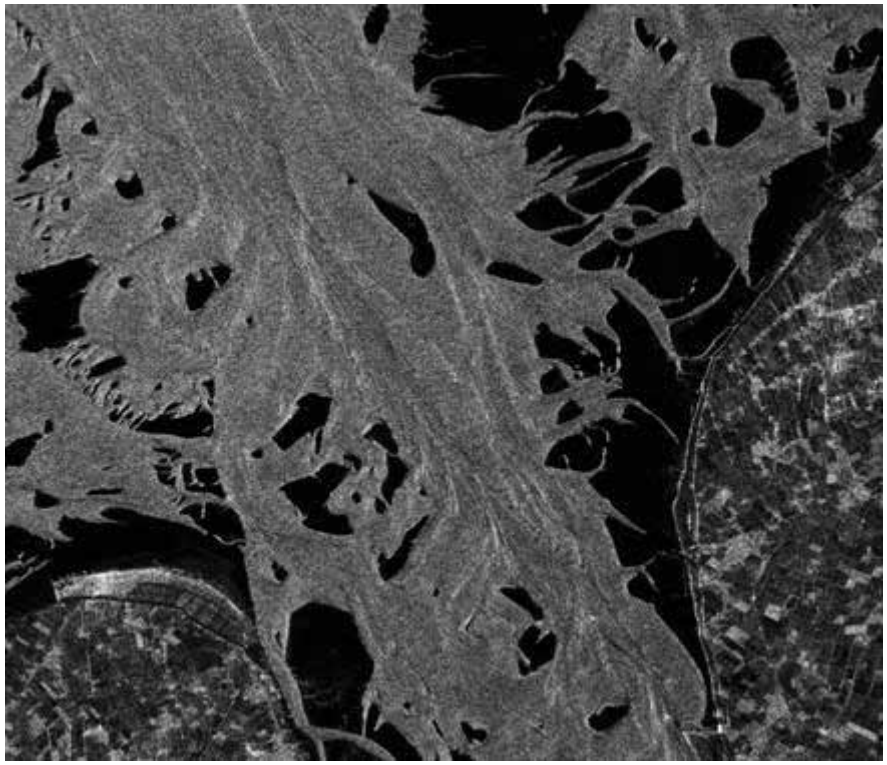
Deutsche Bucht, Elbe Ästuar

TSX – SC VV, 22.10.2007

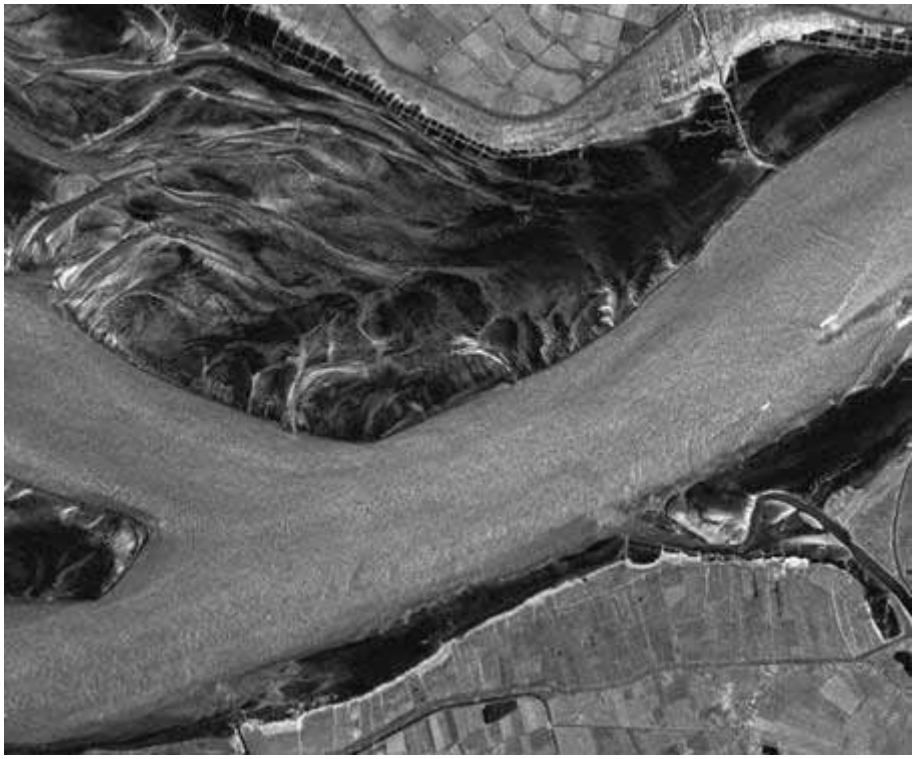


ERS VV, 1994



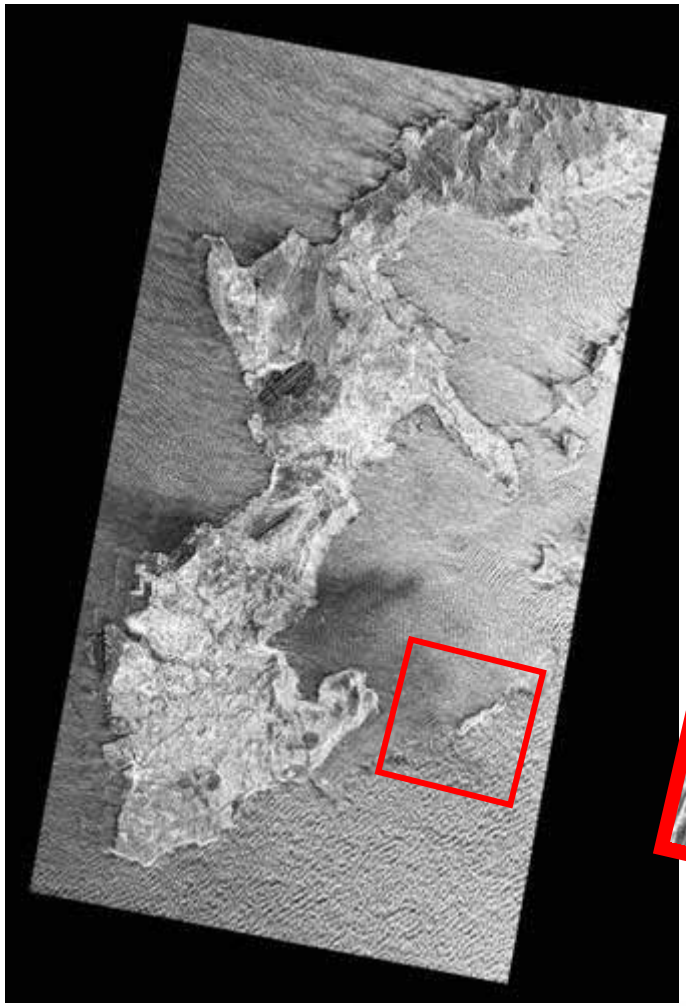


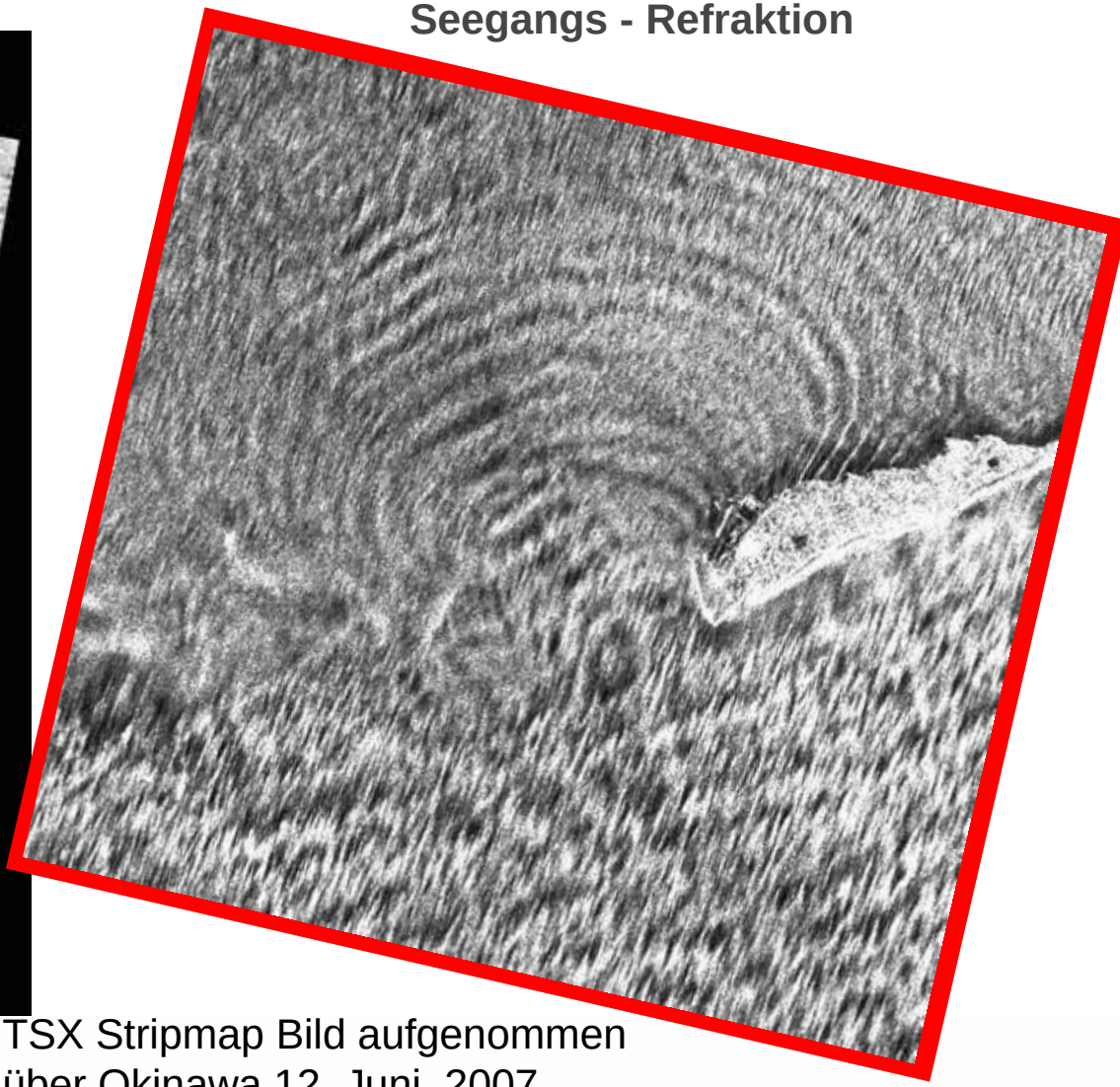
ALOS-PALSAR (Ausschnitt etwa 20 km x 15 km)
12-APR-2007 21:28:30 UTC; Polarimetry mode;
Proccessing Facility: Japan JAXA; HH-Polarisation



TerraSAR-X Spotlight (10km x 10km)
Elbe, Germany
2008-03-20 at 05:50:34 UTC
HH- Polarisation

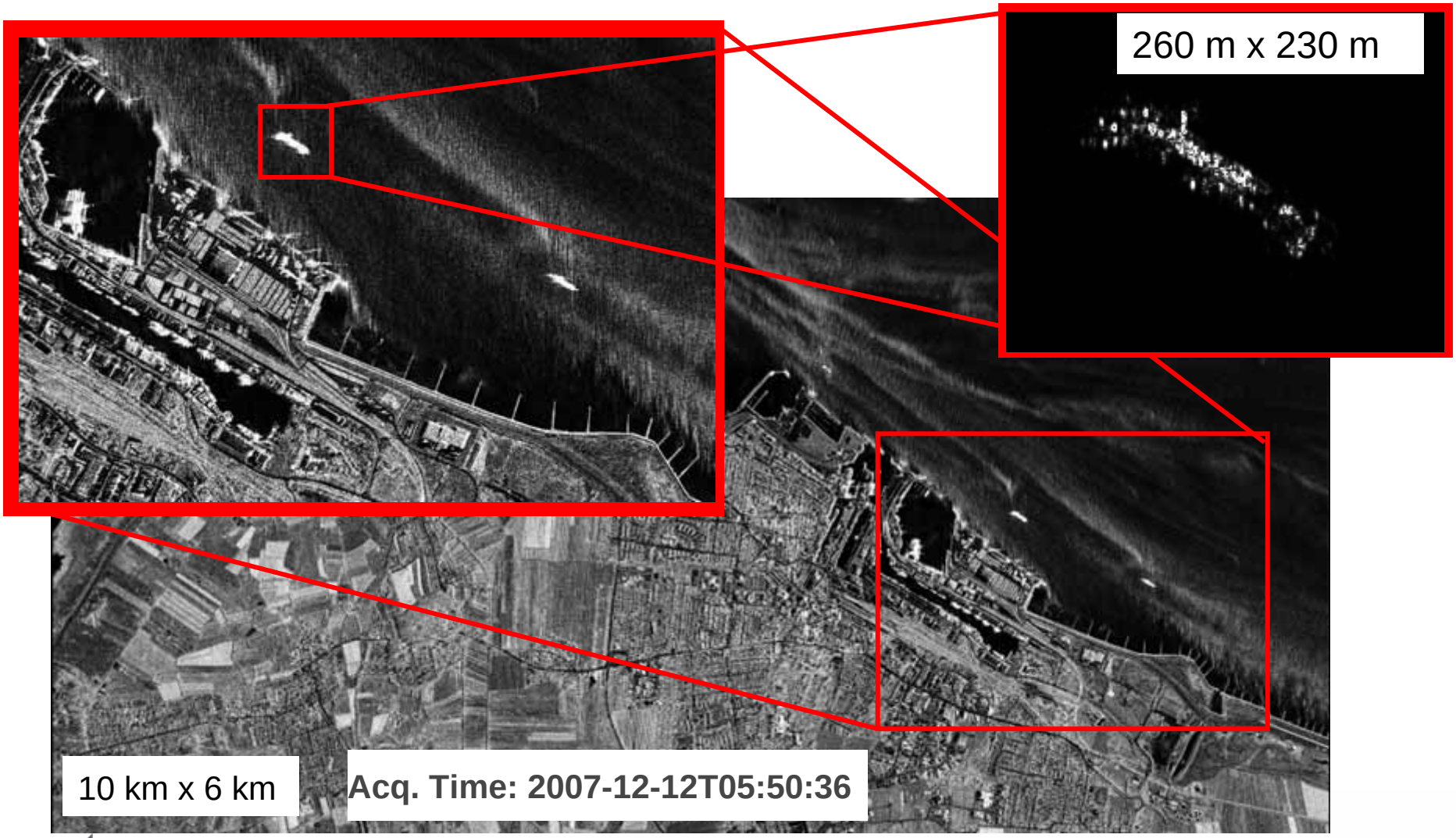
Seegangs - Refraktion



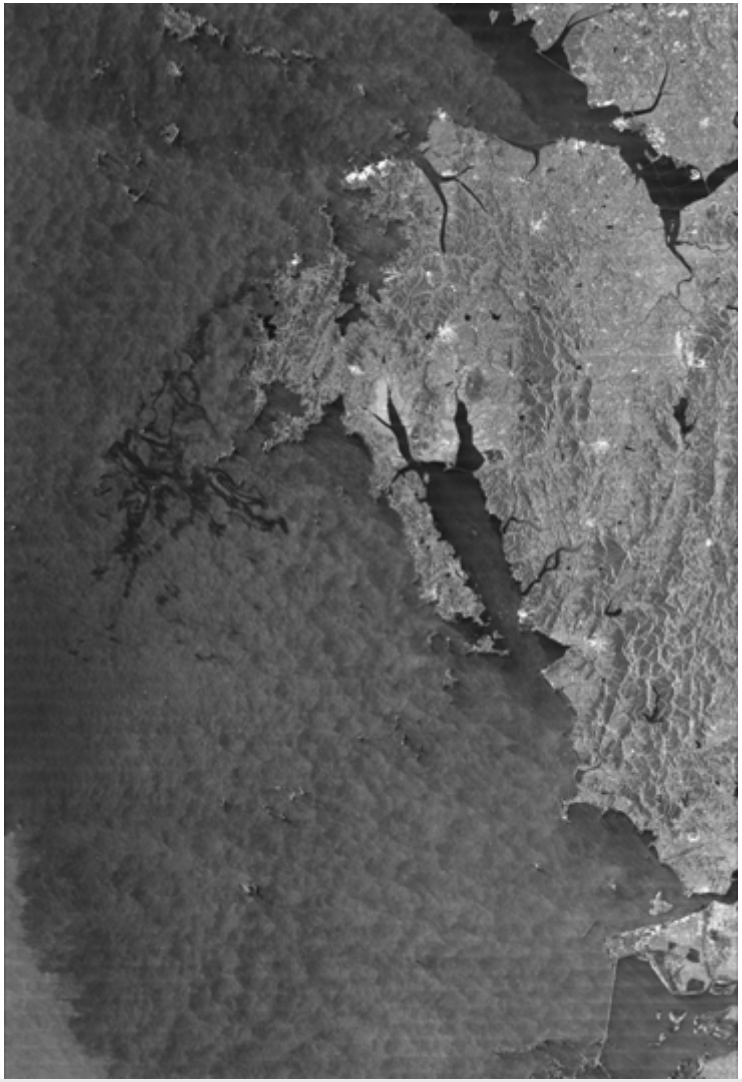


TSX Stripmap Bild aufgenommen
über Okinawa 12. Juni, 2007

TSX Spotlight Szene aufgenommen über Cuxhaven

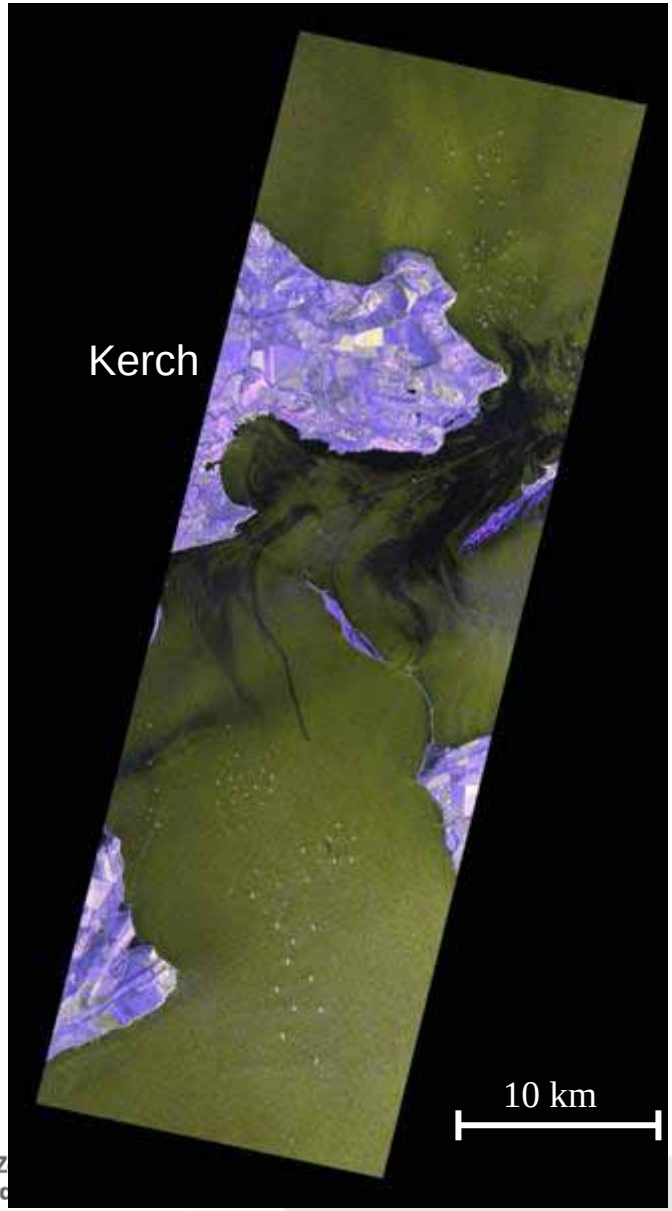


Nutzung des Scansar Modes zur Öldetektion
Süd Korea, Schiffsunfall



Dec 12, 2007, 21:43 UTC

Ölunfall in der Strasse von Kerch



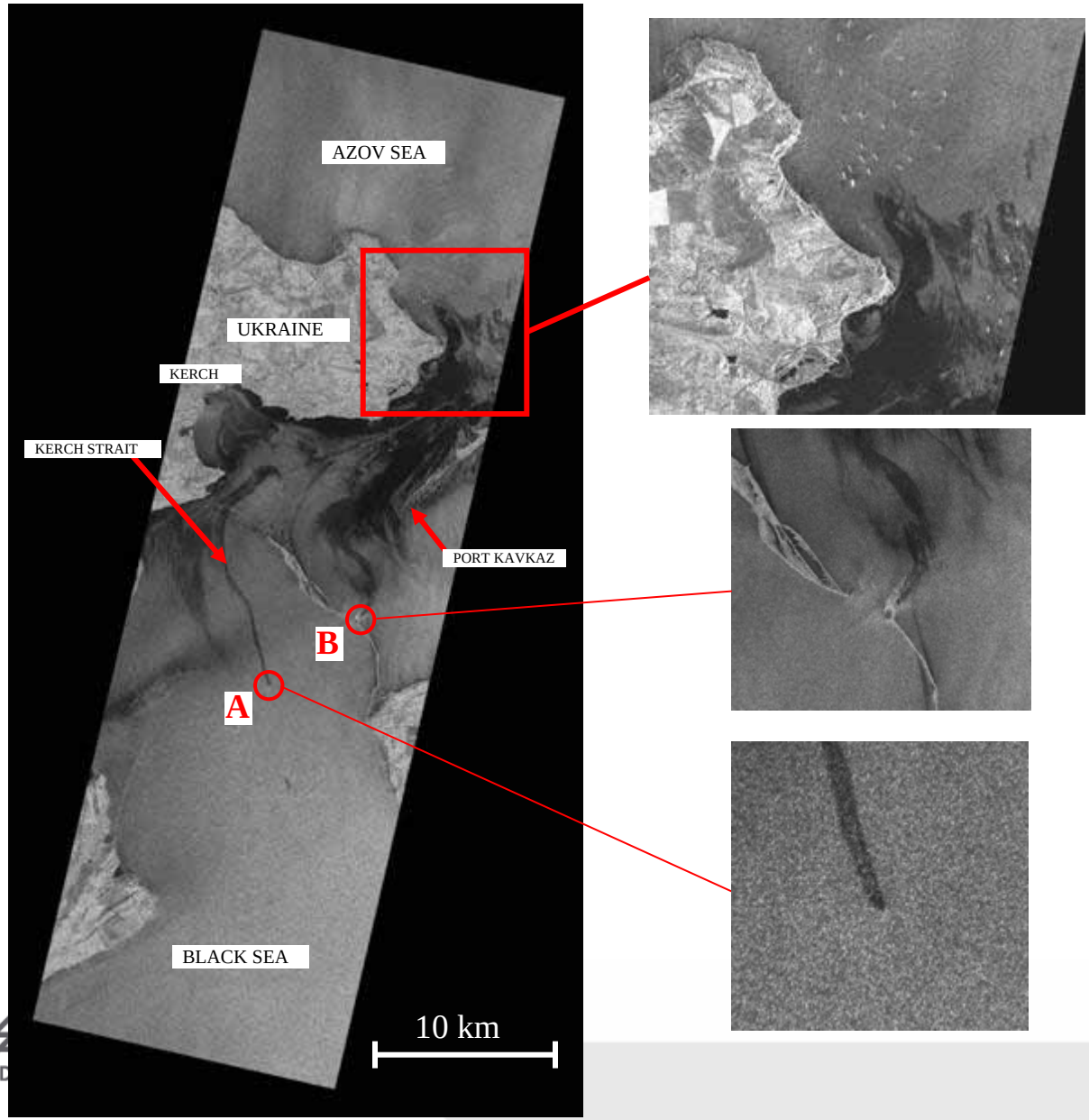
TerraSAR-X Stripmap

16.11.2007, 3:52 UTC.

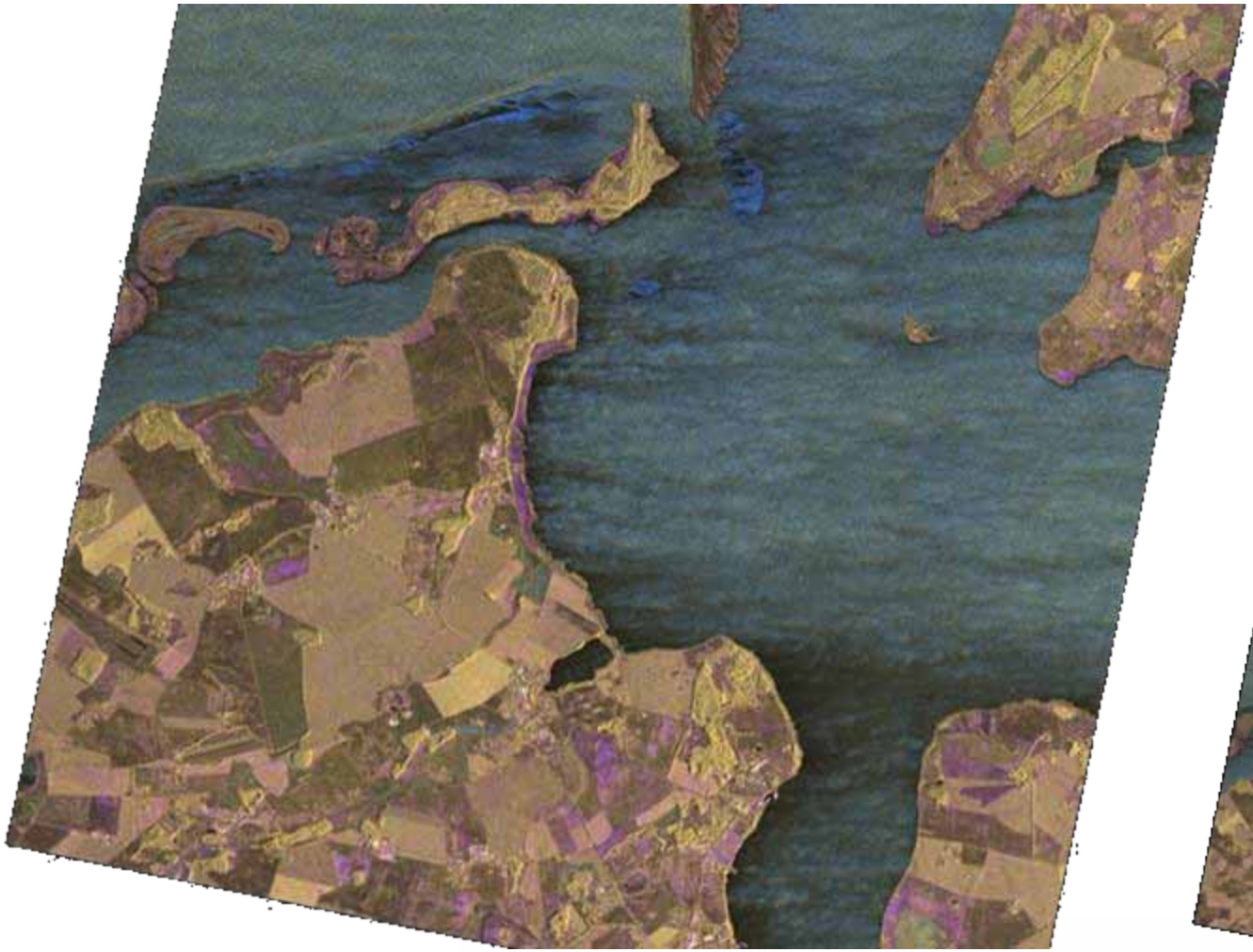
Dual Polarisation

(HH / VV / | HH – VV |)

VV Polarisation

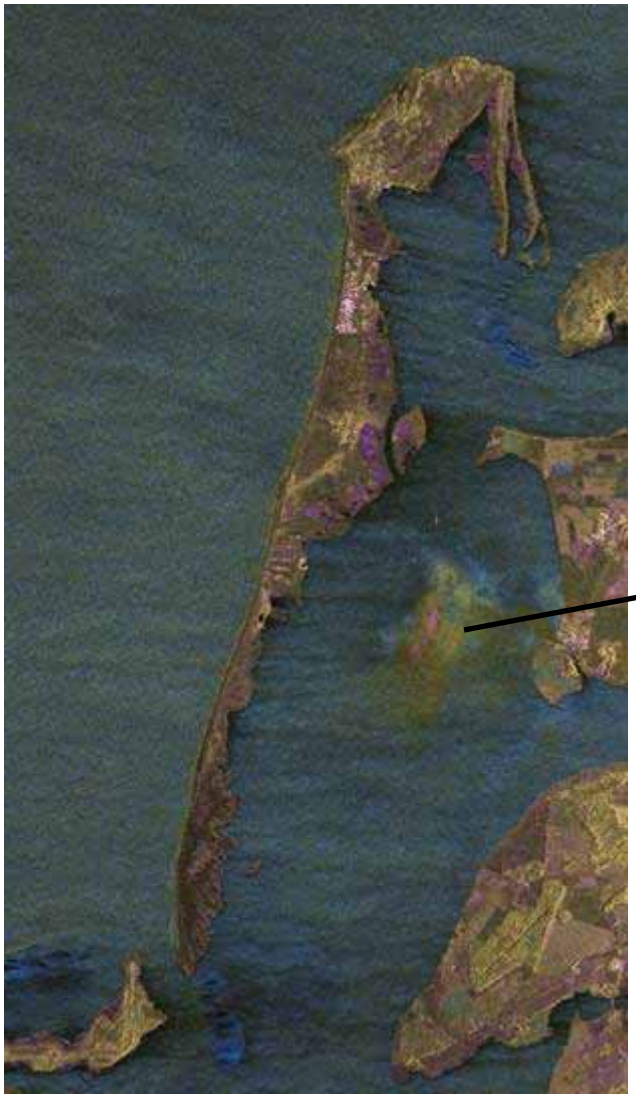


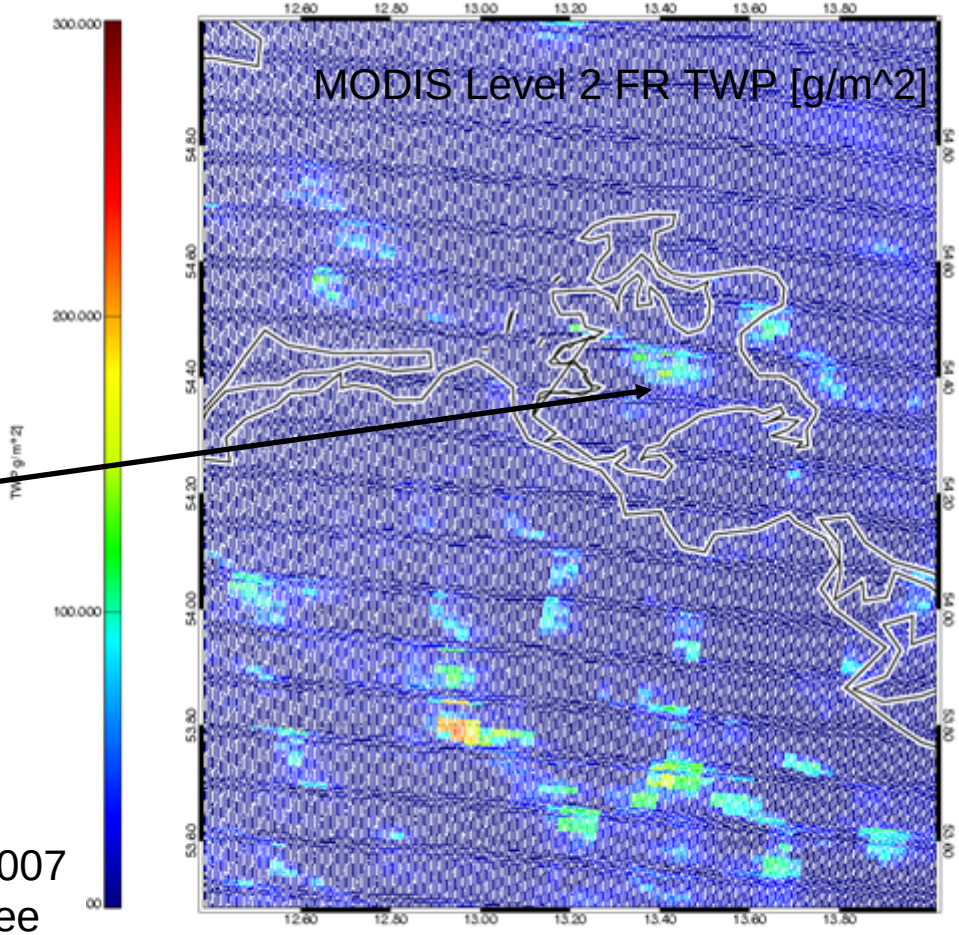
Unterwassertopografie aus Dual Pol Daten



Wolkendetektion

(HH / VV / | HH – VV |)



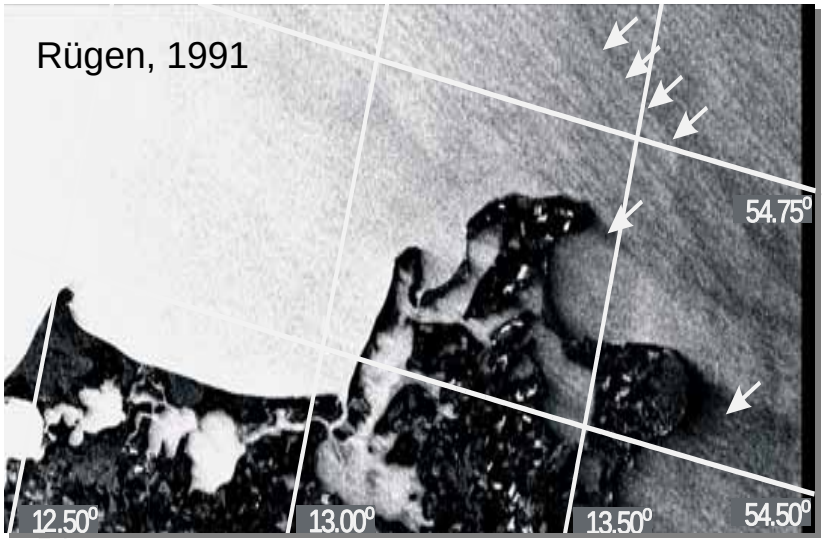


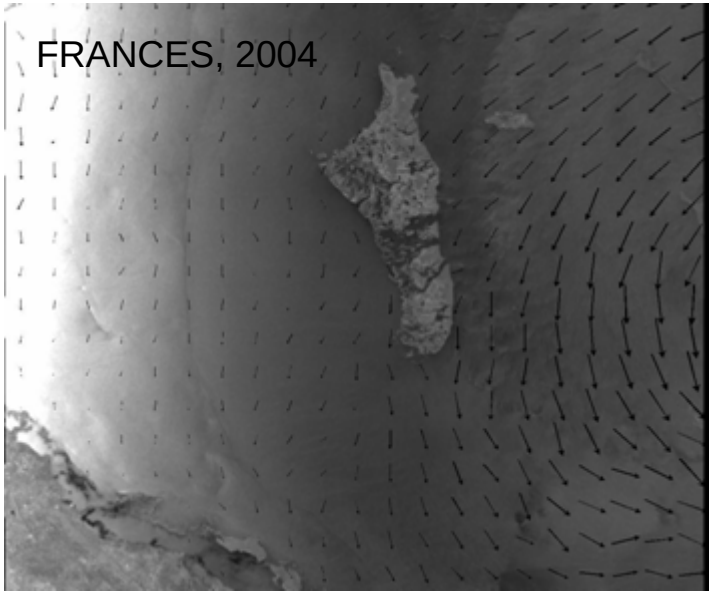
7. Juli, 2007
Hiddensee
05:24 UTC

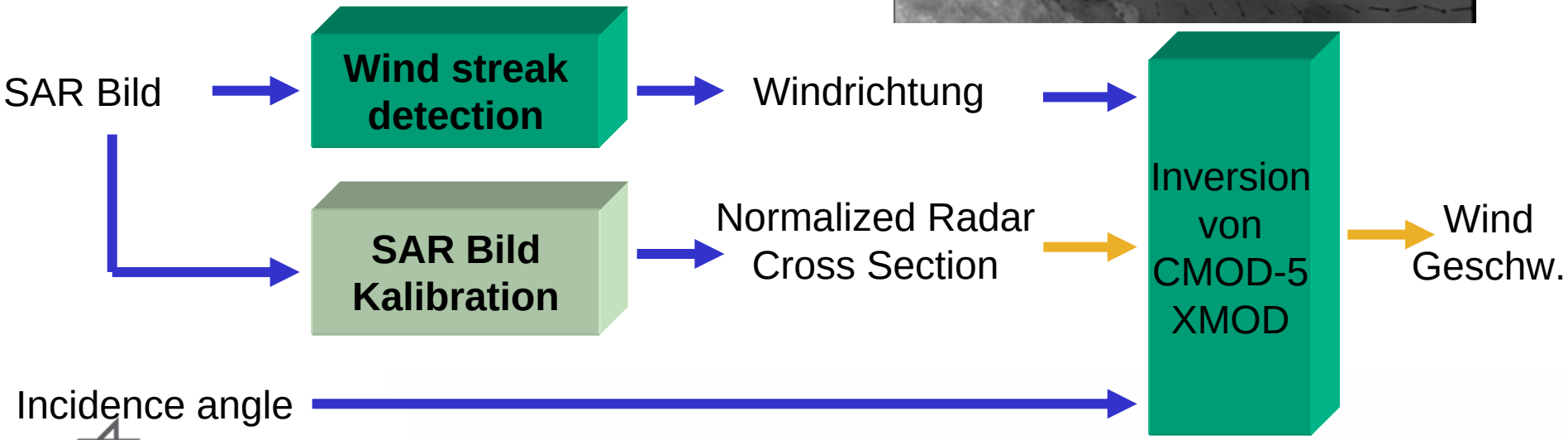
…etwa 2 Stunden Zeitdifferenz (Westwind)

GEC RE, 8 m res., 3.75 m spacing, 50 km x 15 km

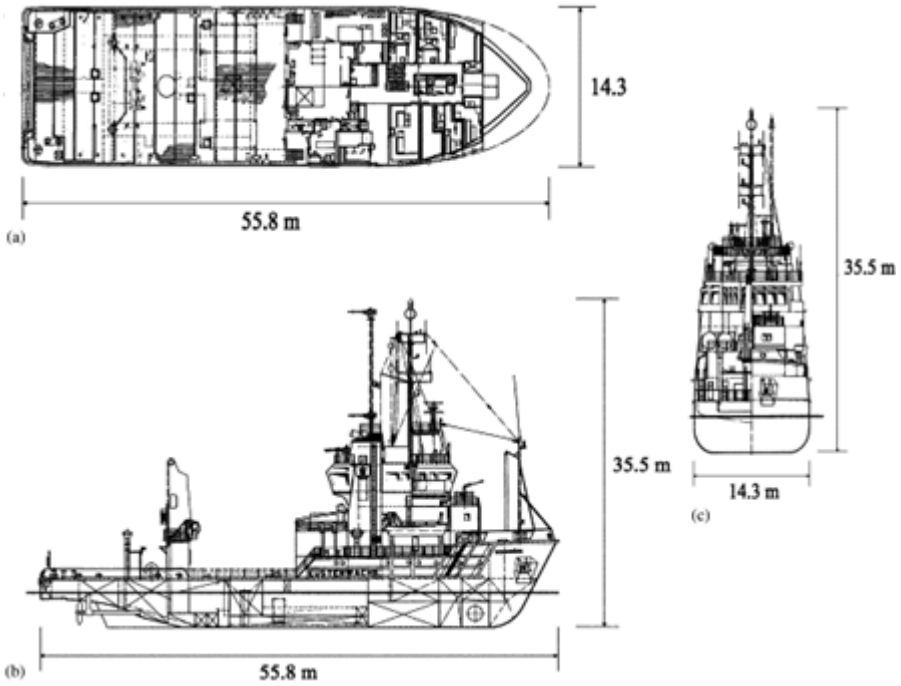
Wind Feld Bestimmung aus SAR Bildern



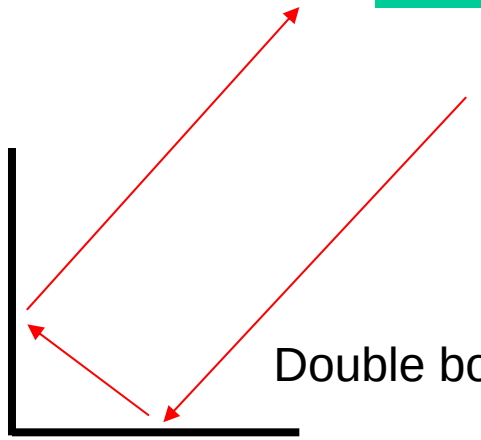




Schiffsdetektion

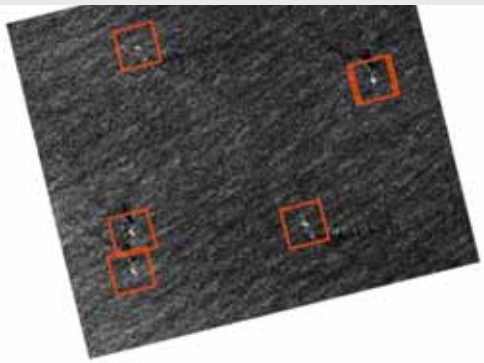


SAR

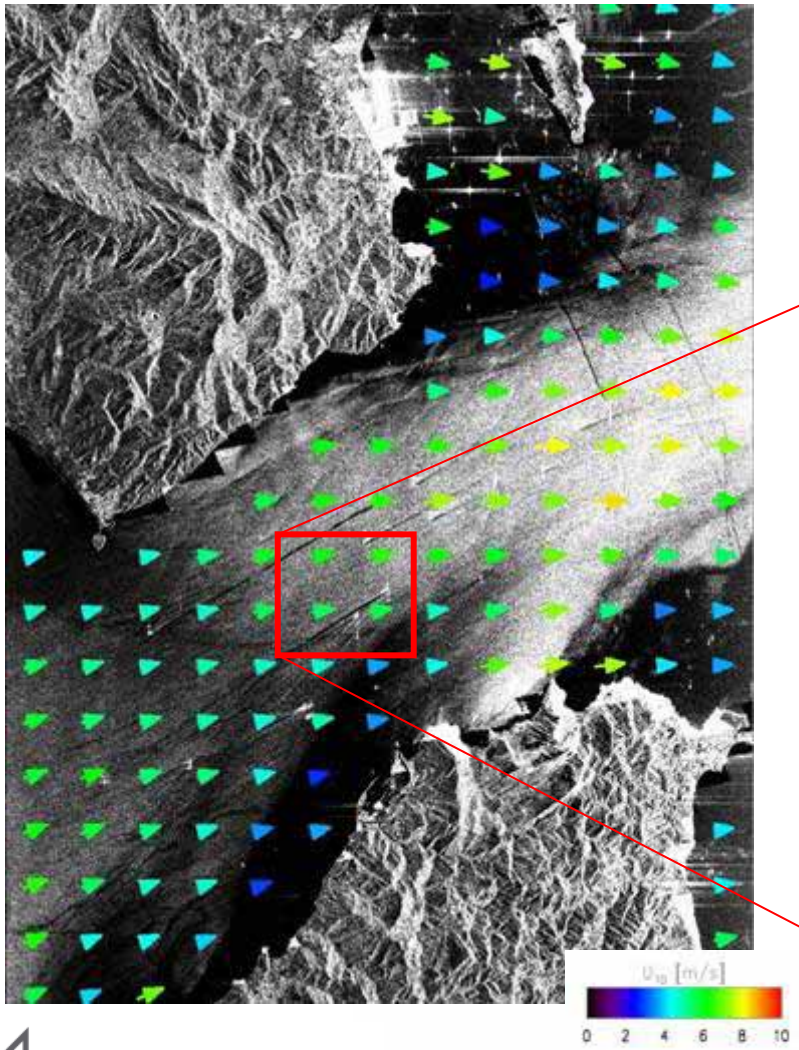


Double bouncing

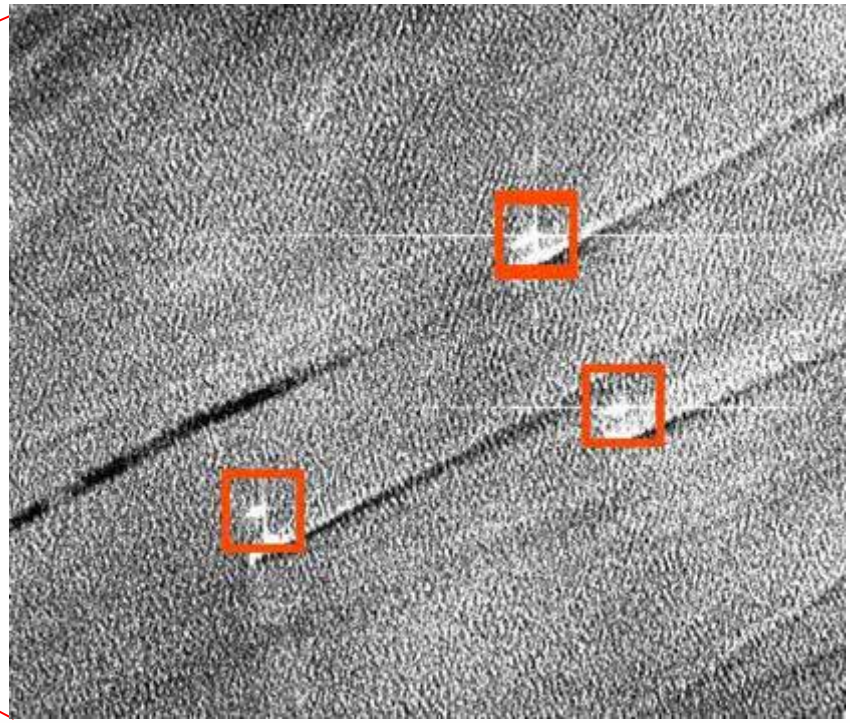
Strong radar return von Schiffen



Strasse von Gibraltar

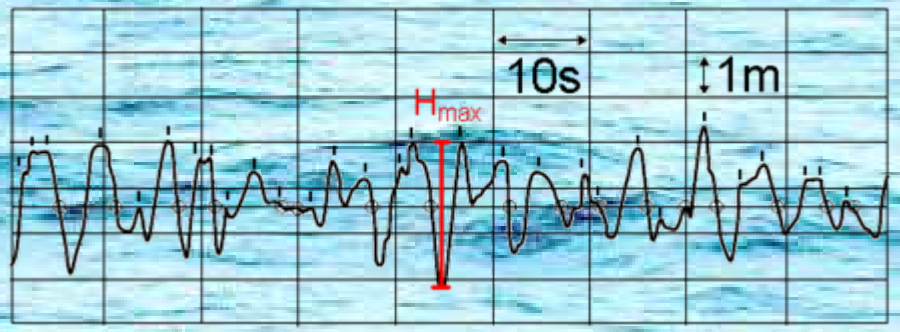


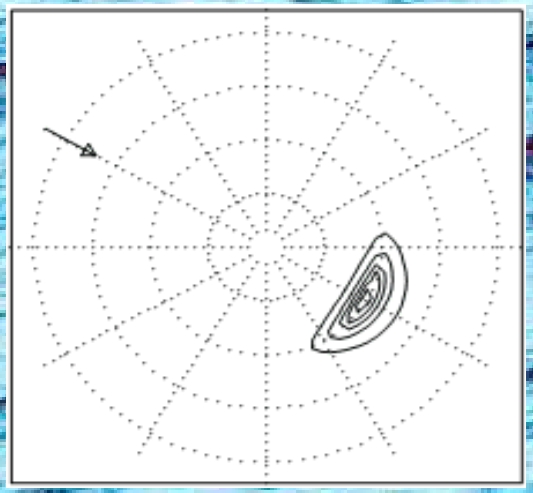
TerraSAR-X Stripmap mode scene
Aufgenommen am
9. Juli, 2007 um 06:29 UTC



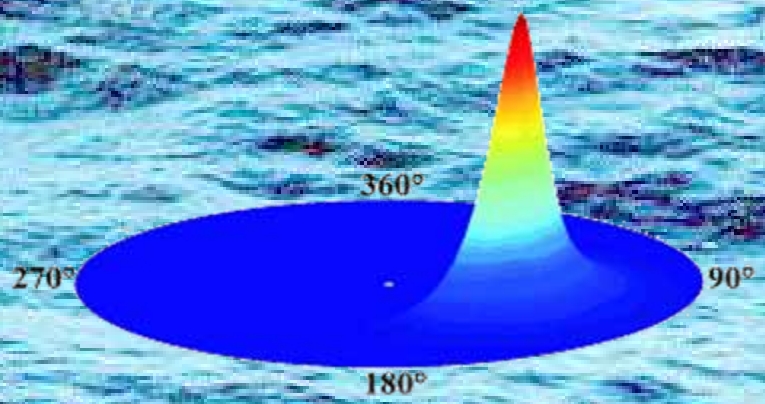
Statistische Beschreibung des Seegangs

Signifikante Wellenhöhe





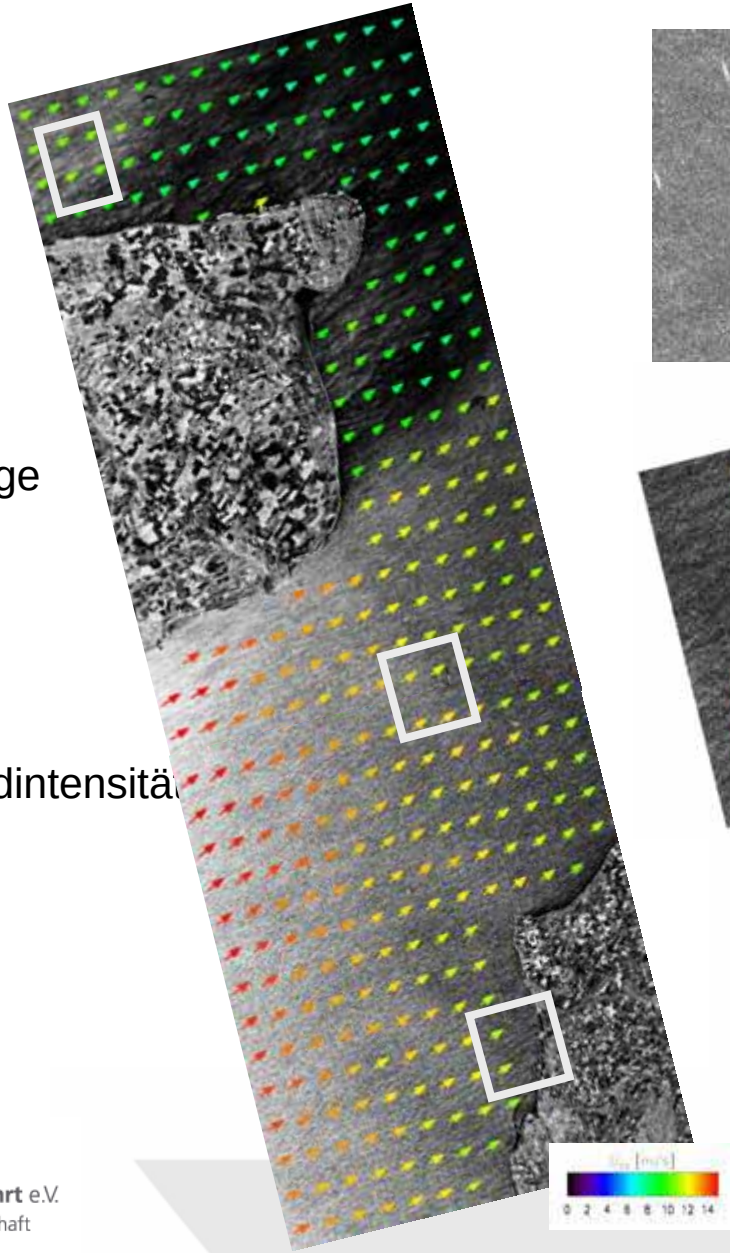
Seegangsspektrum

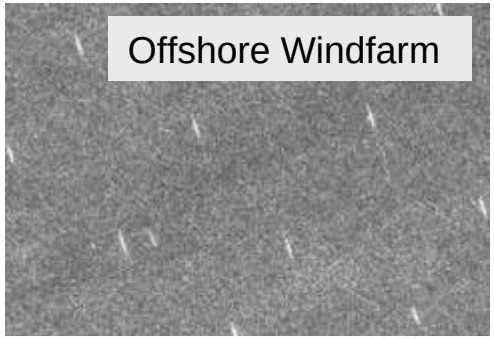


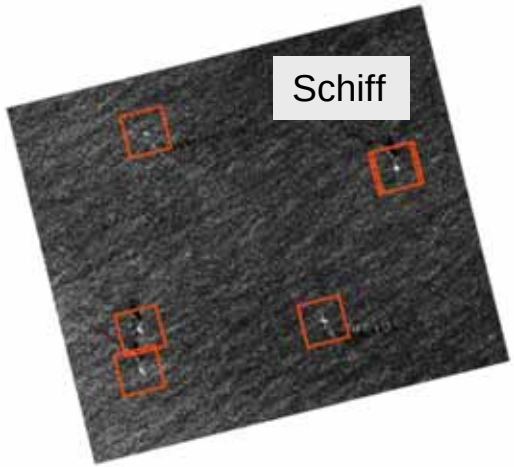
Schiffsdetektion mit TSX X-Band Daten

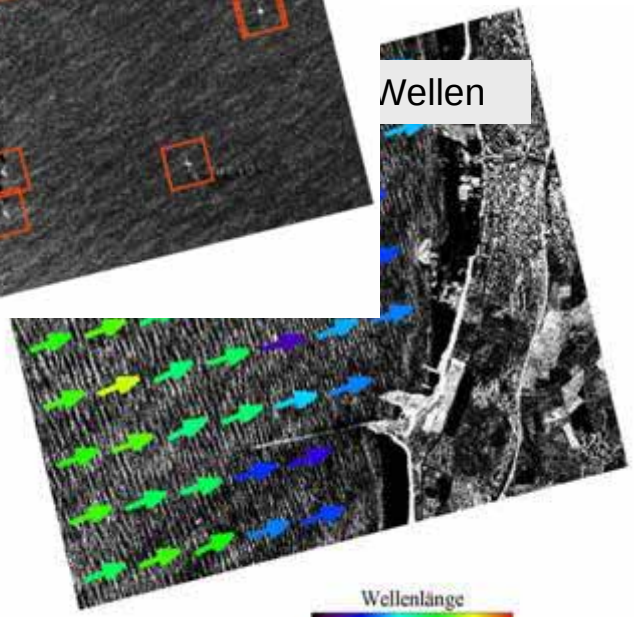
30 km x 100 km
TSX VV Stripmap image
2. July 2, 2007,
7:35 UTC

Überlagertes Windfeld
Abgeleitet aus den Bildintensitä









Oceanography Algorithmen am DLR

Toolbox

- Input, Quicklook Erzeugung
- Bildverarbeitung

Windfeld Analyse – XMOD

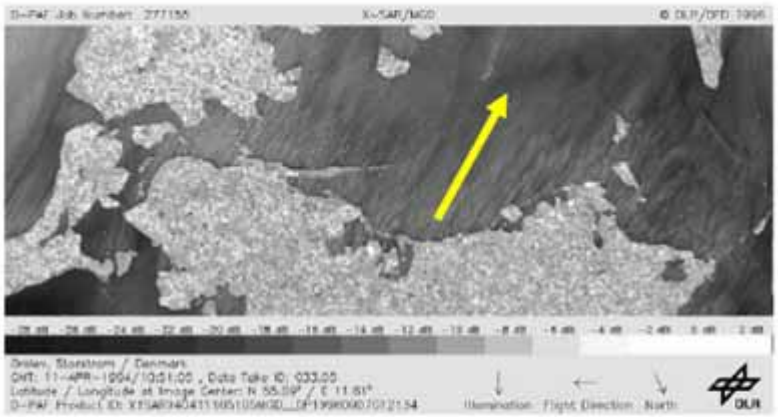
- Kalibration
- Streak Detection – Windrichtung
- Windfeld

Seegang

- Zwei-dimensionale Spektren
- Seegangsparameter

Schiffs und Öl Detektion

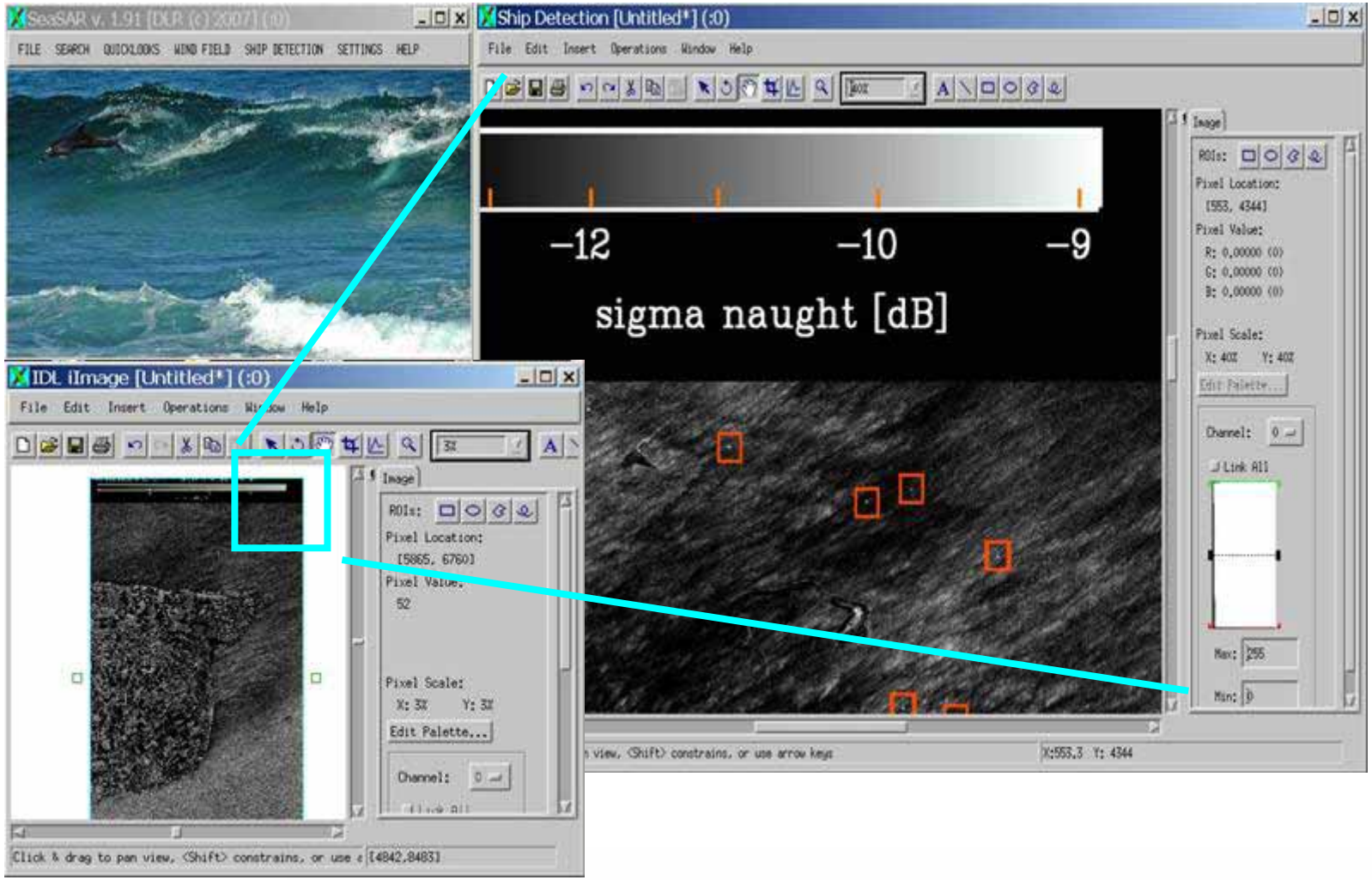
- Threshold Algorithm



X-SAR scene acquired over the Danish Coast on April 11, 1994

ross
suko

SeaSAR V1.93 Toolbox



Nächste Schritte:

Validation X Band Algorithmen

Seegangsspektren global: Satelliten (SAR, Alt) – Modellergebnisse (DWD, ECMWF)

Küste: TerraSAR-X, ALOS, ERS, ENVISAT – hochaufgelöste Modellergebnisse (BAW)

Experiment des marinen Radars WAMOS auf Polarstern

Erweiterung Toolbox zur Verschneidung von Satelliten-, Modell und in Situ Daten

Strömung SLC Daten

Warnsystem – NRT Funktionalität

Internationale Koperationen: Universität Miami, Dragon (ESA)

Vielen Dank für Ihre Aufmerksamkeit!

March, 10, 2008