Direct ocean surface velocity mapping with Wide Swath SAR:

A user’s guide to the range Doppler method

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ESA Funded Project (contract number RFQ 3-13208)
High resolution surface velocity mapping with Wide Swath SAR:

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The idea for this manual is essentially coming from Beal, Young, Monaldo, Thompson, Winstead and Scott book on High Resolution Wind Monitoring with Wide Swath SAR: A Users’s Guide (published by NOAA in June 2005)
Operated as a “speed-gun” in space the ASAR Doppler shift anomalies manifest the range component of the sea surface current. Building on more than 5000 synoptic wide coverage acquisitions since 2007, new high-resolution gridded maps (~ 10 km x 10 km) of intense surface current regimes have been established.

The ASAR based surface velocity estimates that can be related to surface current are not error free, and they rely on careful processing and correction for near surface wind speed effects and wave motions. This will be demonstrated.

A broad range of examples will be given with coincident ASAR roughness, wind field and range Doppler velocity together with auxiliary data and information such as surface drifter data, satellite altimetry and gravimetry, sea surface temperature measurements which all together can resolve circulation patterns that have important implications for oceanographic and air-sea interaction research.
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The book will be colorful and about 100 pages long in landscape format
The Speed-gun in space

Surface Roughness & Surface Motion

Wind, Waves and Current

SAR NRCS & Doppler Shift

SEASAR 2012 | The 4th International Workshop on Advances in SAR Oceanography
18-22 June 2012 | Tromsø, Norway
\[ f_{Dca} = f_{Dc} - f_{Dp} \]

- \( f_{Dc} \): estimated Doppler centroid frequency shift
- \( f_{Dp} \): predicted Doppler shift

Chapron et al. (2003, 2005)
Envisat ASAR scene off the South African coast
14 September 2010, 21:15 UTC
Hansen et al., 2011 (IEEE TGRS)
Estimation of wind and waves effects
Data Coverage
Monitoring intense current regimes

L2 and L3 products from

- Agulhas Current
- Gulf Stream
- North Brazilian
- Norwegian Sea
Exemple over Agulhas current

Radial current  sea surface roughness  wind

Enhanced wind facing current

Strong Over-correction  Atmospheric front
Zonal Current in the Nordic Seas
Data Coverage
GOCE – 1 year integration

ASAR 2007-2011 Climatology
Data Coverage

Density Map

NERSC

Norsk Romsenter

Norwegian Space Centre

ESA

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Wind field anomalies (SAR wind-ECMWF) contains surface current information (cross section modified in the presence of surface current and SST front (via ABL adjustment))
Mean Doppler range velocities and Mean Dynamic Topography
Examples of additional Monitoring Capabilities

Strong river outflow

Hurricanes

Intense rainfall
Challenge – emerging Applications – outlook

From ENVISAT ASAR to Sentinel 1 A/B

With the launch of the Sentinel-1 missions in 2013 and 2015 a Doppler grid product will be made available.
The manual will be released in 1st quarter of 2013