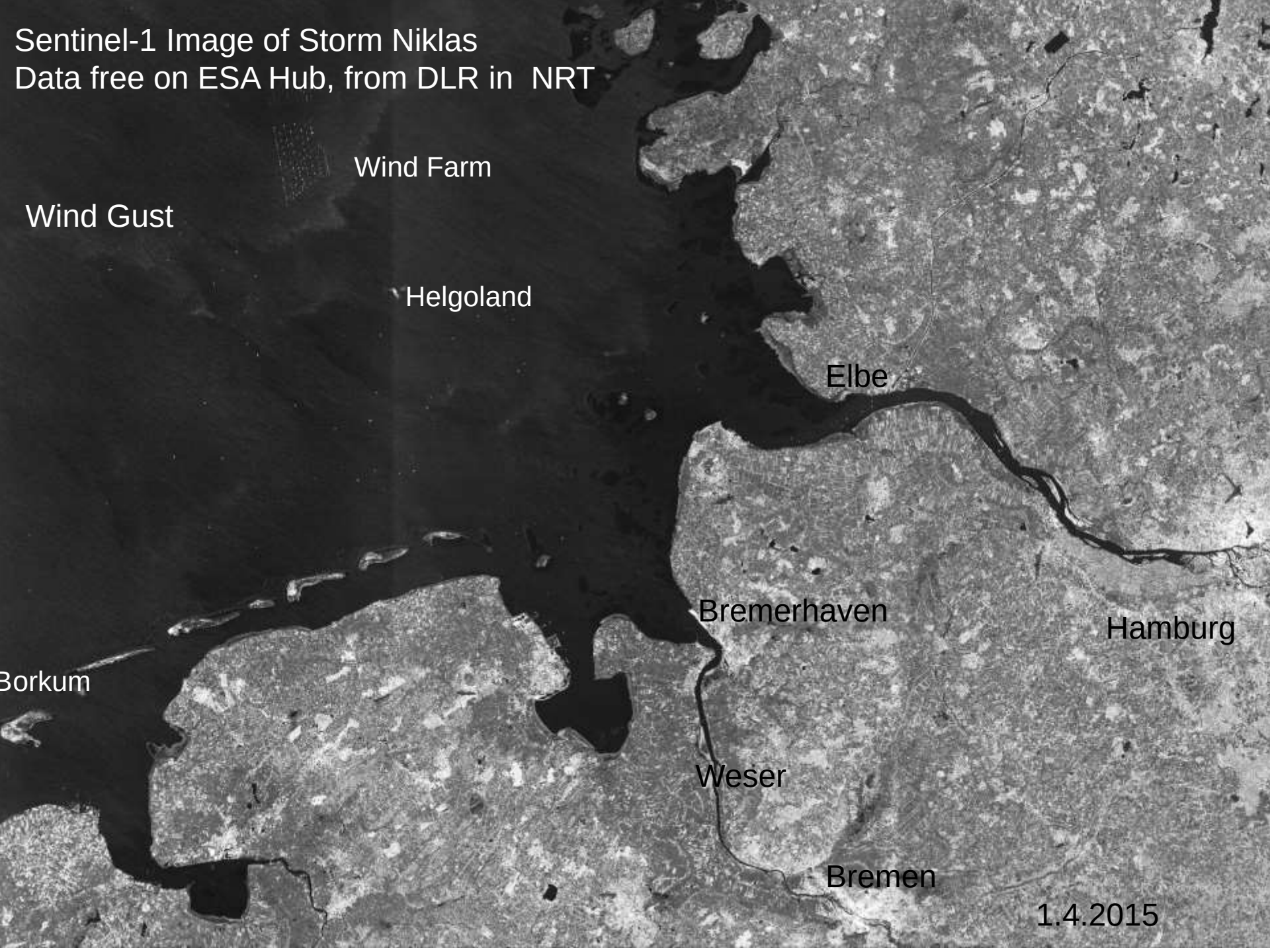
German Aerospace Center (DLR)
Remote Sensing Technology Institute
Maritime Security Lab

Meteo-Marine NRT Products
And the Use of the Service at the Weather Centers

Wolfgang Rosenthal

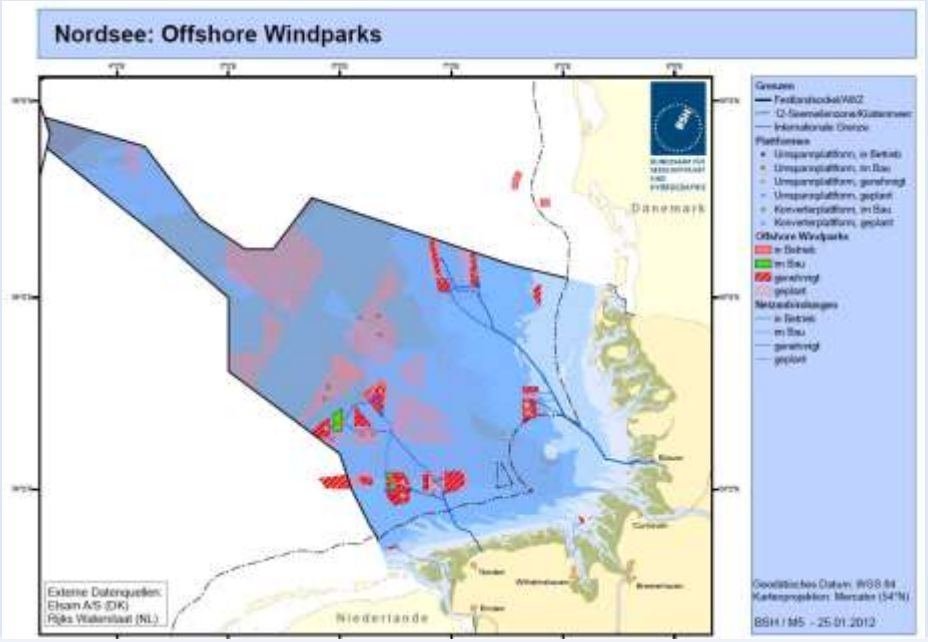
German Aerospace Center (DLR)


Sentinel-1 Image of Storm Niklas
Data free on ESA Hub, from DLR in NRT
Wind Farm
Wind Gust
Helgoland
Elbe
Bremerhaven
Hamburg
Borkum
Weser
Bremen
1.4.2015

Motivation

DeMarine

- Forecast of Sea State has too low resolution in coastal regions.
- Shallow Water effects are not well modelled (Change of Water Level, Breaking Waves, Wave-Current Interaction)
- Increase of Ship Traffic due to Offshore Industry, especially Offshore Windfarming



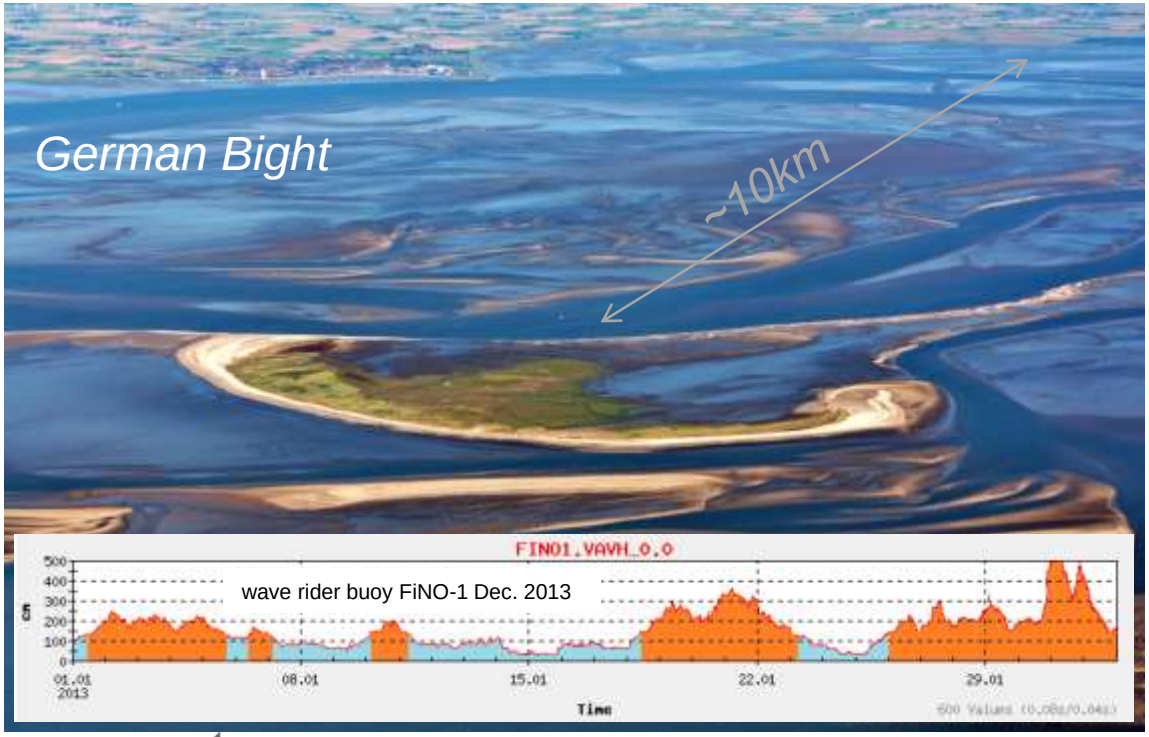
GMES Observing our planet for a safer world

Thomas.Bruns@dwd.de, Seegangsmonitor, 25.10.2012

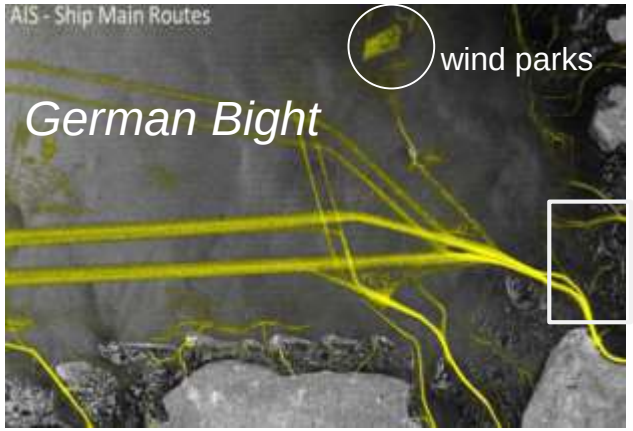
Gefördert durch:
Bundesministerium für Wirtschaft und Technologie
aufgrund eines Beschlusses des Deutschen Bundestages

Introduction:
Sea state in coastal areas
)

German Bight:
- high temporal and spatial variability of sea state, interaction waves/bathymetry/currents
- high activity: shipping and building offshore constructions



AIS messages mapped on TerraSAR-X image



condition: wave height<1.3m –
accurate forecast necessary

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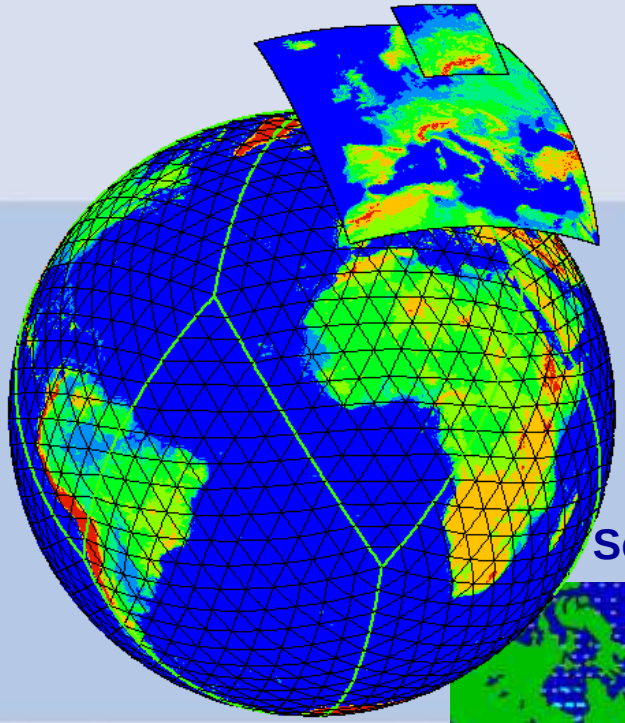
DWD-Modellkette

Deutscher Wetterdienst
Seeschifffahrtsberatung Hamburg

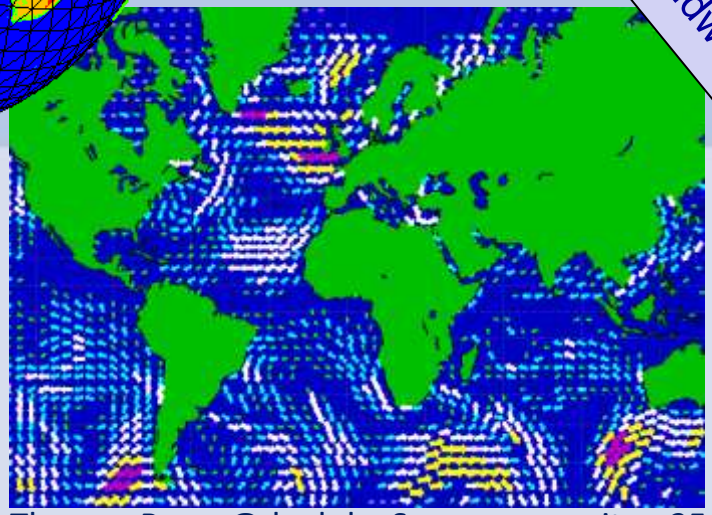


DE-Modell (2.8km)
EU-modell (7km)
Globalmodell (20km)

Wind

Randwerte

Seegangsvorhersage



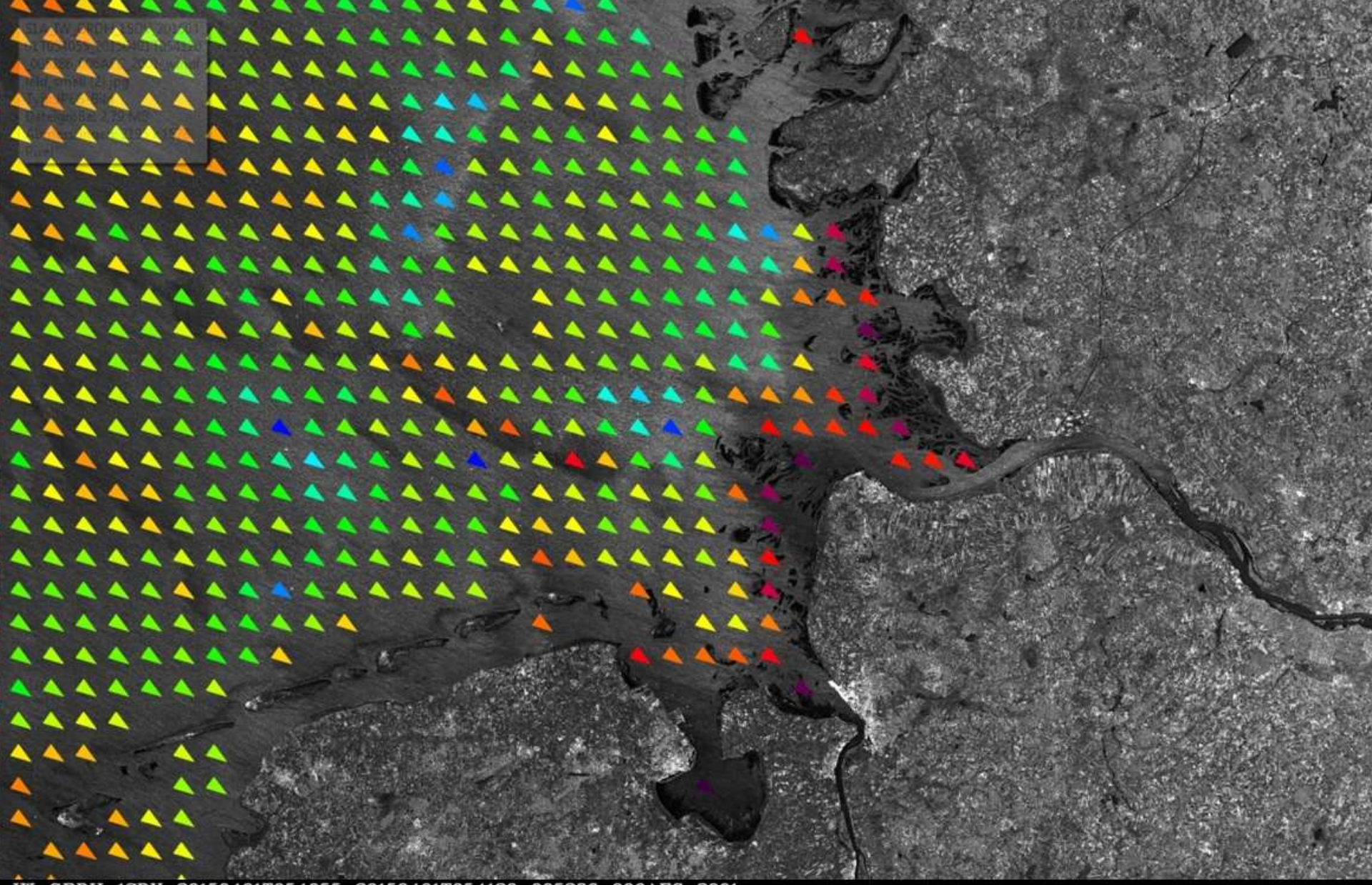
Wettervorhersage

Wind

EuropeanWAveModel
(5km)

GlobalWAveModel
(25km)

Thomas.Bruns@dwd.de, Seegangsmonitor, 25.10.2012


_IW_GRDH_1SDV_20150401T054055_20150401T054120_005286_006AFC_2001
Gusts larger than 30m/sec
Using CMOD_5 on Orkan Niklas
11
m/s
30
sigma naught [dB]

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Orkantief NIKLAS wütet am 31. März 2015 über Deutschland - Korrektur

Dr. Susanne Haeseler, Christiana Lefebvre; Stand: 02. April 2015

Einleitung

Die Sturmserie Ende März 2015 erreichte am 31. mit Orkantief NIKLAS ihren Höhepu
(Abb. 1). Weite Teile Deutschlands waren von dem Sturmfeld betroffen. An der Nords
wurden Spitzenböen von 140 km/h gemessen, auf der Zugspitze sogar 192 km/h. NI
führte zu starken Behinderungen und Ausfällen im Bahn-, Schiffs- und Flugverkehr. E
kippten um. Neben Sachschäden gab es mehrere Tote zu beklagen.

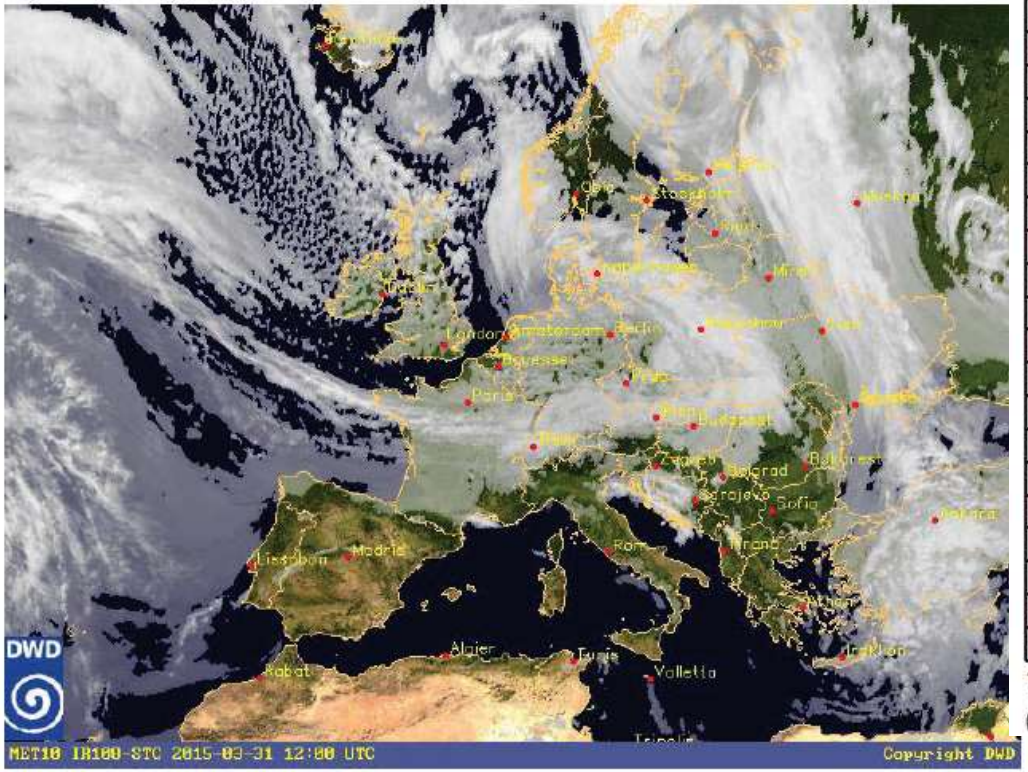
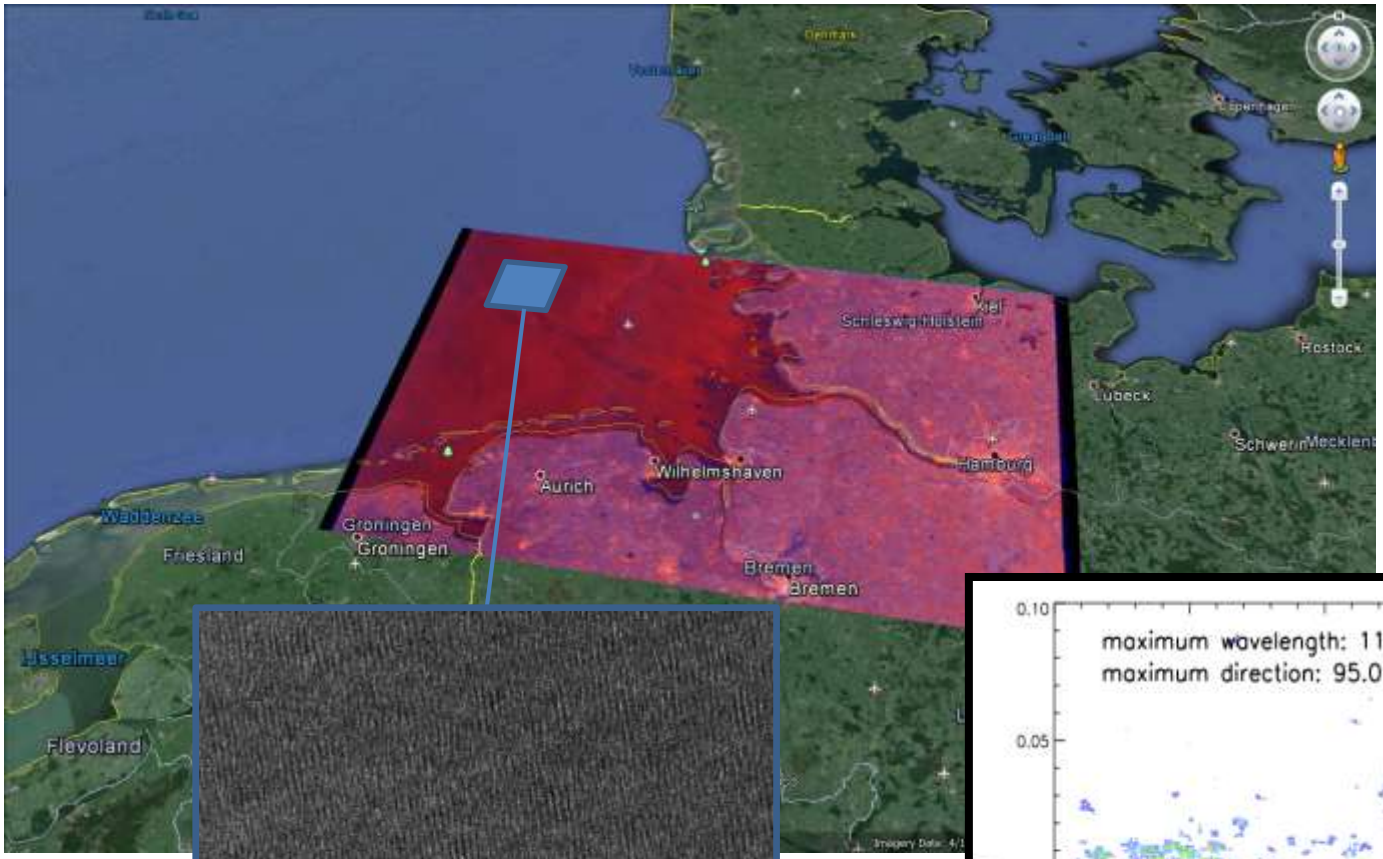


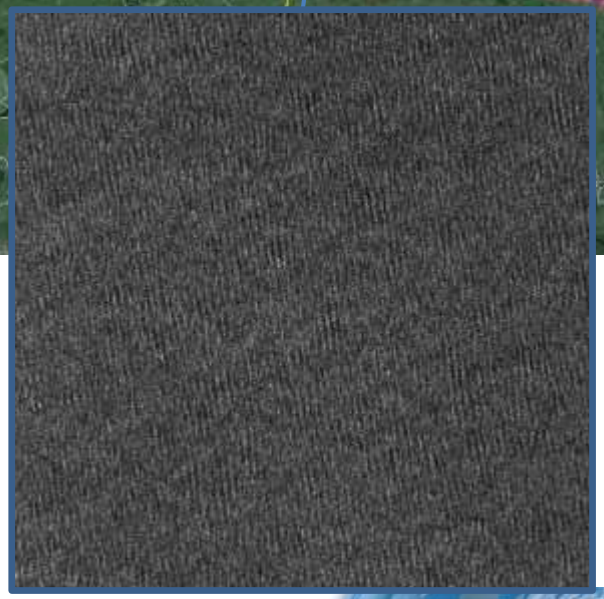
Abb. 1: Satellitenbild vom 31. März 2015, 12 UTC. Der Kern des Orkantief NIKLAS befindet sich im Bereich Dänemarks. [Quelle: DWD]

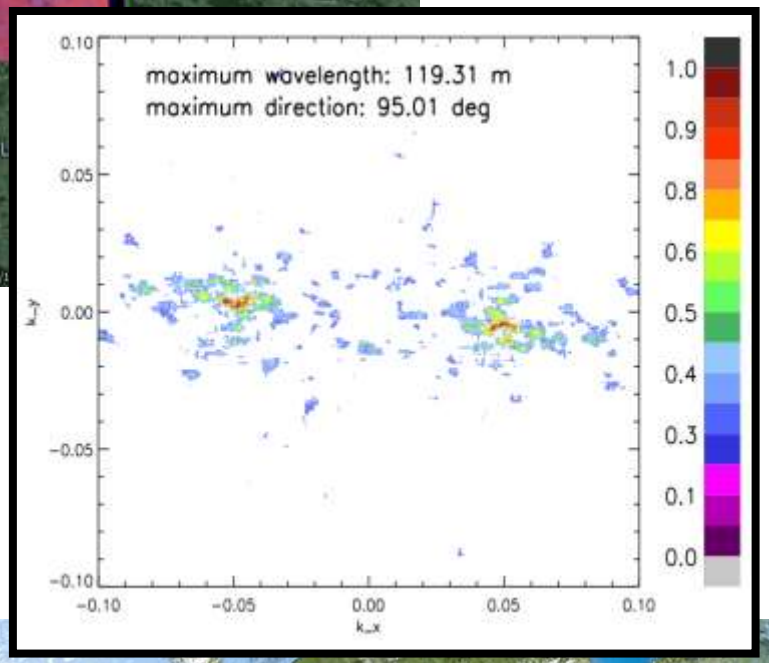
	Spitzenböe in km/h			maximales 10-Min.-Mit	
STATIONSNAME	NIKLAS	CHRISTIAN	KYRILL	NIKLAS	CHRISTIAN
Helgoland	111	147	120	85	1
Hallig Hooge	115	162	120	93	1
Sankt Peter-Ording	121	172	125	87	1
Schleswig	90	128	108	56	
Norderney	121	136	113	91	
Bremerhaven	122	129	110	93	
Cuxhaven	105	117	99	68	
Hamburg-Fuhlsbüttel	107	120	90	68	
Rostock-Warnemünde	116	87	121	96	
Bremen	105	101	98	76	
Lingen	93	103	117	48	
Hannover	111	89	112	76	
Berlin-Tegel	104	84	119	66	
Lindenberg	104	83	119	60	
Düsseldorf	89	89	144	58	
Göttingen	117	87	105	70	
Brocken	162	162	198	115	1
Leipzig/Halle	116	85	112	71	
Wasserkuppe	118	119	172	86	
Meiningen	91	68	107	52	
Fichtelberg	156	107	184	111	
Frankfurt/Main	101	87	95	74	
Kissingen, Bad	91	73	114	58	
Weinbiet	148	127	163	106	
Nürnberg	95	66	100	68	
Regensburg	111	38	115	64	
Freudenstadt	100	78	114	58	
München-Stadt	120	43	104	64	
Feldberg/Schwarzwald	150	127	165	112	
Zugspitze	192	109	183	104	

*Tab. 1: Windgeschwindigkeiten der Stürme NIKLAS (31. März 2015), C
(28. Oktober 2013) und KYRILL (18./19. Januar 2007). [Quelle: DWD]*

Ocean Waves from Storm Niklas over North Sea







Sentinel-1 image in IW mode, descending
5:41 UTC
subscene
of 10km x 10 km)
Wavelength 120 m

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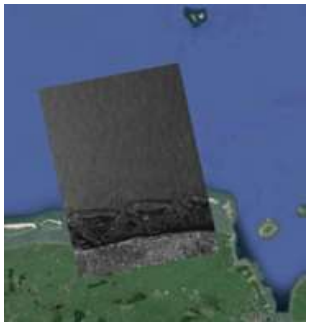
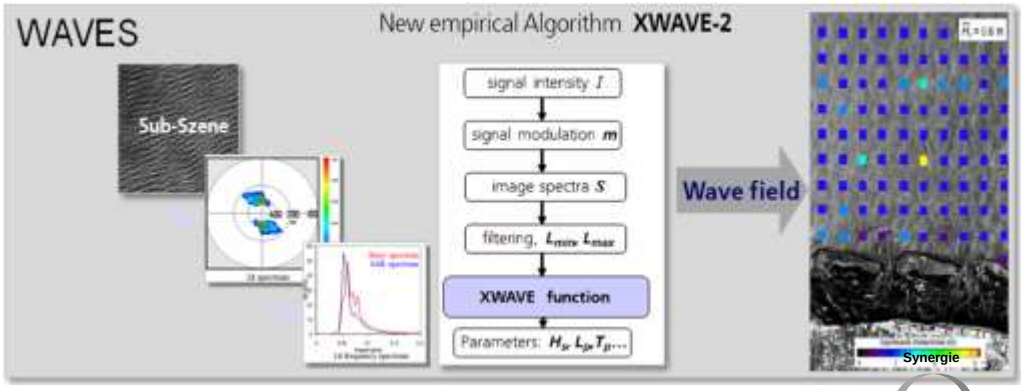
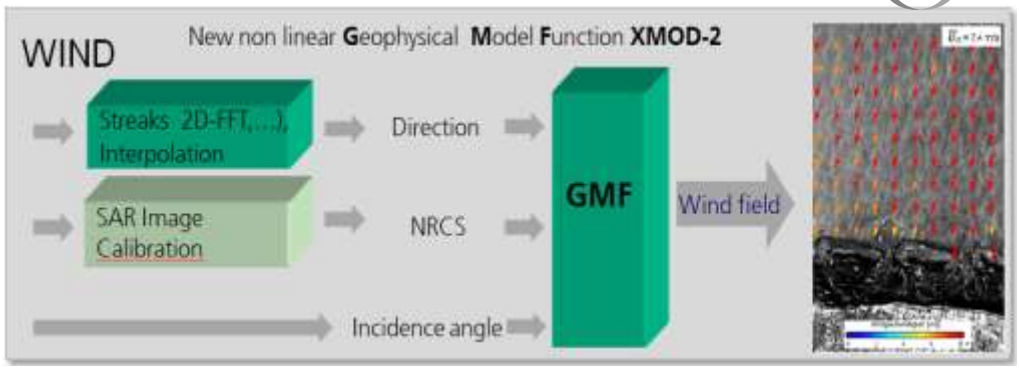
Developments:
Wind and Waves from TerraSAR-X Products for NRT

Algorithm and processing requirements - raster analysis, fast, robust, automatic

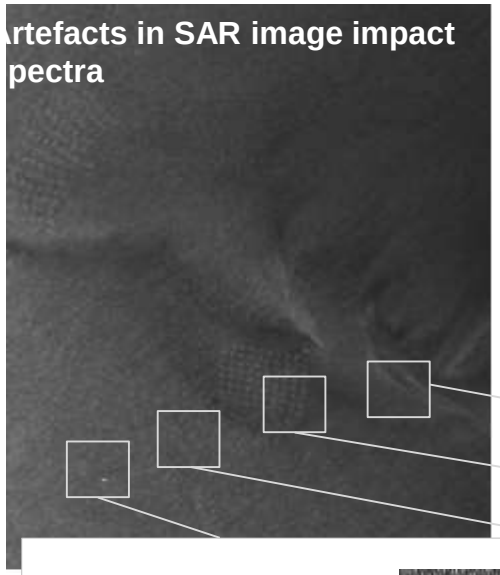
wind and waves from TerraSAR-X







Coastal applications: artifacts impacts spectral analysis

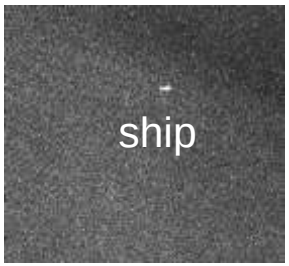


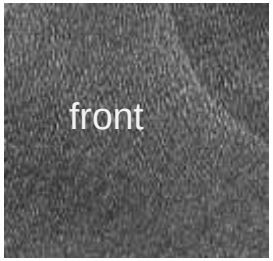
Task №1 - removing artefacts before analysis

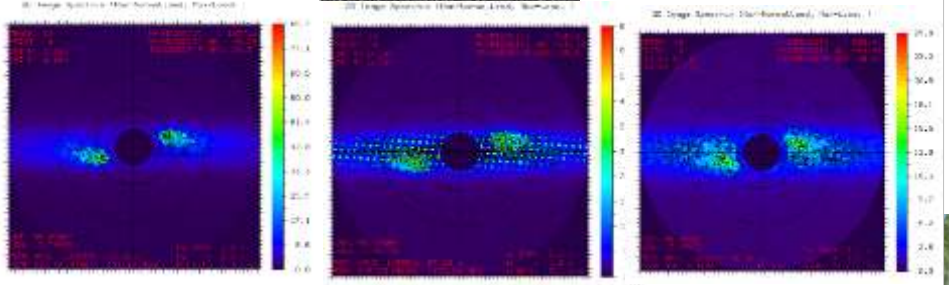
- Sand banks
- Wave breaking
- Ships, Buoys, Wind parks
- Current fronts, ship wakes

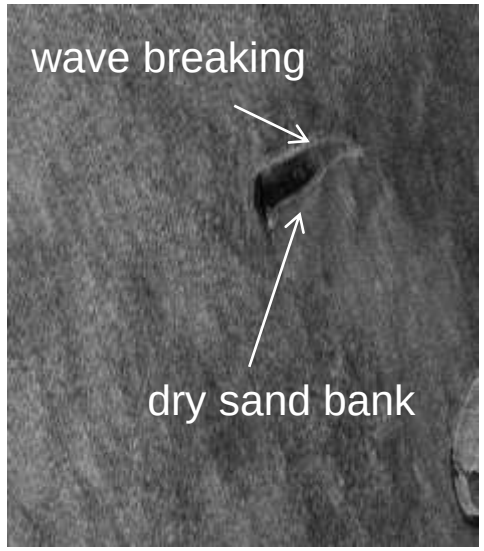
GMF is applicable for “pure” sea state case only:
Pre-filtering of images is necessary for raster analysis

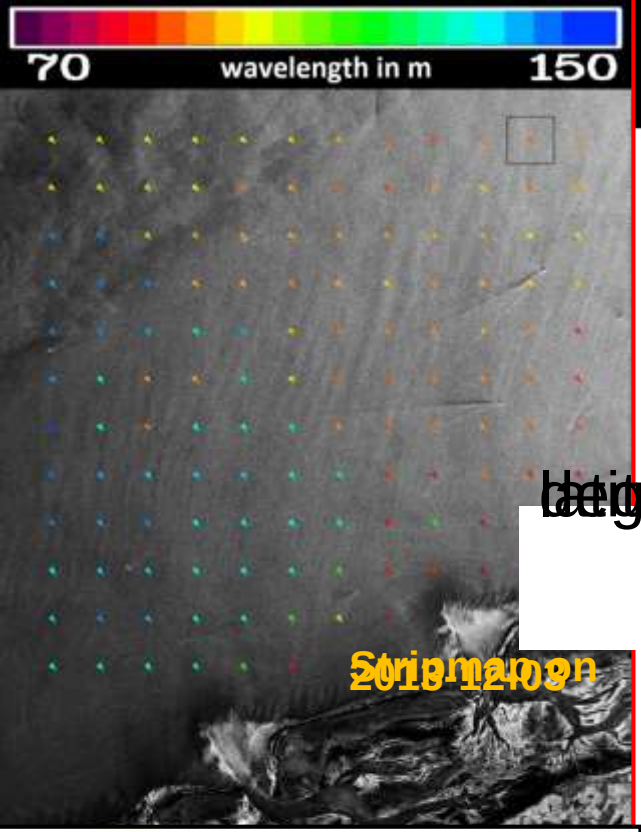
Without pre-filtering Integrated energy and *Hs* can > 10 times overestimate real value



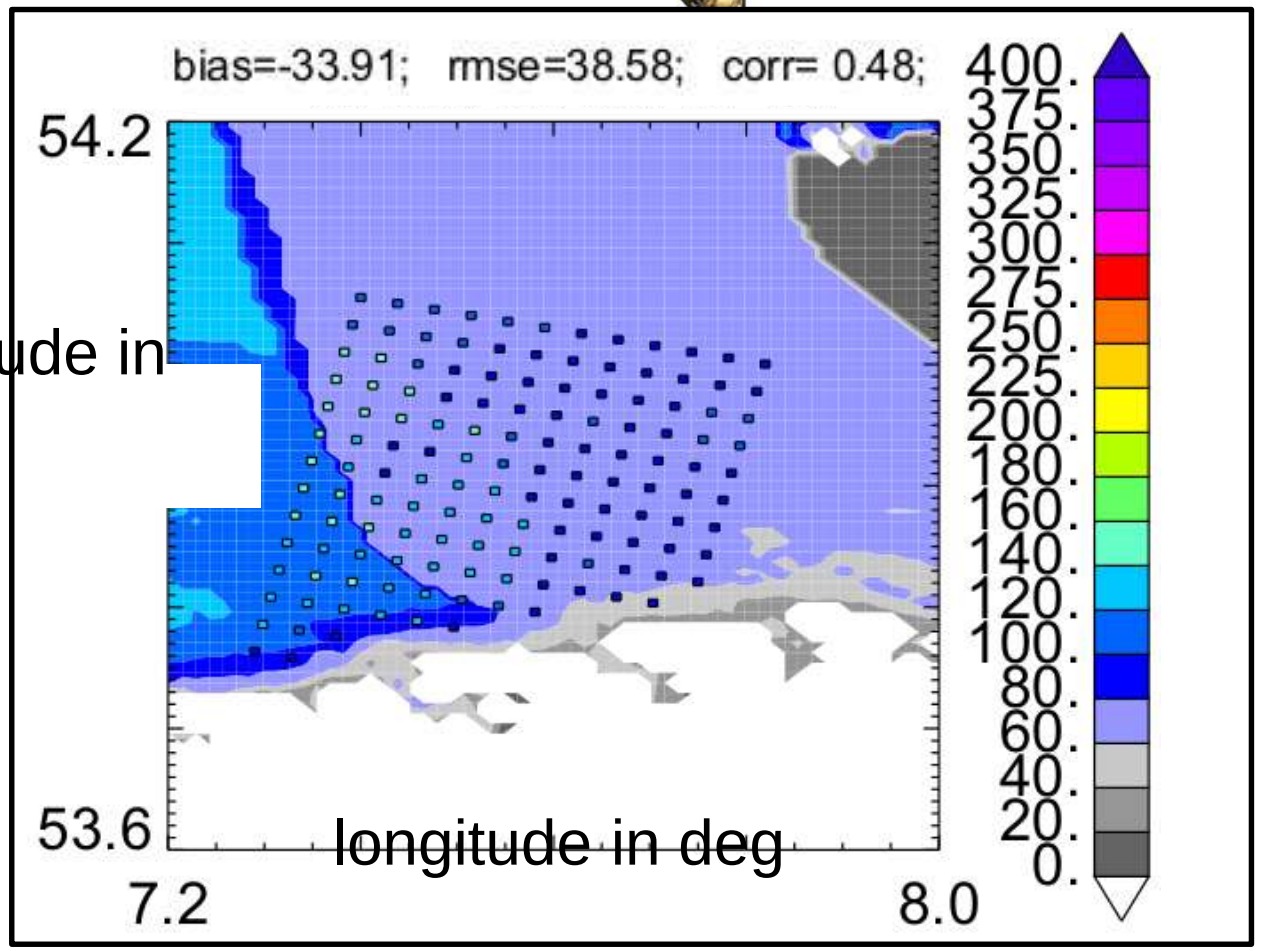








TS-X vs. CWAM



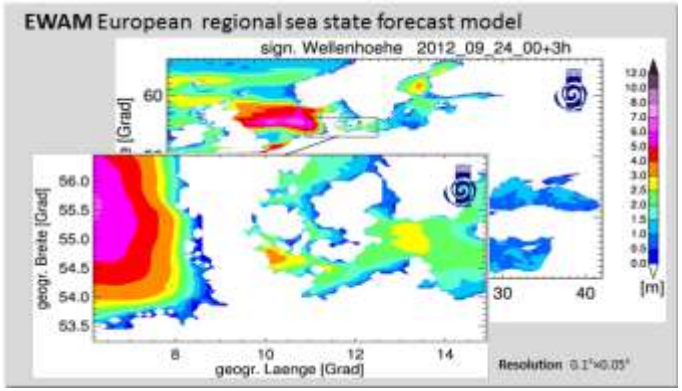
latitude in deg

Strimmen
2013-12-03

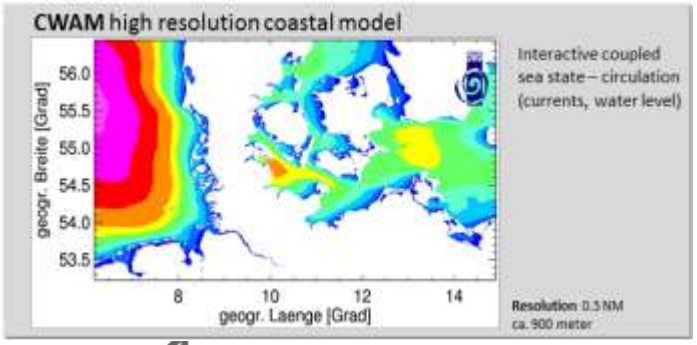
- [illegible]

Introduction: SEEGANGSMONITOR-Project
Remote sensing for validation of forecast model

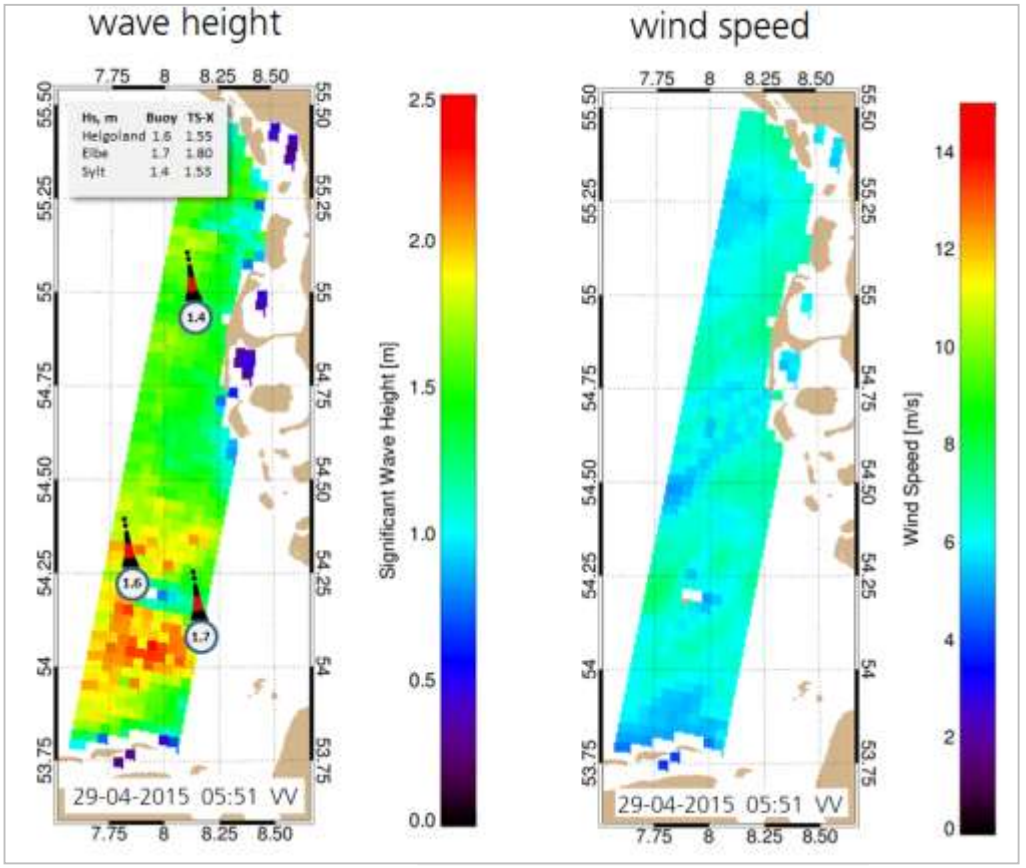
DWD-German Meteorological Service:
Sea sate Forecast -
improvement for coastal regions



Development of a new coastal wave model 900m resolution,
interactively coupled with BSH circulation model



DLR:
Remote Sensing -
Sea State Data for Validations



DLR

Summary:

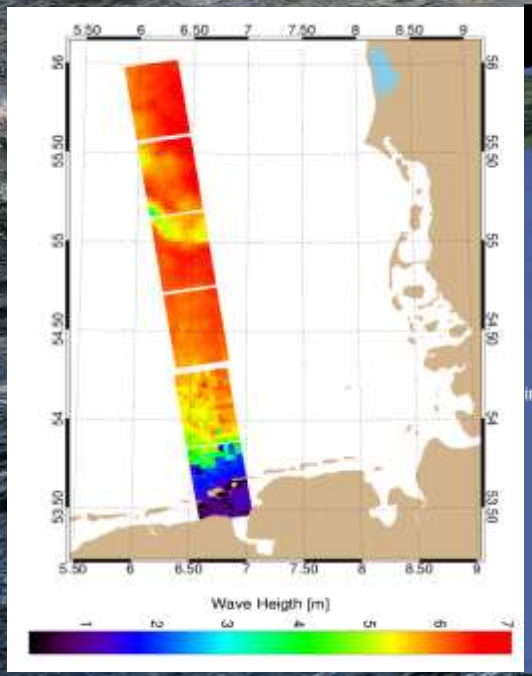
Copernicus Service – Seegangsmonitor

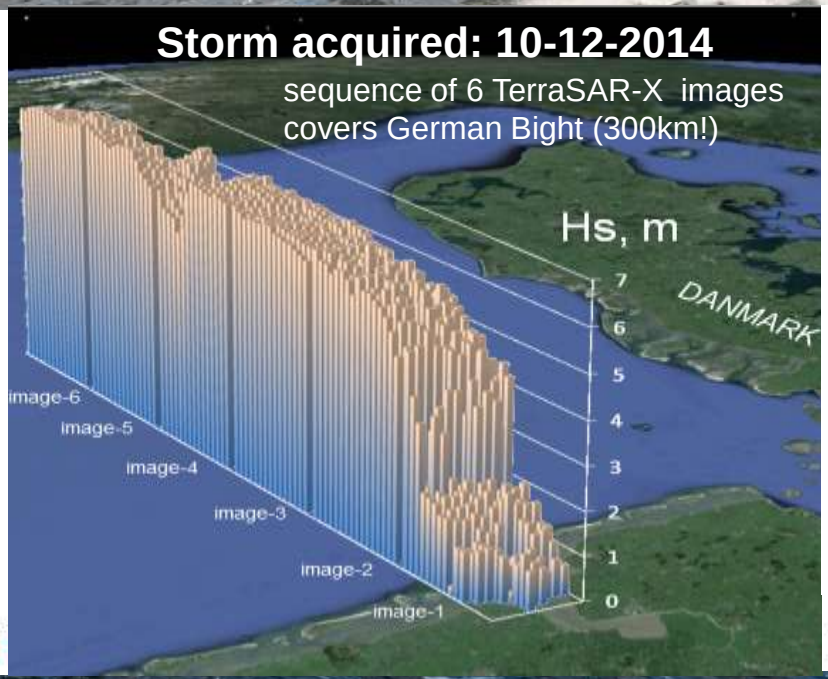
Near Real Time Needed

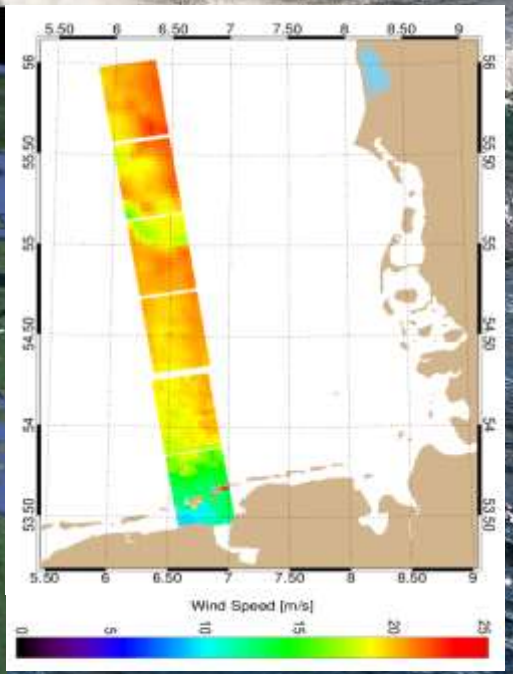
Global Sea State by Sentinel Wave Mode – not yet available

Coastal Sea State measurable on Sentinel - 1 in strong events

Thank you for your attention!



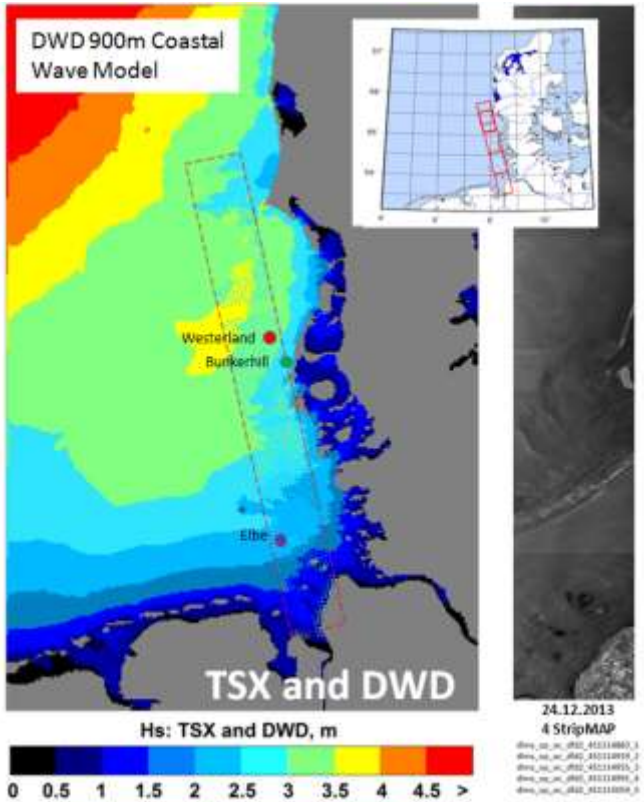




Date acquisition concept: TerraSAR-X Strips covering DWD model domain

6 Buoys in DWD Model domain „German Bight“

Example: TS-X Scene with 5 images



- One TerraSAR-X StripMap scene “strip” cowers 30km x 50-300km
- To date: **51** TerraSAR-X Scenes (overflights/events/days 2013-2015) with **188** Images and **81** buoy collocations

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Mapping of sea surface wind field (Danmark)

Feb. 12, 2012, TSX-SM