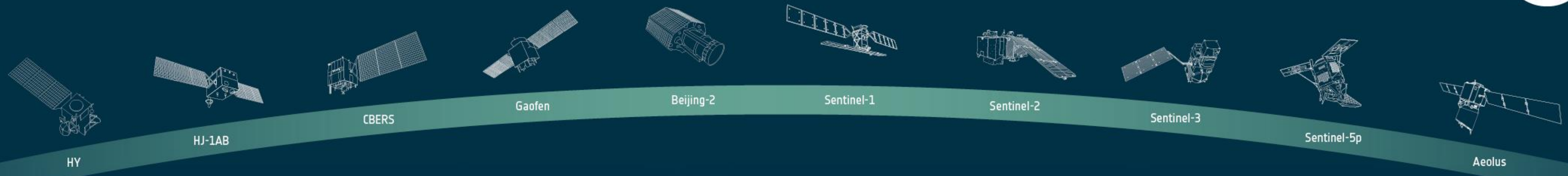

2022 DRAGON 5 SYMPOSIUM

MID-TERM RESULTS REPORTING

17-21 OCTOBER 2022

PROJECT ID. 57192

RESCCOME: REMOTE SENSING OF CHANGING MARINE COASTAL ENVIRONMENTS

Dragon 5 Mid-term Results Project

MONDAY, 17/OCT/2022

PROJECT ID. 57192

PROJECT TITLE: ReSCCoME

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Presented By: XiaoMing Li

OUTLINE

1. **ReSCCoME Project** | Objectivies| Partners |
2. **Data on the Project** | EO data| In-situ data| Field campaigns|
3. **Example Results** | Intertidal Flats| Oil Spill | Internal waves |
4. **Schedule & Planning & Expected Results**
5. **Young Scientists**

ReSCCoME Objectivies

- **ReSCCoME: Remote Sensing of Changing Coastal Marine Environments**

- **Objectivies:**
  - **Exploitation of Copernicus Sentinels, ESA, ESA TPM and Chinese EO data**
    better understanding of the ways, in which coastal ecosystems are exposed to, and react on, various anthropogenic impacts
  - **Scientific exchange**
    bi- or multi-lateral research or educational activities, joint Sino-European research packages
  - **Publication of co-authored results**
    joint publications at the Midterm and Final Dragon 5 Symposia, and in leading peer-reviewed scientific journals
  - **Training to young European and Chinese scientists**
    webinars, excursions, educational courses, and summer schools

ReSCCoME Partners

UHH	Hamburg University , Hamburg, Germany
DTU	Technical University of Denmark, Roskilde, Denmark
UiT	The Arctic University of Norway, Tromsø, Norway
UoB	University of Bucharest, Bucharest, Romania
UoA	University of the Aegean, Mytilene, Greece
AIR	Aerospace Information Research Institute, Beijing, China
HTOU	Hainan Tropical Ocean University, Sanya, China
TJU	Tianjin University, Tianjin, China
OUC	Ocean University of China, Qingdao, China
NSOAS	National Satellite Ocean Application Service, Beijing, China

ReSCCoME Partners

European partners		Chinese partners
Teamleader	Teamleader	
Teamplayer	Teamplayer	
involved	involved	

Contribution of the Partners

Research Packages	European partners					Chinese partners				
	UHH	UoA	UoB	UiT	DTU	AIRCAS	OUC	NSOAS	HNTOU	TJU
1: Intertidal regions	Teamleader				Teamplayer	Teamplayer				Teamleader
2: Offshore wind farms					Teamleader	Teamleader				
3: Offshore oil pollution	Teamplayer	involved		Teamleader			Teamleader	Teamplayer	involved	
4: Coastal pollution		Teamleader	Teamplayer	Teamplayer				Teamleader	Teamplayer	
5: Coastline changes	involved	Teamplayer	Teamleader			involved	Teamplayer		Teamleader	Teamplayer
Cross Cutting Themes										
Synergism of remote sensing data	involved	involved	involved	Teamplayer	Teamplayer	involved	Teamplayer	Teamplayer	involved	involved
Processing of Big Data		Teamplayer		Teamplayer	involved	Teamplayer	Teamplayer		involved	
Coastal stress factors	Teamplayer	Teamplayer				Teamplayer			Teamplayer	involved
Education of Young Scientists	involved	involved	Teamplayer	involved	Teamplayer	involved	involved	involved	Teamplayer	Teamplayer
Dissemination and outreach	Teamplayer	involved	Teamplayer	involved	involved	involved	involved	Teamplayer	involved	Teamplayer

EO data access since July 2020

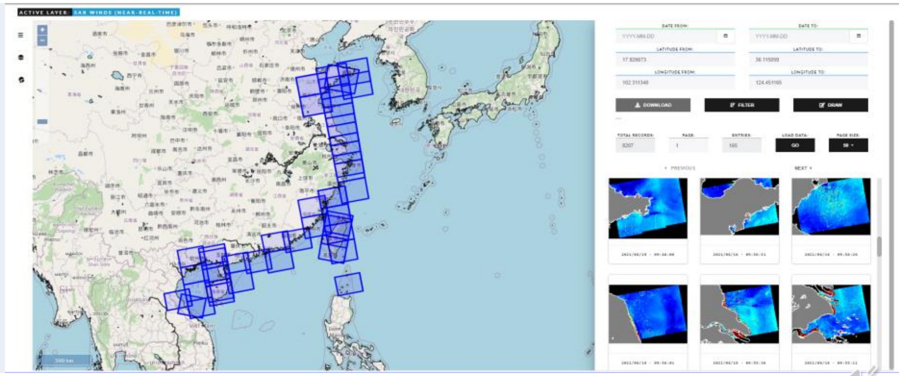
Copernicus Sentinels, ESA data	No. Scenes
1. Sentinel-1 A/B	3000 IW SLC/GRD + 1500 Stripmap SLC, GRD
2. Sentinel-2 A/B	3000 MSI 1b + 1000 MSI 2a +1000MSI 1c
3. Sentinel-3 A/B	500 OLCI + 500 SLTSR
4. ENVISAT / ERS	200 ASAR, 2000 SAR

ESA Third Party Missions	No. Scenes
5. RADARSAT-1/2	10 R1 Fine +5 R2 Fine Dual Pol
6. COSMO-SkyMed	100 SAR
7. TerraSAR-X	100 Stripmap/ ScanSAR/ Wide ScanSAR
8. ALos-1/2	200 PALSAR 1/2 L1

Chinese EO data	No. Scenes
1. GF-1	400 PMS + 400 WFV Camera
2. GF-6	400 WFV Multispectral
3. CBERS-4	400 MUXCAM + 400 IRS
4. Jilin-1	300 HiRes Optical Imager

Full archive of wind maps from DTU:

https://science.globalwindatlas.info/
(select 'Offshore wind fields in near-real-time')

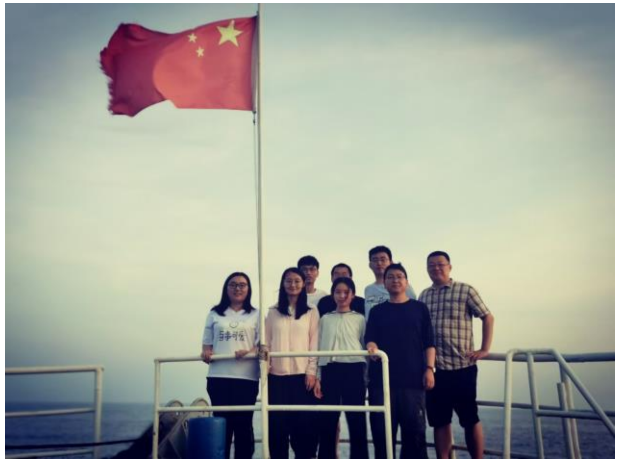


Measurements and Requirements

- **Intertidal Flats**: surface roughness, sediments, moisture, habitats
- **Offshore Wind Farms**: atmospheric and oceanic parameters
- **Offshore Oil Pollution**: surface films, environmental conditions
- **Coastal Pollution**: plastic debris, waves & currents, bathymetry
- **Coastline Changes**: waterlines, water level, bathymetry

Field Data Collection Campaigns

UHH student excursions on the German North Sea coast



AIRCAS staff sails on the South China Sea

OUTLINE

1 ReSCCoME Project | Objectivies| Partners |

2 Data on the Project | EO data| In-situ data| Field campaigns|

3 **Example Results** | Intertidal Flats| Oil Spill | Internal waves |

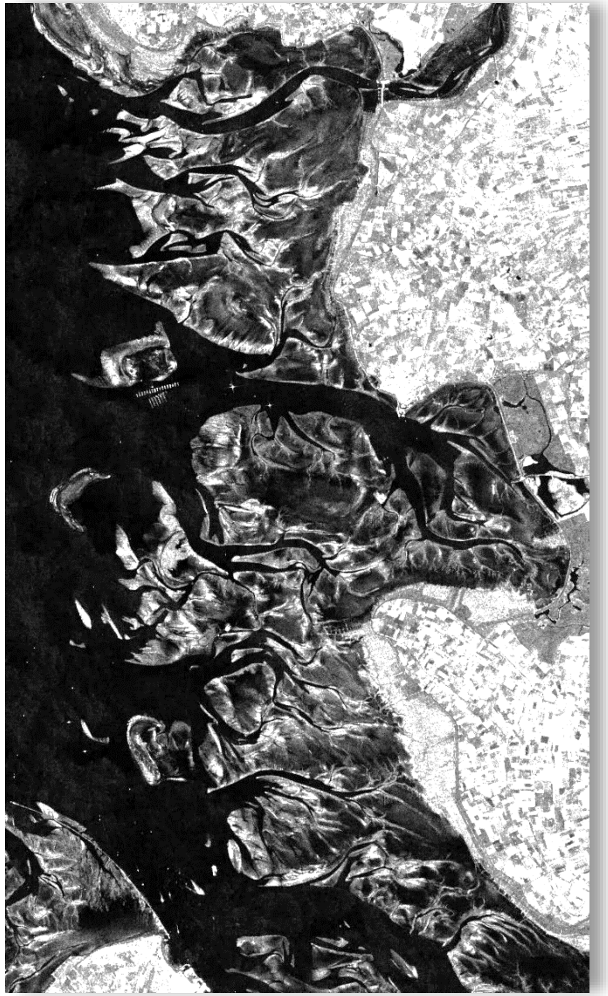
4 Schedule & Planning & Expected Results

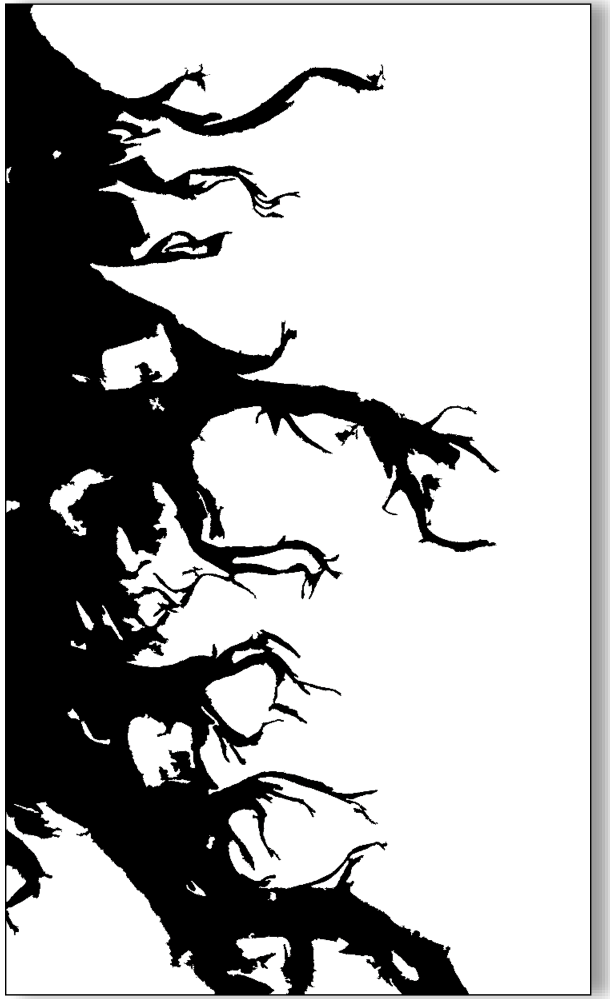
5 Young Scientists

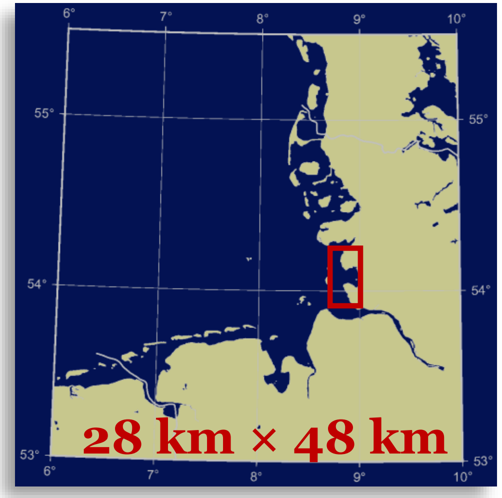
☐ Intertidal Flats: Topography

- Mainland as bright areas
- Exposed flats in different shades of grey
- Open water in dark grey and black

Sentinel-1B (VV)
16 Nov 2021, 1716 UTC







Classification
dry fallen vs. submerged

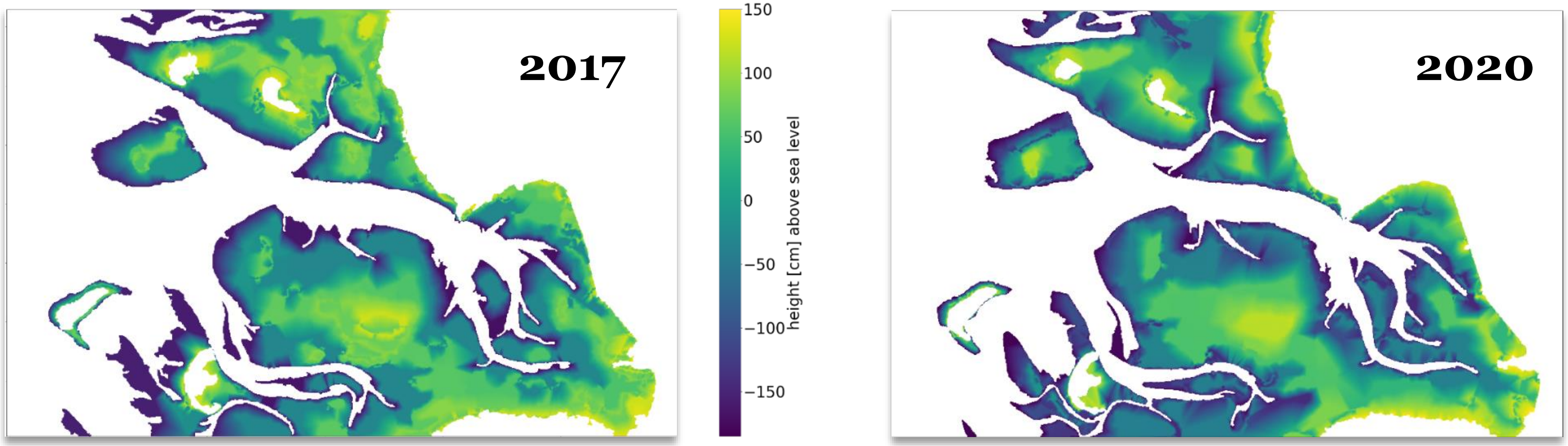
Topography map

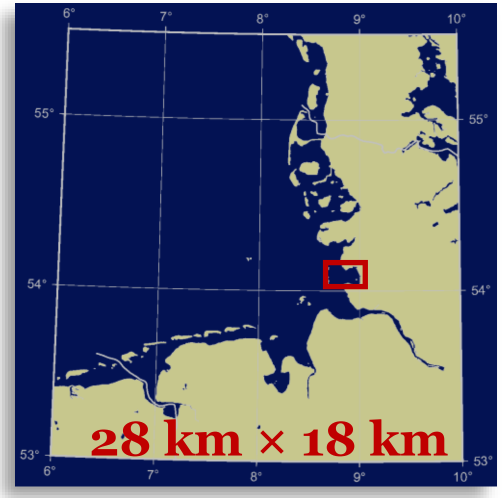
[Peters 2022]

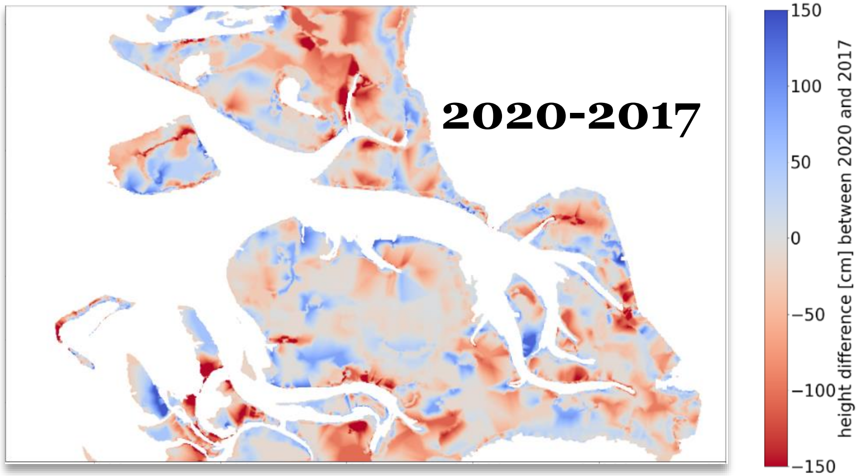
Example Results

Intertidal Flats: Topography

DEMs of Intertidal Flats on the German Coast





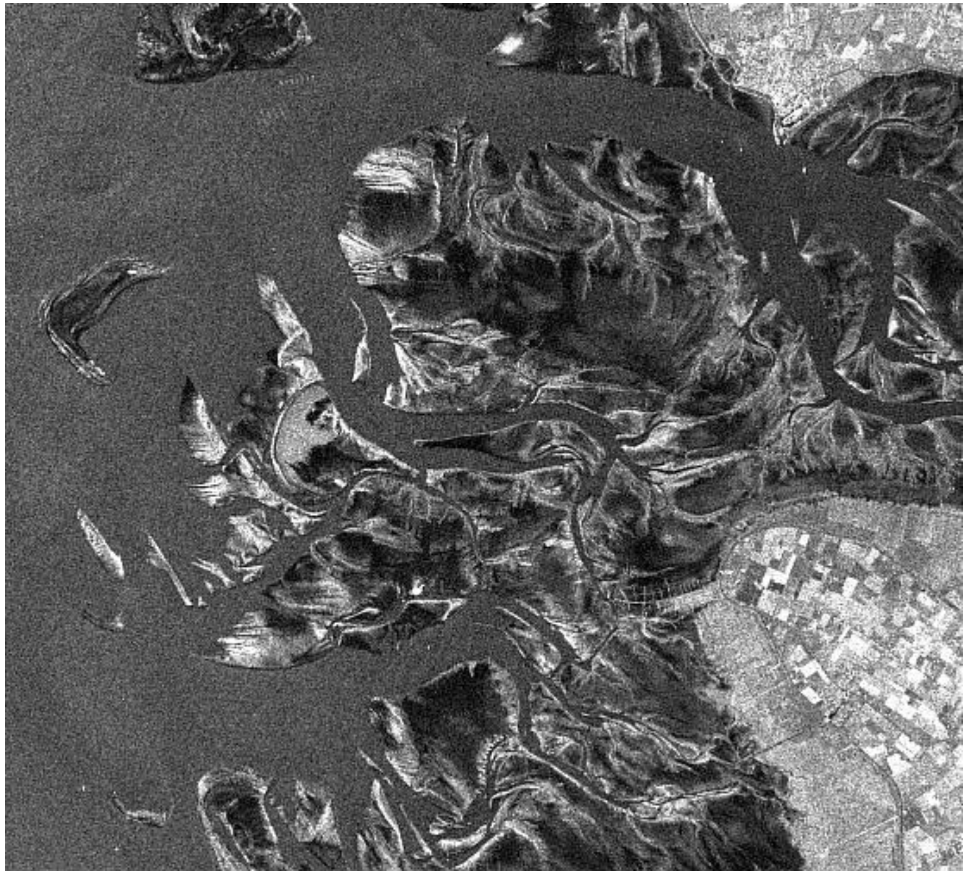


- Accretion
- Erosion

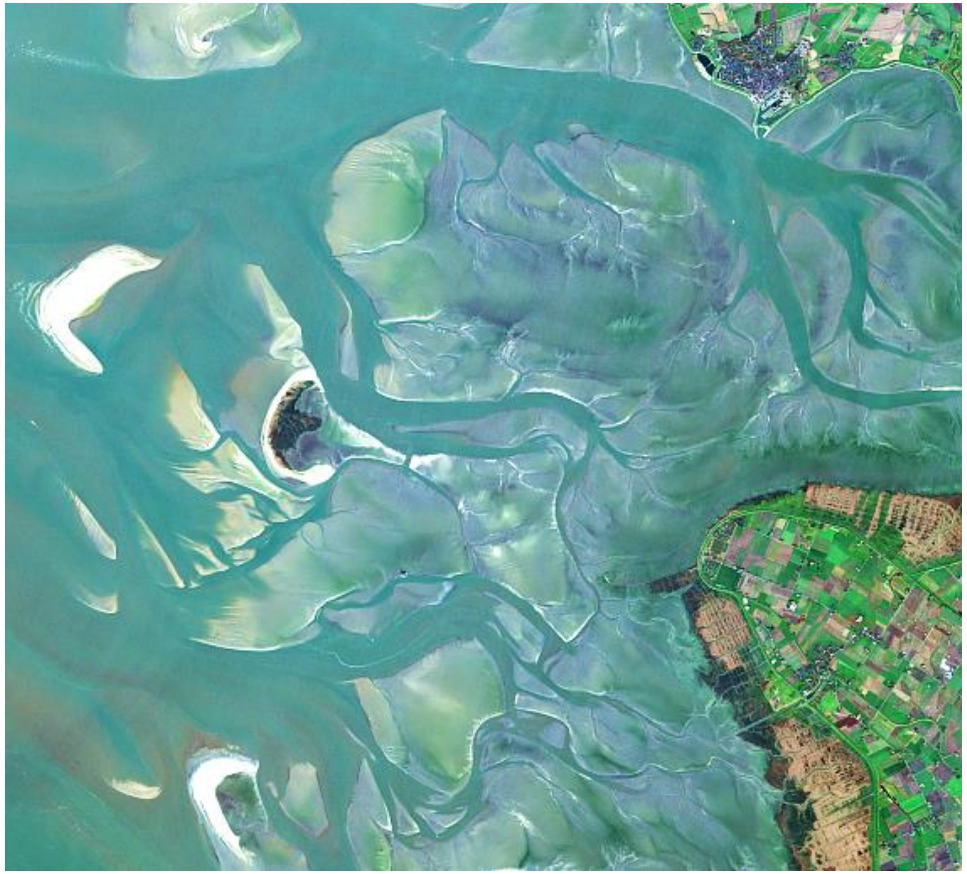
[Peters 2022]

☐ Intertidal Flats: Classification

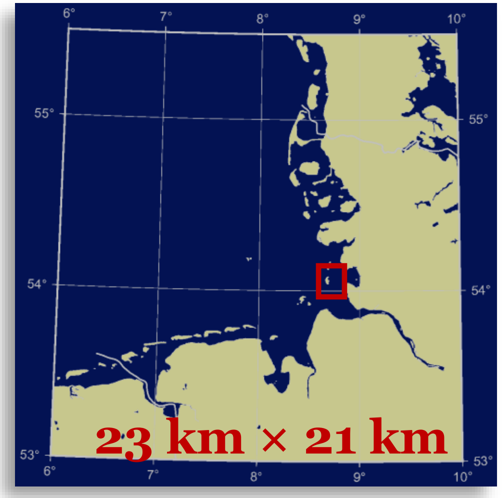
Synergistic Analyses: SAR vs Optical



Sentinel-1A *10 Nov 2019, 1708 UTC*



Sentinel-2B *14 Feb 2019, 1031 UTC*

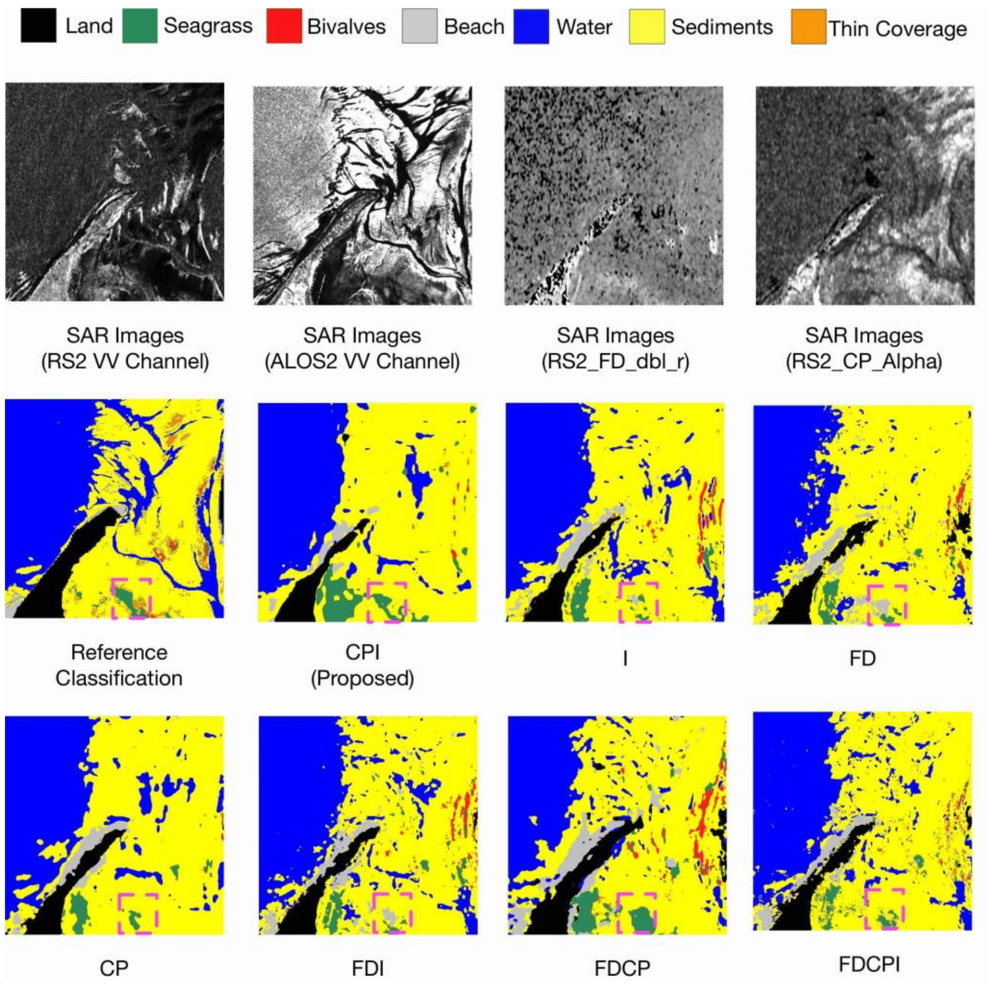


[Peters 2022]

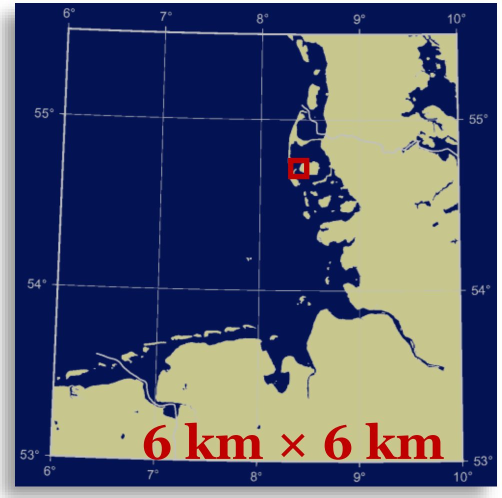
Example Results

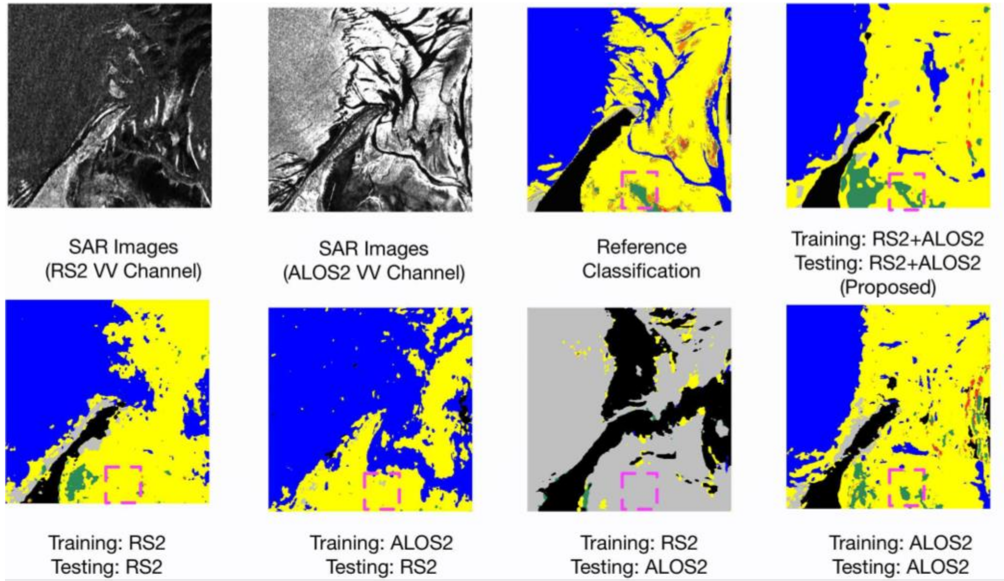
Intertidal Flats: Classification

Classification Based on Deep Learning Using SAR and Optical Data



Radarsat-2 *24 Dec 2015, 0543 UTC*
ALOS-2 *29 Feb 2016, 2257 UTC*
Reference:
Landsat-8, SPOT-4, © Brockmann Consult

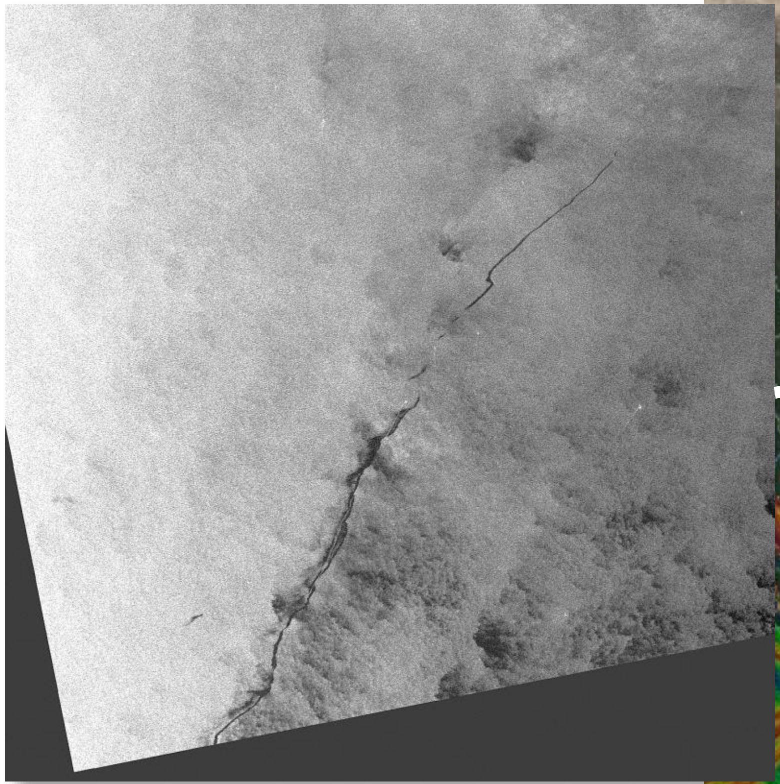




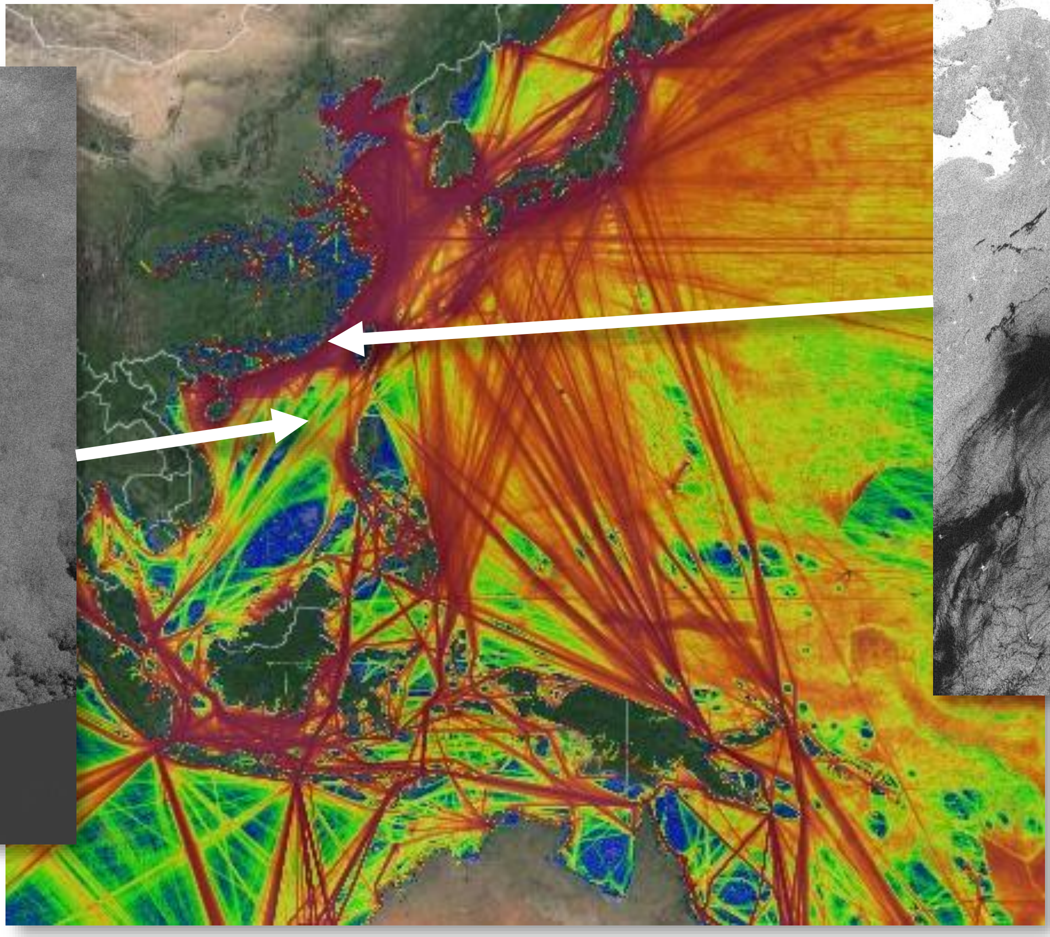
[Zhang 2022]

Example Results

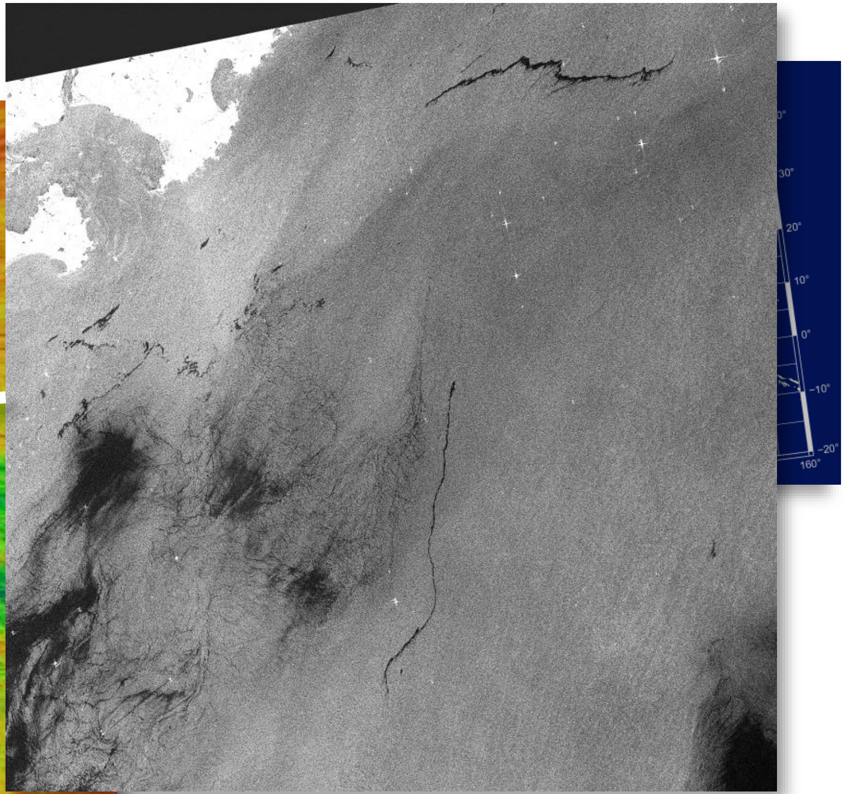
☐ Offshore Oil Pollution: Statistics



Sentinel-1A
114 km × 114 km
15 Sep 16, 1016 UTC



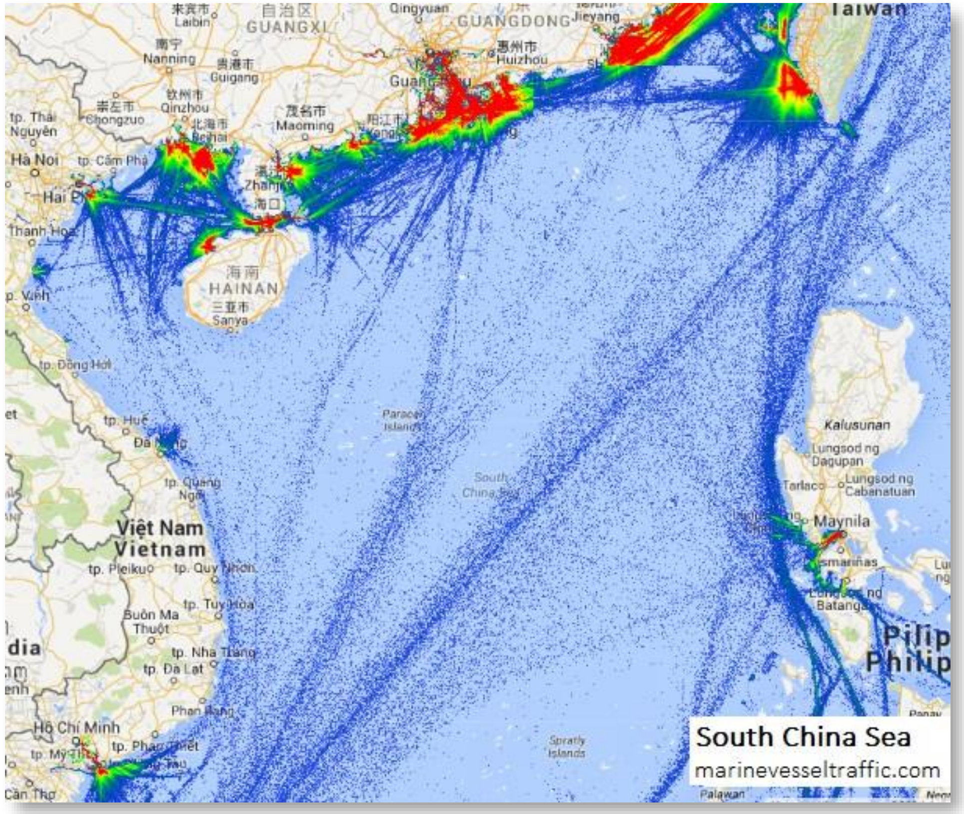
Ship Traffic in East Asia

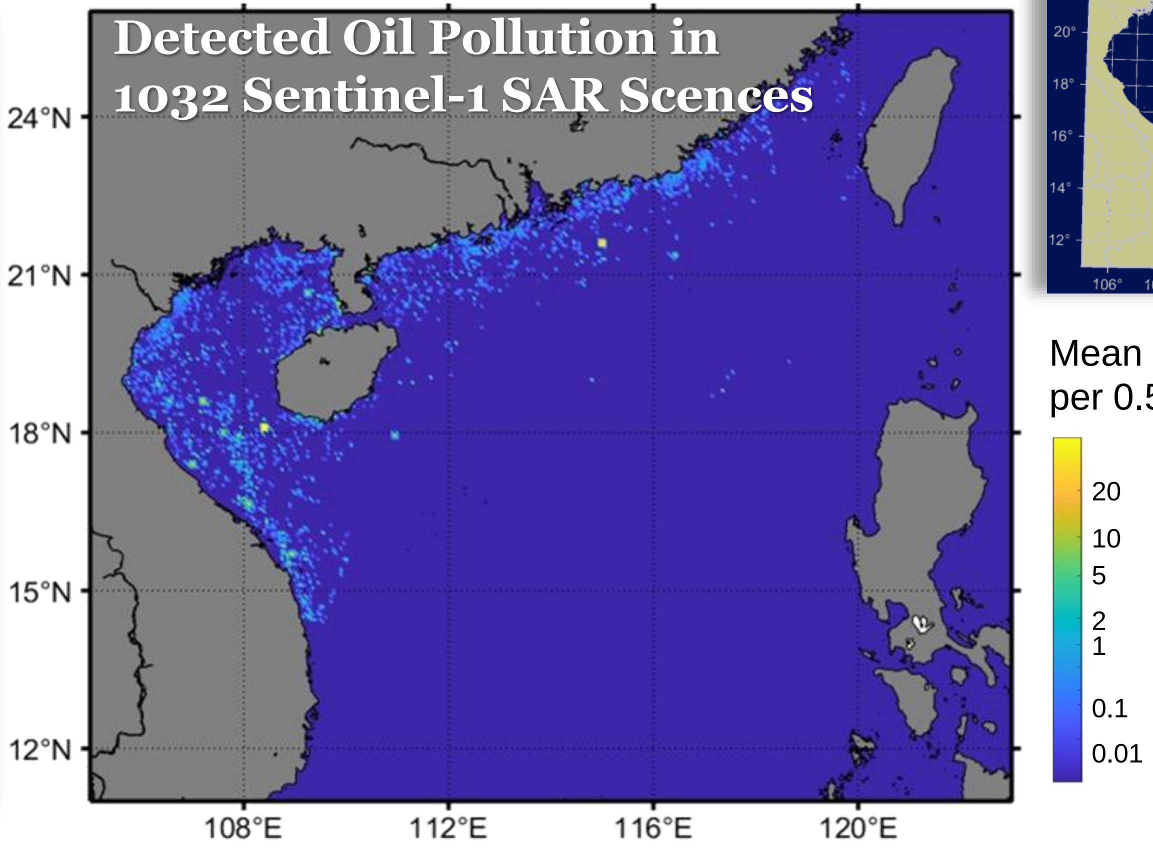


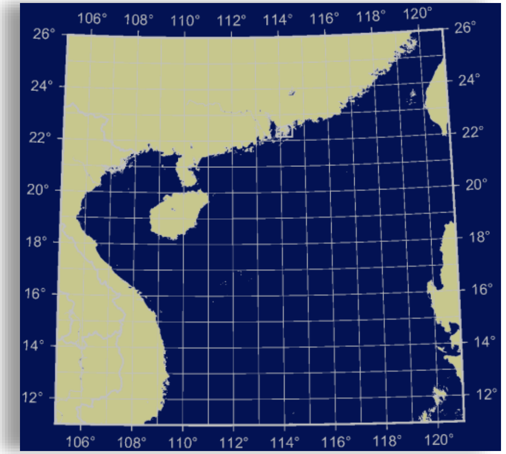
Sentinel-1A
115 km × 113 km
30 Jun 16, 1008 UTC

Offshore Oil Pollution: Statistics

South China Sea: Oil Pollution Detected on SAR Imagery



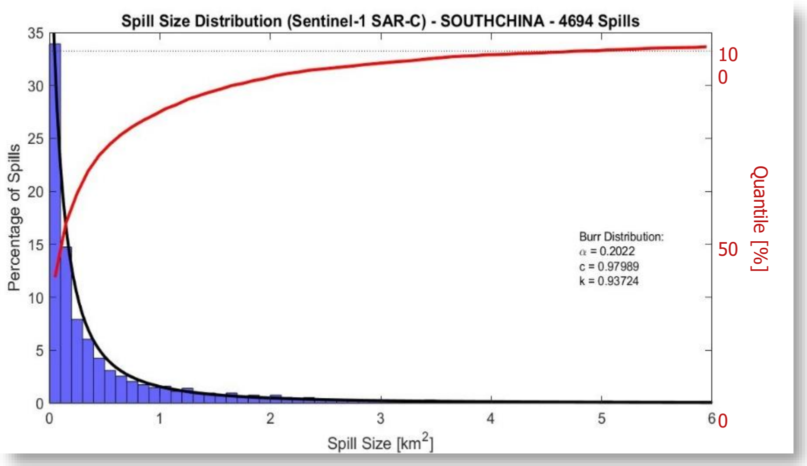


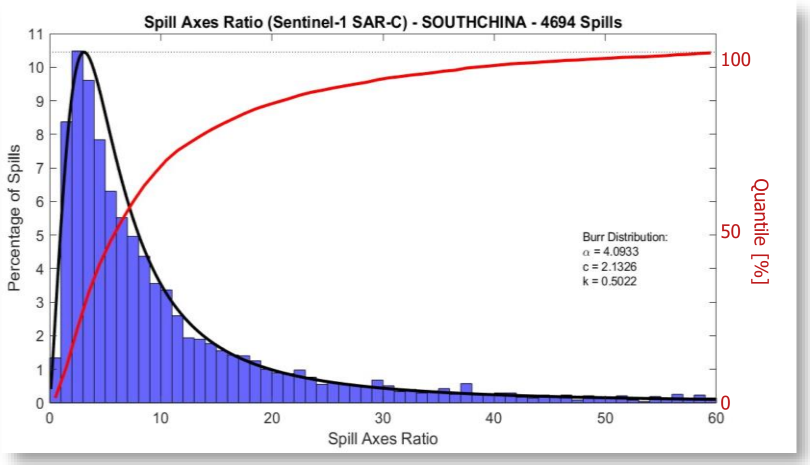


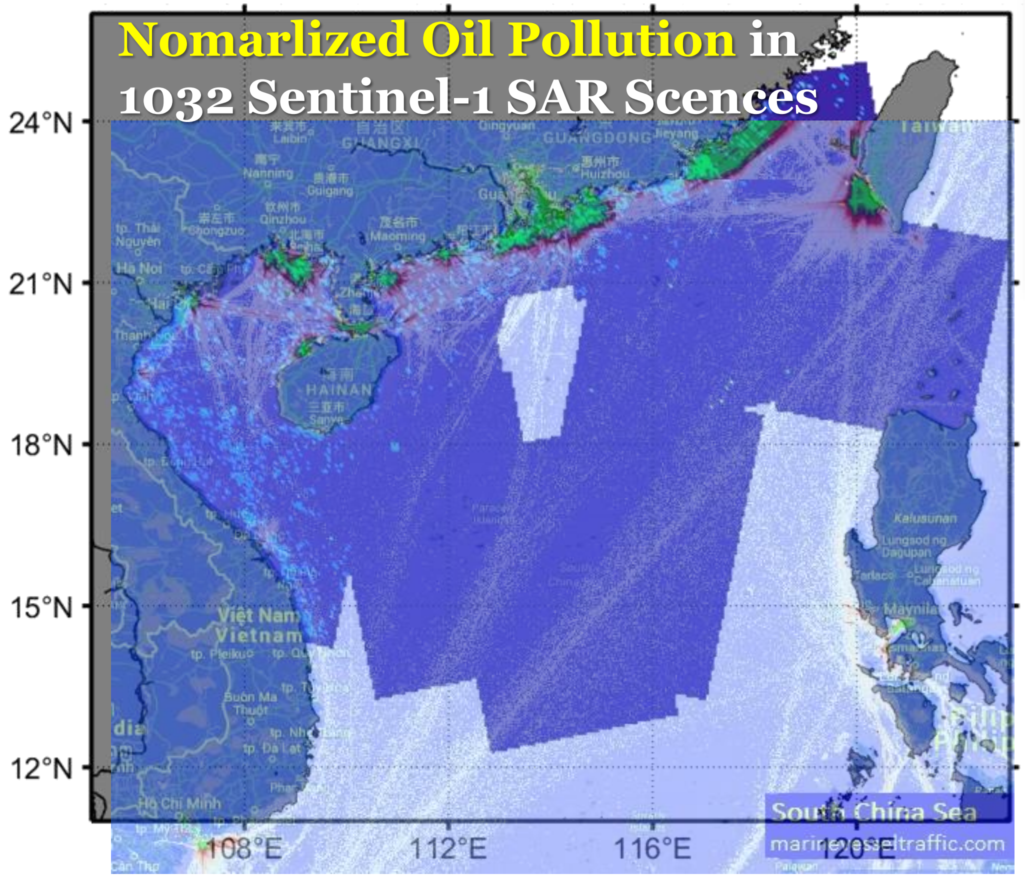
[credits: D.M. King]

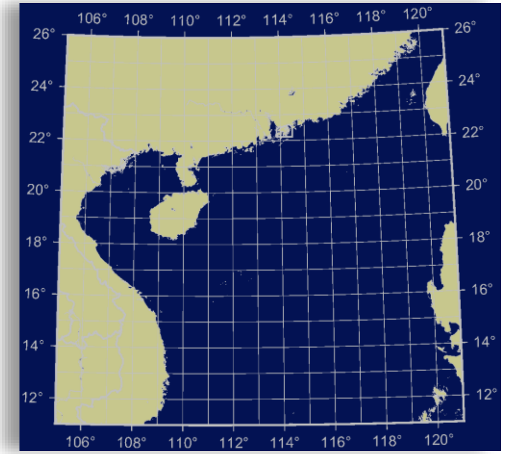
Offshore Oil Pollution: Statistics

South China Sea: Oil Pollution Detected on SAR Imagery







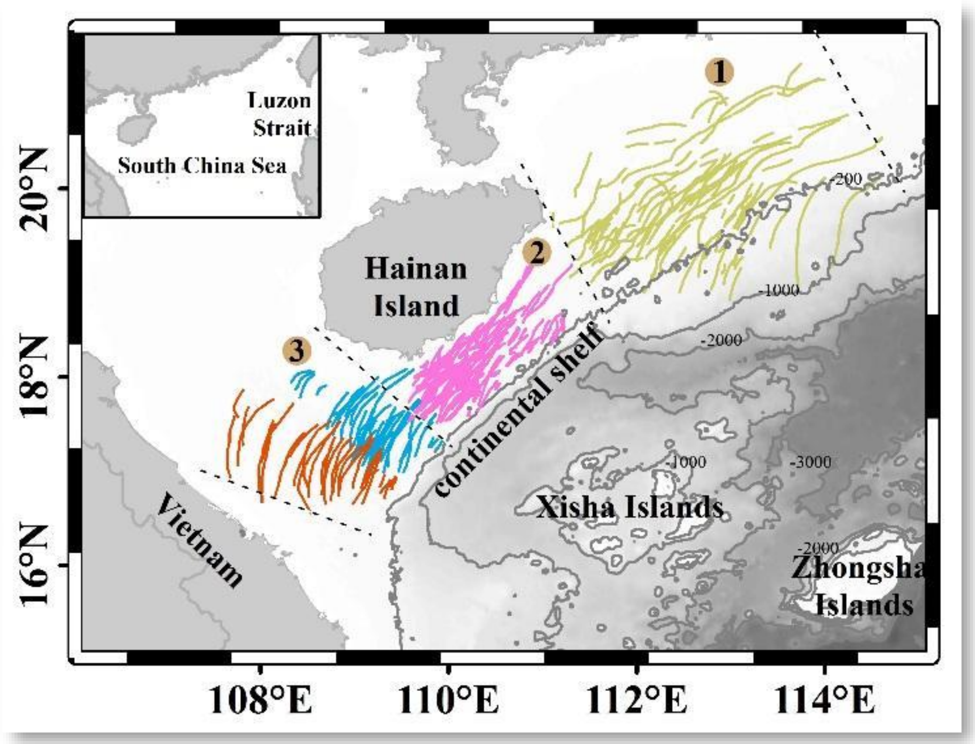


Number of Spills per 0.5° × 0.5°

20, 10, 5, 2, 1, 0.5, 0.05, 0.001

[credits: D.M. King]

Nonlinear Internal Waves (NLIWs): Generation



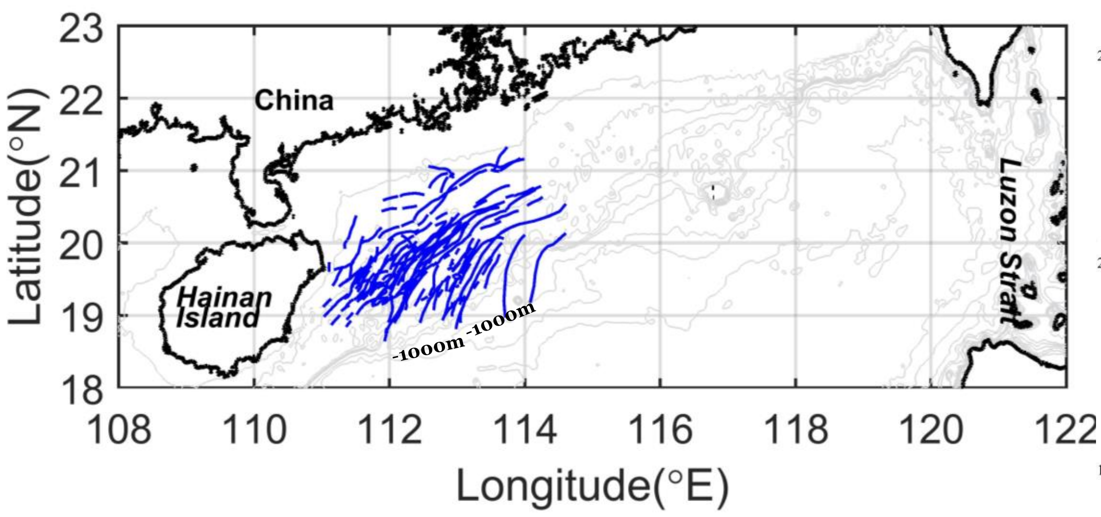
NLIWs (colored curves) observed by ENVISAT/ASAR and ALOS/PALSAR between 2003 and 2011

Three researches around Hainan Island:

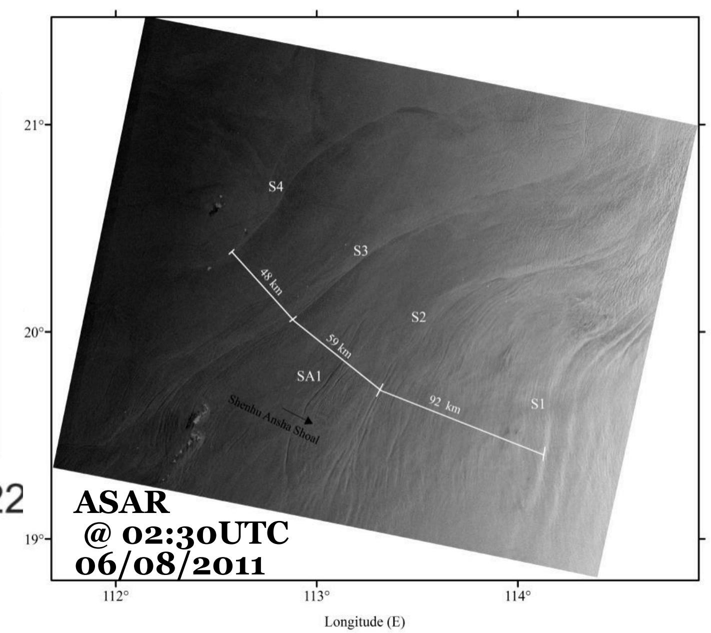
- Generation of NLIWs northeast of Hainan Island
- Generation of NLIWs southeast of Hainan Island
- Generation of NLIWs south of Hainan Island

☐ Generation of NLIWs Northeast of Hainan Island

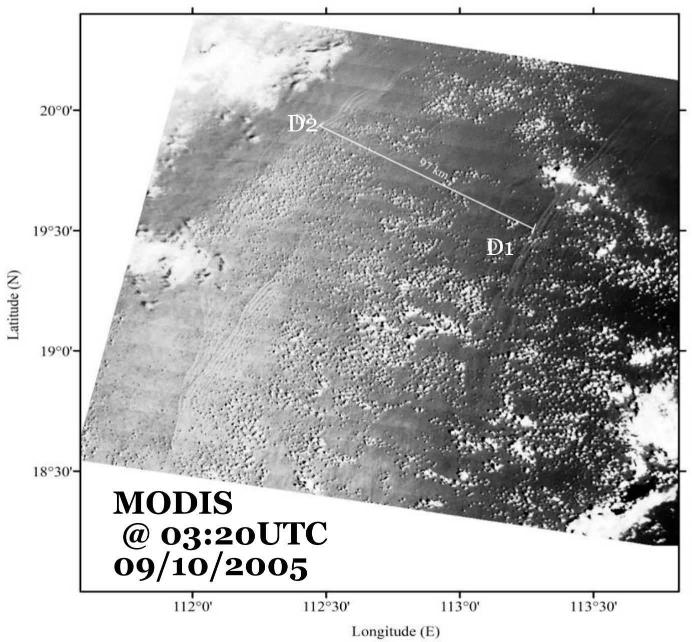
Two types of NLIWs:Type-SP and Type-DP



NLIWs (blue curves) observed by ENVISAT/ASAR in 2005, 2011, and 2012



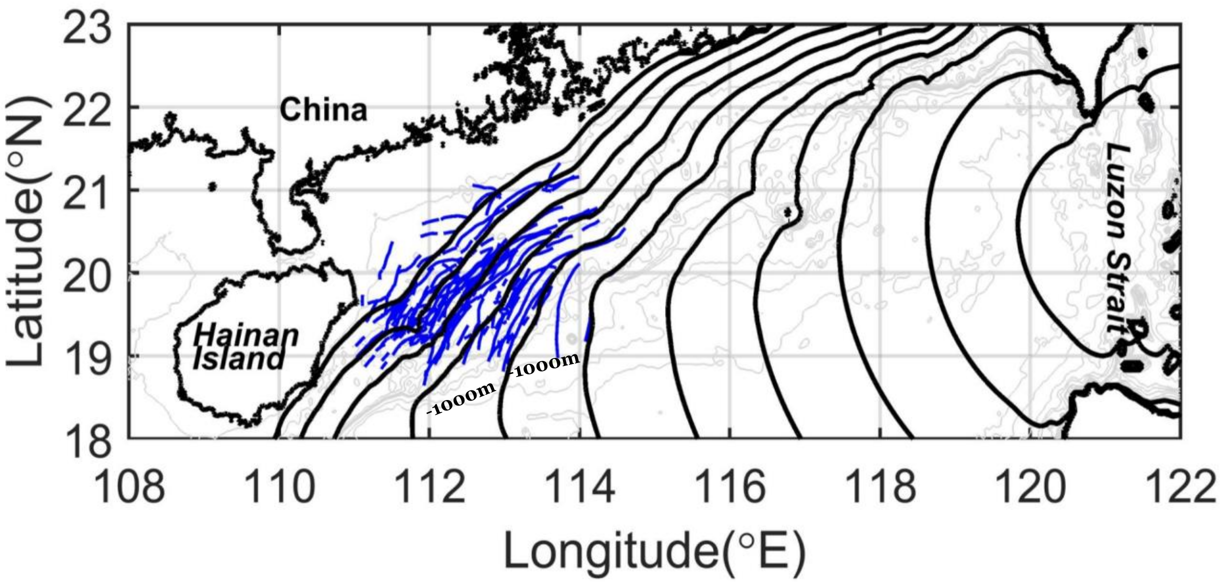
Type-SP NLIWs
(interval of a semidiurnal tidal period)



Type-DP NLIWs
(interval of a diurnal tidal period)

[Liang et al. 2022]

☐ Generation of NLIWs Northeast of Hainan Island



simulated wavefronts from Luzon to Hainan

- blue curves： SAR-observed NLIWs
- black curves： simulated NLIWs in each 12h

- wavefronts appear on continental slope
- simulated wavefronts by solving Eikonal equation agree well with observed wavefronts

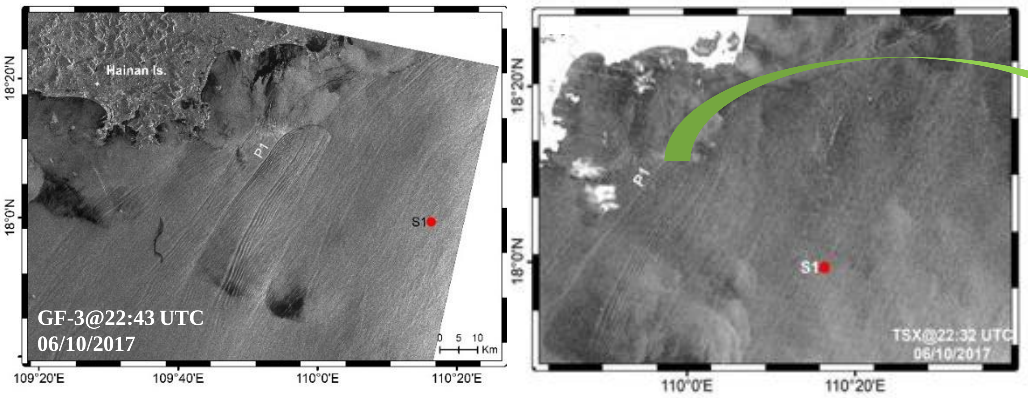
⬇

Source sites: Luzon strait

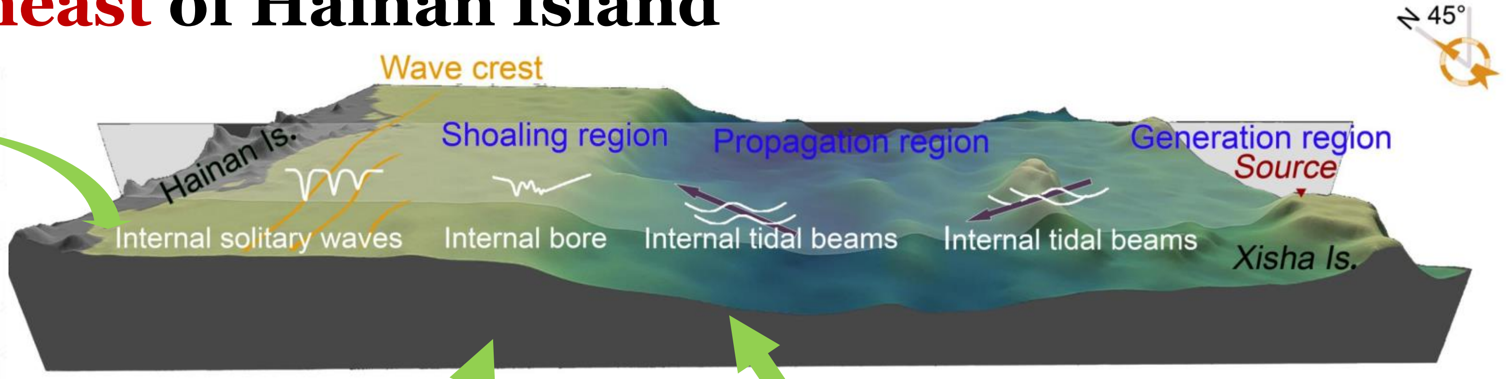
[Liang et al. 2022]

Example Results

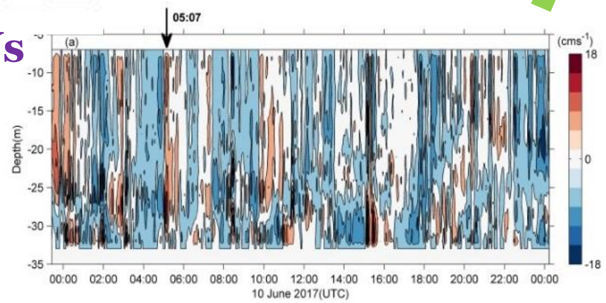
Generation of NLIWs Southeast of Hainan Island



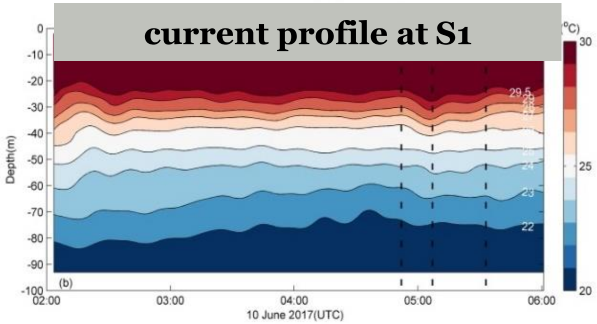
GF-3 and TS-X SAR observation:NLIWs



In situ measurement:
A preceding unduar bore at S1 station

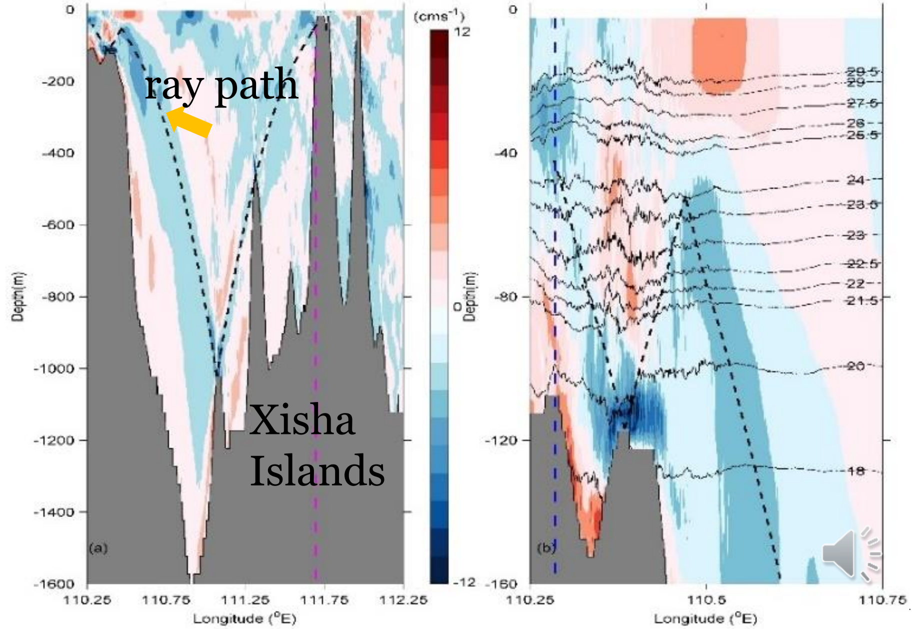


current profile at S1



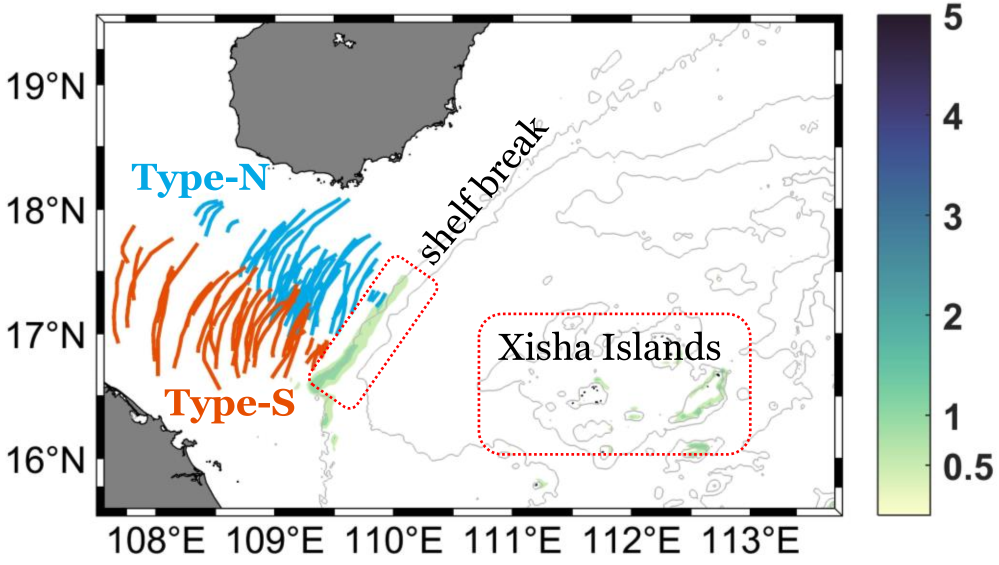
temperature profile near S1

Numerical simulation: Beam reflects from Xisha to shelf

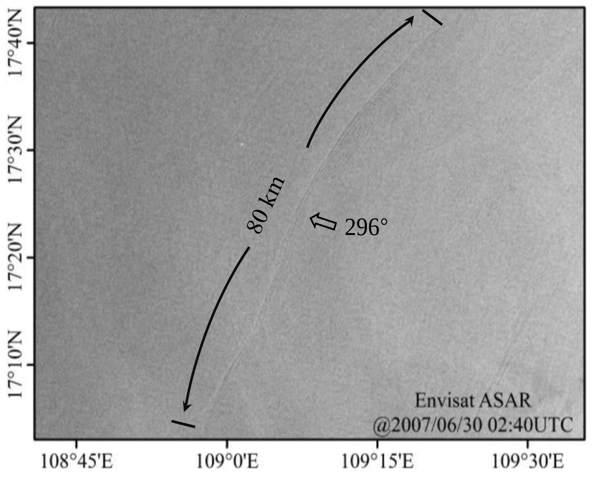


Generation of NLIWs south of Hainan Island

- **Two types of NLIWs:Type-SP and Type-DP**
- **Possible sources of two types of NLIWs: Xisha Islands or local shelf break**

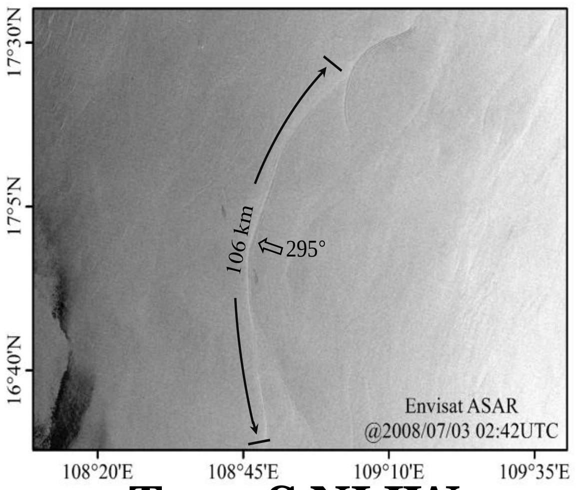


internal tide generating force



Type-N NLIWs

distributed in the north of SHI



Type-S NLIWs

distributed in the south of SHI

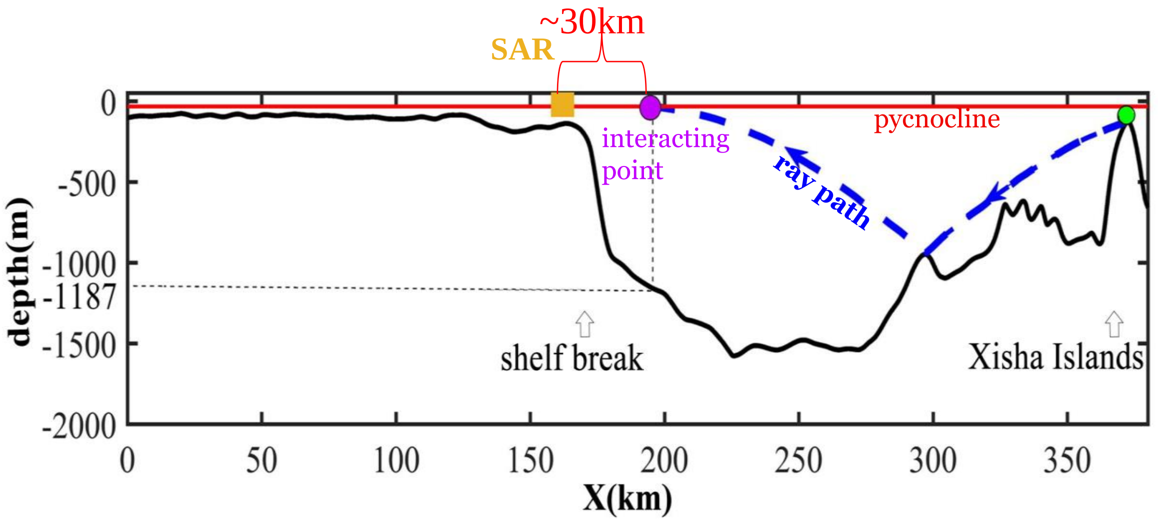
[Jia et al. 2021]

☐ Generation of NLIWs South of Hainan Island: Type-N NLIWs

➢ Source site: Xisha Island

Type-N NLIWs	spring tidal period	neap tidal period
SAR-observed occurrence frequency	33.33%	62.09%

➢ Evolution: internal tidal beam to NLIWs



estimated ray path from Xisha to shelf

Xisha generates internal tide in form of tidal beams

interfacial wave can be generated after beam impinging on pycnocline

interfacial wave disintegrates into NLIWs

[Jia et al. 2021]

Generation of NLIWs South of Hainan Island: Type-S NLIWs

SAR-observed wave occurrence frequency during local spring/neap tidal period:

Type-S NLIWs	spring tidal period	neap tidal period
occurrence frequency	52.63%	41.87%

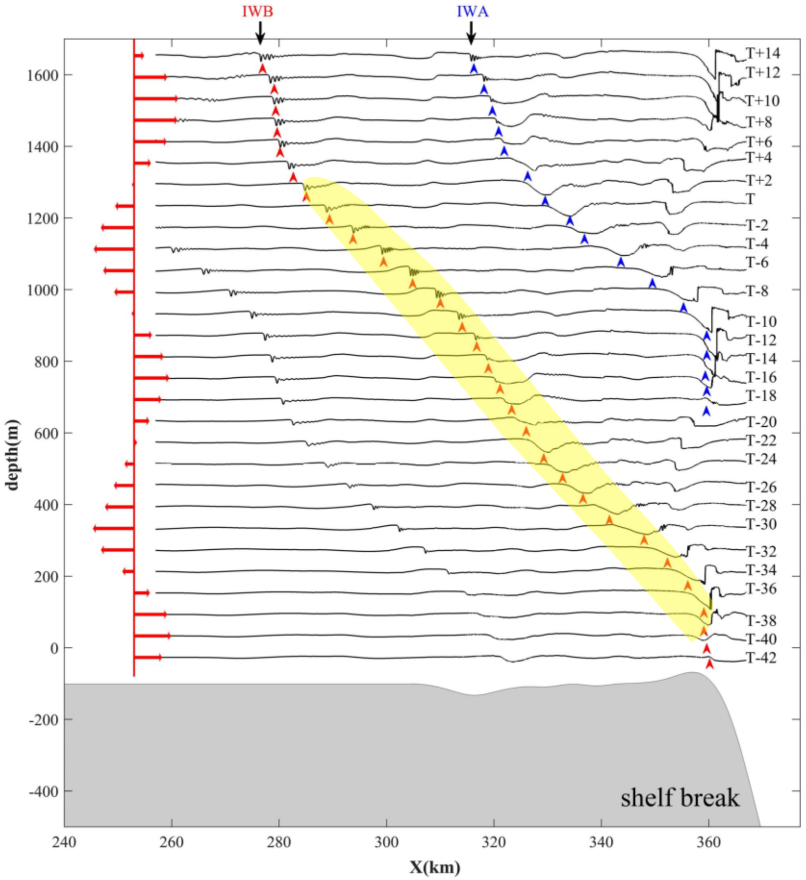
Type-N：
neap>>spring

- Both Xisha and shelf break are sources for Type-S NLIWs
- Compared to Type-N NLIWs, local shelf break is more important for generating Type-S NLIWs

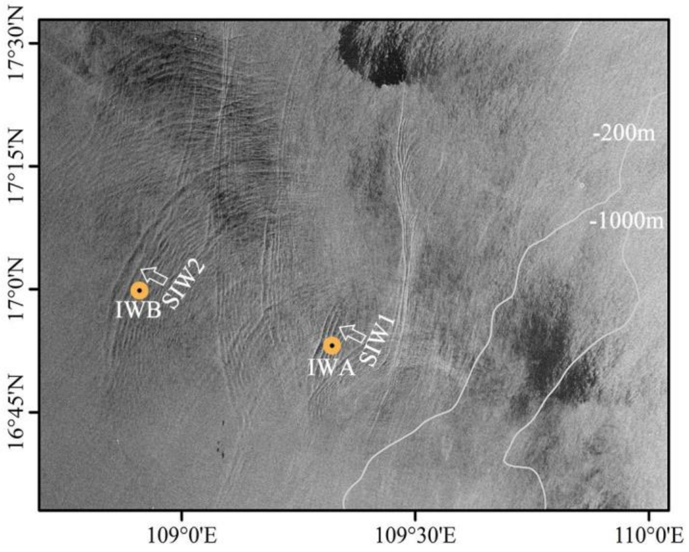
[Jia et al. 2021]

Example Results

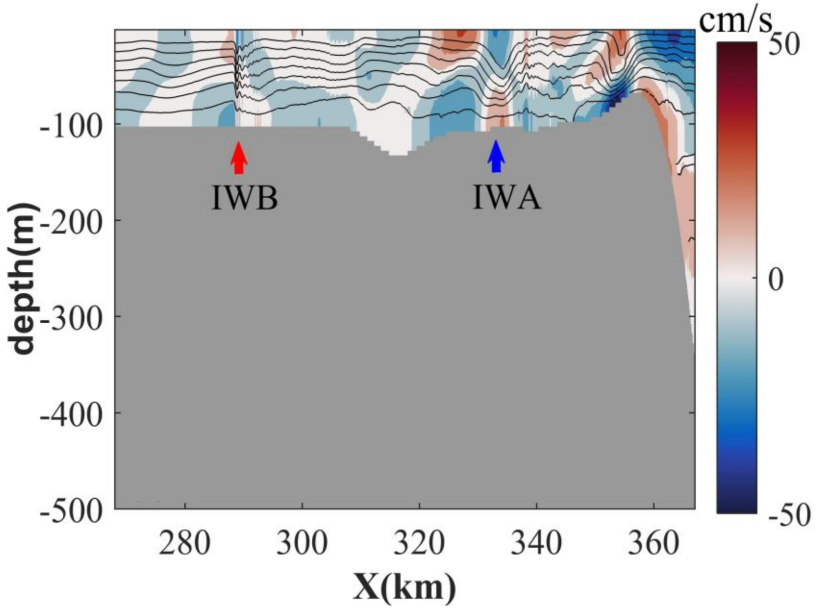
Generation of NLIWs South of Hainan Island: Type-S NLIWs



simulated isotherms from T-42h to T+14h by using 2D MITgcm



ENVISAT ASAR image @02:41 UTC on 23/08/2011 (T)

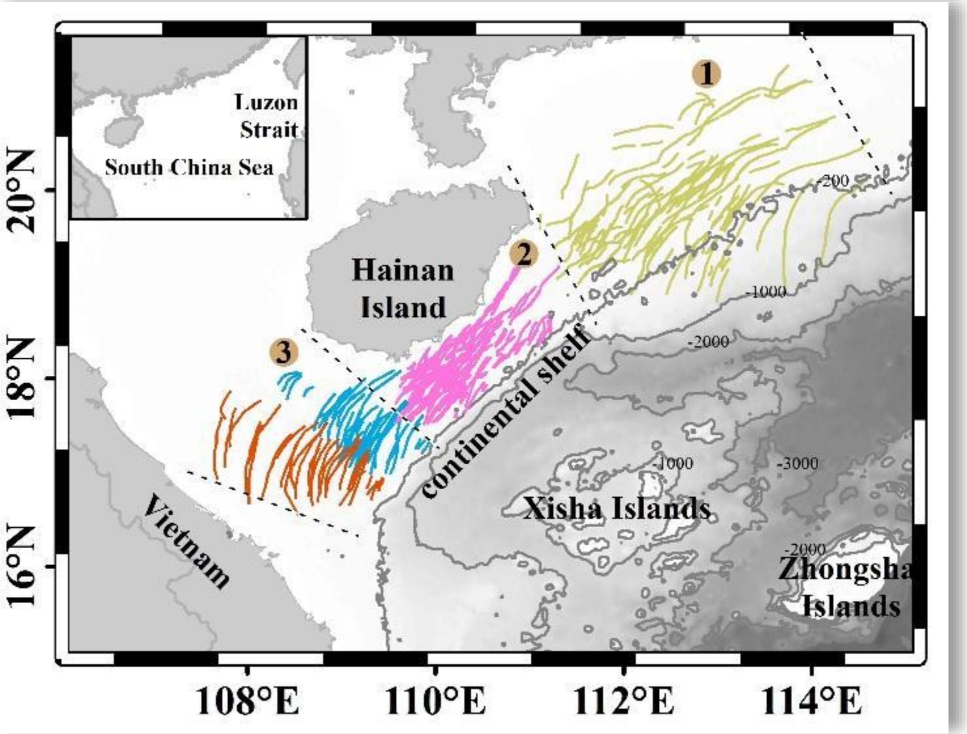


simulated baroclinic velocity field overlain with isotherms at time T

- shelf break can trigger NLIWs by internal tide evolution mechanism
- locations of simulated waves are close to SAR-observed NLIWs

Example Results

Nonlinear Internal Waves: Generation



Summary

- ✓ NLIWs northeast of Hinan Island (region 1) source from Luzon Strait.
- ✓ NLIWs southeast of Hainan Island (region 2) arise from Xisha Islands.
- ✓ Type-N NLIWs in the northern shelf south of Hainan Island (region 3) originate from Xisha Islands, whereas Type-S NLIWs in the southern shelf originate from both Xisha Islands and shelf break, and the shelf break has a larger contribution.

OUTLINE

Schedule & Planning

- **ReSCCoME is organised in 4 Phases, each lasting 1 year.**

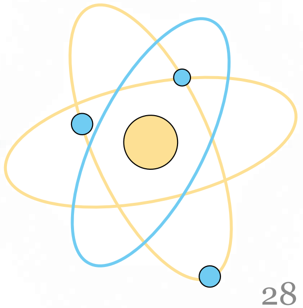
Phase 1:
Data gathering and pre-processing;
Assessment of existing algorithms;
Development of architectures;
Designing and Planning of in-situ campaigns.

Phase 2:
Adaptation of algorithms to special needs;
Development of automated data analysis algorithms based on Deep Learning;
Feasibility studies;
First in-situ campaigns;
First Summer School for Young ReSCCoME Scientists.

Planning

- **Phase 3:**
  Design of scalable architectures for large-scale data analyses;
  Second in-situ campaigns.

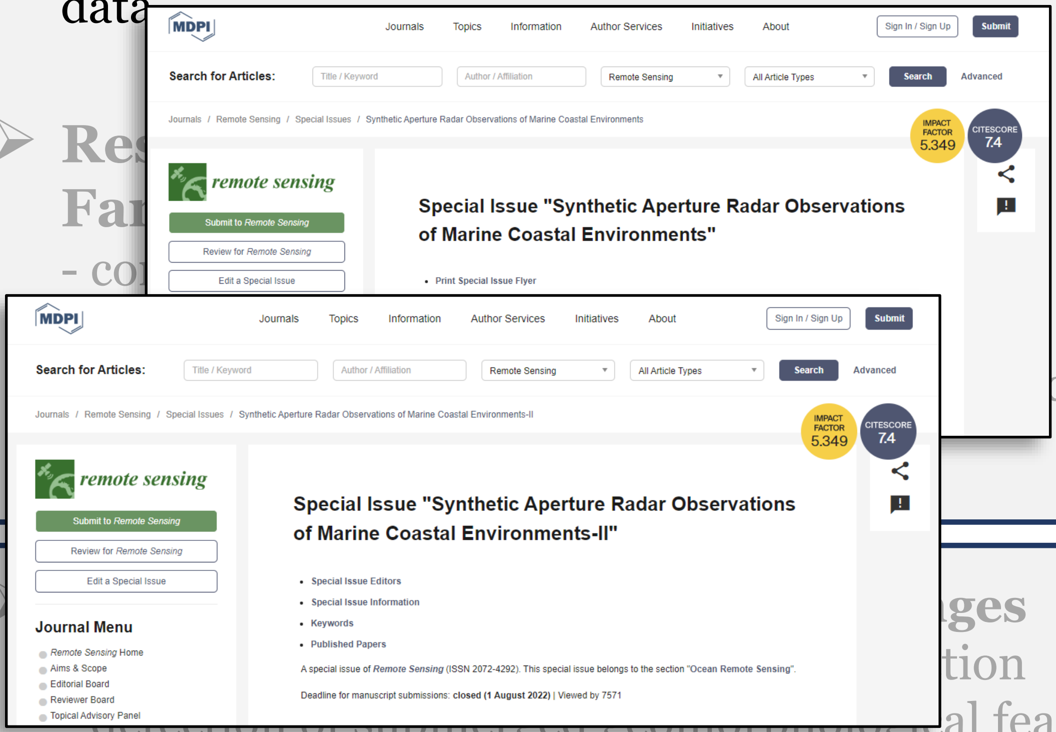
- **Phase 4:**
  Application of the newly developed data processing schemes to assess long-term effects;
  Second Summer School for Young ReSCCoME Scientists;
  Dissemination of results



Expected Results

Research Package 1: Intertidal Flats

- classification maps
- indicators for morphodynamic changes
- updated processing scheme for multimodal EO data



Res… Fa…

- co… …d

Research Package 3: Offshore Oil Pollution

- novel fusion methods and tools for multi-sensor RS data
- precise characterization of oil pollution in regions of poor training datasets
- accurate and scalable methods to assess long-term effects of oil pollution

Research Package 4: Coastal Pollution

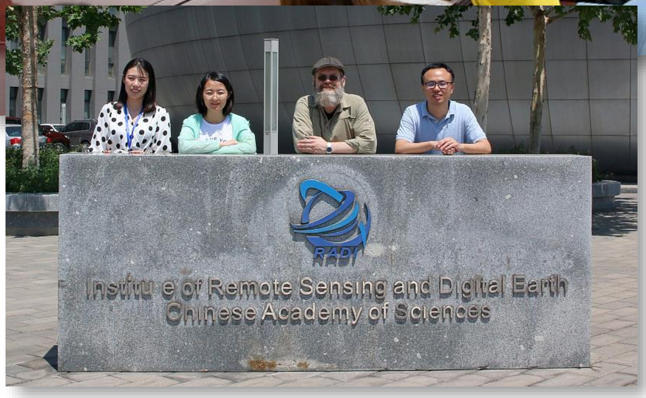
- examination of the visibility of plastic debris on EO data
- inter-comparison of data from spaceborne EO and UAV

…ges
…tion
…detection of submerged geomorphological features and their dynamics

Young Scientists

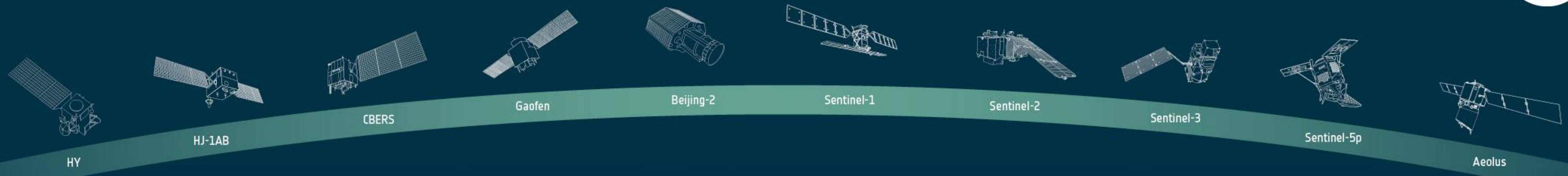
◻ Level & Training of Young Scientists:

- help young professionals in building up their network of peers and new skills that could be used in academic, research, and industrial contexts
- help the young professionals in acquiring problem-solving, decision-making, and critical judgement skills
- benefit from the multicultural and multidisciplinary environment to understand how to deal with multiple points of view on problems and decisions to be taken



Young scientists contributions in Dragon 5

	Name	Institution	Poster title
European Young Scientists	Abdalmenem Owda	DTU	Wind Speed Gradient and Wind Wakes Mapped Using SAR for a Study Area in South-east China
	Simon Schäfers	UHH	Using SAR Data for the Detection of Waterlines With an Image-to Image Network
Chinese Young Scientists	Yujia Qiu	AIR	Retrieval of Sea Ice Drift in the Arctic Based on Sequential Sentinel-1 SAR Data



That's all.

Thanks for your attention!

PROJECT ID. 57192

RESCCOME: REMOTE SENSING OF CHANGING MARINE COASTAL ENVIRONMENTS