Overview Of 'Application Of Multisensory Remote Sensing for Controlling Illegal, Unreported, and Unregulated (IUU) Fishing Activities's Project

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LaSOMS

Laboratory for Satellite Oceanography
& Maritime Safety (LaSOMS)
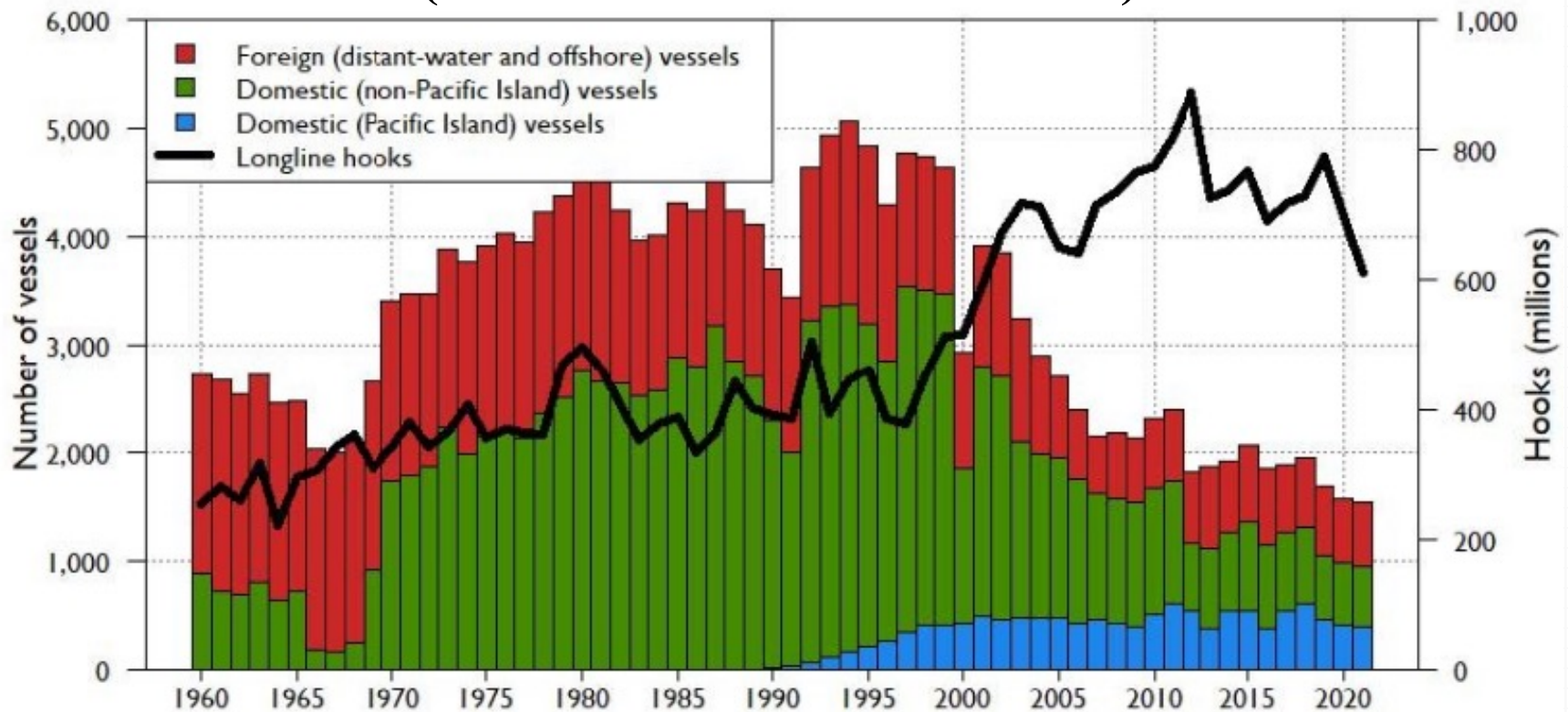
Contents

I.   **Introduction**

II. **Objectives**

1.   **Ship Detection (SAR / EO satellites)**
2.   **Ship Monitoring (NPP VIIRS Satellite platform)**
3.   **Fishing Activity / Ship Type Classification (Deep learning, big data)**

III. **Future Work**

Issues: Increasing of IUU Ships

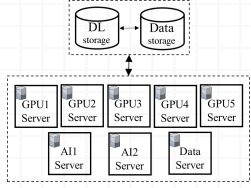**Time series change of number of vessels and hooks**
(2021 overview status of stocks)

LaSOMS
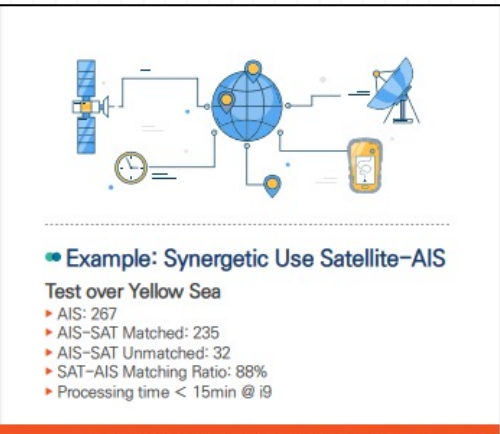
IUU 1ˢᵗ Phase Achievement

Sentinel-1 SAR based developing ship detection system

KIOST
한국해양과학기술원

Hardware

DL storage — Data storage

GPU1 Server | GPU2 Server | GPU3 Server | GPU4 Server | GPU5 Server

AI1 Server | AI2 Server | Data Server

Kubernetes Cluster

Docker

docker

EC2

Korea Institute of Ocean Science & Technology

Example: Synergetic Use Satellite–AIS

Test over Yellow Sea
- AIS: 267
- AIS–SAT Matched: 235
- AIS–SAT Unmatched: 32
- SAT–AIS Matching Ratio: 88%
- Processing time < 15min @ i9

Future Plan Additional Satellite
: Sentinel–2, NPP VIIRS

1. Night time visible infrared
2. Fishing vessel
3. VIIRS Image

Sentinel-2A: 19. 3. 11 02:17 (UTC)

Date: 2019. 8. 5.09:48 (UTC)   AIS   Satellite

Project Objective

* AIS signal loss!

Sat-Ship Monitoring System

Integration: SAT **PPB-Airplane

*AIS: Automatic Identification System
**PPB: Pacific Patrol Boat

Target Satellite Sentinel-1

eesa

Synthetic Aperture Radar
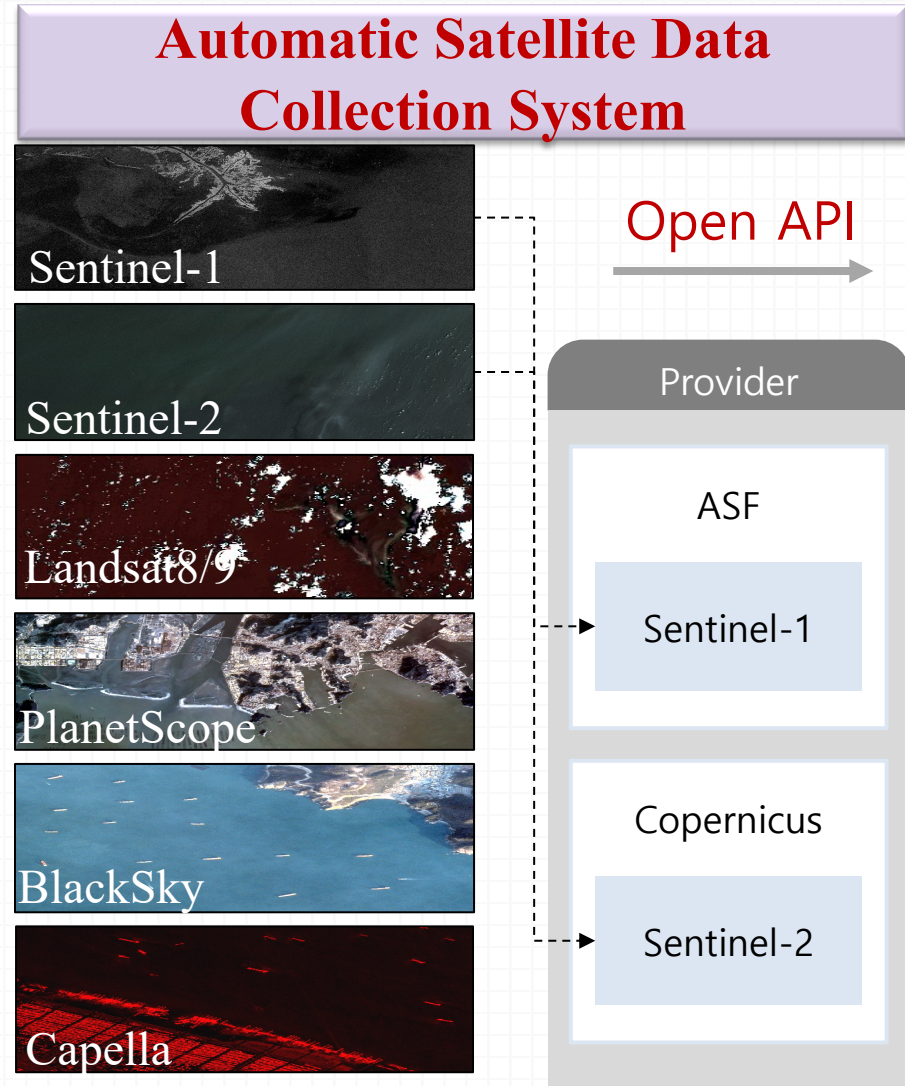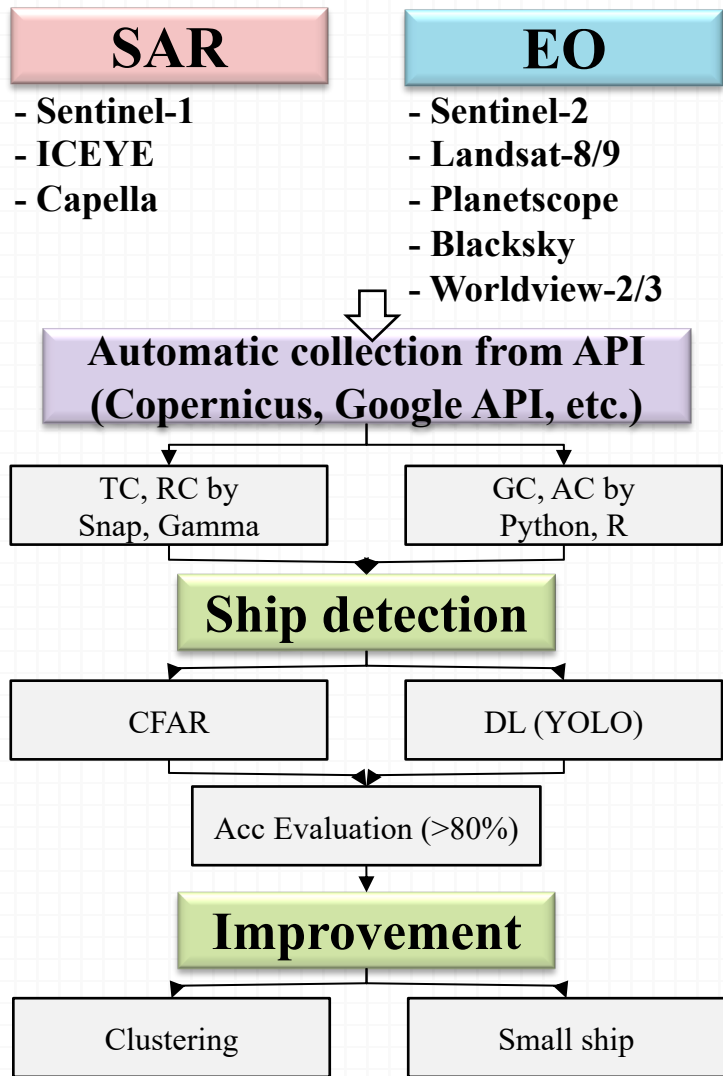: Radar sensor can penetrate cloud, can monitor night time

SAR   Cloud
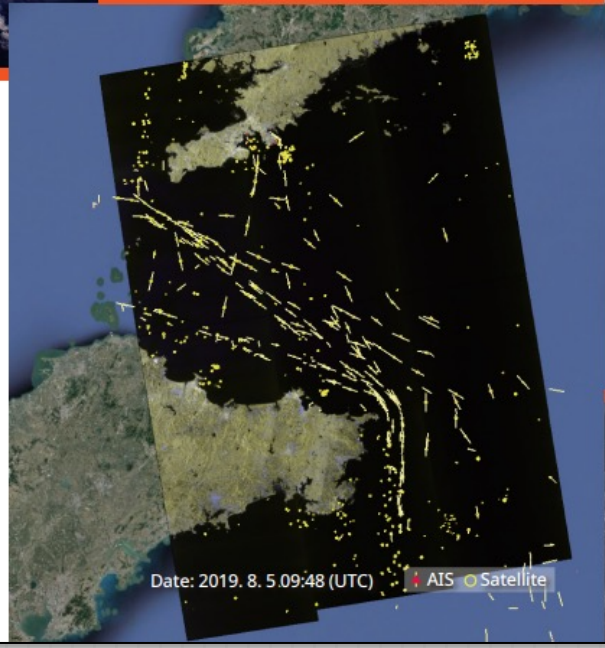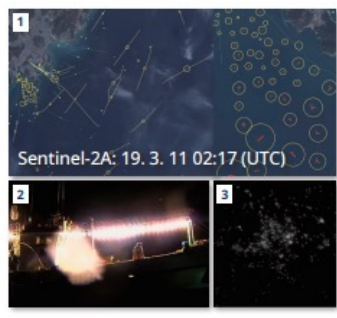
IUU 2nd Phase Purpose and Platform

• **Improvement of Ship detection algorithm and extended platform**

Day **(1)**

SAR

MS-OPTICAL

(1) Ship Detection (for day)
(2) Ship Monitoring (for night)
(3) Fishing Activity (real-time)

(2) Night

VIIRS

Class 7_Small ship 0.71
Class 7_Small ship 0.89
Class 4_Special ship(Barge) 0.91

AIS, V-PASS **(3)**

Real-time monitoring

LaSOMS
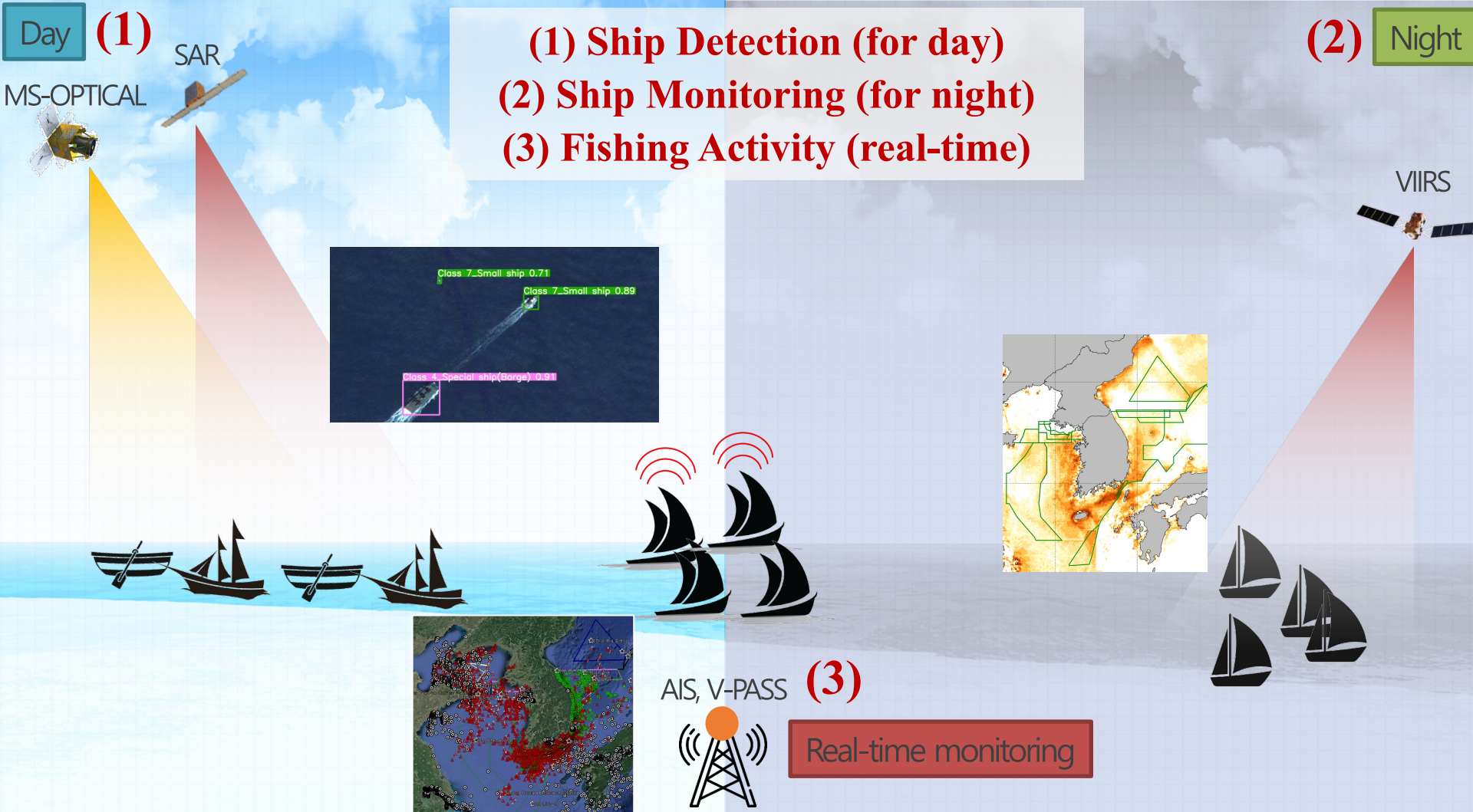
Data Flow for High Resolution SAR/EO satellites

SAR
- **Sentinel-1**
- **ICEYE**
- **Capella**

EO
- **Sentinel-2**
- **Landsat-8/9**
- **Planetscope**
- **Blacksky**
- **Worldview-2/3**

Automatic collection from API (Copernicus, Google API, etc.)

TC, RC by Snap, Gamma	GC, AC by Python, R

Ship detection

CFAR	DL (YOLO)

Acc Evaluation (>80%)

Improvement

Clustering	Small ship

Automatic Satellite Data Collection System

Sentinel-1

Sentinel-2

Landsat8/9

PlanetScope

BlackSky

Capella

Open API

Provider

ASF

Sentinel-1

Copernicus

Sentinel-2

(Source: Fish Information Service)

Ship Detection

(EO) Blacksky (1.0m)
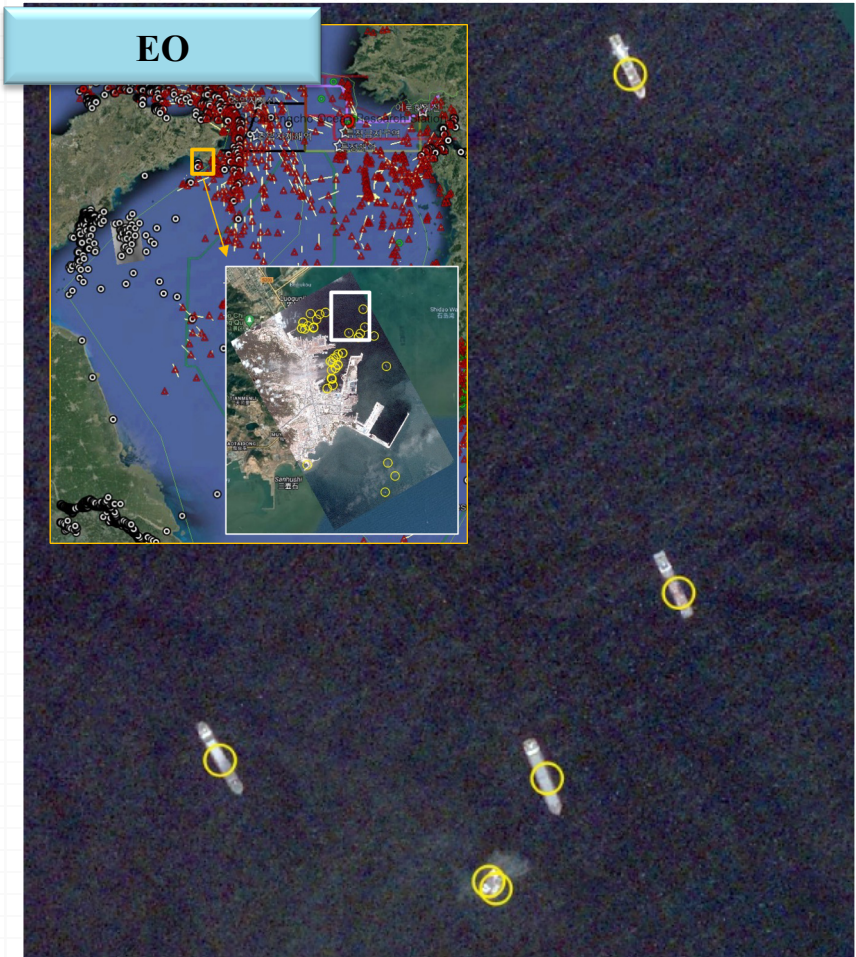
(SAR) ICEYE-X4 SM (2.5m)
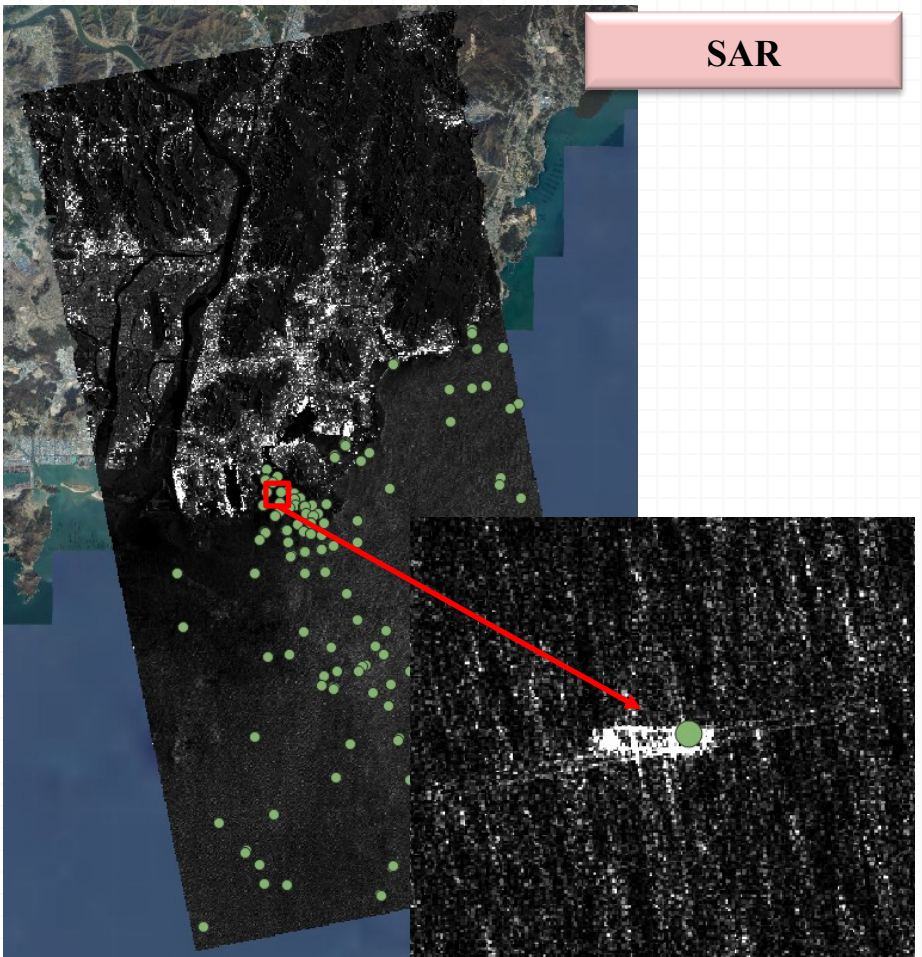
Improvement of Ship Detection
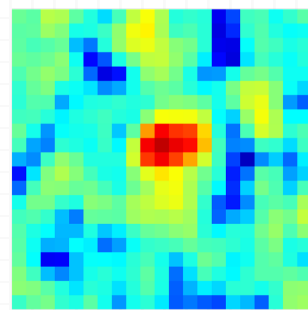
SAR

Dual polarization for small ship detection
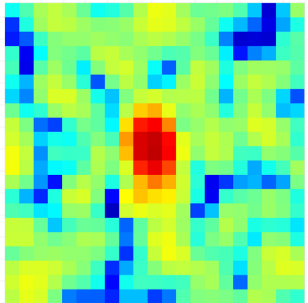
Display chip image by each pol
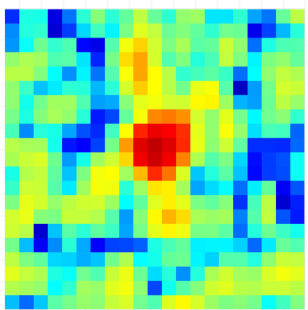
Type1 – VH pol   Type1 – VV pol
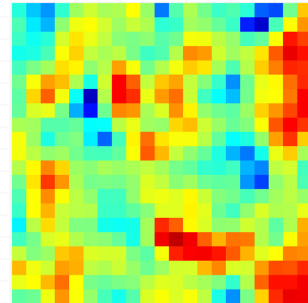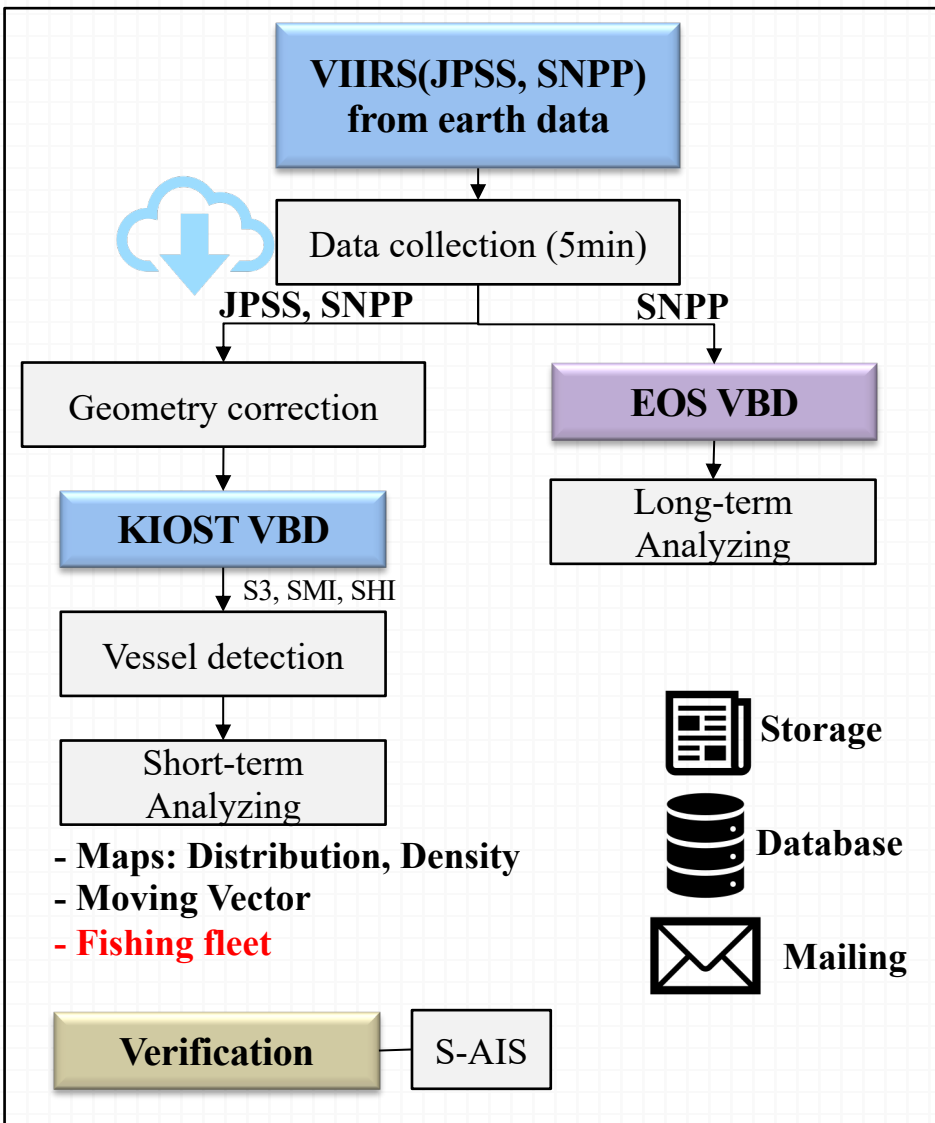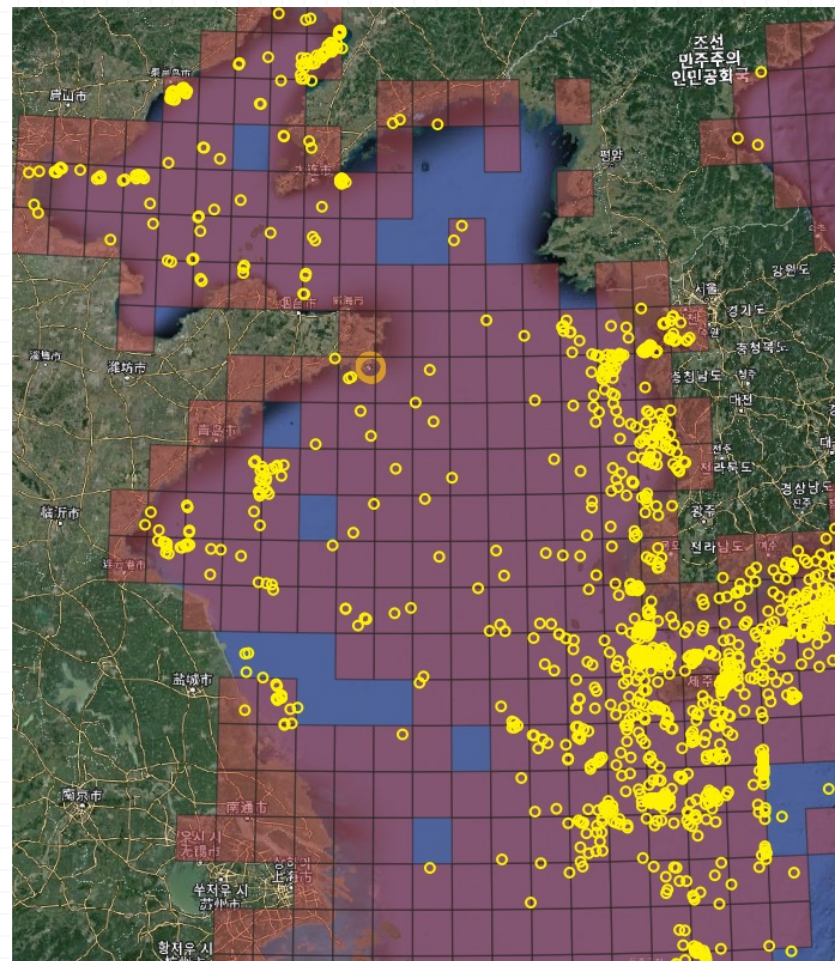
Type3 – VH pol   Type3 – VV pol

Trap Fishing trajectory

plot(based on ship)
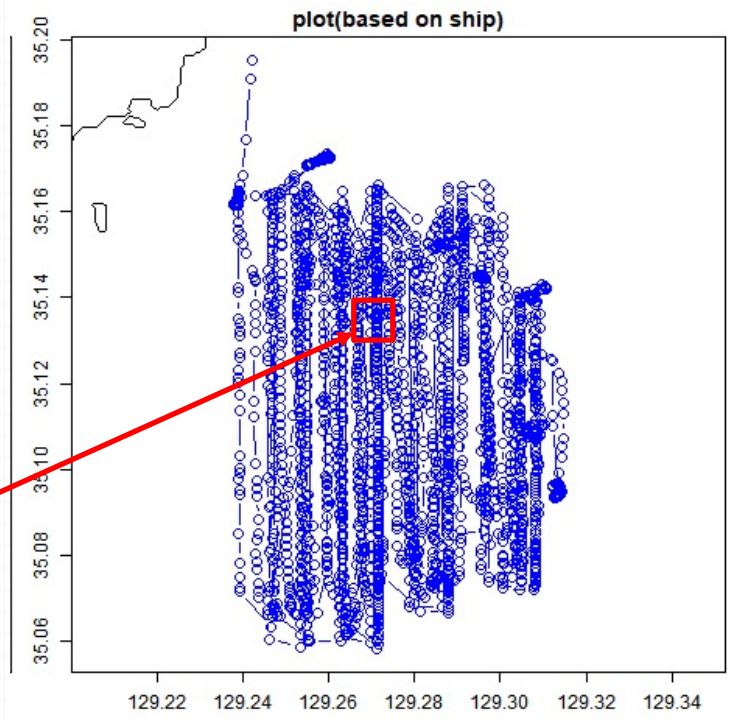
→ Better performance in VH pol in Trap fishing vessel

LaSOMS

Data Flow for Nighttime Fishing Vessel Detection

VIIRS(JPSS, SNPP) from earth data

Data collection (5min)

JPSS, SNPP

SNPP

Geometry correction

EOS VBD

KIOST VBD

Long-term Analyzing

S3, SMI, SHI

Vessel detection

Short-term Analyzing

- **Maps: Distribution, Density**
- **Moving Vector**
- **Fishing fleet**

Storage

Database

Mailing
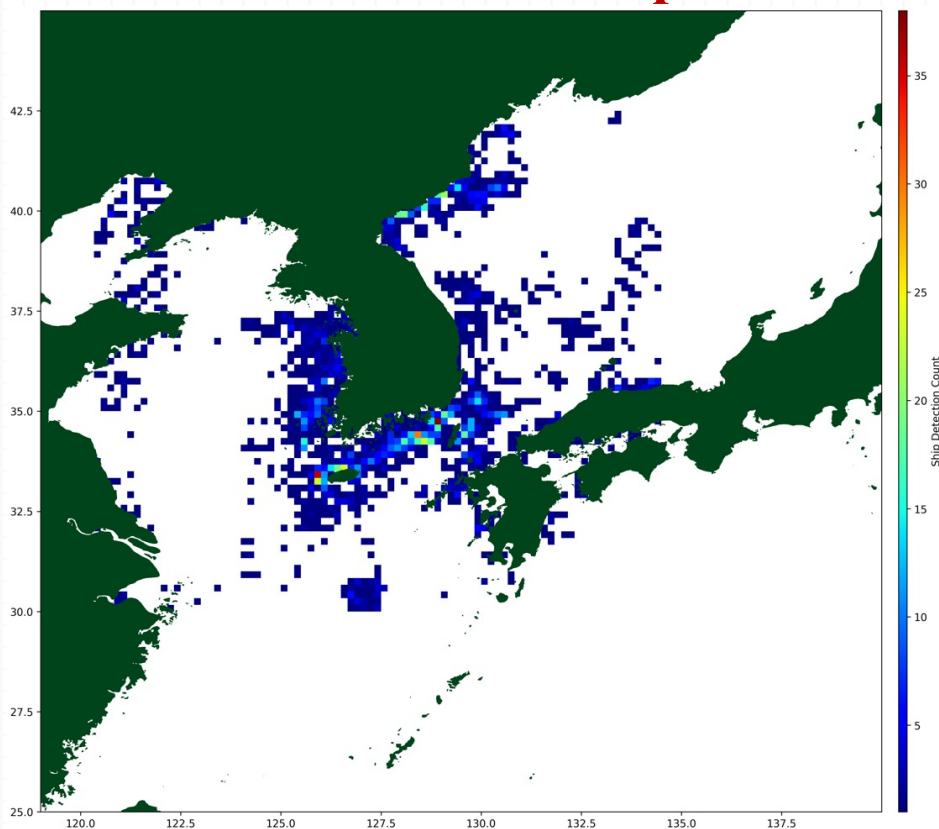
Verification — S-AIS

VIIRS vessel detection

Short-term Analysis

KIOST VBD

Distribution map

Moving vector calculation of fishing vessel

Fishing vector
Moving vector
First detection (17:24)
Second detection (16:36)
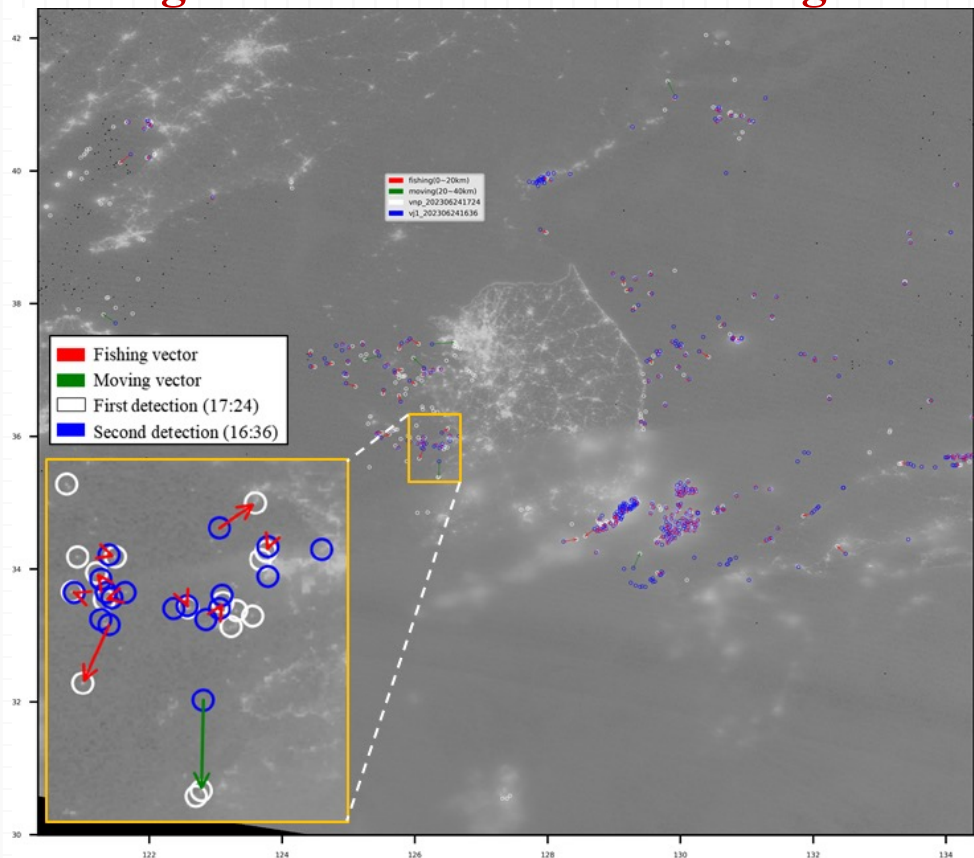
✉ **Automatic Mailing System**

LaSOMS

Long-Term Analysis

EOS VBD

1 Distribution map (2023.04 ~ 2023.07)

3 Yearly trend(2017-2022)

Yearly trend: 09-14 ~ 10-24 for 7 years

GUM:130, MHL:640, HS:2108, FSM:472, PLW:157, JTA:21, NRU:420, KIR(GI):876, HBI:46, PNG:2784, IDN:6120, KIR(PG):279, TUV:140, S):0, TKL:57, SLB:578, WLF:65 WSM:212, FJI:850, AUS:9133, VUT:188, TON:135, NCL:859
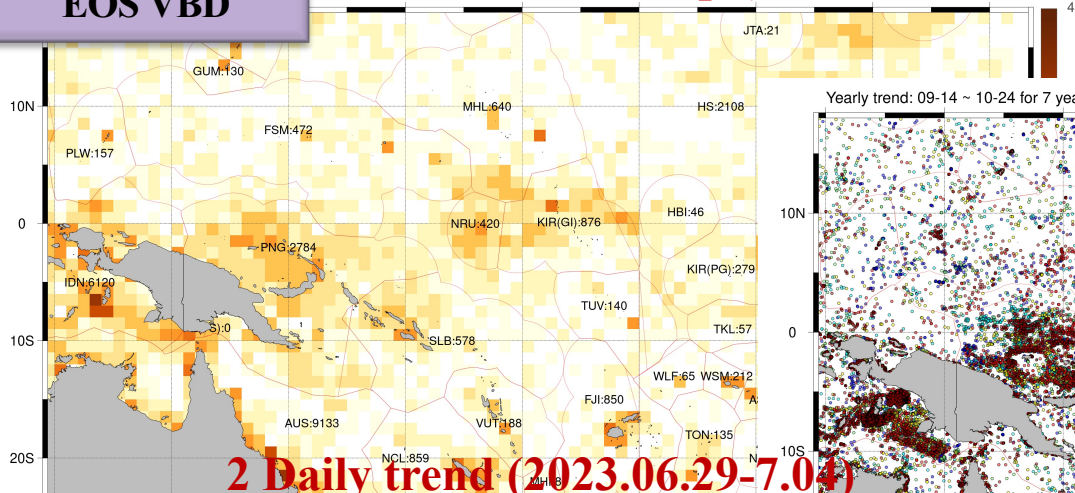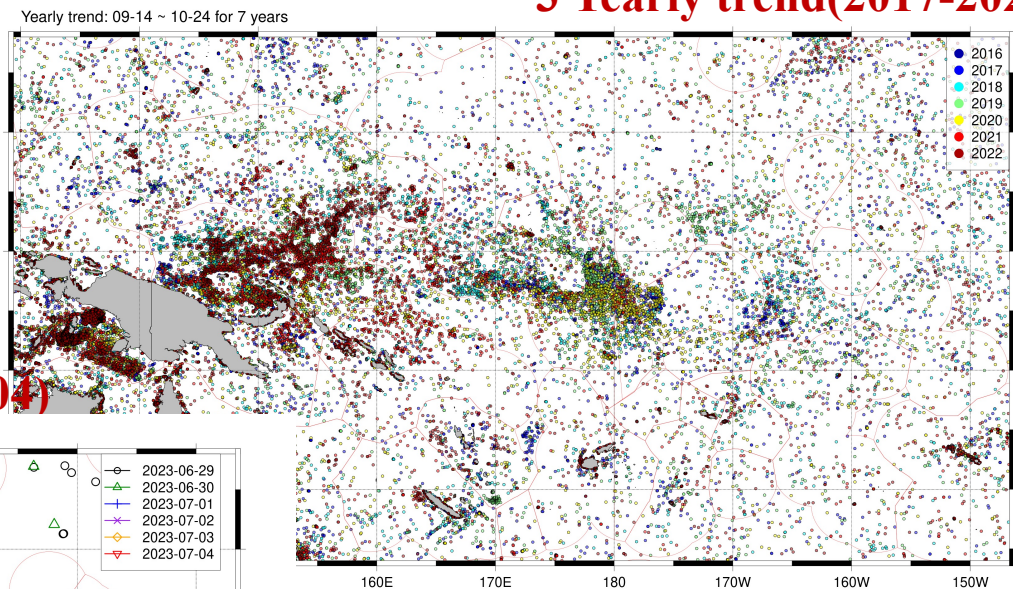
2 Daily trend (2023.06.29-7.04)

Daily trend: 2023-06-29 ~ 2023-07-04
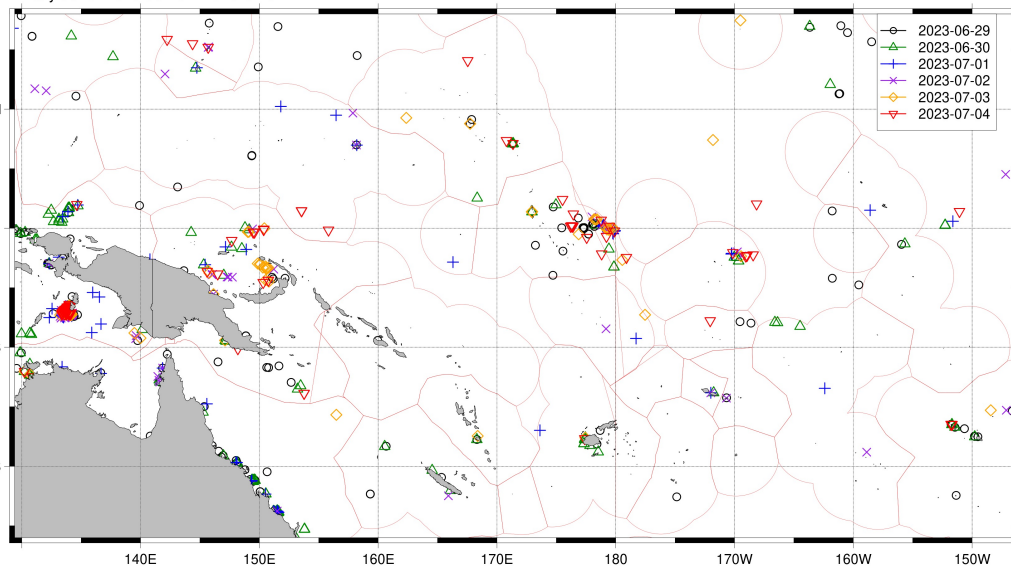
Legend:
- 2023-06-29
- 2023-06-30
- 2023-07-01
- 2023-07-02
- 2023-07-03
- 2023-07-04

Automatic Mailing System

Data Flow for Fishing Vessel Activity Prediction

24h trajectory
AIS, V-PASS(t, lat/lon, spd), VMS

Dataset(1')

HMM

F. Activity: step 1

(Speed)

Fishing or Not

For Fishing

Longlining

Planned

CNN

F. Activity: step 2

(Course, Lat/lon)

Liftnet, Trap, Trawl
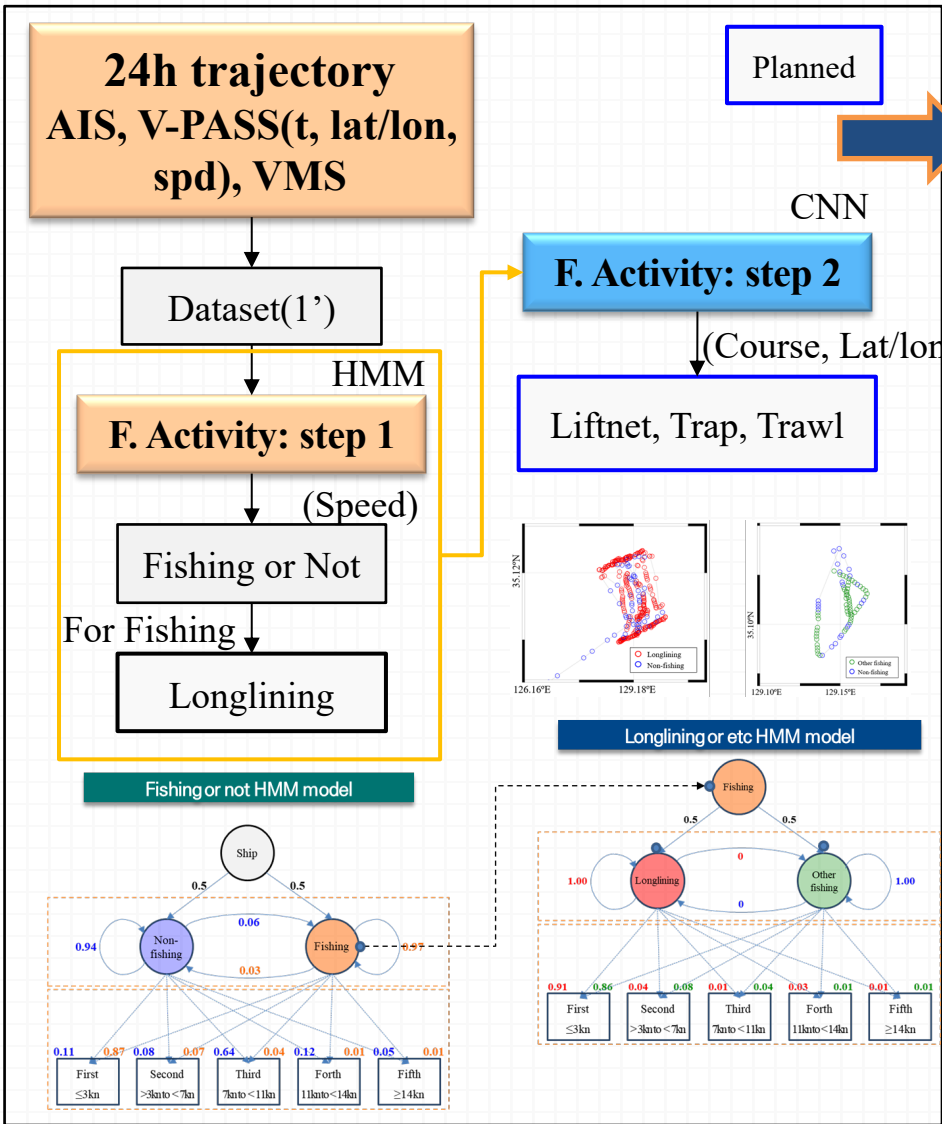
F. Activity: step 1 Accuracy

Shin et al,. 2022

Fishing or not	Longlining	Total
90.45%	86.01 %	88.23 %

Fishing or not HMM model
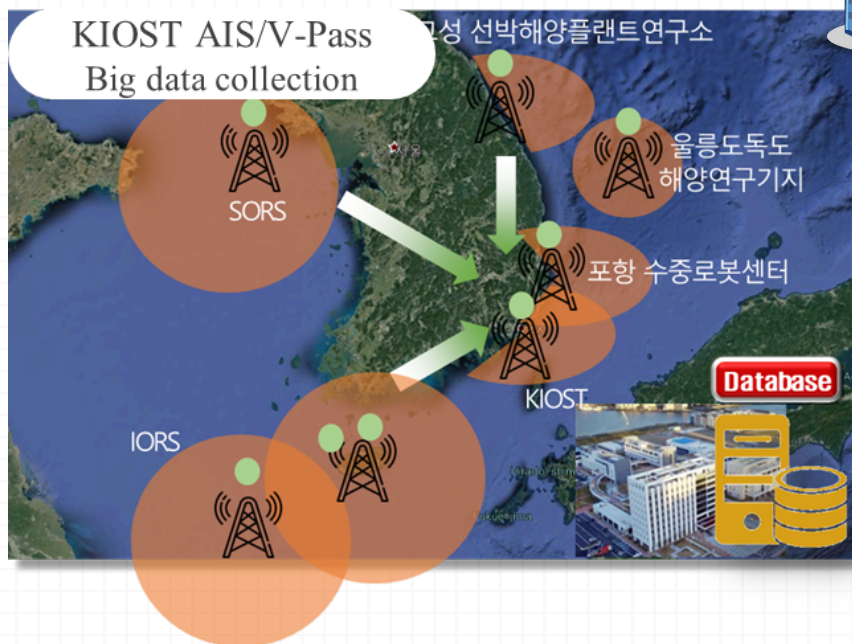
Longlining or etc HMM model
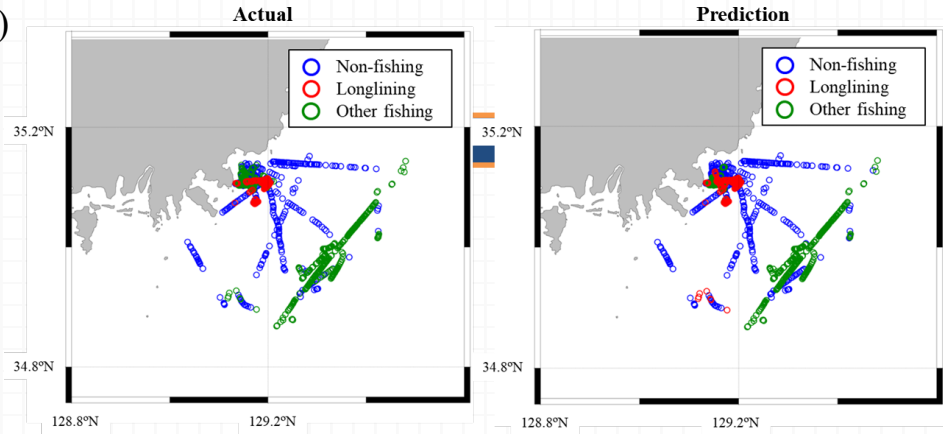
Application to PIF ships
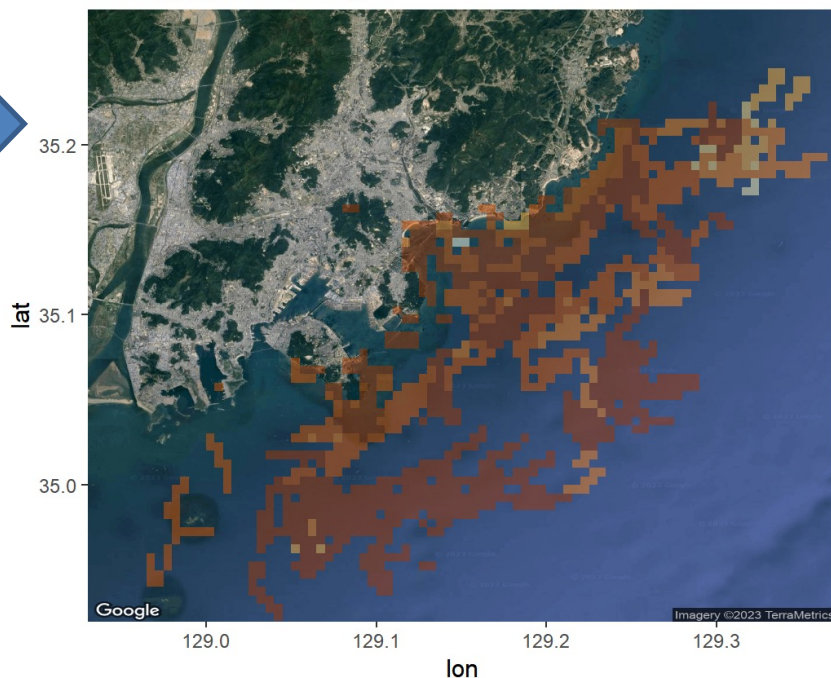
Fishing Vessel Activity Prediction

F. Activity: step 1   Service

AIS/V-Pass System

Mailing service of fishing activity map

VPASS_20230831_fishing

HMM-DNN-CNN Ship Type Classification
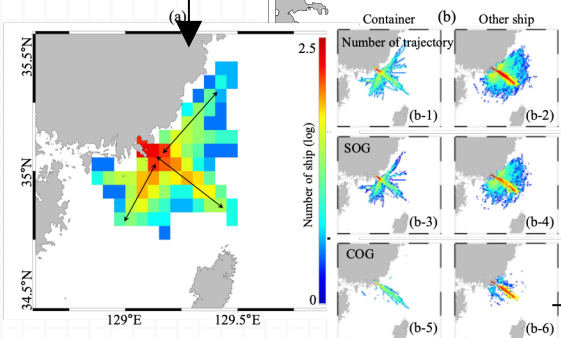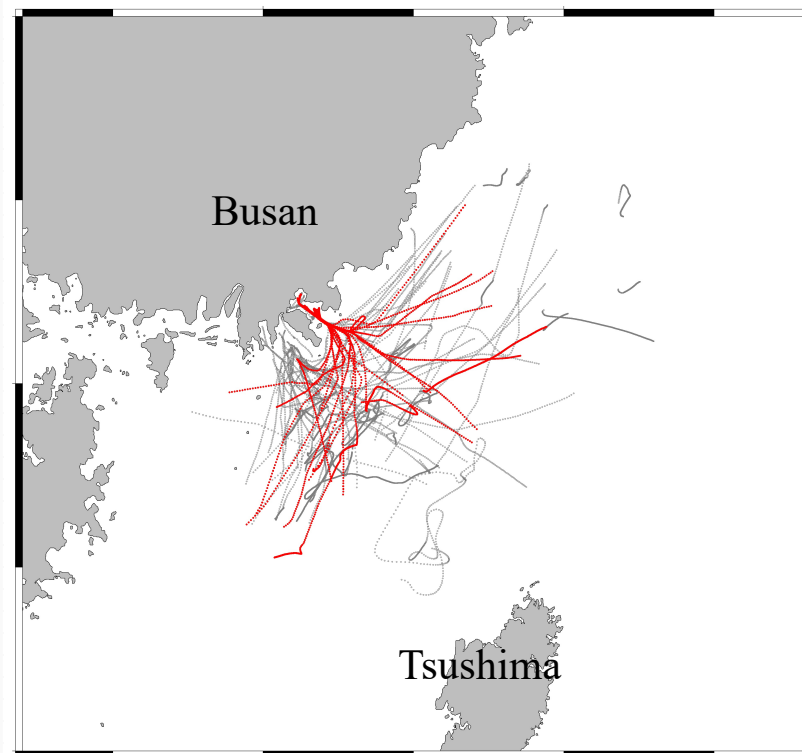
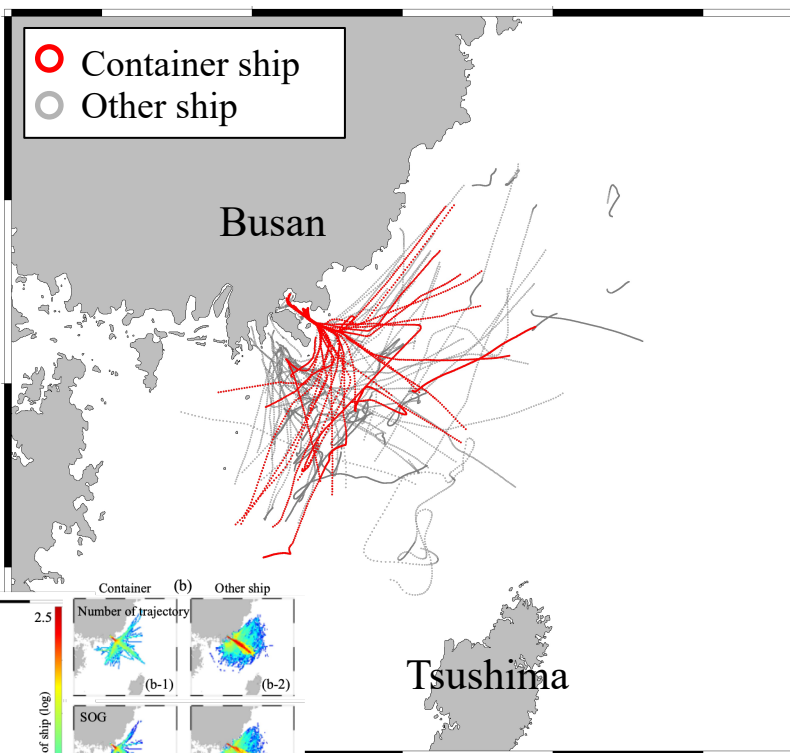**Ship type classification**

Submitted at Aug. to JoN

HMM model

DNN model

CNN model

Ground truth

Container ship
Other ship

Busan

Tsushima

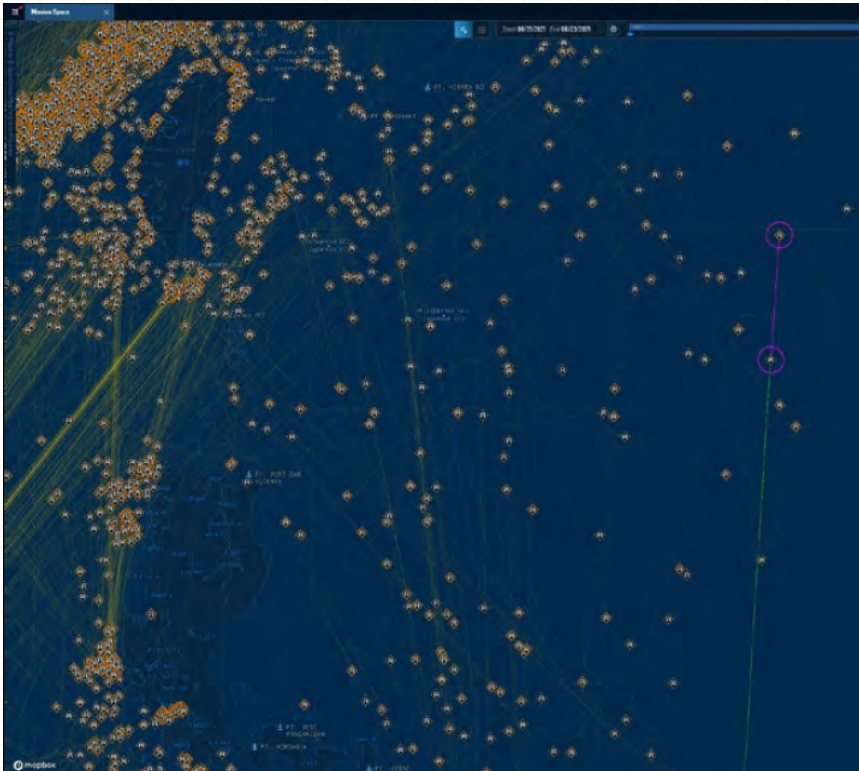**Prediction**

Busan

Tsushima

Over 90% F-1 score

Future work

For the next phase project

Ship detection by RF (Radio Frequency)

Thank you

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