

Development of Decision Ready Tools to Support Coastal and Marine Spatial Planning (I): A Case Study for Funafuti, Tuvalu

Step1

Coastal & MSP

Chan-Su Yang (yangcs@kiost.ac.kr)

Sree Juwel Kumar Chowdhury, Dae-Woon Shin



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PACIFIC ISLANDS FORUM



한국해양과학기술원
KOREA INSTITUTE OF OCEAN SCIENCE & TECHNOLOGY



Step1

Coastal & MSP in Funafuti, Tuvalu

- Under the ROK-PIF Cooperation Fund, The Ministry of Foreign Affairs (MOFA) of the Republic of Korea
- Period: 2021 ~ 2025, US\$ 1.8M

Implementing agencies:

- The Korea Institute of Ocean Science and Technology (KIOST)
- The Pacific Community (SPC)



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KIOST



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Work scope

Target region: Funafuti, Tuvalu

Objectives

Outcome

Land use mapping (LUM)

LUM of Funafuti, Tuvalu

Extraction of Coastline (CE)

S-2 based CE module

Applied

Algorithm: WorldView-2 based CE

Tested in Korea

Retrieval of wave properties
(WPR)

(NRT) WPR test from Sentinel-2 & L-8/9

(Archive) WPR from Sentinel-2 & L-8/9

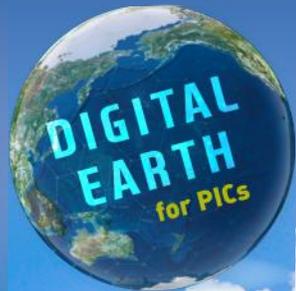
S-2: 2019/10/24~ 2025/10/12

L-8/9: 2014/09/03 ~ 2023/12/17

Contribution

Service: sharing
outcomes

- The output (coastline) can be shared with SPC, which can be demonstrated in the DEP platform. After validation, the outcome from wave properties retrieval can be shared.
- Additionally, the land use map of Funafuti will show the condition of land use in different years (2023 (east side) and 2025 (southeast side))



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 Development of Decision Ready Tools to Support Coastal and Marine Spatial Planning

Land use mapping

	EoV (Internal coastline area)	Land Area (Outer coastline)
2017	1.64 km ²	1.95 km ²
2023	1.60 km ²	1.88 km ²

Optical

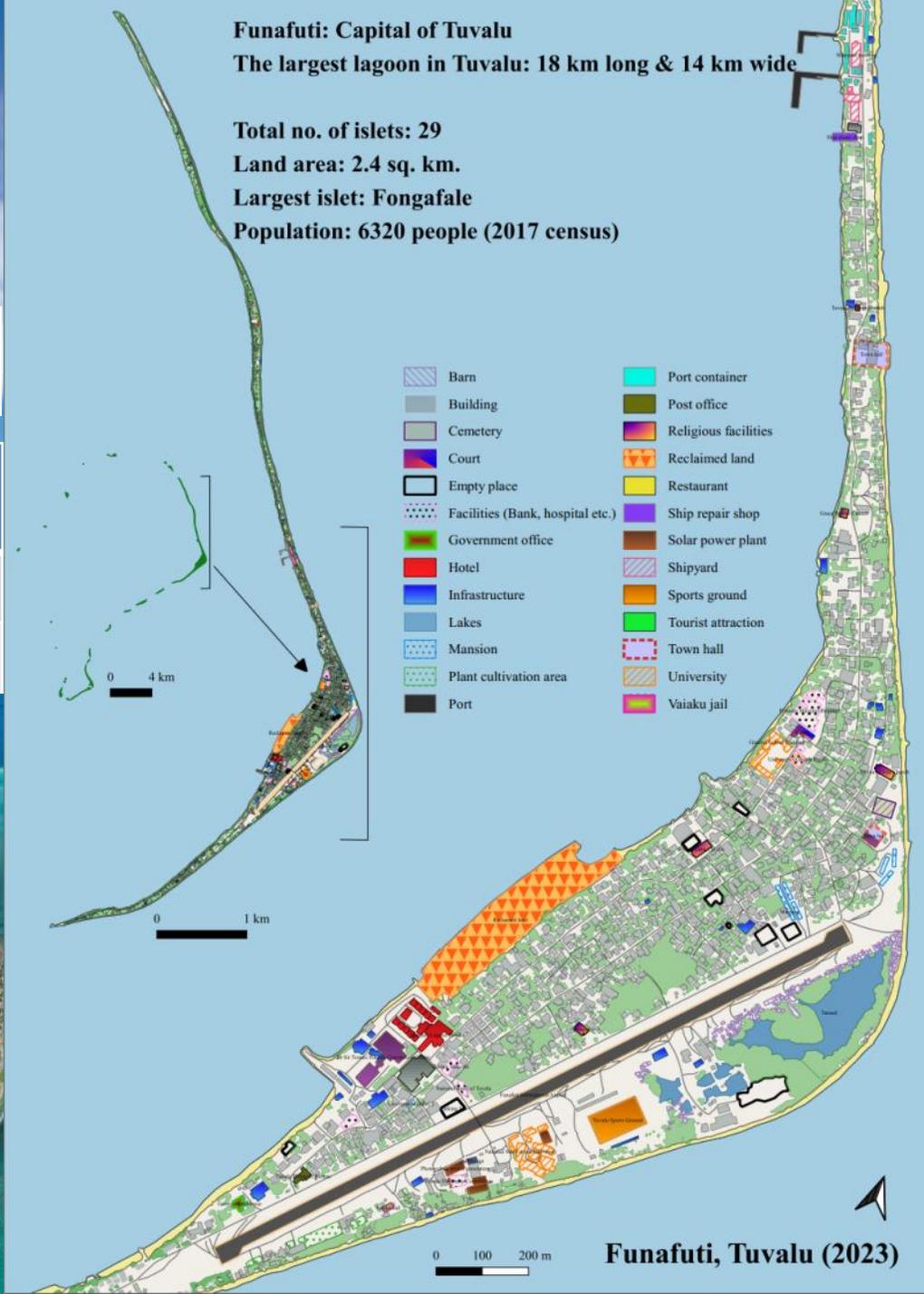
E0 Data	W	C
Sentinel-2	W	C
Landsat 8/9	W	C
High-resolution		
Worldview-2	W	C
PlanetScope	W	C

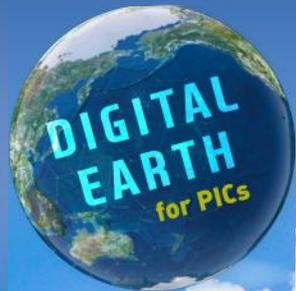


Land use mapping : Funafuti

Funafuti: Capital of Tuvalu
 The largest lagoon in Tuvalu: 18 km long & 14 km wide

Total no. of islets: 29
 Land area: 2.4 sq. km.
 Largest islet: Fongafale
 Population: 6320 people (2017 census)



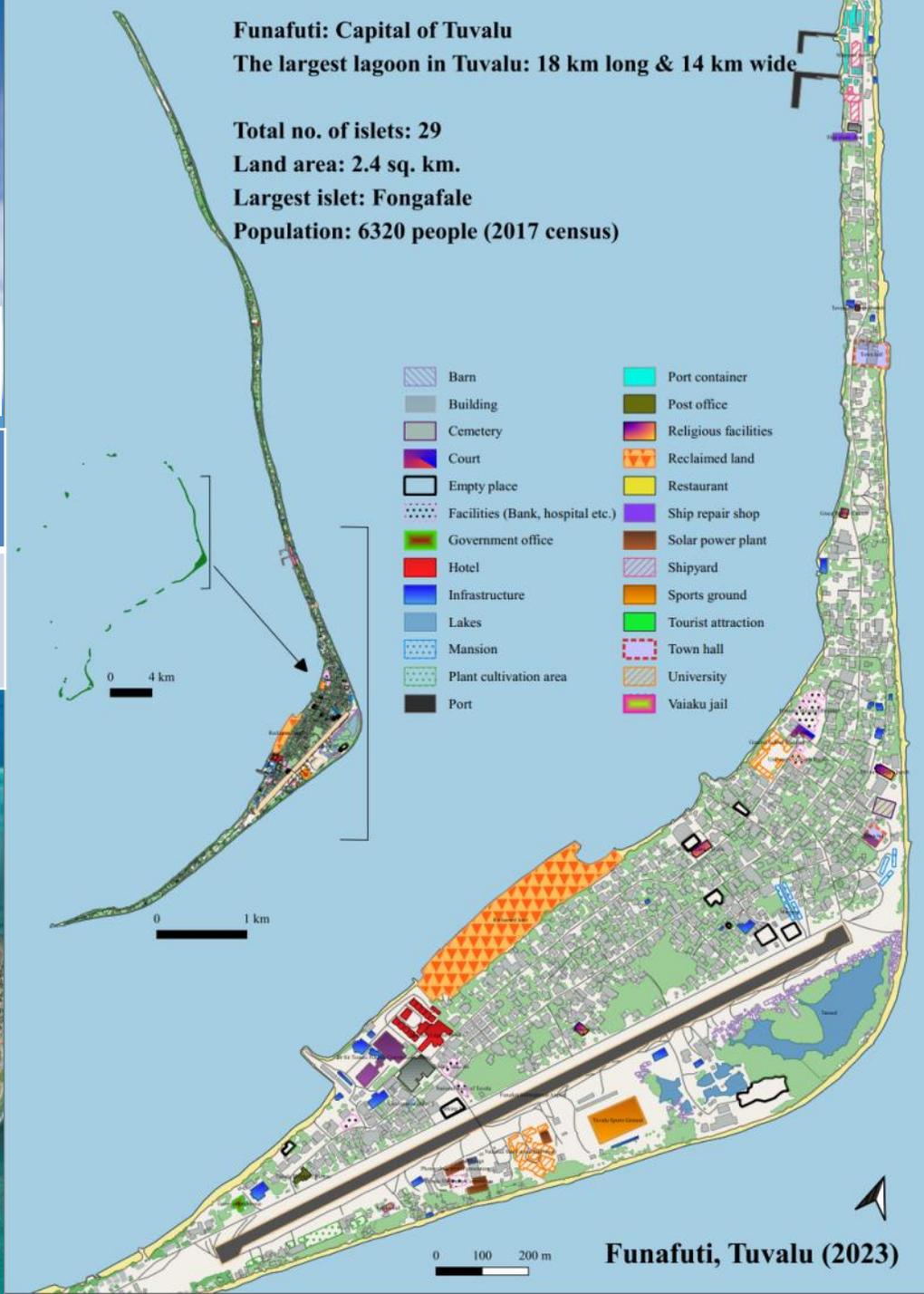
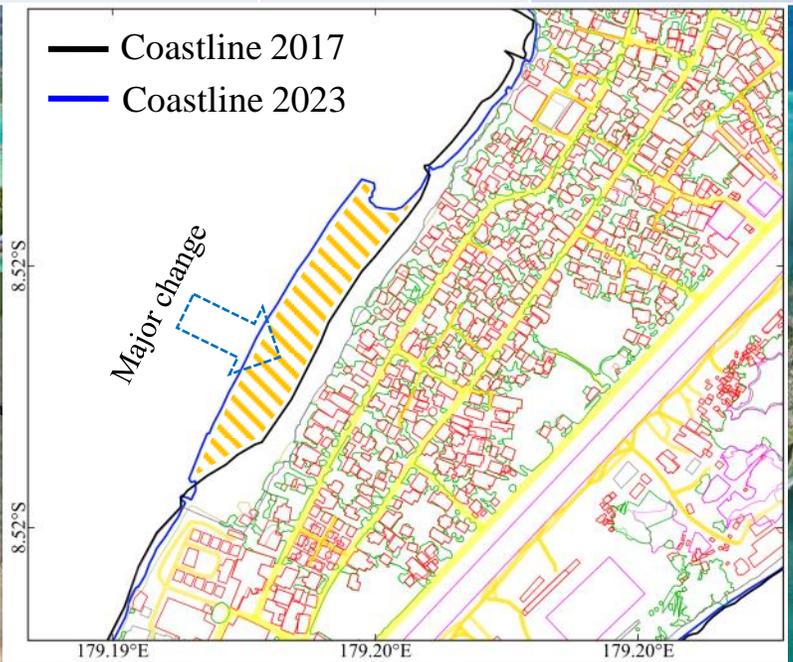
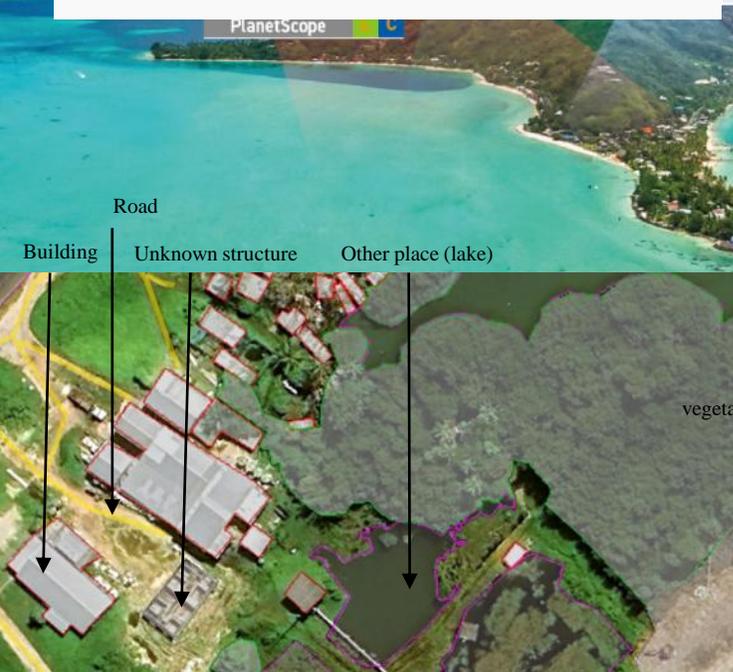


Step 1
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Land use mapping

Changes in total land use on the eastern side of Funafuti between 2017 and 2023

Year	Total area (km ²)	Change (%)
2017	1.95	4.1%
2023	1.87	





Step 1
MSP
Tools to Support
Planning

Funafuti: Capital of Tuvalu
The largest lagoon in Tuvalu: 18 km long & 14 km wide

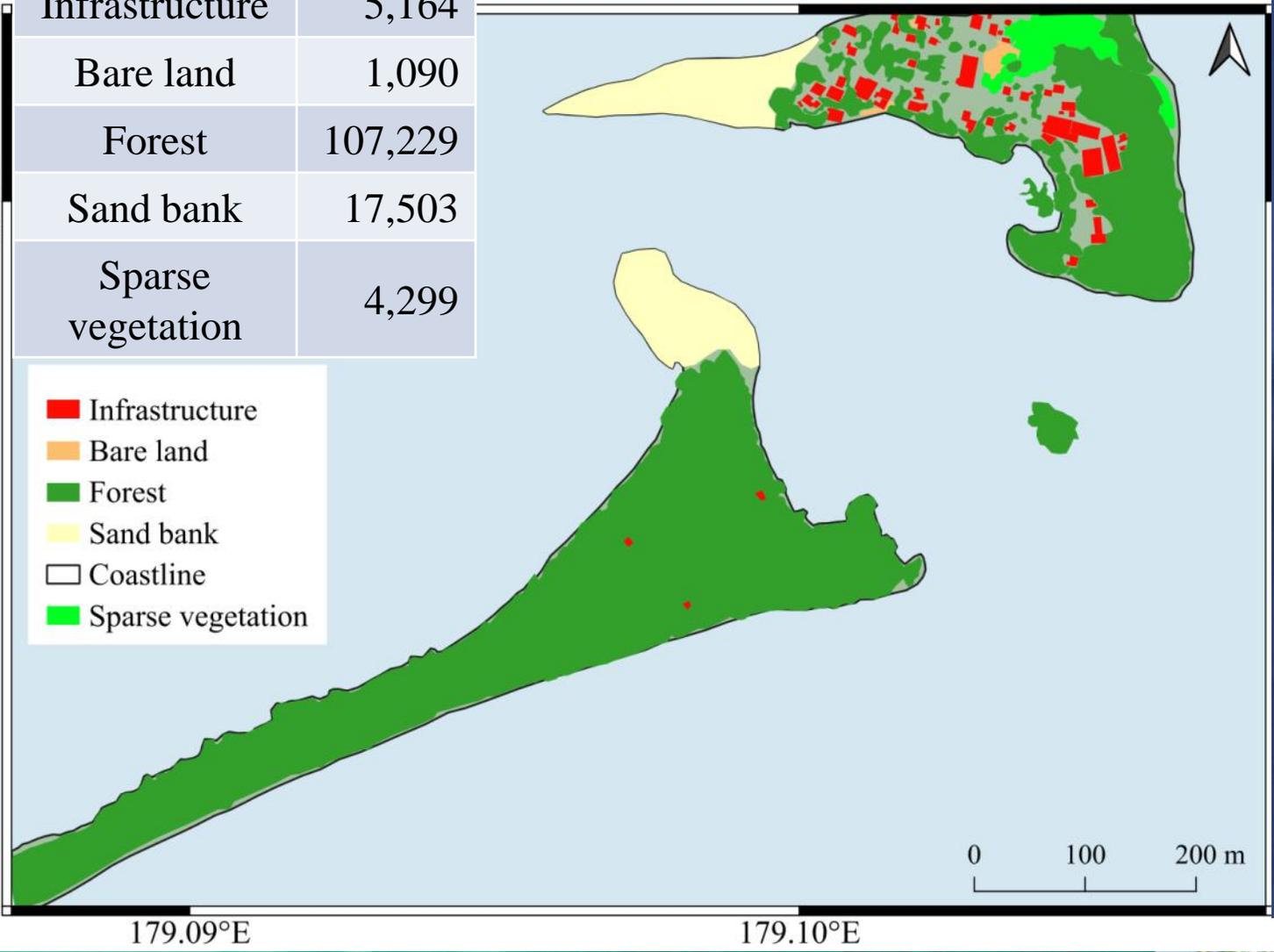
Total no. of islets: 29
Population: 11,500
Male: 5,500
Female: 6,000
Population (2017 census)



Land use mapping

Land use	Area (m ²)
Infrastructure	5,164
Bare land	1,090
Forest	107,229
Sand bank	17,503
Sparse vegetation	4,299

- Infrastructure
- Bare land
- Forest
- Sand bank
- Coastline
- Sparse vegetation



Funafuti, Tuvalu (2023)

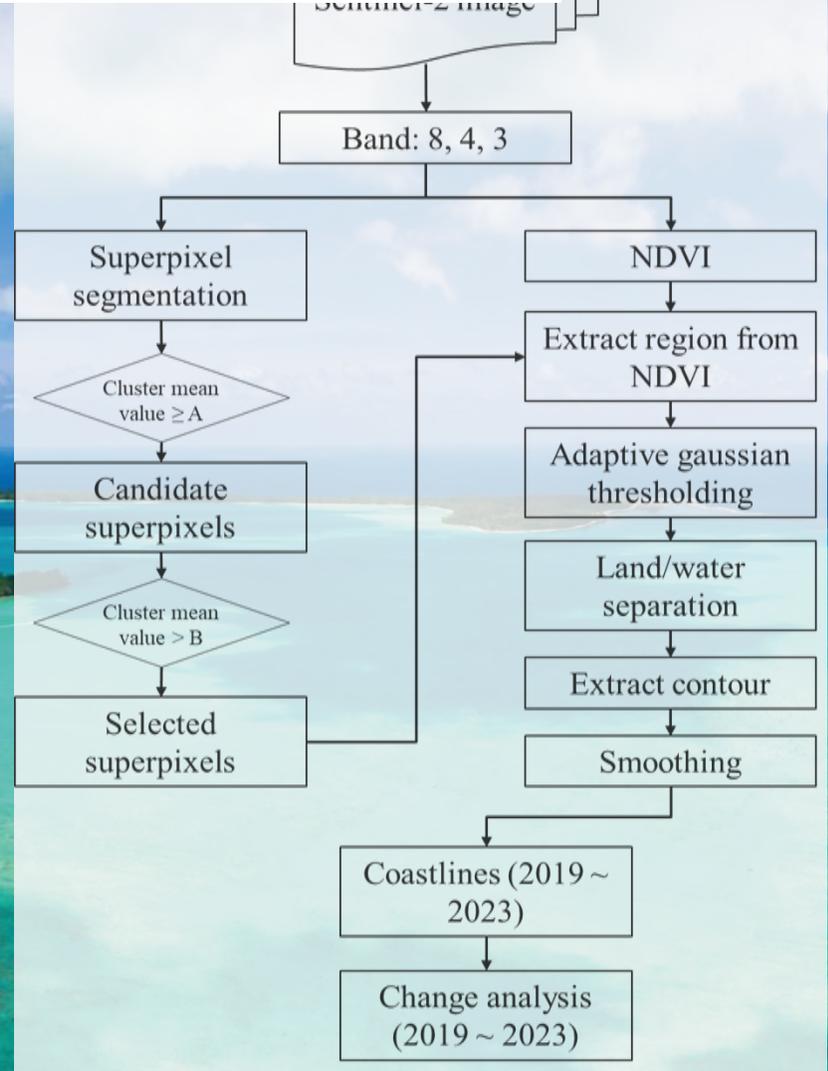


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Coastline monitoring

- Method: Automatic Extraction of Coastline
- Data: Sentinel-2
- NDVI and segmentation is conducted by using band 8, 4 & 3



and use mapping : Funafuti

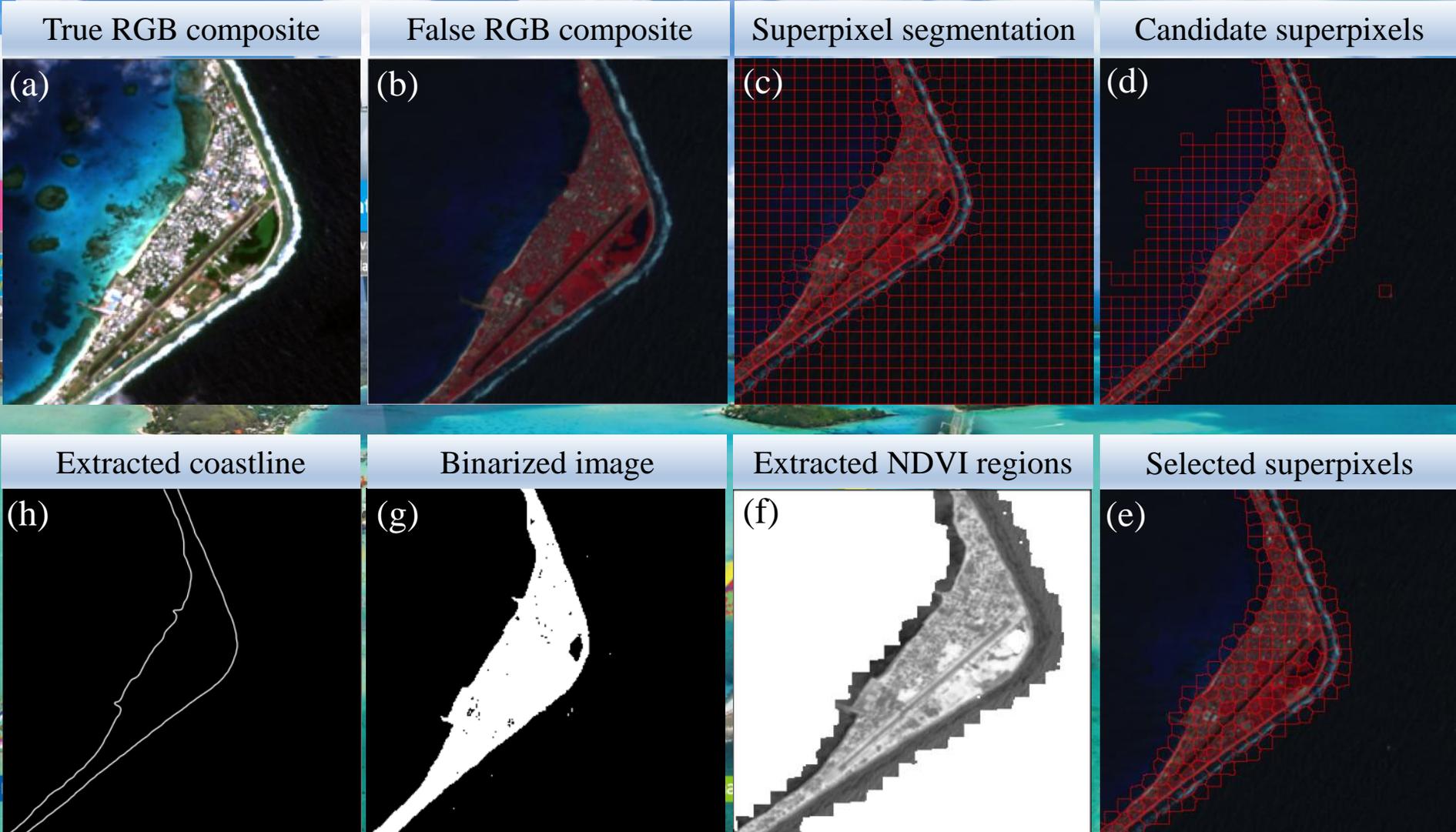
*Remote Sensing (2025), <https://doi.org/10.3390/rs17162794>



Coastline monitoring



- Optical
- E0 Data
- Sentinel-2
- Landsat 8/9
- High-resolution
- Worldview-2
- PlanetScope





Step1

Coastal & MSP

(<https://doi.org/10.3390/rs17162794>)

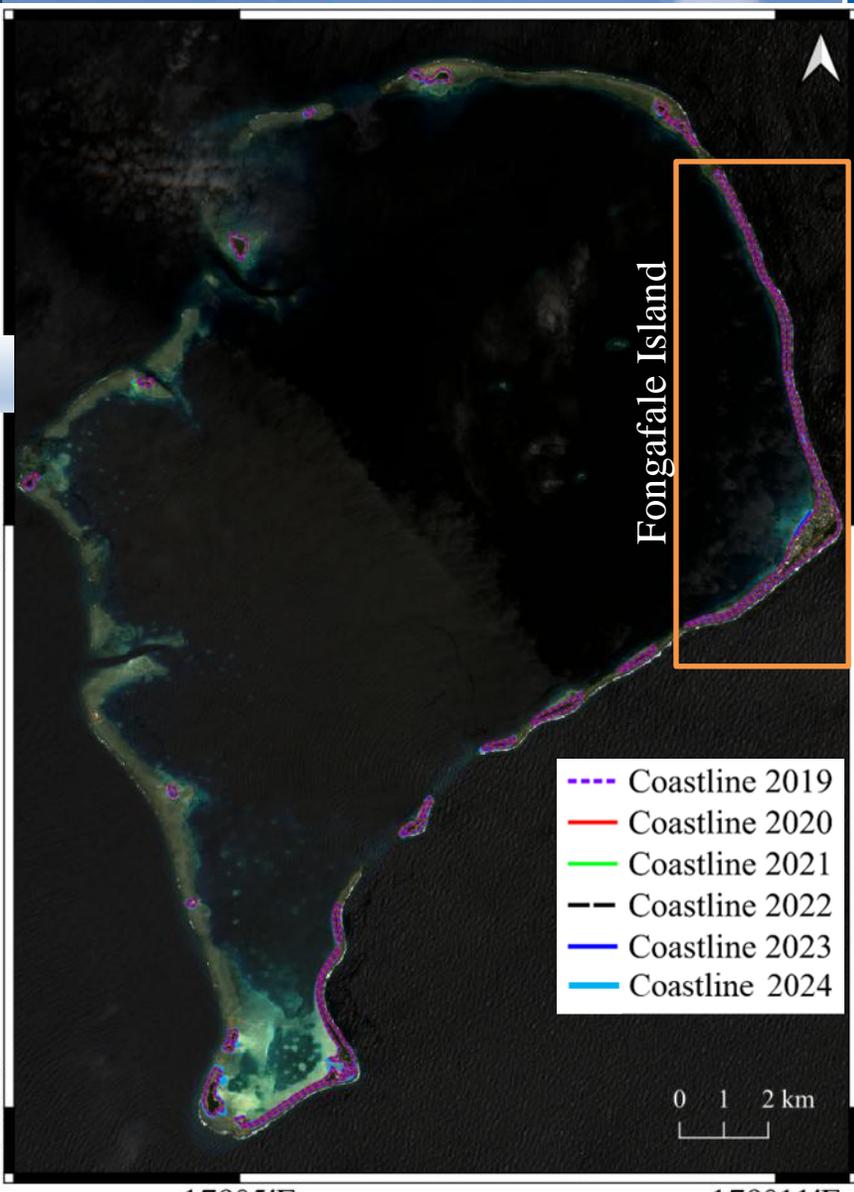
Coastline monitoring

Funafuti Atoll

- EO Data
- Sentinel-2
- Landsat 8/9
- High-resolu
- Worldview
- PlanetScope

8°31'S

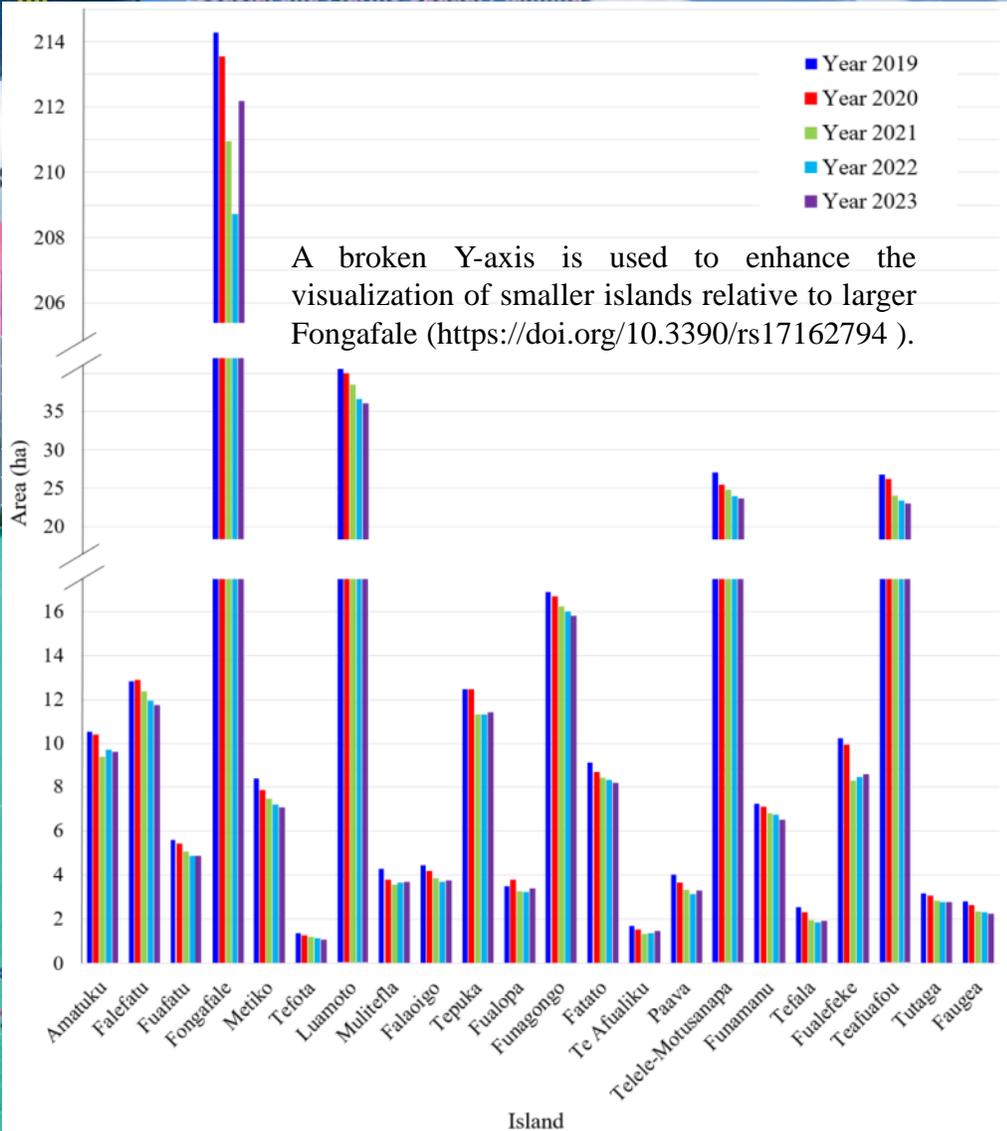
8°38'S



Islands	Length of Coastline (km) in Different Years					Change Rate (%)
	2019	2020	2021	2022	2023	
Amatuku	2.10	2.13	2.12	2.21	2.08	-0.6
Falefatu	2.44	2.41	2.43	2.43	2.40	-1.9
Fuafatu	0.99	1.0	0.98	0.96	0.95	-4.1
Fongafale	25.42	25.39	25.51	25.49	25.56	0.5
Metiko	1.86	1.83	1.81	1.79	1.79	-3.6
Tefota	0.47	0.45	0.44	0.43	0.42	-11.3
Luamoto, Funafala	6.95	6.95	6.9	6.90	6.87	-1.09
Mulitefla	0.76	0.72	0.69	0.70	0.70	-6.7
Falaoigo	0.78	0.76	0.73	0.72	0.72	-7.1
Tepuka	1.45	1.45	1.39	1.40	1.42	-2.2
Fualopa	0.81	0.87	0.95	0.93	0.79	-0.9
Funagongo	2.81	2.78	2.76	2.77	2.76	-1.5
Fatato	2.05	2.03	2.02	2.02	2.02	-1.3
Te-Afualiku	0.51	0.47	0.44	0.46	0.46	-8.8
Paava	0.77	0.74	0.70	0.70	0.70	-8.6
Telele-Motusanapa, Motuloa	6.14	6.10	6.20	6.20	6.15	0.14
Funamanu	1.66	1.65	1.62	1.61	1.61	-3.01
Tefala	0.58	0.55	0.51	0.50	0.50	-13.5
Fualefeke	1.49	1.45	1.36	1.36	1.38	-7.2
Teafuafou, Avalau, Tegasu	2.84	2.83	2.75	2.73	2.71	-4.6
Tutaga	0.64	0.62	0.60	0.60	0.59	-6.4
Faugea	0.64	0.64	0.61	0.61	0.61	-4.08



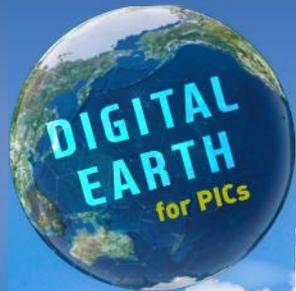
Coastline monitoring



- Temporal variation in island area (enclosed by the extracted coastline boundary) within Funafuti over the period 2019 and 2023.
- A decreasing trend is followed by most of the island (except **Fongafale**)
 - 2019 to 2020: -4.14%
 - 2020 to 2021: -7.75%
 - 2021 to 2022: -1.74%
 - 2022 to 2023: +0.25% [primarily due to land reclamation along the lagoon-facing coast of **Fongafale Island**]



--- Coastline 2019
 --- Coastline 2020
 --- Coastline 2021
 --- Coastline 2022
 --- Coastline 2023



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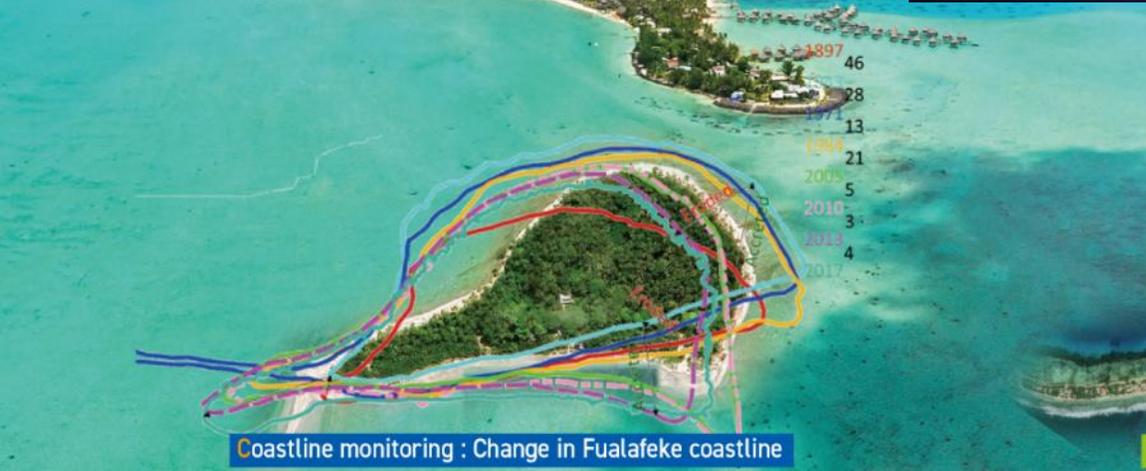
Coastline monitoring



Optical		
E0 Data		
Sentinel-2	W	C
Landsat 8/9	W	C
High-resolution		
Worldview-2	W	C
PlanetScope	W	C

SAR based		
Sentinel-1		C

ICESat-2		
Terrain Elevation		C
Altimetry data		C



Coastline monitoring : Change in Fualafeke coastline

Blue line: Sentinel-2 = 2022.02.15(22:27:49 UTC) >> Sea level: 1.5 m
 Red line: Landsat 8 (2022, by SPC)



Coastline monitoring

Automation of Coastline Extraction (WV-2)



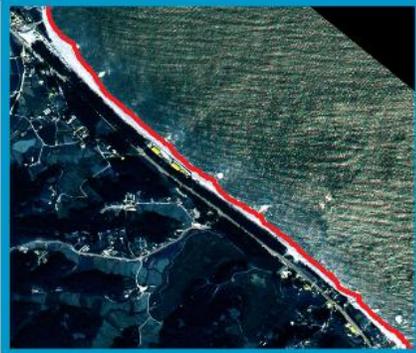
One-click solution
For satellite image input to coastline extraction

Original Extraction Algorithm

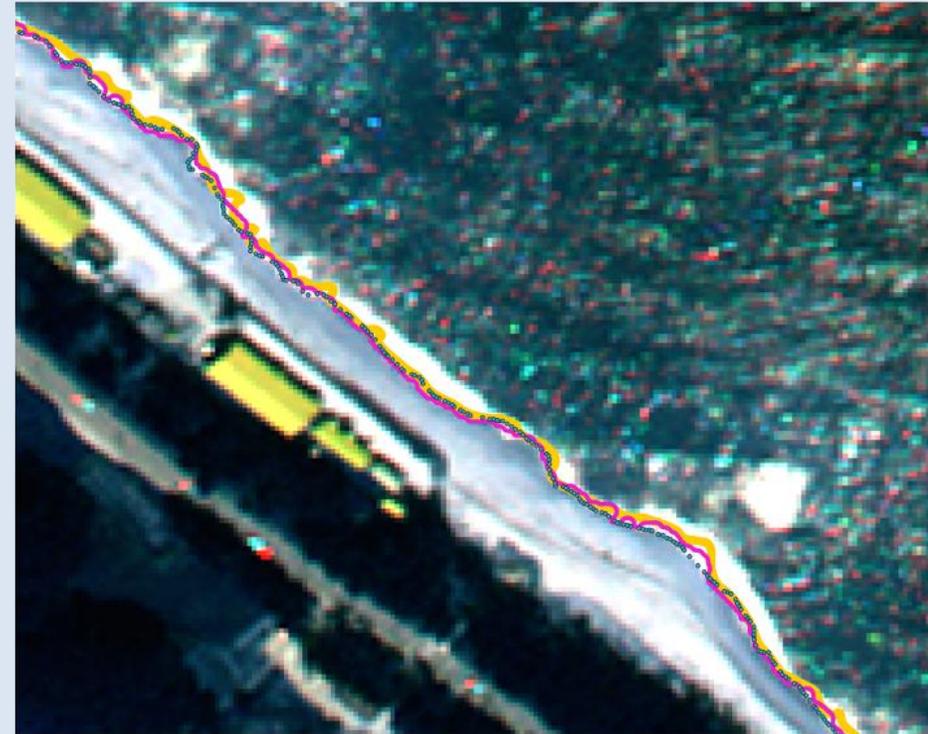


MAE : 1.98m

New Extraction Algorithm



MAE : 1.76m



- Original Extraction Algorithm (Manual)
- New Extraction Algorithm (Auto)
- True Shoreline (2m point)

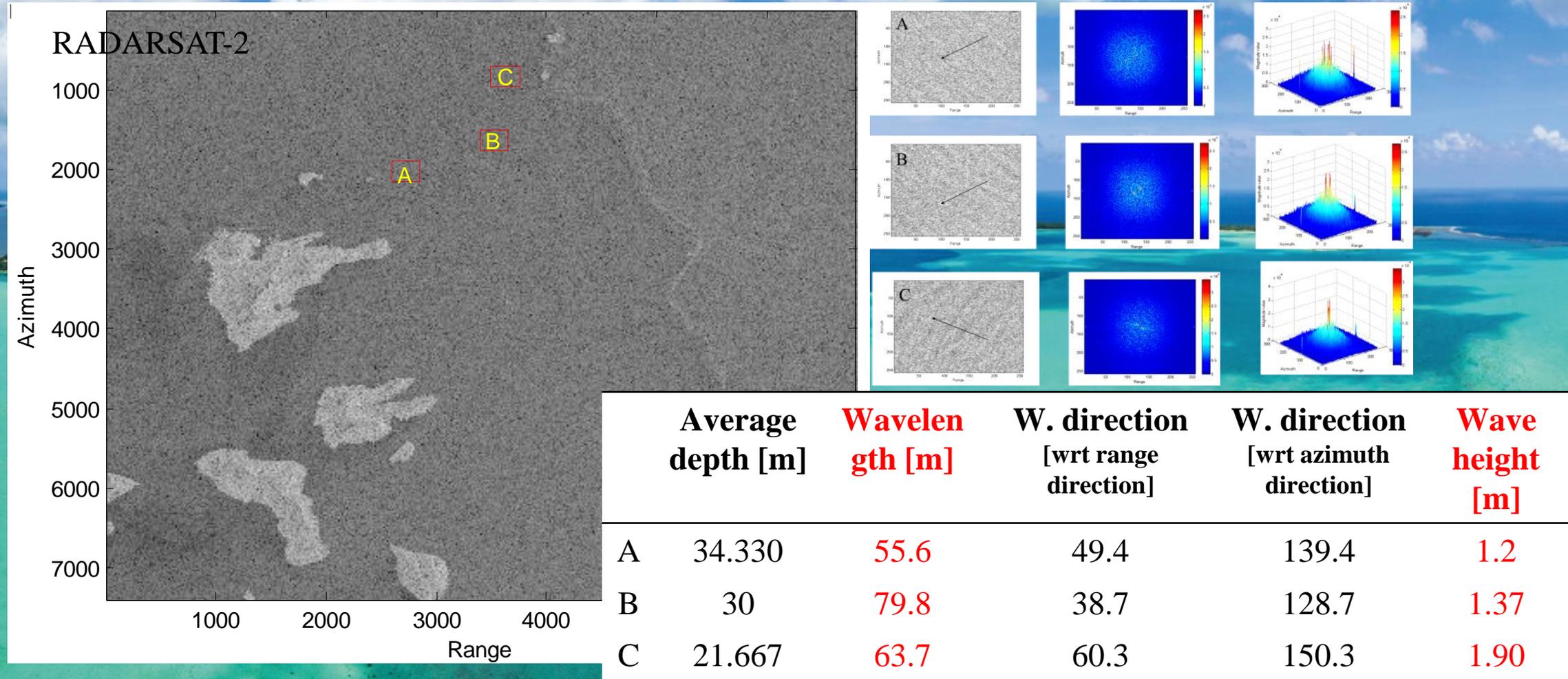
Towards Livable Islands in the Pacific Island Countries

Step1



Coastal & MSP
Development of Decision Ready Tools to Support Coastal and Marine Spatial Planning

Wave properties retrieval



Towards Livable Islands in the Pacific Island Countries

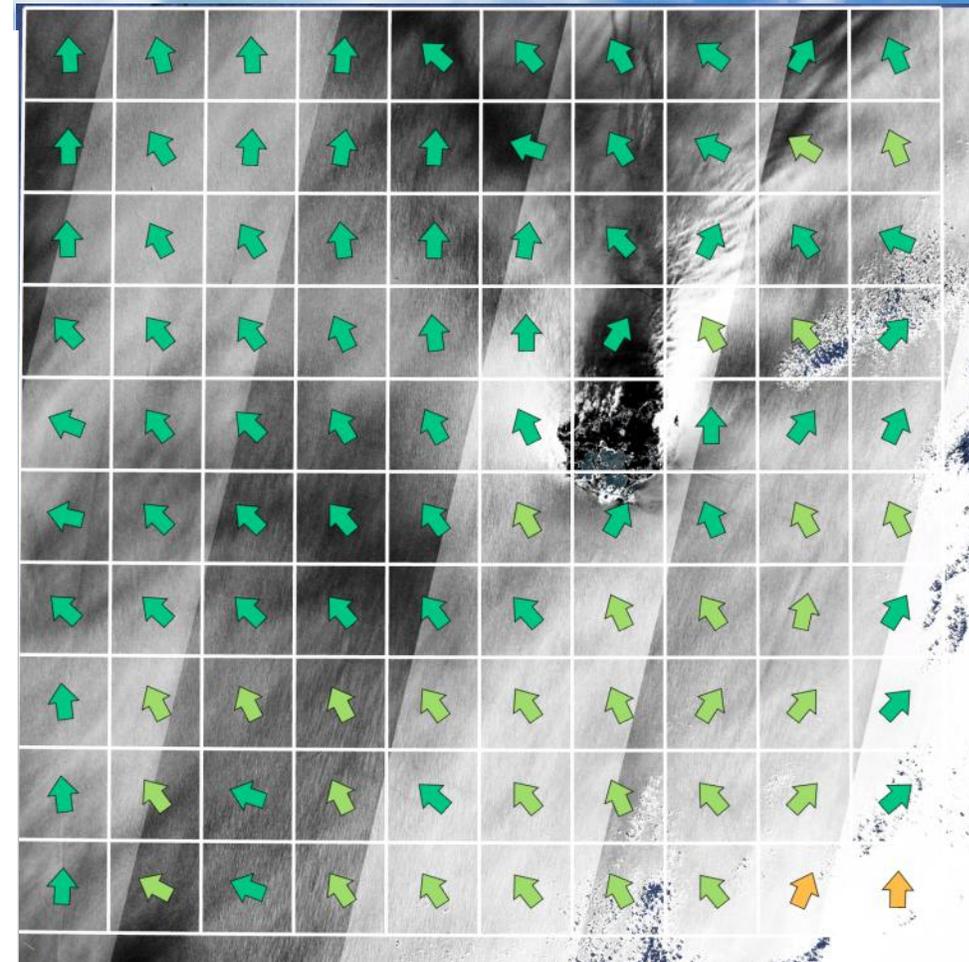
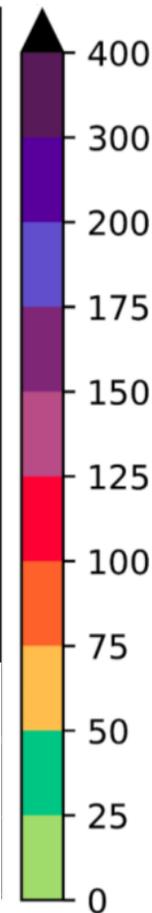
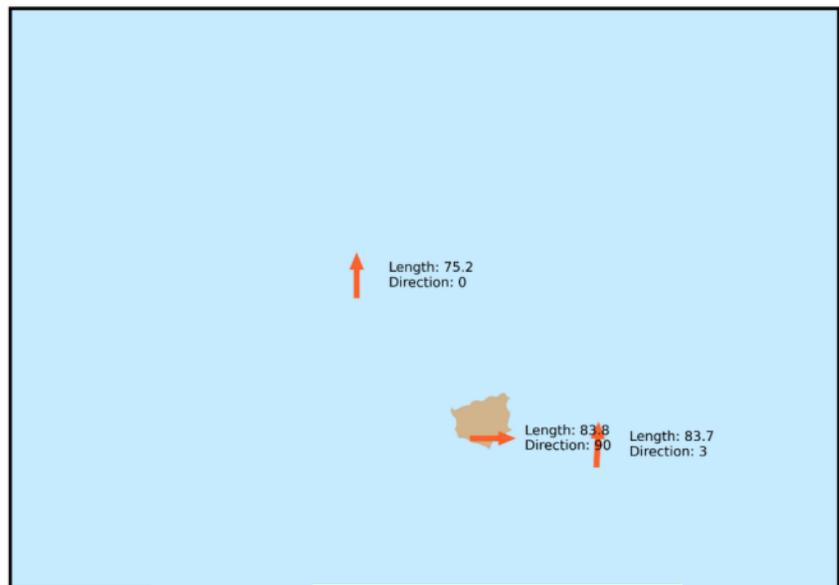
Step1



Coastal & MSP
Development of Decision Ready Tools to Support Coastal and Marine Spatial Planning

Wave properties retrieval

S-2 10m 2023-06-28 02:07:01
Big area Angle compare Wavelength(m)



	Wavelength (m)			Wave Direction		
	S-2	WINK	ERA5	S-2	WINK	ERA5
No.15	75.20	45.48	37.91	0.0	14.0	22.67
No.16	83.79	-	41.39	90.0	-	29.26
No.17	83.71	63.88	41.39	2.72	-	29.26

Towards Livable Islands in the Pacific Island Countries

Step1

Wave properties retrieval

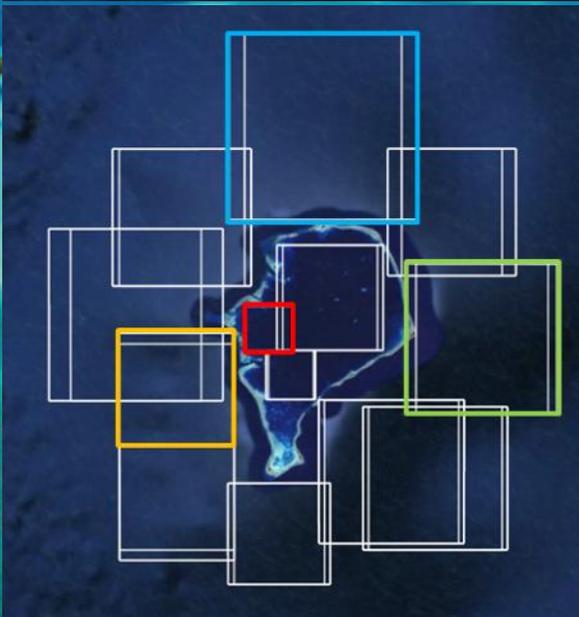
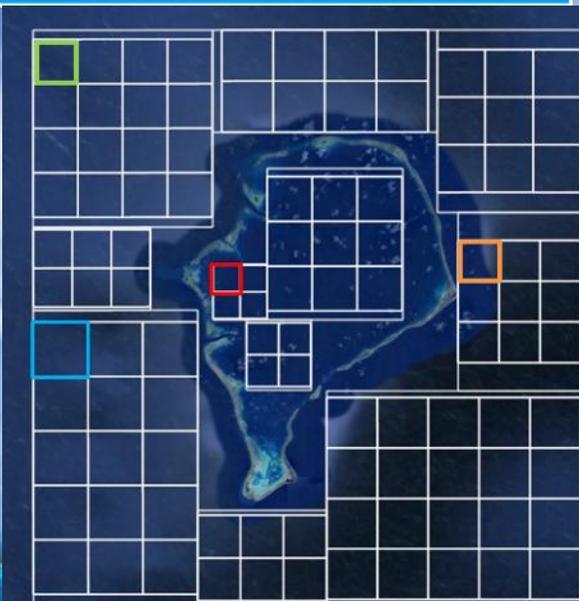


Coastal & Marine Spatial Planning
Development of Decision Ready Coastal and Marine Spatial Planning

Original grid



Big grid



The original grid is divided into small grids

1.82 km

2.7 km

3.1 km

3.6 km

4.5 km

11.1 km

14.5 km

18.1 km

Towards Livable Islands in the Pacific Island Countries

Step1

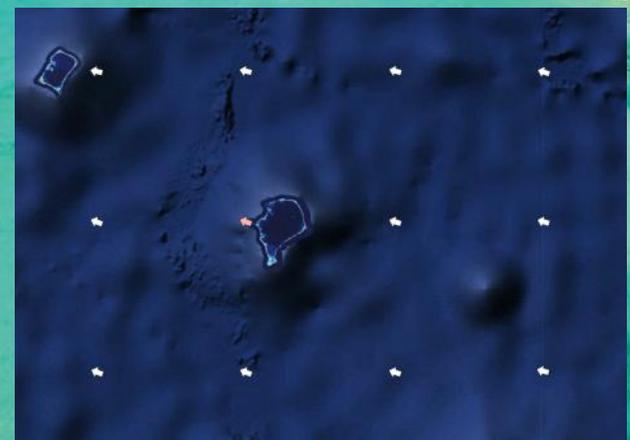
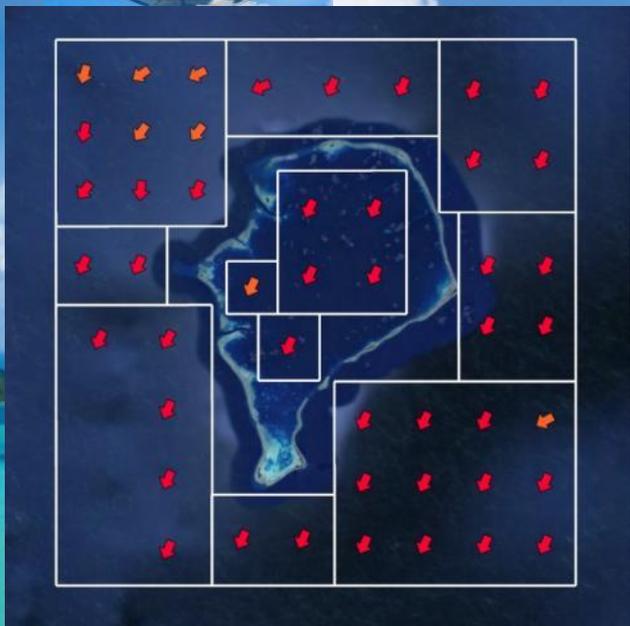


Coastal & MSP
Development of Decision Ready Tools to Support Coastal and Marine Spatial Planning

Wave properties retrieval

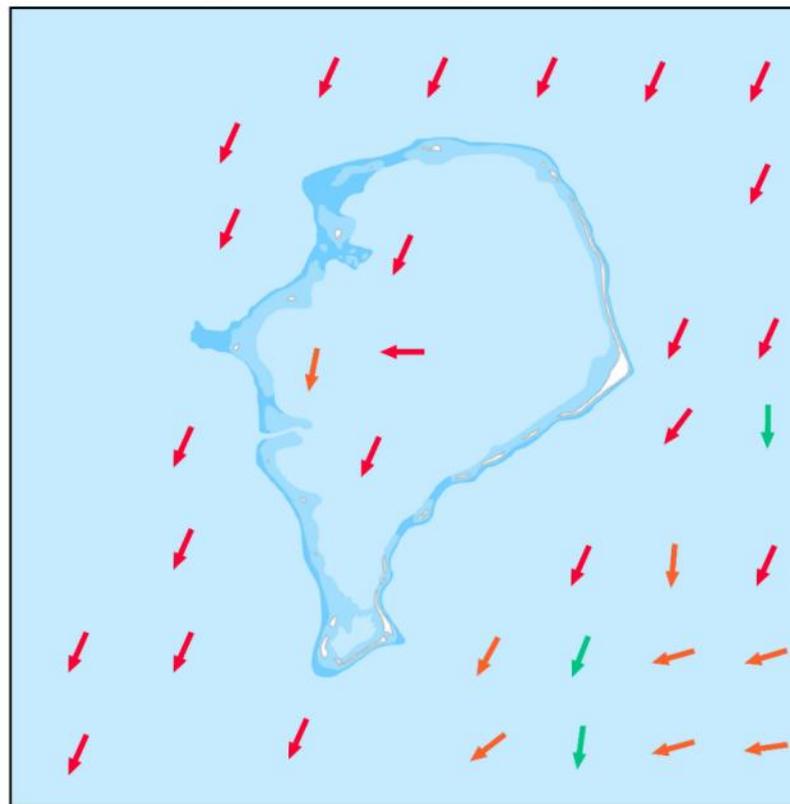
Landsat-8: 102 (Sep. 3 2014~)

Sentinel-2: 179 (2019~)



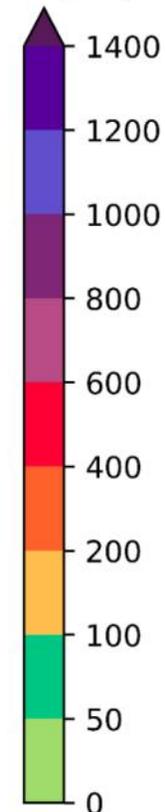
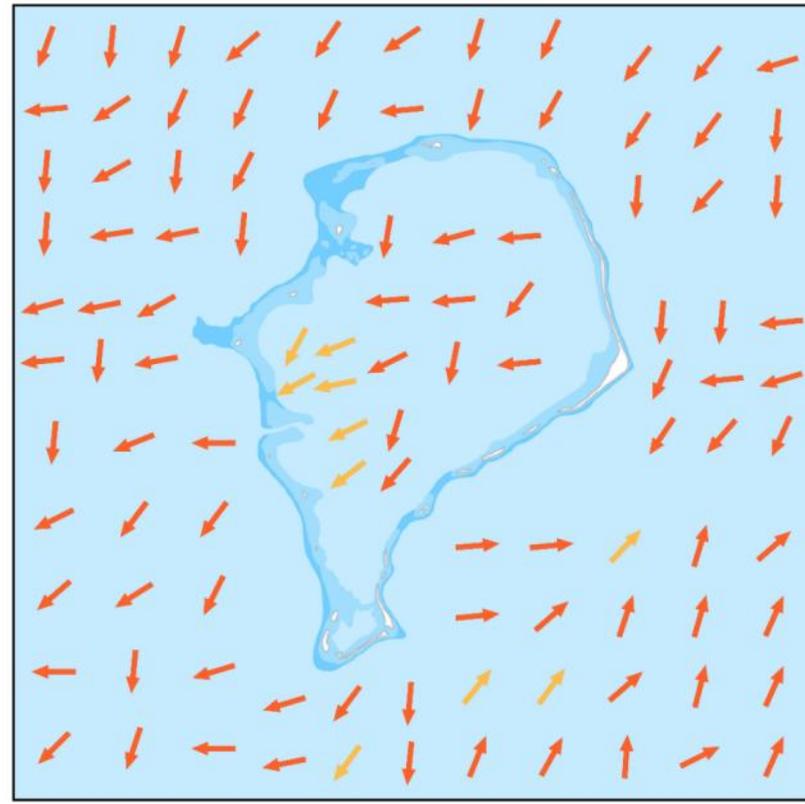
L-8 30m 2014-09-19 22:10:31
Original area Angle compare

Wa



S-2 10m 2020-02-01 22:27:48
Original area Angle compare

Wavelength(m)



Malamala Island
Sheraton

Field Survey (Nov. 21-23, 2024)



Shanori-La

Sigatoka Sand Dunes National Park

Holiday Inn Suva

Nukulau Island



Summary

- KIOST has **developed an algorithm** to extract the coastline from a Sentinel-2 image and applied it to the Funafuti, Tuvalu.
- The coastline of **Funafuti**, extracted from **2019 to 2023**, will be shared with **SPC** and contribute to the DEP (Digital Earth Pacific) platform for demonstration.
- Moreover, an **algorithm** has been developed to estimate the **wave properties**, including wave direction and wavelength, from Sentinel-2 and Landsat data, which has been **applied in Funafuti**.
- It will provide insight into the wave properties around the island and help to understand its impact on the coastal changes. **After validation**, this **outcome** will be shared with **SPC** for **demonstration** on the **DEP** platform.
- The **land use map** of the **eastern** side (2023) and the **southeastern** side of **Funafuti**, Tuvalu, was generated (2025). The land use information will be shared with SPC, which can be added to the DEP platform. It will highlight the land use properties of Funafuti and aid in understanding these properties.
- ✓ Additionally, KIOST has analyzed the long-term changes of the coastal areas of Tuvalu, which depict the circumstances of previous coastal changes.
- ✓ Besides, a long-term analysis of tropical cyclone occurrences in the vicinity of Tuvalu and its possible impact on Tuvalu has been conducted. The output of these analyses will be helpful in understanding the pattern of coastal changes resulting from natural or anthropogenic occurrences.

List of Publications (CMSP)



1. A Review on Multidecadal Coastal Changes at Funafuti, Tuvalu from 1897 to 2015. Korean Journal of Remote Sensing, 2023
2. Long-Term Analysis of Tropical Cyclones in the Southwest Pacific and Influences on Tuvalu from 2000 to 2021. Korean Journal of Remote Sensing, 2023
3. A Study on the Coastline Extraction and Coastal Change Analysis Using Sentinel-2 Imagery in Funafuti, Tuvalu. Remote Sensing, 2025

Korean Journal of Remote Sensing, Vol. 39, No. 1, 2023, pp.23-45
https://doi.org/10.7780/kjrs.2023.39.1.2

ISSN 1225-6161 (Print)
ISSN 2287-9307 (Online)

Review

A Review on Multidecadal Coastal Changes at Funafuti, Tuvalu from 1897 to 2015

Ahmed Harun-Al-Rashid^{1,2,*}, Chan-Su Yang^{3,4,5,6,7}

Korean Journal of Remote Sensing, Vol. 39, No. 4, 2023, pp. 441-458
https://doi.org/10.7780/kjrs.2023.39.4.5

ISSN 1225-6161 (Print)
ISSN 2287-9307 (Online)

Research Article

Long-Term Analysis of Tropical Cyclones in the Southwest Pacific and Influences on Tuvalu from 2000 to 2021

Sree Jewel Kumar Chowdhury^{1,2,*}, Chan-Su Yang^{3,4,5,6,7}

remote sensing

MDPI

Article

A Study on the Coastline Extraction and Coastal Change Analysis Using Sentinel-2 Imagery in Funafuti, Tuvalu

Sree Jewel Kumar Chowdhury^{1,2,*} and Chan-Su Yang^{1,2,3,4,5,6,7}

¹ Sea Power Rejuvenation and Security Research Department, Korea Institute of Ocean Science & Technology, Busan 49111, Republic of Korea; jkcs@kiost.ac.kr
² Department of Convergence Study on the Ocean Science and Technology, Ocean Science and Technology School, National Korea Maritime & Ocean University, Busan 49111, Republic of Korea
³ Marine Technology and Convergence Engineering, University of Science & Technology, Daejeon 34111, Republic of Korea
⁴ Correspondence: yangcs@kiost.ac.kr

Abstract: Temporal alterations in coastlines depict the significant changes in coastal areas, driven by both natural processes and human activities. For island nations, monitoring of the coastline is essential due to their vulnerability to such impacts. In this study, Funafuti Atoll, an archipelago of small and scattered islands around the capital of Tuvalu, is selected as the study region, and the aim is to extract coastlines of different islands and investigate coastal area changes between 2019 and 2023 using Sentinel-2 imagery. A simple linear iterative clustering-based supervised segmentation and adaptive thresholding approach is employed for coastline extraction. Initially, supervised segmentation is conducted to cluster 3-band image pixels into coherent regions, excluding the sea area. Subsequently, the normalized difference vegetation index (NDVI) is calculated, and the superpixels are used to obtain corresponding NDVI regions, on which adaptive Gaussian thresholding is applied to extract coastlines. Finally, the areas enclosed by the extracted coastline boundaries are utilized for change analysis. The results indicate that islands along the western rim of Funafuti exhibited significant alteration (an average decrease of -14.48%), whereas those along the eastern rim remained relatively stable due to the presence of coral rubble ridges and steep slopes. The change analysis revealed that from 2019 to 2023, approximately 15.1 hectares (ha) were eroded, resulting in a net area change rate of -4.14%. Between 2020 and 2021, erosion increased to 20.2 ha, yielding a net change of -7.75%. From 2021 to 2022, 13.2 ha were eroded, corresponding to a -1.74% change. From 2022 to 2023, a net gain of 10.3 ha occurred (+0.25%), primarily due to land reclamation along the lagoon-facing coast of Fongafale Island. Overall, all islands showed a decreasing area trend between 2019 and 2023, with an average net change of -12.97%. The coastal changes occurred along the sand-dominated coast with gentle slopes, possibly driven by the impact of tropical cyclones, prolonged swells, and coastal flooding, which act as the primary driving forces for the study region.

Keywords: coastline; coastal change; spectral index; adaptive threshold; segmentation

1. Introduction

The coastal zone is among the most densely populated and developed regions globally, with over half of the world's population residing within 100 km of the coastline [1,2], and approximately a quarter of global economic production occurring within this area [3].

Received August 2024
¹ Researcher, Marine Technology Research Center, Korea Maritime and Ocean University
² Master Student, Department of Marine and Ocean Engineering, Korea Maritime and Ocean University
³ Principal Researcher, Korea Institute of Ocean Science & Technology
⁴ Professor, Department of Applied Oceanography, Korea Maritime and Ocean University
⁵ Professor, Department of Marine and Ocean Engineering, University of Science & Technology
⁶ Corresponding Author, Korea Institute of Ocean Science & Technology
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Remote Sens. 2025, 17, 2794

https://doi.org/10.3390/rs17162794

Newsletter



As part of promoting activities, several editions of the newsletter have been published and distributed to personnel in Pacific Island countries

Many small island countries are facing the of rising sea levels in the South Pacific. To apply satellite remote sensing to the coastal areas in danger, the Coastal and Marine Spatial Planning (Coastal MSP) project is ongoing by the Institute of Ocean Science and Technology (KIOST) and the Pacific Community (SPC).

기후변화에 따른 해수면 상승으로 인해 사라질 위기에 처한 해안선이 증가하고 있다. 위성 원격 감지 기술을 활용하여 해안 및 해양 공간 계획 (Coastal MSP) 프로젝트를 통해 해양 공간 계획 (Coastal MSP) 프로젝트를 추진하고 있다. (KIOST)과 태평양 공동체 (SPC)에서 진행 중이다.

KIOST - IUU & Coastal MSP Projects

The FFA Regional Fisheries Surveillance Centre (RFSC) is part of the Pacific Islands Forum Fisheries Agency (IFFA) which supports its 17 member countries in sustainable managing fishery resources within their 200-mile Exclusive Economic Zones (EEZs).

The RFSC coordinates regional surveillance operations such as Operation Rai Baling and Operation Island Check which involve collaboration between member nations or partners including Australia, New Zealand, France, and the United States. These operations aim to monitor vast areas of the Pacific by utilizing both surface ships and aerial surveillance to detect and prevent IUU fishing activities. The RFSC's efforts are supported by intelligence gathering and analysis, which enhances the effectiveness of these operations by providing required information.

KIOST - IUU & Coastal MSP Projects

The BlackSky satellite is an optical satellite that is designed to produce images up to 35cm, with the goal of providing approximately 30 minutes of revisit time to most areas. Currently, 15 satellites are in operation. Additionally, it is also capable of detecting ships and other objects at night.

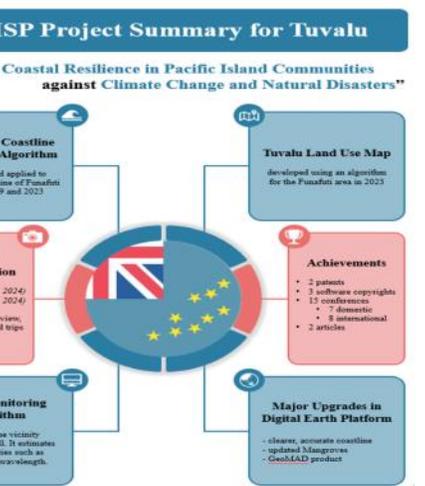
KIOST - IUU & Coastal MSP Projects

The CMSP Technical Collaboration Planning meeting was held in Fiji from November 21-23, 2024. The purpose of the meeting is to share the progress of the CMSP project being promoted by the Secretariat of the Pacific Community (SPC) and Korea Institute of Ocean Science and Technology (KIOST) with the support of the Korea-PF Cooperation Fund and to draw up future cooperation plans. From SPC, seven delegates including H.E. Ngelesile Obai Ulukong, Deputy Director (Seasources and Energy Programme Division), and M. Sachindra Singh, Earth & Oceans Observation Team Leader, and two from KIOST including Dr. Chan Su Hong, participated. The results of the meeting related to CMSP are introduced below.

KIOST - IUU & Coastal MSP Projects

2024년 11월 21일부터 23일까지 Fiji에서 열린 CMSP 기술 협력 계획 회의 회의가 진행되었습니다. 이번 회의는 SPC와 KIOST가 협력하여 추진 중인 CMSP 프로젝트를 소개하고, 한국-태평양포럼 협력기금(Korea-PF Cooperation Fund)을 통해 향후 협력 방안을 마련하는 것을 목표로 하였습니다. SPC측에서는 Ngelesile Obai Ulukong 부국장(Seasources and Energy Programme Division)과 M. Sachindra Singh, Earth & Oceans Observation Team Leader, 그리고 KIOST측에서는 Dr. Chan Su Hong 박사가 참석했습니다. 회의 결과, CMSP와 관련된 내용은 아래와 같습니다.

KIOST - IUU & Coastal MSP Projects



Contents

- Cover story: KIOST findings
- Feature
- Expert Opinion
- What's going on?



Step 2

Coastal & MSP

- Under the ROK-PIF Cooperation Fund
- Period: 2025 ~ 2028 (4 years), US\$ 3.04M
- Tuvalu, Republic of Marshall Island, Tonga (TBD)

Implementing agencies:

- The Korea Institute of Ocean Science and Technology (KIOST)
- The Pacific Community (SPC)

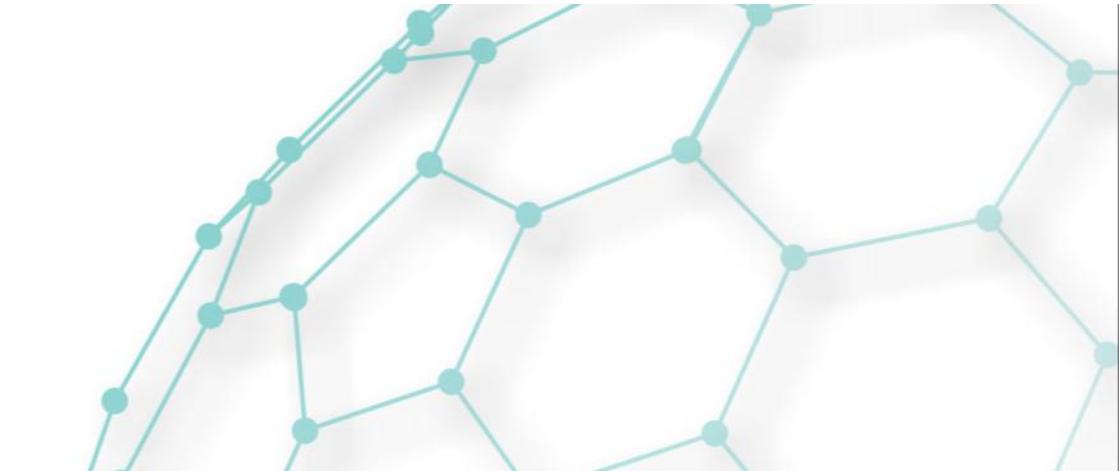
Donors:



Ministry of Foreign Affairs



PACIFIC ISLANDS FORUM

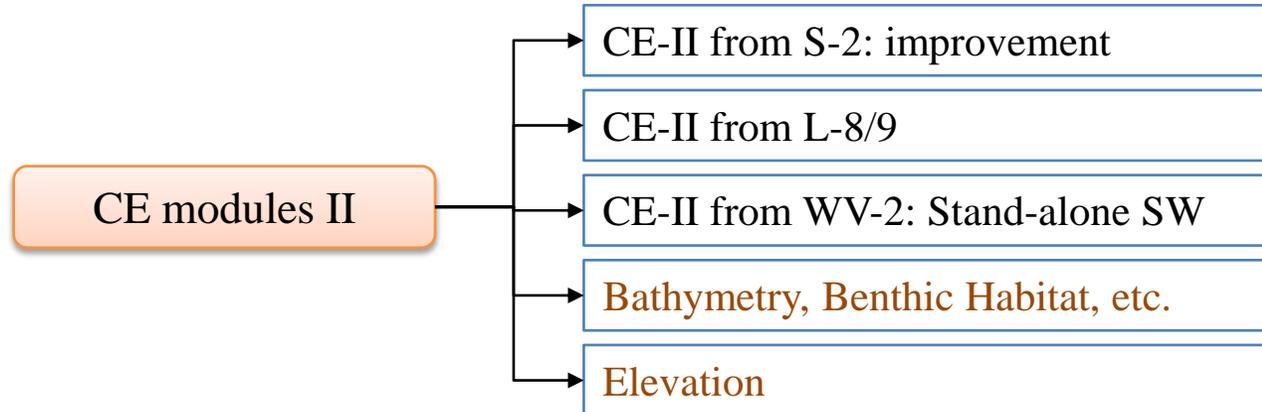


한국해양과학기술원
KOREA INSTITUTE OF OCEAN SCIENCE & TECHNOLOGY

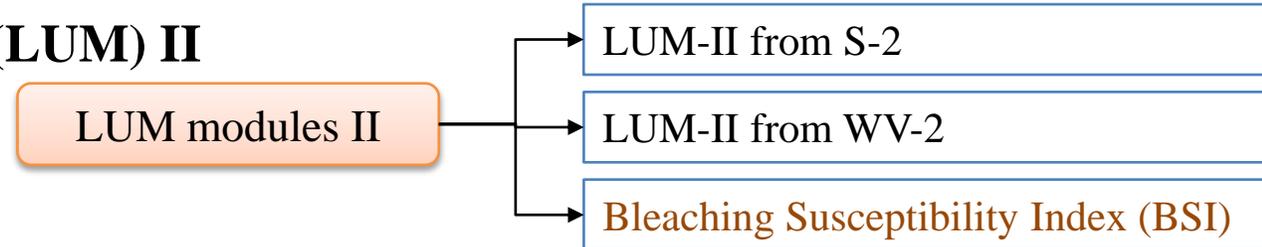
CMSP Step 2 (2025-2028)

Objectives

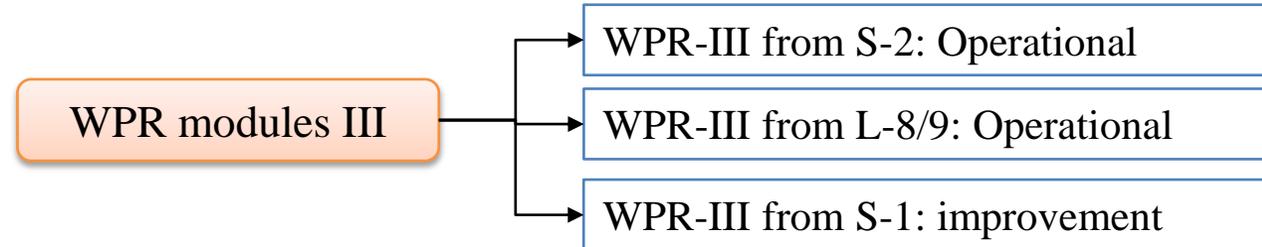
Extraction of coastline (CE) II



Land use mapping & change detection (LUM) II



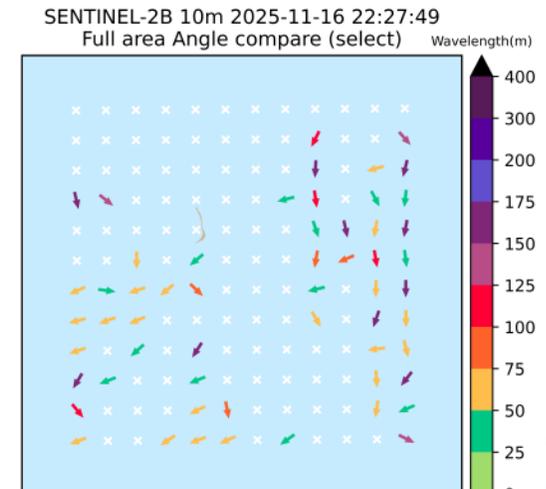
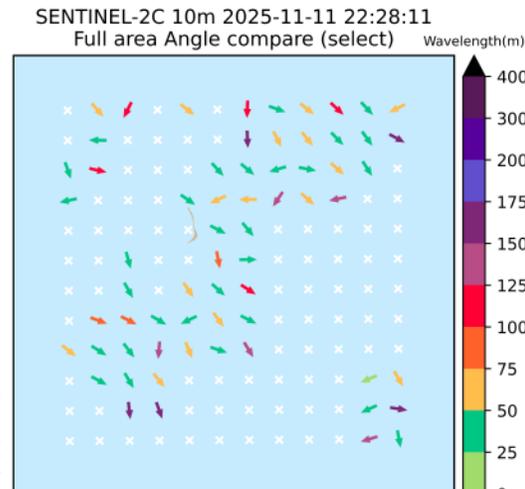
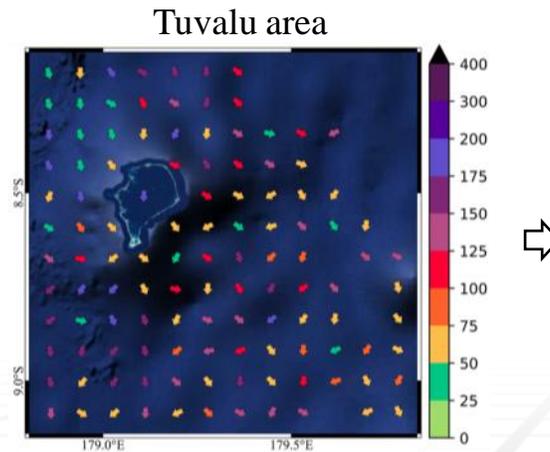
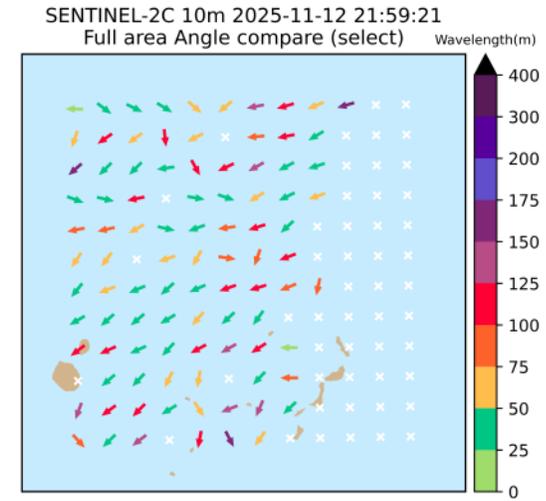
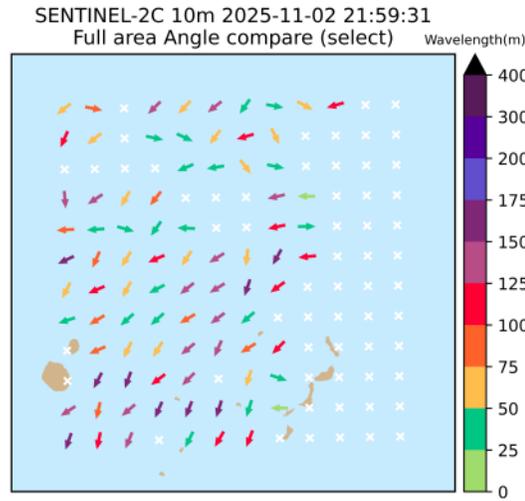
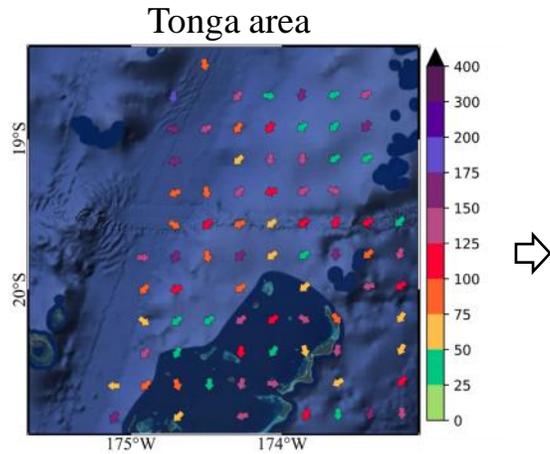
Retrieval of wave properties (WPR) III



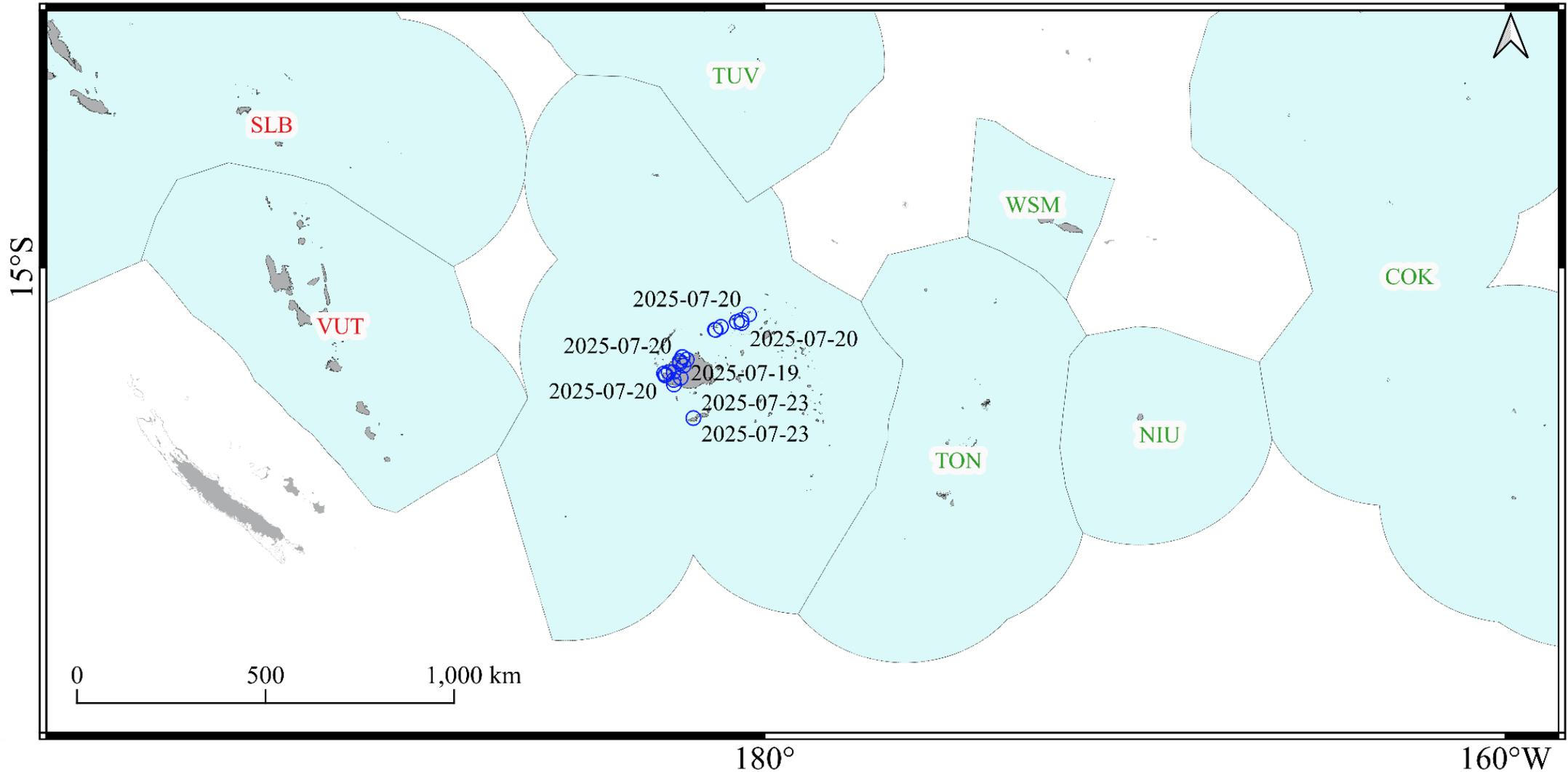
- Current outcome and outcome expected in 2025 will overlap to ensure continuity

NRT Operation: WPR

- Test period: 2025.07.05 ~ current
- Test Area: Tonga and Tuvalu



NRT Operation: Fire Monitoring



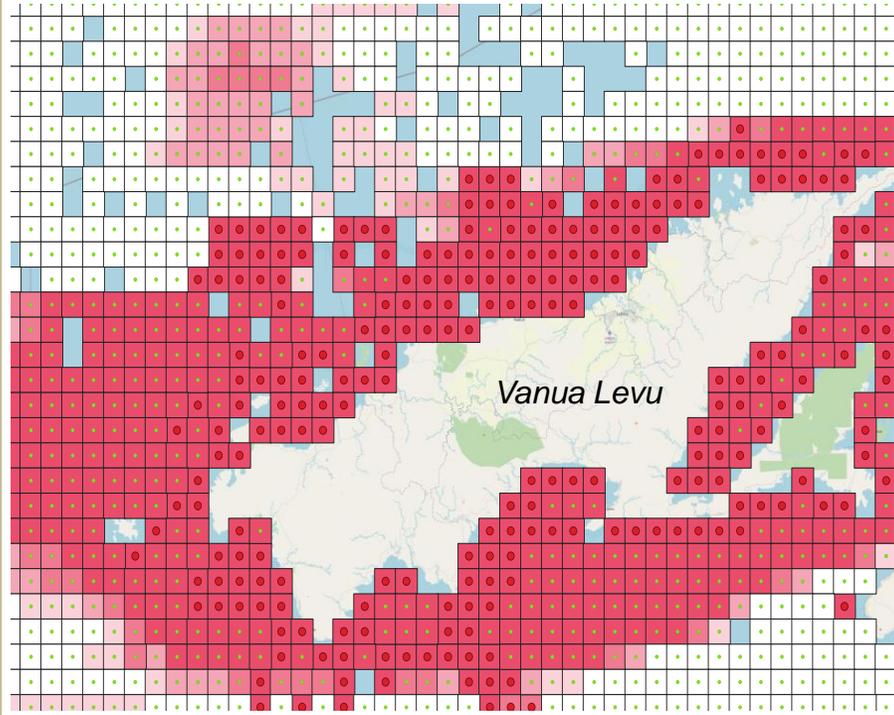
Bleaching Susceptibility Index (BSI)

Fiji

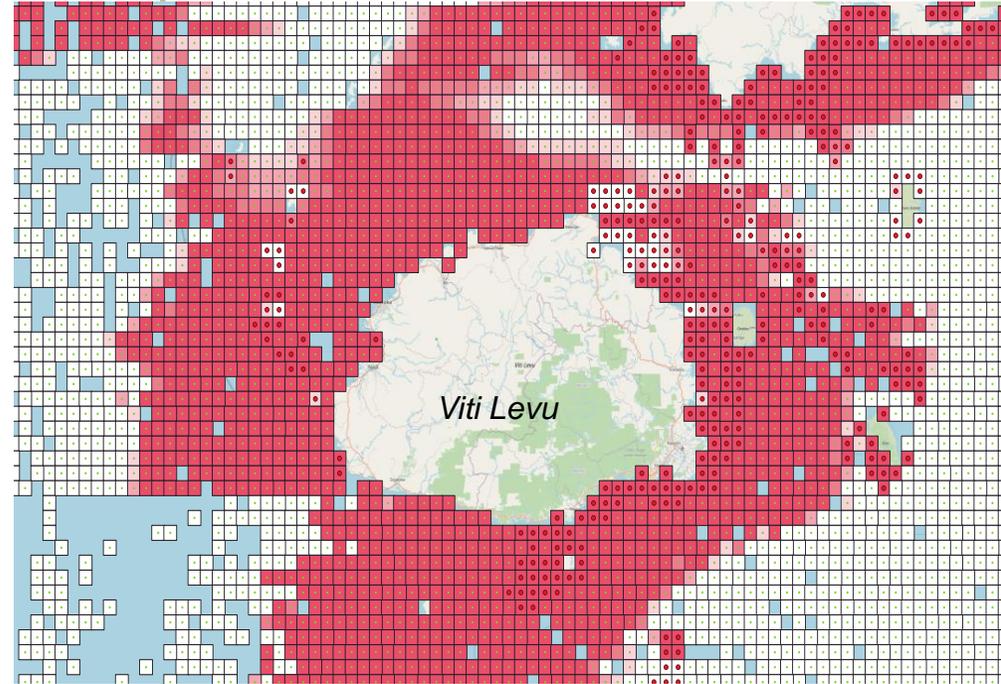
(8 May 2023)



Coral Reef Environmental Stress Index Map, Fiji (8 May 2023)



Coral Reef Environmental Stress Index Map, Fiji (8 May 2023)



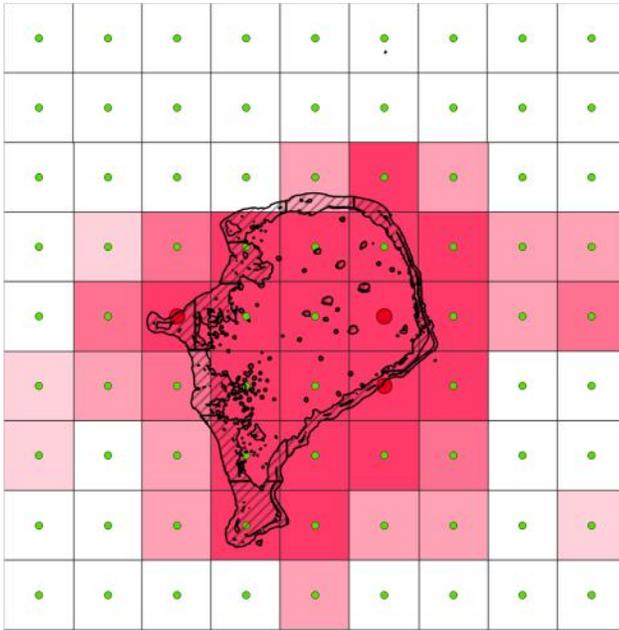
Stress level



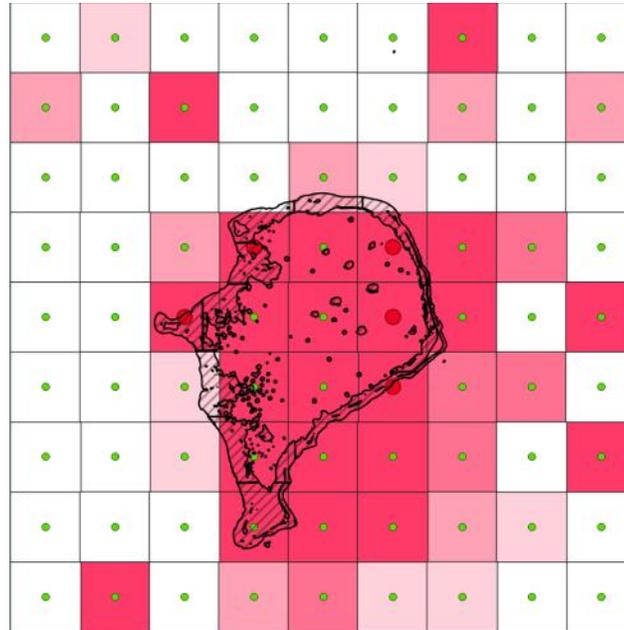
Bleaching Susceptibility Index (BSI)

Funafuti (Tuvalu)

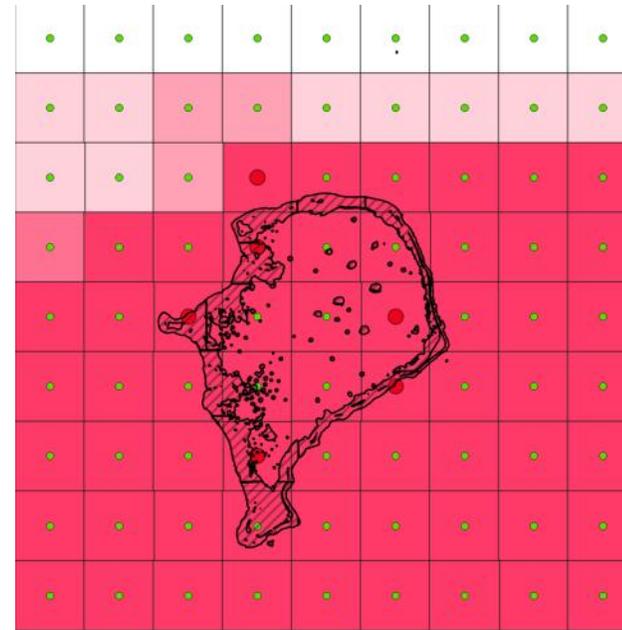
(12 February 2024)



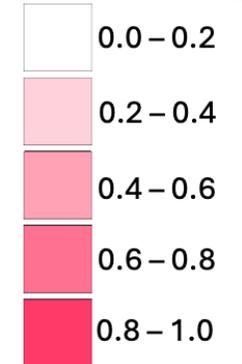
(20 May 2024)



(26 August 2024)



Stress level

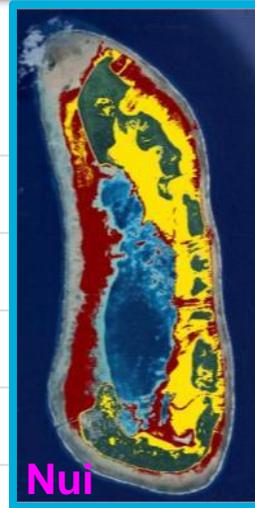


● BO
● BX

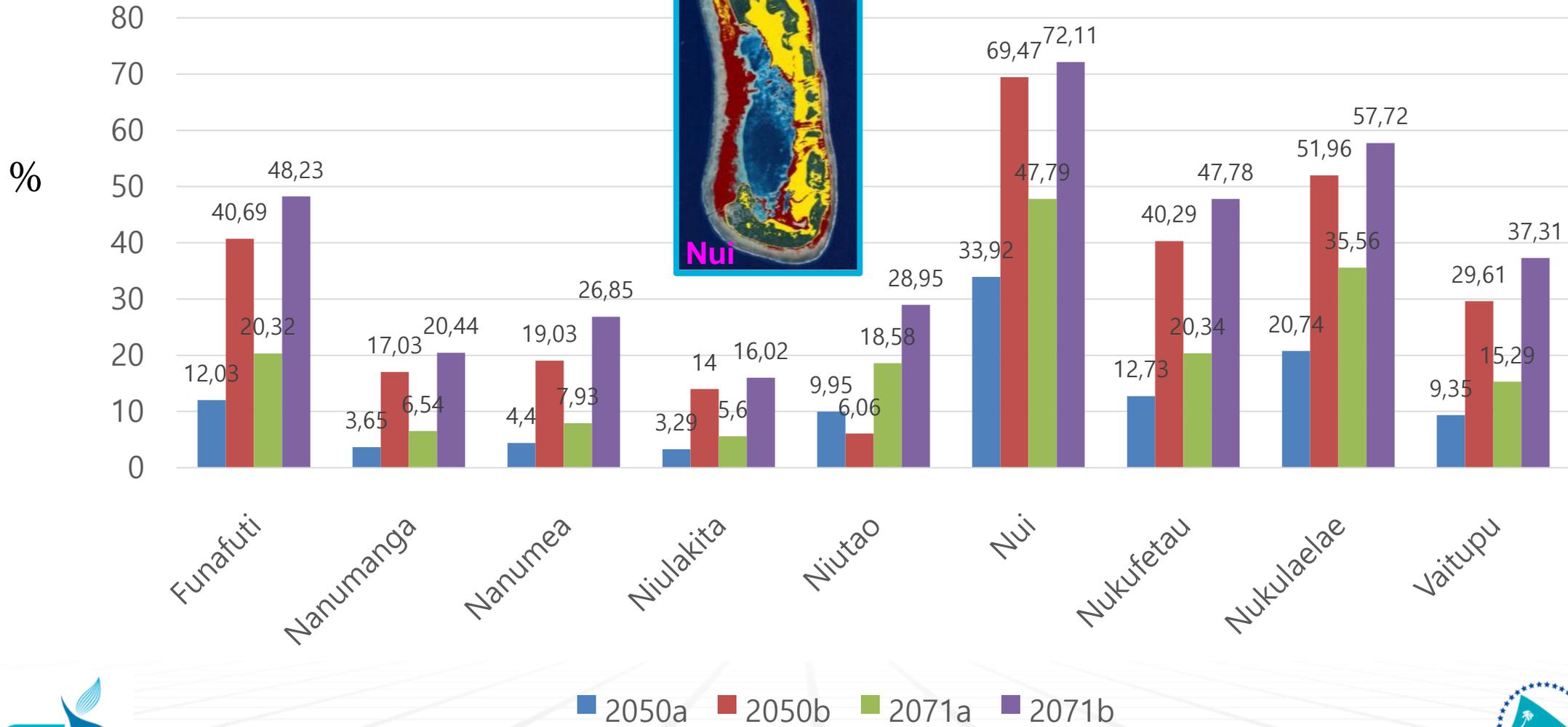


Scenario A: Future Inundation Risk

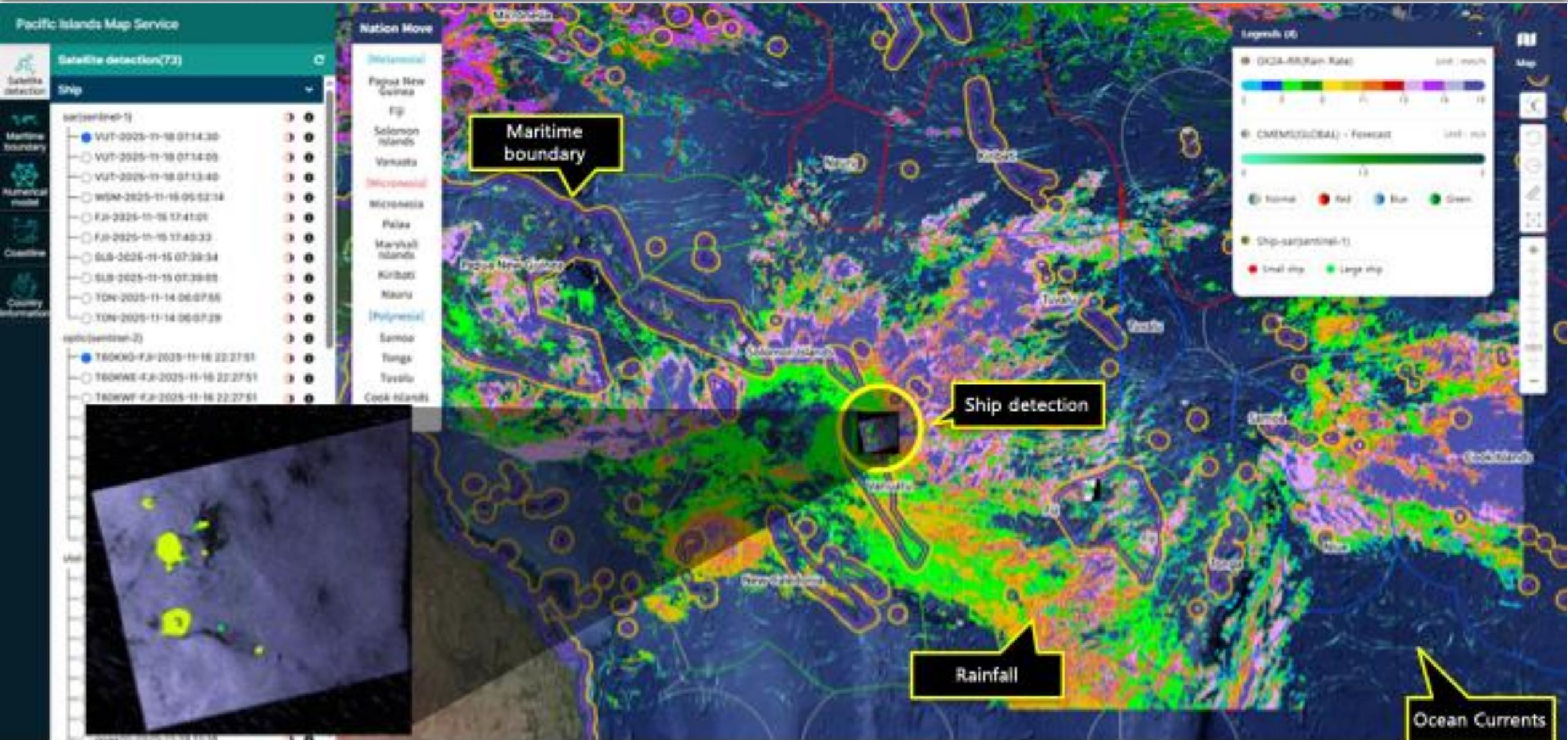
Tuvalu



a MSL, b MSL+Tide



Pacific Data Platform: Map Service



Nation Move

[Melanesia]

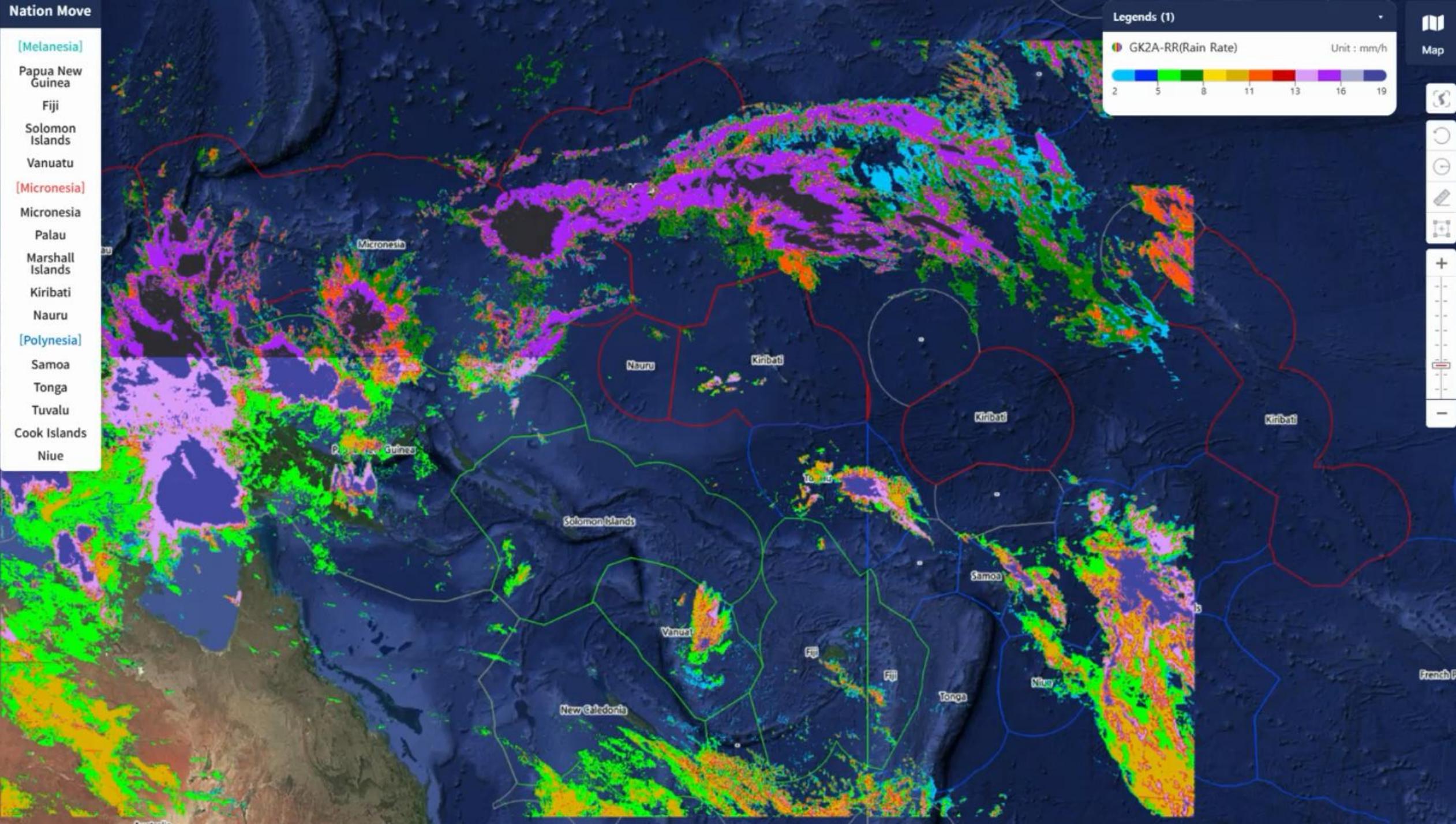
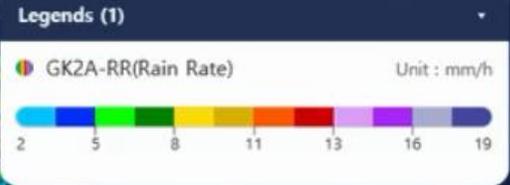
- Papua New Guinea
- Fiji
- Solomon Islands
- Vanuatu

[Micronesia]

- Micronesia
- Palau
- Marshall Islands
- Kiribati
- Nauru

[Polynesia]

- Samoa
- Tonga
- Tuvalu
- Cook Islands
- Niue



Map

Navigation controls: Home, Refresh, Full Screen, Print, Measure, Scale, Zoom In (+), Zoom Out (-), and a vertical scale bar.

Pacific Data Platform

Pacific Islands Map Service

Satellite detection(75)

- T60KWF-FJI-2025-11-16 22:27:51
- T60KWE-FJI-2025-11-16 22:27:51
- T02LLK-WSM-2025-11-14 21:48:06
- T01KFS-TON-2025-11-12 21:59:24
- T60KWE-FJI-2025-11-11 22:30:18

vbd-pics(Ship detection information)

- noaa20-2025-11-20 11:24
- noaa20-2025-11-19 15:06
- noaa20-2025-11-19 15:00
- snpp-2025-11-19 14:42
- snpp-2025-11-19 14:36
- noaa21-2025-11-19 14:12
- noaa21-2025-11-19 14:06
- noaa20-2025-11-19 13:24
- noaa20-2025-11-19 13:18
- snpp-2025-11-19 13:00

- vbd_pic_boats
- vbd-analysis

GK2A

- GK2A RR(Time Lapse)

Nation Move

[Melanesia]

- Papua New Guinea
- Fiji
- Solomon Islands
- Vanuatu

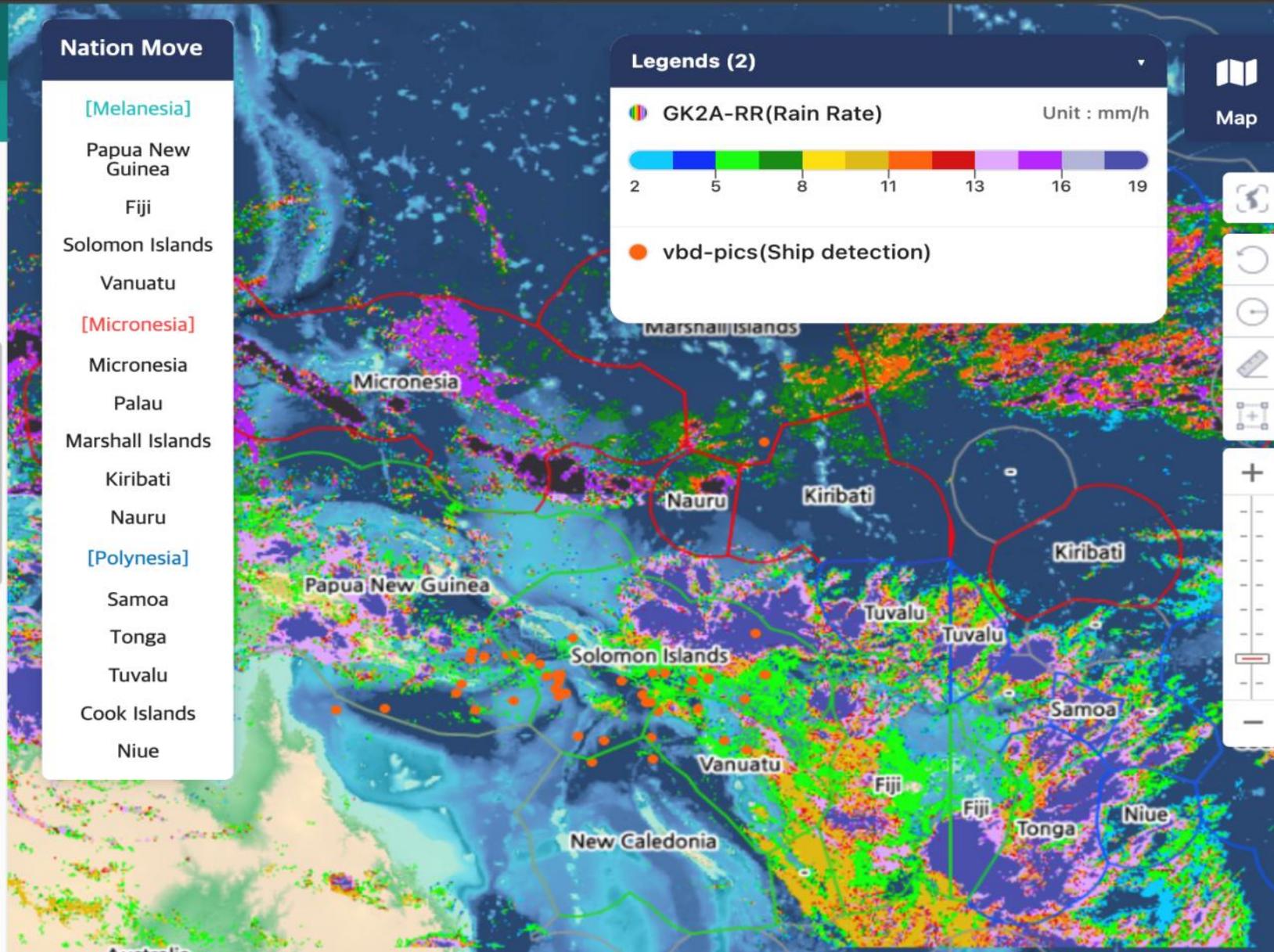
[Micronesia]

- Micronesia
- Palau
- Marshall Islands
- Kiribati
- Nauru

[Polynesia]

- Samoa
- Tonga
- Tuvalu
- Cook Islands
- Niue

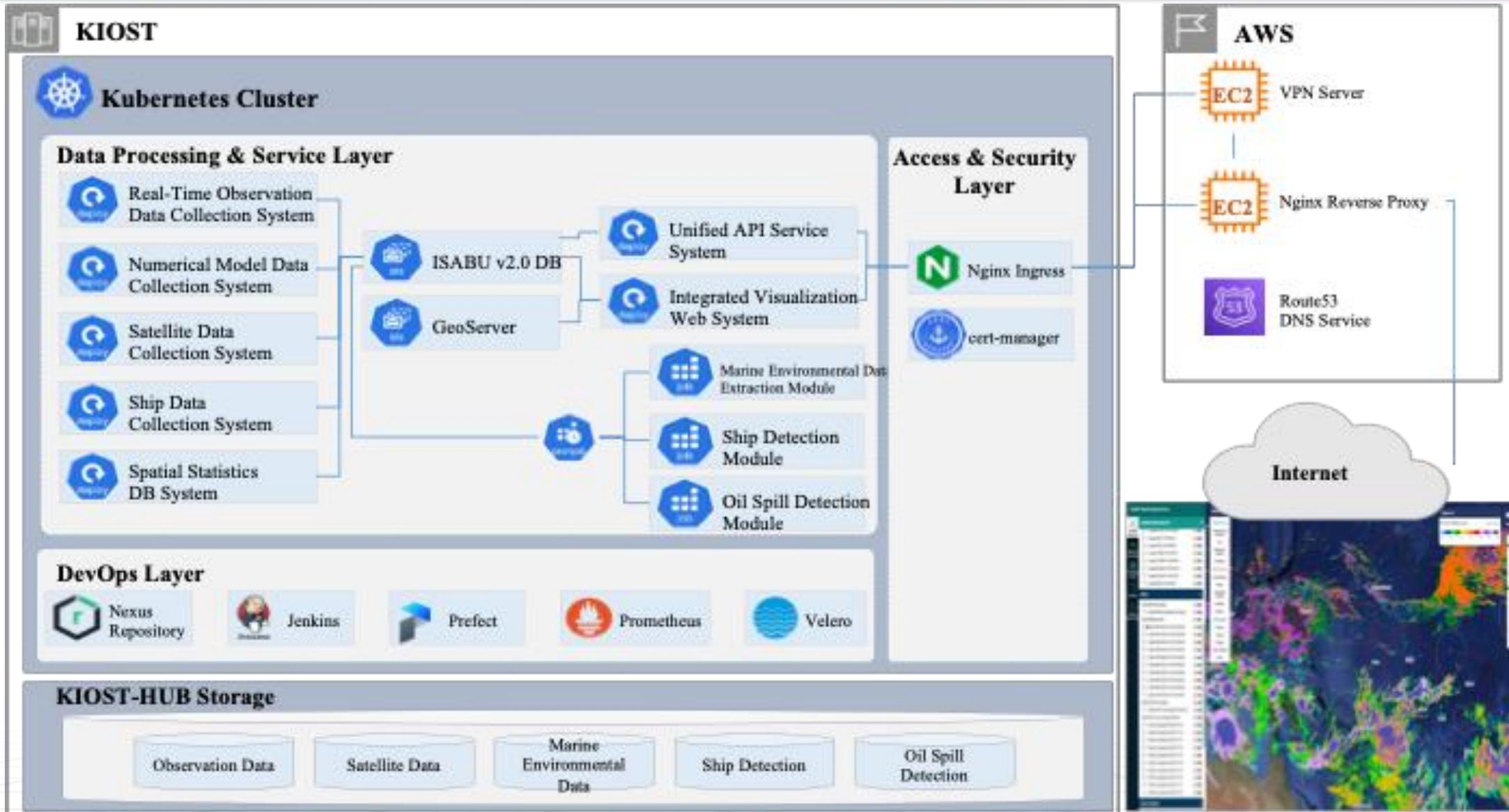
Legends (2)



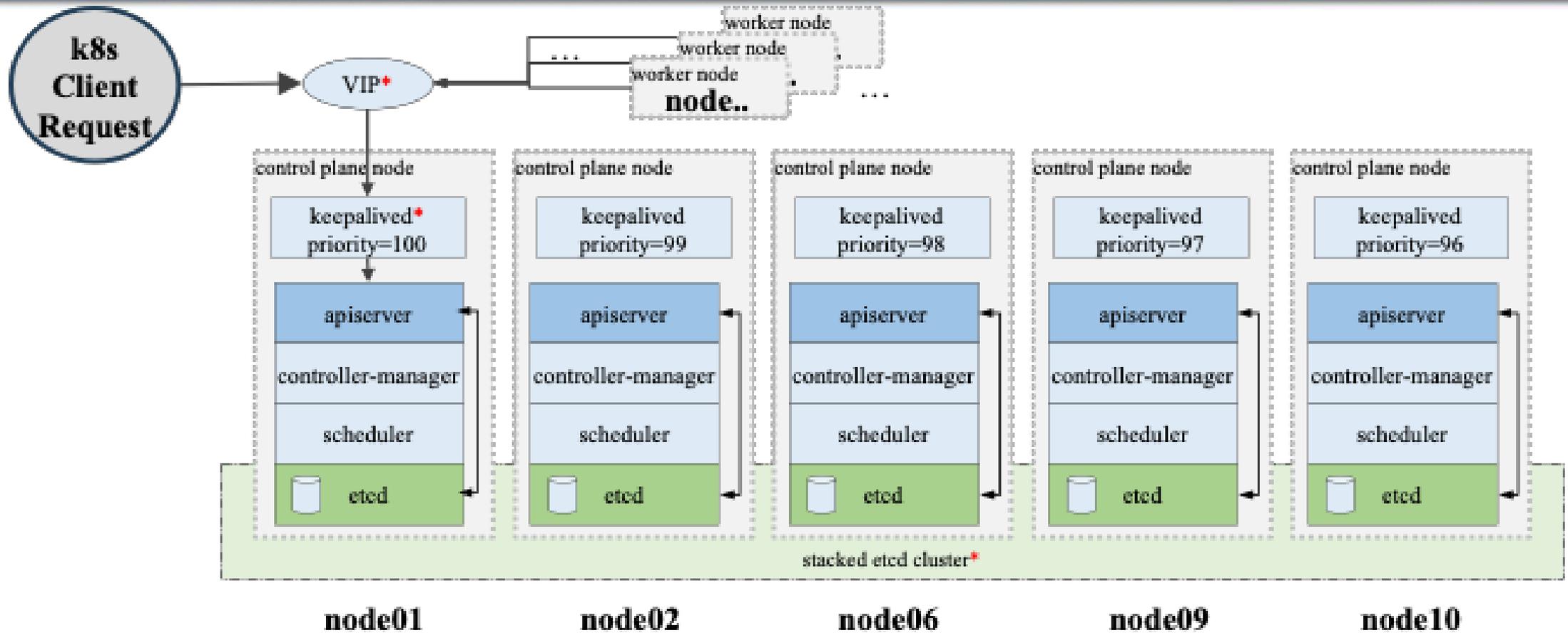
Map

Navigation controls: Home, Refresh, Zoom In, Zoom Out, Full Screen, Scale

Pacific Data Platform: ISABU2.0



Pacific Data Platform: ISABU2.0



Kubernetes clustering provides high availability by automatically recovering from node failures.

- **VIP:** Virtual IP used as the primary access point for the Kubernetes API server
- **keepalived:** Assigns the VIP to the node with the highest priority value
- **Stacked etcd cluster:** Five master nodes running etcd in a clustered, synchronized configuration

Pacific Data Platform



MODIS

- 중분해능 광학 센서
- 해수면 온도(SST)
- 육상 녹지
- 탁도 분석



NOAA-20

- 해수면 온도(SST)
- 해양 클로로필 농도
- 해양오염
- 해양 생태 변화 감시



NOAA-21

- 최신 기후 관측 센서 탑재
- 해양 생태계 및 해양기상 통합 분석 지원



UAV

- 초고해상도 촬영
- 산호초-연안 생태계 정밀 조사
- 신기술 적용



Camera

- 현장 기반 저고도 영상
- 해양 변화 현장 검증 및 추적 자료 보관



Landsat9

- 고해상도 다중영상
- 해안선 변화
- 연안 침식
- 육상 생태계 모니터링



PlanetScope

- 초고해상도(S-Str)
- 신호초 및 연안 지역 변화
- 농업 생태계 감시



Sentinel-3

- 해수면 온도
- 플랑크톤, 탁도
- 해수면 높이
- 해수면화 및 기후 모니터링



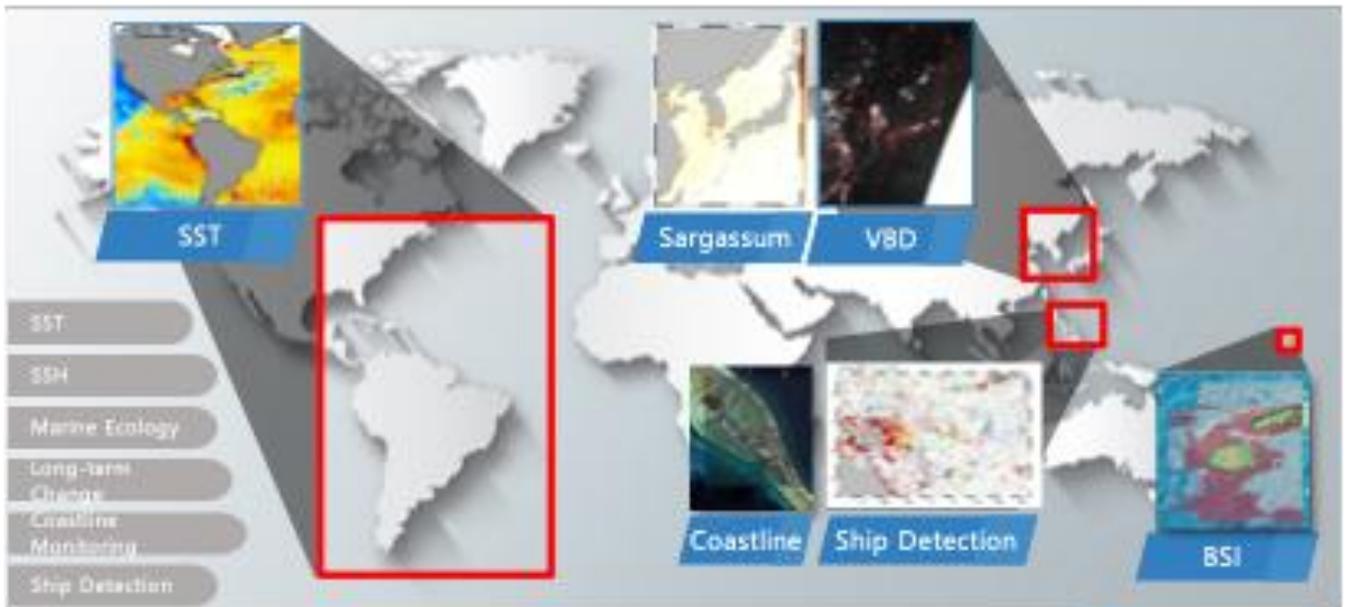
Sentinel-2

- 고해상도 다중센서
- 산호 백화화
- 연안 식생
- 지형 변화 관측



Sentinel-1

- 레이더(SAR) 위성
- 야간 선박 탐지
- 해수면 변화 감지



Ship

Ship A Ship B Ship C Fishing

Climate Change and Impacts

Depth Wave Typhoon Currents

Geographic Information

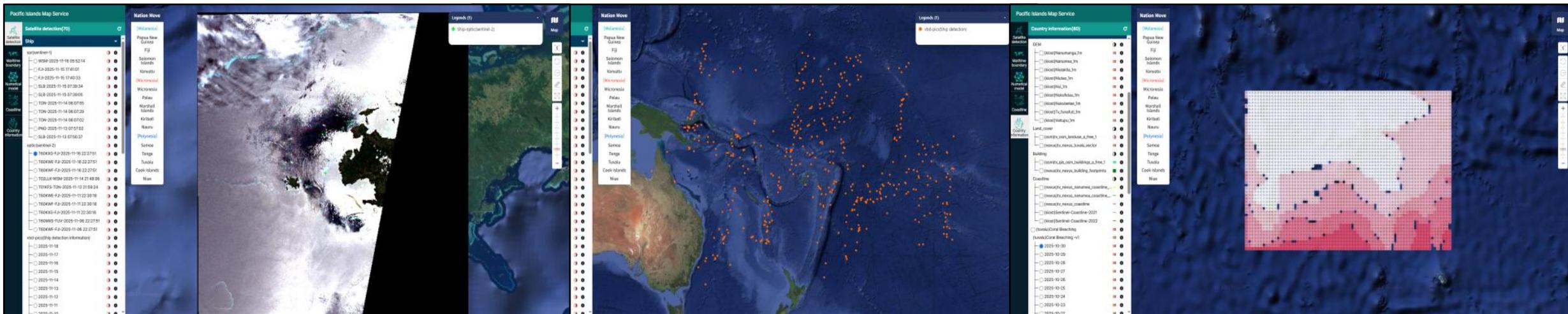
Coastline buildings DEM Land use

Pacific Service

Korean Service

Opne API

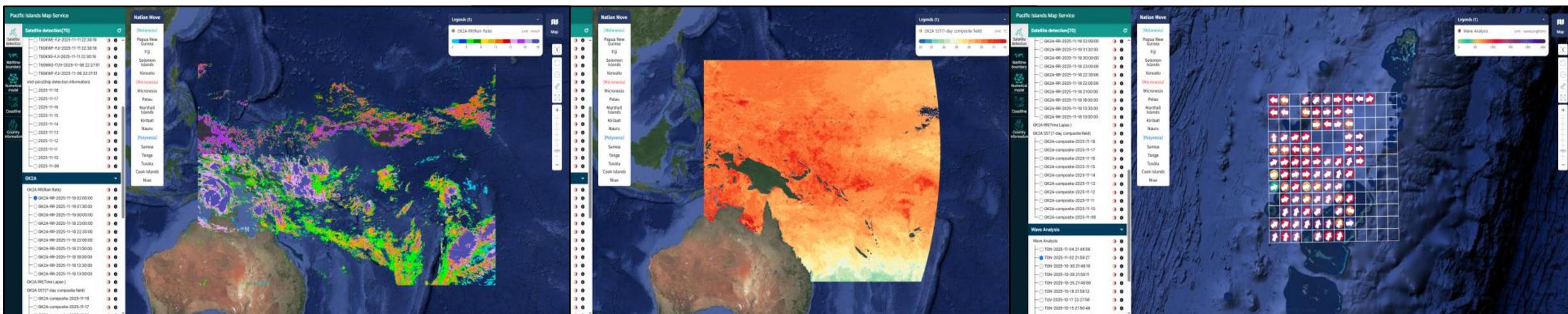
Pacific Data Platform: NRT



sar(sentinel-1)

vbd-pics(Ship detection information)

Tuvalu_BSI v1



GK2A RR(Rain Rate)

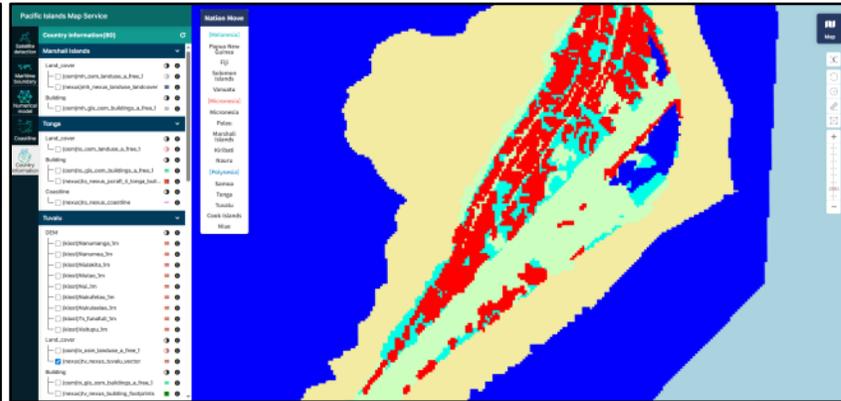
GK2A SST(7-day composite field)

Wave Analysis

Pacific Data Platform: Nexus Portal Spatial information



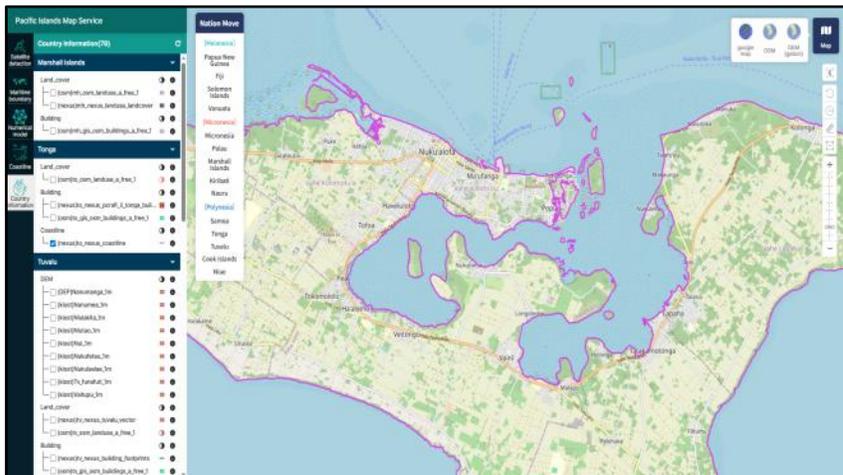
(nexus)mh_nexus_landuse_landcover



(nexus)tv_nexus_tuvalu_vector



(nexus)to_nexus_pcraft_ii_tonga_buildings



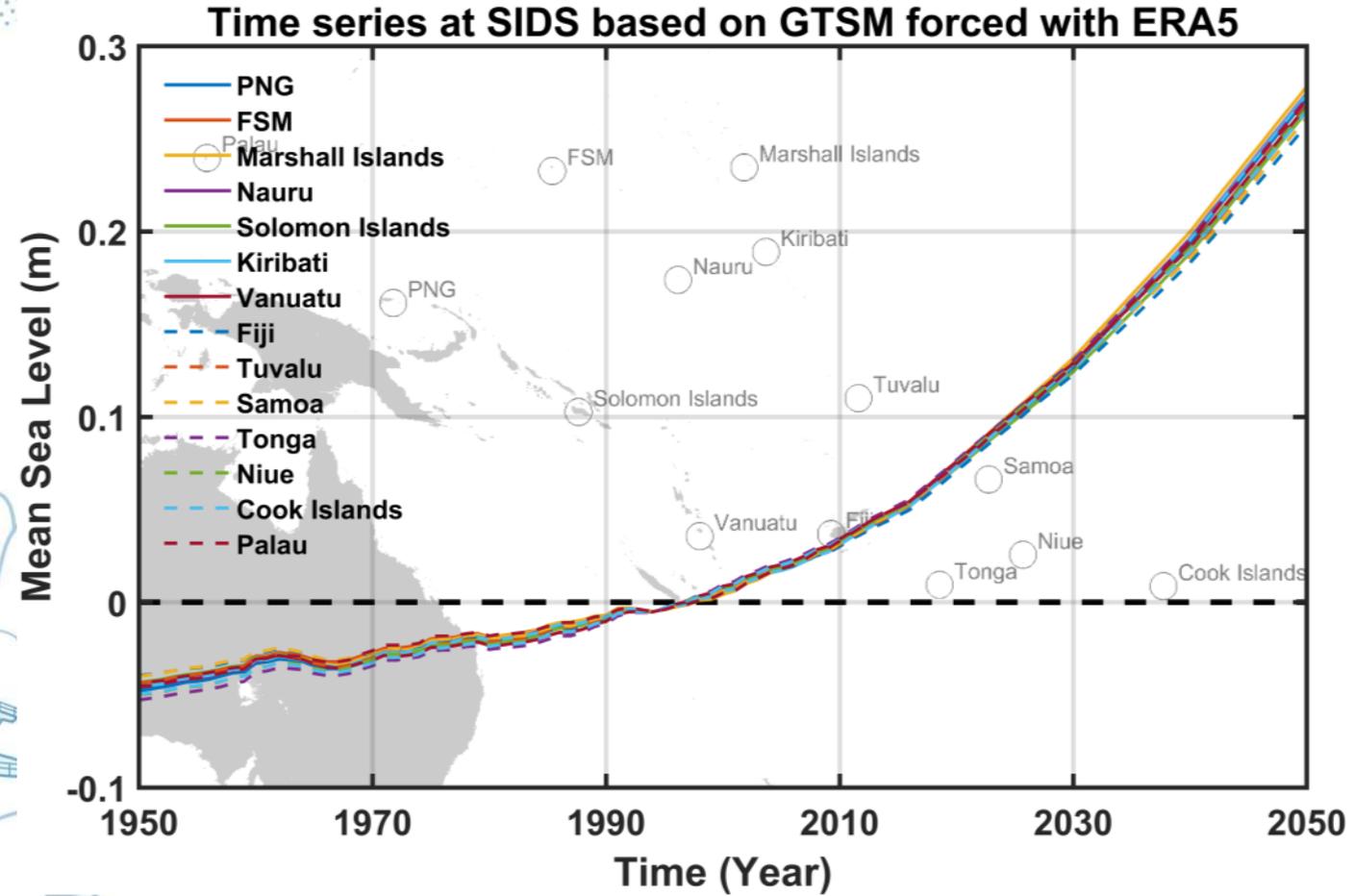
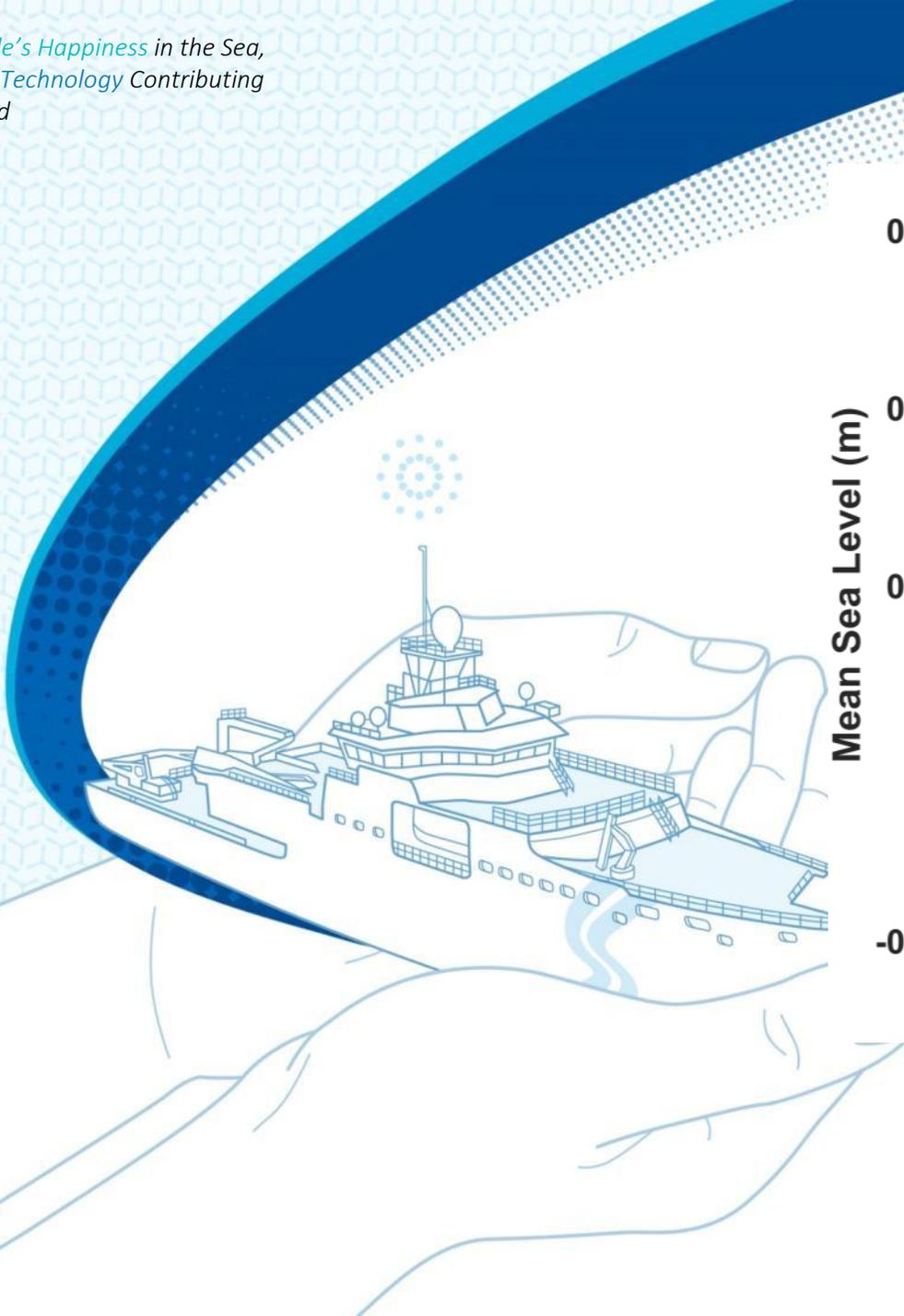
(nexus)to_nexus_coastline



(DEP)Niutao_1m



(DEP)Landsat-coastline(2000-2022)

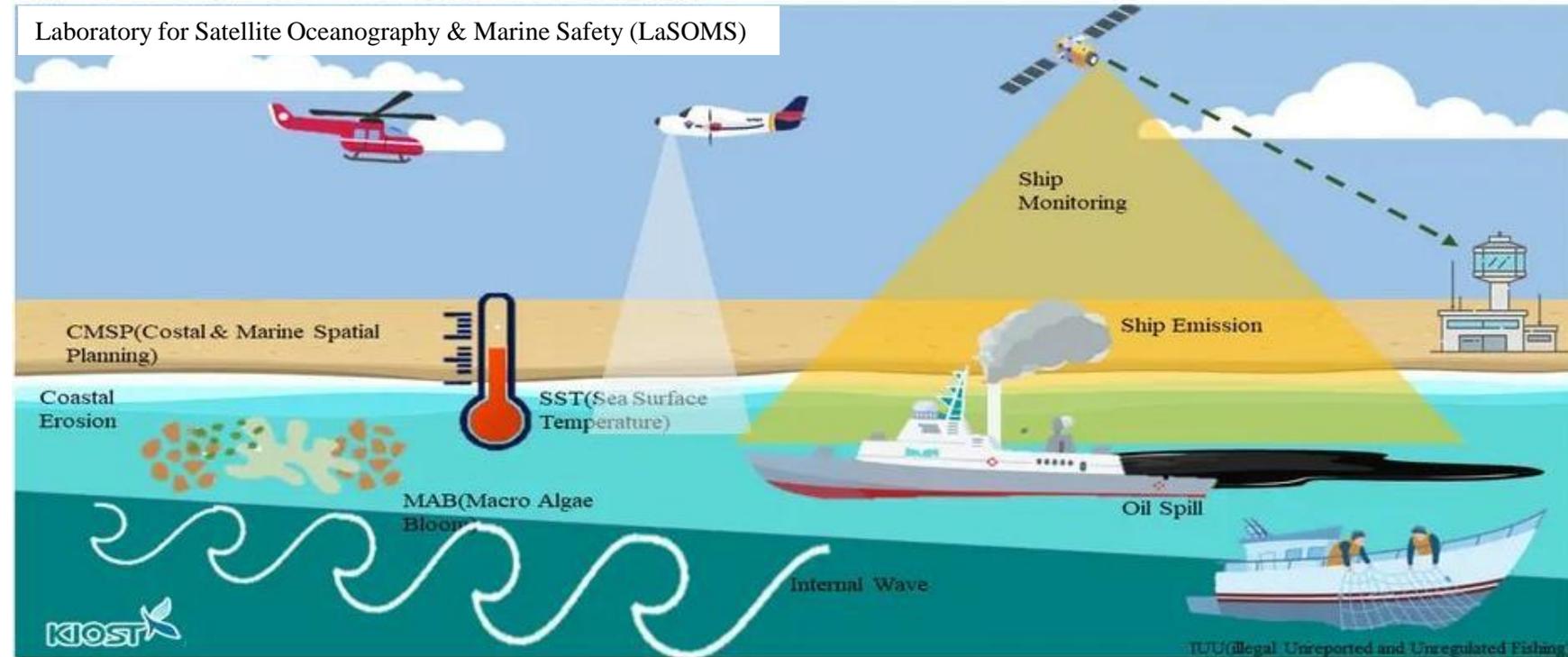


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