

# Data Documentation

## Dataset Information

### Dataset Title:

NCCOS Mapping: Satellite derived bathymetry and benthic habitat mapping to support sea level rise models for the area surrounding Roi-Namur Island, Kwajalein Atoll, Republic of the Marshall Islands

### Description:

Satellite Derived Bathymetry (SDB), benthic habitat, and hydrodynamic friction maps were generated for a study area surrounding Roi-Namur Island, part of the Kwajalein Atoll of the Republic of the Marshall Islands. The SDB and habitat maps were generated from WorldView-2 and -3 satellite imagery. These layers were needed as part of a larger effort to model the impacts of sea-level rise and inundation on Department of Defense installations on atolls in the Pacific Ocean. Tide corrected depth data to parameterize the SDB models and underwater video to aid in classification of the benthic habitat map were collected in the field during an April 2014 mission to Kwajalein Atoll. For a complete description technique and results see Field *et al.* 2022.

### Purpose:

The SDB, benthic habitat and hydrodynamic friction maps developed through this effort were a necessary component of a larger research project led by the USGS Pacific Coastal and Marine Science Center. That project is examining the impacts of sea-level rise and climate change on Department of Defense installations on atolls in the Pacific Ocean. The products described here were a necessary and crucial component of the project models that assessed the impact of sea-level rise and storm-wave inundation on atoll infrastructure and freshwater availability. This was a cooperative effort between the USGS Pacific Coastal and Marine Science Center, the University of Hawaii and NCCOS.

### Methods:

The satellite imagery that was the basis of this effort was from the WorldView-2 and -3 commercial satellites (2m pixel size, 8 spectral bands). Due to issues with tides and cloud cover, 4 satellite images were needed for complete coverage of the study area (12/09/2009, 09/24/2014, 12/29/2014 and 1/23/2015). Non-linear band ratio models were utilized with depth data collected in the field during an April 2014 mission to Kwajalein Atoll to create the SDB. Random points, not used in the SDB models, were selected from the field depth data to provide an estimate of the accuracy of the final product. The benthic habitat maps were generated with the same satellite imagery using a combination of automated image processing techniques and on-screen, heads up digitizing. Underwater video collected during the April 2014 field mission was used as training data for creating the maps. The resulting benthic habitat map was converted to a spatially varying friction coefficient map, using friction values for coral reef habitats from the literature.

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Cited Publications:

- Field, D. W, A. Malhotra, G. A. Piniak. 2022. Development of Satellite Imagery and Benthic Habitat Maps to Support Storm Wave Induced Inundation and Sea Level Rise Studies on Kwajalein Atoll, Republic of the Marshall Islands. NOAA Technical Memorandum NOS NCCOS 307. Silver Spring, MD.
- Federal Geographic Data Committee. 2012. Coastal and marine ecological classification standard, Federal Geographic Data Committee FGDC–STD–018–2012, 343 p.  
[https://www.fgdc.gov/standards/projects/cmecs-folder/CMECS\\_Version\\_06-2012\\_FINAL.pdf](https://www.fgdc.gov/standards/projects/cmecs-folder/CMECS_Version_06-2012_FINAL.pdf)

Data Sources:

- WorldView-2 and WorldView-3 satellite imagery (2m spatial resolution, 8 spectral bands) purchased from DigitalGlobe, <https://www.digitalglobe.com/>

People & Projects

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Collaborators:

- Curt Storlazzi, U.S. Geological Survey, USGS Pacific Coastal and Marine Science Center
- Josh Logan, U.S. Geological Survey, USGS Pacific Coastal and Marine Science Center

Partners:

- U.S. Geological Survey, USGS Pacific Coastal and Marine Science Center

Funding:

- US DOC; NOAA; NOS; National Centers for Coastal Ocean Science (NCCOS)
- US DOD; Strategic Environmental Research and Development Program (SERDP)

Associated Online Resources:

- NOAA NCCOS Project #298, Development of Satellite-derived Bathymetry and Benthic Habitat Maps to Support Sea Level Rise Studies in the South Pacific,  
<https://coastalscience.noaa.gov/project/bathymetry-benthic-habitat-maps-south-pacific/>

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- USGS Project, Coral Reef Project: Kwajalein Island,  
<https://www.usgs.gov/centers/pcmssc/science/coral-reef-project-kwajalein-island>
- SERDP Project, Impacts of Changing Climate on Pacific Island-Based Defense Installations,  
[https://serdp-estcp.org/Program-Areas/Resource-Conservation-and-Resiliency/Infrastructure-Resiliency/Vulnerability-and-Impact-Assessment/RC-2336/RC-2336/\(modified\)/17Nov2020](https://serdp-estcp.org/Program-Areas/Resource-Conservation-and-Resiliency/Infrastructure-Resiliency/Vulnerability-and-Impact-Assessment/RC-2336/RC-2336/(modified)/17Nov2020)

Extents

Start Date: 2009-12-09

End Date: 2015-01-23

Northern Boundary: 09.40841

Southern Boundary: 09.36092

Western Boundary: 167.4436

Eastern Boundary: 167.5021

Keywords

Sea Areas, Water Bodies, Marine Protected Areas:

- Western Pacific
- Republic of the Marshall Islands
- Kwajalein Atoll
- Roi-Namur Island

NCCOS Keywords:

- NCCOS Research Priority > Marine Spatial Ecology (MSE)
- NCCOS Research Topic > Habitat Mapping
- NCCOS Research Topic > Climate Impacts
- NCCOS Research Topic > Coral Reefs
- NCCOS Research Topic > Remote Sensing
- NCCOS Research Location > Region > International
- NCCOS Research Data Type > Geospatial
- NCCOS Research Data Type > Model
- NCCOS Research Data Type > Derived Data Product

File Information

Total File Size: 128 MB total, 17 files in 1 folder (unzipped), 5.13 MB (zipped)

Data File Format(s):

- GeoTiff .TIF (and ancillary files .TFW, .AUX, .OVR, .XML)

Data File Compression: no compression

Data File Resolution: 2m X 2m resolution; 3193 cols X 2605 rows

GIS Projection: Projected Coordinate System: UTM Zone 58N (WKID 32658), Geographic  
Coordinate System: WGS 84 (WKID 4326)

Data Files:

- Satellite\_Derived\_Bathymetry\_Roi-Namur.tif
- Benthic\_habitats\_Roi-Namur.tif
- Hydrodynamic\_Friction\_Roi-Namur.tif

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Documentation Files:

- BrowseGraphic.JPG
- DataDocumentation.PDF

Benthic habitat types: (For complete CMECS habitat definitions see

<https://iocm.noaa.gov/cmeecs/index.html>)

- Back Reef CRZ01, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Coral Rubble S2.2.2, Biotic Shallow Mesophotic Coral Reef Biota B2.1.2, Percent Cover 10% - <50% PC02-PC06
- Pass/Lagoon Channel Gg1.9.1, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Coral Rubble – S2.2.2, Shallow Mesophotic Coral Reef Biota B2.1.2, Percent Cover 10% - <50% PC02-PC06
- Pass/Lagoon Channel Gg1.9.1, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Rock Outcrop Gg1.7, Benthic Macroalgae B2.5.1, Percent Cover 0% - <10% PC01-PC02
- Fore Reef CRZ04, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Shallow Mesophotic Coral Reef, Aggregate Coral Reef Gg2.5.1, Shallow Mesophotic Coral Reef Biota B2.1.2, Percent Cover 0% - <10% PC01-PC02
- Fore Reef (CRZ04), Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Shallow Mesophotic Coral Reef, Aggregate Coral Reef Gg2.5.1, Shallow Mesophotic Coral Reef Biota B2.1.2, Percent Cover 50% - <90% PC07-PC010
- Fore Reef (CRZ04), Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Pavement Area Gg1.44, Carbonate SD01, Shallow Mesophotic Coral Reef Biota B2.1.2, Percent Cover 0% - <10% PC01-PC02
- Fore Reef (CRZ04), Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Shallow Mesophotic Coral Reef, Spur and Groove Coral Reef Gg2.5.11, Shallow Mesophotic Coral Reef Biota – B2.1.2, Percent Cover 10% - <50% PC02-PC06
- Lagoon CRZ05, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Shallow Mesophotic Coral Reef, Patch Coral Reef Gg2.5.9, Shallow Mesophotic Coral Reef Biota – B2.1.2, Percent Cover 50% - <90% PC07-PC010
- Lagoon CRZ05, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Shallow Mesophotic Coral Reef, Coral Pinnacle Gg2.5.4, Shallow Mesophotic Coral Reef Biota B2.1.2, Percent Cover 50% - <90% PC07-PC010
- Lagoon CRZ05, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Pavement Area Gg1.44, Carbonate SD01, Shallow Mesophotic Coral Reef Biota B2.1.2, Percent Cover 10% - <50% PC02-PC06
- Lagoon CRZ05, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Coral Rubble S2.2.2, Benthic Macroalgae B2.5.1, Percent Cover 10% - <50% PC02-PC06
- Lagoon CRZ05, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Coral Rubble – S2.2.2, Shallow Mesophotic Coral Reef Biota – B2.1.2, Percent Cover 10% - <50% PC02-PC06
- Lagoon CRZ05, Substrate group – Sand – S1.2.2.2, No Cover
- Lagoon CRZ05, Substrate Group – Sand S2.2.2, co-occurring Coral Head Gg2.5.3, co-occurring boulder – S1.2.1.1.1, Shallow Mesophotic Coral Reef Biota B2.1.2, Percent Cover 0% - <10% PC01-PC02
- Reef Flat CRZ07, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Pavement Area Gg1.44, Carbonate SD01, Benthic Macroalgae B2.5.1, Percent Cover 0% - <10% PC01-PC02
- Reef Flat CRZ07, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Pavement Area Gg1.44, Carbonate SD01, Benthic Macroalgae B2.5.1, Percent Cover 10% - <50% PC02-PC06, co-occurring boulder – S1.2.1.1.1

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- Reef Flat CRZ07, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Rock Outcrop Gg1.50, Benthic Macroalgae B2.5.1, Percent Cover 0% - <10% PC01-PC02
- Reef Flat CRZ07, Rock Substrate S1.1, Coral Reef Substrate S2.2.1, Rock Outcrop Gg1.50, Benthic Macroalgae B2.5.1, Percent Cover 0% - <10% PC01-PC02 (rock from shoreline stabilization)

Parameter Information:

Parameter Description:

*Parameter:* Depth  
*Property Type:* calculated  
*Units:* meters  
*Observation Category:* model output  
*Sampling Instrument:* Fathometer  
*Sampling and Analyzing Method:*

Depth measured from Ellipsoid WGS 84 Datum by fathometer in the field for calibrating the depth model and assessing accuracy. The dataset is an estimate of bathymetry from commercial satellite imagery. The bathymetry model is based on satellite band ratios scaled to depth using actual depth data collected in the field during an April 2014 field mission to the study site. WorldView-2 and WorldView-3 satellite imagery (2m spatial resolution, 8 spectral bands) purchased from DigitalGlobe (<https://www.digitalglobe.com/>)

*Data Quality Method:*

The accuracy of the final bathymetry layer was estimated via a random sample of field points collected during the April 2014 field mission that were not used in the bathymetry model; fathometer was used to measure depths in the field for calibrating the depth model and assessing accuracy.

Parameter Description:

*Parameter:* Benthic Habitat Type  
*Property Type:* calculated  
*Units:* square meters  
*Observation Category:* model output  
*Sampling Instrument:* Models/Analyses > Data Analysis > Environmental Modeling  
*Sampling and Analyzing Method:*

This data set is a thematic map, a benthic habitat classification of 18 benthic habitat classes. WorldView satellite imagery was classified into 18 different benthic habitat types. WorldView-2 and WorldView-3 satellite imagery (2m spatial resolution, 8 spectral bands) purchased from DigitalGlobe (<https://www.digitalglobe.com/>)

*Data Quality Method:*

The benthic habitat maps were generated using a combination of automated image-processing techniques and on-screen, heads up digitizing. Underwater video collected during the April 2014 field mission was used as training data for creating the maps.

Parameter Description:

*Parameter:* Hydrodynamic Friction  
*Property Type:* calculated  
*Units:* unitless  
*Observation Category:* other  
*Sampling Instrument:* Models/Analyses > Data Analysis > Environmental Modeling

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*Sampling and Analyzing Method:*

Assigned Hydrodynamic Friction values from the literature to the classes in the Benthic Habitat Classification. A measure of the relative ability of a habitat to reduce wave energy. It can be measured in the field or in a lab setting. No measurements were made for this study – all values were derived from the literature. Complete list of the reported parameter, value, and citation in Field *et al.* (2022).

*Data Quality Method:*

No data were processed or analyzed for this study. Values were derived from the literature and applied to the habitats in the benthic habitat map.

## Document Information

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| Date:              | 2022-08-26  |
| Resource Provider: | NCCOS Data Manager, <a href="mailto:nccos.data@noaa.gov">nccos.data@noaa.gov</a> , US DOC; NOAA; NOS; National Centers for Coastal Ocean Science (NCCOS)  |
| Comment:           | This data documentation describes data files archived as a NOAA NCEI data accession, and is intended to provide dataset-level metadata for the purposes of discovery, use, and understanding.                                   |
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