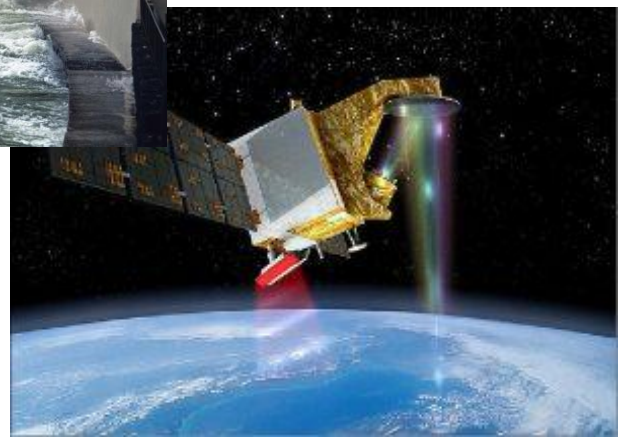
BlueMath

A Collaborative Open-Source Repository for Statistical Analysis and Fast, Efficient Hydrodynamic Emulators of Coastal Climate Hazards

Laura Cagigal, Javier Tausía, Fernando Mendez, Valvanuz Fernandez-Quiruelas, Gabriel Bellido, Etienne Faugere, Jennifer Montaño, Jared Ortiz-Angulo, Alba Ricondo, Pablo Alonso-Alguacil, Beatriz Perez-Diaz, Mirian Jimenez-Tobio, Paula Camus, Sonia Castanedo, Jose A. A. Antolinez

Coastal Hazards



Available tools

ELSEVIER
Environmental Modelling & Software
Volume 165, July 2023, 105712

CCdownscaling: A Python package for multivariable statistical climate model downscaling

Andrew D. Polasky

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https://doi.org/10.1016

JOSS
The Journal of Open Source Software

CoastSeg: an accessible and extendable hub for satellite-derived-shoreline (SDS) detection and mapping

Sharon Fitzpatrick [1], Daniel Buscombe [1], Jonathan A. Warrick [2], Mark A. Lundine

1 Contracted to California, Unit Cruz, California Australia

DOI: 10.21105/joss.06683

ELSEVIER
Computers & Geosciences
Volume 162, May 2022, 105098

APPMAR 1.0: A Python application for downloading and analyzing of III® wave and wind data

German Rivillas-Ospina [a], Diego Casas [b], Mauro Antonio Ma
Marianella Bolívar [d], Gabriel Ruiz [e], Roberto Guerrero [d], José M. Ho
Milton Guerrero [c], Karina Díaz [d], Roberto del Rio [c], Erick Campos [c]

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https://doi.org/10.1016/j.cageo.2022.105098

ELSEVIER
Environmental Modelling & S
Volume 178, July 2024, 106076

PyCoSMoS: An advanced toolbox for simulating real-world hydroclimatic data

Cappelli Francesco [a], Simon Michael Papalexiou [b], Yannis Markonis [c], Salvatore Grimaldi [a]

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ELSEVIER
Environmental Modelling & Software
Volume 122, December 2019, 104528

CoastSat: A Google Earth Engine-enabled Python toolkit to extract shorelines from publicly available satellite imagery

Kilian Vos, Kristen D. Splinter, Mitchell D. Harley, Joshua A. Simmons, Ian L. Turner

Motivation

Only 11% of the analyzed papers provided code

Jansen et al., 2020

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Jansen et al., 2020

70% of the researchers failed to reproduce published research

Baker, 2016

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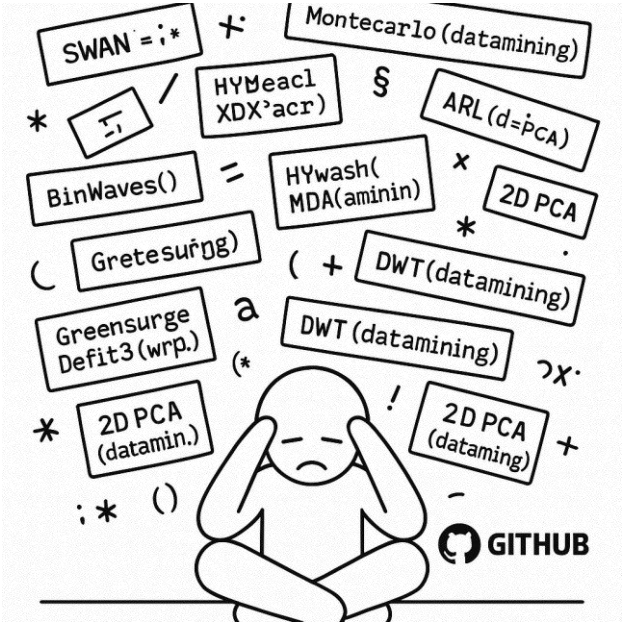
Baker, 2016

Research progress slows down, as integrating **new methodologies** into an existing framework requires significant **time and effort**



BlueMath Goal

Projects and Publications

Perez et al., 2015
Cid et al., 2016
Rueda et al., 2017
Cagigal et al., 2019
Anderson et al., 2019
Anderson et al., 2021
Cagigal et al., 2024
van Vloten et al., 2023
Ricondo et al., 2023
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Ricondo et al., 2023
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1 Identify individual pieces

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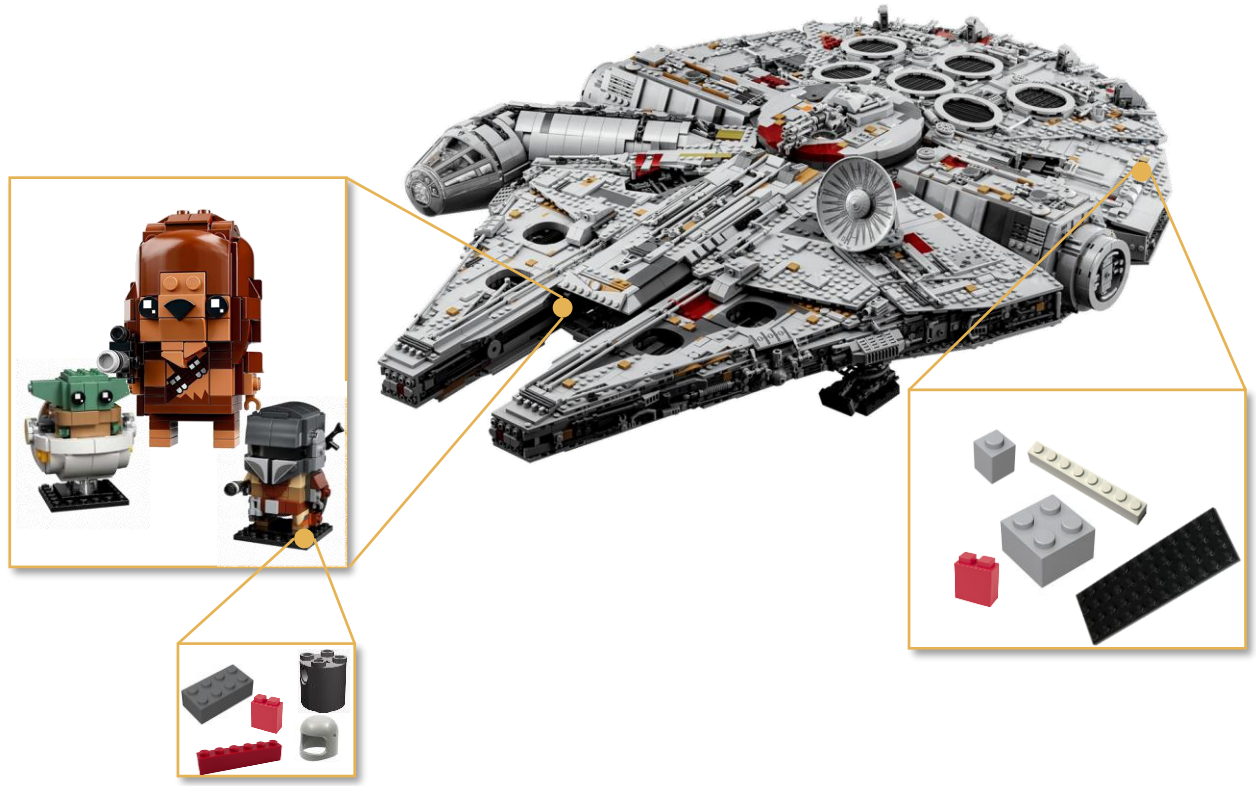
1 Identify individual pieces



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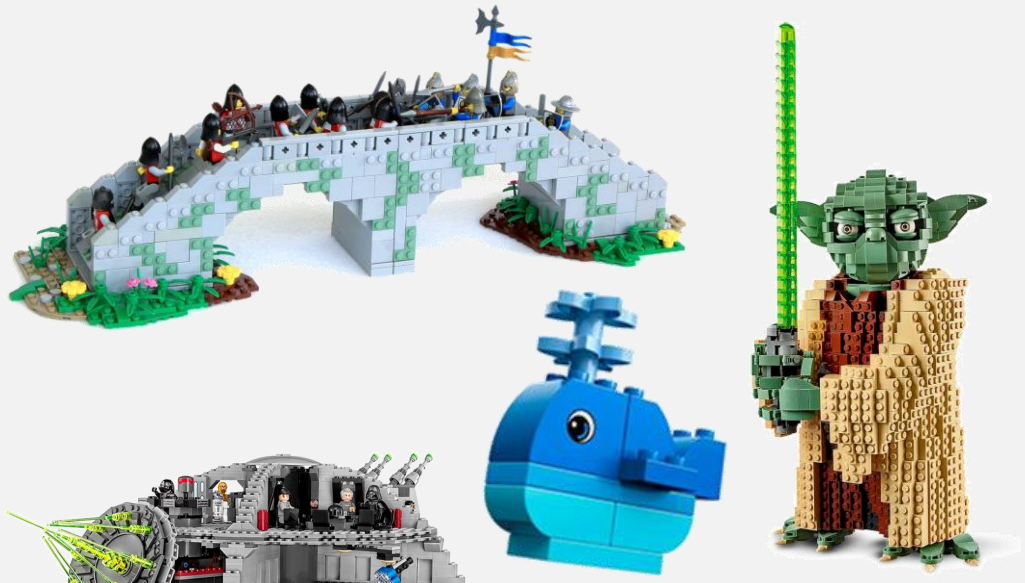
Cagigal et al., 2024
van Vloten et al., 2023
Ricondo et al., 2023
Ricondo et al., 2024

2 Organize pieces

BlueMath Goal

Projects and Publications



Perez et al., 2015
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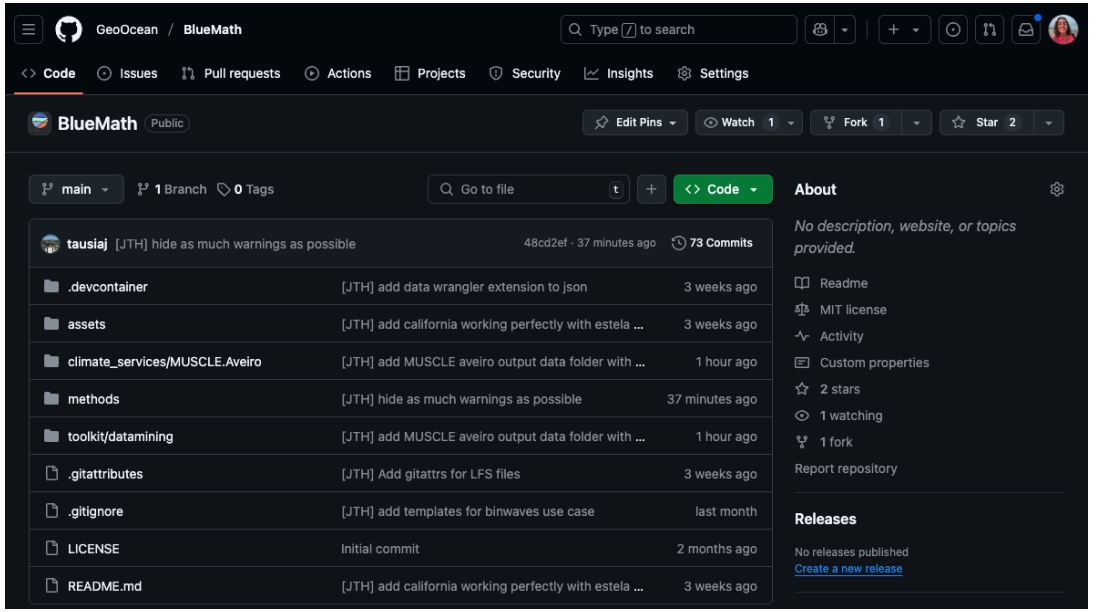
Anderson et al., 2019
Anderson et al., 2021
Cagigal et al., 2024
van Vloten et al., 2023
Ricondo et al., 2023
Ricondo et al., 2024

3 Create an open-source code repository

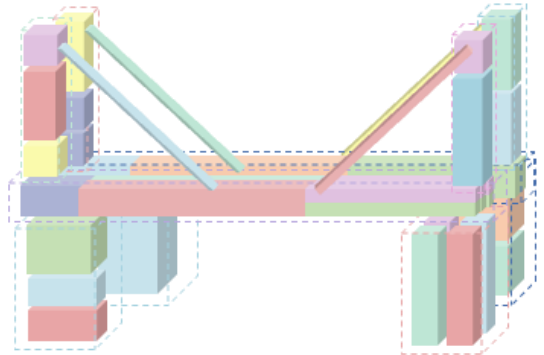
https://github.com/GeoOcean/BlueMath



Structure

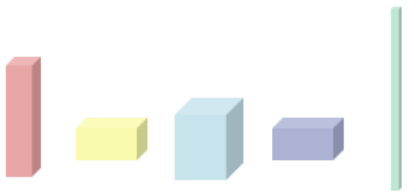
BlueMath

Climate Services



Methods

Toolkit



Toolkit

Datamining

KMA **MDA**

SOM **PCA**

Waves

Wave Climate Analysis

SuperPoint generation (Cagigal et al., 2021)

Wave Correction (Albuquerque et al., 2021)

Wrappers

SWAN **XBeach**

Delft3D **SWASH**

Sfincs

Predictor

DWT **AWT**

TWT

Toolkit

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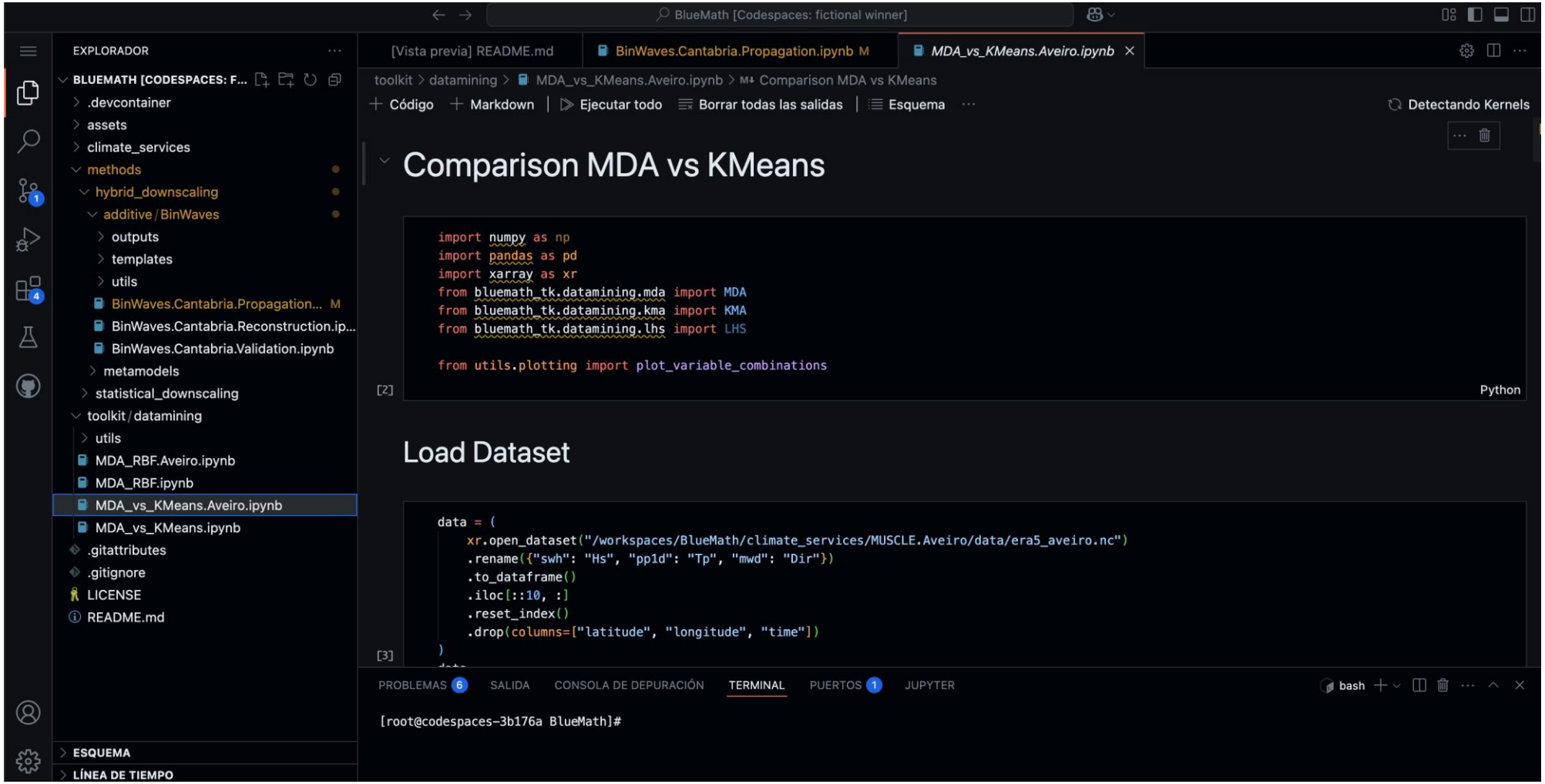
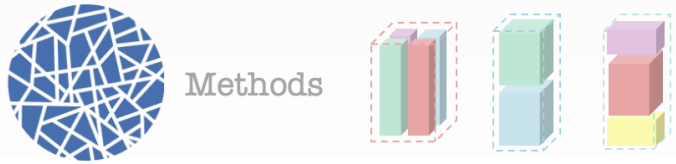
MDA

Maximum Dissimilarity Algorithm



Methods



Statistical Downscaling

SD	**WT Emulator** (Camus et al., 2014)	**DWT** (datamining)	**Montecarlo** (datamining)	
SD	**TESLA** (Anderson et al., 2019)	**DWT** (datamining)	**ALR** (datamining)	**Montecarlo** (datamining)

Hybrid Downscaling

HD	**BinWaves** (Cagigal et al., 2024)	**SWAN** (wrapper)				
HD	**GreenSurge** (Pérez-Díaz et al., 2024)	**Delft3D** (wrapper)				
HD	**SHyTCWaves** (van Vloten et al., 2023)	**MDA** (datamining)	**SWAN** (wrapper)			
HD	**HyBeat** (Zornoza et al., 2024)	**LHS** (datamining)	**MDA** (datamining)	**XBeach** (wrapper)	**2D PCA** (datamining)	**RBF** (datamining)
HD	**HySwash** (Ricondo et al., 2024)	**LHS** (datamining)	**MDA** (datamining)	**SWASH** (wrapper)	**1D PCA** (datamining)	**RBF** (datamining)

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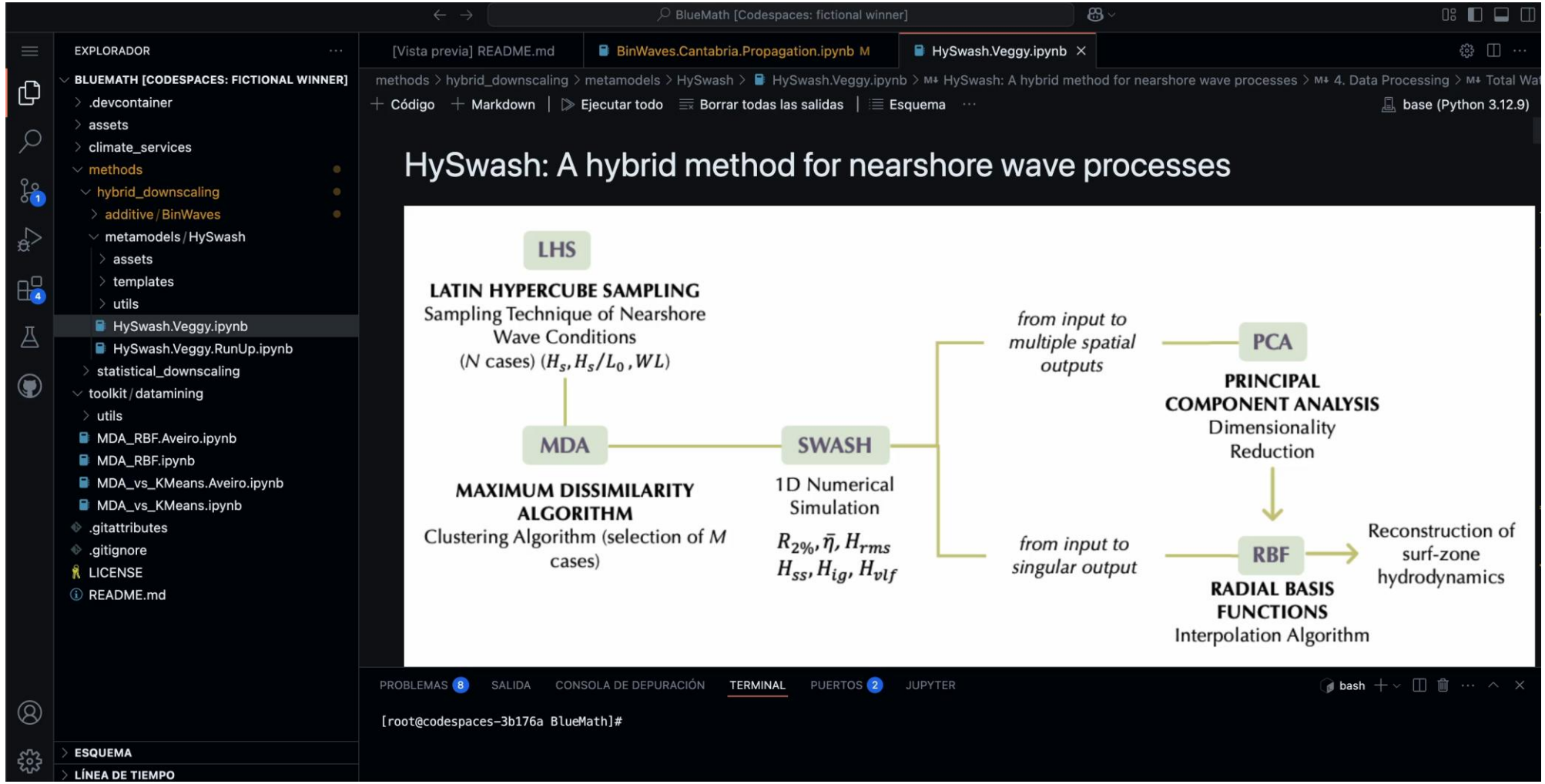
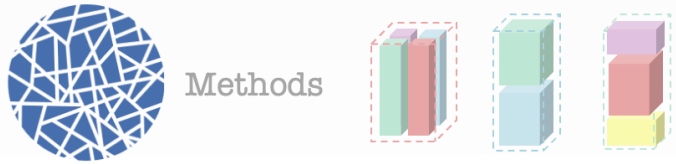
HySwash

Ricondo et al., 2024

Hybrid modelling of wave runup and setup



Methods



Statistical Downscaling

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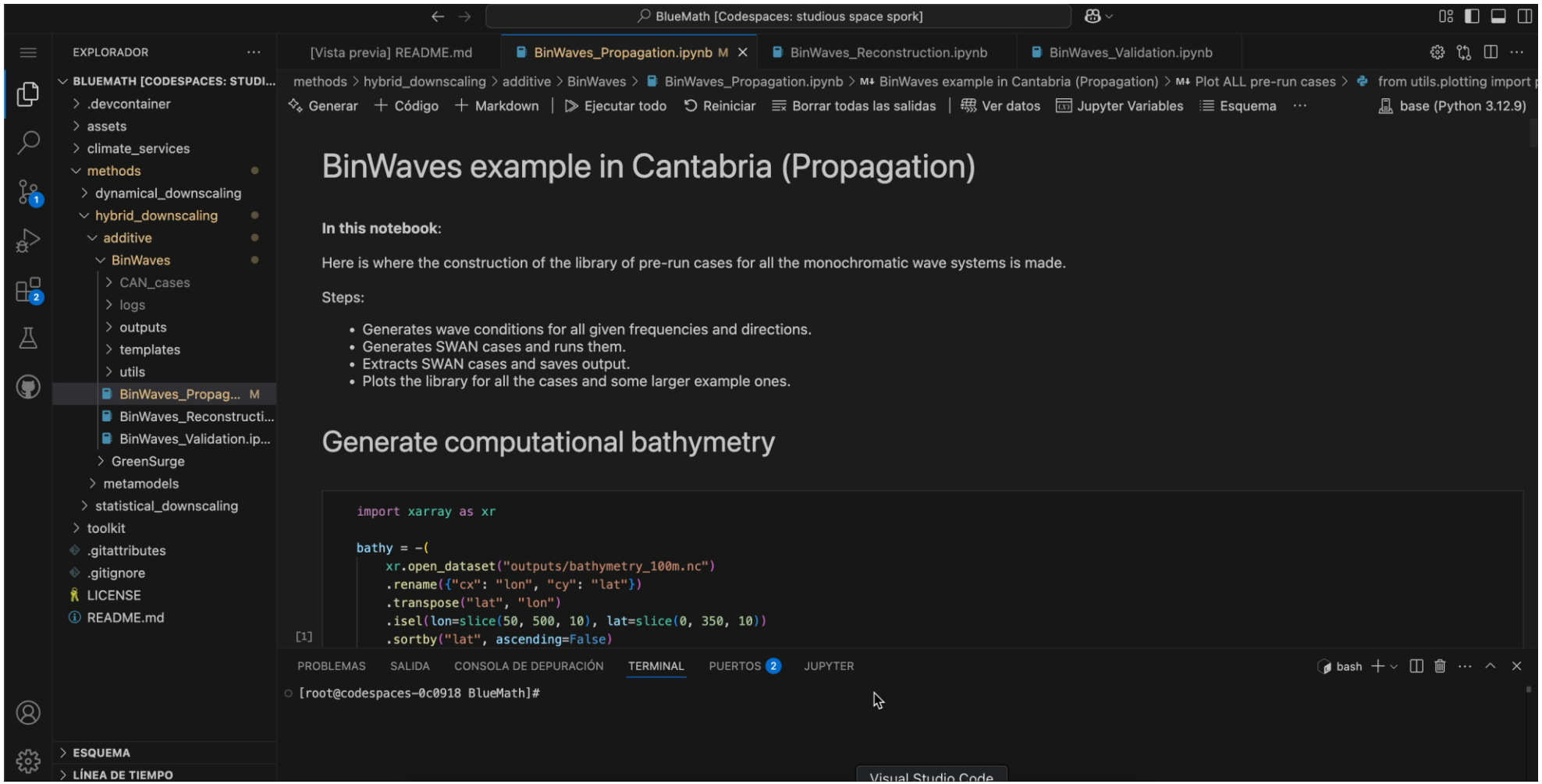
BinWaves

Cagigal et al., 2024

Additive hybrid modelling of wave propagation



Climate services

Wave Forecast System

Data Download → **Wave Correction** (Albuquerque et al., 2021) → **SuperPoint generation** (Cagigal et al., 2021) → HD **BinWaves** (Cagigal et al., 2024)

HD **HyBeat** (Zornoza et al., 2024)

TC Forecast System

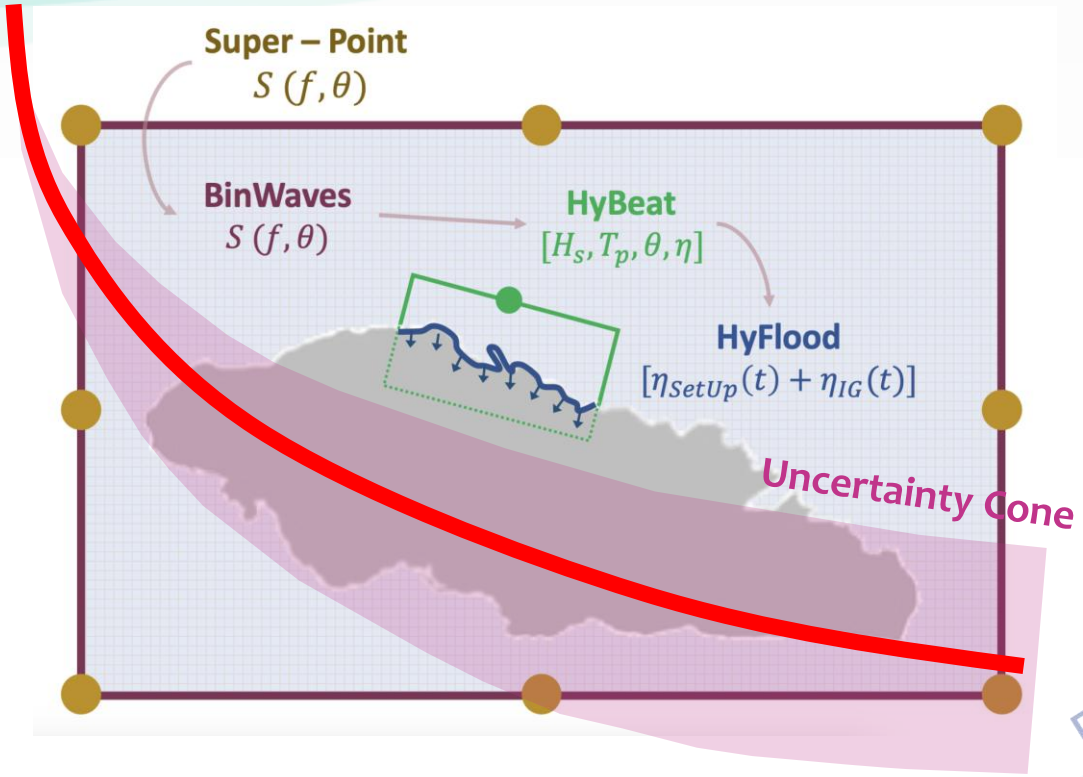
TC Data Download → HD **SHyTCWaves** van Vloten et al., 2023) → **SuperPoint generation** (Cagigal et al., 2021) →

HD **BinWaves** (Cagigal et al., 2024) → HD **HyBeat** (Zornoza et al., 2024)

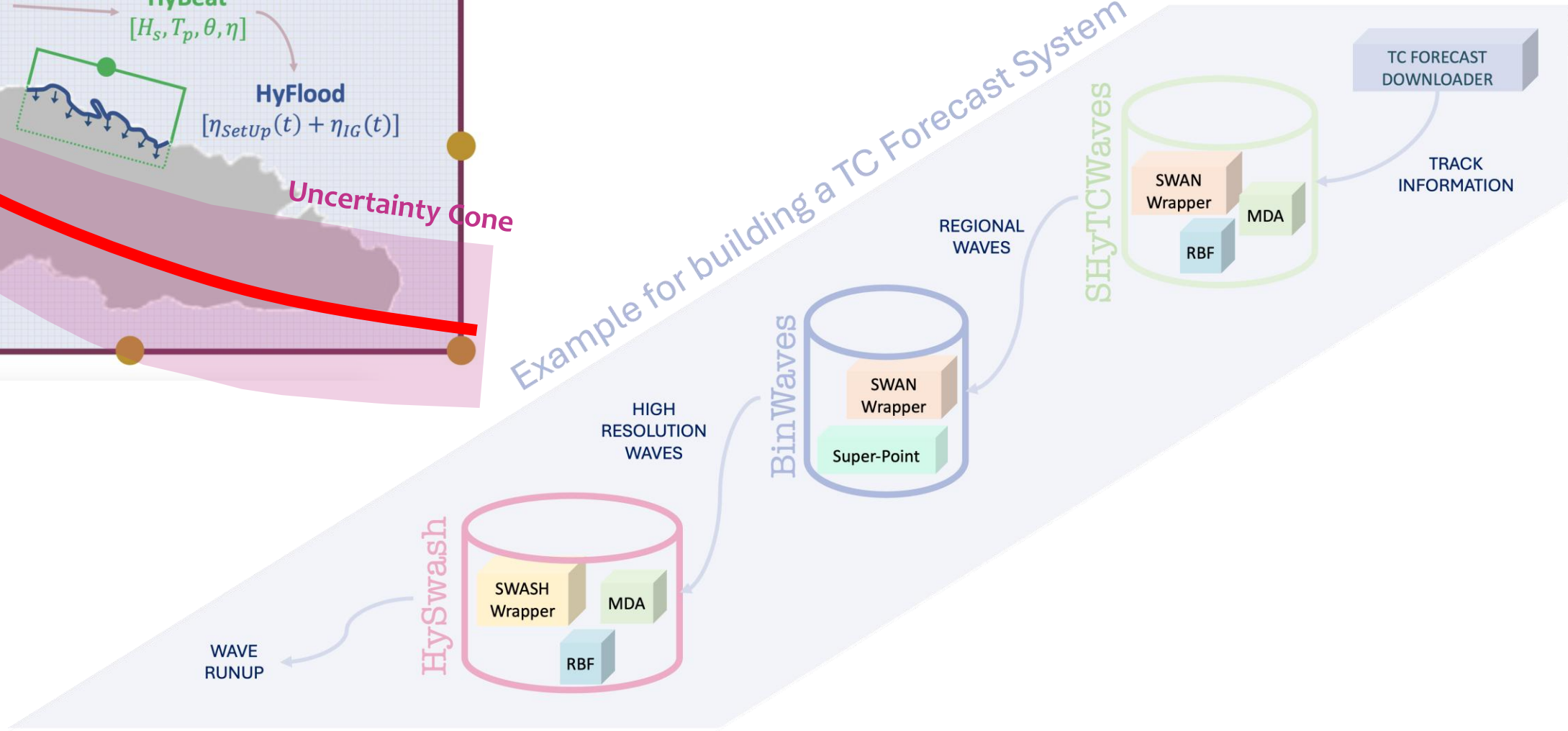
TC Risk Assessment

Data Download → SD **TESLA** (Anderson et al., 2019) → HD **SHyTCWaves** (van Vloten et al., 2023) →

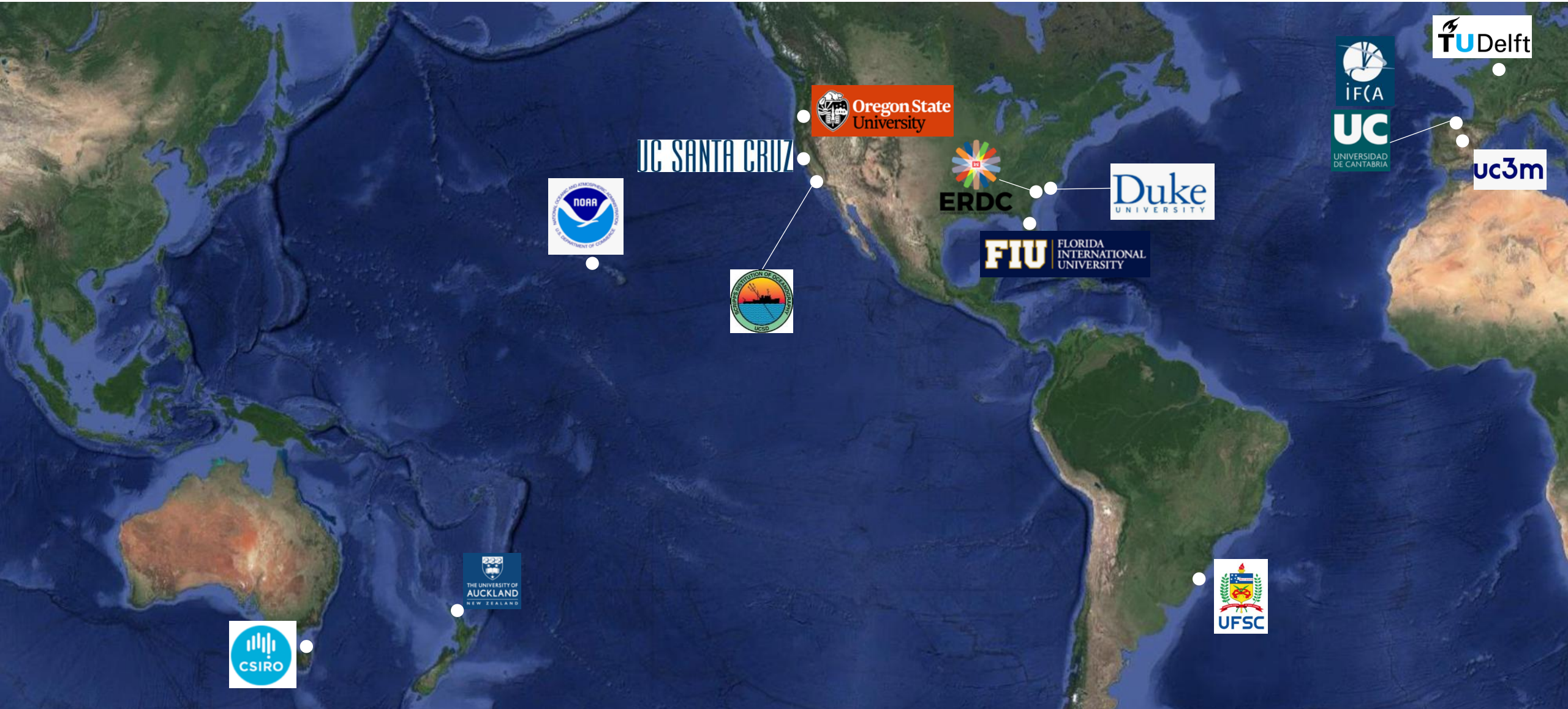
SuperPoint generation (Cagigal et al., 2021) → HD **BinWaves** (Cagigal et al., 2024) → HD **HyBeat** (Zornoza et al., 2024)



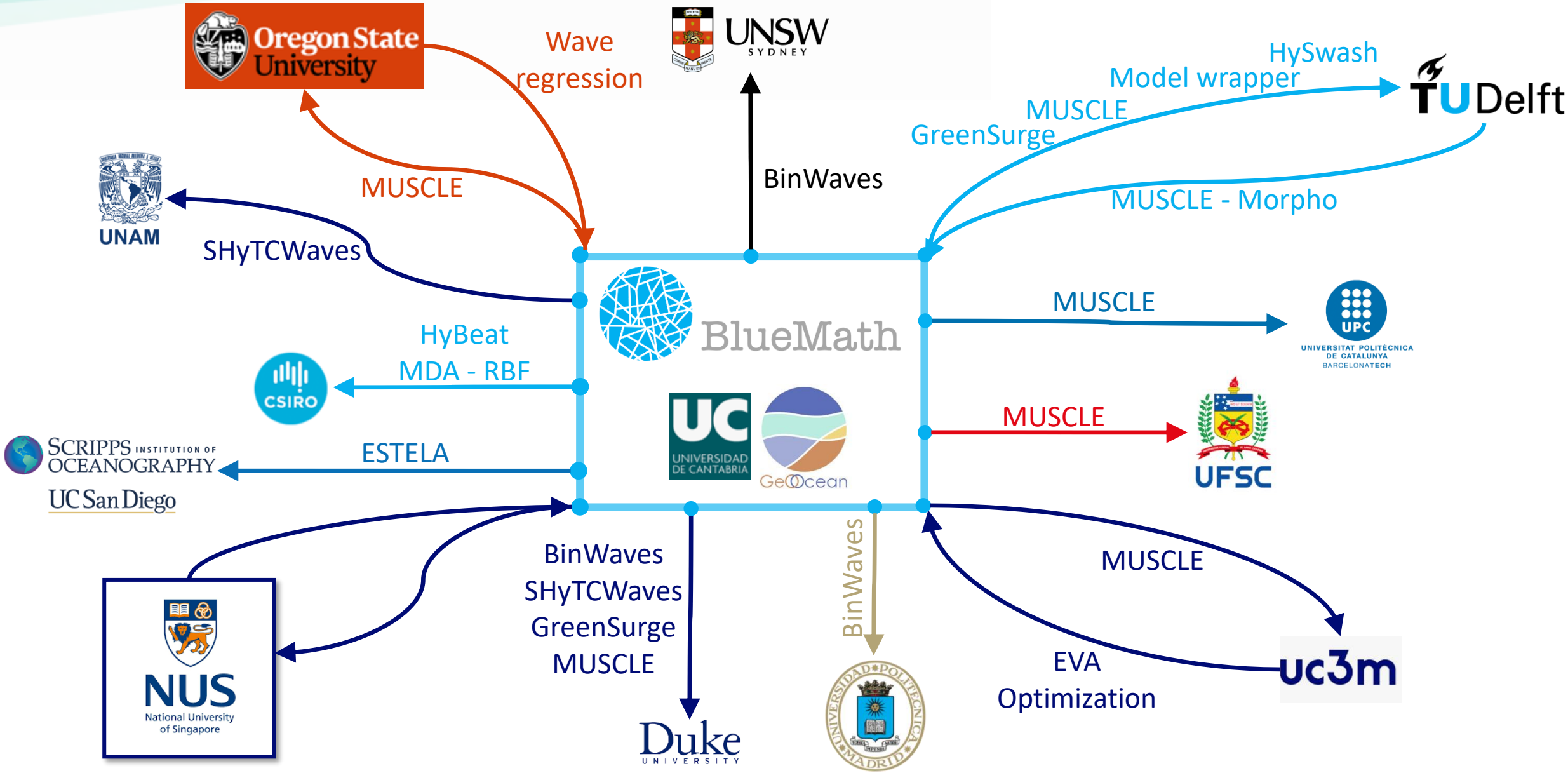
Example for building a TC Forecast System



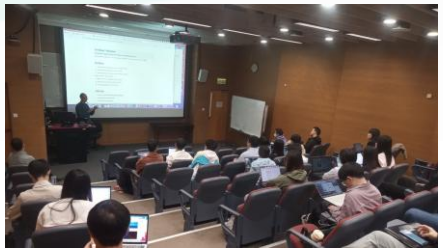
Ongoing collaborations



Users and code providers



Courses



WDWE conference, Hong Kong

December 2024

Coastal Dynamics, Aveiro, Portugal

March 2025

41st IAHR World Congress, Singapore

June 2025

RCEM, Barcelona, Spain

June 2025

UFSC, Brazil

April 2025

DigiShape, Netherlands

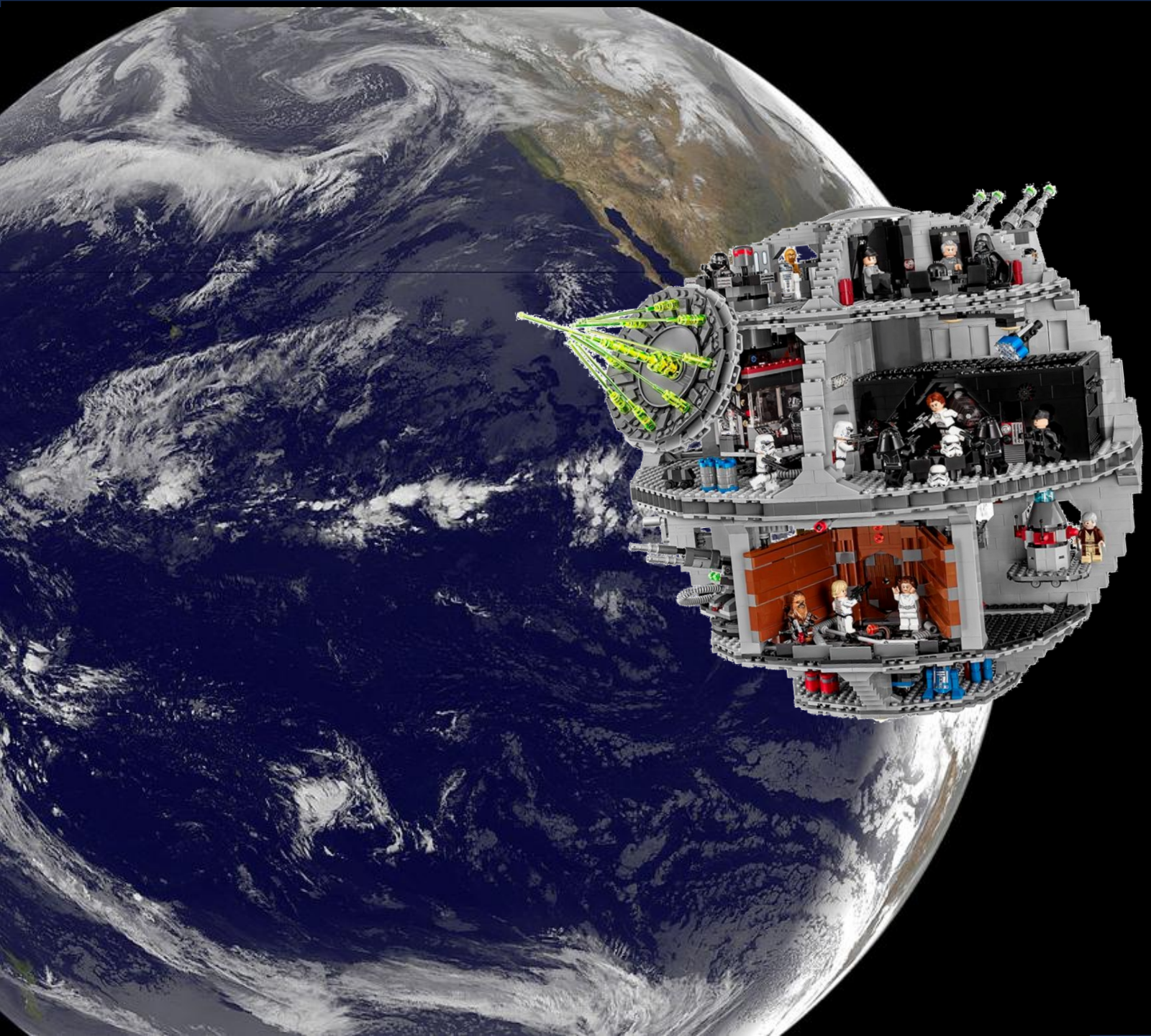
June 2025

NUS, Singapore

September 2025

Water Week, Cairo, Egypt

October 2025



Thank you

laura.cagigal@unican.es

BlueMath Repo

Scan me