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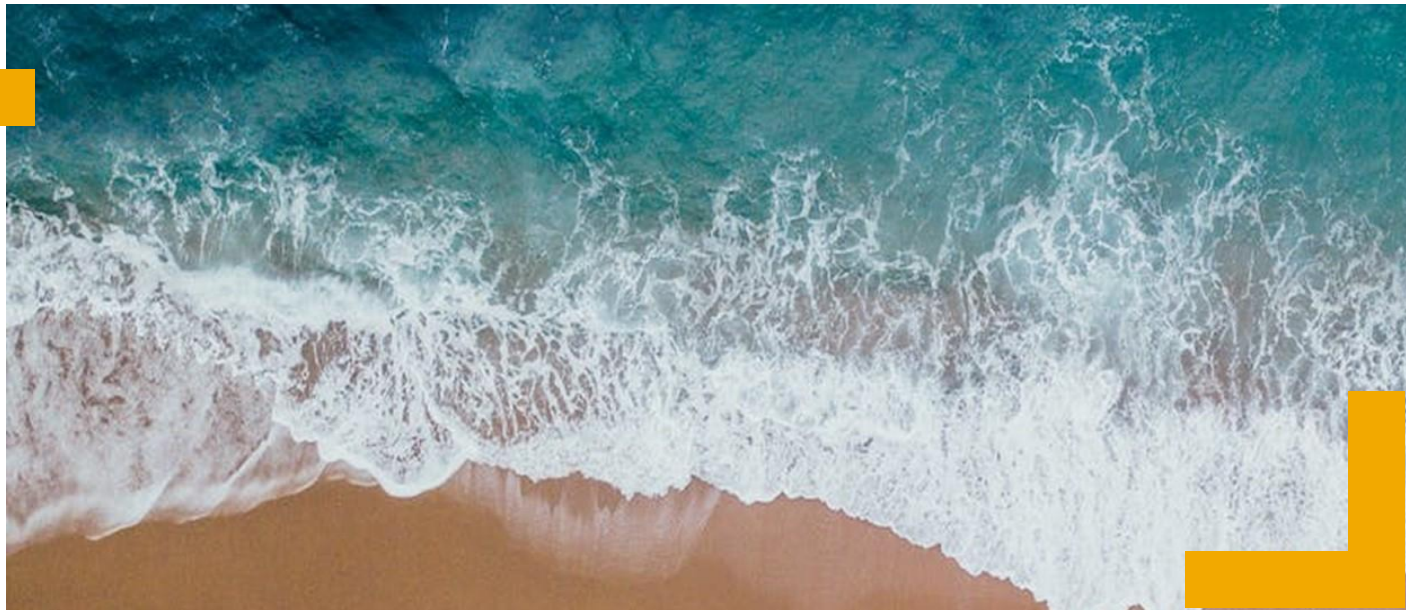


December 2024

Data collection on sea level rise scenarios

Deliverable 1.1.2.

https://medsearise.interreg-euro-med.eu/

ANAT LIKI | aRPa FVG | CCI NICE CÔTE D'AZUR | Cambra de Comerç de Barcelona | L-Università ta' Malta

Deliverable ID

Project acronym	MedSeaRise
Project title	Supporting Adaptation to Mediterranean Sea Level Rise
Project mission	Protecting, restoring and valorising the natural environment and heritage
Project priority	Greener MED
Specific objective	RSO2.4 Promoting climate change adaptation and disaster risk prevention, resilience, taking into account eco-system based approaches
Type of project	Study project (Thematic Project)
Project duration	01/01/2024 – 31/03/2026 (27 months)

Deliverable title	Data collection on sea level rise scenarios
Deliverable number	D.1.1.2.
Deliverable type	Report
Work package number	1
Work package title	Information retrieval, data input and stakeholder awareness
Activity name	Data and scientific information on future scenarios of sea level rise
Activity number	1.1
Partner in charge (author)	ARPA FVG (PP2)
Partners involved	UoM-IBMK (PP4), UM (PP6)

Table of contents

1. Introduction and Objectives

This document presents a specific contribution in the achievement of the general MedSeaRise WP1 objective, namely the results obtained in the frame of the Activity 1.1 which are related to the harvesting and the organization of data on sea level future scenarios.

To this end, MedSeaRise project has considered mandatory to blueprint and implement a data storage and the computational infrastructure to store and analyze big data. In fact, the numerical simulation of the future state of Earth climate are available according to a typical big data file organization and file format.

Thanks to the deliverable D.1.1.2, the MedSeaRise partnership easily accessed the numerical information required to define and conduct the case studies on the impacts of the sea level rise on anthropic activities and ecosystems.

In the following, this deliverable describes the computational infrastructure used in the frame of the project to collect the numerical model outputs, post process them and let them available to the project partners. Furthermore, the set of available climate simulations is described in detail.

This deliverable make synergy with deliverables D.1.1.1, D.2.1.1, D.2.2.1 and D.2.2.2 [1.1].

2. Computational infrastructure

Weather and climate numerical model outputs are usually stored in large file having suitable data formats (i.e. netCDF [2.1]). To operate on such kind of files dedicated software are required (i.e. CDO [2.2], NCO [2.3], etc.). Furthermore, enough disk space is required to download and to store the whole simulation sets. The whole dataset post processing can be carried out with a limited time if a significant computational power is available.

Inside the MedSeaRise partnership, all the conditions are available from PP2. In fact, through the involvement of PP2, the computational and storage resources of Fvg ENhanced Infrastructure and Computational Environment (FENICE [2.4]) supports the High Performance Computation required by the project, especially in achieving the WP1.

In addition to those computational resources, the Activity 1.1 got the full support thank to the skill of PP6 in model output elaboration and visualization.

To make easier the access to the subset of sea level projection and ancillary data, that have been generated in Activity 1.1 to support the Project Partners in conducting the case studies, a Google Drive shared area [2.5] was defined and populated by simulations outputs representative of the MedSeaRise geographical areas.

The whole set of data used in the frame of the project, is available through a dedicated ERDDAP [2.6] [2.7] service, that PP2 has explicitly implemented for the project purposes.

3. Available datasets

The sources of information on the future scenarios of Mean Sea Level, which has been considered in the frame of MedSeaRise project, are a set of monthly averages of fields covering the time period ranging from 1850 to 2100 and the whole Mediterranean Sea area. These data are shortly referred to as ZOS. Furthermore, auxiliary datasets of near surface temperature and precipitations have been collected and prepared to complement the information considered useful to the case study conduction by each Prohect Partners. Those data are shortly referred as TAS and PRE, for temperature and precipitation respectively.

ZOS data sets

Data files were downloaded for as many simulations as possible, related to the four main SSP-RCPs scenarios, namely SSP1-2.6, SSP2-4.5, SSP3-7.0 and SSP5-8.5, together with their historical part. Those files are in netDCF format and are selected from CMIP6 [3.1] data sets with 25 km of (horizontal) spatial resolution. Files are accessible from one of the nodes [3.2] of the Earth System Grid Federation (ESGF) [3.3] [3.4], which is an international collaboration for the software that powers most global climate change research, including the climate assessments of the Intergovernmental Panel on Climate Change (IPCC) [3.5].

From the downloaded files, time series are extracted (nearest neighbor interpolation) for specific geographic locations of interest by each Project Partner (see table 3.1).

location ID	latitude [°N]	longitude [°E]	notes
LP1_00	40.63666	22.94216	Thessaloniki (EL); PRE, TAS
LP1_01	40.41616	22.75137	Point offshore in the Thermaic Gulf; ZOS
LP1_02	40.26243	22.83822	Point offshore in the Aegean Sea; ZOS

PP2_00	45.64325	13.7903	Trieste (IT); PRE, TAS
PP2_01	45.49458	13.15274	Point offshore in the North Adriatic Sea; ZOS
PP3_00	43.70313	7.26608	Nice (FR); PRE, TAS
PP3_01	42.56954	7.34774	Point offshore the Cote d'Azur; ZOS
PP4_00	42.42067	18.76825	Kotor (ME); PRE, TAS
PP4_01	42.16527	18.40141	Point offshore in the South Adriatic Sea; ZOS
PP5_00	41.38879	2.15899	Barcelona (ES); PRE, TAS
PP5_01	41.22654	2.472953	Point offshore in the Balearic Sea; ZOS
PP6_00	35.89972	14.51472	Valletta (MT); PRE, TAS
PP6_01	36.12255	14.73559	Point offshore the coastline of Malta; ZOS

Table 3.1: the locations that the MedSeaRise project has identified to conduct the project activities. Each location ID is associated to the latitude e longitude of the location and the notes report information on the location name and the environmental fields available; namely: sea level (ZOS), air temperature 2 m above the ground (TAS) and precipitation (PRE)

Data are stored in a folder for each Project Partner (PP) and therein other subfolders storing time series files of ZOS. There is one netCDF file for each simulation, geographic location and scenario; the time series are composed by monthly average values extending from an historical part (1850 ÷ 2014) to a future RCP scenario (2015 ÷ 2100).

There is only one location, where ZOS has been considered so far for each PP. It is worth noting that for LP1 two locations have been considered, since for a specific scenario (GFDL-CM4_r1i1p1f1) no data close enough to the area of interest are available.

The number of simulations of ZOS for each considered scenario (historical + SSP-RCP) is listed below:

SSP1-2.6, number of available datasets: 3

SSP2-4.5, number of available datasets: 2

SSP3-7.0, number of available datasets: 6

SSP5-8.5, number of available datasets: 7

The main features of the simulations mentioned above are listed in the dedicated table 3.2.

Project	**Institution ID**	**Model ID**	**SSP-RCP**	**Configuration run**
CMIP6	AWI	AWI-CM-1-1-MR	ssp126	r1i1p1f1
CMIP6	MOHC	HadGEM3-GC31-MM	ssp126	r1i1p1f3
CMIP6	CNRM-CERFACS	CNRM-CM6-1-HR	ssp126	r1i1p1f2
CMIP6	AWI	AWI-CM-1-1-MR	ssp245	r1i1p1f1
CMIP6	CNRM-CERFACS	CNRM-CM6-1-HR	ssp245	r1i1p1f2
CMIP6	AWI	AWI-CM-1-1-MR	ssp370	r5i1p1f1
CMIP6	AWI	AWI-CM-1-1-MR	ssp370	r4i1p1f1

CMIP6	AWI	AWI-CM-1-1-MR	ssp370	r3i1p1f1
CMIP6	AWI	AWI-CM-1-1-MR	ssp370	r2i1p1f1
CMIP6	AWI	AWI-CM-1-1-MR	ssp370	r1i1p1f1
CMIP6	CNRM-CERFACS	CNRM-CM6-1-HR	ssp370	r1i1p1f2
CMIP6	NOAA-GFDL	GFDL-CM4	ssp585	r1i1p1f1
CMIP6	AWI	AWI-CM-1-1-MR	ssp585	r1i1p1f1
CMIP6	MOHC	HadGEM3-GC31-MM	ssp585	r4i1p1f3
CMIP6	MOHC	HadGEM3-GC31-MM	ssp585	r1i1p1f3
CMIP6	MOHC	HadGEM3-GC31-MM	ssp585	r2i1p1f3
CMIP6	MOHC	HadGEM3-GC31-MM	ssp585	r3i1p1f3
CMIP6	CNRM-CERFACS	CNRM-CM6-1-HR	ssp585	r1i1p1f2

Table 3.2: list of the available datasets for each location that the MedSeaRise project has identified to conduct the project activities. Besides the computational experiment (Project) that has generated the dataset, the institution (Institution ID) and the applied model (Model ID) are reported. The Scenario (SSP-RCP) is identified with a string of the type sspXY, that means the SSP X and the RCP Y. The model configuration used to run it is available too (Configuration run).

TAS and PRE datasets

Files of monthly averages, covering part of the XX century and the whole XXI century, are downloaded for several simulations, related to the three main RCP scenarios, namely RCP2.6, RCP4.5 and RCP8.5, and their historical part. Those files are in netDCF format and are selected from EURO-CORDEX data sets [3.6].

From the downloaded files, time series are extracted (bilinear interpolation) for specific geographic locations of interest by each Project Partner (see the PP_XX-locations.csv file [2.5]).

In the main folder [2.5] a subfolder for each Project Partner (PP) and therein other subfolders storing time series files of TAS and PRE. There is one netCDF file for each simulation, geographic location and scenario; the time series are composed by monthly average values extending from an historical part (1951 ÷ 2005 or 1971 ÷ 2005) to a future RCP scenario (2006 ÷ 2100 or 2006 ÷ 2099).

These time series files are used to generate plots (see Appendix A) or summary tables (see Appendix B) supporting the PPs in the interaction with stakeholders and in conducting the case studies of sea level rise related impacts.

The number of simulations of TAS for each considered scenario (historical + RCP) is listed below:

- RCP2.6, number of available datasets: 11
- RCP4.5, number of available datasets: 14
- RCP8.5, number of available datasets: 13

The simulations for PRE are the same as those for TAS.

The main features of the simulations mentioned above are listed in the dedicated table 3.3.

Project	Domain	GCM	RCM	Experiment	Ensemble member	Version	Temporal resolution	Variable
CORDEX	EUR-11	CNRM-CERFACS-CNRM-CM5	CNRM-ALADIN63	rcp26	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	CNRM-CERFACS-CNRM-CM5	KNMI-RACMO22E	rcp26	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	CLMcom-CCLM4-8-17	rcp26	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	KNMI-RACMO22E	rcp26	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	SMHI-RCA4	rcp26	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	DMI-HIRHAM5	rcp26	r3i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MOHC-HadGEM2-ES	KNMI-RACMO22E	rcp26	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	MPI-CSC-REMO2009	rcp26	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	SMHI-RCA4	rcp26	r1i1p1	v1a	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	MPI-CSC-REMO2009	rcp26	r2i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	NCC-NorESM1-M	GERICS-REMO2015	rcp26	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	CNRM-CERFACS-CNRM-CM5	CNRM-ALADIN63	rcp45	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	CNRM-CERFACS-CNRM-CM5	KNMI-RACMO22E	rcp45	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	CLMcom-CCLM4-8-17	rcp45	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	KNMI-RACMO22E	rcp45	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	SMHI-RCA4	rcp45	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	DMI-HIRHAM5	rcp45	r3i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	IPSL-IPSL-CM5A-MR	SMHI-RCA4	rcp45	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MOHC-HadGEM2-ES	CLMcom-CCLM4-8-17	rcp45	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MOHC-HadGEM2-ES	KNMI-RACMO22E	rcp45	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	CLMcom-CCLM4-8-17	rcp45	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	MPI-CSC-REMO2009	rcp45	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	SMHI-RCA4	rcp45	r1i1p1	v1a	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	NCC-NorESM1-M	GERICS-REMO2015	rcp45	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	CNRM-CERFACS-CNRM-CM5	CNRM-ALADIN63	rcp85	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	CNRM-CERFACS-CNRM-CM5	KNMI-RACMO22E	rcp85	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	CLMcom-CCLM4-8-17	rcp85	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	KNMI-RACMO22E	rcp85	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	ICHEC-EC-EARTH	SMHI-RCA4	rcp85	r12i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	IPSL-IPSL-CM5A-MR	SMHI-RCA4	rcp85	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MOHC-HadGEM2-ES	CLMcom-CCLM4-8-17	rcp85	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MOHC-HadGEM2-ES	KNMI-RACMO22E	rcp85	r1i1p1	v2	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	CLMcom-CCLM4-8-17	rcp85	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	MPI-CSC-REMO2009	rcp85	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	SMHI-RCA4	rcp85	r1i1p1	v1a	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	MPI-M-MPI-ESM-LR	MPI-CSC-REMO2009	rcp85	r2i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	NCC-NorESM1-M	GERICS-REMO2015	rcp85	r1i1p1	v1	mon	2m air temperature, mean precipitation flux
CORDEX	EUR-11	NCC-NorESM1-M	GERICS-REMO2015	rcp85	r1i1p1	v1	mon	2m air temperature, mean precipitation flux

Table 3.3: list of the TAS and PRE available datasets for each location that the MedSeaRise project has identified to conduct the project activities. Besides the computational experiment (Project) that has generated the dataset, the geographical domain (Domain), the general circulation model driving the regional simulation (GCM), the regional climate model used for the run (RCM), the set of three IDs characterizing the simulation (Experiment Ensemble member Version), the simulation version (Version), the temporal resolution (Temporal resolution) and the available variables. The Scenario (RCP) is identified with a string of the type RCPXX..

4. Deliverable indicators

This deliverable is summarized by means of the indicators reported here below. For each of them the expected indicator value and the actual one are presented. In addition, comments are reported too, if any.

Indicator	Expected value	Actual value	Comments
Data sets	1	18	For each PP

The indicator refers to the dataset available for each Project Partner to describe the future scenarios of sea level.

Further information available in Google Drive Data area [2.5]

5. Conclusions

MedSeaRise Activity 1.1 was conducted from the first project period to the third and in this last period delivered this document. This document acts as the deliverable describing the data collection on sea level rise scenarios.

This deliverable contributes in achieving the goal of the Activity 1.1 which is summarized as providing the project with data and scientific information on future scenarios of sea level rise, including auxiliary data, suitable to conduct case studies on selected classes of impacts, which are consequences of the sea level rise.

To this end the high performance computing infrastructure was identified, together the supporting services, software and the skill inside the partnership. Sea level trends and auxiliary data were download and data file organization for next post elaborations and analyses.

6. References to additional material

[1.1] Basecamp Key Production WP1

[2.1] Network Common Data Form (NetCDF) - data format

[2.2] Climate Data Operators (CDO)

[2.3] netCDF Operators (NCO)

[2.4] FENICE - Fvg ENhanced Infrastructure and Computational Environment

[2.5] Google Drive MedSeaRise shared area for future climate simulations

[2.6] Data services supporting the MedSeaRise project through ERDDAP

[2.7] MedSeaRise - Interreg Euro-MED Project ERDDAP service

[3.1] CMIP6 - Coupled Model Intercomparison Project Phase 6 https://wcrp-cmip.org/cmip-phases/cmip6/

[3.2] Earth System Grid Federation (ESGF) data search node https://aims2.llnl.gov/search

[3.3] Earth System Grid Federation (ESGF) https://esgf.github.io/mission.html

[3.4] CMIP Model and Experiment Documentation https://wcrp-cmip.org/cmip-model-and-experiment-documentation/

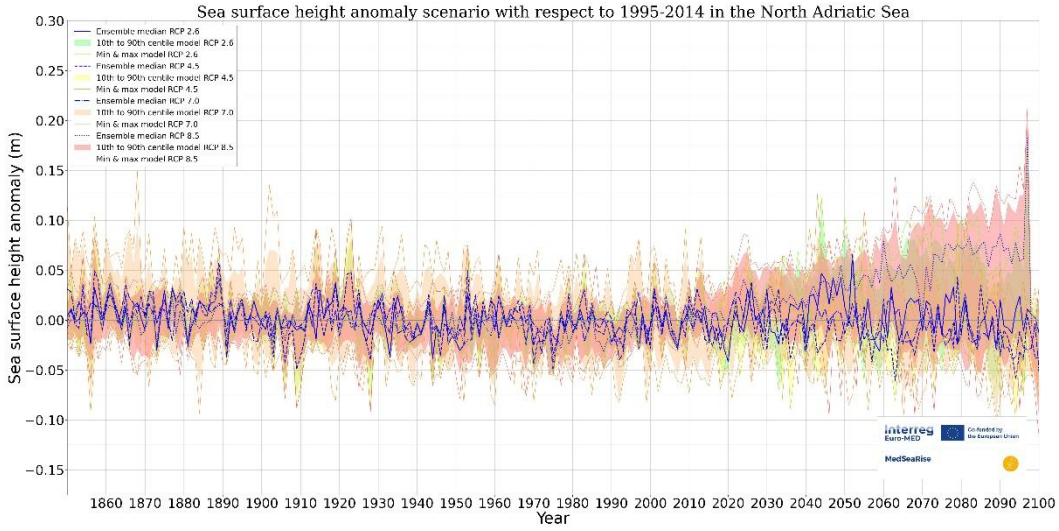
[3.5] The Intergovernmental Panel on Climate Change (IPCC) https://www.ipcc.ch/

[3.6] The Euro-CORDEX regional climate simulations for European area

7. Appendixes

Appendix A:

Text



Example of plot reporting the time series of sea level anomalies for all scenarios at one MedSeaRise location

Appendix B:

Station	PP2_01
Latitude (deg)	45.49458
Longitude (deg)	13.15274
Start Date	01/01/2020 00:00
End Date	31/12/2030 00:00
No of Points	96409
Mean (m)	-0.0087
Median (m)	0.0066
Standard Deviation (m)	0.2426
Minimum (m)	-0.7035
Maximum (m)	0.5984
1st Percentile (m)	-0.5660
5th Percentile (m)	-0.4453
95th Percentile (m)	0.3654
99th Percentile (m)	0.4605

Example of table summarizing the astronomical tide feature.