SEM

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CONTENTS:

SEM (Shoreline Evolution Model) is a powerful tool for simulating shoreline evolution at seasonal to decadal timescales that has a set of great features:

- beaches can develop in either sandy or rocky shores
- flexible baseline definition
- shapefile input and output
- internal or external wave transformation schemes

CHAPTER

ONE

MOTIVATION

Shoreline evolution models are useful tools in analysing and predicting coastal morphological evolution on seasonal to decadal time scales. Several analytic and numerical models have been proposed to describe changes in shoreline based on analysis of the balance of sediment volumes over a certain time period, assuming an equilibrium beach profile (Pelnard-Considère, 1956; Hanson, 1989; Dabees and Kamphuis, 1998; Steetzel et al., 2000; Coelho et al., 2004). In platform beaches, due to sediment scarcity, the equilibrium profile assumption is no longer valid so the longshore drift estimates must consider the presence of a rocky shore platform and limited sand availability. The Shoreline Evolution Model– SEM, was developed to simulate shoreline changes on coastal stretches where continuous or pocket beaches develop over a rocky platform.

SEM model aims to predict beach development and evolution in headland-bay coasts and targets the understanding of some key processes such as beach rotation and sediment headland bypassing.

The present documentation intends to describe SEM model, its fundamentals, calculations procedures and structure, as well its implementation in Phyton and setup.

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TWO

INSTALLATION

To complete

CHAPTER

THREE

FIRST STEPS WITH SEM

3.1 Build your first model

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FOUR

COMPUTATIONAL GRID

CHAPTER

FIVE

BOUNDARY CONDITIONS

5.1 Offshore waves

Offshore wave conditions should be given as a wavetimeseries objet. Data sources include offshore wave buoys and model data. To simulate relative long periods, hindcast data are one of the best options, so the procedure is detailed below.

5.1.1 Using ERA5 based ocean wave hindcast

ERA5 is the fifth generation ECMWF (European Centre for Medium-Range Weather Forecasts) atmospheric reanalysis of the global climate and have a horizontal resolution of 0.5 ° x 0.5 ° for waves.

Warning: Prior to download the wave data make sure that the CDS API and xarray package are properly installed.

See /docs/ERA5-prerequisites for details.

1 - Data selection and downloading

The best way to navigate to the available data is to open ERA5 download page and in the *download tab* select the desired data. In the bottom of the same panel click on the *Show API request* button and copy the code to a python file.

Example

Example of a code for downloading a grib file with wave significant height, mean period and mean direction, for a region offshore mainland Portugal, for all available hours of day 01-April-2020. Data will be download to a file named *download.grib*.

```
import cdsapi
c = cdsapi.Client()
c.retrieve(
    'reanalysis-era5-single-levels',
    {
        'product_type': 'reanalysis',
        'format': 'grib',
        'variable': [
            'mean_wave_direction', 'mean_wave_period', 'significant_height_of_
↪combined_wind_waves_and_swell',
        ],
```

```
        'year': '2020',
        'month': '04',
        'day': '01',
        'time': [
                '00:00', '01:00', '02:00',
                '03:00', '04:00', '05:00',
                '06:00', '07:00', '08:00',
                '09:00', '10:00', '11:00',
                '12:00', '13:00', '14:00',
                '15:00', '16:00', '17:00',
                '18:00', '19:00', '20:00',
                '21:00', '22:00', '23:00',
        ],
        'area': [
                43, -13, 36,
                -7,
        ],
    },
    'download.grib')
```

Output on pyton console

```
2020-05-15 19:26:36,562 INFO Welcome to the CDS
2020-05-15 19:26:36,567 INFO Sending request to https://cds.climate.copernicus.eu/
↪api/v2/resources/reanalysis-era5-single-levels
2020-05-15 19:26:39,209 INFO Request is queued
2020-05-15 19:26:44,134 INFO Request is running
2020-05-15 19:26:52,695 INFO Request is completed
2020-05-15 19:26:52,697 INFO Downloading http://136.156.133.25/cache-compute-0008/
↪cache/data5/adaptor.mars.internal-1589567202.6668167-11772-35-ea112760-394c-4211-
↪a63e-bdfd778e233c.grib to download.grib (33.8K)
2020-05-15 19:26:52,876 INFO Download rate 190.7K/s
```

2 - Loading and converting the data to a wavetimeseries