

SEA-COApp: A web app to analyze, download, and visualize Regional Ocean Model (ROM) datasets in Southeast Asia

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Abstract. To provide weather and climate-related services for disaster management, public policymaking, and adaptation and mitigation efforts, the information regarding climate change is of high importance. However, obtaining or analyzing climate change datasets has been a challenge for those who are not familiar with coding. Therefore, to make the datasets easier to obtain and work with, we develop a tool called “Southeast Asia – Climate-Ocean web App” (SEA-COApp). The SEA-COApp is a web app to aid people to obtain, analyze, or visualize ROM datasets in Southeast Asia. It can be used to obtain chunks of data from the InaROMS server and visualize it easily with an intuitive graphical user interface. Furthermore, it also has functionalities to calculate climatology, area-average, anomaly, and trends. The tool can help those who are unfamiliar with climate change datasets to be able to use the datasets for their research. Thus, promoting cross-disciplinary research.

1. Introduction

Global warming is one of the most serious concerns in the modern world. It is suggested that human activities play an important role in controlling global warming and can result in climate change in the future [1,2]. Therefore, to help create climate-based public policies, manage disasters, adaptation, and mitigation efforts, climate change datasets are important and in dire need. However, due to its huge size of datasets and the requirement of programming skills to obtain them, there has been a challenge for people unfamiliar with climate datasets to analyze the datasets and utilize them in their research.

To help people to get access to the climate change datasets, particularly the projected climate change scenario of Regional Ocean Models (ROM), we present a web app called “Southeast Asia – Climate-Ocean web App” (SEA-COApp). The tool can obtain, analyze, and visualize ROM datasets in Southeast Asia. It can be hosted in the localhost of the user’s computer and can be run with web browsers of any operating system. This paper aims to give the user a general description of the web app and its features.

2. Features

The latest version of SEA-COApp can be downloaded from Github Repository (<https://github.com/iuiuiu-wayy/SEACOAPP>). The web app is based on python 3.x. The repository also provides installation instructions for the users. For the more advanced users, the NCAR Command Language (NCL) version is available on the Github Repository (<https://github.com/fadhilRmuhammad/ReGISFEST2020/releases/tag/IndoSLR-v2.0>), the instructions for the NCL version are also provided.

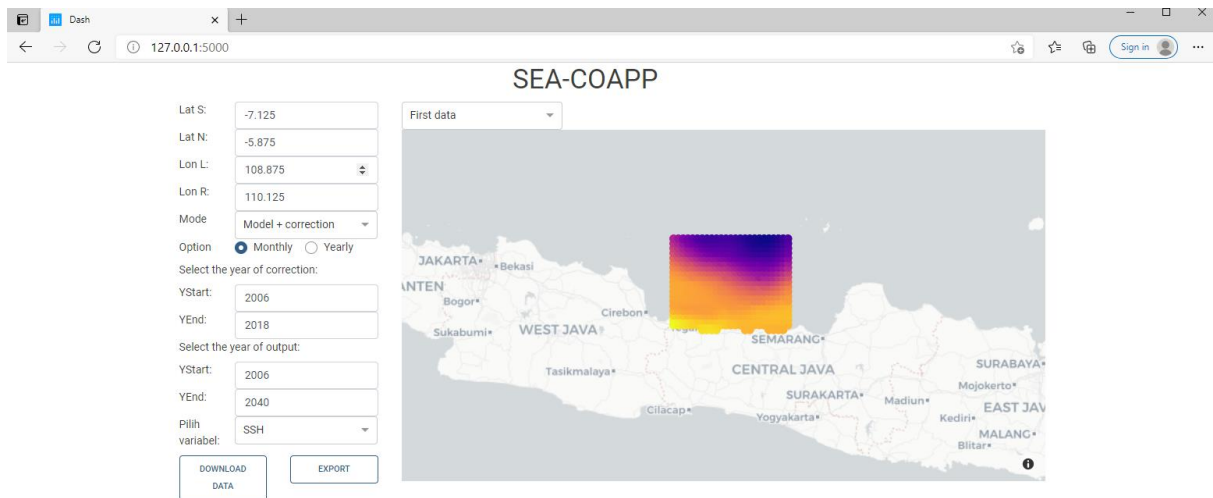


Figure 1. The graphical user interface (GUI) of SEA-COApp.

2.1. Domain and variable selection.

The user can choose their domain of interests by inputting it in the “Lat S”, “Lat N”, “Lon L”, and “Lon R”. The app can obtain several variables from the InaROMS [3] such as sea surface height (SSH), sea surface temperature (SST), Salinity (SALT), zonal velocity (U_VEL), and meridional velocity (V_VEL). The InaROMS dataset is a model simulation of high-resolution climate change projection datasets (RCP4.5 scenario) over most of the ocean in Southeast Asia.

2.2. Mode selection

On the web app, the user can select two modes, “Model” and “Model + Correction”. The “Model” mode is used to grab chunks of InaROMS data from the INA-COAP THREDDS server to the computer (<http://tides.big.go.id:8080/thredds/catalog.html>). This mode is available for all variables described in section 2.1. The user can choose whether to use monthly or yearly variables as the output and check the values in the map shown on the web app.



Figure 2. Example of the "Model + Correction" output from SEA-COApp.

The “Model + Correction” mode calculates the corrected model data using satellite observation datasets ($0.25^\circ \times 0.25^\circ$) obtained from E.U. Copernicus Marine Service Information [4]. Currently, only SSH variable is available for this mode. To calculate the corrected value of the model datasets, we use the delta method that is defined as follows [5,6]:

$$SSH_{corr} = SSH_{mod} + (\overline{SSH_{obs}} - \overline{SSH_{mod}})$$

Where the SSH_{corr} is the corrected SSH value, SSH_{mod} is SSH value from the ROM, $\overline{SSH_{obs}}$ is mean of the SSH obtained from observation datasets and $\overline{SSH_{mod}}$ is the mean of the SSH value from the ROM, both are calculated during the selected correction year.

2.3. Functionalities

After selecting the domain, variable, mode, and period, the user can download the data chunk and view it on the web app. The web app is also capable of several mathematical functionalities, such as calculating climatology or mean (Figure 3), anomaly (Figure 4), and trends (Figure 5). All functionalities are capable to calculate both spatial and area-averaged formats.



Figure 3. Example of monthly SSH climatology output from SEA-COApp.

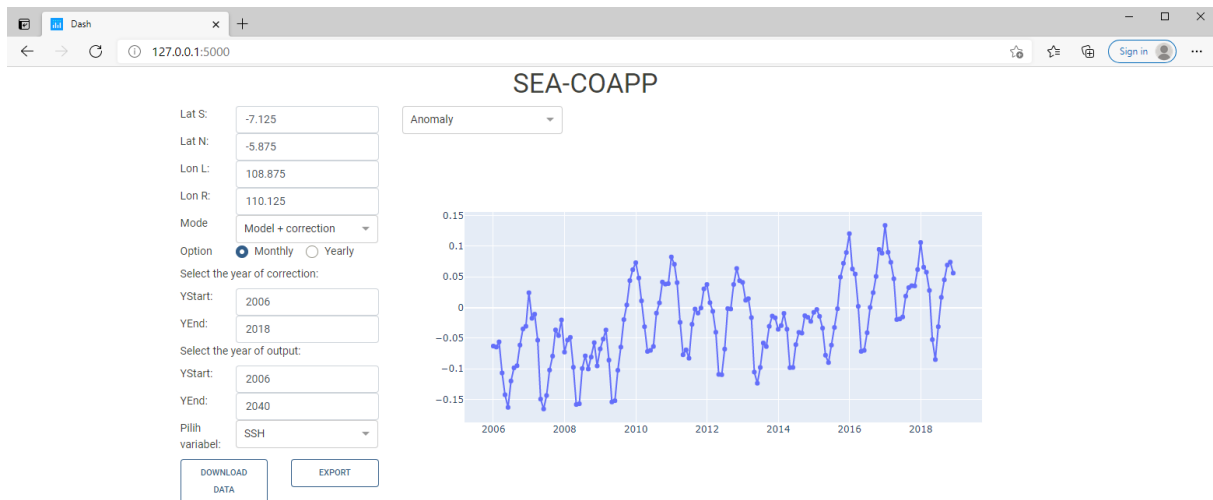


Figure 4. Example of monthly SSH anomaly output from SEA-COApp.

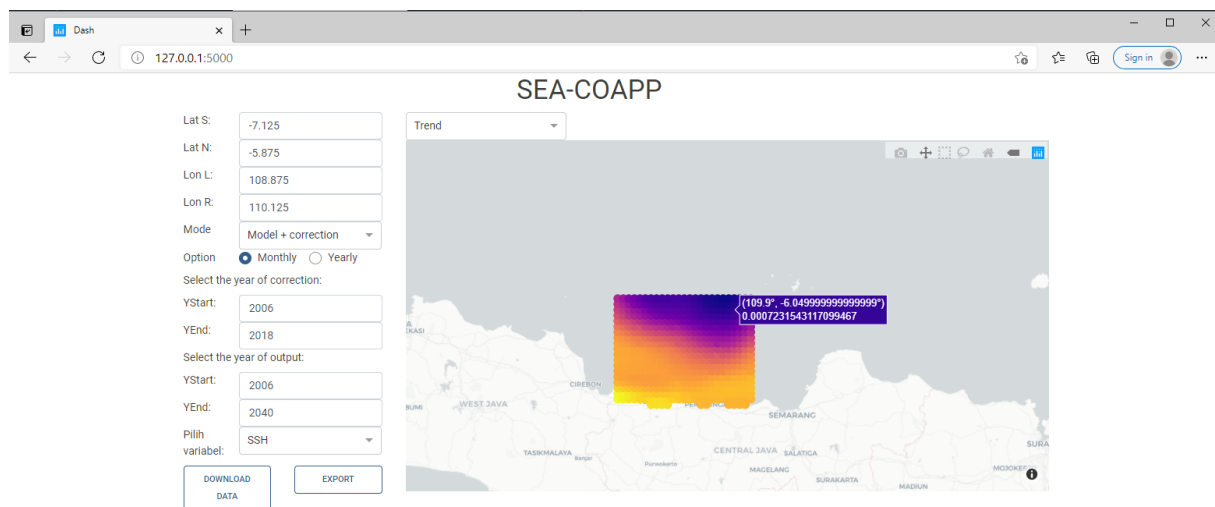


Figure 5. Monthly trends of SSH (m month^{-1}) calculated by SEA-COApp.

2.4. Downloading and exporting data

The downloaded datasets can be exported to local computer and will be available in netCDF (.nc), GeoTIFF (.tiff), and comma-separated value (.csv) formats. The exported datasets consist of raw data, climatology or mean, anomaly, and trend in spatial and area-averaged formats. The exported data can be used for further analysis by opening it in other applications such as QGIS and ArcMap for netCDF and GeoTIFF formats or LibreCalc and Microsoft Excel for comma-separated value format.

3. Case study: Sea surface height in future climates (Pekalongan region)

In the coastal region, the risk of sea-level rise is of high importance due to its catastrophic impacts, such as floods, ecological damages, and infrastructure damages. There have been some studies of the impact of future climate on sea level height and its impact in the coastal region [1,7,8]. Hsu *et al.* [7] analyzed the impact of sea-level rise due to future climate in the coastal and found increasing vulnerability and risk in the coastal region in future climates due to sea-level rise. Moreover, Marfai [9] shows that sea-level rise can affect ecological, infrastructure damages, and widespread health problems in the coastal region.

Pekalongan region is located in the province of central Java at the northern coast of Java island. The region has been affected by the sea flood, partly due to land subsidence (up to ~ 30 cm/year in the coastal region) [10,11]. The coastal region has been affected by sea floods from time to time. Therefore, it is important to provide a climate change projection of the SSH variable for this region. In this section, we will show some examples of the output of the projected SSH variable from the web app and comparing it with the official records from the Third National Communications [3].

Figure 6 shows the trends of yearly SSH as the proxy for sea-level rise obtained from the web app. The result shows that the northern coast of the Pekalongan region is at risk of rising sea level by nearly $0.87 \text{ cm year}^{-1}$ ($0.0087 \text{ m year}^{-1}$). The result from the web app is in agreement with the official record that says rising sea level by around $0.85\text{-}0.9 \text{ cm year}^{-1}$ in the northern coast of Java island [3]. Assuming that the sea-level is around 80 cm in 2020 [11], at this rate, the sea level can rise by up to 97 cm in 2040. The rise of sea-level, along with land subsidence, can submerge many lands in the region and bring damages to the economy [11].

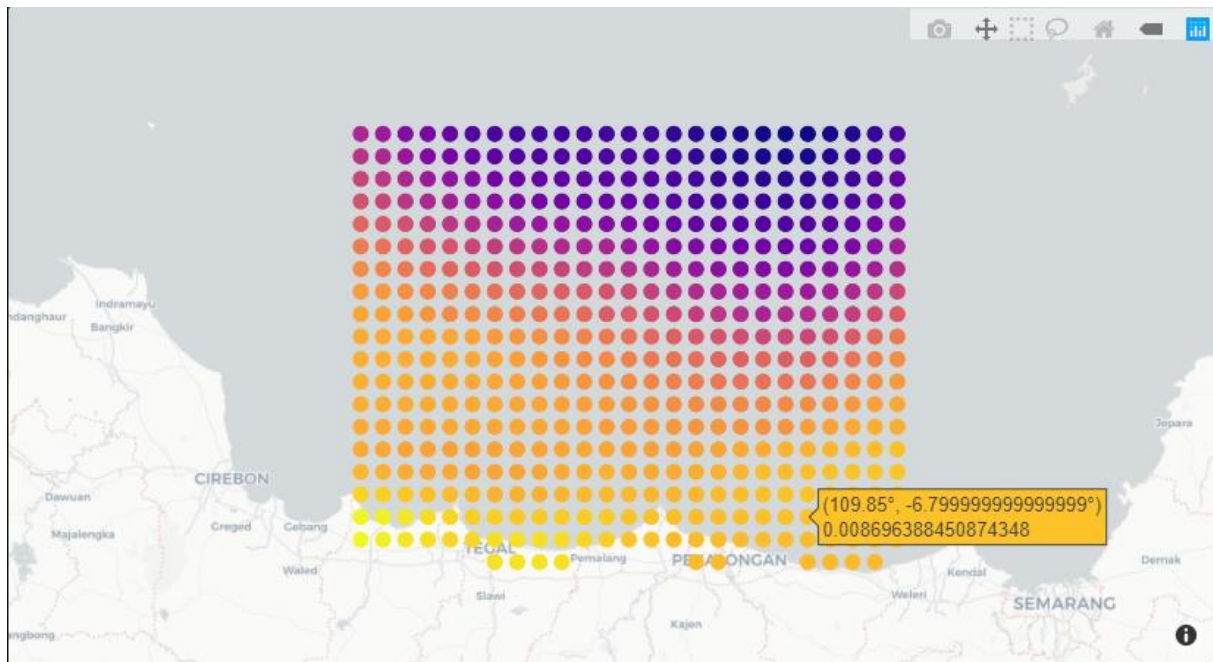


Figure 6. Trends of yearly SSH in Java sea near Pekalongan region. Unit is m year^{-1} .

4. Conclusion

The SEA-COApp web app can aid users in working with ROM climate change datasets. The web app is supplemented by an easy-to-use graphical user interface and functionalities that can assist users to analyze the datasets. The web app can also export the datasets easily from the server without having to download huge amounts of data. These features can help users, particularly non-climate scientists, to utilize the climate change datasets in their research.

Acknowledgments

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