The Journal of Open Source Software

RADWave: Python code for ocean surface wave analysis by satellite radar altimeter

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DOI: 10.21105/joss.02083

Software

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Submitted: 24 January 2020
Published: 31 March 2020

Summary

Satellite radar altimetry is an excellent remote sensing technique that can be used to determine significant wave height and wind speed (Chelton & Callahan, 2001). These measurements can be used to calculate wave height, period and power (Young & Donelan, 2018).

Since the first launch of the *GEOSAT* altimeter in 1985, there has been almost continuous data collection, with only a small gap between 1989-1992 due to no operating satellites. Consequently, analysis of this long-term temporal record provides new insights in inter-annual, seasonal and decadal variation in wave statistics.

Additionally, the high spatial resolution provided by altimeter data is particularly well-suited for remote regions, or locations where no long-term measurements exist (Ribal & Young, 2019). An extensive global database of all altimeter missions spanning from 1985-present is available on the Australian Ocean Data Network and has been compiled, calibrated and validated by (Ribal & Young, 2019). However, for many users, this dataset can be difficult to analyse and only provides significant wave height and wind speed.

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RADWave

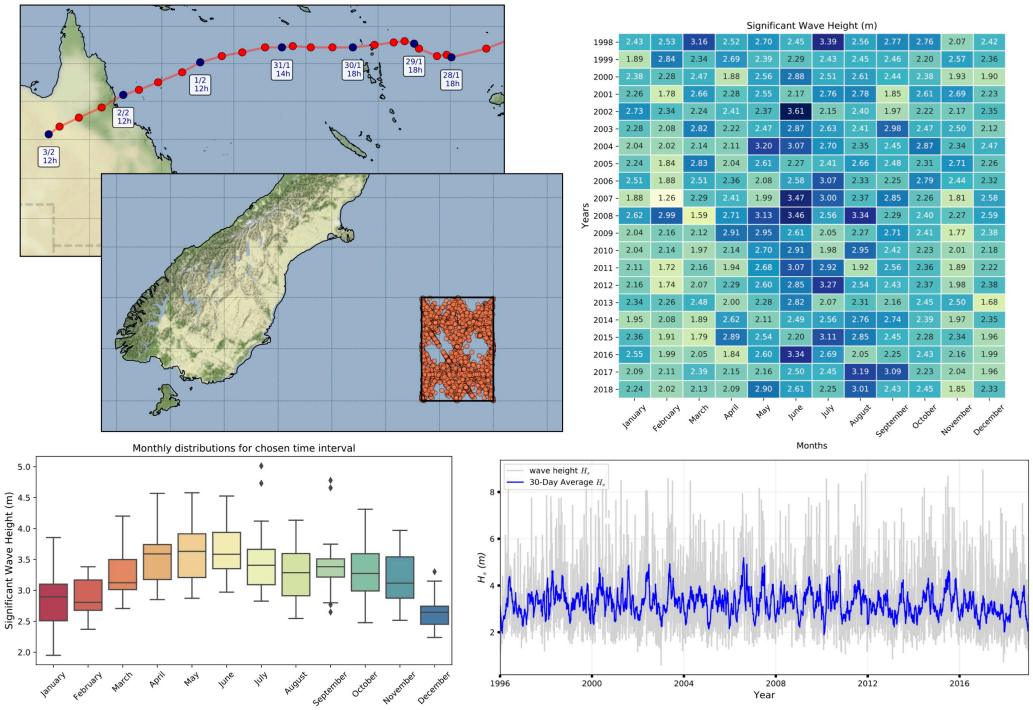

Figure 1: An example of the wave analysis and plotting capabilities of RADWave.

RADWave is Python package that provides a mechanism to access altimeter datasets through web-enabled data services (THREDDS). The package capabilities are illustrated in Figure 1 based on the the Australian Ocean Data Network global database (Ribal & Young, 2019). **RADWave** allows the user to query over a range of spatial and temporal scales altimeter parameters in specific geographical regions and subsequently calculates significant wave heights, periods, group velocities, average wave energy densities and wave energy fluxes.

While domain experts are able to assess satellite radar altimetry datasets, they currently have to download the data manually and write custom analysis and visualization functions using, e.g., numpy, pandas, and matplotlib to extract wave characteristics. **RADWave** combines this all into a simple object-oriented framework.

RADWave can be used to easily calculate past wave conditions and infers long term wave climate variability, providing new insights on wave modal conditions, seasonal changes, long-term trends and associated modulation by climate oscillations. It can also be used to assess locally the impact of wave-generated cyclones in offshore areas.

Along with the documentation a series of Jupyter Notebooks are presented to illustrate the package capability. **RADWave** enhances the ease of access and analysis of altimeter data and is designed for researchers and industry focusing on offshore wave conditions globally. To the authors' knowledge, no open-source code currently exists that provides such capability.

RADWave is currently being applied to the characterisation of wave climate and extreme events offshore the Great Barrier Reef and to determine the magnitude and resulting impacts of extreme wave events offshore One Tree Island, Great Barrier Reef.

Acknowledgements

The authors acknowledge the Integrated Marine Observing System (IMOS), a national collaborative research infrastructure supported by Australian Government and the Australian Ocean Data Network portal (**AODN**), for encouraging and developing the culture of data sharing across the marine science community of Australia.

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