Introduction

This bathymetry product was developed by the ASU team of the Allen Coral Atlas. Shallow water bathymetry is mapped in centimeters. There are several steps in the data processing that are outlined below.

Data Properties

The bathymetry maps are created at a resolution of 10 m using the Google Earth Engine (GEE) Sentinel-2 surface reflectance dataset. Sentinel-2 satellite images with minimal cloud coverage and turbid water over 12 months are selected. The input dataset is aggregated into a single clean mosaic output using the median depth value over 12 months. In the area without sufficient Sentinel-2 coverage, Landsat-8 and Planet Dove satellite images are used to derive depth and produce a composite image from the 3 datasets.

Methods

We developed a new automatic bathymetry mapping method based on a previous single-scene adaptive bathymetry algorithm (Li et al., 2019). Our algorithm was tailored to the clean water mosaic built by GEE. We first calculated remote sensing reflectance R_{rs} from the mosaic surface reflectance ($\rho(\lambda)$) as:

$$R_{rs}(\lambda) = \rho(\lambda)/\pi \qquad (1)$$

Next, we derived below-surface remote sensing reflectance ($r_{rs}(\lambda)$) from the $R_{rs}(\lambda)$ to remove the air-water surface effect:

$$r_{rs}(\lambda) = \frac{R_{rs}(\lambda)}{0.52+1.7R_{rs}(\lambda)} \qquad (2)$$

We estimated shallow water bathymetry by quantifying different attenuation levels between the blue and green bands as:

$$Depth = m_0 \frac{\ln{(1000*r_{rs}blue)}}{\ln{(1000*r_{rs}green)}} - m_1 \qquad (3)$$

The bathymetry estimation parameters (m_0 and m_1) were calculated using a Chlorophyll-a (Chl-a) concentration value as a representative for clean offshore waters:

$$m_0 = 52.073 * e^{(0.957*Chl_a)} \qquad (4)$$
$$m_1 = 50.156 * e^{(0.957*Chl_a)} \qquad (5)$$

As noted previously, we only selected satellite images with low water turbidity to build the mosaic. Also, given that the water mosaic values represent the median value over time (i.e., 12 months), we used a fixed Chl-a value to calculate m_0 and m_1 in our clean shallow water mosaic. This Chl-a value is a mean value calculated from GEE outputted clean water mosiac in 26 sites globally.
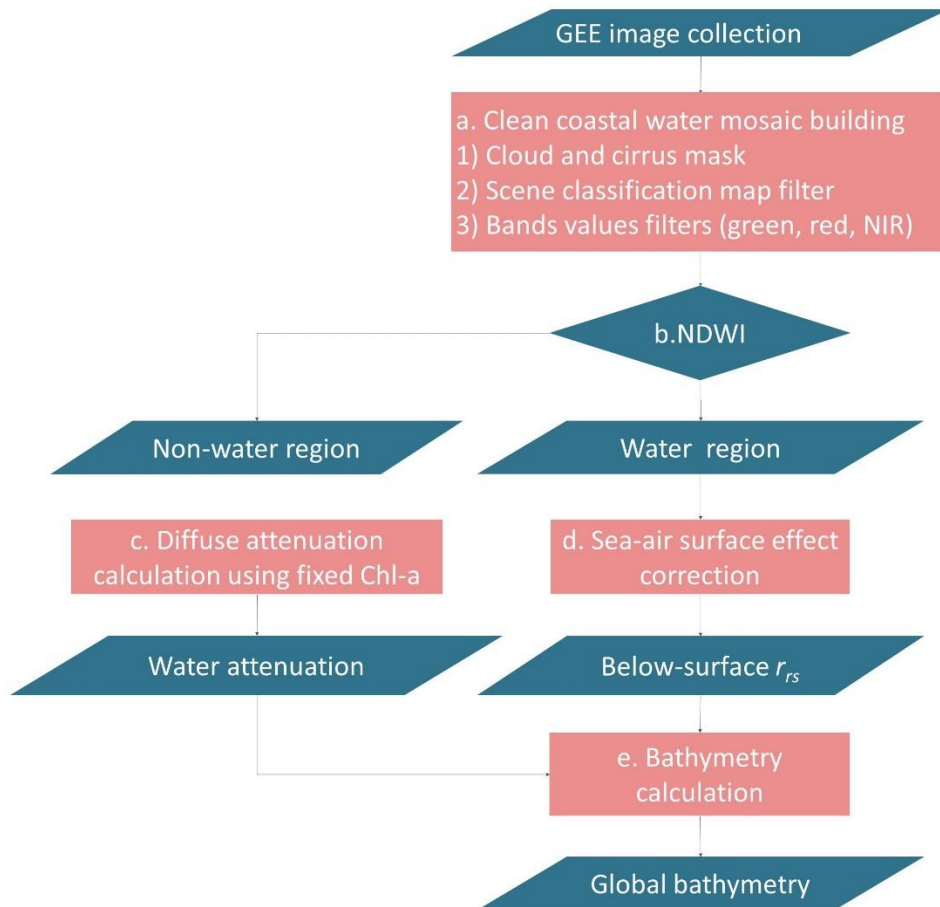
Data Download

The bathymetry products are downloadable. Bathymetry maps show the satellite derived bathymetry values where the bottom is visible in satellite images. The bathymetry image is stored as a GeoTIFF file. Each pixel in the bathymetry image is represented by a 16-bit integer.

Acknowledgements

References

Li, J., D.E. Knapp, S.R. Schill, C. Roelfsema, S. Phinn, M. Silman, J. Mascaro, and G.P. Asner*. Adaptive bathymetry estimation for shallow coastal waters using Planet Dove satellites. Remote Sensing of Environment, 232 (2019).

Li, J., D.E. Knapp, M. Lyons, C. Roelfsema, S. Phinn, S.R. Schill, G.P. Asner*. Automated global coastal water bathymetry mapping using Google Earth Engine. (in review)