Mapping of *Posidonia oceanica* with Sentinel-2 imagery and downscan sonar obtained training data

Tim Grandjean[1,2], Lena Schenke[1,3], Thodoris Tsimidis[1]

[1]Archipelagos Institute of Marine Conservation, Greece | [2]University of Amsterdam, Netherlands | [3]Kiel University, Germany

INTRODUCTION

The seagrass meadows of the Mediterranean endemic Posidonia oceanica provide essential nursery and feeding habitats for many fauna and flora species, while also they support numerous critical ecosystem services for humans[1]. However, they are among the most threatened coastal ecosystems worldwide, with a declining rate of 1.5% per year[2]. To counteract the decrease, of Posidonia meadows, they are protected by European laws such as the EU directive 2008/56/EC[3]. However, in the Eastern Mediterranean basin poor and inaccurate mapping makes their effective conservation a real challenge. In terms of resolution and costs, improvements of P. oceanica mapping is crucial to ensure effective conservation measures. The objective of this research is to create a low-cost method for mapping seagrass meadows around the islands in the SE-Aegean Sea, combining the advantages of sonar and satellite imagery mapping which have been addressed in several studies[4,5]. The study represents a novel workflow that combines supervised classification of Sentinel-2 satellite imagery with downscan sonar obtained training data for P. oceanica presence.

STUDY AREA AND METHODS

The study is conducted near the Kampos Choras and Mesokampos sedimentary basins in the southeast of Samos, Greece (figure 1). Kayak based surveys have been done with sonar downscans (Lowrance 7ti) and video recorders (GoPro) to monitor the local environmental conditions. From the field data are extracted training and accuracy data of P. oceanica presence and absence (figure 2). The Sentinel-2 imagery of 03-04-2017 is improved by atmospheric correction (iCOR), sunglint removal[6] and water column correction[7] before supervised classification is applied with the training data to classify the entire image for P. oceanica presence[4]. The Copernicus open source products SNAP entirely does the remote sensing and classification processing, which process is presented in figure 3.

Figure 1. The kayak transects (black lines) in the Kampos Choras and Mesokampos basins located in the southest of Samos, Greece.

RESULTS AND DISCUSSION

For the water column correction are site-specific algorithm obtained for the simplified applied analytical model of Maritorena et al. (1994). The coefficient of determination shows high correlation for the bathymetric model and attenuation coefficient, respectively 0,87 and 0,90 (graph 1 and 2). .. single sonar data points were used for the supervised classification of the Sentinel-2 imagery (figure 4) and ... points were used for the accuracy assessment. The overall accuracy is ..% with a kappa statistics of ..% up to 15m depth. In the sedimentary basins is the accuracy more accurate with 94% compared to steep rocky areas with 75% accuracy. The combination of Sentinel-2 imagery and downscan sonar data for classification steps provide a rapid and accurate method which is suitable for mapping P. Oceanica around the Aegean islands.

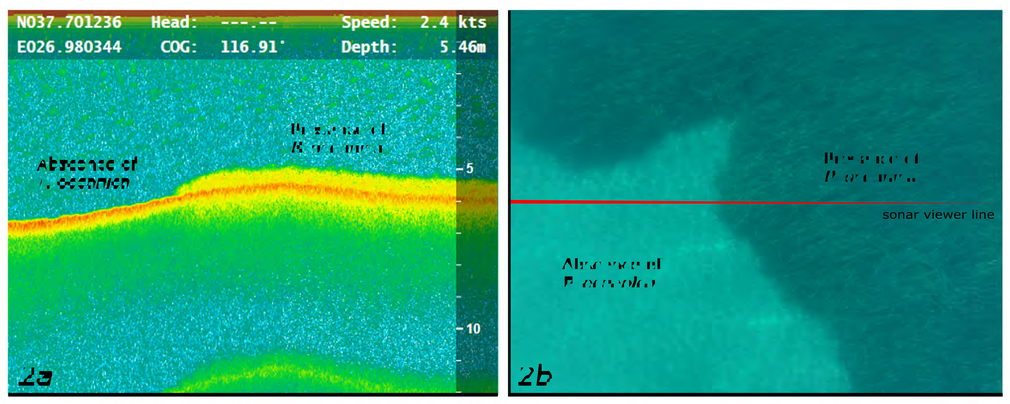


Figure 2a. The sonar (Lowrance 7ti) obtained bottom scan with the presence and absence of P. oceanica. Figure 2b. Image of the same site as 2a obtained by a GoPro which was mounted next to the sonar.

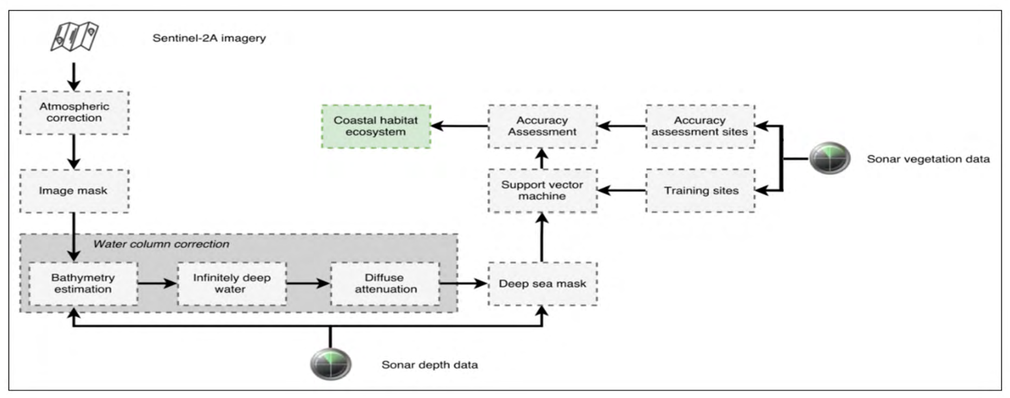


Figure 3. Schematic presentation of the workflow for image classification.

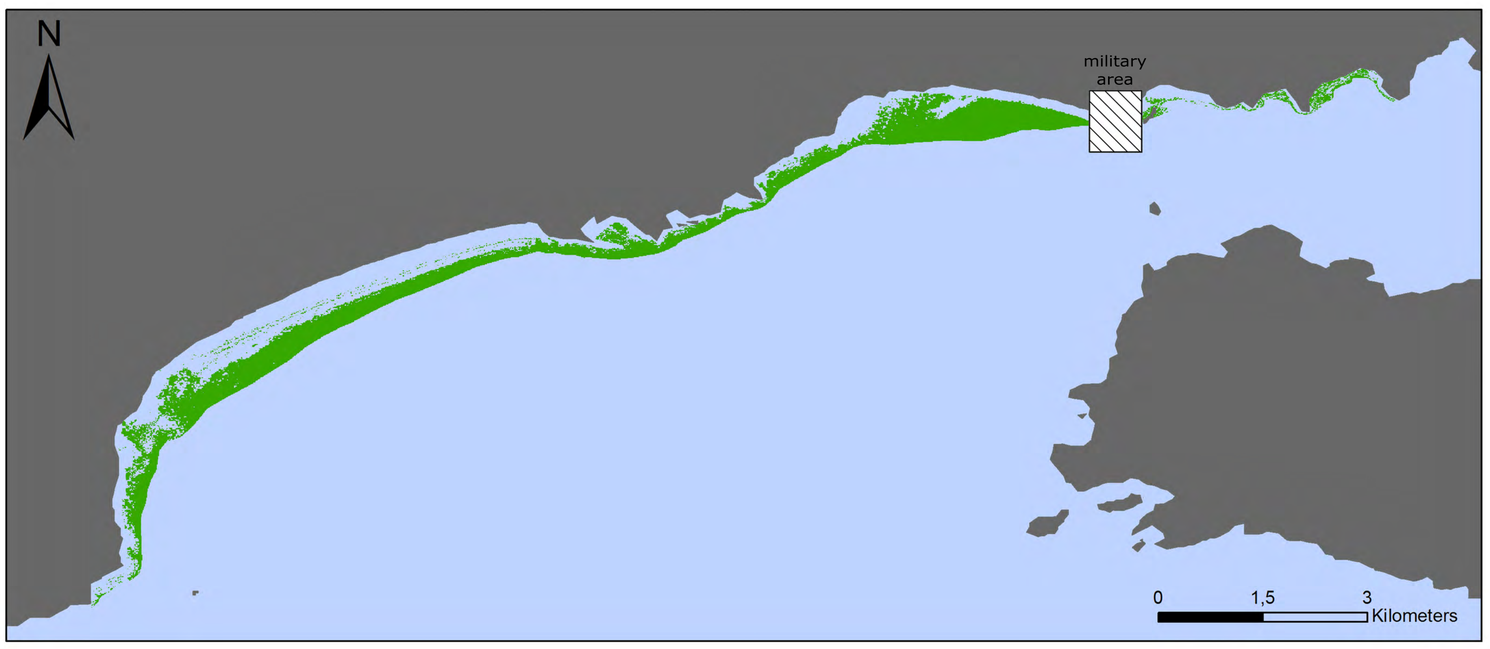
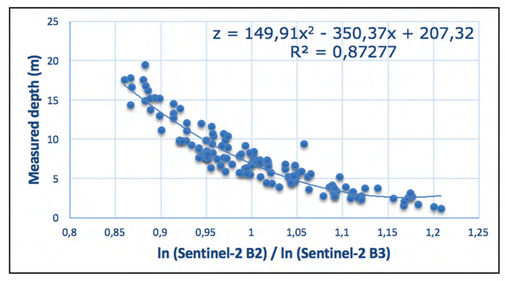
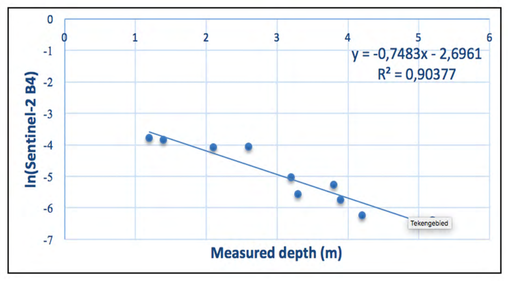


Figure 4. KNN classification of the P. oceanica habitat in the southeast of Samos, Greece. Classified according to the atmospheric corrected, sunglint removed, masked and water column corrected Sentinel 2.



Graph 1. Polynomial regression to define the bathymetric model in the study site.



Graph 2. Defined attenuation coefficient for the collection of water column correction parameters.

REFERENCE

[1] Campagne, C. S., Salles, J. M., Boissery, P., & Deter, J. (2014). The seagrass Posidonia oceanica: Ecosystem services identification and economic evaluation of goods and benefits. Marine Pollution Bulletin, 97(1–2).
[2] Waycott, M., Duarte, C. M., Carruthers, T. J. B., Orth, R. J., Dennison, W. C., Olyarnik, S., ... Williams, S. L. (2009). Accelerating loss of seagrasses across the globe threatens coastal ecosystems. Proceedings of the National Academy of Sciences, 106(30), 12377–12381.
[3] Telesca, L., Belluscio, A., Criscoli, A., Ardizzone, G., ... Salomidi, M. (2015). Seagrass meadows (Posidonia oceanica) distribution and trajectories of change. Scientific Reports, 5(1), 12505.
[4] Traganos, D., & Reinartz, P. (2017). Mapping Mediterranean seagrasses with Sentinel-2 imagery. Marine Pollution Bulletin, (July).
[5] Montefalcone, M., Rovere, A., Parravicini, V., Albertelli, G., Morri, C., & Bianchi, C. N. (2014). Evaluating change in seagrass meadows: A time-framed comparison of Side Scan Sonar maps. Aquatic Botany, 115(C), 36–44.
[6] Hedley, J. D., Harborne, A. R., & Mumby, P. J. (2005). Simple and robust removal of sun glint for mapping shallow-water benthos. International Journal of Remote Sensing, 26(10), 2107–2112.
[7] Maritorena, S., Morel, A., & Gentili, B. (1994). Diffuse reflectance of oceanic shallow waters: Influence of water depth and bottom albedo. Limnology and Oceanography, 39(7), 1689–1703.

ARCHIPELAGOS INSTITUTE OF MARINE CONSERVATION

BLUE PLANET Oceans and Society a GEO Initiative

UNIVERSITY OF AMSTERDAM

C A U Christian-Albrechts-Universität zu Kiel