

# A system to simultaneously measure water color, bottom depth and bottom coverage for the study of submerged environments

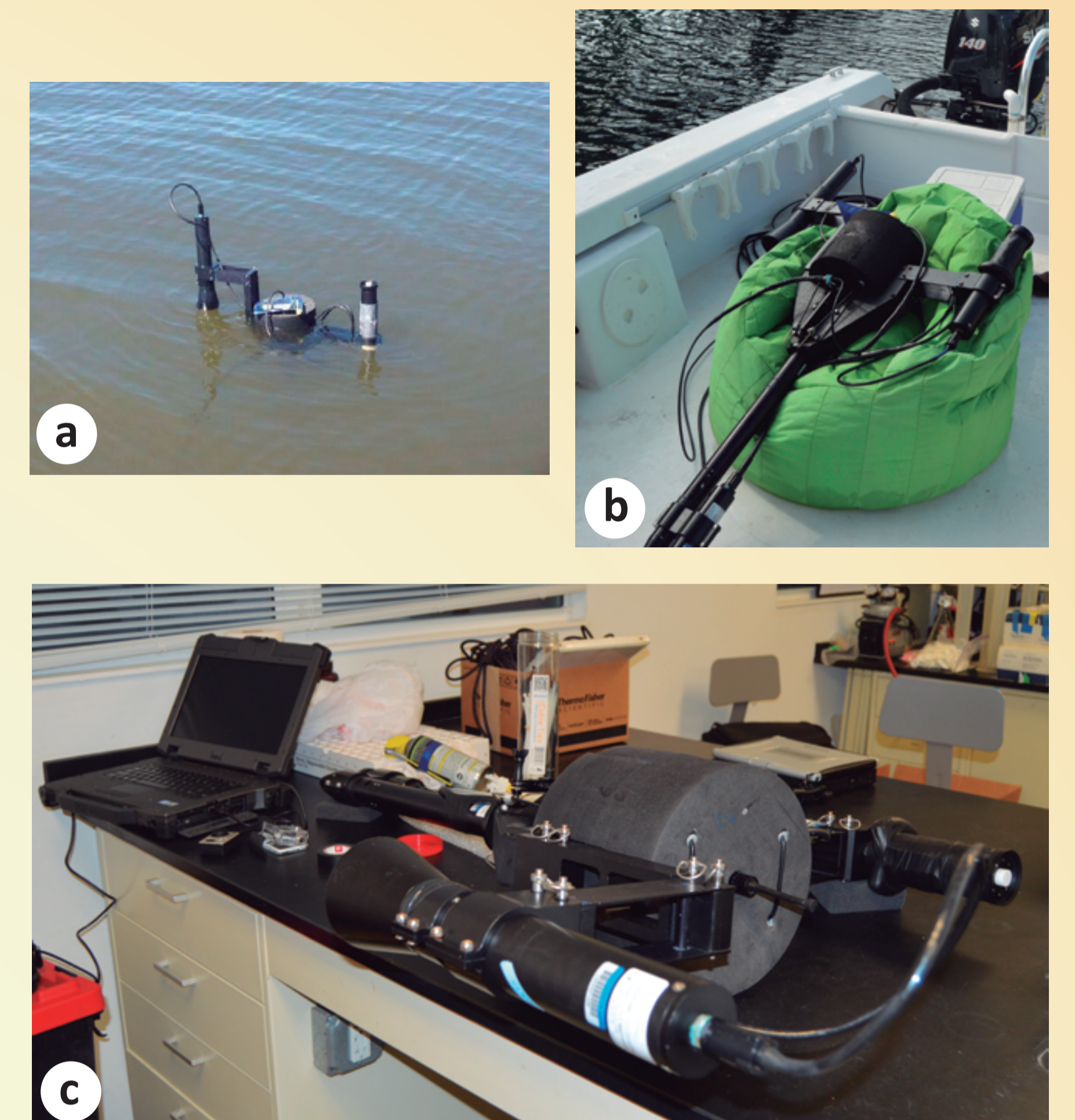
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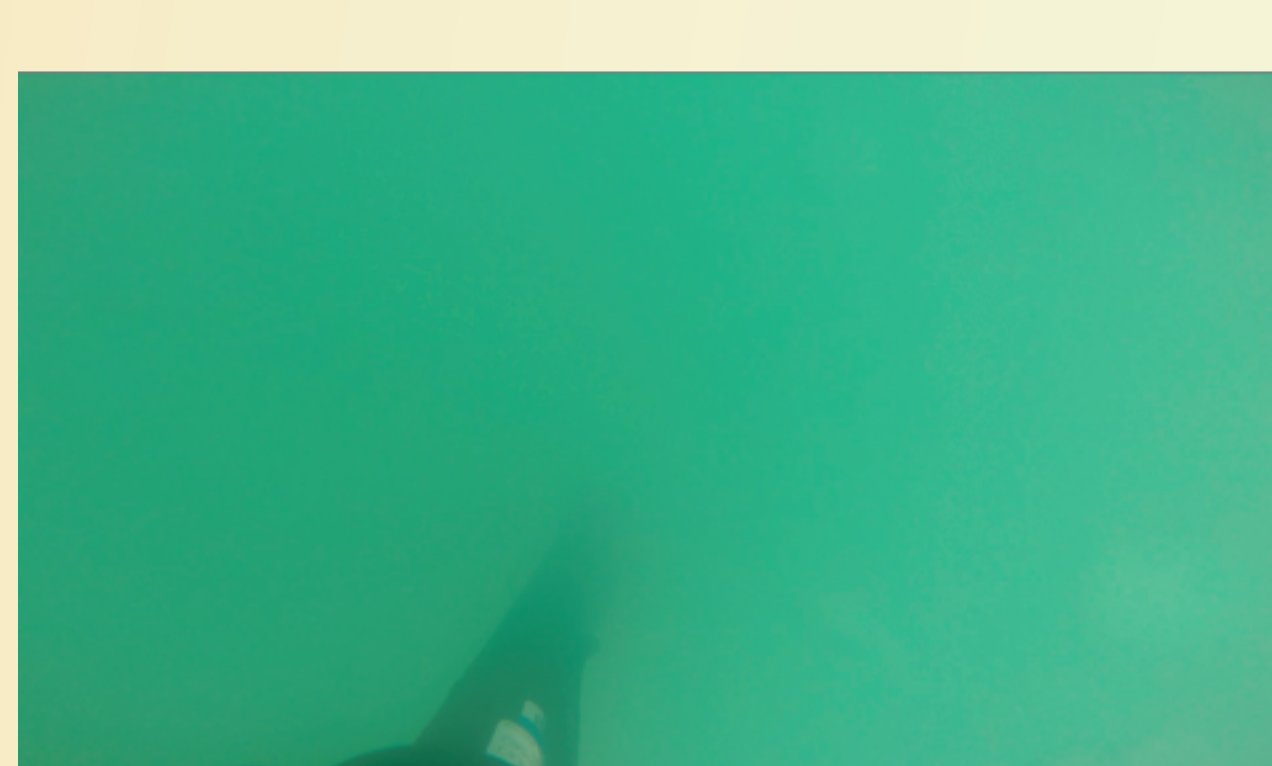
Seagrass meadows, macroalgal beds and coral reefs constitute important coastal habitats, and **remote sensing** provides a feasible approach of broad scale synoptic observations of these fragile aquatic environments. For the development and evaluation of shallow water remote sensing algorithms, it is critical to have **high-quality datasets** covering measurements of both the water color and the bottom properties, where traditional radiometric approaches usually run into various difficulties. Here we highlight a **customized system** (SEACOMES) that **simultaneously** measures hyperspectral water-leaving radiance, benthic cover, and bottom depth.

## The SEACOMES

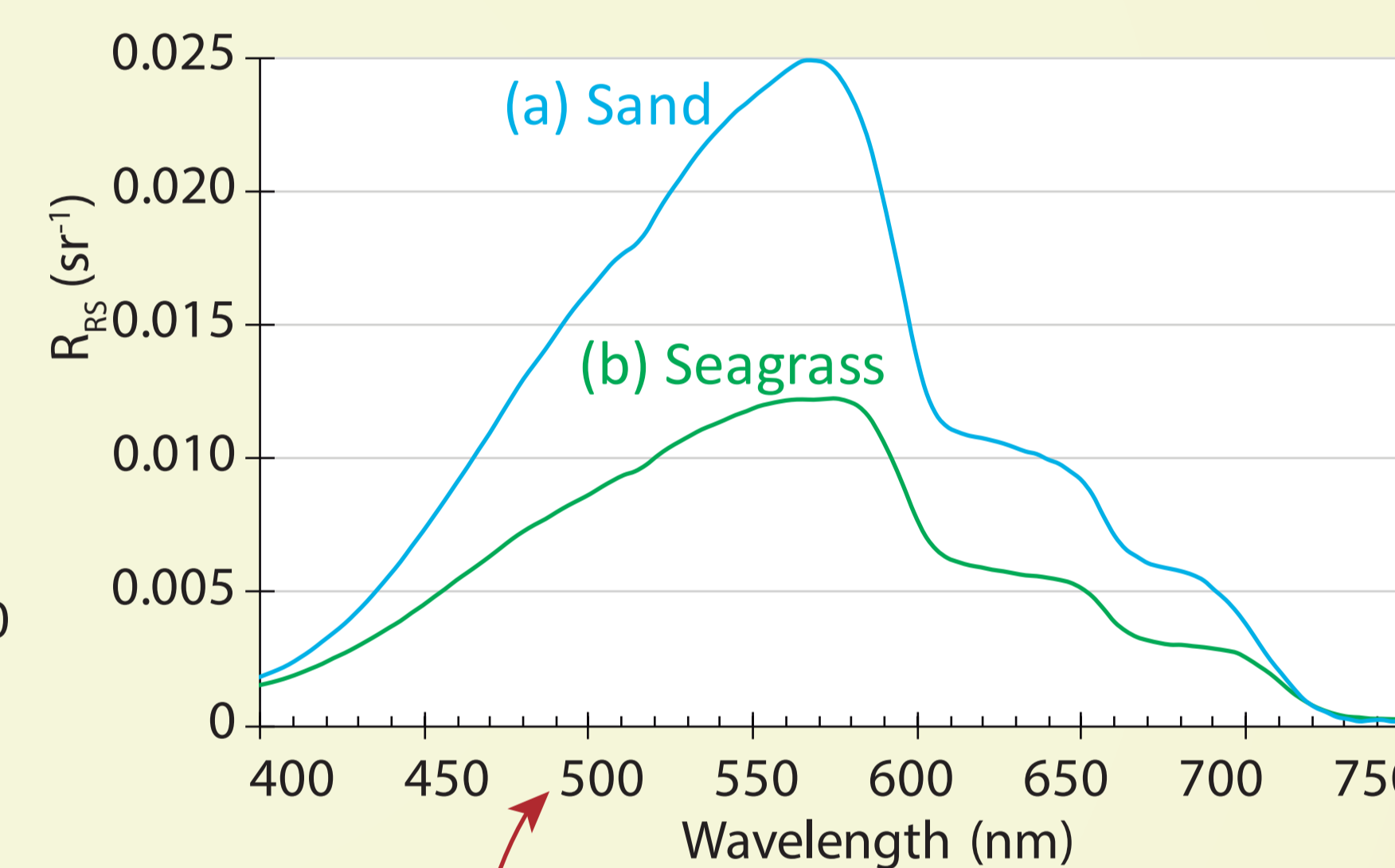
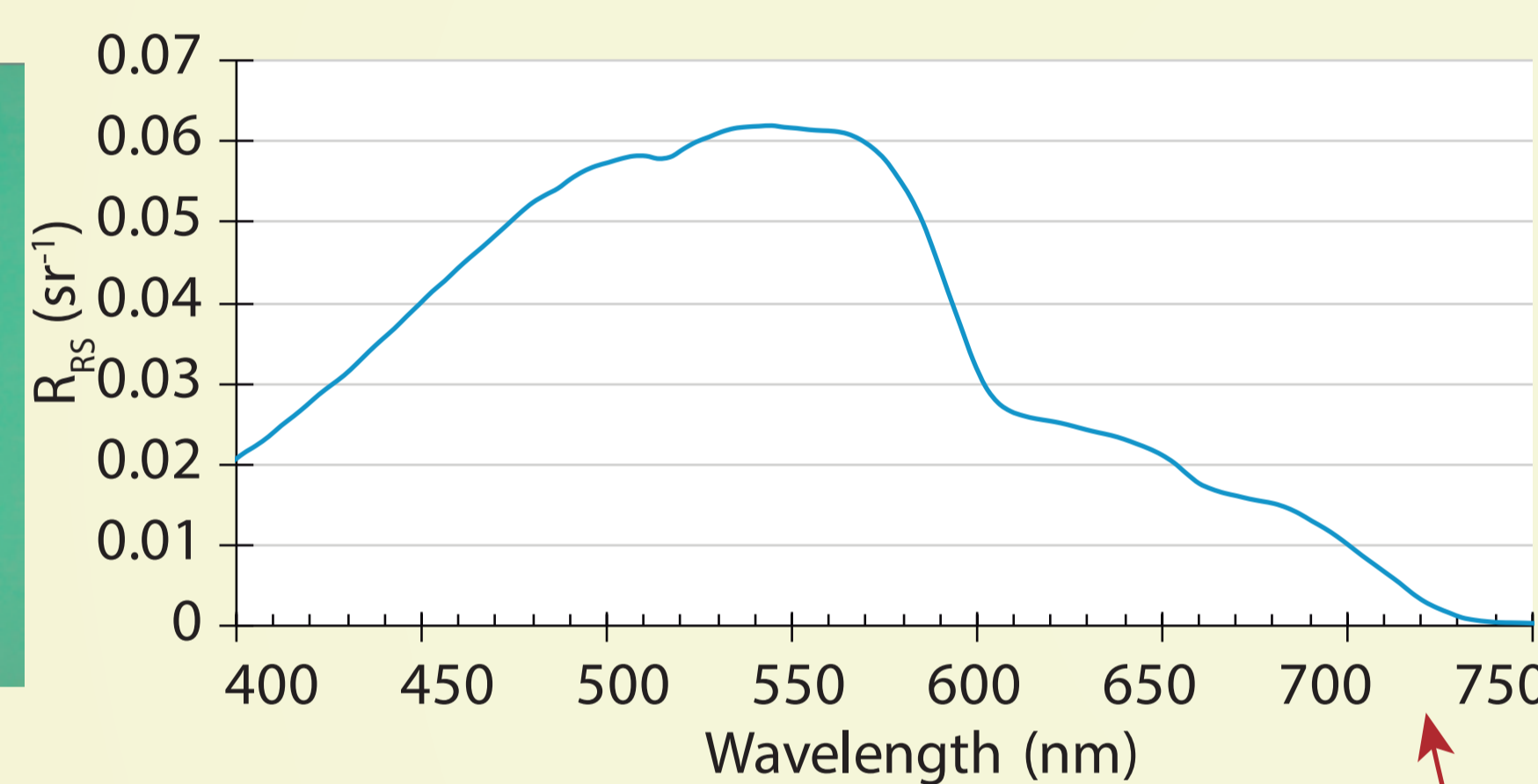
The **Shallow Sea Color Measurements System** (SEACOMES) system allows the measurement of **hyperspectral above water reflectance, bottom characteristics, depth and geographical position**, providing data for remote sensing validations and algorithm improvements. It consists in a **Radiometer** Incorporating a **Skylight Blocking Apparatus** (RISBA, Lee, et al., 2013) with an additional Programmable Sonar **Altimeter** (PSA-916, Teledyne Benthos) attached to the keel of the RISBA's central hub, and a portable **GPS** attached to the floatation collar. A **GoPro** camera in a waterproof housing was also attached near the downward looking HyperOCR radiometer (Satlantic Inc.) in a position that did not interfere with its field of view (11.6°). The system makes **simultaneous** measurements at the water's surface of the main parameters involved in remote sensing of shallow waters.



Pictures of the SEACOMES in the field (a and b) and on the desk (c).



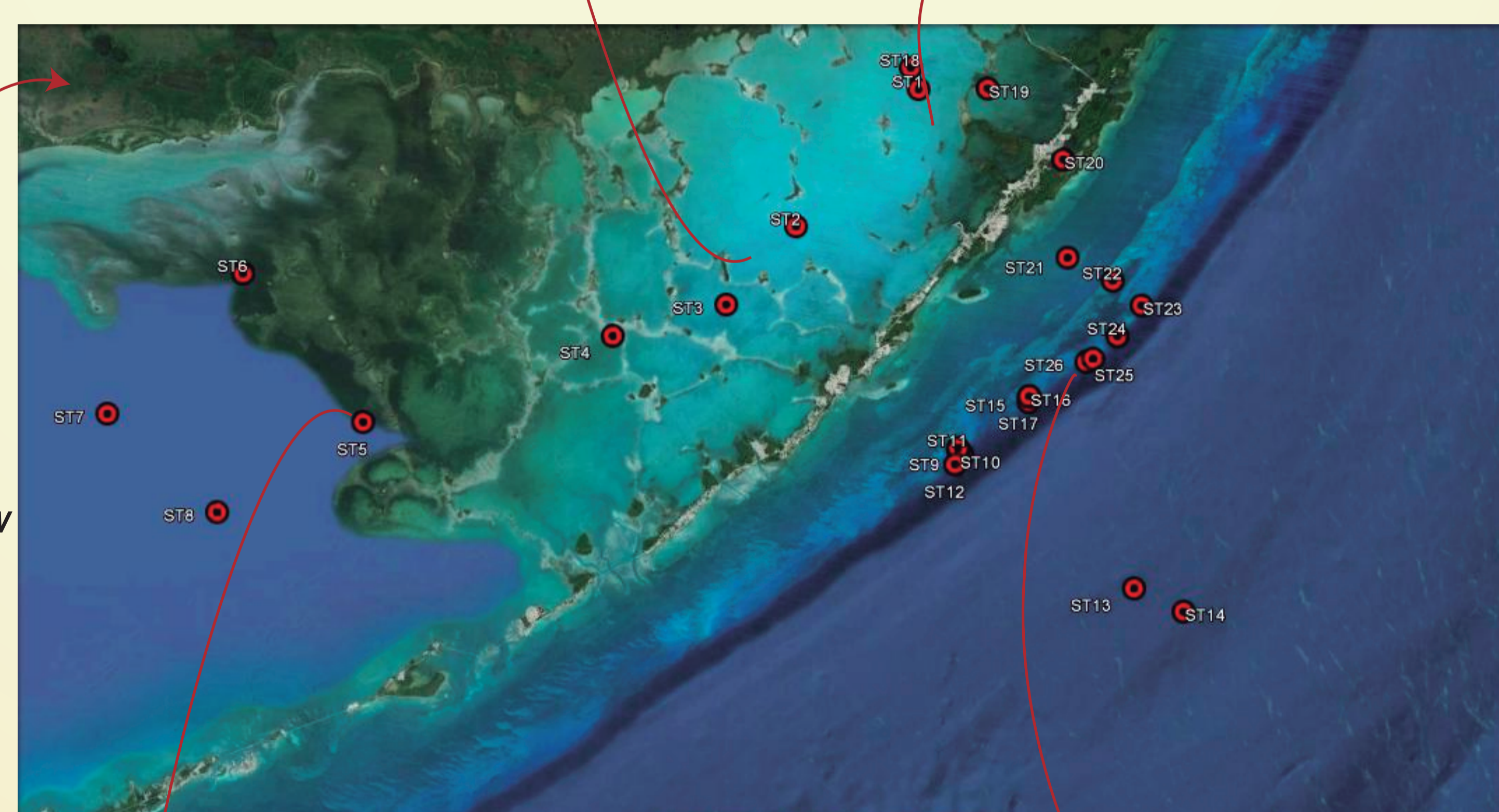
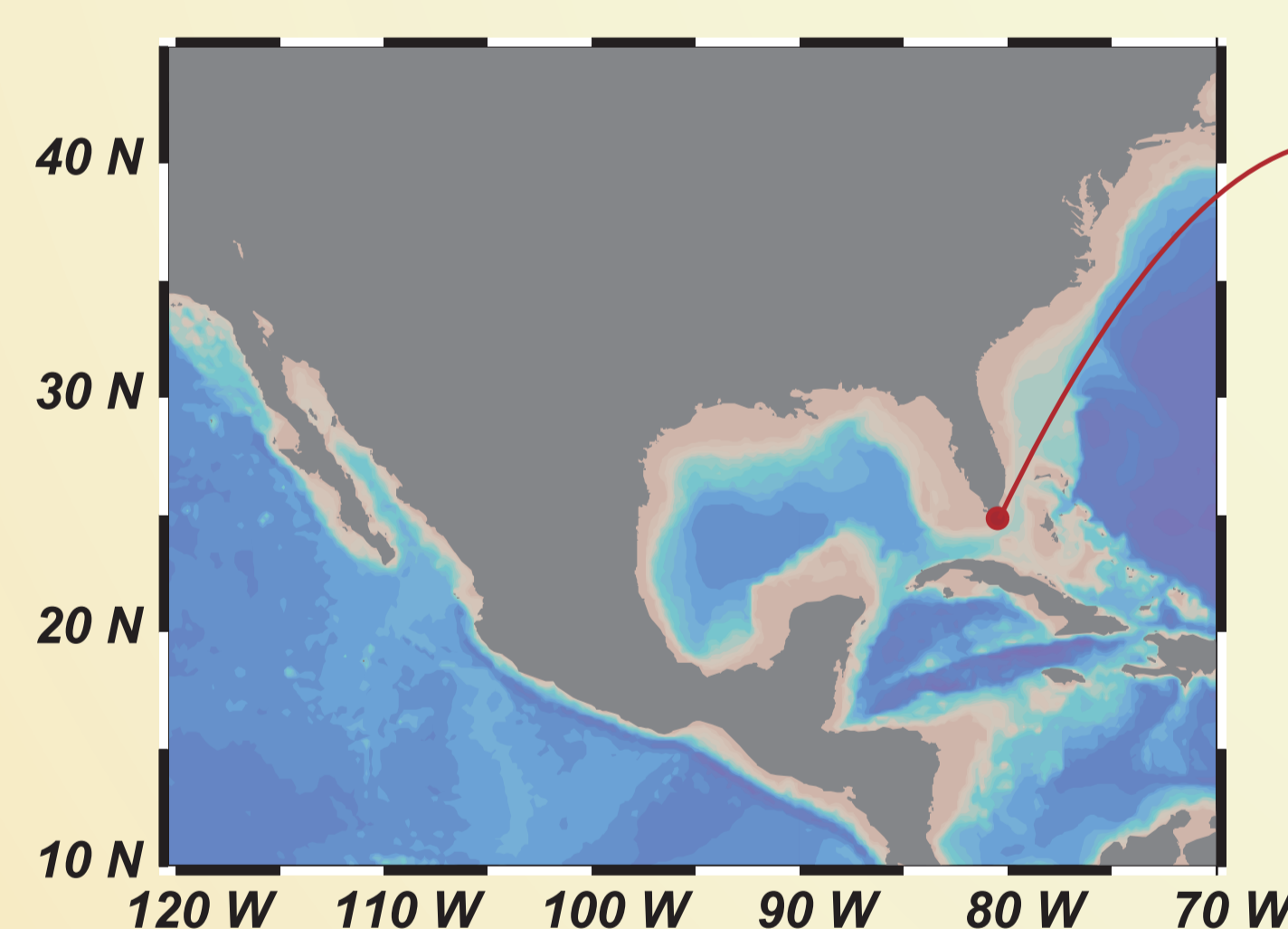
St.2 - Sandy substrate in turbid waters at 1.76 m depth



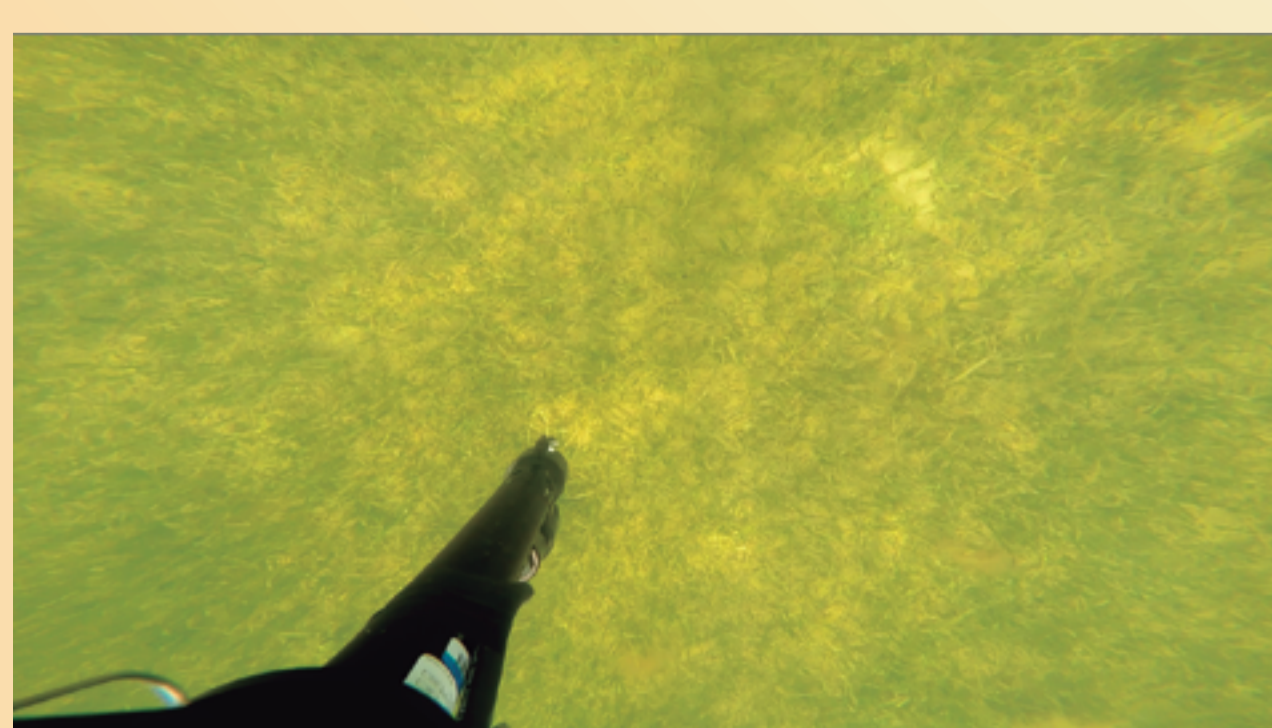
St.19 - (a) Sandy substrate in turbid waters at 1.82 m depth



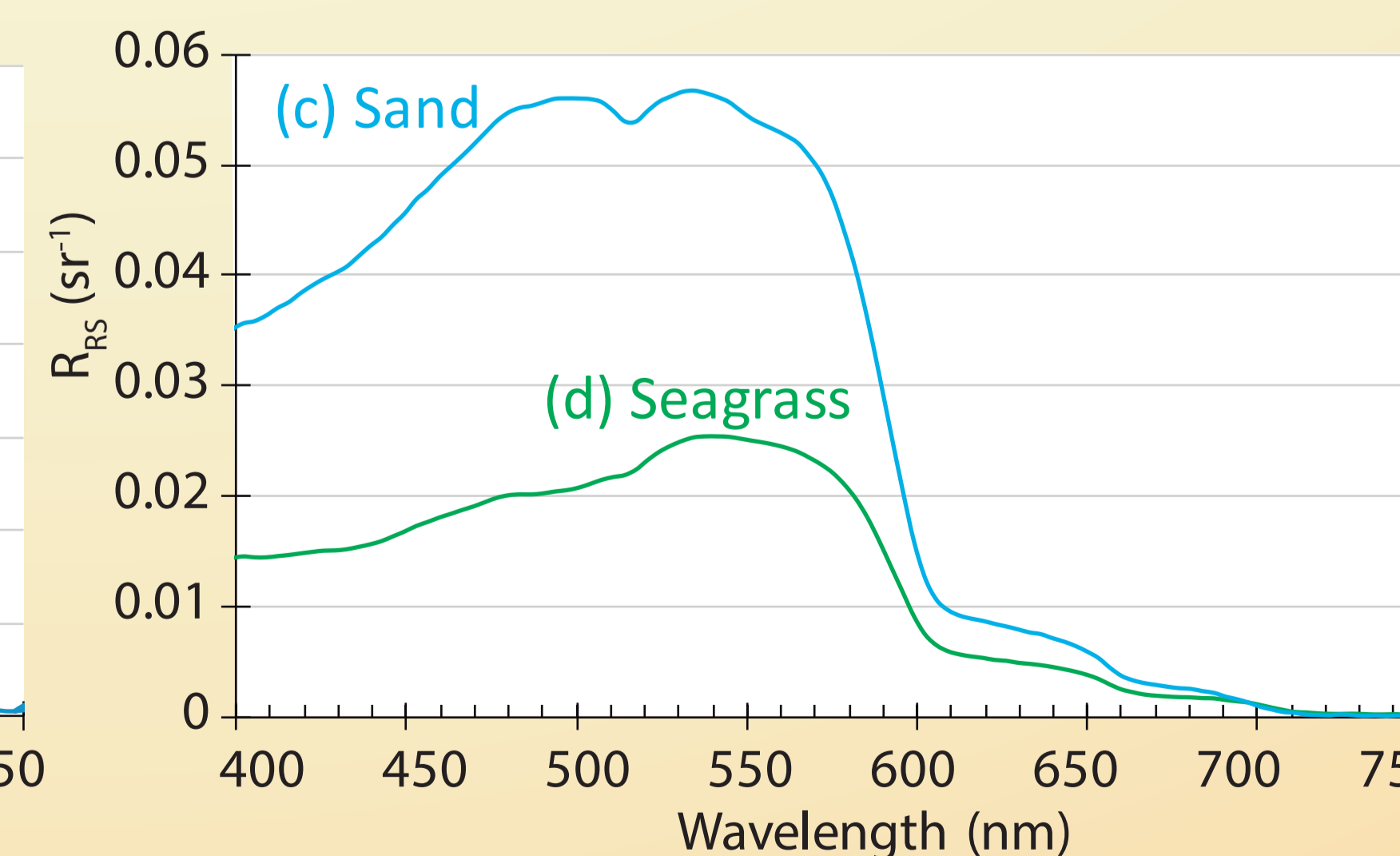
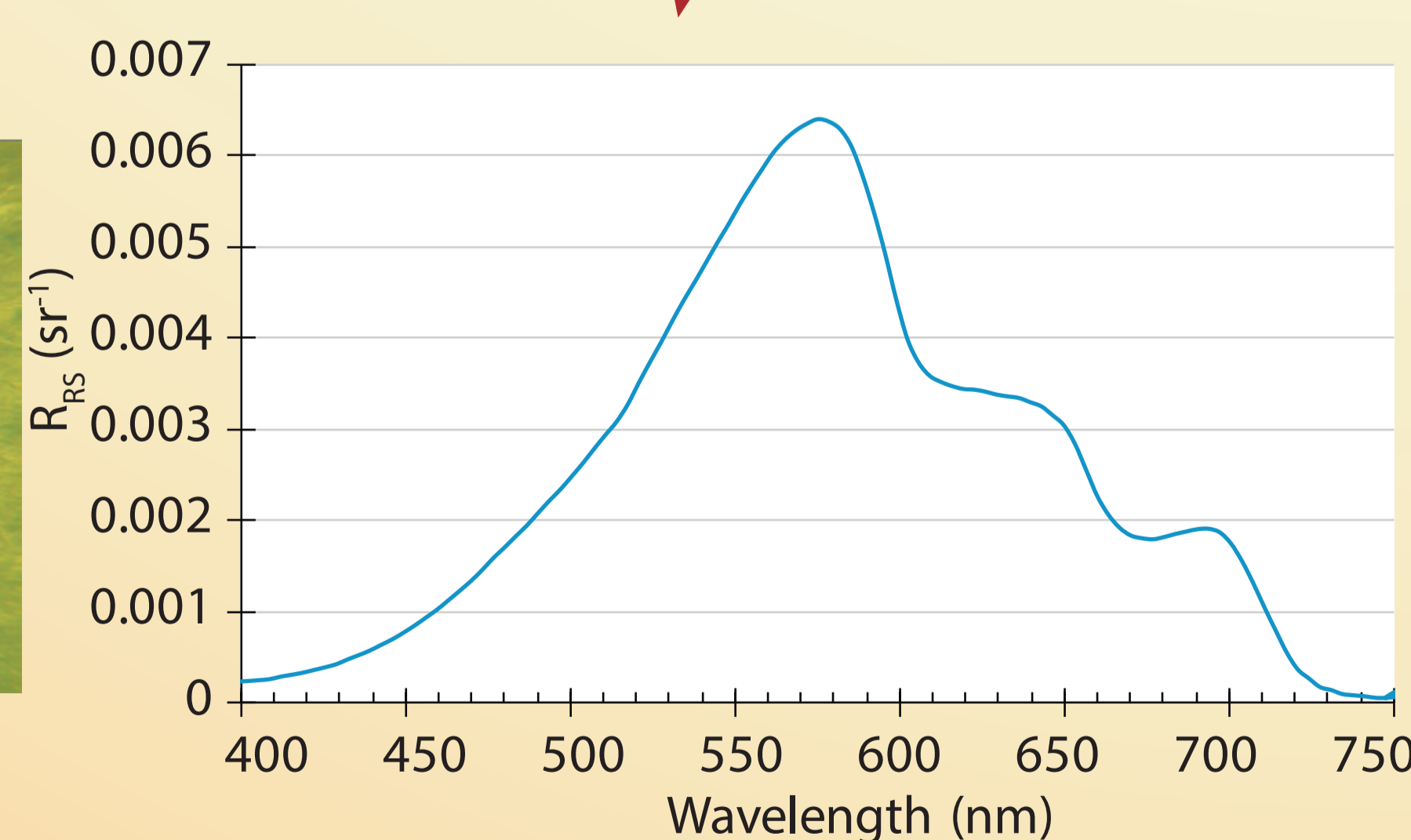
St.19 - (b) Seagrass substrate in turbid waters at 1.77 m depth



Sampling design performed in shallow waters in Florida Bay between March 26-28, 2016 (Middle). Examples of above surface  $R_{rs}$  ( $sr^{-1}$ ) spectra and underwater pictures collected by the SEACOMES system (shown above and below).



St.5 - Dense saeagrass at 1.79 m depth



St.26 - (c) Sandy substrate at 3.46 m depth



St.26 - (d) Seagrass substrate at 2.94 m depth

**References:** -Lee, Z.; Pahlevan, N.; Ahn, Y.; Greb, S.; O'Donnell, D. (2013) Robust approach to directly measuring water-leaving radiance in the field. Applied Optics, 52: 1693-1701, doi: 10.1364/AO.52.001693

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