

USE OF NEW HIGH RESOLUTION DEIMOS-1 SATELLITE IMAGERY TO STUDY COASTAL PROCESSES IN THE GUADALQUIVIR ESTUARY



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Isabel Caballero¹, Aurelio Mart², Águeda Vázquez³, Raúl García¹, Jesús Gomez-Enri³ and Gabriel Navarro¹



1. Institute of Marine Sciences of Andalusia (ICMAN-CSIC), Department of Ecology and Coastal Management, Cadiz, Spain; isabel.caballero@icman.csic.es
2. Deimos Imaging S.L. Edificio Galileo Mod. Gris Of. 101, 47151 Boecillo, Valladolid
3. Applied Physics Department, Cádiz University

ABSTRACT

Estuarine environments are characterized by very complex morphodynamics and represent one of the most critical coastal regions for the exchange of sediment and nutrients. The fertilization of the continental shelf of the Gulf of Cadiz (SW Iberian Peninsula), in which the Guadalquivir and other rivers play an influential role, constitutes the major factor determining the productivity of the basin, from phytoplankton to fisheries resources as anchovy. Moreover, the input of nutrients and suspended particulate matter (TSS) from the rivers has a relevant impact on several socio-economic strategic activities (aquaculture, tourism, navigation). This work was undertaken to analyze the spatial and temporal variability of the Guadalquivir river plume and develop an approach for successfully monitoring water quality parameters as diagnostic tool in the coastal management. The incorporation of DEIMOS-1 novel satellite images of high spatial resolution (22 m) will improve our ability to map turbidity and to assess and predict the plume behavior. To achieve this goal, remote sensing images have been processed and validated against TSS in-situ measurements from several cruises to check the quality and precision of satellite data in this coastal region. The high spatial resolution of these images will allow us to study spatial features related to the dynamics of the turbidity plume in the river mouth and connect these patterns with the meteorological and oceanographic process controlling it.

STUDY AREA



Location of the Gulf of Cadiz coastal region and the Guadalquivir estuary (SW Iberian Peninsula). Right: Sampling sites for the field campaigns in the mouth of the river.

IN-SITU DATA

- Data on Total Suspended Solids (TSS) acquired during several oceanographic field cruises conducted last two years (2010-2011) have been analyzed.
- At each sampling site, water was collected from depths of 0 and 0.25 m below the water surface.
- Total concentrations of suspended solids were measured by filtering a 100 mL aliquot gravimetrically on pre-weighed Whatman GF/F filters after rinsing with distilled water.

VALIDATION



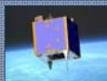
Scatter plot of measured TSS concentration versus DEIMOS-1 radiance in Band 3; time collocation window of 0.5h maximum.

TSS MAPPING: SPATIAL VARIABILITY

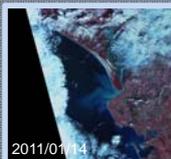
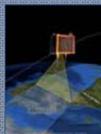


RGB image captured from MODIS satellite (AQUA 250 m), RGB composite from DEIMOS-1 sensor and map of TSS concentration at the river mouth defined by Band 3 DEIMOS-1 radiance for scene 3 March 2011; transversal profile of TSS concentration estimated.

DEIMOS-1 SATELLITE



- DEIMOS-1 system is based on an automatic spatial platform of small size (only 100 kg weight) with a multispectral optical instrument.
- Very advanced technology allowing to achieve the following characteristics:
 - 6 cameras in red, green and near infrared bands, equivalent to Landsat
 - High Spatial Resolution (22 m)
 - Wide field of view (600 km swath)
 - High capacity for repeated imaging
- Level L1T data, ortho-corrected water leaving radiance products with GCPs.
- The wavelengths covered by the sensor bands include: Band 3 (510-618 nm), Band 2 (614-698 nm), and Band 1 (755-906 nm).



CONCLUDING REMARKS

- This study has demonstrated the potential, accuracy and effectiveness of DEIMOS-1 novel imagery to provide reliable information for the optimal management of the Guadalquivir region.
- The high resolution and the synoptic coverage in combination with the sensing ability of the reflective bands are effective tools for detecting and mapping the spatial distribution of suspended solids, turbidity, plume movements and water circulation in a relatively complex system such as the Guadalquivir estuary (Case-II waters).
- Using validated optical remote sensing observations and supporting environmental data sets, we have developed a robust satellite-derived approach improving the representation of TSS concentration across the region (Band 3, Green radiance).
- The DEIMOS-1 satellite products will also present challenges in a wide variety of applications, particularly in coastal research, to supply unique and critical information such as flooded areas, vegetation coverage and shoreline changes.
- Future work will be focused on analyzing the role of different meteorological and oceanographic forcing factors responsible of the plume patterns to check the controlling mechanisms in order to convert this monitoring capacity into operational applications.

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