USE OF NEW SATELLITE IMAGES DEIMOS-1 TO STUDY THE GUADALQUIVIR RIVER PLUME

Isabel Caballero[1], Aurelio Martí[2], Águeda Vázquez[3], Raúl García[1], Jesús Gomez-Enri[3], Javier Ruiz[1] and Gabriel Navarro[1]

1. Departamento de Ecología y Gestión Costera, Instituto de Ciencias Marinas de Andalucía, CSIC, 11510, Puerto Real, Cádiz.
2. Deimos Imaging S.L. Edificio Galileo Mod. Gris Of. 101, 47151 Boecillo, Valladolid
3. Departamento de Física Aplicada, Universidad de Cádiz, 11510, Puerto Real, Cádiz.

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 from the rivers has a relevant impact on several socio-economic strategic activities (aquaculture, tourism, navigation). The work presented here was undertaken to analyze the spatial variability of the Guadalquivir turbidity plume. The incorporation of DEIMOS-1 novel satellite images of high spatial resolution (around 20 m) will improve our ability to map turbidity and chlorophyll in the estuary and to assess and predict the plume behavior. To achieve this goal, remote sensing images from DEIMOS-1 satellite have been processed and validated against in-situ measurements from several cruises to check the quality and precision of satellite data in this coastal area. 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.

Keywords: Guadalquivir estuary; DEIMOS-1 images; chlorophyll; turbidity plume

The Gulf of Cadiz is a wide basin located on the SW coast of the Iberian Peninsula near to where the Atlantic Ocean connects to the Mediterranean Sea through the Strait of Gibraltar. The continental shelf receives substantial fluvial inputs associated with the discharge of major rivers such as the Guadiana, the Guadalquivir and the Tinto-Odiel [1]. The Guadalquivir estuary has undergone substantial rapid agricultural, fisheries, and anthropogenic development, particularly in recent decades. In spite of the social and economic importance, until very recently, only a few studies have been conducted on the zone [2 and references therein]. Water clarity and quality are important for the functioning of the ecosystems of the estuary and adjacent area, acting as an indicator of nutrient loading and sediment dynamics, and are critical variables for seagrass growth. Management strategies and methods that facilitate monitoring of estuaries are required.

Satellite-borne sensors technology is becoming an ideal tool for assessing turbidity and chlorophyll, thus enabling a more effective and reliable analysis of the temporal and spatial dynamics of plumes having the potential for improving our understanding of nearshore processes. The ocean color images of the Guadalquivir estuary is affected by a variety of processes typical of environments with Case-II waters (i.e., the optical properties do not co-vary), including phytoplankton blooms, sediment plumes, and other episodic phenomena, such as runoff events [2, 3]. Each of these processes can individually modulate satellite-detectable signals contributing to the overall variability, especially in these waters which are characterized by a variety of seasonally-varying circulation patterns.

The aim of this study is to assess the potential of DEIMOS-1 remote sensing and bio-optical in-situ data for deriving water-quality parameters, and to develop an approach for successfully monitoring and predicting the turbidity as diagnostic tool in the coastal management of the Guadalquivir estuary. The DEIMOS-1 is the first private satellite in Europe which carry a multi-channel optical sensor. The satellite is an automatic spatial platform with a small size (only 100 kg weight) and very advanced technology that provides optic and infra-red images. It was conceived for obtaining Earth images with a good enough resolution to study the terrestrial vegetation cover, although with a great range of visual field in order to obtain those images with high temporal resolution. The sensor characteristics allow to achieve very high spatial resolution (20 m) and a wide field of view (600 km), hence it is suitable for coastal ocean color observation.

During the last year, several DEIMOS-1 images have been captured over the Guadalquivir estuary. The high spatial resolution of these images will allow resolve the turbidity patterns than can be detected with this new satellite. Figure 1 shows two DEIMOS-1 images from the Guadalquivir estuary where the turbidity plume is located in the Guadalquivir river mouth. The intensity, size, orientation, location, etc of these plumes are different depending on the meteorological and oceanographic conditions (i.e. wind direction, tidal regime, waves, river discharge) that control the appearance and persistence of these plumes.

REFERENCES

[1] L. Prieto, G. Navarro, S. Rodríguez_Gálvez, I.E. Huertas, J.M. Naranjo, J. Ruiz, "Oceanographic and meteorological forcing on the pelagic ecosystem of the Gulf of Cadiz shelf (SW Iberian Peninsula)", Cont. Shelf. Res, 29 (1), pp. 2122-2137, 2009.

[2] G. Navarro, F. J. Gutiérrez, M. Díez-Minguito, M. A. Losada, J. Ruiz, "Temporal and spatial variability in the Guadalquivir estuary: a challange for real-time telemetry", Ocean Dyn. doi 10.1007/s10236-011-0379-6, 2011.

[3] I. Caballero, J. Ruiz, G. Navarro, "Dynamics of the turbidity plume in the Guadalquivir estuary (SW Spain): A remote sensing approach", OCEANS 2011, Santander, Spain.

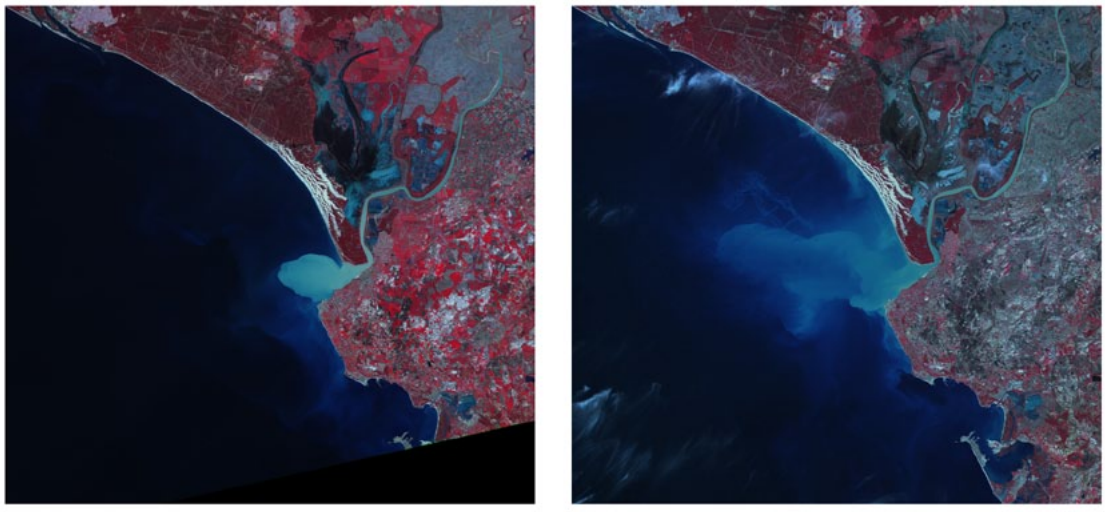

Figure 1. RGB images captured from DEIMOS-1 satellite during 03/03/2011 and 12/16/2010 (left and right panel respectively).