

# MONITORING MORPHO-SEDIMENTARY DYNAMICS OF THE MONO RIVER MOUTH (“BOUCHE DU ROI”) IN BENIN (WEST AFRICA) WITH SATELLITE IMAGERY AND GROUND CHECKS

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## ABSTRACT

Located on the West Beninese coast of Grand-Popo administrative unit, “*Bocca del Rio*” commonly called “*Bouche du Roi*”, is the mouth of swell dominant microtidal estuary river (**Figure 1** and **Figure 2**). It plays an important part of exchange of water and sediments between the ocean and a fluvio-lagoonal system constituted by the coastal lagoon, the Ahô channel and the Ahémé lake (**Figure 2**). The fresh water supply is primarily ensured by the Mono river with a monthly average flow of rising close to 400 m<sup>3</sup> / year (**Figure 3**).

Since the bringing into service of the Nangbéto dam on Mono river in 1987, the “*Bouche du Roi*” morphodynamic is driven by the morphogenesis of a system of spit-cove which forces the mouth to a west-east migration, with a speed reaching 700 m / year.

Based on ground observations made in May, 2014 and on multi-temporal Landsat satellite images from July, 2013 till June, 2014, the present work has for objective to analyze the processes of sedimentary by-pass and “*Bouche du Roi*” sandy spit construction on one hand, and to look for the influence and the relative importance of the swell (and the associated currents) and river currents implied in the aforementioned processes, on the other hand.

The methodological approach is inspired by the hydrodynamic functioning of the “*Bouche du Roi*” external tidal system. Indeed, waves lifted when meeting the terminal lobe are forced to break immediately with propagation towards the sea bottom, under the panache of estuary water. The electromagnetic signal of the breaking body of water and the generated morphosedimentaries entities allow to appreciate the “*Bouche du Roi*”

morphodynamic evolutions and the ones of its external delta (**Figure 4**).

The results show that the sedimentary by-passing as well as the construction of the sandy spit are essentially under the command of the regime of the swell and the hydrological seasons of the Mono river, with a secondary interference of tidal currents. These two sedimentary processes (by-passing, construction of sandy spit) involve a sedimentary stock in the form of sandy bars (swash bars and mouth linear bars) which form and deform on the swash platform. Bars migrate then to the shore and transfer the platform sedimentary stock to the updrift coast or to the downdrift coast, according to the relative importance of the marine and river hydrodynamic agents.

This diachronic study based on Landsat images, allowed to identify the various stages of the annual hydro-sedimentary functioning of the “*Bouche du Roi*” and to determine the relative importance of the forcings which are involved (**Plate 1a**; **Plate 1b** and **Figure 5**). In summary, four stages are distinguished:

- the marine stage, from January till June, in the course of which the hydrodynamism of the swash platform is firmly controlled by the swell and the derived currents; the river flows (river forcing) being seriously reduced;
- the both of fluvio-marine stages respectively of southern winter (from June till September) and summer southern (from November till December) during which the dynamics of the deltaic system is under the double control of the marine and river forcing, with a resultant morphodynamic printed by swell (marine forcing);
- the river stage during which the dynamics of the external platform is firmly controlled by the river flows (river forcing); the marine forcing by the swell being seriously reduced during this stage.

## KEYWORDS

Mono river estuary, sediment-transport, bypassing, sandy bars, swash platform, sandy spit, Landsat imagery, Benin.

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### Figures

**Figure 1** : Geomorphological units of an estuarine mouth (a) and morphology of an ebb delta type (b). Modified according to Smith (1984) and Hayes (1975).

**Figure 2** : Mono river estuary and its mouth (“Bouche du Roi”).

**Figure 3** : Comparative evolution of the monthly flows average of the Mono River (at Athiémé) and winds speeds on Benin coast (in Cotonou).

**Figure 4** : Bouche du Roi Landsat imagery showing the signal wave over the platform of swash which

is lined by sandy bars (bars of swash, linear bars, overlap bars); acquisition date: May 18, 2014.

**Figure 5** : Seasonal evolution of the hydro-sedimentary functioning of the “Bouche du Roi”.

### Plates

**Plate 1a** : Signal wave evolution on the platform of swash and morphodynamic of the “Bouche du Roi” updrift and downdrift coasts (July to December 2013).

**Plate 1b** : Signal wave evolution on the platform of swash and morphodynamic of “Bouche du Roi” updrift and downdrift coasts (January to June 2014).