Algal bloom detection using MODIS fluorescence data: A case study of the Colombian Caribbean Sea

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INTRODUCTION

Algal blooms are a global growing concern. Some of them may generate harmful and/or toxic events, with potential adverse effects on ecosystems and society. Various factors promote the occurrence of algal blooms, like change in temperature (Paerl & Huisman, 2008). In the Colombian Caribbean there have been reports of harmful algal blooms (HAB) with little monitoring and forecasting mainly because of logistical constraints (Mancera *et al.*, 2009). The present study aims to detect possible algal blooms in the Colombian Caribbean Sea using MODIS Fluorescence Line Height (FLH) data and explore its relation to the Sea Surface Temperature (SST).

METHODS

Monthly, level 3, 4km resolution MODIS Aqua FLH and SST data were downloaded from NASA Ocean Color website (http://oceancolor.gsfc.nasa.gov/cms/) for the years 2003 – 2013 for the Colombian Caribbean Sea **(Fig. 1).**

FLH and SST images were processed and FLH images were reclassified to find areas with FLH > 0.04 W m^{-2} μm^{-1} sr^{-1} (Hu et al., 2005) using ArcGIS 10.2. The temporal and spatial variation of blooms occurrence areas and high values of FLH were examined. A Geographically Weighted Regression (GWR) was performed to explore the relationship between FLH and SST.

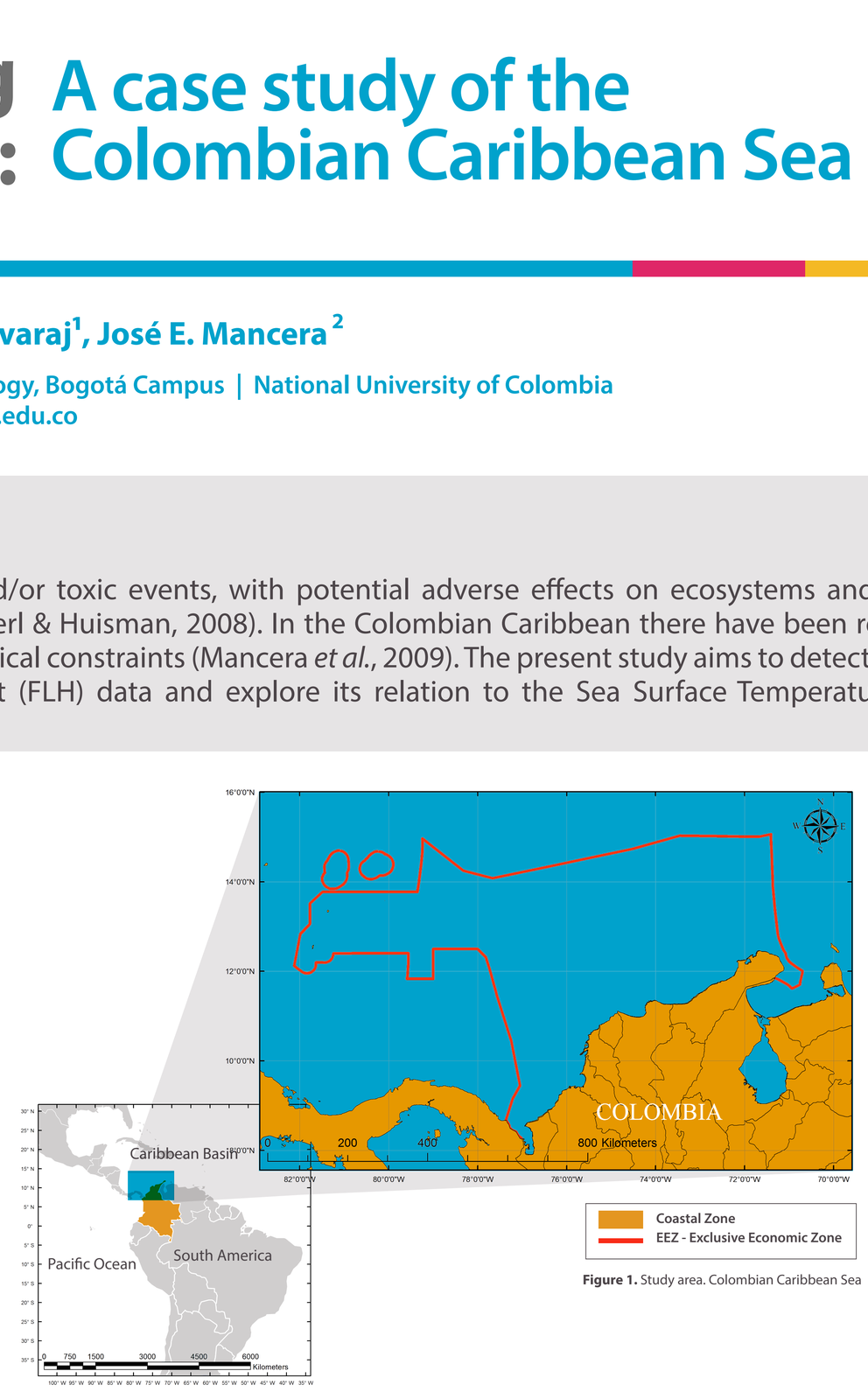

Figure 1. Study area. Colombian Caribbean Sea

RESULTS AND DISCUSSION

Three areas with recurrent presence of blooms were identified: the Guajira Peninsula (GP), the Magdalena River mouth (MRM) and the Urabá Gulf (UG). Analysis of high values of FLH showed that 56.06% were presented in MRM, 31.81% in GU and 12.12% in PG (Fig 2).

The algal bloom areas found and the high values of FLH varied significantly ($p < 0.05$) between months but not between years. The second half of the year (rainy season) showed areas of greatest extent and high values of FLH **(Fig 3).**

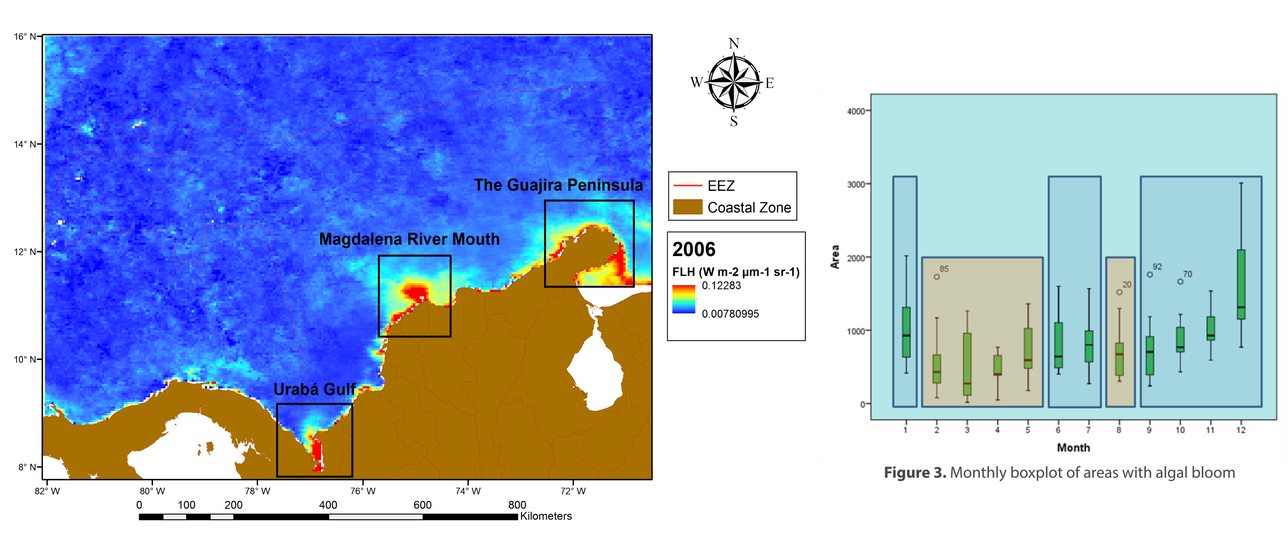

Figure 2. Areas of persistent algal blooms detected in 2003 -2013, as example 2006 image is shown.

Figure 3. Monthly boxplot of areas with algal bloom

GWR showed that SST does not explain FLH spatial variability **(Fig. 4)**. The nutrient supply during the rainy season seems to be a major cause for the rate of massive growth of microalgae, especially from the Magdalena River as this is the largest river discharging directly into the Caribbean Sea (Restrepo *et al.*, 2006).

The present study gives an idea about algal bloom dynamics in the Colombian Caribbean Sea, however more research have to be carried out to differentiate harmful and non-harmful algal blooms.

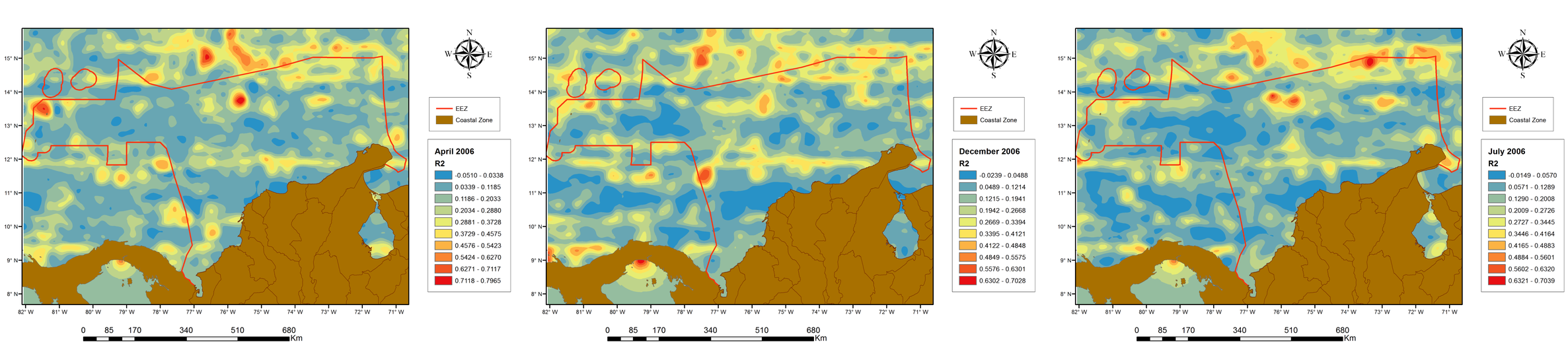

Figure 4. R^2 maps from GWR for April, July and December of 2006

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