ECOLA-14 : Systematic investigation of the spatiotemporal variability of TOXIC hydrogen sulphide events and their potential RISKs for the Namibian fishing and aquaculture industry H2020 project: TOXIC-RISK (2016-2018)

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Scientific Rationale and Methods:

The Benguela upwelling system sustains a very high primary production due to the upwelling of nutriment rich waters forced by trade winds. Due to the subsequent export production and the intense remineralisation, an oxygen minimum zone is present in the northern Benguela upwelling system. Hydrogen sulphide (H_2S) outbreaks and their sulphur (S^0) plumes are unique events in this region (**Fig. 1**).

They influence the marine ecosystem due to their toxic effects, have direct impacts on the biogeochemical cycles and are able to affect the human life. The local fish and shellfish industry, an important Namibian economic factor, is threatened. H_2S-outbreaks can cause the mass mortality of commercially important fishes, oysters, shrimps and prawns.

The TOXIC-RISK project contributed to the understanding of the H_2S-outbreaks and their S^0-plumes. The overall objective was the investigation of the variability of S^0-plumes.

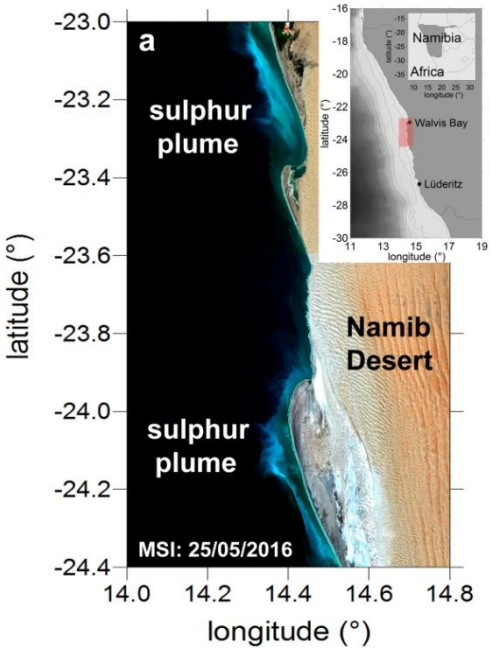

***Fig. 1** : ESA-Sentinel-2 image with the sulphur plumes close to the coast.*

Results

The sulphur events have a strong seasonal cycle with pronounced main and off-seasons forced by local and remote-driven processes **(Fig.2)**. The main peak season is in late austral summer and early austral autumn at the beginning of the annual upwelling cycle caused by increasing equatorwards alongshore winds. The sulphur plume activity is high between February and April during the seasonal oxygen minimum associated with the seasonal reduction of cross-shore ventilation of the bottom waters, the seasonal southernmost position of the Angola Benguela Frontal Zone (ABFZ), the seasonal maximum of water mass fractions of South Atlantic and Angola Gyre Central Waters (SACW and AGCW) as well as the seasonal arrival of the downwelling coastal trapped waves. The off-season is in austral spring and early austral summer during increased upwelling intensity and enhanced oxygen supply.

a) b)

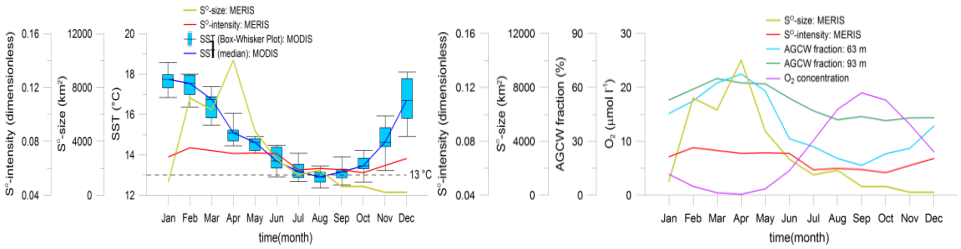

***Fig.2**: Seasonal cycle of sulphur plumes (size, intensity) with: (a) SST from MODIS, (b) AGCW water fraction and O_2 concentration*

The annual variability of sulphur events is characterized by very high activities in years 2004, 2005 and 2010 interrupted by periods of lower activity in years 2002 to 2003, 2006 to 2009 and 2011 to 2012 **(Fig.3).** This result can be explained by the relative contributions or adding effects of local and remote-driven forces (from the equatorial area). The probability for the occurrence of sulphur plumes is enhanced in years with a lower annual mean of upwelling intensity, decreased oxygen supply associated with decreased lateral ventilation of bottom waters, more southern position of the ABFZ, increased mass fraction of South Atlantic Central Water and stronger downwelling coastal trapped waves

a) b)

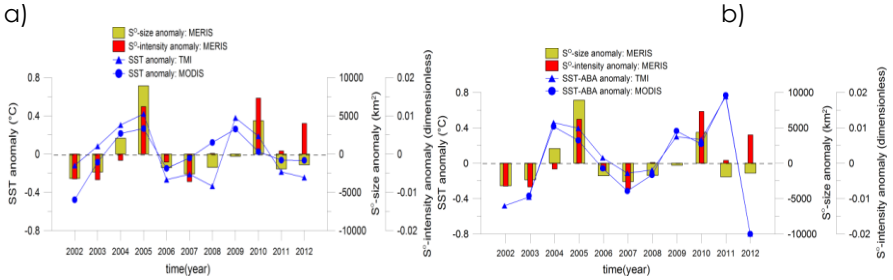

***Fig.3** : Annual variability of sulphur plumes (size, intensity) with: (a) SST from TIM and MODIS, (b) Angola Benguela Frontal Zone (SST-ABA)*

For the first time the seasonal and annual variability of S^0-plumes were determined. The dominant role of the local forcing as well as the remote forcing were demonstrated. Their complex interplay provides the variability of S^0-plumes. The TOXIC-RISK results are a major step forward to forecast such events and to develop a warning system.

Ohde T and Dadou I (2018) : Seasonal and annual variability of coastal sulphur plumes in the northern Benguela upwelling system. PLoS ONE 13 (2): e0192140. https://doi.org/10.1371/journal.pone.0192140

ResearchGate, www.researchgate.net/project/Systematic-investigation-of-the-spatiotemporal-variability-of-TOXIC-hydrogen-sulphide-events-and-their-potential-RISKs-for-the-Namibian-fishing-and-aquaculture-industry-TOXIC-RISK

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Partners and funding

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