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How well do we understand oil spill hazard mapping?

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In simple terms, we could describe the marine oil spill hazard as related to three main factors: the spill event itself, the spill trajectory and the arrival and adsorption of oil to the shore or beaching. Regarding the first factor, spill occurrence rates and magnitude distribution and their respective uncertainties have been estimated mainly relying on maritime casualty reports. Abascal et al. (2010) and Sepp Neves et al. (2015) demonstrated for the Prestige (Spain, 2002) and Jiyeh (Lebanon, 2006) spills that ensemble numerical oil spill simulations can generate reliable estimaes of the most likely oil trajectories and impacted coasts.

Although paramount to estimate the spill impacts on coastal resources, the third component of the oil spill hazard (i.e. oil beaching) is still subject of discussion. Analysts have employed different methodologies to estimate the coastal component of the hazard relying, for instance, on the beaching frequency solely, the time which a given coastal segment is subject to oil concentrations above a certain preset threshold, percentages of oil beached compared to the original spilled volume and many others. Obviously, results are not comparable and sometimes not consistent with the present knowledge about the environmental impacts of oil spills.

The observed inconsistency in the hazard mapping methodologies suggests that there is still a lack of understanding of the beaching component of the oil spill hazard itself. The careful statistical description of the beaching process could finally set a common ground in oil spill hazard mapping studies as observed for other hazards such as earthquakes and landslides.

This paper is the last of a series of efforts to standardize oil spill hazard and risk assessments through an ISO-compliant framework (IT – OSRA, see Sepp Neves et al., (2015)). We performed two large ensemble oil spill experiments addressing uncertainties in the spill characteristics and location, and meteocean conditions for two different areas (Algarve and Uruguay) aiming at quantifying the hazard due to accidental (large volumes and rare events) and operational (frequent and usually involving small volumes) spills associated with the maritime traffic.

In total, over 60,000 240h-long simulations were run and the statistical behavior of the beached concentrations found was described. The concentration distributions for both study areas were successfully fit using a Gamma distribution demonstrating the generality of our conclusions. The oil spill hazard and its uncertainties were quantified for accidental and operational events relying on the statistical distribution parameters. Therefore, the hazard estimates were comparable between areas and allowed to identify priority coastal segments for protection and rank sources of hazard.