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Proceedings of the Maritime Big Data Workshop

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Abstract: The NATO STO Centre for Maritime Research and Experimentation, as part of its mission to put forward the technological maritime research, with the support of the European Union's Horizon 2020 Programme has organized on May 9-10, 2018, the Maritime Big Data Workshop (MBDW). The workshop gathered together researchers, technological providers and members of the operational community to exchange their experience on Big Data innovations for maritime security, safety and security of maritime navigation and transport, sustainable fisheries and exploitation of ocean resources. For two days, 37 researchers and experts from Brazil, Canada, France, Germany, Greece, Italy, Portugal, South Africa, and Vietnam presented their work and main findings on Maritime and Big Data, including the outcomes of 6 ongoing Maritime Big Data projects and initiatives funded by the European Union: datAcron, MARISA, Ranger, EUCISE, AtlantOS, EMODnet.

The workshop's results enable to draw some preliminary conclusions on the current research and developments in Maritime Big Data. There is a general interest towards concrete societal and operational needs, coupled with an emerging tendency to develop methods combining heterogeneous, potentially complementary, information streams (mainly AIS, paired with SAR, Radar, METOC, acoustic), with an increasing attention towards source quality. The approaches adopted come from different areas of research, mainly machine learning and data mining, incorporating also techniques developed in Information and data fusion, but also data warehouse and online analytical processing.

The current trend towards experimenting open source Big Data technologies is challenged by the integration of diversified sources of information, which comes with an increased exigence of enhanced data management capabilities for harmonised data sharing and processing that can overcome the sole exploitation of kinematic data. Meanwhile, there is a prevailing requirement to reduce the uncertainty of detection and prediction results, entailing the development of capabilities to formally handle information and source quality. Analogously, the emergence of novel Artificial Intelligence approaches that, despite showing promising results, challenge results' interpretation, requires an increased involvement of experts in all the phases of the development (the so-called ``Human in the loop"), and the holistic incorporation of approaches addressing human factors' aspects.

Keywords: Maritime Big Data, , Maritime sensors networks, Maritime Intelligent Surveillance and Reconnaissance, Maritime Situational Awareness, Maritime Interoperability, Maritime Information Fusion, Maritime Cyber Security, Human factors, Maritime Open Data, Efficiency of Navigation, Sustainable fisheries

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Towards an analytics of optimal ship routes based on meteo-oceanographic datasets

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Abstract. Maritime routes optimised for meteo-oceanographic conditions can be represented in terms of two key-metrics: their optimal duration and length. They are here proposed as a basis for an automatised analysis of big route datasets.

Big Data is entering the maritime world mainly fed by two kinds of initiatives: the industrial and the geoscientific ones. In addition to internal and market needs, the industry has been stimulated to go digital by initiatives under the e-Navigation umbrella (IMO[1], IALA[2] , STM-Validation[3]). The geoscientific community has driven the evolution of operational meteo-oceanographic systems (GEOSS[4], GOOS[5], CMEMS[6], EMODnet[7]) towards applications directly aimed at a societal benefit (geoBluePlanet[8], AtlantOS[9]).

The outcome of these efforts is the production of large amounts of data, either observational or model data. While within the geoscientific community open-access data policies have been a standard for a long time (NOAA[10], H-2020[11]), legitimate issues of security and market competition have so far prevented a wider uptake of private data. This barrier could be overcome in a win-win loop that has already been outlined[12].

The H-2020 AtlantOS project aims to achieve a transition from a loosely-coordinated set of existing ocean observing activities to a sustainable, efficient, and fit-for-purpose observing system, engaging stakeholders around the Atlantic. Its WP8 will deliver a suite of products that are targeted at issues of societal concern, such as flooding, maritime safety, harmful algal blooms, and offshore aquaculture. The ship routing contribution to AtlantOS WP8 is delivered by CMCC through the development of VISIR[13].

VISIR computes optimal routes in a dynamic environment, keeping into account the safety of navigation. Its first version was aimed to plan least-time routes in presence

[1] http://www.imo.org/en/OurWork/safety/navigation/pages/enavigation.aspx
[2] http://www.iala-aism.org/products-projects/e-navigation/
[3] http://stmvalidation.eu/
[4] https://www.earthobservations.org/geoss.php
[5] http://www.goosocean.org/
[6] http://marine.copernicus.eu/
[7] http://www.emodnet.eu/
[8] https://geoblueplanet.org/
[9] https://www.atlantos-h2020.eu/
[10] https://repository.library.noaa.gov/view/noaa/10169
[11] https://goo.gl/9gECUo
[12] https://goo.gl/XmKrwf > ”Towards a new paradigm for ship routing” (pag.3)
[13] www.visir-model.net

of waves [1] and has been an operational service for the Mediterranean Sea for more than three years [2] by now. The latest VISIR developments include the capability to account, on top of waves, also for ocean currents. Currents impact routes by modifiying the speed over ground (SOG) of the vessel with respect to the speed through water. Thus, additional savings of route duration T^* can be achieved through an optimal use of ocean-currents. However, increases of route length L are also a possible outcome.

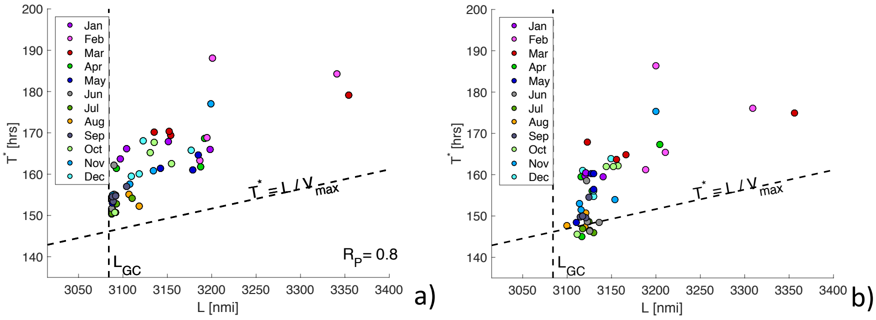

Fig. 1. Scatter plots of L and T^* of optimal routes computed by VISIR in presence of a) waves only and b) both waves and currents. Vessel top seed is $V_{\max} = 21.1$ kts. L_{GC} is the length of the great arc route joining the route endpoints. 4 routes per each month of year 2017 are computed.

Fig.1 shows seasonal route variability in the (L, T^*) plane for a case-study route between the Chesapeake Bay (USA) and Lisbon (Portugal) computed via VISIR using CMEMS ocean currents and waves analyses in input. The half-space below $T^*/L = 1/V_{\max}$ represents the region with route average speed in excess of vessel maximum speed $V_{\max}$. This can be achieved thanks to ocean currents. If the ship engine power is set to be constant, then T^*/L is a proxy of the energy efficiency of the voyage (EEOI), providing an estimation of the route carbon footprint [3].

Furthermore, analysis in the (L, T^*) plane reduces the dimensionality of the original dataset, consisting of the full waypoint-based route information. This enables analysis of larger route ensembles stemming from either observational (voyage reports, AIS data) or model data (optimal paths), from either industrial or academic source.

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