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Analysis of the effects of the Suez blockade on global containership traffic using AIS data and spatio-temporal data cube.

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Abstract:

On 23 March 2021, a containership of more than 20,000 TEU, the EVER GIVEN, ran aground in the Suez Canal, blocking it for six days. During the days of the blockade, awareness grows of how globalisation, as known in recent decades, is more fragile than the world had previously thought. The Suez Canal has a near monopoly on maritime traffic connection between the East Asian ports and European ports and it is crossed by a significant part of the traffic that connects Asia to the east coast of the United States. For this reason, this channel has been defined as one of the main choke points of global trade playing a nodal role in the Chinese Belt and Road Initiative project (UNCTAD, 2021; Hellenic Shipping News, 2021). This episode, which lasted until March 29, had significant repercussions on the global supply chains of important industrial sectors, like the automotive industry, due to the interruption of the flow of industrial components from Asian industries and delays caused by the congestion at some nodal ports of the global logistics network. Longer delivery times, the need to find alternative routes in those days, and the blockage of part of the global cargo capacity in the channel and then outside some ports, caused a dramatic increase in maritime freight rates, already strongly hit by the effects of the covid-19 pandemic (UNCTAD, 2021).
Spatial analysis tools can be considered an innovative approach in order to provide high value-added information useful for the analysis of the immediate effects on maritime trade as well as on environmental protection (Arco et al., 2021).
The starting point of this research is the spatial analysis derived from the AIS containerships data that consists of small transponders fitted to vessels of a certain size and category specified by the International Maritime Organisation (IMO), which use short wave VHF radio signals and GPS/GNNS technology to broadcast each vessel's position (Yang et al., 2019).
Specifically, data used for this research consist of AIS daily positions for containerships above 7000 TEU through 2021 on which the authors created spatio-temporal data cube as a technique that can provide relevant information on immediate trends. ESRI ArcGIS Pro Space Time Pattern Mining toolbox was used to aggregate AIS records into a netCDF data structure by aggregating them into space-time bins. Each bin contains an aggregation of AIS locations in a defined area over a given time interval.
The latitude and longitude fields of the AIS data allow spatial aggregation of ship positions within defined AOIs that will provide the defined location for the creation of the data-cube bins. Statistical calculation of vessel carrying capacity is provided through the TEU field in the AIS data. TEUs are the standard unit of measurement that defines the length of containers in transport. This measure defines how many containers a single ship can carry. Using data cubes, it is possible to visualize certain spatiotemporal trends on a map level by indexing them with different colours to visualize the positive or negative trend of certain phenomena and the degree of intensity of these trends. In addition, individual bins in the data cube can be interrogated in order to display a graph on the time trend of the data in each AOI. In this research, the spatial definition of the bins varied based on the different phenomena analyzed.
The aim of this research is to analyze the trends in the areas of the main hubs of global maritime logistics and on the main routes used by containerships. For these analyses, the AOIs have been defined on the main maritime choke points, on the main global ports. In this way it is possible to quantify the variation of traffic along the main alternative routes to Suez, such as the Cape of Good Hope and the Panama Canal, and the variations of traffic on the main Chinese, European and American ports. The analyses focused on the variation in the number of ships, the cargo capacity blocked near the Suez Canal and the increased waiting times for ships outside the nodal ports. The latter was made possible through the development of a tool in QGIS for calculating the consecutive days of a ship within an AOI.

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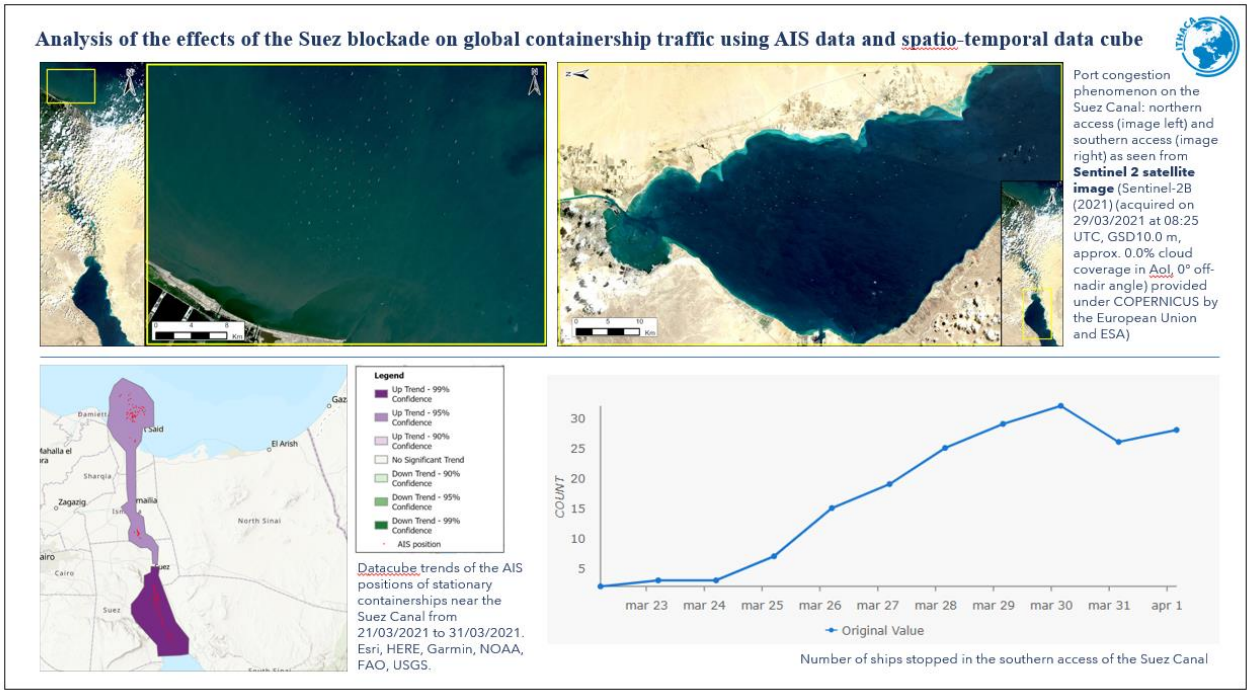

Figure 1. Datacube trend visualization in map and graph visualization of the AIS positions of stationary containerships near the Suez Canal from 21/03/2021 to 1/04/2021 and Sentinel 2 satellite images of the blockade on 29/03/2021. Esri, HERE,Garmin, NOAA, FAO, USGS.

For this analysis, the definition of the AOIs was defined with the "speed" field of the AIS data and with the support of images from the Sentinel 1 and Sentinel 2 satellites capable of capturing the disposition of the anchored ships near the ports.
The production of thematic maps and visualization of graphs on the spatiotemporal trend of phenomena are proven to be an effective method of communicative support for geospatial analyses carried out for data extraction, using data cubes, of considerable value for economic studies.

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