

The Piraeus AIS Dataset for Large-scale Maritime Data Analytics

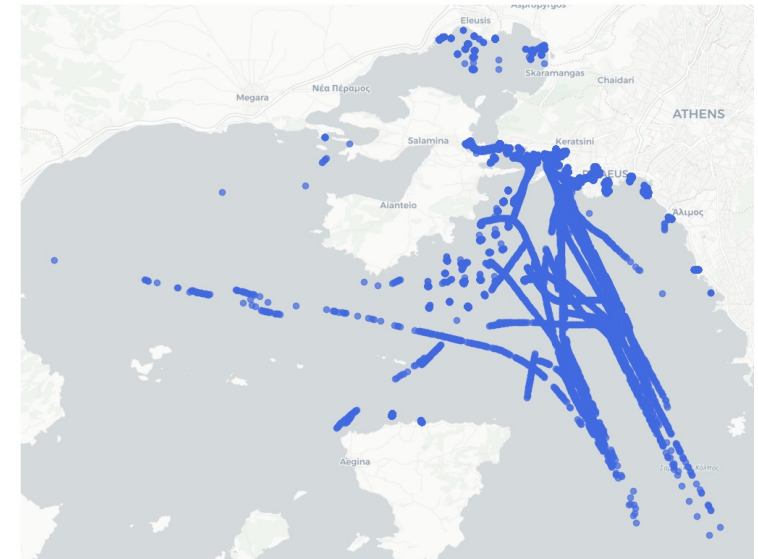
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Overview

- AIS Maritime Activity
 - What: AIS messages
 - Where: Saronic Gulf, Greece
 - When: ~2.5 Years (May 2017 - Dec. 2019)
 - How: AIS station located at the Univ. Piraeus
 - Why: benchmark dataset for maritime data analytics
- Three main categories of information
 - Navigation-related data
 - Geo-related data
 - Weather-related data
- Includes Meta-data useful for data analytics purposes
 - Trajectory Synopses (critical points only)



**A Snapshot from the Saronic Dataset —
sample of AIS positions on July 10th, 2018**

Navigation-related data

- AIS-kinematic
 - ~244M AIS records (16 GB)
 - collected by Univ. Piraeus AIS station (MarineTraffic #2782)
- AIS-static
 - ~6K records (500 kB)
 - anonymized vessel features (id, country, type)
- AIS codes & types
 - 100 records
 - passenger, fishing, sailing, etc.

	timestamp	vessel_id	lon	lat	heading	speed	course
0	1532594172000	280496899716b1750a138524d4452e12dba0fe94bef4ff...	23.632190	37.814593	22.0	22.7	29.9
1	1532594173000	025dc2bc6e81fd02b3deeb1e98ad62fce09c26abe98a0...	23.588238	37.956590	346.0	0.0	0.1
2	1532594173000	fa52f91b78b8d87e9edecebb9615b259c4227ab2deca6c...	23.613055	37.958712	346.0	0.1	58.8
3	1532594173000	adadd2b5a4faab1036505fdb4df766f24ec6cfbbc535fa...	23.582402	37.798450	NaN	12.2	193.2
4	1532594173000	f14b2881f278eb54fc1ffdfce14734d4905faad2090fa8...	23.529328	37.965362	NaN	0.0	0.0
5	1532594173000	f925c27d1ab5db0ef12f54ea9eac24660d9a6caf16240b...	23.624500	37.941000	151.0	0.0	199.0
6	1532594173000	c7264ef76fbbcb3a6695a16313e0bda49aa753d1fe3a5a...	23.588703	37.942988	NaN	0.0	0.0
7	1532594174000	bfa0e846b6d35f8fde7611da7ff55835ba71a7eda53d3...	23.626818	37.939178	63.0	10.0	247.3
8	1532594174000	41466d54ae022d82204410ba227fd0d888c99ab26...	23.588287	37.948403	281.0	9.9	284.6
9	1532594174000	7bf6ebddc7d70538694566e7891fe15cad8df821fdb5f8...	23.595172	37.955022	346.0	0.0	116.1

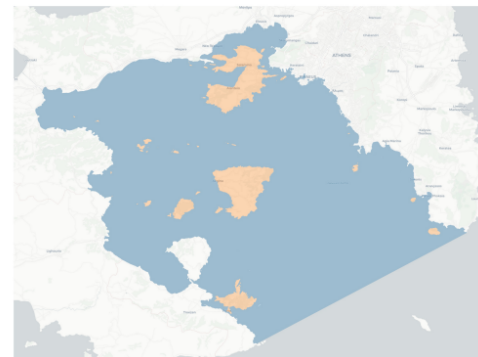
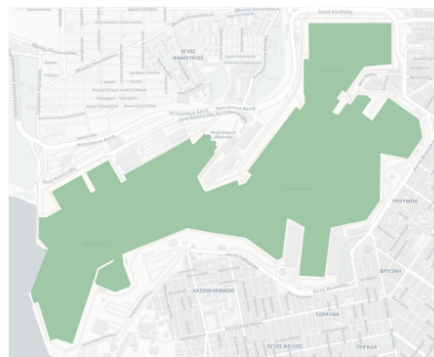
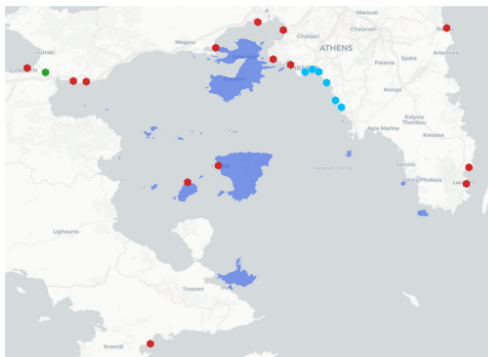
Sample of AIS kinematic records

	vessel_id	country	shiptype
740	da8ce411f6eb032f235332e1ece0dc61e8022bf8e18ceb...	Greece	74.0
741	6d072d74585e2142c5586f8fb8fce730e2b117fedbb1c...	Greece	60.0
742	3fe170e07325320e29f6be55b08c18b2db19492624821a...	Greece	30.0
743	efe2d4d76872f6dee1f6a161392298de47d5940e7dd0a9...	Greece	37.0
744	05edaa038e80b4952faf8ea6ee12f2e95066896dc0bc9...	Greece	70.0
745	06b58392802fe6c1493e12eaa977480a5c052a848cc21c...	Greece	69.0
746	2a373aafb7a58836b52dddadb5a6faf116df154ac00d42...	Greece	60.0
747	bd05373eee21ee21aaa8ee15c58ac48264feb92865438e...	Greece	70.0
748	847250a6464625e5b585d264de6bdfb5dd48ee11f35eae...	Greece	52.0
749	2ca4f54d8b50598db7607d616a8732dbaea43540869f96...	Greece	30.0
750	ae71ef067d60bc8724803e5b64fc22988d33fcb0384eb5...	Greece	99.0

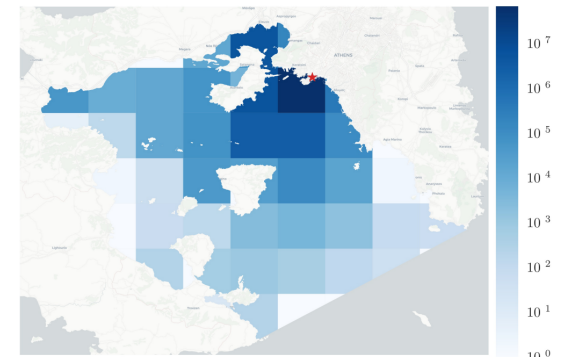
Sample of AIS static records

Geo-related data

- Geographical context
 - AIS receiver location (1 point); Port of Piraeus (1 polygon)
 - Harbours, other than Piraeus (21 points)
 - Islands in Saronic gulf (60 polygons)
 - Spatial coverage (76 polygons)
 - Territorial waters (1 polygon); Regions (13 polygons)



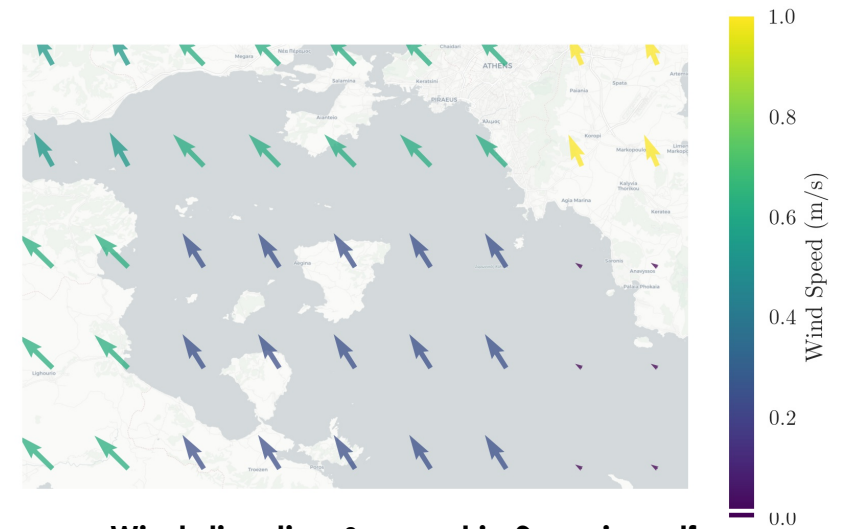
Saronic Gulf harbours (left); port of Piraeus (center); islands & territorial waters (right)



AIS receiver (red star) and typical coverage (heatmap)

Weather-related data

- 14 weather features
 - Wind direction (degrees) & speed (m/s), Visibility (m), etc.
- Resolution:
 - Spatial : 9 x 5 grid
 - Temporal: 6 hours periods
- GRIB Files * using Trajectory-Weather-Integrator s/w **



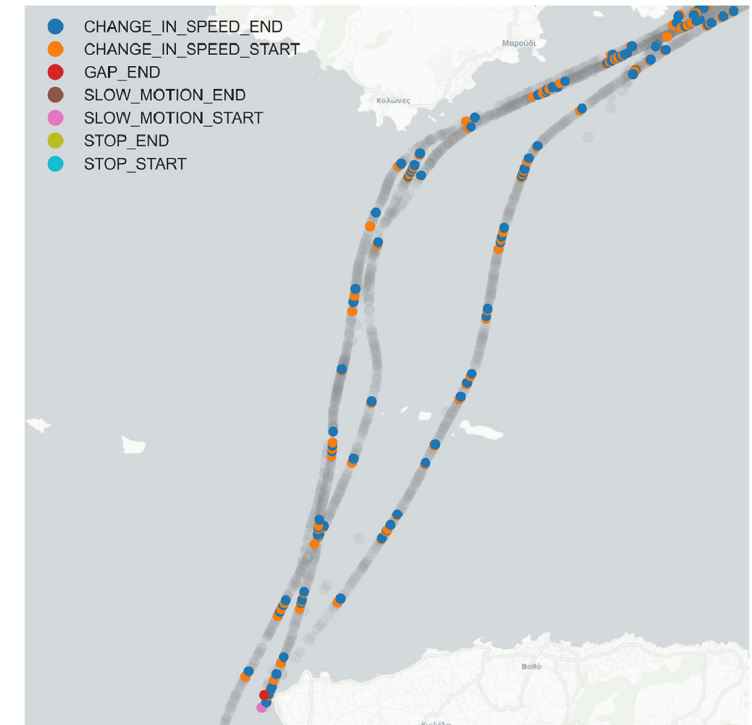
Wind direction & speed in Saronic gulf,
23/07/2018 @ 12:00

* <https://www.noaa.gov>

** <https://github.com/DataStories-UniPi/Trajectory-Weather-Integrator>

Meta-data

- Trajectory synopses (critical points only)
 - ~15.5M semantically-annotated AIS records (1.7 GB) *
 - Critical points only: change in speed, change in heading, etc.
- Gathered using Trajectory-Synopses-Generator s/w **



Vessel trajectory (gray) and its corresponding critical points – synopses (orange) referring to a vessel's voyage on July 23, 2018

* 90% compression rate wrt. the original AIS records (=16 GB; see "Navigation-related data" slide earlier)

** <https://github.com/DataStories-UniPi/Trajectory-Synopses-Generator>

DB schema



noaa_saronic_weather	
PK	ID
	timestamp (Datetime)
	timestamp_unix (UNIX Timestamp)
	longitude
	latitude
	TMP (Temperature)
	TMIN (Min. Temperature @3 hrs.)
	TMAX (Max. Temperature @3 hrs.)
	PRMSL (Pressure @Mean Sea Level)
	RH (Relative Humidity)
	GUST (Wind Gust Speed)
	VIS (Horizontal Visibility)
	DPT (Dewpoint Temperature)
	APCP (Total Precipitation @3 hrs.)
	UGRD (Wind Direction - u-Component)
	VGRD (Wind Direction - v-Component)
	WDIRMAT (Wind Direction - Mathematical)
	WDIRMET (Wind Direction - Meteorological)
	WSPD (Wind Speed)
	geometry (Point Location)

Weather-Related Data

ais_codes_types	
PK	type_code
	description

ais_static_saronic	
PK	vessel_id
	country
	shiptype

ais_kinematic_saronic	
PK	ID
	timestamp
	vessel_id
	longitude
	latitude
	heading
	speed
	course

trajectory_synopses	
PK	ID
	timestamp
	vessel_id
	annotations
	transport_trail

Navigation-Related Data

greek_regions	
PK	region_id
	region_name
	geometry

harbours	
PK	port_id
	longitude
	latitude
	port_name
	type
	locode
	geometry

islands	
PK	FID
	island_name
	geometry

piraeus_port	
PK	FID
	geometry

antenna_coverage	
PK	FID
	geometry

territorial_waters	
PK	FID
	geometry

receiver_location	
PK	FID
	geometry

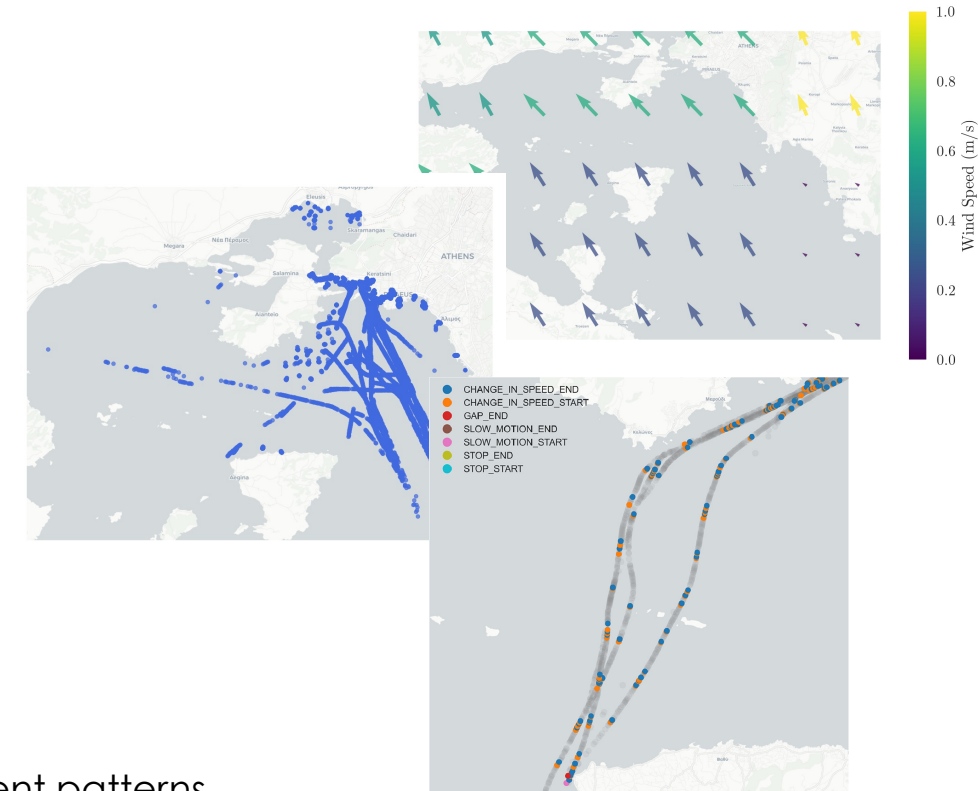
Geographical-Related Data

Meta-Data

References

- Dataset repository: <https://doi.org/10.5281/zenodo.5562629>
- Original publication: (Tritsarolis et al. 2022)
- Used in: (Tritsarolis et al. 2021)

- Acknowledgements:



- Tritsarolis A, et al. (2021) MaSEC: Discovering anchorages and co-movement patterns on streaming vessel trajectories. Proc. SSTD. <https://doi.org/10.1145/3469830.3470909>

- Tritsarolis A, et al. (2022) The Piraeus AIS dataset for large-scale maritime data analytics, Data in Brief (40). <https://doi.org/10.1016/j.dib.2021.107782>