



DISCOVERING MOBILITY BEHAVIOUR USING HISTORICAL VESSEL DATA WITH M-ATLAS

By: Mitchell Allen

Advisor: Dr. Emmanuel Stefanakis

MOTIVATION

- Exploit New Technologies
- Exploit Massive Mobility Databases
- Examine Marine Traffic Behaviour
- Discovery Useful Knowledge to Better Help Manage Transportation Systems

RESEARCH QUESTIONS

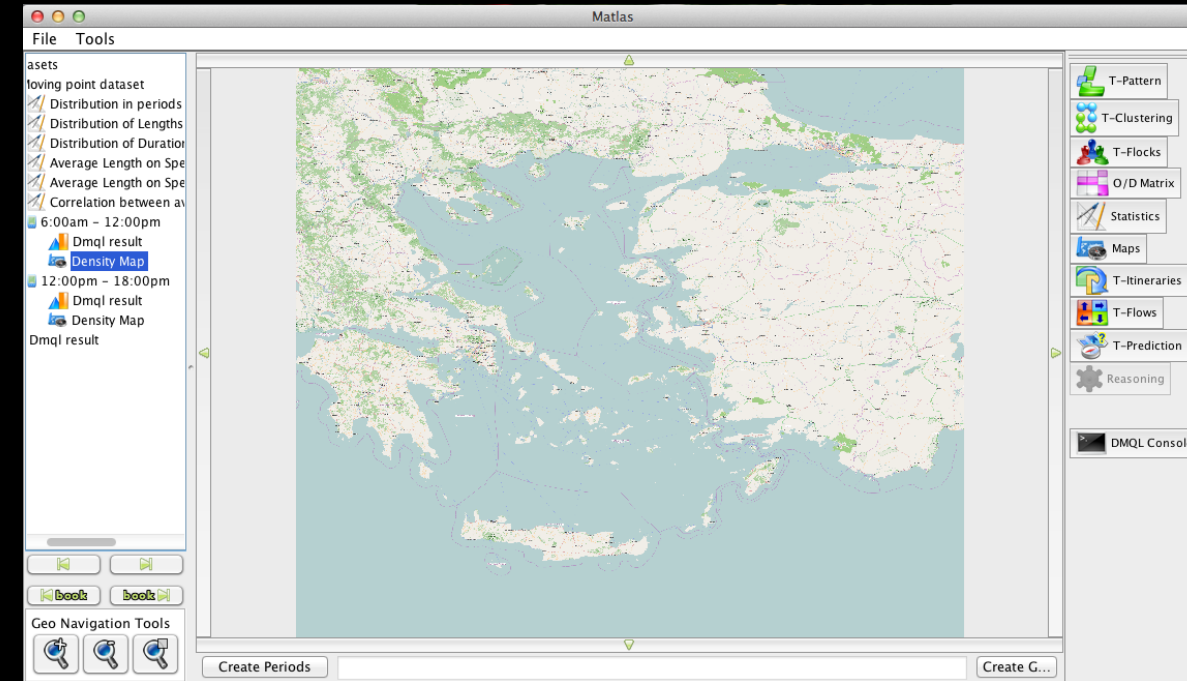
- From massive databases full of mobility data, can we answer fundamental questions about mobility behaviour? Questions pertaining to;
 - Discovering Mobility Patterns
 - Aggregating Large Volumes of Vessel Traffic
 - High-Risk Areas of collision

RESEARCH OBJECTIVES & METHODOLOGY

- Answer Research Questions by Exploiting Marine Dataset by Utilizing;
 - Object-Relational Database Management System (ORDBMS)
 - PostgreSQL
 - Structured Query Language (SQL)
 - Data Mining Query Language (DMQL)
 - M-Atlas

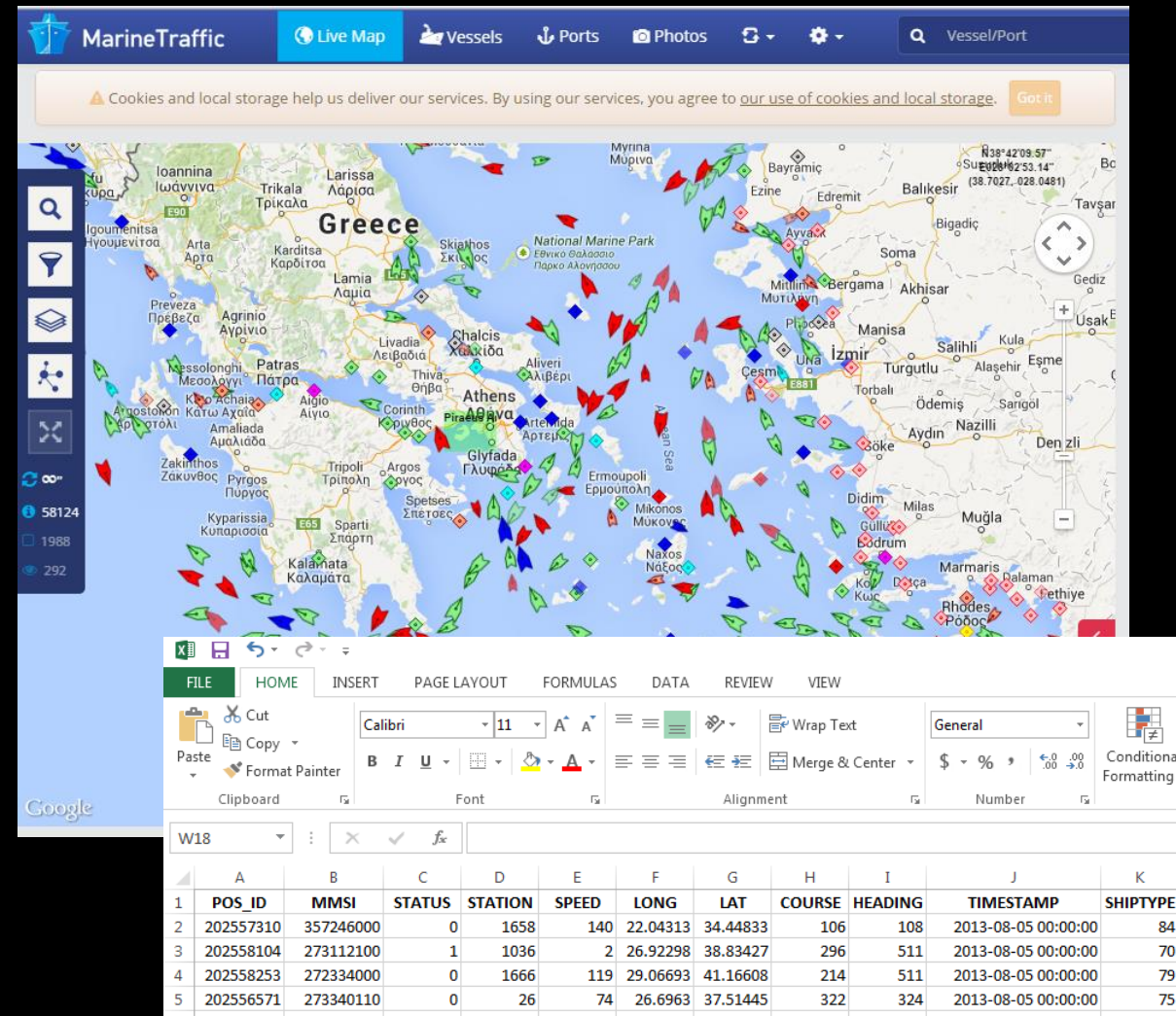
M-ATLAS SOFTWARE

- Mobility Querying and Data Mining System
- Equipped with DMQL for Complex Analytical Capabilities



DATASET INFO

- Aegean Sea
- Automatic Identification System (AIS)
- GPS Traces (Approx. 9 million = 150K Trajectories)
- January & August 2013



PROCEDURE

	A	B	C	D	E	F	G	H	I	J	K
1	POS_ID	MMSI	STATUS	STATION	SPEED	LONG	LAT	COURSE	HEADING	TIMESTAMP	SHIPTYPE
2	202557310	357246000	0	1658	140	22.04313	34.44833	106	108	2013-08-05 00:00:00	84
3	202558104	273112100	1	1036	2	26.92298	38.83427	296	511	2013-08-05 00:00:00	70
4	202558253	272334000	0	1666	119	29.06693	41.16608	214	511	2013-08-05 00:00:00	79
5	202556571	273340110	0	26	74	26.6963	37.51445	322	324	2013-08-05 00:00:00	75
6	202556423	271043322	99	101	0	29.12757	41.20555	0	511	2013-08-05 00:00:00	53
7	202556088	271002612	0	26	95	25.14533	38.74417	28	511	2013-08-05 00:00:00	70

```

SQL Editor Graphical Query Builder
Previous queries CREATE TABLE monday_jan_marine_vessels (gid serial PRIMARY KEY, mmsi int, lon real, lat real, datetime varchar(6... Delete Delete All

DROP TABLE trajetroies_table;
CREATE TABLE trajectories_table (gid serial PRIMARY KEY,
id int,
course int);

INSERT INTO trajectories_table (id, course) VALUES ( 240348000 , 352 );
INSERT INTO trajectories_table (id, course) VALUES ( 677036100 , 316 );
INSERT INTO trajectories_table (id, course) VALUES ( 370835000 , 38 );
INSERT INTO trajectories_table (id, course) VALUES ( 240389000 , 261 );
INSERT INTO trajectories_table (id, course) VALUES ( 677046800 , 315 );
INSERT INTO trajectories_table (id, course) VALUES ( 247146270 , 34 );
INSERT INTO trajectories_table (id, course) VALUES ( 240750000 , 188 );
INSERT INTO trajectories_table (id, course) VALUES ( 512003230 , 107 );
INSERT INTO trajectories_table (id, course) VALUES ( 239299000 , 332 );
INSERT INTO trajectories_table (id, course) VALUES ( 241030000 , 100 );
INSERT INTO trajectories_table (id, course) VALUES ( 370084000 , 124 );
INSERT INTO trajectories_table (id, course) VALUES ( 256824000 , 89 );

```

Object browser: mt_984553854stspav1 > periods > saturday_marine_vessels > scratch > scratch_stats > spatial_ref_sys > sunday_jan_marine_vessels

Columns (7): gid, mmsi, lon, lat, datetime, shiptype, geom_point

Properties for gid [PK] serial: 1, 373574000, 29.0641, 41.1396, 2013-01-06 00:00:00, 70

```

CREATE TABLE sunday_jan_marine_vessels
(
gid serial NOT NULL,
mmsi integer,
lon real,
lat real,
datetime character varying(60),
shiptype integer,
geom_point geometry,
CONSTRAINT sunday_jan_marine_vessels_pkey PRIMARY KEY (gid),

```

```

DMQL Query
select i.*, md.min_distance
from
hour_6100_trajectory_points_matlas as i, (
select ga.object,
min(st_distance(ST_Transform(ga.object,32635),
ST_Transform(gb.object, 32635))) as min_distance
from
hour_6100_trajectory_points_matlas as ga,
hour_6100_trajectory_points_matlas as gb where ga.id<=gb.id and ga.id= '214181915_0'
) as md where st_distance(ST_Transform(i.object, 32635), ST_Transform(md.object, 32635))=md.min_distance;

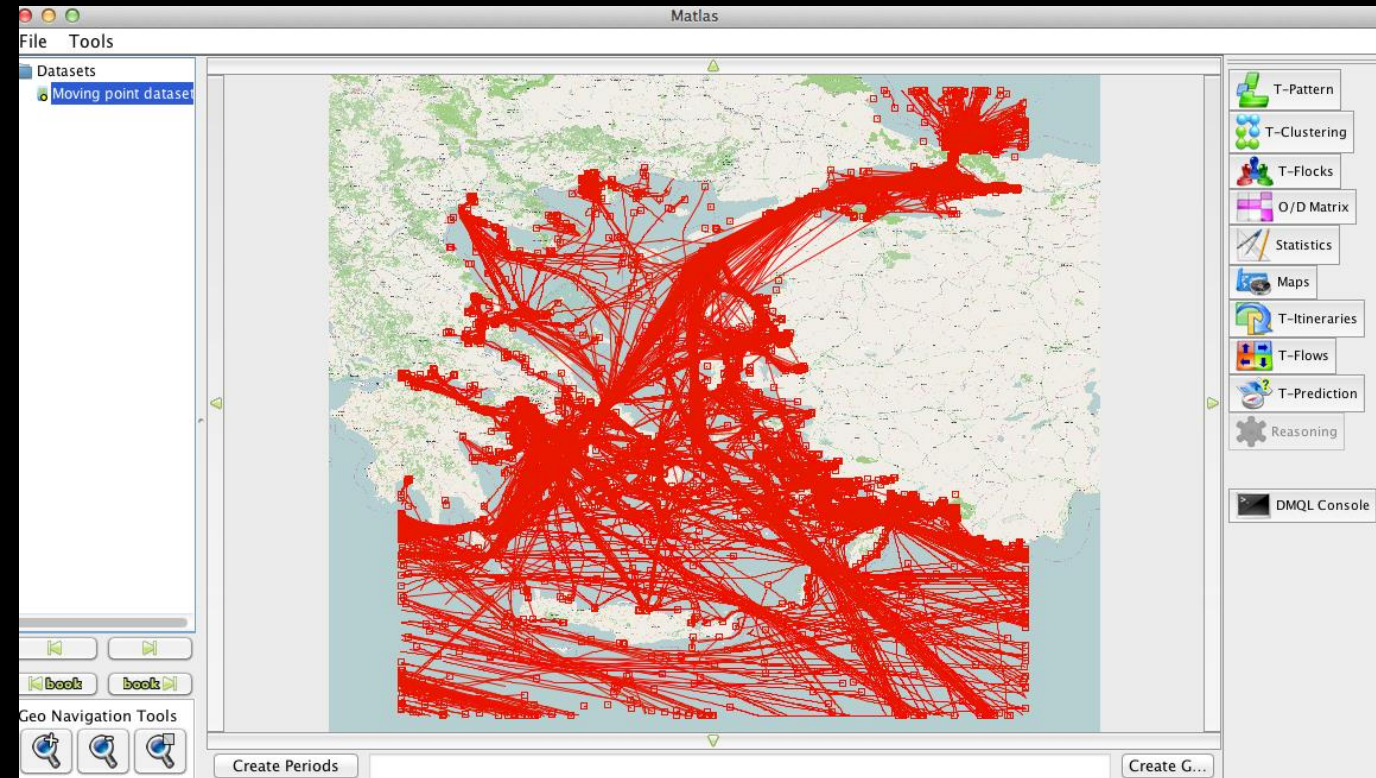
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Database tables: public.friday_marine_vessels, public.geometry_columns, public.hour_6100_points, public.hour_6100_trajectory_points_matlas, public.hour_6100_trajectory_points_matlas_stats, public.mobility_grid_small, public.monday_jan_marine_vessels, public.monday_jan_marine_vessels_matlas, public.monday_jan_marine_vessels_matlas_stats, public.monday_marine_vessels, public.monday_marine_vessels_matlas, public.monday_marine_vessels_matlas_stats, public.monday_vessels_comparison, public.monday_vessels_comparison_stats, public.periods, public.saturday_marine_vessels, public.scratch, public.scratch_stats, public.spatial_ref_sys, public.sunday_jan_marine_vessels, public.sunday_jan_marine_vessels_matlas, public.sunday_jan_marine_vessels_matlas_stats, public.sunday_marine_vessels, public.sunday_marine_vessels_matlas, public.sunday_marine_vessels_matlas_stats, public.sunday_moving_objects, public.sunday_moving_objects_stats, public.thursday_marine_vessels

History: Save Load Link dataset... Execute

RESULTS

- Overall Trajectories for Only 3 Days (Aug. 1st, 4th, 5th, 2013)
- Difficult to Understand Anything



ANALYSIS

- Statistical Analysis
 - Distribution in periods; of Lengths & Durations
 - Average Length on Speed & Speed Density
- Date-Time Comparisons
 - Day vs. Night
 - Weekend vs. Weekday
 - Summer vs. Winter
- Map Creation
 - Density Maps

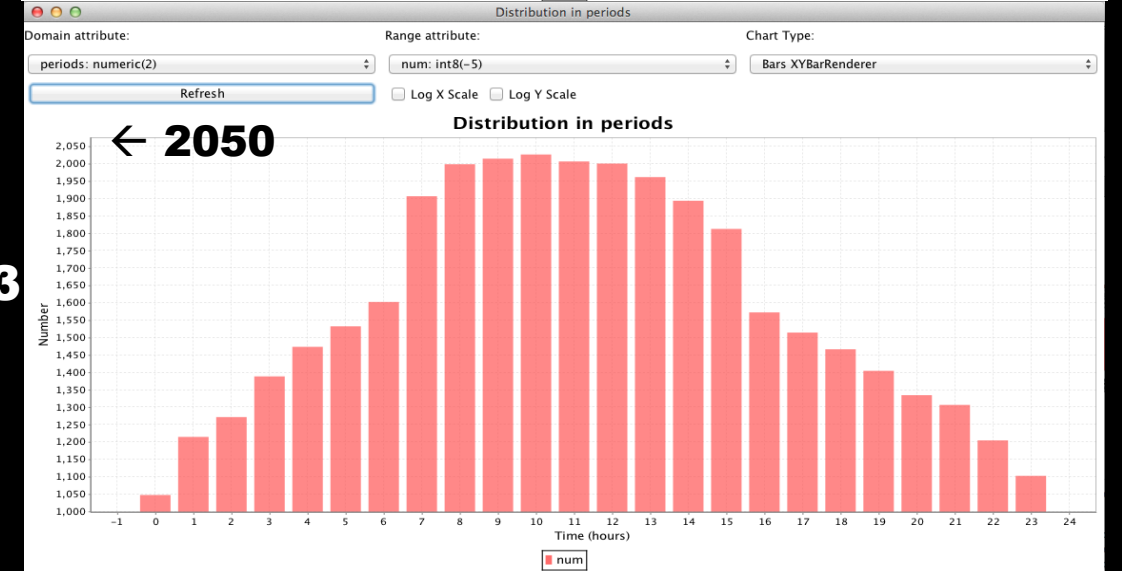
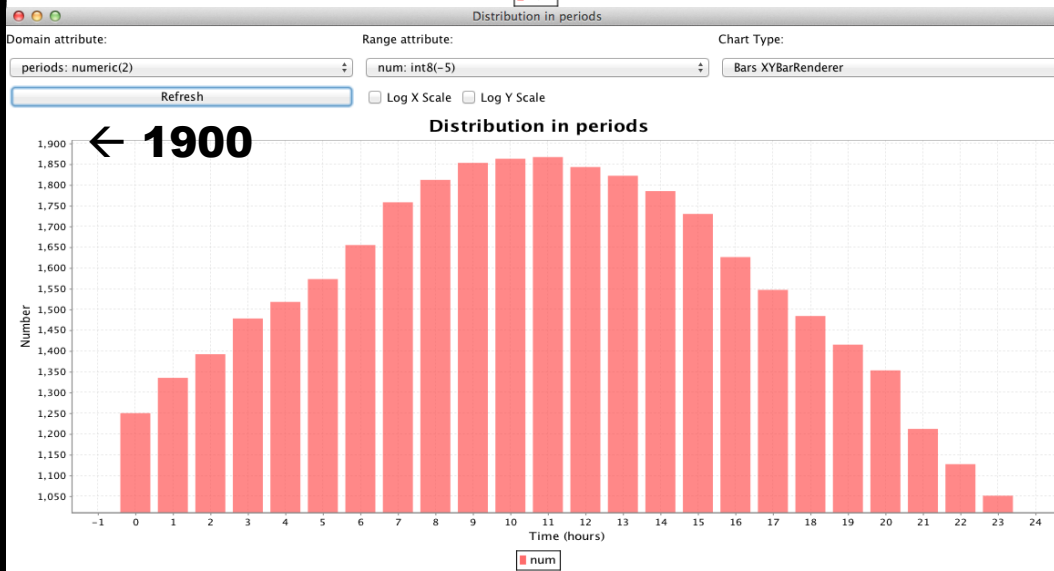
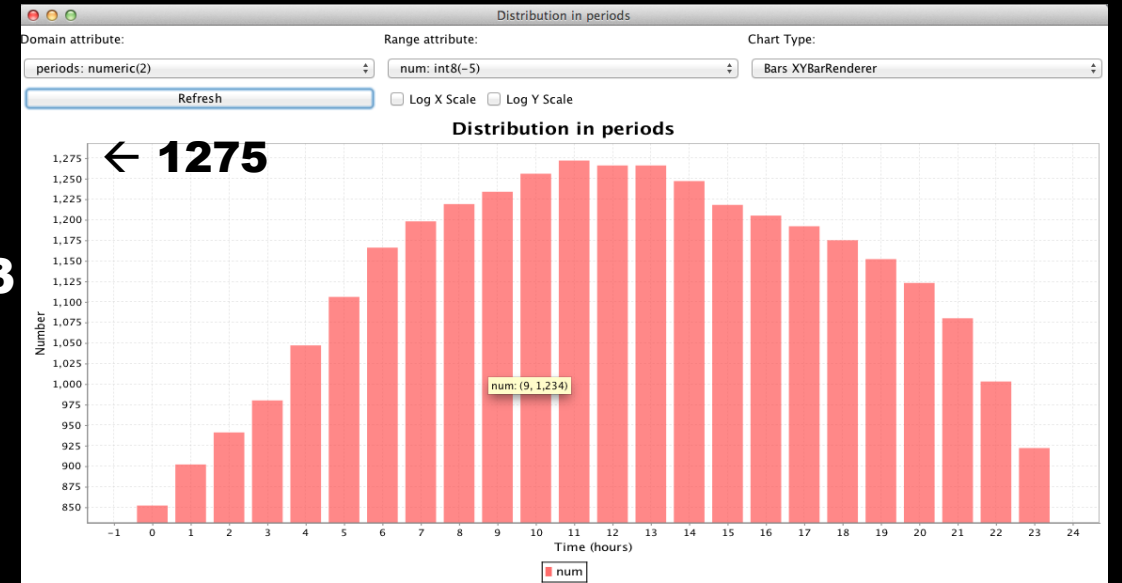
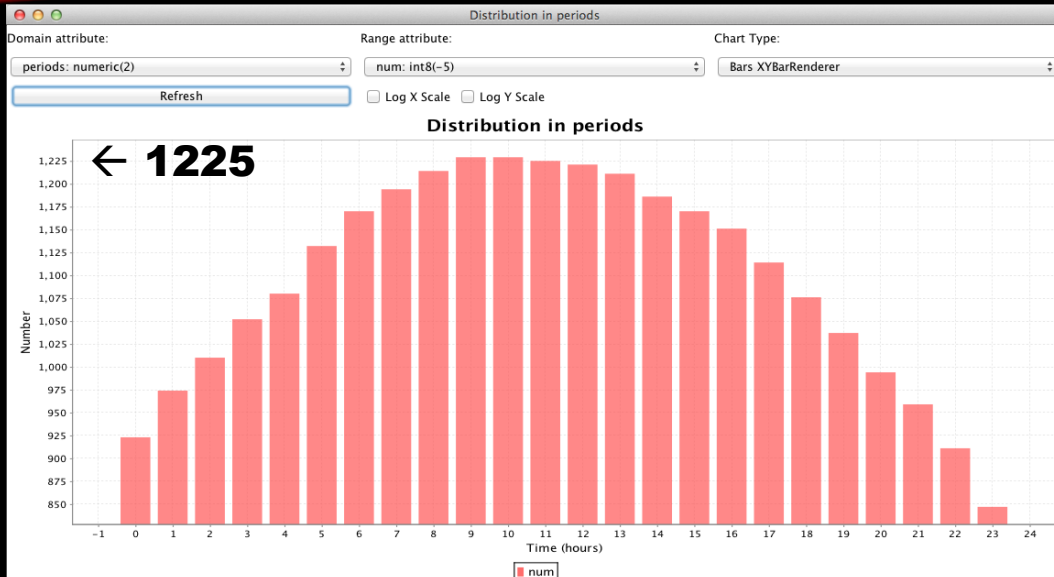
DISTRIBUTION OF PERIODS

Sunday

Monday

Jan. 2013

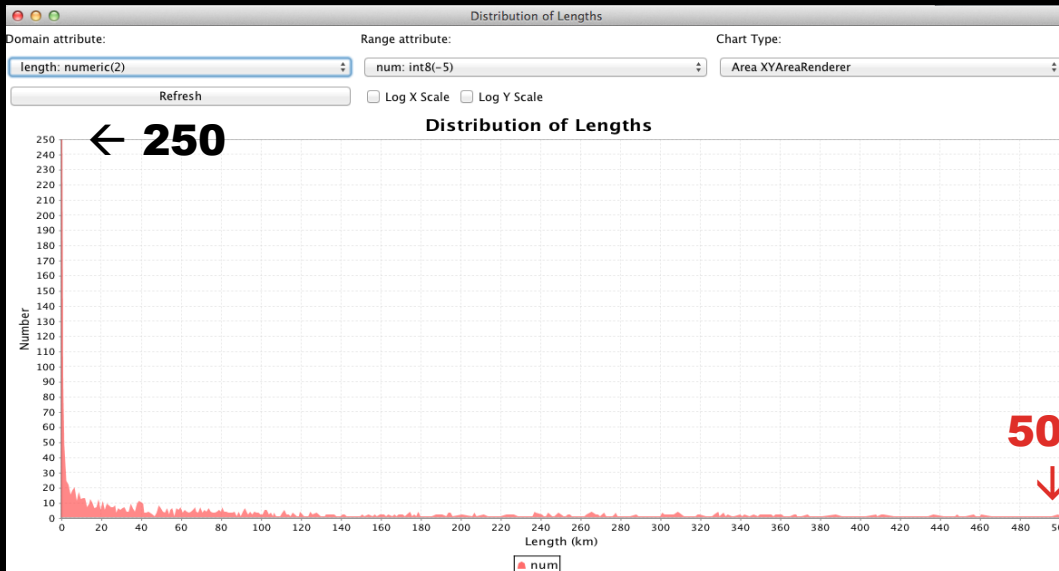
Aug. 2013



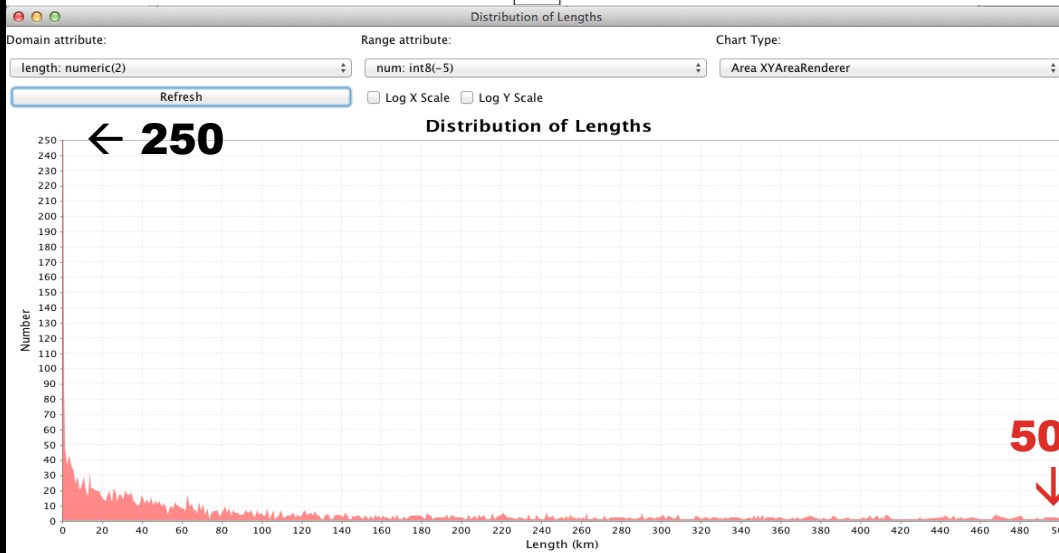
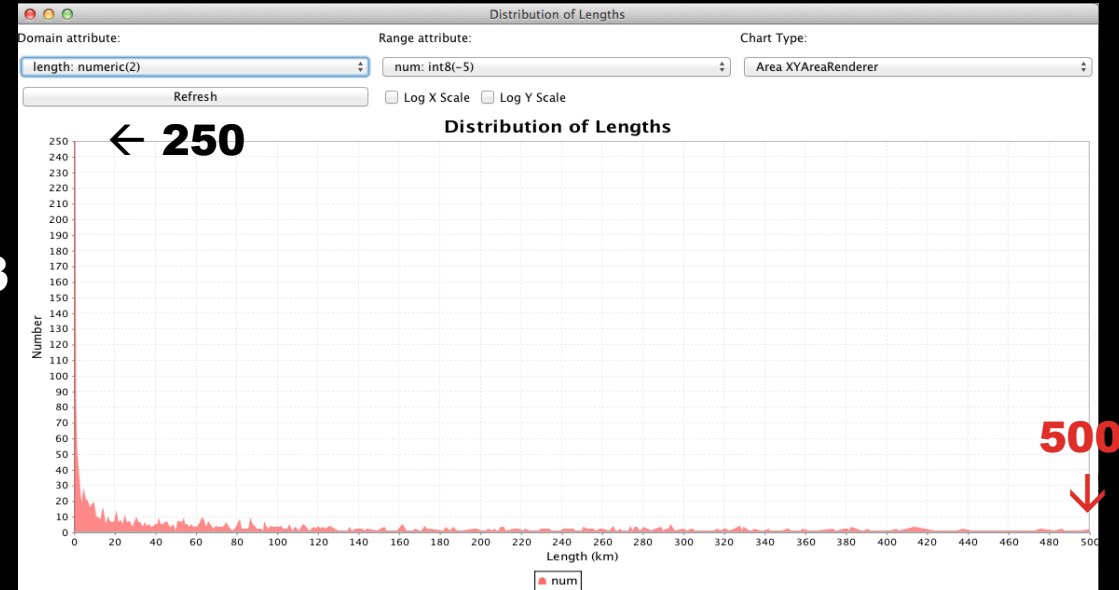
DISTRIBUTION OF LENGTHS

Sunday

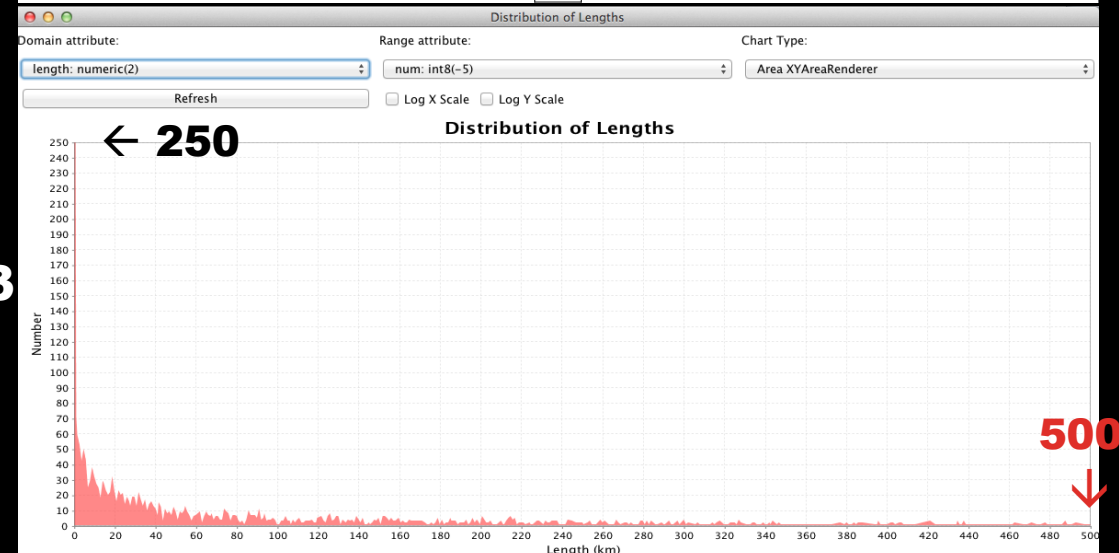
Monday



Jan. 2013



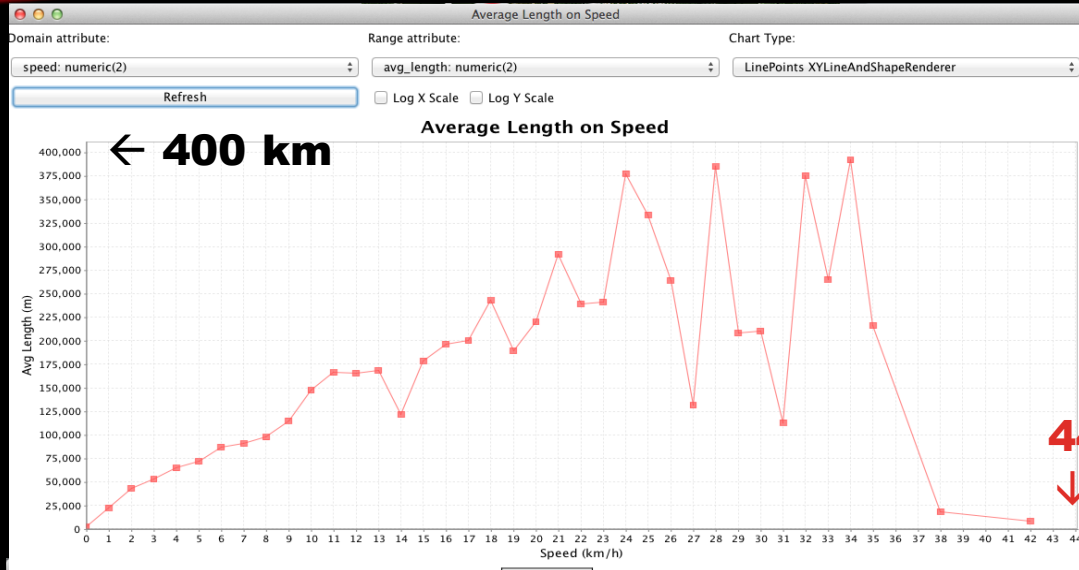
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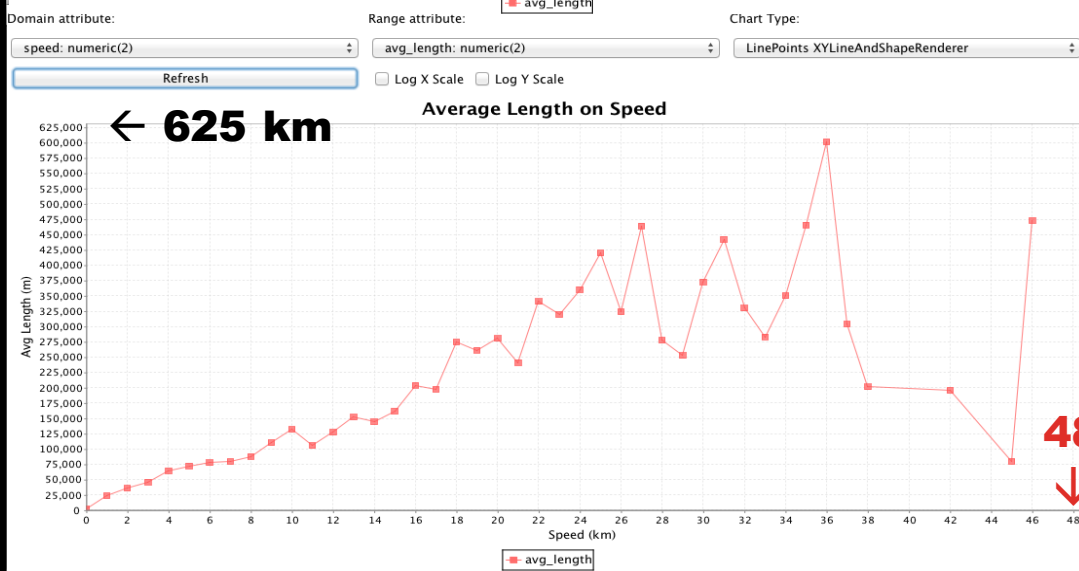
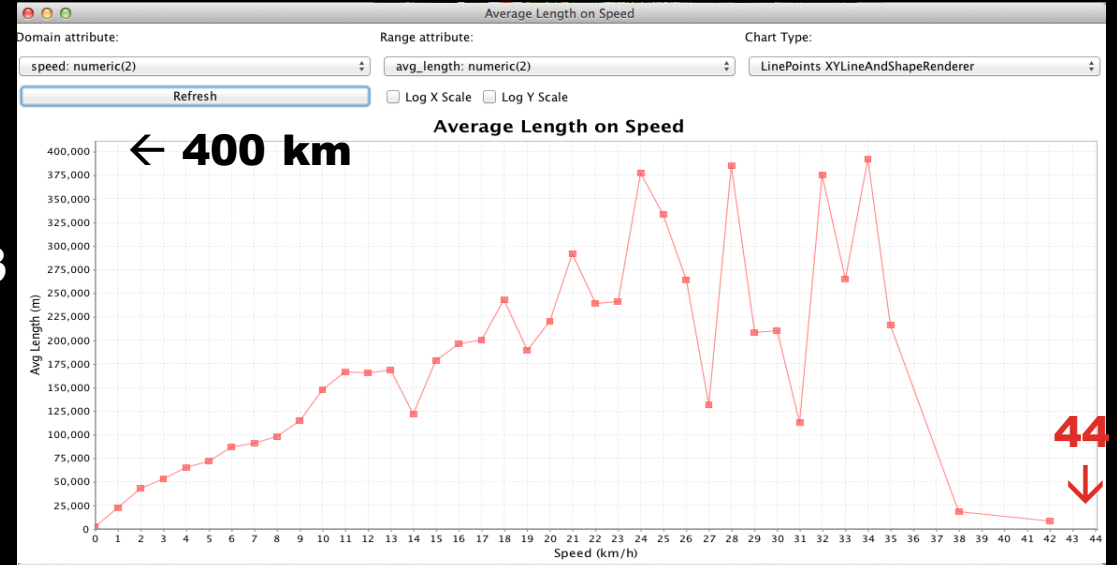
AVERAGE LENGTH ON SPEED

Sunday

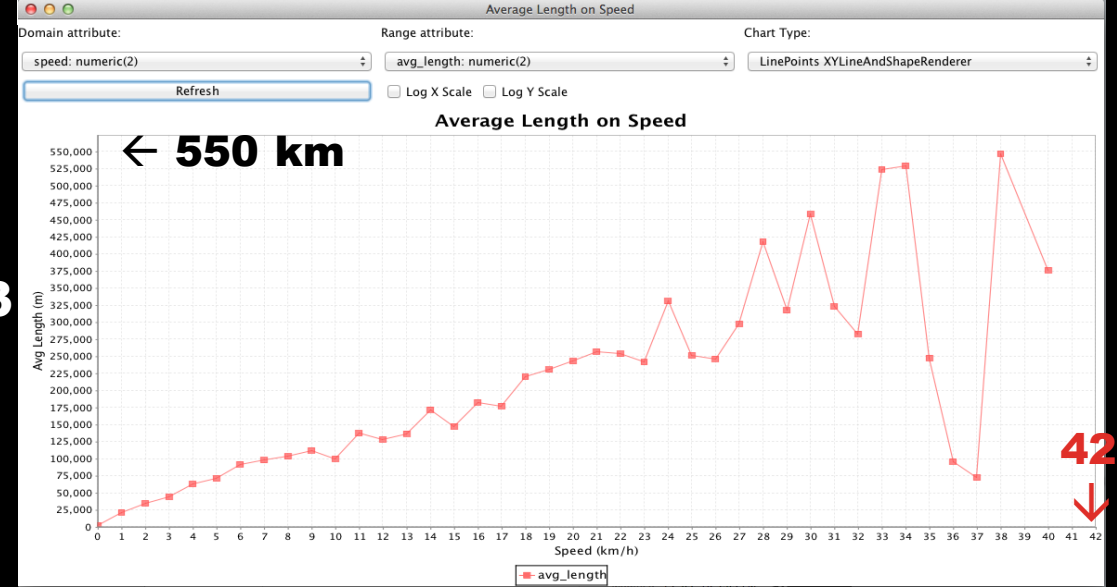
Monday



Jan. 2013



Aug. 2013



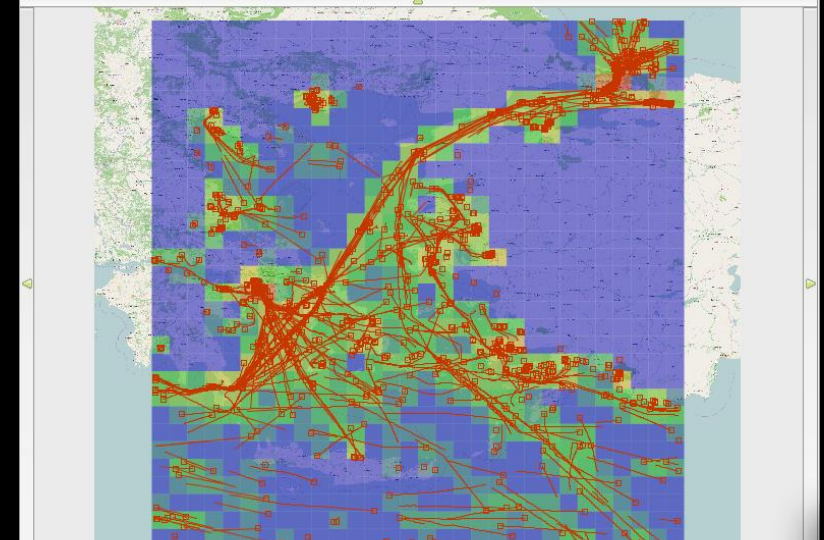
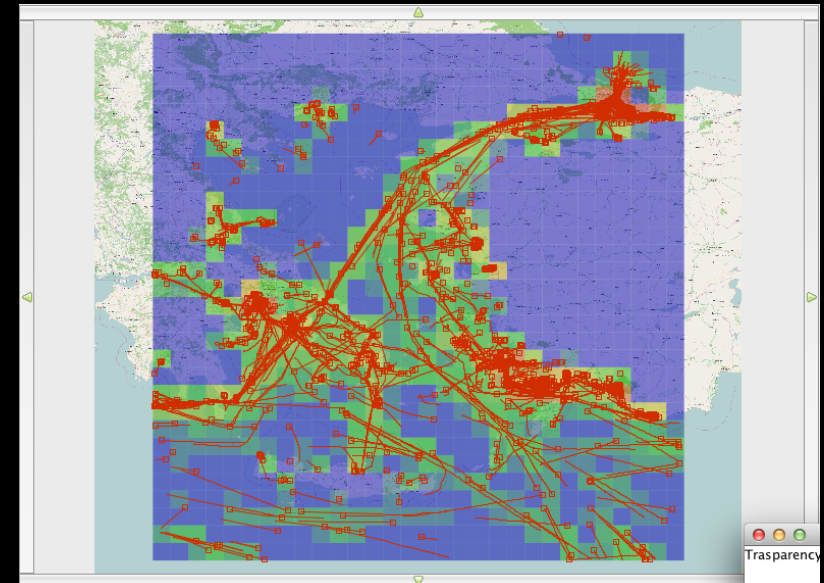
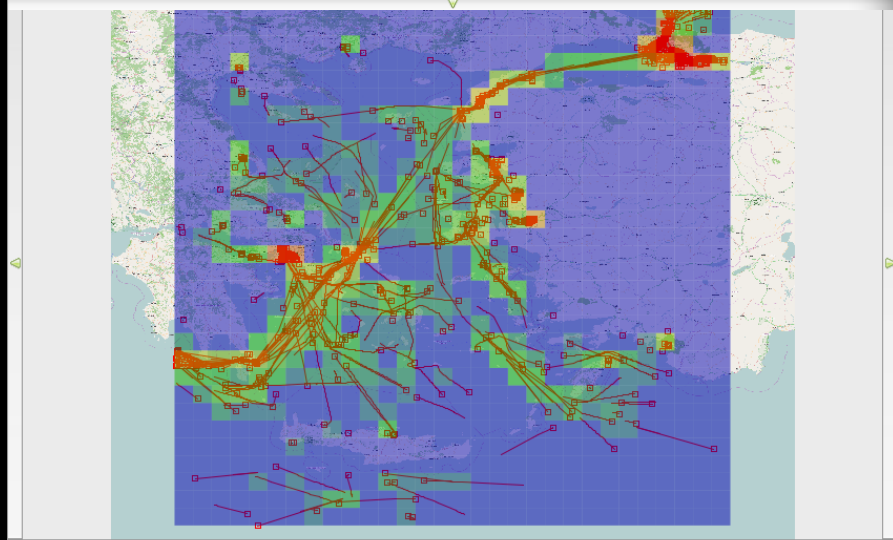
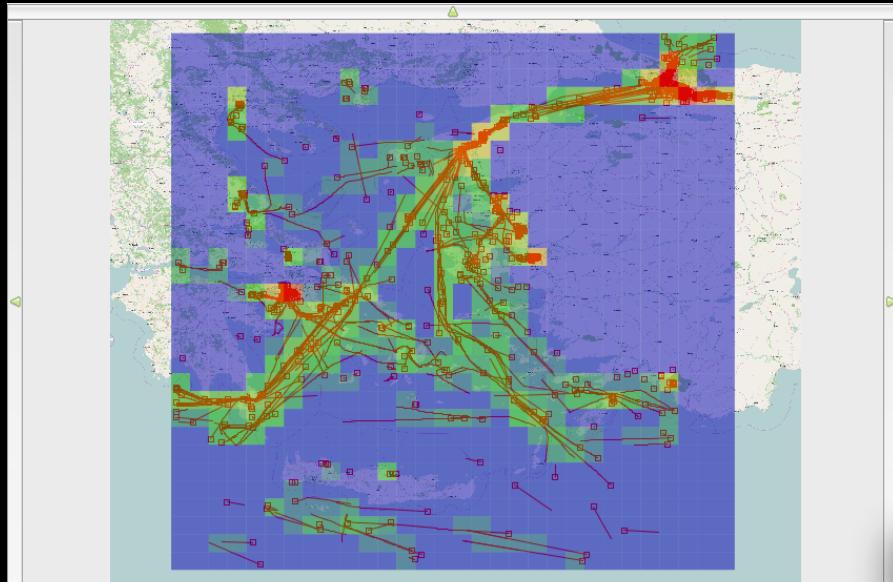
DENSITY MAPS

Monday, Jan. 2013

Monday, Aug. 2013

6am – 12pm

6pm – 12am



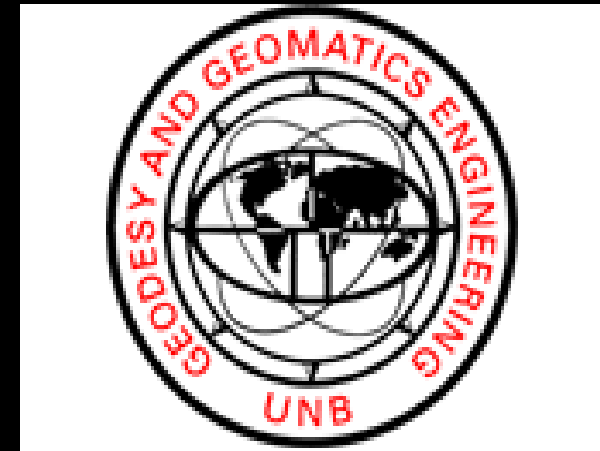
CHALLENGES

- Big Data Limitations
 - Software
 - Hardware
- Query Languages Learning Curves
- Pattern Discoveries with *Marine Datasets*
- Time (even though I have just as many hours in the day as Beyoncé)

CONCLUSION

- Using M-Atlas as a platform for mobility knowledge discovery enables us to answer challenging questions posed by analysts of movement behaviour
- Massive trajectory datasets are indeed a powerful basis for discovering useful knowledge and for future planning
- Though from my experience, applying a marine-based dataset to a terrestrial-based application to identify mobility patterns is not ideal...

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E-mail: v12ky@UNB.ca