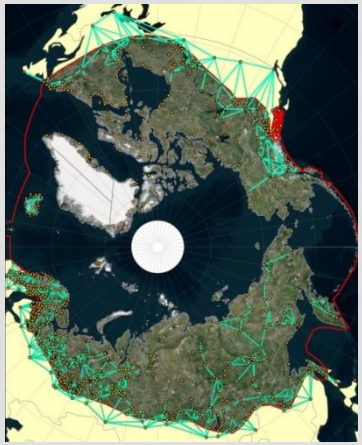
GLOBAL CITIES NETWORK IN THE ARCTIC: THE CONNECTIVITY THROUGH GROUND AND MARITIME TRANSPORTATION



Chanvoleak OURNG
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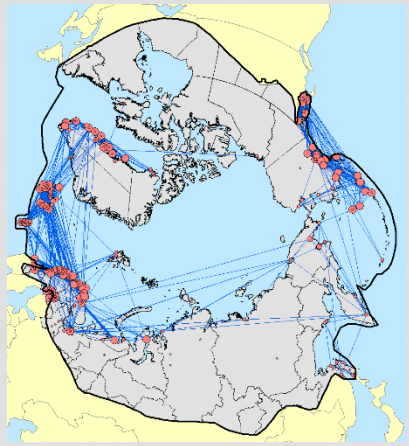

On the Edge
17-19 July 2019, The University of Western Australia
Perth, Australia

PUR Pôles URbains

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OUTLINE

- Introduction
  - Context
  - Where is the North (Arctic)?
  - Objective & hypothesis
- Data & Methodology
- Results
- Conclusion & prospective

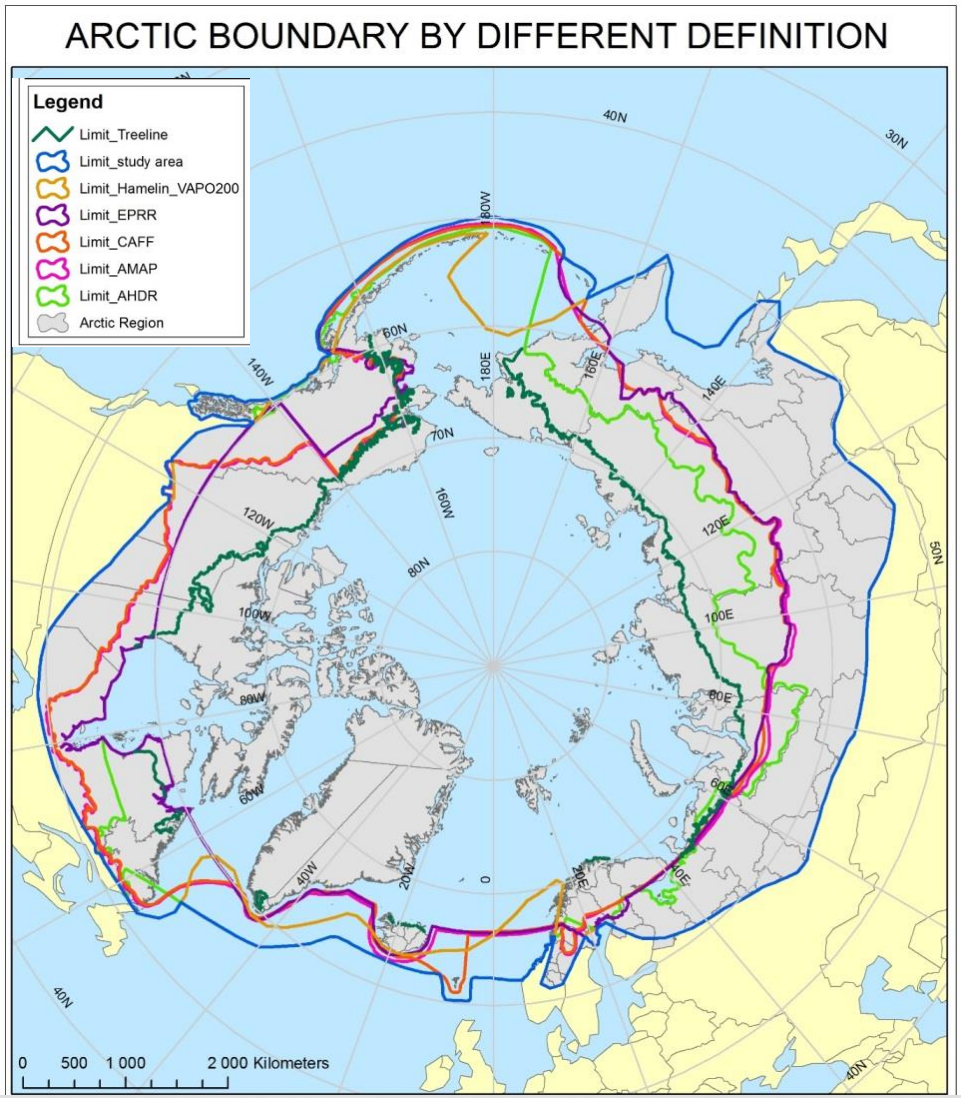
CONTEXT

- ↗ World urbanization: 55% live in urban areas (UN, 2018)

- In the Arctic zone:
  - Urbanization and metropolitan in the arctic: study is still limited
  - The high latitude areas (arctic region) : regarded as a periphery of the global system
  - Climate change + ↗ global demand for resources ➔ globalization in the arctic zone & ↗ urbanization
  - " By mid century (2050), the world would have titled its political and economic axes radically to the north…. *(Smith, 2012)"*

⇒Cities, as central places, will play as a key role and "urbanization is an increasingly central feature and reality of the Arctic" *(Dybbroe, 2010)*

WHERE IS THE NORTH?



- Arctic : the northernmost land and waters
- Extend across northern north America, north Europe, and north Asia (taking 8 countries)
- L.E. Hamelin used both natural and social environment criteria
  - Latitude, summer heat, annual cold, type of ice, precipitation, natural vegetation cover
  - Accessibility (all type of transportation mode), population density, degree of economic activity

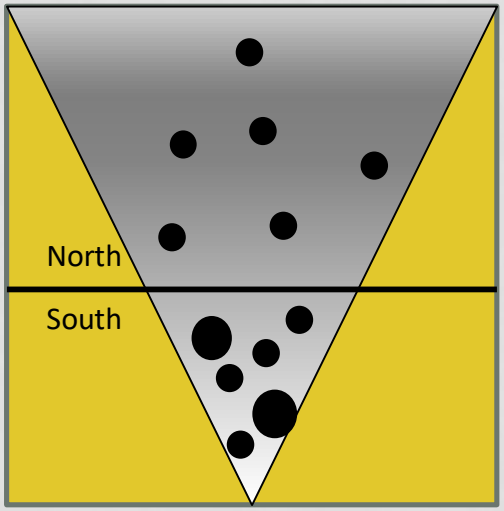
OBJECTIVE

- *Objective*
  - To picture the integration of arctic cities through terrestrial and maritime transportation
    - Network analysis (flow between places)
    - Quantitative and data based approach
- *How?*
  - More and more data are created and available online
  - Access through
    - Open source software/ website
    - API (Application Program Interface)…
- *Which data?*
  - *OpenStreetMap* (roads, railways etc.…) http://download.geofabrik.de/
  - MarineTraffic data => https://www.marinetraffic.com/

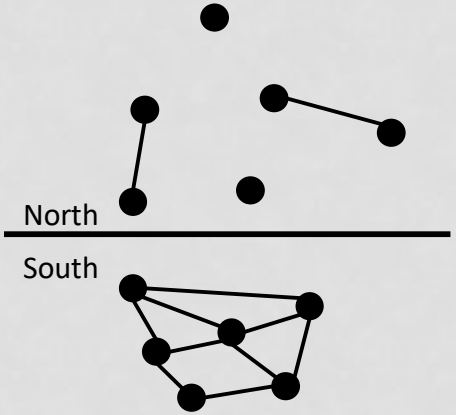
HYPOTHESIS

The closer to the north:

- The fewer number of settlement
- the lower population density
- the fewer number of link
- the fewer connectivity (graph)



Distribution of settlement in the north comparing to the south



Cities integration between the north and the south

WHICH DATA?

OPENSTREETMAP

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GEOFABRIK downloads

Download OpenStreetMap data for this region:

Europe

[one level up]

The OpenStreetMap data files provided on this server do **not** contain the user names, user IDs and changeset IDs of the OSM objects. These metadata fields contain personal information about the OpenStreetMap contributors and are subject to data protection regulations in the European Union. Please note that these regulations apply even to processing that happens outside the European Union because some OpenStreetMap contributors live in the European Union.
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Commonly Used Formats

- europe-latest.osm.pbf, suitable for Osmium, Osmosis, imposm, osm2pgsql, mkgmap, and others. This file was last modified 14 hours ago and contains all OSM data up to 2018-12-12T21:14:02Z. File size: 18.9 GB; MD5 sum: 1469e77f11c9618aca4d888fd3de75bc.
- ~~europe-latest-free.shp.zip~~ is not available for this region; try one of the sub-regions.

Other Formats and Auxiliary Files

- europe-latest.osm.bz2, yields OSM XML when decompressed; use for programs that cannot process the .pbf format. This file was last modified 7 hours ago. File size: 30.5 GB; MD5 sum: d226876b3ea1da1f56c170b92cf2df40.
- ~~europe-internal.osh.pbf~~ The history file contains personal data and is available on the internal server only. See notice above for further information.
- .poly file that describes the extent of this region.
- .osc.gz files that contain all changes in this region, suitable e.g. for Osmosis updates
- raw directory index allowing you to see and download older files

Sub Regions

Click on the region name to see the overview page for that region, or select one of the file extension links for quick access.

Sub Region	Quick Links		
	.osm.pbf	.shp.zip	.osm.bz2
Albania	[.osm.pbf] (27.1 MB)	[.shp.zip]	[.osm.bz2]
Andorra	[.osm.pbf] (1.4 MB)	[.shp.zip]	[.osm.bz2]
Austria	[.osm.pbf] (527 MB)	[.shp.zip]	[.osm.bz2]
Azores	[.osm.pbf] (7.7 MB)	[.shp.zip]	[.osm.bz2]
Belarus	[.osm.pbf] (177 MB)	[.shp.zip]	[.osm.bz2]
Belgium	[.osm.pbf] (302 MB)	[.shp.zip]	[.osm.bz2]
Bosnia-Herzegovina	[.osm.pbf] (61 MB)	[.shp.zip]	[.osm.bz2]
Bulgaria	[.osm.pbf] (87 MB)	[.shp.zip]	[.osm.bz2]
Croatia	[.osm.pbf] (103 MB)	[.shp.zip]	[.osm.bz2]
Cyprus	[.osm.pbf] (12.2 MB)	[.shp.zip]	[.osm.bz2]
Czech Republic	[.osm.pbf] (680 MB)	[.shp.zip]	[.osm.bz2]
Denmark	[.osm.pbf] (270 MB)	[.shp.zip]	[.osm.bz2]
Estonia	[.osm.pbf] (63 MB)	[.shp.zip]	[.osm.bz2]
Faroe Islands	[.osm.pbf] (1.8 MB)	[.shp.zip]	[.osm.bz2]
Finland	[.osm.pbf] (358 MB)	[.shp.zip]	[.osm.bz2]
France	[.osm.pbf] (3.4 GB)	✖	[.osm.bz2]
Georgia (Eastern Europe)	[.osm.pbf] (44.5 MB)	[.shp.zip]	[.osm.bz2]
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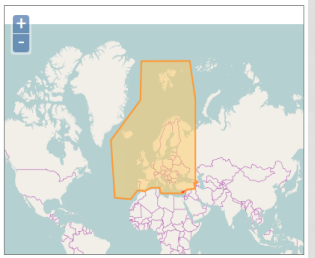

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4 Point Features

4.1 Places ("places")

Location for cities, towns, etc. Ty

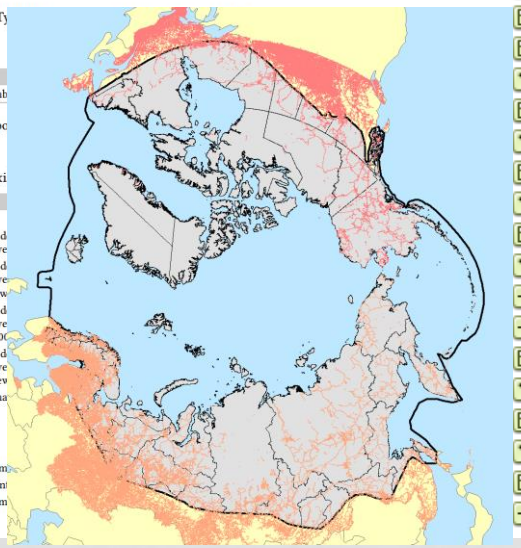
Additional attributes:

Attribute	PostGIS Type	
population	INTEGER	Numb

Note that for many places the po
population is always 0.

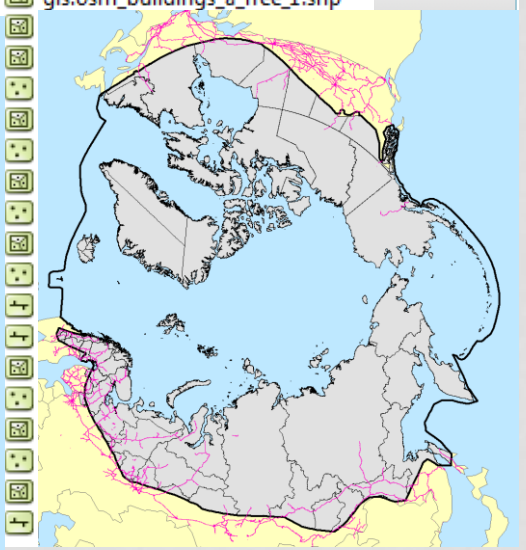
The following feature classes exi

code		fclass	
1000	place		
1001	place	city	As d gove
1002	place	town	As d gove betw
1003	place	village	As d gove 10,0
1004	place	hamlet	As d gove a few
1005	place	national_capital	A na
1010	place	suburb	Nam
1020	place	island	Iden
1030	place	farm	Nam

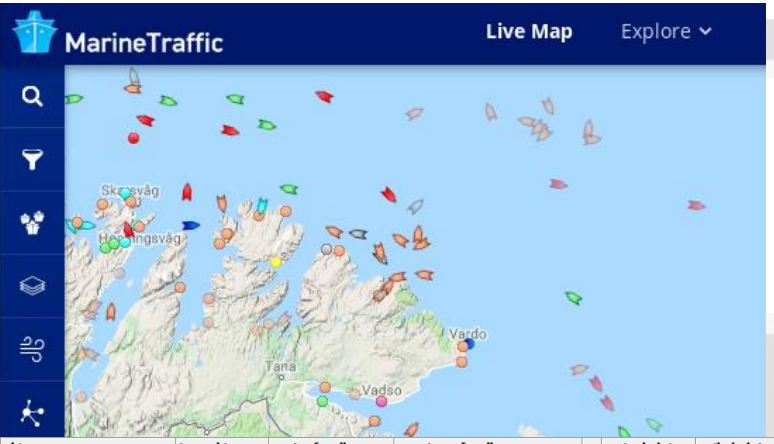


Far Eastern

gis.osm_buildings_a_free_1.shp



www.marinetraffic.com

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  COURSE:           "0"
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  LAT:              "68.97314"
  TIMEZONE:         "3"
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MICHAELA ROSE (1002756)	1002756	Sandnes	Norway	ht	22/07/2016	27/07/2016	117	2016-07-22T09:59:37	42	MICHAELA ROSE	YACHT	Rochelle Marine Ltd
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https://www.marinetraffic.com/en/reports?asset_type=vessels&columns=

Explore

Vessels

Vessels Database

Position History

Voyage Timeline

Events

Ports

Arrivals & Departures

Lights

Stations

Port Congestion

Vessels Database

Quick Search in Name, MMSI, IMO, Callsign

Reset All

Add Filter

Current Port: MURMANSK ×

Flag	Vessel Name	Current Port	Imo	Vessel Type - Generic	Map Icon	Tim Posi		
	50 LET POBEDY	MURMANSK	9152959			2018-11-18 19:53 LT (UTC +3)	68.97314	33.05
	YANTAR	MURMANSK	0			2018-07-02 11:29 LT (UTC +3)	68.97408	33.05087

METHODOLOGY

CITIES CONNECTION THROUGH TERRESTRIAL TRANSPORT

Query:
- City & town
- Major, minor, highway links, small roads
- Railways

Roads, railways

Cities&Town

Network Datasets

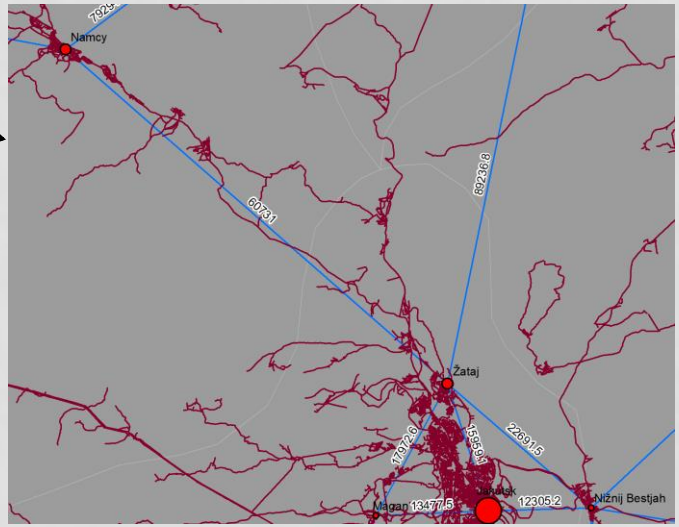
OD-Cost matrix

Graphs (Straight-line)

Degree centrality calculation

Orgin-Destination, Network Analysis Toolbox, ArcGIS

Plug-In QGIS, PosgreSQL/Postgis



Calculate the shortest path

CITIES CONNECTION THROUGH MARITIME TRANSPORT

- Trajectory analysis
  - The location of ports in each city/country
  - Maritime traffic: the movement of the vessel (sailed &arrival date)
- Concept of Time-Geography

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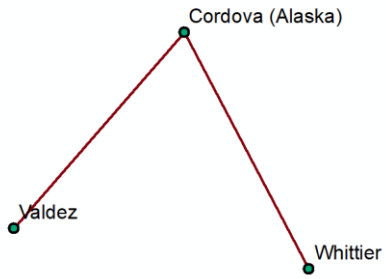
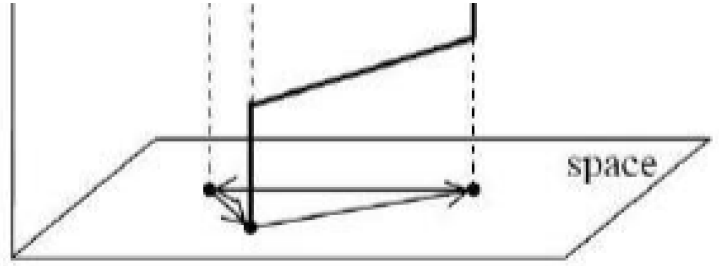
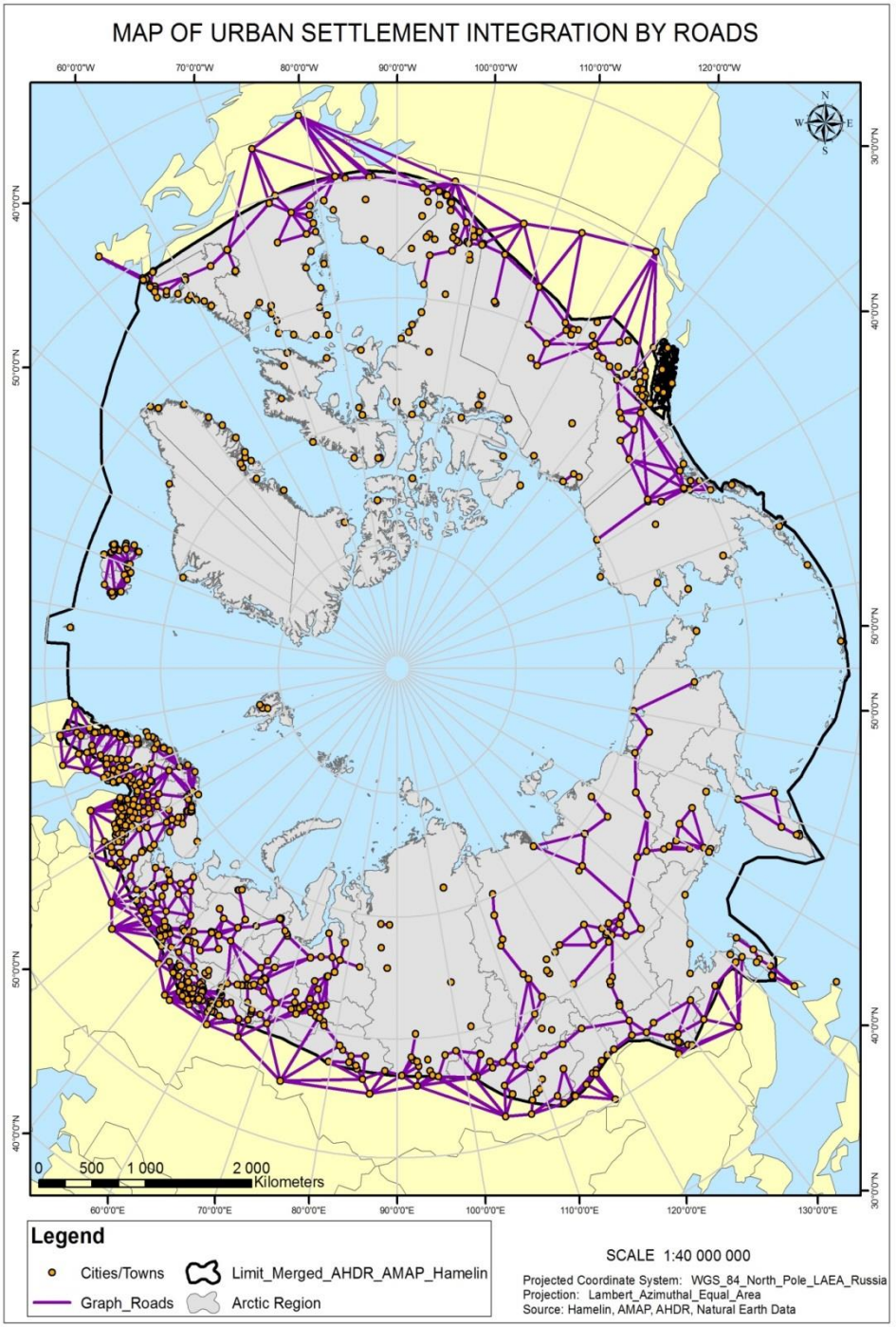
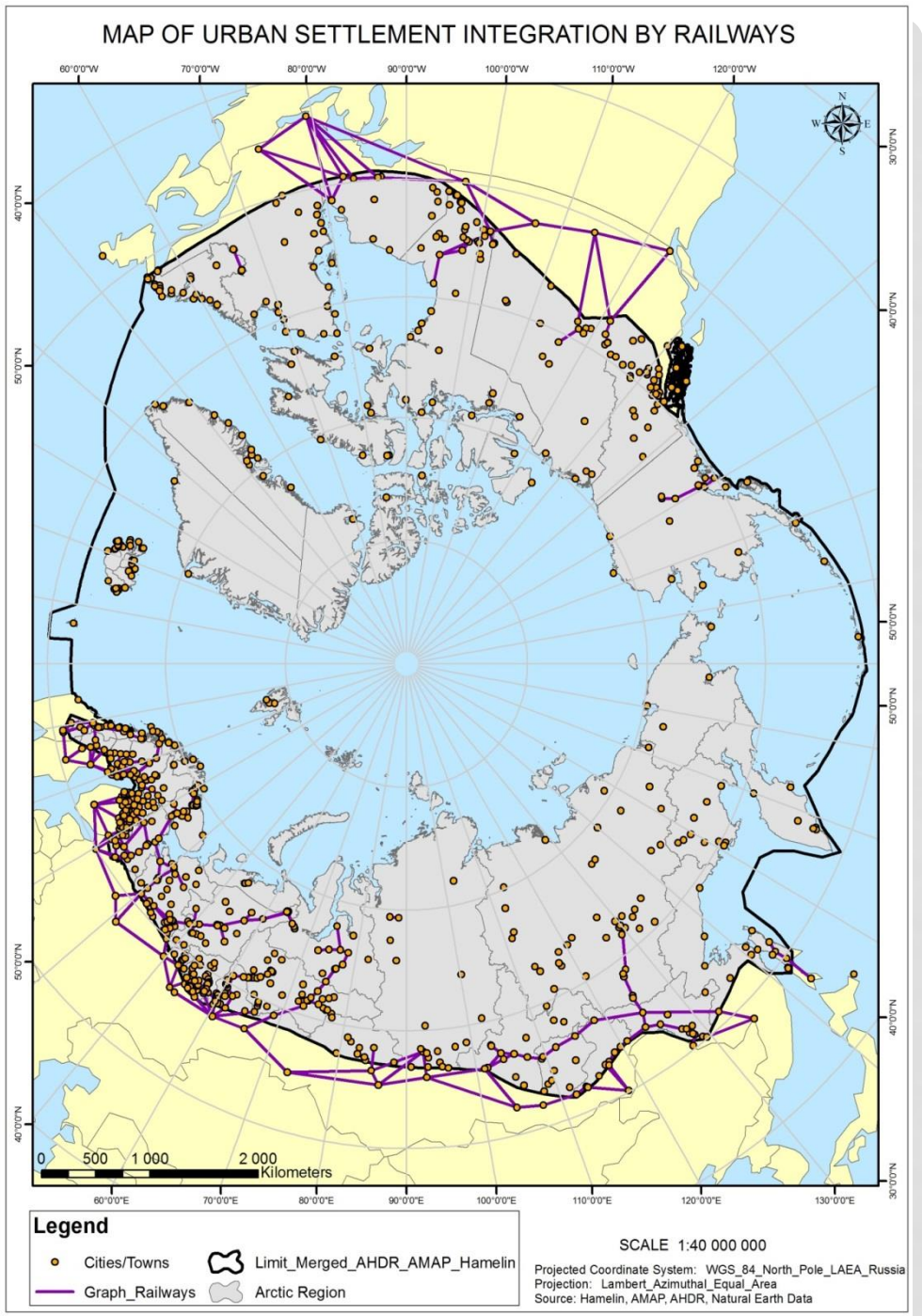
2	AURORA (7502332) 3...	Cordova (Alaska)	United States of America	2016-05-20	2016-05-20	2016-05-20 07:59:49	RORO CARGO/FERRY
3	AURORA (7502332) 3...	Cordova (Alaska)	United States of America	2016-05-20	2016-05-20	2016-05-20 12:09:46	RORO CARGO/FERRY
4	AURORA (7502332) 3...	Whittier	United States of America	2016-05-20	2016-05-20	2016-05-20 19:55:10	RORO CARGO/FERRY

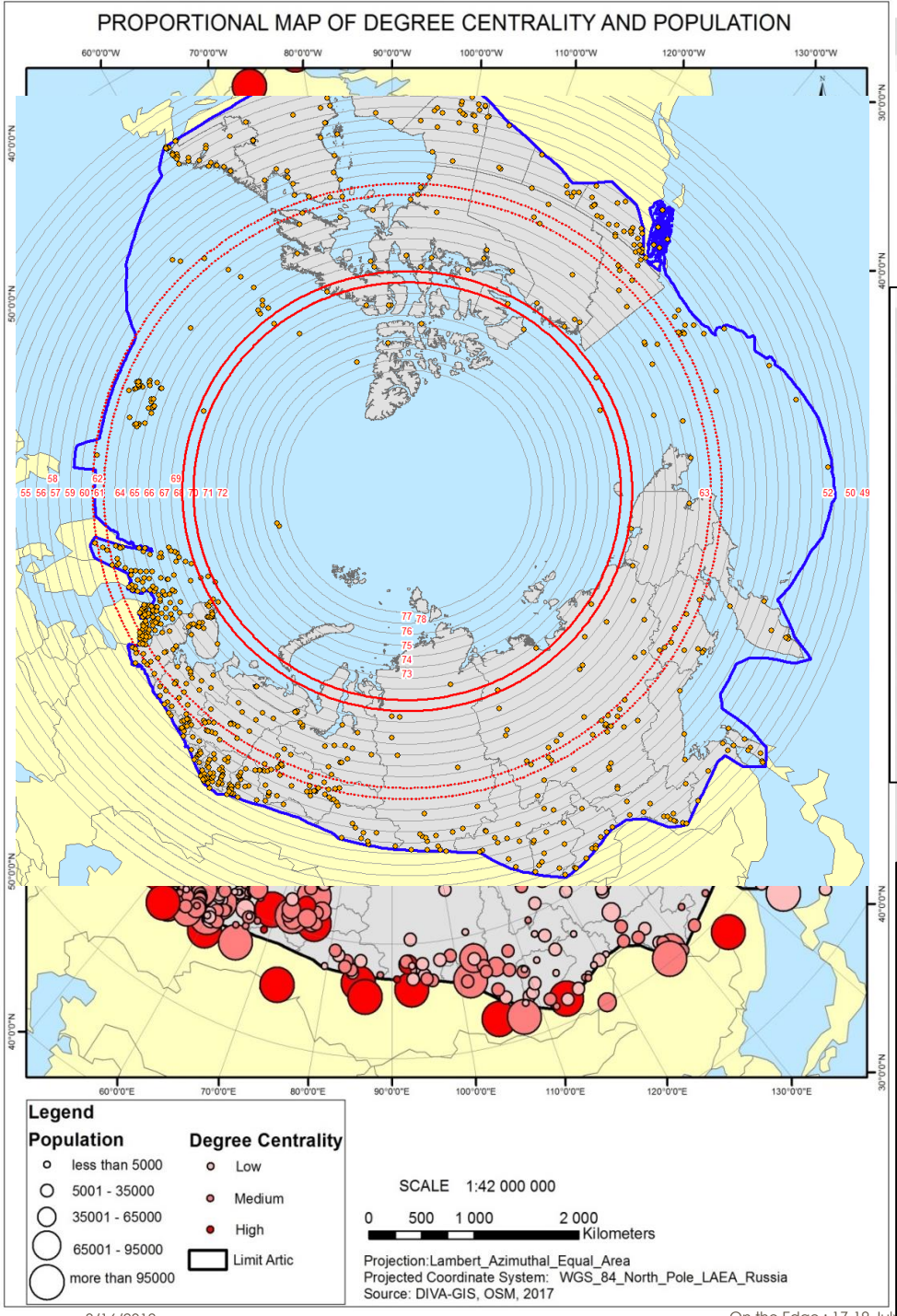




RESULT

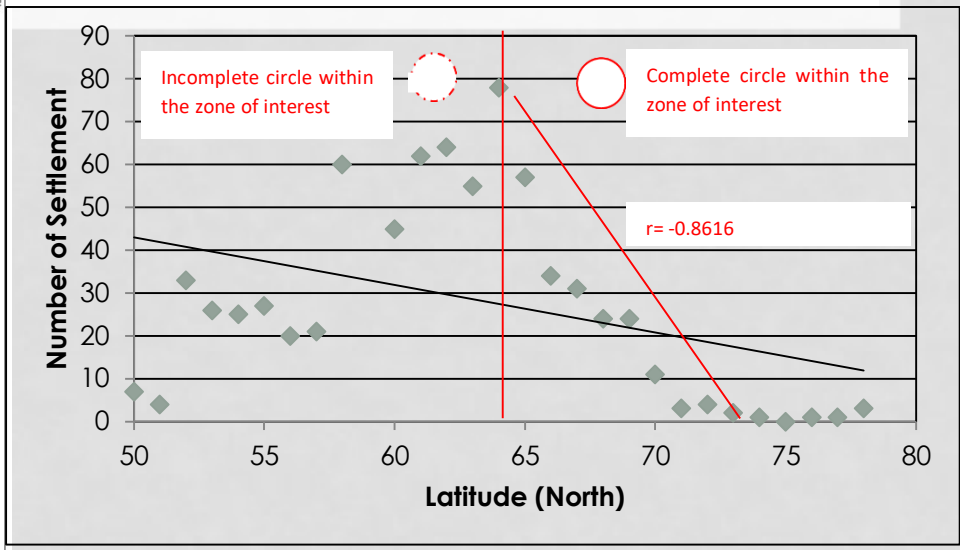

MAP OF URBAN SETTLEMENT INTEGRATION BY ROADS
0 500 1 000 2 000 Kilometers
Legend
Cities/Towns
Graph_Roads
Limit_Merged_AHDR_AMAP_Hamelin
Arctic Region
SCALE 1:40 000 000
Projected Coordinate System: WGS_84_North_Pole_LAEA_Russia
Projection: Lambert_Azimuthal_Equal_Area
Source: Hamelin, AMAP, AHDR, Natural Earth Data


MAP OF URBAN SETTLEMENT INTEGRATION BY RAILWAYS
0 500 1 000 2 000 Kilometers
Legend
Cities/Towns
Graph_Railways
Limit_Merged_AHDR_AMAP_Hamelin
Arctic Region
SCALE 1:40 000 000
Projected Coordinate System: WGS_84_North_Pole_LAEA_Russia
Projection: Lambert_Azimuthal_Equal_Area
Source: Hamelin, AMAP, AHDR, Natural Earth Data



The closer to the north

- the fewer number of settlement
- the lower population density
- the fewer number of link
- the fewer connectivity



Latitude and number of settlement (Europe and North America)
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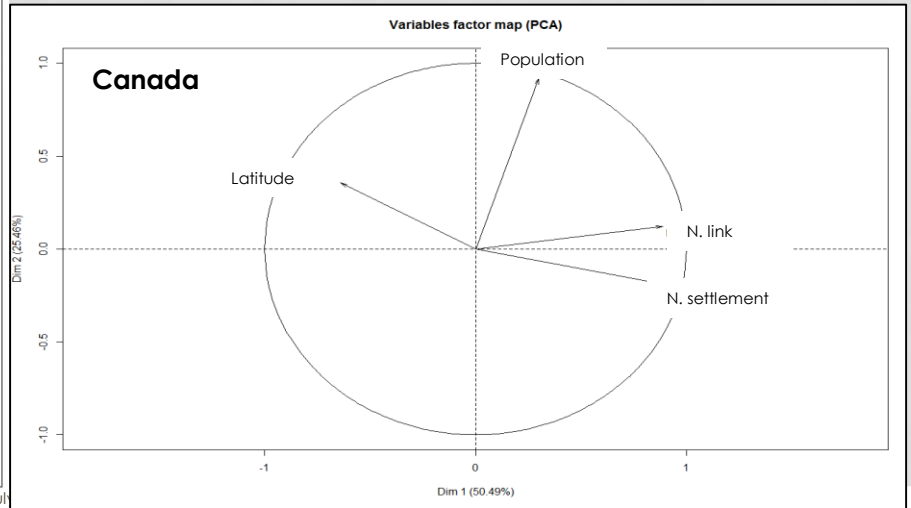
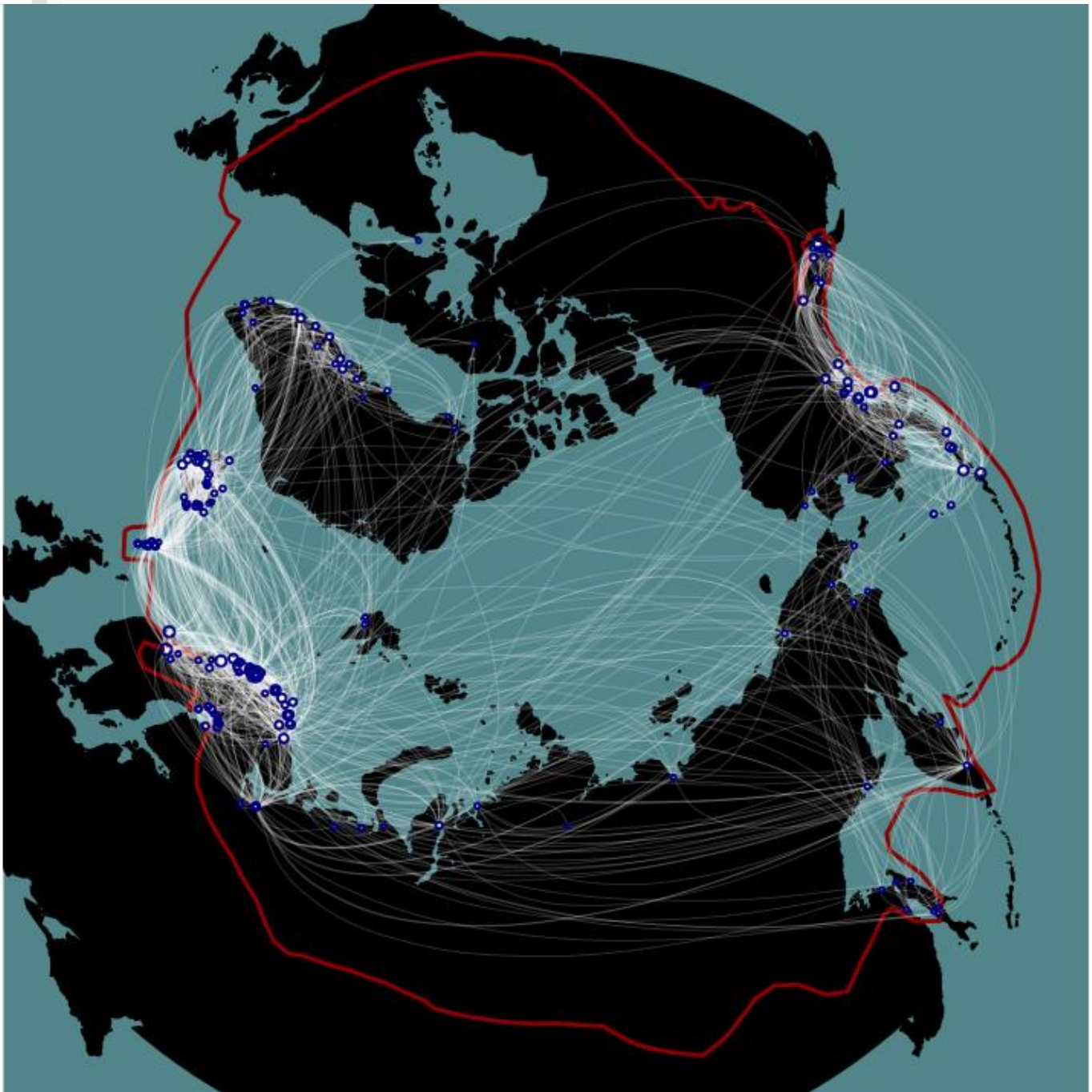
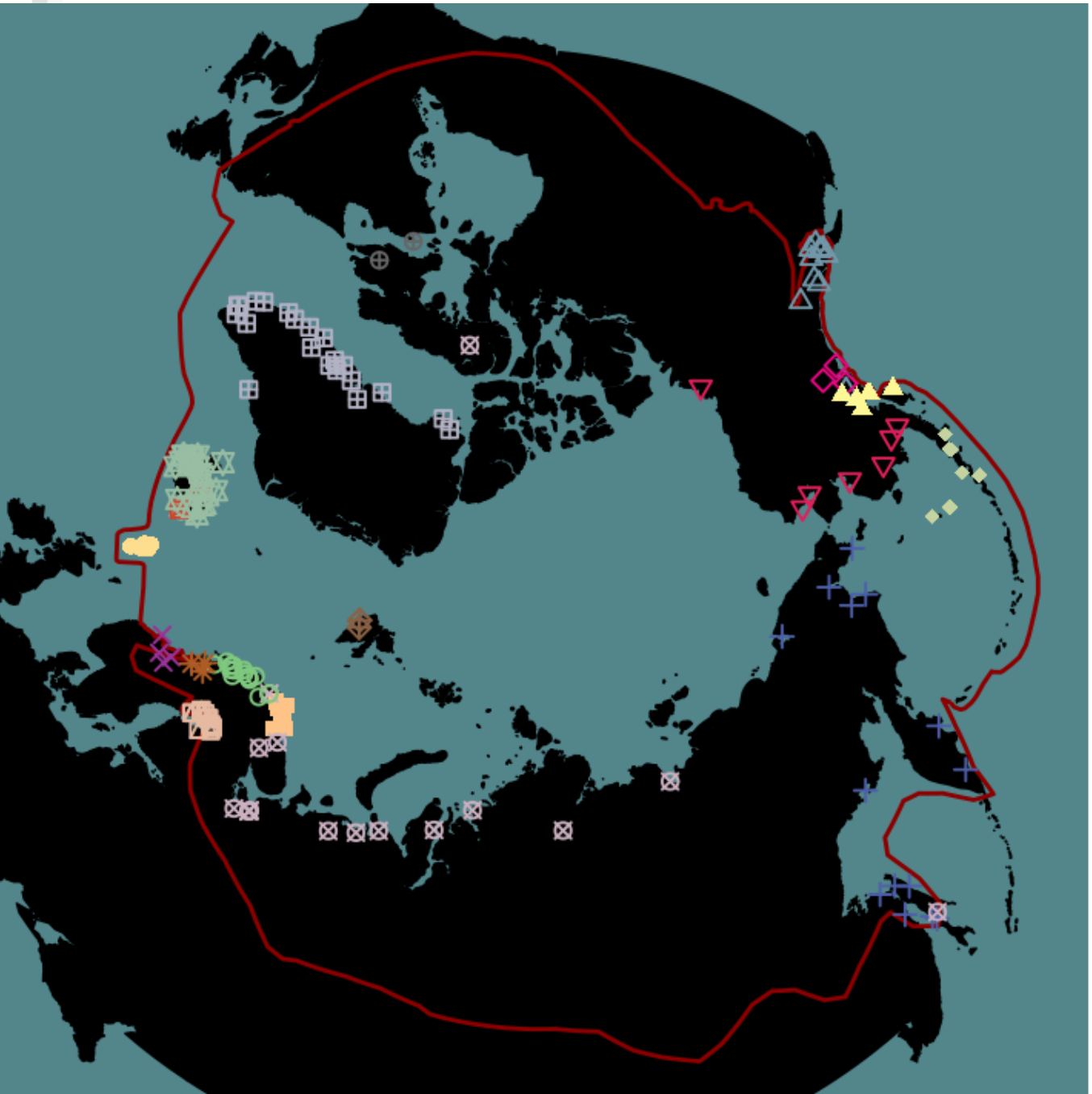
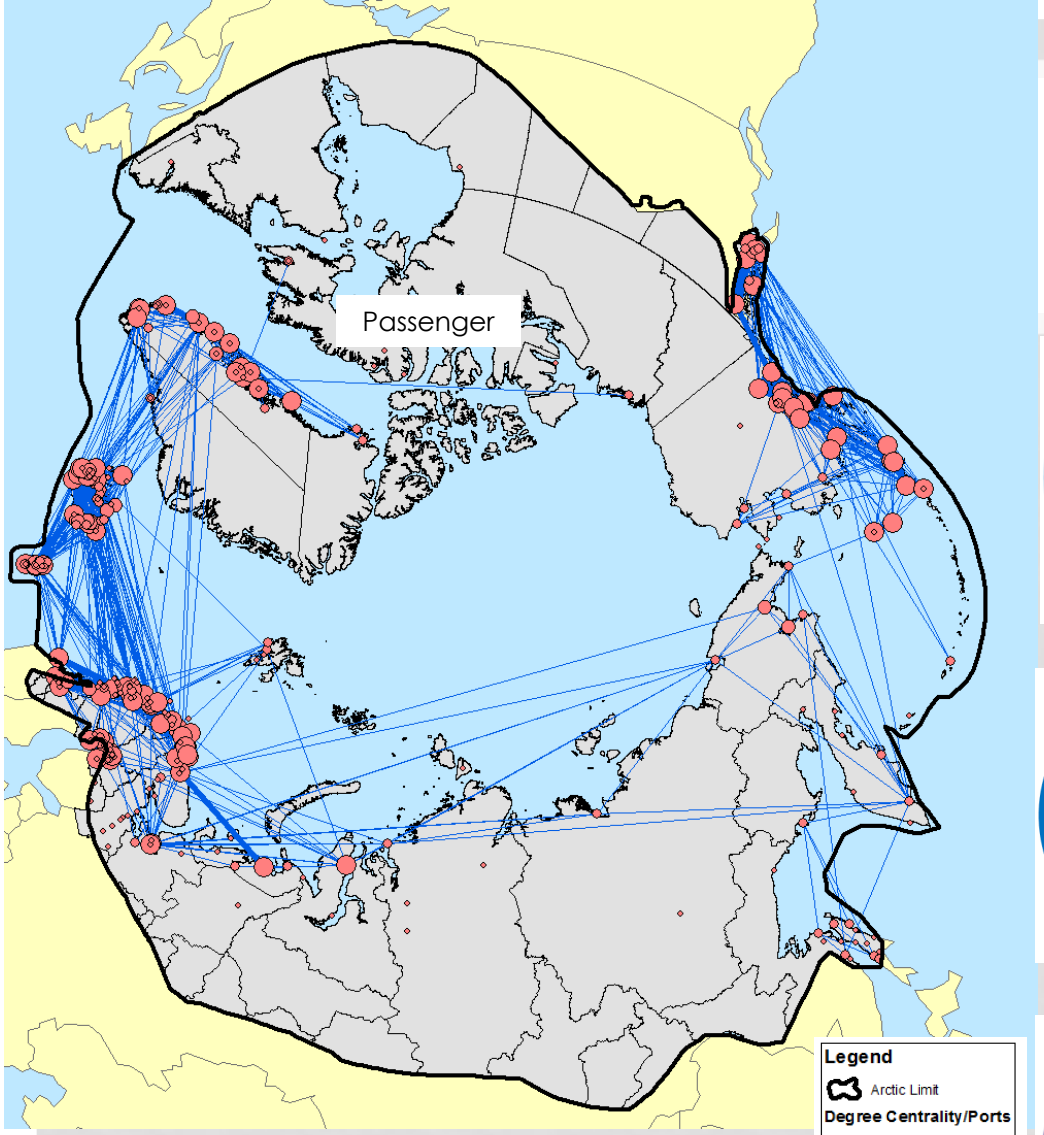


Marine Traffic data – 2016

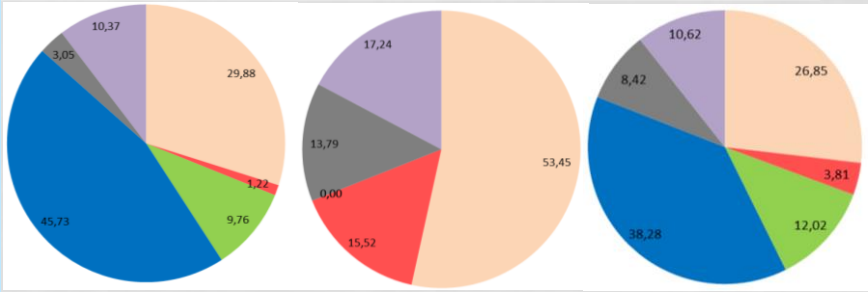


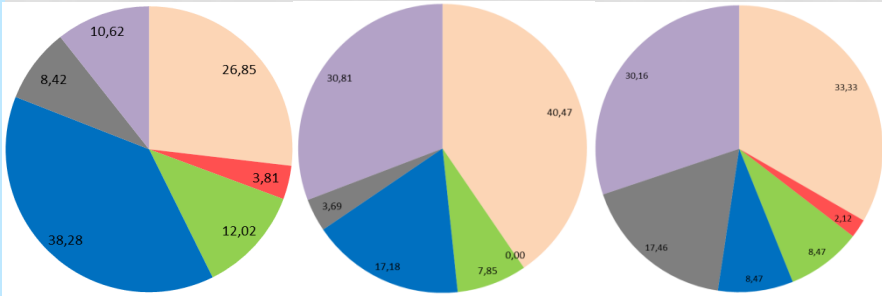
Marine Traffic data – 2016

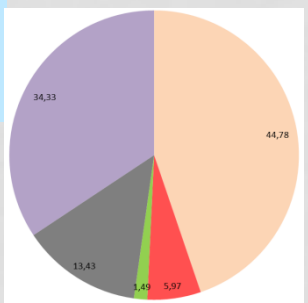


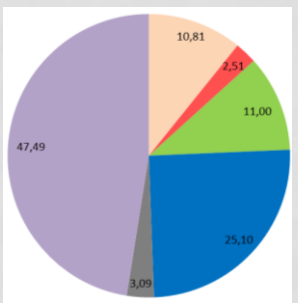


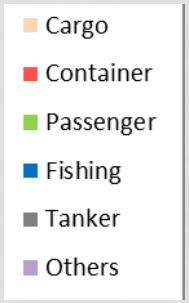
Maritime activity (%) by country











TO SUMMARIZE

- Network analysis: tool to analyse the role of the Arctic cities into the world system
- At the first step of this analysis, such quantitative studies require appropriate and homogenous datasets that are sometimes difficult to collect in a large region covering several countries.
- This study provides a picture of the Arctic cities that allows us to question the common hypothesis “the closer to the north, the fewer integration”.
- It reveals sub-regions where settlements show stronger ties together than with others Arctic regions, as well as Arctic bridgeheads, connected directly with the outside of the circumpolar zone.

PROSPECTIVE

- Various theories of urban system shall be included
  - Rank size rule/zipf's law – hierarchy of the cities
  - Central place theory (Christaller's theory)
- Perfom spatio-temporal analysis
  - Arcticapolis database (demographic change, pattern of settlement)
  - Other type of connectivities (airways, social network…etc)
- Distance & density –the distance & the time of traveling between cities
- Spatial Unit?

flightradar24
LIVE AIR TRAFFIC

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AIRPORTS

NSK/UOOO
Norilsk Alykel Airport
Russia

63%
MY FLIGHTRADAR24 RATING

N/A
WEATHER

N/A
WIND

N/A
ARRIVAL DELAY INDEX

General | Arrivals | Departures | On Ground | Reviews | Routes | Wea

Arrivals

Show all arrivals

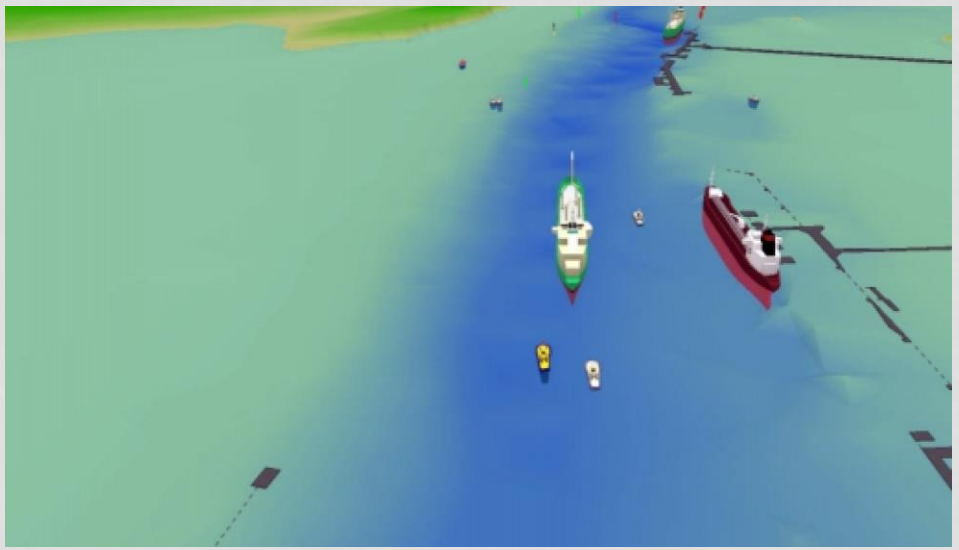
TIME	FLIGHT	FROM	AIRLINE	AIRCRAFT	STATUS
06:00	Y7401	Moscow (DME)	NordStar	B738 (VQ-BDZ)	Delayed 06:40
06:30	Y7916	Novosibirsk (OVB)	NordStar	B738 (VQ-BDN)	Scheduled
07:01	Y7405	St. Petersburg (LED)	NordStar	B738 (VQ-BDW)	Delayed 07:17
07:30	S72251	Moscow (DME)	S7 Airlines	B738 (VP-BDF)	Estimated 07:26

Using an API : https://**api**.flightradar24.com/common/v1/airport.json?code=**nsk**


```
identification:
  id:            "1ed93a56"
  row:           4844552906
  number:
    default:     "Y7401"
    alternative: null
  callsign:      "TYA401"
  codeshare:     null
status:
  live:          true
  text:          "Delayed 06:40"
  icon:          "yellow"
  estimated:     null
```

```
  name:          "NordStar"
  code:          {…}
  short:         "NordStar"
airport:
  origin:
    code:        {…}
    timezone:    {…}
    info:        {…}
    name:        "Moscow Domodedovo International Airport"
    position:    {…}
```

THANK YOU



Etienne, 2012