Spatio-temporal examination of Amazonian river transports
STUDY AREA – Where are we?
No roads in Peruvian Amazonia

Transportation is largely based on river navigation
### WHY IS AMAZONIA SPECIAL?

- Fluvial environment of Amazonia has totally different setting for living compared to urban areas
- Seasonal river dynamics influence on daily activities of people

**River height**

*Difference from average in meters*

- **Highest:** +5 meters
- **Lowest:** -6 meters
Fluvial environment of Amazonia has totally different setting for living compared to urban areas.
Seasonal river dynamics influence on daily activities of people.

**LOCAL SCALE**

Access to healthcare

**REGIONAL SCALE**

Locations of production zones

Access to education

Access to markets
TRANSPORTATION STUDIES

- How to study transportation in Peruvian Amazonia?
- Variety of (real-time) data sources available for studying transportation/movement
No professional observation systems such as AIS available

Need to understand the transportation patterns in the area is high (biodiversity hotspot)

Difficulties in getting hold of commercial GIS softwares for mobility data analysis

Analysing GPS-data is not a straightforward task. Need for automatic analytical tool that is easy to use.

Development of freely available low-cost observation system of riverboats

Development of cost-free openly available analytical tool for data analysis
1. Develop tools for obtaining data about vessel transportation in Peruvian Amazonia

2. Develop tools for analysing GPS data

3. Test the usability of riverboat observation system

4. Test the usability of the analytical tool for analyzing movement data

5. Study the transportation patterns in the study area based on developed tools
   a) Seasonal and direction variation?
   b) Connection between river level and travel speed?
Amazonian Riverboat Observation System (AROS)

- Five low-cost tracking devices
- Sending location (optimally) every 10 minutes
Five low-cost tracking devices
Sending location (optimally) every 10 minutes
RESEARCH INTERESTS VS. LOCAL INTERESTS

- Technical development of the system is only one side of the story

- Social aspects are the second one:
  
  - Data collection and maintaining the system is totally based on voluntary collaboration with local river transport operators

  - How to motivate people to collaborate?
DATA STRUCTURE

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</table>
- Data mass without identifier of a journey
- Transforming/filtering the data into trajectories is needed
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- Transforming/filtering the data into trajectories is needed
- Filter is based on:
  1. Direction of movement
  2. Temporal or spatial gabs between observations
  3. Tolerance distance
TRAT – ANALYTICAL APPROACH

Euclidian distance
Network distance

Reference point dataset

Makes possible to determine:
Direction of movement
Individual journey
Distance between consecutive observations
Travel speed between consecutive observations
Average travel speed of individual journey
Travel speed vs. water level
Travel speed vs. sinuosity

Reference point
ID-number
Position value
Sinuosity index
Water level
Name of the river
Name of the nearby populated place

GPS-waypoint
Entity ID
Latitude coordinate
Longitude coordinate
Timestamp
Unix time
Message type

Iquitos
1 km
Destination harbor

Distance to the closest reference point

370m
AVERAGE SPEED OF THE JOURNEYS WITH QUALITY ASSESSMENT VS. WATER LEVEL - YEAR 2012

DOWNSTREAM

R² = 0.73

R² = 0.06

UPSTREAM

HIGHLIGHTS:
- Average speed (km/h)
- Trajectory quality - Proportion of observed journey
- Ucayali – Water level (meters)
- Mean Water level
- Min / Max Water level

WHAT IS IT POSSIBLE TO DO WITH THE TOOLS?

IQUEITOS-PUCALLPA
WHAT IS IT POSSIBLE TO DO WITH THE TOOLS?

- Spatio-temporal accessibility patterns
CONCLUSIONS

- Developed open source tools make possible to study the transportation patterns in Amazonia with low costs
  - For the use of local scientists or officials

- Tools can provide benefits for the local people and companies
  - Information when the vessels are arriving to their villages

Comparison:
- Waiting for the public transportation in Helsinki takes usually less than 10 minutes
- Waiting for the vessel in Peruvian Amazonia takes usually more than 1 day!!

- All the tools will be found from the Github
  → https://github.com/AccessibilityRG