

Using GPS and GIS to Analyze the physical activity of IFGI students

Final Presentation:
Tracking the Trackers Course

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The Study

Motivation

- Are IFGI Students Getting Sufficient daily Physical Activity?
- Inadequate Physical Activity Contributes to Several Health Complications

Study Aims

- Use combination of Novel Technologies to Measure and Describe Physical Activity in Students
- How Do Students use different Physical Spaces in Their neighborhoods for Physical Activity



[http://johnlewis.scene7.com/is/image/JohnLewis/236552355alt6?\\$prod_mainS](http://johnlewis.scene7.com/is/image/JohnLewis/236552355alt6?$prod_mainS)

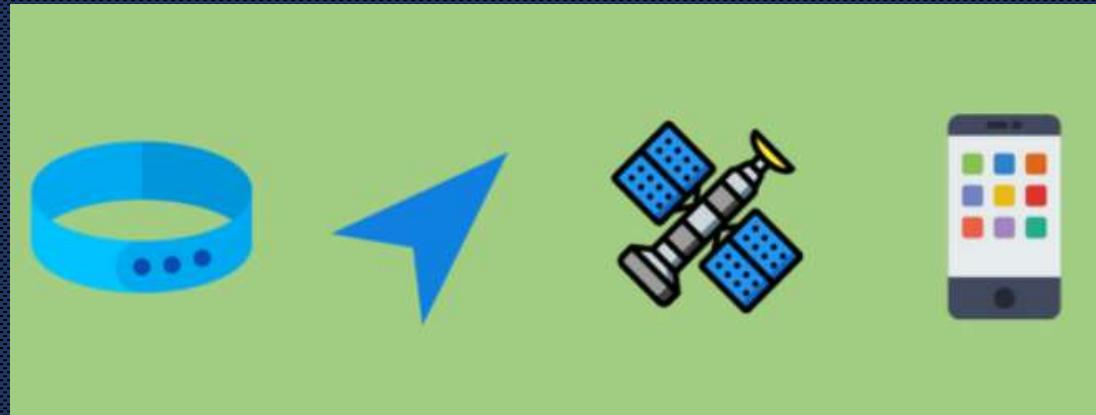
The Study (cont.)

Combine **Global Navigation Satellite Systems** (e.g. GPS) and **Geographical Information Systems** (GIS)

- GNSS = Location
- GIS = Mapping and Analysis
- Which Device is Adequate for GPS Tracking?

Availability

Ease of Use



The Study (cont.)

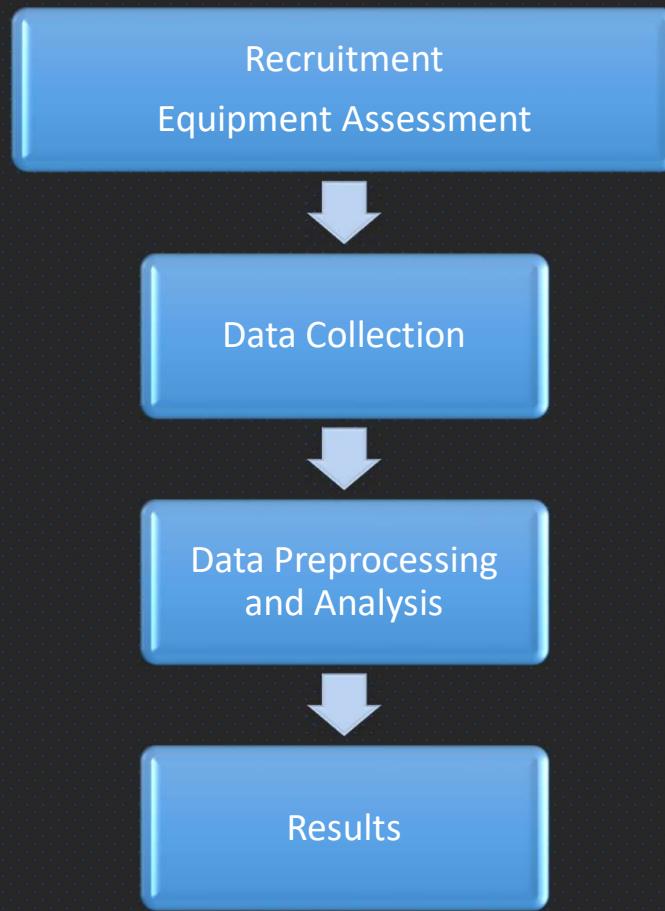
- Recruits at least 5 Students from IFGI
(University of Münster)
- 5 Days Data
- Map out Land-use Categories in GIS
 - Streets, Parks and Recreation, Home, School, Other Indoor, Transportation Mode
- Remuneration: A Free Lunch



<http://www.mngts.org/landuse/>

<https://www.thedatabasediva.com/wp-content/uploads/2010/03/istock-target-market.jpg>

Study Methodology



Methodology : Recruitment & Equipment Assessment

- 2 Males, 3 Females,
- 3 Taking the Bus , Two taking bikes
- Verbal Questionnaire On Mode Of Transport Use and Main Physical Activities Engaged In



Device

- Logistical Issues (Cold Start Time, Signal Loss, Battery Life)
- Availability
- Relative and Absolute Accuracy
- Ease of Use



[https://www.google.com/search?client=firefox-b-d&channel=tow&biw=1536&bih=750&tbo=isch&sa=1&ei=S-MIXf2dNjb6kwX32LL4Dw&q=Q1000-XT+tracker&oq=Q1000-XT+tracker&gs_l=img..11686.14750..15144...0.0.0.116.403.2j.....0...1..gws-wiz-img.SL\[2Lw_Fnx8#imgrc=FxgSVsiSzqaUeM0](https://www.google.com/search?client=firefox-b-d&channel=tow&biw=1536&bih=750&tbo=isch&sa=1&ei=S-MIXf2dNjb6kwX32LL4Dw&q=Q1000-XT+tracker&oq=Q1000-XT+tracker&gs_l=img..11686.14750..15144...0.0.0.116.403.2j.....0...1..gws-wiz-img.SL[2Lw_Fnx8#imgrc=FxgSVsiSzqaUeM0)
<https://zwinlinks.wordpress.com/2017/03/05/test-geo-tracker/>

Methodology : Data Collection

- Phones
 - HTC,
 - LG,
 - Samsung,
 - Huawei,
 - Pocophone
- GeoTracker Version 3.3.0.1338 (geo-tracker.org)



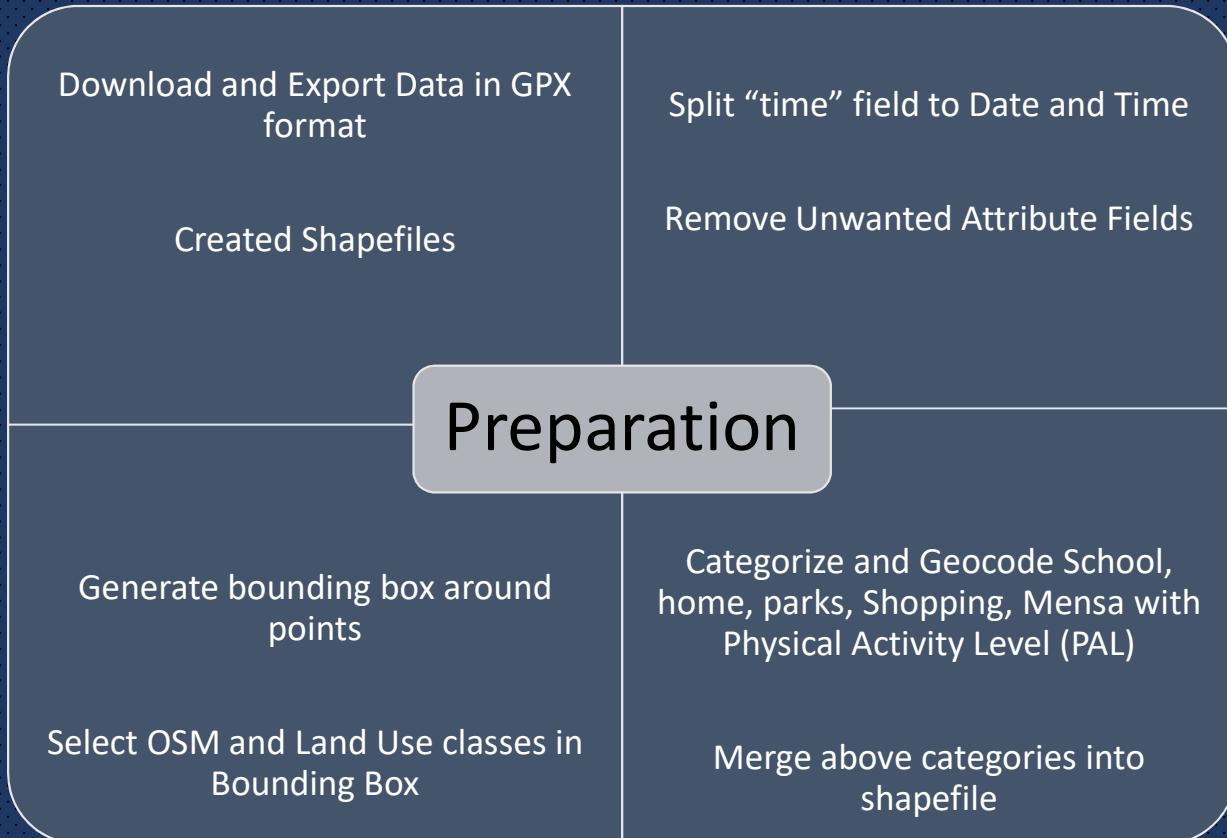
- Land Use Maps

Urban Atlas 2012 (<https://land.copernicus.eu/local/urban-atlas/urban-atlas-2012?tab=download>)

Geofabrik (Open Street Map Data)
(<http://download.geofabrik.de/europe/germany/nordrhein-westfalen/muenster-regbez.html>)



Methodology : Data Preparation



MET Table

Activity level	METs/Hr	Activity of Activity
Very Light	1.3	Standing
	1.5	Reading, talking on telephone
	1.8	Sitting in class, studying, note taking
Light	2.0	Walking at a slow pace (1-2 mi/hr), playing musical instrument, Light gardening, Light office work, light use of hand tools (watch repair or micro-assembly, light assembly/repair); standing, light work (bartending, store clerk, assembling, filing)
	2.5	Walking downstairs, Cooking, light housekeeping, shopping, Pushing stroller with child, walking dog
Light Plus	2.5 - 3	Walking at an average pace (2-2.5 mi/hr), slow dancing, Golf (using power cart), bowling, fishing
	3.0	Standing doing light/moderate work (assemble/repair heavy parts, welding, auto repair, pack boxes for moving, etc), patient care (as in nursing); driving heavy tractor, bus or truck, Washing car or windows, mopping, moderately vigorous playing with children, sweeping outside house, vacuuming, picking fruit or vegetables, scrubbing floors
	3.5	Walking at a brisk pace (1 mi every 20 min), Weight lifting, water aerobics, Golf (not carrying clubs), leisurely canoeing or kayaking, Walking on job, 3 mph (one mile every twenty minutes), in office - moderate speed, not carrying anything, or carrying only light articles.
Moderately Vigorous	4	Walking at a very brisk pace (1 mi every 17 to 18 min), climbing stairs, dancing (moderately fast), leisurely bicycling <10 mph, Raking lawn, planting shrubs, weeding garden, heavy yard work or gardening activities, Masonry, painting, paper hanging, moderately heavy lifting, moderately heavy farm work
	4.5	Slow swimming, Golf (carrying clubs)
Moderately Vigorous Plus	5	Walking at a very brisk pace (one mi every 15 min), Most doubles tennis, Dancing (more rapid), Some exercise apparatuses, Walking downstairs or standing, carrying objects about 25-49 lb, Digging, spading, vigorous gardening, using heavy power tools; general gardening, mowing lawn (hand mower), Painting, carpentry, cleaning gutters, laying carpet, other vigorous activities, Chopping wood
	6	Slow jogging (one mi every 13 to 14 min), Ice or roller skating, Doubles tennis (if you run a lot), Using heavy tools (not power) such as shovel, pick, spade; driving heavy machinery, forestry

<https://www.topendsports.com/weight-loss/energy-met.htm>

Methodology : Analysis

- Spatial Join Land Use and PAL data to Points
- Calculate Speed between Points
- Point Density Analysis
- Interactions od Physical Activeness with Green Spaces and Recreational Facilities

```
# speedby.py - DETERMINING SPEEDS FOR THE TRACKS OF THE PAL DATA (speedby.py)

File Edit Format Run Options Window Help
# Import modules
import arcpy
import numpy as np
import os
import math
import datetime

# Set workspace
wd = os.getcwd()
arcpy.env.workspace = os.path.join(wd, 'Senait')

#populating the field speed
inputArr = arcpy.da.UpdateCursor('S_21.shp', ['FID', 'time_str', 'SHAPE@XY', 'speed'])

for inputR in inputArr:
    if(inputR[0] == 0):
        inputR[3] = 0

        #temporary values of x, y, and time
        X_temp = inputR[2][0]
        Y_temp = inputR[2][1]
        T_temp = datetime.datetime.strptime(inputR[1], '%H:%M:%S')
        print(T_temp)
        h, m, s = inputR[1].split(':')
        T_temp = int(h) * 3600 + int(m) * 60 + int(s)
        print(T_temp)
        inputArr.updateRow(inputR)

        print(T_temp)

    else:
        cx = inputR[2][0] - X_temp
        cy = inputR[2][1] - Y_temp

        #Time in seconds
        h, m, s = inputR[1].split(':')
        times = int(h) * 3600 + int(m) * 60 + int(s)

        #change of time
        cTime = times - T_temp

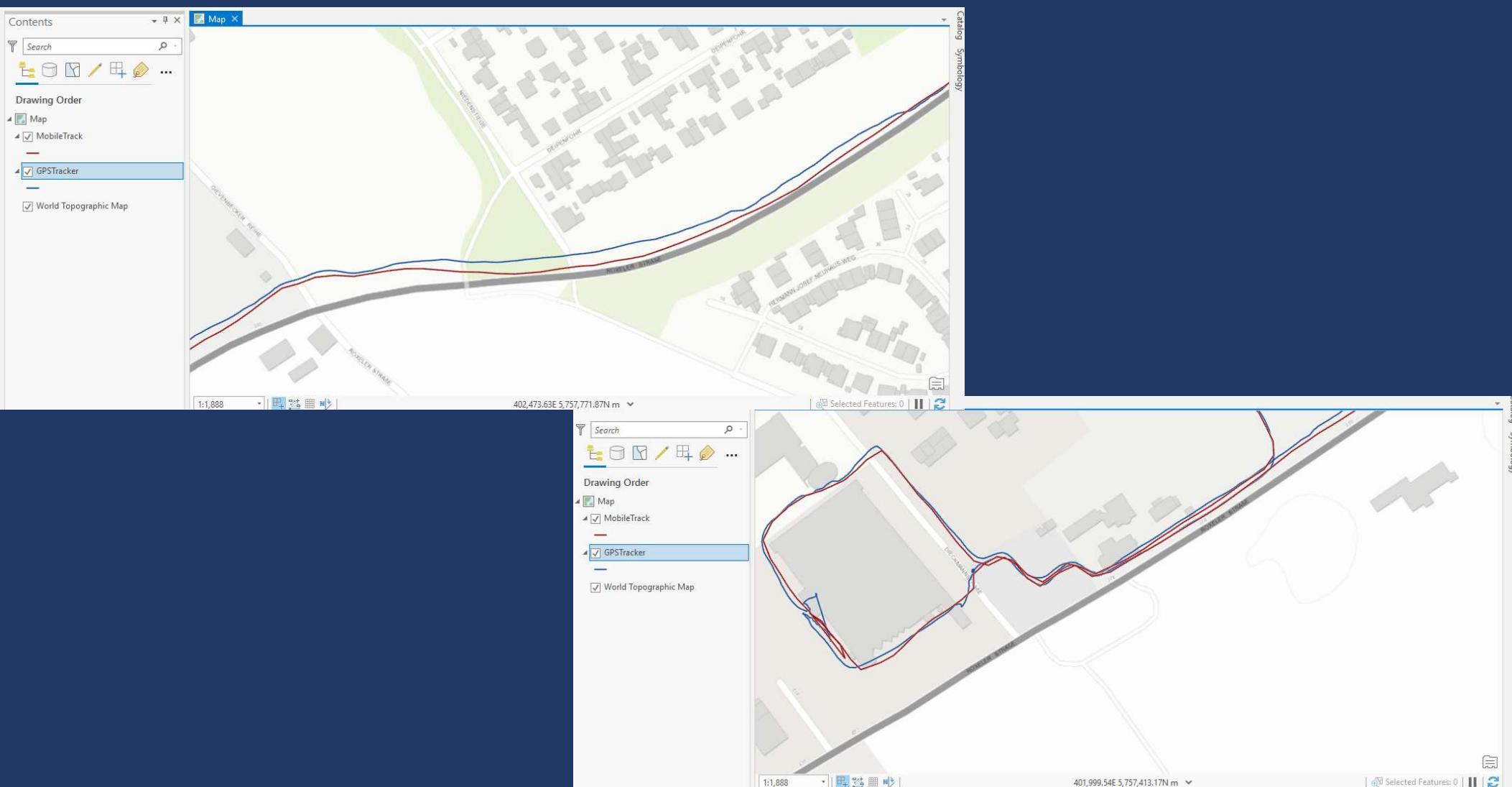
        #distance between points
        dist = np.sqrt(cx**2 + cy**2)
        print(dist)

        #speed
        speed = dist / cTime
        print(speed)
```



<https://www.esri.com/en-us/arcgis/products/insights-for-arcgis/overview>

Results



Results

← My trips ⚡ +📍 🚻 ⋮

25 Jun 2019 09:47:44
4.76 mi 09:56:38 Tue, 25 Jun 2019 09:47:44

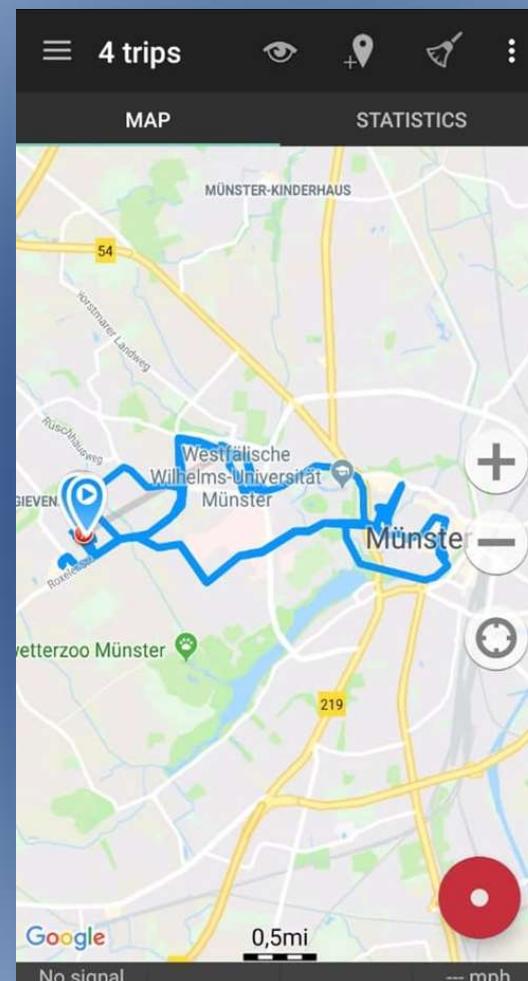
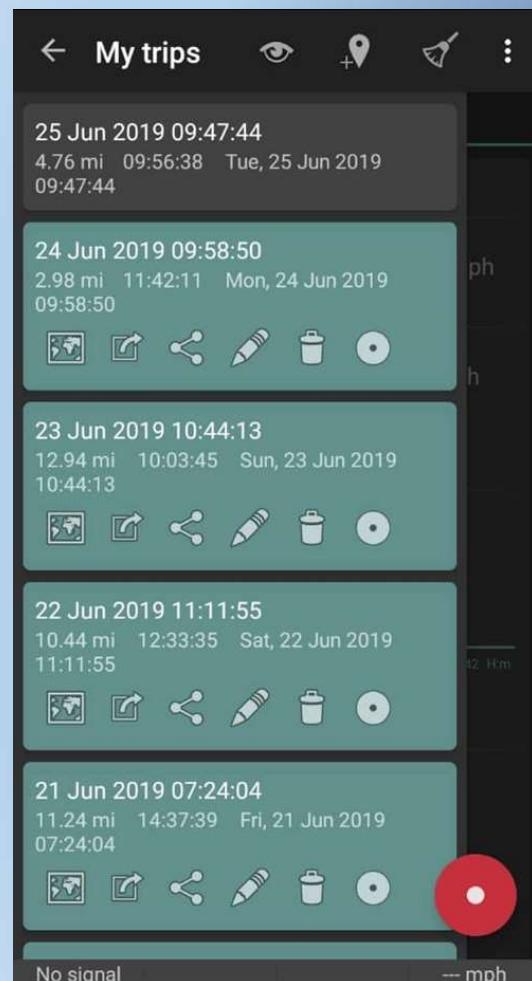
24 Jun 2019 09:58:50
2.98 mi 11:42:11 Mon, 24 Jun 2019 09:58:50

23 Jun 2019 10:44:13
12.94 mi 10:03:45 Sun, 23 Jun 2019 10:44:13

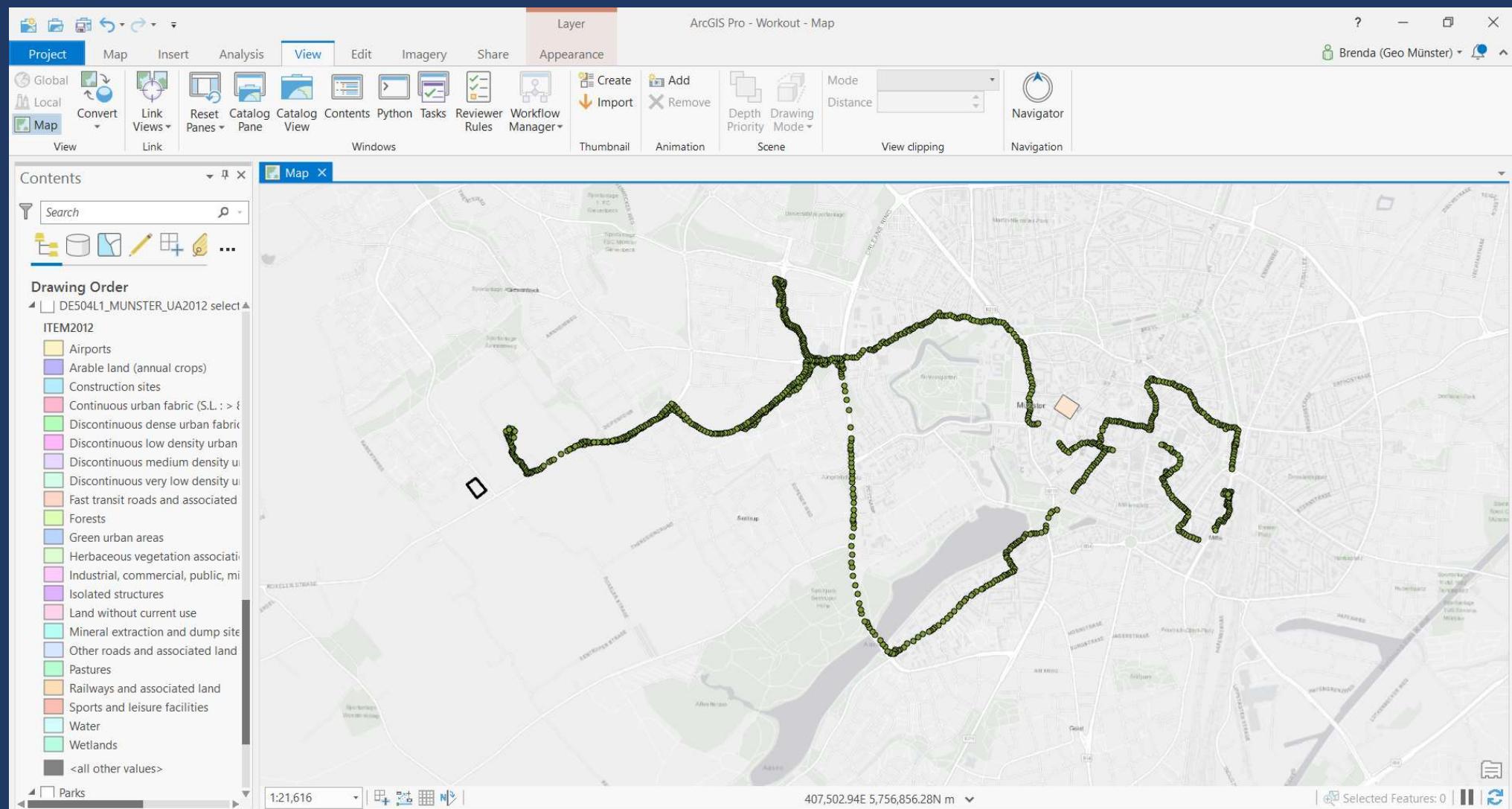
22 Jun 2019 11:11:55
10.44 mi 12:33:35 Sat, 22 Jun 2019 11:11:55

21 Jun 2019 07:24:04
11.24 mi 14:37:39 Fri, 21 Jun 2019 07:24:04

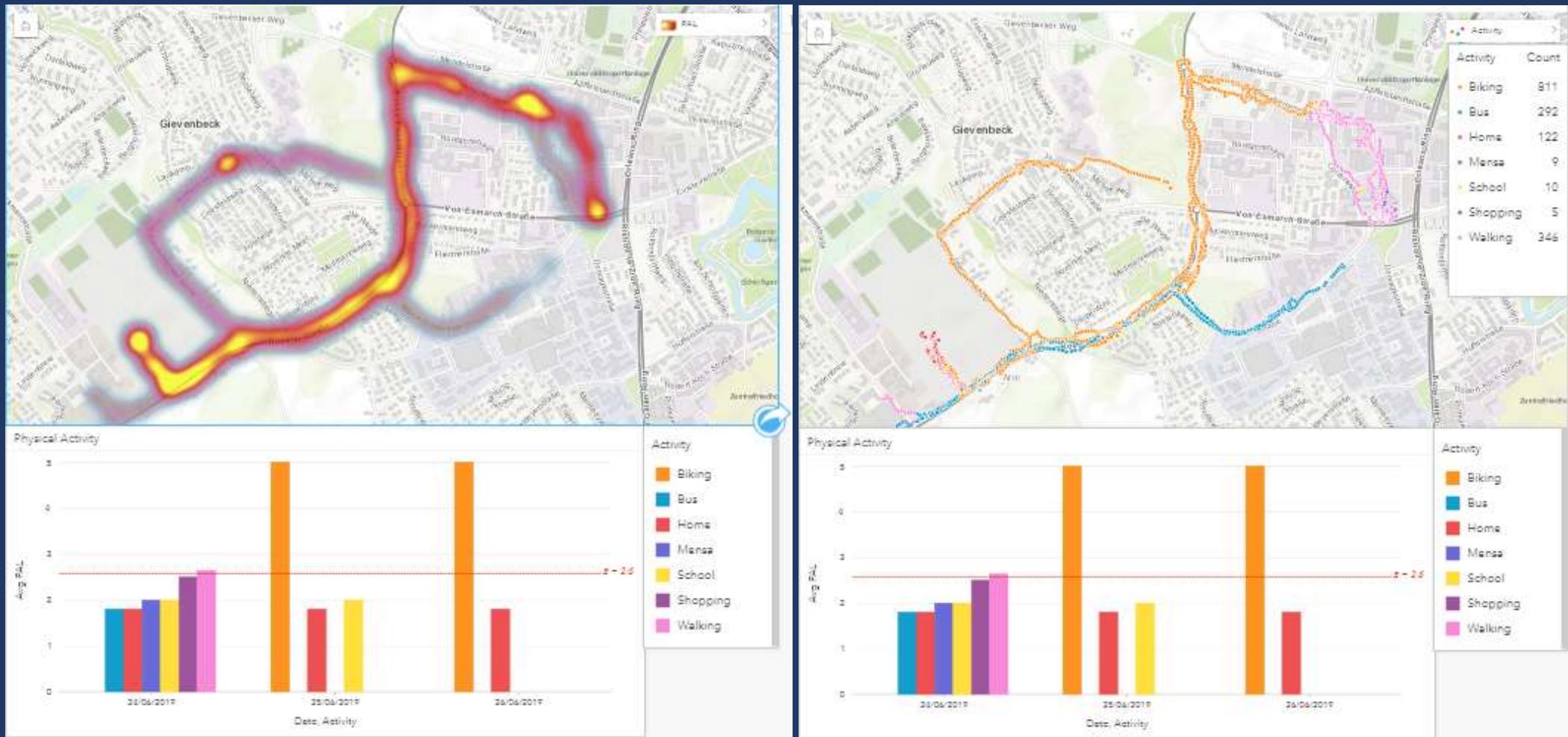
No signal --- mph



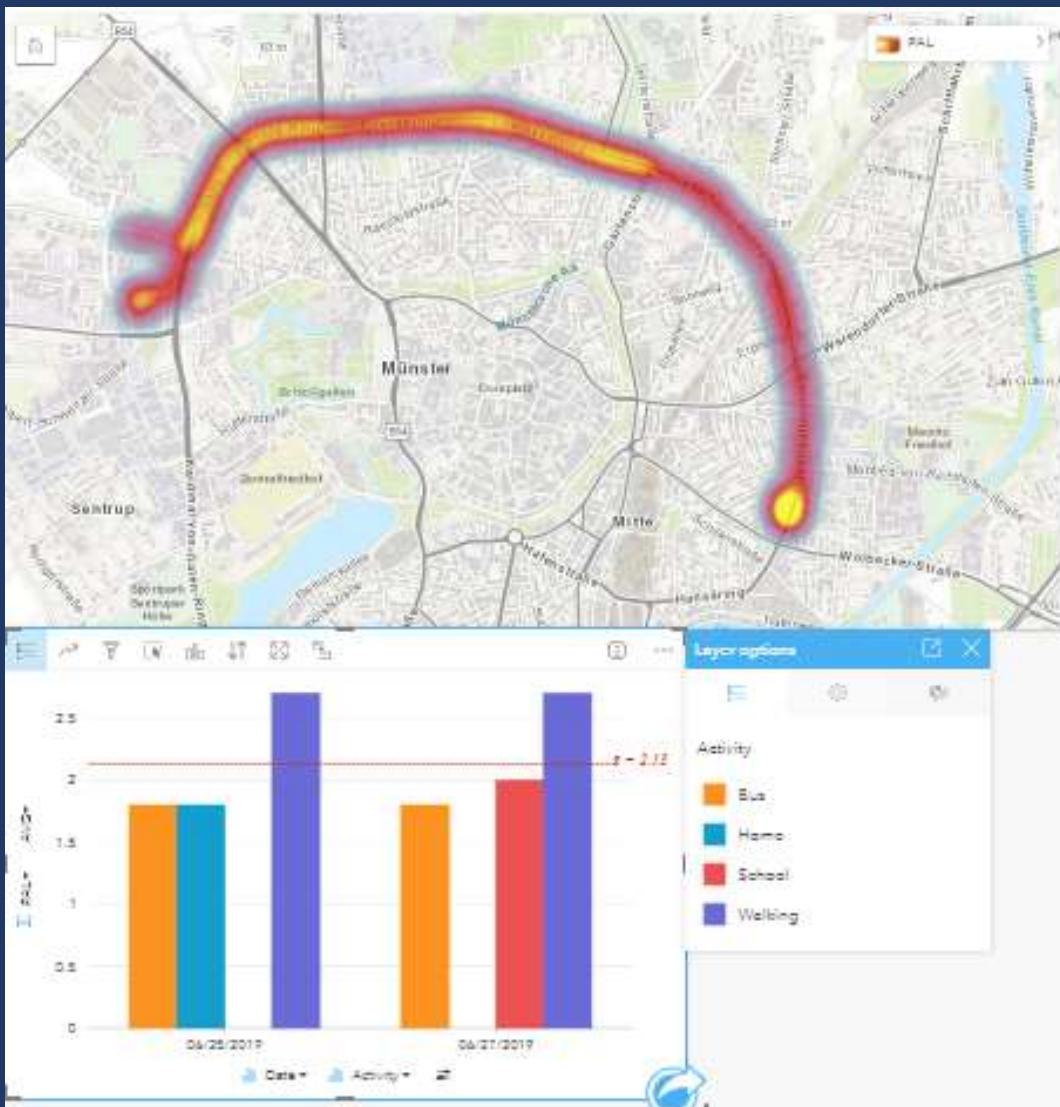
Results and Discussion



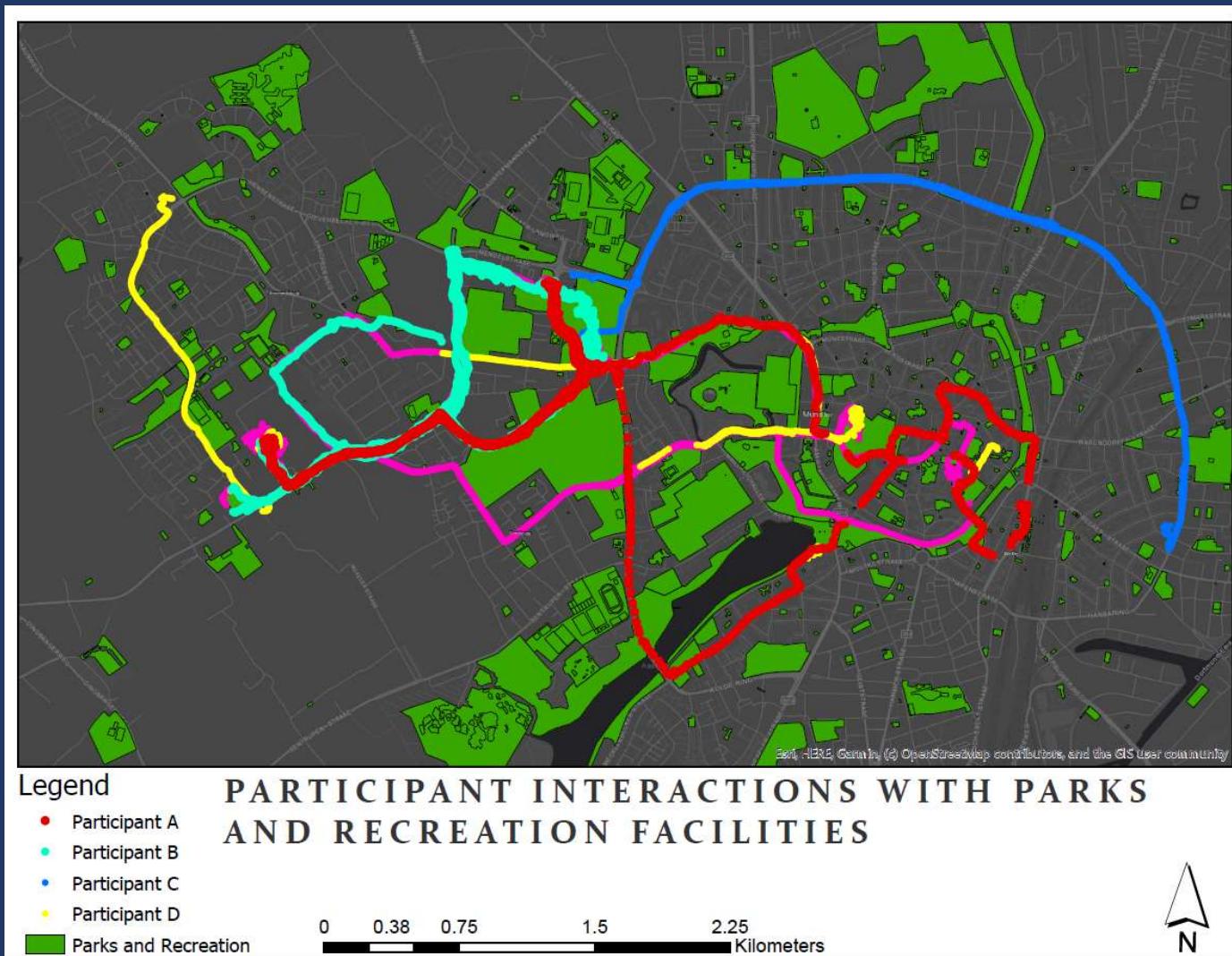
Results and Discussion



Results and Discussion



Results and Discussion



Limitations and Recommendation

Limitations

- Data Not Representative of Phenomena (5 Participants Vs IFGI Student Population)
- 5 day Data

Recommendations

- Longer Duration
- More Participants
- Seasonal Variation Of Data Collection

Conclusion

- Despite the Potential of Technology, Much Is Required to be done Manually.....
- Need For Accelerometer Devices to Aid in Calculation of Physical Activity Levels

Danke schön!!!