HABITUS - Human Activity Behavior Identification Tool and data Unification System

HABITUS

Principles

Open source and collaborative

Sharing of algorithms (and training data)

Sharing of workflows and data processing settings

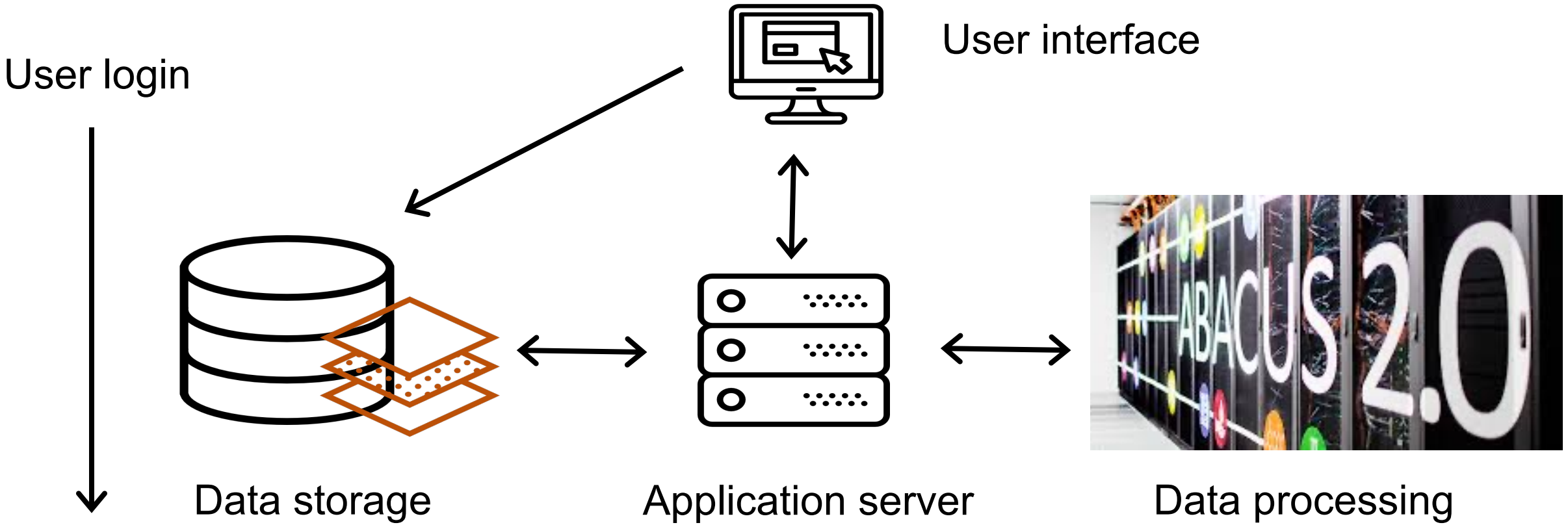
Aims

Make it easier to combine acceleromter and GPS data

Facilitate transparancy of data processing decisions

Offer easy access to secure data storage and supercomputer data processing

HABITUS



Ucloud

UCloud Docs

Login | eScience Center | Developer Guide | User Guide

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About

- Secure Platform
- Interactive HPC
- Data Analytics
- Private Cloud
- Share & Collaborate
- Project Management

Getting Started

- Manage Files and Folders
- Share and Mount Locally
- Access Applications

UCloud User Guide¶

Interactive digital research environment built to support the needs of researchers for both computing and data management, throughout all the data life cycle

Getting Started

Tutorial videos

Platform Overview

Navigate, launch jobs, share & collaborate

Supported Apps

Apps catalogue

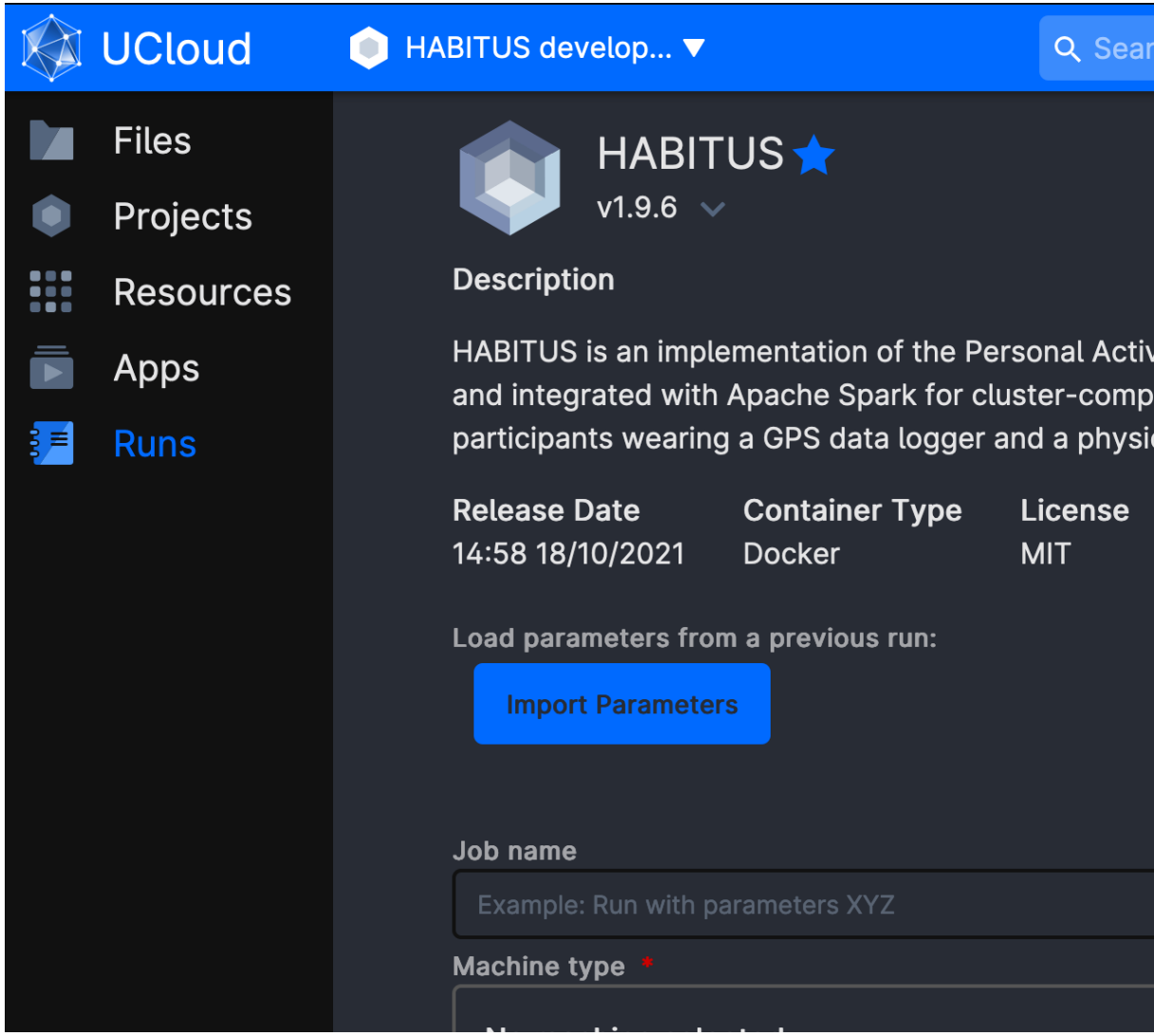
https://docs.cloud.sdu.dk/

Application server

Applications run in a container

Processing is scalable, 1 core per person (>14,000 cores available)

Packages and libraries written in R or python can easily be integrated



Builds on existing open source software

GGIR

R package for accelerometry

Dr Vincent van Hees, Consultant,
www.accelting.com

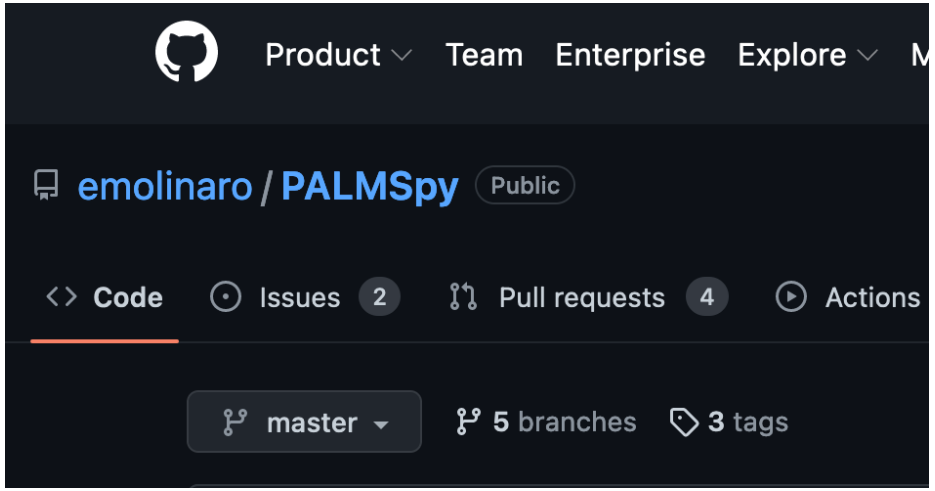
PALMSplus for R

repo status Active | Package version 0.1.0 | Last change 2018-01-12

Overview

palmsplusr is an extension to the *Personal Activity Location Measurement System* (PALMS). This R package provides a customisable platform to combine PALMS data with other sources of information (e.g., shapefiles or csv files). This enables physical activity researchers to answer higher-level questions, such as:

Dr Tom Stewart, Auckland University of Technology



Dr Emiliano Molinaro, University of Southern Denmark

activityCounts

Calculate ActiLife counts from raw acceleration data

Dr Ruben Brondeel et al, Sciensano

User interface

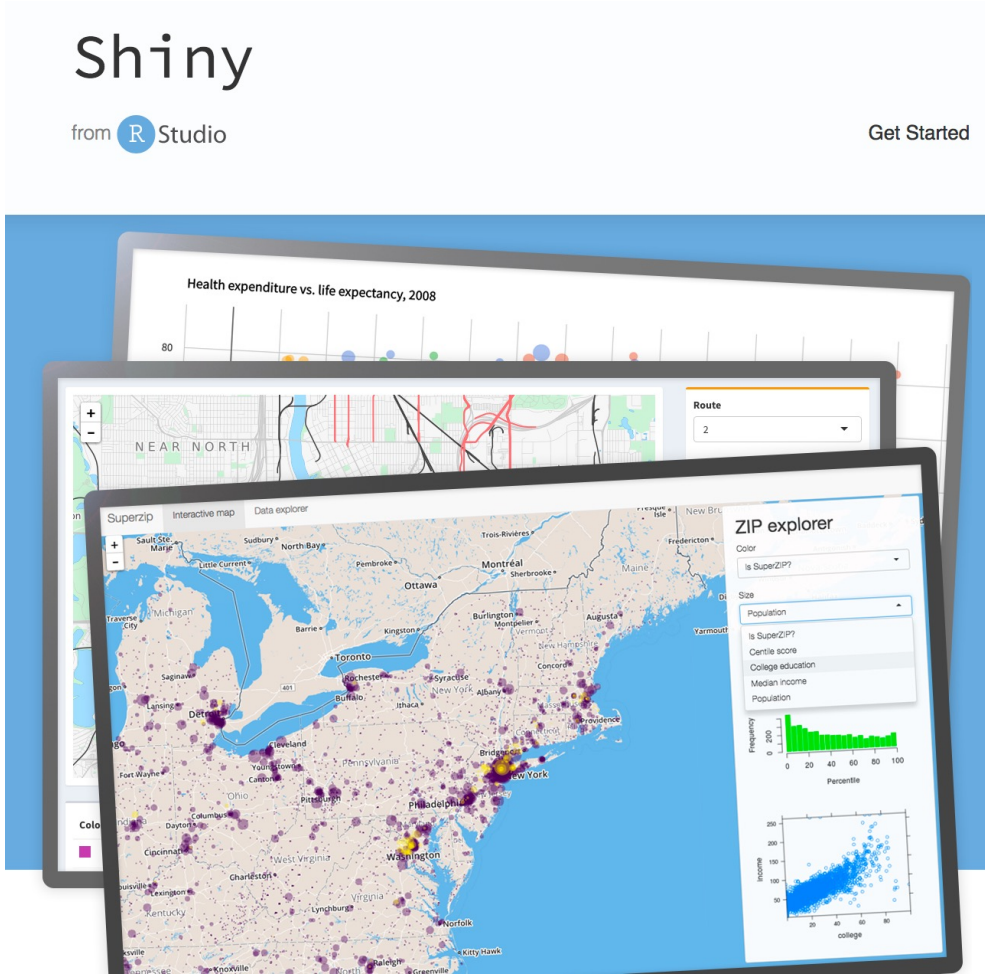
Shiny for Rstudio

Easy to use interface

Limited number of processing options

Visualisation of output data

Developed by Vincent van Hees



Habitus

Which type(s) of data would you like to analyse?

- [ ] Raw acceleration (at least ten values per second per axis)
- [ ] Counts (in ActiGraph .csv format)
- [ ] GPS (in .csv format)
- [ ] GIS (shape files + linkage file)
- [ ] PALMS(py) output previously generated
- [ ] Sleep Diary (in GGIR compatible .csv format)

next

What can HABITUS help you with?

Process raw accelerometer data with GGIR

Generate ActiGraph counts based on raw accelerometer data

Match & merge accelerometer and GPS data

Remove the worst GPS errors (excessive speed and changes in altitude)

Categorize activity intensity (sedentary, light, moderate, vigorous)

Identify trips and tripmode (walking, bicycling, vehicle)

Aggregate data into user-defined domains

Export aggregated data as table or GIS file

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What is you research interest?

- [ ] Data quality assessment
- [ ] Trips (displacements)
- [ ] Relation between behaviour and environment

--> Tick boxes above according to the analysis you would like to do

---

Select the tools you would like to use:

- [ ] GGIR (R package)
- [ ] BrondCounts (R packages activityCounts + GGIR)
- [ ] PALMSpy (Python library)
- [ ] PALMSplus (R package)

Shiny from RStudio

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Shiny from RStudio

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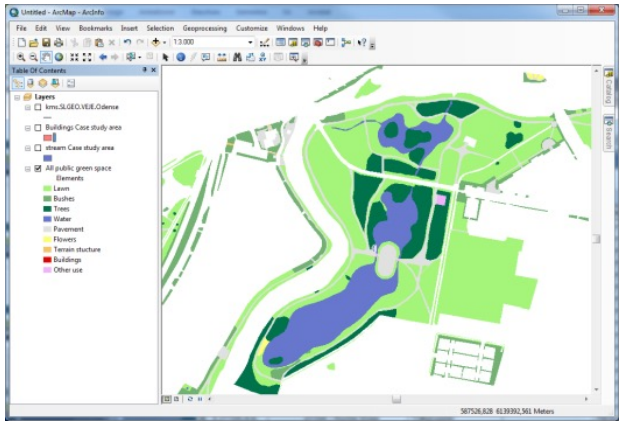
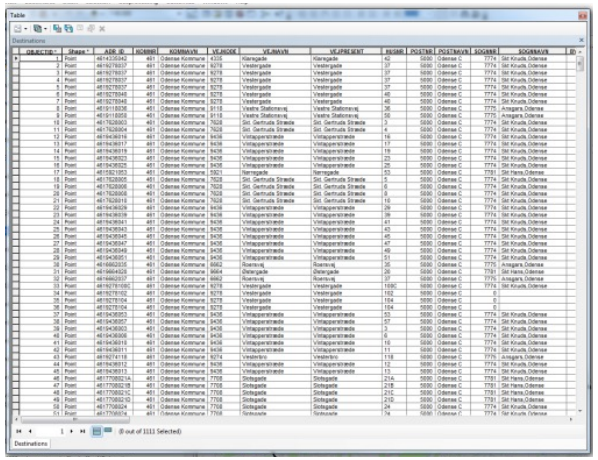
Shiny from RStudio

GIS data and linkage file needed to define domains





At home? Yes → Home domain

No ↓

At work? Yes → Work domain

No ↓

In transport? Yes → Transport domain

No ↓

Transport domain ↓

Other trips

Commuting

Active

Passive

'Other' domain

Habitus - Data selection

Count accelerometry data directory...

/work/LineMatthiesen#8897/test-data-DK/Accelerometer

GPS data directory...

/work/LineMatthiesen#8897/test-data-DK/GPS

GIS data directory...

/work/LineMatthiesen#8897/test-data-DK/GIS

GIS linkage file...

/work/LineMatthiesen#8897/test-data-DK/Tables/participant_basis_dk_10

Output directory...

/work/LineMatthiesen#8897/test-data-DK/test_output_dk

Give your dataset a name:

test-data-DK

prev next

Habitus - Parameter Configuration

PALMSpy

PALMSpy takes as input summarised accelerometer data (ActiGraph counts) and GPS data and uses them to estimate movement behaviours from the perspective location in a country or city and travel distance and speed

PALMSpy configuration files are in .json. If you do not have one Download a template below.

Configuration file...

Download template

Reset

Select a configuration file on the left. Download the template if you do not have a configuration file.

PALMSplus

No parameters are needed for the PALMSplus

prev

next

Habitus - Parameter Configuration

PALMSpy

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PALMSpy configuration files are in .json. If you do not have one Download a template below.

Configuration file...

Download template | Reset

Review the parameter values, especially the ones in yellow, and edit where needed by double clicking:

Show 5 entries | Search:

	value	field	subfield	description	priority
insert_max_seconds	600	gps	general	please insert description	1
insert_missing	true	gps	general	please insert description	1
filter_invalid_values	true	gps	filter_options	please insert description	1
insert_until	false	gps	general	please insert description	0
interval	5	gps	general	please insert description	0

Previous 1 2 3 4 5 ... 8 Next

Showing 1 to 5 of 36 entries

Configuration file has succesfully passed all formatting checks

PALMSplus

No parameters are needed for the PALMSplus

Habitus - Analyses

Recommended order of analyses: PALMSpy -> PALMSplus

PALMSpy:

Start analysis

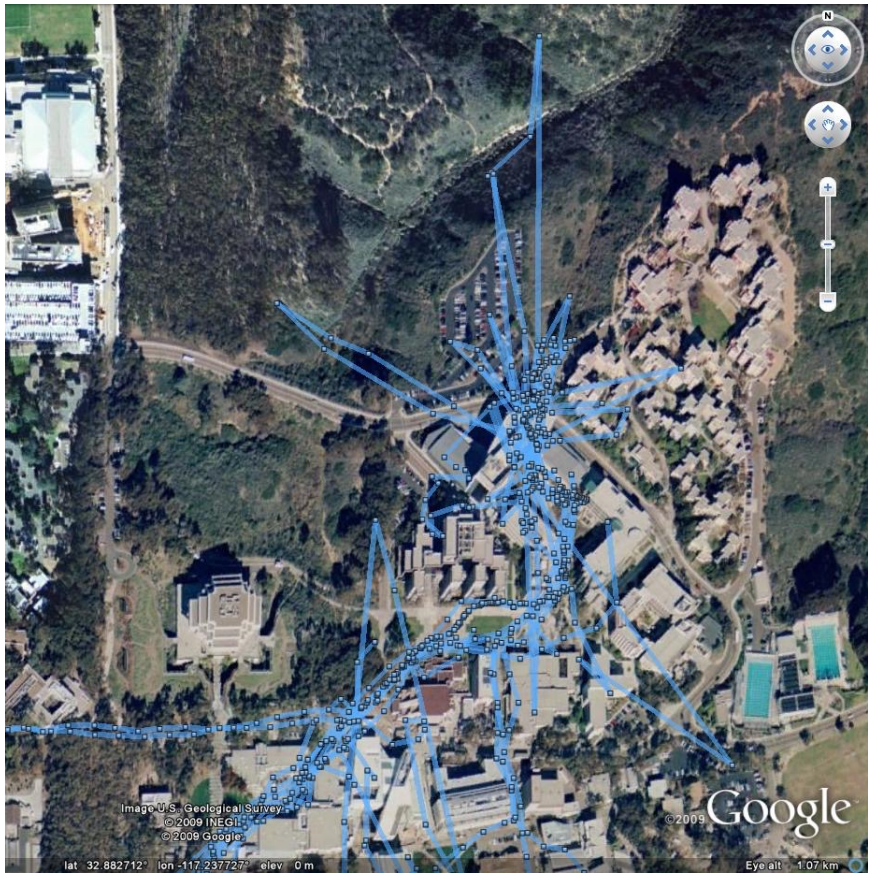
PALMSplus:

Start analysis

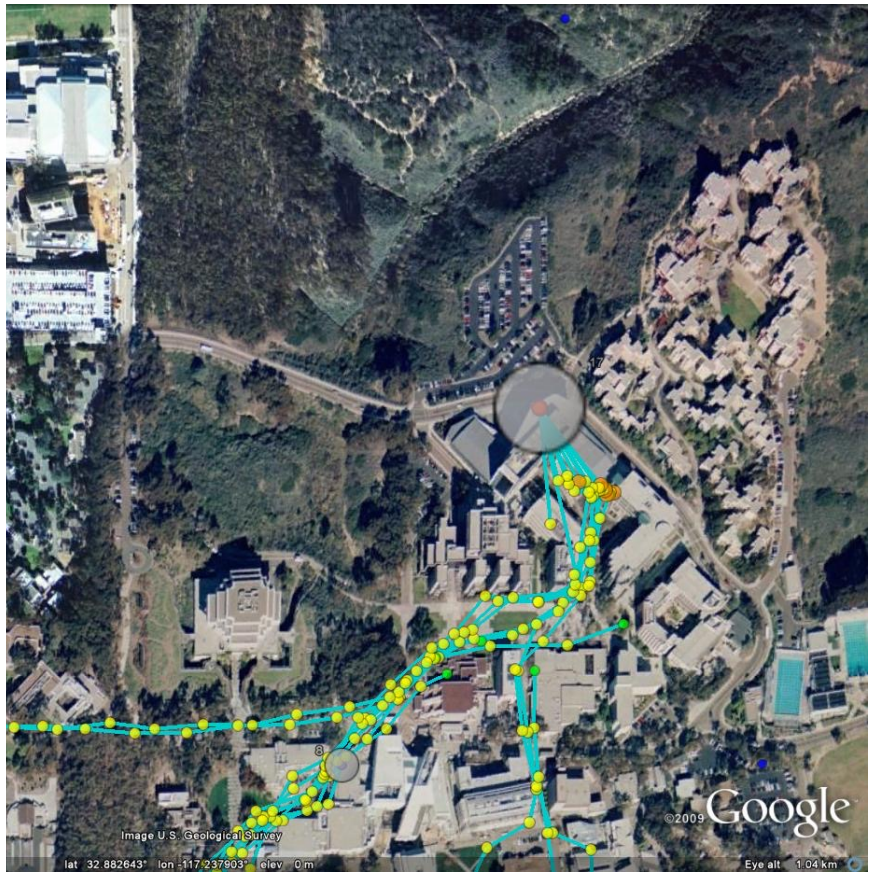
prev

Shiny from RStudio

Data processing – GPS noise removal



Before – Multi-story buildings generate noise



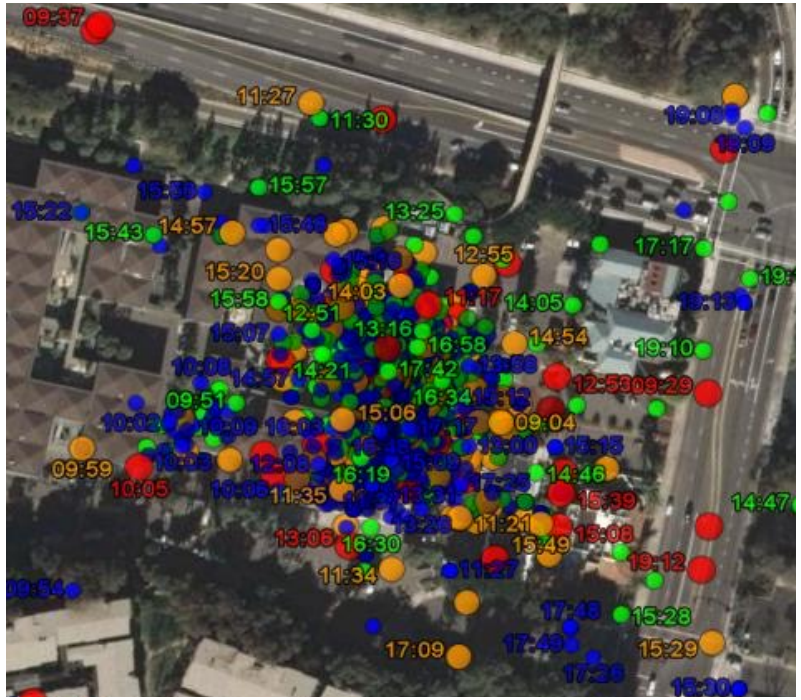
After – Noise removed
Yellow = walking Orange = paused
Gray circles = relative time at location

Data processing – GPS noise removal

Refine grossly invalid trackpoints (bad fixes)

Refine redundant trackpoints (non-movement)

Refine extraneous data points (jitter)



Before

After

Color coded by speed

Data processing – GPS noise removal

Filter lone-fixes – do not filter first and last fixes

Determine if trackpoint is valid

- Check for excessive speed (> X)
- Check for excessive change in elevation
- Check for excessive distance traveled between trackpoints

Determine if trackpoint is redundant

- Check for minimum change in distance between trackpoints (redundant)
- Check for forward / backwards movement (jitter)

If invalid or redundant, delete trackpoint from vector and update derived values in adjacent trackpoint

Data processing – trip detection

- Detects starting and stopping locations of trips
- Detects short pauses during trips
- Note: start point variations due to time to acquire first fix.

Starting point

Ending point

In motion

Paused

Data processing – trip detection

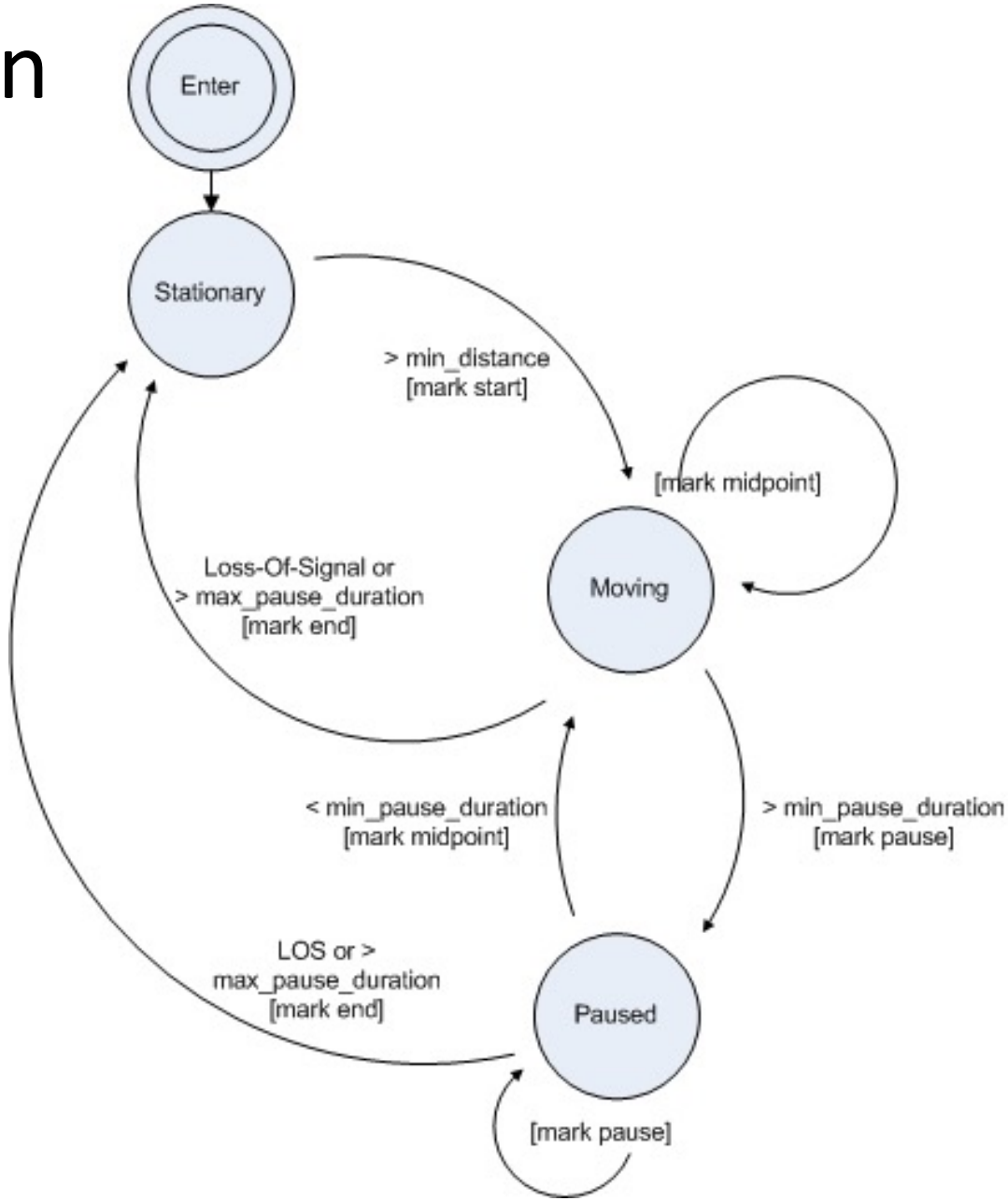
Marks Trackpoints as either:

- Stationary
- Start points
- Mid points
- Pause points
- End points

Start point marked when distance traveled > threshold

End points marked on loss of signal or when duration at point exceeds a time threshold

Pause points when distance travel < threshold & duration at point within a time threshold

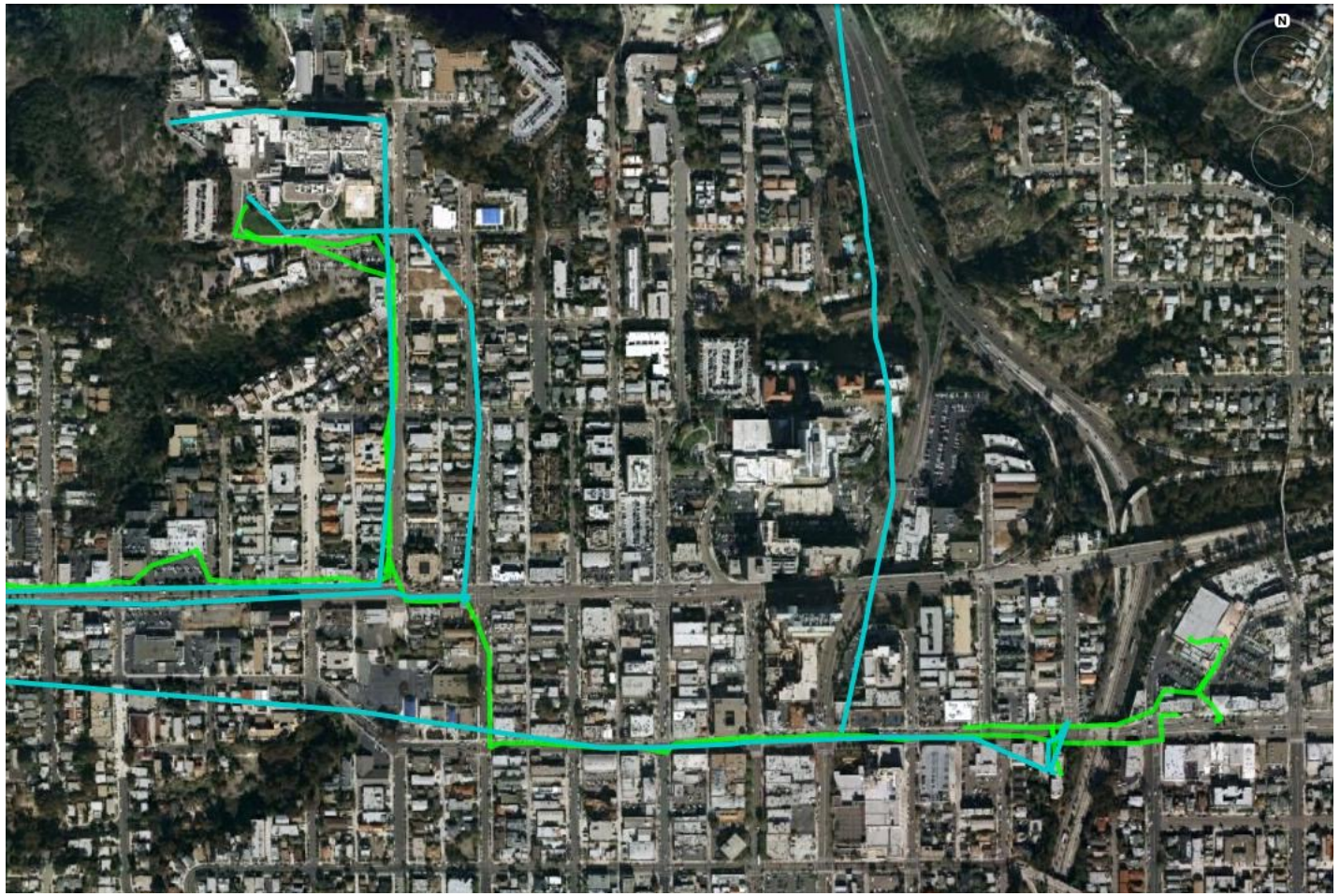


Data processing – trip detection step 2

- Reconsider trips
  - Remove trips where total distance < threshold
  - Remove trips where total duration < threshold
  - Remove trips contained within one location
  - Remove trips totally indoors
- Number trips

Carlson et al. 2014, MSSE

Data processing – mode of transportation



Classify trips as walking, running, bicycle, vehicle

90% trip speed used as classifier

Vehicle

Pedestrian

Bicycle

Habitus - Analyses

Recommended order of analyses: PALMSpy -> PALMSplus

PALMSpy:

Start analysis

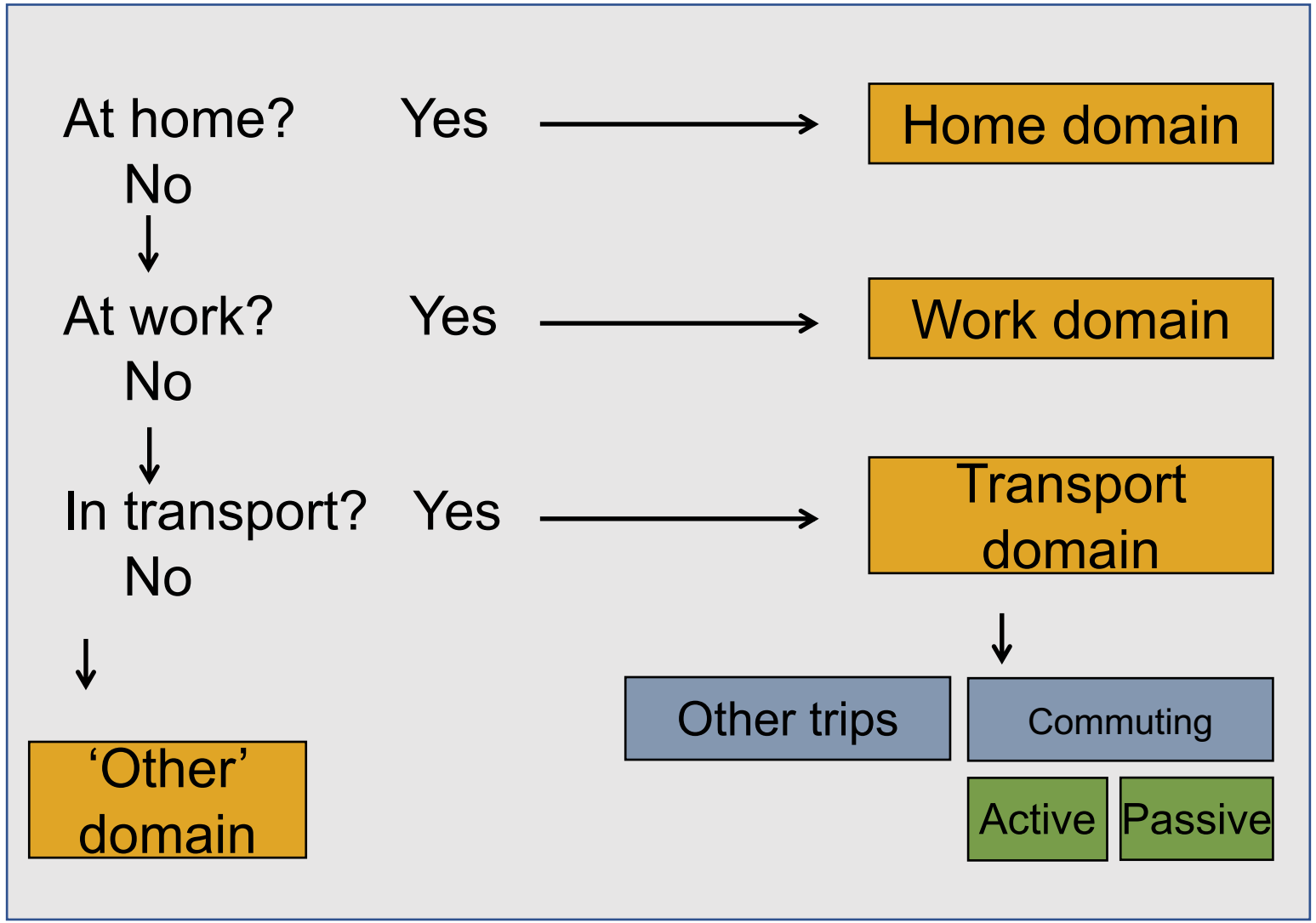
PALMSplus:

Start analysis

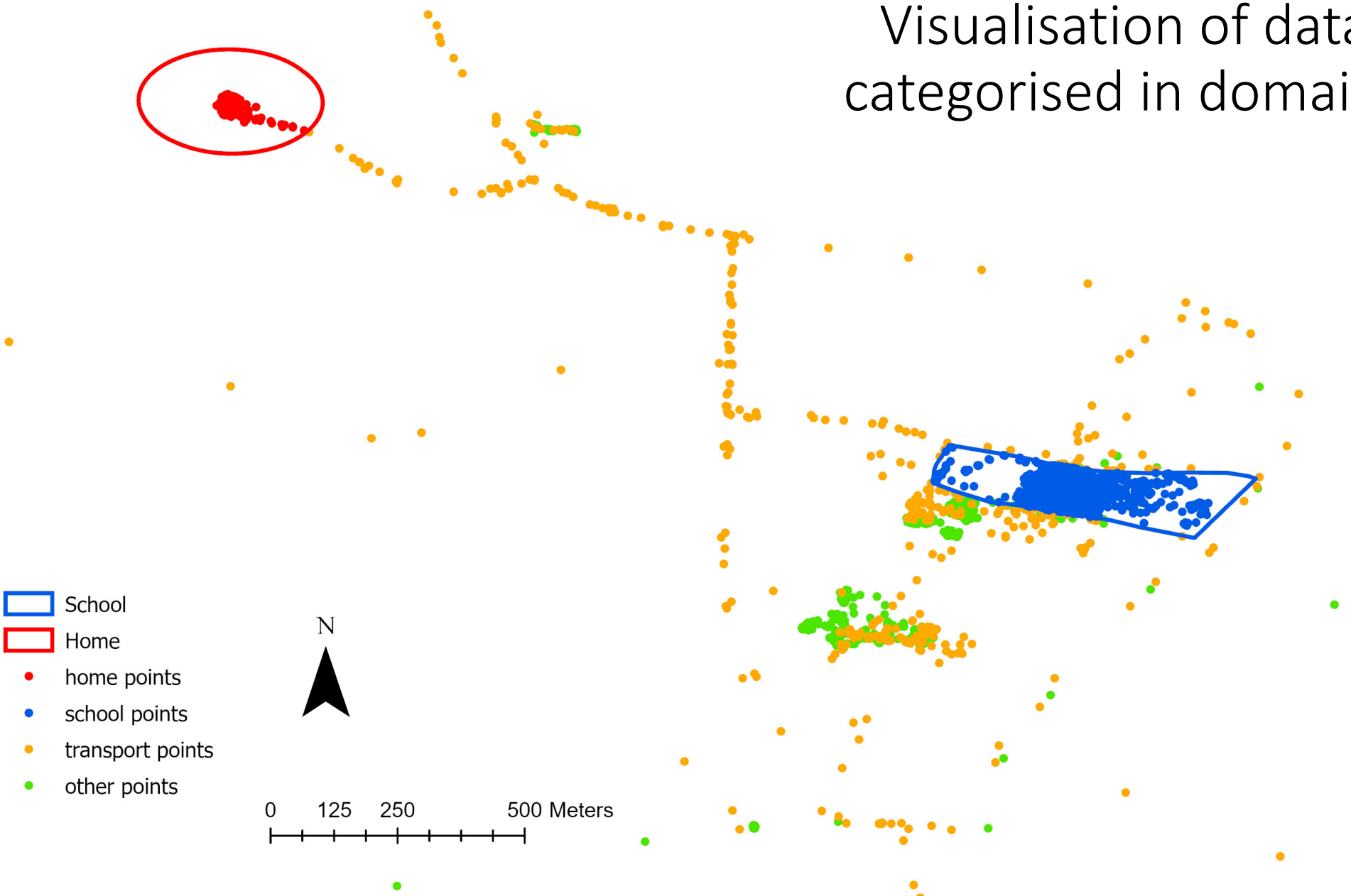
prev

Shiny from RStudio

Data processing – classification in domains



Visualisation of data categorised in domains



Data processing – variables for each domain

Time spent in a domain (duration)

Weartime

Time sedentary (SED)

Time in LPA

Time in MPA

Time in VPA

Time in MVPA

Average CPM

Data processing – data output example

identifier	dte	dow	day_duration	day_weartime	day_lpa	day_mvpa	day_sed	day_cpm
GR012BE	13/06/2017	2	7200	4155	0	0	4155	0.644
GR012BE	14/06/2017	3	86400	11955	2790	15	9150	0.742
GR012BE	15/06/2017	4	86400	47310	9165	0	38145	0.652
GR012BE	16/06/2017	5	86400	21120	2865	15	18240	0.499
GR012BE	17/06/2017	6	86400	21750	5250	0	16500	0.753
GR012BE	18/06/2017	7	86400	4545	0	0	4545	0.095
GR012BE	19/06/2017	1	86400	28875	5175	105	23595	0.604
GR012BE	20/06/2017	2	86400	23310	3540	30	19740	0.522
GR012BE	21/06/2017	3	86400	12225	1455	0	10770	0.323

Next steps – short term

Extensive user testing
Bug fixing
Interface improvement
Creation of guidance materials

Next steps - adding domain classification to the next generation of devices/systems

We hope to build on SurPASS

Activity type data in domains

Non-count accelerometer metrics

https://sens.dk/

Next steps – combine accelerometer and GPS in machine learning

frontiers in
PUBLIC HEALTH

METHODS ARTICLE
published: 22 April 2014
doi: 10.3389/fpubh.2014.00036

Identifying active travel behaviors in challenging environments using GPS, accelerometers, and machine learning algorithms

Katherine Ellis[1]*, Suneeta Godbole[2], Simon Marshall[2], Gert Lanckriet[1], John Staudenmayer[3] and Jacqueline Kerr[2]

[1] *Department of Electrical and Computer Engineering, University of California San Diego, La Jolla, CA, USA*
[2] *Department of Family and Preventive Medicine, University of California San Diego, La Jolla, CA, USA*
[3] *Department of Mathematics and Statistics, University of Massachusetts Amherst, Amherst, MA, USA*

Summing up

HABITUS is functional for users with experience in working with accelerometer, GPS and GIS data

Further improvements to the user friendliness and documentation will be made the coming months

Contact us if you would like to explore options to become a HABITUS user

Email us at habitus@sdu.dk or check www.habitus.eu for more information