

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

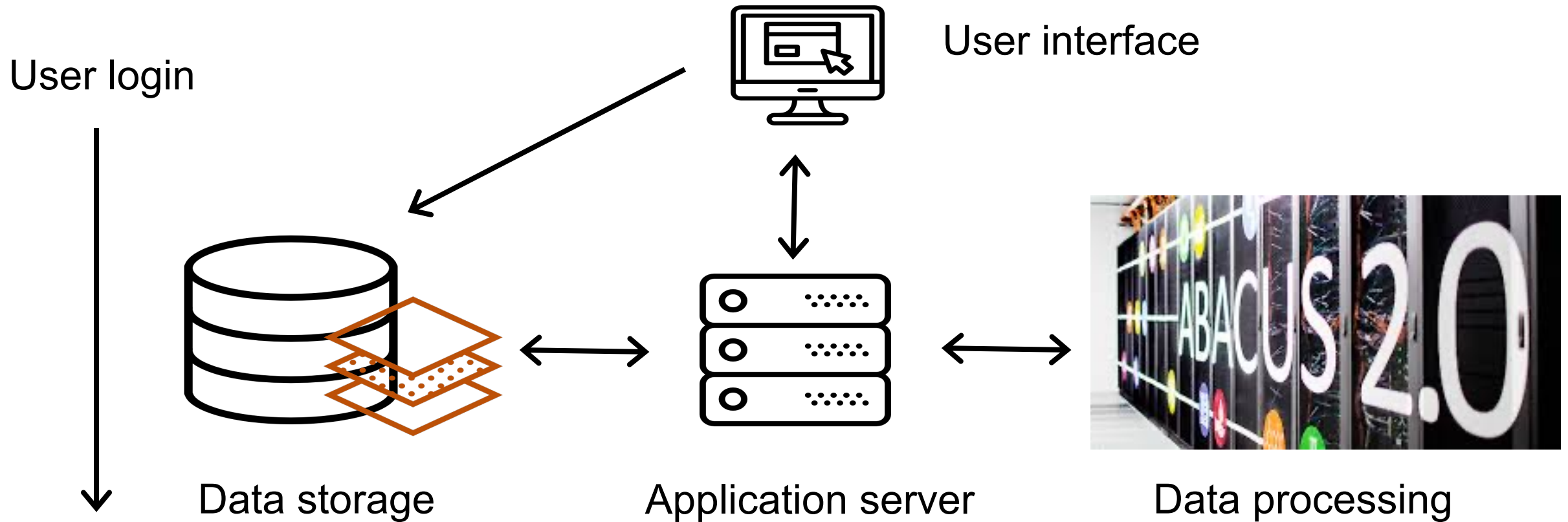
Aims

Make it easier to combine accelerometer and GPS data

Facilitate transparency of data processing decisions

Offer easy access to secure data storage and supercomputer data processing

HABITUS





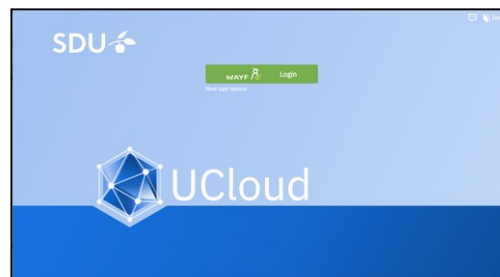
About

[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 

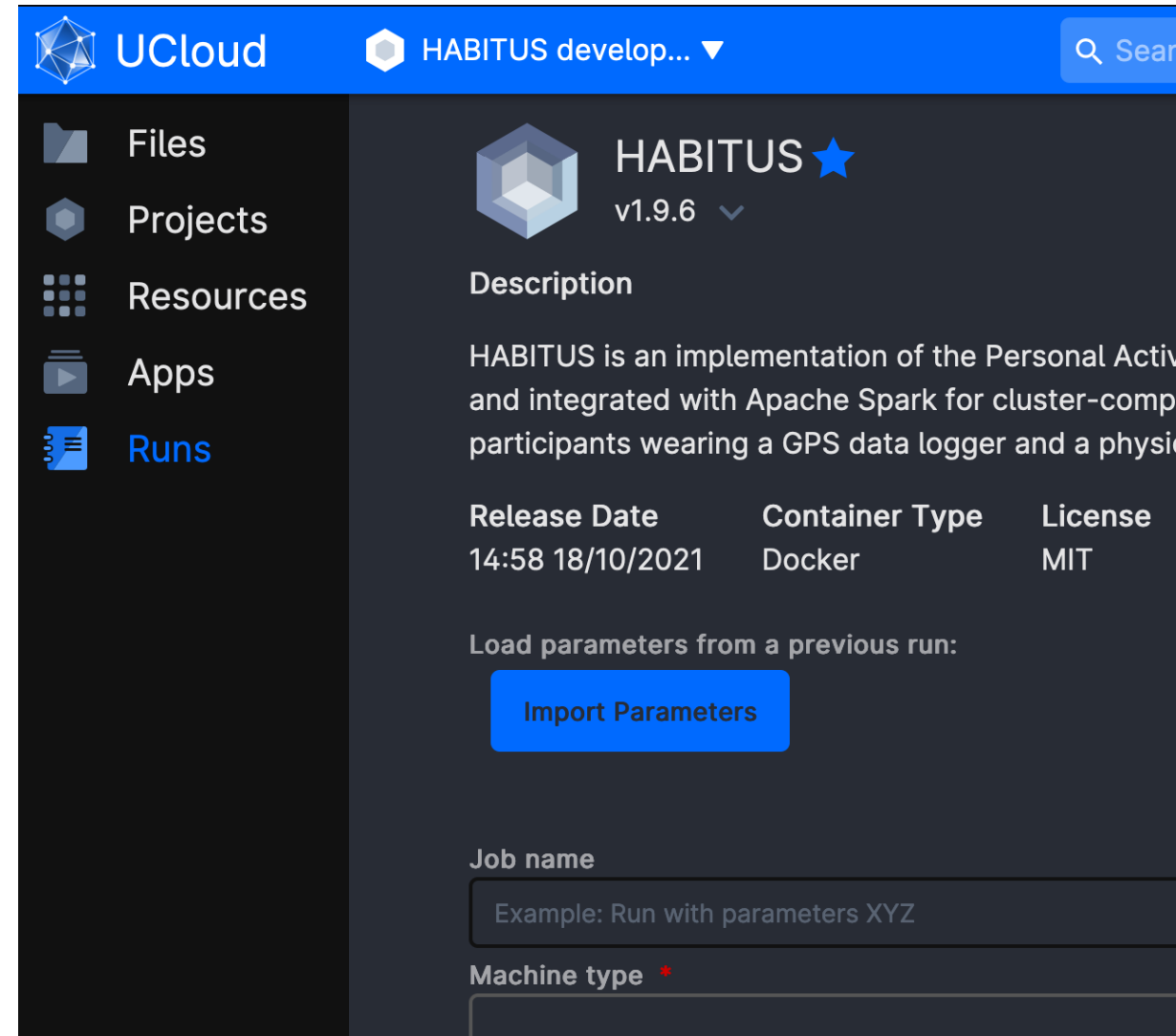
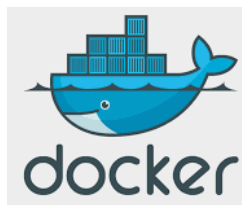
<https://docs.cloud.sdu.dk/>

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



The screenshot shows the UCloud interface for the HABITUS application. The top navigation bar includes the UCloud logo, the application name 'HABITUS develop...', and a search bar. A left sidebar contains navigation links: Files, Projects, Resources, Apps, and Runs. The main content area displays the HABITUS application details, including its version (v1.9.6), a description, release date, container type, and license. Below this, there is a section for loading parameters from a previous run with an 'Import Parameters' button. At the bottom, there are input fields for 'Job name' and 'Machine type'.

UCloud HABITUS develop... 🔍 Search

- Files
- Projects
- Resources
- Apps
- Runs

HABITUS ★
v1.9.6 ▼

Description

HABITUS is an implementation of the Personal Activity Monitoring (PAM) system and integrated with Apache Spark for cluster-computing. It is designed for participants wearing a GPS data logger and a physical activity monitor.

Release Date	Container Type	License
14:58 18/10/2021	Docker	MIT

Load parameters from a previous run:

[Import Parameters](#)

Job name

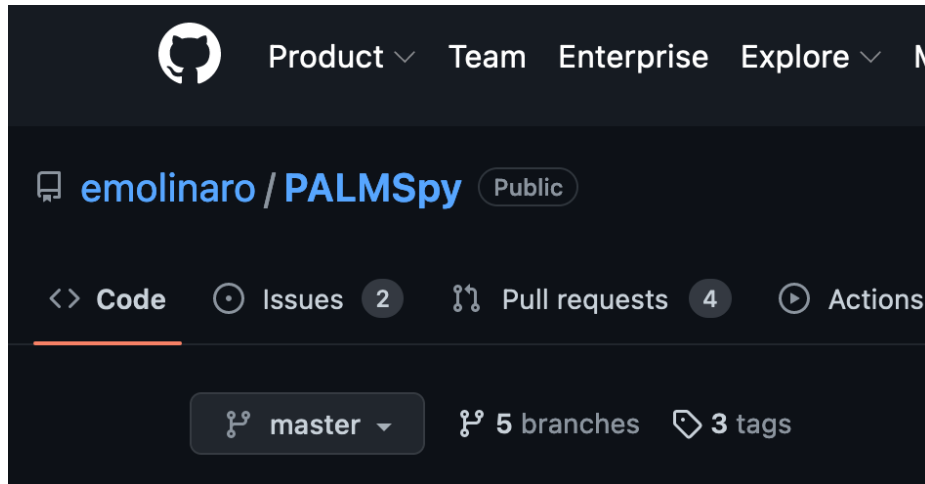
Example: Run with parameters XYZ

Machine type *

Builds on existing open source software



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



Dr Emiliano Molinaro, University of Southern Denmark

PALMSplus for R

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

Overview

palmsplus 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

activityCounts

Calculate ActiLife counts from raw acceleration data

Dr Ruben Brondeel et al, Sciensano

User interface

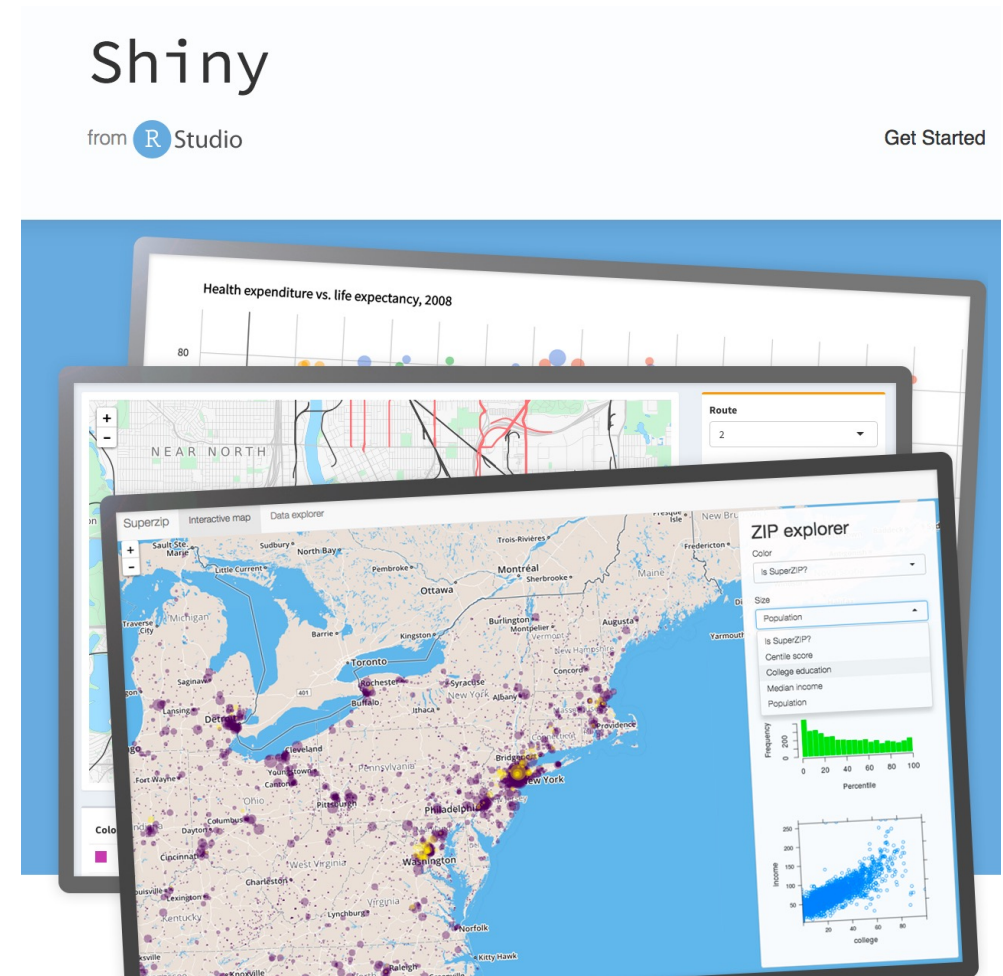
Shiny for Rstudio

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

Shiny

from  Studio

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

Habitus



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What is your 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  Studio

Habitus



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Proposed software pipeline: PALMSpy + PALMSplus

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from  Studio

Habitus



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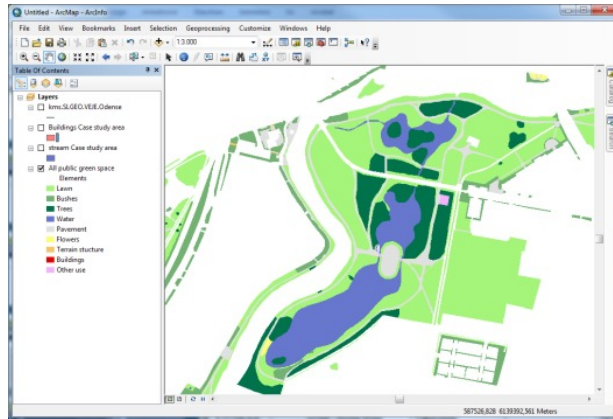
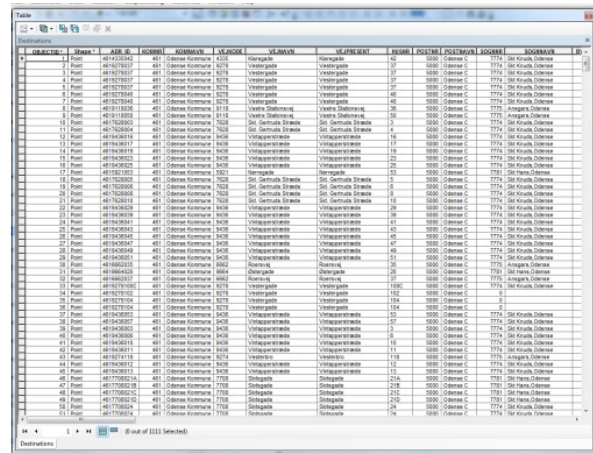
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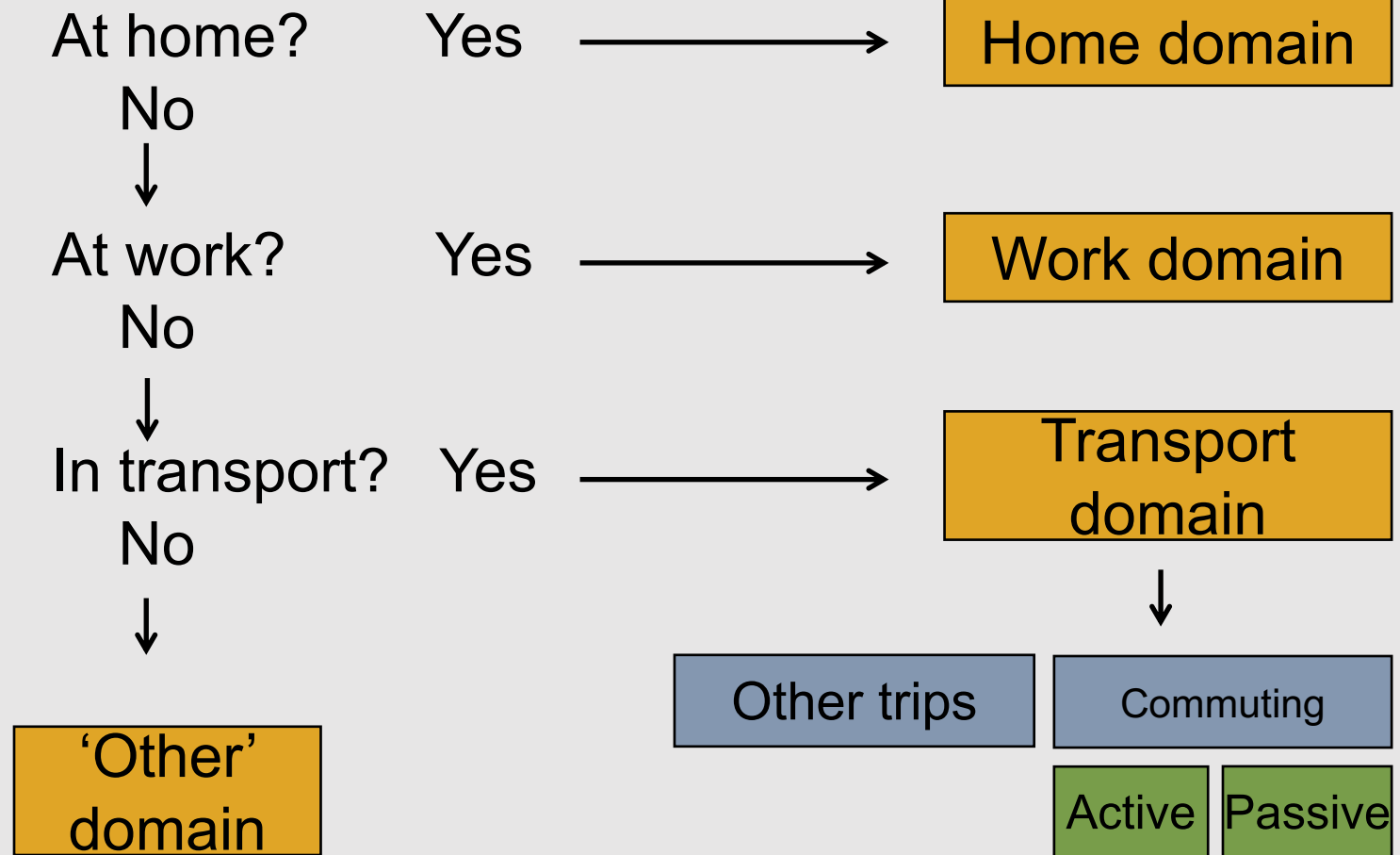
Shiny

from  Studio

GIS data and linkage file needed to define domains

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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

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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

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

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

Configuration file...

 Download template

Reset

PALMSplus

No parameters are needed for the PALMSplus

prev

next

Shiny

from  Studio

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

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

Show 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

Showing 1 to 5 of 36 entries

Configuration file has succesfully passed all formatting checks

[Previous](#)[1](#)[2](#)[3](#)[4](#)[5](#)...[8](#)[Next](#)

PALMSplus

No parameters are needed for the PALMSplus

Shiny

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Habitus - Analyses



Recommended order of analyses: PALMSpy -> PALMSplus

PALMSpy:

Start analysis

PALMSplus:

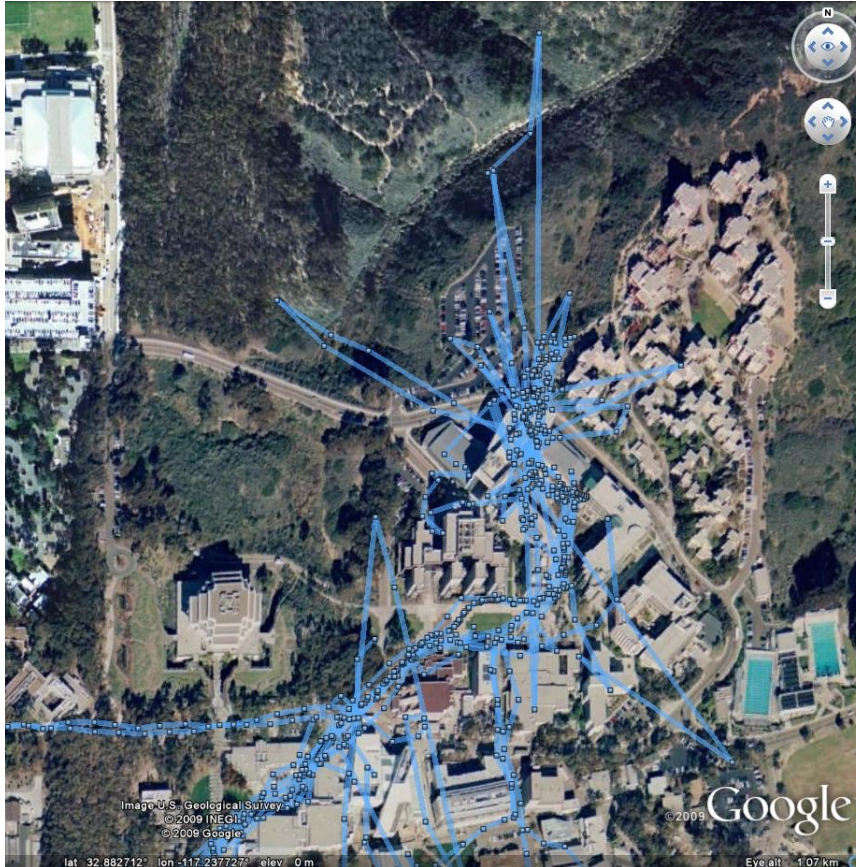
Start analysis

prev

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Data processing – GPS noise removal



Before – Multi-story buildings generate noise



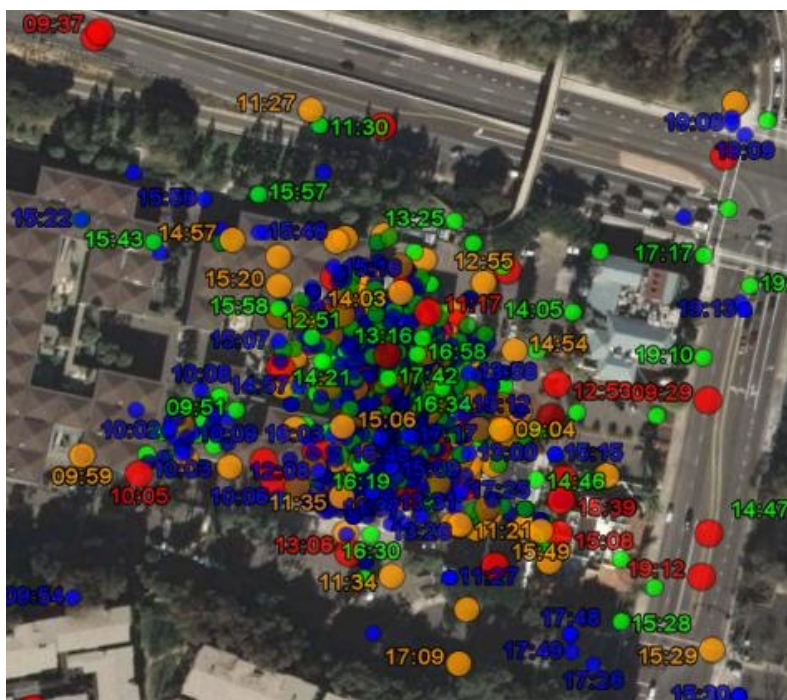
After – Noise removed
Yellow = walking Orange = paused
Gray circles = relative time at location

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

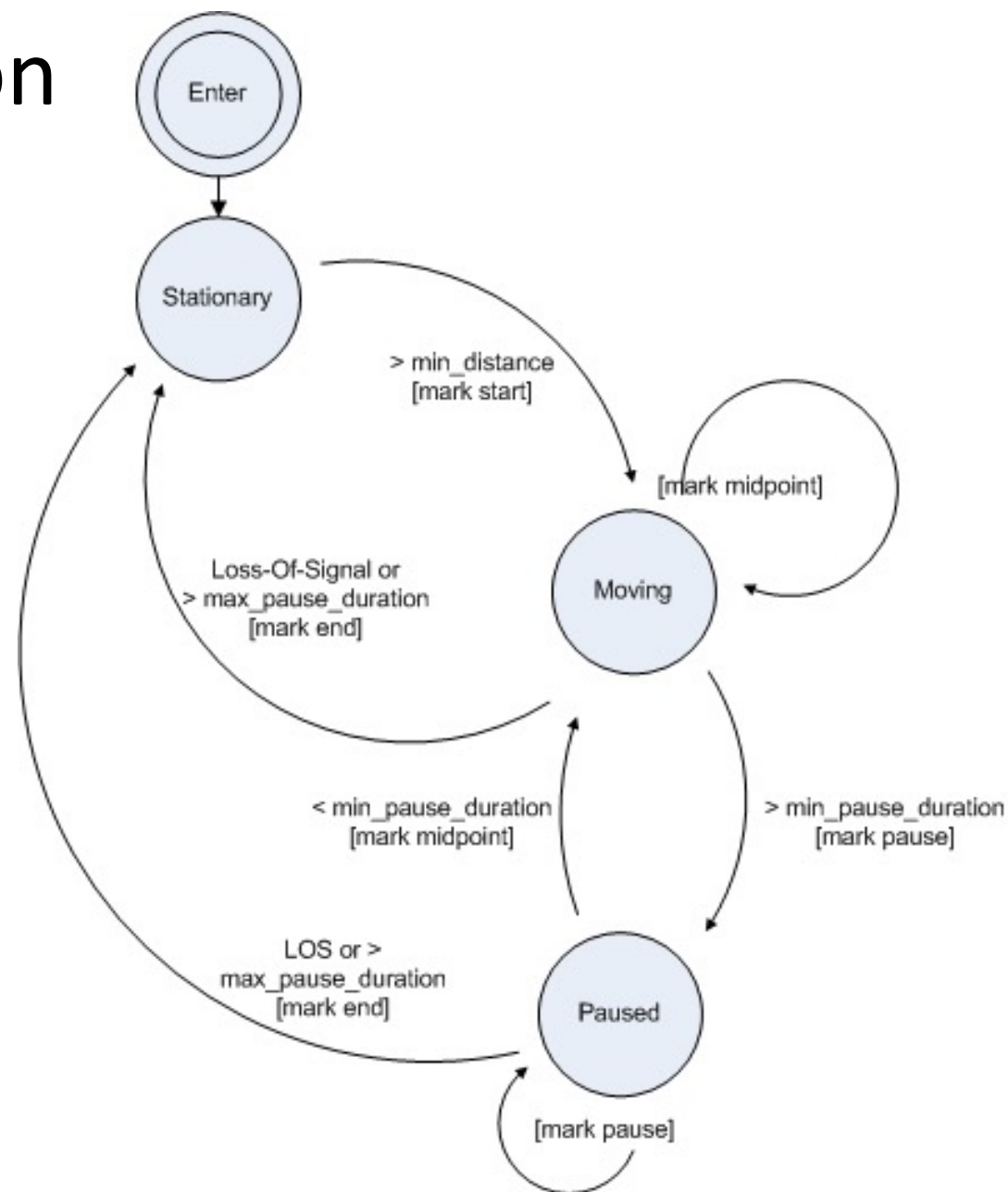
Marks Trackpoints as either:

- 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

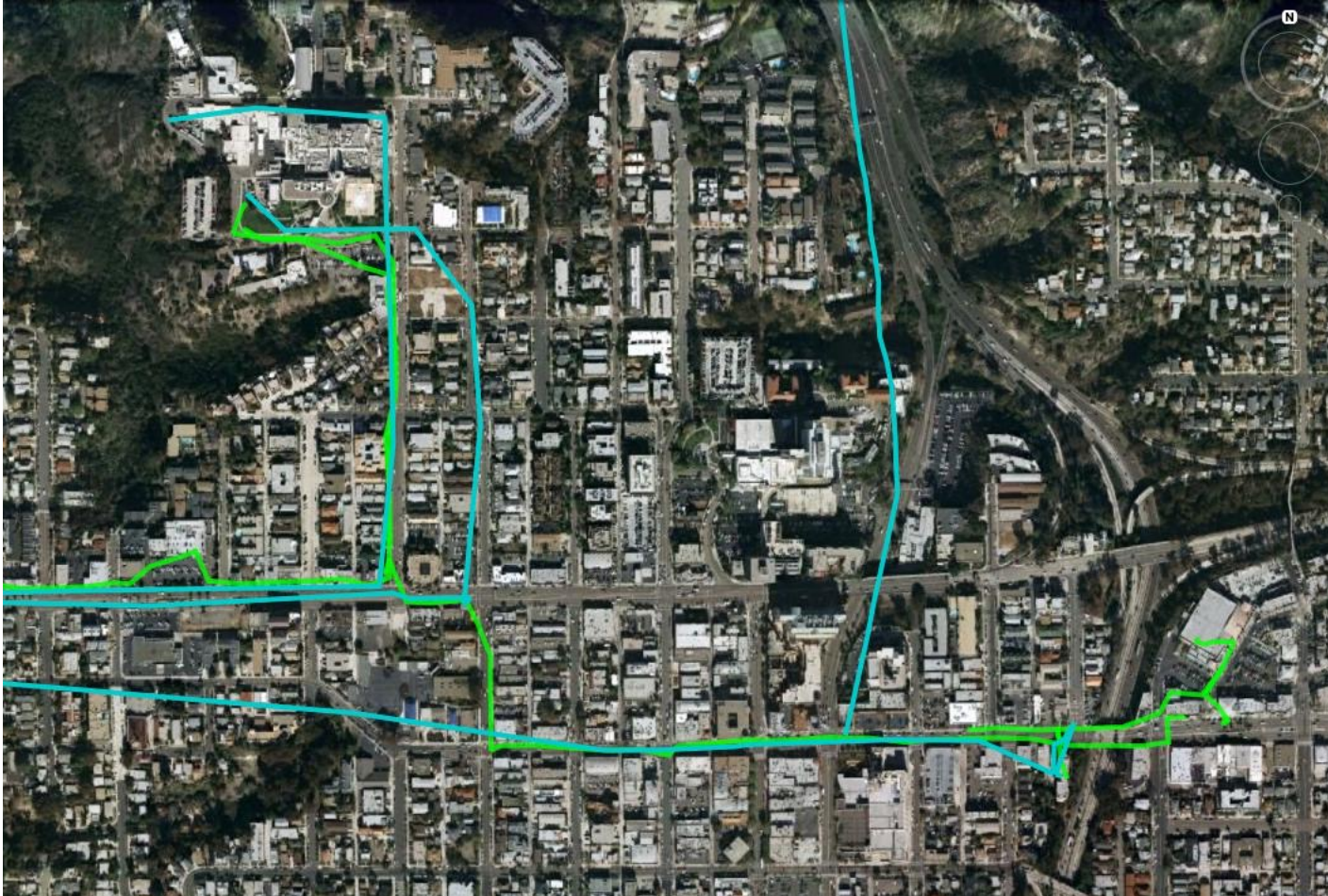
Number trips

Validity of PALMS GPS Scoring of Active and Passive Travel Compared with SenseCam

JORDAN A. CARLSON, MARTA M. JANKOWSKA, KRISTIN MESECK, SUNEETA GODBOLE, LOKI NATARAJAN, FREDRIC RAAB, BARRY DEMCHAK, KEVIN PATRICK, and JACQUELINE KERR

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:

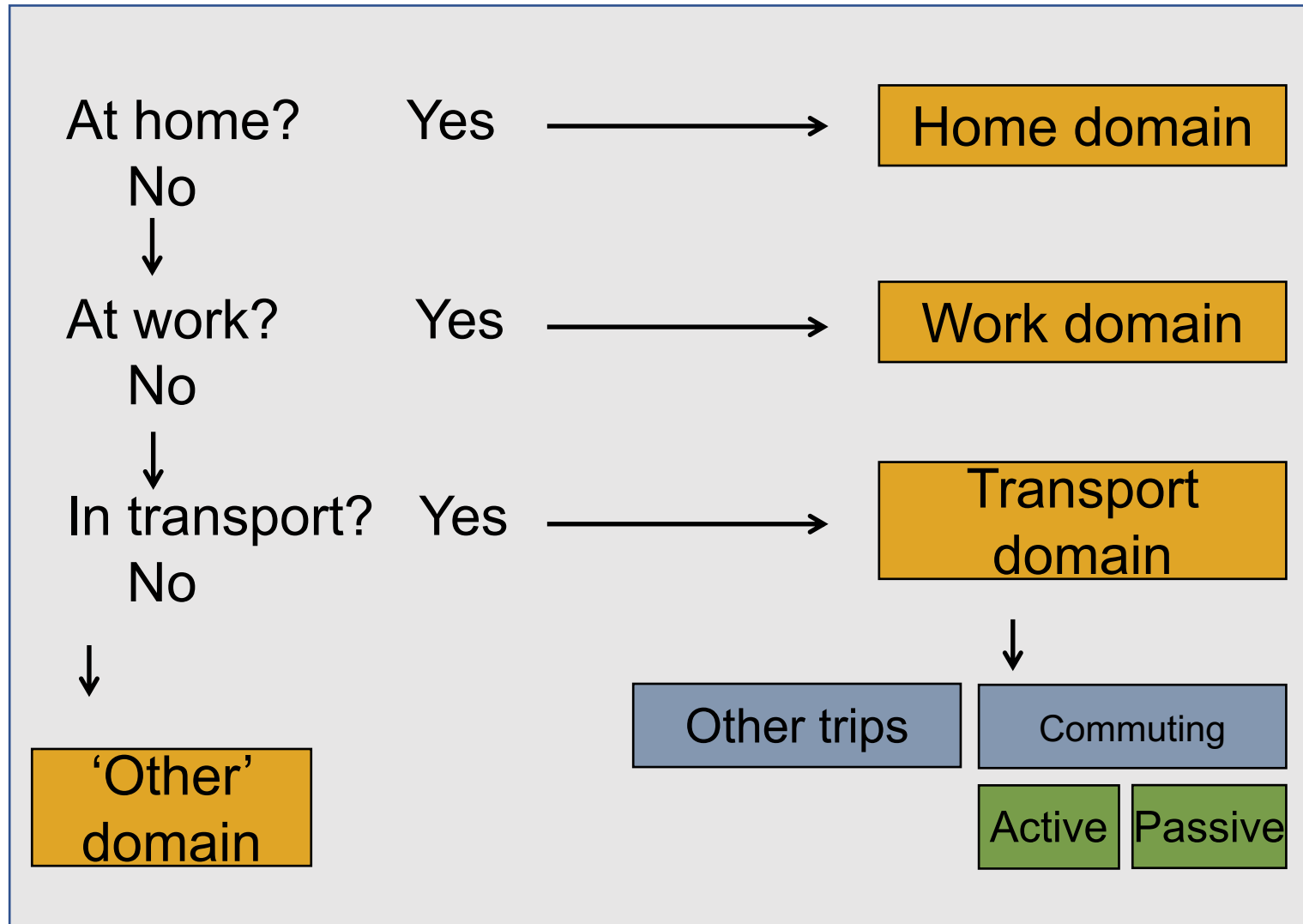
Start analysis

prev

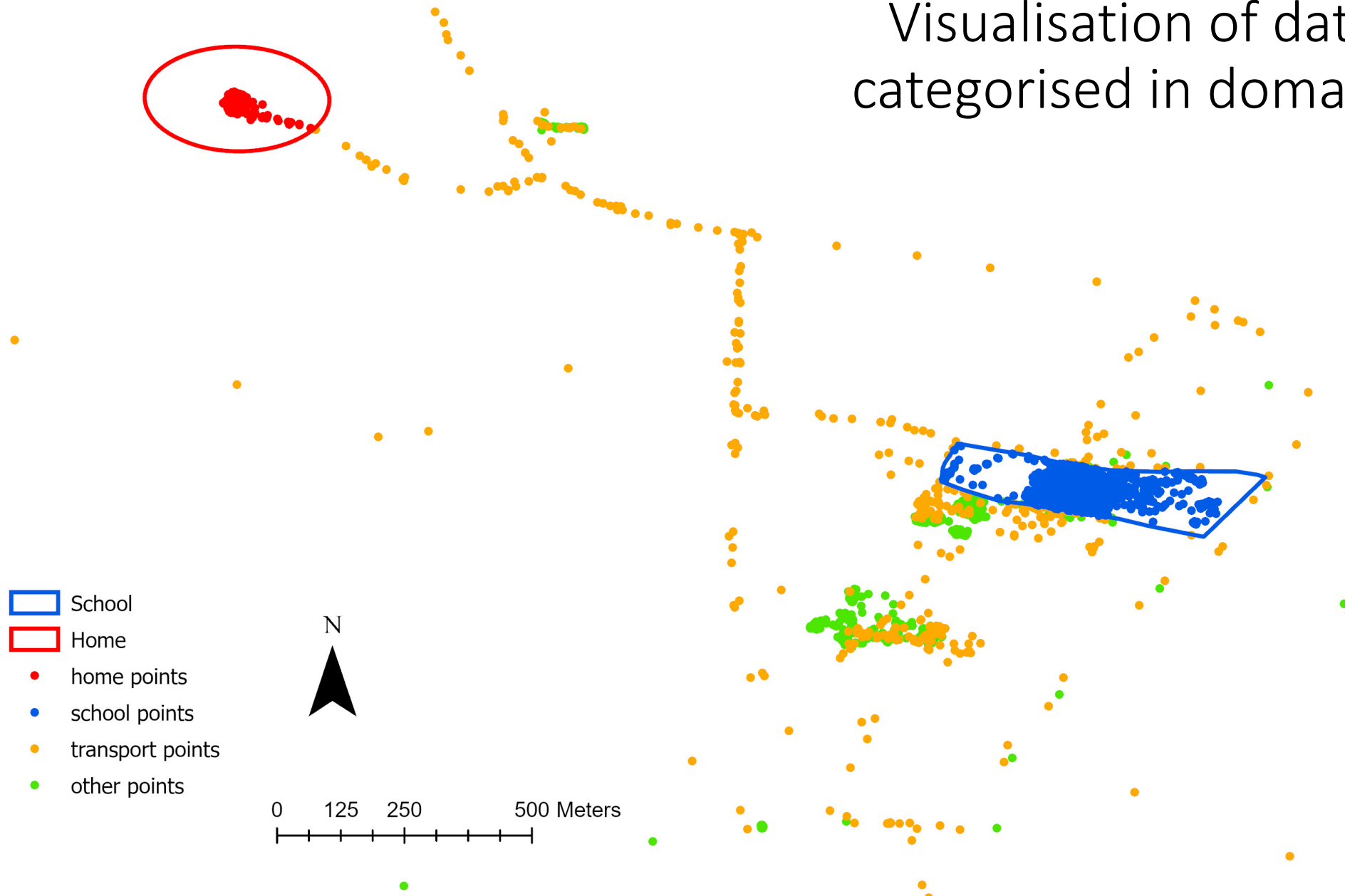
Shiny

from  Studio

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



SENS motion® For Healthcare For Research About Contact

What is SENS motion®



SENS motion® is a wireless medical device for collecting physical activity data from large groups of people. It is especially well suited for use in the healthcare sector and for large research projects. The system measures:

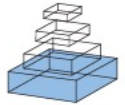
- Rest time
- Standing time
- Walking time
- Running & High-Intensity Movement time
- Cycling time
- Steps taken
- Motion intensity
- Sleep time and quality

<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

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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