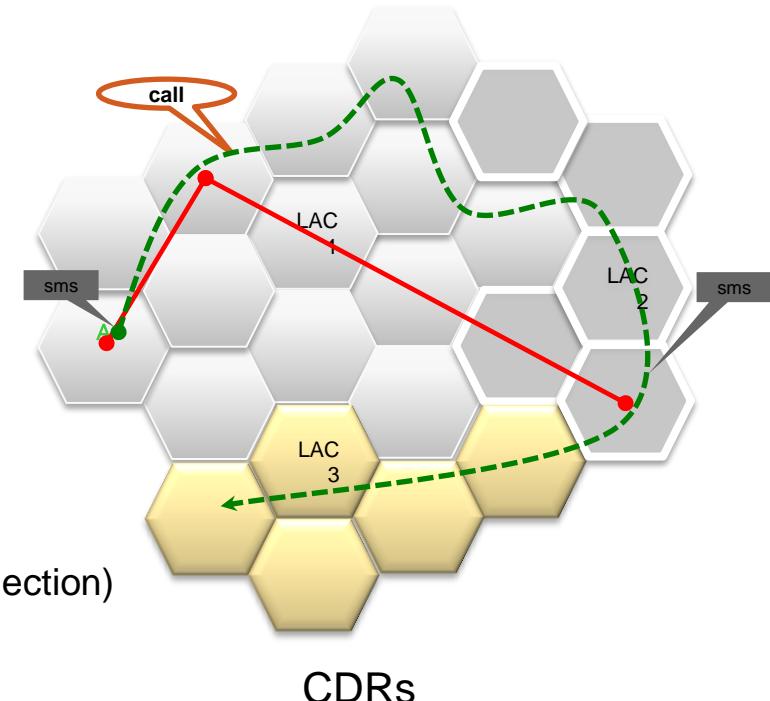
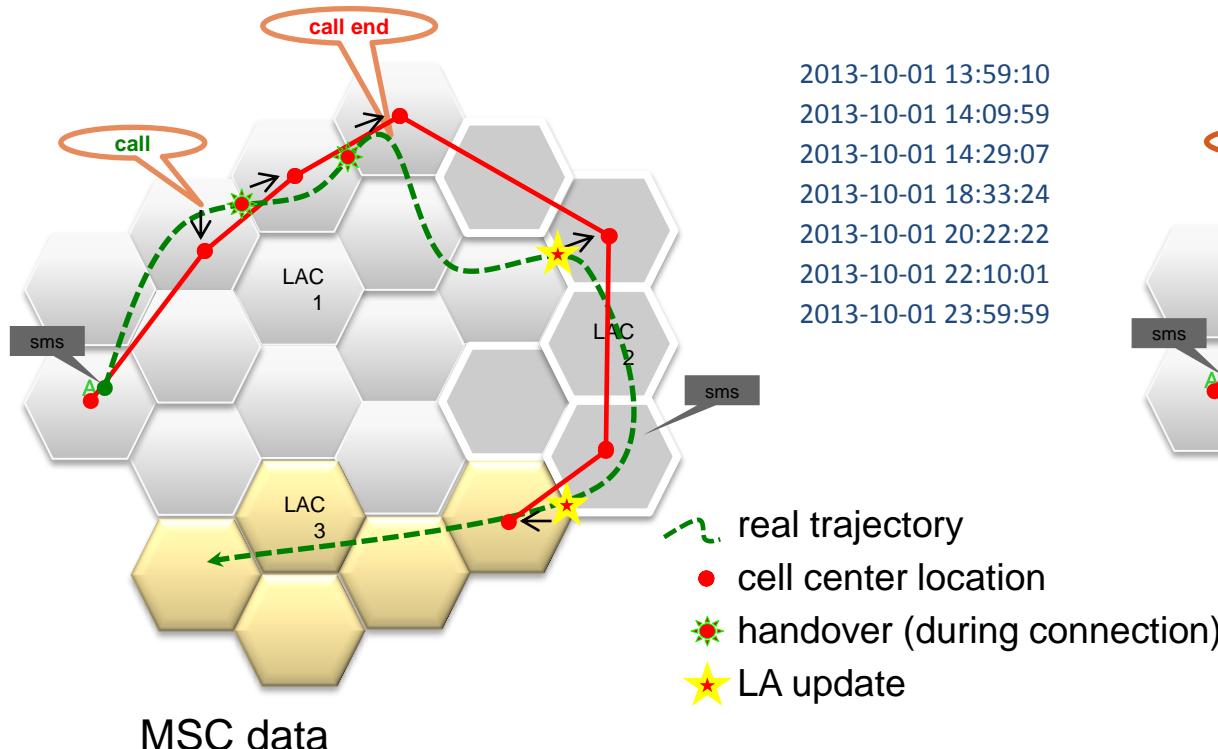


# Données des mobiles pour la recherche sur le comportement humain: retour d'expérience

Zbigniew Smoreda (Orange Labs / SENSE)

# De quoi parle-t-on? données des opérateurs mobiles

- deux possibilités:
  - signalisation réseau ("MSC data")
  - données de la facturation CRA / CDR (Call Detail Records)



# Urban mobs – visualisations des foules avec données des mobiles

Paris - World Music Day 2008

SMS

Voice

faberNovel

faberNovel

Subway

Saturday, June 21 2008 12:00

Roaming

ours étrangers



faberNovel

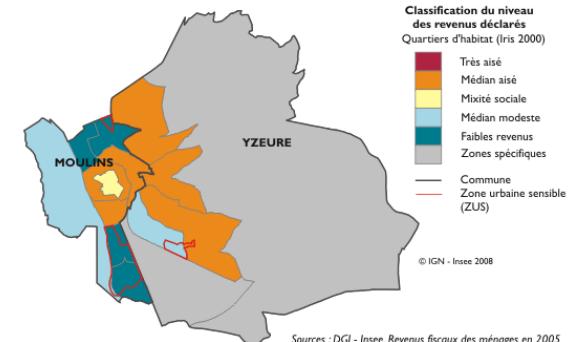
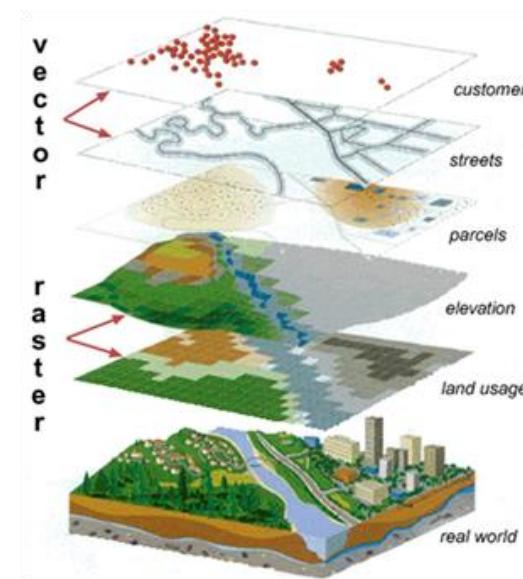
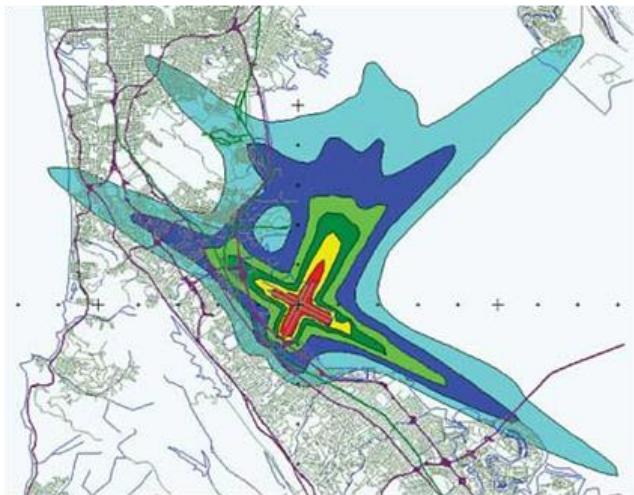


faberNovel

# mais pour être utilisable, la géolocalisation mobile doit être couplé avec d'autres données:

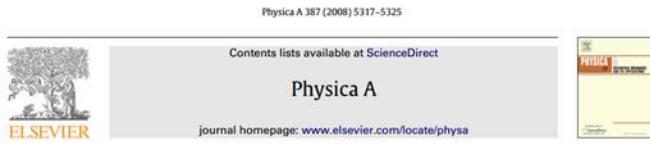
- La sémantique du territoire :

- réseau mobile: positions et couverture cellulaire
- Système d'Information Géographique (raster & vector data)
- données géocodé socio-économiques (INSEE, etc.)



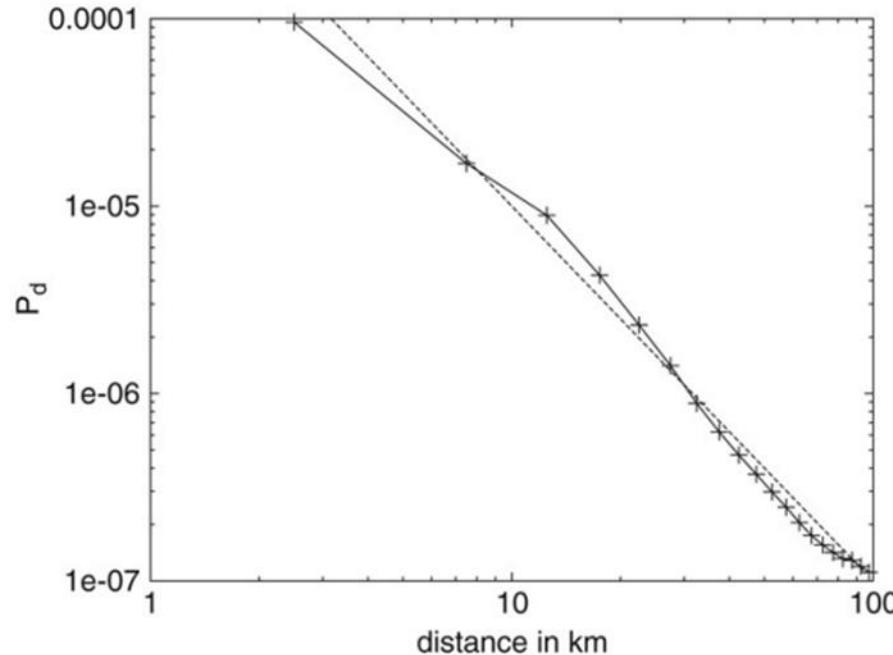
Sources : DGI - Insee, Revenus fiscaux des ménages en 2005

# le début – des réseaux sociaux vers la géographie



## Geographical dispersal of mobile communication networks

Renaud Lambiotte<sup>a,b,\*</sup>, Vincent D. Blondel<sup>a</sup>, Cristobald de Kerchove<sup>a</sup>, Etienne Huens<sup>a</sup>, Christophe Prieur<sup>c</sup>, Zbigniew Smoreda<sup>c</sup>, Paul Van Dooren<sup>a</sup>



**Fig. 2.** We plot the probability  $P_d$  that two people living at a distance  $d$  are connected by a link in a log-log scale. The dashed line is the power-law  $d^{-2}$ .

# ...mobilité humaine

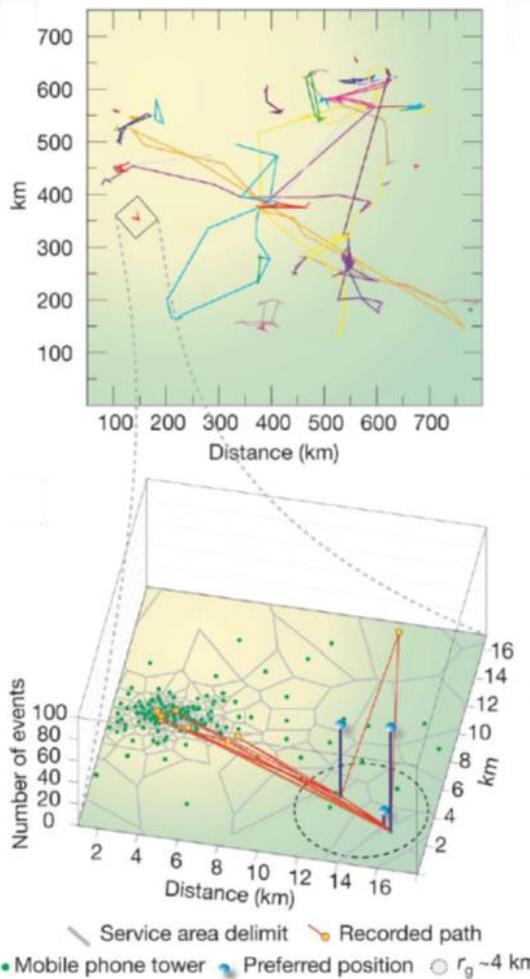
Vol 453 | 5 June 2008 | doi:10.1038/nature06958

nature

LETTERS

## Understanding individual human mobility patterns

Marta C. González<sup>1</sup>, César A. Hidalgo<sup>1,2</sup> & Albert-László Barabási<sup>1,2,3</sup>



## Migrations interpôles du 3 septembre 2007

Effectifs de migrants

Migrations internes

24 817

6 607

106

Migrations inter pôles

supérieures à 5 individus

249

36

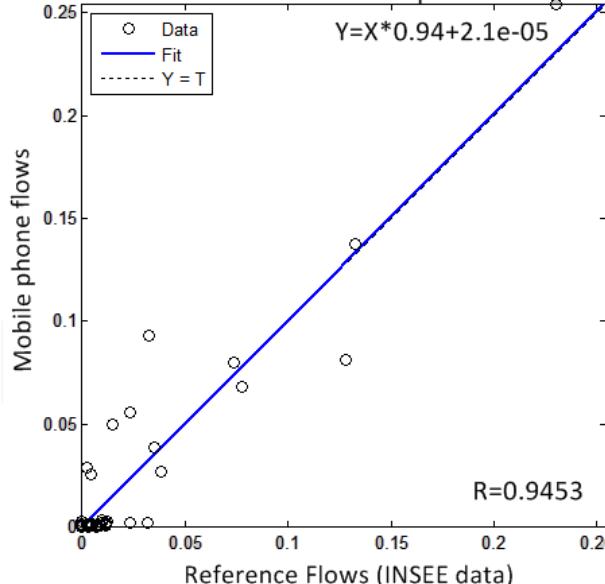
1

Effectifs de migrants

\* Partie française de l'Aire Urbaine (INSEE) de Lille.

Souice : données GSM Orange, 2007.

Linear regression for the O/D matrix  
Reference flows vs mobile phone flows



# NetMob: réunir les chercheurs qui travaillent sur ces données

NetMob - Workshop on the Analysis of Mobile Phone Networks

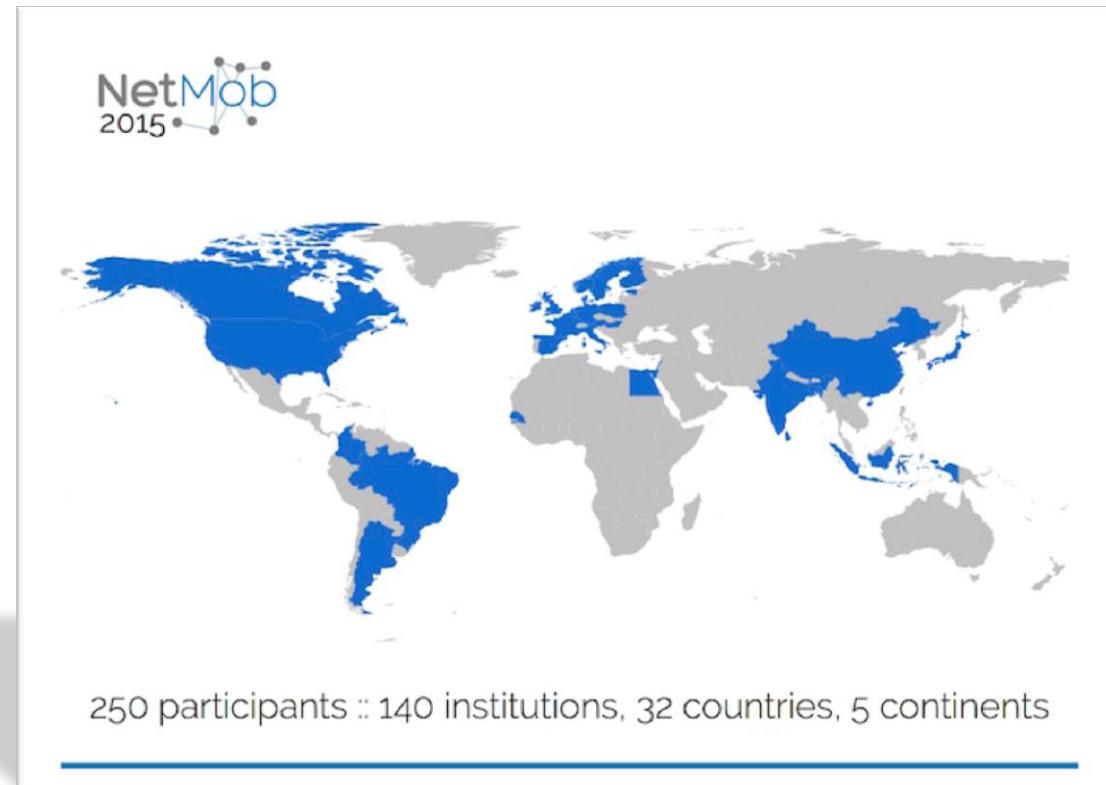
A satellite workshop to NetSci 2010

Tuesday, May 11, 2010

MIT, Cambridge, MA

## Scientific committee

Chair: Vincent Blondel, UCLouvain  
Laszlo Barabasi, Northeastern University  
Rob Claxton, British Telecom (UK)  
Vittoria Colizza, ISI Foundation (Italy)  
Massimo Colonna, Telecom Italia (Italy)  
Nathan Eagle, Santa Fe Institute  
Alexandre Gerber, AT&T Research  
Marta Gonzalez, MIT  
Cesar Hidalgo, Harvard University  
János Kertész, BUT (Hungary)  
Renaud Lambiotte, Imperial College (UK)  
David Lazer, Northeastern University  
Jure Leskovec, Stanford University  
Nuria Oliver, Telefonica Research (Spain)  
Jukka-Pekka Onnela, Harvard University  
Asu Ozdaglar, LIDS, MIT  
Alex (Sandy) Pentland, Media Lab, MIT  
Mason Porter, University of Oxford (UK)  
Carlo Ratti, Senseable City Lab, MIT  
Jari Saramäki, Helsinki U of Technology (Finland)  
Leonardo Soto, AirSage  
Zbigniew Smoreda, Orange Labs (France)  
John Tsitsiklis, LIDS, MIT  
Paul Van Dooren, UCLouvain (Belgium)



# Data for Development – données au service des pays émergeants



+ 50 publications après D4D 2013



Subject Areas | Put

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Mobile Phone Call Data as a Regional Socio-Economic Proxy Indicator

Sanja Šćepanović, Igor Mishkovski, Pan Hui, Jukka K. Nurminen, Antti Ylä-Jääski

Published: April 21, 2015 • DOI: 10.1371/journal.pone.0124160

Andris and Bettencourt Infrastructure Complexity 2014, 1:1  
http://www.infrastructure-complexity.com/content/1/1/1

Infrastructure Complexity  
a SpringerOpen Journal

RESEARCH

Open Access

Development, information and social connectivity in Côte d'Ivoire

Clio Andris\* and Luis MA Bettencourt

■ 2013 – Côte d'Ivoire

■ 2015 - Sénégal

SCIENTIFIC REPORTS  
Home | For Authors | For Referees | About Scientific Reports  
Search > 2014 > August > Article  
Take part in Nature Publishing Group's annual reader survey here for the chance to win a Macbook Air.

SCIENTIFIC REPORTS | ARTICLE

Inferring human mobility using communication patterns

Vasyl Palchykov, Marija Mitrović, Hang-Hyun Jo, Jari Saramäki & Raj Kumar Pan

EPJ Data Science  
2014  
3:3  
DOI: 10.1140/epjds21

Regular article

The geography and carbon footprint of mobile phone use in Côte d'Ivoire

Vsevolod Salnikov<sup>1</sup>✉, Daniel Schien<sup>2</sup>✉, Hyejin Youn<sup>3, 4, 5</sup>✉, Renaud Lambiotte<sup>1</sup>✉ and Michael T Gastner<sup>6, 7</sup>✉

# D4D Senegal

Projects proposals came from all over the world,  
11 with Senegalese universities



Statistics

Health

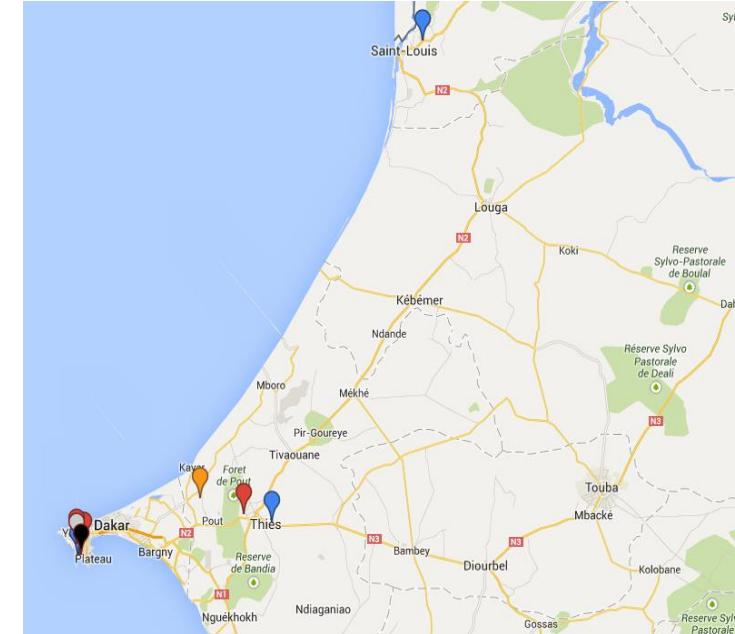
Energy

Agriculture

Transport/Urban

Data Visualisation

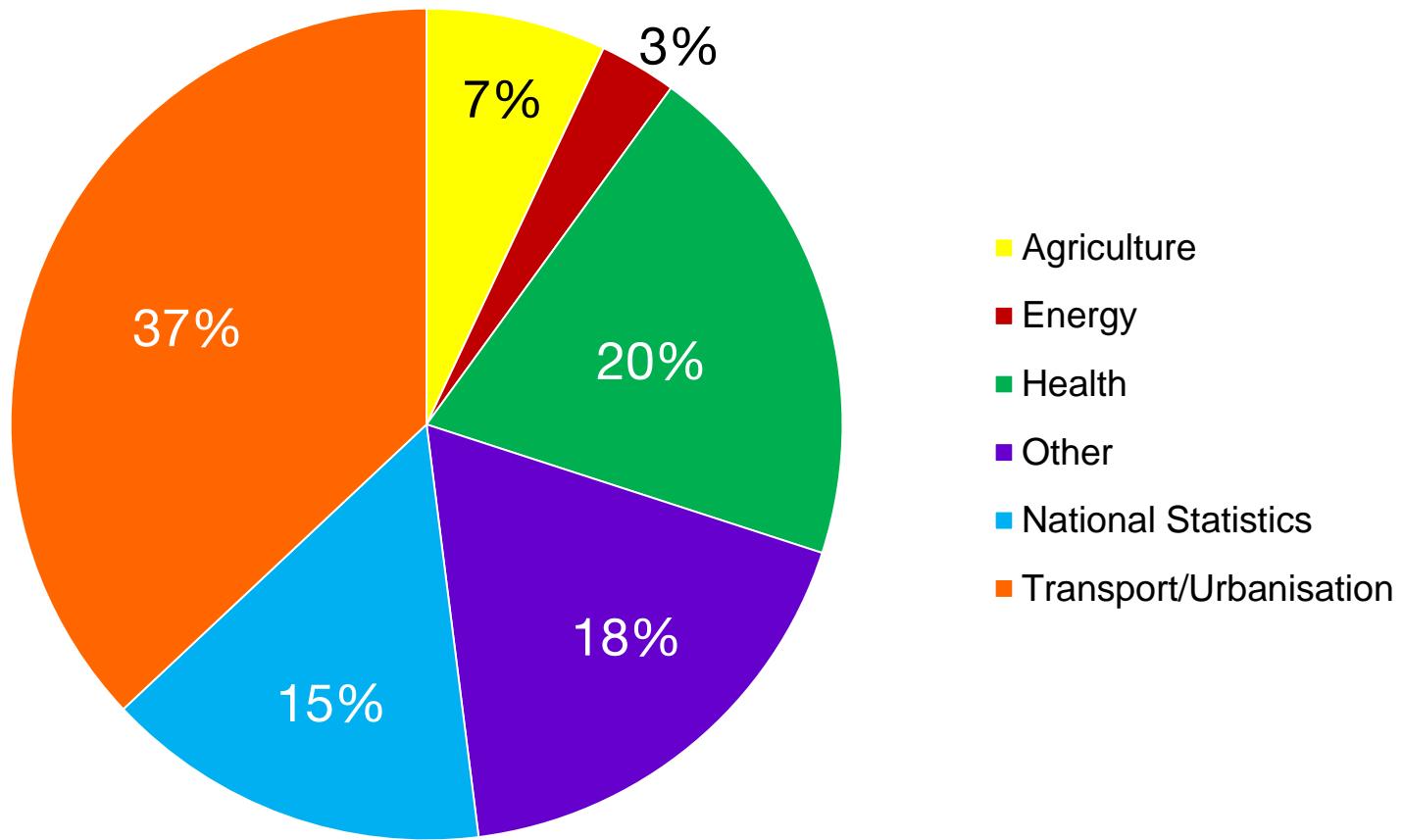
Others



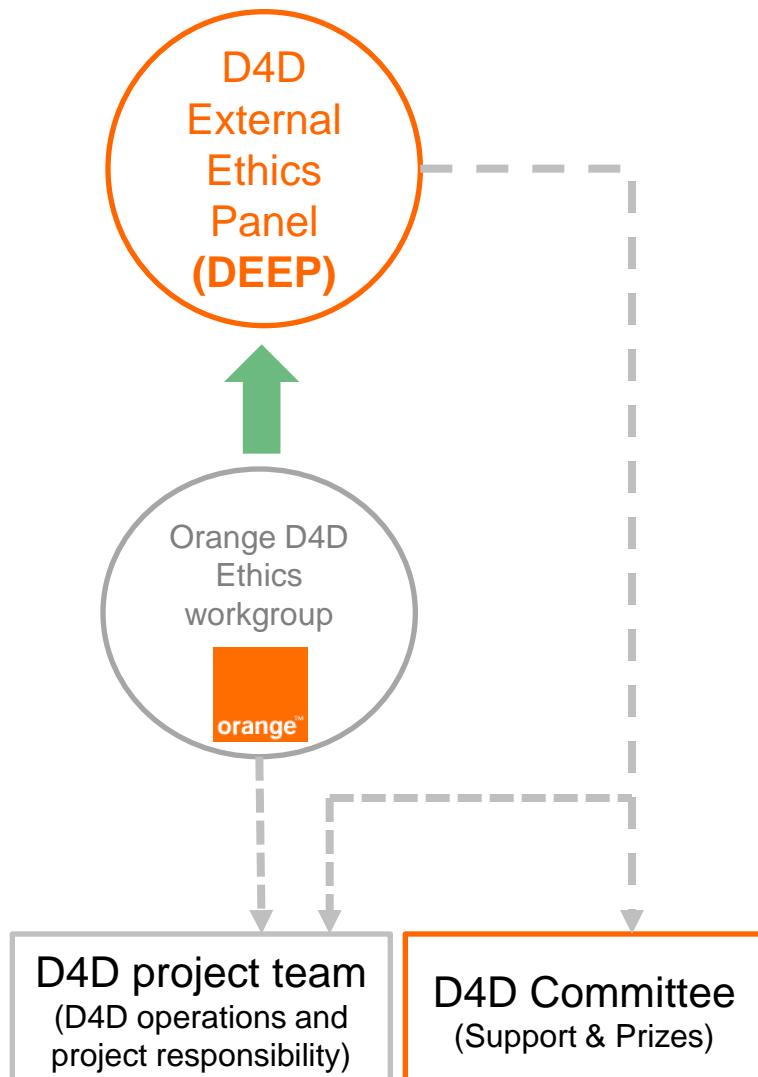
# About 60 high quality submissions on time for the Challenge



All themes are represented, with a majority of Transports, Health and National Statistics



# We set-up a process for Ethics review, involving both Orange/Sonatel managers and external experts



## D4D External Ethics Panel (external)

- External advisors with balanced profile
- Provide advise/perspective to the D4D project team and the D4D Committee

## Orange D4D Ethics workgroup (internal)

- Senior managers, most of them not involved in D4D
- Propose the Sonatel-Orange preliminary position
- Initiate actions in case of obvious need

## D4D Committee (external)

- 13 external members
- Advisor to D4D team and independent Prize allocation



(M-C Sance  
ex. INRIA)

# Results announced at MIT on 9 and 10 April



7-10 April 2015  
MIT MediaLab  
<http://netmob.org>

School // Conference // D4D Challenge



Editors: Esteban MORO, Yves-Alexandre de MONTJOYE, Vincent BLONDEL, Alex 'Sandy' PENTLAND, Nicolas DE CORDES

Organized by



Universidad  
Carlos III de Madrid



**UCL**  
Université  
catholique  
de Louvain

Sponsored by



**RealImpact**  
ANALYTICS



# The event mixed presentations, workshops, datathon social events and the announcement of the winners



# the winners



## First Prize and Energy Prize: Using mobile phone data for electrification planning

E.A. Martínez-Cesena <sup>(1)</sup>, P. Mancarella <sup>(1)</sup>, M. Ndiaye <sup>(2)</sup>, and M. Schläpfer <sup>(3)</sup>

Knowledge of local energy needs is crucial for the electricity infrastructure planning of a country. We have shown that mobile phone data are an accurate proxy of the energy needs and can be used to develop bottom-up demand models. The new methodology supports and prioritizes the electrification plans in areas with scarce information on local activities and energy consumption.

(1)University of Manchester, UK - (2) Ecole supérieure polytechnique de Dakar UCAD, Senegal - (3) Santa Fe Institute, USA



## Data Crossing Prize: Using mobile phone data for Spatial Planning simulation and Optimization Technologies (SPOT)

S. Gueye <sup>(1)</sup>, B.M. Ndiaye <sup>(3)</sup>, D. Josselin <sup>(3)</sup>, M. Poss <sup>(5)</sup>, R.M. Faye <sup>(2)</sup>, P. Michelon <sup>(1)</sup>, C. Genre-Grandpierre <sup>(3)</sup>, and F. Ciari <sup>(4)</sup>

We propose a methodology of location and relocation of amenities (home, shop, work, leisure places) for urban planning decision. Our methodology exploits mobile phone data and other variables and point of interest on maps to propose optimal amenity locations to reduce the overall travel time or travel distance.

(1) LIA, Université d'Avignon, France - (2) LTI, ESP - Université de Cheikh Anta Diop, Senegal - (3) LMDAN, FASEG-Université de Cheikh Anta Diop, Senegal - (4) Institute for Transport Planning and Systems (IVT), Zurich, Switzerland - (5) UMR ESPACE, CNRS, Avignon, France



## Agriculture Prize: Genesis of millet prices in Senegal: the role of production, markets and their failures

D.C. Jacques <sup>(1)</sup>, R. d'Andrimont <sup>(1)</sup>, J. Radoux <sup>(1)</sup>, F. Waldner <sup>(1)</sup>, and E. Marinho <sup>(2)</sup>

Information asymmetries are responsible for price differentials in only the few areas where the mobile phone coverage has not yet reached its full potential, which damages both poor producers and food insecure consumers. To address this issue, we have integrated it in a spatially explicit model that simulates the functioning of agricultural markets.

(1) Earth and Life Institute, Université Catholique de Louvain, Belgium - (2) Independent researcher, Rio de Janeiro, Brazil



## Data Visualization Prize: Data for Development Reloaded: Visual Matrix Techniques for the Exploration and Analysis of Massive Mobile Phone Data

S. van den Elzen, M. van Dortmont, J. Blaas, D. Holten, W. van Hage, J-K. Buenen, J.J. van Wijk, R. Spousta \*, S. Sala \*, S. Chan \*, A. Kuzmickas \* University of Technology SynerScope BV Sensemaking Fellowship

Eindhoven University of Technology & SynerScope BV, The Netherlands  
\* Sensemaking Fellowship (MIT, Harvard University)

In our Visual analytics techniques for the exploration and analysis of massive mobile phone data, users are enabled to identify both temporal and structural patterns such as normal behavior, outliers, anomalies, periodicity, trends and counter-trends.



## Practical Application Prize: Mobile Data as Public-Health Decision Enabler: A Case Study of Cardiac and Neurological Emergencies

E. Mutafungwa <sup>(1)</sup>, F. Thiesnard <sup>(2)</sup>, M. Pathé Diallo <sup>(2)</sup>, R. Gore <sup>(3)</sup>, V. Jouhet <sup>(2)</sup>, C. Karray <sup>(4)</sup>, N. Kheder <sup>(4)</sup>, R. Saddem <sup>(4)</sup>, J. Hämäläinen <sup>(1)</sup>, G. Diallo <sup>(1)</sup>

The objective of the study is to show the areas in which the absence of a nearest hospital can result in death or serious squeals. The identification of areas at high risk in case of stroke or myocardial infarction, requiring rapid intervention, could help Public Health decision makers to prioritize investments.

(1) Department of Communications and Networks, Aalto University School of Electrical Engineering, Finland - (2) ERIAS INSERM U897, ISPED, Université de Bordeaux, France - (3) Virginia Modeling Analysis and Simulation, Old Dominion University, USA - (4) Faculté des Sciences de Tunis, University of Tunis, Tunisia



## Scientific Prize and Ethics Mention: Construction of socio-demographic indicators with digital breadcrumbs

F. Bruckschen <sup>(1)</sup>, T. Schmid <sup>(2)</sup>, T. Zbiranski <sup>(1)</sup>

We show that socio-demographic indicators such as population, age, literacy, poverty, religion, ethnicity, electricity supply and others can be estimated in unprecedented detail and virtually ad-hoc using antenna-to antenna traffic data only. We offer a uniform approach that can be easily extended to other variables. Results are tested for spatio-temporal robustness and visualized as heat maps.

(1) Humboldt Universität Berlin, Germany - (2) Freie Universität Berlin, Germany



## National Statistics Prize: Virtual Networks and Poverty Analysis in Senegal

N. Pokhriyal, W. Dong, and V. Govindaraju  
Computer Science and Engineering, State University of New York at Buffalo, USA

Poverty is a complex phenomenon, but can be approximated by observing mobile phone usages and mobility at regional level and extrapolated at more granular level. Poverty maps showcasing multiple perspectives can provide policymakers with better insights for effective responses for poverty eradication.



## Transport Prize: National and Regional Road Network Optimization for Senegal Using Mobile Phone Data

Y. Wang <sup>(1)</sup>, G. Homem de Almeida Correia <sup>(1)</sup>, and Erik de Romph <sup>(1,2)</sup>

Anonymous mobile phone traces can be filtered with an algorithm to generate a proxy for a trip origin-destination matrix. This is used to develop a gravity model that predicts the future mobility in the country dependent on travel time and number of calls and messages between the departments. This information is then used to improve decision making for road network planning.

(1) Department of Transport and Planning, Delft University of Technology, The Netherlands - (2) DAT.mobility, The Netherlands

# Results are now published

The selected contributions D4D-Senegal are now available for download

D4D communications

[http://netmob.org/assets/img/NetMob%202015\\_D4D%20Challenge%20Senegal\\_Sessions\\_Scientific\\_Papers.pdf](http://netmob.org/assets/img/NetMob%202015_D4D%20Challenge%20Senegal_Sessions_Scientific_Papers.pdf) (298 pages, 83MB)

D4D posters

[http://netmob.org/assets/img/NetMob%202015\\_D4D%20Challenge%20Senegal\\_Sessions\\_Posters.pdf](http://netmob.org/assets/img/NetMob%202015_D4D%20Challenge%20Senegal_Sessions_Posters.pdf) (56 pages, 53 MB)

The D4D contribution can also be downloaded from

<http://www.d4d.orange.com/en/presentation/endowment-and-panel/Folder/The-D4D-Challenge-is-a-great-success>

The datasets for D4D are described <http://arxiv.org/abs/1407.4885>

# D4D challenge

Orange uses big data  
for the benefit of the communities



opening of the Data for  
Development challenge  
in Senegal

- 3 projects are launched to explore use of mobile data for
  - Health: Disease modeling
  - National Statistics: Proxy for indicators
  - Agriculture: Food security

merci