

Inferencia de la Movilidad Urbana usando datos de telefonía

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CONTENIDOS

Centro I+D - Chile

- ▶ Estado del arte
- ▶ Trazas de eventos
- ▶ Aplicaciones

Estado del arte

- ▶ Call Detail Record: herramienta de facturación/contabilidad en telefonía (datos, voz, sms,...)
- ▶ Uso de CDRs para movilidad urbana:
 - Exploring Regression for Mining User Moving Patterns in a Mobile Computing System (Hung 2005)
 - Reality mining: sensing complex social systems (Eagle, 2006)
 - Understanding individual human mobility patterns (González, 2008)
 - The dynamics of a mobile phone network (Hidalgo, 2008)
 - Limits of Predictability in Human Mobility (Song, 2010)
 - HCMM: Modelling spatial and temporal properties of human mobility driven by users' social relationships (Boldrini, 2010)
 - Human Mobility Prediction based on Individual and Collective Geographical Preferences (Calabrese, 2010)
 - Human Mobility Modeling at Metropolitan Scales (Isaacman, 2012)
 - Study on Urban Mobility and Dynamic Population Estimation by Using Aggregate Mobile Phone Sources (Horanont, 2012)
 - Exploration and Analysis of Massive Mobile Phone Data: A Layered Visual Analytics approach (van den Elzen, 2013)
 - Probabilistic Inference of Unknown Locations : Exploiting Collective Behavior when Individual Data is Scarce (Blumenstock, 2014)
 - Origin-destination trips by purpose and time of day inferred from mobile phone data (Alexander, 2015)
 - Analyzing Cell Phone Location Data for Urban Travel: Current 3 Methods, Limitations and Opportunities (Colak, 2015)

Estado del arte

Limits of Predictability in Human Mobility

Chaoming Song,^{1,2} Zehui Qu,^{1,2,3} Nicholas Blumm,^{1,2} Albert-László Barabási^{1,2*}

A range of applications, from predicting the spread of human and electronic viruses to city planning and resource management in mobile communications, depend on our ability to foresee the whereabouts and mobility of individuals, raising a fundamental question: To what degree is human behavior predictable? Here we explore the limits of predictability in human dynamics by studying the mobility patterns of anonymized mobile phone users. By measuring the entropy of each individual's trajectory, we find a 93% potential predictability in user mobility across the whole user base. Despite the significant differences in the travel patterns, we find a remarkable lack of variability in predictability, which is largely independent of the distance users cover on a regular basis.



Origin–destination trips by purpose and time of day inferred from mobile phone data

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The dynamics of a mobile phone network

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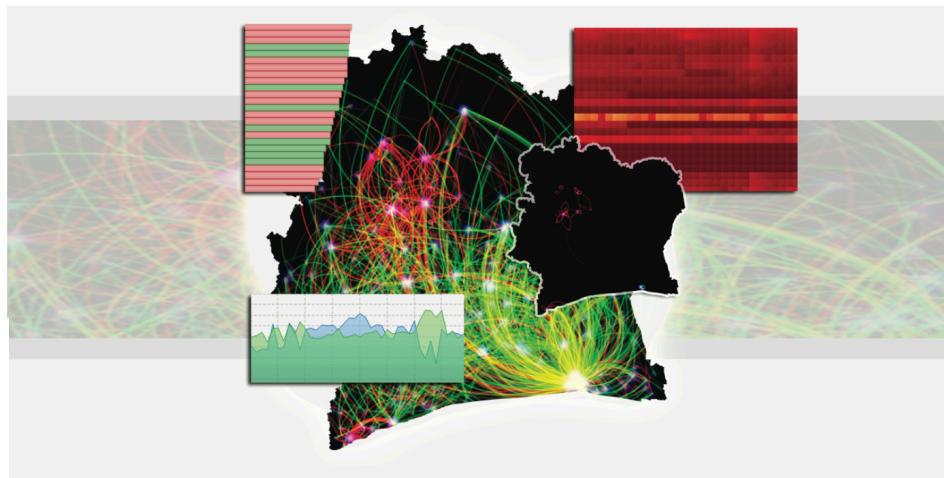
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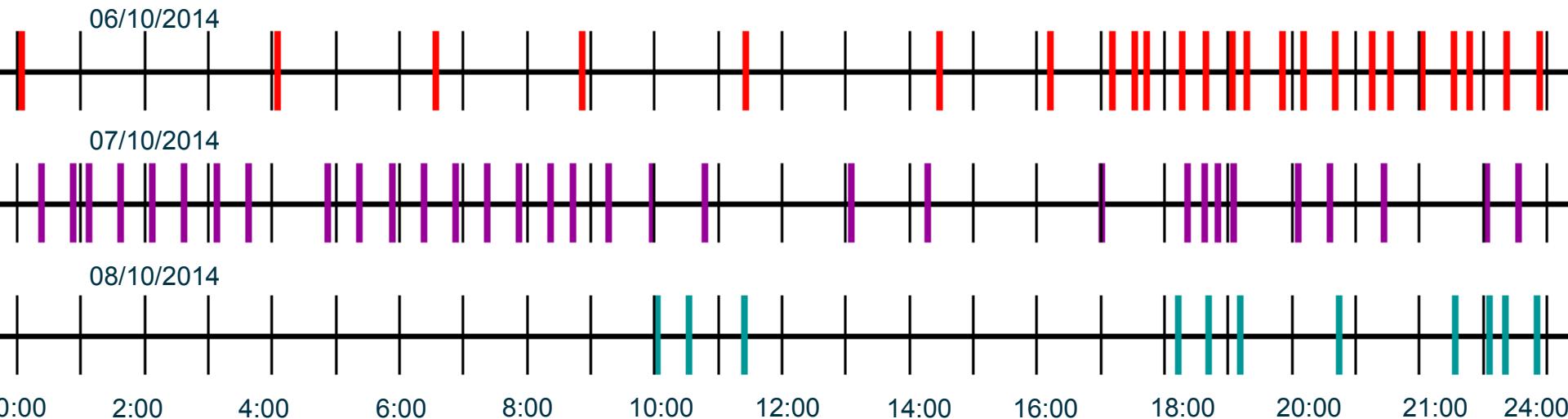
Exploration and Analysis of Massive Mobile Phone Data: A Layered Visual Analytics approach

Stef van den Elzen, Jorik Blaas, Danny Holten, Jan-Kees Buenen, Jarke J. van Wijk, Robert Spousta, Anna Miao, Simone Sala, Steve Chan



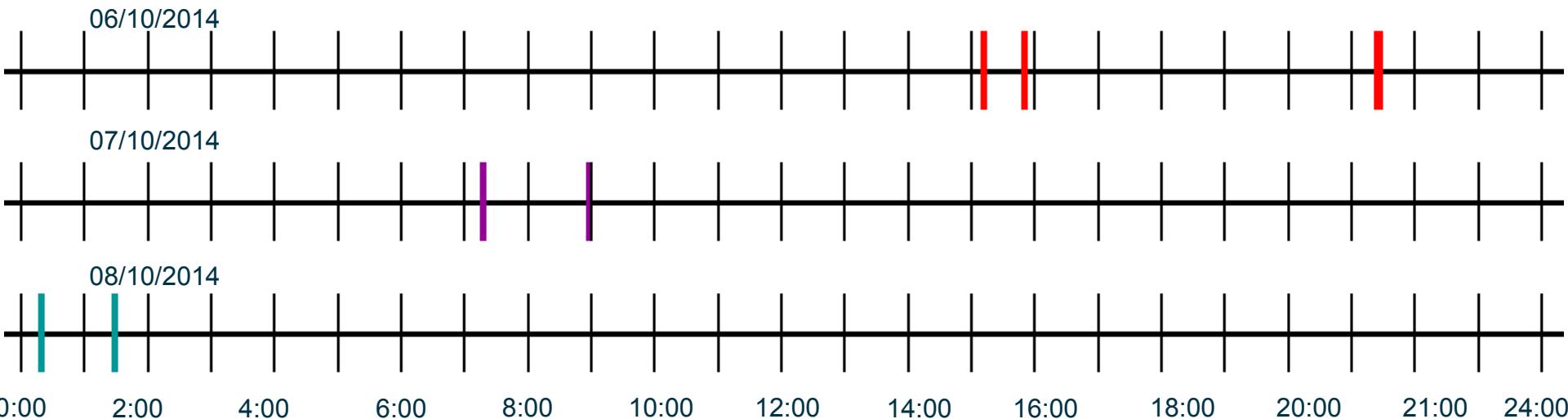
Trazas de eventos para tráfico de datos

- ▶ Ejemplo de trazas para un único dispositivo de Santiago:

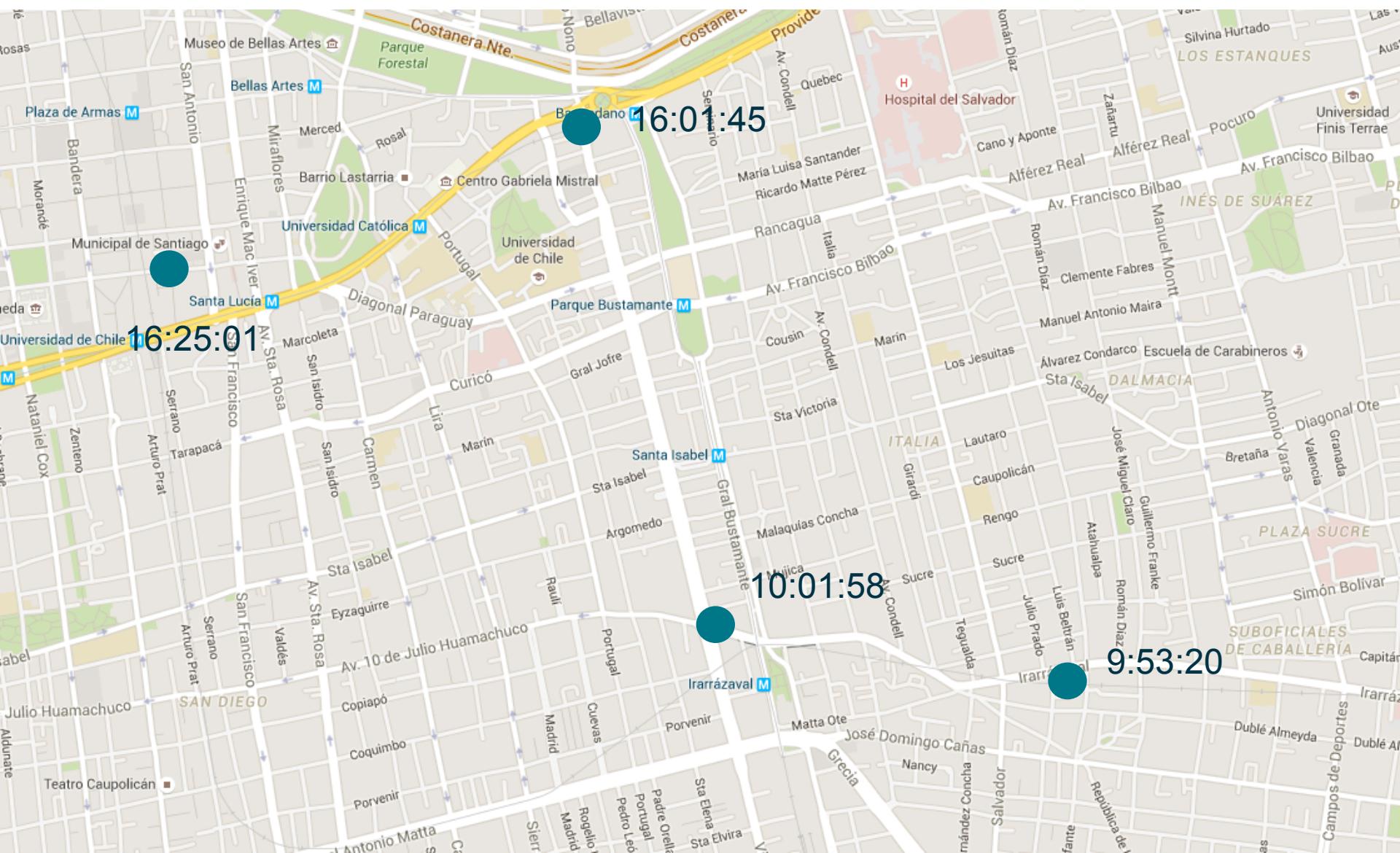


Trazas de eventos para tráfico de voz

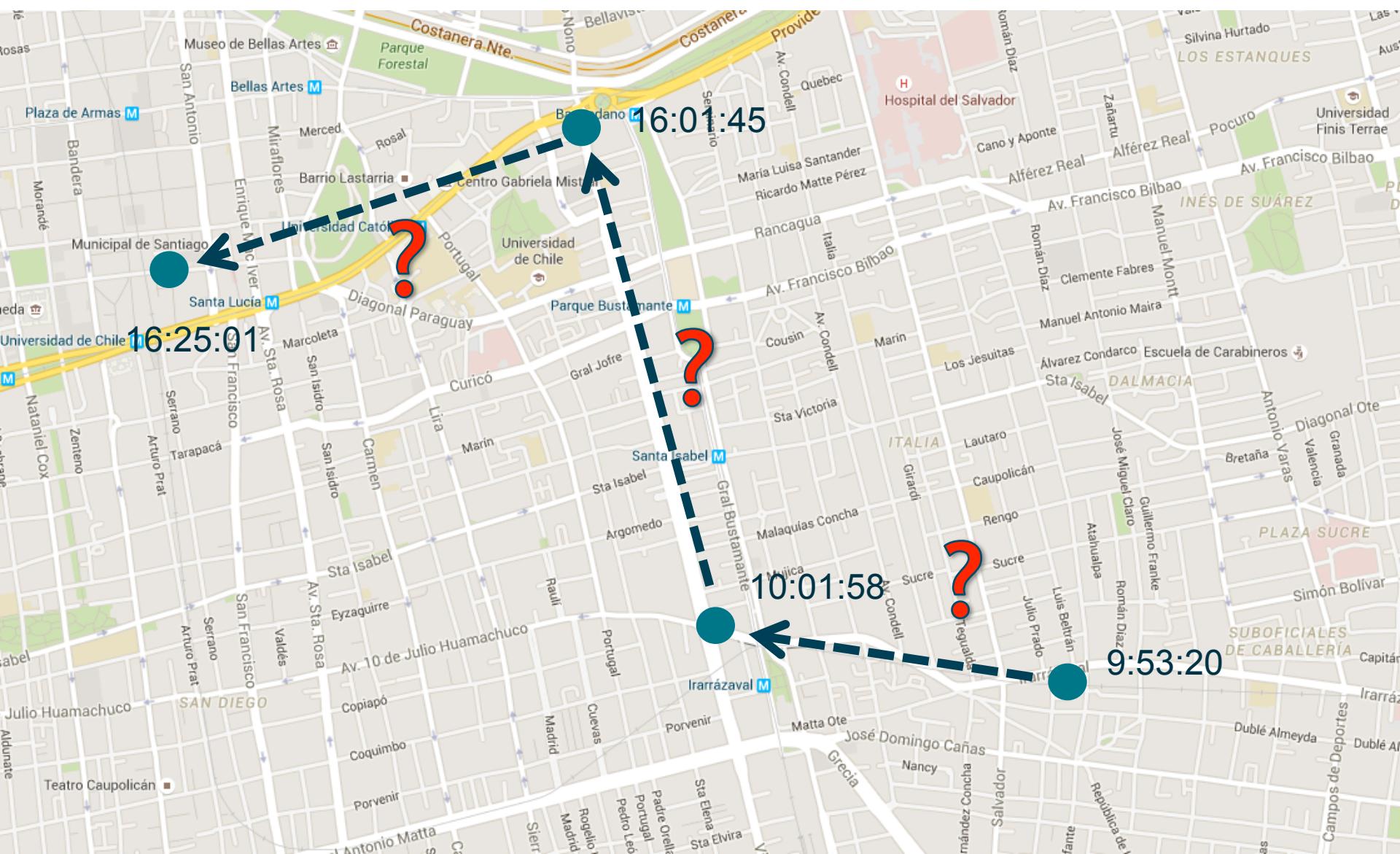
- ▶ Ejemplo de trazas para un único dispositivo de Santiago:



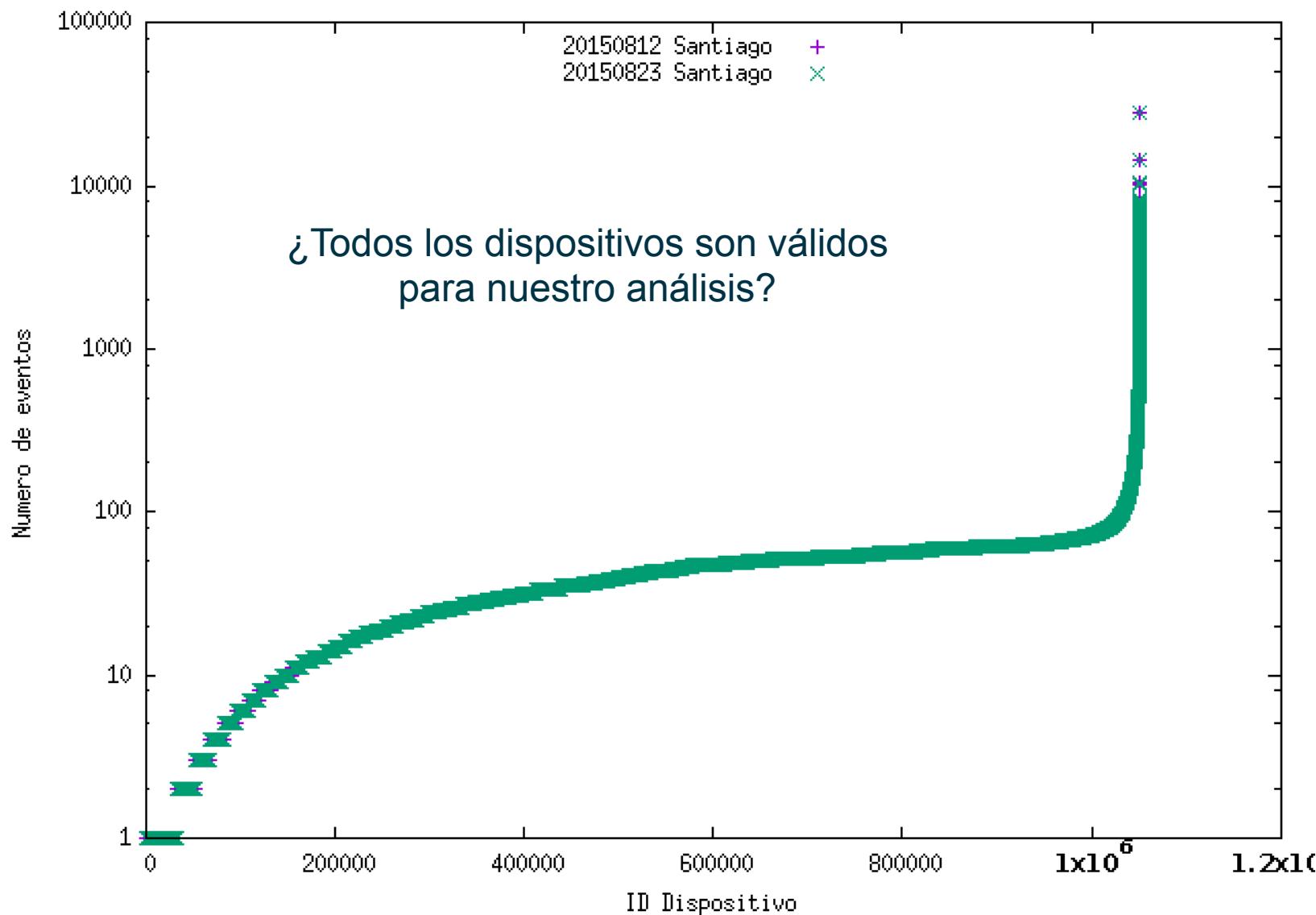
Trazas de eventos sin interpolación



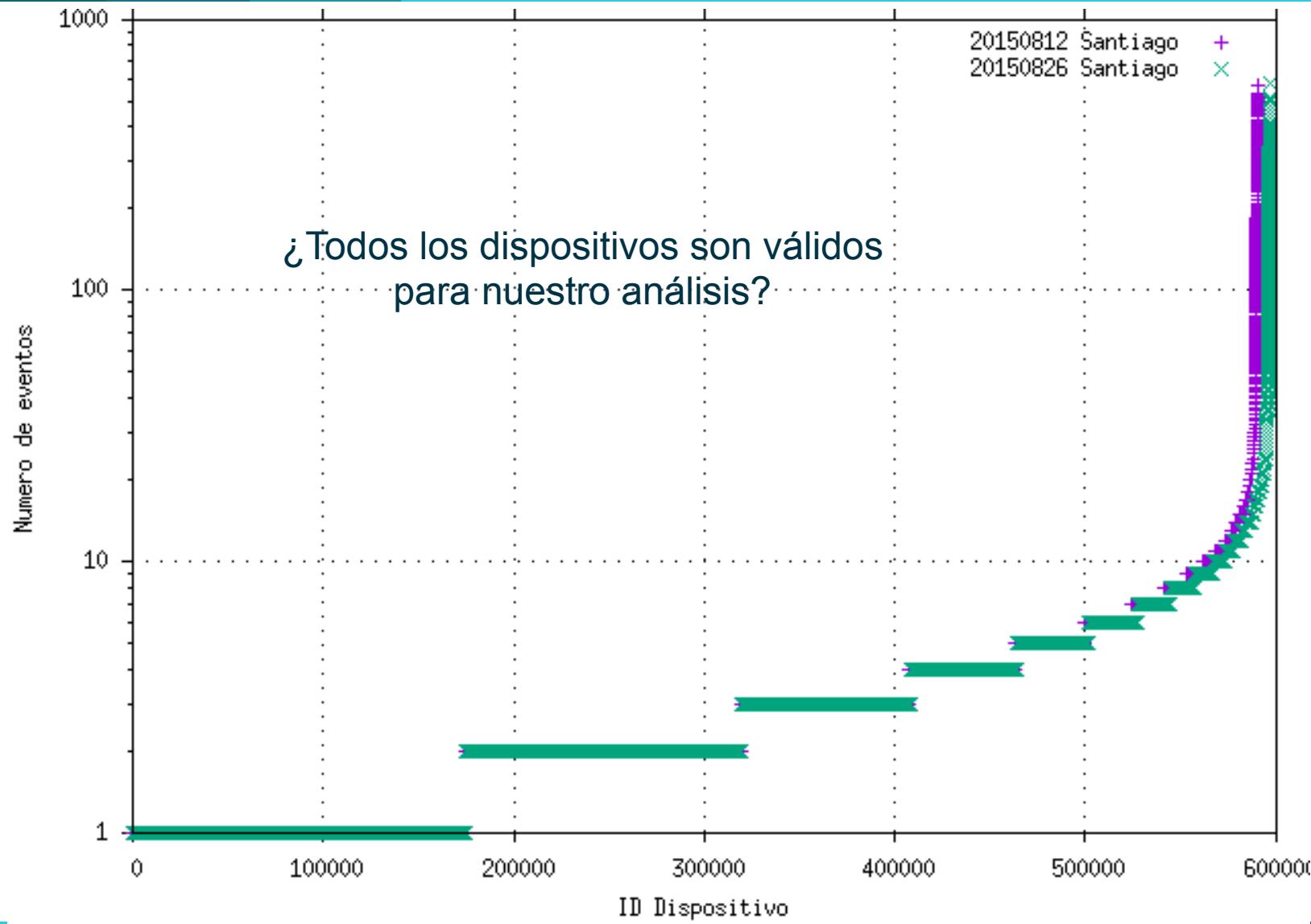
Trazas de eventos



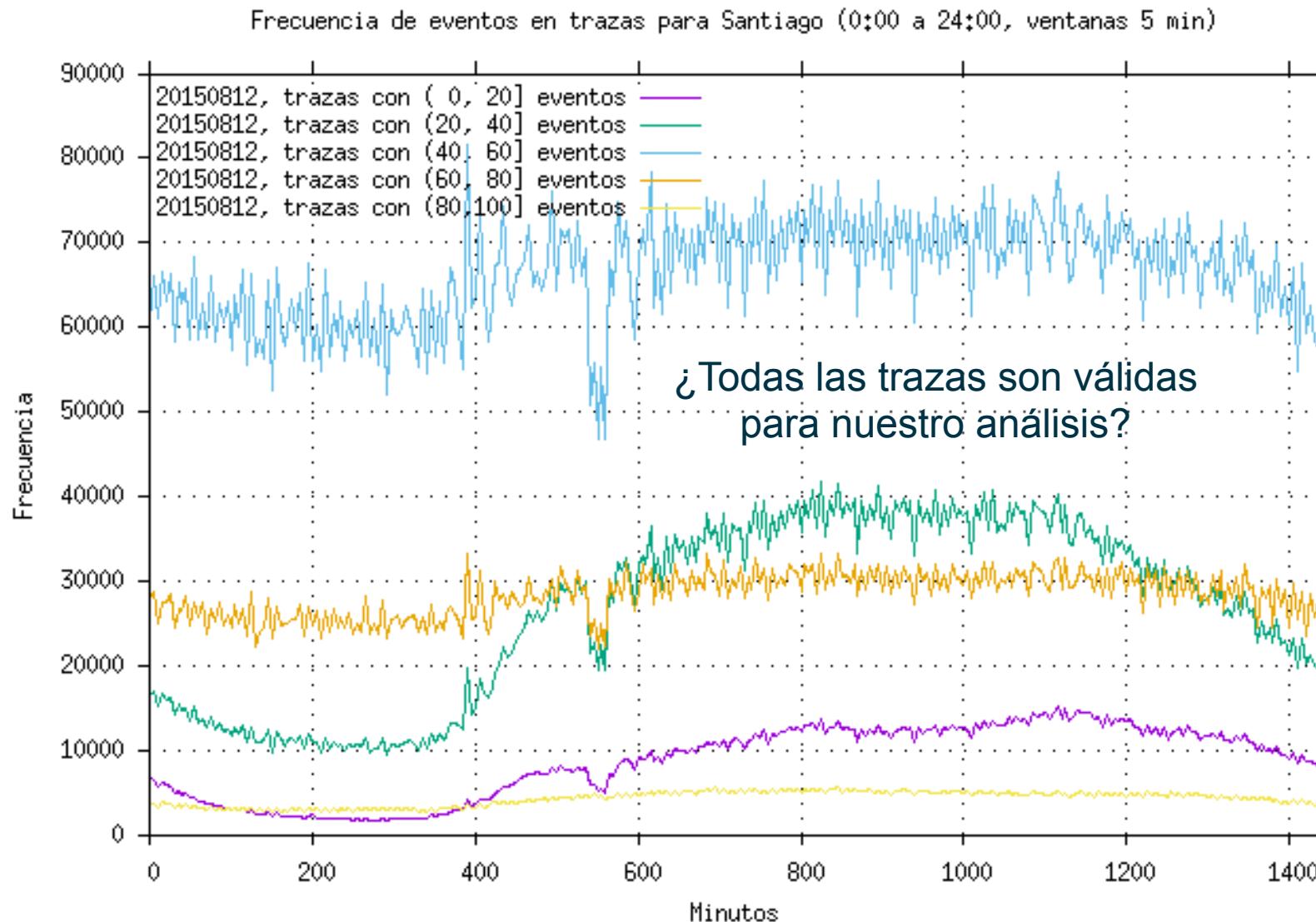
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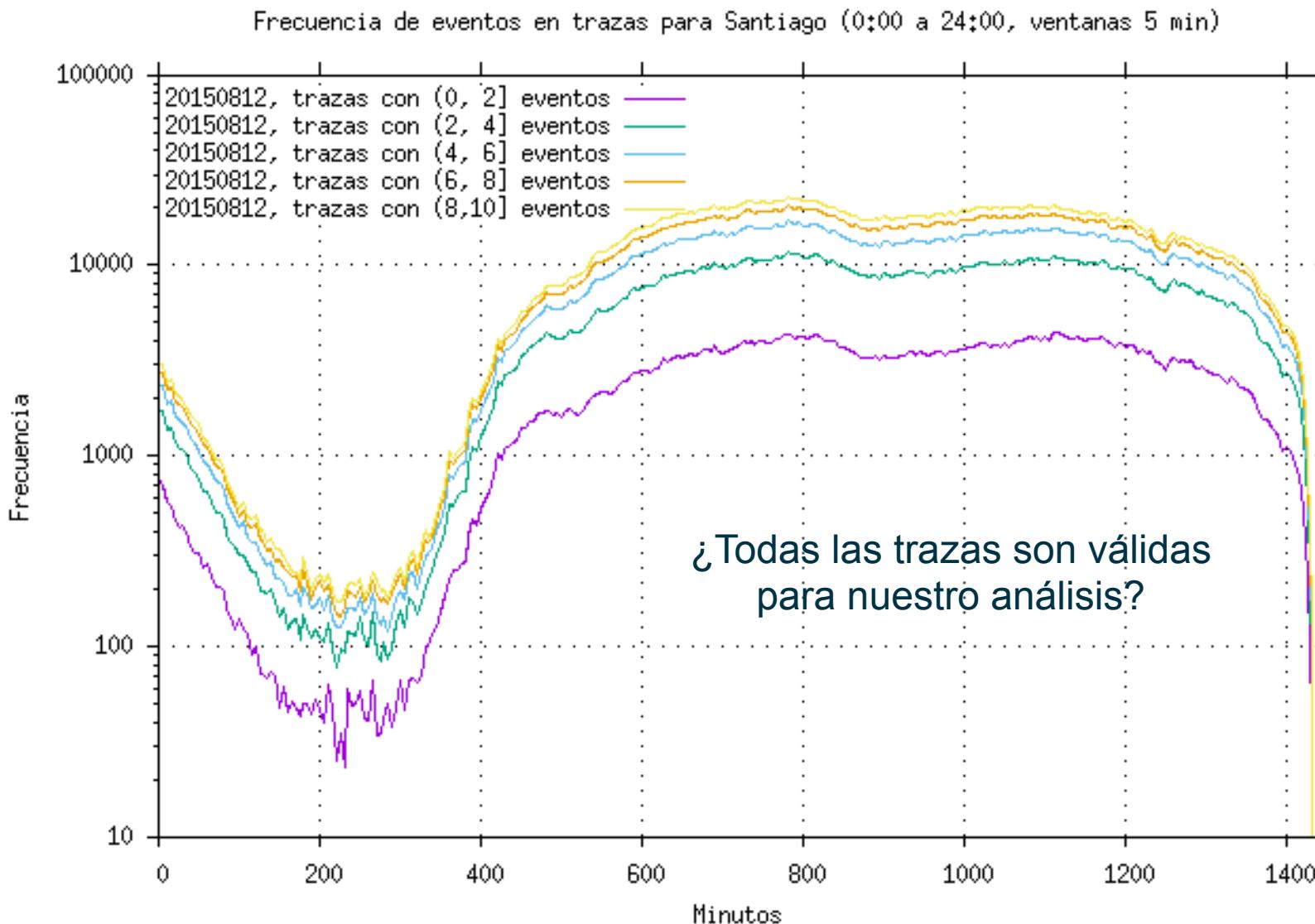
#Eventos_voz/Dispositivo



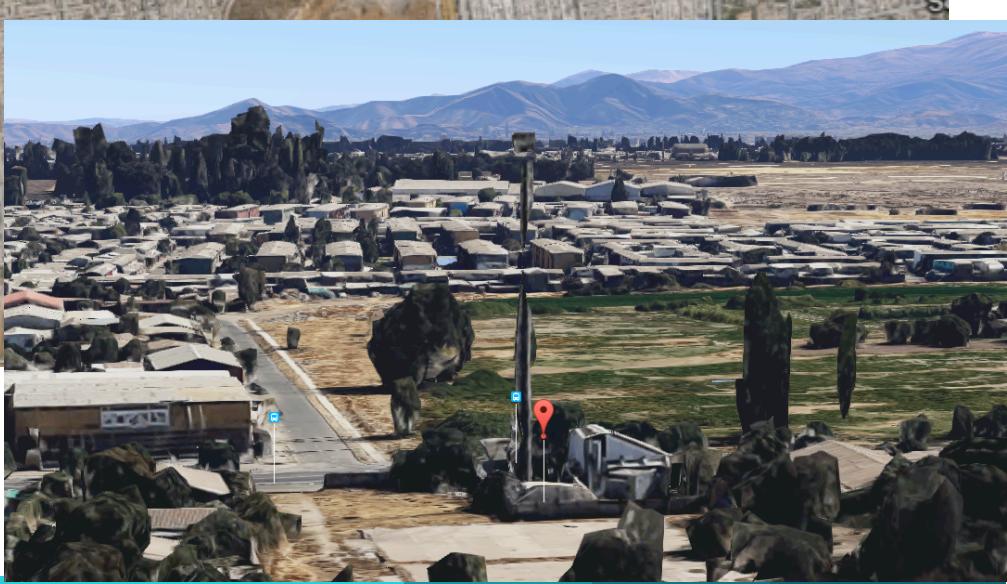
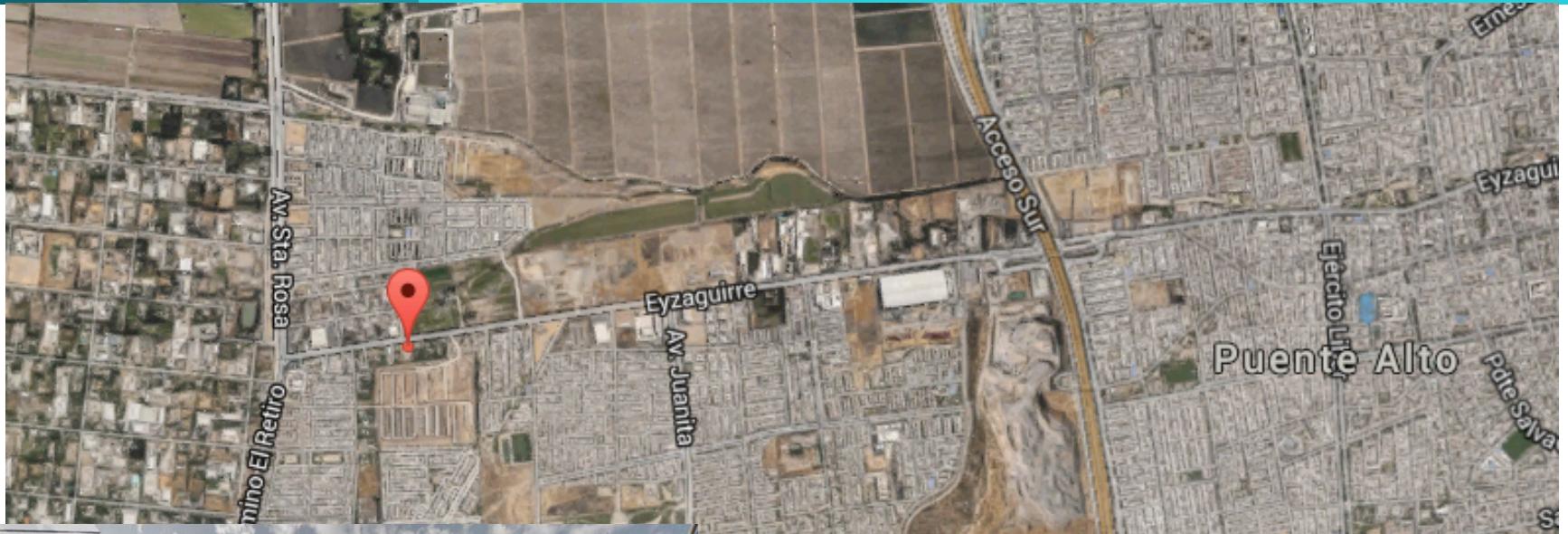
#Eventos_datos/Minuto



#Eventos_voz/Minuto



Curiosidades

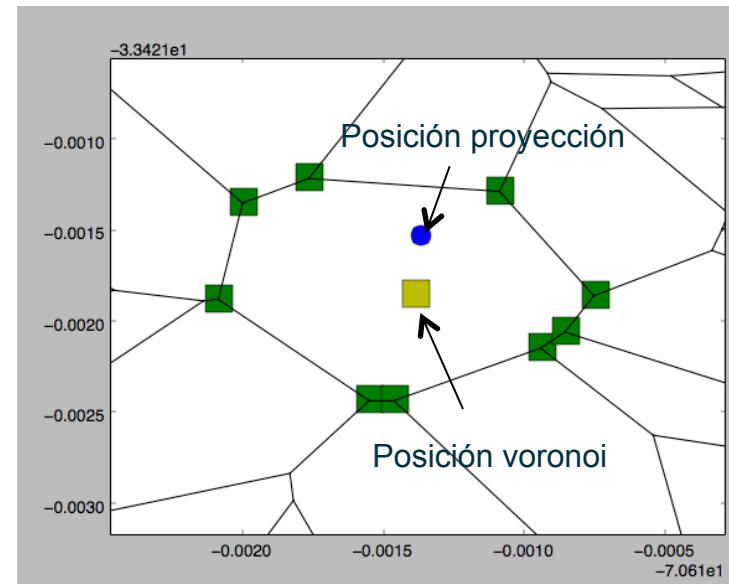
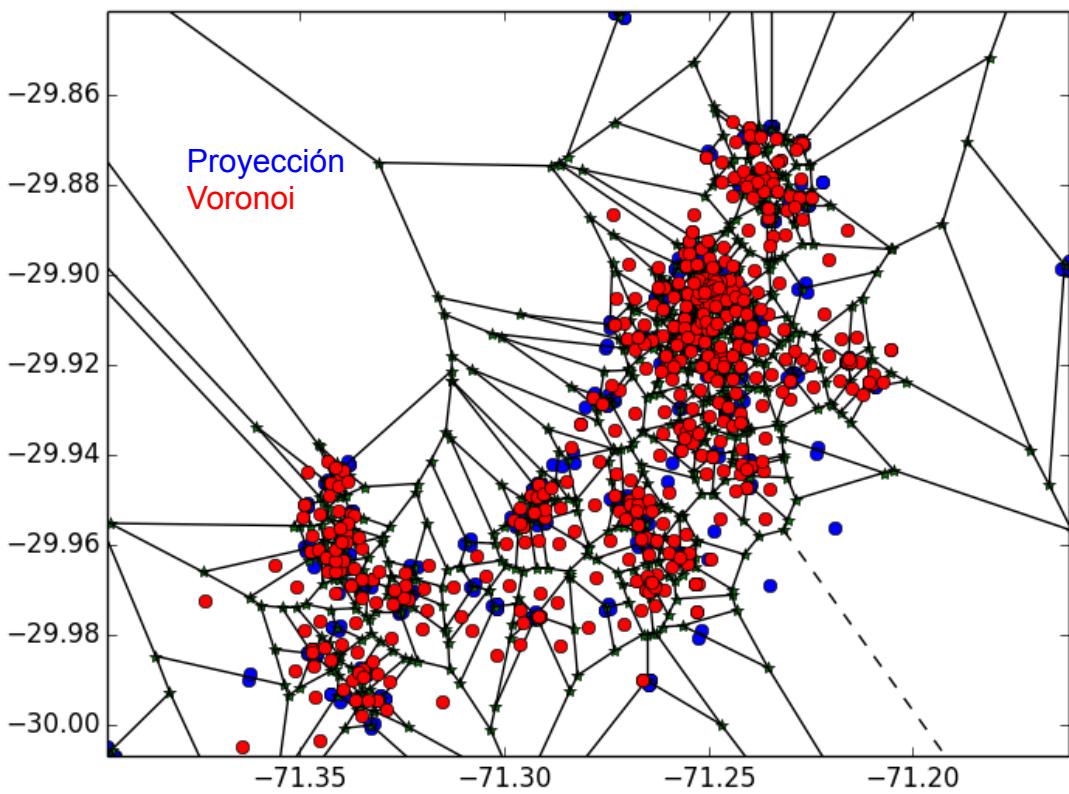


Curiosidades



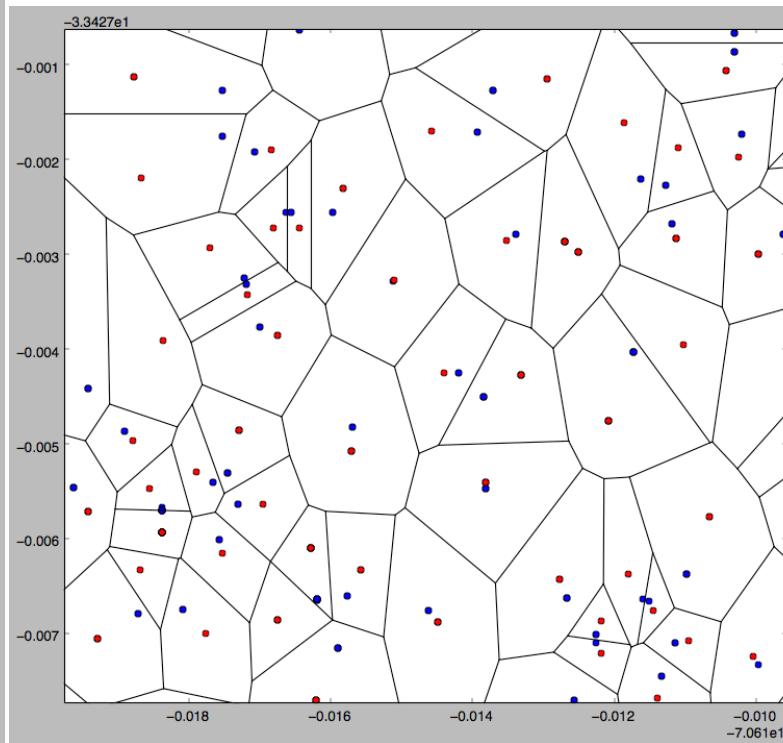
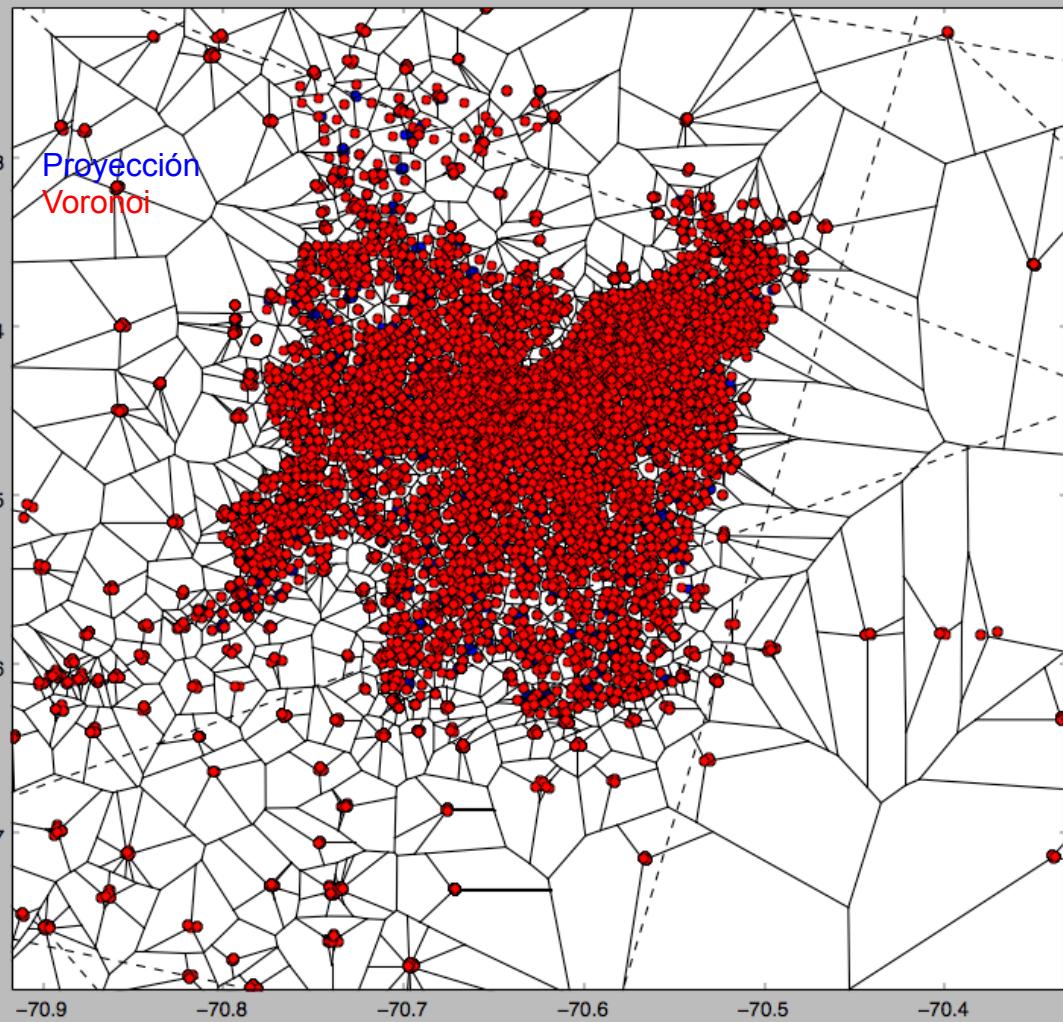
Aplicaciones

► Diagrama de Voronoi (Serena/Coquimbo)



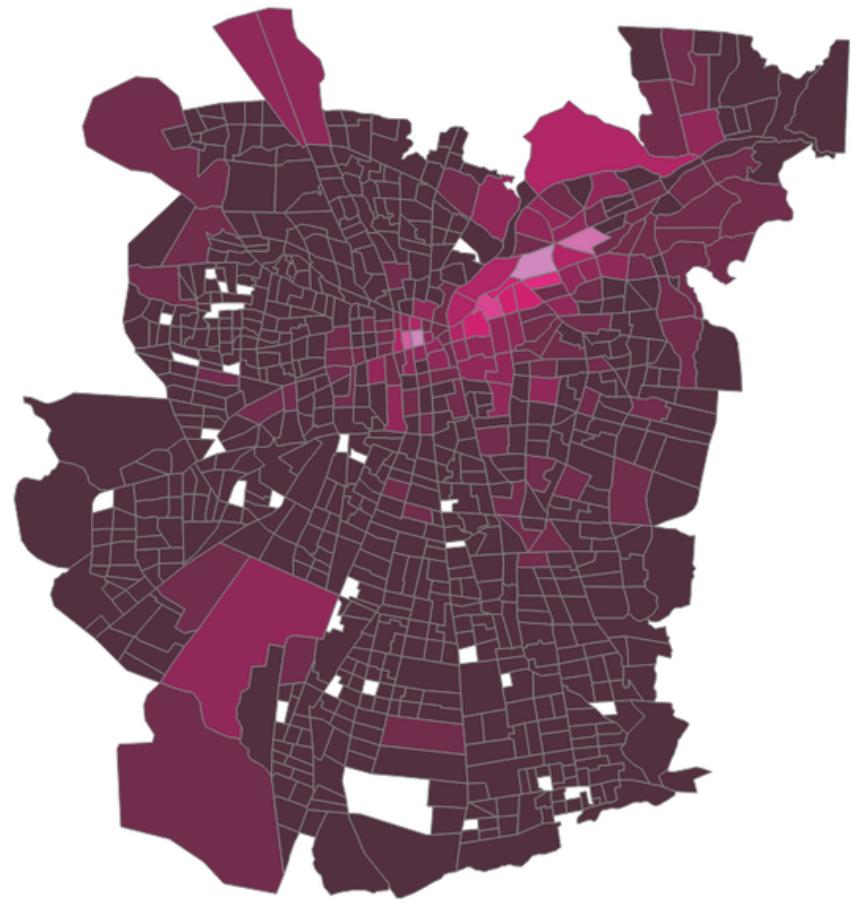
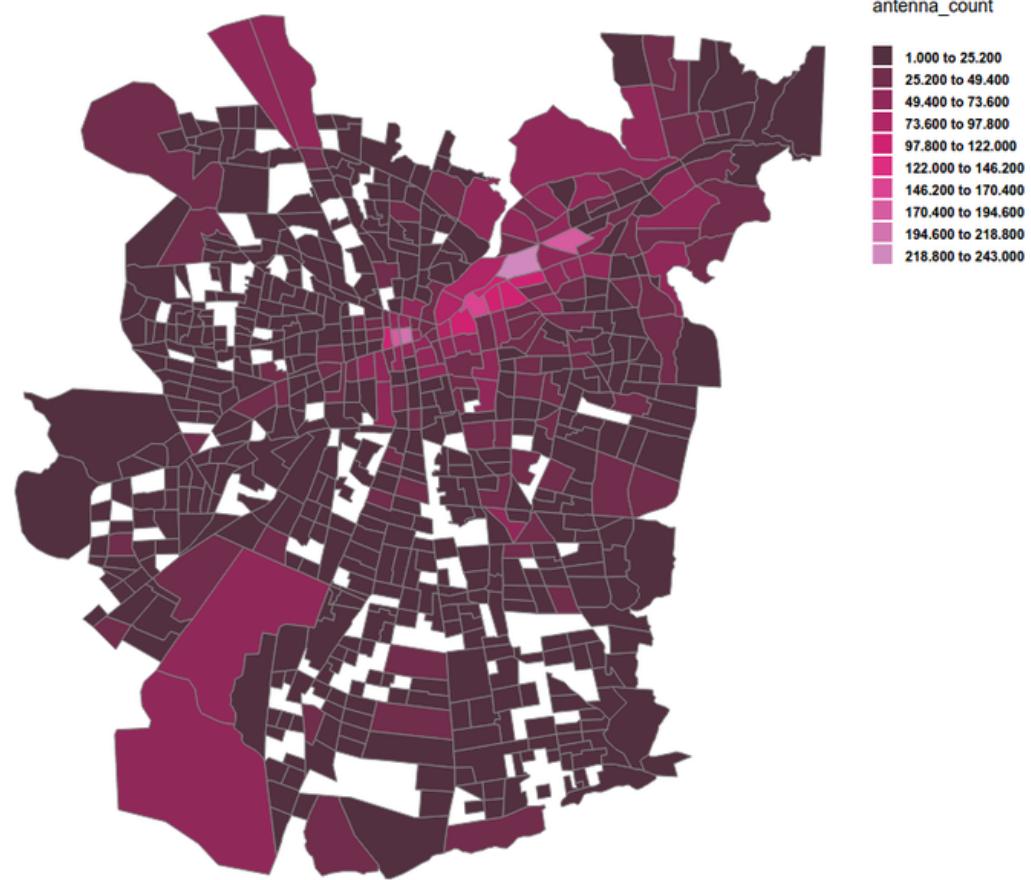
Aplicaciones

▶ Diagrama de Voronoi (Santiago)



Aplicaciones

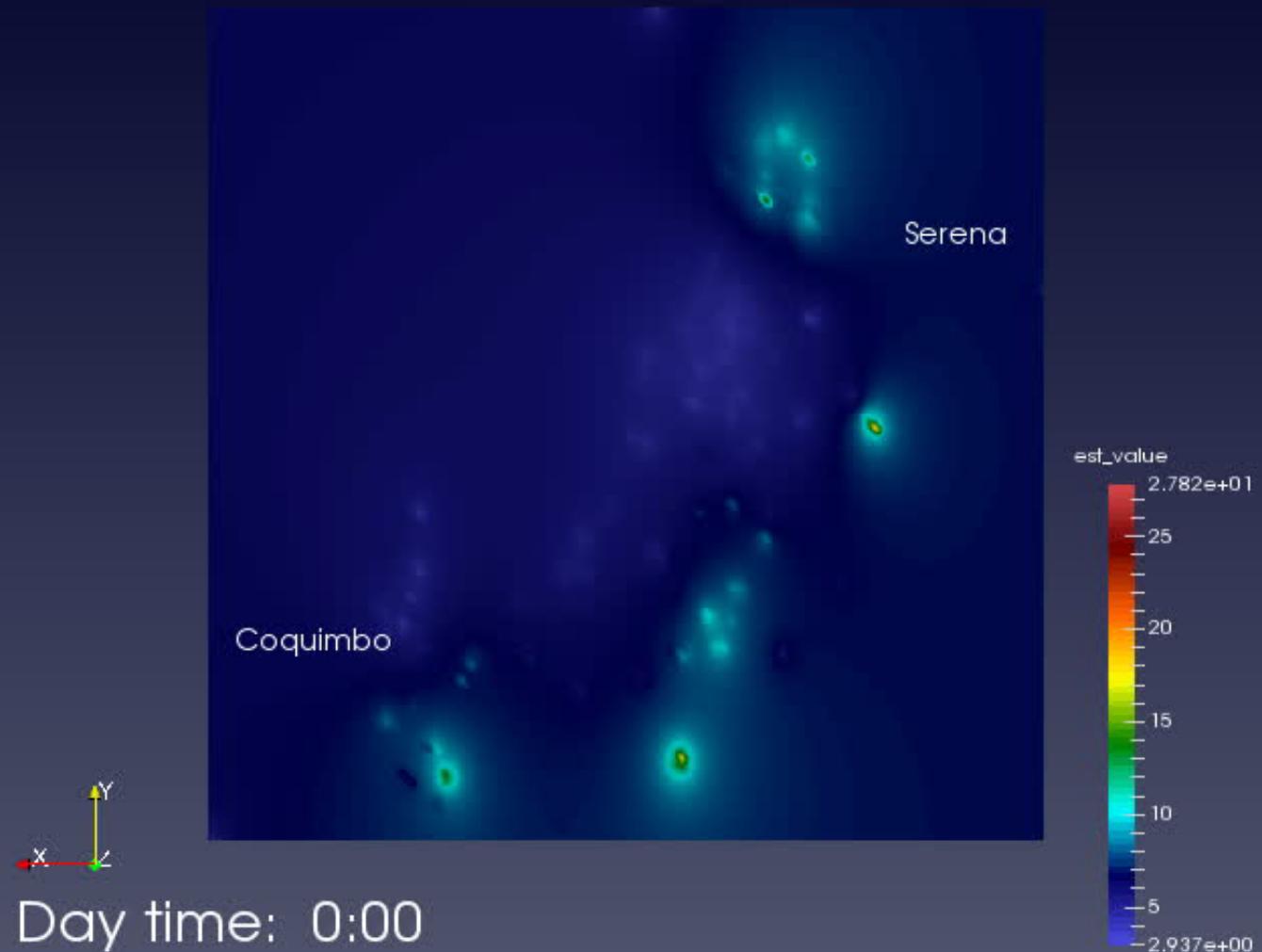
- ▶ Voronoi para mejorar cobertura por zonificación 777 de Santiago (@carny)



Aplicaciones

▶ IDW
Serena/
Coquimbo

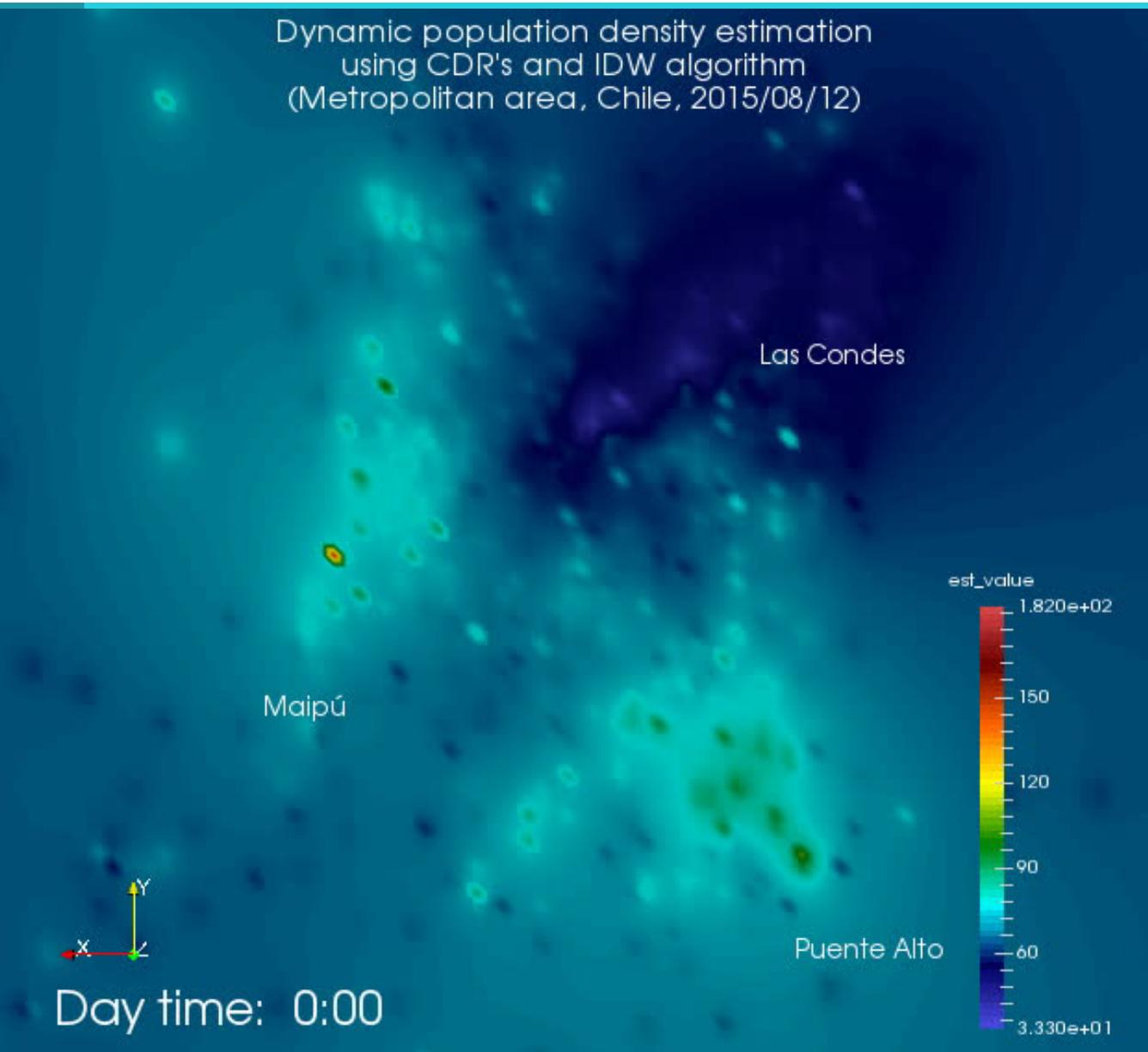
Dynamic population density estimation
using CDR's and IDW algorithm
(Serena/Coquimbo area, Chile, 2015/08/12)



Aplicaciones

▶ IDW
Santiago

Dynamic population density estimation
using CDR's and IDW algorithm
(Metropolitan area, Chile, 2015/08/12)



El futuro...

- ▶ CDRs + Telemetría + Transantiago + Bicicletas + IoT
- ▶ IoT
 - Luminarias
 - Paraderos de bus
 - Estaciones de metro
 - Casas
 - ¿Transbank?
 - ...
- ▶ Bulk y batch, todo bien ¿pero tiempo real?
 - High Performance Computing (tiempos de respuesta ultra rápidos)

¡Gracias!