GEIG
Groupe d'Expertise et d'Information sur la Grippe

Mercredi 24 octobre 2012

Salons de l'Aéro-Club de France
6, rue Galilée, 75116 Paris

25e RENCONTRES SUR LA GRIPPE ET SA PRÉVENTION

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influenza models: values & limits

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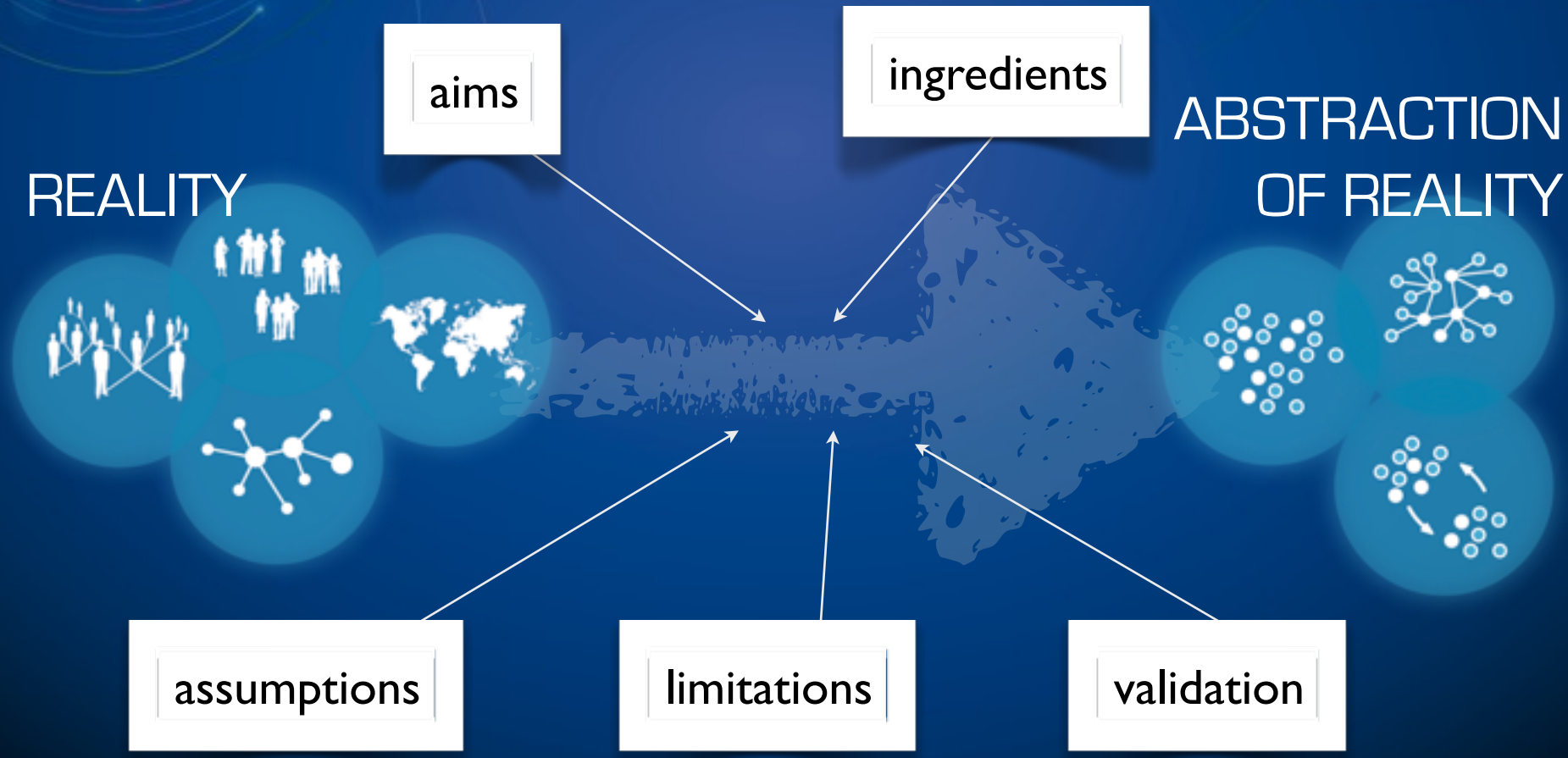
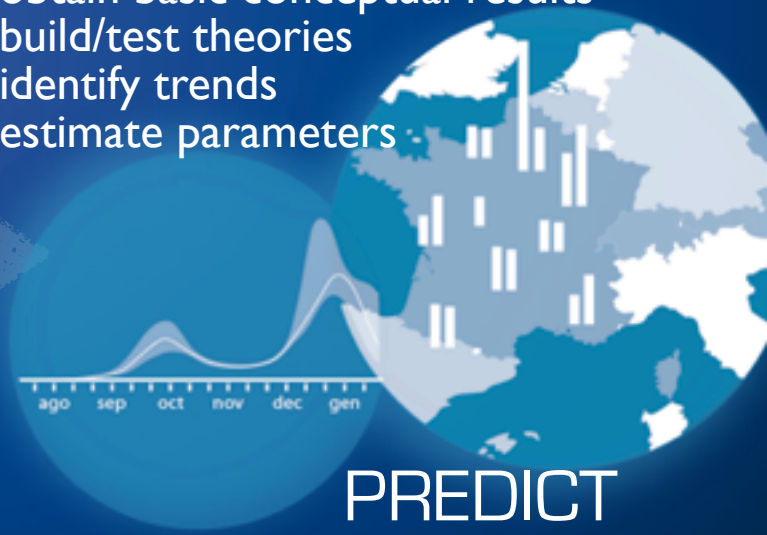
[dynamical] modeling **101**



aims

UNDERSTAND

identify key mechanisms
obtain basic conceptual results
build/test theories
identify trends
estimate parameters



PREDICT

explore scenarios
test/evaluate/compare interventions
answer specific questions
provide forecasts (?)

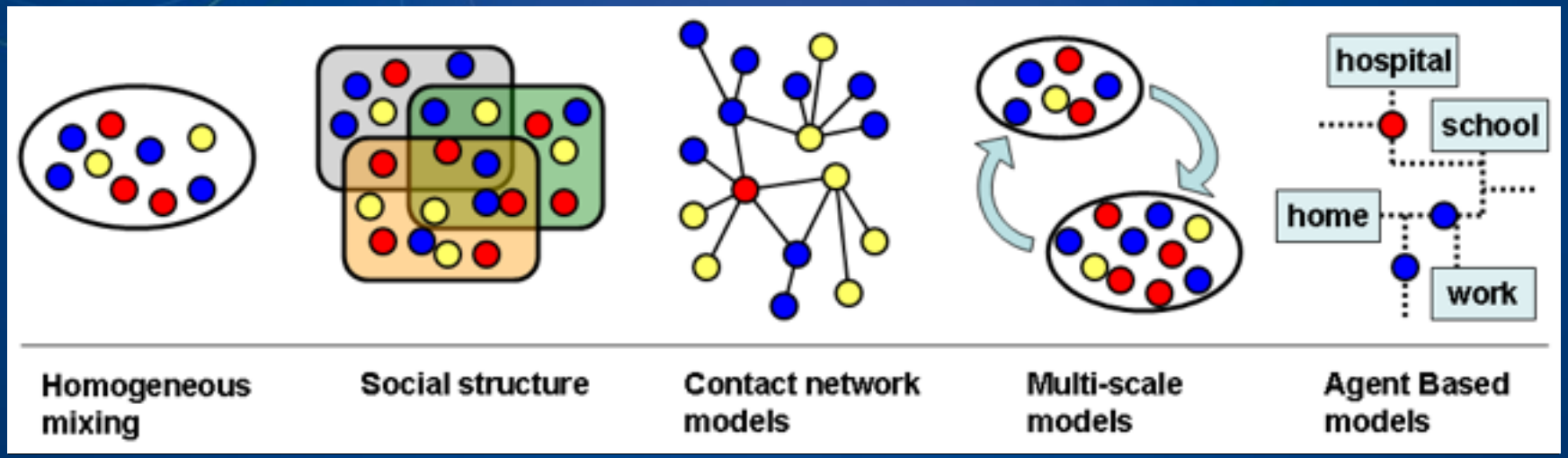
ingredients

PEOPLE

INTERACTIONS /MOBILITY

DISEASE

models' complexity

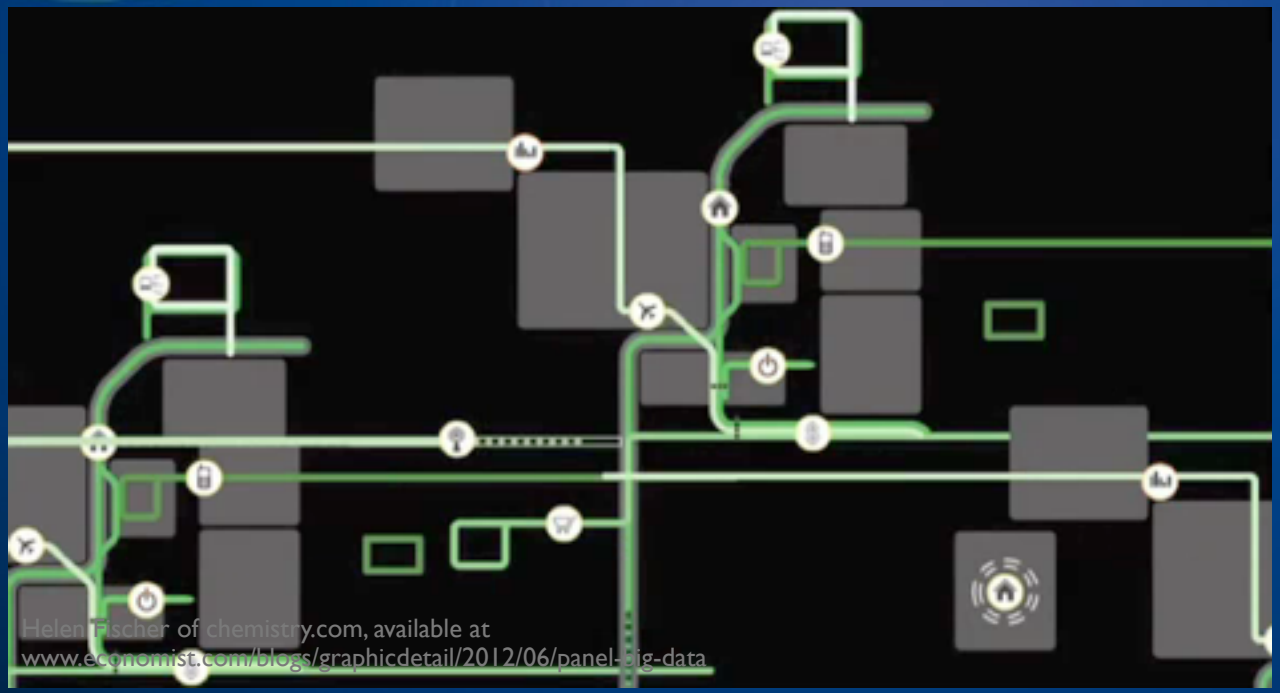


REALISM

low moderate high

>> DATA...

riding the data tsunami...



2008

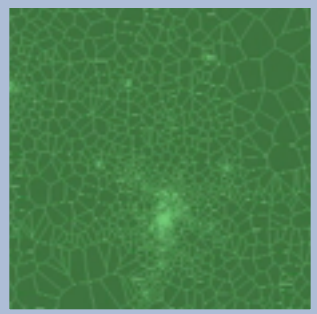
2010

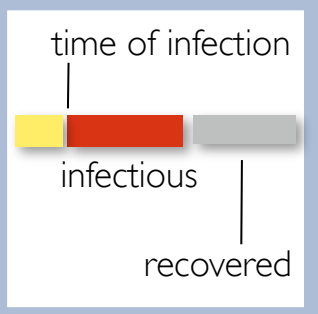
2011

90% of the world's digital data has been created in just the last two years (source: IBM)

data

data

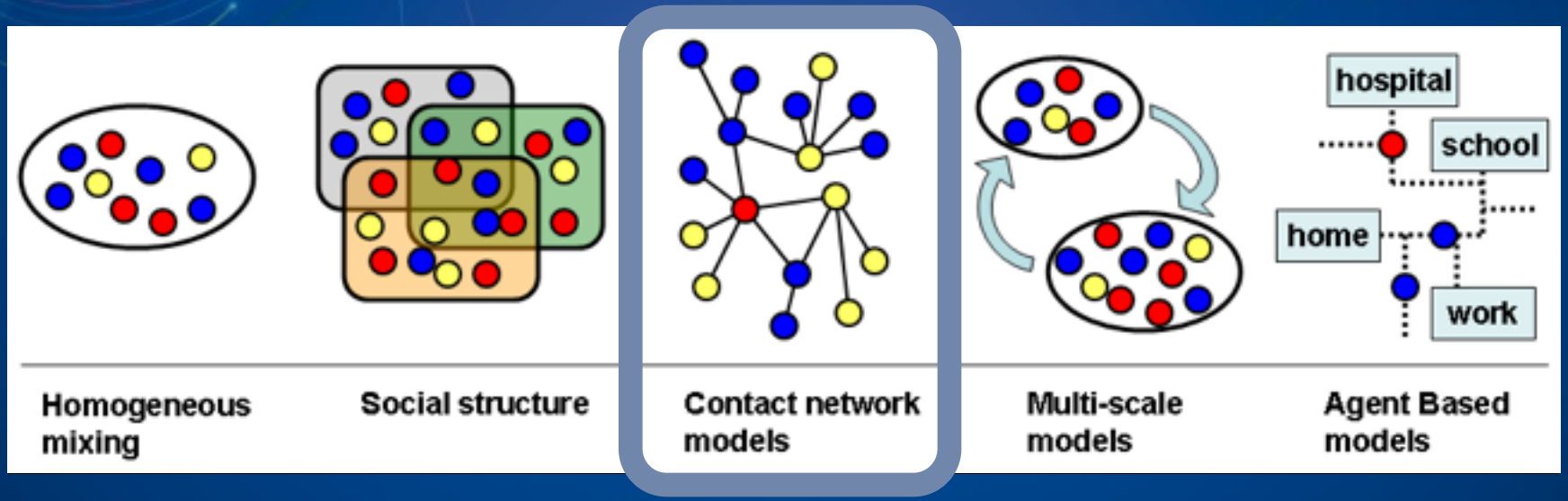




Gonzalez et al (2008)

sociopatterns.org

3 applications to H1N1 pandemic



Carrat et al.: Planning for the next influenza H1N1 season: a modelling study. BMC Inf Dis (2010)

Carrat et al. study

THE PROBLEM

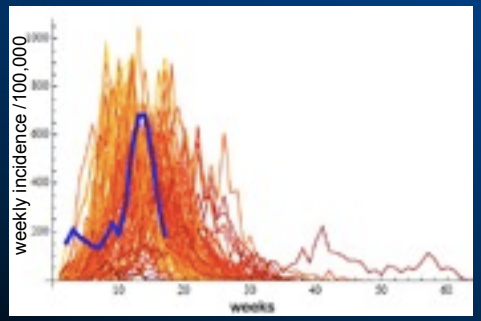
use the RS data of the first pandemic season in France to:

- estimate attack rates, rates of pre- and post-exposure immunity
- explore hypothetical scenarios of virus reintroduction with varying levels of cross-immunity

THE APPROACH

- individual-centered model
- demographic characteristics and household sizes
- network of contacts
- detailed description of health-care seeking behavior, treatment

RESULTS

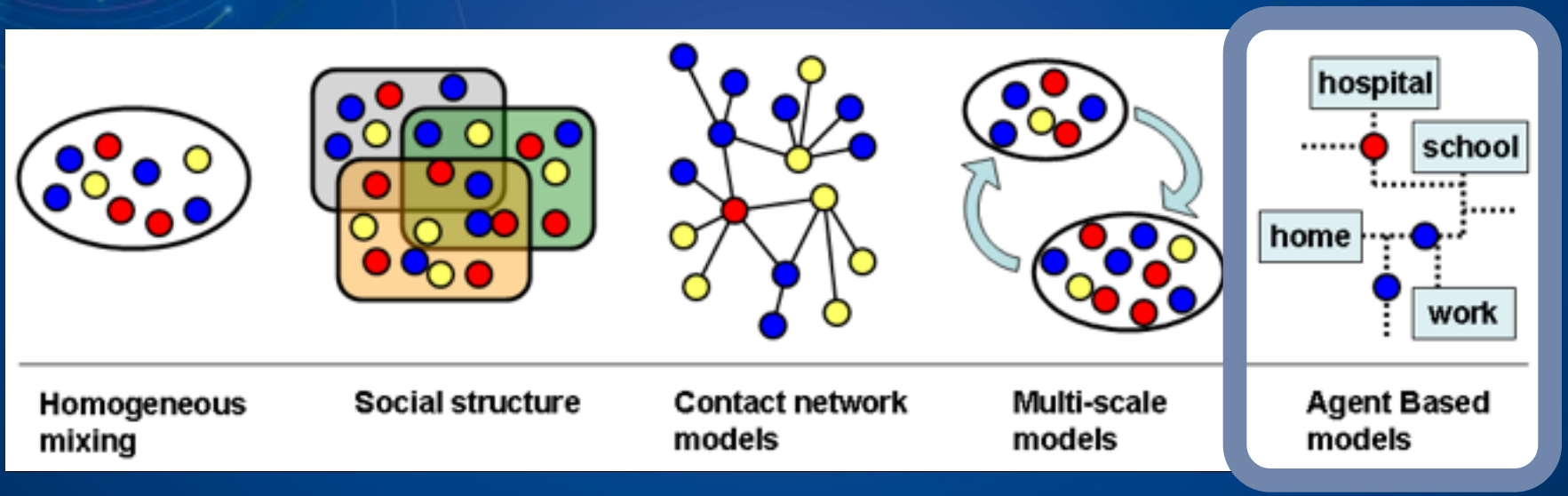


pre-exposure immunity:	young adults	36%
	elderly	85%
second pandemic season, with cross protection:	70%	small epidemic size
	50%	disease burden ~ 1st season
	30%	substantial burden

some limitations...

- difficult to parameterize in real-time
- highly detailed for single population, but *space is missing*

2nd application to H1N1 pandemic



Determinants of the spatiotemporal dynamics of the 2009 H1N1 pandemic in Europe: implications for real-time modelling. PLOS Comp Biol (2011)

Merler et al.

Merler et al. study

THE PROBLEM

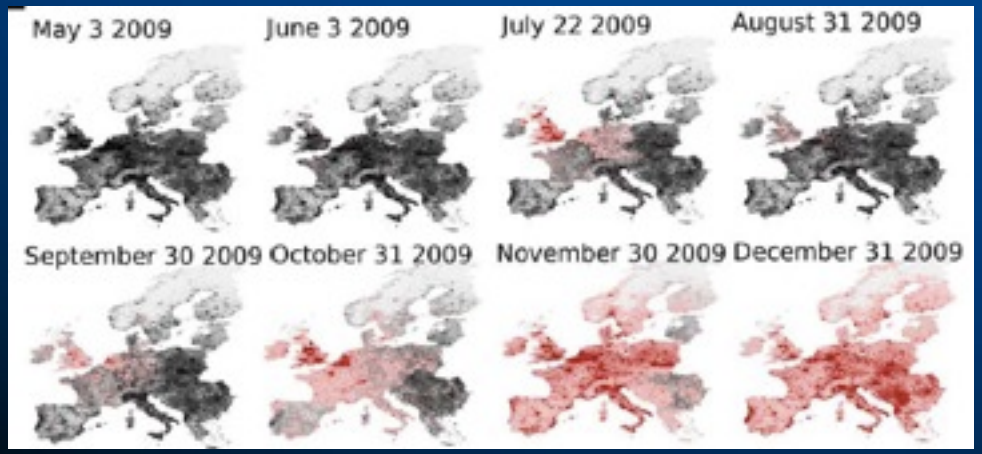
use epidemic data and available estimates up to June 2009 to:

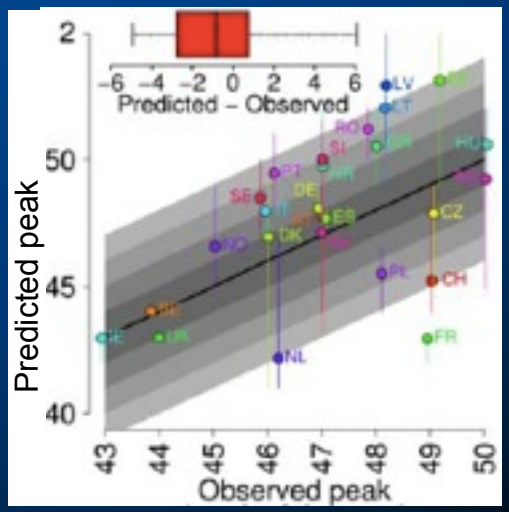
- evaluate the role of EU socio-demographic structures, school calendars, intra-EU mobility in shaping the spatio-temporal spread

THE APPROACH

- agent-based model informed with EU synthetic population
- explicit spatial structure restricted to EU + model for seeding events
- school calendars
- available epidemic estimates

RESULTS

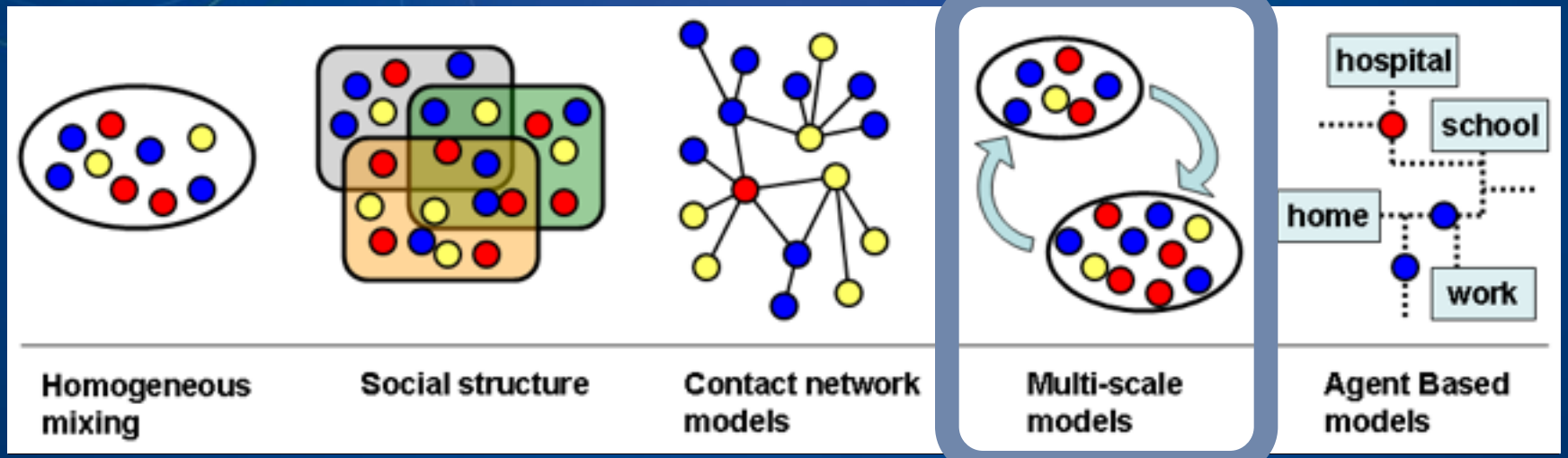




some limitations...

- *difficult to parameterize in real-time*
- high resolution data available for few developed countries

3rd application to H1N1 pandemic



Seasonal transmission potential and activity peaks of the new influenza A/H1N1: a Monte Carlo likelihood analysis based on human mobility. *BMC Med* (2009) — Balcan et al.

Real-time numerical forecast of global epidemic spreading: case study of 2009 A/H1N1pdm. *BMC Med*, in press. — Tizzoni et al.

the GLEAM study

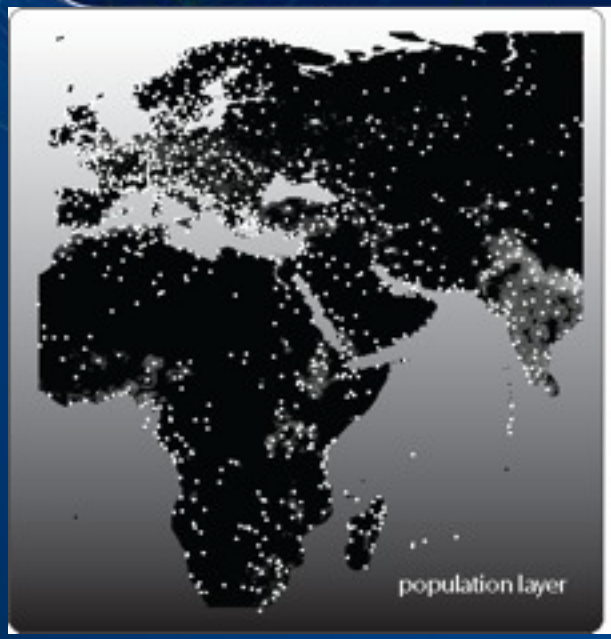
THE PROBLEM

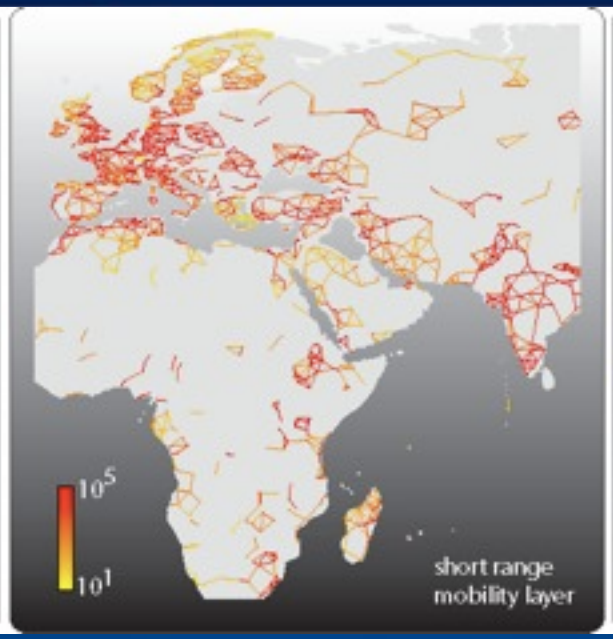
use the epidemic data up to June 2009 to:

- estimate the seasonal transmission potential of the pandemic
- predict in *real-time* the future spatio-temporal propagation at the *global level* and in particular the peak timing for the upcoming winter season

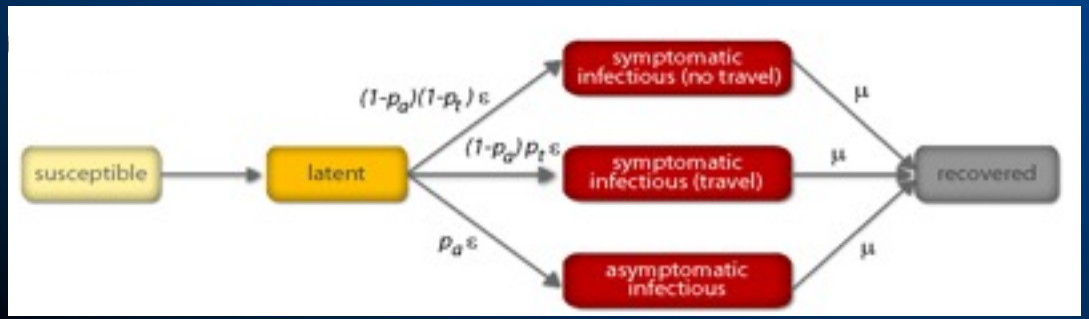
parameter estimation → *predictions*

the approach





- population data in cells ¼° x ¼°
- daily commuting data
- 3400 airports in 220 countries
- 20,000 connections
- traffic data (IATA, OAG)
- >99% commercial traffic



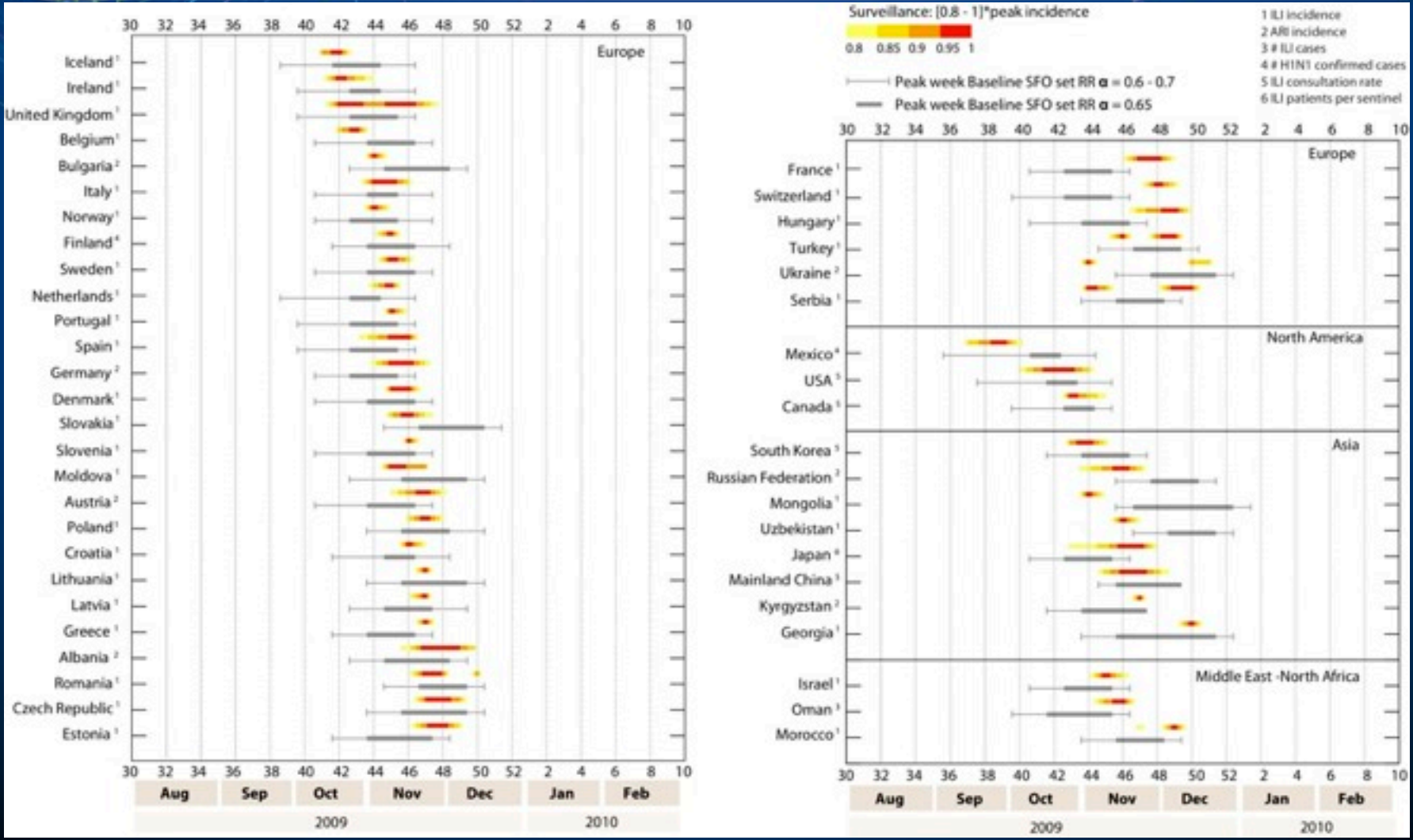
customizable compartmental model

GLEaMviz.org

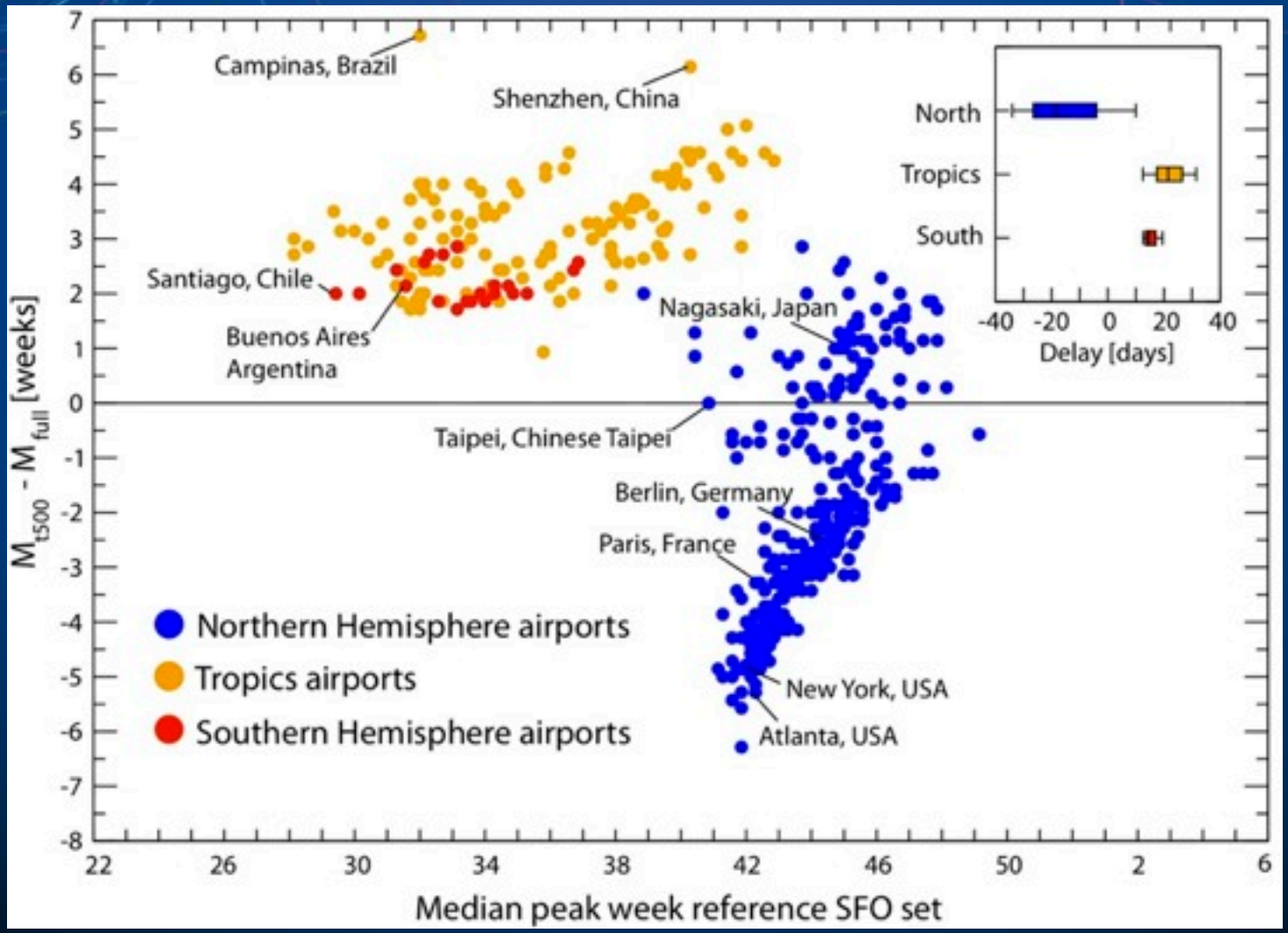
GLEAM: H1N1 output example

www.gleamviz.org
Balcan et al. PNAS 2009

predictions and assessment



importance of mobility



some limitations...

- lack of high resolution description of socio-demographic structures

remaining challenges

- ➡ data to inform models
  - social, behavioral, demographic, mobility...
  - underdeveloped countries?
- ➡ models: integrating different approaches
- ➡ sharing
- ➡ preparedness for emergency (building up collaborative workflows in peacetime)
- ➡ surveillance: high resolution, same case-definition, health-seeking behavior, ...

influenzanet.org

acknowledgments & refs

EPICX lab
U707 INSERM & UPMC
www.epicx-lab.com

www.gleamviz.org
www.epifor.eu

Instituts thématiques
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