

# **Data visualisation at the nexus of science and the public**

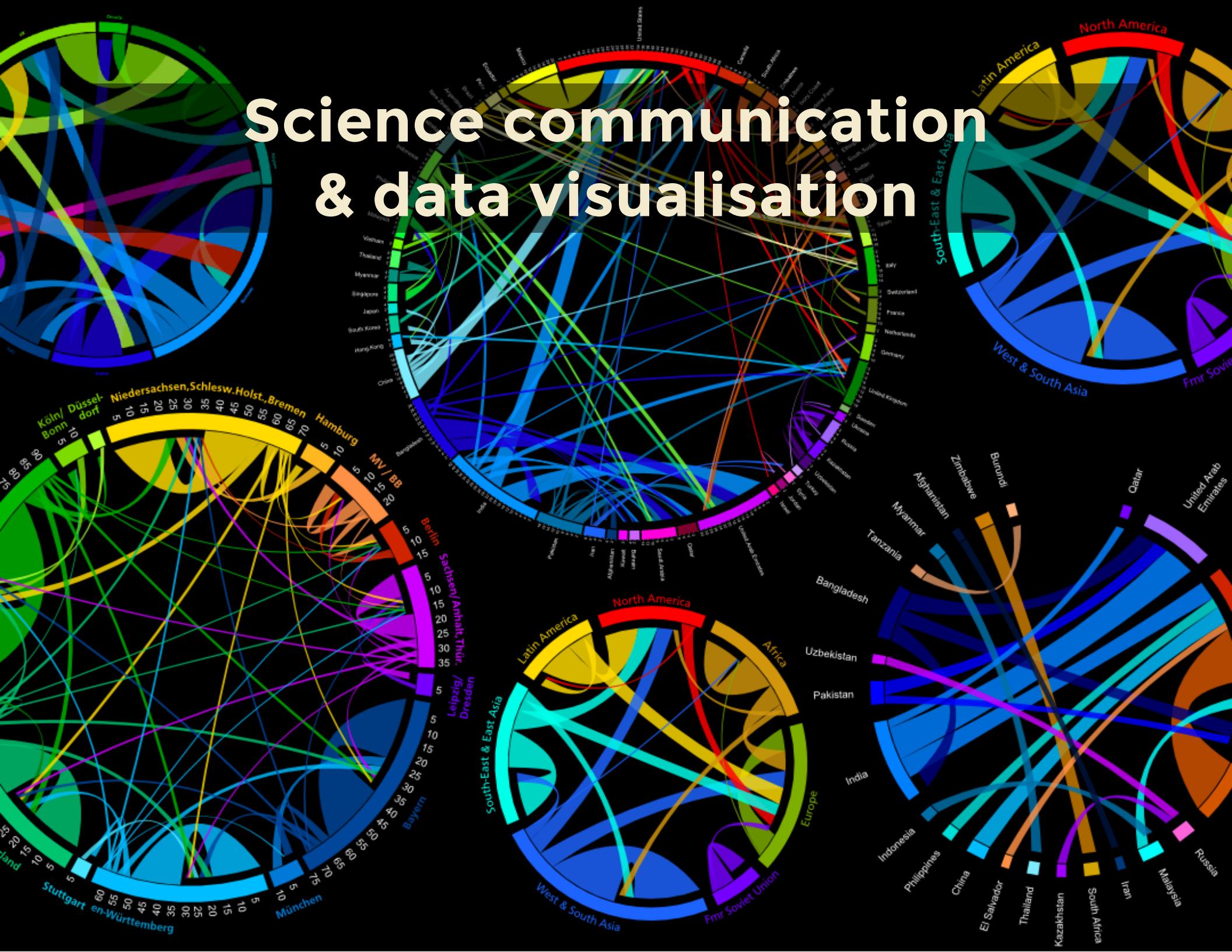
**Nikola Sander, Guy Abel, Ramon Bauer  
& Johannes Schmidt**

**Wittgenstein Centre, Vienna Institute of Demography;  
Null2, Berlin**

**The Graphical Web Conference, August 2014**

**Slides: [nikolasander.com/graphicalweb](http://nikolasander.com/graphicalweb)**

# Science communication & data visualisation



# State of science communication

*“Scientists must learn to communicate with the public, be willing to do so and indeed consider it their duty to do so.”*

Royal Society, 1985

In those cases when census data were of poor quality, not available or outdated, we turned to surveys in order to capture the educational composition of the population. This was mostly the case in developing countries, even so a few European countries did also not conduct a census in recent decades. Preferably, we targeted extensive and representative sample surveys as reliable sources of information on educational attainment, such as national Labour Force Surveys (LFS) for Germany and Bosnia and Herzegovina or other large-scale surveys like the American Community Survey (ACS) for the USA or the National Population Sample Survey for China.

In the absence of extensive national surveys, we had to turn to household surveys on demographic, health and socio-economic issues. This was particularly the case in African countries, where we used primarily Demographic and Health Surveys (DHS). DHS has been carried during the past 15 years or so of a particular survey methodology, information on educational attainment of all household members, including surveys like the Multiple Indicator Cluster Surveys (MICS) in Burkina Faso, Guinea, Quinn, Sierra Leone, Algeria, or Yemen. In addition, Demographic and Health Surveys (DHS) have been carried out in many countries, including India, Pakistan, Bangladesh, Egypt, Nigeria, and many others.

# **Science communication in the digital era**

**A late transition from traditional to digital dissemination.**

**Barriers to communication:**

- **Scientists don't get paid for doing outreach**
- **Scientists lack the skills to communicate**

**Science communication needs a change in attitudes.**

# From informing to engaging the public

More **openness** in the research process encourages participation and engagement.

- Open **access** ... to research articles
- Open **data** ... facilitates the re-use of data
- Open **source** ... enables use and development of applications
- Open **science** ... fosters the accessibility of research processes

# Data visualisation in science communication

*“Visualizations invite people to touch, stroke, and go deeper into the data that underlie them. They engage.”*

Michael Schrage, 2013

## How does data visualisation encourage engagement?

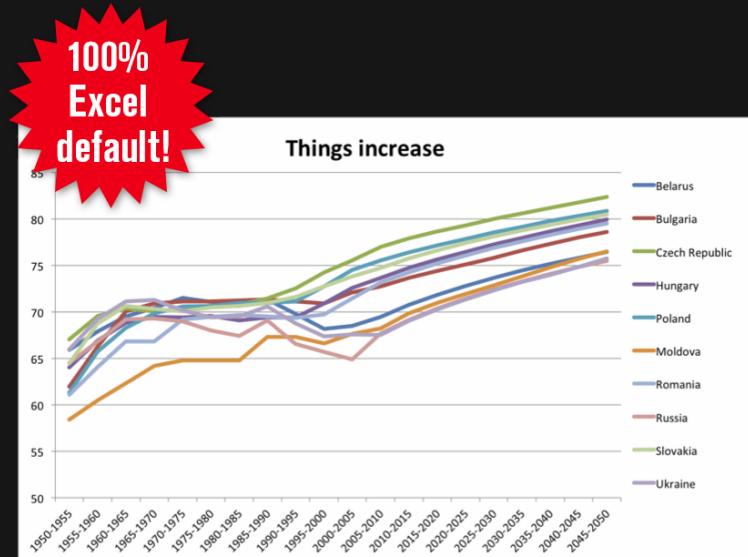
- attract visually (exploiting visual perception)
- re/present data (allows insights)
- facilitate accessibility & understanding (of research findings)
- amplify cognition (allow user to go deeper into the data & topic)

# The problem is ...

*“Scientists do not seem to distinguish between analysis and communication. The last exploratory graph becomes explanatory.”*

Moritz Stefaner, Data Stories Episode 37

Scientists lack the mind & skill sets to communicate data visually



# What skills do we need to engage visually?

**Literacy** refers to the ability to read for knowledge, write coherently and think critically about printed material.

- **Data literacy** ... to make use of quantitative information
- **Statistical literacy** ... to make sense of statistical information
- **Scientific literacy** ... to evaluate the quality of scientific information
- **Visual literacy** ... to construct meaning from visual images
- **Media literacy** ... to apply literacy skills to media and technology messages

# **Ready, willing and able**

**Preconditions required to adopt a new form of behaviour  
(Coale, 1973):**

- **readiness ... a new behaviour must be advantageous**
- **willingness ... a new behaviour must be cultural acceptable**
- **ability ... technical or social means for the realisation of new behaviours**

# **Ready, willing and able to engage with the public**

**Readiness ... why researchers should engage**

→ change in job description

**Willingness ... what it brings for researchers to engage**

→ change in mind set

**Ability ... how they can engage visually**

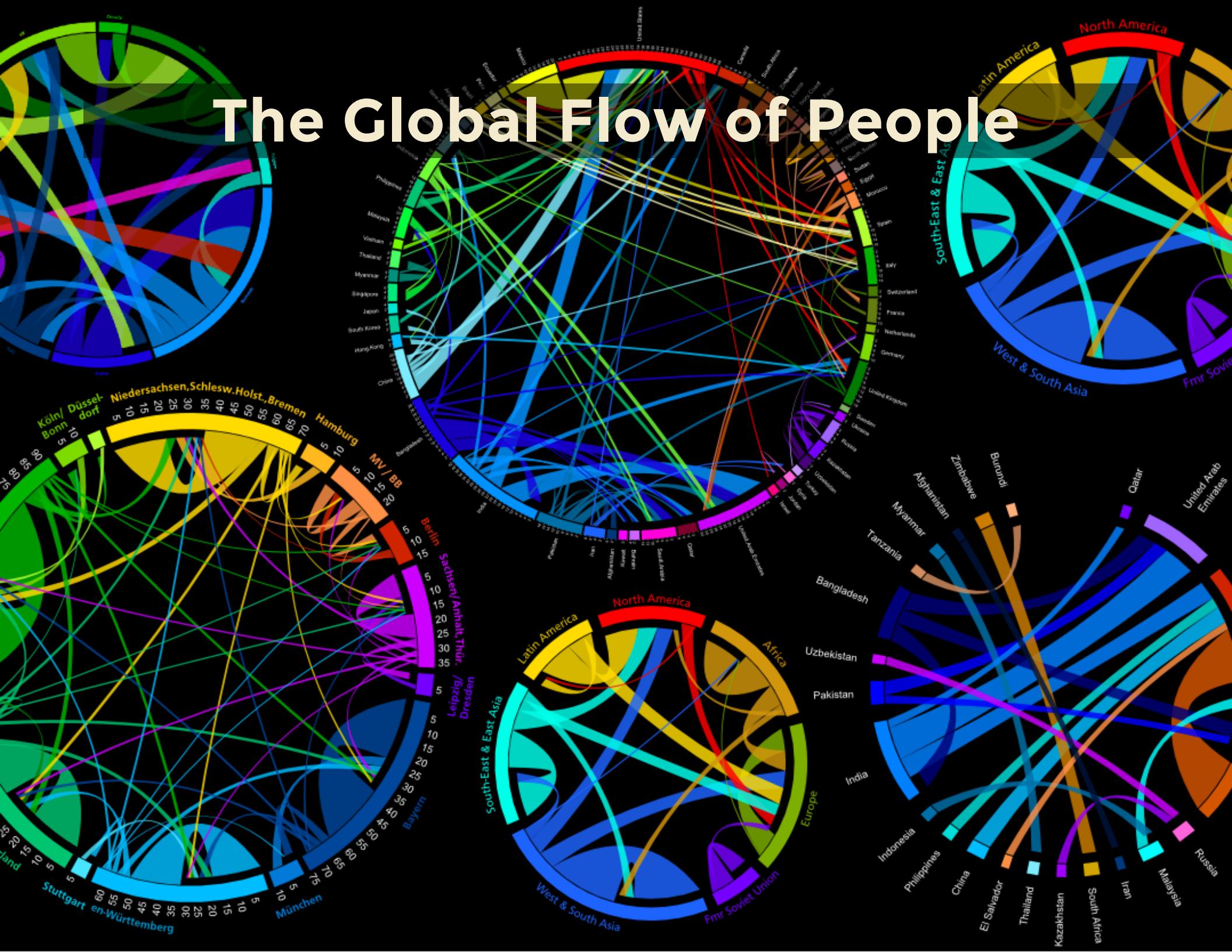
→ change in skill set

***"Data visualisation is a multi-disciplinary subject"***

**Andy Kirk, 2012**



# The Global Flow of People



# **Common presumption:**

**Global migration has accelerated  
and diversified**



# **Problems with data on migration flows**

**Provided by less than 50 countries.**

**Differences in the way of measurement.**

**Harmonised flow data exist only for Europe**

# **Data on migrant stocks**

**Widely captured in population censuses.**

**Country of birth != country of current residence.**

**U.N. released global bilateral dataset in 2013.**

**Accumulative measure that cannot capture recent trends.**

# How many people migrated in the world in 2005-10?



# Estimating flows from stocks

## UN stock data

**lifetime transitions**

**static snapshot of  
immigrant population**

**1990, 2000, 2010**

**~220 countries**



## Our flow estimates

**5-year transitions**

**dynamic movements  
over time**

**1990-95 to 2005-10**

**196 countries**

# Migrant stock table, 2000

Country of residence  
in 2000

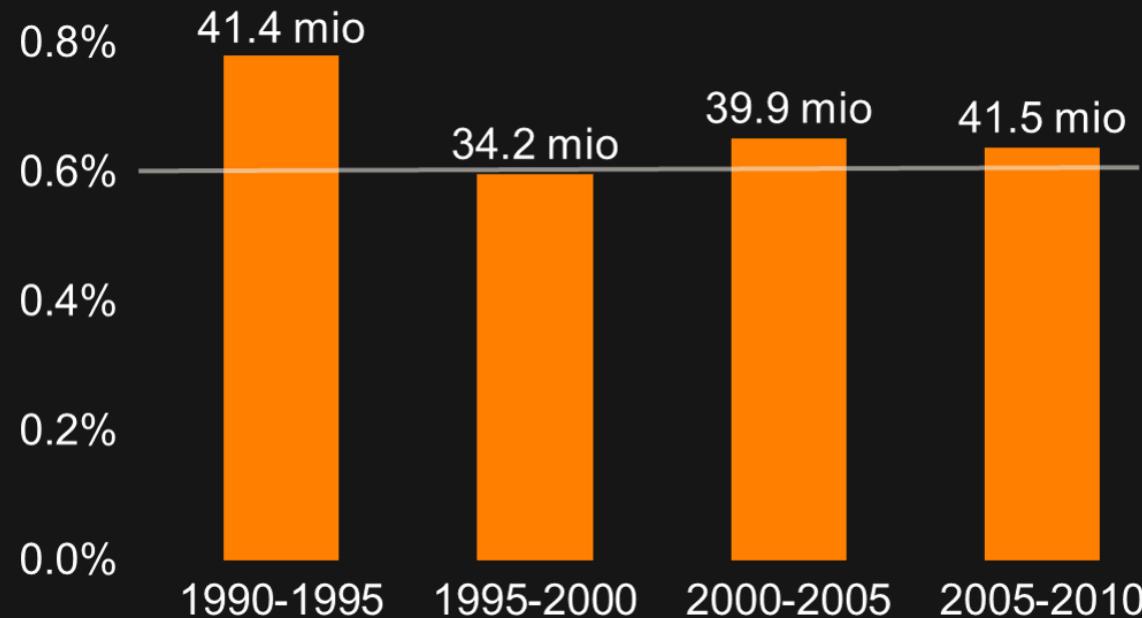
Country of birth	Country of residence in 2000				Sum
	A	B	C	D	
A	1000	100	10	0	1110
B	55	555	50	5	665
C	80	40	800	40	960
D	20	25	20	200	265
Sum	1155	720	880	245	3000

# Estimated flow matrix, 2005-10

		Destination				
		A	B	C	D	Sum
Origin	A		0	50	0	50
	B	35		25	0	60
	C	10	10		0	20
	D	10	10	0		20
	Sum	55	20	75	0	150

# No rising tide of migration

About 0.6 % of world population have moved over 5-year periods since 1995.





CARTE FIGURATIVE et APPROXIMATIVE représentant pour l'année 1858  
les ÉMIGRANTS du GLOBE

Les Pays d'où ils partent et ceux où ils arrivent, dressée par M<sup>me</sup> MINARD  
Inspecteur Général des Ports et Chausées en route, principalement sur les  
renseignements publiés dans l'Emigration Européenne de M<sup>me</sup> A. LEGOY  
et le marchand magasin de New-York.

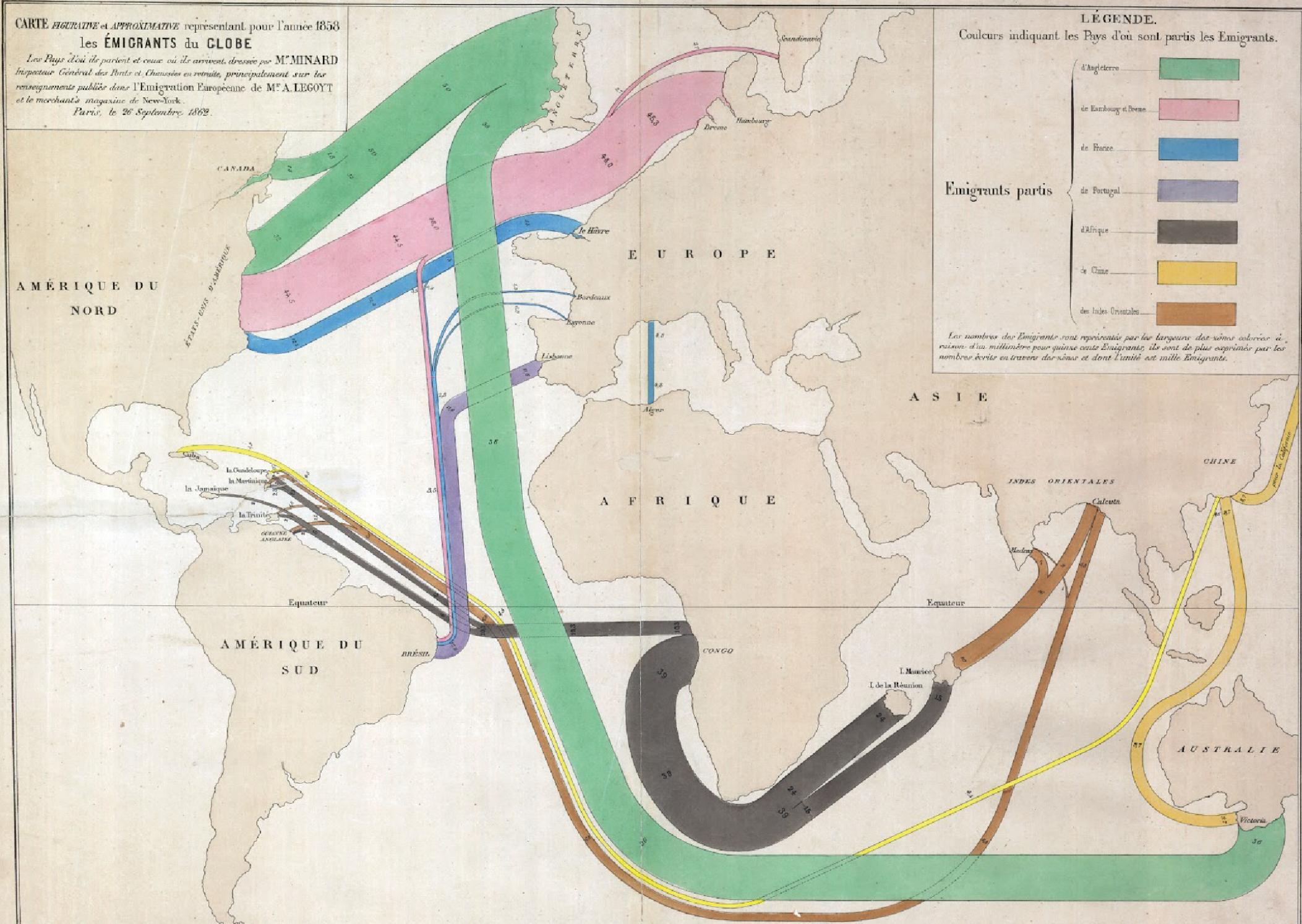
Paris, le 26 Septembre 1862.

LÉGENDE.  
Couleurs indiquant les Pays d'où sont partis les Emigrants.

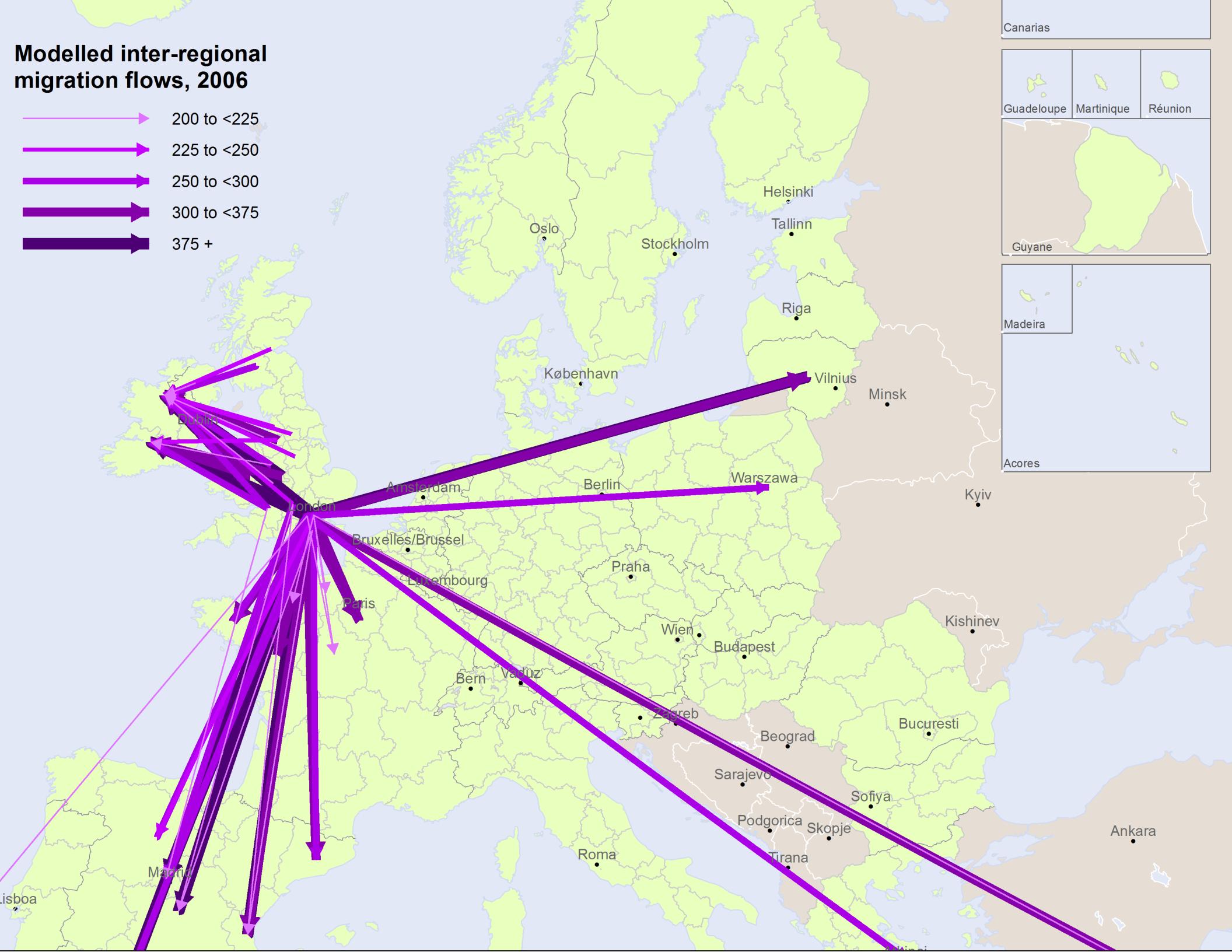
d'Angleterre	
de Hamburg et Breme	
de France	
de Portugal	
d'Afrique	
de Chine	
des Indes Orientales	

Emigrants parti

Les nombres des Emigrants sont représentés par les largeurs des sènes colorées à raison d'un million pour quinze cent Emigrants; ils sont de plus exprimés par les nombres écrits en travers des sènes et dont l'unité est mille Emigrants.



# Modelled inter-regional migration flows, 2006



# CIRCOS – an information aesthetic for comparative genomics

M Krzywinski, J Schein, I Birol, S Jones, M Marra

Canada's Michael Smith Genome Sciences Centre // British Columbia Cancer Research Centre // [www.bcgsc.ca](http://www.bcgsc.ca)



## 1. chromosomes

chromosomes are shown as the inner square. They have oriented, non-contiguous but, contiguous, to the right edge, segments of different genomes, and a general view of genome organization that spans genome intervals. Genomes are often color-coded with an index color assigned to each genome. Segments are colored according to their source genome. In addition to the main circular genome, there are two additional concentric rings: a central ring containing a small number of shorter line segments, and an outer ring containing many more longer line segments. A large segment is often a reference genome, and a smaller segment is often a genome of interest. These segments may be color-coded by genome or genome class. The segments may also be oriented, and the orientation of the segments may be used to indicate the direction of genome evolution.

2. chromosomes of homologous chromosomes

Chromosomes, heterochromosomes and nucleolus organizer regions, but also genes, regulatory elements and other genomic features, are all represented by the same type of segments. These segments are color-coded by either their source genome or their genome class. Chromosomes are often color-coded by genome class. The segments may be oriented, and the orientation of the segments may be used to indicate the direction of genome evolution.

3. chromosomes of sister chromatids

The lineage of sister chromatids can also mean a circular representation of a single genome. This is done by color-coding the segments of the two sister chromatids differently. These segments are color-coded by either their source genome or their genome class. Chromosomes are often color-coded by genome class. The segments may be oriented, and the orientation of the segments may be used to indicate the direction of genome evolution.

4. chromosomes, chromosomes. The same genome is represented twice, each with a different color. This allows to compare two different configurations of the same genome. These segments are color-coded by either their source genome or their genome class. Chromosomes are often color-coded by genome class.

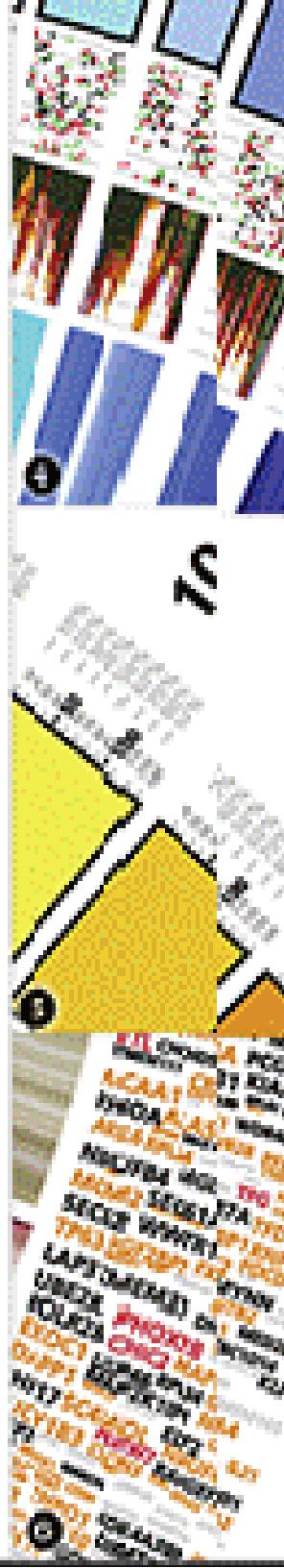
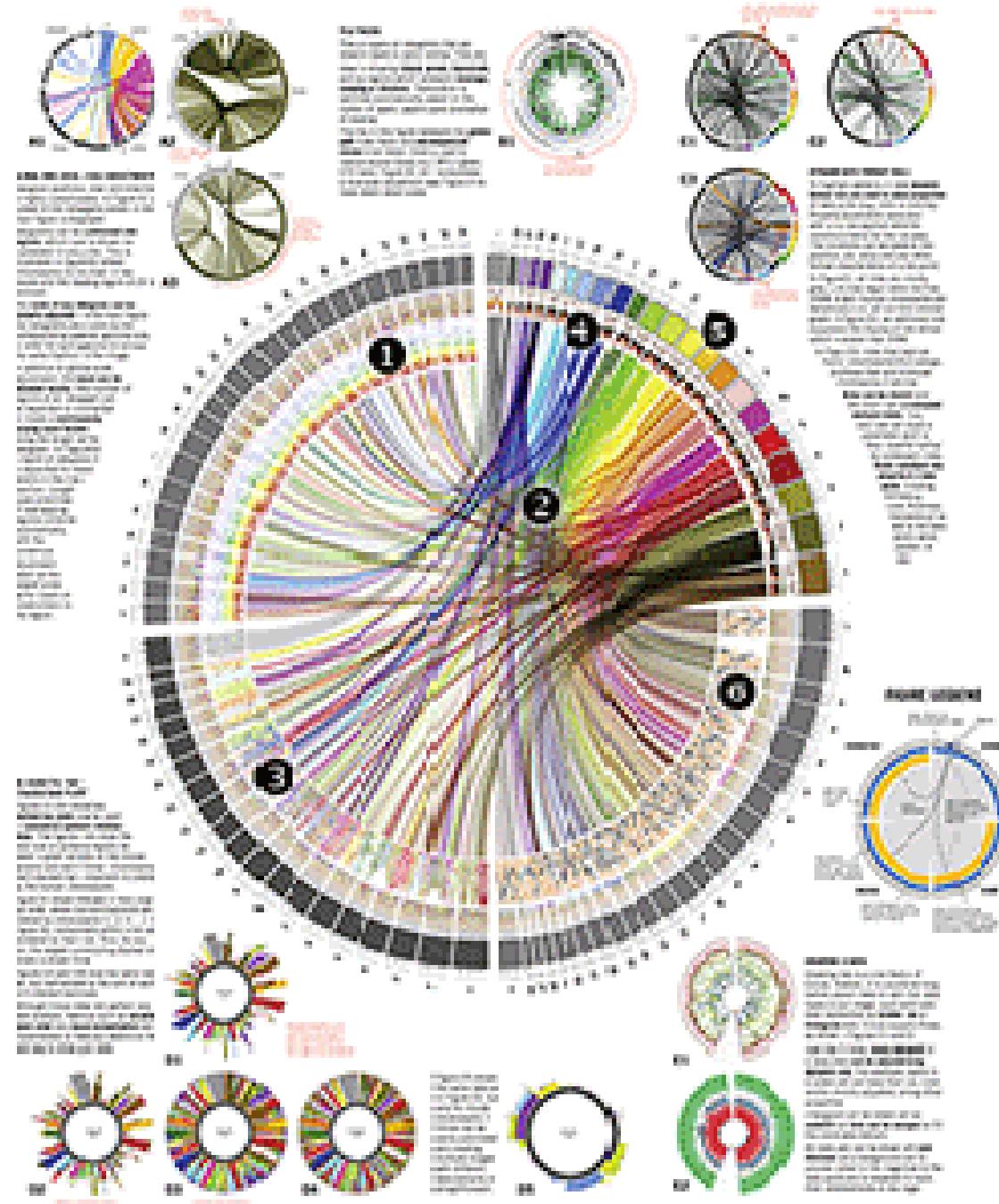
5. chromosomes for both ends same and heterogeneous. The same genome is represented and colored twice in the same. This allows to compare two different configurations of the same genome. These segments are color-coded by either their source genome or their genome class.

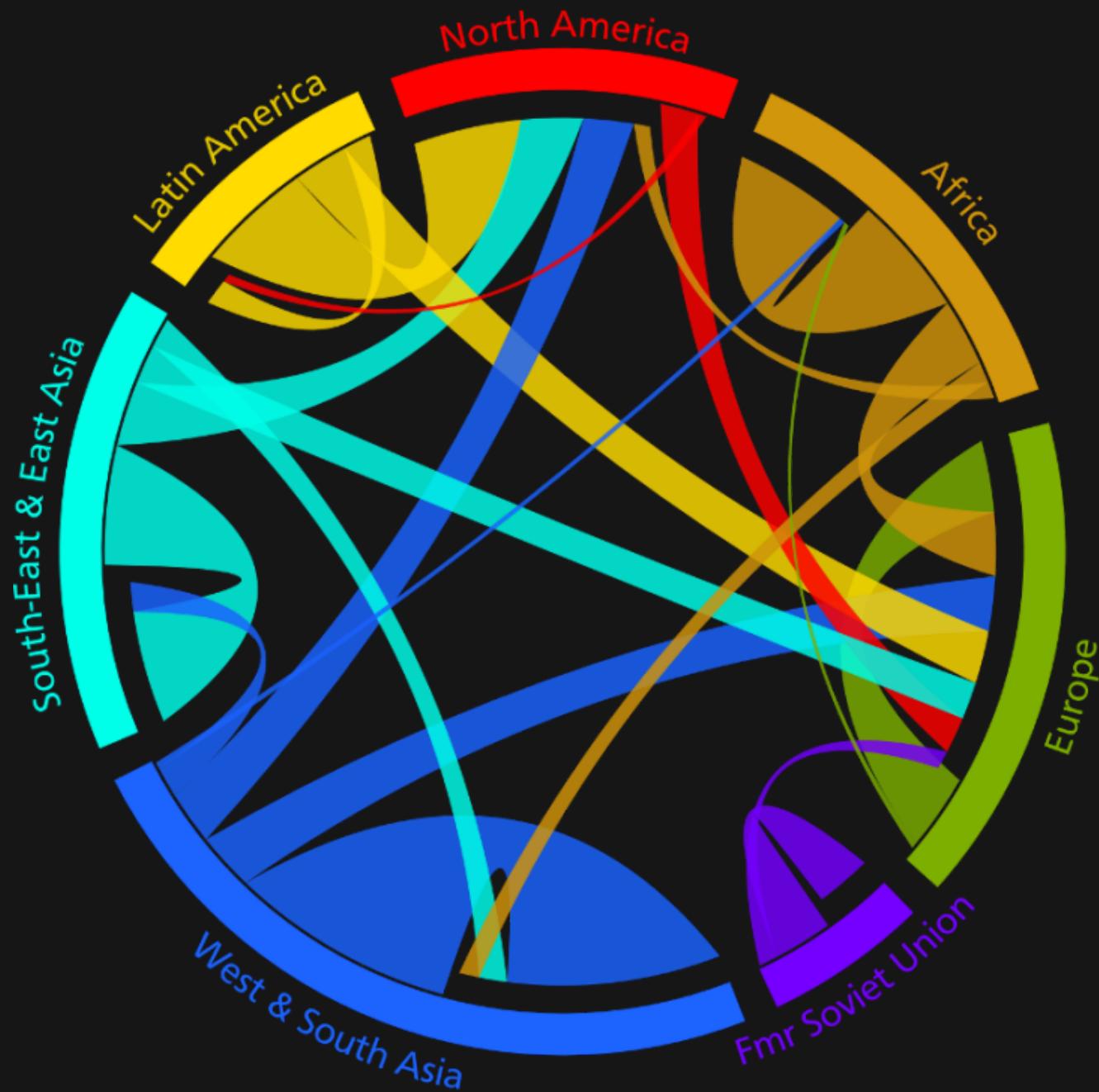
6. segments measured from one end for others to place them individually for each segment and distance. All the segments are color-coded by either their source genome or their genome class. This allows to compare two different configurations of the same genome. These segments are color-coded by either their source genome or their genome class.

7. segments measured from one end for others to place them individually for each segment and distance. All the segments are color-coded by either their source genome or their genome class. This allows to compare two different configurations of the same genome. These segments are color-coded by either their source genome or their genome class.

8. segments measured from one end for others to place them individually for each segment and distance. All the segments are color-coded by either their source genome or their genome class. This allows to compare two different configurations of the same genome. These segments are color-coded by either their source genome or their genome class.

9. segments measured from one end for others to place them individually for each segment and distance. All the segments are color-coded by either their source genome or their genome class. This allows to compare two different configurations of the same genome. These segments are color-coded by either their source genome or their genome class.





# Quantifying Global International Migration Flows

Guy Abel & Nikola Sander.

Published in *Science* on 28 March 2014; vol 343: 1520-1522.





**Teaming up with coders and designers to  
create**

# The Global Flow of People

**Coding: Null2 in Berlin**

**Web design: Elvira Stein in Vienna**

# THE GLOBAL FLOW OF PEOPLE

Explore new estimates of migration flows between and within regions for five-year periods, 1990 to 2010. Click on a region to discover flows country-by-country.

PUBLISHED  
IN Science  
[Free access »](#)

by Nikola Sander, Guy J. Abel & Ramon Bauer  
at the Wittgenstein Centre for Demography and Global Human Capital

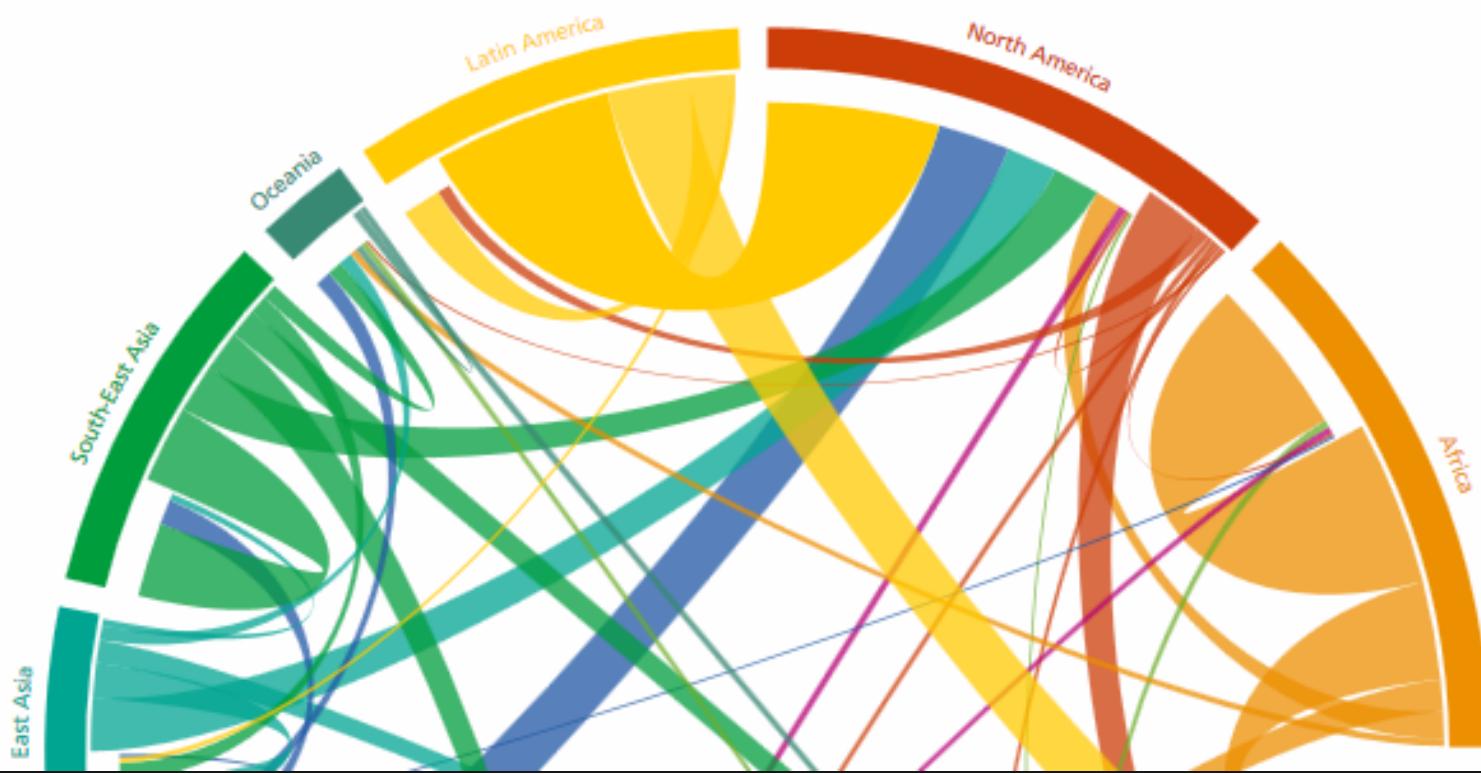
[How to read the plot](#)

1990–1995

1995–2000

2000–2005

2005–2010



1990-1995

1995-2000

2000-2005

2005-2010



0

# Proof at last! Most Britons are eager to quit EU thanks to mass immigration fears

FURY at European rules allowing mass immigration has triggered a rise in anti-EU feeling in the UK.

By: Alison Little

Published: Mon, December 2, 2013

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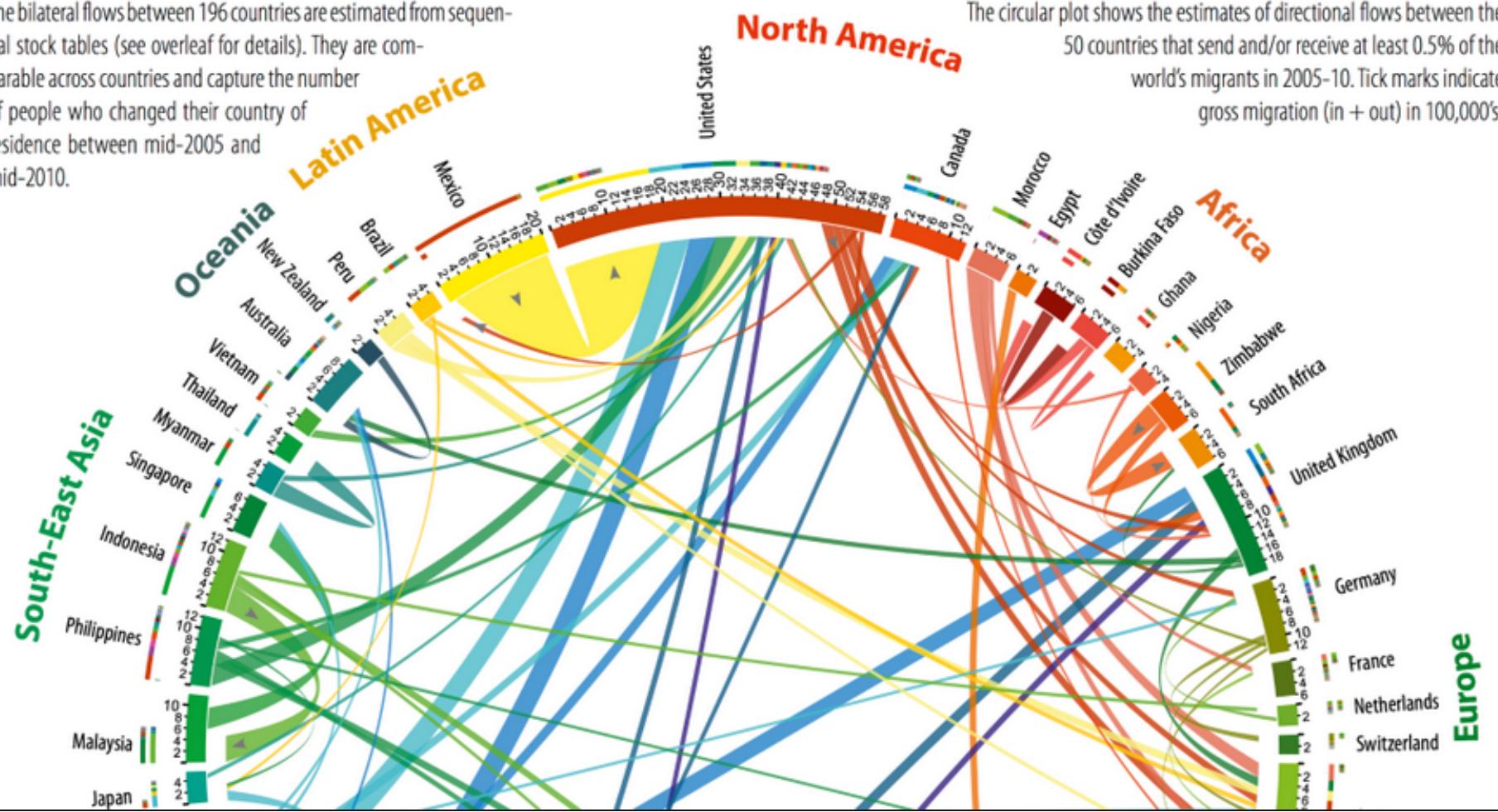


STIR IT UP

# Where everyone in the world is migrating—in one gorgeous chart

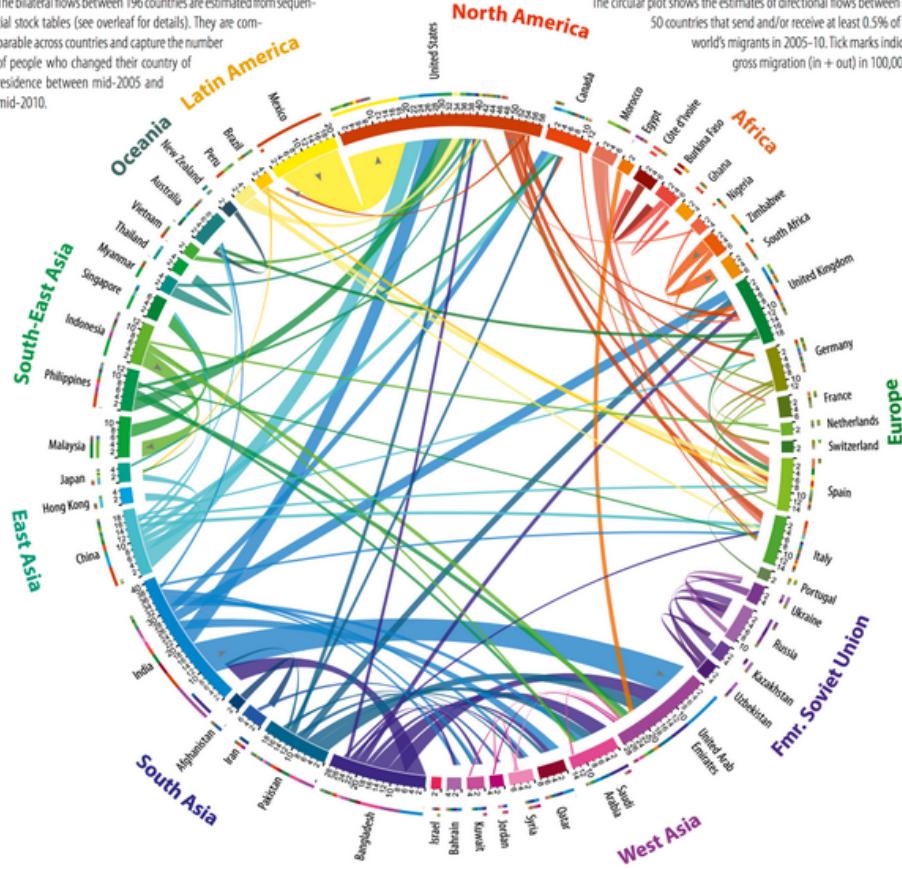
By Nick Stockton | @StocktonSays | March 27, 2014

The bilateral flows between 196 countries are estimated from sequential stock tables (see overleaf for details). They are comparable across countries and capture the number of people who changed their country of residence between mid-2005 and mid-2010.



The bilateral flows between 196 countries are estimated from sequential stock tables (see overleaf for details). They are comparable across countries and capture the number of people who changed their country of residence between mid-2005 and mid-2010.

The circular plot shows the estimates of directional flows between the 50 countries that send and/or receive at least 0.5% of the world's migrants in 2005-10. Tick marks indicate gross migration (in + out) in 100,000's.



Quartz

@qz

Where everyone in the world is migrating [qz.com/192440](http://qz.com/192440)

2:43 AM - 28 Mar 2014

283 RETWEETS 153 FAVORITES





**Pumphrey's Math**  
@PumphreysMath

 Follow

@StocktonSays Fantastic visualization of global migration data. I'm on there if you zoom in a lot.

[qz.com/192440/where-e...](http://qz.com/192440/where-e...)

2:13 PM - 3 Apr 2014

2 FAVORITES



**dukewired**  
@dukewired

 Follow

An eye-opening (& beautifully executed) visualization on  
migration @sciencemagazine  
[global-migration.info/?\\_ga=1.1539097...](http://global-migration.info/?_ga=1.1539097...) Love that data  
can be downloaded!

1:19 PM - 30 Mar 2014

**2 RETWEETS** **1 FAVORITE**



**Craig Owen**  
@craigowen1976

 Follow

Very interesting, pretty, and pretty thought-provoking  
too... puts the UK tabloids' rants into perspective!

[fb.me/6uBIRlg2d](http://fb.me/6uBIRlg2d)

11:15 PM - 31 Mar 2014

1 FAVORITE



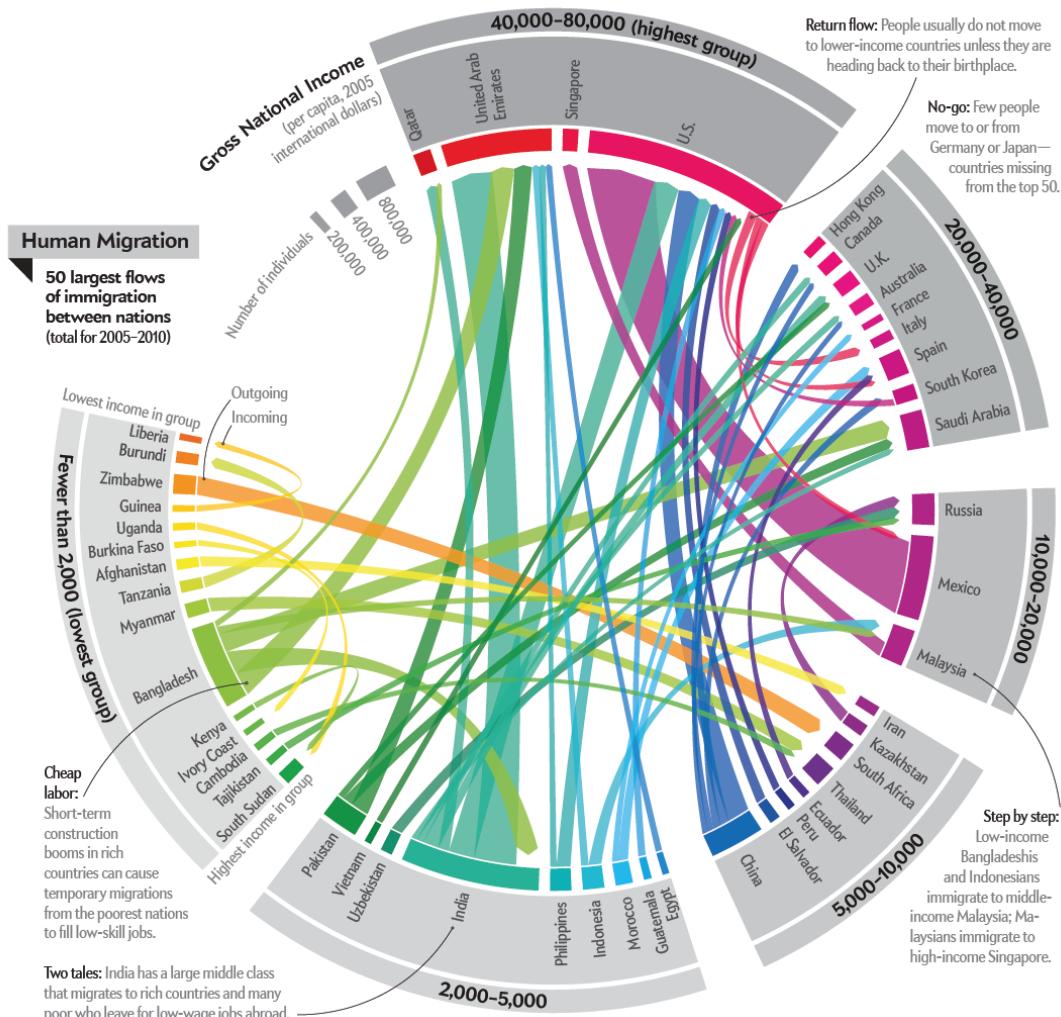
Jacques  
@jacksometer

 Follow

#SomeoneTellMarineLePen African migrants aren't  
"invading us", and here's the data to prove it  
[j.mp/1lxBN0u](http://j.mp/1lxBN0u) [pic.twitter.com/Ug4hTcl8V0](http://pic.twitter.com/Ug4hTcl8V0)

2:00 PM - 31 Mar 2014

9 RETWEETS 3 FAVORITES



## The Not So Wretched Masses

Immigrants go gradually up the wealth ladder

**Immigration is often tied** in the popular imagination to poverty—"the wretched refuse of your teeming shore," as poet Emma Lazarus wrote in 1883 to honor the Statue of Liberty. Data, however, show this notion to be a caricature. In this plot of the 50 largest migration flows, few of the poorest people leave home, and when they do they usually go to middle-income nations. Research suggests that is because they do not have the resources or education to survive in the richest countries. "Just like climbing a ladder, you have to take steps to get from the bottom to the

top," says Nikola Sander, who, with one of her colleagues at the Vienna Institute of Demography in Austria, found the trends using United Nations data. The largest migrations are from middle-income countries (2,000–20,000 segments of circle) to high-income countries—with a few exceptions (*noted on graphic*).

—Mark Fischetti

SCIENTIFIC AMERICAN ONLINE

For an interactive graphic of human migration flows between world regions, see [ScientificAmerican.com/jun2014/graphic-science](http://ScientificAmerican.com/jun2014/graphic-science)

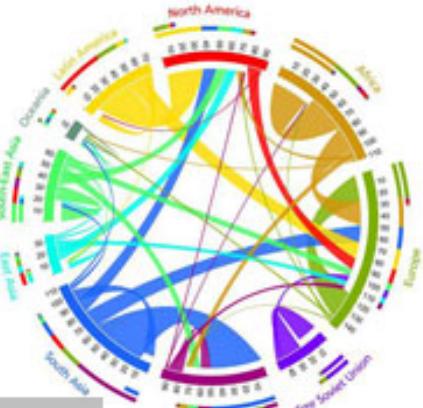
SOURCES: "QUANTIFYING GLOBAL INTERNATIONAL MIGRATION FLOWS" BY GUY J. LABEL AND NIKOLA SANDER IN SCIENCE, VOL. 338, MARCH 28, 2014; THE GLOBAL FLOW OF PEOPLE BY NIKOLA SANDER, GUY J. LABEL AND RAMON BAUER [www.global-migration.info](http://www.global-migration.info)

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# ILO Office for the United Nations



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World of Work 2014



Fair Migration



South-South Dialogue

2/7

103rd International Labour Conference

## Ryder: Migration poses major policy challenges

ILO Director-General Guy Ryder calls for fair migration policies and stronger measures against forced labour at the opening of the 103rd session of the International Labour Conference.

► 103rd Session of the International Labour Conference

## Voice at Work



### Blog post

#### How profitable is the exploitation of people? Sadly, extraordinarily so.

The profits made from the exploitation of the 21 million men, women and children trapped in forced labour in today's private economy is cause for alarm and immediate action.

### Follow us on



### UN News

- UN agencies welcome African-led push to end child marriage ↗
- Top UN envoy in South Sudan stepping down after three years ↗
- On first visit, UN rights chief urges Morocco to expedite pending laws ↗
- Mayors on frontline of battle against climate change – UN ↗

### UN links

- UN Daily Journal ↗
- UN News Centre ↗
- Official UN Documents ↗
- UN Photos ↗

# Internal migration in Germany



# Conclusions

## Using data visualisation to engage the public works

- Teaming up was essential
- Positive feedback from scientists & the public

## How to change a researcher's mind and skill set?

- mind set ... incentives and best practice
- skill set ... education and training

**Data visualisation has the potential to bridge the gap between science and the public**

# "The Global Flow of People"

## Interactive data visualisation

circular-world.com

A collection of our circular migration plots

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ramon@metropop.eu

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