

Tele-connecting local consumption to global land use and water consumption

(Klaus Hubacek, Kuishuang Feng and Yang Yu)

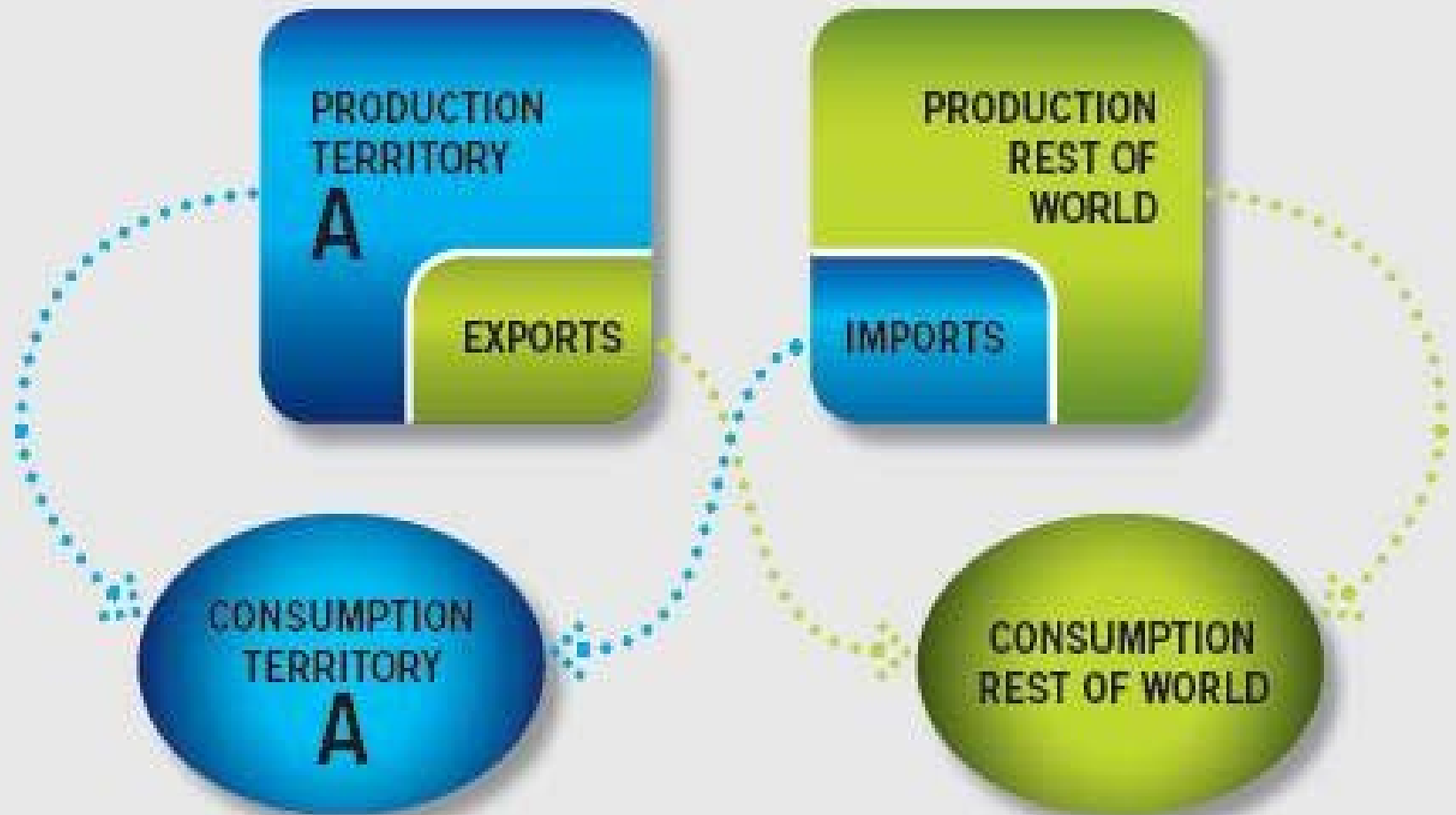
Today's production is based on global supply chains

Division of labor "Sonicare Elite 7000" production and supply locations



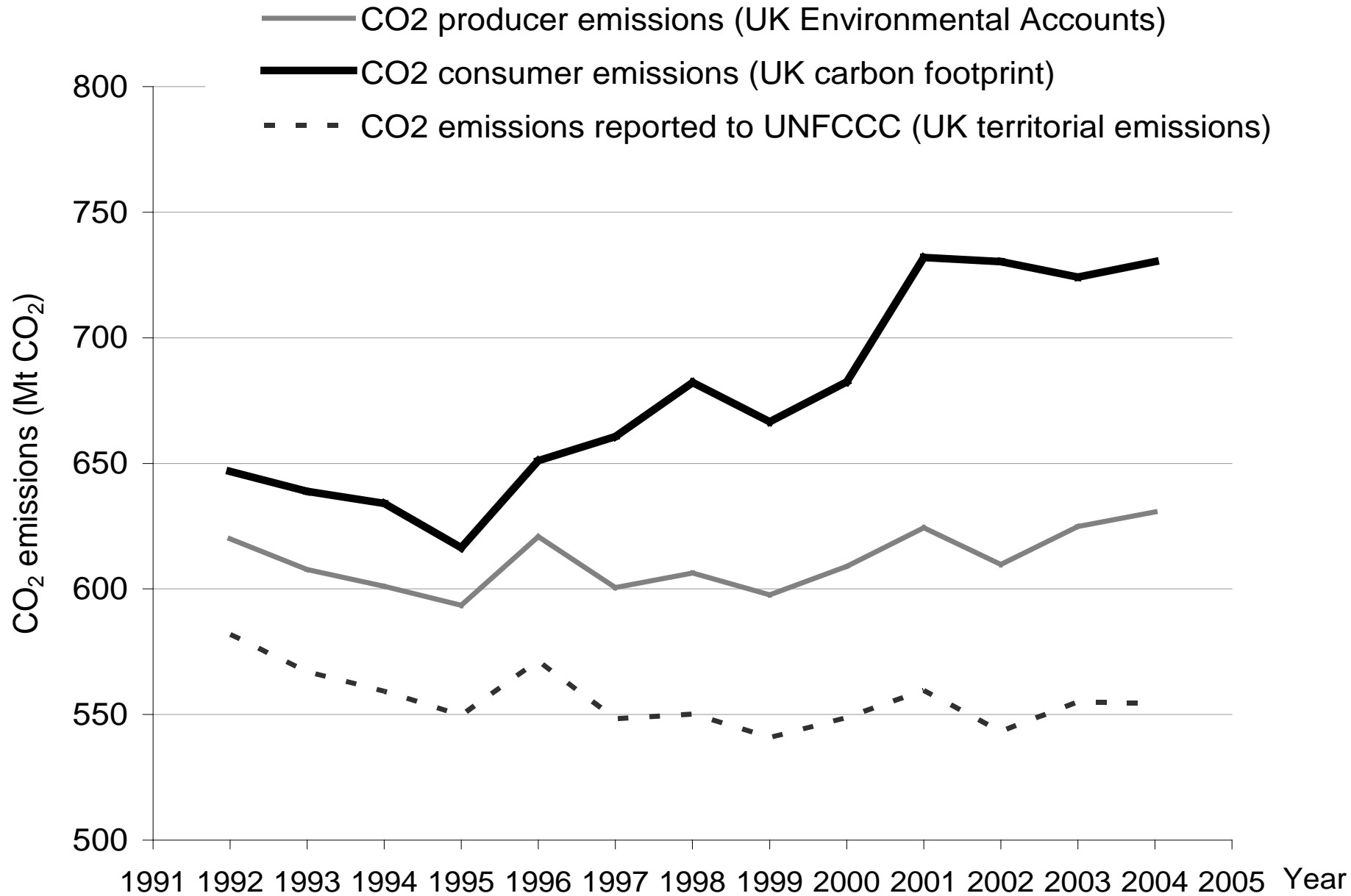
-
- 1** China (Shenzhen), copper coils
 - 2** Japan (Tokyo), nickel cadmium cells
 - 3** France (Rambouillet), charging components
 - 4** China (Zhuhai), etching of circuit boards
 - 5** Taiwan (near Taipei), nickel cadmium cells, circuit board components
 - 6** Malaysia (Kuala Lumpur), circuit board components
 - 7** Philippines (Manila), soldering of circuit board components, tests
 - 8** Sweden (Sandviken), production of special steel
 - 9** Austria (Klagenfurt), pre-cutting of special steel, plastic parts
 - 10** United States (Snoqualmie), assembly of plastic parts
 - 11** United States (Seattle), packaging

What are consumption-based emissions on a national level?

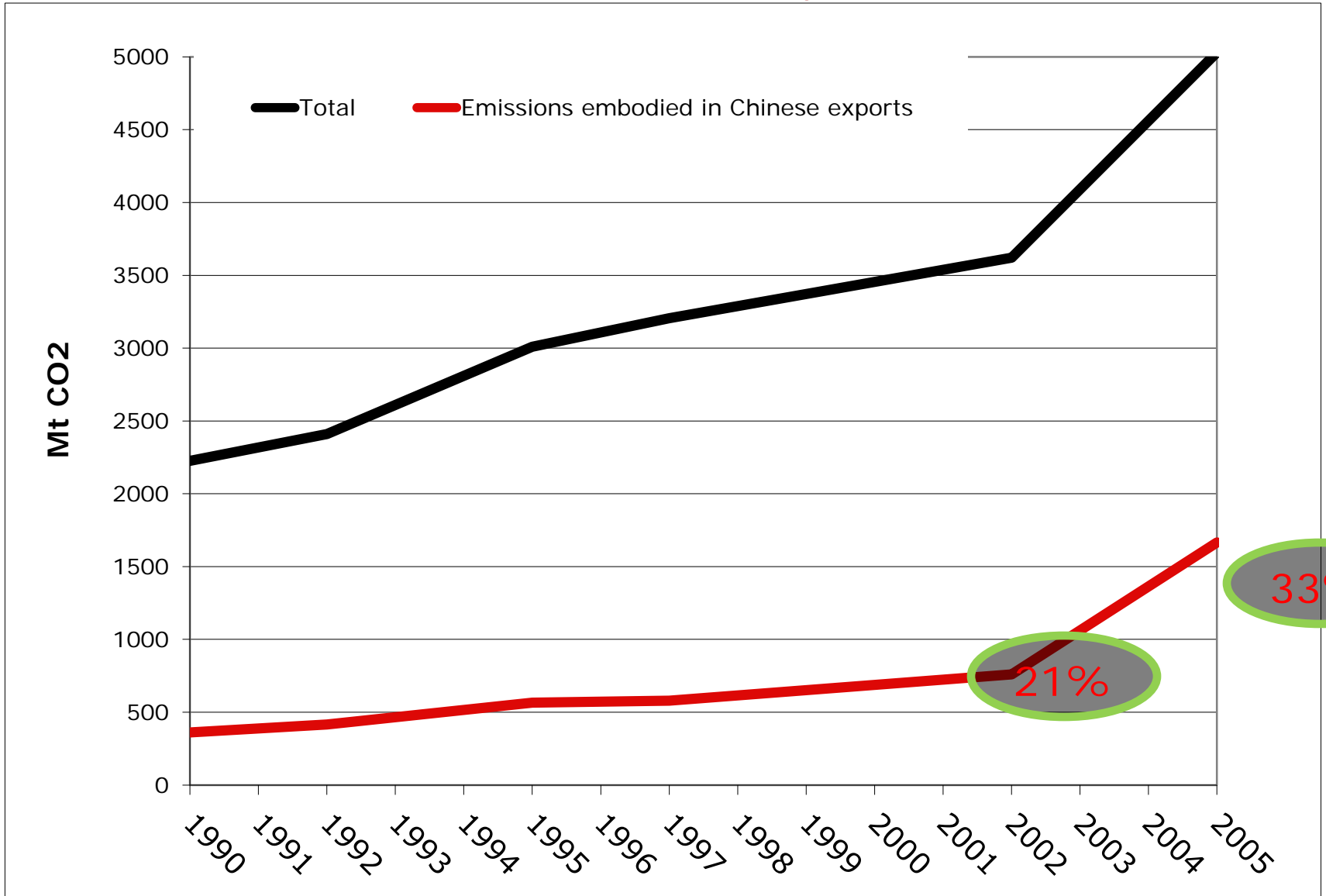


(Carbon Trust, 2006)

UK's CO₂ emissions

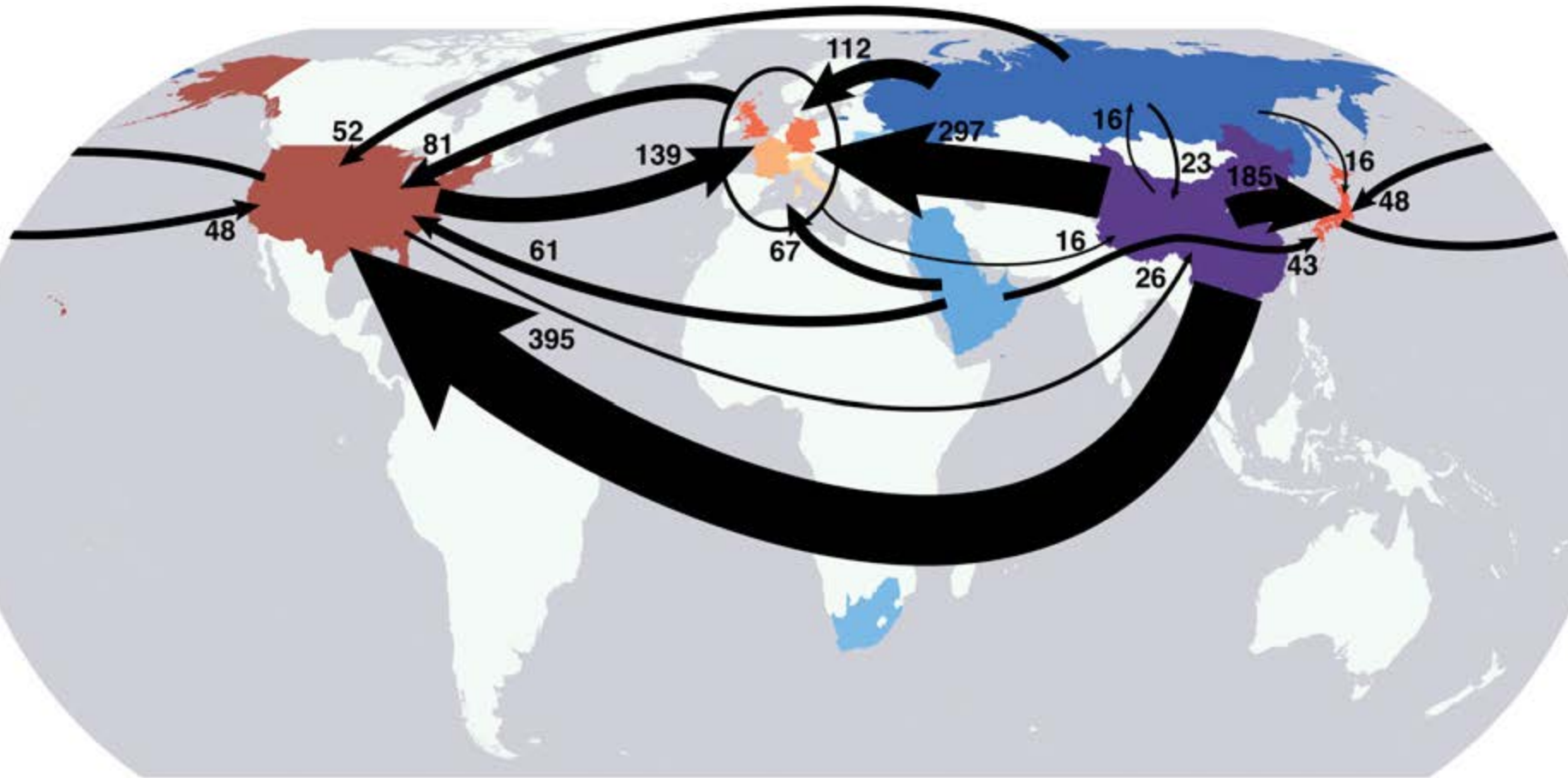


China's exports



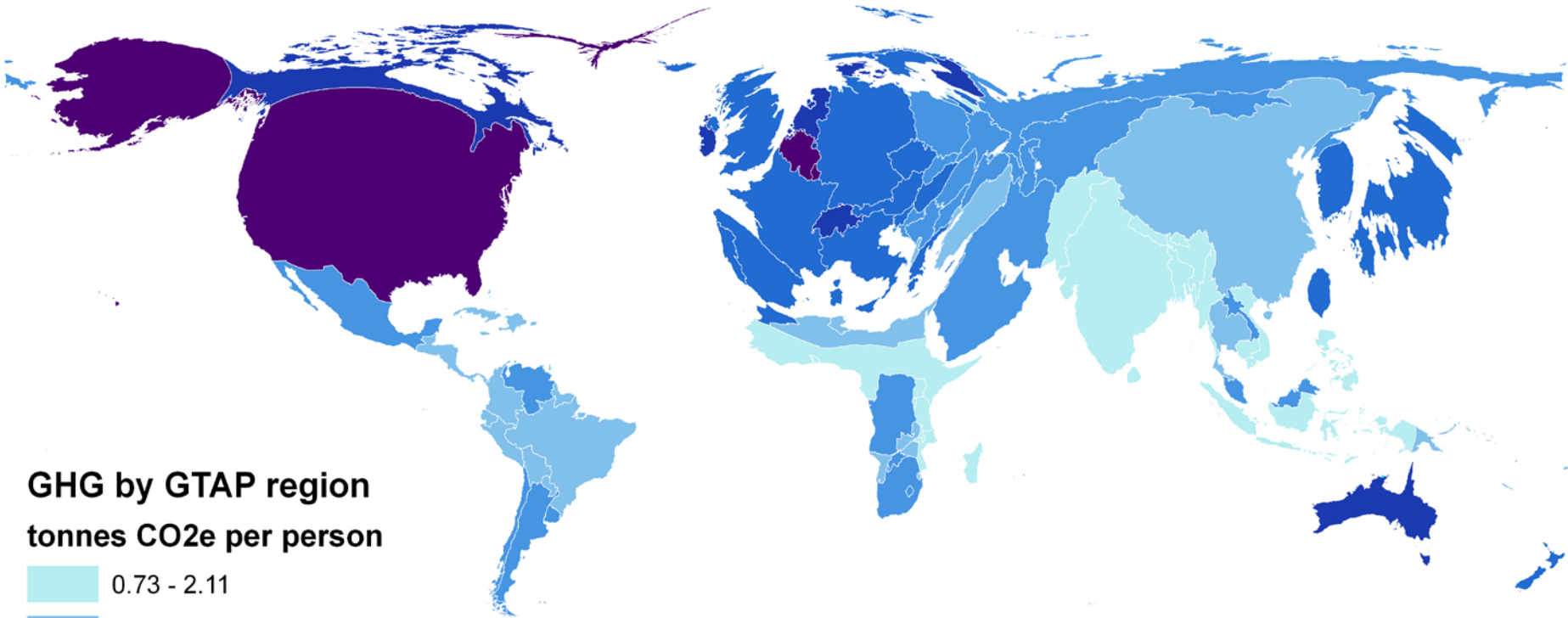
(Weber, Christopher L., Peters, Glen, Guan, Dabo, and Klaus Hubacek (2008) "The Contribution of Chinese Exports to Climate Change"; *Energy Policy*. Vol. 36 3572– 3577.)

Largest interregional fluxes of emissions embodied in trade

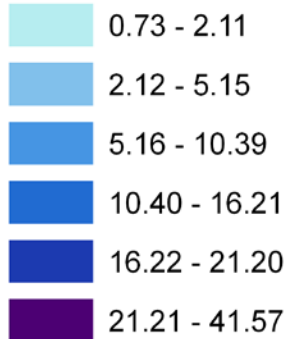


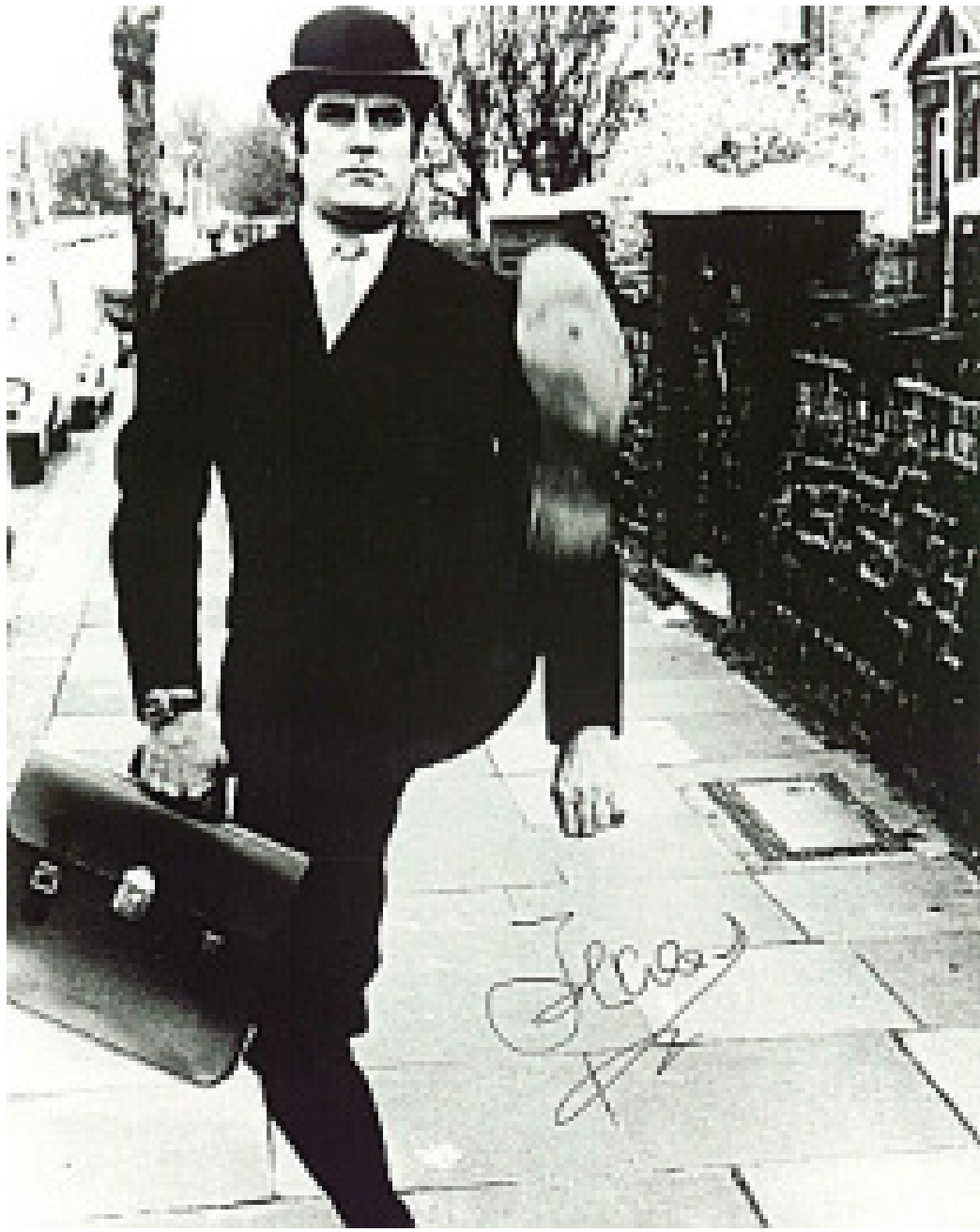
- Largest interregional fluxes of emissions embodied in trade (Mt CO₂ y⁻¹) from dominant net exporting countries (blue) to the dominant net importing countries (red).
- Source: Davis and Caldeira. (2010). Consumption-based accounting of CO₂ emissions. PNAS

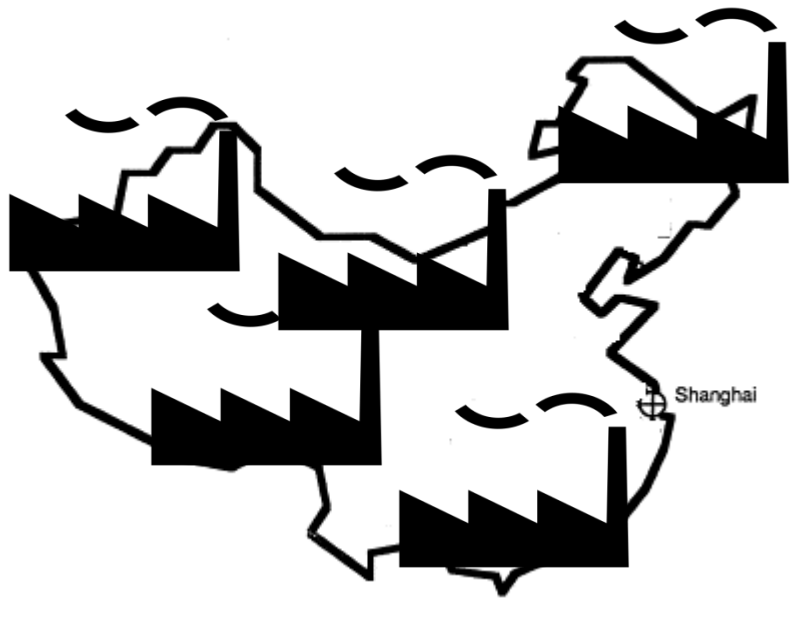
Cartogram morphed by total GHG emissions from consumption



GHG by GTAP region tonnes CO₂e per person

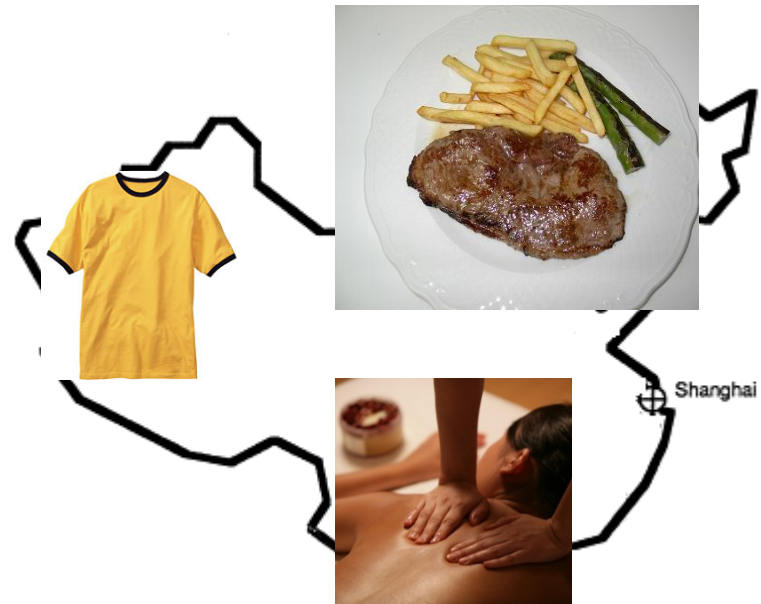






Similar to calculating emissions by all factories in a given territory

we could also calculate emissions by all products and services consumed in that territory





in the first case, we know *WHERE* emissions occur

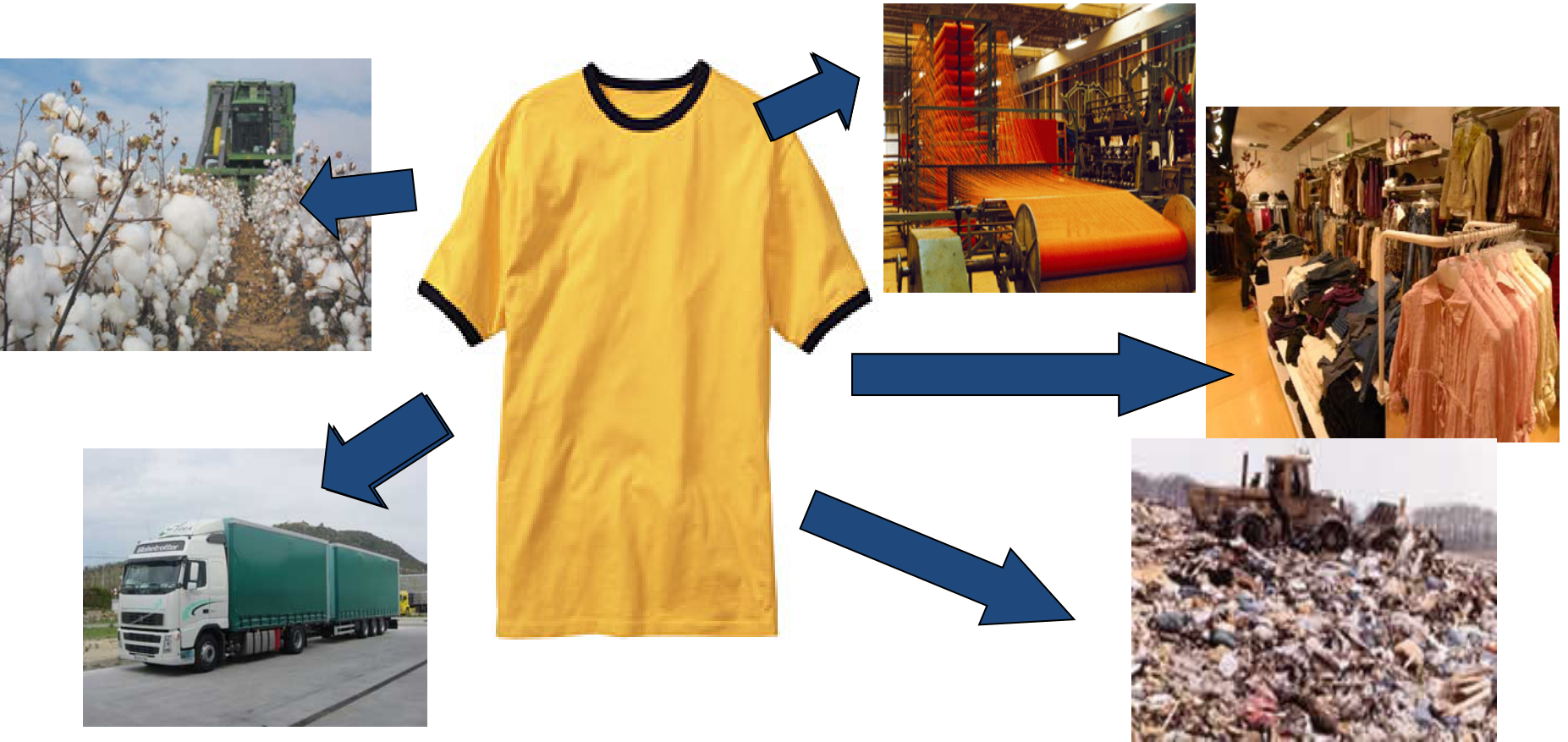


in the second case, we know *WHY* emissions occur



How can we calculate consumption-based emissions and resource consumption?

From cradle to the grave using Life-Cycle Analysis (LCA)



Ecoinvent LCA database

- 4000 products x 4000 processes
- More than 100 environmental indicators (e.g. water use, CO₂ emissions, air pollutants, COD, ...).



The screenshot shows the Ecoinvent website homepage. The browser address bar displays <http://www.ecoinvent.ch/>. The page features a red header with the Ecoinvent logo and the text "Swiss Centre for Life Cycle Inventories". Below the header, there is a navigation menu with buttons for "Organisation", "Database", "Documentation", "News", and "ecoinvent v3". A login section is visible with fields for "Username:" and "Password:", a "Login" button, and a link for "Forgot your password?". The main content area includes a "Latest News" section with three articles: "Presentations from 3rd Int. ecoinvent Meeting available" (dated 15.10.2012), "ecoinvent v3 further postponed ..." (dated 09.10.2012), and "ecoinvent v3 – release date shifts to September 2012!" (dated 24.07.2012). Below the news, there is a "Welcome to the ecoinvent Centre portal" section with a paragraph describing the centre and its data. At the bottom, there is a footer with navigation links: "Home | Contact | Terms of Use | Sitemap | Login INTERNAL area", copyright information, and a privacy notice.

http://www.ecoinvent.ch/

Research Port - My Journals Carbon emissions trading in C... Home ecoinvent

a Competence Centre of ART ETH EMPA

Direct access to database Username: Password: Login Forgot your password?

Organisation Database Documentation News ecoinvent v3

Latest News

Presentations from 3rd Int. ecoinvent Meeting available

All presentations from the 3rd International ecoinvent Meeting (on October 5, 2012, in St-Malo...

[more] 15.10.2012

ecoinvent v3 further postponed ...

Due to some technical problems, the release of ecoinvent v3 is unfortunately further postponed...

[more] 09.10.2012

ecoinvent v3 – release date shifts to September 2012!

In the last month, the ecoinvent Centre team together with the editorial board worked very hard to...

[more] 24.07.2012

| ecoinvent v3 - latest news |

Welcome to the ecoinvent Centre portal

The ecoinvent Centre - a Competence Centre of ETHZ, EPFL, PSI, Empa and ART - is the world's leading supplier of consistent and transparent life cycle inventory (LCI) data of known quality with the **database ecoinvent data v2.2** and offers science-based, industrial, international life cycle assessment (LCA) and life cycle management (LCM) data and services.

ecoinvent data v2.2 ...

- contains international industrial life cycle inventory data on energy supply, resource extraction, material supply, chemicals, metals, agriculture, waste management services, and transport services.
- is used by around 4'500 users in more than 40 countries worldwide and is included in the leading LCA software tools as well as in various eco-design tools for building and construction, waste management or product design.
- is our solution for your data needs in Integrated Product Policy (IPP), Environmental Product Declaration (EPD), Life Cycle Assessment (LCA), Life Cycle Management (LCM), Design for Environment (DfE).

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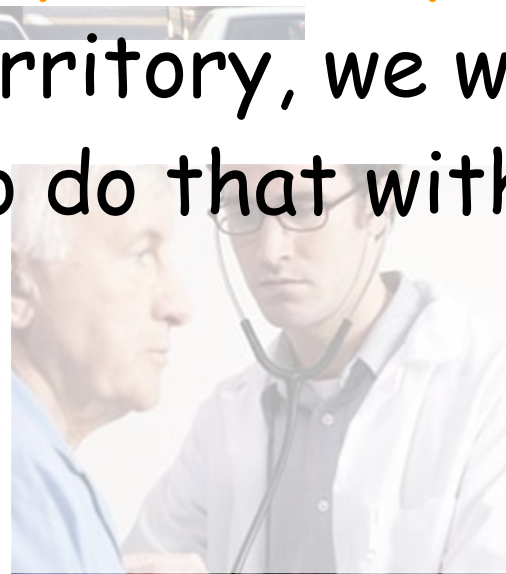
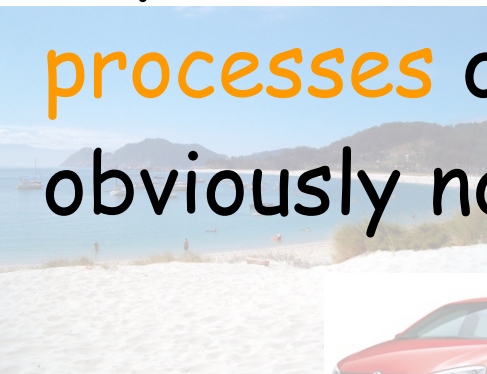




There are millions of products, each one is different from the other!

If we want to calculate all environmental impacts from **all consumption and production processes** of a given territory, we will

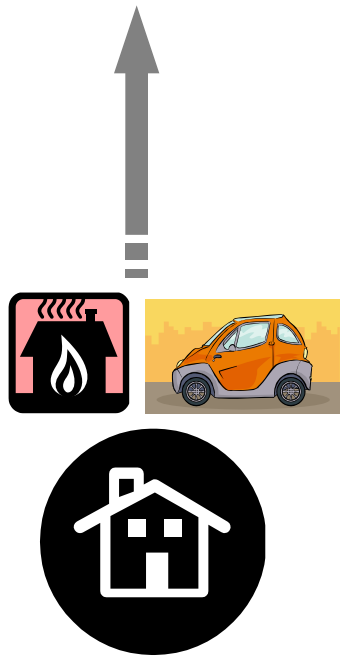
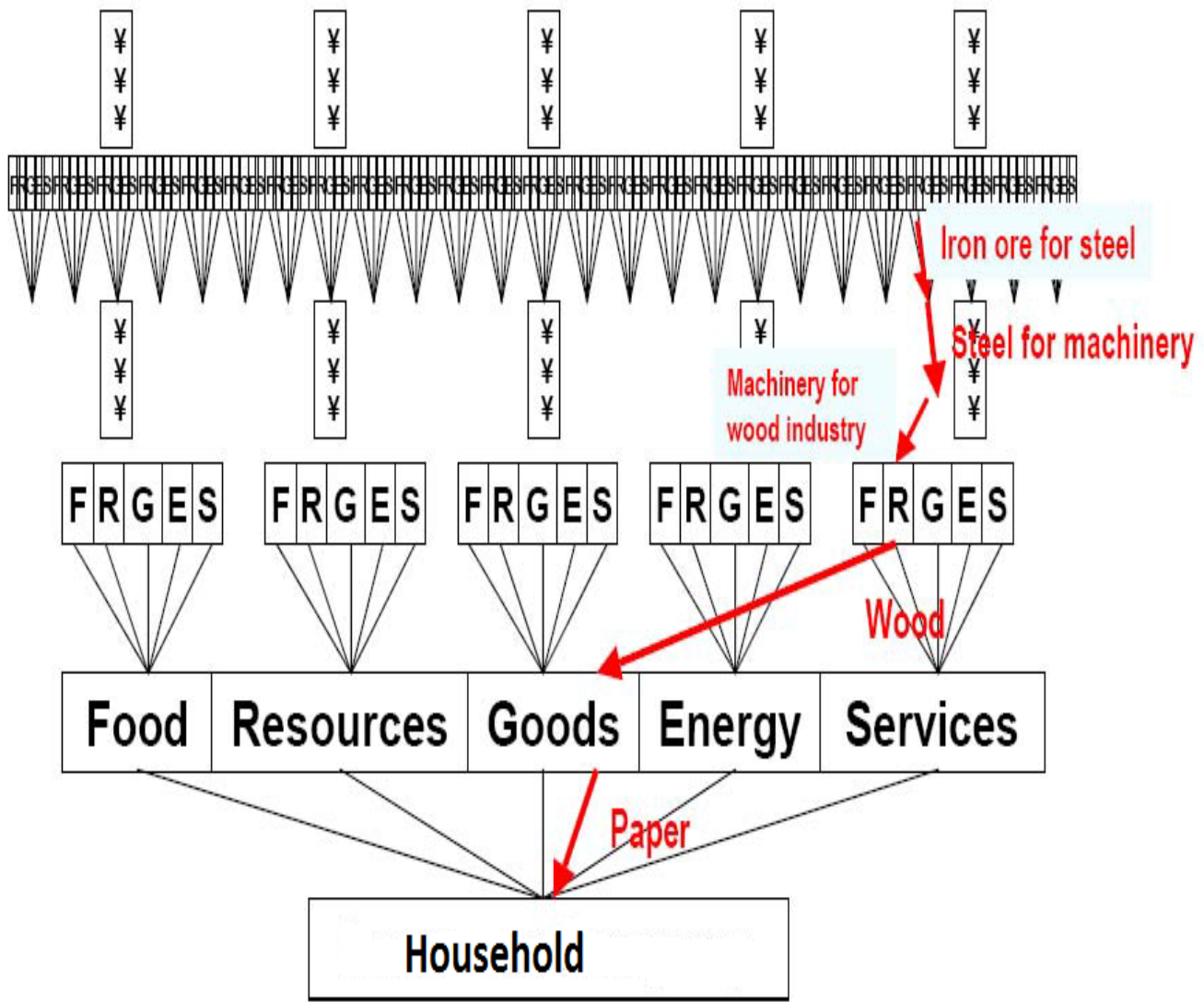
obviously not be able to do that with LCA



What are direct and indirect emissions of a household?

Indirect GHG emissions (supply chain)

Direct GHG emissions



"TOP DOWN" AND "BOTTOM-UP" APPROACH CONSUMPTION EMISSIONS (CARBON FOOTPRINT)



Carbon footprint of countries



Regional carbon footprint
Local carbon footprint



Carbon footprint of companies and organizations

Citizen carbon footprint



Carbon footprint of products and activities

"TOP DOWN"

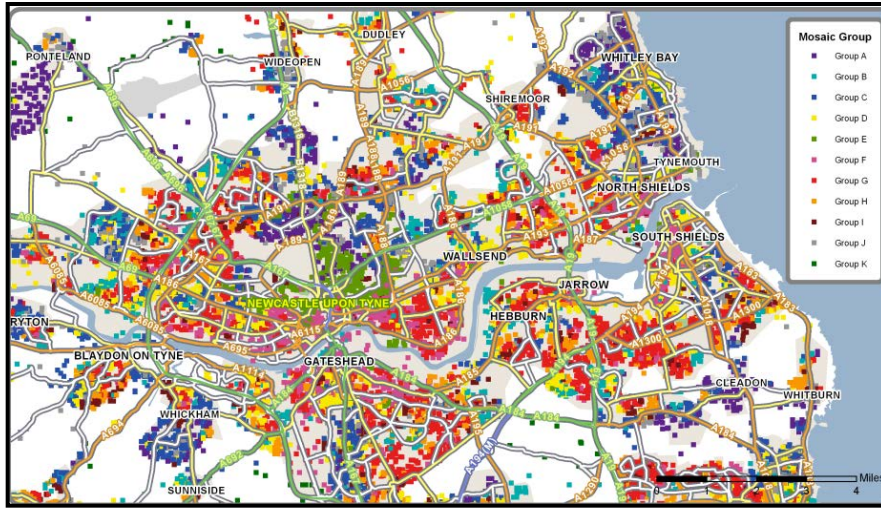
Input-Output Analysis



"BOTTOM-UP"

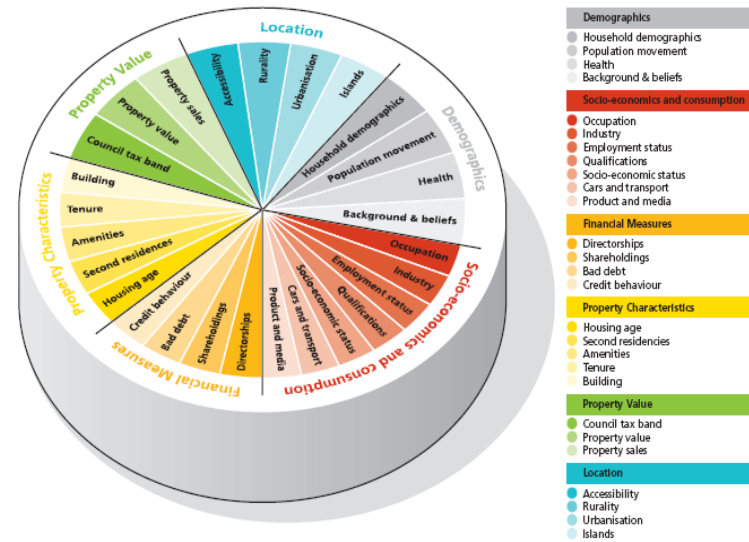
LCA & CES

MOSAIC: Using Geo-demographic Marketing Data



- Experian: world leading supplier of consumer segmentation data
- MOSAIC UK: consumer classification

- Comprehensive post-code specific information on property, residents and their lifestyle
- 61 lifestyle groups
 - “villages with wealthy commuters,”
 - “affluent urban professionals, large flats »
- over 400 variables

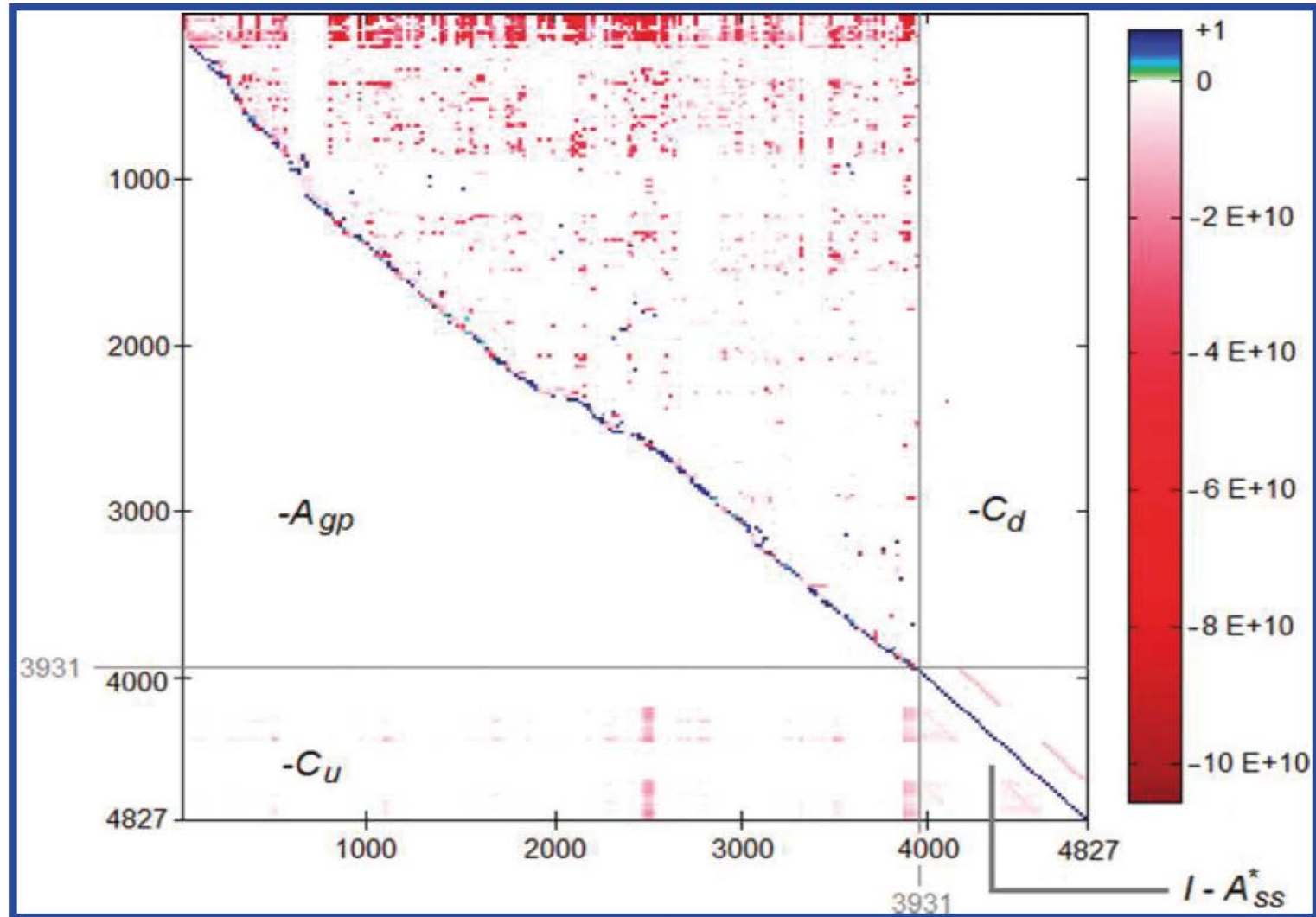


Environmental extensions

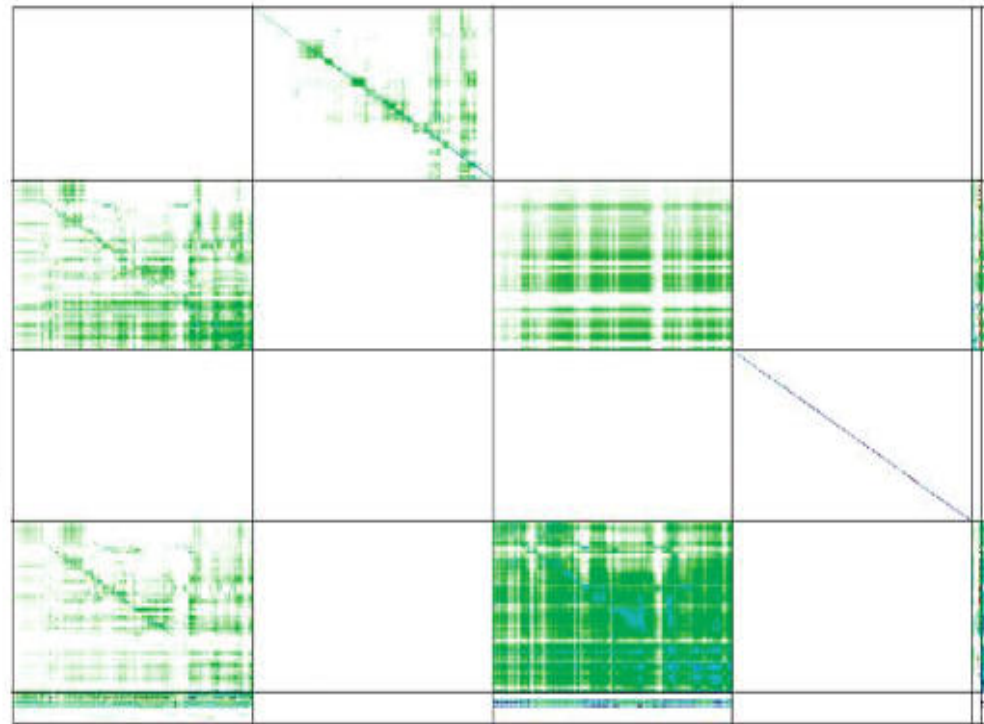
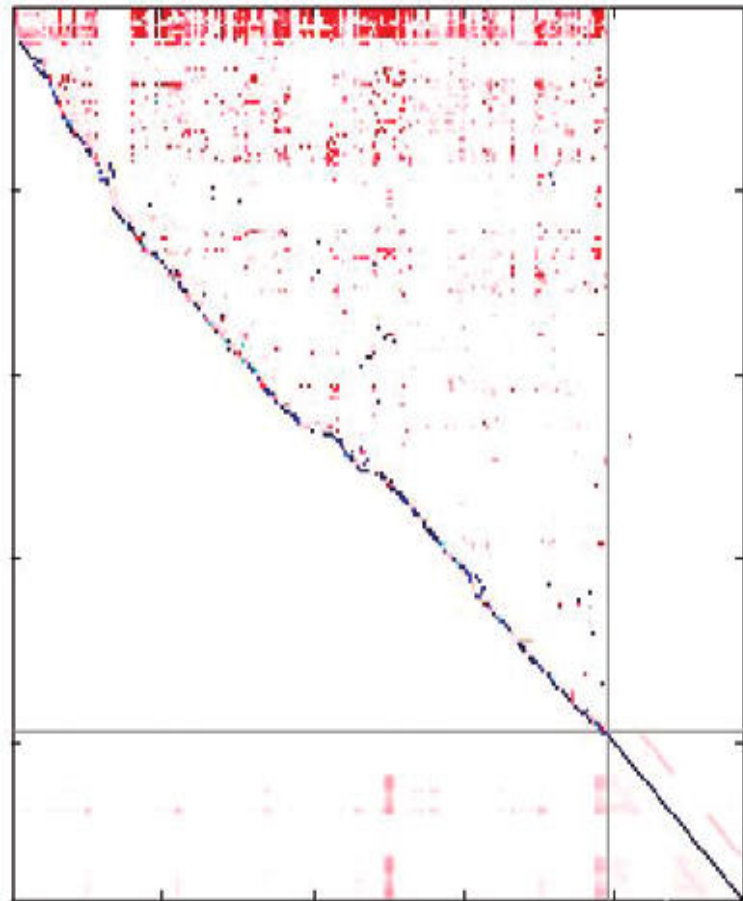
	black coal	natural gas	iron ore	Etc...	gravel	clays	steel making	alumina	nickel	etc
black coal										
natural gas										
iron ore							xxxxxxx			
Etc...										
gravel										
clays										
steel making										
alumina										
nickel										
etc										

- GHG, Energy IO
- Virtual water and water footprints
- Waste IO, MFA
- Biodiversity and Ecosystem Services
- Land
- More than 100 pollutants
- Disaster Footprints

Hybrid LCA

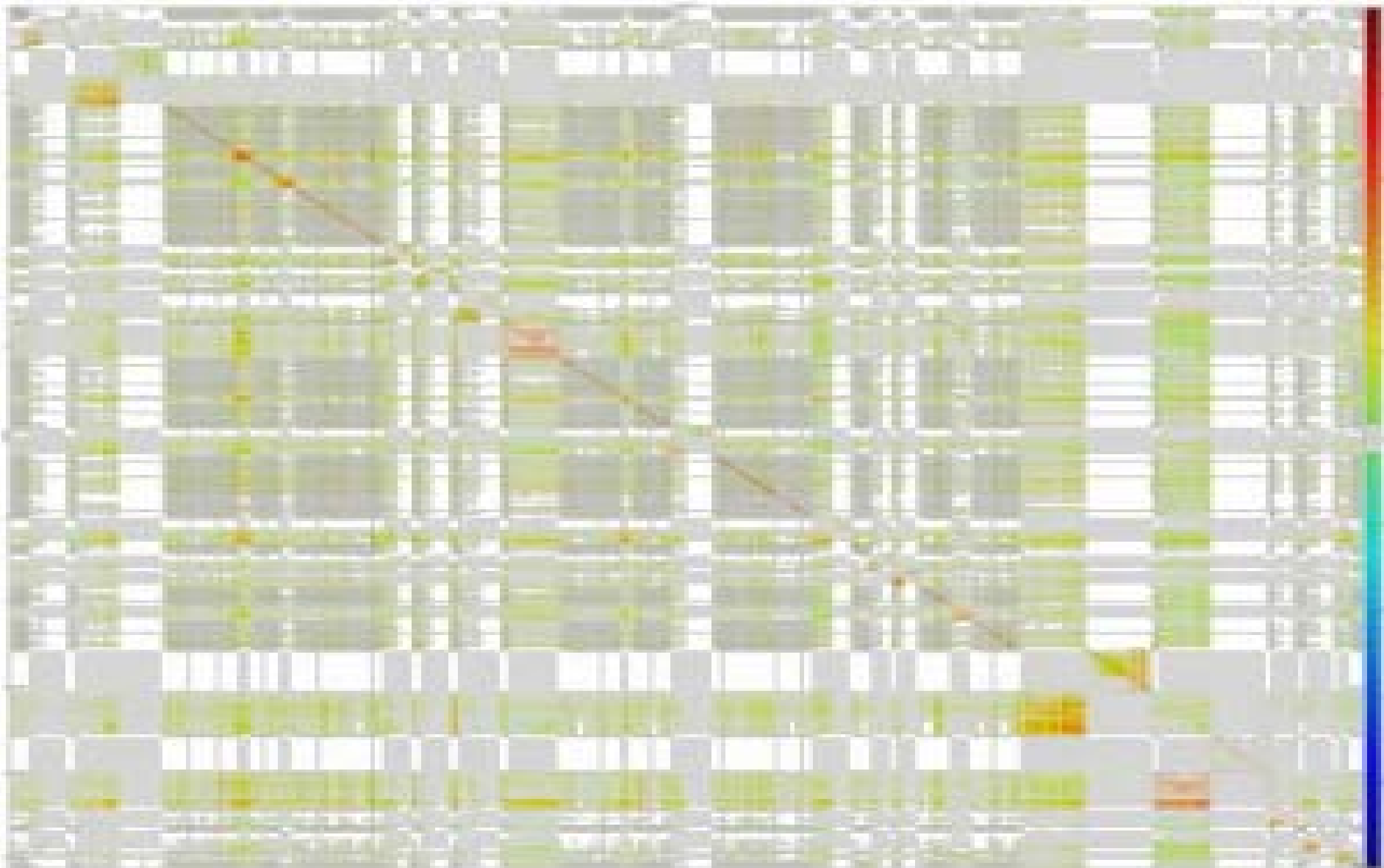


The ultimate combination: Hybrid LCA & domestic plus global MRIO



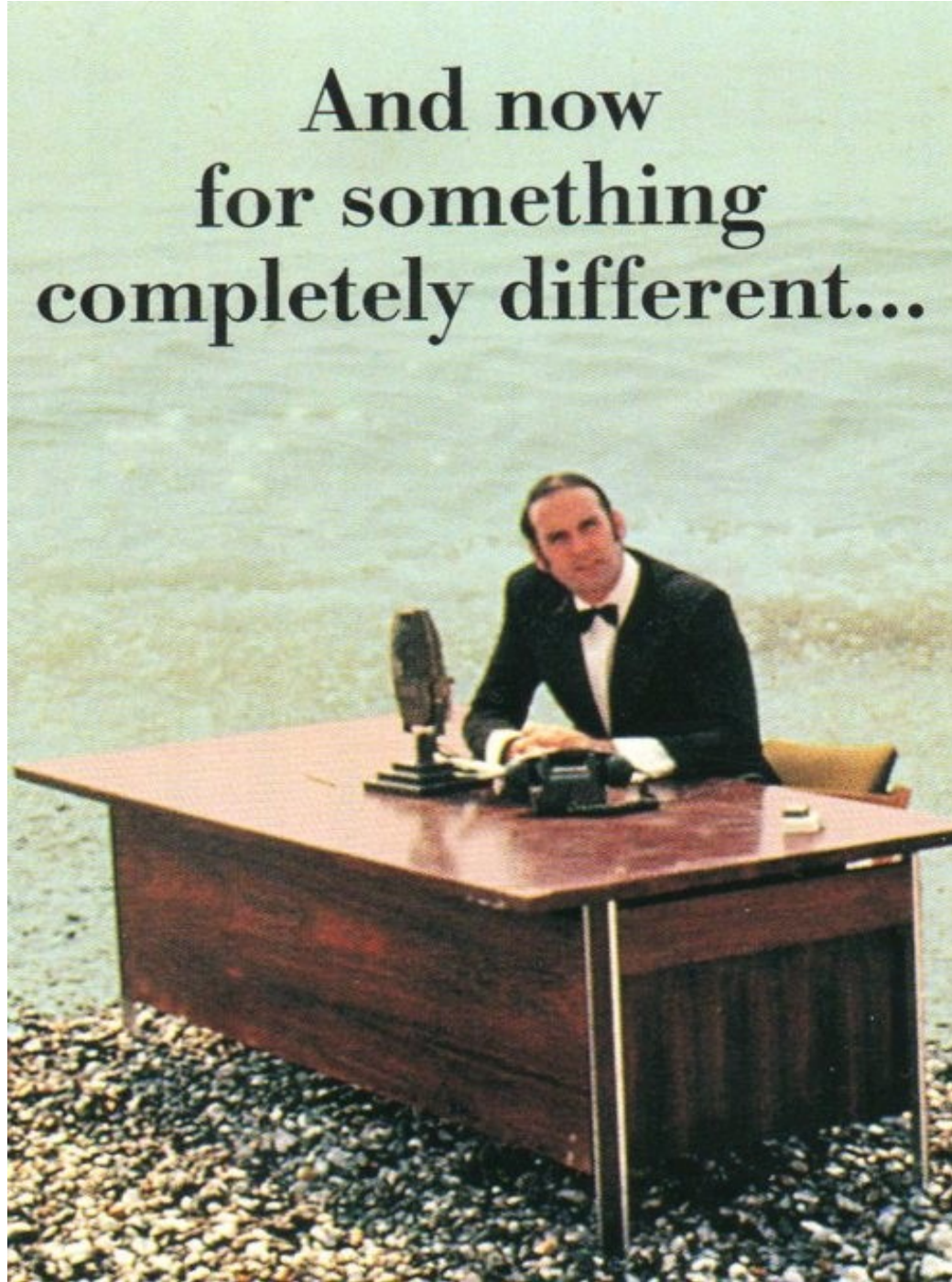
Domestic trade

Have you always wondered what the world economy looks like?



A 160-country 10,000×10,000-sector balanced World MRIO for the year 2000; by Lenzen et al.

**And now
for something
completely different...**



Virtual water flows (embodied water or WFP)

- refers to the sum of water used in the various steps of the production chain.

How much water is required to produce 1 pint of beer?



Beer

Global average water footprint: 75 litres of water for one glass of beer.

One glass contains about 250 ml of beer. Most of the water behind the beer is for producing the barley.

<http://www.waterfootprint.org>

How much water is required to produce 1 Hamburger?



Hamburger

Global average water footprint: 2400 litres of water for one hamburger!

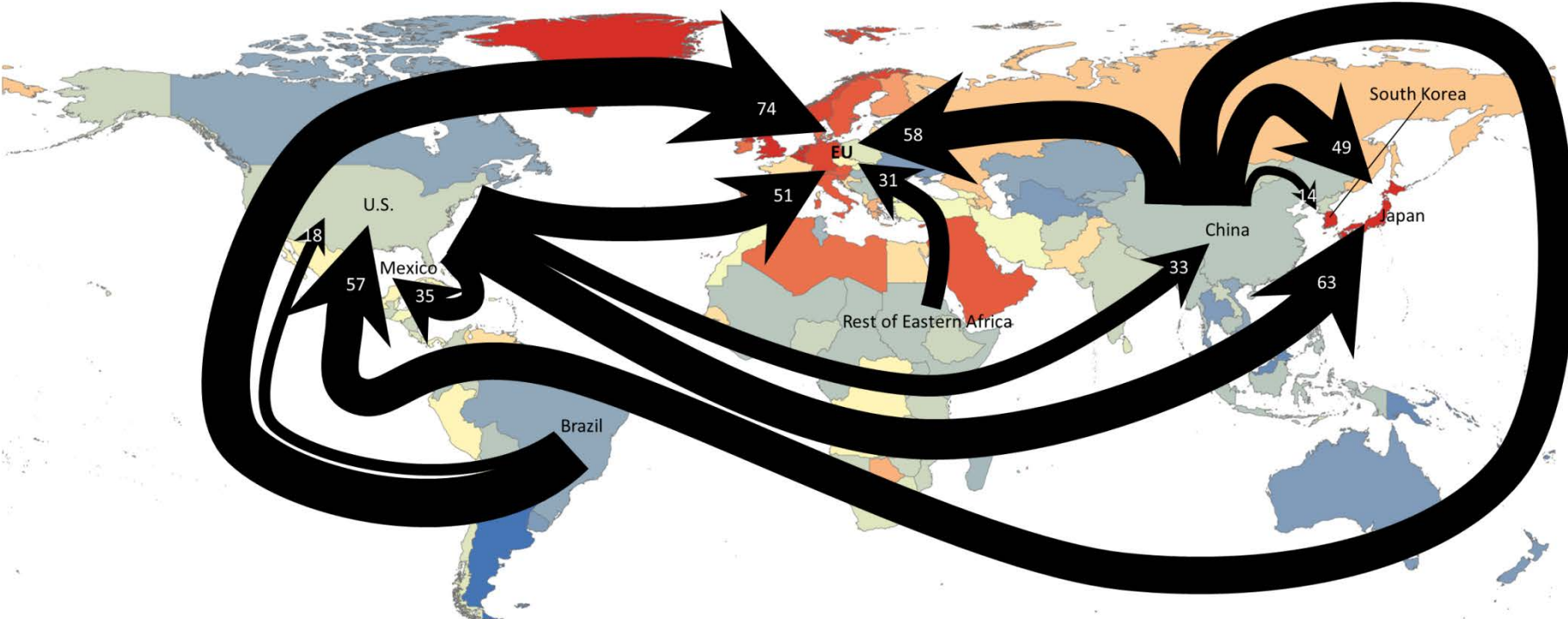
Most of the water is needed for producing the beef contained in the hamburger. In our hamburger we assumed there is about 150 gram of beef.

<http://www.waterfootprint.org>

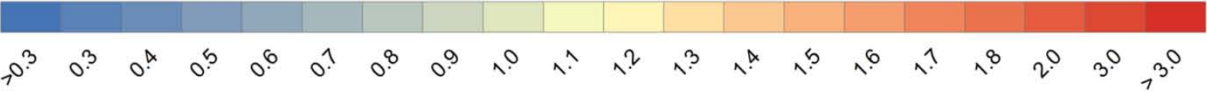
Virtual water flows in trade

- Basic idea, that when goods and services are exchanged, so is virtual water.
- 'Hidden flows' of water of food or other commodities are traded from one place to another.
- Water scarce-regions should import water intensive products and water-rich regions export water-intensive products
- John Allan (1998) argued that countries in the Middle East can save their scarce water resources by relying more on import of food.
- Own research shows that this is not necessarily the case.

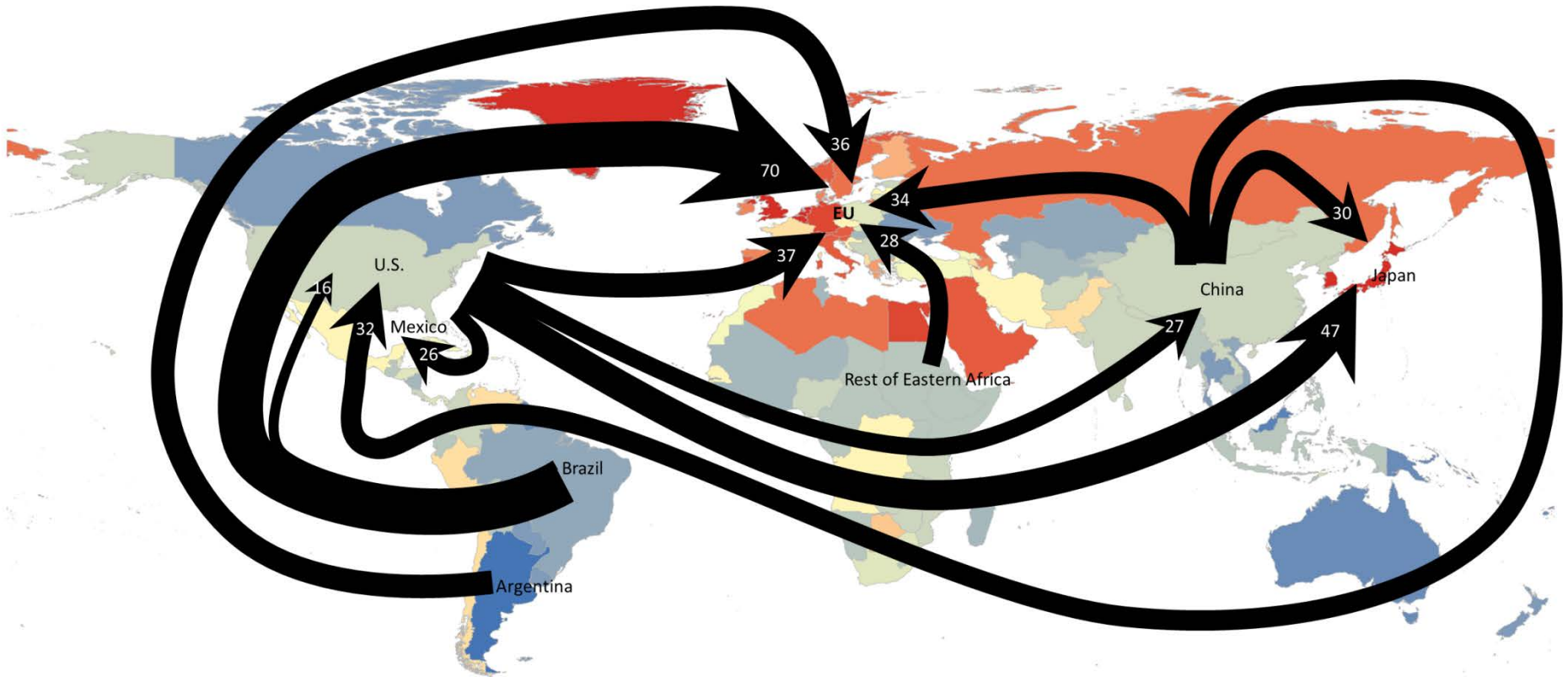
Global virtual water flows (Billion m³)



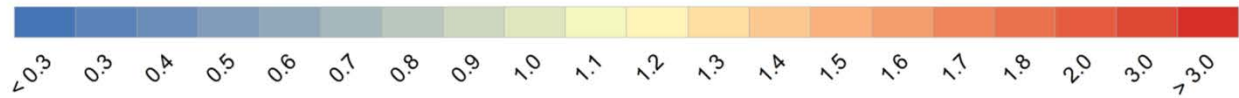
Ratio: Consumption vs. Production



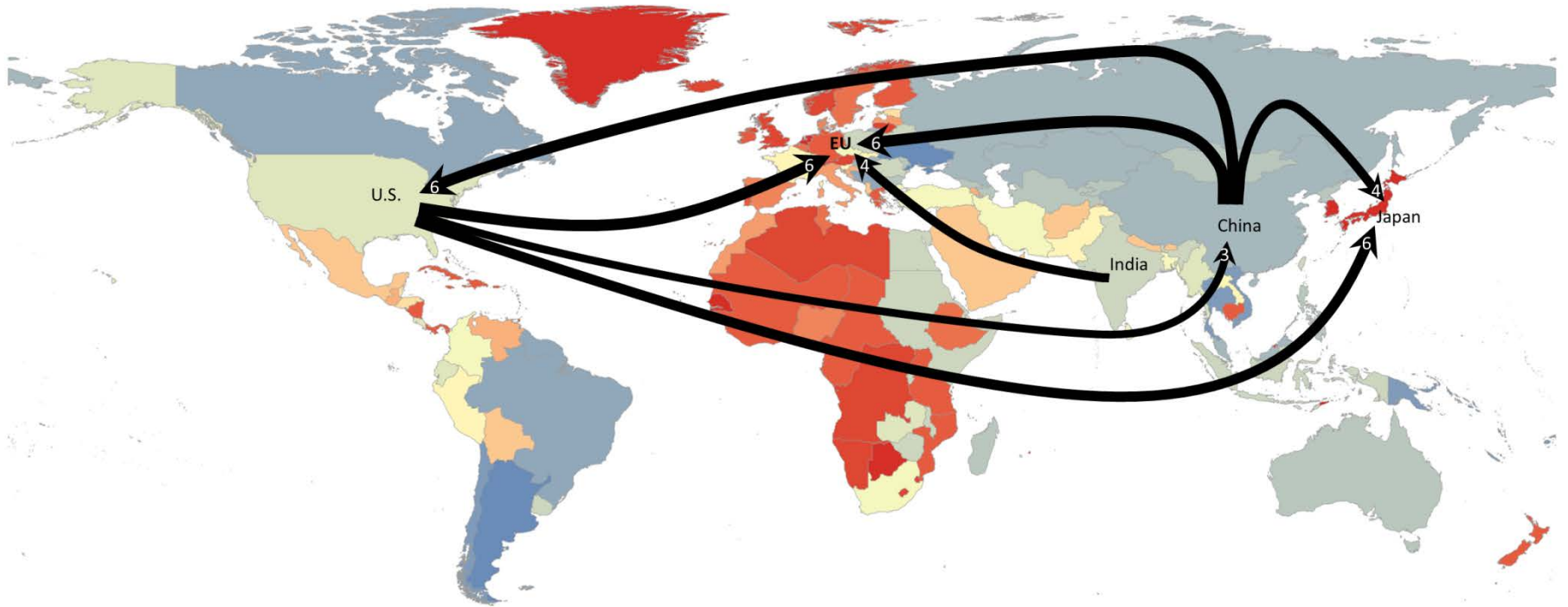
Green water (Billion m³)



Ratio: Consumption vs. Production



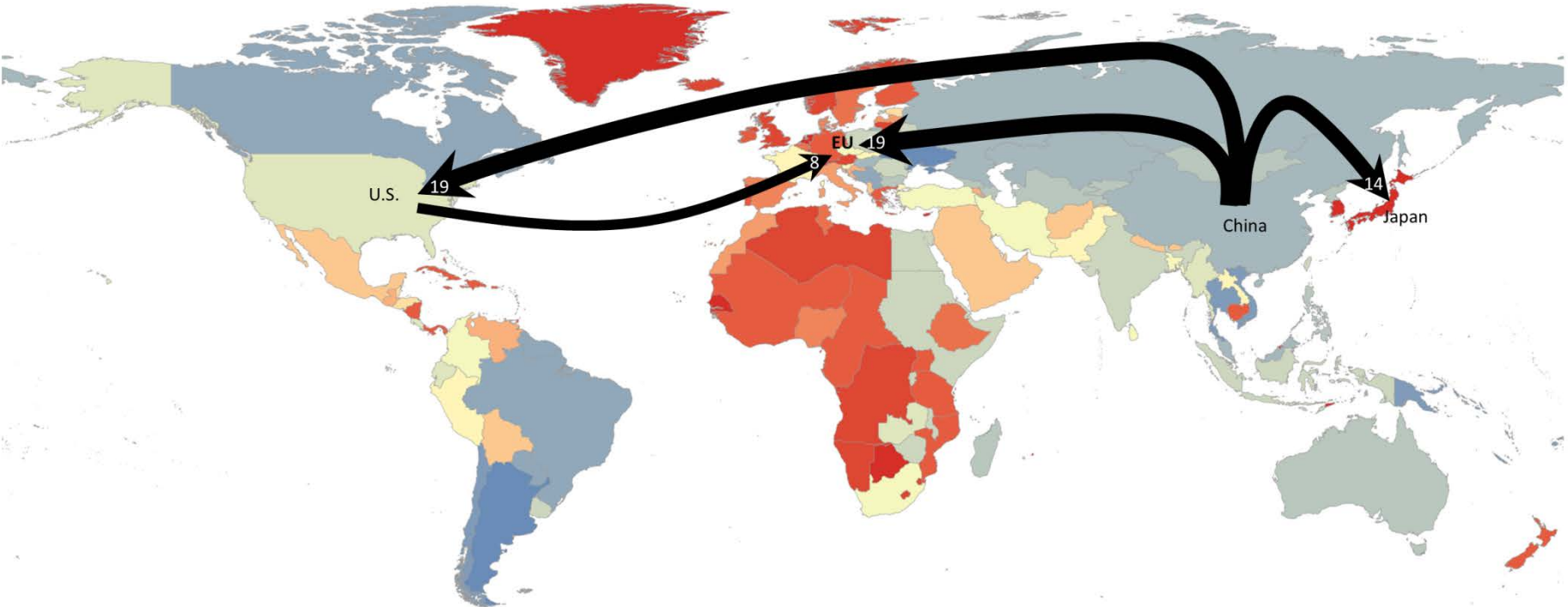
Blue water (Billion m³)



Ratio: Consumption vs. Production



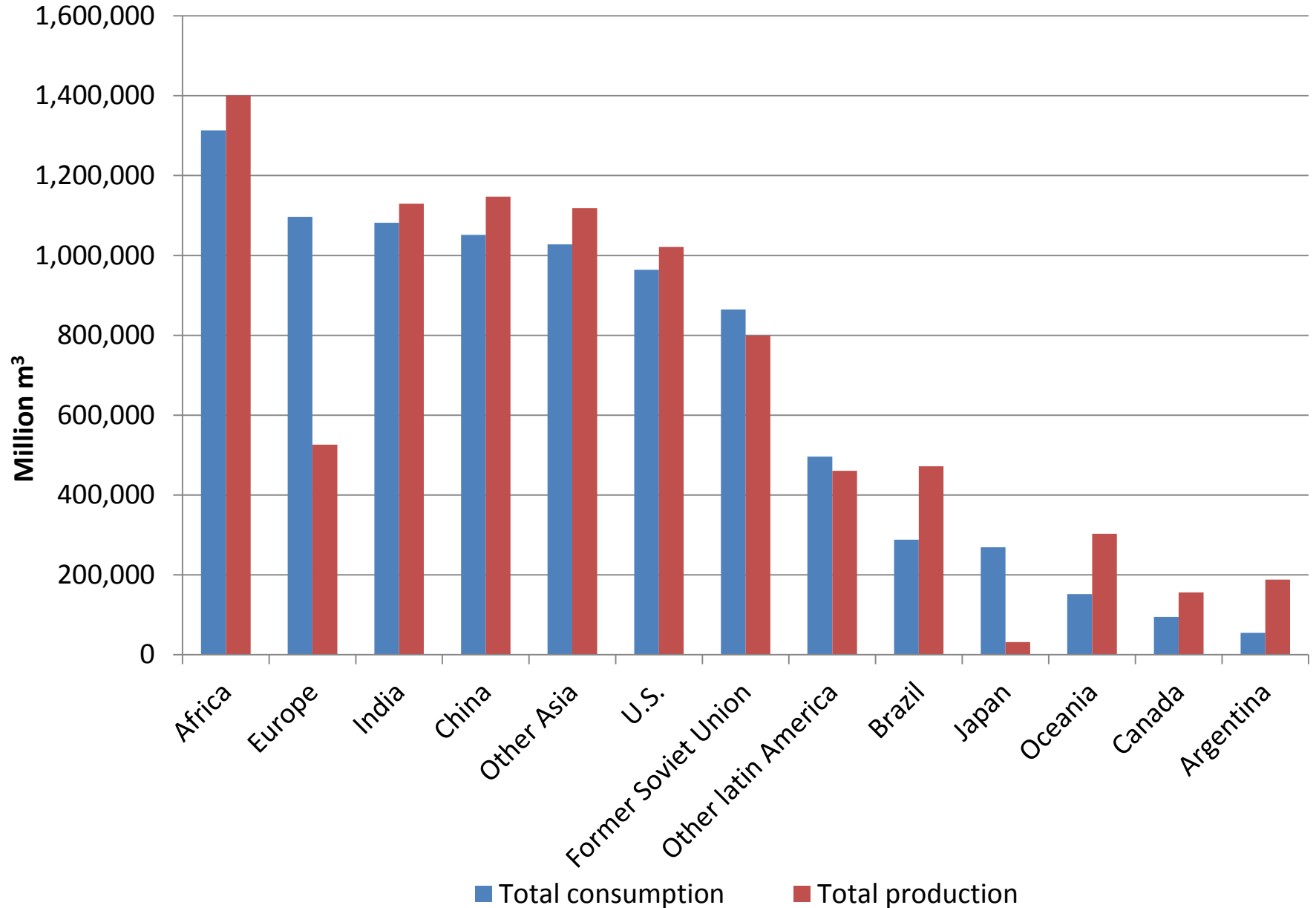
Grey water (Billion m³)



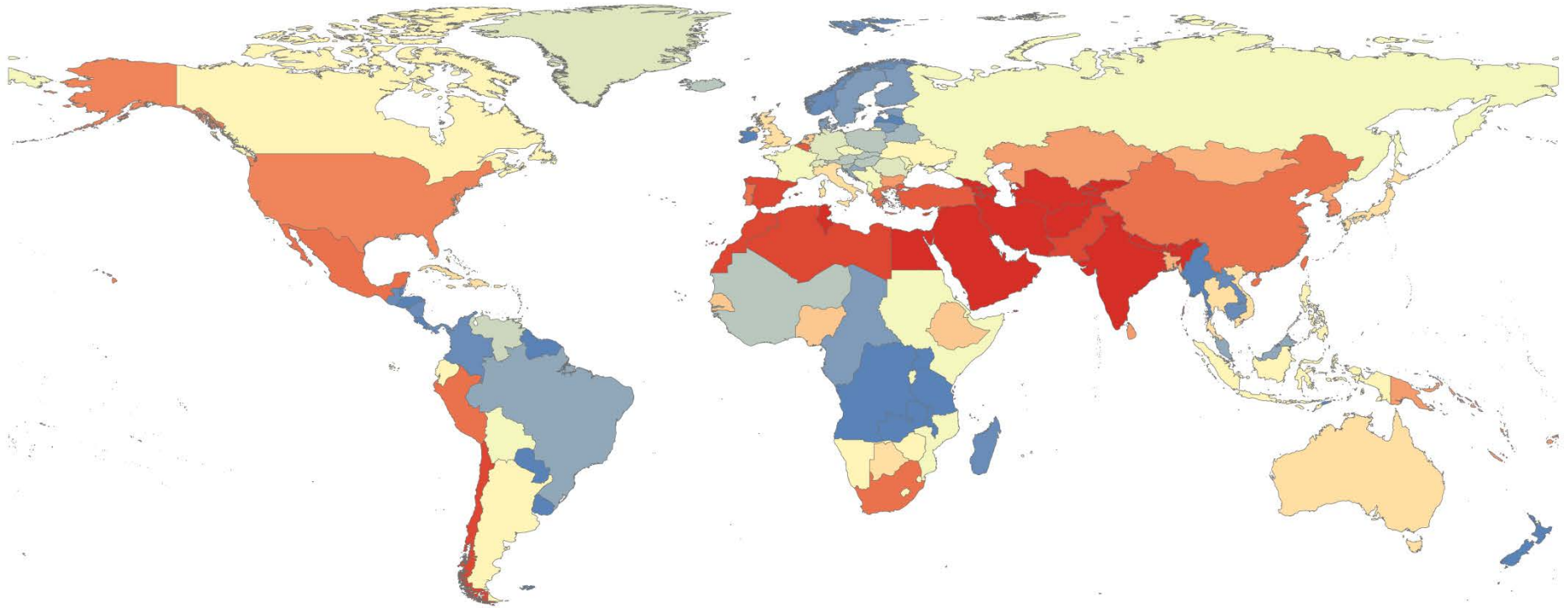
Ratio: Consumption vs. Production



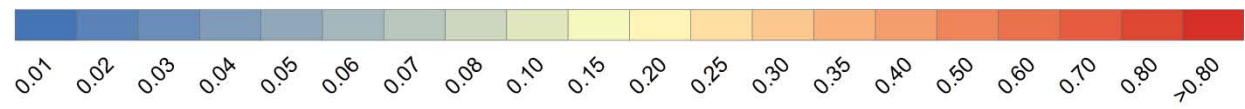
Production and consumption water (Million m³)



Weighted average water stress

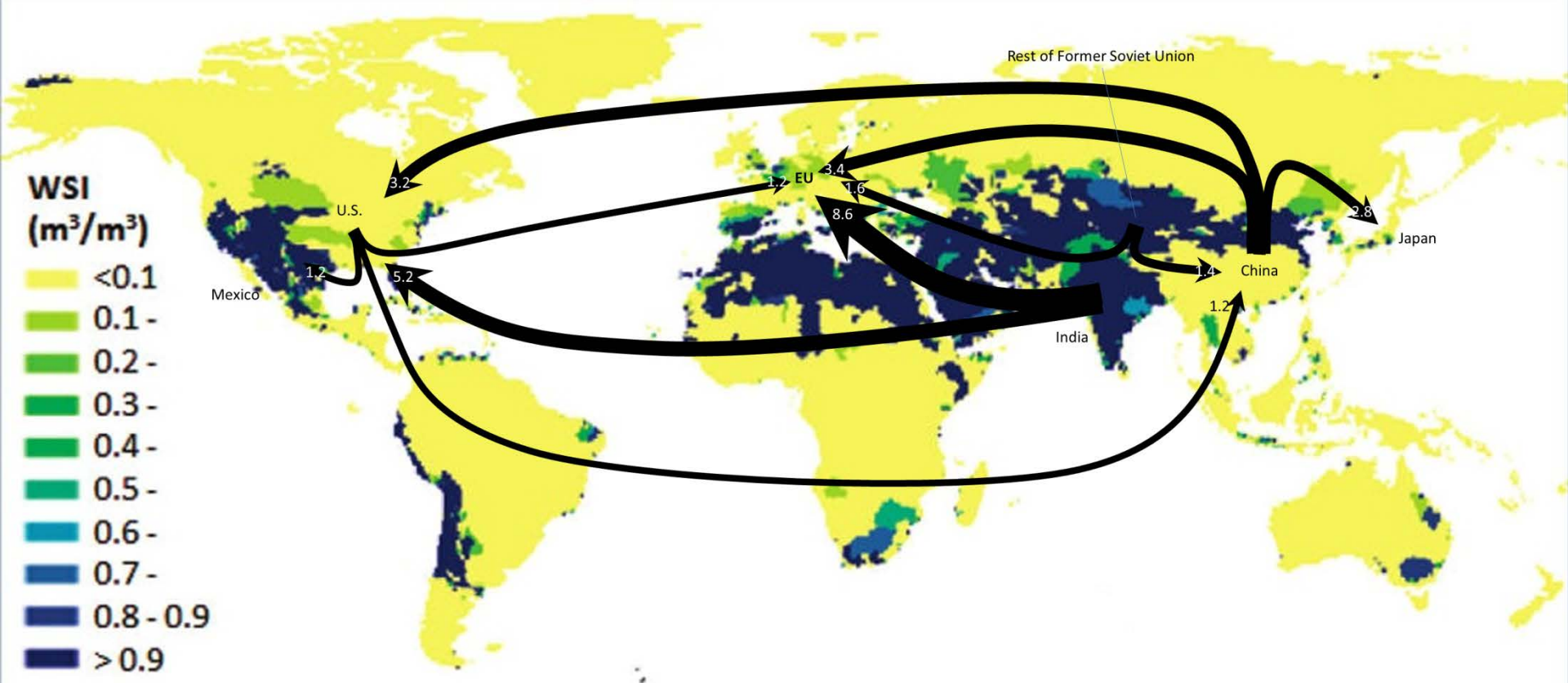


Water Stress Index



Virtual water flows and impacts for cotton

(in billion m³)





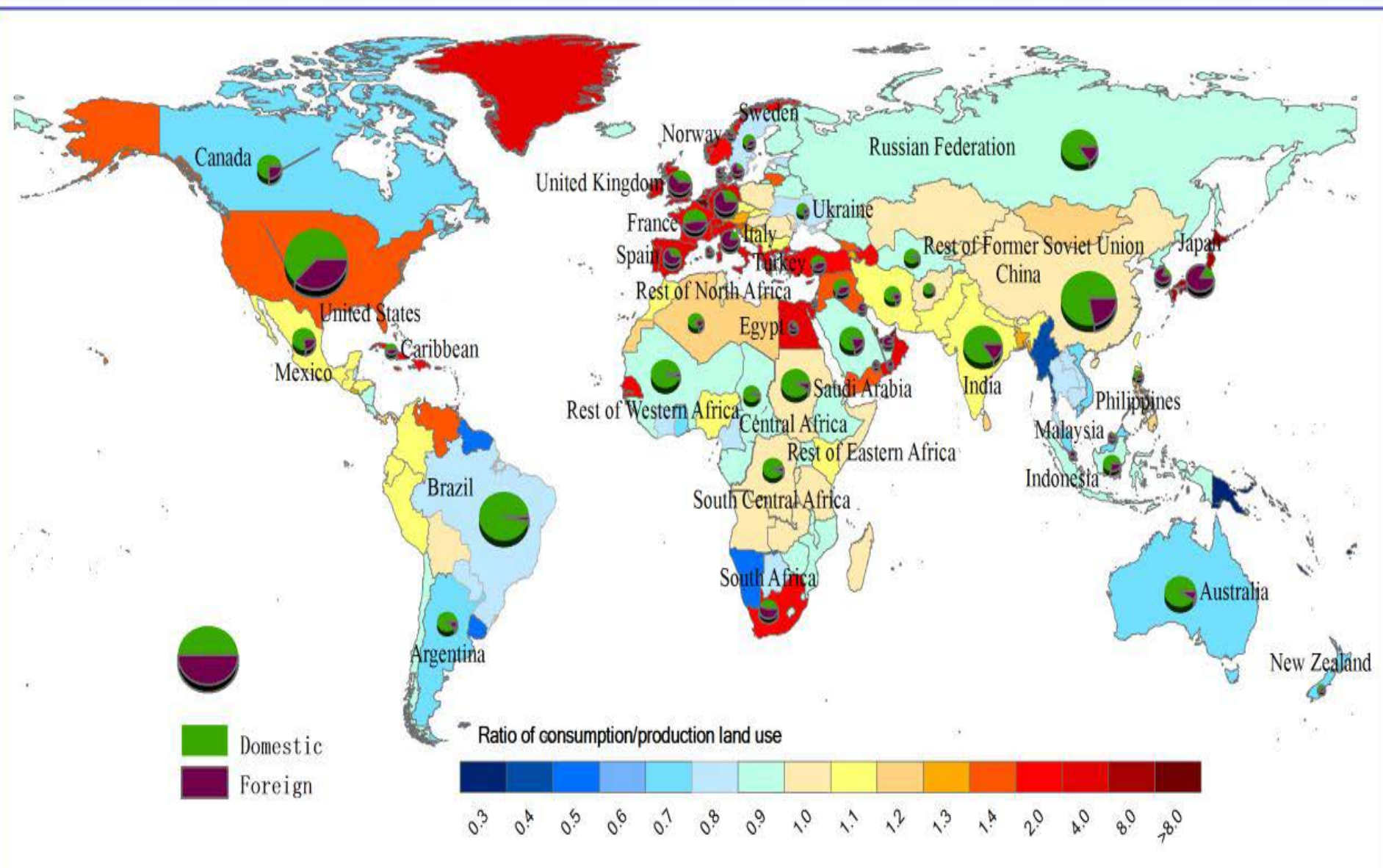
**AND NOW FOR SOMETHING
COMPLETELY DIFFERENT**

Embodied Land

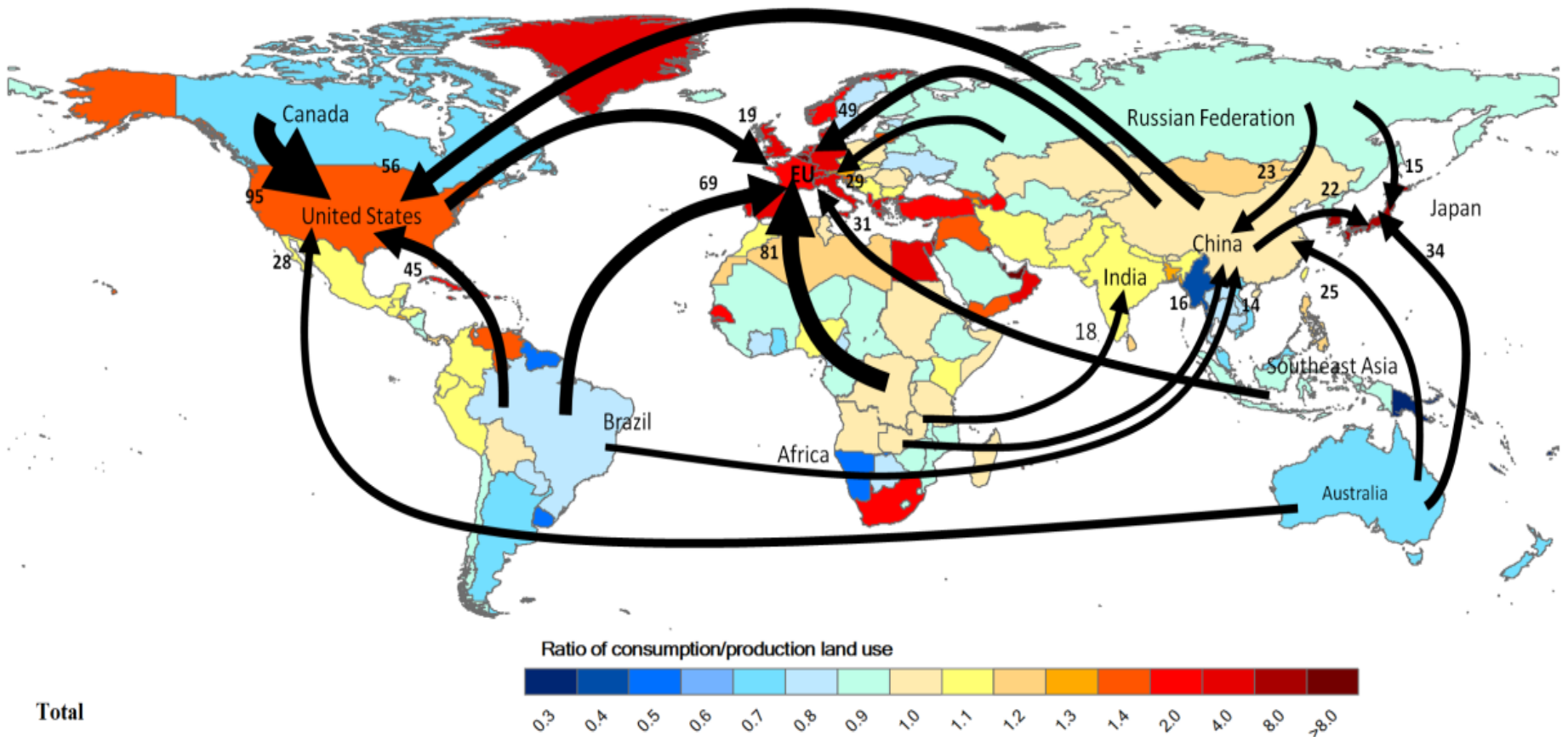
(land footprint, land displacement or land appropriation)

- refers to the amount of land used in the various steps of the production chain.

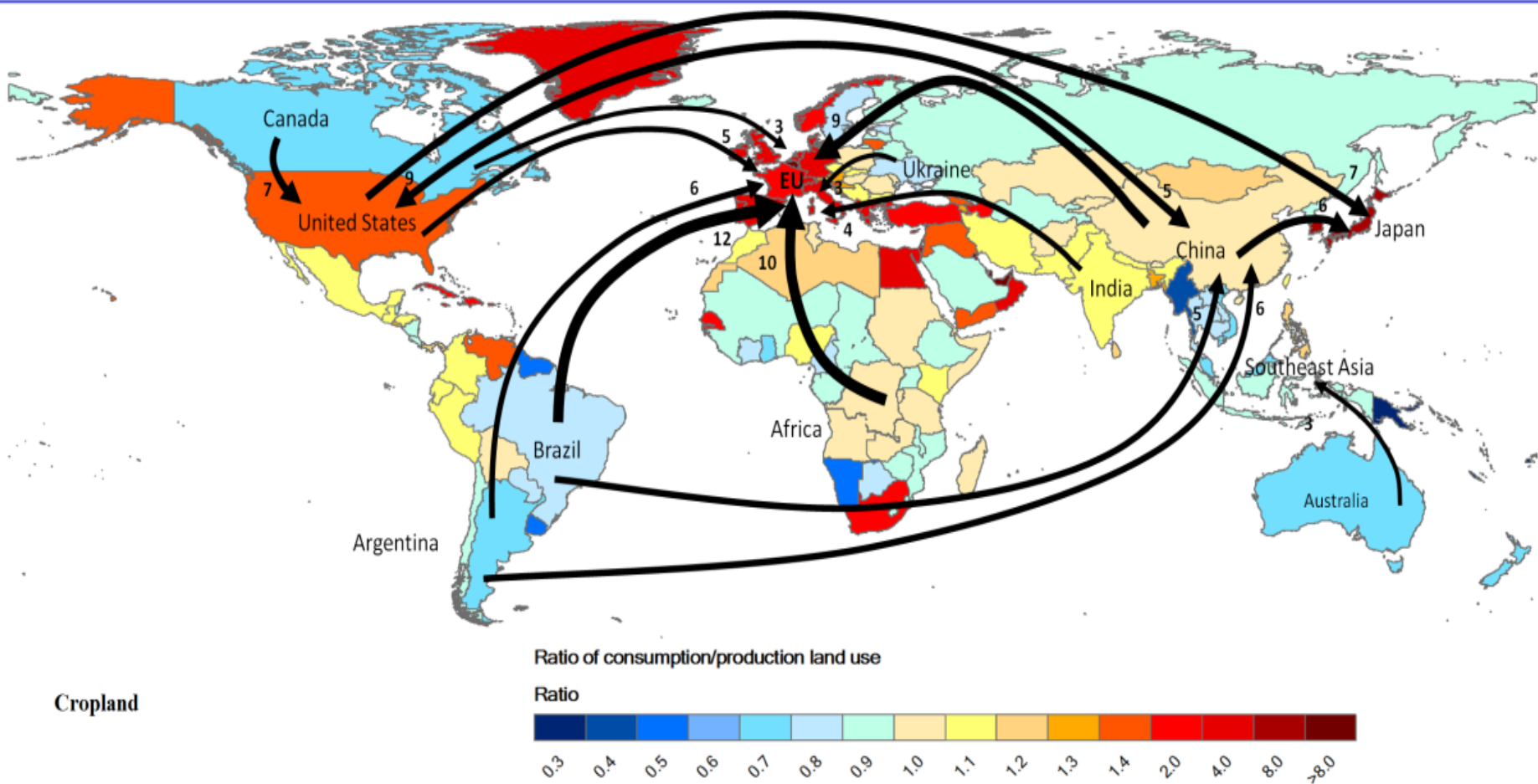
Consumption-based land use inventory: domestic vs. foreign land

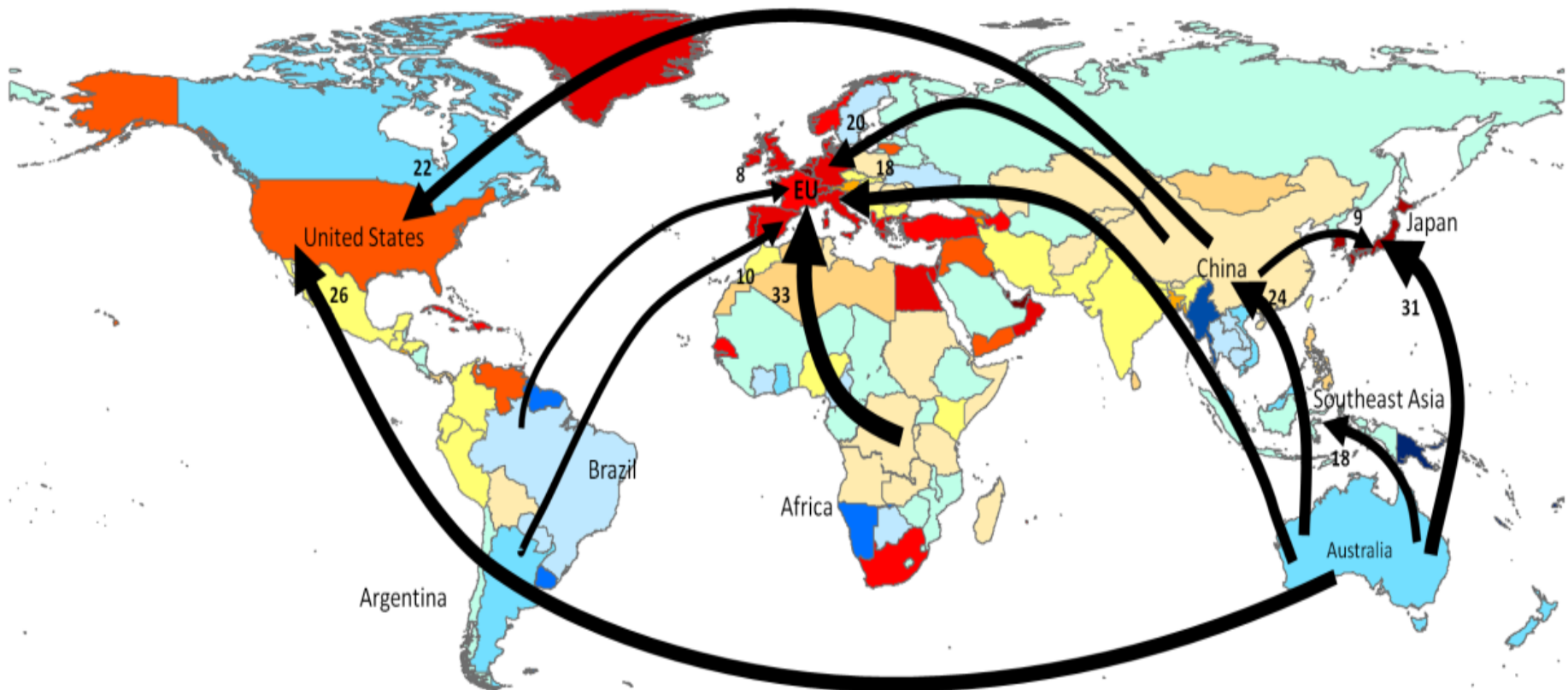


Land 'embodied' in global trade (in Mha)

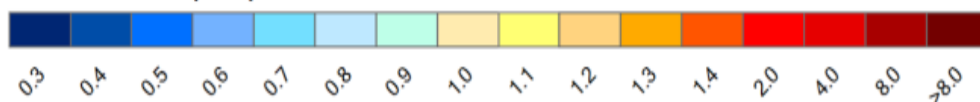


Total

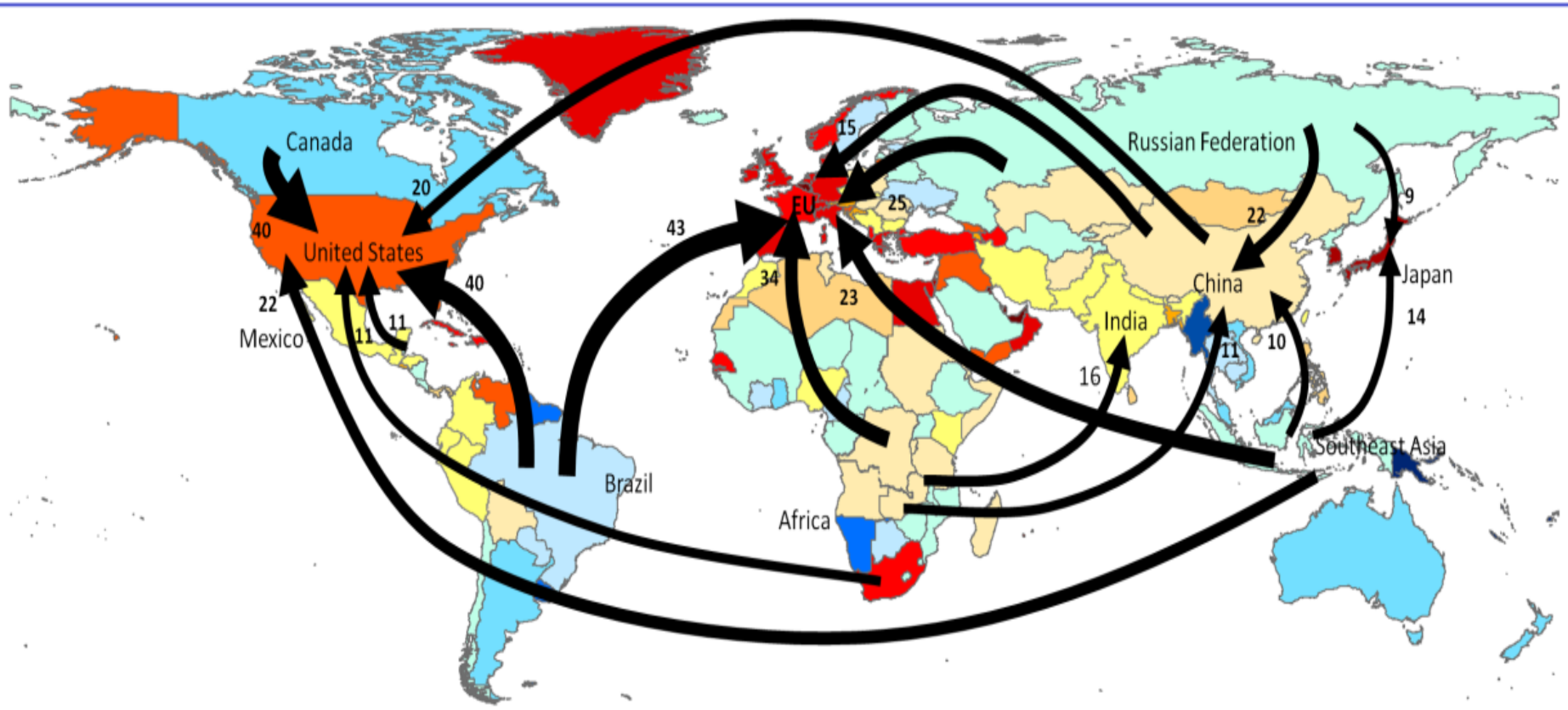




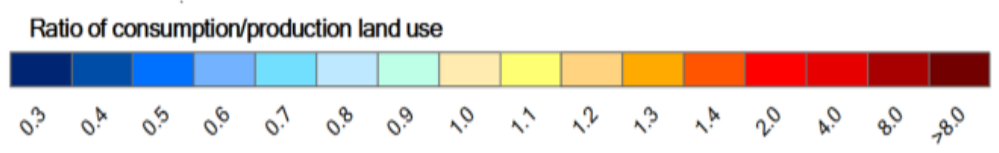
Ratio of consumption/production land use



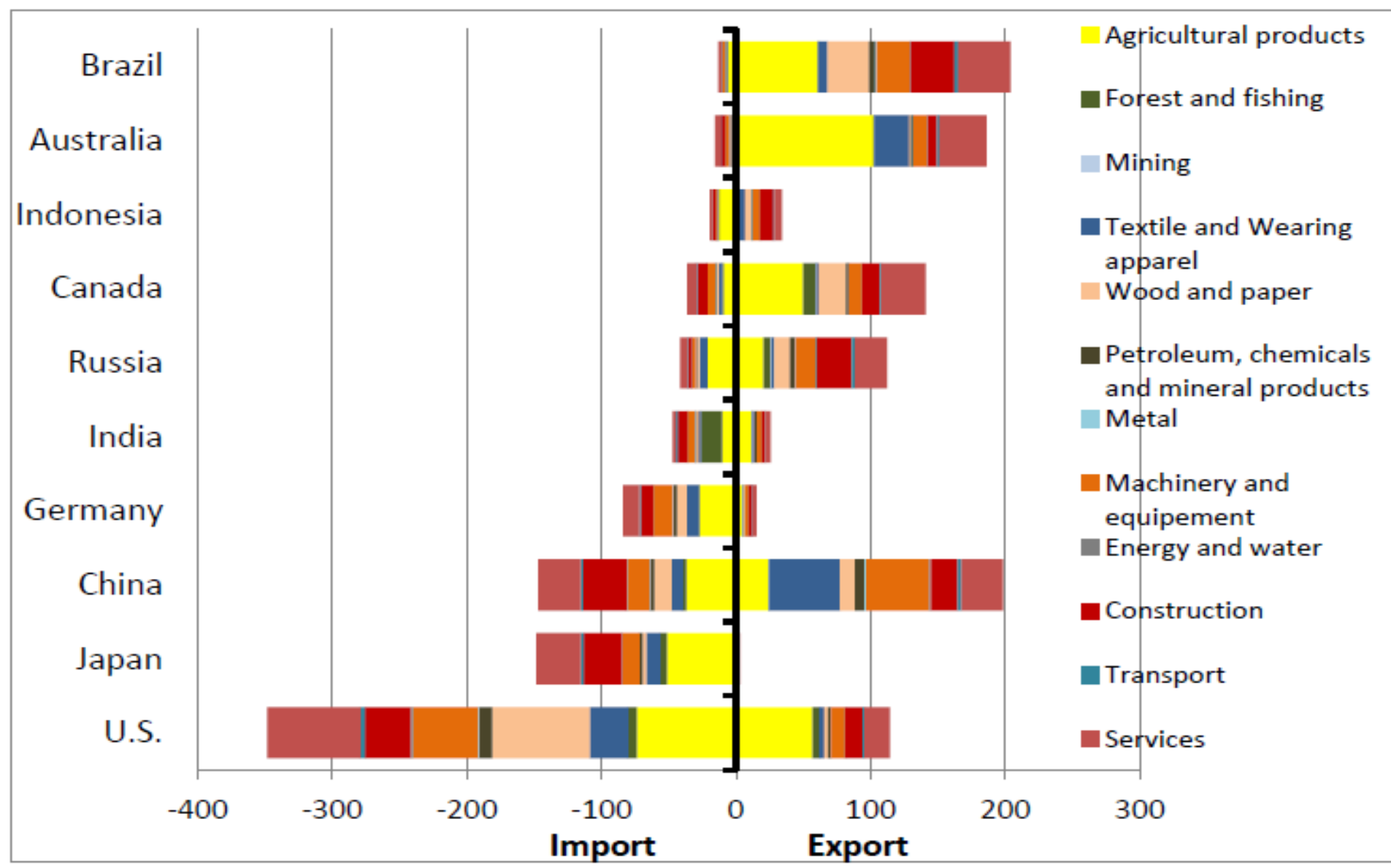
Grazing land



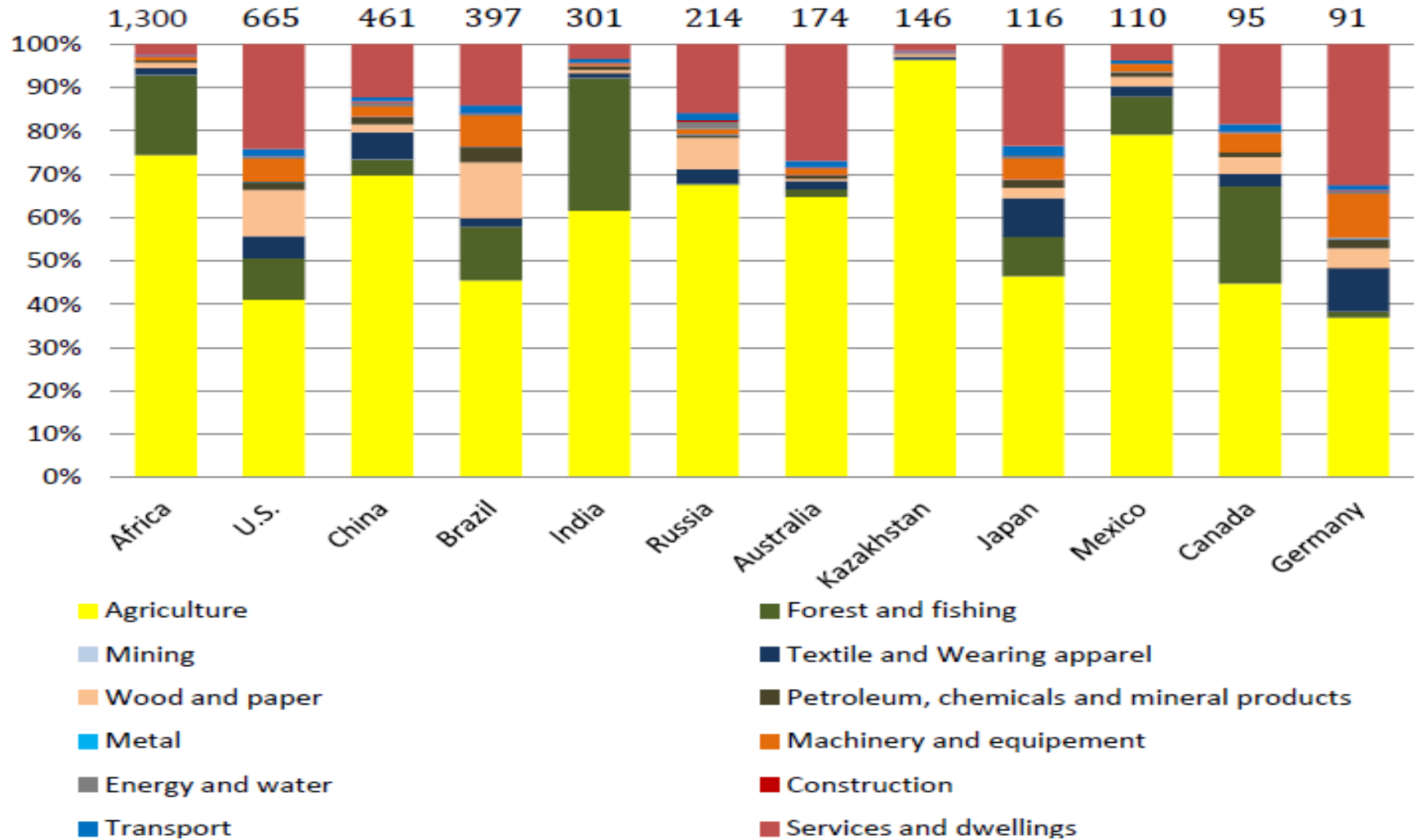
Forest land

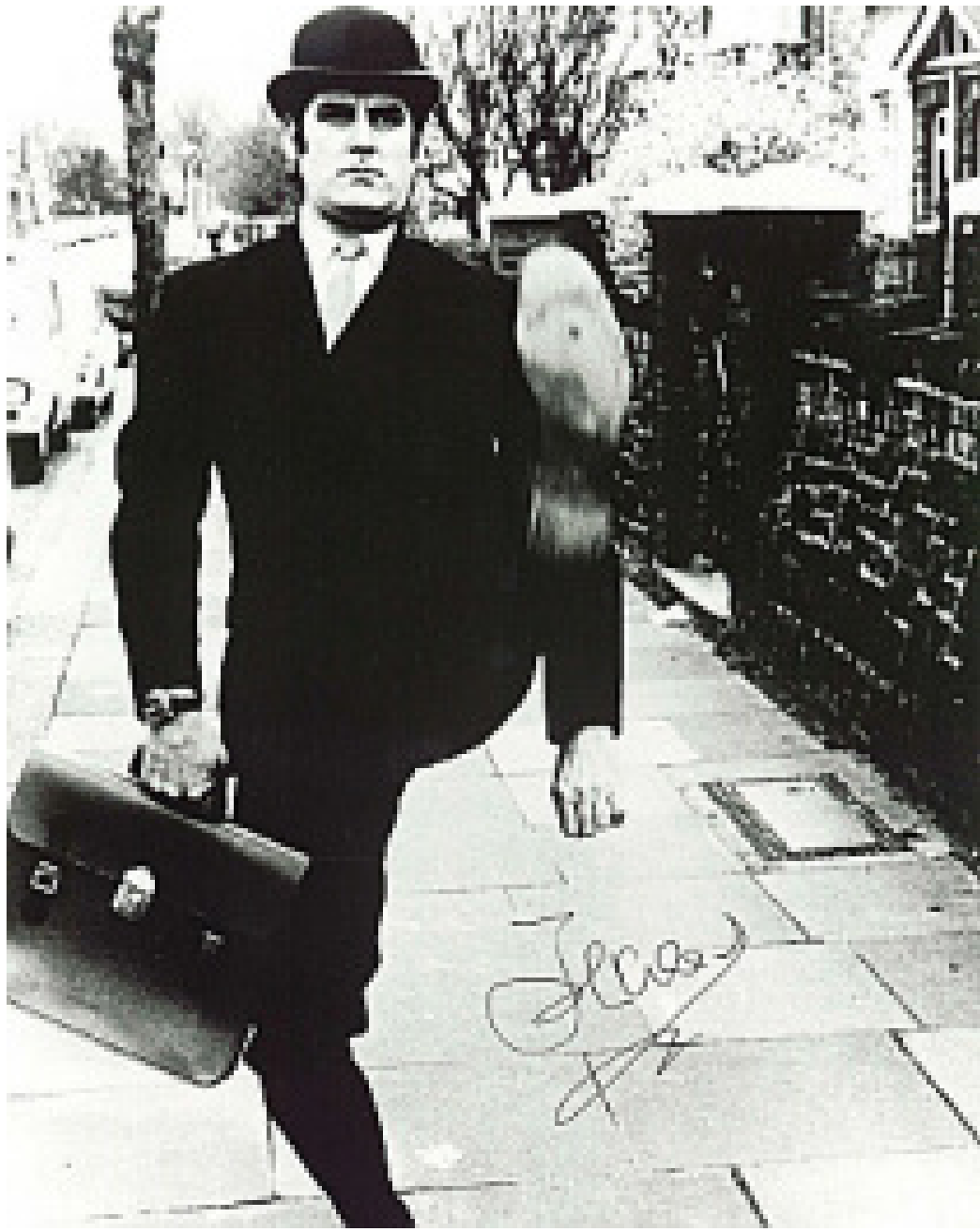


Land appropriation through imports and exports (in Mha)



Land appropriation for household consumption (in Mha)





Conclusions

- Comprehensive approach
- Scalable - Local to global level
- Practical applications (Tesco, supply chain management) and informs theoretical debates (Land transition, WST, Environmental Justice, land grab, climate negotiations)
- But...

But...

- Data
- Space
- Missing links
- Dynamics
- ...

And Now For Something
COMPLETELY DIFFERENT

