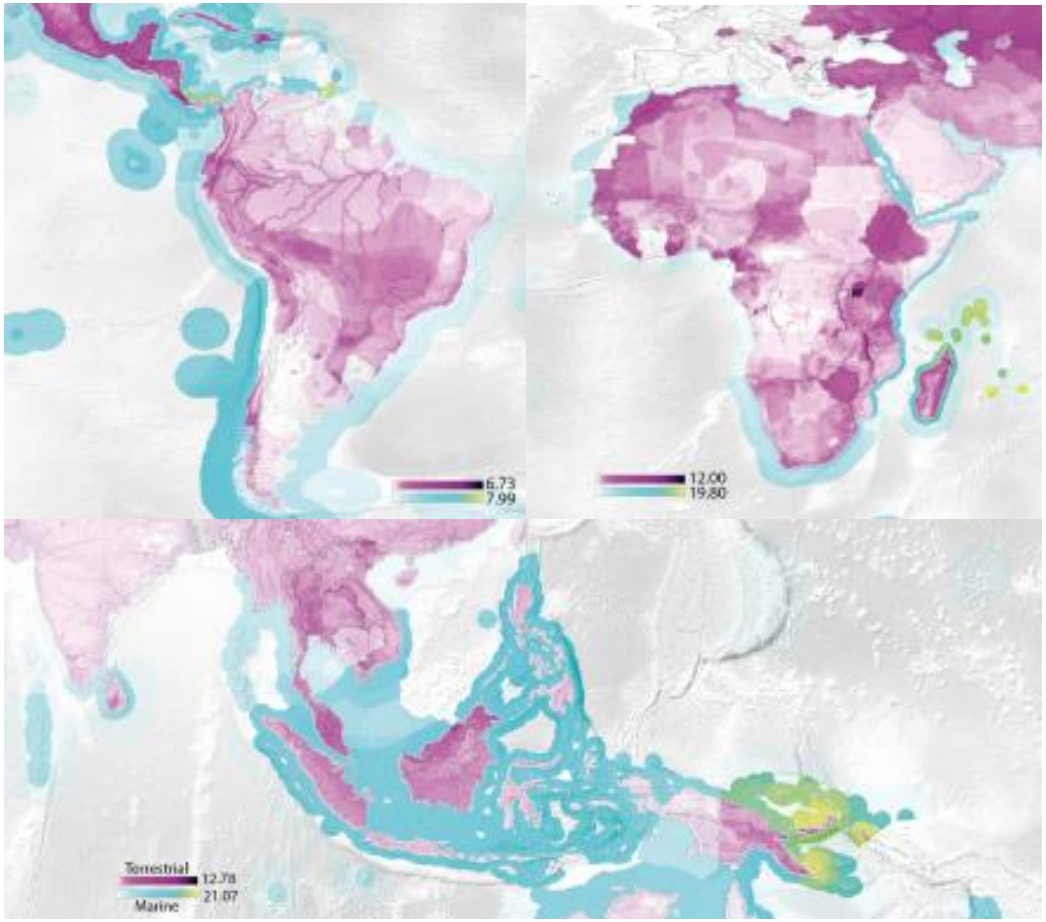
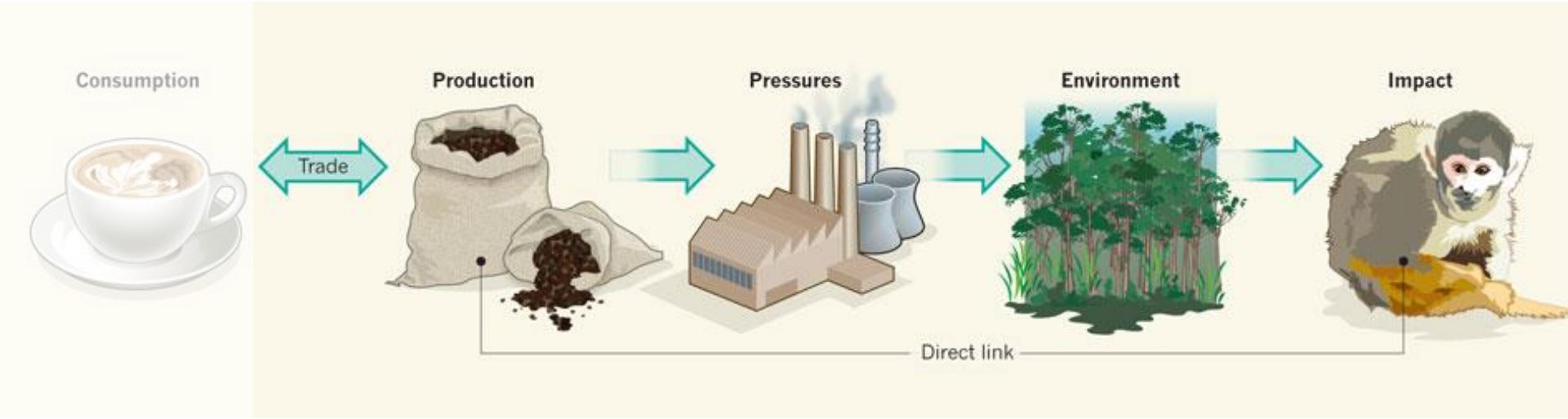
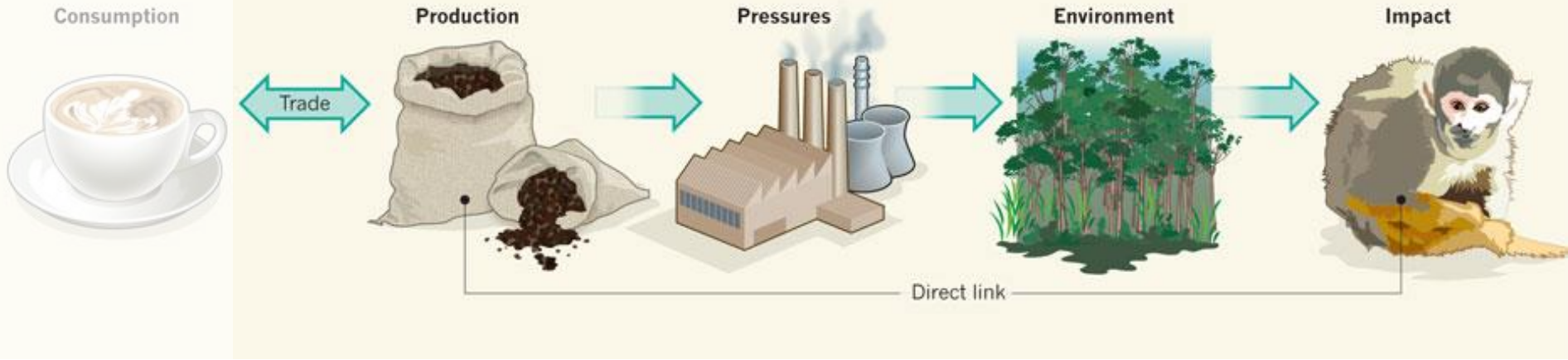
Spatial MRIO Footprints

Daniel Moran
NTNU




Consumption
Trade
Production
Pressures
Environment
Impact
Direct link



FAO Commodity Balance Sheets (CBS)

Signal Probabilities

$$p_k^m = \frac{q_k^m}{\Omega_k(\lambda_t)} \exp[\alpha_k^m \sum_t g_{kt} \lambda_t]$$

Noise Probabilities

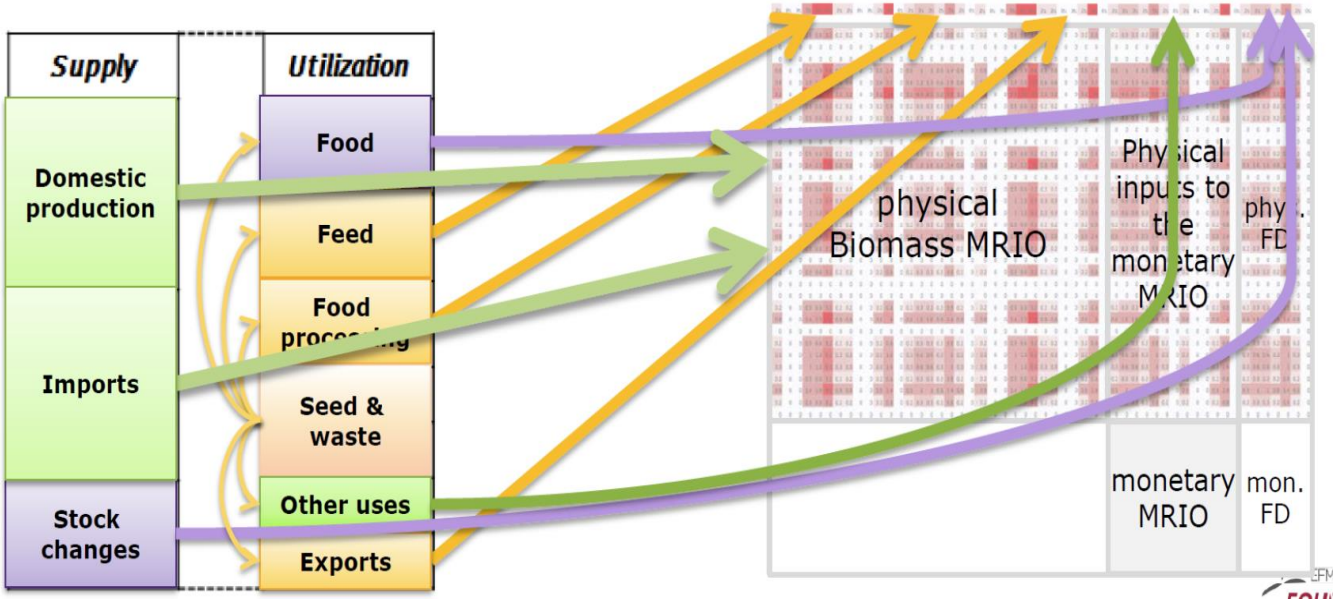
$$w_t^v = \frac{u_t^v}{\Psi_t(\lambda_t)} \exp[\beta_t^v \lambda_t]$$

Normalization Factors: Partition Functions

$$\Omega_k(\lambda_t) = \sum^m q_k^m \exp[\alpha_k^m \sum_t g_{kt} \lambda_t]$$

$$\Psi_t(\lambda_t) = \sum^v u_t^v \exp[\beta_t^v \lambda_t]$$

λ_t = Langrangian Multipliers

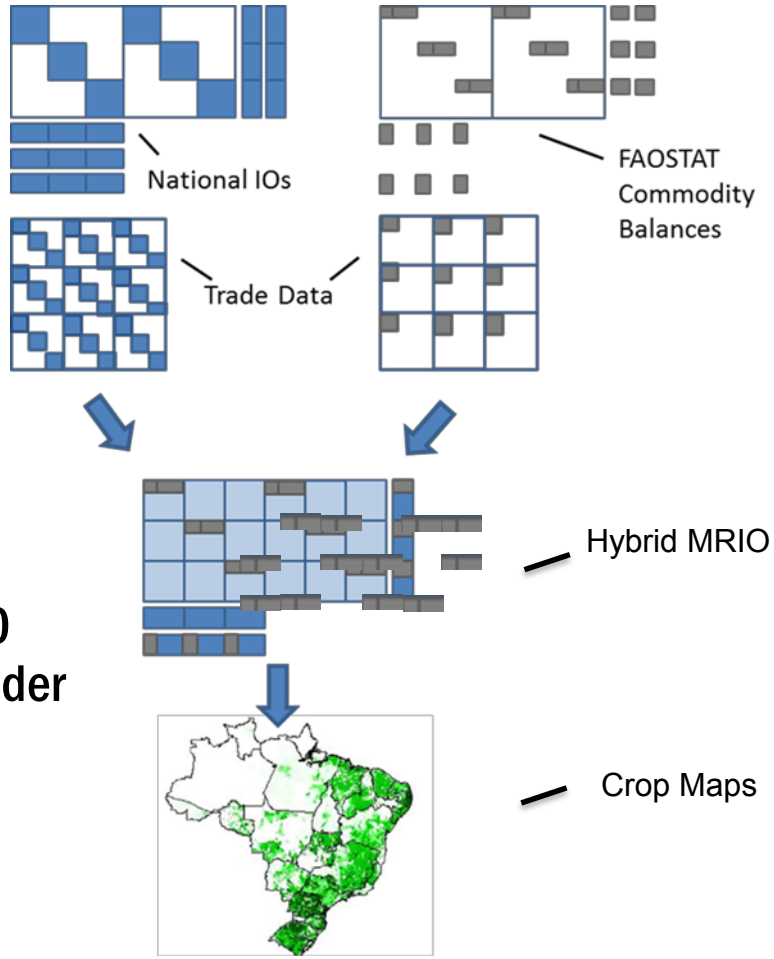


Landuse Footprints of Agricultural Products

Connection between Crop Maps and Supply Chain Information

- Shortcomings of pure monetary and pure physical accounting approaches

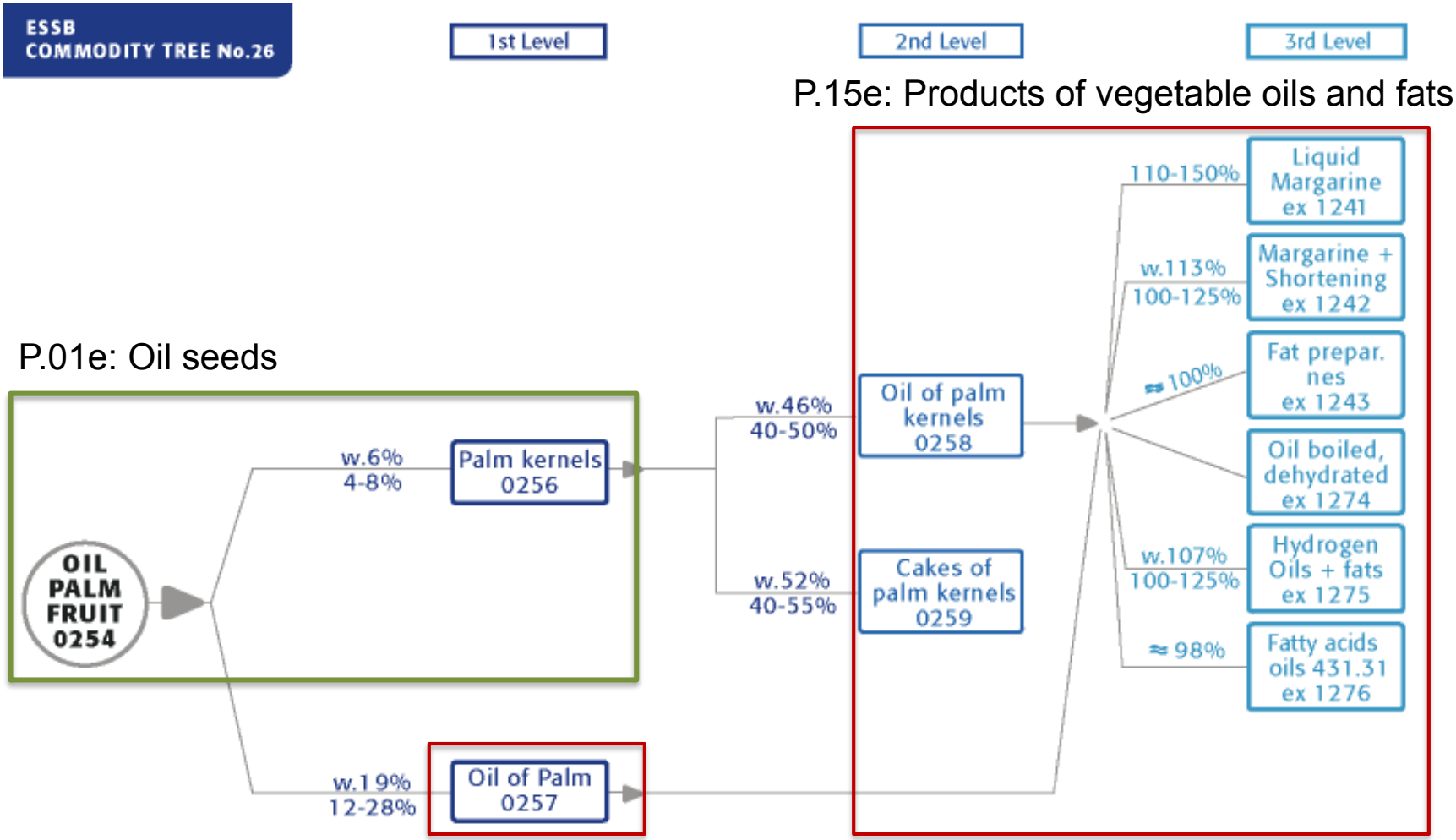
→ Hybrid MRIO linked with crop maps



Main Data Sources:

- <u>Monetary layer:</u> EXIOBASE3
- <u>Physical layer:</u> Physical Biomass MRIO for 130 products covering 175 countries. (currently under construction by M. Bruckner)
- Bilateral trade data (BACI)

FAO: Process chain description



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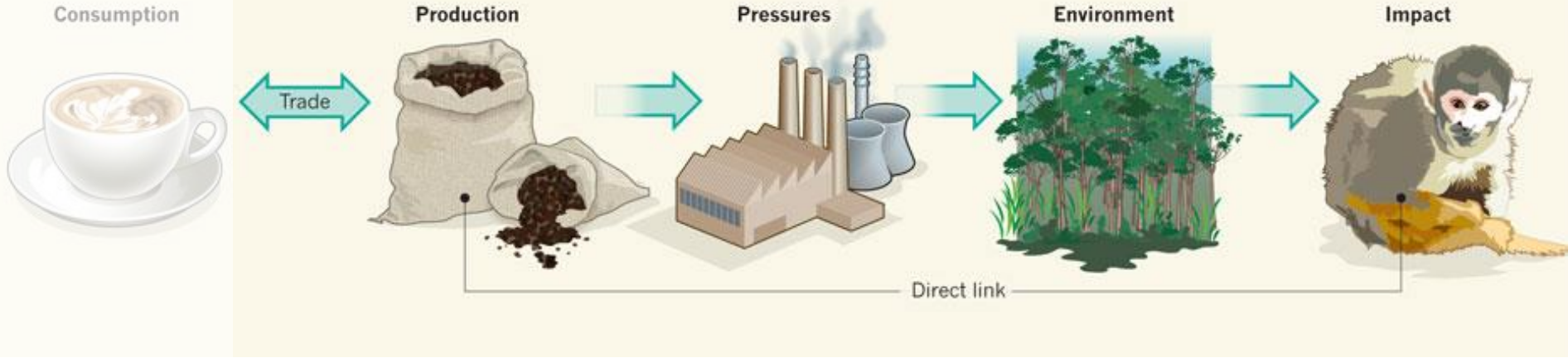
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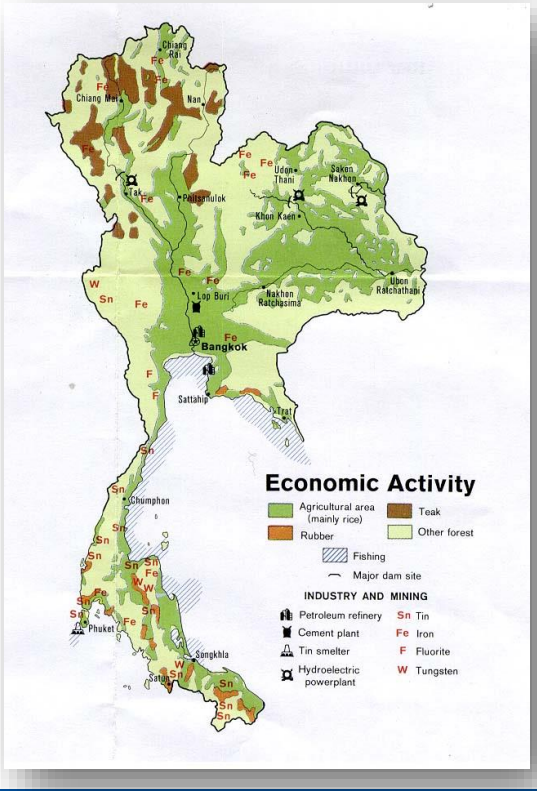
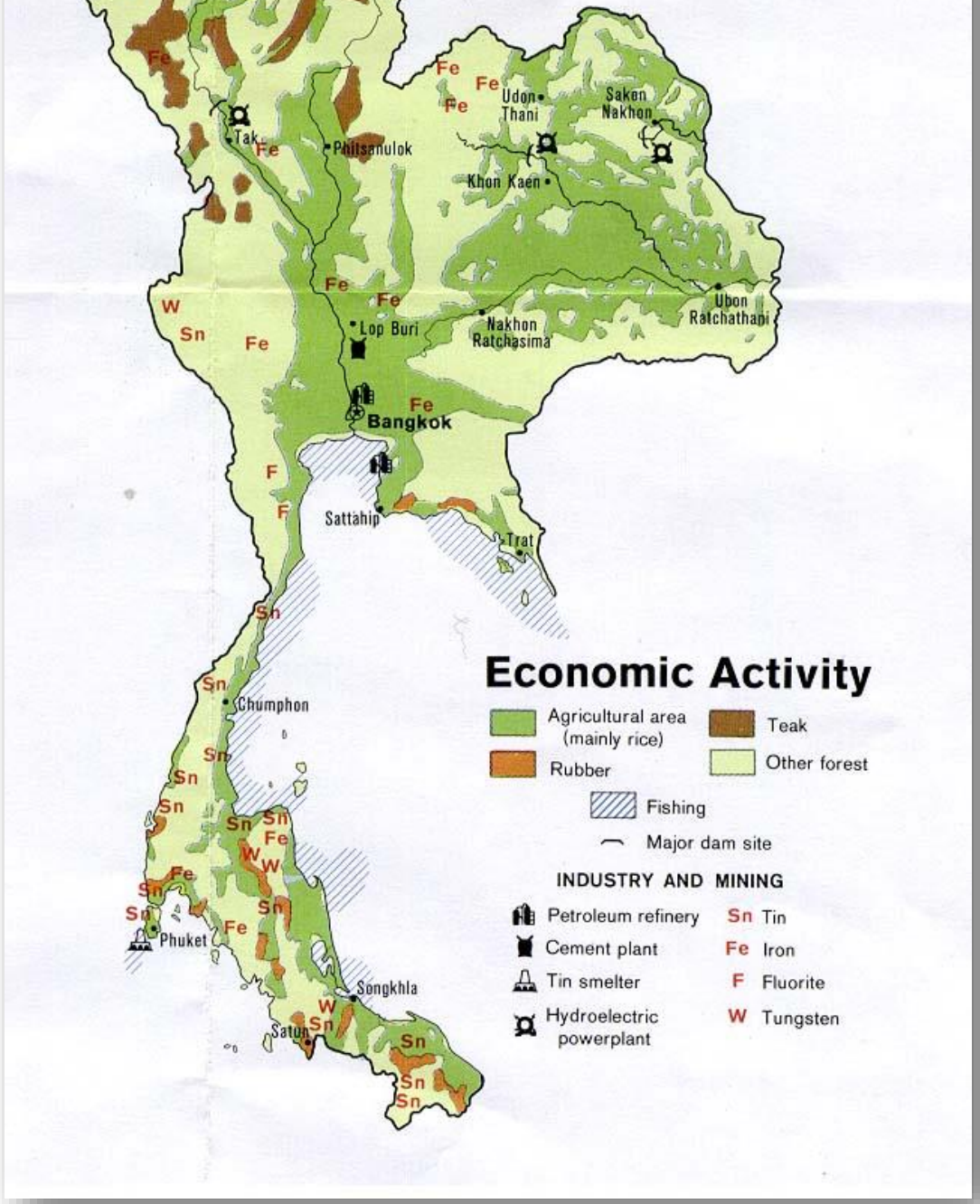

Economic Activity
Agricultural area (mainly rice)
Rubber
Teak
Other forest
Fishing
Major dam site
INDUSTRY AND MINING
Petroleum refinery
Cement plant
Tin smelter
Hydroelectric powerplant
Sn Tin
Fe Iron
F Fluorite
W Tungsten
Bangkok
Phuket
Songkhla
Chiang Rai
Chiang Mai
Nan
Tak
Phitsanulok
Khon Kaen
Udon Thani
Sakon Nakhon
Nakhon Ratchasima
Ubon Ratchathani
Lop Buri
Sattahip
Trat
Chumphon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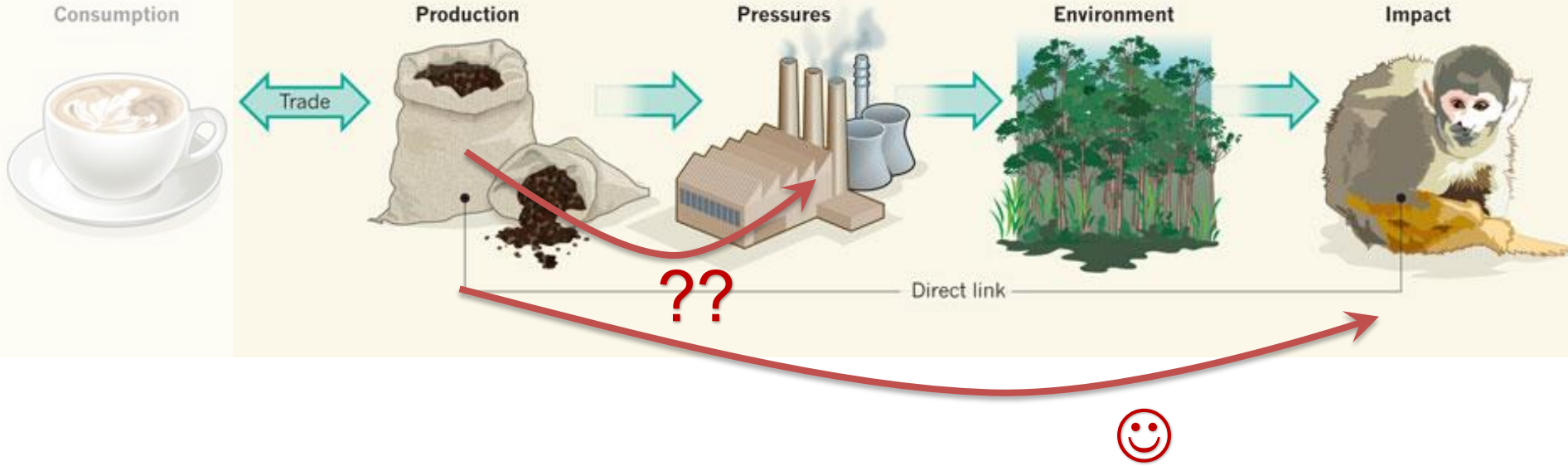
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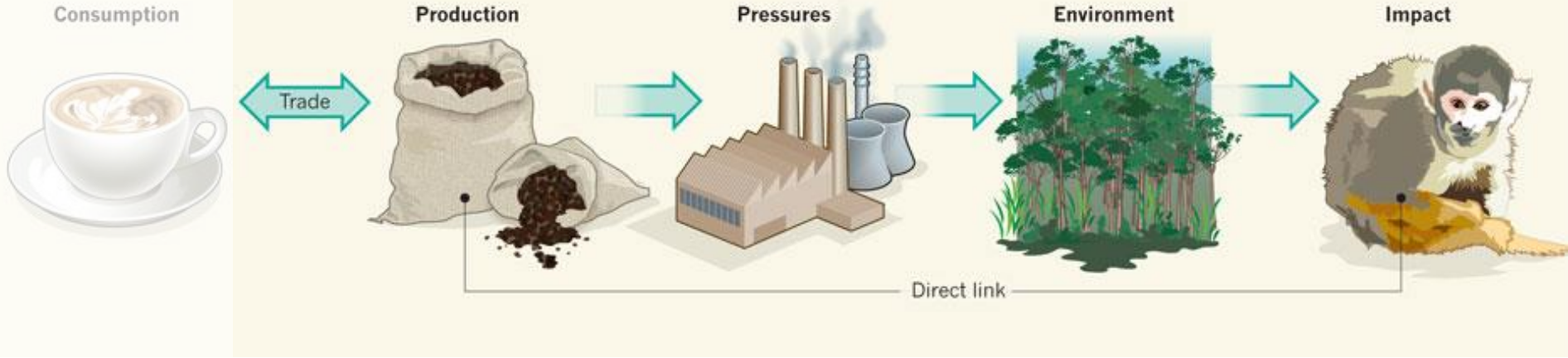
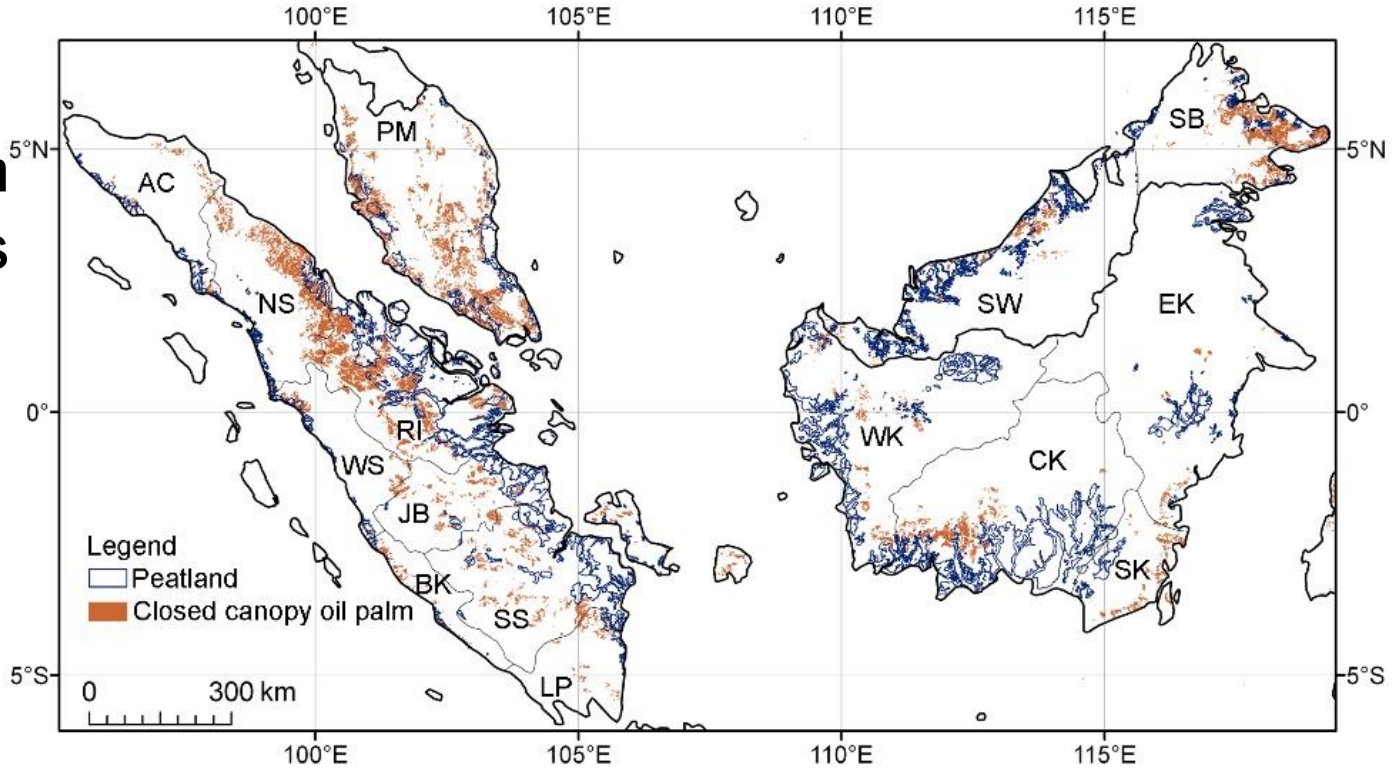


Oil palm cultivation & species richness



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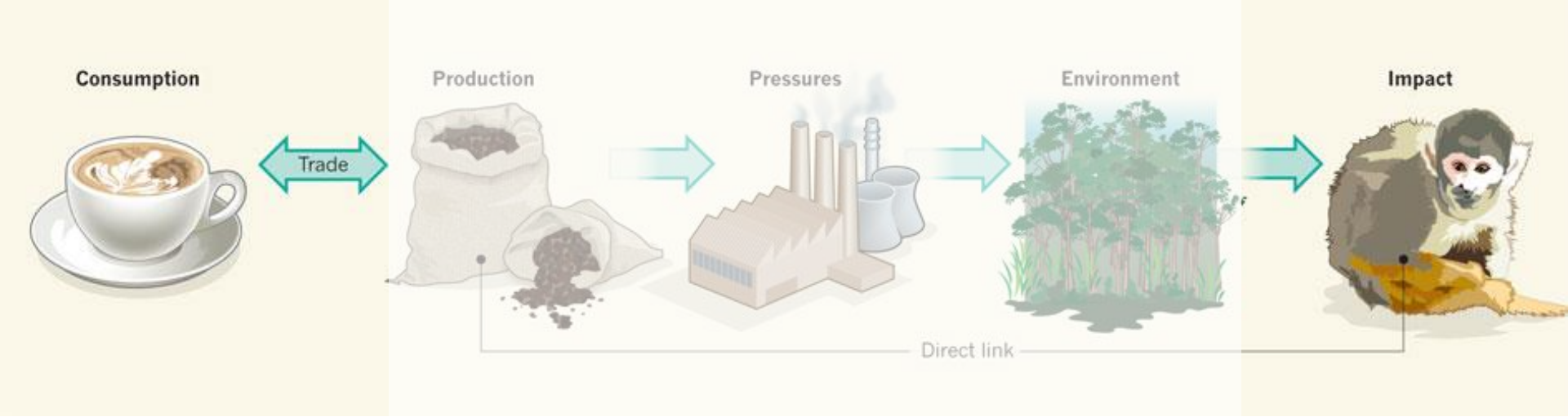
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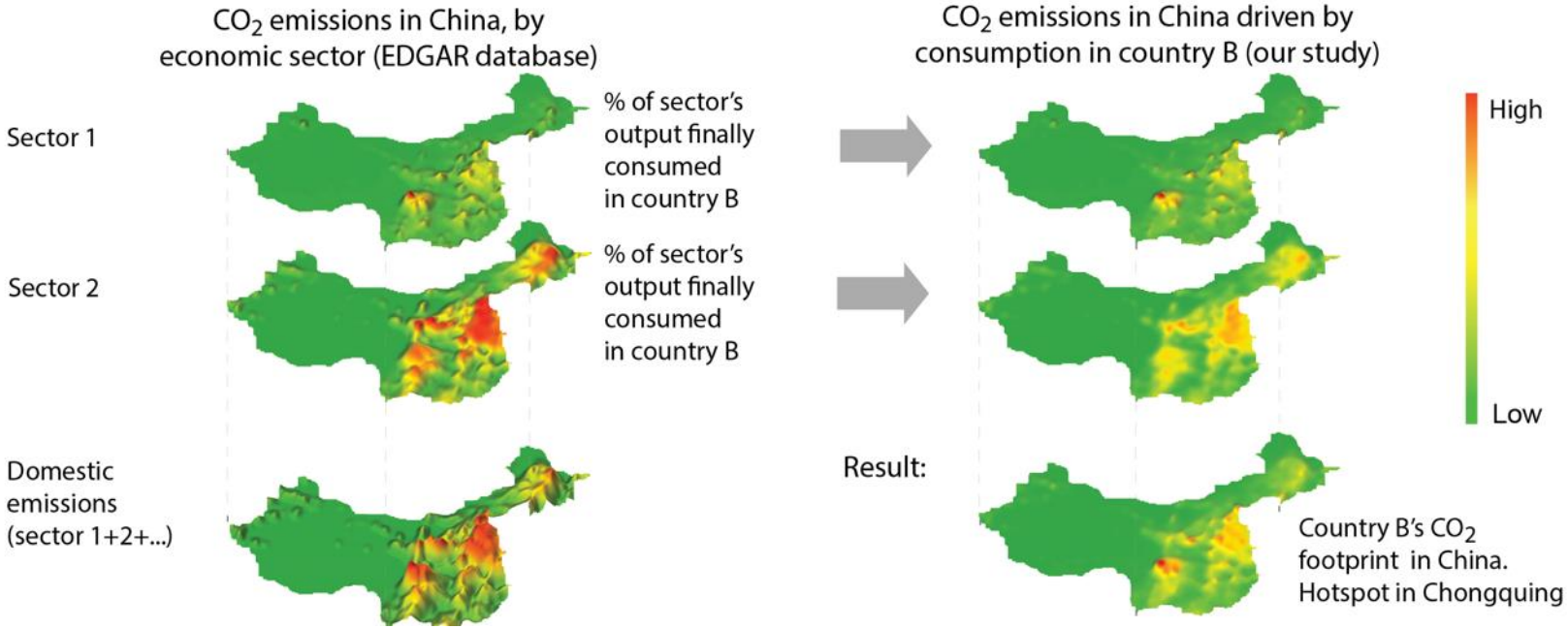
CO_2 emissions in China, by economic sector (EDGAR database)
CO_2 emissions in China driven by consumption in country B (our study)
Sector 1
% of sector's output finally consumed in country B
Sector 2
% of sector's output finally consumed in country B
Domestic emissions (sector 1+2+...)
Result:
High
Low
Country B's CO_2 footprint in China. Hotspot in Chongquing

| ALL OVER THE MAP |

Maps Reveal How Global Consumption Hurts Wildlife

As international trade threatens vulnerable species and natural resources, new maps show some unexpected connections.

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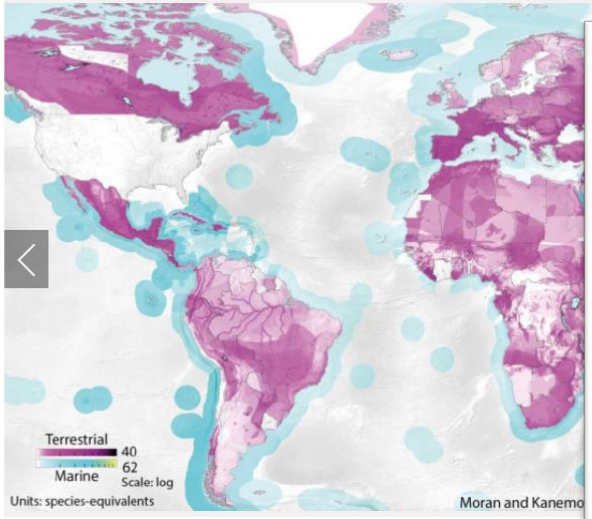


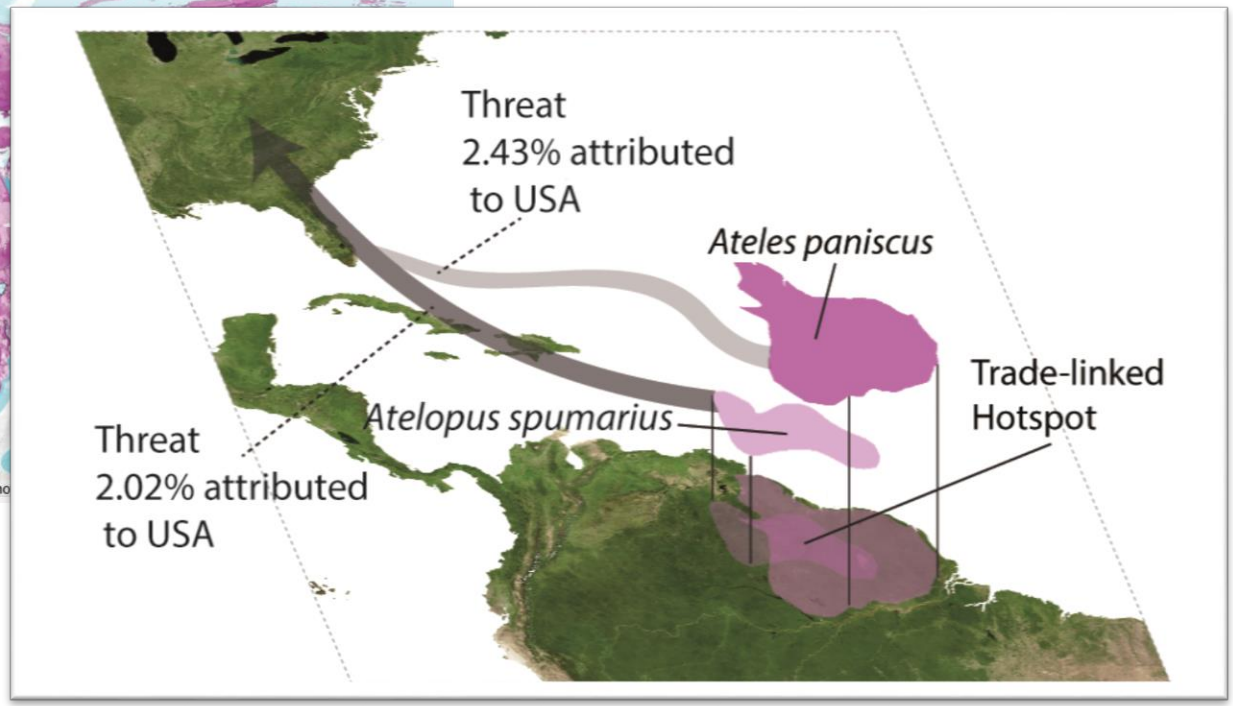
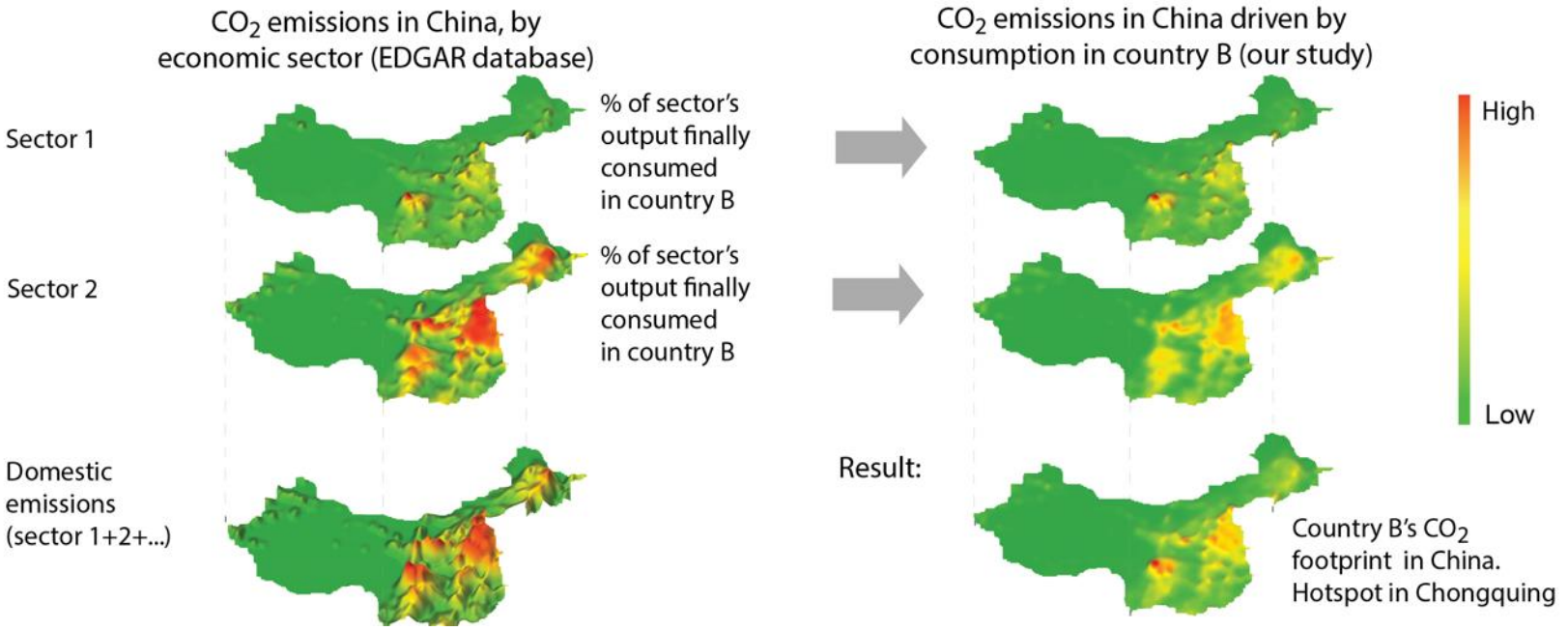


Illustration of Method



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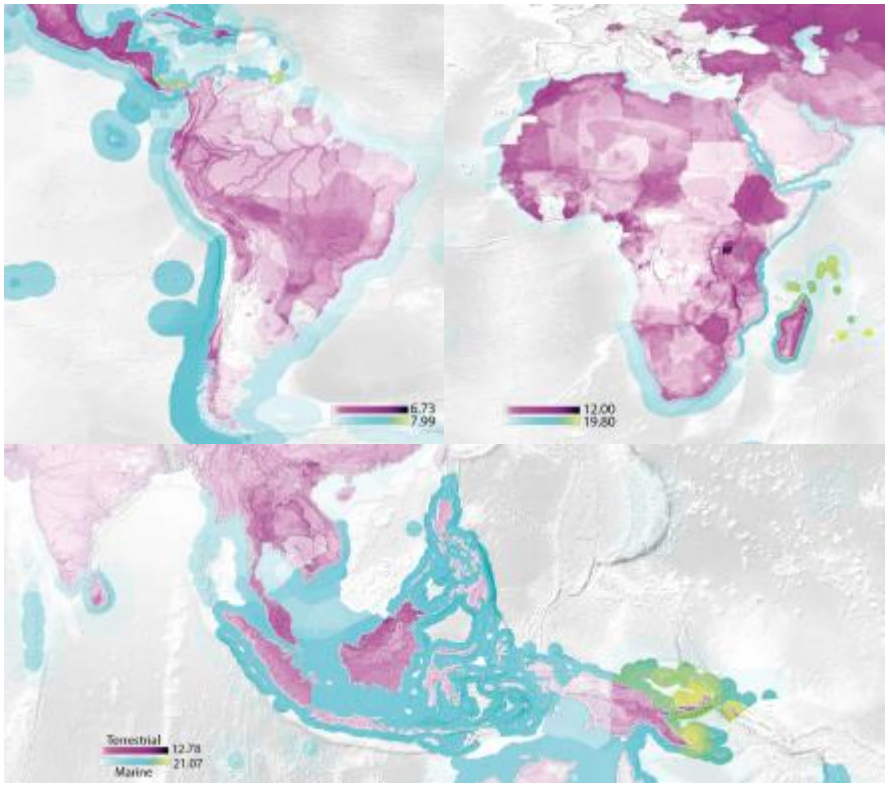
Footprints 2.0 Project

Objective:

- Connect environmental earth observation data with MRIO to estimate Spatially explicit Biodiversity Footprints

- http://f20.indecol.no/
- People: Daniel Moran, Francesca Verones, Richard Wood, Keiichiro Kanemoto, Johannes Többen

Figure 1: Species threat hotspots of Europe's final demand



D. Moran, K. Kanemoto. Identifying Species Threat Hotspots from Global Supply Chains Nature Ecology & Evolution, 1(1), 0023, 2017

Thank you!

Daniel Moran, Keiichiro Kanemoto. "Identifying Species Threat Hotspots from Global Supply Chains" *Nature Ecology & Evolution*, 2017

Keiichiro Kanemoto, Daniel Moran, Edgar Hertwich. "Mapping the Carbon Footprint of Nations" *Environmental Science & Technology*, **50**(19), pp.10512-10517, 2016.

Daniel Moran, Keiichiro Kanemoto. "Tracing Global Supply Chains to Air Pollution Hotspots" *Environmental Research Letters*, **11**(9), 094017, 2016