PAUL SCHERRER INSTITUT

PSI

Chris Mutel :: Paul Scherrer Institut

Using international emissions inventories for the validation of global life cycle assessment databases

International Emission Inventory Conference, Dallas, TX, USA
July 29-Aug 2, 2019

Outline

- What is life cycle assessment (LCA)?
  - Building life cycle inventory datasets and databases
  - Modelling global supply chains
- BONSAI: a new approach for inventories
  - What needs to improve
  - Role of emissions inventories in modern LCA
- Suggestions for emission inventories

What is Life Cycle Assessment?

LCA Example: Travel in a Future Car

3

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- Biofuels
- Petrol
- Electricity

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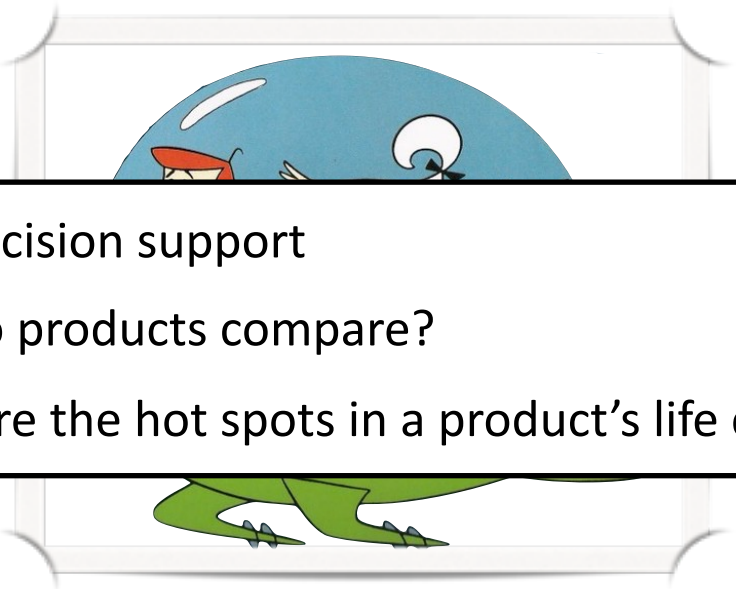
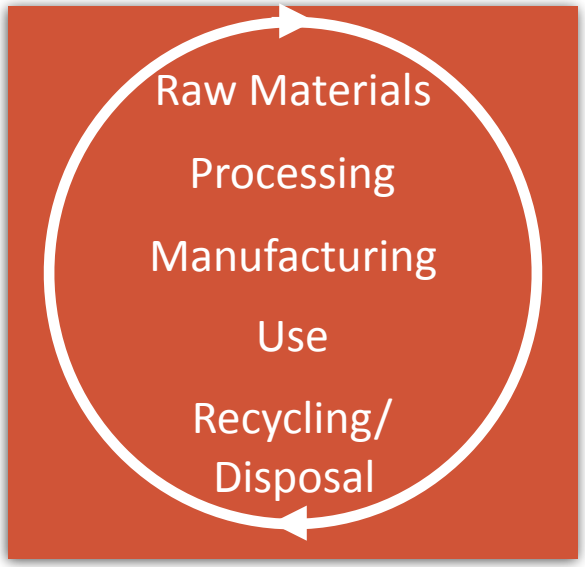


LCA is decision support

- How do products compare?
- What are the hot spots in a product's life cycle?



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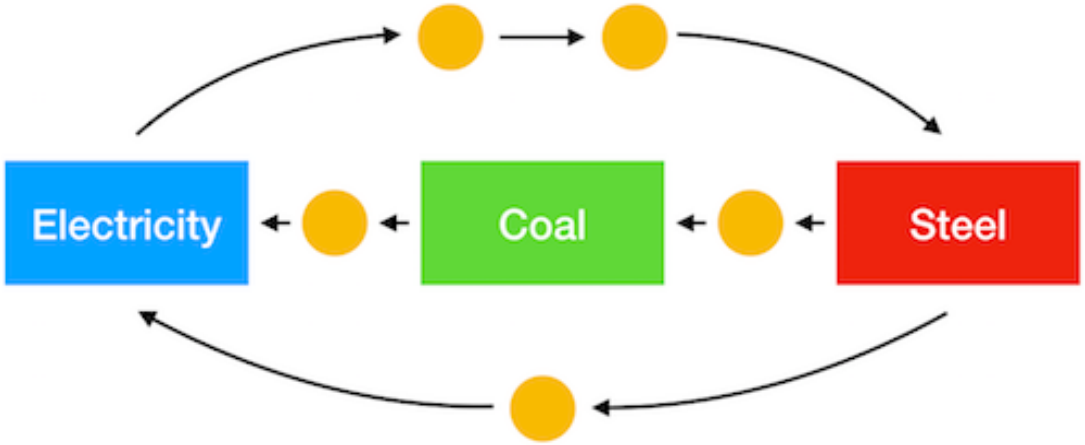
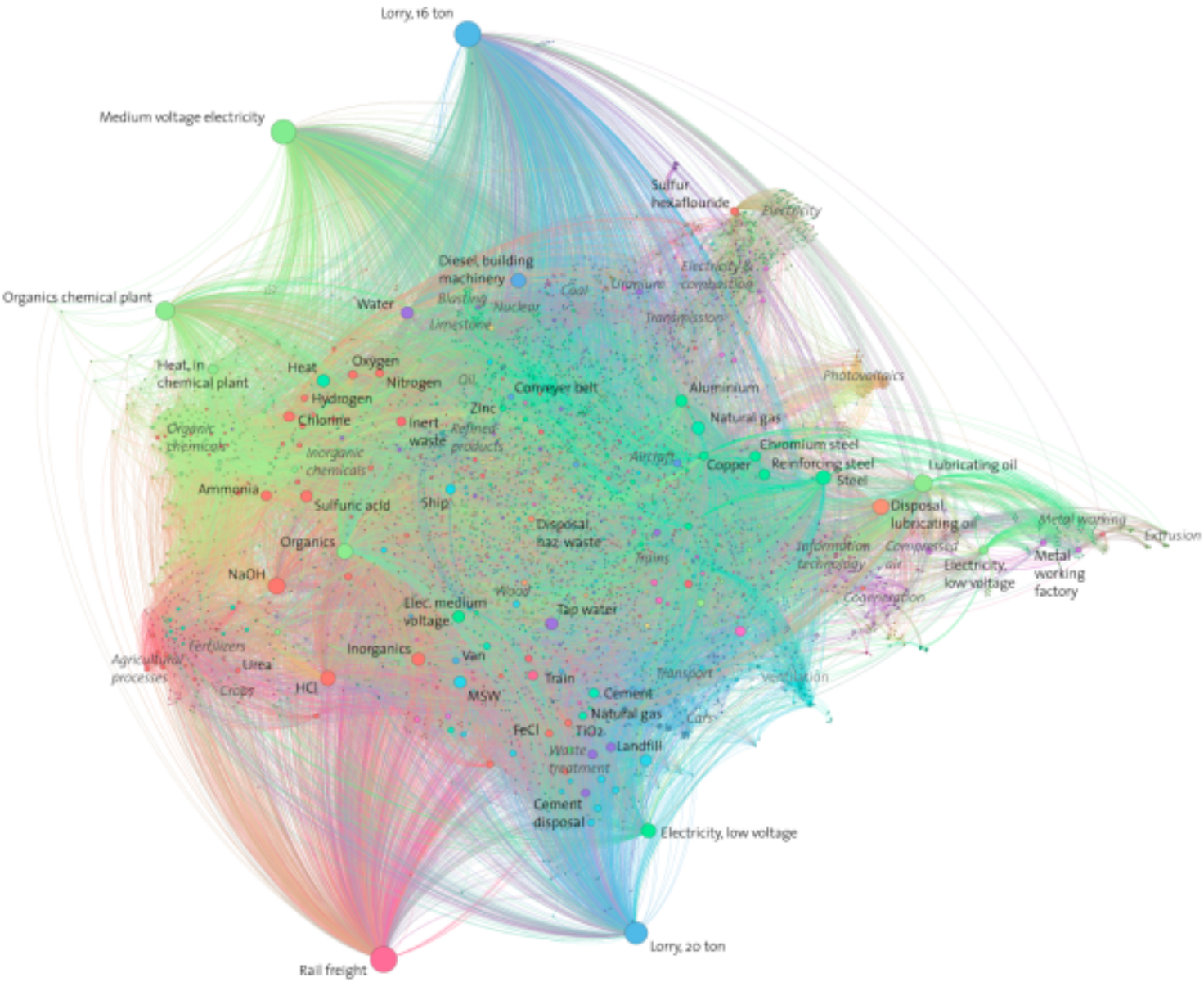
Developing an LCA dataset



40	**Activity**	**geothermal plant, double flash, facilities (electricity)**			
41	comment	From karlsdottir et al. 2015.			
42	location	GLO			
43	production amount	1			
44	type	process			
45	unit	megawatt			
46	**Exchanges**				
47	**name**	**amount**	**unit**	**location**	**typ**
48	market for excavation, hydraulic digger	1901.48368	cubic meter	GLO	tec
49	market for concrete, normal	81.00890208	cubic meter	ROW	tec
50	market for reinforcing steel	11623.44214	kilogram	GLO	tec
51	market for steel, chromium steel 18/8	656.9732938	kilogram	GLO	tec
52	market for aluminium, cast alloy	513.6498516	kilogram	GLO	tec
53	market for copper	133.5311573	kilogram	GLO	tec
54	market for stone wool	528.7833828	kilogram	GLO	tec

Developing a LCA database

- Database-wide standards for:
  - Nomenclature
  - Dataset review
  - Data quality
  - Data formats



System models

Raw unlinked datasets

Consistent database version

Choose between marginal and average production

Allocate multi-output activities

- e.g. combined heat and power

Link inputs with outputs

- In space
- In time

Other dataset checks

- e.g. mass balances

Need to do better

- Poor coverage or poor detail
  - Data collection driven by specific grants
  - No services, no consumer products
  - Highly aggregated, e.g. “ferrous metals”
  - **Needed**: Start with complete global coverage, iterate
  - **Needed**: Strategy on data collection/prioritization

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BONSAI

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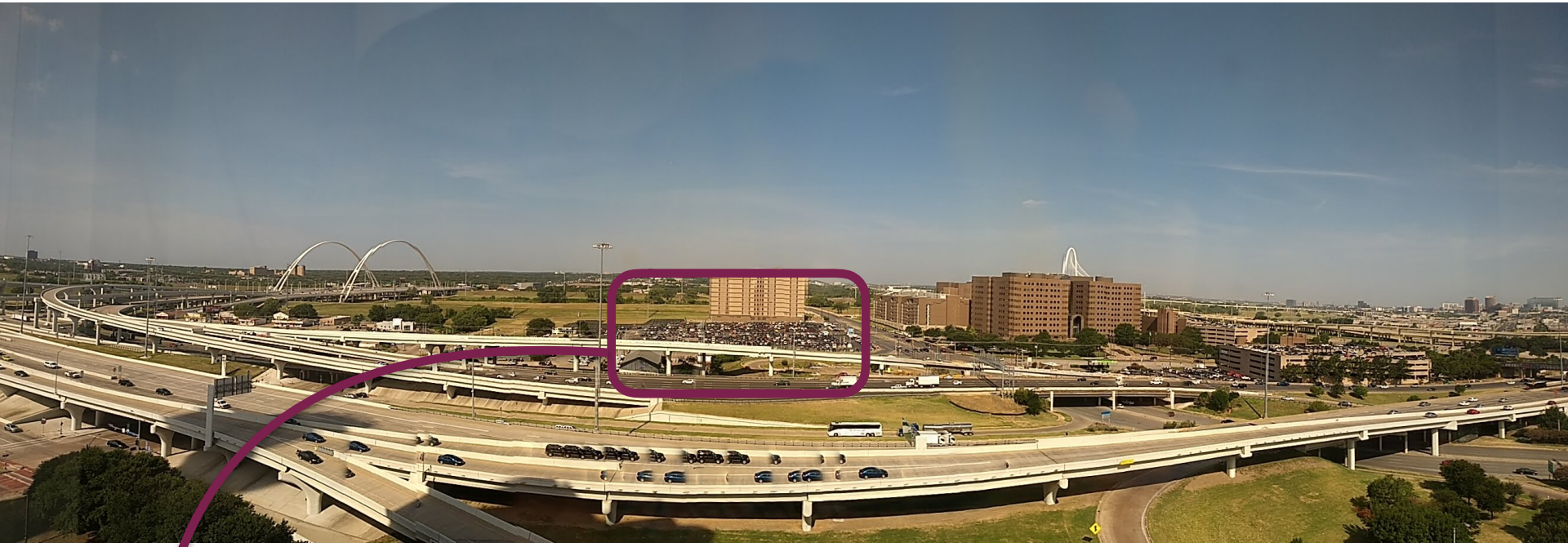
- Coordinating network
  - Volunteers and researchers
  - First hackathon in Barcelona (Spring 2019)
- Non-profit organization (Denmark)

BONSAI

Ideal world

- Transport modal shifts

Ideal world



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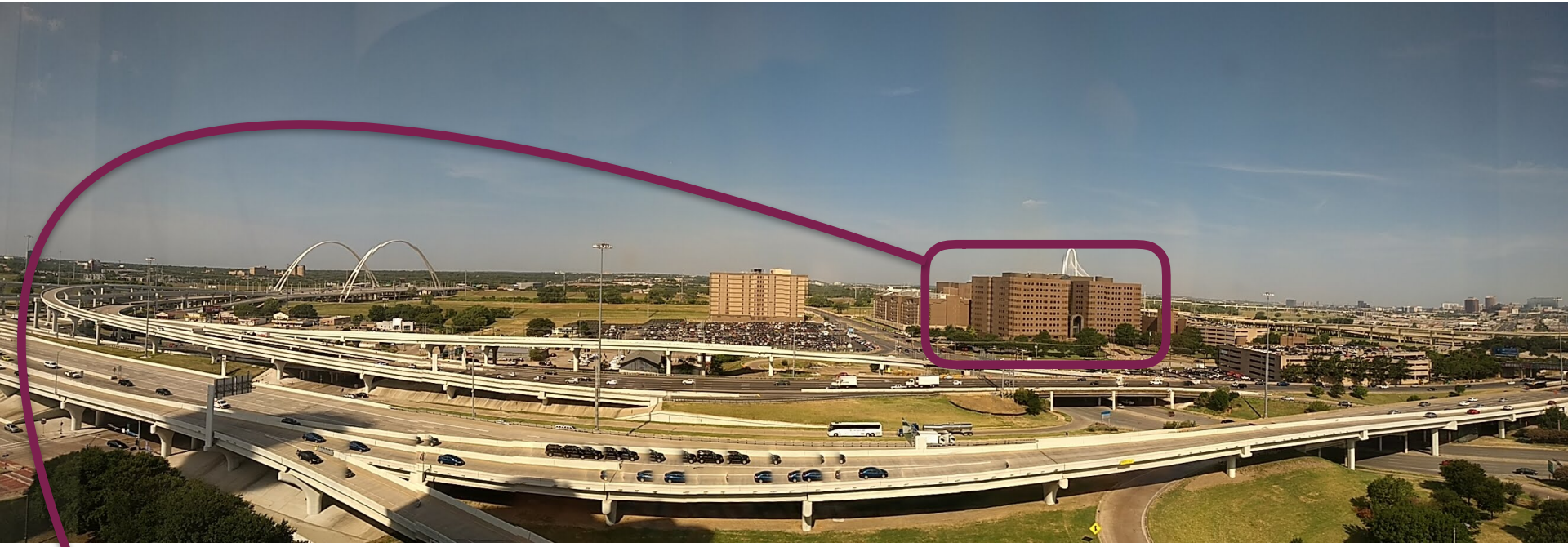

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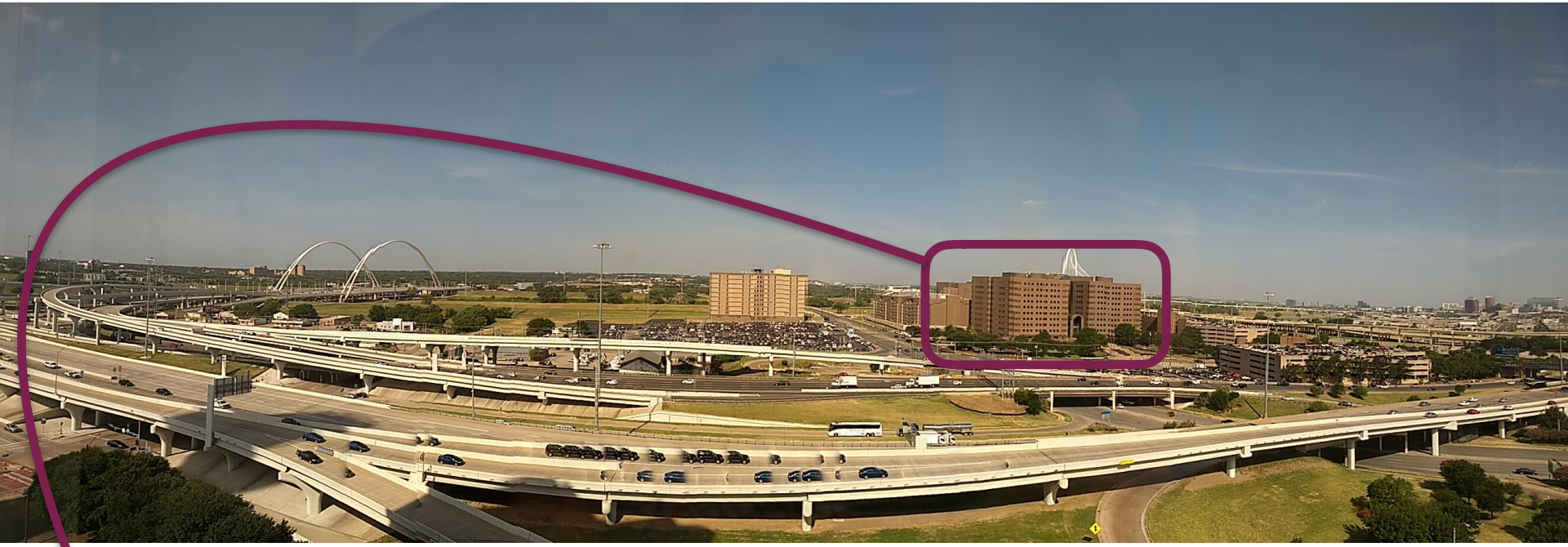

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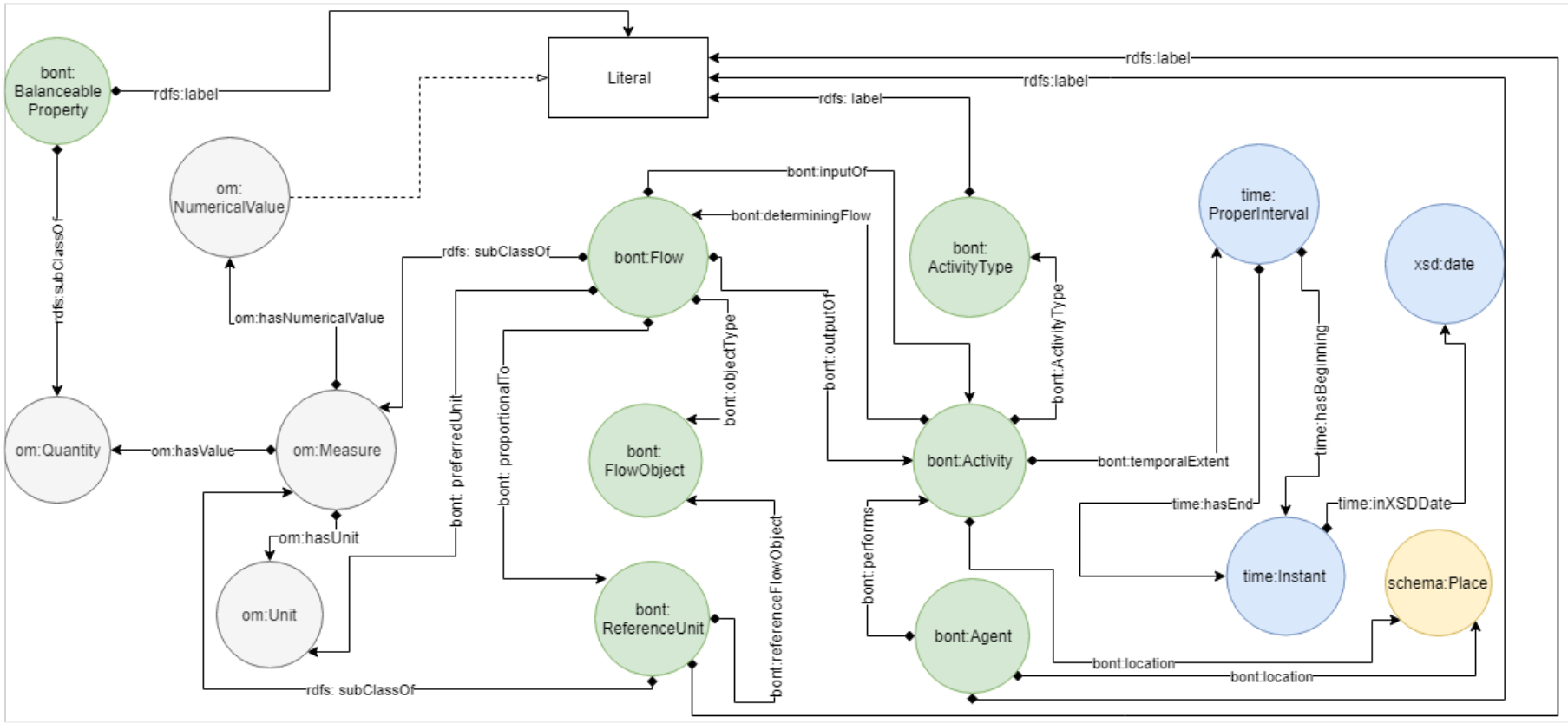
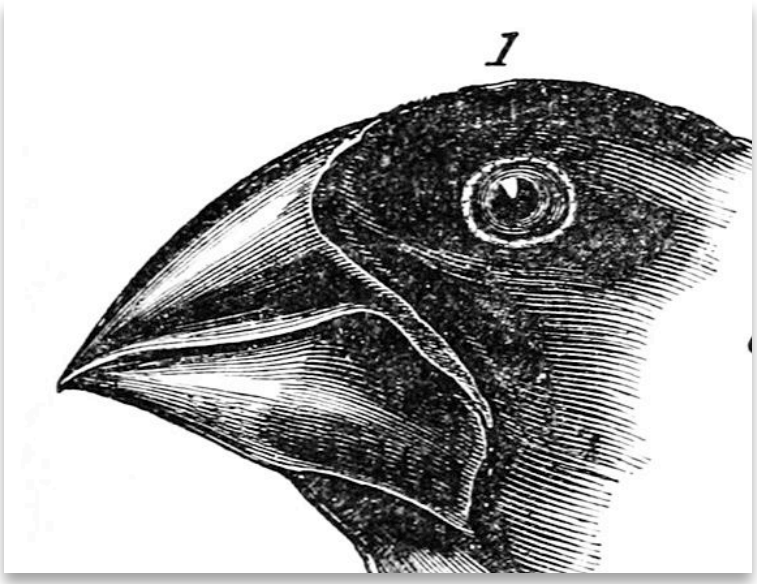
Semantic web database



BONSAI ontology

- Statements, not datasets
  - Abstract system model one step higher
- Import entire databases
  - Unconventional data sources

Build models from raw data



Dataset as document

- No correlation
- Static
- Mute

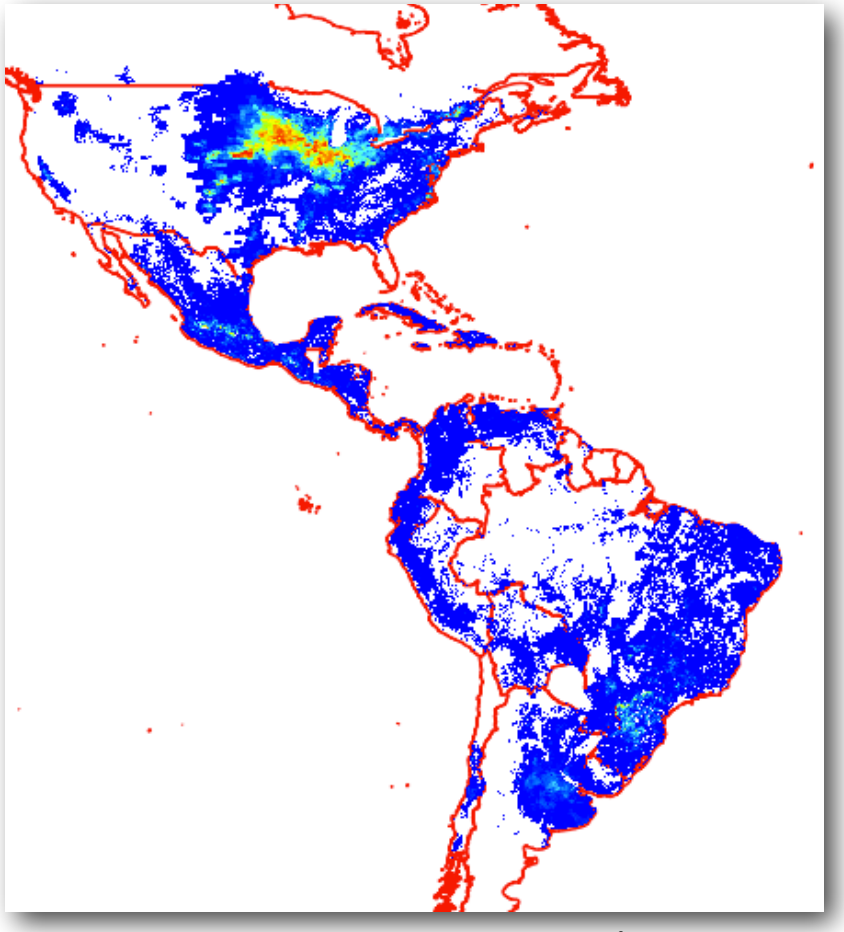
Dataset as model

- Respond to different conditions
- Dynamic
- Can ask questions of the model

- Avoid subjective and inconsistent choices by individual practitioners
- Basic functionality for all models
  - Economic logic, physical balances

Role of EIs: Detailed data in time and space

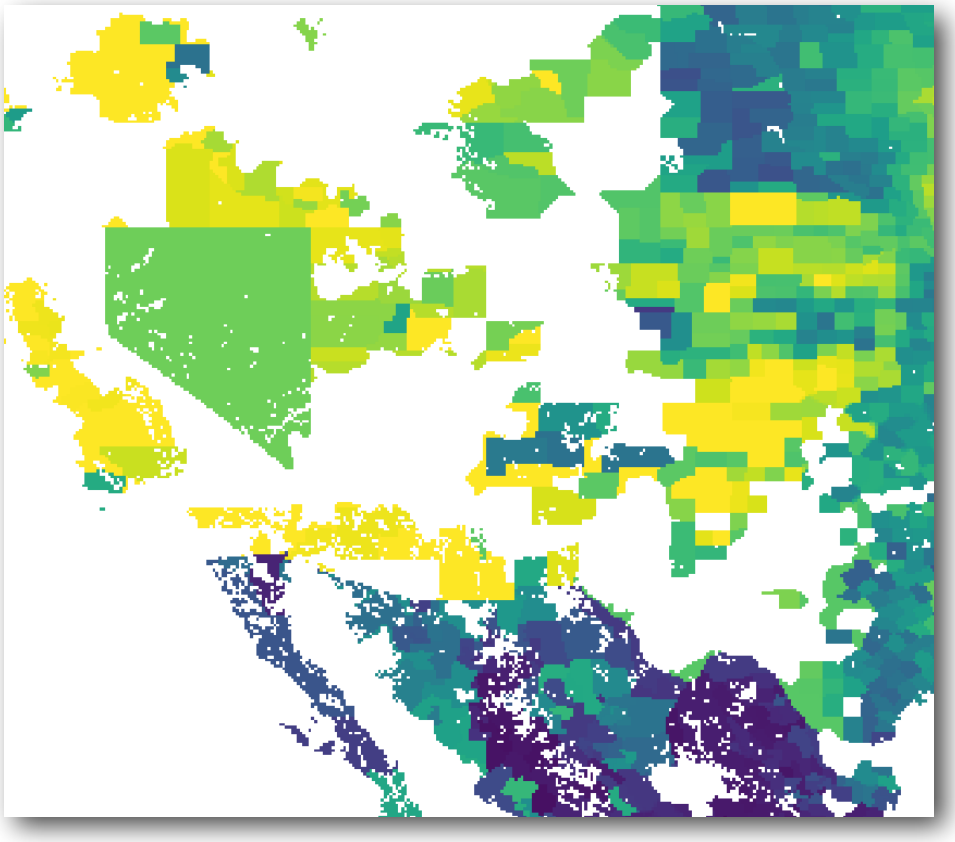
- Detailed maps of point and non-point sources
- Allows multi-scale modelling
- Scientific basis for determining class boundaries



Damage to ecosystem quality due to maize production (relative)

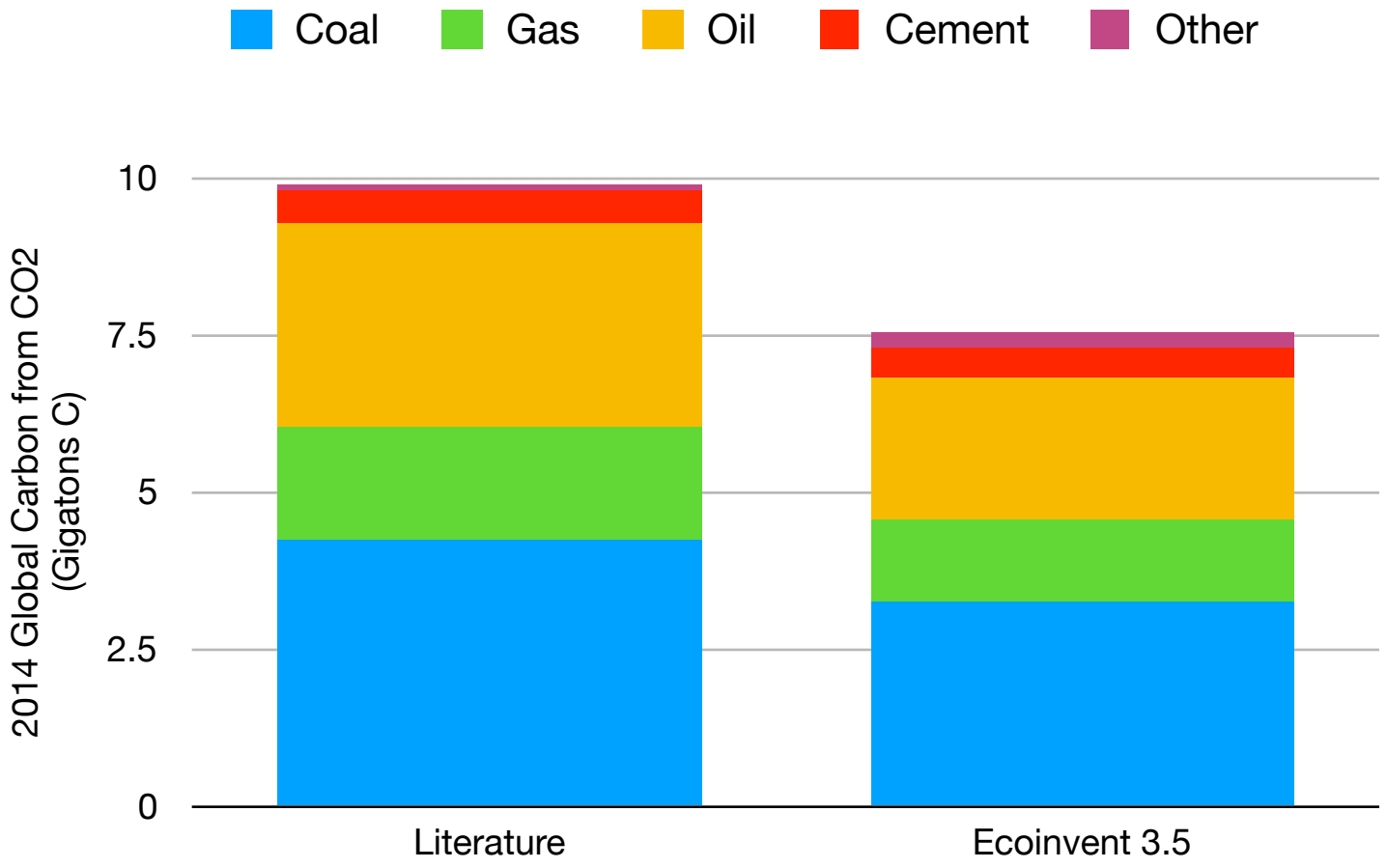
Role of EIs: Validation of global and regional totals

- Regional or global emissions or production values should sum to **independent** measurements or model results
- Remote sensing can an invaluable source of such estimates
  - Though not without their challenges
  - Other emissions inventories are also essential
- Can use **bootstrapping** to estimate strength/influence of individual data points
- Want to build on **your** validation **tools and data**

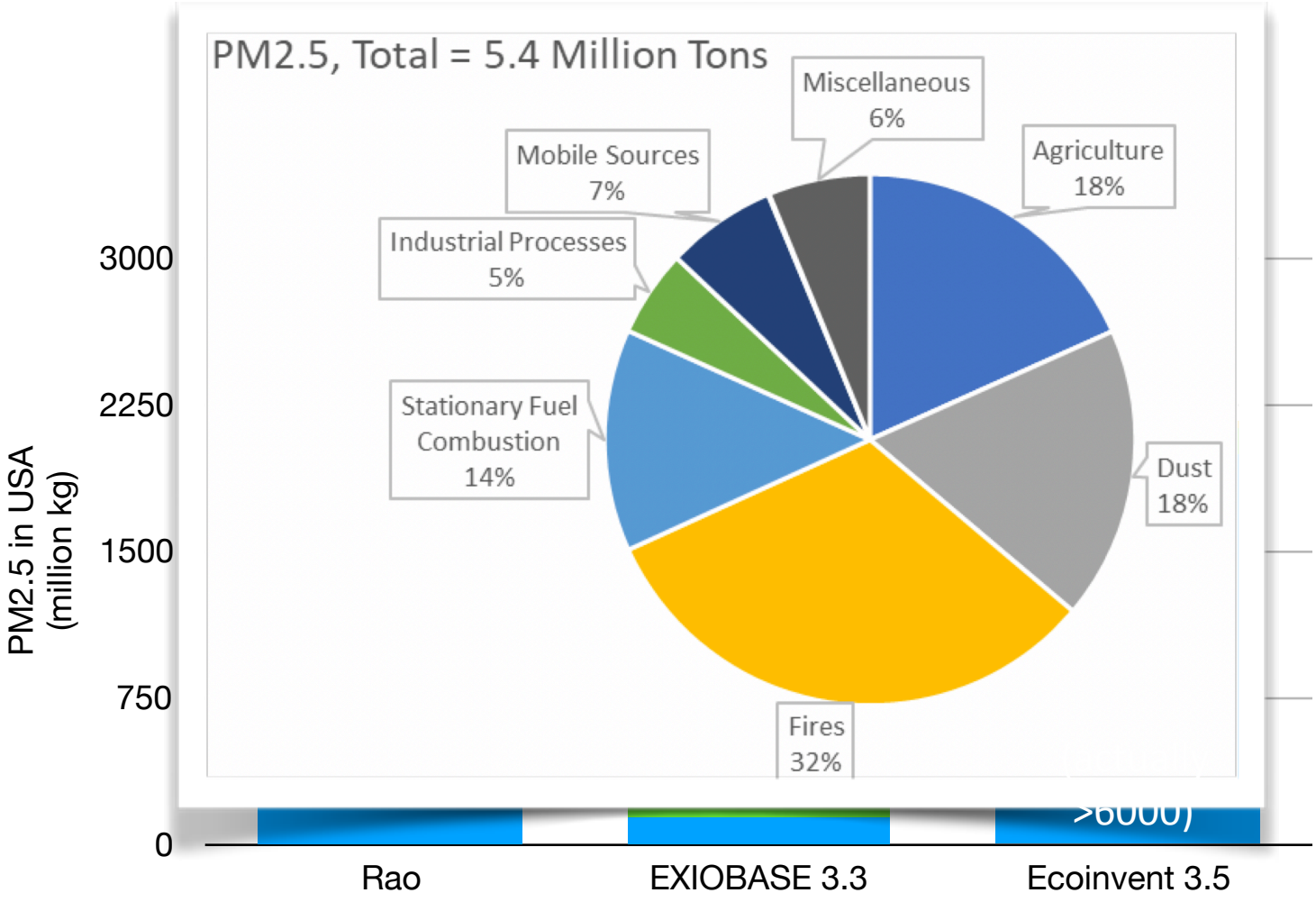


Maize yield (ton/hectare)

Example: CO_2 annual



Example: $PM_{2.5}$ in USA



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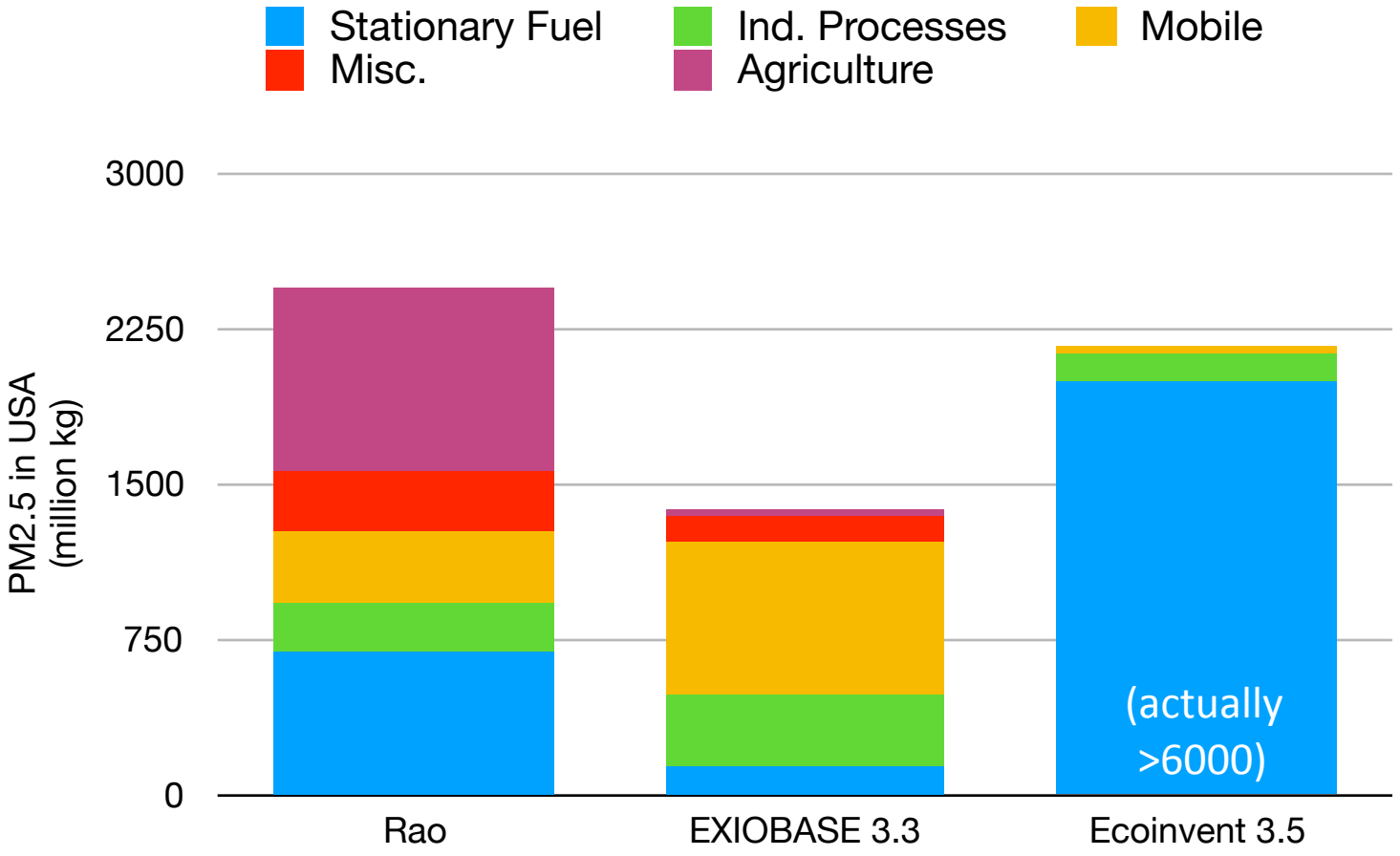

Requests for emission inventory community

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  - We will have to fit uncertainty distributions - better you than us!

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- **You** are welcome to help!
  - Common data needs and workflows
  - BONSAI is a coordinator, not a chief

My thanks go to

- BONSAI volunteers, incl. Matteo and Bo
- PSI TAG group
- LCA community
- You :)

Links:

- bonsai.uno
- github.com/BONSAMURAIS/
- chris.mutel.org
  - “Make LCA great again”