

PIOLab-SE

A global **Physical Input-Output Laboratory** for
Spatially Explicit material and energy footprints and
environmental impact assessment

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Impacts depend on specific location

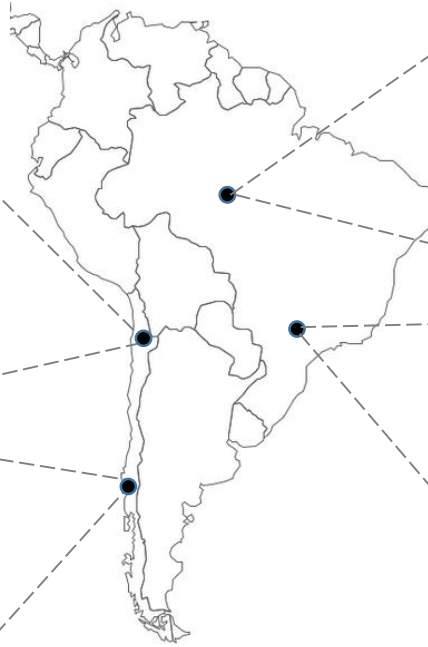
Chile: Copper mining



<http://intradayfun.com/2011/01/10-world-biggest-holes-created-by-human-and-nature/>



http://www.dw.com/image/0%2C%2C19318441_302%2C00.jpg



Brazil: Soybean production



<https://www.greenpeace.org/archive-international/en/news/features/amazon-destruction/>

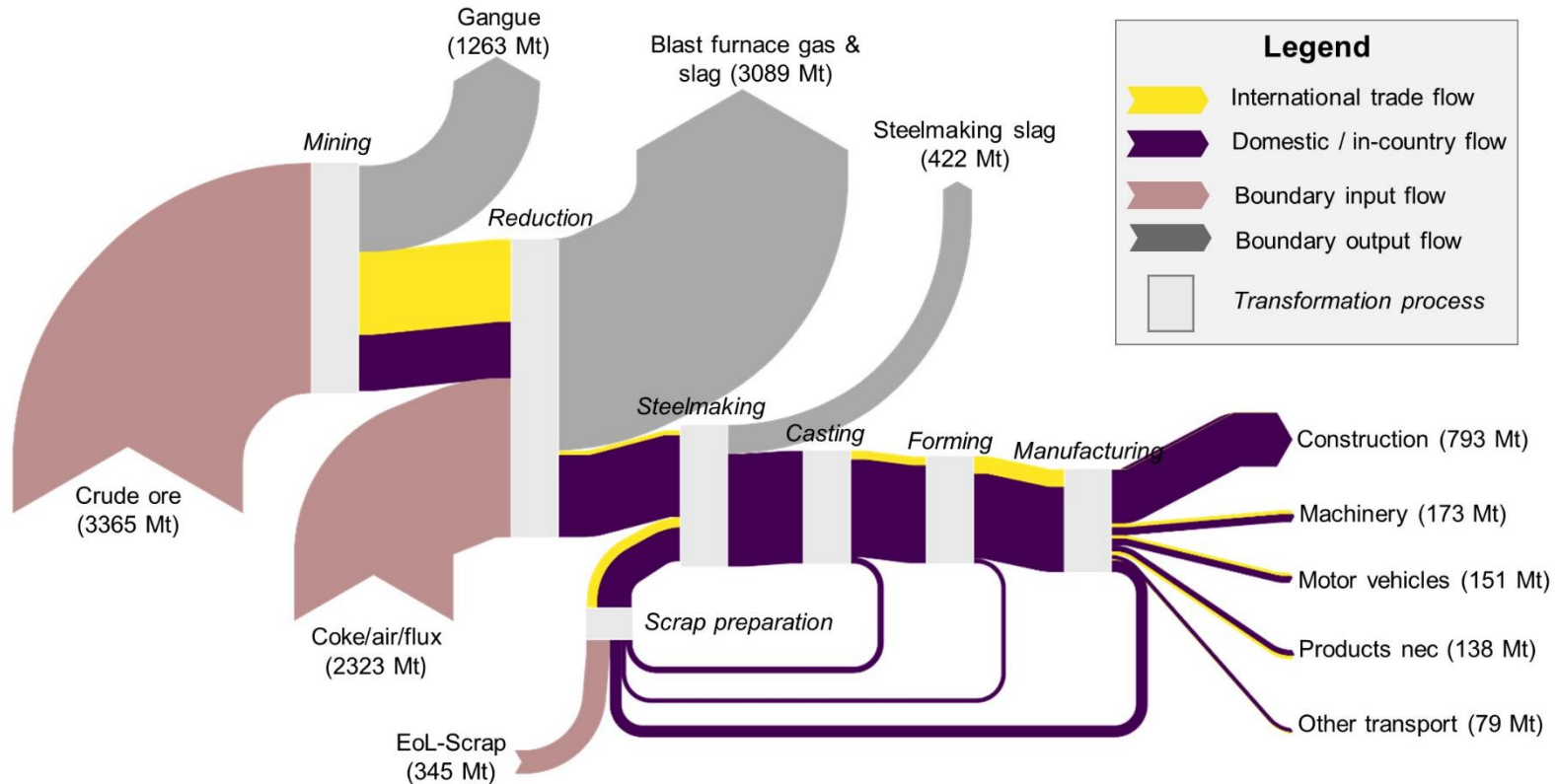


https://es.wikipedia.org/wiki/Archivo:Sembrado_de_soja_en_argentina.jpg

- Generalized raw data management with **root classification**
- **AISHA**: One-step reconciliation engine
 - Constrained optimization, KRAS
- High performance computers
- **Re-use code/data to compile IO tables for specific research questions**

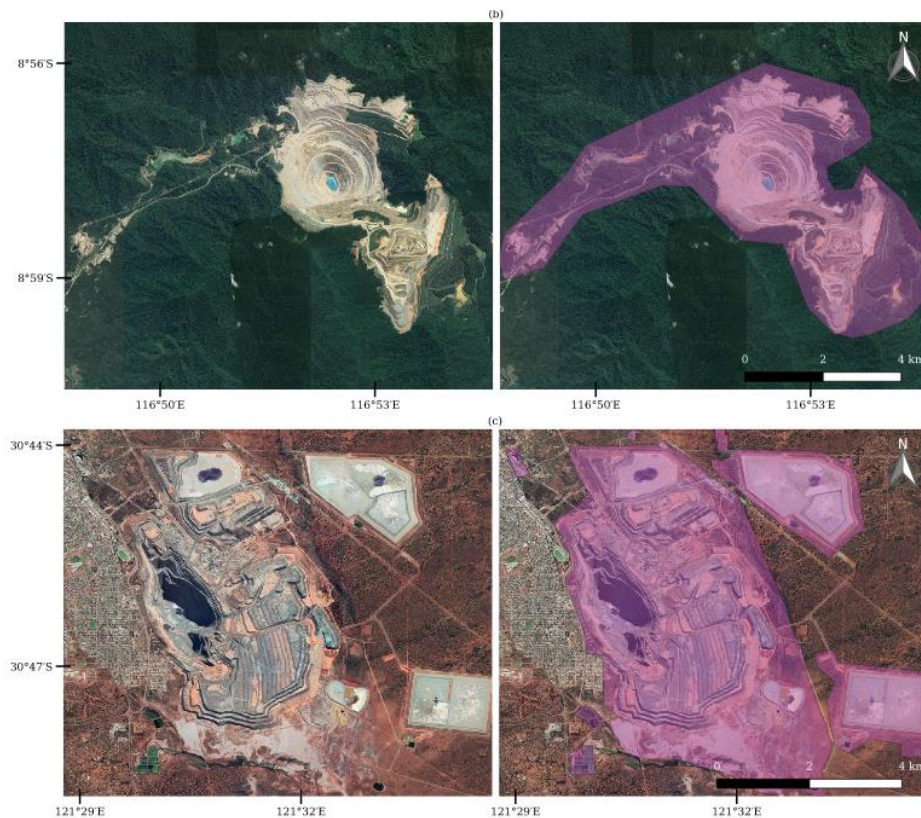
- **Prototype for global iron and steel supply chains**
 - 32 regions, 30 processes & 39 flows
- **Primary data:** World Steel, BACI, UNEP-IRP MFA accounts, ...
- **When primary data unavailable:**
information from MFA, LCA, Waste IO modeling
- Publication forthcoming in JIE, first PIOTs available on Zenodo

Sankey diagram of global iron-steel PIOT (2014)

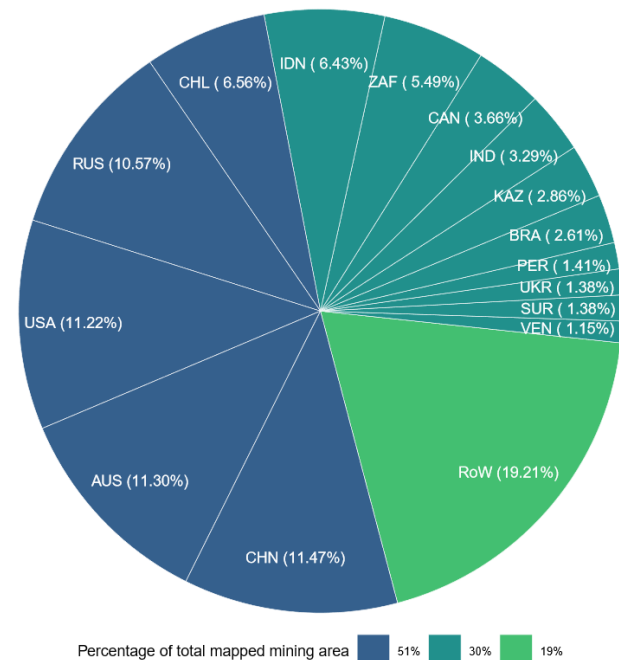


- **Holistic multi-layer physical IO modelling framework for material & energy flows**
- Nested subnational-global PIOTs (30-100 regions) for iron, copper, aluminum, ...
- Extends basic PIOLab approach with subnational impact assessment of mining activities
- Main FINEPRINT tool for impact assessment of metal consumption

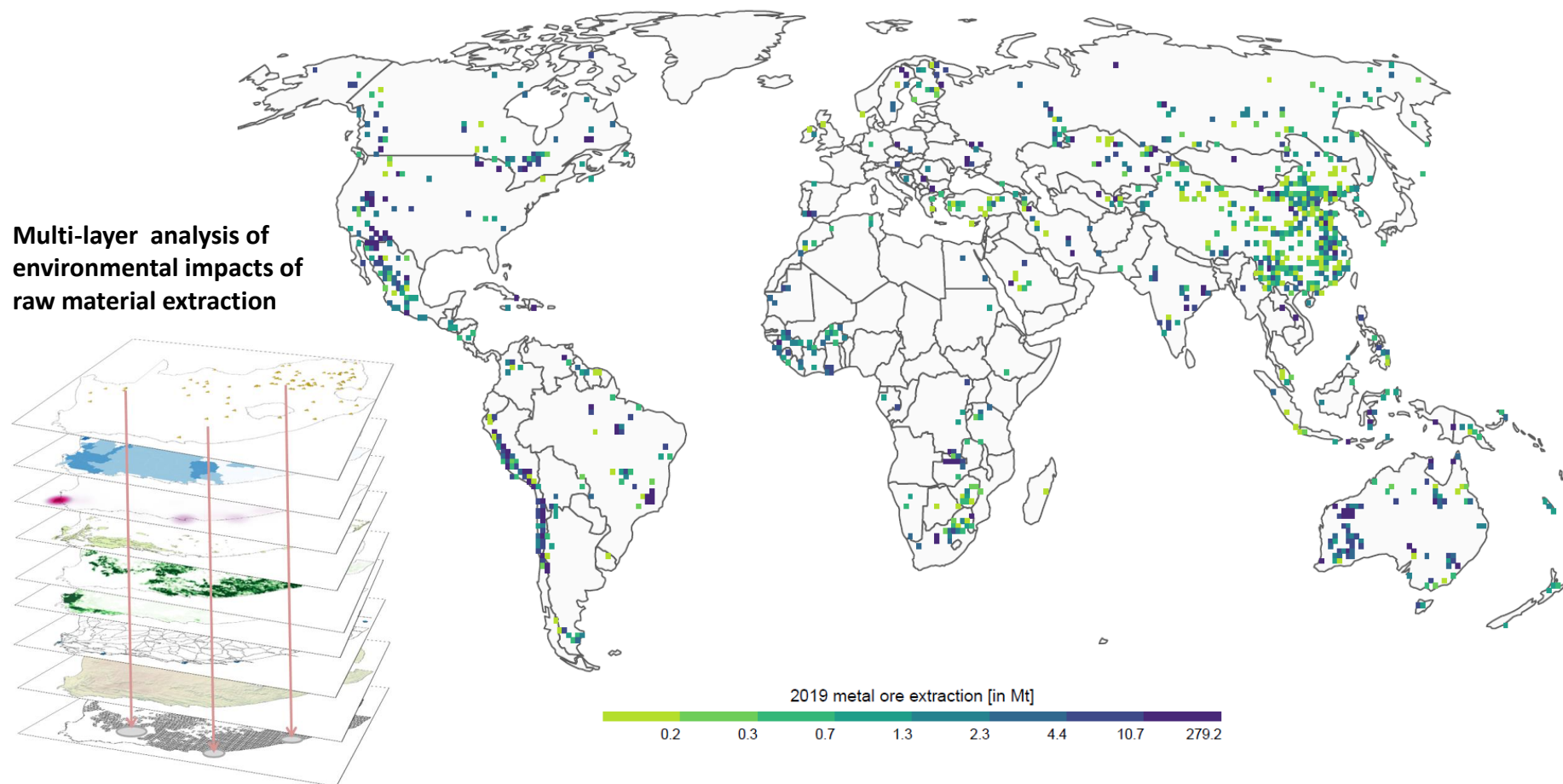
A global-scale data set of mining areas



Total land area: 57,277 km²



Metal ore extraction, 2019, 1° grids



Environmental Pressure Impact Proxy (EPIP) matrix

Type 1

(pressure)

e.g. extraction

$$\mathbf{p} = \begin{pmatrix} p_1 \\ \vdots \\ p_m \end{pmatrix}$$

m stands for number of root regions and global extraction equals $\sum \mathbf{p}$

Type 2

(impact)

e.g. abiotic resource depletion

$$\mathbf{i} = \begin{pmatrix} i_1 \\ \vdots \\ i_m \end{pmatrix} = \mathbf{p} * \mathbf{c}$$

vector $\mathbf{i}$ is derived from secondary/own modeling results or by weighting pressures $\mathbf{p}$ using impact coefficients $\mathbf{c}$, e.g. from LCA

Type 3

(pressure-by-states)

e.g. extraction-by-reserves

$$\mathbf{P} = \begin{pmatrix} p_{1,1} & \cdots & p_{1,n} \\ \vdots & \ddots & \vdots \\ p_{m,1} & \cdots & p_{m,n} \end{pmatrix}$$

n stands for the number of environmental states (e.g. large, medium, small reserves) for which pressures are disaggregated. Row elements of matrix $\mathbf{P}$ sum up to $\mathbf{p}$

Global subnational PIOT example

		WA (Western Australia)			RoW (Rest of the World)			Final use		Boundary output to		Total output
		Mining	Smelting	Manufact.	Mining	Smelting	Manufact.	WA	RoW	SEM	Nature	
WA	Mining		20			40					40	100
	Smelting			100						20		120
	Manufacturing							190	10			200
RoW	Mining		10			490					500	1000
	Smelting			100			1820			200		2120
	Manufacturing							200	1620			1820
Boundary Input from	SEM		90			1590		[kt]				
	Nature	100			1000							
Total input		100	120	200	1000	2120	1820					

Land use	species-rich biome	20			1500		
	species-poor biome	140			600		
Water use	water scarce region	200			1100		
	water abundande region	0			1100		
Extraction from	large reserves	80			200		
	minor reserves	20			800		

[km²]

[1000 m³]

[kt]

EPIP Type 3



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Thank you!

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www.fineprint.global

github.com/fineprint-global

researchgate.net/project/FINEPRINT