InVEST

integrated valuation of ecosystem services and tradeoffs

Biophysical modeling challenges and opportunities

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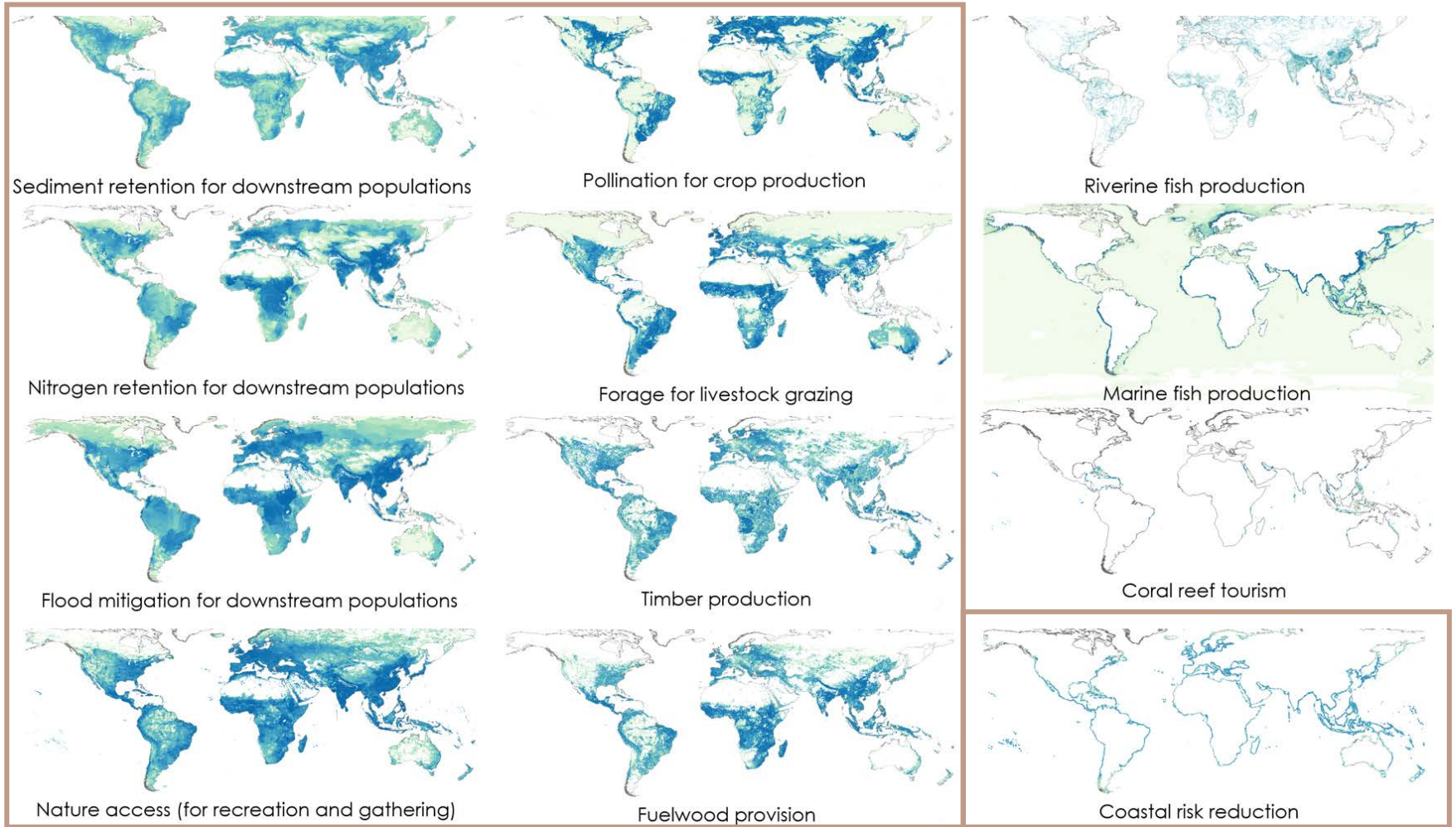
Global ecosystem service modeling (InVEST, Co$ting Nature, and others)

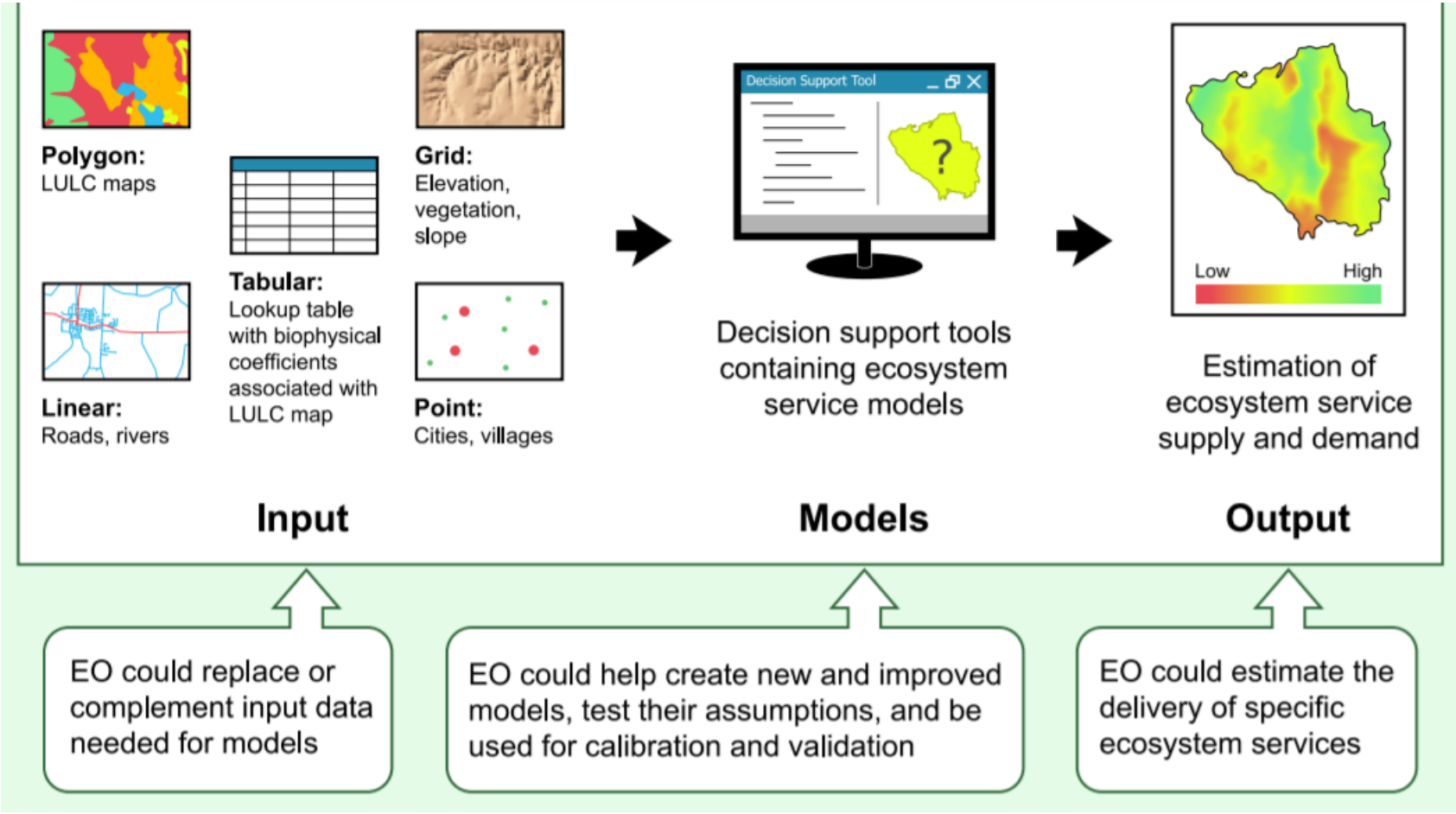


Models based on LULC

Challenges with LULC-based ecosystem service modeling:

- Categorical land-use proxies a diversity of functions
- Oversimplistic representation of ecosystem heterogeneity
- Difficult/time-consuming to parameterize

Global ecosystem service modeling opportunities for advancing integration with EO



Ramirez-Reyes et al. 2019 Science of the Total Environment 665: 1053-63

Models based on EO

Opportunities for EO-based ecosystem service modeling:

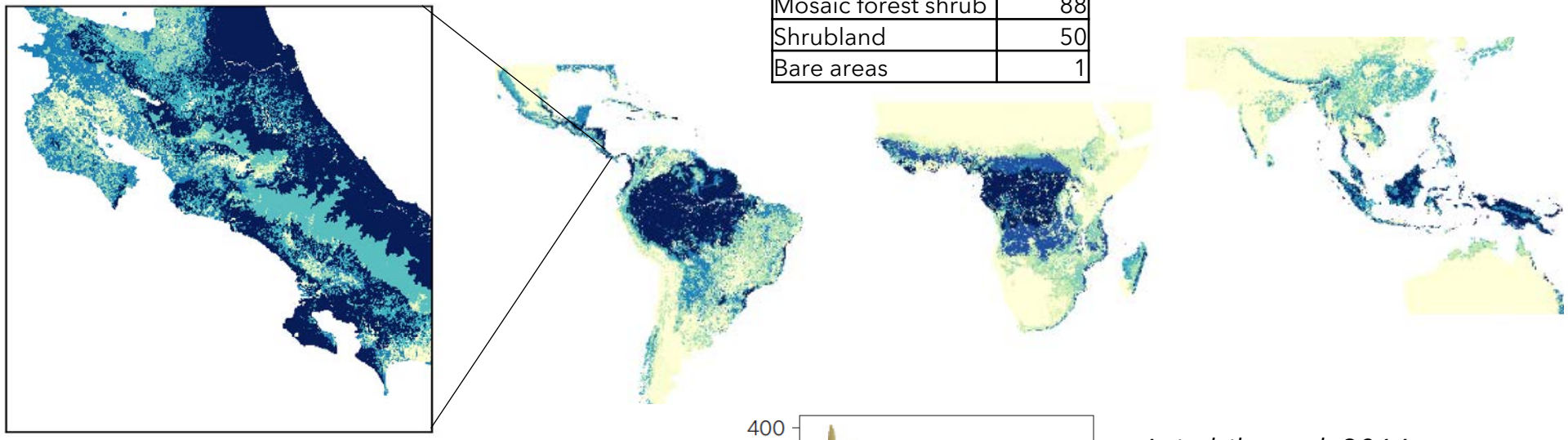
- Functional representation of ecological processes
- More accurate representation of ecosystem heterogeneity
- Easier/more replicable parameterization

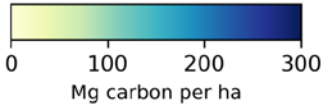
Carbon storage

LULC-based approach

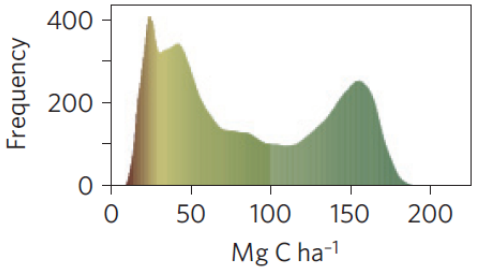
LULC	Mg/ha
Cropland	5
Forest	126
Grassland	4
Mosaic forest shrub	88
Shrubland	50
Bare areas	1

IPCC Tier 1 Look-up Table
Carbon Zone 106

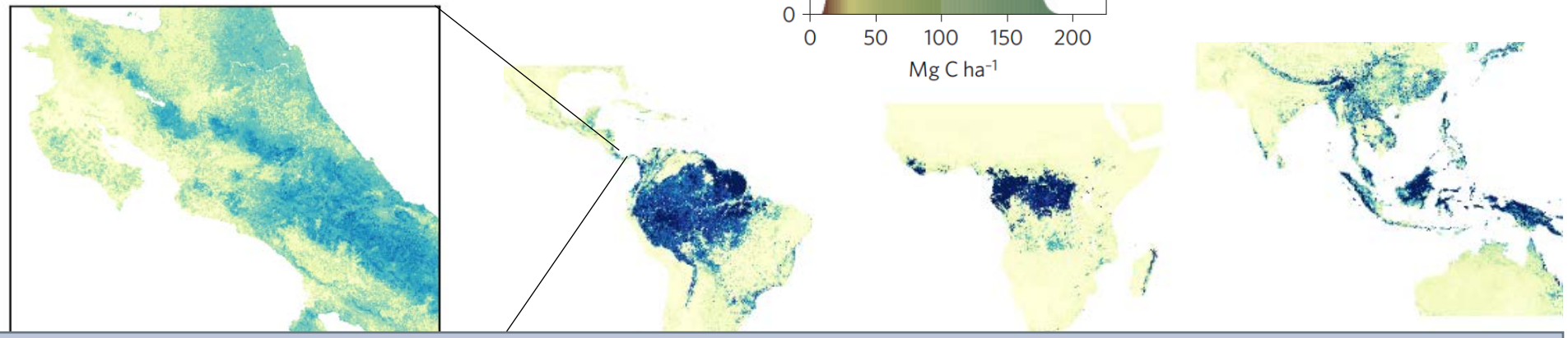




EO-based approach



Avitabile et al. 2016
Baccini et al. 2012, 2017
Santoro et al. 2015



But how to project scenarios?

Regression between EO-derived biomass and other biophysical and socioeconomic variables

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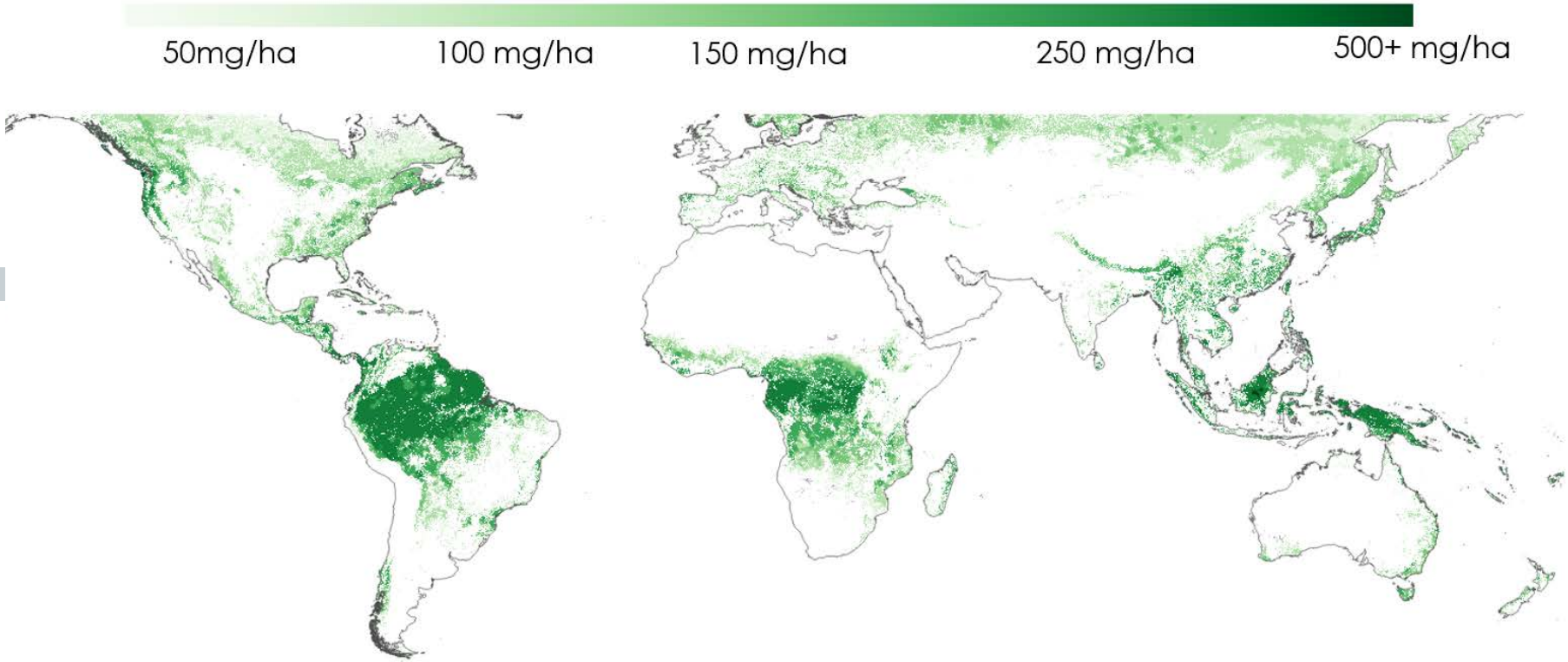
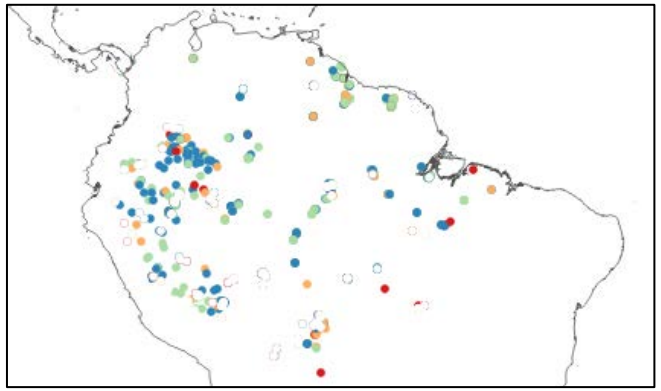
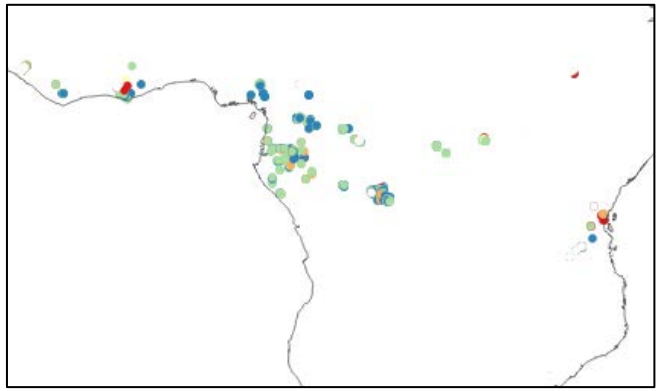
Predictor variables	Effect size
Bulk density of the fine earth fraction	116.36
Temperature Annual Range	-115.22
Mean Temp. of Warmest Quarter	93.88
Precipitation Seasonality	64.41
Mean Diurnal Range	-57.65
Total nitrogen content of soils	56.32
Annual Precipitation	51.46
Available soil water capacity	-43.11
Area of nearby non-forest	-42.77
Depth to bedrock	33.19
Terrain ruggedness index	30.4
Precipitation of Driest Month	-28.1
Precipitation of Driest Quarter	27.07
Proportion of silt particles	-26.72
Proportion of sand particles	25.99
Precipitation of Warmest Quarter	-24.59
Soil pH	-23.15
Cation exchange capacity	-17.96
Mean Temp. of Driest Quarter	17.16
Wind speed	-16.56
Slope	-15.78
Accessibility to cities	15.18
Vol. fraction of coarse fragments	-13.47
Mean Temp. of Wettest Quarter	-11.54
Altitude	-9.74
Soil organic carbon content	9.68
Proportion of clay particles	8.61
Livestock density	-5.11
Min Temp. of Coldest Month	4.16
Organic carbon density of soils	3.69
Nightlights within 10 km	-1.09
Population within 10 km	-0.66
Nightlights on pixel	-0.2

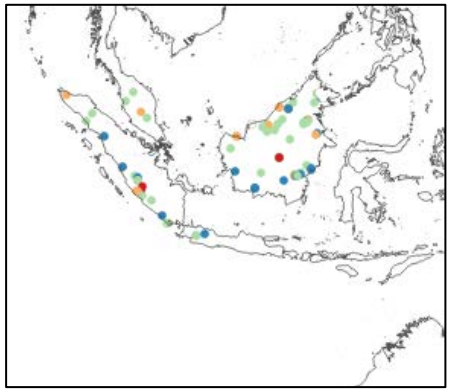
Predicted aboveground biomass



Difference in accuracy for EO regression vs. original EO dataset

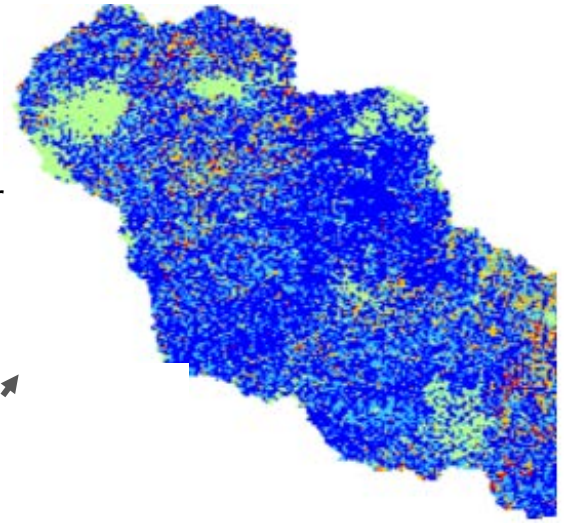




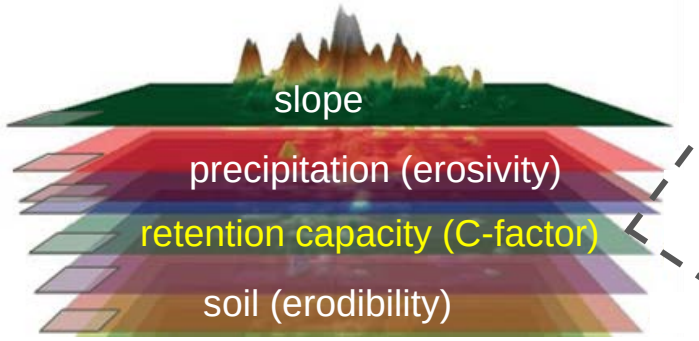


description	lucode	usle_c	usle_p
Urban and paved roads	1	0.99	1
Grass	3	0.034	1
General agriculture	5	0.412	1
Tea	6	0.08135	1
Coffee	7	0.4393	1
Forest	8	0.025	1
Water	9	0	1
Forest plantation	11	0.121	1
Unpaved road	18	1	1
Agroforestry	19	0.121	1

LULC-based C-factor



LULC-based sediment export



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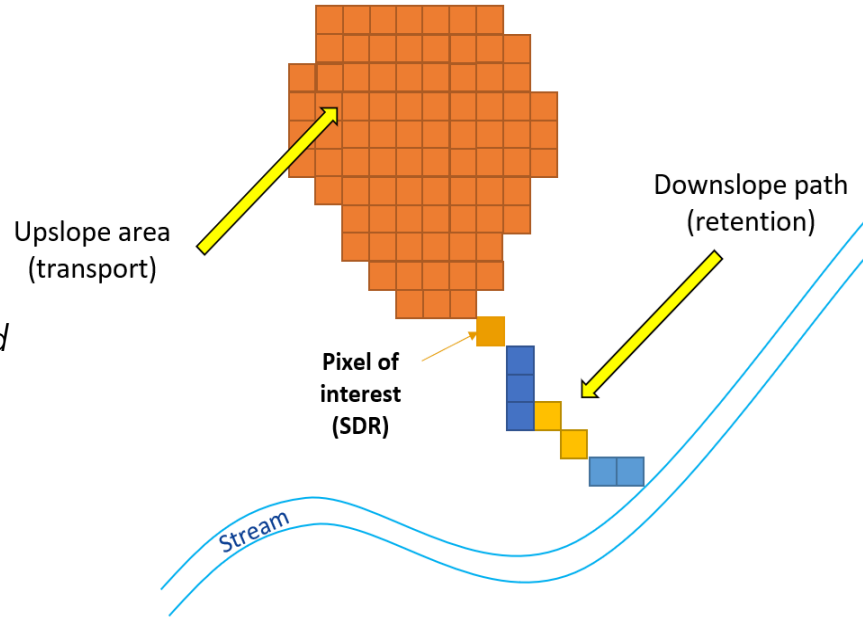
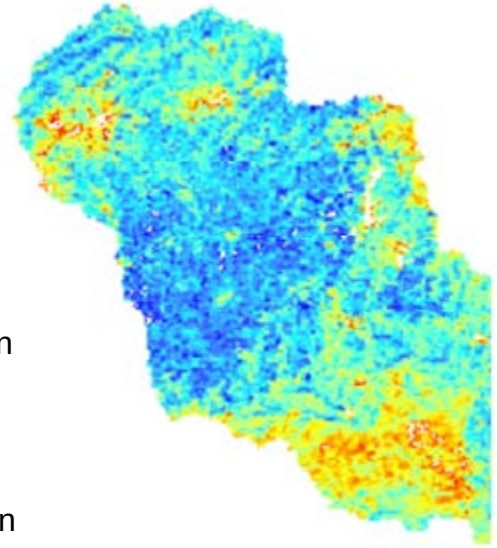
integrated valuation of ecosystem services and tradeoffs

- *Process-based model (USLE)*
- *Routed within watershed*



NDVI-based C-factor



NDVI-based sediment export

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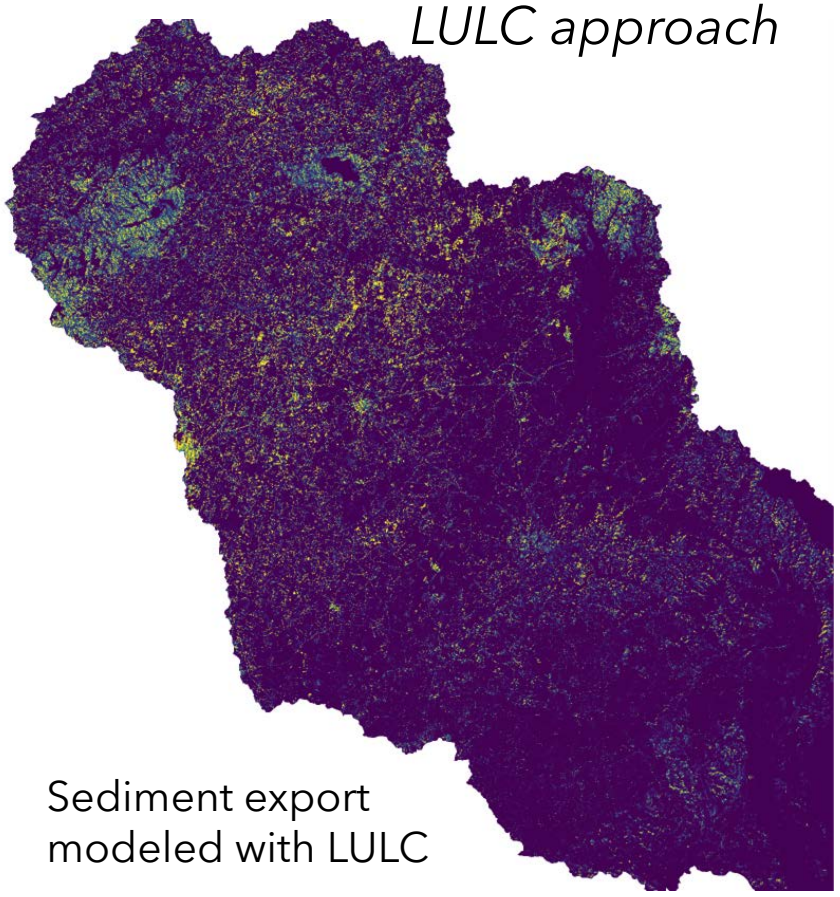
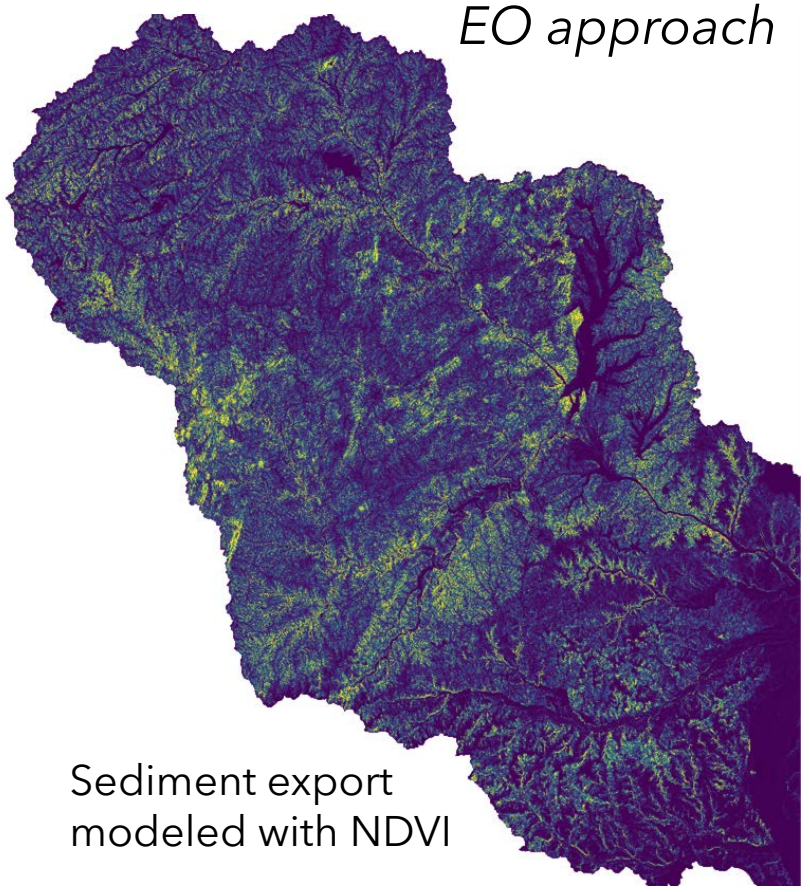
Sediment Retention

LULC approach

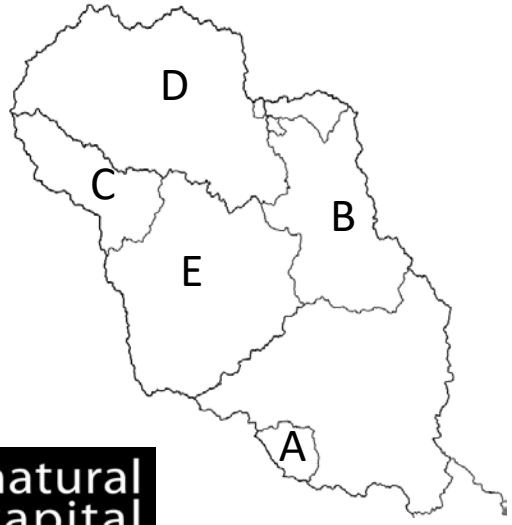


Sediment export modeled with LULC

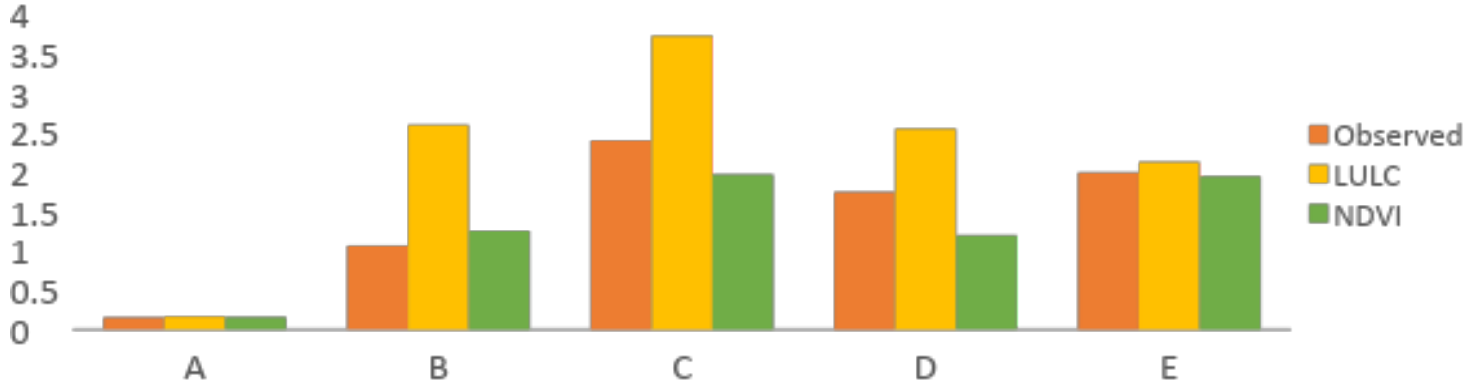
EO approach



Sediment export modeled with NDVI



Sediment export rate



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