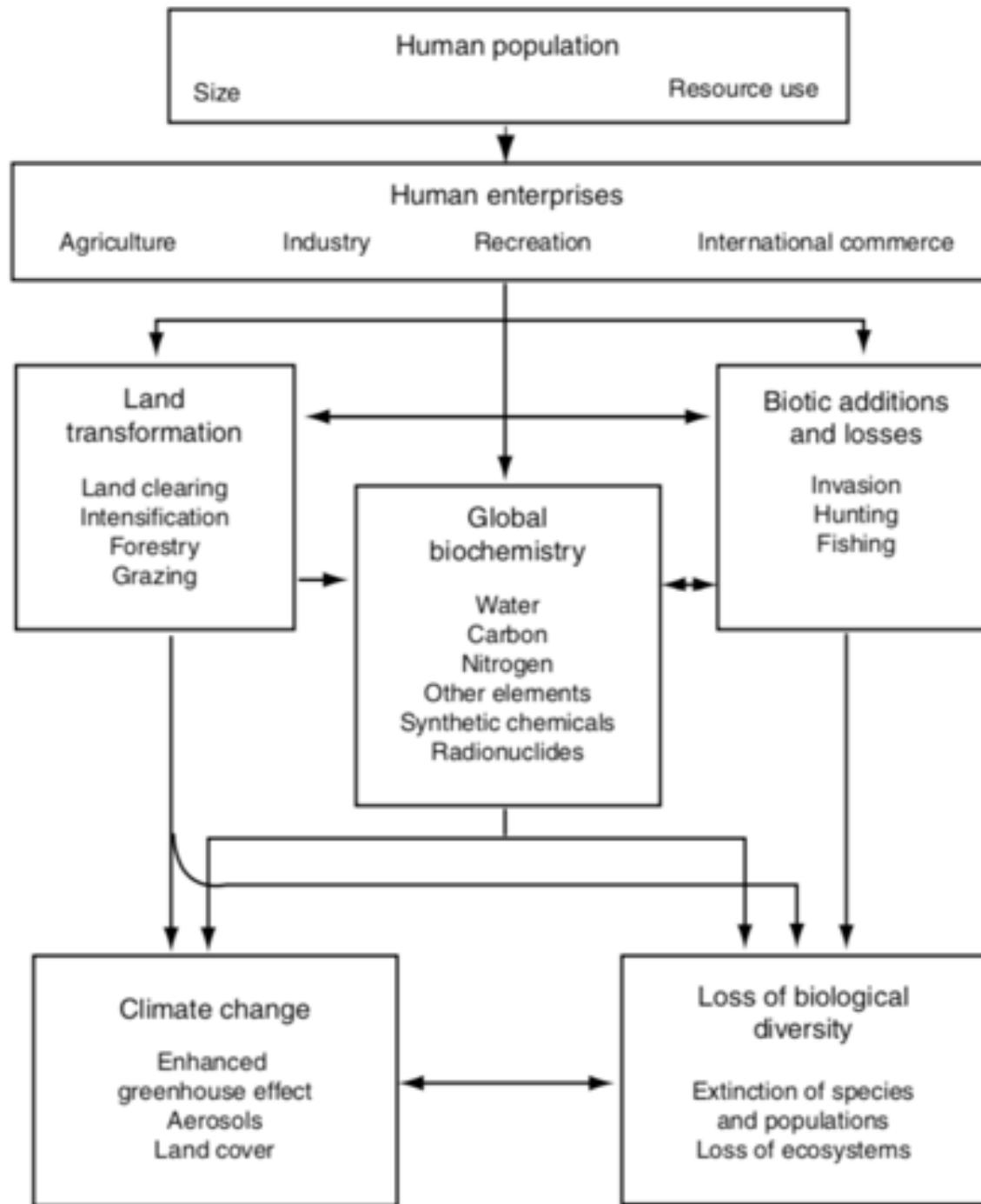


Human Domination of Earth's Ecosystems

Vitousek, Mooney, Lubchenco, Melilo (1997). *Science* 277.

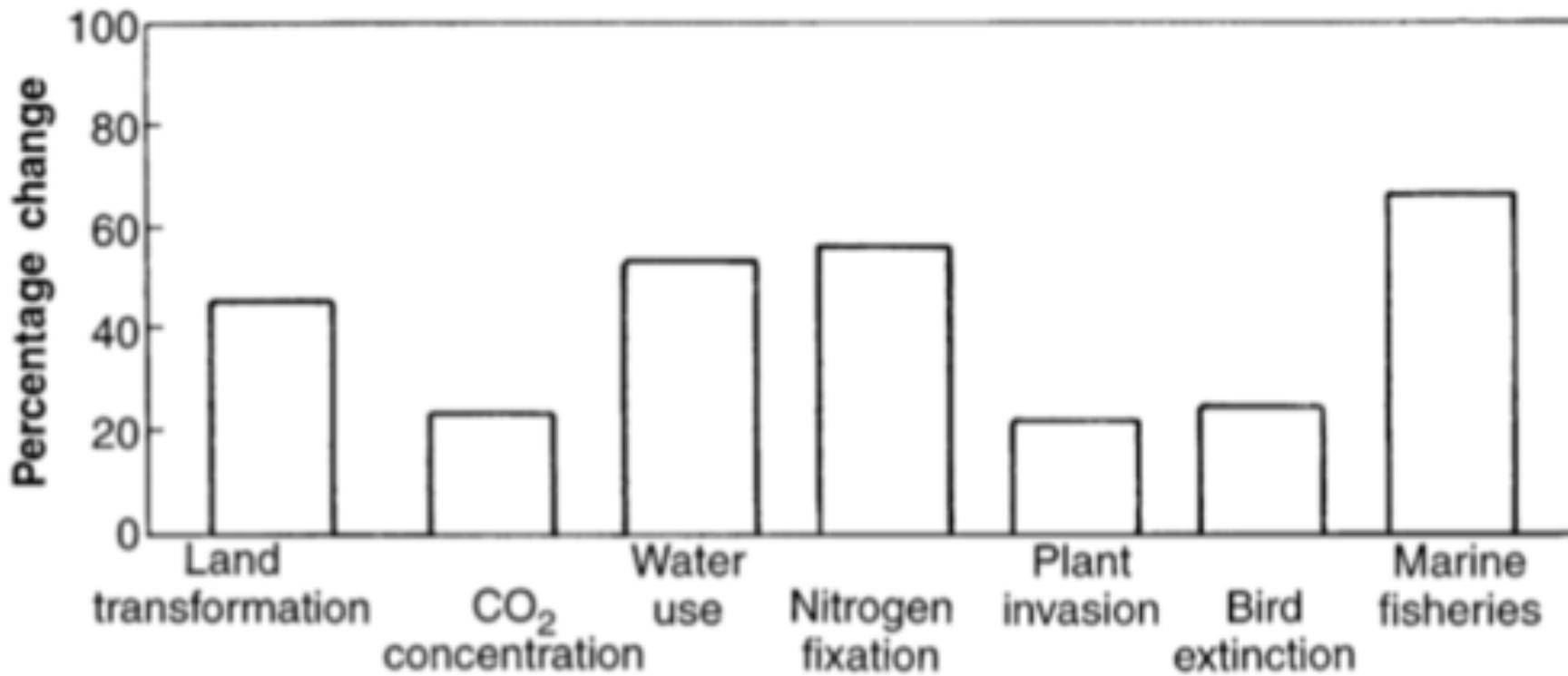
September 5, 2019



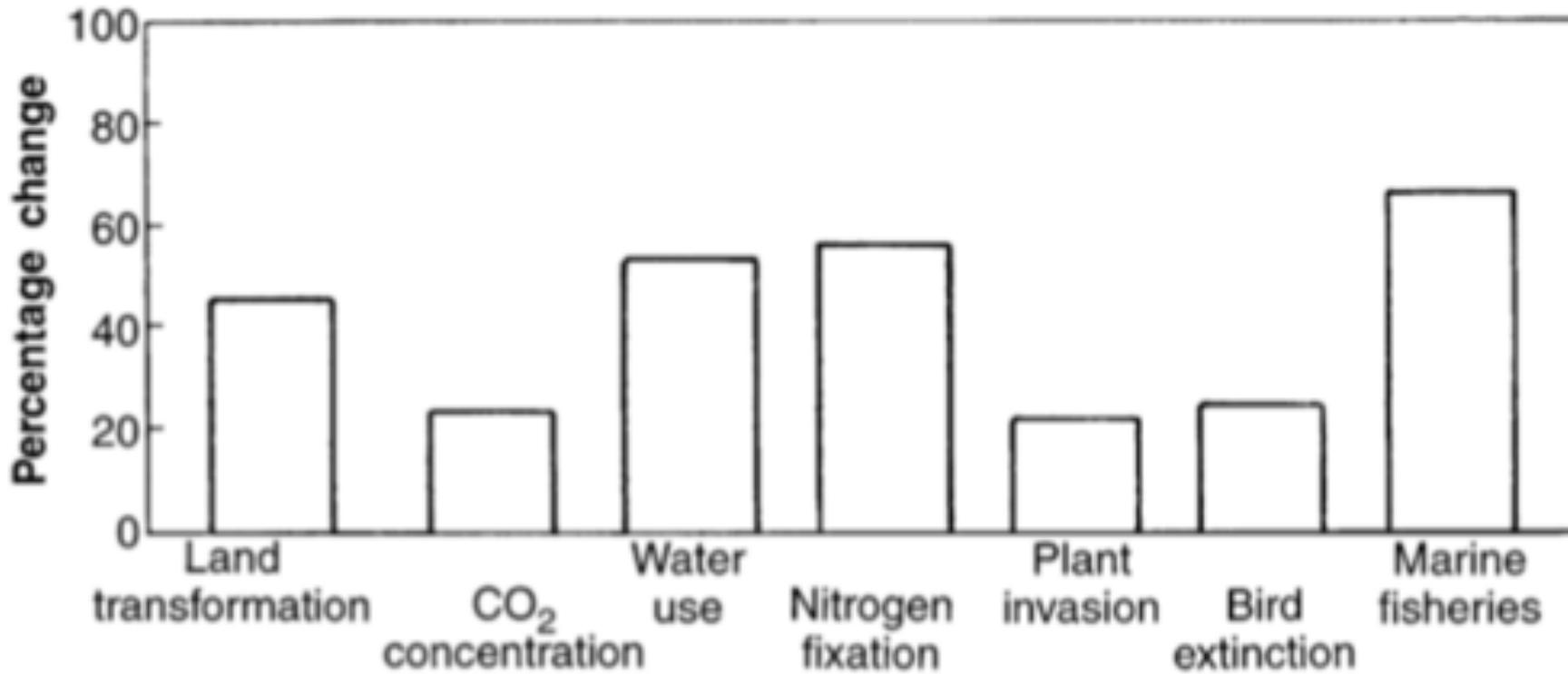


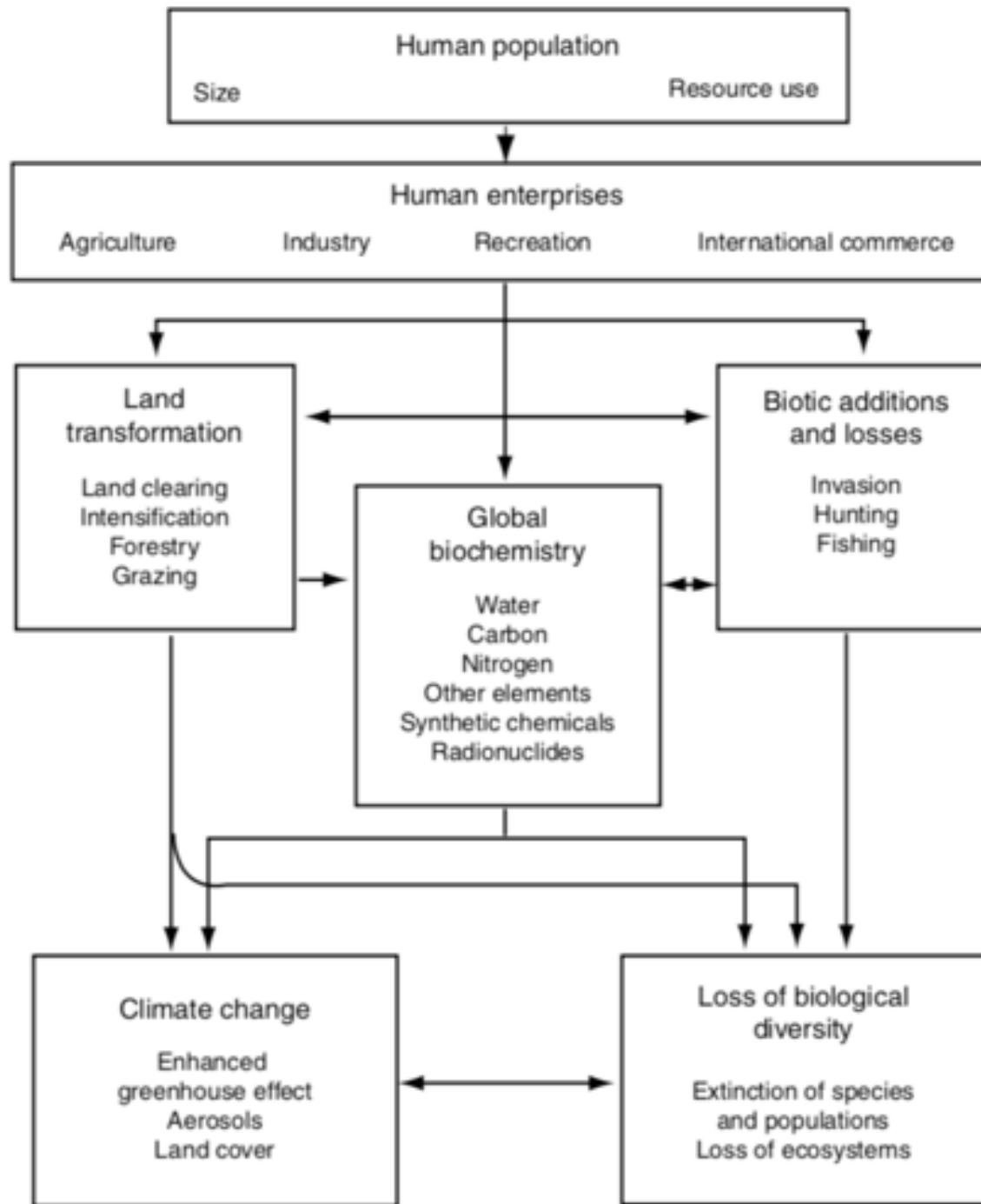
Direct and indirect impacts of humans on Earth's ecosystems

Humans change is not insignificant

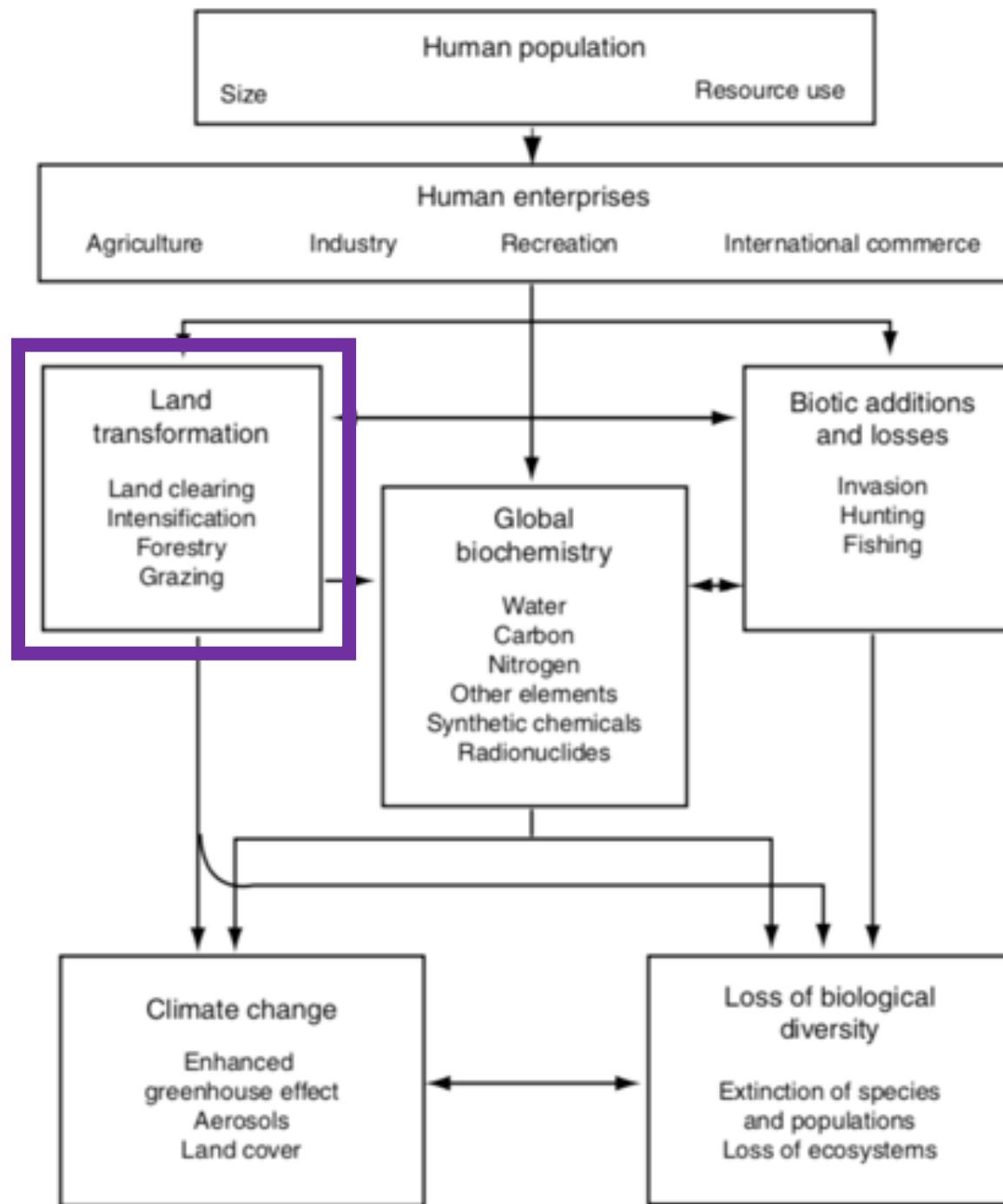


Were any of the facts presented particularly surprising??





Direct and indirect impacts of humans on Earth's ecosystems



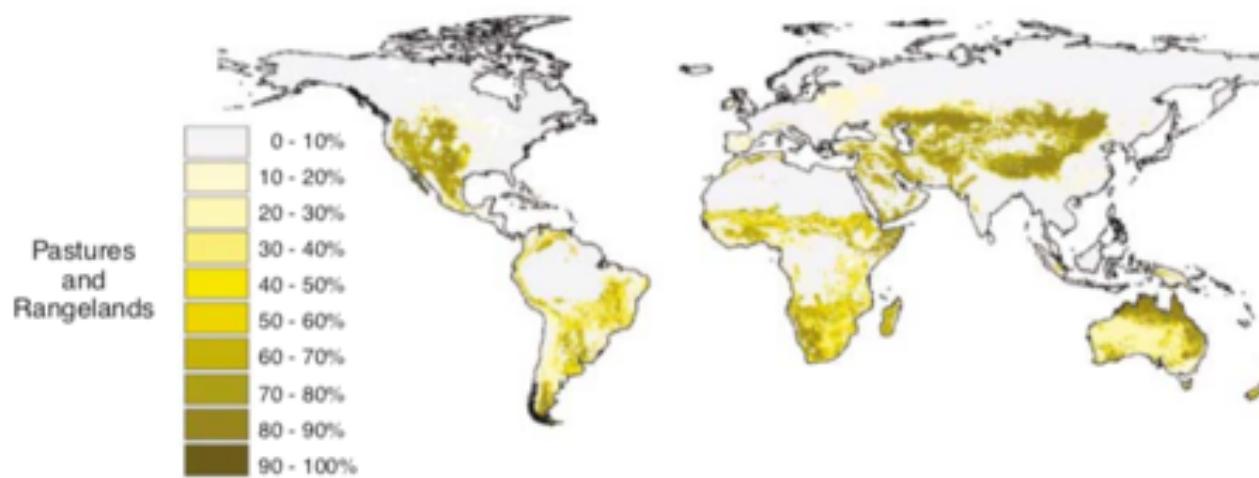
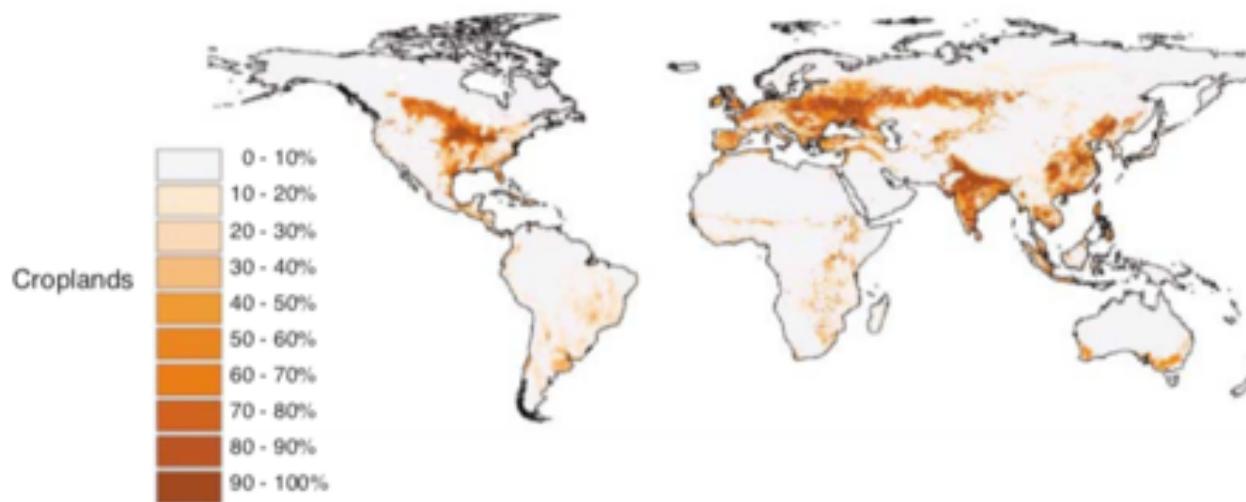
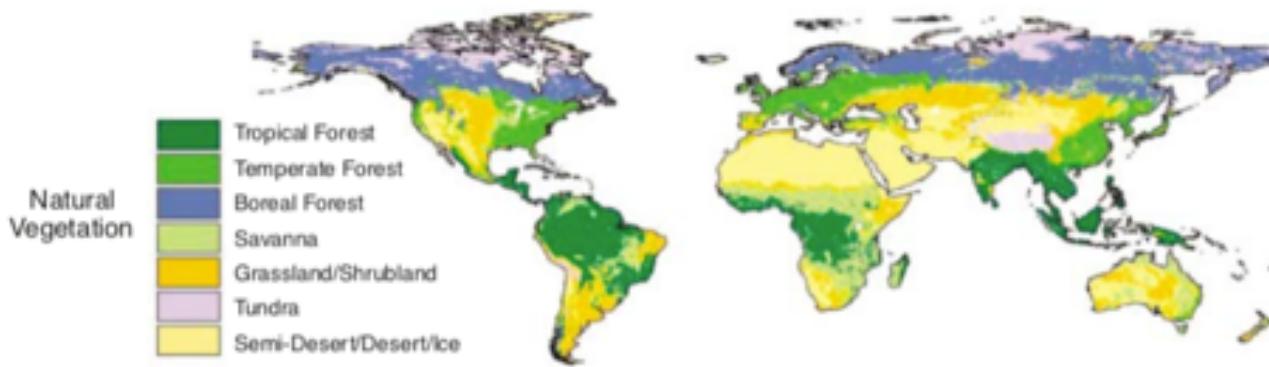
Direct and indirect impacts of humans on Earth's ecosystems

Land transformation

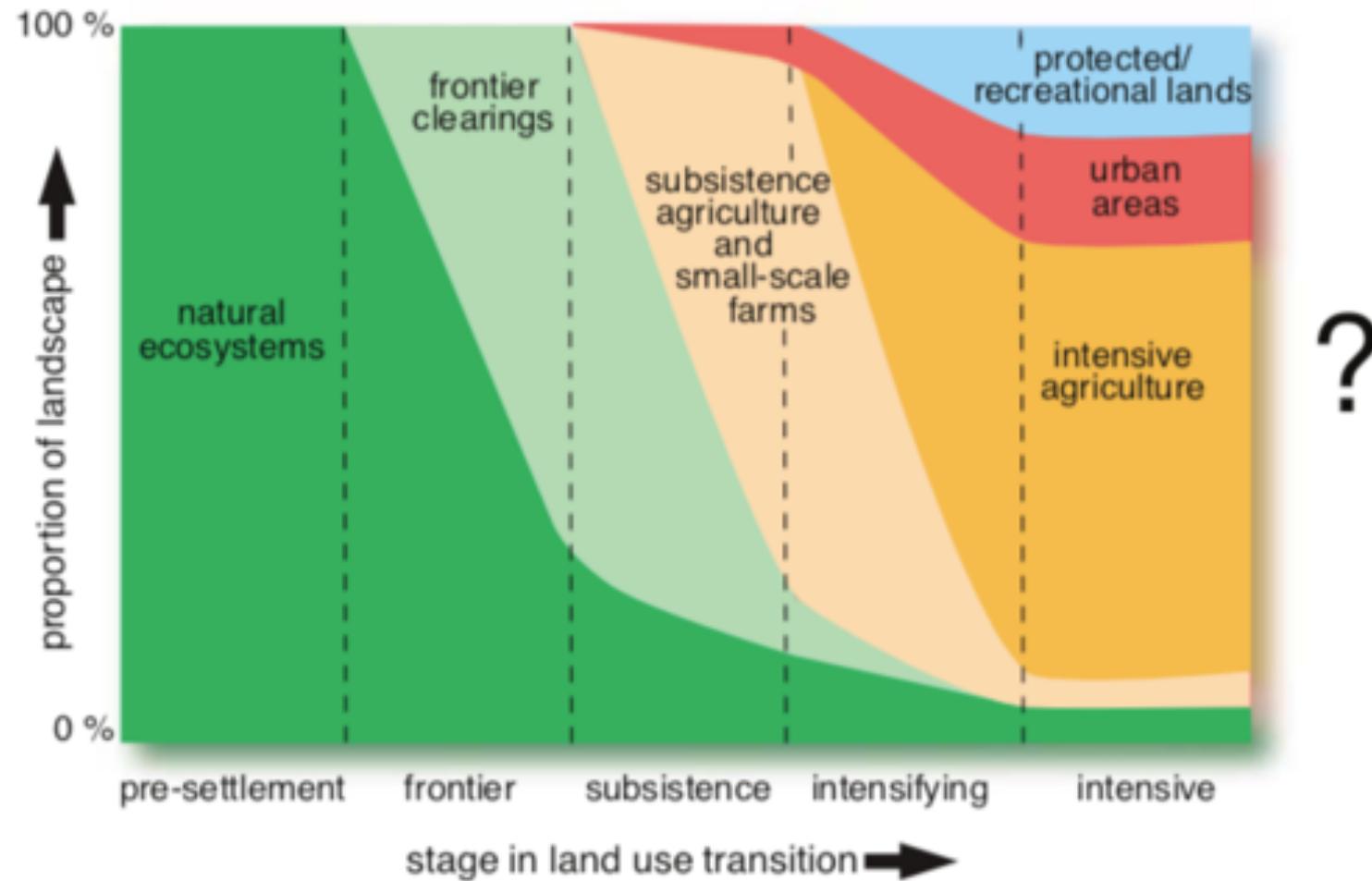
- Nearly 50% of all land has been transformed by humans
- Primary driver of species loss
- 20% of all CO₂ emissions

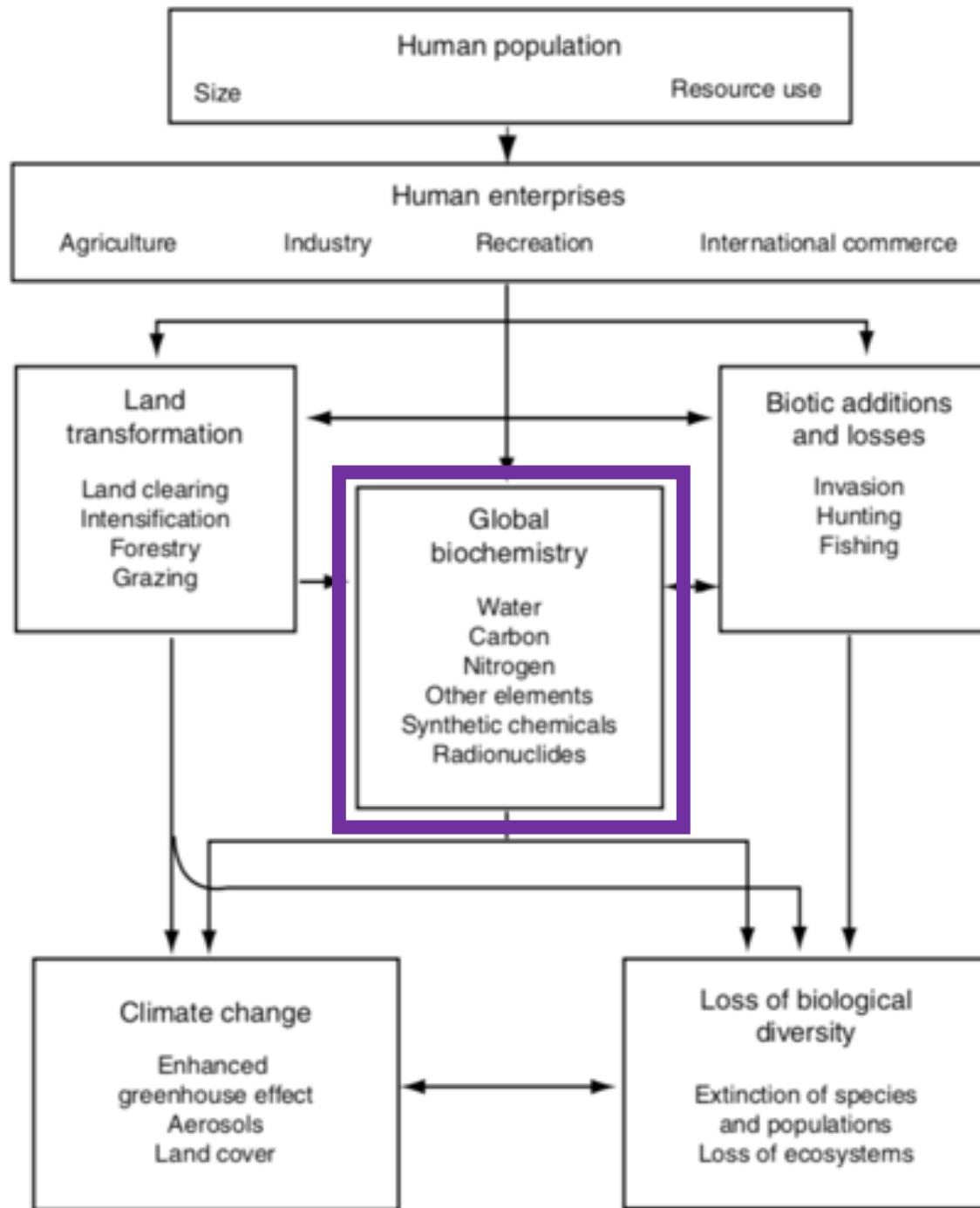


Border between Haiti (left) and Dominican Republic (right)



Progressive land transformation (Foley et al. 2005)

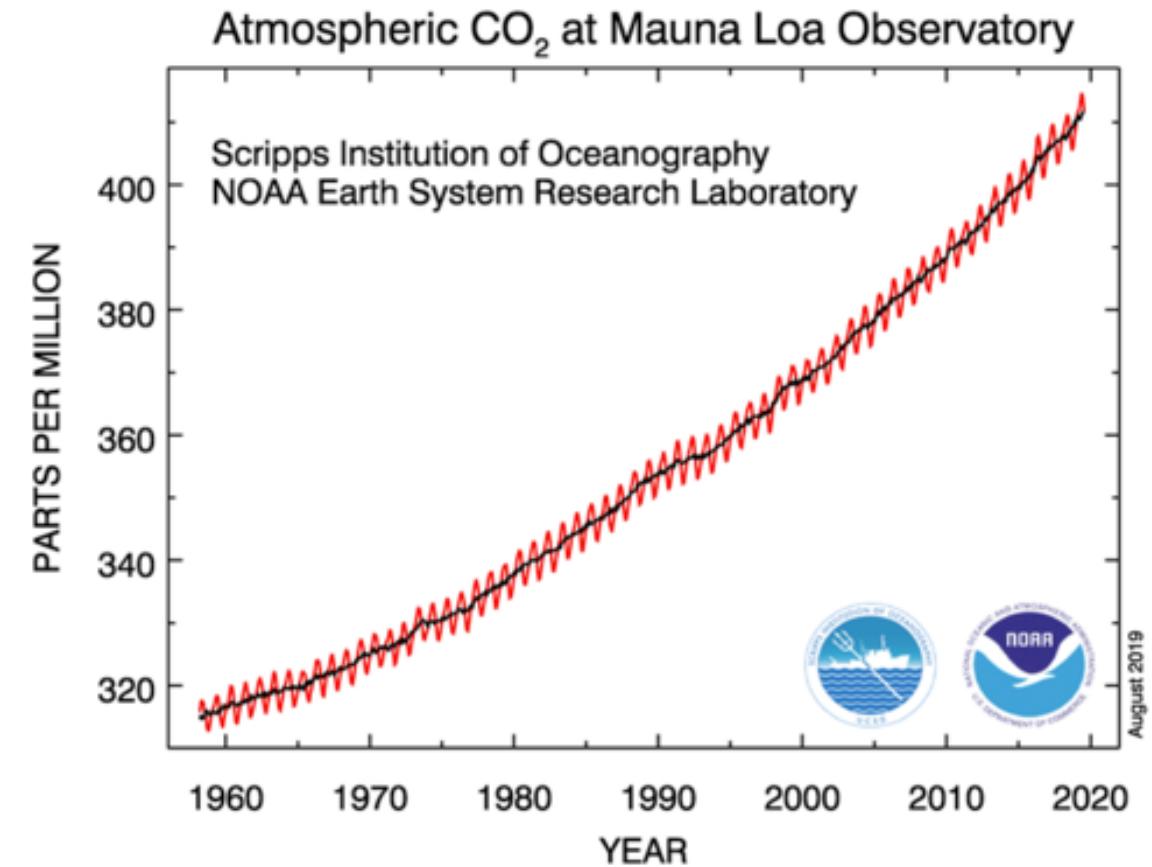




Direct and indirect impacts of humans on Earth's ecosystems

Biogeochemistry - Carbon

- Humans emit 5,500,000 tons of C per year
- Ecosystems take up only 2,300,000 tons per year
- Impacts
 - Climate change
 - Ocean acidification
 - Decreased food quality

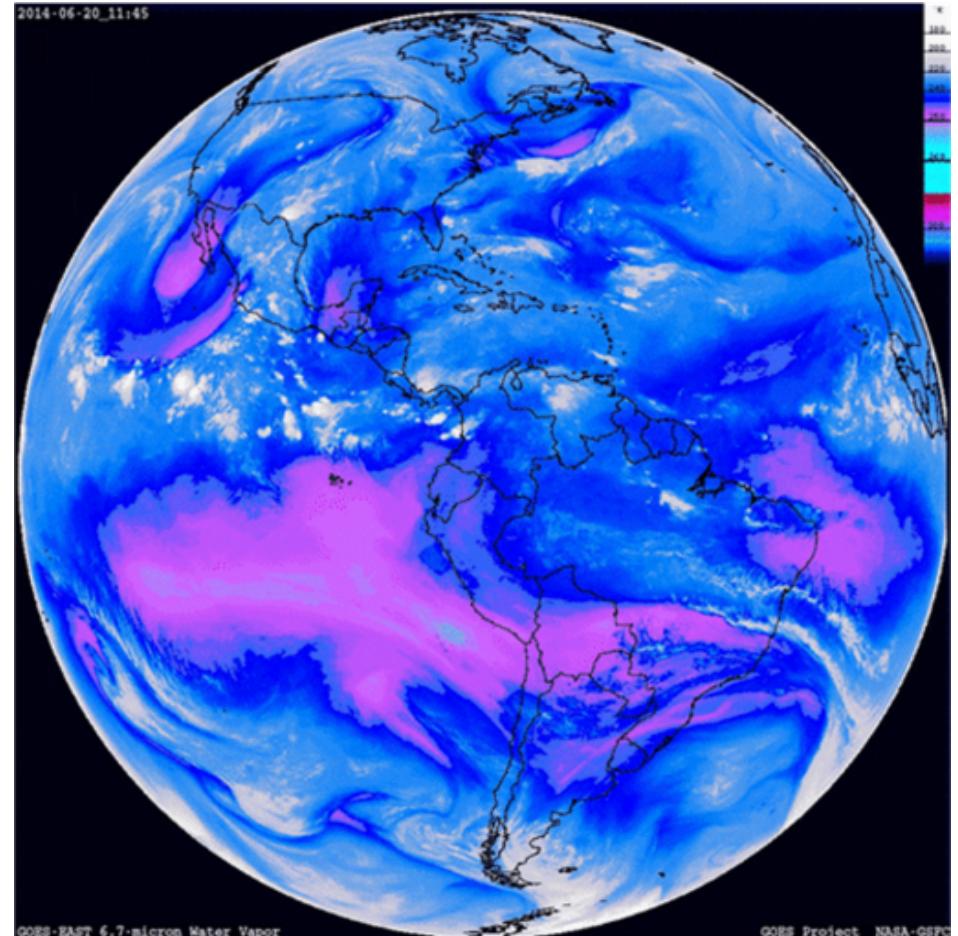


Biogeochemistry - Water

- Humans use 50% of accessible freshwater
 - 70% of that in agriculture!

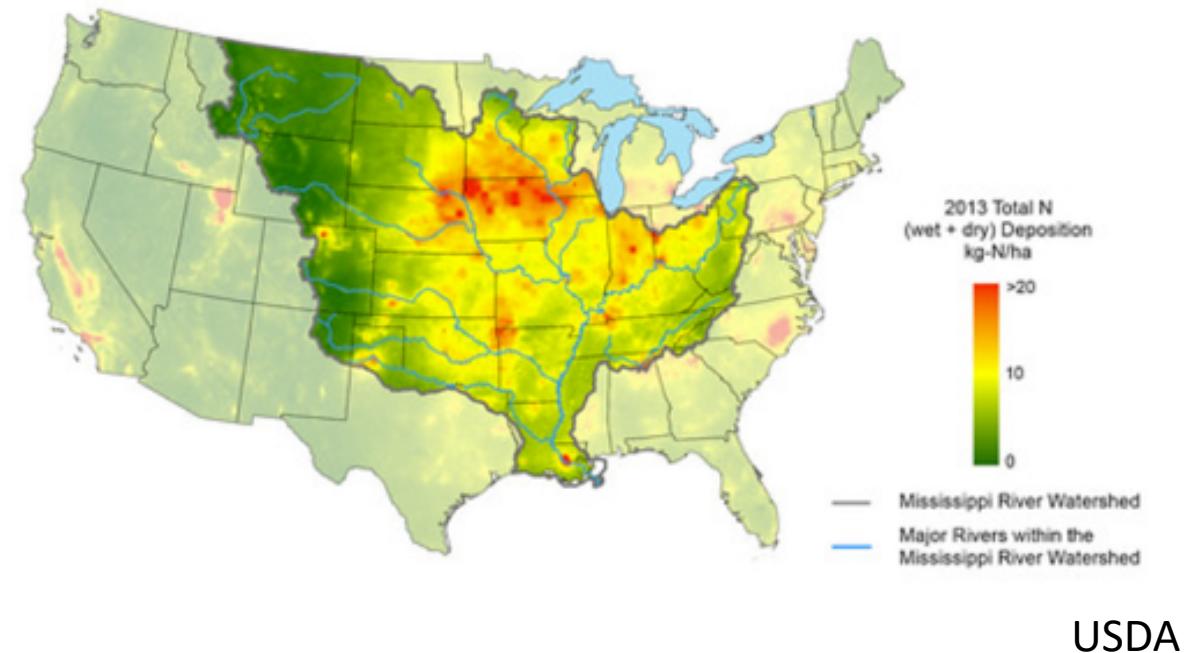
Biogeochemistry - Water

- Humans use 50% of accessible freshwater
 - 70% of that in agriculture!
- Water travels long distances
 - Water use can impact climate locally and far away



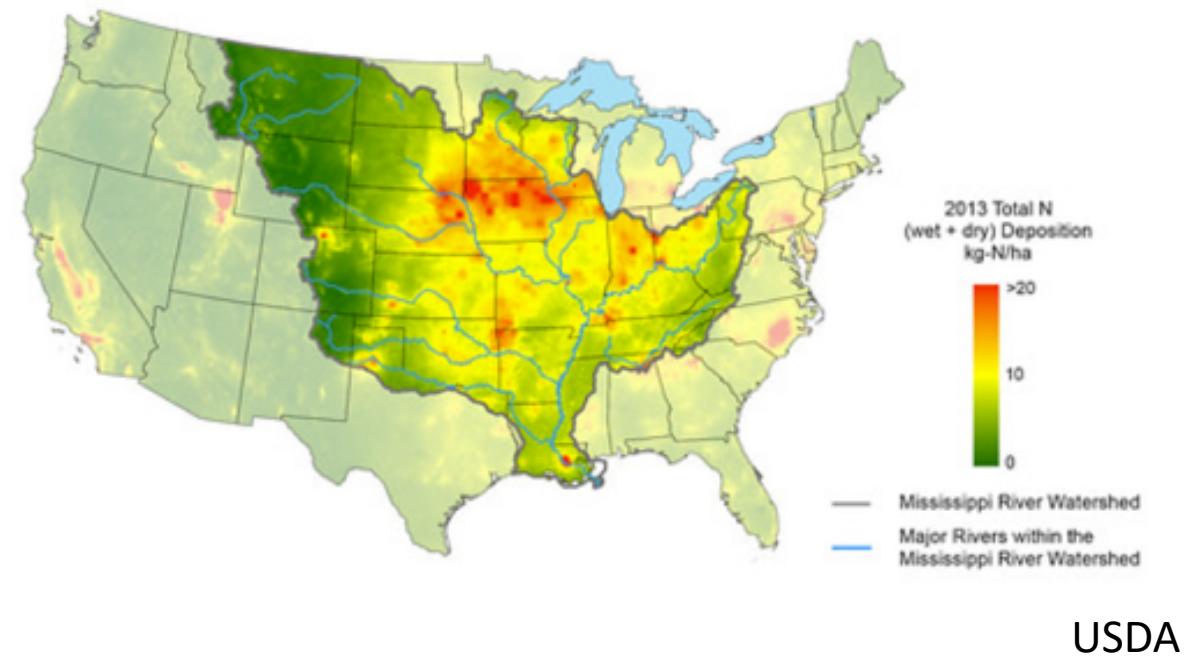
Biogeochemistry - Nitrogen

- Human activities add as much fixed N to terrestrial ecosystems as all natural sources combined!
 - Where does it come from?

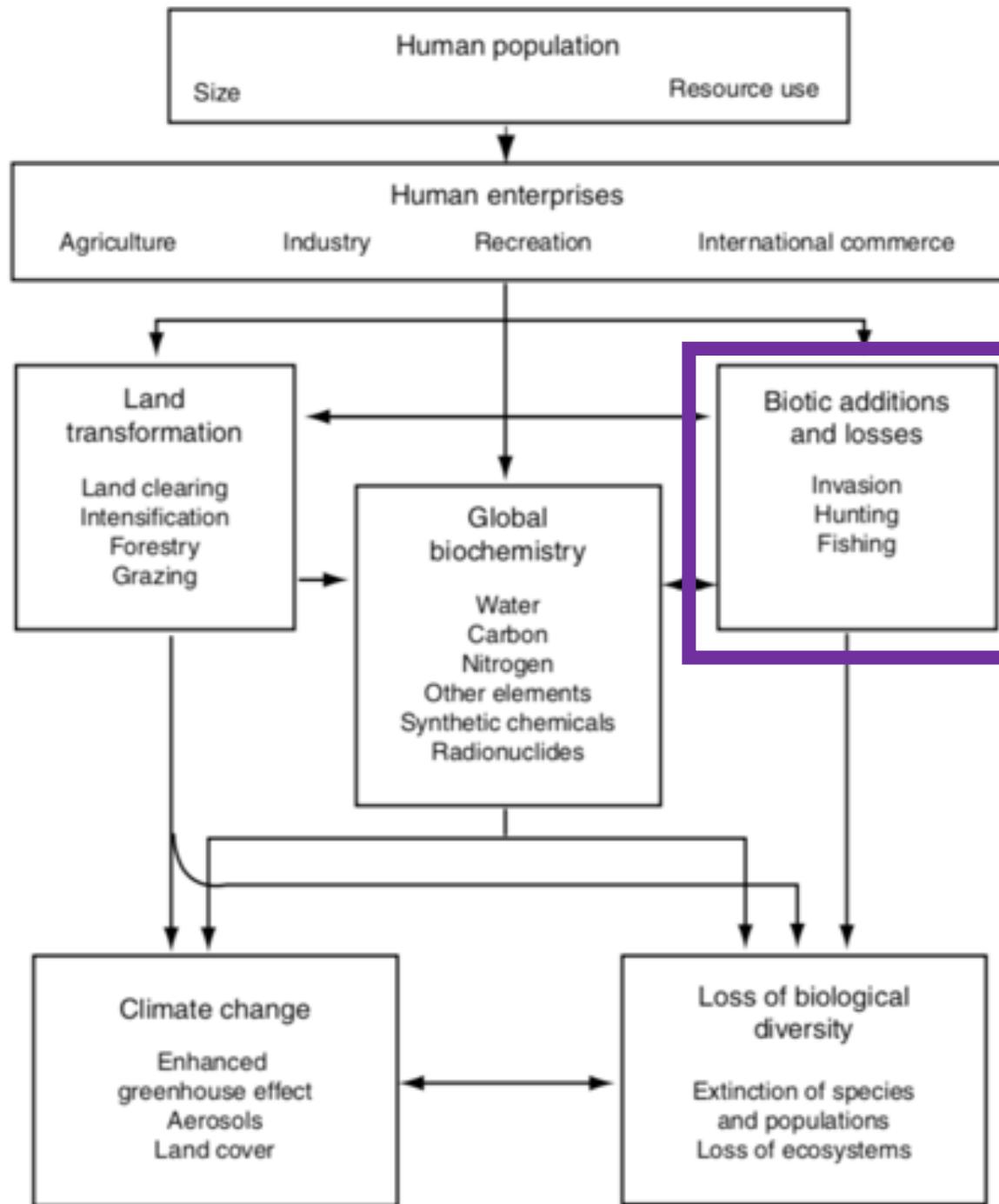


Biogeochemistry - Nitrogen

- Human activities add as much fixed N to terrestrial ecosystems as all natural sources combined!
 - Where does it come from?
- N saturation – not all N can be taken up
 - Where does it go?

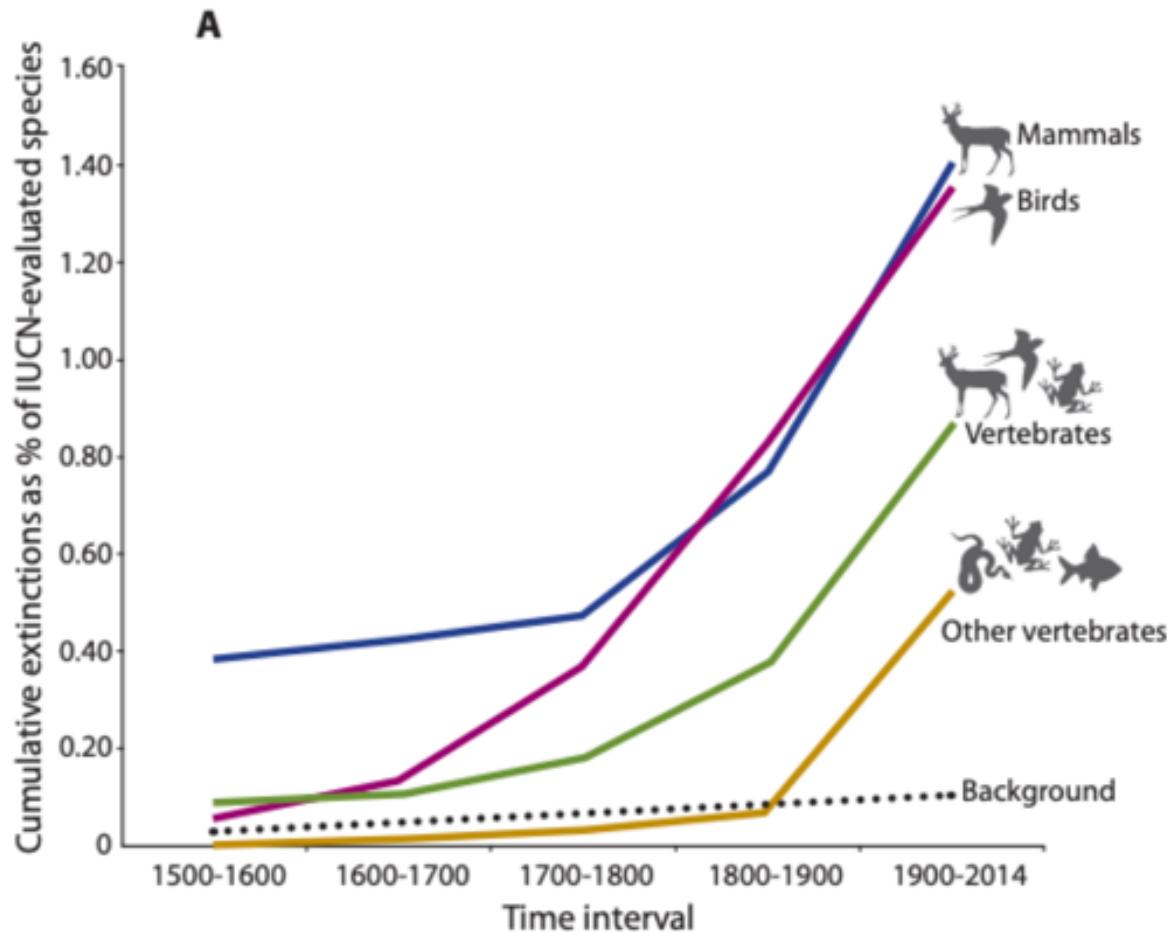


USDA



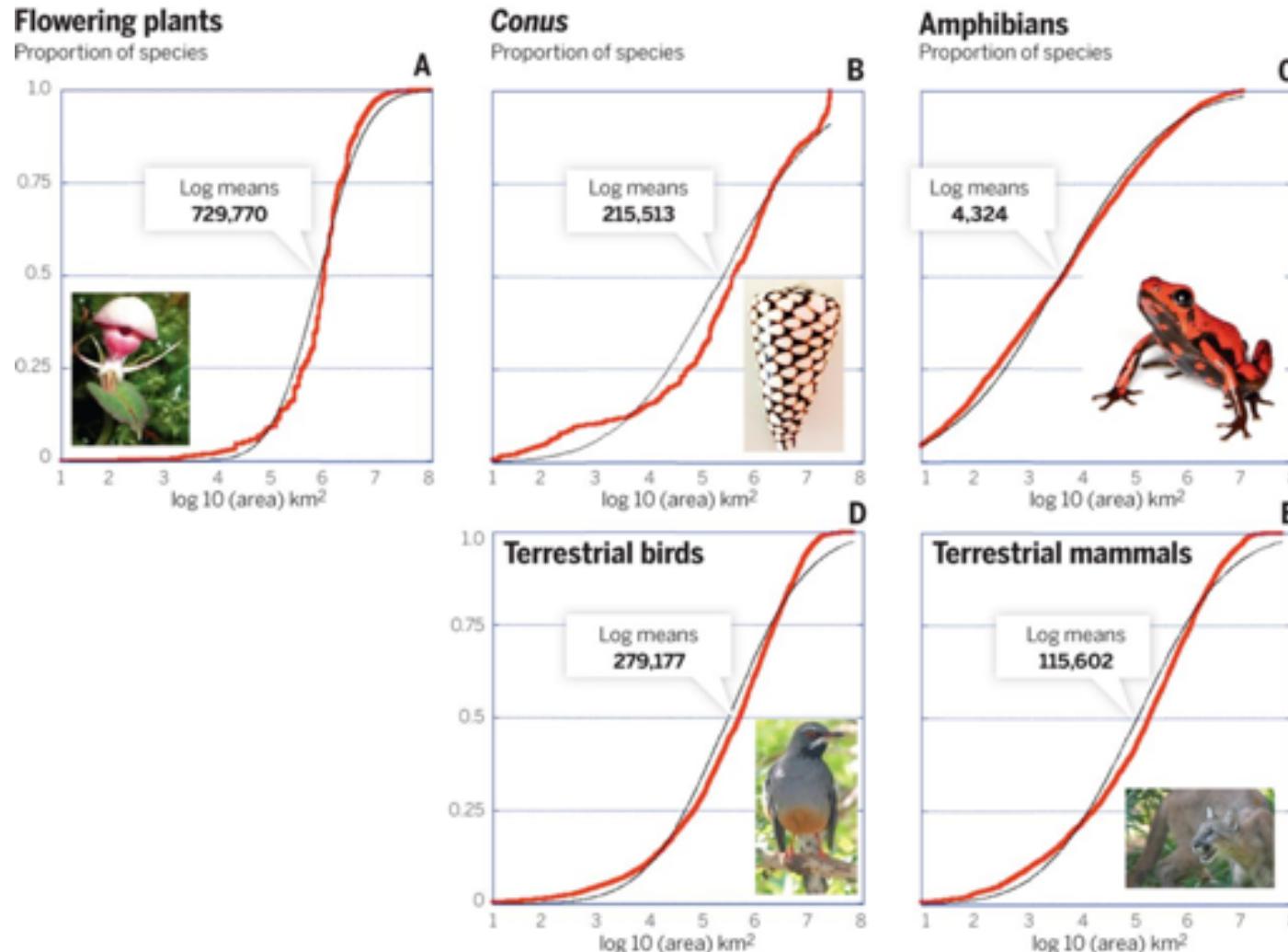
Direct and indirect impacts of humans on Earth's ecosystems

Biotic change – Species loss



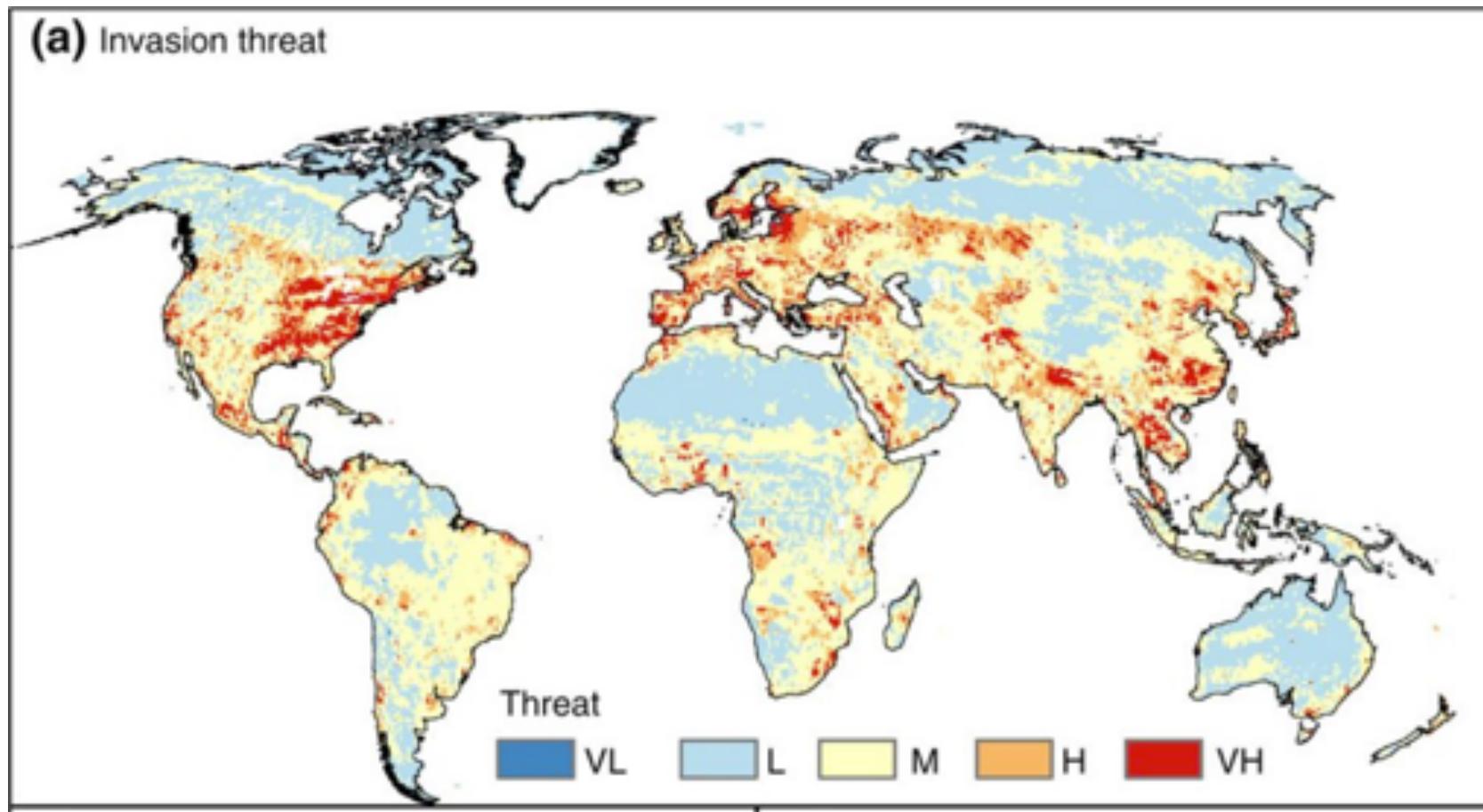
Percent of extinct species
(note the background rate)

Biotic Changes – Species Loss



The number of species increases with space

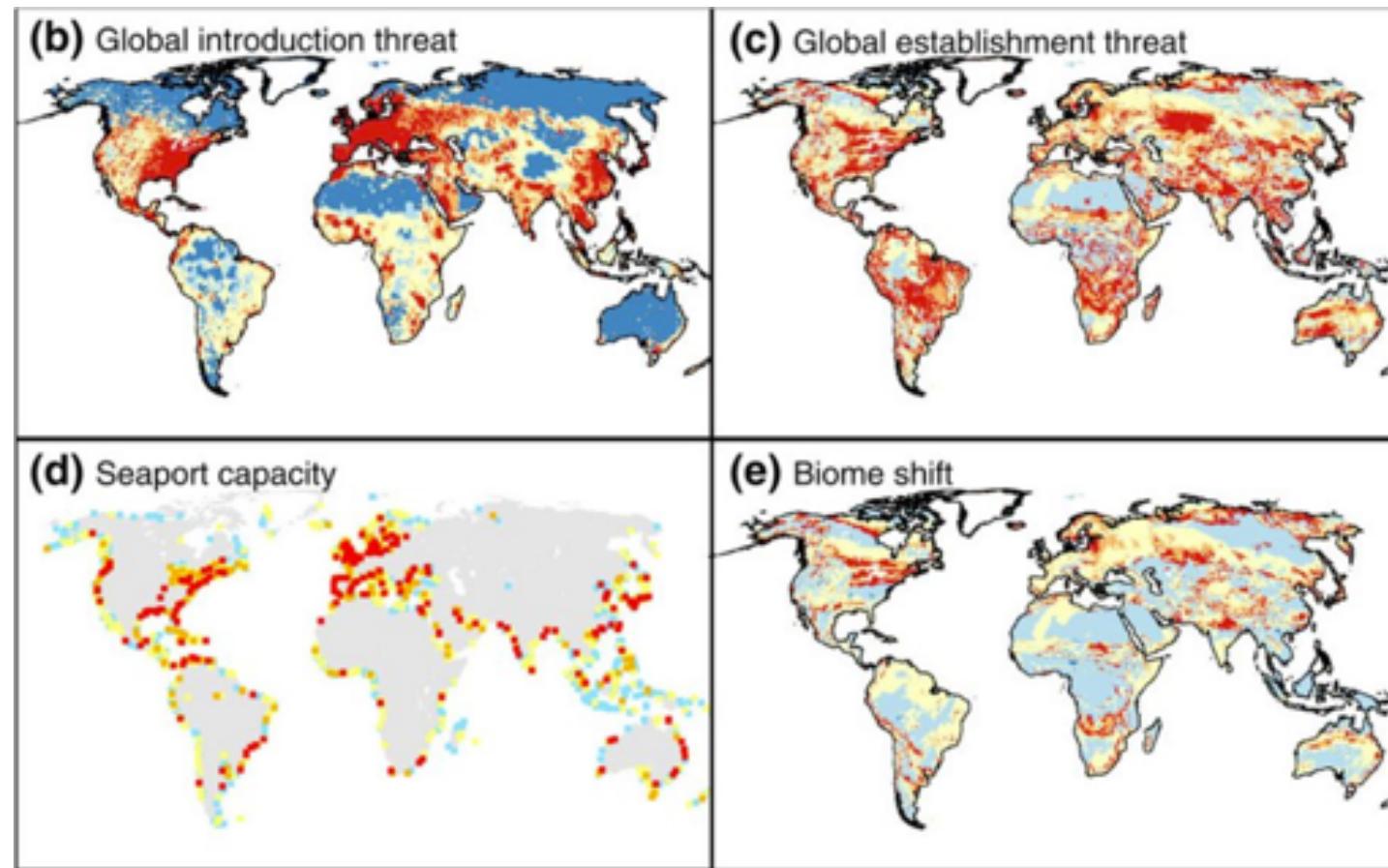
Biotic Changes - Invasion



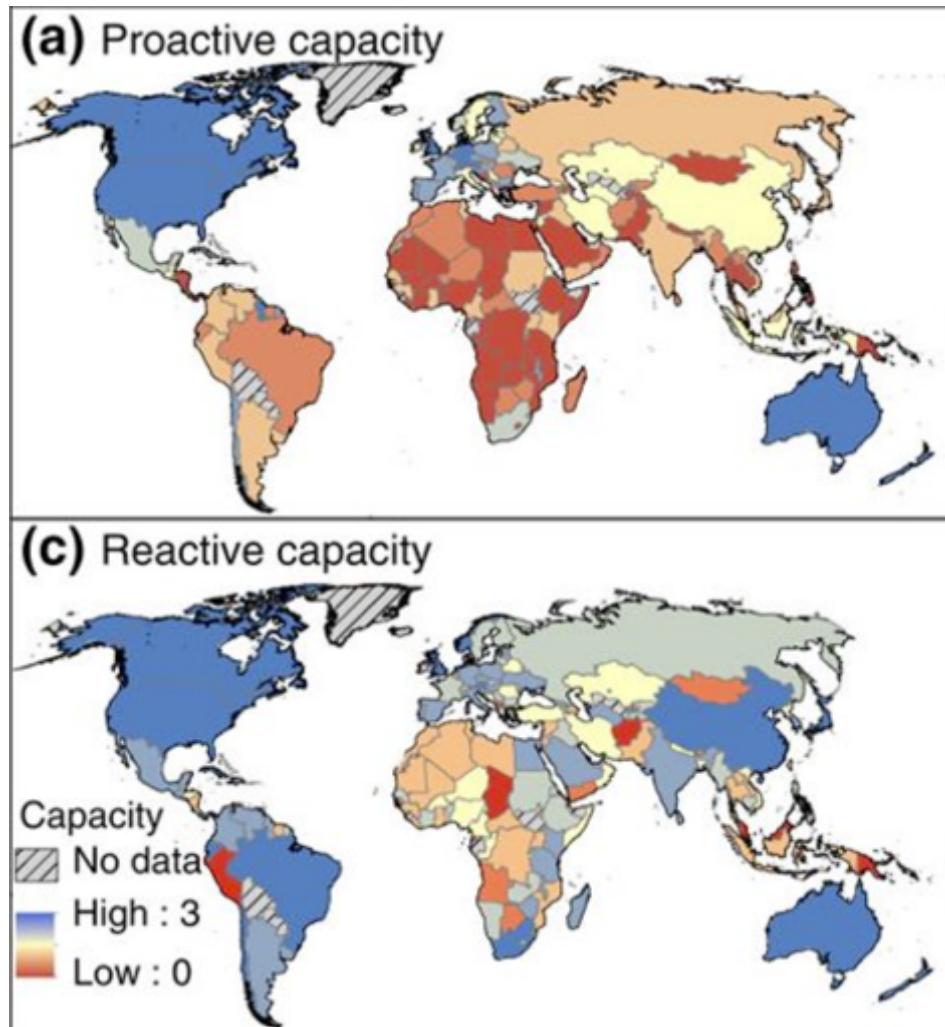
Invasive species are threatening all across the globe.

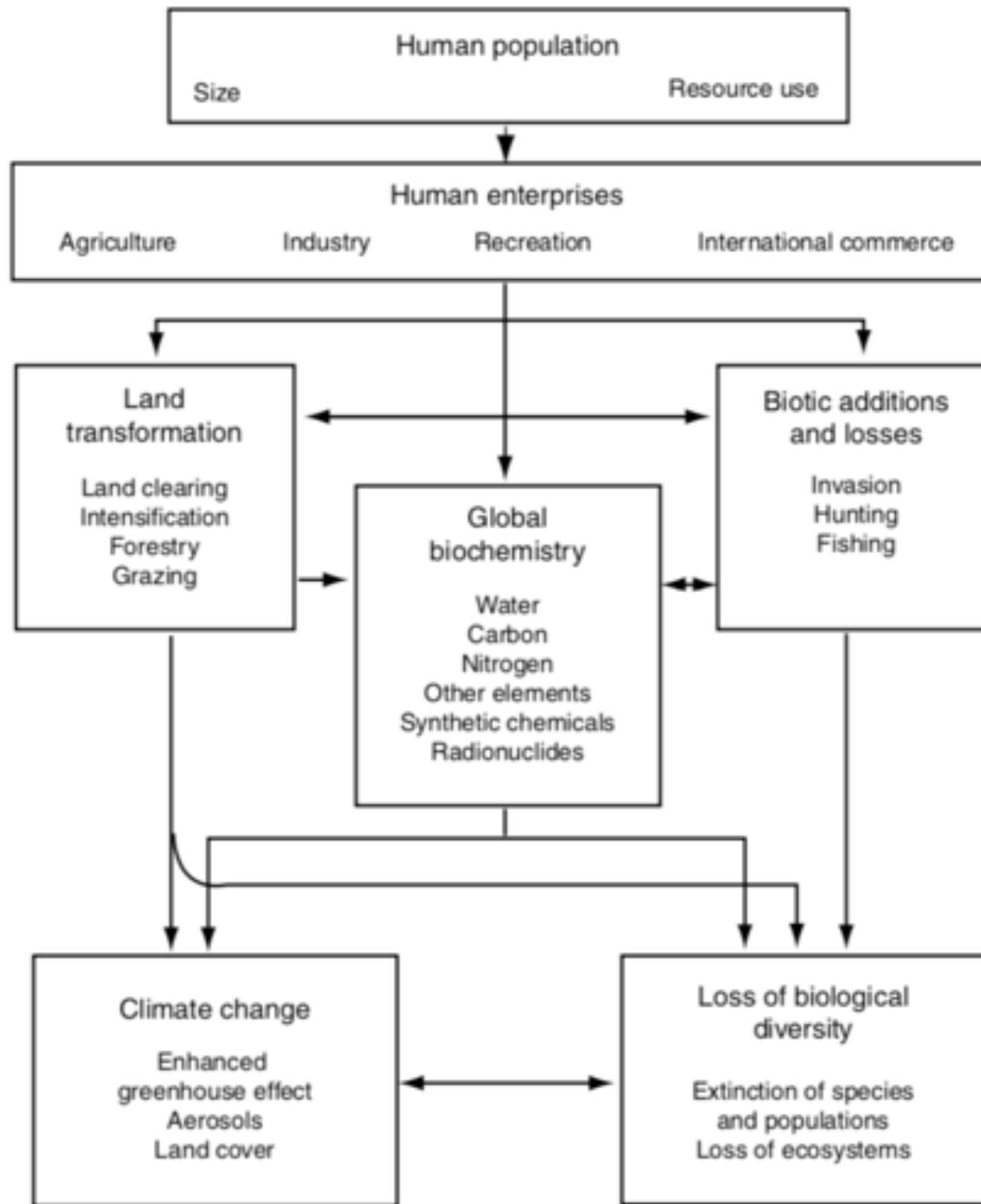
What might explain these patterns?

Biotic Changes - Invasion



Biotic Changes - Invasion



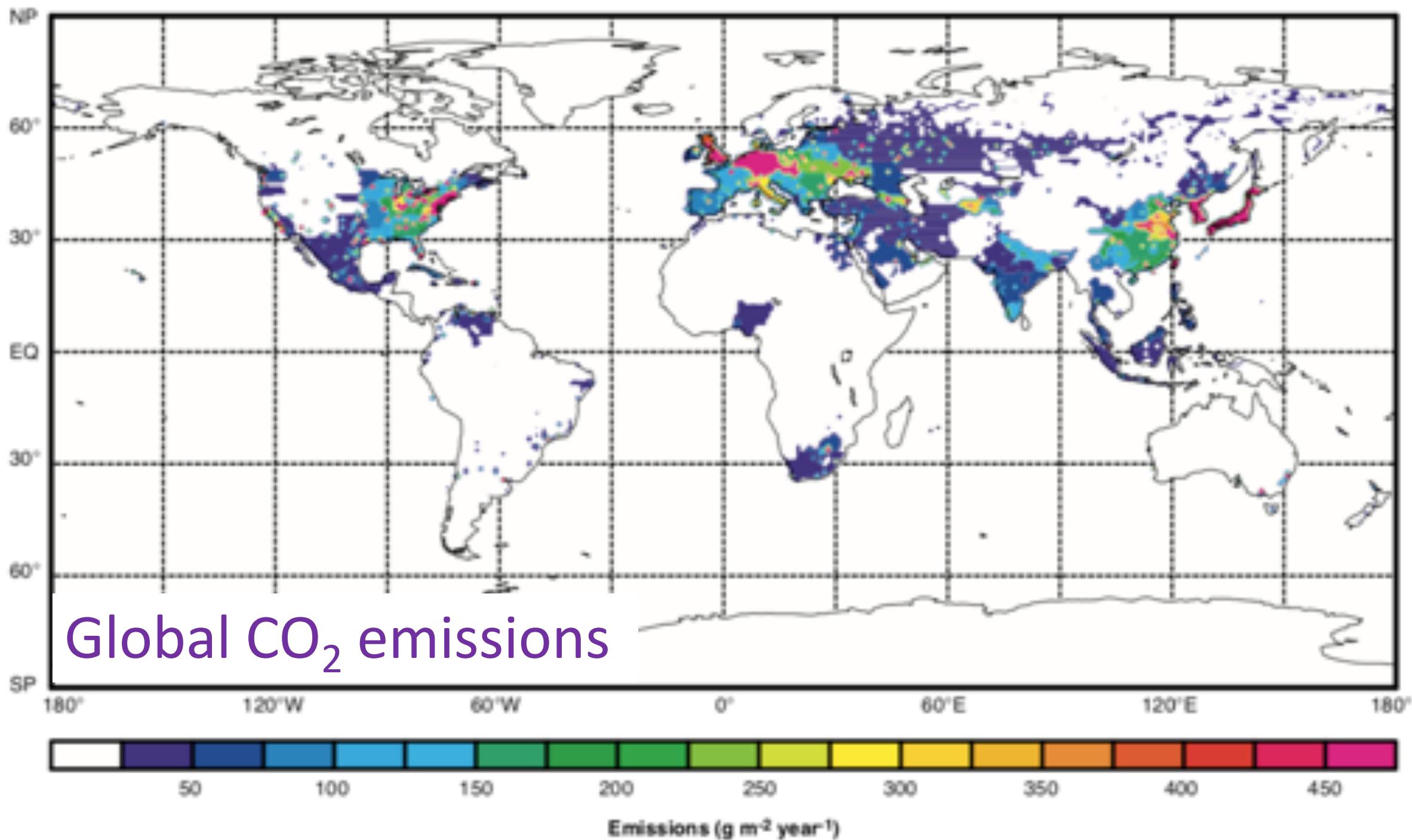


Direct and indirect impacts of humans on Earth's ecosystems

Anything missing??

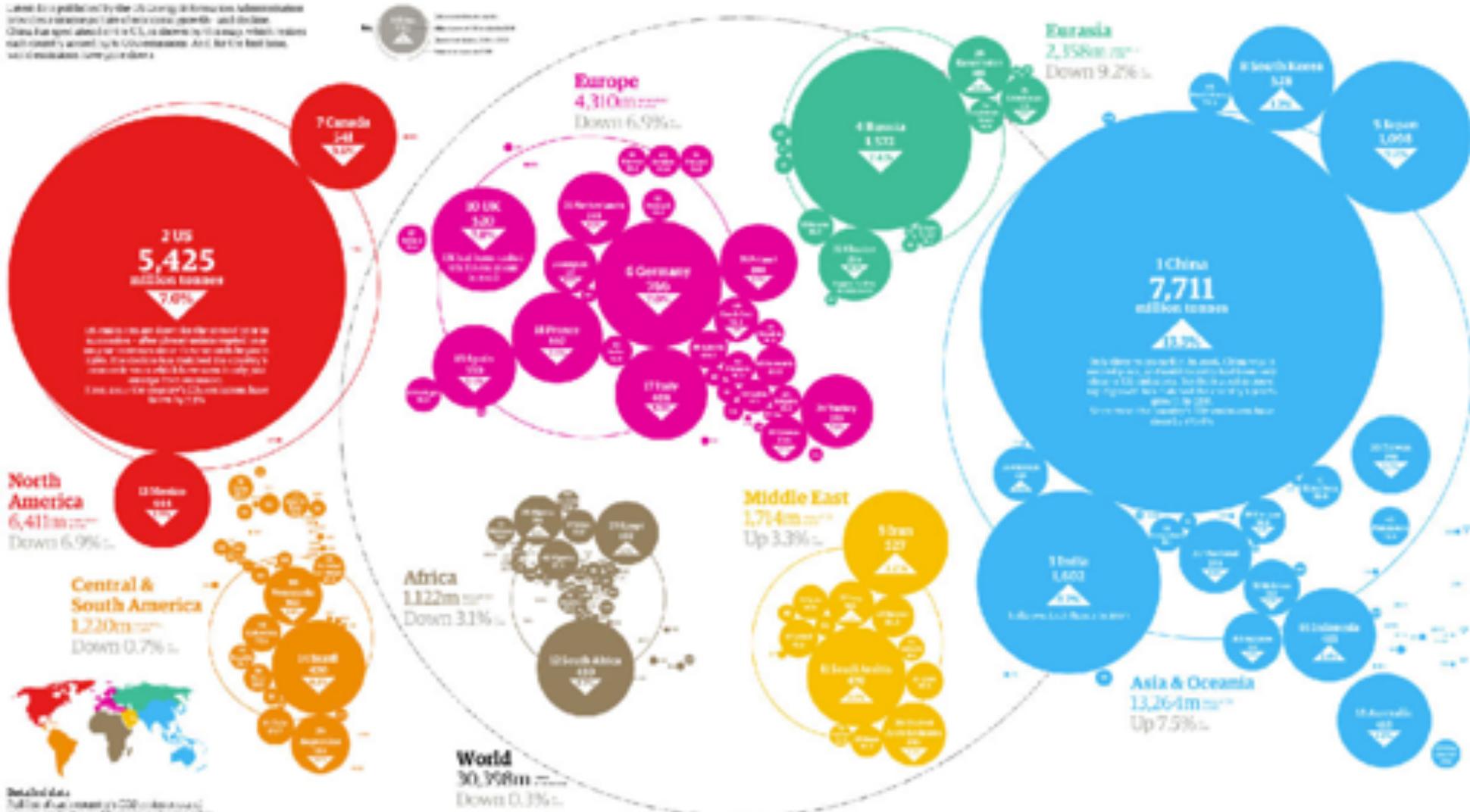
Some things to chat about

1. Who pays the cost?

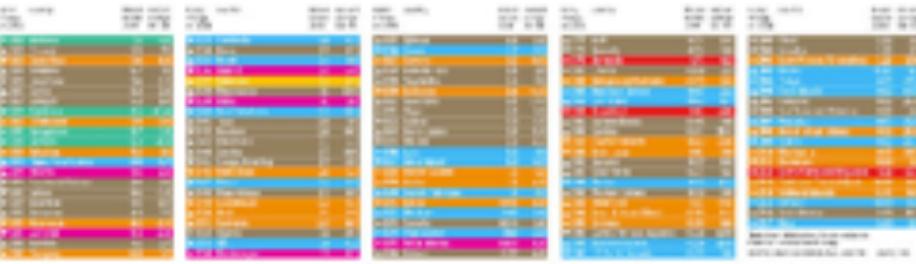
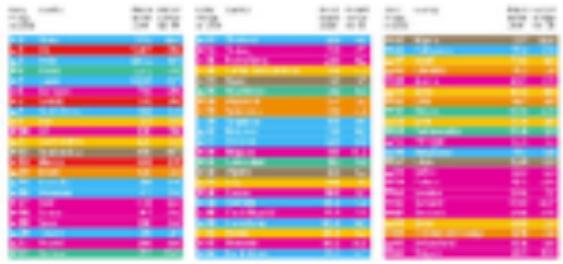


An atlas of pollution: the world in carbon dioxide emissions

Last data published by the US Energy Information Administration
and is a reference point for historical data, and the data
China has been added to in U.S. is derived by Chinese officials, unless
otherwise agreed by its governments. All data is the best available
and is subject to change.

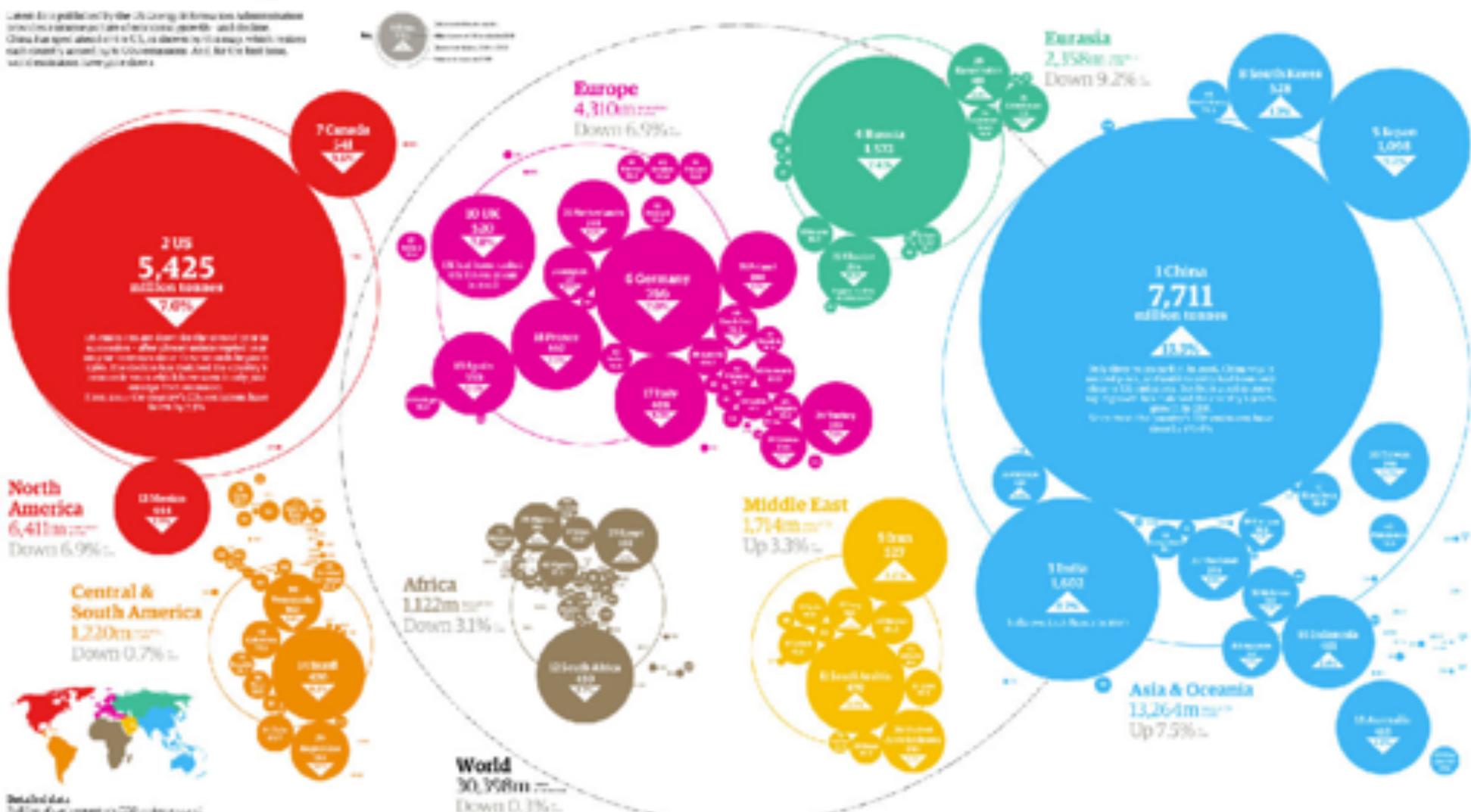


Detailed data
Full data can be found at www.guardian.co.uk/environment/globalpollution



An atlas of pollution: the world in carbon dioxide emissions

Latin America is a political priority for the US George W. Bush administration, which has established a number of new economic partnerships with the Andean states. China has spent about \$10 billion in U.S. oil interests by 2005, which makes each country's interest in Latin America clear. And, like the United States, China is interested in Latin American oil.



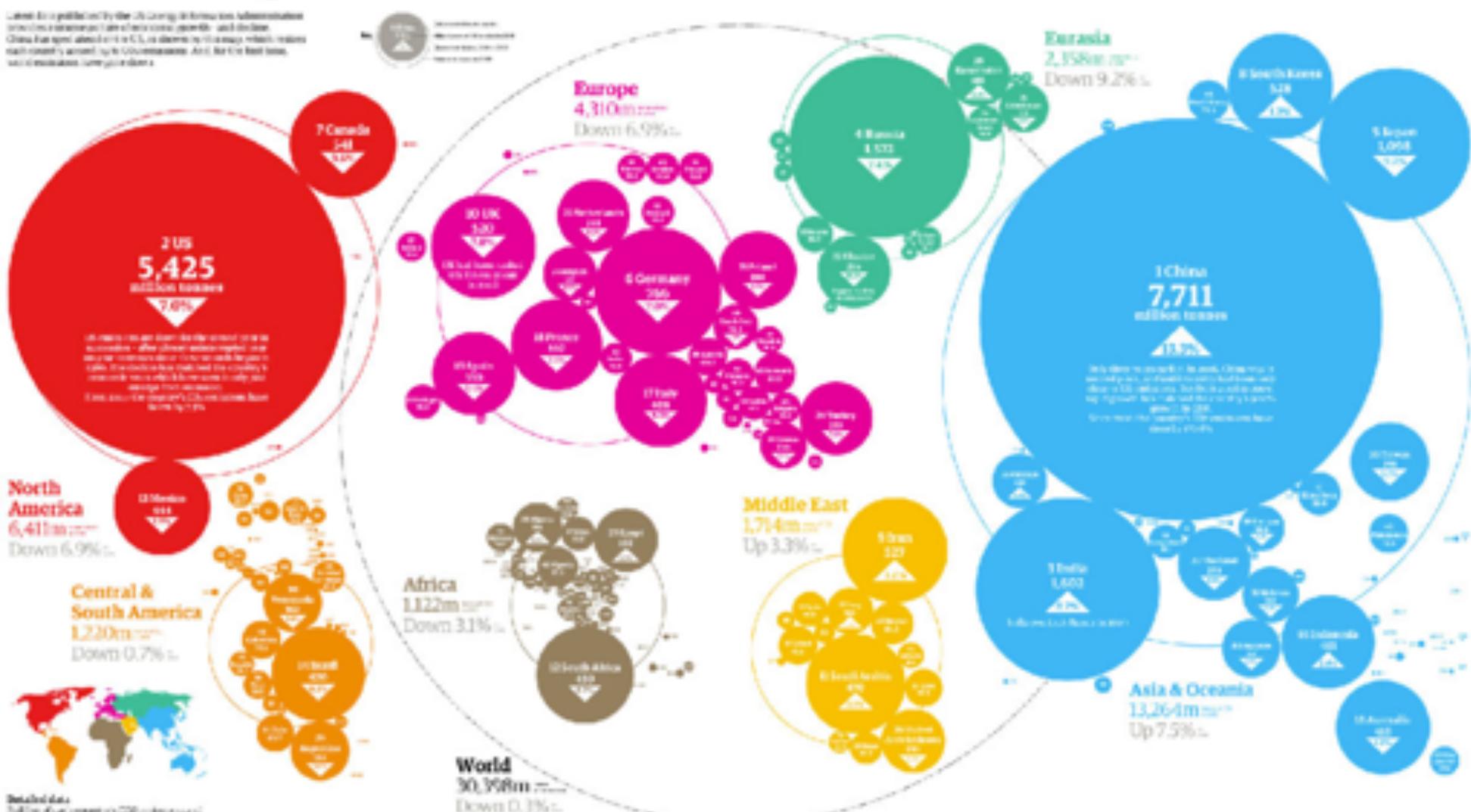
Are consequences paid by the perpetrators?

Rank	Team	Wins	Losses	Win %	GP	GF	GA	Dif	PPG	PPA	PP%	PPG Pct	PPA Pct	PP%	PPG Pct	PPA Pct	PP%	PPG Pct	PPA Pct	PP%
1	Montreal Canadiens	30	14	.682	64	337	250	87	2.10	1.00	.500	3.31	1.50	.469	3.31	1.50	.469	3.31	1.50	.469
2	Toronto Maple Leafs	28	16	.625	64	325	260	65	2.02	1.00	.500	3.19	1.48	.446	3.19	1.48	.446	3.19	1.48	.446
3	Edmonton Oilers	27	17	.609	64	320	265	55	2.00	1.00	.500	3.17	1.46	.429	3.17	1.46	.429	3.17	1.46	.429
4	Vancouver Canucks	26	18	.563	64	315	270	-5	2.00	1.00	.500	3.15	1.44	.417	3.15	1.44	.417	3.15	1.44	.417
5	Calgary Flames	25	19	.546	64	310	275	-65	2.00	1.00	.500	3.08	1.42	.406	3.08	1.42	.406	3.08	1.42	.406
6	St. Louis Blues	24	20	.531	64	305	280	-25	2.00	1.00	.500	3.03	1.40	.394	3.03	1.40	.394	3.03	1.40	.394
7	Phoenix Coyotes	23	21	.523	64	300	295	-5	2.00	1.00	.500	3.00	1.38	.381	3.00	1.38	.381	3.00	1.38	.381
8	San Jose Sharks	22	22	.500	64	295	300	-5	2.00	1.00	.500	2.95	1.36	.368	2.95	1.36	.368	2.95	1.36	.368
9	Chicago Blackhawks	21	23	.484	64	290	305	-15	2.00	1.00	.500	2.90	1.34	.357	2.90	1.34	.357	2.90	1.34	.357
10	Los Angeles Kings	20	24	.455	64	285	310	-25	2.00	1.00	.500	2.85	1.32	.346	2.85	1.32	.346	2.85	1.32	.346
11	Minnesota Wild	19	25	.441	64	280	315	-35	2.00	1.00	.500	2.80	1.30	.333	2.80	1.30	.333	2.80	1.30	.333
12	Philadelphia Flyers	18	26	.429	64	275	320	-45	2.00	1.00	.500	2.75	1.28	.322	2.75	1.28	.322	2.75	1.28	.322
13	Boston Bruins	17	27	.406	64	270	325	-55	2.00	1.00	.500	2.70	1.26	.311	2.70	1.26	.311	2.70	1.26	.311
14	New Jersey Devils	16	28	.357	64	265	330	-65	2.00	1.00	.500	2.65	1.24	.300	2.65	1.24	.300	2.65	1.24	.300
15	Carolina Hurricanes	15	29	.333	64	260	335	-75	2.00	1.00	.500	2.60	1.22	.289	2.60	1.22	.289	2.60	1.22	.289
16	Washington Capitals	14	30	.313	64	255	340	-85	2.00	1.00	.500	2.55	1.20	.278	2.55	1.20	.278	2.55	1.20	.278
17	New York Rangers	13	31	.292	64	250	345	-95	2.00	1.00	.500	2.50	1.18	.267	2.50	1.18	.267	2.50	1.18	.267
18	Nashville Predators	12	32	.281	64	245	350	-105	2.00	1.00	.500	2.45	1.16	.256	2.45	1.16	.256	2.45	1.16	.256
19	Colorado Avalanche	11	33	.265	64	240	355	-115	2.00	1.00	.500	2.40	1.14	.245	2.40	1.14	.245	2.40	1.14	.245
20	Ottawa Senators	10	34	.250	64	235	360	-125	2.00	1.00	.500	2.35	1.12	.234	2.35	1.12	.234	2.35	1.12	.234
21	Tampa Bay Lightning	9	35	.235	64	230	365	-135	2.00	1.00	.500	2.30	1.10	.223	2.30	1.10	.223	2.30	1.10	.223
22	Florida Panthers	8	36	.222	64	225	370	-145	2.00	1.00	.500	2.25	1.08	.212	2.25	1.08	.212	2.25	1.08	.212
23	Montreal Canadiens	7	37	.188	64	220	375	-155	2.00	1.00	.500	2.20	1.06	.201	2.20	1.06	.201	2.20	1.06	.201
24	Edmonton Oilers	6	38	.156	64	215	380	-165	2.00	1.00	.500	2.15	1.04	.190	2.15	1.04	.190	2.15	1.04	.190
25	Vancouver Canucks	5	39	.125	64	210	385	-175	2.00	1.00	.500	2.10	1.02	.179	2.10	1.02	.179	2.10	1.02	.179
26	Toronto Maple Leafs	4	40	.100	64	205	390	-185	2.00	1.00	.500	2.05	1.00	.168	2.05	1.00	.168	2.05	1.00	.168
27	Calgary Flames	3	41	.077	64	200	395	-195	2.00	1.00	.500	2.00	.98	.157	2.00	.98	.157	2.00	.98	.157
28	St. Louis Blues	2	42	.056	64	195	400	-205	2.00	1.00	.500	1.95	.96	.146	1.95	.96	.146	1.95	.96	.146
29	Phoenix Coyotes	1	43	.033	64	190	405	-215	2.00	1.00	.500	1.90	.94	.135	1.90	.94	.135	1.90	.94	.135
30	San Jose Sharks	0	44	.000	64	185	410	-225	2.00	1.00	.500	1.85	.92	.124	1.85	.92	.124	1.85	.92	.124

	2011	2010
Revenue	\$1.3 billion	\$1.2 billion
Net income	\$140 million	\$130 million
EPS	\$0.35	\$0.30
Dividends	\$0.10	\$0.08
EPS after dividends	\$0.25	\$0.22

An atlas of pollution: the world in carbon dioxide emissions

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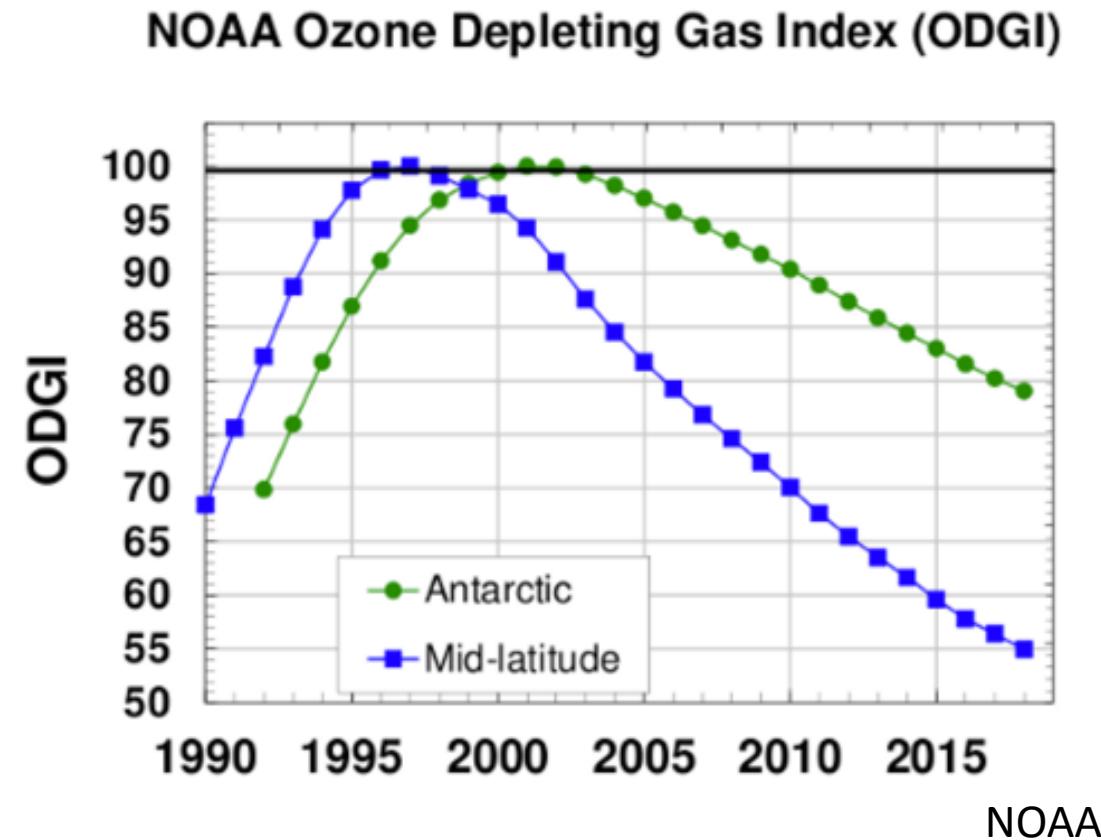


How should we regulate this?

Category	Value
Number of countries	10
Number of regions	10
Number of cities	10
Number of districts	10
Number of villages	10
Number of households	10
Number of individuals	10
Number of families	10
Number of households per family	10

Example of international cooperation: the Montreal Protocol

- 1990 protocol to stop use of chlorofluorocarbons (CFCs)
- CFCs deplete the ozone layer
- Banned CFCs
 - By 2000 in developed countries
 - By 2010 in non-developed countries



2. What would the world look like without humans?



“There is no clearer illustration of the extent of human dominance of Earth than the fact that maintaining diversity of “wild” species and the functioning of “wild” ecosystems will require increasing human involvement”