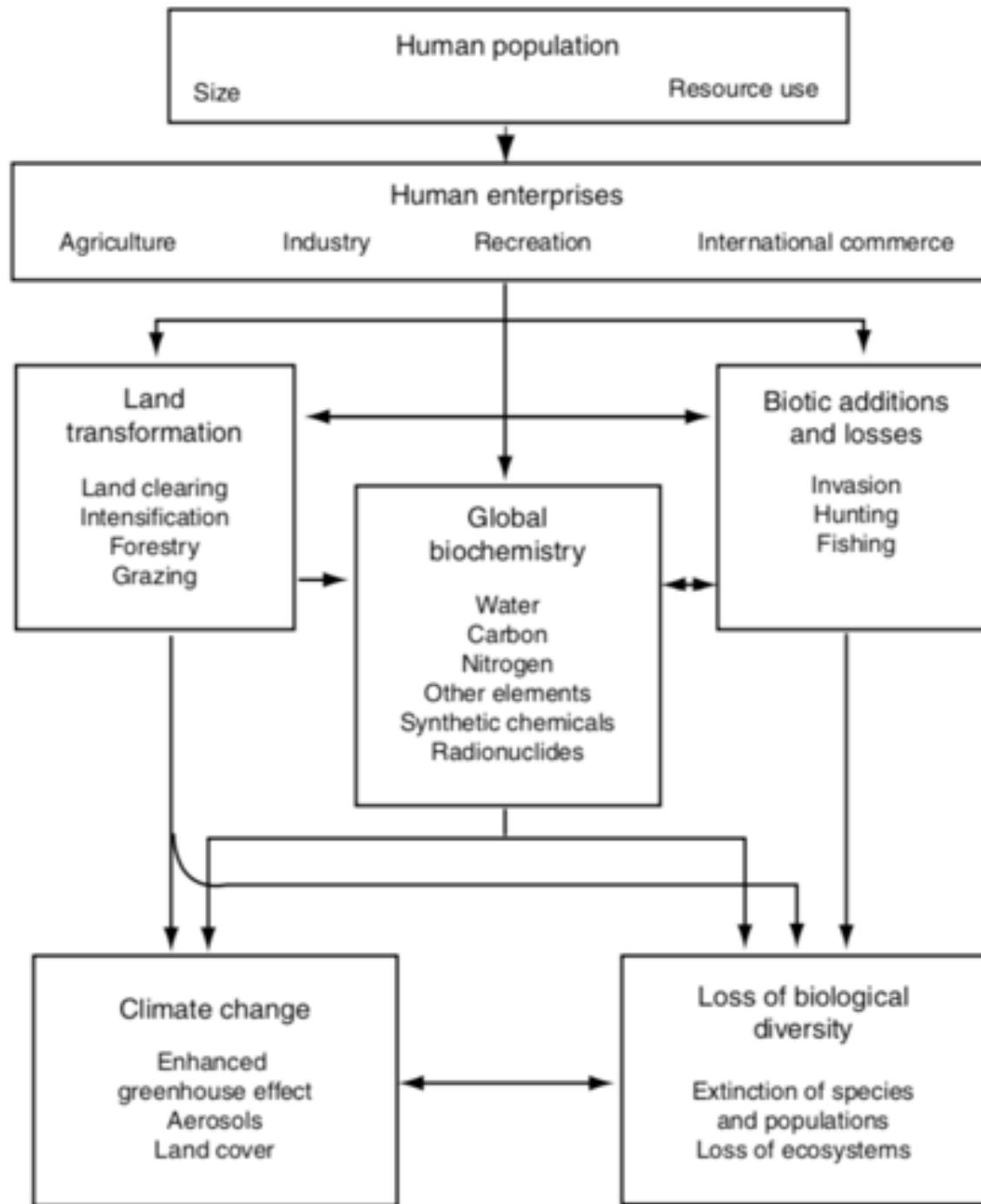


# Human Domination of Earth's Ecosystems

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

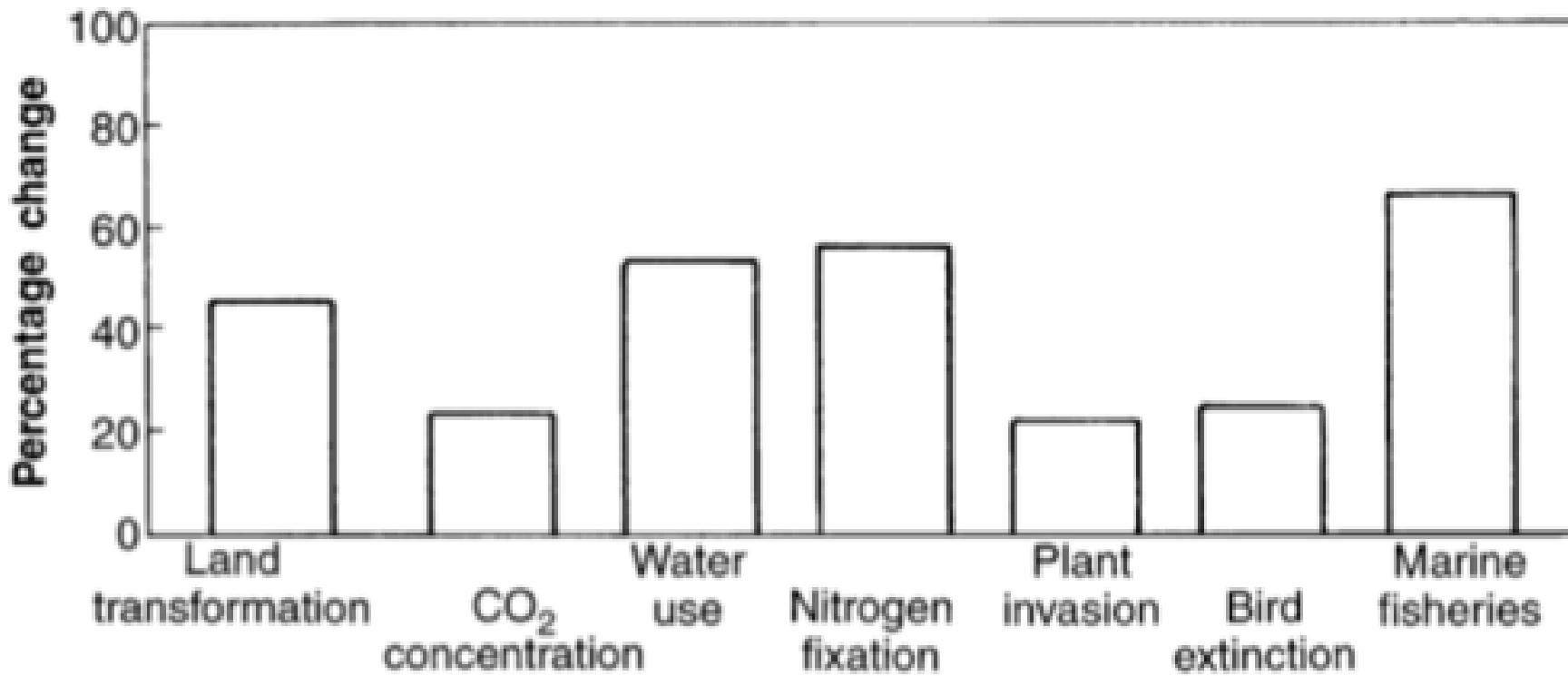
September 5, 2019



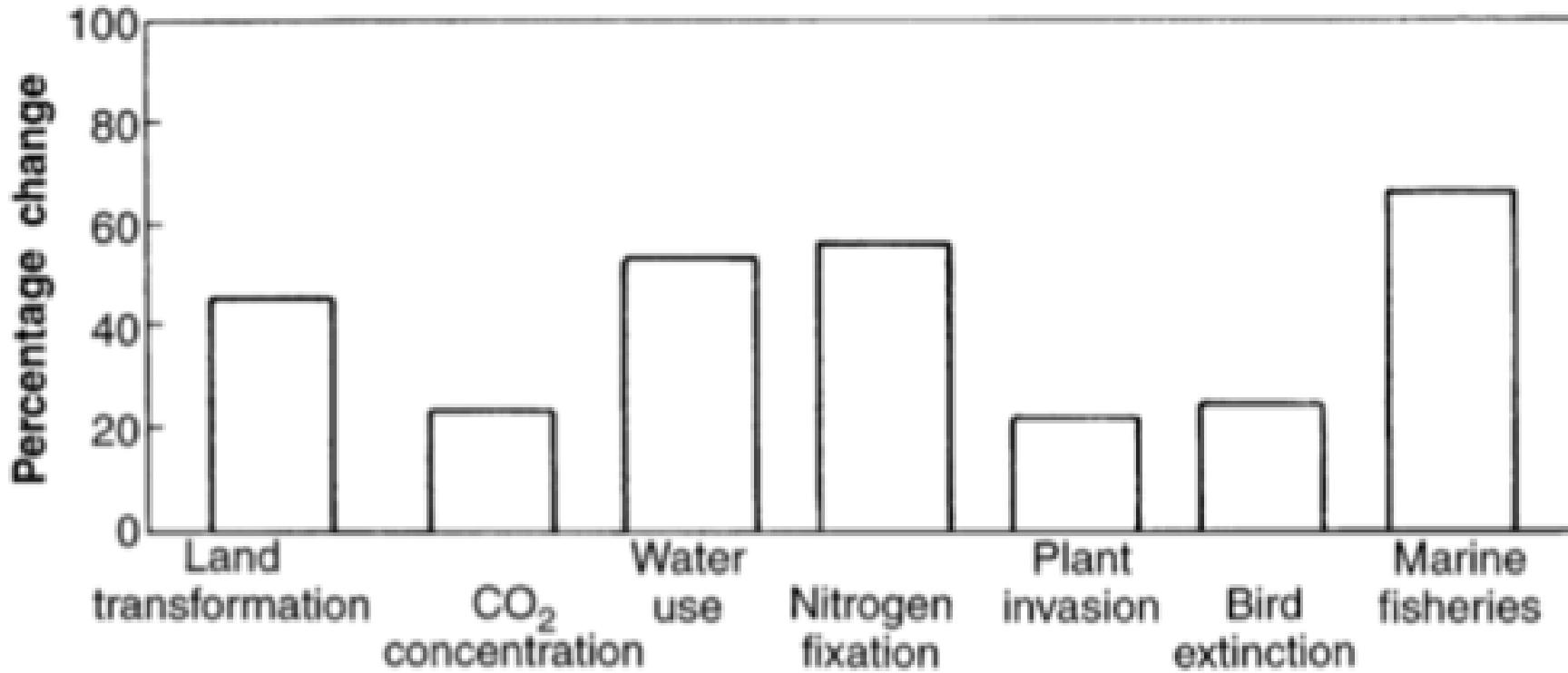


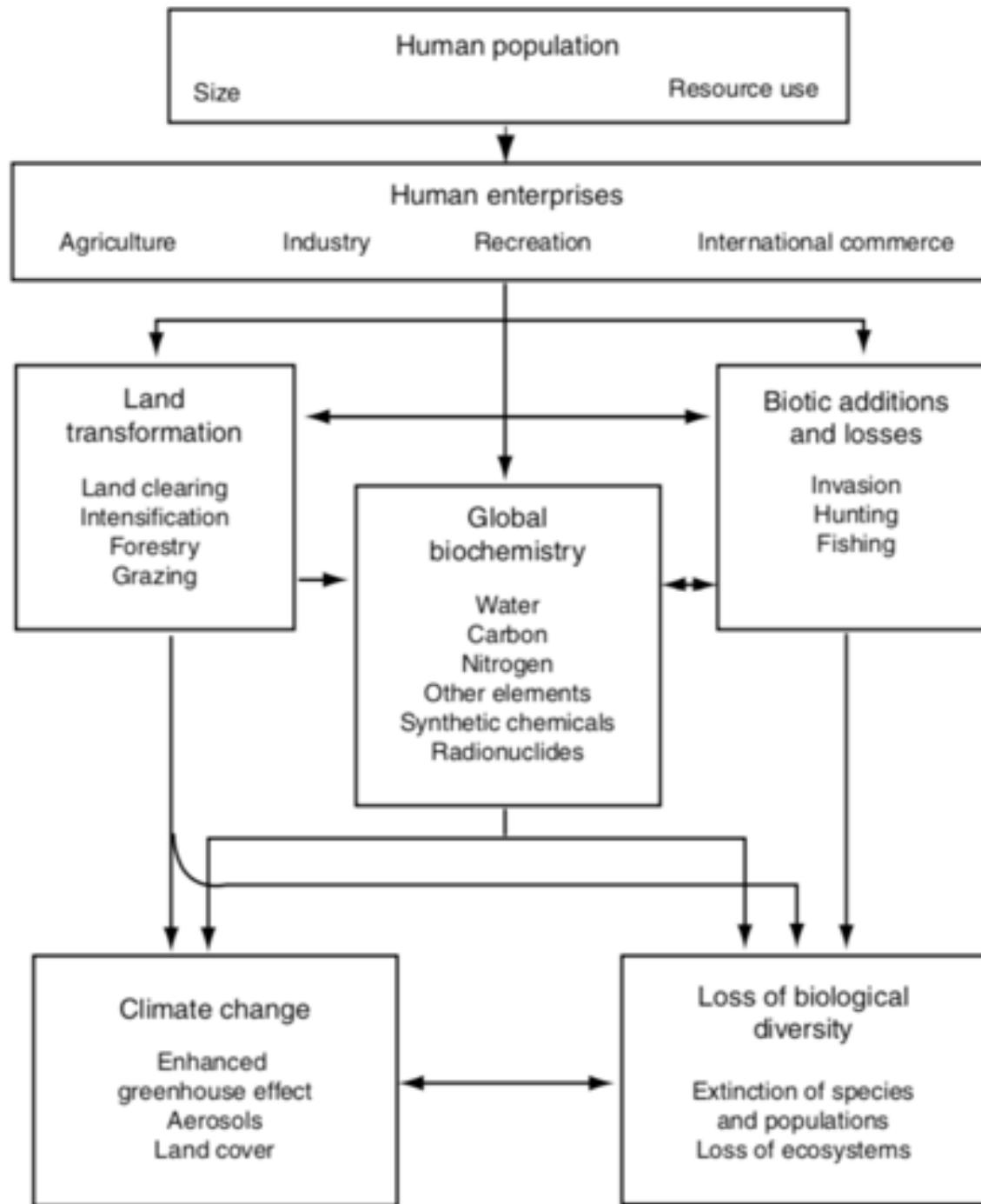
# Direct and indirect impacts of humans on Earth's ecosystems

# Human impact is not insignificant

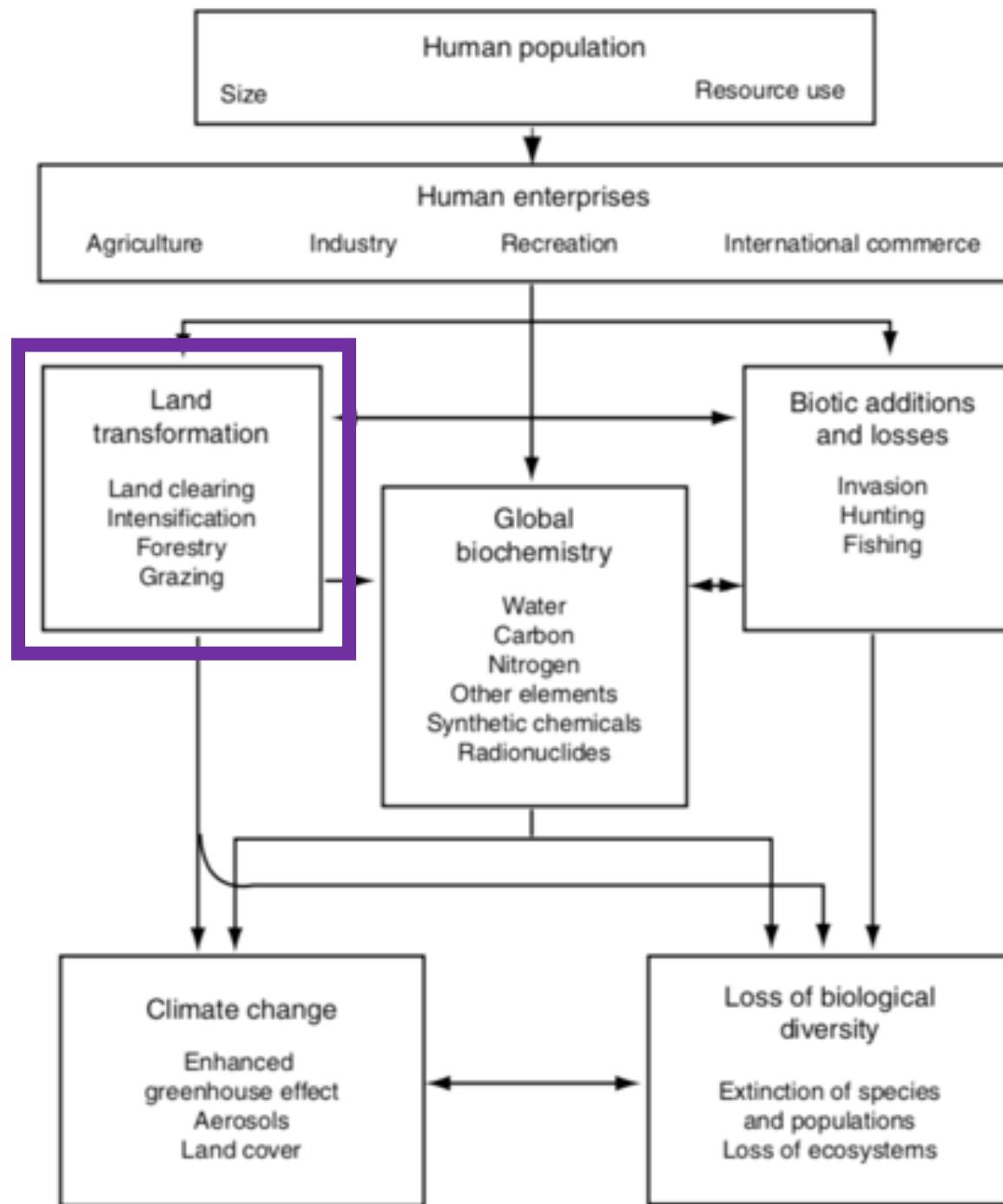


Were any of the facts presented particularly surprising??





# Direct and indirect impacts of humans on Earth's ecosystems



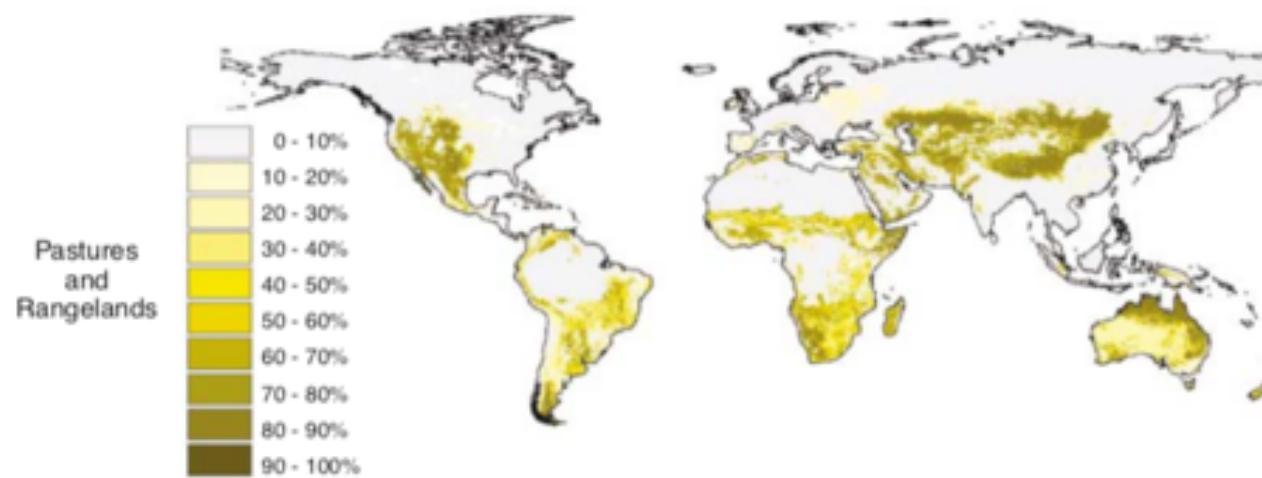
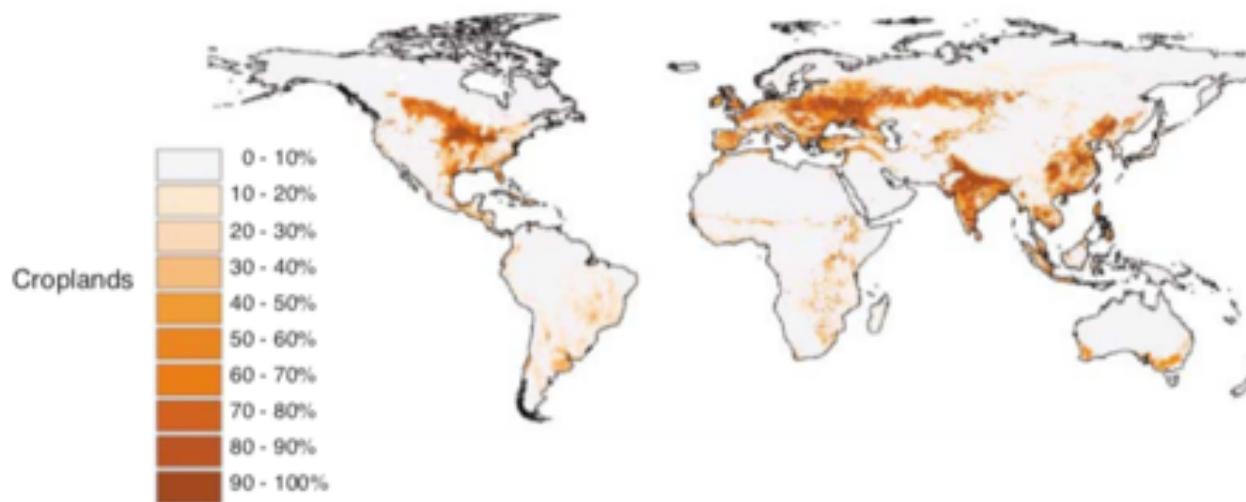
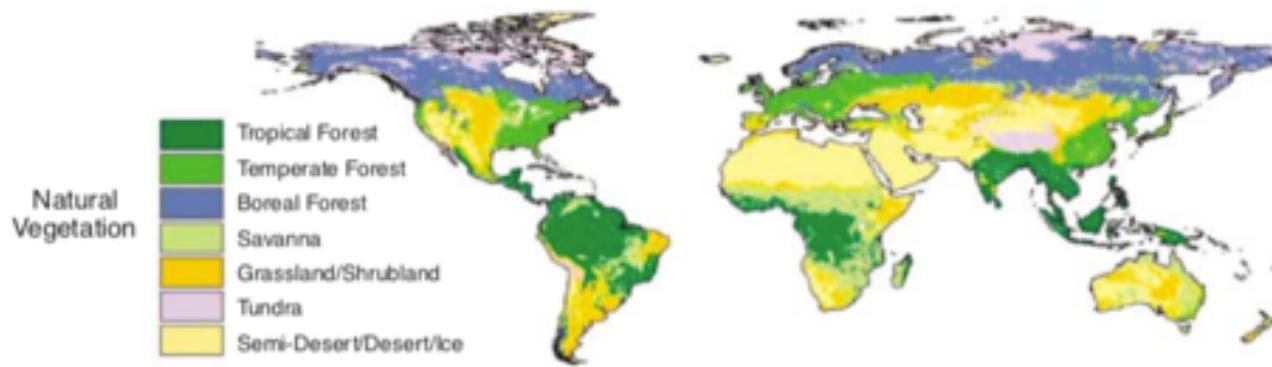
# Direct and indirect impacts of humans on Earth's ecosystems

# Land transformation

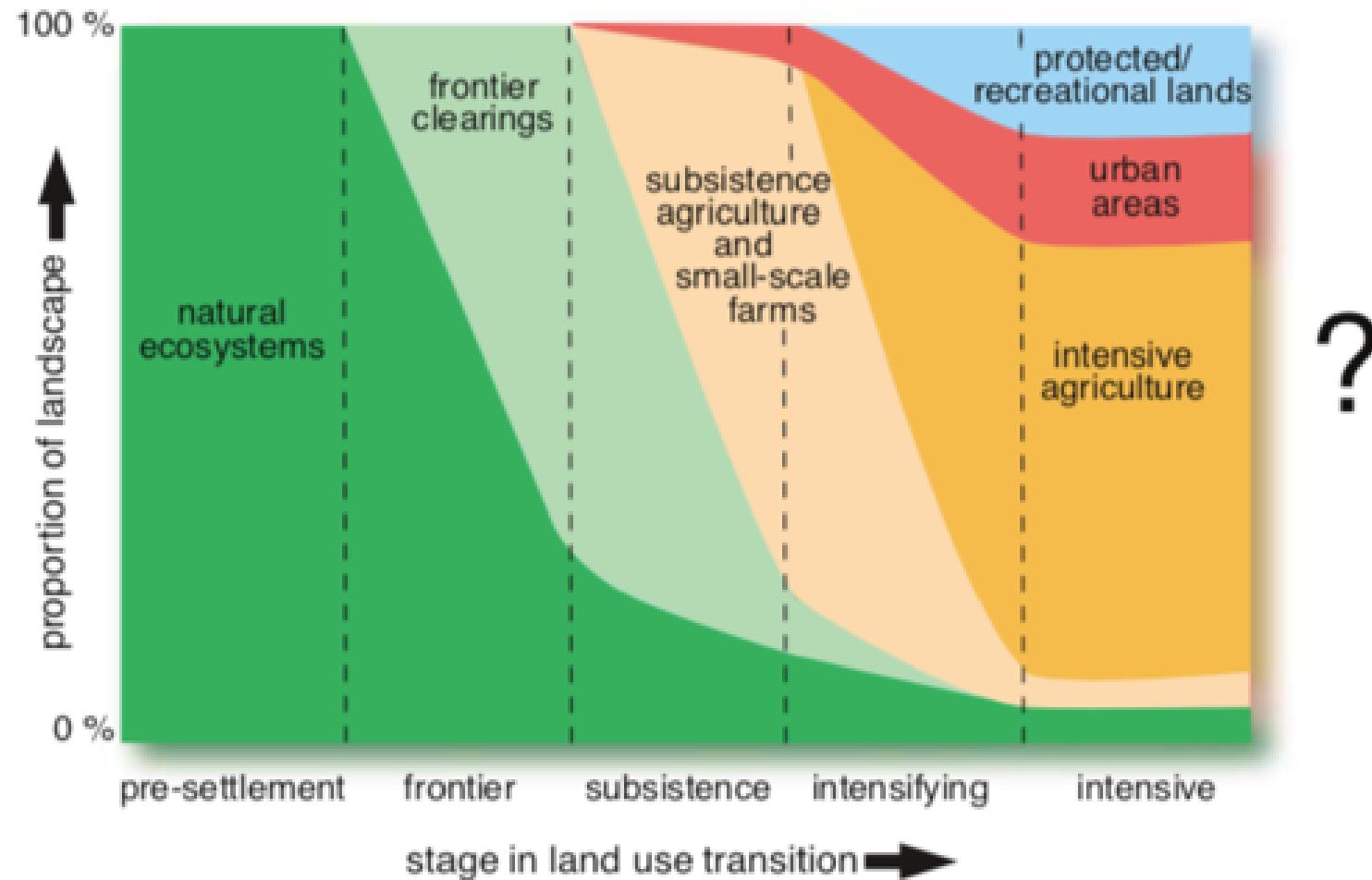
- Nearly 50% of all land has been transformed by humans
- Primary driver of species loss
- 20% of all CO<sub>2</sub> emissions

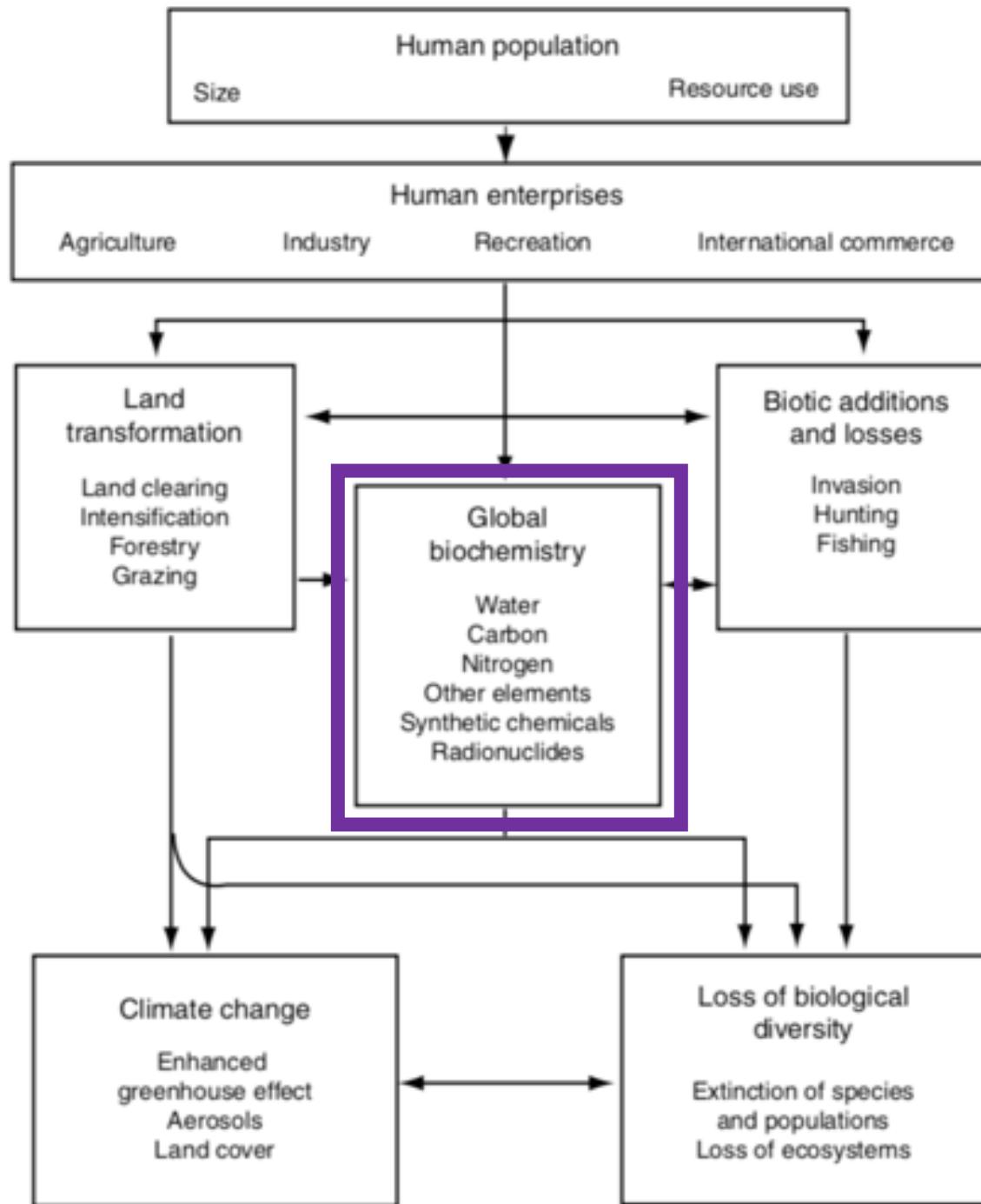


Border between Haiti (left) and Dominican Republic (right)



# Progressive land transformation (Foley et al. 2005)

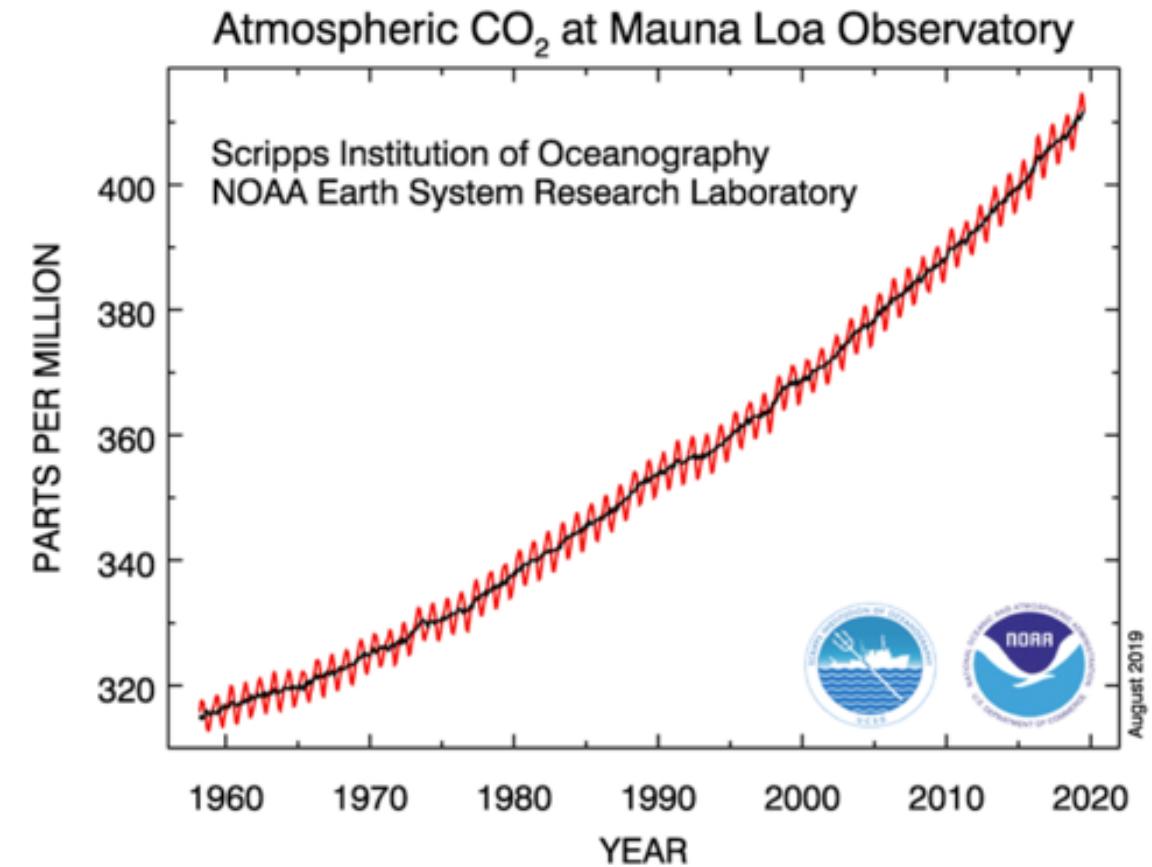




# Direct and indirect impacts of humans on Earth's ecosystems

# 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

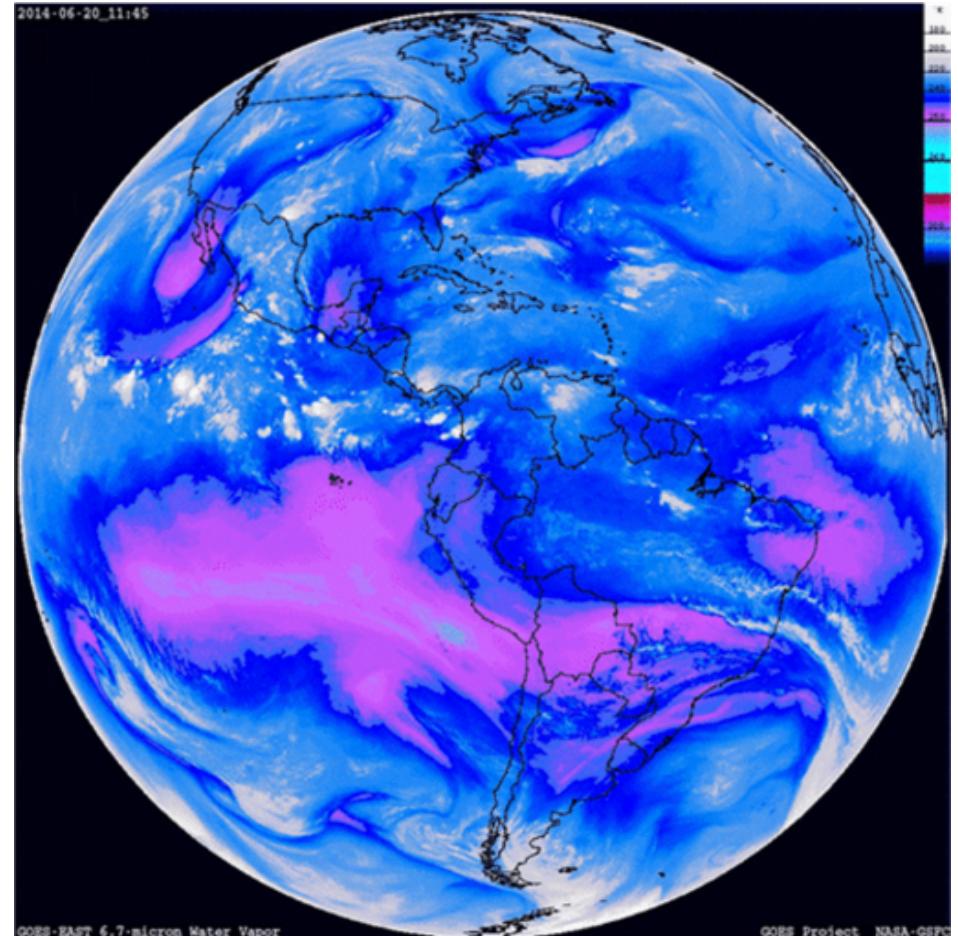


# Biogeochemistry - Water

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

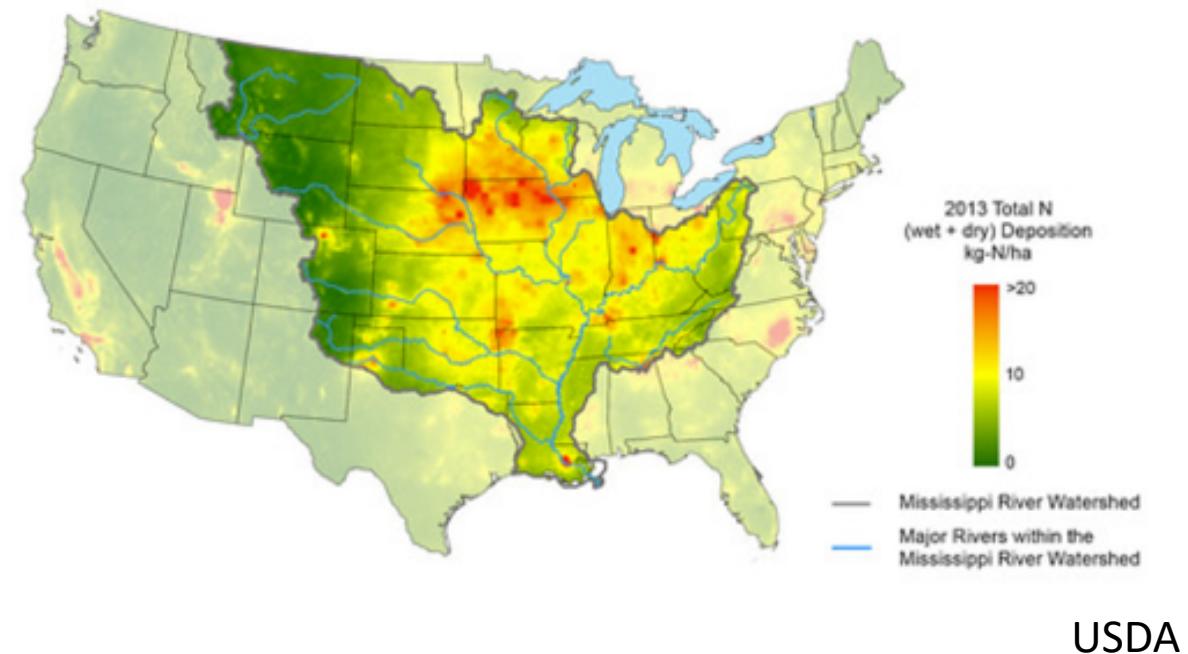
# Biogeochemistry - Water

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



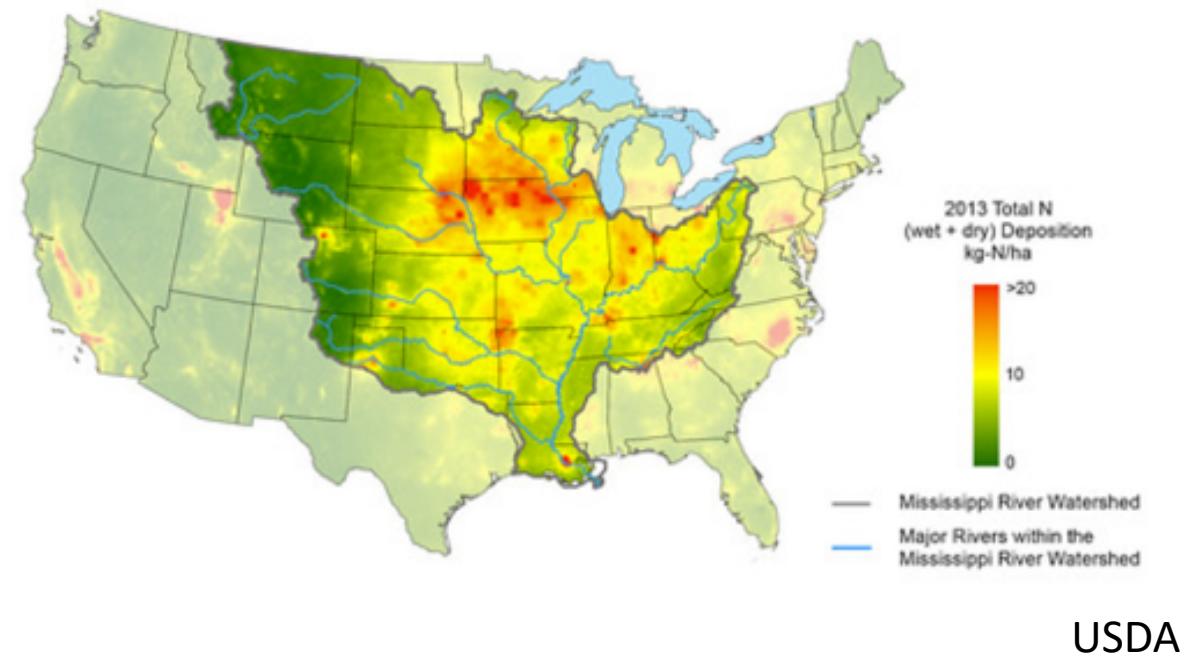
# Biogeochemistry - Nitrogen

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

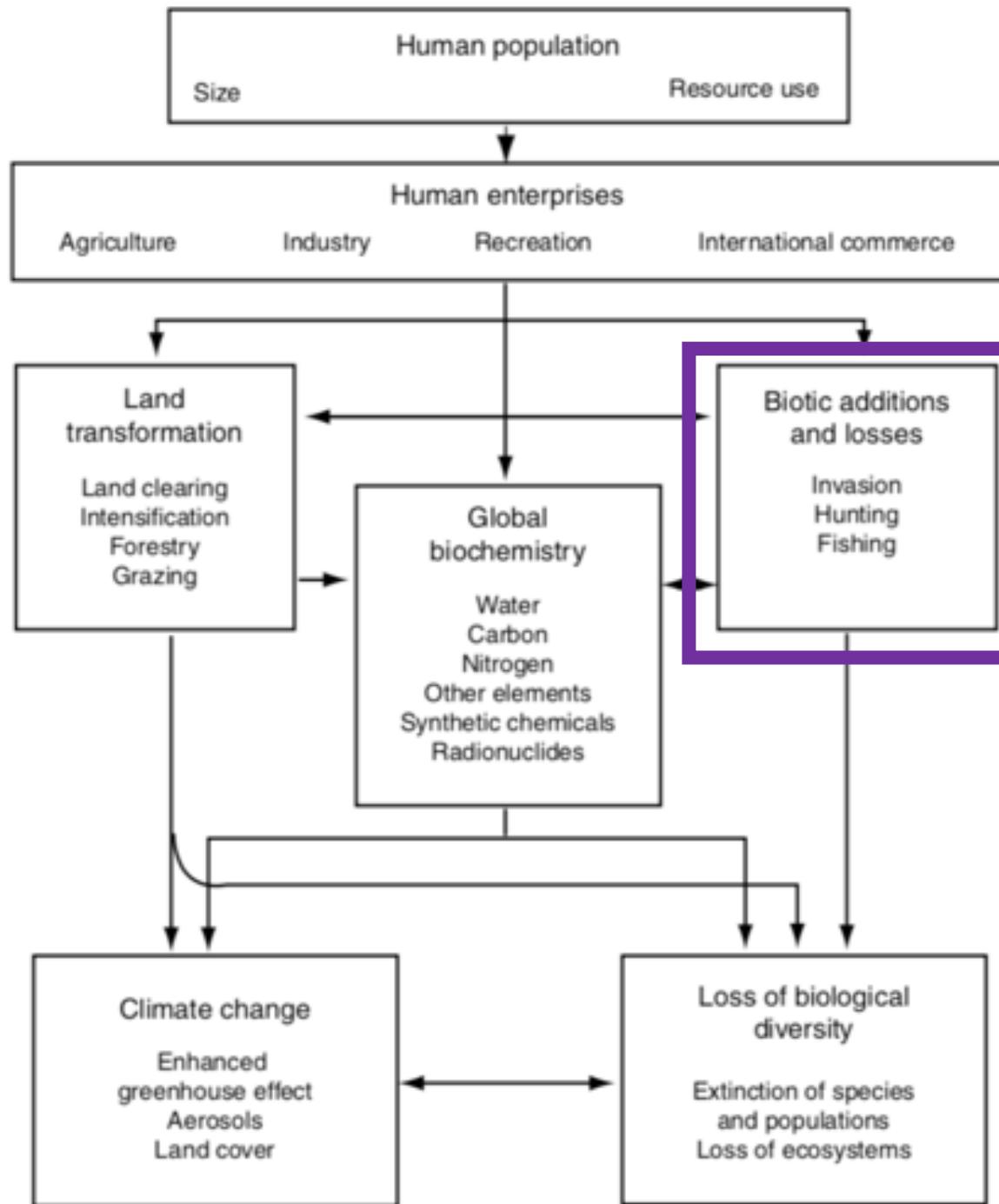


# Biogeochemistry - Nitrogen

- 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?

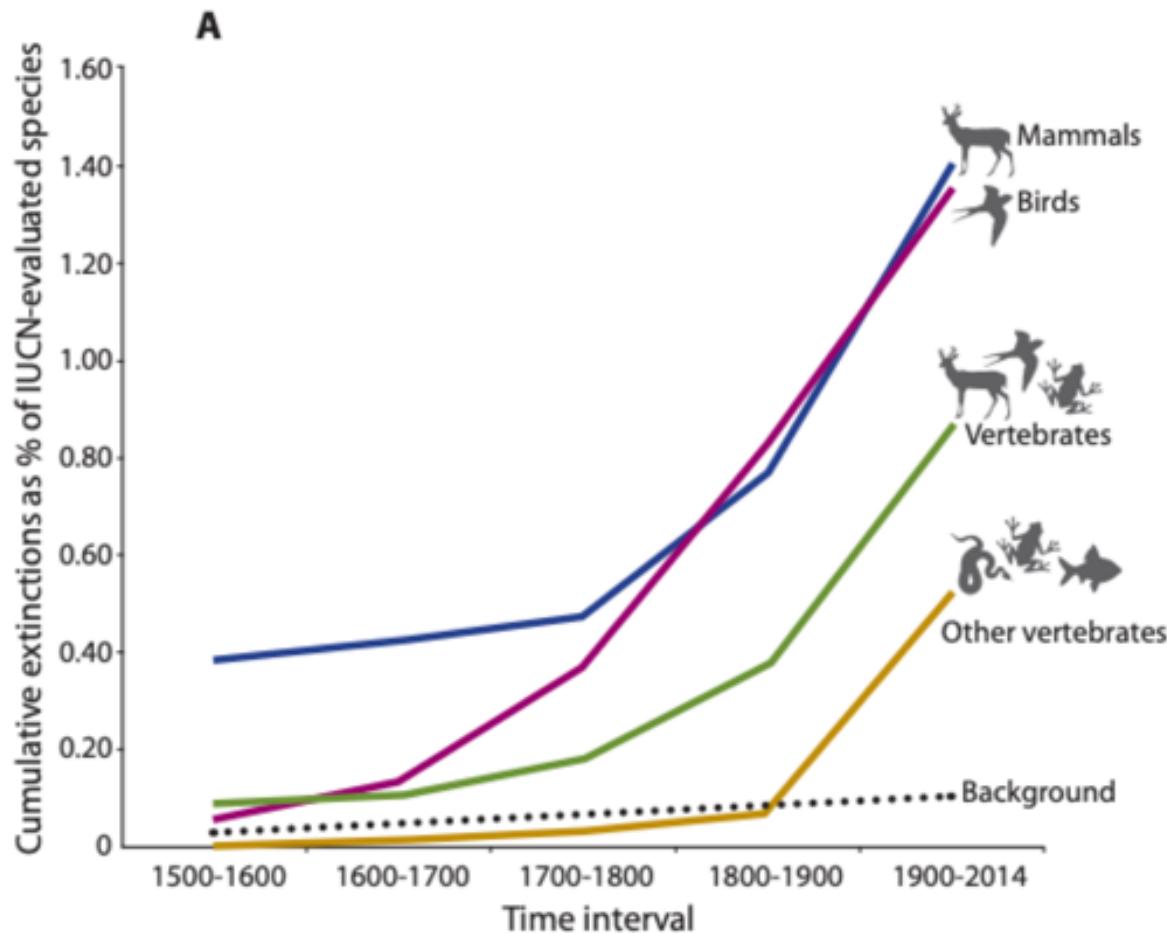


USDA



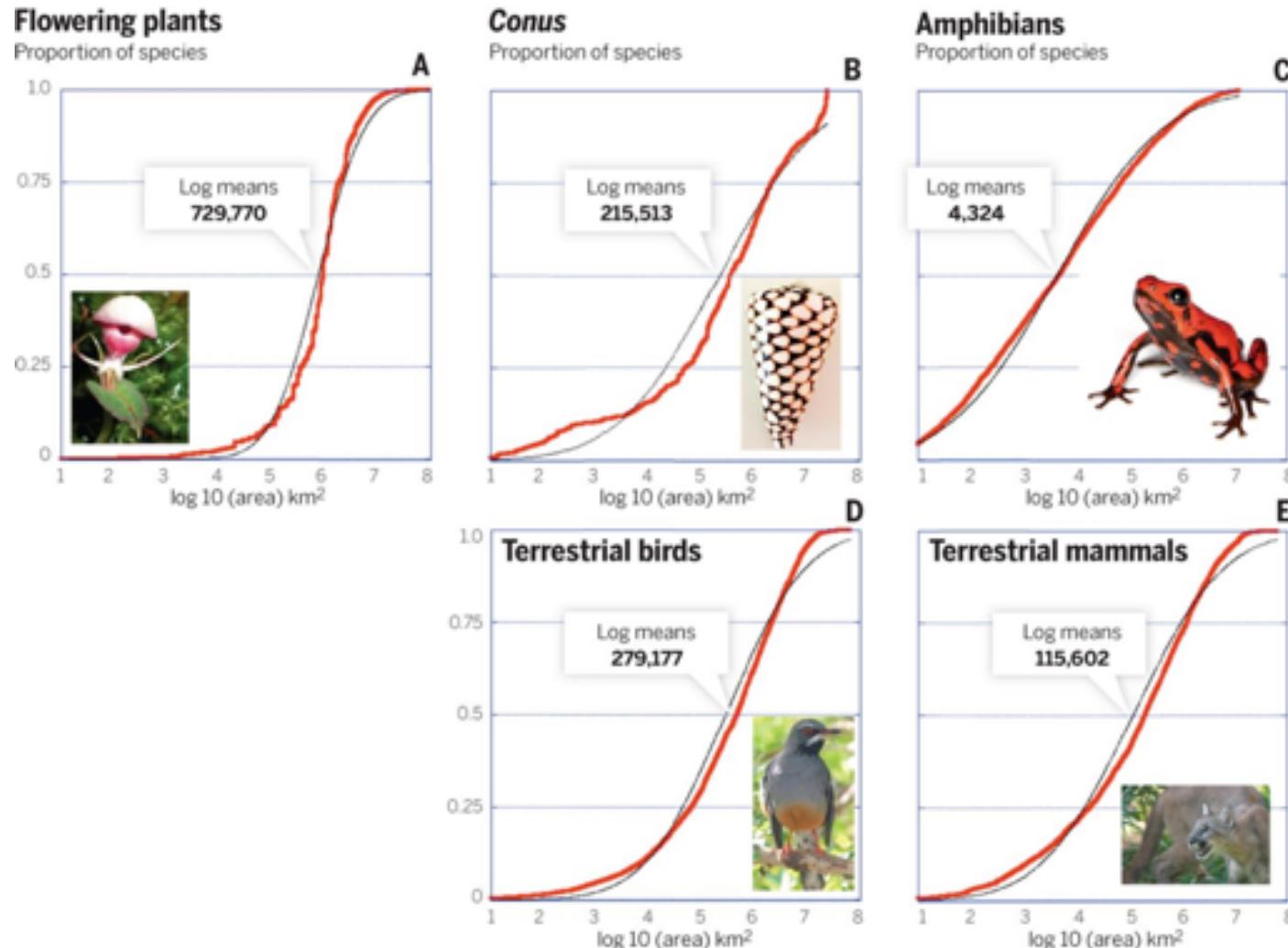
# Direct and indirect impacts of humans on Earth's ecosystems

# Biotic change – Species loss



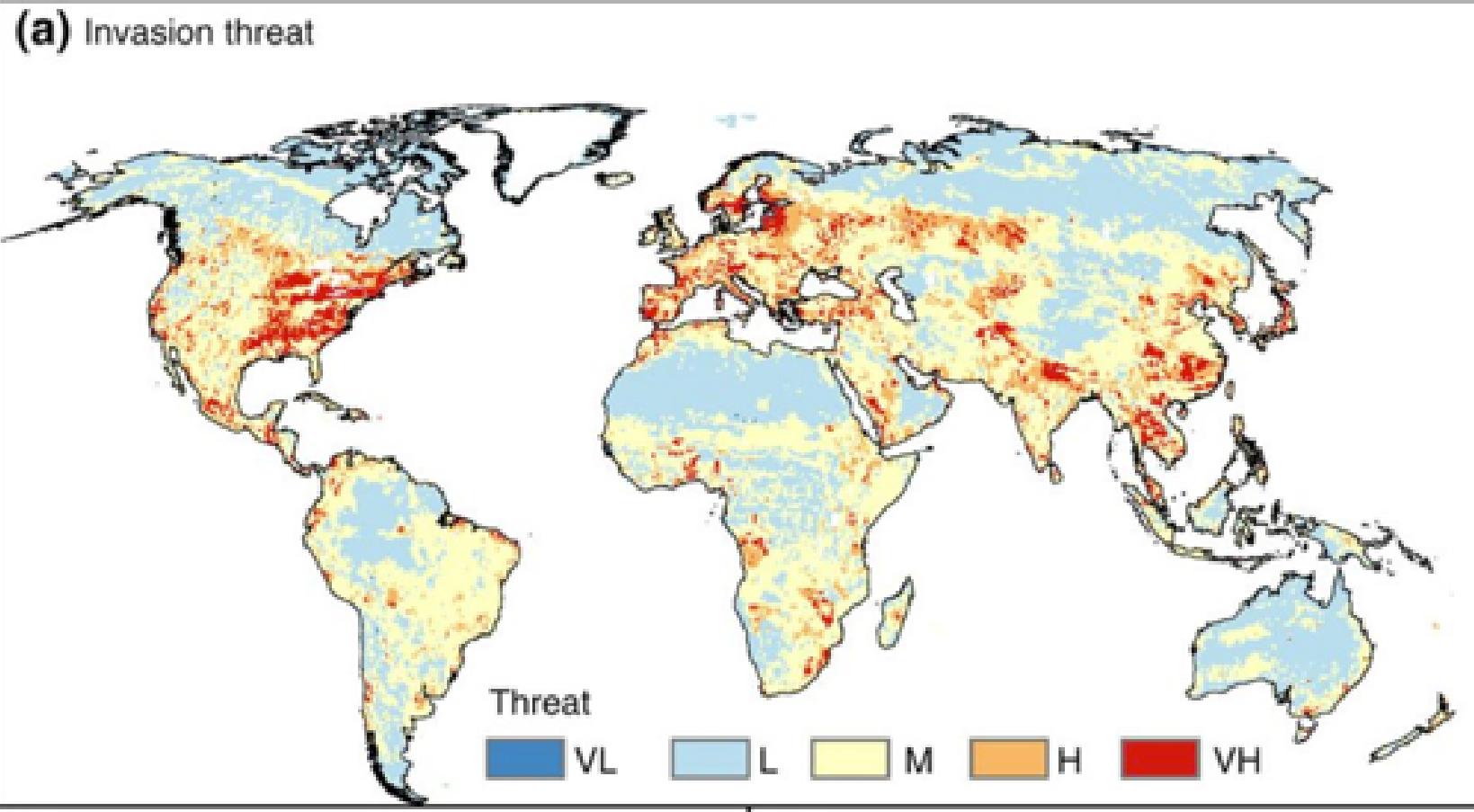
Percent of extinct species  
(note the background rate)

# Biotic Changes – Species Loss



The number of species increases with space

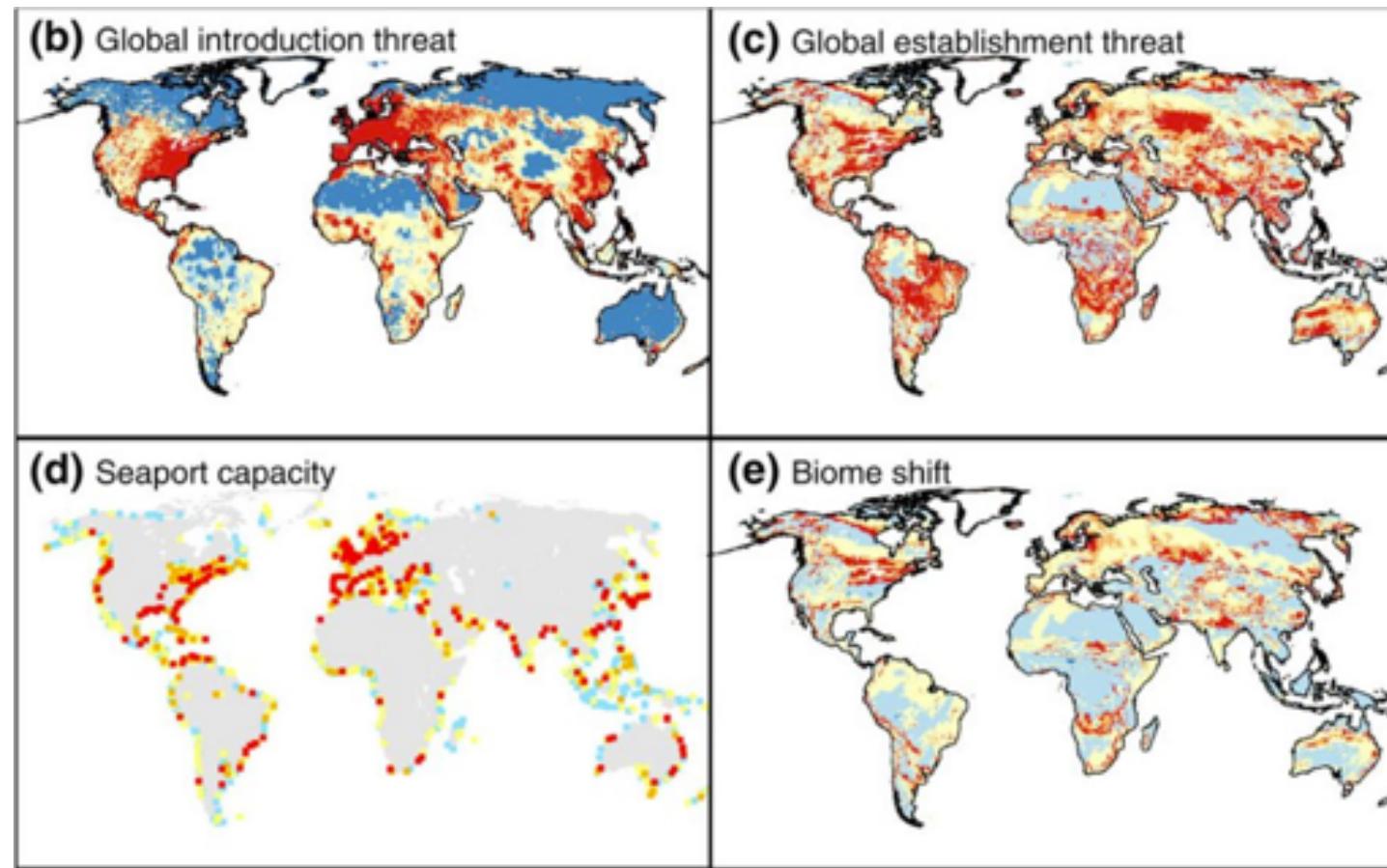
# Biotic Changes - Invasion



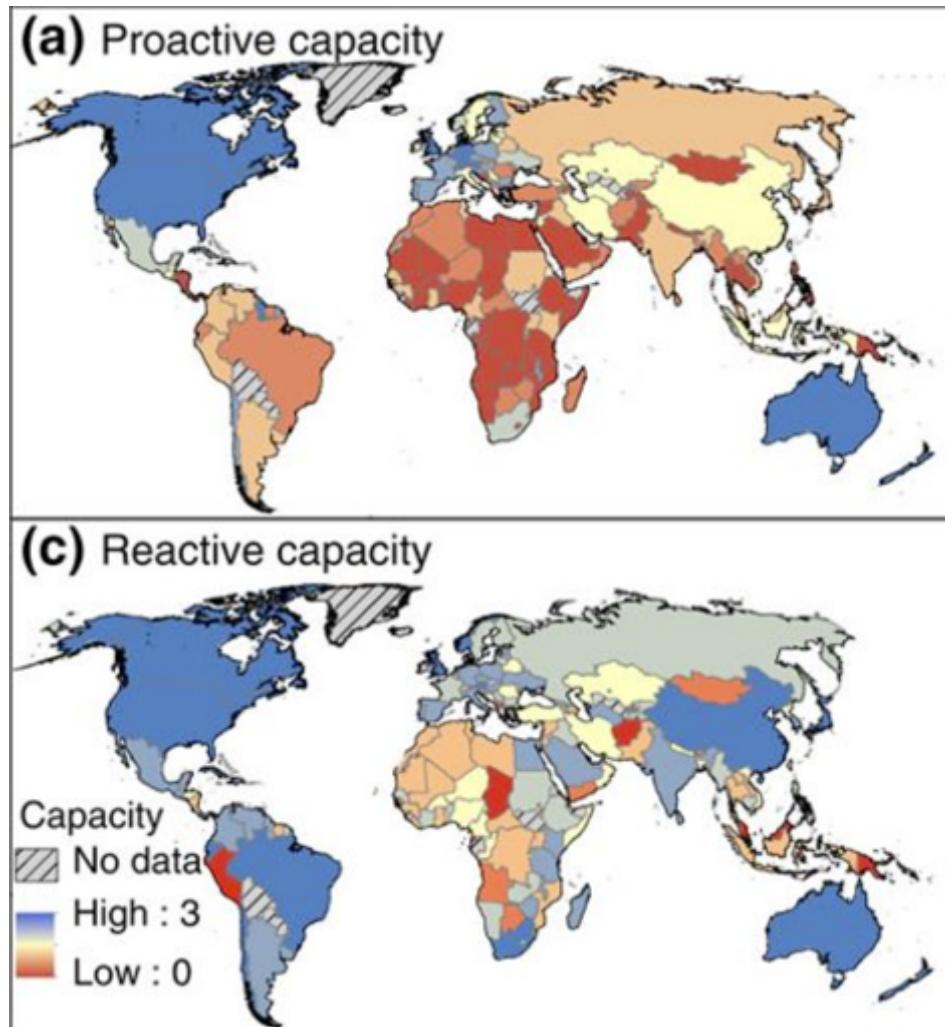
Invasive species are threatening all across the globe.

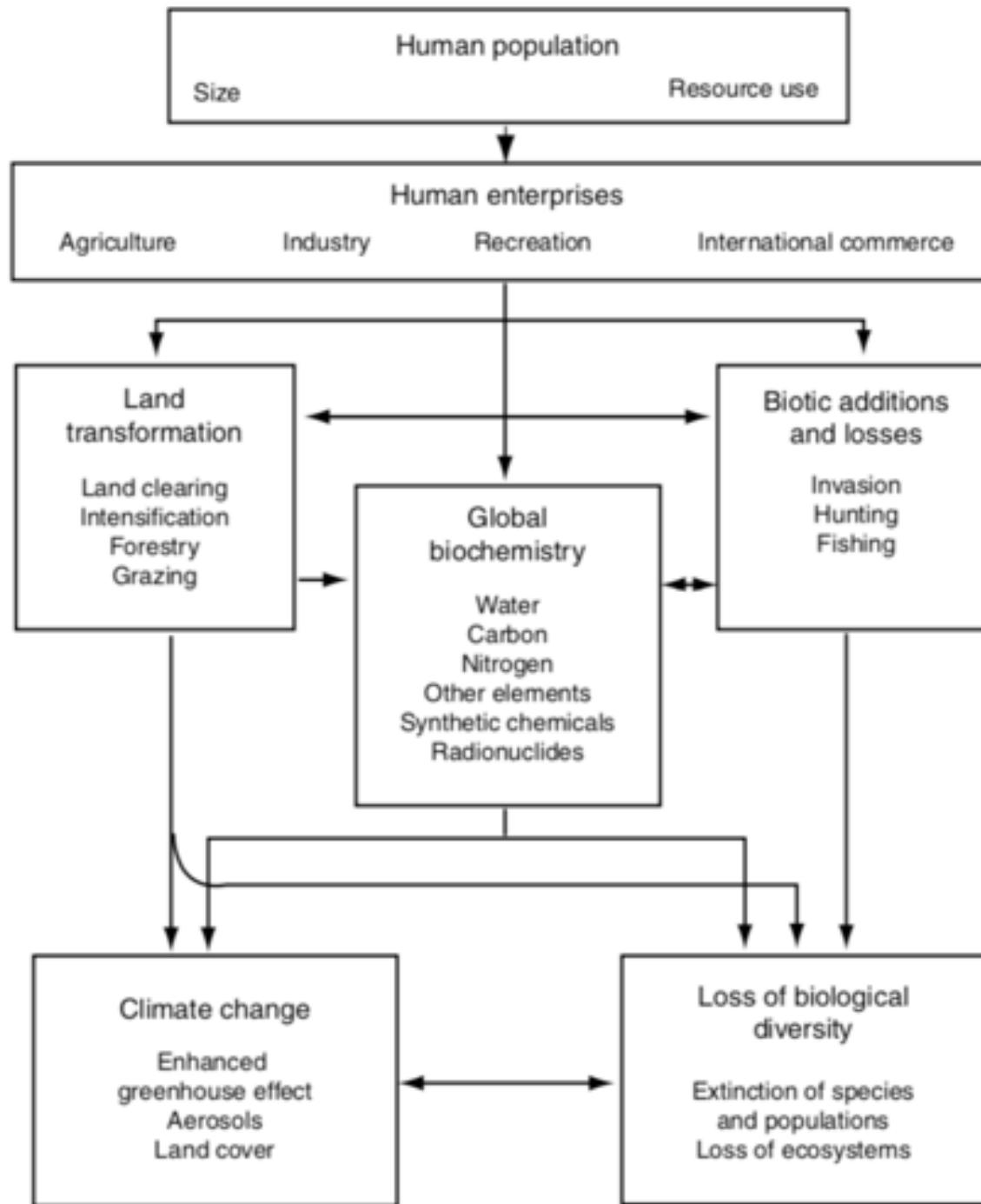
What might explain these patterns?

# Biotic Changes - Invasion



# Biotic Changes - Invasion



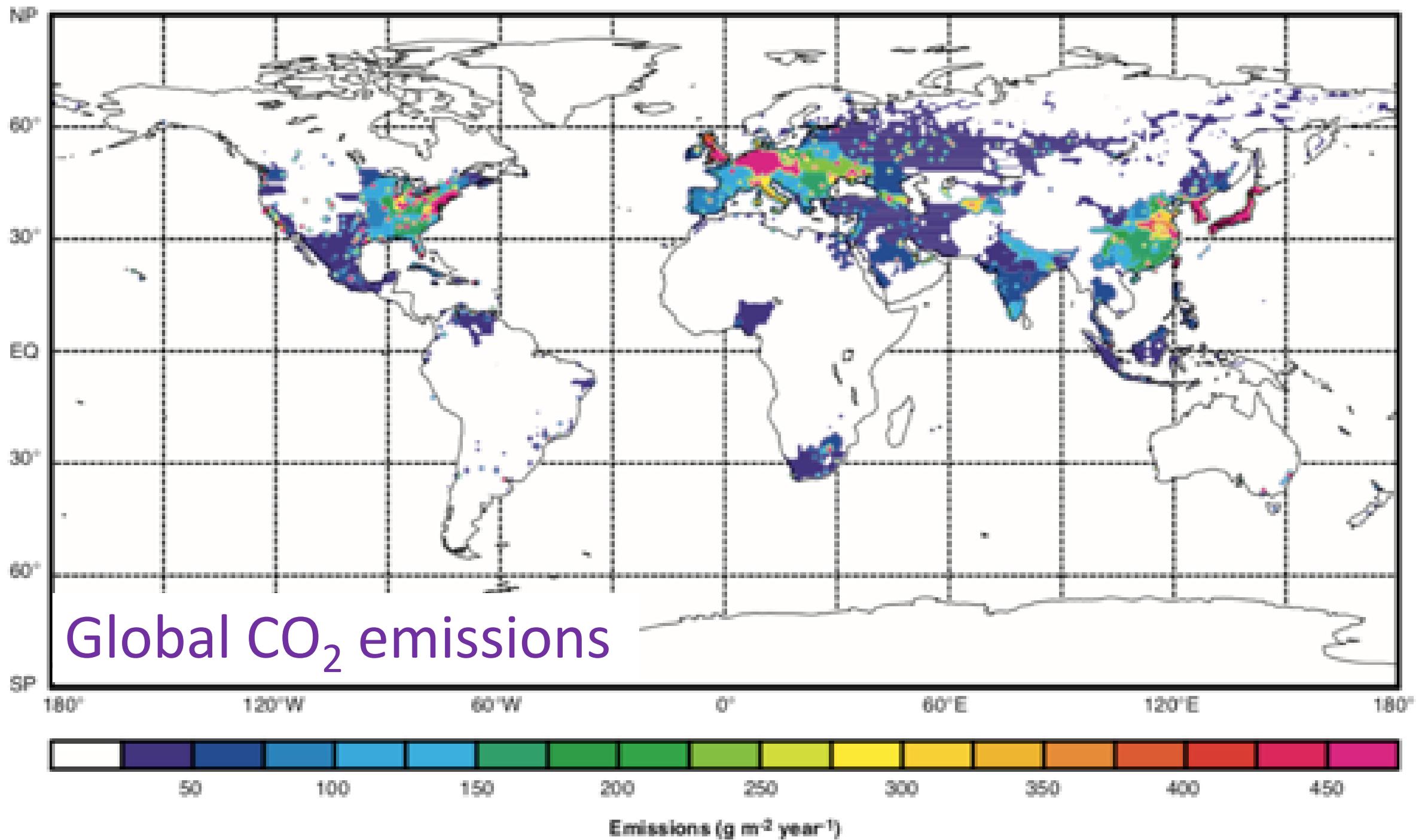


# Direct and indirect impacts of humans on Earth's ecosystems

Anything missing??

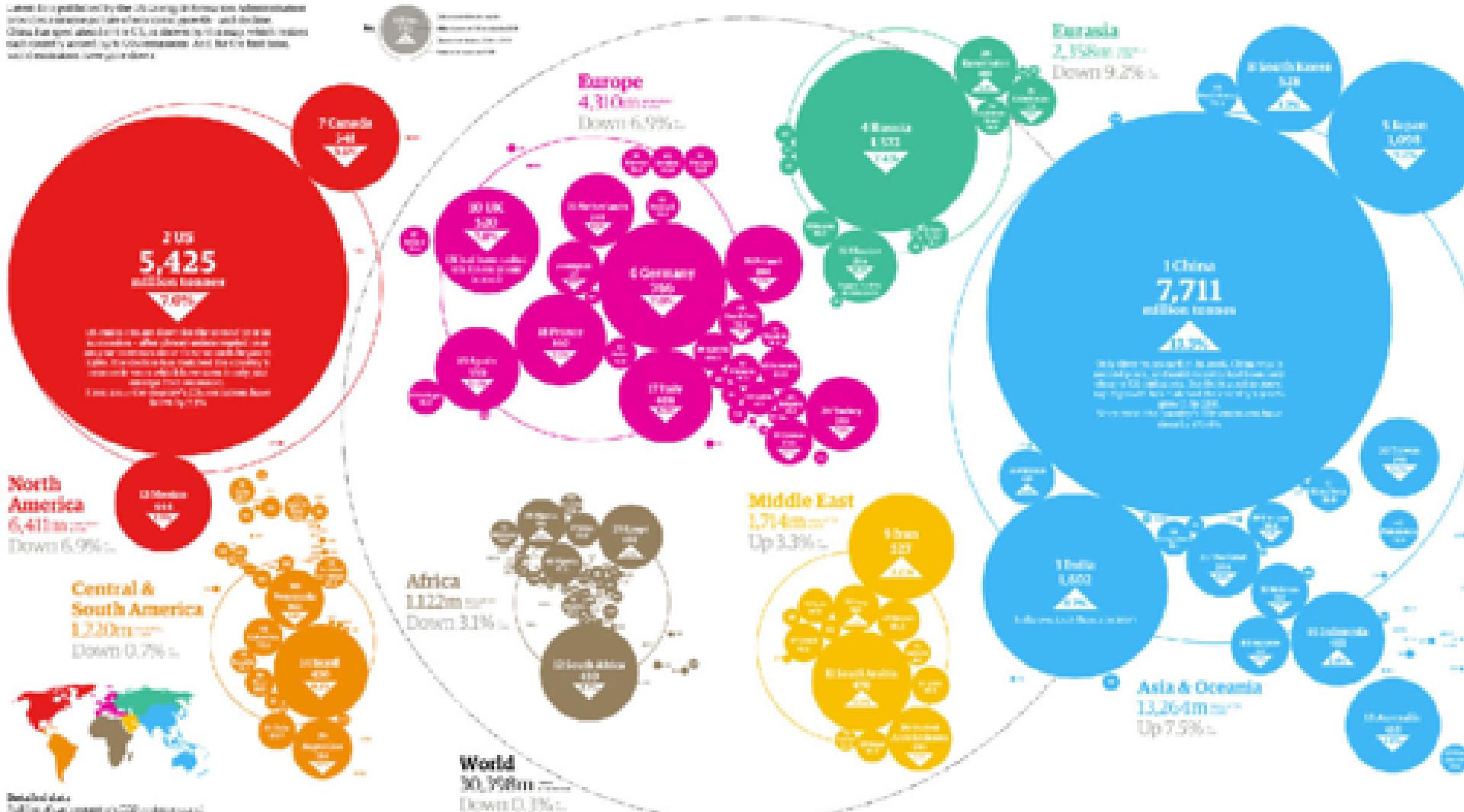
Some things to chat about

1. Who pays the cost?



# An atlas of pollution: the world in carbon dioxide emissions

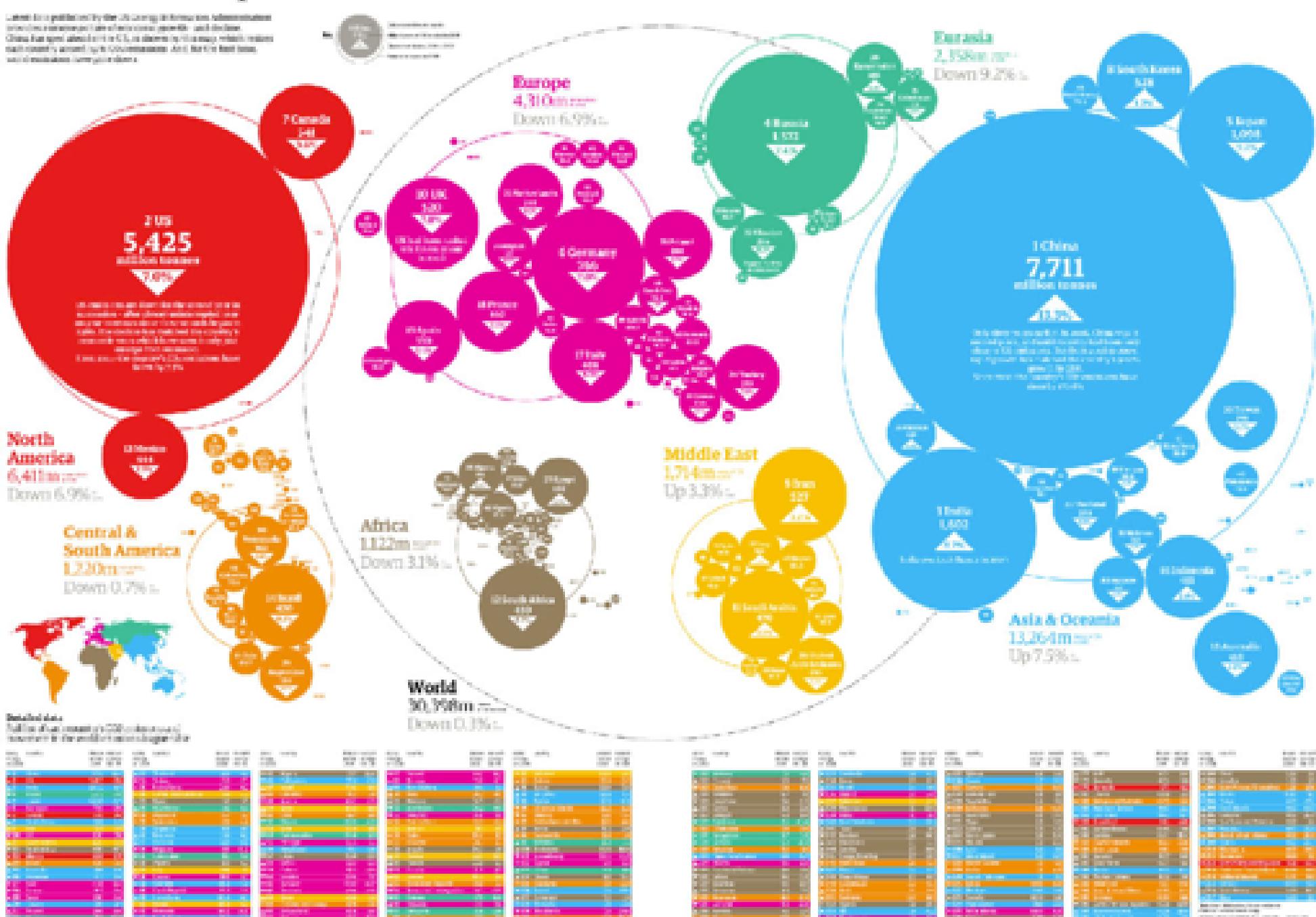
London is polluted by the 20 largest UK power stations, which account for 40% of the country's power needs. In the US, China has spent about \$100bn on clean energy projects since 2005, while India has spent \$60bn.



Detailed data  
Full data (country CO2 emissions)  
available in the full version online



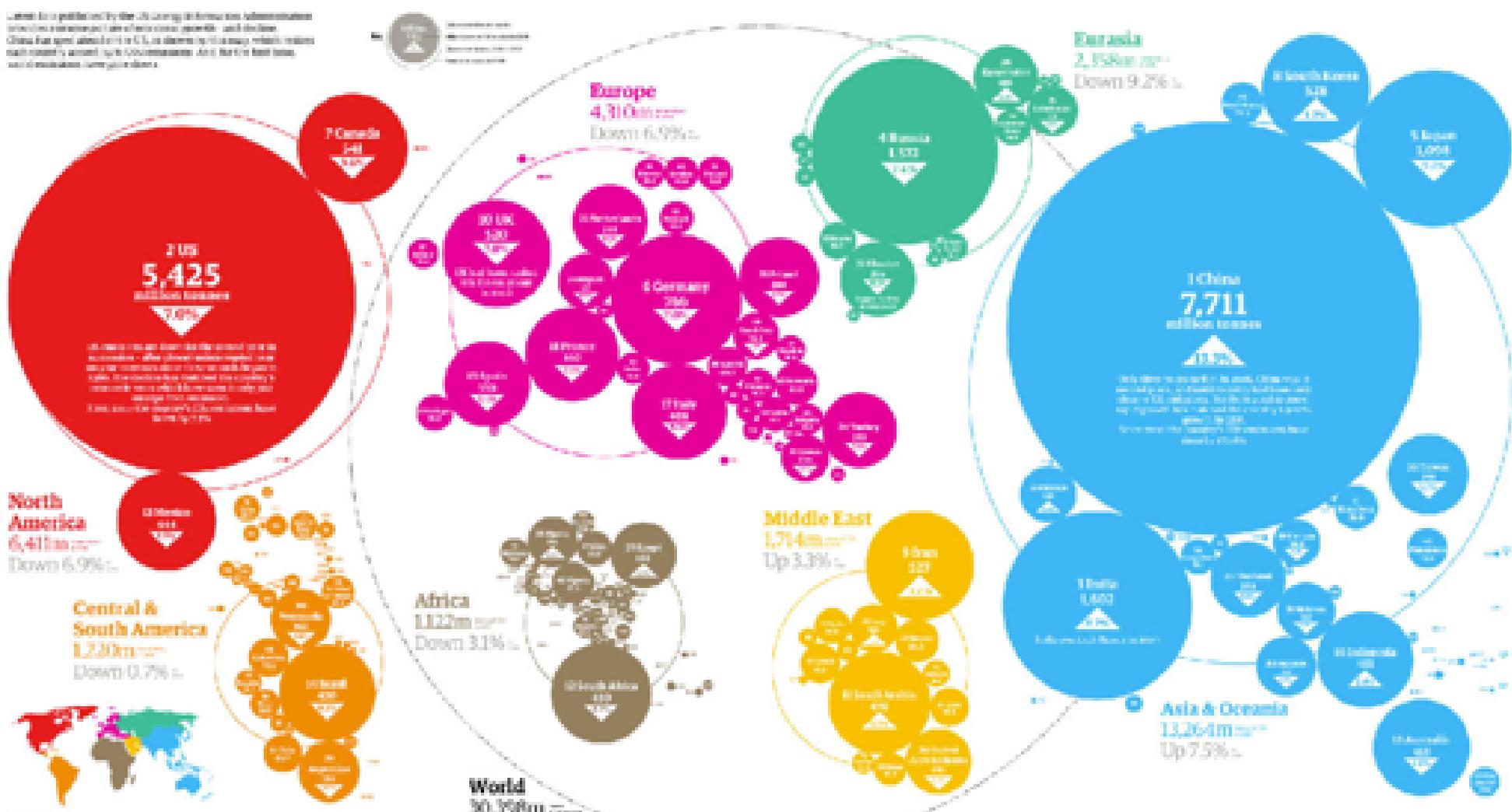
# An atlas of pollution: the world in carbon dioxide emissions



Are consequences paid by the perpetrators?

# An atlas of pollution: the world in carbon dioxide emissions

China has suffered by the US during its former administration under a series of economic policies, and the US. China has sped ahead in US, shown by the way which makes each country's output up to 2000 billion US\$, but the first time, was of course from our side.

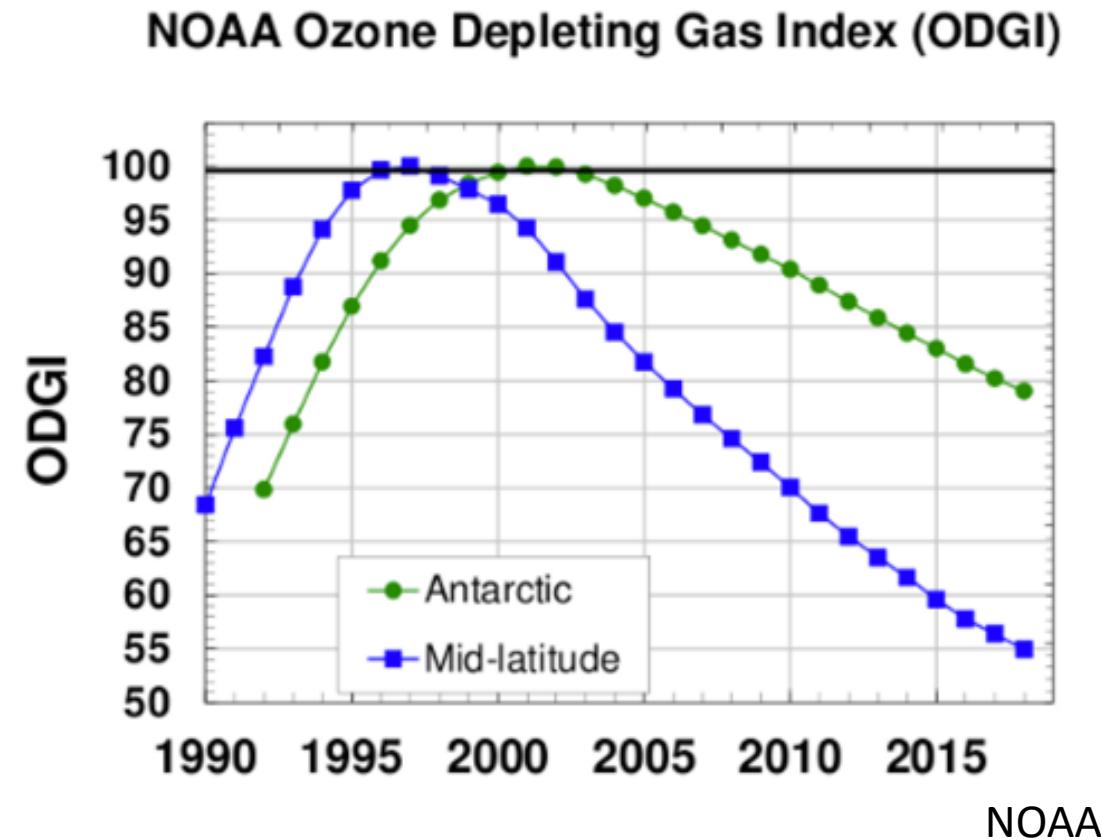


# How should we regulate this?

The figure consists of ten small bar charts arranged horizontally. Each chart has a different color scheme and displays multiple bars of varying heights. The categories represented by the bars are not explicitly labeled but appear to be distinct from one another. The charts are set against a white background.

# Example of international cooperation: the Montreal Protocol

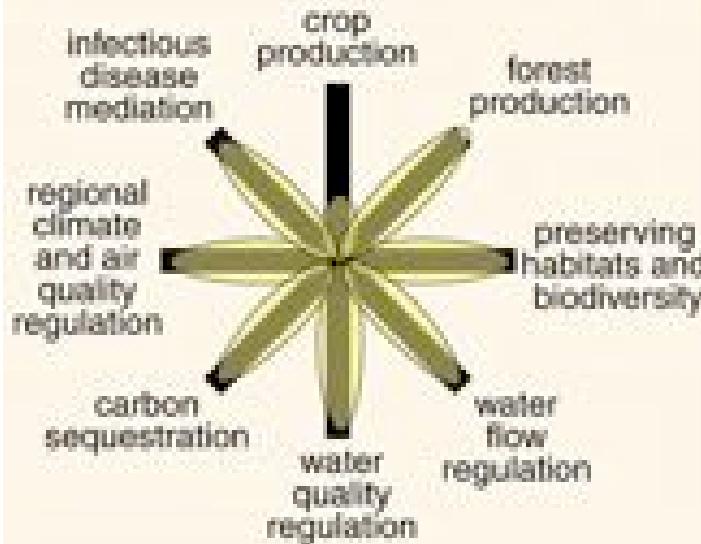
- 1990 protocol to stop use of chlorofluorocarbons (CFCs)
- CFCs deplete the ozone layer
- Banned CFCs
  - By 2000 in developed countries
  - By 2010 in non-developed countries



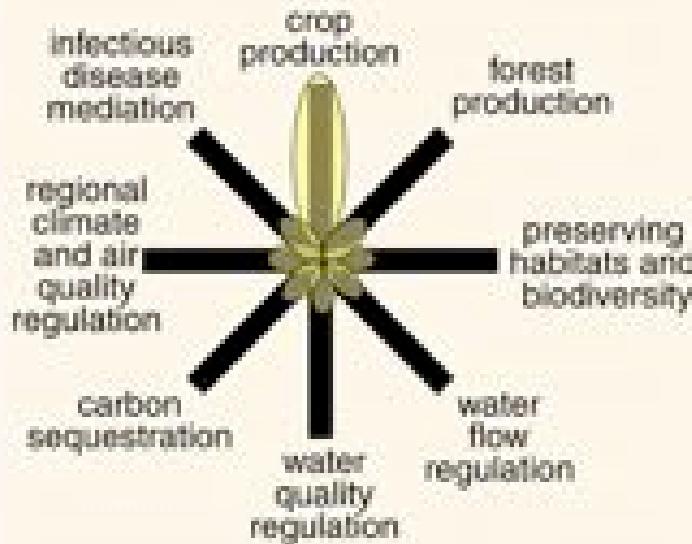
2. What would the world look like without humans?



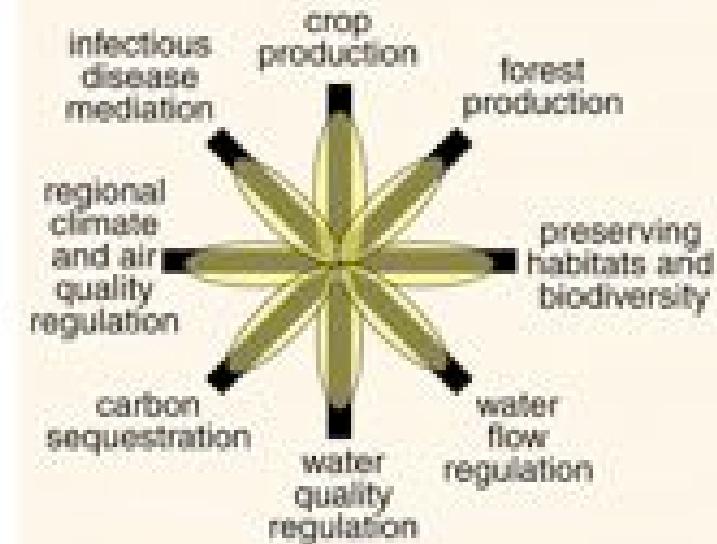
“There is no clearer illustration of the extent of human dominance of Earth than the fact that maintaining diversity of “wild” species and the functioning of “wild” ecosystems will require increasing human involvement”



natural ecosystem



intensive cropland



cropland with restored ecosystem services