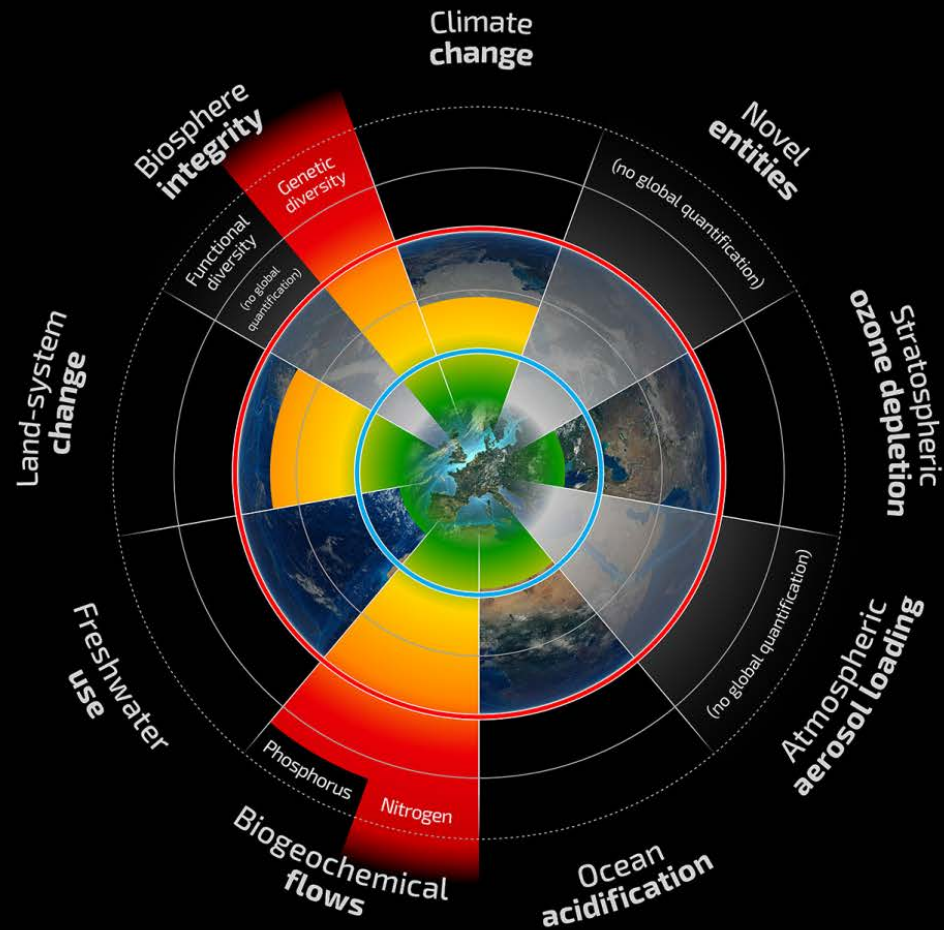




Planetary Boundaries

A safe operating space for humanity



- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

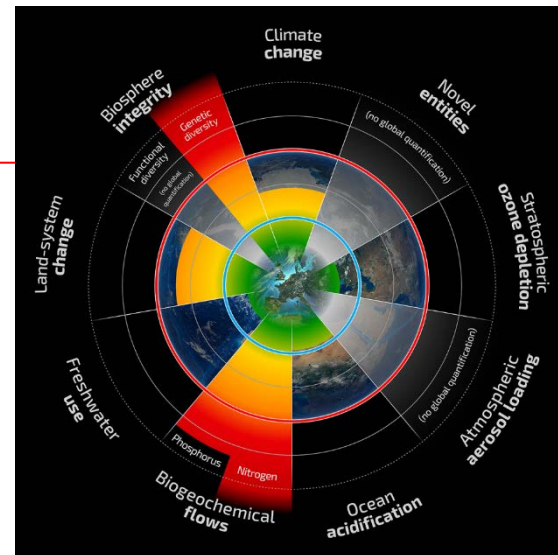
III. Stratospheric Ozone Depletion

Earth-system process	Control variable(s)	Planetary boundary (zone of uncertainty)	Current value of control variable
Stratospheric ozone depletion (R2009: same)	Stratospheric O ₃ concentration, DU	<5% reduction from pre-industrial level of 290 DU (5%–10%), assessed by latitude	Only transgressed over Antarctica in Austral spring (~200 DU)

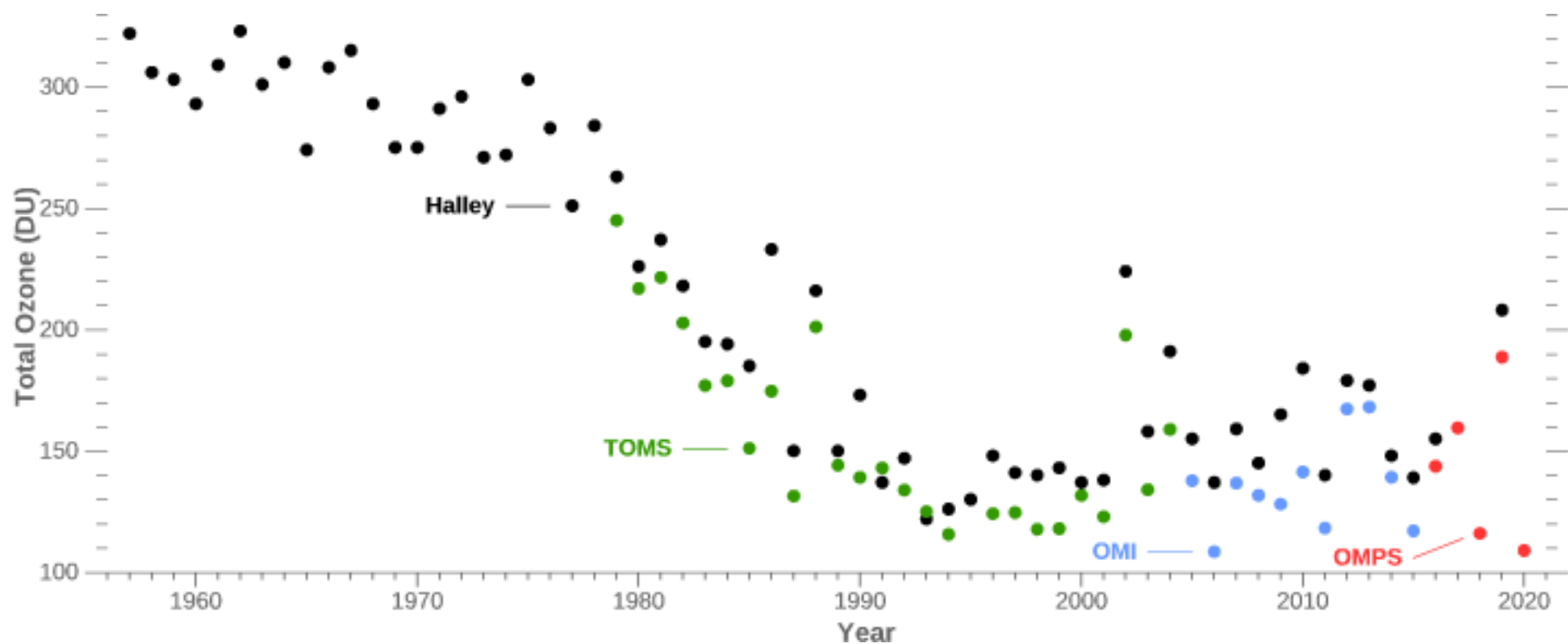
Boundary: Average conc. of stratospheric O₃ no lower than 276 Dobson units

Current level: 283 Dobson units

Diagnosis: Safe, and improving



Stratospheric ozone above Antarctica



History of Ozone Depletion Research

1974

Stratospheric Chlorine: a Possible Sink for Ozone

R. S. STOLARSKI AND R. J. CICERONE

Space Physics Research Laboratory, The University of Michigan, Ann Arbor, Michigan 48105

Received January 18, 1974

This study proposes that the oxides of chlorine, ClO_x , may constitute an important sink for stratospheric ozone. A photochemical scheme is devised which includes two catalytic cycles through which ClO_x destroys odd oxygen. The individual ClX constituents (HCl , Cl , ClO , and OCIO) perform analogously to the respective constituents (HNO_3 , NO , NO_2 , and NO_3) in the NO_x catalytic cycles, but the ozone destruction efficiency is higher for ClO . Our photochemical scheme predicts that ClO is the dominant chlorine

(Reprinted from *Nature*, Vol. 249, No. 5460, pp. 810–812, June 28, 1974)

Stratospheric sink for chlorofluoromethanes: chlorine atom-catalysed destruction of ozone

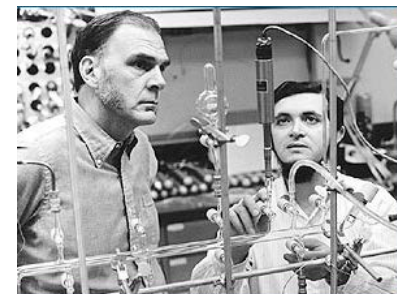
Mario J. Molina & F. S. Rowland

Department of Chemistry, University of California, Irvine, California 92664

Chlorofluoromethanes are being added to the environment in steadily increasing amounts. These compounds are chemically inert and may remain in the atmosphere for 40–150 years, and concentrations can be expected to reach 10 to 30 times present levels. Photodissociation of the chlorofluoromethanes in the stratosphere produces significant amounts of chlorine atoms, and leads to the destruction of atmospheric ozone.

HALOGENATED aliphatic hydrocarbons have been added to the

effective rates of vertical diffusion of molecules at these altitudes are also subject to substantial uncertainties. Vertical mixing is frequently modelled through the use of 'eddy' diffusion coefficients^{10,15–18}, which are presumably relatively insensitive to the molecular weight of the diffusing species. Calculated using a time independent one-dimensional vertical diffusion model with eddy diffusion coefficients of magnitude $K \sim (3 \times 10^3) - 10^4 \text{ cm}^2 \text{ s}^{-1}$ at altitudes 20–40 km (refs 10, 15–18), the atmospheric lifetimes of CFCl_3 and CF_2Cl_2 fall into the range of 40–150 yr. The time required for approach toward a steady state is thus measured in decades, and the concentrations of chlorofluoromethanes in the atmosphere can be expected to reach



- 1 atom of chlorine can decompose circa 100 000 O_3 molecules!

1978

- CFC (chloro-fluoro-carbons) banned in sprays in USA
- CFC consumption in other applications, however, still grows

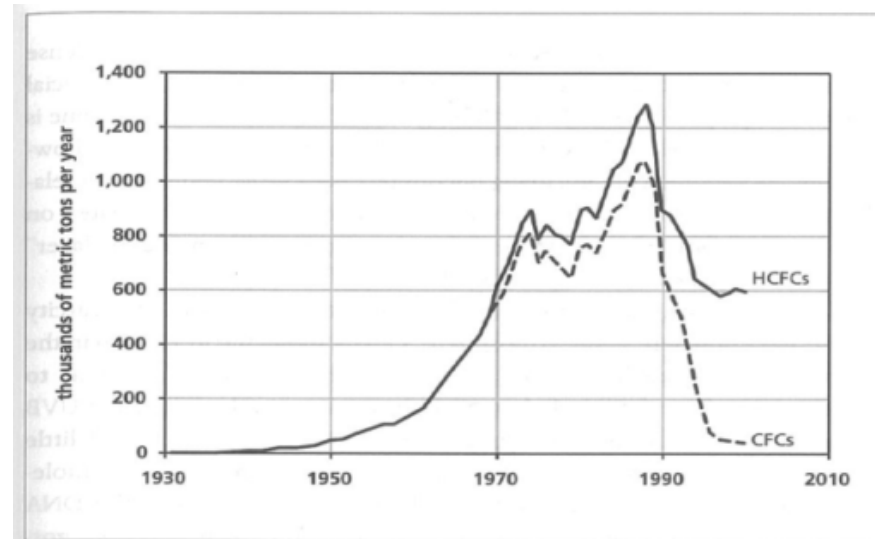


FIGURE 5-1 World Production of Chlorofluorocarbons

1984

- Halley Bay station in Antarctica measured **40 % O₃ decrease**
- the same dramatic decrease verified in another station 1000 miles away

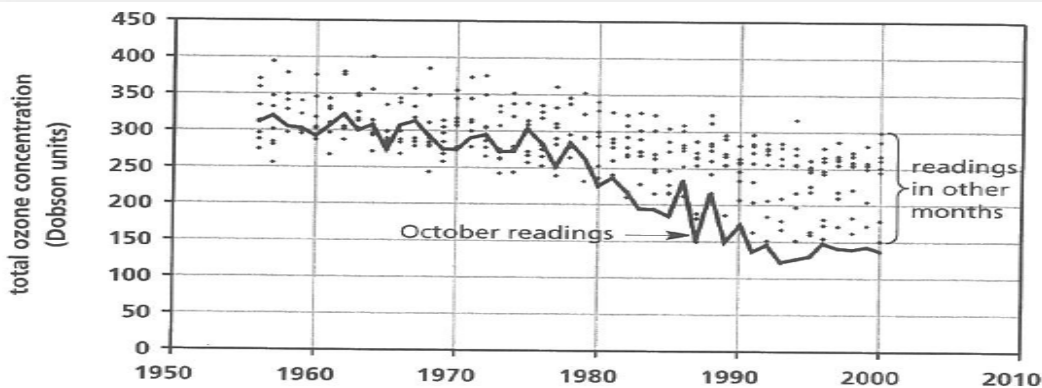


FIGURE 5-4 Ozone Measurements at Halley, Antarctica

Large losses of total ozone in Antarctica reveal seasonal ClO_x/NO_x interaction

J. C. Farman, B. G. Gardiner & J. D. Shanklin

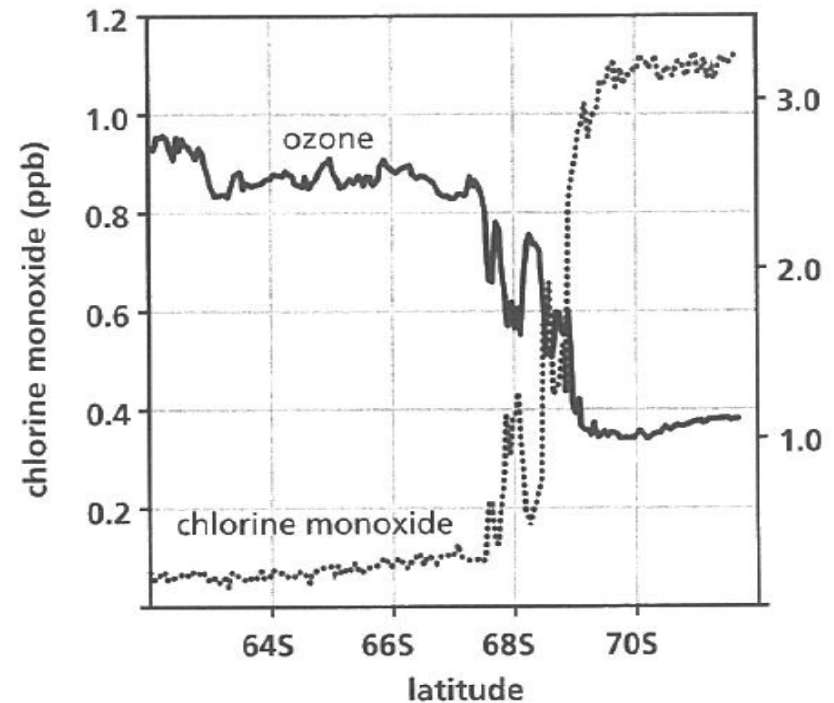
British Antarctic Survey, Natural Environment Research Council,
High Cross, Madingley Road, Cambridge CB3 0ET, UK


Recent attempts^{1,2} to consolidate assessments of the effect of human activities on stratospheric ozone (O₃) using one-dimensional models for 30° N have suggested that perturbations of total O₃ will remain small for at least the next decade. Results from such models are often accepted by default as global estimates³. The inadequacy of this approach is here made evident by observations that the spring values of total O₃ in Antarctica have now fallen considerably. The circulation in the lower stratosphere is apparently unchanged, and possible chemical causes must be considered. We suggest that the very low temperatures which prevail from midwinter until several weeks after the spring equinox make the Antarctic stratosphere uniquely sensitive to growth of inorganic chlorine, ClX, primarily by the effect of this growth on the NO₂/NO ratio. This, with the height distribution of UV irradiation peculiar to the polar stratosphere, could account for the O₃ losses observed.

Total O₃ has been measured at the British Antarctic Survey stations Argentine Islands 65° S 64° W and Halley Bay

1987

- **chlorine-ozone hypothesis confirmed** by the fly of an exploratory plane through the ozone hole measuring concentration of O_3 and ClO
- there was found strong negative correlation between the concentration of both determined compounds



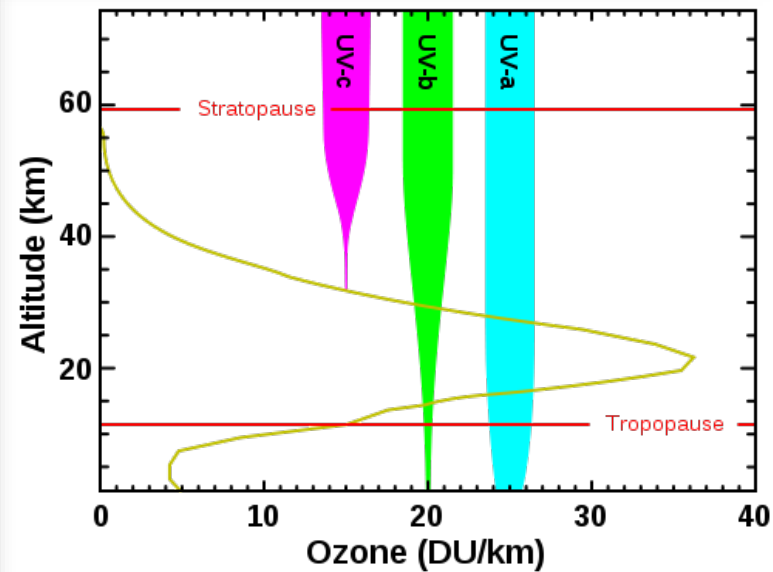
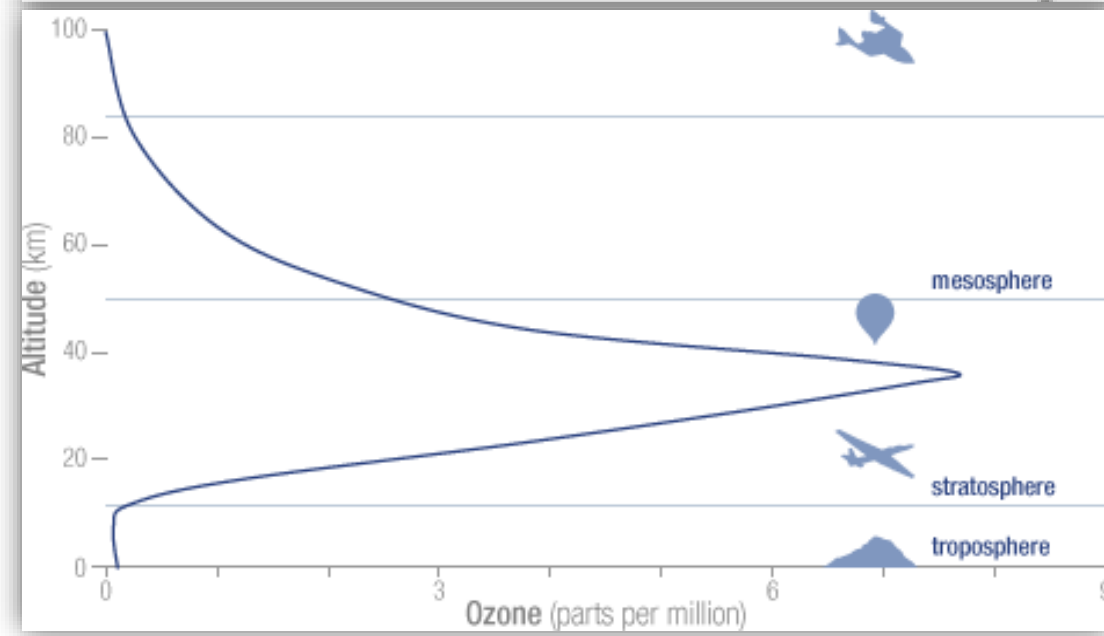
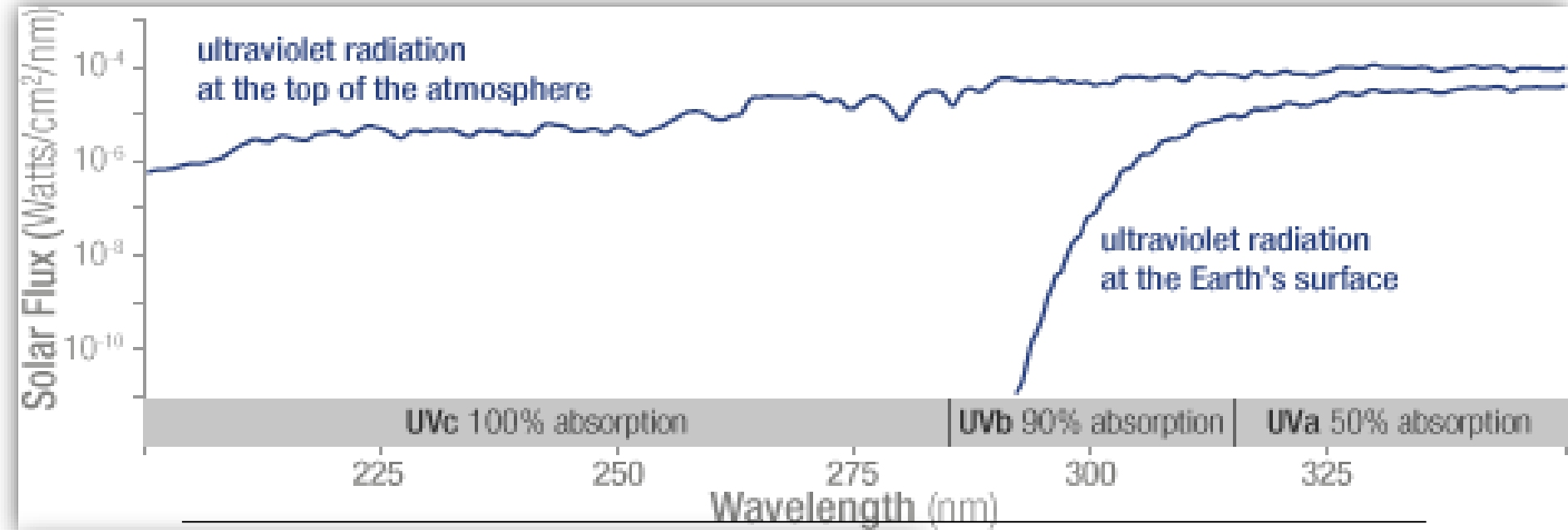


Stratospheric O3 depletion - is it only the one environmental/health issue linked to O3?



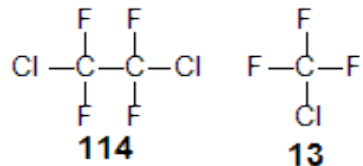
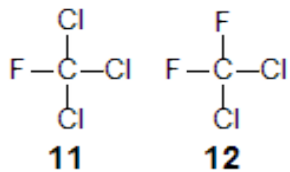
Significance of the Ozone Depletion

O₃ – protection of biosphere against harmful UVB radiation



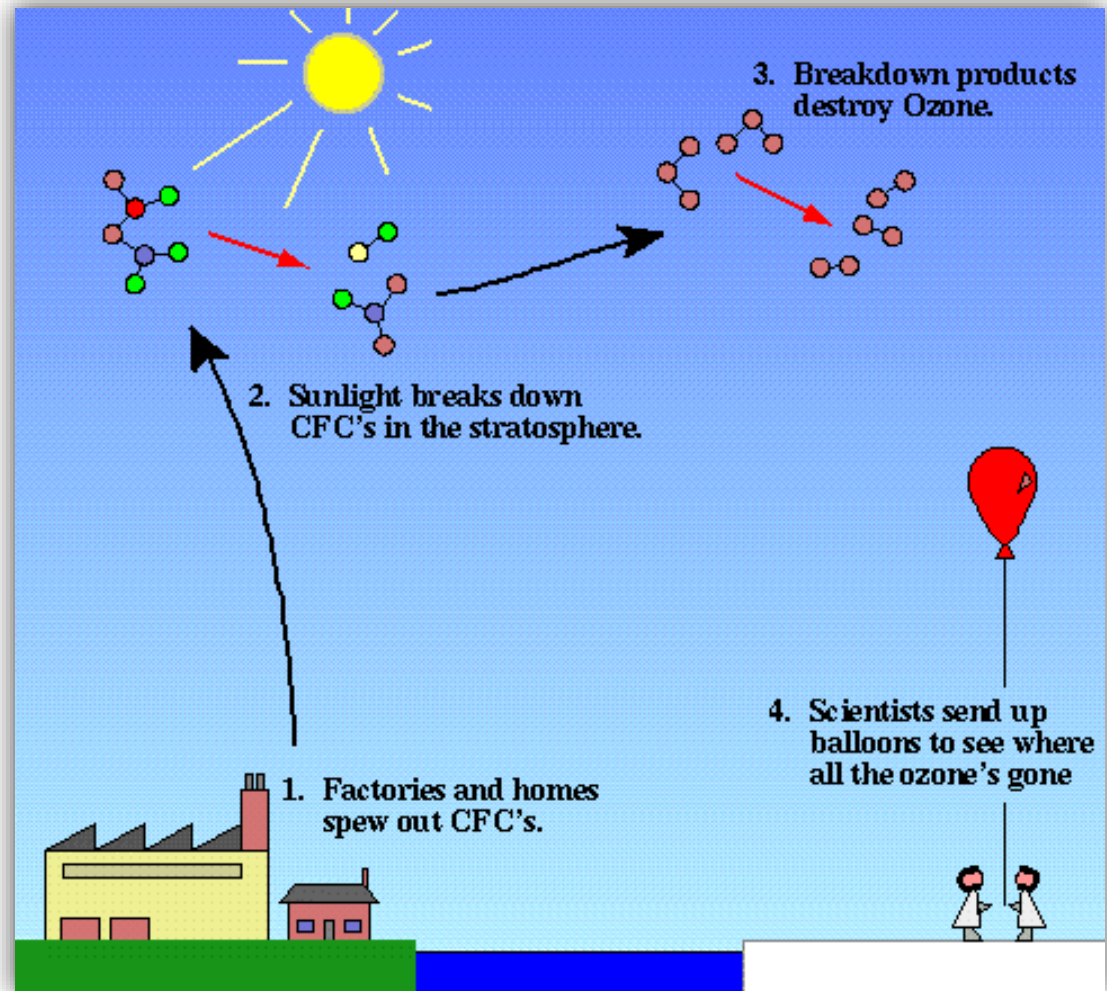
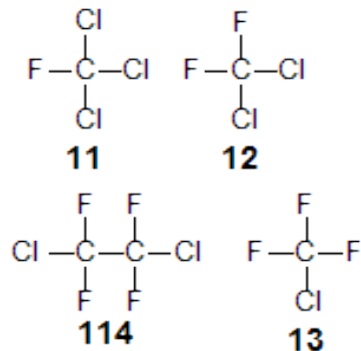
Degradation of O₃ layer

- Cl· radicals from Chloro-fluoro-carbons (CFC, Freon)
- Br· radicals from Bromo-fluoro-carbons (BFC, Halon)



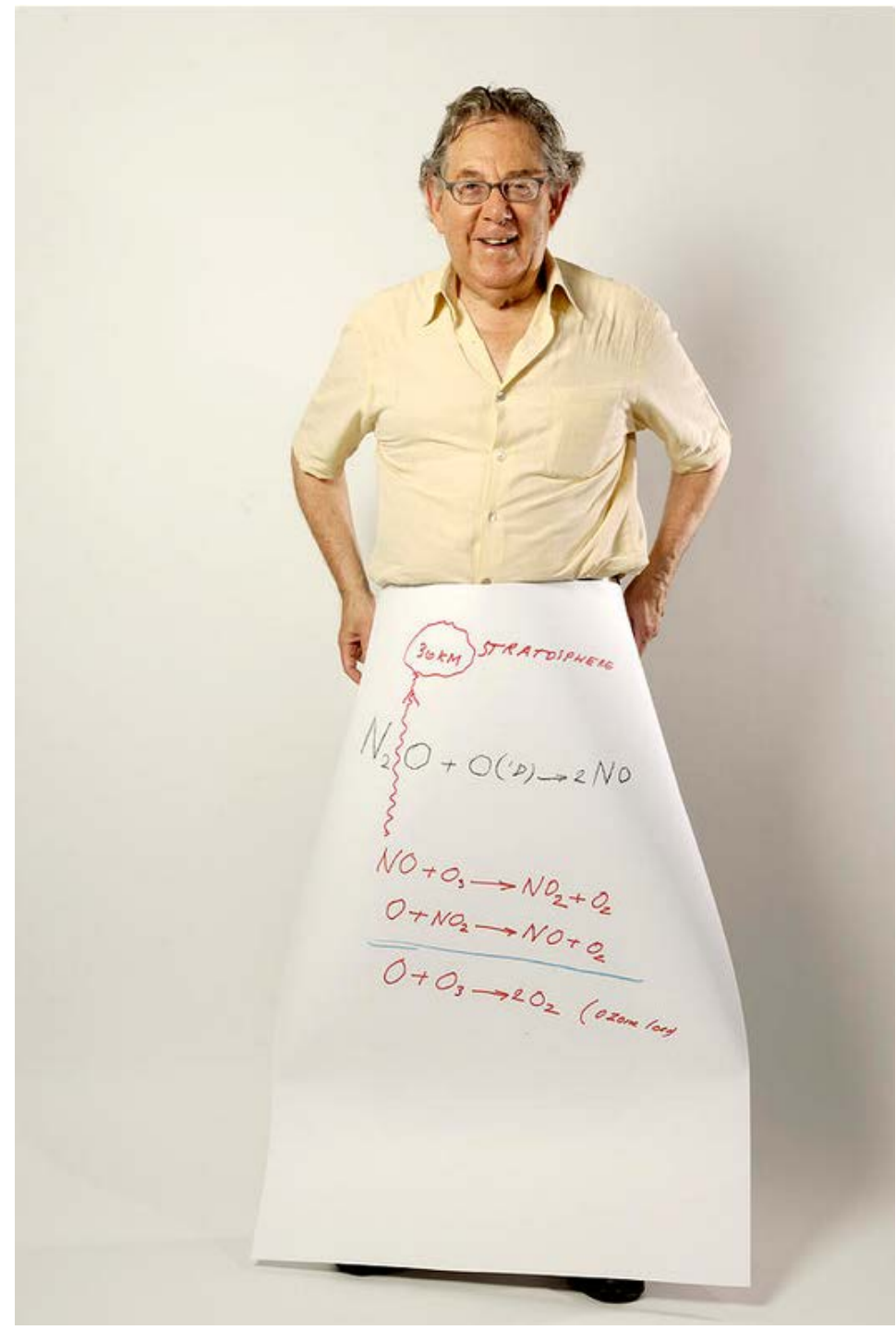
Degradation of O₃ layer

- Cl· radicals from Chloro-fluoro-carbons (CFC, Freon)
- Br· radicals from Bromo-fluoro-carbons (BFC, Halon)



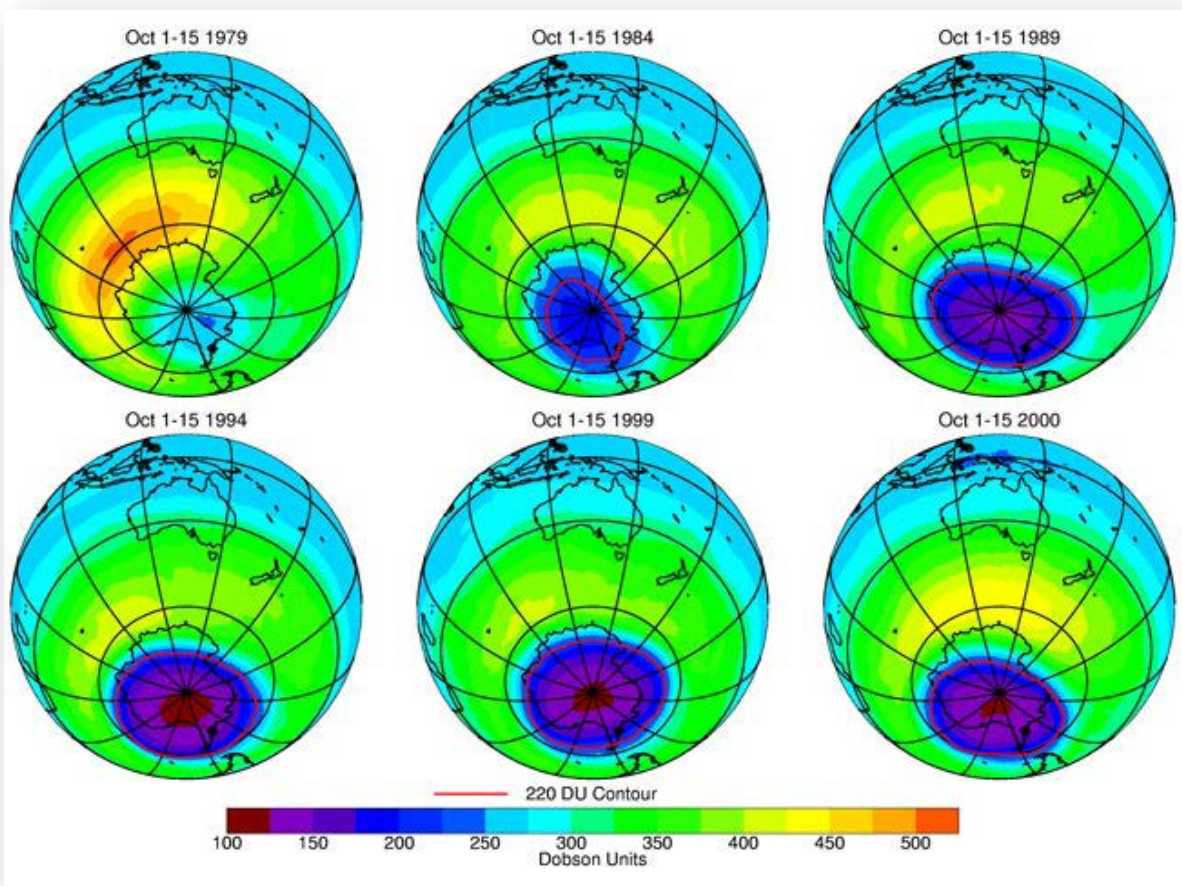
Degradation of O₃ layer

- N₂O from fertilizers

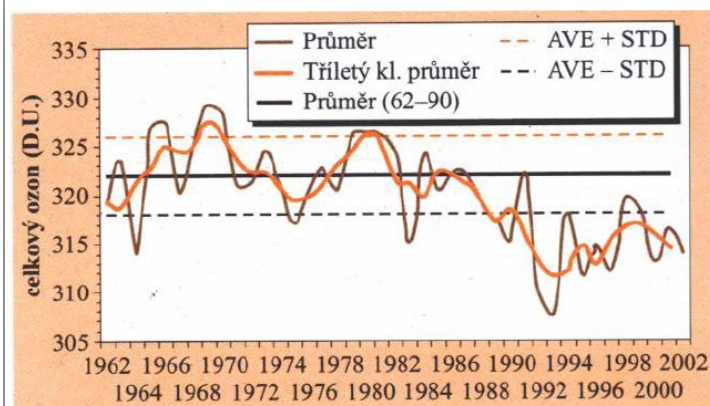


Ozone hole

- ozone depletion primarily over the South pole area
- however, significant O₃ depletion observed everywhere



Průměrné množství ozónu, ČR, 1962–2002



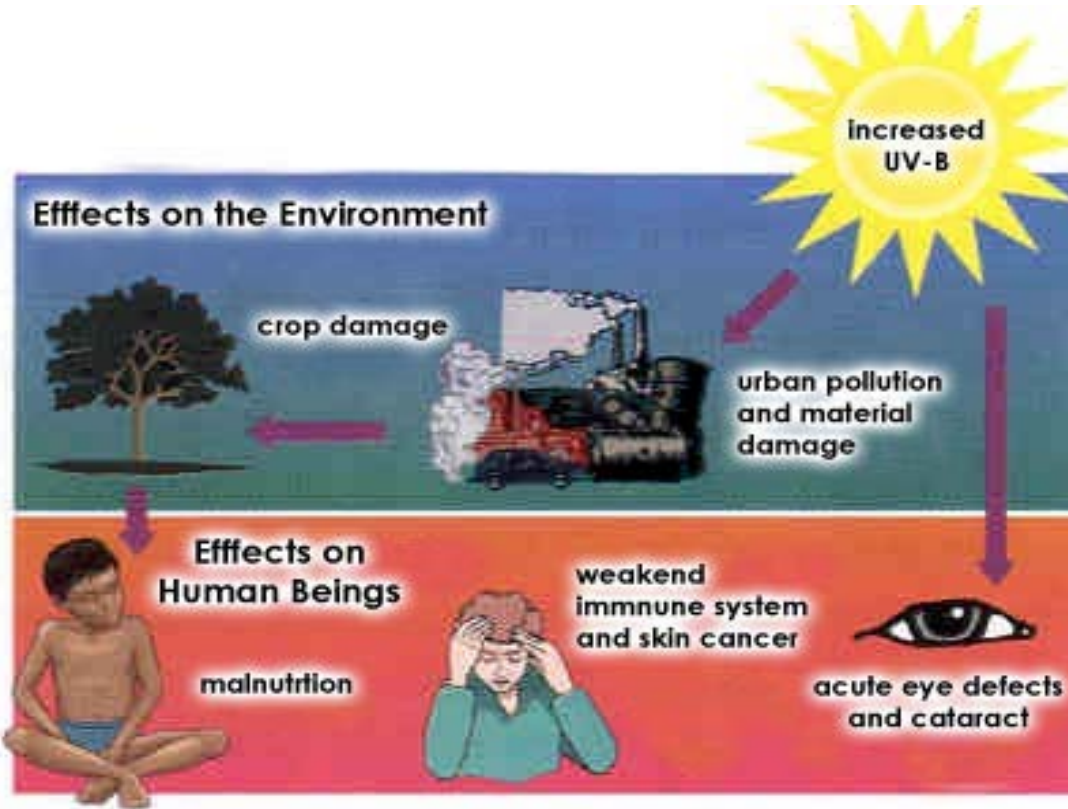
Consequences of O₃ depletion



What are the consequences of the stratospheric ozone depletion?

Less O₃ = more cancer

1% ↓ conc. O₃ ≈ 2% ↑ intensity UVB ≈ 4% ↑ skin cancer hazard



- majority of melanoms are on **sunlit parts of the skin**
- greatest incidence in Australia

Impact of increased UVB irradiation on crop

Possible changes in plant characteristics

- Reduced **photosynthesis**
- Reduced **water-use efficiency**
- Enhanced **drought stress sensitivity**
- Reduced **leaf area**
- Reduced **leaf conductance**
- Modified **flowering**
(either inhibited or stimulated)
- Reduced **dry matter production**

Consequences

Enhanced plant fragility

Growth limitation

Yield reduction

Selected sensitive crops

Rice

Oats

Sorghum

Soybeans

Beans

NB: Summary conclusions from artificial exposure studies.

Source: modified from Krupa and Kickert (1989) by Runeckles and Krupa (1994) in: Fakhri Bazzaz, Wim Sombroek, *Global Climate Change and Agricultural Production*, FAO, Rome, 1996.

Ozone hole

- solution



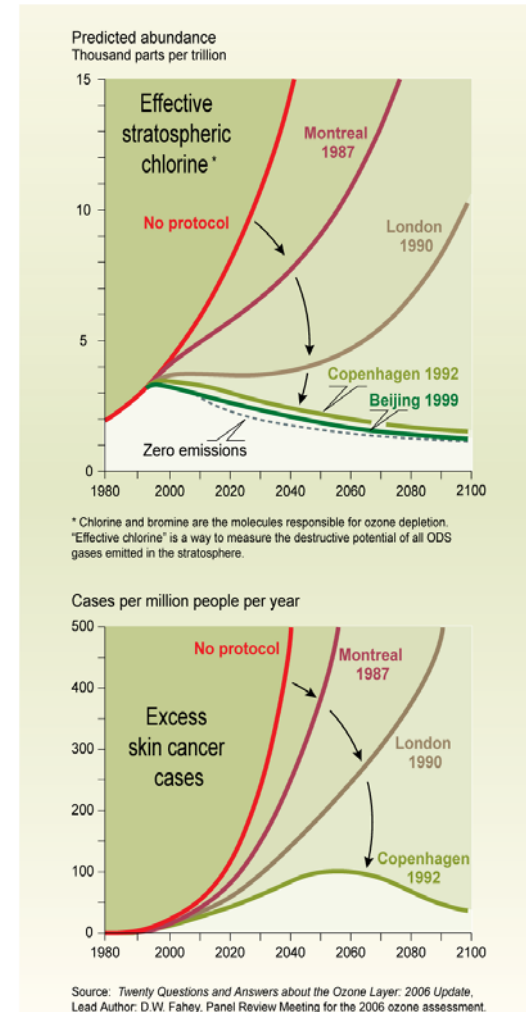
Whata can we do with a stratospheric ozone depletion?

Top

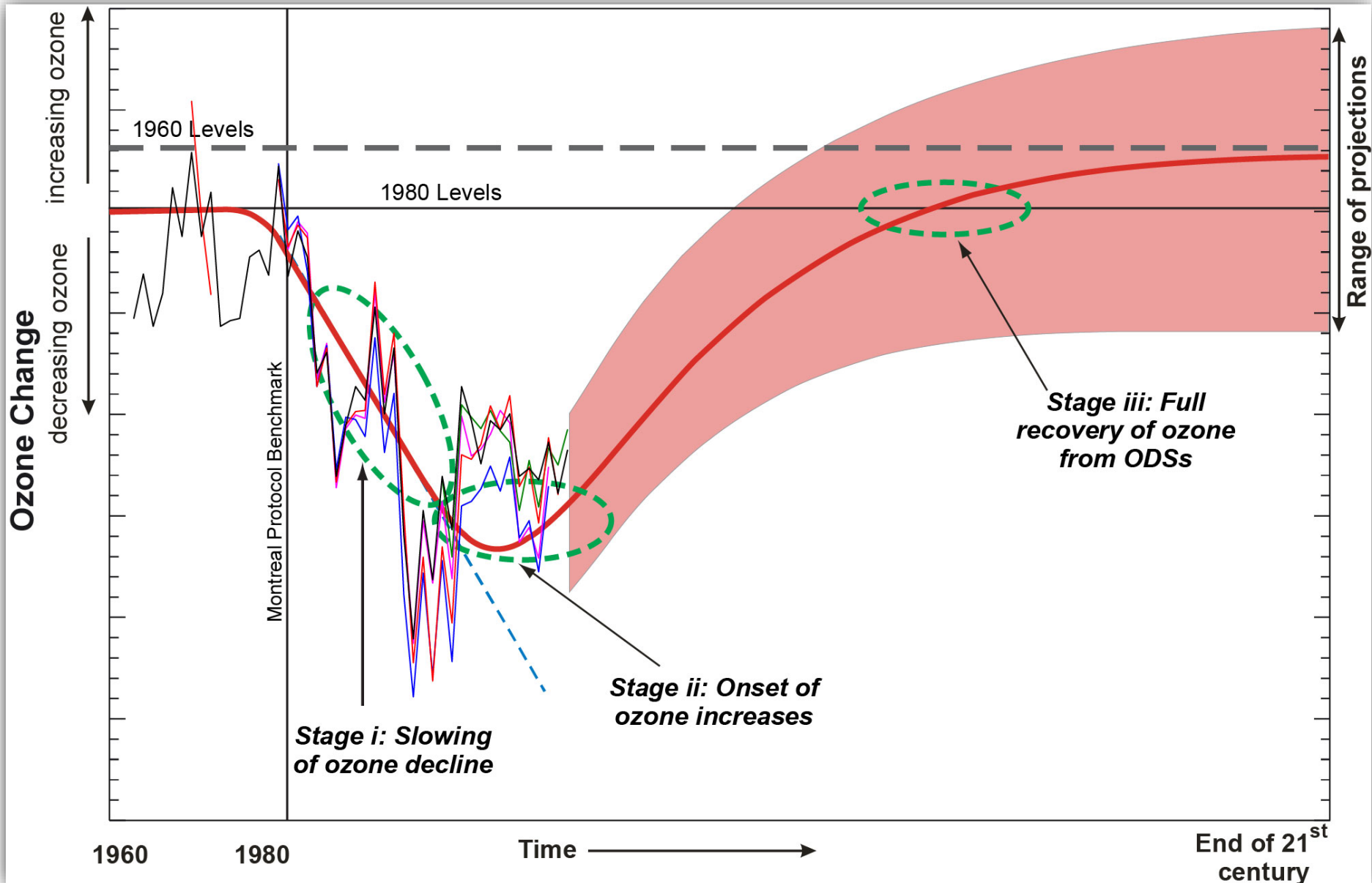
Effect of accepted solutions

- 1985 – Vienna Convention for the Protection of the Ozone Layer
- 1987 – Montreal protocol + amendments

THE EFFECTS OF THE MONTREAL PROTOCOL AMENDMENTS AND THEIR PHASE-OUT SCHEDULES



Time delay – ozone depletion and recovery



Solutions and consequences

1985 – Vienna Convention for the Protection of the Ozone Layer

1987 – Montreal protocol + amendments

The Nobel Prize in Chemistry 1995



Paul J. Crutzen



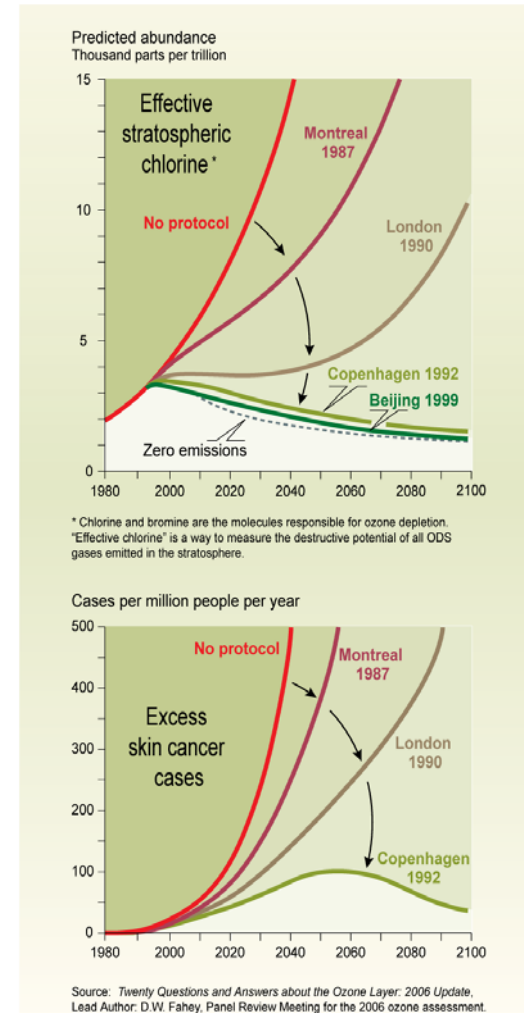
Mario J. Molina



F. Sherwood Rowland

„for their work in atmospheric chemistry, particularly concerning the formation and decomposition of ozone.“

THE EFFECTS OF THE MONTREAL PROTOCOL AMENDMENTS AND THEIR PHASE-OUT SCHEDULES



Effect of accepted solutions

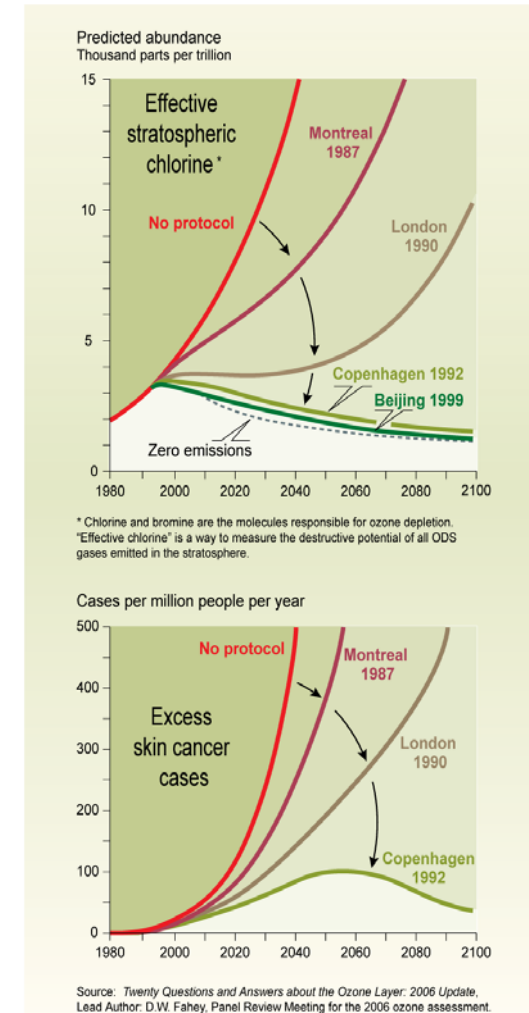
1985 – Vienna Convention for the Protection of the Ozone Layer

1987 – Montreal protocol + amendments

Costs of CFC abandonment

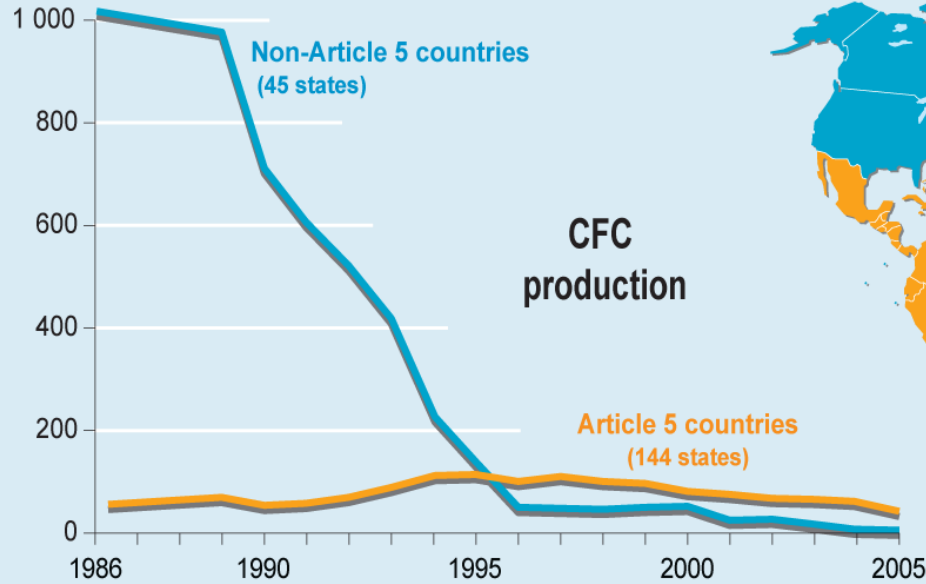
- 1988-2000 – product. decreased for 90%
- overall costs of abandonment - 40 bil. \$
- no job losses
- 1/3 simply not necessary
- **new HFC** in cars increased car price for 50-150 \$ (prognosed 1000-1500 \$)
- CH₃Br for soil **sterilisation** replaced e.g. with crop rotation
- CH₃Br for stores **fumigation** replaced with CO₂

THE EFFECTS OF THE MONTREAL PROTOCOL AMENDMENTS AND THEIR PHASE-OUT SCHEDULES



A common but differentiated responsibility

Thousand Ozone Depleting Potential Tonnes (ODP Tonnes)*



- Article 5 countries (developing)
- Non-Article 5 countries (industrialized)
- Countries that did not ratify the Montreal Protocol (not on the map: San Marino, Vatican, Andorra)

* Tonnes multiplied by the ozone depleting potential of the considered gas.

Source: United Nations Environment Programme Ozone Secretariat

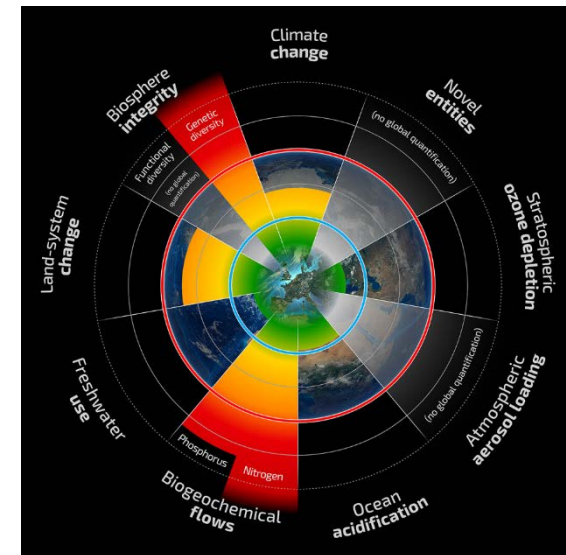
Lesson from successful solution of global issue

- cooperation of all the following stakeholders:
- scientific discoveries and monitoring – **problem notification**
- UNEP – **international coordinator of legal measures**
- environmental activists – **pressure to solve the issue**
- responsible consumers – **purchasing according to env. info**
- technical experts - **developing env.-friendly alternatives**
- flexible and responsible industry

UNEP

IV. Ocean acidification

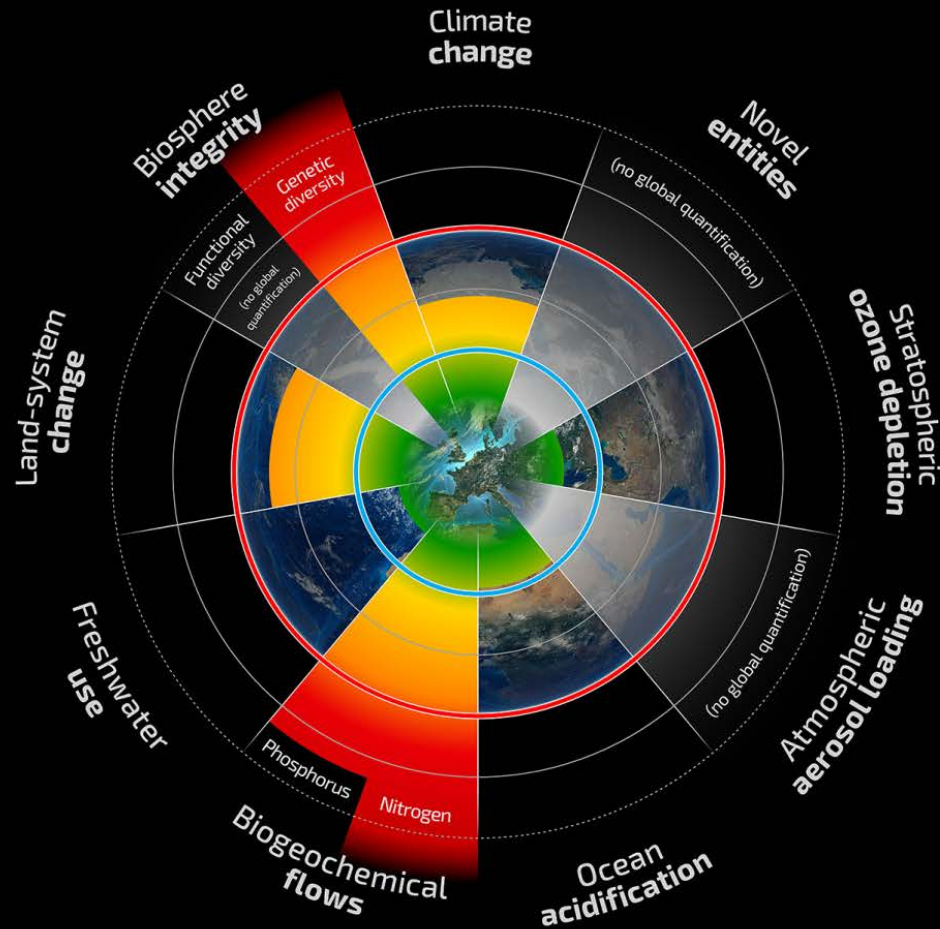
Earth-system process	Control variable(s)	Planetary boundary (zone of uncertainty)	Current value of control variable
Ocean acidification (R2009: same)	Carbonate ion concentration, average global surface ocean saturation state with respect to aragonite (Ω_{arag})	$\geq 80\%$ of the pre-industrial aragonite saturation state of mean surface ocean, including natural diel and seasonal variability ($\geq 80\%$ – $\geq 70\%$)	$\sim 84\%$ of the pre-industrial aragonite saturation state





Planetary Boundaries

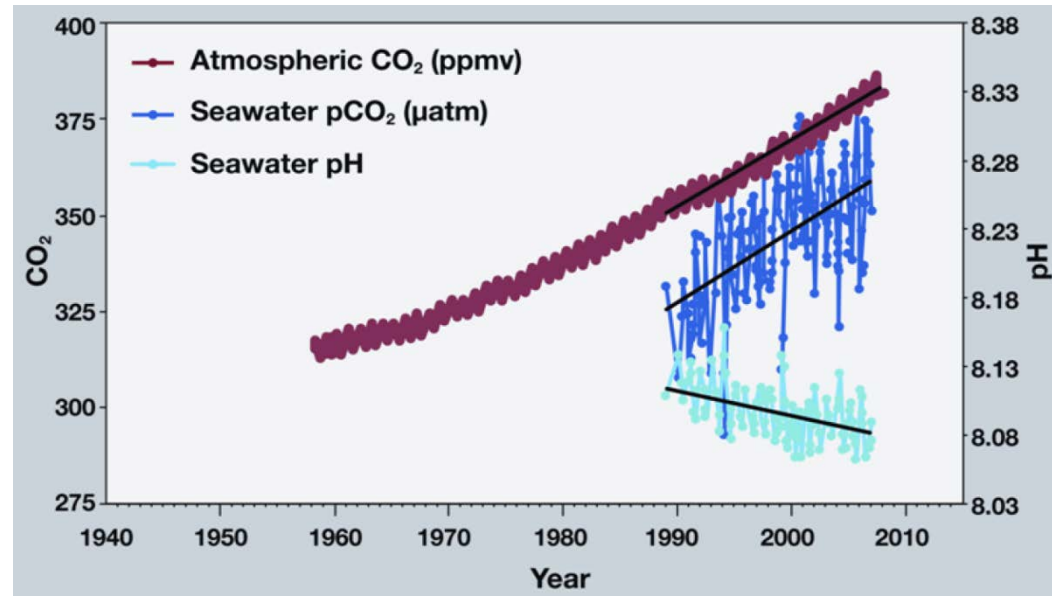
A safe operating space for humanity



- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

Ocean acidification

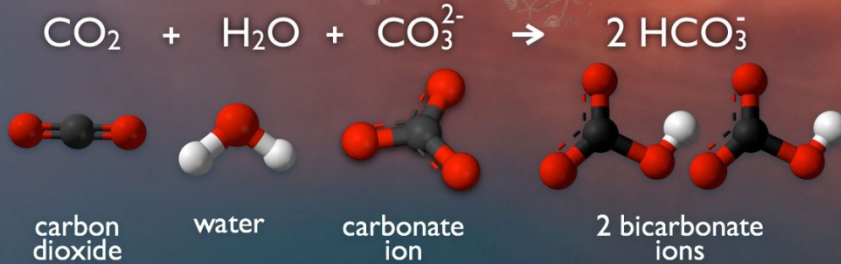
- what is the cause?



OCEAN ACIDIFICATION

HOW WILL CHANGES IN OCEAN CHEMISTRY AFFECT MARINE LIFE?

CO₂ absorbed from the atmosphere



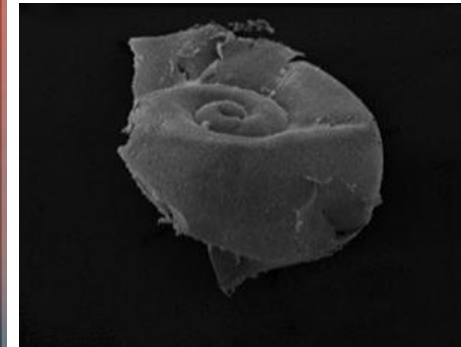
carbon dioxide

water

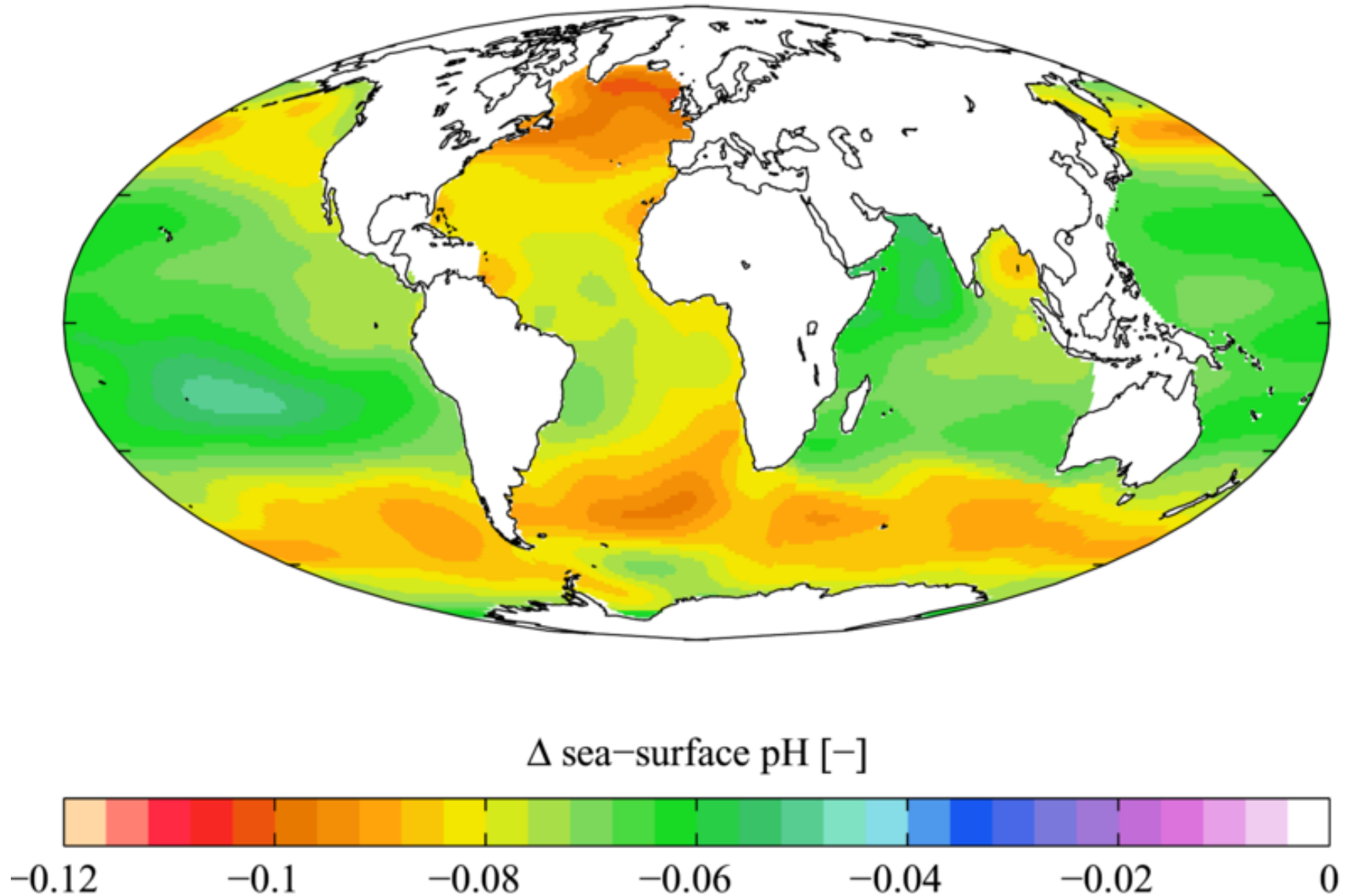
carbonate ion

2 bicarbonate ions

consumption of carbonate ions impedes calcification



Change in pH of oceans 1700-2000

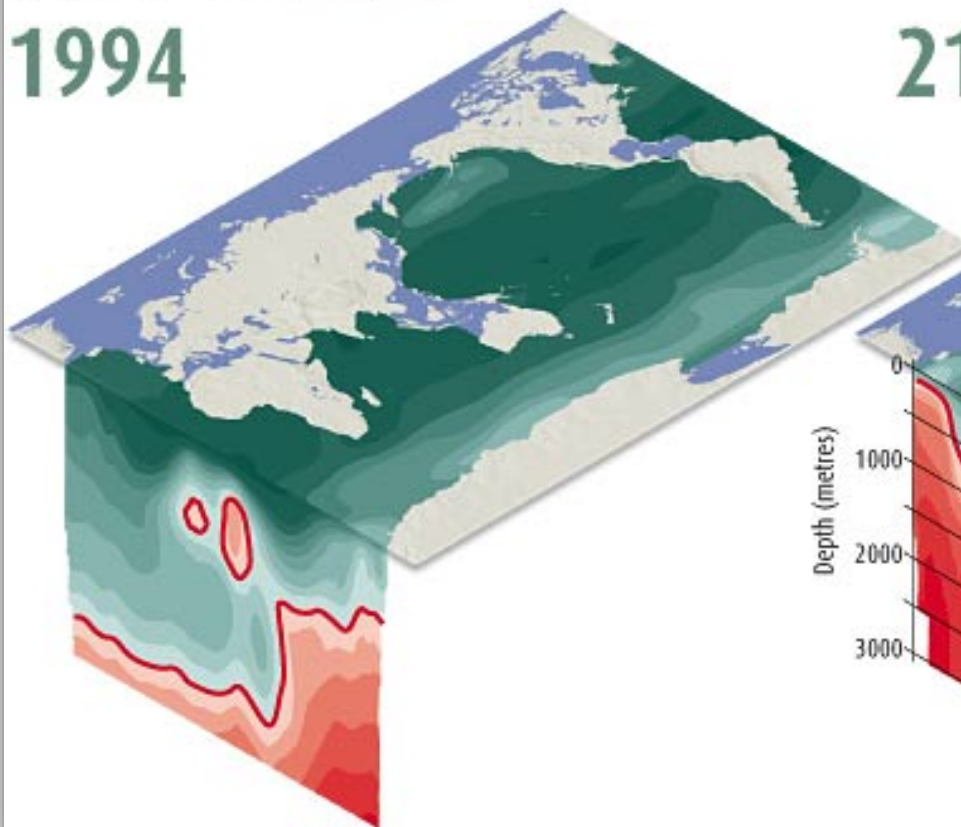


Change in pH of oceans - 3D distribution

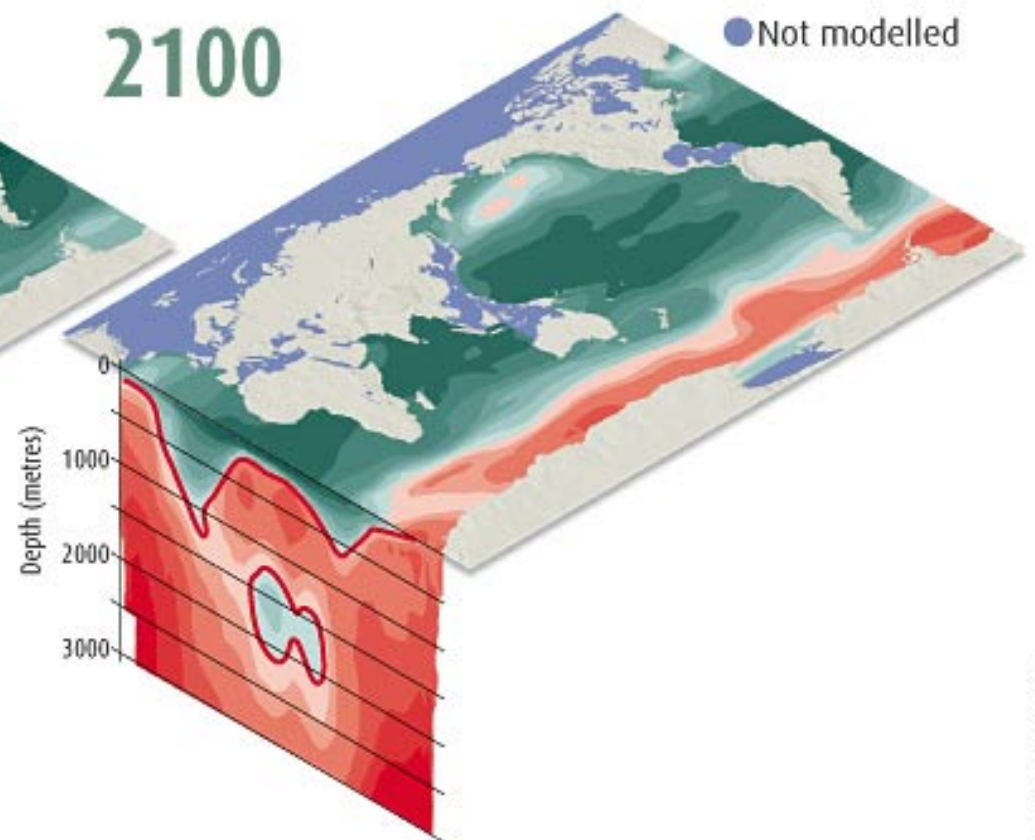
SHELL HELL

Many creatures make their shells or skeletons from a form of calcium carbonate called aragonite. This is possible because, apart from the deepest waters, most seawater is supersaturated with carbonate ions (green areas). As CO_2 levels rise, the saturation horizon will move upwards and even some surface water will become undersaturated (red). Tropical corals thrive in water three or four times past the saturation point (dark green)

1994



2100



„Natural laboratory“

- News Front Page
- Africa
 - Americas
 - Asia-Pacific
 - Europe
 - Middle East
 - South Asia
 - UK
 - Business
 - Health
 - Science & Environment**
 - Technology
 - Entertainment
 - Also in the news
- Video and Audio
- Programmes
- Have Your Say
 - In Pictures
 - Country Profiles
 - Special Reports

Page last updated at 17:08 GMT, Sunday, 8 June 2008 18:08 UK

E-mail this to a friend Printable version

Natural lab shows sea's acid path

By Richard Black
Environment correspondent, BBC News website



Scientists study conditions at the bottom of the Mediterranean Sea

Natural carbon dioxide vents on the sea floor are showing scientists how carbon emissions will affect marine life.

Dissolved CO2 makes water more acidic, and around the vents, researchers saw a fall in species numbers, and snails with their

Related BBC sites
Sport

26 March 2014 Last updated at 23:03 GMT Share

How climate change will acidify the oceans

By Roger Harrabin
BBC environment analyst, Normanby Island



Off the remote eastern tip of Papua New Guinea a natural phenomenon offers an alarming glimpse into the future of the oceans, as increasing concentrations of CO2 in the atmosphere make sea water more acidic.

Streams of volcanic CO2 bubbles emerge from deep under the seabed here, like a giant jacuzzi.

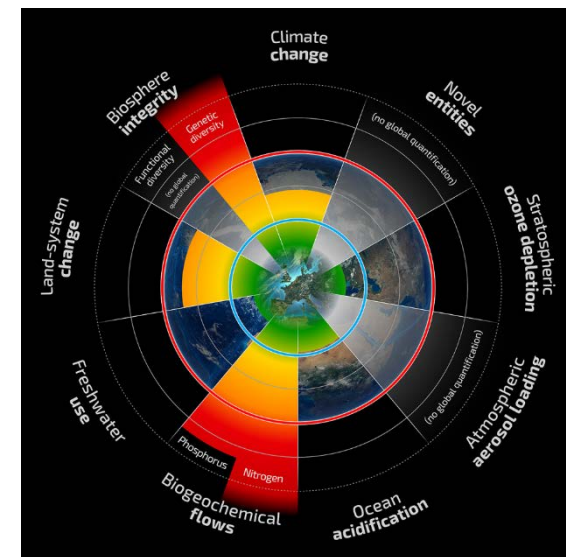
As the bubbles of carbon dioxide dissolve into the water, carbonic acid is

In today's Magazine

One lonely man and his hoard of Nazi art
Malaysia plane: 10 questions that are still unresolved

V and VI. Biogeochemical flows of P and N

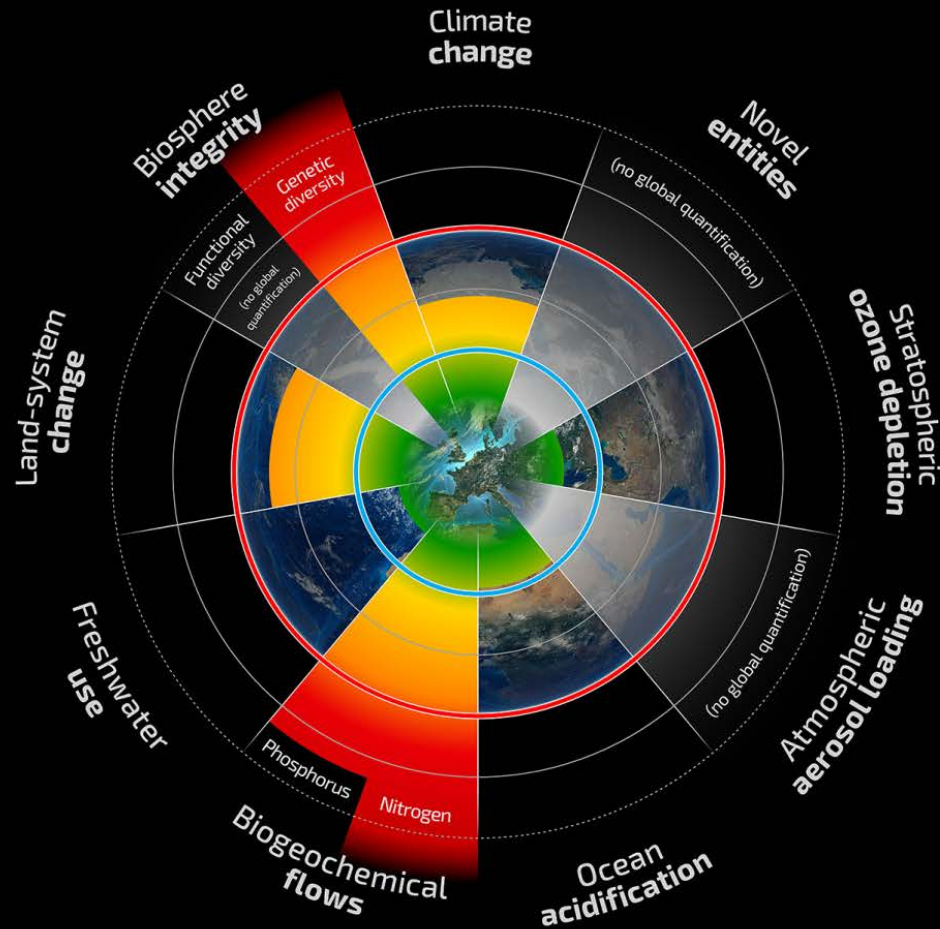
Earth-system process	Control variable(s)	Planetary boundary (zone of uncertainty)	Current value of control variable
Biogeochemical flows: (P and N cycles) (R2009: Biogeochemical flows: (interference with P and N cycles))	<i>P Global:</i> P flow from freshwater systems into the ocean	11 Tg P yr ⁻¹ (11–100 Tg P yr ⁻¹)	~22 Tg P yr ⁻¹
	<i>P Regional:</i> P flow from fertilizers to erodible soils	6.2 Tg yr ⁻¹ mined and applied to erodible (agricultural) soils (6.2-11.2 Tg yr ⁻¹). Boundary is a global average but regional distribution is critical for impacts.	~14 Tg P yr ⁻¹
	<i>N Global:</i> Industrial and intentional biological fixation of N	62 Tg N yr ⁻¹ (62–82 Tg N yr ⁻¹). Boundary acts as a global 'valve' limiting introduction of new reactive N to Earth System, but regional distribution of fertilizer N is critical for impacts.	~150 Tg N yr ⁻¹





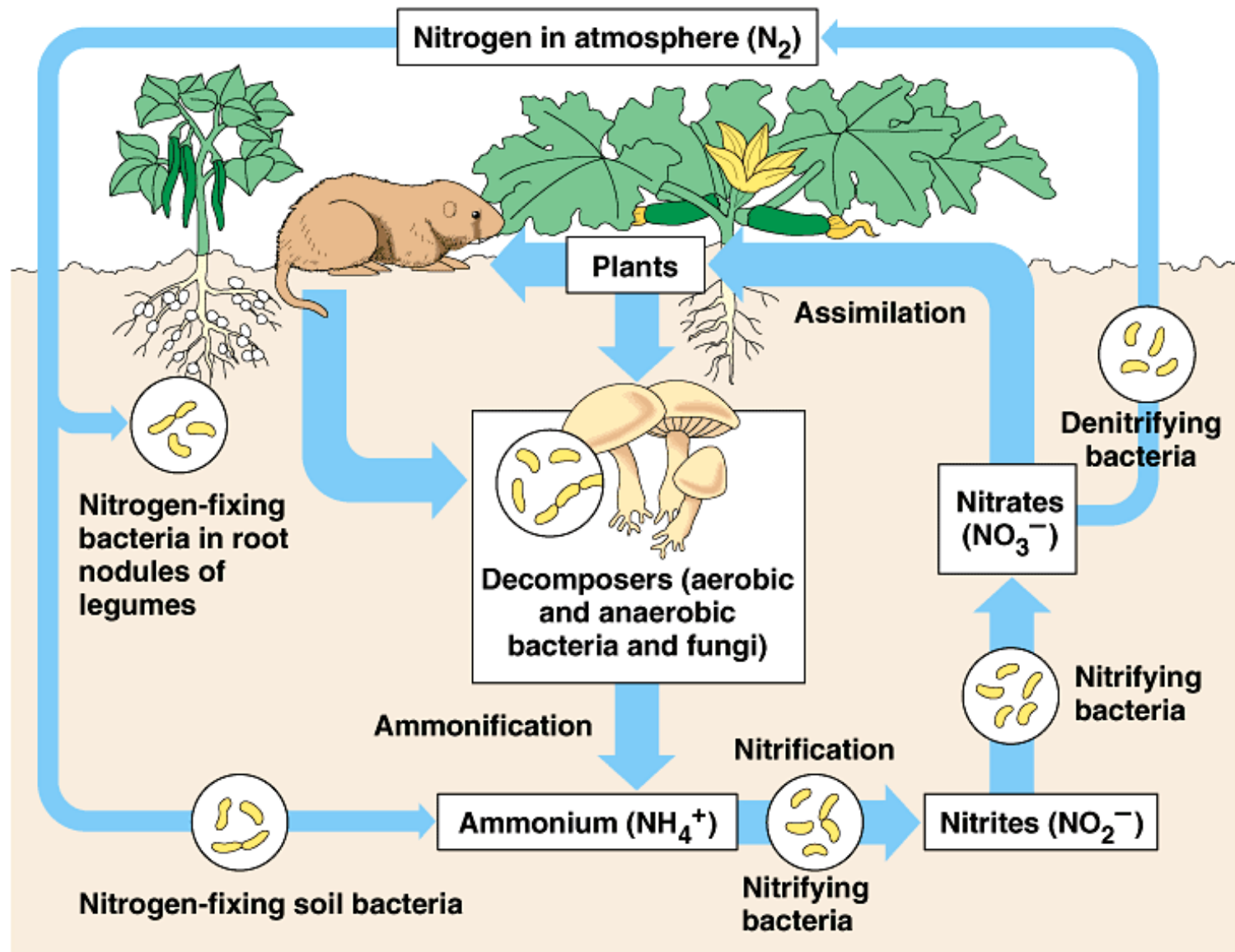
Planetary Boundaries

A safe operating space for humanity



- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

N - Nitrogen – natural geochemical cycle

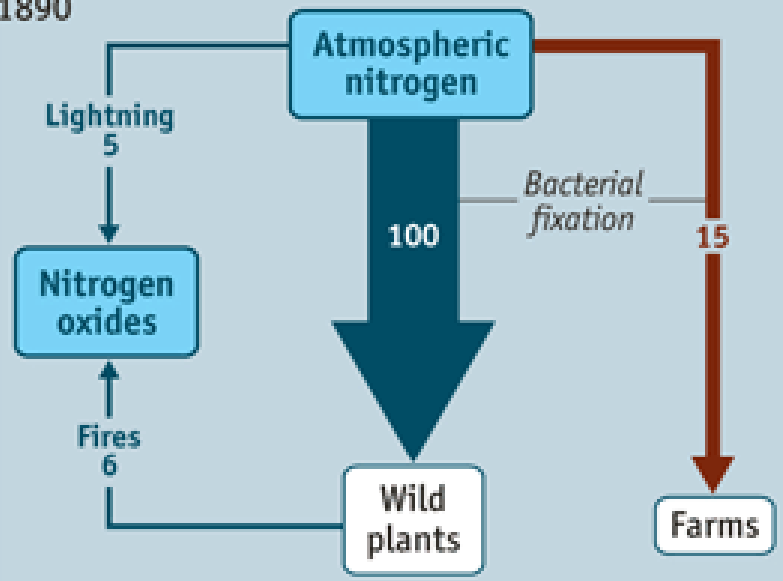


N - Nitrogen

Unbalancing the cycle

Nitrogen flows, megatonnes

1890



Source: Galloway and Cowling, *Ambio*

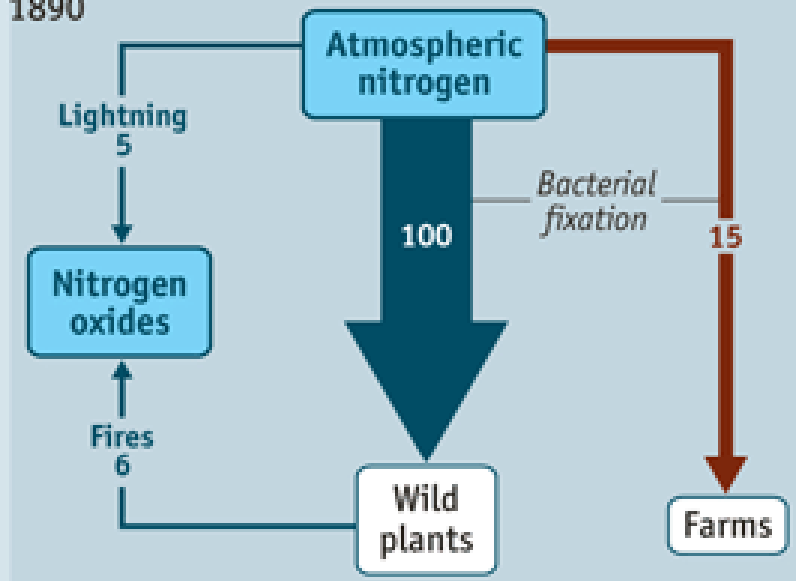
N - Nitrogen

- today, human activity changes **more N_2 to reactive forms of N than all terrestrial processes together**
- Haber-Bosch 80 Mt_N/yr , leguminosities 40 Mt_N/yr , fossil fuels combustion 20 Mt_N/yr , biomass combustion 10 Mt_N/yr

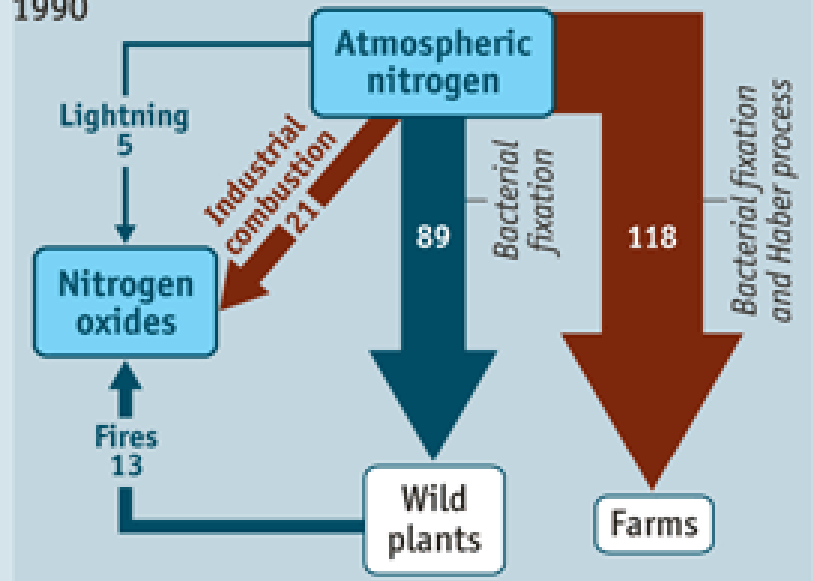
Unbalancing the cycle

Nitrogen flows, megatonnes

1890



1990



Source: Galloway and Cowling, *Ambio*

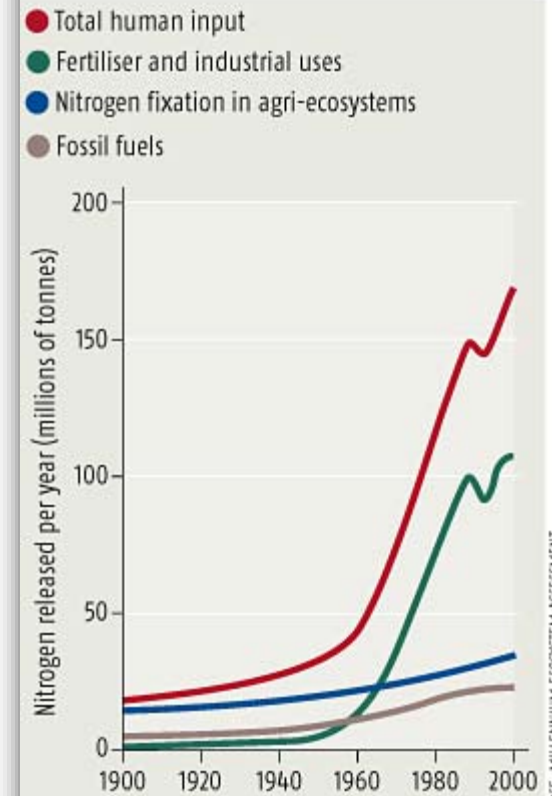
N - Nitrogen

- major reason of N_2 fixation ?



NITROGEN POLLUTION

The amount of reactive nitrogen released into the environment is increasing



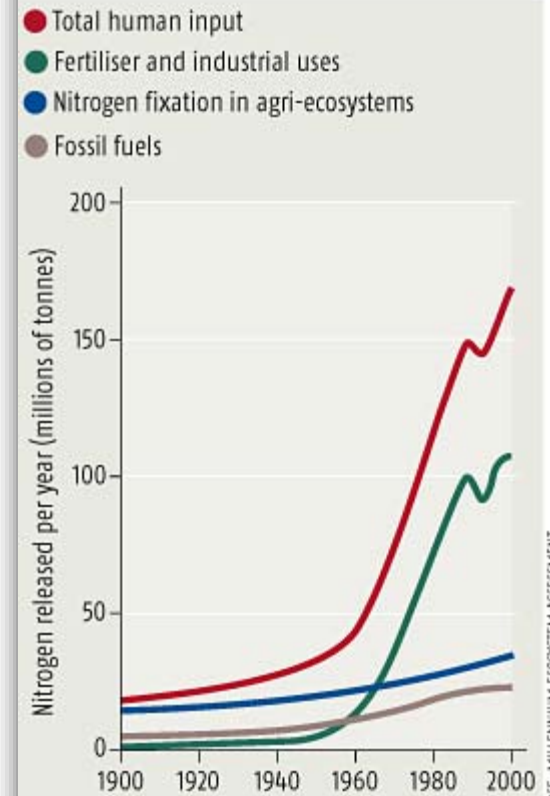
N - Nitrogen

- major reason of N_2 fixation ?
- **N-fertilizers**
- significant part ends in water – **eutrofication and nitrates issue**
- significant part ends in atmosphere **N_2O is GHG and O_3 decomp.**
- overall decrease of resilience of planetary systems thanks to high input of reactive nitrogen molecules

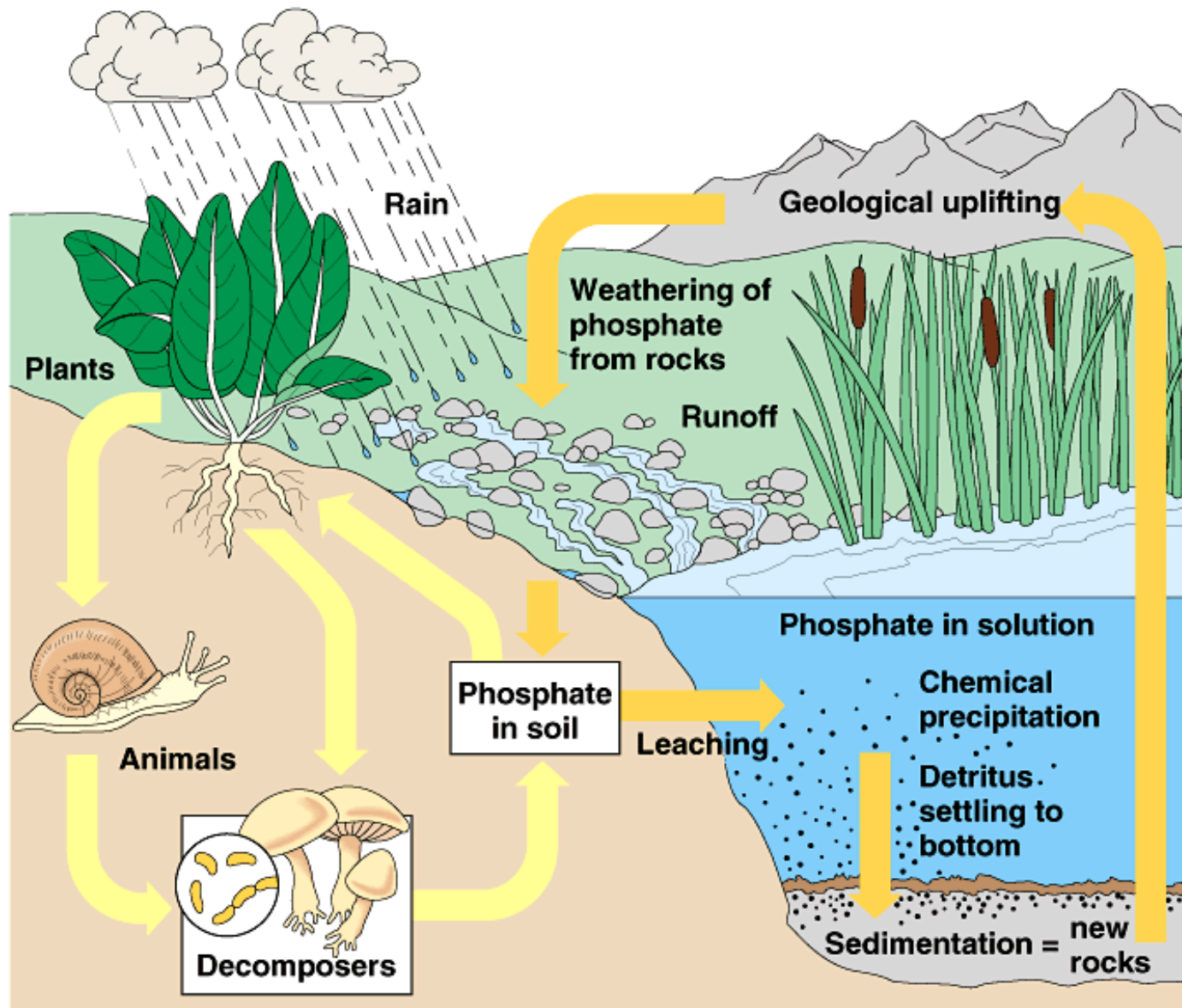


NITROGEN POLLUTION

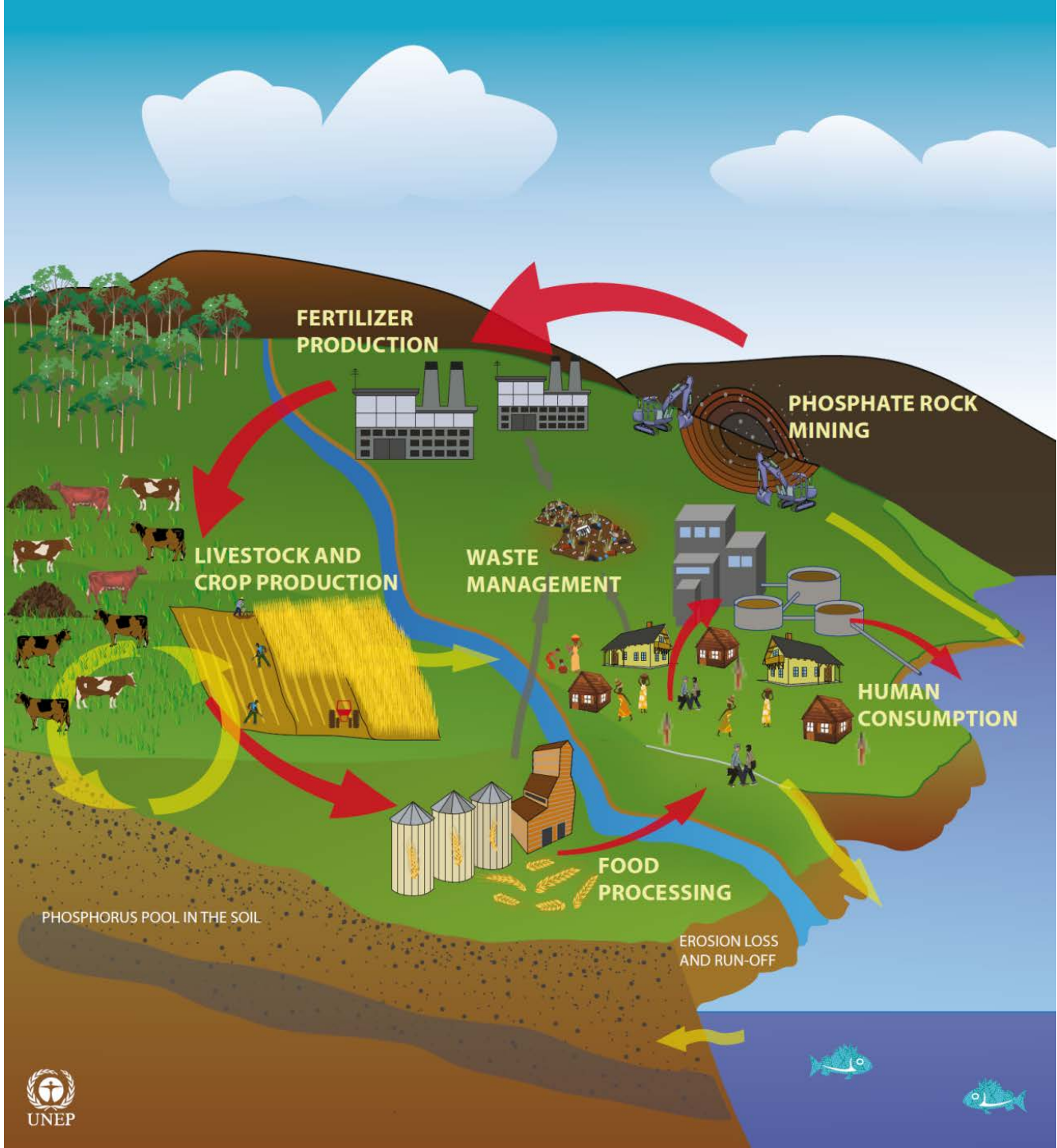
The amount of reactive nitrogen released into the environment is increasing



P – phosphorus – natural geochemical cycle

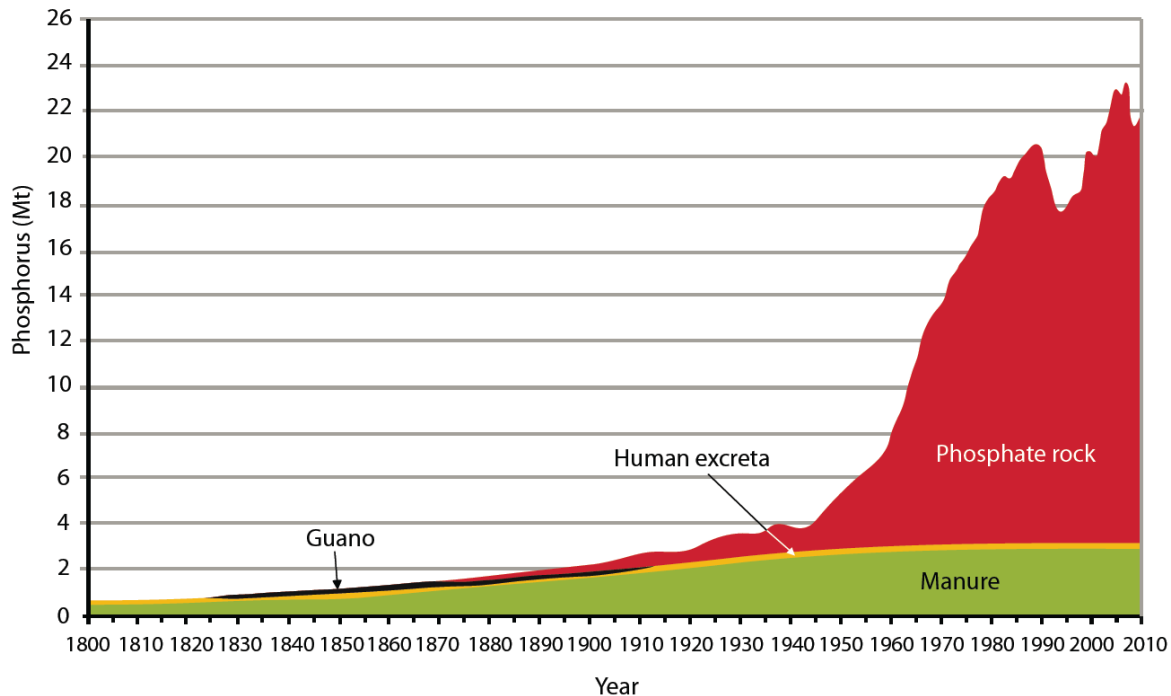


Human intervention to P cycle



P - phosphorus

- primary source - **weathering or apatite mining**
- anthropogenic flow to oceans - 8-9x higher amount
- from 20 Mt_N/yr industr. P – half ends in oceans
- higher risk of **anoxic events**

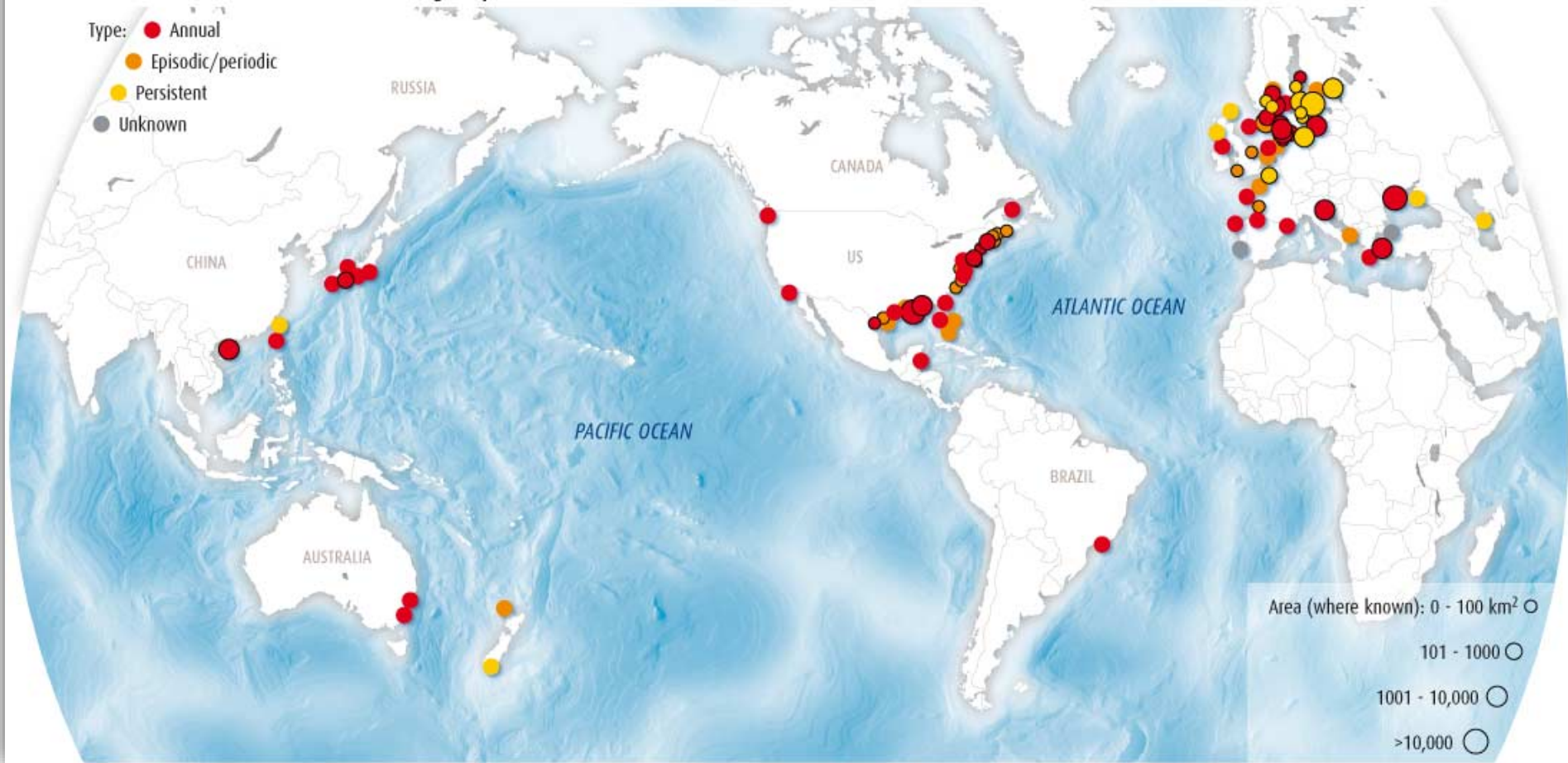


P + N = anoxic zones in oceans

200 AND COUNTING

The number of dead zones around the world is doubling every decade

- Type:
- Annual
 - Episodic/periodic
 - Persistent
 - Unknown

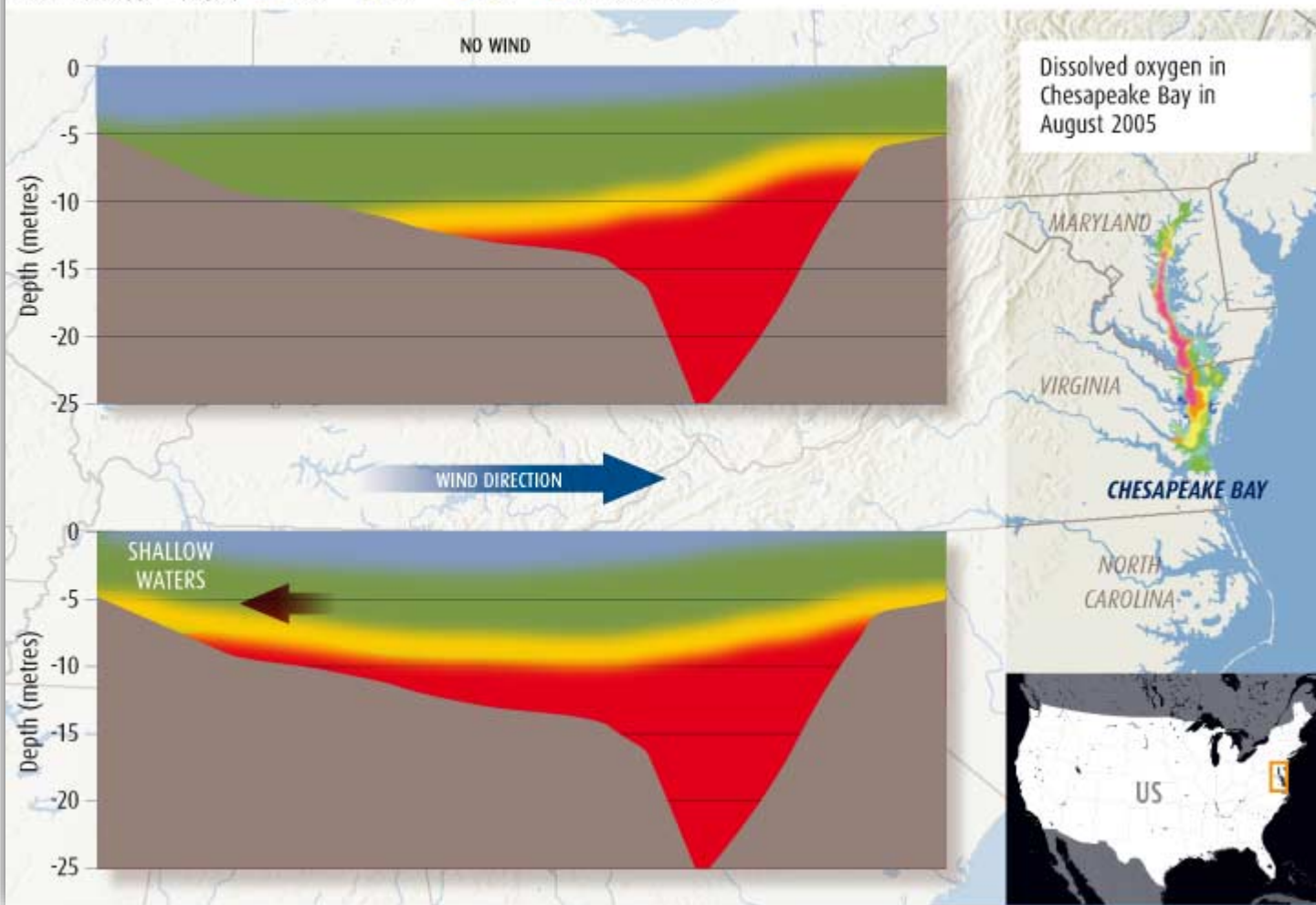


P + N = anoxic zones in oceans

ANNUAL PLAGUE

Every summer, oxygen levels in Chesapeake Bay plummet. Strong winds can make surface water pile up on one side of the bay, causing the dead zone to spill over into the shallow waters

Dissolved oxygen (mg/l) ● 10.0 ● 5.0 ● 2.5 ● 0.0 (dead zone)



Deadly trio

My New Scientist

[Home](#) | [Environment](#) | [Life](#) | [News](#)

The oceans are heating, acidifying and choking

- › 19:58 04 October 2013 by [Fred Pearce](#)
- › For similar stories, visit the [Climate Change](#) Topic Guide

We know the oceans are warming. We know they are acidifying. And now, to cap it all, it turns out they are suffocating, too. A new health check on the state of the oceans warns that they will have lost as much as 7 per cent of their oxygen by the end of the century.

The cascade of chemical and biological changes now under way could see coral reefs irreversibly destroyed in 50 to 100 years, with marine ecosystems increasingly taken over by [jellyfish](#) and toxic algal blooms.

The [review](#) is a repeat of a study two years ago by the [International Programme on the State of the Ocean](#) (IPSO), a coalition of scientists. It concludes that things have become worse since the first study.

"The health of the oceans is spiralling downwards far more rapidly than we had thought, exposing organisms to intolerable and unpredictable evolutionary pressure," says [Alex Rogers](#) at the University of Oxford, the scientific director of IPSO.

Deadly trio

Rogers describes a "deadly trio" of linked global threats. The first is global warming: surface sea water has been [warming](#) almost as fast as the atmosphere. The second is [acidification](#) – a result of the water absorbing ever more CO₂ from the atmosphere. The third is [deoxygenation](#).

[f](#) To see mi fibi 626 [t](#) 256 [g+](#) 109

[Share](#) 171 [Print](#) [Email](#) [Print](#) [Print](#)

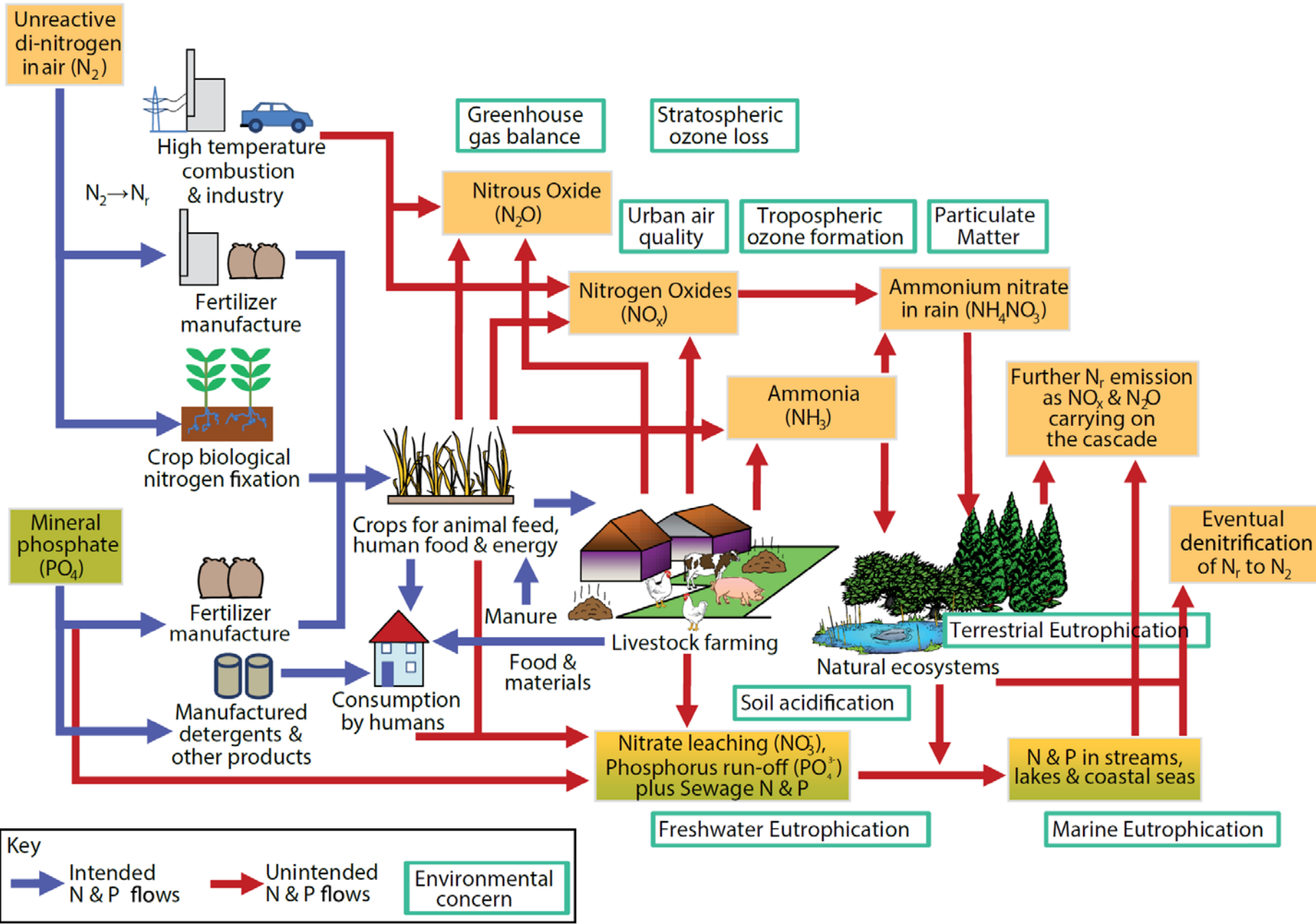


Getting harder to breathe underwater (Image: [Incredible Features/Barcroft Media](#))

ADVERTISEMENT

Hyundai i40 2013, 1.7 CRDI

Simplified view of the nitrogen and phosphate cascade



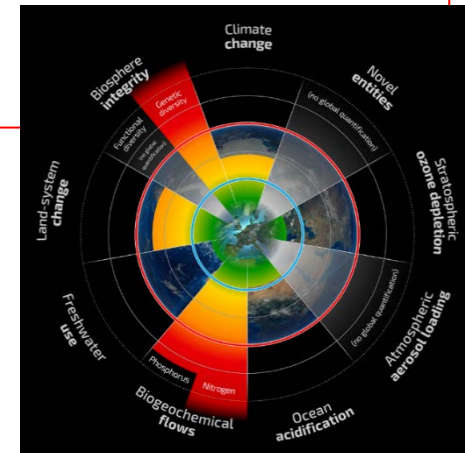
VII. Global freshwater consumption

Earth-system process	Control variable(s)	Planetary boundary (zone of uncertainty)	Current value of control variable
Freshwater use (R2009: Global freshwater use)	<p><i>Global:</i> Maximum amount of consumptive blue water use ($\text{km}^3\text{yr}^{-1}$)</p> <p><i>Basin:</i> Blue water withdrawal as % of mean monthly river flow</p>	<p><i>Global:</i> $4000 \text{ km}^3 \text{ yr}^{-1}$ ($4000\text{--}6000 \text{ km}^3 \text{ yr}^{-1}$)</p> <p><i>Basin:</i> Maximum monthly withdrawal as a percentage of mean monthly river flow. For low-flow months: 25% (25–55%); for intermediate-flow months: 30% (30–60%); for high-flow months: 55% (55–85%)</p>	$\sim 2600 \text{ km}^3 \text{ yr}^{-1}$

Boundary: No more than 4000 km^3 of fresh water consumed per year

Current level: 2600 km^3 per year

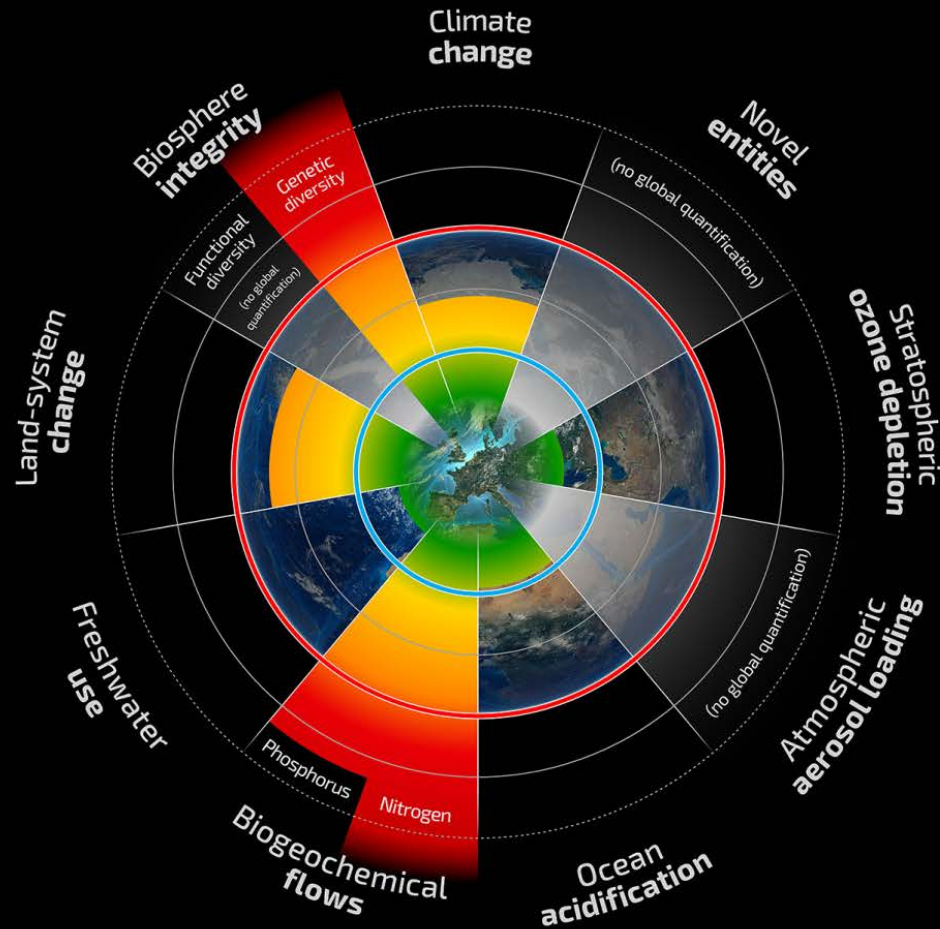
Diagnosis: Boundary will be approached by mid-century





Planetary Boundaries

A safe operating space for humanity



- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

FW issue

- People are a dominant force changing **flow of water in rivers**
- cca 25 % water does not reach the ocean
- consequences for the biodiversity, nutrition, aquatic and terrestrial ecosystems

8 Mighty Rivers Run Dry From Overuse

[Main](#) [About the Freshwater Initiative](#) [Restoring Rivers](#) [Reducing Water Use](#) [News](#) [Videos](#)

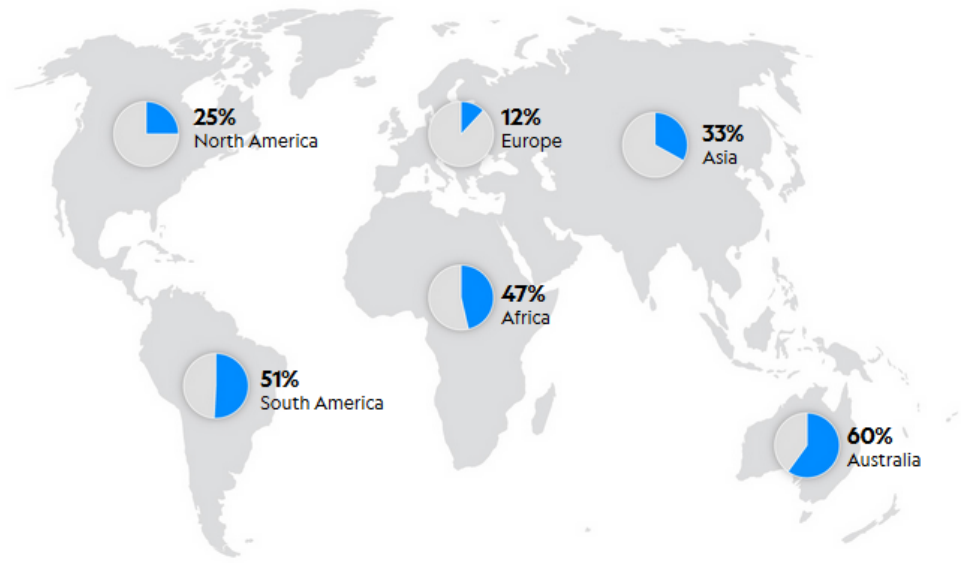




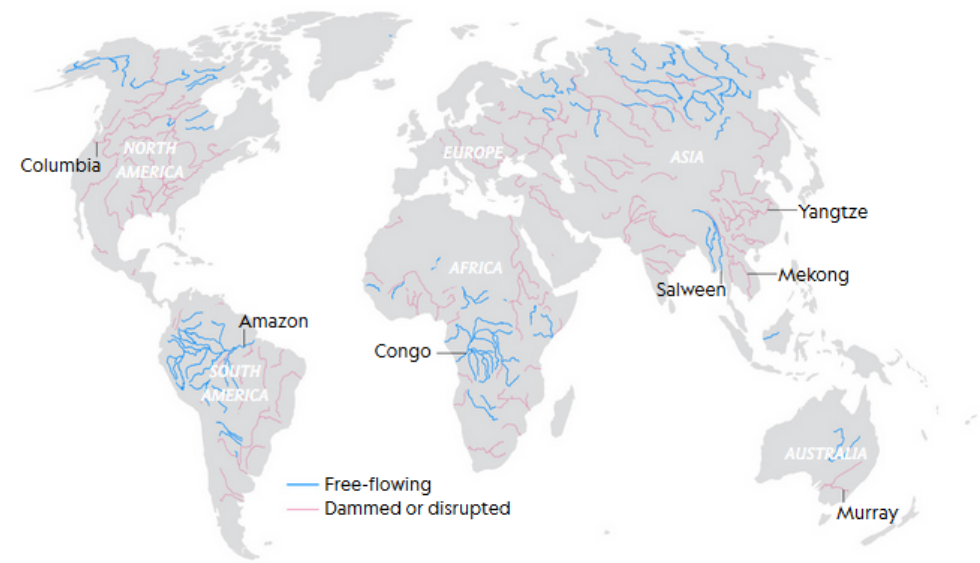
The world's remaining free-flowing rivers

Only 37 percent of world's largest rivers are free of dams or other disruptions. Free-flowing rivers are found primarily in the Amazon and Congo Basins, and in the Arctic.

Percentage of very large rivers (longer than 1,000 km) that remain free-flowing, by continent



Distribution of very large rivers

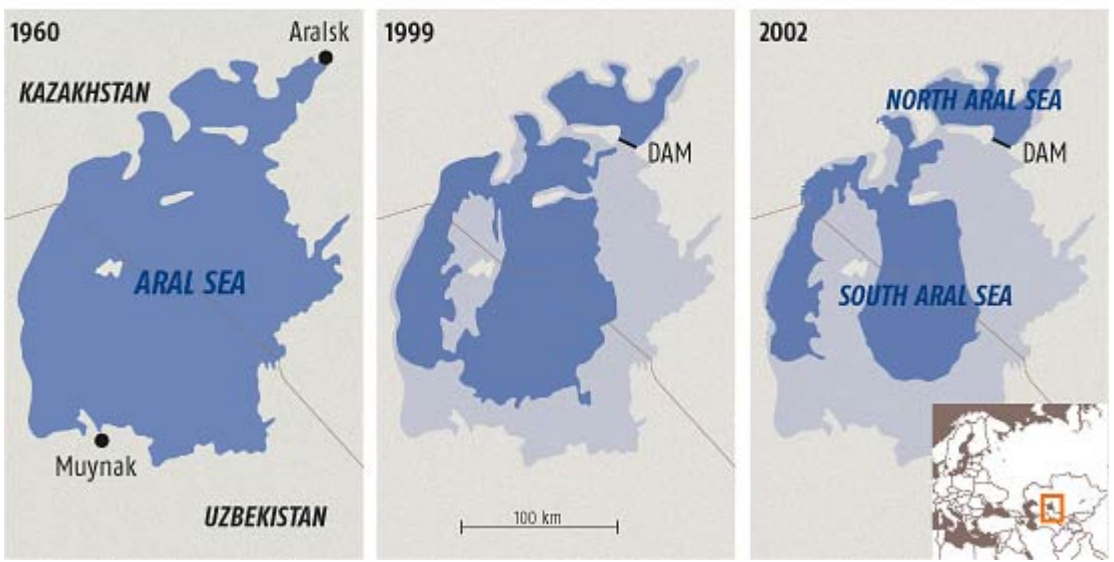


Aral See - Kazachstan, Uzbekistan



THE SHRINKING SEA

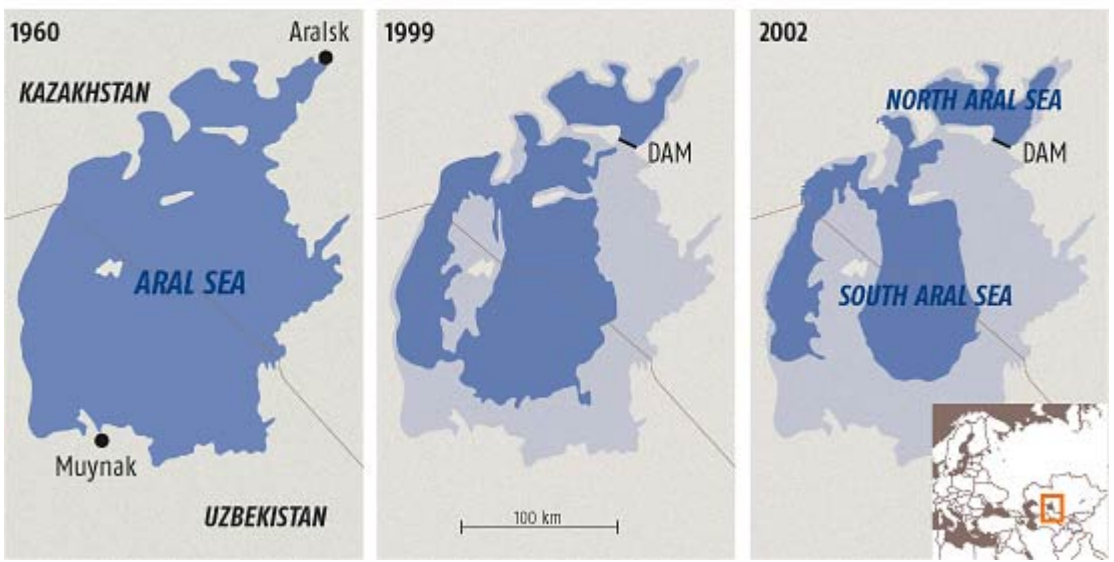
The changed shape of the Aral Sea since 1960



- 2005 – a dam between N and South part was constructed
- what has happened?

THE SHRINKING SEA

The changed shape of the Aral Sea since 1960



- 2005 – a dam between N and South part was constructed
- what has happened?

An original area of the Aral sea (1960) was:

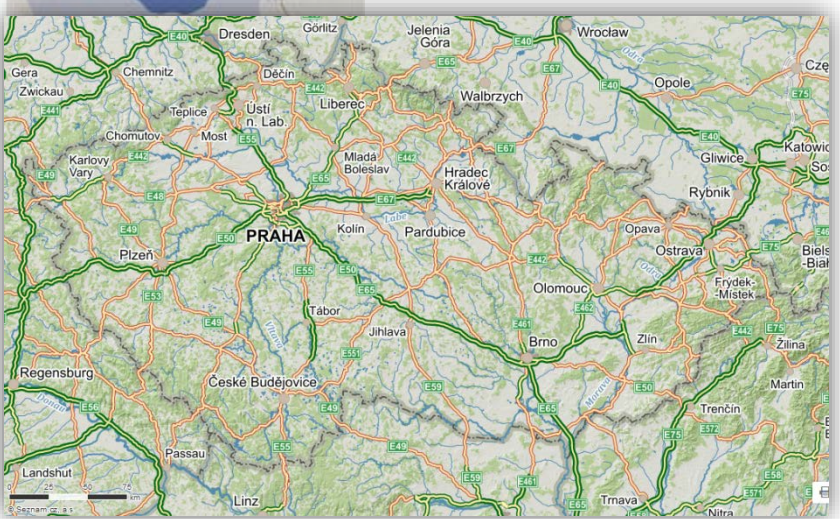
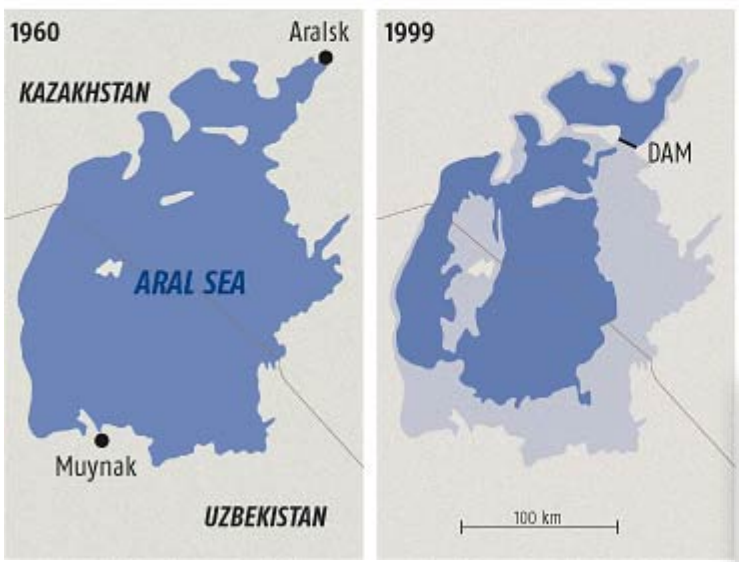
Bigger than
Czechia

Of similar
size to
Czechia

Smaler than
Czechia

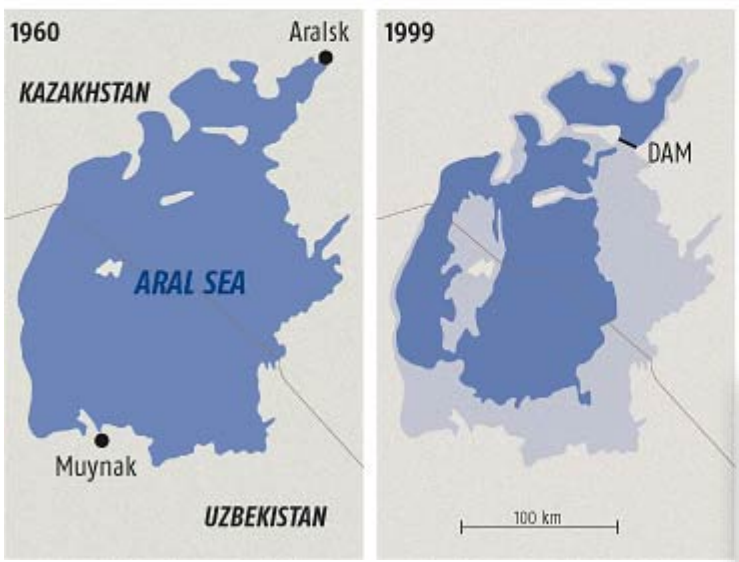
THE SHRINKING SEA

The changed shape of the Aral Sea since 1960

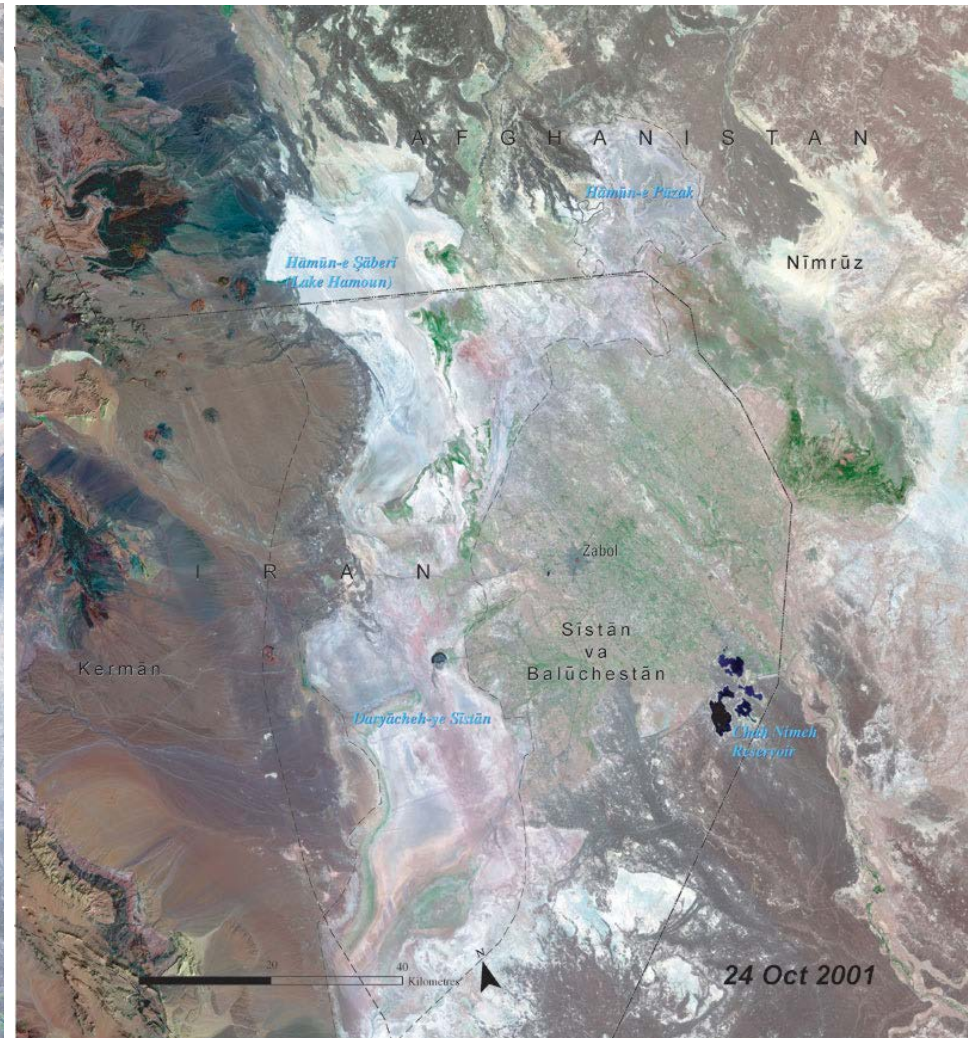
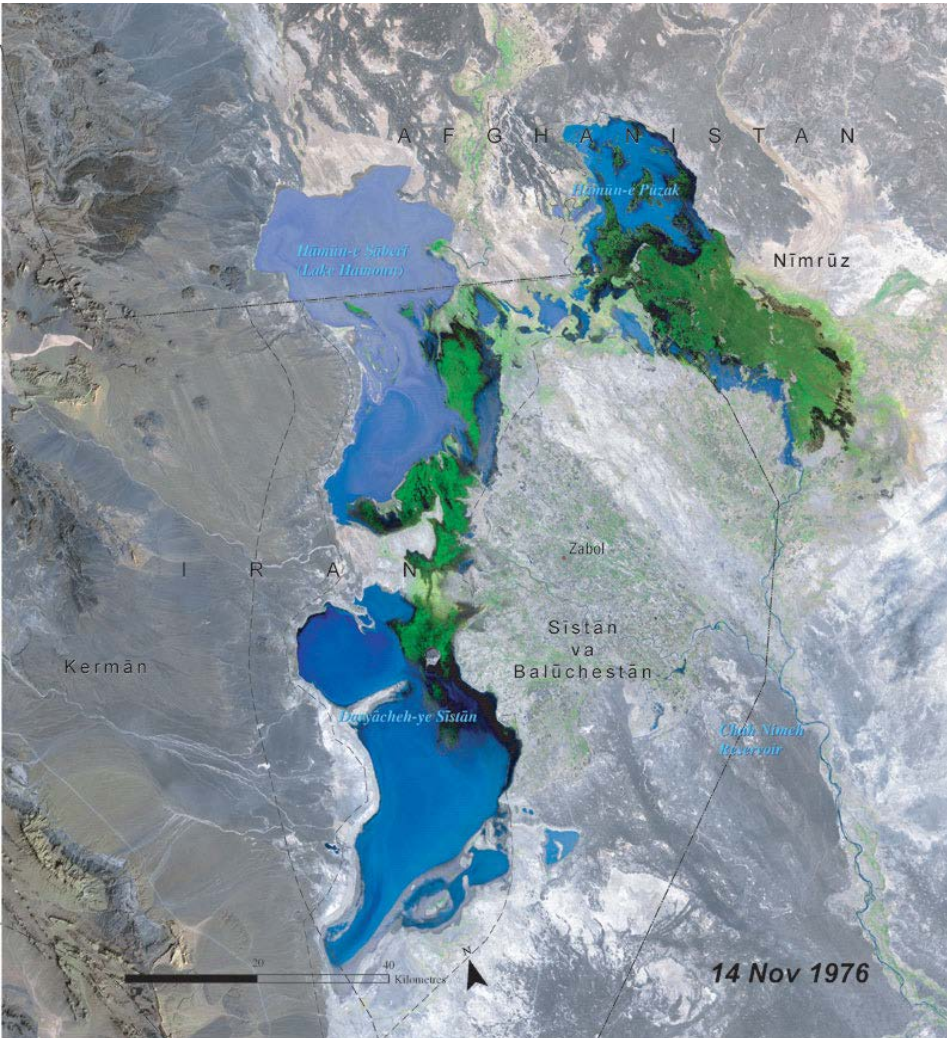


THE SHRINKING SEA

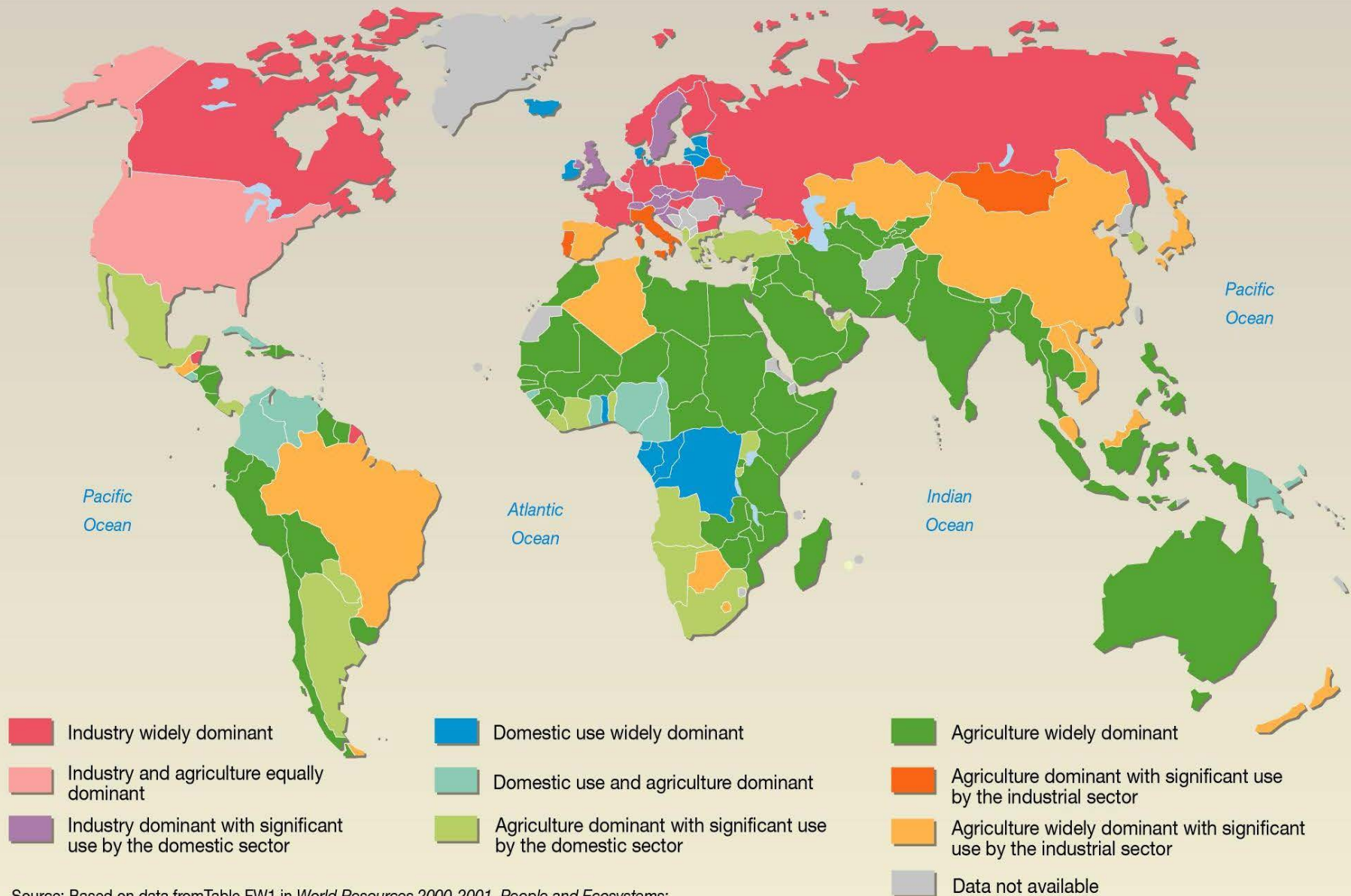
The changed shape of the Aral Sea since 1960



Lake Hamoun – Iran, Afghanistan



Areas and types of water consumption



Source: Based on data from Table FW1 in *World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life*, World Resources Institute (WRI), Washington DC, 2000.

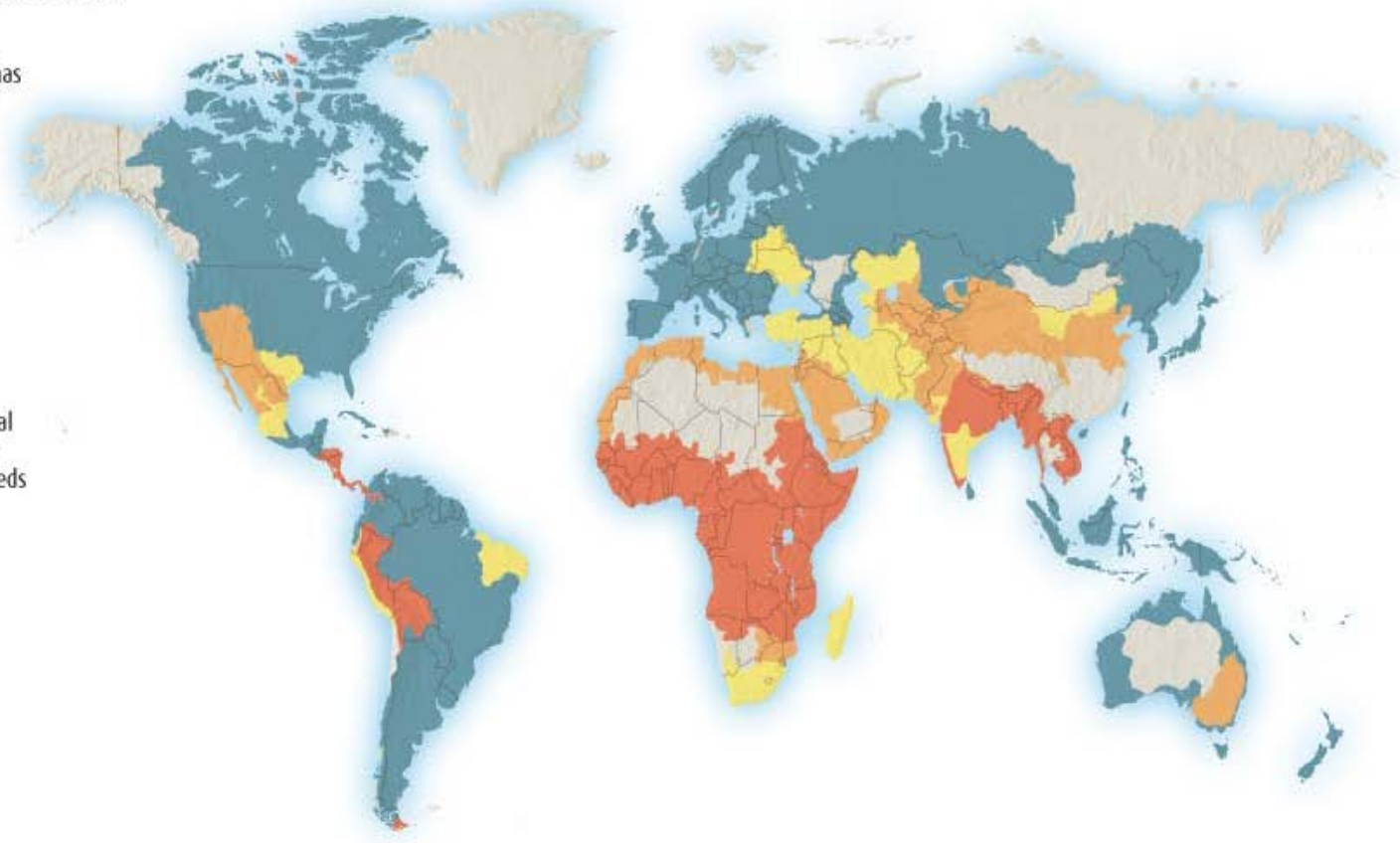


Water consumption - what does it mean?

Areas and types of water scarcity

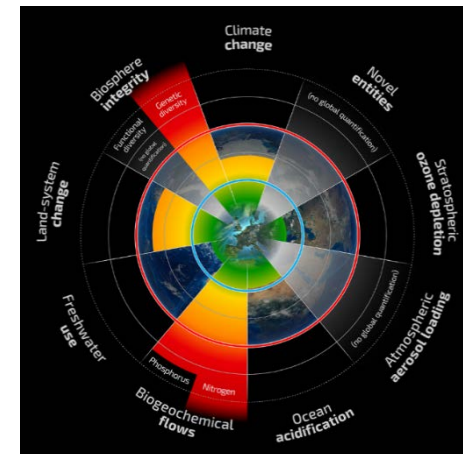
Areas around the globe suffering from depleted water resources

- Physical water scarcity**
Water resource development is approaching or has exceeded sustainable limits. More than 75% of river flow is extracted for agriculture
- Approaching physical water scarcity**
More than 60% of river flow is extracted. These areas will experience physical water scarcity in the near future
- Economic water scarcity**
Limited access to water even though natural local supplies are available to meet human demands. Less than 25% of water extracted for human needs
- Little or no water scarcity**
Abundant water resources relative to use, with less than 25% of water extracted for human purposes
- Not estimated**



VIII. Land use

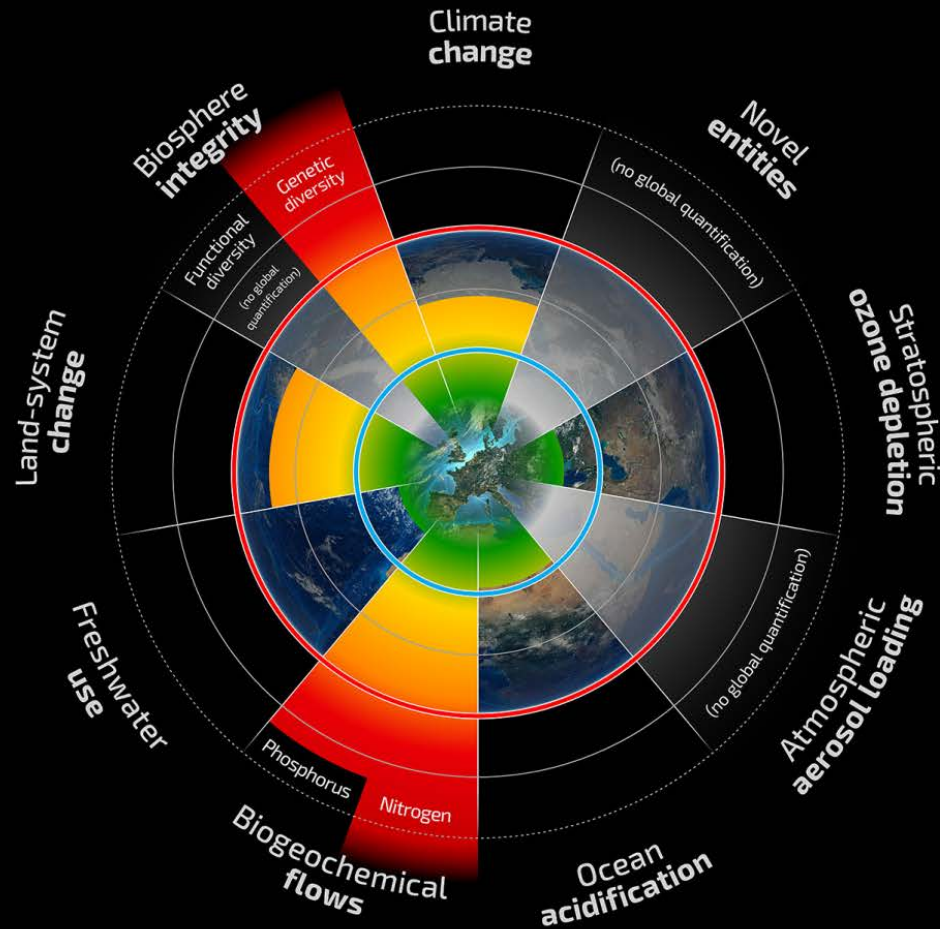
Earth-system process	Control variable(s)	Planetary boundary (zone of uncertainty)	Current value of control variable
Land-system change (R2009: same)	<i>Global:</i> Area of forested land as % of original forest cover	<i>Global:</i> 75% (75–54%) Values are a weighted average of the three individual biome boundaries and their uncertainty zones	62%
	<i>Biome:</i> Area of forested land as % of potential forest	<i>Biome:</i> Tropical: 85% (85–60%) Temperate: 50% (50–30%) Boreal: 85% (85–60%)	





Planetary Boundaries

A safe operating space for humanity



- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)
- Boundary not yet quantified

Santa Cruz, Bolivia

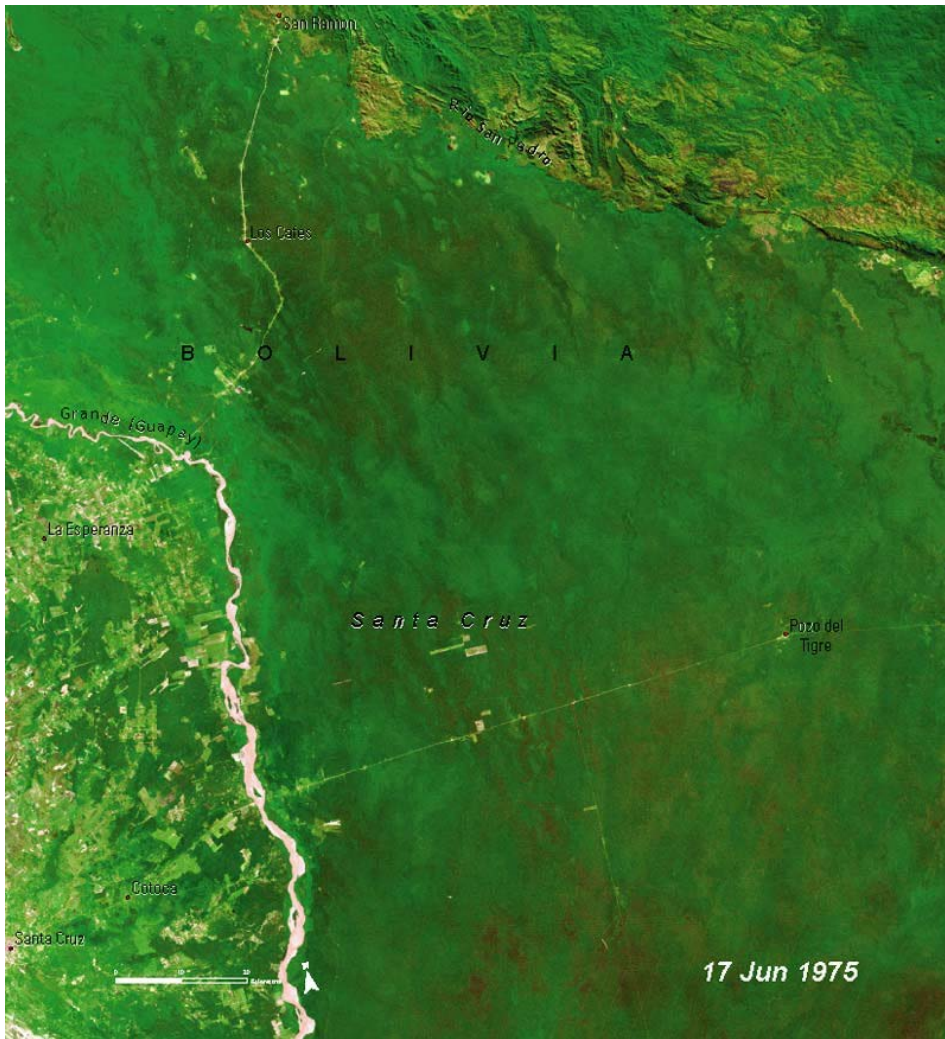
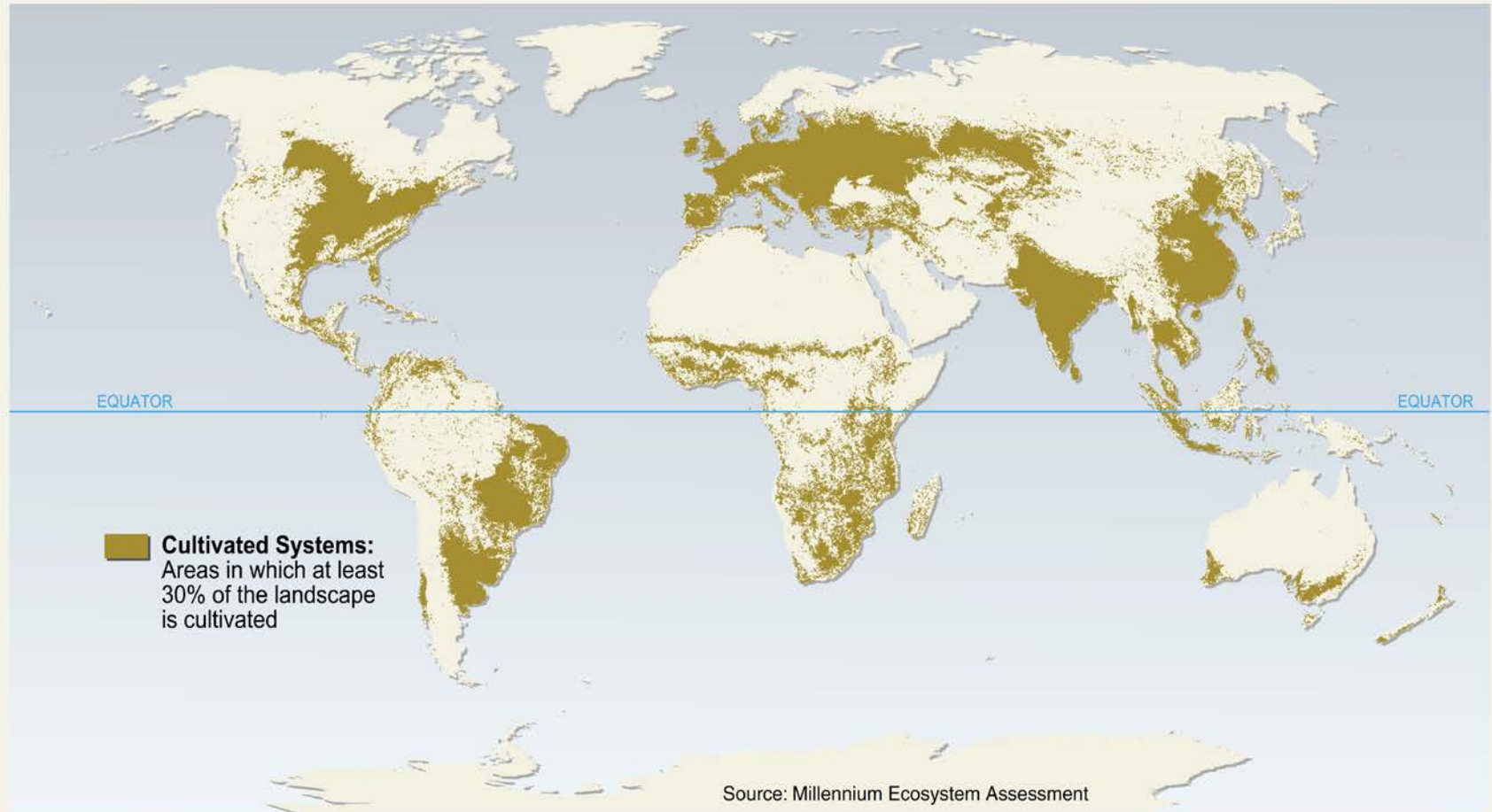




Figure 1. EXTENT OF CULTIVATED SYSTEMS, 2000. Cultivated systems cover 24% of the terrestrial surface.





Change in land system

- **agriculture** (main driver)
- In the last 50 years, change of the ice-free land to the agriculture land circa 0.8% per year
- main force of the changes of **ecosystem services and functions** (e.g. food production, water cleaning, etc.),
- habitat loss is a main force of **biodiversity loss**
- it undermines human **well-being and sustainability**
- exceeding the safe level of a land system change in a certain region can lead to a **sudden change** in the character of the landscape



Change in land system

- **agriculture** (main driver)
- In the last 50 years, change of the ice-free land to the agriculture land circa 0.8% per year
- main **function**
- **habitat**
- it und
- **exceed**
- **certain**
- **chara**

Parts of Amazon close to tipping point

› 13:52 05 March 2009 by [Catherine Brahic](#)

› For similar stories, visit the [Endangered Species](#) Topic Guide

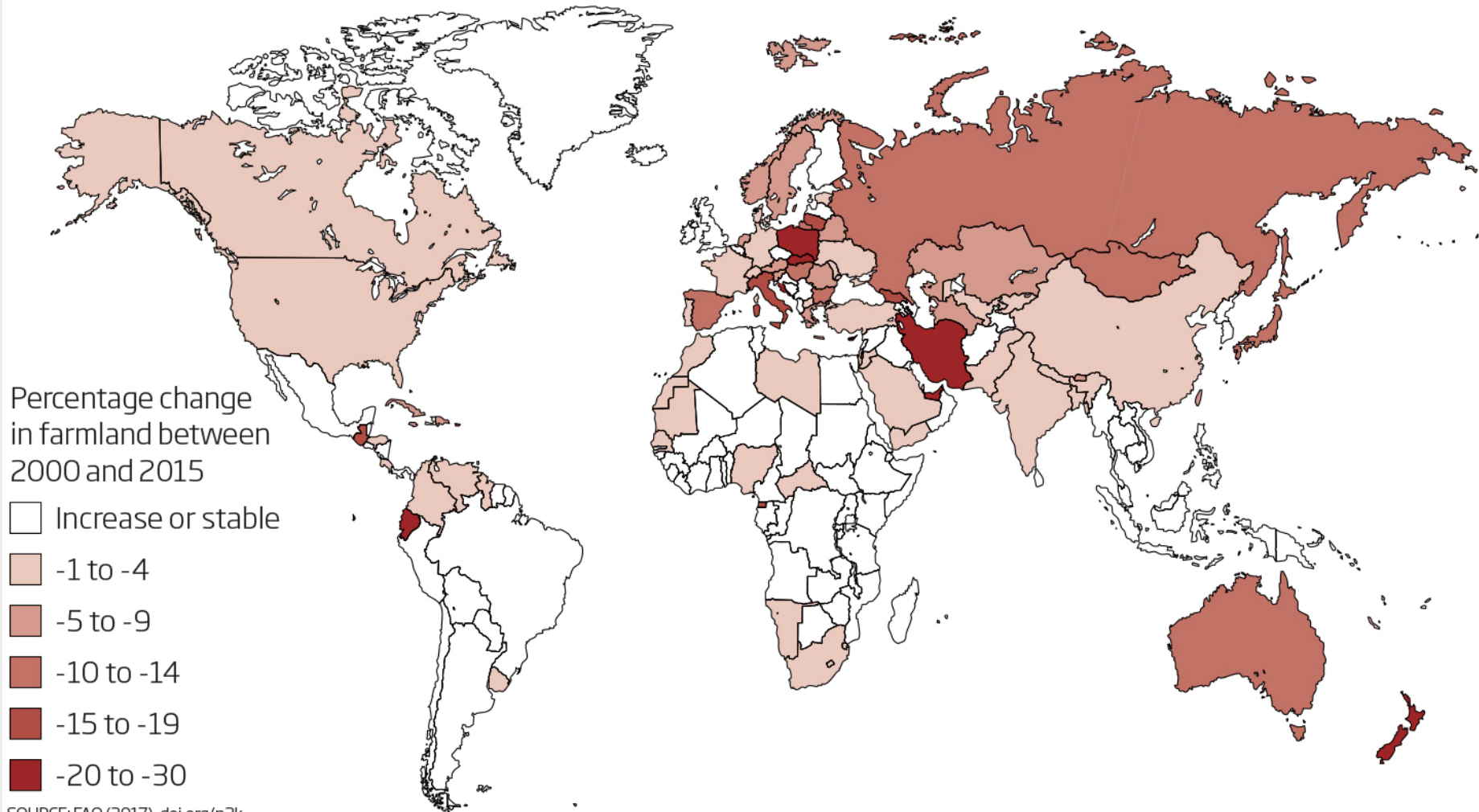
The Mato Grosso, the most scarred region of the Amazon rainforest, is teetering on a deforestation "tipping point", and may soon be on a one-way route to becoming a dry and relatively barren savannah.

[Mônica Carneiro Alves Senna](#) and colleagues at the Federal University of Viçosa, Brazil, used computer models to simulate how the Amazon would recover from various amounts of deforestation. Their simulations ranged from a complete wipe-out of the entire forest to a situation where just one fifth of the forest would be removed.

Optimistic future?

Shrinking farmland

For the first time, more land is being left to return to nature than is being cleared for agriculture



SOURCE: FAO (2017), doi.org/n2k

It looks like an oxymoron, but Earth optimism is worth a try

Decades of environmental doom-mongering have fallen on deaf ears. Maybe a new environmental campaign with a message of hope is just what we need





FEATURE 11 October 2017

Is positive thinking the way to save the planet?

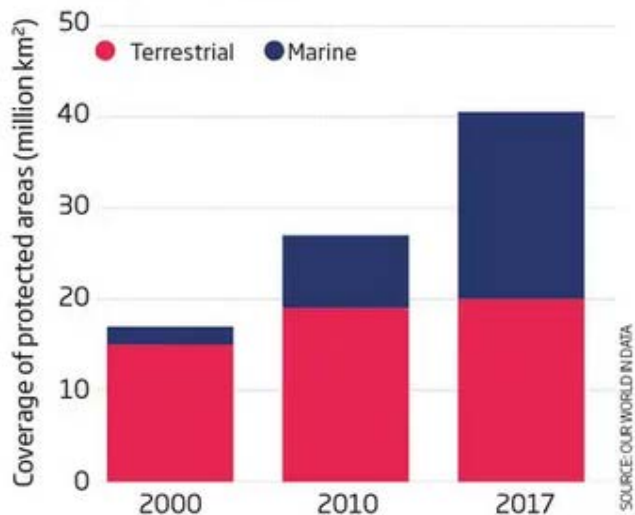
Move over doom and gloom, there is a new environmental movement in town. Earth optimists say focusing on small successes is the way forward



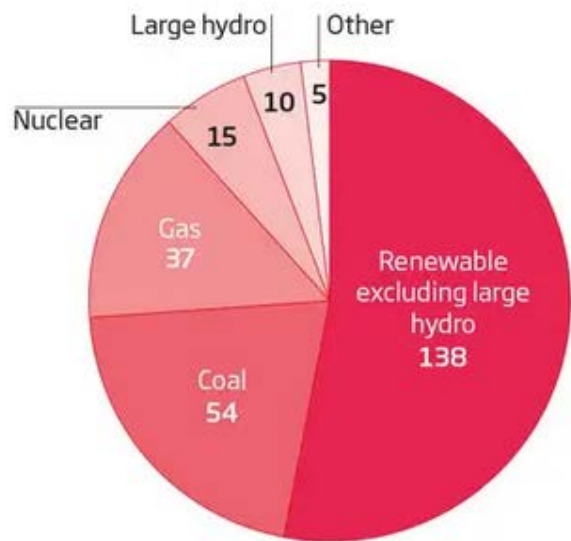


Reasons to be hopeful...

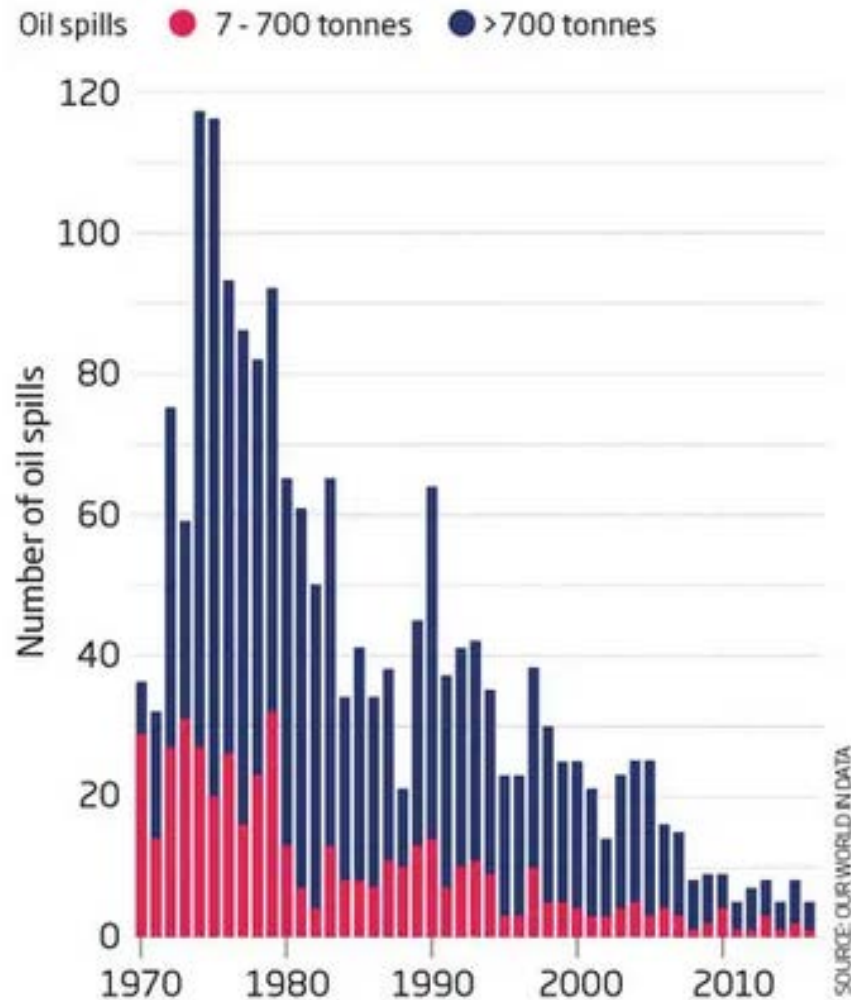
The extent of protected areas is increasing, particularly in the oceans




In 2016, for the second year in a row, renewables accounted for more than half of the new power capacity added globally (in gigawatts)



The number of oil spills has dropped markedly in recent decades





What feelings does such information evoke in you?

Top

