



Centrum pro výzkum  
toxických látek  
v prostředí

# ENV016 Udržitelný rozvoj II

## - souvislosti environmentálního pilíře



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Inovace a rozšíření výuky zaměřené na problematiku životního prostředí na PŘF MU (CZ.1.07/2.2.00/15.0213)  
spolufinancován Evropským sociálním fondem a státním rozpočtem České republiky

## Osnova

- 1) Globální úspěchy a prohry
- 2) Ekologické určení vztahu člověka k ŽP.
- 3) Env. souvislosti získávání energie a potravy.
- 4) Vztah ekologie a environmentalistiky, historický vývoj.
- 5) Environmentální etika.
- 6) Environmentální etika.
- 7) Environmentální ekonomie.
- 8) Environmentální ekonomie.
- 9) Environmentální právo a politika.
- 10) Princip předběžné opatrnosti.
- 11) Hodnotová řešení environmentální krize.
- 12) Hodnotová řešení environmentální krize.







# Ekonomický x sociální x environmentální rozvoj

## SUSTAINABLE DEVELOPMENT: 1980-2007

Human Development Index and Ecological Footprint of Nations



# Sociální rozvoj

The screenshot shows the UNDP website header with navigation links: "UNDP around the world", "About Us", "Publications", "News Centre", "Partners", "English", "Español", and "Français". The main navigation bar includes "Our Work", "Millennium Development Goals", and "Our Perspective". A search bar is located in the top right corner.

Home >

## The Millennium Development Goals

# Eight Goals for 2015

1990 **0.87** years until the end of 2015 2015

- 1** Eradicate extreme poverty and hunger
- 2** Achieve universal primary education
- 3** Promote gender equality and empower women
- 4** Reduce child mortality
- 5** Improve maternal health
- 6** Combat HIV/AIDS, malaria and other diseases
- 7** Ensure environmental sustainability
- 8** Develop a global partnership for development

**Post-2015 Development Agenda**

**THE WORLD WE WANT**

UNDP launched an unprecedented global conversation through which people can help shape the future





THE MILLENNIUM DEVELOPMENT GOALS (MDGs) ARE THE MOST SUCCESSFUL GLOBAL ANTI-POVERTY PUSH IN HISTORY. AS WE APPROACH THE 2015 TARGET DATE OF THE MDGs, LET'S RALLY OUR WORLD TO STEP UP **#MDGMOMENTUM**

**MDG1**



ERADICATE  
EXTREME POVERTY  
AND HUNGER



**EXTREME  
POVERTY**

RATES HAVE BEEN

**CUT IN  
HALF**

SINCE 1990

**LET'S  
STEP  
UP**

**WORLD  
WIDE**

**1 IN 8 REMAIN  
PEOPLE HUNGRY**

**SHARE #MDGMOMENTUM  
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# Eradicate extreme poverty and hunger

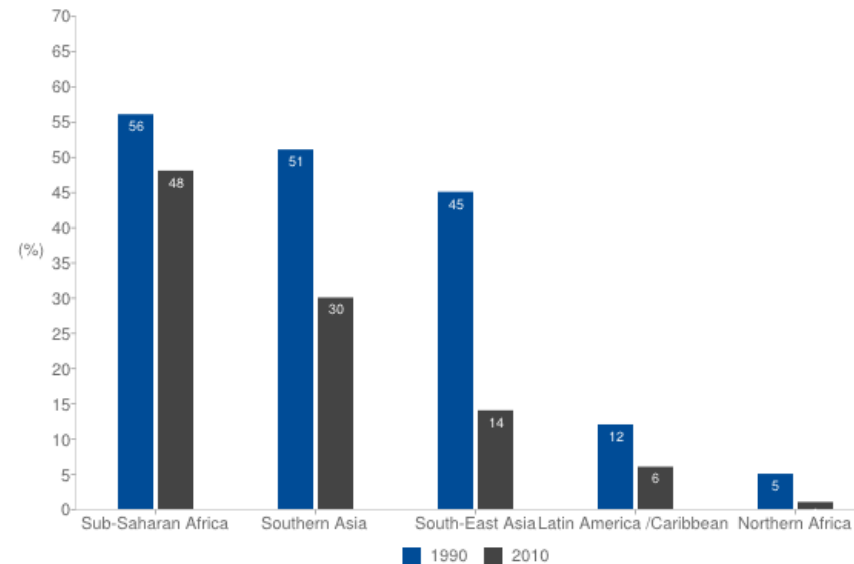
## Where do we stand?

1.2 billion still live in extreme poverty, even though poverty rates have been halved between 1990 and 2010 and the MDG target has been met.

In 2012, a quarter of all children under the age of five years were estimated to be stunted—having inadequate height for their age. This represents a significant decline since 1990 when 40 per cent of young children were stunted. However, it is unacceptable that 162 million young children are still suffering from chronic undernutrition.

*Proportion of people living on less than \$1.25 a day, 1990 and 2010 (Percentage)*

Source: [The Millennium Development Goals Report 2014](#).



- About one in five persons in developing regions lives on less than \$1.25 per day.
- Vulnerable employment accounted for 56 per cent of all employment in developing regions, compared to 10 per cent in developed regions.
- About 173 million fewer people worldwide suffered from chronic hunger in 2011–2013 than in 1990–1992.
- One in four children under age five in the world has inadequate height for his or her age.
- Every day in 2013, 32,000 people had to abandon their homes to seek protection due to conflict.





THE MILLENNIUM DEVELOPMENT GOALS (MDGs) ARE THE MOST SUCCESSFUL GLOBAL ANTI-POVERTY PUSH IN HISTORY.

**MDG2**



ACHIEVE UNIVERSAL PRIMARY EDUCATION

**PRIMARY SCHOOL ENROLMENT**

IN DEVELOPING REGIONS HAS

**REACHED 90%**



**LET'S STEP UP**

**57 MILLION CHILDREN REMAIN OUT OF SCHOOL**

**SHARE**

**#MDGMOMENTUM WITH YOUR COMMUNITY!**



# Achieve universal primary education

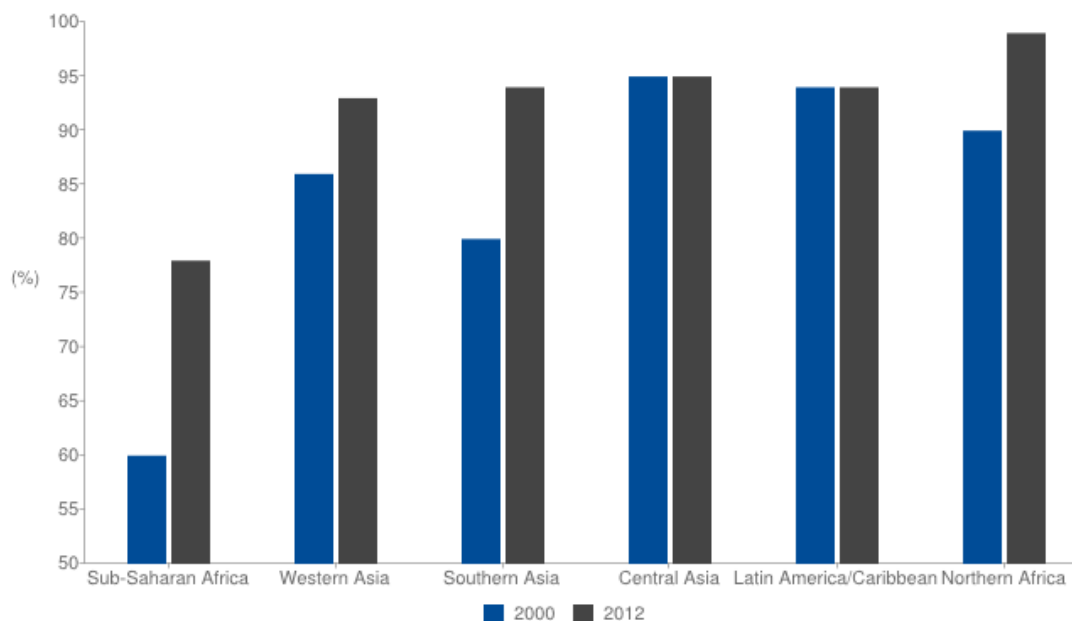
## Where do we stand?

Despite impressive strides forward at the start of the decade, progress in reducing the number of children out of school has slackened considerably.

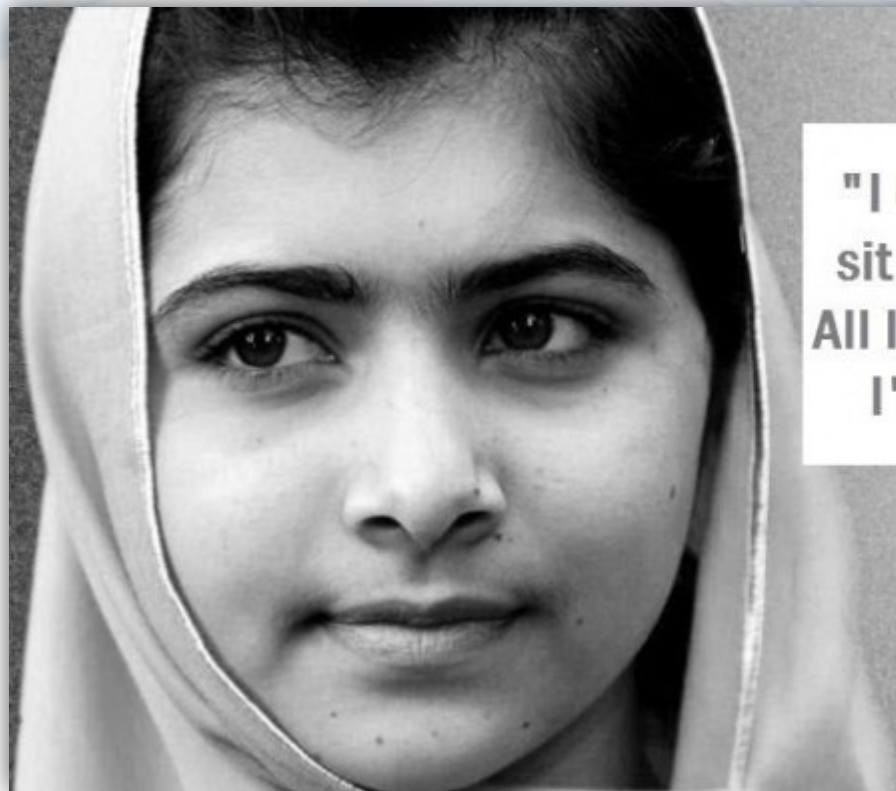
High dropout rates remain a major impediment to universal primary education. An estimated 50 per cent of out-of-school children of primary school age live in conflict-affected areas.

*Adjusted net enrolment rate for primary education, 2000 and 2012 (Percentage).*

Source: The Millennium Development Goals Report 2014.



- Half of the 58 million out-of-school children of primary school age live in conflict-affected areas.
- More than one in four children in developing regions entering primary school is likely to drop out.
- 781 million adults and 126 million youth worldwide lack basic literacy skills, and more than 60 per cent of them are women.



**"I don't mind if I have to  
sit on the floor at school.  
All I want is education. And  
I'm afraid of no one."**

**-Malala Yousufzai**





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**MDG3**



PROMOTE GENDER EQUALITY AND EMPOWER WOMEN

→ THE WORLD HAS

**ACHIEVED EQUALITY**

**IN PRIMARY EDUCATION**

BETWEEN GIRLS AND BOYS

**LET'S STEP UP**

IN MANY COUNTRIES

**WOMEN STILL FACE DISCRIMINATION**

IN ACCESS TO EDUCATION, WORK AND PARTICIPATION IN DECISION-MAKING.

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# Promote gender equality and empower women

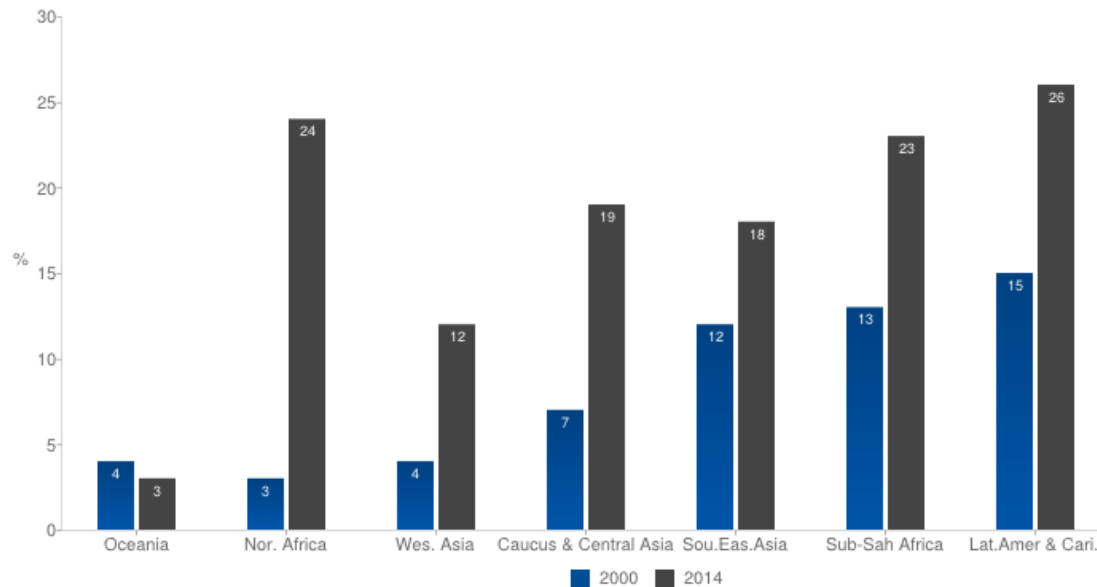
## Where do we stand?

Women are assuming more power in the world's parliaments, boosted by quota systems.

Legislated or voluntary quotas were used in 39 chambers holding elections. Such measures impact positively on women's access to parliament. However, quotas alone are not enough: political parties need to field more women candidates.

*Proportion of seats held by women in single or lower houses of national parliament, 2000 and 2014 (Percentage).*

Source: [The Millennium Development Goals Report 2014](#).



- In Southern Asia, only 74 girls were enrolled in primary school for every 100 boys in 1990. By 2012, the enrolment ratios were the same for girls as for boys.
- In sub-Saharan Africa, Oceania and Western Asia, girls still face barriers to entering both primary and secondary school.
- Women in Northern Africa hold less than one in five paid jobs in the non-agricultural sector.
- In 46 countries, women now hold more than 30 per cent of seats in national parliament in at least one chamber.



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**MDG4**  
  
REDUCE CHILD MORTALITY

**14,000 FEWER**

**CHILDREN DIE EACH DAY** THAN IN 1990

**LET'S STEP UP**

**6.9 MILLION CHILDREN STILL DIE**

BEFORE THEIR FIFTH BIRTHDAY EACH YEAR

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4

# Reduce child mortality

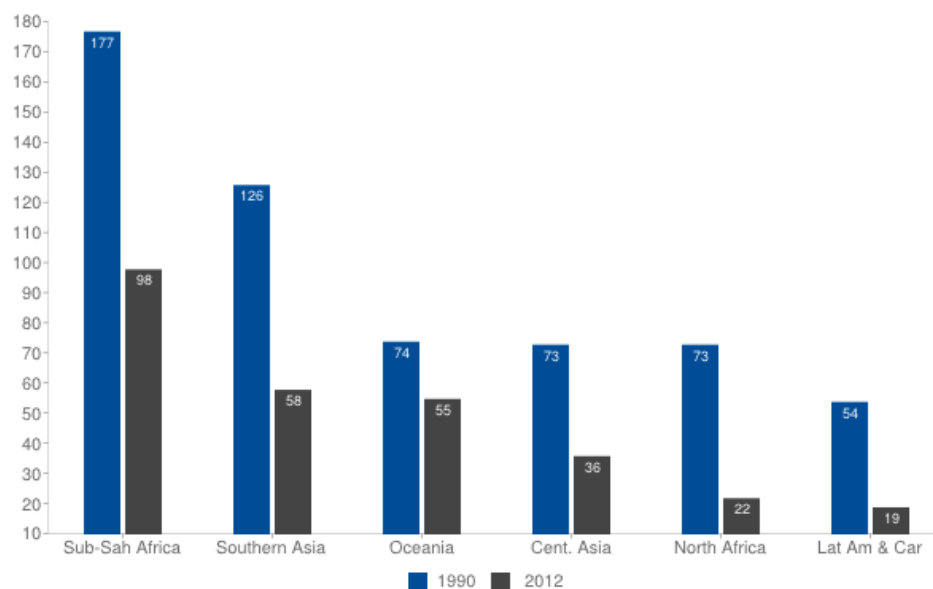
## Where do we stand?

Despite substantial progress, the world is still falling short of the MDG child mortality target.

Preventable diseases are the main causes of under-five deaths and appropriate actions need to be taken to address them.

*Under-five mortality rate, 1990 and 2012 (Deaths per 1,000 live births).*

Source: [The Millennium Development Goals Report 2014](#).



- The child mortality rate has almost halved since 1990; six million fewer children died in 2012 than in 1990.
- During the period from 2005 to 2012, the annual rate of reduction in under-five mortality was more than three times faster than between 1990 and 1995.
- Globally, four out of every five deaths of children under age five continue to occur in sub-Saharan Africa and Southern Asia.
- Immunization against measles helped prevent nearly 14 million deaths between 2000 and 2012.



# Child mortality under five years of age: Deaths per 1,000 (2007)

Child mortality under five rate:  
Deaths per 1,000 (2007)



880 5281  
4/08 2008




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**MDG5**  
  
 IMPROVE MATERNAL HEALTH

**MATERNAL MORTALITY FELL BY 47% SINCE 1990**

**LET'S STEP UP**

**ONLY HALF OF WOMEN IN DEVELOPING REGIONS RECEIVE RECOMMENDED HEALTH CARE DURING PREGNANCY.**

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# Improve maternal health

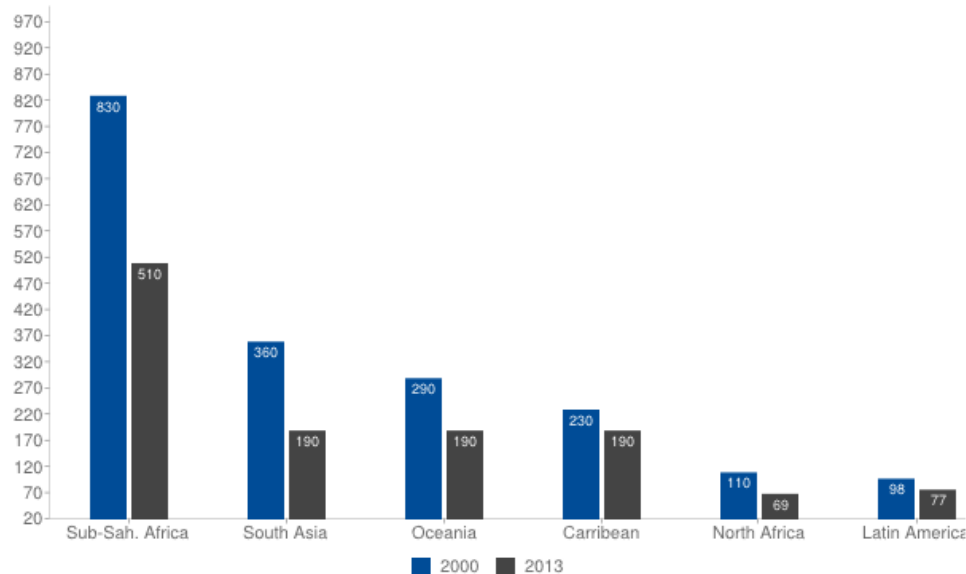
## Where do we stand?

Much more still needs to be done to reduce maternal mortality.

Poverty and lack of education perpetuate high adolescent birth rates. Inadequate funding for family planning is a major failure in fulfilling commitments to improving women's reproductive health.

*Maternal mortality ratio, 1990 and 2013 (Maternal deaths per 100,000 live births, women aged 15-49).*

Source: [The Millennium Development Goals Report 2014](#)



- Almost 300,000 women died globally in 2013 from causes related to pregnancy and childbirth.
- The proportion of deliveries in developing regions attended by skilled health personnel rose from 56 to 68 per cent between 1990 and 2012.
- In 2012, 40 million births in developing regions were not attended by skilled health personnel, and over 32 million of those births occurred in rural areas.
- 52 per cent of pregnant women had four or more antenatal care visits during pregnancy in 2012, an increase from 37 per cent in 1990.



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**MDG6**  
  
 COMBAT HIV/AIDS, MALARIA AND OTHER DISEASES

**8 MILLION PEOPLE WERE RECEIVING LIFESAVING MEDICINES FOR HIV IN 2011**

**1.1 MILLION MALARIA DEATHS WERE PREVENTED IN THE SPAN OF 10 YEARS**

**LET'S STEP UP**

**7 MILLION PEOPLE STILL LACKED ACCESS TO ANTIRETROVIRAL THERAPY FOR HIV IN 2011**

**80% OF MALARIA DEATHS OCCUR IN JUST 14 COUNTRIES**

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# Combat HIV/AIDS, malaria and other diseases

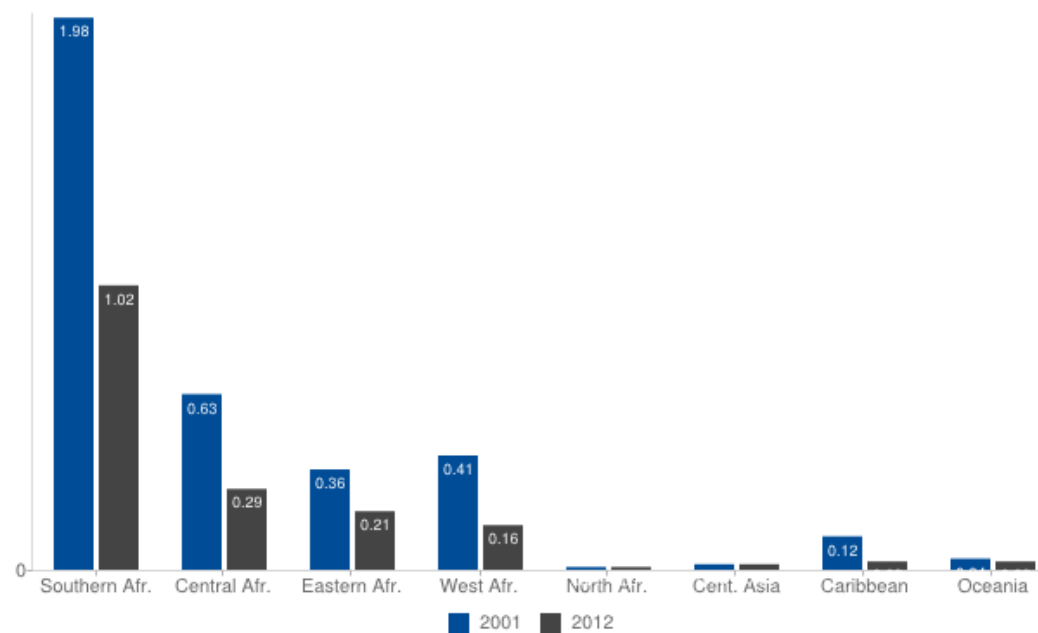
## Where do we stand?

There are still too many new cases of HIV infection.

Access to antiretroviral therapy (ART) for HIV-infected people has been increasing dramatically. ART has saved 6.6 million lives since 1995. Expanding its coverage can save many more. In addition, knowledge about HIV among youth needs to be improved to stop the spread of the disease.

*HIV incidence rate (Estimated number of new HIV infections per year per 100 people aged 15-49), 2001 and 2012*

Source: The Millennium Development Goals Report 2014



- Almost 600 children died every day of AIDS-related causes in 2012.
- Antiretroviral medicines were delivered to 9.5 million people in developing regions in 2012.
- Malaria interventions saved the lives of three million young children between 2000 and 2012.
- Between 1995 and 2012, tuberculosis treatment saved 22 million lives.



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**MDG7**  
  
 ENSURE ENVIRONMENTAL SUSTAINABILITY

**2.1 BILLION PEOPLE** GAINED ACCESS TO **CLEAN DRINKING WATER** SINCE 1990

**LET'S STEP UP**

**2.5 BILLION** DO NOT HAVE BASIC **SANITATION** SUCH AS TOILETS OR LATRINES

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# Ensure environmental sustainability

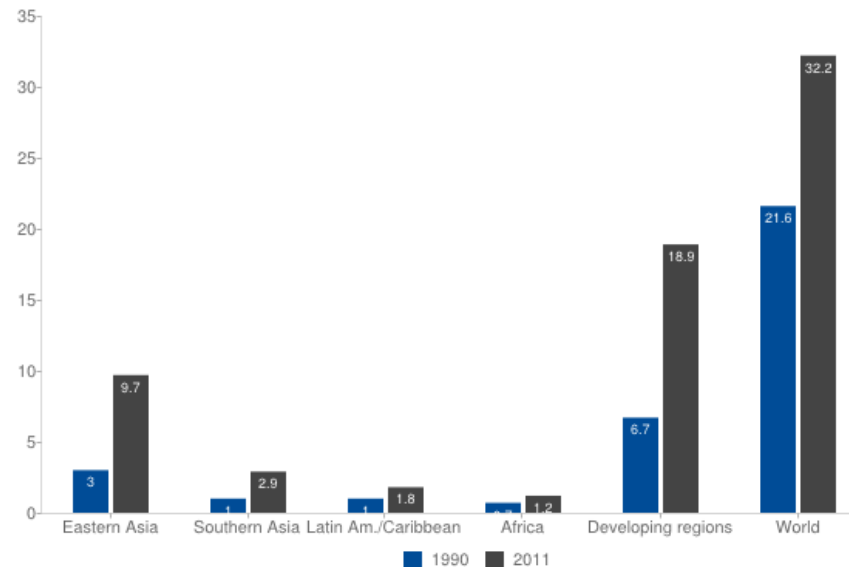
## Where do we stand?

Millions of hectares of forest are lost every year, threatening this valuable asset. Global greenhouse gas emissions continue their upward trend.

Global emissions of carbon dioxide (CO<sub>2</sub>) continued their upward trend and those in 2011 were almost 50 per cent above their 1990 level. Millions of hectares of forest are lost every year, many species are being driven closer to extinction and renewable water resources are becoming scarcer.

*Emissions of carbon dioxide (CO<sub>2</sub>), 1990 and 2011 (Billions of metric tonnes)*

Source: The Millennium Development Goals Report 2014



- Global emissions of carbon dioxide (CO<sub>2</sub>) have increased by almost 50 per cent since 1990.
- Protected ecosystems covered 14 per cent of terrestrial and coastal marine areas worldwide by 2012.
- Over 2.3 billion more people have gained access to an improved source of drinking water since 1990, but 748 million people still draw their water from an unimproved source.
- Between 1990 and 2012, almost 2 billion people obtained access to improved sanitation. However, 1 billion people still resort to open defecation.
- One-third of urban residents in developing regions still live in slums.

# Situace se zlepšuje,

# ale ne dostatečně

## The world has met the MDG drinking water target, five years ahead of schedule

Proportion of population using an improved water source, 1990 and 2010 (Percentage)

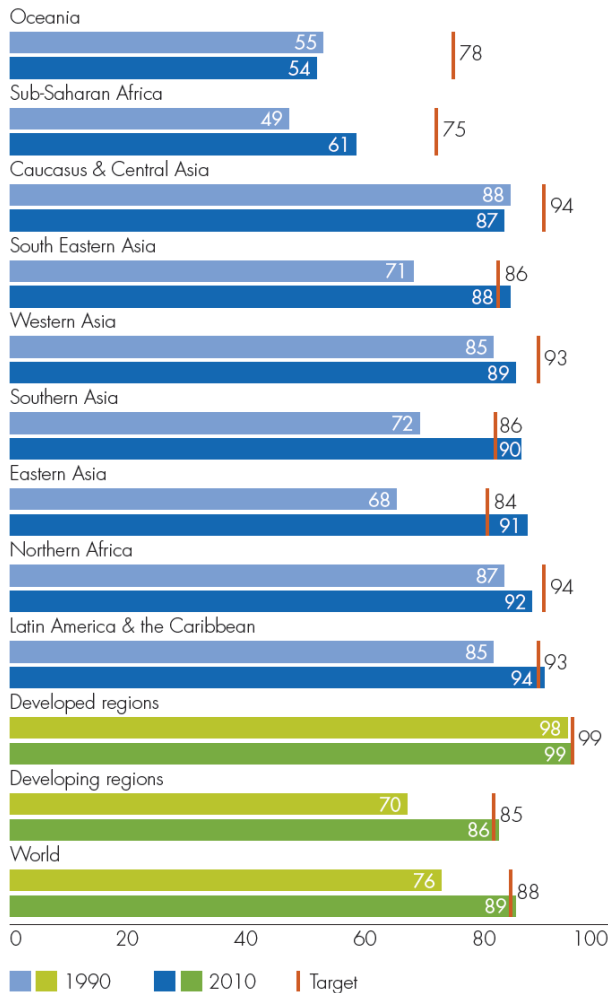
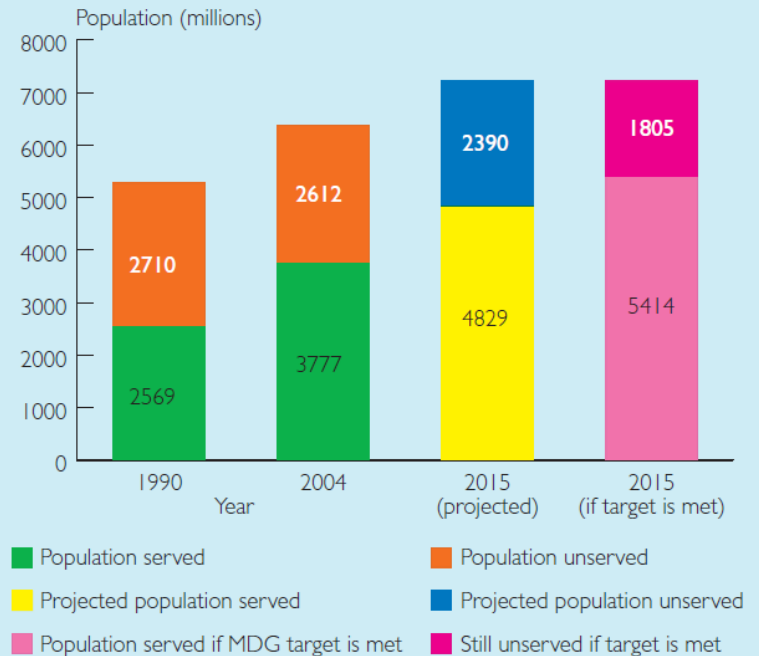


Figure 2

World population with and without access to improved sanitation in 1990, 2004 and 2015



> The number of people without improved sanitation decreased by only 98 million between 1990 and 2004.  
 > The global MDG sanitation target will be missed by more than half a billion people if the trend 1990–2004 continues up to 2015.






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**MDG8**  
  
**A GLOBAL PARTNERSHIP FOR DEVELOPMENT**

**↑ TRADE**  
 CLIMATE CONTINUES TO  
**IMPROVE**

**DEBT SERVICE HAS DECLINED**  
 FOR DEVELOPING COUNTRIES

**LET'S STEP UP**

**CRUCIAL IS AID FALLING**  
 FOR POOREST COUNTRIES

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# A global partnership for development

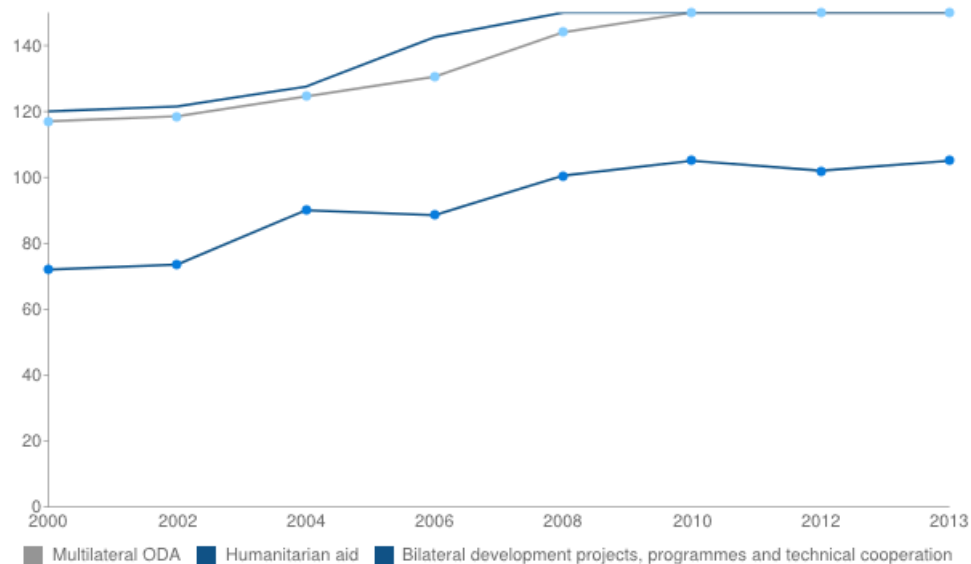
## Where do we stand?

Official development assistance is now at its highest level, reversing the decline of the previous two years.

Aid is shifting away from the poorest countries. 80 per cent of imports from developing countries entered developed countries duty-free and tariffs remained at an all-time low. The debt burden of developing countries remained stable at about 3 per cent of export revenue.

*Official development assistance (ODA), from OECD-DAC countries, 2000–2013 (Constant 2012 US\$ billions)*

Source: The Millennium Development Goals Report 2014



- Official development assistance stood at \$134.8 billion in 2013, the highest level ever recorded.
- 80 per cent of imports from developing countries enter developed countries duty-free.
- The debt burden on developing countries remains stable at about 3 per cent of export revenue.
- The number of Internet users in Africa almost doubled in the past four years.
- 30 per cent of the world's youth are digital natives, active online for at least five years.

# Ekonomický rozvoj x čerpání zdrojů

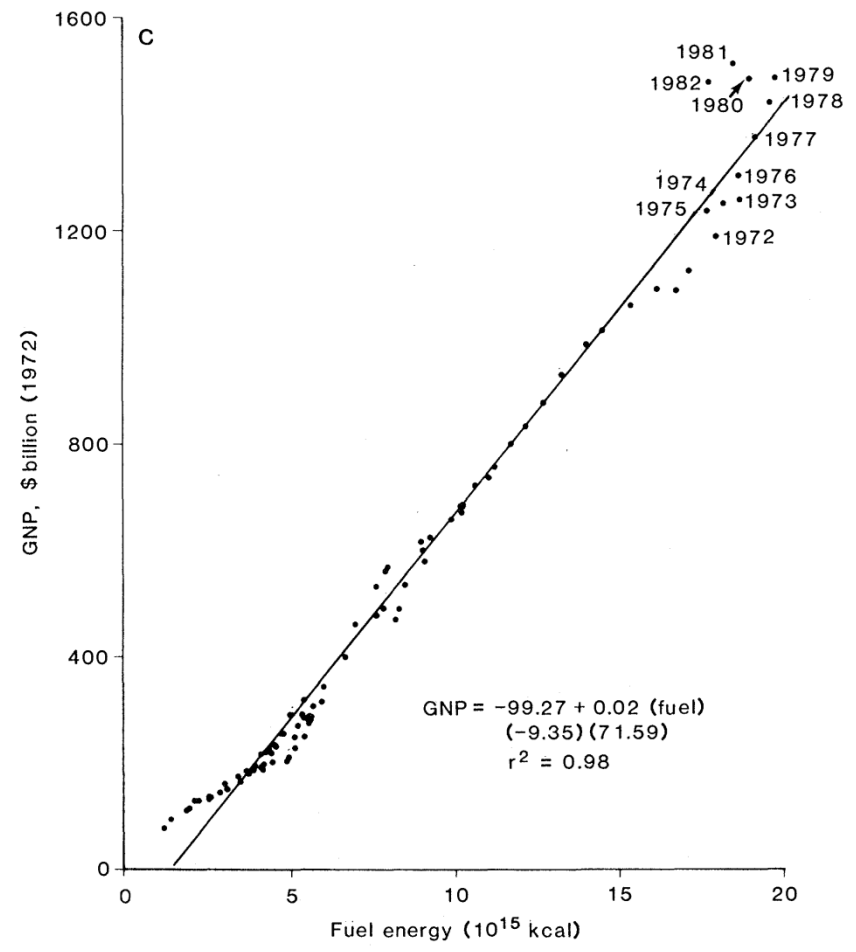
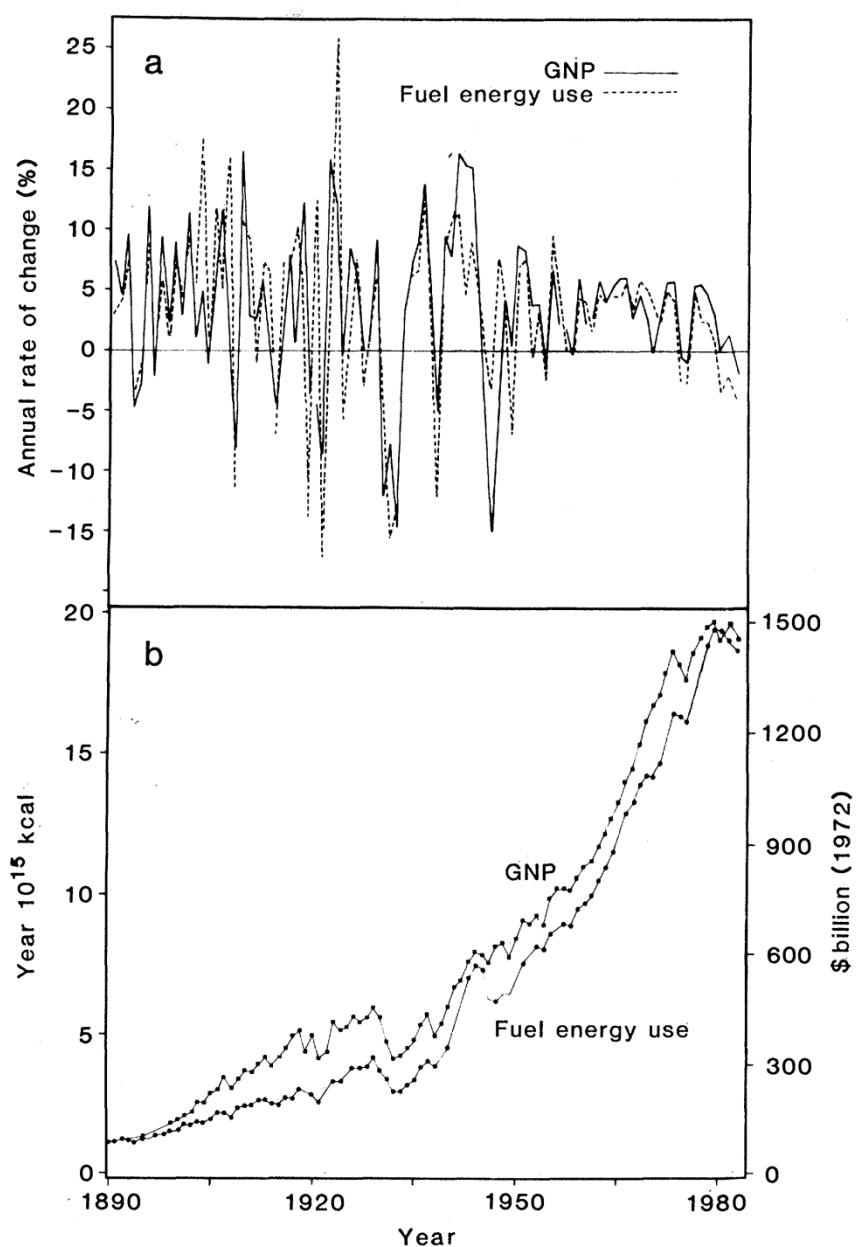
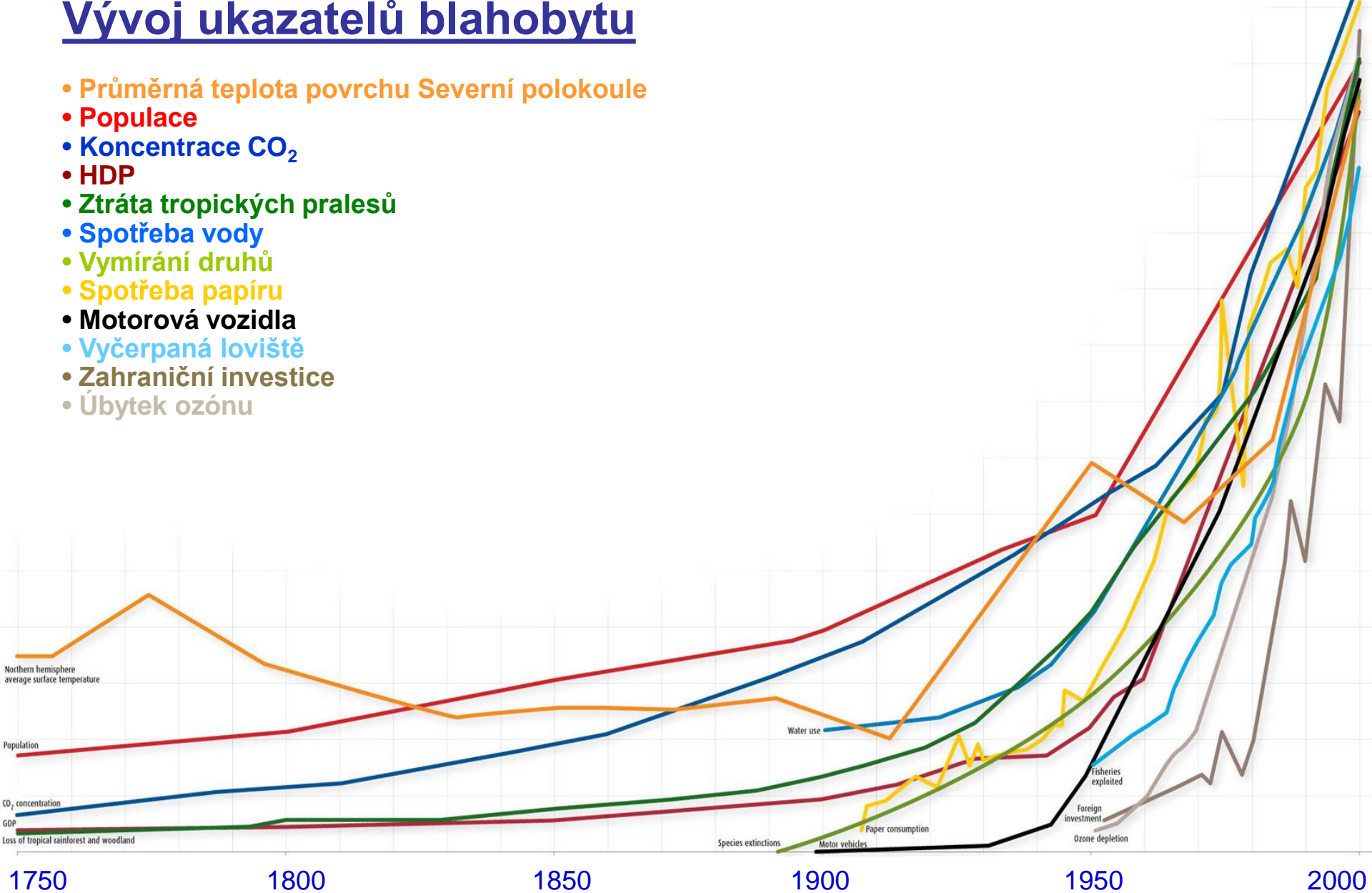


Fig. 1. (a) Annual rate of change in fuel use and real GNP in the United States from 1890 to 1982 (55, 56). Fuel use includes fossil fuels, nuclear, and hydropower. (b) Fuel use and real GNP per year. (c) Results of linear regression model between fuel use and real GNP in the United States from 1890 to 1982. The numbers in parentheses are  $t$ -statistics. Hydro and nuclear power converted to thermal units based on prevailing heat rates at fossil steam electric plants (55, 56).

# Vývoj ukazatelů blahobytu

- Průměrná teplota povrchu Severní polokoule
- Populace
- Koncentrace CO<sub>2</sub>
- HDP
- Ztráta tropických pralesů
- Spotřeba vody
- Vymírání druhů
- Spotřeba papíru
- Motorová vozidla
- Vyčerpaná loviště
- Zahraniční investice
- Úbytek ozónu



# Almeria, Španělsko

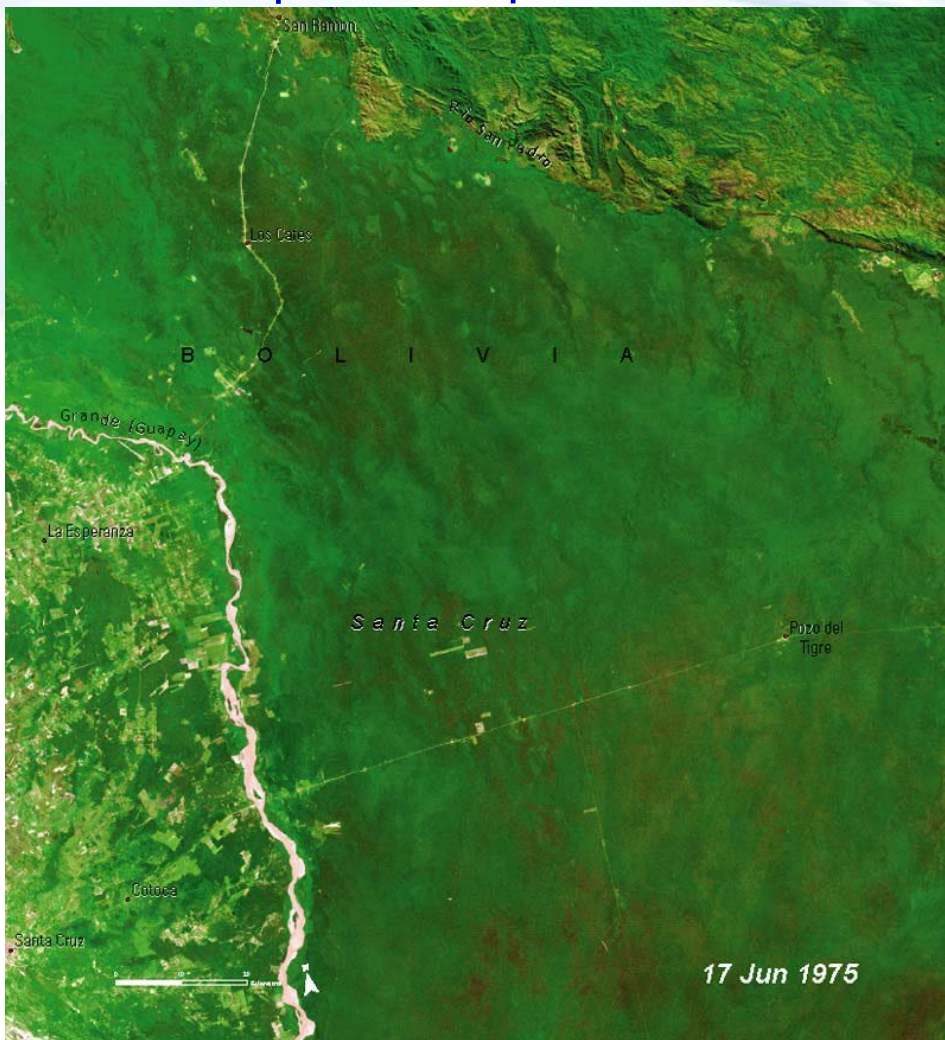
Srovnání situace z let 1974 a 2004: proměna původní zemědělské krajiny na intenzivní skleníkové hospodaření (využití omezených zdrojů vody)

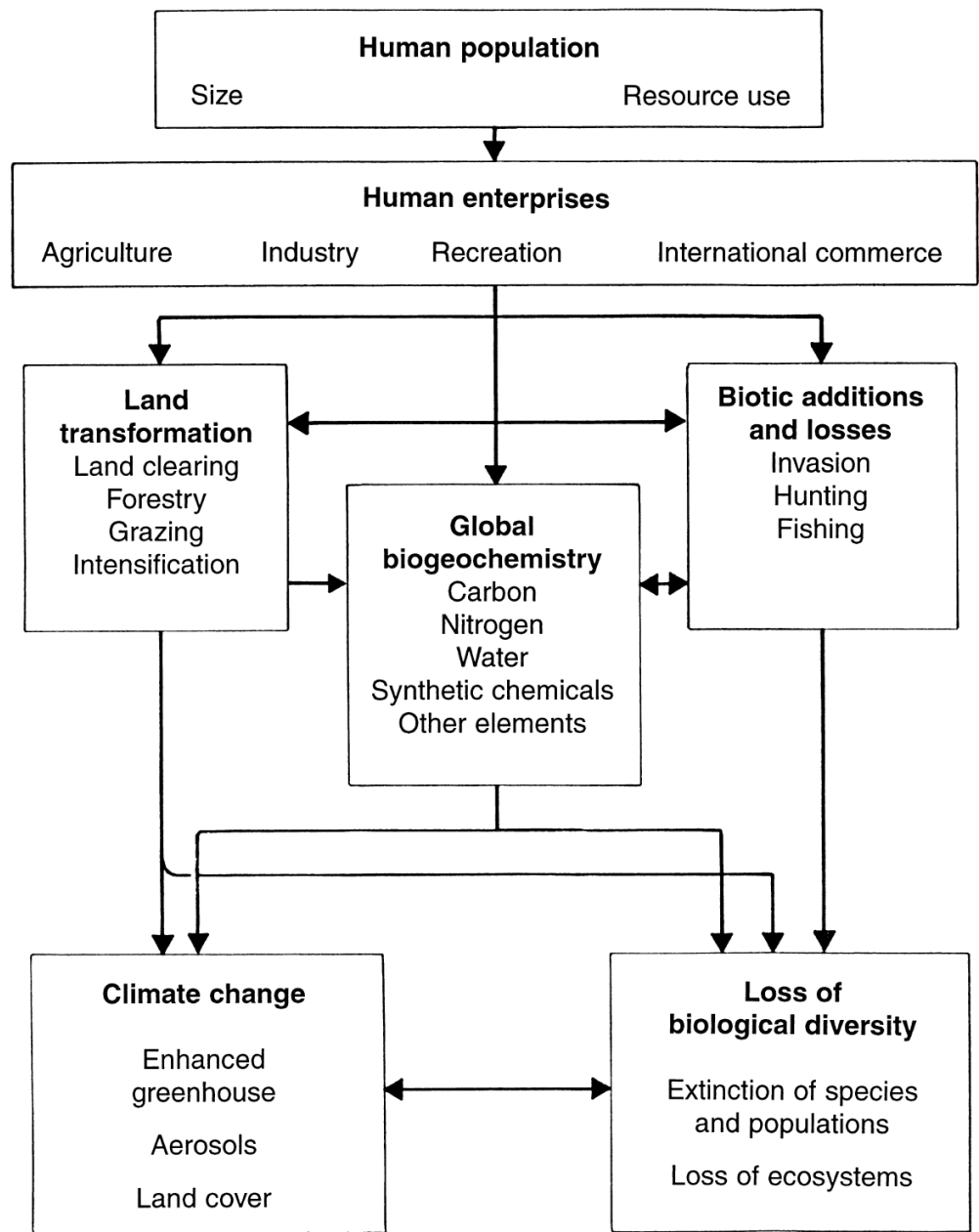


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# Santa Cruz, Bolívie

Roku 1986 byly zbudovány silnice umožňující rozvoj nevyužívaných oblastí pralesa – přeměna na zemědělské usedlosti

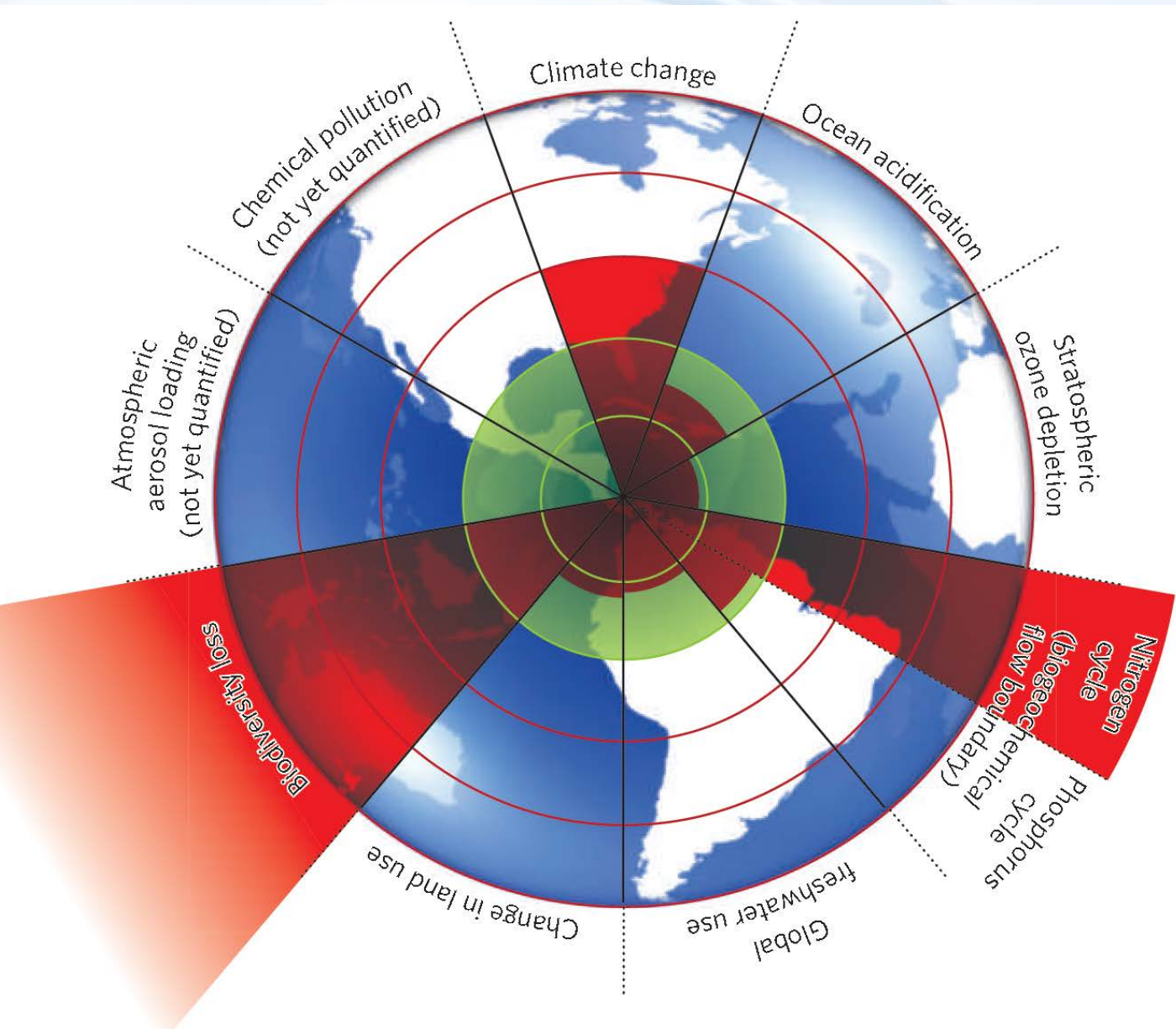




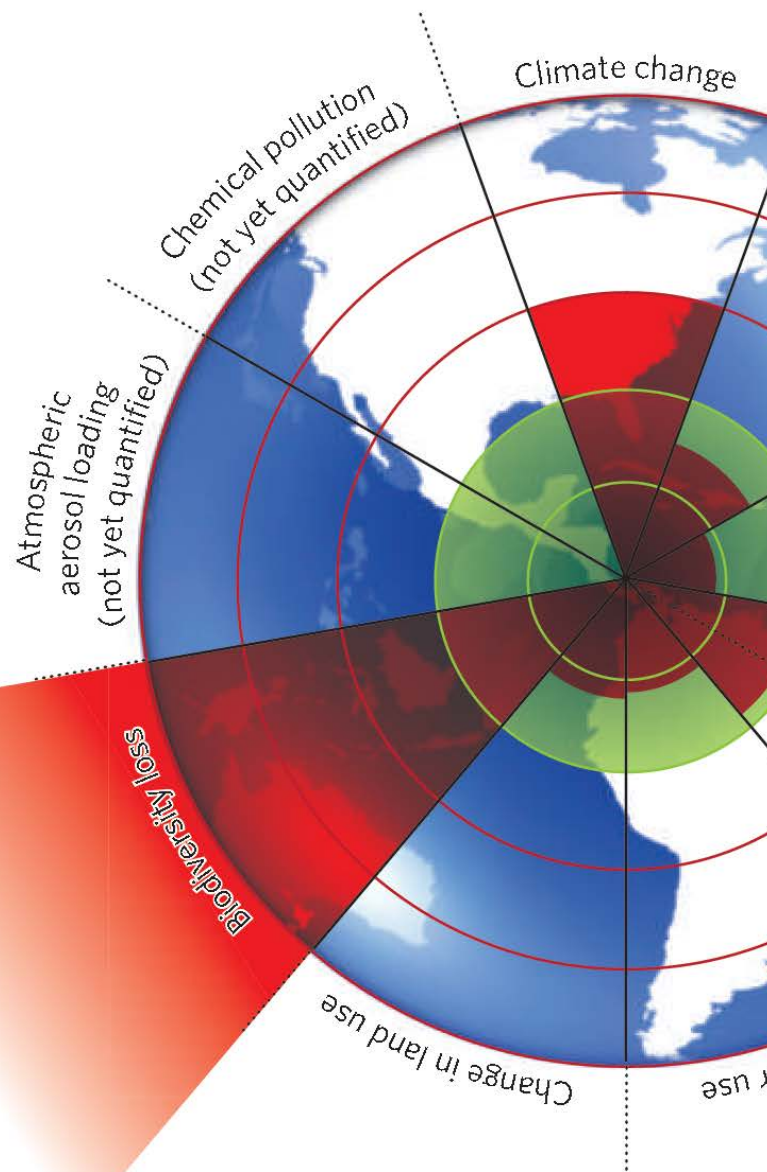
*A conceptual model illustrating humanity's direct and indirect effects on the Earth system*



# Překročení hranic?



# Překročení hranic?



PLANETARY BOUNDARIES				
Earth-system process	Parameters	Proposed boundary	Current status	Pre-industrial value
Climate change	(i) Atmospheric carbon dioxide concentration (parts per million by volume)	350	387	280
	(ii) Change in radiative forcing (watts per metre squared)	1	1.5	0
Rate of biodiversity loss	Extinction rate (number of species per million species per year)	10	>100	0.1-1
Nitrogen cycle (part of a boundary with the phosphorus cycle)	Amount of N <sub>2</sub> removed from the atmosphere for human use (millions of tonnes per year)	35	121	0
Phosphorus cycle (part of a boundary with the nitrogen cycle)	Quantity of P flowing into the oceans (millions of tonnes per year)	11	8.5-9.5	-1
Stratospheric ozone depletion	Concentration of ozone (Dobson unit)	276	283	290
Ocean acidification	Global mean saturation state of aragonite in surface sea water	2.75	2.90	3.44
Global freshwater use	Consumption of freshwater by humans (km <sup>3</sup> per year)	4,000	2,600	415
Change in land use	Percentage of global land cover converted to cropland	15	11.7	Low
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis		To be determined	
Chemical pollution	For example, amount emitted to, or concentration of persistent organic pollutants, plastics, endocrine disrupters, heavy metals and nuclear waste in, the global environment, or the effects on ecosystem and functioning of Earth system thereof		To be determined	



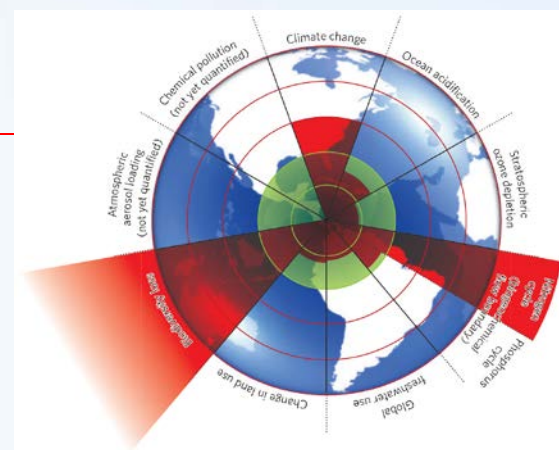
# I. Ztráta biodiverzity

Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Rate of biodiversity loss	Extinction rate, extinctions per million species per year (E/MSY)	Slow variable affecting ecosystem functioning at continental and ocean basin scales. Impact on many other boundaries—C storage, freshwater, N and P cycles, land systems. Massive loss of biodiversity unacceptable for ethical reasons.	<10 E/MSY (10–100 E/MSY)	<ol style="list-style-type: none"> <li>1. Incomplete knowledge on the role of biodiversity for ecosystem functioning across scales.</li> <li>2. Thresholds likely at local and regional scales.</li> <li>3. Boundary position highly uncertain.</li> </ol>

**Boundary:** Annual species extinction rate no more than 10 per million / year

**Current level:** At least 100 per million / year

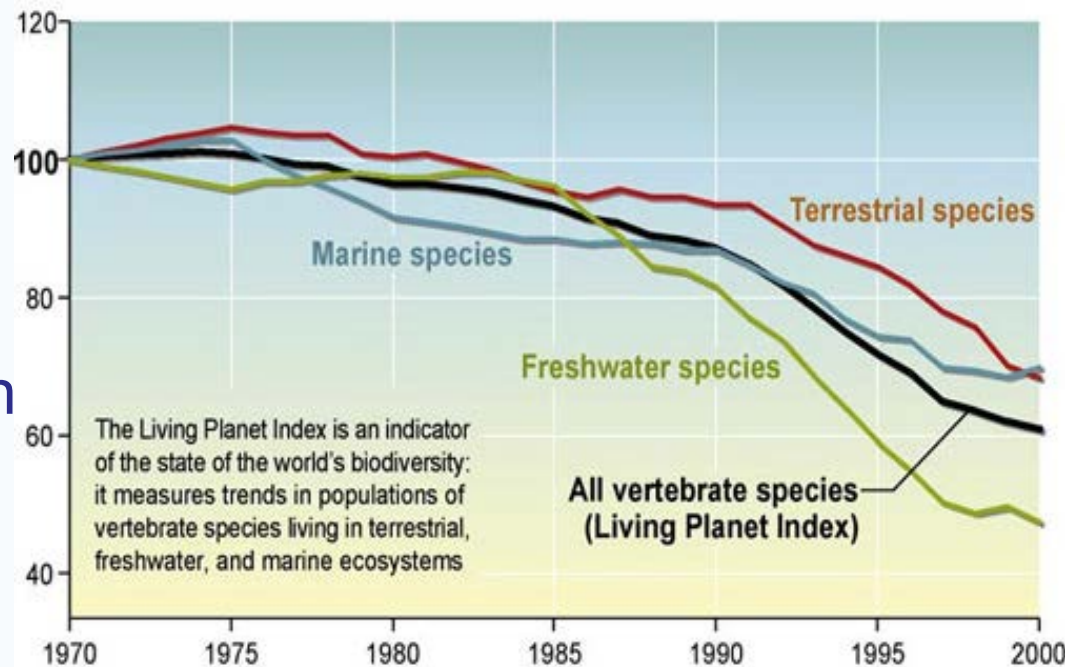
**Diagnosis:** Boundary far exceeded



## II. Ztráta biodiverzity

- dnes probíhá 6. velké vymírání druhů v historii Země
- poprvé je důsledkem lidské činnosti
- ohroženo vyhynutím 12 % druhů ptáků, 23 % savců a 25 % jehličnanů, vyhynutím 32 % obojživelníků, 54 % cykasů
- biodiverzita je nezbytná pro udržení ekosystémových funkcí a služeb a udržení odolnosti a pružnosti ekosystémů
- ztráta biodiverzity může zvýšit zranitelnost terest. a aquat. ekosystémů při změnách klimatu a kyselosti vody

Population Index = 100 in 1970





## II. Globální klimatická změna

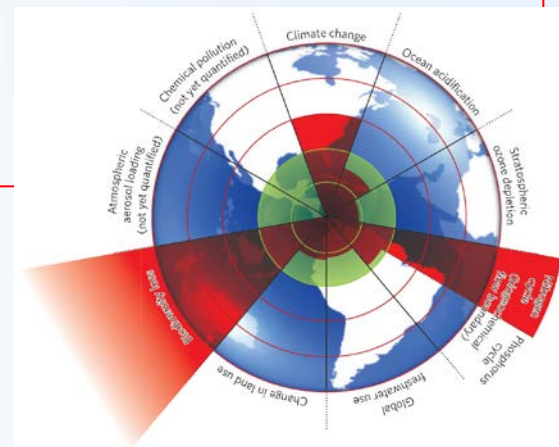
Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Climate change	<p>Atmospheric CO<sub>2</sub> concentration, ppm;</p> <p>Energy imbalance at Earth's surface, W m<sup>-2</sup></p>	<p>Loss of polar ice sheets.</p> <p>Regional climate disruptions.</p> <p>Loss of glacial freshwater supplies.</p> <p>Weakening of carbon sinks.</p>	<p>Atmospheric CO<sub>2</sub> concentration: 350 ppm (350–550 ppm)</p> <p>Energy imbalance: +1 W m<sup>-2</sup> (+1.0–+1.5 W m<sup>-2</sup>)</p>	<p>1. Ample scientific evidence.</p> <p>2. Multiple sub-system thresholds.</p> <p>3. Debate on position of boundary.</p>

**Boundary:** Atmospheric CO<sub>2</sub> concentration no higher than 350 ppm

**Pre-industrial level:** 280 ppm

**Current level:** 387 ppm

**Diagnosis:** Boundary exceeded



# Skleníkový jev a globální změna klimatu

- skleníkový jev - **přírozený atmosférický jev** nutný pro život
- skl. jev tlumí vysoké výkyvy teplot mezi nocí a dnem a zajišťuje příznivé klima pro **život**

-140 °C x 110 °C

## Introduction

How does Earth stay warm and comfortable in the coldness of space? Temperatures on Earth are livable because of a natural process we call the greenhouse effect.

It Starts With the Sun ▶

INTRO

IT STARTS WITH THE SUN

GREENHOUSE EFFECT

GREENHOUSE GASES

EXPLORE MORE



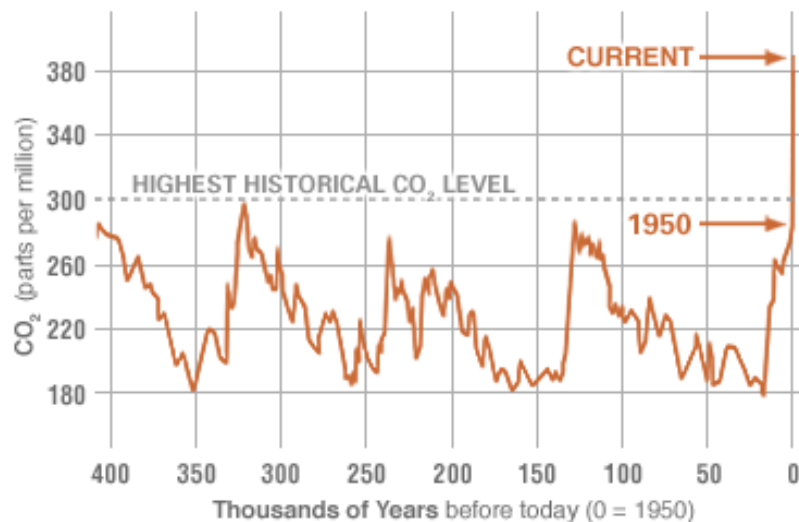
# Růst koncentrace CO<sub>2</sub>

- Koncentrace CO<sub>2</sub> – 398 ppm = 0,0397 %
- koncentrace CO<sub>2</sub> **vzrostla o 25 % od roku 1950**
- spalování fosilních paliv zodpovídá za asi 80 % tohoto vzrůstu

## PROXY (INDIRECT) MEASUREMENTS

Data source: Reconstruction from ice cores.

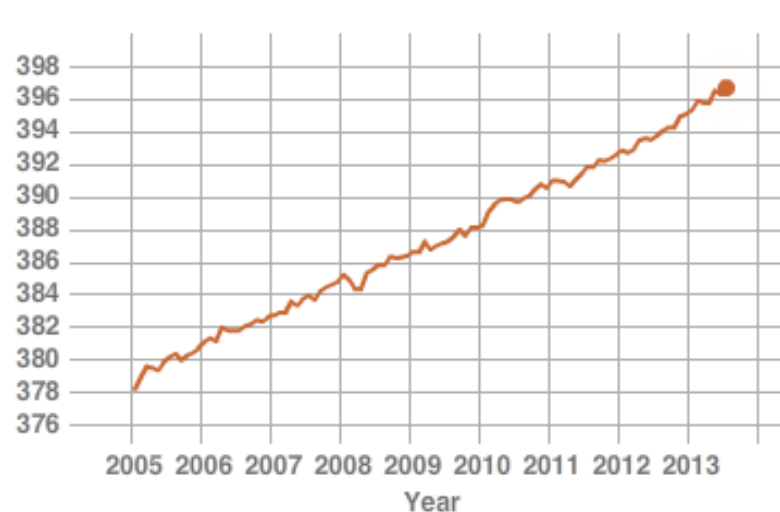
Credit: NOAA



## DIRECT MEASUREMENTS: 2005-PRESENT

Data source: Monthly measurements (corrected for average seasonal cycle). Credit: NOAA

Credit: NOAA



# Další indikátory GW a změn klimatu

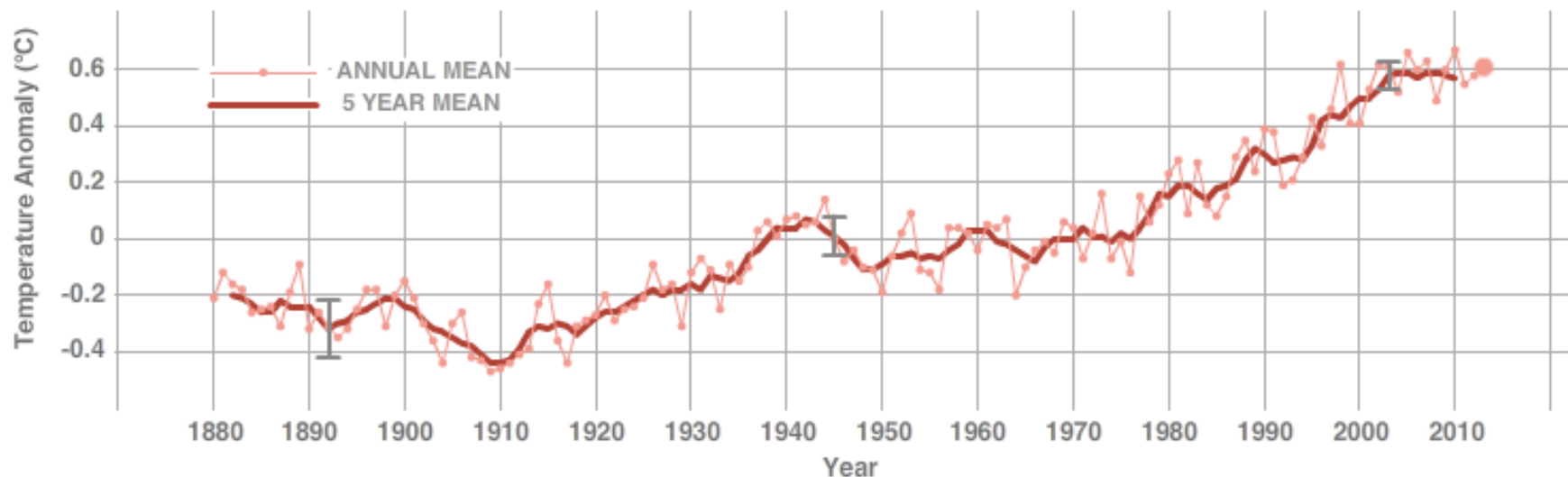
- teplota, zalednění severního ledového oceánu, zalednění severního a jižního pólu (pevnina), výška hladiny moří

## Global Surface Temperature

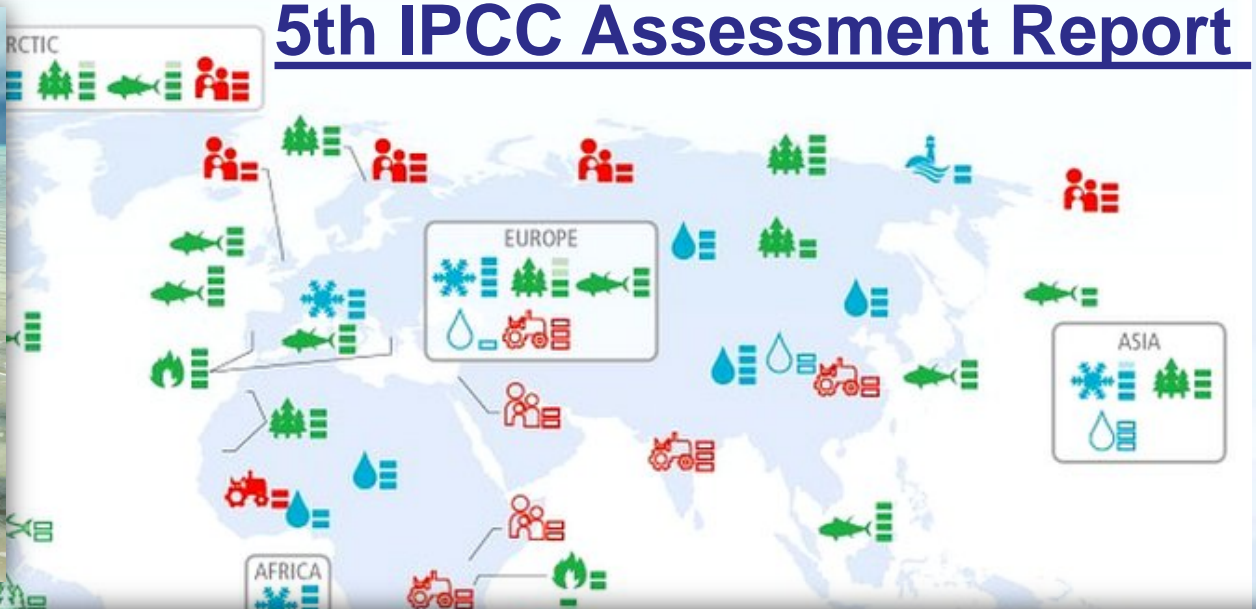
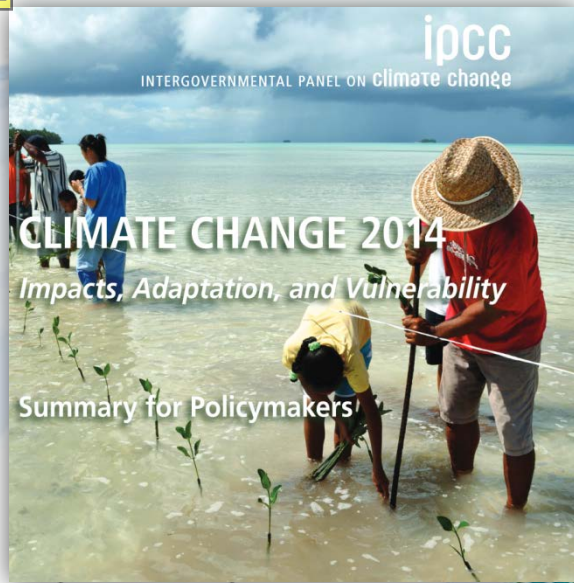
↓ DOWNLOAD DATA

### GLOBAL LAND-OCEAN TEMPERATURE INDEX

Data source: [NASA's Goddard Institute for Space Studies \(GISS\)](#) This trend agrees with other global temperature records provided by the U.S. [National Climatic Data Center](#), the Japanese Meteorological Agency and the Met Office Hadley Centre / [Climatic Research Unit](#) in the U.K. Credit: [NASA/GISS](#)

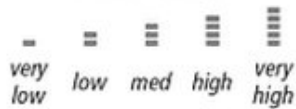


# 5th IPCC Assessment Report



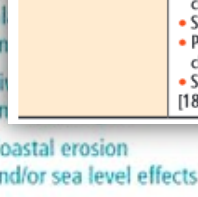
Europe	
Snow & Ice, Rivers & Lakes, Floods & Drought	<ul style="list-style-type: none"> <li>Retreat of Alpine, Scandinavian, and Icelandic glaciers (<i>high confidence</i>, major contribution from climate change)</li> <li>Increase in rock slope failures in western Alps (<i>medium confidence</i>, major contribution from climate change)</li> <li>Changed occurrence of extreme river discharges and floods (<i>very low confidence</i>, minor contribution from climate change)</li> </ul> <p>[18.3, 23.2-3, Tables 18-5 and 18-6; WGI AR5 4.3]</p>
Terrestrial Ecosystems	<ul style="list-style-type: none"> <li>Earlier greening, leaf emergence, and fruiting in temperate and boreal trees (<i>high confidence</i>, major contribution from climate change)</li> <li>Increased colonization of alien plant species in Europe, beyond a baseline of some invasion (<i>medium confidence</i>, major contribution from climate change)</li> <li>Earlier arrival of migratory birds in Europe since 1970 (<i>medium confidence</i>, major contribution from climate change)</li> <li>Upward shift in tree-line in Europe, beyond changes due to land use (<i>low confidence</i>, major contribution from climate change)</li> <li>Increasing burnt forest areas during recent decades in Portugal and Greece, beyond some increase due to land use (<i>high confidence</i>, major contribution from climate change)</li> </ul> <p>[4.3, 18.3, Tables 18-7 and 23-6]</p>
Coastal Erosion & Marine Ecosystems	<ul style="list-style-type: none"> <li>Northward distributional shifts of zooplankton, fishes, seabirds, and benthic invertebrates in northeast Atlantic (<i>high confidence</i>, major contribution from climate change)</li> <li>Northward and depth shift in distribution of many fish species across European seas (<i>medium confidence</i>, major contribution from climate change)</li> <li>Plankton phenology changes in northeast Atlantic (<i>medium confidence</i>, major contribution from climate change)</li> <li>Spread of warm water species into the Mediterranean, beyond changes due to invasive species and human impacts (<i>medium confidence</i>, major contribution from climate change)</li> </ul> <p>[6.3, 23.6, 30.5, Tables 6-2 and 18-8, Boxes 6-1 and CC-MB]</p>
Food Production & Livelihoods	<ul style="list-style-type: none"> <li>Shift from cold-related mortality to heat-related mortality in England and Wales, beyond changes due to exposure and health care (<i>low confidence</i>, major contribution from climate change)</li> <li>Impacts on livelihoods of Sámi people in northern Europe, beyond effects of economic and sociopolitical changes (<i>medium confidence</i>, major contribution from climate change)</li> <li>Stagnation of wheat yields in some countries in recent decades, despite improved technology (<i>medium confidence</i>, minor contribution from climate change)</li> <li>Positive yield impacts for some crops mainly in northern Europe, beyond increase due to improved technology (<i>medium confidence</i>, minor contribution from climate change)</li> <li>Spread of bluetongue virus in sheep and of ticks across parts of Europe (<i>medium confidence</i>, minor contribution from climate change)</li> </ul> <p>[18.4, 23.4-5, Table 18-9, Figure 7-2]</p>

## Confidence in attribution to climate change



▬ indicates confidence range

## Physical systems



Outlined symbols = Minor contribution of climate change  
Filled symbols = Major contribution of climate change



# III a IV. Biogeochemické toky P a N

Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Biogeo-chemical flows: interference with P and N cycles	<p>P: inflow of phosphorus to ocean, increase compared with natural background weathering</p> <p>N: amount of N<sub>2</sub> removed from atmosphere for human use, Mt N yr<sup>-1</sup></p>	<p>P: avoid a major oceanic anoxic event (including regional), with impacts on marine ecosystems.</p> <p>N: slow variable affecting overall resilience of ecosystems via acidification of terrestrial ecosystems and eutrophication of coastal and freshwater systems.</p>	<p>P: &lt; 10× (10× - 100×)</p> <p>N: Limit industrial and agricultural fixation of N<sub>2</sub> to 35 Mt N yr<sup>-1</sup>, which is ~ 25% of the total amount of N<sub>2</sub> fixed per annum naturally by terrestrial ecosystems (25%–35%)</p>	<p>P: (1) Limited knowledge on ecosystem responses; (2) High probability of threshold but timing is very uncertain; (3) Boundary position highly uncertain.</p> <p>N: (1) Some ecosystem responses known; (2) Acts as a slow variable, existence of global thresholds unknown; (3) Boundary position highly uncertain.</p>

**Boundary N:** < 35 million tonnes of N fixed from the atmosphere per year

**Current level:** 121 million tonnes per year

**Diagnosis:** Boundary far exceeded and effects worsening

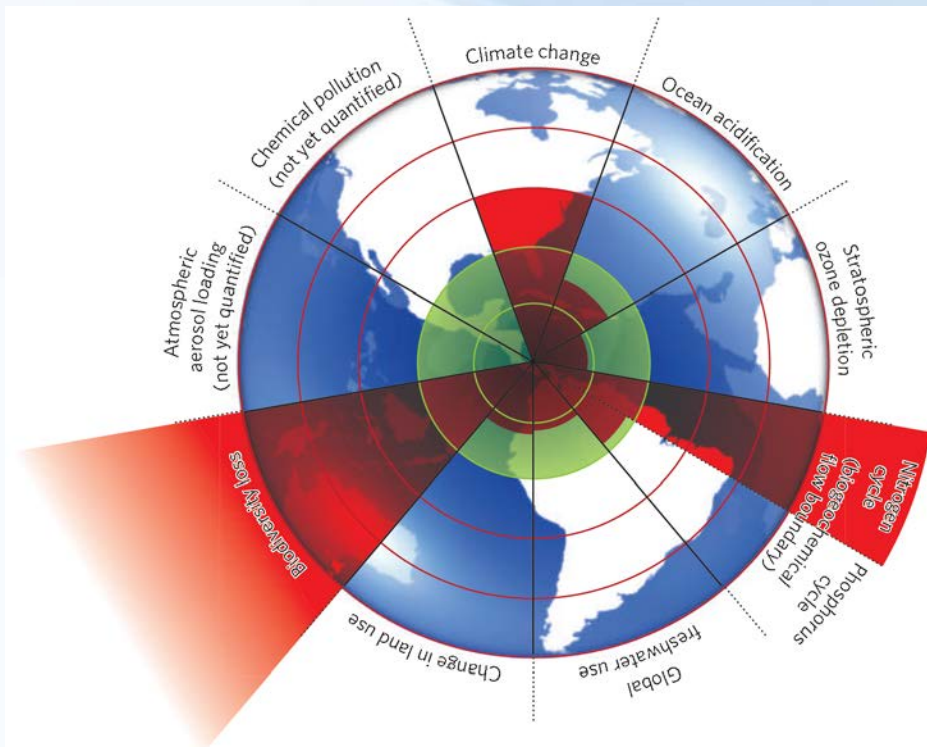
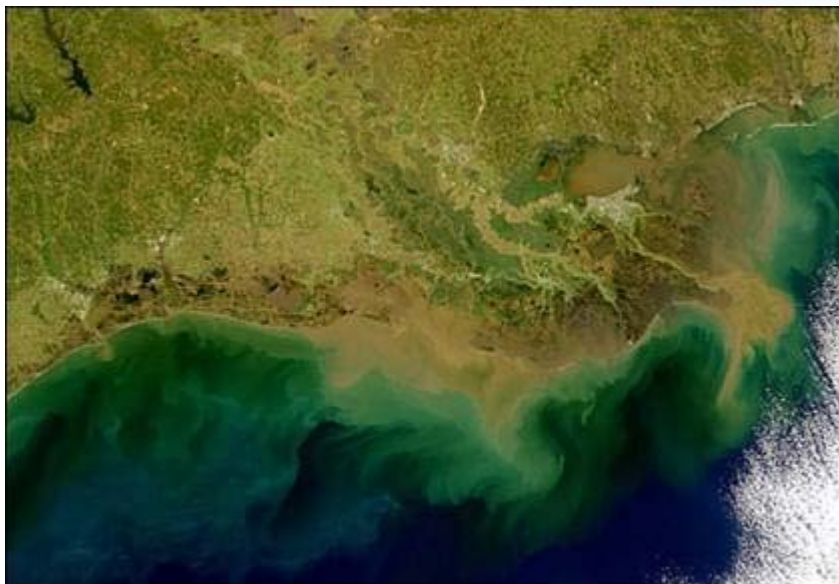
**Boundary P:** < 11 million tonnes of P to flow into the oceans per year

**Current level:** 9 million tonnes per year

**Diagnosis:** Boundary not yet exceeded

# Změny

- ovlivňování biogeochem. cyklů P a N působí:
  - 1) na lokální až regionální úrovni náhlé změny v jezerních a mořských ekosystémech (např. anoxie v jezerech a Baltickém moři)
  - 2) nelineární změny z oligotrofního stavu do eutrofního



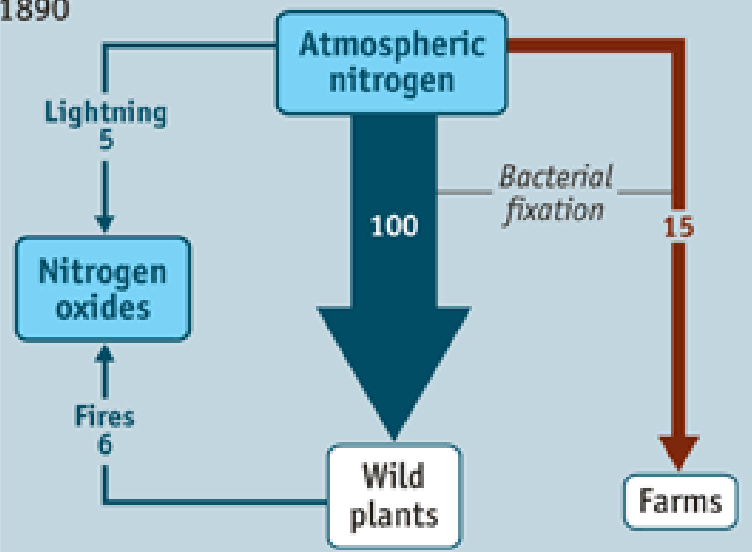
# Dusík

- lidskou aktivitou je dnes přeměněno více  $N_2$  na reaktivní formy N, než ve všech terestriálních procesech dohromady
- Haber-Bosch 80  $Mt_N/yr$ , leguminózy 40  $Mt_N/yr$ , spalování fosilních paliv 20  $Mt_N/yr$ , spalování biomasy 10  $Mt_N/yr$

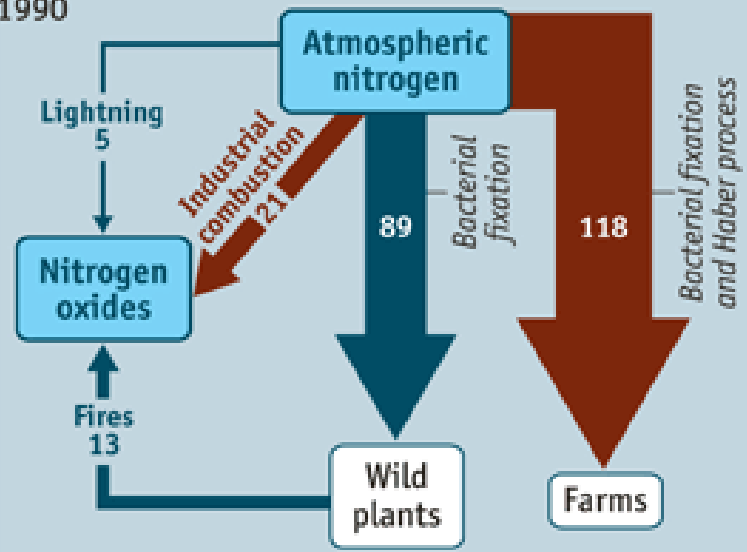
## Unbalancing the cycle

Nitrogen flows, megatonnes

1890



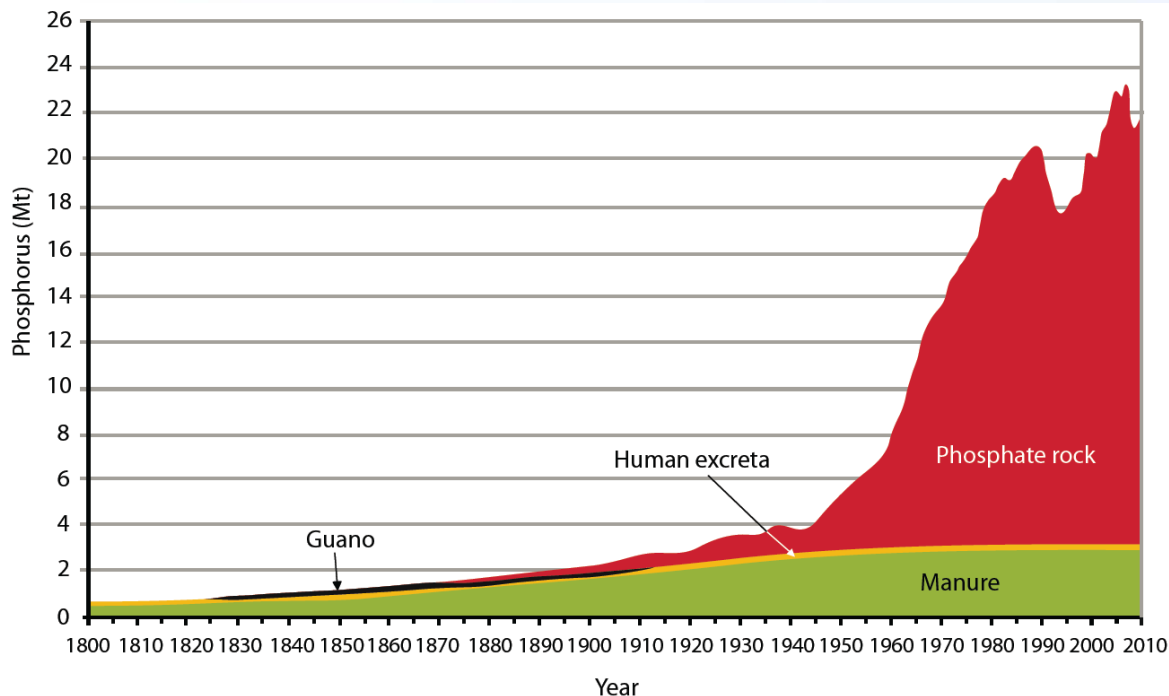
1990



Source: Galloway and Cowling, *Ambio*

# Fosfor

- primární zdroj P v ekosystému – **zvětrávání či těžba apatitu**
- lidskou činností proudí do oceánů 8-9x větší množství P než přirozeně
- z 20 Mt<sub>N</sub>/yr průmyslového fosforu skončí polovina v mořích
- přítok P do oceánů zvyšuje riziko anoxických událostí, práh nastání této události je ale zatím nejasný



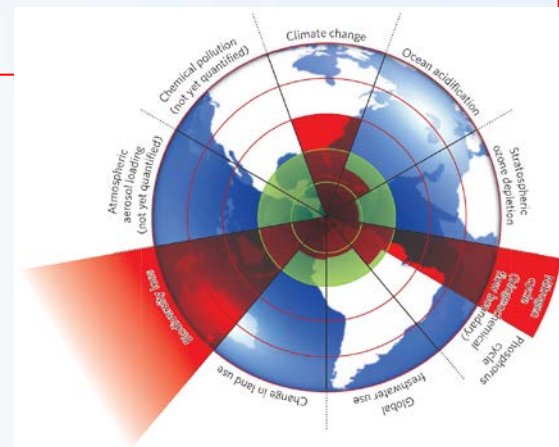
# V. Úbytek stratosférického ozónu

Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Stratospheric ozone depletion	Stratospheric O <sub>3</sub> concentration, DU	Severe and irreversible UV-B radiation effects on human health and ecosystems.	<5% reduction from pre-industrial level of 290 DU (5%–10%)	<ol style="list-style-type: none"> <li>1. Ample scientific evidence.</li> <li>2. Threshold well established.</li> <li>3. Boundary position implicitly agreed and respected.</li> </ol>

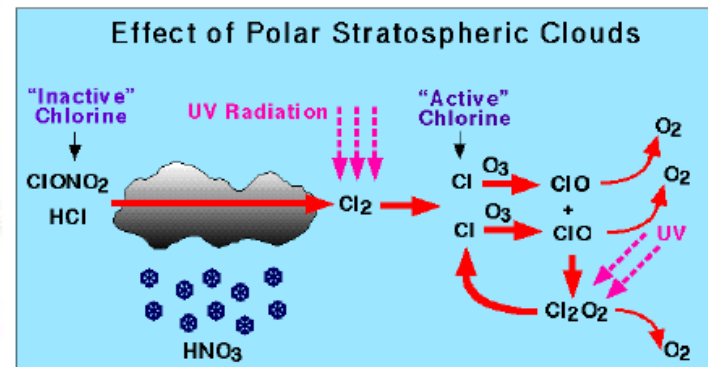
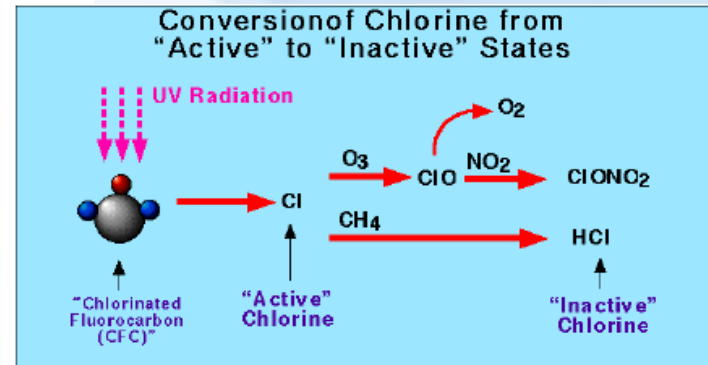
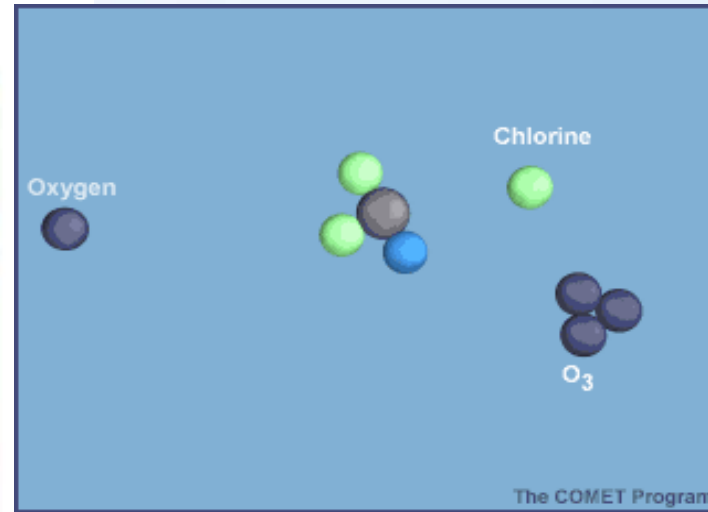
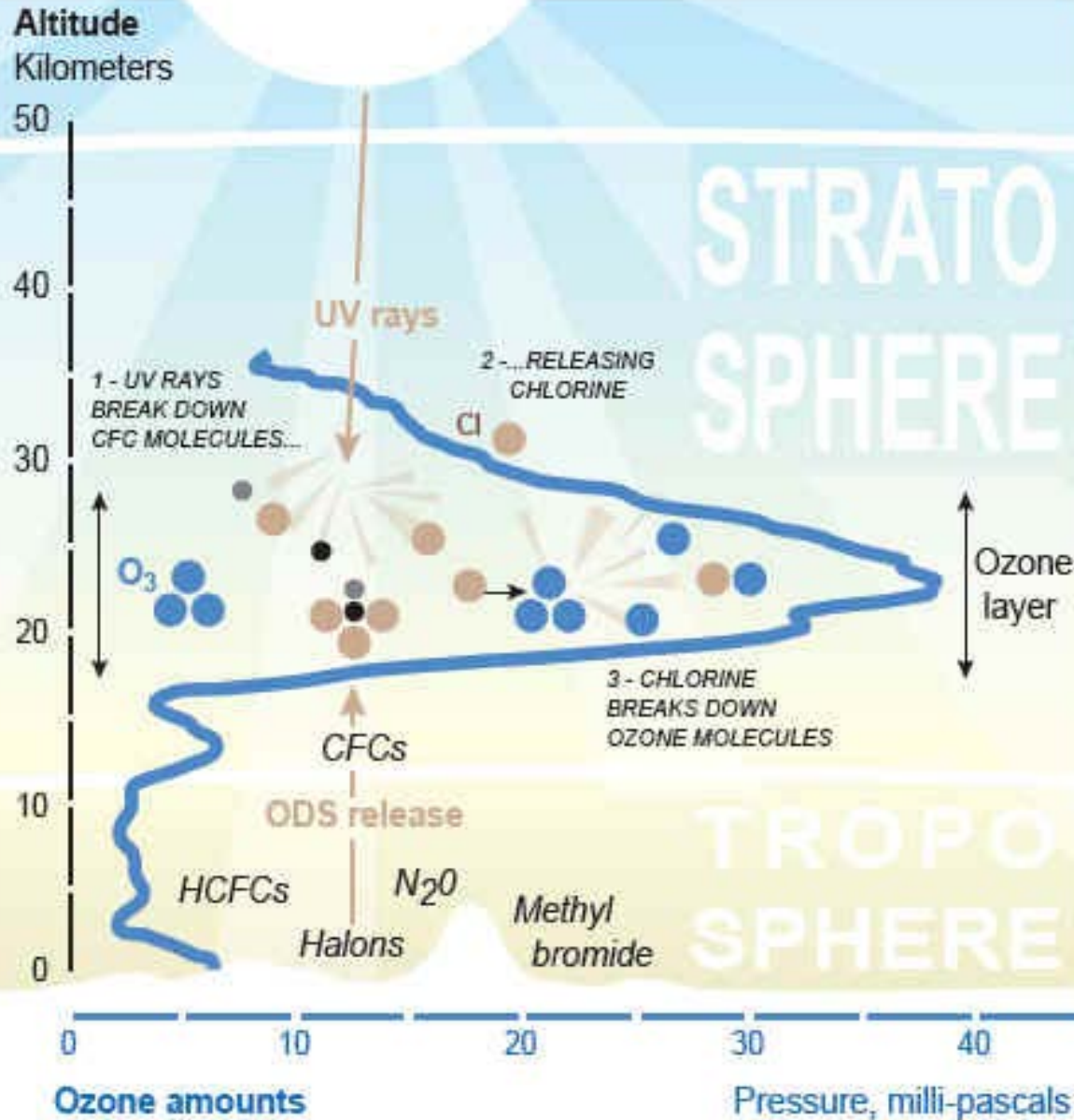
**Boundary:** Average conc. of stratospheric O<sub>3</sub> no lower than 276 Dobson units

**Current level:** 283 Dobson units

**Diagnosis:** Safe, and improving



# CHEMICAL OZONE DESTRUCTION PROCESS IN THE STRATOSPHERE



# VI. Okyselování oceánů

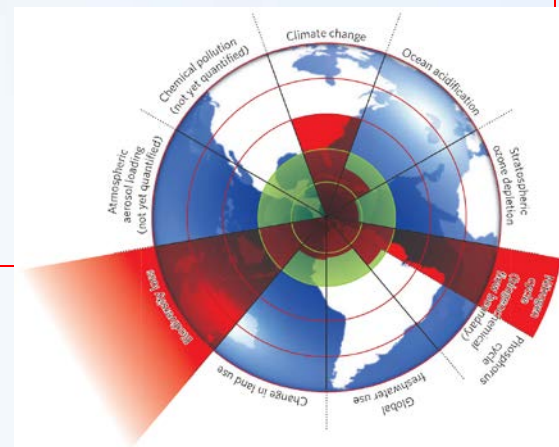
Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Ocean acidification	Carbonate ion concentration, average global surface ocean saturation state with respect to aragonite ( $\Omega_{arag}$ )	Conversion of coral reefs to algal-dominated systems. Regional elimination of some aragonite- and high-magnesium calcite-forming marine biota Slow variable affecting marine carbon sink.	Sustain $\geq 80\%$ of the pre-industrial aragonite saturation state of mean surface ocean, including natural diel and seasonal variability ( $\geq 80\% - \geq 70\%$ )	<ol style="list-style-type: none"> <li>1. Geophysical processes well known.</li> <li>2. Threshold likely.</li> <li>3. Boundary position uncertain due to unclear ecosystem response.</li> </ol>

**Boundary:** Global average aragonite "saturation ratio" no lower than 2.75:1

**Pre-industrial level:** 3.44:1

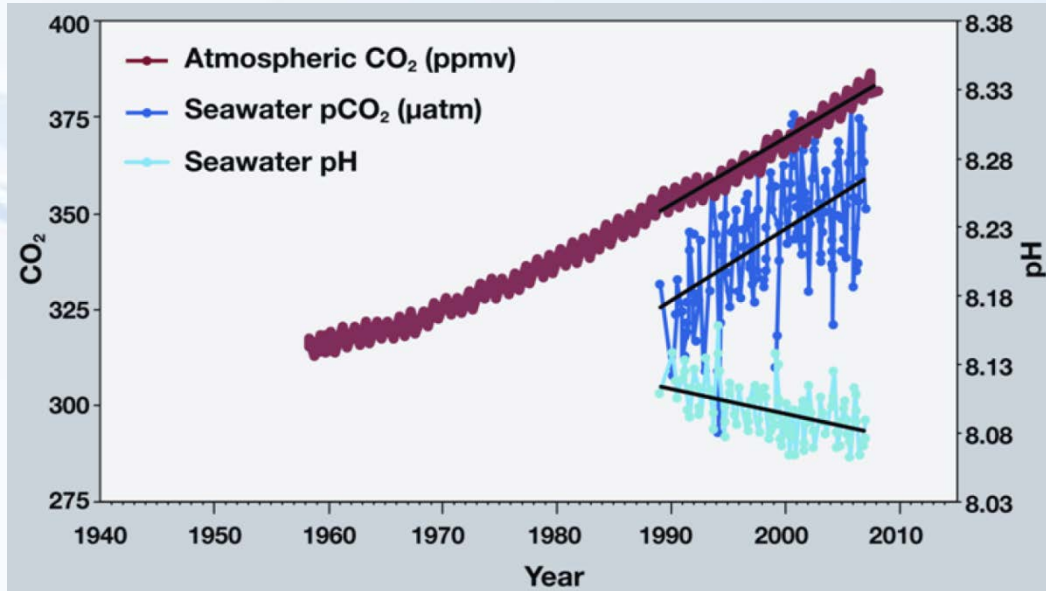
**Current level:** 2.90:1

**Diagnosis:** Safe for now, but some oceans will cross threshold by mid-century



# Okyselování oceánů

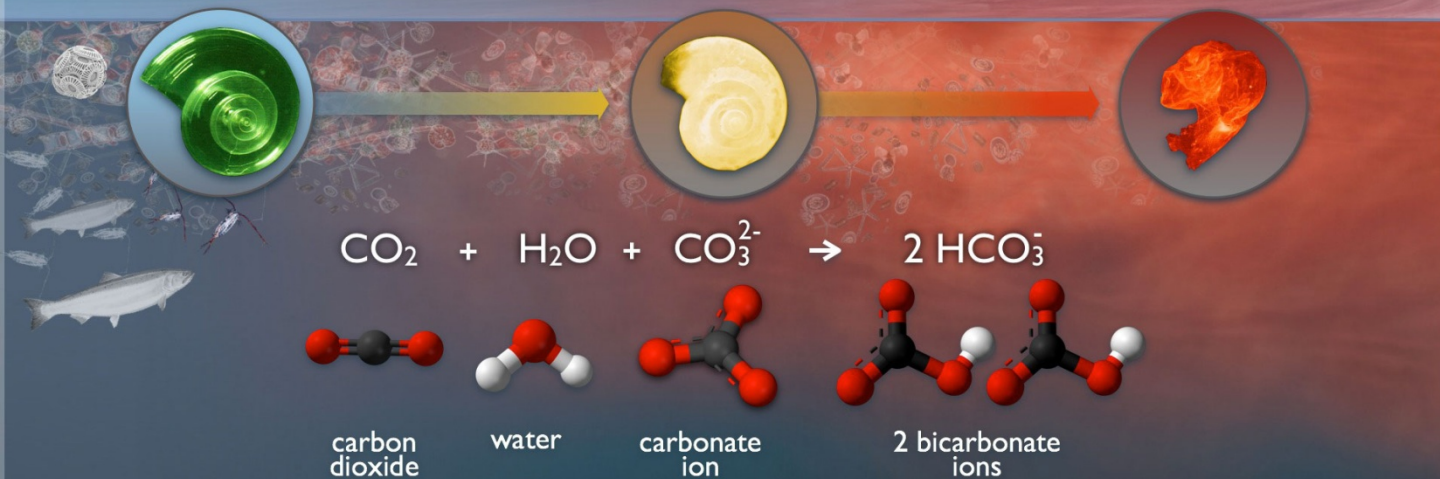
- čím je způsobené?



## OCEAN ACIDIFICATION

HOW WILL CHANGES IN OCEAN CHEMISTRY AFFECT MARINE LIFE?

CO<sub>2</sub> absorbed from the atmosphere



consumption of carbonate ions impedes calcification



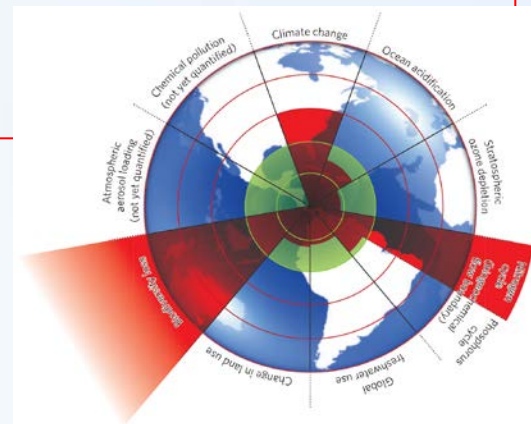
# VII. Globální spotřeba vody

Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Global freshwater use	Consumptive blue water use, km <sup>3</sup> yr <sup>-1</sup>	<p>Could affect regional climate patterns (e.g., monsoon behavior).</p> <p>Primarily slow variable affecting moisture feedback, biomass production, carbon uptake by terrestrial systems and reducing biodiversity</p>	<4000 km <sup>3</sup> yr <sup>-1</sup> (4000–6000 km <sup>3</sup> yr <sup>-1</sup> )	<ol style="list-style-type: none"> <li>1. Scientific evidence of ecosystem response but incomplete and fragmented.</li> <li>2. Slow variable, regional or subsystem thresholds exist.</li> <li>3. Proposed boundary value is a global aggregate, spatial distribution determines regional thresholds</li> </ol>

**Boundary:** No more than 4000 km<sup>3</sup> of fresh water consumed per year

**Current level:** 2600 km<sup>3</sup> per year

**Diagnosis:** Boundary will be approached by mid-century



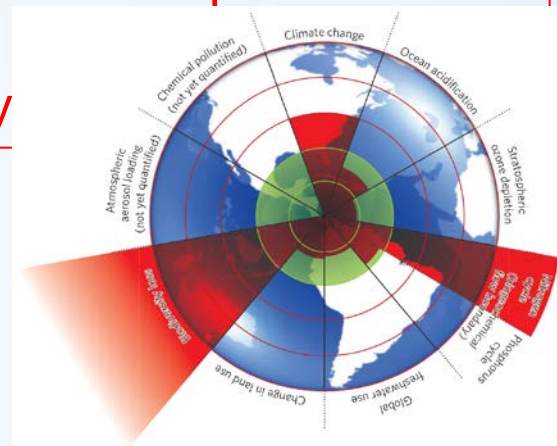
# VIII. Změna využívání krajiny

Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Land-system change	Percentage of global land cover converted to cropland	<p>Trigger of irreversible and widespread conversion of biomes to undesired states.</p> <p>Primarily acts as a slow variable affecting carbon storage and resilience via changes in biodiversity and landscape heterogeneity</p>	≤15% of global ice-free land surface converted to cropland (15%–20%)	<p>1. Ample scientific evidence of impacts of land-cover change on ecosystems, largely local and regional.</p> <p>2. Slow variable, global threshold unlikely but regional thresholds likely.</p> <p>3. Boundary is a global aggregate with high uncertainty, regional distribution of land-system change is critical.</p>

**Boundary:** No more than 15 % of ice-free land to be used for crops

**Current level:** 12 %

**Diagnosis:** Boundary will be approached by mid-century



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.

# Změna využívání krajiny

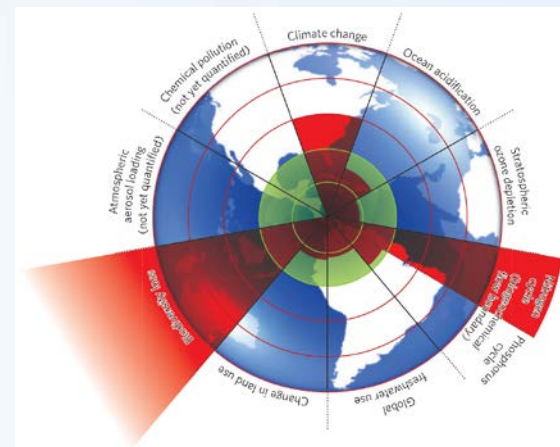
- poháněno expanzí zemědělství a jeho intenzifikace
- posledních 50 let byly lesní a další ekosystémy měněny na zemědělskou půdu rychlostí 0,8% ročně
- hlavní síla řídící ztrátu ekosystémových funkcí a služeb (např. produkce potravin a cyklus vody), ztrátu biodiverzity a podkopává lidský blahobyt a dlouhodobou udržitelnost
- **maximální únosná míra přeměny ekosystémů na zeměd. půdu je přibližně 15 % nezaledněné plochy souše – v současnosti je to 12 %**
- při překročení únosné míry využívání v určitém regionu může dojít k náhlé změně charakteru krajiny
- **např. nadkritická přeměna Amazonských pralesů na zemědělské plochy či pastviny může „skokově“ změnit celý charakter povodí na polosuchou savanu**



# IX. Chemické znečištění

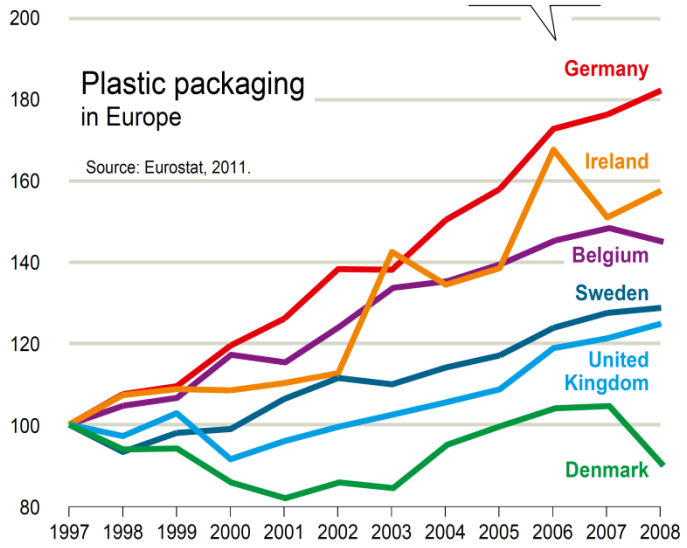
Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Chemical pollution	For example, emissions, concentrations, or effects on ecosystem and Earth System functioning of persistent organic pollutants (POPs), plastics, endocrine disruptors, heavy metals, and nuclear wastes.	Thresholds leading to unacceptable impacts on human health and ecosystem functioning possible but largely unknown.  May act as a slow variable undermining resilience and increase risk of crossing other thresholds.	To be determined	<ol style="list-style-type: none"> <li>1. Ample scientific evidence on individual chemicals but lacks an aggregate, global-level analysis.</li> <li>2. Slow variable, large-scale thresholds unknown.</li> <li>3. Unable to suggest boundary yet.</li> </ol>

**Boundary: Not yet identified**



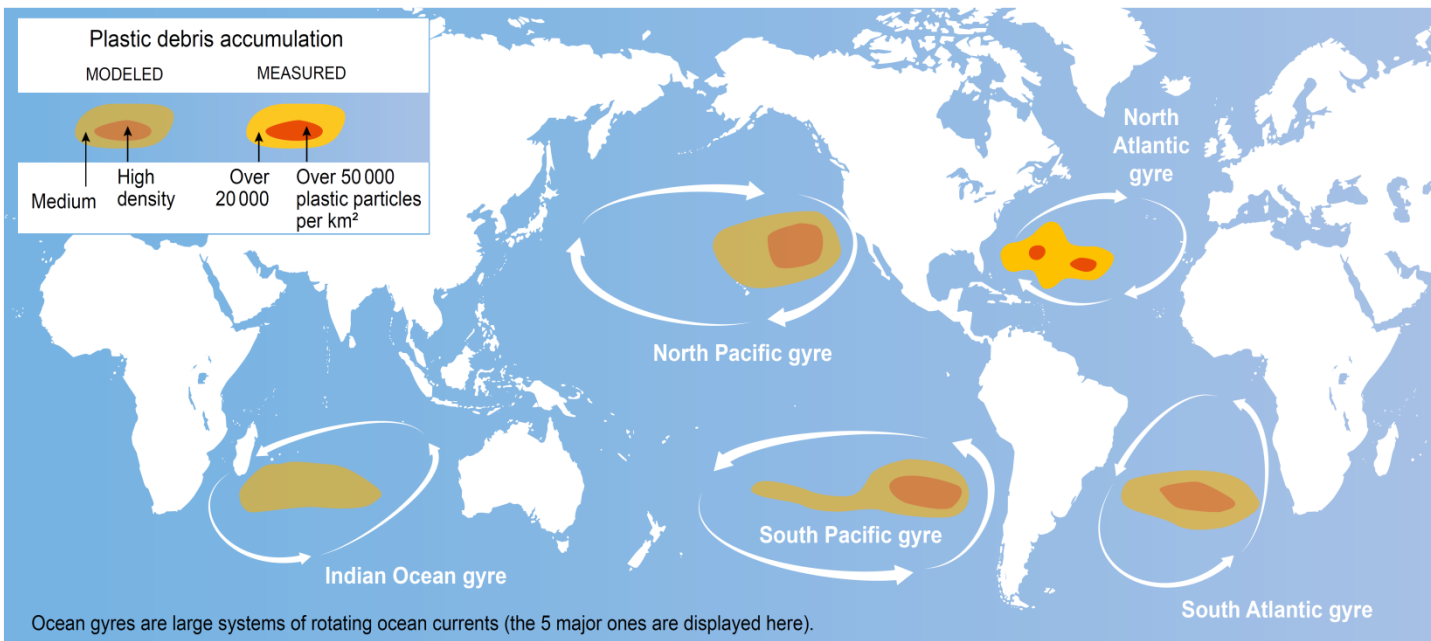
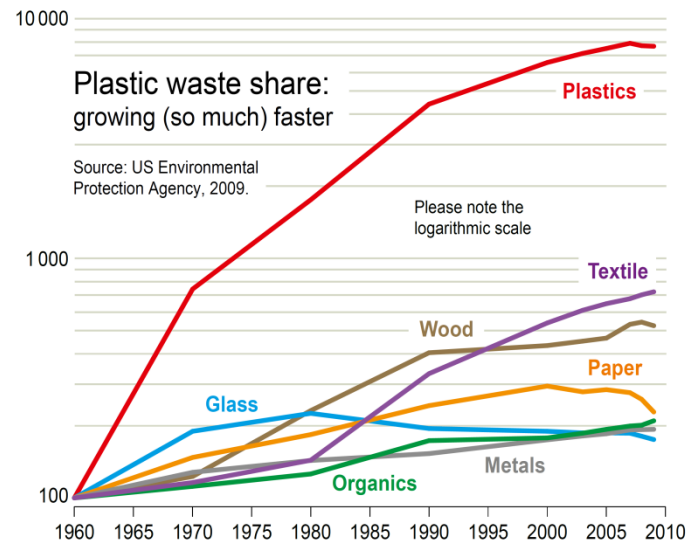
### Trend for weight of plastic packaging generation

Index = 100 in 1997



### Trend for waste streams in US municipal waste output

Index = 100 in 1960



Sources: Nickolai Maximenko et al. cited in Tracking Ocean Debris, IPRC Climate, Newsletter of the International Pacific Research Center, 2008; Kara Lavender Law et al., Plastic Accumulation in the North Atlantic Subtropical Gyre, Science, September 2010; US National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program, 2010; www.5gyres.org.

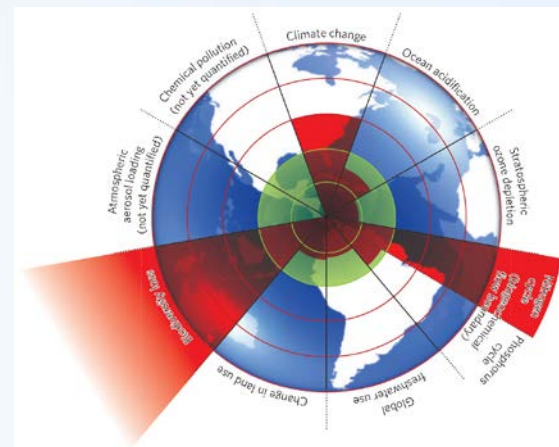




# X. Emise atmosférických aerosolů

Earth System process	Control variable	Threshold avoided or influenced by slow variable	Planetary Boundary (zone of uncertainty)	State of knowledge*
Atmospheric aerosol loading	Overall particulate concentration in the atmosphere, on a regional basis	Disruption of monsoon systems. Human-health effects. Interacts with climate change and freshwater boundaries.	To be determined	1. Ample scientific evidence. 2. Global threshold behavior unknown. 3. Unable to suggest boundary yet.

**Boundary: Not yet identified**



# Emise atmosférických aerosolů - důsledky

- 1) *Ovlivnění klimatického systému*
- 2) *Škodlivé účinky na lidské zdraví*

ad 1) globální koncentrace aerosolů je od prům. rev. dvojnásobná  
**aerosoly ovlivňují:**

- radiační rovnováhu planety  
zvýšeným odrazem do vesmíru
- hydrologický cyklus změnou  
mechanizmu tvorby srážek
- **cirkulaci asijských monzunů**
  - aerosoly nad Indo-Ganžskou plání více zahřívají  
atmosféru, zatímco dochází k ochlazování povrchu
  - dochází tak k posunu srážek do oblasti Himalájí a  
změnu časového rozvržení



The screenshot shows a webpage from NewScientist's Environment section. The article title is "Air pollution is stunting India's monsoon", dated 12:16 30 September 2011 by Michael Marshall. The article text discusses how air pollution is affecting the monsoon in India, mentioning that the monsoon has weakened since the 1950s and that emissions further afield are also a factor. It quotes Yi Ming of Princeton University, who says that the summer monsoon provides up to 80 per cent of total annual rainfall in south Asia and supports 20 per cent of the world's population. The article also mentions that the monsoon is brought by large-scale wind patterns that transport heat between the northern and southern hemispheres.



Proč k takovým změnám v ŽP dochází,  
když si je nepřejeme?

