

# Future Earth and its implication in Asia and Pacific

2013.11.06 23:30JST (06 NOV 2013 14:30UTC)

MTSAT JMA

**Tetsuzo YASUNARI<sup>1,2,3</sup>**

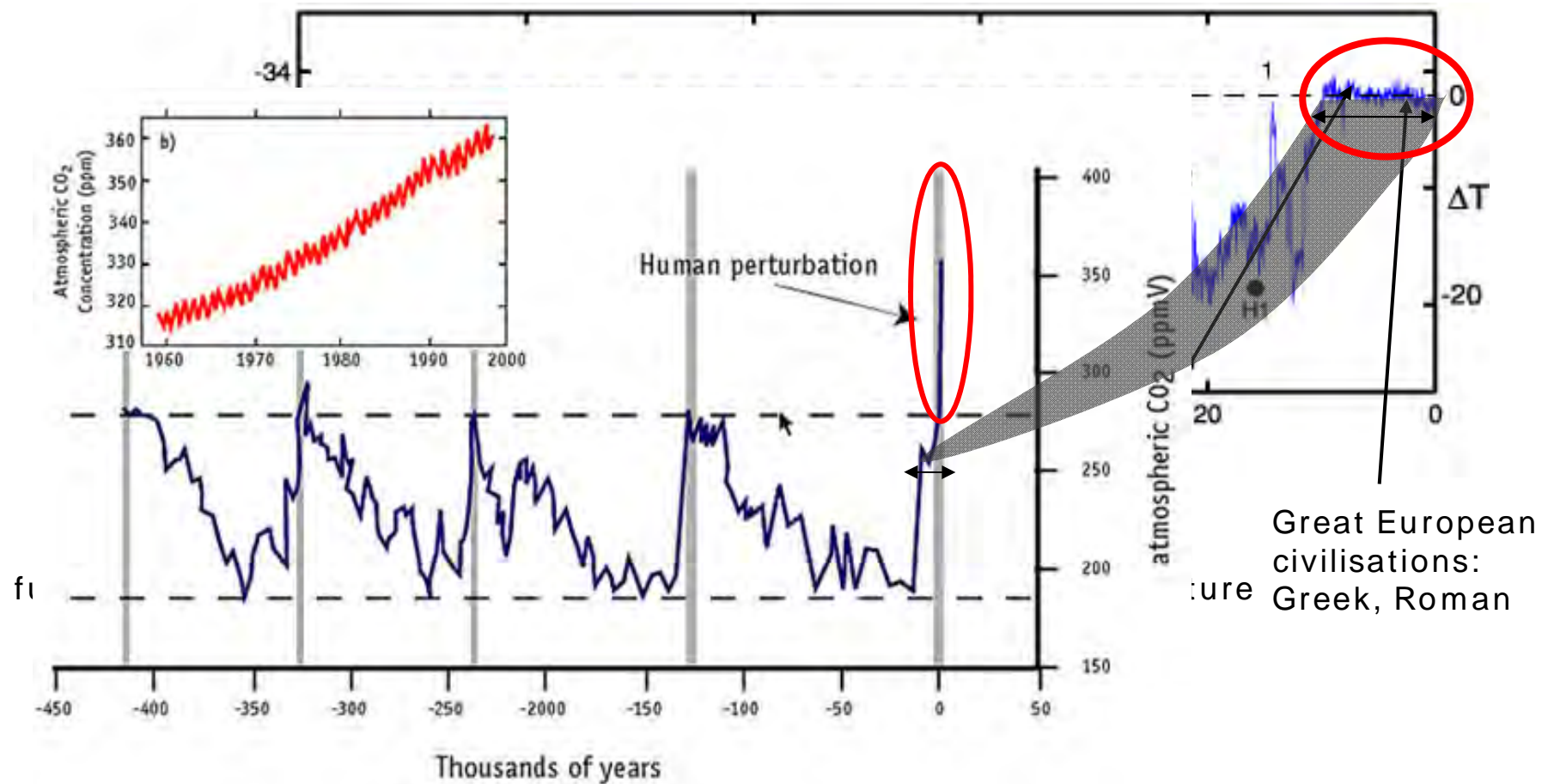
**1 Research Institute for Humanity and Nature (RIHN), Kyoto**

**2 chair, Japan National Committee for Future Earth, SCJ**

**3 member, Future Earth (International) Scientific Committee**

**Present status  
of the global environment  
in the long history of the earth ?**

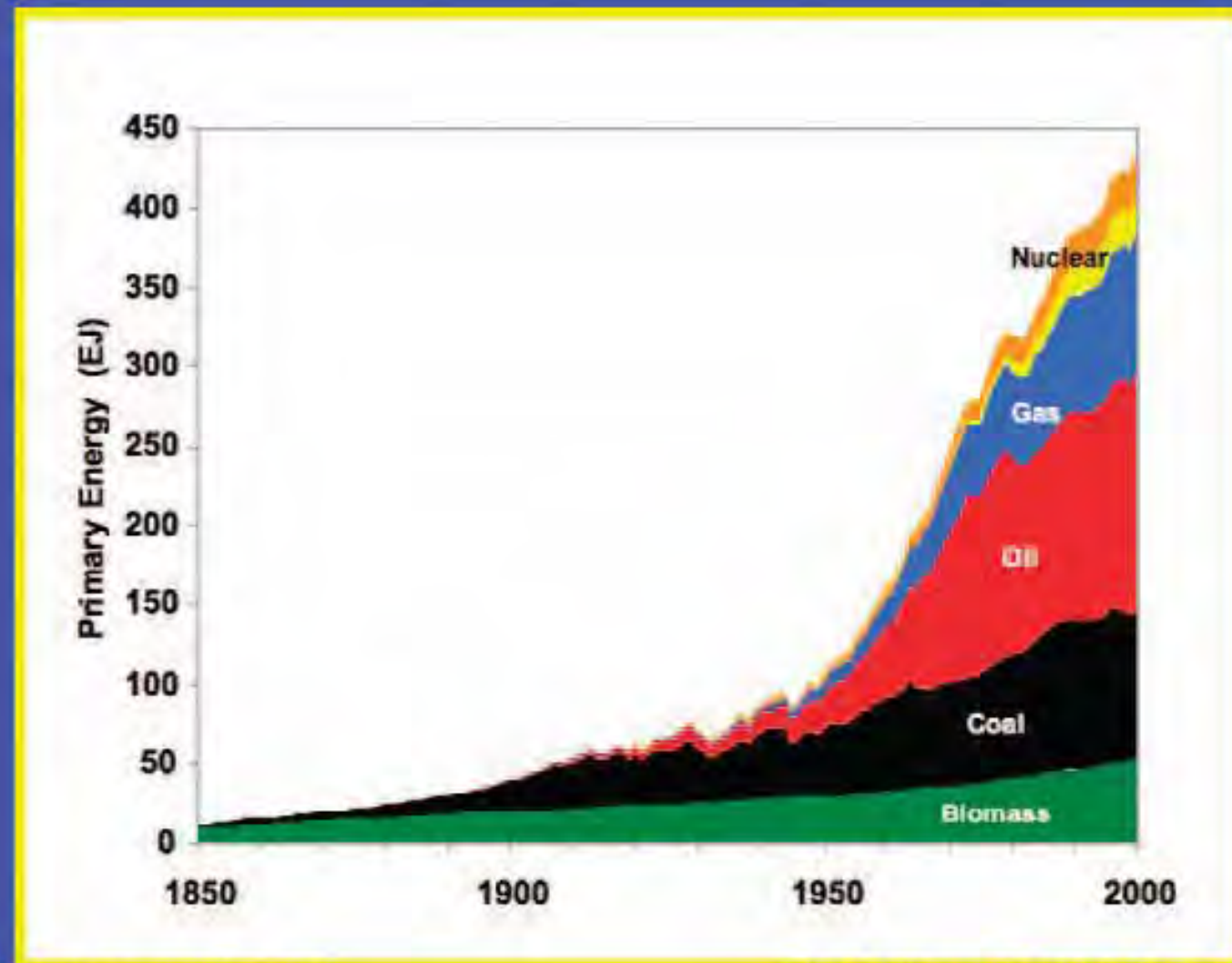
# From Holocene to Anthropocene ? – the last 10000 years



Source: GRIP ice core data (Greenland) and S. Oppenheimer, "Out of Eden", 2004

# Rapid increase of energy since around 1950

[Era of dominant influence of human activity on the earth]



Nakicenovic #1

TU-Wien & IIASA 2003

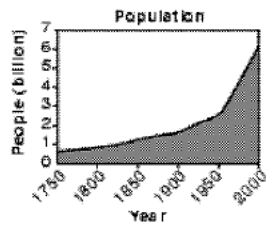


# Change from 1750 to 2000

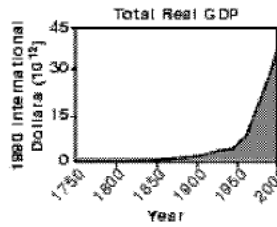
(Left) human activities

(right) environment

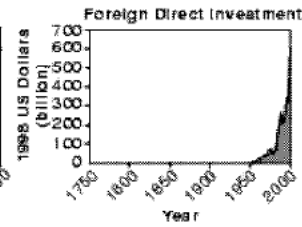
人口



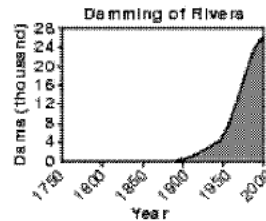
GDP



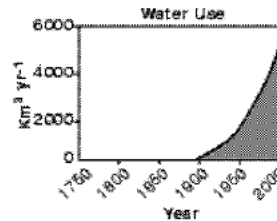
外国投資



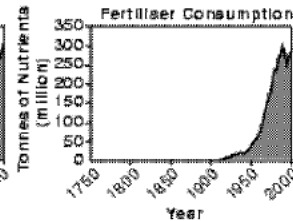
河川ダム数



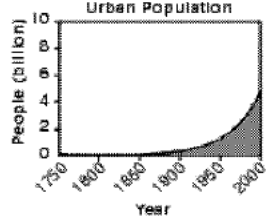
水利用



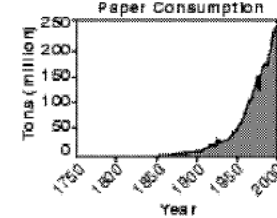
肥料使用



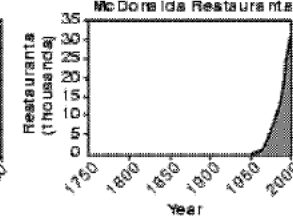
都市人口



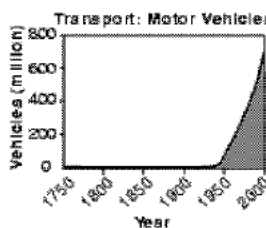
紙の消費



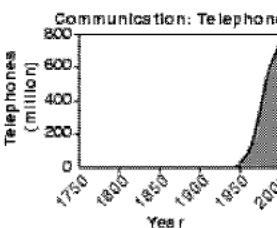
ハンバーガー店



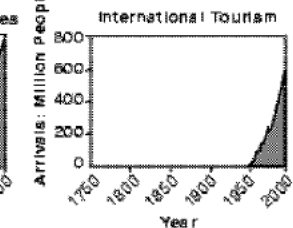
自動車



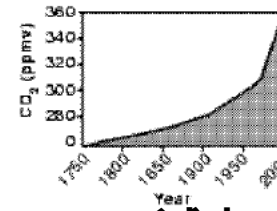
電話台数



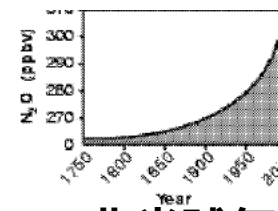
外国旅行者



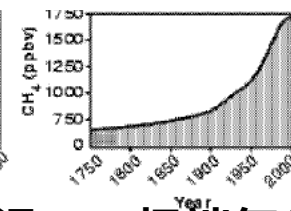
CO<sub>2</sub>



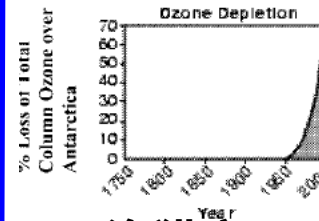
N<sub>2</sub>O



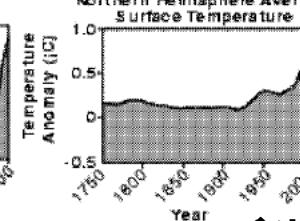
CH<sub>4</sub>



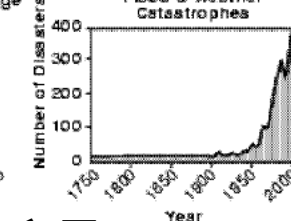
O3 減少



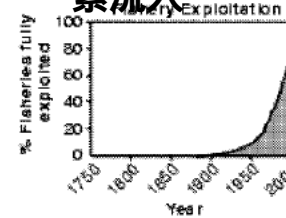
北半球気温



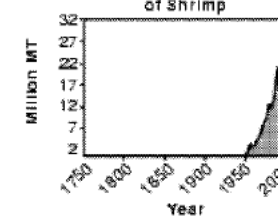
極端気象



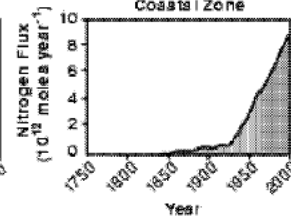
漁獲高  
素流入



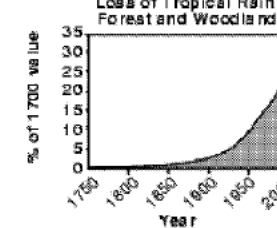
エビ生産量



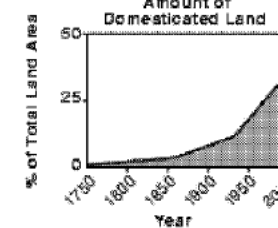
海への窒



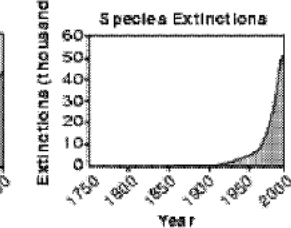
熱帯林減少



耕作地

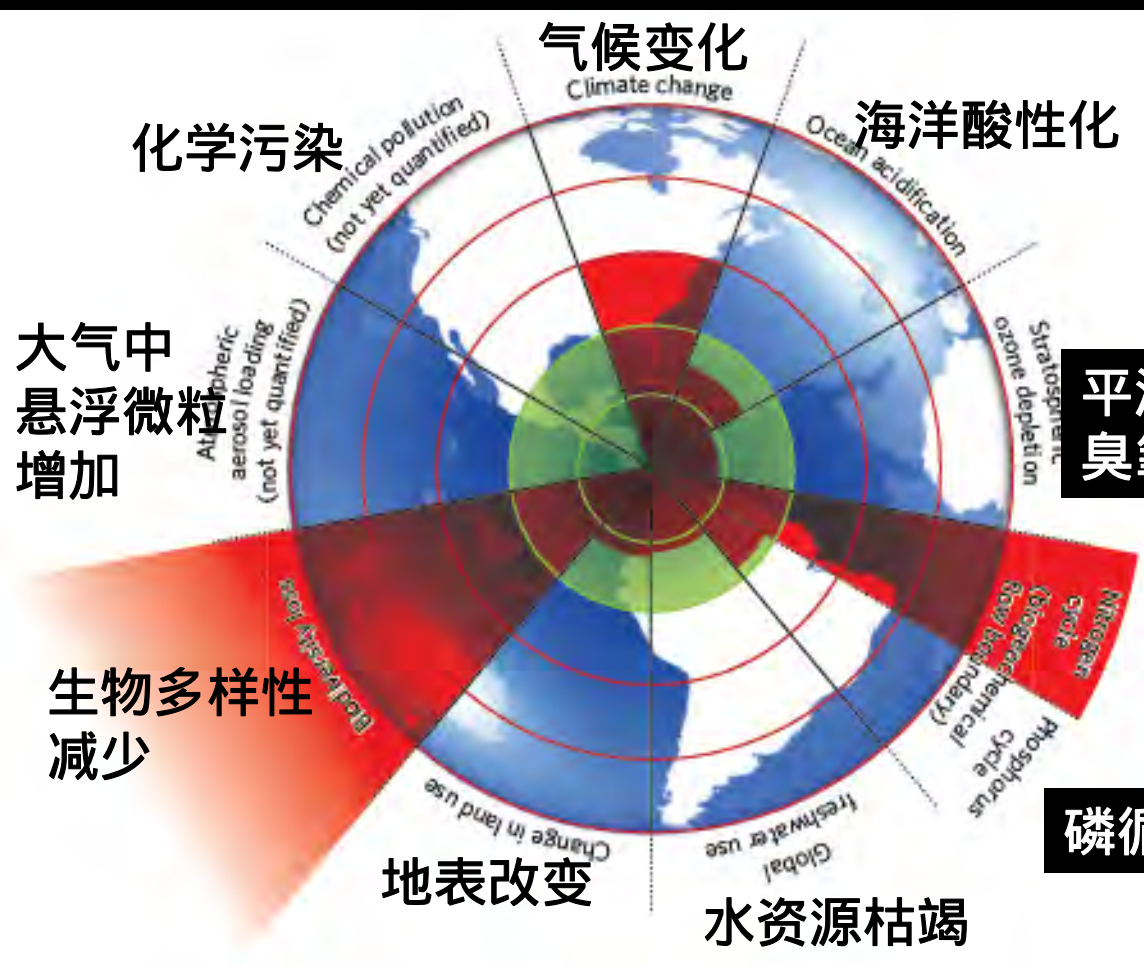


種の減少



# 地球环境正趋于极限？

The Earth environment is approaching  
Planetary Boundaries ? **tipping points**的可能性



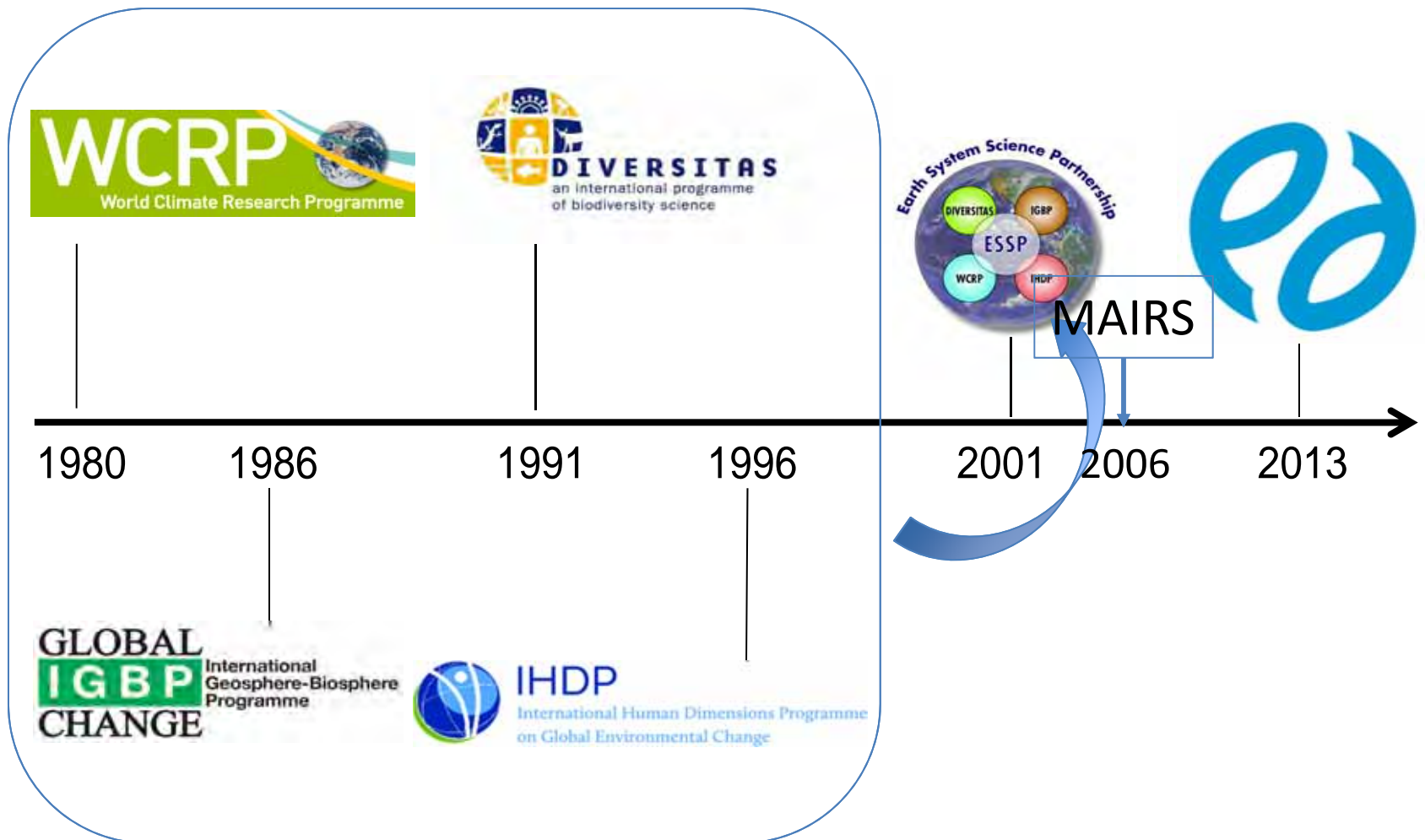
Prof. Johan Rockström  
Stockholm Resilience  
Centre

# Grand societal challenges

- **Feeding 9 billion people within sustainable planetary boundaries**
- **Valuing and protecting nature's services and biodiversity**
- **Transitioning to low carbon societies**
- **Adapting to a warmer and more urban world**
- **Coping with disasters**
- ....



# Historical context of Future Earth - integration of GEC programmes-





# Science and Technology Alliance for Global Sustainability



# What is Future Earth?

- A **global platform** for international research collaboration on global environmental change and sustainable development
- Provides **integrated research** on major global change challenges and transformations to sustainability
- Strengthens partnerships between researchers, funders and users of research through **co-design/co-production** of research
- Is **solutions-oriented**, aiming to generate knowledge that contributed to new more sustainable ways of doing things

# Co-Design and co-production of Knowledge



# Importance of Future Earth in Asia/Pacific for local, regional and global sustainability

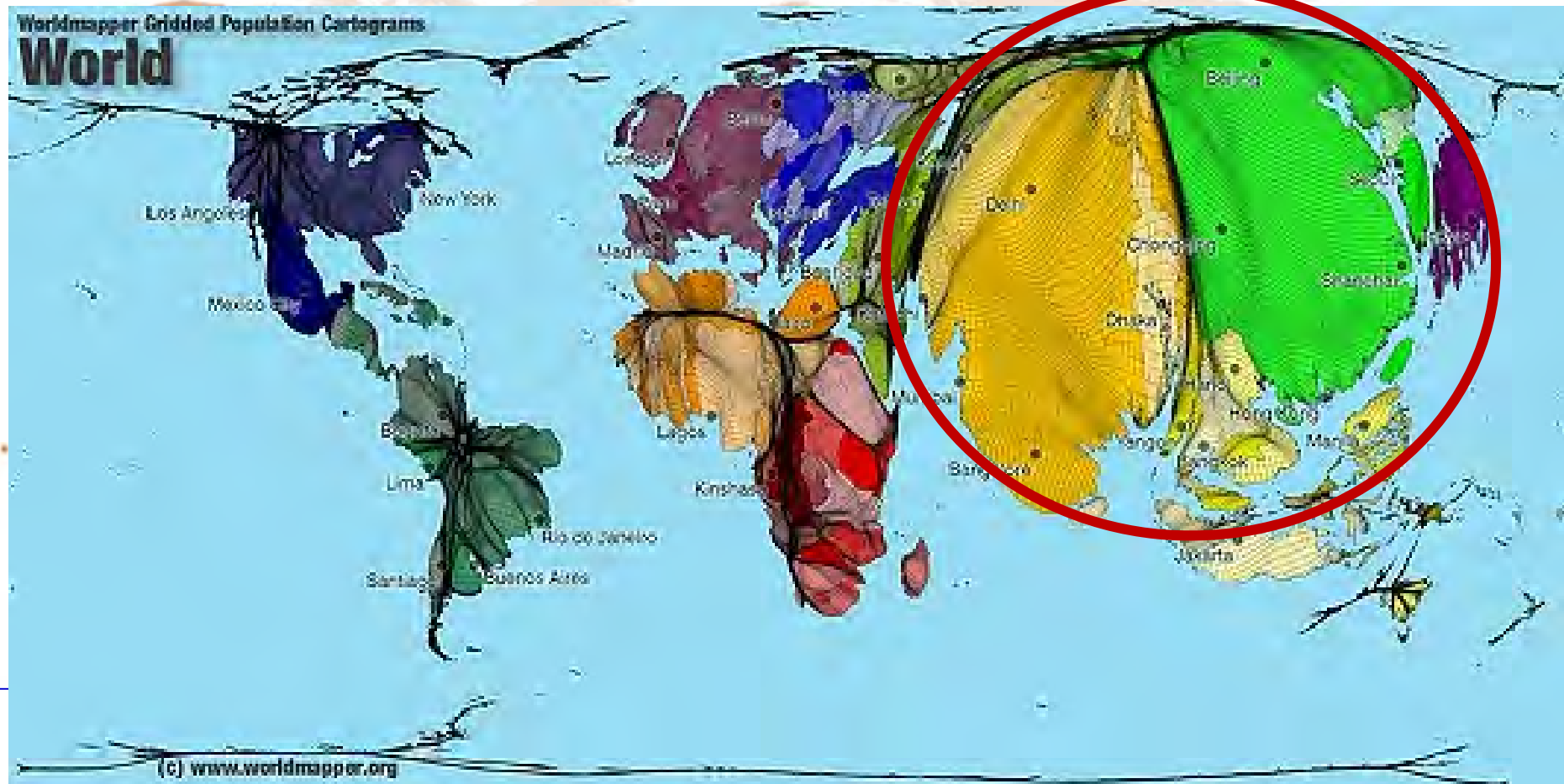




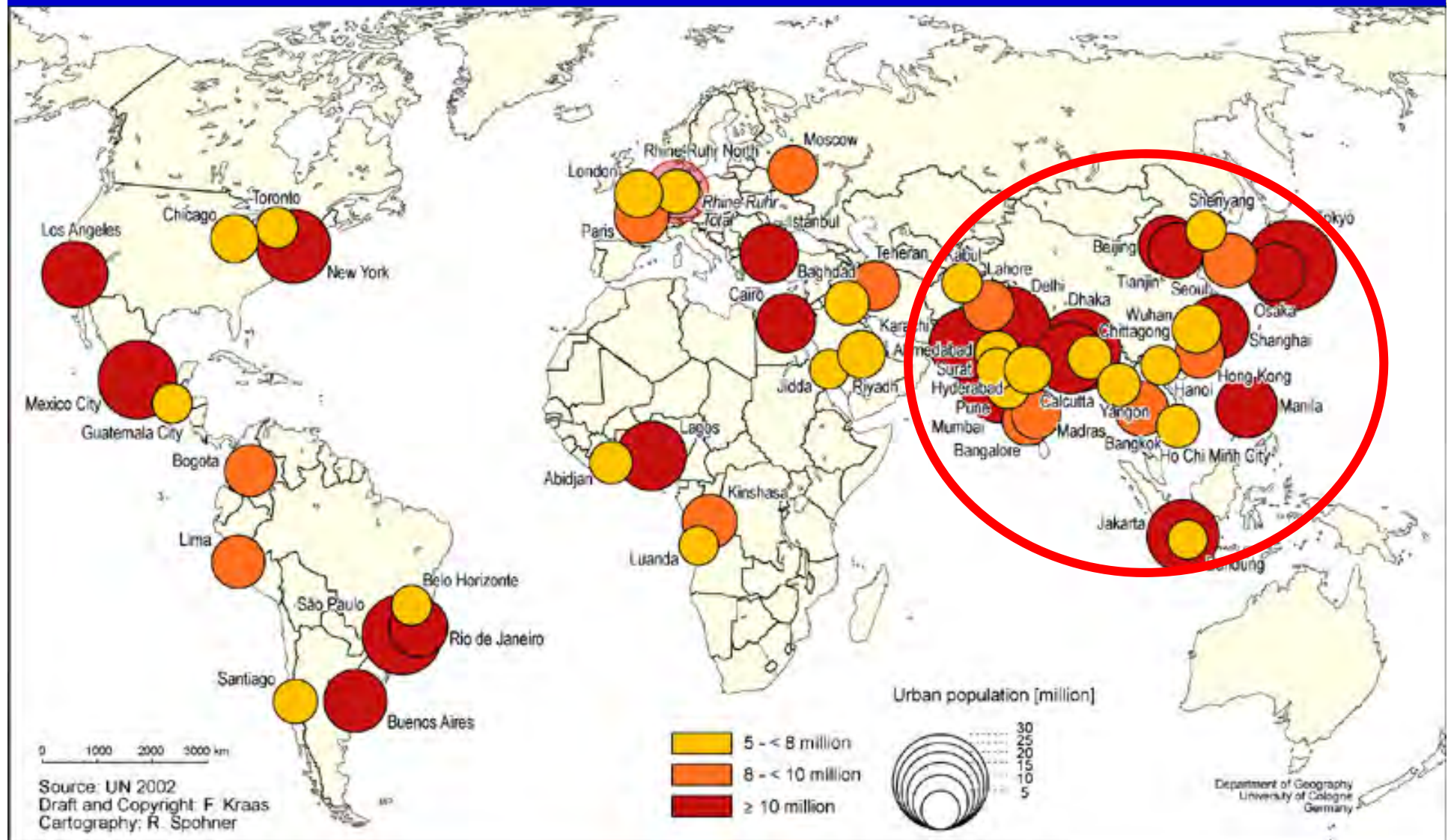
# World Population

ensity.svg[http://en.wikipedia.org/wiki/File:Countries\\_by\\_population\\_density.svg](http://en.wikipedia.org/wiki/File:Countries_by_population_density.svg)

More than 60% of the world population live in Asia.

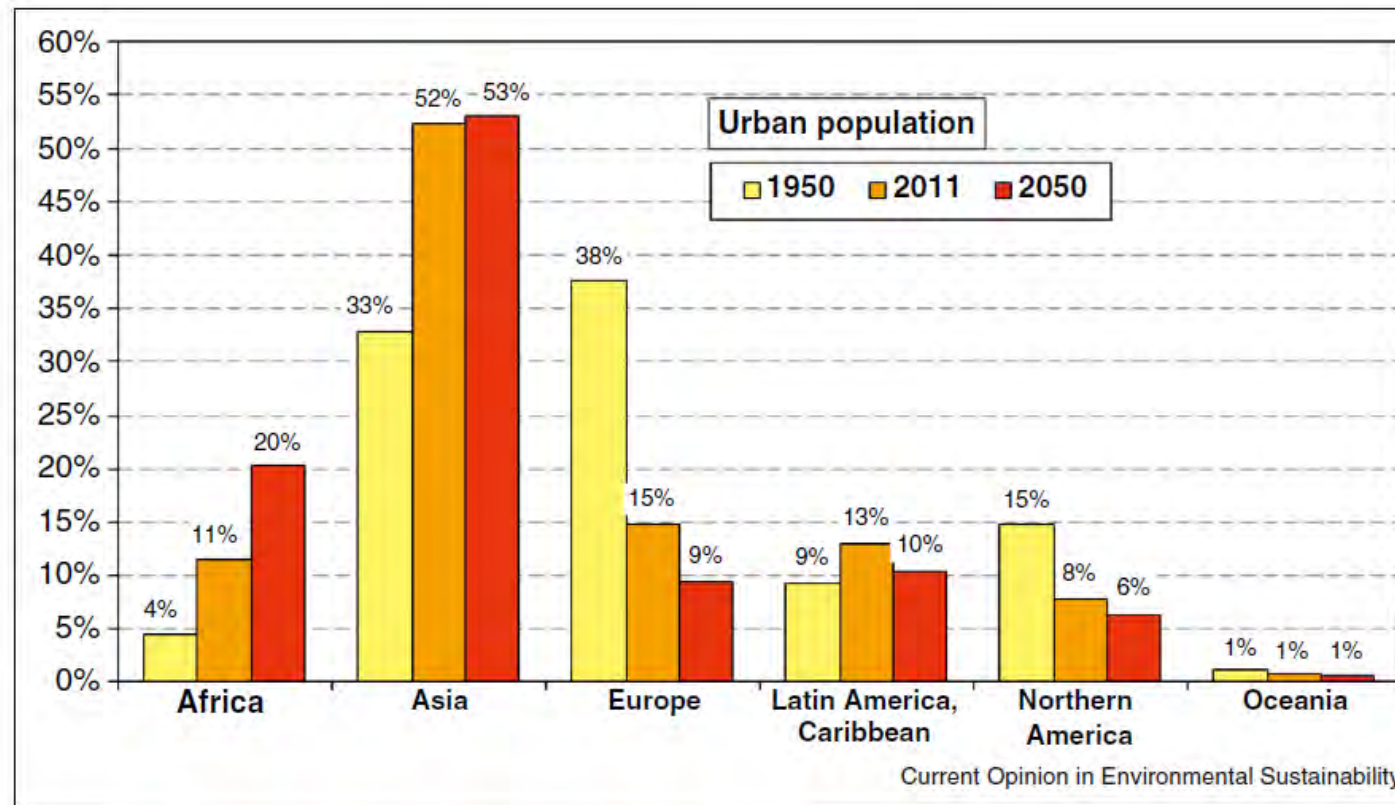


# Mega-cities in the world are concentrated in Asia



<http://www.megacities.uni-koeln.de/documentation/megacity/map/MC-2015-PGM.jpg>

# Distribution/change of world's urban population



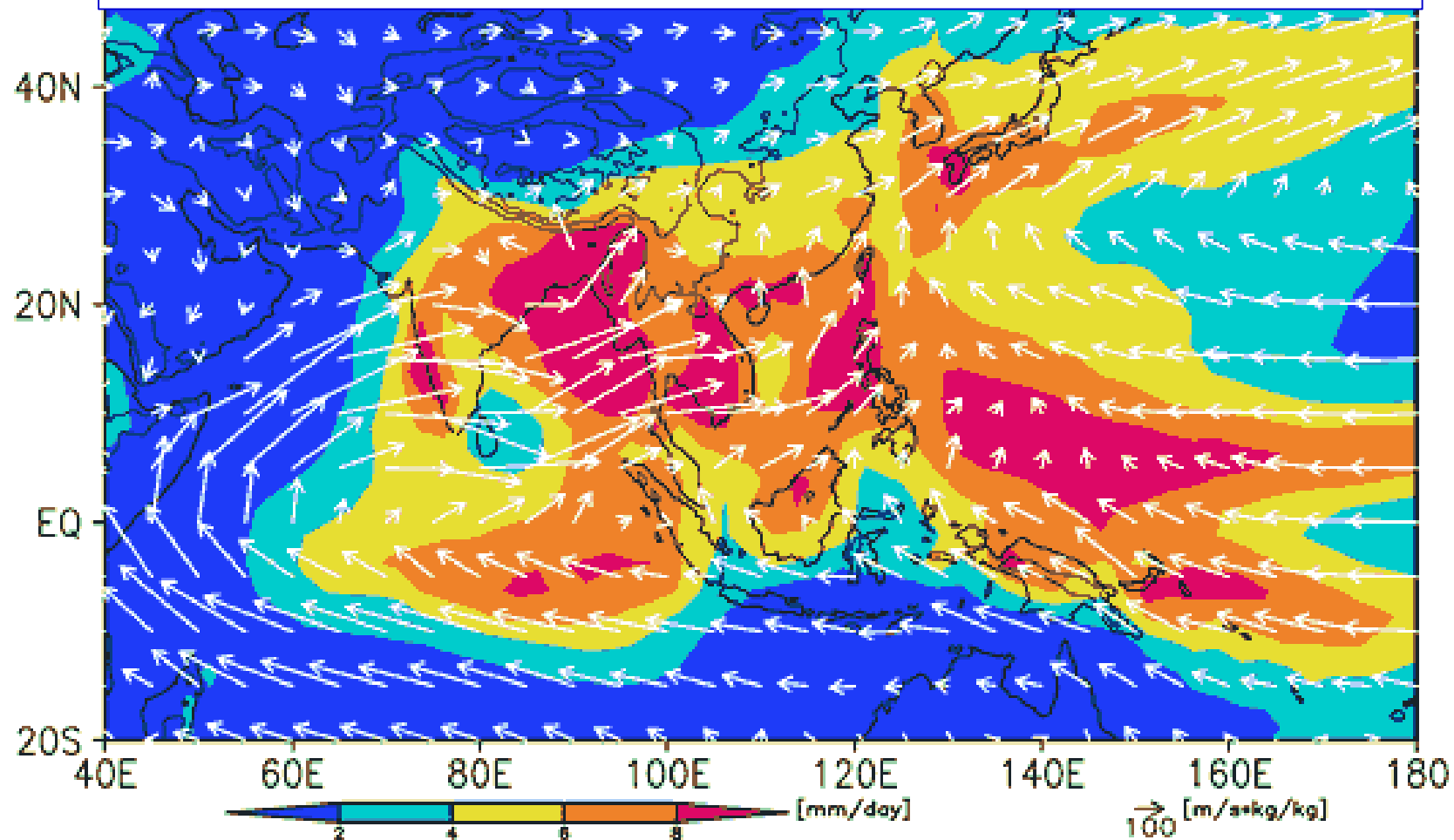
Distribution of World's Urban Population: 1950, 2011, and 2050 (predicted).

Source: United Nations Department of Economic and Social Affairs/Population Division 5. World Urbanization Prospects: The 2011 Revision.

**More than 50% of the population in Asia is concentrated in urban areas.**

# Precipitation and water vapor flux over Asia (June, July August)

The Asian monsoon climate system underpins the ecosystem services on which the livelihoods and wellbeing of billions of people depend.





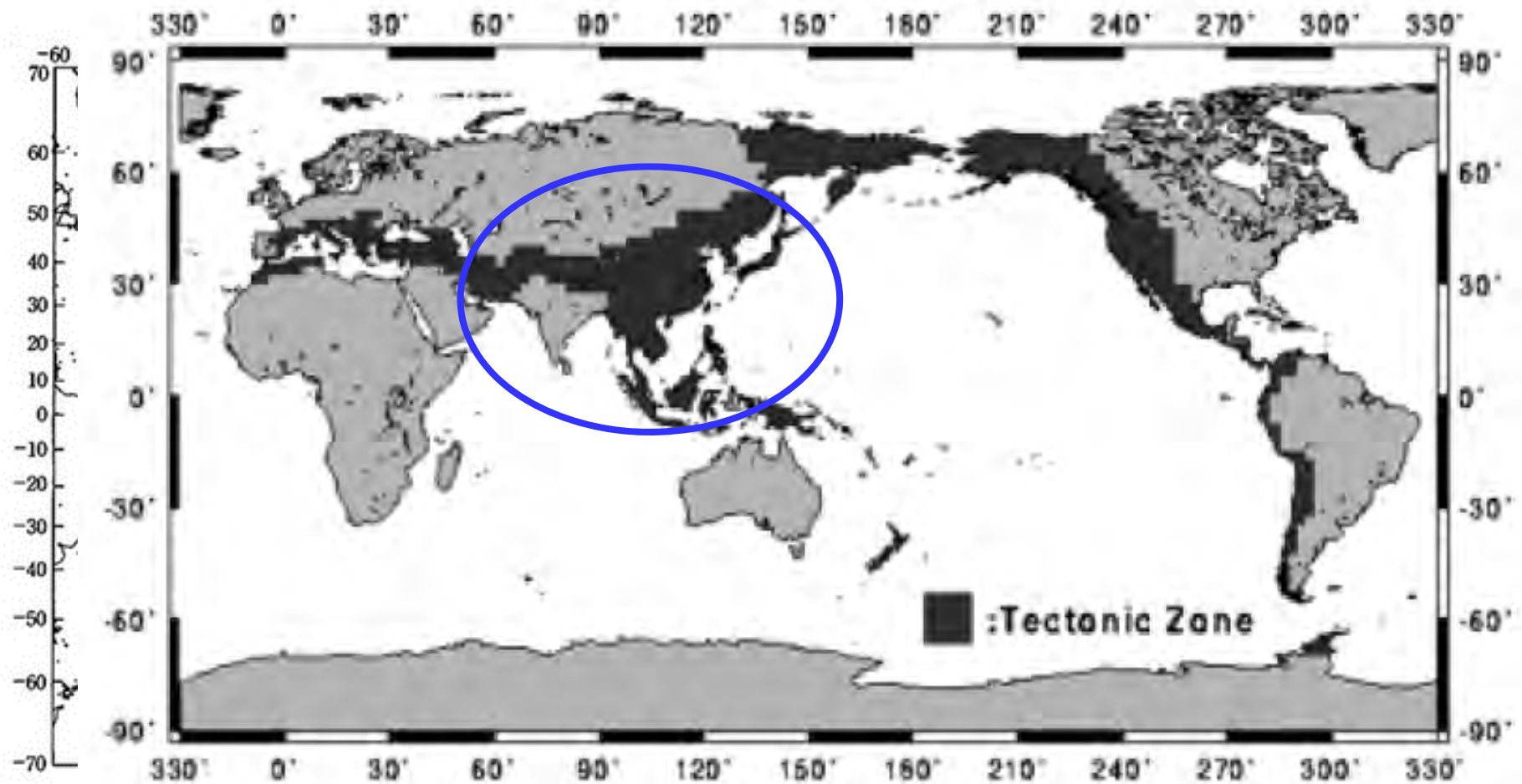
## Rice paddy field - A typical landscape of monsoon Asia

**Asia contains a complex mosaic of social and ecological systems developed through a long history of human interaction with nature. Many customary but large-scale systems of resource management, such as a complex system of paddy-rice, pasture and forestry system “Satoyama” and/or “Satoumi”, contributed to agro & coastal biodiversity and maintained intensive food & fishery production, employment opportunities and community livelihood over long periods of time.**



# World distribution of earthquake and tectonic zone

図2 変動帯の世界分布



出所：Strahler, A.H. And Strahler, A. N. (1992) *Modern Physical Geography*, John Wiley & Sons, Inc. より作成

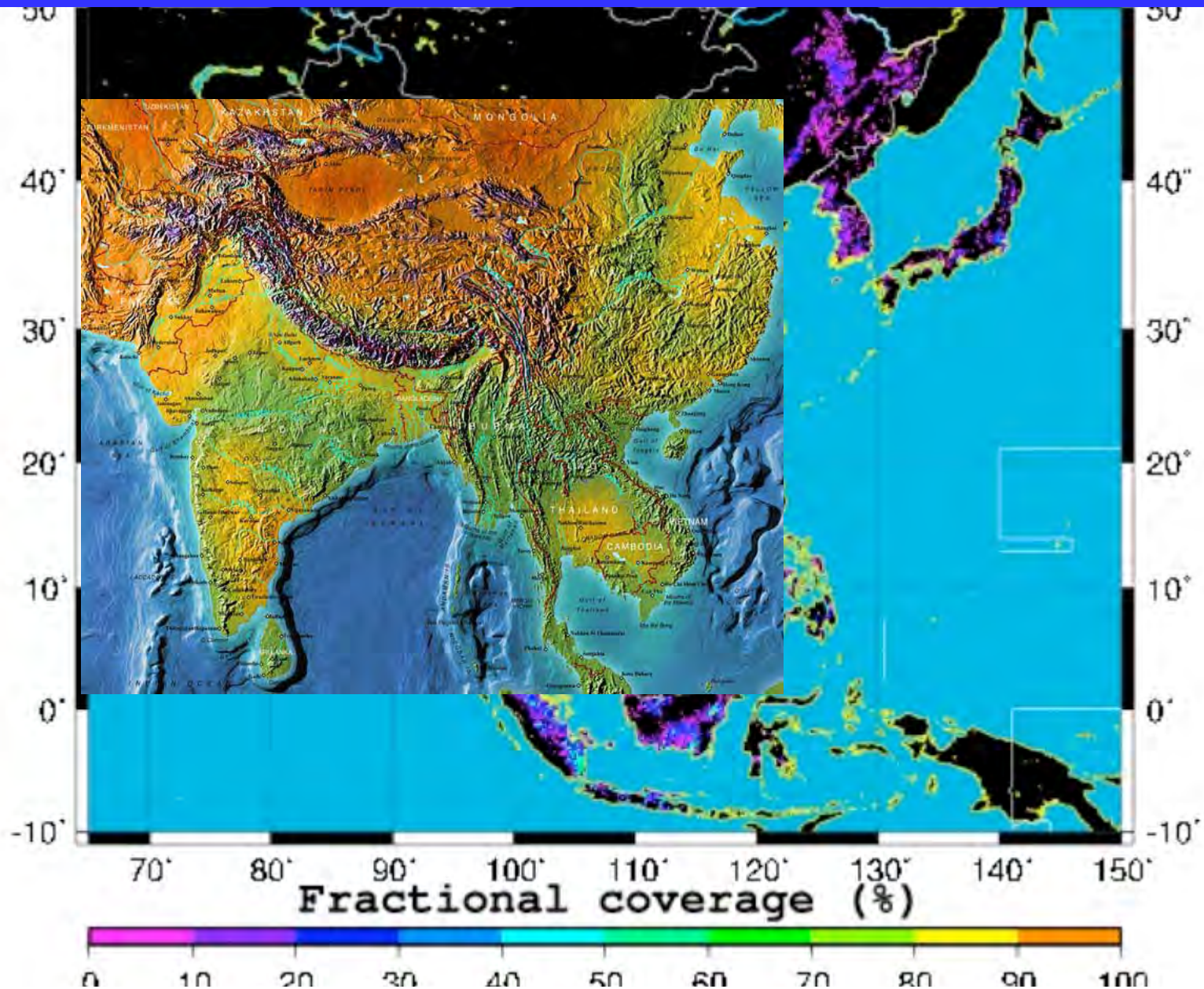
# The Great Earthquake & Tsunami in Eastern Japan 2011.3.11

**Asia must improve its capacity for risk management of both natural and human-caused disasters, since the region exhibits high human vulnerability not only to extreme weather events (typhoons, heavy rains, floods and droughts etc.), but also to severe tectonic events (earthquakes, landslides, and tsunami).**





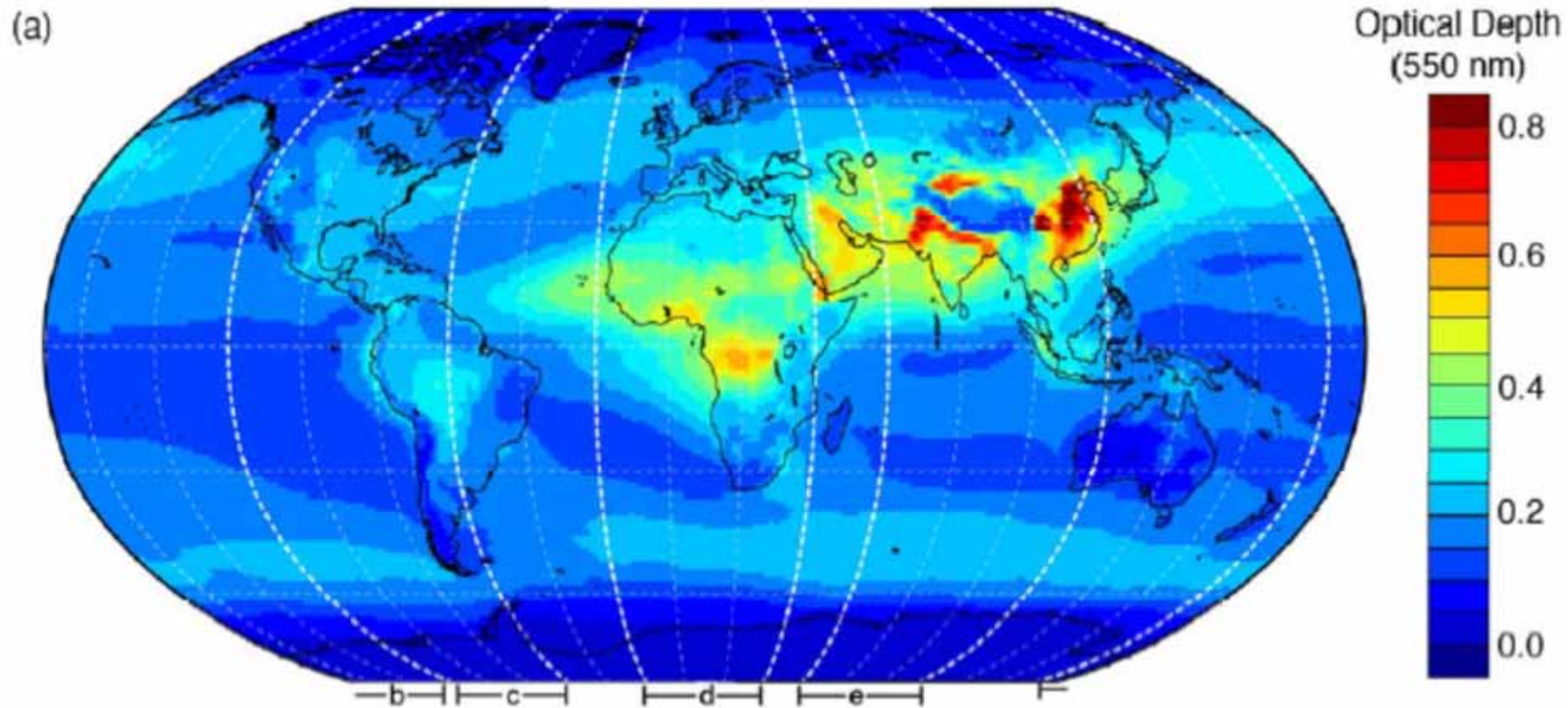
**Rice paddy fields in monsoon Asia have well utilized the alluvial basins & plains formed as part of the tectonic zone**





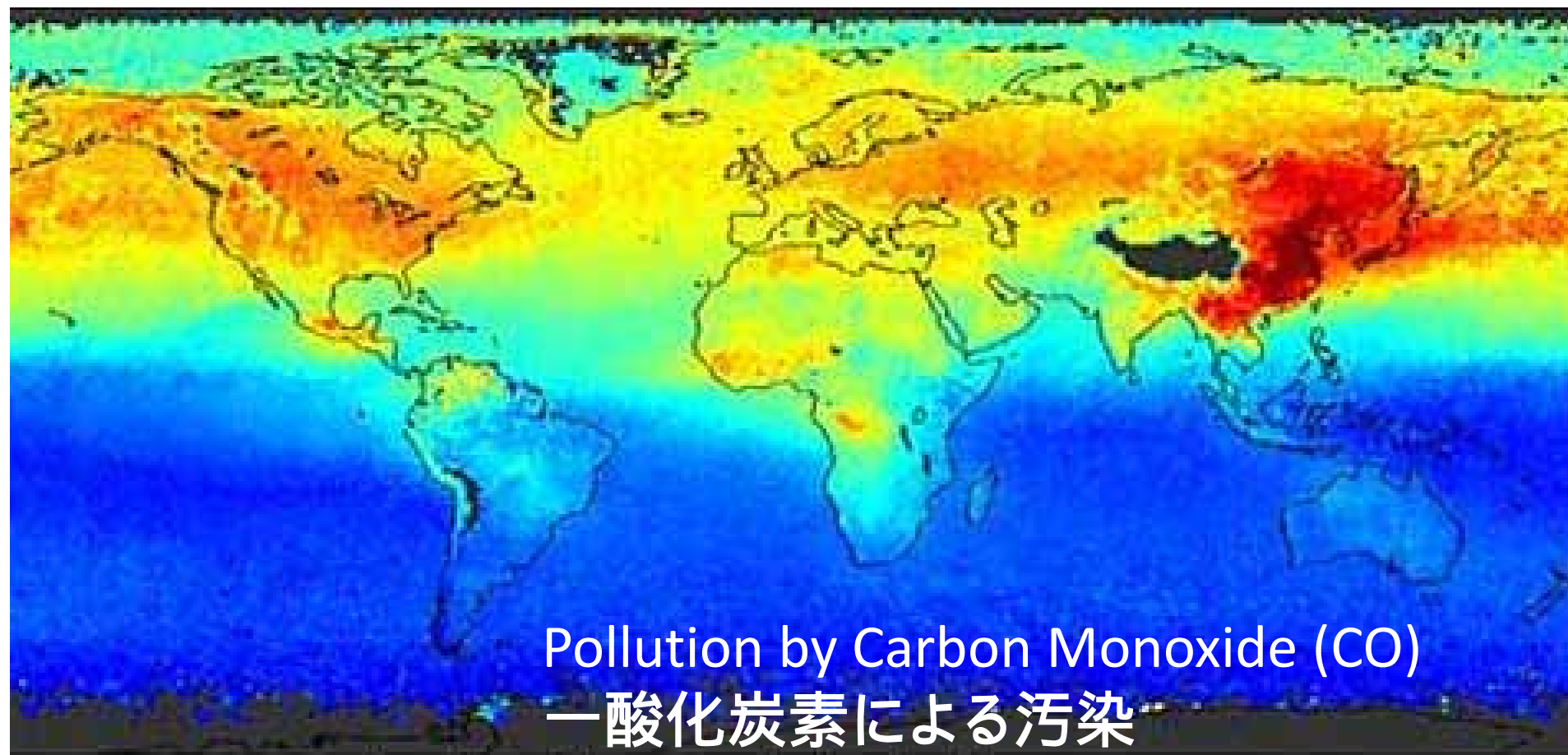
**Human impact on the environment  
in the Asia/Pacific region  
has become enormous  
in the recent several decades**

# Optical thickness by aerosols (2003-2010) (IPCC, 2013)



**Asia is one of the major emission areas  
of Air and water pollutants**

Figure 7.14: a) Spatial distribution of the 550 nm aerosol optical depth (AOD, unitless) from the ECMWF Integrated Forecast System model with assimilation of MODIS aerosol optical depth (Benedetti et al., 2009; Morcrette et al., 2009) averaged over the period 2003-2010.



Pollution by Carbon Monoxide (CO)

—酸化炭素による汚染

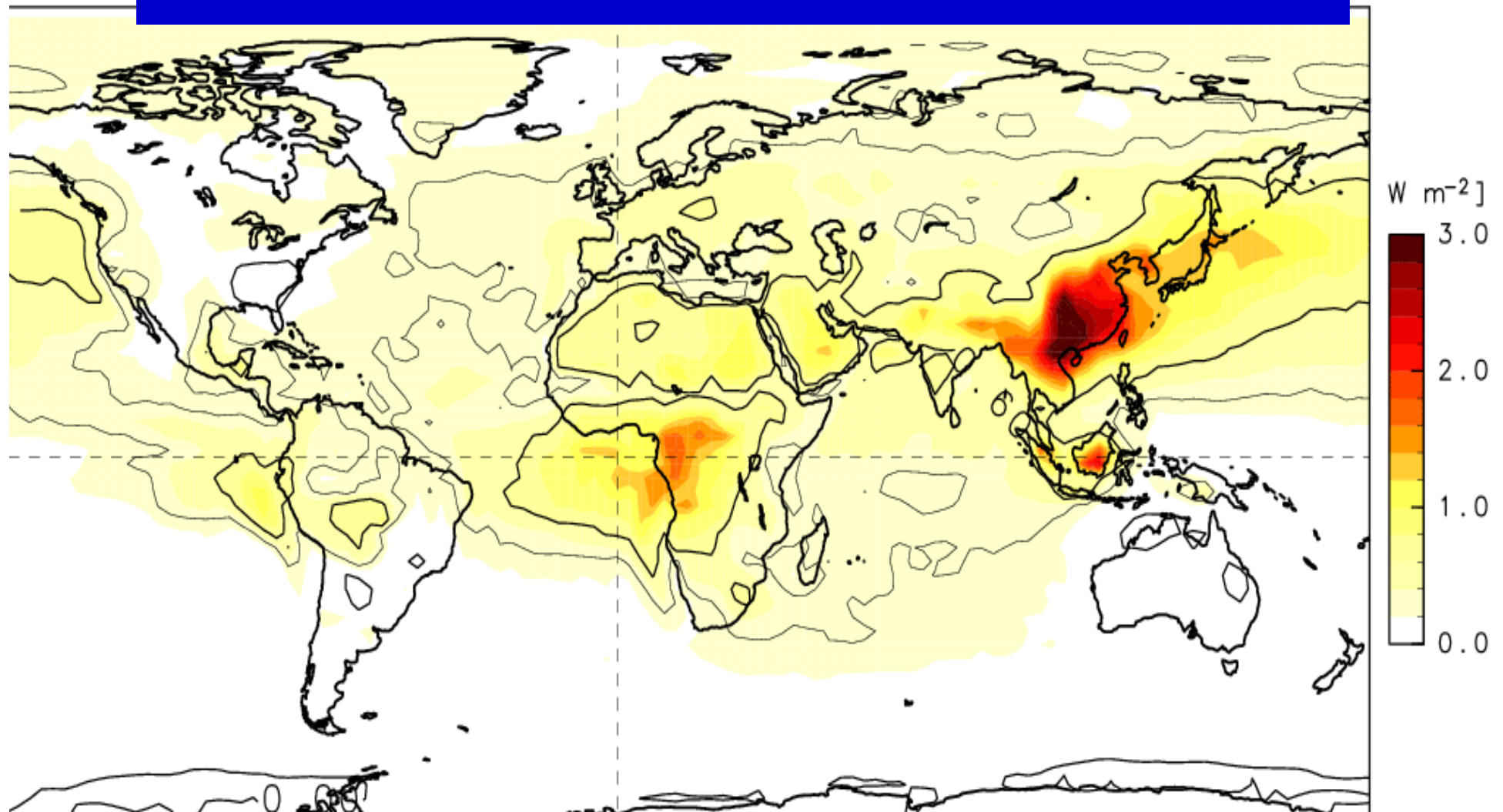
Carbon Monoxide concentration (ppbv)



**Asia is one of the major emission areas  
of Air and water pollutants**

ect

## Black Carbon (direct radiative forcing)

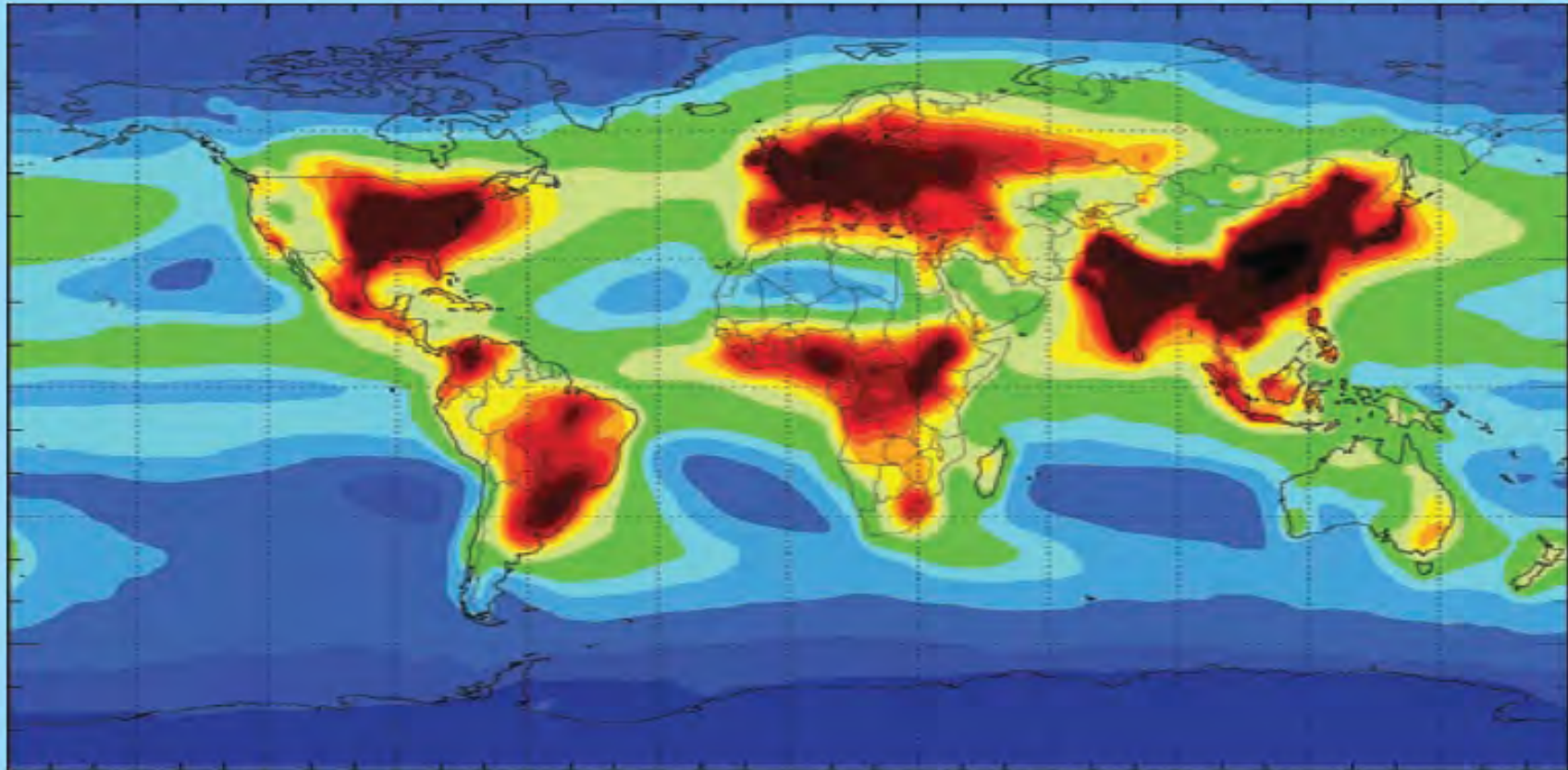


**Asia is one of the major emission areas  
of Air and water pollutants**



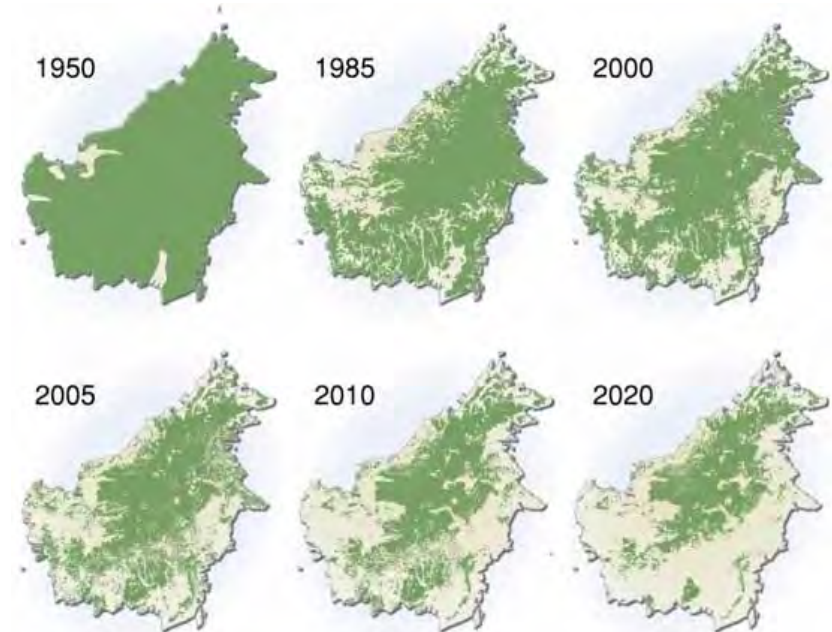
# Nitrogen Loading is already damaging the biosphere

N Deposition rates ( 0 – 60kg/ha/yr )



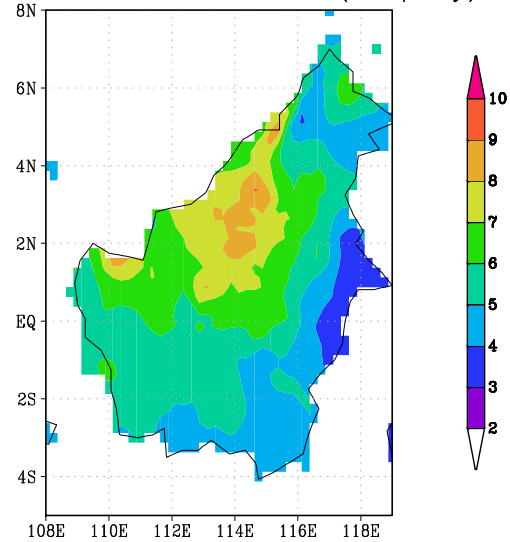
Galloway et al Science 2008

# Rapid Forest loss in South East Asia



**Asia is experiencing significant transformation of terrestrial and aquatic ecosystems. Most extensively, forest disruption and conversion continues in developing countries, particularly in the tropics in the late 20th century, causing big biodiversity loss and regional hydro-climate change.**

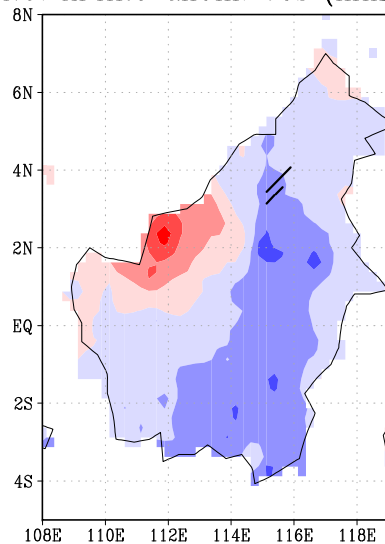
ANNU: APHRO clim. 70-07 (mm/day)



# Decadal-scale precipitation Change 1970s to 2000s (using APHRODITE data)

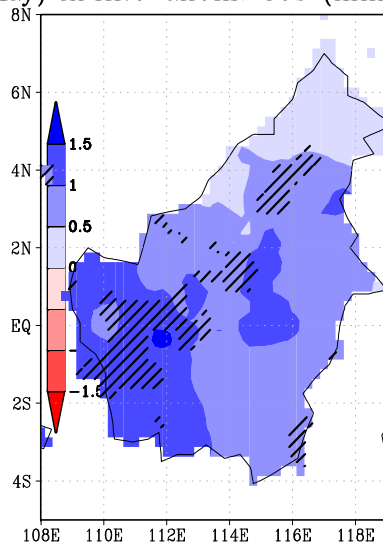
1970s

ANNU: APHRO anom. 70s (mm/day)



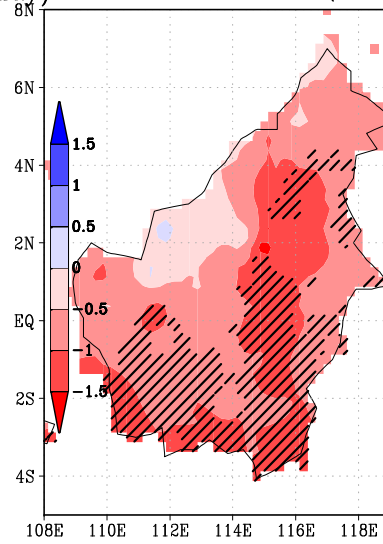
1980s

ANNU: APHRO anom. 80s (mm/day)



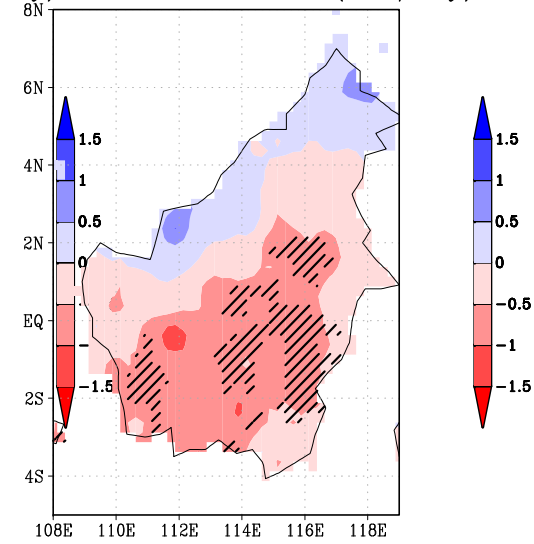
1990s

ANNU: APHRO anom. 90s (mm/day)



2000s

ANNU: APHRO anom. 00s (mm/day)

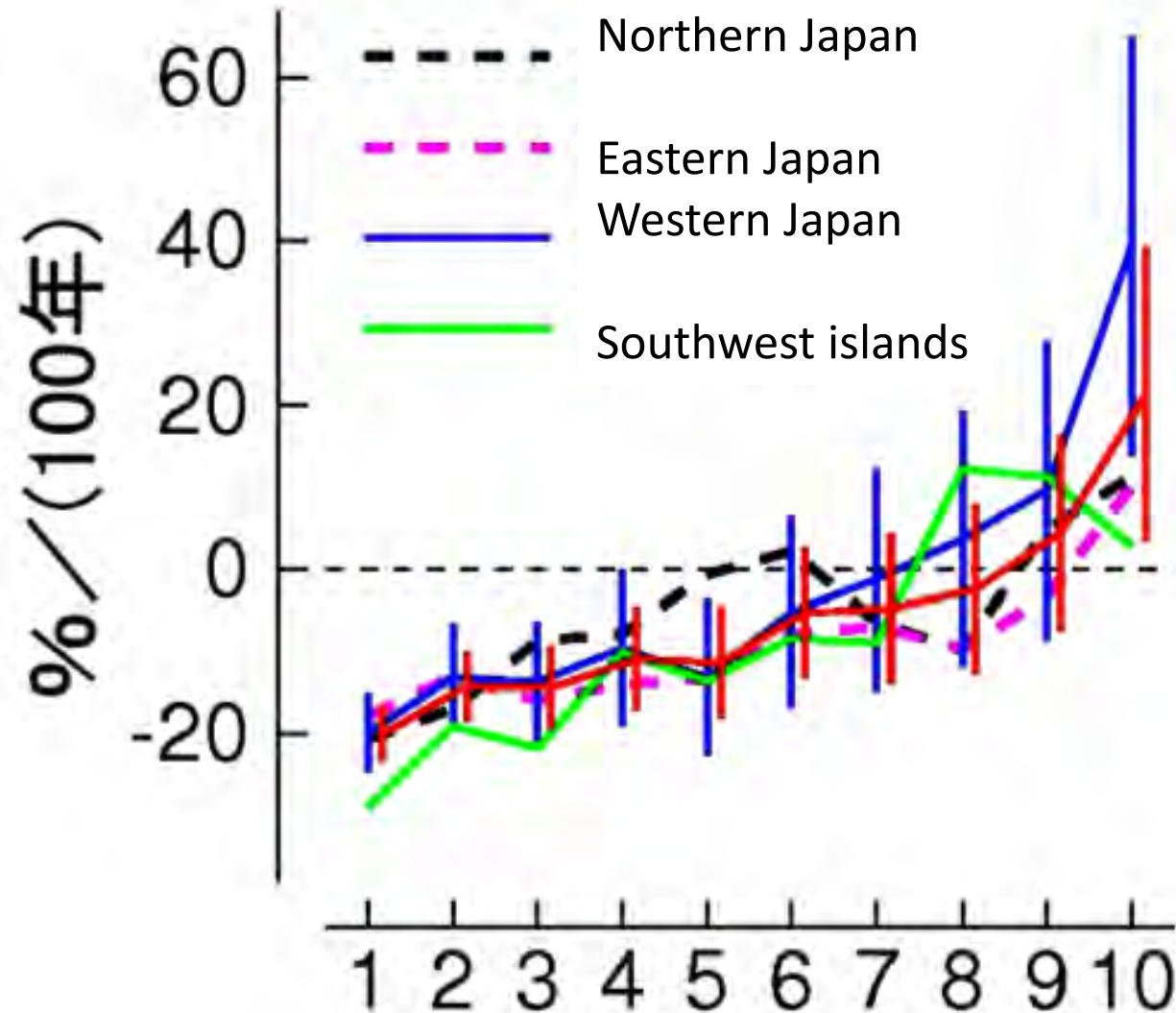


Impact of GHG increase  
on hydro-climate and water cycle  
is becoming serious over the whole  
globe, particularly in Asia-Pacific  
region



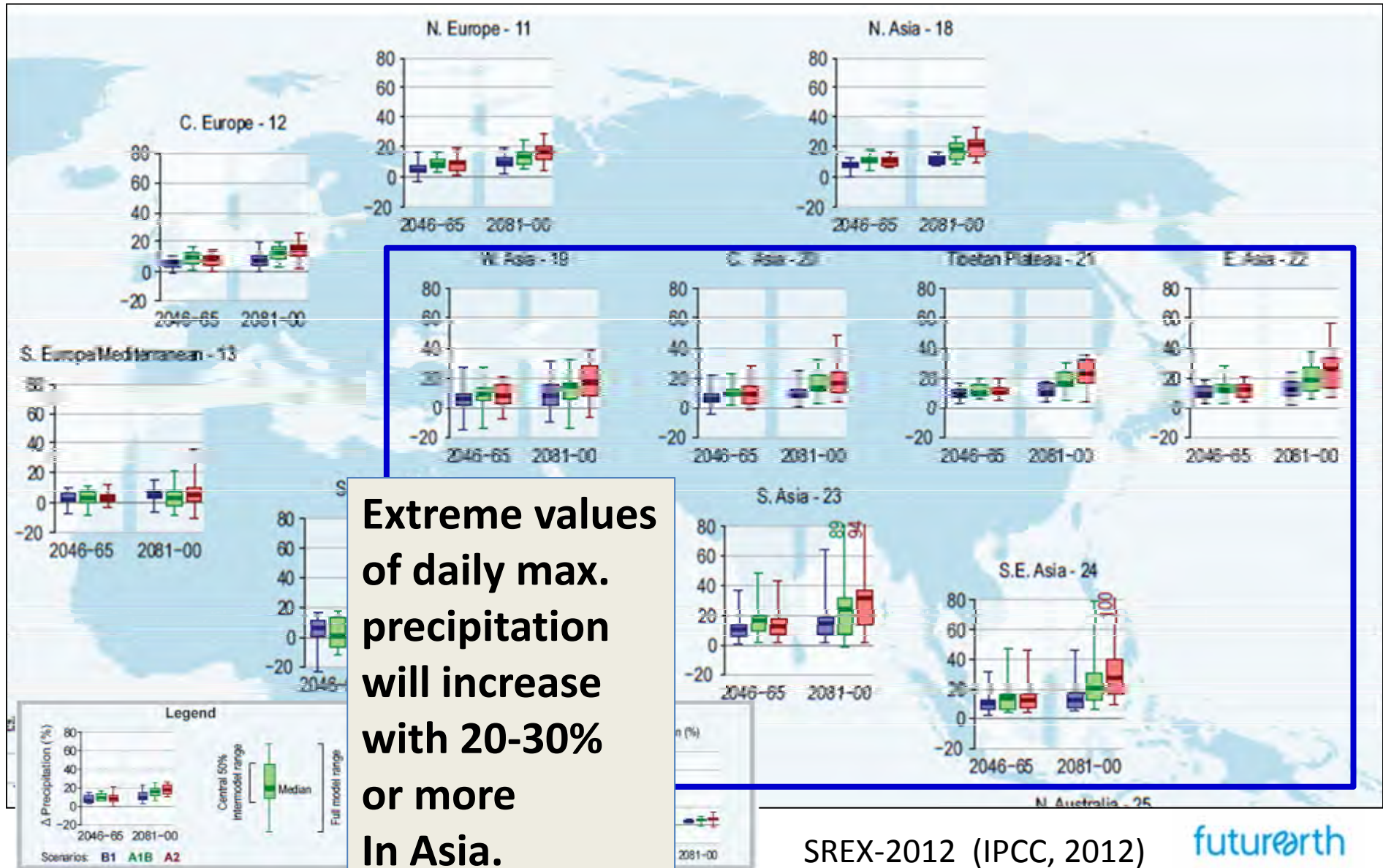
Trend values of rate-classified (1 to 10) rainfall amounts in the past 100 years in 4 regions of Japan

**Strong rain (8,9,10) show increasing trends, but weak rain (1-5) show decreasing trends.**





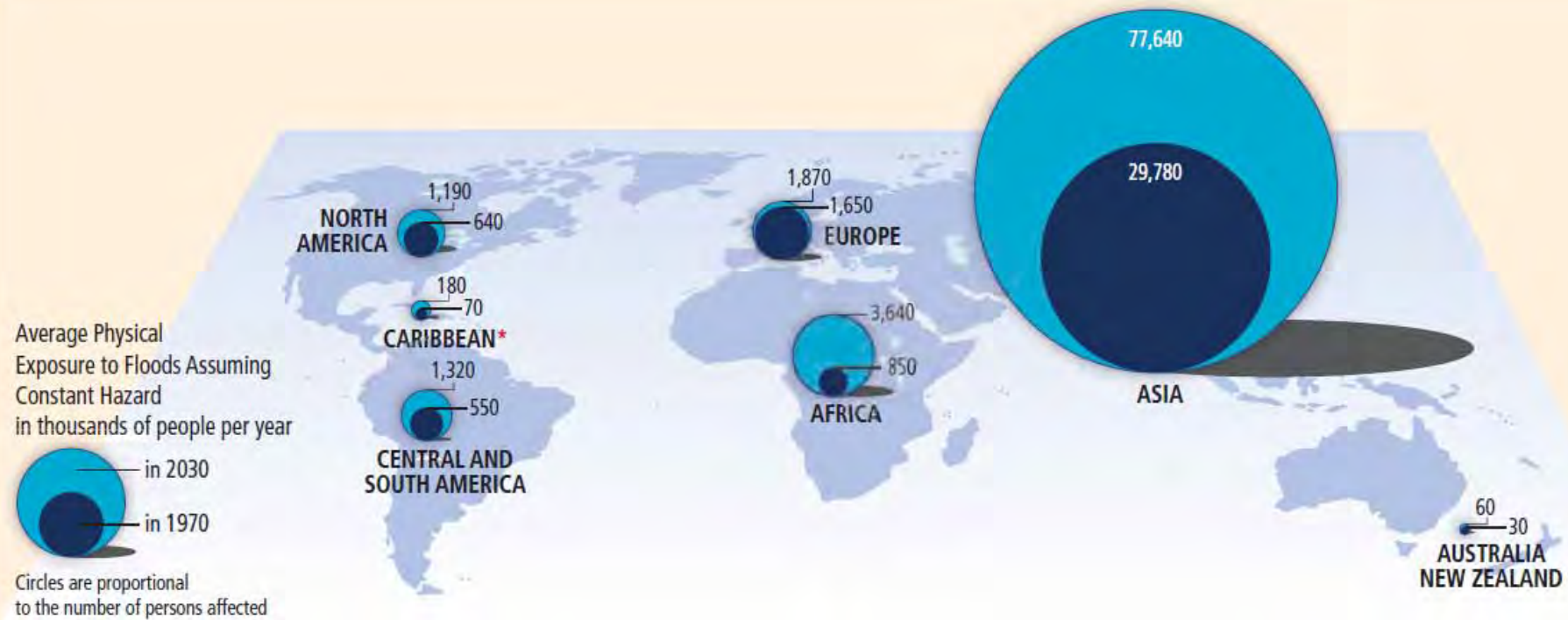
# Change of 20-year return values of annual 24-hour maximum precipitation (%) associated with GHG increases (to 2100)



SREX-2012 (IPCC, 2012)

futureearth

# Change of population exposure to floods (in 1970 & 2030)



\*Only catchments bigger than 1,000 km<sup>2</sup> were included in this analysis. Therefore, only the largest islands in the Caribbean are covered.

**Figure 4-2** | Average physical exposure to floods assuming constant hazard (in thousands of people per year). Data from Peduzzi et al., 2011.

# The Asian/Pacific Challenge

- The region as a whole is characterized by rapid population and economic growth and urbanization, great disparities of wealth both within and between countries, and social and ecological vulnerability to the potential impacts of climate change.
- Associated with this rapid population & economic growth, this region has become a huge hot-spot of GHG increase, air and water pollutions, affecting regional to global climate change.
- **This region is located in the midst of monsoon climate and the huge tectonic zone. These natural conditions cause high frequency of natural disasters, but also provide rich natural resources for agriculture & fisheries.**

# **Needs for International and multi-national collaboration in Asia/Pacific**

- **To promote sustainability studies, innovative funding sources and institutional support mechanisms need to be established by national science foundations, relevant government agencies, and multi-national & international actors and institutions.**
- **The complexity of sustainability issues in Asia/Pacific requires visionary political and scientific leadership and high level of exchange and coordination between different epistemic communities in the region.**
- **The science community and society should tightly collaborate particularly in Asia/Pacific to form Future Earth in Asia/Pacific initiative.**



Inter-University Research Institute Corporation, National Institutes for the Humanities, Japan

# Research Institute for Humanity and Nature



大学共同利用機関法人 人間文化研究機構  
総合地球環境学研究所

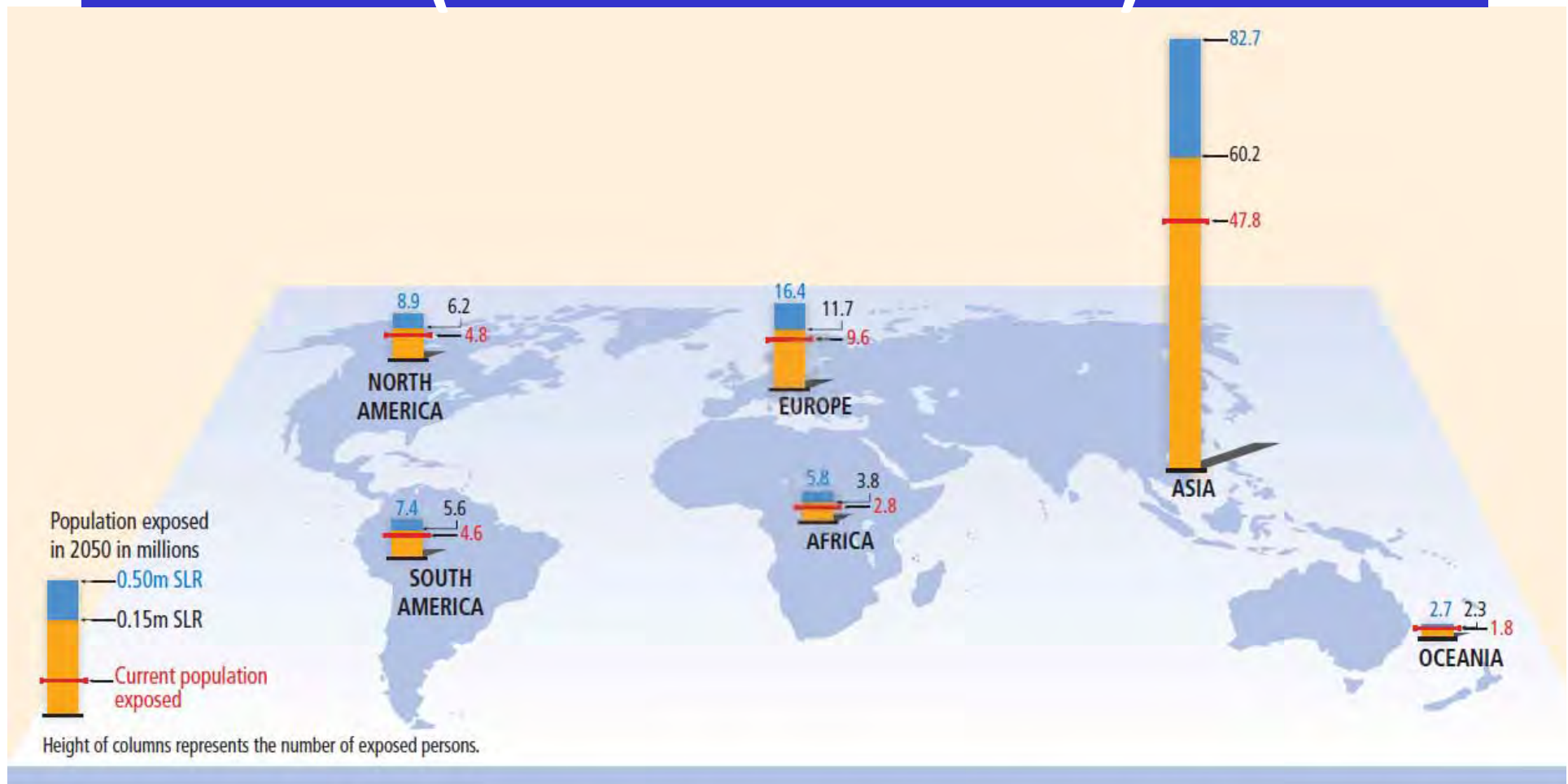


**Formally appointed  
as the Asian regional hub for Future Earth**

**Inter-disciplinary & trans-disciplinary research  
for regional to global environment and sustainability  
(futures) of the human-nature interactive system**

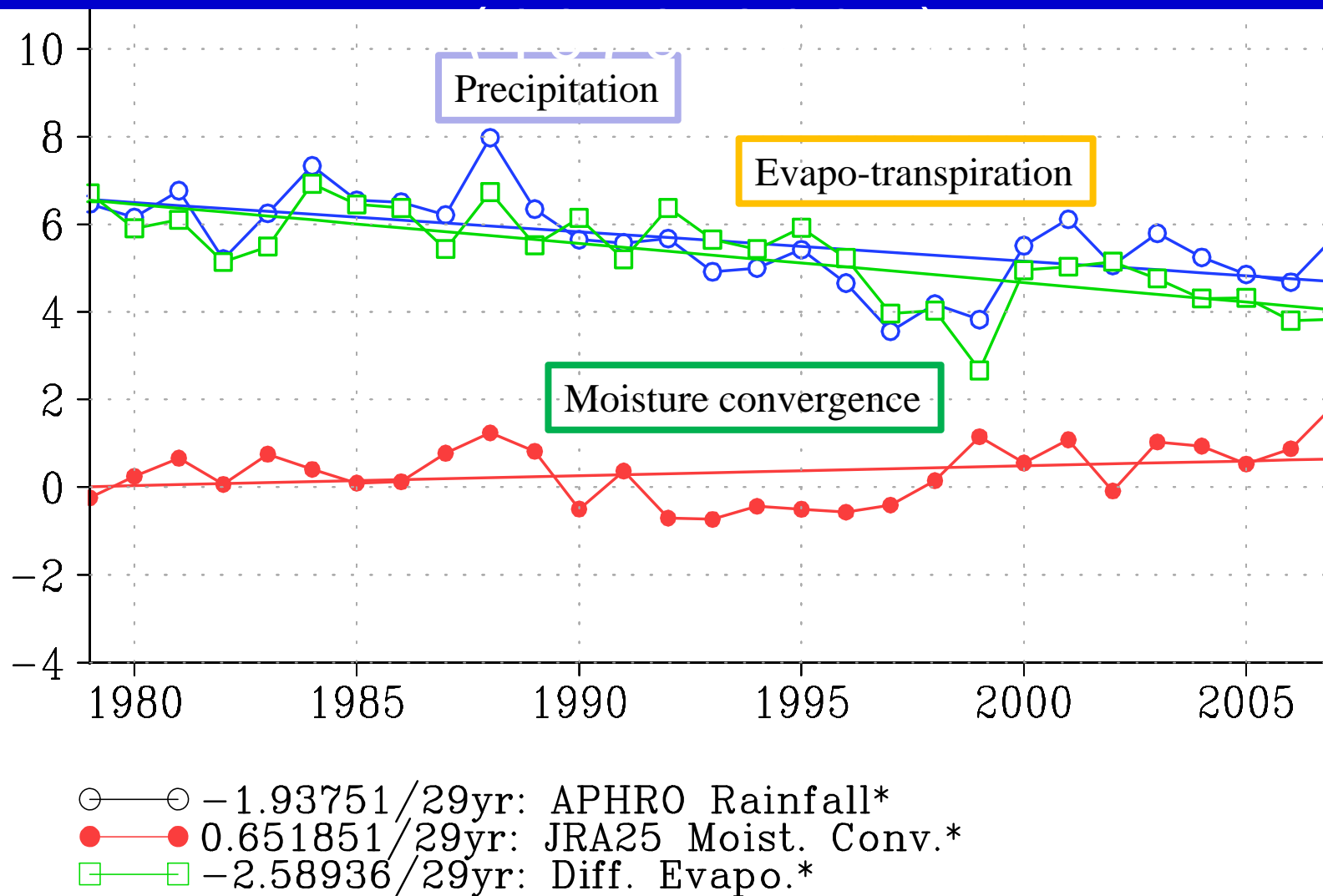
<http://www.chikyu.ac.jp/gec-jp/events/>

# Change of population exposure to innudation due to sea-level rise (current vs. in 2050)



**Figure 4-5** | For low-elevation coastal areas, current and future (2050) population exposure to inundation in the case of the 1-in-100-year extreme storm for sea level rise of 0.15 m and for sea level rise of 0.50 m due to the partial melting of the Greenland and West Antarctic Ice Sheets. Data from Lenton et al., 2009.

# Interannual change of atmospheric water balance



Yasunari, Kanamori et al. in preparation