The global relevance of a post-Kyoto agreement: lessons from India and central South Asia

10 REASONS FOR ACTION

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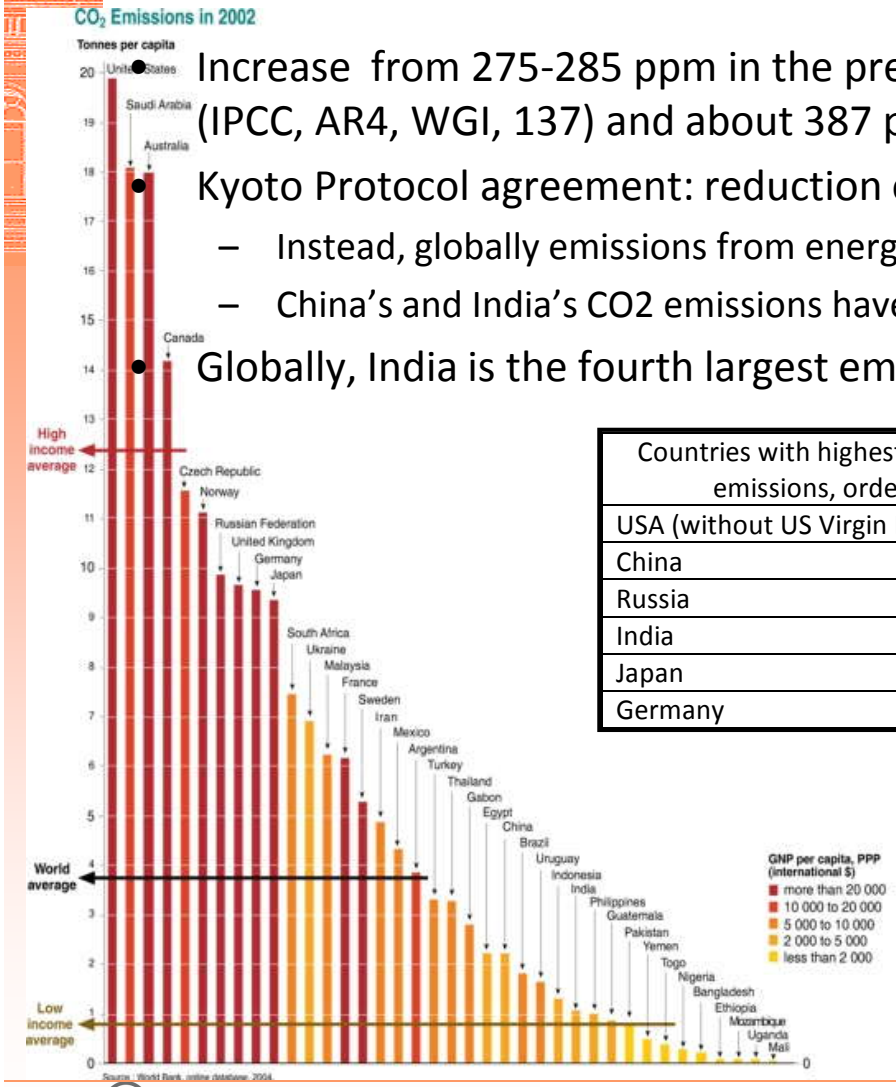
I. CO_2 emissions and estimates for 2050/2100



- Increase from 275-285 ppm in the pre-industrial era (AD 1000–1750) to 379 ppm in 2005 (IPCC, AR4, WGI, 137) and about 387 ppm in 2008
- Kyoto Protocol agreement: reduction of CO2 emissions by 5.2% (1990-2020) (UNEP, 2007).
  - Instead, globally emissions from energy use have risen by more than 24%
  - China's and India's CO2 emissions have doubled; India: +96.9% since 1990 (UNSTATS)
- Globally, India is the fourth largest emitter of GHGs (UNSTATS) in 2004

Countries with highest absolute emissions, ordered	CO2 emissions, 2004, [million tons]	CO2 emission/ capita 2004, [tons]
USA (without US Virgin Islands)	5987.98	20.40
China	5010.17	3.84
Russia	1617.94	11.20
India	1342.96	1.2
Japan	1285.81	10.10
Germany	885.85	10.70

- Shukla et al.(2008) calculated India's CO2emissions in 2050: 6,636 million tons in the base case scenario (GDP +23.6 times higher)
- If unmitigated, global CO2 emissions at about 450-750 ppm depending on scenarios

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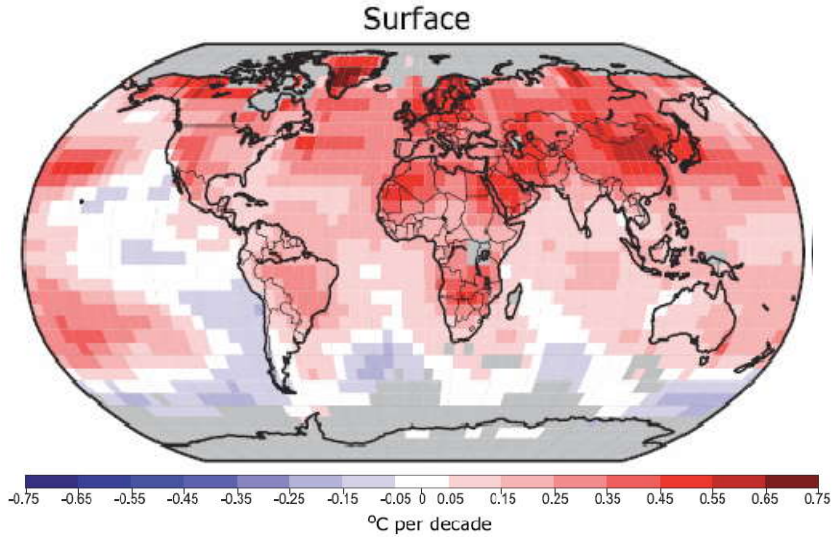
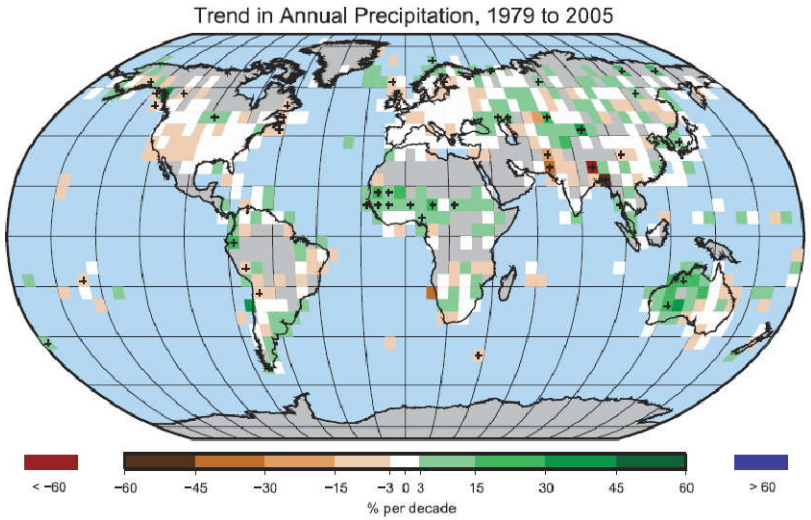
II. Impacts of CO2 emissions: Observations & projections

- Temperature (T)
  - Observations: Global mean surface T risen by 0.74°C ± 0.18°C (1906–2005), warming rate of last 50 years almost double than that of last 100 years
    - Fig: Patterns of linear global temperature trends from 1979 to 2005
  - Projections for 2090-2099 relative to 1980-1999: +1.8°C to +4.0°C (1.1°C-6.4°C)(IPCC)
- Precipitation (P)
    - Fig: Observations: based on 1961-1990 mean; + : significant trends at the 5% level
    - Trends in P very heterogeneous over Asia → therefore …





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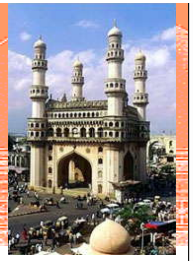
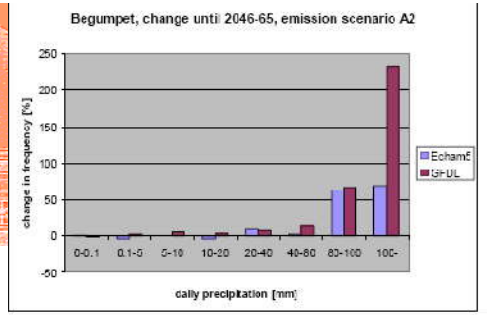
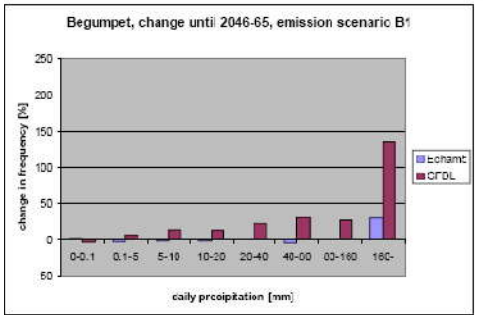
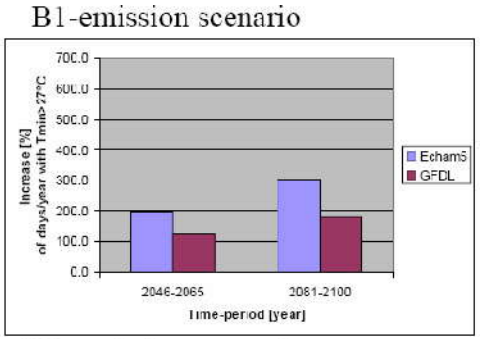
Projections for Hyderabad/India

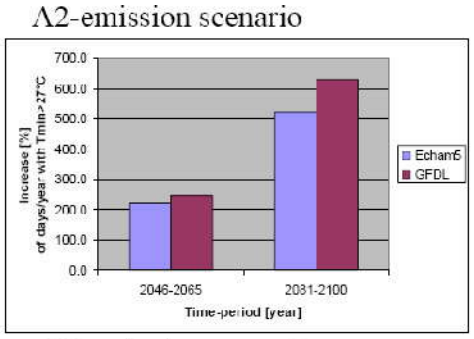


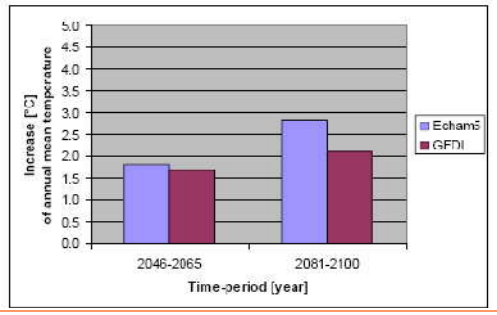
- <u>Daily precipitation:</u> Rain events of > 80mm/d (from 1981-2000 to 2046-2065)
  - B1 leaves the city longer to prepare
  - Extreme events > 160mm/d increase over-proportionally
- <u>Total annual precipitation:</u> changes -4% to +17%
  - Differences between AOGCMs larger than between SRES scenario
- <u>Frequency of heat waves:</u> average nr. of days with night temperatures >27°C
  - will approximately triple until 2050, relatively independent from SRES scenario
  - frequency of heat waves longer than one week will double to triple until 2050
- <u>Mean annual temperature</u>
  - Up to ~+5°C in 2100

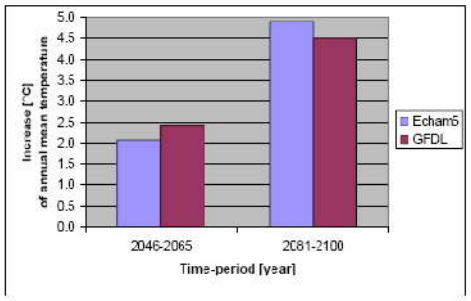












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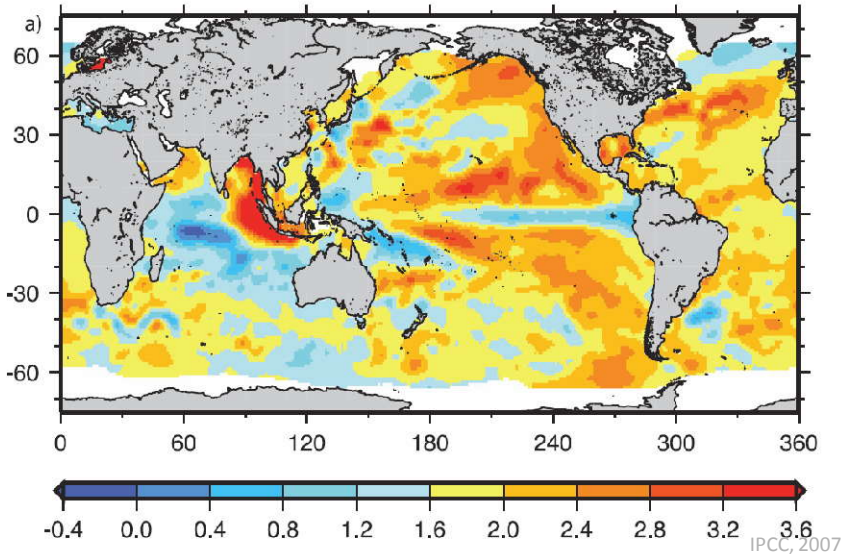
III. First order CC impacts: glaciers, sea level rise, cyclones

- **Glaciers melt**
  - in Asia faster in recent years than ever before recording (Pu et al., 2004 in Bals et al., 2008)
  - Tibetan Plateau glaciers of <4km length projected to disappear with +3°C of global mean T; glacier area may shrink by 80% (1995-2030) (Bals et al., 2008)

- **Sea level rise**
  - Fig: Long-term linear trends in mean sea level (mm/yr) 1955-2003 (IPCC, 2007)
  - Short-term trend: slight reduction (not shown)



- Occurrence of extreme weather events
  - E.g. increase in frequency and intensity of tropical **cyclones** by 2050 predicted(Unnikrishnan et al, 2004, in Bals et al., 2008)
  - → stronger precipitation in the coastal regions during both, the SW- and NE-monsoon (Bals et al., 2008); SST of + 2-4°C in, e.g., the Bay of Bengal associated with increase in tropical cyclone intensity by 10-20% (Knutson & Tuleya, 2004, in Bals et al., 2008)

IV. Second order impacts: biodiversity, water/energy/food

- Ecosystems along coast lines
  - 2500km² mangroves pot. lost in Asia, 4871 km² impacted in India, species move north- & upwards, there potentially higher species distribution (FAO)
  - 30% of Asia's coral reefs pot. lost in 30a (Bals et al., 2008)

- WATER
  - Glacier melt, higher evaporation → reduced water availability & quality

- Food
  - Rice, maize, wheat production declines, e.g. in China, due to water stress, increasing frequency of El Nino, and reduction of rainy days (Tao et al., 2004).
  - +6-10% in agricultural water demand for 1°C increase in T
  - Decrease of 2-5% in yield potential of wheat and maize for +0.5-1.5°C in T in India (Aggarwal, 2003)

  → 30% decline in cereal yields in 2080 = 266 million Asians facing hunger (Bals et al., 2008)

http://www.ens-newswire.com/ens/feb2008/20080203_mangroves.jpg

http://go635254.s3.amazonaws.com/ecoworldly/files/2009/07/drought-hit-land-in-the-state-of-andhra-pradesh-in-2005.gif

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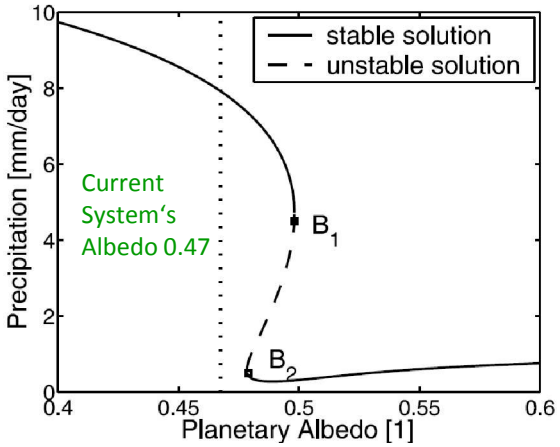
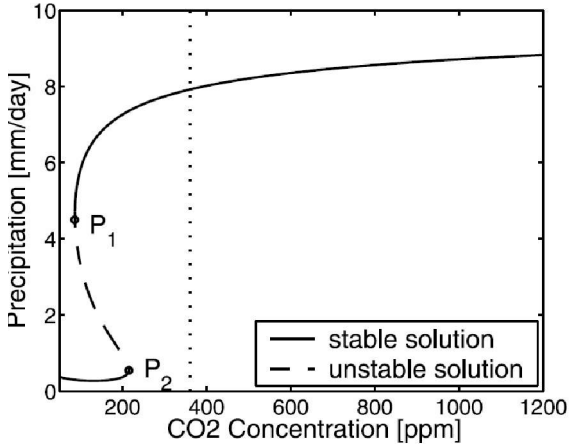
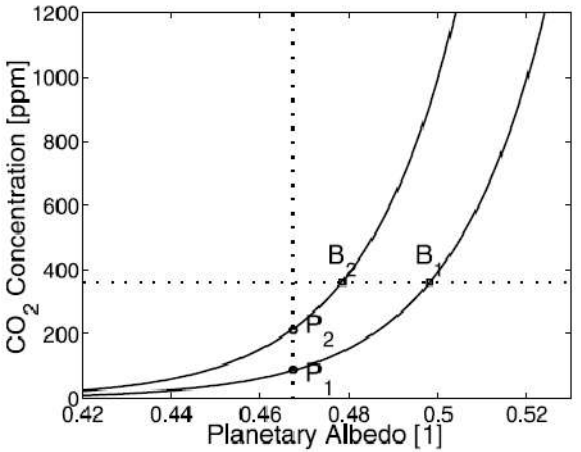
V. Tipping points in the Earth System

http://images.onesite.com/my.telegraph.co.uk/user/will_heaven/20070716155109.jpg

- Indian summer monsoon (ISM)
  - S-Asia: 90% of annual P dependent on the SW-monsoon affecting 700 million people (agriculture, forestry and fisheries) (Mehra, 2007); India: 45% of the variation in GDP over last 50a explained by fluctuations in P (FAO, 2006, in Rajan, 2008)
  - Most estimations: increasing P in S-India with increase in CO2, but, inter- & intra-annual variations increase substantially too
  - Greatest concern: ISM monsoon pattern shift abruptly (Shukla, 2007, in Rajan, 2008)
  - Model simulations: two highly non linear meta-stable regimes ("active" and "weak" monsoon phase) (Lenton et al., 2008), switch induced on short time-scales (~1a)







- SLR: Rapid melting of West Antarctic ice sheet and Greenland ice sheet poss. resulting in SLR of > 5m by 2100 (Lenton & Schellnhuber, 2007)

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VI. Third order impacts: urbanisation, migration

- Globally, about 50% of all humans lives in urban areas
- India's urban population: 27.9% (2001) & increasing rapidly: 31.2% decadal growth rate (Census of India 2001, Ministry for Urban Development)
- Many megacities in developing countries & along coast

  Bals et al. (2008): 2.6-18.8 million people at risk of flooding along SE-Asian coast in 2100

  Rajan (2008):

  – BAU scenario/750 ppm could largely deurbanize Dhaka, Mumbai, Kolkata pot. by 2045; with sea sevel rise (SLR) of ~5m in 2100 = 125 million people in need of displacement from coasts

  – Policy scenario (ambitious goal of restricting climate change to 2°C global warming above pre-industrial levels) would buy time for adaptation = 5 million people affected

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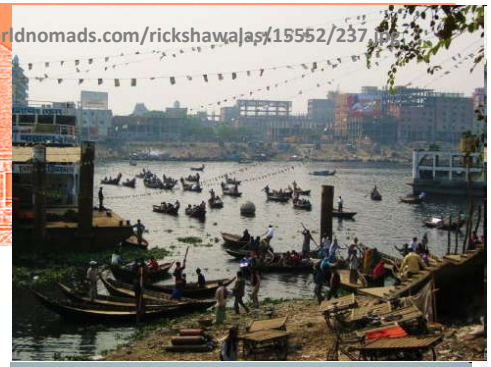
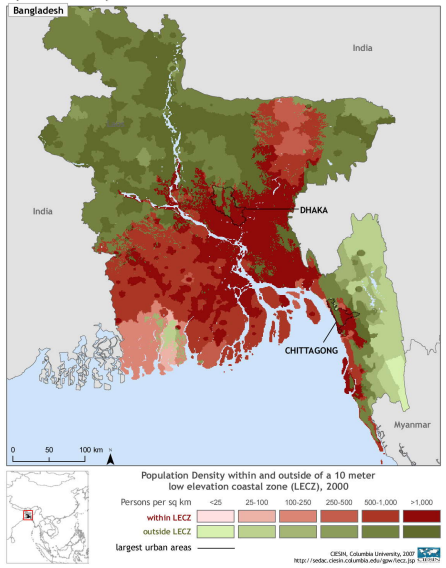


Population Density within and outside of a 10m Low Elevation Coastal Zone



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VII. Political conflict, social security

www.lebenshaus-alb.de

- Severe CC impacts in regions with:
  - Glacier retreat (increased floods, erosion & water stress)
  - Monsoon pattern changes (water supply, agriculture)
  - SLR &
  - Cyclones activity (Bay of Bengal, Bangladesh)

- Increased risk for social security in regions already hit by cross-border conflicts (India/Pakistan) and unstable governments (Pakistan, Bangladesh)(Bals et al., 2008)

- Storm and flood disasters correlate positive with civil unrest/political crises, e.g. floods and following food shortages in Pakistan in 1970, 1974, and 1988

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VIII. Responsibility

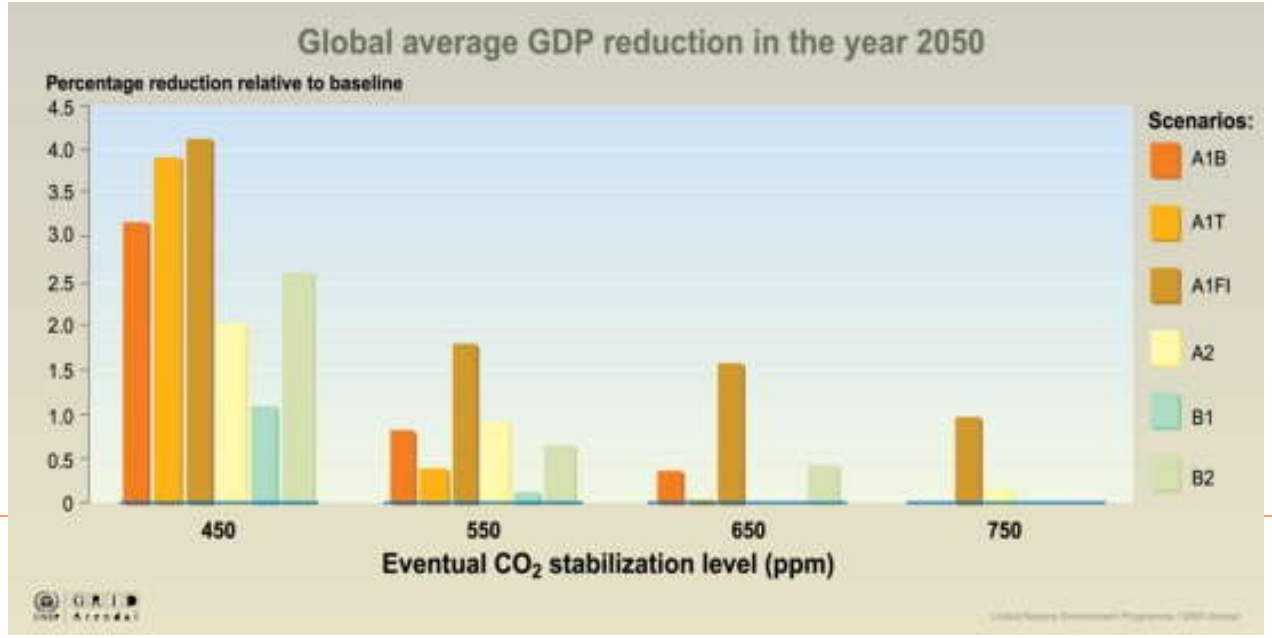
- Today's emissions will be the historical responsibility of the future

- There is social, ethical, intergenerational, (ecological) responsibility
  - Roughly 1 of 6 persons on the planet is Indian, 70% of India's population is <36a old, this country will be "the global future" (Mehra, 2007, p11)
  - Smallholder and subsistence farmers, pastoralists, and artisanal fishers suffer particularly; 87% of the world's smallholder farmers live in Asia (Aggarwal et al., 2000, in Bals et al., 2008)
  - Not all of India's problems are external in nature (& can serve as reason avoiding responsibility), e.g. social inequality, corruption. If India asks to be a global player (economical, political) it has to accept international and national responsibility

- 11th Five Year plan (2007-2012): words 'climate change' appear twice in 109 pages (Mehra, 2007)

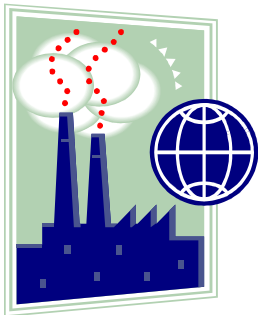
IX. Mitigation and adaptation costs

- Adaptation:
  - Minimum cost of protection against 1m SLR expected ~$500,000/km (Tol, 2002); would still leave many unprotected (Rajan, 08)
  - Doubts that developing/tiger countries have ability to adapt – cost too high
  - Martin Parry, et al. (2009) criticise cost of adaptation given, e.g., by the UNFCCC as too low - real costs likely 2-3 times greater than estimates; for Asia not sufficiently possible
- Mitigation:
  - Global estimates: 5-20% of global GDP, if current trends continue; compared to ~1% when mitigated at early stage (Stern Report, 2007; Mehra, 2007)



X. Unite CC action with poverty reduction & development goals

- Safe and livable future development only possible with de-carbonized growth path
  - India imports ~78% of annual crude oil -> Green technologies could increase energy security & decrease dependencies



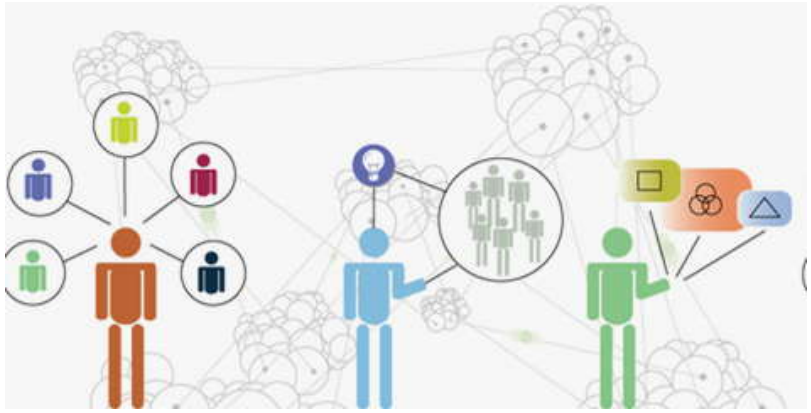
- Using CDMs directed and smart is one option for financing CC actions
  - India benefitted substantially from CERs (Certified Emission Reductions) after China
  - Gained in monetary terms while reducing an equivalent of 27 million tones of CO2/a
  - However, CDM projects have not reduced emissions significantly, mainly been allocated to non-CO2 emitting appliances (e.g. HFC-23) -> criticised
  - The “spectacular failure of these carbon markets is demonstrated by the fact that notwithstanding their enormous size, they have failed to persuade China and India to reduce their dependence on coal or to built more efficient coal power stations” (Rajan, 2008, p12)

- Big nations have opportunity to influence the welfare of huge populations at once

The world needs India & India needs the world

(to contribute reducing emissions in the future) & (to reduce emissions for its own people‘s livelihood)

http://darmano.typepad.com/logic_emotion/images/2007/12/12/tipping.jpg



“It is too late for a politics of blame”.

The (climate) problem is about recognizing a shared dilemma and grasping the necessity for collective action (Mehra, 2007, p11).

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