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CRIDA
Feb 18, 2008

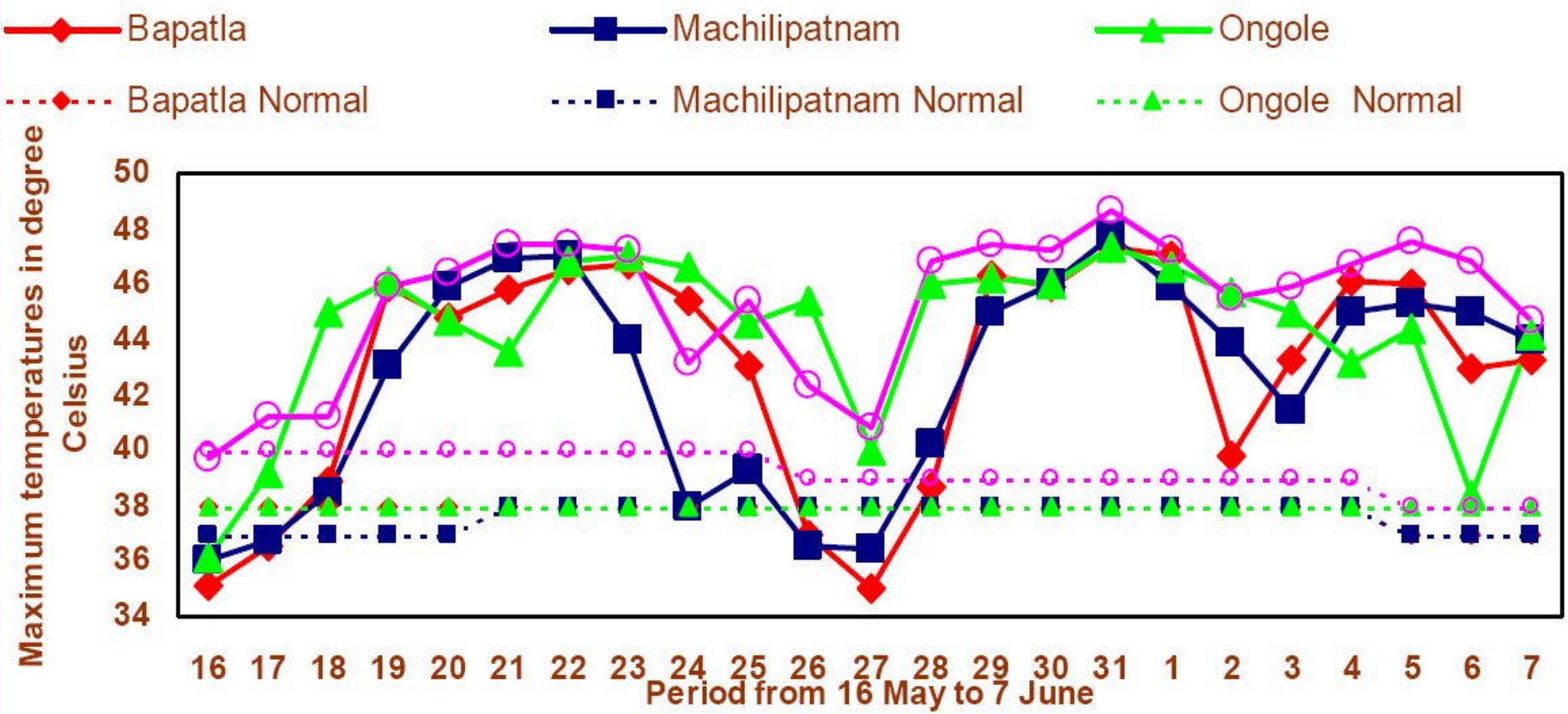
Issues in Carbon Trading for Managing Future Agriculture

From Bali to Copenhagen:

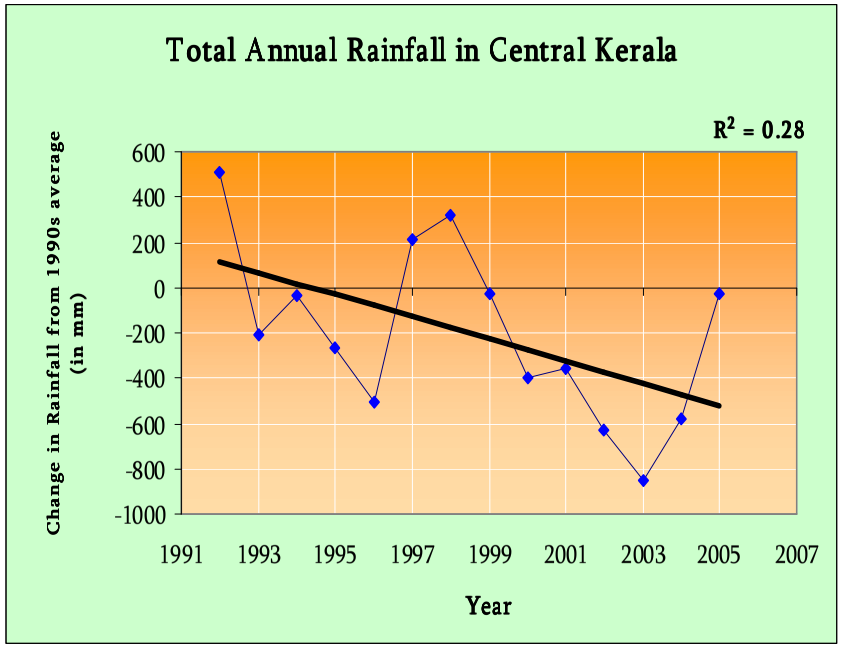
The Question of Equity and Carbon Justice

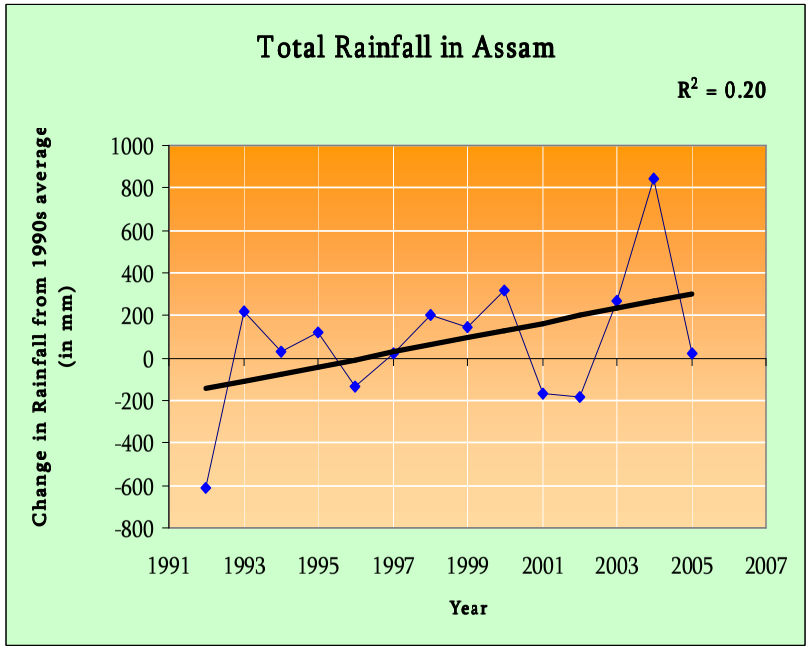

Climate Change is
Real and Here!
Impacts on Ecosystems

Maximum temperatures in Andhra Pradesh in 2003

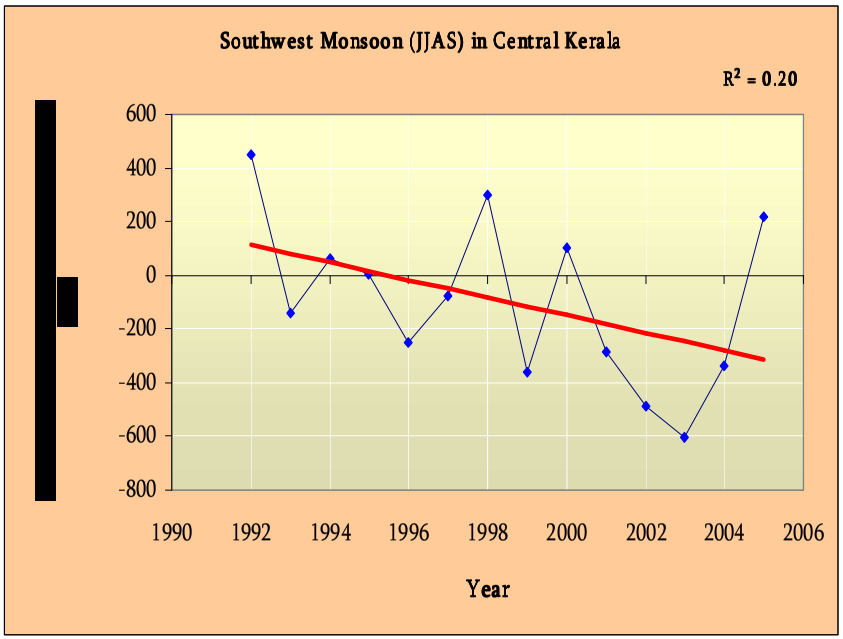


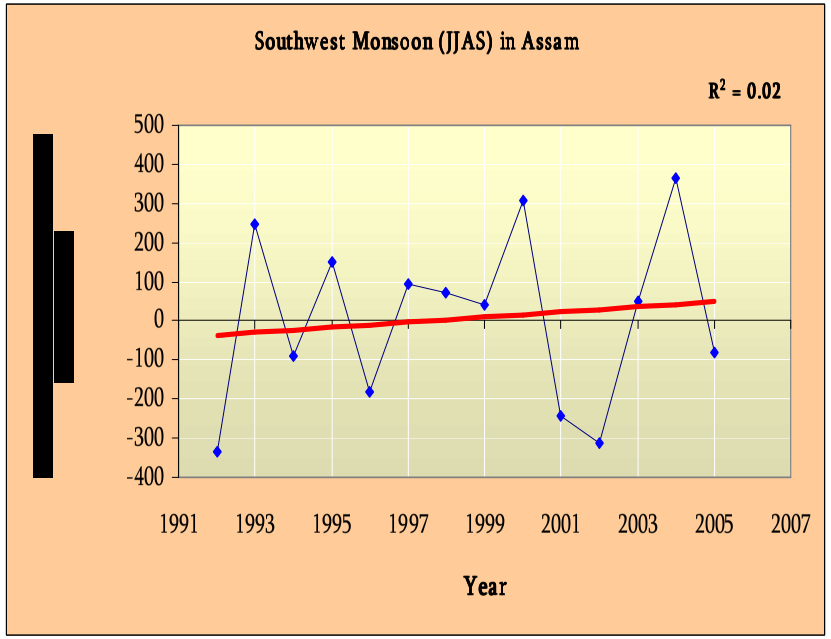
Anomalies in Total Annual Rainfall in Central Kerala and Assam



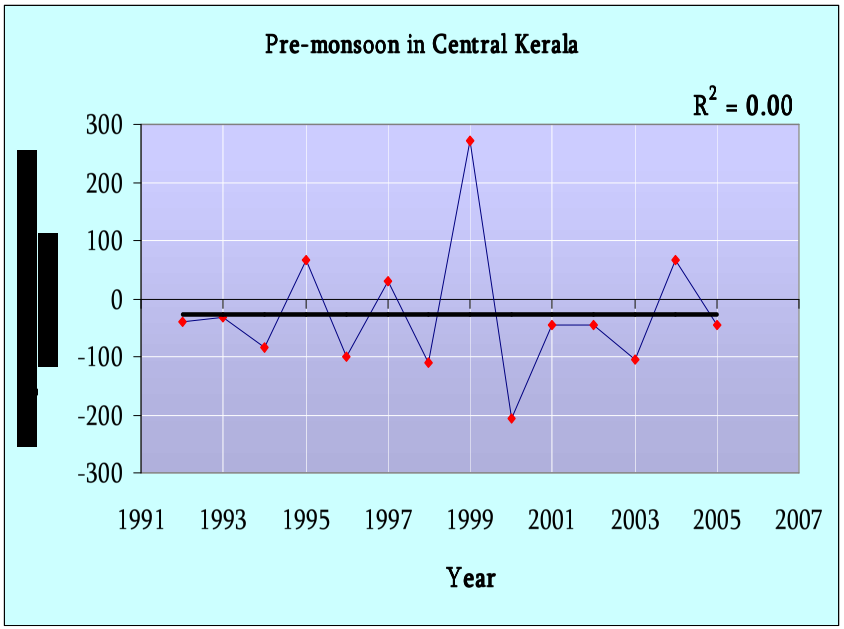


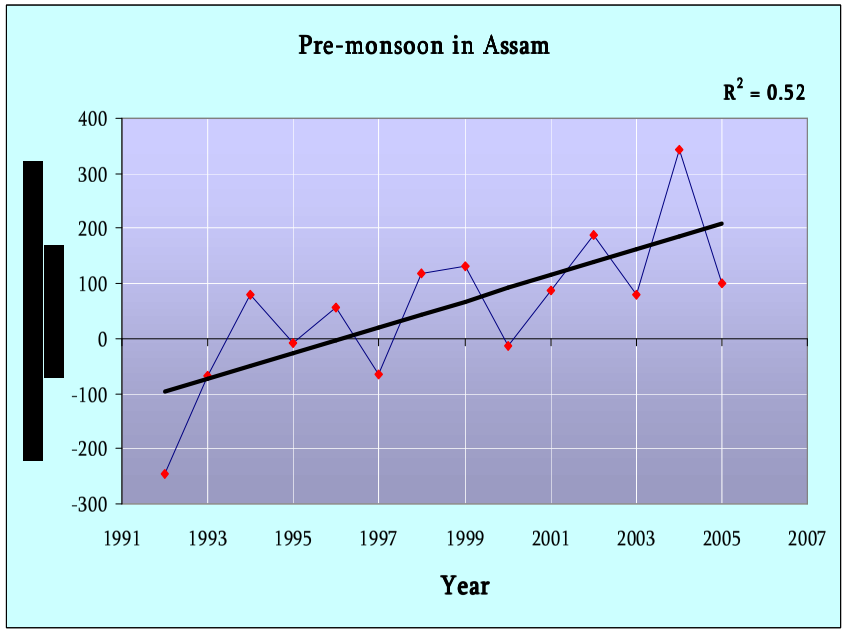
Southwest Monsoon (JJAS)



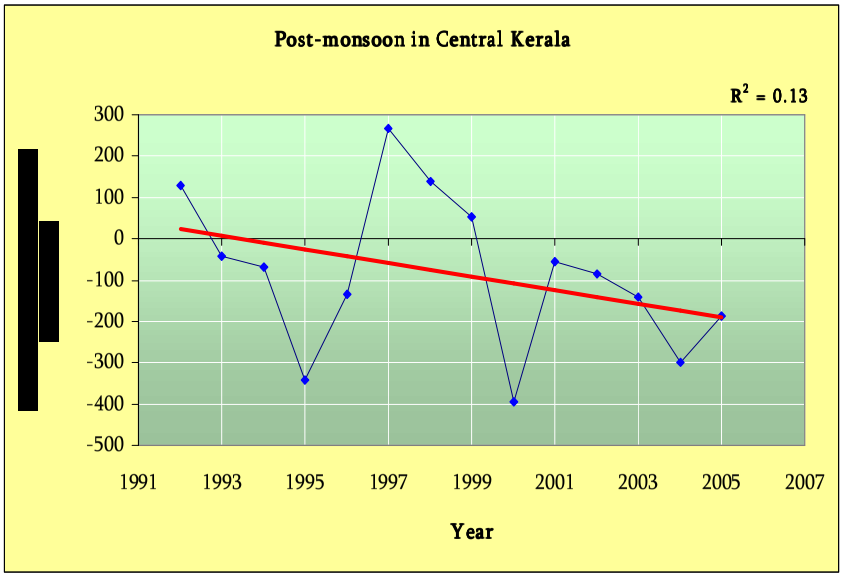


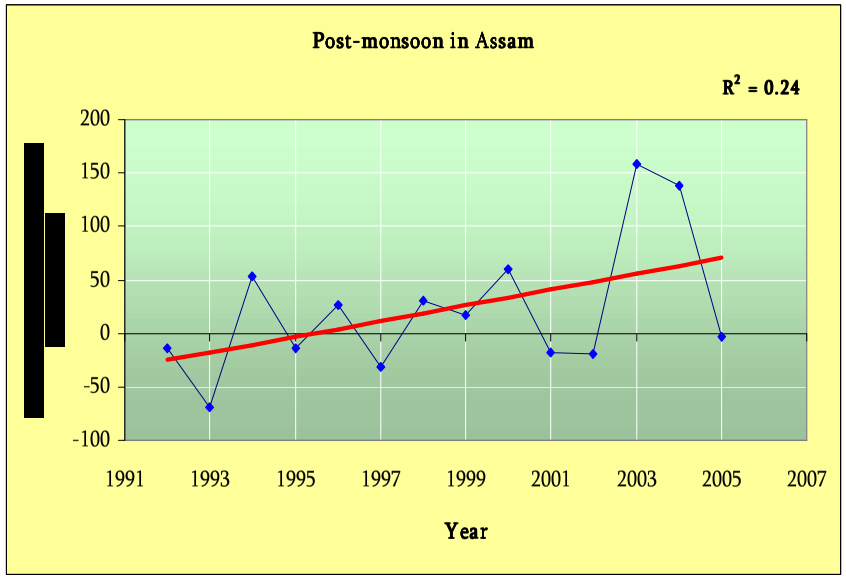
Pre-monsoon Rainfall (MAM)



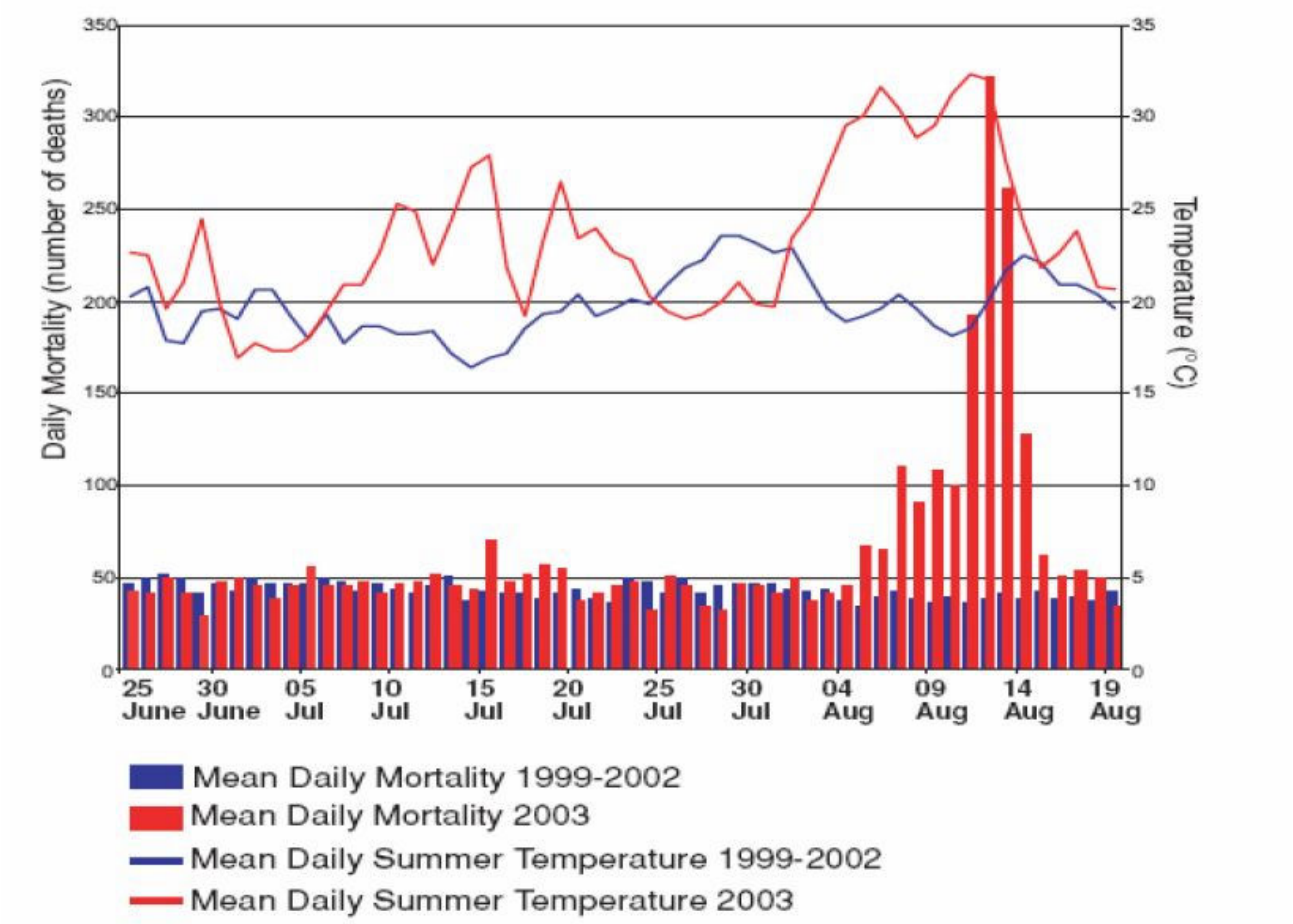


Post-monsoon Rainfall (OND)





Number of deaths in Paris in summer 2003 (Ch 8)



WMO

UNEP

Heavier precipitation, more intense and longer droughts….







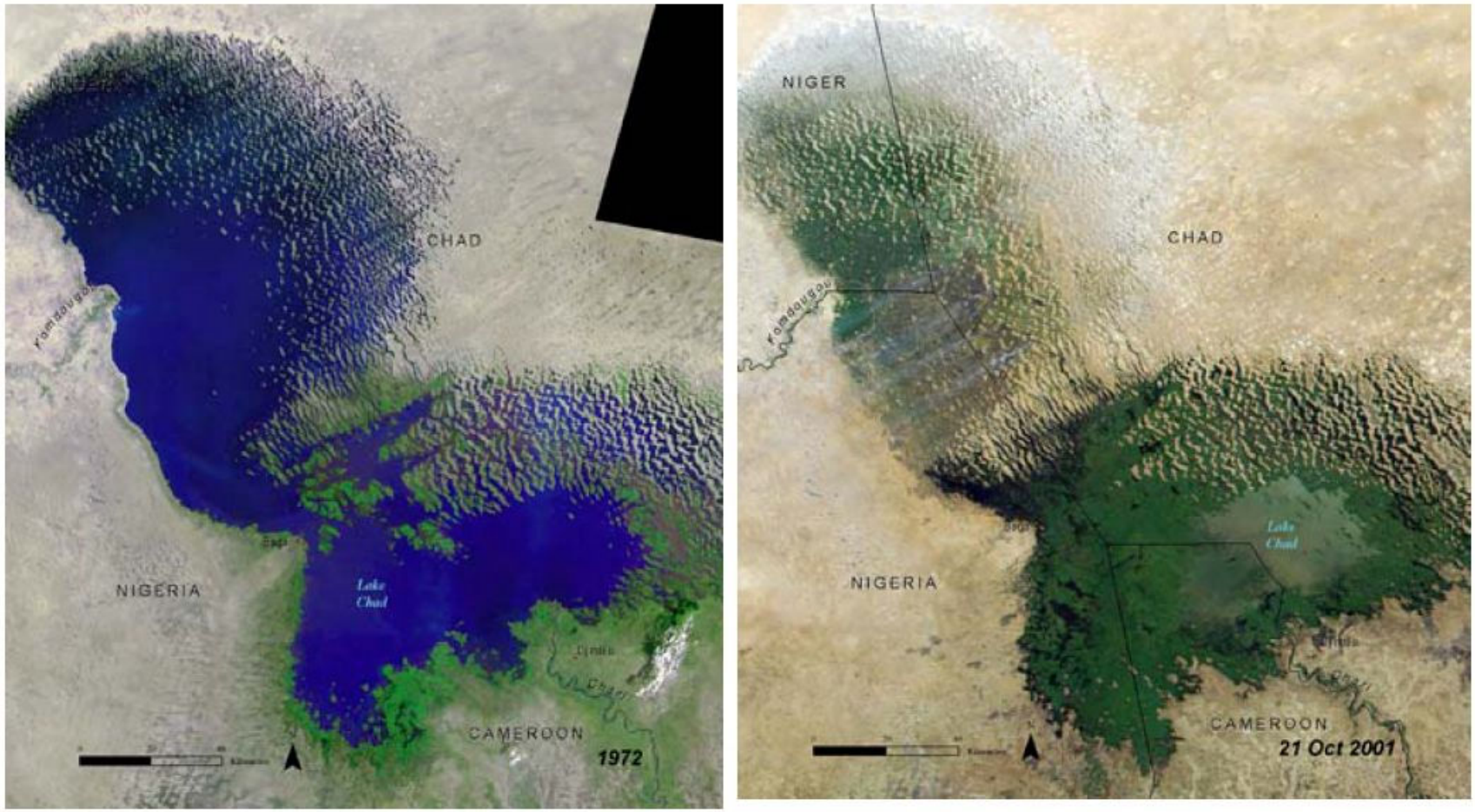
Changes in insect outbreaks



Changes in fire regime



Lake Chad (from the TAR)



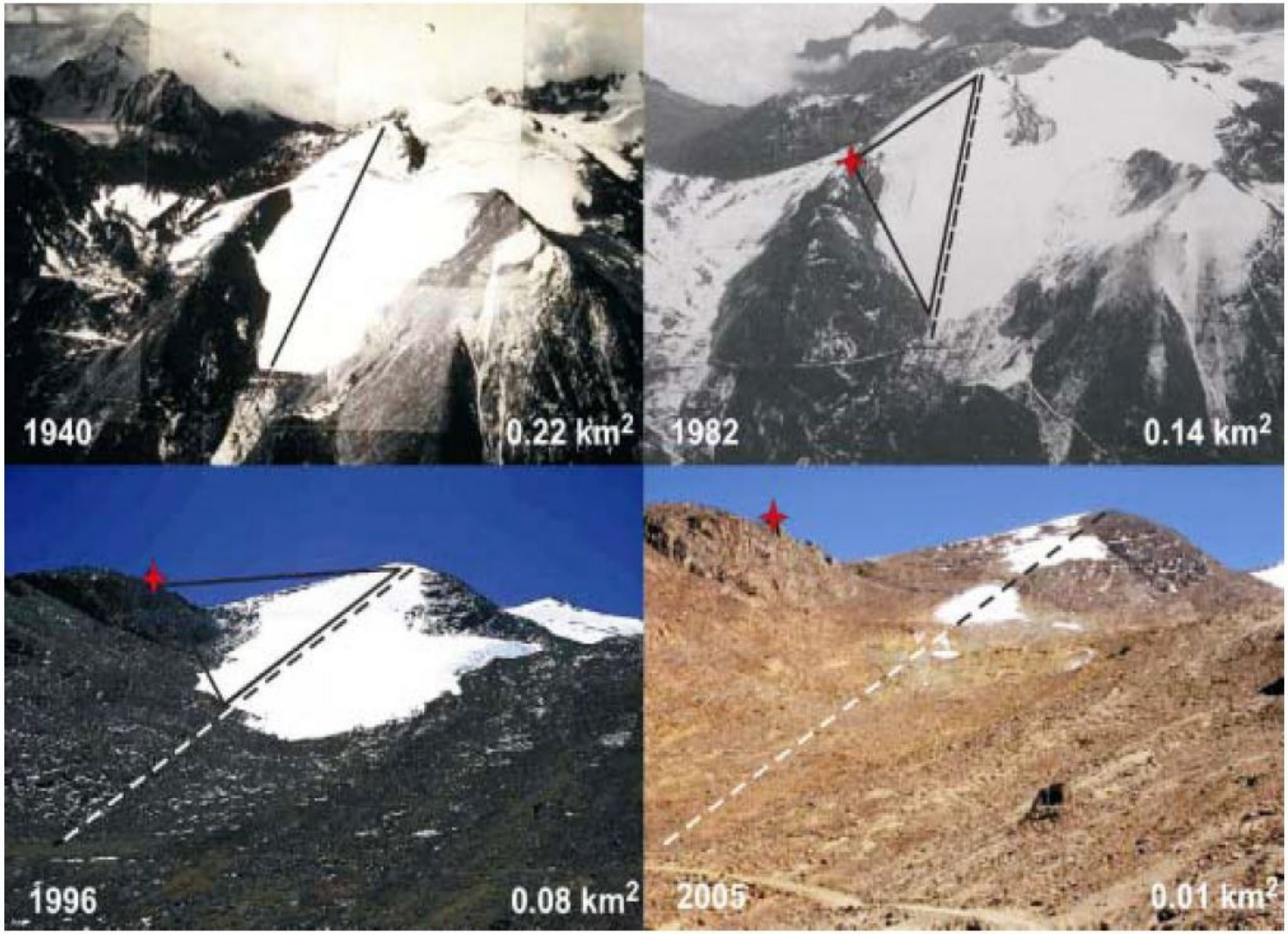
This image set displays a continued decline in lake surface area from 22 902 km² (8 843 square miles) in 1963 to a meager 304 km² (117 square miles) in 2001.

Extreme climatic conditions (drought and floods)



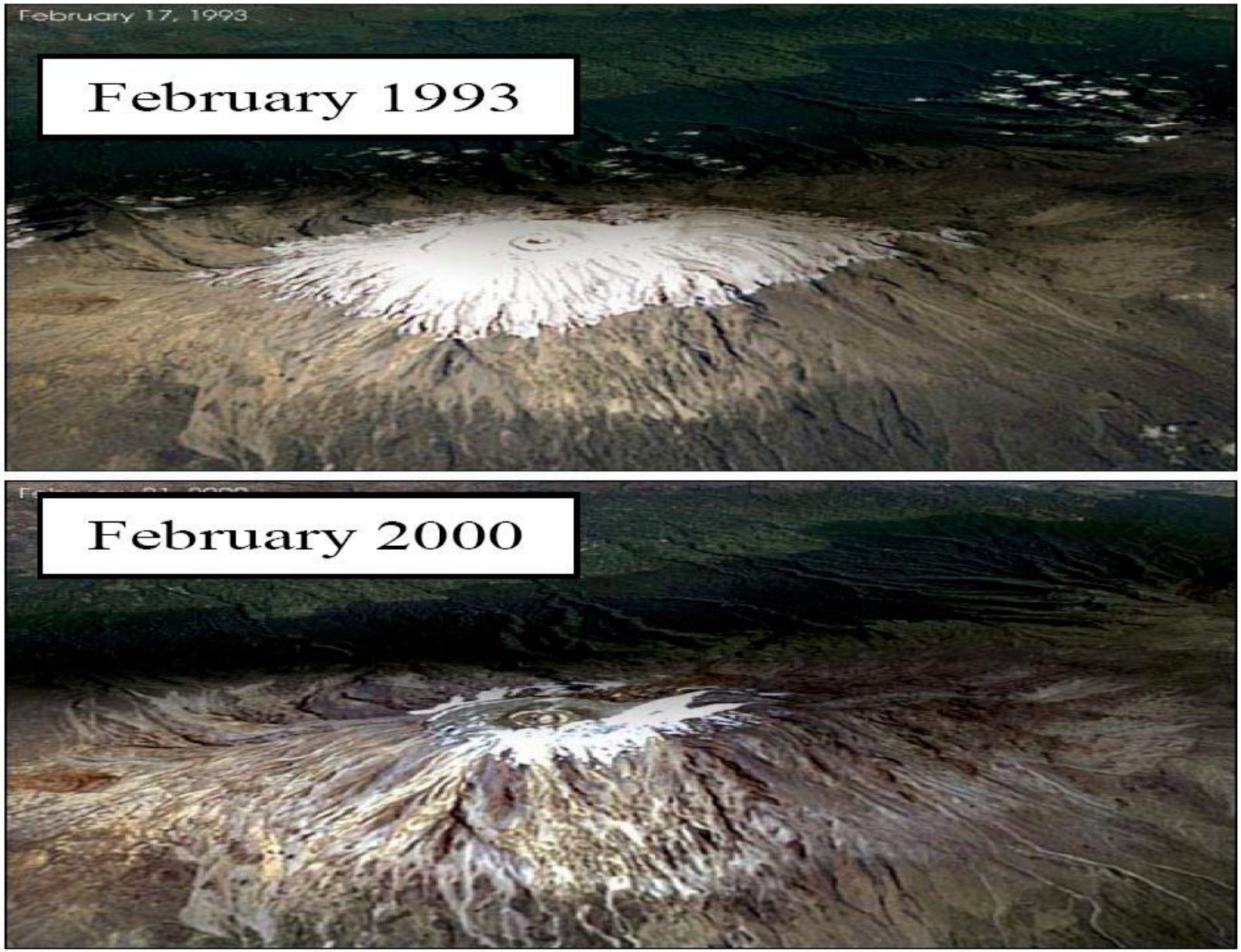






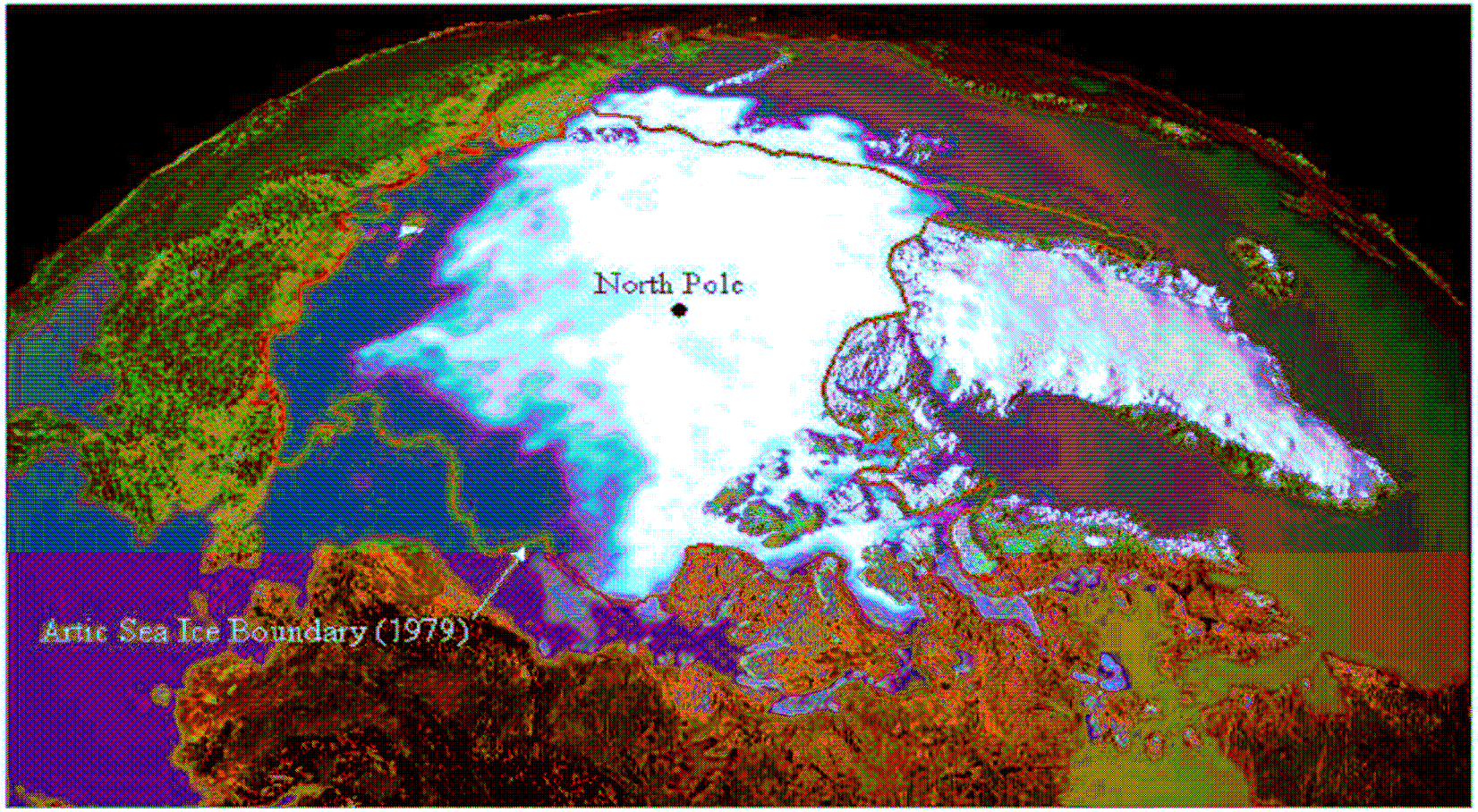
Areal extent of Chacaltaya Glacier, Bolivia, from 1940 to 2005

Change on Mt Kilimanjaro and climate interaction



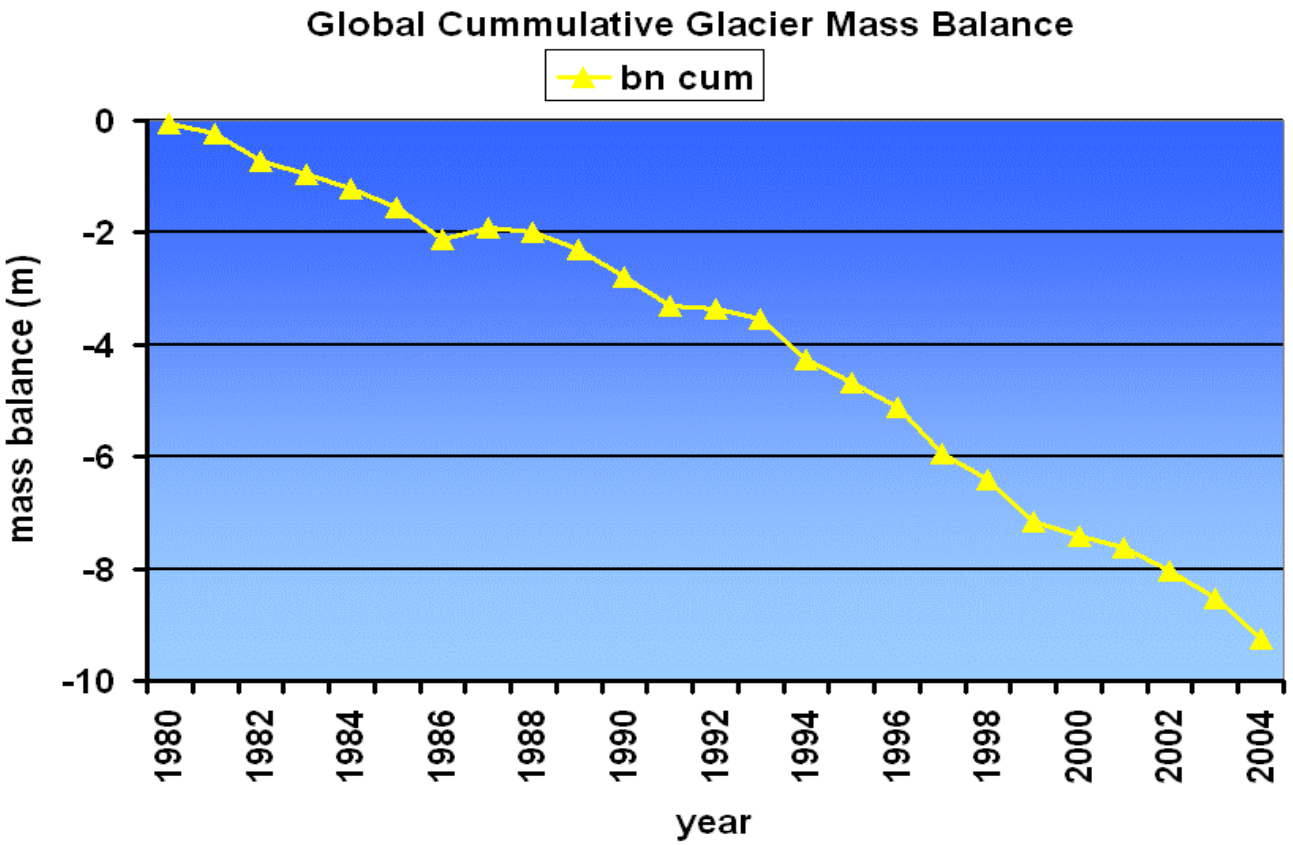
Arctic Sea Ice Loss: Greater than Land Area of Texas, California, and Maryland Combined

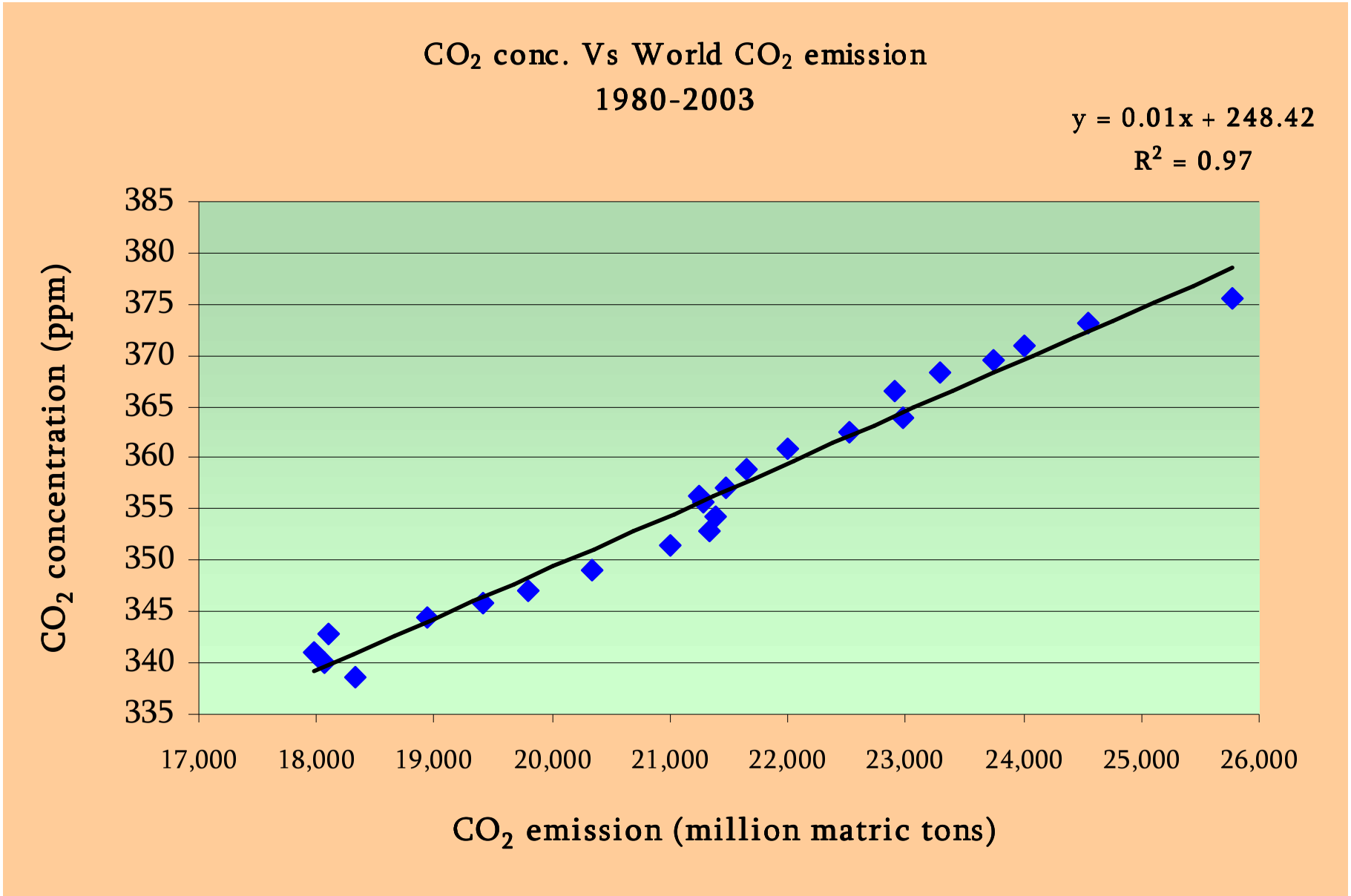
2003 vs. 1979 Comparison

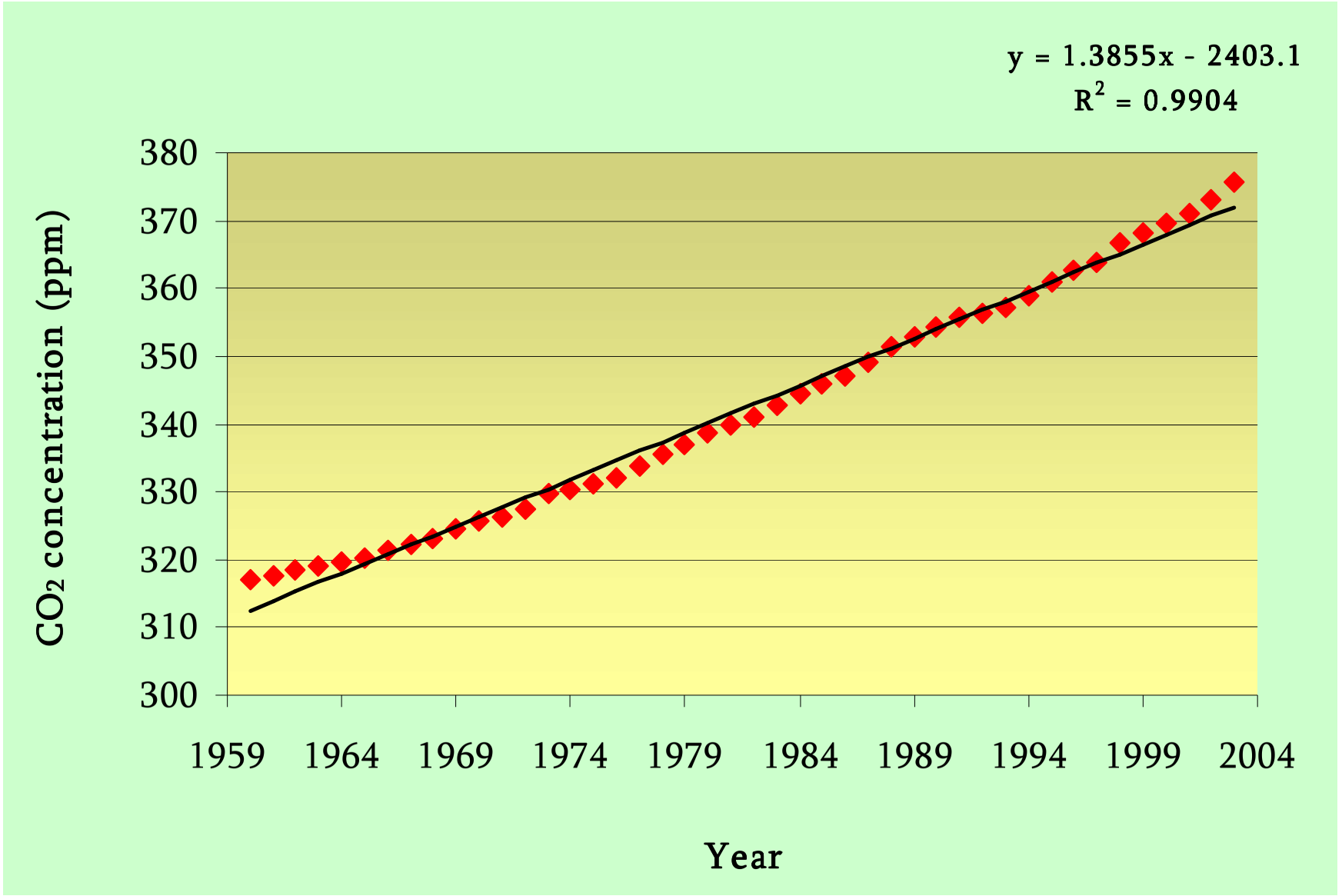


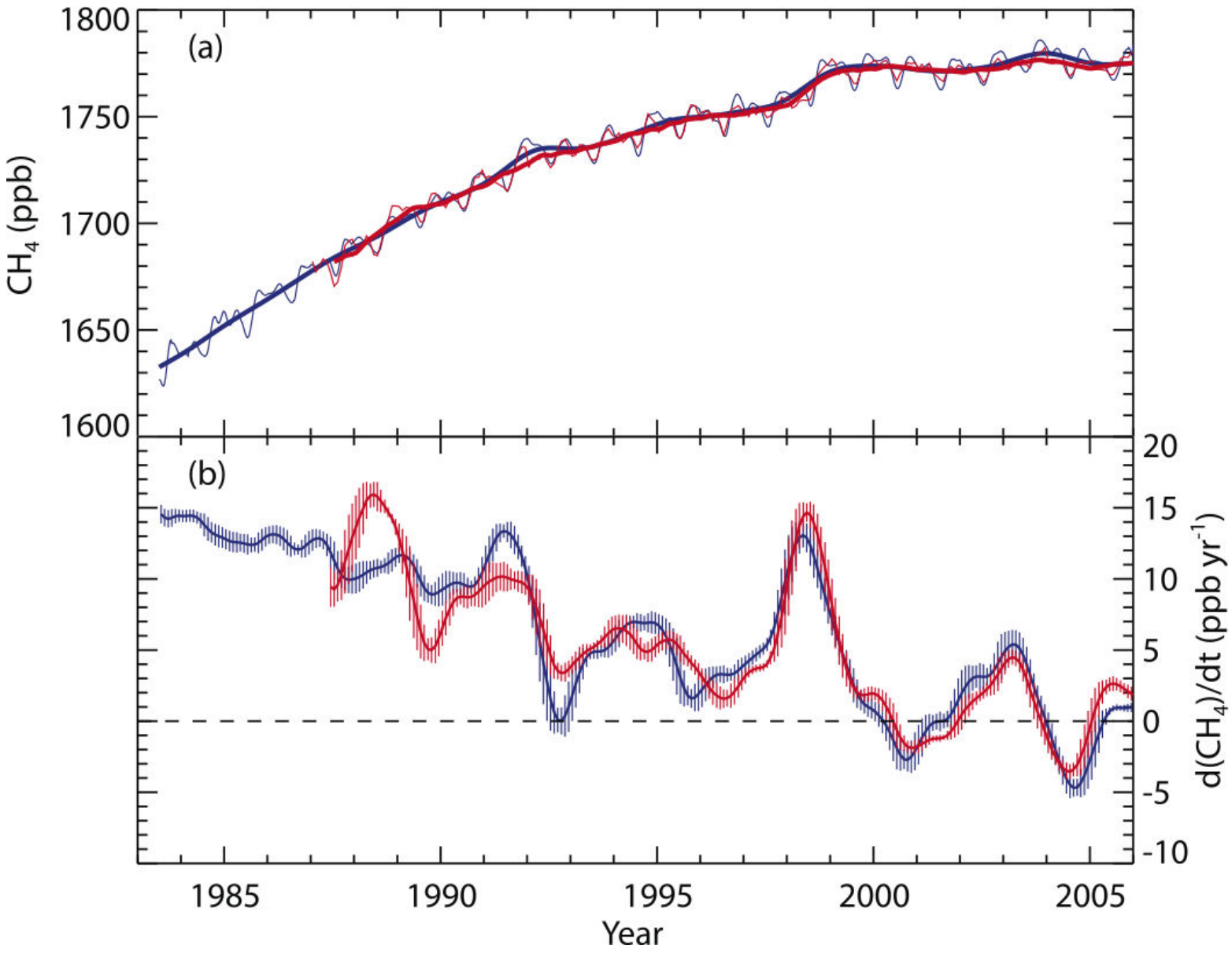
Glacier Mass Balance (GMB)

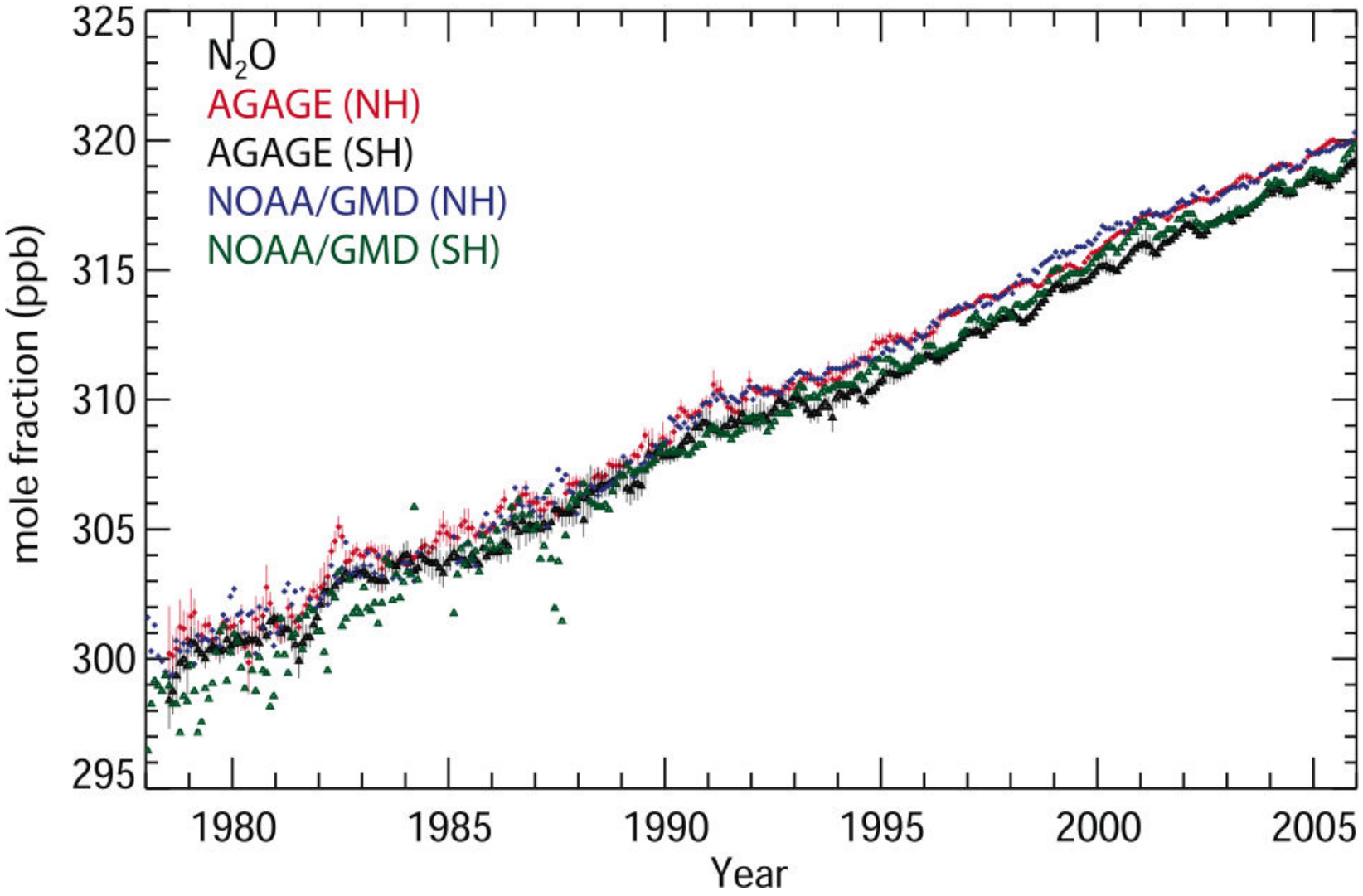
The difference between accumulation and ablation (melting and sublimation) is called GMB which is decreasing due to global warming.

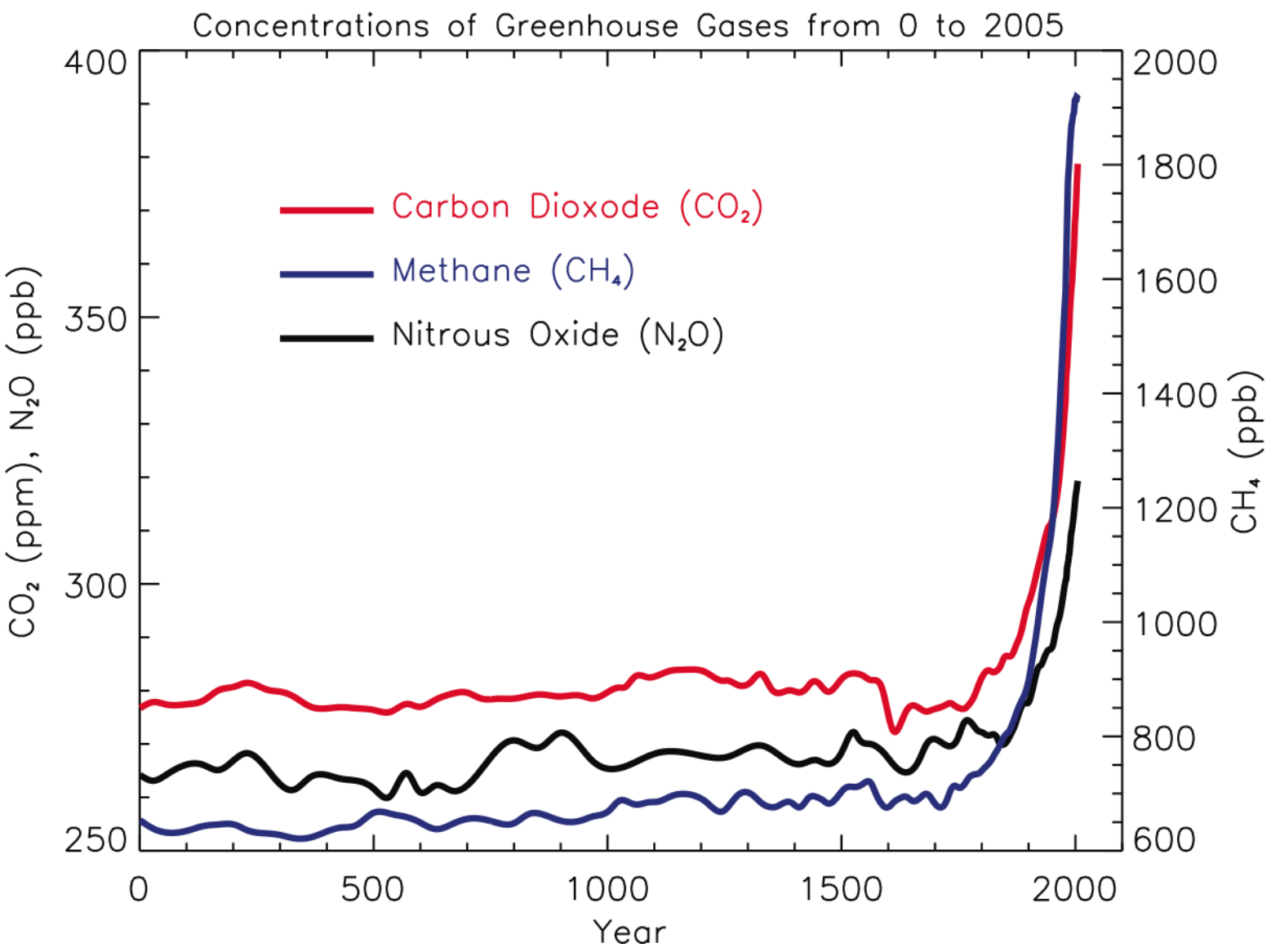


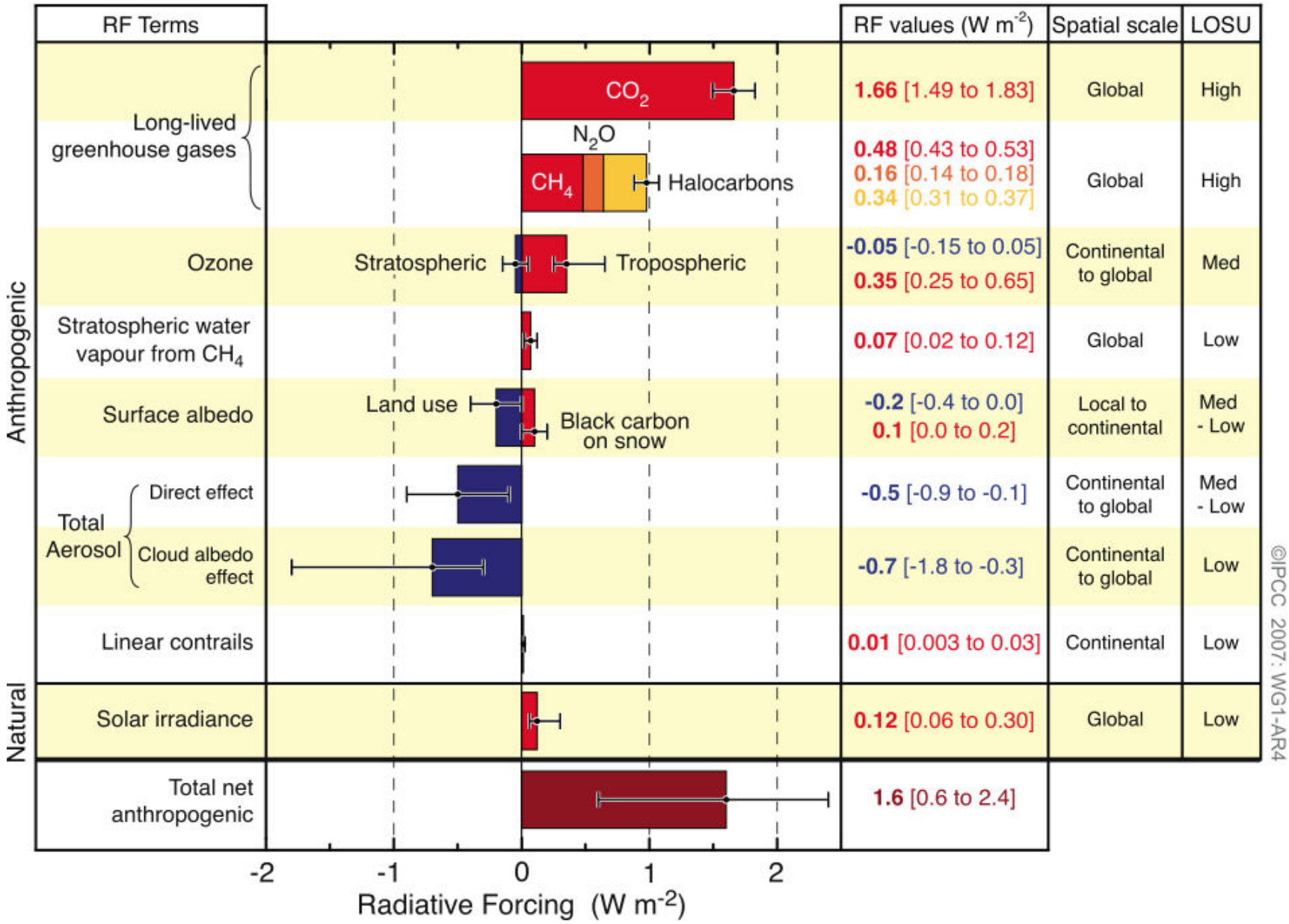

CO2 conc. Vs World CO2 emission
1980-2003
y = 0.01x + 248.42
R2 = 0.97
CO2 concentration (ppm)
385
380
375
370
365
360
355
350
345
340
335
17,000
18,000
19,000
20,000
21,000
22,000
23,000
24,000
25,000
26,000
CO2 emission (million matric tons)

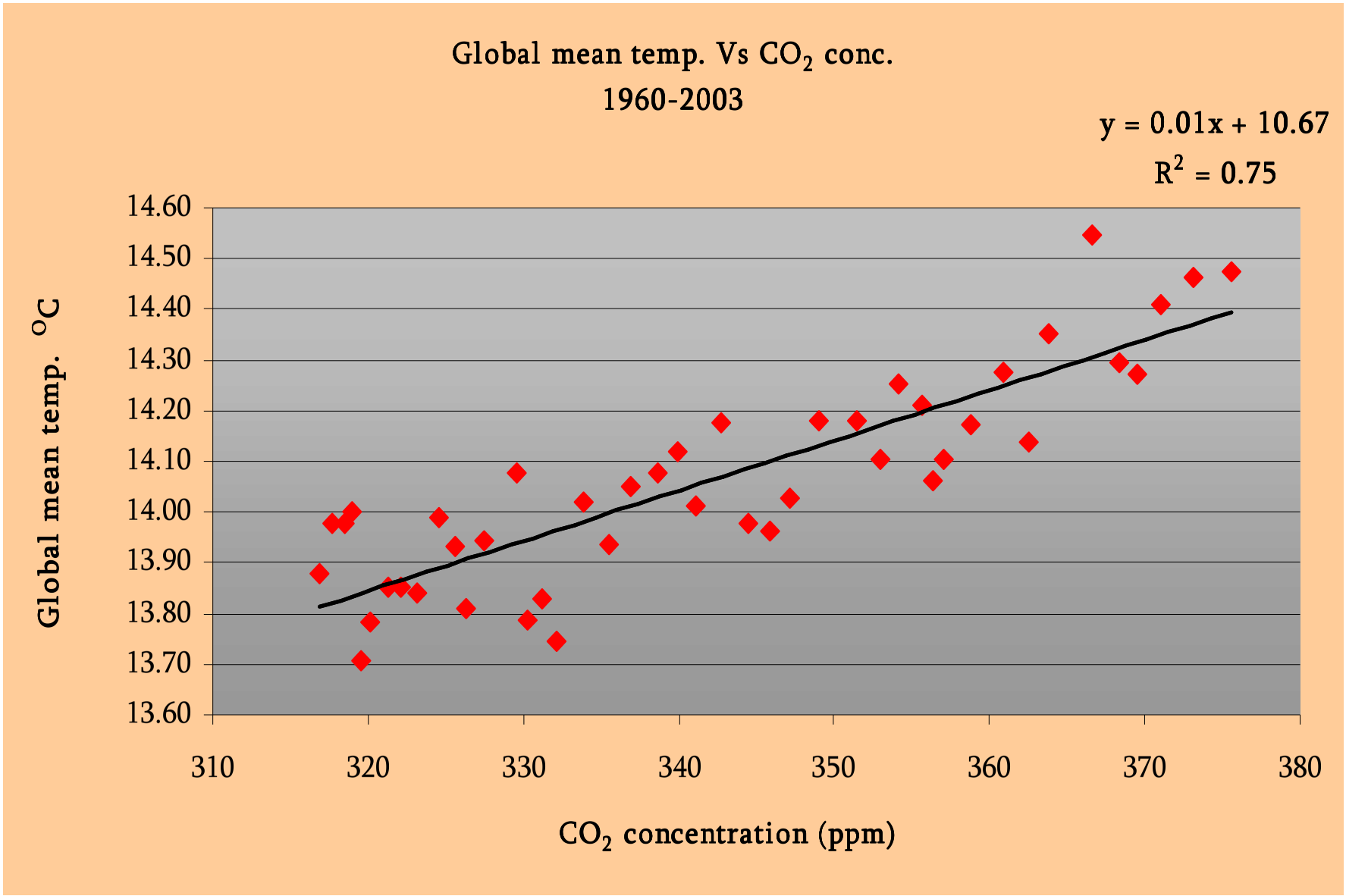

y = 1.3855x - 2403.1
R2 = 0.9904
CO2 concentration (ppm)
380
370
360
350
340
330
320
310
300
1959
1964
1969
1974
1979
1984
1989
1994
1999
2004
Year


(a)
(b)
1800
1750
1700
1650
1600
CH4 (ppb)
20
15
10
5
0
-5
-10
d(CH4)/dt (ppb yr-1)
1985
1990
1995
2000
2005
Year


N2O
AGAGE (NH)
AGAGE (SH)
NOAA/GMD (NH)
NOAA/GMD (SH)
mole fraction (ppb)
325
320
315
310
305
300
295
1980
1985
1990
1995
2000
2005
Year


Concentrations of Greenhouse Gases from 0 to 2005
Carbon Dioxode (CO_2)
Methane (CH_4)
Nitrous Oxide (N_2O)
CO_2 (ppm), N_2O (ppb)
CH_4 (ppb)
400
350
300
250
2000
1800
1600
1400
1200
1000
800
600
0
500
1000
1500
2000
Year

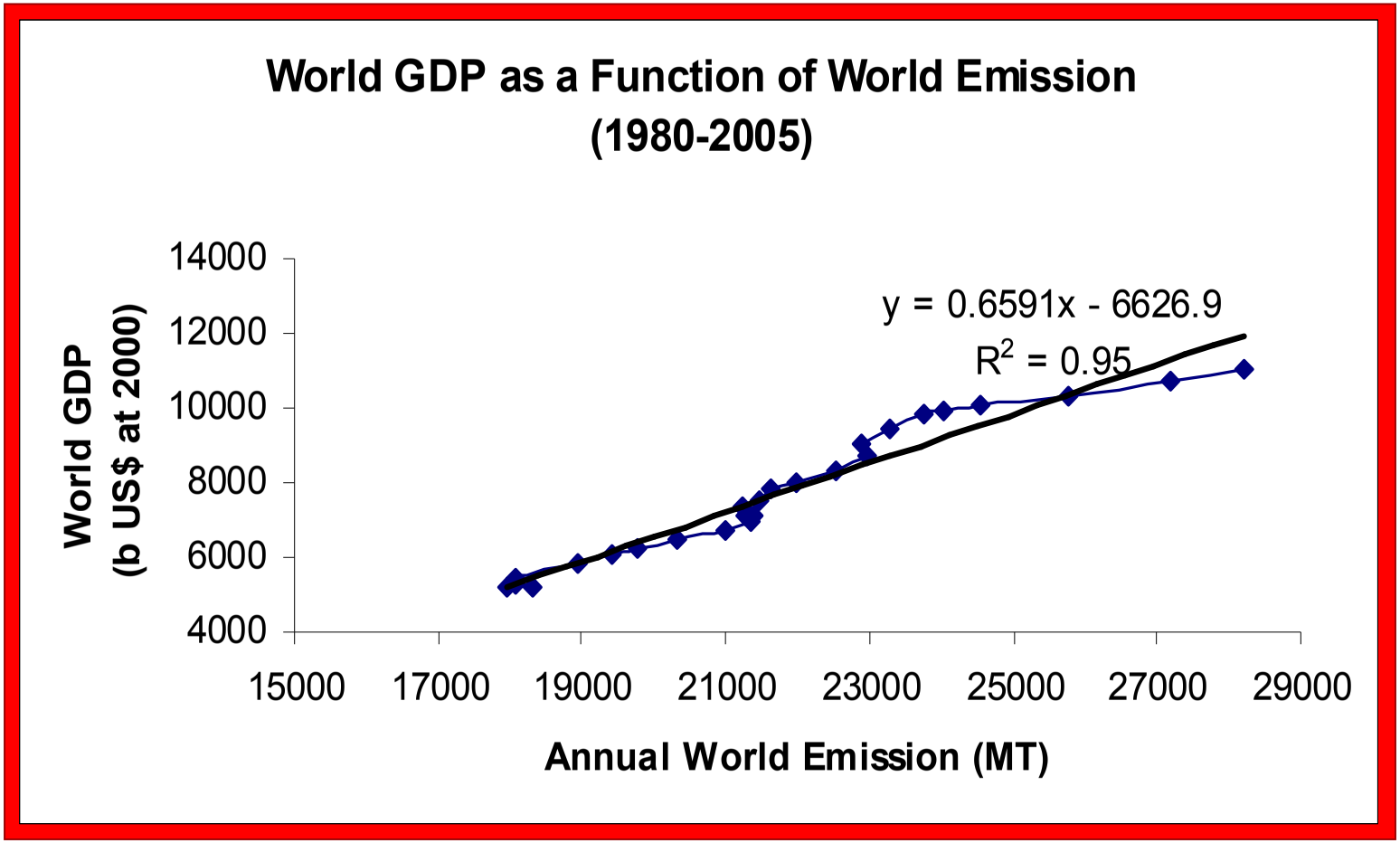

RF Terms
RF values (W m-2)
Spatial scale
LOSU
Anthropogenic
Natural
Long-lived greenhouse gases
CO2
N2O
CH4
Halocarbons
1.66 [1.49 to 1.83]
Global
High
0.48 [0.43 to 0.53]
0.16 [0.14 to 0.18]
0.34 [0.31 to 0.37]
Global
High
Ozone
Stratospheric
Tropospheric
-0.05 [-0.15 to 0.05]
0.35 [0.25 to 0.65]
Continental to global
Med
Stratospheric water vapour from CH4
0.07 [0.02 to 0.12]
Global
Low
Surface albedo
Land use
Black carbon on snow
-0.2 [-0.4 to 0.0]
0.1 [0.0 to 0.2]
Local to continental
Med - Low
Total Aerosol
Direct effect
-0.5 [-0.9 to -0.1]
Continental to global
Med - Low
Cloud albedo effect
-0.7 [-1.8 to -0.3]
Continental to global
Low
Linear contrails
0.01 [0.003 to 0.03]
Continental
Low
Solar irradiance
0.12 [0.06 to 0.30]
Global
Low
Total net anthropogenic
1.6 [0.6 to 2.4]
-2
-1
0
1
2
Radiative Forcing (W m-2)
©IPCC 2007: WG1-AR4

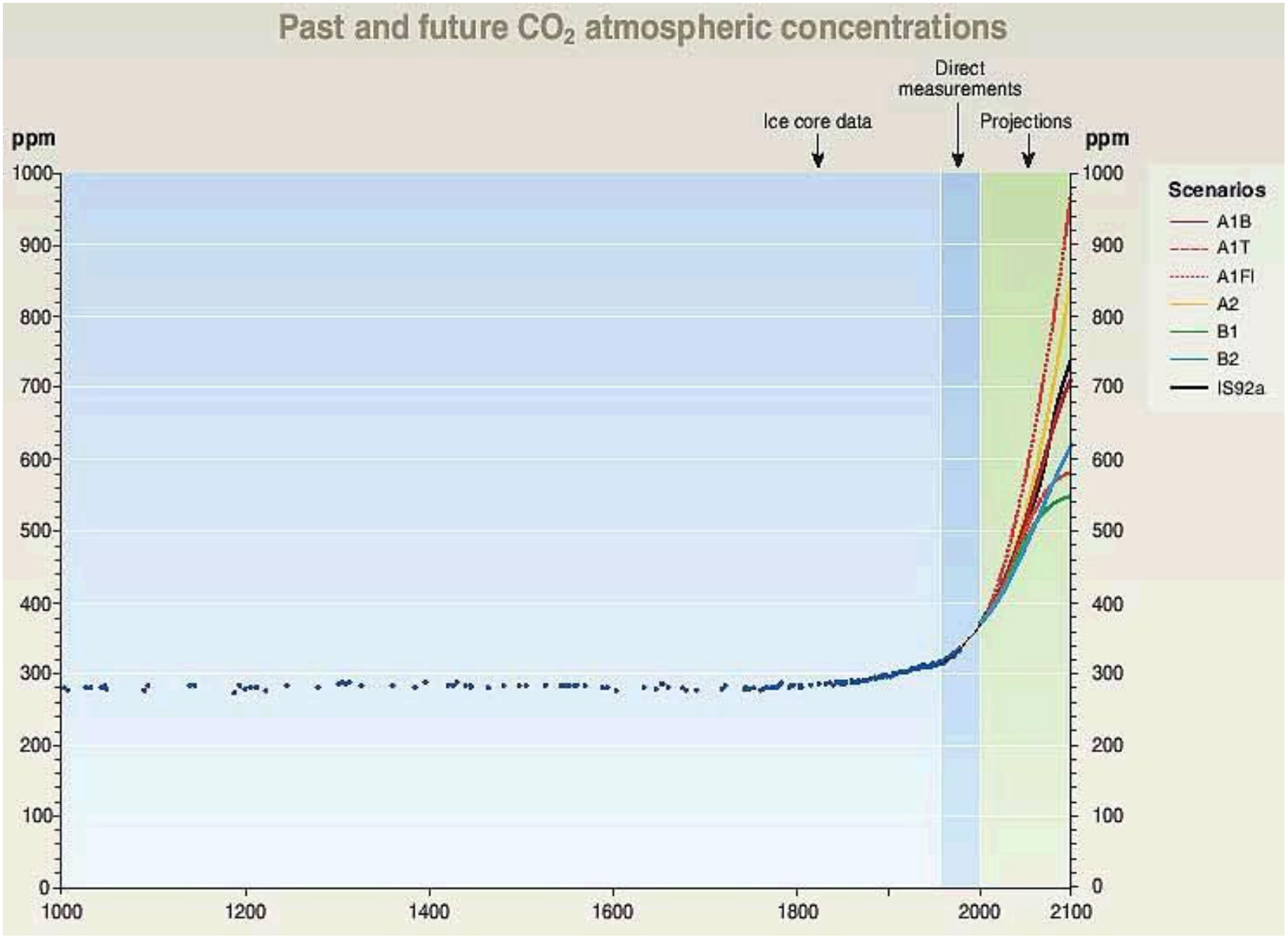

Global mean temp. Vs CO_2 conc.
1960-2003
y = 0.01x + 10.67
R^2 = 0.75
Global mean temp. °C
14.60
14.50
14.40
14.30
14.20
14.10
14.00
13.90
13.80
13.70
13.60
310
320
330
340
350
360
370
380
CO_2 concentration (ppm)

The world will continue to emit more and more CO2 in the absence of better technologies and emission reduction regulations

(Raven and Berg, 2001).

Source	Percentage of the total energy generated
Oil	39
Coal	24
Natural Gas	22
Hydroelectric	7
Nuclear	6
Alternatives	<1

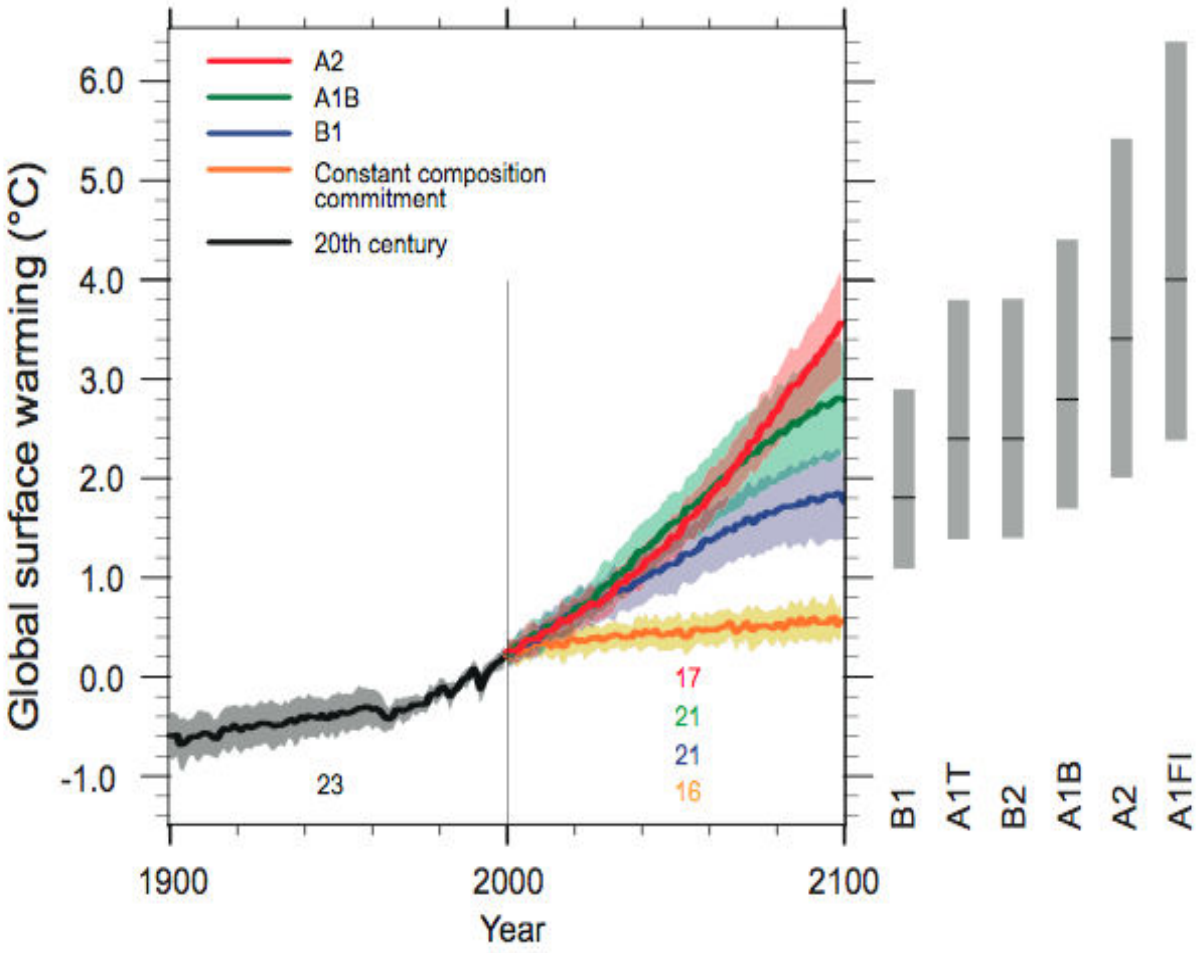

World GDP as a Function of World Emission
(1980-2005)
World GDP
(b US$ at 2000)
14000
12000
10000
8000
6000
4000
y = 0.6591x - 6626.9
R2 = 0.95
15000
17000
19000
21000
23000
25000
27000
29000
Annual World Emission (MT)


Past and future CO_2 atmospheric concentrations
Ice core data
Direct measurements
Projections
ppm
ppm
1000
900
800
700
600
500
400
300
200
100
0
1000
1200
1400
1600
1800
2000
2100
Scenarios
A1B
A1T
A1FI
A2
B1
B2
IS92a

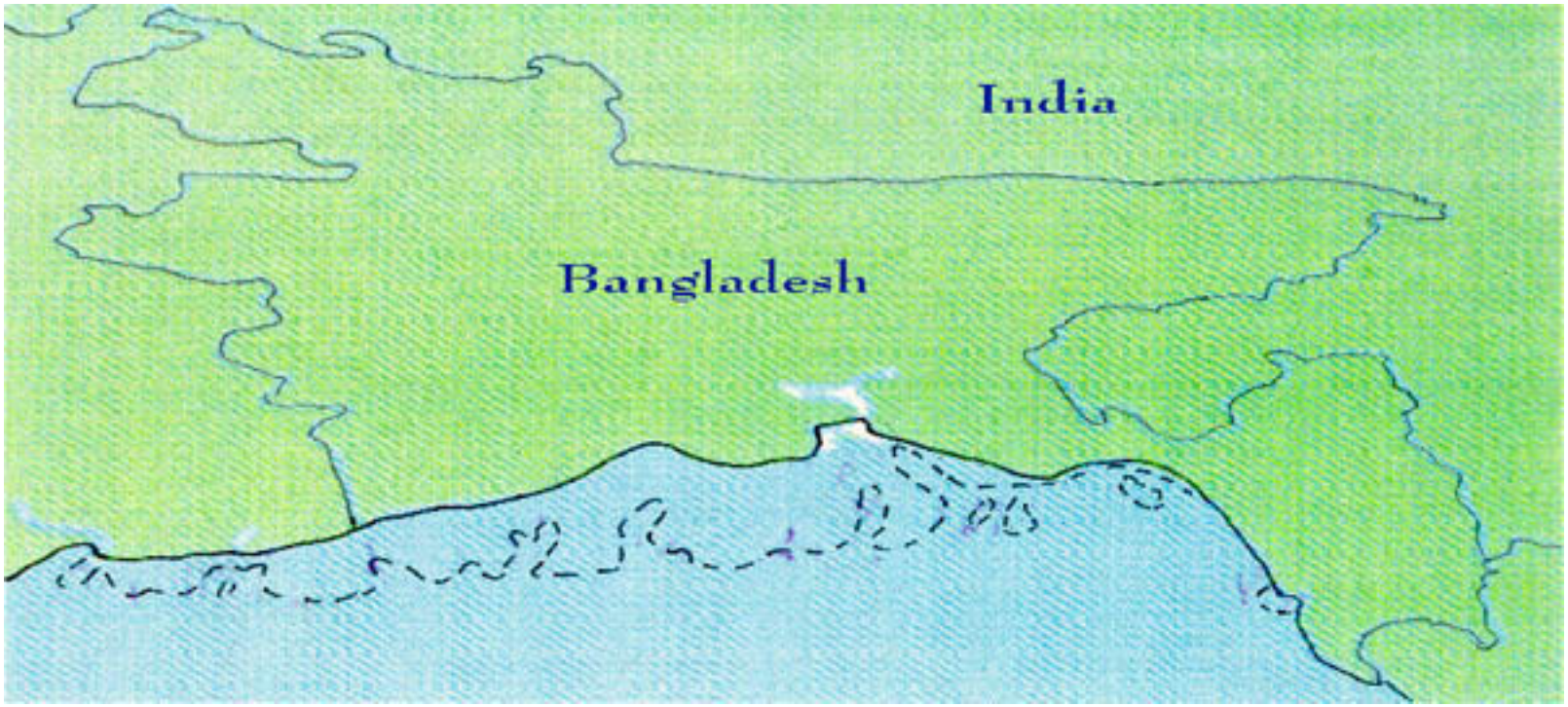
Projections of Future Changes in Climate

Best estimate for low scenario (B1) is 1.8°C (*likely* range is 1.1°C to 2.9°C), and for high scenario (A1FI) is 4.0°C (*likely* range is 2.4°C to 6.4°C).

Broadly consistent with span quoted for SRES in TAR, but not directly comparable



Bangladesh is projected to lose about 17% of its land area with a sea level rise of one meter - very difficult to adapt due to lack of adaptive capacity



Not a very sustainable development path.

So, what do we do?

Prevent global warming by reducing GHG emission? (Mitigation)

Adapt to a warmer world? (Adaptation)

Whatever we do, there is a price tag…

And it is here, the question of equity and carbon justice coming up.

Because,

It is the rich and the developed nations that are responsible for the largest emissions, historically.

But, the poor and less developed nations suffer the most from climate change, although, they did not contribute to climate change.

For them mitigation is costly or compromising their much needed development for poverty alleviation and better living standard.

And for them adaptation to climate change is also costly as they do not have the technology or the financial power.

For the rich countries, adaptation is all about (well, more or less) adjusting the thermostats or going for better ice making machines to dump snow and ice on the Swiss Alps so that they can go skiing.

“Common, but differentiated responsibility”

June 1992: UNFCCC signed at the Earth Submit in Rio de Janeiro

UNFC

- Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system

- Such a level should be achieved within a time-frame sufficient
  - to allow ecosystems to adapt naturally to CC
  - to ensure that food production is not threatened
  - to enable economic development to proceed in a sustainable manner

UNFCCC

- No legally binding targets; doesn't say how much to reduce and by what time.

- Need agreement with emission reduction commitments with a specific timetable

1997: CoP3 to UNFCCC adopts the Kyoto Protocol

March 2001: US pulls out of KP; Russian ratification becomes inevitable.

April 2002: EU ratifies Kyoto Protocol

October 2004: Russia ratifies Kyoto Protocol
(128th country to do so)

February 16, 2005: Kyoto Protocol enters into force

2012: Commitment period of KP ends

December 2007: 13 CoP 13 at Bali

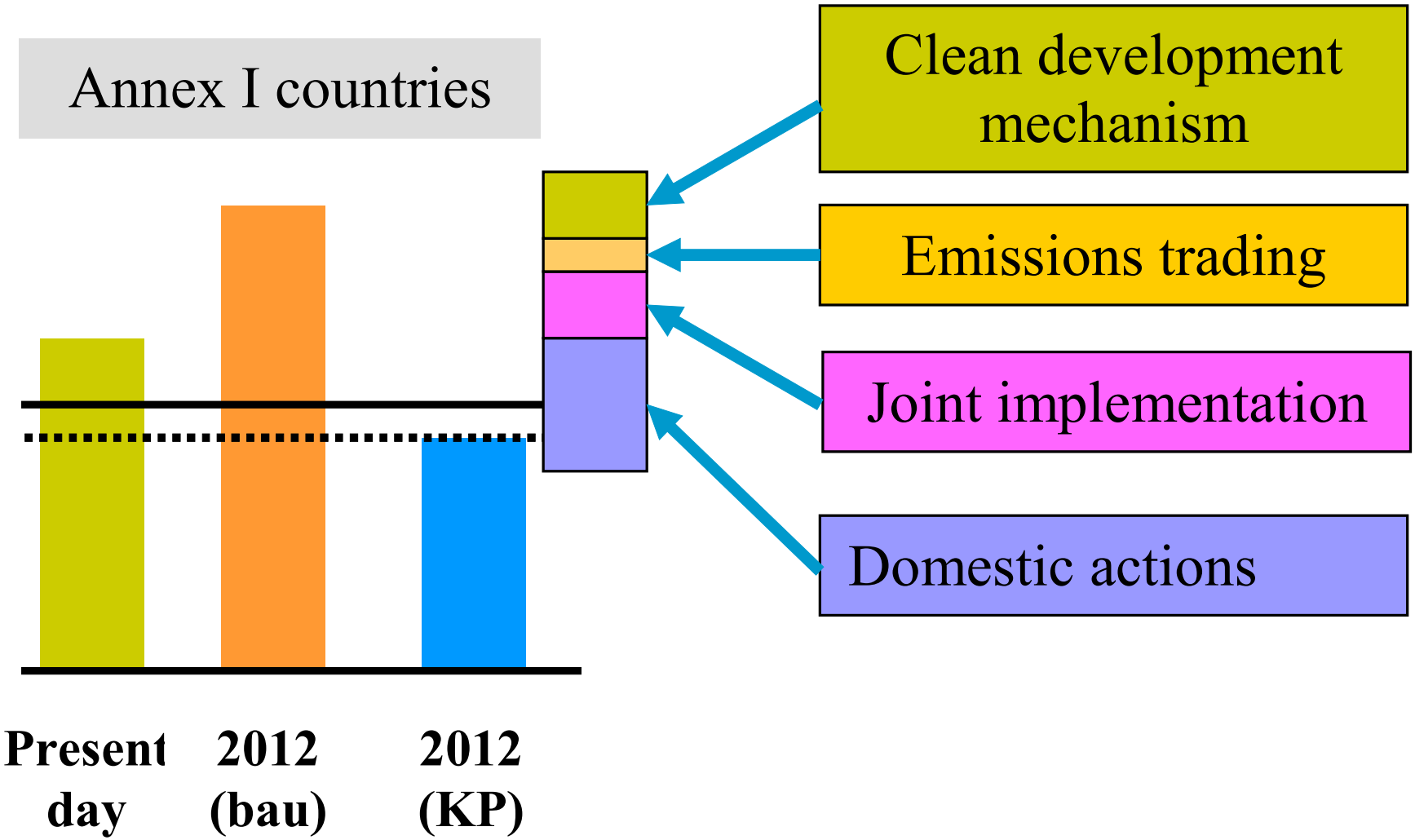
December 2008: CoP 14 in Poland

December 2009: CoP 15 Copenhagen to negotiate an agreement that will be ratified and put in place by 2012 in place of KP

Kyoto Protocol

- Overall emission reductions of 5.2% over 1990 levels by Annex I parties
- Differentiated targets among Annex I (e.g. Japan 6%, US 7% reduction, Australia 8% increase over 1990 levels)
- First commitment period 2008-12

Meeting the Kyoto Protocol targets



CDM

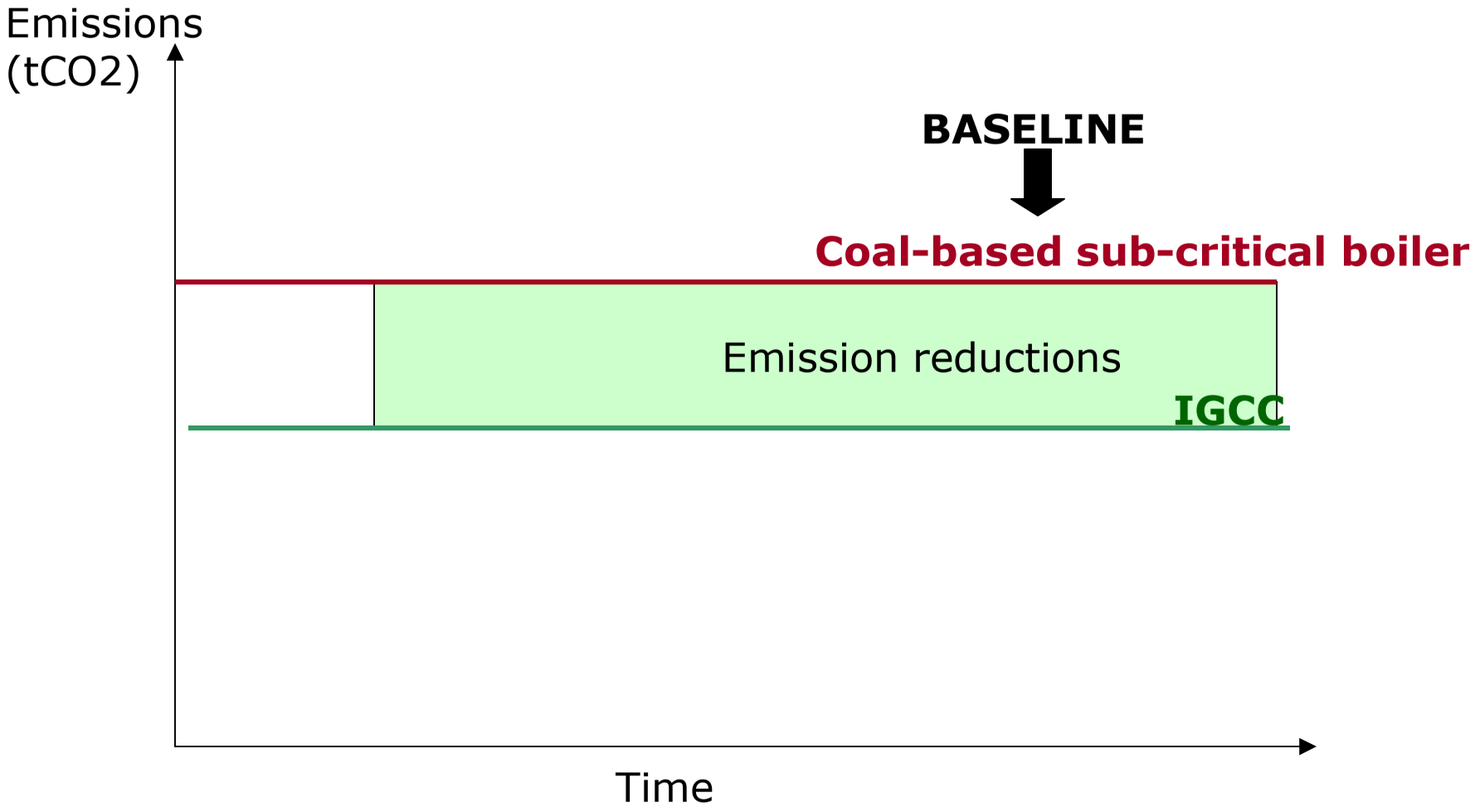
- Projects in developing countries which reduce GHG emissions relative to the "baseline"
- 1 tonne CO_2 = 1 Certified Emission Reduction (CER)
- Used by developed countries to offset meet their Kyoto Protocol targets
- Contribute to sustainable development in developing countries

Sectoral scopes

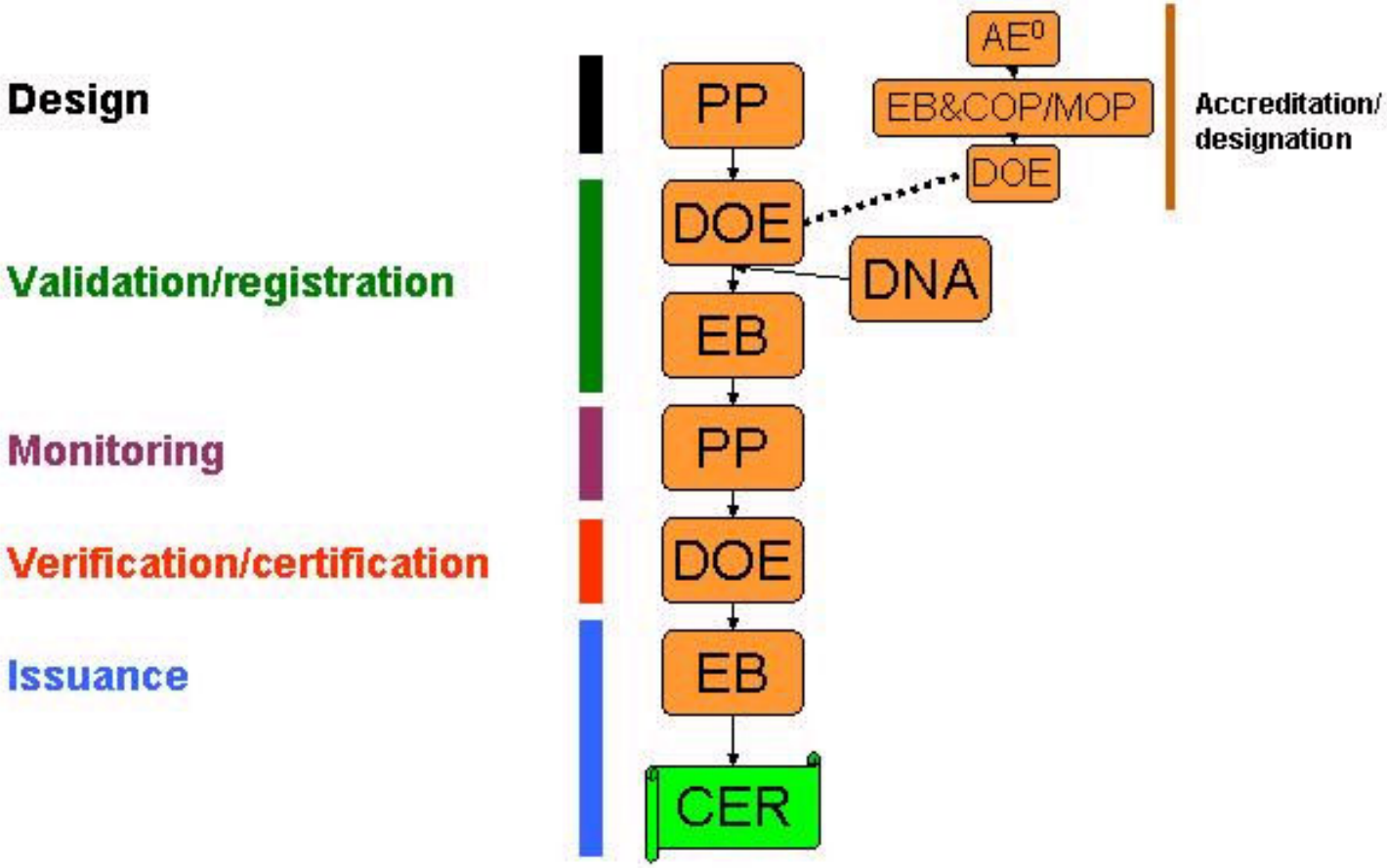
Sector 01 Energy industries (renewable / non-renewable resources)
Sector 02 Energy distribution
Sector 03 Energy demand
Sector 04 Manufacturing industries
Sector 05 Chemical industries
Sector 06 Construction
Sector 07 Transport
Sector 10 Fugitive emissions from fuels (solid, oil and gas)
Sector 11 Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride
Sector 12 Solvent use
Sector 13 Waste handling and disposal
Sector 08 Mining/mineral production
Sector 09 Metal production
Sector 14 Afforestation and Reforestation
Sector 15 Agriculture

How to establish additionality?

Baseline – scenario that reasonably represents the situation in the absence of the proposed project activity



CDM project activity cycle



Structure and functions of NCA

- “National CDM Authority” (under section 3 of Environment Protection Act 1986 (29 of 1986)
  - Notification released during May 2004
  - Inter ministerial committee
  - Single window clearance
- Interim approval criteria available at http://envfor.nic.in/cdm/

TECHNOLGY

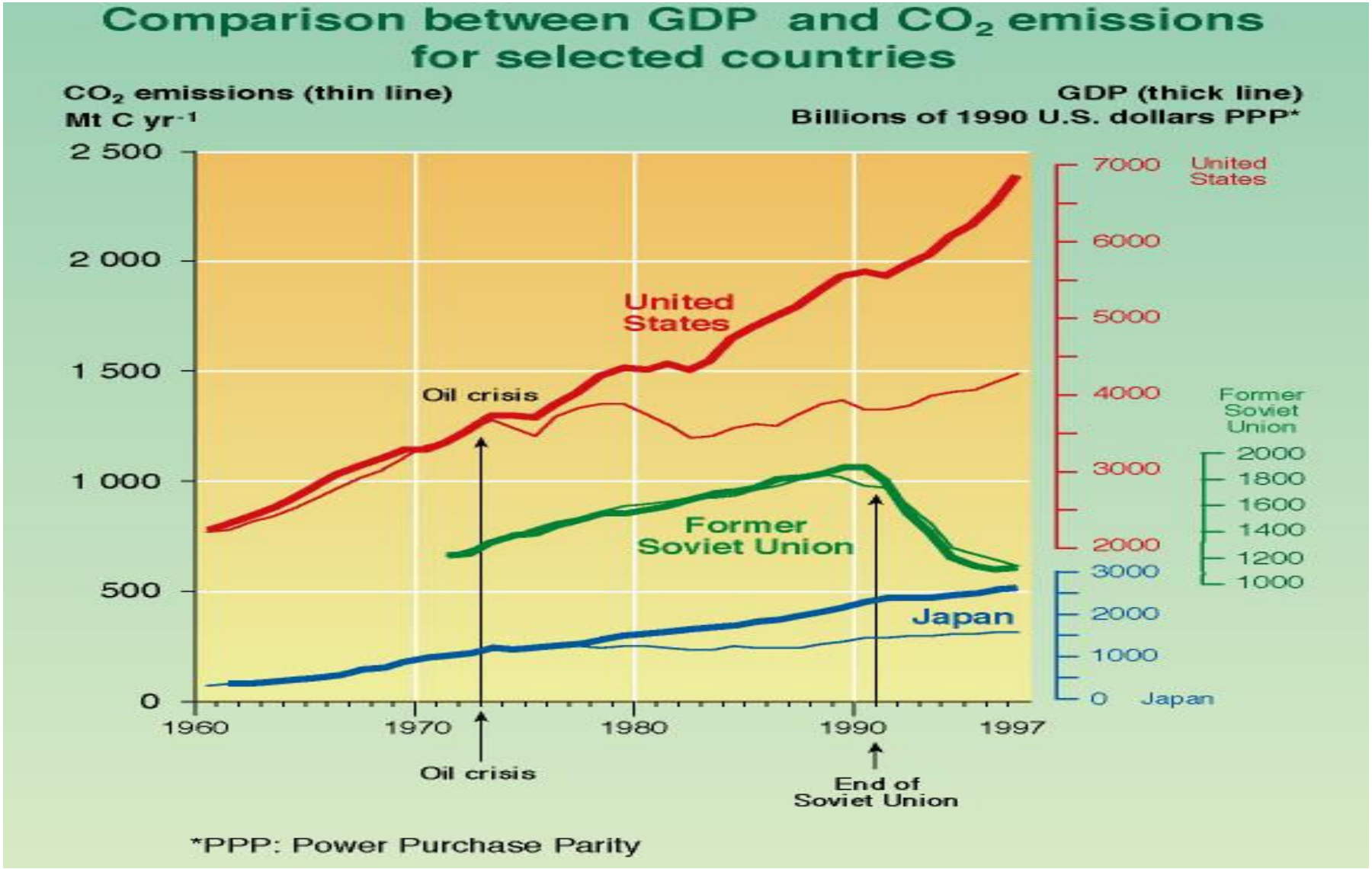
REGULATIONS (TAXES, INCENTIVES)

FAIR VALUE FOR CARBON

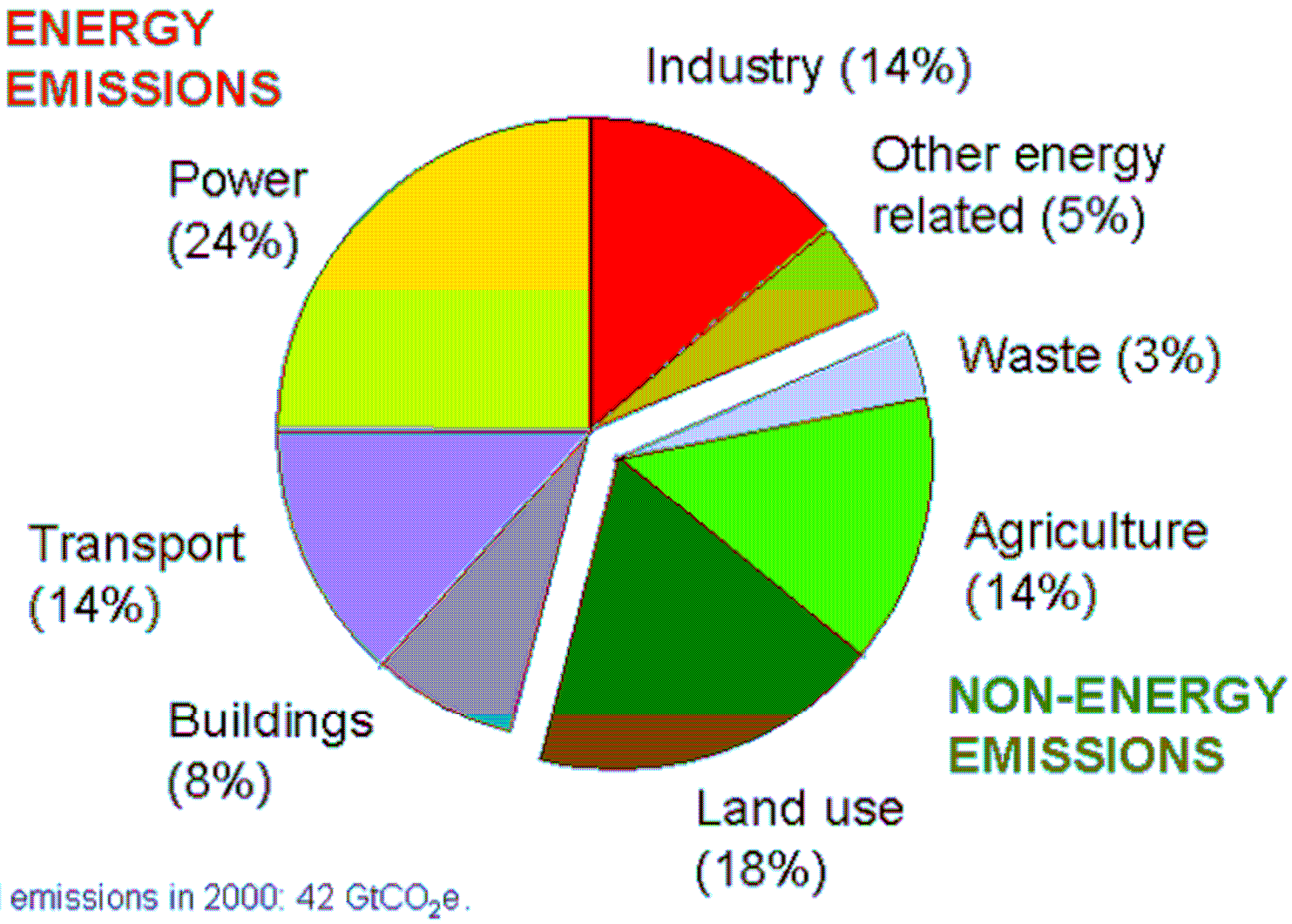
INVESTMENTS

POLITICAL AND ECONOMIC WILL

The 1:1 Relationship between GDP and CO_2 emissions can be de-linked



Global Emissions by Sector



Total emissions in 2000: 42 $GtCO_2e$.



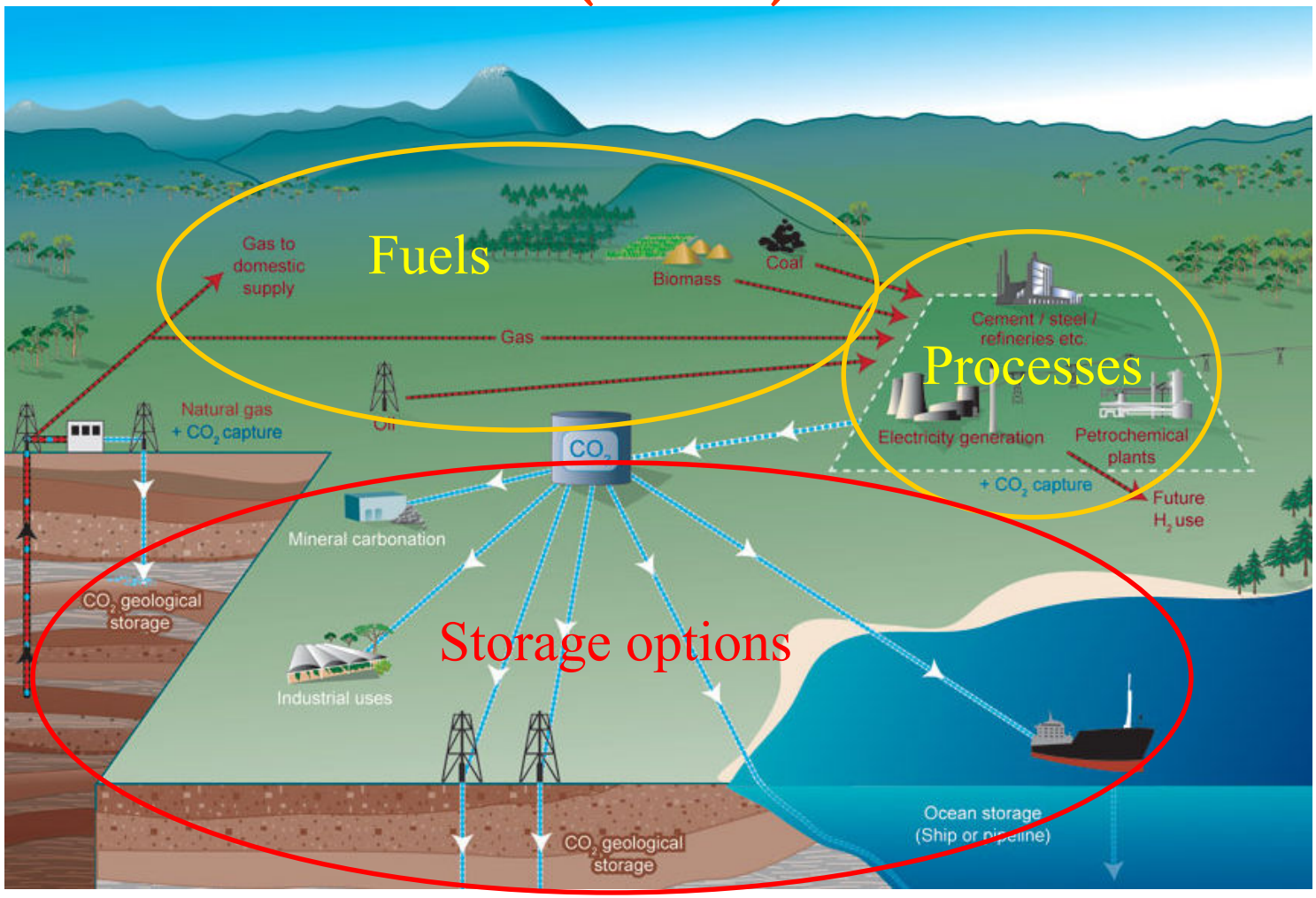
TECHNOLGY

Energy sector
Carbon Capture and Storage (CCS)

Energy efficient buildings

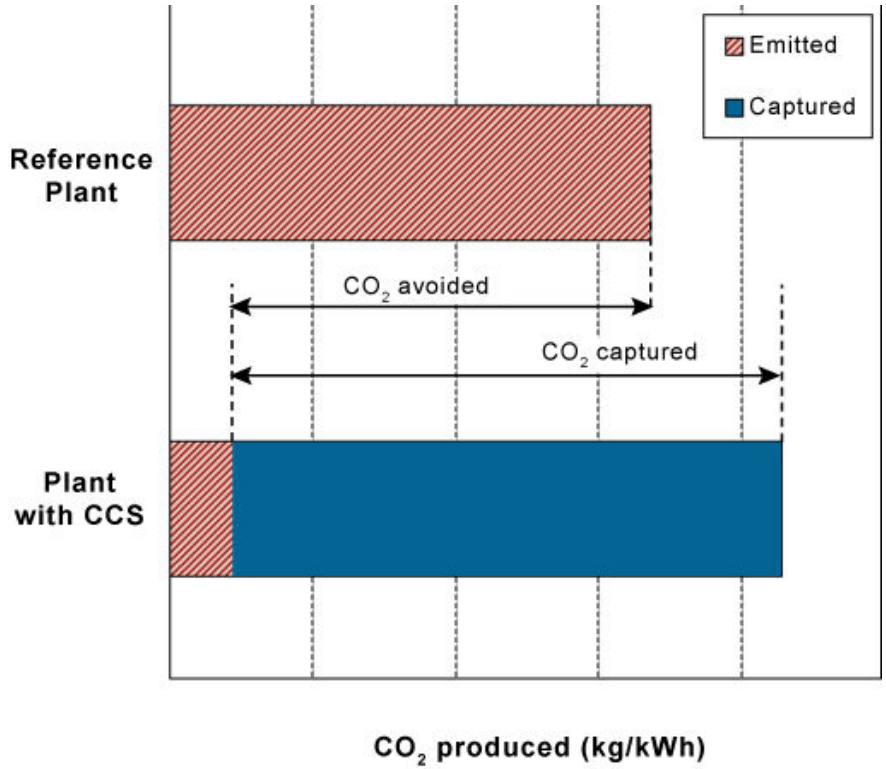
Nuke energy, Renewables, Hybrid cells, Solar etc.

CO_2 Capture and Storage System (CCS)



Energy requirements

- Additional energy use of 10 - 40% (for same output)
- Capture efficiency: 85 - 95%
- Net CO_2 reduction: 80 - 90%
- Assuming safe storage



Global large stationary CO_2 sources with emissions of more than 0.1 $MtCO_2$/year

Process	No. of sources	Emissions ($MtCO_2$/yr)
Fossil Fuels		
Power (coal, gas, oil and others)	4,942	10,539
Cement production	1,175	932
Refineries	638	798
Iron and steel industry	269	646
Petrochemical industry	470	379
Oil and gas processing	N/A	50
Other sources	90	33
Biomass		
Bioethanol and bioenergy	303	91
Total	**7,887**	**13,466**

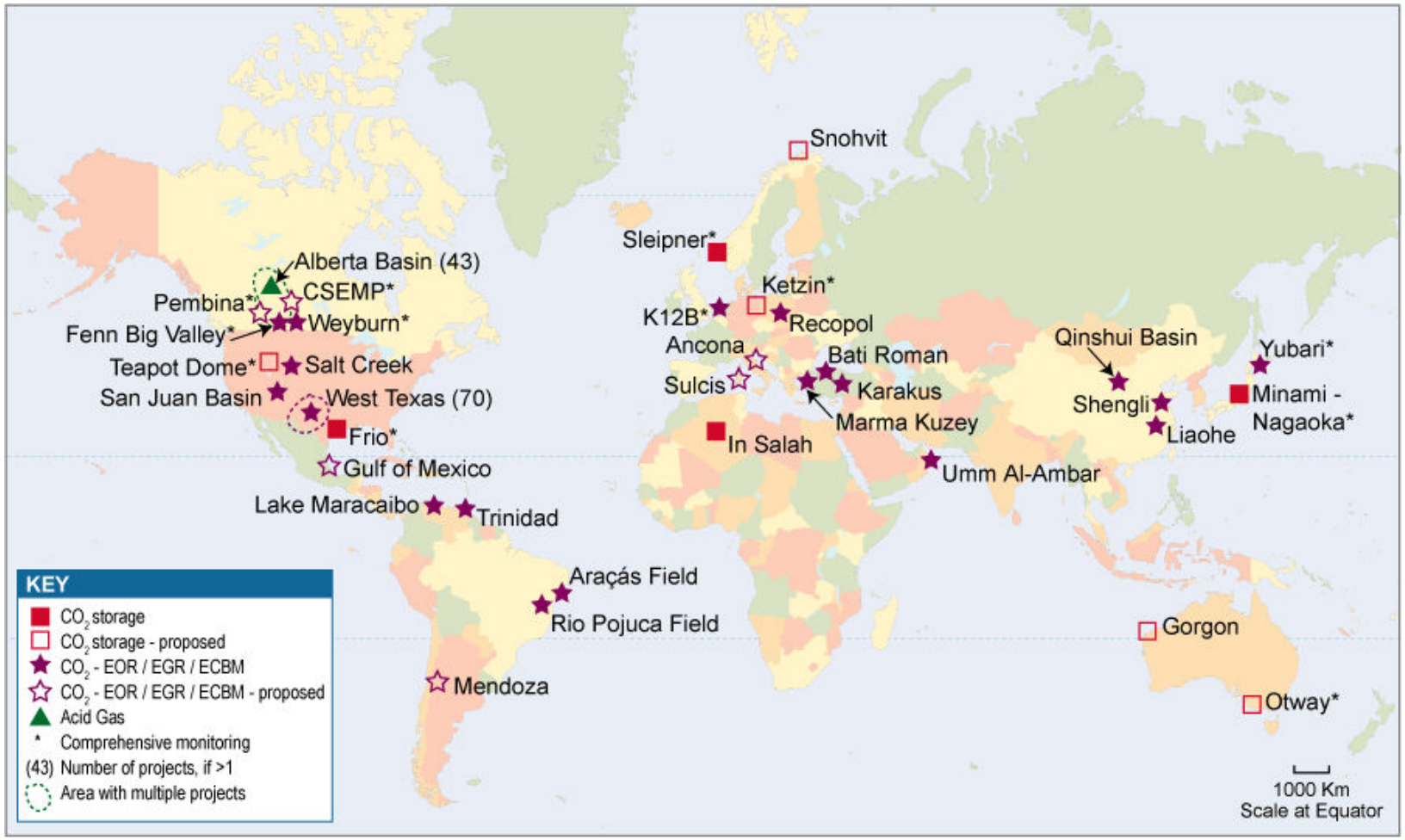
Examples of existing CO_2 capture installations





(

Planned and current locations of geological storage



Costs

Two ways of expressing costs:

- **Additional electricity costs**
  - **Energy policymaking community**
- **CO_2 avoidance costs**
  - **Climate policymaking community**

Different outcomes:

0.01 - 0.05 US$/kWh

20* - 270 US$/t$CO_2$ avoided

(with EOR: 0*– 240 US$/t$CO_2$ avoided)

*** low-end: capture-ready, low transport cost, revenues from storage: 360 MtCO_2/yr**

Forestry sector

Avoided deforestation

Agriculture sector

Carbon sequestered in the soil.



Burning of forest vegetation prior to shifting cultivation

Eco-restoration through rubber cultivation



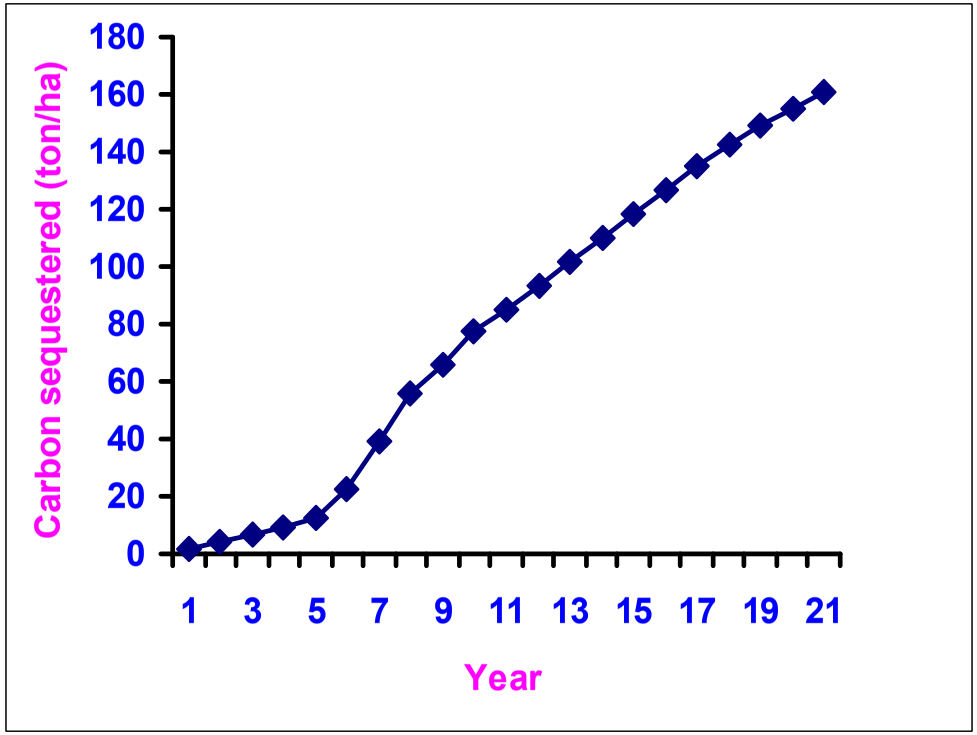








Rate of Carbon Sequestration



TOTAL C = 164.18 T C / hectare (in 21 yrs)

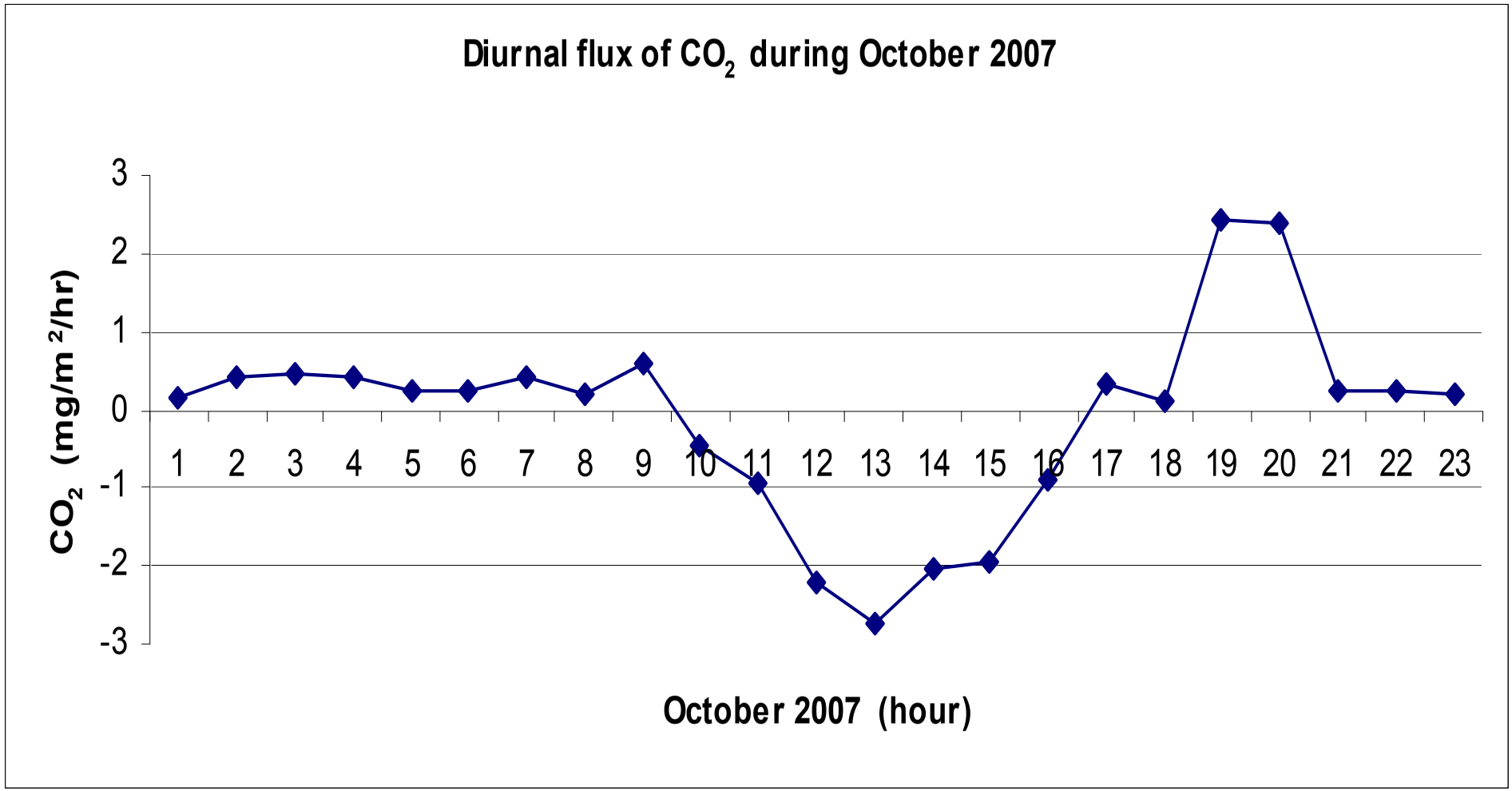
ANNUALIZED MEAN = 28.7 T CO_2/ha/year

Say 30 T CO_2/ha/year ; or 30 CER/ha/year

Current CER price for sink projects is only US$ 5/CER (PCF WB). For other CERs, it is much more (Euro 16/CER)

CDM potential of NR plantations is to the tune of 30x5=US$150/ha/year, for every year.

Diurnal flux of CO_2 during October 2007 (Eddy Covariance)



Political and Economic Will

Progressive tax on emission

Fair price for carbon

ToT and financing

Equitable sharing of the climate change burden

Carbon Justice

Without the US coming on board, there is no equity.

Also, C price is low without the US in the carbon market.

Developing countries with fast growing economies should also fix emission limits without compromising growth.

Thank you

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