STATUS OF FOREST & WILDLIFE OF INDIA & IMPACT OF CLIMATE CHANGE

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Author

This Universe is the creation of the Supreme Power, Meant for the benefit of his creations. Individual species must, therefore, learn to enjoy its benefits by forming a part of the system in close relation with other species. Let not any one species encroached upon the other's right.

Upnishad

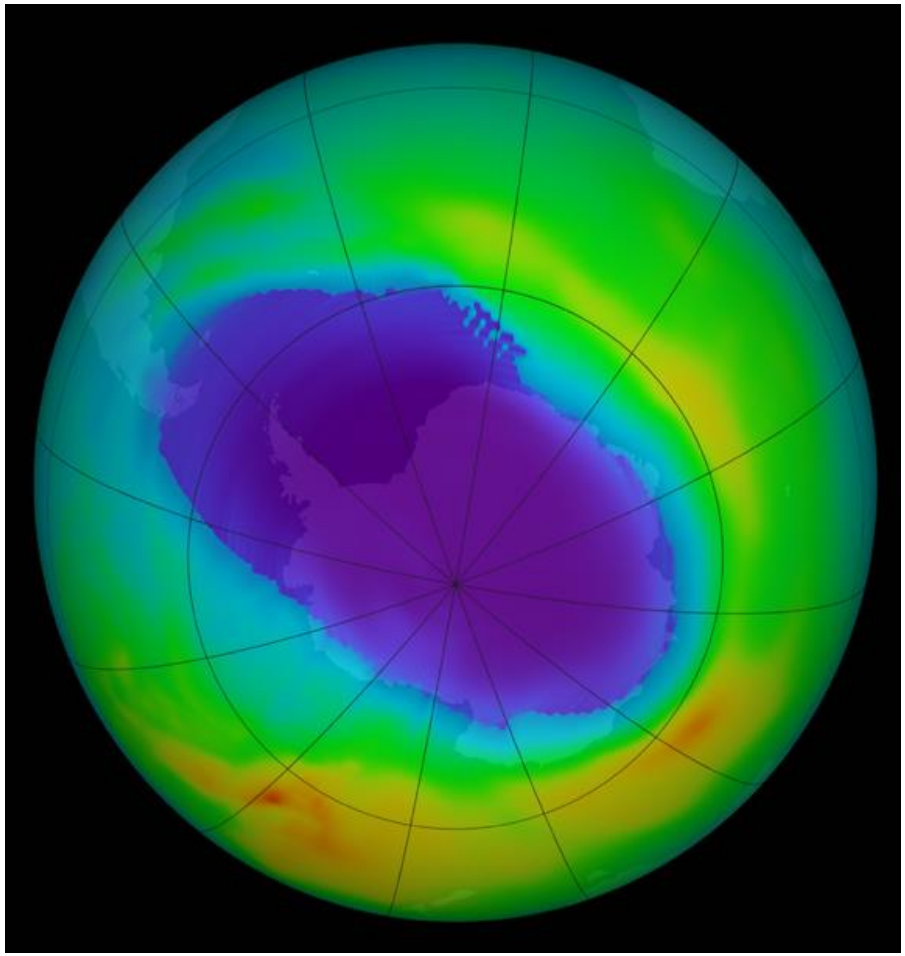
ATTRIBUTES OF ENVIRONMENT & FORESTRY MANAGEMENT IN THE WORLD

Anthropo-centrism and contempo-centrism

- Country has never been subjected to “ecological audit”. The country may be registering economic growth rate of 4 to 7%, but unofficial estimates provide that in ecological terms our growth rate is about (-)4%.
- National Forestry Action Plan accepts that “forestry” contributes about 5-6% to economic GDP, while resource allocation is meager less than 0.1%. Even whatever meager is allotted is being diverted for non-forest purposes. Forest resource has been divested @ 6% p.a.

The Mother Earth as visible from the Space

Montreal Protocol

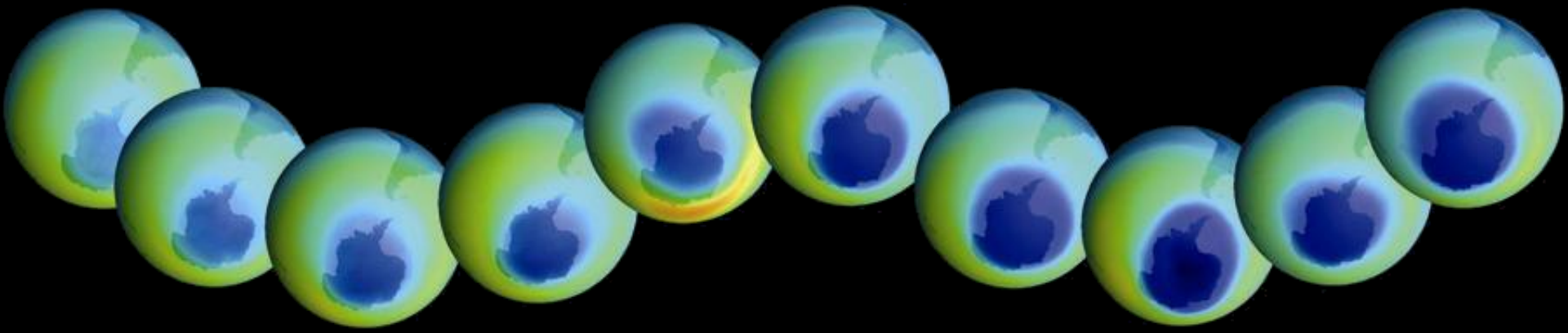


As evident from satellites of thinning of the Ozone layer led to the Montreal Protocol for reducing CFC's.

Hole in the "Ozone Layer" above Antarctica, due to CFCs emission & threat.

The details are provided in next three slides.

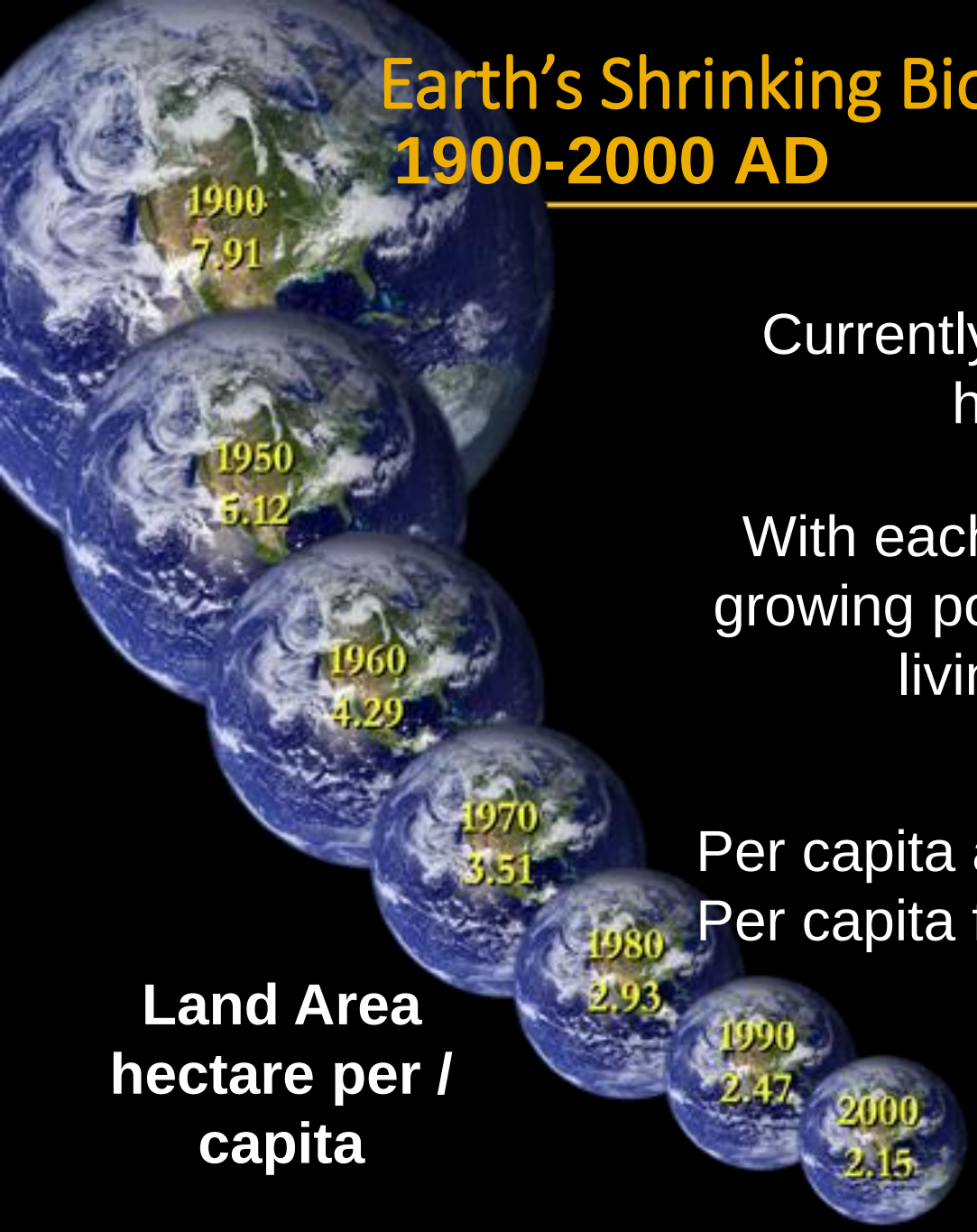
Ozone Depletion



Growth of the Antarctic ozone hole over 20 years, as observed by the satellite

Darkest blue areas represent regions of maximum ozone depletion.

Earth's Shrinking Biosphere
1900-2000 AD



Land Area hectare per / capita

Currently, the Earth is the only home we have.

With each new person added to our growing population, the amount of our living space decreases.

INDIA

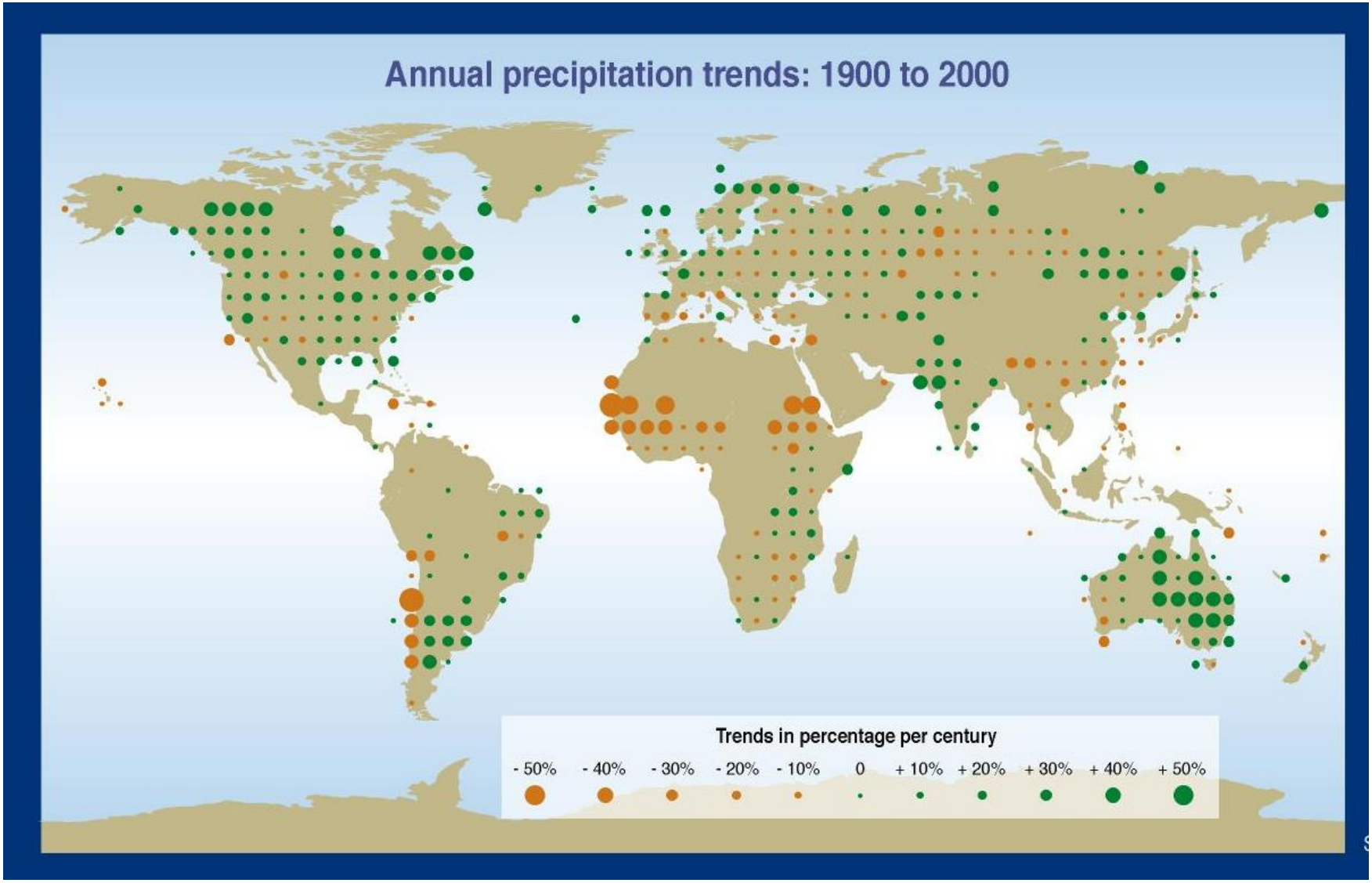
Per capita agricultural area - 0.60 Ha.

Per capita forest area - 0.04 Ha.

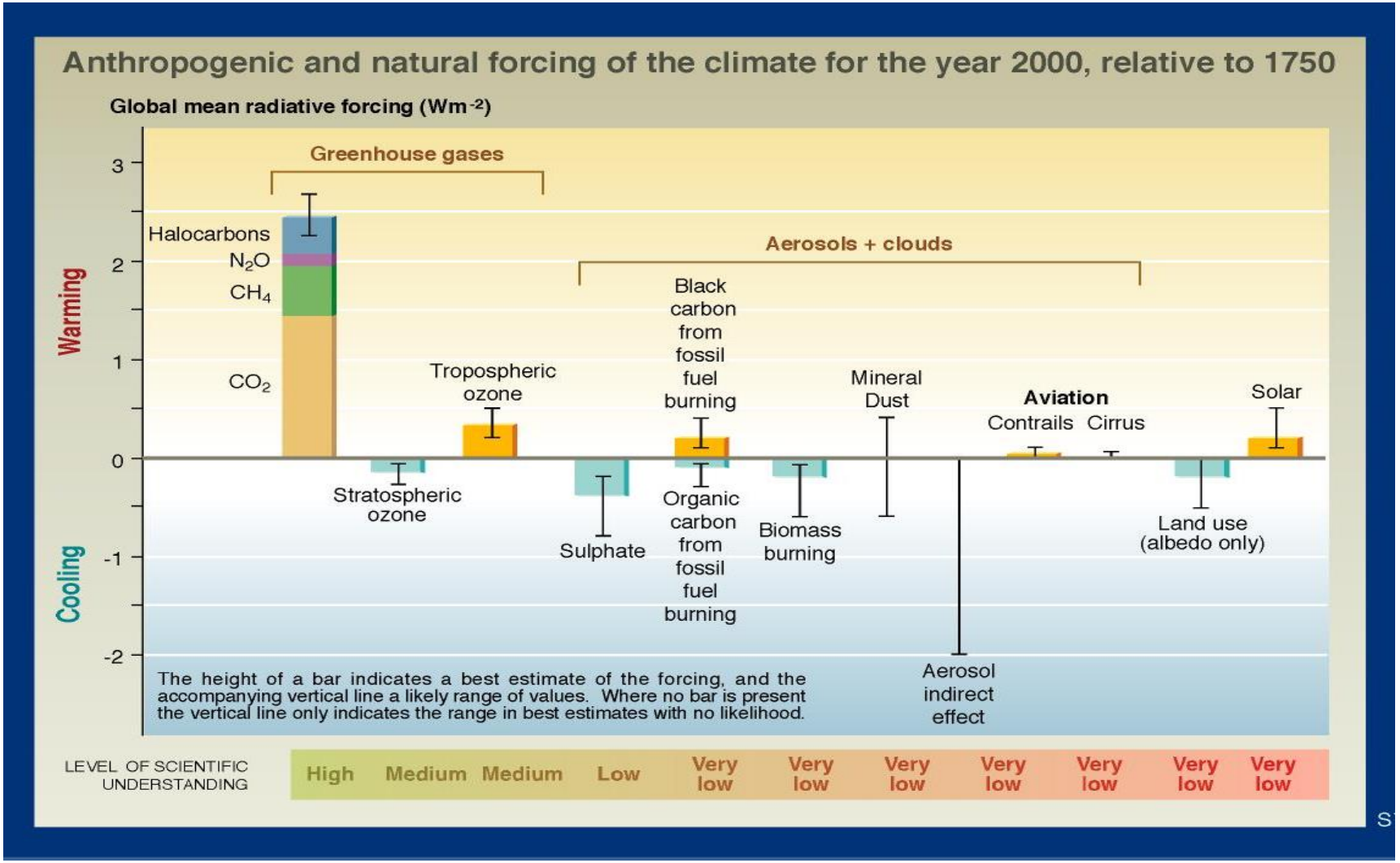
Transboundary: Dust over the Pacific

Images taken between April 29 and May 5, 2005 shows dust from the Gobi Desert crossing the Pacific, well on its way to North America.

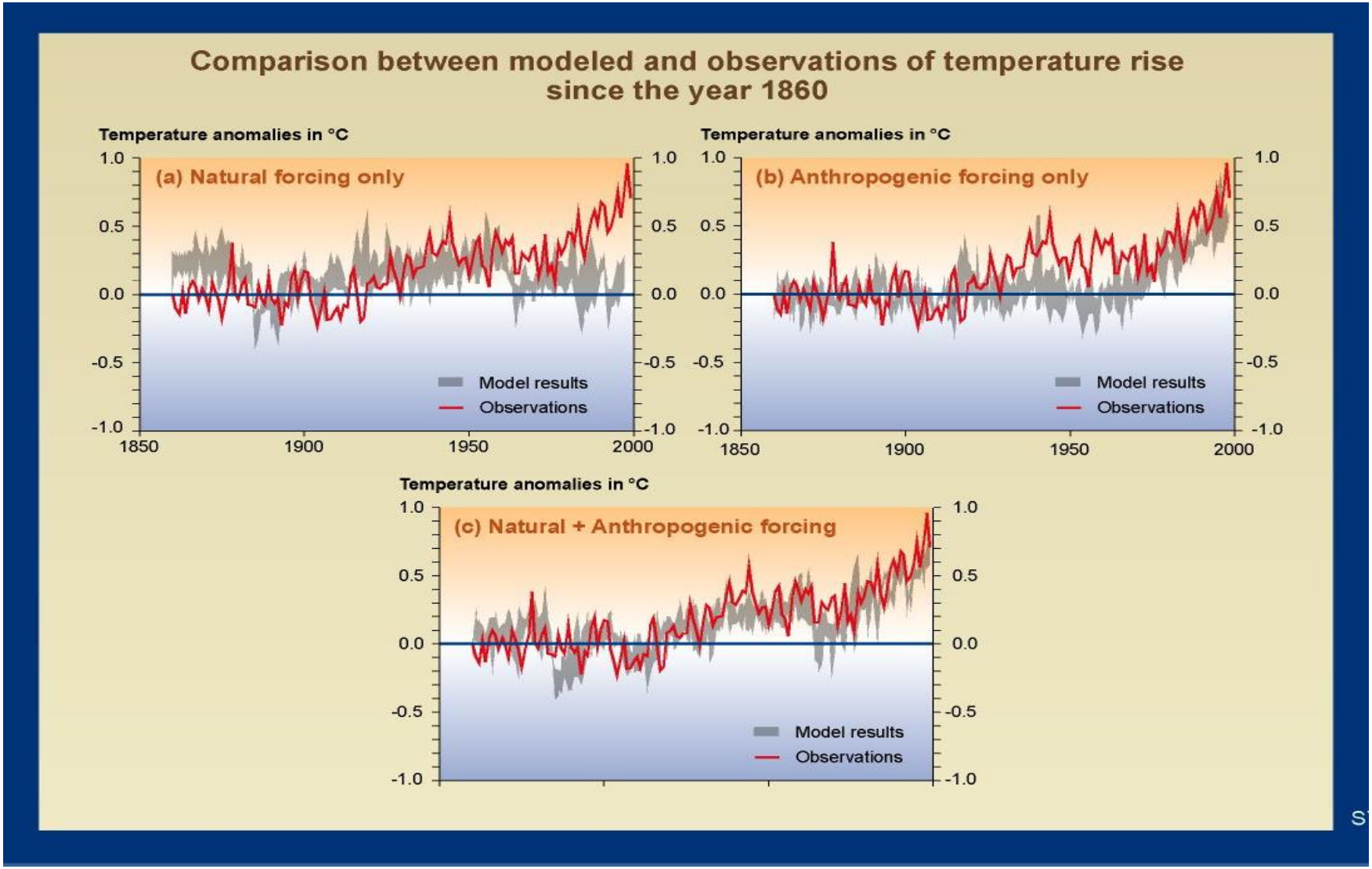
World - Annual Precipitation Trends



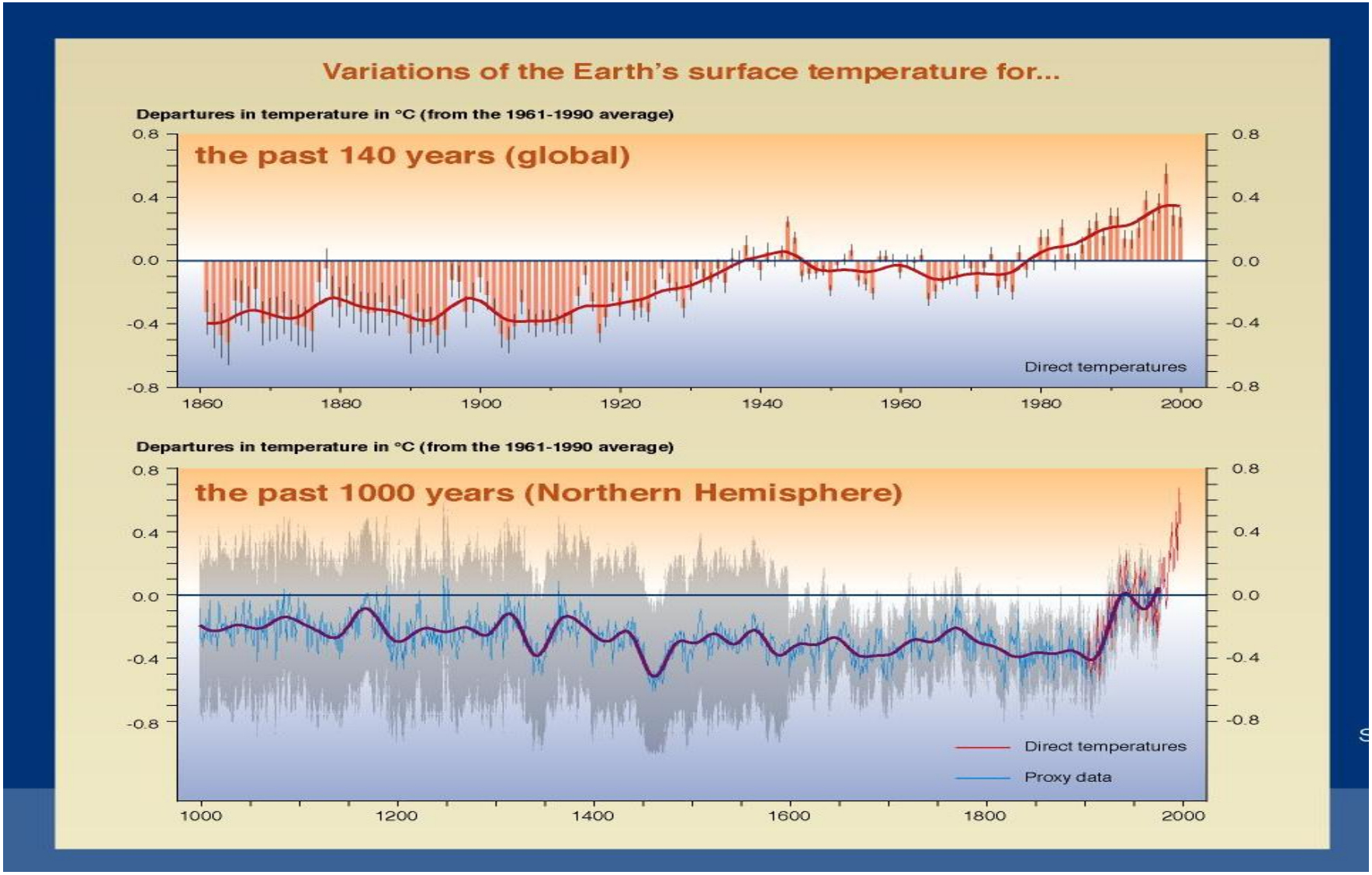
Anthropogenic Radio-active System



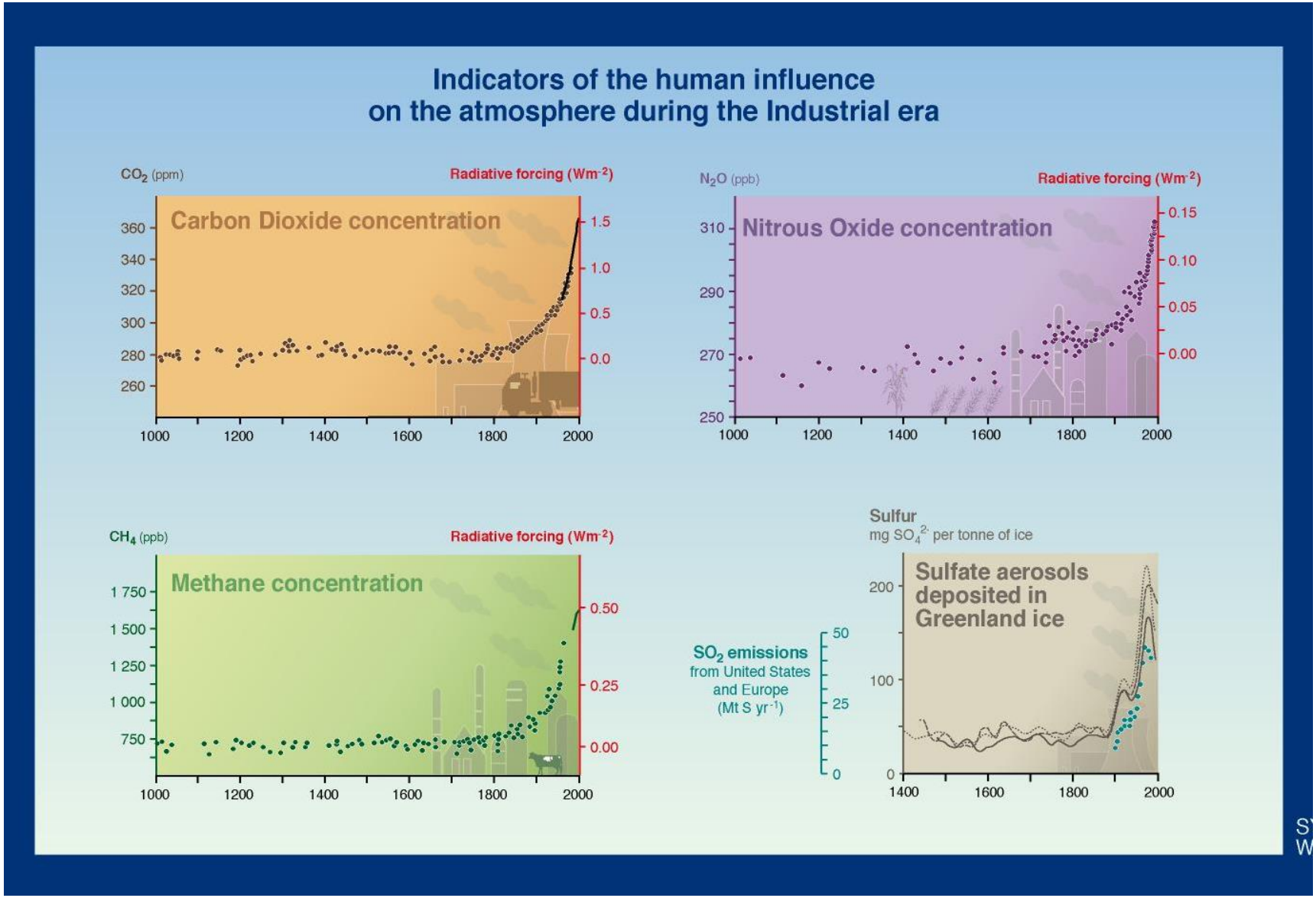
Comparison of Temperature Change



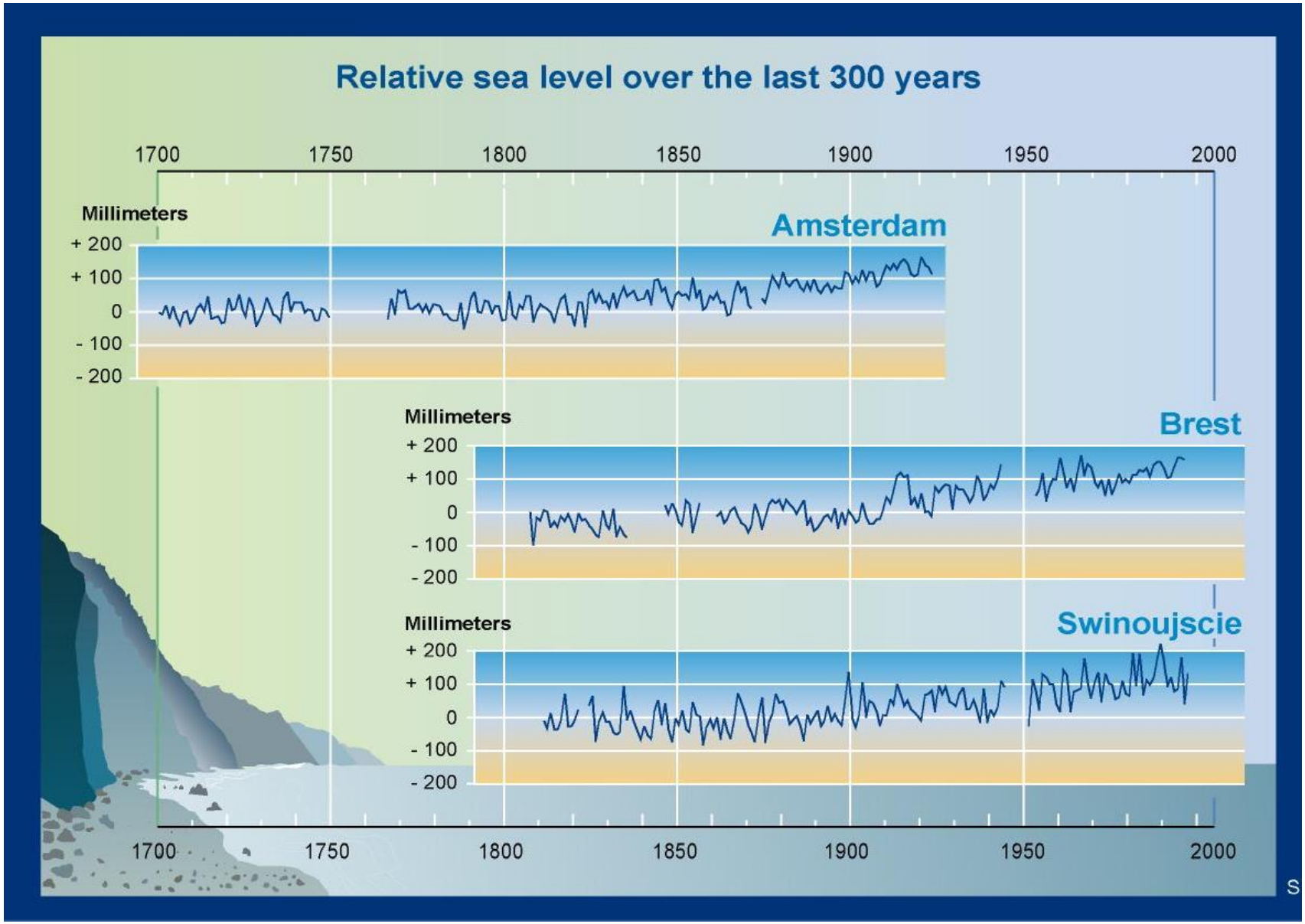
Global Temperature Range



Indicators of Human Influence



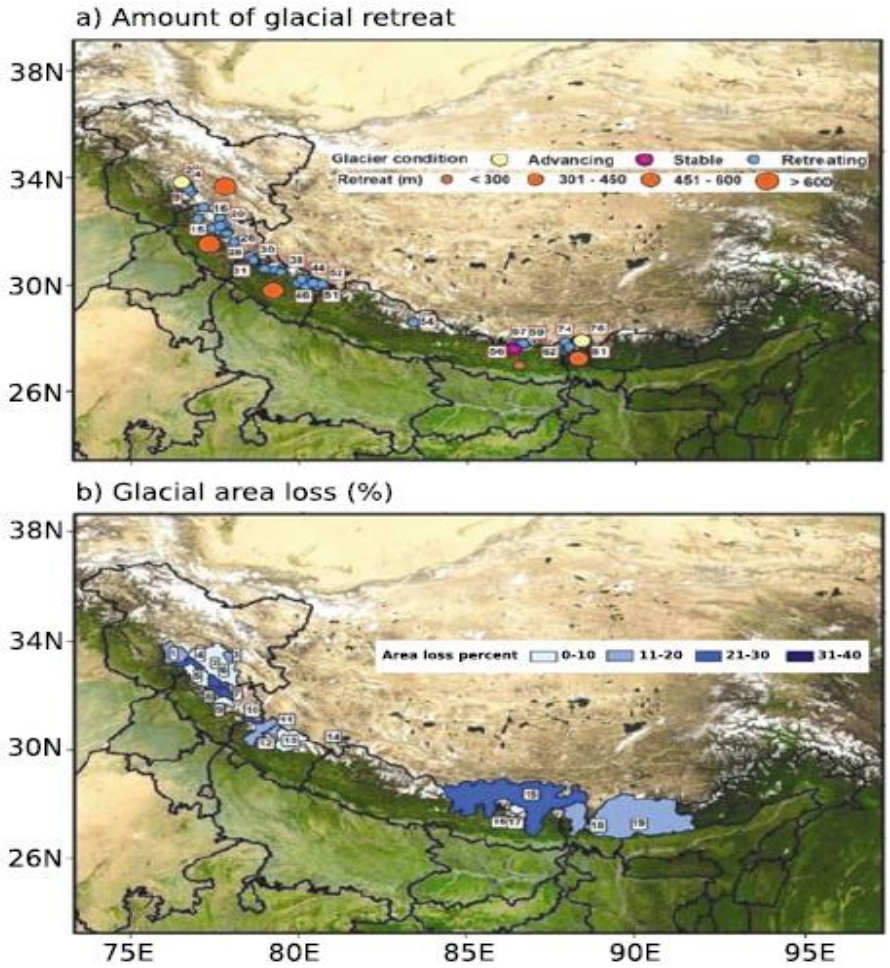
Rising Sea Level



Receding Gangotri Glacier, Northern India

- Receding since 1780
- Last 25 years, Gangotri Glacier has retreated more than 850 m (2 788 ft)

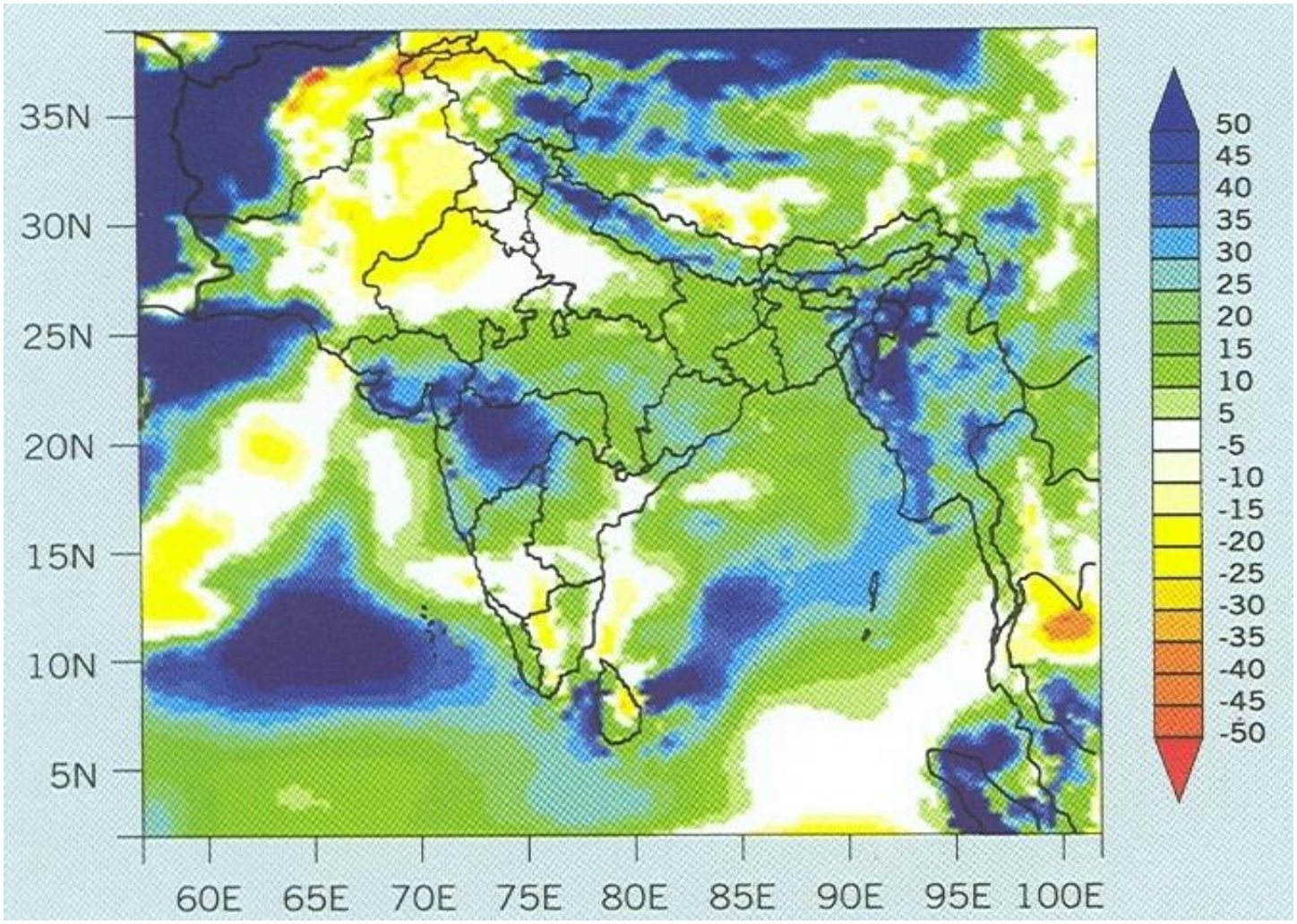
GLACIAL RETREAT BETWEEN 1960 & 2000



Under “Indus Water Treaty, 1960” – the waters of Indus, Jhelum and Chenab has been assigned to Pakistan for exclusive use.

Spatial patters of the changes in summer monsoon rainfall

2071-2100 (baseline 1961-1990 : A-2 scenario



Constitutional provisions related to "forest" & "wildlife"

At the time of promulgation of the Constitution of India, subject of "forests" was kept in the "State List". There was no entry of "wildlife".

"Forests" transferred to the "Concurrent List", List-III as Entry–17A and "Wildlife" as the Entry-17B by the 42nd Constitutional Amendment Act, 1976.

Article-251 & 254 of the Constitution provides that state statutes cannot be repugnant to Central Acts. If there is any repugnancy, state statutes automatically becomes "null & void".

All forest & wildlife statutes - FCA, WLPA, IFA, PESA, STOFDRFRAct are Central Acts. The statutory reforms are in jurisdiction of the Parliament. Statutory reforms virtually impossible.

NATIONAL FOREST POLICY, 1988

- Previous Forest Policies were enunciated in 1894 & 1952.
- Salient features of National Forest Policy, 1988.
  - Principal aim - ensuring environmental stability and maintenance of ecological balance.
  - Emphasis on afforestation, social forestry and farm forestry (extension in non-forest areas).
  - Involve local communities in forest protection.
  - Enhance investment and other resources for forestry.

Chink.jpg

Principal Forest and Wildlife Statutes

- Indian Forest Act, 1927 (RF and PF cannot be used for carbon trading purposes).
- Wildlife (Protection) Act, 1972 (prohibitory in nature, plantations / forest crop cannot be harvested in protected areas of the country).
- Forest (Conservation) Act, 1980 (regulate allocation of forest areas to private entities).

These forest statutes are silent about "carbon trading". Thus to facilitate carbon trading in the country, a statute may be having title "Indian Carbon Sequestration & Trading Act" should be enacted in near future. Indian Contract Act is unable to take care of this complicated issue.

FORESTS AT A GLANCE

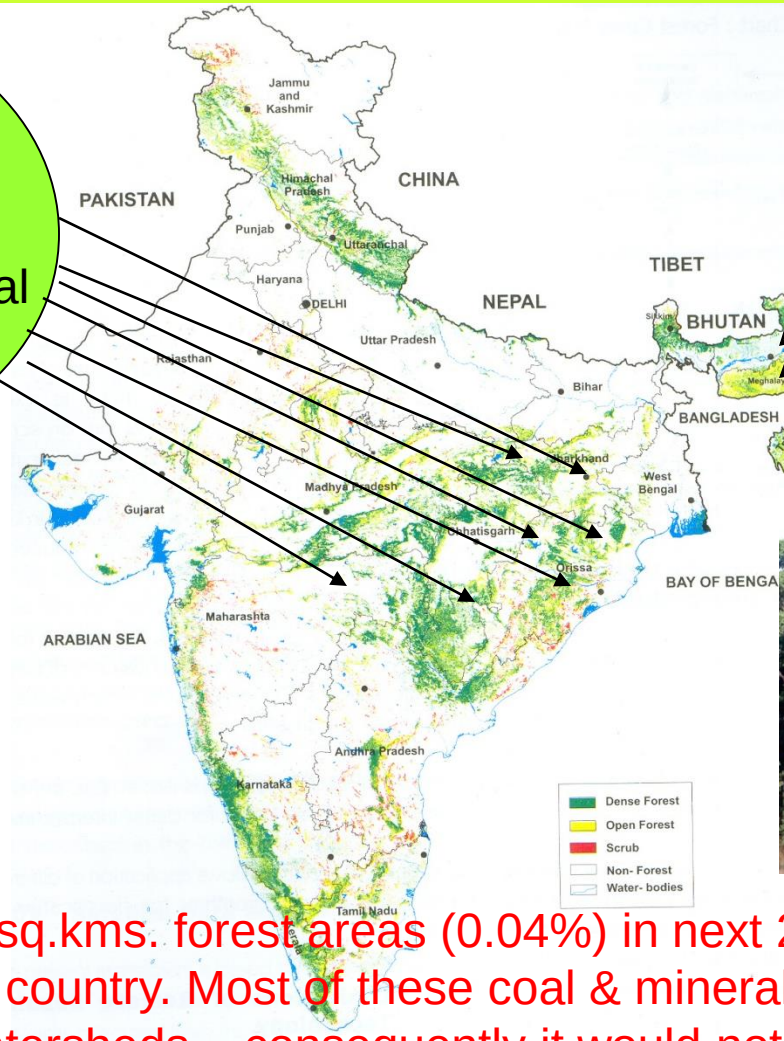
- Geographical area – 32,87,263 sq. kms.
- Forest area – 7,57,740 sq. kms.
- Forest cover – 6,78,333 sq. kms. – the eco-resource for livlihood.
- Legal status of forest area –
    - A. Reserve Forests (RF) – 3,99,919 sq. kms.
    - B. Protected Forests (PF) – 2,38,434 sq. kms.
    - C. Un-classed forests – 1,36,387
- Un-culturable non-forest areas – 2,11,286 sq. kms.
- Growing Stock – 4740.858 million cubic meter
- Growing Stock / ha. – 74.42 cubic meter
- Current Annual Increment – 8.76 million cubic meter
- Current C.A.I. - 0.69 cubic meter / ha.
- Potential CAI possible - 3.60 cubic meter / ha. (Peterson's formula)
- Simpson's Biodiversity Index, Berger-Parker Species Richness Index, Shannon Weiner Biodiversity Index not provide promising picture.
- Forest cover stagnant with cyclical change, qualitative deterioration of ecological resources due to scarcity of finances.

Forest Cover of India

(S.F.R., 2019 of Forest Survey of India)

Mineral rich areas of coal and coal bed methane (CBM). Also inhabit large tribal Population - FRA

Schedule-VI Areas

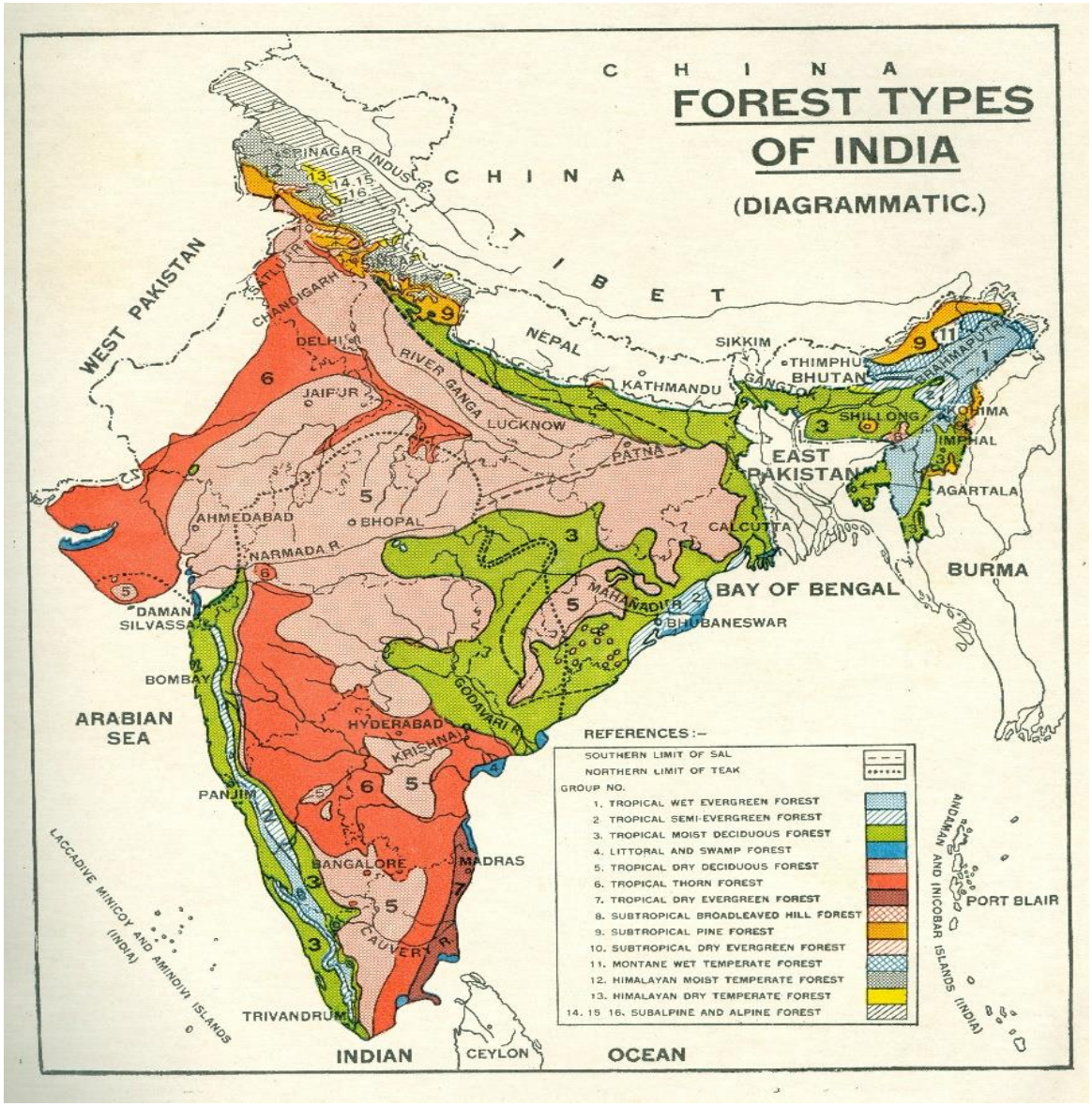


Diversion of about 300 sq.kms. forest areas (0.04%) in next 20 years can solve the energy problems of the country. Most of these coal & mineral blocks are situated in different micro & milli-watersheds – consequently it would not cause great ecological problems. Coal Blocks are site specific projects and should get priority.

Importing 274 MT Coal with foreign exchange of Rs. 1,12,500/- Crores and petroleum crude with Rs. 12,00,000/- Crores

Forest Types of India

(Champion & Seth, 1968)



SILVICULTURE – THE SCIENCE OF FOREST MANAGEMENT

- The type of forests are functions of edaphic factor, rainfall pattern, water resources, temperature, latitude and longitude, exposure, aspect, altitude, biotic factors etc.
- Silviculture is the “science of forest management” – Forest are managed on the basis of “Silviculture Management Systems”.
- Forest Working Plans are prepared after thorogh study of area for 3 years. These Working Plans are sanctioned by the State Government and GOI under the Section-2(iv), Forest Conservation Act, 1980.
- Average Growing Stock of the World – 110 cmt/ha., while Indis’s average is 65 cmt/ha.

Classification of “forests” on the basis of temperature

On this primary basis of temperature, India may be divided up as follows :

Zone	Mean annual temperature	Mean January temperature	Winter
I. Tropical	Over 24°C	Over 18° C	None; no frost.
II. Subtropical	17° to 24°C	10° to 18°C	Definite but not severe; frost rare.
III. Temperate . . .	7° to 17°C	-1o to 10°C	Pronounced, with frost and some snow.
IV. Alpine	Under 7°C	Under -1°C	Severe, with much snow.

BROAD CLASSIFICATION OF INDIAN FORESTS

1. Wet evergreen forests	.	.	.	.	.	.	**Dense tall forest, entirely evergreen or nearly so.**
2. Semi-evergreen forests	.	.	.	.	.	.	Dominants include deciduous species but evergreens predominate.
3. Moist deciduous forests	.	.	.	.	.	.	Dominants mainly deciduous but sub-dominants and lower storeys largely evergreen. Top canopy rarely dense and even, but over 25 m. high.
4. Littoral and swamp forests	.	.	.	.	.	.	Mainly evergreen, of varying density and height, but always associated predominantly with wetness.
5. Dry deciduous forests	.	.	.	.	.	.	Entirely deciduous or nearly so. Top canopy rather light and rarely over 25 m. high, usually 8-20 m.
6. Thron forests	.	.	.	.	.	.	Deciduous with low thorny trees and xerophytes predominating. Canopy more or less broken. Height under 10 m.
7. Dry evergreen forests	.	.	.	.	.	.	Hard leaved evergreen trees predominant with some deciduous emergent, often dense, but usually under 20 m. high.

TROPICAL FORESTS

SPECIAL FUNCTIONAL FORESTS

A.	Littoral forests	.	.	.	.	.	.	.	On coastal sand, usually seral to 1 to 2 and somewhat resembling 2.
B.	Tidal swamp forests		.	.	.	.	.	.	On estuarine mud, seral to any of the other types.
C.	Freshwater swamp forests			.	.	.	.	.	On wet alluvium, seral to 1-3 or 5 and resembling 2.
D.	Seasonal swamp forests		.	.	.	.	.	.	On alluvium in which the seasonal submersion is the dominant influence although the soil may become relatively dry for part of the year.
E.	Riverain fringing forests			.	.	.	.	.	Along stream sides where subsoil water is available throughout the year.

ANALYSIS &PARAMETERS OF DIVERSION OF FORESTS

- But when we analyse our forests in terms of productivity, growing stock, site quality, bio-diversity indexing, almost absence of trees above selection girth, rapid depletion of mesophytic species and increase of xerophytes, crown density, regeneration, MAI, CAI, susceptibility to biotic factors the scenerio becomes grim and our future is bleak.
- Xerophytic, deciduous species are being planted in evergreen moist areas e.g. Eucalyptus, Teak (*Tectona grandis*) in the habitat of Sal (*Shorea robusta*). Since the xerophytic species has got wide range of tolerance, the survival and growth is more in such evergreen regions, but the consequence is deterioration of site and mostly it is irreversible due to depletion of moisture regimes.
- We have got one more anamoly in presentation of forest data - the forest area does not provide details about plantations and the area subjected to one or more felling cycles. Mostly these areas lack bio-diversity & regeneration and separate information about these types should be provided in data of forest area to facilitate correct assessment of forest cover.

- Amphibians are having narrow range of tolerance, the population of species like *Hyla hyla, Rana tigrina, Bufo melanofrictis* has declined substantially. The useful insects like *Apis mellifera, Apis dorsata, Listeria dudgeni, Papilio elephenor, Baltia butleri sikkima, Lethe guluihal guluihal* are disappearing at fast rate. The xerophytic species like *Calotropis procera, Argemone maxicana, Prosopis juliflora* are appearing in area which are not their natural habitats. It is evident that mesophytes are giving way to xerophytes; the nature is sending warning signals in shape of ecological indicators but we are not ready to open our eyes and perceive the disaster looming on us.

Sal Forests, Kanha National Park

BER (*ZIZYPHUS NUMULARIA*) FORESTS

PENCH NATIONAL PARK

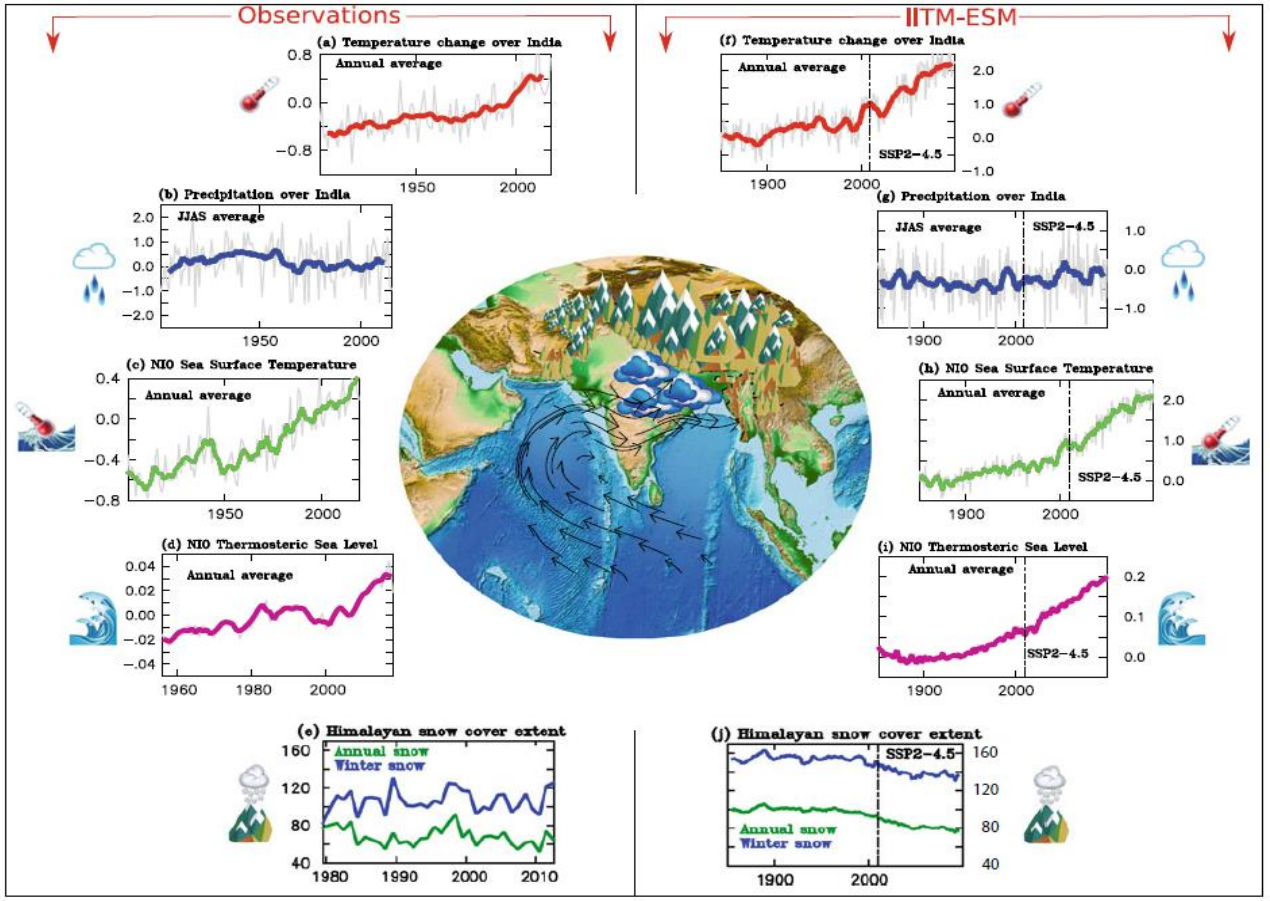
Fir & Spruce Forests During Winter

CLIESTANTHUS FORESTS,
SATPUDA NATIONAL PARK, HOSHANGABAD

Deodar Forests, Himachal Pradesh

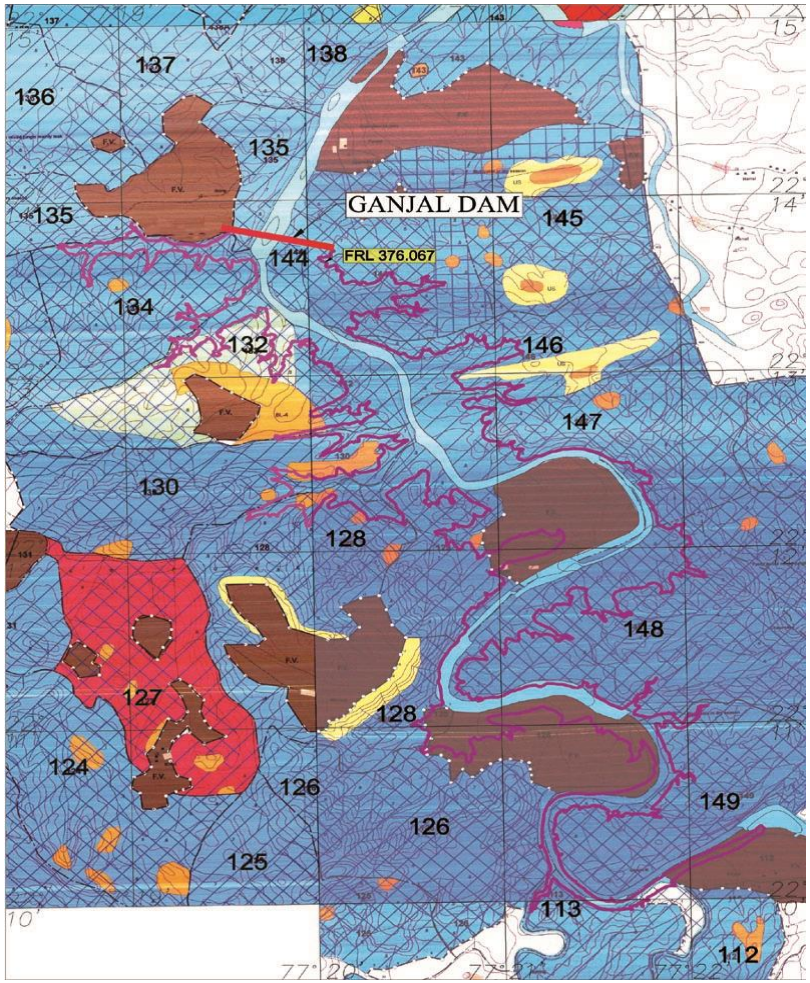
Dipterocarpus Forests with Mangroves, Andaman Archipelago

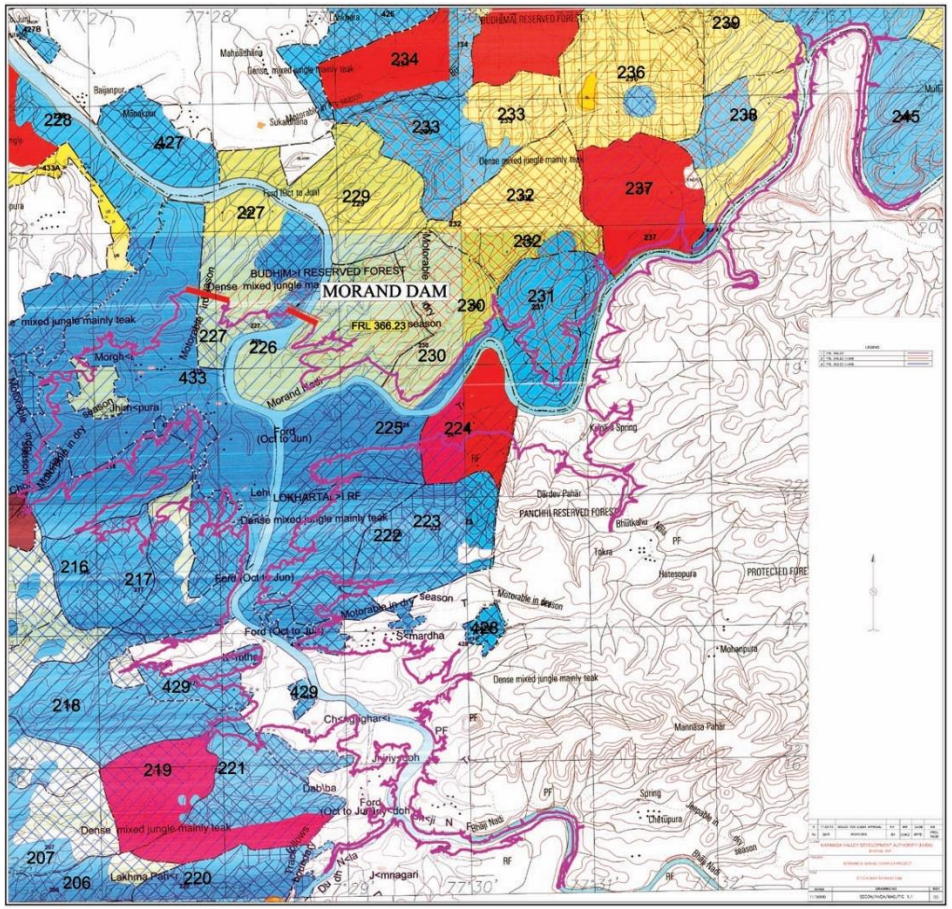
EFFECT ON SEA CURRENTS ON AQUATIC LIFE AND MANGROVE FORESTS



There will be immense problems and extinction for Whales, Dolphins, Dugongs, Mantees, Turtles and other marine species

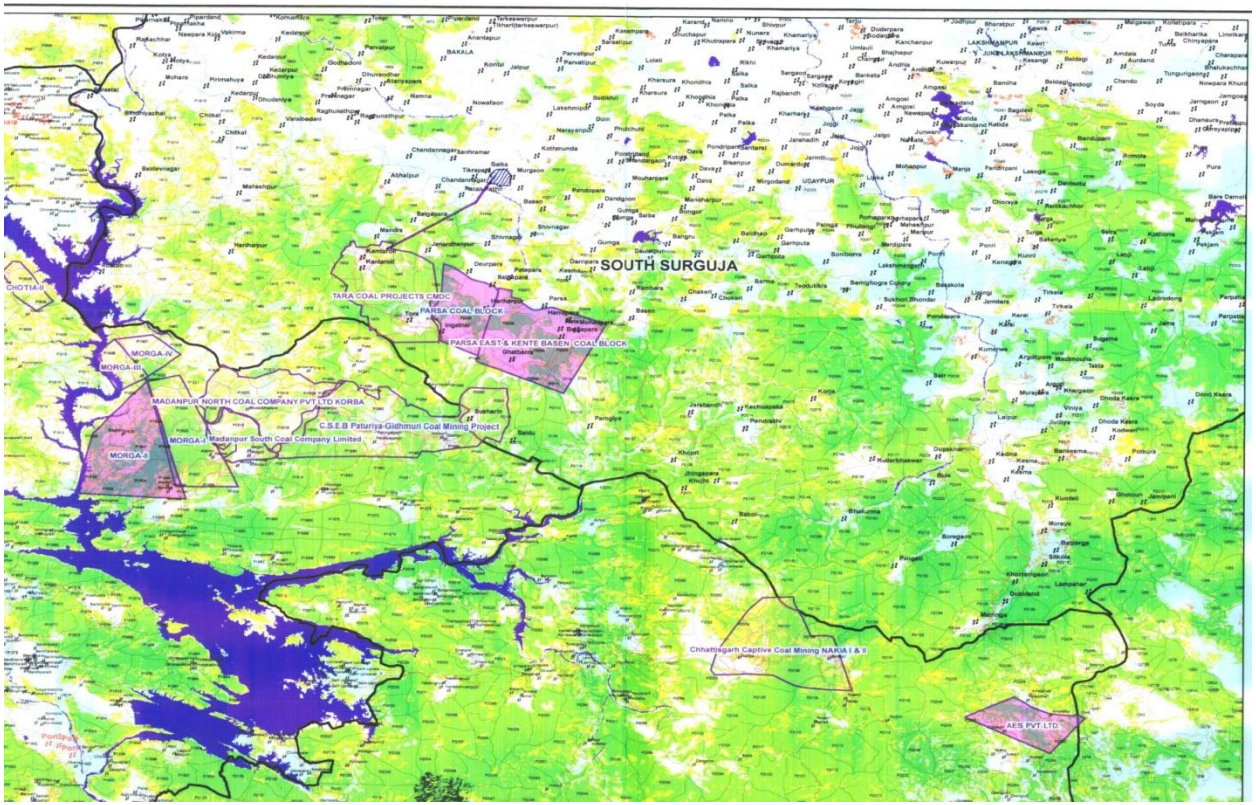
Maps and satellite imageries



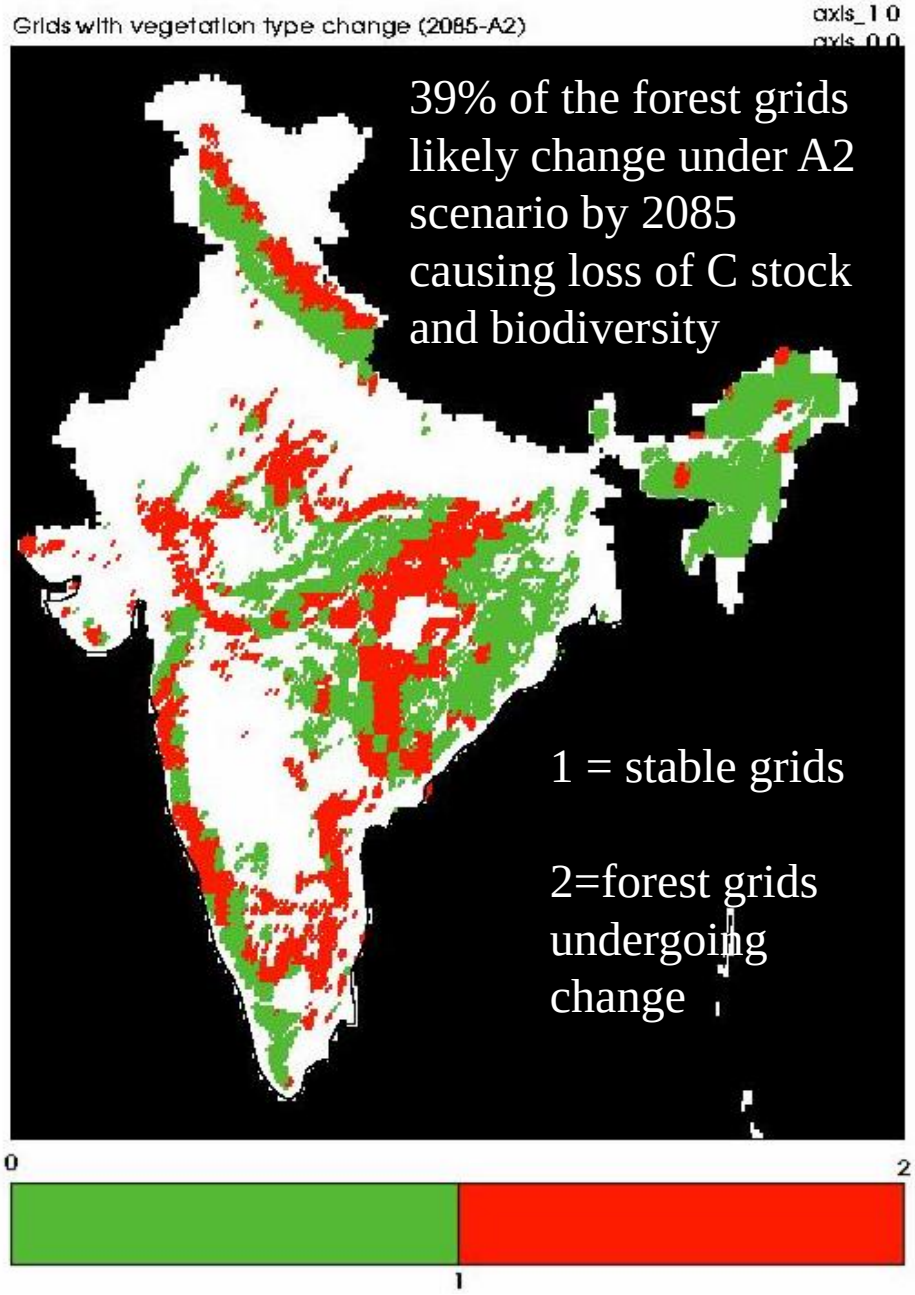


Forest maps are vital for silviculture crop assessment and determination of Net Present Value (vital document)

Forest Satellite Imagery – only land-use discernible, legal status cannot be ascertained



"Gap Light Analyser" is available for Crown Density Determination. The forest crop should be analysed for crown density, site quality, regeneration, Yield Table parameters, Basal Area calculation based on Wedge Prism.



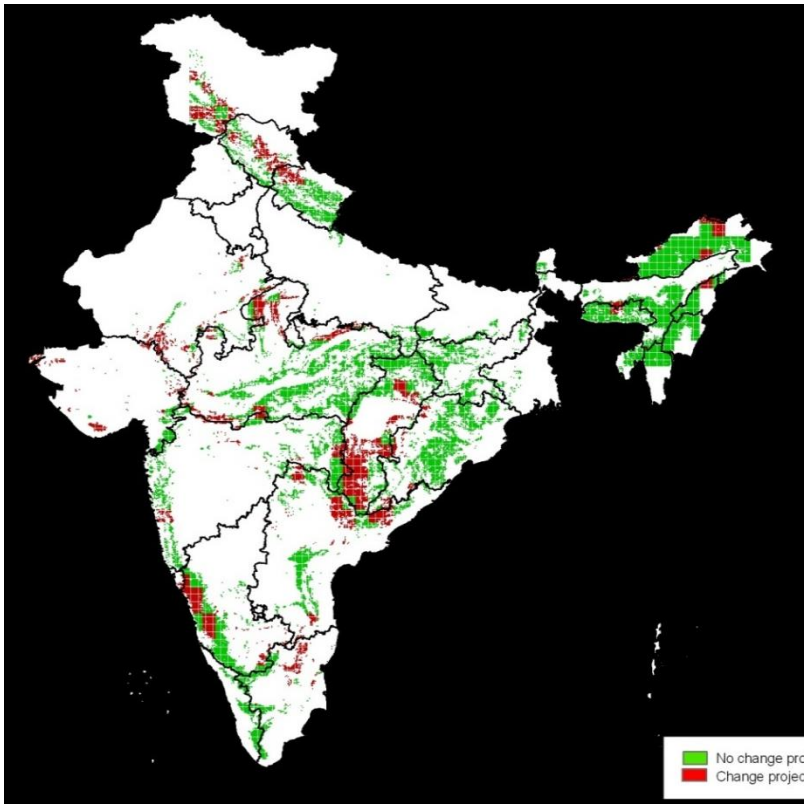
Source: Chaturvedi et al., 2011

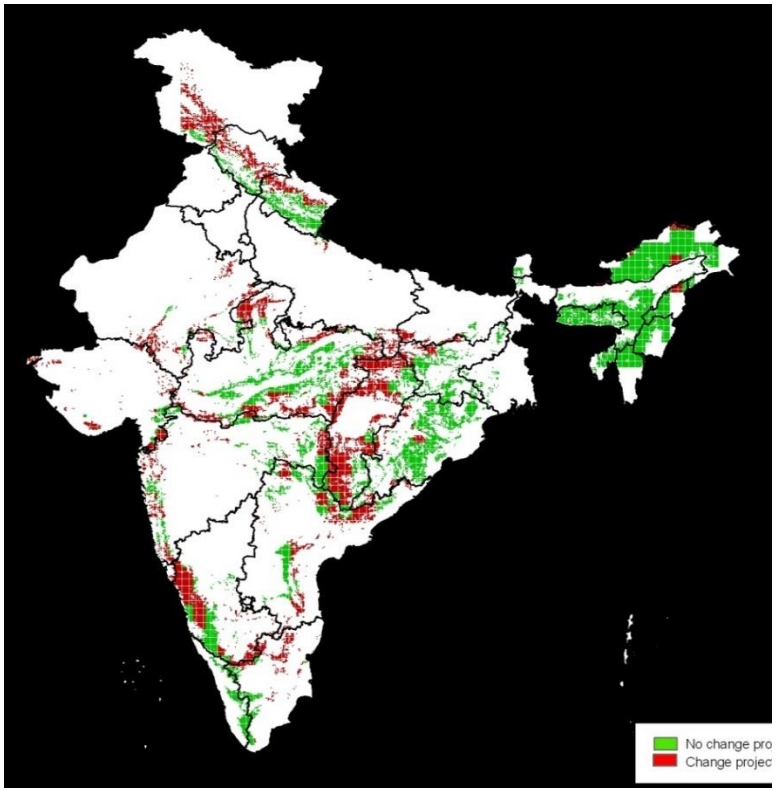
PROJECTED IMPACT OF CLIMATE CHANGE ON FORESTED GRIDS IN INDIA A2 SCENARIO

(based on the experiments carried-out by Indian Institute of Science, Bengaluru)

Climate Change and Forests

Vegetational changes projected by 2021-2050 and 2071-2100



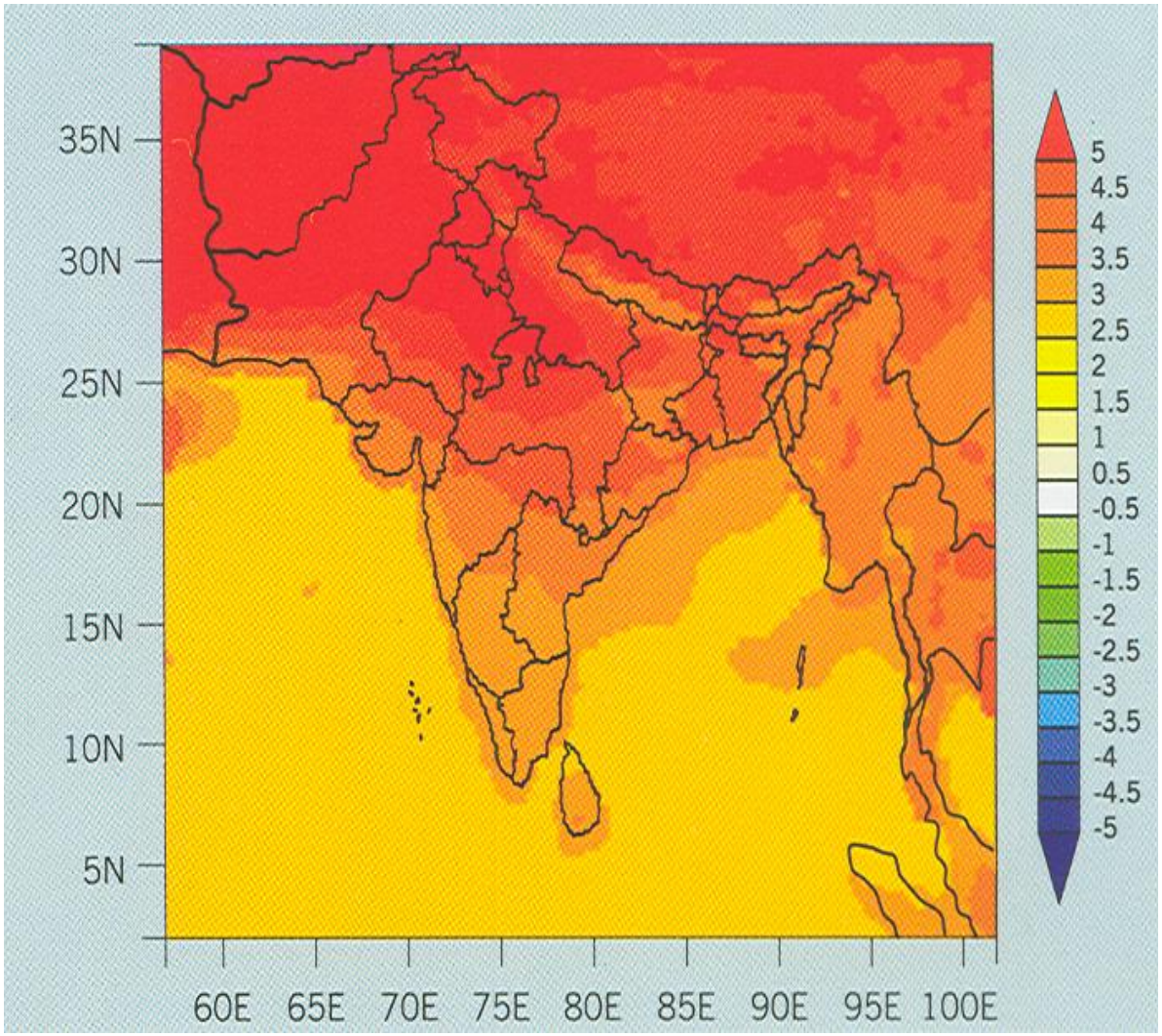


Red indicates that a change in vegetation is projected at that grid in the time-period of 2021-2050 and 2071-2100 (under A1B scenario). Green indicates that no change in vegetation is projected by that period.

Based on computer simulation models of National Remote Sensing Agency & ICFRE

Spatial patterns of the changes in annual mean surface air temperature

[2071-2100 (baseline 1961-1990 : A-2 scenario)



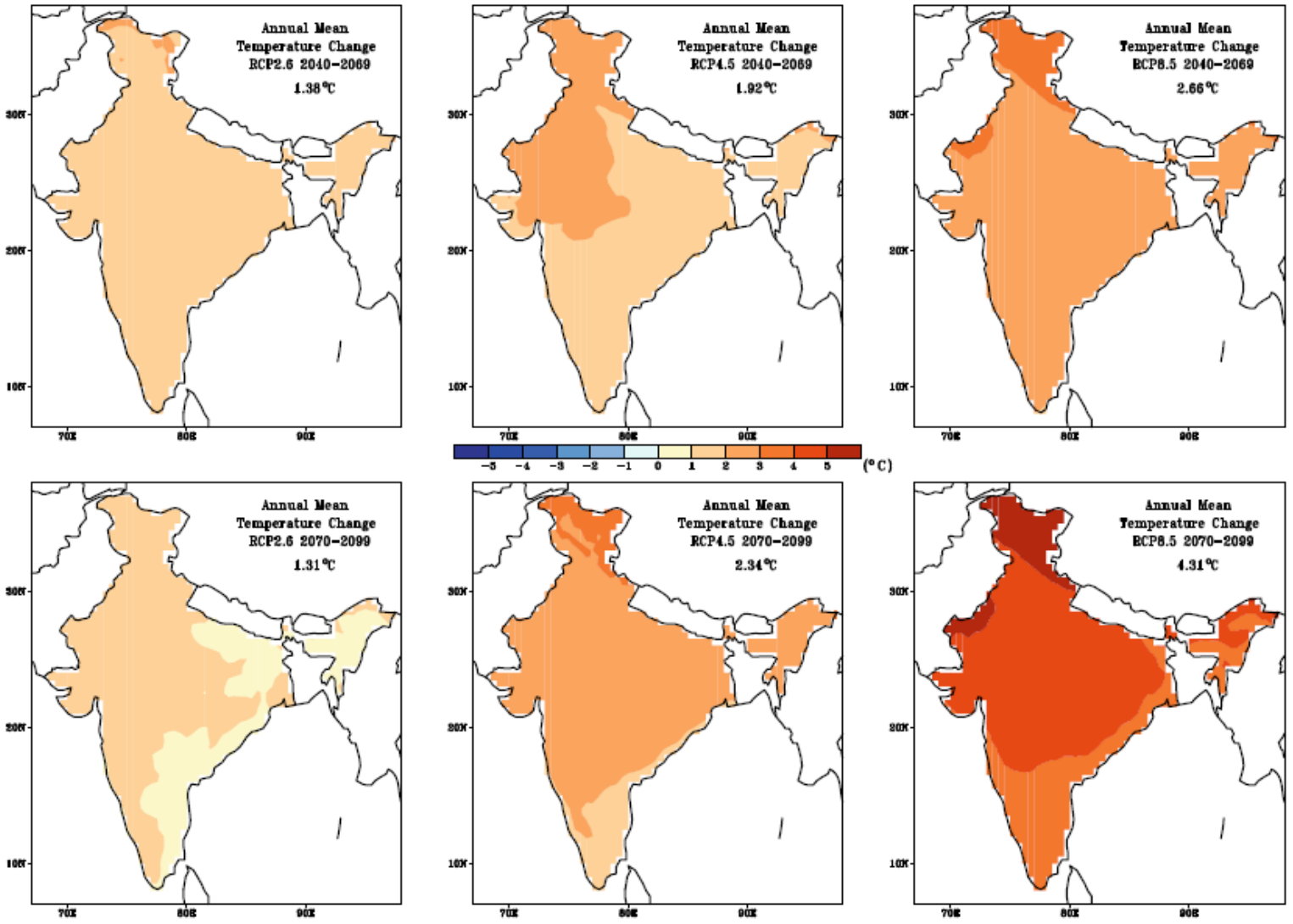
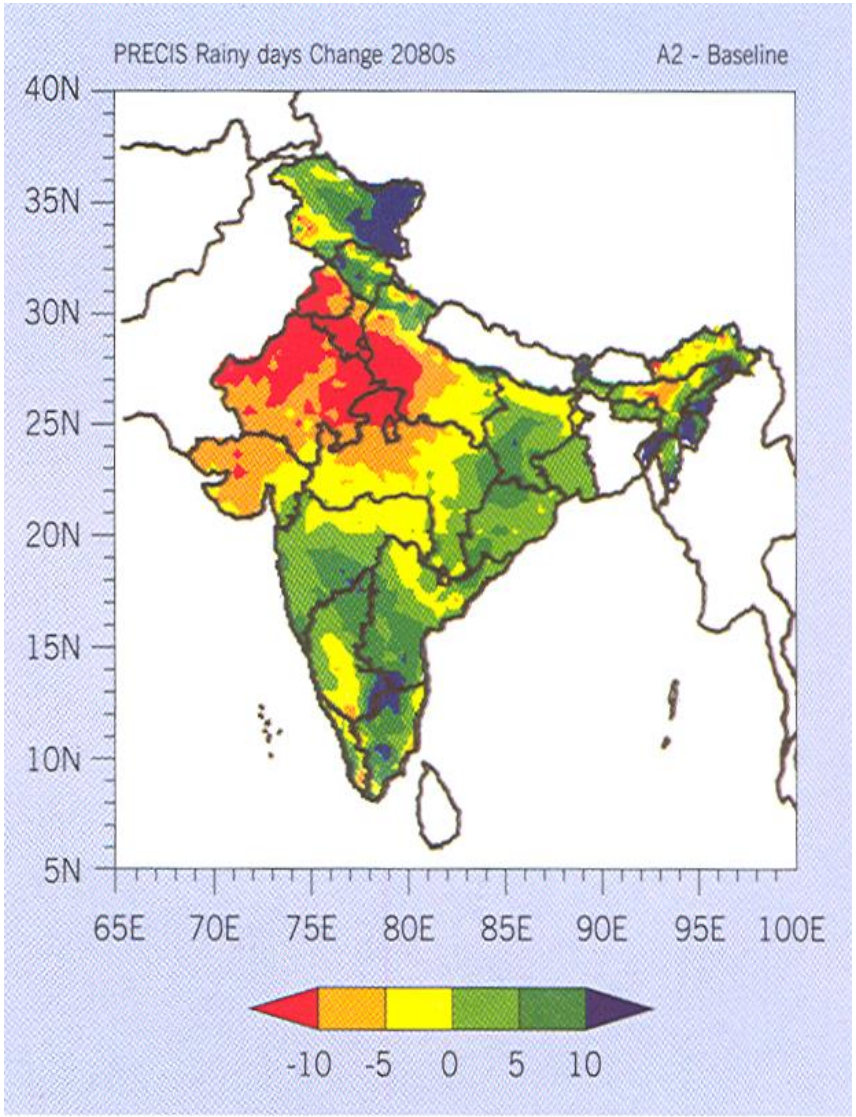


Fig. 2.7 CORDEX South Asia multi-RCM ensemble mean projections of annual average surface air temperature changes (in °C) over India for the mid-term (2040–2069) and long-term (2070–2099) climate relative to 1976–2005 under RCP2.6, RCP4.5 and RCP8.5 emission scenarios. The estimates of all India averaged ensemble mean projected changes are shown in each panel

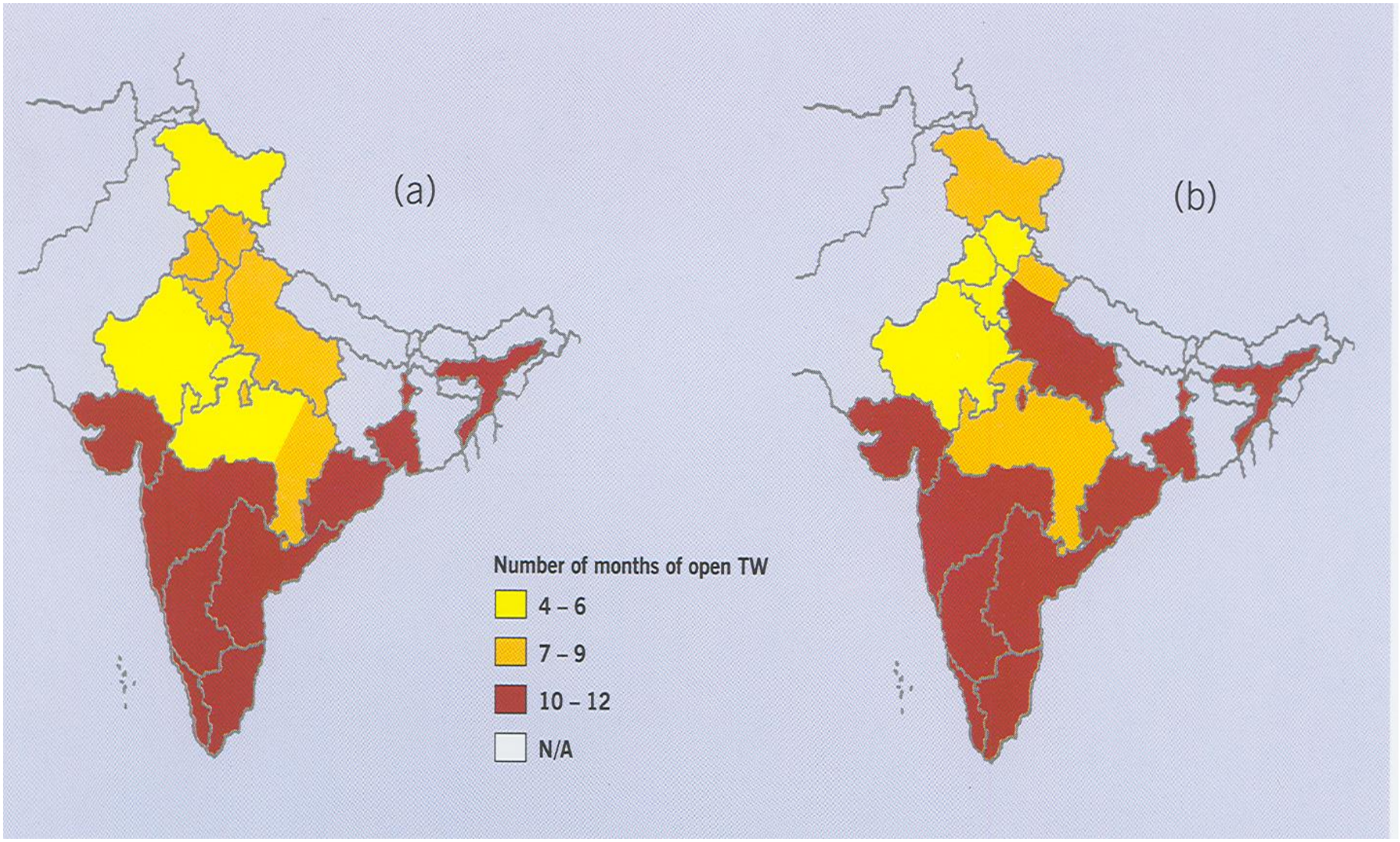
Ibex Roasted Alive in the Himalayas in Intense Forest Fire – 2018 : Uttrakhand fire lines were not maintained

Forests are drying at fast pace and there will be increased susceptibility to fires – US, Brazilian and Australian fires are testimony to this hypothsis.

CHANGES IN ANNUAL NUMBER OF RAINY DAYS
(A-2 scenario)

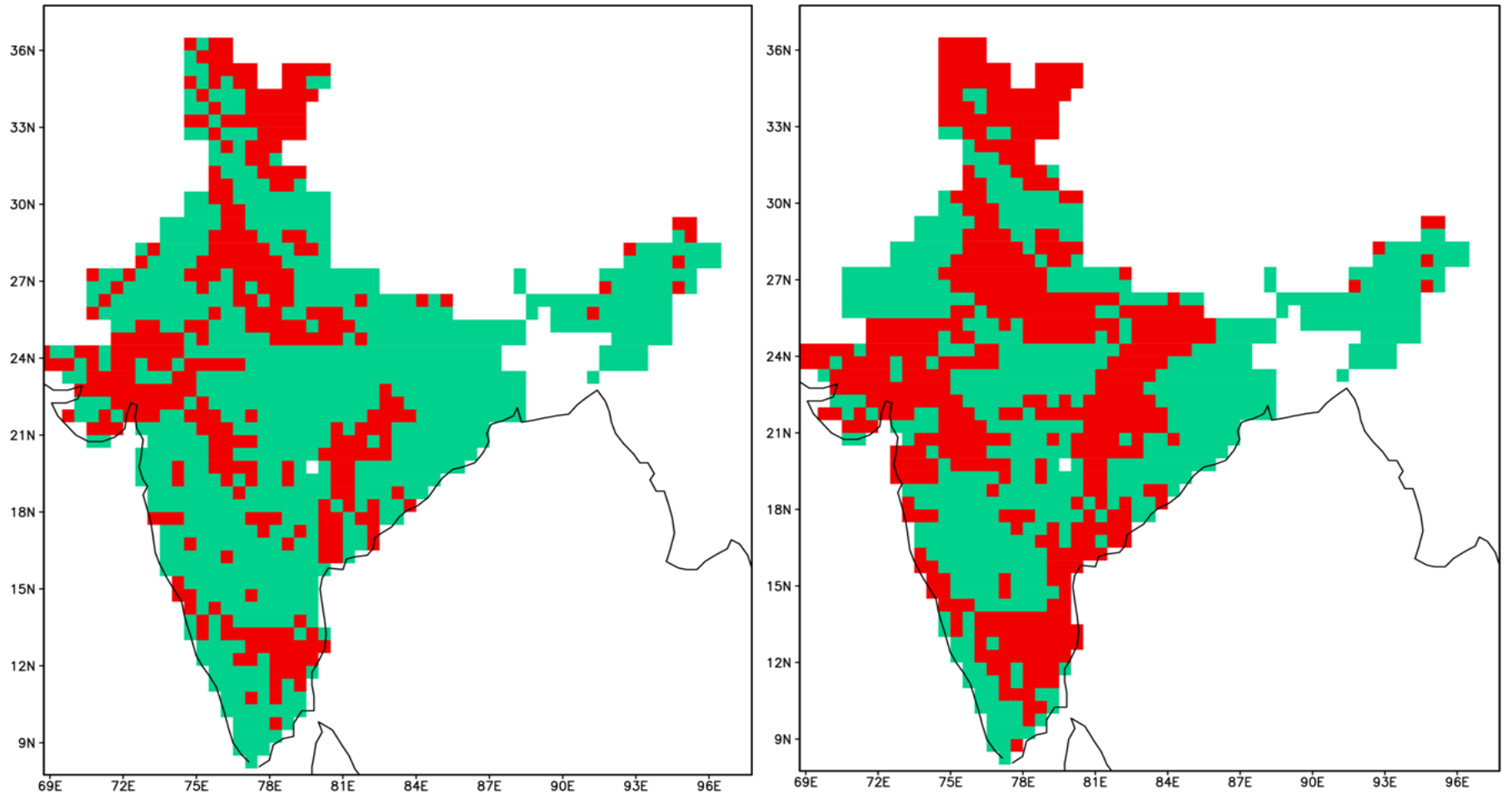


Transmission Window of Malaria in Different States of India



Climate Change and Biodiversity

Vegetational changes projected by 2021-2050 and 2071-2100

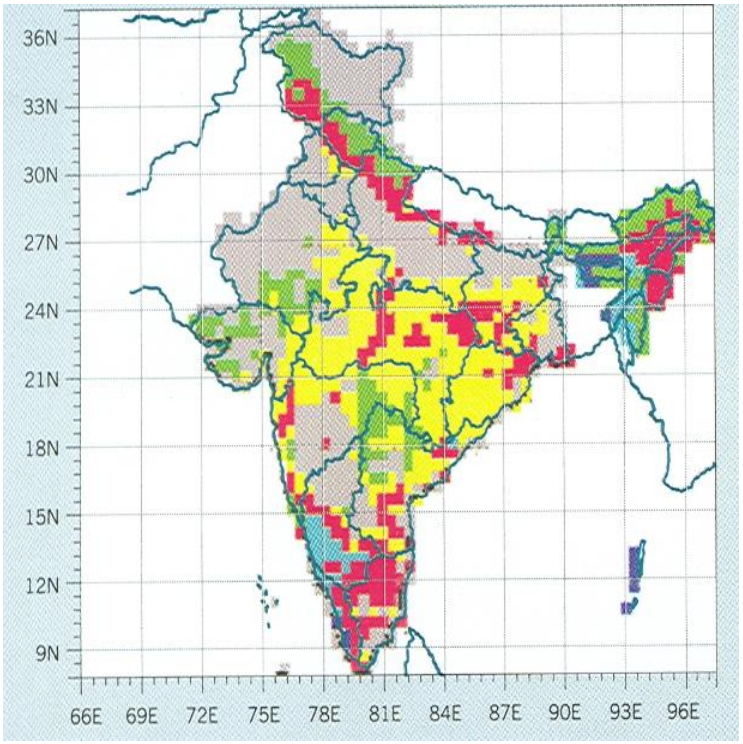


Biodiversity Vulnerable Grids of India (marked red) in the A1B scenario – for India - 2035 and 2085

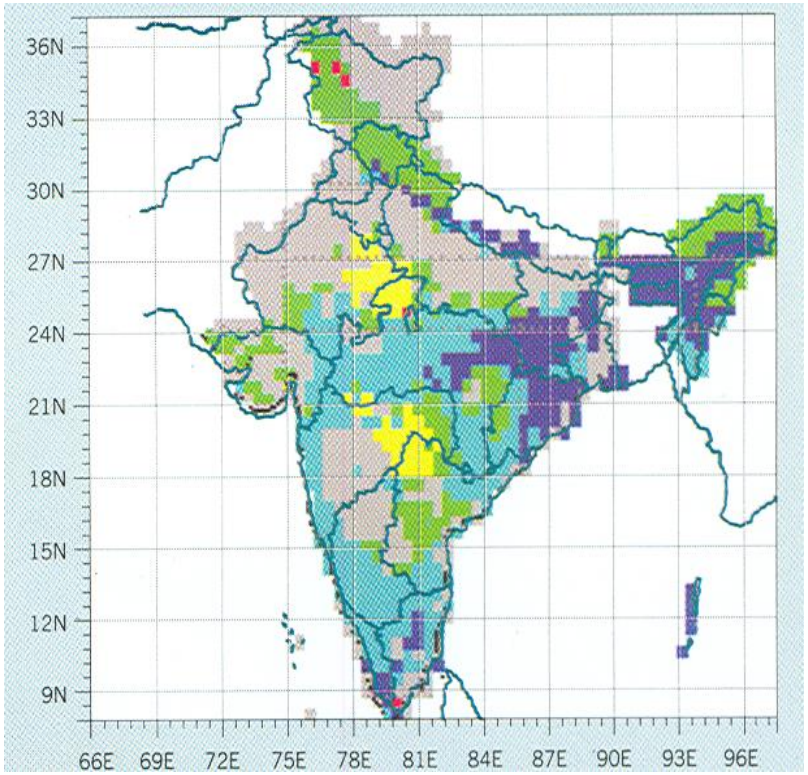
(Based on ICFRE studies)

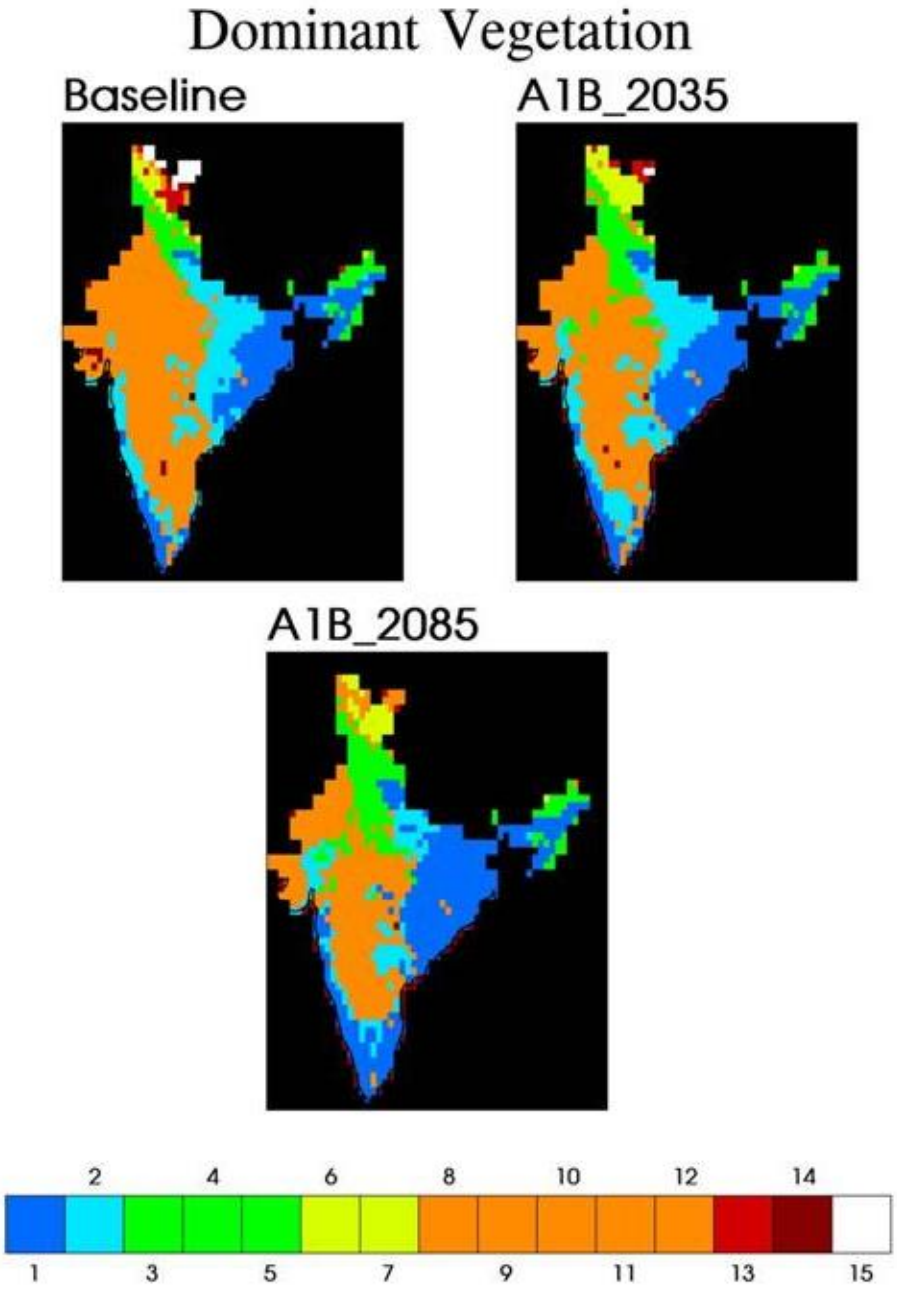
Impact of Climate Change on Moist Forest Biomes

Distribution of Forest Biomes in 1975



Projected distribution of Forest Biomes in 2085

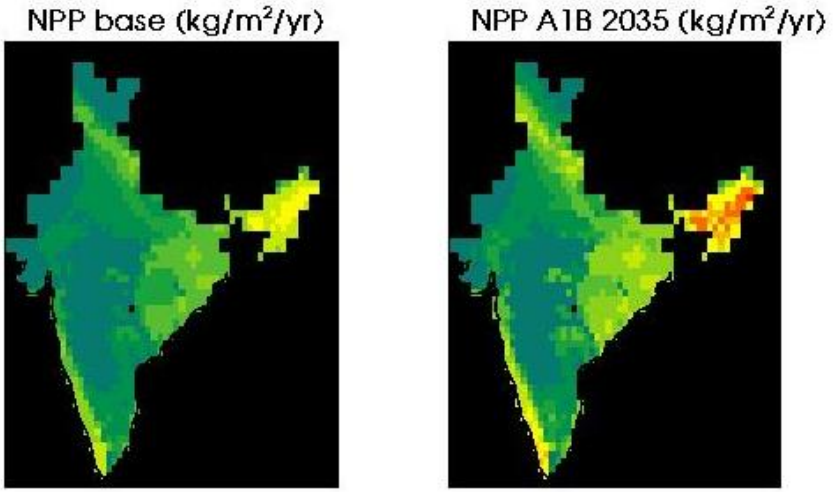




Forest type distribution and extent simulated by IBIS for the baseline case and A1B (2035 and 2085) scenarios. (VT – refers to Vegetation Types. The numbers refer to the following vegetation types

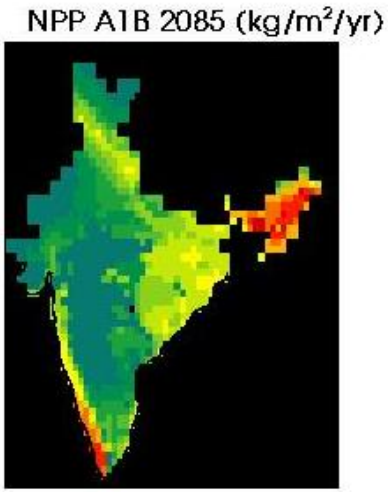
1: Tropical evergreen forest / woodland,
2: Tropical deciduous forest / woodland,
3. Temperate evergreen broadleaf forest / woodland,
4: Temperate evergreen conifer forest / woodland,
5: Temperate deciduous forest / woodland,
6: Boreal evergreen forest / woodland, 7: boreal deciduous forest / woodland, 8: mixed forest / woodland,
9: Savanna,
10: Grassland/ steppe,
11: Dense shrubland,
12: Open shrubland,
13: Tundra,
14: Desert,
15. Polar desert / rock / ice)

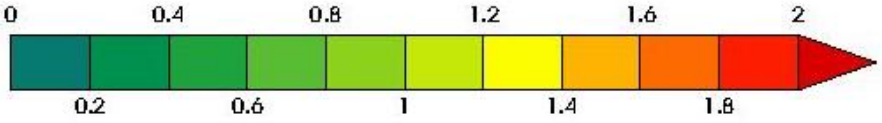
Impact of CC on Net Primary Productivity (NPP)



Current NPP – 835 g C/m3

NPP Increase in all the forest grids projected due to CO_2 fertilisation effect





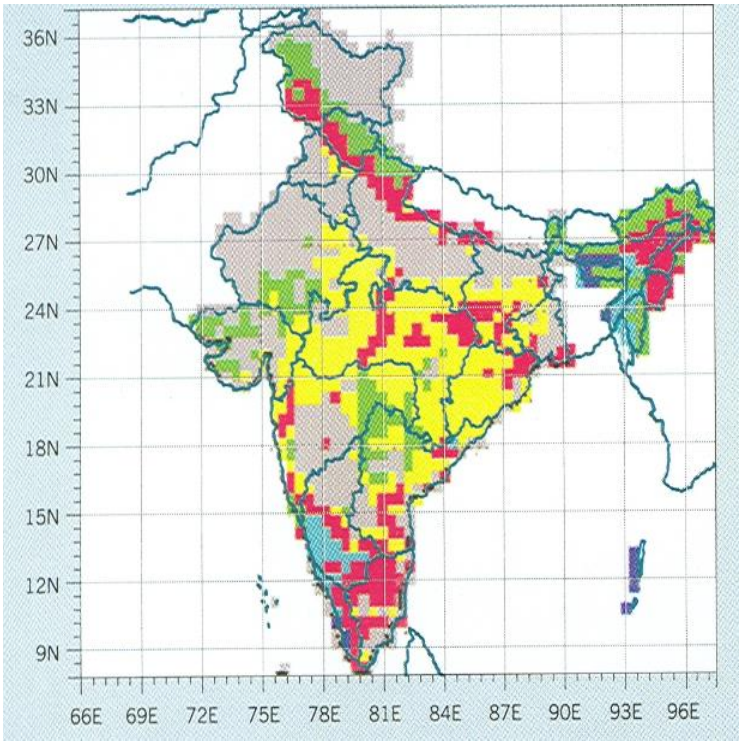
A2
GHG scenario – doubling of NPP predicted

B2
GHG scenario - 73% NPP increase predicted

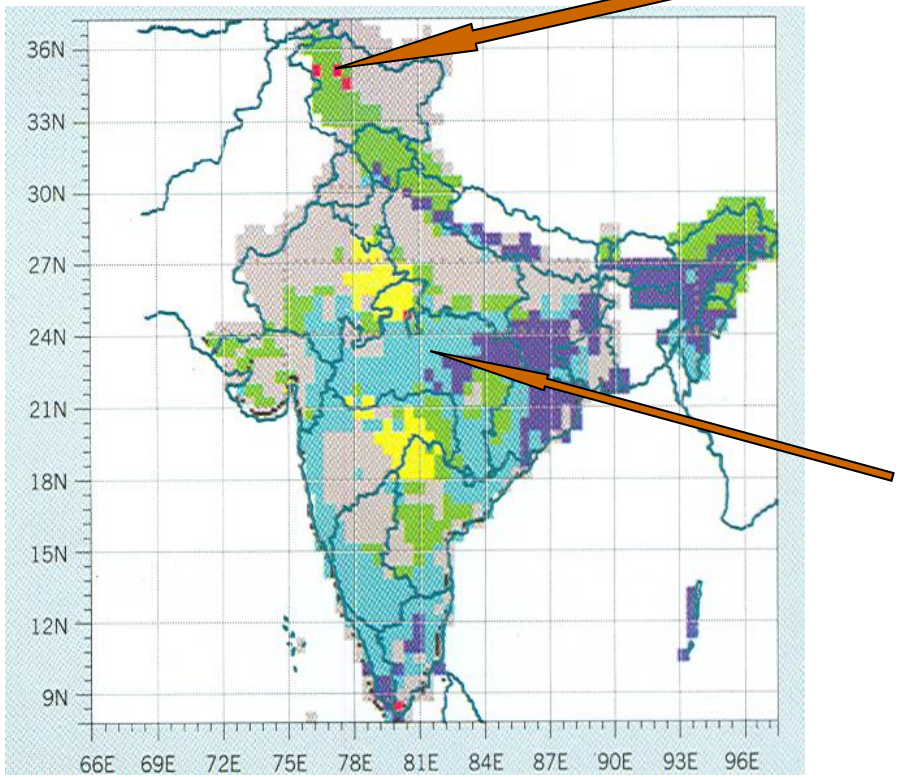
NPP distribution (kgC/m²/year) simulated by IBIS for baseline and A1B scenarios

Impact of Climate Change. on Forest Biomes

Distribution of Forest Biomes in 1975



Projected distribution of Forest Biomes in 2085



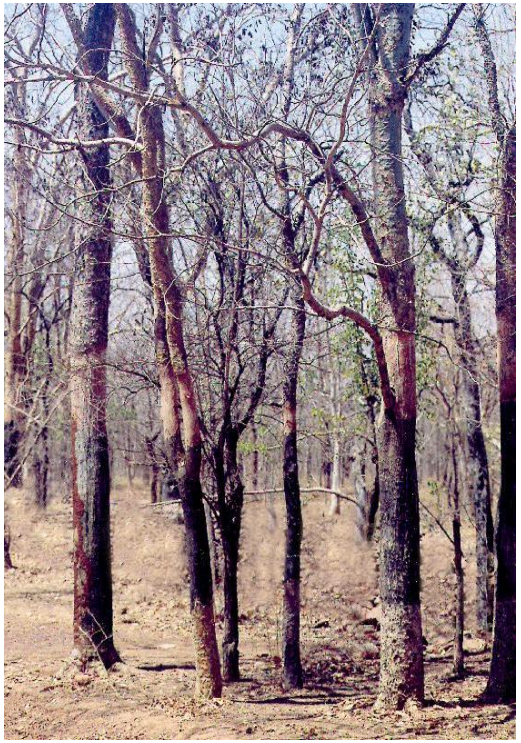
Biome Types in India

Dry Savanna

Wet Savanna

Biome Types in India (contd.)

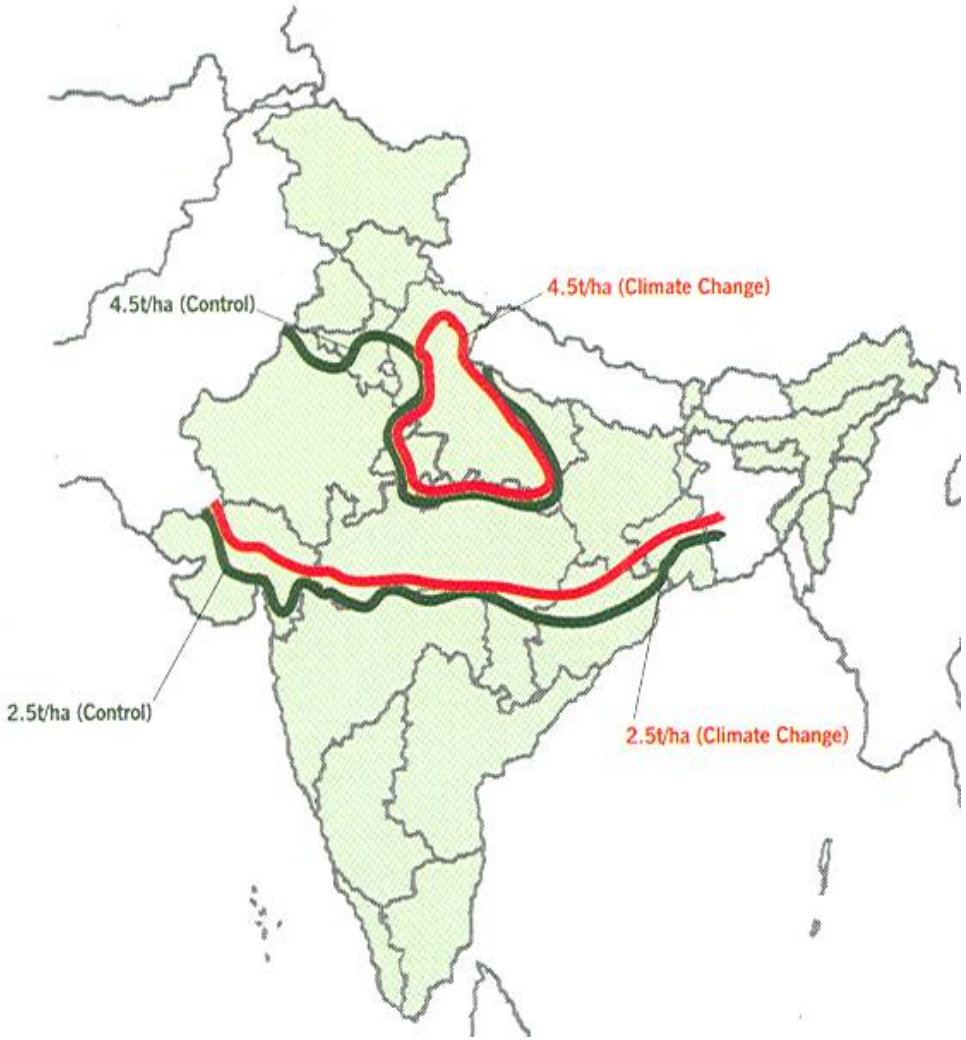
Tropical Seasonal Forests

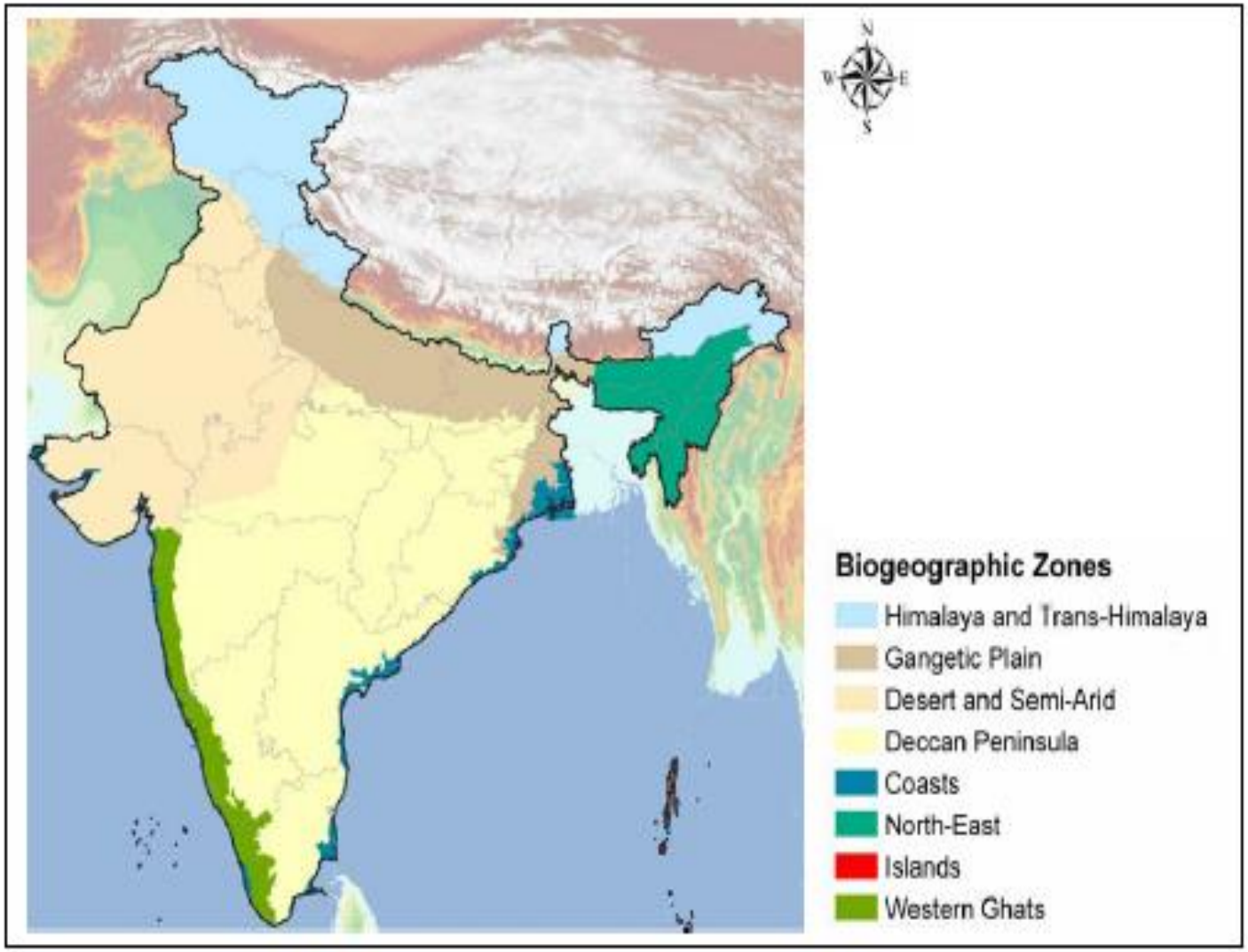


Xeric Woodlands

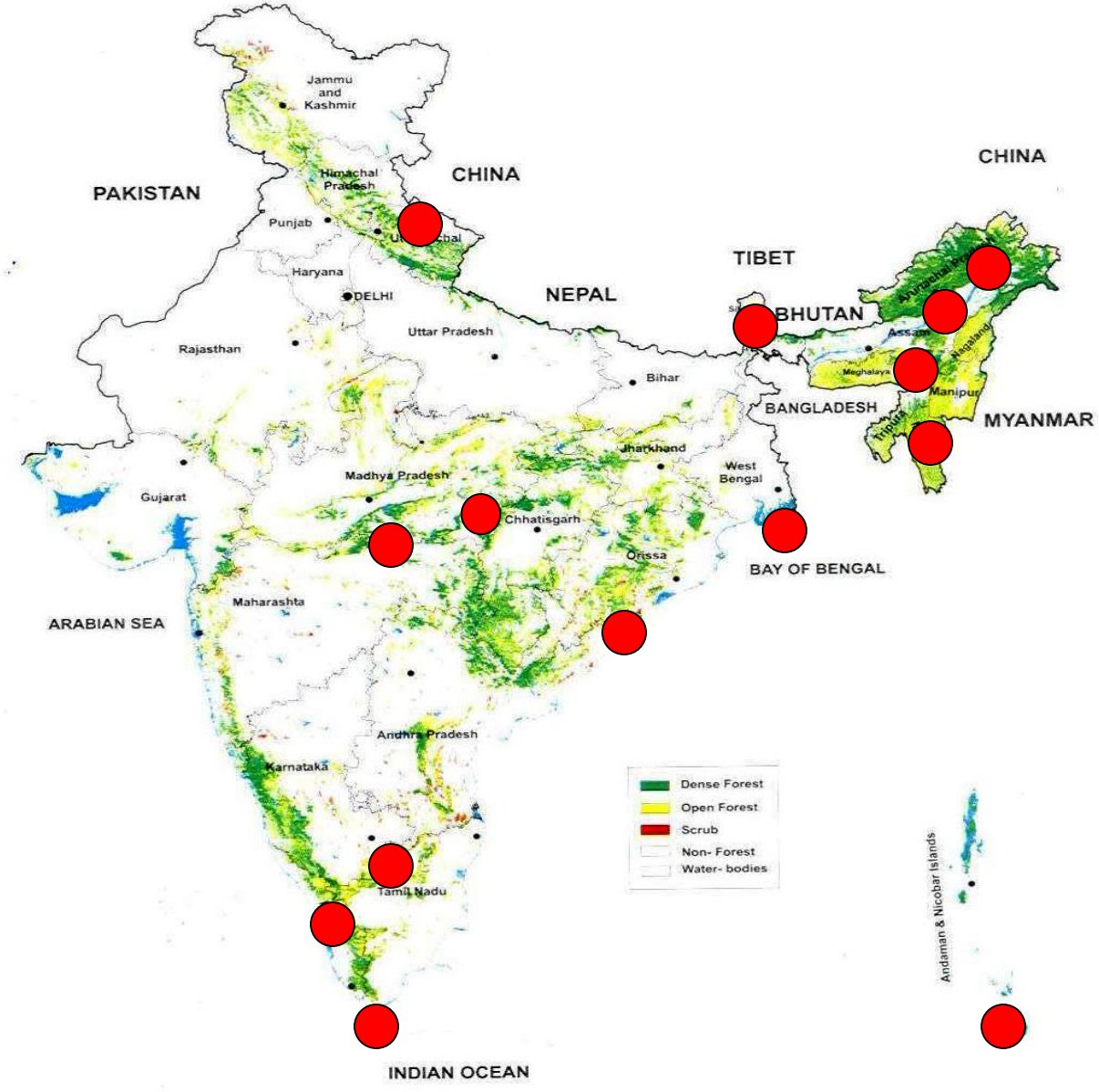
REDUCTION IN AREA FOR PRODUCTIVITY OF IRRIGATED WHEAT

Impact under 425 ppm CO_2 concentration and 2^0C temperature rise





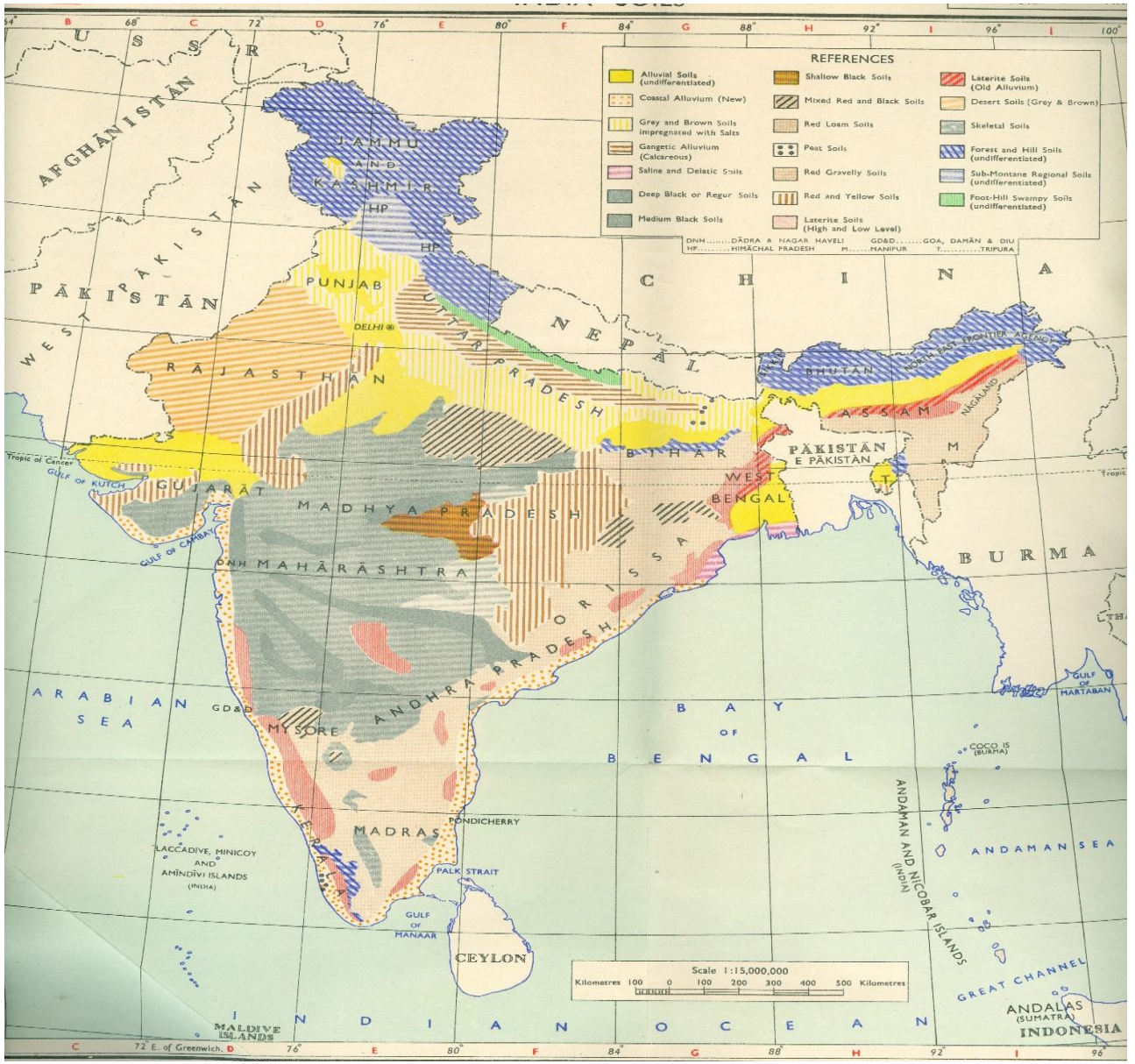
Biogeographic Zones of India



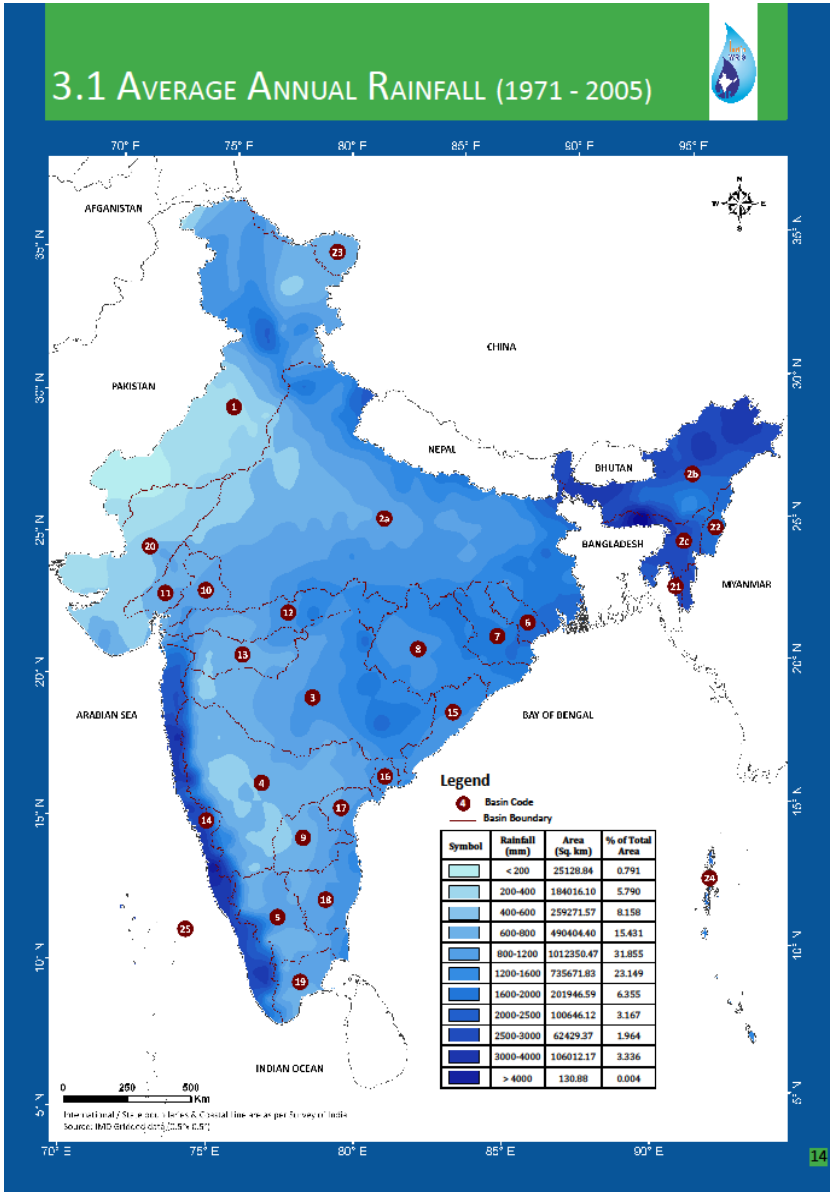
Forest Cover and Biosphere Reserves of India

(Notified under the "Man & Biosphere" program of UNO)

Soil Types of India

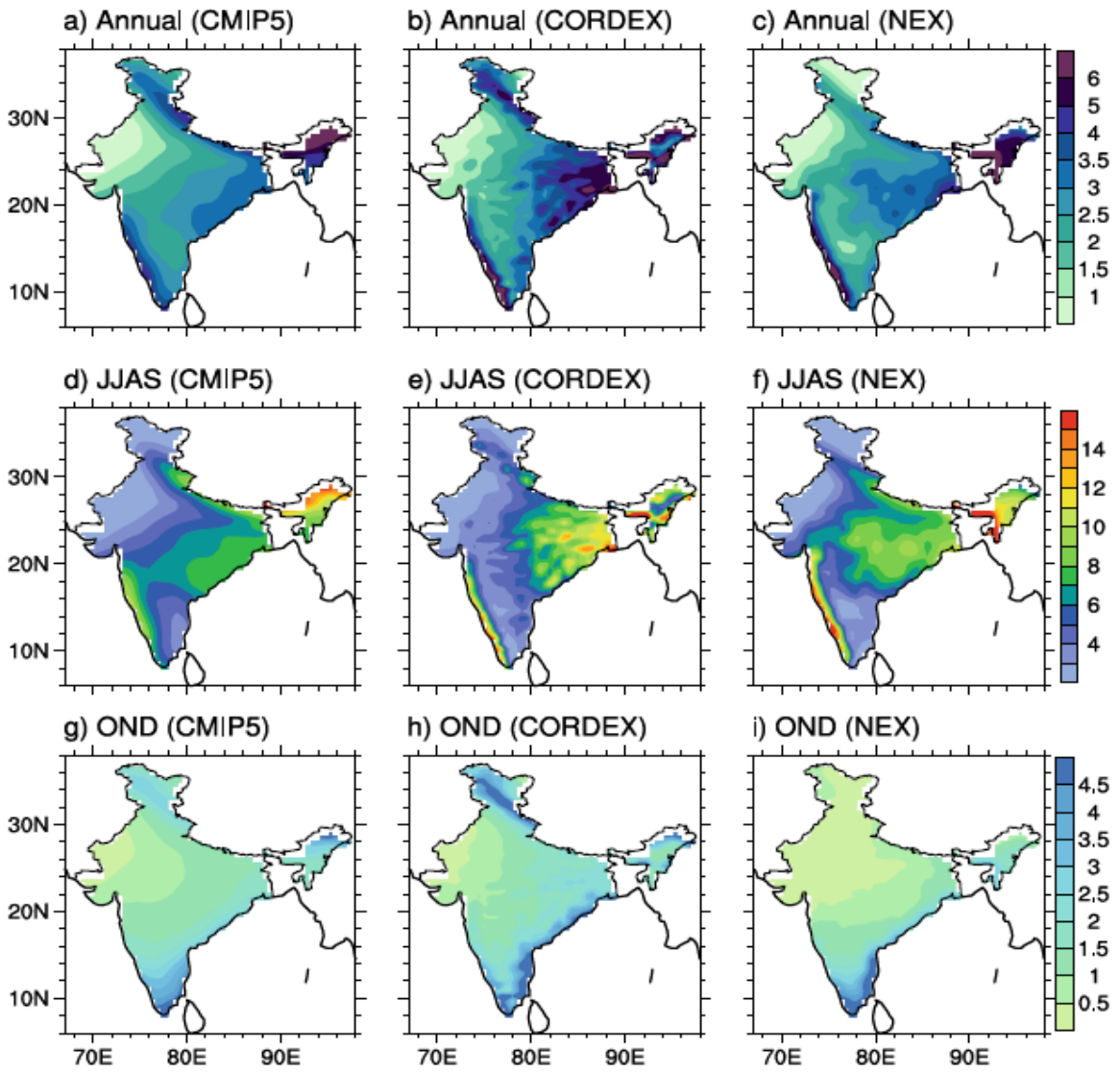


Average Annual Rainfall of India – 1971 to 2005



Mean Precipitation of India

Fig. 3.6 Mean precipitation (mm/day, 1976–2005) from multi-model ensemble simulations for annual, JJAS, and OND seasons from CMIP5, CORDEX-SA, and NEX-GDDP experiments



THUNDERSTORM SUSCEPTIBLE REGIONS OF INDIA

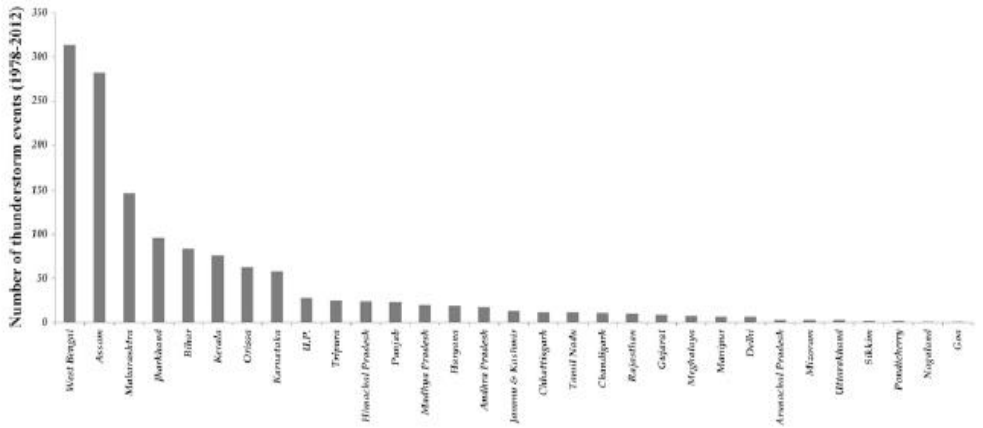


Fig. 8.5 State-wise distribution of thunderstorm events in India for the period 1978–2012. *Source* IMD, see also Bharadwaj et al. (2017)

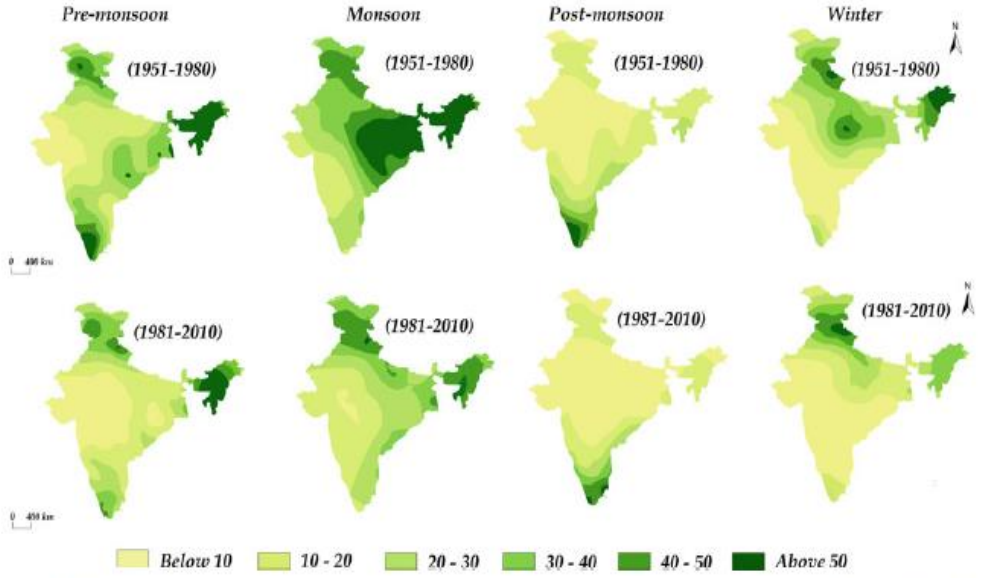
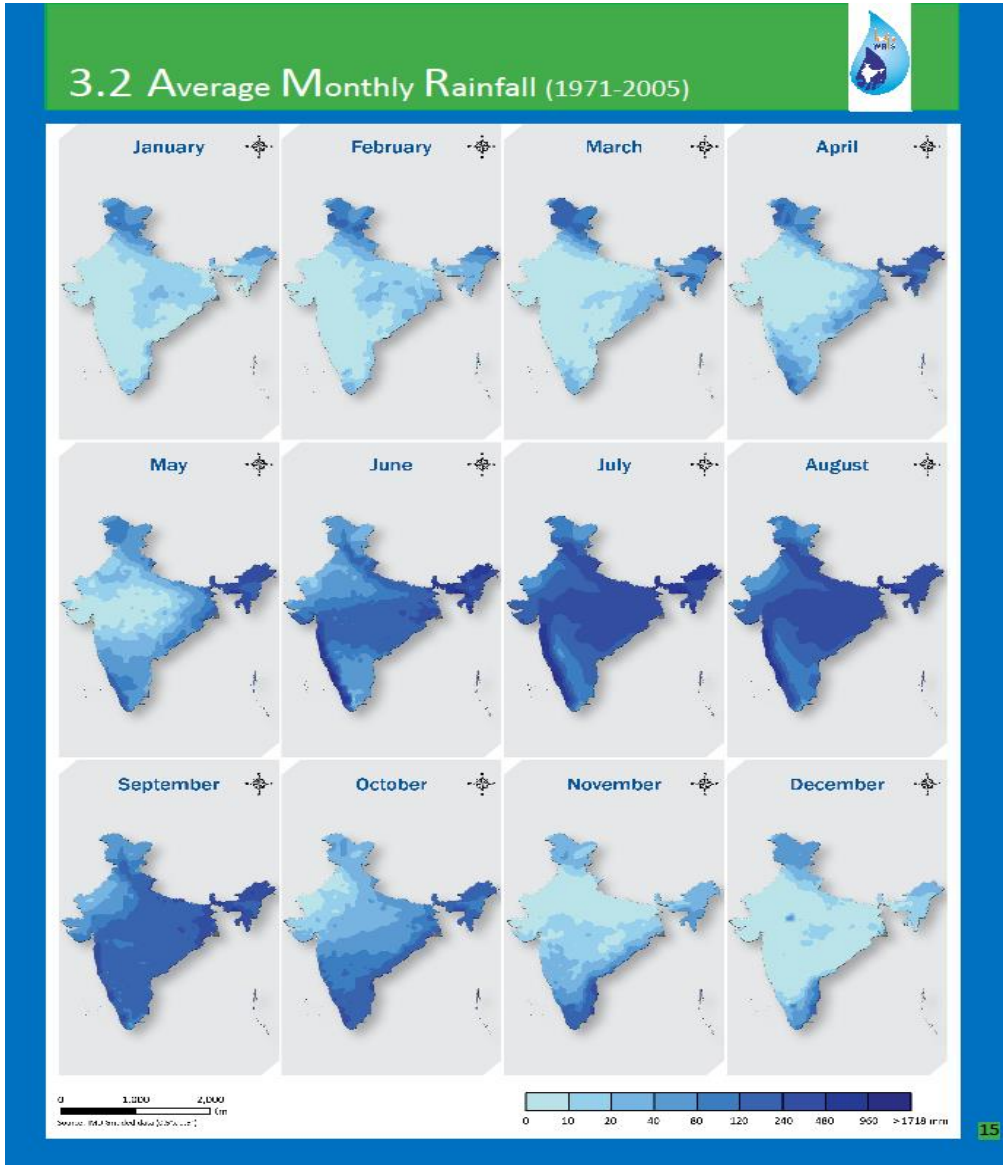


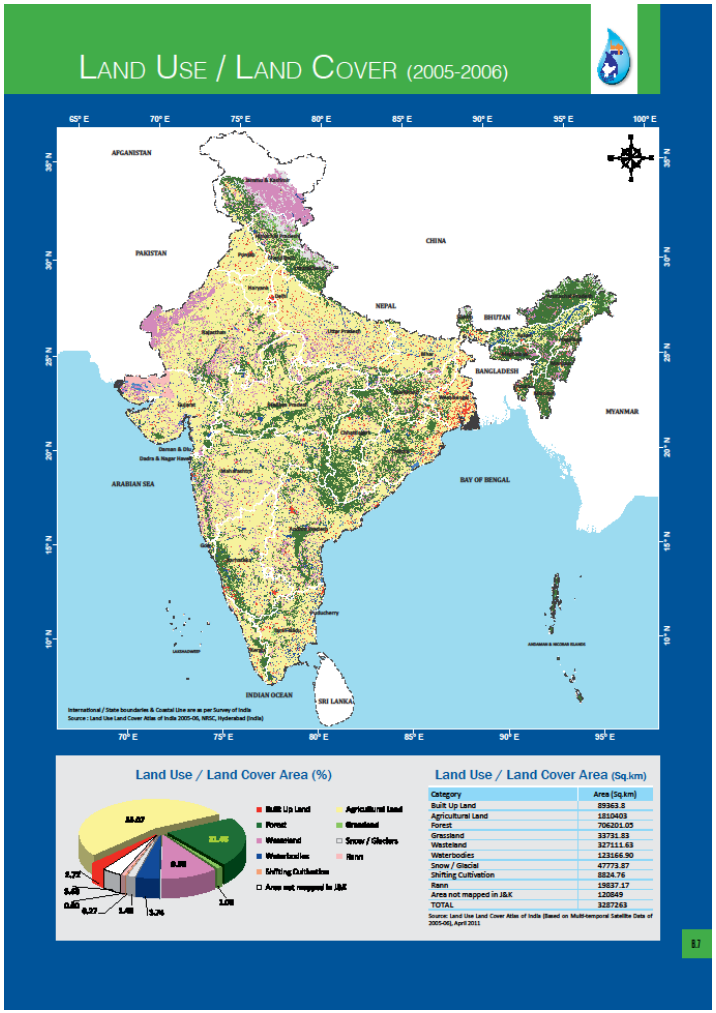
Fig. 8.6 Number of thunderstorm days in India: mean frequency during different Indian seasons for the period 1951–1980 and 1981–2010. *Source* IMD; Adopted from Bharadwaj and Singh (2018) under CC BY-NC 4

Monthly Rainfall Data of India – Shrinking of Monsoon is clearly Visible : Serious Threat to Sal Regeneration



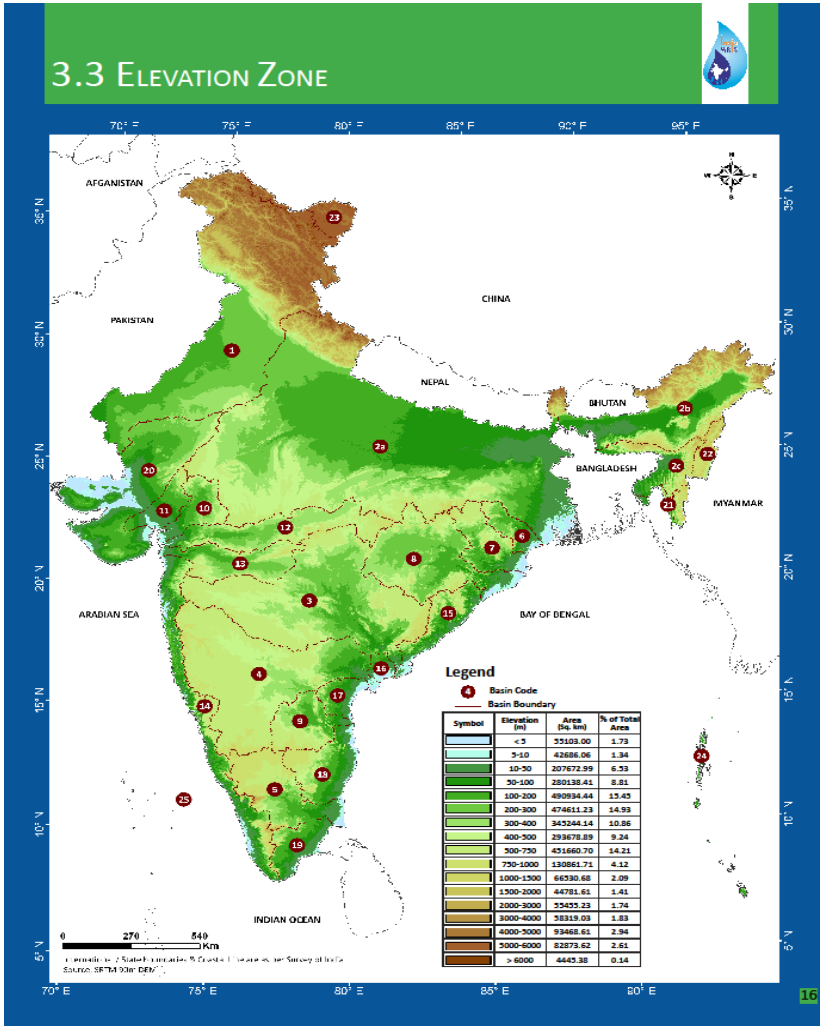
Landuse & Land Cover Map of India

Porosity and fragmentation are the root-cause of drying of forests, leading to intense fires.



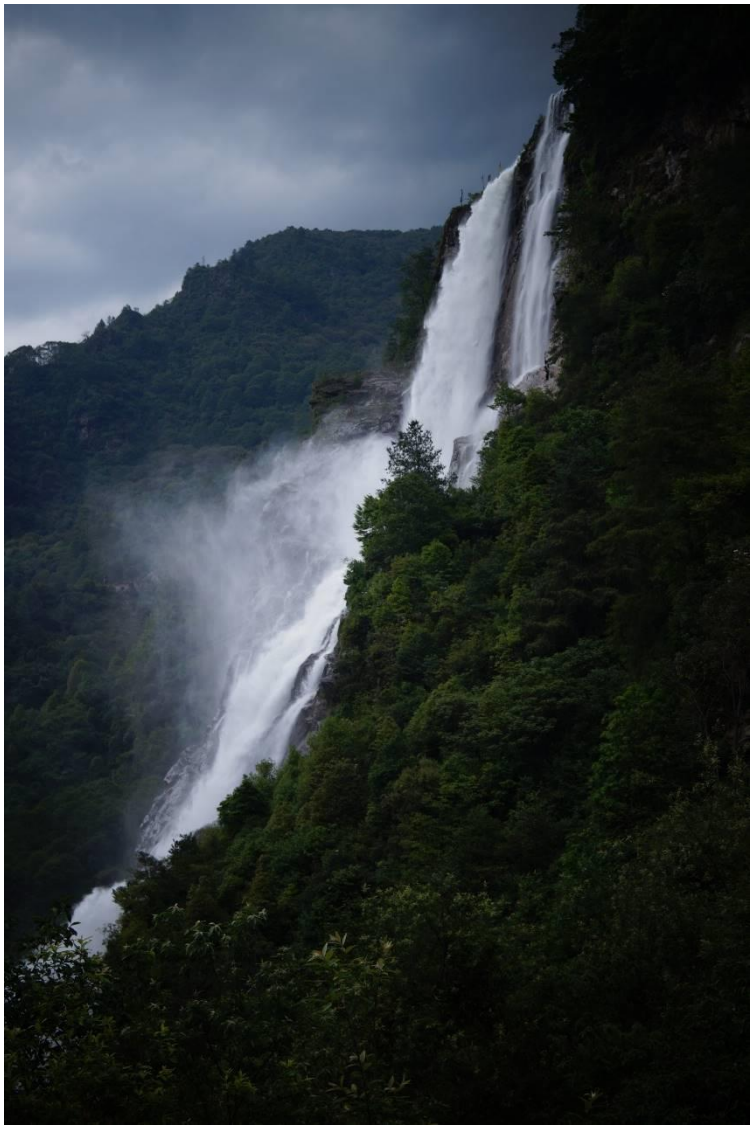
Serious threat to “Wildlife Corridors” – cause of reduced “gene flow”, reduced “genetic vigor” and expression of mutant genes.

Elevation Zone Map of India



The Central and Peninsular India is drying down ver fast, shall be a serious threat to forest and wildlife. Central India forests will be converted into grasslands, in near future.

The Earth Mankind Inherited



These areas will become “habitable and cultivable” due to increase in temperature – the “tree line” will move upward : China is trying to control water resources of the region.

INVIOLATE FOREST ECOSYSTEMS

Mangrove Forests – Highly Threatened