Climate Change and Natural Hazards in India

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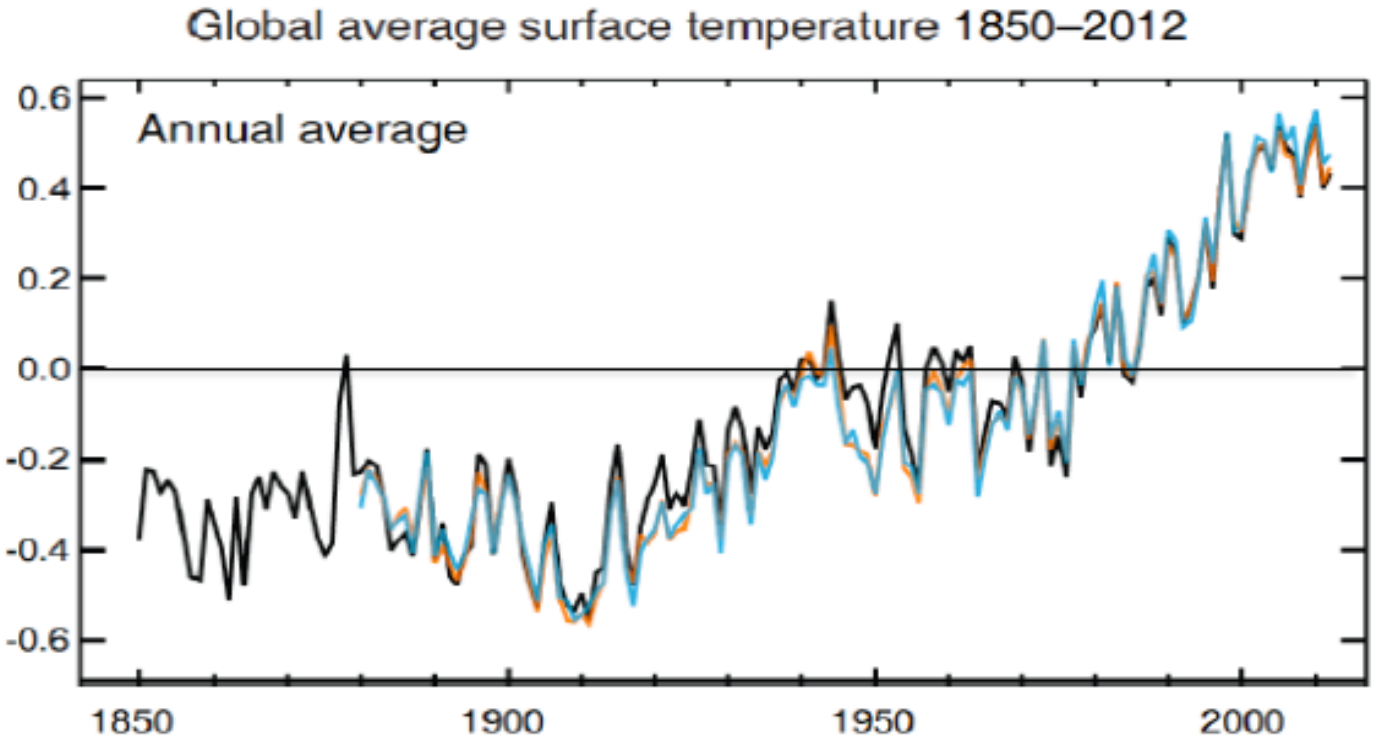
Outline

- Climate Change at Global scale and in India
- India's current programmes and actions on Climate Change
- Extreme Weather Events and their Linkage with Climate Change
- DST's Initiatives for Building Human and Institutional Capacities
- Summary

Global Climate Change:
Key Messages from AR5

Annual Global Combined Land and Sea Temperature

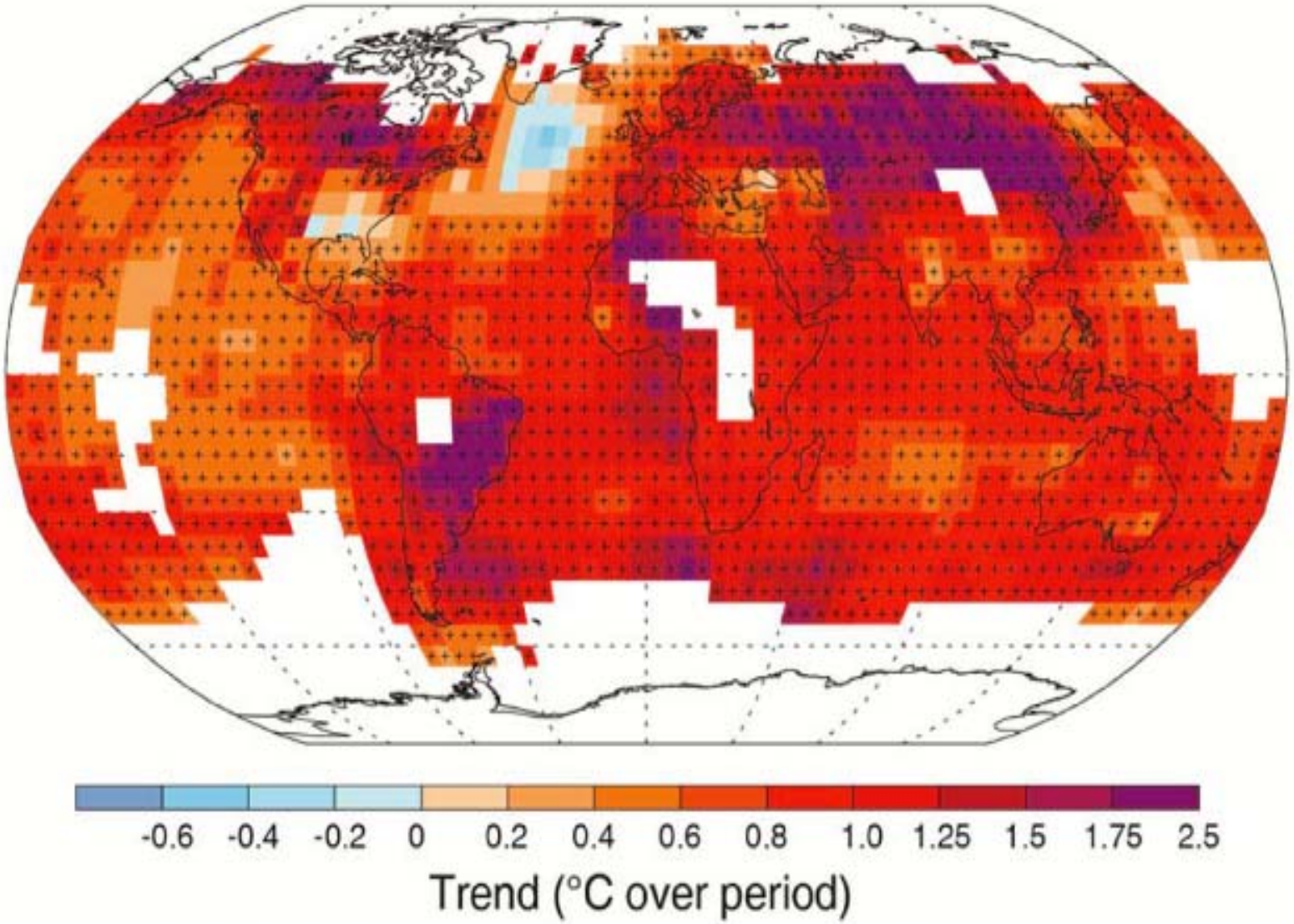


(IPCC 2013, Fig. SPM.1a)

HadCRUT4 (black), MLOST(orange) and GISS (blue) are shown.

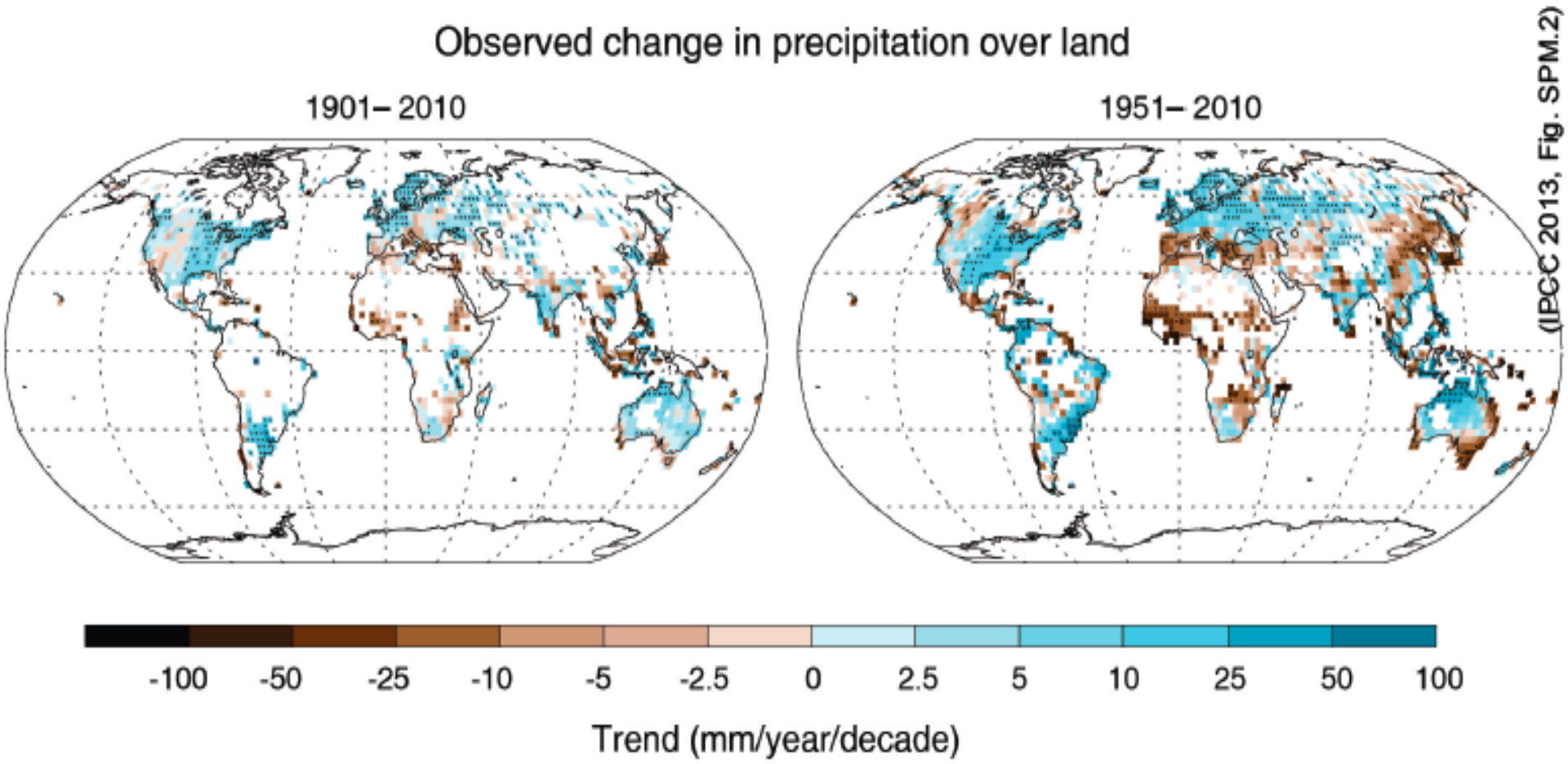
The globally averaged combined land and ocean surface temperature data, show a warming of 0.85 [0.65 to 1.06] °C , over the period 1880–2012. The total increase between the average of the 1850–1900 period and the 2003–2012 period is 0.78 [0.72 to 0.85].

Observed change in average surface temperature 1901–2012

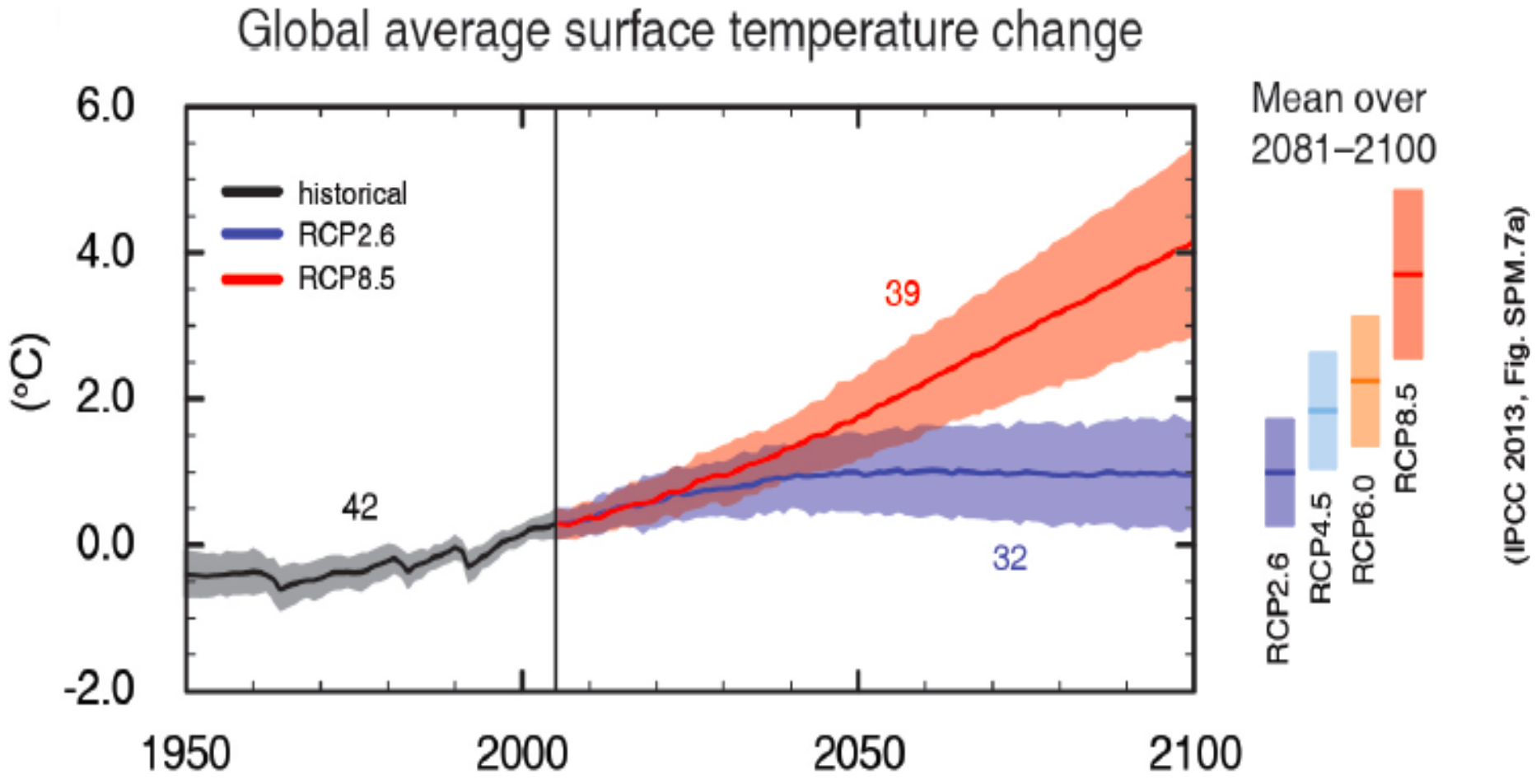


(IPCC 2013, Fig. SPM.1b)

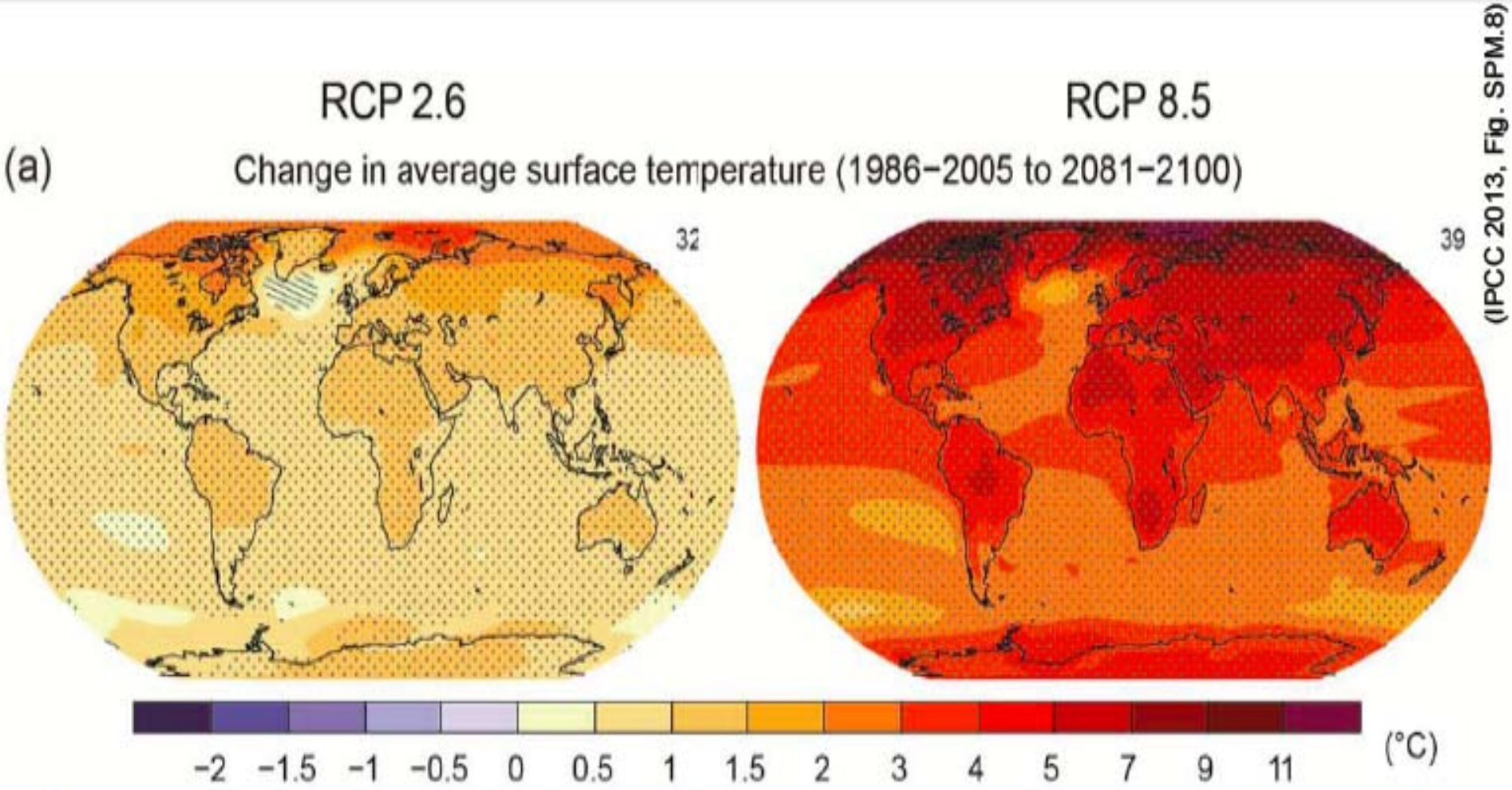
Warming in the climate system is unequivocal



Confidence in precipitation change averaged over global land areas since 1901 is low prior to 1951 and medium afterwards. Averaged over the mid-latitude land areas of the Northern Hemisphere, precipitation has increased since 1901 (medium confidence before and high confidence after 1951). For other latitudes area-averaged long-term positive or negative trends have low confidence.



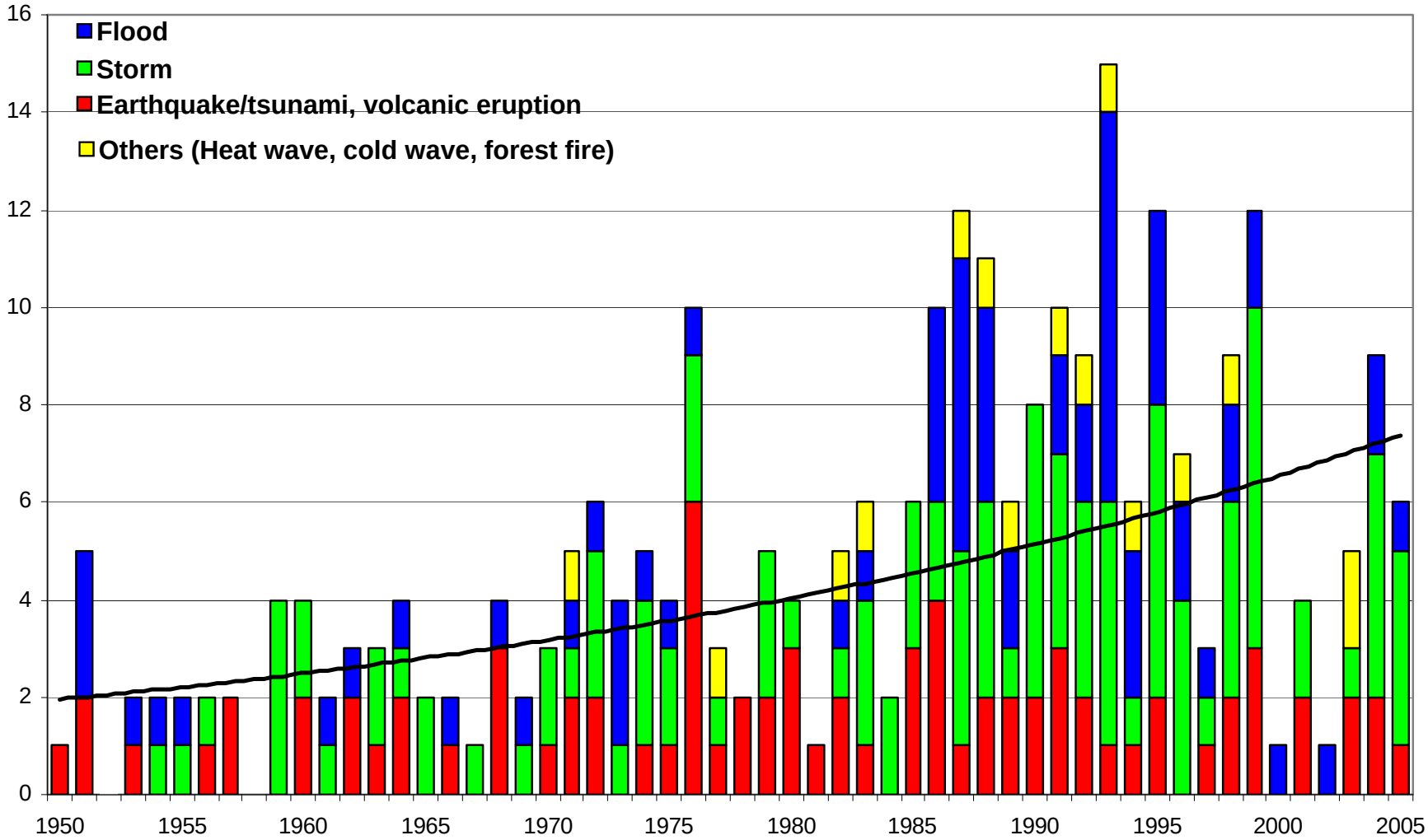
Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5°C relative to 1850 for all scenarios



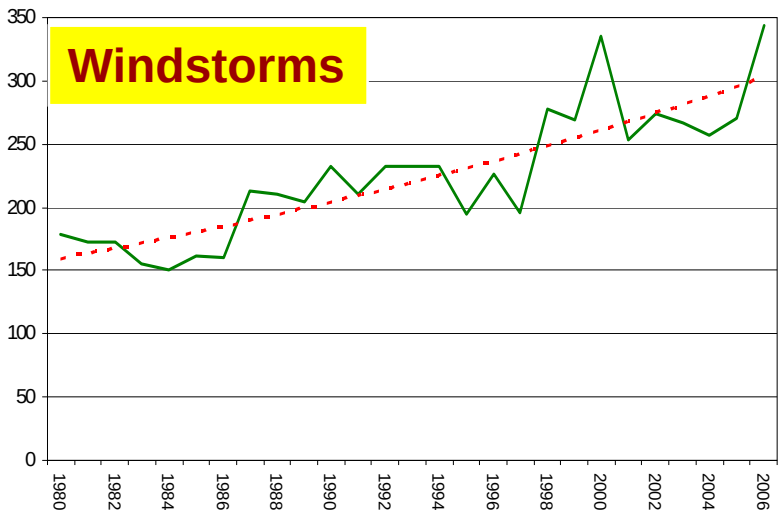
(IPCC 2013, Fig. SPM.8)

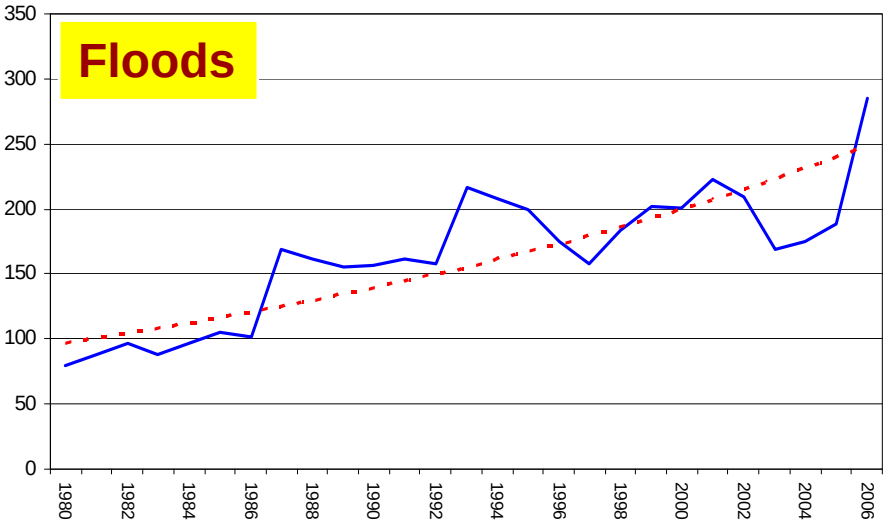
Increase of global mean surface temperatures for 2081–2100 relative to 1986–2005 is projected to likely be in the ranges derived from the concentration driven CMIP5 model simulations, that is, 0.3°C to 1.7°C (RCP2.6), 1.1°C to 2.6°C (RCP4.5), 1.4°C to 3.1°C (RCP6.0), 2.6°C to 4.8°C (RCP8.5).

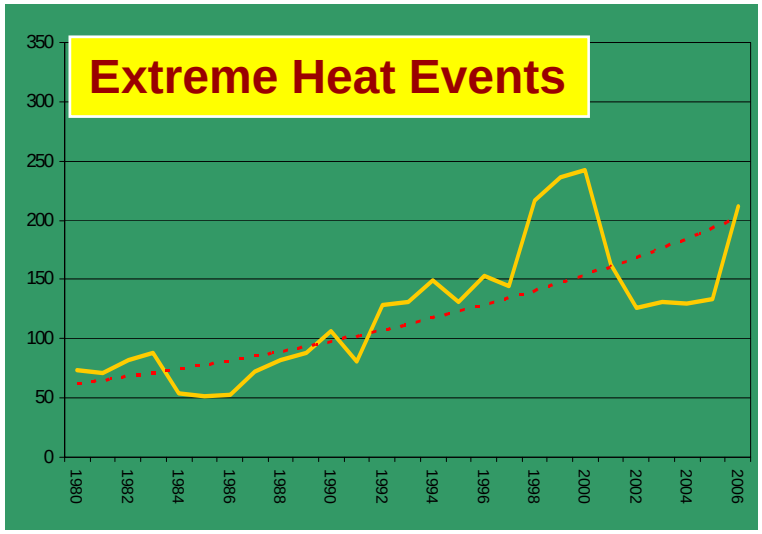
Annual Frequency of Natural Disasters 1950 – 2005

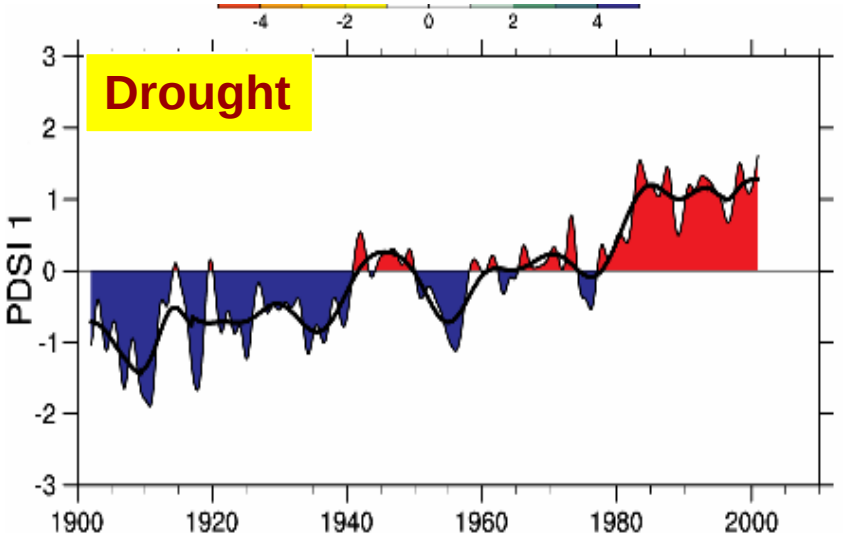


Recent Increasing Trends in Frequency of Natural Hazards

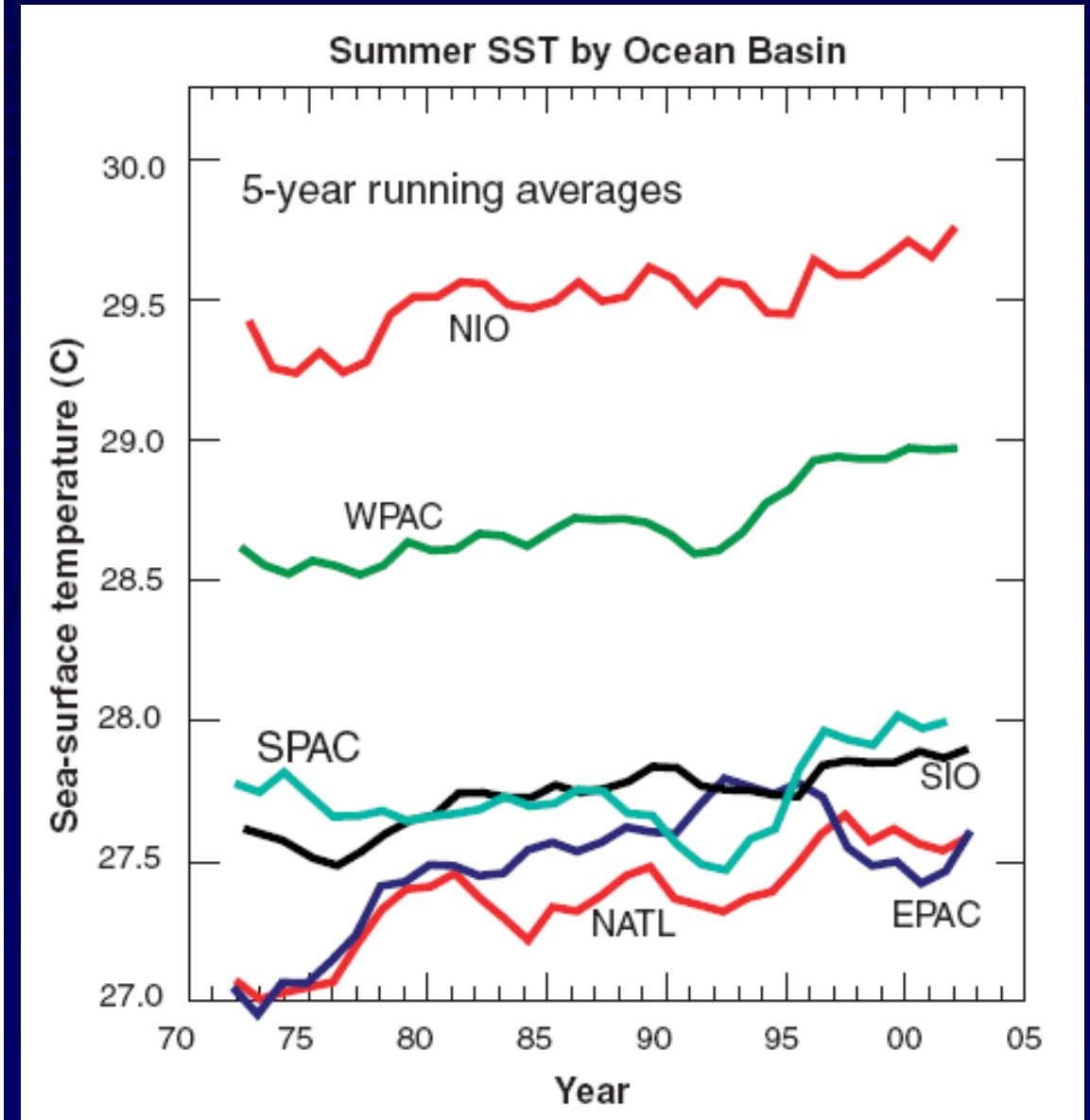








Observed Changes in Sea Surface Temperatures

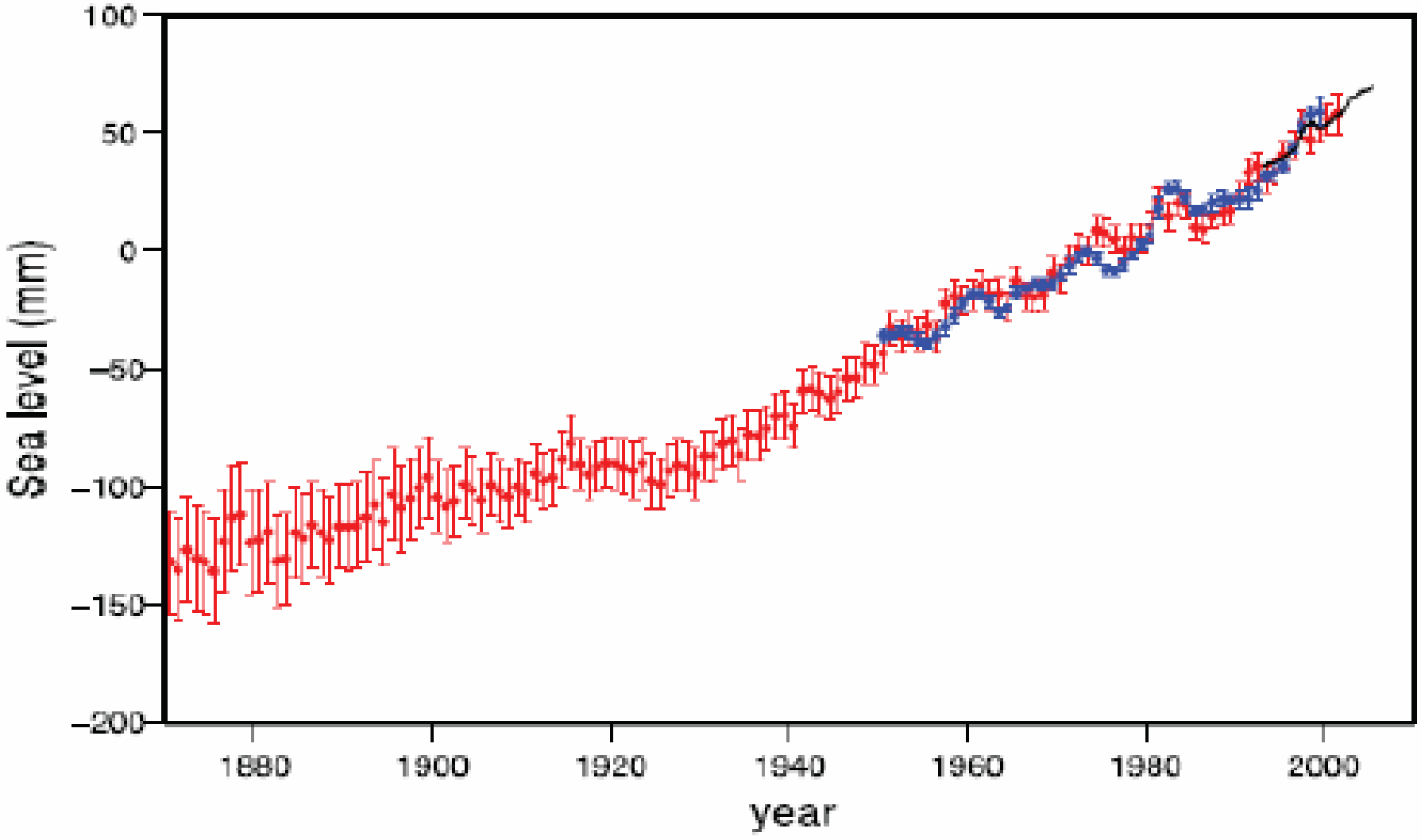


NATL = North Atlantic
WPAC = West Pacific
SPAC = South Pacific
EPAC = East Pacific
NIO = Northern Indio
SIO = Southern Indio

Source: Webster et al. (2005), Science, 309

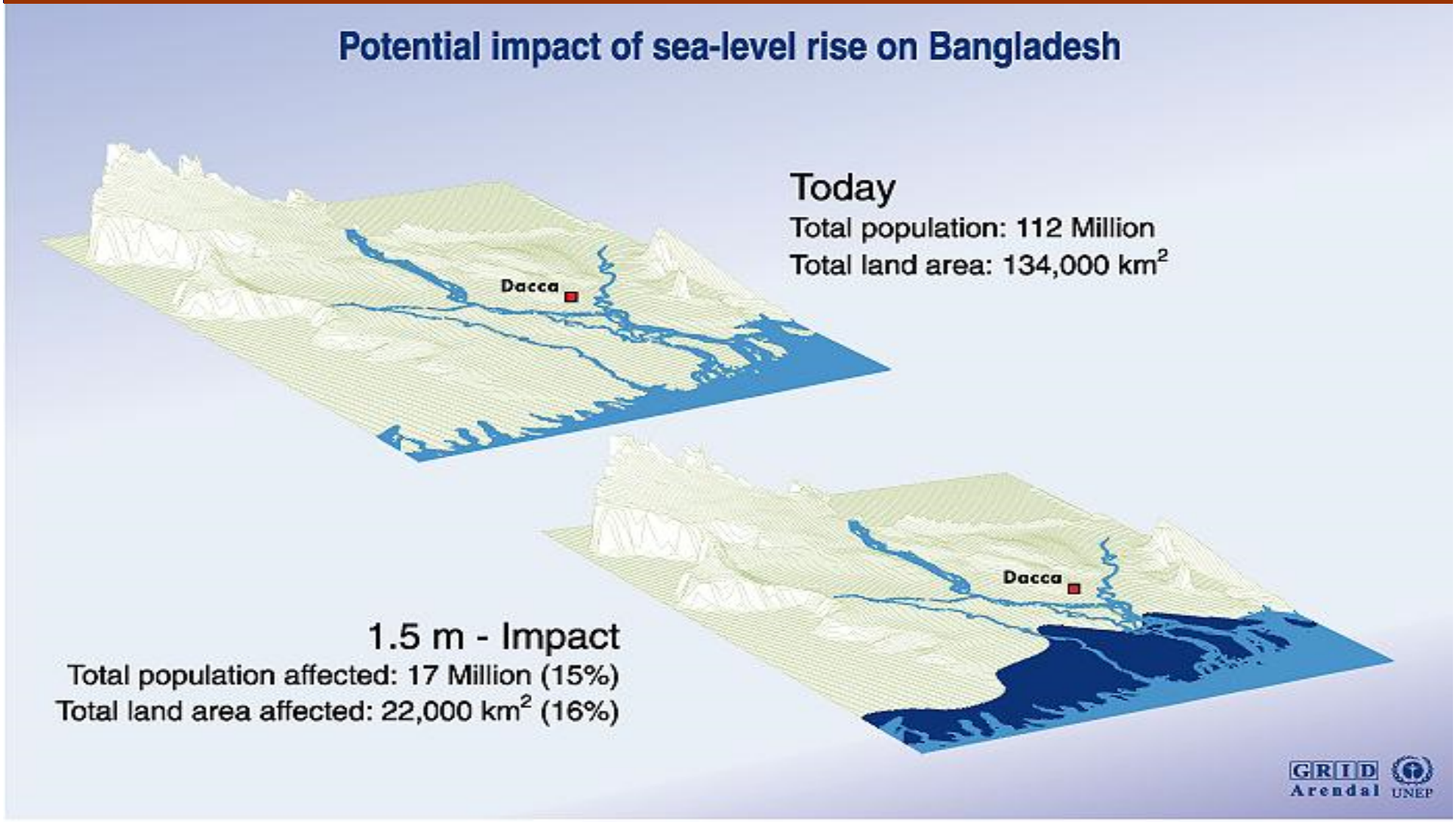
Changes in Sea Level since 1850 and Projection

(IPCC 4thAR, WGI, Paris, 5.2.2007)



Global average sea level has risen since 1961 at an average rate of 1.8mm/yr and since 1993 at 3.1mm/yr

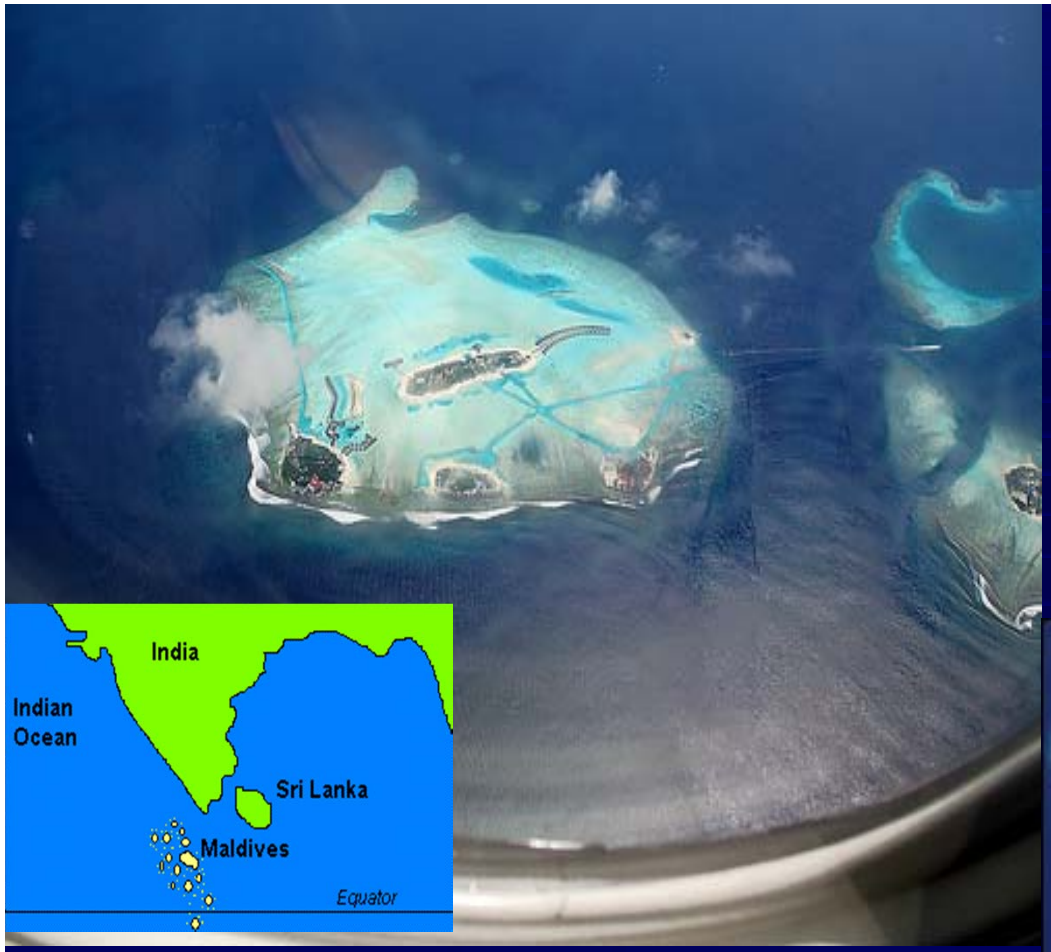
Bangladesh is projected to lose about 16% of its land area with a sea level rise of 1.5 m



Source : UNEP/GRID Geneva; University of Dacca; JRO Munich; The World Bank; World Resources Institute, Washington D.C.

Sea-Water Inundation Example: Maldives

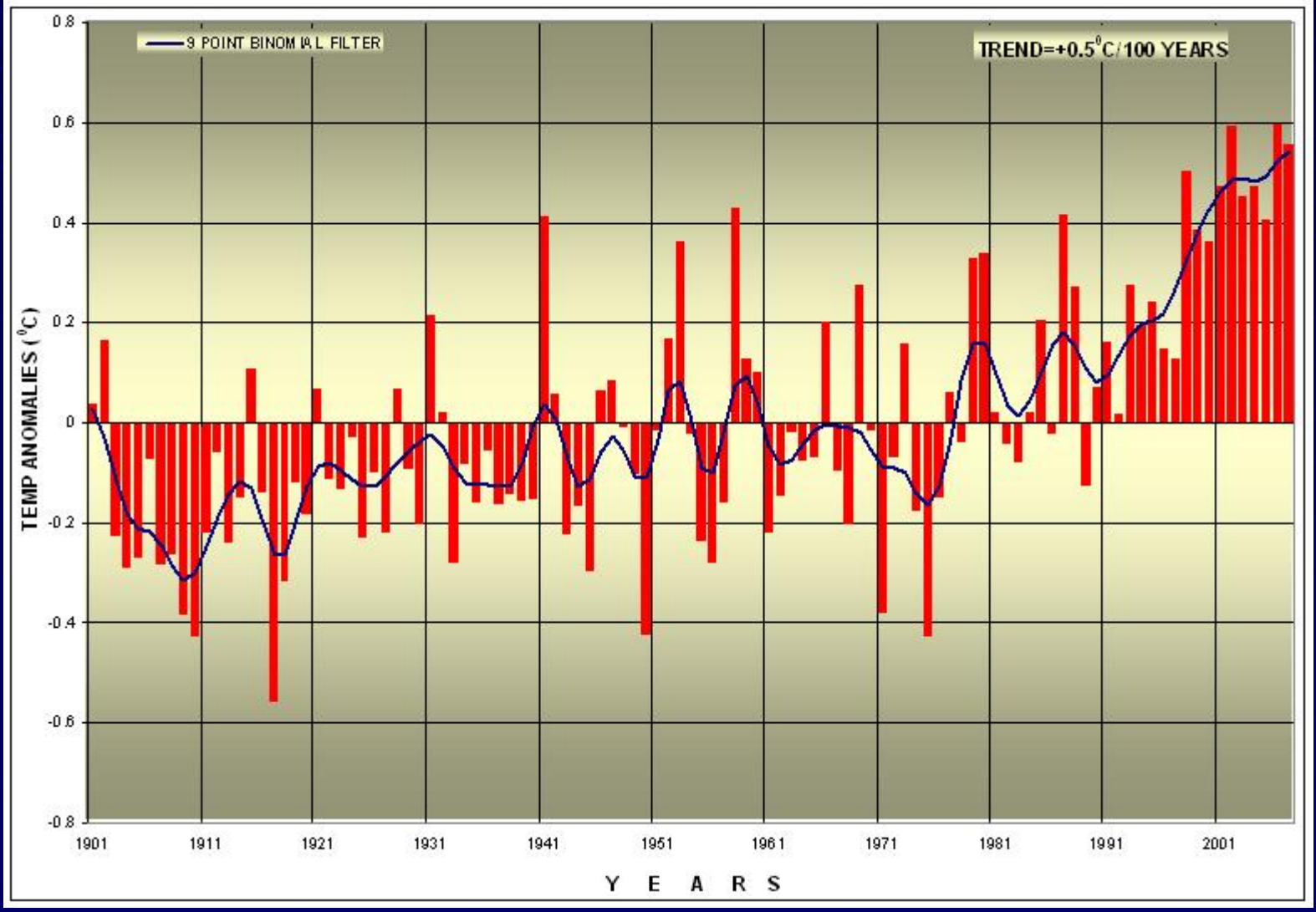
Area: 115 square miles
Population: 143,000
Highest point: 20 ft above sea level



Climate Change induced Sea Level Rise may inundate some of the islands of Maldives

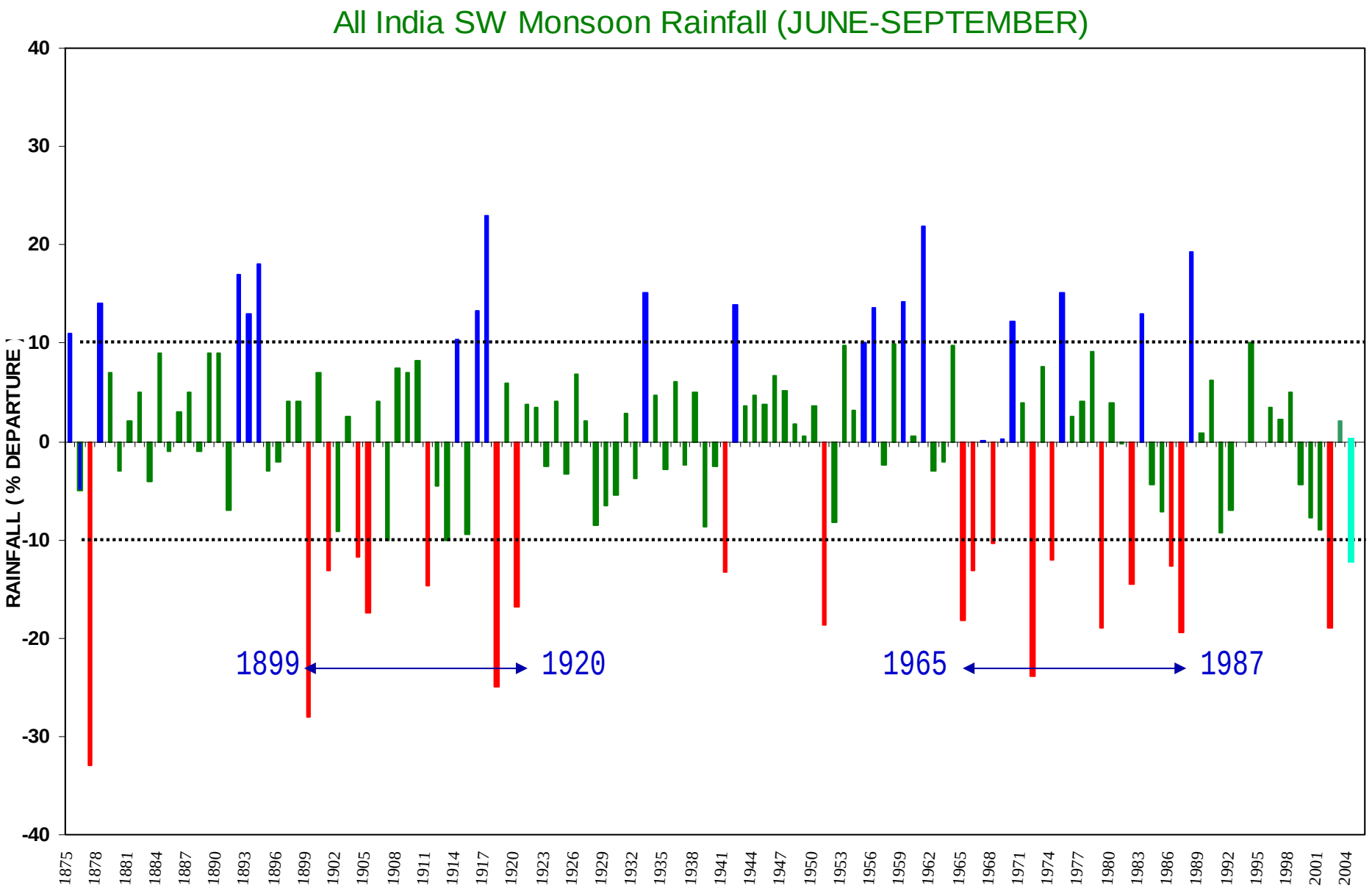
Climate Change in India

All-India Temperature Time Series



Source: India Meteorological Department, National Climate Centre, Pune

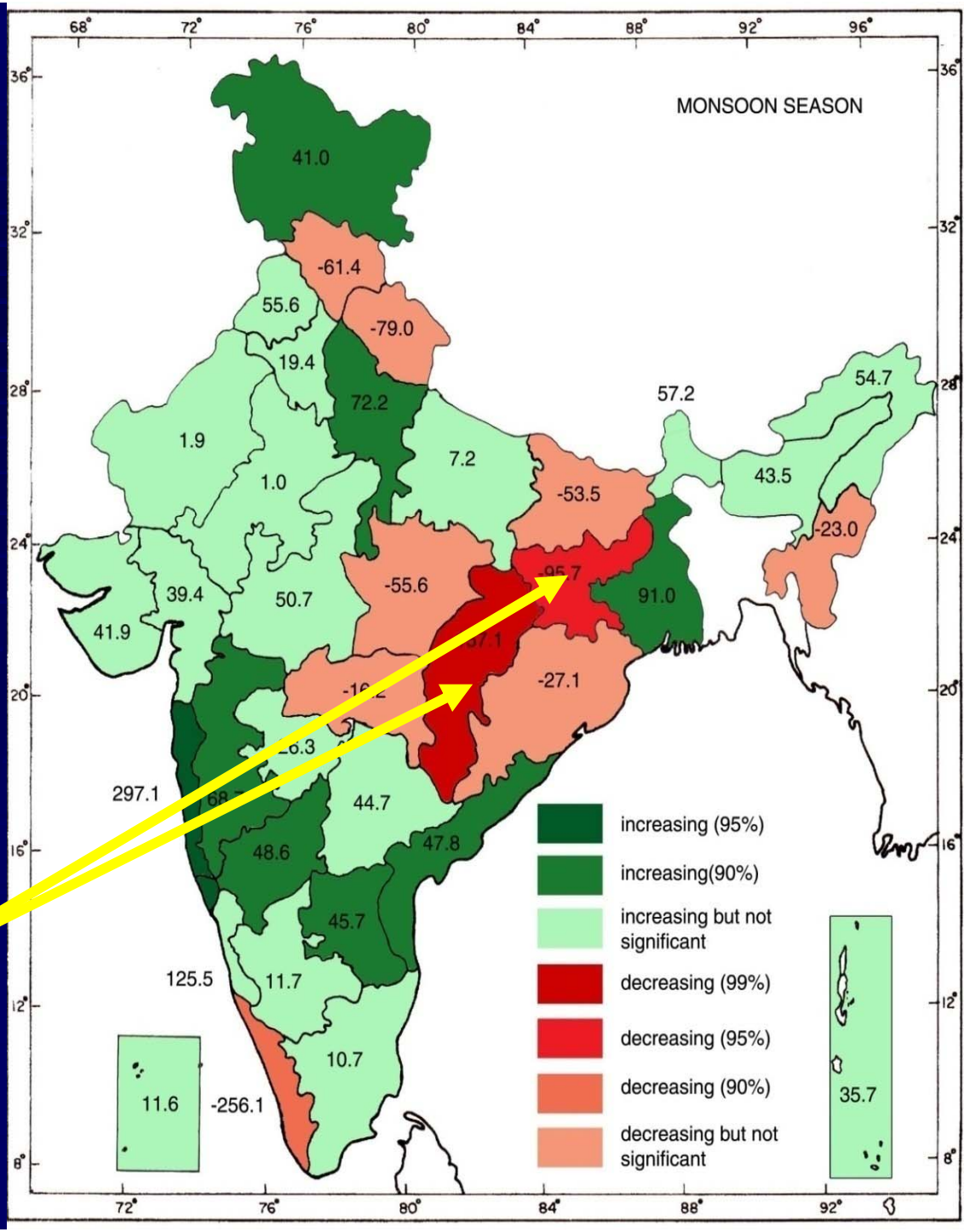
INTER-ANNUAL MONSOON RAINFALL VARIABILITY



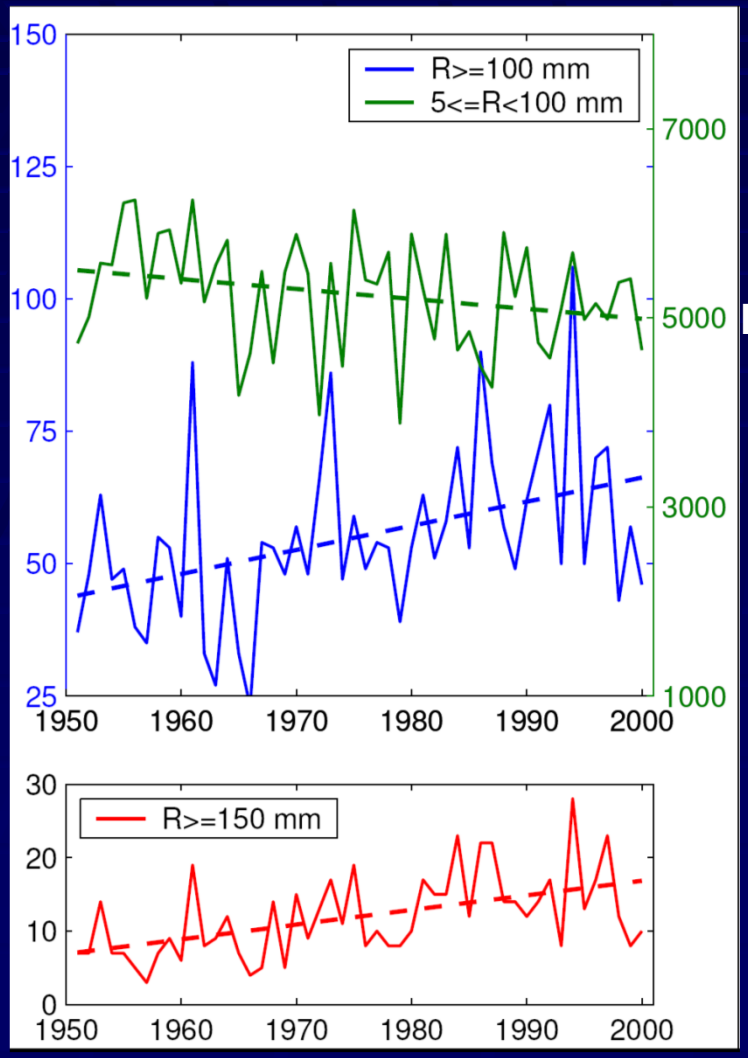
Spatial patterns in Monsoon Rainfall Trends during past 100 years

Inferences:

- Mixed Trend- somewhere increasing and somewhere decreasing
- Chattisgarh and Jharkhand showing marked decreasing trends



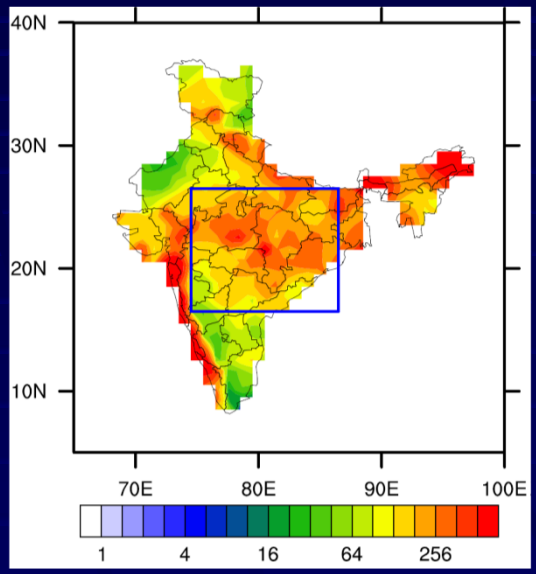
Changes in the Frequency of Extreme Rainfall



Low & Moderate events

Heavy events (>10cm)

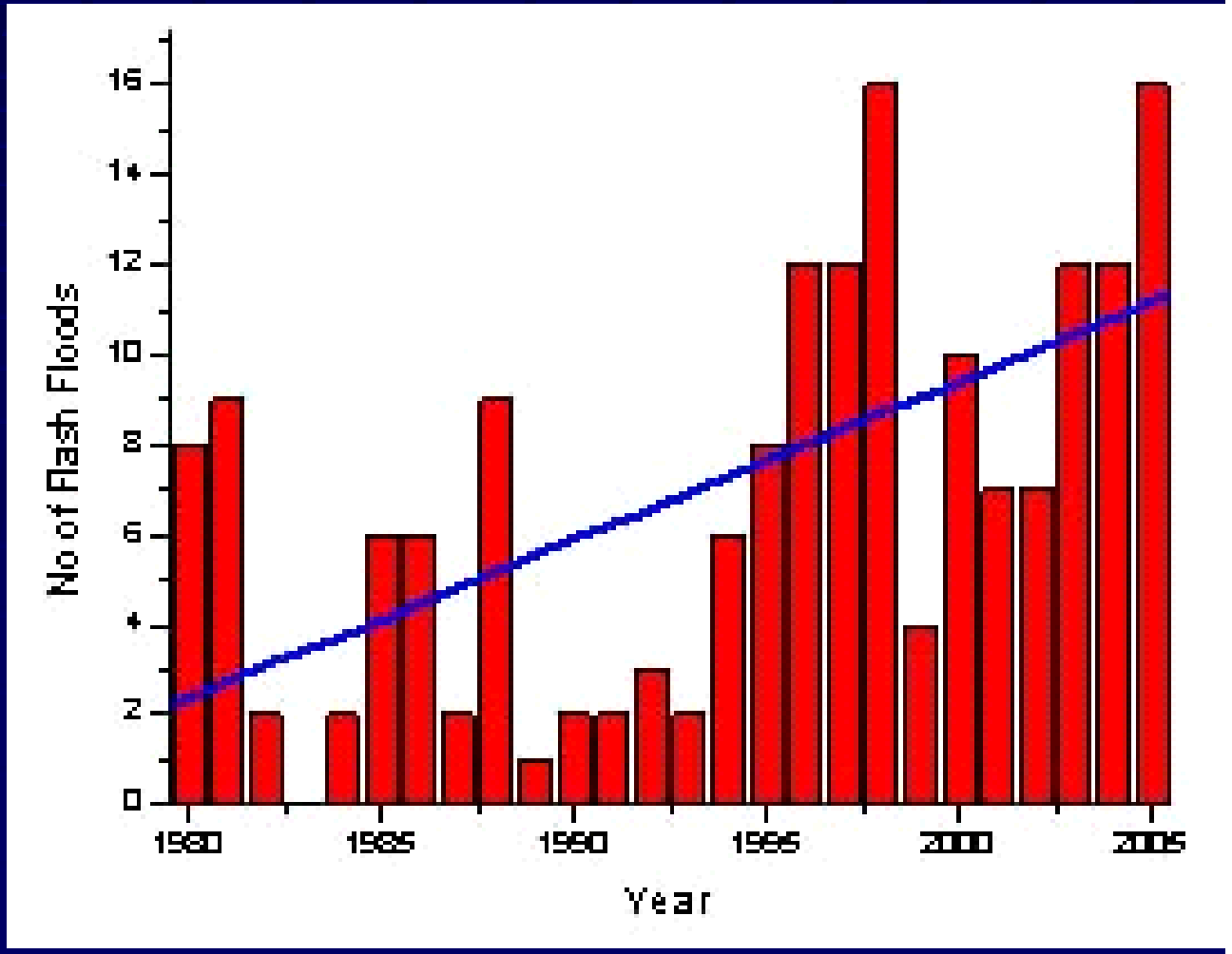
V. Heavy events (>15cm)



Goswami et al., Science, Dec., 2006

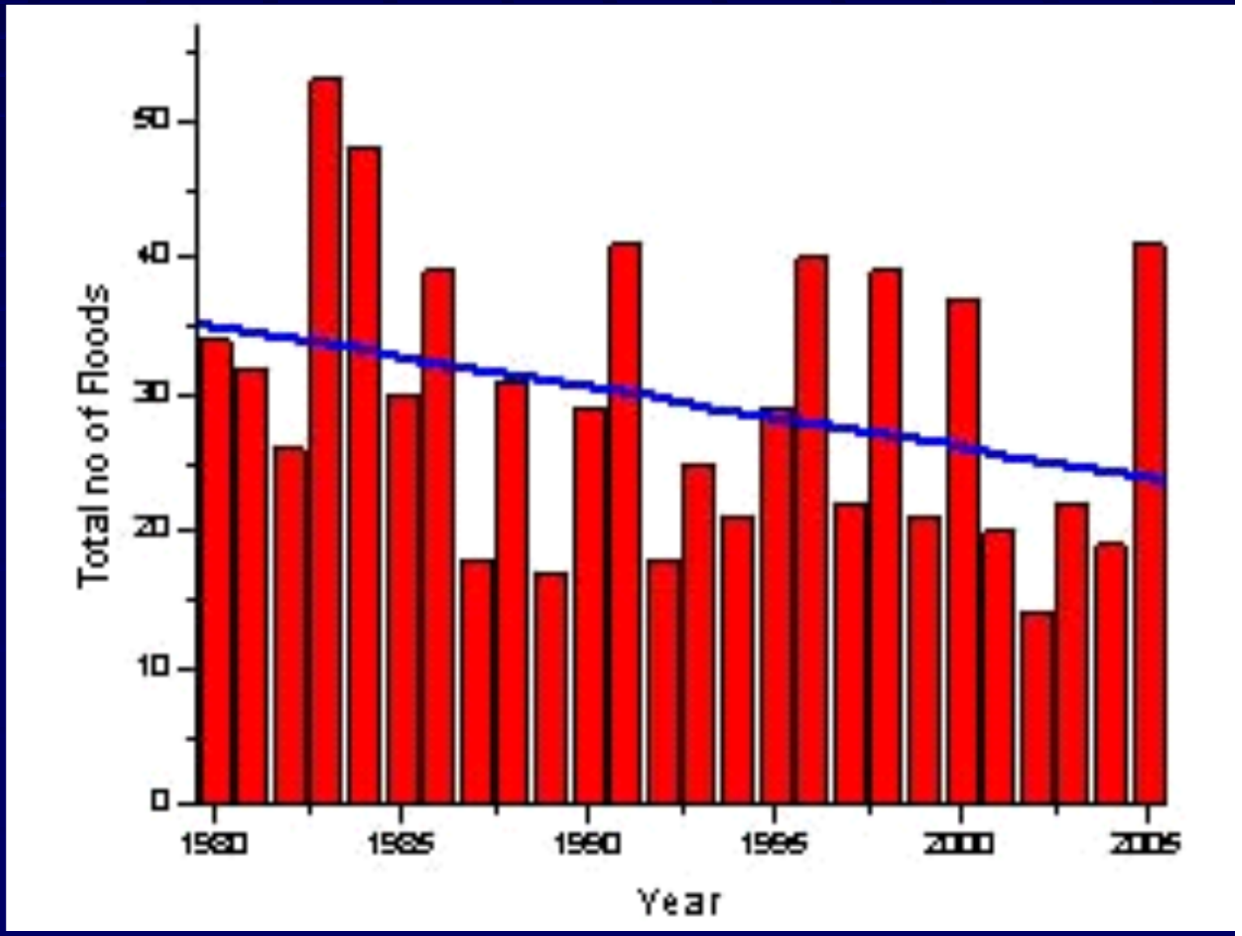
Number of Flash Flood Events in India (1980-2006)

Increasing Trend in Flash Flood Events during past 25 years



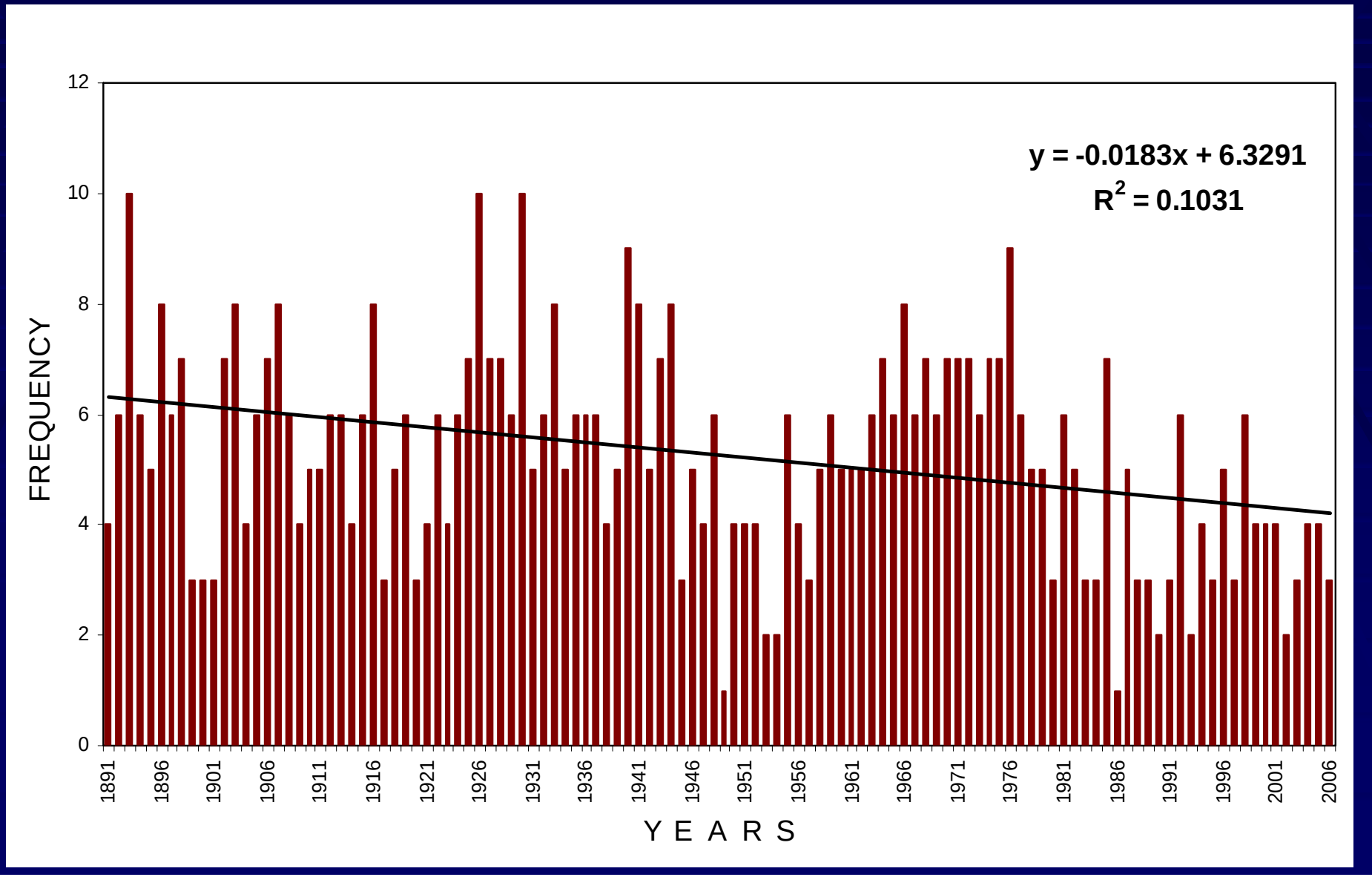
Total Number of Flood Events in India (1980-2006)

Decreasing Trend in Total Flood Events during past 25 years

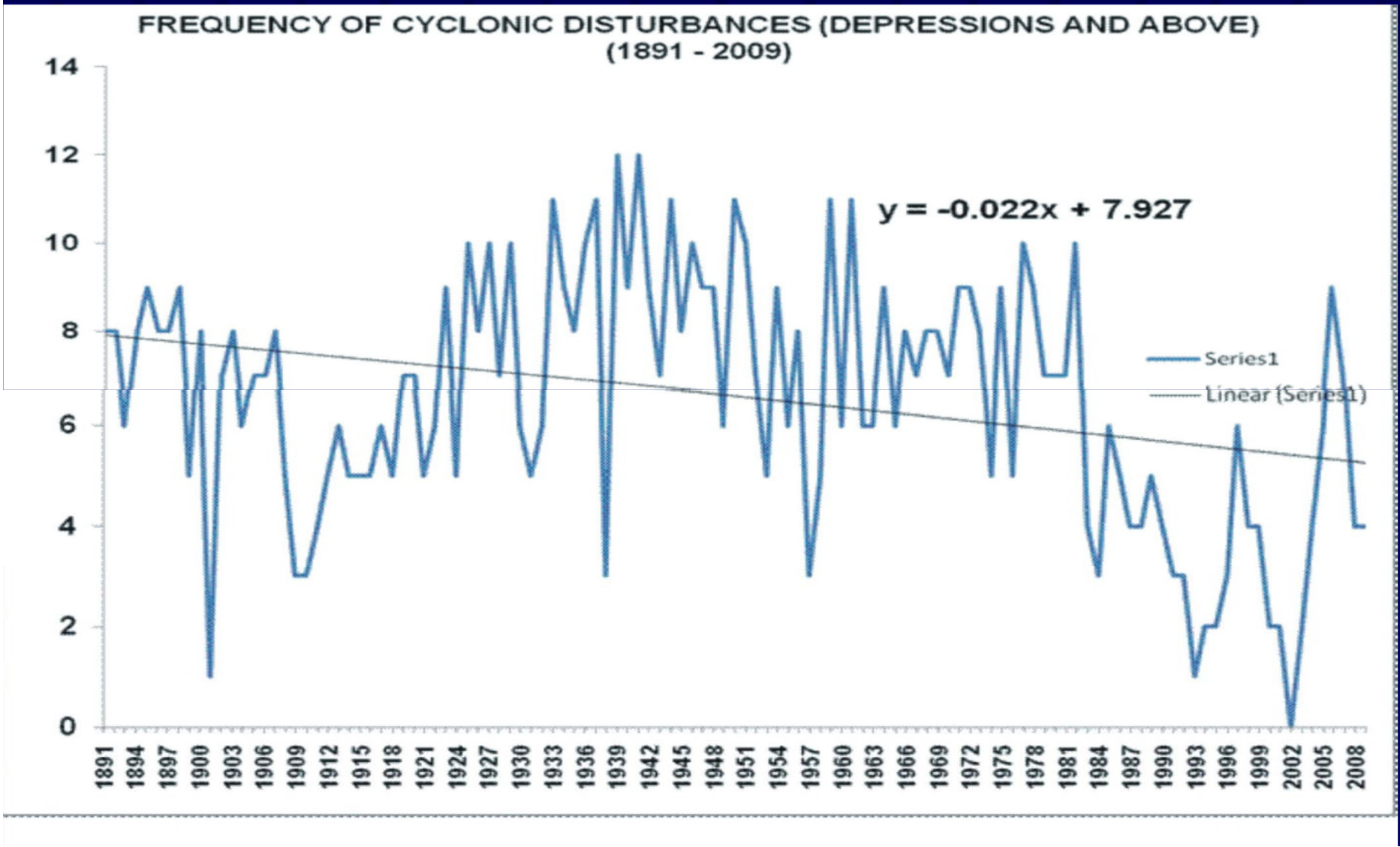


Trend in the Frequency of Low Pressure Systems over India

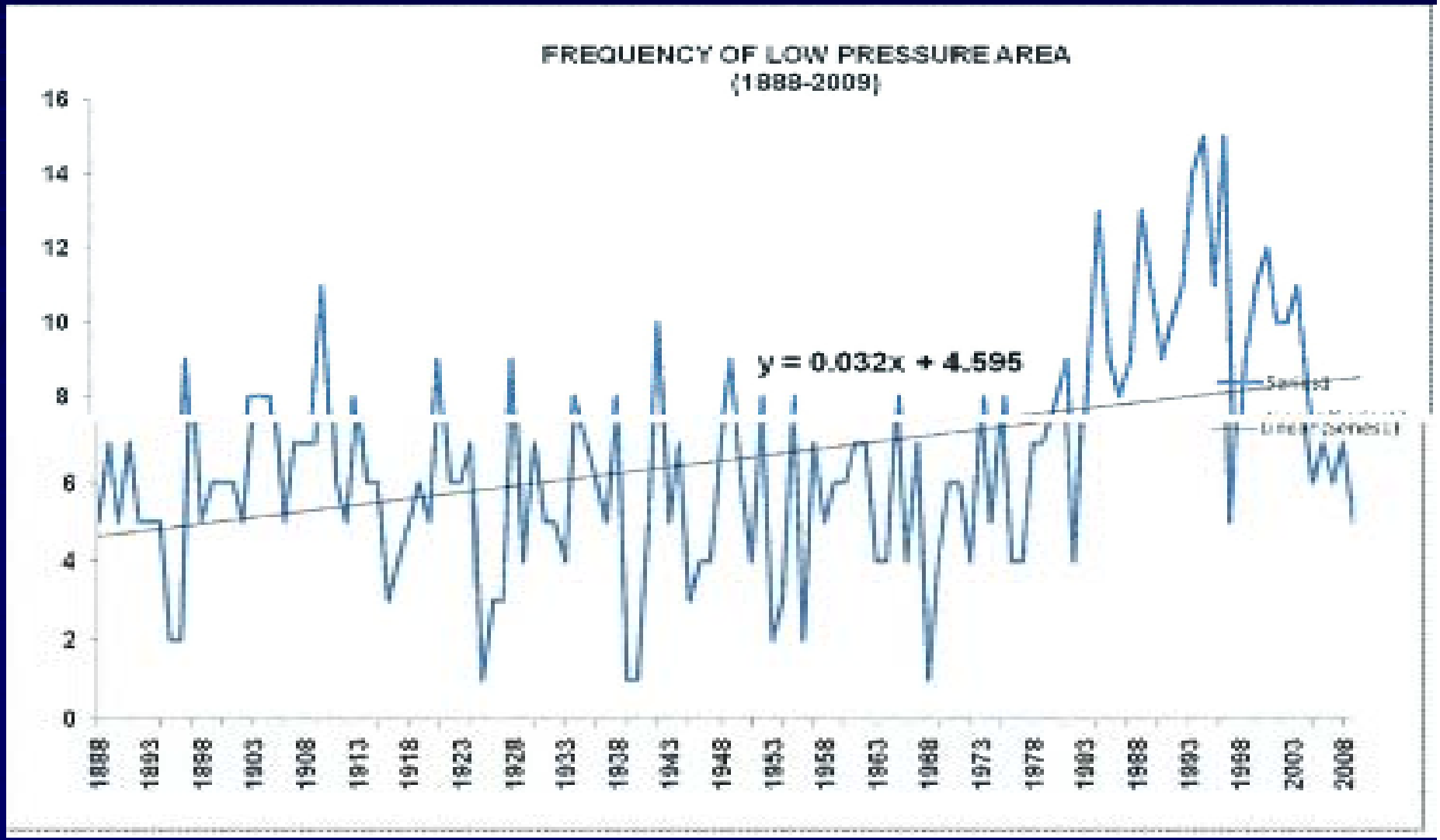
Decreasing Frequency of Total Number of Cyclonic Storms over India during 1891-2006



Decreasing Frequency of Total Number of Cyclonic Disturbances over India during past 120 years (1891-2009)

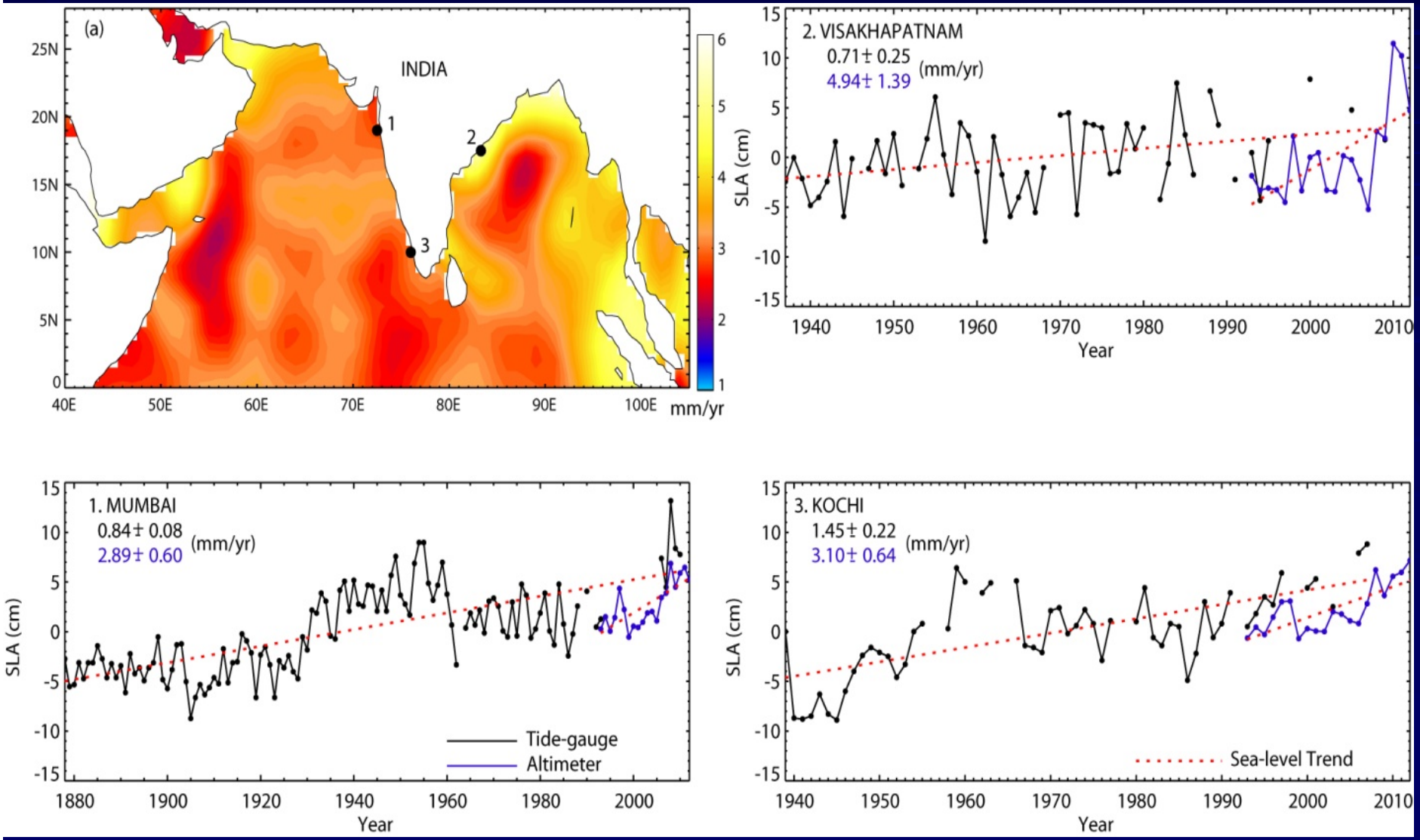


Increasing Frequency of Total Number of Low Pressure Areas over India during past 123 years (1888-2009)



Trend in the Sea Level Rise off Indian Coasts

Trend in Sea Level Rise in India



India's Climate Change Programme

National Action Plan on Climate Change (NAPCC)

- **NAPCC- To fulfill India's vision of sustainable development in the context of climate change, the Prime Minister's Council (PMC) has launched the National Action Plan on Climate Change (NAPCC) during September 2009 comprising of 8 national missions.**

Eight National Missions

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- National Mission for Sustaining the Himalayan Eco-system
- National Mission for a Green India
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

Eight National Missions on Climate Change

- Of the total of eight missions under NAPCC, two were assigned to the Ministry of Science and Technology. They are -
  - National Mission on Strategic Knowledge for Climate Change
  - National Mission for Sustaining the Himalayan Eco-system
- Both call for such mission mode actions that **build, strengthen and sustain national S&T capacities** to sustain an ecosystem and self-learn for developing strategic knowledge.

National Programmes for Adaptation

National Programme on adaptation would focus:

- Agriculture
- Forestry
- Disaster management
- Water sector
- Coastal zones
- Health sector

Extreme Events and their linkage with Climate Change

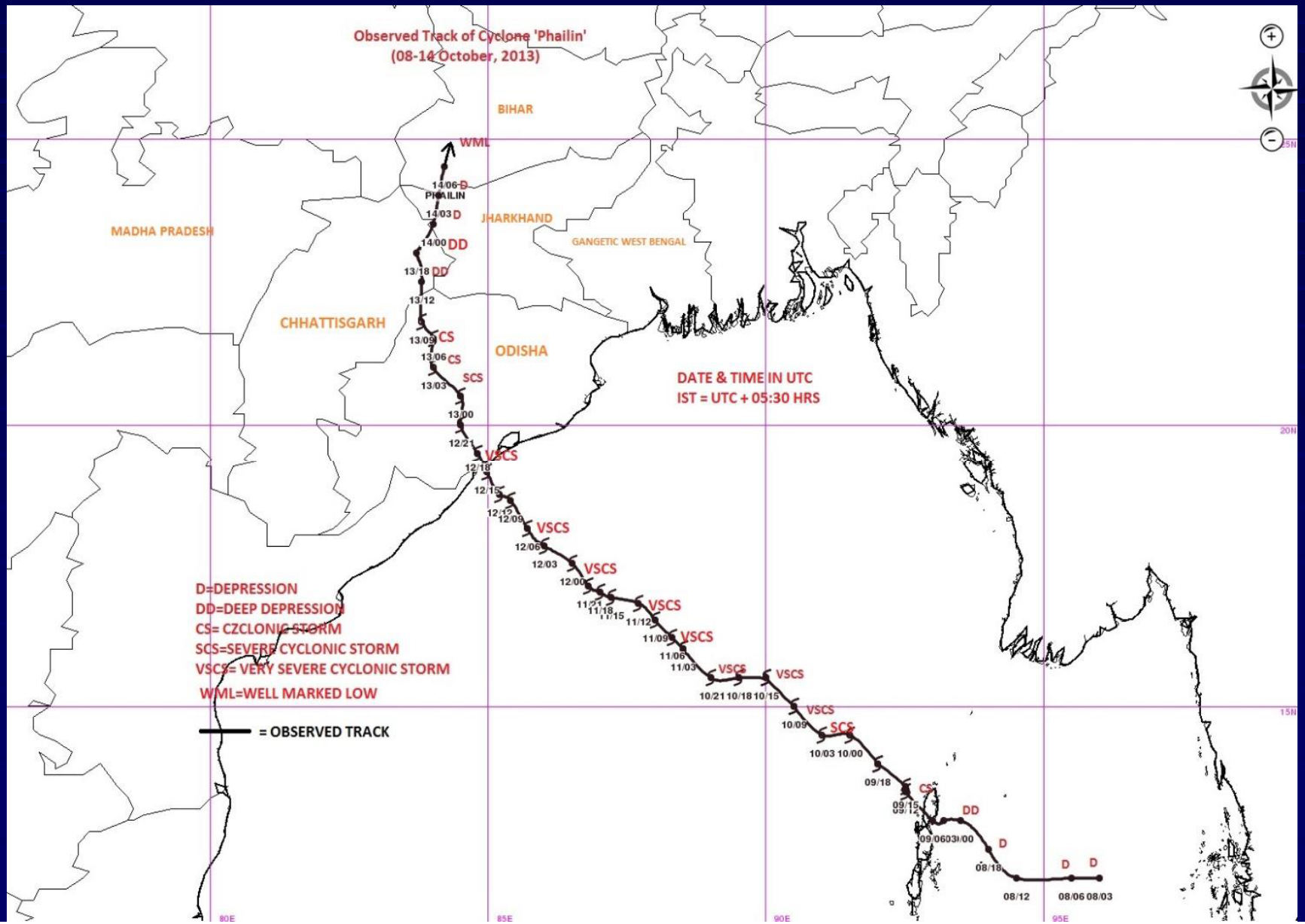
Impact of Climate Change on Extreme Weather Events

- Climate Change could impact frequency and severity of events on long term and not year to year
- No clear long term trend is observed in this regard but a number of regions have reported increase in variability.
- Events which are directly connected to temperature change have shown positive trends

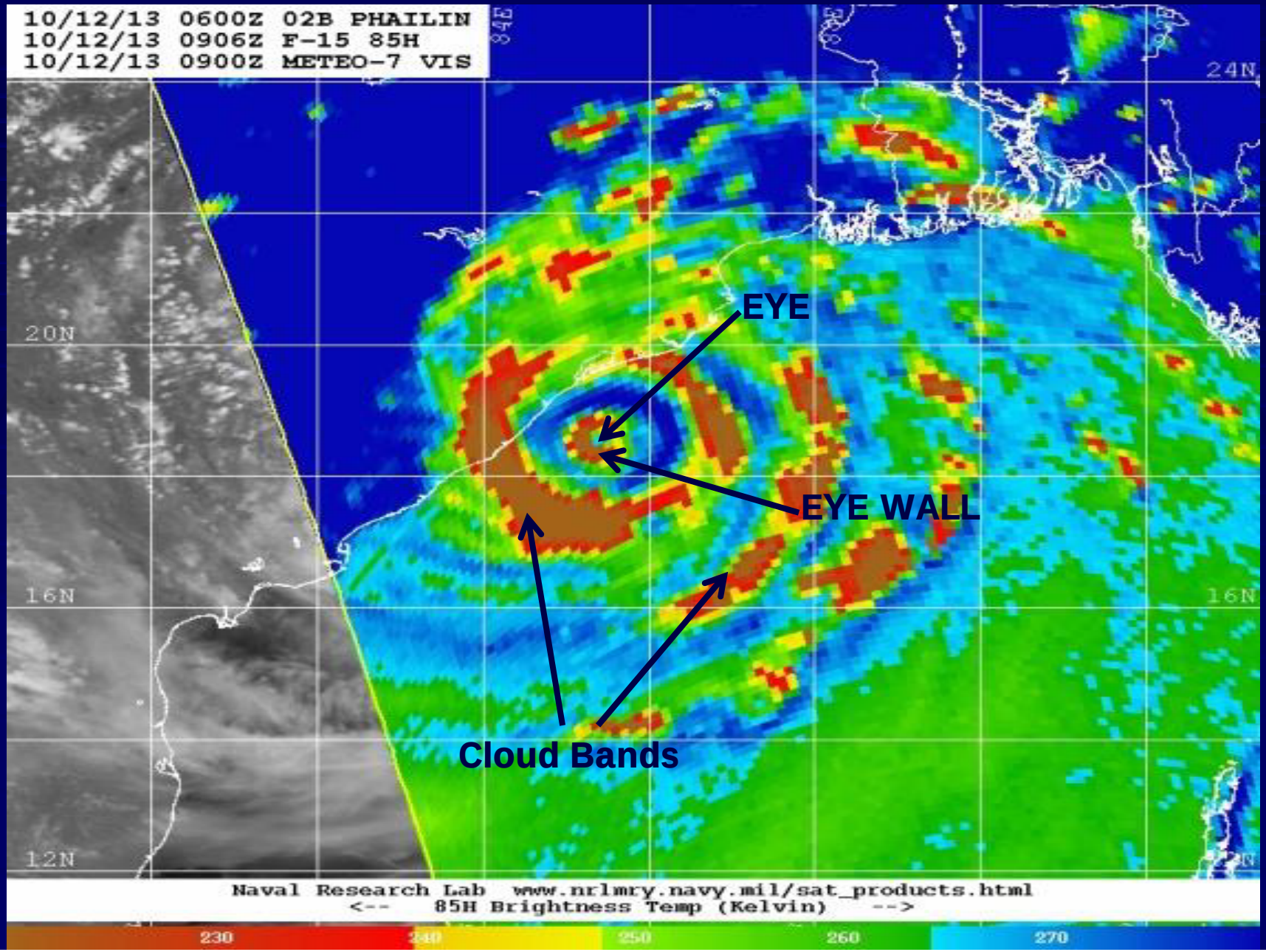
Extreme Events which are directly and indirectly linked to CC

- Those extreme events which are directly linked to the warming are likely to increase- Heat waves, droughts, extreme rainfall (floods), etc.
- Those indirectly related are still doubtful to have been impacted by climate change- Increase in number/intensity of cyclones, tornadoes, local severe storms, etc.

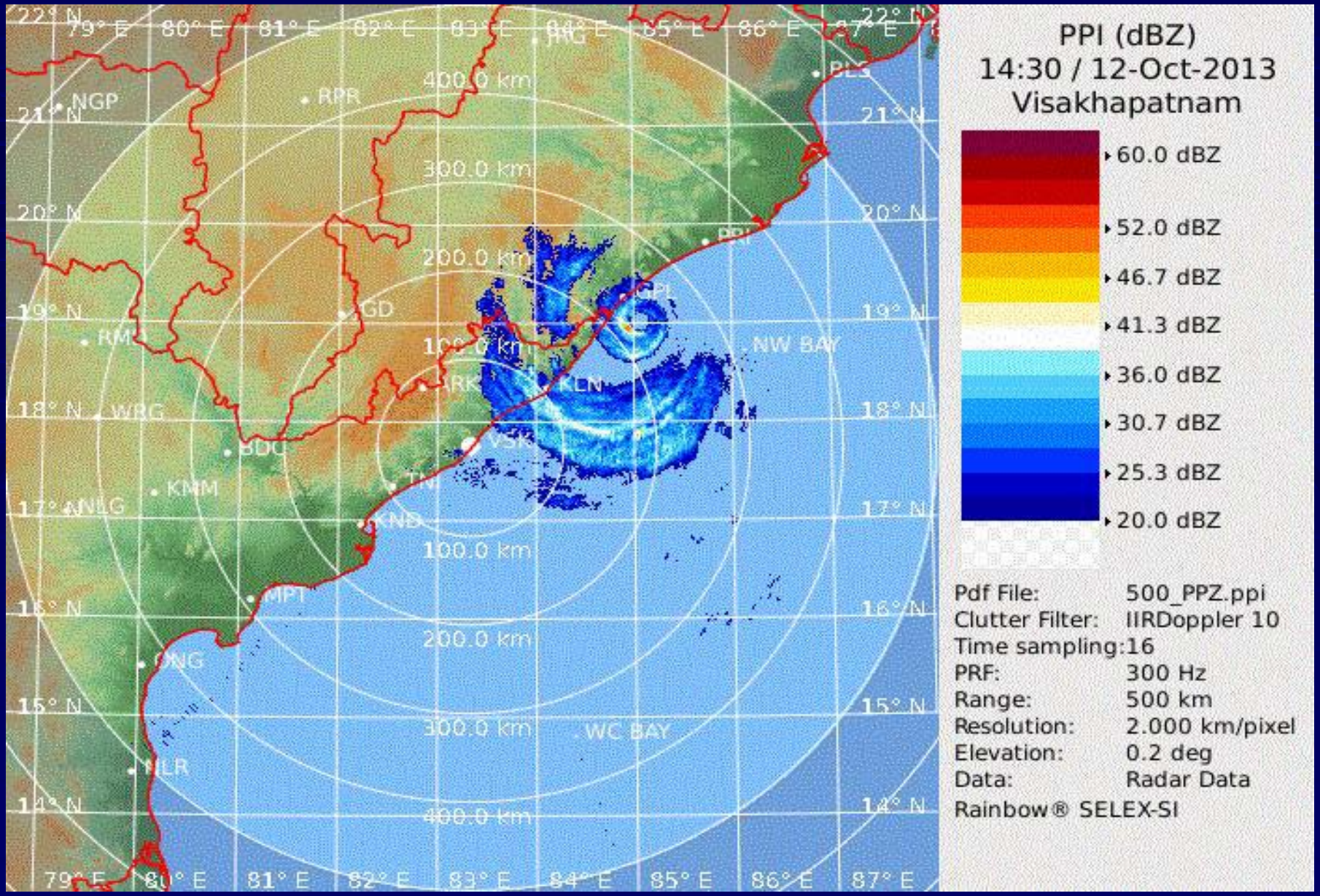
Cyclone Phailin: Observed Track



Microwave Imagery of Cyclone Phailin



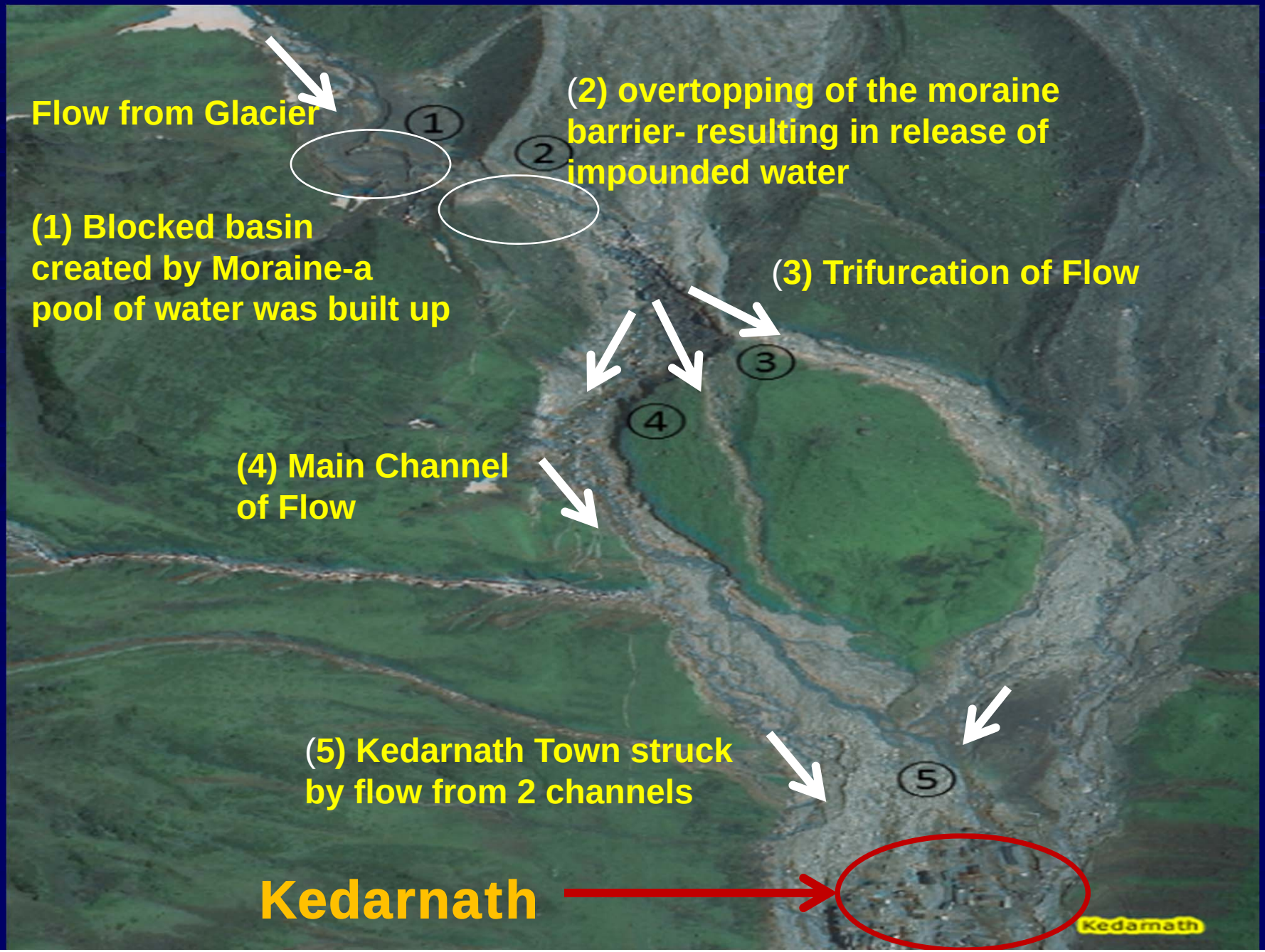
Doppler Radar Imagery of Cyclone Phailin



Main Causes of Uttarakhand (Kedarnath) Deluge June 2013

- An unconfirmed **cloudburst** event,
- **Glacier** and **moraine outbursts**,
- **Steep slopes** associated with the terrain,
- Sudden **gushing of water and debris** into the valley regions,
- **Flooding of rivers** on account of incessant rain,
- Exceeding of **carrying capacity of rivers**,
- Major **landslides,**
- **Panic reactions** of people

High Resolution Satellite Imagery of Uttarakhand Disaster



Uttarakhand Disaster vs Cyclone Phailin

	Uttarakhand	Phailin
Wx System	Cloud Burst	Cyclone
Size	50 km	1000km
Prediction Accuracy	Poor	Very Good
Prediction time	6-12 hrs in advance	5-6 days in advance
Lead time for Disaster management	3-4 hrs	3-4 days

How can we reduce the impact of Extreme Weather Events in the Changing Climate?

- **VULNERABILITY MAPPING** of areas with present and projected scenarios of climate change in relation to extreme events
- **DEVELOPING CAPACITIES TO ADAPT** climate change in highly vulnerable regions
- **INCREASING CAPABILITY TO DETECT AND PREDICT** extreme events with greater accuracy and longer lead time.
- Deploying a **MULTI-HAZARD INTEGRATED DECISION SUPPORT SYSTEM**
- **PUBLIC AWARENESS** about possible impact of climate change and ways & means to cope up

…thank you