



Conference on Decadal Predictability

16 - 20 August 2010

**Conference on Decadal Predictability
(Opening Remarks)**

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Conference on Decadal Predictability
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ICTP, 16 August, 2010



Examples of Weather and Climate Variability

- **Annual Cycle**
- **Daily Weather**
- **Seasonal Climate**
- **Interannual (ENSO)**
- **Decadal**
- **Centennial (Climate Change)**



Daily, Intraseasonal, Seasonal, Interannual, and Decadal Variations

- **“Short range” weather variation**
 - Hours; thunderstorms, tornadoes, squall lines, fronts,
 - Diurnal cycle; Organized convection
 - “Cyclones”, Easterly waves, Depressions,
- **“Medium range” weather variations**
 - Blocking; Growth, decay of tropical, troposphpherical disturbances
- **Intraseasonal variations**
 - Madden Julian “Oscillation” (MJO), Monsoon Intraseasonal variations, Pacific North American (PNA) variations, Annular modes
- **Seasonal mean variations**
 - Persistent droughts; Floods; Persistent “hot” and “cold” days; “Anomalous” number and tracks of cyclones
- **Interannual variations**
 - ENSO, QBO, TBO, NAO, NAM, SAM
- **Decadal variations**
 - PDO, Thermohaline circulation, Sahel drought, Decadal ENSO
- **Climate change**
 - Solar, Volcanoes, Greenhouse gases, Land use change



Mechanisms of Variability

Internal

External

Weather: 1. Internal Dynamics of Atmosphere

- Boundary Condition of SST, Soil wetness, Snow, Sea ice, etc.

Climate: 2. Internal Dynamics of Coupled Ocean-Land-Atmosphere
(seasonal-decadal)

- Solar, Volcanoes

Climate Change: 3. Internal Dynamics of Sun-Earth System

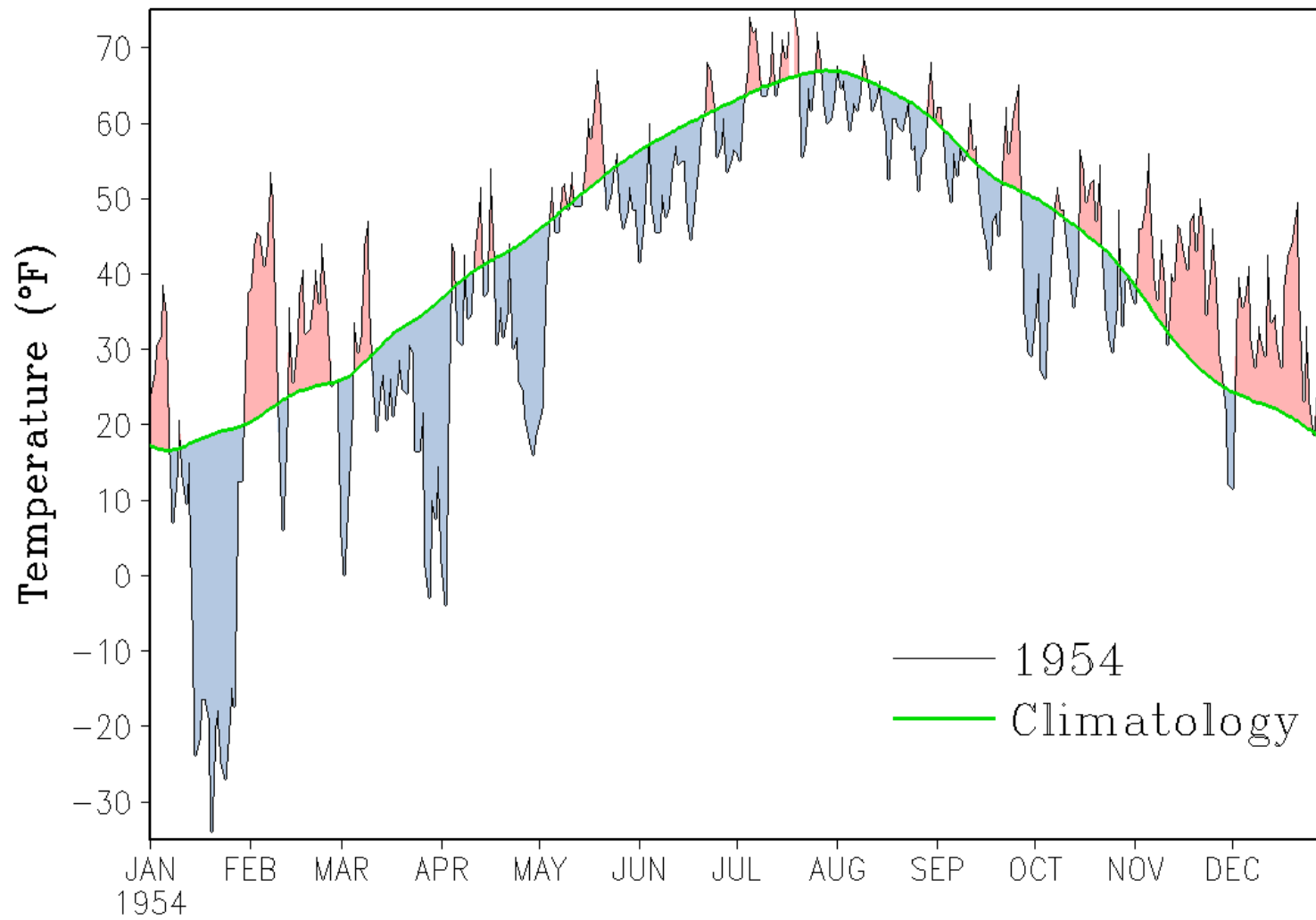
- Human effects:
(Greenhouse gases, land use changes)



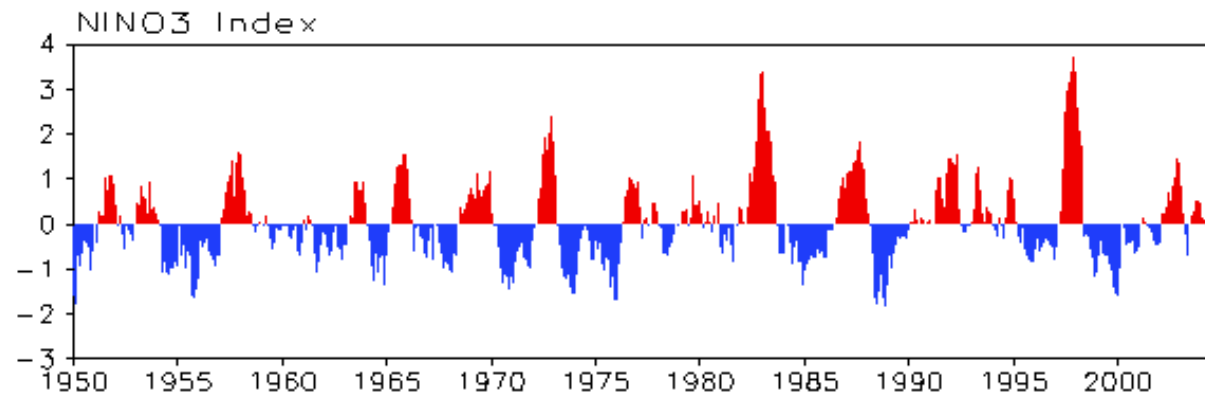
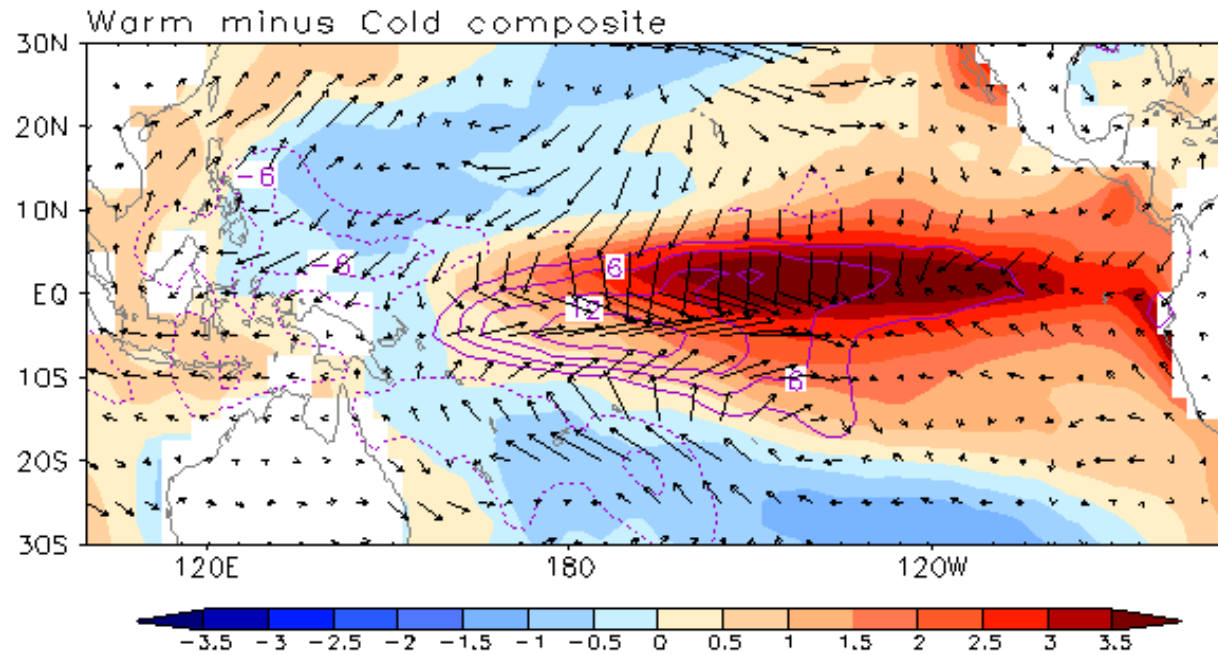
Examples of Weather and Climate Variability

- **Annual Cycle**
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Daily Average Temperature at 49N, 112W

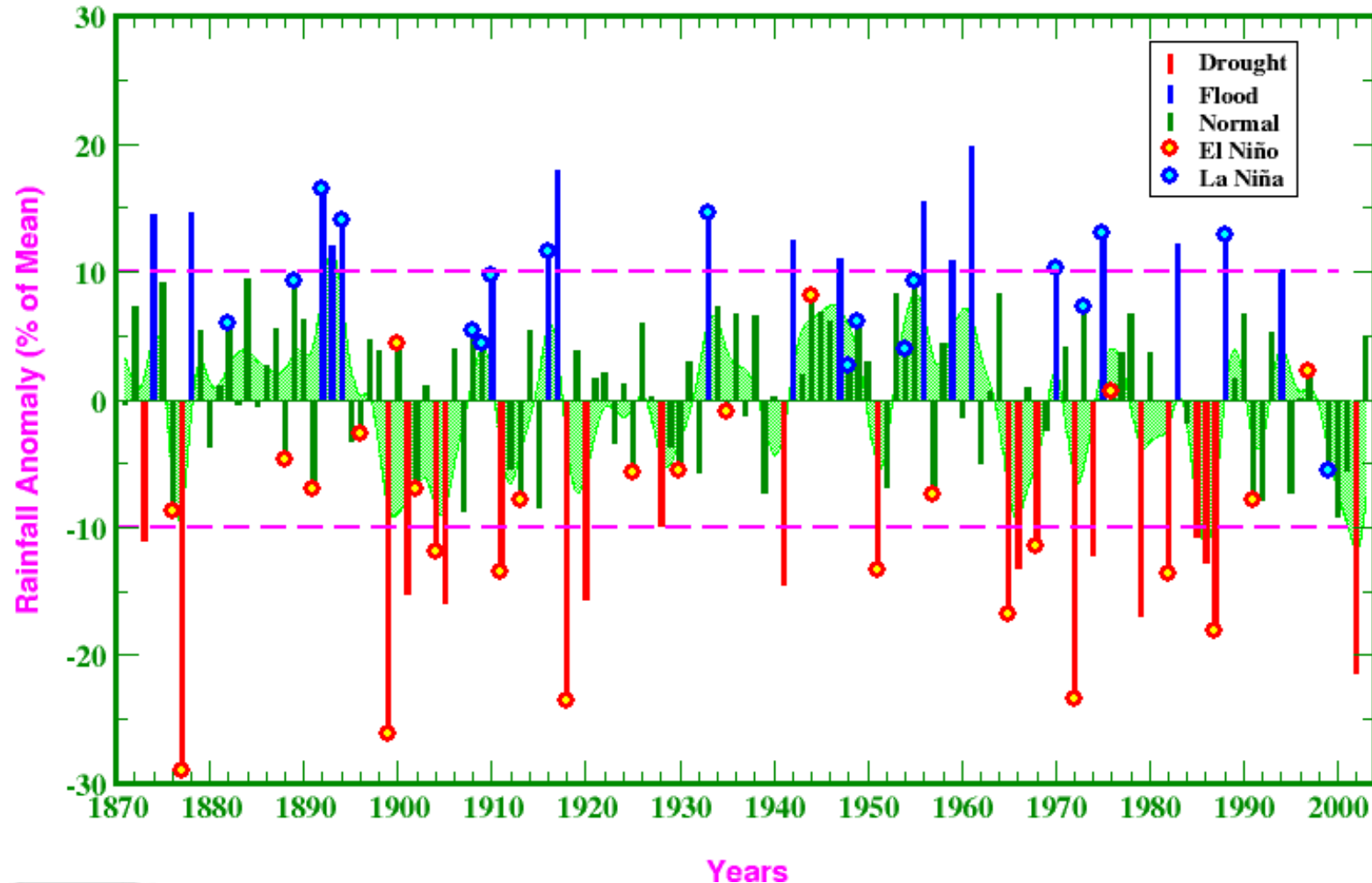


El Nino/Southern Oscillation



All-India Summer Monsoon Rainfall (1871-2003)

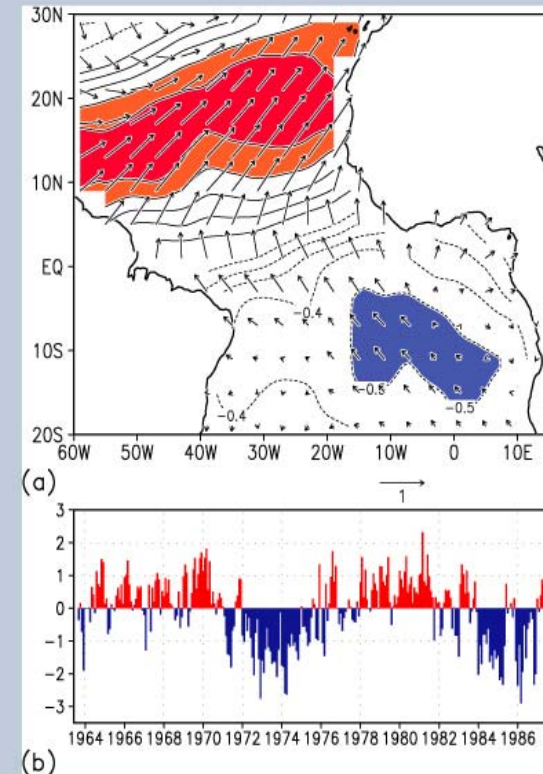
(based on IITM homogeneous Indian Monsoon Rainfall dataset)



This figure shows the time series evolution of AISMR anomalies, expressed as percent departures from its long-term mean.

... and the interannual variations need not be ENSO-like:

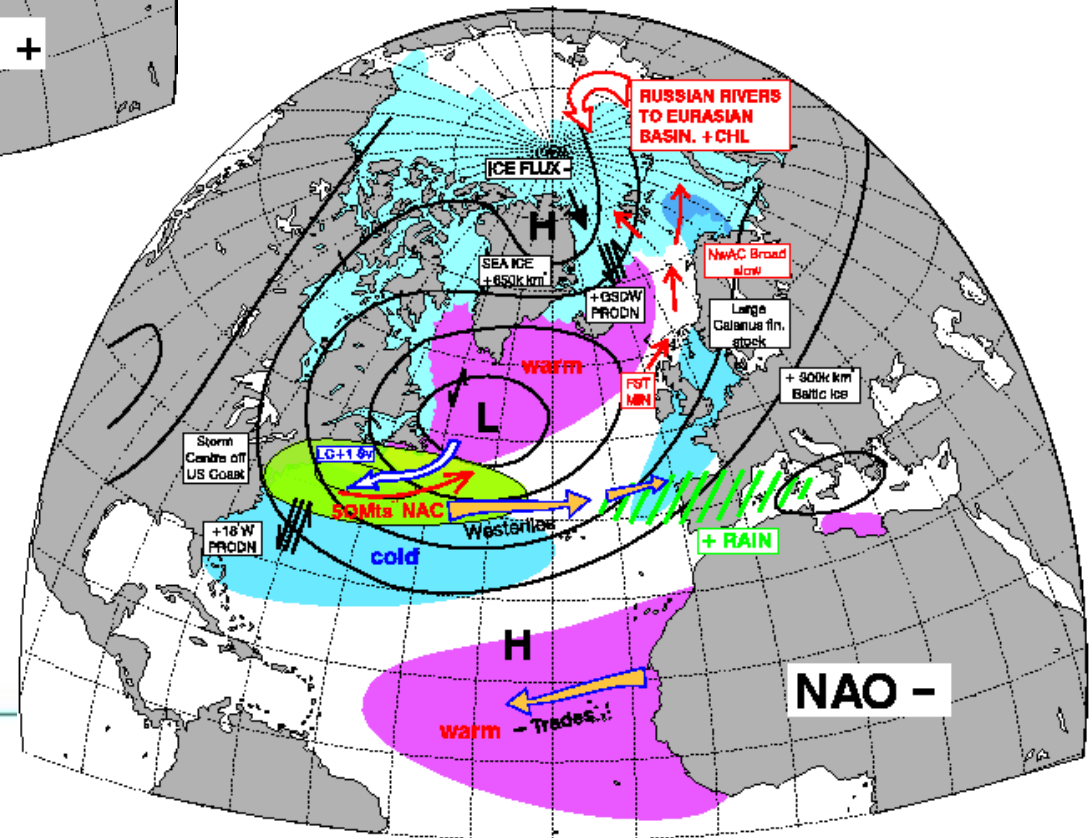
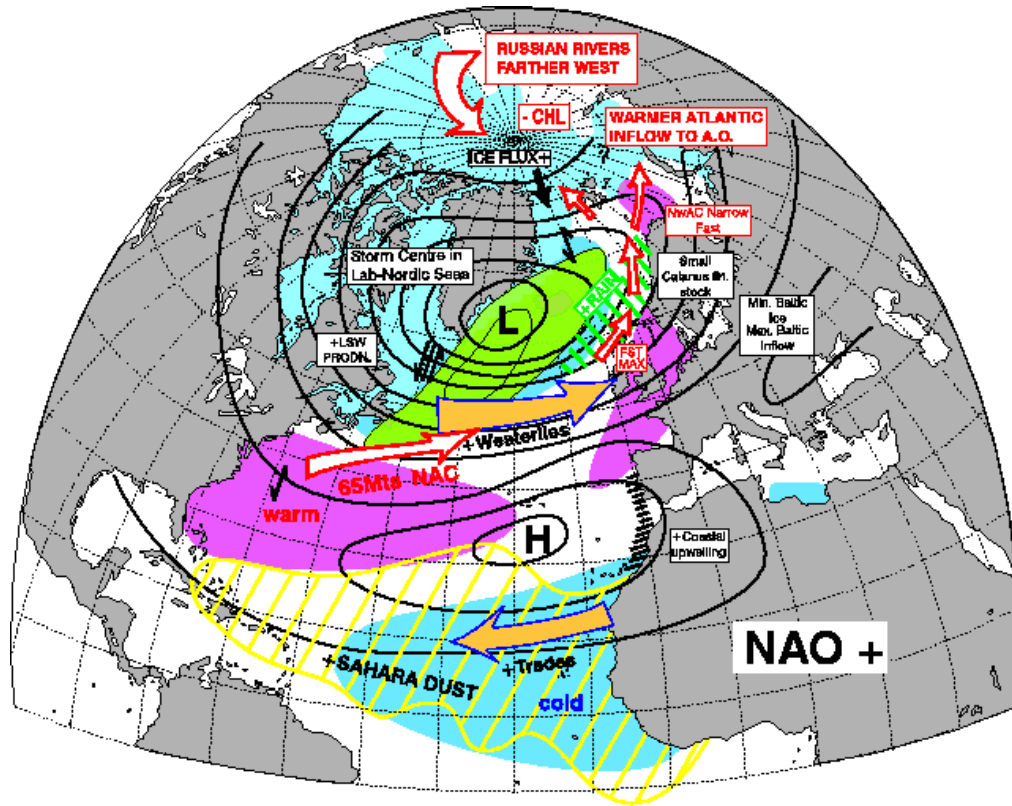
Tropical Atlantic Climate Variability An Atlantic Dipole ?



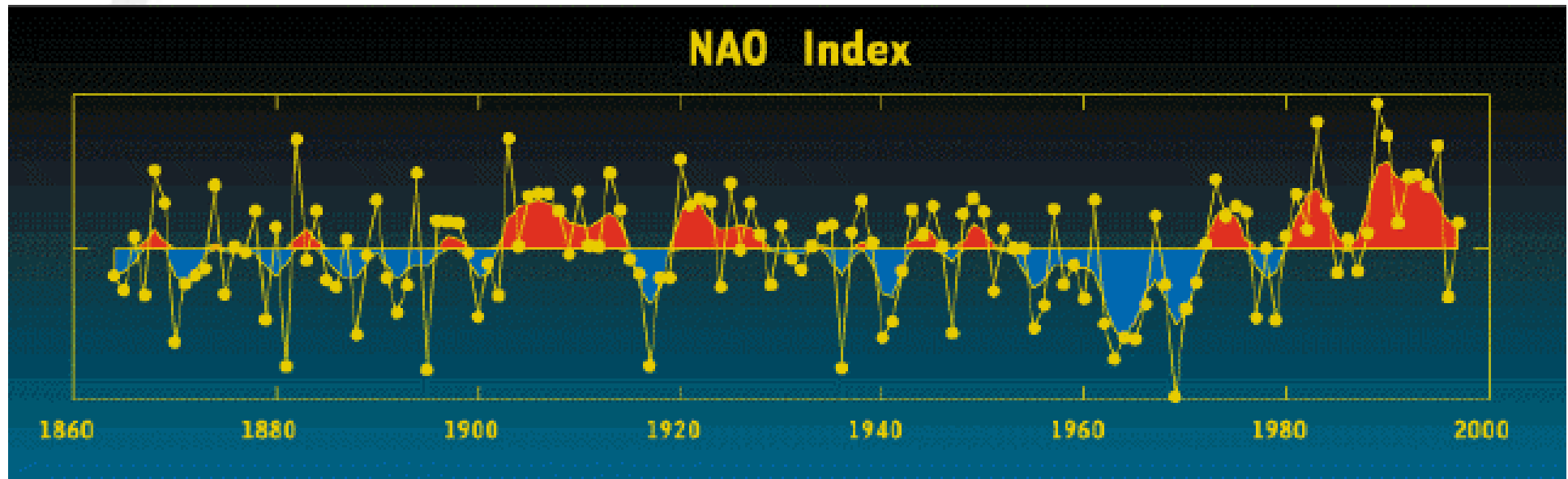
The dominant joint patterns of sea surface temperature and surface wind stress variability over the Atlantic for the period September 1963 to August 1987 and the associated time series. The time series show a dominant signal at lower frequencies but as well, there are seasonal and interannual fluctuations (Nobre and Shukla, 1996, *J. Climate*, 9, 2464-2479).

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North Atlantic Oscillation: the major mode of variation in the extra-tropical winter climate (contracted in summer)

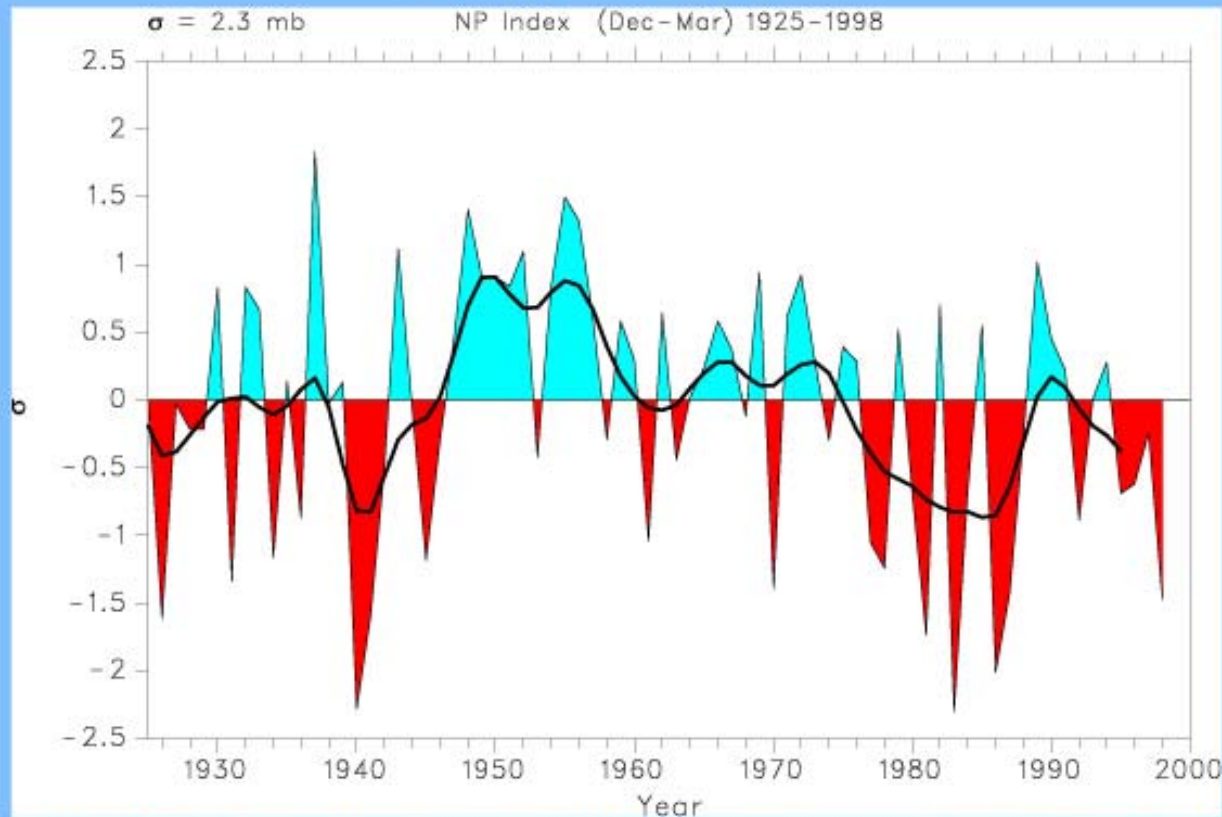


Decadal Variability of North Atlantic Oscillation



The NAO index is defined as the anomalous difference between the polar low and the subtropical high during the winter season (December through March).

Decadal Variability in the Pacific - The North Pacific Mode -



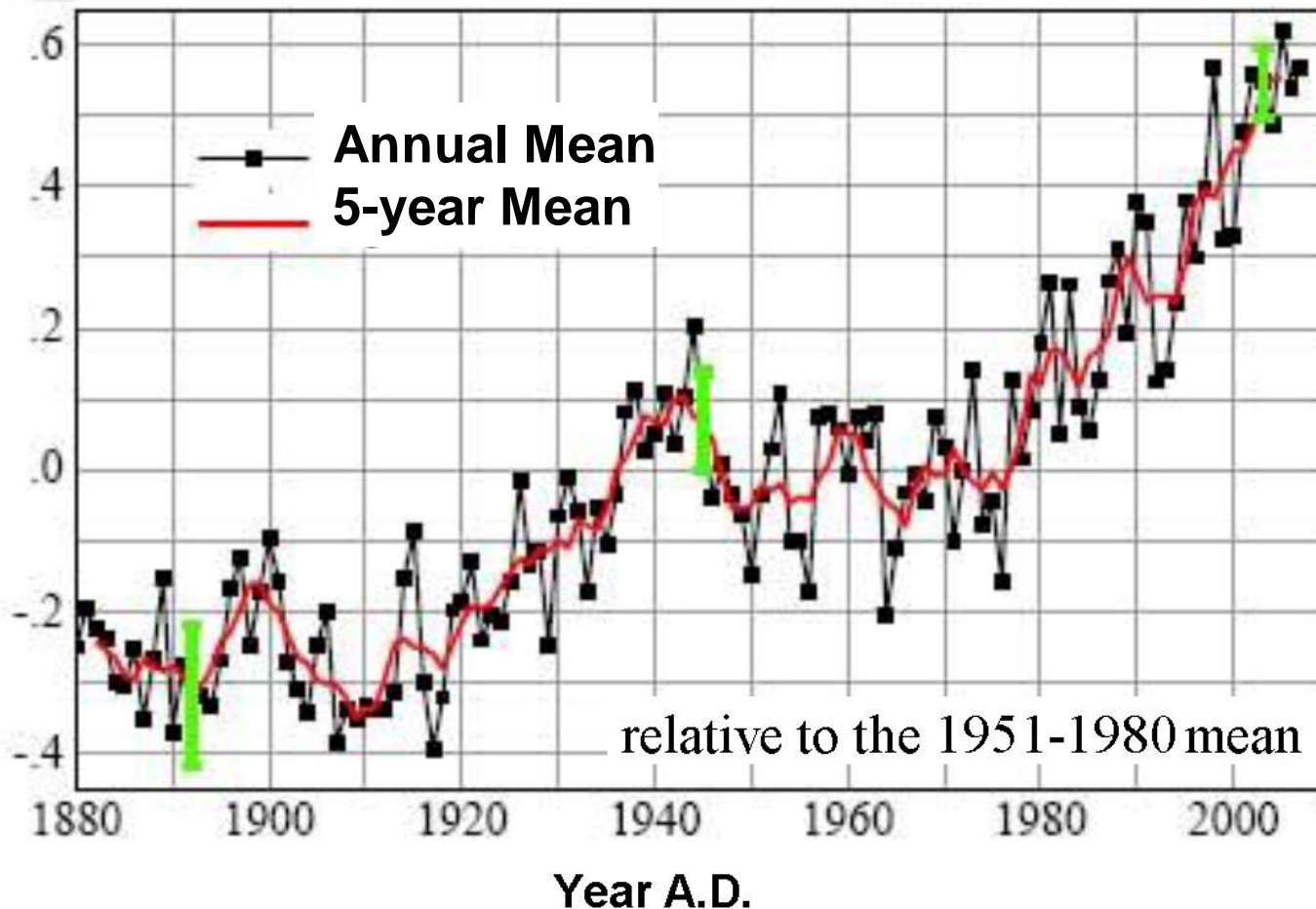
The North Pacific (NP) Index is the area-weighted sea level pressure over the region 30°N - 65°N , 160°E - 140°W and shows a high level of decadal time scale variability (after Trenberth and Hurrell, 1994, *Climate Dynamics*, 9, 303-319).

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Global Warming

Global Warming is the increase in the **average temperature** of the Earth's near surface air and oceans since the mid-20th century and its projected continuation. (Wikipedia)

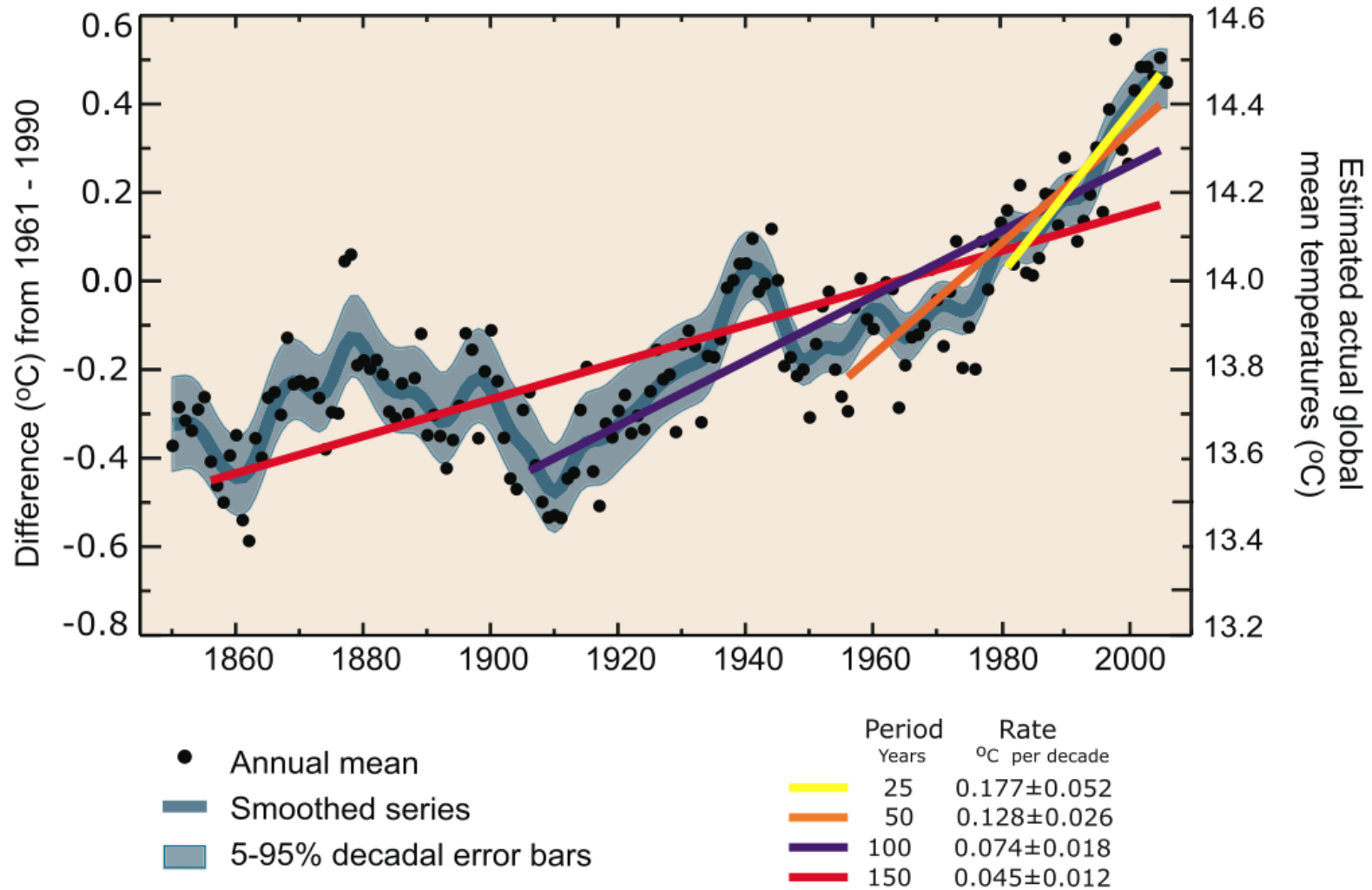
Global Temperature Change (°C)



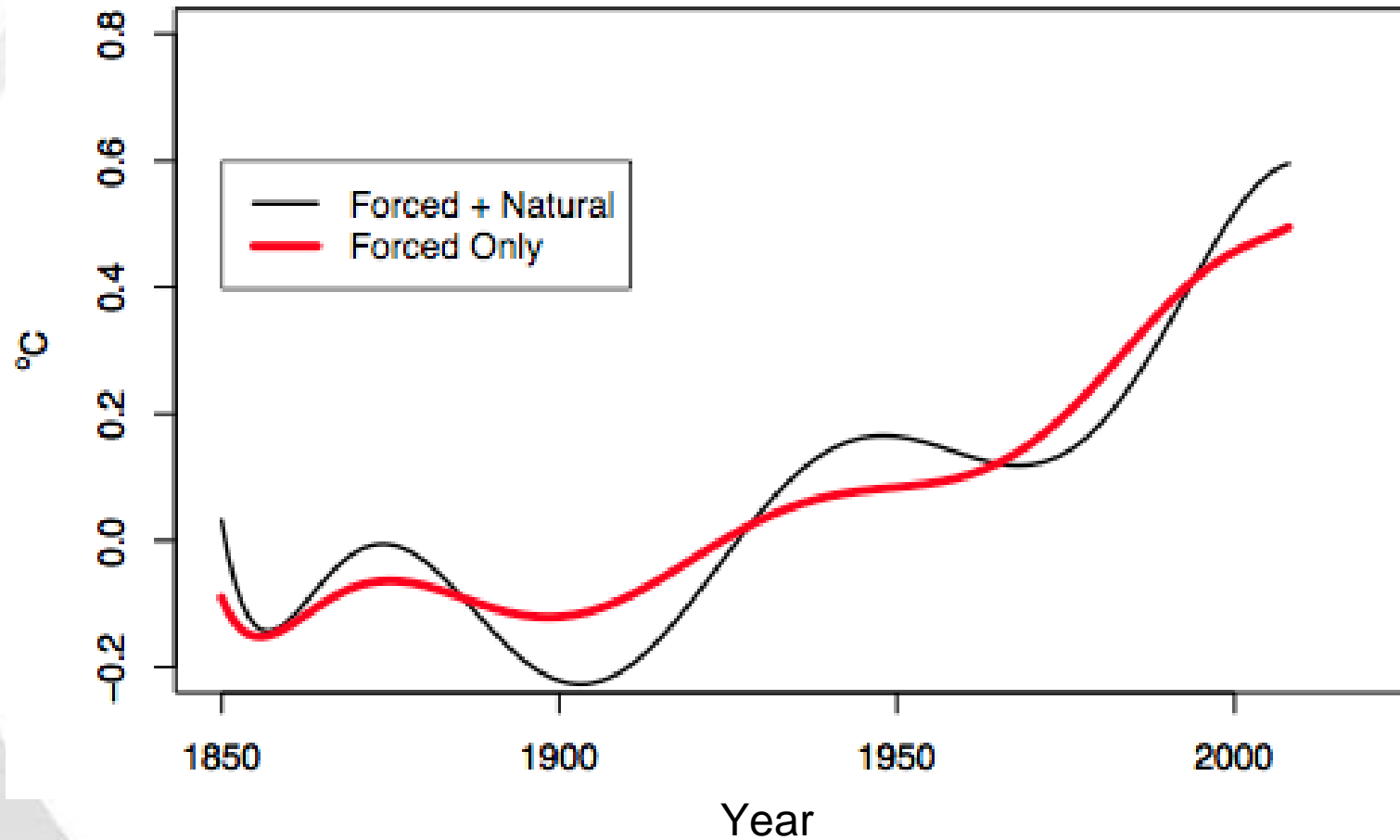
0.76°C (1.4°F) since 1900

0.55°C (1.0°F) since 1979

Global Mean Temperature



Low-Pass Spatially Averaged Surface Temperature on 'Well-Observed' Grid



- Use S/N and Trend to calculate forced pattern.
- Use IPCC pre-industrial control runs to calculate internal variability pattern.



Recent Papers

**“A significant Component of Unforced Multidecadal Variability in
Twentieth Century Global Warming”**

**Timothy DelSole, Michael K. Tippett, Jagadish Shukla
(Under Review: Journal of Climate)**

**“The Impact of North Atlantic-Arctic Multidecadal Variability on
Northern Hemisphere Surface Air Temperature”**

**Vladimir A. Semenov, Mojib Latif, Dietmar Dommenges, Noel S. Keenlyside,
Alexander Strehz, Thomas Martin, Wonsun Park
(To Appear: Journal of Climate)**

“On the Trend of the Global Mean Surface Temperature”

**Norden E. Huang, Zhaohua Wu, John M. Wallace, Xianyao Chen, Brian Smoliak,
Compton J. Tucker
(Under Review: Science)**



THANK YOU!

ANY QUESTIONS?