

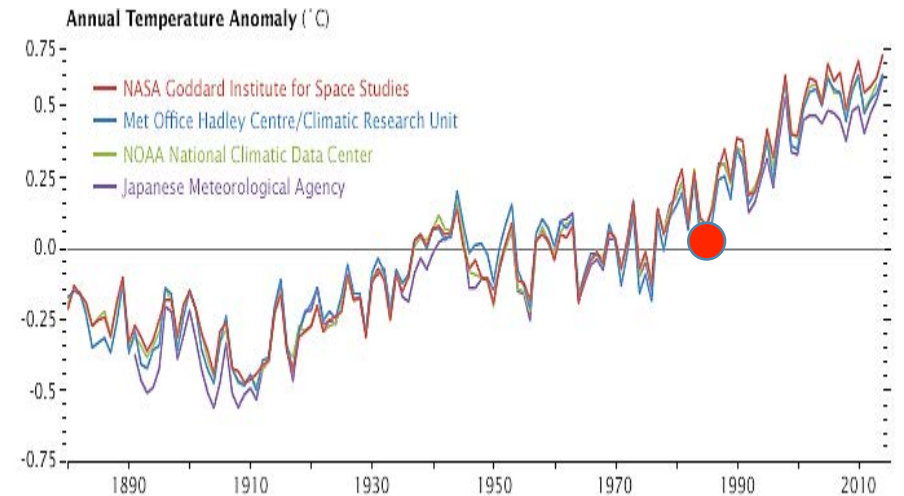
Climate Research and Prediction

Contributions from ***Climate Processes Group*** (Igor Esau, Stephen Outten, Linling Chen, Richard Davy, Victoria Miles, Anna Mikelsen, Tobias Wolf) and

Climate Dynamics and Prediction Group (Yongqi Gao, Detelina Petkova Ivanova, Francois Counillon, Helene R. Langehaug, Kjetil Lygre, Lingling Suo, Madlen Kimmritz, Yanchun He, Yiguo Wang)

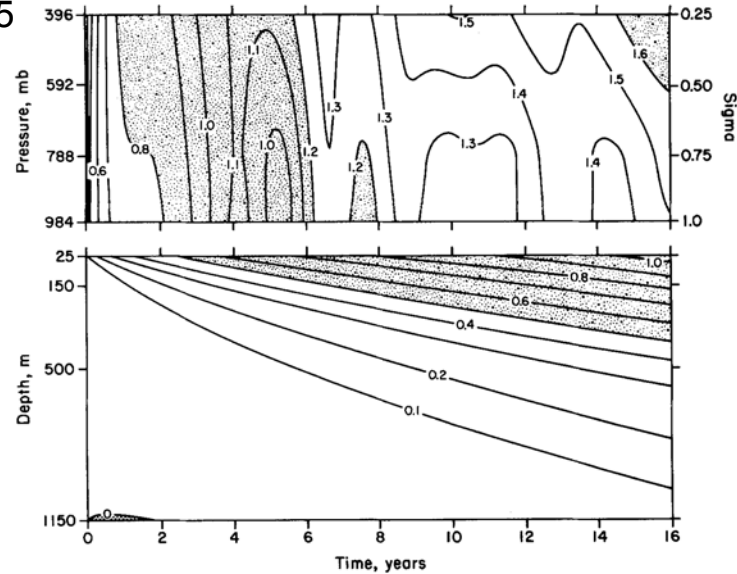
Historical remarks: Looking back at 1986

- CO2 concentration was **342 ppmv**
- The 1st year in the still continuing series of **positive** mean global surface air temperature anomalies
- Only 40 papers with **climate change** in the **topic** (ISI WoK) were published
- The **ocean was a swamp**, chemistry and biosphere did not exist, but CO2 scenarios were rather realistic
- No coherent global **climate records** exist
- The most of **climate parameters were free** to speculate about
- Applied climatology was seen as a **reference book** given once and forever



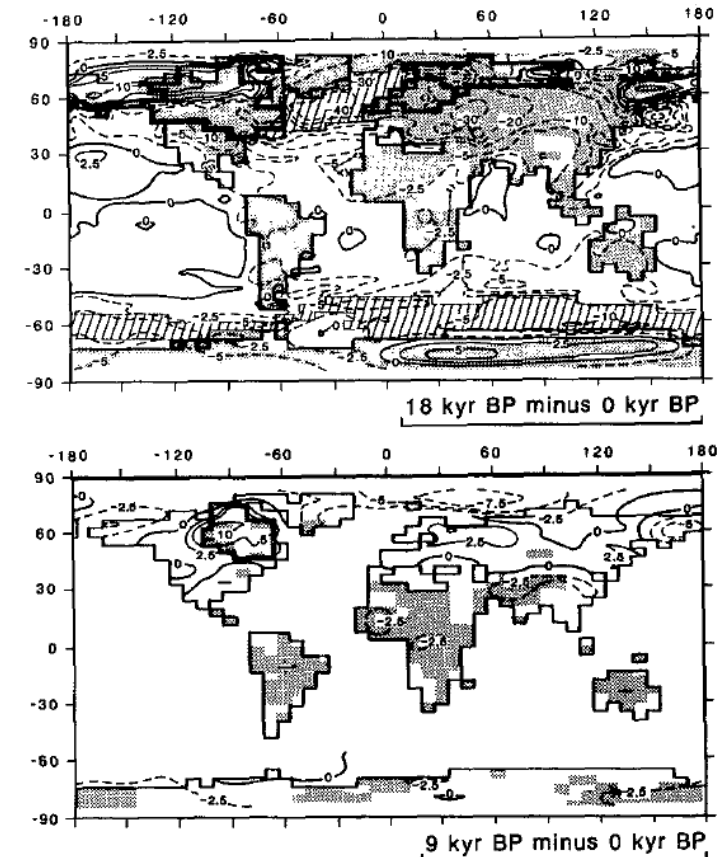
Two seminal publications from 1986

Schleziinger, M.: Equilibrium and transient climatic warming induced by increased atmospheric CO₂, *Climate Dynamics*, **1986**, 1, 35



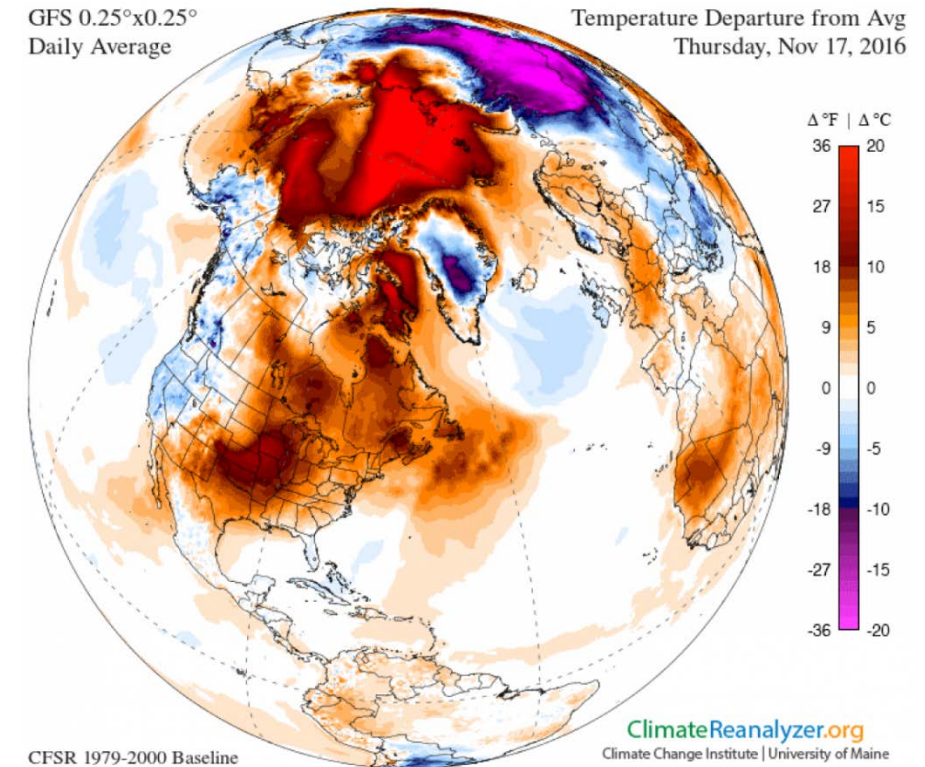
Theoretical studies for a realistic CO₂ increase (1850-1980) indicate that this sequestering of heat into the ocean's interior is responsible for **the warming being only about half** that which would have occurred in the absence of the ocean... that the climate system **will continue to warm** towards its as yet unrealized equilibrium temp. change, even **if there is no further increase in the concentration**.

Kutzbach, J. & Guetter, P. The Influence of Changing Orbital Parameters and Surface Boundary Conditions on Climate Simulations for the Past 18 000 Years, *Journal of the Atmospheric Sciences*, **1986**, 43, 1726–1759



30 years later: Climate challenges 2016

- CO₂ concentration has passed **400 ppmv** and the temperature anomaly **+1.0°C** in 2015
- Number of **climate change** publications exceeded 1000 per year
- Fully coupled **Earth System Models** have matured
- **Coherent climate records** have been assembled and extended for hundreds years in the past
- Applied climatology **dares to predict** climatic anomalies and detail their regional and socioeconomic impact



World
+ 0.55 °C
Tropics
+ 0.31 °C

Northern Hemisphere
+ 0.94 °C
Southern Hemisphere
+ 0.15 °C

Arctic
+ 6.42 °C
Antarctic
+ 0.92 °C

Climate Research at NERSC:

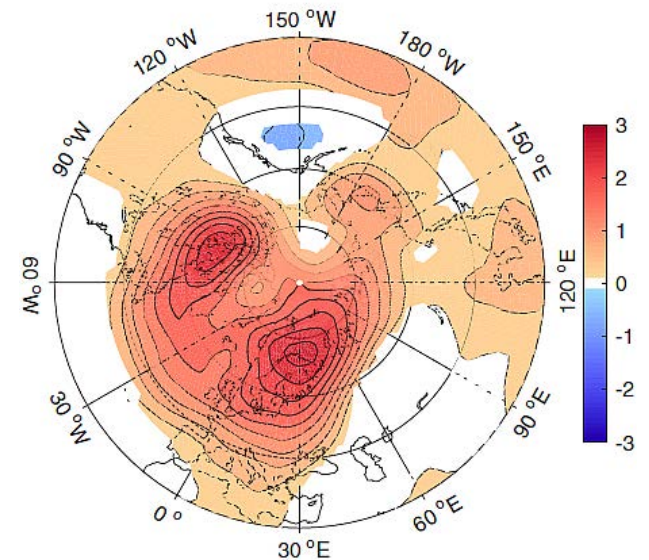
Expanding efforts, Increasing contributions, Answering societal demands

- Assembling climate records (GAIA-CLIM)
- Development the *Climate Prediction System* (Francois Counillon)
- Understanding climate Dynamics, Teleconnections, acting *Physical Processes and Feedbacks* (Igor Esau)
- Run regional climate research for Arctic, Norway and widely for the Eurasia and PEEEX regions pursuing *Challenges of Extreme Weather* (Linling Chen)
- The most recent publication – Strong evidence for Bjerknnes compensation in **600 years** of BCM data

Clim Dyn
DOI 10.1007/s00382-016-3447-2

Bjerknnes compensation in the Bergen Climate Model

Stephen Outten¹ · Igor Esau¹



Map of the ocean heat flux regressed onto geopotential height at 500 hPa, where the flux is leading by 2 years. Contour levels and units are 0.25 (m). *White* regions are below the 95% significance level

Climate Research and Prediction

- **Norwegian Climate Prediction Model** by *Francois Counillon*
- **Atmospheric boundary layer in climate models** by *Richard Davy (Igor Esau)*
- **Arctic change and extreme weather** by *Linling Chen*

Questions and discussion