- Global oppvarming har STANSET


Foto: AP
Global mean surface temperature

"Hiatus"

Courtesy Helge Drange, based on GISS and CRU data
Global mean surface temperature

Courtesy Helge Drange, based on GISS and CRU data
Observed and simulated GMST

Global surface temperature
Observed 1850-present (HadCRUT4)
Modelled 1850-2005
RCP8.5 2006-2100
RCP2.6 2006-2100

Temperature anomaly (°C)

1850 1875 1900 1925 1950 1975 2000 2025 2050 2075 2100

Courtesy Helge Drange, updated from Medhaug and Drange 2016
Observed and simulated sea ice loss

"Hiatus"

Updated from Stroeve et al 2007
Accelerating mass loss from Greenland ice sheet since 2002. Evidence of slowing trend in recent years?

End "hiatus"

Albedo anomaly summer (JJA) 2015
Rapid increase in Arctic temperatures and melting coincide with hiatus in global warming
What cause variations in global climate on annual to multidecadal time scales?
Observed temperature change

Global mean temperature change (CRU data set)
Changes in four forcing factors: CO2, ENSO, Volcanoes, Sun spots. They are all known to influence global climate.
Observed and reconstructed temp

CRU TEMP: Trend=0.14 deg/decade
RECONSTRUCT: Trend=0.14 deg/decade

CORRELATION=0.907
Drivers of year-to-year variability

Multiple regression performed between global mean temperature and linear combination of all four forcing factors. Lags from 0 to 5 months tested.
Decadal to multidecadal variability

Difference between observed and constructed temp

Other drivers?
- Aerosols?
- Non-linearity?
- Low-frequent internal variability?
- The role of the ocean?

Pacific decadal oscillation (PDO)

Atlantic Multidecadal Oscillation (AMO)
PDO and AMO

Both exhibits multidecadal time scales. Mechanisms not fully understood. Likely combination of many factors (stochastic forcing, ocean mixed layer, ocean dynamics)

(see e.g. Newman et al, 2016, in press)
An ocean of studies point to Pacific (PDO / trade winds) as main driver for decadal to multidecadal fluctuations in global mean climate
Observed global temp and PDO

Trenberth et al 2014; Trenberth 2015
Warm versus cold periods

Strong warming

Weak warming / cooling

Sea surface temperature anomaly

0-300 m heat content

Medhaug and Drange 2015
Warm periods

Cold periods

Ensemble mean temperature for Warm and Cold composites from piCtrl averaged between 5°S and 5°N in the Pacific Ocean. The ensemble mean thermocline, here indicated by the model mean 20°C isotherm, is shown in gray.

Medhaug and Drange 2015
Tropical Pacific can also influence the Arctic
PDO and global climate


Oct - Mar

Surface Temperature

Sea level pressure

Apr - Sep

Trenberth, et al 2014
PDO and global climate

Observations

Simulation


Trenberth, et al 2014
PDO modulating Arctic warming?

Strongest arctic warming in negative PDO phase (as observed)

Return to positive PDO "could act to temporarily reduce the pace of the wintertime Arctic warming"
Conclusion

- A period with modest global warming ("hiatus" or "pause") has coincided with strong warming in the Arctic.

- Observations and models identify variations in sea surface temperatures in the Pacific to be the cause.

- Short term fluctuations (yrs to a decade) driven by ENSO variability. Longer term by the Pacific Decadal Oscillation.

- SST anomalies in the tropical Pacific partly responsible for very rapid Arctic warming.

- Return to positive phase of the PDO: Rapid global warming but a reduced pace in warming of the Arctic?