**Sustainability Day:**
**NTNU Ålesund. 12.12.2018**

# How Does Climate Change Affect Marine Ecosystems?

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***Norwegian University of Science and Technology***

# Research: Climate Eco systems

1995-2007: Climate => Ecosystems
2004: Dr. Philos.: Tides =>Climate => Barents Sea
2014-2016: Solar variability
2016-2018: Global Climate variability

Papers: > 25: Climate & Marine eco systems
2018-Conferences: Vienna, Porto, München

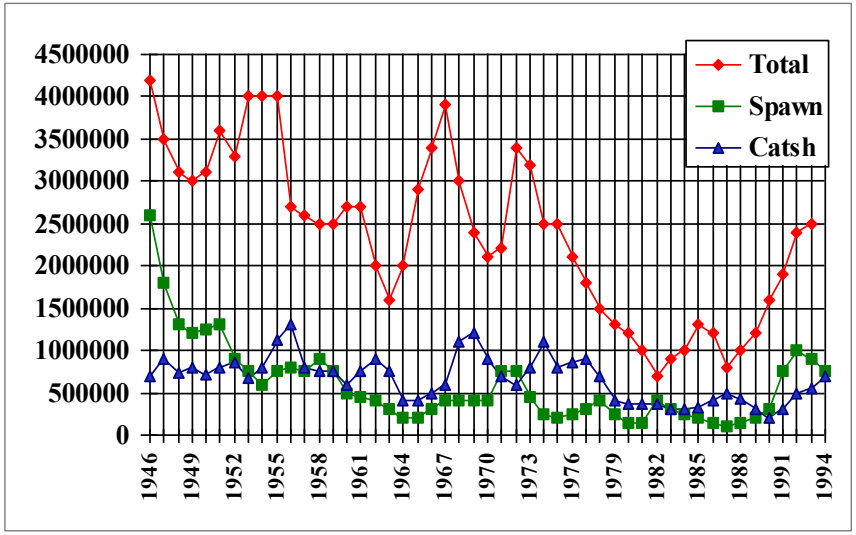
# Ålesund: 1960->1970

**The fishery was growing, until it disappeared**
**But who´s to blame: Fisherman or marine scientists**

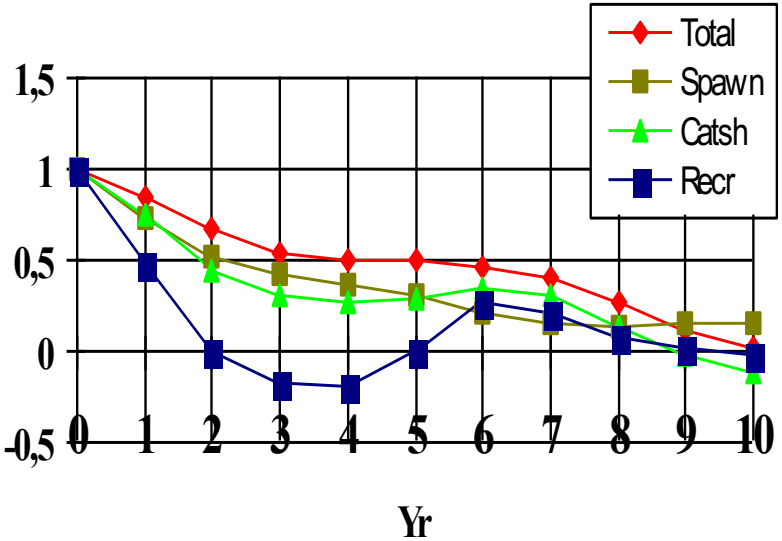
# Cod biomass => next 10 years?

## But is the biomass predictable?

Cod biomass timeseries



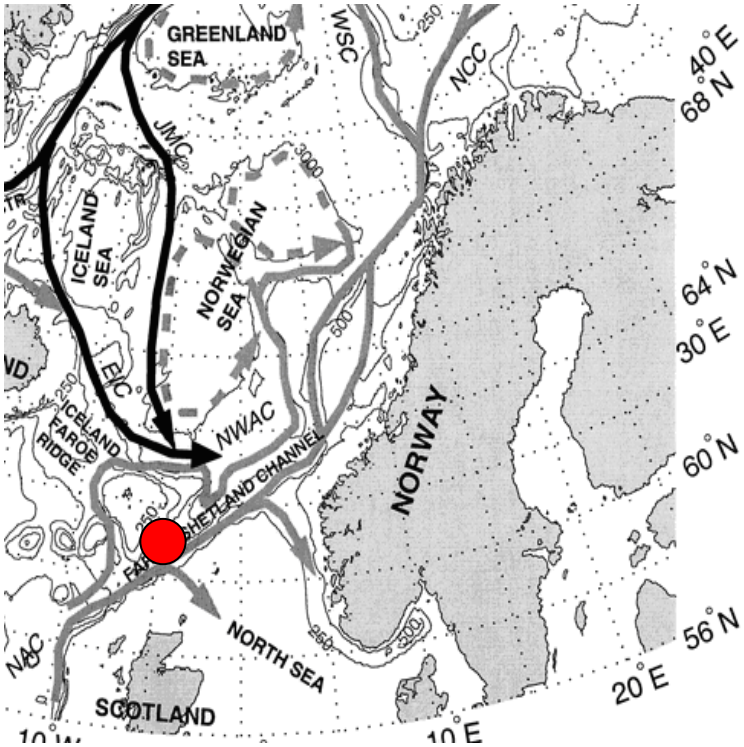

The autocorrelation

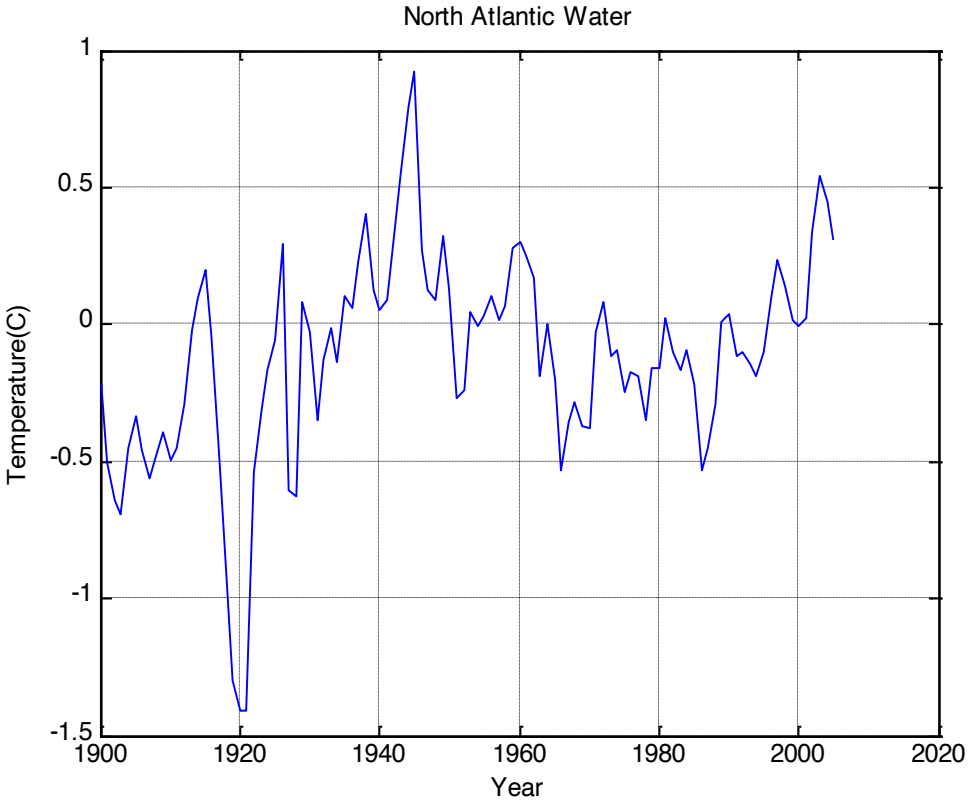



A stationary cycle in the biomass of Northeast Arctic cod?
If so, we may predict futuere biomass fluctuations

# North Atlantic Water temperature

## NAW temperature => Random or deterministic?

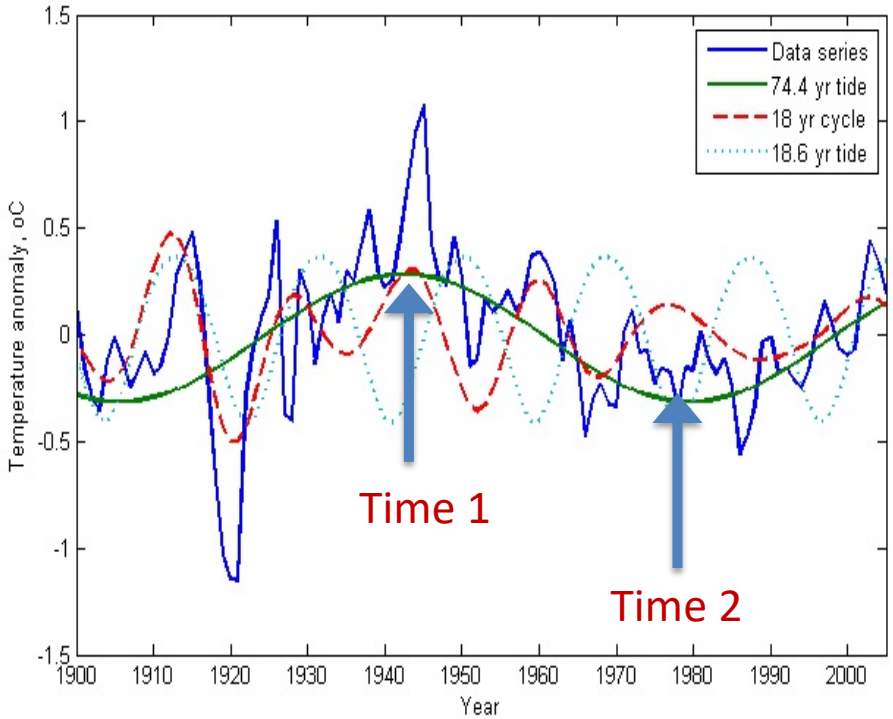


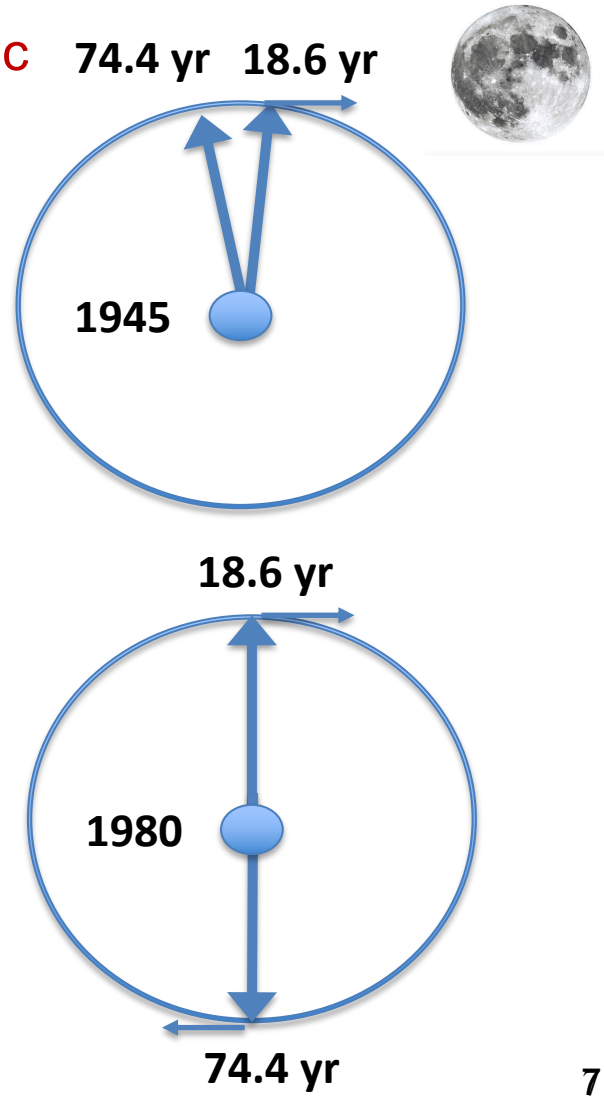
# Atlantic Temperature Clock

NAW: Controlled by 18.6-yr tide => Spectrum
Climate controlled by the Moon => Deterministic

**North Atlantic water temperature**




(Yndestad el al, 2004)



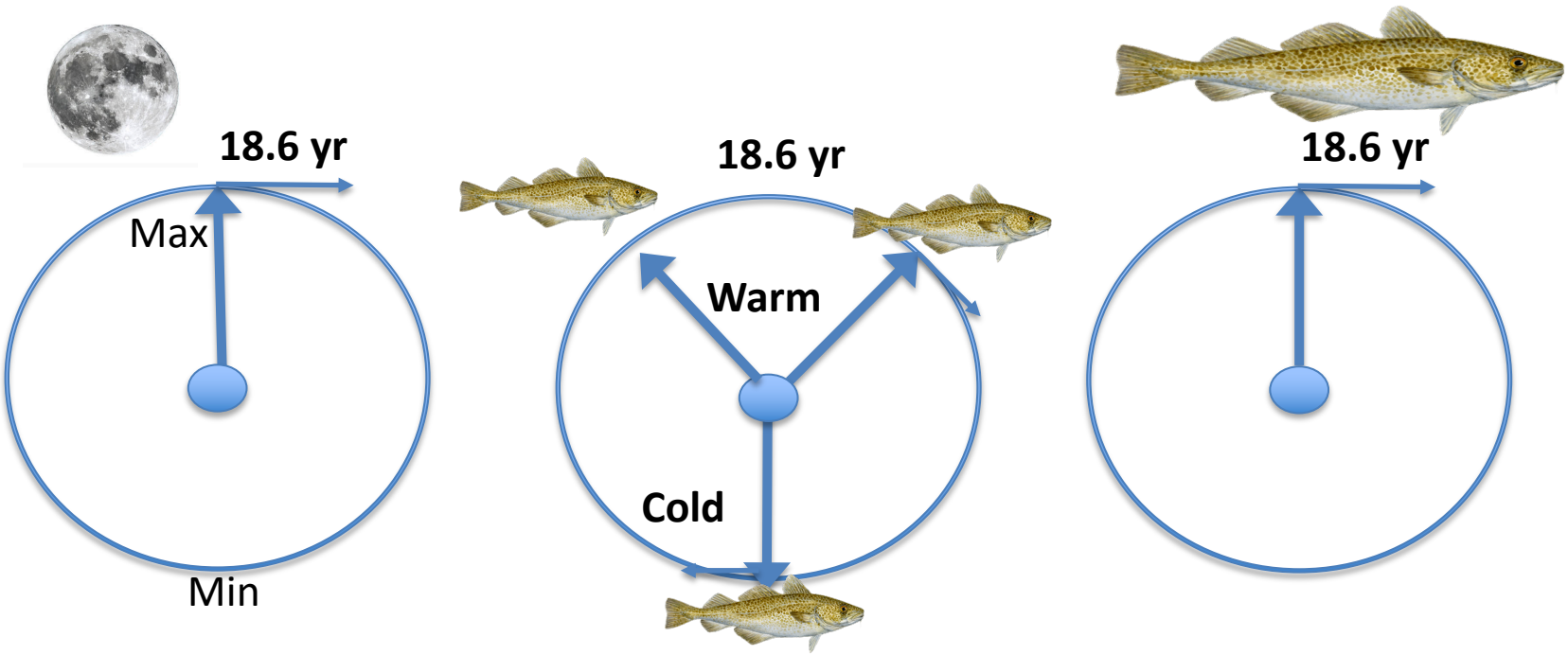
# Marine Eco system Resonance

**Cod biomass: Period and phase-locked to the 18.6 yr Lunar temperature period**

**Ocean: Temperature**

**Cod spawning period**
**18.6/3= 6.2 yr**

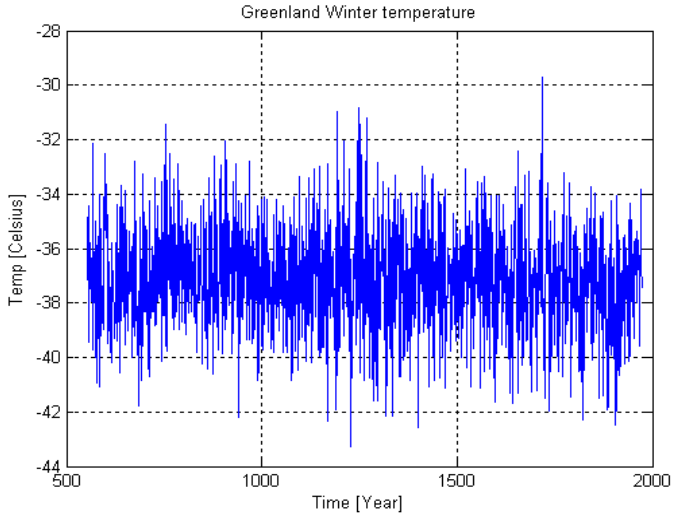
**Cod biomass**
**18.6 yr**



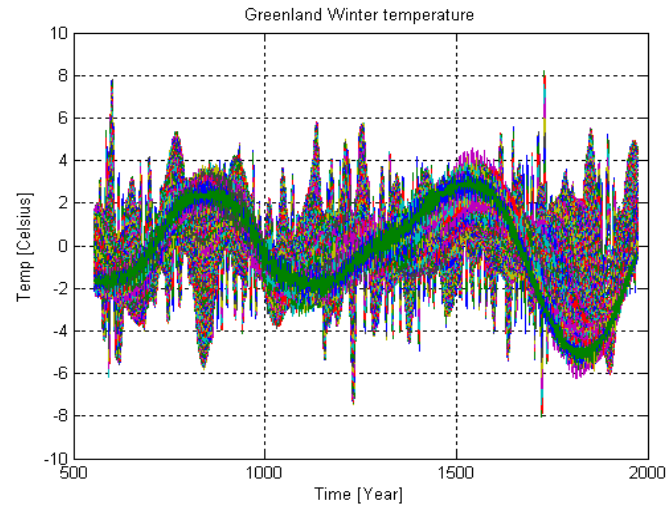

**+0.5 degree => 20 time more cod recruitment**

# 2004: PhD Disputation

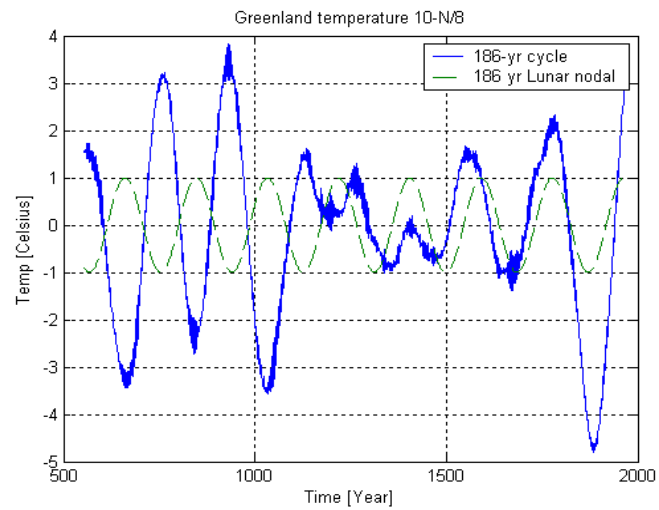
## Greenland temperature




## Wavelet spectrum




## Selected nodal cycle of 186 years



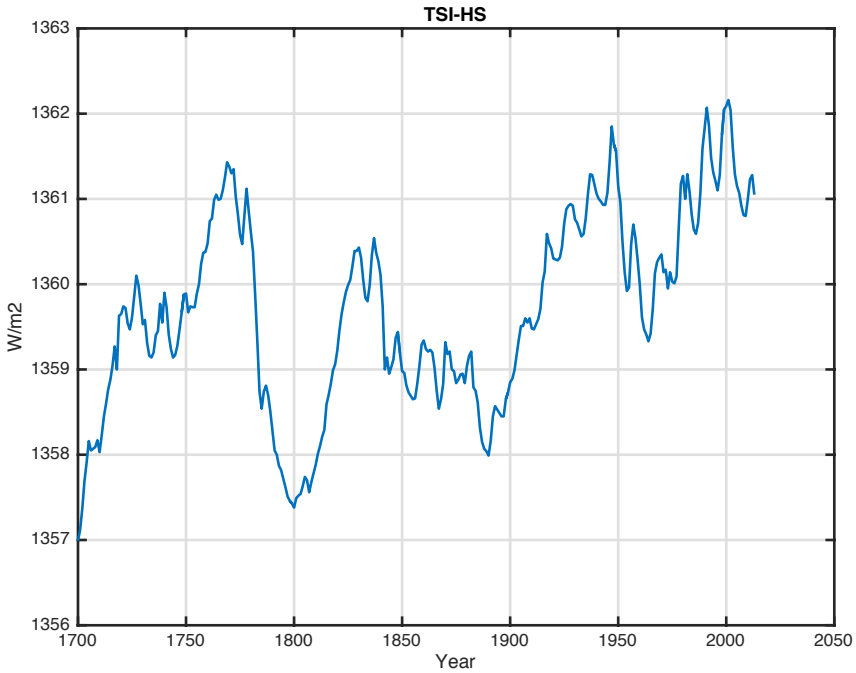

**Given Question:**
**IPCC: Arctic temp +5-7 degr =>2100**
**Effect on marine eco system?**

**My forecast:**
**186-yr period: Next minimum => 2040 AD**
**Deep temperature minimum => 2105**
**A new deep cold period => 1400 AD**
**A biomass collapse collapse => 2100 AD**

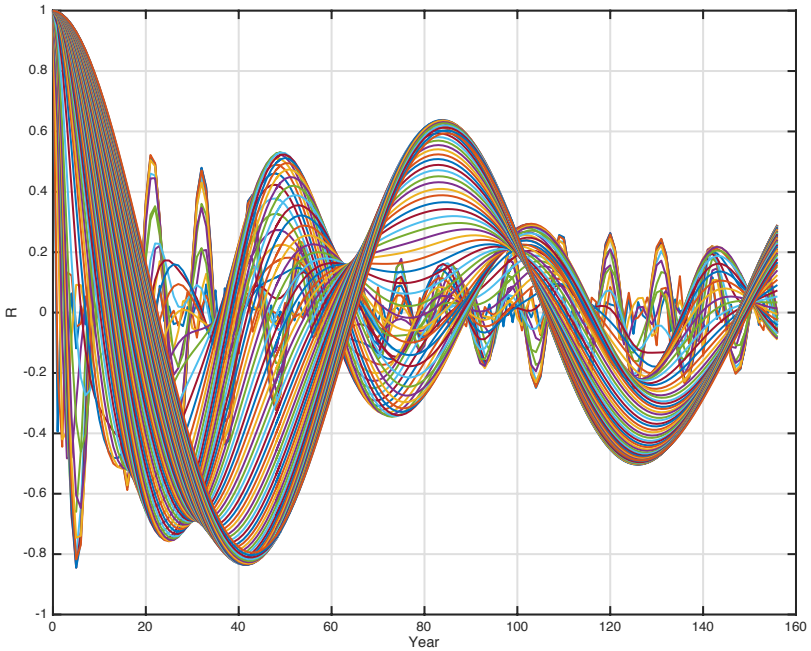
# 2014: Total Solar Irradiation periods

**NSA: ACRIM TSI (Hoyt-Schatten)**

*(Scafetta and Willson 2014 )*




Autocorrelations of the Wavelet spectrum




**Periods: "Planets fingerprints"**

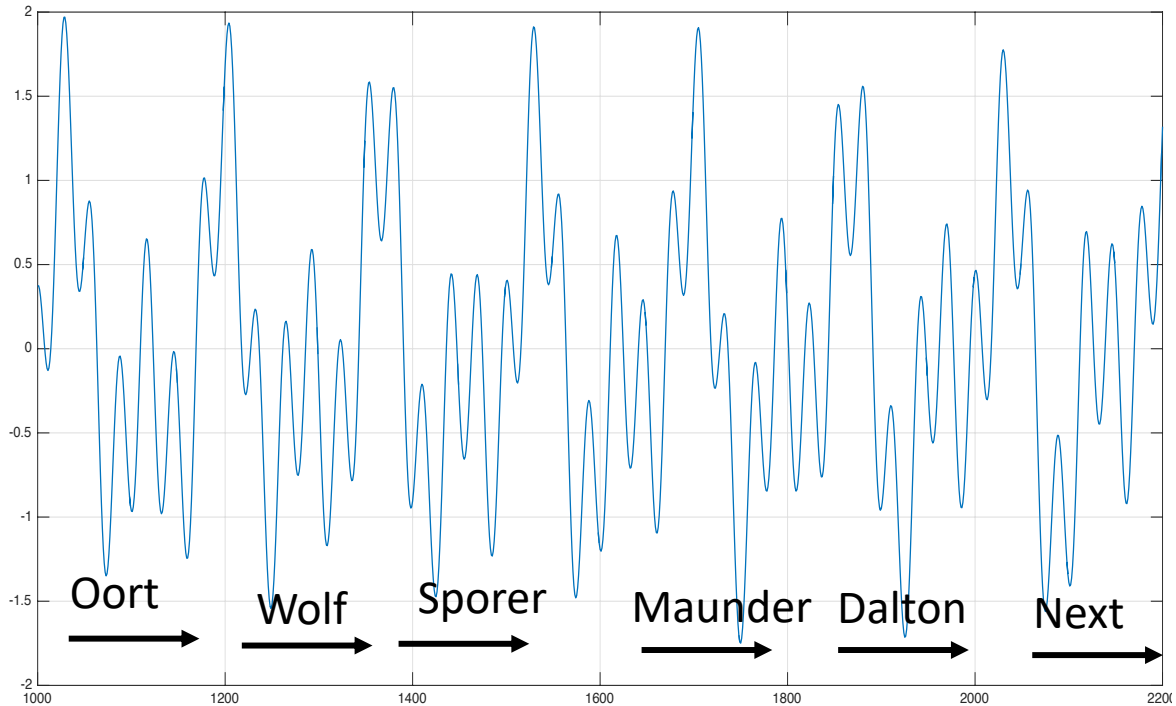
- 11-yr => Jupiter; 29-yr => Saturn;
- 84-yr => Uranus; 167-yr => Neptune

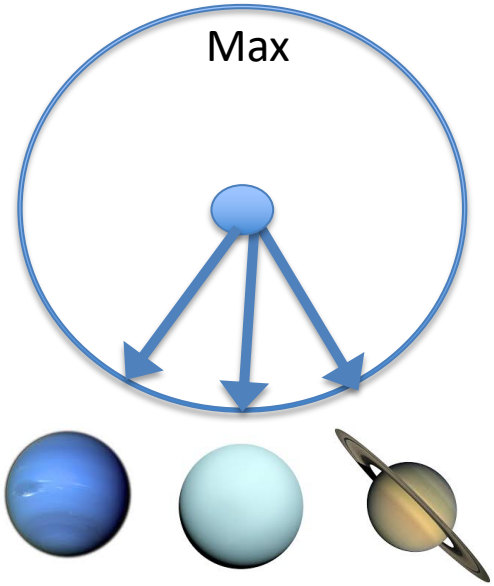
(Yndestad and Solheim, 2017, New Astronomy)

# Solar System Model

**Deterministic periods => Solar model: => Prediction 4266 years**

**Computed Solar irradiation: 1000 – 2200 AD**



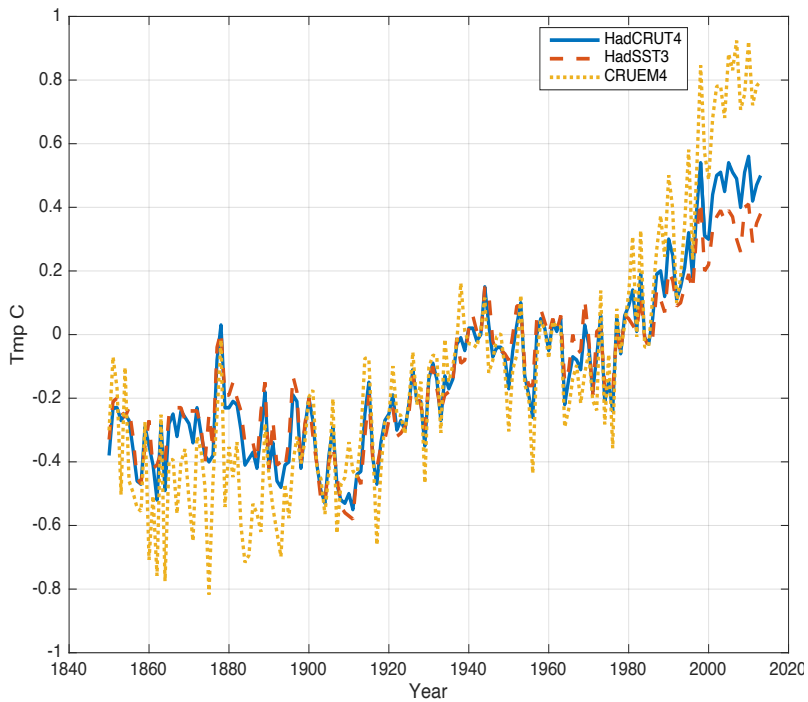




**Coincidences to known minimum solar periods:**
**Next deep solar minimum: 2060**
**The 186 year Greenland period => 178-year solar period**

# Global Earth Temperature

## Temperature: Random or deterministic?

**Global temperature (HadCRUT4): 1850 to 2017 AD**

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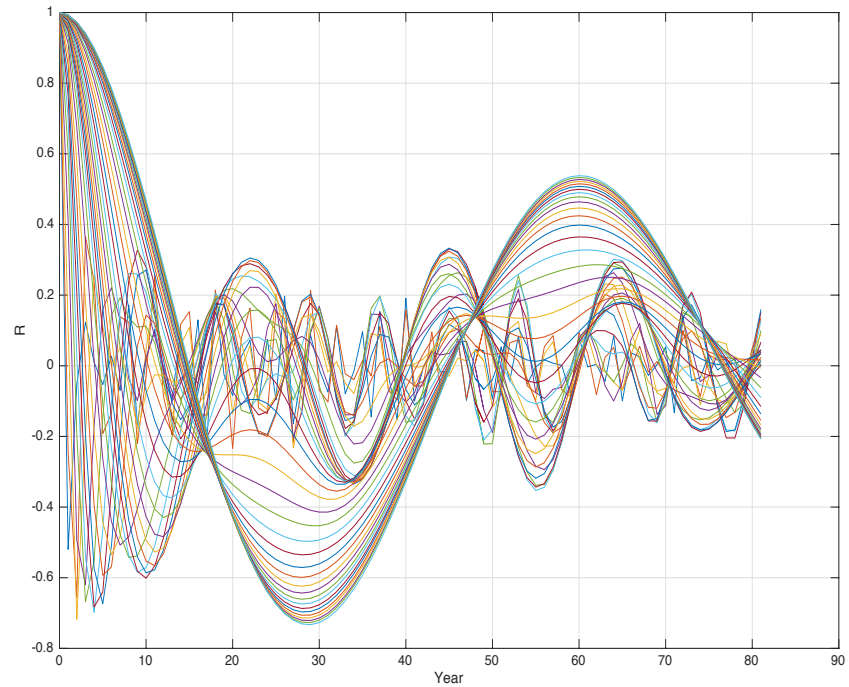


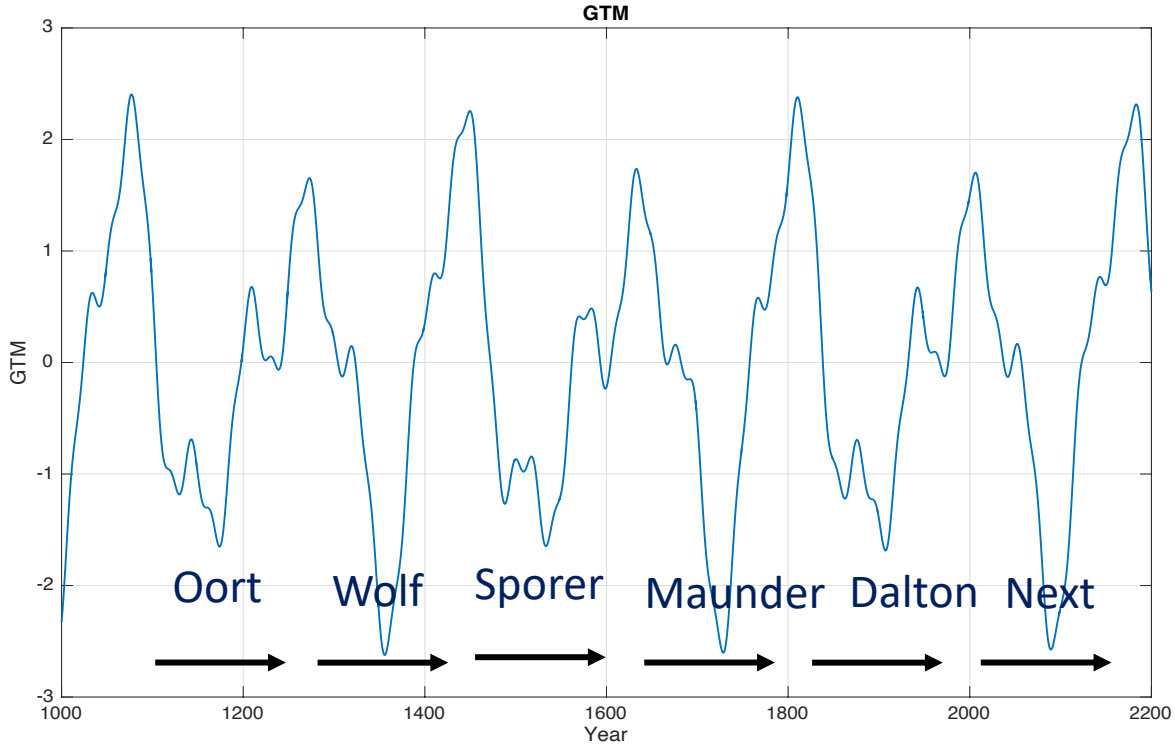

**Periods: "Solar-Lunar fingerprints"**

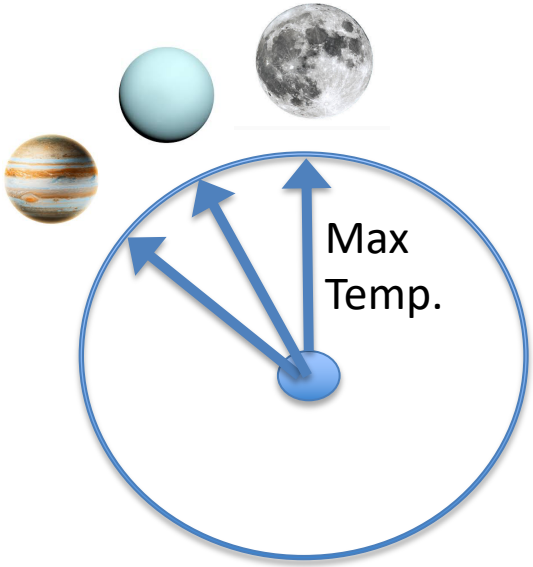
- 18.6-yr => Lunar; 22-yr => Solar;
- 61-yr => Solar-Lunar; 178-yr => Solar Neptune

# Global Earth Temperature Model

**Deterministic periods => Climate Model => Compute climate**

**Computed data series: 1000 - 2200 AD**

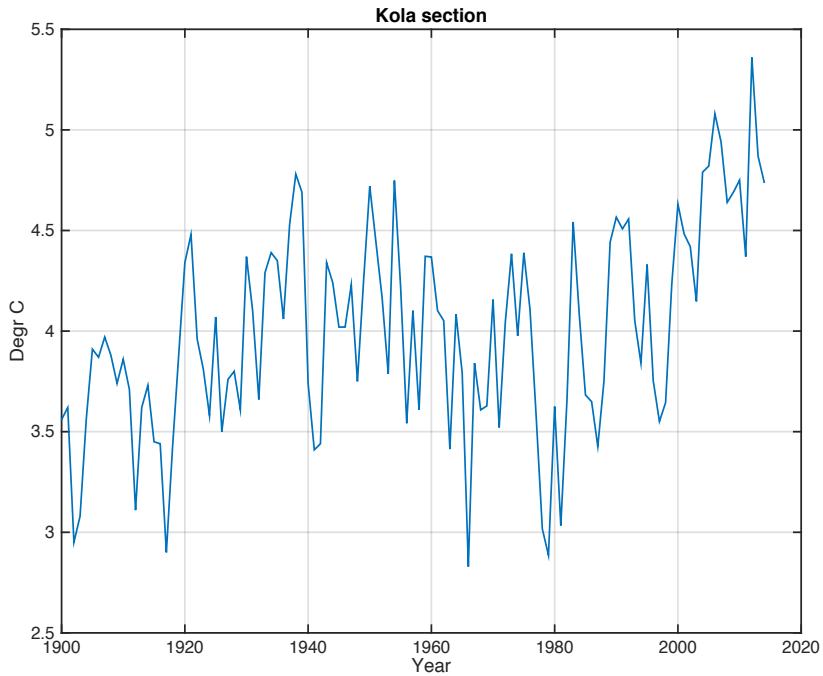


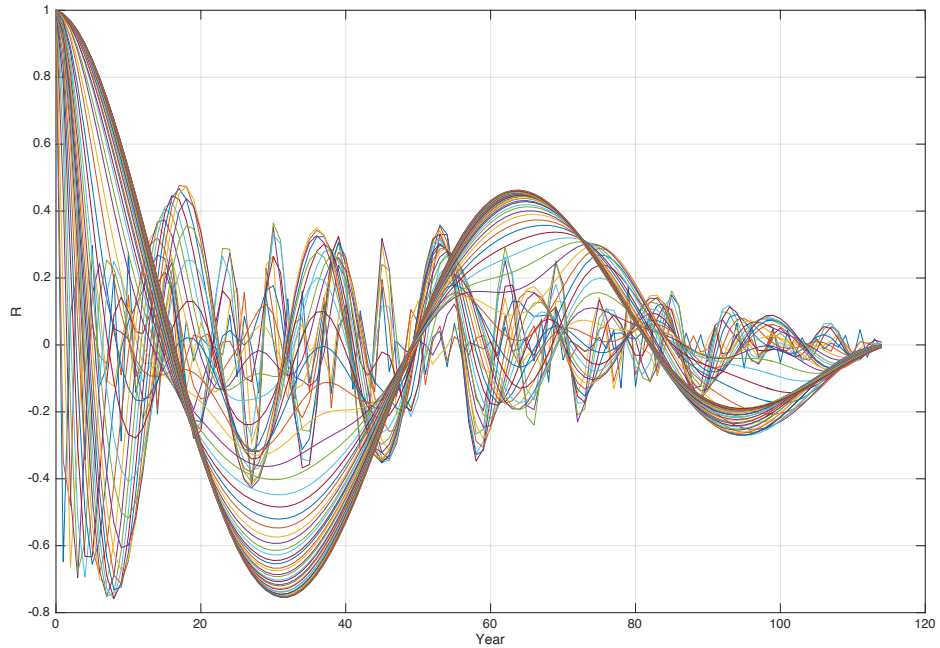

**Minimum temperature => Known minimum solar variability**
**Computed Maximum Global Temperature: 2030**
**Next deep minimum temperature: 2090 AD**

# The Barents Sea Temperature

Kola data series: 1900-2017




Autocorrelations of the Wavelet spectrum



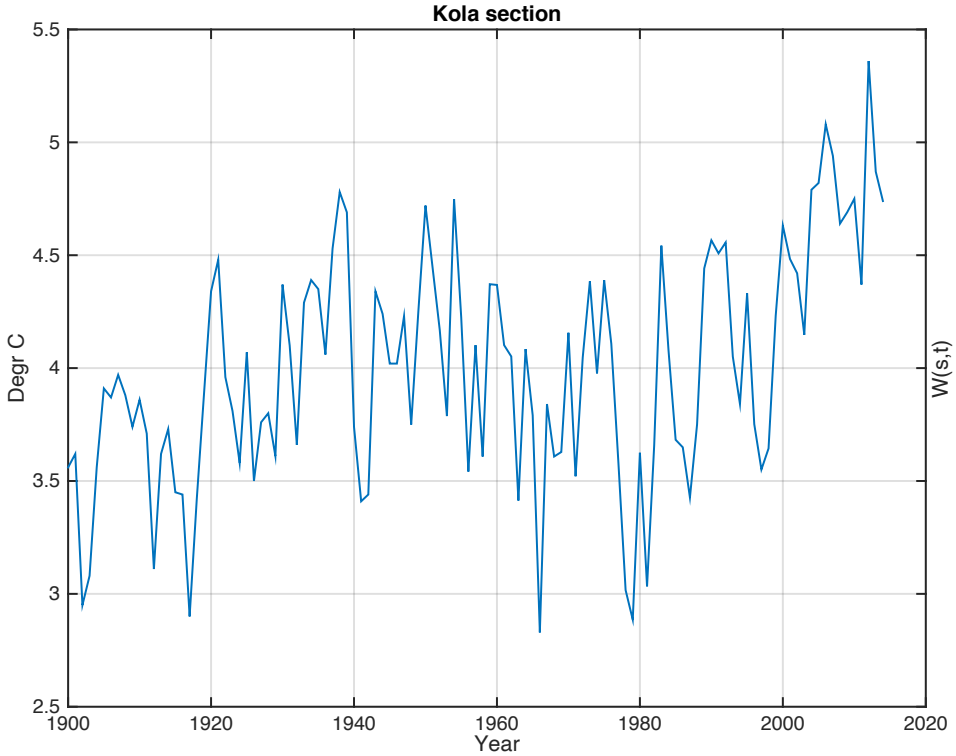

**Periods: "Solar-Lunar fingerprints"**

- 18.6-yr => Lunar;
- 61-yr => Solar-Lunar;
- 178-yr => Solar

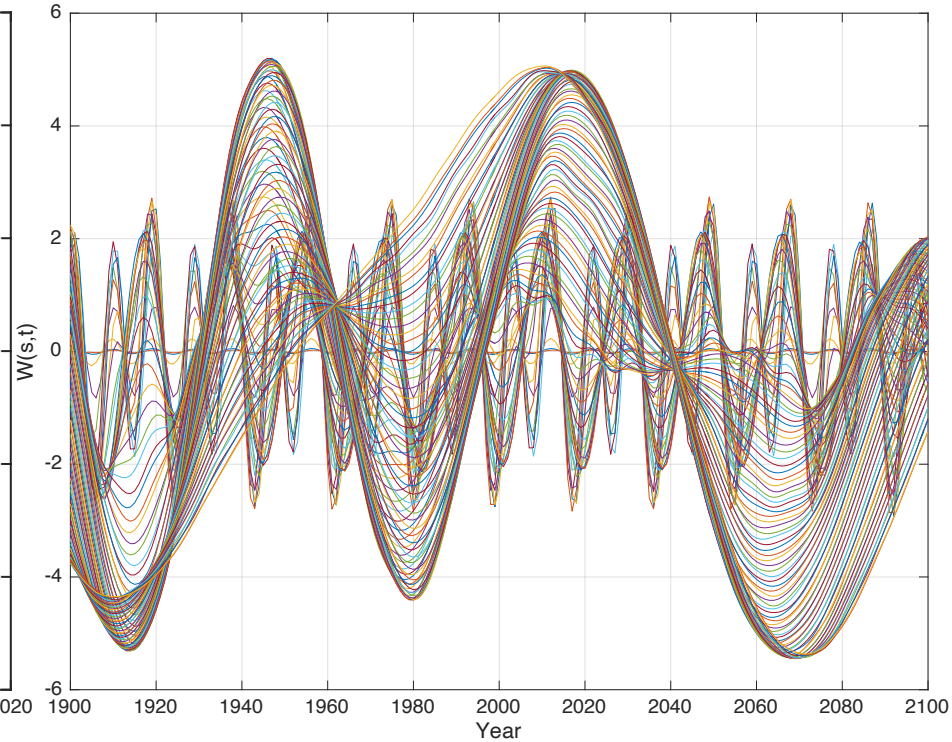
# Barents Sea Climate Model

**Data series => Specter => Model => Prediction => Specter**

Kola data series: 1900-2017




**The wavelet specter**




**Maximum: 2018 ; Minimum: 2070**

# Climate variability

## Deterministic periods

- A spectrum of solar-lunar periods: => 18, 60, 178,…yr
- Climate periods: predictable, not controllable
- After a warm period => a cold period
- Data analysis => Upcoming deep cold period

Global temperature:

| | |
|---|---|
| Modern maximum: | 2030 A.D |
| Next deep minimum: (-1.5 C) | 2090 A.D. |

The Barents Sea temperature

| | |
|---|---|
| Modern maximum | 2020 A.D |
| Next deep minimum | 2070 A.D |

# How Climate change marine eco systems

- No balance sustainability in nature
- Climate periods => Biomass growth and life cycles
- Cold periods: Eco systems adapts by mortality

**Implication of next cold period: max 2020 => min 2100**

- Marine ego system => a deep minimum
- Big risk of destroying the eco system.
- Big impact on the marine industry.
- Big impact on the economy in Norway
- Global warming hypothesis => Action delay

**Eco system sustainability => Prediction, to control dynamics**

# Thank you

**Eco systems need your support**