



ILMATIETEEN LAITOS  
METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE



# Impact of Climate Change on the Gulf of Bothnia

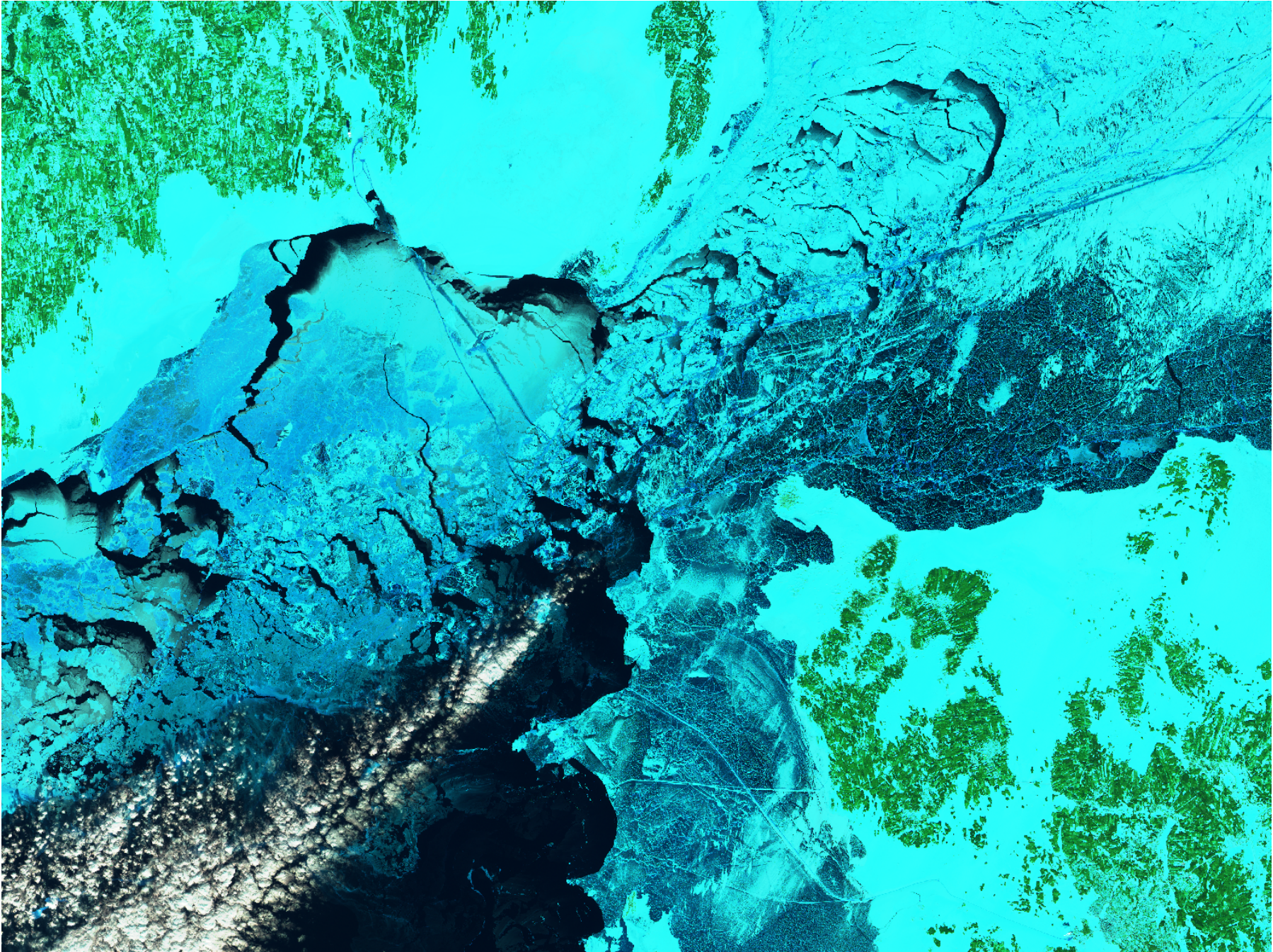
Jari Haapala

Research Professor, Head of Marine Research  
Finnish Meteorological Institute





# QUARKEN FROM SPACE, 28<sup>th</sup> FEBRUARY 2018



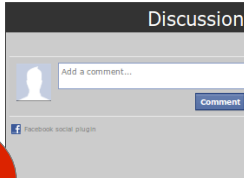
(c) FMIARC, False color image, Sentinel 2



# SEA ICE AS AN INDICATOR OF CLIMATE VARIABILITY

May 4, 2008  
**Sweden's weather service says Baltic Sea region winter was mildest on record**

2008



...a region was the mildest on  
...levels of ice since measurement

The Telegraph

2010



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Sweden

**Over 1000 trapped as ships stuck in Baltic ice**

Nearly 1,100 people were trapped on two passenger ferries and two c

**Dozens of merchant vessels stuck in packed ice in Gulf of Bothnia**

Getting ships detached from the ice will take at least a week

Owing to the strong winds and the difficult ice situation, almost all ship traffic to and from harbours has ground to a halt in Northern Finland. The vessels cannot get to the harbour through the packed ice without the help of icebreakers.

2011



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**Warm Winter Kills Baby Seals**

By Christel KUCHARZ  
PASSAU, Germany March 11, 2008

**Hailuodon jäätie voi jäädä ensimmäistä kertaa tekemättä**

2015



WORLD NEWS

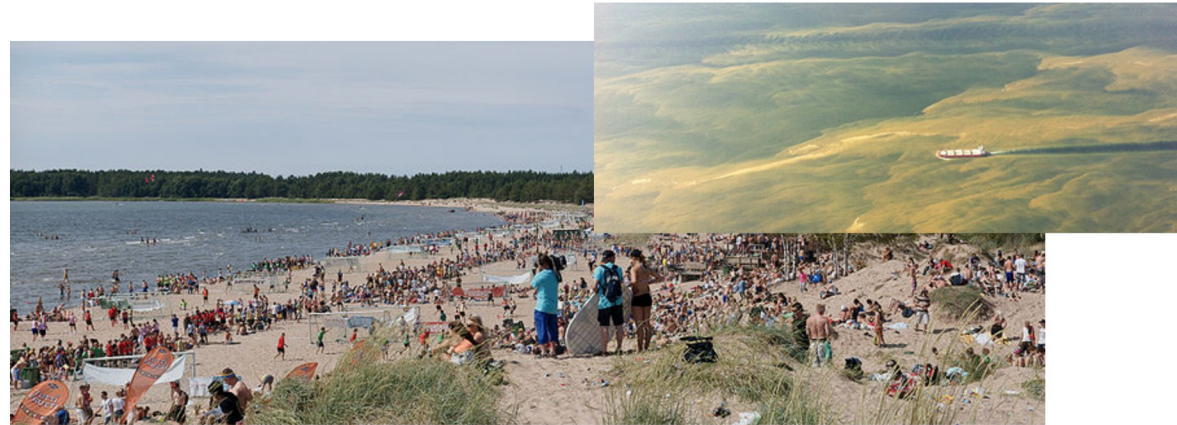


**Ships stuck in Baltic Sea ice**

05/03/10 07:31 CET

# OUR CLIMATE IS CHANGING WHAT HAPPENS FOR THE GULF OF BOTHNIA REGION ?

WARMER SUMMERS ?  
MORE ALGAE BLOOMS ?



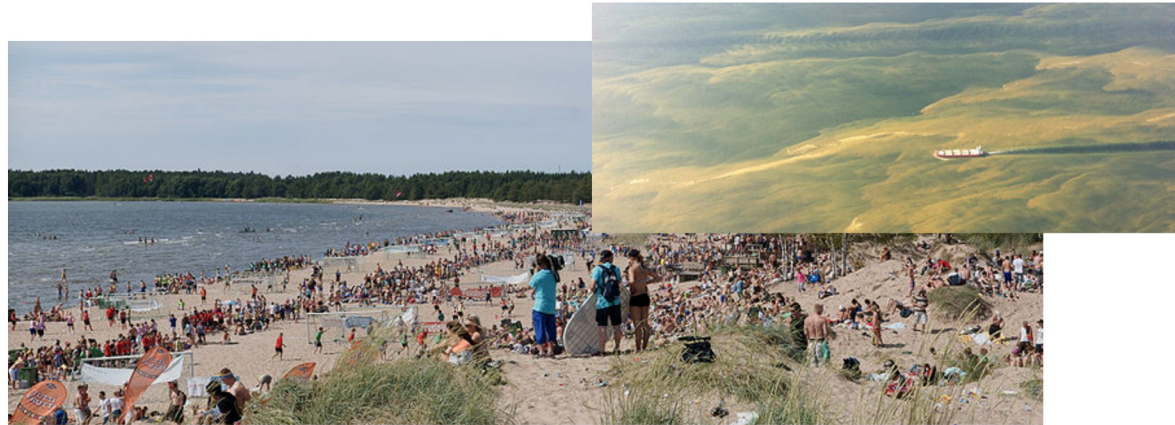


# OUR CLIMATE IS CHANGING

## WHAT HAPPENS FOR THE GULF OF BOTHNIA REGION ?

WARMER SUMMERS ?  
MORE ALGAE BLOOMS ?

WARMER WINTERS ?  
LESS SNOW AND ICE ?



Science/Environment

May 4, 2008

### Sweden's weather service says Baltic Sea region winter was mildest on record

STOCKHOLM, Sweden — Sweden's national weather service said Saturday that the ice-winter in the Baltic Sea region was the mildest on record, with the lowest levels of ice since measurement

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VÅDER. Vädervarningarna för kusten har utökats.

Annons

**Umeå** KOM OCH  
Performance Center HÄLSA PÅ!

VI ERBJUDER EXPERTIS

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## WHAT HAPPENS FOR THE GULF OF BOTHNIA REGION ?

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MORE STORMS ?  
MORE WAVES ?  
MORE FLOODS ?



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**Saija Saha**  
@SaijaInkeri

#vaasa #ukkosmyrsky #  
#huoneistokeskus

Discussion



**Live: Snökaos vid kusten**

VÄDER. Vädervarningarna för





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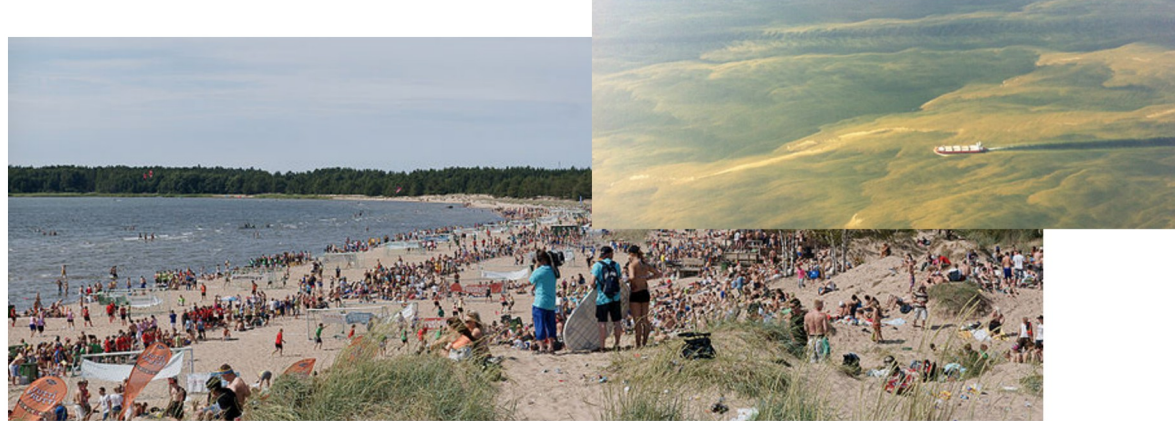
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LESS SNOW AND ICE ?

MORE STORMS ?  
MORE WAVES ?  
MORE FLOODS ?

LESS SALT ?  
LESS HERRING ?  
MORE VENDANCE ?



Saija Saha  
@SaijaInkeri

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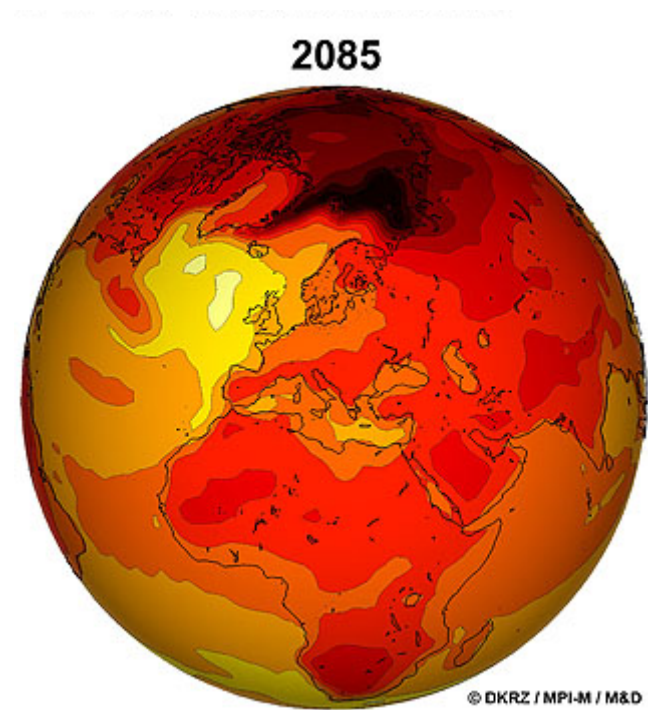


**Live: Snökaos vid kusten**

VÄDER. Vädervarningarna för



# ONE ESTIMATE ON GLOBAL WARMING





# DRIVER OF THE BALTIC SEA RESEARCH

## UNDERSTAND VARIABILITY AND CHANGE OF ECOSYSTEM

What is the link between the global scale change and local characteristics ?

### 1. Global to North-Atlantic / Eurasian scale

- controlled by the global climate system
- very strong feedback between scales

### 2. Baltic Sea scale

- climate variability very much controlled by the atmospheric circulation
- some feedback to large scale

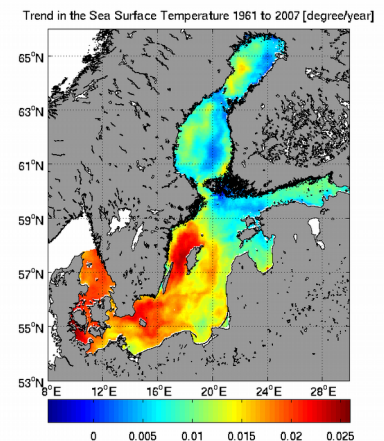
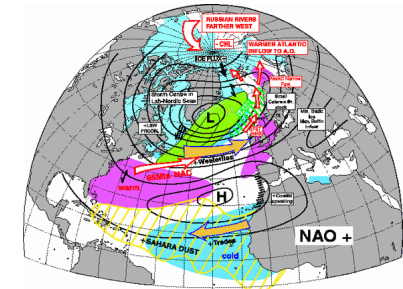
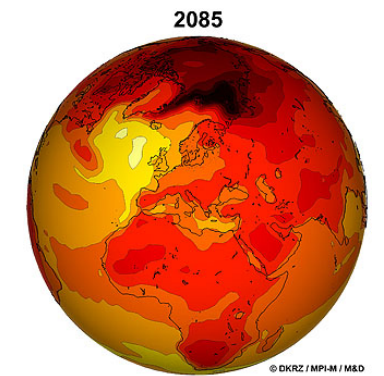
### 3. Basin scale

- atmospheric forcing is modified by the local characteristics : shape of the basin, interaction between the sub basins, river runoff etc.

### 4. Response of the ecosystem

- depends very much on the basin scale characteristics, even smaller sub-basin scale changes could be important.
- downscaling from global to the basin scale has been actively studied during the last 10+ years, but comparable little is know on the impact of CC on local scale.

LINK BETWEEN SCALES

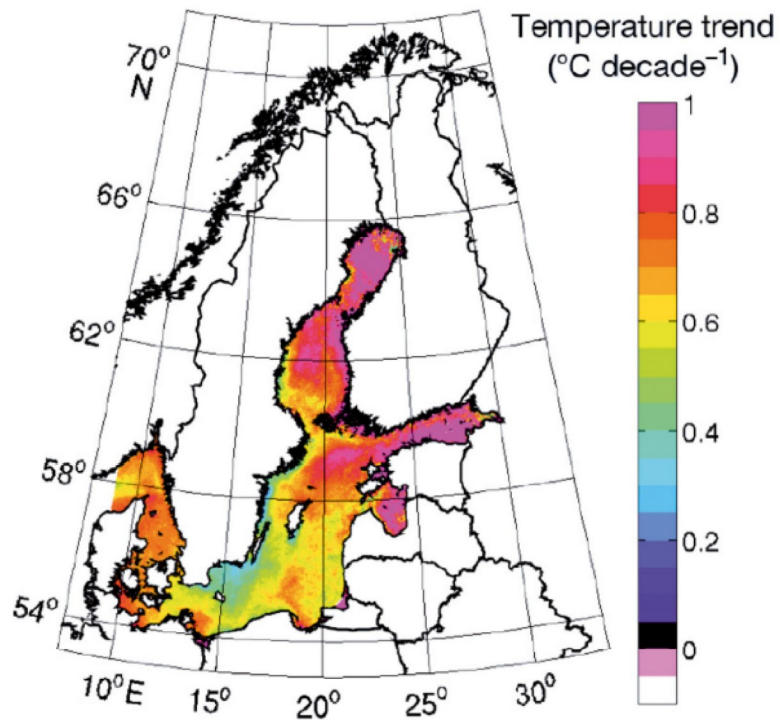


# WHAT HAPPENS FOR THE GoB REGION ?

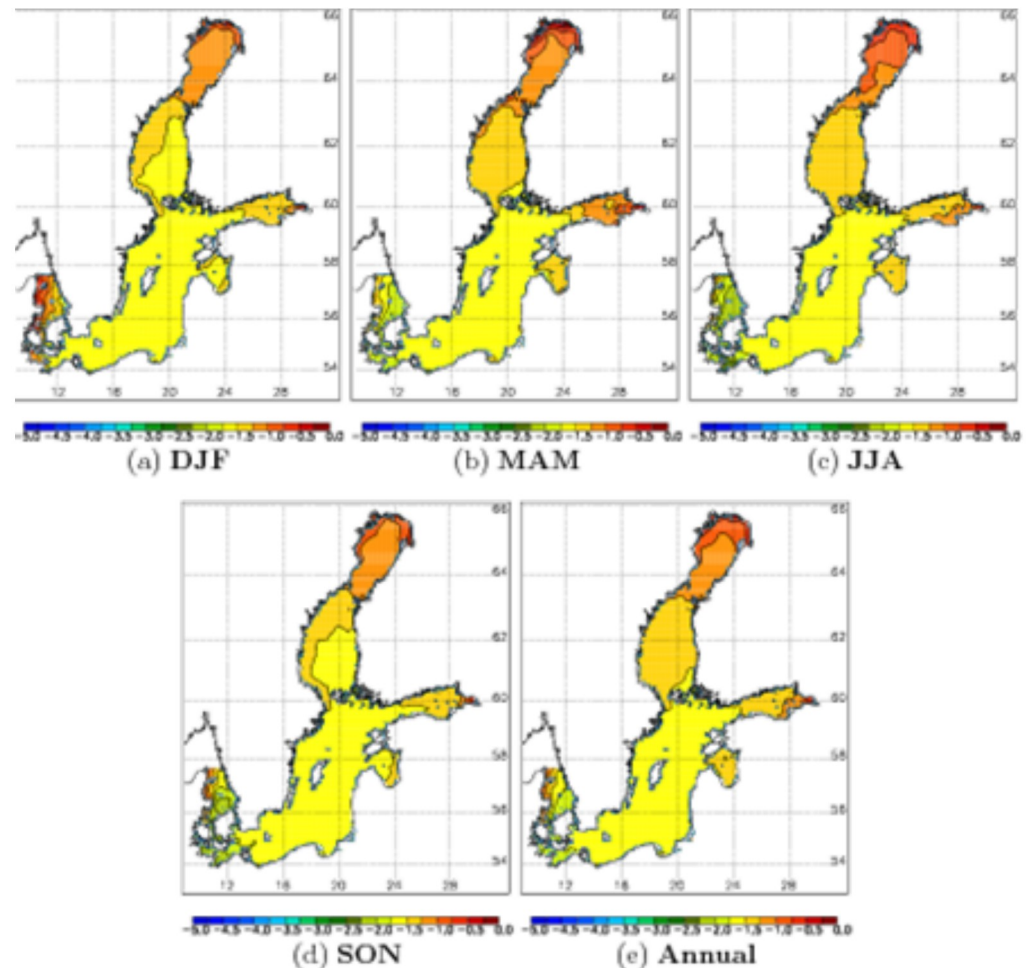
Warmer summers ? Definitely yes, large regional differences

More algae bloom ? Yes, if nutrient loads remain same

## OBSERVED TREND



## PROJECTIONS UNTIL END OF CENTURY





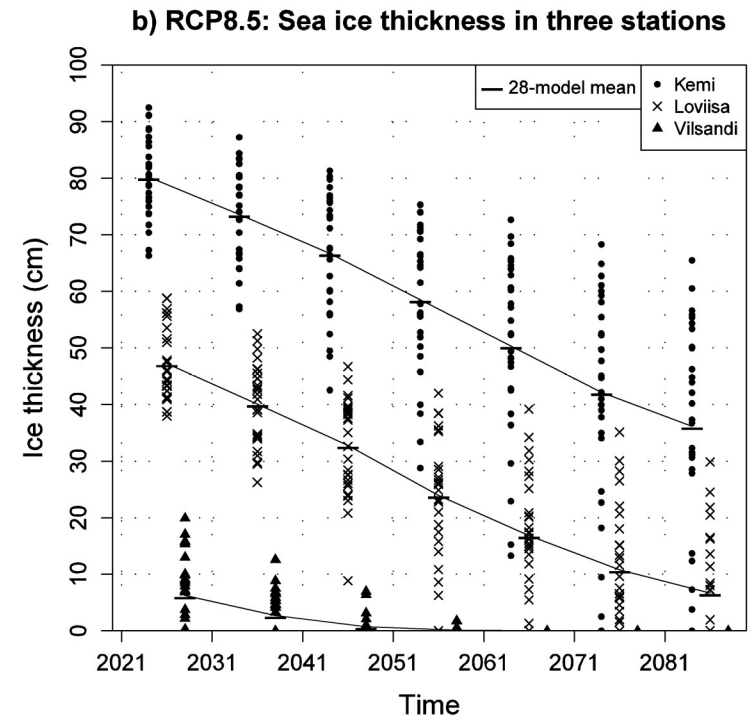
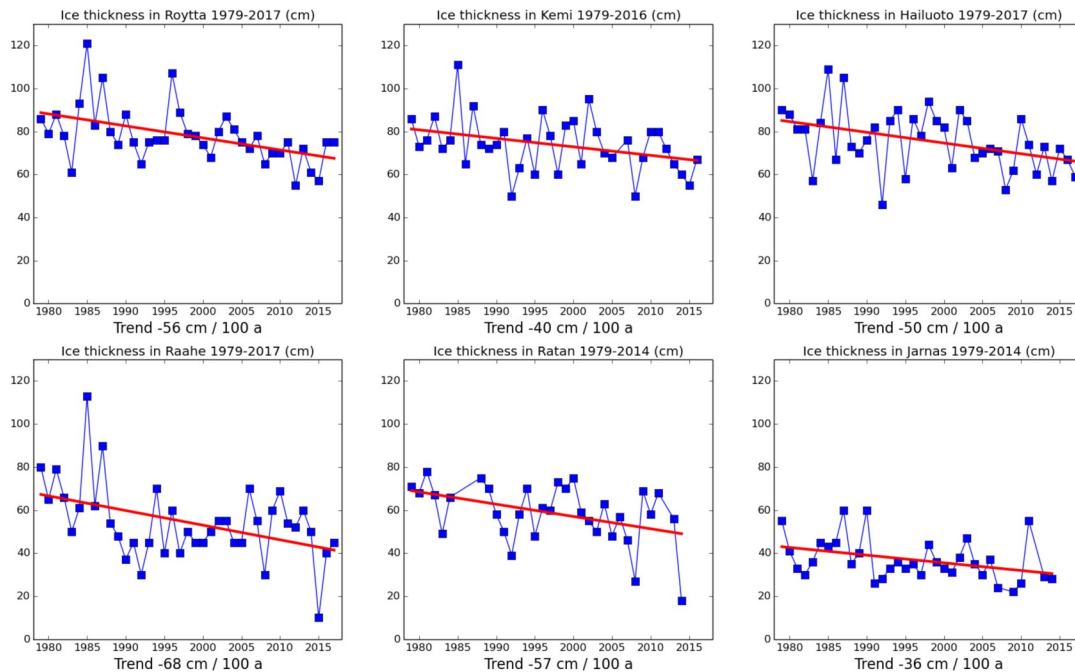
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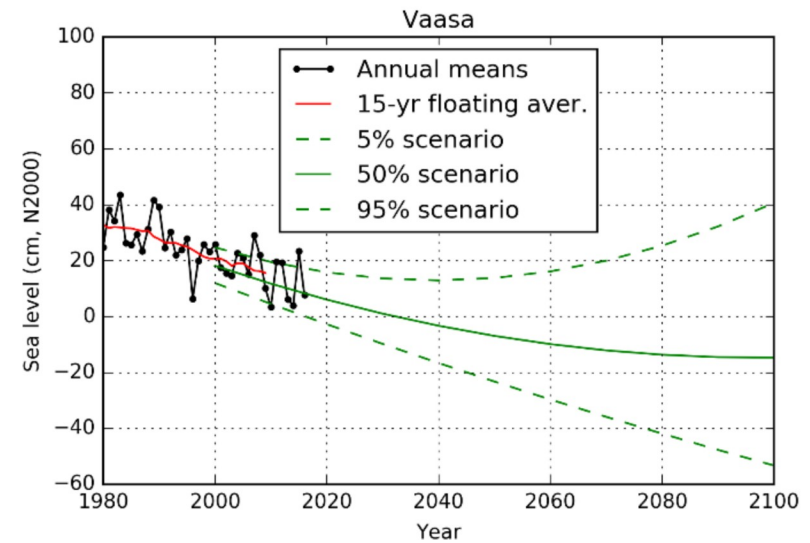
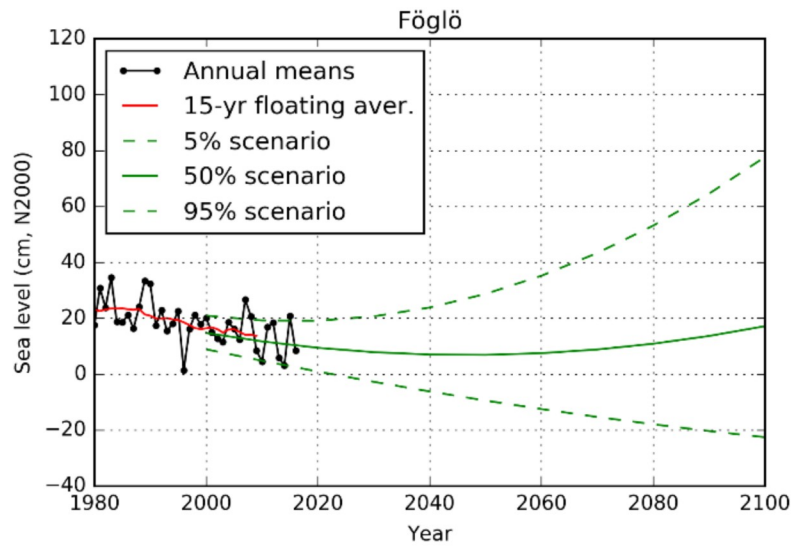
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Warmer winters ? Yes, change larger than summer

Less snow and ice ? Sea ice has already reduced much,  
inter-annual variability large, but trend continues



# WHAT HAPPENS FOR THE GoB REGION ?



More storms ? This is very uncertain  
More waves ? Yes, because disappearance of ice  
More floods ? Not really, thanks to coastal uplift



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Less salt ? Yes, Baltic will become fresher, but how much ?

Less herring ? Difficult to say, but distribution of fishes depends on salinity

For more information, visit

[smartsea.fmi.fi](http://smartsea.fmi.fi)

COMING SOON

SmartSea Gulf of Bothnia Climate Change Assessment





INVITATION TO THE  
WORKSHOP ON “FUTURE OF THE GoB”

18<sup>th</sup> - 19<sup>th</sup> September 2018, Vaasa

