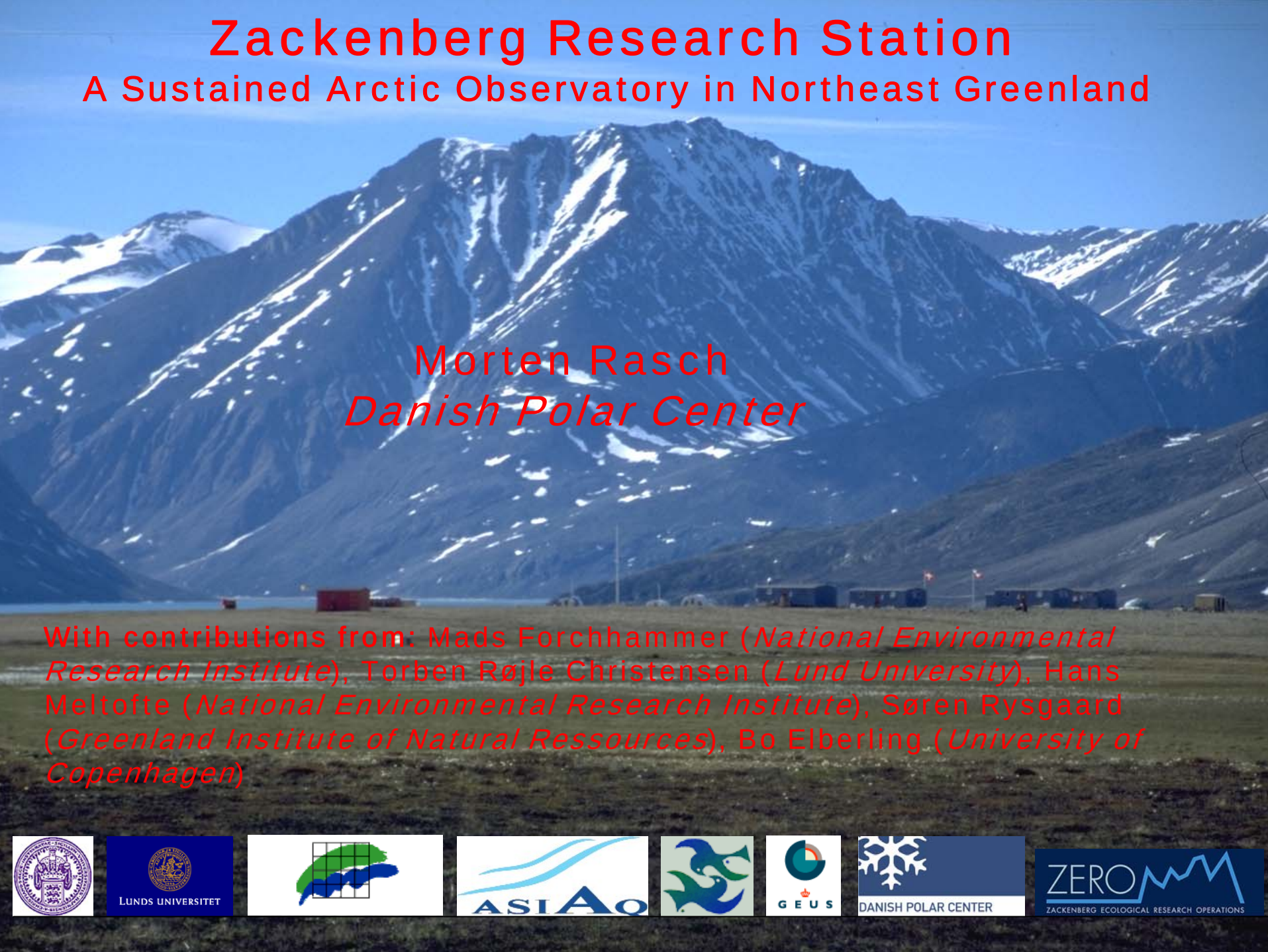
Zackenberg Research Station

A Sustained Arctic Observatory in Northeast Greenland



Morten Rasch

Danish Polar Center

With contributions from: Mads Forchhammer (*National Environmental Research Institute*), Torben Røjle Christensen (*Lund University*), Hans Meltofte (*National Environmental Research Institute*), Søren Rysgaard (*Greenland Institute of Natural Ressources*), Bo Elberling (*University of Copenhagen*)

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ZACKENBERG ECOLOGICAL RESEARCH OPERATIONS

Zackenberg Research Station

A Sustained Arctic Observatory in Northeast Greenland

'Zackenberg Ecological Research Operations (ZERO) will during the next 50 years provide data to describe the dynamics of a high arctic ecosystem in 'Year Zero' for Global Climate Change'

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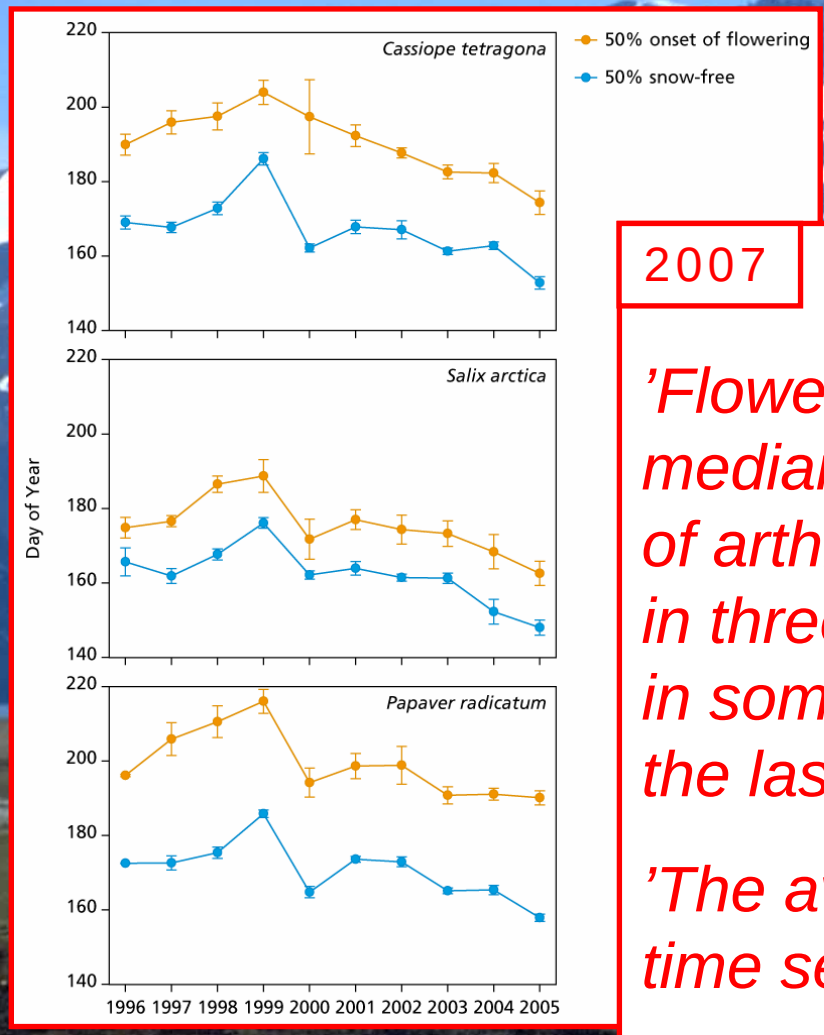

2007

'Flowering dates in six plant species, median emergence dates of twelve taxa of arthropods, and clutch initiation dates in three species of birds have advanced, in some cases by over 30 days during the last decade'

'The average advancement across all time series was 14.5 days per decade'

Hoye et al. 2007: *Current Biology 17(12)*, 449-51.

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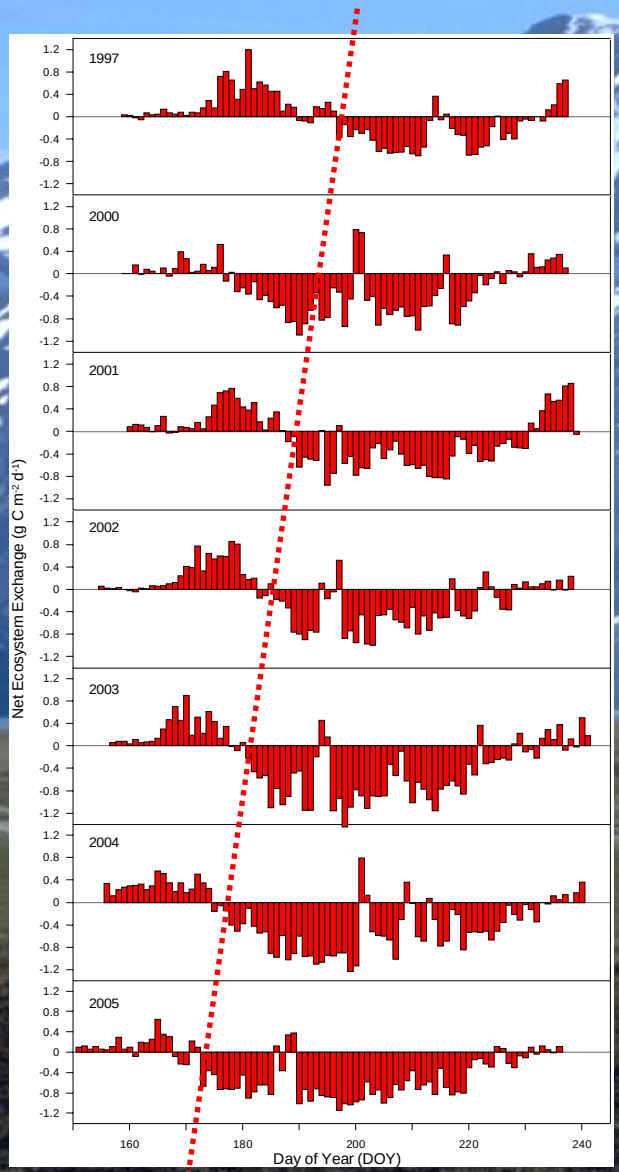

Carbon dioxide exchange from the tundra to the atmosphere has been measured almost continuously at Zackenberg since 1997.

The timing of snowmelt, temperature during the growth season, the concomitant thaw depth and plant growth intensity are the primary controlling factors.

In general the start of growing season has occurred earlier and earlier at Zackenberg since 1997

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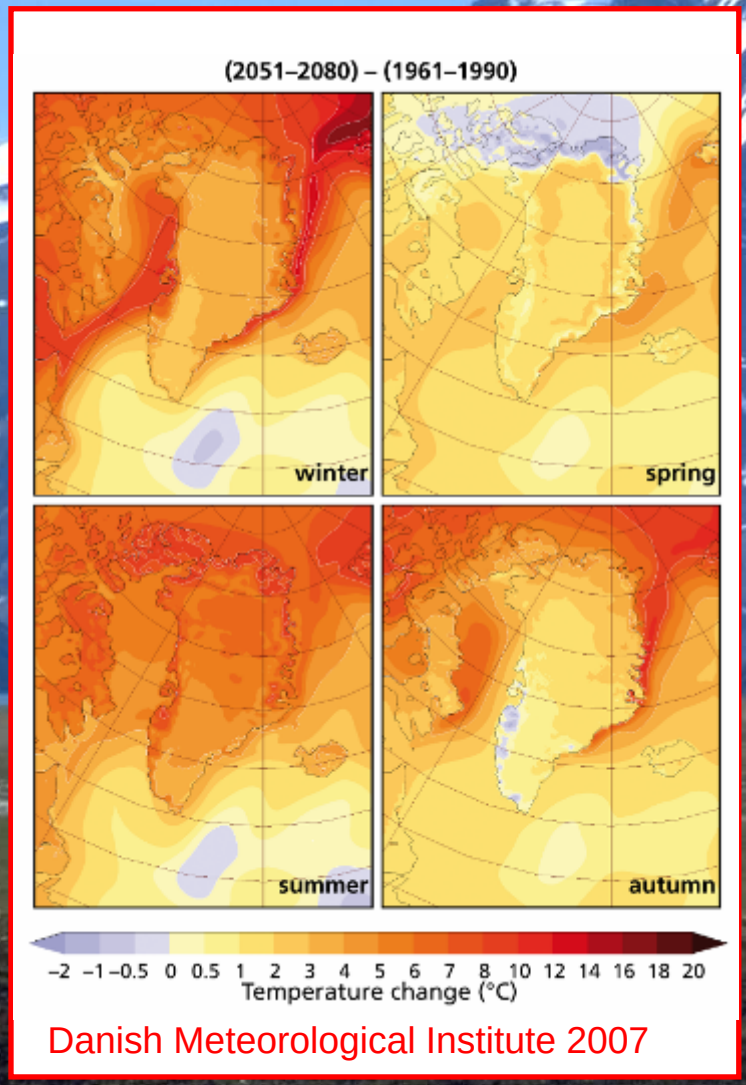

Danish Meteorological Institute 2007

Temperature in Northeast Greenland will during the next c. 100 years increase by up c. 8 °C

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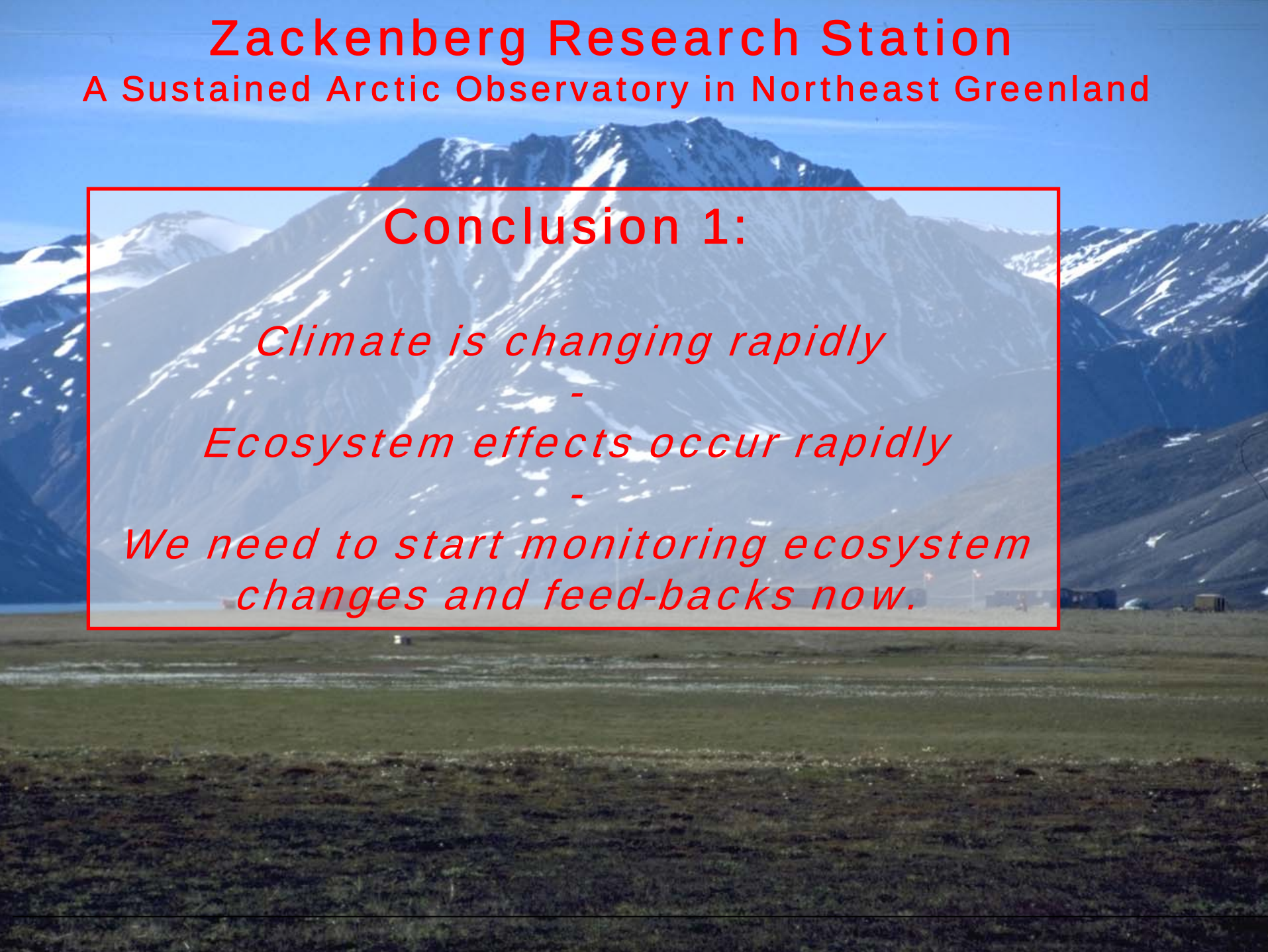

Conclusion 1:

Climate is changing rapidly

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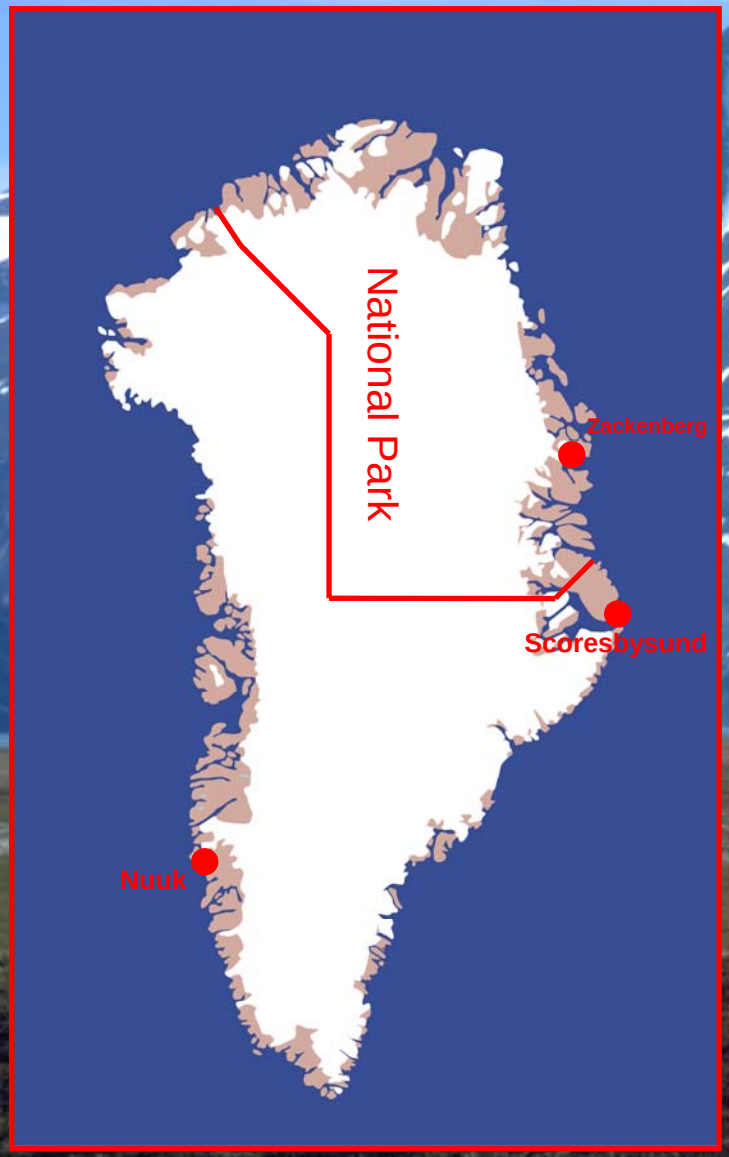
Ecosystem effects occur rapidly

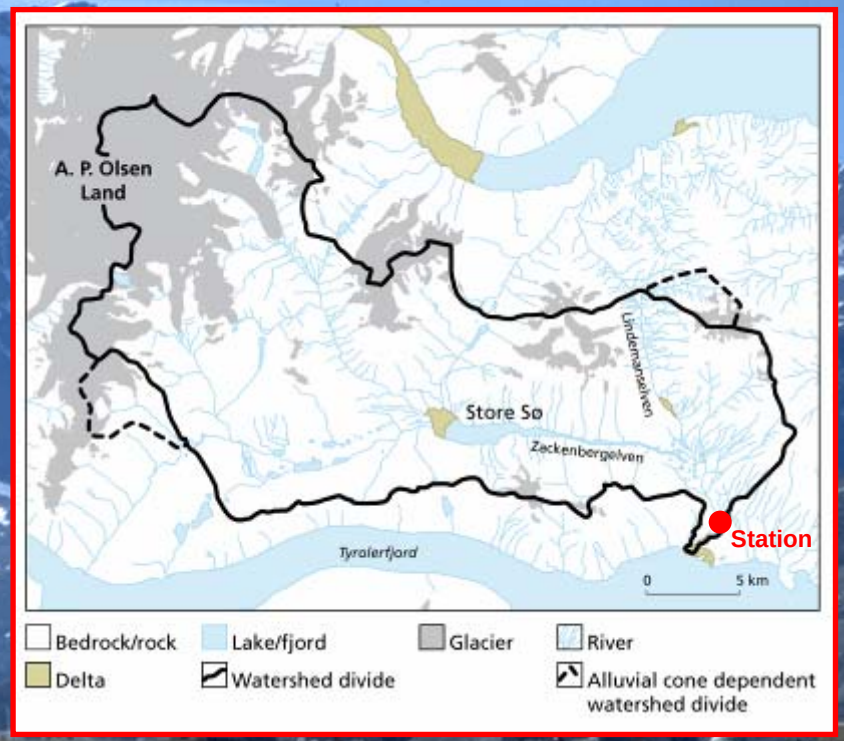
-

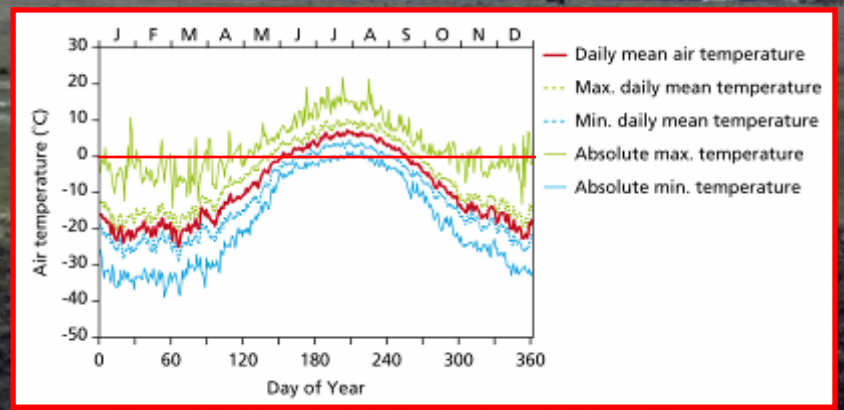
We need to start monitoring ecosystem changes and feed-backs now.

Zackenberg Research Station

Study area

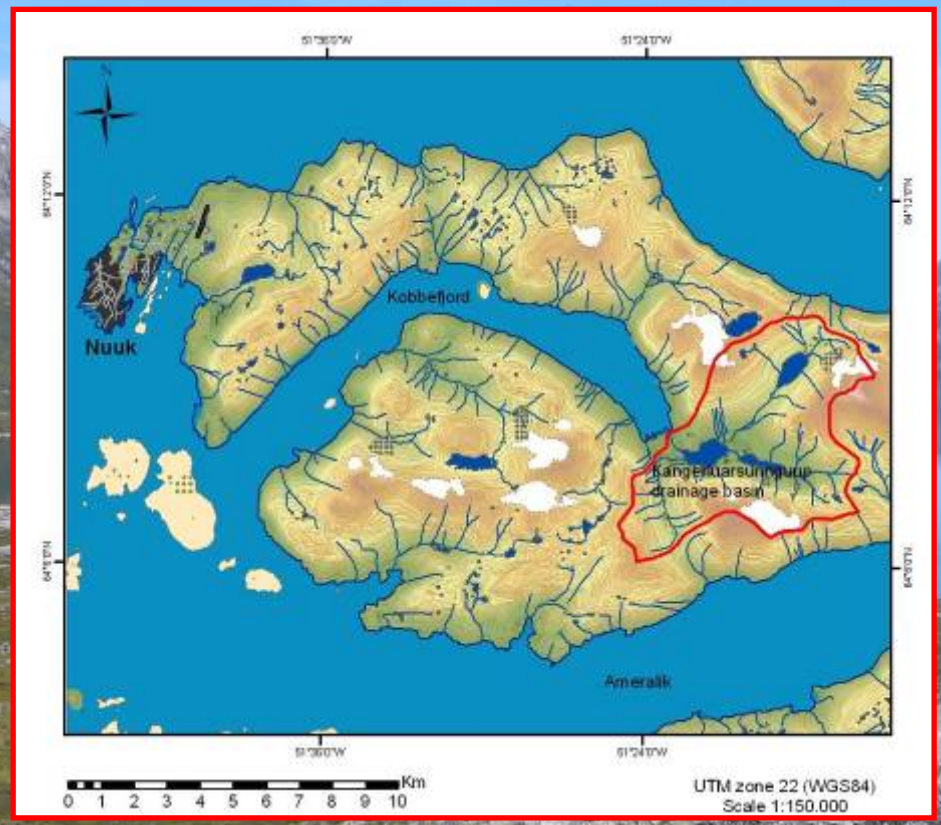






Nuuk Basic

– A Sustained Arctic Observatory in low arctic West Greenland



Same concept as Zackenberg Basic but with a study area situated in a low arctic setting influenced by humans. Initiated in 2007.

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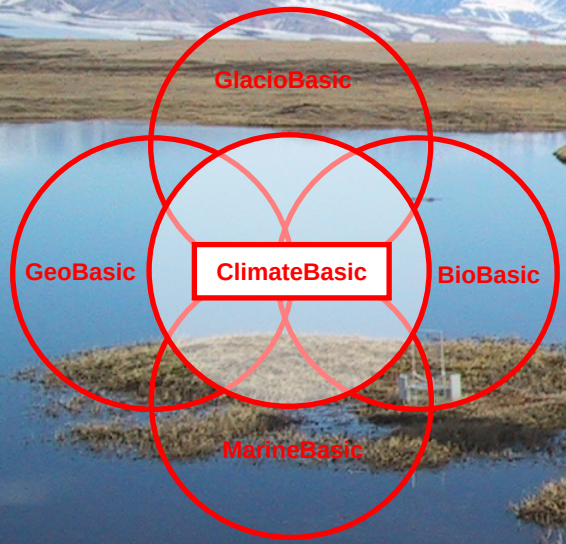
Zackenberg, Facts:

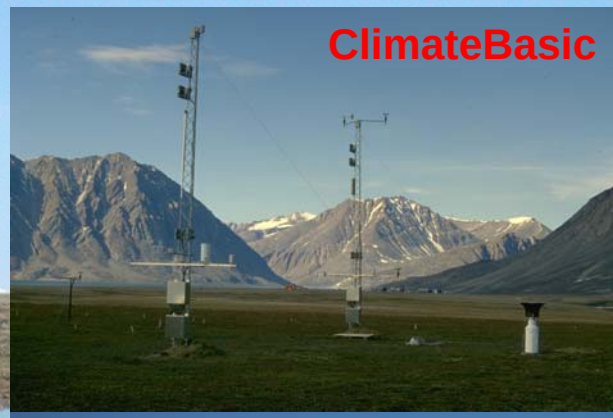
- **Terminology:**
  - Zackenberg Research Station – Field Station (Observatory) in Northeast Greenland
  - Zackenberg Ecological Research Operations (ZERO) – Research Programme (Synthesis)
  - Zackenberg Basic - Monitoring Component of ZERO (Observations)
- **History:** Zackenberg Basic was established in 1995 concurrently with the opening of Zackenberg Research Station
- **Organisation:** Zackenberg Basic is being maintained in cooperation between six Danish and Greenlandic insitutions. The programme secretariat is situated at Danish Polar Center
- **Funding:** Zackenberg Research Station is being maintained through funding from The Danish Ministry of Science, Technology and Innovation. The monitoring at Zackenberg is funded by The Danish Ministry of The Environment in Cooperation with The Greenland Home Rule
- **Staff:** Zackenberg Basic has a permanent staff corresponding to c. five-six full-time employee's. Permanent staff is supplemented by two-three field assistents during the field season (June – August)

Zackenberg Basic – monitoring at Zackenberg Research Station

Major questions

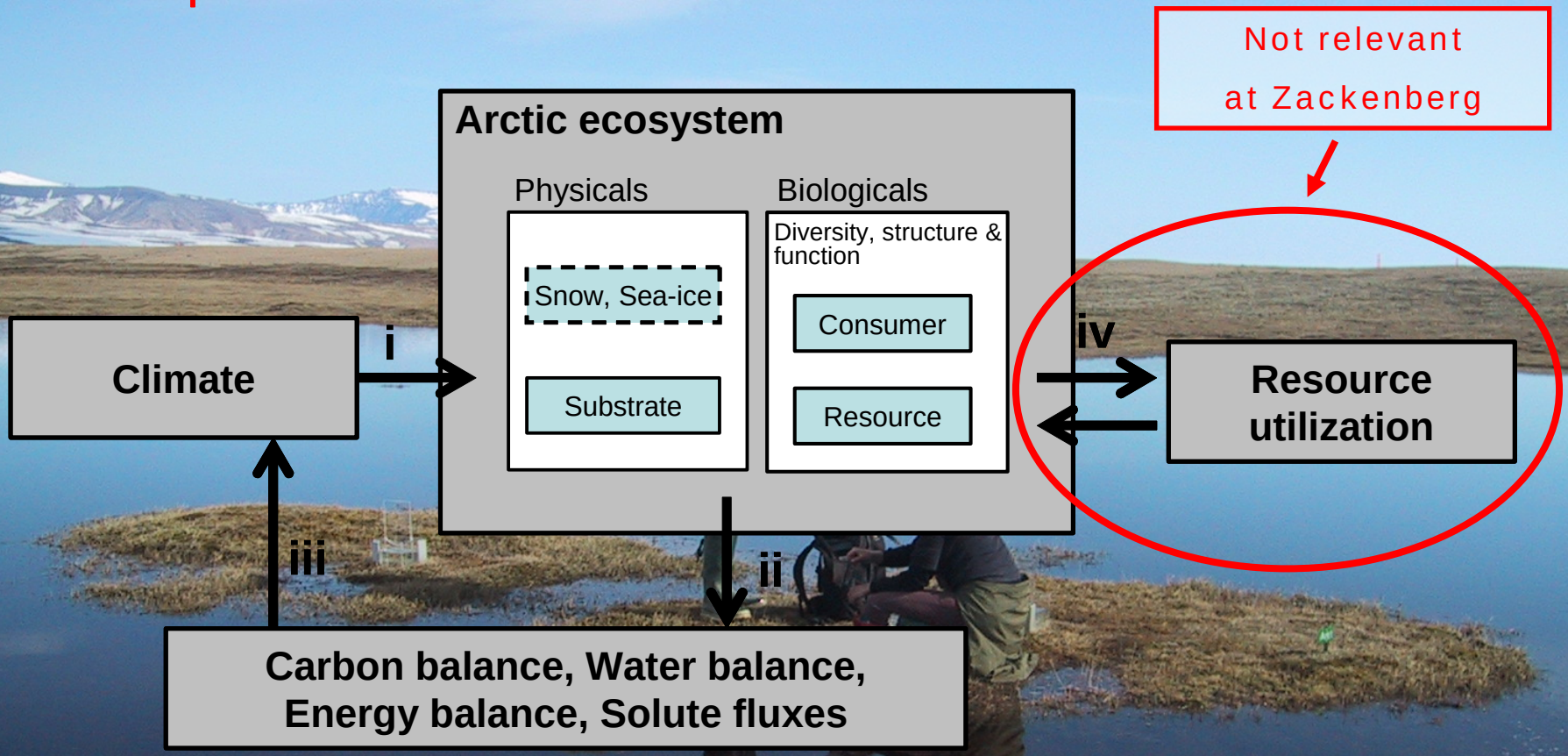
1. How and why does climate variability influence the dynamics of high arctic ecosystems?
2. How do high arctic ecosystems affect climate?





Zackenberg Basic – monitoring at Zackenberg Research Station

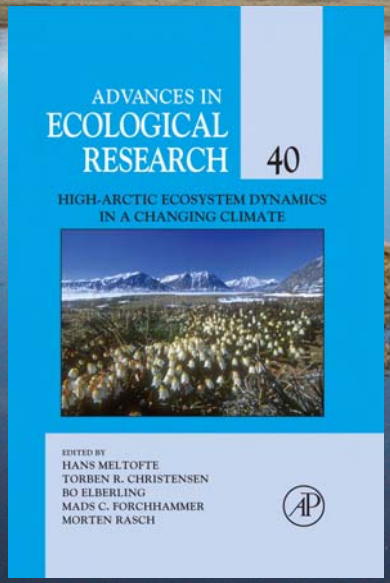
Concept:



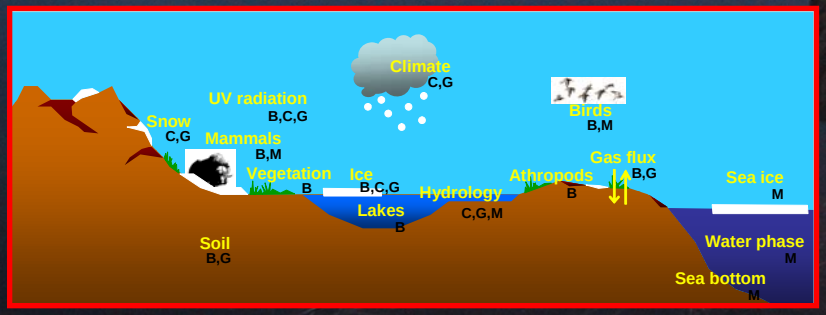
Zackenberg Basic – monitoring at Zackenberg Research Station

Measurements, data and publication:

- Zackenberg Basic focus on thirteen scientific themes being monitored in cooperation between the five monitoring sub-programmes
- A total of c. 3,500 parameters are measured each year at different time intervals (from several per second to one per year)
- All measurements are collected in a common database which is avialable on-line at www.zackenberg.dk
- Data are provided free-of-charge to anyone being interested in using the data
- Data from Zackenberg Basic are thoroughly reported each year to the ZERO Annual Report's
- A reporting of the first ten years of monitoring and research at Zackenberg will be published by Academic Press (Advances in Ecological Research 40) in early 2008. This book is also meant to be an educational book for graduate students concerning function of arctic ecosystems.



Scientific theme	Description
Climate	Temperature (air, surface and soil), wind, humidity, precipitation
Snow	Cover, thickness, distribution
Hydrology	Water balance, nutrient cycling
Glacier ice	Iceberg export to Godthåbsfjorden
Sea ice	Cover, thickness, distribution
UV radiation	Strength, seasonal,interannual variations and ecosystem effects
Soil	Water balance, chemistry, soil arthropods, decomposition
Vegetation	Species diversity, growth, reproduction, phenology, parasitism, distribution of vegetation types, UV radiation effects
Gas flux	Carbon dioxide, methane, interactions with structure and function of herbivore-plant interactions
Lakes	Chemistry, Carbon balance, abundance and production of plankton and fish
Athropods	Insect abundance, reproduction and phenology
Mammals & Birds	Selected terrestrial, freshwater and marine species, species diversity, Abundance, distribution, reproduction, phenology
Water phase	Temperature, salinity, currents, chemistry, carbon balance, plankton, crustacean, fish.
Sea bottom	Chemistry, carbon balance, growth, abundance and distribution of benthic animals



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Zackenberg Research Station

A Sustained Arctic Observatory in Northeast Greenland

Conclusion 2:

From a Zackenberg point-of view terrestrial / coastal ecosystem monitoring at a few large observatories (flagships) with extensive cross-disciplinary monitoring programmes gives better value-for-money than monitoring of the same single parameters at a wealth of different sites

Zackenberg Basic – monitoring at Zackenberg Research Station

International Cooperation

International cooperation is of high priority in Zackenberg Basic. It is our strategy to be involved in all relevant international monitoring networks/programmes/projects and to provide data to these networks/programmes/projects

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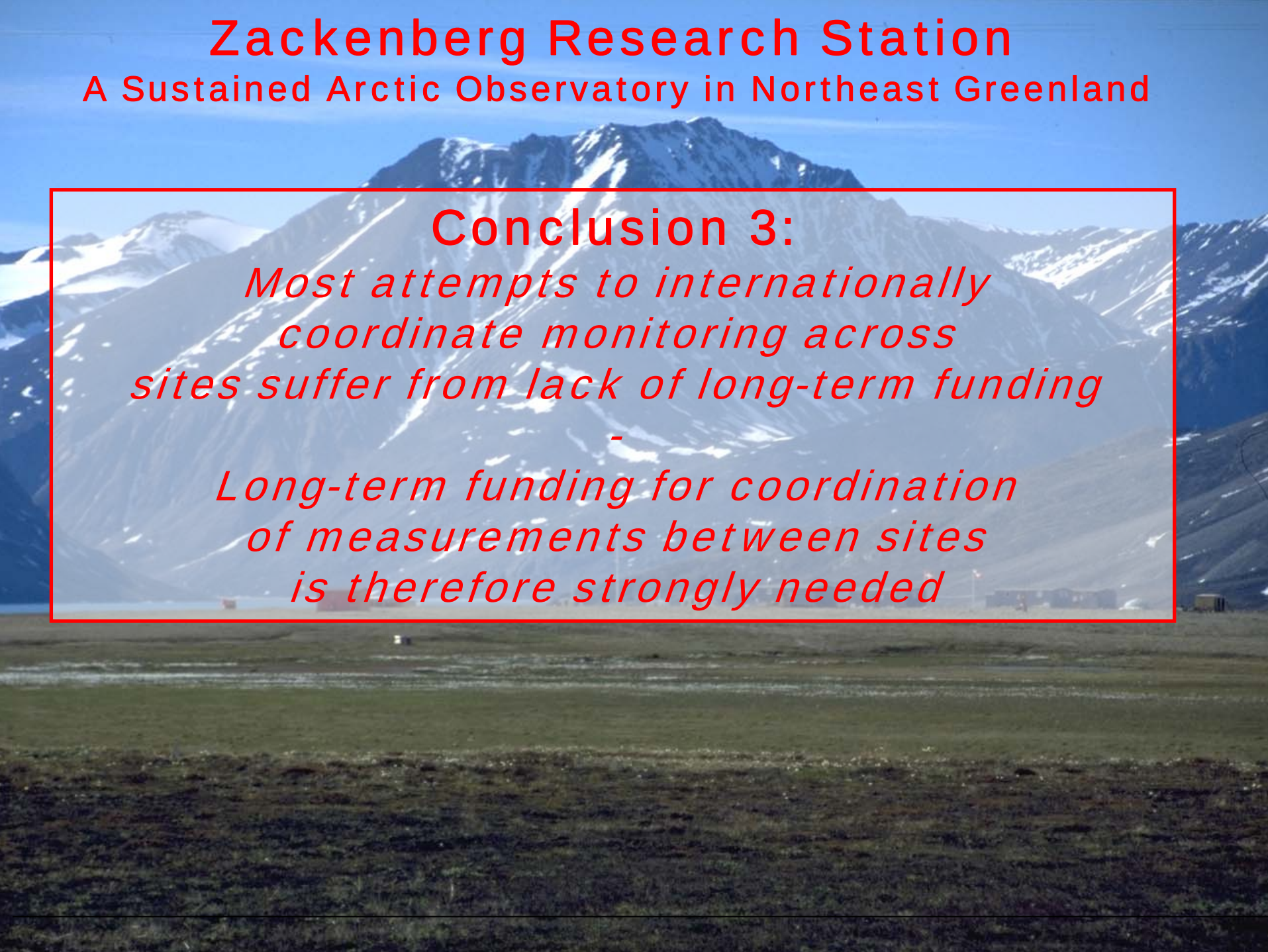

Conclusion 3:

Most attempts to internationally coordinate monitoring across sites suffer from lack of long-term funding

-

Long-term funding for coordination of measurements between sites is therefore strongly needed

Zackenberg Basic – monitoring at Zackenberg Research Station

Economy

- Zackenberg Basic is financed by The Danish Ministry of the Environement while the run of Zackenberg Research Station is funded by The Danish Ministry of Science, Technology and Innovation
- Funding has increased significantly during the last five years

Budget, Zackenberg, 2008:

	EURO	EURO
Logistics		**330,000.00**
Run of Zackenberg Research Station	330,000.00	
Monitoring		**940,000.00**
Climate Basic	105,000.00	
Geo Basic	246,000.00	
Bio Basic	224,000.00	
Marine Basic	216,000.00	
Glacio Basic	149,000.00	
Programme development		**60,000.00**
Different smaller projects	60,000.00	
Sum	**1,330,000.00**	**1,330,000.00**

The total for running cost for Nuuk Basic is c. 800,000 EURO

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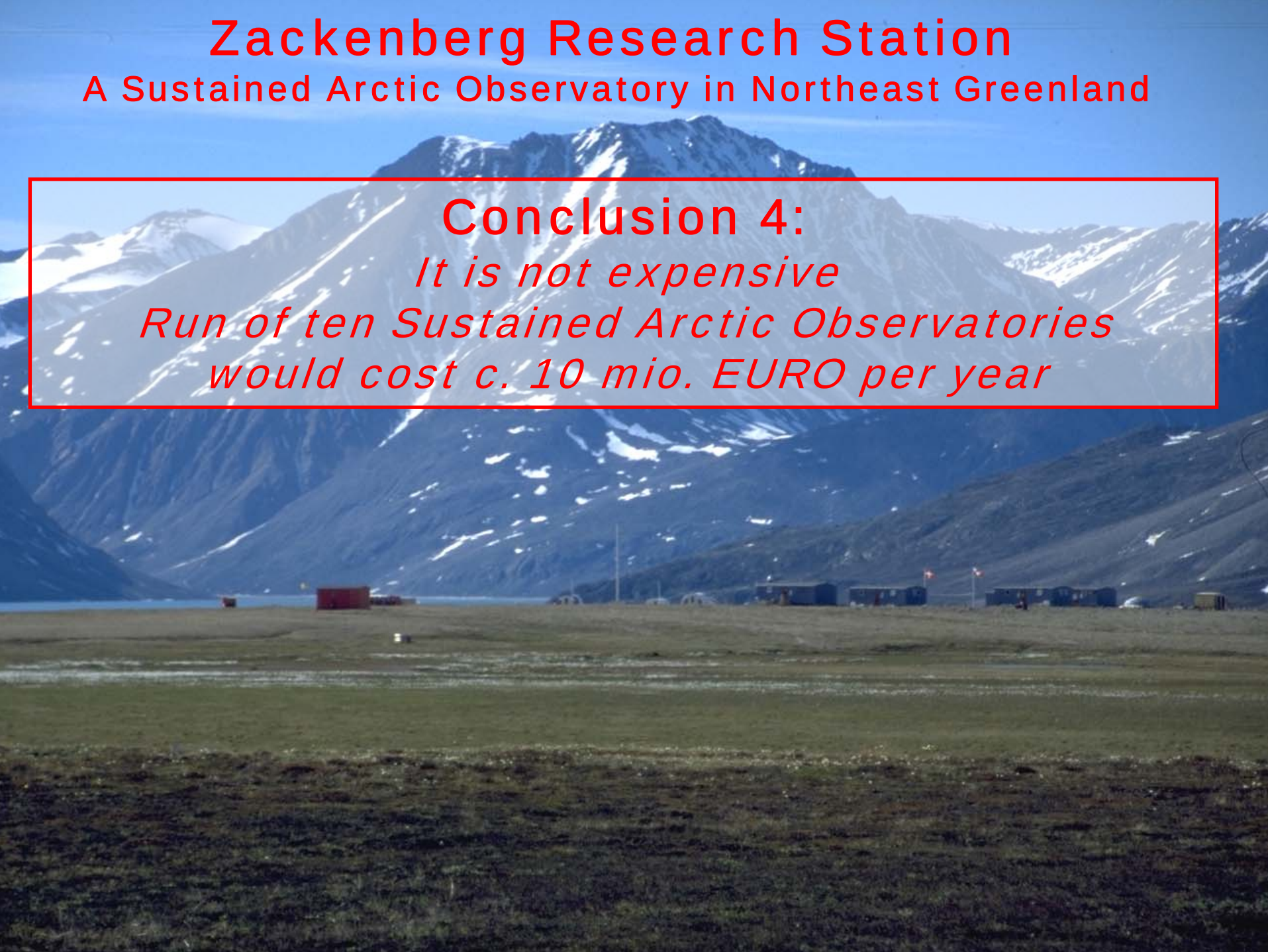

Conclusion 4:

It is not expensive

Run of ten Sustained Arctic Observatories would cost c. 10 mio. EURO per year

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Further information: www.zackenberg.dk