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Climate change:

Impacts and consequences for Norway

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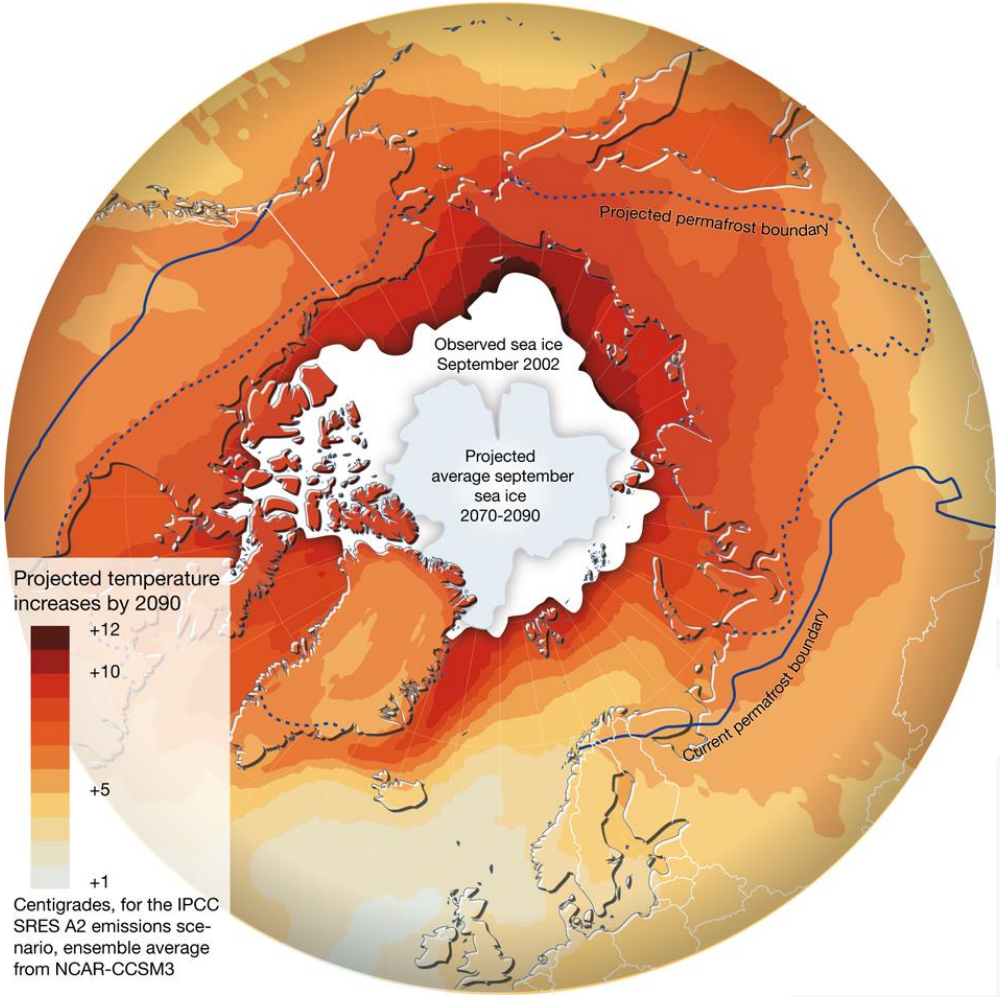
Presentation outline

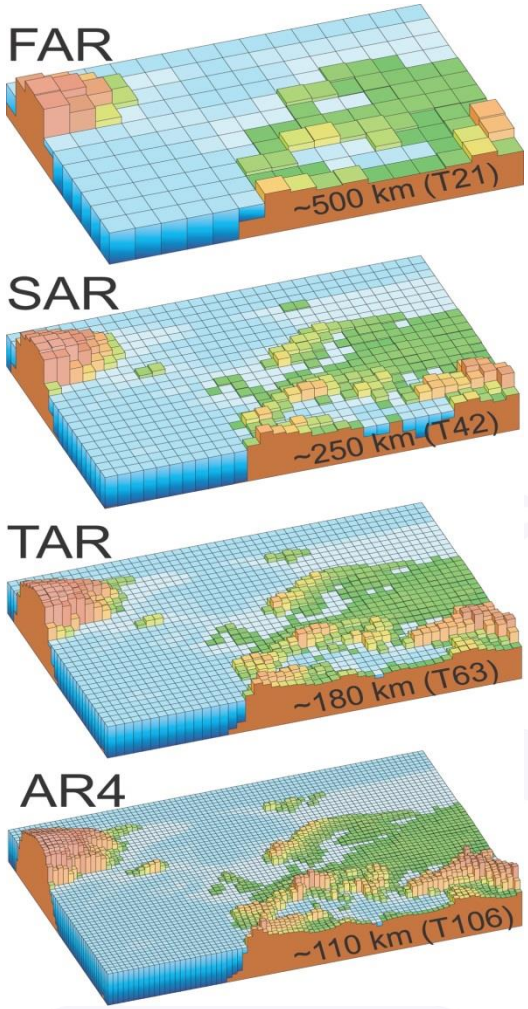
- The arctic area and Norway's position
- Projected changes in Norway
- Weather forecast for 2050
- Impacts and consequences for infrastructure
- Summing up

Arctic projections



The impact of climate change

- Climate change has national and local impact
  - Scaling down of the IPCC reports
  - More unpredictable weather patterns
- Generally for Norway:
  - Warmer
  - Wetter
  - Wilder
  - …and more unpredictable



Warmer

- Average temperature is growing
- During the last century: Up 0,8˚C (mainland Norway)
- Expected increase by 2100: Up 2.3-4.6˚C

Warmer

- Norway in 2050

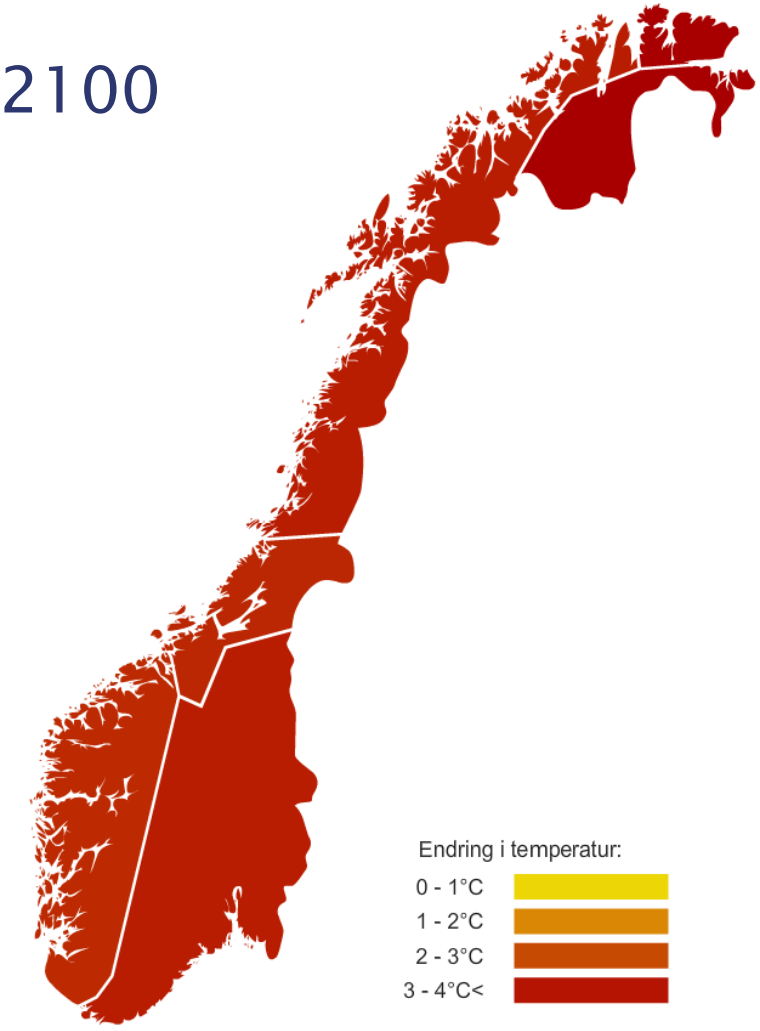
2050 | 2100

Norge

Lav:	+1,2°C
Middels:	+1,9°C
Høy:	+2,5°C

Warmer

- Norway in 2100



2050	2100
Norge	
Lav:	**+2,3°C**
Middels:	**+3,4°C**
Høy:	**+4,6°C**

Wetter

- Great variation within Norway has been normal
  - Normal year precipitation ranges between 279-3550mm
- On average 20% increase in precipitation over the last century
  - Strongest growth after 1980
- 5-30% increase by 2100
  - More intense precipitation
  - No. of days with extreme precipitation up 7-23%
- Stronger geographical variation in precipitation
  - Greatest increase in West-Norway
  - More modest growth in inland East-Norway

Wetter

- Norway in 2050

2050 | 2100

Norge

Lav:	+2,4%
Middels:	+9,6%
Høy:	+14,0%

Wetter

- Norway in 2100

2050 | 2100

Norge

Lav:	+5,4%
Middels:	+18,3%
Høy:	+30,9%

Wilder

- A warmer and wetter climate is also likely to lead to more frequent extreme weather events
- More intense precipitation and extreme temperatures
  - In turn leading to more avalanches, land slides, health impacts etc.
- Uncertainty regarding more/less wind, but
  - Global models expect more storms around the poles
  - Higher temperatures and more precipitation increase statistic probability of thunder storms
  - Probably large local variations

Beyond the WWW

- *Other changes expected by 2100:*
- Sea level rise
  - Significant regional and local variation – but uncertainty!
  - Southern and Western coast: ≈70cm
  - North Norway: ≈60cm
  - Oslo Fjord and Trondheim Fjord: ≈40cm
- A warmer ocean
  - Average annual ocean temperature in the North Sea expected to rise 1.5-2 degrees
- Ocean acidification
  - Minus 0.5pH units

Weather forecast for 2050

Norwegian Metrological Institute (03:41)

YR - Norway 2050 (English subtitles).mp4

Impact

- Taken together, a warmer, wetter and wilder climate will make an impact
- Consequences depend on
  - extent of actual climatic change
  - ability, opportunity and willingness of society to
    - take changes into account
    - actively adapt to reduce harmful impact

Impact

- Environment
- Food production
- Health
- ***Infrastructure***
- Businesses in Norway
- Cultural heritage
- Indigenous population (Sami)

Impact: Infrastructure

- All infrastructure vulnerable for climate impact
  - Extent of vulnerability in infrastructure important for how society affected by climate change
  - Network sectors
    - Electricity, water (supply and sewage), transport (rail, road, airports, harbours), electronic communication, renovation and buildings
    - Interdependence between different types of infrastructure (e.g. electricity for trains, communications)
- Demand for more robust infrastructure
  - Climate impact reinforcing challenge of investment and maintenance backlog
  - Particular challenge for water supply and sewage systems

Impact: Infrastructure

- Transport
  - Major maintenance backlog for road, rail and electricity
  - More interruptions, threats to traffic safety and damages due to flooding and landslides
  - More pressure on drainage systems with higher precipitation
  - Maritime transport infrastructure (breakwaters, lighthouses, harbours etc.) will need to tackle tougher conditions than today

Impact: Infrastructure

- Electricity
  - If larger interruptions, this will have great economic consequences and pose a risk to life and health
  - Relatively robust today (according to government), but climate impact could increase need for maintenance due to higher strain
  - Wetter →higher hydro power production (thus requiring grid expansion)
  - Warmer →lower power demand for heating
  - Wilder → more damages
- Buildings
  - Vulnerable to extreme weather events
  - Wetter →Decomposition challenge will grow, higher risk

Impact: Infrastructure

- Water and sewage
  - Maintenance backlog
  - Challenges with underdimensioned system already today (resulting in clogged points)
  - Will need to handle increased precipitation to avoid flooding
  - Increased risk of service impairment (interruption, insufficiently purified drinking water – health implications)
  - Strain on equipment and water pipes
- Electronic communication
  - Damages from flooding, landslides, icing of cables
  - Relatively frequent updating and replacement of infrastructure decreases vulnerability

Impact: Businesses in Norway

- Indirect impact via services that businesses depend on (e.g. infrastructure)
- Direct impact depend on type of activity
  - Primary industries (e.g. fisheries) greater adjustment likely to be necessary (relocation in accordance with fish migration towards the north due to temperature increase)
  - Tourism (e.g. hotels, ski resorts) affected by shorter winter season
  - Electricity sector: higher production from hydro power plants (7-22% growth 2050-2100) = higher income
  - Shipping: New trading routes (Northwest and -east passages)
  - Insurance companies: new opportunities as more risk (e.g. due to more unstable weather) but also higher costs

Summing up climate impacts

- Climate change means a warmer, wetter and wilder Norway. This entails:
  - imbalances in the environment, with ripple effects across eco-systems
  - longer growing season for food production, which however will be more difficult
  - higher health risks especially for vulnerable groups
  - strain on infrastructure that will have to handle more challenging conditions
  - differential direct impact on businesses in Norway
  - higher risk of decomposition of cultural heritage
  - threat to Sami culture interwoven with the environment