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Climate change:

Impacts and consequences for Norway

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Tallinn,
3rd March 2015

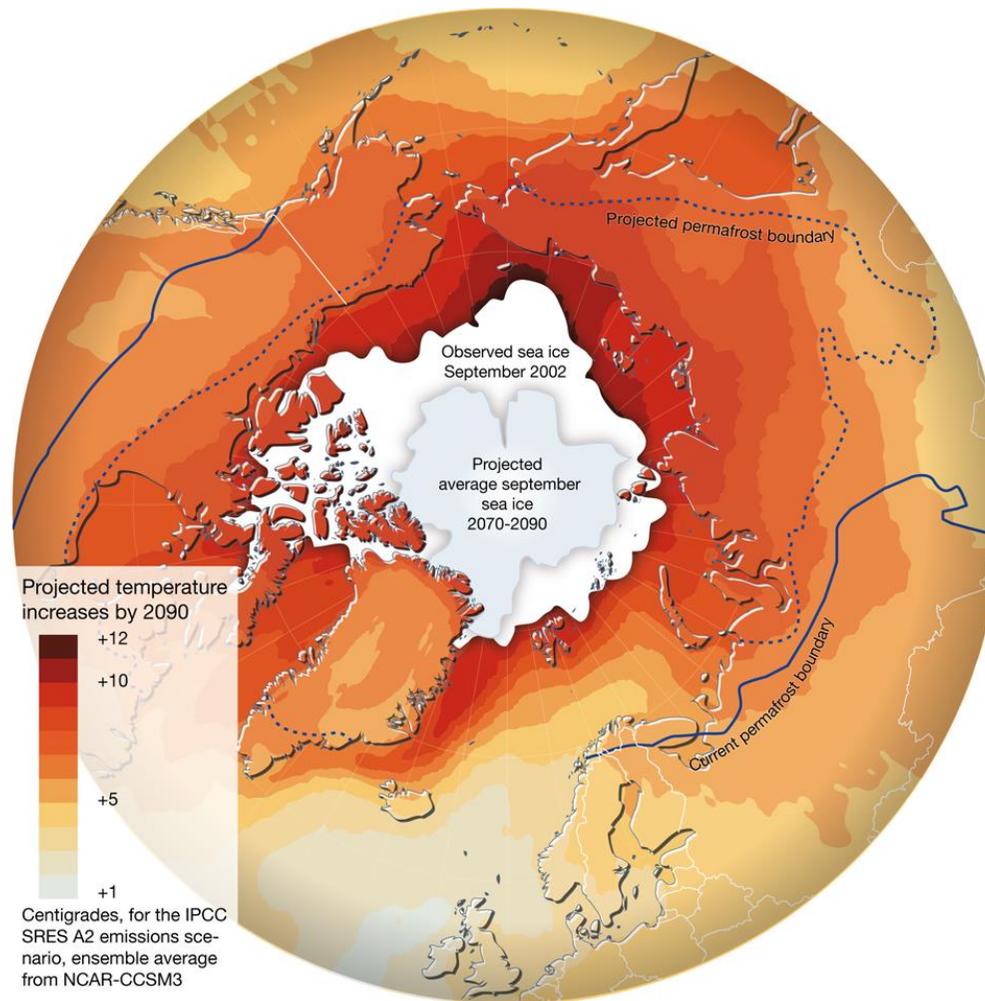
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Presentation outline

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

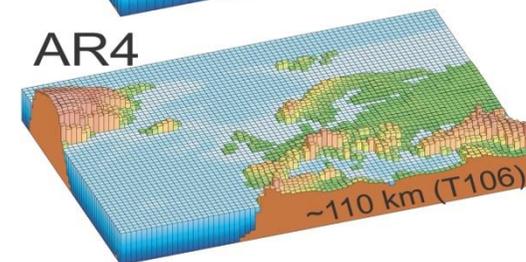
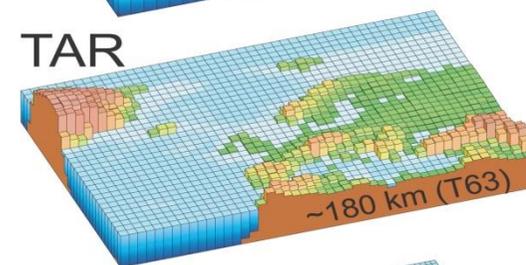
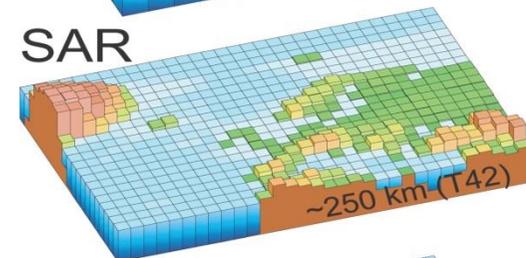
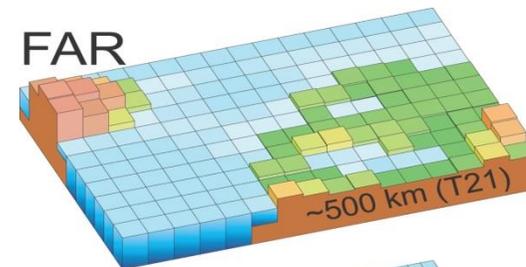


Arctic projections



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



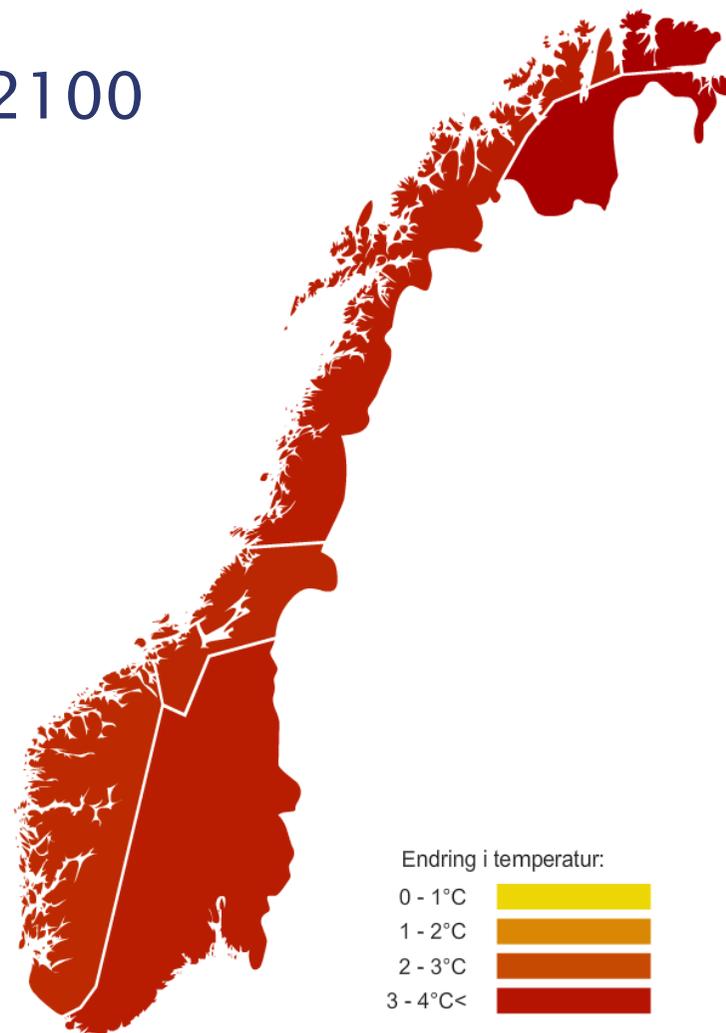
Warmer

- Norway in 2050

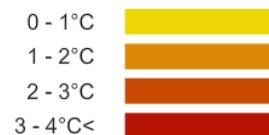


Warmer

- Norway in 2100



Endring i temperatur:



2050

2100

Norge

Lav: **+2,3°C**

Middels: **+3,4°C**

Høy: **+4,6°C**



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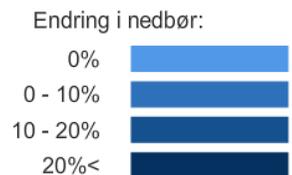
Wetter

- 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: $\approx 70\text{cm}$
 - North Norway: $\approx 60\text{cm}$
 - Oslo Fjord and Trondheim Fjord: $\approx 40\text{cm}$
- 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



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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

