

Climate Change and Ski Centers in Norway

Robert Steiger

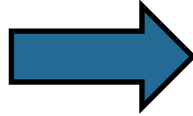
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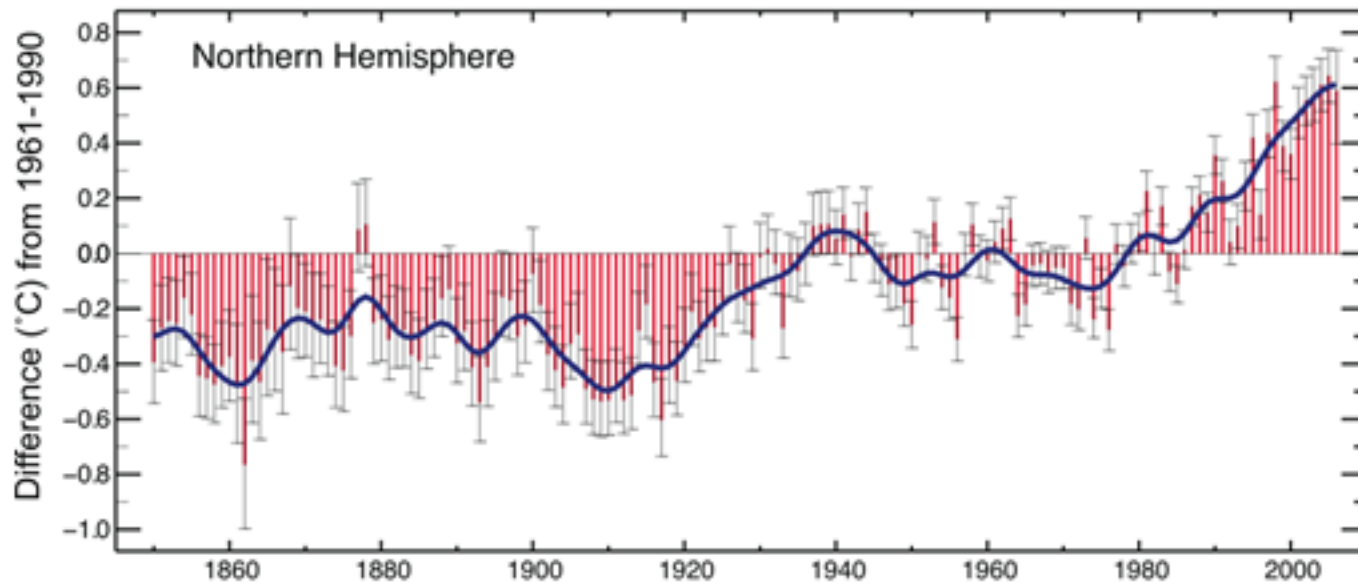
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Background

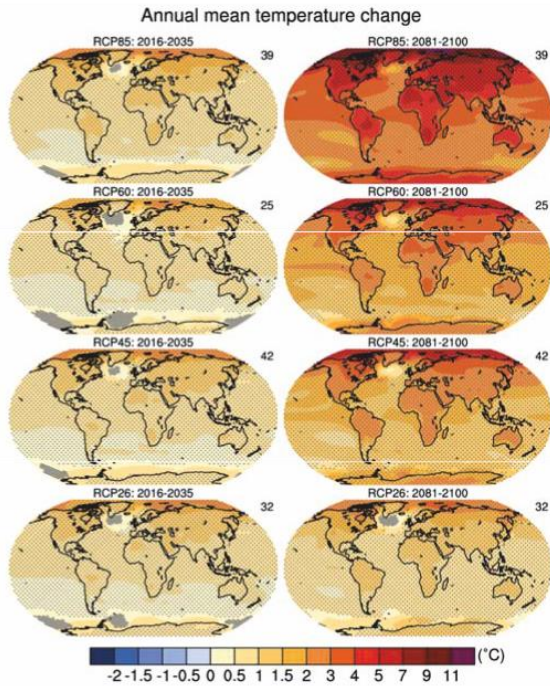


Climate Change



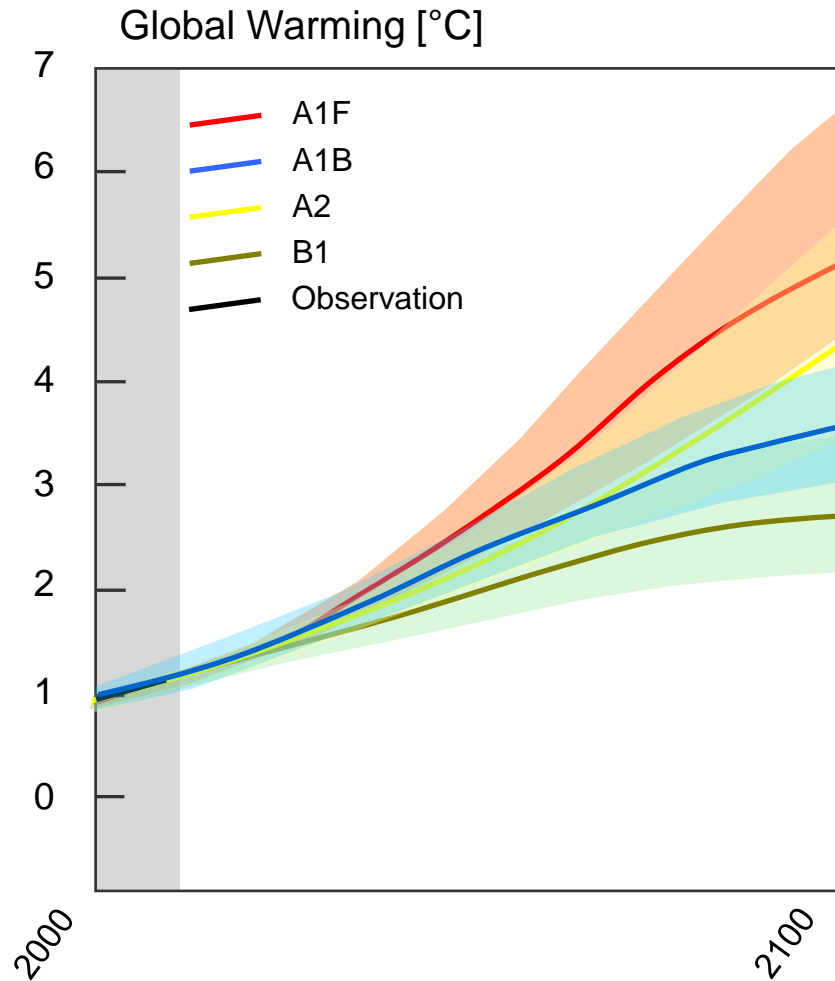
Climate Change

Emission scenarios



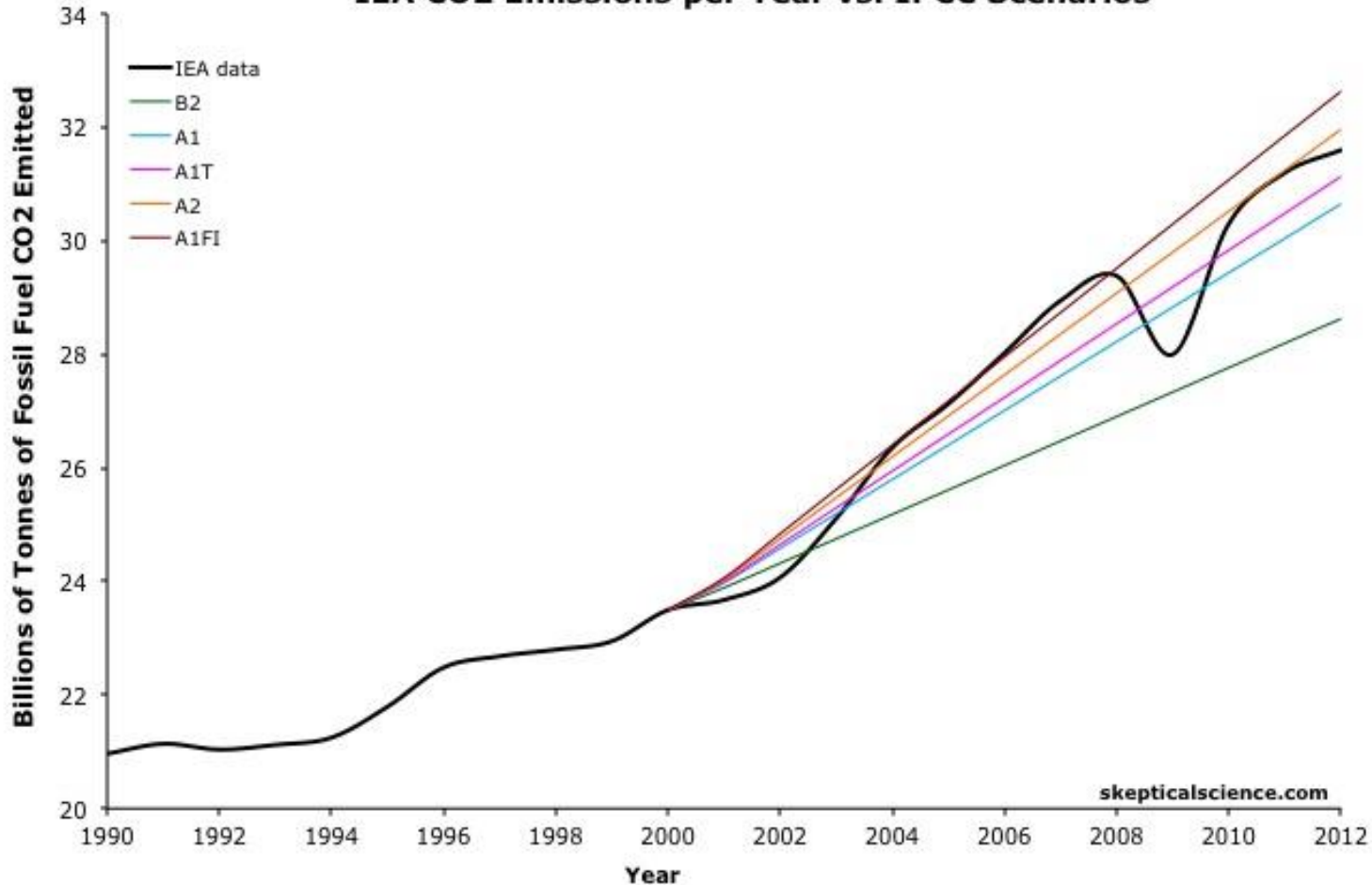
Different computer models

Different Pathways



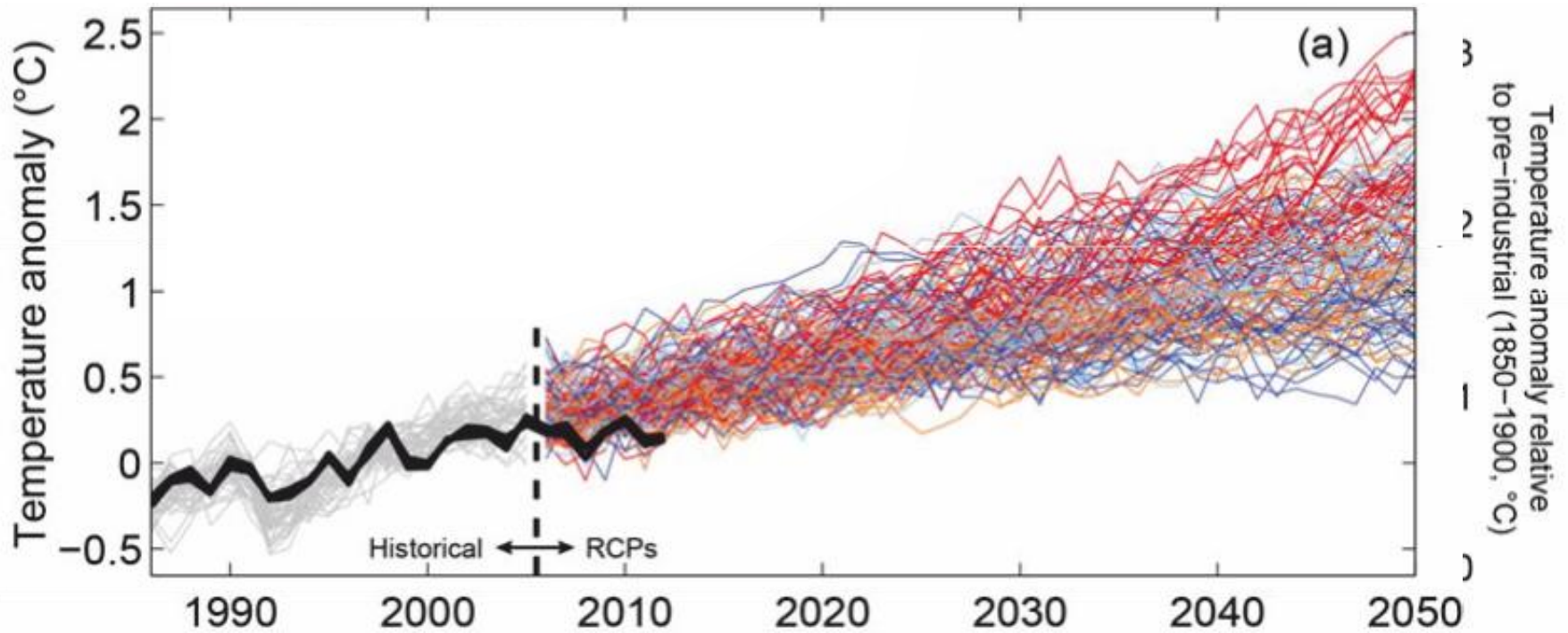
Different Pathways

IEA CO2 Emissions per Year vs. IPCC Scenarios



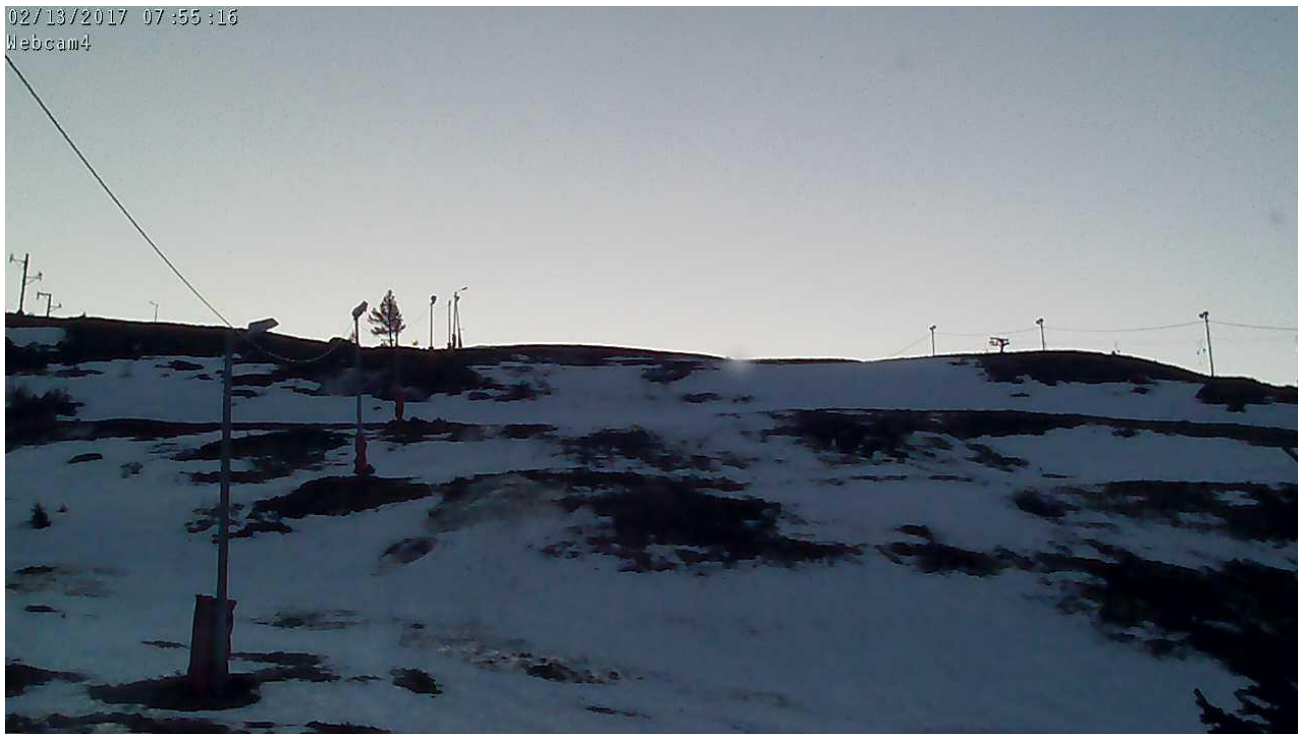
skepticalscience.com

Different Computer Models



Research Project

Climate change impacts on ski areas in Norway

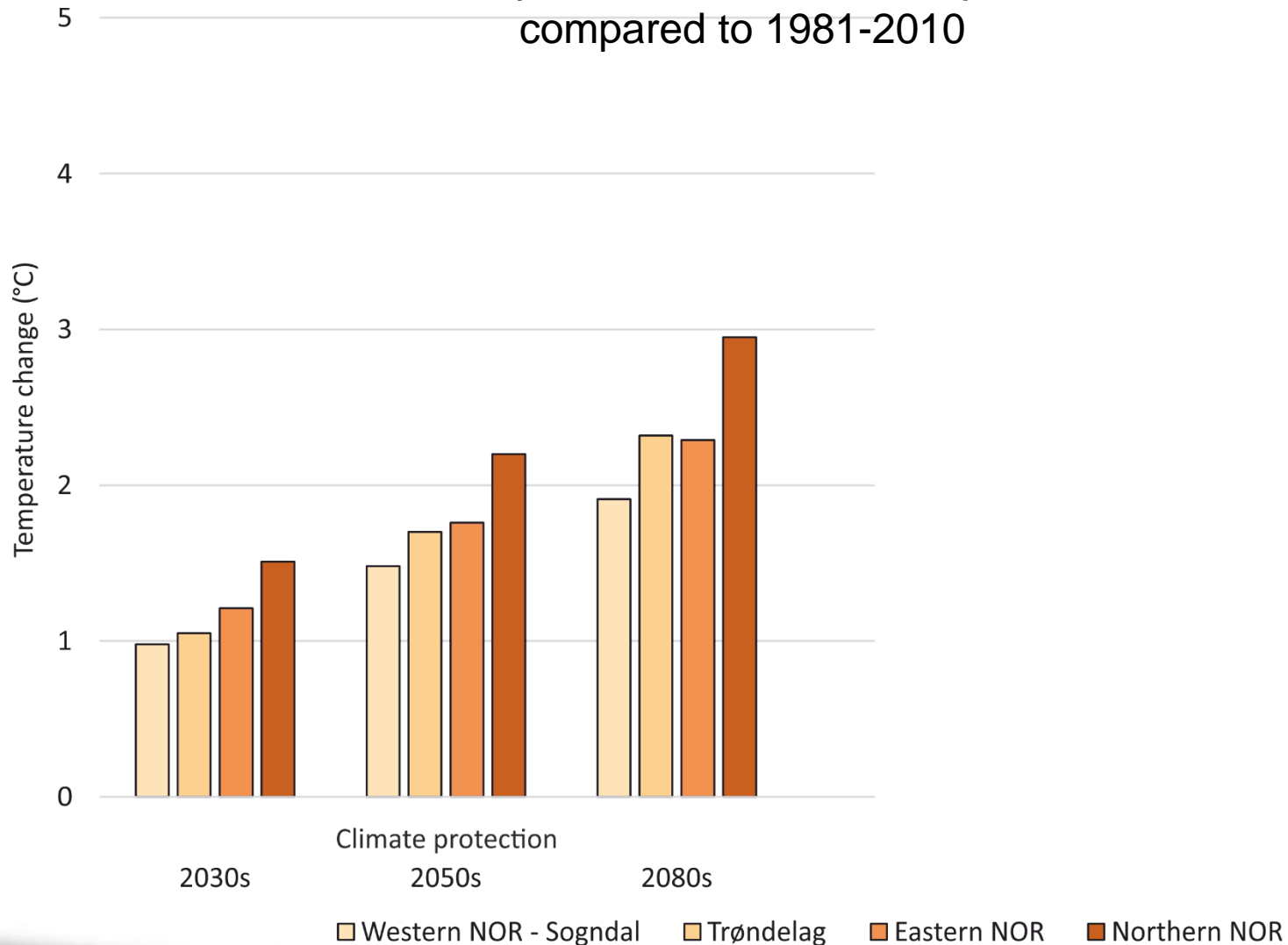


Climate Scenarios

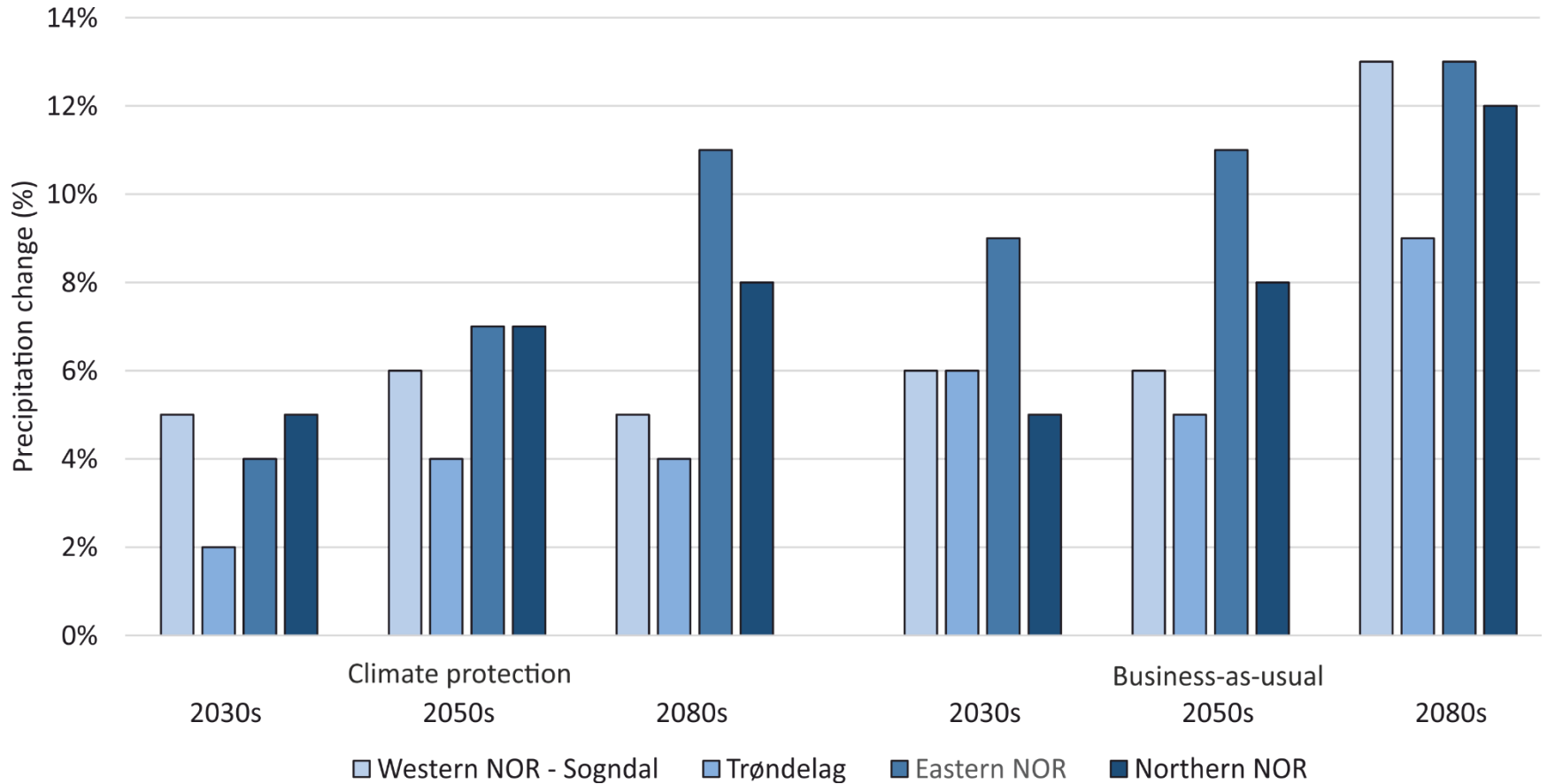
- Two Climate Change Emission Scenarios:
 - „Climate Protection“ (RCP 4.5)
 - „Business-as-usual“ (RCP 8.5)
- For 4 regions
(+ more regions for precipitation)
- For three time periods
 - 2030s (2021-2050)
 - 2050s (2041-2070)
 - 2080s (2071-2100)

Climate Scenarios – Temperatur (winter months)

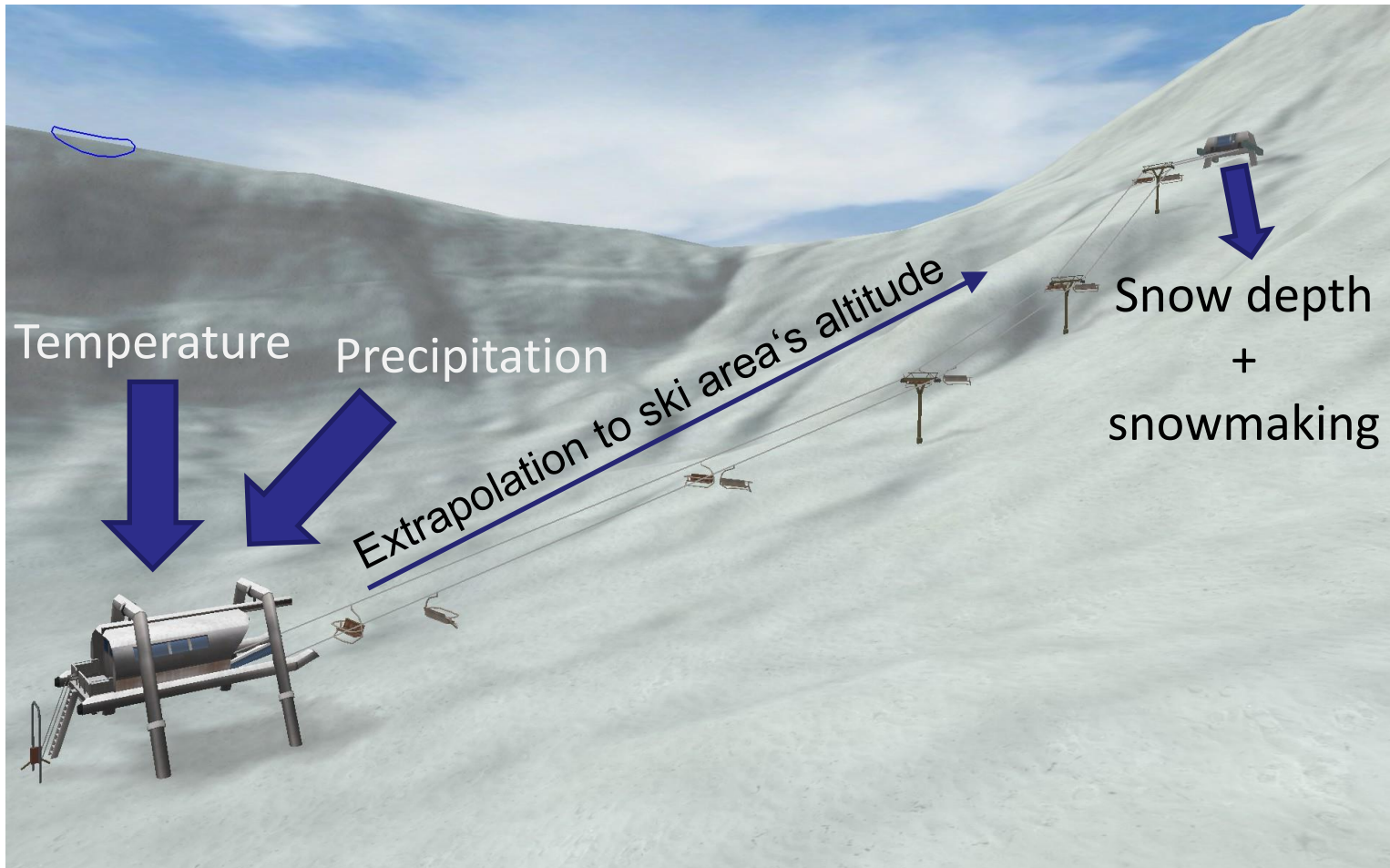
compared to 1981-2010



Climate Scenarios – Precipitation (winter months) compared to 1981-2010



Ski season model



Ski season model

Some key assumptions:

- Snowmaking dates Nov 1 – Mar 31
- Temperature threshold: -5°C
- Snowmaking capacity: 10 cm / 24 hours
- Scheduled season closing: Apr 15



Ski season model

Natural snow depth /
Natural snow reliability



Variable density

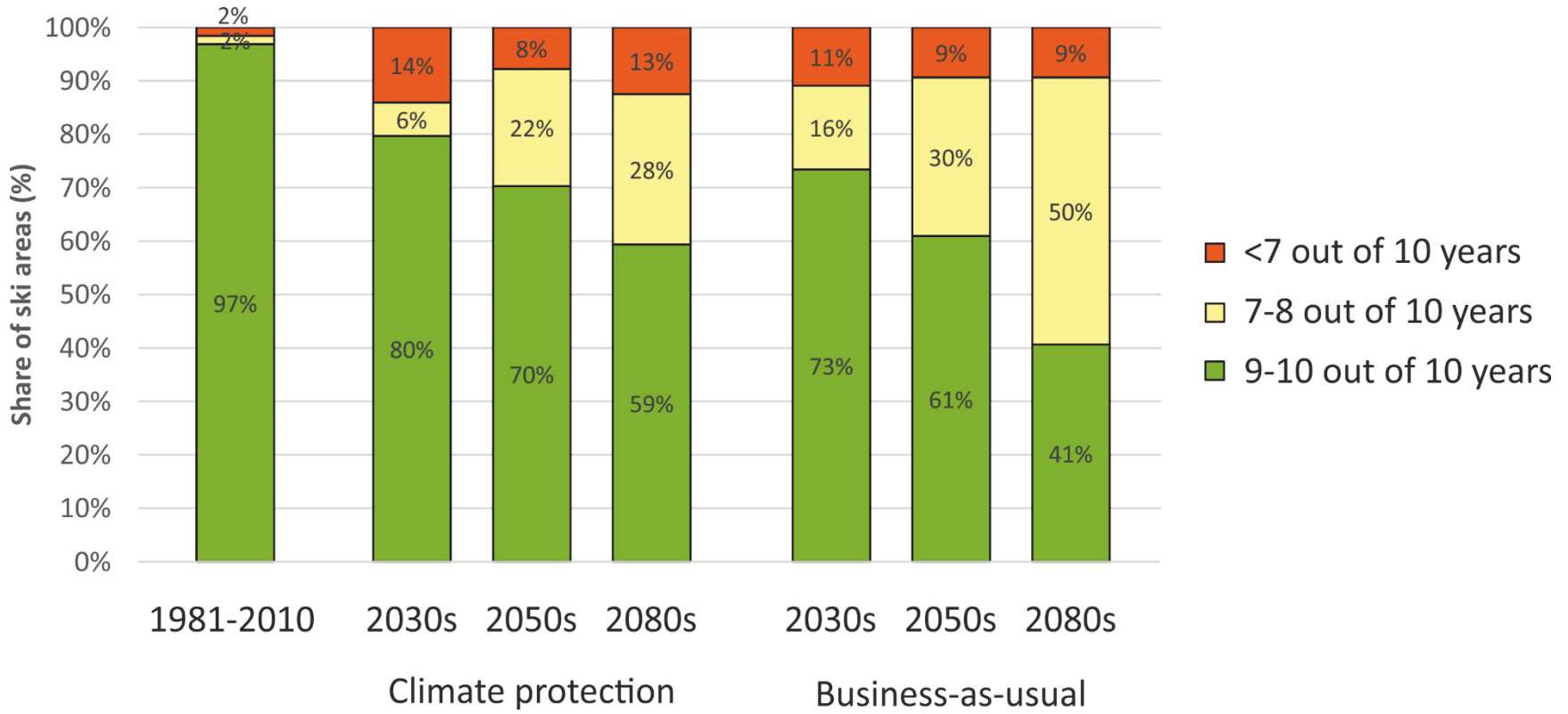
Snow depth incl. snowmaking /
Technical snow reliability



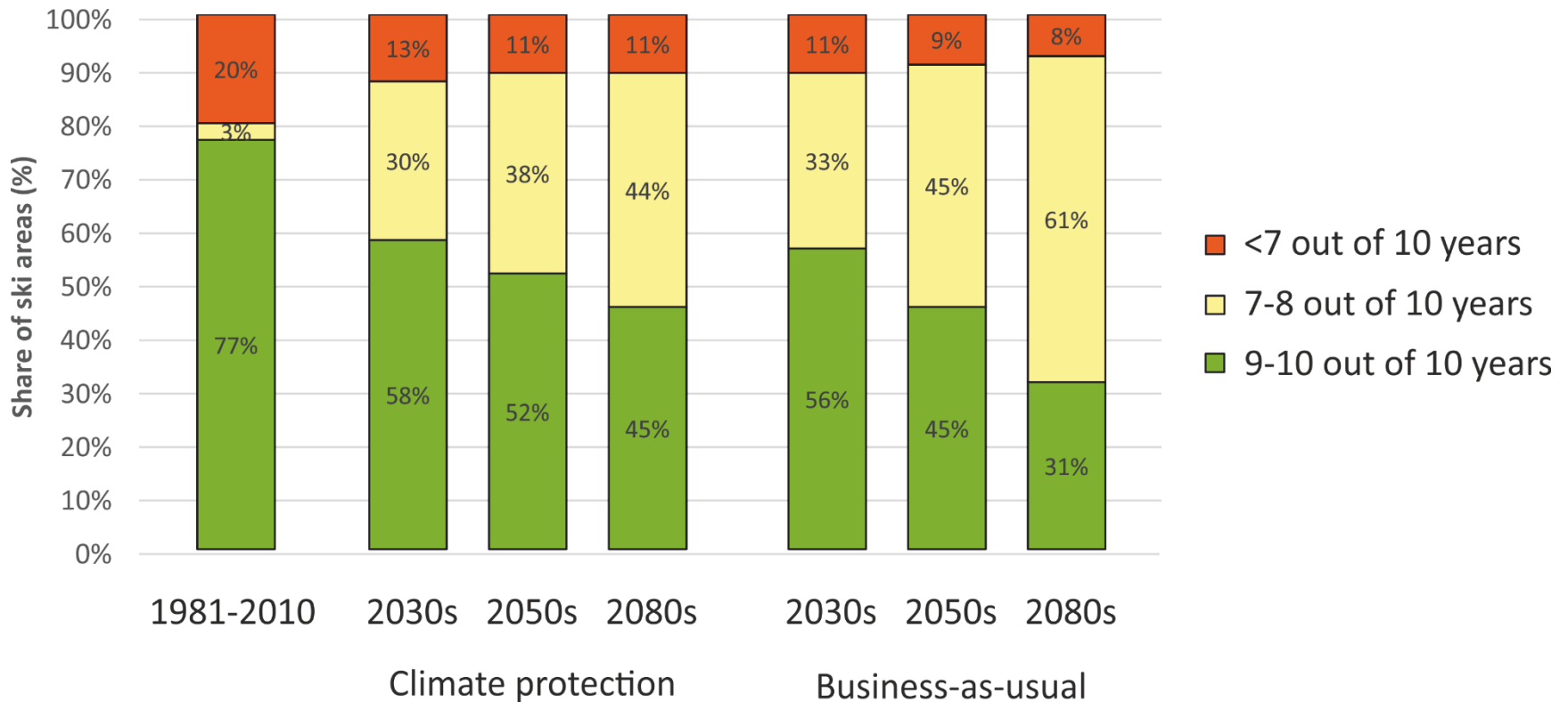
Constant density (400 kg/m³)

30 cm \neq 30 cm

Snow reliability – 100 day season

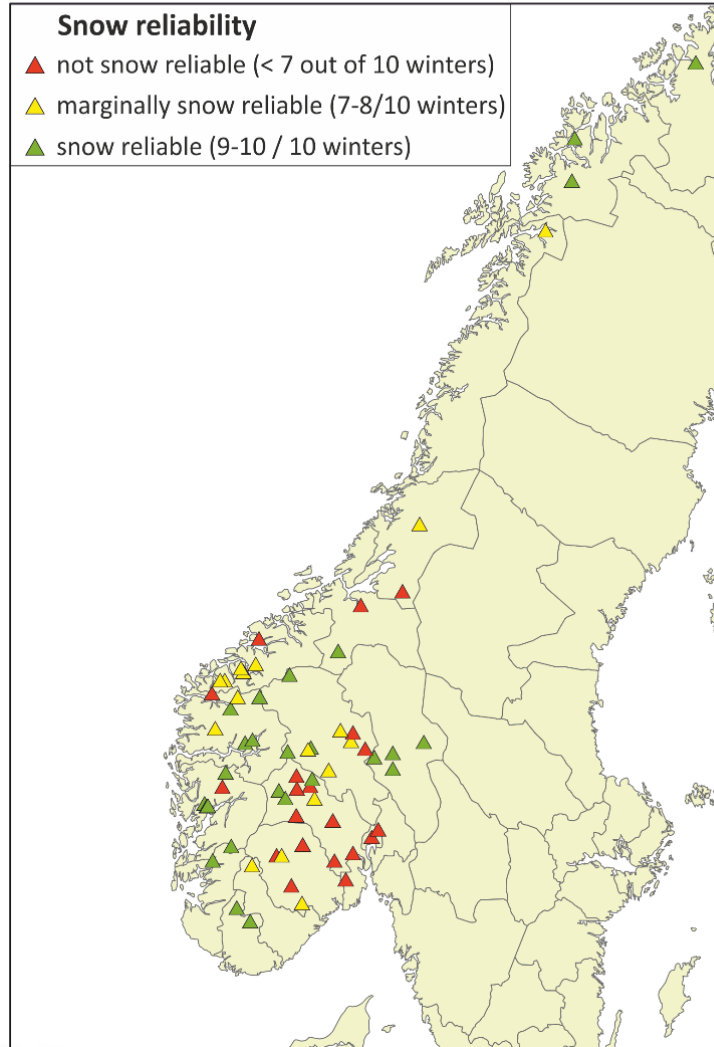


Snow reliability – Christmas Holidays

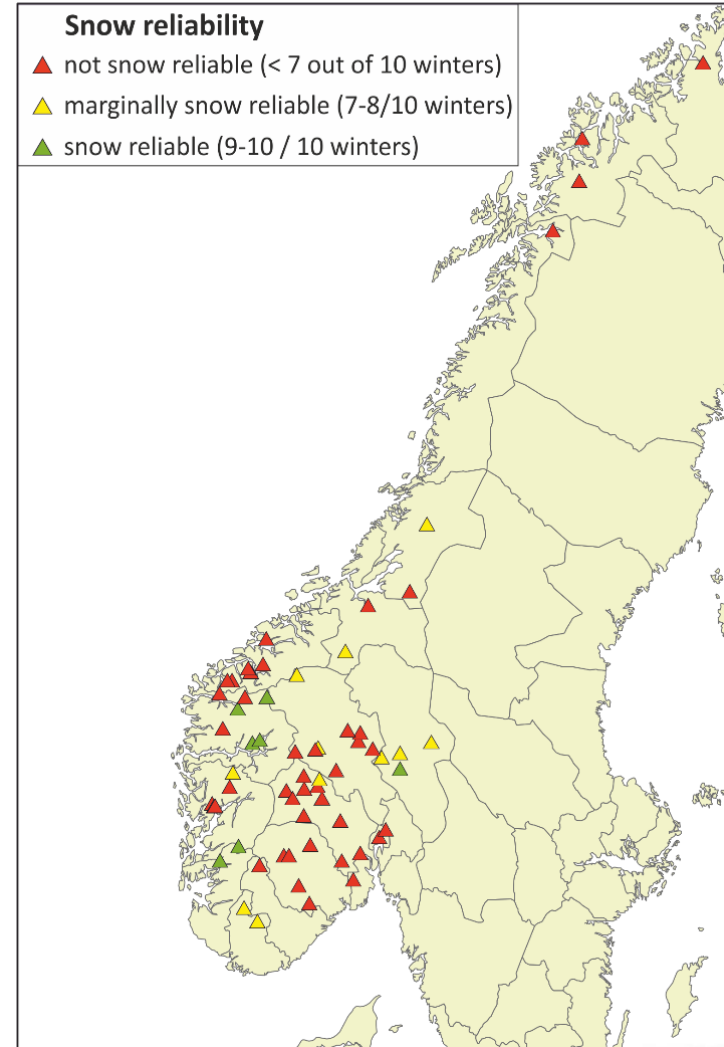


Snow reliability – Today with natural snow

100 day-season

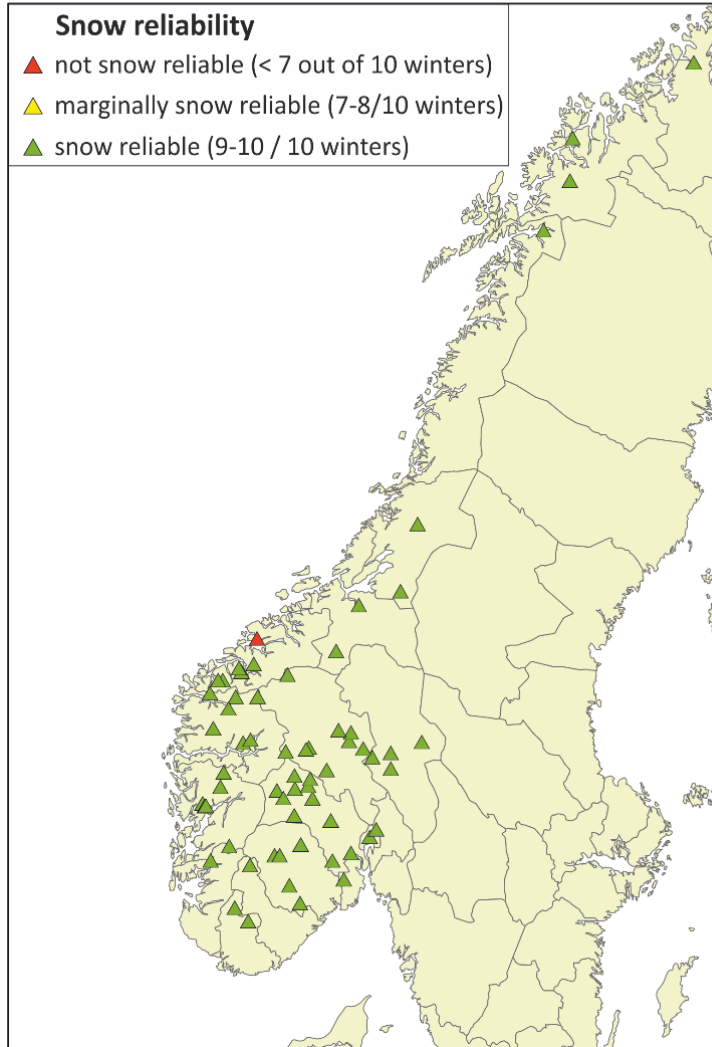


Christmas Holidays

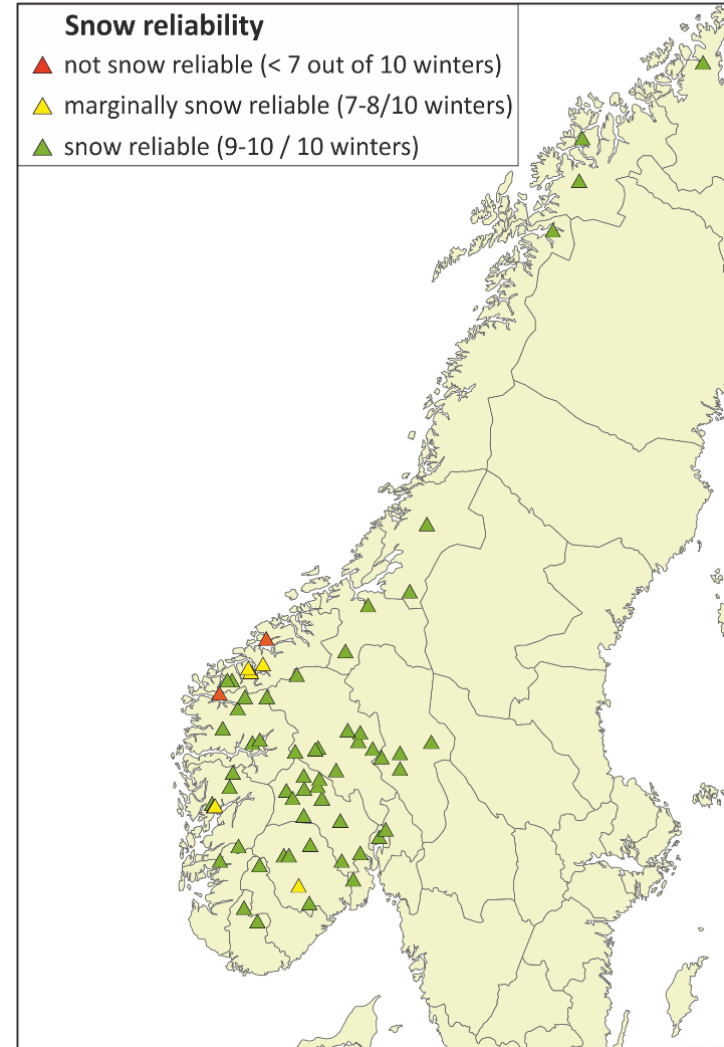


Snow reliability – Today with snowmaking

100 day-season

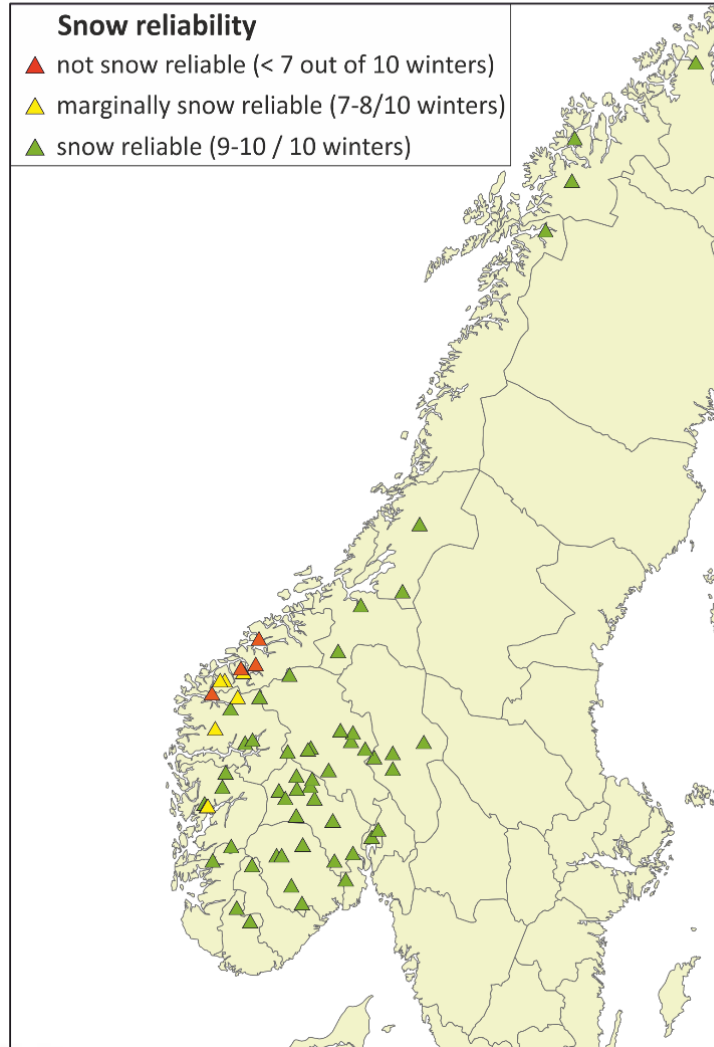


Christmas Holidays

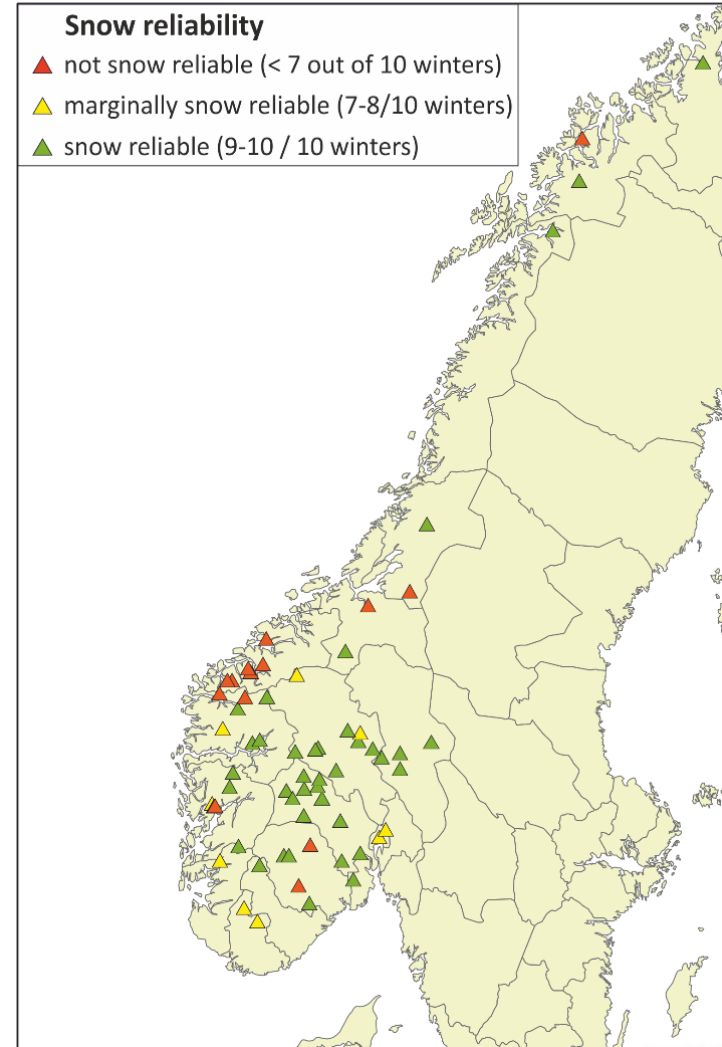


Snow reliability – Climate protection 2030s

100 day-season

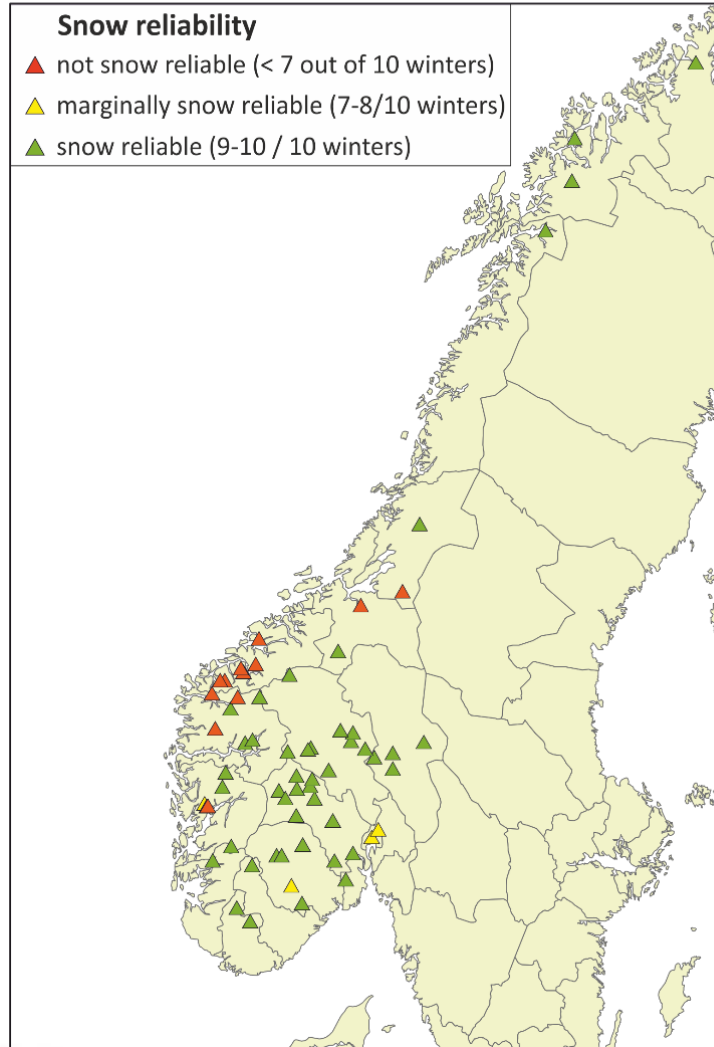


Christmas Holidays

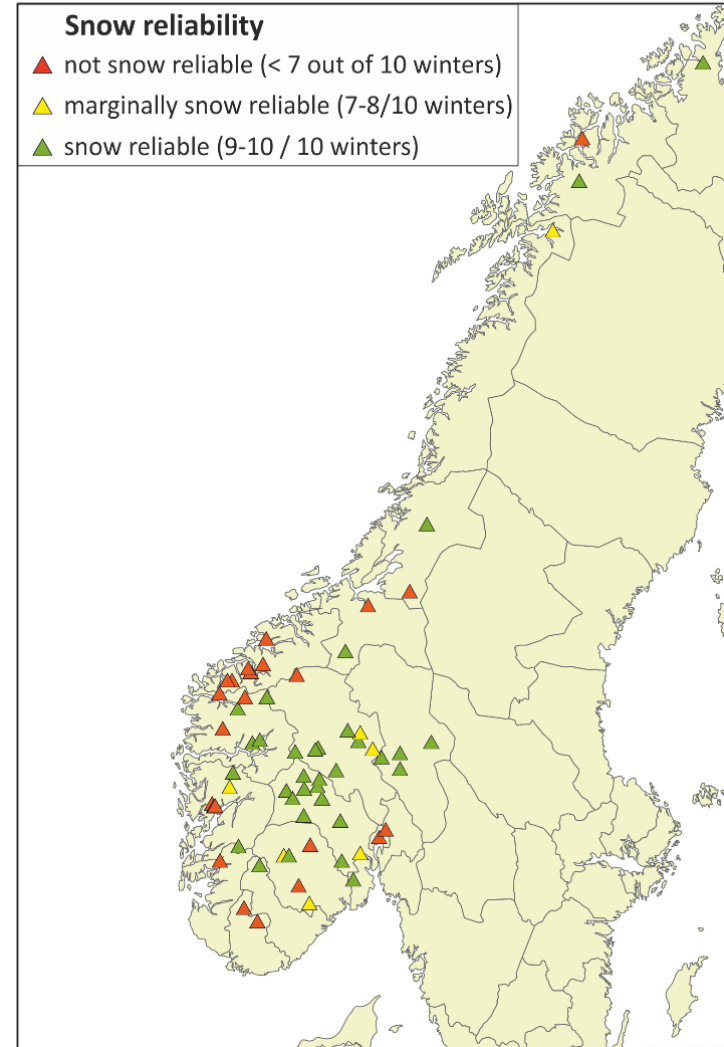


Snow reliability – Climate protection 2050s

100 day-season

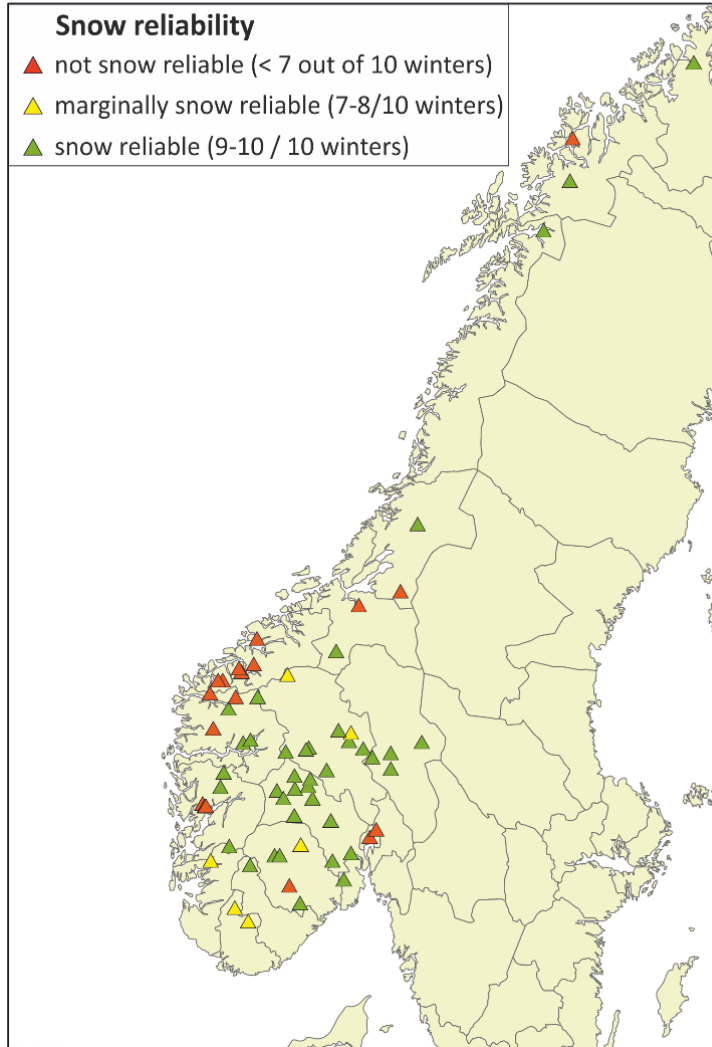


Christmas Holidays

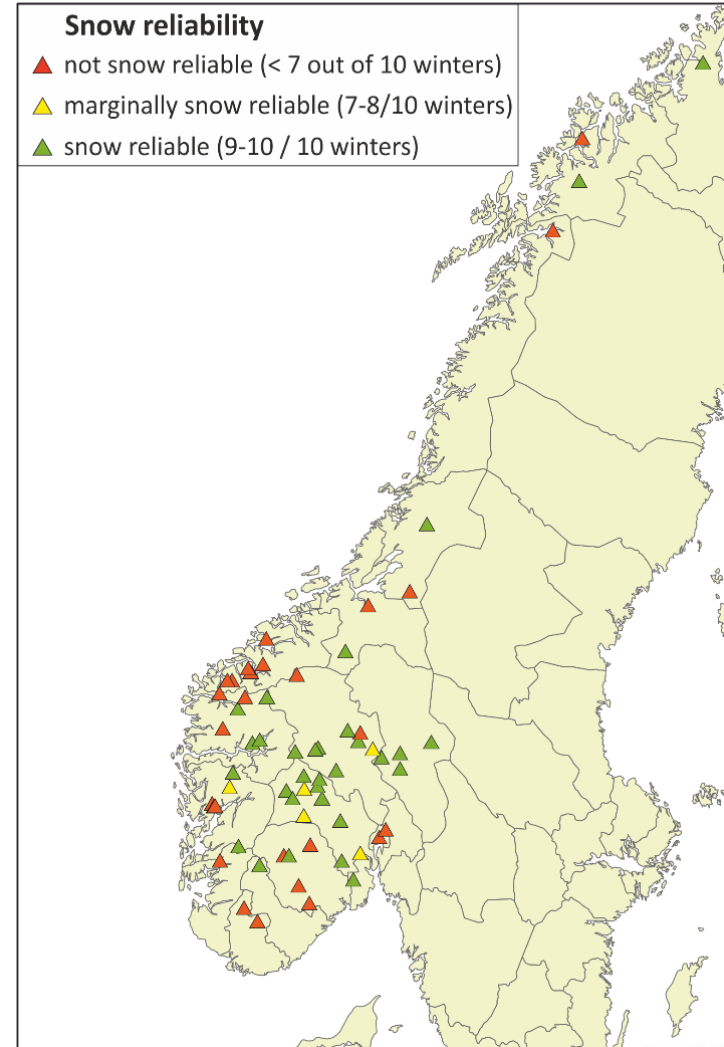


Snow reliability – Climate protection 2080s

100 day-season

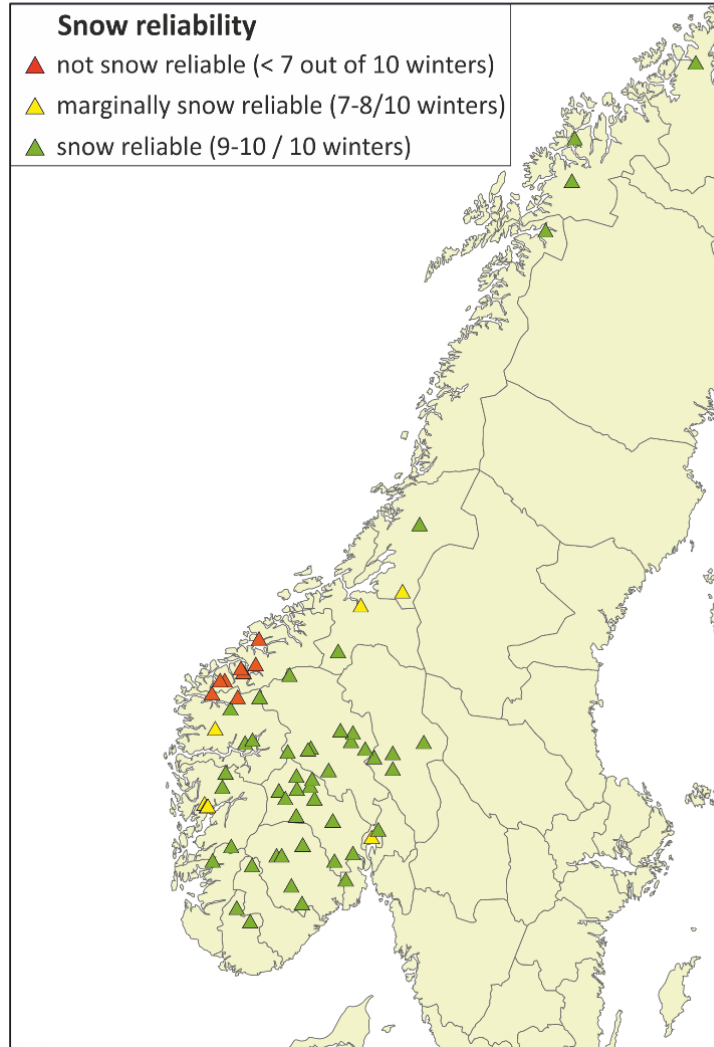


Christmas Holidays

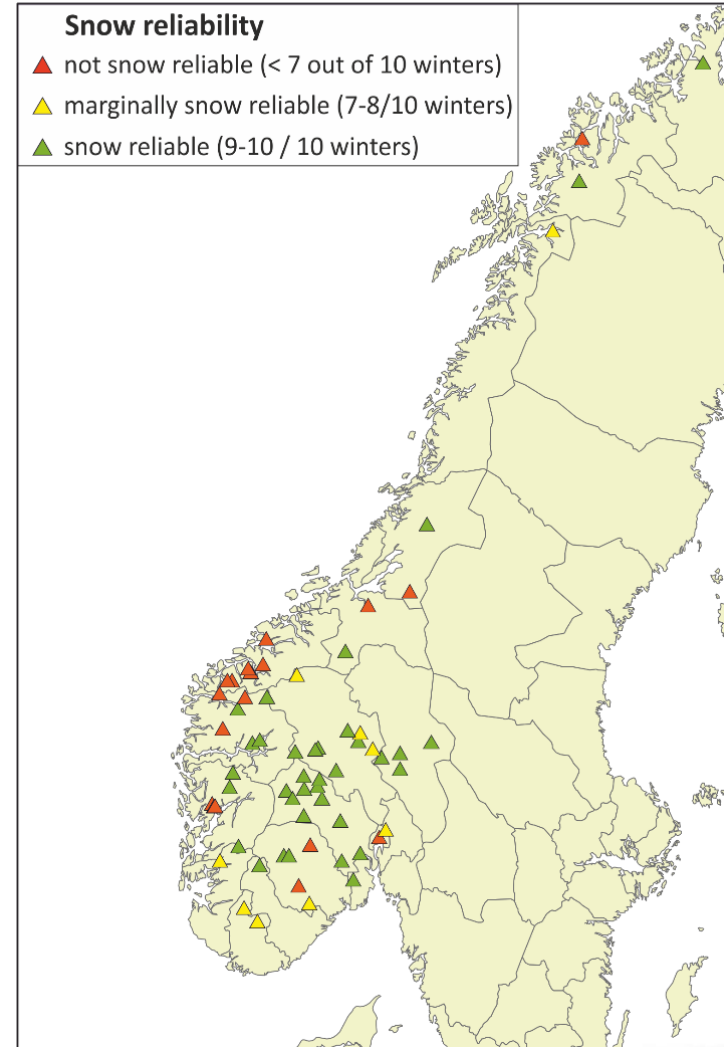


Snow reliability – Business as usual 2030s

100 day-season

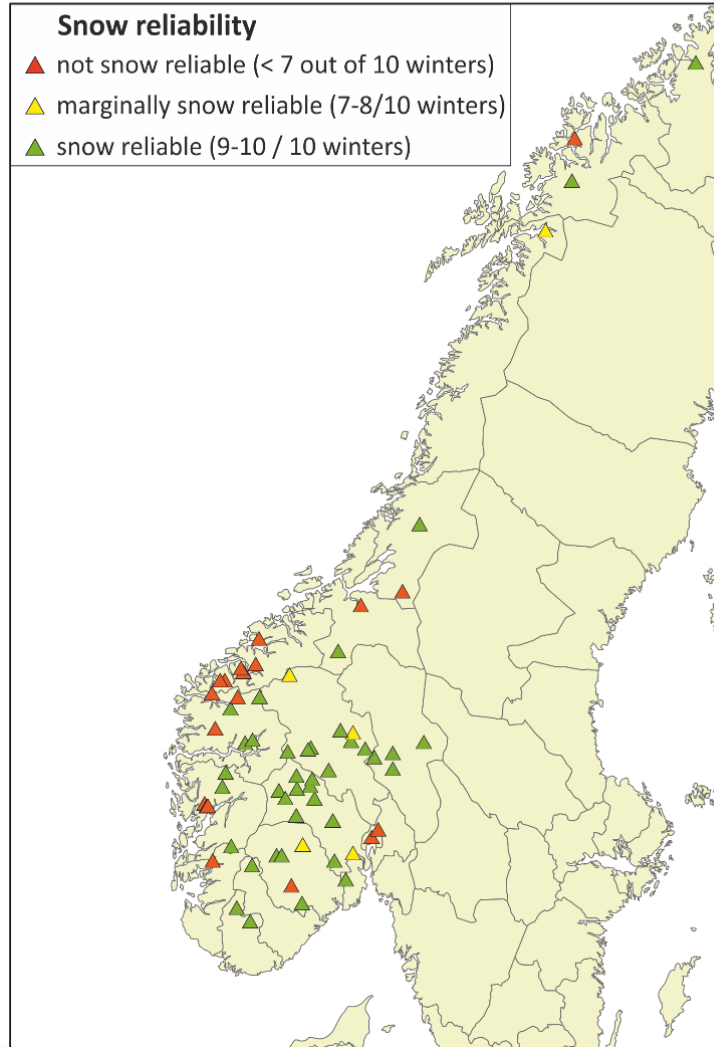


Christmas Holidays

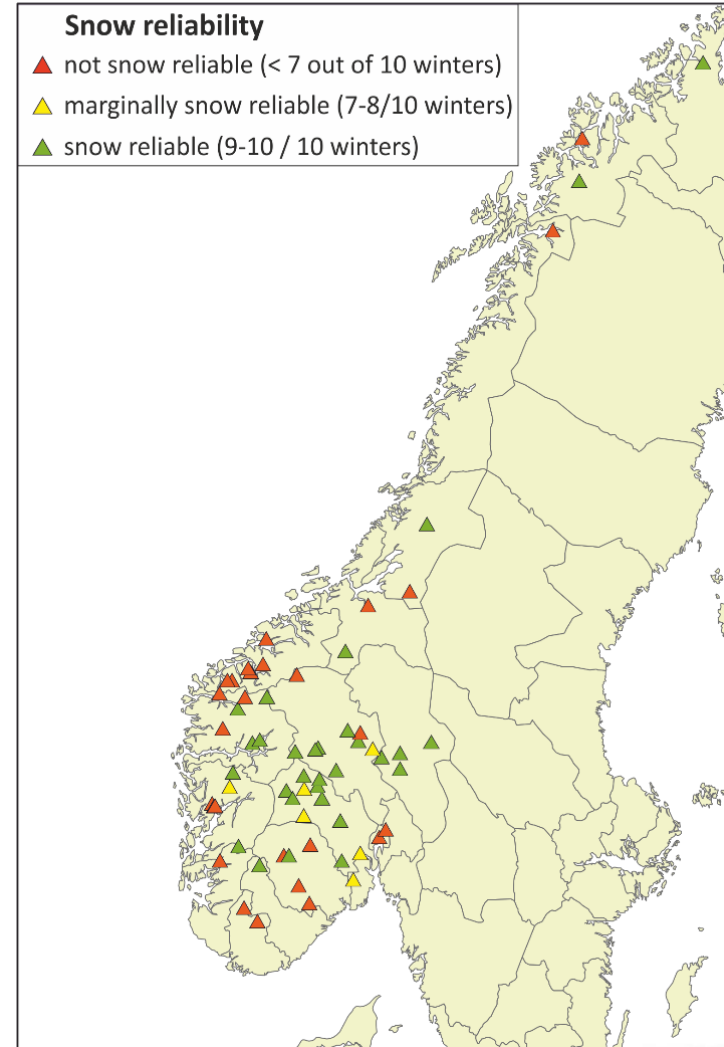


Snow reliability – Business as usual 2050s

100 day-season

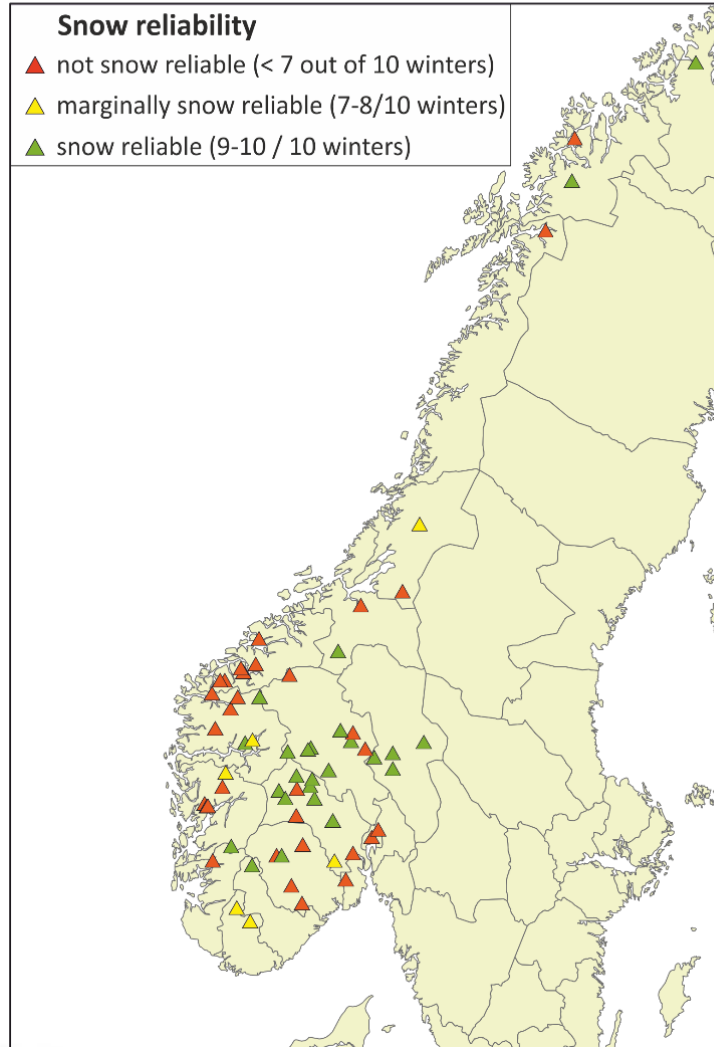


Christmas Holidays

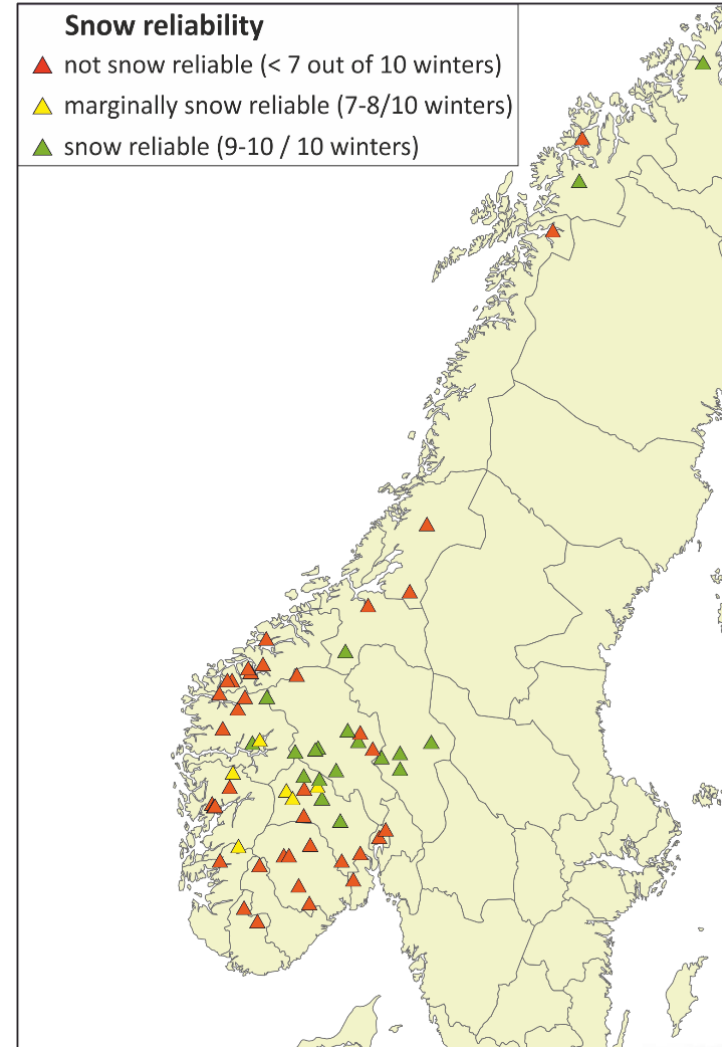


Snow reliability – Business as usual 2080s

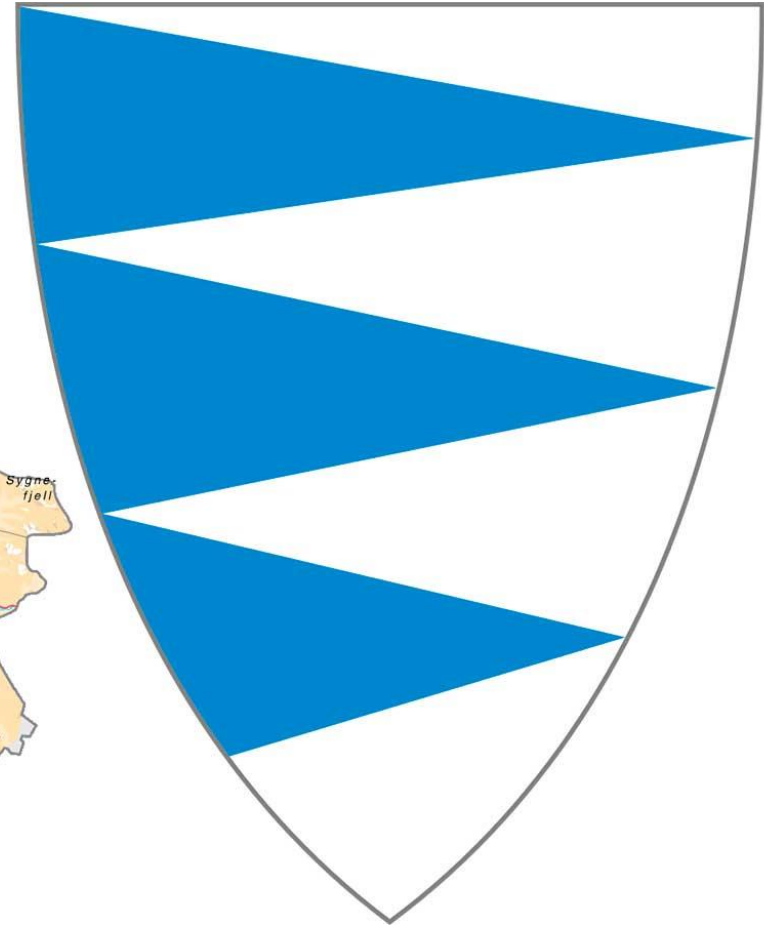
100 day-season



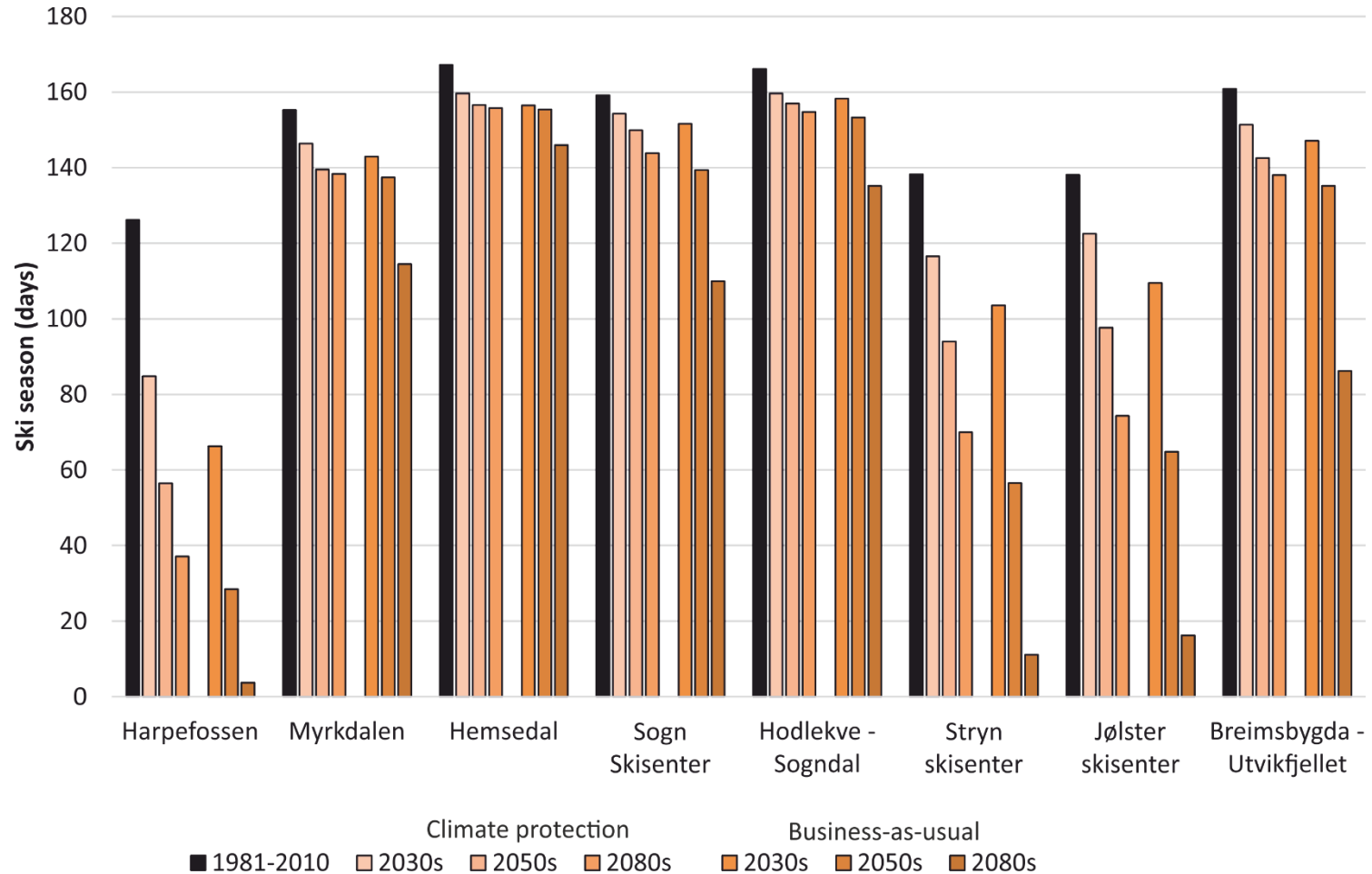
Christmas Holidays



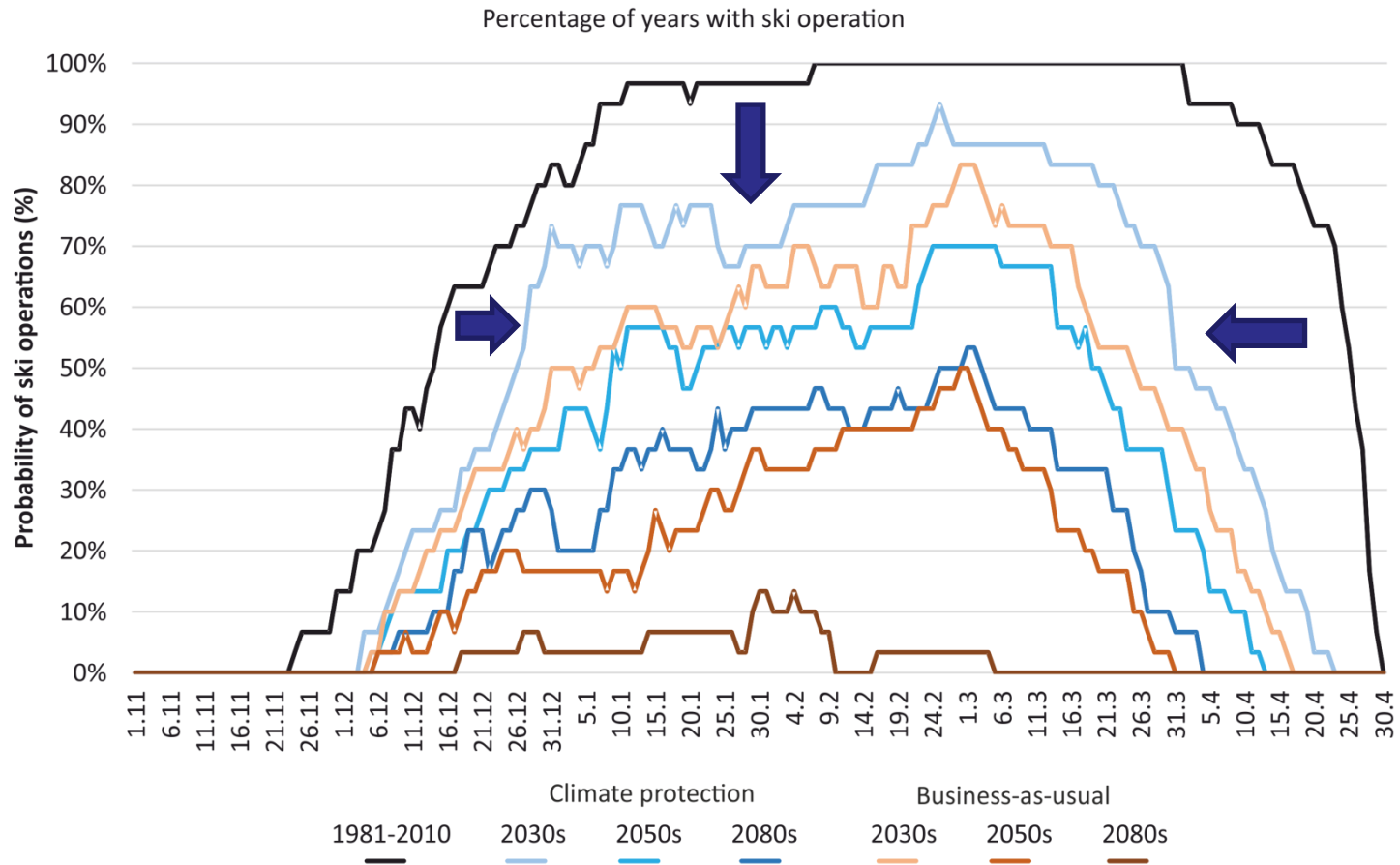
Details for some ski areas



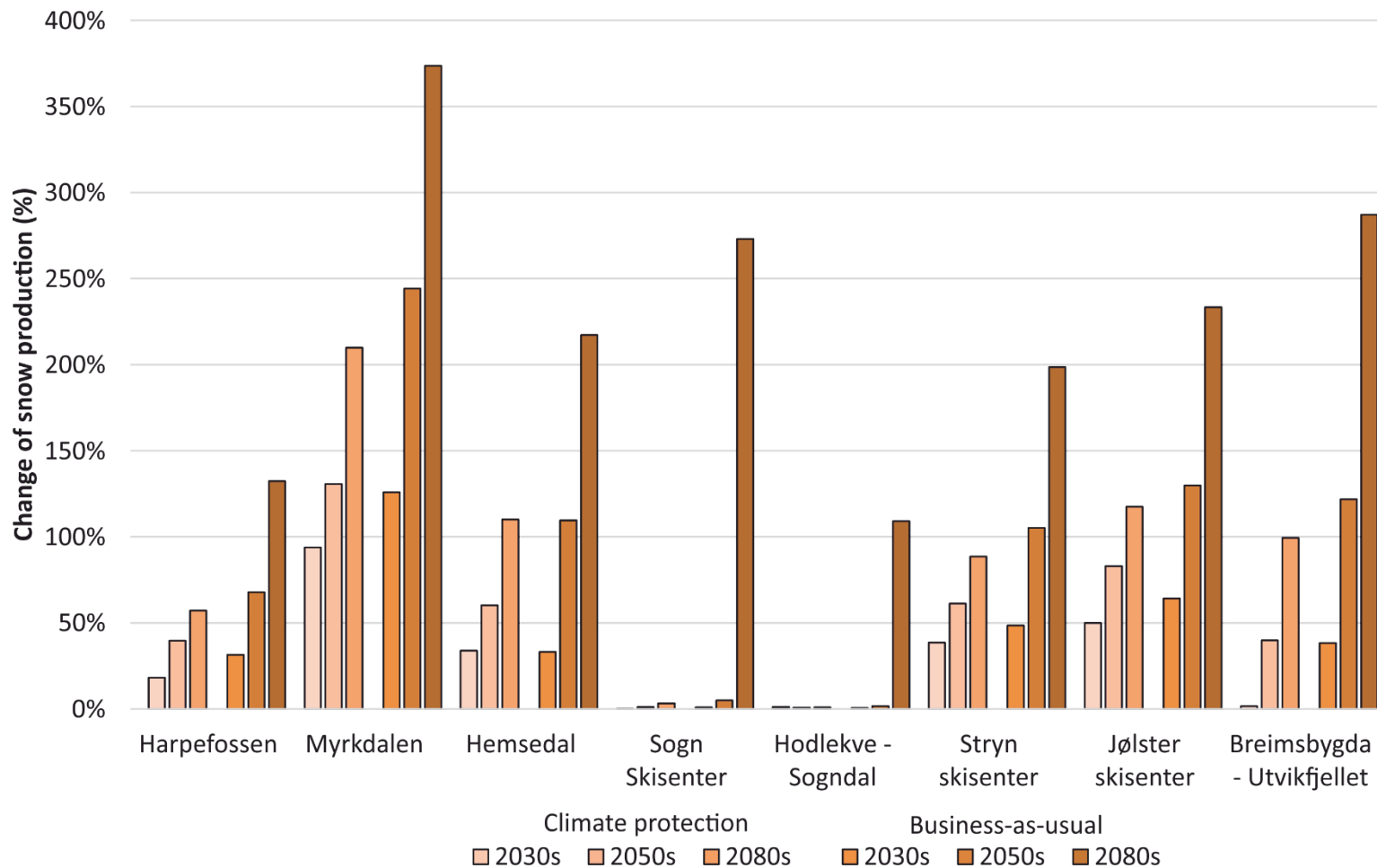
Length of the ski season



Seasonality



Required increase in snow production



Conclusion

- Climate Change is not the end to skiing in Norway
- BUT: Regionally highly diverse impacts
- Potential set of winners and losers
- Necessary actions and potential in each ski area?

Potential adaptations

Intensified Snowmaking



Potential adaptations

Snow depots



Potential adaptations

Alternative Products



Thank you!

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