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Administration

Climate Change Adaptation

Climate Change and the Norwegian Road Network

06.12.2017



Foto: Jarle Wæhler

- Europaveg
- Statveg
- Riksveger



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Public roads, total:	93 214 km
National roads (state-owned):	10 500 km
County roads:	44 000 km
Municipal roads:	38 515 km
Bicycle paths	3 500 km

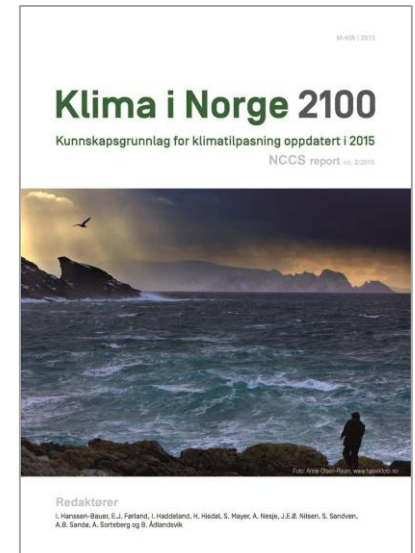




National framework for adaptation to CC

What basis do we have for climate adaptation of the road network?

- Report: «Climate in Norway 2100»
- Webportal: klimaservicesenter.no
- Collaboration with other agencies





NPRA programmes



2007 – 2012

Aim: investigate all effects of climate change on roads & propose remedial measures.



2012 – 2015 / **Collaboration between:**

- NPRA
- Norwegian National Rail Administration
- Norwegian Water Resources and Energy Directorate



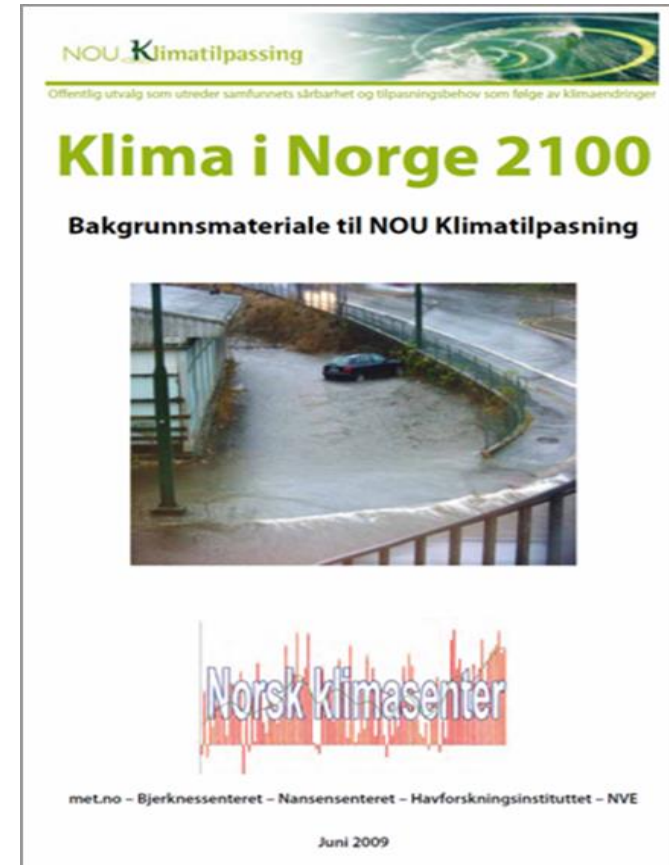
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Climate projections

Main conclusions

- Wetter
- Warmer
- More frequent extreme weather





What are the challenges?



- Higher risk of flood and erosion
- Insufficient drainage capacity



- Better maintenance required



- Higher risk of landslides and avalanches
- Occurring new places and more frequently



- A need for better and more efficient preparedness



Climate change adaptation

How do we manage these problems?

Measures to answer these problems in four groups:

- **Planning and construction**: limit the vulnerability of climate impact in the operational phase
- **Operation and maintenance**: More and better
- Having a well-developed **preparedness system for natural hazards management**, based on good data and cooperation with other governmental agencies
- **Increased knowledge** on climate change adaptation, included knowledge from collaborators.

Climate change adaptation

What are the tasks of priority?

Climate change adaptation as part of our ordinary tasks!

New roads

- Considering natural hazards in planning
- Design - adaptation of dimensioning criteria and methods
- Water management and drainage
- Avalanche and landslide prevention
- ...

- Avalanche and landslide forecasting as a preparedness measure
- Vulnerability analysis of existing road network
- Contingency plans on natural hazards
- Data collection and -processing

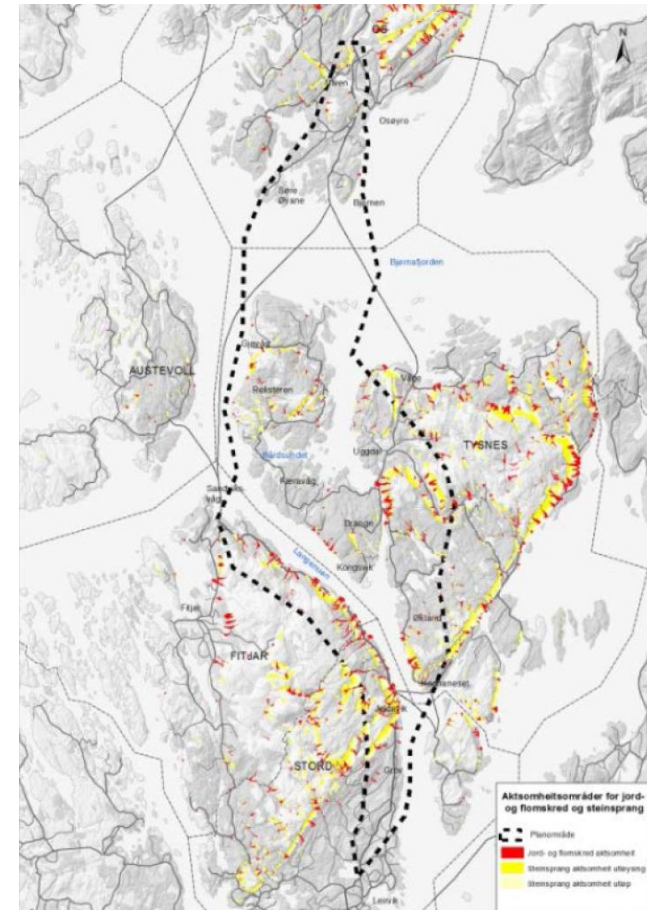
Existing roads



New roads – avoiding vulnerability

Planning and construction

- Vulnerability should be reduced by careful planning!
- Knowledge about natural hazards
- In situ inspections
- Working on better risk analysis for natural hazards



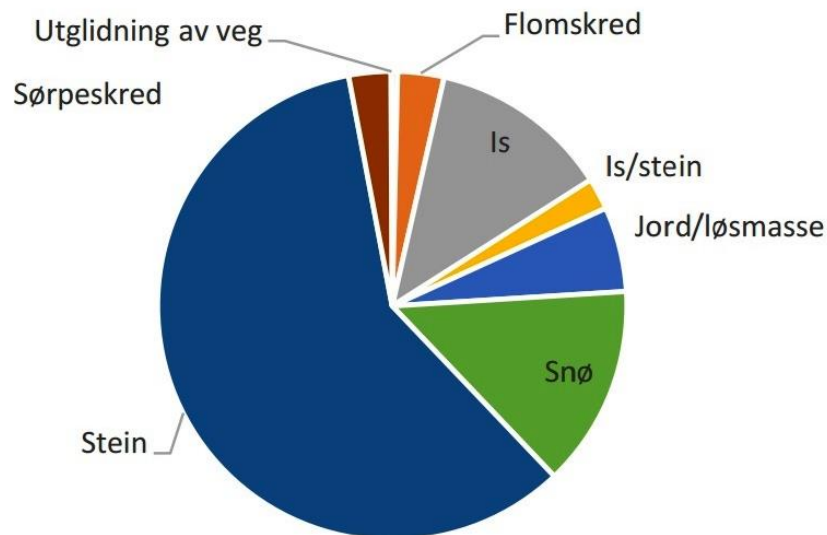
Example risk and vulnerability map of E39 Stord – Os



New roads and existing roads – adaptation to CC

Landslide and avalanche protection

- Analyses and reports on protection needs are updated regularly, latest Dec 2015.
- Total number of points 1700, 300 of these are highly prioritised



- Acceptance limits for risk: guidelines for new protection measures.



Cooperation facilitates CC adaptation

Forecasting avalanche and landslide risk on roads

- Something we would have done anyway, but still CC adaptation..
- Alternative to expensive protection measures
- The aim is to alert the road users and to close the road before an event
- As well as minimizing the closure time

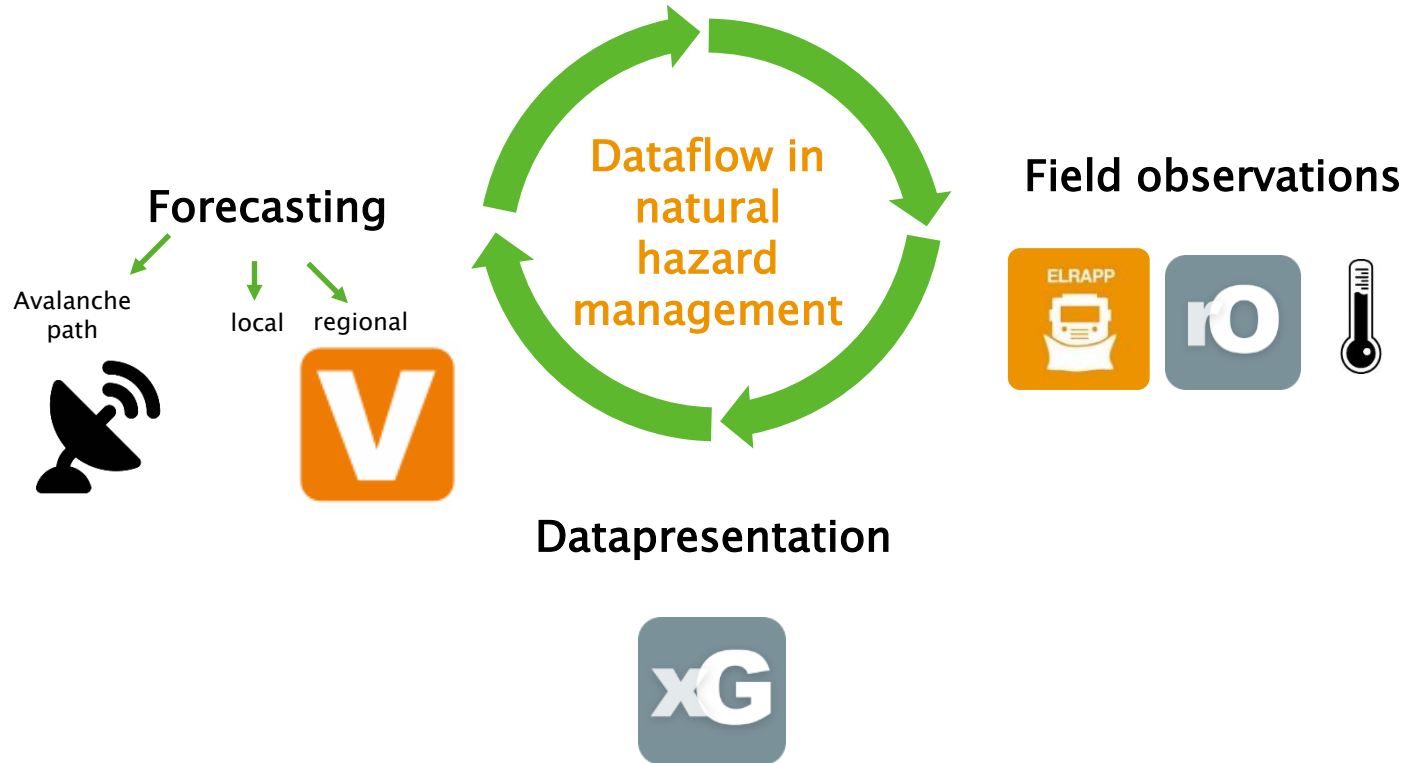
Measures for improving preparedness



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Contingency plans



Measures for improving preparedness



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Norwegian avalanche, flood and landslide hazard warnings

V
varsom.no

Search

Avalanche bulletins

Flood and landslide warning service

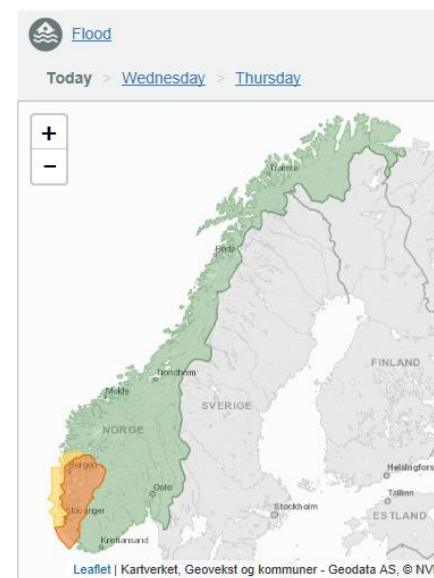
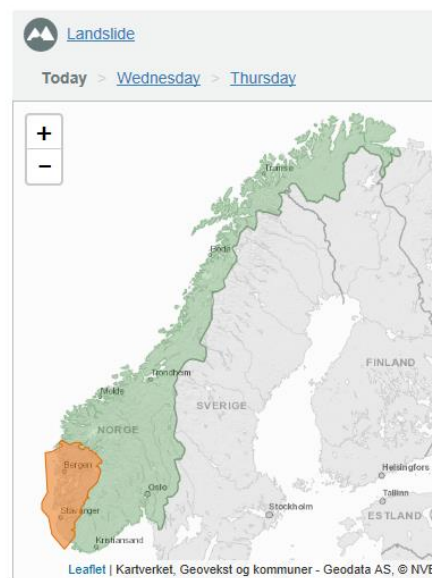
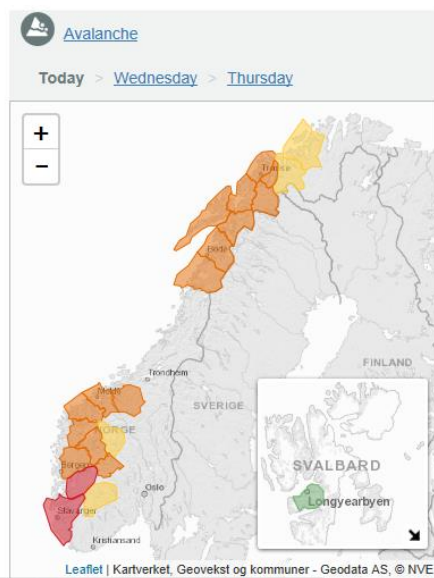
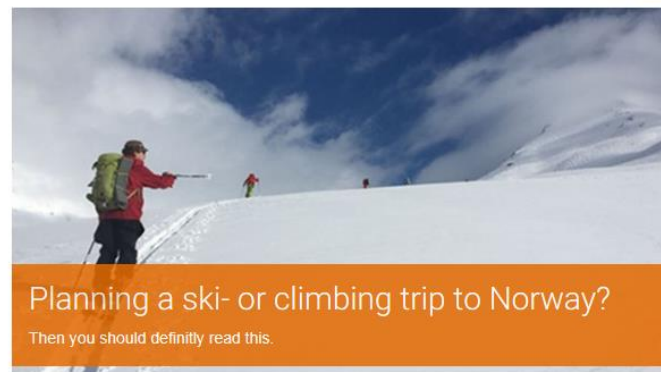
News

Norwegian avalanche, flood and landslide hazard warnings, all in one place.

Current warning levels

	Tue	Wed	Thu
Avalanche	4	3	?
Flood	3	3	3
Landslide	3	3	2

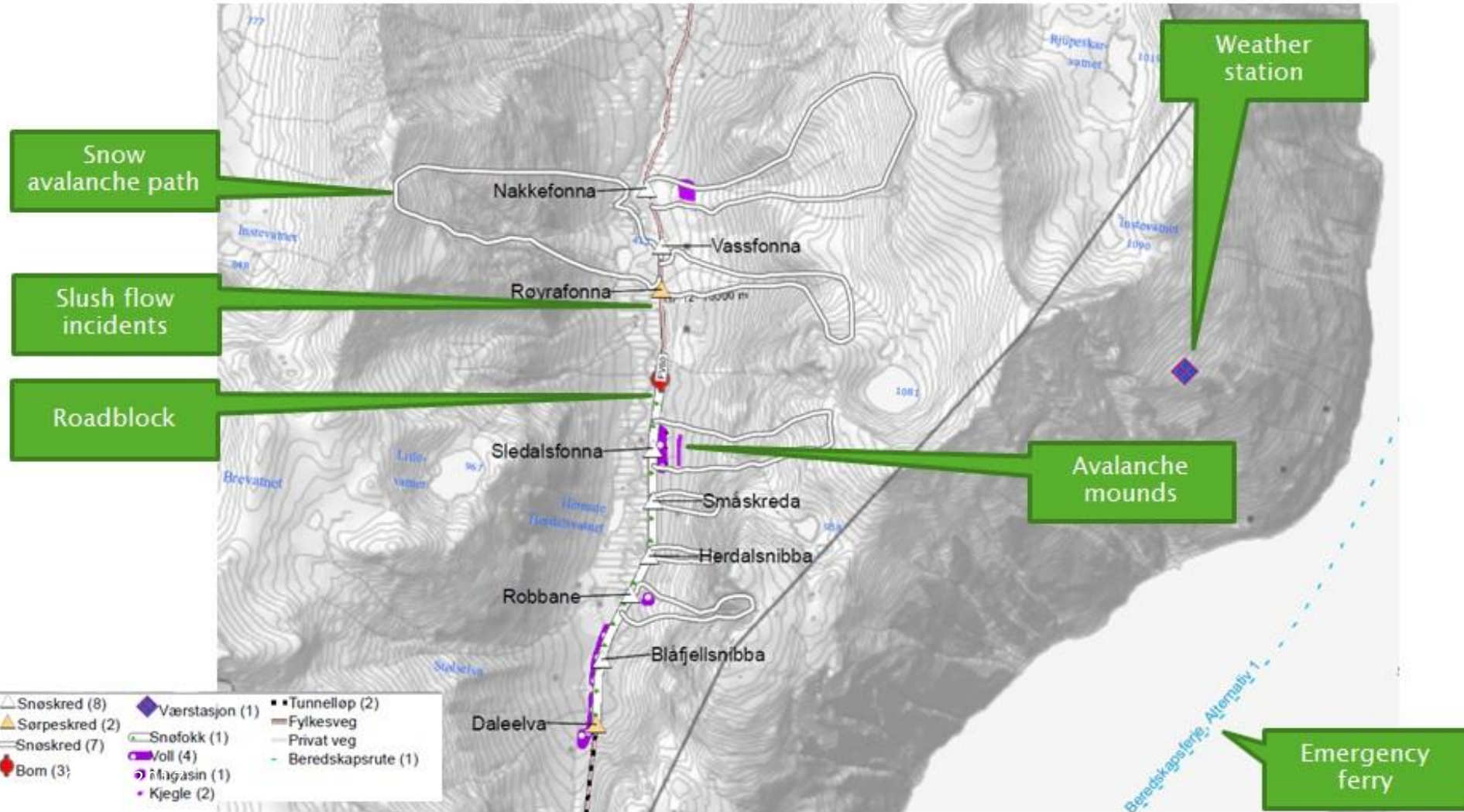
[Slope angle map for Norway](#)





Measures for improving preparedness

Preparedness – contingency plans



Field observations



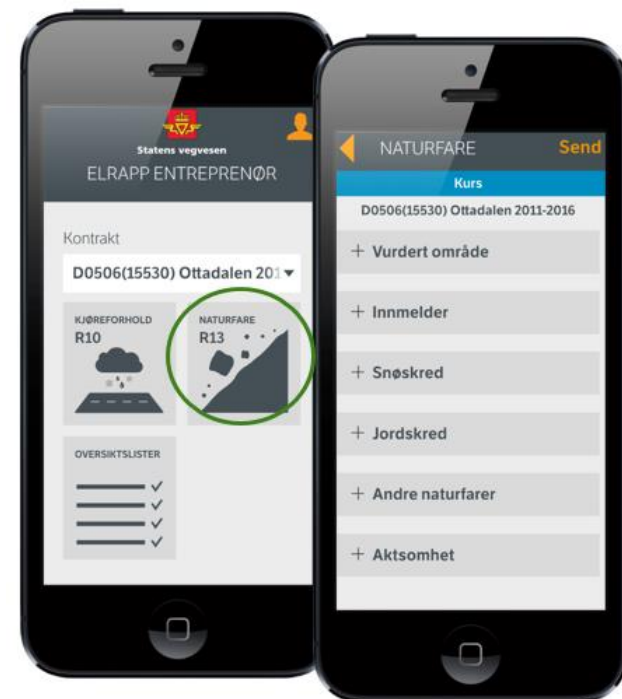
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Elrapp



Fv 13 Gaularfjellet
Foto: I B Hynne, SVV



Field observations



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RegObs



Foto: T H Medgard, SVV



PHOTO: HÅVARD NESBØ



Foto: J Tveit, SVV

Field observations



Weather stations



Weather station at Myklebustfjellet.
Photo: J Tveit, SVV



Maintenance of snow sensor at Svarthammartinden.
Photo: Hallvard Nordbrøden, SVV



Datapresentation



xG xgeo.no - expert tool for notification and emergency

placename/station Search

Feedback About xgeo.no Norsk Logg inn



Floods and landslides | **Avalanche** | Road | Railway | All data

Precipitation last 3 days at 07 AM on Dec 26, 2016

<<< << < Today > >> >>> 12/26/2016

Vis rapport

Grid data | Point/line data | Event data

- My favorites
- Weather
 - Fresh snow depth ☆
 - Fresh snow depth 3 days ☆
 - Precipitation ☆
 - Precipitation weekly ☆
 - Precipitation last 3 days ☆**
 - Temperature ☆
 - Temperature change ☆
- Farekart

Filter events on map

Filter events [days]
0 show current date

Days back: 0

Days ahead: 0

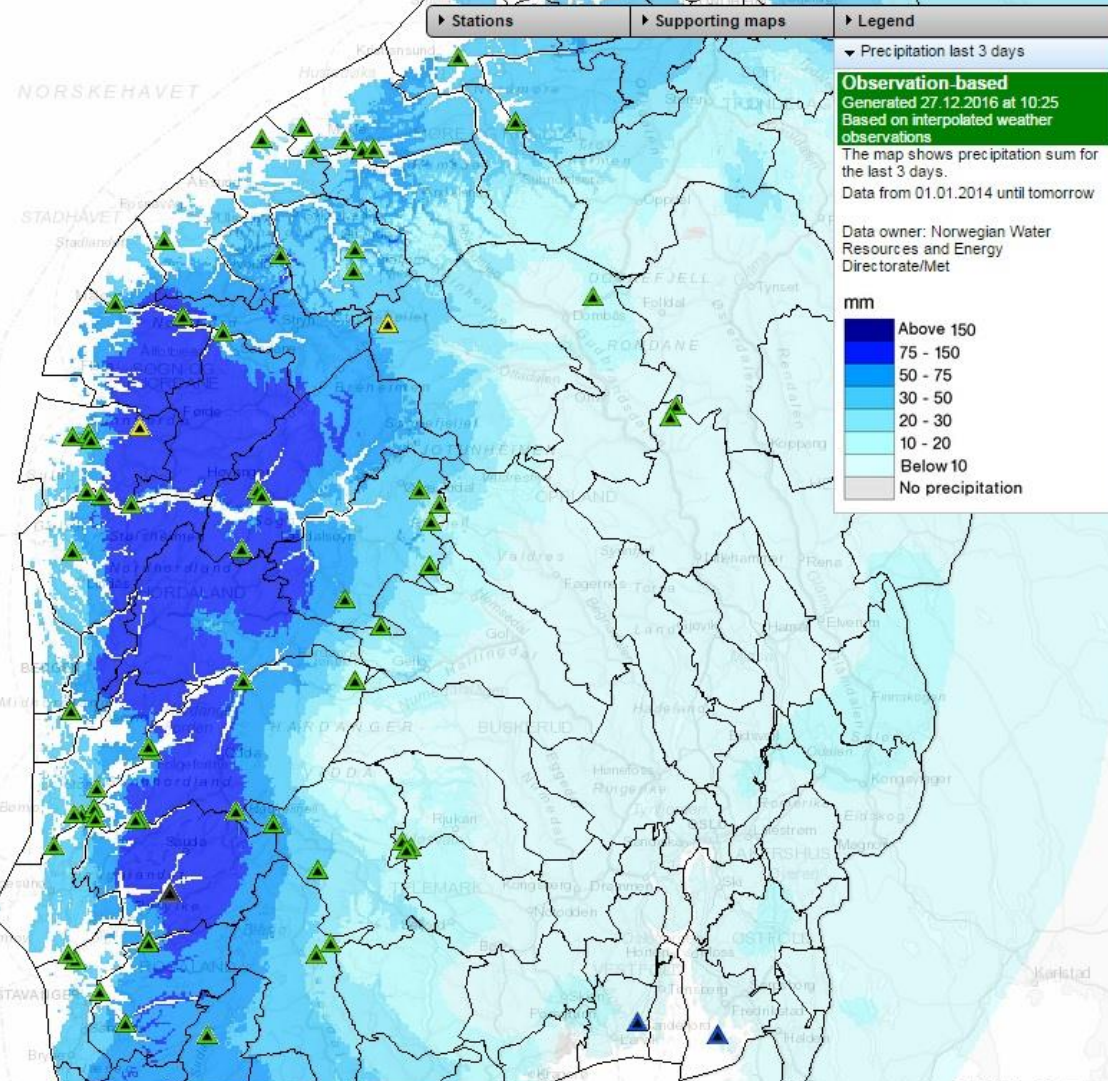
Landslides and snow avalanches database

regObs

- All pictures
- Avalanche
- Avalanche evaluation
- Avalanche problem
- Danger sign
- Flood danger sign
- Free text
- Incidents/accidents
- Land slide danger sign
- Observed land slide
- Snow depth and fresh snow depth
- Snow profile
- Snow stability
- Weather

Traffic report

- Avalanche
- Avalanche danger
- Bad weather
- Flood
- Land slide
- Rock fall



Stations | Supporting maps | Legend

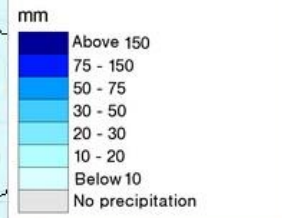
Precipitation last 3 days

Observation-based
Generated 27.12.2016 at 10:25
Based on interpolated weather observations

The map shows precipitation sum for the last 3 days.

Data from 01.01.2014 until tomorrow

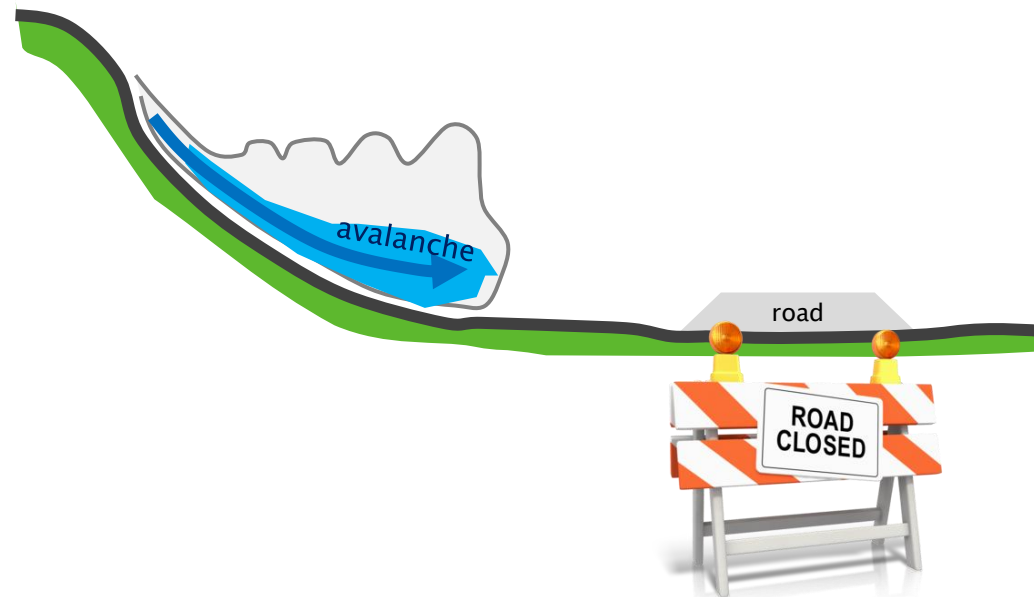
Data owner: Norwegian Water Resources and Energy Directorate/Met



Height filter | Change opacity: - + | Change zoom: - +

Regional forecast– local measures

- Close the road due to avalanche danger?



Regional forecast– local measures



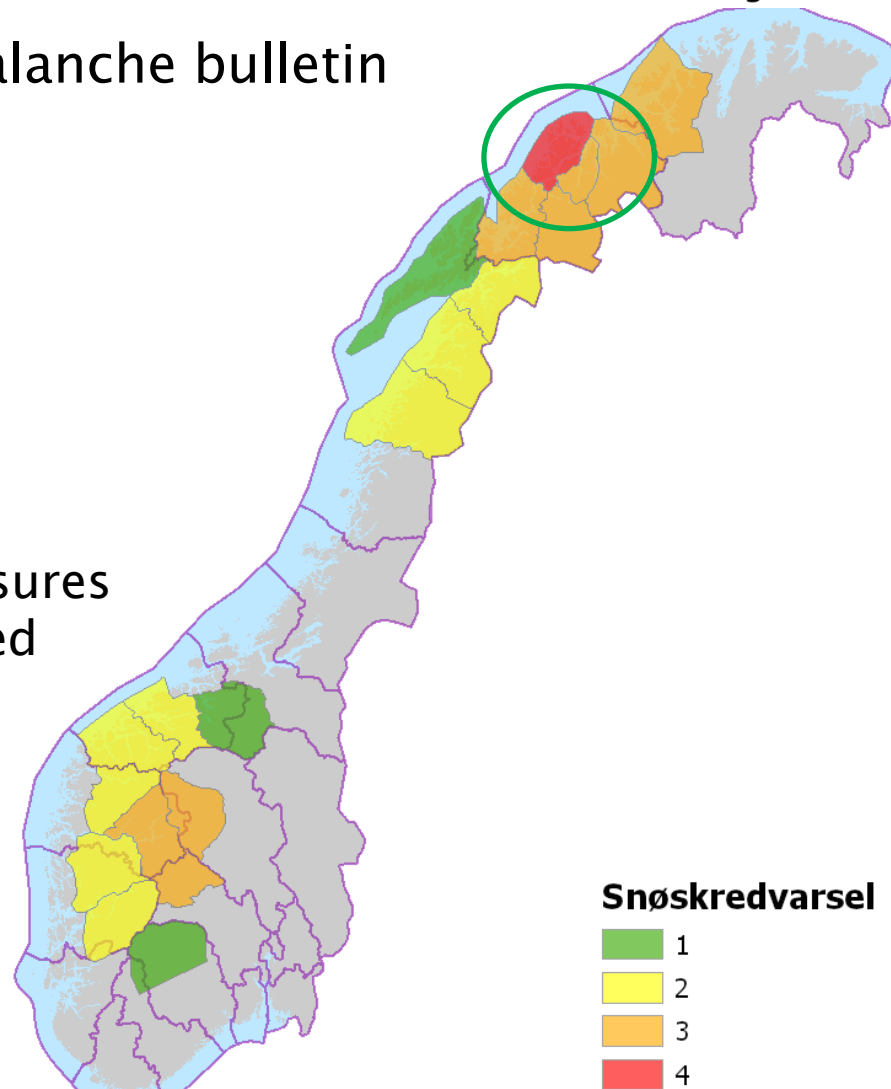
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Example on how to use the avalanche bulletin

- Regional \Rightarrow Local

«Increased awareness»

Initiate measures where needed



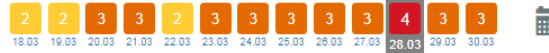
Regional forecast– local measures



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rads

Snøskredvarsel for Tromsø tirsdag 28.03.2017

Varsom - Forside > Snøskredvarsling > Snøskredvarsel for Tromsø tirsdag 28.03.2017



Danger level

4 Stor

Publisert: 27.03.2017 kl. 14.00

Krevende forhold. Polart lavtrykk med byggevær kan gi store lokale forskjeller. Vær svært varsom i leområder med nysnøflak. Naturlig utløste skred forventes.

Skredfarevurdering

På grunn av byggevær og mulighet for polare lavtrykk ventes det store variasjoner i både vindstyrke og nysnømengde i regionen, og dermed også i snøskredfare. Men pågående vind fra NV fører til fortsatt pålagring av nysnøflak i de samme leområdene, hovedsakelig mot Ø-S. Litt lavere temperatur gjør også at stabiliseringen av nysnøflak går saktere, særlig i høyden. Vær i tillegg oppmerksom på at det kan finnes et vedvarende svakt lag av kantkorn i snødekket. Dette er lettest å påvirke der snødekket er tynt, og mindre skred i fokksnøen kan føre til større skred der det finnes kantkornlag dypere i snødekket. Faregraden forventes å kunne øke til 4 – stor i de områdene som får mest nedbør, og naturlig utløste skred er sannsynlig.

Preparedness message

Noen store naturlige utløste skred forventes

Skredproblem og ferdslsråd

Avalanche problem

Nysnøflak

Nedføyket svakt lag med nysno



[Skredtype:](#)
[Skredstørrelse:](#)
[Utløsningsårsak:](#)
[Utbredelse:](#)
[Sannsynlighet:](#)

Flakskred
3 - Middels
Naturlig utløst
Mange bratte heng
Sannsynlig

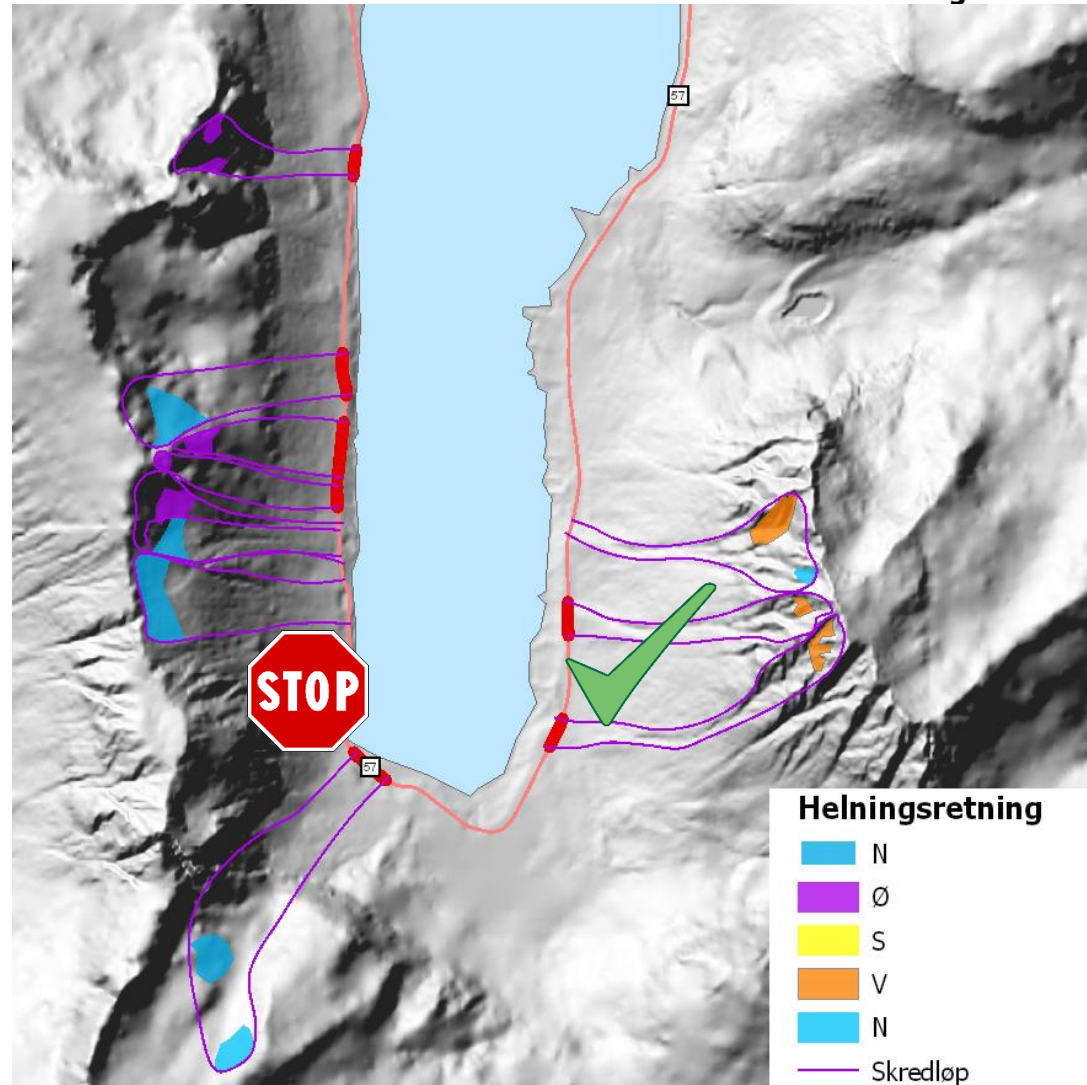
Regional forecast– local measures



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Local assessment Fv57 Grøt fjorden





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Norwegian Roads Adapting to Climate Change

Conclusions

- Thinking early – including aspects of climate change in planning
- Mainstreaming adaptation – become a “natural” part of our work
- **Cooperation** is a condition for adaptation!
Climate projections, climate data, forecast services etc.



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BANE NOR

A photograph of a two-lane asphalt road winding through a snowy mountain valley. The road has a yellow center line and white edge lines. The surrounding mountains are rugged and covered in snow, with some rocky outcrops visible. The sky is a clear, pale blue. The overall scene is serene and majestic.

Thank you

More Information

For info or further questions on this seminar and the activities of the JASPERS Networking Platform, please contact the JASPERS Networking and Competence Centre at the following email:

jaspersnetwork@eib.org

JASPERS Website:

jaspers.eib.org

JASPERS Networking Platform:

www.jaspersnetwork.org

