



Norwegian Flood and Landslide Hazard Forecasting and Warning Service

Hervé Colleuille

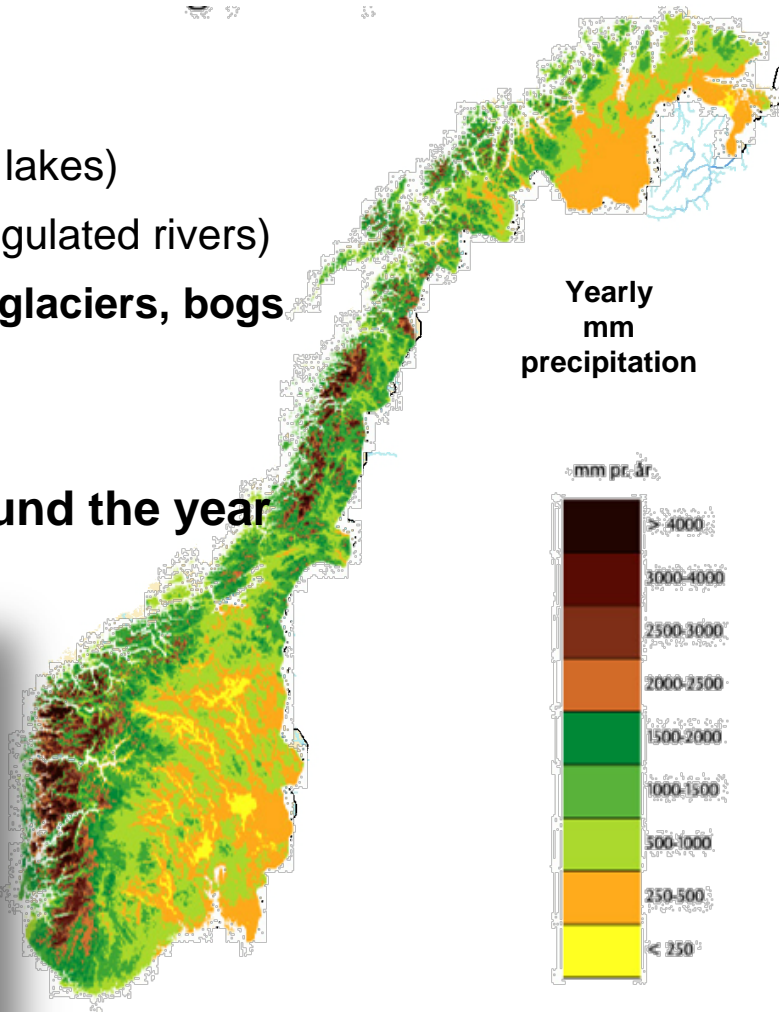
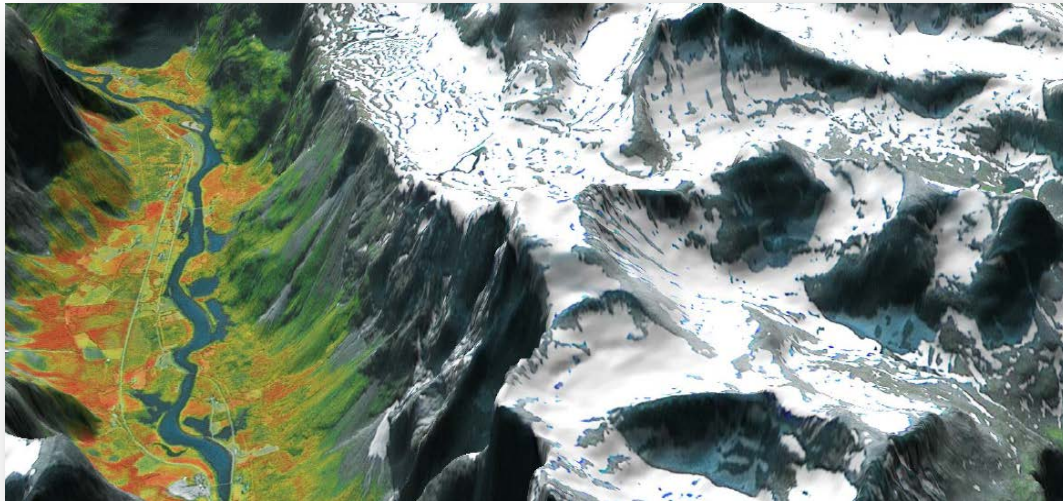
Hydro geologist

Section Head, Hydrology department

Norwegian Water Resources and Energy Directorate

Basic information

- About 500 000 km rivers and streams (250 000 lakes)
- 99% electricity production from water (many regulated rivers)
- Landscape: fjords, U-shaped valleys, mountains, glaciers, bogs
- Large climatic contrasts from West to East
- >1/3 precipitation as snow
- Rainfall and snowmelt induced events all around the year



- Area: 324 000 km² (+ Svalbard)
- Population: 5.2 mill. Density: 16 people per km²

NVEs forecasting & warning services:



1989: Nationwide Flood forecasting and warning system

2013: Establish a regional early warning system for shallow landslides & snow avalanches as a joint initiative across public agencies:

Expanding the hydrological/meteorological station network, Strong development of IT-tools (decision tools, warning portal), Research and Development



• Snowmelt induced spring flood



Gudbrandsdalen, East Norway, summer 2011 Foto Scanpix



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- **Heavy rain induced flood**



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• Summer showers induced Flash flood/Debris Flows



Notodden, South Norway - 23 juli 2011 Foto J. Simonsen

• Rain and/or snowmelt induced Debris flows



Kvam mai 2013



Otta, mai 2008 Foto: Scanpix



Kvam juni 2011/East Norway Foto: NVE



- Debris slides due to prolonged rain & snowmelt



Sør-Trøndelag 2012 Foto: O.J. Kjellmark, Adressa.no



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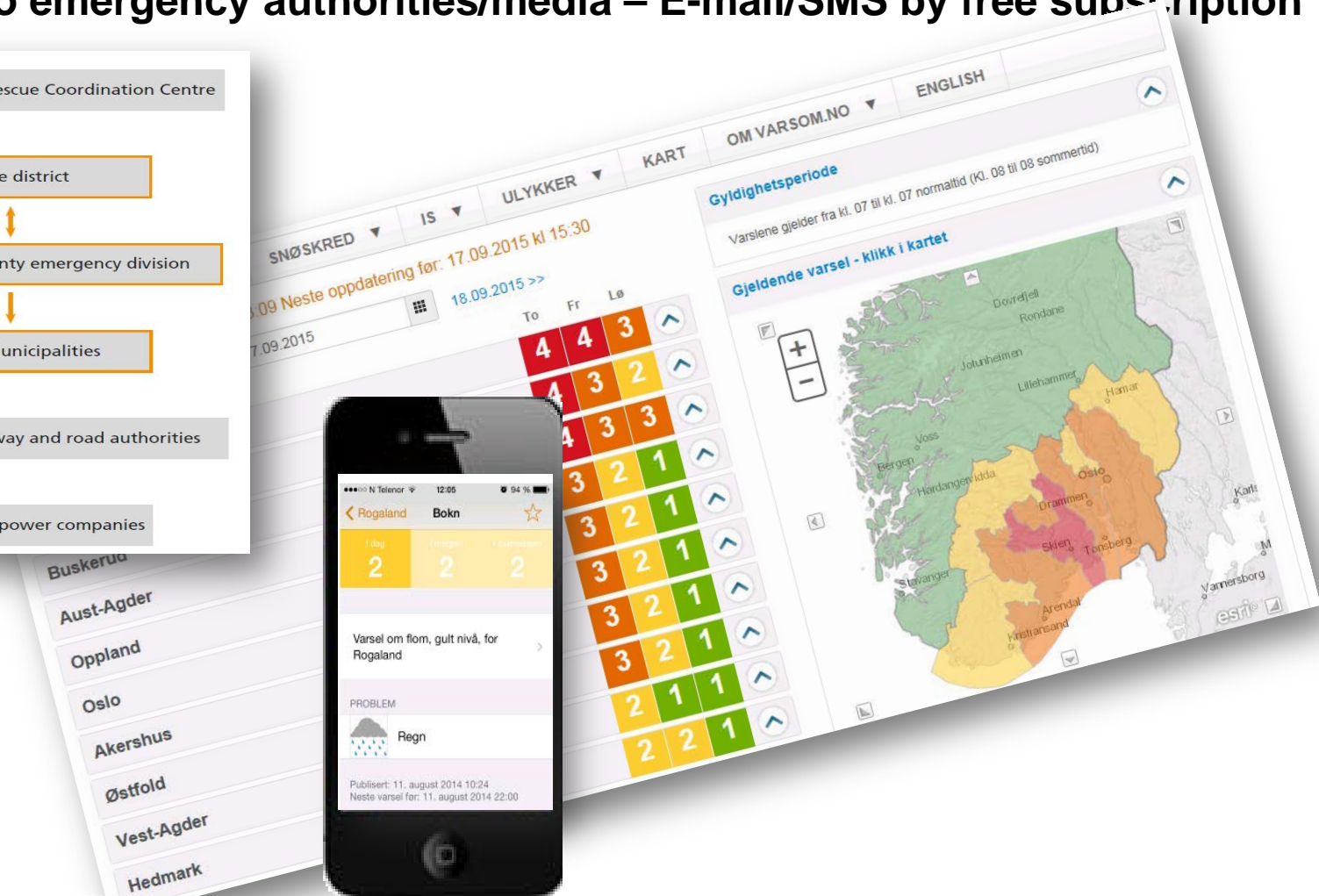
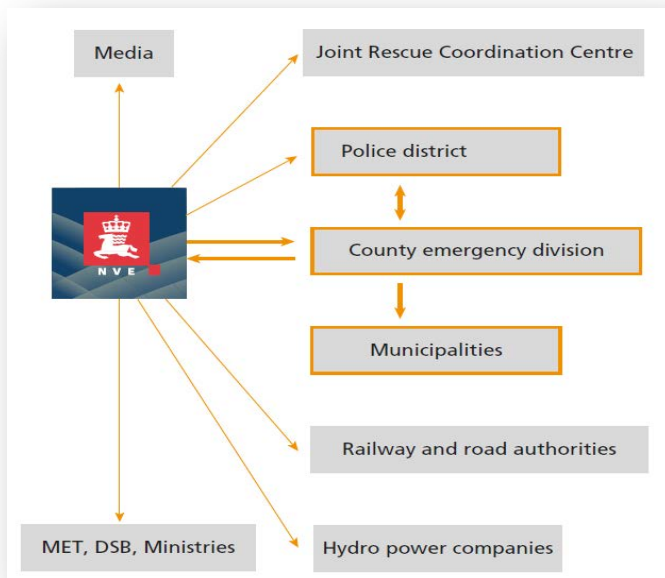
• Snowmelt and/or rain induced Slush Flows



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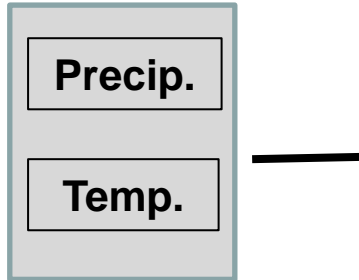
What are we doing?

- Notify on potentially dangerous hydrological situations (Assessment for 3 days);
- Inform about ongoing situation and expected development so that the situation can be handled best possible locally
- Warnings are issued at www.varsom.no
- E-post send to emergency authorities/media – E-mail/SMS by free subscription

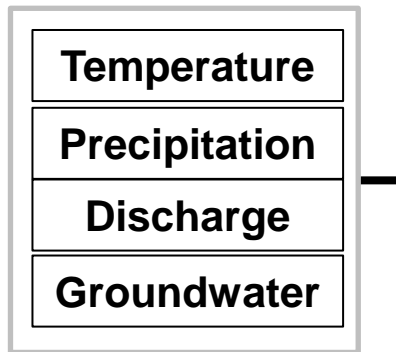


How we assess flood and landslide hazard?

Forecasts
MET Norway



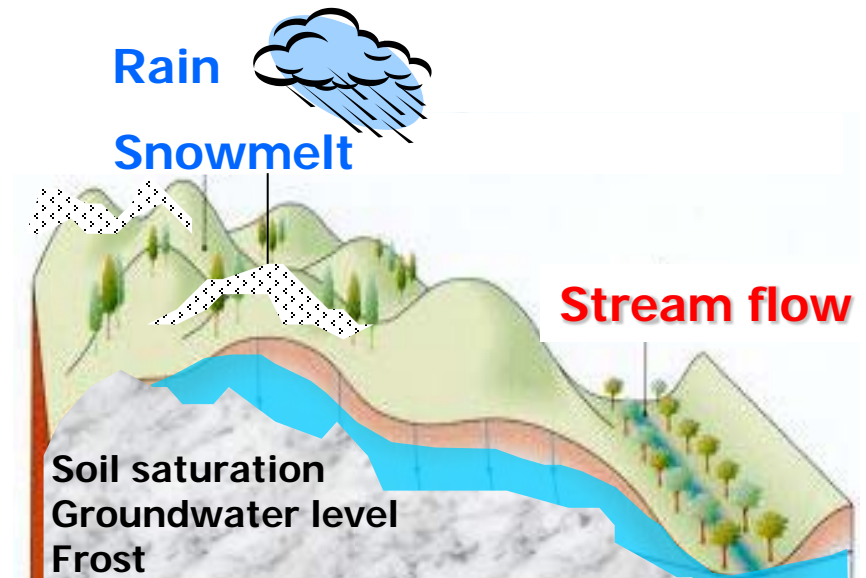
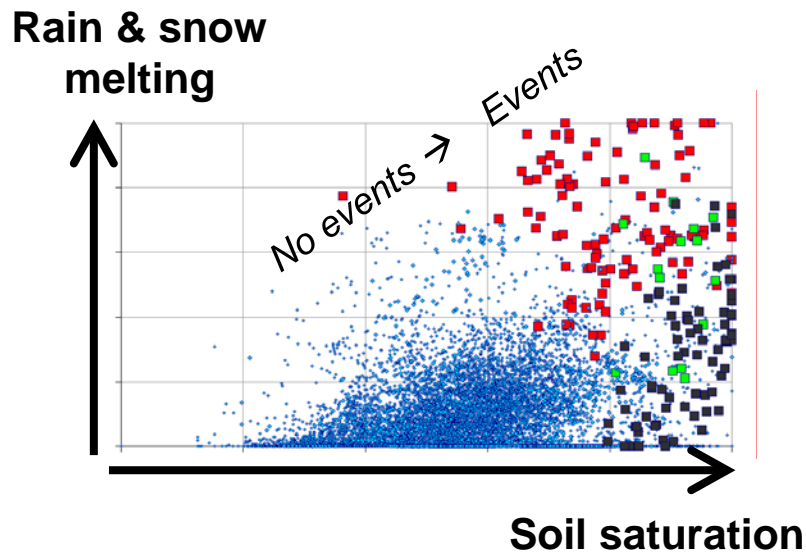
Real-time obs.



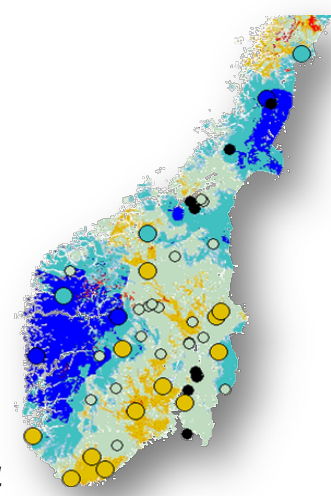
National flood & landslide database

Early warning system for landslides:

- The methodology is based primarily on threshold values for water supply (rain & snowmelt) and groundwater conditions based on analysis of historical events
- Warning messages are issued when a combination of threshold values are exceeded;



Hydrological models

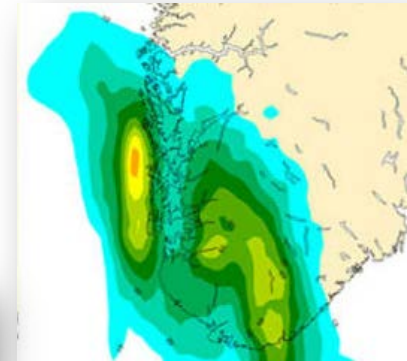


- 2 versions of the conceptual rainfall-runoff HBV-model
 - 150 calibrated river-catchment models (Time steps: 24h & 3h)
 - A spatially distributed version (24h – 1x1 km²) *Beldring et al. 2003*
- A rainfall-runoff catchment model **DDD** (24 & 3h) mainly parameterized from map data and runoff records *Skaugen and Onof, 2014*
- 2D hydraulic models (HEC-Ras/Mike 11): 4 lakes – 2 rivers

Weather forecast (Precipitation & temperature)



- **AROME - MetCoOp** 66 hour forecasts every six hours (2.5 km resolution)
- **ECMWF** (10 days, 16 km resolution)



Observations (real-time update hourly or daily)

- Discharge/water levels: > 400
- Groundwater levels: 70
- Precipitation: 400 – Temperature: 230



Xgeo.no: A GIS & web-based decision tool

xgeo.no - a precautionary tool for notification and emergency

Location search Feedback About xgeo.no Norsk Logg inn

Floods and landslides Avalanche Road Railway All data

Forecast Sum of rain and snow melt previous 24 hours until at 08 AM on May 17, 2015

-1 year -1 week -1 day Today +1 day +1 week +1 year 5/17/2015

Vis rapport

Grid data Point/line data Event data Height slider

Stations Supporting maps Legend

Rain and snow melt

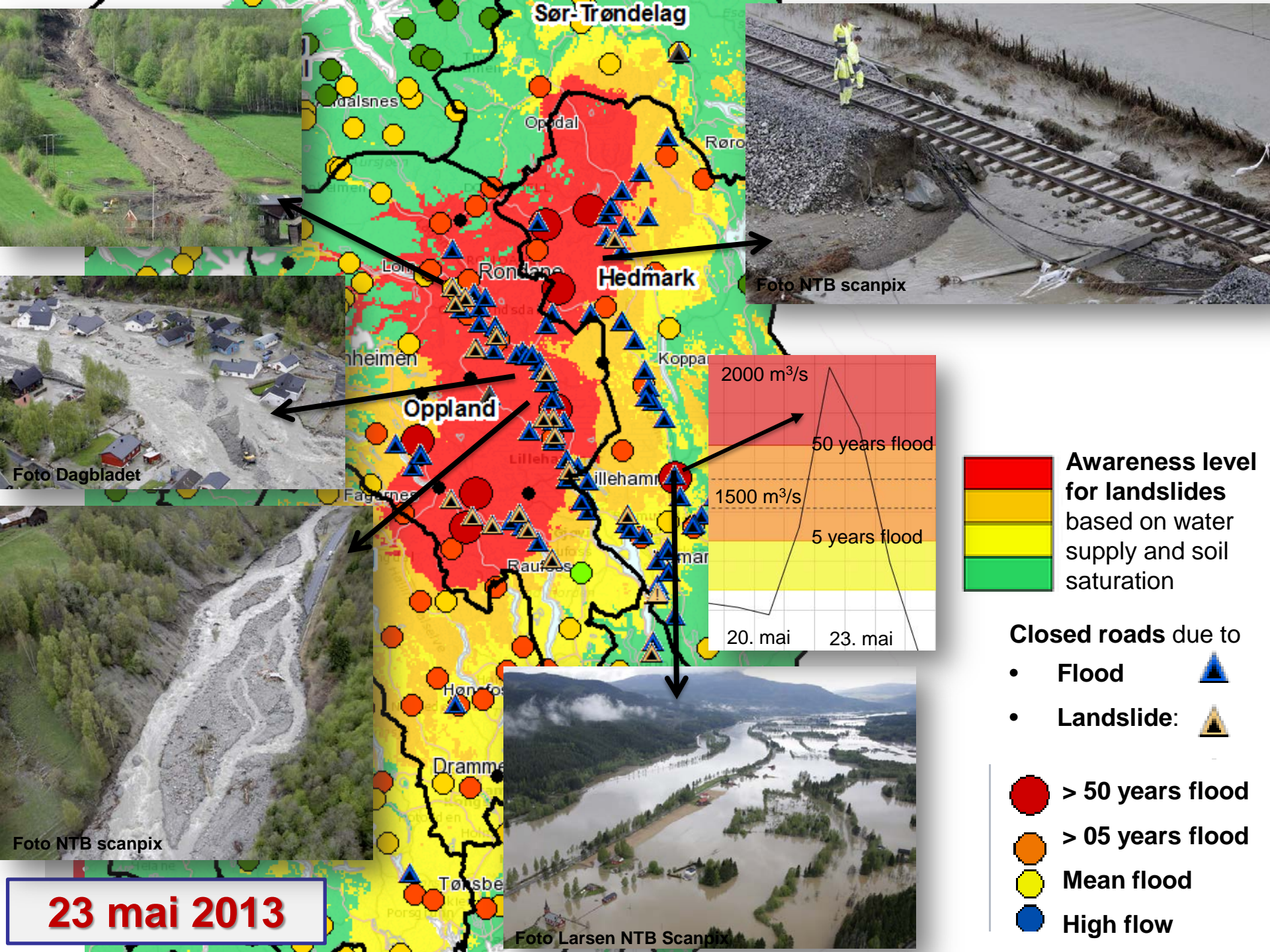
Forecast
Generated 15.05.2015 at 11:11
Based on Arøme MET CoOp 06H
The map shows total amount of rain and snow melt in mm water during previous 24-hour period.
Updated around 0, 6, 8, 9, 12, 18, 19 and 21 Norwegian standard time.
Data from 01.09.1957 until tomorrow
Metadata
Data owner: Norwegian Water Resources and Energy Directorate

mm water

| |
|-----------|
| Above 100 |
| 80 - 100 |
| 60 - 80 |
| 40 - 60 |
| 20 - 40 |
| 10 - 20 |
| Below 10 |
| 0 |

- No password: Open data policy for sharing observations
- 1km² simulated hydro-meteorological gridded maps: Water supply, snow, groundwater, frost, soil saturation.. Threshold values to evaluate flood, landslide, avalanche hazards
- Simulated runoff at catchment scale
- Historical archive from 1957
- Daily prognosis (9 days) & Real-time observations
- Historical events and closed roads

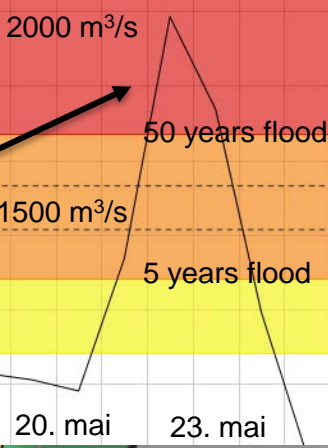
Slush avalanche
Snow
Alternative forecasts
Satellite images



Sør-Trøndelag

Hedmark

Oppland



Awareness level for landslides based on water supply and soil saturation

- High awareness level (Red)
- Medium awareness level (Orange)
- Low awareness level (Yellow)
- Very low awareness level (Green)

Closed roads due to

- Flood
- Landslide:

- > 50 years flood
- > 05 years flood
- Mean flood
- High flow

Foto NTB scanpix

Foto Dagbladet

Foto NTB scanpix

Foto Larsen NTB Scanpix

23 mai 2013

Development tasks

in close cooperation with Norwegian Meteorological Institute

- Implementation of CAP format (Common Alert Protocol)
- Improved observation-based grid-data of temperature & precipitation (daily and hourly data)
- Use of ensembles (ECMWF and AROME EPS-system) for uncertainty assessment
- Improved methods for data assimilation (discharge & snow)
- More physical based models: snow conditions and evaporation
- Use of weather radar to precipitation estimation and Nowcasting



Norwegian Water Resources and Energy Directorate



Thank you for
your attention

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Welcome to visit NVEs Flood/Landslide Forecasting & Warning Center



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