Snow storage

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Snow storage

Purposes with snow storage:

- Cross country skiing / Biathlon
- Alpine skiing
- Ski jumping
- Other winter activities
- Snow cooling

Snow storage

- Mikko Martikainen - Pioneer within snow storage
- Snow Secure
- Snow specialist and advisor for the organization committee at Sochi Olympic Games

- http://www.snowsecure.fi/en/photos-and-articles/snow-storage-method.html

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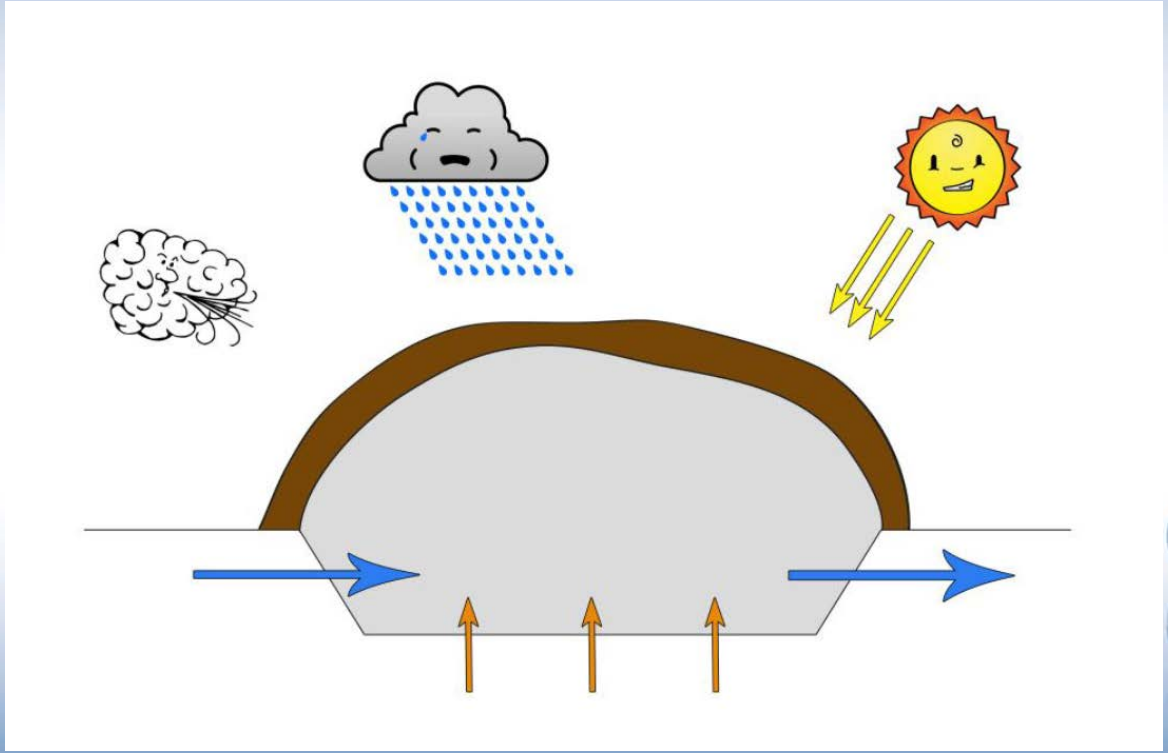
Factors affecting the melting rate



Factors affecting the melting rate

Major factors

- Thickness of insulating layer
- Wind velocity
- Light intensity
- Air temperature
- Absolute air humidity

Minor factors

- Moisture content in insulating layer
- Evaporation
- Solar reflectivity
- Rain
- Ground melt

Of importance for the melting rate

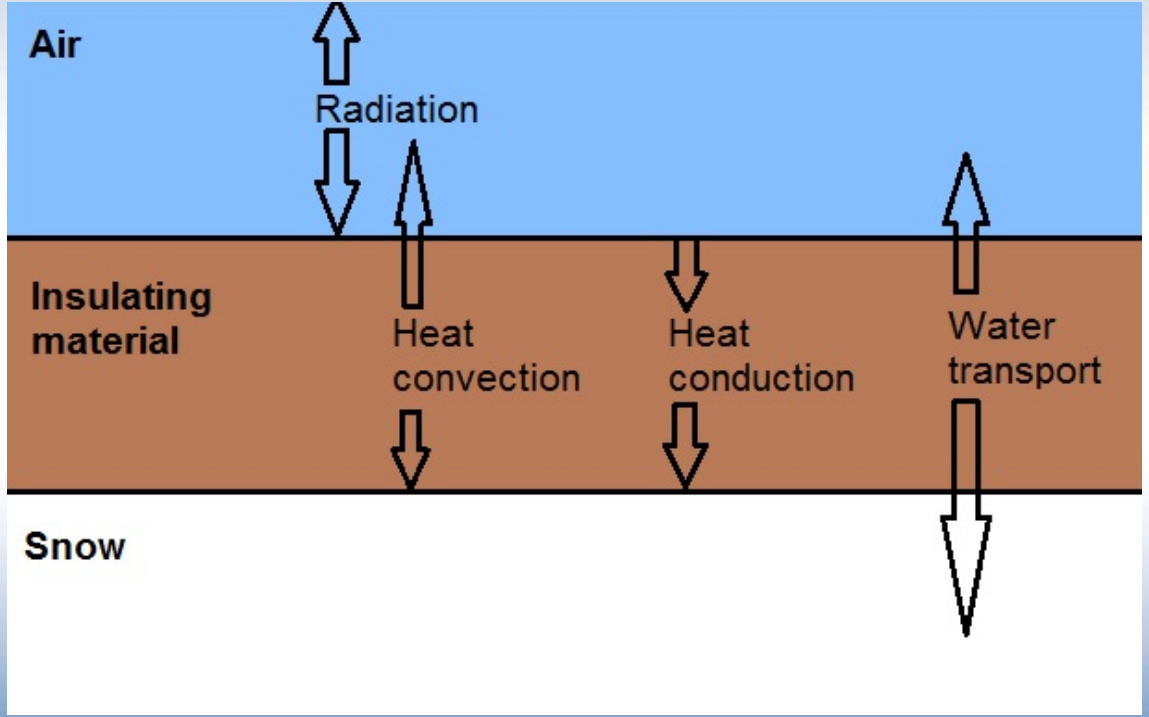
- The initial volume of the snow
- The geometry of the pile
  - ✓ Surface area
  - ✓ Bottom area
- Type and thickness of the insulating material
- Drainage

Snow storage

- Three methods to insulate a snow depot:

✓ Breathable method (evaporation)
✓ Not breathable method (only insulation)
✓ Mix method

Heat and mass transfer through an insulating layer



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Insulating materials

Natural materials

- Wood chips
- Cutter shavings
- Saw dust
- Bark
- Rice shells
- Debris

Fabricated materials

- Loose sheets
- Geo textile
- Aluminium folio
- Plastic sheets
- Thermal foam

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Some examples of stored snow

Place	Volume [m^3]	Cover material	Approx. melt [%]
Vuokatti	20 000 – 25 000	Sawdust (≈ 30-40 cm)+ Tarpaulin	20
Östersund (2006)	20 000	Sawdust (≈ 70-80 cm)	30 (10% ice)
Östersund (2016)	2*(30 000)	Sawdust (≈ 40 cm)	
Orsa	5000	Bark (≈ 40-50 cm)	
Piteå (2012)	2400	Bark (50-70 cm) + Geotextile + Plastic	30
Piteå (2013)	3400	Bark (50-60 cm) + Geotextile + Partly covered with plastic	30
Arjeplog (2013)	1600	Bark (≈ 40-50 cm) + Textile	60
Sochi, Russia (2013)	800 000 (several piles)	Geotextile (several layers), Thermal foam in between, Reflective aluminum on top	20-50

Snow storage

Snow storage – Sochi 2013

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Experiment in Arjeplog (2013)

- 3 st piles of snow
- Volume ≈ 200 m^3
- Test start: 15th of April
- Last measurements: 8th of October

Approx. 60% melted

Approx. 53% melted

Everything had melted in the beginning of June

Calculated value of snow melt (sawdust) ≈ 60%

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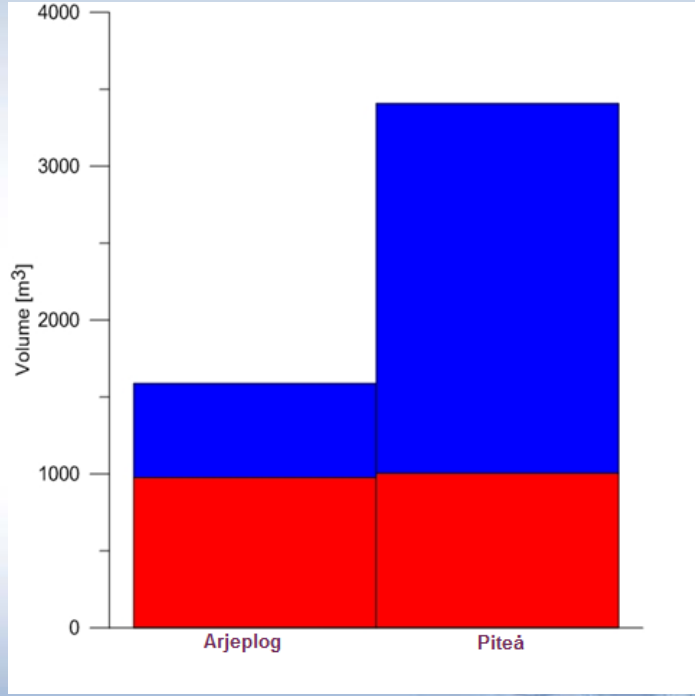
Experiment in Arjeplog and Piteå (2013)

Storage period: April 15 – October 8

	Arjeplog	Piteå
Initial volume [m^3]	1600	3400
Ground surface area [m^2]	800	1200
Remaining volume [m^3]	610	2400



Approx. 60% melted Approx. 30% melted

Less successful experiments

Arjeplog

Kiruna

- Pile of artificial snow was covered with plastic sheets and on top natural snow from a snow deposit
- 60-70% of the volume melted
- Poor drainage
- Snow does not have the insulating properties needed

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Examples of stored snow

- First insulated snow storage in the world was in Ruka, Finland, 2001.

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Examples of stored snow

- Vuokatti
- Outdoor track opens 10th of October

Use of stored snow

Photo: Snow Secure

Quality of stored snow

- Coarse grained structure
- Higher density (≈ 400 kg/m^3 -> 600 - 700 kg/m^3)
- Salting
- Snow hardener
- Good quality tracks and slopes also when non-freezing temperatures

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Thank you for your attention

Questions?