Simplified method for estimating outflow from bottom of snowpack

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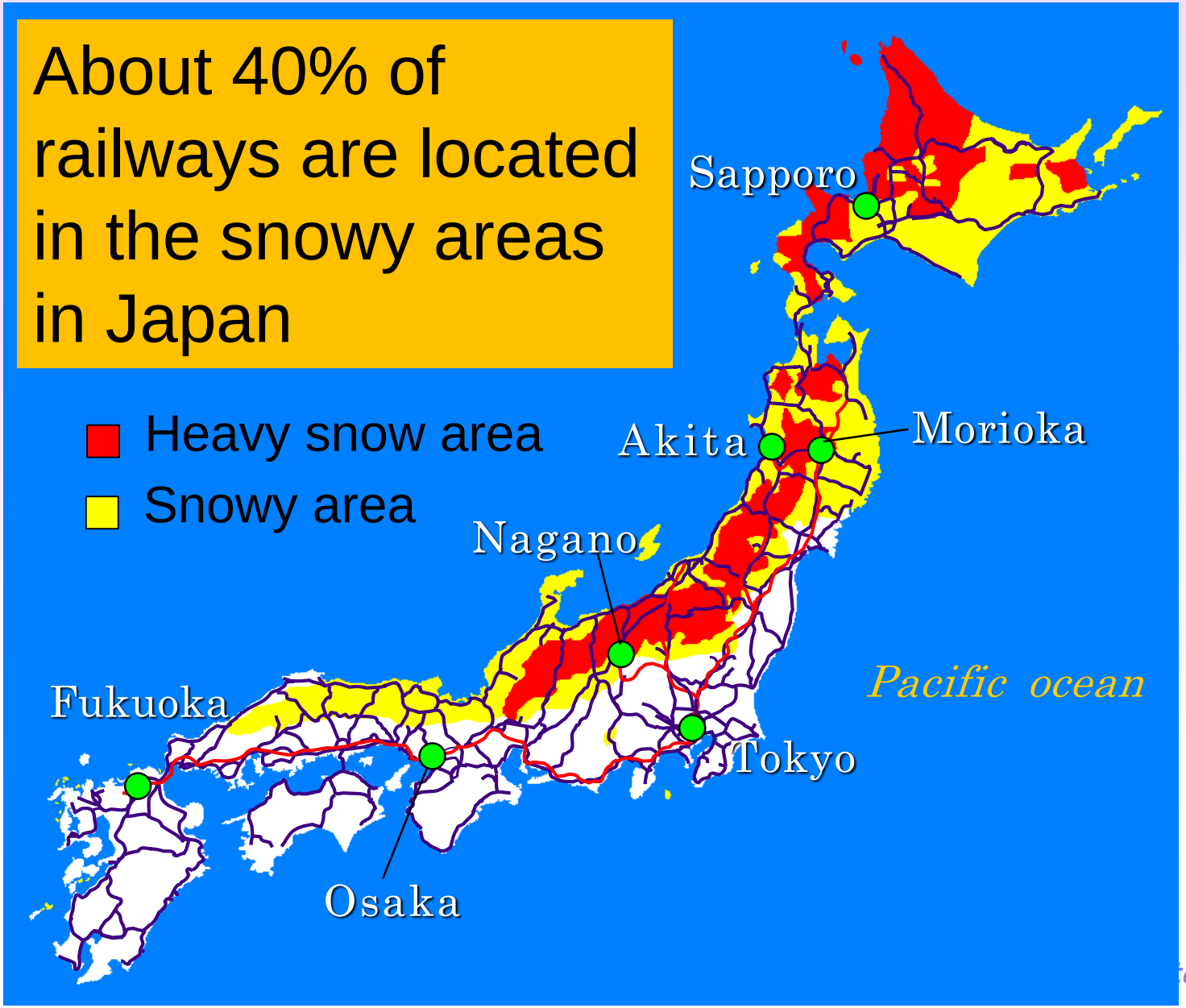
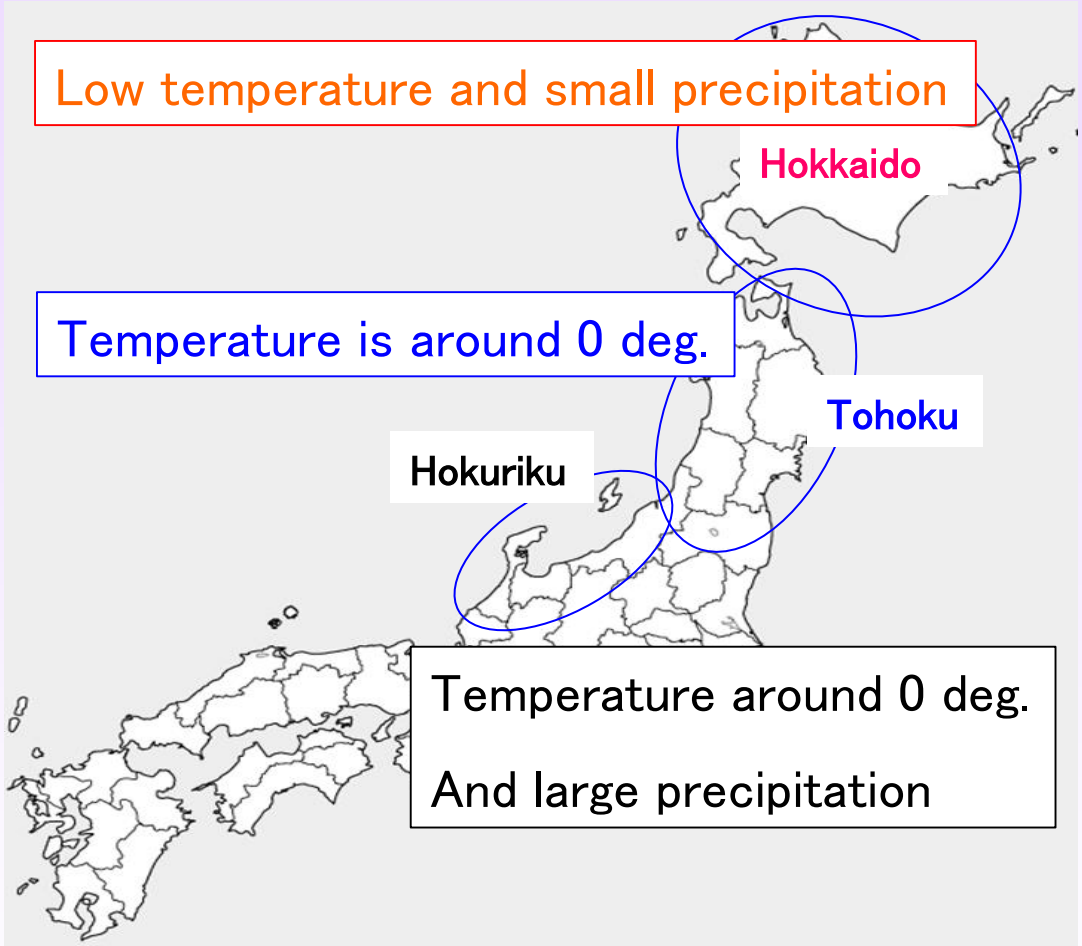
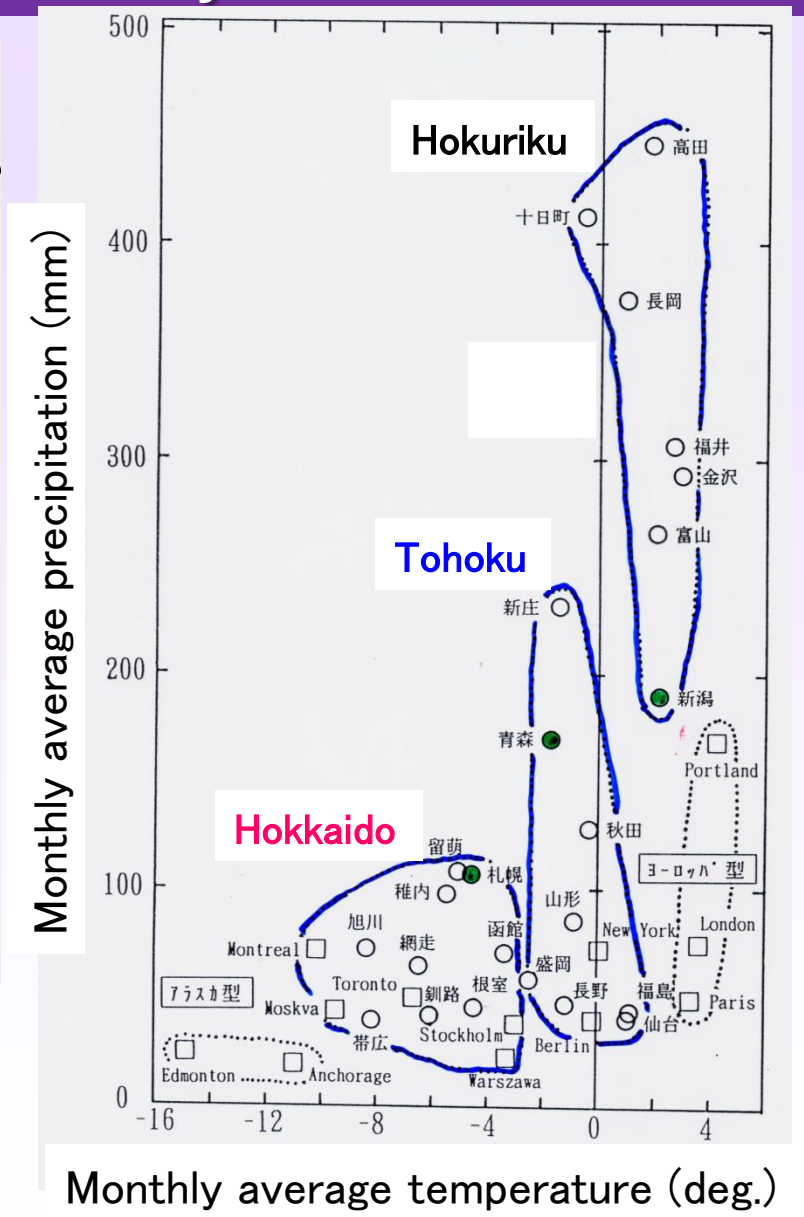
Snowy area and Railway location



Climate properties in Snowy area





Snow is sensitive to temperature!

Climate change impact on snow

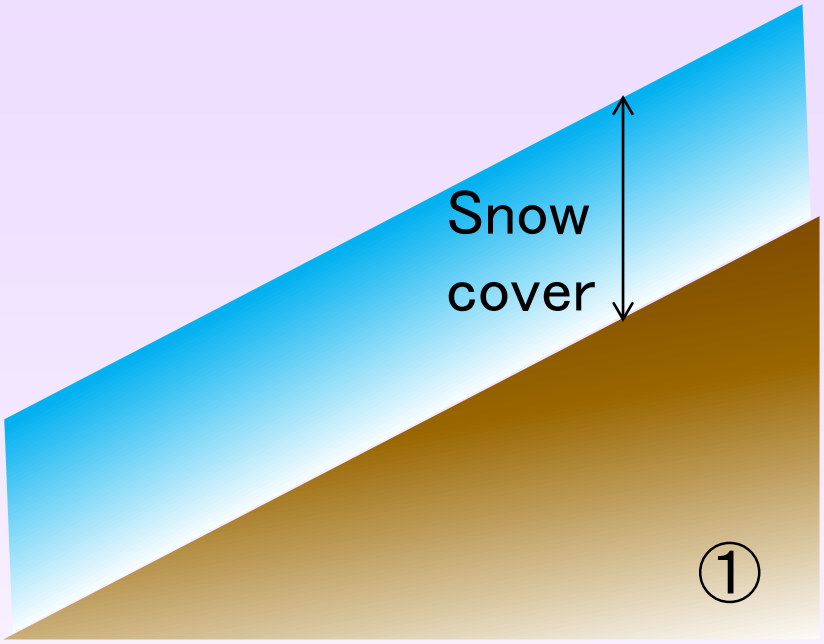
Japan Meteorological Agency reports Climate change

- ✓ Rising average temperature → Snow melt
- ✓ Reduction maximum annual snow depth
- ✓ Reduction maximum daily snow fall

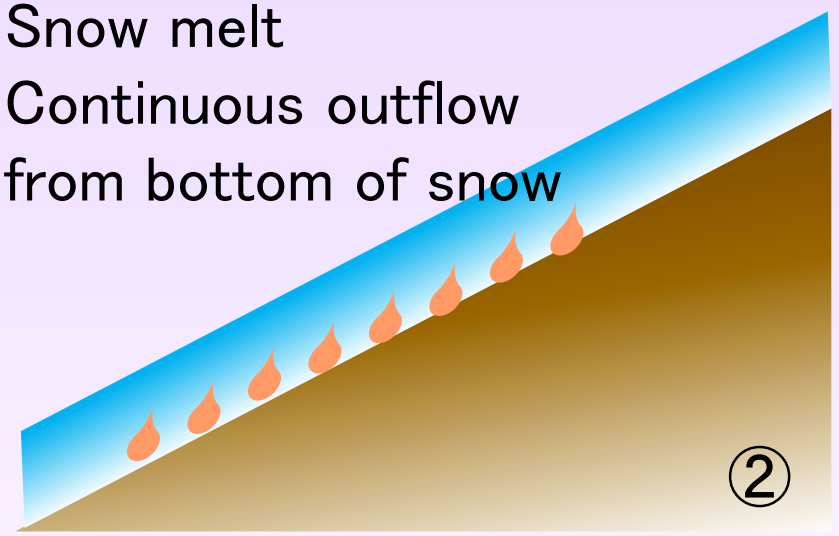
→Increase frequency of short-term snow fall

- ➢ Increase frequency of snow melt
- ➢ Recently we have rainfall in February

Disasters caused by snow melt

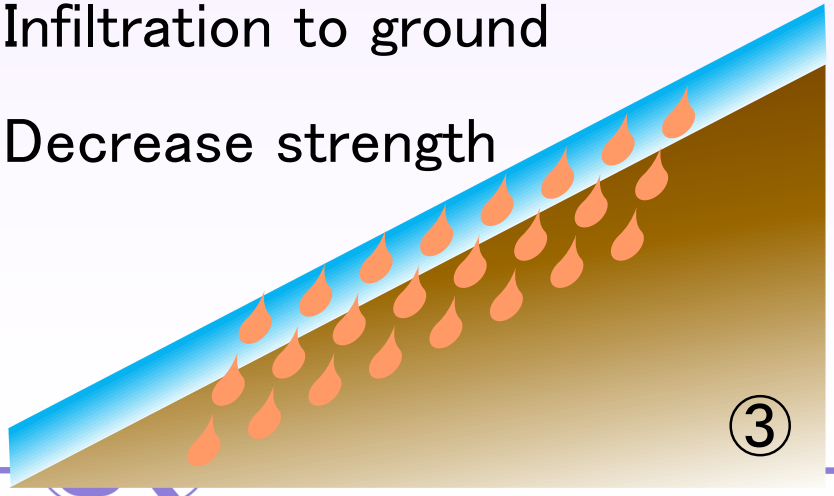


Snow melt
Continuous outflow
from bottom of snow



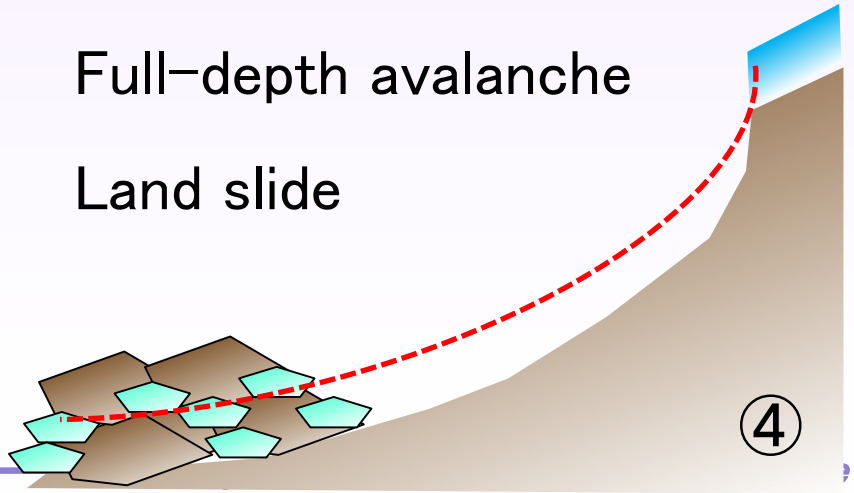
Infiltration to ground

Decrease strength



Full-depth avalanche

Land slide



Purpose

- Trains running through snowy area have the possibility to be damaged by a full-depth avalanche and land slides.

■ In order to carry out a countermeasures such as track patrol and train operation control more effectively and efficiently,

it is important to establish a method to evaluate the stability of the slope snowpack.

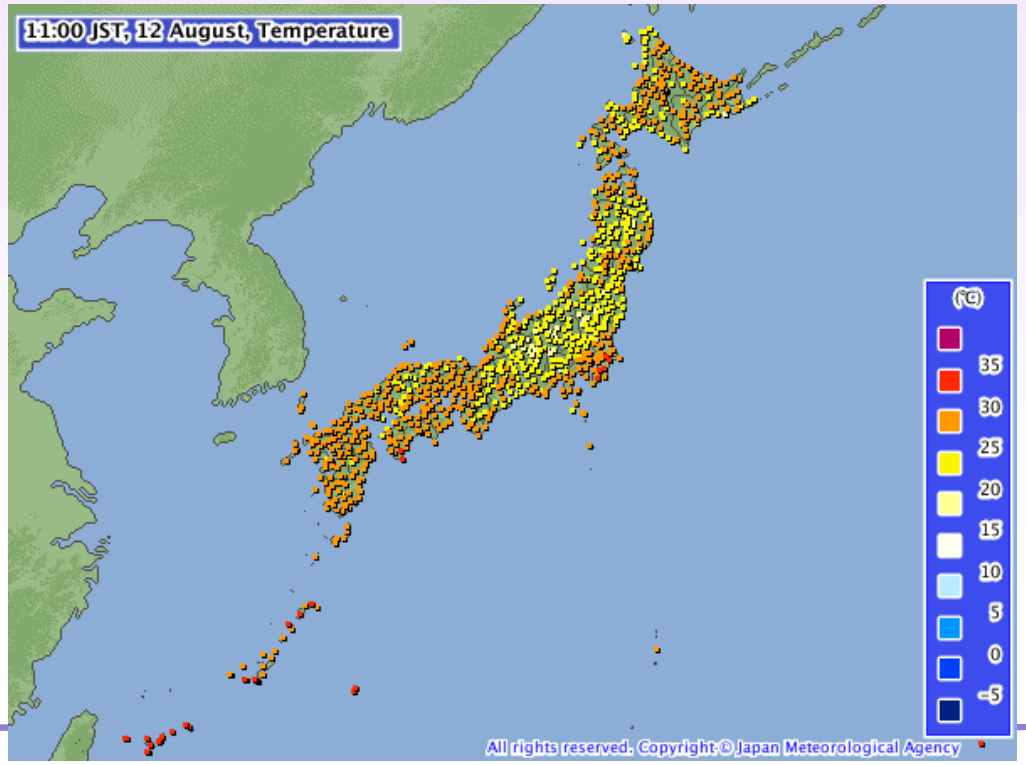
Simplified method for estimating the outflow from the bottom of snowpack

Development Concept

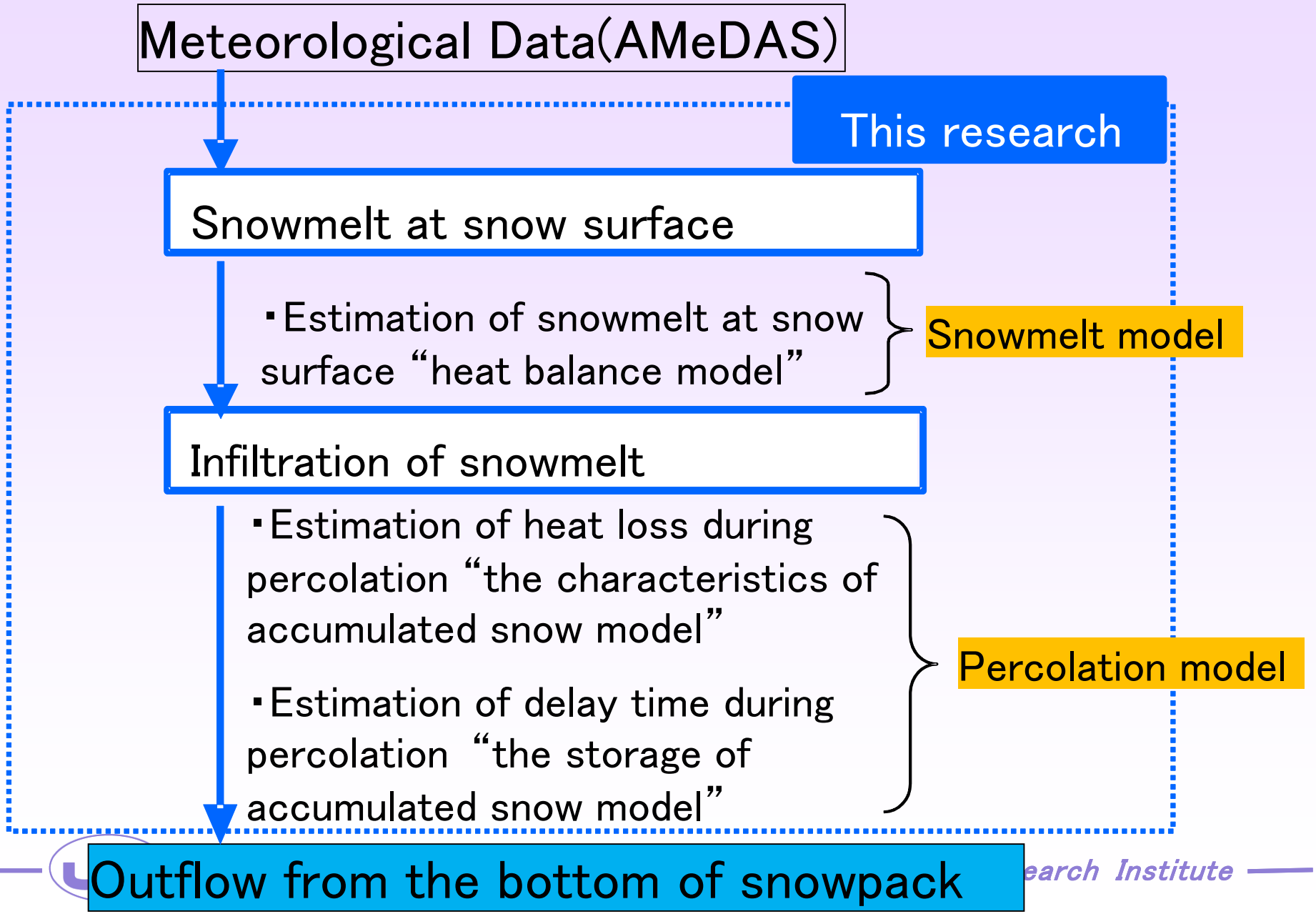
In this research, we estimate outflow

By 4 meteorological data of AMeDAS (Temperature, Precipitation, Wind-velocity, Hours of sunshine)

▼AMeDAS :"Automated Meteorological Data Acqui-sition System" (1300 points in Japan)



Procedure of estimating outflow

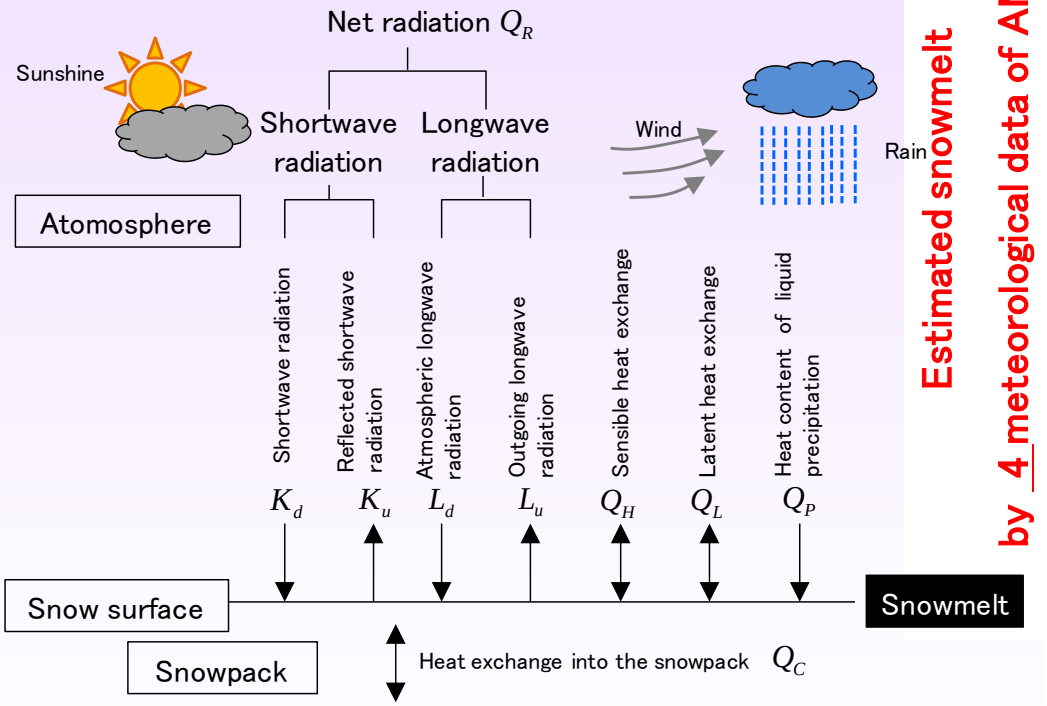


Snow melt model

Snowmelt at snow surface is estimated by heat balance

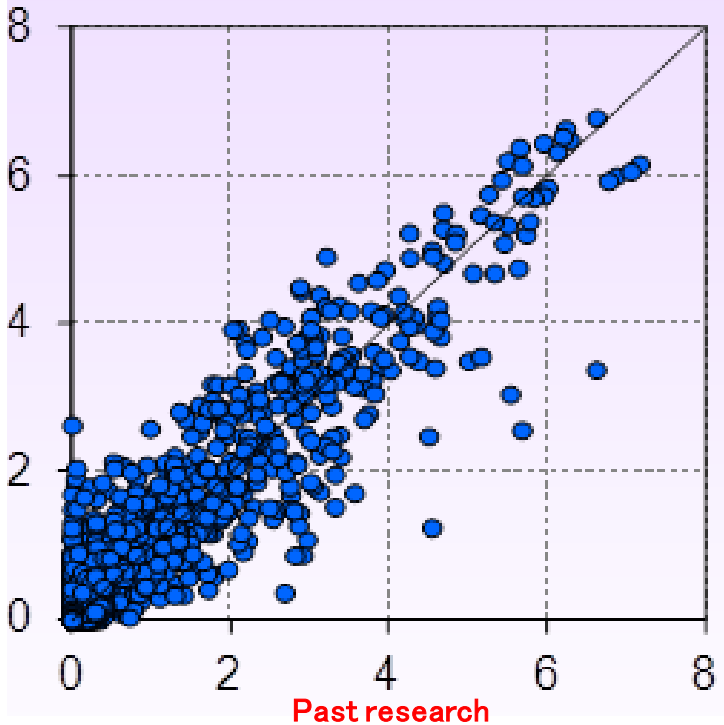
＜Heat Balance Method＞

$$Q_M = Q_R + Q_H + Q_L + Q_P + Q_C$$



Estimated snowmelt by 4 meteorological data of AMeDAS

This research



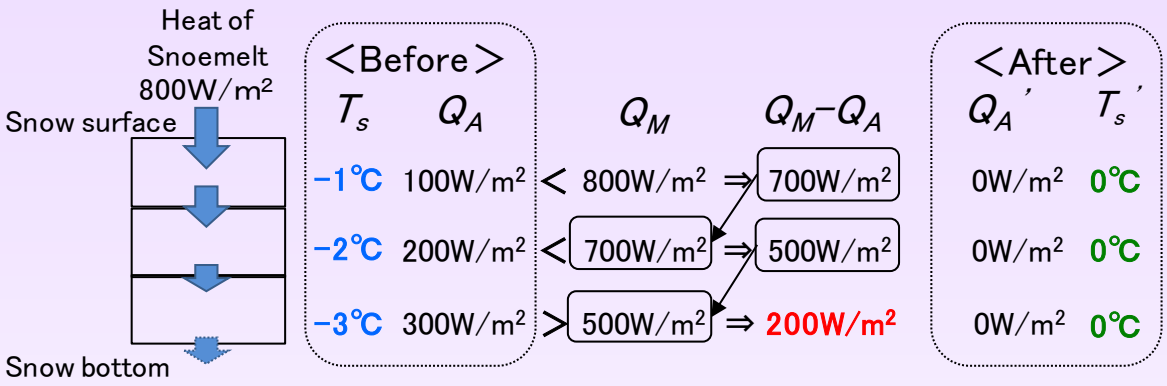
by observed 7 meteorological data.

Simplified method is agreed with conventional detailed method.

Percolation model

Infiltration of snowmelt is estimated by heat loss and snow depth

(2)Case of outflow from the bottom of snowpack

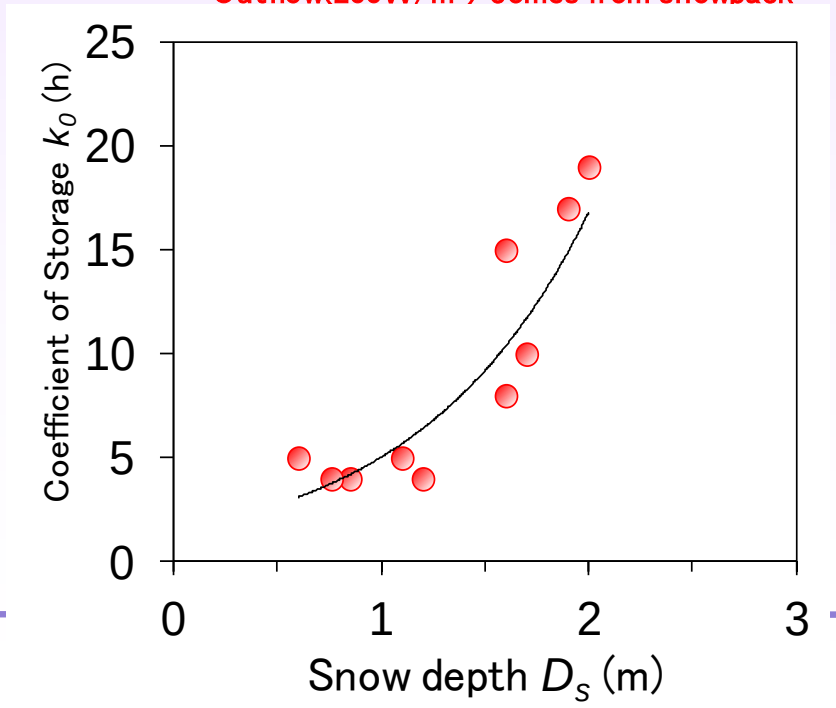


Result: $\Sigma Q_A < Q_M$

Outflow(200W/m²) comes from snowpack

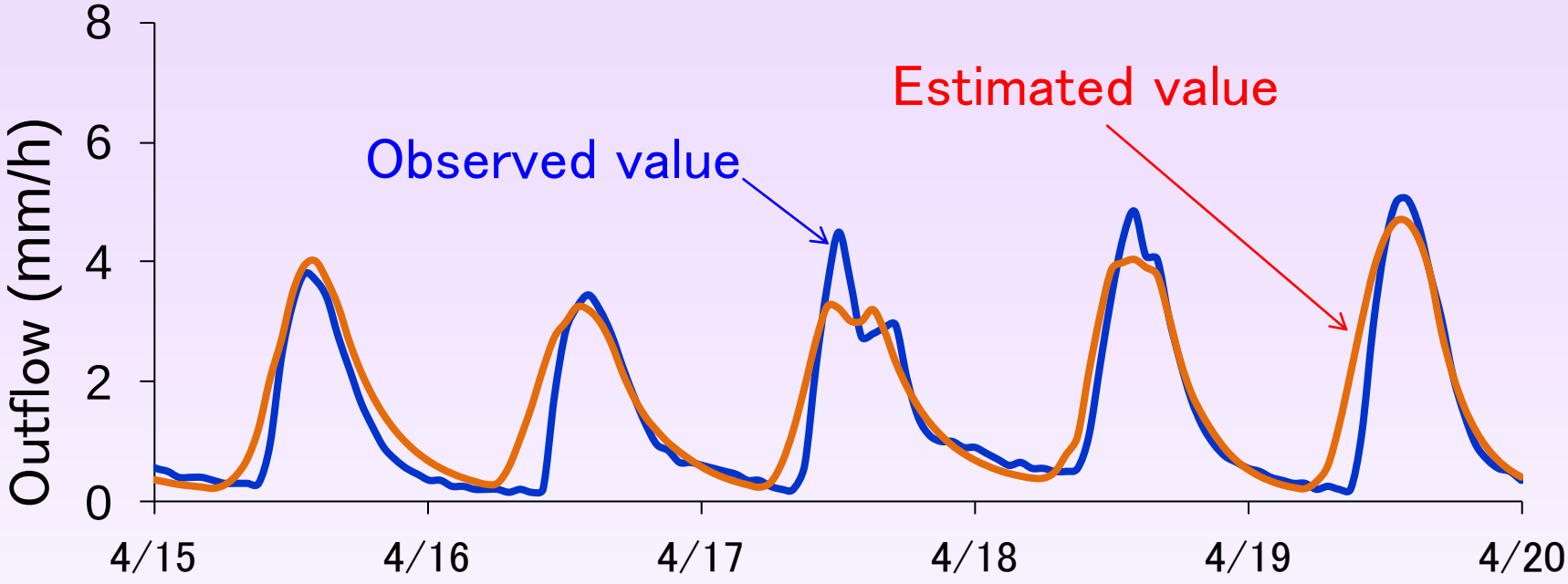
Calculation of heat loss

Outflow amount



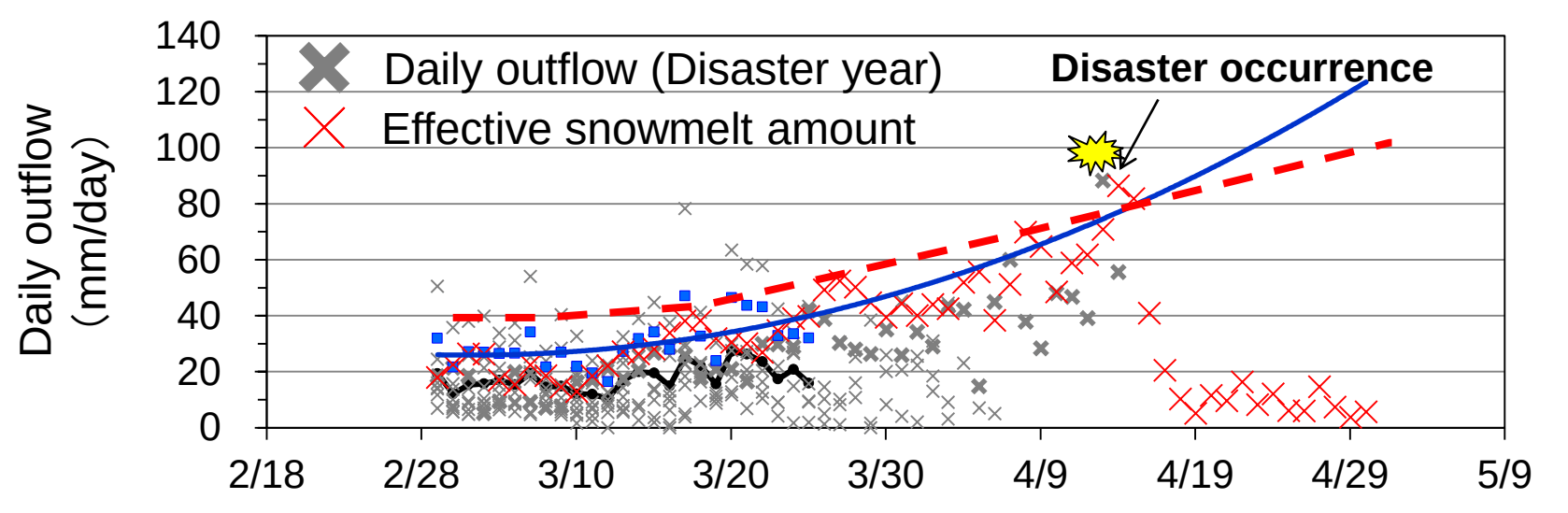
Calculation of delay time from snow depth

Example of estimated value



Estimated value coincides with the observed value in both amount and time.

Future study plan



Past 20-30 year meteorological data

Each area

Alert index value for track patrol

(Blue line)

Future meteorological data

(include climate change)

New Alert index value

(Red line)