Resolution dependency of mountainous snow cover simulated by Non-hydrostatic Regional Climate Model (NHRCM)

~for Regional Climate Simulation~

The 5th Research Meeting of Ultrahigh Precision Meso-scale Weather Prediction

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■ **Japanese mountainous snow**

- Sea of Japan side is one of the heaviest snowfall area in the world, especially mountainous areas. Understanding mountainous snow is important for snow disasters and water resources.

Niigata prefecture (Mar. 1, 2012)

雪 の 大谷
Enormous snow in valley

17m snow depth

Tateyama-Kurobe Alpine Route in Toyama prefecture

■ Japanese mountainous snow

- Sea of Japan side is one of the heaviest snowfall area in the world, especially mountainous areas. Understanding mountainous snow is important for snow disasters and water resources.

■ Altitude dependency of snow depth

- It is well known that the snow depth and the altitude have a linear relationship. [e.g., *Peck and Brown, 1962*]

- The interannual variation of snow depth in the plain area is, on the other hand, different from that in the mountainous area. [*Yamaguchi et al., 2011*]

- The mountainous snow cannot be estimated from snow depth in the plain area using a simplified altitude dependency.

However, it is quite difficult to observe the mountainous snow.

■ Simulation of Japanese mountainous snow

- Numerical weather models can simulate the horizontal distribution of Japanese mountainous snow.

- Since the topography of Japanese mountains are complicated, high resolved and long-term simulations are needed to simulate the mountainous snow .

Purpose

We investigate the resolution dependency of snowfall and snow depth over the Central Japan using Non-Hydrostatic Regional Climate Model (**NHRCM**).

Experimental design

NHRCM (Meteorological Research Institute) [*Sasaki et al.*, 2008]

Grid interval : 20km -> **5km** -> **2km**, **1km**

Boundary Condition : JRA55

Boundary layer : Improved Mellor-Yamada Level3 (MYNN)

Land surface : MRI/JMA-SiB

Microphysics : Bulk-type cloud microphysics (qc, qr, qi, qs, qg, Ni, Ns, Ng)

[*Murakami et al.*,1994]

Cumulus convection: Kain-Fritsch (for 5km) [*Kain and Fritsch* 1993]

Integration : **2012/9/15 - 2013/8/31** *2012/9/11 - (5km)
[2012/9/11(15)-30: Spin up duration]

model topography [1km]
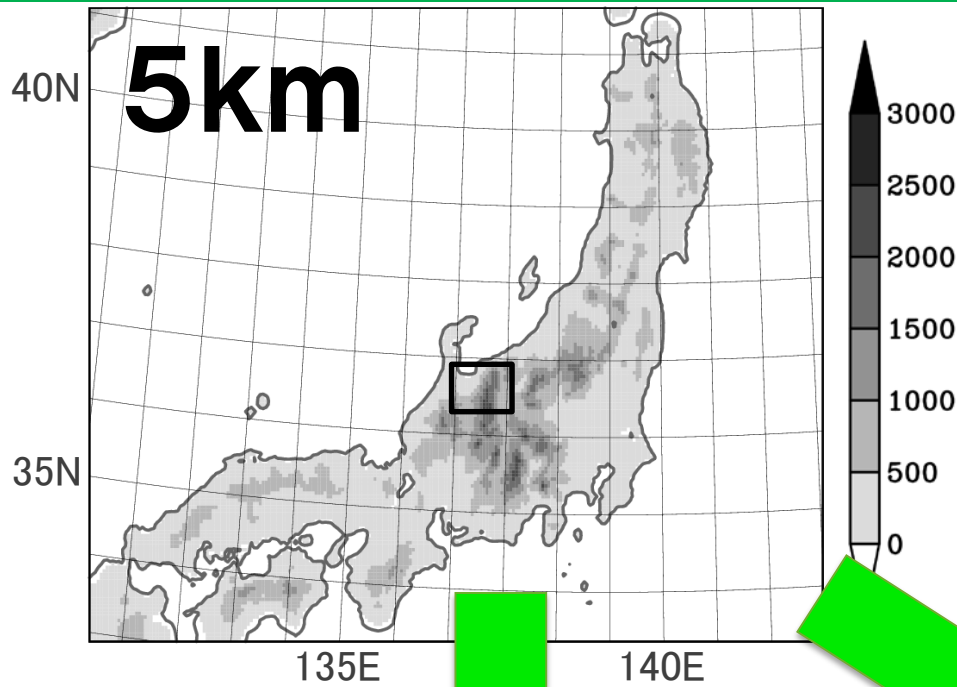
Model Domain
（One way nesting）
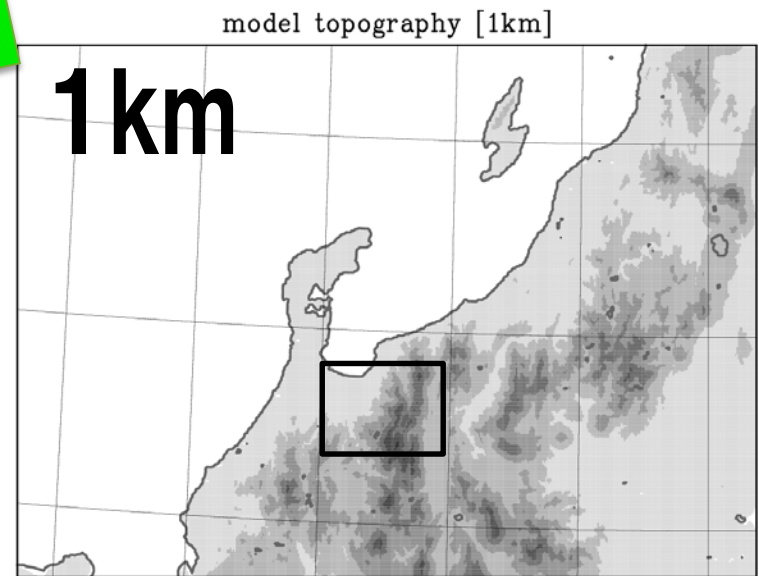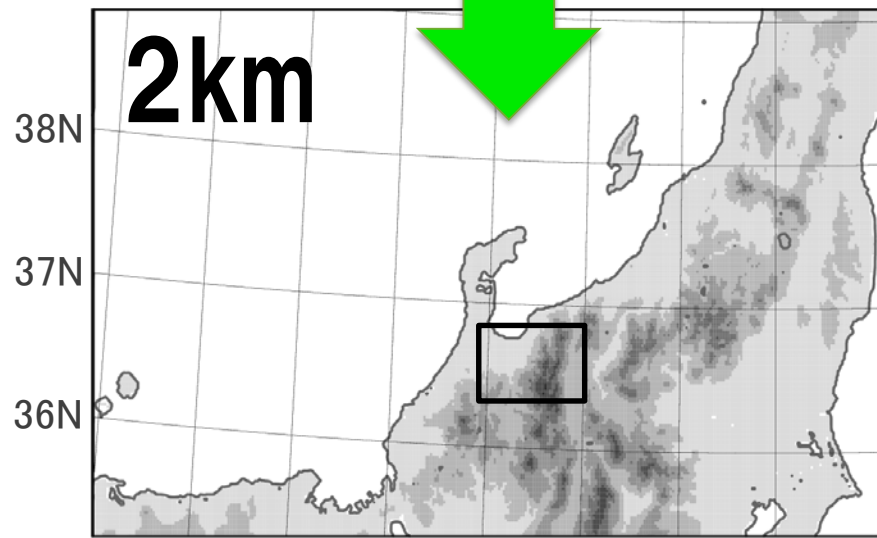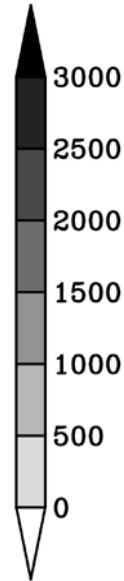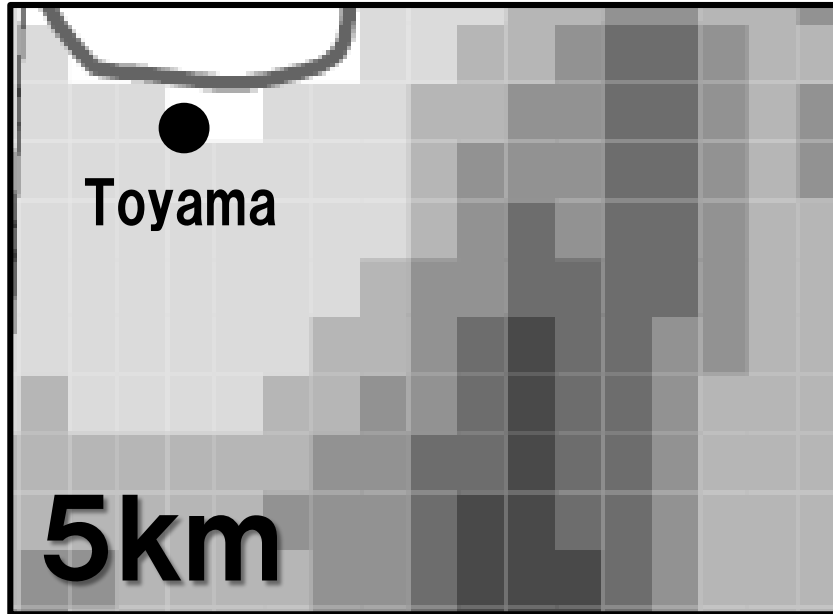
Topography of northern Japanese Alps

5km

2km

1km

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Experimental design

Tateyama-Kurobe Alpine Route

Bijyudaira(977m)

Daikandai(1470m)

Midagahara(1930m)

Murododaira (2450m)

★ Yukiono Ootani

2km

Google map -©2014 Google

Toyama

2km

Toyama

Tateyama-Kurobe Alpine Route

1km
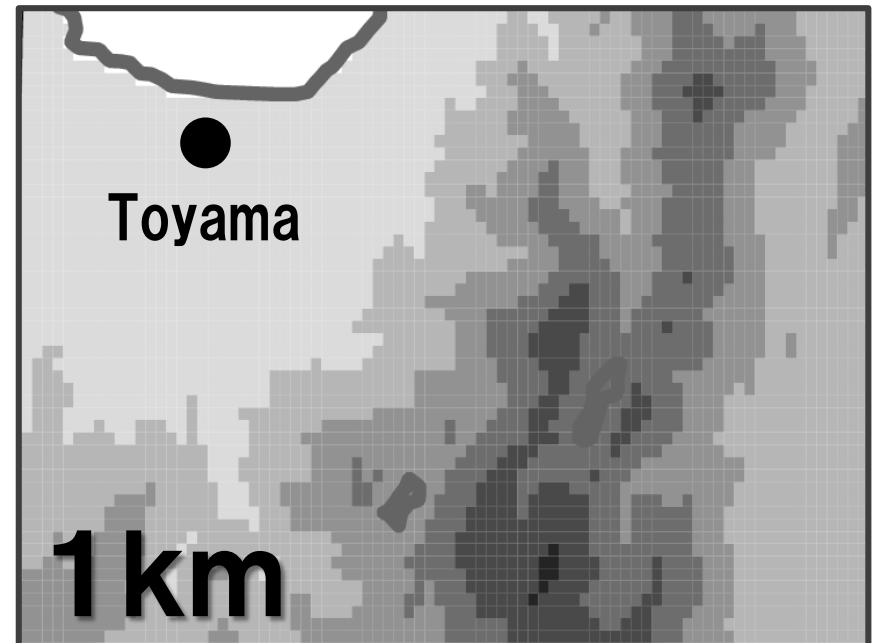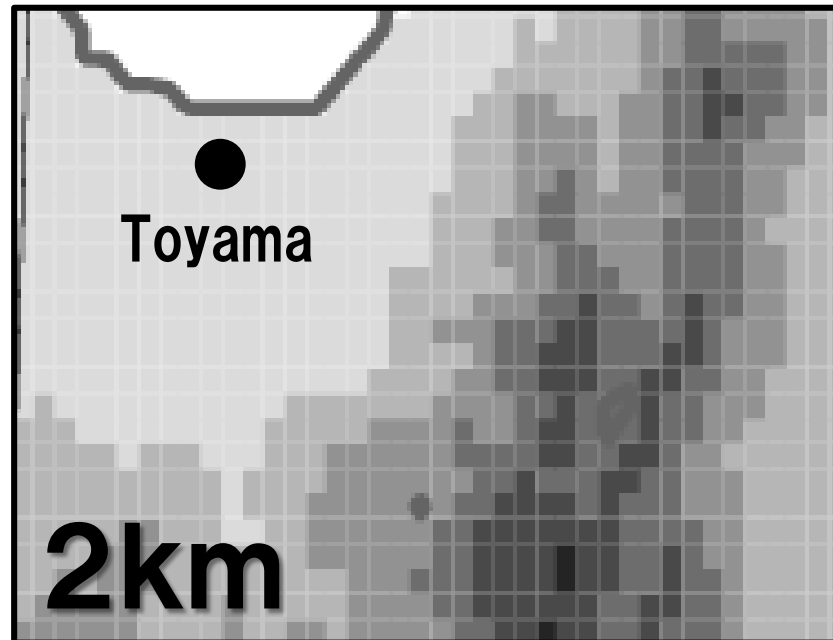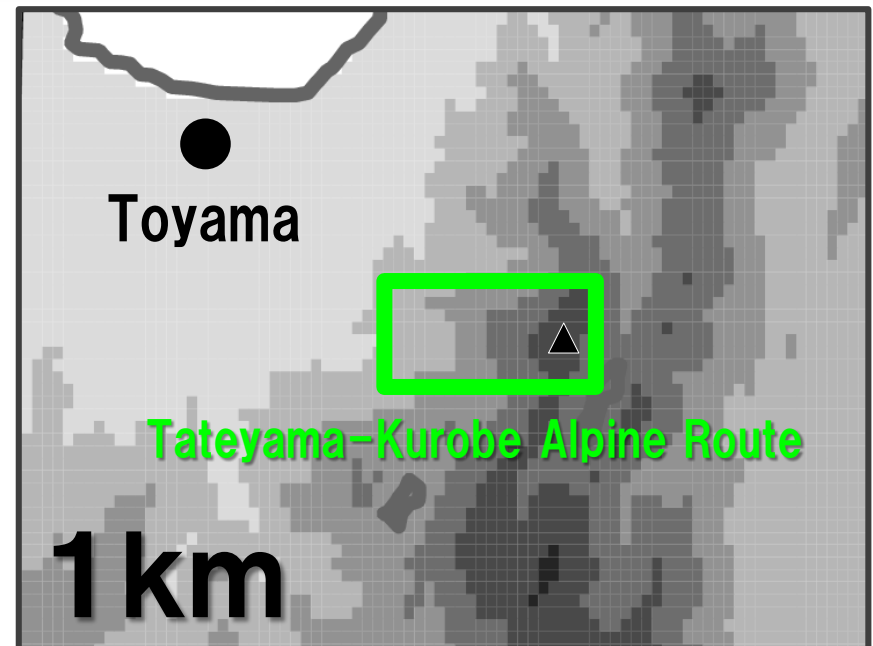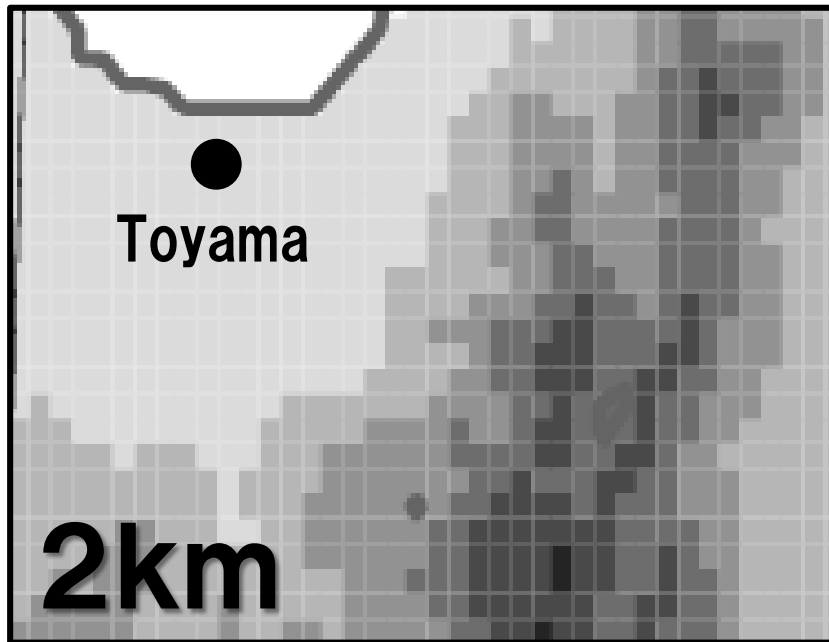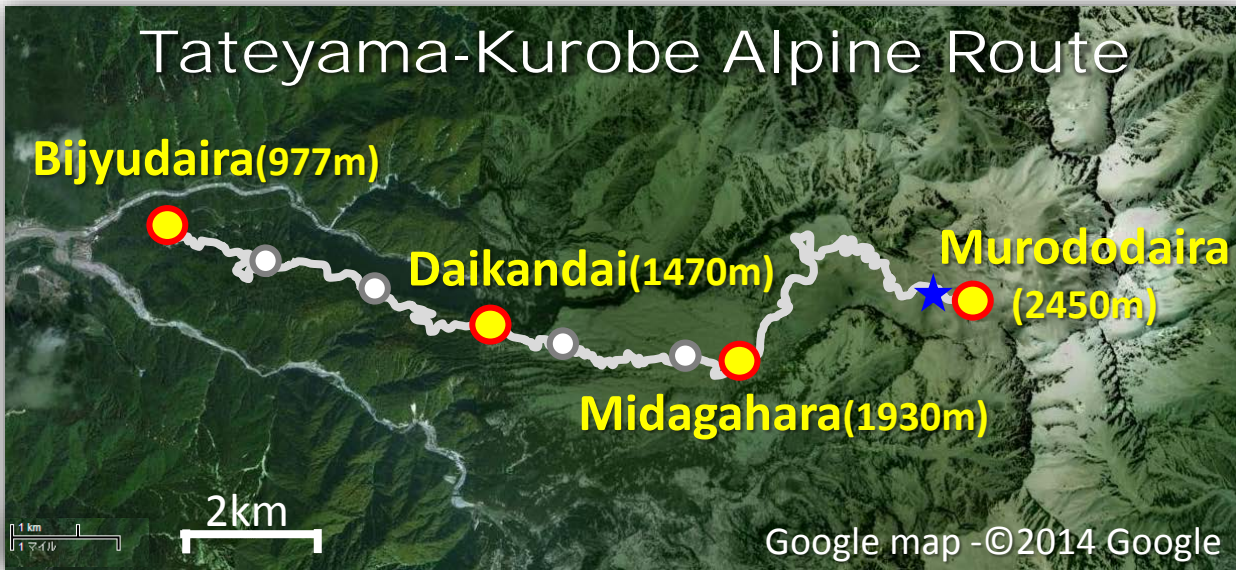
Observed snow ~Tateyama-Kurobe Alpine Route~

Tateyama-Kurobe Alpine Route

Bijyudaira(977m)

Daikandai(1470m)

Murododaira (2450m)

Midagahara(1930m)

2km

Google map -©2014 Google

Murododaira (2450m)

Place		Bijyodaira	Daikandai	Midagahara
Altitude		977	1,470	1,930
2014	Snow depth	240	360	420
	date	2/25	2/25	3/4
2013	Snow depth	270cm	470cm	600cm
	date	2/26	2/26	3/4
2012	Snow depth	250	350	440
	date	2/28	2/28	2/28
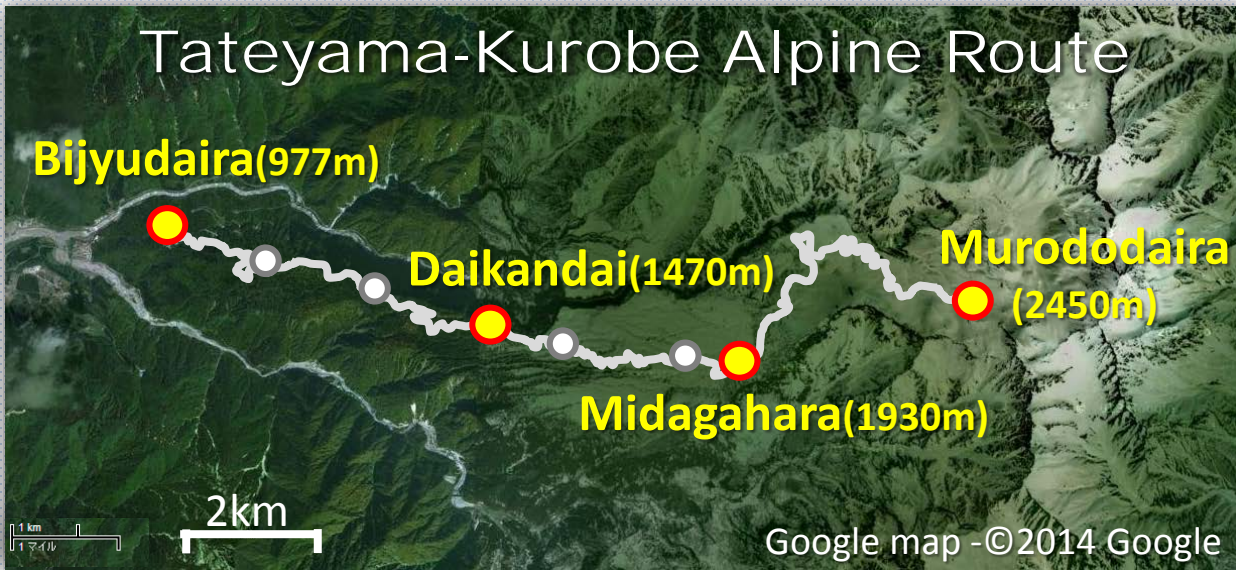
Snow Survey

date	snow depth
2012/4/21	610cm
2013/4/21	734cm
2014/4/17	617cm

by Toyama Univ. and others for their research

This data is obtained not for the research. (Tateyama Kurobe Kanko Company)

Simulation Results

Simulation —Snow depth—
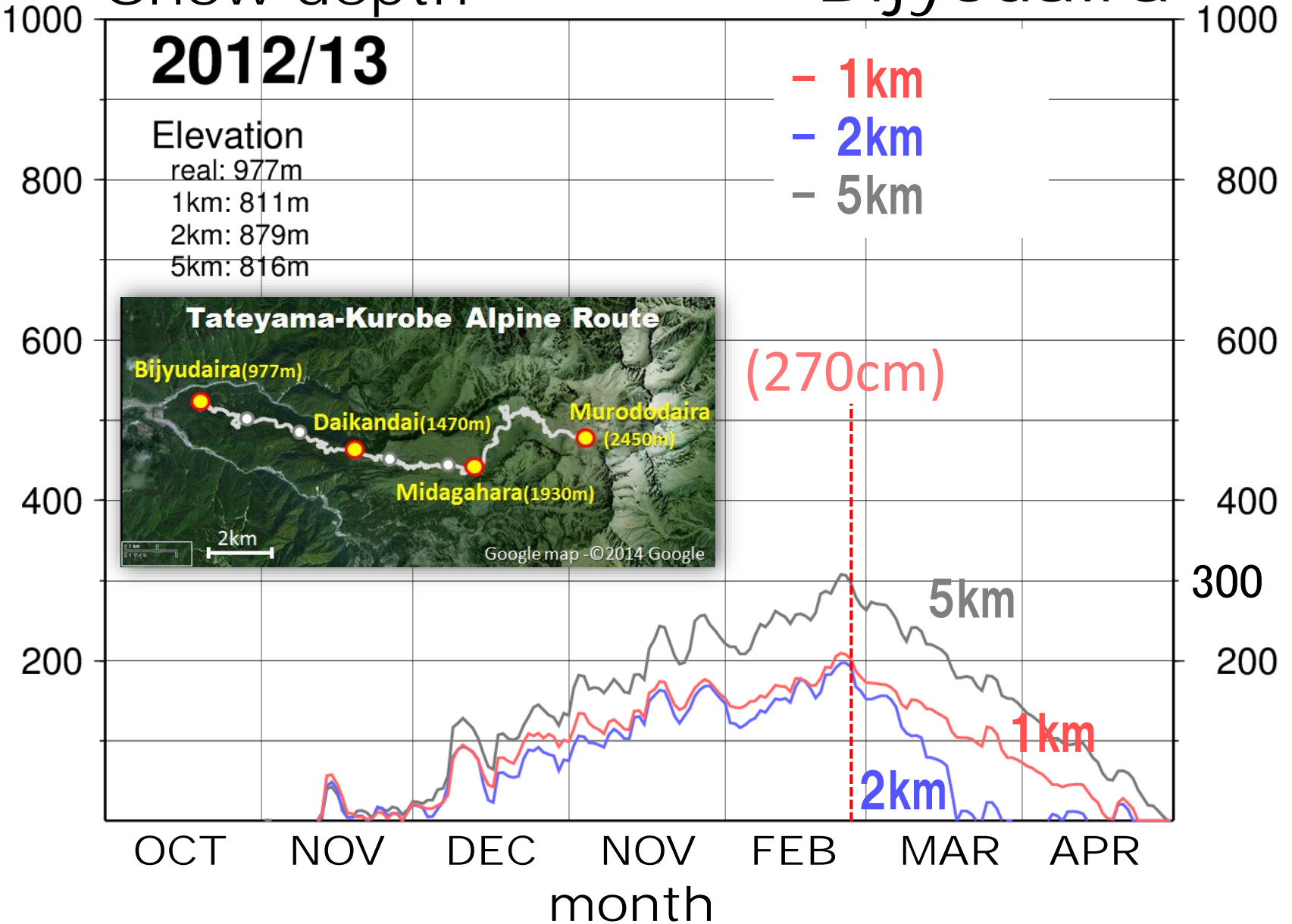
Simulation ―daily Snow depth―
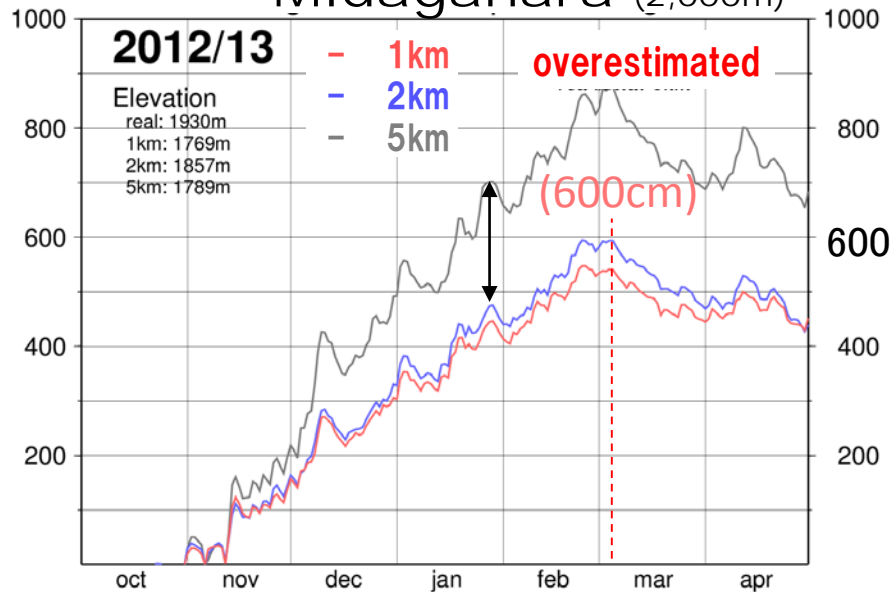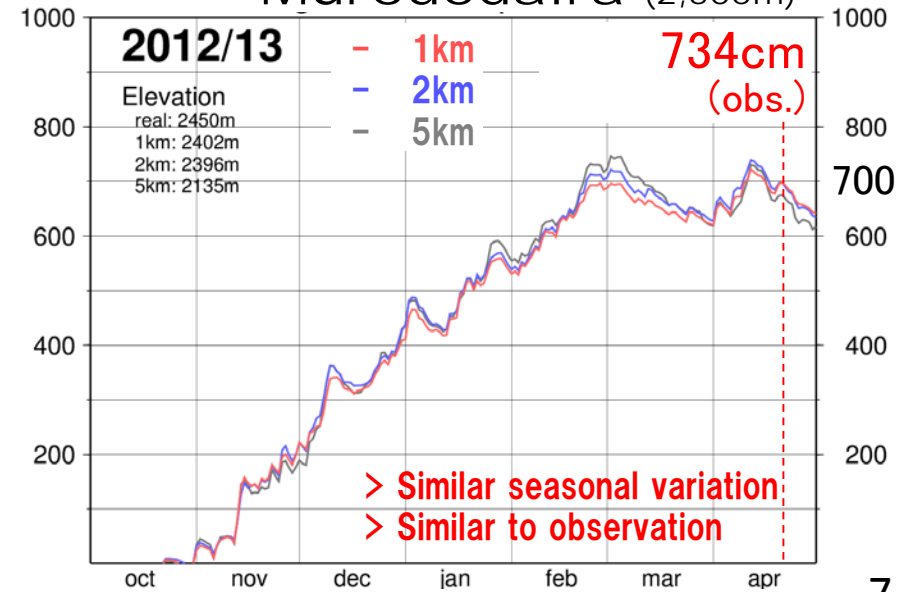
Simulation ―monthly Precipitation―
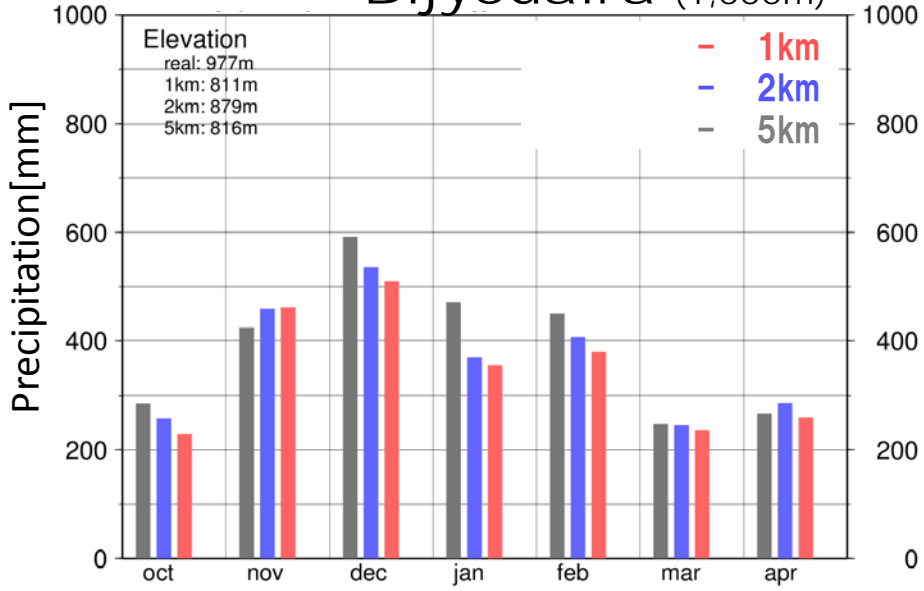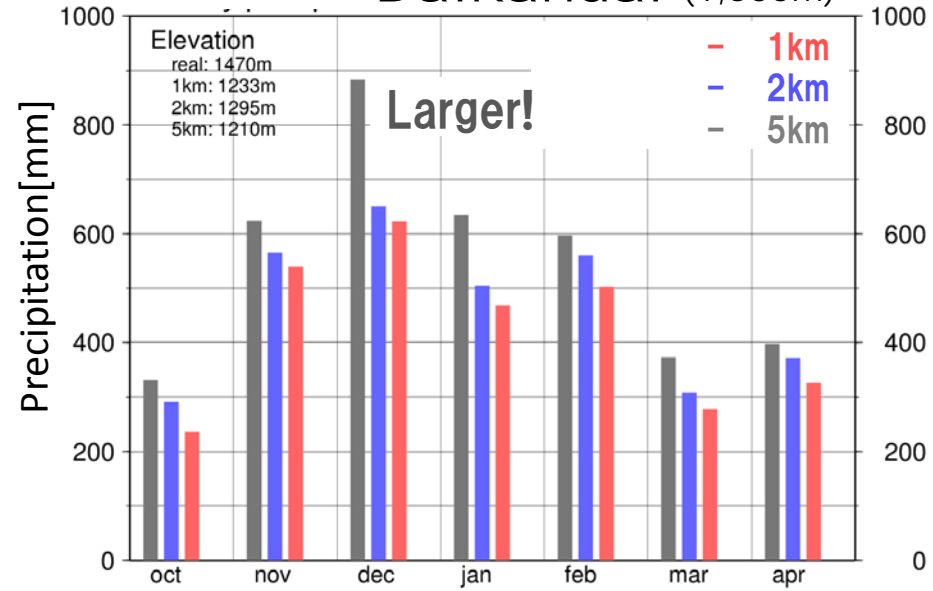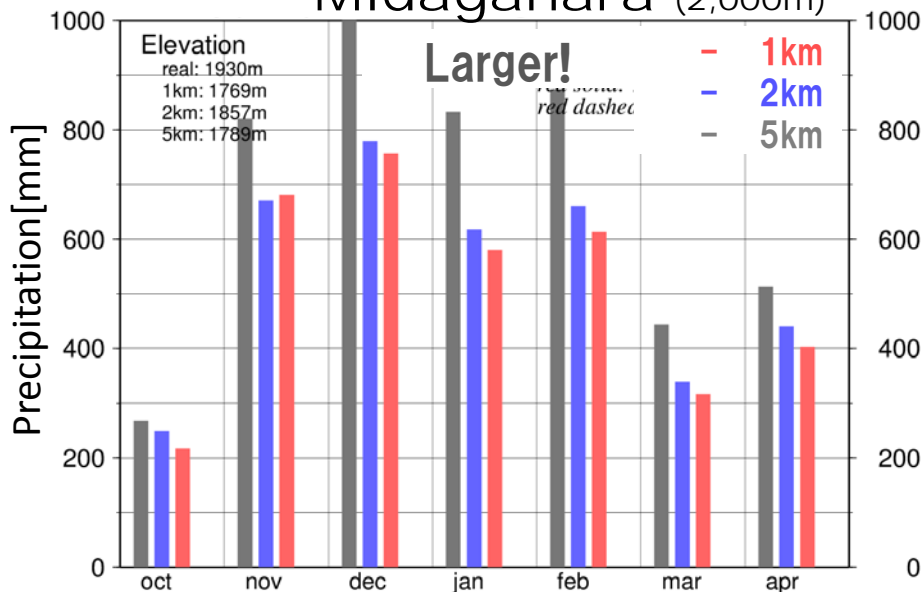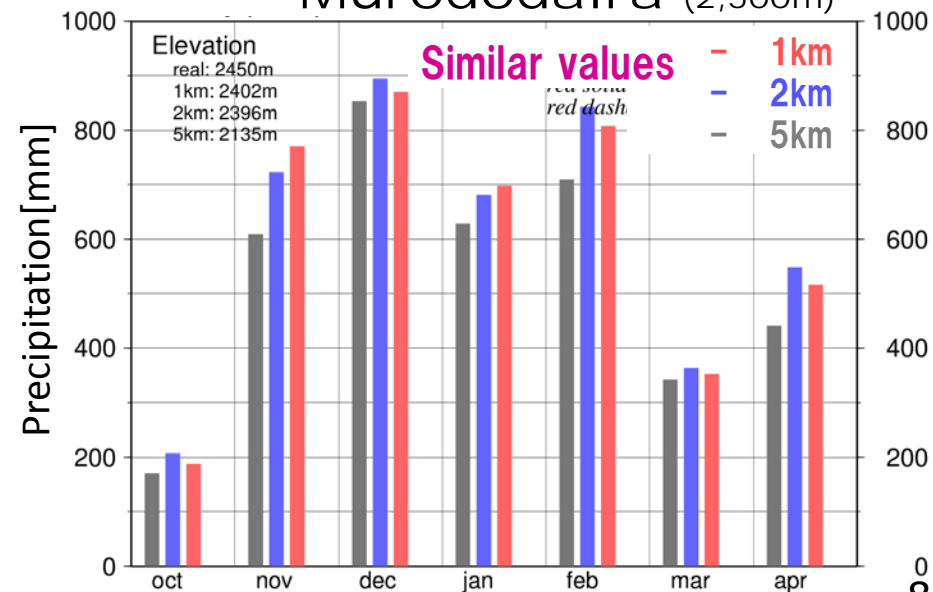
Regional mean in each altitude
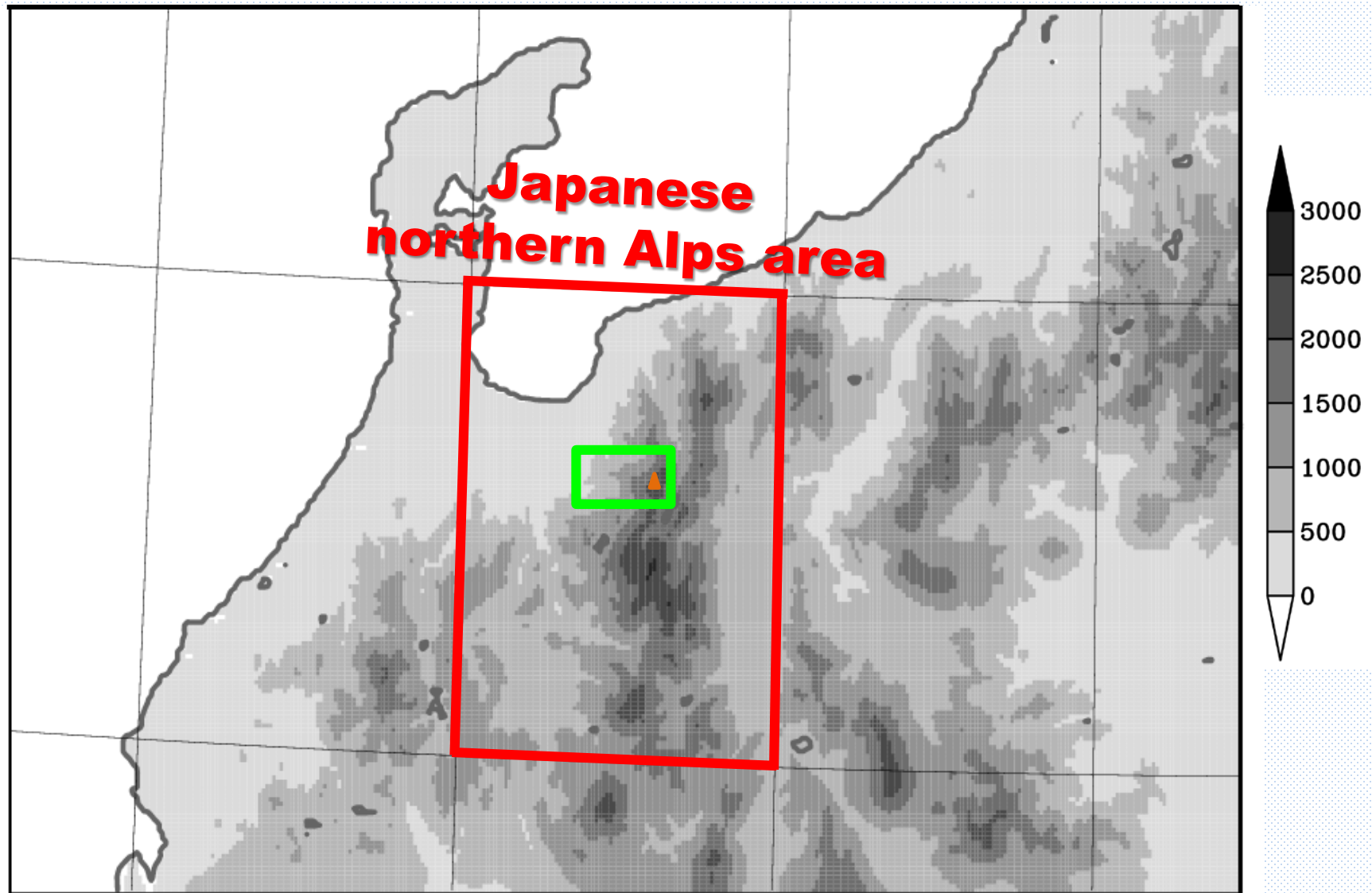
Simulation —Regional mean Precipitation—
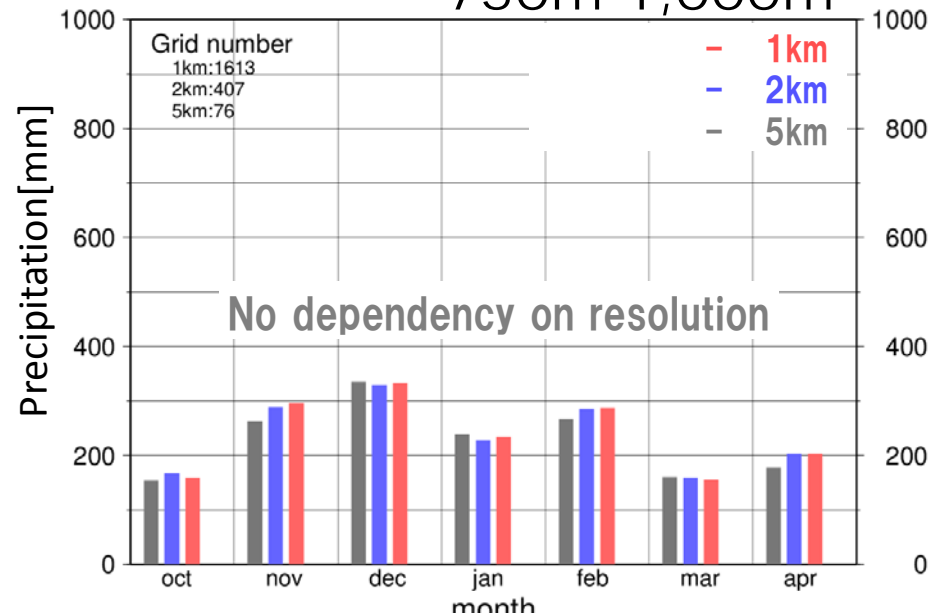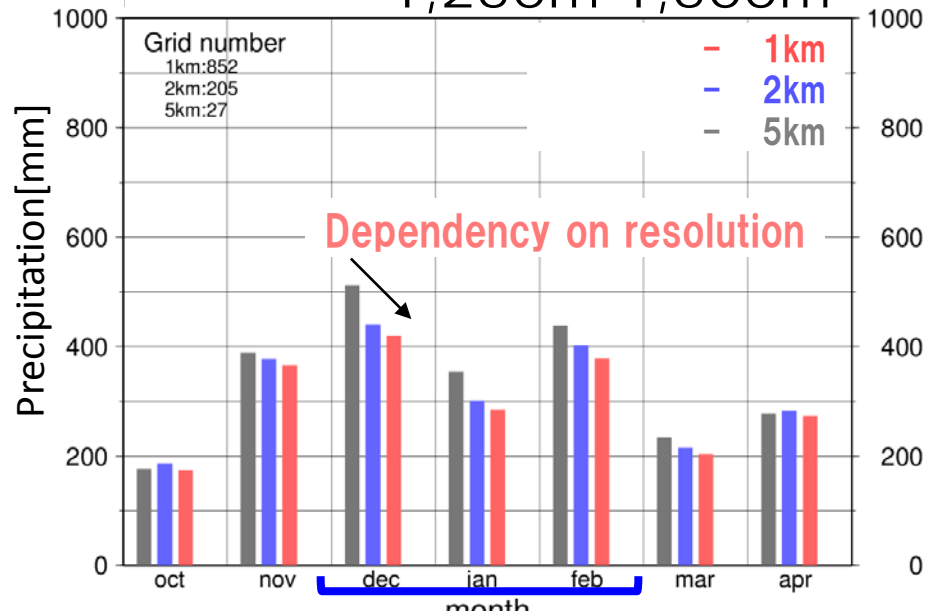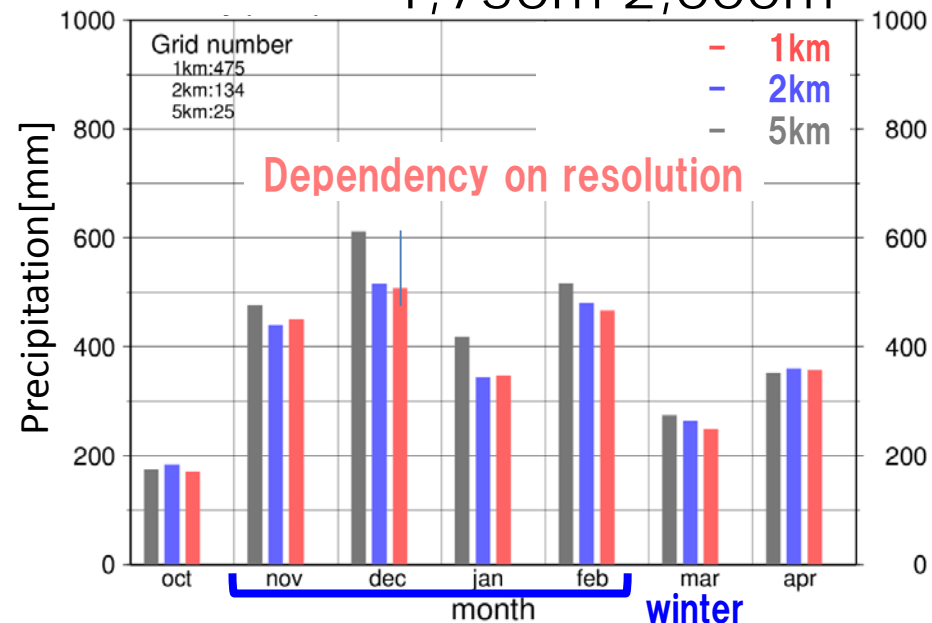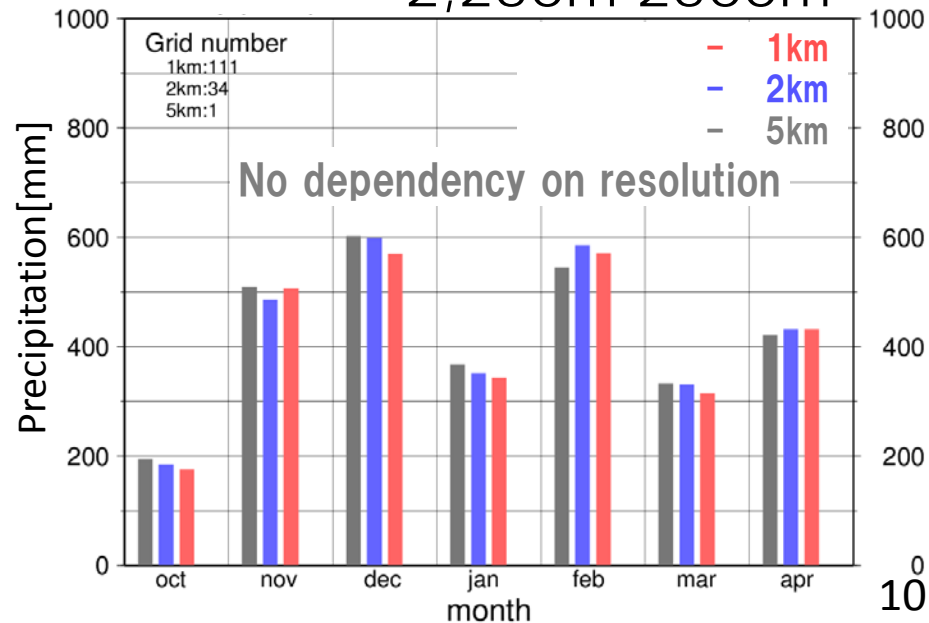
Simulation ─DJF Precipitation─

Summary and Future works
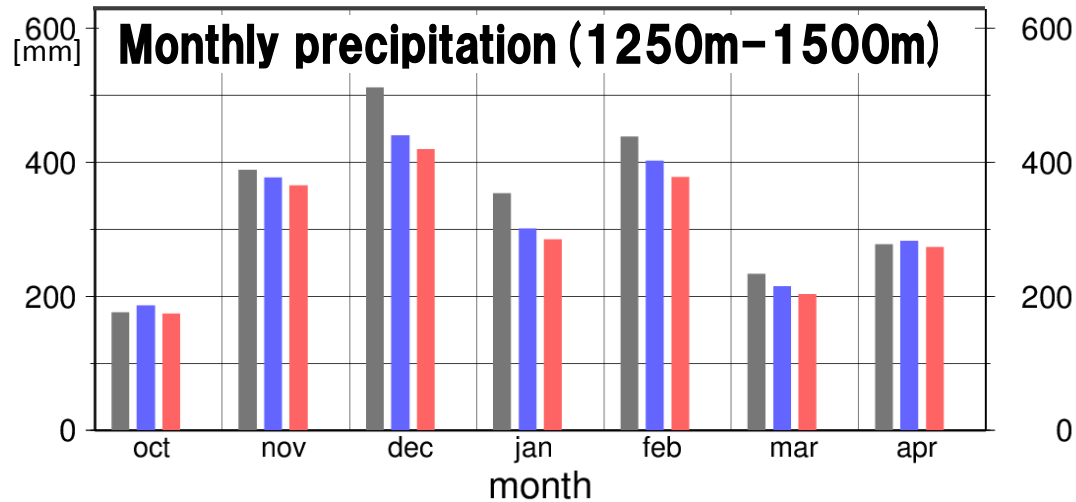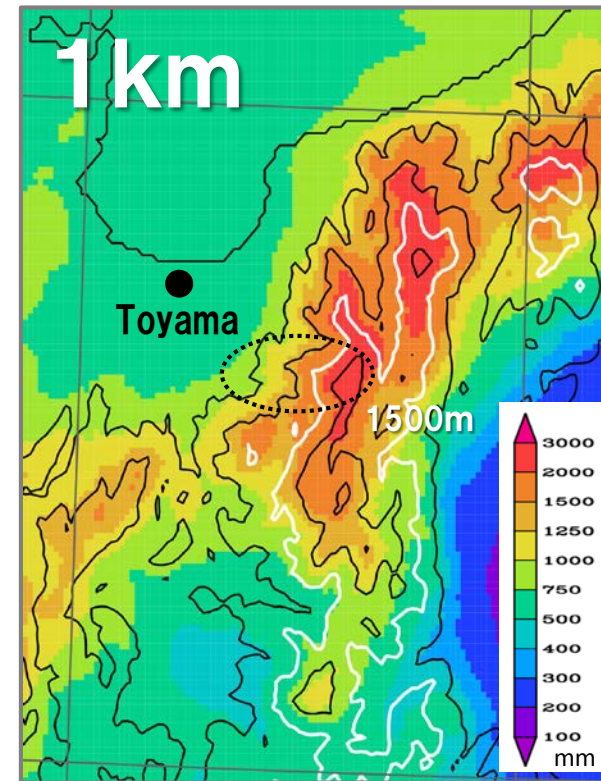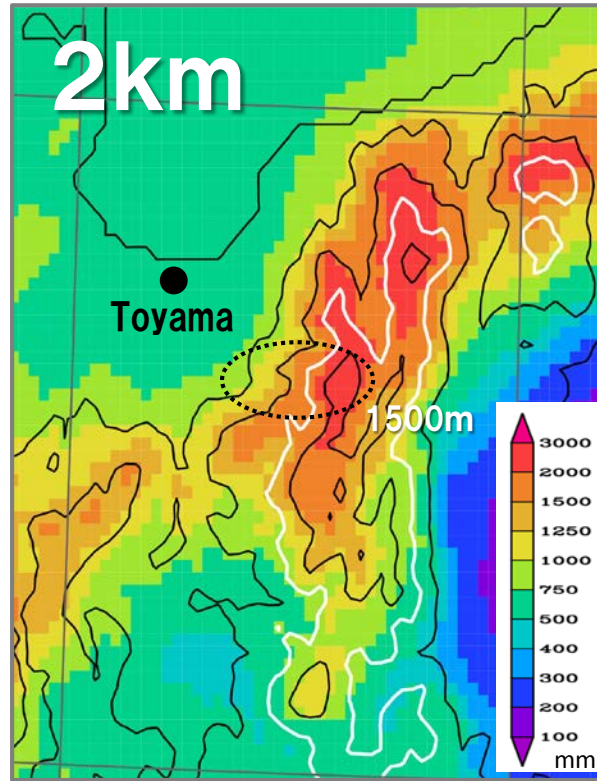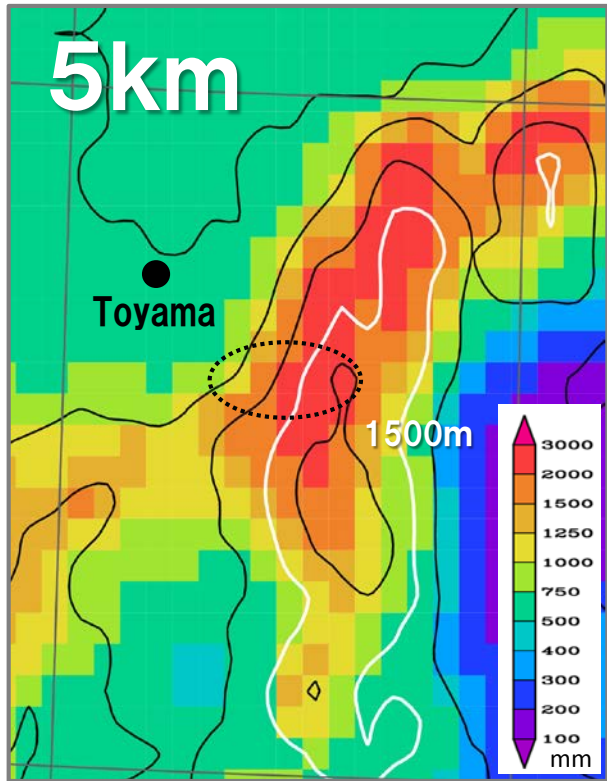
■ Resolution dependency of snow depth

- The snow depth, snowfall, and precipitation depend on the horizontal resolution of NHRCM (5km/2km/1km).

- Larger snow depth and snowfall were simulated by lower-resolved experiments around 1,000m-2,000m, which resulted from larger precipitation.

- The high-resolved topography can modify the horizontal distribution and amount of precipitation even in the same altitude.

- Future Works -

◆ *Analysis of atmospheric fields*
The atmospheric mechanisms causing precipitation differences in the different resolution need be analyzed.

◆ *Higher-resolved simulation (=>800m, 500m ...)*
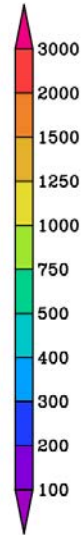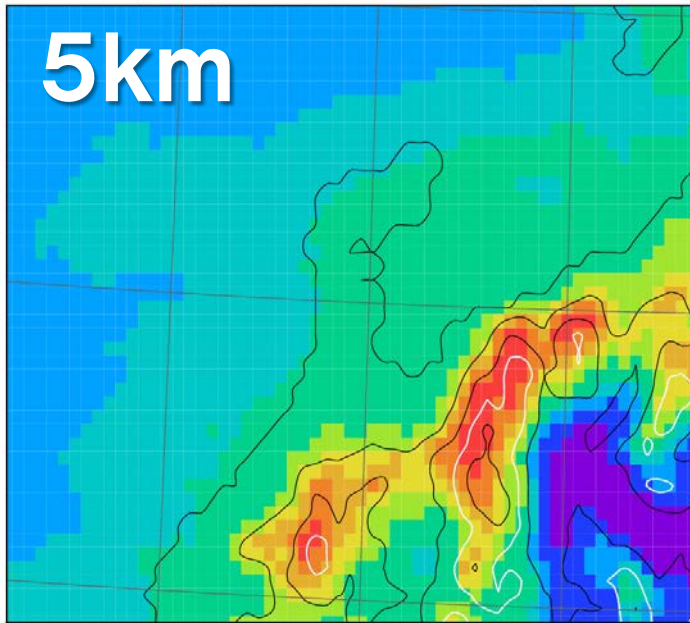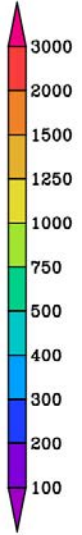More complicated mountains can be resolved, but ...

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Apr. 23, 2014 Yuki-no-Ootani

Thank you

Result—DJF Precipitation—