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(出版者 / Publisher)

Japan Climatology Seminar

(雑誌名 / Journal or Publication Title)

Japanese progress in climatology

(巻 / Volume)

2012

(開始ページ / Start Page)

16

(終了ページ / End Page)

20

(発行年 / Year)

2012-12

Reprinted from

Geographical Review of Japan Series A 83-4 375-383 2010

Analyses of Southerly Winds along the Kitakami Basin when the Yamase Prevails

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The Yamase is a cold, humid, northeasterly wind blowing toward the coast on the Pacific side of the Tohoku region of Japan during summer. However, the Yamase blows in a southerly direction in the Kitakami Basin. In this study, analyses of data and numerical experiments using the Weather Research and Forecasting (WRF) model were conducted to determine the reason for this southerly direction.

The results of numerical experiments indicated that the Yamase is southerly in the Kitakami Basin where the actual topography is reduced to 90% of the average terrain height. Meanwhile, it is easterly in areas of the Kitakami Basin when the topography is reduced to 80% of the average terrain height. The results of numerical experiments were consistent with those of mechanical analyses using the Froude number and Rossby number. Analyses of the Yamase in the Kitakami Basin therefore suggest that its characteristics are influenced by topographic obstacles and gravitational flow.

Key words: Yamase, channeling effect, Kitakami Basin, topography, numerical experiment, Froude number, gravitational flow

Table 1 Parameters for analysis of the Froude number and Rossby number

温位勾配 (Γ)	2.4 K/km
平均温位 (Θ)	290.4 K
平均風速 (U)	6.9 m/s
谷の幅 (D)	30 km

Table 2 Conditions for calculations using the WRF

初期時間 (JST)	2001年7月26日21時
積分時間	54時間
初期値・境界値	NCEP FNL ($1^\circ \times 1^\circ$) 6時間ごと
格子間隔	第1領域: 15 km 第2領域: 5 km
鉛直層数	30
長波放射モデル	RRTM
短波放射モデル	Dudhia
地表面モデル	SLAB
大気境界層モデル	YSU
雲物理モデル	WSM3
積雲対流スキーム	Kain-Fritch

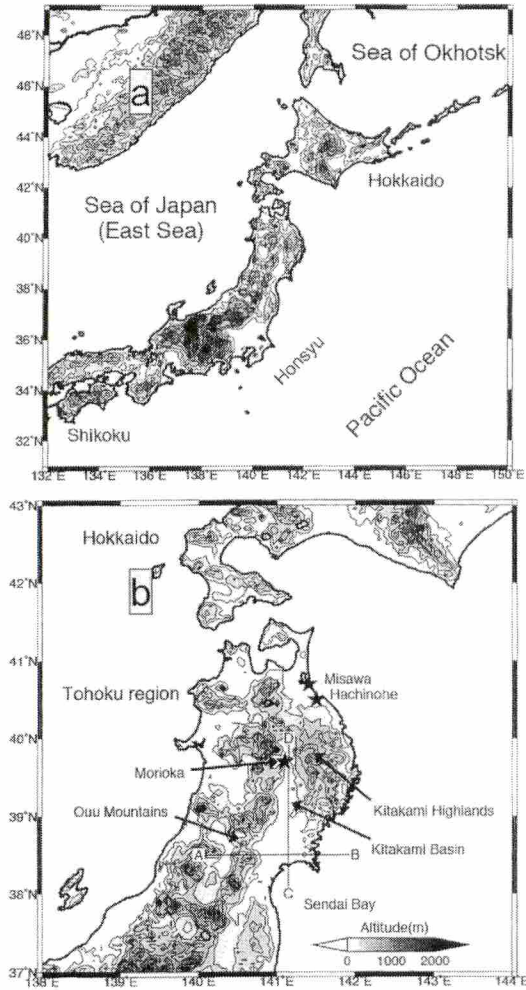


Fig. 1 Topography of the Tohoku region, Japan (a, area 1; b, area 2)

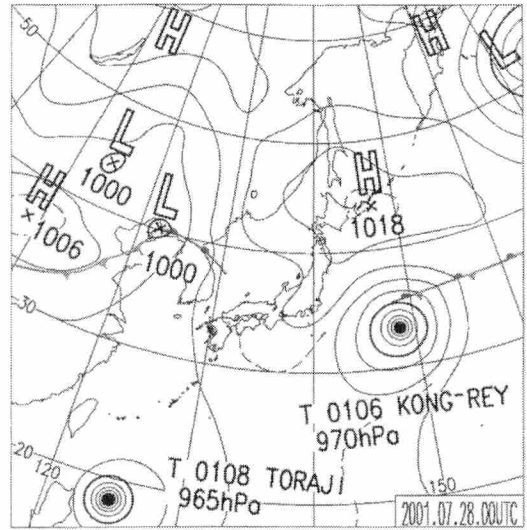


Fig. 2 Surface weather chart at 09:00 (JST) on July 28, 2001

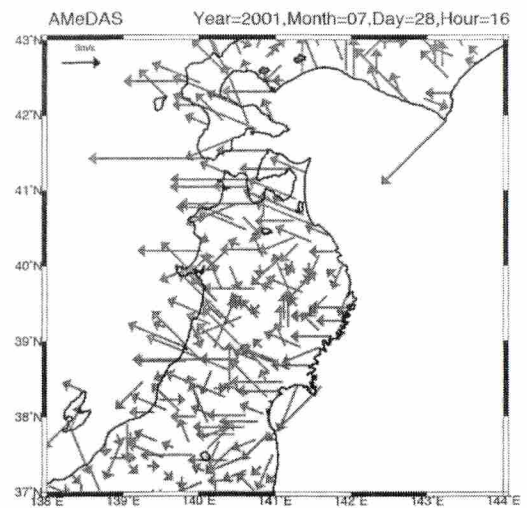
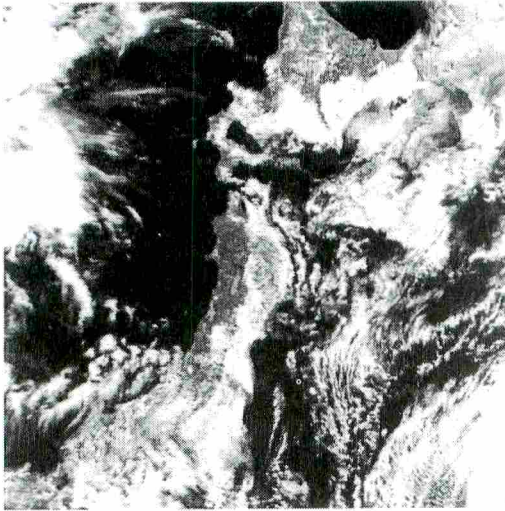


Fig. 3 Distribution of surface wind observed by AMeDAS at 16:00 (JST) on July 28, 2001



(<http://asiadb.cneas.tohoku.ac.jp/jaidas/>)
 Fig. 4 Satellite image of NOAA/AVHRR Ch.2 at 12:23 (JST) on July 28, 2001

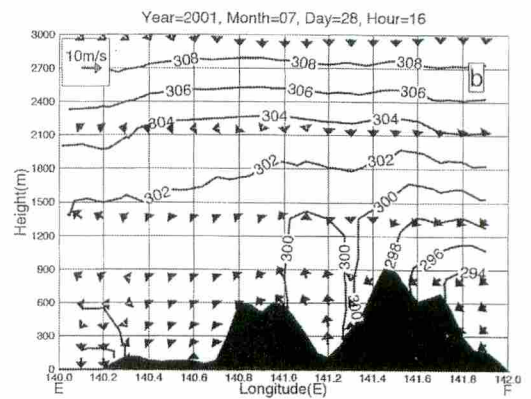
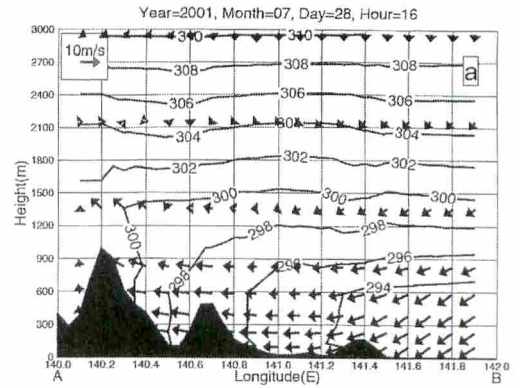


Fig. 6 Horizontal wind and potential temperature (K) of numerical experiment at 16:00 (JST) on July 28, 2001
 (a, line A-B in Fig. 1; b, line C-D in Fig. 1)

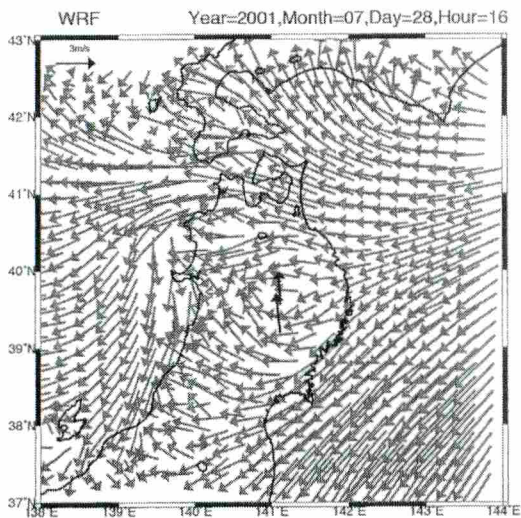


Fig. 5 Surface wind in numerical experiment at 16:00 (JST) on July 28, 2001

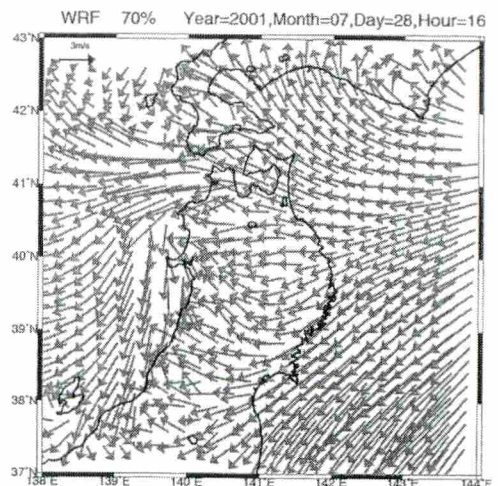


Fig. 7 Surface wind in numerical experiment assuming 70% of the average terrain height of the Kitakami Highlands at 16:00 (JST) on July 28, 2001

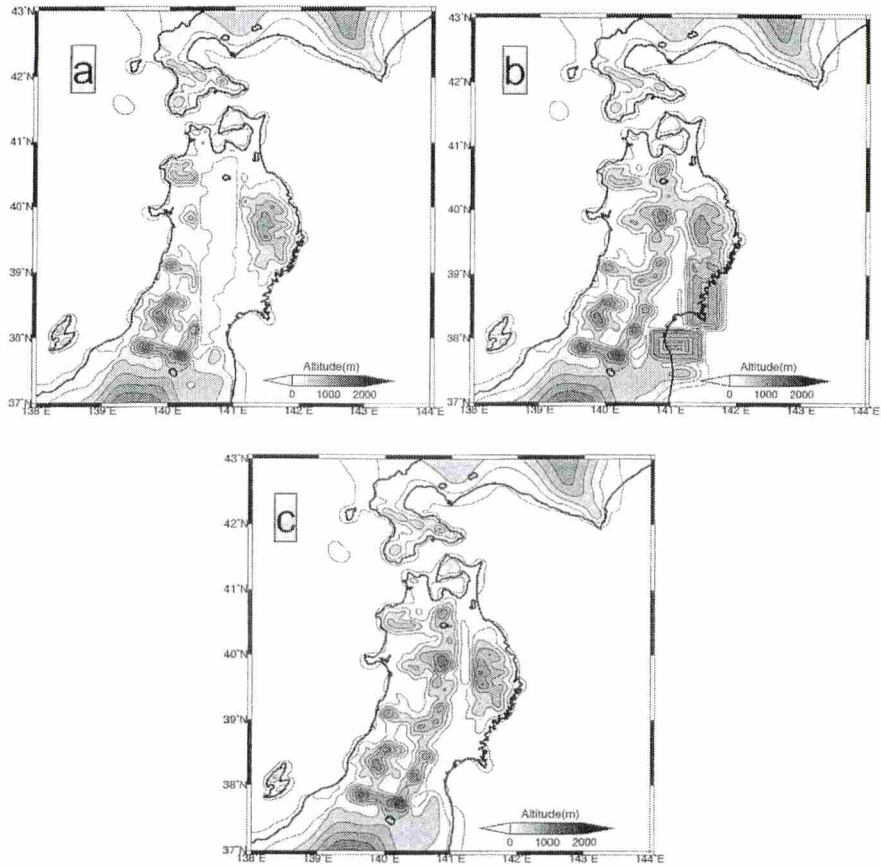


Fig. 8 Topography in numerical experiments assuming different topographic conditions
(a: Removing Ou Mountains; b: blocking up Sendai Bay; c: connecting Kitakami Basin and Hachinohe)

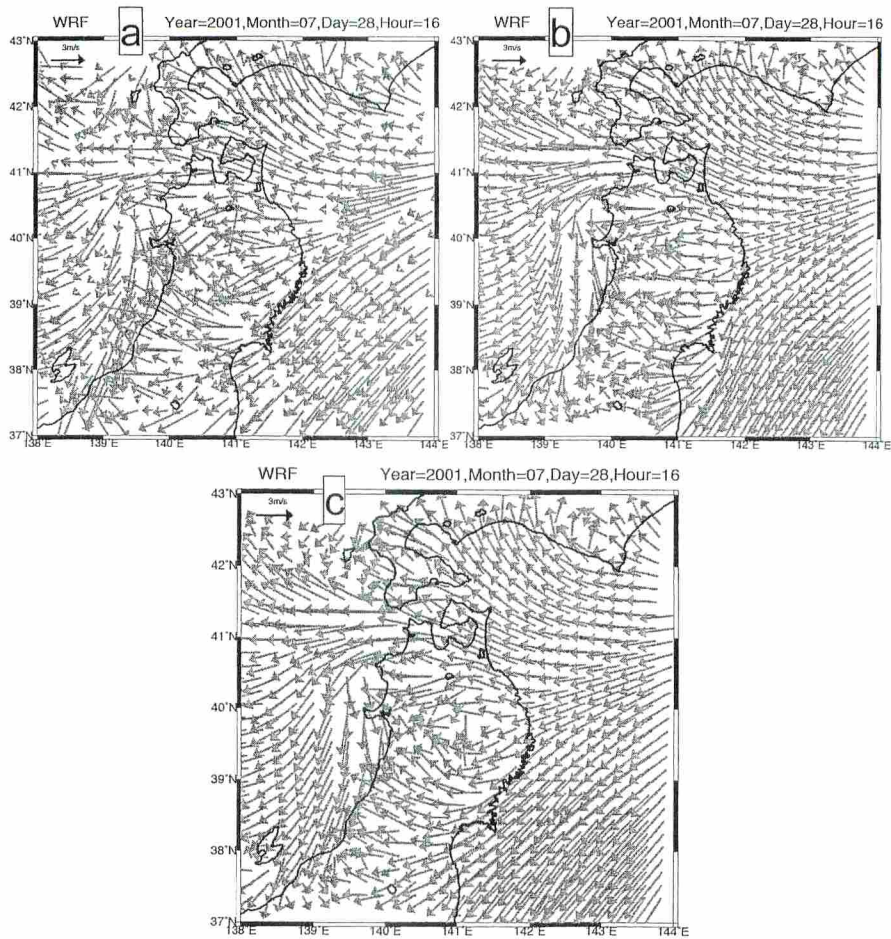


Fig. 9 Surface wind in numerical experiments assuming different topographic conditions at 16:00 (JST) on July 28, 2001
(a: Removing Ouu Mountains; b: blocking up Sendai Bay; c: connecting Kitakami Basin and Hachinohe)

Reprinted from *Geographical Review of Japan*. Series A, 83-4, 375-383, 2010