An attempt to detect of Atmospheric River by Satellite Cloud Images in the Antarctic

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1. Introduction

In recent years, Atmospheric Rivers (ARs), formed by convective clouds, have been related to water vapor transport and heavy snow in the Antarctic [1]. Therefore, we have been conducting research for the purpose of automatic identification by deep learning using cloud images that can be discriminated from ARs during snowfall at Syowa Station [2].

We present the results of our study on the contribution of cloud images to water vapor transport and snowfall from a meteorological point of view.

2. Data and Methodology

In this study, we used cloud images acquired by the NOAA/AVHRR sensor (Channel 4), ground-based meteorological data, and radiosondes (2 times/day) received at Syowa Station in 2009. The cloud images were merged with multiple images to obtain the overall structure of the target cloud because the observation area varies with the satellite orbit every hour [2]. For each event where a blizzard and snowfall were observed, the cloud area were calculated as the number of pixels in the area judged to be high height clouds [2]. The AR events were selected based on the conditions that the clouds were over Syowa Station and that the clouds were persistent over a long distance.

3. Results

Here, we used the IVT [3] to detect the AR but it is a point data for Syowa Station from ERA-5. The time-series of IVT for each month are shown in figure 1. We calculated the monthly threshold to recognize a rare event to find atmospheric river and large amount snowfall (Table 1). Arrows indicate when events exceeded 3σ in Table 1. We are convinced our new AR cloud can be as parameter for estimation of snowfall in the Antarctic. However, ARs in the polar region should be detected the other criteria because the water vapor contents in the atmosphere are poorer than lower and mid latitudes. Because the IVT did not exceed the threshold as AR in this time.

4. Summary

From the relationship between the pixels of HTC area and Precipitable Water at Syowa Station, the clouds used as AR in this study are characterized by their large cloud area. Based on the IVT from ERA-5 reanalysis, 8 of 10 events as the "Positive" clouds have IVT exceeding the monthly threshold (3σ).

Table 1. Event number of extreme IVT in 2009

	3 σ (kg/m/s)	Event Num
JAN	80.0499	1
FEB	108.8280	1
MAR	64.1961	1
APR	65.0578	1
MAY	107.6485	1
JUN	89.0853	1
JUL	69.3157	2
AUG	41.7319	1
SEP	43.4851	1
OCT	47.5708	1
NOV	53.8796	1
DEC	18.7183	2

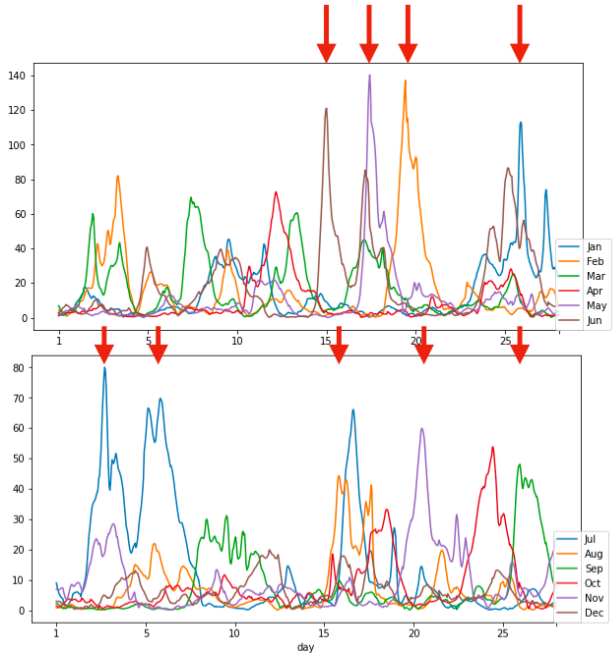

Figure 1. Time-series of IVT over Syowa from ERA-5 in 2009

References

[1] Gorodetskaya et al., GRL, 2014.
[2] Suzuki et al., Advances in Artificial Intelligence, 2021.
[3] Mundhenk et al., J. Clim., 2016.