The cloud patterns in the snowfall conditions at Syowa Station, Antarctica

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Here, we attempt to estimate the surface mass balance (SMB) of Antarctica by accounting of the snowfall values based on the spatial synoptic patterns among some elements (e.g. geopotential height, relative humidity, sea ice concentration, and so on) for several decades. Since the snowfall amount provided by ERA-reanalysis data shows a lot of disagreements with the observed snowfall event at Syowa Station, we should verify the elements from ERA-reanalysis data are sufficient for interpreting of snowfall events.

For this subject, we investigate the relationship among the atmospheric synoptic patterns and cloud patterns from satellite data. The characteristic spatial patterns between atmospheric elements and clouds can be defined based on the observation data at Syowa Station. Regarding these patterns as a training set, we apply to the machine learning techniques to find similar patterns automatically. We build an image classifier based on Convolution Neural Network (CNN) to apply this method for the blizzard events in 2009. The image data are Ch,4 of NOAA/AVHRR, SST and Sea ice concentration. First, merge of several images for analysis. The image of NOAA/AVHRR does not have a whole area, it depends on the satellite orbit. We need to analyze the whole construction of the cloud. After merging, analysis for blizzard events are done. The clouds with snowfall are analyzed about the structure and the amount. We compare a spatial characteristic of heavy snow clouds to that of light snow clouds. After these preparations, we can run to learn the cloud patterns with CNN. The results, the validations of distinctions distributed from 95 to 97 percent. However, the distinctions have not been clarified about what is the based on. The images with feature extract of the clouds is the feature of clouds in the shallow layers and we found the fine feature in the deep layers.

Adding to this distinction of cloud patterns, we examined the relationship between the sum of cloud pixels observed snow depth data at Syowa Station in 2009. We divided all blizzard events to two groups; ‘heavy’ and ‘light’ snowfall groups depend on the snowfall amounts. In the heavy snowfall group, we gained the huge cloud pixels compared with the light snowfall group. The high – trained cloud patterns were not depending on the snowfall amounts. We found that the position of the high-trained cloud which cause the huge snowfall was close to Syowa station or not (figure1a, b). This theory has a good agreement with the air transport routes reached to Syowa station directly from the ocean in the snowfall conditions (Suzuki et al. 2008).

a) b)

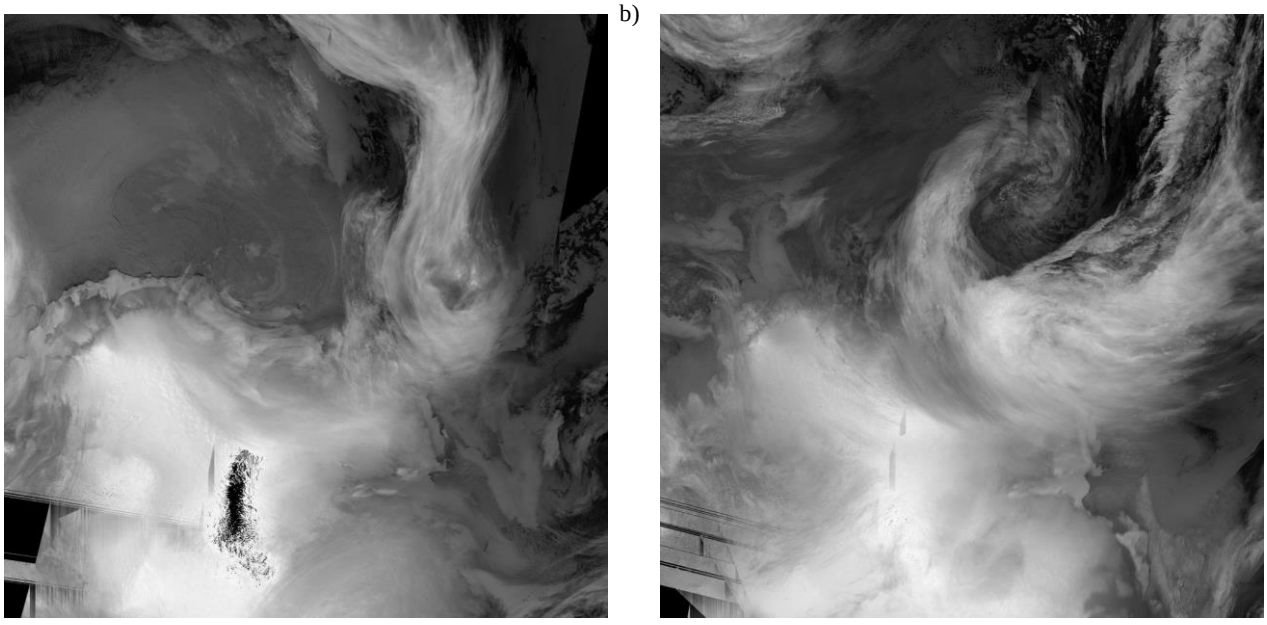

Figure 1. Merged satellite images at Syowa Station. a: heavy snowfall condition; b: light snowfall condition

References

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