Properties of long-time digital camera records in Changchun and Ulaanbaatar

Kisei Kinoshita [(1)], Hiroyuki Kikukawa [(2)], Naoko Iino [(3)],

Wang Ning [(4)], Zhang Gang [(4)], Jugder Dulam [(5)],

Tsatsaral Batmunkh [(5)] and Satoshi Hamada [(1)]

(1) Faculty of Education, Kagoshima University, Kagoshima, 890-0065, Japan
(2) Faculty of Fisheries, Kagoshima University, 890-0056, Japan
(3) Department of Mechanical Engineering. Kagoshima University, 890-0065, Japan
(4) Environmental Science Department, Northeast Normal University, Changchun, China
(5) Institute of Meteorology and Hydrology, Ulaanbaatar 210646, Mongolia

Abstract : Digital cameras to record fixed wide views with one-hour interval are operating in Changchun, China since the middle of March 2003, and in Ulaanbaatar, Mongolia since the middle of March 2004, to study visibility and air turbidity affected by Asian dust. Digital video cameras with ten-minute interval are also in operation there. We discuss the results of the observation in the spring and summer of 2004, and the optical properties of the digital photo records.

Key Words: Asian dust, digital image ,interval recording, turbidity, visibility

1. Introduction

Long-time visual recordings by using digital cameras are very effective for the studies of atmospheric phenomena as reviewed in [1] concerning volcanic cloud observation. In order to observe the Asian dust phenomena from the ground in Northern Asia, digital photo and video cameras have been set at Northeast Normal University in Changchun, Jilin Province, China since 18 March 2003, and also at the Institute of Meteorology and Hydrology, Ulaanbaatar, Mongolia since 16 March 2004. Digital photo cameras were also set at two stations, Bulgan and Dalanzadgad in southern Gobi, Mongolia in the spring of 2004. The ground observation at these stations, shown in Fig. 1, are important to study the rise and the transport of the dusty air in the northern roots toward Northern Pacific, as often observed in the satellite imagery [2]. On the other hand, the web-camera recording in Kagoshima, southwest Japan, started in the end of 2000, preceded by video recording since 1987 and extended to southern islands including Mayon volcano, Philippines, as summarized in [3].

The results of ground observations and satellite imagery of dust events in 2003 were already reported in [4]. In this report, we discuss the ground observation results in Changchun, Ulaanbartar and two stations in southern Gobi in 2004, with special attention to the optical properties and the performance of digital cameras. Preliminary results concerning the dust events supplemented with the satellite imagery are reported in [5, 6].

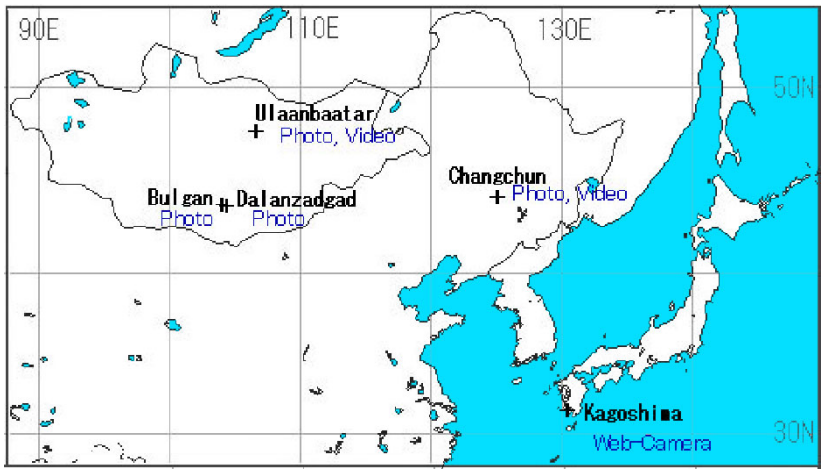
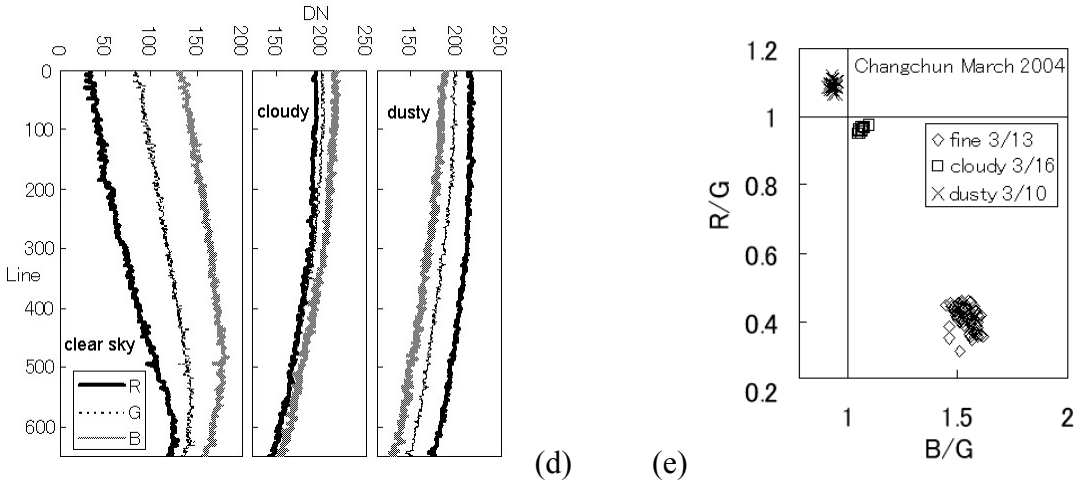


Fig. 1. Location map of observation stations.

2. Observation in Changchun and digital RGB analysis

Interval recordings by digital photo and video cameras in Changchun in 2004 started in the evening on March 9. On the next day, very dusty air was observed almost all the day. The recordings continued until August 21, by changing medias on May 24. The cameras were set at the window toward the north on the fifth floor in a building of Environmental Science Department, College of Urban and Environmental Sciences, Northeast Normal University. Fig. 2 (a), (b) and (c) are typical images by photo camera Casio QV-R4 of clear sky, cloudy and dusty scenes in the daytime in the middle of March. The differences in color and the brightness change according to the vertical angle are obvious in the images.

(a) clear sky: 13 March at 11 CST (b) cloudy: 16 March at 12 CST (c) dusty: 10 March at 14 CST



(d) (e)

Fig. 2. The photo scenes (a-c) at the Changchun station, RGB profiles (d) along a common vertical line shown in (c), and the scatter diagram (e) of R/G vs. B/G at the upper part of the line indicated in (a) for three scenes.

These images are taken by the format 1280 pixels * 960 lines in the normal mode. Quantitative study can be done by taking the RGB (Red, Green and Blue) profiles in 8 bit, such as shown in Fig.2(d), along a common vertical line in the sky shown in Fig. 2(c). In the case of clear sky, the relationship among three color-components is B > G > R and the difference of each is significantly large especially in the sky region far away from the horizon. For cloudy sky, the differences become small, especially between G and R, but never change the relation. For dusty sky, the above relationship is reversed as B < G < R, and the differences increase with dusty levels. A scatter diagram of the values B/G and R/G normalized by the Green component in the upper part of the vertical line, shown in Fig. 2(a), are exhibited in Fig. 2(e), where three clusters are clearly separated corresponding to the air turbidity.

We may also study the decrease of the visibility in dusty air in the photo data. Fig. 3(a) is a comparison of the views near the horizon in Fig. 2 (a, b and c). The RGB values along a line there are displayed in Fig. 3 (b, c and d). The decrease of the contrast between the buildings far away and the background sky is obvious for cloudy and dusty scenes.

In order to see the air turbidity from the color information of the sky, the white-balance of the color was set to the daylight (outdoor) mode. The zooming of the camera was set as wide as possible.

All of the photo records were edited by html to see a few days from dawn to dusk at a glance, keeping original jpeg images without change, after renaming to indicate the place and the date-time and separating nighttime scenes.

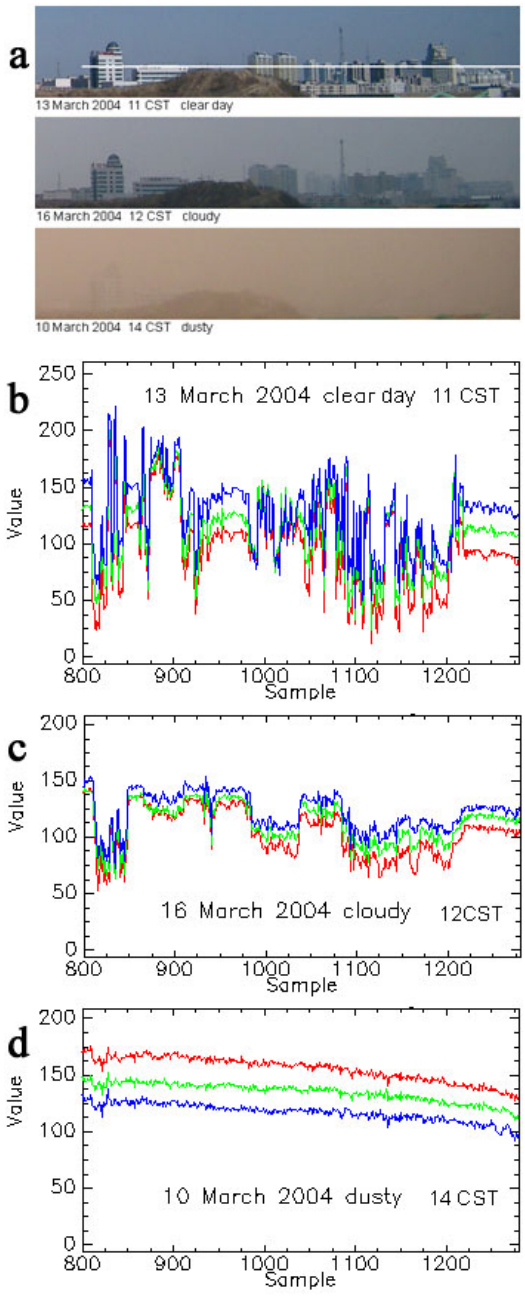


Fig. 3. (a) Parts of photo scenes near the horizon in Fig. 2 (a-c). (b-d) RGB values along the line indicated in (a).

Fig. 4. A list of photos on June 29 in Changchun, as indicated by ch040629hh with CST (=UTC+8) for hh.

Thus, we may have quick look images of seasonal change of daytime hours as well as weather changes in day and time. Fig. 4 is a sample of a photo list in a fine and longest day in the end of June. We see that the development and decrease of cumulus clouds around the mid-day.

In Changchun, a video camera Sony DCR-TRV40E has been operating with ten-minute interval, with somewhat close-up because of the limitation of the window frame for wider view. In Fig. 5, we compare the photo and video records in dusty and clear days in March. We see that the difference of the air turbidity is remarkable, though the color contents somewhat depend on the cameras.

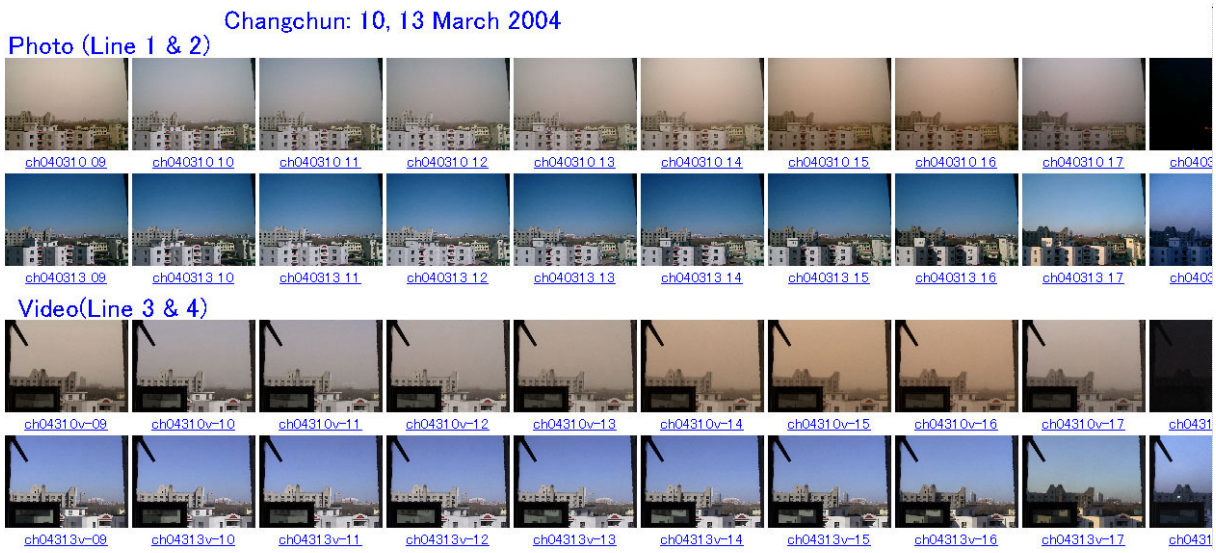


Fig. 5. Comparison of photo (line 1 and 2) and video (line 3 and 4) records on 10 and 13 March, corresponding to dusty and clear days respectively in Changchun.

3. Observation in Ulaanbaatar

Fig. 6. A semi-fish eye video scene at IMH, Ulaanbaatar..

In Ulaanbaatar, a photo camera with wide view, Ricoh Caplio G4wide, and a video camera Sony DCR-TRV900 with semi-fish eye converter lens Kenko x0.45 have been set at a window toward the west on the third floor of Institute of Meteorology and Hydrology (IMH). A tall bank building in front of the window somewhat disturbs the view as shown in Fig. 6, which is a semi-fish eye view of the video camera. The photo camera has been tilted by 90 degrees, so as to take wide vertical view. In 2004, photo records were obtained during 16 March and 20 June with one-hour interval, and video records between 16 March and 2 June with ten minutes interval as in Changchun. The video records were converted into mpeg files for each day separately from dawn to dusk. Fig. 7 is a quick look list of photos for seven days in the middle of

April from the sunrise to dusk for a day in a line. The filename of each photo indicates the place (UB) and the date-time, where Mongolian standard time (MST= UTC+8) is used. In these photos, we see the mirror images of rising sun around 6 MST, and the direct images of falling sun in the afternoon partly shielded by the bank building. In Fig. 7, light dusts were occasionally seen on 13-14 and 17-19, while very fine sky is seen in many other days and times.

Fig. 7. A sample of quick look scenes at IMH, Ulaanbaatar, for 13-19 April, 2004, 6-19 MST.

4. Observation in southern Gobi

At Bulgan and Dalanzadgad in southern Gobi, photo cameras Casio QV-R4 and Sharp MD-PS1 were set at the windows toward the south and the west respectively on the ground floors in the meteorological stations there, with the zoomings of the cameras as wide as possible. At the Bulgan station isolated in Gobi desert, the camera was powered by a battery-pack outside. We got the records there for 26 days since 18 March. (At the other stations in general, the cameras have been powered by AC converters connected to AC power sources through uninterrupted power supplies.) At the Dalanzadgad station, restart of the camera was necessary for many times, and the photos were obtained during 27 March and 17 June, lacking the records of March 31, April 1-7 and 14-19, May 6, 12-13 and 20-31, and June 8-10. The white-balance of MD-PS1 had to run by automatic mode only.

Fig. 8 shows quick look images for two days in the afternoon in the end of March at two stations. We may see dusty air to the south of these stations in the afternoon on 27 March.

Fig. 8. Quick look images at Bulgan (BL) and Dalanzadgad (DZ), in the afternoon on 27-28 March 2004.

5. Remarks

Interval digital records of photo and video cameras are useful for the studies of dusty air and many other aspects of weather changes. Studies of Asian dust in conjunction with satellite imagery and other related data are in progress, as partly reported in [5, 6]. Three photos per day at local standard time 9, 12 and 15 hours at Changchun and Ulaanbaatar are archived in http://volceye.edu.kagoshima-u.ac.jp/webcam/archive/ .

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