

THE IMAGE INTEGRATED DATABASE FOR WEATHER STUDY USING MT. SAKURAJIMA

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ABSTRACT:

Mt. Sakurajima is a volcano located about 10km east from Kagoshima University. We are continuing observation of this Sakurajima volcano with a web camera since December 2000. The picture is taken from 5:00 to 20:00 JST at 5 minutes interval, and archived in web server. The flow of volcanic plumes and meteorological clouds covering the summit are influenced by the surrounding weather condition. Therefore, the observation of Mt. Sakurajima is important for weather study to expect a motion of the distribution of atmospheric pressure and the front by reading a wind direction and velocity. The database for weather study we built has the following features. - It is possible to show the cloud picture of the Sakurajima volcano of the day we wish. - It can compare the weather map and the satellite cloud picture simultaneously with the image of the Sakurajima volcano. - The feature of the weather phenomenon read in an image is shown also as a text. - Easy operation. - Public presentation by a web is possible. We expect that students can perform weather study effectively by using the picture of Mt. Sakurajima, clouds data from satellite, and weather maps.

1. INTRODUCTION

In Japan, The contents of learning from elementary school to upper secondary school are decided in the course of study notified by MEXT - Ministry of Education, Culture, Sports, Science and Technology -.

"The weather and its change" are included in the second field of lower secondary school science, and are taught at the second grade. Objectives of science teacher are to make students realize the regularity of weather changes through meteorological observations and measurements, and on the basis of this knowledge, to strengthen students' recognition of their mechanism and regularity.

Moreover, in both lower and upper secondary school science, the positive application of computer communication network is called for in information retrieval, data processing, and experimental measurement.

1.1 Previous Research in Japan

Japan Society of Earth Science Education is one of the central societies of Japan which is performing activity from 1948 about earth science education. Many researches of weather education have been done since inauguration, and the proposal to the weather teaching materials using satellite images is reported from 1975 (e.g. Yamada, 1975a, 1975b, Kitamura et al., 1982, and Urano et al., 1983). They use the images from NOAA launched in the U.S. since 1970, and HIMAWARI launched in Japan since 1977. On the other hand, computer use in weather teaching materials also started with the spread of the personal computers from the 1980s (e.g. Urano et al., 1984, 1989).

With extension of the Internet, researches using the cloud picture taken from the Internet resources and live cameras are reported (Sakakibara, 1995, Misaki, 1996).

Matsumoto and Tsubota (1997) developed the teaching materials which connected the web camera images at several places in Japanese, and the satellite cloud picture. The satellite

is taking the cloud picture from the space. Therefore, some motions of clouds become the reverse of ground observation, and the students who get confused may exist. By combining the cloud picture of satellite and ground observation with a camera, students would be able to understand a motion of clouds in tree-dimension. Ikemoto and Sakakibara (2000) developed the teaching materials which learn a distribution and form of clouds using the satellite picture which can be obtained by the Internet. Nakazawa and Sakakibara (2003) report the digital pictorial book of clouds, and make public on the Web. Moreover, Nakagawa et al (2004) tries to integrate the live camera network which observes clouds, satellite cloud pictures, and weather bulletin pictures, such as a weather map, and is achieving success.

All aim at attaining the target of weather study by combining the weather bulletin from a satellite with a familiar weather phenomenon. In every research, an important element is the necessity for accumulation of the continued observation data.

1.2 Sakurajima Volcano

Sakurajima is an isolated volcanic mountain in the Kagoshima bay, and it is in the south of the Aira caldera formed after blowing off the Ito pyroclastic flows about 25,000 years ago. In recent years, the crater of the south-side summit, 1040m above sea level, erupted in October 1955, and it is continuing eruption activities till today. This volcano is located in about 10km east from the down town of Kagoshima-shi.

Since Sakurajima is an isolated volcano, the clouds produced near the summit, ash or vaporous plumes flow are greatly influenced by surrounding weather conditions (Kinoshita et al., 2003a, 2003b, Tsuchida et al., 2003).

Therefore clouds production, motions, and plumes flow will show surrounding weather conditions, e.g., frontal passage, change of atmospheric pressure, change of the upper winds, and so on. Sakurajima can be called a vary big anemometer in nature.

2. CONSTRUCTION OF ING IMAGE INTEGRATED DATABASE FOR WEATHER STUDY

As in the preceding section, Sakurajima gives us the interesting knowledge about relevance not only with a volcanic eruption phenomenon but a weather factor. Then, we projected to develop weather teaching materials using the information that we would get from Sakurajima. For the student who lives in Kagoshima, Sakurajima is familiar existence. And student would often see clouds and plumes of Sakurajima with TV news and a weather forecast, nevertheless it is hard for a student to notice the effect of weather phenomenon on this. It is outside the course of study for lower secondary school that students learn about relationship between clouds of Sakurajima and weather phenomena. However, by introducing such phenomena of Sakurajima, the Kagoshima residents' symbol, we expect students to keep the interest about weather phenomena after science classes.

2.1 Continuous Observation of Mt. Sakurajima

Sakurajima is one of the volcanoes that the Kagoshima University Volcanic Cloud Research Group is holding continuous monitoring from the ground and satellite. Since December 2000, we are continuing observation of Sakurajima with a video camera (SONY 1/3" 380,000 pixels CCD video camera SSC-DC430, CANON video lens: $f=6.5\text{mm}-65\text{mm}$) (Figure 1). This camera system is shown in Figure 2. Video inputs are captured for making a still image (640 x 480 pixels) from 5:00 to 20:00 JST in every 5 minutes by the web-camera software (ListCam, <http://www.clavis.ne.jp/>), and stored in HDD of a web-server.

This web-server's URL is <http://voley.e.kagoshima-u.ac.jp/>. In April 2006, amount of still images accumulated at the server is about 20GB. It is about 30KB-120KB/picture, and about 20MB/day.



Figure 1. Sakurajima observation camera installed in faculty of education, Kagoshima univ.

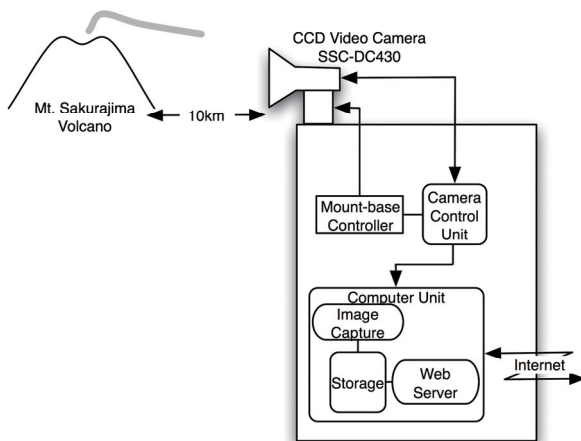


Figure 2. System diagram of Sakurajima web camera

2.2 Transformation Still Images to Quick Time Movie

The Sakurajima picture accumulated at the server is a still picture. We can access these still pictures through the Internet. By saving as still picture data in every 5 minutes, HDD capacity required for preservation can be made small. Moreover, we can carry out advanced analyses using these still images, e.g., height measurement and structure observation of plumes and clouds.

However, as introductory teaching materials to a weather phenomenon, it is hard to evoke interests of lower secondary school student using still pictures only. A motion is required for the image to be used. Then, we planned to change the archived still picture data into a video data.

Still picture data is named as a sequential file-name which consists of a photography date and time. And it is saved in the holder newly created day by day.

In this research, we transformed these still pictures to a movie file for each holder using the QuickTime©, Apple inc. The Quantity of one movie per day is about 2.5MB, 6 frame/s.

Now, we have finished converting Sakurajima pictures, taken in 2000 and 2001, into movie files. We can observe comparing those movies with satellite cloud pictures and weather maps.

There are also days that we couldn't get images because of the down of networks, a server, or power supply, and so on (APPENDIX).

2.3 Selecting Database Management System and Frame Structure

In this research, it is necessary that we should construct the database to integrate a lot of Sakurajima movies, satellite cloud pictures, and weather maps. Furthermore, we consider that school science teacher participate in our research for construction and improvement of this database in the future. Therefore, the database management system is demanded the following features.

- Movie data can be treated.
- A novice of a database can also build easily.
- Database field can be created and added easily.
- Database has the relational function for reduction of single file size, and an easy improvement of it.
- The correction and distribution are possible though the Internet.

We chose FileMakerPro6©, FileMaker Inc., that satisfied these matters.

As users will be able to gain easy and quickly accesses to data that they wish, this database has frame structure as shown in Figure 3.

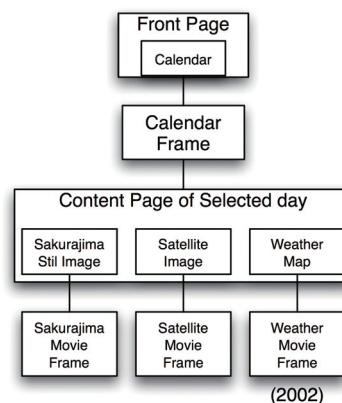


Figure 3. Frame structure of data base

2.4 Operational Images

The step of choosing data from a database is as follows.

1. Select a year you wish to see on a front page.
2. Click a day to see in calendar form.
3. If a contents page comes out and you click the Sakurajima picture, the Sakurajima movie frame of the day will be shown.
4. Moreover, you click a satellite cloud picture on a content page, the movie frame of a NIR cloud image is presented.

In the content page of 2002, we can also see the motion picture of weather maps.

A satellite cloud picture is allowed to use this database from the Sendai science museum. We have transformed these pictures to the motion image (2 frame/s).

This URL of The Sendai science museum is <http://www.kagakukan.sendai-c.ed.jp/himawari/index.html/>. Moreover, the weather map in 2001 has been obtained permission to use from the windsurfing weather bulletin (wivon - <http://www.wivon.com/tenkizu.htm/>.)

The weather map of 2002 has been permitted by the Kanagawa labour union of mountains (<http://k-rouzan.net/main.html/>). These weather maps are saved in every 3 hours at their server. We have made motion images from those still pictures with 1 frame per second.



Figure 4. Front Page

If you wish to select events in 2001, click a calendar of 2001.



Figure 5. Calendar frame for selecting a day

This case shows that January 5th is chosen.

You will be able to select another day or month.



Figure 6. Content page include Sakurajima image, a satellite image and a weather map

If you wish to see a Sakurajima movie, click Sakurajima picture.

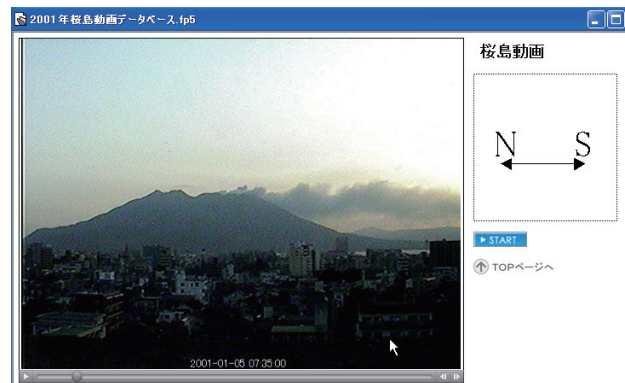


Figure 7. Open new frame for showing a Sakurajima movie.

Click Sakurajima image to show a movie

(Left side of this image is north, and right side is south.)

QuickTime[®] C₂
 TIFFAiatkC*CuA1ELEEvEcEOEaEa
 C™C=CÆEsENE EEC%#@CECZC/C...ÇOKovC-ÇiAB

Figure 8. Click satellite image to show a NIR clouds movie

3. FUTURE TASKS

In order to develop this database furthermore, we need to do the following work.

- To develop the system for gathering weather maps automatically from JWA web site.
- To construct the system for generating motion images automatically from the archive of Sakurajima still pictures.
- To try local web publication by using the web companion tool plugged in FileMakerPro6.
- To inquire some teaching methods for using effectively in lower secondary school science.

REFERENCES

Ikemoto, H., Sakakibara, Y., 2000. Learning about the Weather in Four Seasons with the Internet and a Cloud Distribution Model Made of Cotton. *Educat. Earth Sci.*, 53(1), pp.1-7.

Kinoshita, K., Kanagaki, C., Tupper, A., Iino, N., 2003a. Observation and Analysis of Plumes and Gas from Volcanic Island in Japan. Proc. of PHYSMOD2003, pp.78-83.

Kinoshita, K., Kanagaki, C., Minaka, A., Tsuchida, S., Matsui, T., Tupper, A., Yakiwara, H., Iino, N., 2003b. Ground and Satellite Monitoring of Volcanic Aerosols in Visible and Infrared Bands. Proc. CERES Int. Symp. Remote Sensing - Monitoring of Environmental Change in Asia. pp.187-196.

Kitamura, S., Higashida, S., Aoki, H., 1982. Development of the Curriculum used the Pictures of the Weather Satellite. *Educat. Earth Sci.*, 35(1), pp.1-7.

Matsumoto, N., Tsubota, Y., 1997. A Studying the Weather via the Internet -Weather Watching in Real Time with Live-Cameras -. *Educat. Earth Sci.*, 50(2), pp.37-43.

Matsumoto, N., Takahashi, N., 1998. Constructing the Internet Live Camera. *Educat. Earth Sci.*, 51(1), pp.41-45.

Misaki, T., 1996. Basic Research Concerning Observation of HIMAWARI's Cloud Image of Internet which can be Retrieved. *Educat. Earth Sci.*, 49(4), pp.123-130.

Nakagawa, K., Sakakibara, Y., Shimoyama, N., Itaba, T., Nakazawa, Y., 2004. Supplemental Deployment of the Existing Live Weather & Sky Camera Network and Development of an Auto-Recorder and Viewer of Internet Weather Data. *Educat. Earth Sci.*, 57(3), pp.69-83.

Nakazawa, Y., Sakakibara, Y., 2003. Development of a Digital Picture Book about Cloud for Beginning Learners. *Educat. Earth Sci.*, 56(1), pp.47-57.

Sakakibara, Y., 1995. The Educational Use of GMS Cloud Image and the Evaluation of the Media by which it is obtained. *Educat. Earth Sci.*, 48(1), pp.25-30.

Tsuchida, S., Kinoshita, K., Kanagaki, C., 2004. Teaching Material of Clouds with Time-laps NIR Images. Report of Sci. Educat. Japan., 19(2), pp.43-46

Urano, H., Nagoshi, T., Suzuyama, H., Shimanuki, A., 1983. Development of the Curriculum Using Geostationary

Meteorological Satellite Pictures for Study of the Tendency of Cloud clusters. *Educat. Earth Sci.*, 36(4), pp.169-178.

Urano, H., H., Shimanuki, A., 1984. Teaching materials using Stereographical weather map for Meteorological education. *Educat. Earth Sci.*, 37(6), pp.163-169.

Urano, H., H., Shimanuki, A., 1989. Development of Personal Computer software Drawing Isobar from Weather Report Data. *Educat. Earth Sci.*, 42(3), pp.95-102.

Yamada, M., 1975a. Educational Material using Remote Sensing. *Educat. Earth Sci.*, 28(6), 31.

Yamada, M., 1975b. NOAA -Meteorological satellite-. *Educat. Earth Sci.*, 28(6), 32.

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APPENDIX

Date	Time (JST)
2001/1/19	8:55-9:10
2001/3/14	12:10-12:25
2001/3/15	9:10-9:50
2001/3/19	12:20-12:30
2001/3/19	15:30, 16:10, 16:15
2001/4/22	8:35-19:00
2001/7/18	4:30-9:00
2001/8/24	4:30-9:30
2001/9/22	9:05-19:50
2001/11/3	all the day
2001/11/4	all the day
2001/11/5	6:00-8:25
2001/12/16	8:35-18:55
2002/1/29	10:40-11:55
2002/1/29	12:05-12:15
2002/1/29	17:25-18:55
2002/7/10	18:15
2002/8/1	7:35-7:40
2002/9/16	5:00-17:50
2002/9/21	9:05-19:50
2002/11/17	15:40
2002/11/18	10:25
2002/12/15	8:35-18:20

Table 1. Date and time without images (2001, 2002)