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Prepared by JMA
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Review of Current Satellite Data Application in view of Climate Monitoring Principles

This document reports the current practice of satellite data handling at JMA to the GCOS (Global Climate Observing System) climate monitoring principles, in response to Action 31.32.

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1 Introduction

GCOS proposed "Climate Monitoring Principles (hereinafter referred to as CMPs)" in CGMS-XXX. After some revision, the proposal was adopted at 14th WMO Congress (May 2003). The CMPs advocates an emphasis of consecutive observations of the earth for climate monitoring with meteorological satellites as long as possible.

JMA has operated a series of geostationary meteorological satellites for more than 25 years since 1977 and has acquired earth image data continuously. The images have been used for climate monitoring as well as weather watch. JMA will continue to operate geostationary satellites, and to provide users with the data obtained from the satellite.

This working paper describes the current activities of JMA with respect to the CMPs preface and article 11 – 20, to which satellite systems for climate monitoring should adhere. (Italics in the following section are quoted from CGMS-XXXI WMO-WP-25.)

2. The GCOS Climate Monitoring Principles and current activities by JMA

(a) Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system; and

(b) Take steps to sample the earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be resolved.

These two items are elaborated in the following ten articles. In particular, refer to articles 14, 15, 18, 20 for item "(a)", article 11 for an observation schedule of item "(b)" and article 16 for a transmission data of item "(b)".

11. Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained.

The observation schedule based on hourly full-disk observations will be maintained. The daily observation of MTSAT-1R, the successor of the GMS-5, is basically comprised of hourly full-disk observations and supplemental northern-hemisphere observations. Every six hours (00, 06, 12, 18 UTC), two northern-hemisphere observations and two southern-hemisphere observations are performed before and after the full-disc observation respectively to obtain three successive 15 minute-interval half-disk images used to derive satellite wind motion vectors.

12. Overlapping observations should be ensured for a period sufficient to determine inter-satellite biases.

JMA makes its best efforts to ensure a period to evaluate the quality of observation data

of a successor satellite prior to the commencement of its operation. However, it is challenging to ensure overlapping observations with MTSAT-1R for a period sufficient to determine inter-satellite biases, judging by present circumstances, i.e. GMS-5 has been operated on the geostationary orbit far beyond its designed lifetime and that the backup of GMS-5 with the GOES-9 in cooperation with NOAA/NESDIS has been carried out.

Comparison between MTSAT-1R and MTSAT-2 may be possible, since the two satellites are planned to be on orbit together for 9 years. However, operational simultaneous observation with the two satellites is not planned, since the ground subsystems in the Meteorological Satellite Center (MSC) will not support multi-satellite operations. Therefore, operational and contiguous comparison is not planned.

13. *Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured.*

JMA has fully recognized the importance of the continuous operation of the space based observations without any interruption. After the launch failure of MTSAT in 1999, JMA settled on a new plan to launch MTSAT-1R as an immediate replacement of MTSAT and to launch a follow-on MTSAT-2. The manufacture of MTSAT-1R, the successor to GMS-5, was completed, and the construction of MTSAT-2 has been progressing satisfactorily. Please refer to JMA-WP-03 for more information about the plan on MTSAT. Meanwhile, NOAA/NESDIS and JMA have been jointly making cooperation to implement the back-up operation of GMS-5 with GOES-9 over the western Pacific.

14. *Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national meteorology institute, should be ensured.*

JMA has examined ground-based calibration for the sensors onboard GMS satellites. The calibration was examined to meet requirements sufficiently. JMA has examined ground-based calibration for MTSAT-1R and will examine those for MTSAT.

15. *On-board calibration adequate for climate system observations should be ensured and associated instrument characteristics monitored.*

GMS-5 has an on-board calibration system for the infrared channels with absolute accuracy of about 1K. MTSAT-1R and MTSAT-2 will also have on-board calibration system for infrared channels with the same accuracy of GMS-5.

16. *Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate.*

JMA has processed GMS-5 images statistically and provided products to ISCCP and

GPCP. Since GOES-9 took over the observation on the Asia-Pacific area, JMA has been providing data based on GOES-9 images. After the launch of MTSAT-1R, JMA plans to provide the data successively and implement them by using the images of the additional channel of MTSAT-1R as well as conventional channels.

In January 2004, JMA commenced generating the product of aerosol optical thickness routinely. The aerosol product is based on GOES-9 visible channel 1 images and is planned to be provided for MTSAT-1R continuously.

Additionally, JMA re-computed the AMVs to response to the request of the Japanese re-analysis project called "JRA-25 (Japanese Re-Analysis 25)." The details of the AMV re-computation can be found in CGMS-XXX JPN-WP-16.

17. Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed-mode analysis, should be established and maintained.

Currently, images observed by the geostationary satellites are saved in DVD media, which are maintained in off-line. After the replacement of the computer system of MSC planned in March 2005, all images as well as the satellite products will be copied to a tape library system and available to be accessed on-line for internal use only.

18. Use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when these exist on de-commissioned satellites.

JMA has recognized the importance of the continuous operation of the space based observations and the importance of a long-term evaluation of the sensor characteristics. JMA has been made its best efforts to keep satellites on orbit as long as possible.

19. Complementary in-situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation.

JMA has collaborated and implemented various *in-situ* observations including ground surface, upper-air and ocean in close coordination and cooperation with international project (WCP, GCOS, GOOS, and so on) in order to contribute to approaches for climate monitoring.

20. Random errors and time-dependent biases in satellite observations and derived products should be identified.

JMA has evaluated the products derived from satellite observation data in comparison with in-situ baseline observations. Moreover, AMV product is monitored in conjunction with an output from NWP.