WORLD METEOROLOGICAL ORGANIZATION

REGIONAL ASSOCIATION II (ASIA)

WORKING GROUP ON PLANNING AND IMPLEMENTATION OF THE WWW IN REGION II
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STATUS OF THE WWW IMPLEMENTATION AND OPERATIONS

Regional Aspects of the GOS – Space-based Subsystem

(*Submitted by the Secretariat)*

SUMMARY AND PURPOSE OF DOCUMENT

This document provides summary information on the space-based components of the GOS in RA II.

ACTION PROPOSED

The group is invited to take note of the information provided.

Appendices: None

REGIONAL ASPECTS OF THE GOS – SPACE-BASED SUBSYSTEM

1. Components of the current space-based Global Observing system relevant to RA II are described in this document. It is not practical to describe all satellites and the functions of all payload instruments in detail as this would render the document excessively long, therefore brief details are provided here and the session is encouraged to follow the web links embedded in the text to discover further details to the level required.

Geostationary satellite coverage

2. Due to the geographical nature of RA II, the region is observed by several geostationary satellites and parts of the region lie in the field-of-view of more than one satellite.

3. The nominal global configuration of operational geostationary satellites, as agreed by the members of the Coordination Group for Meteorological Satellites (CGMS), includes 6 spacecraft to ensure full coverage from 50°S to 50°N with a spacecraft zenith angle less than 70° and is shown in Figure 1.

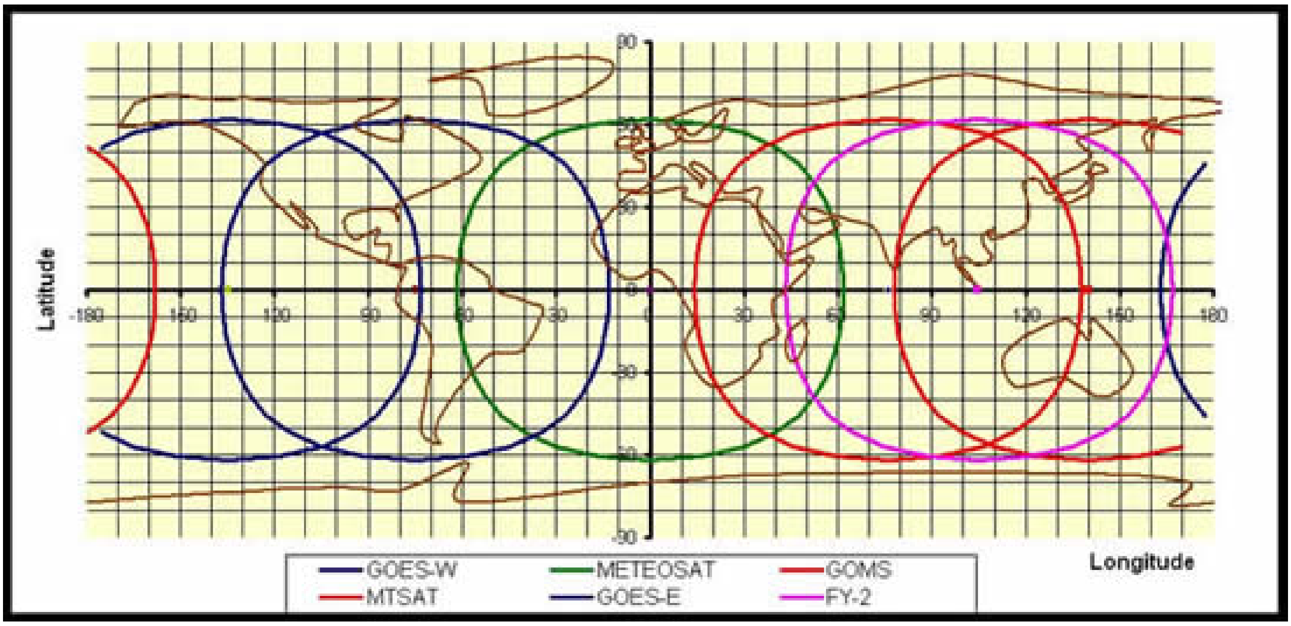

Figure 1. The nominal configuration of operational geostationary satellites

4. The current unserviceability of the GOMS satellite at 76°E is partly compensated for by the temporary operation by EUMETSAT of Meteosat-7 located at 57.5°E under the so-called Indian Ocean Data Coverage (IODC) service. It should be noted that the continuation of this service beyond the end of 2008 is not yet confirmed and is the subject of ongoing discussions by EUMETSAT Members and others in response to the strong requirement for continued coverage of this area expressed by WMO Members at Cg-XV.

5. In addition to the nominal configuration shown in Figure 1, parts of RA II are observed by two further geostationary satellites operated by India Meteorological Department (IMD), namely Kalpana-1 and INSAT-3A.

6. The CGMS members regularly exchange information on the latest status of geostationary satellite operations and the WMO Space Programme maintains web pages with the most up-to-date information available (including current and future geostationary, low-earth orbit and R&D satellites). The web pages may be viewed at:
http://www.wmo.int/pages/prog/sat/GOSgeo.html (geostationary satellites)
http://www.wmo.ch/pages/prog/sat/GOSleo.html (low-earth orbit satellites)
http://www.wmo.ch/pages/prog/sat/GOSresearch.html (research & development satellites)

7. Several of the operating agencies of the geostationary satellites also have dedicated data processing centres which routinely generate level 2 geophysical products, for example Atmospheric Motion Vectors (AMV) which are valuable observations for use with Numerical Weather Prediction (NWP), and disseminate these products via the GTS and via other means.

8. Brief descriptions of all of the geostationary meteorological satellites that observe RA II (listed from east to west) are presented in the following sections.

9. More detailed information on most of the satellites along with their associated data, products and services are available from the web sites of the respective operational space agencies. In addition, a more comprehensive description of the global space-based component of the GOS, as it was defined in the lead-up to CGMS-34 in autumn 2006, may be found on the WMO Space Programme web pages at:
http://www.wmo.ch/pages/prog/sat/documents/SAT-TG-09_v-CGMS-34-WMO-WP-25.pdf

MTSAT-1R

10. MTSAT-1R is the currently operational geostationary satellite of the Japan Meteorological Agency (JMA) and is located at longitude 140°E. MTSAT-1R was launched on 26 February 2005 and carries a payload including a 5-channel imager.

11. The 5-channel imager has 4 channels centred on infrared (IR) frequencies (including a water vapour (WV) absorption channel) and 1 channel in the visible (VIS) spectral range. The spatial resolution is 4 km at nadir for the IR channels and 1 km for the VIS channel.

FY-2C

12. FY-2C is the currently operational geostationary satellite of the China Meteorological Agency (CMA) and is located at longitude 105°E. FY-2C was launched on 19 October 2004 and carries a payload including the Visible and Infrared Spin Scan Radiometer (VISSR) and the Space Environment Monitor (SEM) instruments.

13. VISSR is a 5-channel radiometer with 4 channels centred on infrared (IR) frequencies (including a water vapour (WV) absorption channel) and 1 channel in the visible (VIS) spectral range. The spatial resolution is 5 km at nadir for the IR channels and 1.25 km for the VIS channel.

14. SEM is a space particle and x-ray monitoring instrument used for gathering information about the environmental conditions at geostationary orbital altitude.

INSAT-3A

15. INSAT-3A, launched in April 2003, is currently located at longitude 93.5°E. The satellite is a multi-purpose platform catering the needs of television and radio broadcasting and communications as well as meteorology.

16. The INSAT-3A payload includes a 3-channel radiometer (IR, WV and VIS channels) and a CCD camera.

Kalpana-1

17. Kalpana-1 was launched in September 2002. It is a dedicated meteorological satellite whose payload includes a 3-channel radiometer similar in performance to that of INSAT-3A. Kalpana-1 is positioned at longitude 74°E.

Meteosat-7

18. As mentioned above, EUMETSAT positioned Meteosat-7 at 57.5°E towards the end of 2006 to take over the Indian Ocean Data Coverage (IODC) service from Meteosat-5 which was de-orbited from its previous position at 63°E in April 2007.

19. The payload of Meteosat-7 includes a 3-channel radiometer (IS, WV and VIS) with a spatial resolution of 5 km at nadir for the IR and WV channels and 2.5 km for the VIS channel.

20. A Data Collection Platform (DCP) service has been activated within the IODC mission in support of a Tsunami warning systems. In support of this activity Meteosat-6 has also been manoeuvred to a position over the Indian Ocean. This is to ensure continuity of collection and retransmission of DCP information during the time when Meteosat-7 is operated in eclipse mode (around local midnight either side of the NH spring and autumn equinox).

Meteosat-9

21. The extreme SW part of RA II lies within the field-of-view of Meteosat at its primary location of 0 degrees longitude. This service is currently being provided by EUMETSAT using the Meteosat-9 satellite.

22. Meteosat-9, launched in December 2005, is the second satellite in the Meteosat Second Generation (MSG) series and its payload includes SEVIRI, an advanced 12-channel radiometer. SEVIRI has 3 VIS channels (including a High Resolution Visible (HRV) channel), one near-IR (NIR) channel and 8 IR channels including two channels at WV absorption frequencies, one in the CO_2 absorption band and one in the Ozone absorption band.

23. The SEVIRI instrument completes a full earth scan every 15 minutes and has a horizontal resolution of 3 km at nadir for eleven of the channels and 1 km for HRV.

Low-earth orbit satellite coverage

24. A number of operational meteorological low-earth orbit (LEO) satellites currently observe the global earth / atmosphere system. The current operational satellites are briefly described in the following sections, but it should be noted, however, that it is common practice for satellite operators to use backup or spare vehicles, which are sometimes only partly functionally, in a quasi-operational mode. The full list may be found via the links in paragraph 6 above.

NOAA-18

25. NOAA-18 (designated NOAA-N prior to launch) was launched in May 2005. It is in sun-synchronous orbit with an Equator Crossing Time (ECT) around 13:55 and, as such, it fills the afternoon position in the collaborative effort between EUMETSAT and NOAA known as the Initial Joint Polar System (IJPS).

26. The NOAA-18 payload instruments include: AVHRR/3, HIRS/4, AMSU-A, MHS, SBUV and SEM. More details about all of these instruments may be found in the NOAA-KLM User Guide (with NOAA-N / N' supplement) at:
http://www2.ncdc.noaa.gov/docs/klm/index.htm

FY-1D

27. FY-1D was launched by CMA in May 2002 and has already exceeded its life expectancy although it continues to function well. It is in a sun-synchronous orbit which has an early morning ECT of around 06:50.

28. FY-1D carries a payload which includes a 10-channel visible and infrared scan radiometer (MVISR) as well as a SEM instrument.

29. The next generation of CMA low-earth orbiting satellites, starting with FY-3A, carrying a much enhanced instrument payload are due to be launched in the near future.

Metop-A

30. Metop-A, Europe's first meteorological LEO satellite, was launched in October 2006 and has recently been declared operational. It is in sun-synchronous orbit with an ECT around 09:30 and, as such, it fills the morning position in the IJPS.

31. The Metop-A payload includes a mix of heritage instruments, originally developed and flown on the NOAA satellite series, plus some novel instruments developed in Europe specifically for the Metop missions. The instruments include: AVHRR/3, HIRS/4, AMSU-A, MHS, IASI, ASCAT, GRAS, GOME-2 and SEM. More details about all of these instruments may be found on the EUMETSAT web site at:
http://www.eumetsat.int/Home/Main/What_We_Do/Satellites/EUMETSAT_Polar_System/Space_Segment

DMSP-F13 and -F16

32. The Defence Meteorological Satellite Program (DMSP) series of low-earth orbit satellites provide an important source of data, especially for NWP applications. Being classified as military spacecraft access to data and products is restricted and normally arranged through bilateral agreements with NOAA.

33. The satellites fly in sun-synchronous orbits and currently DMSP-F13 has an ECT of around 18:33 and DMSP-F16 around 20:13. Other satellites in the series are also active although some with reduced functionality.

34. Of particular note in recent years has been the significance of the exploitation of data from the Special Sensor Microwave Imager (SSM/I) instrument on DMSP-F13 and -F15 and the successor Special Sensor Microwave Imager/Sounder (SSMIS) instrument on -F16 for the provision of temperature and moisture profile information for NWP models.

Data concentration

Regional ATOVS Retransmission Systems (RARS)

35. In 2002, in response to the requirements of Limited Area NWP modelling over Europe (HIRLAM then ALADIN) whose modelling area exceeded the coverage of a single HRPT station, and whose timeliness constraints were not compatible with the current scheme of global data collection, EUMETSAT initiated the so-called EUMETSAT Advanced Retransmission Service (EARS). By merging the data sets from several HRPT stations EARS enabled the extended coverage and short timeliness requirements of the NWP Operators to be met.

36. In recognition of the very positive impact that EARS data has made to Numerical Weather Prediction, the Co-ordination Group for Meteorological Satellites (CGMS), at its thirty-second session in May 2004, asked whether the system could be expanded into other Northern Hemisphere regions, as well as extended to cover the Southern Hemisphere.

37. Since the initial and most important data type to be gathered (or "concentrated") in this way are ATOVS data, these initiatives are referred to as Regional ATOVS Retransmission Systems (RARS). It should be noted, however that the original EARS system now carries regional data from other instruments such as AVHRR and ASCAT.

38. The EARS system is well established with coverage as shown in Figure 2. Of particular note to countries in RA II is the fact that in recent months an Asia-Pacific version of EARS, the so-called A-P RARS, has started gathering and retransmitting data. The current coverage of the A-P RARS is shown in Figure 3. A similar system covering South America has also been initiated.

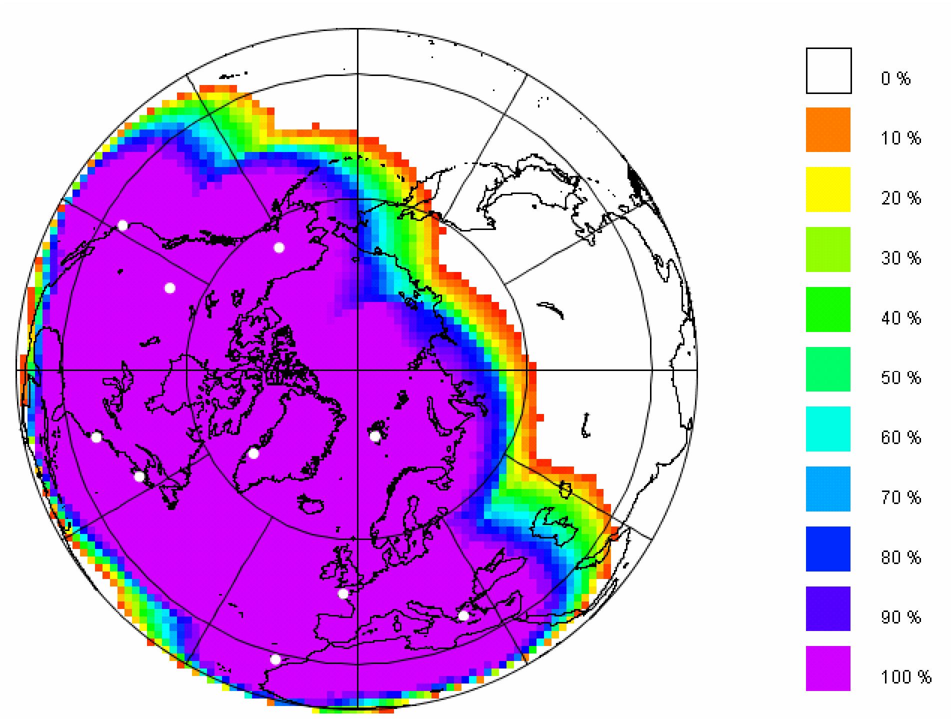

Figure 2. EARS service coverage – HRPT stations are shown as white dots.

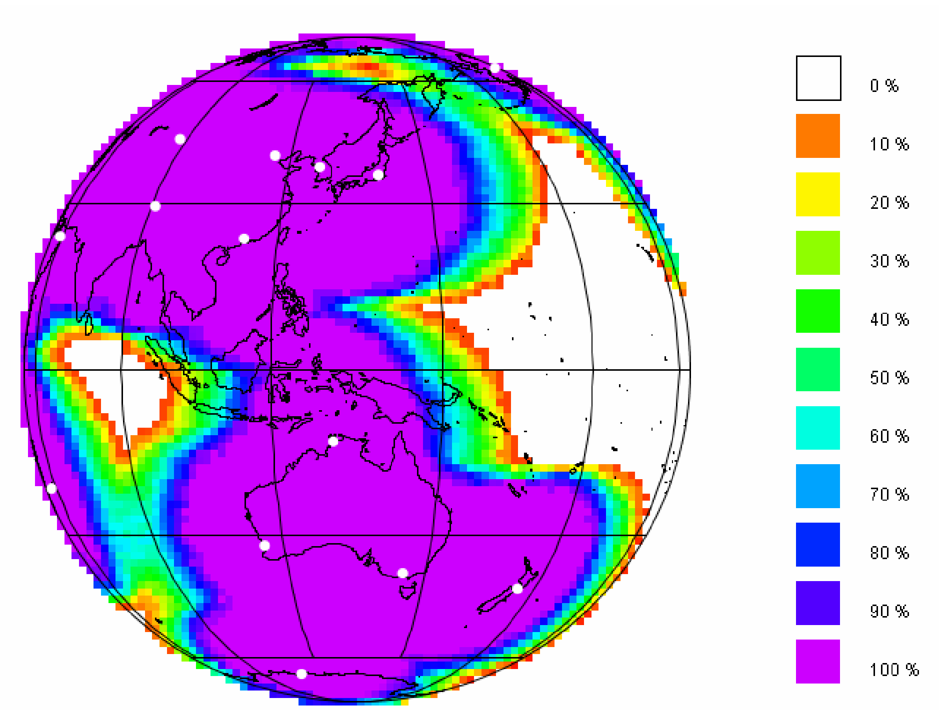

Figure 3. Asia-Pacific RARS service coverage – HRPT stations are shown as white dots.

Data dissemination / access methods

39. The space-based component of the GOS is in a state of almost constant change. New satellite launches occur every year, including the migration to new, more advanced and well-equipped generations of spacecraft. More and more data sets originating from R&D satellites are becoming available in a timely manner as their potential value for operational applications is recognised. In addition data dissemination and access methods are undergoing fundamental changes.

40. In response to the coordinating role of the CGMS, satellite operators are making the transition from methods and formats based on ‘yesterday’s technology’, such as the analogue WEFAX and APT standards, to the introduction of modern, digitally-based methods of data distribution and exchange in accordance with agreed standards. These are necessary to effectively disseminate and exploit the high volume of data that originates from the systems described in the earlier sections of this document.

41. As well as methods which rely on the meteorological satellites themselves to transmit the data to end-users via direct reception there is an increasing trend to use advanced dissemination methods (ADM) including the use of Digital Video Broadcast by Satellite (DVB-S) technology to deliver satellite data to the widest possible audience.

Direct reception

42. For low-earth orbiting satellites direct reception from the satellite is possible while it is passing over the reception station (usually above an elevation of about 5°). The exceptions to this are the DMSP satellites as described above. Tracking reception systems based on the HRPT/LRPT standards are required to receive the data. Full orbit data, dumped for direct reception by dedicated reception systems in polar regions, are collected by the satellite operator and made available either via bilateral agreements using dedicated communication means or via ADMs – see also the ADM section below.

43. For the geostationary satellites described above direct reception is generally possible by suitably equipped and authorised users in the field-of-view of the satellite. In general the transition to use of the CGMS-approved LRIT/HRIT standard is well underway (e.g. for MTSAT-1R, FY-2C, Meteosat-9) whereas for Meteosat-7 the HRI standard is still in use and for Kalpana-1 and INSAT-3A a proprietary standard is employed.

Advanced Dissemination Methods (ADM)

44. Three operational ADM systems are operating wholly or partially within RA II. These are described briefly below but further detailed information may be obtained by the various ADM system operators.

45. CMA operate FengYunCast to distribute data from FY-1, FY-2, MTSAT-1R and other satellite data and products to suitably equipped users via a commercial satellite using DVB-S technology. Although primarily intended for users within China, activities are underway to integrate FengYunCast into a global system of systems to increase the data content (by agreeing data exchange procedures with other satellite operators) and widen the user community (see IGDDS section below). The potential coverage of FengYunCast is illustrated in Figure 4.

46. EUMETSAT operate EUMETCast using commercial satellites and DVB-S technology to distribute very large volumes of satellite data. The reception footprint of the components EUMETCast-Europe and EUMETCast-Africa include some western parts of RA II and, in the same way as described above for FengYunCast, EUMETCast forms part of an integrated system, which should eventually achieve almost global coverage, improving the availability of data to a wide range of users. The potential coverage of EUMETCast is illustrated in Figure 4.

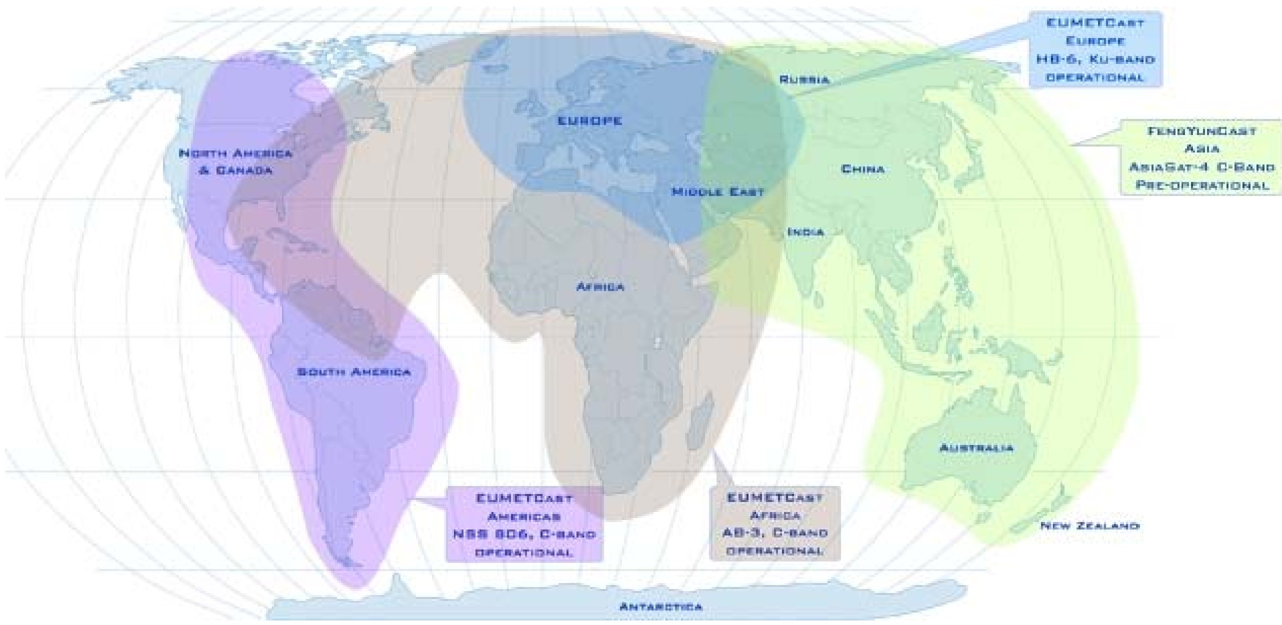

Figure 4. Coverage of the various ADM systems currently in place

47. The Russian MITRA ADM system currently serves users in Russia and neighbouring states and, once again, discussions are underway to investigate whether MITRA might be included in the concept of a global IGDDS system

GTS

48. Many level 2 satellite data, including such products as the derived Atmospheric Motion Vectors (AMV) which are vital for NWP applications, are disseminated via the GTS. Recently, some limited level 1 satellite data have also been distributed via the GTS (e.g. a subset of IASI global data from Metop).

Internet

49. As the Internet accessibility and reliability improves and its available bandwidth steadily increases, opportunities arise to consider the Internet for operational (or backup) satellite data dissemination means. Within RA II, JMA are already distributing limited data from MTSAT-1R using this method.

Integrated Global Data Dissemination System (IGDDS)

50. In recognition of the potential for maximising the effectiveness of the various individual satellite data dissemination systems that already exist or are planned a concept of a global integrated system of systems, based on the principles of the WMO WIS, has been defined. The so-called Integrated Global Data Dissemination System (IGDDS) brings together satellite operators to implement an inter-connected system, with global and regional components, that link ADMs, the GTS and the Internet to maximise the timely distribution and exchange of satellite data to meet the requirements of the WMO user community.

51. This ambitious project, originally based on the experiences gained by the operation of three EUMETCast components in an integrated way, is already well underway.

52. One important aspect of IGDDS is to put in place mechanisms to ensure that regional requirements are captured and addressed. The various ADMs each have a regional footprint and, whereas these footprints do not generally coincide with WMO RA boundaries, it is thought

important to engage the WMO regional entities in the question of defining regional requirements for IGDDS. A separate paper is submitted to this session of the RA II WG-PIW addressing precisely this question.