CGMS-43 WMO-WP-04
13 May 2015

Prepared by WMO
Agenda Item: D.4
Discussed in WGIII/2.3 and
Plenary

Satellite data user needs in the Indian Ocean region
In response to CGMS Action/Recommendation: WG III A42.01
HLPP reference: 1.1.6

To inform the discussion on satellite data coverage services over the Indian Ocean region, WMO carried out in February/March 2015 a survey among key users of satellite data. Responses from eleven countries were received, regarding baseline requirements for satellite data (L1 and L2) needed for routine operations, and additional requirements in case of an emergency or a severe event.

Key conclusions from the survey are that (i) requirements are dominated by the need to monitor and forecast tropical cyclones; (ii) requirements are not limited to the need for observing the Indian Ocean but also address land applications, such as fire detection; (iii) some redundancy in satellite coverage of the region is needed; (iv) according to the majority of responses, the required baseline repeat cycle for GEO imagery over the region is 30 minutes; (v) GEO has higher importance in case of emergencies or severe events due to its higher repeat cycle; most users require additional GEO imagery in such cases, with the majority requiring rapid-scan imagery every 10 minutes or less, (vi) several users expressed a requirement for GEO lightning products (both as baseline and as additional requirement).

The requirements identified in the survey have not yet been validated by the broad user community in the Indian Ocean region, nor matched against existing or planned capabilities. Further refinement and consolidation of the requirements needs to be discussed.

Action/Recommendation proposed:

- CGMS members to take into account the user requirements identified in the WMO survey when discussing continuous satellite coverage over the Indian Ocean region.

- WMO to validate and consolidate the preliminary user requirements for satellite data in the Indian Ocean region with major user groups and stakeholders in the region, and to report on results to CGMS-44.

Satellite data user needs in the Indian Ocean region

1   INTRODUCTION

To assist in securing meteorological satellite coverage over the Indian Ocean region, WMO carried out a user survey among key users to learn more about their detailed needs for satellite datasets and products.

WMO thereby contributes to an action (42.01, WG III) by the Coordination Group on Meteorological Satellites (CGMS) which is investigating options for continuing satellite coverage of the area in response to user requirements, in light of the planned de-commissioning of the EUMETSAT Meteosat-7 geostationary satellite in 2016.

In the survey, users were asked for details on their satellite data needs (both at L1 (e.g., soundings, basic imagery) and L2 (products). Users were requested to make a distinction between satellite data required as baseline for regular operations, and requirements for additional datasets required in case of an emergency or severe weather event, for example from enhanced satellite operations (questionnaire in Appendix 2).

The survey was undertaken by email between 23 February and 30 March 2015, and addressed to the WMO RA I Dissemination Expert Group (RAIDEG), the RA II WIGOS Satellite Project Coordination Group, the RA V Task Team on Satellite Utilization, the Australian Bureau of Meteorology, BMKG Indonesia, the IMD Satellite Meteorology Division, the Oman Department of Meteorology / VLab Centre of Excellence, the VLab Centre of Excellence in the Russian Federation, and the Regional Specialized Meteorological Centre - Tropical Cyclones (RSMC-TC) La Réunion.

Responses from 11 countries were received:

Country	Contact
Australia	Agnes Lane, Andrew Burton (Western Australian Bureau, Australian Bureau of Meteorology)
Hong Kong	CK So (Hong Kong Observatory)
Indonesia	Roro Purwanti, Riris Adryianto (BMKG)
India	RP Sharma (IMD Cyclone Warning Division)
Mauritius	Ram Dhurmea (Mauritius Meteorological Service)
Myanmar	Ms. Khin Cho Cho Shein (Director Met Division, NMS Myanmar)
Oman	Mahmood AL-KHAYARI (Oman Meteorological Department)
Pakistan	Muhammad Aslam (Pakistan Meteorological Department)
Thailand	Phanumat Lewcharoenthrap (Ms) (Thai Meteorological Department)
Sri Lanka	Lalith Chandrapala (DG of Meteorology, Dept of Meteorology, Sri Lanka)
Viet Nam	Nguyen Vinh Thu (National Meteorological and Hydrological Service, Viet Nam)

2   RESULTS

The results from the survey are summarized in the following, and distinguished by baseline and special (additional) requirements in case of an emergency or severe event. When users gave a range of values in their response (e.g., "repeat cycle 2-10 minutes"), the more stringent requirement has been taken for the analysis here. Tables 1 and 2 in Appendix 1 provide a summary, along with supplementary qualitative information.

2.1   Baseline requirements

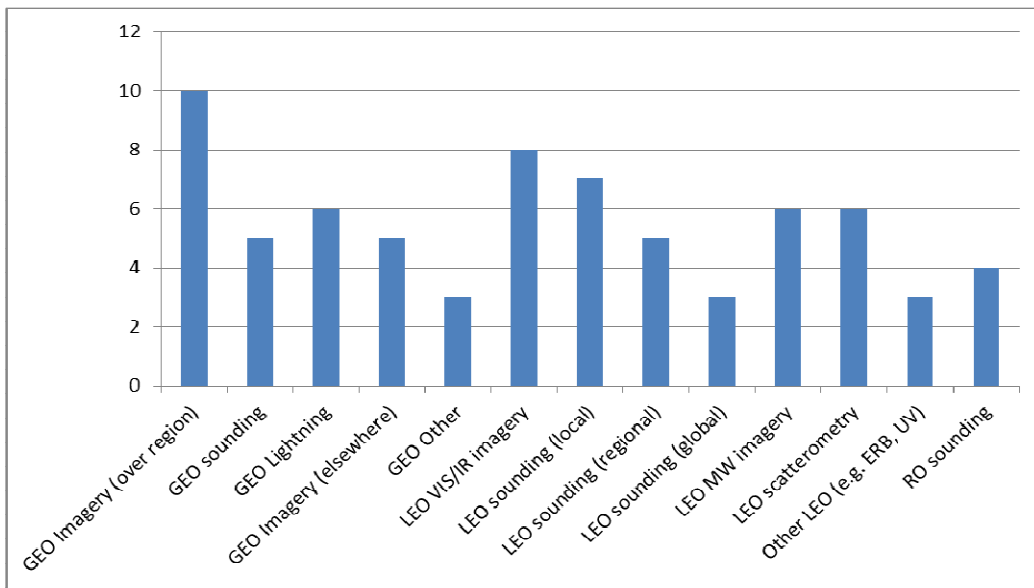*Fig. 1: Baseline requirements for Level 1 data (number of responses)*

Fig. 2: Baseline requirements for GEO Imagery repeat cycle (number of responses)
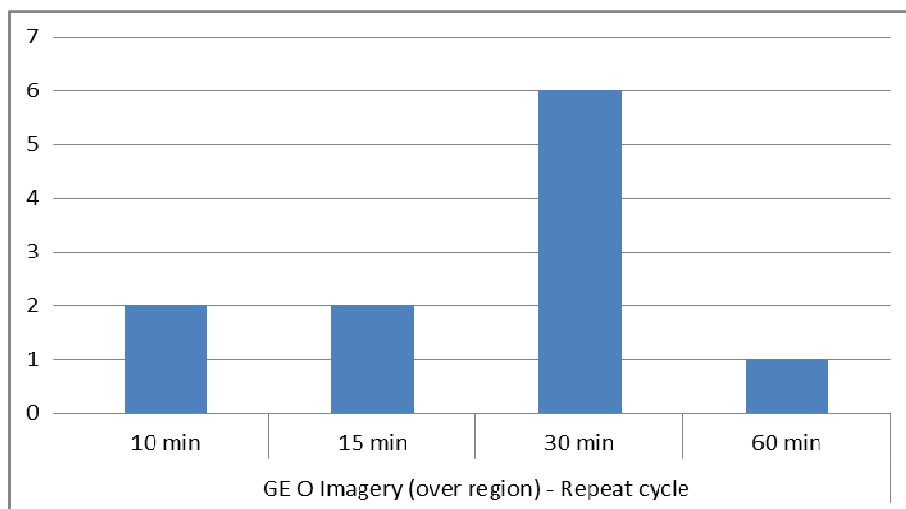
Fig. 3: Baseline requirements for Level 2 products (number of responses)
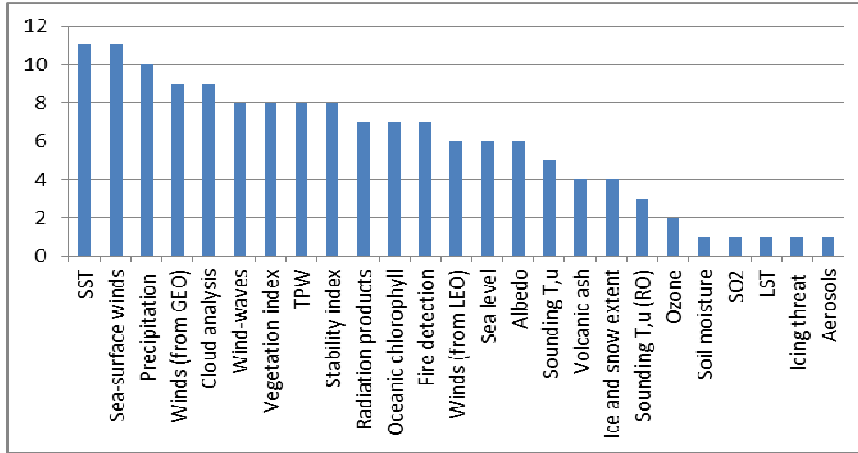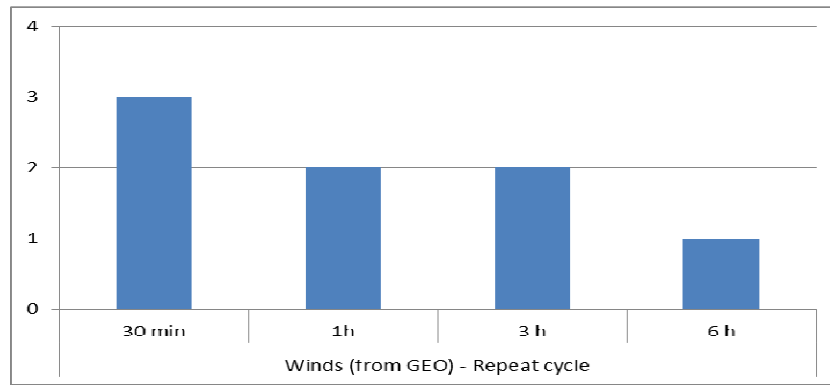

Fig. 4: Baseline requirements for repeat cycle of Winds from GEO (number of responses)

2.2   Additional requirements in case of emergency or severe event

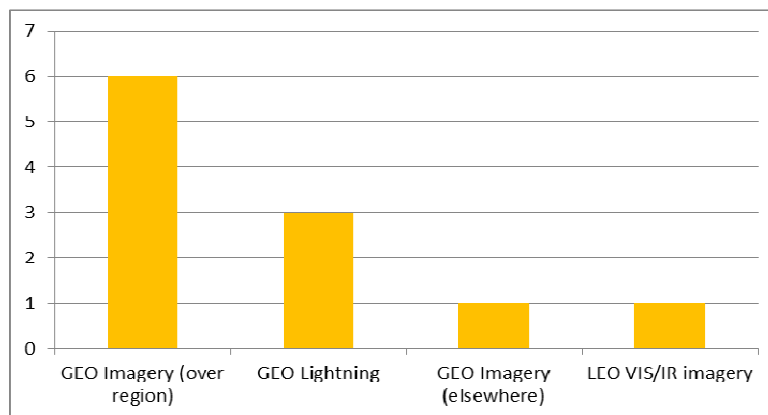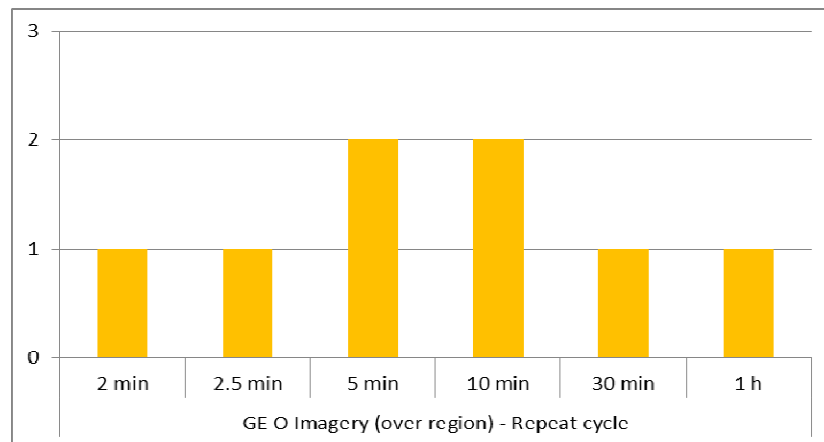*Fig. 5: Additional requirements for Level 1 Data (number of responses)*

Fig. 6: Additional requirements for repeat cycle of (Rapid Scan) GEO Imagery (number of responses)

2.3 Analysis

Some conclusions from the survey:

i.   Requirements are dominated by the need to monitor and forecast tropical cyclones;

ii. Requirements are not limited to the need for observing the Indian Ocean area itself; many users rely on satellites for important land applications, such as by using vegetation indices, fire detection, sea level, and precipitation products;

iii. Users rely on both GEO and LEO L1 data in their baseline operations, and several use GEO imagery not only over the region, but from elsewhere; some redundancy in satellite coverage seems therefore needed;

iv. According to the majority of responses, the required baseline repeat cycle for GEO imagery over the region is 30 minutes;

v.   According to the majority of responses, the required baseline repeat cycle for winds derived from GEO imagery is 30 minutes;

vi. GEO has higher importance in case of emergencies or severe events due to its higher repeat cycle; most users require additional GEO imagery in such cases: desired rapid scan repeat cycles range from 2 minutes to 1 hour, with the majority requiring rapid-scan imagery every 10 minutes or less;

vii. Several users expressed a requirement for GEO lightning products (both as baseline and as additional requirement).

It should be stressed that the requirements identified in this paper have not been validated and consolidated by all users in the Indian Ocean region, or matched against existing or planned capabilities. Further action may be required in this regard.

3   ACTIONS AND/OR RECOMMENDATIONS FOR CONSIDERATION BY CGMS PLENARY

- CGMS members to take into account the user requirements identified in the WMO survey when discussing continuous satellite coverage over the Indian Ocean region.

- WMO to validate and consolidate the preliminary user requirements for satellite data in the Indian Ocean region with major user groups and stakeholders in the region, and to report on results to CGMS-44.

APPENDIX 1: SUMMARY OF REQUIREMENTS

Table 1: Summary of requirements for Level 1 satellite data over the Indian Ocean Region

Type of data and source	Baseline requirement		Additional requirement (e.g., in case of emergency)	
	Type of data	Repeat cycle; Timeliness[1]	**Type of data**	Repeat cycle; Timeliness
GEO imagery over the Region	VIS, NIR, IR, WV RGB composites (microphysics, airmass, convective storm, snow-fog, natural colours)	10 min; 15 min (5 min for VIS/IR)	VIS, IR; sometimes used for back-up	2 min; <15 min
GEO sounding channels over the Region	Input to NWP	30 min; 30 min		
GEO lightning data over Region, when available	X	10 min; 15 min	X sometimes used for back-up	6-10 min; 30 min
GEO other instruments when available	X	30 min		
GEO imagery elsewhere	X	30 min	X sometimes used for back-up	1 hour; 30 min
Operational LEO VIS-IR imagery	X	Every pass (30 min?); 15 min	X sometimes used for back-up	1 hour; 30 min
Local operational LEO sounding data	Input to NWP	Every pass (30 min?); 15 min		
Regional operational LEO sounding	Input to NWP	Every pass (30 min?); 30 min		
Global operational LEO sounding	Input to NWP	Every pass; 30 min		

[1] For example: Repeat cycle 1 hour means "update every hour"; Timeliness 30 minutes means "maximum of 30 minutes between time of observation and data availability"

Type of data and source	Baseline requirement		Additional requirement (e.g., in case of emergency)	
	Type of data	Repeat cycle; Timeliness[1]	**Type of data**	Repeat cycle; Timeliness
LEO MW Imagery	X	Every pass; 30 min		
Other LEO data from operational or preoperational instruments (such as Earth radiation, UV)	SNPP VIIRS Day/Night Band Solar irradiance; ERB; O3	Every pass; 20 min		
Scatterometer	Wind vectors and ambiguities	Every pass; 30 min		
Radio-occultation sounding	Input to NWP	3 hourly; 30 min		
R&D instrument data				
Other (please specify)				

Table 2: Generic requirements for derived satellite-based products over the Indian Ocean Region (up to level 2)

Product Categories	Baseline requirement		Additional requirement (e.g., in case of emergency)	
	Type of data	Repeat cycle; Timeliness[2]	**Type of data**	Repeat cycle; Timeliness
Wind vectors (from GEO)	Wind speed and direction; Input NWP and nowcasting	30 min; 30 min	Cyclone intensity estimation	6-10 min; 15 min
Wind vectors (polar)	Input to NWP	30 min; 30 min		
Sea surface winds	Mostly from scatterometry	30 min; 30 min	Mostly from scatterometry	10 min; 30 min
Sounding T,U (radiometric)	Global coverage	30 min; 30 min		
Sounding T,U (radio occultation)	Global coverage	30 min; 30 min		
Cloud analysis	Cloud top properties, type, fog/low cloud, overshooting tops	10 min; 15 min	Regional coverage	30 min; 30 min
Stability index	CAPE; Convective indices, k-index	10 min; 15 min	Regional coverage	(30 min; 30 min)
Total Precipitable Water	Highly valuable for TC analyses	30 min; 30 min	Regional coverage	30 min; 30 min
Precipitation	Rate (24h); Heavy Rainfall Potential; Rainfall probability	30 min to Daily; 30 min	Heavy rainfall in TC season; Regional coverage	30 min; 30 min
SST	Regional, global	1 hour; 30 min	Regional coverage	1 hour; 30 min
Wind-waves	Wave height/intensity; Global coverage	30 min; 30 min	Regional coverage	1 hour; 30 min
Sea level	Global coverage	30 min; 30 min	Regional coverage	1 hour; 30 min
Solar and Earth radiation products	Surface exposure; Solar irradiance;	3 hours; 30 min		

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[2] For example: Repeat cycle 1 hour means "update every hour"; Timeliness 30 minutes means "maximum of 30 minutes between time of observation and data availability"

Product Categories	Baseline requirement		Additional requirement (e.g., in case of emergency)	
	Type of data	Repeat cycle; Timeliness[2]	**Type of data**	Repeat cycle; Timeliness
	OLR			
Albedo	Global coverage	1 hour; 30 min	Regional coverage	30 min; 30 min
Fire detection	Global coverage	1 hour; 30 min	Regional coverage	30 min; 30 min
Ice and snow extent	X (including using SAR)	30 min; 30 min		
Vegetation index	Global coverage	1 hour; 30 min		
Oceanic chlorophyll	Ocean colour	1 hour; 30 min		
Volcanic ash	Global coverage	1 hour; 30 min	Regional coverage	30 min; 30 min
Others (please specify)	Surface currents (highest priority gap for ocean modelling)			
	Significant wave height (SWH), sea surface height anomaly (SSHA) altimetry			
	Sea surface salinity			
	Icing threat to aircraft	1 hour; 15 min		
	Aerosol parameters (AOD, …)	10 min; 15 min		
	SO2	10 min; 15 min		
	Ozone profile, TC	Daily		
	LST	Daily		
	Soil moisture	1.5 days		

APPENDIX 2: QUESTIONNAIRE

WMO SURVEY ON INDIAN OCEAN SATELLITE DATA REQUIREMENTS

(in response to CGMS Action 42.01)

DUE DATE: 30 MARCH 2015

NOTE:
**THE FOLLOWING TWO TABLES ARE FOR GUIDING YOUR RESPONSE; YOU MAY
PROVIDE ADDITIONAL OR DIFFERENT RESPONSES**

**Table 1: Generic dissemination requirements for satellite data over the Indian Ocean
Region (up to level 1)**

Type of data and source	Essential requirement (routine operations)		Additional requirement (needed e.g., in case of emergency)	
	Type of data	Repeat cycle; Timeliness[3]	**Type of data**	Repeat cycle; Timeliness
GEO imagery over the Region				
GEO sounding channels over the Region				
GEO lightning data over Region, when available				
GEO other instruments when available				
GEO imagery elsewhere				
Operational LEO VIS-IR imagery				
Local operational LEO sounding data				
Regional operational LEO sounding				
Global operational LEO sounding				
LEO MW Imagery				

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[3] For example: Repeat cycle 1 hour means "update required every hour"; Timeliness 30 minutes means "maximum of 30 minutes between time of observation and data availability"

Type of data and source	Essential requirement (routine operations)		Additional requirement (needed e.g., in case of emergency)	
	Type of data	Repeat cycle; Timeliness[3]	**Type of data**	Repeat cycle; Timeliness
Other LEO data from operational or preoperational instruments (such as Earth radiation, UV)				
Scatterometer				
Radio-occultation sounding				
R&D instrument data				
Other (please specify)				

Table 2: Generic dissemination requirements for derived satellite-based products over the Indian Ocean Region (up to level 2)

Product Categories	Essential requirement (routine operations)		Additional requirement (needed e.g., in case of emergency)	
	Type of data	Repeat cycle; Timeliness[4]	**Type of data**	Repeat cycle; Timeliness
Wind vectors (from GEO)				
Wind vectors (polar)				
Sea surface winds				
Sounding T,U (radiometric)				
Sounding T,U (radio occultation)				
Cloud analysis				
Stability index				
Total Precipitable Water				
Precipitation				
SST				
Wind-waves				
Sea level				
Solar and Earth radiation products				
Albedo				
Fire detection				
Ice and snow extent				
Vegetation index				
Oceanic chlorophyll				
Volcanic ash				
Others (please specify)				

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[4] For example: Repeat cycle 1 hour means "update required every hour"; Timeliness 30 minutes means "maximum of 30 minutes between time of observation and data availability"