CGMS

CGMS-39 WMO-WP-16
v1, 15 September 2011
Prepared by WMO
Agenda Items: H.2
Discussed in Plenary

DOSSIER ON THE SPACE-BASED GOS

In response to Recommendations 37.01 and 37.02

Summary

The September 2011 update of the WMO Dossier on the Space-based Global Observing System (GOS Dossier), incorporating the latest information provided by satellite operators, is available for review by CGMS Members.

The GOS Dossier comprises an introduction followed by five volumes:
- Vol. 1 Satellite programmes description
- Vol. 2 Earth observation satellites and their instruments
- Vol. 3 Gap analysis in the space-based component of GOS
- Vol. 4 Estimated performance of products from typical satellite instruments
- Vol. 5 Compliance analysis of potential product performances with user requirements

The Dossier is available for download from the "Information Resources" page of the new WMO Space Programme web site (www.wmo.int/sat). This issue of the GOS Dossier includes several substantial changes, some structural, with respect to the version submitted to CGMS-38. The main changes are indicated in the text that follows.

Action/Recommendation proposed:

CGMS Satellite Operators are invited to note the September 2011 issue of the GOS Dossier, which can be downloaded from the WMO Space Programme web site (www.wmo.int/sat), and to forward to WMO (bibizzar@tin.it) any update or missing information concerning their programmes for inclusion in the January 2012 issue of the Dossier.

DOSSIER ON THE SPACE-BASED GOS

1 INTRODUCTION

Since its first version submitted to CGMS-32 in Sochi, 17-20 May 2004, the GOS Dossier is updated at least once a year, and up to three times per year since 2009. The GOS Dossier is available for download from the "Information Resources" page of the new WMO Space Programme web site (www.wmo.int/sat). The current version was published on 1st September 2011. This version includes substantial changes with respect to the version submitted to CGMS-38.

2 HIGHLIGHTS OF THE CHANGES

The major changes from the version presented to CGMS-38 are highlighted below.

2.1 Updates of Volume 1 (Programmes)

Volume 1 is now structured by application areas, rather than by satellite operator:

Operational meteorological satellites:
- satellite constellation in geostationary orbits (including a reference to HEO missions)
- satellite constellation in sunsynchronous orbits.

Specialized atmospheric missions, for:
- precipitation
- radio occultation
- atmospheric radiation
- atmospheric chemistry
- atmospheric dynamics.

Missions to ocean and ice, for:
- ocean topography
- ocean colour
- sea surface wind
- sea surface salinity
- waves
- ocean ice.

Land observation missions:
- main operational or near operational missions
- disaster monitoring constellation
- all-weather high resolution monitoring (by SAR).

Missions to Solid Earth, for:
- space geodesy
- earth's interior.

Missions to Space Weather:
- solar activity monitoring
- observation of the magnetosphere
- observation of the ionosphere
- space environment observation from operational meteorological satellites.

The Space Weather section has been considerably expanded, following the approval of Space Weather by the WMO Congress, in May 2011, as an activity of the WMO Space Programme.

The new structure of Vol. 1 is aiming to provide better visibility on the support of satellite programmes to the various application areas.

2.2 Updates of Volume 2 (Instruments)

The number of instruments described in the various tables has been considerably extended from 266 (in the October 2010 version) to 413 (in the current version). This is largely due to:

Detailing certain instrument packages for Land observation at individual instrument level.

Explicit description of instruments for Solid Earth (previously mentioned collectively).

Higher number of missions to Space Weather, detailed at individual instrument level.

It should be noted that the degree of completeness of the information recorded in the various instrument tables has significantly improved, but there are several residual gaps.

2.3 Updates of Volume 3 (Gap analysis)

There are now 33 missions assessed through the Gap analysis (the previous single entry for Solid Earth and Space Weather has been broken down into 4 distinct missions). The number of instruments contributing to the various missions is much higher, particularly in the areas of Land observation, Solid Earth and Space Weather. The granularity of instrument performances to qualify how much an instrument contributes to a mission has been refined.

The summary analysis closing each mission has been streamlined, to better emphasize the future "factual" situation in respect of the "expert" recommendations. Expected gaps and risky areas are identified in sharper terms.

2.4 Updates of Volume 4 (Products)

The names and definitions of the geophysical variables that can be derived from satellite remote sensing have been aligned as far as practical with the updated typology of variables adopted in the WMO Observing Requirements Database (http://www.wmo-sat.info/db/), which is still evolving in the Rolling Requirements Review process (See CGMS-39 WMO-WP-13). Their current number is 112.

The review of the possible sensing principles for each variable has been updated.

The evaluation of the potential performance of the various techniques available for observing a geophysical variable has been iterated and, in the case of vertical profiles, streamlined by reducing the layers to troposphere and stratosphere, plus total column when applicable. This makes it easier to capture the main features of the satellite-derived product quality.

It is noted that, in the case of Space Weather, the identification of the observable variables and the estimated product quality are still tentative.

2.5 Updates of Volume 5 (Compliance)

The objective of Vol. 5 is to compare satellite product performances with user requirements, in order to support the Rolling Requirements Review process aimed at providing guidance to space agencies about desirable developments, and to users about realistic expectations. This Vol.5 had not been updated in 2010 pending consolidation of user requirements.

Since requirements are evolving, and the value of compliance analysis depends very much on the specific interest of the particular application communities, the objective of this Vol. 5 has been revised for the present issue.

Rather than a *compliance analysis*, this Vol. 5 is *a tool for compliance analysis*. The main document, in WORD format, is provided for demonstration purpose; it contains tables populated with "synthetic" user requirements interpolated/extrapolated from a wide number of sources, which are compared with calculated performances of relevant observing techniques (derived from Vol. 4) for each of the 112 addressed geophysical variables. One example is given in the figure below. This static document is delivered with a collection of 112 Excel files, one for each of the variables, which constitute a tool that can be used in entering specific user requirements instead of the "synthetic" requirements and actual performances instead of "estimated" performances, at the discretion of the user for case studies.

Example of output of the Excel-based compliance analysis tool.

Wind (horizontal) Compliance analysis

KEY APPLICATIC	LAYER	Uncertainty (RMS			x (km)			z (km)			t (h)			(h)		OBSERVING TECHNIQUE Orbit type	Principle of the instrument	PERFORMANCES Accurac (RMS)	x (km)	z (km)	t (h)	OBSERVING CONDITIONS Assumed no. of sat	Limitations or special features
		Unit	thres	break	goal	thres	break	goal	thres	break	goal	thres	break	goal	thres	break	goal							
		m/s	5	3	1	300	50	10	3	1	0.3	24	3	1	6	0.5	0.1	LEO	Doppler lidar (non-scanning)	1 m/s	50	0.5	180	1	Clear-air
		m/s	5	3	1	300	50	10	3	1	0.3	24	3	1	6	0.5	0.1	LEO	VIS/IR image sequences	5 m/s	15	6	4	3	Need for tracers, polar regi
NWP	Troposphere	m/s	5	3	1	300	50	10	3	1	0.3	24	3	1	6	0.5	0.1	GEO	VIS/IR image sequences	3 m/s	50	6	1	6	Need for tracers
(large-scale)		m/s	5	3	1	300	50	10	3	1	0.3	24	3	1	6	0.5	0.1	LEO	IR image-sounder	3 m/s	160	2	4	3	Clear-air, polar regions
		m/s	5	3	1	300	50	10	3	1	0.3	24	3	1	6	0.5	0.1	GEO	IR image-sounder	2 m/s	160	2	1	6	Clear-air
	Stratosphere	m/s	10	3	1	1000	100	20	10	3	1	48	12	3	6	0.5	0.1	LEO	Doppler lidar (non-scanning)	4 m/s	50	2	180	1	Non-scanning
		m/s	10	3	1	1000	100	20	10	3	1	48	12	3	6	0.5	0.1	LEO	Doppler shift (limb mode)	5 m/s	300	2	72	1	Daylight
		m/s	5	2	1	30	5	1	1	0.3	0.1	6	1	0.25	3	0.5	0.1	LEO	Doppler lidar (non-scanning)	1 m/s	50	0.5	180	1	Clear-air
NWP		m/s	5	2	1	30	5	1	1	0.3	0.1	6	1	0.25	3	0.5	0.1	LEO	VIS/IR image sequences	5 m/s	15	6	4	3	Need for tracers, polar regi
(small-scale)	Troposphere	m/s	5	2	1	30	5	1	1	0.3	0.1	6	1	0.25	3	0.5	0.1	GEO	VIS/IR image sequences	3 m/s	50	6	1	6	Need for tracers
		m/s	5	2	1	30	5	1	1	0.3	0.1	6	1	0.25	3	0.5	0.1	LEO	IR image-sounder	3 m/s	160	2	4	3	Clear-air, polar regions
		m/s	5	2	1	30	5	1	1	0.3	0.1	6	1	0.25	3	0.5	0.1	GEO	IR image-sounder	2 m/s	160	2	1	6	Clear-air
		m/s	5	2	1	300	30	3	3	1	0.3	6	1	0.25	1	0.25	0.1	LEO	Doppler lidar (non-scanning)	1 m/s	50	0.5	180	1	Clear-air
Actual		m/s	5	2	1	300	30	3	3	1	0.3	6	1	0.25	1	0.25	0.1	LEO	VIS/IR image sequences	5 m/s	15	6	4	3	Need for tracers, polar regio
weather	Troposphere	m/s	5	2	1	300	30	3	3	1	0.3	6	1	0.25	1	0.25	0.1	GEO	VIS/IR image sequences	3 m/s	50	6	1	6	Need for tracers
		m/s	5	2	1	300	30	3	3	1	0.3	6	1	0.25	1	0.25	0.1	LEO	IR image-sounder	3 m/s	160	2	4	3	Clear-air, polar regions
		m/s	5	2	1	300	30	3	3	1	0.3	6	1	0.25	1	0.25	0.1	GEO	IR image-sounder	2 m/s	160	2	1	6	Clear-air
		m/s	5	3	1	500	100	20	3	1	0.3	24	3	1	168	72	24	LEO	Doppler lidar (non-scanning)	1 m/s	50	0.5	180	1	Clear-air
		m/s	5	3	1	500	100	20	3	1	0.3	24	3	1	168	72	24	LEO	VIS/IR image sequences	5 m/s	15	6	4	3	Need for tracers, polar regi
Climate	Troposphere	m/s	5	3	1	500	100	20	3	1	0.3	24	3	1	168	72	24	GEO	VIS/IR image sequences	3 m/s	50	6	1	6	Need for tracers
(large-scale)		m/s	5	3	1	500	100	20	3	1	0.3	24	3	1	168	72	24	LEO	IR image-sounder	3 m/s	160	2	4	3	Clear-air, polar regions
		m/s	5	3	1	500	100	20	3	1	0.3	24	3	1	168	72	24	GEO	IR image-sounder	2 m/s	160	2	1	6	Clear-air
	Stratosphere	m/s	5	3	1	500	100	20	3	1	0.3	24	3	1	168	72	24	LEO	Doppler lidar (non-scanning)	4 m/s	50	2	180	1	Non-scanning
		m/s	5	3	1	500	100	20	3	1	0.3	24	3	1	168	72	24	LEO	Doppler shift (limb mode)	5 m/s	300	2	72	1	Daylight
		m/s	5	3	1	100	20	5	1	0.3	0.1	12	3	1	168	72	24	LEO	Doppler lidar (non-scanning)	1 m/s	50	0.5	180	1	Clear-air
Climate		m/s	5	3	1	100	20	5	1	0.3	0.1	12	3	1	168	72	24	LEO	VIS/IR image sequences	5 m/s	15	6	4	3	Need for tracers, polar regi
(small-scale)	Troposphere	m/s	5	3	1	100	20	5	1	0.3	0.1	12	3	1	168	72	24	GEO	VIS/IR image sequences	3 m/s	50	6	1	6	Need for tracers
		m/s	5	3	1	100	20	5	1	0.3	0.1	12	3	1	168	72	24	LEO	IR image-sounder	3 m/s	160	2	4	3	Clear-air, polar regions
		m/s	5	3	1	100	20	5	1	0.3	0.1	12	3	1	168	72	24	GEO	IR image-sounder	2 m/s	160	2	1	6	Clear-air
		m/s	10	5	2	500	100	20	6	3	1	168	72	24	720	168	24	LEO	Doppler lidar (non-scanning)	1 m/s	50	0.5	180	1	Clear-air
Biosphere		m/s	10	5	2	500	100	20	6	3	1	168	72	24	720	168	24	LEO	VIS/IR image sequences	5 m/s	15	6	4	3	Need for tracers, polar regi
(large-scale)	Troposphere	m/s	10	5	2	500	100	20	6	3	1	168	72	24	720	168	24	GEO	VIS/IR image sequences	3 m/s	50	6	1	6	Need for tracers
		m/s	10	5	2	500	100	20	6	3	1	168	72	24	720	168	24	LEO	IR image-sounder	3 m/s	160	2	4	3	Clear-air, polar regions
		m/s	10	5	2	500	100	20	6	3	1	168	72	24	720	168	24	GEO	IR image-sounder	2 m/s	160	2	1	6	Clear-air

The first two columns display "key applications", with the layer of interest. The columns displaying the "synthetic" requirements follow (with uncertainty, horizontal, vertical and temporal resolution, and timeliness, each being characterized by threshold, breakthrough and goal values). In the next columns the product performances are displayed as evaluated in Vol. 4. Colours indicate the degree of compliance. The EXCEL version provided in addendum to the WORD document allows the user to tune the requirements and performances, for case studies.

3 MAINTENANCE OF THE DOSSIER

With elapsing time, the GOS Dossier has continuously grown in size and degree of complexity. Its maintenance is a challenge. In order to ensure consistency throughout the volumes, most of the numerical information contained in the Dossier is in the process of being stored in a database. It is envisaged that the next issue, to be published in 2012, will be generated to a large extent by information imported from the Database at least as concerns Vol. 1, Vol. 2 and Vol. 3.

4 SOME APPLICATION OF THE DOSSIER IN 2011

During 2011, the methodology of Vol. 3 has been applied to perform the Gap analysis of the GCOS "Essential Climate Variables" (ECV). This is reported in WG III under document WMO-WP-31.

5 PROPOSED ACTION

CGMS Satellite Operators are invited to note the September 2011 issue of the GOS Dossier, and to forward to WMO any update or missing information concerning their programmes for inclusion in the 2012 issue of the Dossier.