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OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON SATELLITE SYSTEMS
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VISION OF SPACE-BASED OBSERVATION IN 2025

Status of the Vision for the GOS in 2025 and proposed updates

(Submitted by J.Lafeuille, WMO Secretariat)

Summary and Purpose of Document

The *Vision for the Global Observing System in 2025* was adopted by WMO in 2009. It sets high-level, challenging but achievable goals to guide the evolution of the Global Observing System in the coming decades. The adoption of the new Vision was followed by important actions:

- An Implementation Plan for Evolution of Global Observing Systems (EGOS-IP) was developed, approved by CBS-15 and submitted to the Executive Council for adoption;
- The CGMS has responded to the Vision in agreeing a new baseline for operational/sustained missions, which incorporates major elements of the new Vision;
- An update to the Manual on the Global Observing System was updated accordingly, to specify the new space-based capabilities to be implemented by WMO Members.

Since the Vision was adopted, several suggestions for further updating the Vision have been recorded. They are provided in the present document for information.

ACTION PROPOSED

The Expert Team is invited to:

- Note the current status of the *WMO Vision for the GOS in 2025*
- Consider the proposed updates to this Vision, and provide guidance for further updates, if necessary.

REFERENCES

Vision for the Global Observing system in 2025:
http://www.wmo.int/pages/prog/www/OSY/gos-vision.html

Status of the Vision for the GOS in 2025 , proposed updates and implementation actions

1. BACKGROUND

The *Vision for the Global Observing System in 2025* was adopted by WMO in 2009. It sets high-level goals to guide the evolution of the Global Observing System in the coming decades. These goals are intended to be challenging but achievable. The Vision addresses both surface- and space-based observations, and emphasizes the need for response to user needs, expansion of applications, integration, interoperability and consistency.

The major development between the previous *Vision for the GOS in 2015* and the current *Vision for the GOS in 2025* is its wider scope : the previous Vision was mainly focusing on the needs of weather forecasting and its applications, whilst the new Vision includes aims to also respond to additional needs, in particular for operational climate monitoring.

2. SUMMARY OF THE SPACE-BASED COMPONENT IN THE VISION

Instruments:	**Geophysical variables and phenomena:**
Operational geostationary satellites. At least 6, separated by no more than 70 deg longitude	
High-resolution multi-spectral Vis/IR imagers	Cloud amount, type, top height/temperature; wind (through tracking cloud and water vapour features); sea/land surface temperature; precipitation; aerosols; snow cover; vegetation cover; albedo; atmospheric stability; fires; volcanic ash
IR hyper-spectral sounders	Atmospheric temperature, humidity; wind (through tracking cloud and water vapour features); rapidly evolving mesoscale features; sea/land surface temperature; cloud amount and top height/temperature; atmospheric composition
Lightning imagers	Lightning (in particular cloud to cloud), location of intense convection.
Operational polar-orbiting sun-synchronous satellites distributed within 3 orbital planes (~13:30, 17:30, 21:30 ECT)	
IR hyper-spectral sounders	Atmospheric temperature, humidity and wind; sea/land surface temperature; cloud amount, water content and top height/temperature; atmospheric composition
MW sounders	
High-resolution multi-spectral Vis/IR imagers (including thermal IR water vapour absorption channel)	Cloud amount, type, top height/temperature; wind (high latitudes, through tracking cloud and water vapour features); sea/land surface temperature; precipitation; aerosols; snow and ice cover; vegetation cover; albedo; atmospheric stability
Additional operational missions in appropriate orbits (classical polar-orbiting, geostationary, others)	
MW imagers – at least 3 – some polarimetric	Sea ice; total column water vapour; precipitation; sea surface wind speed [and direction]; cloud liquid water; sea/land surface temperature; soil moisture
Scatterometers - at least 2 on well separated orbital planes	Sea surface wind speed and direction; sea ice; soil moisture
Radio occultation constellation – at least 8 receivers	Atmospheric temperature and humidity; ionospheric electron density

Altimeter constellation including a reference mission in a precise orbit, and polar-orbiting altimeters for global coverage	Ocean surface topography; sea level; ocean wave height; lake levels; sea and land ice topography
IR dual-angle view imager	Sea surface temperature (of climate monitoring quality); aerosols; cloud properties
Narrow-band high-spectral and hyperspectral resolution Vis/NIR imagers	Ocean colour; vegetation (including burnt areas); aerosols; cloud properties; albedo
High-resolution multi-spectral Vis/IR imagers – constellation	Land-surface imaging for land use and vegetation; flood monitoring
Precipitation radars operated in conjunction with passive MW imagers in various orbits	Precipitation (liquid and solid)
Broad-band Vis/IR radiometer + total solar irradiance sensor - at least 1	Earth radiation budget (supported by imagers and sounders on polar-orbiting and geostationary satellites) and collocated aerosols and cloud properties measurements
Atmospheric composition instruments constellation, including high spectral resolution UV sounder on geostationary orbit and at least a UV sounder on am + pm orbit	Ozone; other atmospheric chemical species; aerosols – for greenhouse gas monitoring, ozone/UV monitoring, air quality monitoring
Synthetic aperture radar	Wave heights, directions and spectra; floods; sea ice leads; ice shelf and icebergs
Operational pathfinders and technology demonstrators, including	
Doppler wind lidar on LEO	Wind; aerosol; cloud-top height [and base]
Low-frequency MW radiometer on LEO	Ocean surface salinity; soil moisture
MW imager/sounder on GEO	Precipitation; cloud water/ice; atmospheric humidity and temperature
High-resolution, multi-spectral narrow-band Vis/NIR and CCD imagers on GEOs	Ocean colour, cloud studies and disaster monitoring
Vis/IR imagers on satellites in high inclination, highly elliptical orbits (HEO)	Winds and clouds at high latitudes; sea ice; high latitude volcanic ash plumes; snow cover; vegetation; fires
Gravimetric sensors	Water volume in lakes, rivers, ground, etc.
Polar and geo platforms / instruments for space weather	
Solar imagery Particle detection Electron density	Solar radiation storms, high-energy particle rain, ionospheric and geomagnetic storms, radio black-out by X-ray photons

3. PROPOSED UPDATES RECORDED AS OF MAY 2013

Although most of the elements described in the Vision are still fully up-to-date, it was noted that a couple of issues were evolving and should be closely monitored, furthermore some observing capabilities might have been omitted or underestimated and should be considered for inclusion. The following elements have been proposed for addition in a future revised version of the Vision for the GOS (this table only addresses space-based observation):

Element/ Station type	***Geophysical variables***	***Comment***	***Ref.***
Cloud Radars	Clouds, cloud structure (top, bottom)	In addition to Precipitation Radars that are well addressed, CBS has suggested to include Cloud Radars into the Operational pathfinders and technology demonstrators	CBS-XIV, 2009, Section 6.1.14 of the General

			summary
Lidars	Clouds, aerosols	CBS suggested including Cloud and aerosol lidars in the Operational pathfinders and technology demonstrators. The Vision mentions Doppler lidar , which is too restrictive.	CBS-XIV, 2009, Section 6.1.14 of the General summary
Radio-occultation constellation	Temperature, humidity, electron density	The current Vision calls for at least 8 GNSS RO receivers; it would be more appropriate to specify a minimum number of occultations per day, e.g. 10,000 occultations/day distributed globally.	ET-SAT-7 Final report Section 6.3
Multi-angle, multi-polarization visible/infrared imagery	Albedo, aerosols	The current Vision only calls for an “IR dual angle view imager”; the potential of multi-angle and multi-polarization sensors should be recognized for proper monitoring of albedo and aerosols.	ET-SAT-7 Final report Section 6.3
Limb sounders for atmospheric composition	Stratospheric ozone and GHG	The current Vision only calls for “including high spectral resolution UV sounder on geostationary orbit and at least a UV sounder on am + pm orbit”. This does not provide a precise enough reference for planning. Distinction should at least be made between nadir and limb sounders. More detailed requirements should be expressed by the relevant scientific community,	ET-SAT-7 Final report Section 6.3
Geostationary constellation, maximum longitude separation	Many variables, including cloud products, atmospheric motion vectors, stability, lightning, etc.	The maximum separation of 70 degrees will not be achieved under current plans. Suggestion to consider 70 ° as a *desirable target* instead of a *strict maximum*, unless the 70 ° value can be justified by quantitative impact studies. Such justification is presently not available.	ET-SAT-7 Final report Section 6.3

4. CONCLUSION

The Expert Team is invited to:

- Note the current status of the *WMO Vision for the GOS in 2025*
- Consider the proposed updates to this Vision, and provide guidance for further updates, if necessary.