DRAFT
J.Eyre, 2 March 2008

VISION FOR THE GOS IN 2025

1. General trends and issues

Response to user needs

- The GOS will provide observations in response to the needs of all WMO Members and Programmes.
- It will provide observations when and where they are needed in a reliable, stable and sustained manner.
- It will respond to user requirements for observations of specified spatial and temporal resolution, accuracy and timeliness.
- It will continue to provide effective global collaboration in the making and dissemination of observations, through a composite and increasingly complementary system of observing systems.
- It will evolve in response to a rapidly changing user and technological environment, based on improved scientific understanding and advances in observational and data-processing technologies.

Integration

- The GOS will evolve to become part of the WIGOS, which will integrate current GOS functionalities, which are intended primarily to support operational weather forecasting, with those of other applications: climate monitoring, oceanography, atmospheric composition, hydrology, and weather and climate research.

Expansion

- There will be an expansion in both the user applications served and the variables observed.
- This will include observations to support the production of Essential Climate Variables, adhering to GCOS climate monitoring principles.
- Sustainability of new components of the GOS will be secured, with some R&D systems integrated as operational systems
- The range and volume of observations exchanged globally (rather than locally) will be increased.
- Some level of targeted observations will be achieved, whereby additional observations are acquired or usual observations are not acquired, in response to the local meteorological situation.

Automation

- The trend to develop fully automatic observing systems, using new observing and information technologies, will continue, where it can be shown to be cost-effective.
- There will be improved access to real-time and raw data.

Consistency and homogeneity

- There will be improvements in calibration of observations and the provision of metadata, to ensure data consistency and reference to absolute standards.
- There will be increased interoperability, between existing observing systems and with newly implemented systems.
- There will be improved homogeneity of data formats and dissemination via WIS.

2. The space-based component

Platform	Instruments	Observed variables	WMO programme
Operational geostationary satellites At least 6, nearly equally spaced	Vis/IR imagers	Cloud amount, type, top height/temperature; wind; sea/land surface temperature; precipitation; aerosols; snow cover; vegetation cover; atmospheric stability; fire detection	WWW, GCOS, WCP, WCRP, DRR
	IR sounders (some hyperspectral)	Atmospheric temperature, humidity and wind; sea/land surface temperature; cloud amount and top height/temperature; atmospheric composition	
Operational polar-orbiting sun-synchronous satellites 3 orbital planes (~13:30, 17:30, 21:30 ECT)	IR sounders (hyperspectral)	Atmospheric temperature, humidity and wind; sea/land surface temperature; cloud amount, water content and top height/temperature; atmospheric composition	All major WMO programmes
	MW sounders		
	Vis/IR imagers	Cloud amount, type, top height/temperature; wind (high latitudes); sea/land surface temperature; precipitation; aerosols; snow and ice cover; vegetation cover; atmospheric stability	
Other LEO capability on primary operational or other satellites	MW imagers – at least 3? – [some polarimetric]	Sea ice; total column water vapour; precipitation; sea surface wind speed [and direction]; precipitation; cloud liquid water	WWW, JCOMM, GCOS
	Scatterometers - at least 2	Sea surface wind speed and direction; sea ice; soil moisture	WWW, GCOS, JCOMM
	UV sounders - at least 2	Ozone and other atmospheric composition variables; aerosols	WWW, GCOS
	Radio occultation constellation – at least 6	Atmospheric temperature and humidity; ionospheric electron density	WWW, GCOS
	Altimeter constellation	Ocean surface topography; sea level; ocean wave height	WWW, GCOS, JCOMM
	IR dual-angle view imager	Sea surface temperature (of climate monitoring quality); aerosols; cloud properties	GCOS, WWW, JCOMM, …?
	Narrow-band Vis/NIR imager	Ocean colour; vegetation (including burnt areas); aerosols; cloud properties	WWW, GCOS, JCOMM, DRR, AREP, WCRP
	High-resolution VIS/IR imagers – constellation	Land surface imaging for land use and vegetation	WWW, GCOS, AMP/AgM, DRR, HWRP
	Active and passive MW instruments - constellation	Precipitation	GCOS, WWW, HWRP, DRR, WCRP
	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)	GCOS, WCRP, WWW(SIA)
	Atmospheric composition instruments – constellation	Ozone; other atmospheric chemical species; aerosols – for greenhouse gas monitoring, ozone/UV monitoring, air quality monitoring	GCOS, AREP, WWW
	Synthetic aperture radar	Wave heights, directions and spectra; oil spills; floods; other hazards; earthquake and faults monitoring; sea ice leads; damage assessment; ice shelf and icebergs	WWW, DRR, JCOMM
Capability on R&D satellites and operational pathfinders including:	Doppler wind lidar on LEO	Wind; aerosol; cloud-top height [and base]	WWW, GCPS, AMP/AeM
	Low-frequency MW radiometer on LEO	Ocean surface salinity; soil moisture	WWW, GCOS, …?
	MW imager / sounder on GEO	Precipitation; cloud water/ice; atmospheric humidity and temperature	WWW
	Lightning imager on GEO	Lightning	AMP/AEM, DRR, WWW
	Vis/IR imagers on satellites in highly elliptical orbit (HEO) missions ? justification ?	Winds and clouds at high latitudes; sea ice	WWW, ??

Others? – to be discussed		Three-dimensional cloud water/ice fields; Sea and land ice topography; Flood monitoring;	

3. The surface-based component

***In situ* observations**			
Land - upper air	Upper air synoptic stations: rawinsondes/radiosondes: - RBSN, plus GUAN and GRUAN	Wind, temperature, humidity, pressure	WWW,GCOS
	Aircraft	Wind, temperature, pressure, [humidity,] turbulence, icing, thunderstorms, dust/sandstorms, volcanic ash/activity	WWW
	UAVs?		WWW
	Ozone sondes	Ozone	WWW, GCOS, …
	Other?		
Land – surface	Surface synoptic stations: - GSN, …?	Surface pressure, temperature, humidity, wind; visibility; cloud amount, type and base-height; precipitation; weather; …?	WWW, GCOS
	Atmospheric composition station	Ozone, …?	WWW, GCOS, …
	Other?		
Land – hydrology	?		
	?		
Ocean – upper air	Rawinsondes/radiosondes: Automated ship aerological programme	Wind, temperature, humidity, pressure	
	Other?		
Ocean – surface	Ships	Surface pressure, temperature, humidity, wind; visibility; cloud amount, type and base-height; precipitation; weather; sea surface temperature; wave direction, period and height; sea ice; …?	WWW, GCOS, JCOMM
	Buoys – moored and drifting	Surface pressure, temperature, humidity, wind; visibility; sea surface temperature; wave direction, period and height; …?	WWW, GCOS, JCOMM
	Ice buoys	?	
	Tide gauges	Tide height	
	Other?		
Ocean – sub-surface	Profiling floats	Temperature, salinity, current	WWW, GCOS, JCOMM
	Other?		
Remotely-sensed observations			
	Weather radar	Precipitation (hydrometeor distribution, size, phase), wind (radial component), …?	WWW
	Profilers (radar, lidar, radiometer)	Wind, cloud base, cloud water, temperature, humidity, …?	WWW
	Lightning detection systems	Lightning	WWW
	GPS (and similar) receivers	Total column water vapour	WWW, GCOS
	Others?		

4. System-specific trends and issues

4.1 Space-based

- There will be an **expanded community** of space agencies contributing to the GOS.
- There will be **increased collaboration** between space agencies, to ensure that user requirements for observations are met in the most cost-effective manner, and that system reliability is assured through arrangements for mutual back-up.
- Observational capability demonstrated on **R&D** satellites will be progressively transferred to **operational** platforms, to assure the reliability and sustainability of measurements.
- **R&D satellites** will continue to play an important role in the GOS; although they cannot guarantee continuity of observations, they offer important contributions beyond the current means of operational systems. Partnerships will be developed between agencies to extend the operation of functional R&D and other satellites to the maximum useful period.
- Some user requirements will be met through **constellations** of satellite, often involving collaboration between space agencies. Expected constellations include: altimetry, precipitation, radio occultation, atmospheric composition and Earth radiation budget.
- **Improved availability and timeliness** through operational cooperation among agencies.

4.2 Surface-based

- **The surface-based GOS will provide:**
  - improved detection of mesoscale phenomena, such as severe storms, lightning, moisture, and clouds, and observations to aid disaster detection, mitigation and prevention,
  - data that cannot be measured by space-based component,
  - data for calibration and validation of space-based data,
  - long-term datasets for the detection and understanding of environmental trends and changes to complement those derived from space-based systems.
- **Radiosondes networks** will be optimised, particularly in terms of horizontal resolution which will decrease in data-dense areas. They will be complemented by **aircraft (AMDAR)** ascent/descents profiles for most of the airports worldwide and supplemented by **profilers** in some regions.
- **Radiosonde profiles** will disseminated at **higher vertical resolution**, commensurate with user needs.
- The **GUAN** subset of radiosonde stations will be maintained for climate monitoring. A GCOS Reference Upper Air Network (GRUAN) will be developed to serve as a reference network for other radiosonde sites, for calibration and validation of satellite records, and for other applications.
- **Aircraft observing** systems will be **integrated** into the broader observing framework.
- **Aircraft observations** systems flight-level and ascent/descent data at user-selected temporal resolution. They will be available from most airports, including those regions not currently well covered (Africa, South America and parts of Asia).
- **Aircraft** instruments will be introduced to observe **humidity**, in addition to temperature and wind.
- **Aircraft observing systems** will also be developed **for small aircrafts** with flight levels in the mid troposphere and providing ascent/descent profiles into different airports.
- These observations may be supplemented by **UAVs**, but not on a regular basis (possibly as part of targeting strategies).
- **Surface observations** will come from a wider variety of surface networks (e.g.: road networks) and multi-application networks. They will achieve higher levels of reliability and availability.
- The **GSN** subset of surface stations will be maintained [and improved?] for climate monitoring.
- **Radar** observing systems will continue to provide precipitation products but with an increased data coverage. They will increasingly provide information on other atmospheric variables, such as radial winds. There will be much improved data consistency, with defined minimum standards for quality control and accuracy. There will be new radar technology, e.g. phased array antenna and passive bistatic radars (for full 3D windfields). Collaborative multi-national networks are likely, to control costs and to deal with increasing technological complexity.

- Current regional **radar data exchanges** will be supplemented by global exchanges for NWP centres.
- **Profilers** will be developed and used by more applications. A wider variety of techniques will be used (lidars, radars, microwave radiometers). These observing systems will be developed into coherent networks and integrated with other surface networks.
- **GPS** receiver networks, for observing total column water vapour, will be extended.
- **Long-range lightning detection systems** will provide cost-effective, homogenized, global data with a location accuracy of about 2 km, significantly improving coverage in data sparse regions including oceanic and polar areas.
- Sustained systems will provide **ocean sub-surface profiles** of high vertical resolution data.
- Drifting buoys … moored buoys … ice buoys … other ocean obs [anything to say?]
- **Communications for marine observations** will be improved through two-way, high data rate satellite data systems, which will collect the in situ observational data
- **Marine observing technology** will be improved, including cost-effective multi-purpose in situ observing platforms and ocean gliders.
- Surface-based observations of **atmospheric composition** (complemented by balloon- and aircraft-borne measurements) will contribute to an integrated three-dimensional global atmospheric chemistry measurement network, together with a space-based component. New measurement strategies will be combined to provide near real time data delivery.
- Surface-based observations of **hydrological parameters** at the global level are expected to diminish. [Why?] However, the exchange of data within the river basins should substantially increase.
- More **meteorological observing platforms** will be **shared** by instruments for different applications, and more meteorological observations will be performed on "platforms of opportunities", or using some infrastructures which have been set up for non-meteorological purposes.
- In response to **economic and other pressures**, there will be:
    - a broader range of station siting,
    - a broader range of instrumentation quality,
    - less uniformity in networks,
    - increased attention to IT security.
- Observational data will **collected and transmitted** in digital, highly compressed forms. Data processing will be highly computerised.
- Others?