WMO OSCAR

Observing Systems Capability Analysis and Review Tool

A building block of Rolling Requirements Review

- Quantitative user-defined requirements for observation of physical variables in application areas of WMO
- Detailed information on all earth observation satellites and instruments
- Expert analyses of space-based capabilities
- Facilitates the Rolling Requirements Review process, comparing "what is required" with "what is, or will be available", in order to identify gaps and support the planning of integrated global observing systems
- Future objective is to automatically generate first-level analyses of compliance between the quantitative requirements and the actual capabilities (space- or surface-based).

Can IWWg contribute to OSCAR state-of-the-art:

- Improvements in presenting EO satellites and instruments? (producers)
- Requirements for observation of wind in WMO application areas? (users)

http://www.wmo-sat.info/oscar/

OSCAR wind application areas

- Global NWP / High Res NWP
- Nowcasting and Very Short Range Forecasting
- Nowcasting: Synoptic Meteorology
- Seasonal and Inter-Annual Forecasts
- Aeronautical Meteorology
- Agricultural Meteorology
- Atmospheric Chemistry
- Hydrology
- Ocean Applications
- WCRP requirements — GEWEX, CLIVAR, CLIC, SPARC
- Climate requirements (mainly large scale)
- Climate Monitoring - Atmospheric Domain — AOPC
- Climate Monitoring - Oceanic Domain — OOPC
- Climate Monitoring Research — WCRP, TOPC, AOPC, OOPC
- Ocean surface — GOOS
- Marine biology
- CLIC
- Space Weather

IWWg parameters:
179: Wind, horizontal
183: Surface wind vector
180: Wind, vertical
182: Surface wind stress
181: Surface wind speed
205: Surface wind gust

Parameters used by IWWg :
- Cloud parameters

http://www.wmo-sat.info/oscar/applicationareas

OSCAR and RRR

- Used by satellite agencies to contribute to the IGOS
- Played a major role for
  - MTG
  - EPS-SG
  - NOAA
  - ESA atmospheric convoy study
  - . . .

Details

Name	Global NWP
Description	Global Numerical Weather Prediction
Corresponding Institution	World Meteorological Organization
Contact Person	Erik Andersson

Example

- Also available for all other application areas

Variables measured in this Application Area

Theme	Variables		
Basic atmospheric	Air pressure (at surface)	Air specific humidity (at surface)	Air temperature (at surface) Atmospheric temperature
	Specific humidity	Specific humidity (Total Column)	Wind (horizontal) Wind (vertical)
	Wind speed over the surface (horizontal)	Wind vector over the surface (horizontal)	
Clouds and precipitations	Accumulated precipitation (over 24 h)	Cloud base height Cloud drop effective radius	Cloud cover Cloud ice
	Cloud ice (total column)	Cloud liquid water	Cloud liquid water (total column)
	Cloud top height	Cloud type	Precipitation intensity at surface (liquid or solid)
	Precipitation intensity at surface (solid)		
Aerosols and radiation	Aerosol column burden	Aerosol mass mixing ratio	Downward short-wave irradiance at Earth surface
	Downward long-wave irradiance at Earth surface	Earth surface short-wave bidirectional reflectance	Fraction of Absorbed PAR (FAPAR)
	Long-wave Earth surface emissivity	Short-wave cloud reflectance	Upward short-wave irradiance at TOA
	Upward spectral radiance at TOA	Upward long-wave irradiance at TOA	Upward long-wave irradiance at Earth surface

Capabilities

Multi-purpose VIS/IR imagery from LEO	This capability consists of medium-resolution multi-channel radiometers operating in the VIS and IR parts of the spectrum in Low Earth Orbit.
Multi-purpose VIS/IR imagery from GEO	This capability consists of medium-resolution multi-channel radiometers operating in the VIS and IR parts of the spectrum, in geostationary orbit.
IR temperature/humidity sounding from LEO	This capability consists of medium spectral resolution spectrometers or radiometers operating in the IR part of the spectrum, in Low Earth Orbit.
IR temperature/humidity sounding from GEO	This capability consists of medium spectral resolution spectrometers or radiometers operating in the IR part of the spectrum, in geostationary orbit.
MW temperature/humidity sounding from LEO	This capability consists of MW radiometers supporting the IR sounder for nearly-all-weather conditions, in Low Earth Orbit.
MW temperature/humidity sounding from GEO	This capability consists of sounding/imaging radiometers operating in the millimetre and submillimetre range of the spectrum, in geostationary orbit, so as to enable using antennas of practicable sizes.
Multi-purpose MW imagery	This capability consists of MW radiometers exploiting conical scanning in order to operate with more polarisations (conical scanning provides constant zenith angle). It is a multi-purpose capability in Low Earth Orbit.
Low-frequency MW imagery	This capability consists of MW radiometers addressing applications that require low frequencies, thus large antennas, in Low Earth Orbit
Radio occultation sounding	This capability consists of receivers of signals from navigation systems (GPS, GLONASS, Galileo, Beidou) embarked on LEO satellites, during the occultation phase.
Earth radiation budget from LEO	This capability consists of two components: - On one hand, broad-band radiometry of the total radiation from Earth-Atmosphere to Space and its short-wave component (reflected solar radiation) measured from Low Earth Orbit; provision of additional information from key narrow-band channels, and on multi-directional viewing (to retrieve irradiance) is necessary; -On the other hand, the incoming solar radiation (by cavity radiometer) must also be observed.
Earth radiation budget from GEO	This capability consists of broad-band radiometry of the total radiation from Earth-Atmosphere to Space, and of its short-wave component (reflected solar radiation), from geostationary or higher orbits.
Sea-surface wind by active and passive MW	This capability consists of radar scatterometers that provide backscatter coefficient observations under a number of viewing angles. Another technique makes use of passive MW imagers exploiting several polarisations (up to full-polarisation) in a number of channels.

Multi-purpose VIS/IR imagery from GEO

Details on this required capability

Full name	Multi-purpose VIS/IR imagery from GEO
Definition	This capability consists of medium-resolution multi-channel radiometers operating in the VIS and IR parts of the spectrum, in geostationary orbit.
Reference Observing Strategy	The reference observing strategy is: • six sectors, 60 degrees wide along the equator (centres: 0°, 60°E, 120°E, 180°E, 120°W, 60°W); • at least one "SEVIRI-class" instrument in each sector, and one backup, as similar as possible.

Example:

➢ Also available for all other observing capabilities

Evaluation

Evaluation of "Multi-purpose VIS/IR imagery from GEO" after 2020	
0°± 30°	Adequate data are expected to be provided by the MTG-I FCI (with redundancy) and the likely follow-on of the Electro-M MSU-GSM.
60°E± 30°	Adequate data are expected to be provided by the FY-4 AGRI and the likely follow-on of the Electro-M MSU-GSM.
120°E± 30°	Adequate data are expected to be provided by the FY-4 AGRI, the Himawari AHI and the likely follow-on of the COMS-2 MI-FO.
180°± 30°	Only the Electro-L MSU-GS is planned to station in this sector. Possibly to be improved if Electro-M with MSU-GSM follow-on. Note that the sector is partly covered by Himawari and GOES-W, located on each side close to the sector limits.
120°W± 30°	Adequate data are expected to be provided by the GOES-W ABI, backed by a GOES in stand-by position at 105°, also backing GOES-E.
60°W± 30°	Adequate data are expected to be provided by the GOES-E ABI, backed by a GOES in stand-by position at 105°, also backing GOES-W.
Overall	All sectors covered with redundancy, except sector 180°± 30°, that lacks redundancy.

Relevant Instruments and their contribution

The rating describes how the instruments, by design, have the potential to contribute to a capability identified in the WMO Vision of global observing systems, assuming nominal operation of space and ground segments. For this particular capabilty, instrument performance is considered to be driven by:

- the extension of the spectral range through the VIS, NIR, SWIR, MWIR and TIR bands
- the number of channels and their distribution across the spectral range
- more detailed features such are channel bandwidths and radiometric resolution.

The performance level, associated to a colour code, is rated as follows:

1. Observation of a wide range of geophysical variables, with emphasis on cloud classification and properties, aerosol main properties, land temperature, and sea surface temperature in coastal waters; atmospheric motion wind by cloud and water vapour tracking; very high product quality.
2. Observation of a wide range of geophysical variables, with emphasis on cloud classification, aerosol detection, land temperature, and sea surface temperature in coastal waters; atmospheric motion wind by cloud and water vapour tracking; good product quality.
3. Cloud analysis, aerosol inference, land temperature, and sea surface temperature in coastal waters; atmospheric motion wind by cloud and water vapour tracking; product quality sufficient to operational monitoring purposes.

Rating	Type of Instrument	Instruments
1	01. Moderate-resolution optical imager	AGRI
1	01. Moderate-resolution optical imager	ISR
1	01. Moderate-resolution optical imager	ABI AHI FCI AMI MSU-GSM
2	01. Moderate-resolution optical imager	MSU-GS MSU-GS/A
2	01. Moderate-resolution optical imager	SEVIRI
3	01. Moderate-resolution optical imager	IMAGER (INSAT)
3	01. Moderate-resolution optical imager	IMAGER (GOES 8-11) IMAGER (MTSAT-2)

Instrument	Rating	Satellite	Orbit	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Radiomet	2	Meteor-M N3							X	X	X	X	X	X										
ROSA	3	Megha-Tropiques	20 °		X	X	X	X	X	X														
Tri-G (COSMIC-2)	1	Cosmic-2 (1-6)	24 °							X	X	X	X	X	X									
IGOR (COSMIC)	3	COSMIC (6 sats)	71 °	X	X	X																		
Tri-G (COSMIC-2)	1	Cosmic-2 (7-12)	72 °									X	X	X	X	X	X							
Tri-G	1	GRACE-2 (2 sats)	89 °							X	X	X	X	X	X									
BlackJack (GRACE)	3	GRACE (2 sats)	89 °	X	X	X																		
TRSR (Ørsted)	4	Ørsted	96.5 °	X	X	X																		
AOPOD	2	KOMPSAT-5	06:00 asc			X	X	X	X	X	X													
IGOR	3	Paz (SEOSAR)	06:00 asc			X	X	X	X	X	X													
GNOS	2	FY-3D	14:00 asc						X	X	X	X												
GNOS	2	FY-3F	14:00 asc										X	X	X	X								
Radiomet	2	Meteor-MP N1	15:30 asc								X	X	X	X	X	X								
IGOR (TerraSAR-X)	3	TerraSAR-X	06:00 desc	X	X	X	X																	
IGOR (TerraSAR-X)	3	TerraSAR-X2	06:00 desc						X	X	X	X	X	X	X	X								
ROSA	3	SAC-D	06:00 desc		X	X	X	X	X	X														
IGOR (TanDEM-X)	4	TanDEM-X	06:00 desc	X	X	X	X	X	X															
RO	1	MetOp-SG-A1	09:30 desc											X	X	X	X	X	X	X	X	X		
RO	1	MetOp-SG-A2	09:30 desc																		X	X	X	X
RO	1	MetOp-SG-B1	09:30 desc													X	X	X	X	X	X	X	X	
RO	1	MetOp-SG-B2	09:30 desc																				X	X
Radiomet	2	Meteor-MP N2	09:30 desc									X	X	X	X	X	X							
GRAS	3	MetOp-A	09:30 desc	X	X	X																		
GRAS	3	MetOp-B	09:30 desc			X	X	X	X	X	X													
GRAS	3	MetOp-C	09:30 desc							X	X	X	X	X	X									
GNOS	2	FY-3C	10:00 desc				X	X	X	X														
GNOS	2	FY-3E	10:00 desc								X	X	X	X										
GNOS	2	FY-3G	10:00 desc												X	X	X	X						
GOLPE	4	SAC-C	10:20 desc	X	X	X																		
ROSA	3	OceanSat-2	12:00 desc	X	X	X	X	X																

Geophysical variable \ Instrument type		01 LEO - Multi-purpose VIS/IR imagery	02 GEO - Multi-purpose VIS/IR imagery	03 LEO - Temp/humidity IR sounding	04 GEO - Temp/humidity IR sounding	05 LEO - Temp/humidity MW sounding	06 GEO - Temp/humidity MW sounding	07 LEO - Multi-purpose MW imagery	08 LEO - Low-frequency MW imagery	09 LEO - Radio-occultation sounding	10 LEO - Earth radiation budget	11 GEO - Earth radiation budget	12 LEO - Scatterometry / MW polarimetry	13 LEO - Radar altimetry	14 LEO - Ocean colour imagery	15 GEO - Ocean colour imagery	16 LEO - Imagery with special viewing	17 LEO - Lightning imagery	18 GEO - Lightning imagery	19 LEO - Cloud & precipitation radar	20 LEO - Lidar-based missions	21 LEO - SW cross-nadir spectrometry	22 GEO - SW cross-nadir spectrometry	23 LEO - IR cross-nadir spectrometry	24 GEO - IR cross-nadir spectrometry	25 LEO - Limb-sounding SW spectrometry	26 LEO - Limb-sounding IR spectrometry	27 LEO - Limb-sounding MW spectrometry	28 LEO - H.R. optical imagery	29 LEO - H.R. SAR imagery	30 LEO – Instruments for Solid Earth	31 LEO – Instruments for Space Weather
Atmospheric temperature	LT			X	X	X	X			X														X	X							
	HT			X	X	X	X			X														X	X	X	X	X				
	LS			X	X	X	X			X														X	X	X	X	X				
	HS&M			X	X	X	X			X														X	X	X	X	X				
Specific humidity	LT			X	X	X	X			X											X			X	X							
	HT			X	X	X	X			X											X			X	X	X	X	X				
	LS			X	X	X	X			X											X			X	X	X	X	X				
	HS&M			X	X	X	X														X			X	X	X	X	X				
	T	X	X	X	X	X	X	X	X	X											X			X	X							
Wind (horizontal)	LT		X		X																X											
	HT		X		X																X					X						
	LS																				X					X						
	HS&M																				X					X						
Wind vector over the surface (horizontal)								X	X				X	X																		
Height of the top of the PBL				X	X					X											X			X	X							
Height of the tropopause				X	X					X											X			X	X							
Temperature of the tropopause				X	X	X	X			X														X	X	X	X	X				
Cloud detection (mask)		X	X																													
Cloud top temperature		X	X	X	X																			X	X							
Cloud top height		X	X	X	X															X	X	X	X	X	X							
Cloud type		X	X																													
Cloud cover	LT+HT			X	X															X												
	T	X	X	X	X																											
Cloud base height																				X												
Cloud optical thickness		X	X														X				X											

Geophysical variable \ Instrument type		01 LEO - Multi-purpose VIS/IR imagery	02 GEO - Multi-purpose VIS/IR imagery	03 LEO - Temp/humidity IR sounding	04 GEO - Temp/humidity IR sounding	05 LEO - Temp/humidity MW sounding	06 GEO - Temp/humidity MW sounding	07 LEO - Multi-purpose MW imagery	08 LEO - Low-frequency MW imagery	09 LEO - Radio-occultation sounding	10 LEO - Earth radiation budget	11 GEO - Earth radiation budget	12 LEO - Scatterometry / MW polarimetry	13 LEO - Radar altimetry	14 LEO - Ocean colour imagery	15 GEO - Ocean colour imagery	16 LEO - Imagery with special viewing	17 LEO - Lightning imagery	18 GEO - Lightning imagery	19 LEO - Cloud & precipitation radar	20 LEO - Lidar-based missions	21 LEO - SW cross-nadir spectrometry	22 GEO - SW cross-nadir spectrometry	23 LEO - IR cross-nadir spectrometry	24 GEO - IR cross-nadir spectrometry	25 LEO - Limb-sounding SW spectrometry	26 LEO - Limb-sounding IR spectrometry	27 LEO - Limb-sounding MW spectrometry	28 LEO - H.R. optical imagery	29 LEO - H.R. SAR imagery	30 LEO – Instruments for Solid Earth	31 LEO – Instruments for Space Weather
Cloud liquid water	LT					X	X	X												X												
	HT					X	X	X												X												
	T					X	X	X												X												
Cloud drop effective radius	LT+HT					X	X													X												
	CT	X	X														X			X	X											
Cloud ice	LT					X	X	X												X												
	HT					X	X	X												X												
	T	X				X	X	X												X												
Cloud ice effective radius	LT+HT																			X												
	CT	X	X														X			X	X											
Freezing level height in clouds						X	X													X												
Melting layer depth in clouds						X	X													X												
Precipitation (liquid or solid)	LT+HT					X	X	X												X												
Precipitation rate at surface (liquid or solid)			X			X	X	X												X												
Accumulated precipitation (over 24 hours)			X			X	X	X																								
Lightning detection																		X	X													
Aerosol optical thickness		X	X												X	X	X				X	X	X									
Aerosol concentration	P																X				X	X	X			X						
	T	X	X														X				X	X	X									
Aerosol effective radius	P																X				X	X	X									
	T																X				X	X	X									
Aerosol type	P																X				X	X	X									
	T	X	X														X				X	X	X									
Volcanic ask	P																X				X	X	X			X						
	T	X	X														X				X	X	X									
Downwelling solar irradiance at TOA											X																					
Outgoing spectral radiance at TOA				X																		X		X								
Outgoing long-wave irradiance at TOA											X	X																				
Outgoing short-wave irradiance at TOA											X	X					X															
Short-wave cloud reflectance		X	X														X															

Geophysical variable	Volume	Orbit	Technique	Accuracy (RMS)	Δx (km)	Δz (km)	Δt (h)	Number of sats	Conditions
Wind (horizontal) **Vector error!**	**LT**	LEO	Doppler lidar	1.5 m/s	50	0.5	180	1	Clear-air
		LEO	VIS/IR image sequences	3 m/s	15	4	4	3	Polar areas
		GEO	VIS/IR image sequences	3 m/s	50	4	1	1	Need for tracers
		LEO	IR imager-sounder	3 m/s	160	2	4	3	Clear-air, polar regions
		GEO	IR imager-sounder	2 m/s	160	2	1	1	Clear-air
	HT	LEO	Doppler lidar	2.5 m/s	50	1	180	1	Clear-air
		LEO	VIS/IR image sequences	5 m/s	15	5	4	3	Polar areas
		GEO	VIS/IR image sequences	5 m/s	50	5	1	1	Need for tracers
		LEO	IR imager-sounder	4 m/s	160	3	4	3	Clear-air, polar regions
		GEO	IR imager-sounder	3 m/s	160	3	1	1	Clear-air
	LS	LEO	Doppler lidar	4 m/s	50	2	180	1	-
		LEO	Doppler shift (limb mode)	5 m/s	300	2	72	1	Daylight
	HS&M	LEO	Doppler shift (limb mode)	5 m/s	300	2	72	1	Daylight
Wind vector over the surface (horizontal)	**Surface**	LEO	Radar scatterometer	2 m/s	20	-	12	3	All weather
		LEO	Polarimetric MW radiometry	3 m/s	10	-	8	3	All weather
		LEO	MW imagery	3 m/s	10	-	8	3	All weather, speed only
		LEO	Radar altimetry	3 m/s	100	-	120	2	All weather, speed only
Height of the top of the PBL	**N/A**	LEO	Backscatter lidar	0.1 km	50	-	360	1	Clear-air
		LEO	From IR sounding	0.5 km	20	-	4	3	Clear-air
		GEO	From IR sounding	0.5 km	20	-	0.25	1	Clear-air
		LEO	From GNSS sounding	0.3 km	300	-	12	12	All weather
Height of the tropopause	**N/A**	LEO	Backscatter lidar	0.1 km	50	-	360	1	Clear-air
		LEO	From IR sounding	2 km	20	-	4	3	Clear-air
		GEO	From IR sounding	2 km	20	-	0.25	1	Clear-air
		LEO	From GNSS sounding	0.5 km	300	-	12	12	All weather
Temperature of the tropopause	**N/A**	LEO	From IR sounding	2 K	20	-	4	3	Clear-air
		GEO	From IR sounding	2.5 K	20	-	0.25	1	Clear-air
		LEO	From GNSS sounding	1 K	300	-	12	12	All weather
		LEO	From limb sounding	1.5 K	300	-	72	1	Clear-air
Cloud detection (mask)	**N/A**	LEO	VIS/IR radiometry	0.07 FAR/HR	0.5	-	4	3	Degraded at night (no VIS)
		GEO	VIS/IR radiometry	0.1 FAR/HR	3	-	0.1	1	Degraded at night

OSCAR gap analysis

Example on next slide:

- Wind (horizontal)
- Vertical profiles are required

What's missing in a gap?

- Variable, e.g., wind
- Mission, e.g., DWL
- Requirement, e.g., vertical resolution Δz

Implicitly, but not explicitly, addressed

- Atmospheric processes

www.wmo-sat.info/oscar/gapanalyses?view=179

S-VISSR (FY-2C/D/E)	3-Medium	FY-2E	105°E	X	X	X	X	X																
S-VISSR (FY-2F/G/H)	3-Medium	FY-2G	105°E				X	X	X	X	X													
GIIRS	1-Primary	FY-4B	105°E								X	X	X	X	X	X	X							
GIIRS	1-Primary	FY-4D	105°E												X	X	X	X	X	X				
GIIRS	1-Primary	FY-4F	105°E																			X	X	X
S-VISSR (FY-2F/G/H)	3-Medium	FY-2F	112°E			X	X	X	X	X														
S-VISSR (FY-2F/G/H)	3-Medium	FY-2H	123.5°E						X	X	X	X	X											
AMI	2-High	GEO-KOMPSAT-2A	128.2°E								X	X	X	X	X	X	X	X	X	X	X	X		
MI	3-Medium	COMS-1	128.2°E	X	X	X	X	X	X	X	X													
AHI	2-High	Himawari-8	140°E					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
AHI	2-High	Himawari-9	140°E							X	X	X	X	X	X	X	X	X	X	X	X	X	X	
JAMI	3-Medium	Himawari-6 (MTSAT-1R)	140°E	X	X	X	X	X	X															
IMAGER (MTSAT)	3-Medium	Himawari-7 (MTSAT-2)	145°E	X	X	X	X	X	X	X	X													
MSU-GS	2-High	Electro-L N3	166°E						X	X	X	X	X	X	X	X								
MSU-GS/A	2-High	Arctica N1	63.4 °					X	X	X	X	X	X											
MSU-GS/A	2-High	Arctica N2	63.4 °					X	X	X	X	X	X											
ISR	2-High	PCW-1	63.4 °									X	X	X	X	X	X	X	X					
ISR	2-High	PCW-2	63.4 °									X	X	X	X	X	X	X	X					
TIDI	2-High	TIMED	74 °	X	X	X	X	X																
VIIRS	4-Useful	Suomi-NPP	13:25 asc		X	X	X	X	X	X														
MODIS	4-Useful	EOS-Aqua	13:30 asc	X	X	X																		
VIIRS	4-Useful	JPSS-1	13:30 asc							X	X	X	X	X	X	X	X							
VIIRS	4-Useful	JPSS-2	13:30 asc												X	X	X	X	X	X	X	X		
MERSI-2	4-Useful	FY-3D	14:00 asc						X	X	X	X												
MERSI-2	4-Useful	FY-3F	14:00 asc										X	X	X	X								
MSU-MR-MP	4-Useful	Meteor-MP N1	15:30 asc								X	X	X	X	X	X								
VIIRS	4-Useful	DWSS-1	05:30 desc									X	X	X	X	X	X							
VIIRS	4-Useful	DWSS-2	05:30 desc													X	X	X	X	X	X	X		
ALADIN	1-Primary	ADM-Aeolus	06:00 desc				X	X	X															
MSU-MR-MP	4-Useful	Meteor-MP N2	09:30 desc									X	X	X	X	X	X							
MetImage	4-Useful	MetOp-SG-A1	09:30 desc											X	X	X	X	X	X	X	X	X		
MetImage	4-Useful	MetOp-SG-A2	09:30 desc																		X	X	X	X
MERSI-2	4-Useful	FY-3E	10:00 desc								X	X	X	X										
MERSI-2	4-Useful	FY-3G	10:00 desc												X	X	X	X						
MODIS	4-Useful	EOS-Terra	10:30 desc	X	X	X																		

All instruments for measuring *Wind (horizontal)*

Instruments	Relevance of Measurement	Processing Maturity	Operational Limitations
ALADIN	Primary	Methodology to consolidate	Non-scanning, radial viewing, Cloud
GIIRS IRS HIS	Primary	Methodology to consolidate	From humidity profile and tracers
HRDI TIDI WINDII	High	Methodology being tuned	Mesosphere and lower thermosphere
ABI AHI FCI AGRI AMI MSU-GSM	High	Consolidated methodology	Tracers needed
MSU-GS SEVIRI MSU-GS/A ISR	High	Consolidated methodology	Tracers needed
IMAGER (GOES 8-11) IMAGER (INSAT-3D) IMAGER (MTSAT) JAMI MI IMAGER (GOES 12-15) S-VISSR (FY-2C/D/E)	Medium	Consolidated methodology	Tracers needed

Variables not assessed in RRR

Wind profile (vertical component)	WMO, EUM	The parameter could be derived from Doppler lidar designed to measure wind profile in clear-air (a radial measurement). Thus it is measured contextually with *Wind profile (horizontal)* (no. 002), two orders-of-magnitude larger. Accuracy impossible to assess, but certainly very poor.
Turbulence profile (wind variability)	EUM	Accuracy impossible to assess, but certainly very poor.
Wind speed/vector over land surface (horizontal)	WMO, EUM	No satellite remote sensing principle available for these parameters.
Wind speed over sea surface (horizontal)	WMO, EUM, GCOS, GOOS, IGBP	Incomplete observation. See *Wind vector over sea* (003).
Air temperature (at surface; 2m) Air specific humidity (at surface; 2m)	WMO, EUM, CGOS, WCRP	Satellite IR and MW temperature and humidity sounders provide measurements with too coarse vertical resolution, and are disturbed by surface emissivity. Active instruments (lidar, radar) are blind close to surface. These parameters are better estimated by assimilation of *Atmospheric temperature and humidity profiles* (no.s 001 and 004).
Atmospheric stability index	WMO	Requirement incomplete (accuracy missing). To be derived from *Atmospheric temperature and humidity profiles* (no.s 001 and 004).
Specific humidity profile - Troposphere column	GCOS	Tropopause column to be computed by integrating LT and HT (that are provided).
Air pressure over land surface	WMO, EUM, GCOS	No satellite remote sensing principle available for this parameter.
Air pressure over sea surface	WMO, EUM, GCOS	Some principle proposed, based on measuring total-column O_2 by: - spectroscopy in the band around 760 nm - combined active-passive measurements in the 54 GHz band. Marginal performances and too limiting conditions. Derived from *Wind vector over sea surface* (#003)
Air-sea delta pressure	GCOS	From close-by CO_2 semi-transparent channels. However, marginal feasibility and unreliable results.
Air temperature profile in the PBL	EUM	Marginal feasibility. Part of *Temperature profile* in the LT (no. 001).
Cloud water profile (< 100 μm) Cloud water profile (> 100 μm)	WMO, GCOS, WCRP	Merged in only one, named "*Cloud liquid water profile*" (no. 017). For drop size, there is the EUMETSAT requirement for "*Cloud drop effective radius profile*" (no: 018). The term "Liquid" was added to make distinction from "ice" (no. 19). There is also "*Cloud ice effective radius profile*" (#20).
Cloud ice profile in LS and HS&M	WCRP	Requirement not sure (same values as for Troposphere). Anyway, not feasible as profile (at most, detection could be feasible).
Precipitation detection Precipitation type	EUM	Parameters difficult to be handled *per-sé*. Considered under parameter no. 024 (*Precipitation rate*) in relation to "Hydrology" by split into three classes of (< 1 mm/h, 1-10 mm/h and > 10 mm/h).
Vertical layers of Aerosol optical depth profile (LT, HT, LS and HS&M)	WMO, EUM, GCOS, WCRP, IGBP	In no. 027, WMO, EUM and GCOS have constant requirements with height, WCRP and IGBP only very few changes. Not worth to discriminate. However, the four layers are discriminated in no. 086 (for Atmospheric chemistry, required from WMO and EUM).
Column-integrated contents in LT, HT, LS and HS&M of: - Specific humidity - Aerosol absorption optical depth (), - Aerosol optical depth (+IR)	GCOS	Partial columns not considered in this study, if not because possible to be retrieved from the profiles (provided). In addition, as aerosol is concerned, the requirement is too much detailed (discrimination of the absorption component, specific spectral ranges, …).
Total aerosol single scattering albedo Aerosol absorption optical depth profile Aerosol phase function	EUM	Parameters specific to one model; and their inference too much model-dependent. Equivalent information is implied by the parameters *Aerosol optical depth* (no. 028), *Aerosol effective radius* (no. 029) and *Aerosol type* (no. 030).
Cirrus optical depth Cirrus phase function	EUM	The information can be derived from "*Cloud type*" (no. 013) and "*Cloud optical thickness*" (no. 016)

Definition

Full name	Wind (horizontal)		
Definition	3D field of the horizontal vector component (2D) of the 3D wind vector. The acuracy is meant as vector error, i.e. the module of the vector difference between the observed vector and the true vector.		
Measuring Units	m/s	Uncertainty Units	m/s
Horizontal Res Units	km	Vertical Res Units	km

Comment:	N/A
Last modified:	

Classification

- Domain: Atmosphere
  - Theme: Basic atmospheric
    - Variable: Wind (horizontal)
      - Measured in Layers:
        - HS&M
        - LS
        - HT
        - LT

Used in Application Areas:

- Aeronautical Meteorology
- Climate-AOPC
- Global Modelling/WCRP
- Global NWP
- High Res NWP
- Nowcasting
- Ocean Applications
- SPARC
- Synoptic Meteorology

Requirements defined for *Wind (horizontal)* (29)

This tables shows all known Requirements defined for this variable area. For more operations/export, please go to the main Requirements page

Note: In reading the values, goal is marked blue, breakthrough green and threshold orange

Id	Layer	Application Area	Uncertainty	Horizontal Resolution	Vertical Resolution	Observing Cycle	Availability	Conf Level	Val Date	Source	Comment
119	HS&M	Climate-AOPC	2 m/s 3 m/s 7 m/s	100 km 200 km 500 km		3 h 3.8 h 6 h	3 h 6 h 12 h	firm	2007-07-19	AOPC	1m/s is typically several % of climatological wind strength aloft.
120	HT	Climate-AOPC	2 m/s 3 m/s 5 m/s	100 km 200 km 500 km		3 h 4 h 6 h	3 h 6 h 12 h	firm	2007-07-19	AOPC	1m/s is typically several % of climatological wind strength aloft.
121	LS	Climate-AOPC	2 m/s 3 m/s	100 km 200 km	0.5 km 0.65 km	3 h 4 h	3 h 6 h	firm	2007-07-19	AOPC	1m/s is typically several % of climatological wind strength aloft.

122	LT	Climate-AOPC	2 m/s 3 m/s 5 m/s	100 km 200 km 500 km		3 h 4 h 6 h	3 h 6 h 12 h	firm	2007-07-19	AOPC	1m/s is typically several % of climatological win strength aloft.
22	HT	Aeronautical Meteorology	2 m/s 2.7 m/s 5 m/s	50 km 63 km 100 km	0.15 km 0.238 km 0.6 km	5 min 6.3 min 10 min	60 min 84 min 3 h	firm	2000-06-23	ET ODRRGOS	Near steep topography or jet streams min requirements for vertical gradient information 5m/s1000ft
23	LS	Aeronautical Meteorology	2 m/s 3 m/s 5 m/s	50 km 70 km 100 km	0.15 km 0.3 km 0.6 km	5 min 7 min 10 min	60 min 90 min 3 h	firm	2000-06-23	ET ODRRGOS	Near steep topography or jet streams min requirements for vertical gradient information 5m/s1000ft
239	HS&M	Global Modelling/WCRP	3 m/s 4 m/s 5 m/s	50 km 100 km 500 km	2 km 3 km 5 km	3 h 6 h 12 h	30 d 45 d 60 d	reasonable	1998-10-29	WCRP	
24	LT	Aeronautical Meteorology	2 m/s 3 m/s 5 m/s	50 km 70 km 100 km	0.15 km 0.3 km 0.6 km	5 min 7 min 10 min	60 min 90 min 3 h	firm	2000-06-23	ET ODRRGOS	Near steep topography or jet streams min requirements for vertical gradient information 5m/s1000ft
240	HT	Global Modelling/WCRP	2 m/s 3 m/s 5 m/s	50 km 100 km 500 km		3 h 6 h 12 h	30 d 45 d 60 d	reasonable	1998-10-29	WCRP	
241	LS	Global Modelling/WCRP	2 m/s 3 m/s 5 m/s	50 km 100 km 500 km		3 h 6 h 12 h	30 d 45 d 60 d	reasonable	1998-10-29	WCRP	
242	LT	Global Modelling/WCRP	2 m/s 3 m/s 5 m/s	50 km 100 km 500 km		3 h 6 h 12 h	30 d 45 d 60 d	reasonable	1997-05-28	WCRP	
310	HS&M	Global NWP	1 m/s 5 m/s 10 m/s	50 km 100 km 500 km	1 km 2 km 3 km	60 min 6 h 12 h	6 min 30 min 6 h	firm	2009-02-10	John Eyre	
311	HT	Global NWP	1 m/s 3 m/s 8 m/s	15 km 100 km 500 km	0.5 km 1 km 3 km	60 min 6 h 12 h	6 min 30 min 6 h	firm	2009-02-10	John Eyre	
312	LS	Global NWP	1 m/s 3 m/s 5 m/s	15 km 100 km 500 km	0.5 km 1 km 3 km	60 min 6 h 12 h	6 min 30 min 6 h	firm	2009-02-10	John Eyre	

etc., etc. .....

Variable: Wind (vertical)

Definition

Full name	Wind (vertical)		
Definition	3D field of the vertical component of the 3D wind vector		
Measuring Units	cm/s	**Uncertainty Units**	cm/s
Horizontal Res Units	km	**Vertical Res Units**	km

Comment:	N/A
Last modified:	

Classification

- **Domain:** Atmosphere
  - **Theme:** Basic atmospheric
    - **Variable:** Wind (vertical)
      - **Measured in Layers:**
        - HS&M
        - LS
        - HT
        - LT

- **Used in Application Areas:**
  - Global NWP
  - High Res NWP
  - Nowcasting

Id	Layer	Application Area	Uncertainty	Horizontal Resolution	Vertical Resolution	Observing Cycle	Availability	Conf Level	Val Date
314	HS&M	Global NWP	1 cm/s 5 cm/s 5 cm/s	15 km 200 km 500 km	0.5 km 2 km 3 km	60 min 6 h 12 h	6 min 30 min 6 h	tentative	2009-02-10
315	HT	Global NWP	1 cm/s 5 cm/s 5 cm/s	15 km 200 km 500 km	0.5 km 2 km 3 km	60 min 6 h 12 h	6 min 30 min 6 h	tentative	2009-02-10
316	LS	Global NWP	1 cm/s 5 cm/s 5 cm/s	15 km 200 km 500 km	0.5 km 2 km 3 km	60 min 6 h 12 h	6 min 30 min 6 h	tentative	2009-02-10
317	LT	Global NWP	1 cm/s 5 cm/s 5 cm/s	15 km 200 km 500 km	0.5 km 2 km 3 km	60 min 6 h 12 h	6 min 30 min 6 h	tentative	2009-02-10
386	HT	High Res NWP	1 cm/s 2 cm/s 5 cm/s	5 km 10 km 20 km	0.5 km 0.65 km 1 km	15 min 60 min 12 h	15 min 30 min 2 h	speculative	2011-07-29
387	LS	High Res NWP	1 cm/s 2 cm/s 5 cm/s	10 km 25 km 100 km	2 km 3 km 5 km	30 min 60 min 12 h	15 min 30 min 2 h	speculative	2011-07-29
388	LT	High Res NWP	1 cm/s 2 cm/s 5 cm/s	0.5 km 2 km 10 km	0.1 km 0.25 km 0.5 km	15 min 60 min 12 h	15 min 30 min 2 h	tentative	2011-07-29
454	LT	Nowcasting	1 cm/s 1.7 cm/s 5 cm/s	5 km 17.1 km 200 km		15 min 23.8 min 60 min	4.8 min 8.8 min 30 min	firm	2003-10-20

Support OSCAR

- Review OSCAR

Issues:

- Are wind capabilities well represented?
- And wind requirements?
- Are cloud requirements well expressed for use in AMV derivation?

- Send comments/updates by mid September to ?

- Present integrated report to next WMO CGMS and report suggestions to OSCAR