SURVEY ON THE DIFFERENT AMV PRODUCTS – MAY 2023

0. CONTACTS FOR EACH CENTRE	
EUMETSAT GEO&LEO	Régis Borde (EUMETSAT, regis.borde@eumetsat.int)
NWCSAF GEO&LEO	Javier García-Pereda (NWCSAF/AEMET, jgarciap@aemet.es)
JMA GEO	Kazuki Shimoji (JMA, kazuki.shimoji@met.kishou.go.jp)
KMA GEO	Inchul Shin (KMA, icshin@korea.kr)
NOAA GEO&LEO	Operational Products: Hongming Qi (NOAA/OSPO, homgming.qi@noaa.gov) Research Products: Jaime Daniels (NOAA/STAR, jaime.daniels@noaa.gov) Andrew Bailey (NOAA/STAR, andrew.bailey@noaa.gov) Wayne Bresky (NOAA/STAR, wayne.bresky@noaa.gov)
CIMSS GEO&LEO	Dave Santek (CIMSS/SSEC, dasantek@wisc.edu) Richard Dworak (CIMSS/SSEC, rdworak@ssec.wisc.edu) Dave Stettner (CIMSS/SSEC, stettner@ssec.wisc.edu)
CPTEC/INPE GEO	Renato Galante Negri (CPTEC/INPE, renato.galante@inpe.br)

AMV PRODUCT IDENTIFICATION

1. Operational status of the AMV product	
EUMETSAT GEO&LEO	Operational centre.
NWCSAF GEO&LEO	Operational product “NWC/GEO-HRW High Resolution Winds” for GEO. Demonstrational product “NWC/PPS-HRW High Resolution Winds” for LEO.
JMA GEO	Operational at JMA/MSC: (1) AMV for global model. (2) High resolution and rapid scan AMV of Full-disk and regional observations (for internal users only).
KMA GEO	Operational centre.
NOAA GEO&LEO	NOAA/NESDIS/OSPO (operational winds as of 06/Jun/2023): GOES-16, GOES-18, NOAA-15, NOAA-18, NOAA-19, S-NPP, NOAA-20, Metop-B/C, Aqua/Terra Incoming: NOAA-21 NOAA/NESDIS/STAR (non-operational, research): All GOES and Himawari (ABI/AHI), LEO (AVHRR/VIIRS)
CMISS GEO&LEO	Non-operational center - Research applications.
CPTEC/INPE GEO	Operational and research at CPTEC/INPE.

2. Availability of the AMV product	
EUMETSAT GEO&LEO	Products disseminated via GTS, EUMETCAST.
NWCSAF GEO&LEO	Calculated locally with “NWC/GEO geostationary software package” and “NWC/PPS polar software package” The software package can be obtained without any cost from NWCSAF Helpdesk www.nwcsaf.org, after registration as NWCSAF user.
JMA GEO	(1) Distributed via GTS in BUFR (2) Local distribution.
KMA GEO	Distributed via GTS in BUFR.
NOAA GEO&LEO	Operational AMVs distributed by PDA at NOAA/NESDIS/OSPO and GTS Research products generated locally; available via ftp by request
CIMSS GEO&LEO	Products generated locally at CIMSS and available via ftp/http.
CPTEC/INPE GEO	Local use only, but it could be distributed over ftp/http or GEONETCast Americas service.

3. Type of AMV product	
EUMETSAT GEO&LEO	GEO: MET-9 (IODC), MET-10 (FES/prime mission), MET-11 (RSS). LEO: Metop-B and Metop-C, Global AVHRR, Triplet Mode AVHRR. GEO: MTG-FCI (Expected to be operational Q1 2024) LEO: Dual S3 SLSTR (Expected to be operational Q3 2024) 3D winds: 3D IASI (Expected to be operational Q3 2024)
NWCSAF GEO&LEO	GEO AMVs: MSG, GOES, Himawari-8/9; MTG-I expected Q1 2024 LEO AMVs: calculated with any combination of images from AVHRR-3, VIIRS, MODIS, MERSI-2, SLSTR radiometers (in up 16 different satellites)
JMA GEO	GEO AMV product.
KMA GEO	GEO AMV products.
NOAA GEO&LEO	GEO, LEO, GEO-GEO and GEO-LEO Stereo AMV products. (Stereo AMV products are currently research versions).
CIMSS GEO&LEO	GEO, LEO, and LEO/GEO AMV products generated.
CPTEC/INPE GEO	GEO AMV product.

4. AMV Output format	
EUMETSAT GEO&LEO	New BUFR sequence implemented.
NWCSAF GEO&LEO	- Local NetCDF and BUFR formats for AMVs and Trajectories. - New IWWG BUFR sequence for AMVs. - Heritage IWWG BUFR sequence for AMVs (GEO versions up to v2021 only). (The heritage BUFR sequence is not available anymore in any LEO versions or any future GEO versions)
JMA GEO	Heritage BUFR sequence
KMA GEO	Heritage BUFR format: COMS, GK-2A. NetCDF: GK-2A. New BUFR sequence to be implemented soon.
NOAA GEO&LEO	New IWWG BUFR sequence:: Operational and Research Products Heritage BUFR sequence: Operational Products NetCDF, ASCII, McIDAS MD: All research products
CIMSS GEO&LEO	Products available in ASCII text, BUFR, and McIDAS MD file formats (Note: All products not available in all formats). GOES-R AMV products are in netCDF format.
CPTEC/INPE GEO	Local ASCII and BUFR. Heritage IWWG BUFR sequence.

5. Status of implementation of the new AMV BUFR output	
EUMETSAT GEO&LEO	Applied since February 2021.
NWCSAF GEO&LEO	Implemented in all GEO versions since v2018.1 (available since January 2020), and in all LEO versions.
JMA GEO	Not implemented.
KMA GEO	A compressed version implemented on 21 December 2021.
NOAA GEO&LEO	Applied since 23 April 2019.
CIMSS GEO&LEO	Not implemented.
CPTEC/INPE GEO	Not implemented.

6. Particularities in the AMV Output	
EUMETSAT GEO&LEO	MSG products include an additional AMV altitude set using the OCA product, and pressure standard deviation in hPa.
NWCSAF GEO&LEO	The satellite and satellite channels for which AMVs are calculated, the calculation of "clear air AMVs", and the region for which AMVs are calculated are configurable by the user. The region can be as large as the full disk, or as small as the size of a country. In the GEO versions, images from the same satellite are considered for the AMV calculation, but in the LEO versions, images from different satellites can be considered for the AMV calculation.
JMA GEO	Additional parameters are being computed but not disseminated.
KMA GEO	Output including own QI scores: COMS, GK-2A Output including common QI scores: GK-2A Output including individual QI test scores: COMS, GK-2A Output including Expected Error quality value: GK-2A
NOAA GEO&LEO	The satellite, satellite channels and region for which AMVs are obtained are configurable by the user for both cloud-track and clear-sky (i.e., water vapor) AMVs. The output includes: ● the temperature and pressure error associated with the 1DVar cloud top height algorithm. ● the min/max/median values of cloud top pressure, height and temperature. ● the dominant phase and cloud type of target scene. ● common QI and individual QI test scores. ● the vertical temperature gradient and vertical wind shear associated with the Expected Error quality value. ● various parameters associated with the cluster analysis algorithm (DBSCAN) used to find the dominant motion in the target scene.
CIMSS GEO&LEO	All products include AMV satellite source, channel source, lat., lon., pressure level, speed, direction, QI. Some products also include CIMSS recursive filter quality value, expected error, feature brightness temperature, times of triplet images.
CPTEC/INPE GEO	Output comprehends the main AMV aspects with a Quality Index flag similar to the EUMETSAT QI.

7. Options to calculate AMVs, considering the configurations for "global models" and "regional models" defined by the NWP community, and when these options can be implemented	
EUMETSAT GEO&LEO	No plan to consider specific configuration for 'global' or 'regional' applications so far.
NWCSAF GEO&LEO	- NWC/GEO and PPS-HRW AMVs are calculated locally, with outputs available around 10min after the satellite data reception. With this, the requested timeliness for both global and regional models is fully fulfilled. - The requested "temporal frequency" for both configurations (1hour in global, 10/15 min in regional) is already available in NWC/GEO-HRW, and approximately also in NWC/PPS-HRW (LEO) if all usable polar satellites are processed together. - Considering the requested "target size", the user can configure 16x16 pixels or smaller, although the default configuration is using larger values for the moment. The default option to a smaller size can be changed in the second NWC/GEO-HRW version for MTG-I (around 2026) if corresponding validation results positive. - Considering the "time interval" for GEO AMVs, the requested 10min for global configuration is available for the new GEO satellite generation (Himawari-8/9 and GOES-R; also for MTG-I when the satellite is operational). The requested 5min for regional configuration can only be reached for the moment for MSG Rapid scan service. It will be extended to MTG-I when its Rapid scan service starts. - The requested calculation of AMVs with high-resolution channels is already available for all defined GEO satellites. - If AMVs from different satellite channels are considered, target overlapping is already avoided. Beyond this, targets are separated by variable distances (configurable by the user) up to 40 kilometres at sub-satellite point, which depend on the satellite, the channel resolution and the tracer cloud type. The default AMV density can be increased more if so requested by the users. - Considering the "derivation information", some information related to the clouds and the height assignment errors is already provided in the outputs (AMV cloud amount, standardized cloud type and phase, ice/liquid water path, AMV pressure error). Additional info requested in the 16IWW will be provided such as shown in other questions of this survey.
JMA GEO	Target box size and temporal resolution of imagery for regional model are smaller than for global model
KMA GEO	-
NOAA GEO&LEO	Numerous configuration options (spatial/temporal/spectral) are available within the framework for use in a variety of user-specific applications (global, regional, hi-res, etc.).
CIMSS GEO&LEO	Many different configurations are used by several groups within SSEC/CIMSS for specific applications (standard, tropical cyclone, rapid scan imagery, optical flow).
CPTEC/INPE GEO	-

8. Options for use of the AMV product in global AMV Climate Data Records (considering the 2027 new harmonized GEO ring level 1 inputs or harmonized LEO level 1 inputs; considering also climate applications like jet stream/monsoon location trends and changes; considering also the calculation of AMVs considering dust or atmospheric trace gases).	
EUMETSAT GEO&LEO	Already in use for CDRs (contact: Marie Doutriaux-Boucher).
NWCSAF GEO&LEO	- The fact that both options (NWC/GEO and PPS-HRW) permit to obtain AMVs with a very homogeneous algorithm in all corners of the world with a high update frequency, makes the product very suitable to calculate any Climate Data Records (CDRs). - NWCSAF has no resources to run CDRs by itself, but contacts have been established with Alessio Lattanzio at Eumetsat so that NWC/GEO and PPS-HRW can be used for any coming Eumetsat CDRs. - Collaboration is also open with any other institution who wants to calculate CDRs with NWCSAF AMV product.
JMA GEO	Reprocessed AMVs are used for climate analysis as CDR.
KMA GEO	-
NOAA GEO&LEO	Reprocessed GOES/8-12 and AVHRR AMVs are used in NCEP reanalysis effort. NESDIS is supporting several Level-1b reprocessing activities across all of the GOES series (1975 - present). They will serve as the foundation to enable future GOES (all series) AMV reprocessing.
CIMSS GEO&LEO	Reprocessed AMVs have been used in reanalysis products (NASA/GSFC MERRA; ECMWF ERA)
CPTEC/INPE GEO	-

INPUT DATA

9. Satellite series which can be used	
EUMETSAT GEO&LEO	GEO: MSG-SEVIRI. LEO: Metop-AVHRR radiance
NWCSAF GEO&LEO	Considering the latest versions: For geostationary satellites: - MSG, GOES-13/14/15/16/17/18, Himawari-8/9 with NWC/GEO v2021.1 software - MTG-I1 with coming NWC/GEO v2024 software expected in Q1 2024. For polar satellites: Any combination of images from: - AVHRR/3 (NOAA-15/16/17/18/19, Metop-A/B/C), VIIRS (SNPP, NOAA-20/21), MODIS (Terra, Aqua), MERSI-2 (FY3D) and SLSTR (Sentinel-A/B) with NWC/PPS v2021.3 software.
JMA GEO	Himawari-8/9
KMA GEO	COMS, GK-2A, Himawari-8 (proxy)
NOAA GEO&LEO	GEO: GOES-13/14/15 GVAR series, GOES-16/17/18 ABI series, Himawari-8/9 AHI series, Meteosat 8-11 SEVIRI series LEO: NPP/NOAA-20/21 VIIRS series, NOAA-15/16/17/18/19 AVHRR series, Metop-A/B/C AVHRR series, Terra/Aqua MODIS series
CIMSS GEO&LEO	CIMSS heritage WINDCO package used for GOES-N and MSG (0 degrees longitude) NESDIS GOES-R package with GOES-N, GOES-R, MSG (Indian Ocean), Himawari-8 LEO: WINDCO used for NOAA/AVHRR, Metop/AVHRR, Terra and Aqua MODIS; GOES-R algorithm used for VIIRS.
CPTEC/INPE GEO	GOES-R or MSG.

10. Satellite channels which can be used	
EUMETSAT GEO&LEO	GEO MSG : VIS0.8 and HRVIS reflectances, WV6.2, WV7.3 and IR10.8 radiances. GEO MTG : VIS0.8 reflectances, IR 3.8, WV6.3, WV7.3 and IR10.5 radiances. LEO AVHRR : IR10.8 radiances LEO S3 SLSTR: IR10.8 radiances
NWCSAF GEO&LEO	In all cases, any of following channels configurable by the user: GEO: With MSG series, HRVIS/VIS06/VIS08 reflectances and IR108/IR120/WV062/WV073 brightness temp. With GOES-N series, VIS07 reflectances and IR107/WV065 brightness temp. With Himawari-8/9 series, VIS06/VIS08 reflectances and IR112/WV062/WV070/WV073 brightness temp. With GOES-R series, VIS06/VIS08 reflectances and IR112/WV062/WV070/WV074 brightness temp. With coming MTG-I series, VIS06/VIS08 reflectances and IR105/IR123/WV063/WV073 brightness temp. LEO: With AVHRR-3, VIIRS, MODIS, MERSI-2, SLSTR radiometers, VIS06 reflectances and IR108 brightness temp. With MODIS and MERSI-2 radiometers, also WV073 brightness temp. With MODIS radiometer, also WV067 brightness temp.
JMA GEO	VIS0.64um reflectance, IR(3.9, 10.4, 12.3 and 13.3um) and WV(6.2, 7.0 and 7.3um) brightness temp. (for AMV distributed via GTS, using image spatial resolution of 2km at nadir)
KMA GEO	(1) COMS AMVs: VIS(670 nm) reflectance, SWIR(3.7 um), IR-WV(6.7 um), IR-Window(10.8 nm) radiances. (2) GK-2A AMVs: VIS(645 nm) reflectance, SWIR(3.85um), IR-WV(6.25,6.95,7.35um), and IR-Window(10.45,11.2um) radiances.
NOAA GEO&LEO	GOES-13/14/15 series: VIS064 reflectance, IR039/IR107/WV065 br.temp. GOES-16/17/18 and Himawari- 8/9 series: VIS046 reflectance, IR039/IR112/WV062/WV069/WV073 br.temp. NPP/N20 series: IR112 brightness temp. NOAA-15/18/19 & Metop-A/B/C: Band 4 (11um) br.temp. and radiances Terra/Aqua: Bands 27 (6.7um) and 31 (11um) br.temp. and radiances

CIMSS GEO&LEO	MSG AMVs with VIS06 reflectances and IR039/IR108/WV062 brightness temp. Triplet breakdown. 30 min interval for Full disk for clear sky WV062/WV073. 15 min. interval for Full disk VIS06/IR039(dark only)/IR108/WV062(cloud top). GOES-N AMVs calculated with VIS062 reflectances, and IR039/IR107/WV065/WV074 brightness temp. GOES-15 Northern hemisphere triplet breakdown: 30 min interval for Full NH for VIS062(2 km resolution)/IR039(dark only)/ IR107/WV065. 15 min interval for CONUS for VIS062(2 km resolution)/IR039(dark only)/ IR107/WV065. The smaller GOES-15 sounder sector images are included when available with 60 minute triplet intervals for WV074. GOES-15 Southern hemisphere image triplet breakdown: 30 min for Full southern hemisphere (SH) for VIS062(2 km resolution)/ IR039(dark only)/IR107/WV065. GOES-R AMV's calculated with VIS064 reflectances, and IR039/IR112/WV062/WV069/WV073 brightness temp. Triplet breakdown: 30 min interval for Full Disk for clear sky water vapor WV062/WV069/WV073. 15 min interval for Full Disk for VIS064(2 km resolution)/ IR039(dark only)/IR112/WV062(cloud top). 5 min for CONUS for VIS064(2 km resolution)/IR039(dark only)/IR112/ WV062(cloud top). Meso triplet breakdown: 1 min interval for VIS064(0.5 km resolution)/ IR039(dark only)/IR112/WV062(cloud top). Himawari-8 AMV's calculated with VIS064 reflectances, and IR039/IR112/WV062/WV069/WV073 brightness temp. Triplet breakdown: 30 min for Full Disk for clear sky water vapor WV062/WV069/WV073. 10 min for Full Disk for VIS064(2 km resolution)/IR039(dark only)/ IR112/WV062(cloud top).
CPTEC/INPE GEO	High resolution Visible channels (reflectance) or IR brightness temperatures.

	11. Use of other input products for the AMV processing (Clouds, other observations,… and for which tasks).
EUMETSAT GEO&LEO	GEO: SCE (scene information), CLA (cloud analysis), OCA (optimal cloud analysis), RTM (radiative transfer model), forecast fields. LEO: Metop-AVHRR: AVHRR cloud mask (CLM), and IASI cloud top pressure (IASI_SND_02 products).
NWCSAF GEO&LEO	NWC/GEO or LEO(PPS) Cloud products: - CMa (Cloud mask), CT (Cloud type), CTTH (Cloud top temperature and height) and CMIC (Cloud microphysics) used for the "AMV height assignment". The products are also provided inside NWC/GEO or NWC/PPS software packages, and are calculated together with NWC/GEO or LEO-HRW AMV products. "Operational Sea Surface Temperature and Sea Ice Analysis (OSTIA)" data (used for NWC/GEO Cloud products calculation only). These data are not strictly needed but their use is recommended for better AMVs
JMA GEO	Climatological vegetation map and land elevation data used for the quality checking process.
KMA GEO	Own cloud mask products for target selection. Own cloud top pressure (height) products for target selection and height assignment processes
NOAA GEO&LEO	CRTM, forecast fields Cloud Mask: Used as part of the cloud amount test when selecting which target scenes to process. It is also used to screen out pixels that do not have a cloud top pressure associated with them. Cloud Top Pressure, Cloud Top Pressure quality, and Cloud Top Temperature: Used to assign a representative height to the target scene being tracked. The median cloud-top pressure from the sample of cloud-top pressures belonging to the largest cluster serves as the representative height to assign the AMV. Low-level Inversion Flag: Used to assign a representative height to the scene being tracked within a GFS model designated low-level inversion. Solar Zenith Angle: Used to determine day/night pixels Satellite Zenith Angle: Used to screen out AMVs with target scene center points beyond a 70 degree threshold Land mask/Surface type: Used to classify each ABI pixel as being land or water.
CIMSS GEO&LEO	Cloud Mask: Used as part of the cloud amount test when selecting which target scenes to process. It is also used to screen out pixels that do not have a cloud top pressure associated with them. Cloud Top Pressure, Cloud Top Pressure quality, and Cloud Top Temperature: Used to assign a representative height to the target scene being tracked. The median cloud-top pressure from the sample of cloud-top pressures belonging to the largest cluster serves as the representative height to assign the AMV. Low-level Inversion Flag: Used to assign a representative height to the scene being tracked within a GFS model designated low-level inversion. Solar Zenith Angle: Used to determine day/night pixels. Land mask/Surface type: Used to classify each ABI pixel as being land or water. Expected Error Coefficients File: A set of regression coefficients corresponding to a number of predictors used to compute the Expected Error quality flag that is appended to each AMV that is computed.
CPTEC/INPE GEO	DSA/CPTEC/INPE cloud classification for target selection and height assignment.

12. Use of NWP for the AMV processing (NWP source & variables, for which tasks, including use in the other input products).	
EUMETSAT GEO&LEO	GEO: Forecast from ECMWF, used in Quality Control for QI with forecast and low level Inversion in height assignment. LEO: Forecast from ECMWF used for: wind guess used for Tracking, Quality Control for QI with forecast, estimation of EBBT pressure and low level inversion in height assignment.
NWCSAF GEO&LEO	NWP grid data needed to calculate NWC/GEO or LEO Cloud and AMV products. For GEO, NWP grid data provided from many sources; configurable by the user. Most common ones: ECMWF NWP, MétéoFrance ARPEGE, NOAA GFS. For LEO, NWP grid data provided from ECMWF NWP. Next NWP variables are used for the AMV calculation: - NWP forecast temperature, forecast geopotential, forecast surface pressure and forecast and analysis wind (for the "Quality control forecast test", the optional use of "wind guess", the "Parallax correction" calculation, and the autovalidation with NWP winds). Up to 16 NWP forecast variables are used for the NWC/GEO or LEO Cloud product calculation.
JMA GEO	Temperature, geopotential, humidity, pressure and wind components used for the forward calculation of the radiative transfer model. Expected clear sky radiances from ideal black body placed at each level used for height assignment and quality checking process.
KMA GEO	KMA GDAPS forecast: Vertical Temperature profiles used for Inversion layer correction. Skin (Surface) temperature used for CO2 slicing method. Vertical U/V profiles used for calculating QI component with forecast. T/q profiles, U/V profiles, 1.5m temperature/humidity, 10m U/V, and surface pressure used for the forward calculation of the radiative transfer model (RTM). RTM(RTTOV) profiles: EBBT and transmittance used for height assignment processes. CSR used for CO2 slicing method.
NOAA GEO&LEO	Short-term forecast temperature and wind data on pressure surfaces from the National Centers for Environmental Prediction's (NCEP) Global Forecast System (GFS) model are used to calculate target heights and for calculating model shear and model temperature gradients used in the Expected Error algorithm. Currently, EE is calculated, but not used. Short-term GFS forecast wind profiles are used to center the search box on the predicted locations of targeted features being tracked in the first and last images of the loop sequence. Quality Control: Short-term GFS forecast wind profiles are used to compute a vector difference between the model vector and the satellite derived wind. Winds exceeding band-dependent thresholds are discarded. Relatively large thresholds are used so this serves as a gross error quality control check.
CIMSS GEO&LEO	Short-term forecast temperature and wind data on pressure surfaces from National Centers for Environmental Prediction's (NCEP) Global Forecast System (GFS) model are used to calculate target heights and for calculating model shear and model temperature gradients used in the Expected Error algorithm. Short-term GFS forecast wind profiles are also used to center the search box on the predicted locations of targeted features being tracked in the first and last images of the loop sequence. Short-term GFS forecast wind profiles are also used to compute a vector difference between the model vector and the satellite derived wind. Winds exceeding a band-dependent threshold are discarded.
CPTEC/INPE GEO	CPTEC/INPE NWP profiles used for Height Assignment and cloud classification and quality control. Variables used: Temperature, Humidity and Pressure for height assignment and wind components for quality control check.

FEATURE IDENTIFICATION

13. Method for the definition of features used.	
EUMETSAT GEO&LEO	GEO: Maximum contrast (nominal) or maximum entropy (alternative). LEO: Target screening based on local contrast.
NWCSAF GEO&LEO	Two methods used for definition of tracers: - "Gradient method", as defined by "C.M.Hayden & R.T.Merrill, 1988: Recent NESDIS research in wind estimation from geostationary satellite images". It defines tracer locations where maximum gradients of reflectance/brightness temperature are found, while the reflectance/brightness temperature value and distribution exceeds some configurable limits in the tracer pixels. - "Tracer characteristics method", based on new development. It checks that a significant contrast and a minimum value ("frontier") are found in the tracer reflectance/brightness temperature histogram. Then, it checks that pixels with reflectance/brightness temperature values over and below the frontier are properly distributed inside the tracer, so having enough variability in the different directions. "Tracer characteristics tracers" are looked for in areas where "Gradient tracers" could not be found.
JMA GEO	Targets on grid points defined in pixel-lines base are used.
KMA GEO	A pixel with the largest standard deviation of brightness temperature or albedo in target box as representative of target.
NOAA GEO&LEO	A valid target must contain a minimum user-defined contrast Target centered on maximum brightness temperature/reflectance gradient within the scene. Targeting is done on the middle image of a 3-image loop. Coakley/Bretherton algorithm used to remove multi-layer cloud scenes. Coherence check applied to remove scenes that are too coherent.
CIMSS GEO&LEO	Target centered on maximum brightness temperature gradient within the scene. Targeting is done on the middle image of a 3-image loop. Coakley/Bretherton algorithm used to remove multi-layer cloud scenes. Coherence check applied to remove scenes that are too coherent.
CPTEC/INPE GEO	Target windows (tracers) are initially chosen using a fixed spaced grid and then a feature check is performed. If the target window is too homogeneous or has too many clear sky pixels, a new target window is searched near the original point. For Visible and NIR 3.9 µm, only low level cloud tops are selected, masking out all other cloud tops.

14. Thresholds/limits/particularities/controls in the method for definition of the features	
EUMETSAT GEO&LEO	Cloudy targets must have a minimum fraction of cloudy pixels (25%).
NWCSAF GEO&LEO	Limits are defined for the satellite zenith angle and the solar zenith angle (configurable by the user). "Persistent tracers" and "Trajectories" are defined tracking the same tracer in several consecutive images (with the "tracer" located in the "tracking centre location" of the previous round).
JMA GEO	Target points are selected to avoid "correlated error" (target overlapping) in the tracking process.
KMA GEO	None.
NOAA GEO&LEO	BT gradient limit and Coakley/Bretherton algorithm used to filter out low contrast scenes and scenes with uniform structure. 10% cloud amount threshold used when tracking cloudy features. 0.8 threshold used in Coakley/Bretherton algorithm to filter 3x3 cloud scenes into coherent/non-coherent samples. 80% threshold limit placed on size of coherent sample. If the sample of coherent 3x3 scenes exceeds 80% the target is rejected as being too coherent
CIMSS GEO&LEO	BT gradient limit and Coakley/Bretherton algorithm used to filter out low contrast scenes and scenes with uniform structure. 10% cloud amount threshold used when tracking cloudy features. 0.8 threshold used in Coakley/Bretherton algorithm to filter 3x3 cloud scenes into coherent/non-coherent samples. 80% threshold limit placed on size of coherent sample. If the sample of coherent 3x3 scenes exceeds 80% the target is rejected as being too coherent.
CPTEC/INPE GEO	For Visible and NIR 3.9 µm, the target window needs to have at least 25% of pixels identified as low level cloud top. For IR 10.3 µm, if a target window has more than 80% pixels identified as clear sky, it is rejected and a new one is chosen.

15. Types of features used (Clouds/WV humidity,…)	
EUMETSAT GEO&LEO	GEO: Clouds are tracked using the VIS0.8, WV6.2, WV7.3, IR10.8 and HRVIS channels (cloudy AMVs). WV features are tracked using the WV6.2 and WV7.3 channels (clear-sky AMVs). LEO: Clouds.
NWCSAF GEO&LEO	Cloud features used for AMV calculation with all satellite channels (cloudy AMVs). Moisture features also used for AMV calculation with all water vapour channels (clear air AMVs).
JMA GEO	Clouds.
KMA GEO	Both clouds and clear-sky water vapor features.
NOAA GEO&LEO	Both clouds and clear-sky water vapor features.
CIMSS GEO&LEO	Both clouds and clear-sky water vapor features.
CPTEC/INPE GEO	Clouds for all channels and humidity features for WV channels.

16. Scale of features used (in pixels/kilometres,…)	
EUMETSAT GEO&LEO	GEO MSG: 24x24 pixels (72x72 km2) at nadir for VIS/WV/IR cloudy AMVs. 32x32 pixels (32x32 km2) at nadir for HRVIS channel cloudy AMVs and WV clear-sky AMVs. GEO MTG: 16x16 pixels at nadir for VIS/WV/IR cloudy AMVs. 24x24 pixels at nadir for WV clear-sky AMVs . LEO: Target box size 28x28 pixels, 28x28 km2 at nadir
NWCSAF GEO&LEO	Square tracers of 24 pixels ("Basic AMVs") used as default option. An additional set of square tracers of 12 pixels ("Detailed AMVs") can additionally be defined. The tracer size is configurable by the user, but for the moment it is similar for all satellite channels.
JMA GEO	Both small and large target box sizes (7x7 pixels and 31x31 pixels) are used.
KMA GEO	Target box size is 16 X 16 pixels for IR(2 km) and 48 X 48 pixels for VIS(0.5 km).
NOAA GEO&LEO	LWIR: 19x19 pixel target box All other winds: 15x15 pixel target box
CIMSS GEO&LEO	This varies depending on the spatial resolution and image time interval. Generally: LWIR: 19x19 pixel target box All other winds: 15x15 pixel target box
CPTEC/INPE GEO	Square tracers with size varying from 16x16 up to 24x24 pixels.

17. Localization of features used (grid scale, tracer separation,…)	
EUMETSAT GEO&LEO	GEO MSG: Regular grid with grid spacing of 24 pixels (72 km at nadir) for VIS/WV/IR. Regular grid with grid spacing of 32 pixels (32 km at nadir) for HRVIS. GEO MTG: Regular grid with grid spacing of 16 pixels for VIS/WV/IR. LEO: 28 pixels, 28 km at nadir.
NWCSAF GEO&LEO	Tracers separated by variable distances up to 40 kilometres at sub-satellite point, which depend on the satellite, the channel resolution and the tracer cloud type (configurable by the user). The real separation between tracers changes a bit, depending on corrections in the location of each tracer, inferred by the methods used for the feature identification.
JMA GEO	Grid gap is 17 pixels (34km at nadir) for global model users.
KMA GEO	Grid scale is 16 X 16 pixels for IR(2 km) and 96 X 96 pixels for VIS(0.5 km).
NOAA GEO&LEO	Tracer separation: 15 pixels
CIMSS GEO&LEO	Tracer separation: 15 pixels
CPTEC/INPE GEO	Operationally, tracers are defined adjacent in a fixed regular grid with a maximum overlap of 25%.

TRACKING

18. Method for calculation of the tracking or feature displacement	
EUMETSAT GEO&LEO	GEO: Cross correlation (nominal) or Euclidean distance (alternative). LEO: Cross correlation.
NWCSAF GEO&LEO	"Cross correlation" or "Euclidean distance" (configurable by the user). The first option is used as default one.
JMA GEO	Cross correlation (Pearson correlation coefficient) method.
KMA GEO	Cross Correlation.
NOAA GEO&LEO	Cloudy features: "Nested Tracking" - Sum of Squared Differences (SSD) of smaller 5x5 sub-targets combined with a cluster analysis algorithm to determine dominant motion and cloud height associated with the largest motion cluster. Clear sky WV: Sum of Squared Differences (SSD) of entire 15x15 target scene. No cluster analysis to determine dominant motion.
CIMSS GEO&LEO	Cloudy features: Sum of Squared Differences (SSD) of smaller 5x5 sub-targets combined with a cluster analysis algorithm to determine dominant motion and cloud height associated with largest motion cluster. Clear sky WV: Sum of Squared Differences (SSD) of entire 15x15 target scene. No cluster analysis to determine dominant motion.
CPTEC/INPE GEO	Maximum Cross Correlation method.

19. Options to implement the "Feature Matching and Consensus (FMC)" method, as additional tracking method.	
EUMETSAT GEO&LEO	The algorithm is currently tested on dual-AVHRR and dual-SLSTR AMVs, with the intent to disseminate datasets to interested NWP centers by the end of 2023.
NWCSAF GEO&LEO	No plan is defined for the moment to test the "FMC method", waiting to receive further information from Eumetsat on the impact the method might have in LEO AMV derivation.
JMA GEO	No plans to implement the FMC at this present
KMA GEO	-
NOAA GEO&LEO	No plans.
CIMSS GEO&LEO	No plans.
CPTEC/INPE GEO	-

20. Options to calculate winds from satellite sounders (GEO or LEO), considering “Optical Flow” or any other procedures. (“Optical flow” procedures should also incorporate model independent quality information, including traditional AMV quality control techniques adapted to the dense wind fields).	
EUMETSAT GEO&LEO	- IASI 3D optical flow winds provided as demonstrational in 2024. - Eumetsat has 3D wind algorithm prepared for MTG/IRS, based on current IASI 3D winds, which should provide data less than a year after satellite commissioning (2025).
NWCSAF GEO&LEO	- No specific product has been defined for release to users during current NWCSAF phase up to 2027. - However, calculation of winds and wind profiles will be evaluated with MTG-S/IRS radiances/BTs and T/q profiles (considering AMVs or an “optical flow” algorithm) during this phase.
JMA GEO	JMA will incorporate a GEO sounder in their following GEO series (2029); Research starting now for related wind products.
KMA GEO	-
NOAA GEO&LEO	Not currently being done, but wind/wind profiles will be calculated using optical flow and traditional feature tracking approaches from MTG-S/IRS radiances/BTs and T/q profiles and evaluated as a risk reduction effort in advance of NOAA’s future GeoXO sounder instrument.
CIMSS GEO&LEO	WINDCO heritage algorithm (cross correlation) is used for tracking retrieved quantities on pressure surfaces. This has been demonstrated with AIRS, CrIS, IASI, ATMS vertical profile retrievals of humidity and ozone.
CPTEC/INPE GEO	-

21. Thresholds/limits/particularities used in the tracking or feature displacement	
EUMETSAT GEO&LEO	None.
NWCSAF GEO&LEO	The use of “wind guess” for the definition of the tracking area (implemented as default option in the LEO AMVs), and the “subpixel tracking process” (implemented as default option in all cases) are available for the tracking process. The size of the “tracking area” is also configurable by the user (with a default value considering displacements for the tracer of at least 272 km/h). A gradual approach in the tracking process, considering four iterations, and based on the idea that “Euclidean distance”/”Cross correlation” change slowly (such as shown by “Xu J. & Zhang Q., 1996: Calculation of Cloud motion wind with GMS-5 images in China”), is used for the calculation of the “Euclidean distance minima”/”Cross correlation maxima”. Up to three tracking centres (with the best “Euclidean distance”/”Cross correlation” values) are calculated for each tracer, so defining up to three possible AMVs. Later, in the AMV output filtering, only one of them is retained. The “initial image” related to the “tracer” calculation and the “later image” related to the “tracking centre” calculation are not necessarily consecutive in the GEO AMVs; the interval between images can be configured by the user. A “correlation threshold” is defined for valid AMVs using “Cross correlation” (using as default option 40% in the LEO AMVs, 50% in the GOES-N GEO AMVs, and 80% in the rest of GEO AMVs).
JMA GEO	Four cross-correlation surfaces are calculated with small and large target boxes using 3 sequential images. The four cross-correlation surfaces are averaged and the averaged cross-correlation surface is used for tracking. Cross correlation threshold is 75%.
KMA GEO	None.
NOAA GEO&LEO	Cloudy features: 80% correlation threshold applied to individual 5x5 sub-targets Clear sky WV features: 60% correlation threshold applied to 15x15 target
CIMSS GEO&LEO	Cloudy features: 80% correlation threshold applied to individual 5x5 sub-targets Clear sky WV features: 60% correlation threshold applied to 15x15 target
CPTEC/INPE GEO	Tracers with MCC lower than 70% correlation are rejected.

22. Thresholds/limits/particularities used in the calculation of the wind	
EUMETSAT GEO&LEO	GEO MSG: The final AMV is the average of three AMV intermediate components. LEO: None.
NWCSAF GEO&LEO	The displacement between the “tracer” and the “tracking centre” is calculated considering the corresponding “great circle”, as defined by “haversine formula”. If “CCC method” is used for the height assignment, the location in the “tracer”/”tracking centre” with the largest contribution to the correlation is used to define the displacement of the AMV. The real time the “tracer”/”tracking centre” was scanned in the initial and final images, and not the nominal time of both images, is used for the calculation of the wind. Since NWC/GEO v2018, a “parallax correction” of the latitude/longitude of the “tracer”/”tracking centre” location is used in the GEO AMVs, to correct the horizontal deviation in the apparent position of the “tracer”/”tracking centre” due to its height over the Earth surface. Its use is configurable. Since NWC/GEO v2018, a “mixed calculation method” is available for processing in the GEO AMVs, considering at the same time short and long time intervals (not used as default option). Through this, tracers are tracked considering smaller time intervals, but AMVs are calculated considering 2 to 4 displacements of the same tracer in longer time intervals.
JMA GEO	Defined in the quality check process.
KMA GEO	The final AMV is the average of two intermediate winds between three images.
NOAA GEO&LEO	Gross error checks using model background, band-dependent threshold. Acceleration check of the two intermediate winds, band dependent Cloudy winds: DBSCAN cluster analysis algorithm used to determine number of motion clusters and to identify the largest one.
CIMSS GEO&LEO	Gross error check uses model background threshold. Acceleration check of two intermediate winds, band dependent Cloudy winds: DBSCAN cluster analysis algorithm used to determine number of motion clusters and to identify the largest one.
CPTEC/INPE GEO	The final wind direction/speed corresponds to the tracer displacement between the second and third images. The displacement calculated using the first and second images are used only for quality control check. The real scanning time for the central target pixel in each image are used to calculate the wind speed.

HEIGHT ASSIGNMENT

23. Height assignment method	
EUMETSAT GEO&LEO	GEO: CCC method used nominally for cloudy AMVs, with Cloud Top Pressure estimated on a pixel basis. AMVs extracted at low level are set to the temperature inversion level whenever a temperature inversion exists and certain criteria are met. EBBT height used whenever the AMV pressure calculated using CCC is found below the temperature inversion level. NTC/NTCC methods used nominally for clear-sky AMVs. LEO: CCC method applied with EBBT estimated on pixel basis. AMVs extracted at low level are set to temperature inversion level when temperature inversion exists. IASI L2 Cloud Top Pressure used when IASI footprint collocated with feature tracked.
NWCSAF GEO&LEO	"CCC method" or "Brightness temperature interpolation method" used for the AMV height assignment (configurable by the user). The first option is used as default one.
JMA GEO	AMV height assignment is based on the optimal estimation method using the derived motion vectors, the observed IR radiances, the wind vertical profile of NWP and the estimated brightness temperatures using the radiative transfer model.
KMA GEO	CCC, EBBT&IR/WV rationing, CO2 slicing for cloudy AMVs NTC, NTCC for clear-sky AMVs.
NOAA GEO&LEO	Cloudy winds: median cloud top pressure (CTP) of largest motion cluster. The pixel level cloud heights are obtained from a cloud height retrieval algorithm that is run upstream of the AMV algorithm. Clear sky winds: median BT of coldest 20% of target scene used as lookup with forecast model temperature profile.
CIMSS GEO&LEO	Cloudy winds: median cloud top pressure (CTP) of largest motion cluster. Clear sky winds: median BT of coldest 20% of target scene used as lookup with forecast model temperature profile. Depending on satellite and channel, BT or cloud top product is used.
CPTEC/INPE GEO	Effective Black-body Brightness Temperature (EBBT), WV/IR rationing and CO2 intercept

24. Thresholds/limits/particularities used in the Height assignment process	
EUMETSAT GEO&LEO	None.
NWCSAF GEO&LEO	"CCC method" applies to both cloudy and clear air AMVs. "CCC method" includes the calculation of an "AMV pressure error", for which only values up to 150 hPa are valid (this is configurable by the user). For cloudy AMVs, "CCC method" includes a "Microphysics correction" of the "AMV pressure", related to the cloud thickness and calculated through NWC/GEO or LEO Cloud Microphysics product. This correction is applied to all satellite series except GOES-N, for which NWC/GEO-Cloud Microphysics product is not available. For clear air AMVs, the "AMV temperature" is calculated through the brightness temperature of the pixels considered by the method, and then this "AMV temperature" is converted to "AMV pressure" through interpolation to the NWP temperature forecast. "Brightness temperature interpolation method" is used when NWC/GEO-Cloud products are not available. Two pressure values are calculated by the method: "AMV top pressure" and "AMV base pressure", from which the "AMV pressure" is defined depending on the "AMV cloud type".
JMA GEO	If the geometric mean of radiance likelihood term is less than 0.5 or if the optimal radiance and the observed radiance are significantly different, the target is rejected. (QC process)
KMA GEO	None.
NOAA GEO&LEO	10% cloud amount threshold used when tracking cloudy features 100% clear sky threshold for clear sky WV winds. 100 hPa threshold applied to the difference between intermediate cloud top pressure assignment of the largest motion cluster. Visible and SWIR winds are limited to 700-1000 hPa layer. Cloud top WV winds limited to 100 - 350 hPa layer. LWIR winds are limited to 100 -1000 hPa layer. Dominant Cloud Phase check for target scene: If AMV height assignment is above (below) 500 hPa and the dominant cloud type for the target scene is liquid water (ice/cirrus), the AMV fails.
CIMSS GEO&LEO	10% cloud amount threshold used when tracking cloudy features 100% clear sky threshold for clear sky WV winds. 100 hPa threshold applied to difference between intermediate cloud top pressure assignment of largest motion cluster. Visible and SWIR winds are limited to 700-1000 hPa layer. Cloud top WV winds limited to 100 - 350 hPa layer. LWIR winds limited to 100 -1000 hPa layer.
CPTEC/INPE GEO	EBBT is used for all opaque tracers. Semi-transparent tracers are identified using the local cloud classification product and its brightness temperature are corrected by WV/IR and CO2 slicing methods.

25. NWP/products specifically used in the Height assignment process	
EUMETSAT GEO&LEO	NWP fields are used in AMV software only when EBBT method or inversion methods are applied
NWCSAF GEO&LEO	With “CCC method” and Cloudy AMVs, CT (Cloud type), CTTH (Cloud top temperature and height) and CMIC (Cloud microphysics, when available) outputs are used. With “CCC method” and Clear air AMVs, the brightness temperature of the pixels and the NWP temperature forecast are used. With “Brightness temperature interpolation method”, the brightness temperature of the pixels, the NWP temperature forecast and CT (Cloud type) outputs are used.
JMA GEO	Brightness temperature for all bands, at each vertical layer, calculated using NWP vertical profile with RTTOV. First guess wind vertical profile. Vegetation data for BIAS correction
KMA GEO	NWP Temperature profiles are used for Inversion layer correction for cloudy AMVs if there is inversion layer.
NOAA GEO&LEO	The upstream 1DVar cloud height and cloud phase algorithms use several NWP profile parameters. The AMV algorithm uses the NWP wind profiles for gross error (vector difference) checks and the NWP temperature profile for clear sky WV height assignment.
CIMSS GEO&LEO	The upstream 1DVar cloud height and cloud phase algorithms use several NWP profile parameters. The AMV algorithm uses the NWP wind profiles for gross error (vector difference) checks and the NWP temperature profile for clear sky WV height assignment.
CPTEC/INPE GEO	Temperature, pressure, humidity and wind profiles.

26. Options to calculate “stereo heights”, considering the parallax of an AMV viewed by two different satellites (evaluating how the height assignment compares to existing approaches and NWP best-fit pressure, and noting the expanded coverage using the GEO ring and a combination of GEO-LEO).	
EUMETSAT GEO&LEO	GEO-GEO stereo heights could be computed between Meteosat-9 (IODC) and Meteosat-10 (FES). Possibilities exist for GEO-LEO heights as well. However, no investigation is currently planned.
NWCSAF GEO&LEO	A “Visiting Scientist Activity” is planned for 2024 with Dong Wu and Jim Carr to include their “stereo height procedure” in NWC/GEO-HRW algorithm, considering the pair of satellites GOES-East and MTG-I. The procedure can be later extended to other satellite combinations.
JMA GEO	JMA operates just only one GEO, so study about stereo heights is not planned
KMA GEO	-
NOAA GEO&LEO	Stereo winds capability has been developed that uses combinations of GEO-GEO (GOES-E, GOES-W, Himawari) and GEO-LEO (GOES-E, GOES-W, Himawari, S-NPP, NOAA-20, NOAA-21) satellites. Operational transition efforts begin in 2024.
CIMSS GEO&LEO	Not planned.
CPTEC/INPE GEO	-

QUALITY AND AMV FILTERING

27. Quality methods used for the AMV filtering	
EUMETSAT GEO&LEO	Weighted average of consistency checks based on Holmlund 1998
NWCSAF GEO&LEO	Four methods are used one after the other for the AMV filtering: 1. "Quality Indicator" method. The method uses exactly the same procedure and configuration that EUMETSAT is using, but with a triple weight for the spatial and temporal vector consistency tests. 2. "Common Quality Index without forecast" self-contained Fortran method, distributed to the IWWG in May 2017. 3. A "Final control check". The function calculates velocity and direction histograms for all valid AMVs in square boxes of 5x5 degrees of latitude and longitude. When any of the histogram columns has only one element, that AMV is excluded. 4. "Orographic flag" method, which combining topographic information and NWP data, detects and rejects AMVs affected by land influence.
JMA GEO	Wind speed range, satellite zenith angle, maximum cross-correlation coefficient, radiance likelihood checking and stripe noise check. Imagery navigation error check with "QI not using forecast".
KMA GEO	Own QI: Weighted average of each QI tests scores based on Holmlund 1998 Common Quality index (QI) Expected Error(EE)
NOAA GEO&LEO	Quality Indicator approach used, which includes common QI approach. Acceleration thresholds used on the intermediate wind vectors, band-dependent. Vector difference thresholds applied using the forecast wind, band-dependent. Satellite zenith angle threshold (70 degrees) applied to all AMVs.
CIMSS GEO&LEO	Acceleration thresholds used on the intermediate wind vectors, band dependent. A vector difference threshold is applied using the forecast wind, band dependent.
CPTEC/INPE GEO	Local Quality Index based on the one used by EUMETSAT.

28. Specific Quality indices provided in the AMV output	
EUMETSAT GEO&LEO	GEO: QI with forecast, QI without forecast, QI without forecast based on OCA (rather than CLA), Common QI. LEO: QI with FC, QI without FC, Common QI.
NWCSAF GEO&LEO	"Quality Index with forecast". "Quality Index without forecast". "Common Quality Index without forecast" "Orographic flag".
JMA GEO	Quality Index with forecast Quality Index without forecast
KMA GEO	Own QI and common QI with forecast Own QI and common QI without forecast
NOAA GEO&LEO	EUMETSAT Quality Indicator (QI) with forecast term. Common QI without forecast Individual QI component test values. Expected Error computed but not used.
CIMSS GEO&LEO	QI without forecast and CIMSS recursive filter flag in text and MD files, same as NESDIS for netCDF files
CPTEC/INPE GEO	Own Quality Index flag with NWP forecast. Own Quality Index flag without NWP forecast. A common QI could be added in the future.

29. Status of implementation of the Common Quality index	
EUMETSAT GEO&LEO	Applied since November 2018 for MPEF release 2.7.
NWCSAF GEO&LEO	Implemented in all GEO versions since v2018 (available since February 2019), and all LEO versions
JMA GEO	Applied since 17 March 2019.
KMA GEO	Applied since 28 October 2019.
NOAA GEO&LEO	Implemented in May 2022.
CIMSS GEO&LEO	Not implemented
CPTEC/INPE GEO	In time before the 4th AMV Intercomparison.

30. Options to calculate a “tracking error”, related to the shape and size of the AMV correlation surfaces, and when these options can be implemented	
EUMETSAT GEO&LEO	Currently studying the link between correlation surface statistics and AMV quality on GEO and LEO. No use in operational products planned yet.
NWCSAF GEO&LEO	The inclusion of the “tracking error”, related to the shape and size of the AMV correlation surfaces, is planned for the second NWC/GEO-HRW version for MTG-I satellite (around 2026).
JMA GEO	There is no doubt that the correlation coefficient surface is strongly related to the probability distribution of tracking errors, but it is very difficult to formulate it mathematically. At present, there is no level of knowledge that can be applied to operations.
KMA GEO	-
NOAA GEO&LEO	Not implemented.
CIMSS GEO&LEO	Not implemented.
CPTEC/INPE GEO	-

31. Thresholds/limits/particularities used as “gross error check” in the AMV output filtering, which are related to a comparison with the NWP wind.	
EUMETSAT GEO&LEO	None.
NWCSAF GEO&LEO	The only impact of the NWP wind in the AMV output filtering, is its use in the “forecast quality test” included in the “Quality index with forecast”, which is used as default option for the AMV filtering (with “Quality Index with forecast” ≥ 75% for GEO AMVs and ≥ 83% for LEO AMVs). However, the threshold and the fact of using for the filtering the “Quality Index with/without forecast” is configurable by the user.
JMA GEO	Gross error check using NWP winds is not implemented.
KMA GEO	-
NOAA GEO&LEO	Vector difference thresholds: Visible (low levels): 6 m/s SWIR (low levels): 7 m/s Cloud-top WV: 8.5 m/s Clear-sky WV: 12 m/s GEO LWIR: 8 m/s LEO LWIR: 7 m/s
CIMSS GEO&LEO	Vector difference thresholds: Visible (low levels): 6 m/s SWIR (low levels): 7 m/s Cloud-top WV: 10 m/s Clear-sky WV: 12 m/s LWIR: 10 m/s
CPTEC/INPE GEO	-

32. Other thresholds/limits/particularities used as “gross error check” in the AMV output filtering, which are not related to a comparison with the NWP wind.	
EUMETSAT GEO&LEO	GEO: None. LEO: Only a pair of images are used to extract Global AVHRR and single mode AVHRR AMV products. So, a reverse tracking is done to calculate the temporal consistency check.
NWCSAF GEO&LEO	“Quality Index with forecast” ≥ 75% is used for GEO AMVs and ≥ 83% for LEO AMVs. However, the threshold and the fact of using for the filtering the “Quality Index with/without forecast” is configurable by the user. All AMVs affected by land influence are rejected. However, this is configurable by the user. AMVs related to some specific pressure values, some cloud types, and some “spatial quality flags” are rejected, depending on the satellite channel. However, this is configurable by the user. Considering the up to three AMVs calculated for each tracer, only the one with best values for most quality tests plus correlation (when calculated) is retained.
JMA GEO	Only AMVs that have passed quality control process and quality index thresholds are retained. “QI with forecast” has to be larger than 75% (85% for WV AMV).
KMA GEO	AMVs with pressure between 1000 and 100 hPa.
NOAA GEO&LEO	Solar (VIS and SWIR) and Satellite Zenith angle (all channels) cutoff thresholds are applied. Visible and SWIR winds are limited to 700-1000 hPa layer. Cloud top WV winds limited to 100 - 350 hPa layer. LWIR winds are limited to 100 -1000 hPa layer. Dominant Cloud Phase check for target scene: If AMV height assignment is above (below) 500 hPa and the dominant cloud type for the target scene is liquid water (ice/cirrus), the AMV is screened. QI thresholds: Visible winds: QI >= 50% All winds except visible: QI >= 60%
CIMSS GEO&LEO	Text/MD files are available both with/without AMV’s over land. Synoptic scale QI thresholds: GOES-N QI>=50% for all channels GOES-R QI>=50% for all channels Meteosat-8 VIS006 QI>=70%, other channels QI>50% Meteosat-11 VIS006 QI>=70%, other channels QI>50% Himawari-8 QI>=60% for all channels GOES-16 mesoscale products: VIS064 QI>=90%, pressure level >= 700 hPa or pressure level <= 300 hPa and cloud top temperature <= 220 K IR039(dark only)/IR112/WV062(cloud top) QI>=60%.
CPTEC/INPE GEO	Recommendation to use only AMV with QI over 70%. Except AMVs rejected during the MCC calculation, all AMVs evaluated by the final QI remain in the final output. AMVs with speed out of a predefined range receive a QI=0.