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Recent upgrades and progresses of satellite radiance data assimilation at JMA

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Recent upgrades and progresses of satellite radiance data assimilation at JMA

- List of Upgrades
  - Use of Metop-C/AMSU-A, MHS (LA, Nov. 2021)
  - Use of Metop-C/IASI (GA, Nov. 2021)
  - Additional use of AMUS-A/ch 8-11 with model top extension (MA, Mar. 2022)
  - Implementation of hybrid 3D-Var (La, Mar. 2022) (Yokota, S., et al., 2022)
  - Update RTTOV v10.2 to v13.0 (minimal changes) (GA and MA, Jun.; LA, Aug. 2022)
  - Use of Suomi-NPP, NOAA-20/ATMS (183GHz) (MA, Jun.; LA, Aug. 2022)
  - Switch IODC Meteosat-8 to Meteosat-9 AMV and CSR (GA, Jun. 2022)
  - Switch Meteosat CSR to stored CSR in ASR product (GA, Oct. 2022)
  - Switch Himawari-8 to Himawari-9 AMV and CSR (GA, MA and LA, Dec. 2022)
  - Additional use of Hyperspectral IR sounders' humidity channels (GA, Mar. 2023)
  - Use of Hyperspectral IR sounders (MA and LA, Mar. 2023)
- Future Plans
  - Use of GOES-18 AMV and CSR in GA
  - Computer system replacement
  - Use of NOAA-21/ATMS, CrIS
  - Update to RTTOV-13.0 (new coefficients and functions)
  - Use of CO2 band CSR of geostationary satellites
  - Use of AMSU-A and ATMS window channels
  - Implementation of Dynamic Emissivity (DE) over land for lower peaking microwave channels
  - Optimization of observation error
  - All-sky assimilation of microwave radiances in MA and LA
  - All-sky assimilation of geostationary infrared radiance

Satellite data used in the operational assimilation systems. (as of Mar. 2023)

Type	Satellite/Instrument	Global Analysis	Meso-scale Analysis	Local Analysis
MW Sounder	NOAA15,18,19, Metop-B,-C/AMSU-A	Radiance	Radiance	Radiance
	NOAA19,Metop-B,-C/MHS	**Radiance**	Radiance	Radiance
	DMSP-F17,18/SSMIS	**Radiance**	-	-
	Suomi-NPP, NOAA20/ATMS	Radiance (T,**H**)	Radiance (H)	Radiance (H)
	FY-3C/MWHS-2	**Radiance**	-	-
IR Sounder	Metop-B,-C/IASI	Radiance (T,*H*)	*Radiance (T,H)*	*Radiance (H)*
	Suomi-NPP, NOAA20/CrIS	Radiance (T,*H*)	*Radiance (T,H)*	*Radiance (H)*
MW Imager	DMSP-F17,18/SSMIS	**Radiance**	Radiance, Rain Rate	Radiance
	GCOM-W/AMSR2	**Radiance**	Radiance, Rain Rate	Radiance, Soil Moisture
	GPM-core/GMI	**Radiance**	Radiance, Rain Rate	Radiance
VIS/IR Imager	Himawari-9	CSR, AMV	CSR, AMV	CSR, AMV
	GOES-16,(17)	CSR, AMV	-	-
	Meteosat-9,11	CSR, AMV	-	-
	NOAA15,18,19, Metop-B,-C/AVHRR	AMV	-	-
	Aqua,Terra/MODIS	AMV	-	-
	Suomi-NPP, NOAA20/VIIRS	*AMV*		
	LEOGEO composite image	AMV	-	-
Scatterometer	Metop-B,-C/ASCAT	OSWV	OSWV	*OSWV* Soil Moisture
Radio Occultation	Metop-B/GRAS	Bending Angle	Refractivity	-
	TerraSAR-X/IGOR	Bending Angle	Refractivity	-
	TanDEM-X/IGOR	-	Refractivity	-
Radar	GPM/DPR	-	Relative Humidity	-

*) Red indicates updates in the operational system since ITSC-23.
*) *Italic* indicates plans to be implemented in Mar. 2023.
*) **Blue** indicates all-sky assimilation.