MSM specifications

1. System	
System	Meso-scale model (forecast model: ASUCA)
Date of implementation	1 Mar. 2001 (ASUCA: 28 Feb. 2017)
2. Configuration	
Domain	Japan, Lambert projection, 817 × 661 grid points
Horizontal resolution	5 km at 60 and 30°N (standard parallels)
Number of model levels	76
Model top	21.8 km
Forecast length	39 hours
Runs per day (times in UTC)	8 (00, 03, 06, 09, 12, 15, 18 and 21 UTC)
Coupling to ocean/wave/sea ice models	None
Integration time step	100/3 seconds (3-stage Runge-Kutta method)
3. Initial conditions	
Data assimilation method	4D-Var analysis with mixing ratios of cloud water, cloud ice, rain, snow and graupel derived from preceding forecasts in consideration of consistency with the analysis field of relative humidity
4. Surface boundary conditions	
Sea-surface temperature	Observed SST (fixed during time integration) and sea-ice distribution
Land surface analysis	Climatological values of evaporability, roughness length and albedo Snow cover analysis over Japan using a land surface model
5. Lateral boundary conditions	
Model providing lateral boundary conditions	GSM
Lateral boundary condition update frequency	4 times/day 00 – 45-hour GSM forecasts initialized at 00/06/12/18 UTC for (03, 06)/(09, 12)/(15, 18)/(21, 00) UTC forecasts
6. Other model details	
Soil scheme	Ground temperature prediction using an eight-layer ground model Evaporability prediction initialized using climatological values depending on location and season
Radiation	Short wave: two-stream with delta-Eddington approximation (every 15 minutes) Long wave: two-stream absorption approximation method (every 15 minutes)
Large scale dynamics	Finite volume method on Arakawa-C-type staggered coordinates, horizontally explicit and vertically implicit time integration scheme, combined third- and first-order upwind horizontal finite difference schemes in flux form with a limiter by Koren (1993) in advection treatment for monotonicity Fully compressible non-hydrostatic equations
Boundary layer	Improved Mellor-Yamada Level 3 scheme Similarity theory adopted for surface boundary layer
Convection	Kain-Fritsch convection scheme
Cloud/microphysics	Three-ice bulk cloud microphysics Considering PDF based cloud distribution in microphysics Time-split treatment for rain and graupel precipitation Cloud water and cloud cover diagnosed using a partial condensation scheme
Orography	Mean orography smoothed to eliminate shortest-wave components
Horizontal diffusion	None
Gravity wave drag	None