A High Resolution Global NWP Model at Japan Meteorological Agency

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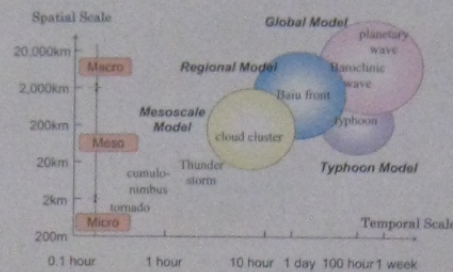
Model Specification

- Resolution: TL319 (60 km) ⟶ TL959 (20km); 40 layers ⟶ 60 layers
- Dynamics: Spectral method (Semi-Implicit Semi-Lagrangian); Finite difference (σ-pressure vertical coordinate)
- Convection: Arakawa-Schubert mass flux
- ABL: K closure (based on Ri number)
- Radiation(L): k-distribution and table look-up
- Radiation(S): Two-stream approximation
- Cloud: Prognostic (statistical approach)
- GWD: Orographic GWD is parameterized
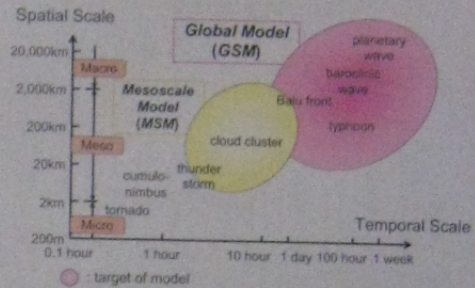- Land surface: Simple Biosphere (SiB) model

JMA NWP models

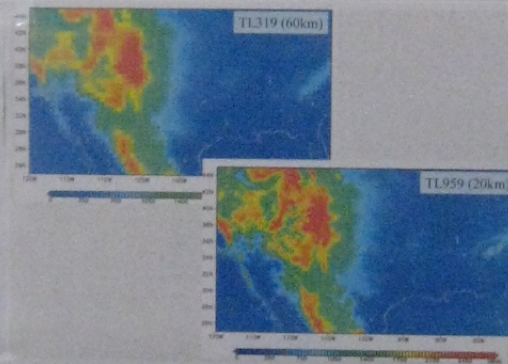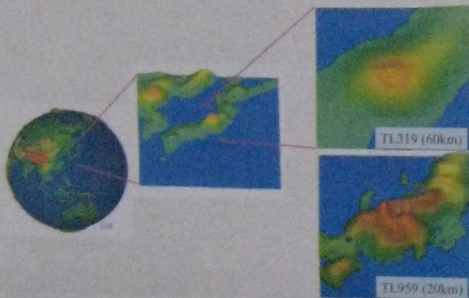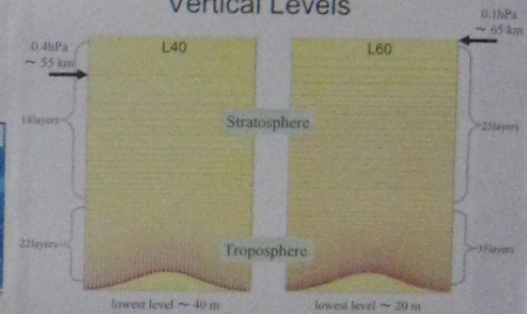| Model	GSM	RSM	MSM	TYM
Horizontal Resolution (#Grid points)	0.5625 deg (640 x 320)	20 km (325 x 257)	5 km (721 x 577)	24 km (271 x 271)
Vertical Levels	40 (Surface to 0.4 hPa)	40 (Surface to 10 hPa)	50 (Surface to 21,800 m)	25 (Surface to 17.5 hPa)
Initial Times	00, 06, 12, 18 UTC	00, 12 UTC	00, 03, 06, 09, 12, 15, 18, 21 UTC	00, 06, 12, 18 UTC
Forecast Hour	36 / 90 / 216	51	15	84

Current Configurations

Future Plan

: target of model

Orography and Resolutions

TL319 (60km)

TL959 (20km)

TL319 (60km)

TL959 (20km)

Vertical Levels

L40   L60

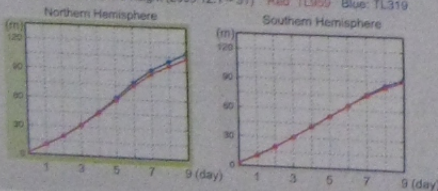Stratosphere

Troposphere

lowest level ~ 40 m   lowest level ~ 20 m

Prediction Skill

A high resolution global model shows obvious increases of the NWP skill compared to the current JMA models.

RMSE of 500hPa height (2005.12.1 – 31)   Red: TL959   Blue: TL319

Northern Hemisphere   Southern Hemisphere

TL319

TL959

TL959BCP

Precipitation
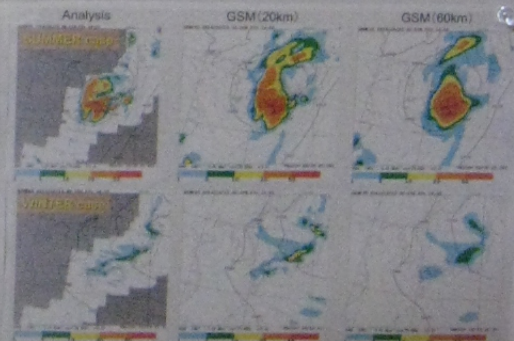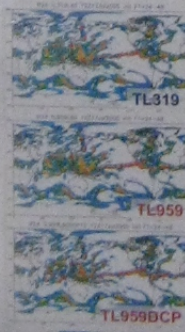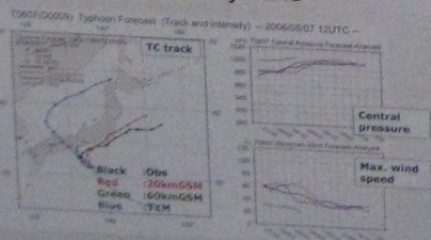
Convection trigger function

Xie and Zhang (2000)

Deep convection is assumed to occur only when DCAPE(dynamic CAPE generation rate)>0, which corresponds to dynamic warming or moistening in the lower troposphere.

$$DCAPE = \Delta CAPE\,(T,q)/\Delta t$$
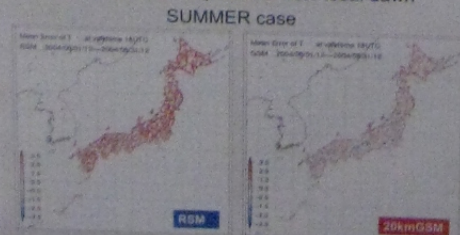
$$CAPE = \int g \frac{T_v'' - \bar{T}_v}{\bar{T}_v}\,dz$$

Analysis   GSM (20km)   GSM (60km)

Tropical Cyclone

Typhoon Forecast (Track and Intensity) – 2006/08/07 12UTC –

TC track

Central pressure

Max. wind speed

Black : Obs
Red : 20kmGSM
Green : 60kmGSM
Blue : TYM

Surface Meteorology

Errors in 2m air temperature near local dawn
SUMMER case

RSM   20kmGSM

WINTER case

RSM   20kmGSM
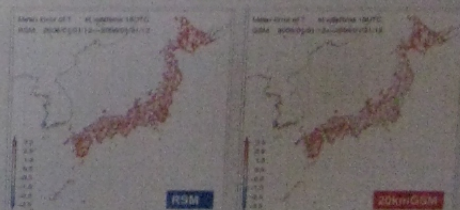
Boundary layer and snow/land processes must play crucial roles in daily minimum temperature over cold region (such as northern part of Japan islands).