High-resolution global simulations of high-impact weather

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8 December 2004
High-resolution global simulations using AFES

Three examples of simulations of global-to-local events using AFES (AGCM for the Earth Simulator) are shown:

1. November 2002: Prestige disaster
2. August 2002: Floods in central Europe

All cases are integrated from GPV (grid-point value) data set provided by JMA at T639L48 resolution (20-km horizontal, 25 hPa vertical in the troposphere).
November 2002: Prestige disaster
250 hPa PV and wave activity flux

JMA analysis 12 UTC 13 Nov

AFES T639L48 FT=24
Near-surface winds

QuickSCAT
QuickSCAT/L3 asc 13 Nov 2003  u m/s

AFES T639L48 FT=24
U  925hPa 12UTC 13 Nov
August 2002: Floods in central Europe
JMA 25-member ensemble forecast

FT=72 valid:12 UTC 11 Aug
Sensitivity analysis using ensemble forecasts

TE J/kg mode=0 contrib=42.6% FT=72hr INIT=20020808
Perturbed run

slp (hPa) perturbed − unperturbed

FT=60

0UTC 11 Aug 2002

FT=72

12UTC 11 Aug 2002

JAMSTEC
1st THORPEX Symposium
July 2004: Heat wave in Tokyo area

- **Observed**: Max T (°C) = 39.5°C on 20 July
- **Climatology**: Temperature trend for July

Map showing high-pressure system (H) and wind flow at 1000 hPa on 20 July, near Tokyo.
Silk road pattern


JMA analysis
Simulated temperature $\text{FT}=114$
Simulated temperature near Tokyo

T degC (simga=0.994)

Tokyo 139.7E, 35.7N

1st THORPEX Symposium
850 hPa $\theta_e$ and winds
Simulated heat wave
Summary and discussions

- Meso-scale resolving AGM’s are a useful tool to study global-to-local events.
  - represents fast energy propagation by Rossby waves.
  - resolves local events such as streaks of PV and moisture, gusts and fronts.

- Initial perturbations sensitive to a disturbance in a pre-defined region can be calculated from ensemble forecasts. Those perturbations can be used in perturbed simulations at a higher resolution to investigate the impact.

- Local events may be skillfully predicted when it is influenced by large-scale (dry) dynamics. Local (moist) events may modulate large-scale flows and affect local events at remote places.