Large ensemble based data assimilation with MASINGAR-mk2

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10,240-member Data Assimilation (DA)

○ SPEEDY model (Molteni 2003)
- Intermediate AGCM (T30/L7 ~ dx = 400 km)

○ LETKF (Hunt et al. 2007)
- One of ensemble Kalman filters using a transform matrix in the local space
- High parallelization efficiency

○ Miyoshi et al. (2014), Kondo and Miyoshi (2016) successfully implemented 10,240-member LETKF with the SPEEDY model under the perfect model scenario.

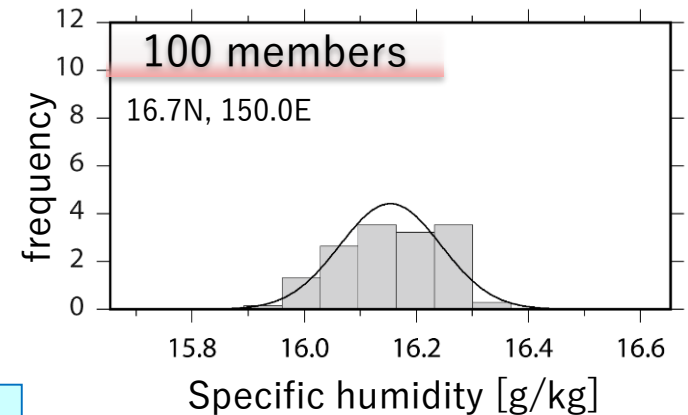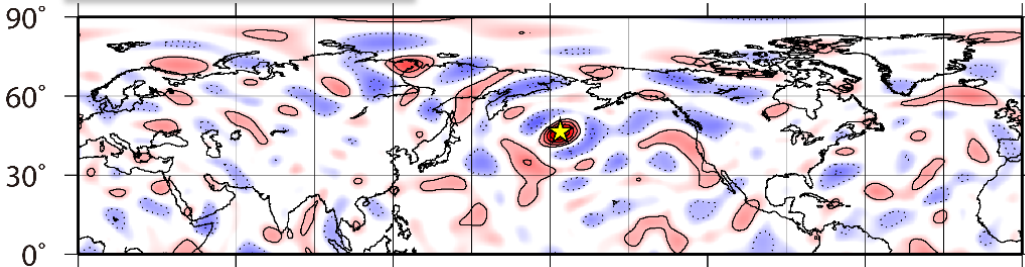Revealed background covariance structure and PDF in the atmosphere

10,240-member Data Assimilation

○ Miyoshi et al. (2014), Kondo and Miyoshi (2016) successfully implemented 10,240-member LETKF with the SPEEDY model under the perfect model scenario.
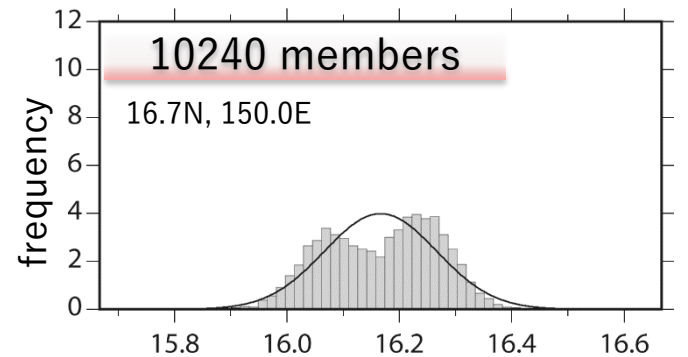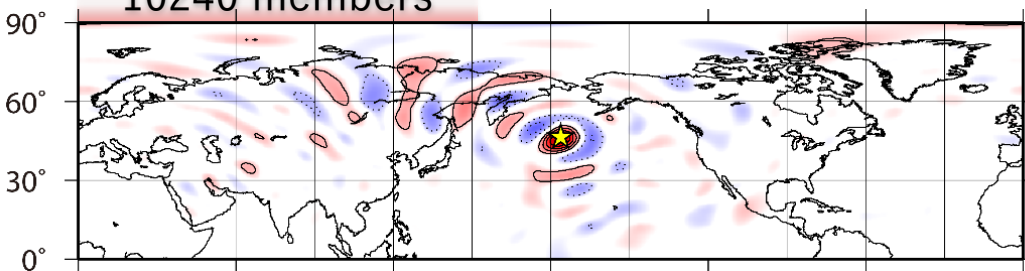
Auto-correlations for Q from ⭐ at 00 UTC 17 January.

Specific humidity [g/kg] at a single grid point

Sampling noise reduced

High-precision probabilistic representation

NICAM: Non-hydrostatic Icosahedral Atmospheric Model

The horizontal resolution can be increased by splitting one triangle into four triangles.

Grid division level	Horizontal resolution
6	112 km
7	56 km
8	28 km
9	14 km
10	7 km
11	3.5 km
12	1.7 km
13	0.87 km

(0) grid division level 0   (1) grid division level 1
(2) grid division level 2   (3) grid division level 3
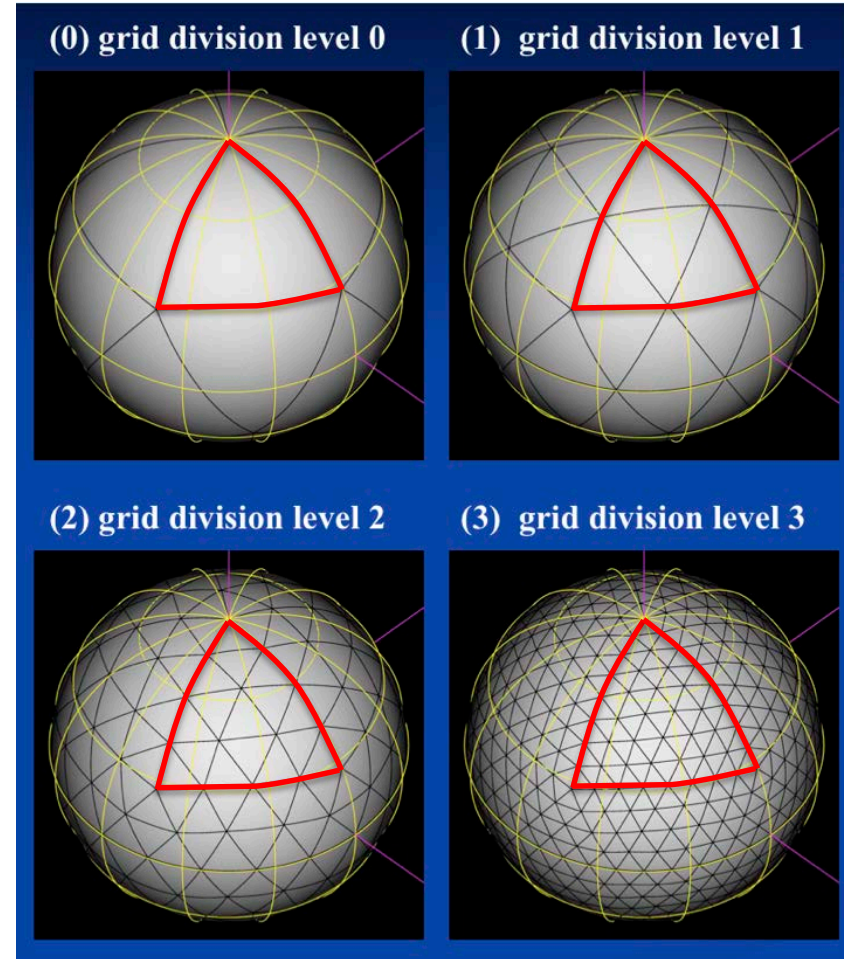
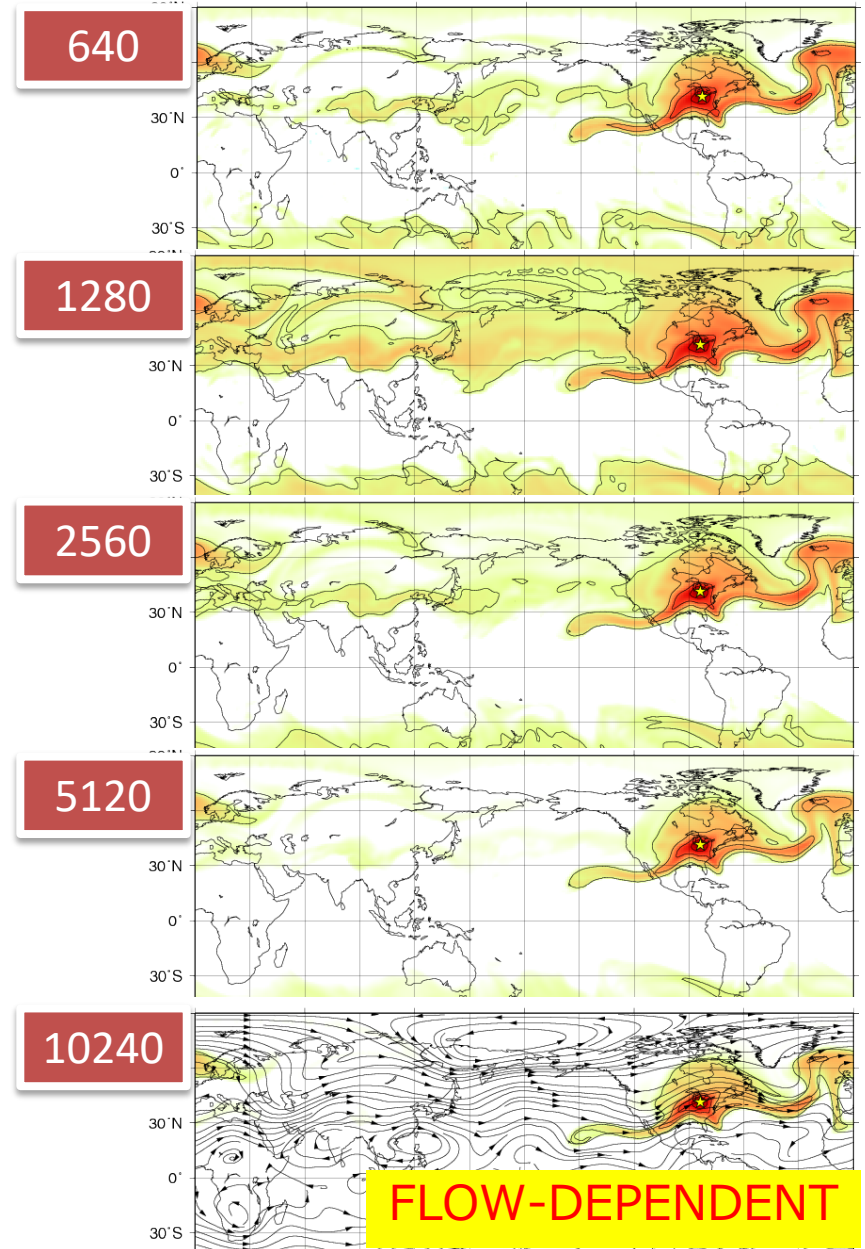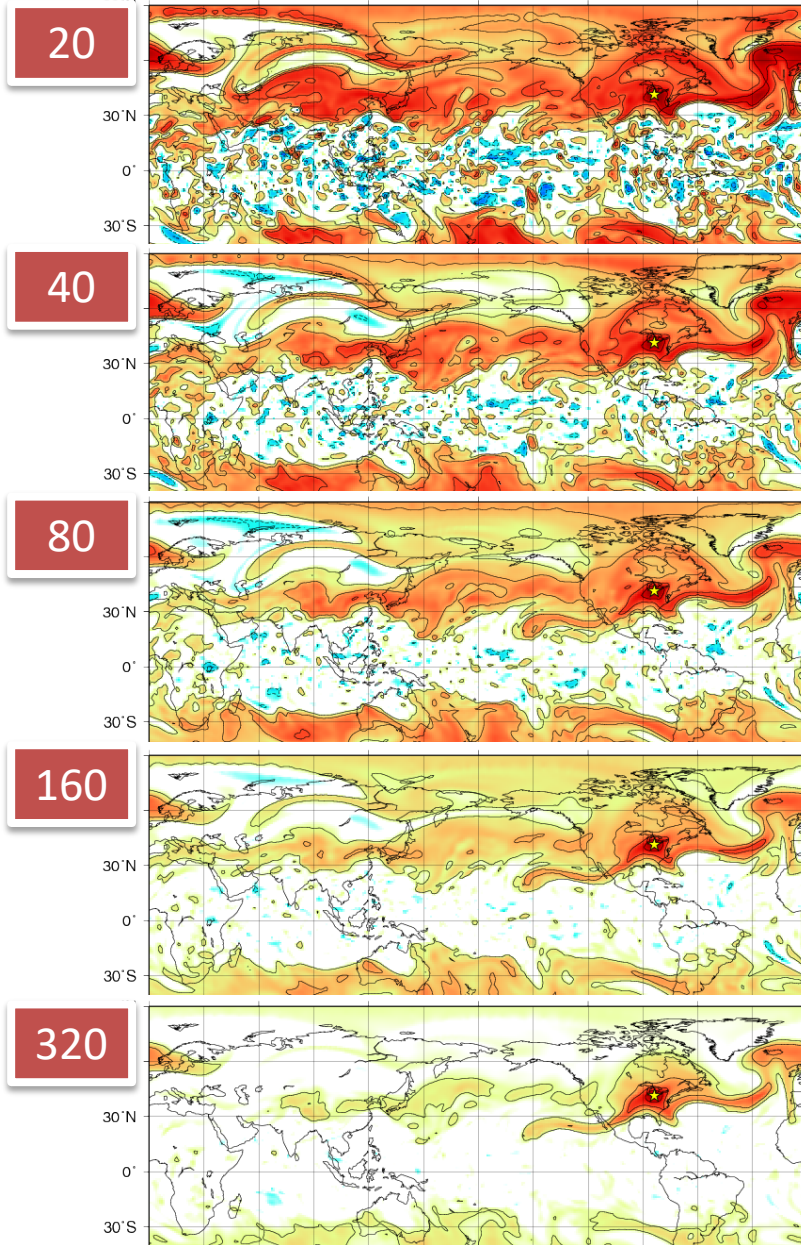## NICAM-LETKF with 10240 members is performed.

Advantage of 10240 samples (auto correlation)
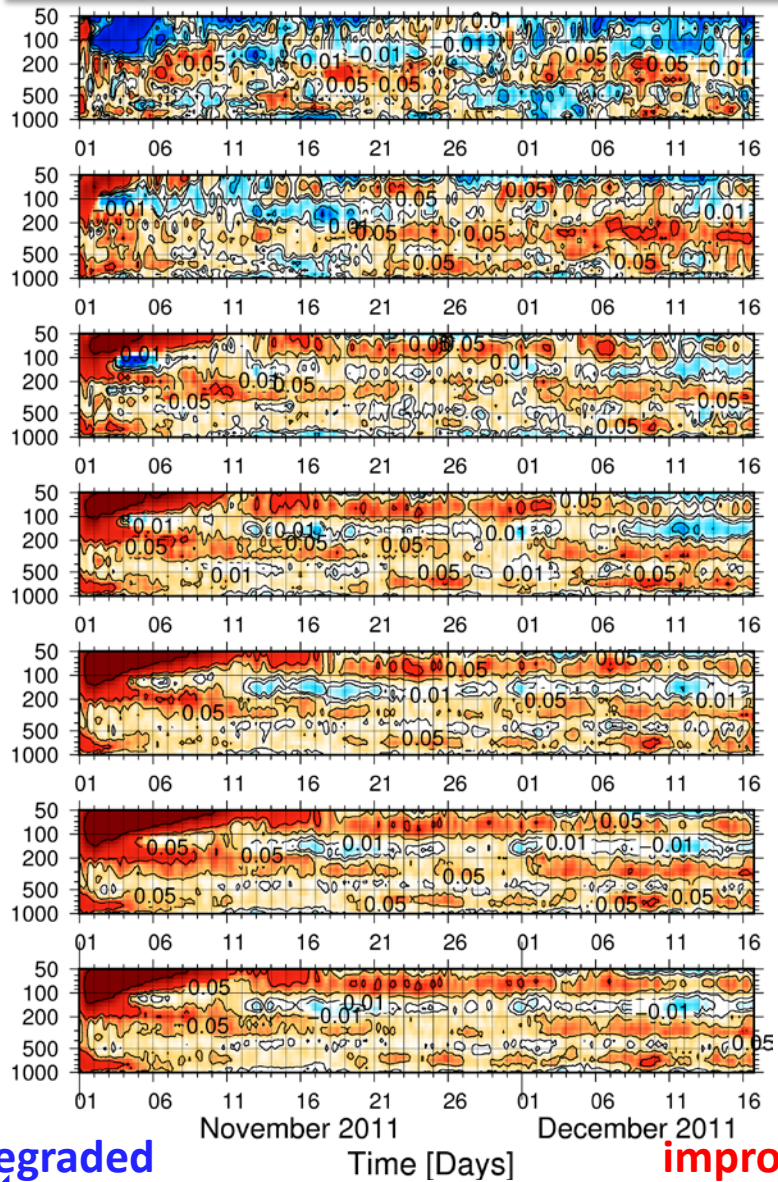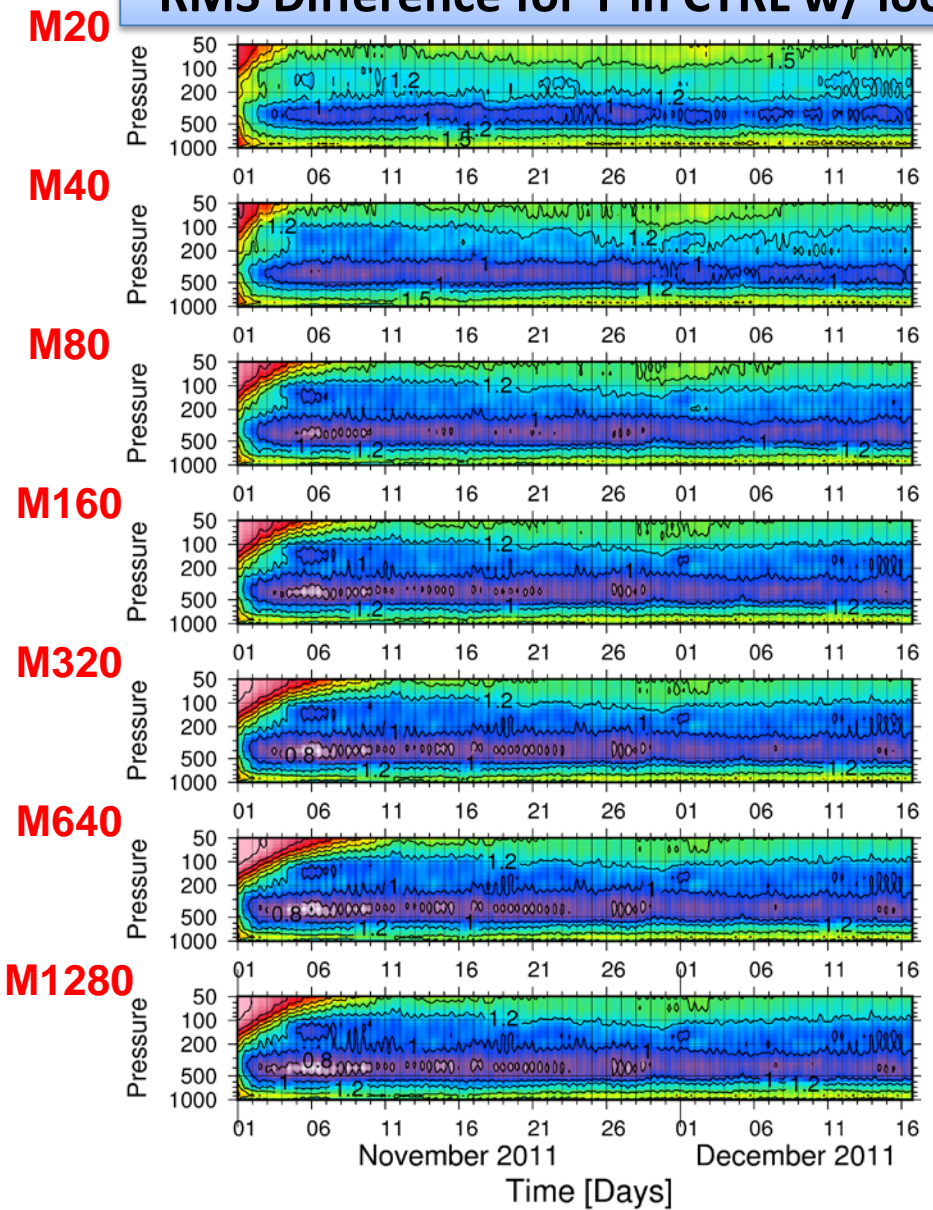
FLOW-DEPENDENT

Vertical Localization for Satellite Radiances (AMSU-A)

RMS Difference for T in CTRL w/ loc.

Improvement for TEST w/o loc.

M20, M40, M80, M160, M320, M640, M1280
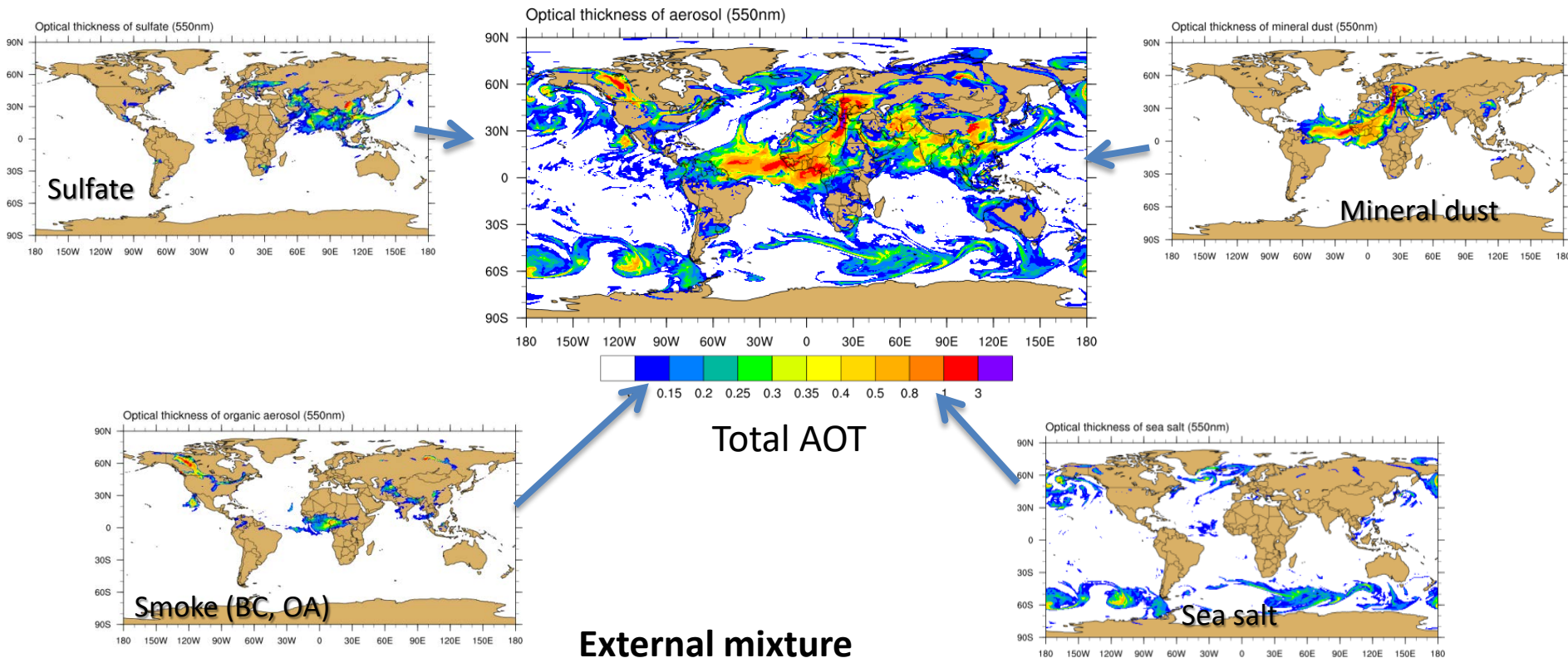
degraded — improved

Research Plans in MRI

○ Large ensemble DA using MASINGAR

- MASINGAR: Model of Aerosol Species in the Global Atmosphere (Tanaka et al. 2003)
  - Sulfate, black carbon, organics, sea salt, and mineral dust.
- MASINGAR-LETKF (Yumimoto et al. 2016)

Sulfate

Mineral dust

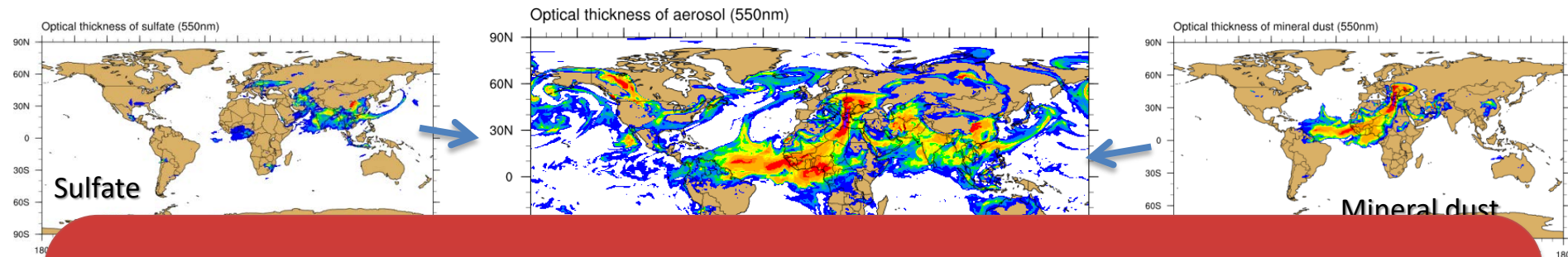Total AOT

Smoke (BC, OA)

Sea salt

External mixture

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Optical thickness of sulfate (550nm)

Sulfate

Optical thickness of aerosol (550nm)

Optical thickness of mineral dust (550nm)

Mineral dust

Motivation
Large ensemble DA would reveal the correlations between aerosol species.

Smoke (BC, OA)

External mixture

Sea salt

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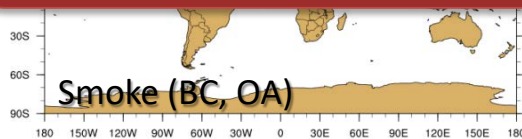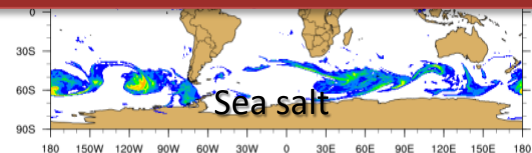
  • MASINGAR-LETKF (Yumimoto et al. 2016)

○ Optimal vertical localization for satellite observations

○ Multi-scale DA (Miyoshi and Kondo 2013, Kondo et al. 2013)

Higher resolution

Multi-localization

| Num. of obs = 4 | Num. of obs = 2 | Num. of obs = 7 |