# Big Data assimilation for weather forecasting

Arata Amemiya (RIKEN Center for Computational Science, Data assimilation research team)

## Simulation of the global atmosphere with 850m horizontal resolution



(Miyamoto et al., 2013)

#### **Data assimilation** combines observation and model simulation



#### **Data Assimilation**



#### Kalman filter

$$x^{a} = x^{f} + \mathbf{K}(y - \mathbf{H}x)$$
$$\mathbf{K} = \mathbf{B}\mathbf{H}^{\mathrm{T}}(\mathbf{H}\mathbf{B}\mathbf{H}^{\mathrm{T}} + \mathbf{R})^{-1}$$

- **B** : background covariance matrix  $(N \times N)$
- **R** : observation covariance matrix  $(M \times M)$
- **H** : observation operator ( $N \times M$ )

### **Parallelization 1: Domain decomposition**

Most atmospheric processes are vertically coupled

- Cloud and precipitation
- Radiation
- $\rightarrow$  efficient horizontal 2-D decomposition



#### **Parallelization 2: Ensemble forecast**



Multiple domains × Multiple ensemble members  $\downarrow$ O(100)~O(1000) processes

