Ensemble data assimilation for a large parallel numerical weather prediction model: Development of the SCALE-LETKF system

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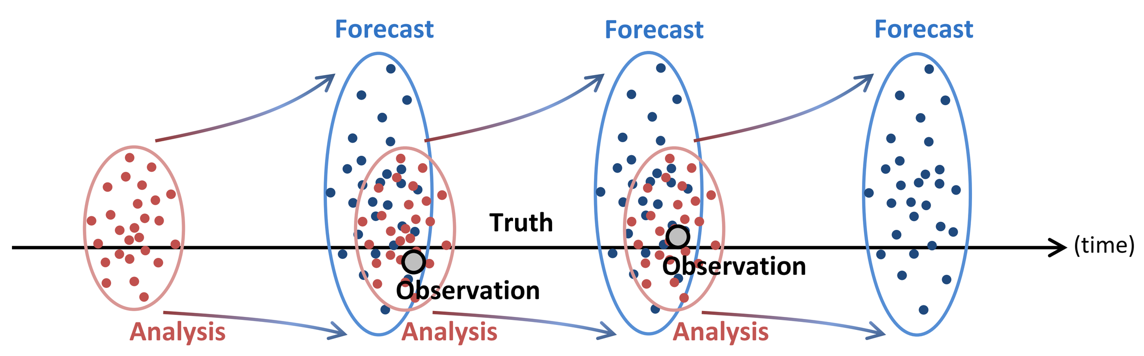
K computer
Computer simulations create the future

Introduction

Local ensemble transform Kalman filter (LETKF)

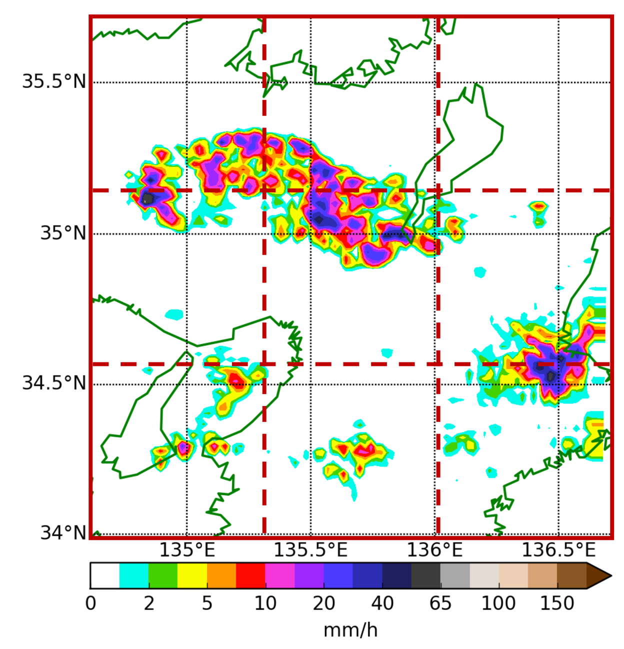
- An ensemble Kalman filter (EnKF) data assimilation scheme.
  - Use an ensemble to represent the probability distribution of the model states.
  - Combine the forecasts (prior state) and the observations to obtain the analyses (posterior state).
  - Performs the computation in ensemble space and in each local domain.
- The core code of LETKF has been coupled with several atmospheric and oceanic models:
  https://code.google.com/p/miyoshi/



Scalable Computing for Advanced Library and Environment (SCALE)

- The SCALE library:
  - A basic library for weather and climate model of the earth and planets.
  - Developed with co-design by researchers of computational science and computer science.
- SCALE-LES:
  - A numerical weather prediction model performing large eddy simulation (LES) based on the SCALE library.

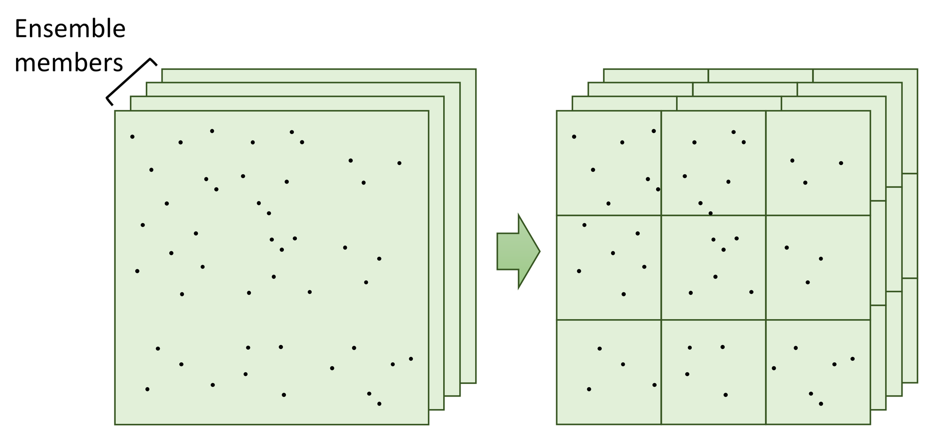
SCALE simulation of precipitation rate



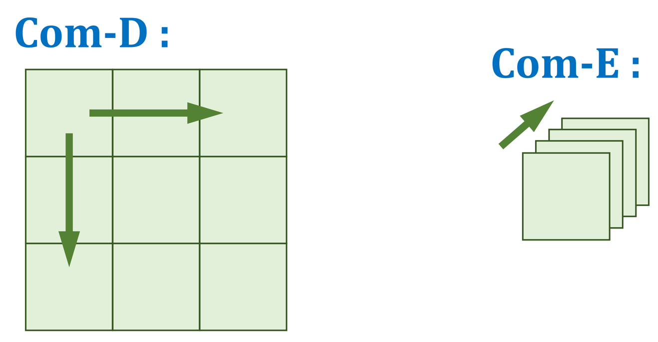
(9 subdomains; one process is in charge of a subdomain)

Objectives

- To improve the LETKF code for a large parallel numerical weather prediction model.
  1. Change the parallelization scheme of the LETKF program.
  2. Save the memory space for very large problems.
  3. Improve the scalability for very large problems.
  4. Change the data I/O flow (use local disks as much as possible; *not shown in this poster*).
  5. Portable to various types of machines.
- To run rapid update cycle data assimilation experiments at very high resolution (100~1000 m).

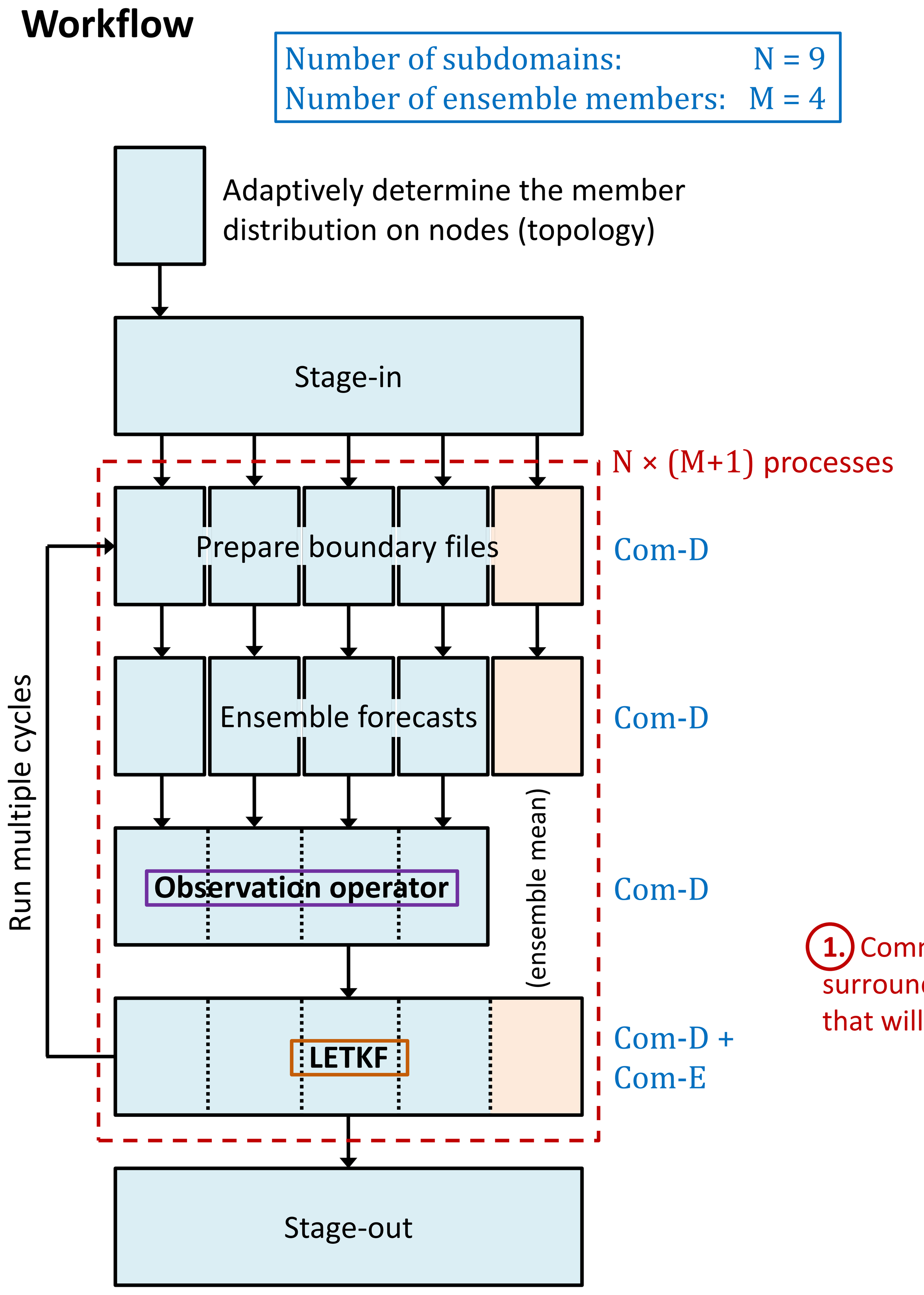


- Match the LETKF processes to the model processes.
- Two kinds of communication groups (MPI communicators):



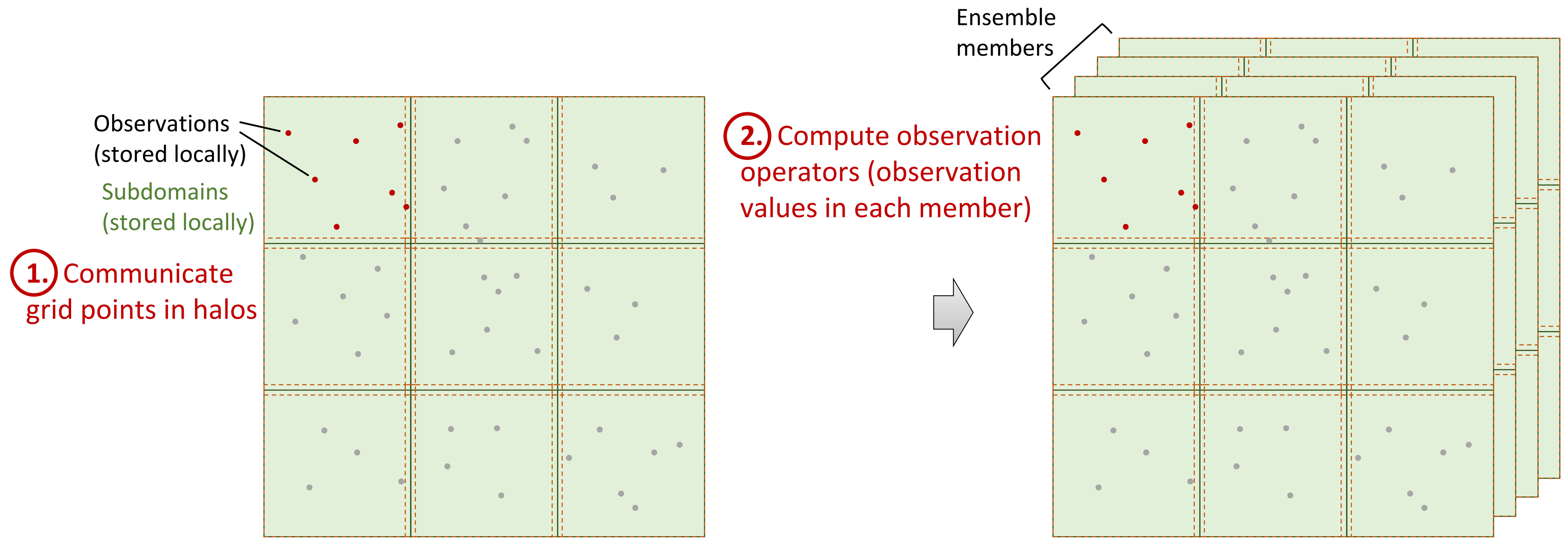
System design

Workflow

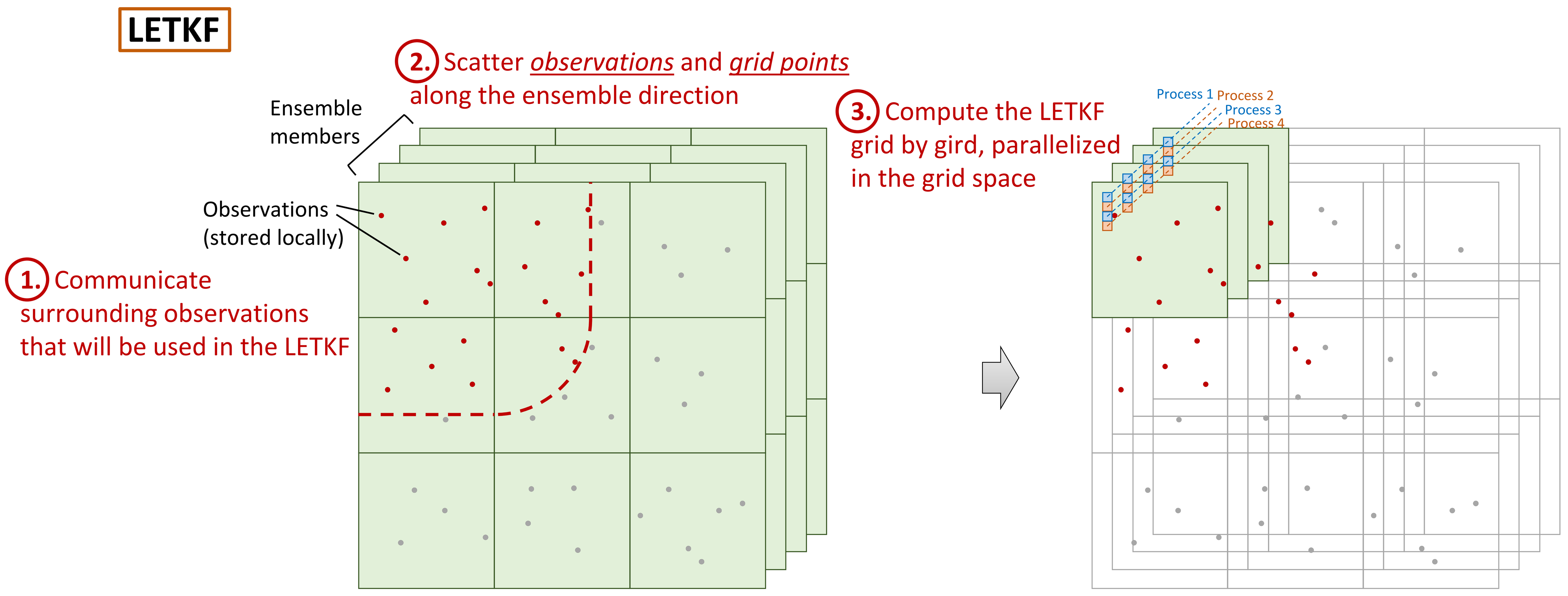


Observation operator

(One process is in charge of a subdomain for a member)



LETKF



Plans

- The computational efficiency will be measured.
- Experiments of rapid-update-cycle convective scale data assimilation will be conducted using this system.