Present and Future Computing Requirements

Anthropogenic Climate Change Using Super-Parameterization

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and

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NERSC BER Requirements for 2017
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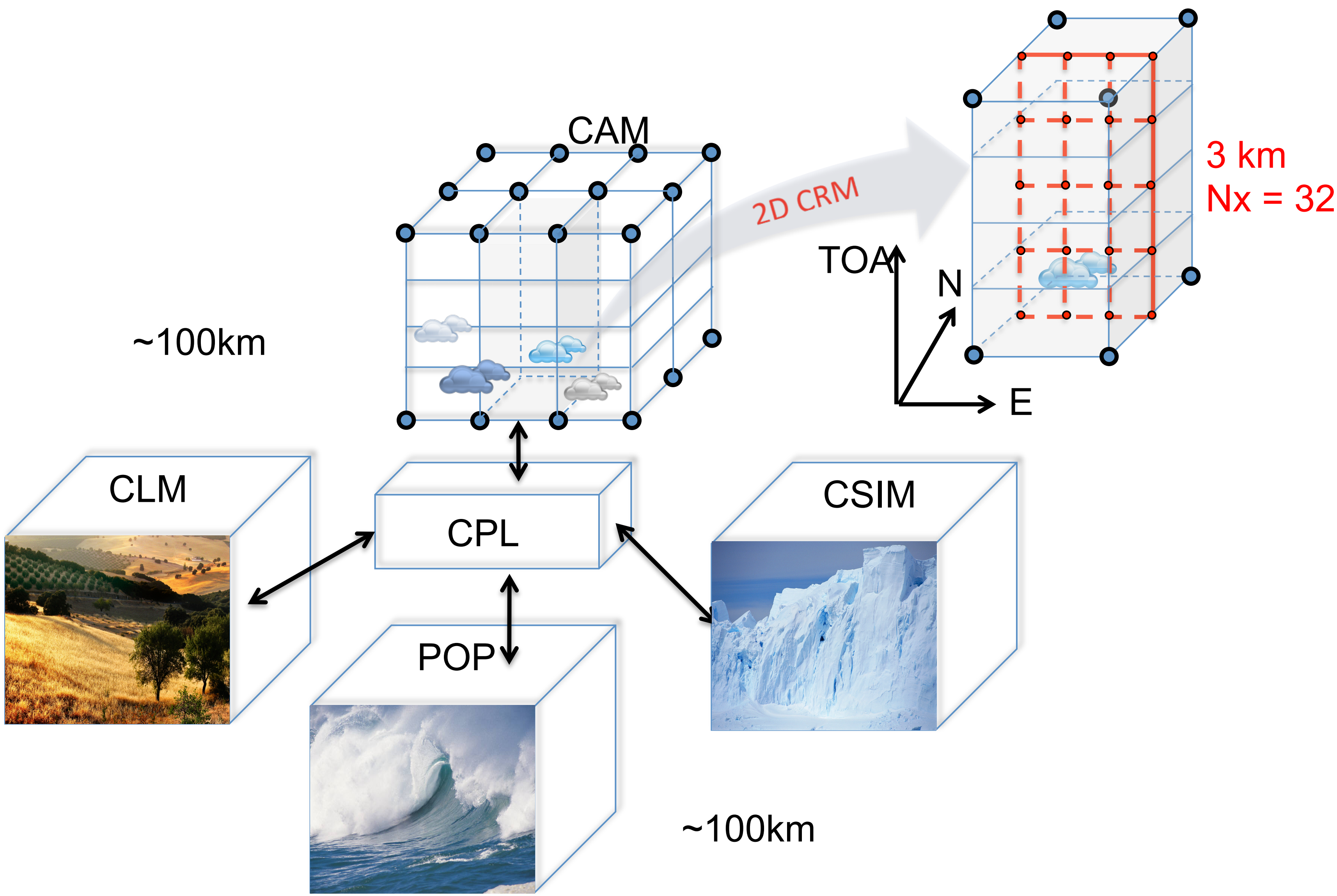
1. Project Description

- Objective: Conduct and analyze simulations of anthropogenic climate change within a framework in which the atmosphere model has a cloud-resolving model embedded in each grid column.

- Our present focus is to conduct simulations in which the cloud-resolving model is 2D.

- By 2017 we expect to conduct simulations in which the cloud resolving model is 3D.

1. Project Description



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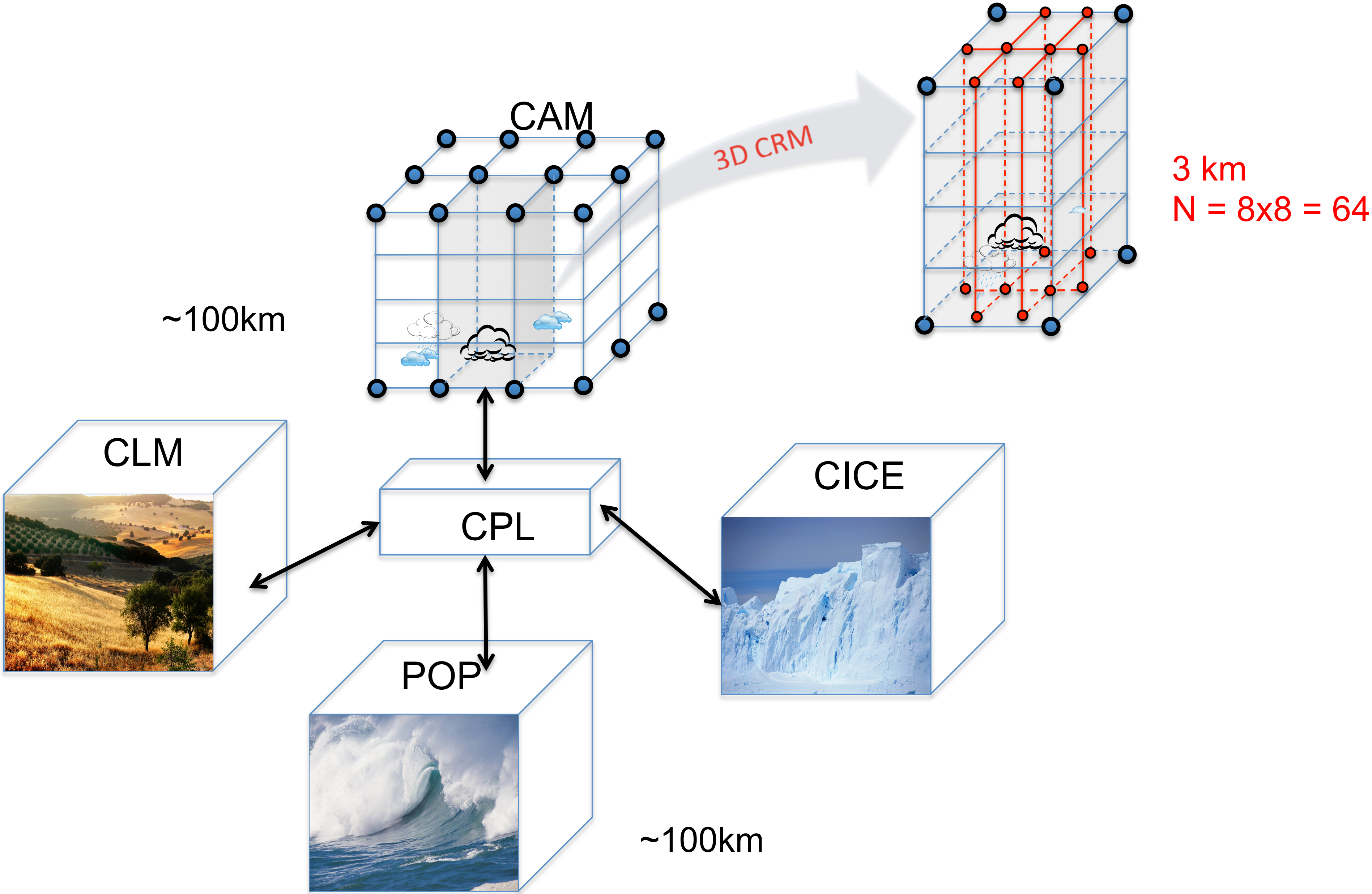
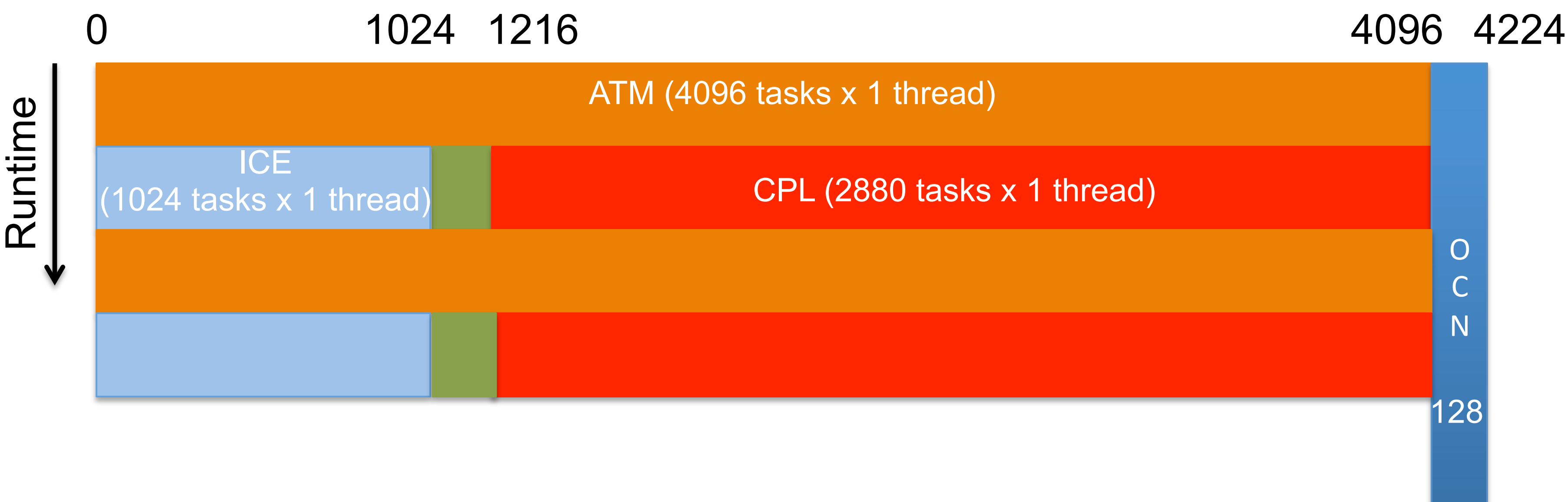


2. Computational Strategies

- We approach this problem computationally at a high level using MPI
  - Dynamical core: Finite Volume
  - ATM: Nx = 288, Ny = 192, Nz = 30; CRM: Nx = 32, NZ = 28;
  - LND: Nx = 288, Ny = 192;
  - OCN: Nx = 320, Ny = 384, Nz = 60;
  - ICE: Nx = 320, Ny = 384;

Mixed Mode Execution



2. Computational Strategies

- ATM: Nx = 288, Ny = 192, Nz = 30; CRM: Nx = 32, NZ = 28;
- CRMs = 288 x 192 = 55,296
- The maximum number of MPI processes used in the latitude-vertical decomposition is 64 x4 = 256;
- 13.5 CRM calculations per core;

- The CRM uses a finite difference representation with stretched vertical and uniform horizontal grids;
- The advection of momentum is computed with the second order finite differences in the flux form with kinetic energy conservation;
- The equation of motions are integrated using the third-order Adam-Bashforth scheme with a variable time step;

- We expect our computational approach not to change by 2017 but the code will change to include improved physics;

3. Current HPC Usage

- Machines: Hopper, Kraken
- Hours used in 2012: NERSC = 10.3M; NICS = 5M
- Typical parallel concurrency: variable
- Run time: 16 hours; number of runs per year: 3
- Data read/written per run: 4.75TB
- Memory used per core: 1.33GB
- Necessary software: pgi/fortran; netCDF/pnetCDF; mpich; libsci
- Data resources used HPSS: ~8TB

4. HPC Requirements for 2017

- Compute hours needed ~50-60M

- Changes to parallel concurrency: 2; number of runs per year: 5

Experiment	Resolution	Simulated Years	Ensembles
Control	1deg/3km	100	1
Climate Change	1deg/3km	100	4

- Changes to data read/written: 6TB/run

- Changes to memory needed per core: 4GB

- Changes to necessary software, services or infrastructure: none

5. Summary

- Regional and Global Climate Modeling Program
  - Use very high spatial resolution simulations to understand climate variability and change at regional and global scales
  - Shed some light on the nature of tropical biases
  - Gain a better understanding of multivariate extremes

- What "expanded HPC resources" are important for your project?
  - Increased memory per core
  - Tools for making the data available to large groups of users