

# Computational Issues

*(CISE does matter.)*



# Projections

Number of processors	Conventional T42 CAM			Current Super-CAM			Near-Future Super-GCM		
	Phys	Dyn	Total	Phys	Dyn	Total	Phys	Dyn	Total
1	1	1	2	360	1	361	360	1	361
32	1/30	1/30	1/15	12	1/30	12	12	1/30	12
1024	1/30	1/30	1/15	12	1/30	12	1/2	1/100	1/2



## Getting real numbers

We need to demonstrate the scaling of current model to 1024 processors and beyond. This will happen very soon, courtesy of Phil Duffy at the Lawrence Livermore National Laboratory.



## Two kinds of computational needs

- Cycles

We are going to need a lot of computer time on very large machines.

- Computer science

To ensure that we are making efficient use of these large resources, we will need involvement by computer science professionals.



## Computational issues 1

- To what extent is inter-processor communication a bottleneck with a super-GCM that uses the quasi-3D approach?
- What are the memory requirements of super-GCMs, and how do they affect scalability?
- What are the software engineering issues associated with super-GCMs?
- Is data ingest an issue for data assimilation with super-GCMs?
- What is the best way to record the simulation obtained with a super-GCM? Is it practical to write out the high-resolution cloud fields simulated by the CSRMs in each GCM grid cell?



## Computational Issues, 2

- Design of numerical methods for use with the quasi-3D approach, including
  - Compatibility between the equations of the large-scale model and the CSRM
  - Prediction of the large-scale wind field using the thermodynamic structure and momentum fluxes predicted by the CSRM
  - Nudging the CSRM towards the large-scale wind field
  - Exploration of convergence as resolution is increased
- Development of visualization methods for use with the super-parameterization
- How can we couple a super-GCM with an ocean model, a land-surface model, and a sea ice model? Will the coupling represent a computational bottleneck?
- Can the super-parameterization approach be useful for ocean modeling?



# Potential Partners on the Computational Side

*San Diego Supercomputer Center*

*IBM*

*CCCSR/Earth Simulator*

*Oak Ridge (Cray X1)*

*Livermore*

*PNNL*

