

Subcolumns in CAM Physics

National Center for Atmospheric Research
CGD: Atmospheric Modeling & Predictability

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Outline

- Why subcolumns?
- Quick review of CAM physics
- Using subcolumns
- Advantages, disadvantages, status

Acknowledgments

Software Engineering

- Cheryl Craig
- Brian Eaton

Early Adopters

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- Julio Bacmeister

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Why Subcolumns?

Approaches:

- Allow for finer granularity than the traditional grid box by spatially sub-dividing the column (grid cell)
- Use a statistical approach to sample subgrid variability within a single column

or



Features:

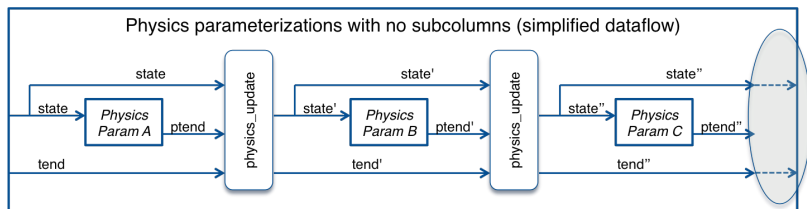
- Avoid having to increase the resolution on entire model to study one parameterization in detail
- Share subcolumn data between parameterizations (unlike current sub-grid-scale parameterizations such as radiation)

Quick review of CAM physics

Quick review of CAM physics

- CAM physics is column (grid-cell) based – no horizontal communication
- Comprised of parameterized physics or chemistry processes (parameterizations)
- Each parameterization takes the model state and returns changes to the model state ('tendencies')
- To allow for threading, a group of grid-cell columns (chunk) is processed together
- When using subcolumns, the columns in a chunk remain the same but the chunk now consists of all of the subcolumns

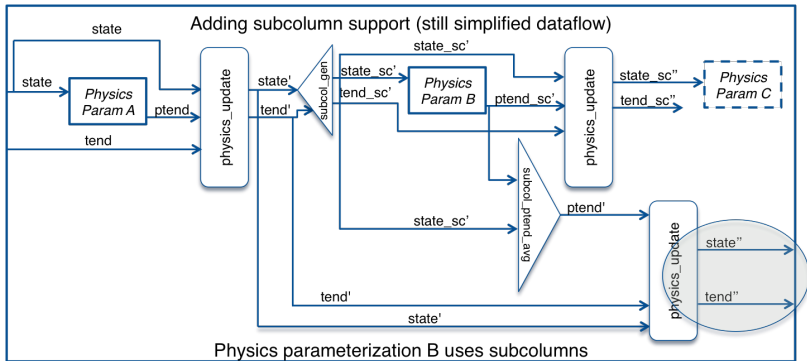




- state: The CAM physics state
- tend: The changes to variables used by the dynamical core (e.g., \dot{u} , \dot{v} , \dot{t})
- ptend: The changes to state variables calculated by a parameterization

So you want to use subcolumns?

1. Make some (or all) of your data fields big enough to hold subcolumns (add flags controlled by namelist entries)
2. Distribute the data for a column into its subcolumns (write a subcolumn generator)
3. Average subcolumn data back into the column before moving on to column-only code (using one of several supported averaging functions or writing your own)



CAM Subcolumns - Advantages and Limitations

- Modular parameterization code (below the interface layer) requires no changes to run with or without subcolumns
- Variable number of subcolumns per grid column
- Subcolumn fields are only allocated as requested (typically controlled by the namelist)
- Support for arbitrary subcolumn data generation algorithms. Subcolumn data distribution controlled by namelist variables

but...

- No current support for changing the number of subcolumns in a column during a single run
- Number of subcolumns cannot vary by level

Current Status

- First subcolumn code being readied for the CAM trunk
- Subcolumn infrastructure complete
- Subcolumn support in CAM microphysics (Gettleman, Craig)
- At least one subcolumn generator scheme (Thayer-Calder)
- First results! (Thayer-Calder: AMWG Monday @10:15)
- More subcolumn generators under development (Bacmeister, Goldhaber, Gettleman)

Thanks!

Questions?

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