

CAM-SE Development Updates

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U.S. Department of Energy

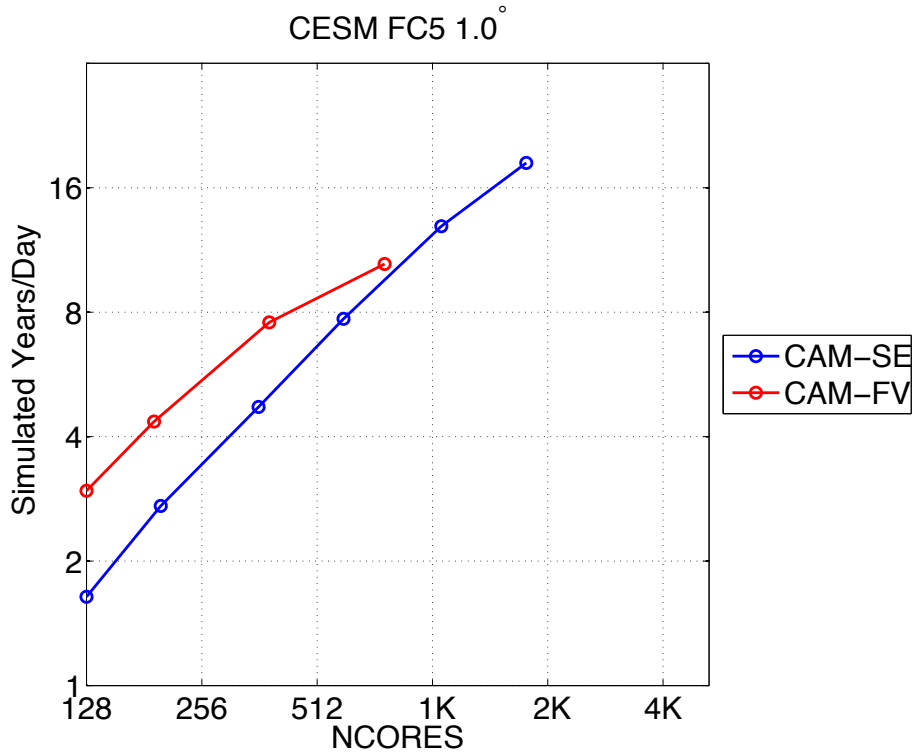


Office of Science

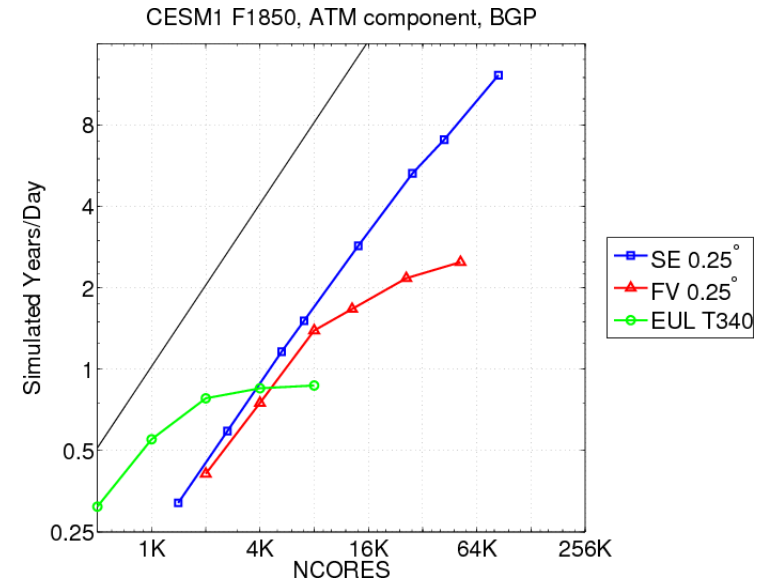
Computational Performance

- CAM5 on Titan
- ne120_tx01 (0.25° cubed-sphere grid, 0.1° POP tripole grid)
 - CESM (non-ATM) 16%
 - Physics 19%
 - Dynamics 19%
 - Tracers (horizontal/SE) 36%
 - Tracers (vertical remap) 12%
- Upcoming improvements target tracer transport:
 - ORNL: PPM vertical remap (2x faster)
 - ORNL: GPU acceleration of Tracers (vertical & horizontal) >> 2x faster
 - SNL: Vertically Lagrangian dynamics: 5x less *tracer* vertical remaps
 - NCAR: CSLAM: >>3x (horizontal advection)
- Net gain in CESM performance: 1.4-1.6x with GPU acceleration or CSLAM

CAM5 1.0° SNL Redsky



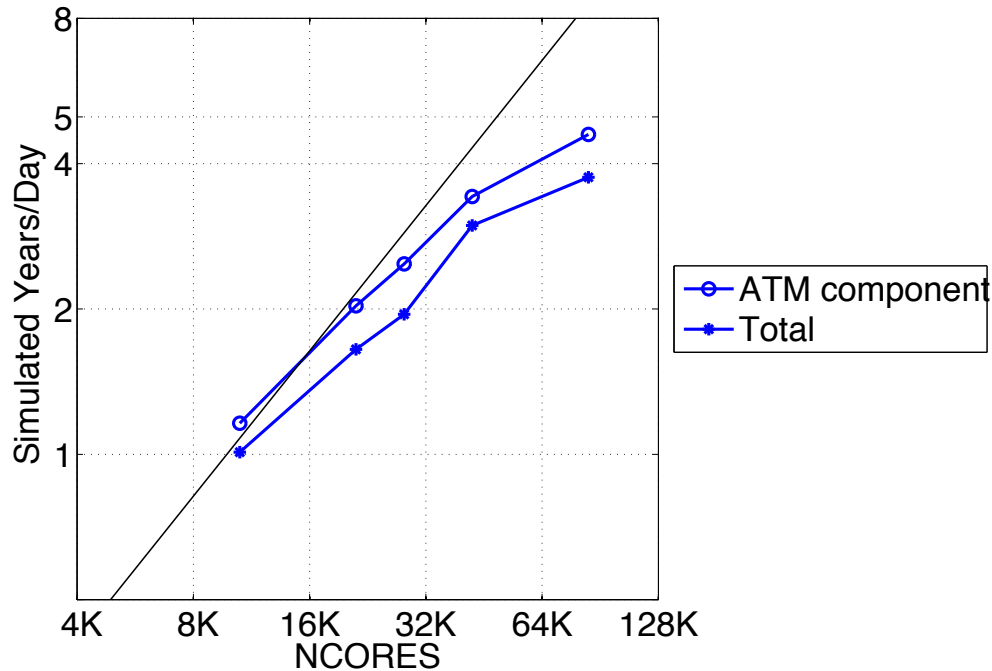
CAM4 0.25° ANL Intrepid



- CAM5: 128 cores: CAM-SE 1.8x slower than CAM-FV (1.65 vs 2.96 SYPD)
- CAM5: CAM-SE breakeven: 768 cores (10 SYPD)
- CAM4: SE and FV are comparable (due to fewer tracers)

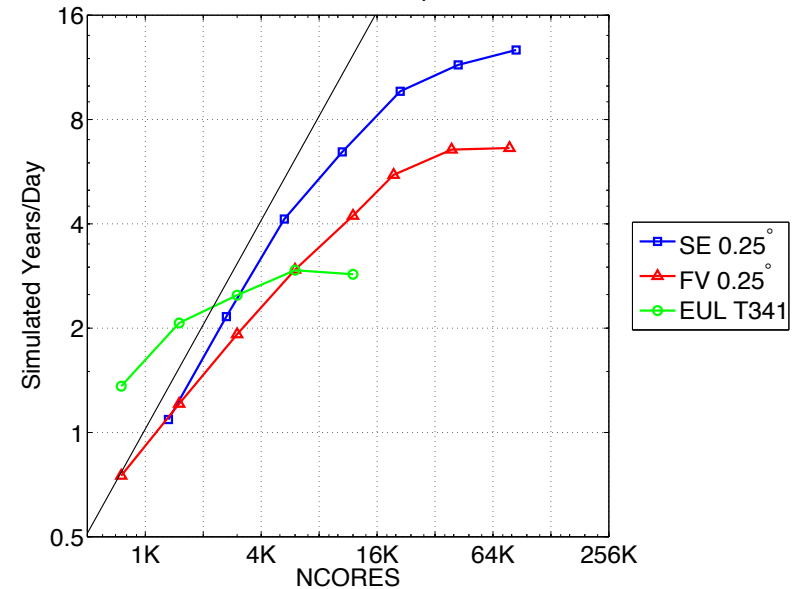
CAM5 0.25° Titan

CESM F1850 0.25°



CAM4 0.25° Jaguar

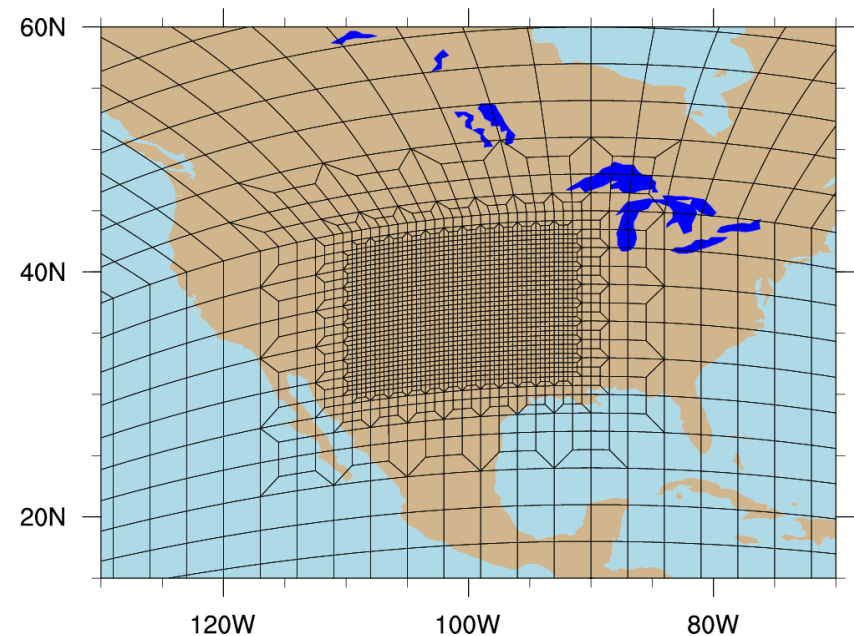
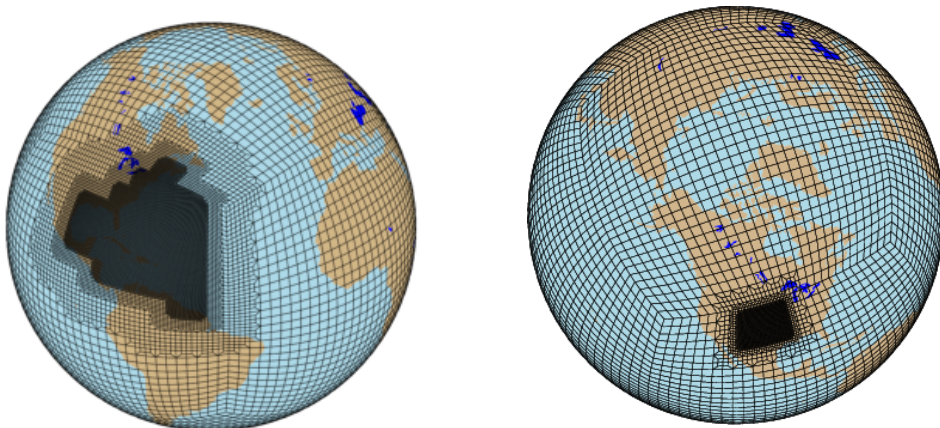
CESM1 F1850, ATM component, XT5



- Improved scaling on Titan (16 cores per CPU) as compared to Jaguar (6 cores per CPU) out to 1 spectral element per core
- CAM5-SE 0.25° F1850 running on Titan at 3 SYPD on 43200 cores (ATM: 3.4 SYPD)
- CAM5 on Titan ~2.8x more expensive than CAM4 on Jaguar

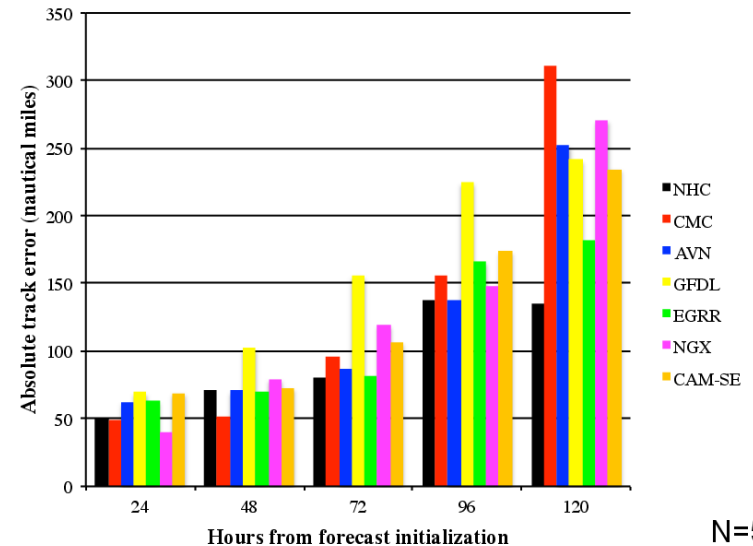
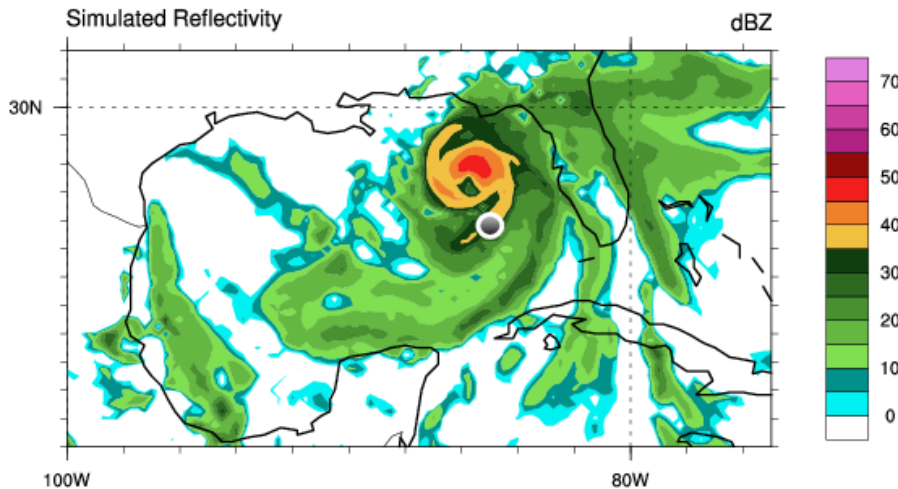
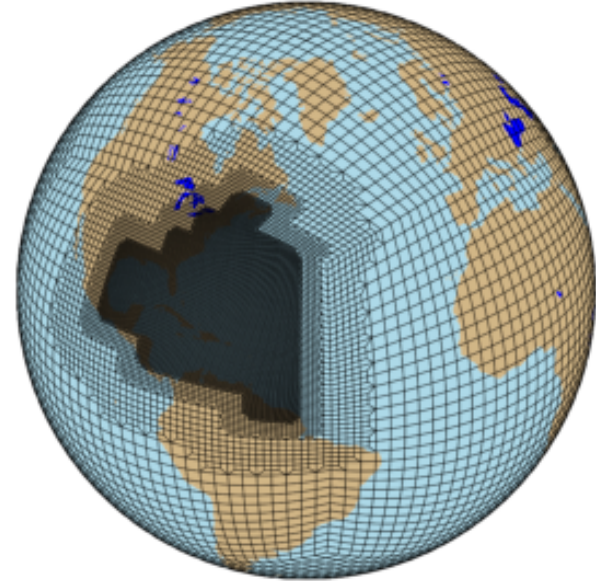
Variable Resolution

- Software included in CAM5.2 release
- Not documented or supported
- Running at SNL and LLNL for CSSEF project: 1/8 degree resolution over continental U.S.
- Running at Michigan (C. Zarzycki, C. Jablonowski) (1/8 degree hurricane simulations)
- Challenges:
 - CUBIT for mesh generation
 - Generation of data sets
 - Resolution dependent topo smoothing
 - Tuning dycore dissipation parameters

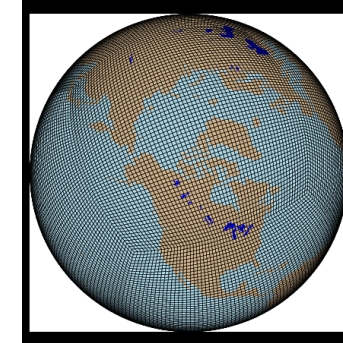
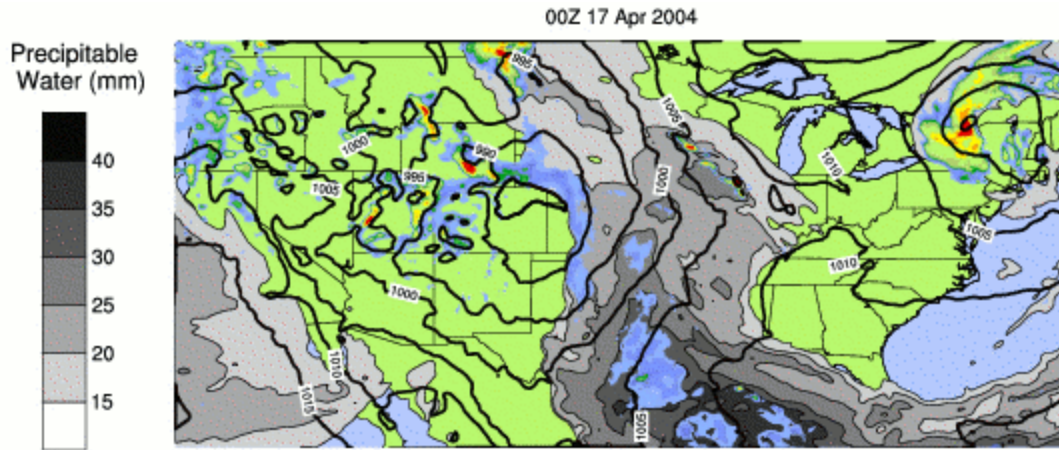


Hurricane Isaac 2012

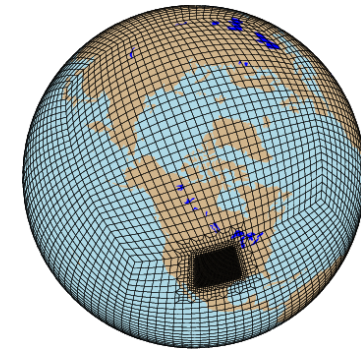
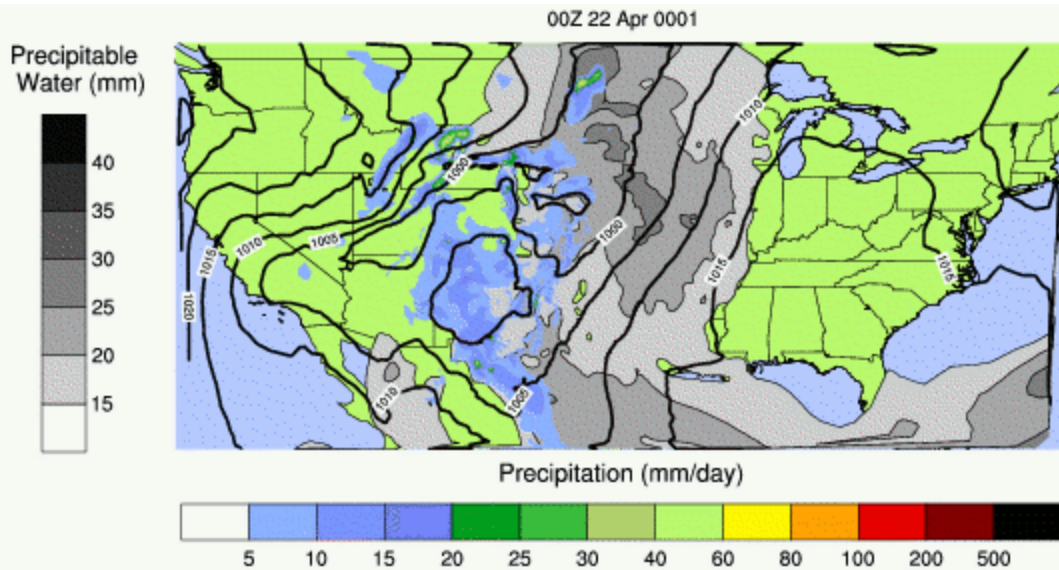
- Global Forecast System (GFS) initial conditions + CAM-SE
- 5 day simulation with 1/8 degree resolution over Atlantic, 1 degree global
- 5-10x speedup over global 1/8 degree (3h on Bluefire)
- Images courtesy of Colin Zarzyki, Univ. Michigan



1/8 Continental U.S. variable resolution configuration for DOE CSSEF Atmosphere Test-bed



Global $1/8^\circ$ 6M core hours per year ANL/Intrepid



SGP 8x grid ($1/8^\circ$ over SGP ARM site) 0.12M core hours per year SNL/redsky

Precipitable water (gray), precip rate (color), sea level pressure (contours)