

An update on GigaLES

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Physical Processes Session

What is GigaLES?

- Giga - 10^9 grid points (2048 x 2048 x 256 layers)
- LES - resolution sufficient to resolve the larger atmospheric eddies - 100m horizontal, 50 - 150m vertical.
- Together multiple scales are simulated from the large eddies through individual clouds to organized cloud systems.

Model Configuration

SAM 6.10.4 modified to include:

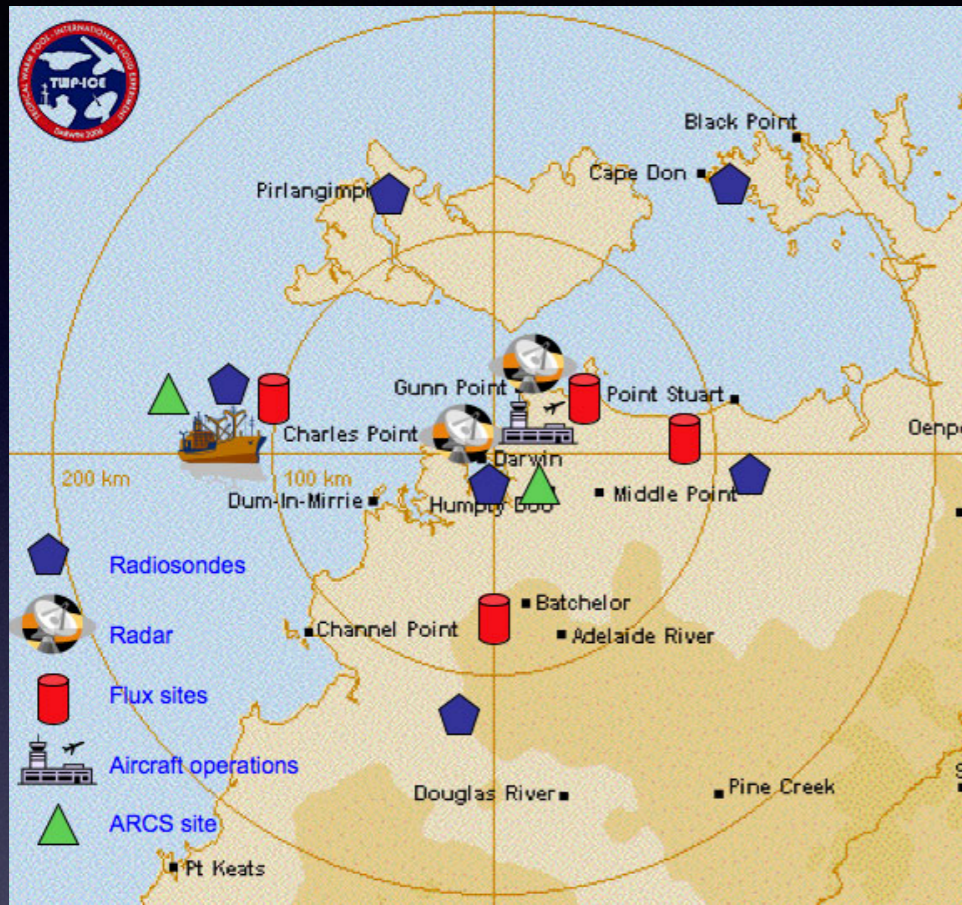
- New cloud optical properties based on CAM5, including radiatively-active snow and using predicted size distributions from the two-moment microphysics.
- Lagrangian Parcel Tracker (LPT) diagnostic package that predicts the trajectories of user-defined parcels.
- The elliptic pressure solver and 3D output routines were replaced with more computationally scalable versions.

2048x2048 horizontal domain with 100m grid spacing – 205km x 205km.

256 vertical levels: 50m spacing near surface; 100m spacing near tropopause, 300m spacing near model top (27km).

	GigaLES 1	GigaLES 2
Large Scale Forcing	GATE (IDEAL) - steady	TWP-ICE - time-varying
Radiation	Prescribed steady	RRTM interactive
Microphysics	Single Moment	Two-moment Morrison 2005
Scalar Advection	MPDATA	Ultimate Macho - 5th order
Duration	24 hours	4 days (and continuing)

Maritime: Tropical Warm Pool - International Cloud Experiment

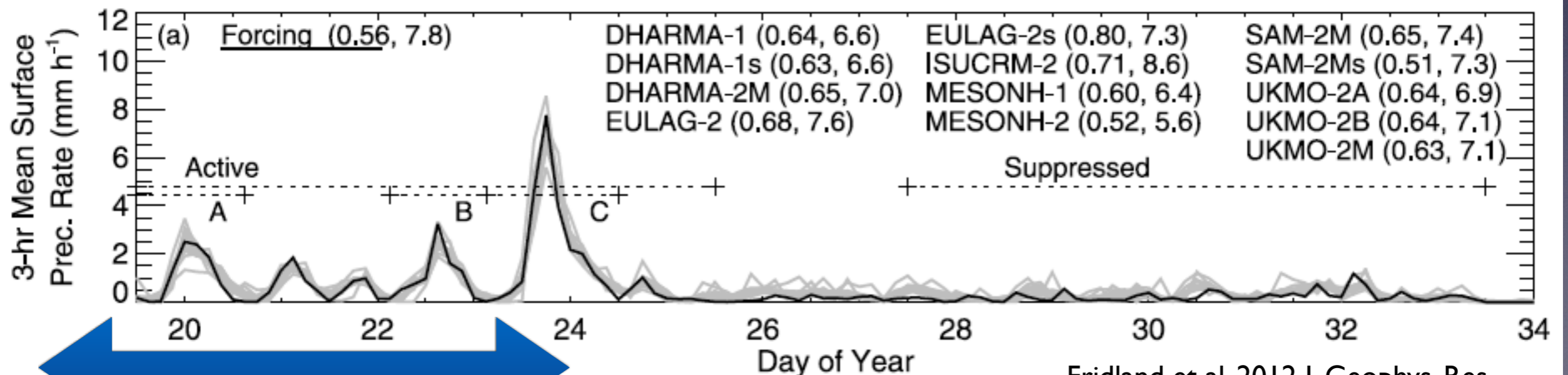


Location – 130.9E,12.4S

Intense measurement period – 18 Jan 2006 – 4 Feb 2006.

Features active (19 Jan.–25 Jan.) and suppressed (27 Jan.–4 Feb.) monsoon periods.

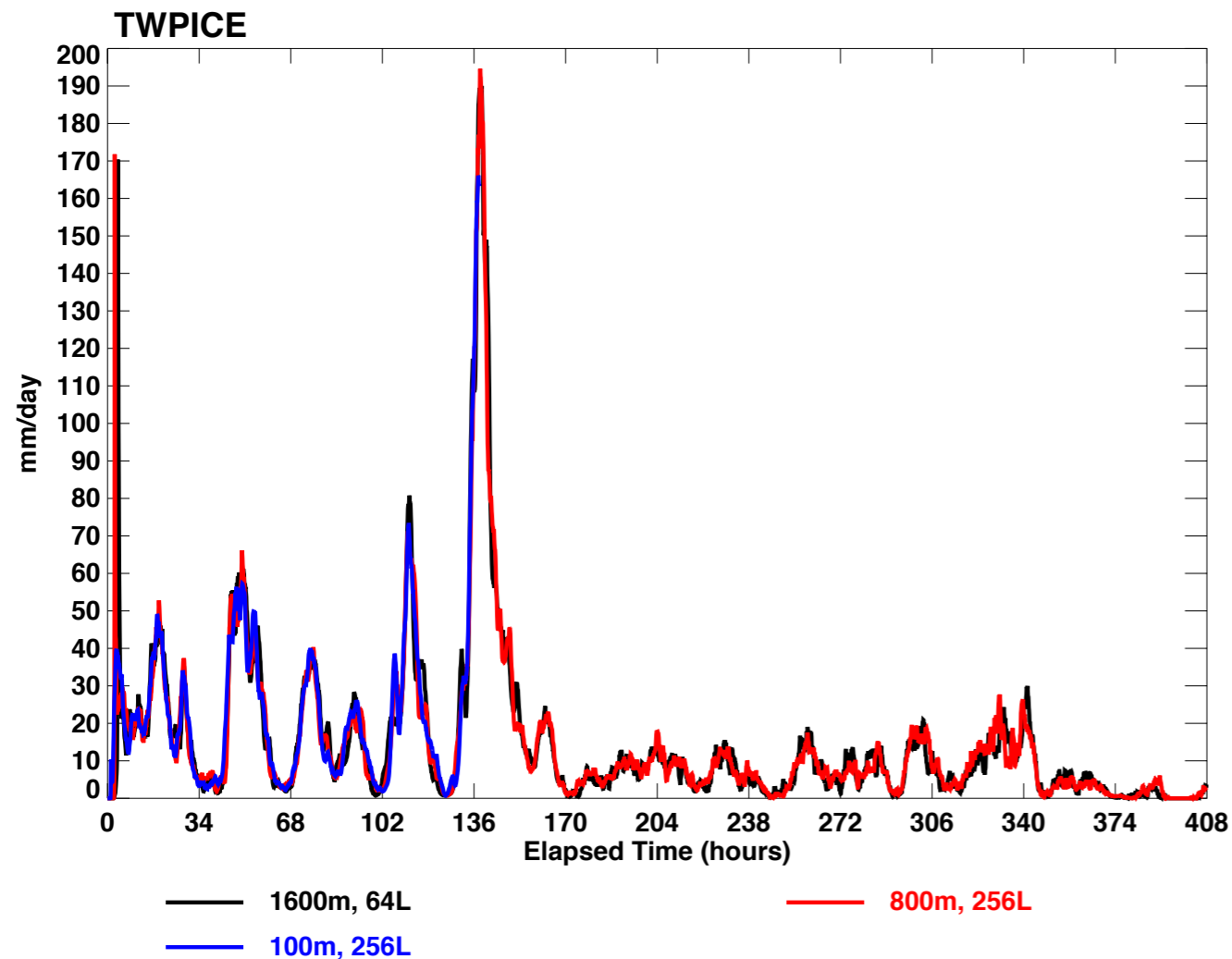
The model is run according to the CRM intercomparison specifications in Fridland et al, 2012. The domain is treated as a uniform ocean surface with fixed SST.



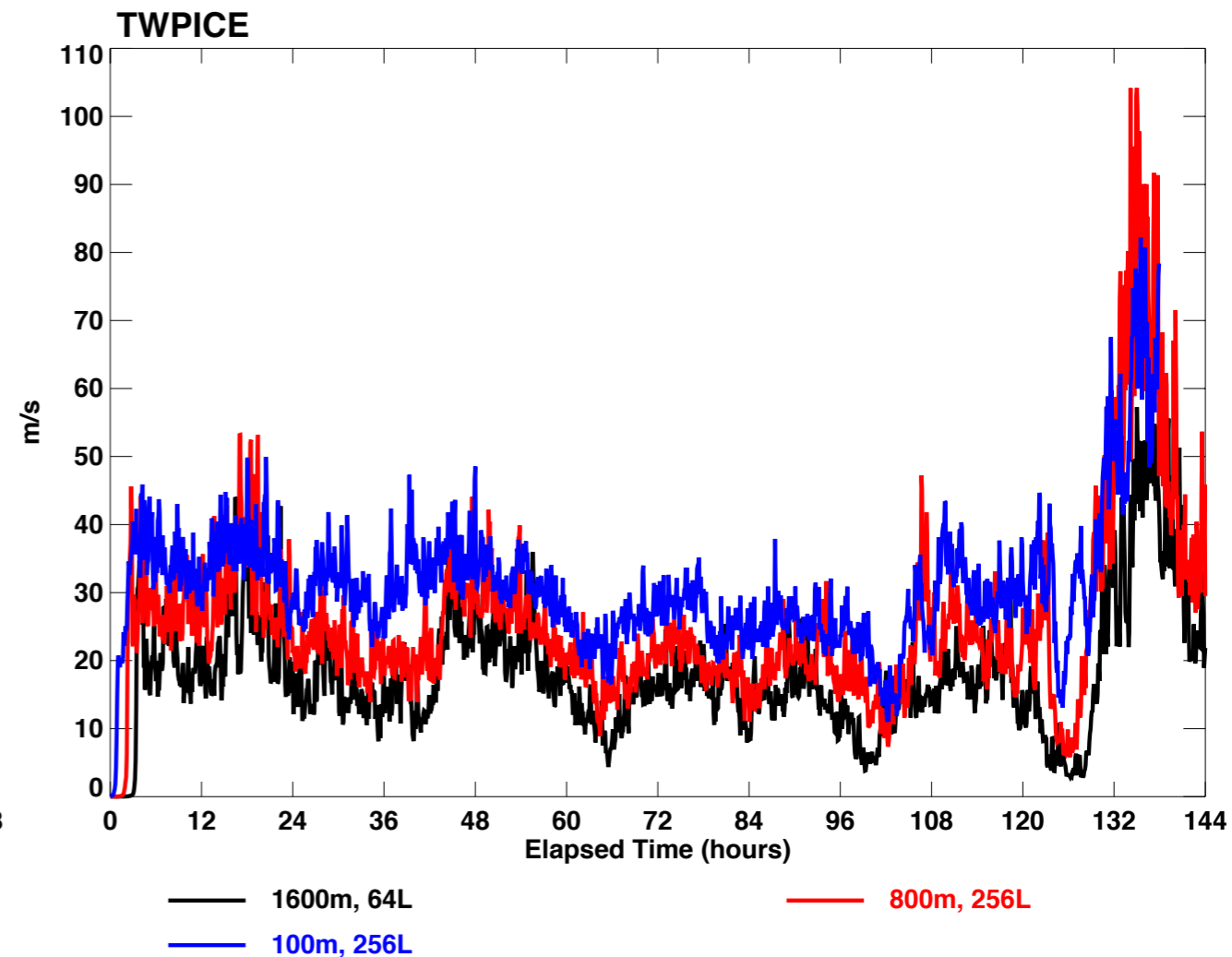
Run Status

- Control - no snow-radiation interaction, 1600m, 64L - 17 days
- Control - no snow-radiation interaction, 800m, 256L - 17 days
- CAM5 snow radiative properties, 1600m, 64L - 17 days
- CAM5 snow radiative properties, 800m, 256L - 17 days
- CAM5 snow radiative properties, 100m, 256L - 144 hours (complete)
- LPT 100m, 256L - 2 hours starting from hour 48 of the previous run

Surface Precipitation



Maximum Updraft Velocity

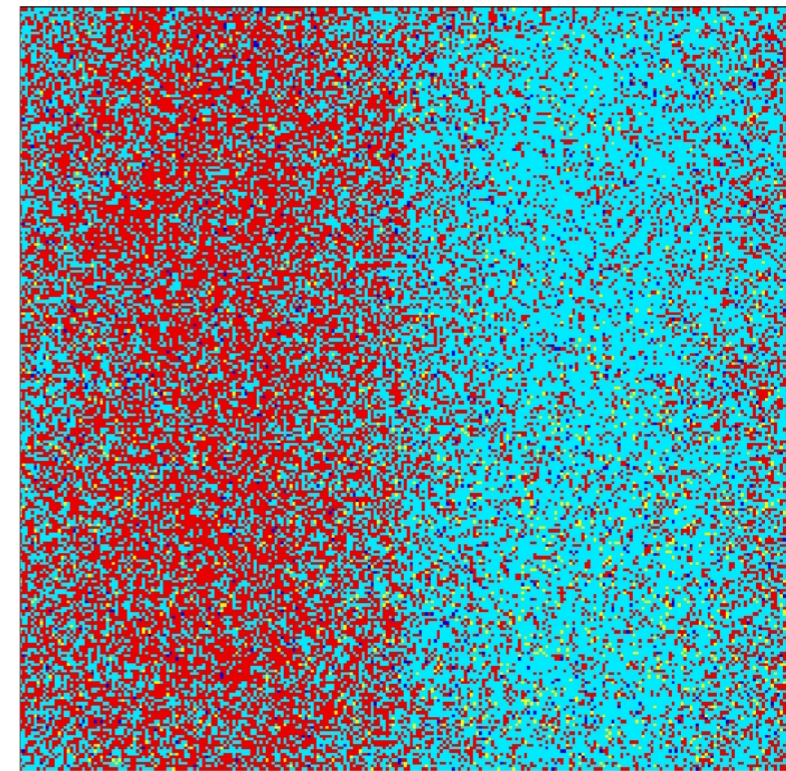
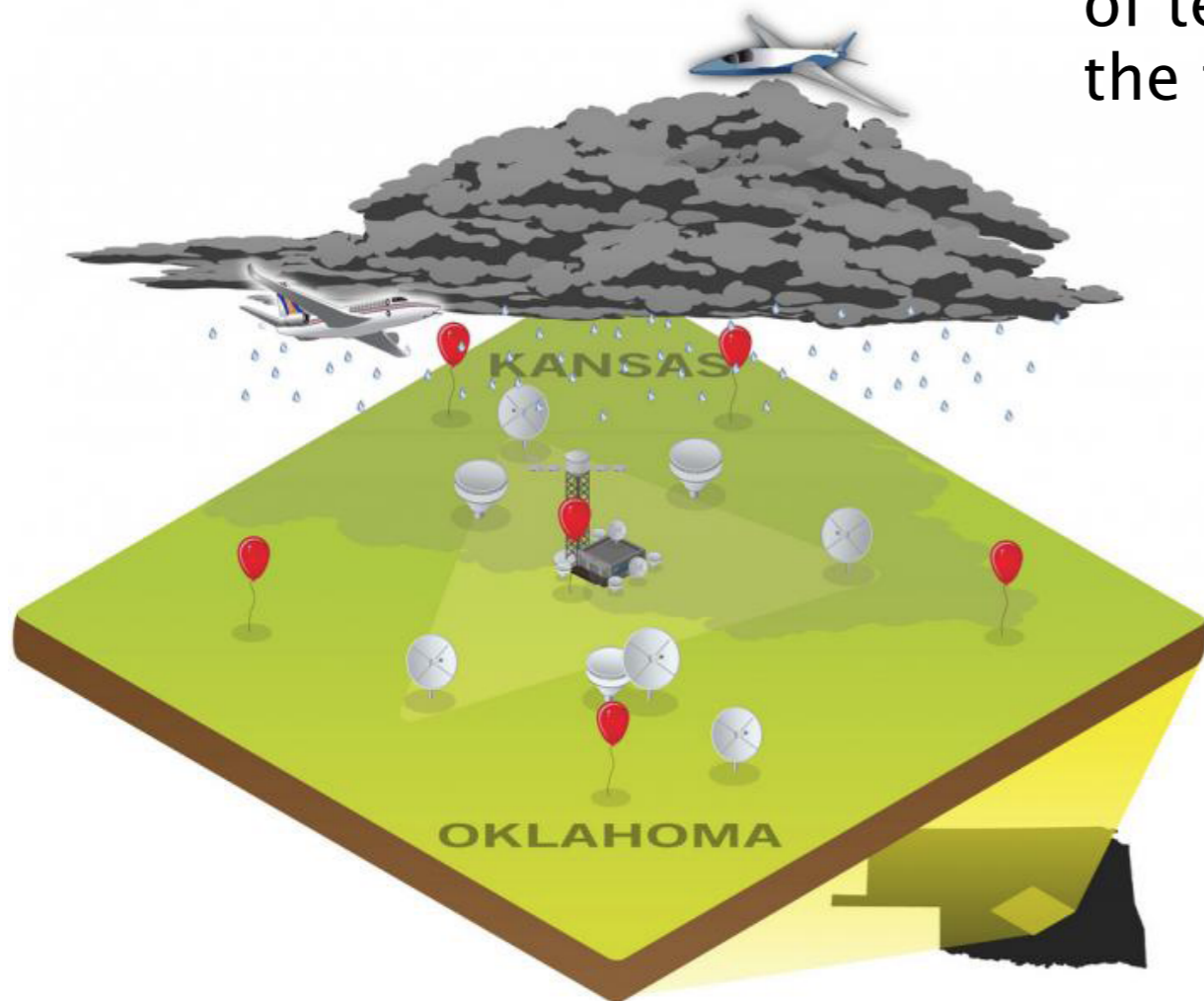


Output and Distribution

- Output types: Domain average profiles (OUT_STAT); 2D horizontal fields; 3D fields; LPT (Lagrangian Parcel Tracker) output for hours 48 through 50.
- Currently, must contact me (dazlich@atmos.colostate.edu) to arrange transfer.
- I will extract the fields you want to minimize the size of the transfer.
- Files < 2GB in size can be placed on the Randall group doc exchange -
<http://kiwi.atmos.colostate.edu/rr/docexch.php>
- Over 60 TB output generated to date. We have a complete archive at CSU
- There is an archive at TACC 'wrangler' accessible through Globus Online but you need XSEDE credentials - see John Helly.

Continental: Mid-latitude Continental Convective Cloud Experiment (MC3E)

- Location – 97.5W, 36.5N
- Period – 22 Apr 2011 – 7 Jun 2011; 23 May – 26 May for 100m grid spacing.
- The CRM is forced with advective tendencies of temperature and water vapor derived from the field campaign observations.



Forest



Grassland



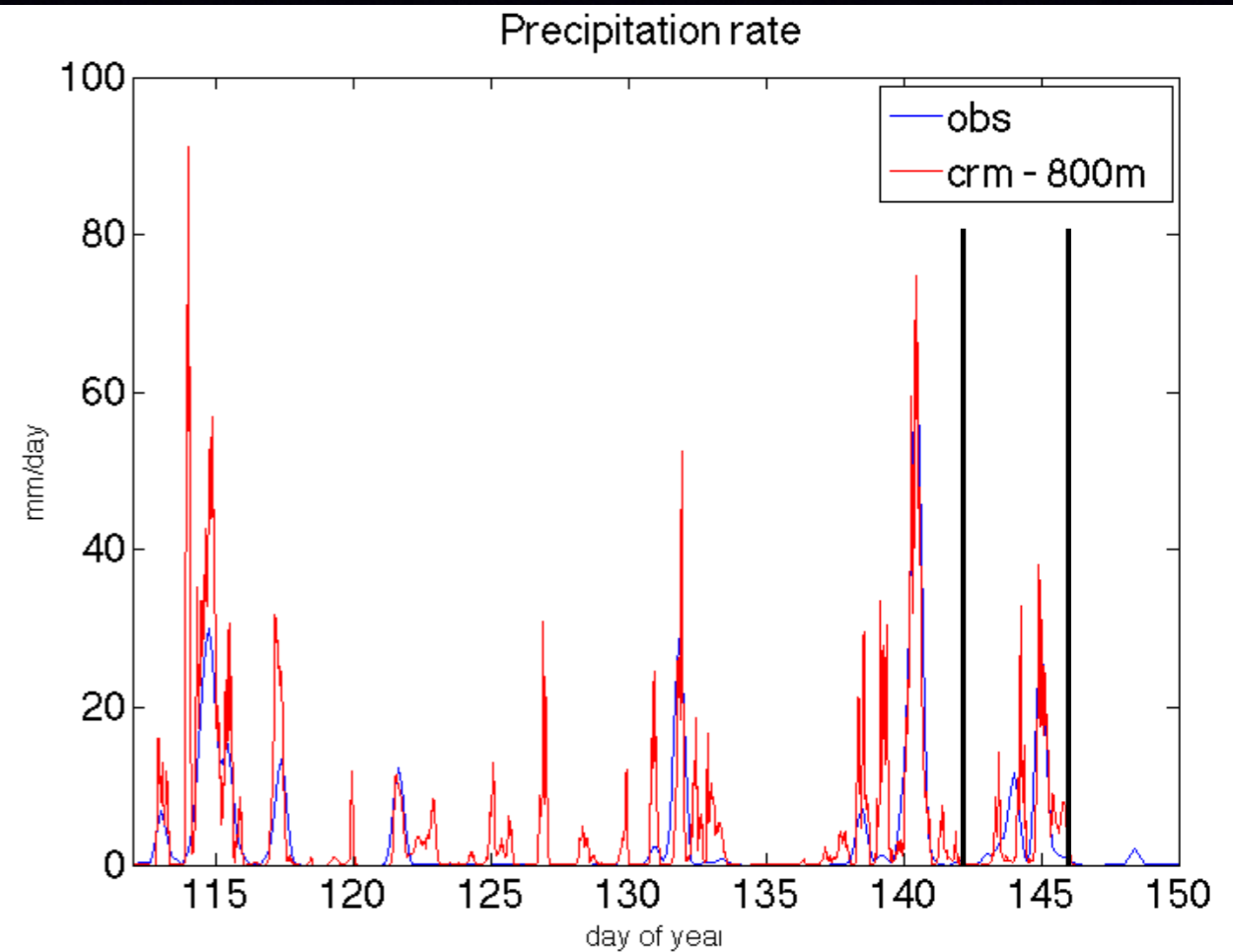
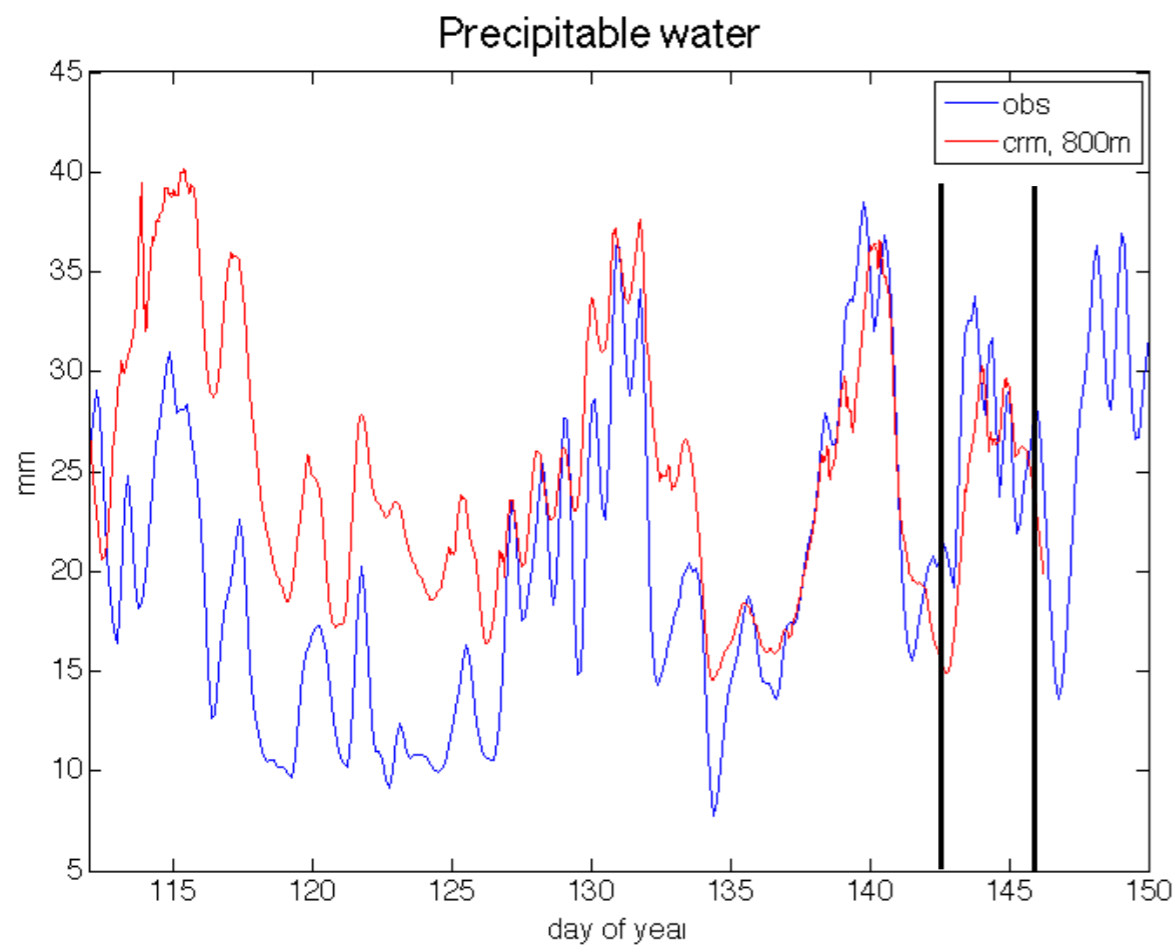
Agriculture



MC3E Strategy

- Target period for 100m run chosen 06z 22 May through 18z 25 May because the nature of the convection during that period appeared to be less due to large scale systems like fronts or squall lines.
- Port SiB3 land surface parameterization into SAM.
- Spin up 4 biomes (crop, 2 grasslands and deciduous forest) with 20 years of NCEP reanalysis for 4 1degree cells.
- Start 800m run on 0z 22 Apr.
- Run 30.25 days to 6z 22 May to spin up land surface heterogeneity.
- Start 100m run with 6z 22 May atmospheric profiles and the 800m land surface restart for the same time.

How does 800m stack up?



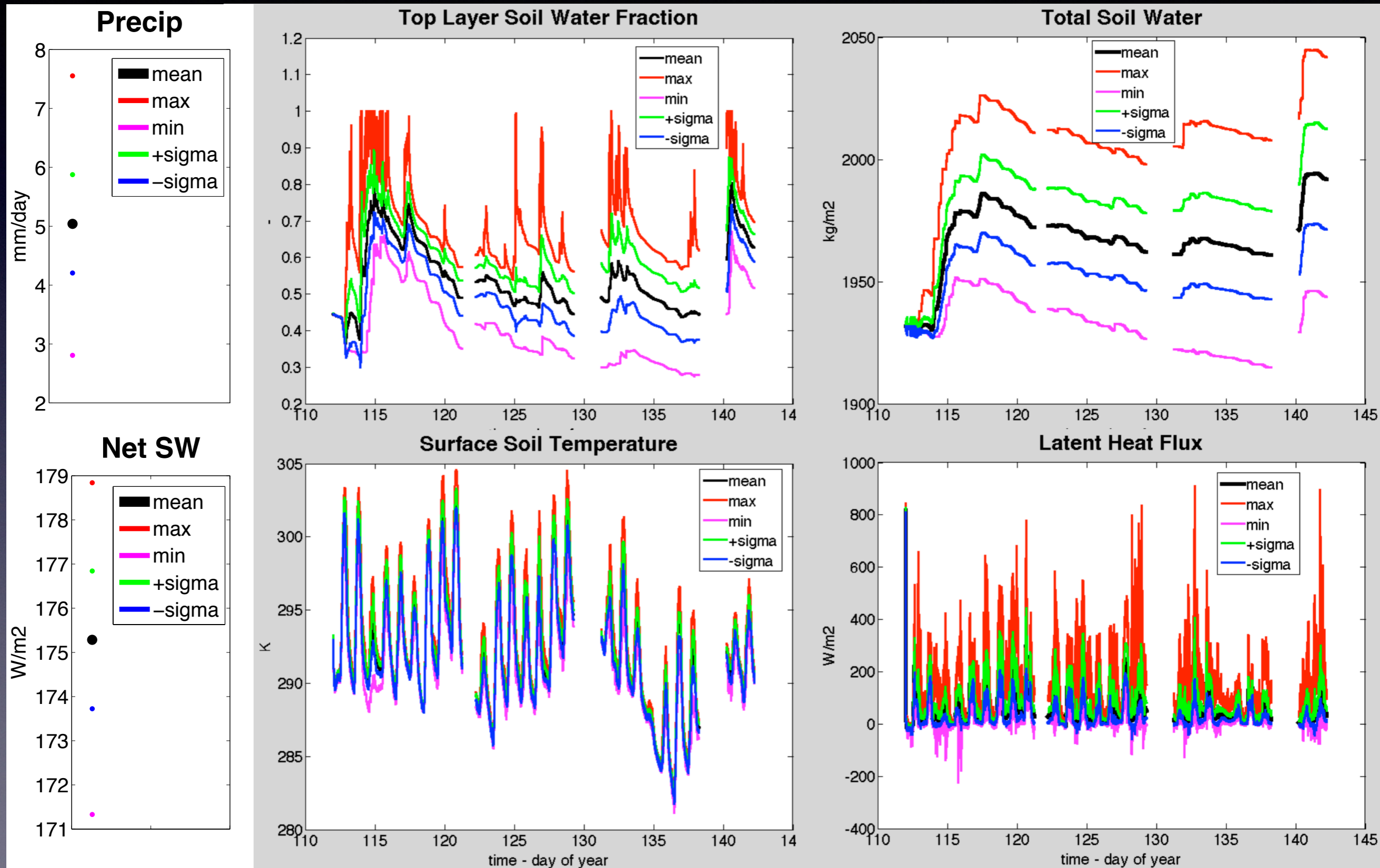
The precipitable water started out moist but as the integration approached the target period (outlined in black) it matched the observations more closely.

The model produced extra precipitation events during the spinup, but again, matched the observed more closely near and during the target period.

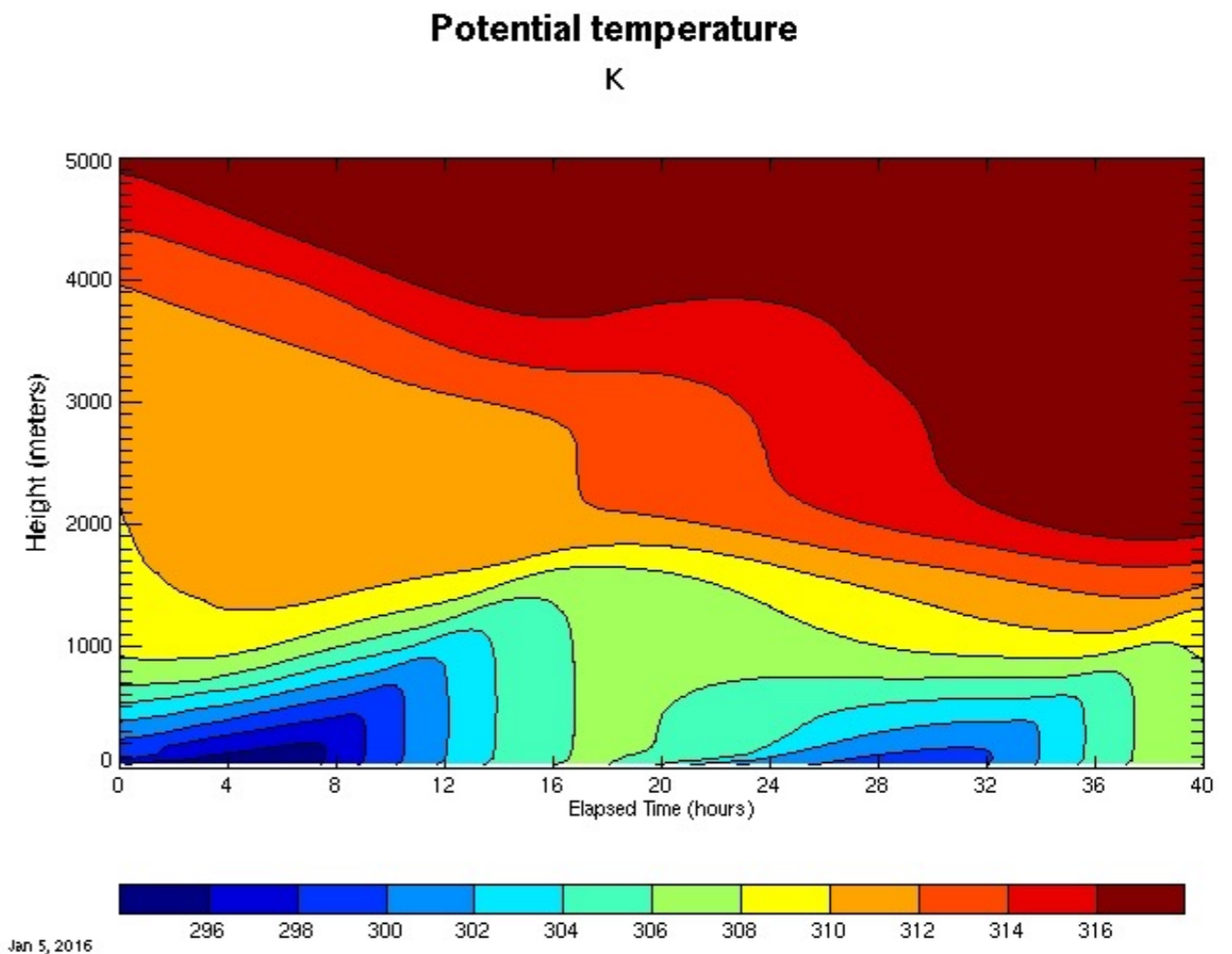
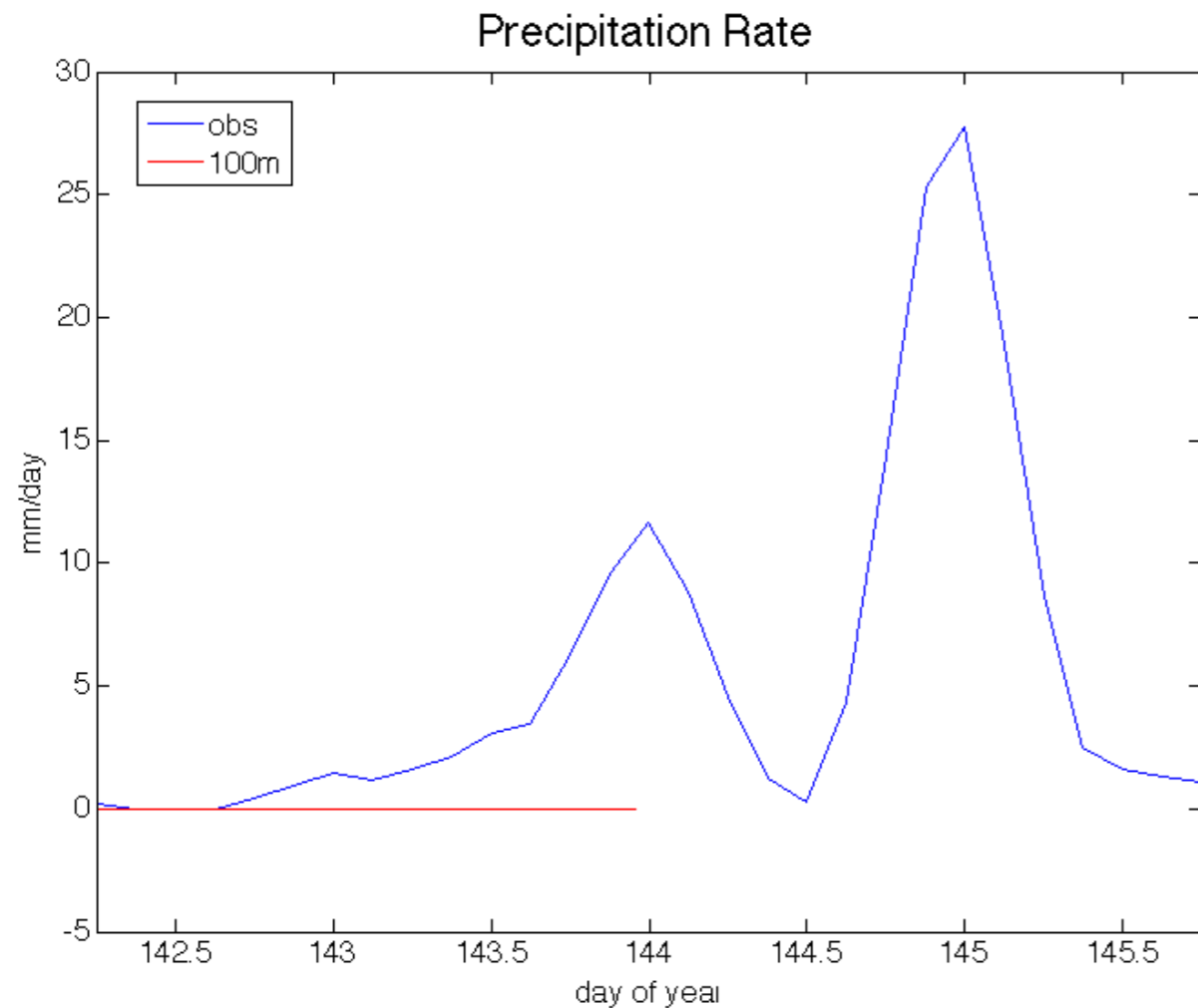
800m surface spinup

time avg

Biome 2 (forest), SW reanalysis: ~160 grid cells



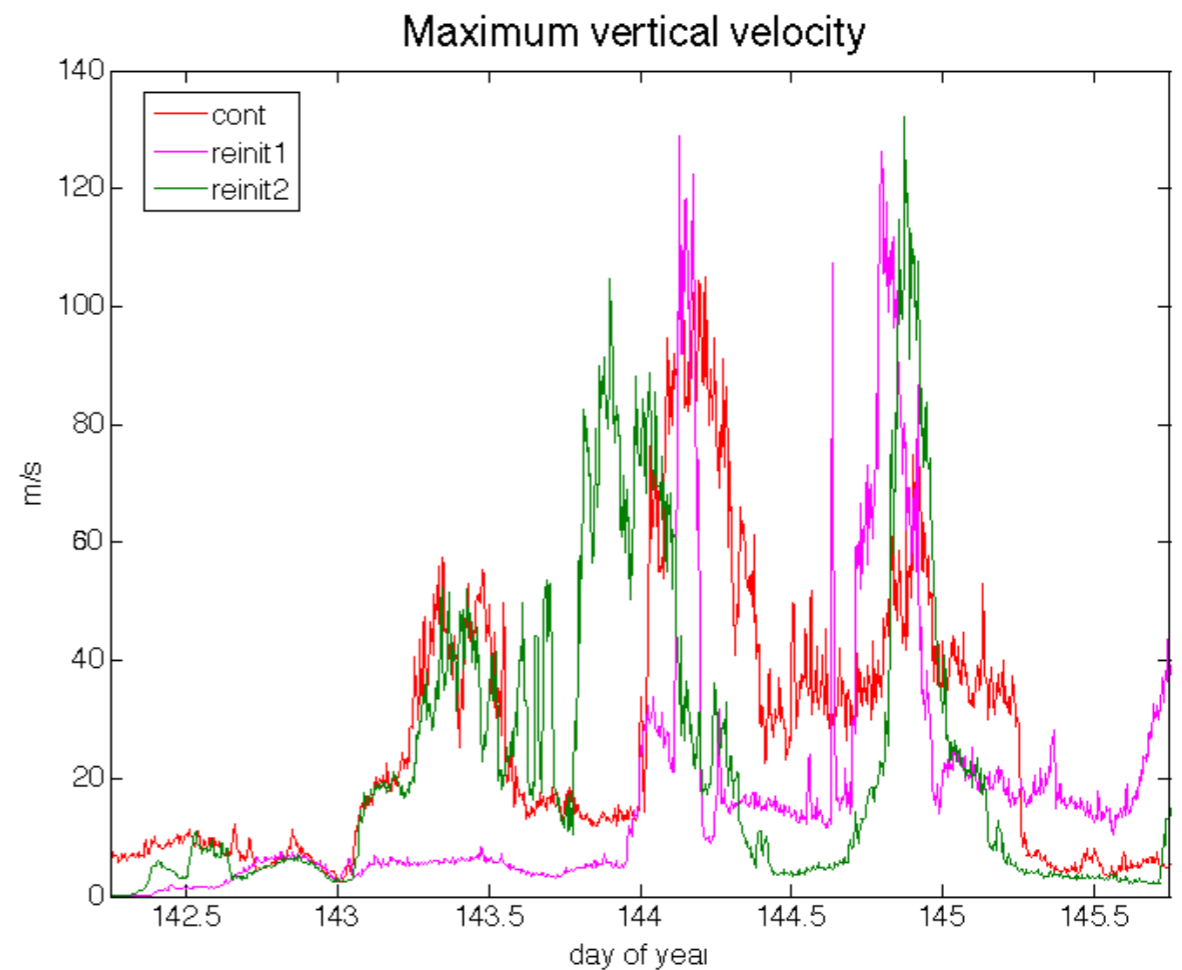
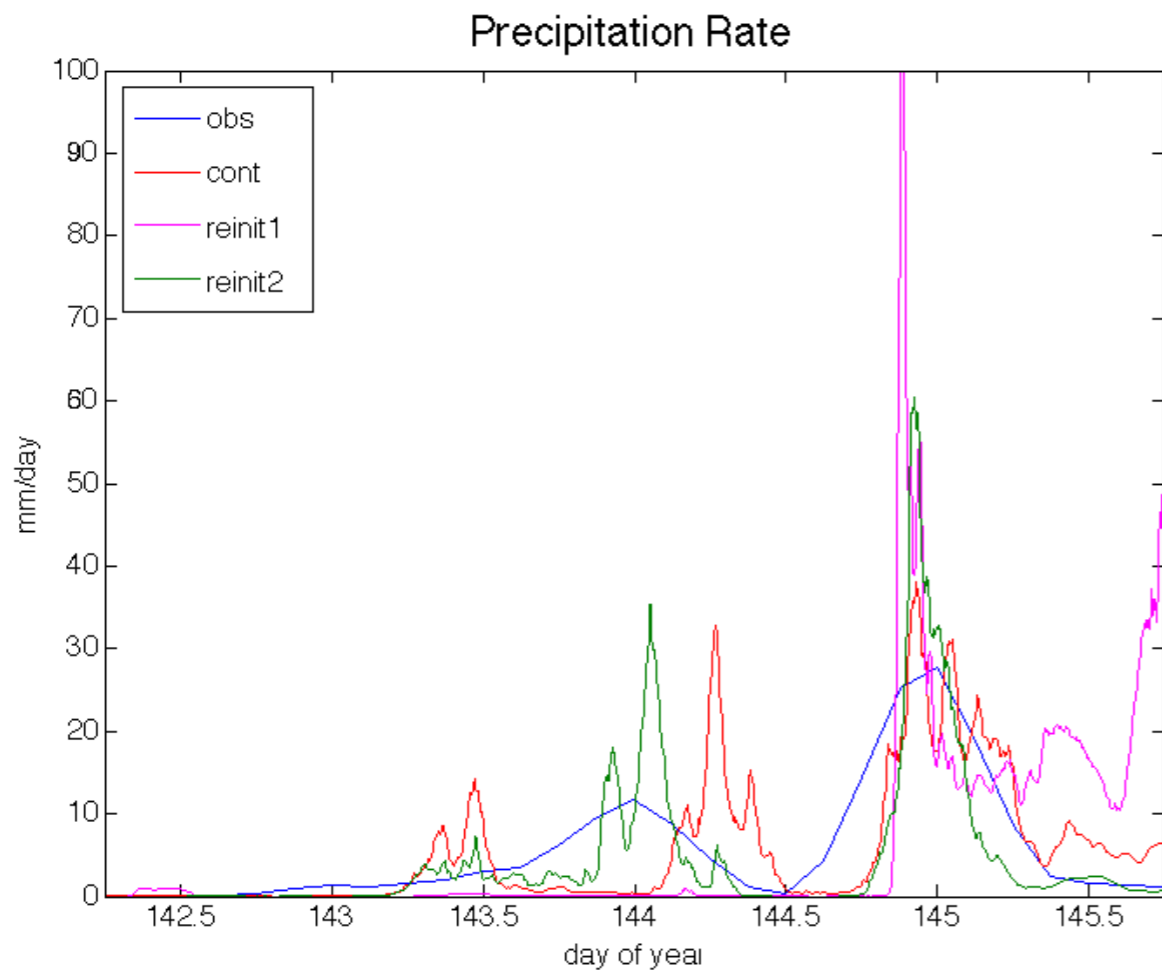
100m, attempt number 1



Part way into the 100m run I noticed that no convection was being generated when it should.

Strongly stable atmosphere above the boundary layer

Experiments with restarting at 800m

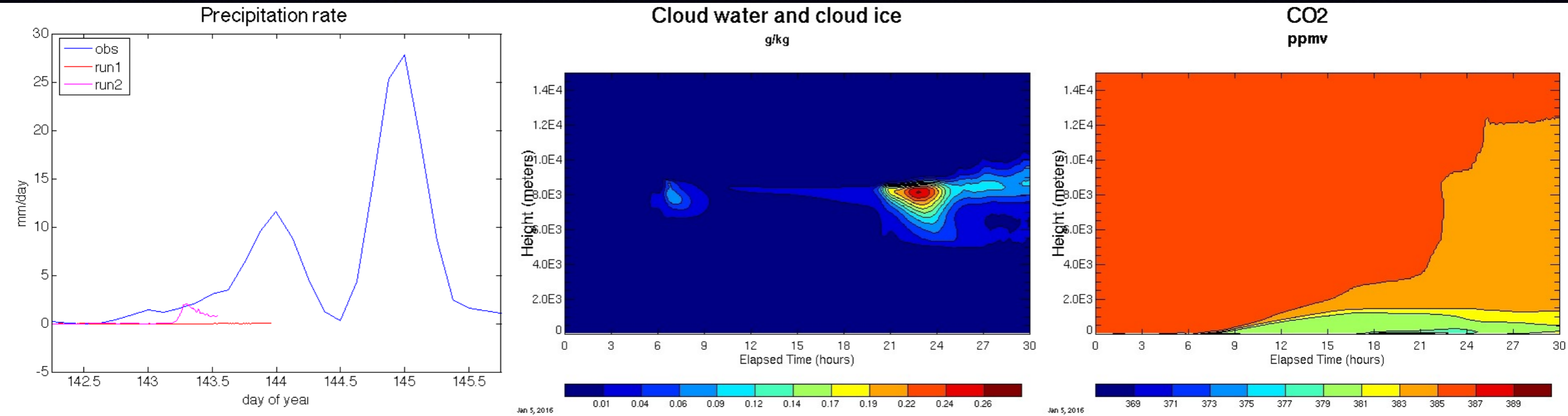


How did the 100m run differ from 800m? Initialization

I went back to 800m and restarted it from day 30.25 in two different ways. REINIT1 started just as the 100m run did with the IOP data soundings for that time. REINIT2 started with a sounding that was the domain average of the original 800m run at day 30.25.

REINIT1 behaved like the 100m run. REINIT2 behaved like the original run and the obs.

100m, attempt number 2



Run2 has begun to precipitate. It is currently at hour 31 and is continuing.

Summary

- GigaLES-2 simulation has completed all six days planned at 100m and a two-hour LPT run was done at hour 48. Over 60 TB output generated to date.
- TWP-ICE data available at CSU and TACC wrangler. Contact me or John Helly
- After fits and false starts MC3E GigaLES underway. MC3E convection is violent and slows the simulation due to CFL criteria. The XSEDE allocation to run it is exhausted and it will have to be continued with other resources.
- GigaLES-2 output is a community resource available for analysis. Team members are encouraged to find imaginative applications for it.