An update on GigaLES-2

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Physical Processes Breakout

What is GigaLES?

- Giga - 10^9 grid points (2048 x 2048 horizontal x 256 layers)

- LES - with 100m horizontal and 50m vertical discretization the model simulates scales from the large eddies associated with the boundary layer and cloud entrainment and detrainment, through individual cloud elements, all the way to mesoscale 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)

# Tropical Warm Pool - International Cloud
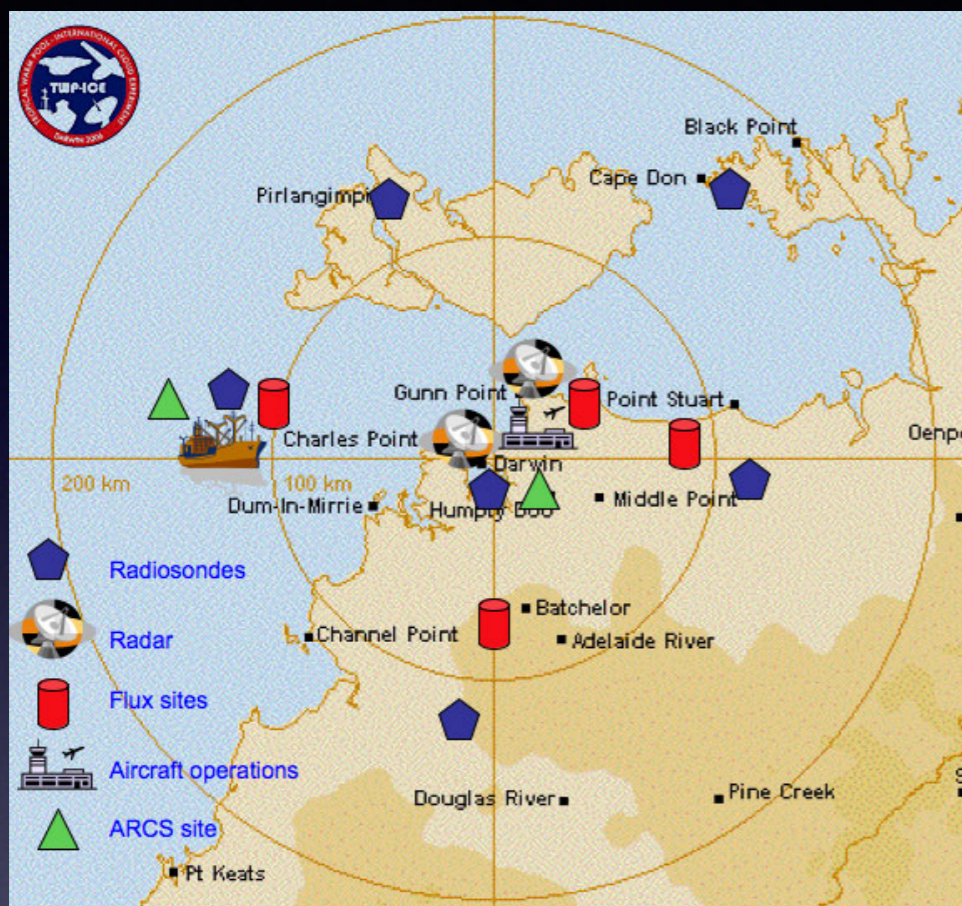
Location – 130.9E, 12.4S

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.

Fridland et al, 2012 J. Geophys. Res.
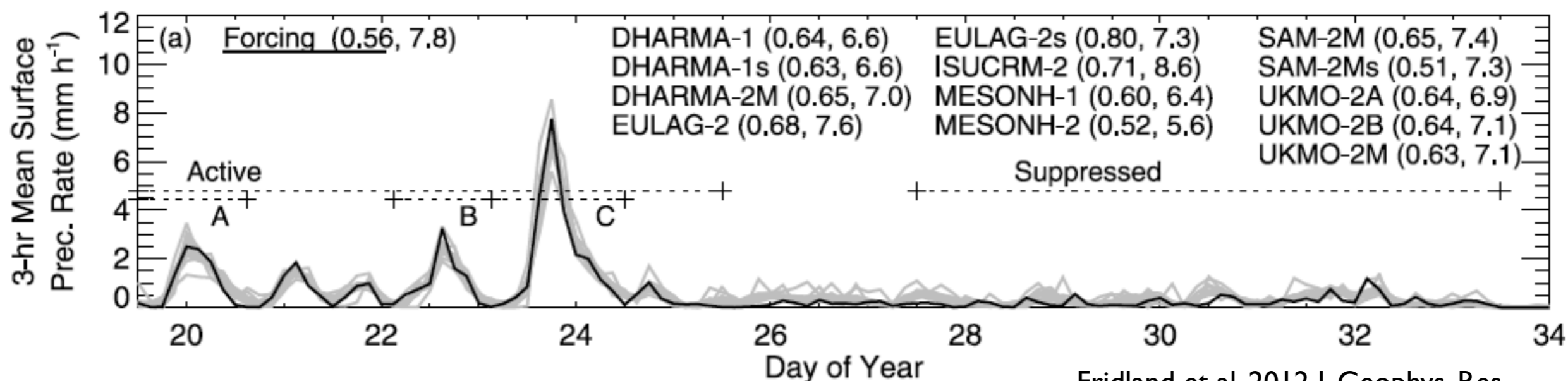
Run Status

- 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
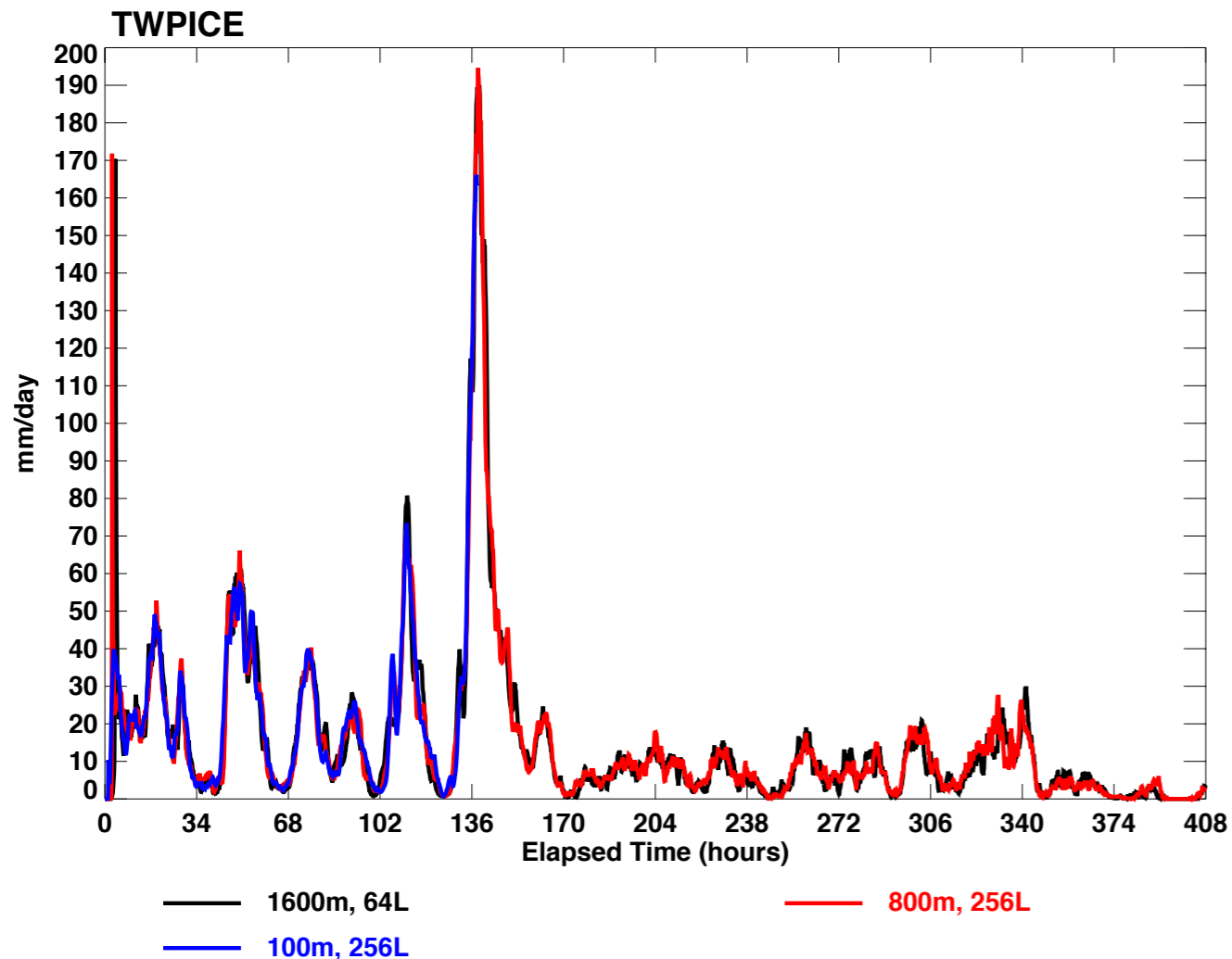
Maximum Updraft Velocity
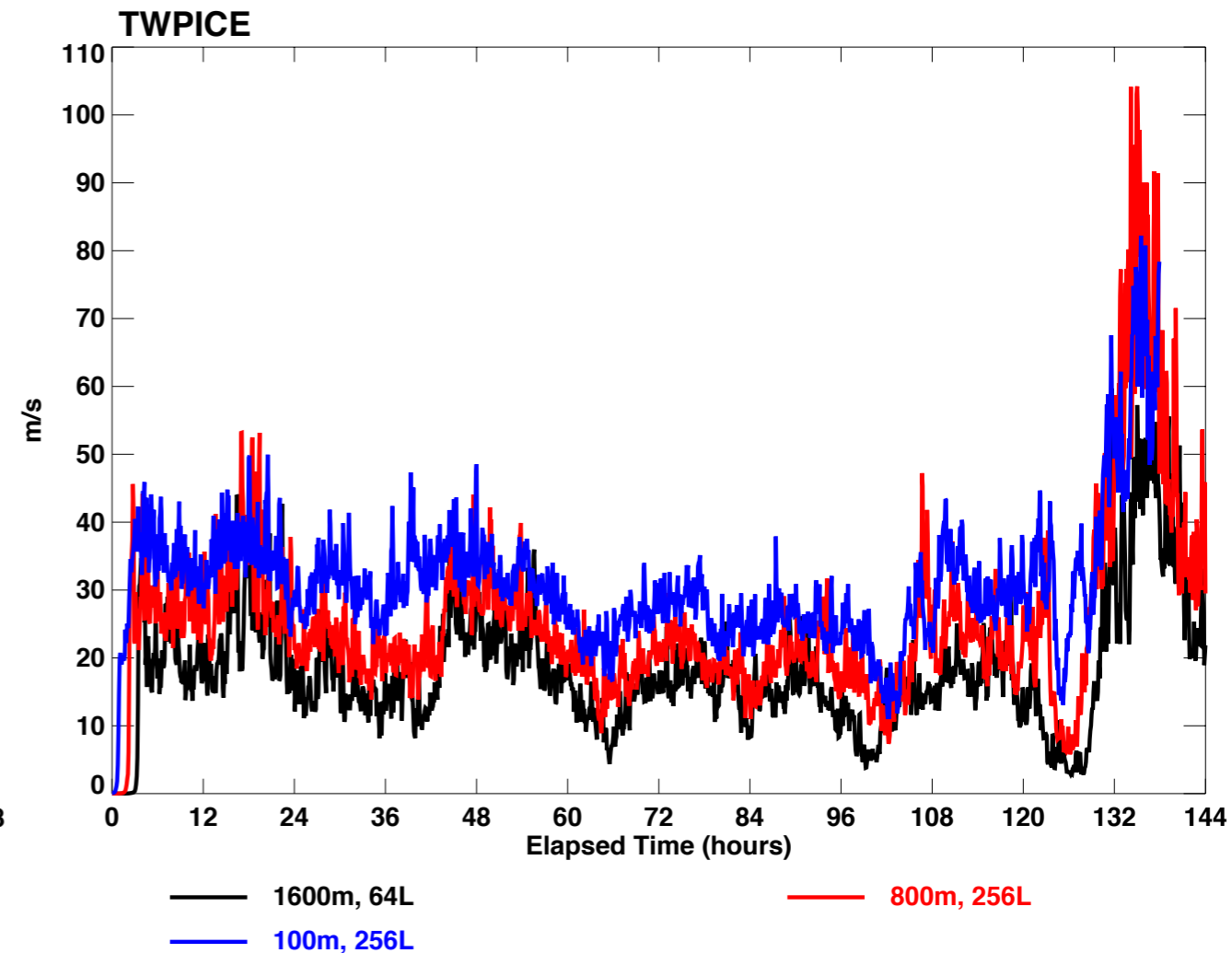
Resources Awarded in September

        Your request:
        Large Eddy Simulations (GigaLES) of Deep Convection Over Continental and
Oceanic Domains Using the System for Atmospheric Modeling (SAM) Cloud-resolving
Model (CRM)
        ATM100027

        Has been awarded and allocation on the following resources:
        SDSC Appro with Intel Sandy Bridge Cluster (Gordon Compute Cluster):
613,018.0 SUs
TACC Dell PowerEdge C8220 Cluster with Intel Xeon Phi coprocessors (Stampede):
766,273.0 SUs
TACC Long-term tape Archival Storage (Ranch): 1,000,000.0 GB
SDSC Medium-term disk storage (Data Oasis): 51,200.0 GB
XSEDE-Wide File System (XWFS): 100,000.0 GB
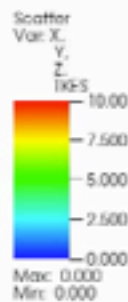TACC HP/NVIDIA Interactive Visualization and Data Analytics System (Maverick):
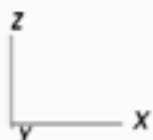100,000.0 SUs

Output types - OUT_LPT

- Lagrangian Parcel Trackers

- 146800640 (every grid point at 35 levels from 250m to 17,250m every 500m initialization at hour 48.

- 30 s frequency

- 37 variables

- NetCDF-4 with compression, 1 file per timestep (13 GB/file)

Variable	Units	Description
NVI	[number]	Number of vertical initialization
X	[m]	X position
Y	[m]	Y position
Z	[m]	Z position
U	[m/s]	U wind
V	[m/s]	V wind
W	[m/s]	W wind
PRES	[Pa]	Pressure
RHO	[kg/m3]	Density
PPRIME	[Pa]	Pressure perturbation
LWSE	[K]	Liquid water static energy
MSE	[K]	Moist static energy
DSE	[K]	Dry static energy
VDSE	[K]	Virtual dry static energy
SMSE	[K]	Saturation moist static energy
TABS	[K]	Absolute temperature
THETA	[K]	Potential temperature
THETAL	[K]	Liquid water potential temperature
THETAV	[K]	Virtual potential temperature
THETAE	[K]	Equivalent potential temperature
QV	[g/kg]	Water vapor
QCL	[g/kg]	Cloud water
QSAT	[g/kg]	Saturation mixing ratio
RELH	[unit]	Relative humidity
TKE	[m2/s2]	Parameterized ensemble-mean resolved scale TKE
TKES	[m2/s2]	SGS TKE
Rig	[unit]	Gradient Richardson number
NC	[#/cm3]	CLOUD WATER NUMBER CONCENTRATION
QR	[g/kg]	RAIN
NR	[#/cm3]	RAIN NUMBER CONCENTRATION
QI	[g/kg]	CLOUD ICE
NI	[#/cm3]	CLOUD ICE NUMBER CONCENTRATION
QS	[g/kg]	SNOW
NS	[#/cm3]	SNOW NUMBER CONCENTRATION
QG	[g/kg]	GRAUPEL
NG	[#/cm3]	GRAUPEL NUMBER CONCENTRATION
TR01	ppbv	Ozone-initialized passive tracer
TR02	kg/kg	PBL-source=1, 12 hour decaying tracer

DB: TWPICE_gigaLES_LTP048_LPT00001.nc
Cycle: 0

Scatter
Var: X,
Y,
Z,
TKES
— 10.00
— 7.500
— 5.000
— 2.500
— 0.000
Max: 0.000
Min: 0.000
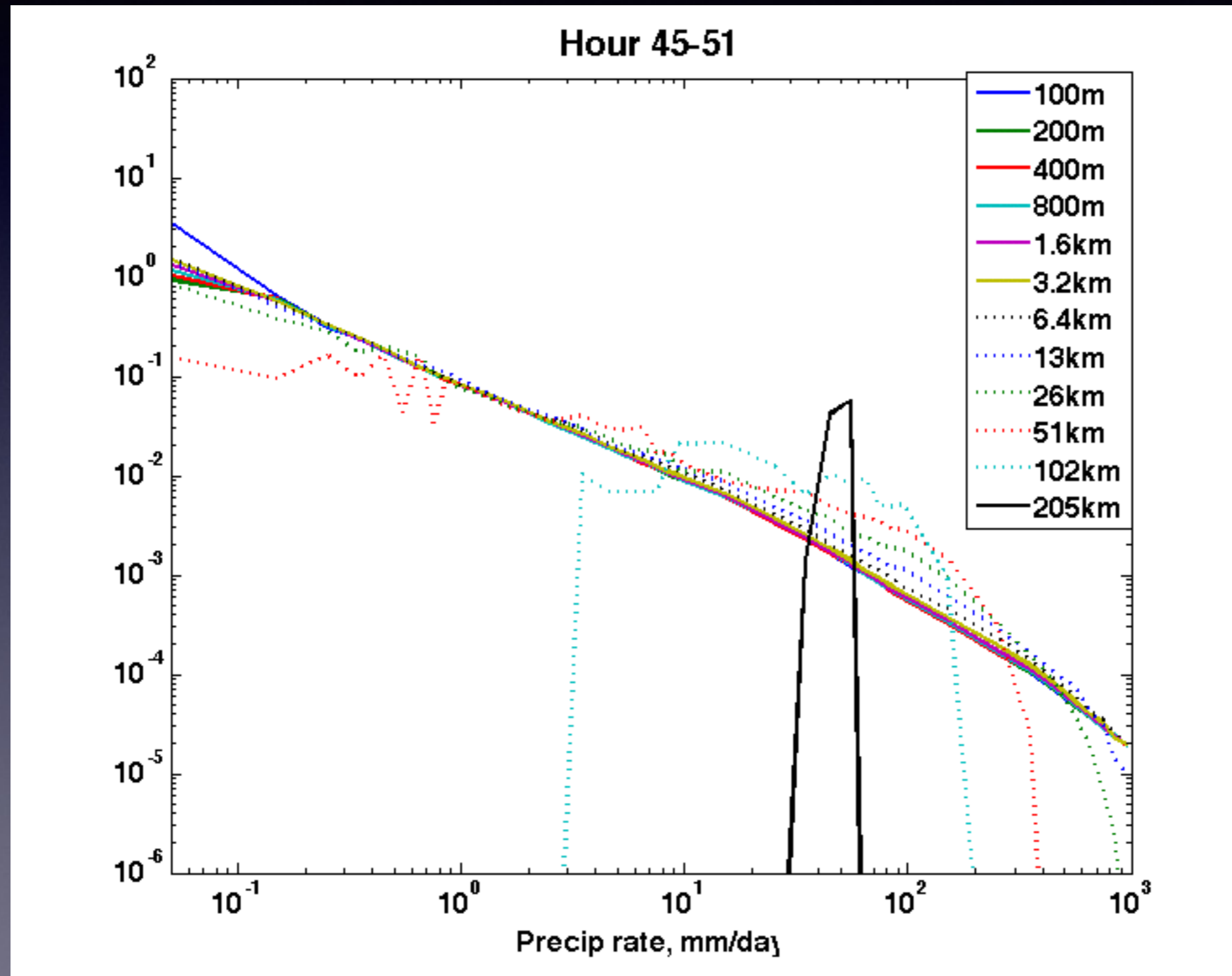
0   50   100 X (x 10^3) 150   200250300(x10^3)

z
x
y

Analysis example

- Probability density function of precipitation

Distribution

- Currently, must contact me 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`

- OUT_STAT files have been placed there already and available for download and inspection

TWPICE_1.6km_64L_CONT.nc.gz	Aug 04, 2014	264M
TWPICE_1.6km_64L_RADSNOW.nc.gz	Aug 04, 2014	264M
TWPICE_800m_256L_CONT.nc.gz	Aug 04, 2014	1G
TWPICE_800m_256L_RADSNOW.nc.gz	Aug 04, 2014	1G
TWPICE_gigaLES.nc	Jul 24, 2014	653M

Distribution - update

- In the last six months GigaLES data has already been distributed:

  Steve Krueger - Utah

  Brian Mapes - Miami

Land GigaLES - MC3E
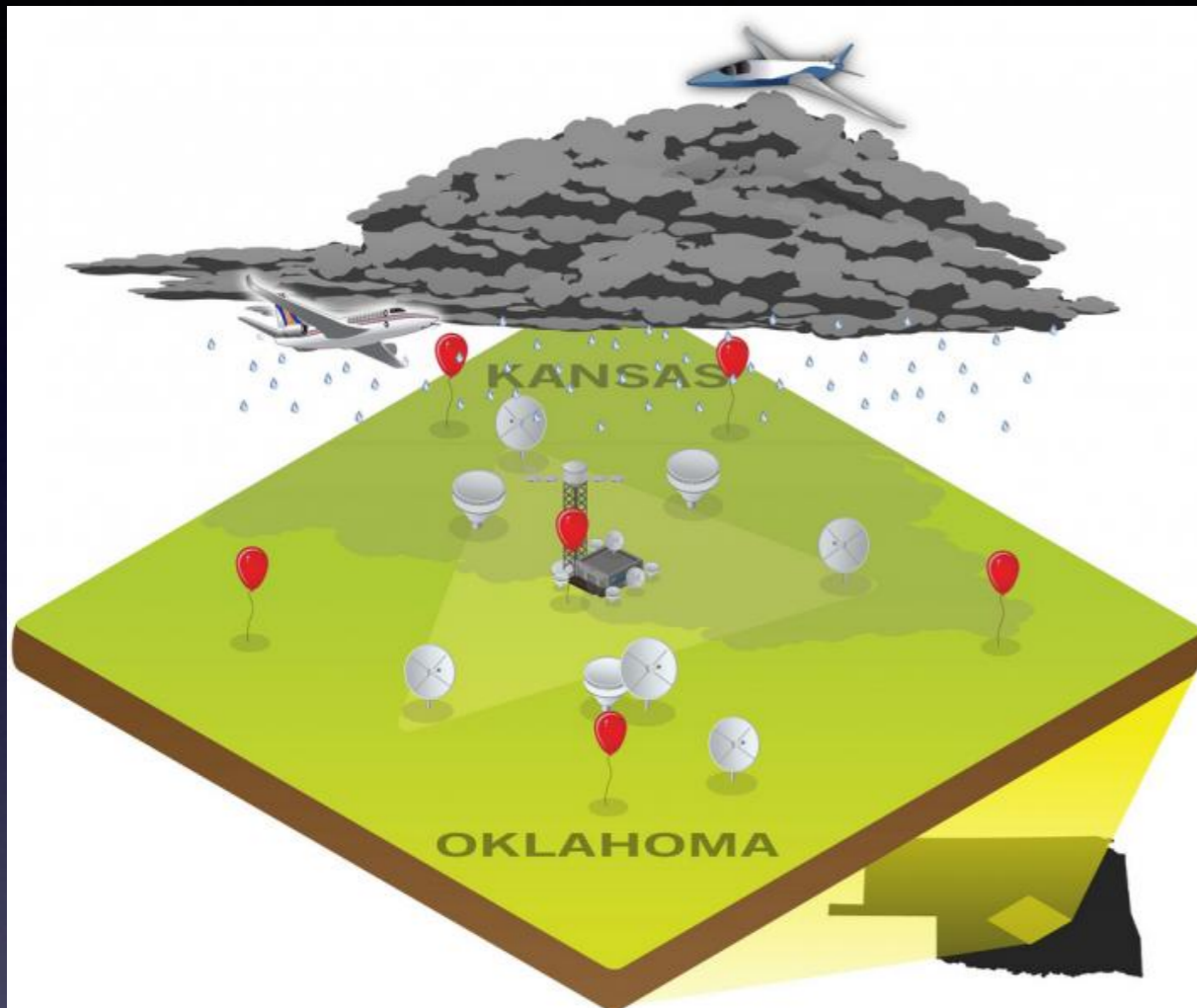
IOP - 22 Apr 2011 to 6 Jun 2011

Plan:

- 22 Apr to 22 May - spin up land-surface heterogeneity (800m horizontal resolution)
- 0600UTC 22 May - 1800UTC 25 May - run GigaLES and continue 800m.

- The GigaLES will simulate a period of convection occurring 23-24 May.

- A 800m x 256L spin-up is complete through 0600 22 May. We are evaluating the response of the land-surface to this point.

- Have already found the need to adjust the respiration to bring the CO_2 into reasonable balance.

Summary

- GigaLES-2 simulation has completed all six days planned at 100m for the TWPICE case. Over 60 TB output generated to date.

- 100m has been run with LPT for two hours starting from hour 48.

- Data still only available through me (dazlich@atmos.colostate.edu)

- Working on a complete data archive at TACC ranch.

- Land case has spun-up the land surface heterogeneities and is ready for GigaLES

- GigaLES-2 output is a community resource available for analysis. Team members are encouraged to find imaginative applications for it.