A Preliminary Analysis of the TWP-ICE GigaLES

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Physical Processes Breakout

Model Configuration

SAM 6.10.4 modified to include:

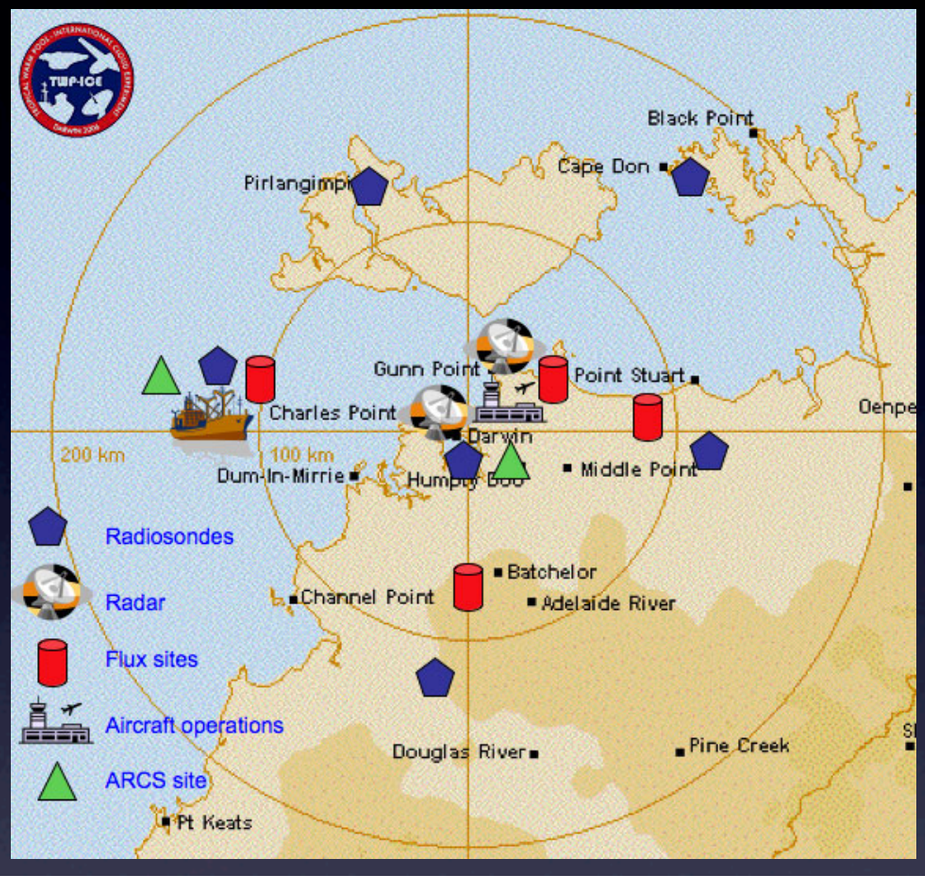
- New cloud optical properties based on CAM5, including radiatively-active snow and using predicted size distributions from the two-moment microphysics.
- Lagrangian Parcel Tracker (LPT) diagnostic package that predicts the trajectories of user-defined parcels.
- The elliptic pressure solver and 3D output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

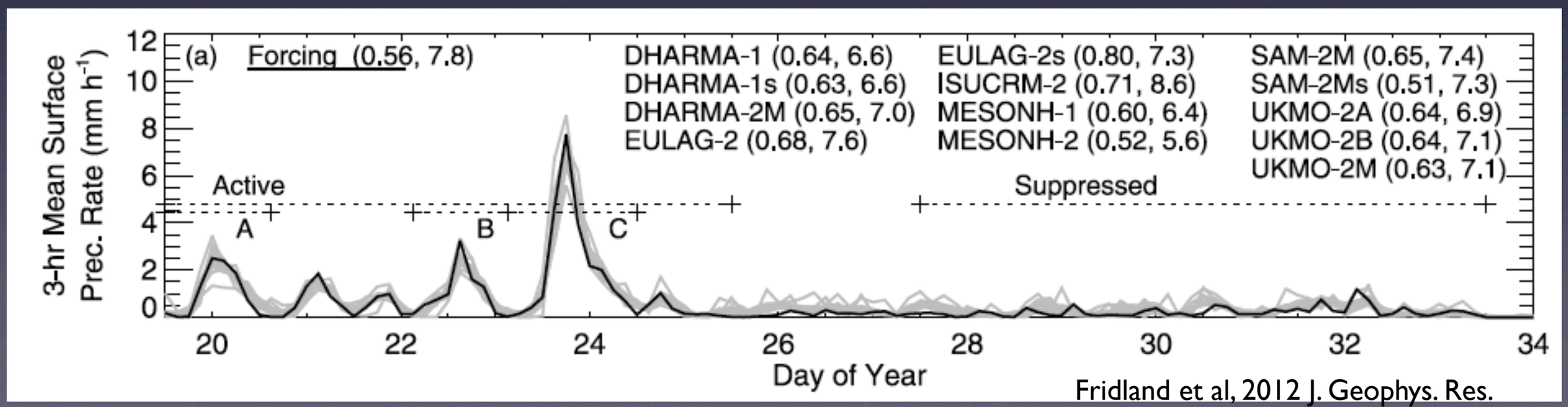
	GigaLES 1	GigaLES 2
Large Scale Forcing	GATE (IDEAL) - steady	TWP-ICE - time-varying
Radiation	Prescribed steady	RRTM interactive
Microphysics	Single Moment	Two-moment Morrison 2005
Scalar Advection	MPDATA	Ultimate Macho - 5th order
Duration	24 hours	4 days (and continuing)

Tropical Warm Pool - International Cloud Experiment



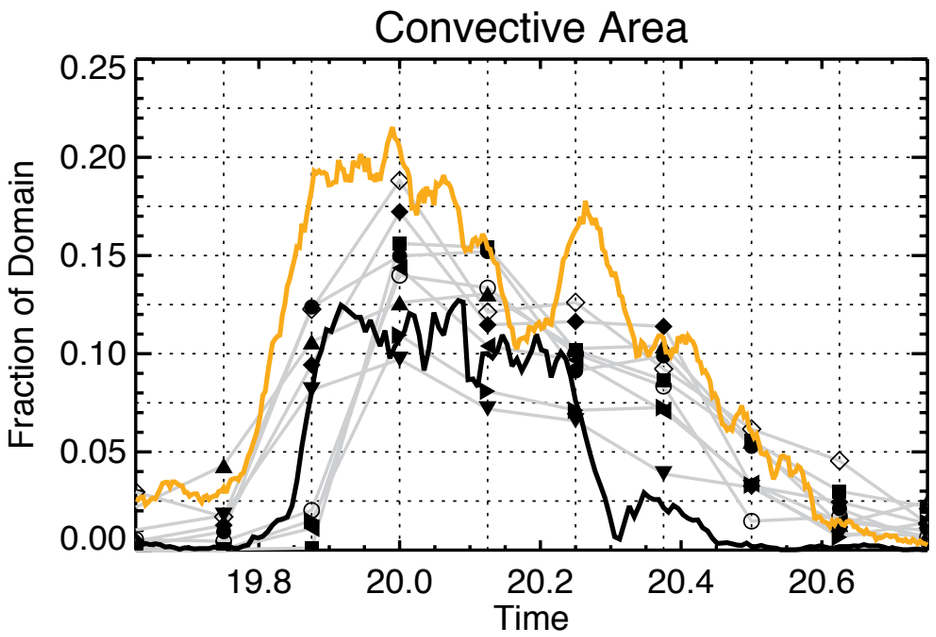
Location – 130.9E,12.4S

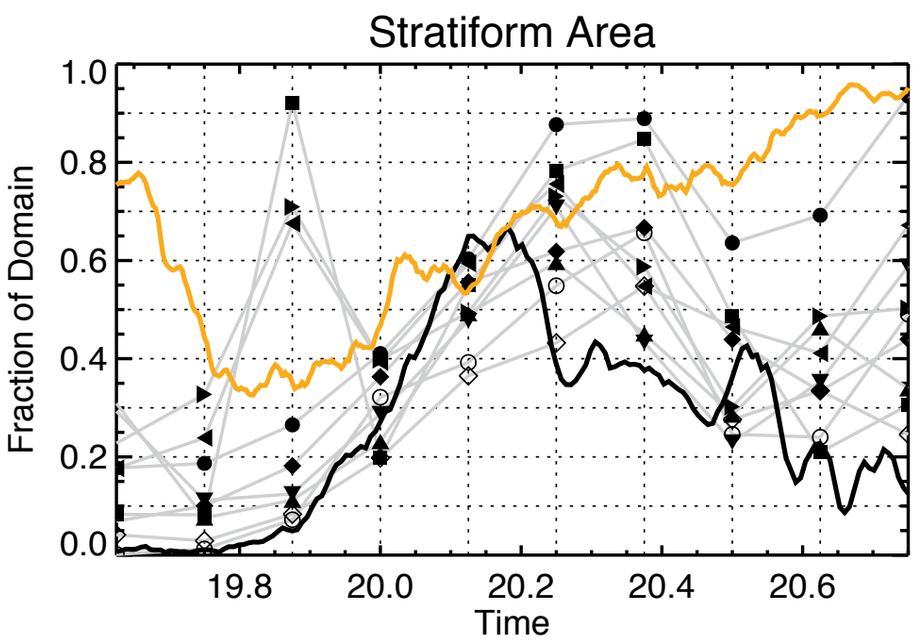
- Intense measurement period – 18 Jan 2006 – 4 Feb 2006.
- Features active (19 Jan.–25 Jan.) and suppressed (27 Jan.–4 Feb.) monsoon periods.
- The model is run according to the CRM intercomparison specifications in Fridland et al, 2012. The domain is treated as a uniform ocean surface with fixed SST.

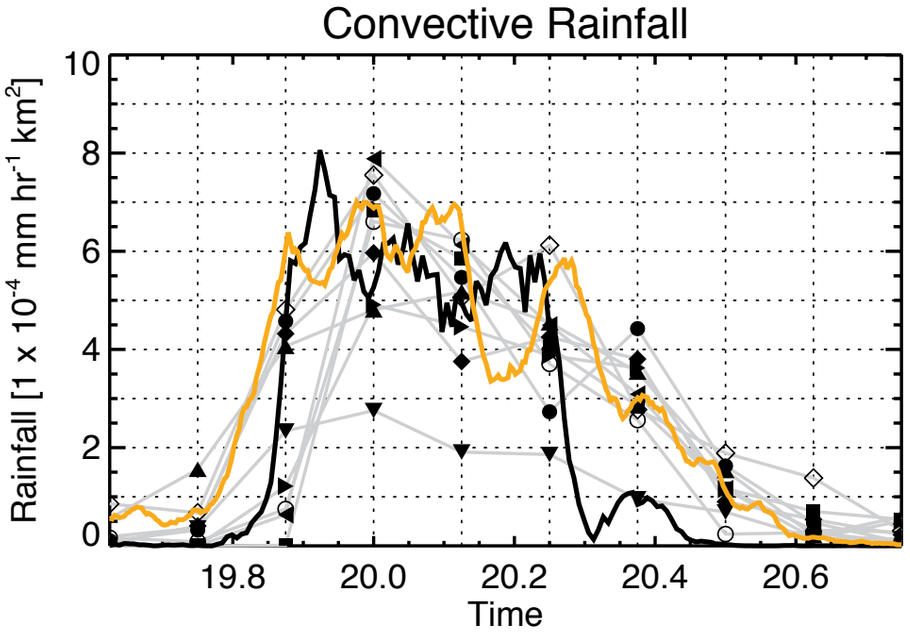


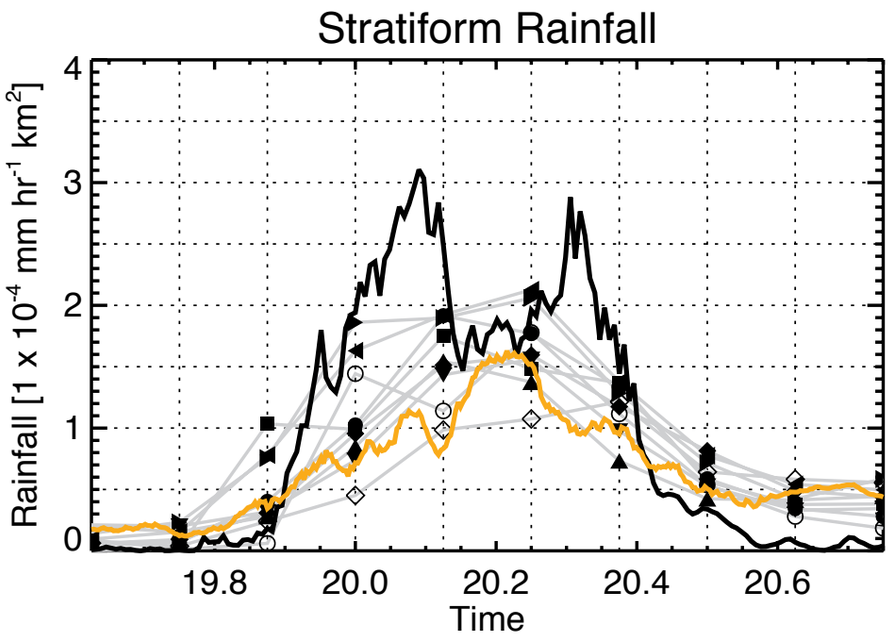
Fridland et al, 2012 J. Geophys. Res.

Convective/Stratiform Precipitation Comparison with TWP-ICE



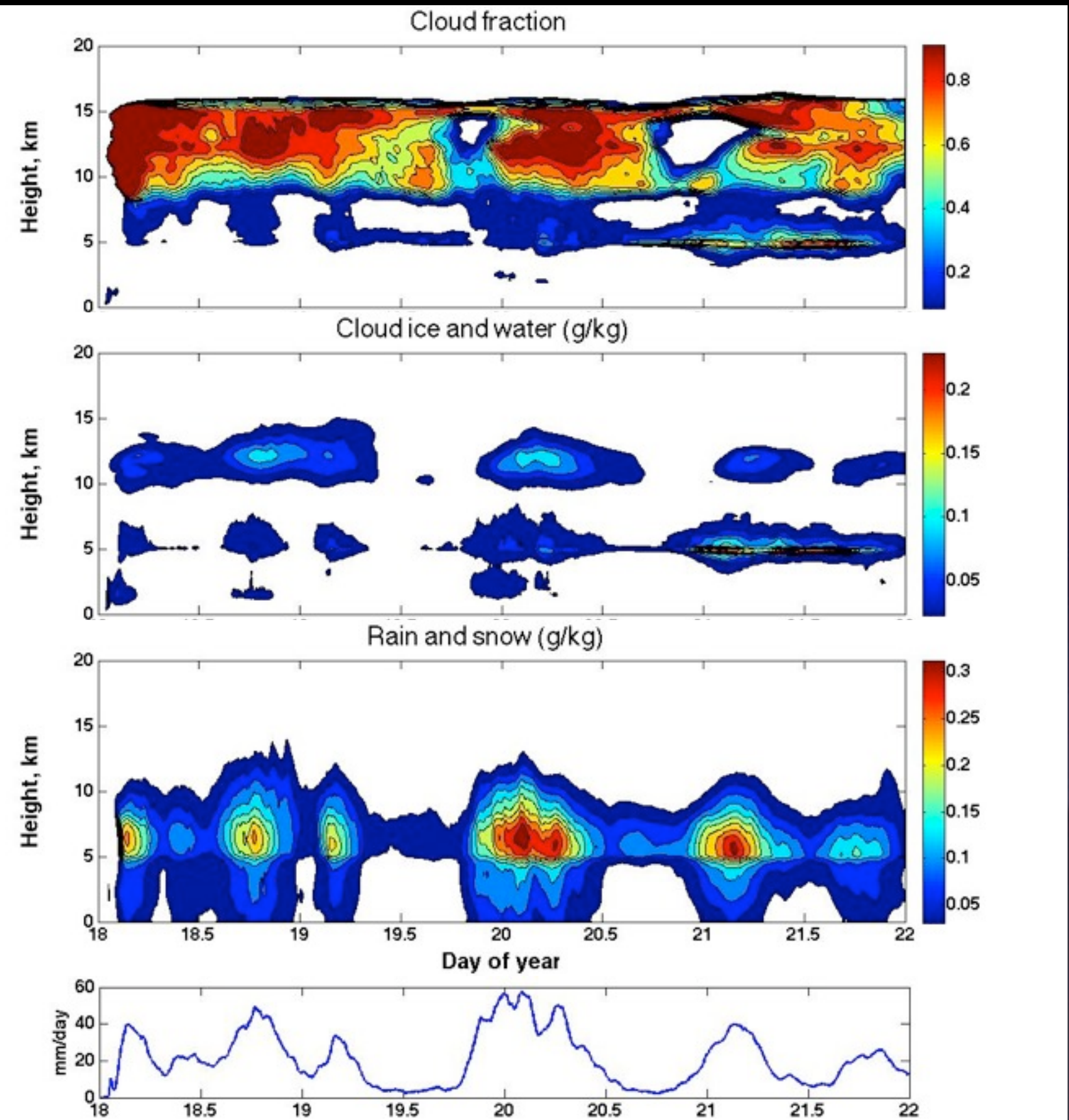






CPOL radar retrievals are in black, nine CRMs from the TWP-ICE CRM Intercomparison Study (Varble et al. 2011, Fridlind et al. 2012) are in gray with symbols, and the SAM giga-LES is in orange. Convective and stratiform regions are separated by applying the Steiner et al. (1995) algorithm on 2.5-km altitude reflectivity at a horizontal grid spacing of 2.5 km. CRM and giga-LES output were degraded to 2.5-km horizontal grid spacing to match the radar retrievals.

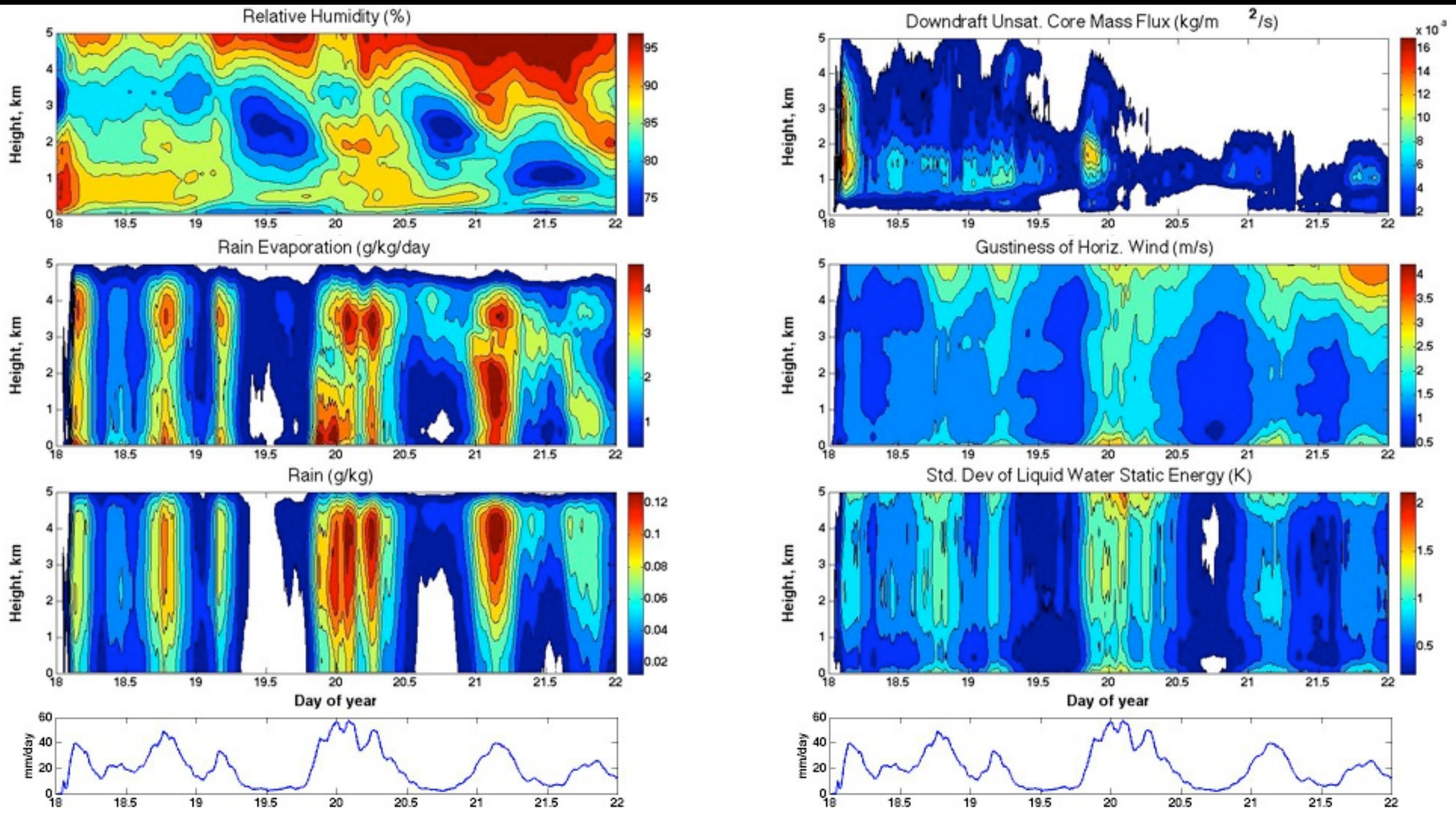
Clouds and Precipitation



Domain average profiles:

Tri-modal cloud structure simulated in GigaLES-1 is again present.

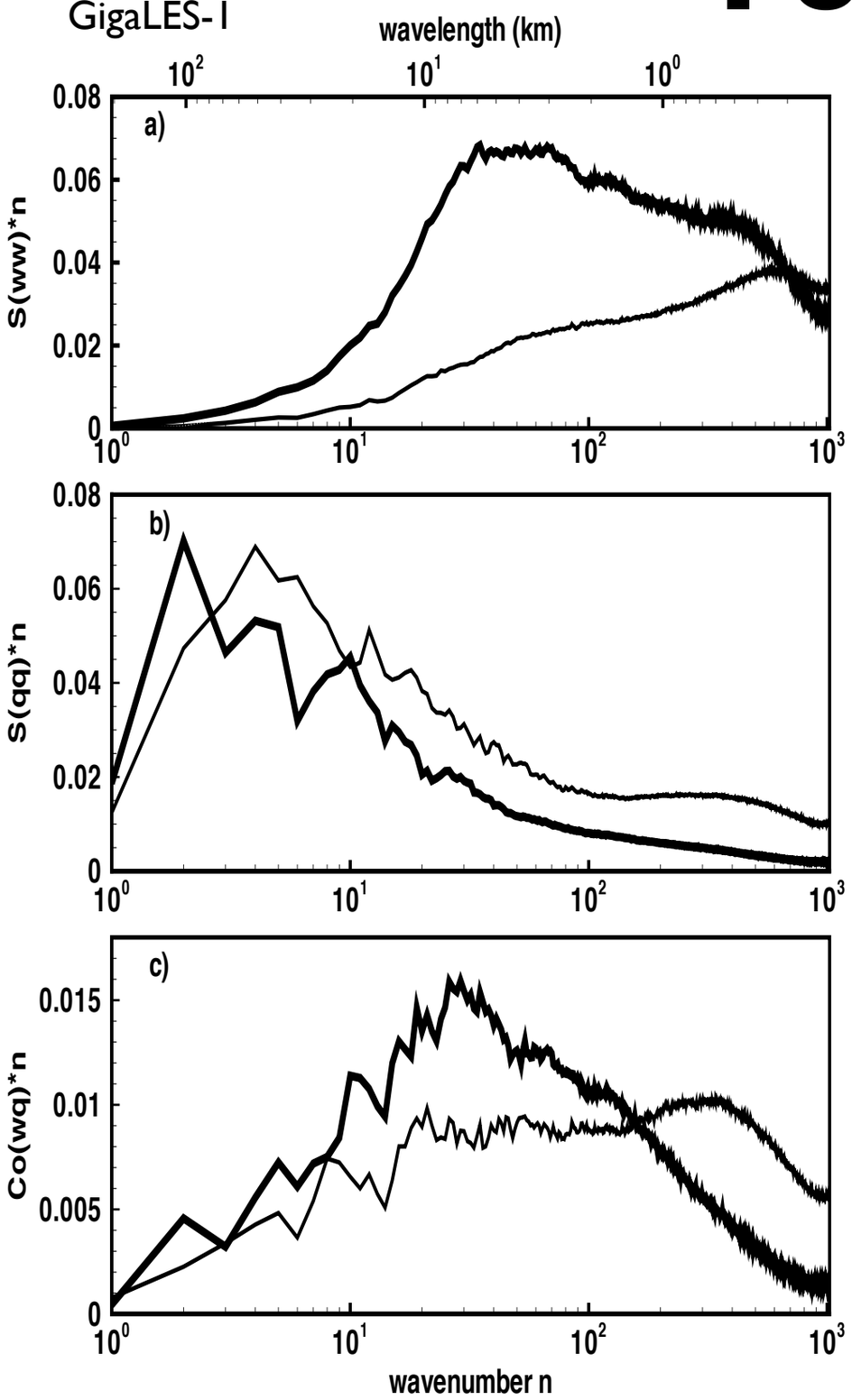
Rain Evaporation, Downdrafts and Cold Pools



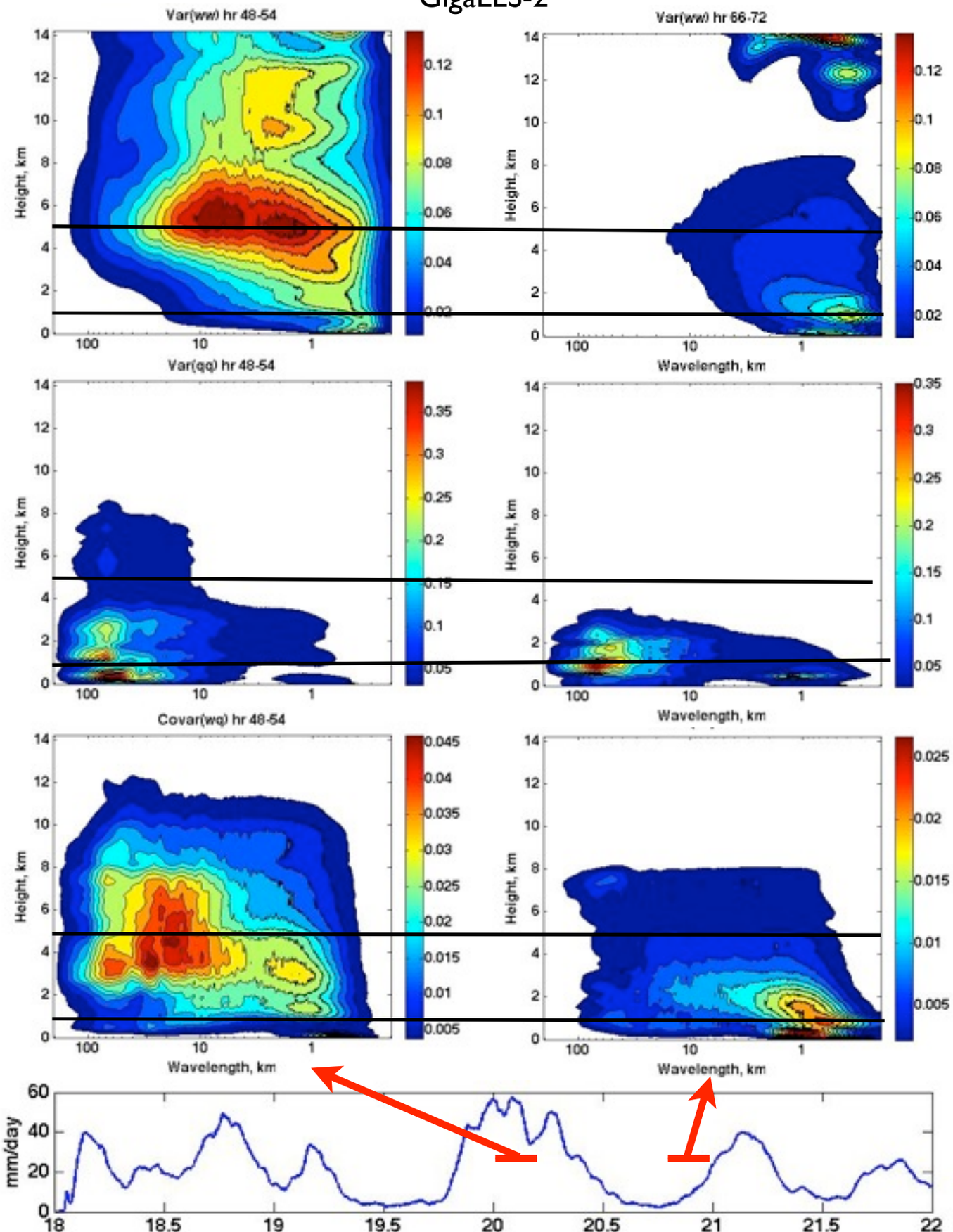
The left three panels show how the rain evaporation rate is related to both relative humidity and rain mixing ratio. The bottom two panels display two indicators of cold pools: large variability of the horizontal wind vector and of the temperature near the surface. Cold pools are most active around days 18.8, 19.2, and 19.9–20.3. The best indicator for cold pool activity is the near-surface rain evaporation rate (except during the spin-up period at day 18.2), while downdraft unsaturated core mass flux (top right) is a poor indicator.

Power Spectra

GigaLES-1

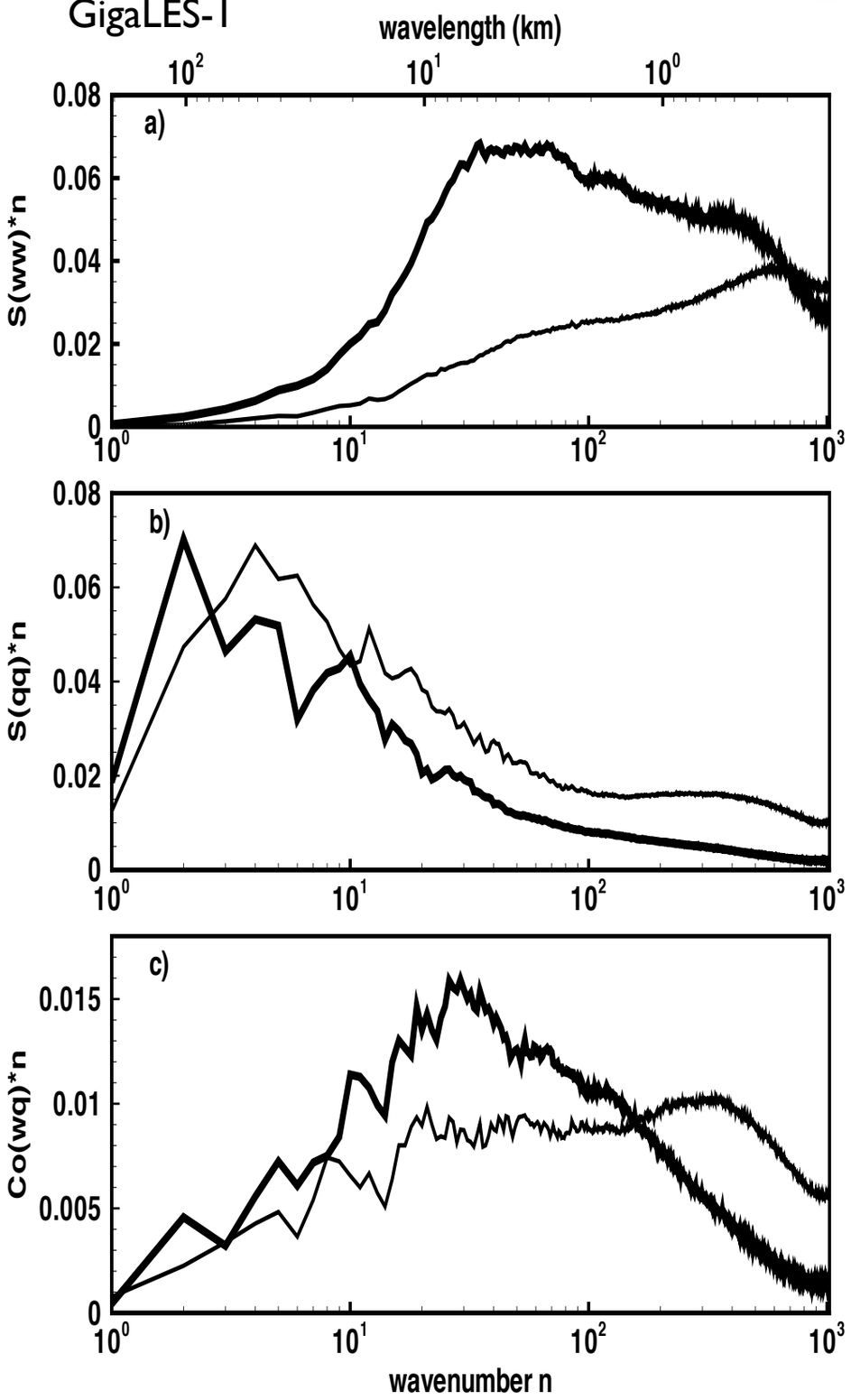


GigaLES-2

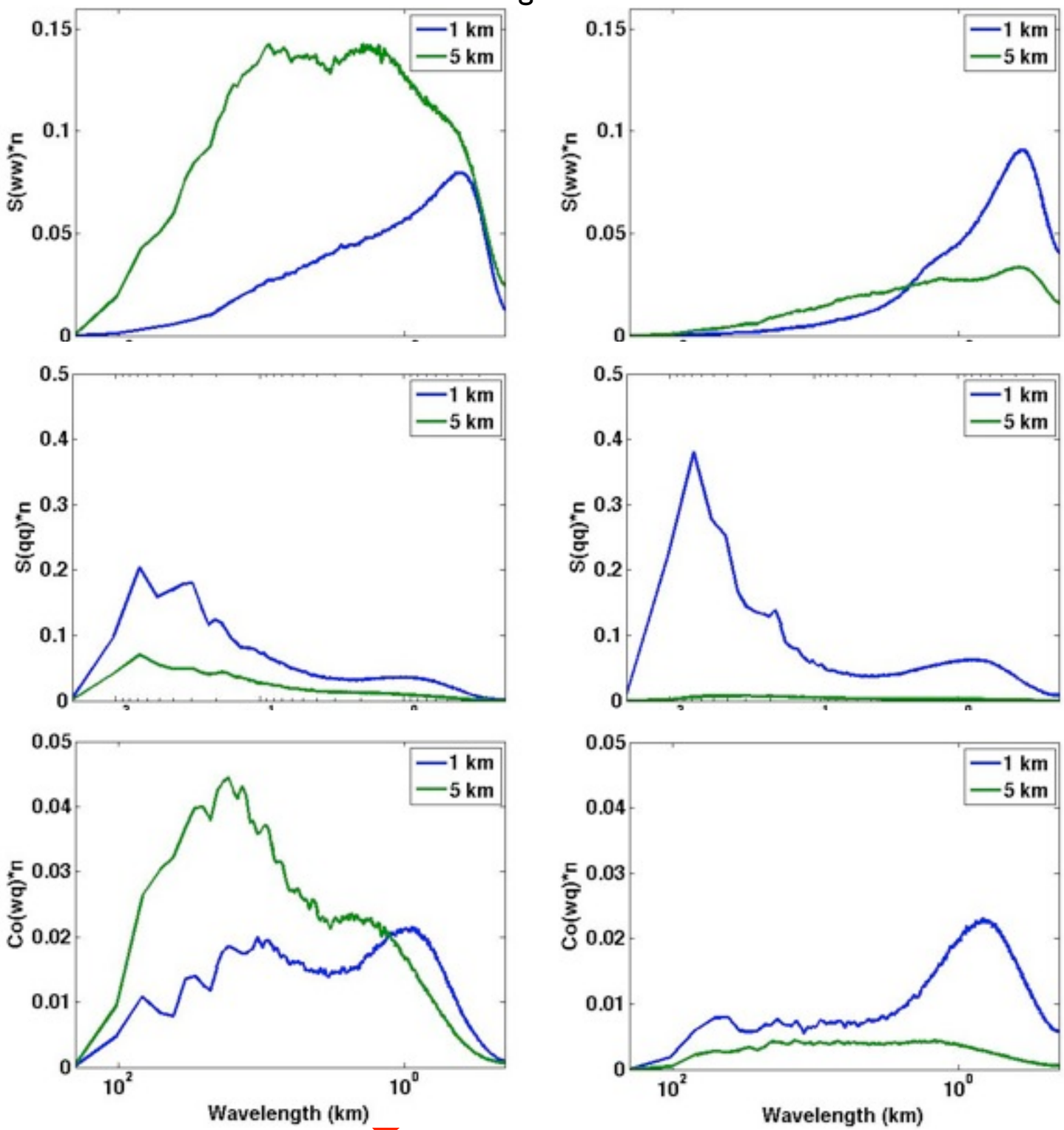


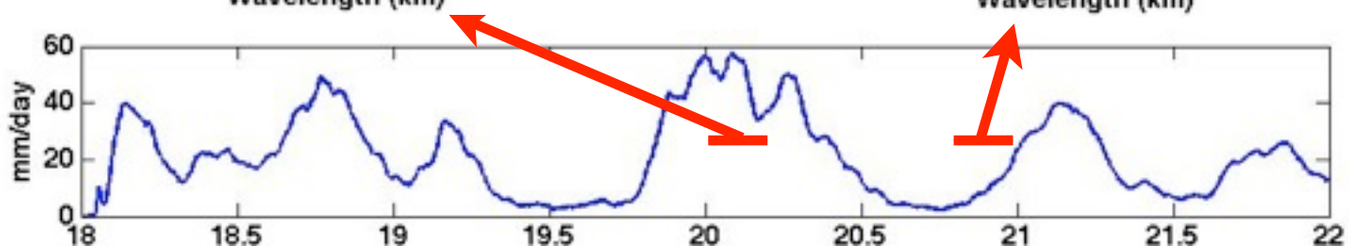
Power Spectra

GigaLES-1



GigaLES-2

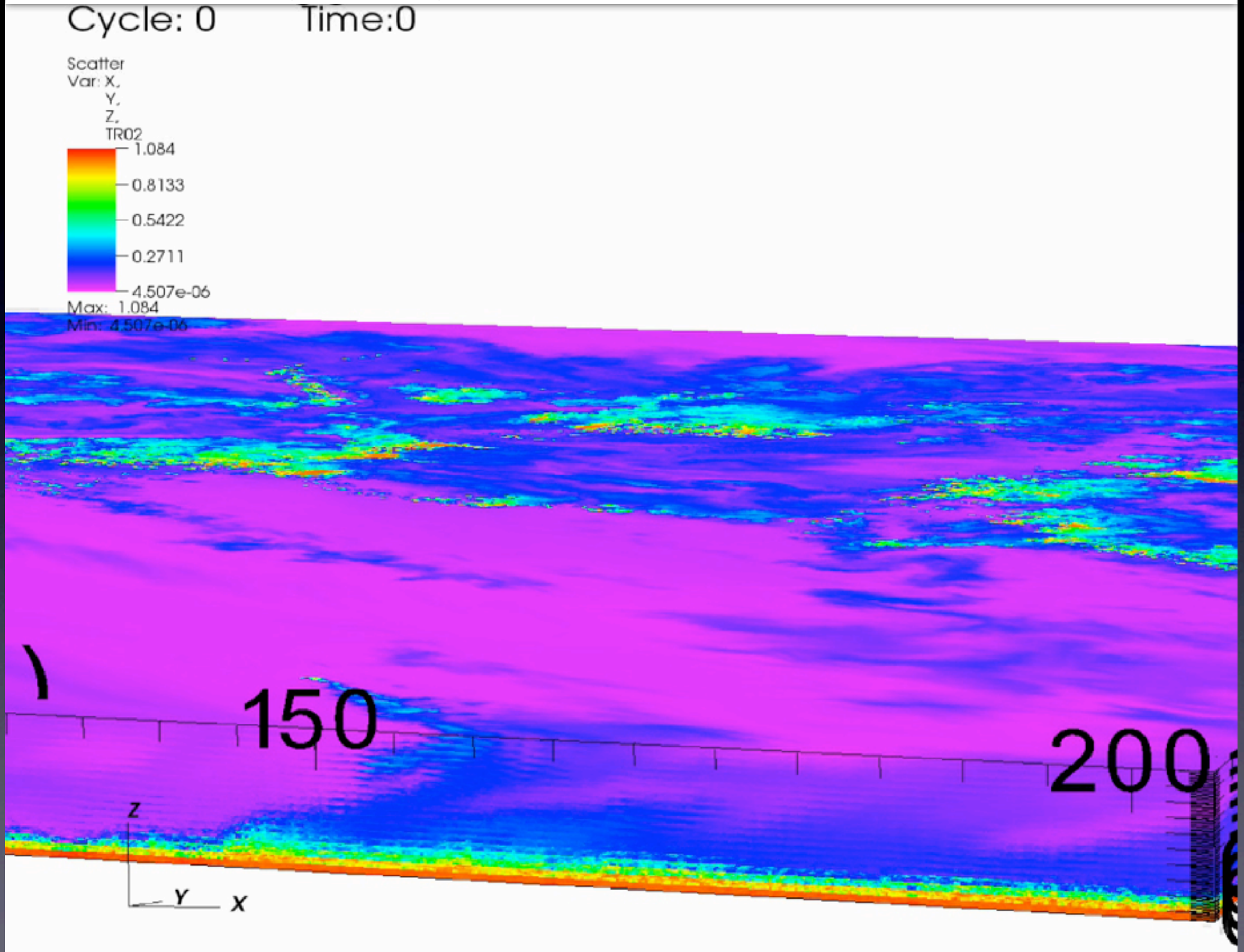




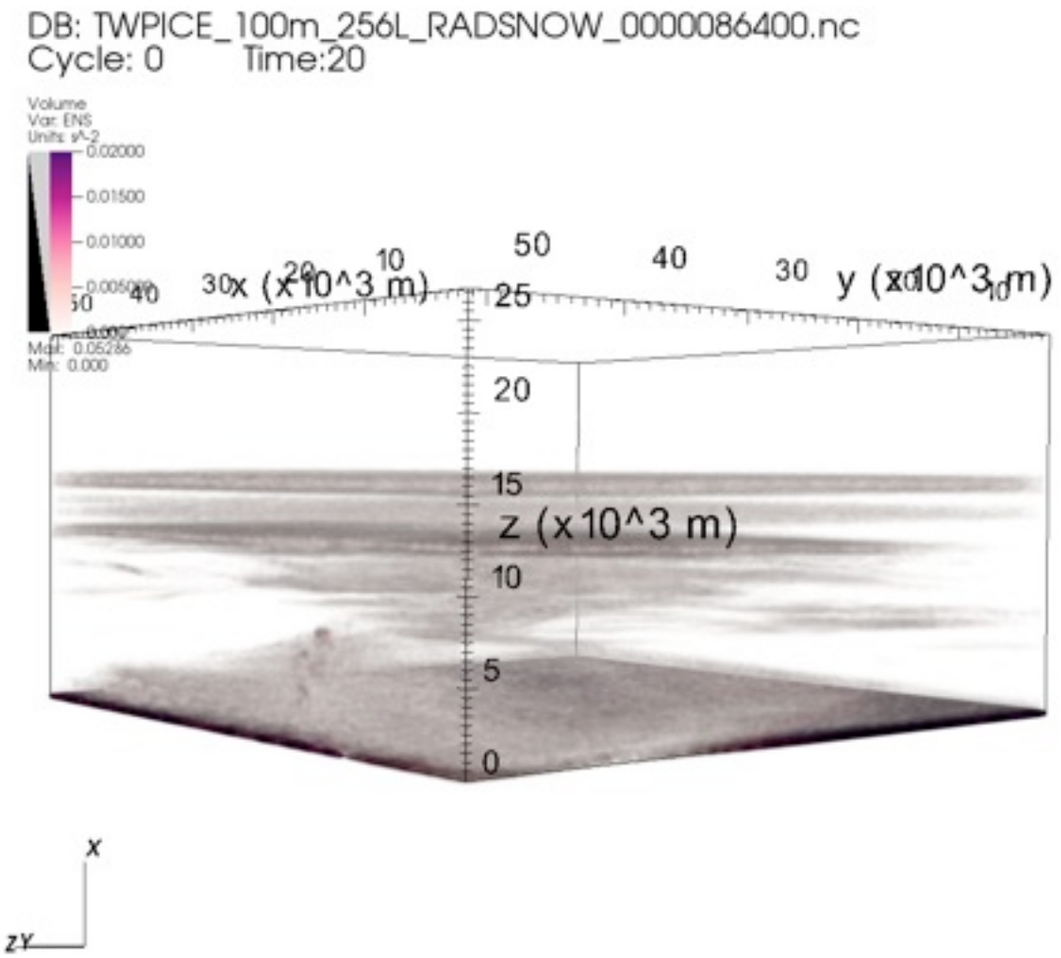
5km w-variance is proportional to precipitation.
1km q-variance largest for the drier period.

GigaLES-1 precip=13.4mm/day

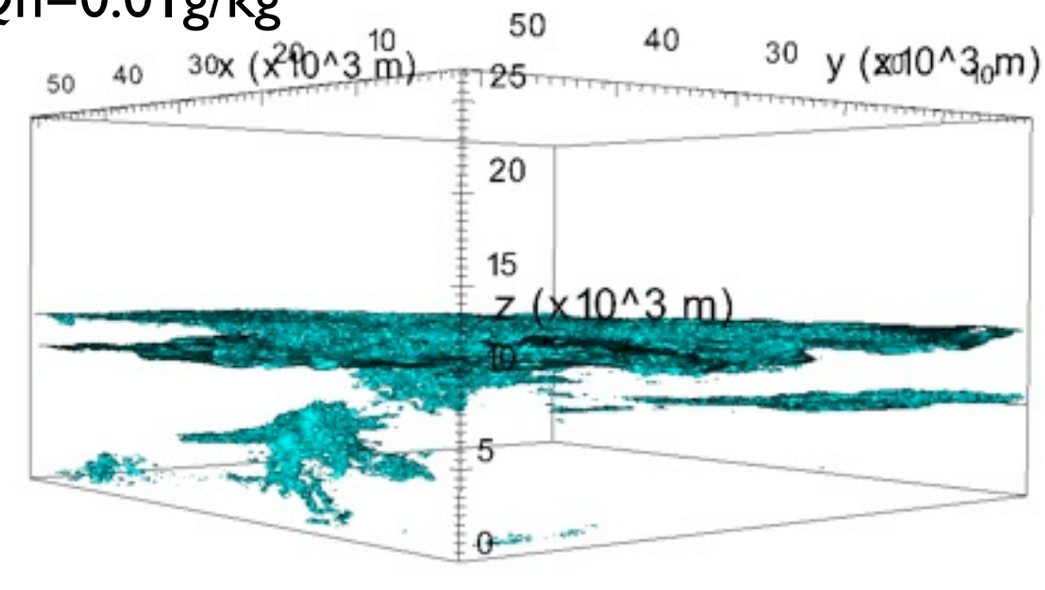
Lagrangian Parcel Tracker

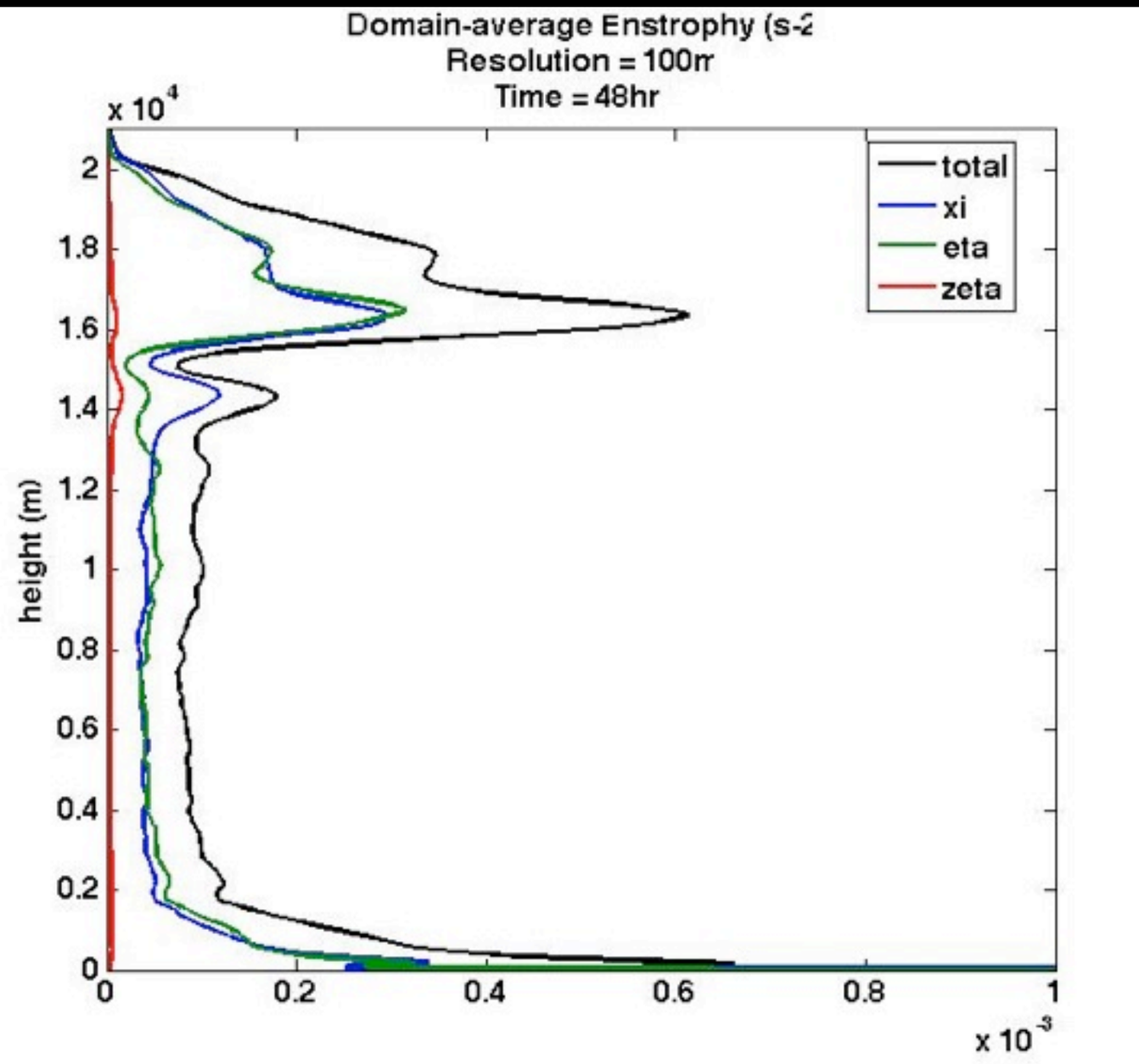


Enstrophy



Cloud-
Qn=0.01g/kg

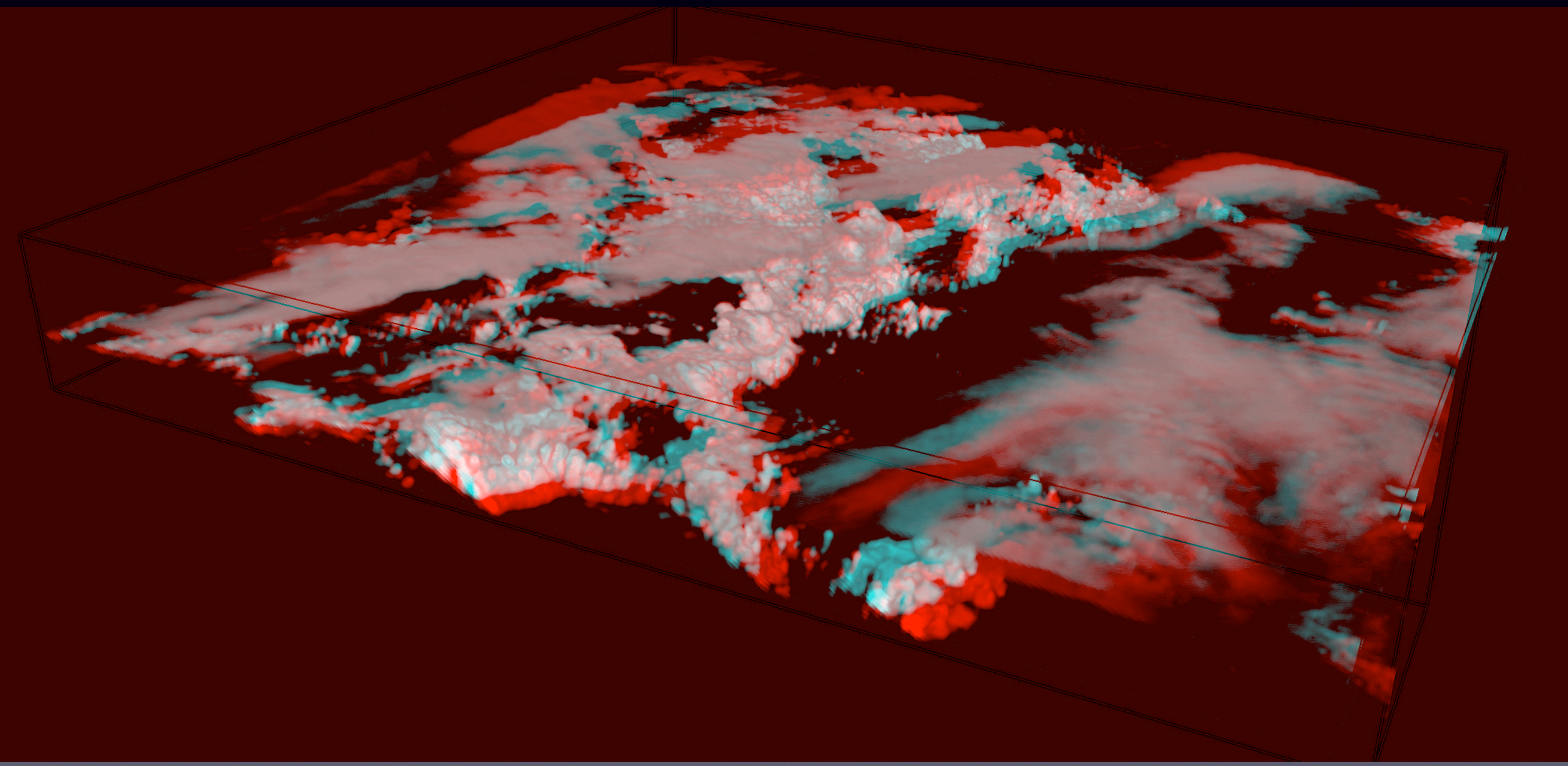




- Dave Randall is looking at possible application of enstrophy to turbulent mixing.
- Enstrophy corresponds well to cloud field.
- Additional high enstrophy layer above the cloud-top layer.

Visualization

Volume rendering of the cloud water plus ice mixing ratio field at day 20.0. The spatial resolution is that of a 400-m horizontal grid size and 200-m vertical grid size after regridding from the original resolution. The stereo image was produced with VAPOR (www.vapor.ucar.edu) and RedGreen (mac.clauss-net.de/redgreen).



Summary

- GigaLES-2 simulation has completed 4 days of an intended 6.5 days and reasonably simulates the observations. Over 50 TB output generated to date.
- The additional sophistication of GigaLES-2 (interactive radiation, time-varying forcing) permits investigation into a greater number of aspects of deep convection.
- Tools like Lagrangian Parcel Trackers will assist analysis.
- GigaLES-2 output is a community resource available for analysis. Team members are encouraged to find imaginative applications for it.