

ARM/GCSS Ensemble Single Column Model intercomparison for TWP-ICE

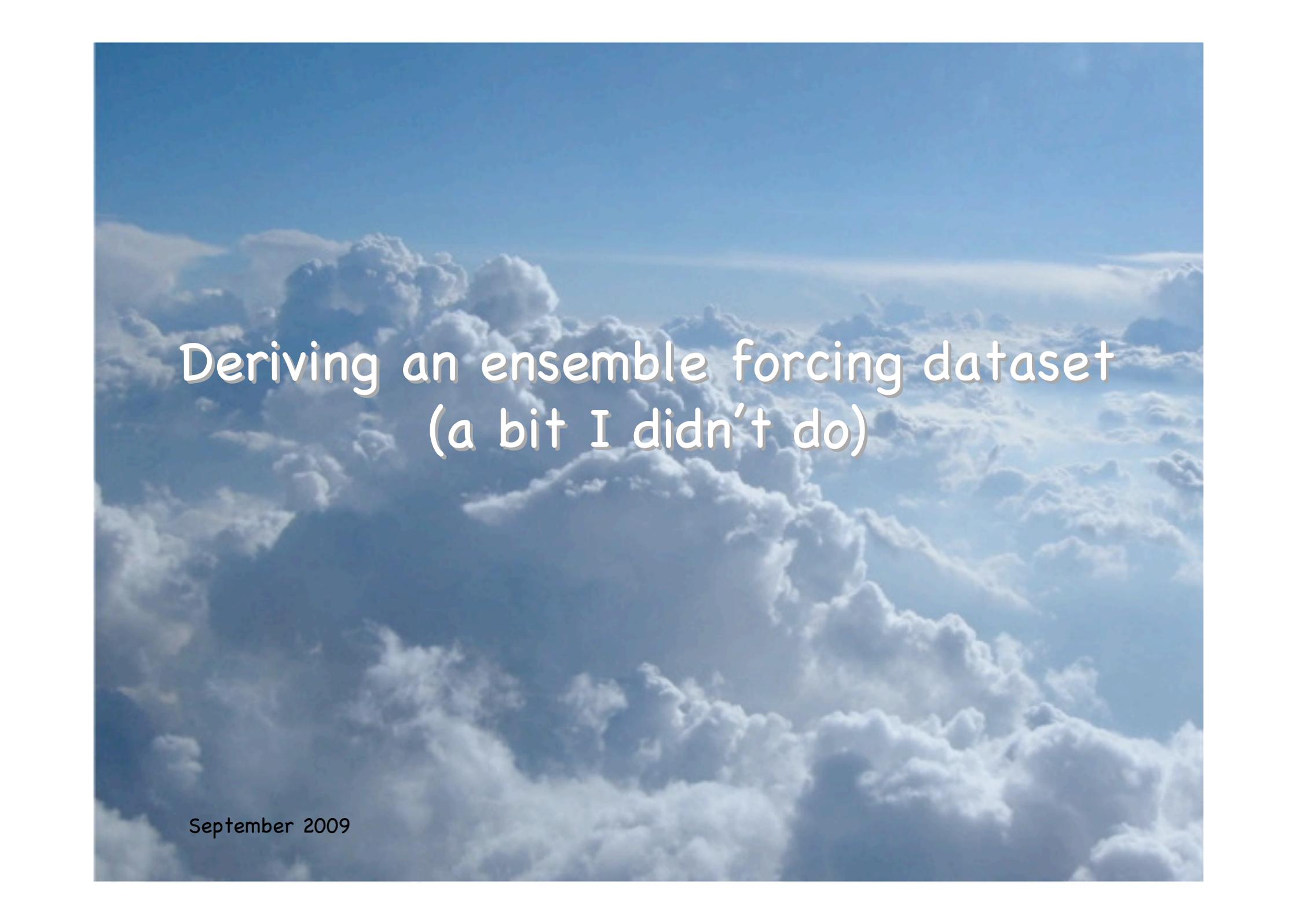
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September 2009



Outline

- Deriving an ensemble forcing dataset.
- Simulations of TWP-ICE
 - What kind of analysis is going on?
 - What additional information can we get from an ensemble?
- Lots of questions and time for feedback.



Deriving an ensemble forcing dataset
(a bit I didn't do)

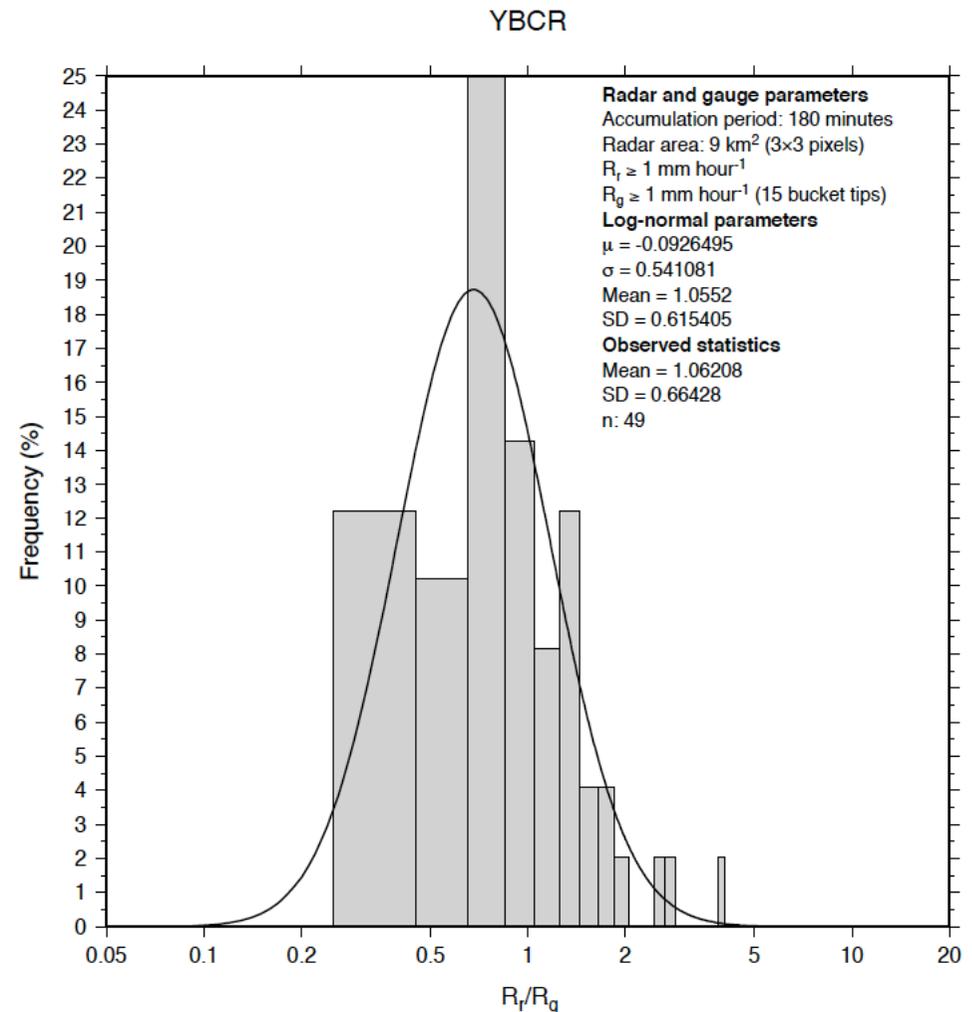
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Forcing sensitivities

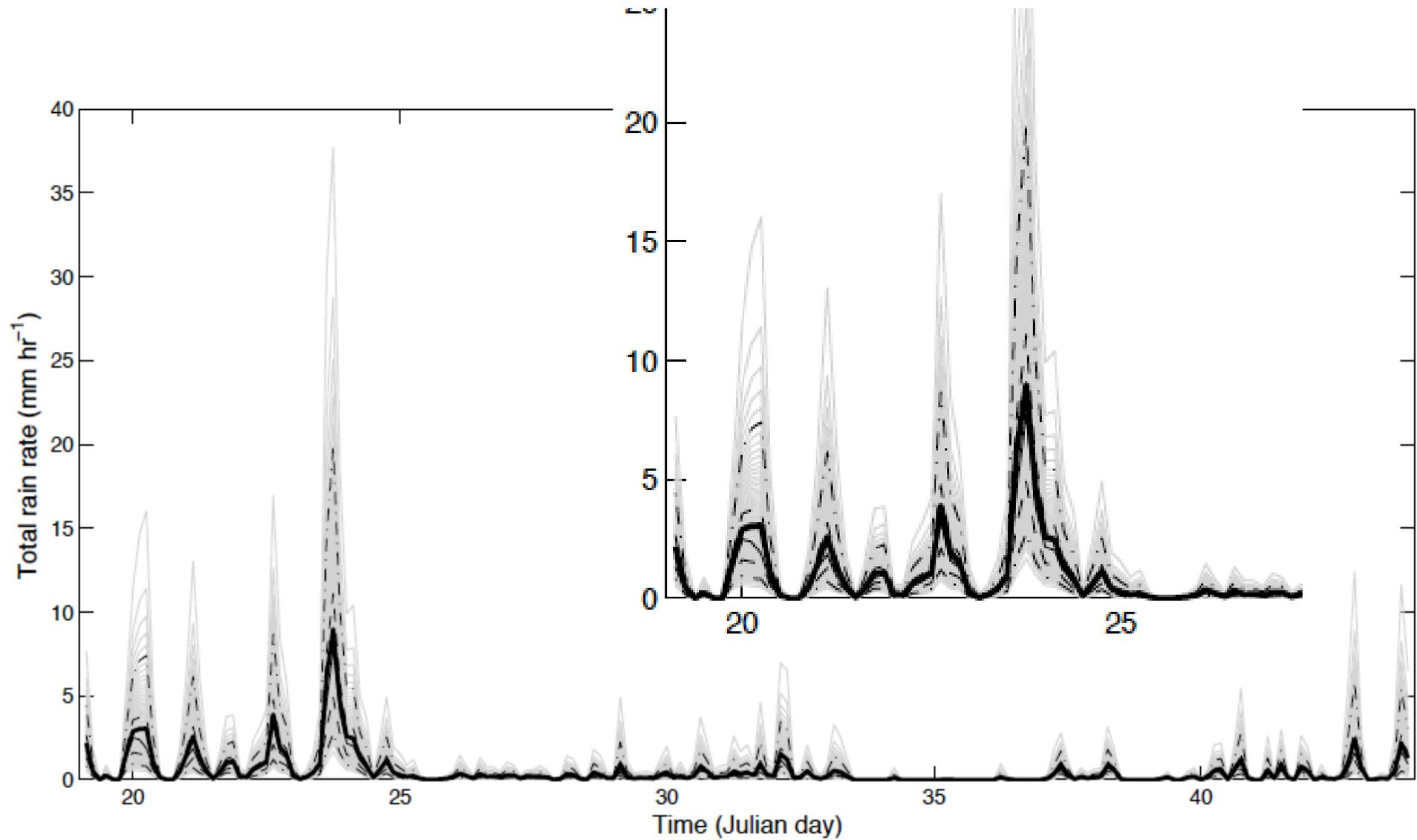
- One of the key inputs to the variational analysis is surface precipitation.
- It has been shown that the derived forcing dataset is particularly sensitive to surface precipitation.
- The derivation of precipitation is also hard and liable to error.
- What are the errors in the radar-derived precipitation?
- How might these errors effect the derived forcing dataset?
- Christian Jakob and collaborators have investigated these errors for TWP-ICE.

An ensemble of forcings

- For TWP-ICE, investigate the errors in radar-derived rainfall by comparing with rain gauge data.
- Construct p.d.f.s of the errors.
- Use the p.d.f.s to construct possible rainfall scenarios (currently 100).
- All scenarios are possible given rainfall error.
- Perform variational analysis on each scenario to create an ensemble (100 members) of forcing datasets.

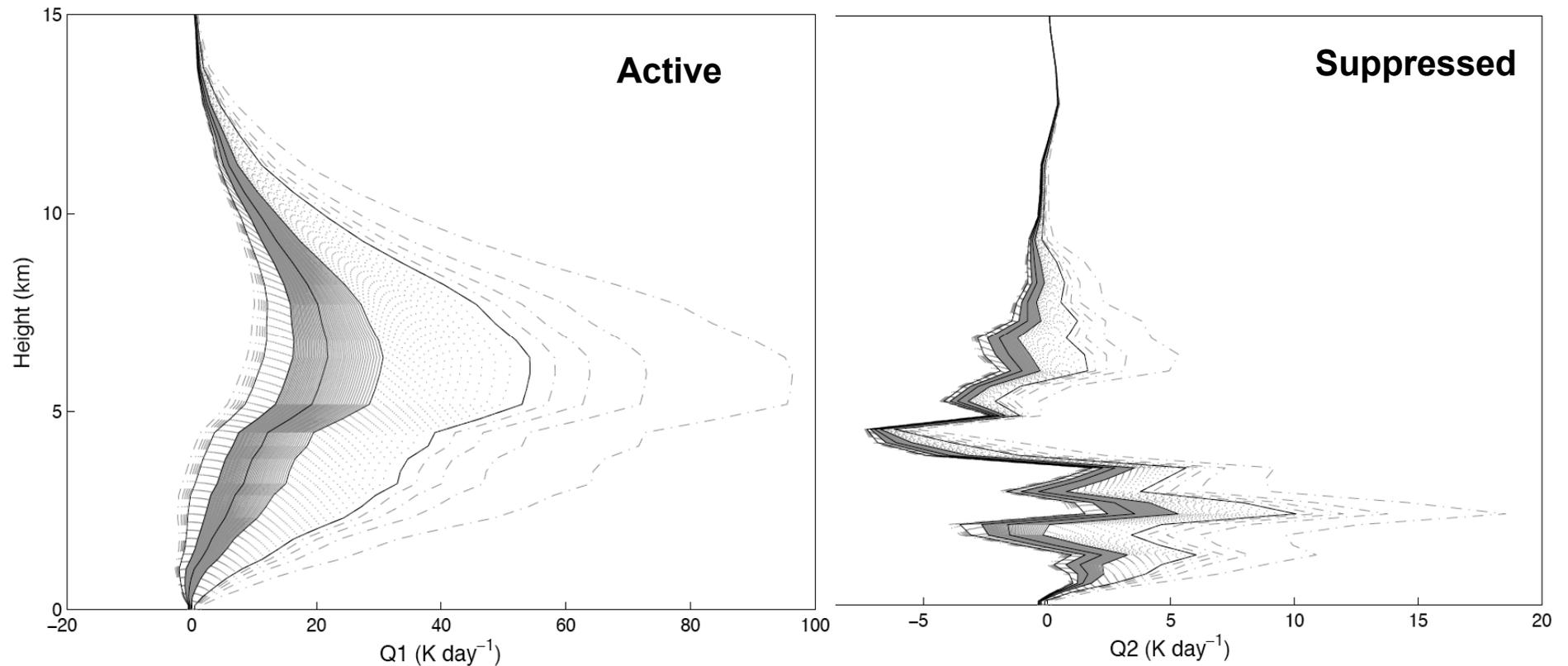


Rainfall timeseries



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Ensemble Q1 Q2



Strong latent heating through deep layer during the active monsoon.

Low level cloud during suppressed monsoon.

An aerial photograph showing a vast expanse of white, fluffy cumulus clouds stretching towards the horizon under a clear, bright blue sky. The clouds are densely packed and vary in height, creating a textured, three-dimensional appearance. The lighting is bright, suggesting a clear day.

SCM intercomparison

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SCM intercomparison specification

- Initialised at 0300Z 19 Jan 2006
- Fixed time-invariant SST of 29 °C. Interactive surface fluxes.
- Interactive radiation with diurnal cycle.
- Horizontal winds relaxed on 2 hr timescale.
- Horizontal advective tendencies of T and q only.
- Observed ozone profile.

- Simulate 1 control (best estimate)
- And 100 ensemble members

What additional information can we gain from using an ensemble?

Participants...so far

- University of Reading, UK. UM (6.0?) standard and with stochastic scheme. (Dr Robert Plant, Dr Richard Keane)
- UKMO, UK. UM with 2 different forcing methods. (Dr Jon Petch)
- PNL. SCAM and SAM-Liu microphysics. (Dr Xiaohong Liu)
- Scripps. SCAM-RZM. (Dr. Guang Zhang, Dr Xiaoliang Song)
- NOAA. NCEP GFS model. (Dr Weiguo Wang)
- GISS. GISS model. (Dr Audrey Wolf)
- University of Wisconsin. CLUBB. (Brandon Nielson, Prof Vincent Larson)

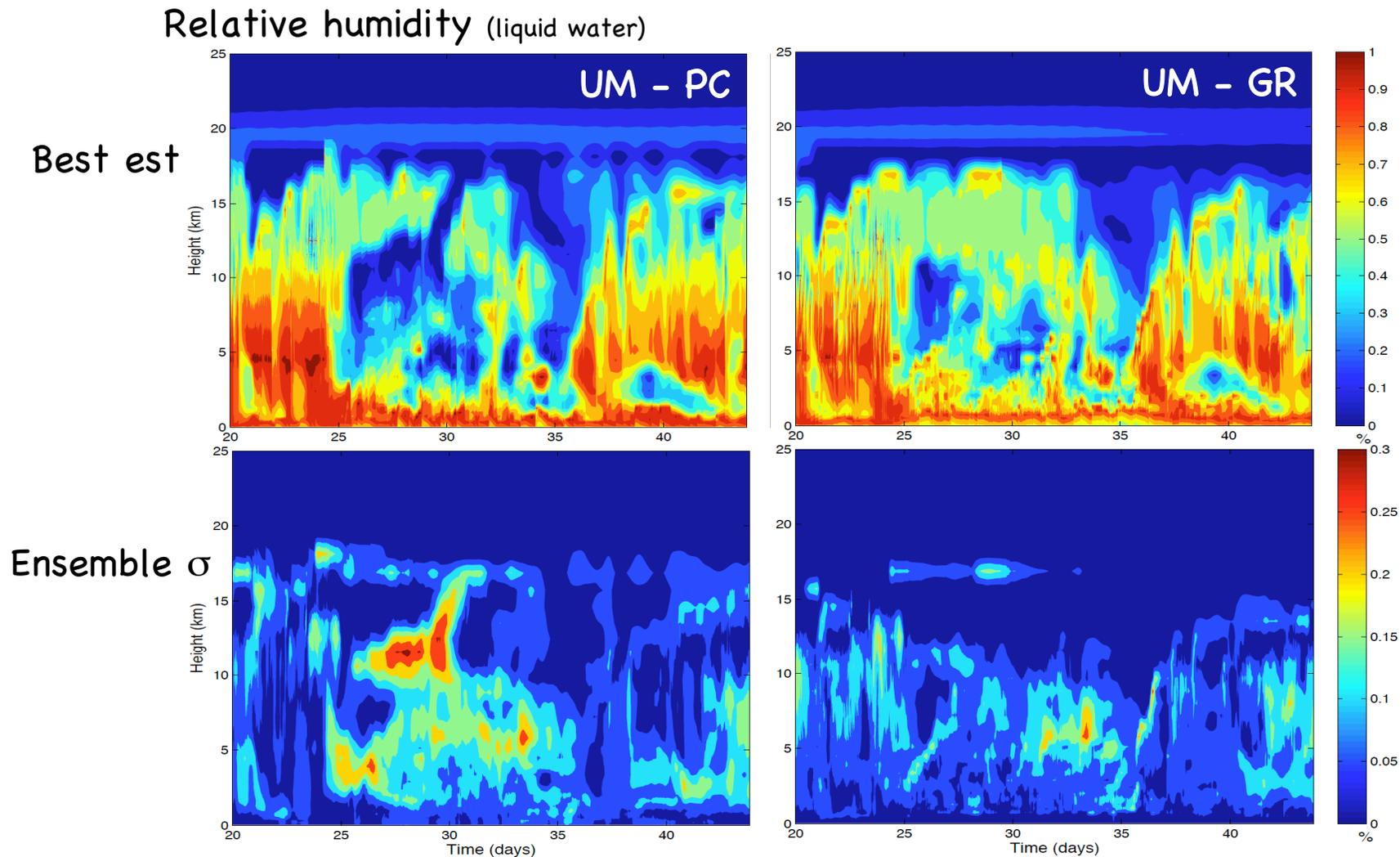
- Dr Jason Cole, results in progress.
- Dr Jun-Ichi Yano. NAMSCA.
- UKMO, UK. Met Office LEM running 2D ensemble simulations.



Initial single column model results

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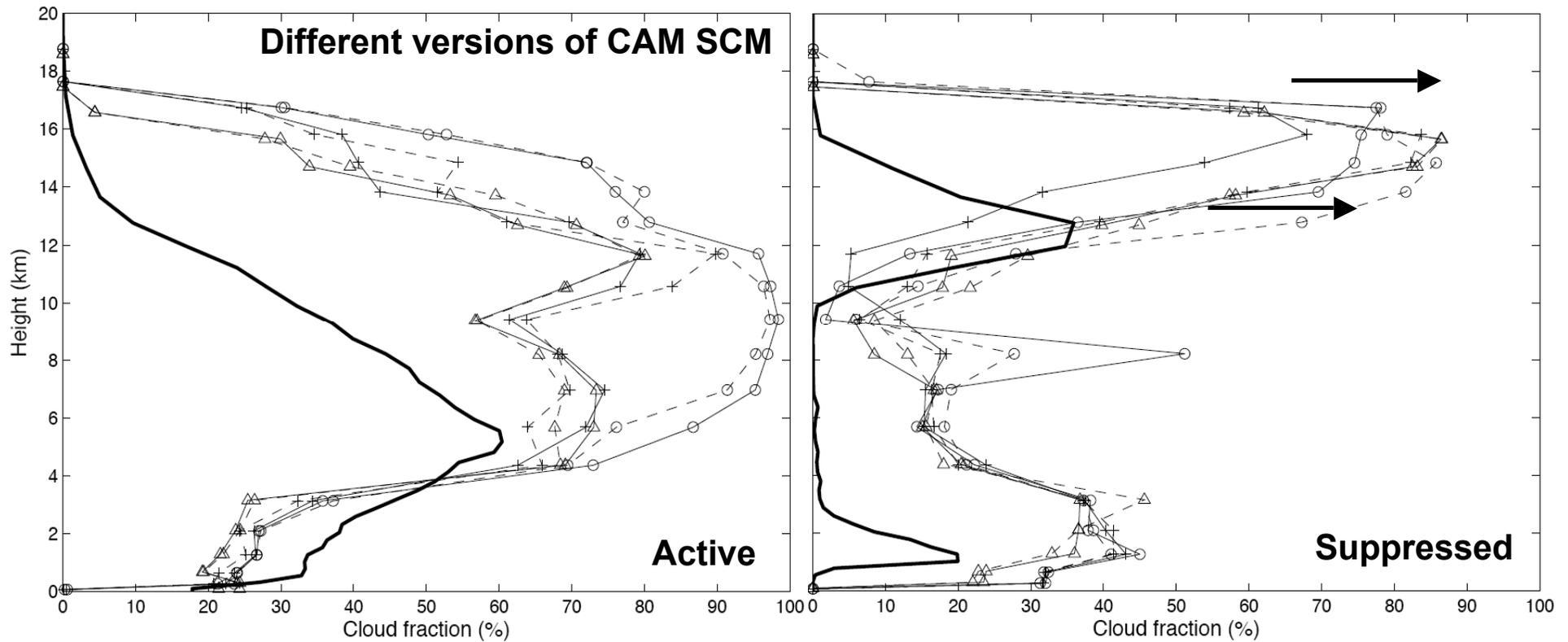
Best estimate and ensemble spread



Models more moist below 10km during active monsoon and drier in suppressed period.
Different spatial-temporal distribution of spread between models.

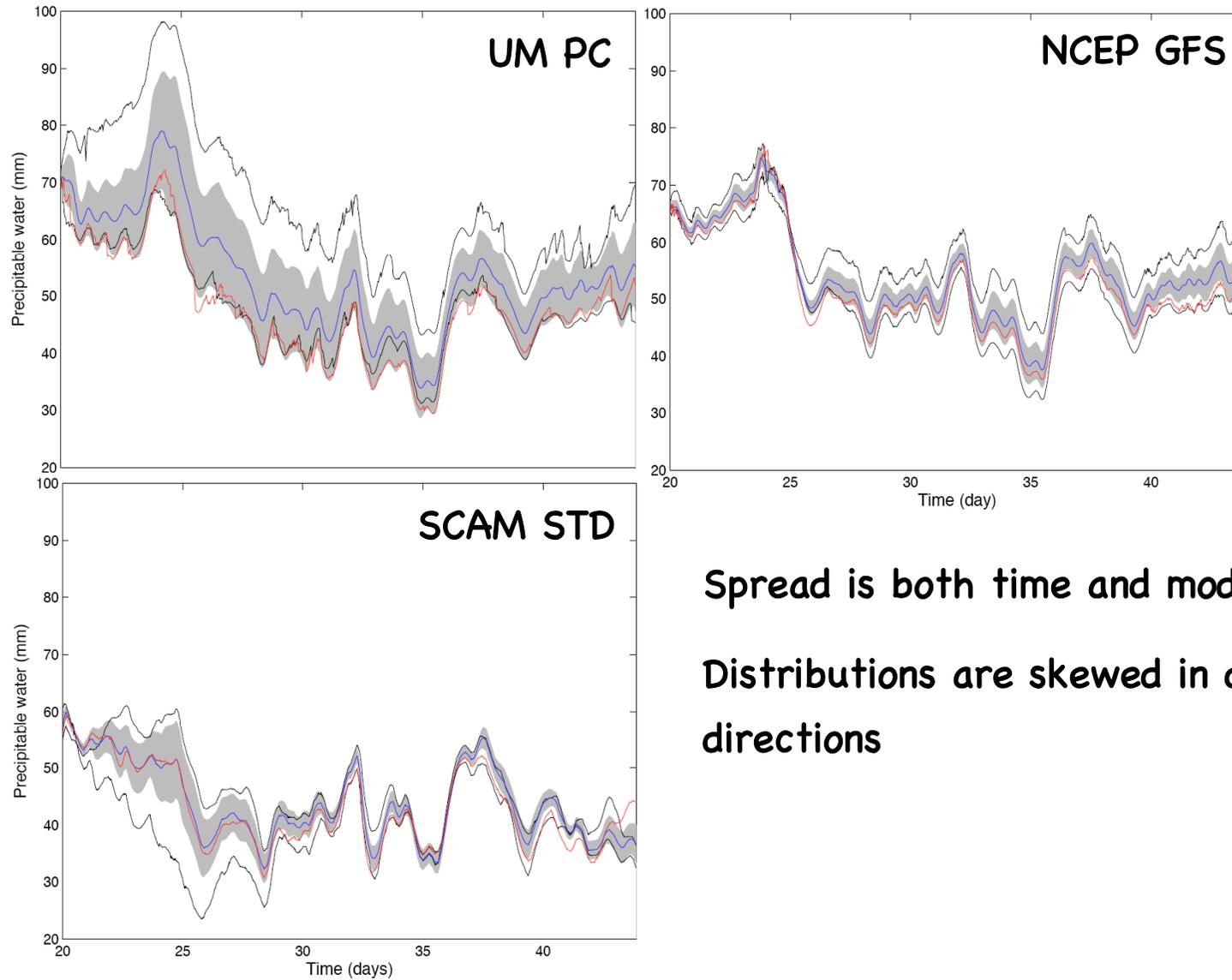
Ensemble vertical cloud structure

In some models, at some times, the cloud structure changes when comparing best estimate to ensemble mean.



Solid (light) - Best est
Broken - Ensemble mean (10-90)
Symbols are different models

Timeseries of PW

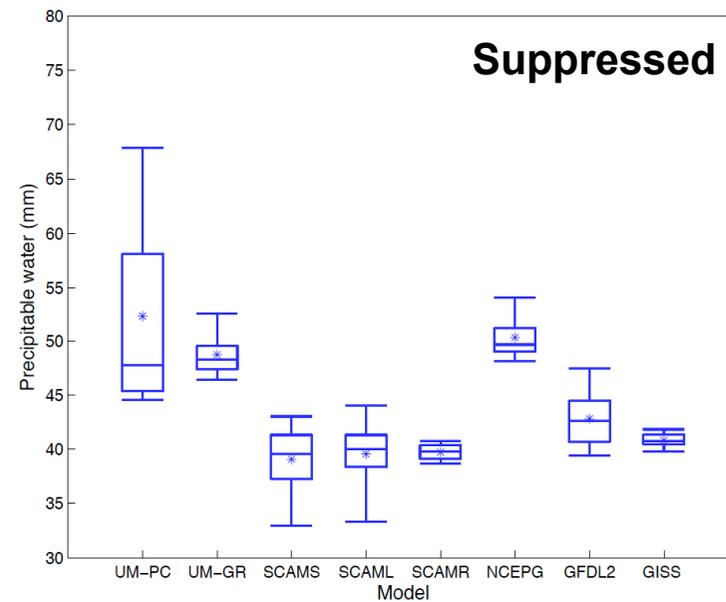
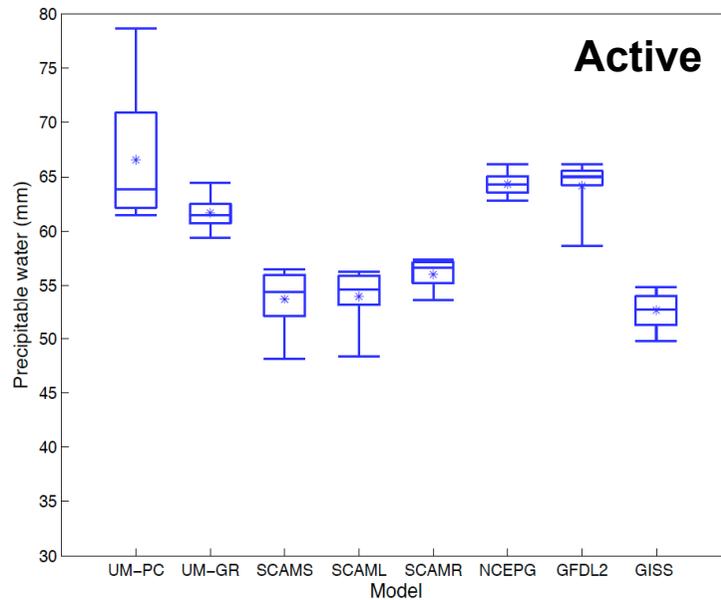


Spread is both time and model dependent.

Distributions are skewed in different directions

Comparison of model PW

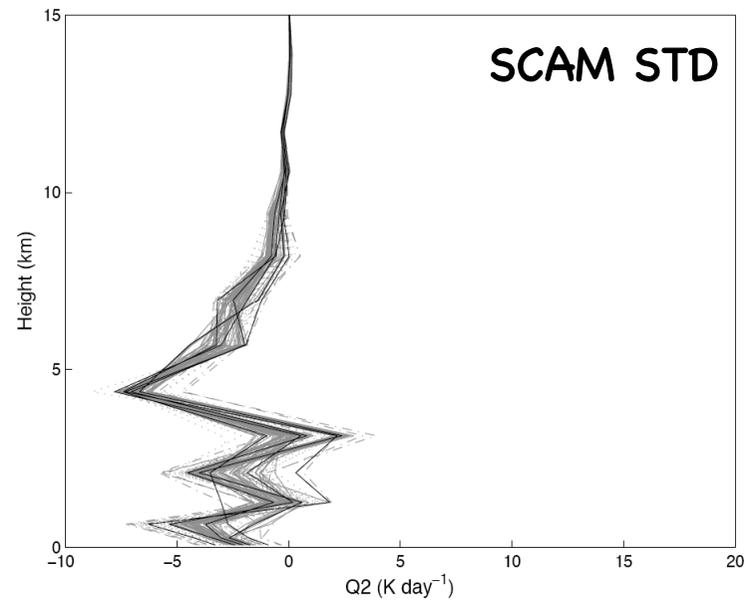
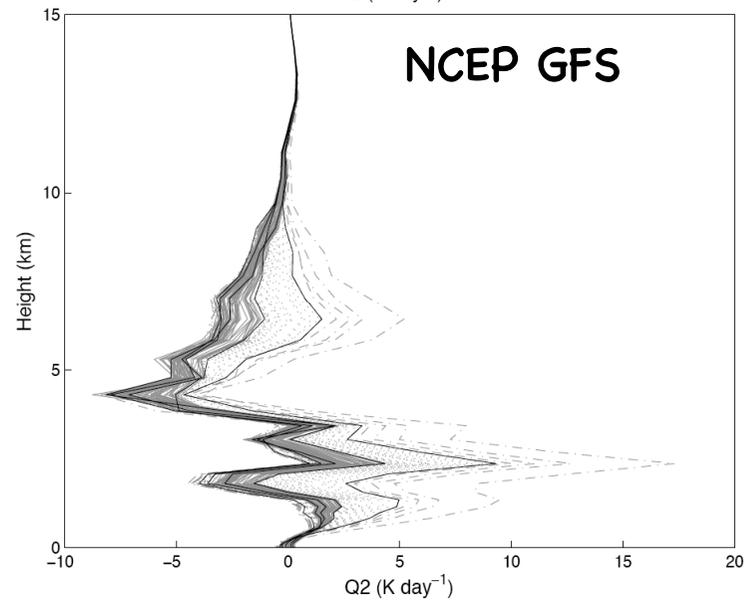
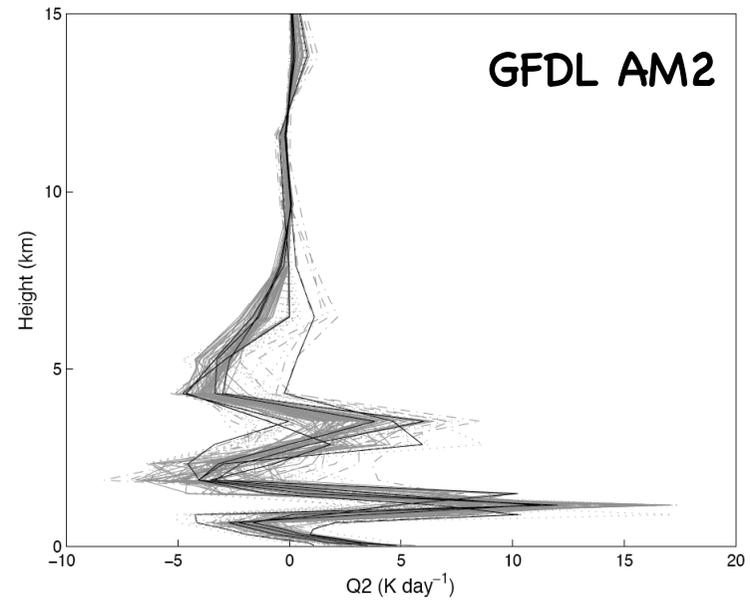
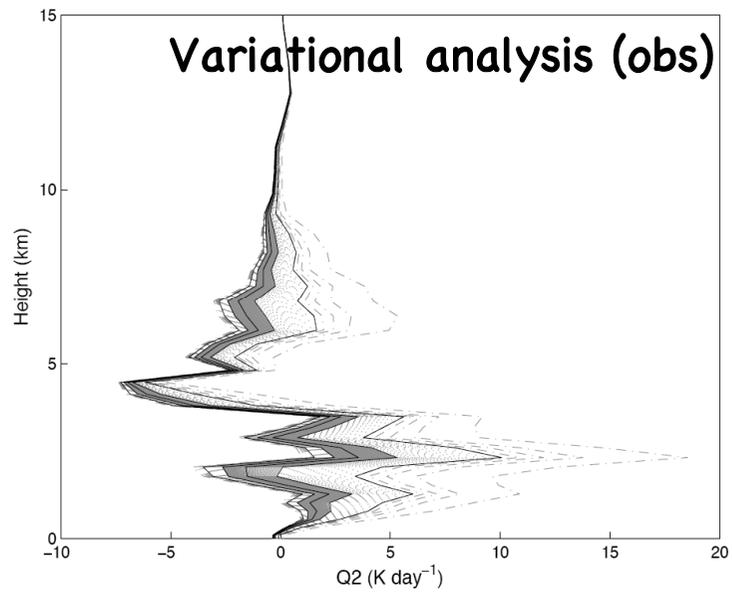
Box plots of ensemble PW (members 10-90)



Different behaviour between the different models.

Compare differences in mean and spread between models.

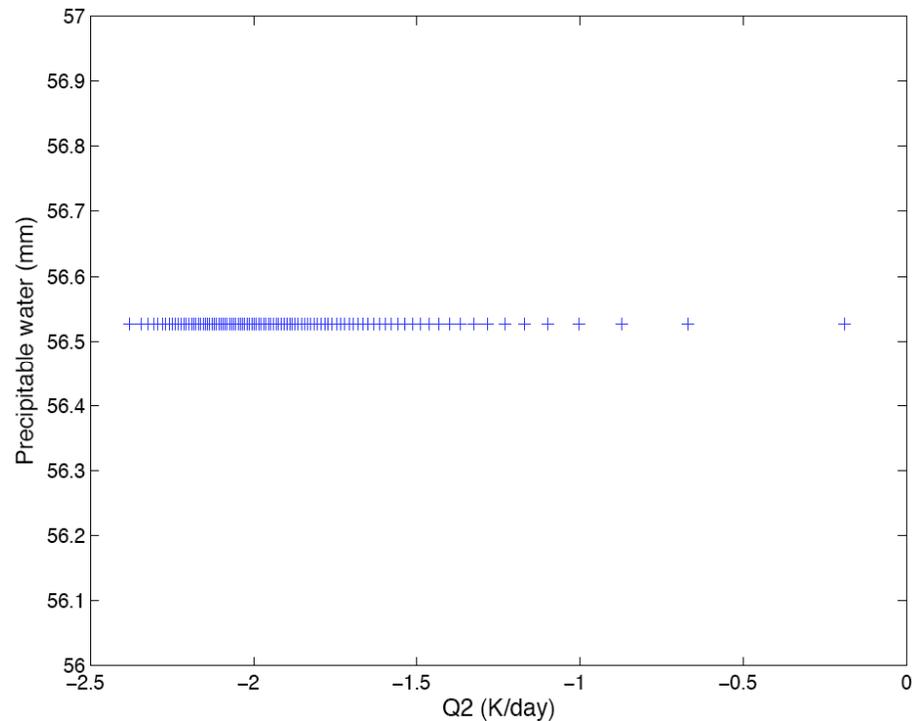
Ensemble moisture tendencies



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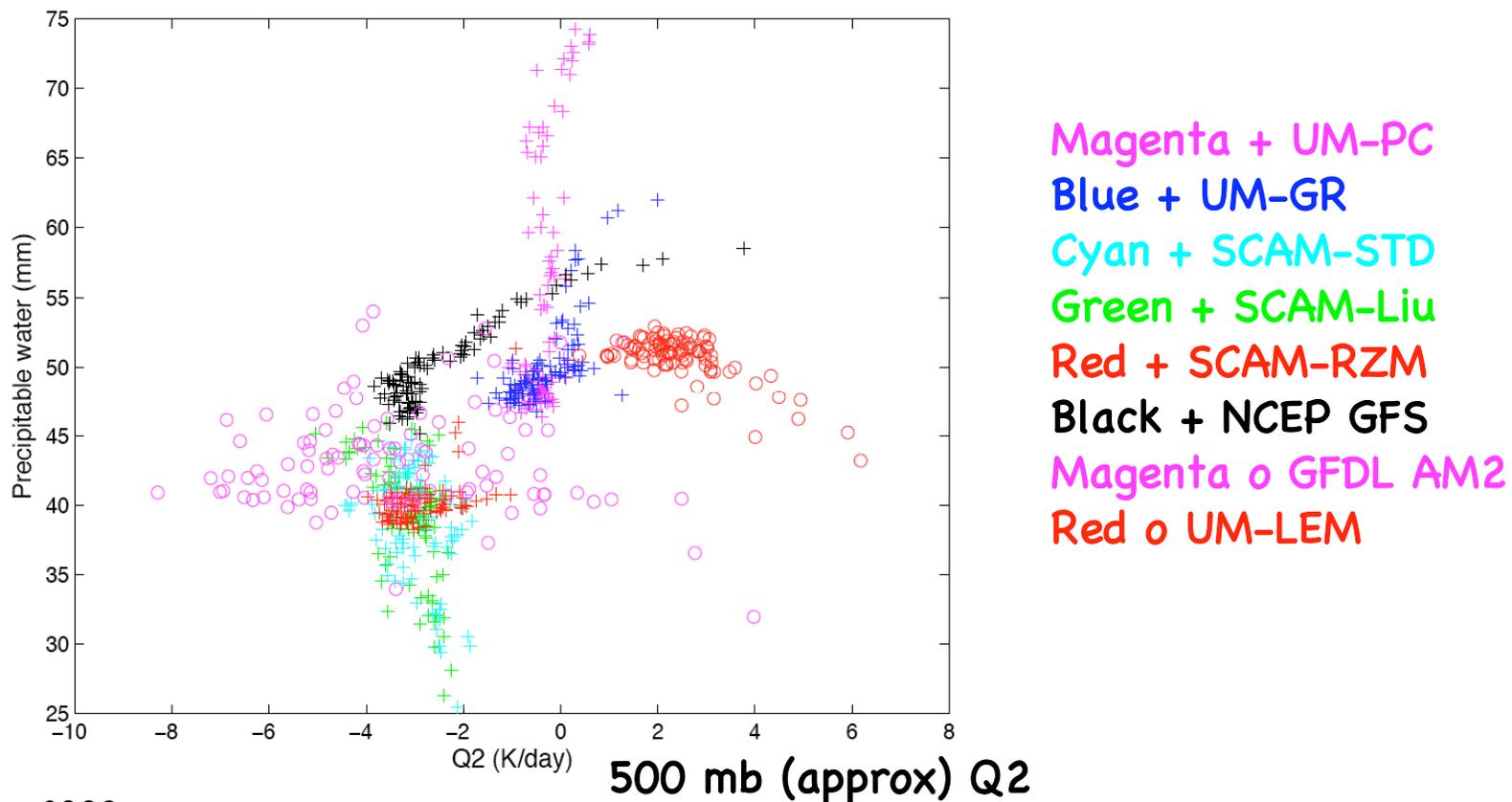
Relationship large-scale and sub-grid

- Variational analysis constrains the forcing given observations
- We are effectively changing the large-scale forcing but holding the observations fixed.
- The variational analysis therefore, correctly, must account for this change in forcing by changing the sub-grid terms, $Q1$ and $Q2$.



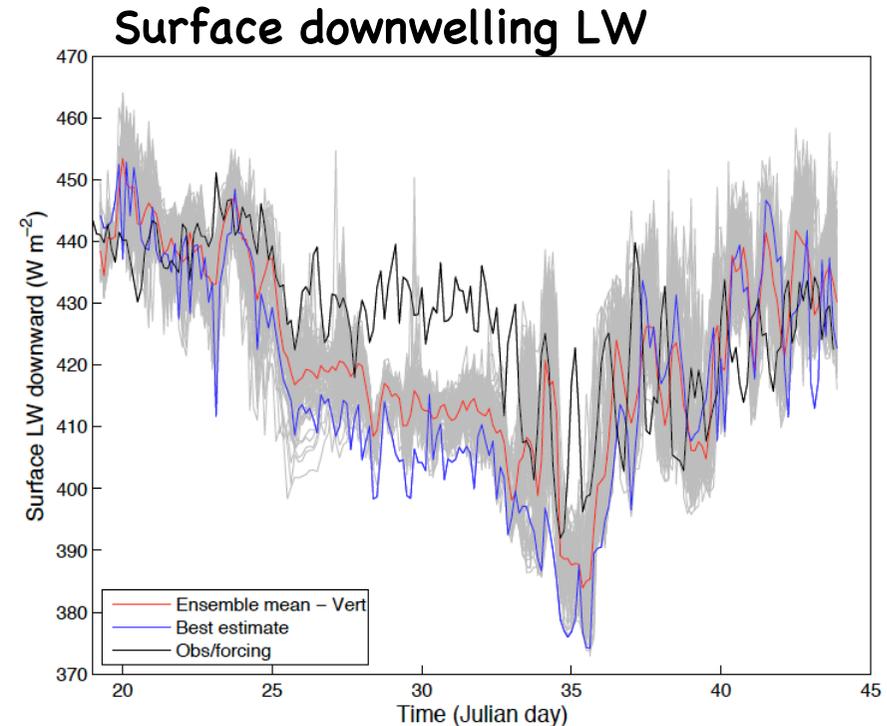
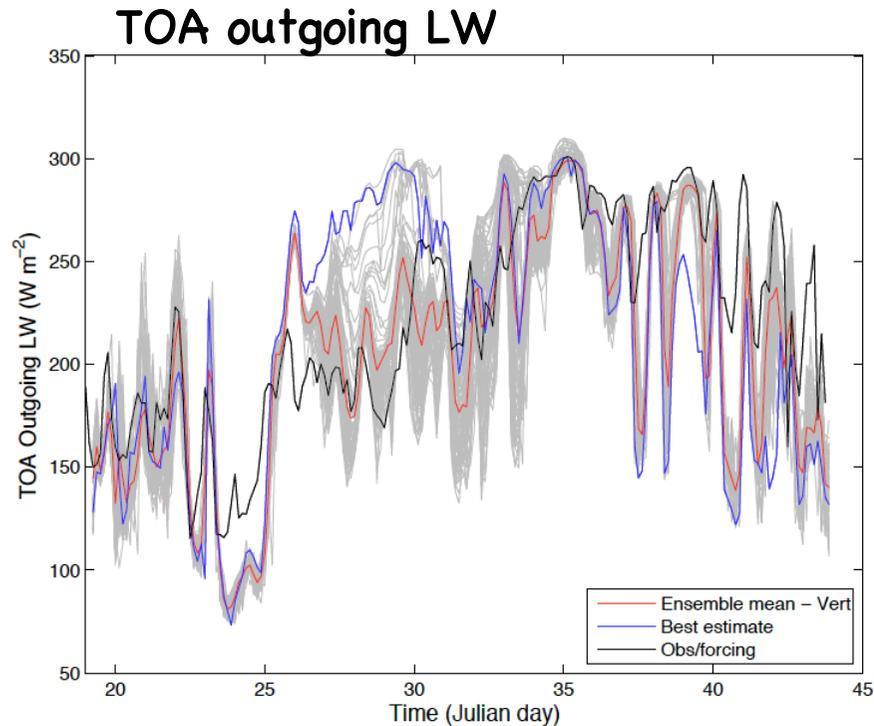
Relationship large-scale and sub-grid in models

- What does this plot mean?
- Different models have a different relationship between Q2 and PW.
- What is truth? What should be the relationship between Q2 and PW?



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LW Radiation



During MCS model always produces excessive high cloud.

The model high cloud is sensitive to the forcing during the suppressed monsoon.

There is insufficient low-level cloud during the suppressed monsoon.

Summary

- Ensemble simulations have been performed for many different SCM (and one CRM!).
- The different models are exhibiting different behaviour which can be see:
 - in the difference between the best estimate and the ensemble mean.
 - in different model spread.
 - in the relationship between key variable.
- What further work needs to be done? Good question...

Further details:

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laura.davies@sci.monash.edu.au

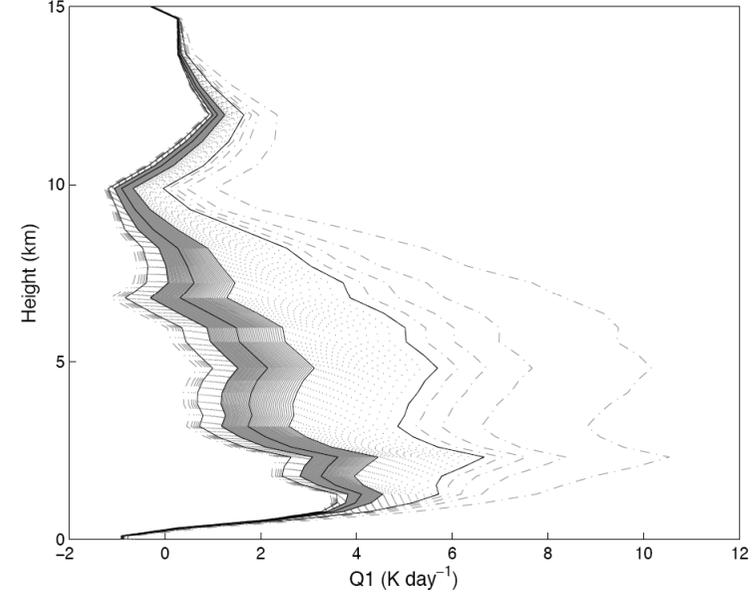
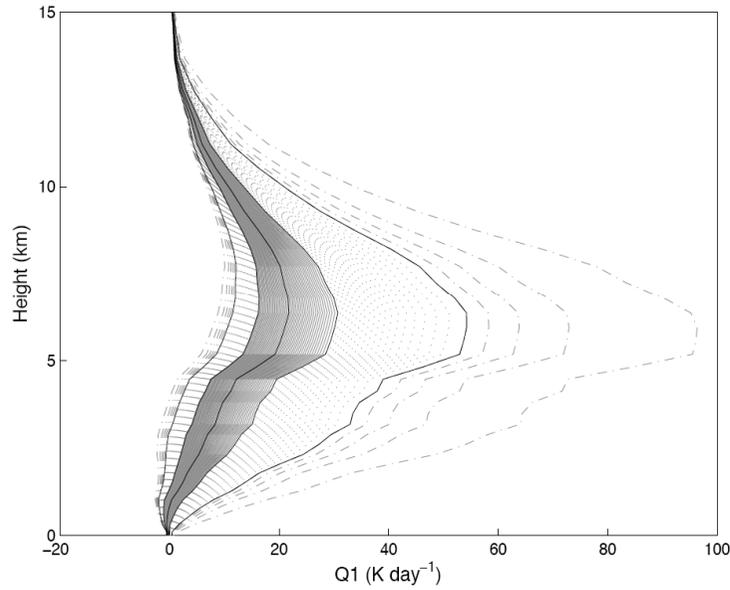
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Ensemble Q1 Q2

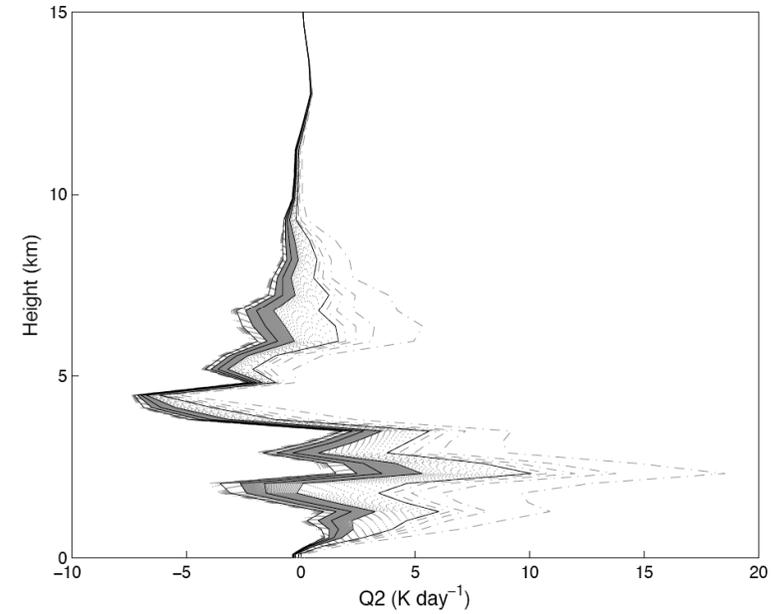
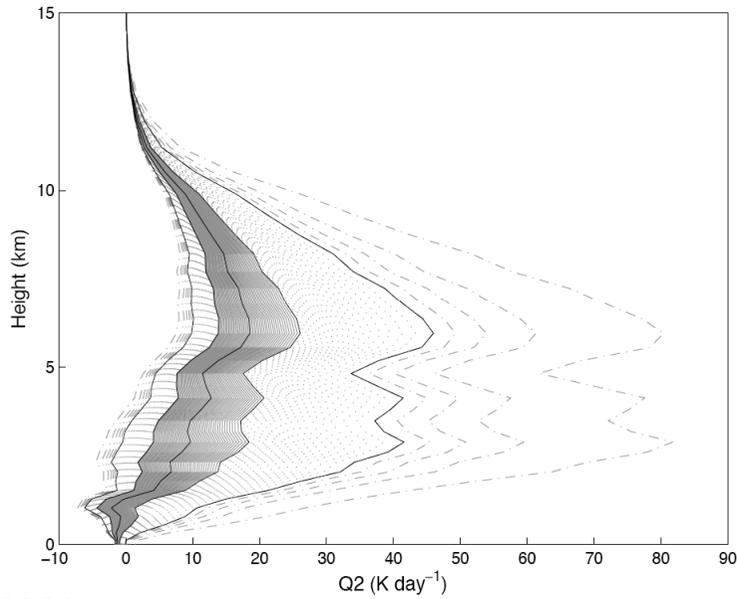
Active

Suppressed

Q1



Q2



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