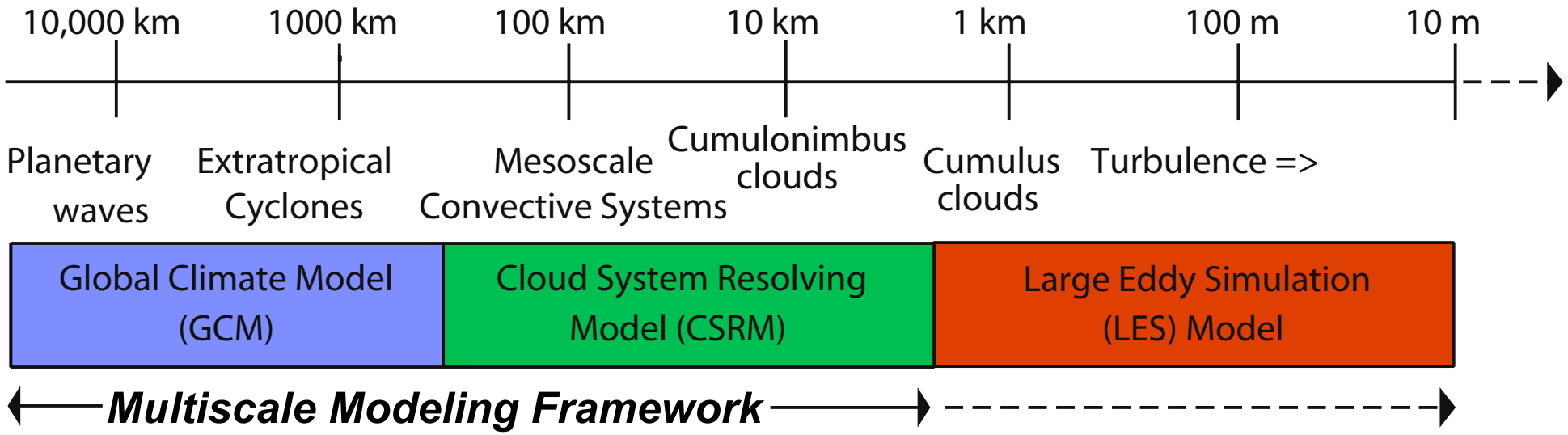
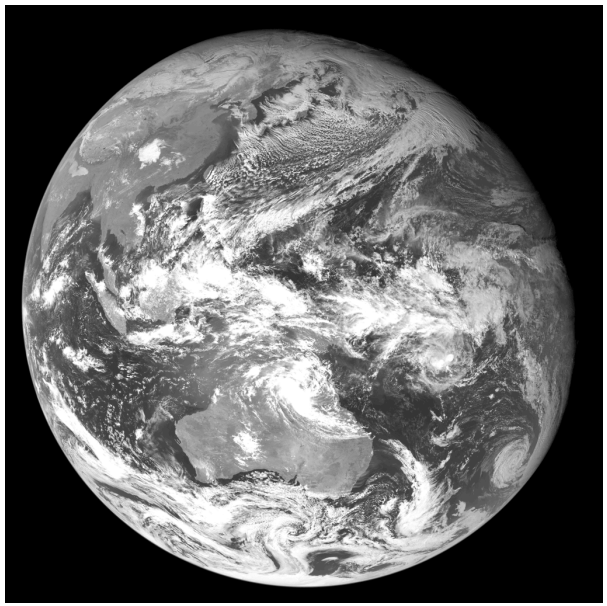
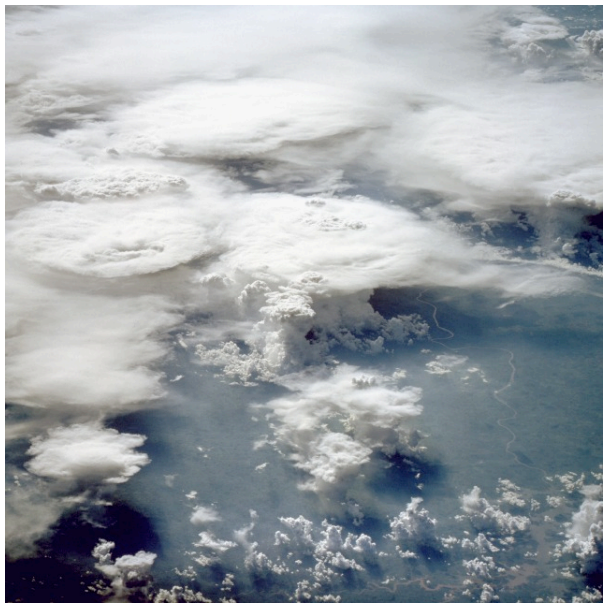
Scales of Atmospheric Motion







Boundary layer clouds in cloud-system-resolving models (CSRMs)

- CSRMs may have horizontal grid sizes of 4 km or more.
- Such CSRMs are used in MMF, GCRMs (global CSRMs), and tropical cyclone models.
- In MMF and GCRMs, CSRMs are expected to represent all types of cloud systems.
- However, many cloud-scale circulations are not resolved by CSRMs.
- Representations of SGS circulations currently used in CSRMs can be improved.

Short-term Plans accomplished during 2009

- **Goal:** ***Identify physical processes responsible for MMF deficiencies.***

  ACTION: Performed new MMF simulations that involved changes to MMF physics.

  (1)**:**

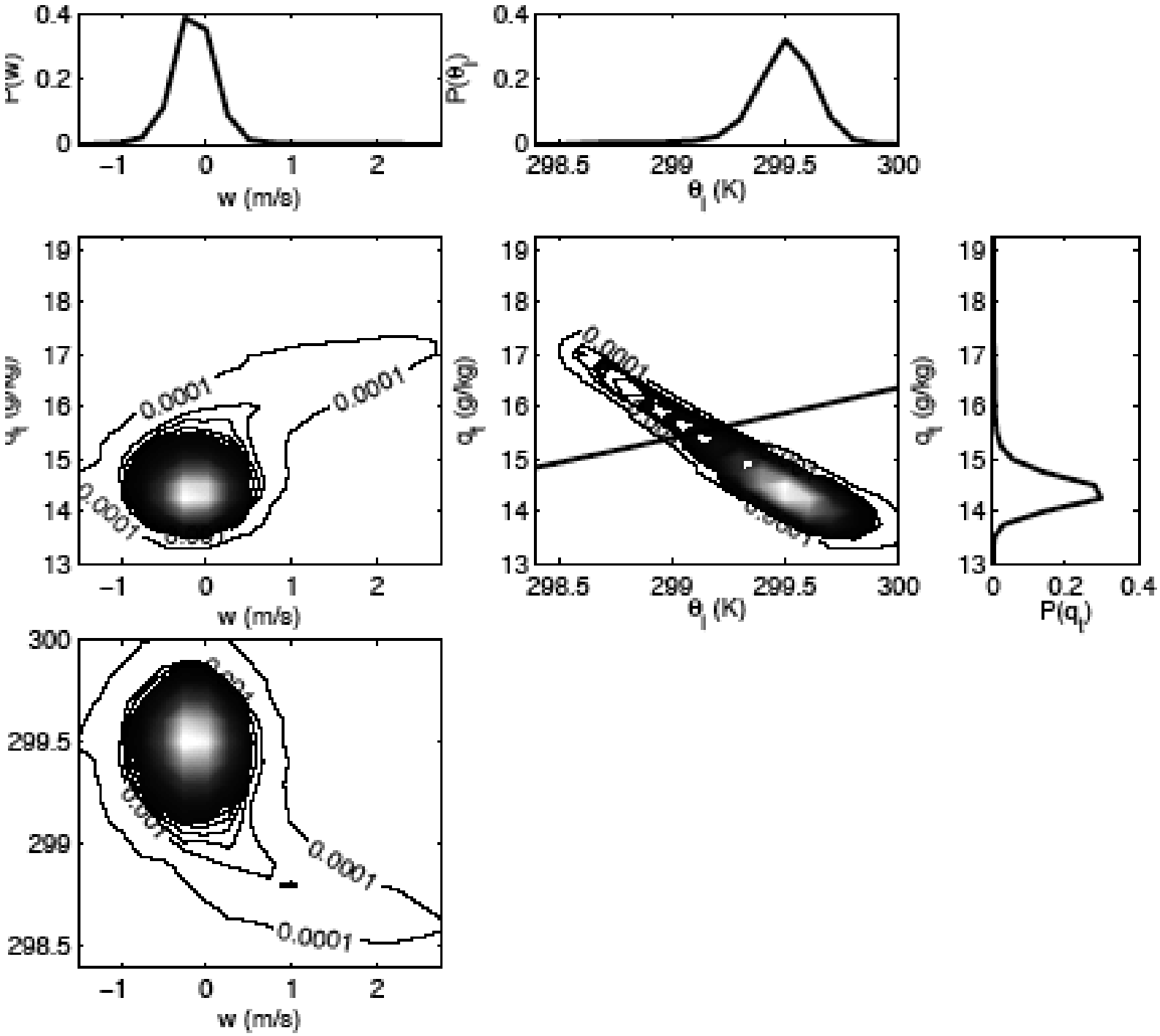
  Anning Cheng.

  (2) **Used higher spatial resolution:**

  A Low Cloud Feedbacks activity.

Examine assumed PDF method using giga-LES

- Trade-wind cumulus case
- Joint PDFs of vertical velocity, liquid water potential temperature and total water mixing ratio:
  - LES (“truth”)
  - Single-Gaussian PDF
  - Double-Gaussian PDF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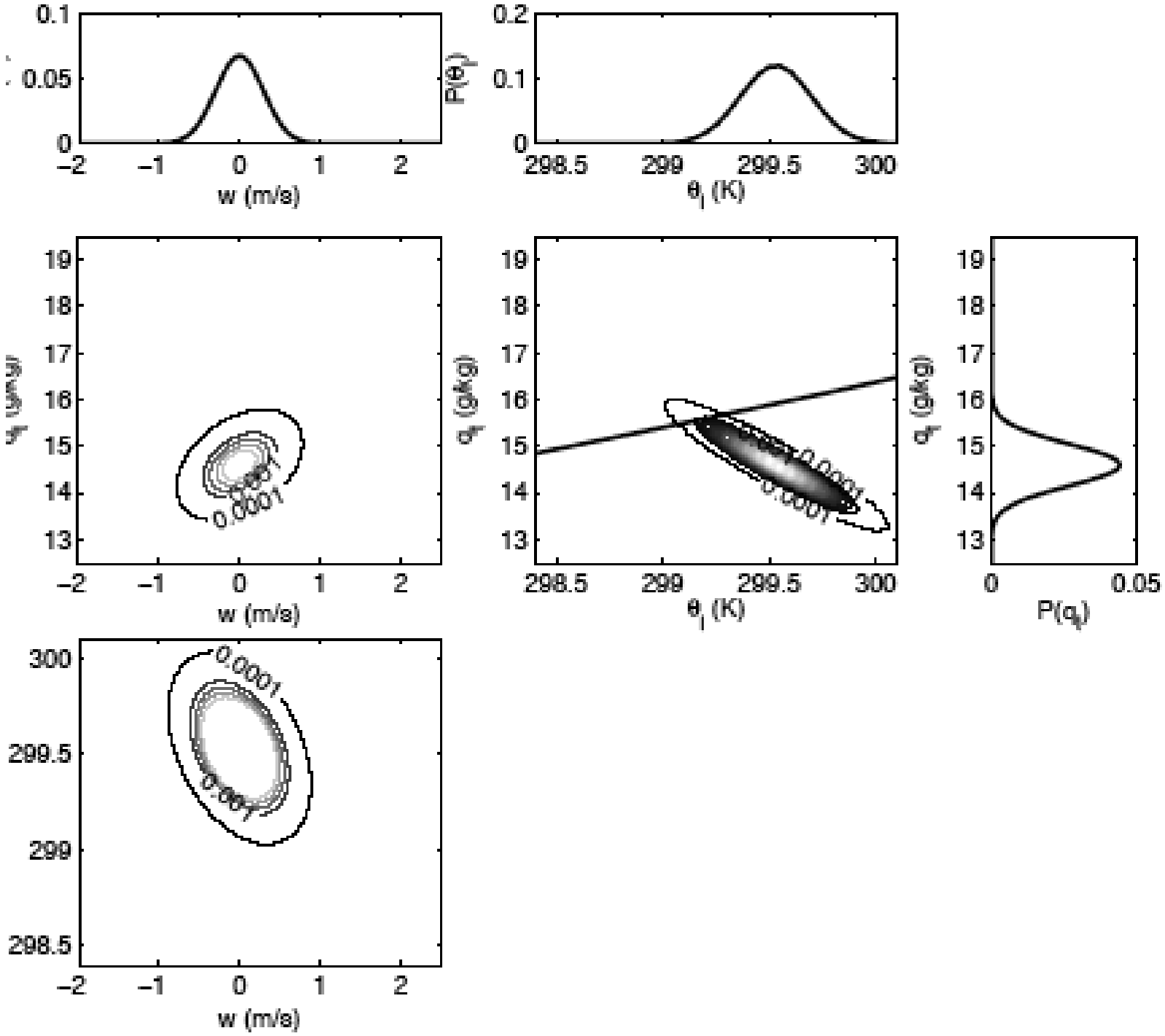
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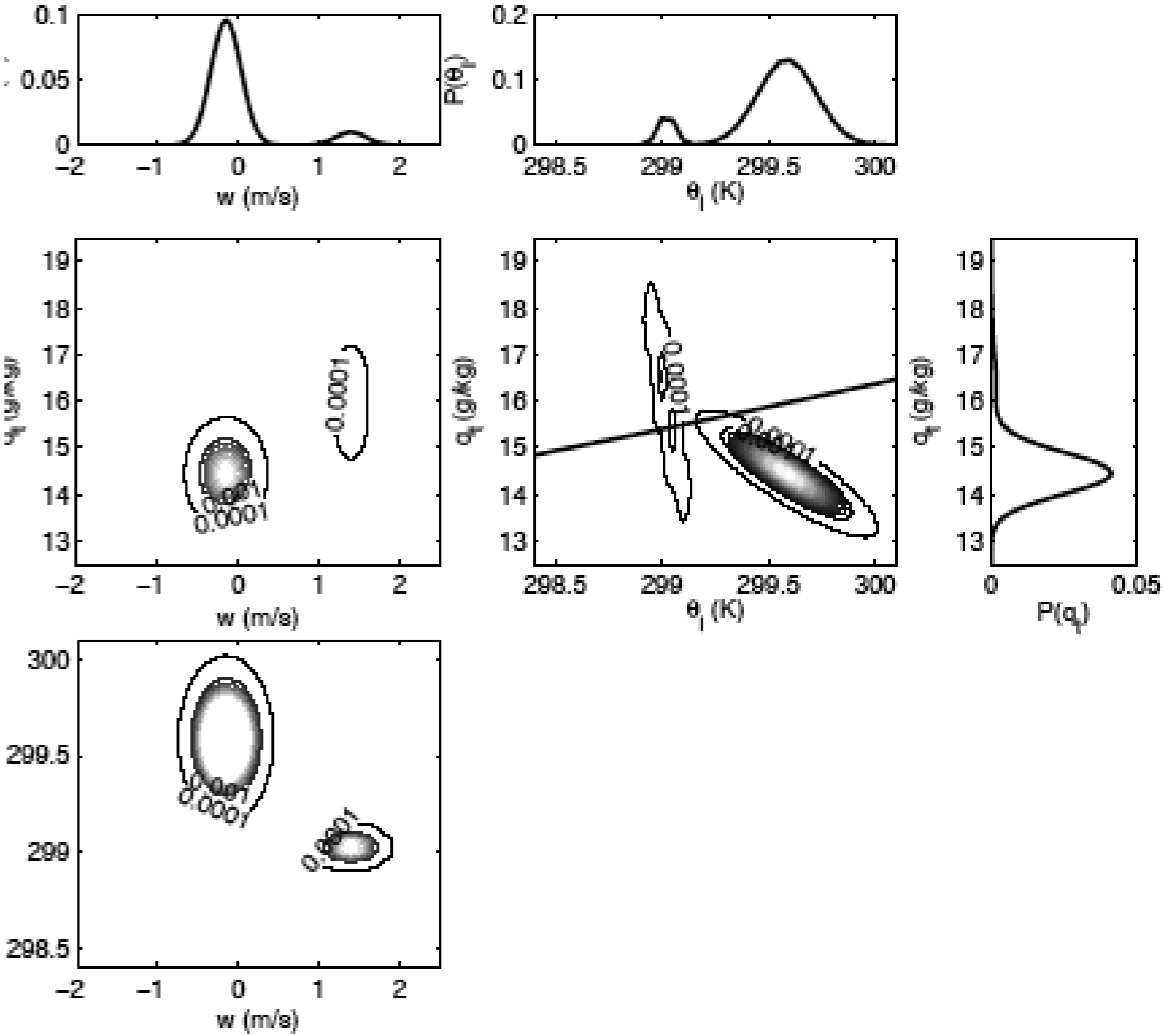
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Test higher-order boundary layer turbulence scheme in MMF

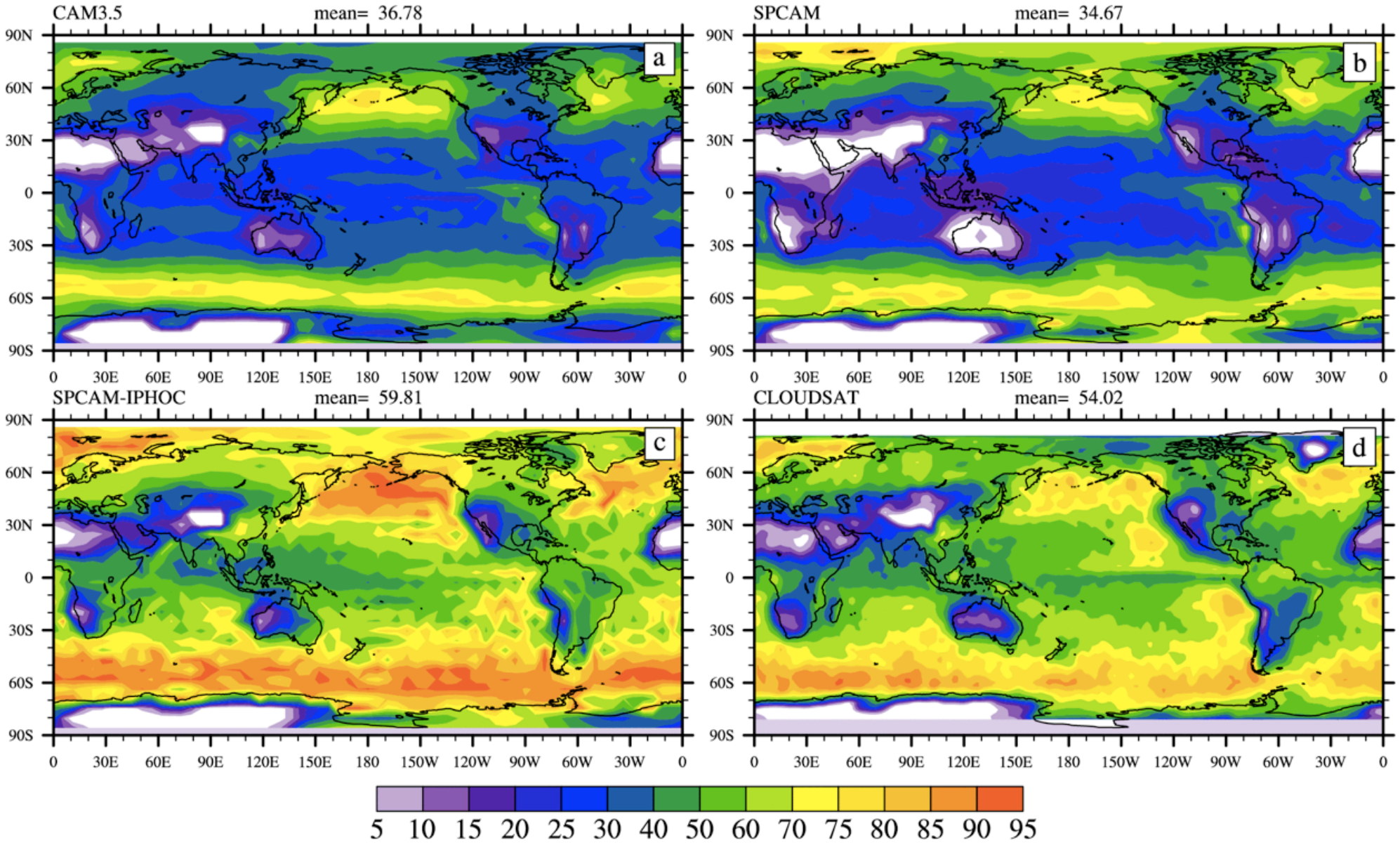
- All models were run at T21 with 26 levels, for both CRMs and GCMs, due to limited computational resources.

- Next two slides show:

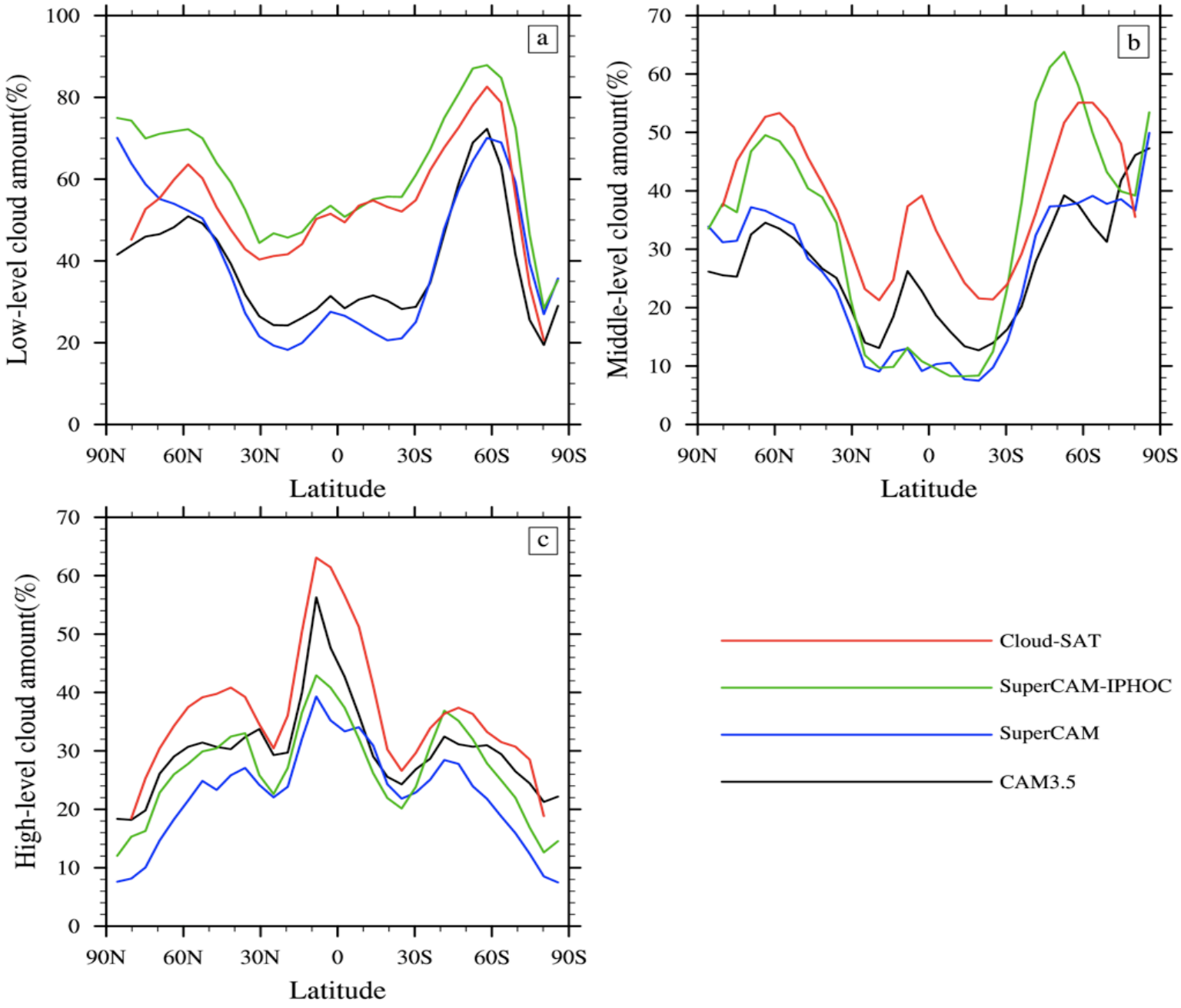
  - **Annual-mean low cloud amount** from 2-year simulations of CAM-3.5, SP-CAM with the standard first-order turbulence closure, and SP-CAM with a higher-order turbulence closure (IPHOC), compared with CloudSat observations.

  - **Annual-mean zonal-averaged low, middle, and high level cloud amounts.**

Annual-mean low cloud amount



Annual-mean zonal-averaged cloud amounts



Test higher-order boundary layer turbulence scheme in MMF

- The position and amount of low clouds near the west coasts of the continents shows substantial improvement in SP-CAM IPHOC.
- The large areas of trade wind cumulus between 30 S and 30 N are also much better represented.
- The middle-level cloudiness produced by the mid-latitude storms can also be clearly seen in the annual-zonal mean plot with the new closure.

Long-term Plans

- **Continue to develop and test parameterizations for coarse-grid CRMs in stand-alone SAM.**
- **Continue to test improved physics in MMF.**
  - ***Issue:*** Modifying SP-CAM code to test new parameterizations is difficult.
  - ***Propsed solution:*** Marat will make stand-alone SAM interchangeble with SAM used in MMF.