Focus on deep and shallow convection, and turbulence

Steve Krueger and Chin-Hoh Moeng

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Interactions of Deep and Shallow Convection and Turbulence

Introduction & Overview -- Steve Krueger & Chin-Hoh Moeng

"A new cumulus scheme" -- Minoru Chikira (Frontier Research Center for Global Change) (30 min)

“Diurnal Cycle Over Land: What Controls the Transition from Shallow to Deep Convection?” -- Chien-Ming Wu (UCLA) (20-30 min)

"Sensitivity of MMF low cloud climatology to resolution" -- Matt Wyant, Peter Blossey, Chris Bretherton (U of Washington) (10 min)

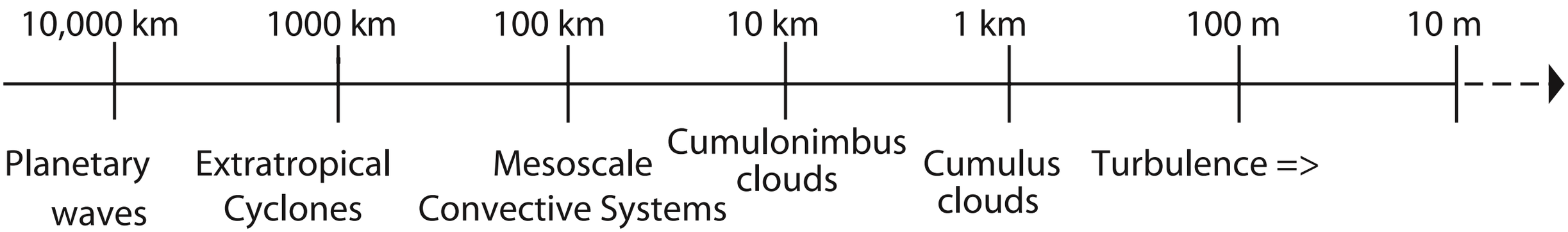
"Resolution sensitivity of shallow cumulus simulations" -- Steve Krueger (U of Utah) (10 min)

"Very large LES of a CBL" -- Chin-Hoh Moeng (NCAR) (5-10 min)

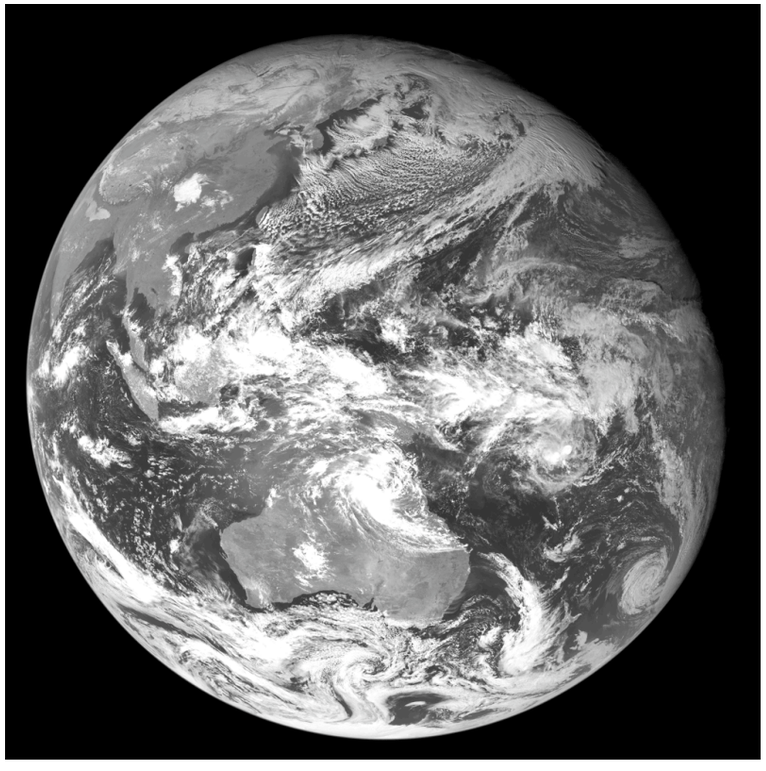
"Microphysical impacts on squall line organization" -- Hugh Morrison (NCAR) (10 min)

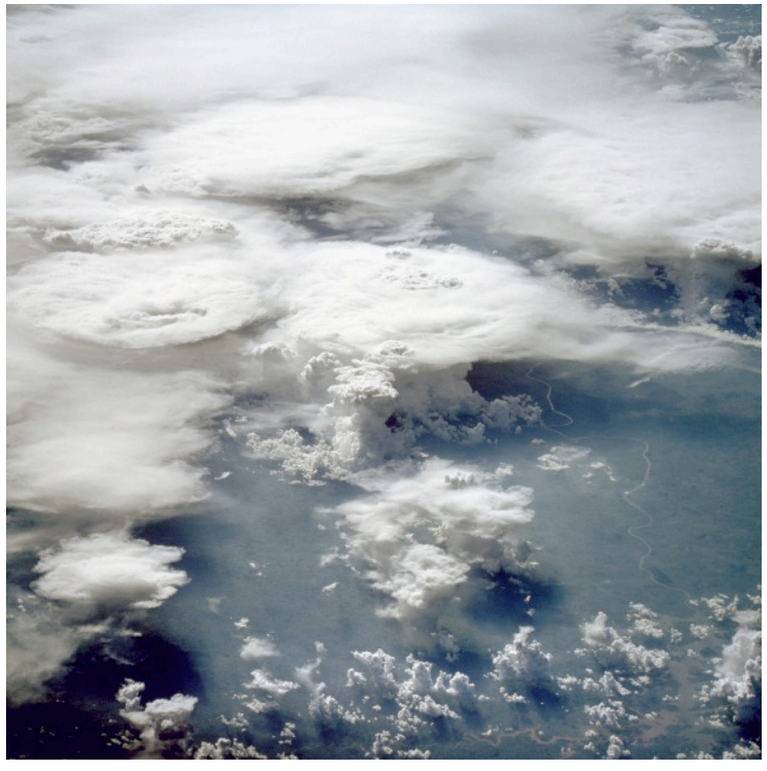
"Using CERES tropical convective cloud object observations to evaluate the cloud physical/radiative properties of ERA-40 and ECMWF operational analyses" -- Kuan-Man Xu (NASA LARC)(10 min)

Scales of Atmospheric Motion



Multiscale Modeling Framework





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.

Strategy

- **Objectives:**
  Improve the representation of SGS convection, turbulence, and microphysics in CSRMs used in MMFs, GCRMs, and NWP.
- **Proposed parameterizations**
  - *PDF/HOC:* Cheng & Xu, Lappen & Randall
  - *Two-scale MMF:* CSRM plus boundary-layer-eddy-resolving model (ERM)
- **Additional physics to be included**
  - SGS microphysics
  - Effects of *surface inhomogeniety* (elevation, land surface properties): both resolved by the CSRM and SGS

Strategy

- **Better understand interactions of deep and shallow clouds, and turbulence.**
- **Better understand representation of interactions of deep and shallow clouds, and turbulence in prototype MMF.**
- **Test improved physics in MMF.**

Short-term Plans

- **Better understand interactions of deep and shallow clouds, and turbulence.**
  - Analyze existing and new *benchmark simulations.*

    ACTION ITEM: Perform large-domain LES of deep convection. (Computer time is required.)
  - Analyze *observational datasets.*

    ACTION ITEM: Identify and/or develop appropriate datasets.

Short-term Plans

- **Better understand representation of interactions of deep and shallow clouds, and turbulence in prototype MMF**
  - Identify physical processes responsible for MMF deficiencies (e.g., great red spot).

    ACTION ITEM: Analyze existing MMF simulations.

    ACTION ITEM: Perform new MMF simulations that involve changes to MMF physics. *(Computer time is required.)*

    (1) Use CAM physics except for convection tendencies (Q_1, Q_2).

    (2) Replace boundary layer turbulence scheme used in CRM.

Long-term Plans

- **Test improved physics in MMF.**

Issues

- **Computer time will be required for the proposed simulations.**
- **Large size of large-domain LES output dataset will make it a challenge to access and analyze. We need help to design.**
- **Access to SP-CAM code and results: We need a clone of Marat!**