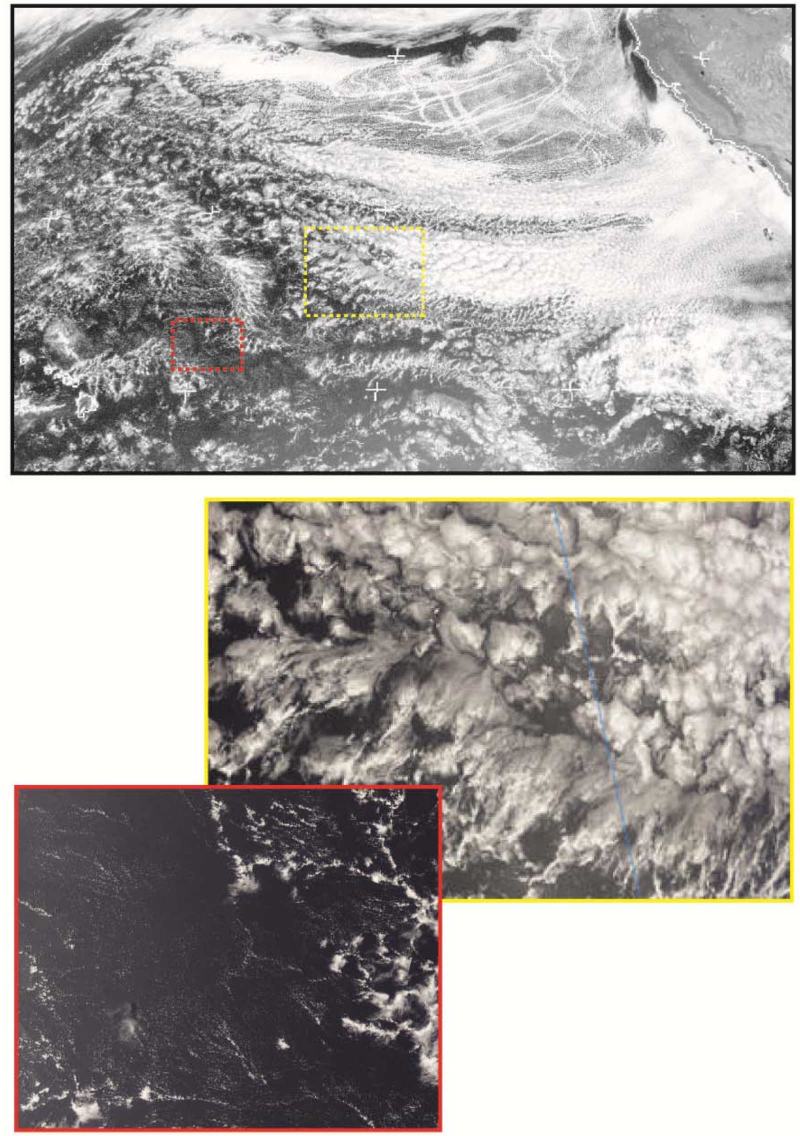
Cloud System Evolution in the Trades--CSET

Investigators:
Bruce Albrecht and Paquita Zuidema (UM)
Robert Wood and Chris Bretherton (UW)
Virendra Ghate (Rutgers)

Purpose: To study cloud and boundary layer evolution along trajectories within the north-Pacific trade-winds using the NSF/NCAR Gulfstream G-V (HIAPER). These characterizations along trajectories will be designed to aid in our understanding and simulation of the transitions between the two convective regimes.



Scientific Objectives:

- Define the evolution of the cloud, precipitation and aerosol fields in stratocumulus clouds as they transition into the fair-weather cumulus regimes within the subtropical easterlies over the northern Pacific.
- Examine the cloud microphysical properties and processes as a function of boundary-layer depth, towards assessing the relative contributions of internal and external processes to boundary-layer decoupling.
- Assess the relative importance of boundary layer deepening and precipitation processes in driving boundary layer decoupling and cloud breakup.
- Develop integrated data sets and use them to evaluate LES model simulations of cloud system evolution relying on differing resolution and complexities.

Experiment Design-- Lagrangian Approach

- Sample aerosol, cloud, precipitation, and boun dary layer properties upwind from the transition zone over the North Pacific and sample these areas two and four days later.
- Evaluate the moisture, dry static energy and mass budgets and estimate changes in these budgets between the upstream Sc region sampled and the downstream Cu region sampled on subsequent flights.
- Lagrangian approach minimizes uncertainties in the large-scale forcing due to horizontal advection in the lower troposphere as air masses move from colder to warmer sea surface temperatures and thus facilitate model simulations and isolate critical physical processes.
- Approach enabled by HIAPER capabilities (performance and remote sensing)

Instrumentation

- Remote sensing instruments will be used to define macroscopic and microscopic cloud properties as the G-V flies above, below, and in the clouds.
  - HIAPER Cloud Radar (HCR) developed by NCAR EOL for deployment on GV specially designed wing pod.
  - High Spectral Resolution Lidar (HSRL) that was developed under the NSF HIAPER Aircraft Instrumentation Solicitation (HIAS) (also for aerosol characterizations above the boundary layer)
- Meteorology and turbulence sensors
- Cloud microphysics, aerosol, and precipitation probes
- Radiation sensors (HIAPER Atmospheric Radiation Package; and Kipp &Zonen pyranometers and pygeometers)
- Dropsondes for thermodynamic and wind structure on flights above boundary layer

Observing Strategy

- Flight from west coast to Hawaii
  - Remote sensing and dropsonde sampling at altitude above boundary layer (surveillance mode)
  - Detailed boundary layer observations in 2-3 selected areas in stratocumulus and trade cumulus areas

- Return flight (after one day rest) sample same air masses sampled in detail on previous legs
- Repeat Sequence after 1- day rest