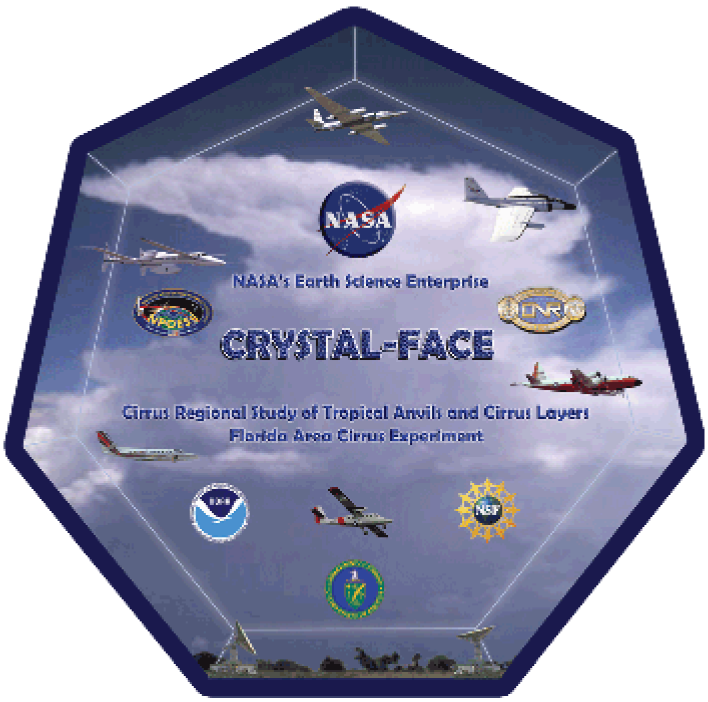
Cirrus Regional Study of Tropical Anvils and Cirrus Layers − Florida Area Cirrus Experiment (CRYSTAL−FACE)



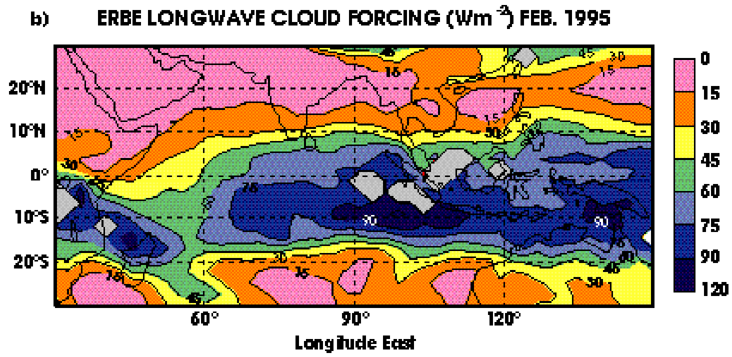
- Motivation
- Science objectives
- Platforms
- Location, timing
- Modeling

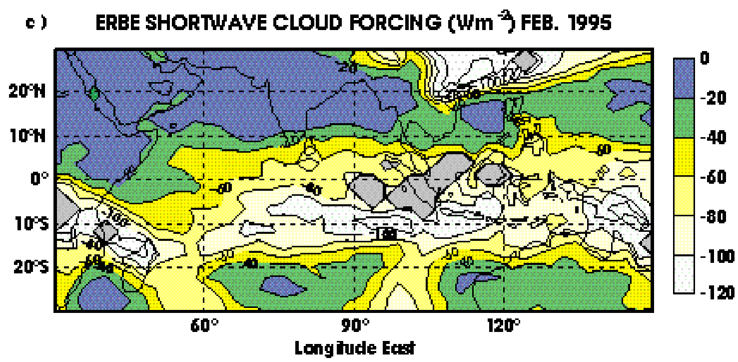
Motivation

- Importance of tropical cirrus in climate system; feedback effects
- Role of cirrus in upper tropospheric and stratospheric water vapor budgets
  - Deep convection as a source for upper tropospheric water
  - Freeze drying at the tropical tropopause
- Challenge of representing tropical cirrus in GCMs
  - Scale mismatch problem
  - Limited understanding of tropical cirrus processes

- **Clouds are the leading source of uncertainty in GCMs**

ERBE cloud forcing



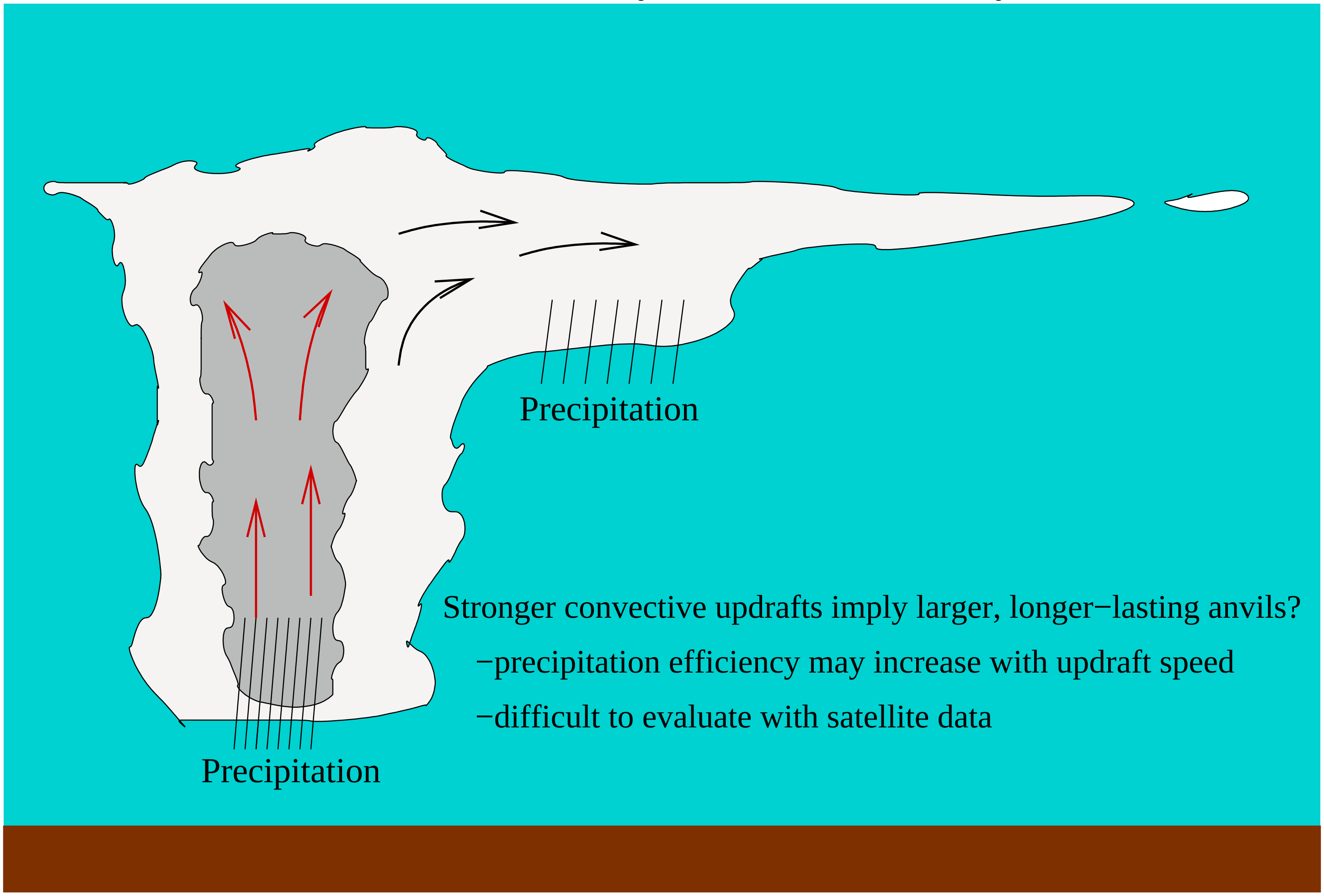


CRYSTAL Science Goals

- Cirrus anvil sensitivity to convective intensity

- **Approach:** Measurements and model simulations of case studies linking convective mass flux to anvil properties.

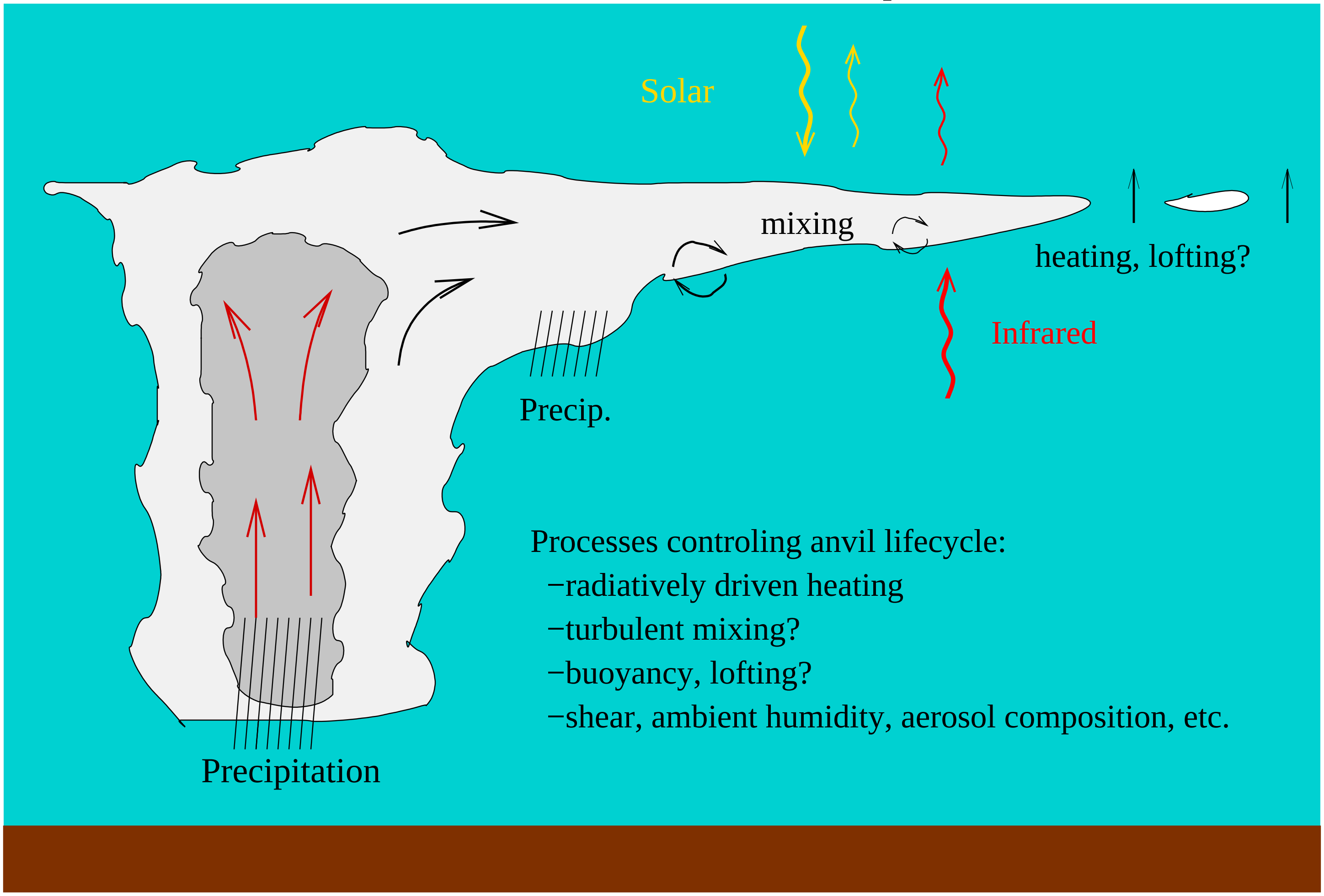
Cirrus Anvil Sensitivity to Convective Intensity



- Evolution and dissipation of tropical cirrus

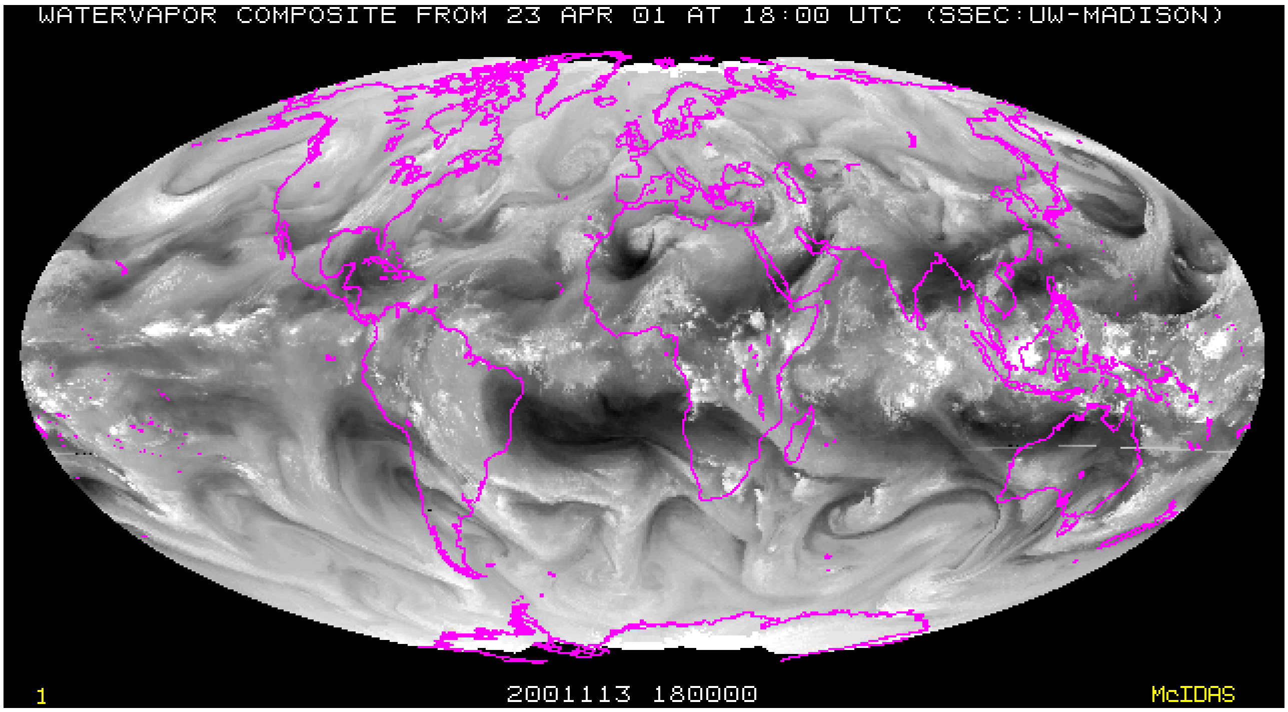
- **Approach:** Measure the microphysical and radiative properties of cirrus anvils through as much of their lifetime as possible. Simulations of dynamic and microphysical processes in tropical cirrus.

Cirrus Anvil Maintenance and Dissipation

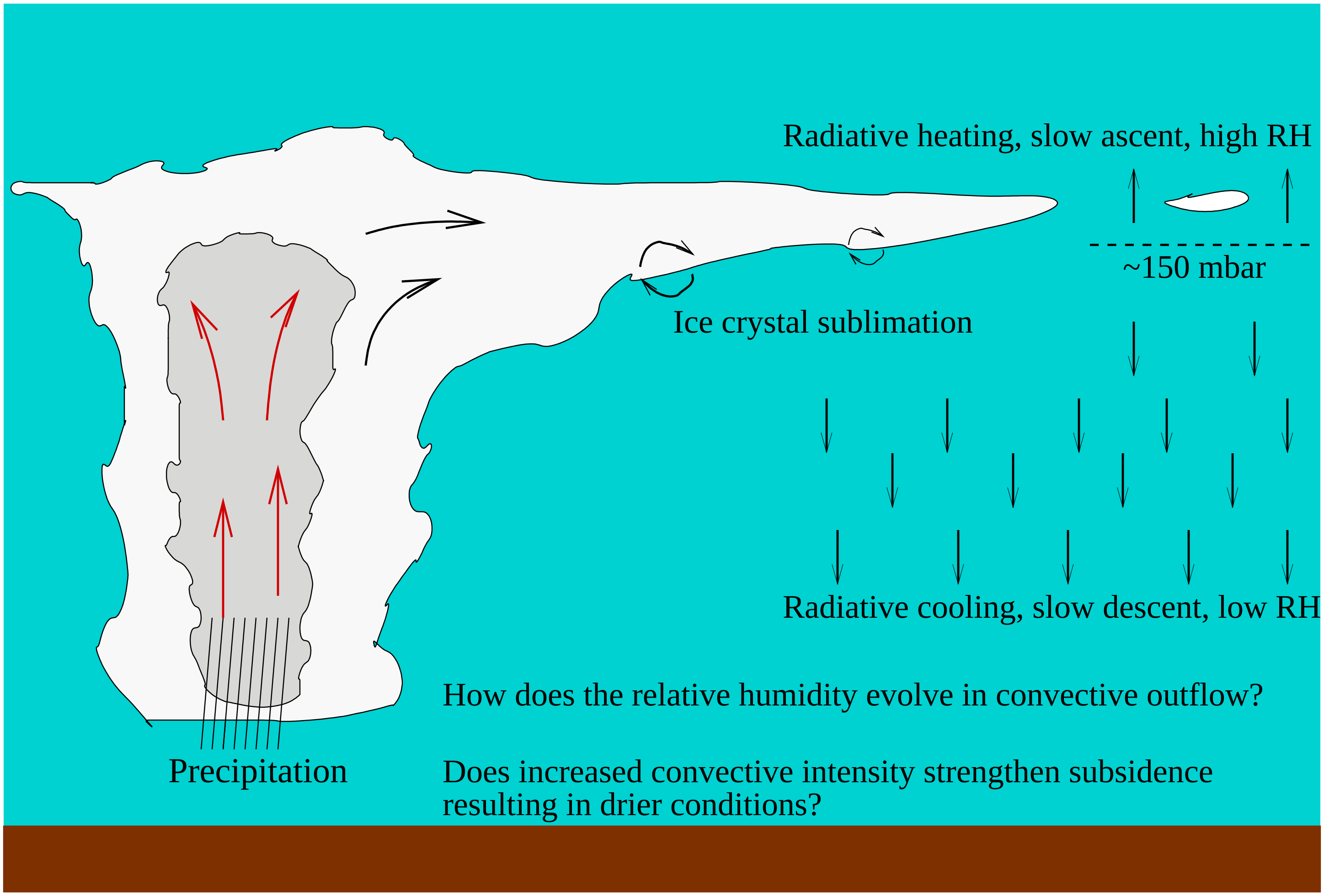


- Relationship between tropical cirrus and upper tropospheric water vapor.

- **Approach:** Measure upper tropospheric water vapor along with tracers of convection.



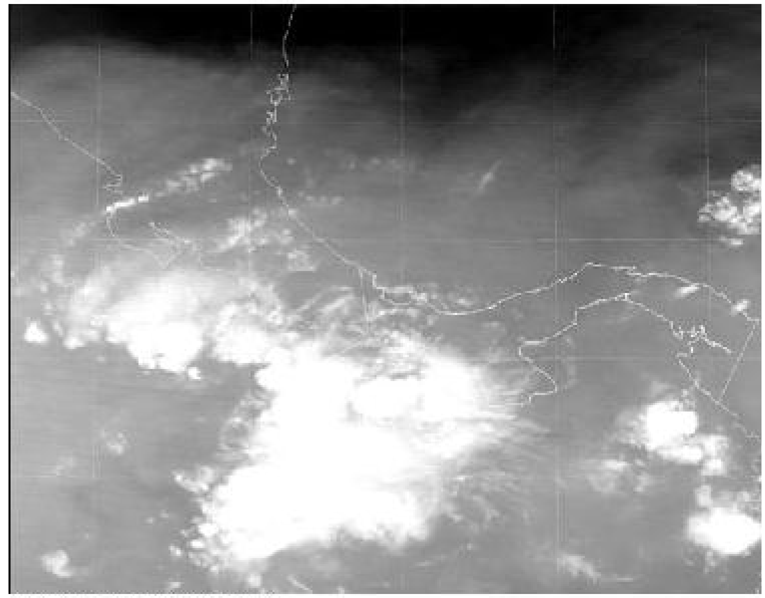
Deep Convection and Free Tropospheric Water Vapor



- Relationship between tropical cirrus and stratospheric water vapor.

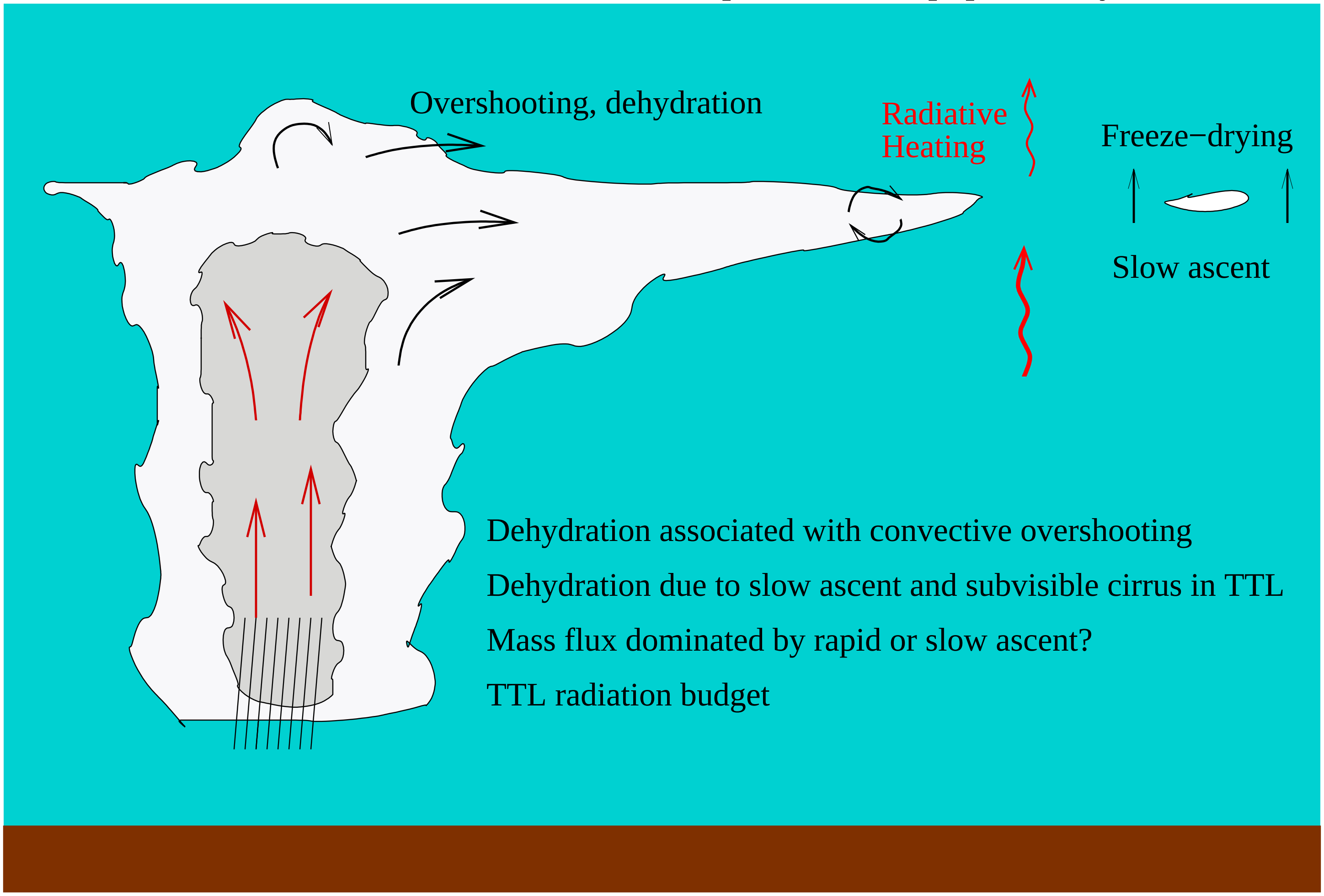
- **Approach:** Measure water vapor in the tropopause layer along with cloud microphysics, water isotopes and other tracers.

true color



cirrus detection channel (1.38 μm)

Convection, Cirrus, and Water Vapor in the Tropopause Layer



- Validation of remotely sensed cirrus properties.

- **Approach:** Obtain in situ cirrus microphysical measurements along with remote sensing measurements from ground−, aircraft−, and satellite−based instruments.

Platforms

ER−2: Remote sensing of cirrus, aerosols, gases, etc.; radiative flux measurements

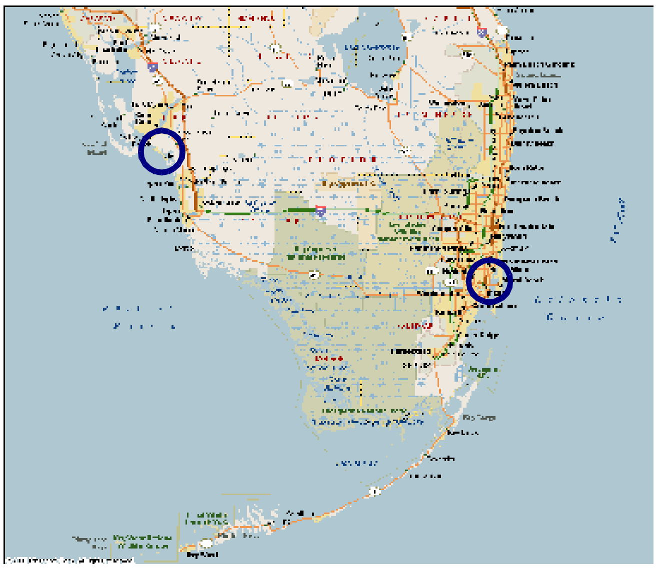
Proteus: Remote sensing of cirrus, aerosols, gases, etc.

WB−57: In situ sampling of ice crystals, aerosols, tracers, water vapor, etc.; radiative flux measurements

Citation: In situ sampling of ice crystals, ice nuclei, and water vapor

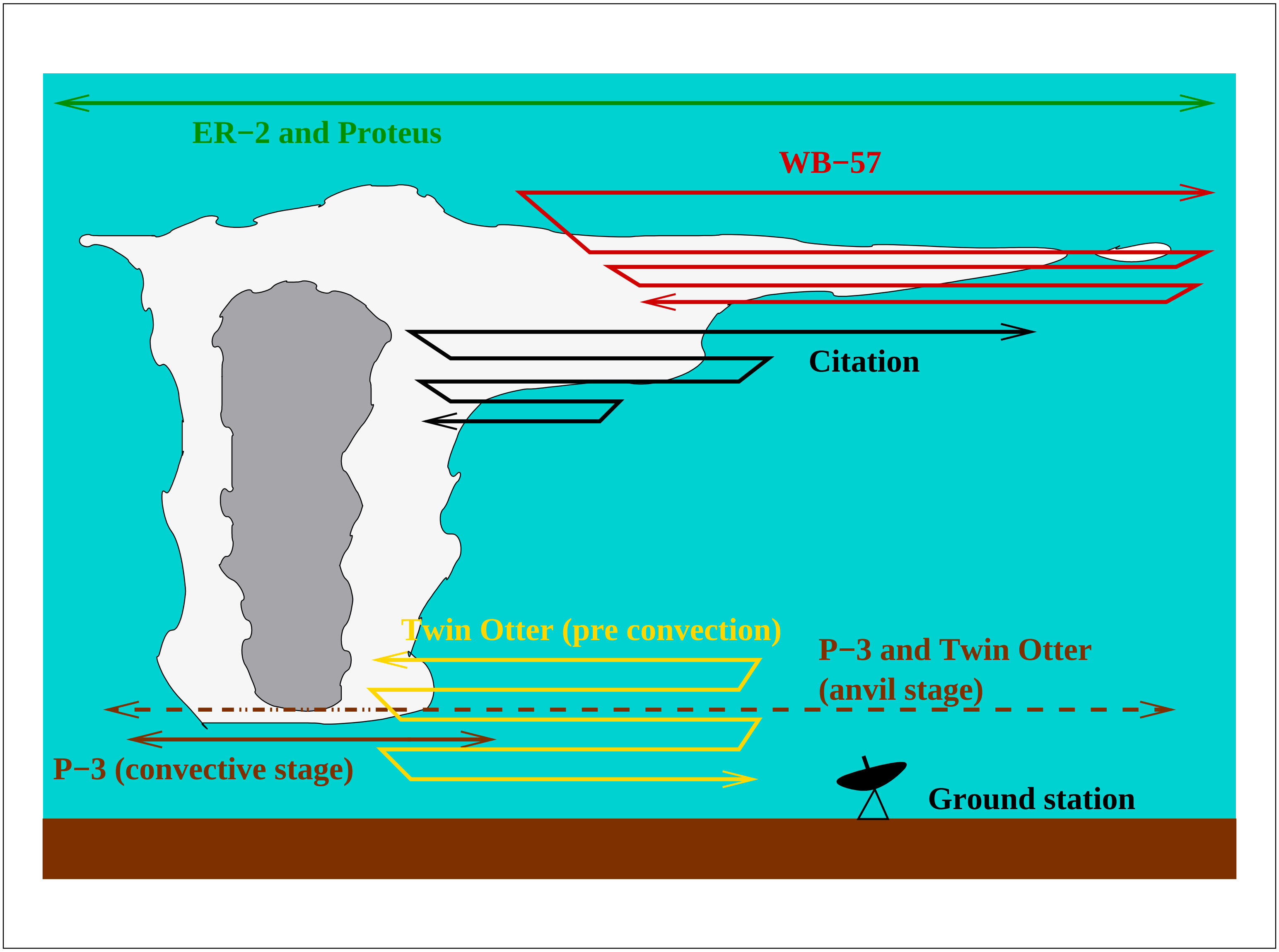
Twin Otter: In situ sampling of aerosols, tracers, meteorology; radiative flux measurements

P−3: ELDORA doppler radar



Ground sites: remote sensing using radar, lidar, radiometers, imagers, etc.

Satellites: Terra, TRMM, Aqua. SCIAMACY, etc.


ER−2 and Proteus
WB−57
Citation
Twin Otter (pre convection)
P−3 and Twin Otter
(anvil stage)
P−3 (convective stage)
Ground station

SARASOTA
DE SOTO
HIGHLANDS
MARTIN
Englewood
Port Charlotte
Punta Gorda
CHARLOTTE
GLADES
Lake Okeechobee
Clewiston
LaBelle
Tequesta
Jupiter
Palm Beach Gardens
Singer Island
Riviera Beach
West Palm Beach
Belle Glade
South Bay
Wellington
PALM BEACH
Boynton Beach
Delray Beach
Boca Raton
Deerfield Beach
Pompano Beach
Fort Myers
Cape Coral
Sanibel Island
Fort Myers Beach
Estero
Lehigh Acres
HENDRY
Bonita Springs
Immokalee
FLORIDA
Big Cypress I.R.
Coral Springs
Sunrise
Plantation
Fort Lauderdale
Golden Gate
North Naples
Naples
East Naples
COLLIER
BROWARD
Everglades Wildlife Management Area
Cooper City
Hollywood
Pembroke Pines
Big Cypress National Preserve
North Miami Beach
North Miami
Hialeah
Miami Beach
Westchester
Miami
Coral Gables
Kendall
Gulf of Mexico
Atlantic Ocean
MIAMI-DADE
Cutler Ridge
Homestead
Florida City
MONROE
Biscayne N.P.
Everglades National Park
Key Largo
Florida Bay
Tavernier
Islamorada
Marathon
Big Pine
Great White Heron N.W.R.
Marquesas Keys
Key West National Wildlife Refuge
Florida Keys
Key West
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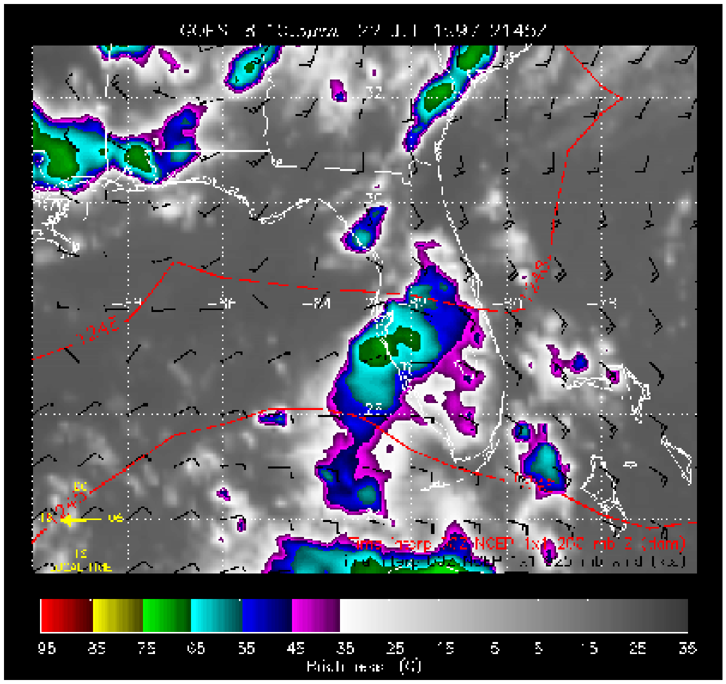
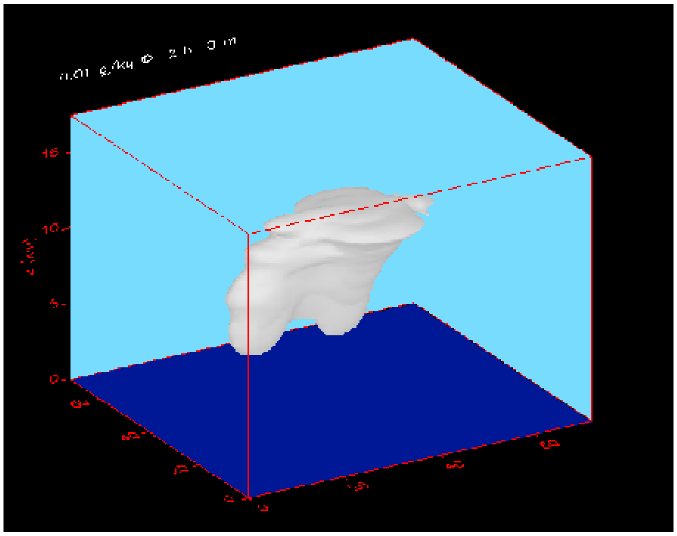


Modeling Approach



Numerous types of models included:

- Cloud resolving models and LES
- NWP models (cloud−scale and mesoscale)
- Cloud system resolving models
- General circulation models
- Single column models
- 0−D, 1−D, and 2−D cirrus models with prescribed dynamics

Objectives:

- Improve our understanding of tropical cirrus properties
- Improve our ability to model tropical cirrus.