Aircraft Measurements of IR Irradiance – Radiative Effects of Tropical Cirrus

Anthony Bucholtz, Elizabeth Reid
Naval Research Laboratory, Monterey, CA

Basic quantities measured:

- Upwelling and Downwelling Broadband IR Irradiance
- Estimated accuracy: 3-5%

Derived quantities:

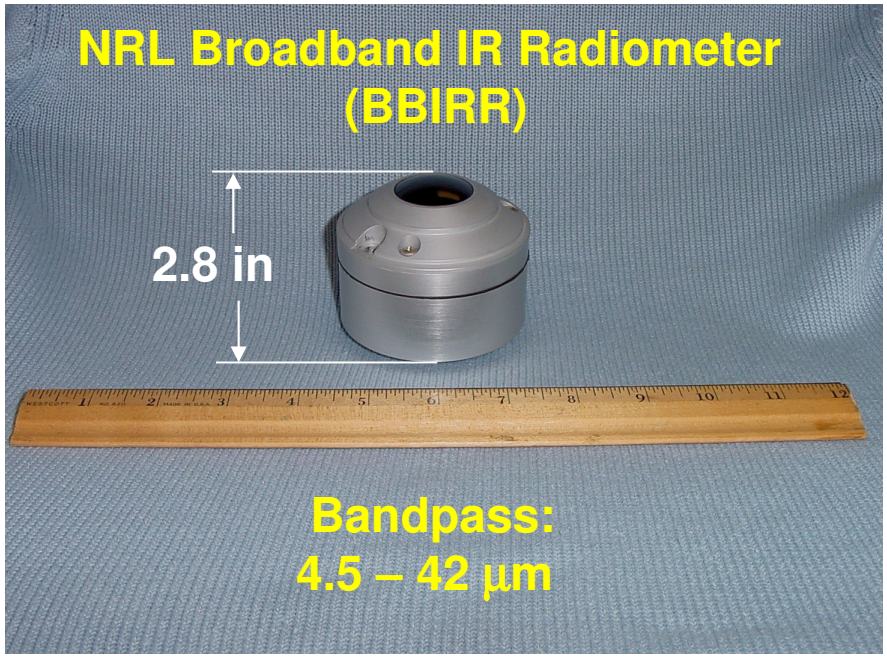
- Net IR Flux
- IR absorption and heating rates

TC4 Platforms:

- DC-8 and ER-2
- Up- and down-looking on both aircraft

Working in collaboration with SSFR:

- Pilewskie, Gore, et al.



Satellite Validation Capability – CERES on Terra and Aqua

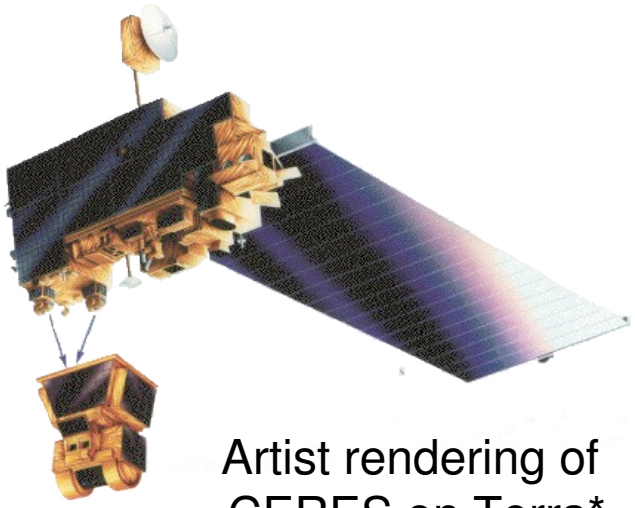
Comparisons of upwelling IR irradiance:

- CERES:

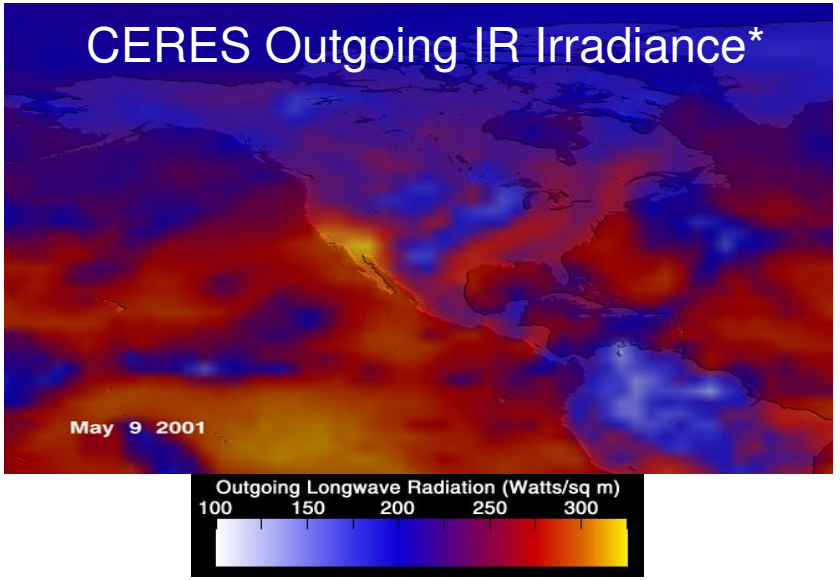
  Derive broadband IR irradiance 5 – 100 μm from difference of (total – solar) broadband irradiance, larger spatial footprint

- BBIRR:

  Direct measurement of 4.5 – 42 μm broadband irradiance, smaller spatial footprint



Artist rendering of CERES on Terra*



Desired satellite coordination:

- Terra and/or Aqua

***Images from CERES website http://asd-www.larc.nasa.gov/ceres/**

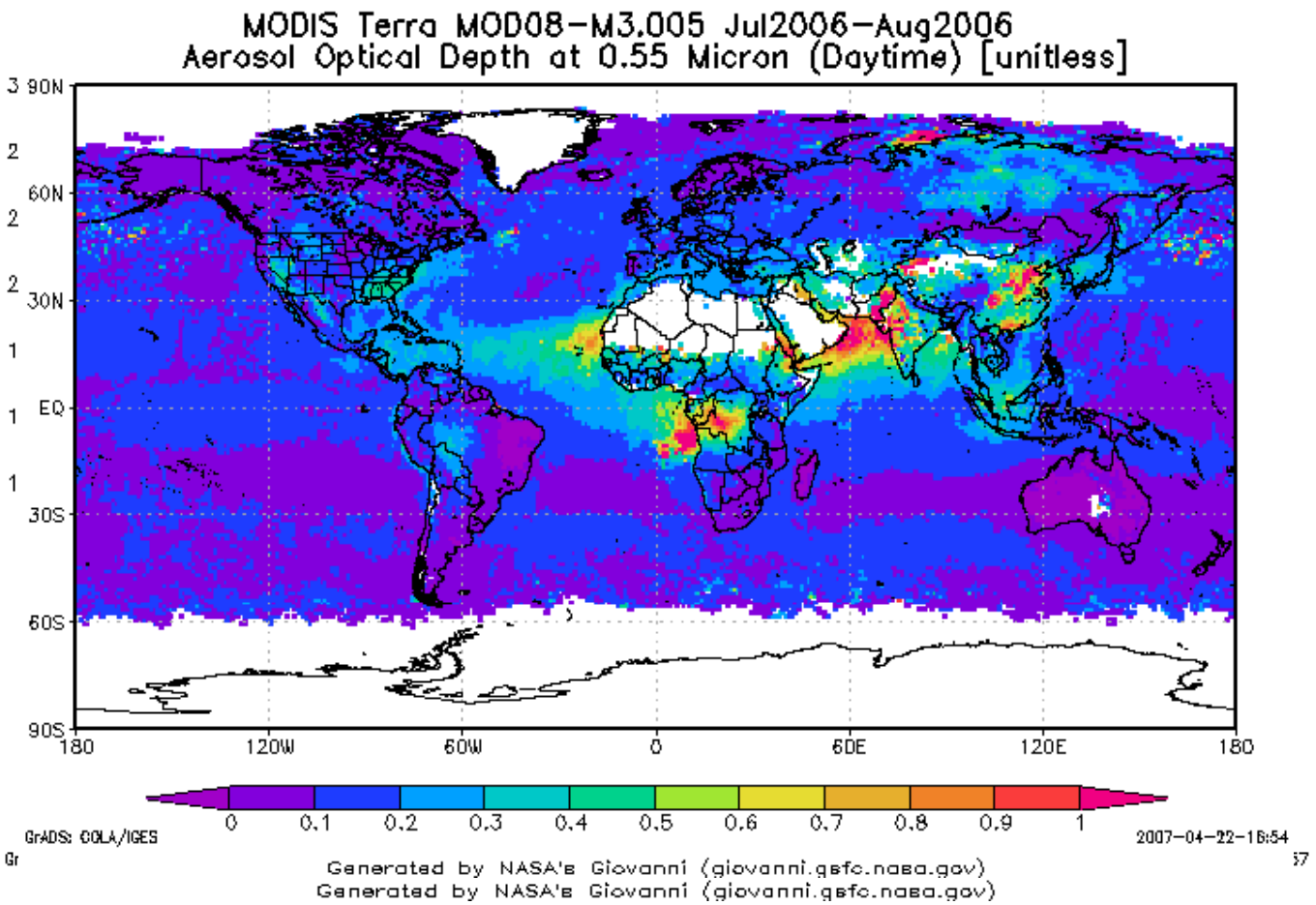
Science Goal 1: Investigate the changing radiative properties of tropical cirrus as they evolve over their life cycle

Method:

- Over the lifecycle of a cirrus anvil measure the up- and down-welling solar and IR irradiance above and below cloud concurrently with measurements of microphysical, meteorological, and dynamical properties of the clouds

  => characterize cloud for modeling studies

Science Goal 2: Investigate role of aerosols (e.g. Saharan dust, smoke from fires in Central and South America) on the radiative properties of tropical cirrus

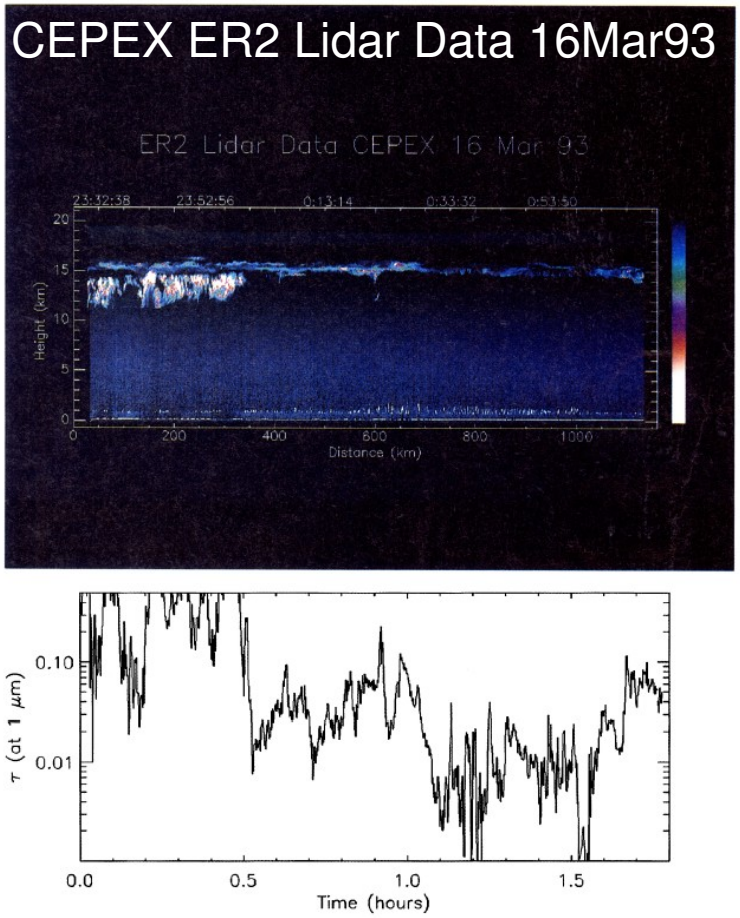


Method:

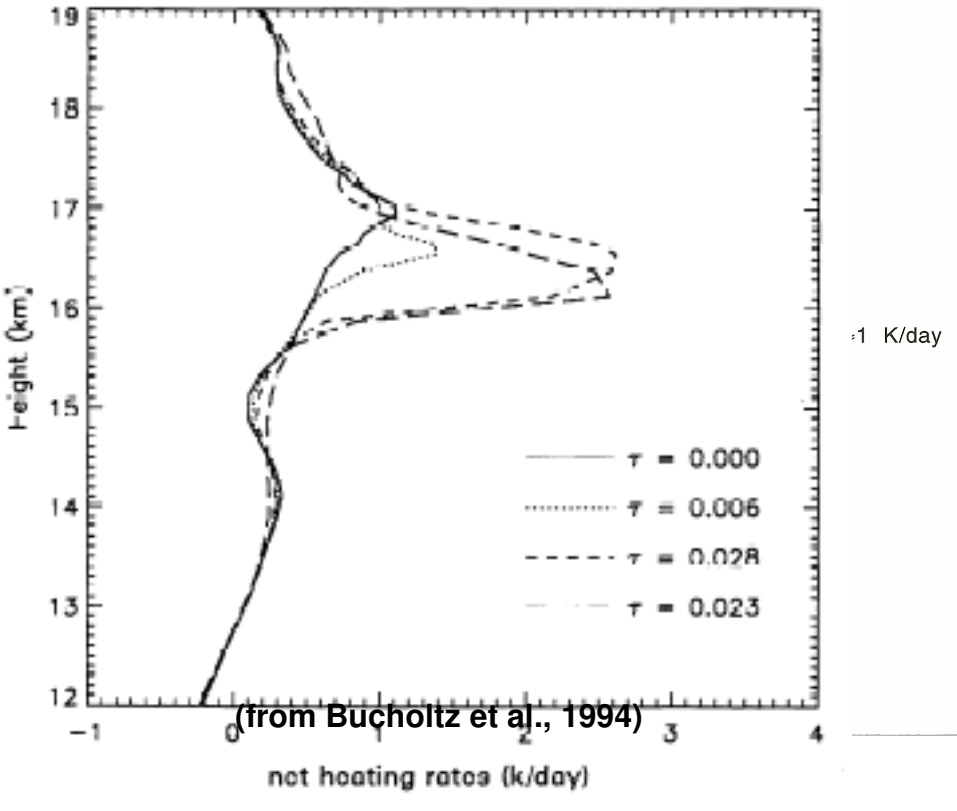
- For different aerosol regimes measure the up- and downwelling solar and IR irradiance above and below cloud concurrently with measurements of microphysical properties of the clouds => Utilize NRL Aerosol Model, Satellite Aerosol AOT

***Image from MODIS Online Visualization and Analysis System (MOVAS)**

Science Goal 3: Investigate role of IR absorption on the lifting and persistence of thin, subvisible, tropical cirrus



(from Jensen et al., 1996)



(from Bucholtz et al., 1994)

Method:

- Measure the up- and downwelling solar and IR irradiance above and below cloud concurrently with measurements of microphysical properties of the clouds

=> Derive heating rates, modeling studies

Desired Aircraft/Satellite Coordination and Collaborations

Aircraft Coordination:

- ER-2:

  Measured irradiances above cloud

- DC-8:

  Measured irradiances below cloud

- WB-57

  Measured in situ microphysical cloud properties

Desired Satellite Coordination:

- Terra and/or Aqua

Collaborations:

- SSFR, CPL, MAS, CERES, MODIS, MISR, in-situ μphys