Broadband Radiative Fluxes Measured from Long-Duration Stratospheric Balloons

by

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Objectives of the Project

Measure Top-of-the Atmosphere Broadband Fluxes

with High Accuracy and High Spatial Resolution

to Validate CERES Bidirectional Reflectance Models

Establish whether Long-Duration Stratospheric Balloons can be

Useful Platforms for Earth Radiation Budget Missions:

- High resolution flux measurements

- Dynamic observation of the radiative field

- Global coverage by constellation of balloons

People involved in the project outside CERES:

NASA Wallops Flight Facility: Provide platform and want improved input data for balloon performance models.

- I. Steve Smith (ULDB Program Manager)
- Keith De Weese (Guidance, Navigation and Control Aerospace Engineer)

NASA Goddard Space Flight Center: ERB from Constellation of 35-km balloons.

- Warren Wiscombe

Global Aerospace: Balloon trajectory prediction and control, and performance models.

- Kerry Nock (President)

ULDB Project

ULDB

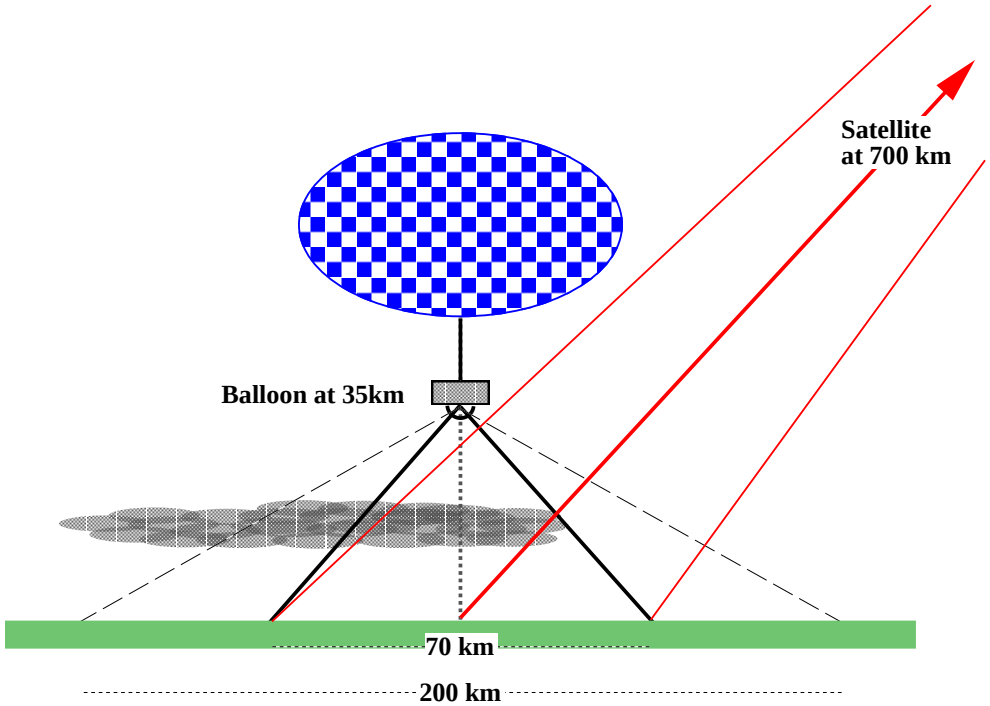
- Developed at NASA Goddard's Flight Facility (Wallops, VA)
- Super-Pressure (closed) balloon (inside pressure 20-200mb)
- Constant Volume (700,000 m^3) and Density $\Rightarrow$ Constant Altitude (35.3-35.0 km)
- Balloon: Polyester Fabric + Polyester Film + Polyethylene Film + Meridional Tendons
- 100-day mission (12/2001 Launch): 1500-kg TIGER payload to study cosmic rays

Comparisons of ULDB and CERES Irradiances

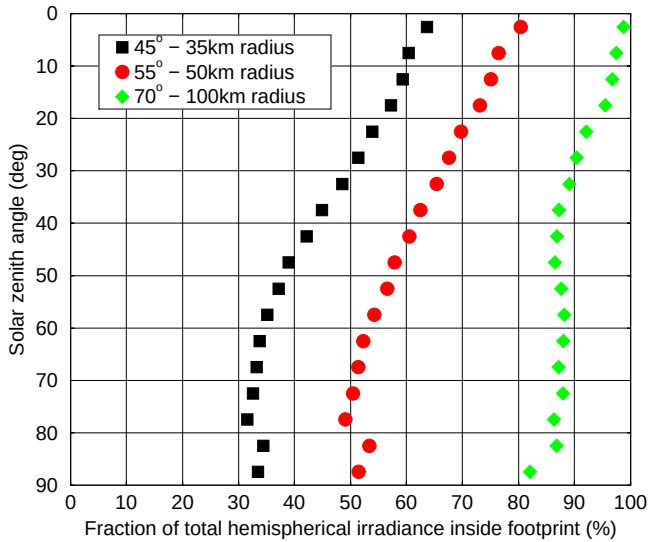
CERES: Narrow Field-of-View Broadband Radiances (~20 km resolution) + BRDF

ULDB: Hemispherical Broadband Irradiances (spatial resolution depend on scene)

Discrepancies: Calibration, Spectral Response, Spatial Resolution



Integrated radiance field at
TOA above clear-sky ocean



Instrumentation

Instruments:

- Eppley: Precision Spectral Pyranometer (PSP w/ thermistors) and Pyrgeometer (PIR)
- Kipp&Zonen: CM22 Pyranometer (4-mm Quart domes) + CG04 Pyrgeometer

Tests:

- Eppley performed PSP calibration from 200-310K (-70 to +40oC) (July 2000)
- Thermal/vacuum test of modified PSP (Sep. 2000)
- Meeting with Kipp&Zonen R&D scientist to adapt design (Feb. 2001)
- Thermal/vacuum test of PSP and CM22 at Wyle Laboratories (Feb. 2001)
- Calibration of PSP at NASA Langley (Mar. 2001)
- Test Flight of PSP from Ft. Sumners, NM (04/2001)

Flight Opportunities

ULDB Engineering Flight (Jan. 2001):

- Modified PSP delivered to NASA Wallops: July 2000
- Attached to ULDB Balloncraft - shipped to Australia: Dec. 2000
- Casualty Estimate for ULDB flight > $10e^{-6}$ $\Rightarrow$ flight likely to be terminated into ocean
- ULDB Balloncraft shipped back to US
- ULDB launched from Alice Springs, Australia, Jan. 2001 with another gondola

ULDB-Balloncraft Test Flight (April 2001):

- 24-48-hr flight from Ft. Sumners, NM
- LDB (300,000 m^3) 35-km altitude
- Possibility of installing the PSP on other short test flights
- Must design system to recover instrument (5 m/s landing speed)

ULDB TIGER Science Flight (Dec. 2001):

- 100-day flight
- Eppley and Kipp&Zonen instruments
- Launch from Antarctica(?)
- Casualty Estimates to be modified using trajectory prediction software

Future and Parallel Developments

- Good validation tool for GERB radiative flux time series
- Constellation of balloons to make dynamic measure of ERB (Wiscombe)
- Balloon trajectory prediction and control (Global Aerospace)