SLA

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SHUTTLE LASER ALTIMETER

Principle Investigator: Dr. Jack Bufton

January 1996 STS-72

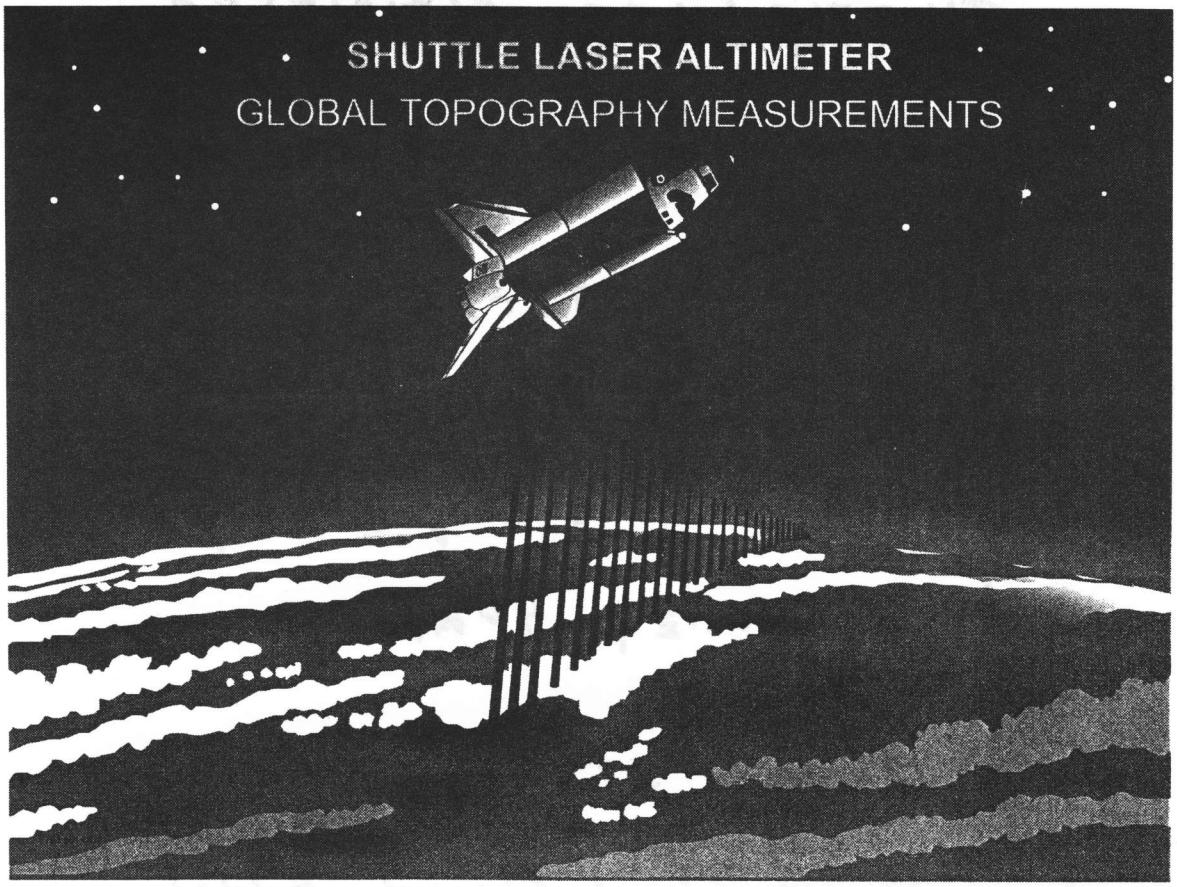
- 60 Hrs Data Acquired
- 1064 nm Surface Ranging Only
- Laser 10 Hz, 40 mJ

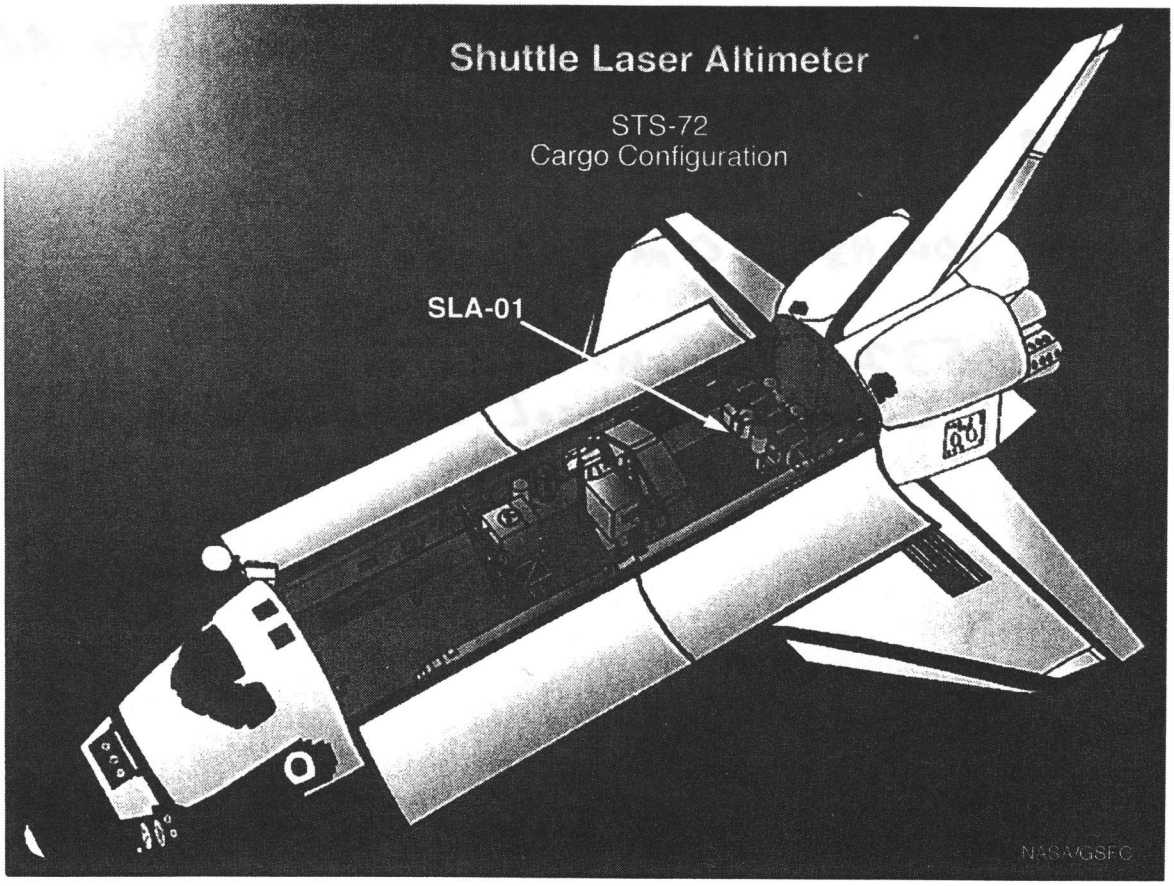
July 1997 STS-85

- 1064 nm Cloud Channel Added
- Infrared Spectral Imaging Radiometer Add

1999

- 100 Hz, 30 mJ Laser Added
- 532 Photon Counting
  Cloud & Aerosol Channel Added


SHUTTLE LASER ALTIMETER
GLOBAL TOPOGRAPHY MEASUREMENTS


Shuttle Laser Altimeter
STS-72
Cargo Configuration
SLA-01
NASA/GSFC

SHUTTLE LASER ALTIMETER

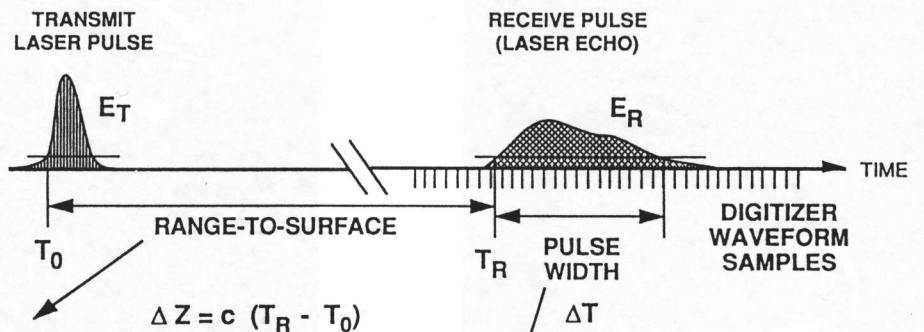
by acquisition of land topography, vegetation, and water surface data samples.

- Produce ground elevation control points.
- Obtain surface elevation profiles (relative) over short-arcs (~200 km)
- Derive vegetation height from pulse shape analysis
- Construct a catalog of within-footprint vertical structure measurements & apparent surface reflectivity
- Evaluate atmospheric propagation & cloud backscatter effects

for laser altimeter sensors.

- Utilize 100 m sensor footprints
- Evaluate ranging electronics and algorithms at the threshold of detection
- Perform return pulse waveform digitization

LASER ALTIMETER MEASUREMENTS



FIRST RETURN FROM HIGHEST SURFACE:
- LAND SURFACE (SOIL, ROCK, SAND)
- VEGETATION CANOPY TOP
- WATER (OCEAN, RIVER, LAKE)
- CLOUD TOPS
- SNOW & ICE COVER
- AEROSOL LAYERS

PULSE ENERGY RATIO: E_R / E_T
- ALBEDO
- ATMOSPHERIC PROPAGATION
- BACKSCATTER & EXTINCTION

PULSE SPREADING:
- SURFACE SLOPE
- LASER BEAM POINTING OFF-NADIR
- VEGETATION HEIGHT & STRUCTURE
- SURFACE ROUGHNESS
- CLOUD STRUCTURE & LAYERS
- AEROSOLS

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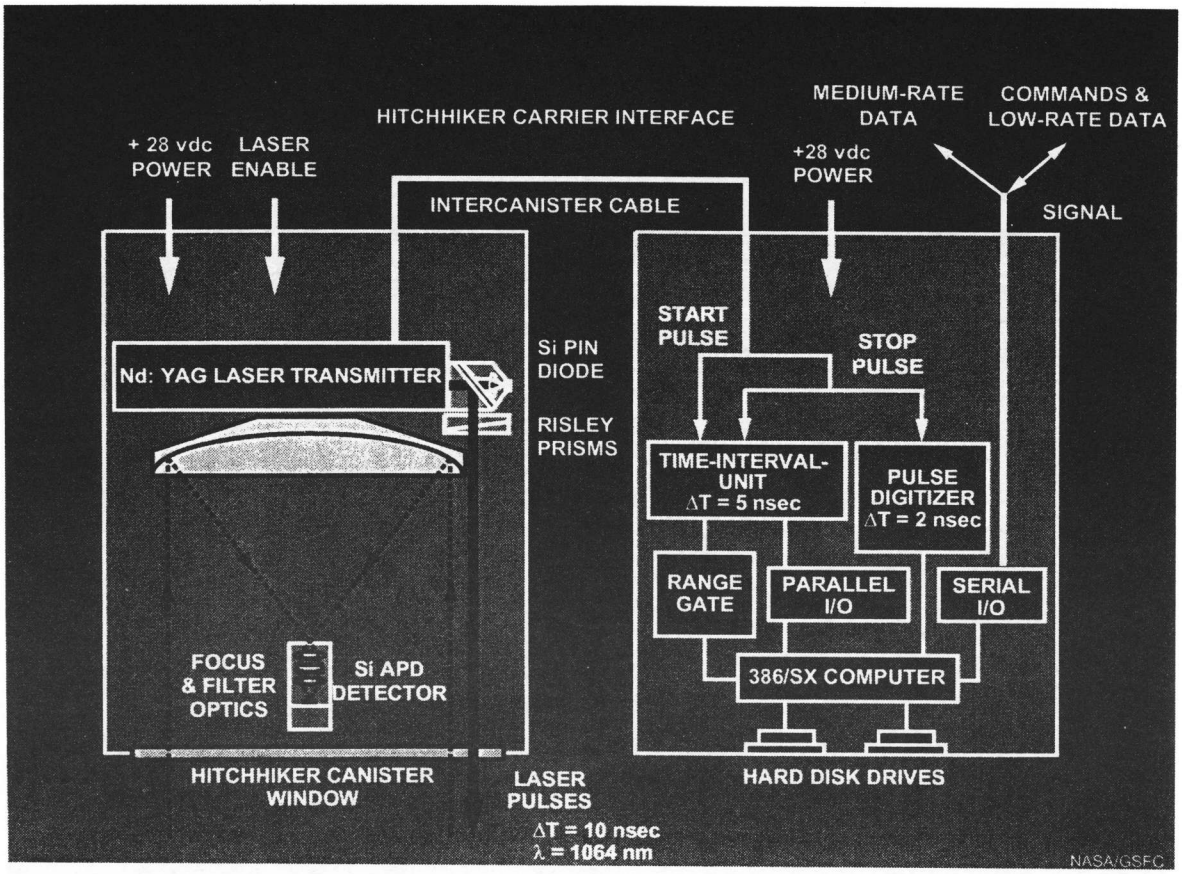
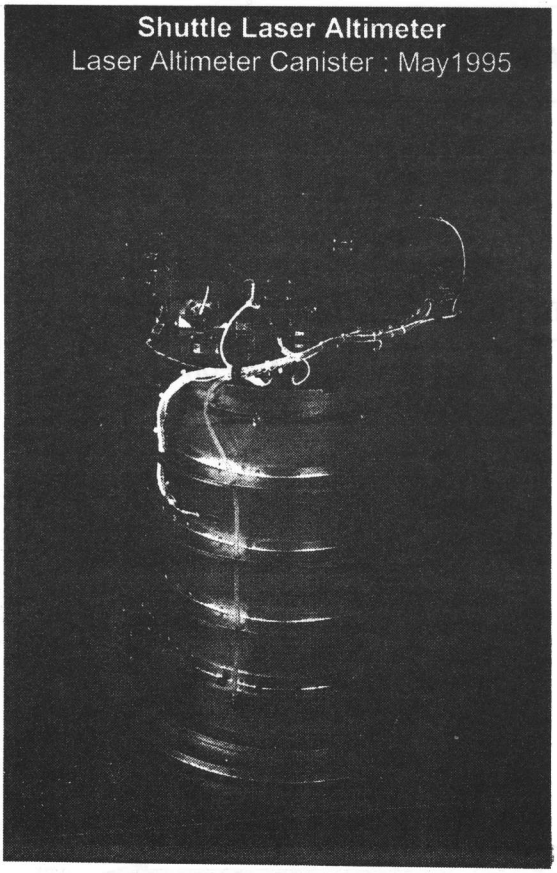
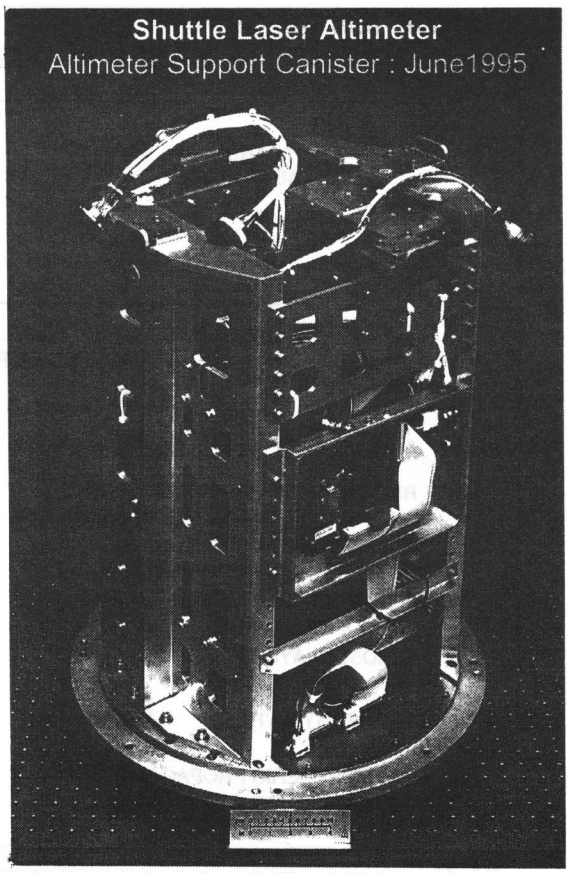
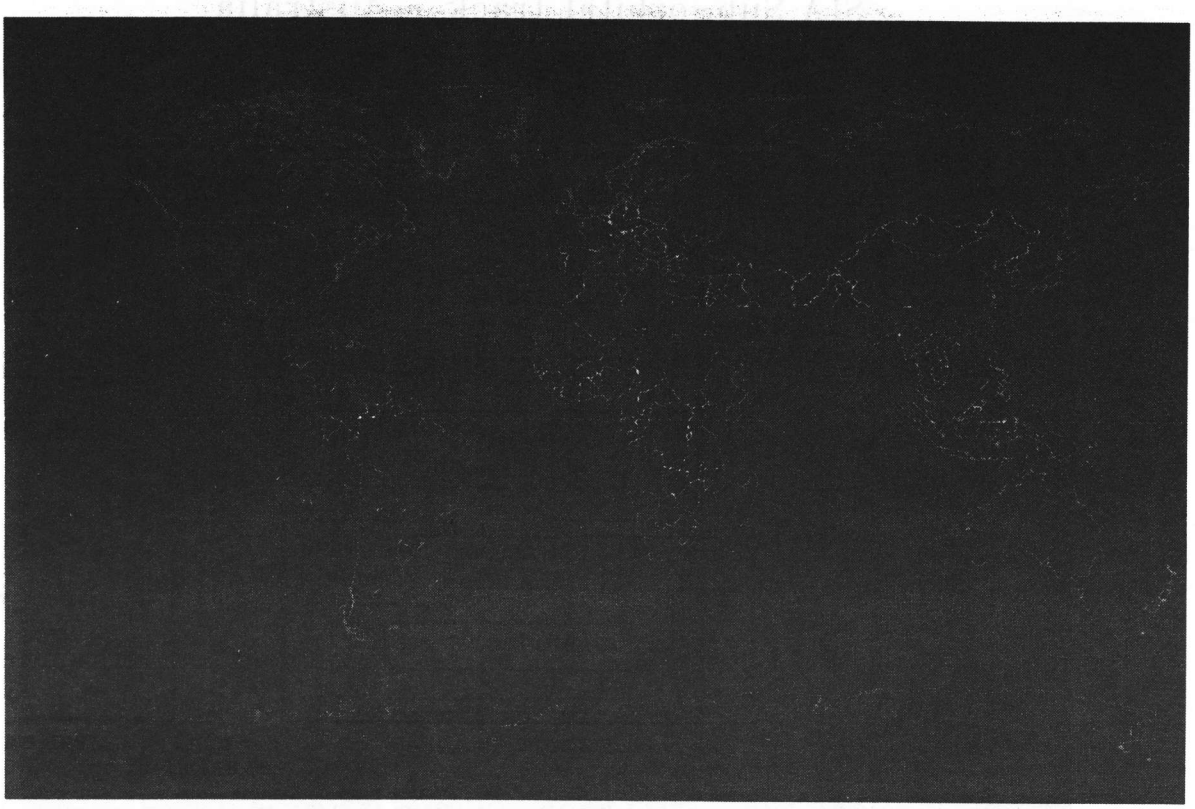

HITCHHIKER CARRIER INTERFACE
MEDIUM-RATE DATA
COMMANDS & LOW-RATE DATA
+ 28 vdc POWER
LASER ENABLE
+28 vdc POWER
SIGNAL
INTERCANISTER CABLE
START PULSE
STOP PULSE
Nd: YAG LASER TRANSMITTER
Si PIN DIODE
RISLEY PRISMS
TIME-INTERVAL-UNIT ΔT = 5 nsec
PULSE DIGITIZER ΔT = 2 nsec
RANGE GATE
PARALLEL I/O
SERIAL I/O
386/SX COMPUTER
FOCUS & FILTER OPTICS
Si APD DETECTOR
HITCHHIKER CANISTER WINDOW
LASER PULSES
ΔT = 10 nsec
λ = 1064 nm
HARD DISK DRIVES
NASA/GSFC


Shuttle Laser Altimeter
Laser Altimeter Canister : May1995


Shuttle Laser Altimeter
Altimeter Support Canister : June1995



SHUTTLE LASER ALTIMETER

AUGMENTATIONS for STS-85 MISSION (July 1997)

MISSION SENARIO:

simultaneous high-resolution altimetry (land & vegetation) & lidar (clouds & aerosols)
57° inclination, 300 km orbit altitude

LASER TRANSMITTER: (Fibertek SBIR)

100 mJoule per pulse (total) @ 50 pulses per sec @ 1064 nm & 532 nm wavelengths
30 m diameter laser pulse footprints (100 μrad divergence)
single spatial mode with ~ 5 nsec pulsewidth

DETECTORS (simultaneous two-color):

low noise hybrid silicon APD detector/amplifier (ref.: Brilliant Pebbles/Clementine) for 1064 nm
green photon-counting detector for 532 nm

DATA SYSTEM:

photon-counting electronics

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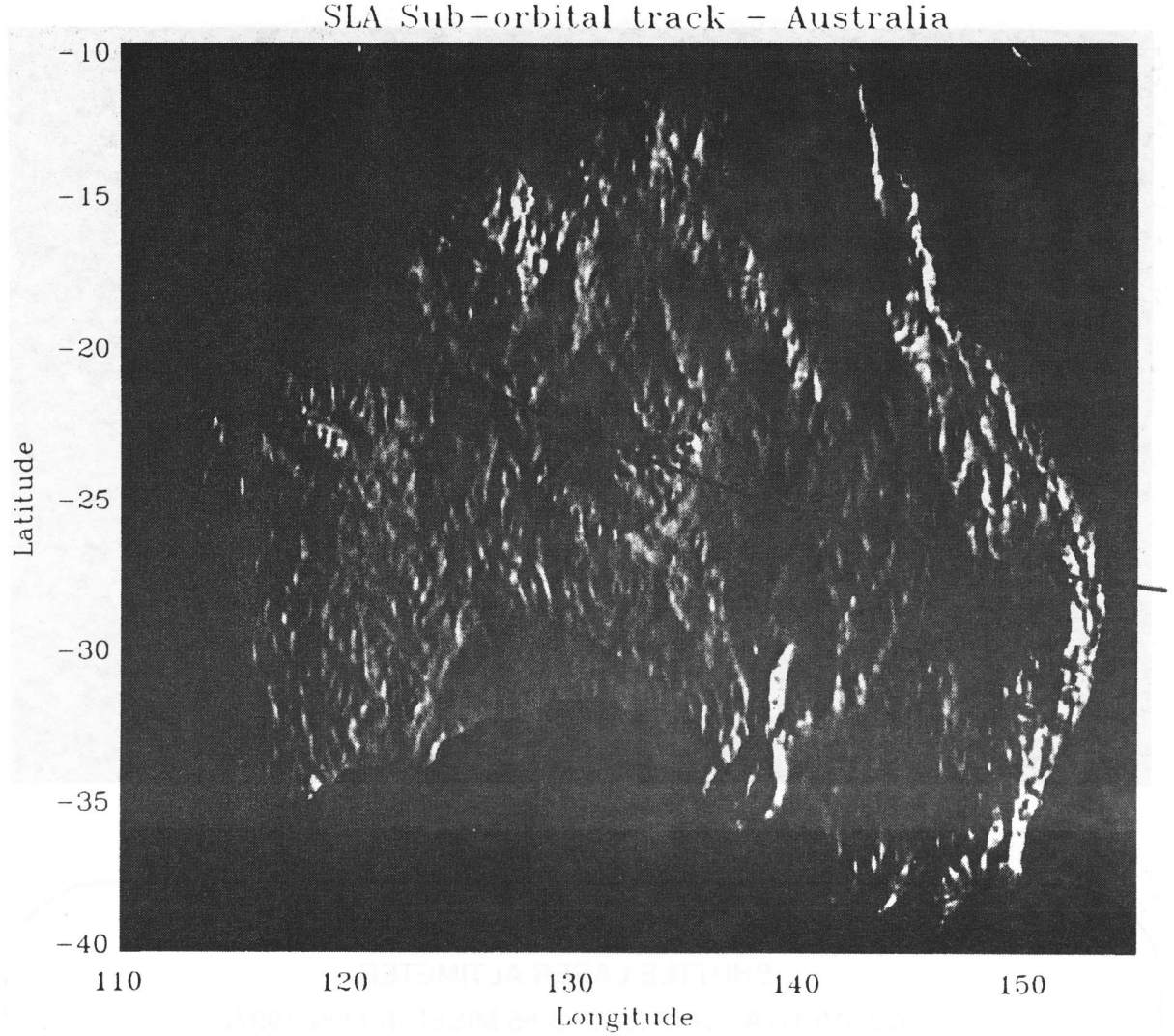
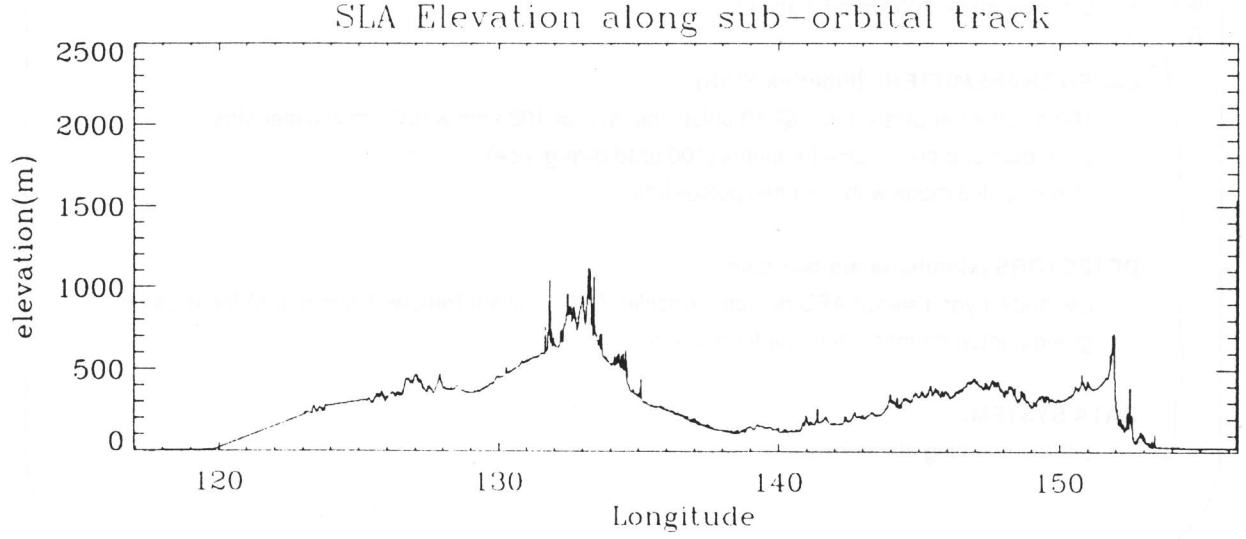
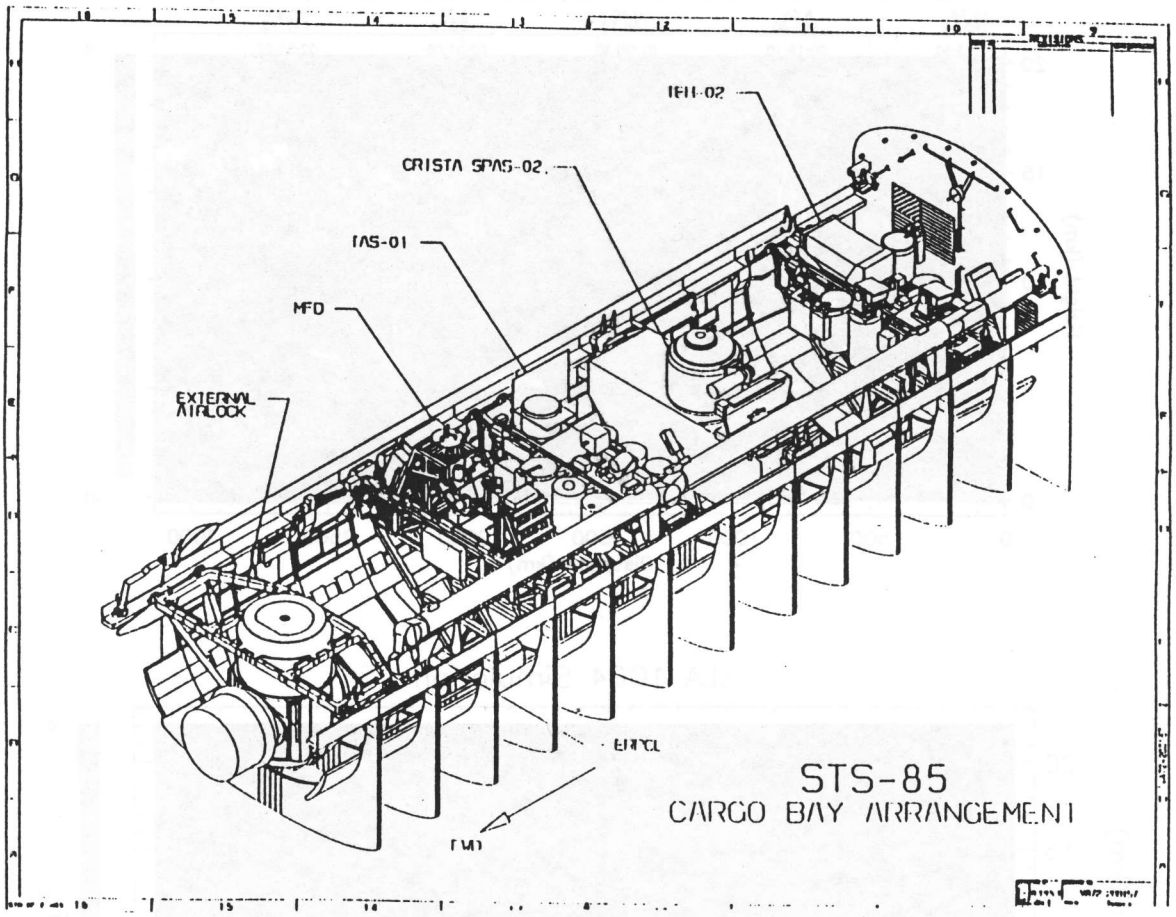
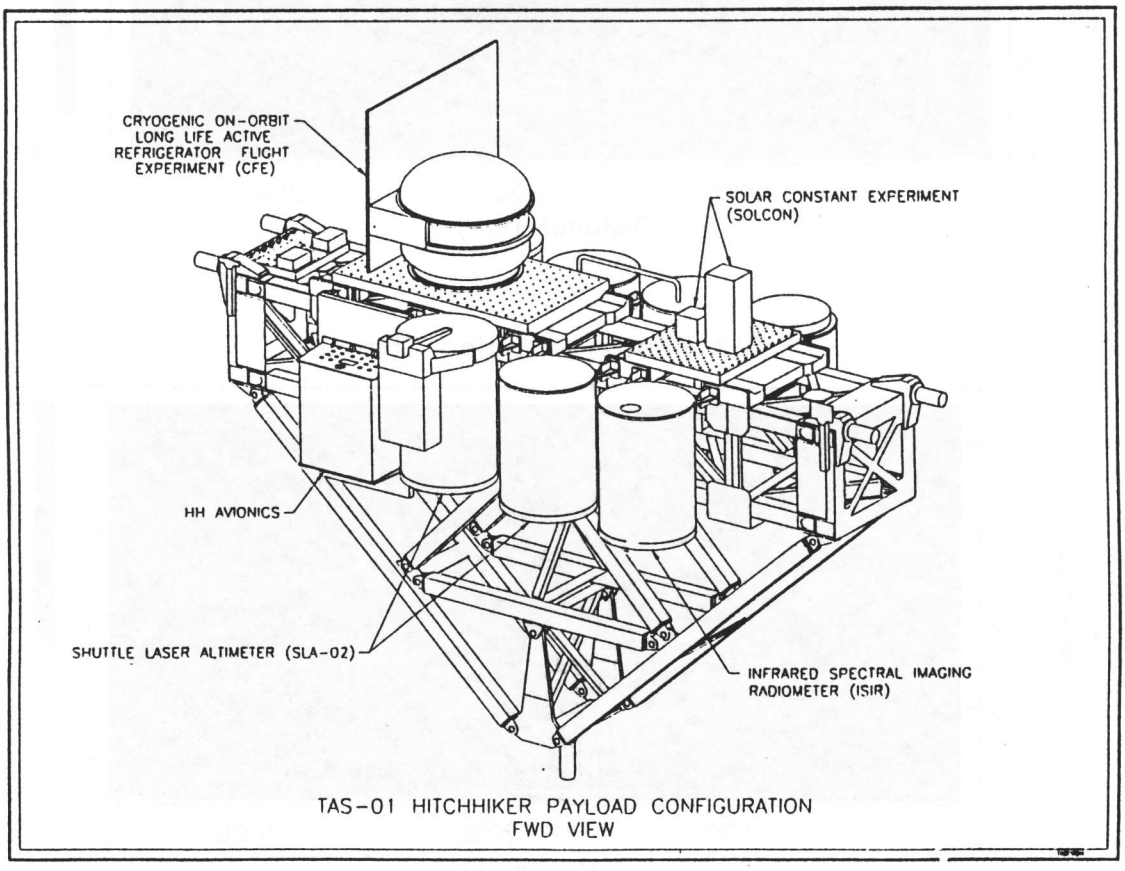
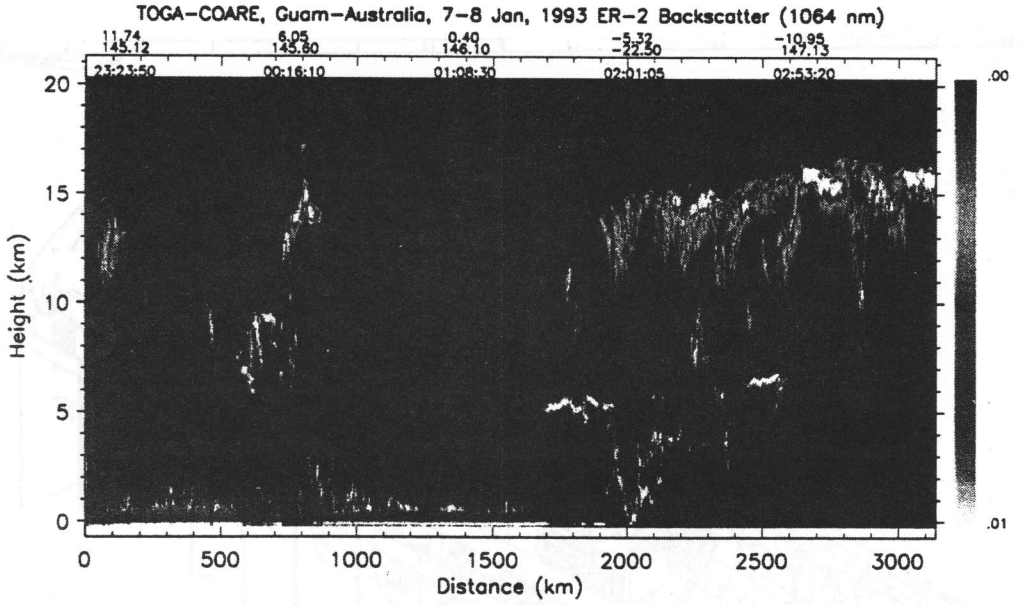

SLA Sub-orbital track - Australia
-10
-15
-20
-25
-30
-35
-40
Latitude
110
120
130
140
150
Longitude

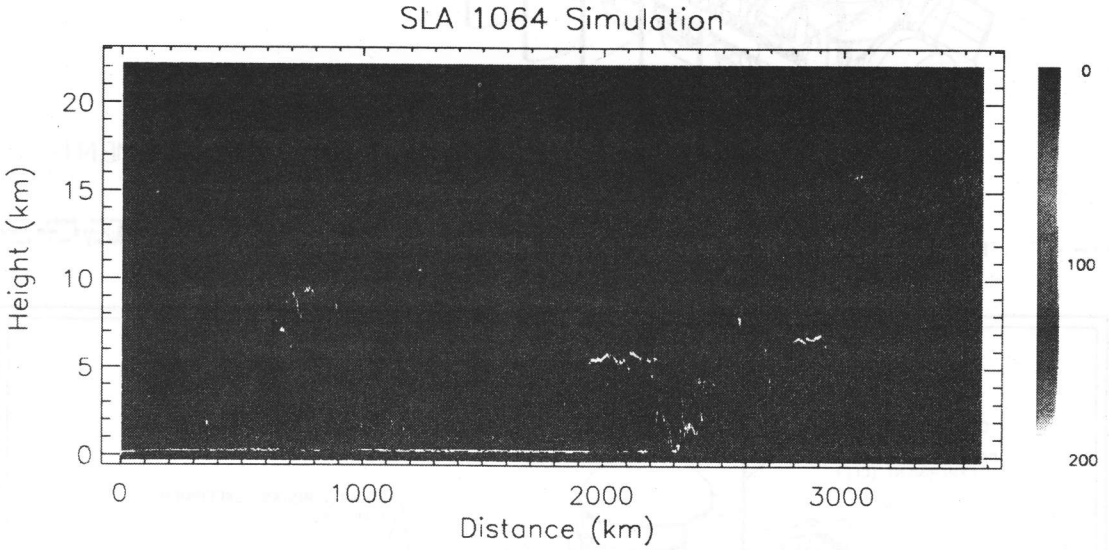

SLA Elevation along sub-orbital track
2500
2000
1500
1000
500
0
elevation(m)
120
130
140
150
Longitude

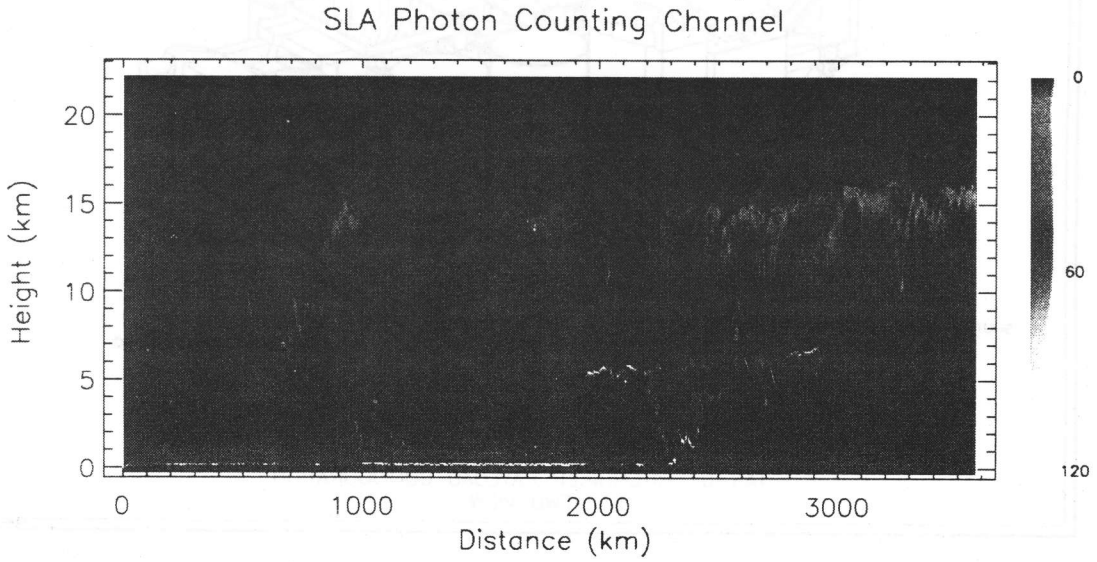




TAS-01 HITCHHIKER PAYLOAD CONFIGURATION
FWD VIEW


TOGA-COARE, Guam-Australia, 7-8 Jan, 1993 ER-2 Backscatter (1064 nm)
11.74
145.12
6.05
145.60
0.40
146.10
-5.32
-22.50
-10.95
147.13
23:23:50
00:16:10
01:08:30
02:01:05
02:53:20
Height (km)
Distance (km)
.00
.01


SLA 1064 Simulation
Height (km)
Distance (km)
0
100
200


SLA Photon Counting Channel
Height (km)
Distance (km)
0
60
120