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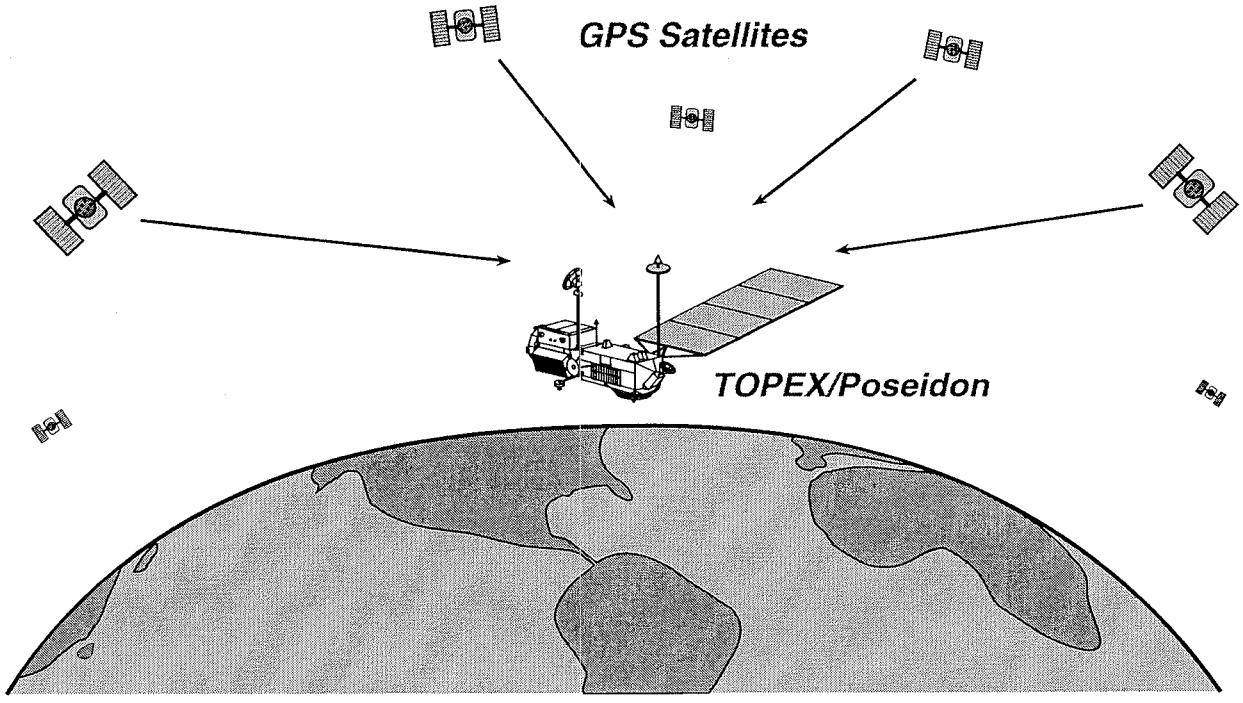
SPACEBORNE GPS AT JPL

An Overview

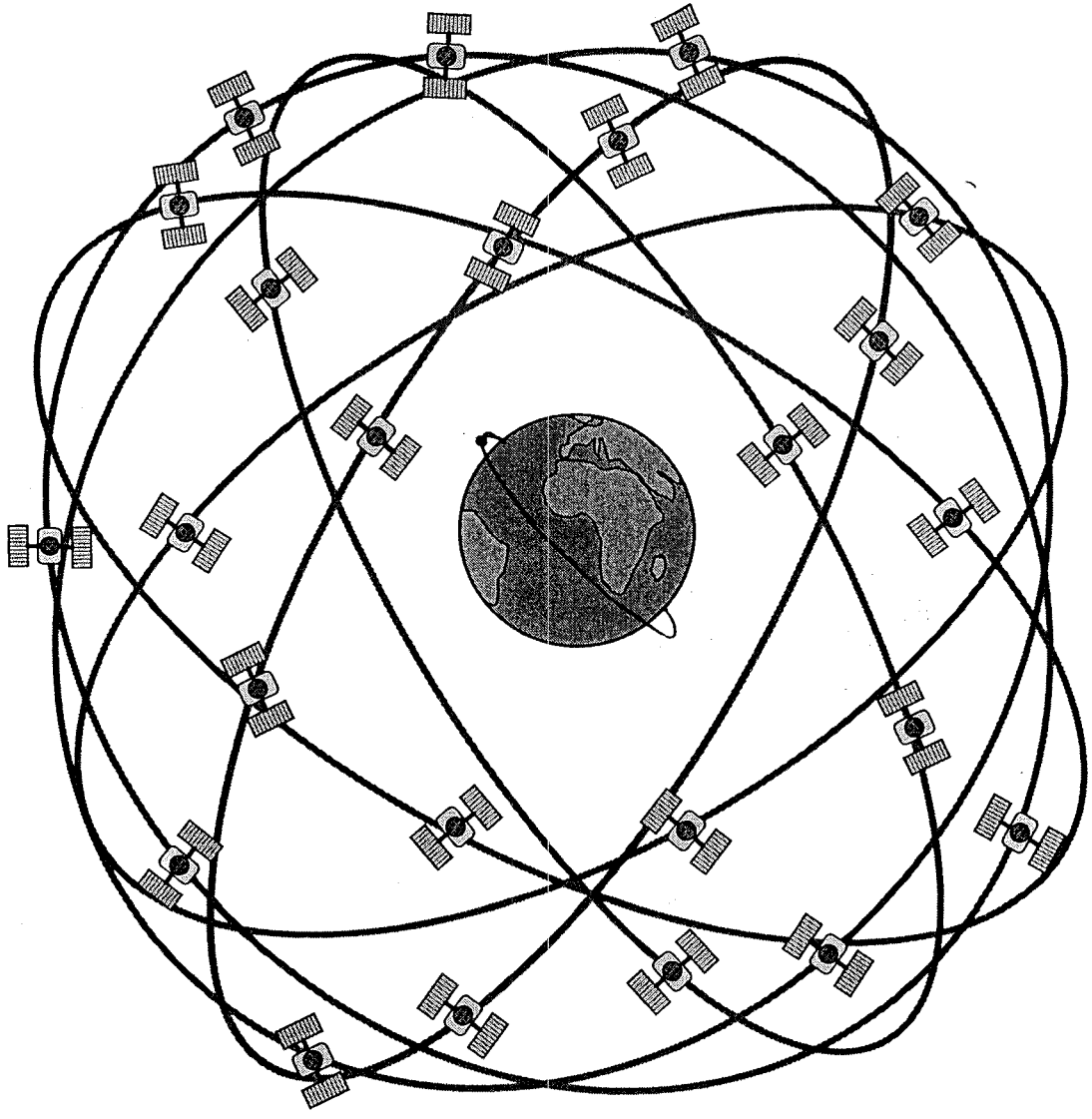


The Jet Propulsion Laboratory

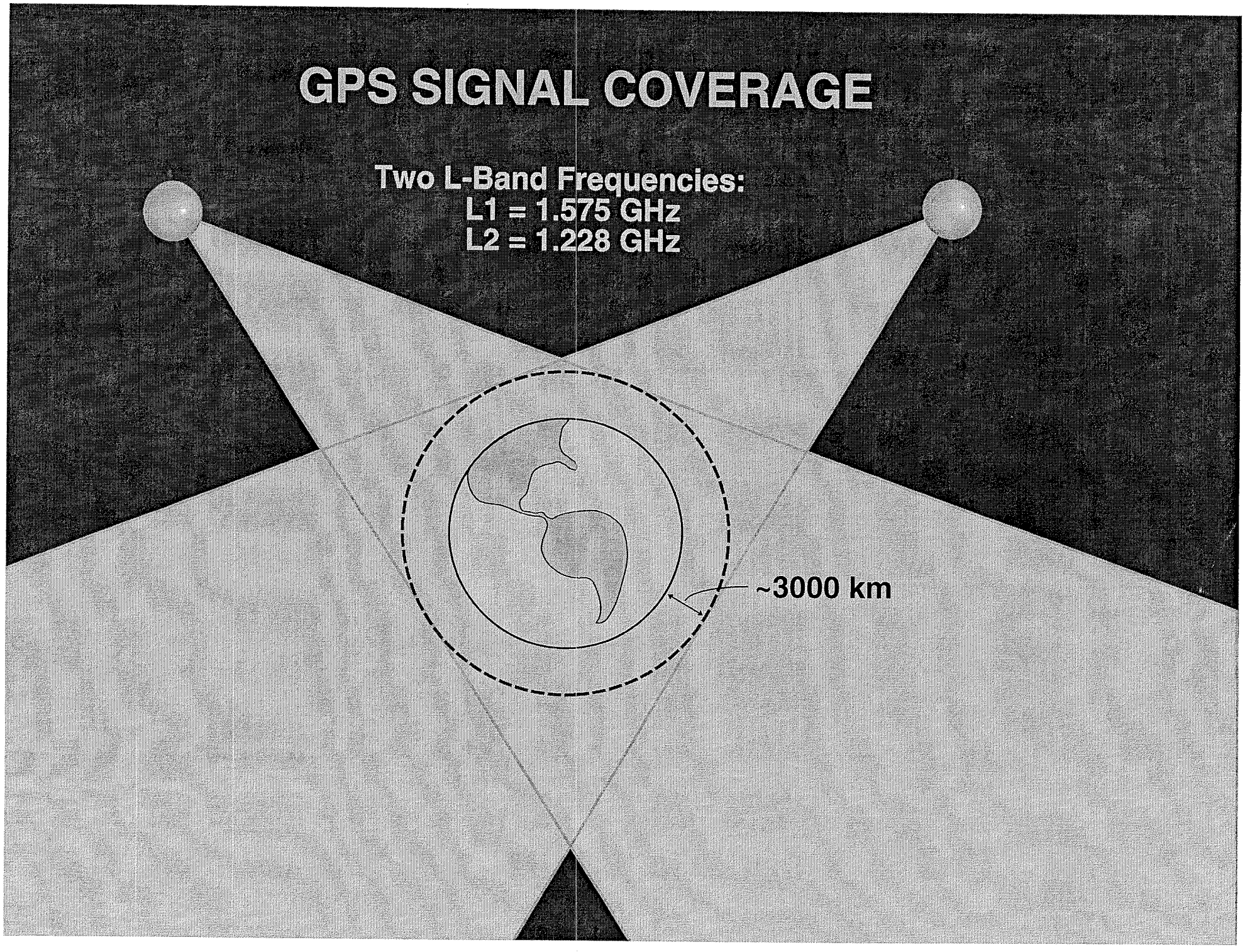
~~10 June 1998~~

23 Jan 2002

THE GLOBAL POSITIONING SYSTEM



GPS SIGNAL COVERAGE



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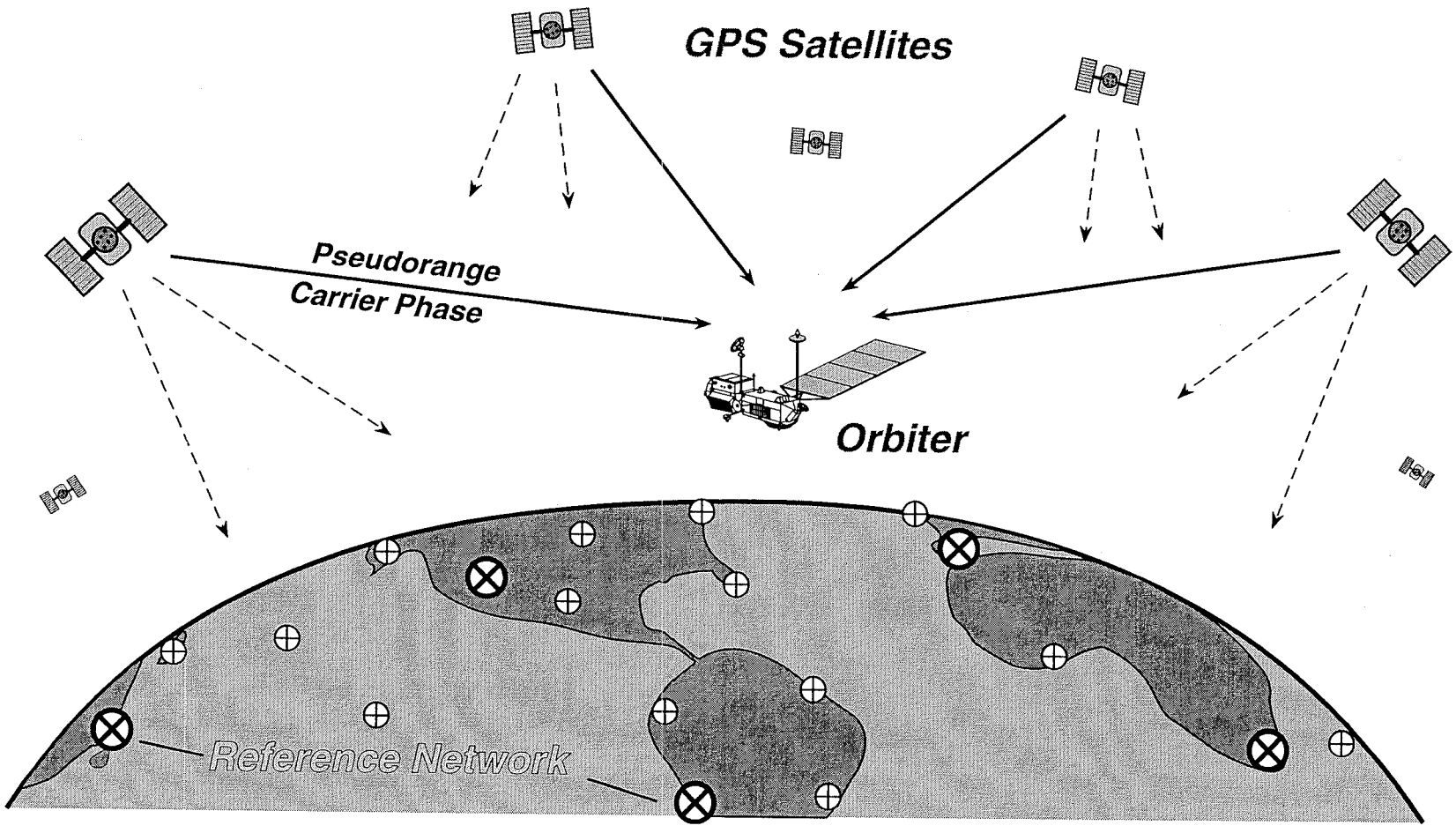
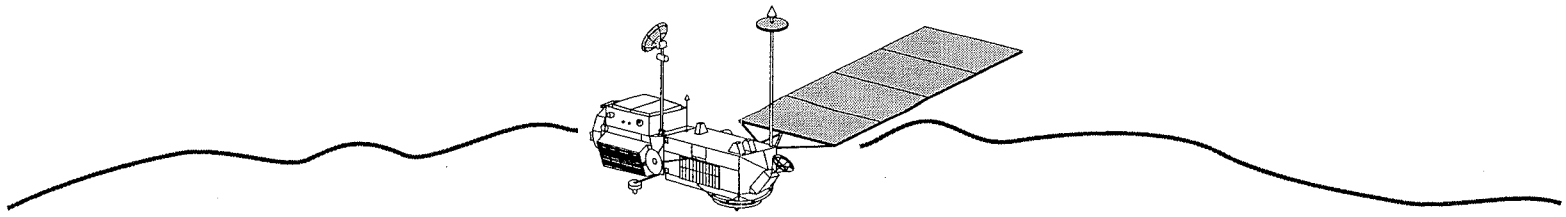
TYPICAL GEOMETRY FOR SPACEBORNE GPS



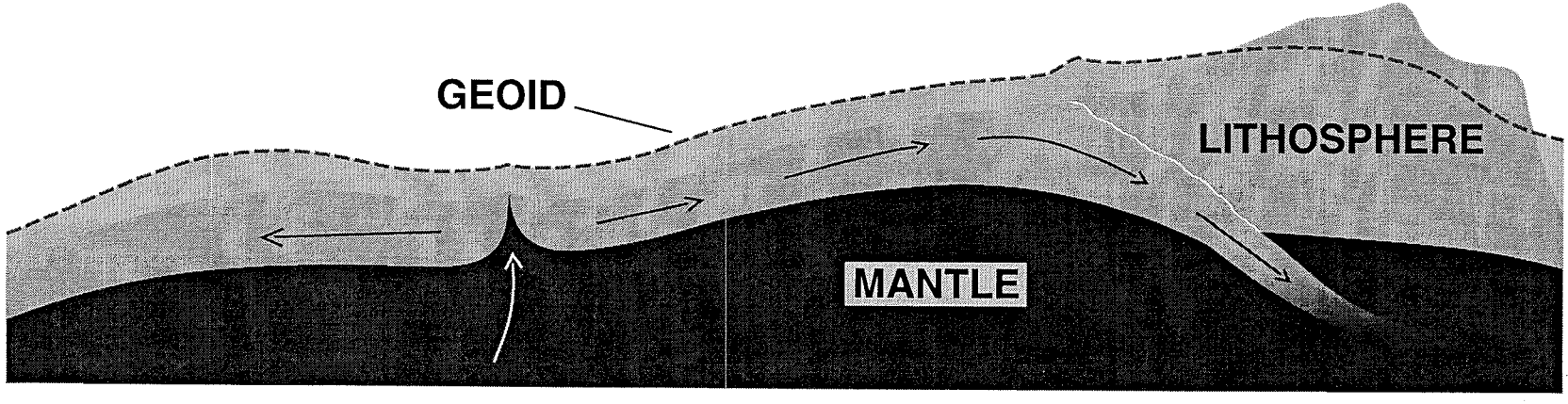
GRAVITY DATA IN EARTH SCIENCE

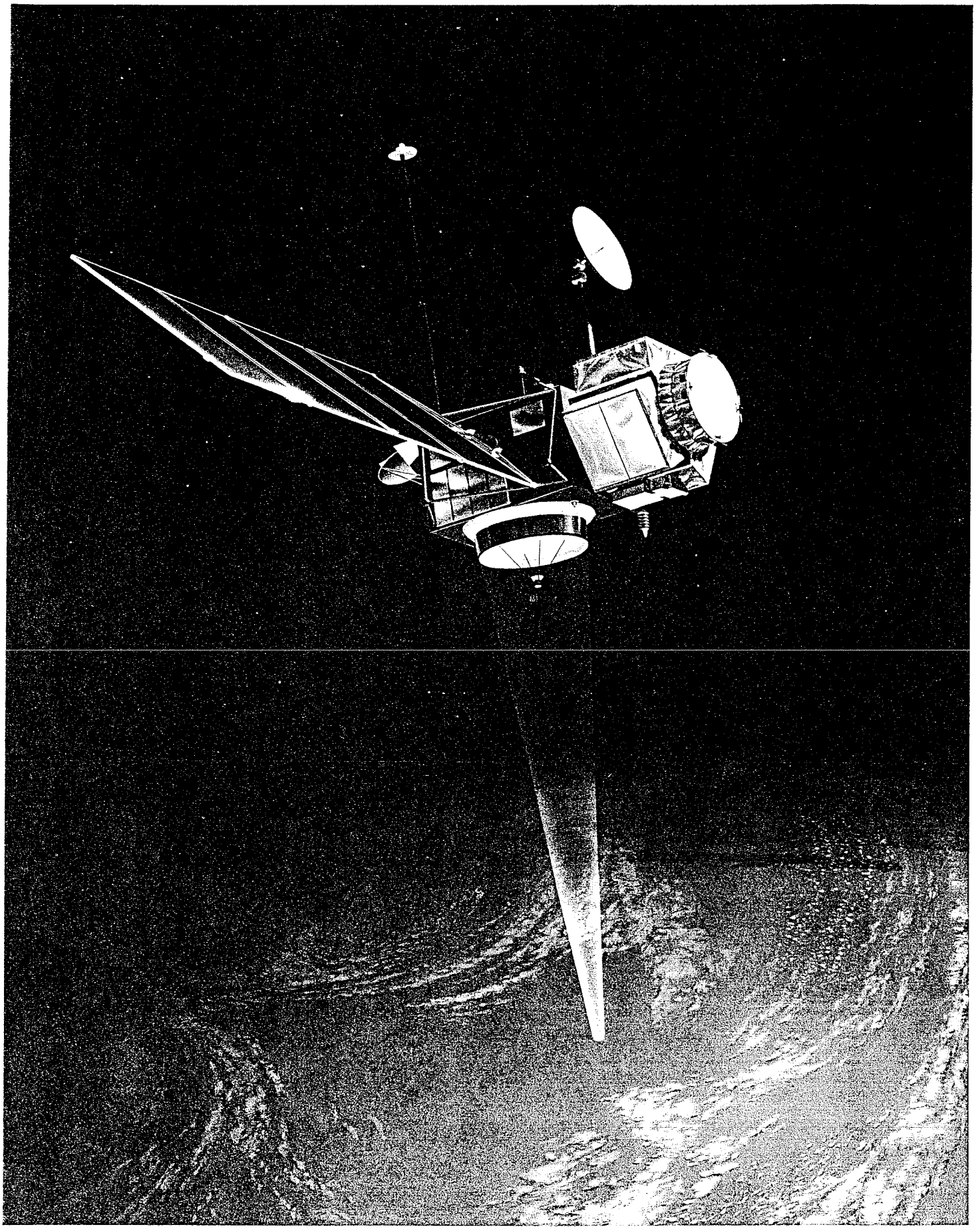


GRAVITY VARIATIONS REVEAL VARIATIONS IN MASS DISTRIBUTION OF THE SOLID EARTH:

- SURFACE TOPOGRAPHY
- INTERNAL DENSITY DISTRIBUTION
- VARIATIONS OVER TIME
  - — TIDES, WATER, ICE, MAGMA, AIR, TECTONICS,...

GRAVITY DATA ARE USED TO STUDY THE STRUCTURE, COMPOSITION, AND EVOLUTION OF THE EARTH'S INTERIOR

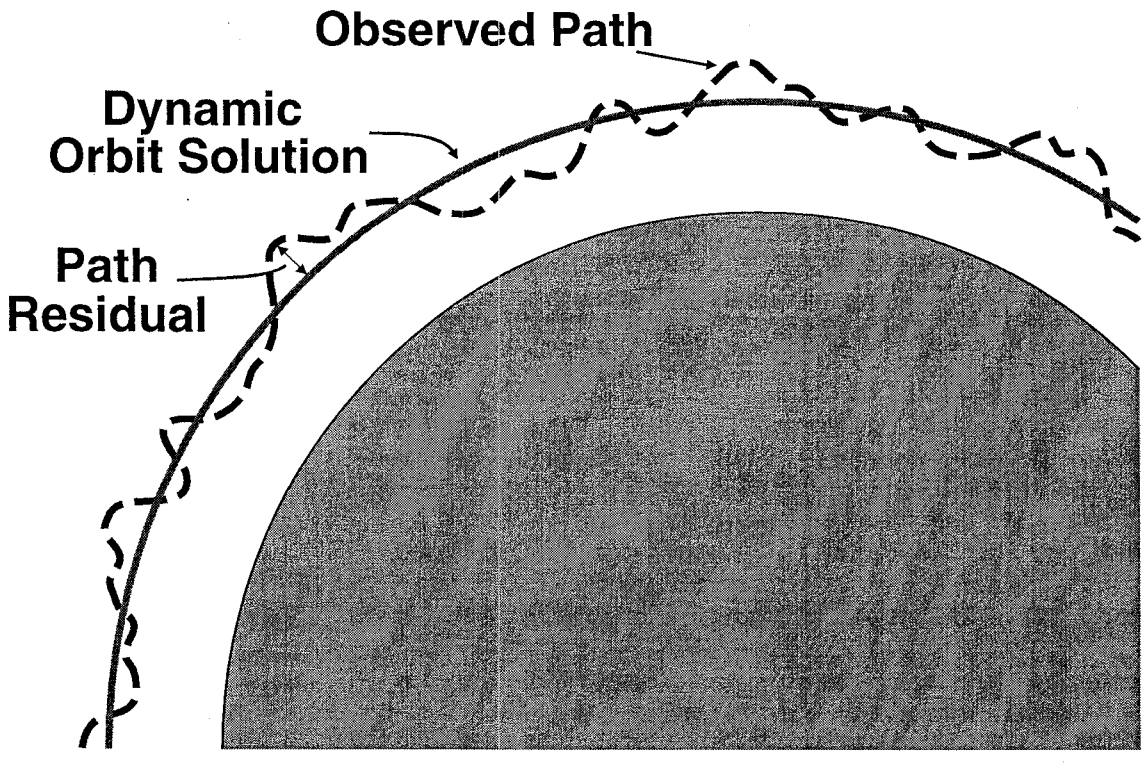




THE ELEMENTS OF REDUCED DYNAMIC ORBIT DETERMINATION WITH GPS

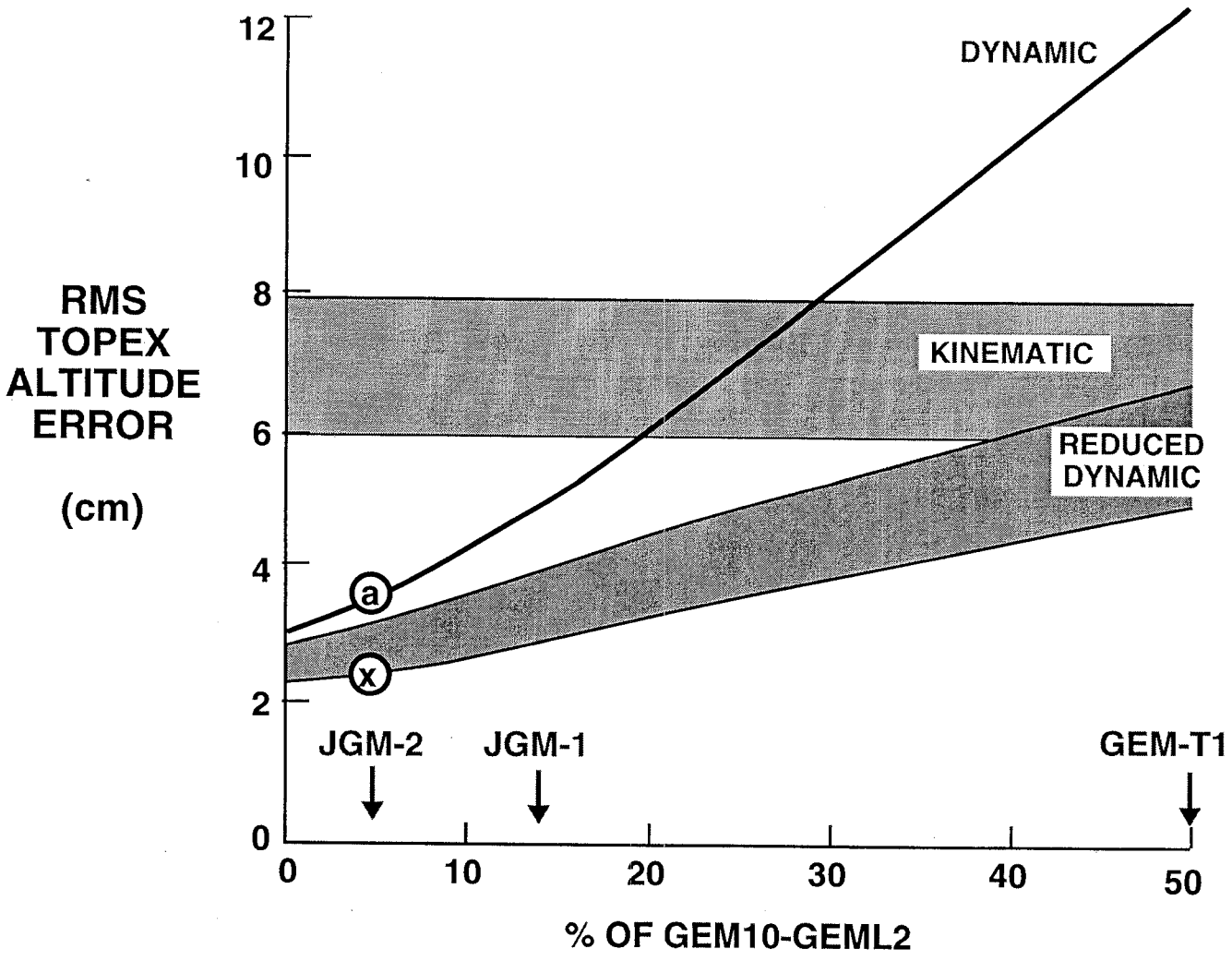
GPS PROVIDES:
Continuous 3D Coverage
Millimeter Precision Phase

The observed path can be reconstructed from a dynamic solution and the 3D residuals



COMPARISON OF TOPEX POD TECHNIQUES:

PERFORMANCE vs GRAVITY MODEL ACCURACY



ⓐ – Dyn minus Red Dyn RMS ⓧ – Estimated reduced dynamic accuracy

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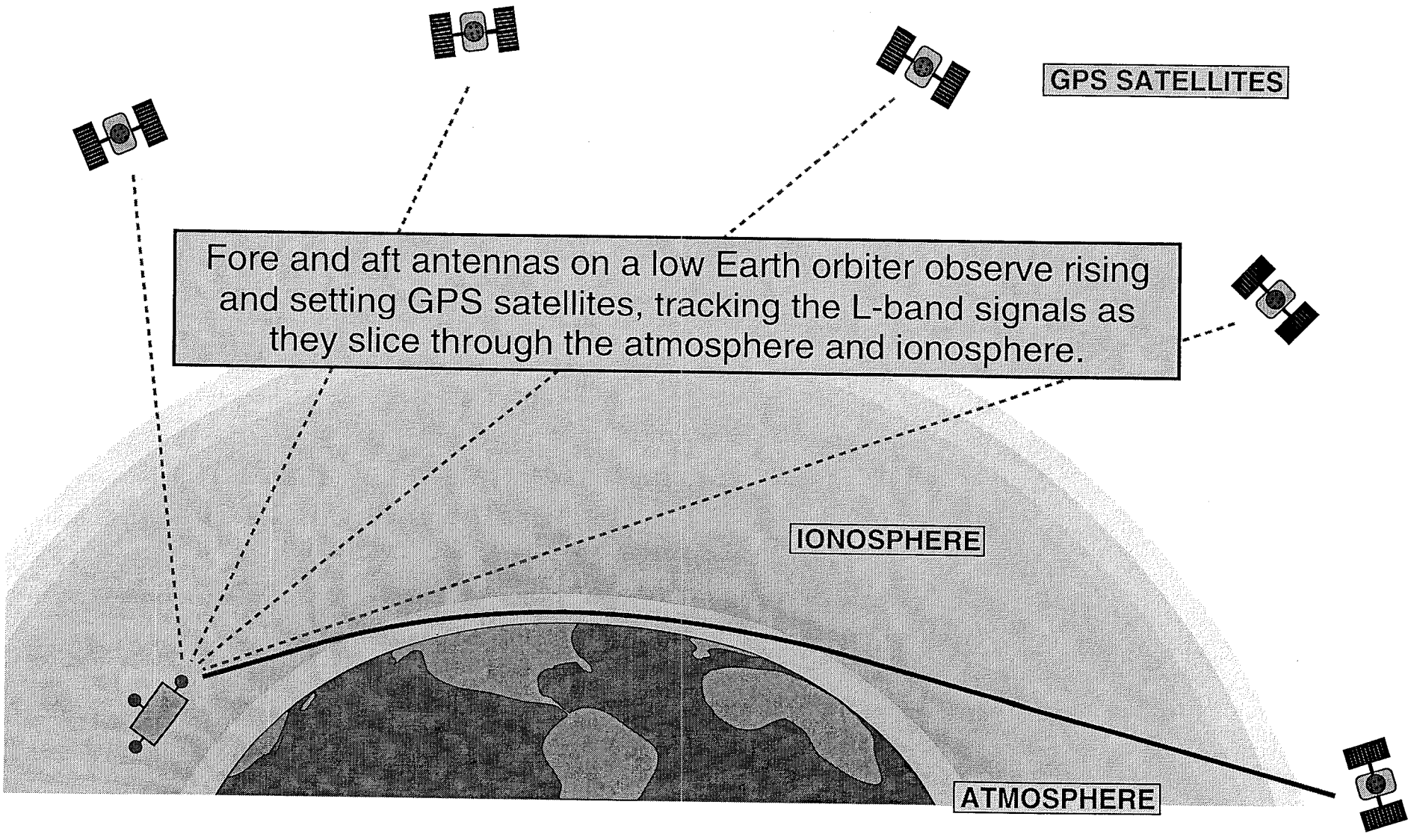
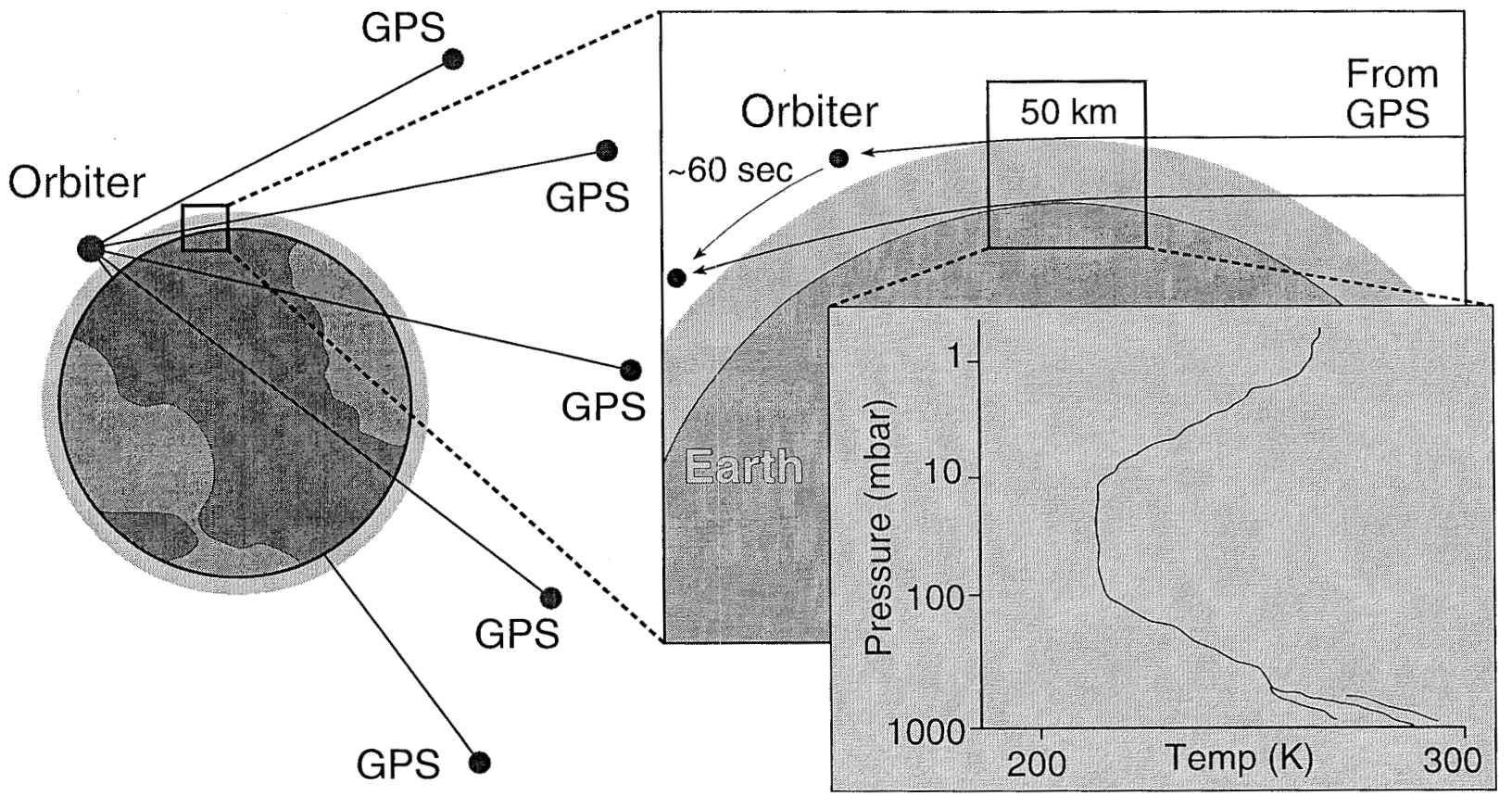
GPS OCCULTATION GEOMETRY



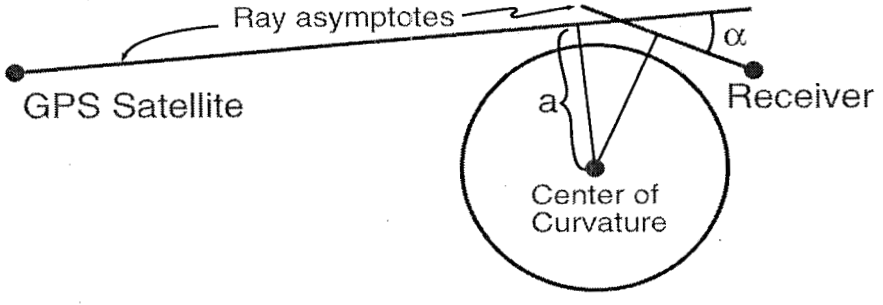
Fore and aft antennas on a low Earth orbiter observe rising and setting GPS satellites, tracking the L-band signals as they slice through the atmosphere and ionosphere.

ATMOSPHERIC TEMPERATURE PROFILING WITH GPS LIMB-SOUNDING



RECOVERING THE TEMPERATURE PROFILE

1: COMPUTE THE RAY ASYMPTOTE MISS DISTANCE (a) AS A FUNCTION OF THE BENDING ANGLE (α).



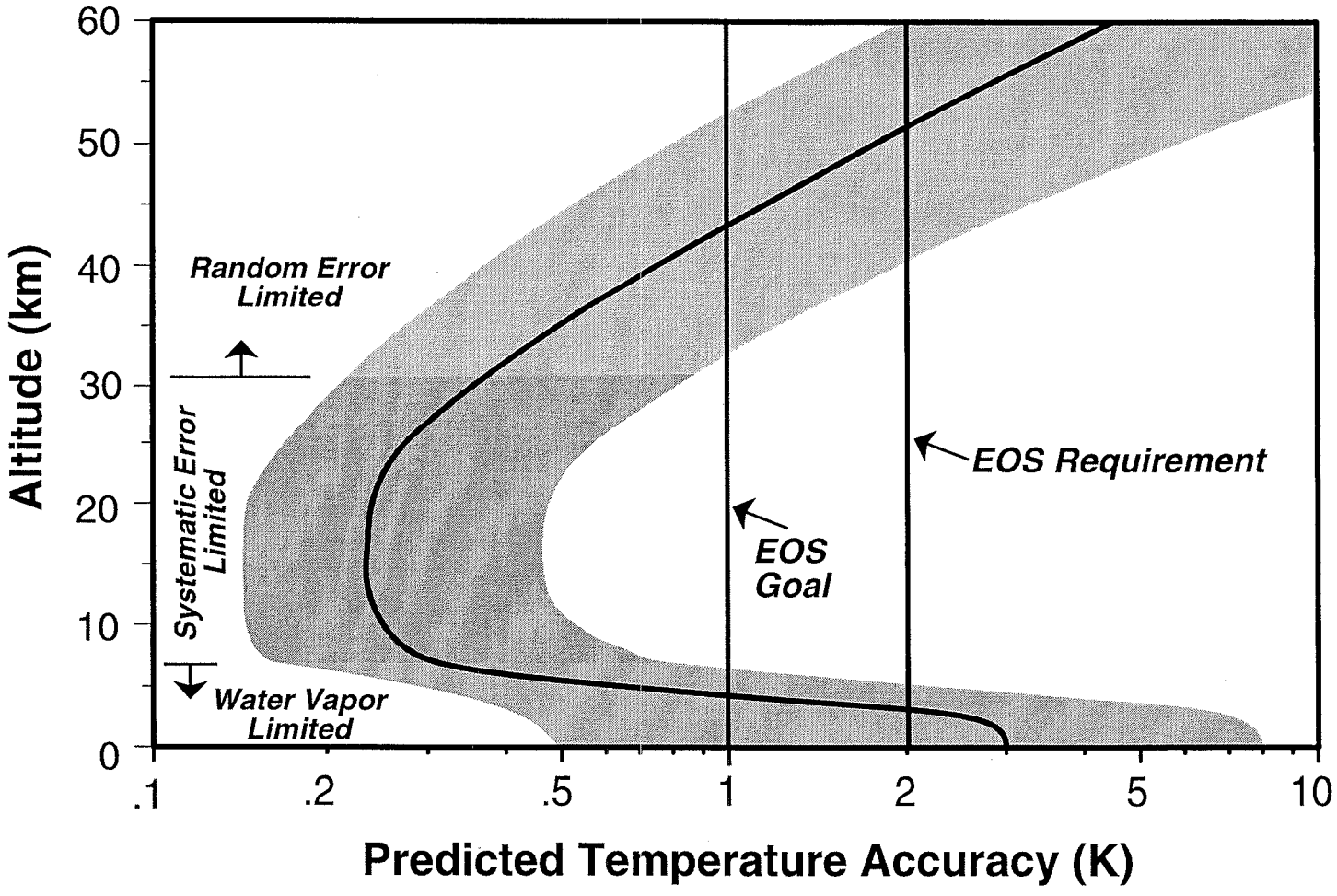
2: DETERMINE THE REFRACTIVE INDEX DISTRIBUTION FROM a(α) BY SOLVING AN INTEGRAL EQUATION.

3: COMPUTE VERTICAL NUMBER DENSITY PROFILE FROM REFRACTIVITY PROFILE.

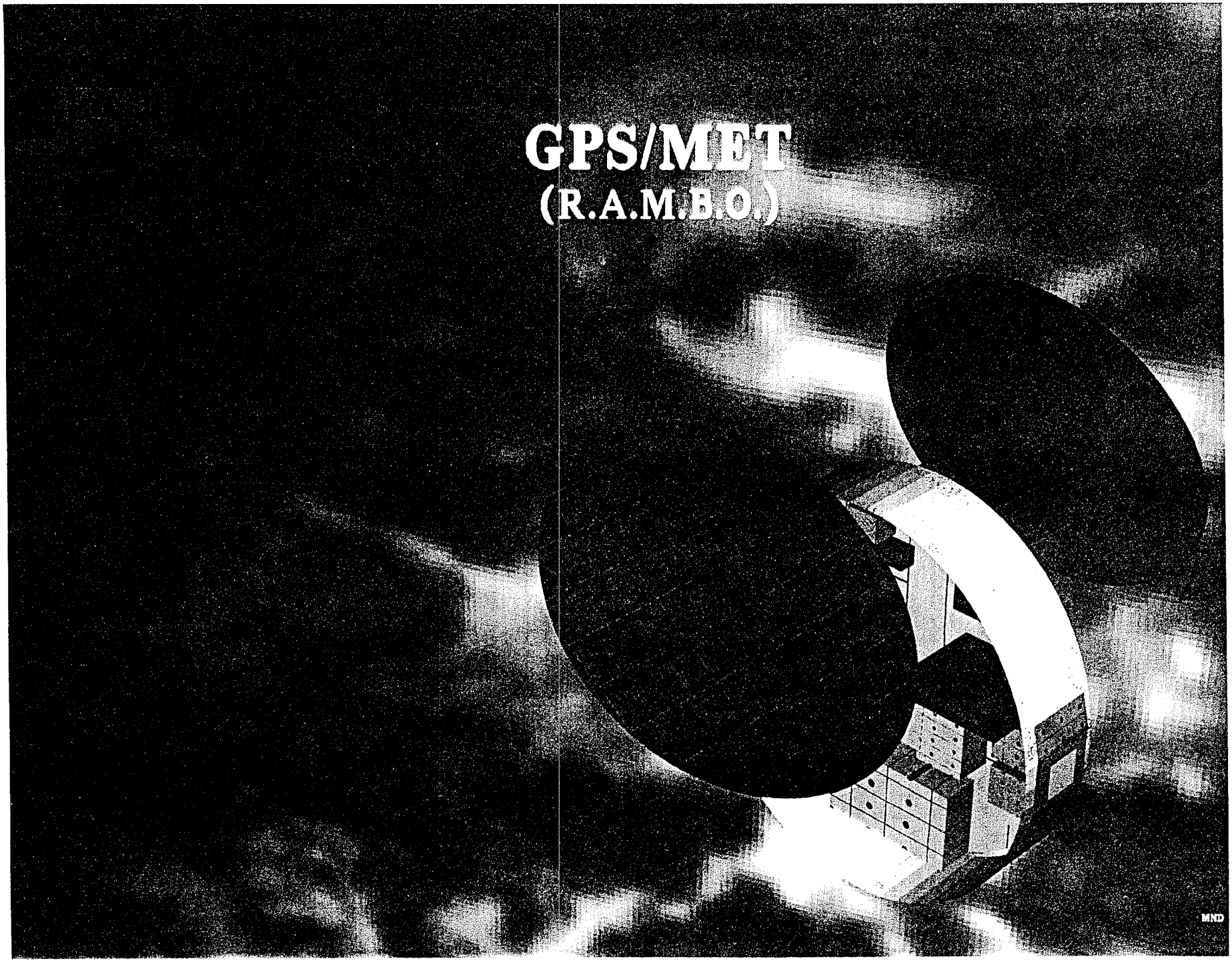
4: COMPUTE THE VERTICAL PRESSURE DISTRIBUTION BY INTEGRATING AIR DENSITY FROM THE TOP OF THE ATMOSPHERE DOWNWARD TO THE SURFACE.

5: FORM TEMPERATURE PROFILE FROM NUMBER DENSITY AND PRESSURE PROFILES USING THE EQUATION OF STATE.

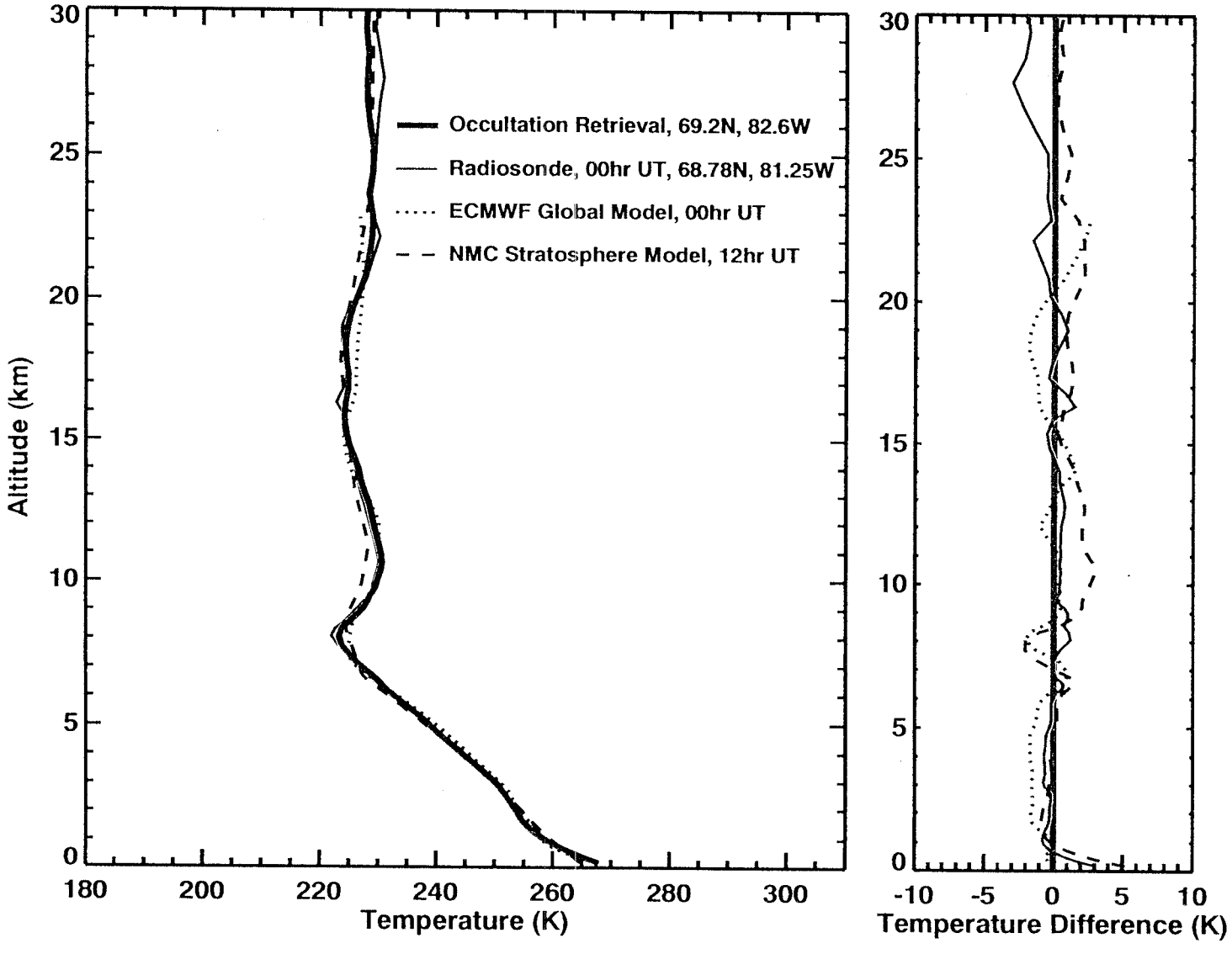
PREDICTED GPS-BASED ATMOSPHERIC TEMPERATURE ACCURACY



GPS/MET
(R.A.M.B.O.)



Hall Beach, Northwest Territories, 1995/05/05 at 01:33



JPL: Kursinski, Hajj, Bertiger, Leroy, Romans, Schofield et al. (7 July 1995)

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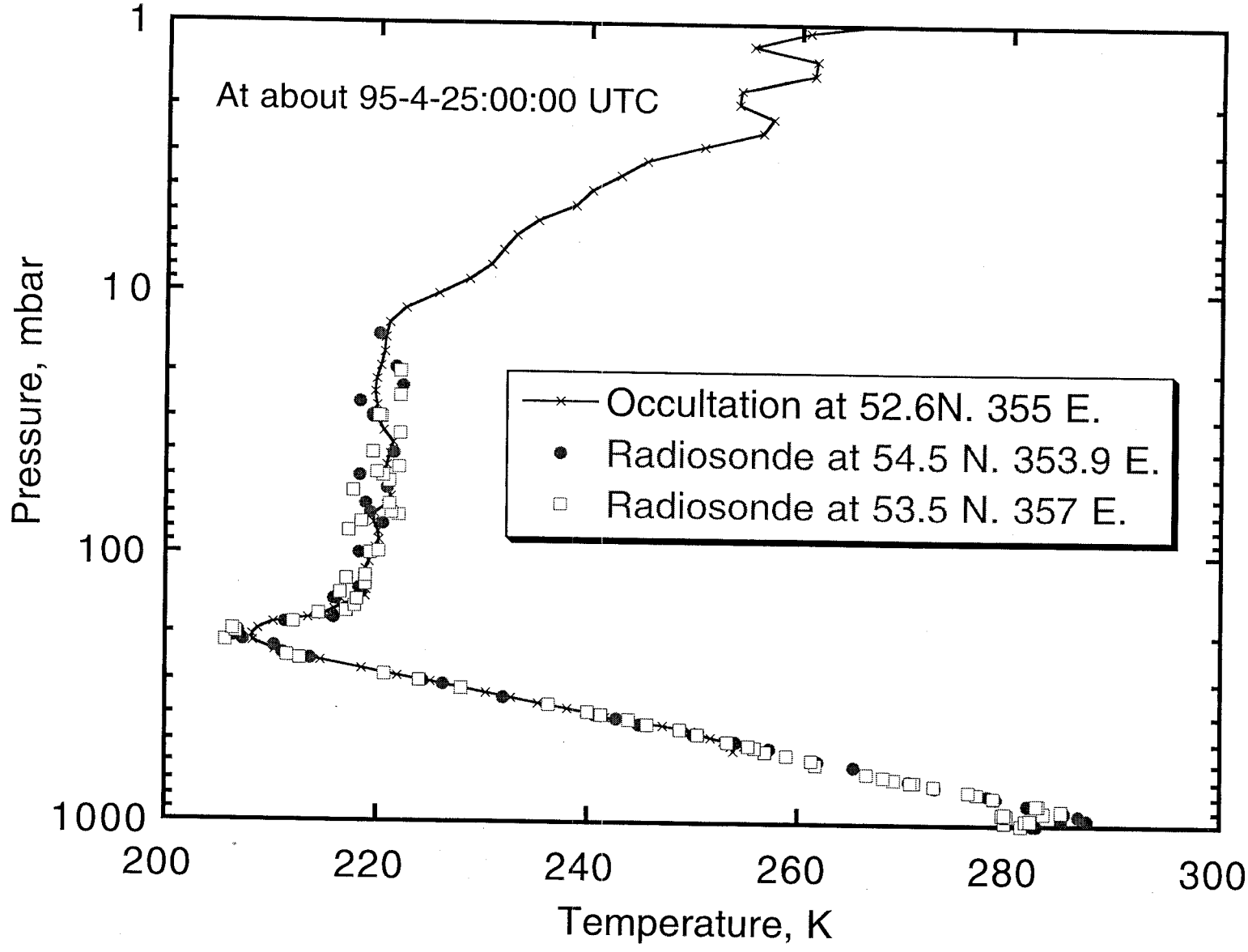
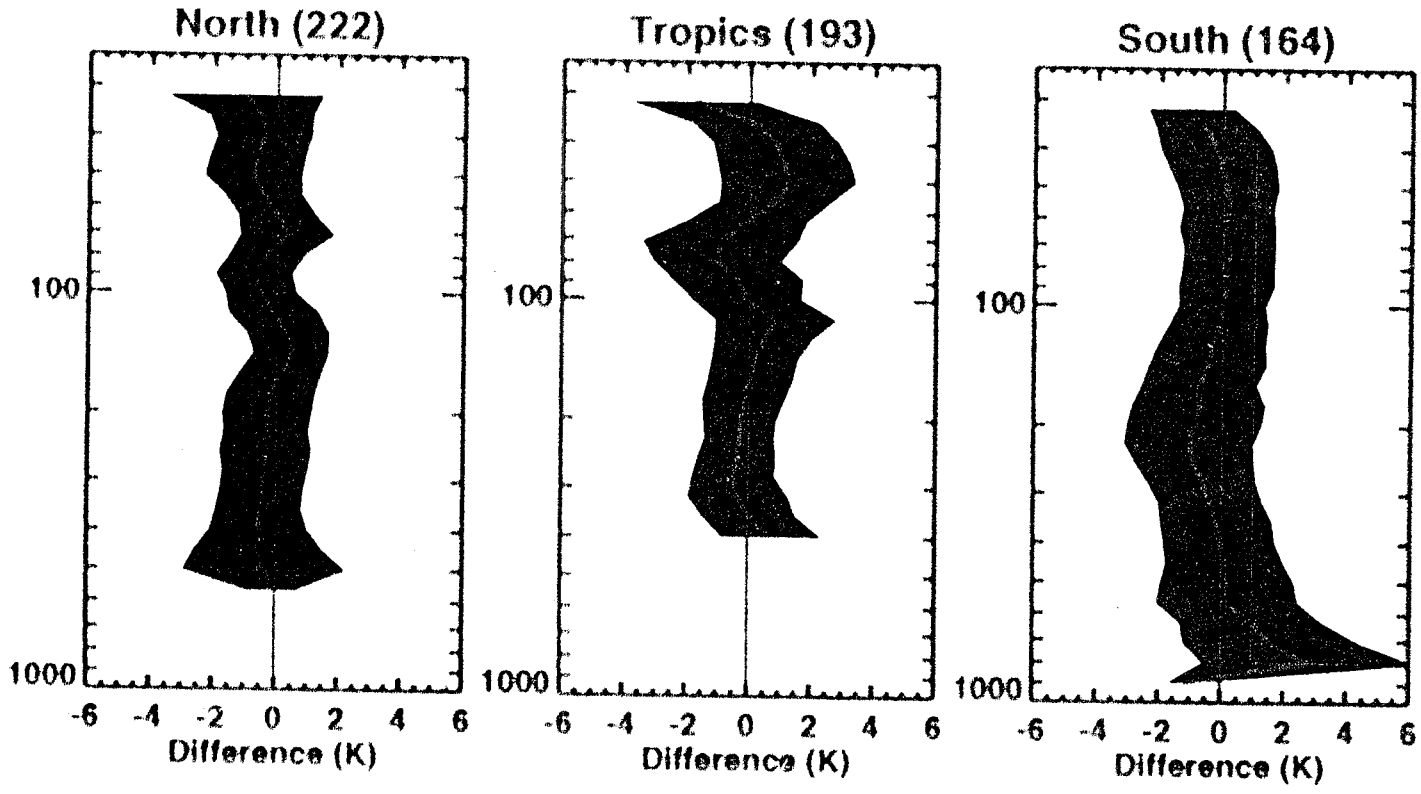
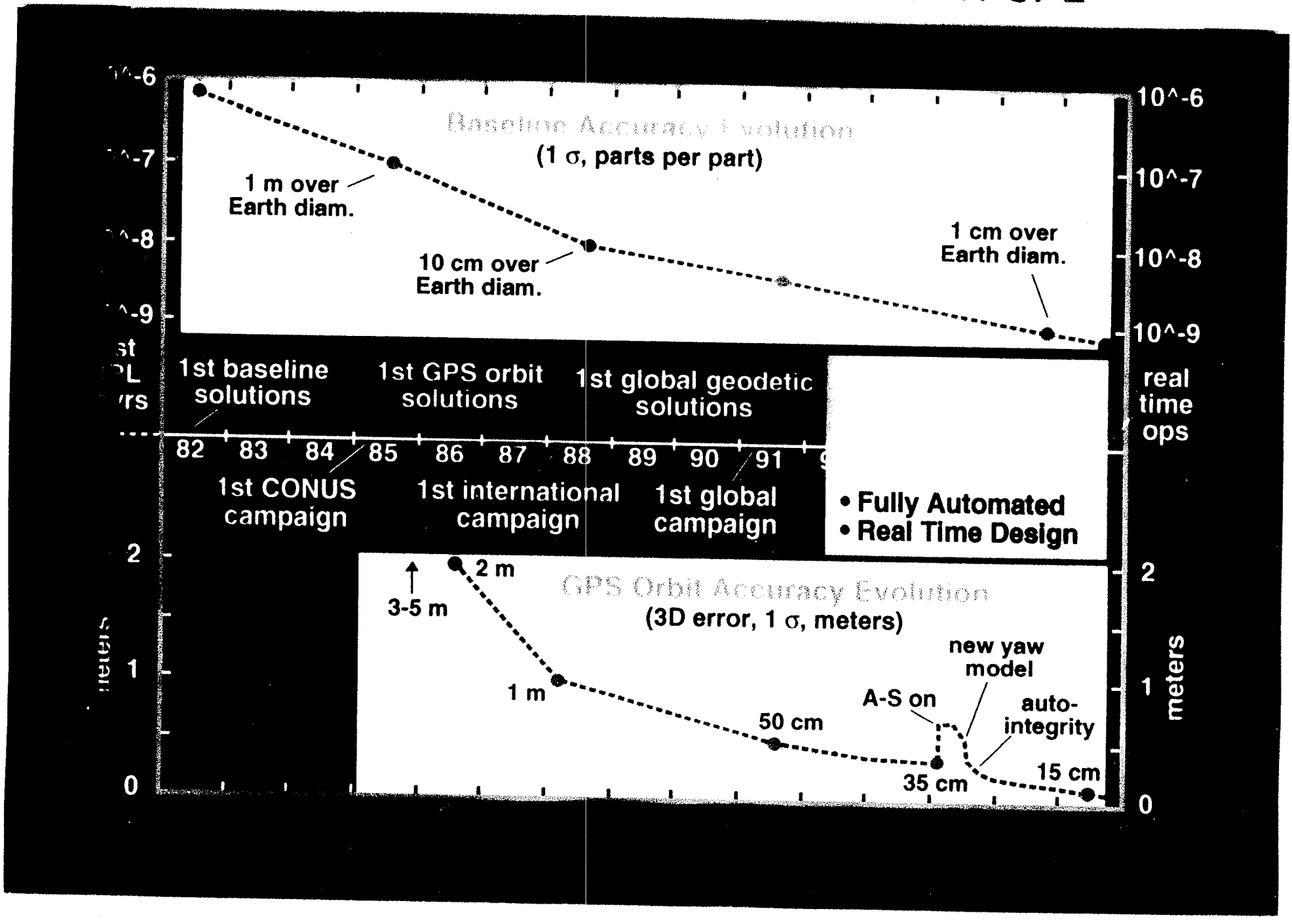
TEMPERATURE PROFILES NEAR ENGLAND



Comparison of GPS/MET Temp. Retrievals to the ECMWF Model

Summer AS-off Period



JPL: Kursinski, Hajj, Bertiger, Leroy, Romans, Schofield, et al. (8 December 1995)

15 YEARS OF DGPS OPERATIONS AT JPL