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N74-16006

(E74-10219) TERRAIN PROPERTIES AND TOPOGRAPHY FROM SKYLAB ALTIMETRY Monthly Progress Report, Dec. 1973 (Naval Research Lab.) 6 p HC $3.00 CSCL 08B

Unclas
G3/13 00219

Organization:	**Naval Research Laboratory**
Title:	**Terrain Properties and Topography from Skylab Altimetry**
Period Covered:	**Monthly Progress Report, December 1973**
EREP Number:	**EPN 363**
Contract Number:	**T-4716B**
Principal Investigator:	**Allan Shapiro**
Date Written:	**28 January 1974**
Technical Monitor:	**Larry York, NASA Johnson Space Center, Code TF6, Houston, Texas 77058**

The height analysis of SL-2 data over U.S.A. terrain has been completed. A summary of the analysis, results and preliminary conclusions is included.

The reflecting properties of the observed areas have been investigated and show that terrain in terms of radar returns can be classified roughly into three categories. The reflected radar energy from

1. Lakes is about 10 db above mean ocean returns,
2. Deserts, Valleys, Cities, and Plains is comparable to ocean returns, and
3. Hills, Mountains, and Forests is about 10 db below mean ocean returns.

The high relative radar return from terrain, where range lock is achieved, implies some specular reflection, i.e., reflection from a small smooth area ($< 10^4$ m^2) that is normal to incident radar signal. This is confirmed by preliminary statistical analysis of radar returns. However the specular component decreases as one changes from terrain of category 1 to category 3.

The waveform and statistical analysis of SL-2 will be completed by the next reporting period.

The following passes from SL-3 flight were received: 16 (GT 30), 17 (GT 44), 18 (GT 1), 23 (GT 31) 28 (GT 59), and 31 (GT 15/16). A quick look at the data indicates that the Skylab altimeter operated in all passes except pass 31.

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TERRAIN TOPOGRAPHY FROM SKYLAB ALTIMETRY

The Skylab Earth Resources Experiment Package (EREP) instrumentation includes a narrow pulse radar altimeter for measuring the height of the spacecraft along the sub-satellite ground track with a radar footprint of about 8 x 8 km over the earth's surface. While the altimeter was specifically designed to operate over the relatively small height and reflectivity variations of the ocean surface, it was proposed to evaluate the altimeter performance over land areas where large fluctuations of height and reflectivity may occur along the sub-satellite track. The objective of this experiment was to gain insight into the performance of this instrument over terrain and how applicable the derived information is to the topography and the physical properties of the areas along the spacecraft ground track.

On May 30, 1973 during the Skylab 2 mission, the altimeter was operational (ground track 20) as the Skylab approached the coast of Oregon and a series of height measurements were taken over 2.5 minutes in 1-second intervals. The range measurements were converted to topographic heights in the following four steps:

(1) System and atmospheric delays are subtracted from range measurements to obtain the effective range to sub-Skylab regions along the track.

(2) The spacecraft height is computed relative to a reference surface from the satellite ephemeris and corrected for geoidal height variations.

(3) The measured effective height is subtracted from the computed height to obtain the desired measured topographic height.

(4) A small residual height correction (8 m) is applied to all topographic heights to account for an apparent height bias of the spacecraft relative to the mean sea level. Thus the topographic heights are measured relative to mean sea level near the Oregon coast.

To evaluate the quality of the measured topographic heights, the corresponding topographic heights were obtained from geological survey maps for the same ground track. For each observation area, the minimum and maximum heights were established and the height that corresponded to the largest normal area within a given footprint was used as an estimate of the expected altimeter height.

The comparison between the measured and derived topographic heights are shown in Fig. 1. While in general, the altimeter measured height values correlate with the profile obtained from the topographic maps, there are several areas where the altimeter range tracker lost lock with a resulting loss of height data. This is primarily due to relatively sudden changes of height in mountainous regions which the range tracker cannot follow and/or relatively rapid changes in signal level caused by variations of the size of normal reflecting areas which cannot be accommodated by the automatic gain control. The loss of range lock is shown in Fig. 1 when the altimeter track crosses the coast line into a mountainous area. However as the height of normal areas become more uniform, the range tracker acquires lock but loses it again whenever rapid changes of topography occur. For areas where range lock is obtained, there is usually a close correspondence between the altimeter topogaphy and the topography obtained from maps. Preliminary analysis indicate that discrepancies are primarily due to (1) uncertainties of reading unique height intervals on the map and (2) the inability of the range tracker to follow rapid variations in height that exceed 100 to 200 m/s. In the latter case, if the range tracker locks, it will lock to the preceding range with a linear range rate increase due to the spacecraft motion.

These preliminary results indicate that a satellite altimeter can be employed for profiling land areas, but that it will need response times both in range and sensitivity that match the topographic and physical reflecting changes of the observed areas. The measured height will however relate to the larger horizontal areas within the normal footprint. Additional altimeter data is expected from SL-3 and SL-4 which will be used to confirm these initial conclusions and provide a larger data base over different areas, as well as determining signal level changes over the same areas due to seasonal variations of the observed surface.

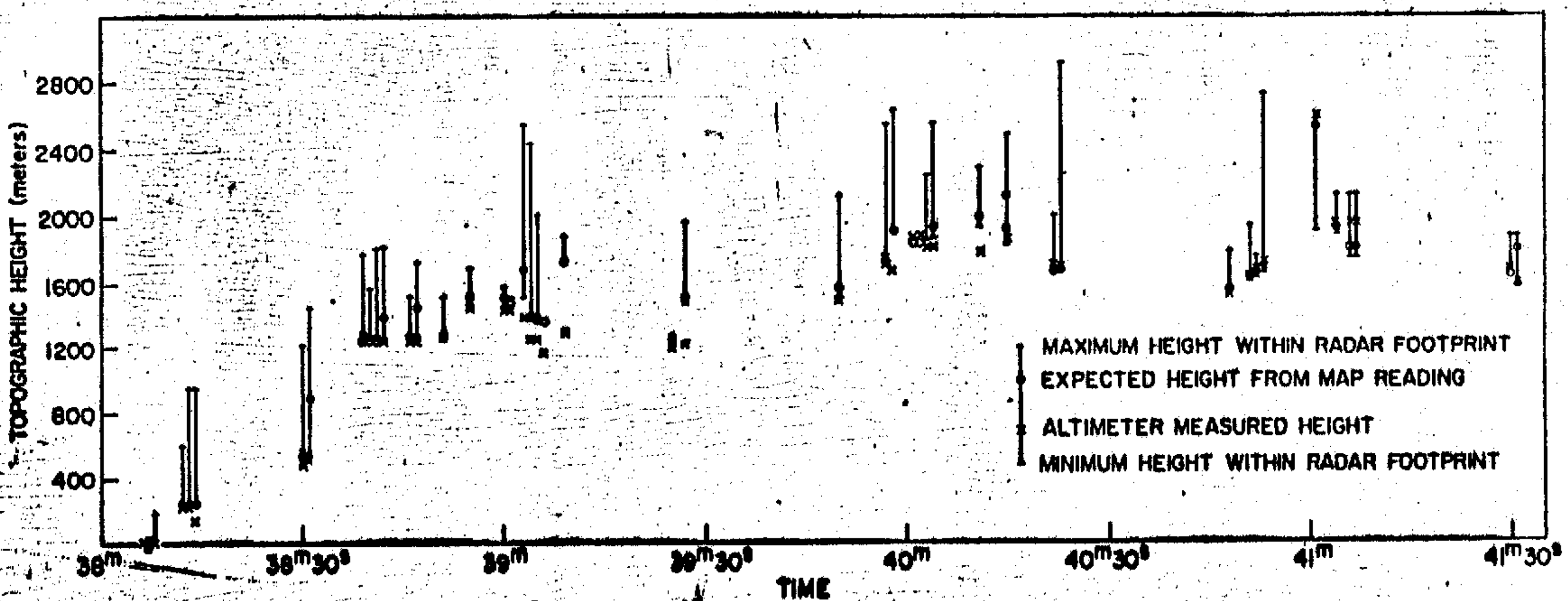
TOPOGRAPHIC HEIGHT (meters)
2800
2400
2000
1600
1200
800
400
38m
38m30s
39m
39m30s
40m
40m30s
41m
41m30s
TIME
MAXIMUM HEIGHT WITHIN RADAR FOOTPRINT
EXPECTED HEIGHT FROM MAP READING
ALTIMETER MEASURED HEIGHT
MINIMUM HEIGHT WITHIN RADAR FOOTPRINT

Figure 1