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TO: Contracting Officer, Code 245, NASA/GSFC
Technical Officer, Code 651, NASA/GSFC

FROM: Thomas O. Haig
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REFERENCE: Contract NAS5-21798

SUBJECT: Monthly Progress Report for "Studies of Soundings and Imaging Measurements from Geostationary Satellites"

Task A Investigation of Meteorological Data Processing Techniques

Recent activities on this task have been in the areas of processing, investigation of limb radiance profile characteristics, and verification testing.

Processing: Tapes with corrected line starts have been prepared for days 202, 203, and 204 of 1969 (ATS III data). As of the last quarterly report (May 1973), corrected tapes had been written for 16 images on day 204 and 7 images for day 203. Recently an effort to complete the 203 image set, which required corrections based on detection of the right hand earth edge, was unsuccessful. Transmission noise near this edge was so severe for day 203 that no choice of algorithm parameters was able to yield a stable earth edge detection. Data for day 202, 1969 was not so severely affected and corrected tapes (all based on the difficult right hand edge detection) have been prepared for 8 images.

Profile Studies: The investigation of limb radiance profile characteristics has been hampered by unexpected data quality problems. Our criterion for choosing data for this study is that the synchronizer errors be small. (The synchronizer error displayed on ATS 3 images represents the time differences between the detected sun pulse and the "smoothed" sun pulse output by the phase locked loop.) Small synchronizer errors indicate that the phase locked loop is tracking well and that line start timing errors are also small. Much of the older ATS III data shows the very small synchronizer errors indicative of accurate line start timing. For this reason, day 48, 1970 was chosen initially. This data was on analog tapes which had to be digitized prior to analysis. During digitizing it was discovered that the A/D refrence frequency on the analog tape was not stable. This caused enormous line to line jitter in the digital data and made it unusable for analysis.

After this experience, we chose a data set which was at least partially available on digital tapes, and also had low levels of synchronizer

error. Day 131, 1970 was chosen. The digital data available covered the latter part of the day from 2106 GMT to 2408 GMT (0008 GMT, day 132). This restricted our analysis to profiles of the left hand limb only. Profiles averaged over 50 scan lines were obtained for seven images for latitudes 10°N, 20°N, 30°N, 40°N and 50°N. Corrections were applied to compensate for changes in scattering angle, and for the inclination of the scan lines relative to the normal to the earth's surface at the limb. The resultant profiles show unexpectedly large variations which are inconsistent with our earlier results (for day 204, 1969) which showed considerable success in tracking landmark shifts from frame to frame. The largest variations occur in latitude and are unexplained at present. In order to understand these variations and to verify that programming or navigation errors are not responsible, it is necessary to expand the study to include data which shows both left and right earth limbs illuminated. In order to meet this requirement, 131/70 data covering the time period from 1610 GMT to 1928 GMT (10 images) has been digitized. We are now in the process of navigating these images prior to analysis.

Verification Tests: Although obvious data timing improvements in the corrected tapes can be seen by comparing time sequence TV displays of raw and corrected data, we nevertheless need to make the comparison on a quantitative basis. We are currently using wind sets derived from corrected data and wind sets derived from raw data to make this comparison. For each comparison three images at time t_1, t_2, and t_3 are used for each data type. Cloud tracers are selected separately from each data type, although overlays are used to keep the distribution of tracers approximately the same. Winds are derived from cloud motions between t_1 and t_2 and between t_2 and t_3. The differences (residuals) between these two wind sets are a measure of the quality of the derived winds. Many factors can influence these residuals, including cloud tracer characteristics, navigation accuracy, noise, and line start timing stability. The last factor has significant effects on only the U-component (east-west component) of the residuals. Tests so far show that the U-component residuals are more sharply peaked for winds derived from corrected data than they are for winds derived from raw data. The raw data winds also show latitude bands of large residuals which are absent from corrected data winds. Full details will appear in the final report.

Task B Sun Glitter

No significant effort on this task during the reporting period.

Task D Cloud Growth Rate

During June, we received the multiple scattering program from J. Hansen of NASA, GISS, New York, which will be used as a basis for a cloud brightness normalization procedure. There have been several problems in adapting this program for the UW computer. These problems have included: 1) having to repunch the program cards so that they will be

compatible with the UW computer; 2) supplying system routines for Gaussian quadrature numerical integration which were not part of the UW computer system; and 3) reducing the program core requirements to fit the UW computer. In addition,to the work on the normalization procedure, a literature search parameterization of convection has been started.

Task E Comparative Studies in Satellite Stability

The coding for the Univac 1108 for this task has nearly been completed. The angular velocity responses for several typical satellite configurations have been plotted in our Calcomp plotter to test the program. Results are exactly as expected indicating basic program validity. The response of the individual sensor sub-assemblies inside a satellite is being programmed now, and is expected to be completed soon.

Task F High Resolution Optics Study

Work on the study of meteorological uses of SEOS continues, with a final report due at the end of July. During June, Professor Suomi visited GSFC to report on program activities through the end of May. The basic program (outlined in last month's report) was approved with the recommendation that a strong emphasis be placed on meteorological uses unique to SEOS which no existing system can supply. Additionally, some emphasis will be placed on the value of quick dissemination of information to the public. Activity during June centered on refining the work of the student seminar to adequately parameterize developing weather systems. We are now defining a monitoring system capable of measuring those parameters to the necessary accuracy and on the appropriate time and space scales. During July, an observation system will be defined in which the unique value of SEOS will be emphasized.