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Geologic Application of thermal inertia mapping from satellite

Type II Progress Report
March - May 1978

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15. Supplementary Notes

16. Abstract

There were two significant results from this reporting period. A theoretical evaluation of the proportional and linear relationship between absolute and relative thermal inertia was performed and a potentially more accurate expression for absolute thermal inertia mapping was proposed. Preparations were made for the field trip to the Powder River Basin in July.

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Figure 2. Technical Report Standard Title Page

A. Problems

Our investigation has been impacted by the loss of the two technicians who maintained and operated the thermal scanner and field equipment. Training the new personnel has been time consuming; but we still anticipate being ready to acquire low-altitude aircraft thermal data and to deploy our ground monitoring crews at selected sites in the Powder River Basin in July/August during times of selected satellite overpasses. If this also coincides with the U2 flights a unique data set can be acquired.

B. Accomplishments

Our investigation has focused on two areas: further evaluation of the thermal model and preparation planning for the USGS aircraft flights and field support.

We have re-examined the theoretical basis for the realtionship between absolute thermal inertia and "relative" thermal inertia. The proportional approximation proposed by Price is satisfactory under certain conditions but the linear approximation derived from our previous modeling studies was found to be more accurate. Our most recent analysis suggests a much more accurate form:

$$P_{abs} = \alpha \cdot P_{rel} + \beta \cdot P_{rel}^{-1}$$

where $P_{rel} = (1-A)/\Delta V$

ΔV = day-nite temperature difference

A = albedo

α, β - coefficients which are functions of site parameters and topography.

A least squares comparison among these forms, based on a limited set of site parameters indicates that the non-linear form has a 5 times smaller

error than the linear and a 25 times smaller error than the proportional form.

This expression for absolute thermal inertia will be tested using the HCMM data.

In preparation for comparing low-altitude thermal-inertia products to those produced with satellite data, we have performed an analog to digital conversion on USGS scanner data over a portion of Cabeza Prieta in Arizona. We are in the process of geometrically registering the daytime images to the nighttime as the next step in producing the relative thermal-inertia image.

The field equipment, consisting of radiometric and meteorological instrumentation and recorders, has been modified to be field portable. The recorders have been calibrated, and all instruments appear to be functioning properly. We are also in the process of acquiring a normal incidence pyrheliometer modified with a silicon detector; this instrument will be used to measure the direct component of the solar radiation in the same spectral bandwidth as HCMM. In addition, we have made arrangements to borrow a rocketsonde and receiving station; the rocketsonde will be used in conjunction with ground measurements to obtain temperature and humidity profiles for atmospheric transmission modeling in the thermal IR region.

The objectives planned for the next quarter will include the preflight preparation (flight line selection, scanner calibration, ground crew cordination), site selection and development of ground stations, and the mission overflights. In addition we will be examining the first HCMM screening products and plan to place orders for appropriate data.

C. Significant Results

The significant results from this reporting period are:

- Theoretically evaluated the proportional and linear relationship between absolute and relative thermal inertia and proposed a potentially more accurate expression for absolute thermal-inertia mapping.
- Prepared ground support equipment for the field trip to the Powder River Basin.

For details of these results, see the accomplishments section.

D. Publications & Presentations

Ken Watson made a presentation at NASA Headquarters review on March 29, 1978 on background studies and future applications of thermal inertia mapping.

E. Recommendations

At the HCMM program review discussions occurred about the value of extending the program for at least one or two years. We strongly support this need both to complete analysis of data acquired late in the mission and to support integration of these studies with other thermal satellite data including LANDSAT-3 and Tiros-N.

F. Funds Expended

Total expenditures to date: $14,175

G. Data Utility

No U2 or satellite data have been made available to us.