Biographical Sketch

Since 1968 Vincent V. Salomonson has been working for NASA as a research meteorologist in the Laboratory for Meteorology and Earth Sciences, Goddard Space Flight Center, Greenbelt, Maryland. Prior to working for NASA he served as a weather officer in the U.S. Air Force doing weather forecasting for the Strategic Air Command in Newfoundland, Louisiana, and Mississippi. He received a B.S. in agricultural engineering from Colorado State University in 1959, a B.S. in meteorology from the University of Utah in 1960, an M.S. in agricultural engineering from Cornell University in 1964, and a Ph.D. in atmospheric science from Colorado State University in 1968. He has performed research in several areas including the leaching of saline-alkaline soils, erosion magnitudes under furrow irrigation practices, agricultural meteorology and plant climate, radiative transfer and, in particular, anisotropy in reflected solar radiation, satellite meteorology as applied to observations of jet streams, sea surface temperature, cloud statistics, and ozone, and hydrological observations from Nimbus satellites.

Nimbus 3 and 4 Observations of Snow Cover and Other Hydrological Features in the Western Himalayas

by

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Several of the great rivers of the world begin their flows to the seas in the Himalayan region of southern Asia. Since much of this region is often inaccessible, programs are underway to assess the possibility of monitoring its hydrological features via satellite observations. A series of photographs from the Nimbus 3 and 4 Image Dissector Camera Systems (IDCS), the Nimbus 3 High Resolution Infrared Radiometer (HRIR), and the Nimbus 4 Temperature-Humidity Infrared Radiometer (THIR) has been collected to illustrate and demonstrate the application of these data in observing snow cover and other hydrological features in the Western Himalayas. This collection of imagery shows the relative merits of daily observations of these features in the visible, near infrared (0.7-1.3 μm), and far infrared (10-11 μm) portions of the electromagnetic spectrum with sensors having nominal spatial resolutions between 4 and 8 kilometers. Particular emphasis has been placed on observing features associated with the Indus River because of the economic and social importance of this river in the lives of millions of people.

The resolution and spectral response of the IDCS made it the best system available on Nimbus 3 and 4 for mapping the areal extent of snow cover over the Indus River watershed. This parameter has been measured in terms of the percent of the watershed covered and graphically related to the mean monthly runoff observed at a stream gauging station near the northern border of West Pakistan. The areal extent of the snow cover was assessed on 10 different days during the period from April 1969 to April 1971. As can be seen in Figure 1, during the period of major snowmelt from April to late July 1969 very good agreement between the monthly mean runoff and the snow cover is evidenced. Further efforts to study the stability of this result during the 1970 snowmelt season are in progress.

The contrast between the reflectivity of water and the reflectivity of neighboring vegetation and soil surfaces in the near infrared make the Nimbus 3 HRIR daytime observations very useful in observing the courses of rivers and the locations of lakes in the Tibetan region. As illustrated in Figure 2, nearly the entire course of the Indus River can be observed during cloud free conditions. The paths of many other rivers and many lakes in Tibet can also be easily seen.

The Nimbus 4 THIR monitors the radiation emitted in the 10-11 μm region and thereby permits observations of cloud top temperatures and subsequent estimates of the amount of convective activity occurring over large regions. Figure 3 shows that the extent and character of cloudiness over the Himalayas can be assessed and estimates made of the impact of monsoonal rainfall on Indus River flow.

The overall results of this pilot study clearly indicate that it is feasible to monitor quantitatively the extent of the snow cover over the Indus River watershed during a given year and from one year to another using meteorological satellite imagery that is available on a routine and continuing basis. These observations, in conjunction with other observations taken in the near infrared and far infrared, appear to offer a potentially valuable input for water management systems where conventional observations are either not available or are very costly and difficult to obtain.

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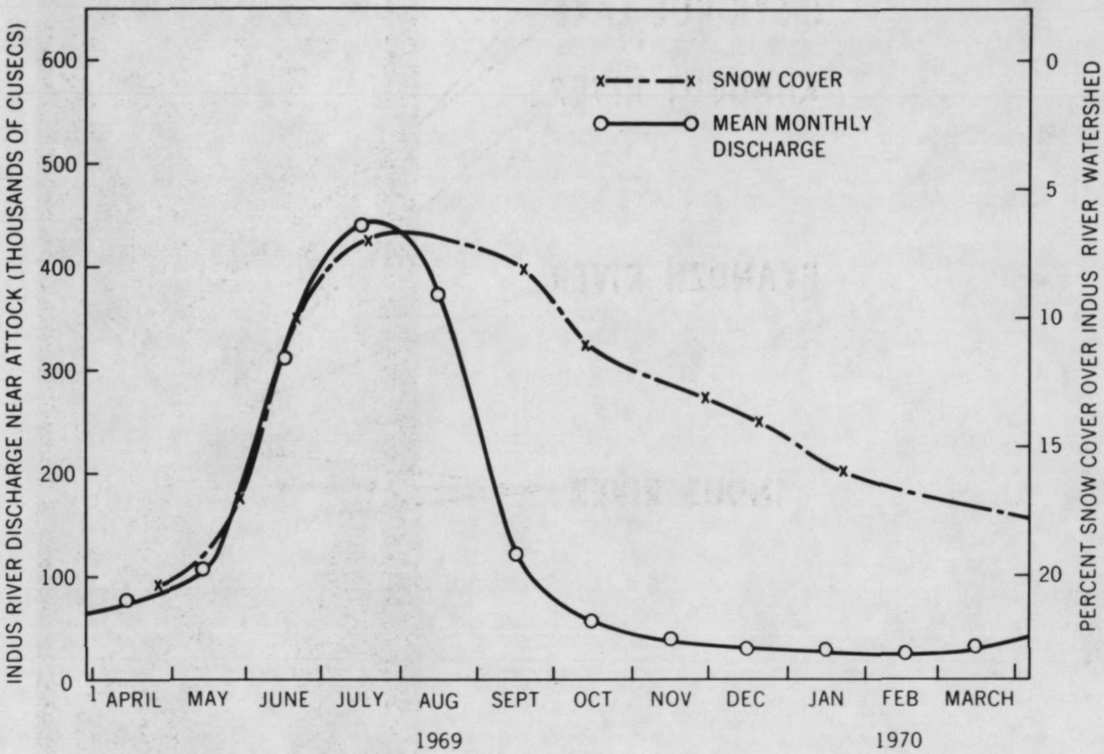

Figure 1. A plot showing the relationship between the percent snow cover over the Indus River watershed and the mean monthly discharge in the Indus River near Attock in West Pakistan. The snow cover area was obtained from the observations of the Nimbus 3 and 4 Image Dissector Camera Systems.

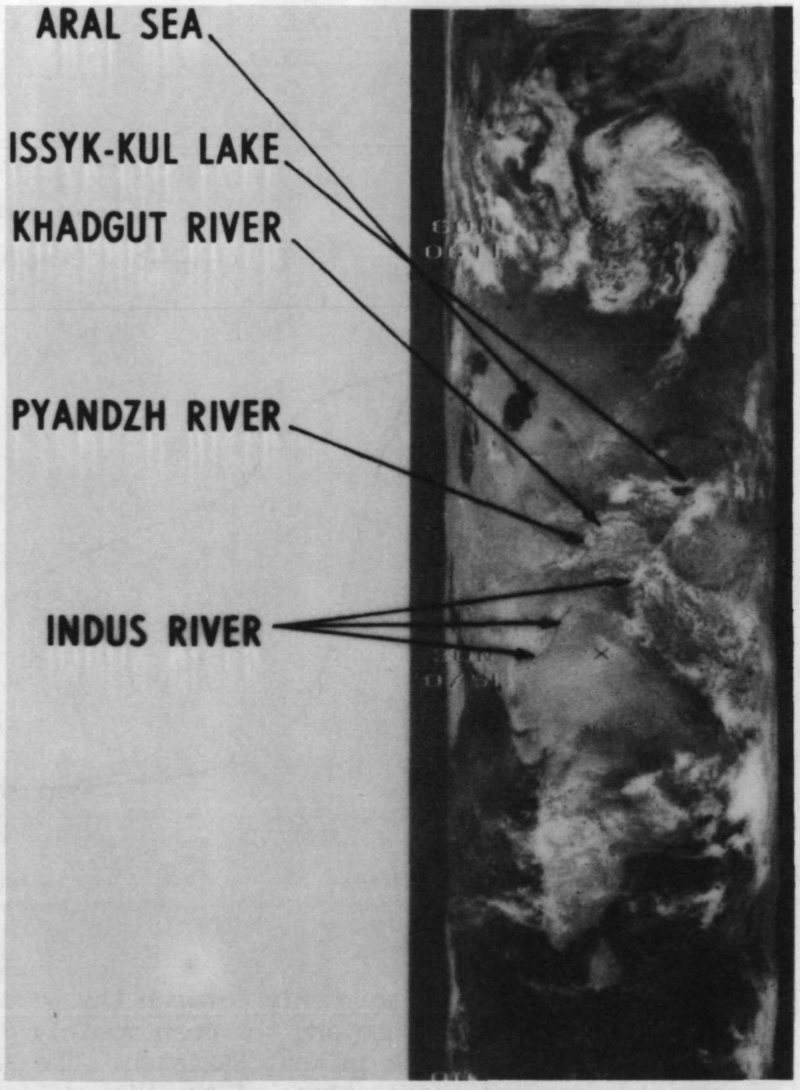

Figure 2. Nimbus 3 High Resolution Infrared Radiometer (HRIR) daytime photofacsimile picture taken over the Himalayas and adjoining regions on orbit 911, 21 June 1969. The spectral response of the HRIR during daytime observations is predominantly in the 0.7-1.3μm region.

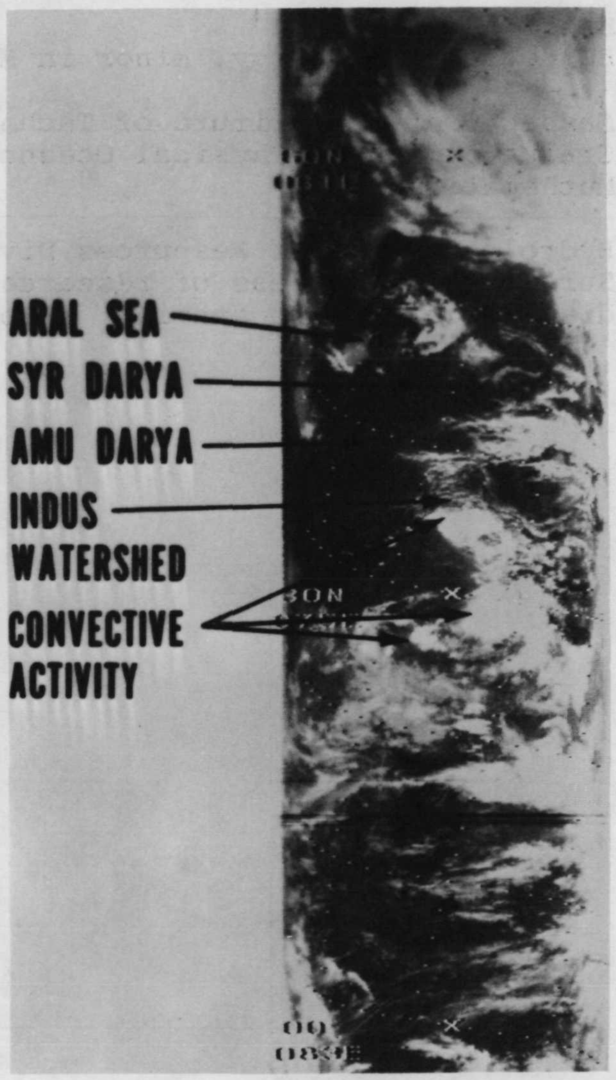

Figure 3. A Nimbus 4 Temperature-Humidity Infrared Radiometer (THIR) 10-11$_{u}$m photofacsimilie picture of the region over and near the Himalayas taken on orbit 1087, 28 June 1970.