ISLSCP: International Satellite Land-Surface Climatology Project^{1,2}

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More than 100 geophysicists and space scientists, drawn from a variety of disciplines and from 22 countries, deliberated in two week-long workshops held in Boulder, Colorado (United States) and Innsbruck (Austria) and in a two-day briefing session in New Delhi (India) this summer as part of the United Nations Environment Program (UNEP) supported International Satellite Land-Surface Climatology Project, within the World Climate Impact Studies Program.

The principal motivation for such a project comes from three important considerations: 1) both climate induced and man-made changes on the earth's surface are known to be large and of profound significance; 2) satellites are ideally suited to measure these changes globally and over long-time scale (years, decades); 3) but there is currently no uniform methodology to derive consistent surface cover information from radiances measured by currently operating satellites.

The purpose of the workshops was to define a program of research which would lead, within five years, to agreed upon methodologies for converting satellite measured radiances into quantitative data concerning the earth's surface. There are two purposes for developing standard algorithms. First, by applying them to satellite data already available since 1972 and to those which are being acquired now, we can strive to establish, by 1992, not only a 20-year homogeneous data set of normalized radiances, but also of surface variables such as extensions of range land, vegetation cover, forest, deserts, snow cover, and ice sheets. Second, as soon as these algorithms have been developed, evaluated, and standardized, we would hope that the agencies which operate satellites such as NOAA, Meteosat, and Landsat would incorporate them in their routine and operational procedures. A continuous monitoring of the state of the land surface and the extent of the vegetation cover over the whole globe and especially over climatically vulnerable regions would then become possible.

This should, in turn, lead to furthering our understanding of land-surface climate feedback process.

Vegetation cover is the variable which is of greatest susceptibility both to the climatic fluctuations and human activities. Vegetation cover also has a direct bearing on the life of man on earth. A precise monitoring of seasonal and year-to-year changes in the extent and type of vegetation cover over large areas of the globe is probably the single most important objective for a program which seeks to assess the impact of climate on man and visa-versa. Climatic fluctuations also change the extent of snow cover and ice sheets; natural climatic fluctuations along with human activity also affect the soil humidity and the boundaries of the desert. At the same time, these very changes on the earth's surface can themselves influence the climate of a region or even the globe. They certainly affect the energy and momentum transfer between surface and atmosphere as well as the soil hydrology. A program for quantitative monitoring of these parameters, on a routine basis, is therefore essential for both climate impact and climate change studies. Both of these are elements of the World Climate Program.

Currently, satellites appear to be capable of measuring a few of these land-surface variables with some precision; none of the parameters, however, is determinable with high enough consistency and accuracy that a long-term history of changes on the earth's surface can be documented. A careful assessment of the state-of-the-art of space technology at the workshops indicated that although the satellite sensors have become quite sophisticated, many important fundamental problems have yet to be solved satisfactorily before the radiances measured at the satellite could be adequately interpreted in terms of changes in surface properties of the earth. These problems include the lack of ancillary observations to make adequate corrections for atmospheric scatter, absorption, and emissions in the spectral bands of interest, satellite-to-satellite calibration to maintain coherency of the long-term data fields, corrections for angle of view, and above all, simultaneous ground measurements over large enough areas to cover adequately the field of view of the satellites. In spite of the fact that some ten years of quantitative satellite observations are available, these problems have not been solved to the extent required. It was the conclusion of the workshops that now we understand the problems well enough to plan an initial program to solve them.

The major recommendation of the workshops were to initiate a program with the following components:

- 1) Evaluation of retrospective satellite data (starting from July 1972 when Landsat-1 became operational) to demonstrate whether they actually can be used to detect climate-related or man-induced changes on the surface of the earth quantitatively. (It has already been demonstrated that changes can be detected.)
- 2) Validation of current satellite-based information with carefully planned ground-truth campaigns in a number of different types of regions, and also compare different

¹ For a copy of the full report of the workshops, please write or call: Stan Ruttenberg, NCAR, P.O. Box 3000, Boulder, CO 80307, U.S.A. (303) 497-1658.

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methods of extracting quantitative information from satellite observations.

- 3) Preparation for an operational phase involving testing of the selected information extraction algorithms for converting the measured satellite radiances to surface albedo, moisture content, vegetation indices and the other physical quantities needed by climate modellers and for impact studies.

At the workshops, the participants identified 15 candidate sites where large changes in surface properties are known to have taken place during the last decade and therefore were ideal for quantitative evaluation of retrospective satellite data. These include, for example, Bangladesh (tropical deforestation), Egypt (overgrazing), the Sahel (drought), Haiti (deforestation and soil erosion), Southwest United States (climate fluctuations), and Northwest Canada (ice cover change).

It was agreed that ISLSCP would promote studies over such areas by competent scientists using not only Landsat but NOAA, Meteosat, and GOES, specify the evaluation and intercomparison procedures, hold workshops specifically to intercompare results obtained by the participating groups, and draw lessons from these studies. This activity is planned to begin in early 1984 and come to fruition of its initial phase in mid-1985. At that time ISLSCP would start the preparatory work for the selection of algorithms, which would eventually be recommended to the satellite operating agencies so that they can routinely convert the down coming stream of radiation data into information on land surface properties.

By 1985 the planning for coordinated ground truth campaigns will be completed also. In these campaigns, simultaneous over-pass of satellites such as NOAA, Landsat, and SPOT will be used in conjunction with measurements at the surface to calibrate, validate, and interpret satellite-measured

radiances in terms of physical parameters on the ground. These campaigns should be part of on-going activities such as the First ISCCP Regional Experiment (FIRE) in the United States and (PATAC) in France. This experimental program will commence in 1986 and will eventually merge into a quasi-permanent quality control activity in which carefully selected "anchor stations" on-ground will be used to validate satellite observations repeatedly in space and time. Also, by 1986 a project manager will be appointed who, with help of the ISLSCP Steering Committee, will lead the project into its operational phase. Throughout this program, close contacts will be maintained with the climate modeling community to insure that the analysed satellite data will serve their needs and that there will be available models of land surface processes suitable for relating the ISLSCP data sets to fundamental climate processes.

In summary, at this set of three workshops, it was abundantly clear that satellites can be a major tool to really assess globally the impact of climate and of man's activity on the character of the surface of the earth. It was also clear that if the satellites are to be an adequate tool, then one has to "calibrate" them with ground "truth" repeatedly in time and in space, and one scientist's interpretation of the measurement has to be compared with that of other workers. Only then can one visualize a homogenous and authentic data set which can be used to assess quantitatively key parameters for climate studies. It was agreed that if this objective is to be accomplished before the end of the decade, the evaluation, and validation studies as described briefly here must start at once because all the ingredients to initiate such a program are available now: more than a decade of satellite data, improved models of land surface-atmosphere interactions, ground observations at key locations, competent scientists and, very importantly, the motivation of appropriate international agencies to coordinate such an activity on a global scale. ●

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pilot program, which began collecting samples in 1980, is located at the National Bureau of Standards (NBS) in Gaithersburg, Md., and sponsored by the Environmental Protection Agency (EPA). It has concentrated on collecting two types of specimens, human liver tissues and marine mussels, which were chosen for their tendency to accumulate environmental contaminants. The West German researchers announced that their country intends to proceed with plans to establish a large-scale, permanent environmental specimen bank, beginning early in 1985. Future plans for the American project are still under discussion.

Thunder data available

As part of a recently completed National Science Foundation (NSF) project, thunder-day data for the 1901–80 period have been obtained for about 360 weather stations around the world. These data were acquired for a study of temporal trends in thunder-day activity on a global scale, with particular emphasis on North America. Carefully evaluated to eliminate questionable records, these historical data show, for each station, the monthly number

of days of thunder for each year from 1901 to 1980. Further information on the research is available in the AMS publication *Preprint Volume of 13th Conference on Severe Local Storms*.

A list of the stations, and the length of quality records available for each, can be provided upon requestor. Copies of the computer tape (nine track, 10-inch tape in EBCDIC format) containing the data can also be provided for copying and shipping costs. To obtain the data, as well as a final report on the project, contact Stanley A. Changnon, Jr., Chief, Illinois State Water Survey, Box 5050, Station A, Champaign, IL 61820.

meeting of interest

9–13 April 1984: The Centre National d'Etudes Spatiales (CNES), the French space agency, is conducting the international symposium "Satellite Aided Search and Rescue, Experimental Results

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