SCALE PROBLEMS IN HYDROLOGY

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Runoff Generation and Basin Response

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PREFACE

A special workshop on scale problems in hydrology was held at Princeton University, Princeton, New Jersey, during October 31-November 3, 1984. This workshop was the second in a series on this general topic. The proceedings of the first workshop, held in Caracas, Venezuela, in January 1982, appeared in the *Journal of Hydrology* (Volume 65:1/3, 1983). This book contains the papers presented at the second workshop.

The scale problems in hydrology and other geophysical sciences stem from the recognition that the mathematical relationships describing a physical phenomenon are mostly scale dependent in the sense that different relationships manifest at different space-time scales. The broad scientific problem then is to identify and formulate suitable relationships at the scales of practical interest, test them experimentally and seek consistent analytical connections between these relationships and those known at other scales. For example, the current hydrologic theories of evaporation, infiltration, subsurface water transport and water sediment transport overland and in channels etc. derive mostly from laboratory experiments and therefore generally apply at "small" space-time scales. A rigorous extrapolation of these theories to large spatial and temporal basin scales, as mandated by practical considerations, appears very difficult. Consequently, analytical formulations of suitable hydrologic theories at basin wide space-time scales and their experimental verification is currently being perceived to be an exciting and challenging area of scientific research in hydrology. In order to successfully meet these challenges in the future, this series of workshops was initiated.

Even though the scale problems described above can be safely speculated to manifest themselves in most, if not all, components of the hydrologic cycles, the papers in this book mostly concern themselves with process of runoff generation and structure of the runoff hydrographs from different subbasins of a basin, including the basin itself. Typically the various papers presented in this book consider one or more aspects of spatial variability in river basins due to geology, channel network geomorphology, soil and vegetation and space-time variability in the climate via rainfall in formulating and testing relationships at large scales, governing runoff generation from hillslopes and the structure of basin hydrographs.

New theoretical advances in the descriptions of hydrologic processes at large scales require developing testable hypotheses and performing suitable experiments for testing these hypotheses. These issues pose problems whose solutions mandate that a group of scientists of some critical size from all over the world participate in both experimental and theoretical aspects of the scale problems and meet periodically in taking stock of the progress as well as identifying outstanding problems. We hope that these workshops will motivate a greater interdisciplinary participation from the international scientific community in this very important area of hydrologic science.

The four days of workshop provided an opportunity for an exciting and free exchange of ideas and long useful discussions. We thank Princeton University for its hospitality and the University of Mississippi for its administrative support. The hospitality and help extended by the Utah Water Research Laboratory at Utah State University during the final stages of preparation of this book are gratefully acknowledged. This workshop was supported by the National Science Foundation through grant CEE-84-17682 and by the Army Research Office through grant 22323-GS-CF. Sincere gratitude is expressed to these two agencies for without their support this workshop would not have been possible.

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