〈轉 載〉

1979~1982 水文學 分野別 發展報告

美國地球物理學會編

美國地球物理學會(American Geophysical Union)에서는 4年에 1回씩 水文學의 各分野에 대한 發展(主로 學問的)에 대한 評價를 實施하고 있으며 이를 IUGG(International Union of Geodesy and Geophysics)의 총회에 報告하고 있다. 이의 內容은 水文學 全般, 頻度分析, 地表水文學(On-line 推定), 地表水文學(流出模擬發生), 都市水文學, 水理動力學模型, 非飽化흐름, 地下水水文學으로 區分되고 있으며 各分野別 評價와 함께 參考文獻을 收錄하고 있다. 앞으로 紙面이 許容되는 대로 이를 原文 그대로 轉載할 예정이다. 〈편집자 註〉

Hydrology

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The quadrennium 1979-1982 produced notable advances in surface water and groundwater hydrology, as well as important trends towards a more scientific basis for engineering hydrology. Examples of these developments will be given below, as well as an assessment of current trends.

One of the most significant areas to emerge during the last quadrennium is stochastic groundwater analysis. The basis for the conceptulization of groundwater flow and transport as a stochastic process is two-fold: 1) the realization that hydrologeological environments are extremely heterogeneous, regardless of the scale of modeling or data collection and 2) the use of groundwater flow and transport modeling results within broader water resources or hazardous waste management studies where risk analysis requires and incorporates groundwater uncertainty.

The work over the last quadrennium can be grouped into three broad areas: 1) statistical analysis of parameters and inputs that influence groundwater; the main methodological approach being optimal linear estimation (kriging, state estimation), 2) stochastic prediction of model outputs; the main approaches include spectral analysis, and Monte Carlo simulations, 3) statistical analysis for groundwater model identification and parameter estimation. In all three areas, special sessions have been held at national and international symposia to disseminate results. While significant results have been obtained, much work remains in developing fundamental theory that relates the scale of the process to equation formulation in a manner that incorporates the heterogeneity of the medium. This work is critical to the groundwater transport problem.

During the last quadrennium, the awareness of groundwater contamination from hazardous wastes—especially chemical wastes— has grown. As data from waste sites are being collected and attempts to model contaminant transport are made, it is clear that current models and procedures are insufficient in at least two areas: 1) relationships among microscale hetogeneity, numerical model representation and data collection are not well coordinated at the landfill siterscale, and 2) understanding of the chemical processes (for example, adsorption or desorption), biological processes (for example, degradation of chlorinated hydrocarbons), or physical processes (for example, relative conductivities or mixing properties of multiphase organics in saturated media) is incomplete.

Fundamental work, including both laboratory and field analyses, is required if progress is to be made at improving the predictive capabilities of groundwater transport models.

In surface water hydrology, progress has been made on several fronts. Most notable in the area of engineering hydrology, are advances in the implementation of on-line flood forecasting systems. During the quadrennial period, fundamental advances were achieved in applying systems theory and state-estimation to on-line hydrological forecasting. These advances include: model structure identification and parameter estimation, as well as embedding hydrological models within a state-space framework capable of the necessary feedback to incorporate on-line data. Some of the most important work has been in the area of parameter identifiability for conceptual hydrological models. Results indicate that the available data are insufficient to estimate all the parameters accurately— either the models need to be simplified or additional components of the hydrological budget need to be measured.

The implementation of on-line flood alert systems, coordinated by the U.S. National Weather Service, has grown by a factor of ten during the quadrennium, with the demand for such systems growing far faster than State and Federal agencies can fulfill. The National Weather Service is leading the way in this important area. The most notable aspect is the desire of field hydrologists to incorporate recent research results into these systems. Internationally, this area is gaining in importance, as can be seen from recent conferences devoted to flood forecasting (e.g. IAHS, 1980).

The current quadrennium saw consolidation rather than significant developments in thé area of statistical hydrology. The last quaddrennium ended with a conference on hydrologic data networks. Langbein(1979) in summarizing the conference, recommended five areas where the research results could be extended and applied to important data acquisition problems. These recommendation included: data transfer among stations (regionalization), broaden the scope so as to apply techniques common to surface water to other hydrological areas, carry out audits to see how networks fulfill current or modified objectives, investigate how data needs vary with water management objectives, and improve coordination among various data networks.

The general area of regionalization, as applied to flood frequency, has received more attention during the current quadrennium than other topics. The concern has been two-fold: 1) development of statistical models and procedures that better represent flood data and 2) development of robust estimates using regional data in a hydrologically and statistically responsible manner. In the research community, there is wide belief that current operational methods should be improved.

Fundamental research into flow generation and basin structure has started to pull together work in widely varying areas: geomorphology, soil physics, surface hydrology and statistical hydrology. A unifying theory for hydrologic responses at varying basin scales has not yet been developed; work during the last quadrennium focused upon various issues including 1) the basin response and flood statistics based upon its geomorphological structure, 2) soil variability and runoff variability and 3) role of macro-pore flow, interflow and contributing area surface runoff in the flow response. It is crucial that adequate and detailed data be available so that theories concerning runoff generation can be adequately tested.

In hydrology, the long-term trend appears to be a bifurcation of the field into scientific hydrology and engineering hydrology. Exciting developments in scientific hydrology will be made in all areas: equation formulation for porous media flow, advances in our understanding of hydrological processes at various scales, and improved statistical representation of hydrological processes in time and space. One hopes that equally exciting developments will occur in engineering hydrology. At present, one sees some very creative applications of research results— especially in the area of groundwater modeling. It is important for the engineering side of hydrology to understand recent developments and to apply them where appropriate; likewise it is important for those in hydrologic research to understand the problem faced by field and engineering hydrologists.

REFERENCES

IAHS, "Hydrological Forecasting Symposium," Proceedings of the Oxford Symposium 15-18 April 1980, IAHS-AISH Publication No. 129, 571 pp., 1980.

Langbein, W.G., "Overview of Converence on Hydrologic Data Needs," Water Resources Research, 16(6), 1867-1871, 1979.