FOREWORD

This is a unique book. Many of the hydrology texts currently available offer accounts of the principles of hydrology, illustrated by way of examples. In this book, examples are the backbone of the presentation, explaining practical problems to be solved, while the methods that were used to find a solution, are secondary.

The book offers the experience of a hydrologist with extraordinary practical expertise, assembled over more than half a century, from nearly all the continents, in areas with different climates, topographies, socio-economic systems, levels of development, and cultures.

While many of Dr Sutcliffe's works have been conducted in Britain, the thread of hydrological studies has taken him to some 50 countries, including: Egypt, Sudan, Jordan, Abu Dhabi, Bahrain, Yemen, Iran, Senegal, Botswana, Kenya, Uganda, India, Sri Lanka, Argentina, New Zealand, Bosnia and Poland. The Nile basin, including the Jonglei Canal and the Nile wetlands, has played a particular role in his studies and he developed a considerable and long-lasting expertise there. Dr Sutcliffe knows well what he is writing about, having gathered first-hand experience by visiting places, and working in the field, in addition to studying the academic literature, consultant reports and data sets. He has built a mental picture of each investigation area and a feel for the dominant processes.

Basic hydrology is indeed a question of balance. This is the most basic issue. Water balance law must be fulfilled—the principle of the conservation of mass is elementary and powerful with no exceptions. Thanks to the fundamental water balance equation we can determine values of a variable which we do not know, based on the (observed or estimated) values of other variables, that occur in the budget equation. Any apparent departure from the balance simply means that we are in error and that not all the terms in the water balance equation have been adequately evaluated. Hence, checking the water balance is useful to evaluate whether our assessments are realistic. For instance, the explanation of a substantial residual in the water balance can be that evaporation has been either under- or overestimated.

Actually, hydrology comprises much more than just the water balance—there are other important general laws, with the conservation of energy and momentum being of ubiquitous validity. However, if we wish to prioritize and focus on a single, most essential principle, which still enables one to draw useful conclusions, then the water balance is definitely what matters most.

When summarizing a hydrological publication, one usually seeks the principal strengths falling into two major classes: novel and innovative methodology (holding potential for application), and/or contribution to the understanding of hydrology of a particular region. The principal asset of Dr Sutcliffe's book is undoubtedly in the latter category. It covers global hydrology—not in the sense of modelling of the global

hydrological cycle, but rather in the sense of presentation of case studies worldwide, hence contributing to understanding of water availability conditions in many regions of the world.

Since the case studies presented in the book span the time interval from the 1950s on, the author has focused on what he actually did rather than what might be done (modern equipment and methodology being available). In a way it is a tribute to what can be done without broader applications of the tools of modern technology—Geographic Information Systems, remote sensing, isotopes, etc. Dr Sutcliffe has had to be a pragmatist and address the problem with what was available at the time, and his best knowledge.

At the advent of the PUB (Prediction in Ungauged Basins) initiative, the current flagship IAHS activity, many a younger PUB expert could learn from Dr Sutcliffe's approach to the intriguing issue: What can be done if there are no data but there is a burning practical problem and a decision must be made anyway, regardless of the state of scientific understanding? Stating "I do not know" is not acceptable—one has to make an "optimal", informed decision, despite the circumstances of high uncertainty. Dr Sutcliffe undertakes a "mission impossible", trying to synthesize scarce information, based on his expert feeling and intuition, common sense and the law of water balance. In one figure in the book, he is happy with ten data points; this is all that was available. Yet, it gave him orientation in understanding the process behaviour. Dr Sutcliffe explains how to augment the database, using auxiliary information from different sources, where detective work, based on common sense and logical thinking is needed. Like a detective, he knows where to look for traces—where water may have left them, and how to look for traces, equipped with an analogue of a magnifying glass—an arsenal of robust hydrological practices. Field reconnaissance and air photography allowed him to estimate transpiration and water use in the Middle East. He estimated flows using areas of perennial date palms and other crops irrigated near villages along the stream. Deciphering evidence from the remote past, he placed ancient water-related infrastructures in central India in their hydrological context.

The question is not only what to do in ungauged, or inadequately gauged, basins, but what to do if the available data are suspected to be wrong and need to be corrected. In order to do so, Dr Sutcliffe has sought ancillary information from various non-standard sources, estimating flow and groundwater recharge in an indirect way. Interdisciplinary contacts with meteorologists, geologists, civil engineers, planners, botanists, and archaeologists allowed him to draw robust corollaries from scarce proxy, and uncertain, information. He has been tuned to receiving useful information when talking to apparently lay people, like a teacher in New Zealand. When he and I chatted together about Polish floods in Poznań, John was seeking information with a vigour and concentration which would be envied by many a young hydrologist.

The name of the author is well known to the hydrological community. Web browsers give multiple entries related to his name. Whether you "google" or "yahoo", in a fraction of a second you will have a myriad of references to Dr John Sutcliffe on your screen (be careful; several individuals bearing this name and surname have made themselves known in various areas of activity). He is often cited in academic publications, most frequently (many hundreds of citations) with reference to his paper published jointly with the late Professor Nash in 1970. However, this paper, containing the formula broadly known as the Nash-Sutcliffe criterion of model performance (also

called: goodness-of-fit or efficiency criterion), being widely used and cited over decades, summarizes just a small episode in the author's rich career, which included leadership of the team which produced the *Flood Studies Report* for the British Isles.

Dr Sutcliffe makes interesting comments on the decrease of time available for hydrological investigations. This reminds me of the words I heard in 1969, as a freshman student at the Technical University of Warsaw, from a professor of mathematics: "We do not develop mathematics in order to construct machines, but we develop machines in order to have more time to deal with mathematics." This has turned out to be a largely incorrect statement. The technology is there and it improves the efficiency of our work, but time has become more rare and precious. In the past, time constraints were not that severe. The same pertained to data availability in many regions. The severity of water-related problems grows but, counter-intuitively, fewer ground-truth data are being collected now than in the past. Today, satellite watch embraces the whole globe, but understanding of the local detail is missing. Hydrological services receive inadequate funding and shut down monitoring/ hydrometric stations, even those with long continuous time series of observations. If we only had the time and the data—this is a common longing.

Dr Sutcliffe's hydrology, built around the water balance law, has been applied in vast areas of less developed countries, where water-related problems are many and severe, while the human coping capacity and expertise, and the available data, are scarce. This is where the book is likely to find a considerable resonance. This publication fits the IAHS mission—to enhance development of hydrological sciences worldwide, including less developed countries, where having too little, too much, or too polluted water is commonplace. Experts involved in development assistance will find the book of interest. Among potential readers are also experts in the new member countries of the extended European Union, which are likely gradually to turn from being beneficiaries of international development assistance to providers of international aid.

Dr Sutcliffe has been a prolific author; the bibliography contains several dozen works by him, often in co-authorship. Many occur in IAHS publications, spanning the time frame from 1960 to 2004, including several papers published in *Hydrological Sciences Journal* and in the IAHS Red Book series, and *Hydrology of the Nile* (co-authored with Yvonne Parks), a volume in the IAHS Special Publications series. Unlike many consultants, who produce project reports only (an obligatory element of a solicited study) and are not interested in converting their findings into academic publications (which may require far more work, attention, and pain to get through the peer review process), Dr Sutcliffe has done both. In addition to reports to the funding agencies, after each of the many projects, he has published papers in the professional hydrological science literature. This must have been driven by an internal mechanism—as a consultant he has not been subject to the pressure of the academic "publish or perish" principle.

The book will be of interest to several international initiatives, such as the IAHS PUB initiative mentioned above, the HELP (Hydrology for Environment, Life and Policy) initiative of UNESCO, and the Millennium Development Goals, illustrating the importance of freshwater resource assessment, and of estimating different components of the water balance (both long-term averages and variability).

A common Polish greeting, conveyed in a song used when celebrating someone's nameday, birthday, etc. is a wish for him, to live a hundred years in good health and prosperity. Celebrating the birth of the book, let me echo this Polish wish to Dr Sutcliffe, after having added my hope that he will continue to share his expertise with younger generations, and to provide his valuable input to IAHS activities. I do hope that this book is widely read and used among the global hydrological community, for it will bring benefits by improving our understanding of the water cycle.

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