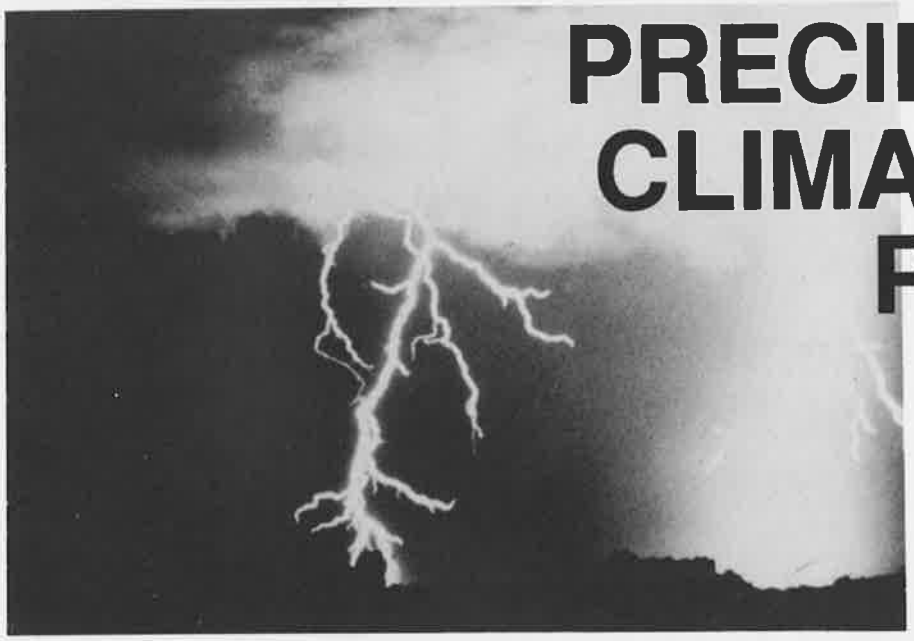
THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

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THE GLOBAL PRECIPITATION CLIMATOLOGY PROJECT



Current concern about the well-being of the planet focuses sharply on the need for a better understanding of our climate system.

In particular, there are still large uncertainties about the components of the water and energy budgets of the atmosphere and the oceans. These problems are being addressed by the World Climate Research Programme's Global Energy and Water Cycle Experiment (GEWEX). A key part of GEWEX will be the need to model accurately the global distribution of rain and snowfall, as explained here by *Chris Collier* of the UK Met. Office.

Introduction

Modelling the distribution of rain and snow requires global estimates of precipitation, both for initialization procedures in the case of weather forecasting and for the assessment of model performance in the case of both weather and climate models.

Conventional surface-based measurements do not exist over large areas of the globe, in particular over the world's oceans, and therefore remotely sensed satellite-based techniques offer the only hope of providing the required data. Moreover, better estimates of the distribution of latent heat release, which are required in models, would be aided by measurements of vertical profiles of precipitation as well as of available water vapour. Again, space-based techniques offer the only hope of providing the required global data.

There are two ways to approach the problem of developing the algorithms for estimating precipitation:

(1) to compare the space-borne measurements with detailed ground and/or air truth, and

(2) to develop cloud scale models that represent the dynamical and microphysical structure of the clouds and then to compute by means of appropriate radiative (or backscatter) models how the clouds and associated precipitation would appear when observed from space using radiometers (or radars).

Data from a combination of ground-based radars and autographic raingauges may provide snapshots of the precipitation distribution at times corresponding to separate overpasses of the space-borne observing system. The interpretation of the relationship between the space measurements and the surface precipitation will be aided by a knowledge of the precipitation processes and the microphysical structure in the vertical, as inferred from aircraft penetrations and/or specialised (multiparameter) radars.

Studies of this kind are needed in a number of different regions of the world, representative of the whole range of climatic types. Furthermore, to provide global estimates of precipitation that are consistent requires a comparison of the many algorithms that are being developed by different workers for use with satellite data. This is already being done as part of the Algorithm Intercomparison Programme under the auspices of the WCRP Global Precipitation Climatology Project.

Algorithm Intercomparison Programme (AIP)

The AIP will assess the skill of various techniques for estimating rainfall from satellite observations and identify the reasons for observed variations in algorithm performance. Separate projects will address these questions in various climate regimes. Improved skills in geostationary and polar-orbiting satellite algorithms are expected from ongoing research activity in various countries, including the UK.

The goal is to identify optimum techniques for estimating large-scale, time-average rainfall from observations made by both types of operational satellites in different climate regimes. Suitable guidelines for further algorithm development for the estimation of both large-scale and meso-scale rainfall amounts will also be set.

For each project, approximately two months of data of the following types will be assembled:

- Geostationary satellite VIS/IR data,
- DSMP polar-orbiting satellite microwave data,
- Raingauge and digital radar observations,
- Composite rainfall analyses based on raingauge and digital radar observations,
- Atmospheric circulation and moisture analyses and precipitation forecasts from operational MWP centres.

A composite data set of the above will be constructed for each participant in the programme to use in the preparation of rainfall estimates and for technique development. Workshops will be convened at the end of each project to compare the results obtained using various algorithms on the same data set.

The selection of sites for these intercomparisons is based on the various rainfall regimes found globally and also on the availability of high-quality *in situ* observations (raingauge, digital radar). Sites representative of monsoonal systems, tropical and mid-latitude convection, and mid-latitude and high-latitude stratiform rainfall are desired.

The first project was carried out during two special periods in 1989 over an area encompassing the main islands of Japan (23°N - 46°N and 120°E - 147°E). The observation periods were chosen to enable groups in the AIP to study the rainfall associated with a persistent frontal regime ("Baiu" rain during June) and a tropical convective region (mid-July to mid-August).

UK participation in the AIP

The Meteorological Office has agreed to organise a second phase of the intercomparison project to take place during the winter of 1990-91 focusing on stratiform winter precipitation. The details of this project have yet to be finalised and will be the subject of a future article.

Chris Collier
Meteorological Office

STOP PRESS

The University Research series will continue in *Circulation 27*, featuring the Department of Environmental Sciences at the University of Stirling.



NEWS FROM MEMBERS

Members on the Move

Mike Lowing has moved on from the Institute of Hydrology after 21 years in the 'applied' side of the business. After taking the postgraduate course at Imperial College, he emigrated to Australia to work for the Tasmanian Hydro-Electric Commission and, later, at the University of Western Australia. He returned to the UK in 1969 to join the Flood Studies Team where he was responsible for the rainfall-runoff method (Chapter 6 for the *cognoscenti*).

During the 1970s he was responsible for implementing the forecasting model on the Welsh Dee, for the hydrological input to the WASP procedure, and for a variety of projects at home and overseas.

In 1982 he took over management of the National Surface Water Archive and masterminded a new series of yearbooks (*Hydrological data: UK*) and other publications. In recent years he has been involved with the development of the Institute's Water Information System and with exploitation of digital map data.

Mike has been active in the Society from its early days. He was a member of the Initial Planning Group, was on the national committee for four years and organised both the inaugural meeting at the Royal Society and the first national Symposium at Hull. He is responsible for the name of our newsletter and the idea for our logo.

In his 'retirement', Mike has become an independent consultant. He has been retained by Watson Hawksley and will also be working with Chiltern Digitising Services, the software and bureau business run by his wife. He plans, through one or other of these links, to maintain close contact with friends and colleagues throughout the water industry. He also nurtures hopes of having more time for canoeing, bird watching and even getting back into BHS activities. But first he has to complete one more extension to the family home to accommodate his new 'office', and several computers!

Mike will be working from home:

Whitehouse Lodge,
Brightwell Baldwin,
Oxford OX9 5NT.
Tel.: 049161 2581; Fax: 049161 2578

Churchill Fellowship

James Bathurst of the NERC Water Resource Systems Research Unit, University of Newcastle upon Tyne (on secondment from the Institute of Hydrology) has been awarded a Churchill Travelling Fellowship for 1990. James's award comes under the category "Open for Projects in New Zealand" and he will be using it as an opportunity to study the impact of landslide erosion on sediment supply to mountain rivers.

James will be based mainly at the DSIR Geological Survey at the University of Canterbury but will also be in contact with other research groups.

"The topic represents a new area of personal research interest for me," says James, "which will also contribute directly to my work at the Newcastle Unit, adding a landslide erosion component to the advanced hydrological modelling system known as SHE (Système Hydrologique Européen).

I intend to carry out a literature review of landslide erosion and sediment yield, benefitting from the expertise on the subject at both the DSIR and other centres in Christchurch. I shall also carry out a number of field excursions along the Southern Alps to study examples of landslides and their impacts. The results will be presented in a report and, I hope, a joint journal publication."

NATURAL DISASTER REDUCTION:

How Meteorological and Hydrological Services can help

Royal Meteorological Society/BHS Meeting
28 March 1990

The decade commencing in 1990 has been designated by the United Nations as the International Decade for Natural Disaster Reduction (IDNDR), a period in which all countries and agencies should work together to reduce the devastation caused by natural diasters, including storms, floods and droughts. WMO embraced this topic by designating the theme of the celebrations for the World Meteorological Day marking the 40th anniversary of WMO on 23 March 1990 as "*Natural Disaster Reduction: how meteorological and hydrological services can help*". To celebrate both these events, a one-day meeting on the topic was held at the Royal Society, arranged jointly by the Royal Meteorological Society and BHS. The meeting comprised nine talks, most of which are published in the March issue of *Weather*, followed by an hour-long panel discussion.

The meeting was opened by **Dr K A Browning**, President of the Royal Meteorological Society, who surveyed the scale of the problem, including the fact that three million people have been killed and 800 million affected by natural disaster since 1970. Although earthquakes ranked as the number one killer - above tropical cyclones, floods and droughts - each of the latter affected more people than earthquakes.

Dr J Rasmussen (WMO) expanded on this theme giving a "Global perspective of meteorological and hydrological extremes" and emphasising the need to improve observational systems, especially in the tropics. There followed a series of papers on meteorological forecasting on increasing timescales. **Dr C G Collier** (UKMO) talked on "Extreme rainfall assessment", illustrating the problem of forecasting intense convective precipitation and **Mr R M Morris** (UKMO) discussed "Forecasting extra-tropical and tropical cyclones", pointing out that as a result of recent experiences UK forecasters had become better acquainted with the relationship between the intensity of a storm and its potential for damage.

Dr T N Palmer (ECMWF) talked on "Probabilistic rainfall prediction in the medium and extended range using ensembles of forecasts", pointing out that predictability should be considered as much a model forecast variable as the meteorological variables. Finally, **Mr C K Folland** (UKMO) talked on "Prediction of seasonal rainfall in the tropics", describing the development of methods of forecasting the summer rainfall over the Sahel region of Africa and over north-east Brazil, based upon sea-surface temperature anomalies. An encouraging result was that extreme events were particularly well forecast.

The afternoon session was chaired by Prof P O Wolf, Past President of BHS, reflecting the hydrological tone of this session. **Prof I D Cluckie** (University of Salford) talking under the title "Extreme flood assessment" gave a wide-ranging account of the historical development and current state of techniques to estimate return periods for flood events and dam failures. Two schools of thought had emerged emphasising statistical or deterministic approaches. Possible fallacies in the current view of the impact of climate change on these estimates were also described. **Mr G J Dimmock** (Swiss Reinsurance Co. (UK) Ltd) talked on "Meteorological and hydrological disasters - an insurer's view", describing the problems that widespread disasters caused the insurance industry. Efforts were being made to estimate losses from possible worst case events such as storms.

Mr R Hunt (UKMO) described "Disaster alleviation in the UK and overseas". The development of systematic strategies for warning the public and emergency services since the October 1987 storm was described, stressing the importance of explaining the likely damage implied by a forecast. Finally, **Prof W B Wilkinson** (Director, IH) and **Mr F M Law** (IH) discussed "Engineering design for climatic extremes". Prof Wilkinson surveyed the problem in assessing risk factors relating to floods, dam design and drought, and also listed the ways the Meteorological and Hydrological Services of the developed world can help developing countries. Mr Law described the difficulties in estimating long return periods from limited observations, emphasising the benefits of a regional approach.

Several issues emerged from the talks which were discussed by a panel comprising the speakers plus **Allan Lambert**, President of BHS. First, with regard to forecasting procedures, it was agreed that satellite measurements would play a key role in seasonal forecasts based upon sea-surface temperature anomalies, with the combined use of satellite data and surface observations seen as the way forward. The possibility of



developing sub-regional seasonal rainfall forecasts was raised and promising results were reported from initial trials.

The use of warnings was considered and issues raised included the need to study human reactions to warnings and the effect of power failures on the warning systems. There was general agreement that cost-benefit studies of warning systems should be initiated as had been done earlier for weather radars and short-period rainfall forecasts. The problem of legal liability for errors was seen at present as mainly a problem in the United States; if it became more widespread some form of insurance scheme against claims might be the answer.

A lively discussion on climate statistics and climate change ensued when the accuracy of estimates of the timescale of global warming due to the greenhouse effect was queried, as was the difference between such warming and natural variability. The panel view was that we were already committed to some warming and that if nothing was done to slow down the increase in concentration of greenhouse gases, the warming will eventually match model predictions, even if the predicted timescale was in error. Despite the uncertainties it was felt to be prudent for engineers to introduce flexibility into future designs to allow for climate change.

Under the topic of preparedness, the role of legislation was raised, for example to prohibit housing development in areas prone to flooding. Panel reactions to this were rather mixed. For instance, a flood risk index had been drawn up in Sydney which has affected the price of pre-existing properties; in some cases it can be seen to be cost-effective to build on flood plains when the benefit of bringing the land into use is balanced against eventual flood damage, the philosophy adopted in Japan.

Finally, the transfer of technology to developing countries was discussed. Methods used currently by the developed countries were seen to be more easily applied in developing countries which had reasonably advanced meteorological and hydrological services. Some optimism was expressed in the rate at which the developing countries were acquiring technology such as weather radar and in the operation of the WMO's HOMS scheme, although the problem of maintaining such a scheme was seen as a key one to be addressed.

The meeting was closed by **Prof Peter Wolf**, who suggested that a common theme of the meeting had been that our meteorological and hydrological knowledge was still insufficient. Engineers can produce designs to withstand natural disasters but they must have reliable information.

R Brown

NEW MEMBERS

We welcome the following new members to the Society:

Baird, A.J.	University of Bristol
Eastwood, J.C.	Poole, Dorset
Evans, N.A.	Basingstoke, Hants.
Henworth, S.P.	University of Southampton
Hughes, C.	Institute of Hydrology
Lawson, J.D.	Sir William Halcrow & Partners
MacIntyre, M.J.S.	University of Aberdeen
Maddock, I.P.	Loughborough University
Mayall, S.	Anglesey, Gwynedd
Newsome, Prof. D.H.	Reading, Berks.
Ramsay, W.J.H.	Cambridge
Salmon, S.	Bromsgrove, Worcs.
Watts, R.S.	Norwich, Norfolk
Wesson, R.J.J.	Bedford
Wilby, R.L.	Long Eaton, Nottingham
Young, A.O.	Taunton, Somerset
Younger, P.L.	NRA, Yorkshire Region

River Flows and Channel Geometry

BHS Southern Section meeting 11 October 1989

There was a good attendance at this meeting held in Imperial College. The theme of the meeting was based on recent studies by *George Heritage* and *Richard Hey* (University of East Anglia) on dominant discharge in alluvial channels and by *Geraldene Wharton* (University of Southampton) on river discharge estimated from channel dimensions.

The first talk on the effects of river flow on channel form was presented by **George Heritage** who described an evaluation of the discharge conditions which exert most effect upon channel geometry over time. There were three questions to be answered : Is there a flow magnitude that mainly influences channel geometry? If so, does the channel shape provide the answer to the dominant discharge? Does this flow have a definable return period?

Although a series of flows right across the low, medium and high range contribute to producing the channel form, research suggests bankfull flow conditions appear to have the most influence over time. It was suggested, therefore, that flood relief schemes would benefit from being designed with geometries corresponding to those for bankfull conditions although difficulties will arise with channels which have been modified artificially.

The research assessed the average probability of the occurrence of bankfull flow for rivers in the UK so that bankfull conditions for any river could be determined given the river's flow history. The return period of bankfull flow is dependent on the flow and sediment transport regime of the river and the degree to which the river is eroding or depositing. For stable channels the intermediate flood flows are the dominant channel forming flows since they transport most material in the long term. In degrading channels, bankfull flow is increased and occurs less frequently than in stable rivers, and vice versa for aggrading channels.

Previous studies had often shown large variation in bankfull flow return periods, probably due to variation in the factors that affect bankfull frequency at differing sites, differences in the definition of bankfull stage between studies, and the stability/instability of the section.

The procedures for estimating bankfull flow were briefly described. The stage elevation corresponding to bankflow along the surveyed reach was determined on the basis of the stage corresponding to the minimum width/depth ratio which generally equated with the bankfull condition derived by valley flat geometry.

In addition, longitudinal profiles of the channel bed and bankfull elevations were surveyed to the gauging station and the bankfull discharge obtained from the stage/discharge curve. The critical threshold discharge for the movement of surface bed material at each site was determined in a similar manner, based on Shields' threshold criteria.

To assess the frequency of bankfull discharge, fourteen stable gravel bed British rivers were chosen for the study and the analysis was based on the annual maxima, annual exceed-

ance and partial duration series data sets. Data were obtained from the Flood Studies Report and the Institute of Hydrology. The problem with the annual maximum series was found to be that some events during which significant sediment transport occurred were missed. The partial duration series provides a better definition of the probability of occurrence of bankfull flow. In this case bankfull flow was found to occur on average every 1.3 years with a median value of 0.9 years.

Rivers in regime have adjusted their bankfull dimensions to the flow, transporting most material over a period of years. Any attempt to modify the bankfull capacity of the river will therefore lead to channel instability. Any channel alignment may therefore lead to aggradation as the river attempts to establish its bankfull capacity to the flow transporting most sediment. Solutions which preserve the natural channel stability are to be recommended, as shown by the success of the schemes on the River Lugg, north of Hereford, and the River Roding at Abridge. Dominant discharge should be estimated when considering channel alignment.

A question from the audience on whether there is a single dominant discharge for all river channels in Britain led to the view that a range of flow conditions is probably more appropriate.

The second speaker, **Geraldene Wharton** (University of Southampton) considered the topic of estimating river flow from channel characteristics and presented the results of her research on the subject. This work has led to the development of a method for estimating flood discharge at ungauged sites in Britain, based on river channel geometry. Flood discharges are often required at such locations and estimation methods frequently use catchment characteristics, as in the Flood Studies Report (FSR) procedures. Considerable work on evaluating the relationship between channel characteristics and flood flows has been undertaken in the last 20 years by the US Geological Survey, and in New Zealand and northwest Italy. Geraldene concentrated on the development of the method for British rivers, either as an alternative to other conventional techniques for flood estimation, or used in conjunction with regression-based catchment approaches, hydrological or hydraulic methods.

The background to the development of the technique was discussed and the method for estimating flood discharges from channel geometry was presented. One of the main attractions of the method is the relative ease of obtaining the appropriate information for a site compared to say the calculation of numerous local catchment and climatic characteristics. The channel-geometry method is based on the assumption that channel size and shape at a site are determined mainly by the water and sediment discharged past that site. Measurement of the channel characteristics, therefore, can provide information on discharge characteristics. In essence, the channel shape is the integrator of all the catchment characteristics.

The advantages of the method are that it is relatively quick, easy and inexpensive, it is the least indirect of the indirect methods, and it is probably equivalent in accuracy to the 10 years or more of gauged record when estimating flow events such as the 5-10 year flood. Results using the method have been shown to be comparable with those based on the equations derived from catchment characteristics.

A set of channel geometry equations was derived for Britain based on the assumption that channel dimensions (width, depth and capacity) and a measure of discharge such as the mean annual flood are related by a power function. The coefficients of the equations were estimated numerically from the data and channel geometry equations were developed for sites from all over Britain which provided a representative sample of the range of natural river types in Britain. Both field surveyed and archived data sources were utilised. To reduce problems due to inconsistency in defining the channel geometry reference level, two sets of channel geometry equations were developed:

(1) based on bankfull level as determined from the detailed field survey;

(2) for the level of over-topping according to the cross-sectional survey data contained in the archive.

Gauging stations used in the study were those which had annual maxima flood peak data, those graded A or B by FSR with respect to stage-discharge rating curve, those with at least five years of data to 1973 (although longer records were available and covered at least 15 years for most stations when the analysis was undertaken), those without artificial modifications of the flow regime so that flood peaks are unaffected, and (most importantly) those whose river channel was not modified by channelisation. The archive data set was extended through additional field surveys. The preference for obtaining field survey data was noted and details for obtaining these were outlined.

A different set of equations has been developed for estimating MAF, $Q_{1.5}$ and Q_5, and recommended limits were given for locations for which they should be used (based on values of channel geometry at the site of interest).

The method may be combined with dimensionless regional flood frequency curves to obtain floods of higher return periods.

Copies of the discussion paper *'Guidelines for Estimating Flood Discharges in Britain from River Channel Dimensions'* were available for purchase at the meeting, as Geraldene is keen to encourage the use of the equations and would welcome comments on any applications. This in turn will lead to further discussions and refining of the techniques. [*Further copies may be obtained from Ms Wharton at the Department of Geography, University College, London.*]

Questions from the floor related to when it would be appropriate to use the technique in preference to the FSR methods. It was felt that small channels may be an appropriate situation, or it may act as an alternative index method for obtaining the MAF. A further questioner asked whether channel roughness had been taken into account: the reply was that this had not been done directly, but Manning's 'n' for each site had been estimated. In response to a question as to whether channel slope had been considered, it was noted that the contribution of this parameter had been evaluated but that the use of S1085 was found not to improve relationships.

Geraldene Wharton would like to thank all those who have read and commented on the Guidelines. These comments, both on the general approach and on the detailed procedures are presently being considered for a revised set of guidelines; thus any further comments can be reported on the questionnaire which accompanies the Guidelines, or can be given separately, and would be most welcome.

Sue Postle

FIRST SYMPOSIUM ON POST-GRADUATE HYDROLOGY

Loughborough University
26-27 March 1990

The first symposium on Postgraduate Hydrology was held in the Department of Geography, Loughborough University over two days. The meeting was attended by 35 research students drawn from 12 different universities and polytechnics and representing a wide range of hydrology-related interests. The opening address given by *Allan Lambert*, President BHS, encouraged everyone to capitalise on the informal atmosphere of the meeting and to take the opportunity to improve presentational skills within a sympathetic arena!

By means of an introduction to the breadth and relevance of current hydrological research, **Max Beran** (IH) then gave a talk on issues relating to global hydrology and biogeochemical cycles. This emphasised the significant role that hydrology could or should play in many topical issues, most notably global warming and climate change. This presentation was followed by three sessions on catchment and hydrochemical studies, hydrological modelling, and environmental hydrology. Each session included four 20-minute papers given by post-graduates on their specialist topic with 10 minutes allocated to discussion.

Nick Haycock (Oxford University) had the task of breaking the ice in the first session and gave a clear presentation on the nitrogen solute behaviour of a floodplain in the Cotswolds. He

suggested that in terms of managing these nitrates the scientific definition of the 'riparian zone' should be extended to include a significant proportion of the flood plain. Referring to the Coalburn experimental catchment in Northumberland, **Phil Hind** (Newcastle University) highlighted some of the difficulties involved in monitoring the solute flux through acid catchments. Continuing this theme of acid waters research, **Adrian Muscutt** (Imperial College) presented some results of detailed hydrochemical field analyses undertaken in the headwaters of the River Wye, Wales. This work emphasised the need to consider such hydrological factors as the antecedent conditions, source areas, rainfall intensity and duration when interpreting the calcium response of the catchment. Finally, by means of the Shifting Climate and Catchment Acidification Model (SCAM), **Robert Wilby** (Loughborough University) showed the need to consider climate change when modelling the long-term hydrochemical response of acidic catchments.

The second postgraduate session dealt with various aspects of hydrological modelling. **Nicholas Tranter** (Middlesex Polytechnic) described the results of a semi-distributed runoff routing model (RORB) which was applied to an experimental catchment in Essex. This work showed some of the difficulties involved in obtaining optimum parameters for conceptual models. **Andrew Baird** (Bristol University) identified the time delays which exist between rainfall/evaporation and the subsequent response of the water-table measuring devices as a source of uncertainty in the data used to calibrate drawdown models. The following two papers by **Chris Onof** (Imperial College) and **Mark Futter** (Newcastle University) provided concise accounts of the use of probability distributions for rainfall modelling and short-term flood risk assessment respectively. Both of these presentations examined the inclusion of seasonality as a means of improving estimates.

The day's formal sessions were concluded by **Paul Quinn** (Lancaster University) who gave a brief overview of the use of digital terrain models in hydrological studies, making special reference to the TOPMODEL.

After an informal evening reception, **Prof Malcolm Newson** (Newcastle University) delivered the guest presentation. The talk gave a stimulating view of the world of hydrology, both past and present, covering a wide range of thought-provoking topics. Participants then had an opportunity to follow up any points of interest during the obligatory excursion to sample the Loughborough night-life!

The third postgraduate session held on the following morning was conducted under the broad heading of environmental hydrology. **Susanne Charlesworth** (Coventry Polytechnic) presented some preliminary results of chemical, palaeoecological and magnetic analyses carried out on sediments taken from two contrasting lakes. The cores taken from Wyken Slough showed a marked increase in heavy metals since c1850. **Malcolm MacIntyre**'s (Aberdeen University) work on sediment transport processes in mixed bed streams identified a number of logistical and technical difficulties which must be solved before he can successfully sample the highly dynamic field sites. **Heather Dalgleish** (Coventry Polytechnic) gave an interesting outline of research in progress into the usefulness of ^{137}Cs distribution as a tracer for lowland soil erosion. Finally, the paper given by **John Wainwright** (Bristol University) provided a fascinating close to the formal presentations with his work on computer and hardware modelling of archaeological sediment transport on semi-arid hillslopes. It was an appropriate reflection of the range and versatility of current postgraduate research interests as sampled by the three sessions.

The final part of the programme moved towards the practical aspects of hydrological consultancy and water resource management. **Terry Evans** (Mott MacDonald) gave a varied account of a number of projects from home and abroad ranging from pig-farming to oil exploitation! The potential consequences of climate change provided a sober reminder of the need to manage finite water resources effectively and efficiently. Emphasis was also placed upon the need for consultants to think laterally when tackling complex local and regional problems.

The following workshop session made available several examples of state-of-the-art hydrological software. **David Floyd** (Consultant) demonstrated the results of work that he had recently undertaken in Indonesia and Oman which exemplified some of the difficulties involved in obtaining and using basic hydrometric data. Three packages designed for efficient irrigation management were on display, courtesy of Mott MacDonald. Along with the Micro-Low Flows program - demonstrated by **Andy Bullock** (IH) - this software gave a clear indication of the level of 'user-friendliness' and graphic detail which is now possible using PCs. The software provided by **John Pirt** (Severn Trent NRA) showed the ease and speed with which it is possible to use radar information for real-time flow forecasting across the region's numerous catchments.

To summarise the two-day meeting, the major asset was the relaxed and informal atmosphere in which all the presentations were conducted. This was undoubtedly reflected in the high standard of delivery of all of the papers. It is hoped that the second symposium on postgraduate hydrology, to be held at the Polytechnic South West next year, will be equally successful and that it will strengthen further the links between the BHS and the 'grass-roots' of postgraduate hydrological research.

Robert Wilby

A Message from the New President

My fascination with Hydrology, which started during my student days, has remained with me since then, and being President of BHS is without doubt the greatest professional honour I could imagine. To those of you in BHS who I do not already know as friends and colleagues, I look forward to meeting you during the next two years.

The BHS membership is extraordinarily diverse, covering many disciplines and interests. In order that the Main Committee members are readily known and accessible to you, and so that we may benefit from any ideas, comments or suggestions you may have, you will find once a year in *Circulation* a full list of Main Committee members with a schedule of BHS Sub-Committees and representation on other national and international groups. Please use these contacts to help us to improve and extend the ways in which BHS serves you.



The three themes of this message are progress, enjoyment and continuity.

PROGRESS: Our Society continues to grow vigorously: we now have over 650 members in the UK and overseas. We are seeking new initiatives, in particular links with Europe, and ensuring that all students in hydrology-related fields in the UK are aware of our existence and activities.

The first Postgraduate Symposium at Loughborough in March this year (see page 5) was thoroughly enjoyed by the participants and meets a clear need which we will continue to fill; next year's event is at Polytechnic South West in Plymouth and is likely to attract some European postgraduate students.

In the February issue of *Circulation* (page 5) you may have read of the initiative of sponsored lectures, whereby lecture fees are donated to BHS to fund new student memberships. This has also been a success and most of the Main Committee will now give specialist lectures on a similar basis. If any member wishes to be involved in this initiative, either as a donor or recipient, could they please contact me.

One of the principal aims of the Society is "to foster the involvement of its members in international activities". I see the role of the Main Committee here as providing and developing broad links and encouraging individual members to use these should they wish to do so. Thus in April I attended the XVth Assembly of European Geophysical Society in Paris: EGS are considering the formation of a permanent hydrology section and I wished to ensure that they fully understood BHS's existence as the UK's learned society for hydrology. We are currently working to finalise arrangements whereby BHS members can become members of EGS at reduced subscription rates, and seeking co-operation through co-sponsorship and mutual publicity. We have also recently concluded arrangements whereby BHS will assist the Royal Society in articulating the interests of the UK's hydrological community in the activities of IAHS.

There is a significant number of BHS members for whom the subject of Chartered Engineer status is an important issue. Susan Walker and her colleagues on the Education and Training Sub-Committee have been working hard to ensure that hydrology specialists have such an opportunity.

This summer we will be seeking your views, by ballot, on a proposal to create a small class of Honorary Membership within BHS. Is the Society now large enough to recognise outstanding contributions to BHS activities in this way? It is your views which will decide, so please study the proposal carefully when you receive it.

The decision of the Main Committee to charge moderate attendance fees for BHS meetings is, I know, not popular with some members. However, I would ask you to keep in mind that unless the expenses of meetings are covered by attendance fees, the costs - including speakers' expenses - can only be raised through increases in the annual membership fee, and because of our diverse locations it is considered fairer that those who attend meetings should be asked to contribute a little more than those who do not or cannot attend.

ENJOYMENT: If, like me, you are a member of more than one Society or Institution, you probably find you prefer to be most involved in those whose activities you most enjoy. Enjoyment usually goes naturally with participation and commitment and I would hope that your individual involvement with BHS will be such that your enjoyment is evident, particularly to others who may wish to join us. Why not bring a colleague to the next BHS meeting you attend and introduce them to BHS activities?

Ultimately, the test of our Society is of course the quality, content, range and success of our meetings and symposia. We are always looking for interesting and relevant inter-disciplinary topics; so, if you have any ideas, proposals or comments, please do not hesitate to contact a Committee member.

CONTINUITY: As members join and leave the Main Committee, it is essential to ensure continuity, as our meetings programme is flexibly drafted up to two years ahead. To assist in this aim, we will be seeking nominations for the next President this year (12 months earlier than previously) so that he or she may benefit from a "running-in" period as President-Elect.

We will also be seeking your approval - again by ballot - for a change in statutes to give each of the three ICE Regional Groups (Pennines, Scottish and Welsh) a permanent representation on the Main BHS Committee (they attend by invitation at present). Many individual members of the regional groups are also BHS members and I hope you will endorse these proposals in the interests of strengthening the liaison between all members of the hydrological community throughout the UK.

During the next two years I will be seeking to attend local meetings of all the groups and sections and to listen to your views on the Society and its activities, particularly our international activities. With your help, I hope that during my time as BHS President I will be able to enhance the reputation and membership of BHS in the UK and abroad.

Finally, I must also thank my employers, Welsh Water, for their positive support to my presidency, without which it would be impossible for me to try and achieve anything of significance.

With best regards to you all,

Allan Lambert

INTERDEPARTMENTAL COMMITTEE ON HYDROLOGY

Because of the importance of global environmental issues and the critical role that hydrology plays in them, it has been felt for some time that a formal mechanism should exist to coordinate UK hydrological activities.

Members may be interested to know, therefore, that there is now a re-born Inter-departmental Committee on Hydrology. This committee was established originally in 1979, later merged with the Royal Society's Sub-Committee on Hydrology and was subsequently disbanded.

The Committee has had its first meeting and decided that its terms of reference shall be as follows:

- Ensure inter-Departmental consideration and coordination of UK Government involvement in hydrological activities;
- Nominate and brief delegates to relevant inter-governmental meetings;
- Coordinate UK interdepartmental responsibility for international hydrological projects;
- Liaise with hydrological academia;
- Support the Hydrological Adviser to the UK Government;
- Publicise international developments in hydrology to the wider UK hydrological community;
- Set up *ad hoc* working groups to address specific topics as necessary;
- Report the committee's work to Departments.

The Committee comprises representatives from the following Departments: MAFF, DES (NERC), DoE, MOD (Met. Office), DEn, FCO (ODA), DoE Northern Ireland, SDD and the Welsh Office. It was also agreed that the Committee may invite participation by other relevant bodies as appropriate.

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Sheffield Proceedings - continued

Update of CIRIA Technical Note 100

At the Second National Hydrology Symposium in Sheffield in September 1989an additional topic, the update of the Technical Note 100, was included as the second part of Session 2, Urban catchments and Receiving Waters, with Mike Hall (Middlesex Polytechnic) as chairman. Since the update to TN100, the CIRIA guide to the Design of Storage Ponds in Partly Urbanised Areas, was not available when the proceedings were reported (see *Circulation 24*); since we did not want to overburden our readers, the write-up of this part of Session 2 appears now.

Owen Jenkins from the Construction Industry Research and Information Association began with a brief background on CIRIA and its current activities. With a staff of about 40 and an annual turnover of less than £2m, the organisation spans the entire construction industry. There are currently 60 active projects, some of which he outlined: e.g. work on the document 'Sewers for Adoption', which encompasses the design, approval, construction and inspection of sewers, including agreements between developers and authorities. It essentially aims to unify the practice.

The 'Control of Urban Runoff' project aims to promote flood attenuation, covering the full range of facilities at various scales: downpipes, gully outlets, soakaways, storage ponds, etc.. The guidelines established from the CONFLOW 88 conference could be reflected in this study, taking an entire catchment approach, rather than limiting consideration to an individual development site. The study was due for completion in 1990 and would appear in four volumes, including a Summary, Review of Practices, Guidelines and Policy Procedure and Social Issues.

On the particular aspect of flood storage ponds, TN100 is being revised to reflect present requirements such as those of smaller catchments, with new sections covering operational maintenance, multipurpose ponds (with environmental, recreational and conservation functions) and water quality aspects, which he stressed need to be considered at the design stage.

A project addressing the problem of "Sediment Deposition in Sewers" aims to overcome the existing problems of divided responsibilities by coordinating activities between above-ground maintenance operations and problems associated with sedimentation in sewers.

Mike Hall then raised some hydrological issues related to these projects and stressed the need for guidelines on measures either for flow retardation or for attenuation. It was also recognised that the situation was very similar in the USA, with much progress needed. The question of scale was highlighted with examples illustrating different modes of use from large-scale strategic catchment storage schemes, localised storage with a new development to the smallest scale of localised on-site storage for an individual sewer system. This raises the question, he said, of when you would switch from one design approach to another for a particular application. In terms of strategic catchment planning, Mike argued that, traditionally, the tendency has been to solve only the immediate problem and that the longer term perspective really needs to be considered, which raised some important points:

(a) The need to use distributed models combining open channel and sewered systems, which increase data input requirements.

(b) Important planning objectives, including the discharge from certain T-year floods, minimising quality deterioration, capital costs, storm damage, engineering works, etc.

(c) The methodology to identify the best plan to cope with urbanisation. In this context, he made reference to the catchment zoning approach, (outlined in Craig Woolhouse's earlier paper), designed to prioritise restrictions on new developments.

Brian Ellis (Middlesex Polytechnic) concluded the presentations with a consideration of the Water Quality implications. Despite continued massive investment by industry, there had been little change in the water quality of UK rivers: 10-11% were still class 3 or 4 quality, although the situation was little different in Europe. Surface water sewers present water quality problems which have become more apparent (including chemical oxygen, metals, oils, carbon, nutrients etc). Practically every runoff event, he argued, exceeds the EEC threshold criteria, established as causing detrimental effects in the ecological environment downstream. For the on-site disposal of stormwater and pollutants, developers must bear in mind the particular concentration and problems of these pollutants. The TN100 update aims to help the developer identify his immediate responsibilities, constraints and opportunities and includes a flow chart providing a step-by-step guide to appropriate actions. Quality problems are greatest for small/medium sized events and Brian advocated that a two-stage outlet, retrofitted to ponds could tackle the first flush quality problems associated with small events as well as the quantity problems associated with larger events. Again this was being covered by the rewritten TN100, along with other options including porous paving and infiltration trenches.

Mike Hall then opened the session for discussion. **Linda Aucott** (Wessex NRA) welcomed the efforts of the TN100 update in view of the problems of lack of guidance for developers. She made the point that not all stormwater runoff was poor quality: roof runoff for example was clean enough for recharge. In reply, Mike stressed the need for continuity in any application for dealing with roof runoff; Brian referred also to the legal/institutional problems concerning continuity of projects. Owen said the experience from overseas was useful in this respect and the fact that the new CIRIA report recognised this was an important plus.

Rod Hawnt (Hydrologic) made the point that local knowledge was crucial in model building. **Mike Acreman** (Institute of Hydrology) said that in his opinion people used a model because "it was there", and what was needed was an overall strategy.

Duncan Reed (IH) asked whether, for the situation of a serious localised storm, there were any lessons to be learnt regarding the use of storage ponds. Mike Hall replied that in terms of quantity there were some good case studies, and that in terms of quality, there was little UK experience. From overseas evidence, it seemed that the notion of 'the bigger the better' was most popular in dealing with associated water quality problems.

John Gardner (NRA Thames) introduced the "Catchment Planning Guide", a document being produced by his NRA Thames group. **Mike Mansell-Moullin** (Consultant) enquired about the extent of its planned availability and pointed out that, despite what he saw as the great value of public perception, it was often dismissed as unreliable. John replied that a decision had not yet been taken regarding availability and pricing of the Catchment Planning Guide but he emphasised its holistic approach including its incorporation of public perception.

Frank Law (IH) queried whether the CIRIA TN100 rewrite would place a lot of emphasis upon examples from southeast England, as the earlier one had done. Owen Jenkins remarked that whilst the answer was "Yes", the document was primarily designed as a set of general guidelines. On the quality aspect Brian Ellis referred to examples from Newcastle and Glasgow but said that other data were still derived from examples in the South.

Mike Acreman raised the question of whether rising groundwater levels in urban areas would cause problems for an approach based upon recharge when dealing with urban runoff. **Brian Wilkinson** (Institute of Hydrology) believed that they could, but in London, where rising levels are in the chalk, the great depths mean that the situation is not really a problem, while in Birmingham, where levels are rising in the triassic sandstones such recharge schemes could cause problems.

Brian Wilkinson questioned whether any work had been done in identifying sources of particular pollutants. Brian Ellis confirmed that sources could be identified from the literature, and for this reason an integrated approach was needed for the control of pollution, although this was unlikely to emerge readily.

Howard Wheater (Imperial College), referring to the subject of distributed modelling, said that RORB, which he applied in the River Lee area, was a standard and simple technique for catchment management; he questioned why more widespread use of this approach had not been made. Mike Hall wondered whether such a model was too simple and perhaps misleading, in that individual subcatchments might not be well represented within a catchment-wide mode. Howard referred to its advantages of flexibility in investigating implications of different storage policies. **John Packman**, speaking for the Institute of Hydrology, said that in their experience RORB gave good results for downstream situations, but he had grave doubts about small upstream subcatchments - something which the RORB manual itself recognised. For small upstream subcatchments he suggested that discrete models were better.

Craig Woolhouse (NRA Thames) pointed out that RORB gave information on the quantity aspect only and that other models were also needed for validation. John Gardner, commenting on RORB's application within the Thames region, said that the model had been useful for investigating implications of changes from rural to urban land use. It also allowed them to interface these results with those from other models such as FROSIM, developed in-house (originally with the GLC, Thames Water and now NRA). He referred to work done at Aylesbury and the forthcoming Thames NRA report on "Catchment Planning" for which he welcomed comments from delegates.

Jeremy Neal (then of Flood Hazard Research Centre, Middlesex Polytechnic) enquired how far the rewritten CIRIA document would go with reference to "sewerage law". Brian Ellis replied that it was identifying the legislative framework rather than solutions.

John Packman referred to earlier comments about pond failure, making the point that the problem arose in designing a pond for a certain storm, with failure occurring for a different type of storm. He stressed therefore, the problems in relying upon models for design. Brian Ellis suggested that the greater experience and evidence available in the USA should be of value.

Finally, **Carolyn Roberts** (College of SS Paul & Mary) gave a brief plug for her poster displays of work done throughout the UK, all of which concentrated on a catchment-wide approach, rather than looking at individual development sites.

Chalk, groundwater and low flows

BHS Southern Section Meeting 24 January 1990

The two papers presented at this meeting considered the baseflows in the chalk area of the River Kennet and their relationships and reviewed the development of the chalk aquifer of the Isle of Wight.

The first paper "*Baseflows in the Thames Chalk Area - Do they relate to anything?*' was presented by **Mike Owen** of NRA Thames Region, but much of the original work had been done by **Brian Hardcastle** and **Brian Greenfield** and since updated. It concerned the Kennet Valley at the western end of the London Basin. In this area the Kennet is a typical chalk stream with winterbourne tributaries. The valley is underlain by chalk until it reaches the Newbury area, where the chalk is then overlain by the Tertiary London Clay.

The catchment is now well instrumented and is not heavily used in abstraction terms, but there has been much recent complaint about the state of the river, particularly in the upper area. The modelling in the area was based on Gerry Mander's relationship for unconfined storage, where flow is proportional to the square of available groundwater lead. This was used in preference to the traditional exponential recession curves which did not fit well.

The model was first applied to the precursors of the West Berkshire augmentation scheme, where net gains were being investigated. Using the relationship a good reproduction of the flow hydrograph of the Lambourn was produced with some (but not all) wells. The results were always offset in time because of the groundwater level to flow time relationship. It was also difficult to use in ephemeral stream areas of the catchment.

Latterly the modelling strategy was used in the Marlborough area at Axford, where a groundwater supply abstraction close to the river exports water to Swindon. More abstraction was necessary and a river minimum residual flow condition (MRF) was to be applied to the increase. Using Mander's equation a relationship between groundwater level and flow was produced which predicted when the MRF would be reached. Other methods which were tried did not give a good fit. The model worked well so far.

To conclude, Mike said that river flows in chalk areas related well to groundwater levels, provided the right spot in the catchment was picked for correlation. The fit was least good in ephemeral stream areas.

Questions were then asked regarding abstraction levels in the catchments whether they had changed radically and whether other models had been applied to the same areas. Abstraction levels as low as 15% of annual recharge had caused problems in the ephemeral area in some NRA regions because of the small heads involved in springflows. Mike said that changes in abstraction had been allowed for where necessary and that other models had not given such good results. The most difficult area to model and predict was the ephemeral area but the Mander method had proved itself to be a good working relationship.

Discussion then revolved around whether complaints about over-abstraction were about level rather than flow which is often a matter of river-keeping. This was followed by questions of drought perception and whether the NRA could convince people that infrequent drought events occurred naturally. This led on to the proposed NRA licencing policy to identify chalk catchments with an over-abstraction problem. In most cases remedies to the problems, whether real or perceived, are available but they would cost large amounts of money.

The second paper was entitled "*Development of the Chalk Aquifer of the Isle of Wight*', presented by **Paul Shaw** of the NRA Southern Region. He began with a summary of how the 1989 drought had affected the chalk of southern England. He then went on to talk in detail about the chalk catchments on the Isle of Wight. Here the chalk occurs in very small outcrops but it is extremely important in water supply terms because of the island location. On the Isle of Wight the public water supply demand always has to be considered as well as the hydrological cycle and baseflow.

Over much of the island the chalk is underlain by the Upper Greensand and the two often act as a single aquifer although the mode of linkage is uncertain. Combe deposits are also important and mask many of the springlines. These, together with the landslips in many areas, make water balance calculations very difficult.

All the sections of chalk aquifer are heavily developed for water supply but the hydrogeological conditions vary enormously, from almost horizontal bedding to almost vertical in the east of the island. Some of the abstraction points are conventional boreholes but others vary from large diameter wells to collecting mains/adits and an old railway tunnel which drains part of one section of aquifer.

Paul then contrasted the very high February 1988 groundwater levels with the low 1989 levels, with particular reference to the central chalk block where conditions seemed to be almost perched in some areas. This was followed by a case study at Ashey where the chalk and greensand are seen to act separately. This became evident during a test pumping when different drawdown could be seen in chalk and greensand boreholes.

Questions then centred around the degree of water supply abstraction development and how this could be related to the baseflows because of the difficulties of baseflow separation and spring measurement. Paul admitted that this was very difficult to do, but said that estimates had been made which agreed reasonably well with later monitoring. He also confirmed that the water table in the central block of the chalk behaves oddly, although from the evidence of observation borehole data it does not seem to be perched.

P Midgley
Hampshire

INDEX

An index to the first 25 issues of *Circulation* is in preparation and is expected to appear with *Circulation 27* in August.

APOLOGY

Readers of *Circulation 25* may have found the report of the BHS South West Section meeting on "Soils, Water and Engineering" difficult to follow. This was through no fault of the reporter, **Bruce Webb**: two pages of the original report were transposed when being typed, and the proof-reader failed to spot what had happened. We apologise to Bruce, to **Malcolm Anderson** and **Jim Pontin** whose contributions were intermingled, and to members reading it.

IHE
DELFT

International Institute
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Postgraduate Diploma Courses and M.Sc. programmes in Civil and Environmental Engineering

During its 34th Academic Year, from 18 October 1990 till early September 1991, IHE will offer the following one-year postgraduate courses:

A Postgraduate Course in Hydraulic Engineering

The course in Hydraulic engineering has six branches corresponding as closely as possible to needs expressed by developing countries. The study programme of each branch includes basic subjects to be studied by every participant, and facultative subjects from which participants make a selection.

The various branches are:

Branch 'a'
Hydraulic engineering in upland areas
for the design and construction of dams, barrages, weirs, river control and flood protection.

Branche 'b'
Hydraulic engineering in lowland areas
for the design, operation and management of plans and structures for flood protection and the control of rivers and estuaries.

Branch 'c'
Land and water development
for the development of soil and water resources for agricultural and other purposes.

Branch 'd'
Experimental and computational hydraulics
for mathematical modelling and laboratory investigations in support of the design, management and construction of various hydraulic structures and works.

Branch 'e'
Port engineering
for the planning, design and construction of ports and harbours.

Branch 'f'
Coastal and offshore engineering
study of the physical properties of the sea and the coast and their influence on coastal and offshore structures.

A Postgraduate Course for Hydrologists

The course for Hydrologists is directed towards solving water-related problems of quantity, quality and availability. The growing need for guaranteed supplies of water, and protection from flooding and pollution, imposes heavy demands on hydrological scientists and engineers. Participants study the latest developments in the field and are trained in the use of new methods and techniques. Apart from the study of fundamental transport processes, the course deals with engineering hydrology, which includes aspects of analysis, planning and design.

Awards
Both courses lead to a Certificate of Attendance, Diploma or Diploma with Distinction. *Participants who have obtained the Diploma with good results can continue with the IHE M.Sc. Programme (additional duration approximately 6 months).*

Admission requirements
For both courses a degree in civil engineering or a related field of science or engineering, with at last three years of practical experience. A good command of the English language is indispensable.

Tuition fee: 5,000 Dutch guilders.

Fellowships
Donors that can be approached for fellowships include various international organizations such as UNESCO, UNEP, UNDP, Food and Agriculture Organization (FAO), World Meteorological Organization (WMO), Commission of the European Communities (EEC), Association of Southeast Asian Nations, International Association of Ports and Harbours, etc. Furthermore, nationals coming from developing countries may apply at the Netherlands diplomatic representatives in their country.

Candidates are always advised to check first with their employer or with their own government if financing for their studies could be provided from local sources, or from training components of development project budgets.

In addition, during 1990 IHE will organize the following

Short Courses

Basics of Modelling Groundwater Flow and Contaminant Transport
from March 5-9, 1990

International Seminar on Port Management
from May 7 - June 15, 1990

Stochastic and Geostatistical Analysis in Groundwater Modelling
from June 18-22, 1990

Modelling for Groundwater Management
from June 25 - September 28, 1990

Senior Advanced Course on Appropriate Modernization and Management of Irrigation Systems
from September 10 - October 19, 1990

Applied Modelling of Groundwater Pollution
October - November 1990

For all courses, please contact the IHE registrar for detailed brochures, application forms and further information. Address: P.O. Box 3015, 2601 DA Delft, The Netherlands. Phone: +31-15-784466. Telex: 38099 ihe nl. Cable: Interwater. Fax: +31-15-122921.
IHE in Delft also offers postgraduate diploma courses in Sanitary Engineering, Water Quality Management, Environmental Science and Technology, Transportation and Road Engineering and can organize courses on topics in its areas of competence tailored to special needs, which can then be conducted either in Delft or overseas. IHE assists governments and universities in developing countries in designing and conducting postgraduate training courses. IHE moreover carries out research in hydraulic engineering, hydrology, sanitary engineering, water quality mangement and environmental management.

BOOKS

Evaporation studies

Evaporation in the Uplands, I. R. Calder, 1990. 148pp. John Wiley and Sons, Chichester, UK. £29.95 Hardback. ISBN 0 471 92487 3

Penman would have loved this book: the very meat of the matter of evaporation from plant-covered surfaces is attacked from all angles, for a zone of Britain for which prediction is essential (yet was missing for much of the history of both water resource and forestry development). Possibly the biophysiological approach is underplayed, but the logical and highly practical way in which the author has approached every new predictive problem presented by the physics of conifer, heather and grassland canopies is very impressive; so is the illustration of the book.

Calder reviews the signal contribution of the late Frank Law to the origins of the debate about conifer afforestation of upland catchments and shows how the move to a more extensive experimental scale at Plynlimon eventually required the controlled lysimeter experiments which Law had pioneered. Law had also carried out lysimeter studies on heather, a canopy type relevant to large areas of the uplands. A chapter on the basic physics and physiology of evaporation includes the contributions of Dalton, Penman, Monteith and Rutter, amongst others; its successor takes up the interception process alone.

There then begins the intriguing battle for field knowledge, from a series of appropriate field experiments, via lysimeters, gamma-ray attenuation and net rainfall sheets, to the use of the data to calibrate or test predictive models. As a collaborator with Calder on his simplest model, it is important for me to recognise his continual aim to produce "appropriate technology" for practical hydrology, whilst at the same time realising the restrictions imposed by using available data. His chapter on a test area, the Crinan Canal, represents "the proof of the pudding" in this respect. A final chapter reviews the remaining research tasks, such as adequate measurements and altitudinal effects.

This is a highly authoritative account by a researcher who, thanks to the encouragement of the Institute of Hydrology and to the efforts of his select and devoted team, has been able to show his flair for the appropriate field experiment. That 25 of his 129 references are by the author himself, and a further 31 by the IH team, shows the measure of this book's authority. It is highly readable by any environmental scientist. Many will enjoy it; one more who would have done so is Frank Law.

Malcolm Newson
Newcastle upon Tyne

Weather radar

Applications of Weather Radar Systems - a Guide to Uses of Radar Data in Meteorology and Hydrology, C. G. Collier, 1989. 294 pp, 132 figures (8 in colour). Ellis Horwood Ltd/John Wiley & Sons, Chichester. £44.50 Hardback. ISBN 0 74580510 8.

The book can be conveniently divided into two halves - theory/methods and uses. Following the introductory chapter, the next four chapters cover basic theory, measurement of precipitation, weather radar networks and methods of estimating precipitation from satellite data (used to extend data available from radar networks). In the final five chapters are described the use of radar for short period forecasting; flood forecasting; hydrometeorological studies; effects of man and meteorological research.

The book is well written and easy to read. Many of the relevant equations are included which are useful for the more mathematically oriented readers, but can easily be passed over by the more general reader. The author refers very fully to his own and other previous work, often using the figures as well as giving full references. In total there are 132 figures of which 8 are in colour. Of the 700 or so references about half are less than 10 years old. I think the assessment of cause and the sizes of the errors of radar and satellite estimates of rainfall rates will be particularly useful. There are some typing/typesetting errors: in Equation 2.4 the whole summation should be squared rather than only the final term; in Figure 2.4, $\sigma_b=\sigma/(\pi a^2)$, not σ/π_a^2.

I think that this will be a useful reference book for university students as well as the research scientist. It provides a useful review as well as a starting point for further research, though at nearly £45 a copy, I cannot see many copies being bought privately.

John Stewart
Wallingford

Reservoir management

Water Management in Reservoirs, L. Votruba and V. Broza, 1989. Developments in Water Science, Volume 33. Elsevier, Amsterdam. 444pp. + illustr. ISBN 0 444 98933 1

For 5000 years civilisations have created reservoirs to overcome problems of seasonal water shortage. Today reservoirs form the centre of large-scale water management systems, many providing inter-annual storage to mitigate problems of year-to-year rainfall/runoff variations. River regulation is a fundamental component of modern hydrology.

Water Management in Reservoirs introduces methods for solving technical and economic problems related to reservoir development. The book is divided into five sections. The first section (A) provides a classification of reservoirs and introduces the basic graphical, mathematical and statistical tools for analysing hydrological data. Section B applies these tools to the analysis of reservoir function for storage and release control (multi-year, annual, short-term and compensation) giving due regard to reservoir systems as well as to individual reservoirs. The third and fourth sections focus on data analyses to optimise the flood-control functions of reservoirs (C) and to develop operational control rules (D). Finally Section E examines the role of reservoirs in water-management systems, the economic effectiveness of reservoirs, and reservoirs in the environment.

For those requiring a straightforward, state-of-the-art treatment of approaches and tools to assess hydrological problems related to the design and operation of individual reservoirs or integrated systems, this book is not recommended. However, for those interested in the science of hydrology in general, Votruba and Broza make a useful contribution to the literature. This very readable volume provides an interesting insight into problems of water management and the approaches recommended for their solution in an eastern European, relatively dry country. It offers a useful synthesis of the (predominantly Czechoslovakian) literature, but of the 300 or so references about 80% pre-date 1980.

In Czechoslovakia, the mean annual runoff is 216mm but it can fall to 127mm in a low-flow year and the drought season can end at any time from September through to March. Reservoirs, often in an integrated network, are seen as the basis of water management. By the year 2000, if all those planned are constructed, Czechoslovakia will have 495 reservoirs, an increase of 310 since 1970.

The book reflects the three-stage development of the analysis of water management of reservoirs. Firstly, prior to 1960, the function of an isolated reservoir with short-term, or within-year, control cycle was determined by direct methods in real series. Secondly, since the 1950's, the solution of the function of isolated reservoirs with a within-year and over-year control cycle, was achieved using probability methods. Thirdly, since 1970, the solution of the functions of reservoirs in single-purpose and multi-purpose systems has given due regard to socio-economic considerations.

Although the book includes a final chapter on 'Reservoirs and the Environment', it fails to give due weight to environmental conservation, in particular to the problems of setting patterns of prescribed flows to maintain the river environment downstream of the dam. Indeed, the book ends with the statement "Environmental protection has its limits: we cannot stop the construction or limit the main functions of reservoirs".

Following the changes that began in the USA and Western Europe during the 1980's, and recent political changes in eastern Europe, Czechoslovakian reservoir operations are likely to enter a fourth phase of development in the near future, one that gives due regard to the problems of allocating water to sustain environmental values.

Geoff Petts
Loughborough

Academic link for IH

The Institute of Hydrology has been accorded the status of an Associated Institution of the University of Reading. IH has long had good working links with the Departments of Meteorology and of Soil Science, and is now involved in some additional teaching in the Postgraduate Research Institute for Sedimentology. The Institute is very pleased therefore that this partnership is to be strengthened in this way.

Errata

In *Circulation 25* some of the BHS Committee's telephone numbers were printed incorrectly.
Dr Susan Walker's telephone number at North West Water is 0925 233577, and her Fax number is 0925 233368.
Dr John Pirt's Fax number is 0602 817743.

FORTHCOMING EVENTS

Courses

FOUR-DAY RESIDENTIAL COURSE
Hydraulics for River Engineers
2-5 July 1990
University of Bradford

This course is relevant to scientists, hydrologists and practising engineers involved with river engineering. It aims to provide an up-to-date review of hydraulics by means of lectures, design case-studies and model applications using PCs. Topics will include open channel and floodplain flows, sediment transport, flow measurement, dam break analysis, river intakes, control structures, modelling unsteady flow, HEC-2 application and gradually varying flow. The scope will extend well beyond undergraduate hydraulics, aiming to increase design efficiency through improved understanding of the subject and application of computer models.

It is possible to attend only one, two or three days of this course at a reduced rate; the full course fee is £310, with full-board accommodation for £85 extra. Details of the programme may be obtained from Professor R.A. Falconer, Department of Civil Engineering, University of Bradford, Bradford, West Yorkshire, BD7 1DP. Telephone: 0274 733466; Fax: 0274 305340.

Meetings

SUMMER SEMINARS
25-29 June 1990
Dubrovnik, Yugoslavia

Three seminars are being run by IRTCUD and two American universities, with support from UNESCO, UNDP and the EC.

One is on **Urban drainage and receiving waters**, covering effects of polluted urban drainage on rivers, lakes, reservoirs and coastal waters, lasting five days.

Running concurrently is a seminar on **Methods for urban storm drainage systems analysis, design, renovation and control**, dealing with engineering aspects of design and rehabilitation, and emphasising the application of computers.

The third seminar, **Water related information retrieval**, looks at internationally-available data bases and setting up local or national information systems, focussing on the use of compact discs and on the UNESCO CDS/ISIS software.

Contact: Prof. Cedo Maksimovic, IRTCUD, Faculty of Civil Engineering, P.O. Box 895, 11000 Belgrade, Yugoslavia. Fax: 010 38 11 320-237 or 010 38 11 329-190.

INTERNATIONAL SYMPOSIUM
Remote Sensing and Water Resources
20-24 August 1990
Enschede, The Netherlands

Designed for specialists and users, this symposium will cover recent developments in the application and operation of remote sensing for water resources studies, including atmospheric, surface and ground water, excluding only the sea.

Topics to be included are rainfall, snow and ice, soil water and evapotranspiration, water management, catchment hydrology and modelling, water temperature, water quality and sedimentation, hydrogeology and hydrological applications of GIS and remote sensing, future perspectives and education.

The proceedings will be pre-published in two volumes with colour photographs, price Dfl. 185.00, to be ordered from the conference secretariat.

The address for further details is Convention Bureau Twente, P.O.B. 1003, 7500 BA Enschede, The Netherlands. Telephone: 053 30 30 70; Fax: 053 30 41 62.

INTERNATIONAL CONFERENCE
River Flood Hydraulics
17-20 September 1990
Wallingford

The importance of river management has increased alongside the requirement for a broad view of the entire catchment. The aim of the conference is to link experimental and analytical research to the needs of engineering practice. Topics have been selected to cover important areas of research interest and practical importance, in the hope of advancing the art of river engineering. These include flood analysis and prediction, engineering design, field data, physical and mathematical modelling, hydraulics of flood flows, sediment transport and geomorphology.

The total cost, including accommodation in Oxford, the published papers, banquet and technical visit, is £448.50, reduced to £437 for BHS members. The conference organiser is Jacqueline Watts, Hydraulics Research Limited, Crowmarsh Gifford, Wallingford, OX10 8BA. Telephone: 0491 35381; Fax: 0491 32233.

CONFERENCE
Hydrological Research Basins and the Environment
24-28 September 1990
Wageningen, The Netherlands

This conference, to be held at the International Agricultural Centre, follows the third General Meeting of the European Network of Experimental and Representative Basins.

Its objectives are to bring together scientists working in this field and to give them an opportunity to exchange their experiences and to discuss their results in a few selected areas. An interchange of ideas will be encouraged, in order to identify needs for international cooperation in research projects and to outline directions for future developments.

The major themes are: (i) Biogeochemical cycles and transport of contaminants in groundwater, (ii) Man-made effects, (iii) Plant-water-soil interactions, and (iv) Surface water quality.

Participants should register before **1 July 1990**; a few contributions for the poster session might still be accepted.

For details, contact P. Warmerdam, Agricultural University Wageningen, Dept. of Hydrology, Soil Physics and Hydraulics, Nieuwe Kanaal 11, 6709 PA Wageningen, The Netherlands. Tel.: 8370 82400; Fax :8370 84759.

IWEM CONFERENCE
Water and the Environment
30 April - 2 May 1991
Birmingham

Papers are invited for this conference on the environmental impact of water services: synopses of no more than 300 words should have reached the IWEM office by **30 April**, but might still be accepted. Final manuscripts are required by **30 November 1990**.

Subject areas to be considered include the impact of river engineering and reservoir construction, water abstraction and protection of river and underground water, effects of discharges, avoidance of adverse consequences from landfill engineering, treatment works design and environmental impact assessment.

Further information may be obtained from the Conference Manager, The Institution of Water and Environmental Management, 15 John Street, London WC1N 2EB. Telephone: 071 831 3110; Fax 071 405 4967.

Diary

25th May 1990
BHS National Meeting
"The Future of Distributed Modelling"
Venue: The University of Lancaster.
Contact: Keith Beven, 0524 65201, ext. 4312.

13th June 1990
Hazards Forum
"Floods and Gales" (coastal, not hydrological)
Time: 5.00 for 5.30 p.m.
Venue: Institution of Civil Engineers, 1-7 Great George Street, Westminster, London SW1.
Contact: Professor Peter Wolf, 081-340 6638.

18th-19th October 1990
BHS North Tyne Field Meeting
Seminar and field day on recent hydrological, geomorphological, geochemical and fisheries research on land and water management at and near Kielder Reservoir.
Venue: Riverdale Hall Hotel, Bellingham, Northumberland (numbers limited).
Contact: Professor Malcolm Newson, Dept. of Geography, University of Newcastle, NE1 7RU.

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Please address all correspondence to the Editor, Celia Kirby, Institute of Hydrology, Wallingford, OX10 8BB. Telephone: 0491-38800 extension 2360.