

Specific recommendations

The review has sought more to communicate than to judge; there are few general answers to be found to flood forecasting problems. However, a number of specific points which have emerged from the review are listed below.

- 7.1 Flood warning problems differ widely in character and there may be good reason to design telemetry systems and flood forecasting methods on a "one-off" basis. However, given the breadth of experience currently being gained, there may soon be scope for a greater Interchange of methodologies. The sharing of computer software may be particularly appropriate if a trend towards localized microcomputer based systems materializes.
- 7.2 It is desirable that the choice of computer for telemetry control should recognize the needs of flood forecasting modellers, either by the support of a high level programming language or through compatibility with a further computer on which modelling can be carried out.
- 7.3 There is need of publication of operational experience gained in the use of automatic data validation and "in-filling" techniques.
- 7.4 Flood warnings based on monitoring river levels should not be undervalued. There is scope to refine monitoring methods by linking the issue of an alarm to both river level and rate of river level rise.
- 7.5 Simple flood routing methods based on regression continue to be found useful 'in some flood warning schemes. It is recommended that, where practicable, correlations are sought between flows rather than levels.
- 7.6 The variable parameter Muskingum-Cunge method of flow routing has much to commend it. There is, however, need of clearer guidance as to how the method is best implemented in real time.
- 7.7 There is need of a greater awareness of the special character of real time forecasting applications of hydrological models. Models designed to simulate past events may require substantial modification for real time use. It is recommended that, where practicable, models are calibrated in the real time structure in which they are destined for use.
- 7.8 Basic attributes sought in a flood forecasting model are accuracy, reliability and timeliness. It is especially desirable that, where possible, model forecasts are interpreted or corrected by reference to telemetered flow data.
- 7.9 Although other forms of real time correction may be appropriate with particular models, the "error prediction" method is to be generally recommended.
- 7.10 One goal of further research should be the development of an objective function that is capable of balancing "value" errors and "timing" errors.
- 7.11 The transfer function method is Intrinsically suited to real time forecasting. However, its proponents could do much to make the approach more comprehensible by offering simple unidirectional guidance in the choice and calibration of transfer function models.
- 7.12 Scope exists to make greater use of physics based models and remote sensing techniques in snowmelt forecasting.
- 7.13 It is suggested that the application of generalized rainfall/runoff models to forecast flows on

ungauged rivers is unlikely to yield forecasts that are sufficiently good to be the sole basis of flood warnings. An exception to this may be the application of simple rainfall/runoff models (based on catchment characteristics) and radar derived rainfall data to "flag" extreme conditions in localities for which no regular flood warning scheme is justified.

- 7.14 Weather radar has qualities that make it exceptionally useful in flood forecasting. However, techniques using quantitative rainfall data in models are still being developed and much work remains to be done on the calibration and quality control of radar rainfall data. Perhaps a theoretical study, of the tolerance of flood forecasting models to errors in rainfall estimation, would complement operational assessments.
- 7.15 Calibration of rainfall/runoff models to yield optimum forecasts at a specific lead time may make an implicit allowance for continuing rainfall. This may create difficulties if the model is subsequently used with explicit forecasts of rainfall.
- 7.16 Effective flood warning on rapidly responding catchments may be heavily dependent on rainfall forecasts. This calls for close co-ordination of meteorological and hydrological services. In certain cases there may be a role for simple algorithmic methods of rainfall forecasting.
- 7.17 Consideration should be given to carrying out research into methods whereby the issue of a flood warning is linked to the probability of a specified flow being exceeded given present conditions and probabilistic scenarios of future rainfall.