PRACTICAL SOLUTION OF SOME FORWARD AND INVERSE PROBLEMS IN HYDROLOGY

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1. INTRODUCTION

What is the need for solving inverse problems in hydrology? The basic answer to this question is that many laws in hydrology invoke parameters that are not easily measured or even observed. This means that modelling will require at the very least a calibration of parameters from observation of other variables, often termed indirect observations. For example the transmissivity or rate at which water is transmitted through an aquifer depends on the physical properties of the medium and these properties are reflected partly in the observations of aquifer water level. Often hydrologic models require additional knowledge of the specific functional forms of system dependent terms within the general model structure. For example, the functional approximation of hydraulic conductivity in Richards equation for transport in unsaturated soil depends on the soil properties. These model structure identification and parameter estimation problems from indirect observations and other prior knowledge represent fundamental inverse problems.

Why in the title of the paper, qualify the solution of inverse problems with the word 'practical' and why include 'forward' with 'inverse' problems? Practical solution implies that the forward modelling task has a specific purpose, perhaps ranging through simple investigatory analysis, on-line operational or off-line management and planning to improved scientific understanding of natural processes. The inclusion of forward with inverse problems is necessary because solving an inverse problem requires awareness of the forward modelling aspects. In practice, the motivation for solving an inverse problem, and the formulation eventually selected, is dependent on the forward problem of interest.