

CATCHMENT HYDROLOGY AND SUSTAINABLE MANAGEMENT (CHASM)

A hydrological research initiative in the UK.

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CHASM is part of a research initiative to establish seven widely-distributed instrumented catchments throughout the UK in which hydrological experiments can be undertaken. Geomorphological and hydro-ecological studies will also be integrated into the research programme. Four catchments are serviced by the CHASM group of universities and research institutes. These are the Eden in the Pennines, the Feshie in the Cairngorms, the upper Severn in Wales and the River Oona in County Tyrone. The CHASM group is chaired by Professor Enda O'Connell at Newcastle University and includes scientists from the Universities of Aberdeen, Dundee, Durham, Lancaster, Leeds, and Ulster. Research institutes in the group include the NERC Centre for Ecology and Hydrology. Scientists from the Macaulay Land Use Research Institute are involved in the Feshie study.

A complimentary project, LOCAR, focuses on three lowland catchments in central and southern England: the Pang/Lambourne catchment in Berkshire (on chalk); the Frome in Dorset (on chalk / Greensand) and the Tern in Shropshire (on Trias sandstone). Already given substantial NERC funding LOCAR focuses on problems associated with water abstractions in two major English aquifers and the effects of abstraction on hydrology and ecology. LOCAR is headed by Professor Howard Wheater at Imperial College and includes representatives from the Universities of Birmingham and Exeter, as well as from the NERC's Centre for Ecology and Hydrology and the British Geological Survey..

In essence NICHE is underpinned by a belief that sustainable management of water resources must be underpinned by science and aims to:

- provide an international lead in promoting sustainable development of water resources.
- promote understanding through experimentation and predictive modelling, e.g. of hydrological conditions under future climate scenarios.
- provide the understanding needed to define levels of investment required to counter climate change.
- quantify the levels of stress that catchments can absorb.
- provide runoff models at catchment scales of about 100km², i.e. the scale at which sustainable development management decisions will have to be made. This is ten times the scale of most existing models and the need to scale up our existing understanding lies at the heart of NICHE.
- provide new instrumentation and imaginative ways of sampling the UK's spatial heterogeneity in topography, soils, vegetation and geology.
- provide a range of results applicable across the UK's bioclimatic zones.
- research anthropogenic influences, especially in relation to ecological diversity and biogeochemical cycling.
- provide new insights into hydrological and ecological functioning of mesoscale catchments and to generalize insights by coverage of a wide range of hydrological regimes.

The study of scalar responses underpins the CHASM and LOCAR initiatives and a uniform approach to measurement across all catchments is being developed. A key question in CHASM is why hydrological responses in large catchments are so difficult to predict by simple scaling of small catchment responses. Landscape variability has to be taken into account and it is hoped that new developments in scaling theory will emerge from field measurements made at similar scales in areas of different hydrological response. A nested patch / hillslope / subcatchment / catchment design is the essence of the field monitoring approach being adopted, sub-catchments within each of the four CHASM catchments being identified at micro – (1 km²), mini- (10km²) and meso- (100km²) scales. These will, hopefully, define the scale dependence of response, underpin the development of new

scaling theories, and provide a rational, scientific, framework to address a range of anthropogenic issues.

For each catchment funding is available to provide for

- (i) installation of permanent instrumentation. This includes an automatic weather station for each catchment, precipitation gauges, streamflow gauges, and equipment for water chemistry sampling.
- (ii) installation of staged instrumentation. This will provide for measurement of water in the unsaturated zone and includes funds for tensiometers, permeameters, lysimeters etc. These data will be collected at the patch / hillslope / soil profile scale.
- (iii) purchase of mobile light-weight tracked vehicle to deploy field equipment in remote locations.
- (iv) data purchase and management
- (v) appointment of a senior technician
- (vi) transport within the catchment. A Land Rover or equivalent will be available for each catchment.

The CHASM catchments represent a range of bioclimatic environments in the UK. The Feshie is a very steep highland catchment, in some of the most heavily glaciated areas of upland Britain. The river is characterised by coarse bedload and wide floodplains. Streamflow includes a significant snowmelt component. The upper Severn catchment is also an upland catchment, extensively planted in conifers many of which have now matured and been harvested. The Eden is another upland catchment in the Pennines with extensive mire systems, several Sites of Special Scientific Interest and excellent salmonid fisheries. In contrast to these the Oona is a lowland catchment, entirely under 300m. Characterised by drumlin topography, the catchment is situated on very impermeable soils.

A range of anthropogenic problems is represented, to varying degrees of intensity, in all four catchments: overgrazing; acid deposition - the Allt a Mharcaidh catchment in the Feshie system is part of the UK Scandinavian Surface Water Acidification project; climatic variability; pathogens in upland water sources; instream habitat enhancement, rehabilitation and restoration. The upper Severn has long been the focus of evapotranspiration studies associated with afforestation, the Eden is experiencing water abstraction problems and the Oona has been extensively drained arterially as part of the cross-border Blackwater Drainage Scheme in the 1980s. Extensive habitat improvement work has also been undertaken on the Oona to improve salmonid fisheries. The hydro-ecology of instream habitats is likely to be a developing area of research in the Oona study, alongside the study of phosphorus loss mechanisms from soil to rivers and lakes.

To date, the CHASM project has matured to the stage at which experimental designs have now been approved for all four catchments. A CHASM Experimental sub-committee has been established and databases brought together for each of the four catchments to identify appropriate sub-catchments within each. A programme of field visits to all catchments took place in the summer of 2000 to confirm initial micro- and mini- catchments. It is hoped that the first phase of instrumentation will take place in spring 2001.

The Northern Ireland catchment study will be seen through CHASM and NICHE as part of a national infrastructure. Management of all the CHASM catchments is to involve catchment management committees on which potential endusers of research outcomes are represented. The Environment Agency and the Scottish Environmental Protection Agency are involved with the English, Welsh and Scottish catchments. The Oona Management Committee includes representation from the Northern Ireland Rivers Agency, Environment and Heritage Service in the Department of the Environment for Northern Ireland, the Northern Ireland Geological Survey and the Northern Ireland Meteorological Office. It is also hoped to involve representation from the Blackwater Catchment Rural Development Strategy.

