Distributed Temperature Sensing (DTS): A new tool to study catchment hydrologic responses in small streams

Introduction

This poster presents the outline of the research project “Modelling spatial catchment hydrology using Distributed Temperature Sensing (DTS) and Earth Observation Systems”. Numerous models have been built to replicate and understand the hydrologic process, but are heavily constrained by data availability over varying spatial and temporal scales on the one hand. This project combines new data and model based technologies to improve the spatial parameterization and modelling of catchment hydrological processes.

Objectives

- Identify lateral inflows to the stream using a Distributed Temperature Sensing System (DTS).
- Model instream temperature and lateral inflows using energy based model. DTS data will be used to parameterize the model in relation to the spatial characteristics of the upland contributing land areas.
- Assess the hydrological responses of different catchment land use patterns.
- Model spatial catchment hydrology using an integrated catchment model and upscale the local catchment knowledge to regional model of Sjælland area.

Instream Temperature and hydrological Modelling

An energy based model will be created to model instream temperature and quantify lateral inflows. This is facilitated by the application of model inputs derived from rich spatial data sources comprising continuous temperature data, weather data, channel morphology, hydraulics and near stream land cover data. GIS and remotely sensed data will be incorporated into the analysis for many of these parameters. At a later stage, temperature data from the DTS system will be used to parameterize a spatially distributed hydrological model in relation to the spatial characteristics of the upland contributing land areas.

Preliminary Field Work Results

Boreholes, Transect, Stream networks

Location of the stream Elverdamsåen in the island Sjælland, Denmark

A 2 km fiber optic cable with DTS system was installed in a small stream in Sjælland, Denmark. The DTS system measures temperature by inducting a light pulse from a laser into a fiber optic cable and then measuring the backscattered light to determine time-of-flight and then position. The resultant temperature data from the DTS instrument will be used to identify lateral inflows.

Instream temperature model

Earth Observation Systems

DTS data

DTU Environment
Department of Environmental Engineering