

## **SWEDISH HYDROLOGICAL PREDICTIONS FOR THE ENVIRONMENT (S-HYPE) - NATIONAL PROCESS-BASED MODELLING TOOL TO SUPPORT WATER AUTHORITIES WITH NUTRIENT SCENARIOS IN CATCHMENTS AND THE COASTAL ZONE**

*Joel Dahné, Swedish meteorological and hydrological institute (SMHI)*

A new hydrological model called HYPE (Hydrological Predictions for the Environment) developed at SMHI has recently been calibrated and evaluated for Sweden (S-HYPE). The aim is to provide the water authorities (WA) in Sweden with a tool for decision making in their work with the Swedish interpretation of the water framework directive (WFD). The water authorities are challenged with the task of classifying all water bodies and river reaches in Sweden (approximately 40 000) according to their chemical and ecological status. The model will also be used by the WA in making action plans analyses for lowering the load of nutrients to the coastal zone of the Baltic Sea. S-HYPE has been tested within the HOME water system for visualisation of results, calculation of source apportionment and estimating the effect of various nutrient reducing measures. The HOME water divides the coast into 606 marine basins. Today, HOME water is already operational but the model used is at a lower resolution than required by the WA. The challenge in the new model approach is the high spatial resolution and process description required for scenario simulations. In the HYPE model structure, the landscape is divided into sub catchments given an area, altitude and water flow directions (i.e to down stream sub catchment). Furthermore, each sub catchment is divided into classes according to differences in vegetation, soil type and soil depth. Each of these classes can have a maximum of three soil layers with individual thicknesses, each layer with individual computations of soil wetness and nutrient processes. In agricultural lands, the soil is divided into the maximum number of layers, representing the top soil, intermediate layer and a sub layer. The model simulates water flows, and soil turnover of nitrogen and phosphorus for all classes within each sub basin. Nutrients follow the same pathways as water in the model: surface runoff, macropore flow, tile drainage and groundwater flow. Rate coefficients and parameter values are related to either soil type or vegetation. Rivers and lakes are described separately with routines for turnover of nutrients in each hydrological compartment. The data required by the model, besides the geographical attributes mentioned above, are daily precipitation and daily mean air temperature. At the moment the model consists of 17 000 sub catchments covering almost 500 000 km<sup>2</sup>, including parts of Norway and Finland with runoff to Sweden. The number of sub catchments within S-HYPE will increase with time to harmonize with the WFD. S-HYPE has recently been tested in operational mode and evaluated over a ten year period regarding flow, and nitrogen and phosphorus concentrations. The results shows high accuracy regarding the hydrological part for the unregulated watercourses where the model is able to capture fluctuations well, with a median R<sup>2</sup> of 0.74, 168 gauging stations (g.s). The mean absolute error for both regulated and unregulated (total 322 g.s ) is 10%. For the nutrients, the model manages to describe the spatial variation and distinguish between high and low concentrations. But the fluctuations in time are not well captured, especially for phosphorus. The mean absolute error for total Nitrogen (600 g.s) and total Phosphorus (598 g.s) is 37% and 57% respectively.