Regionalization of HYPE parameters

The HYPE parameters can be grouped into different categories based on the scale at which they operate. Parameters that operate at the HRU scale are generally soil type or landuse dependent and their values are estimated based either on landuse or soil type. There are also a group of parameters that are defined at a subbasin scale. These include those parameters designated as *general parameters* that are assigned the same value throught the model domain and *super parameters*, which are region specific parameters. This section gives a brief introduction to the option HYPE offers to the regionalization of these subbasin scale parameters. The method's use on an model set-up of Europe has been described in Hundecha et al. (2016)

HYPE offers the possibility for regionalization of the subbasin scale model parameters as a linear function of a set of catchment descriptors that are expected to control the parameter in question. This allows introducing variability of both the *general parameters* and the *super parameters* across the model domain based on variability of the physical controls of the processes the parameters describe. Furthermore, since the approach links the model parameters with measurable catchment characteristics, it allows estimation in ungauged catchments. One has the choice to implement these estimators globally across the entire model domain or employ separate estimators for a number of different groups of subbasins within the model domain. Any kind of grouping of subbains can be employed and subbasins that consitute a given group need not be geographically contiguous.

The user has to identify and list, for each subbasin, the potential catchment descriptors that act as controls to the different parameters in a file CatchDes.txt. Each of the parameters can be regionalized based on a subset of the descriptors listed in CatchDes.txt. If the parameters are regionalized separately for different regions, the descriptors used to regionalize the same parameter in different gropus of catchments could be different. Information about which descriptors are used to regionalize each of the model parameters in each group and the employed linear estimator are supplied in the file reg_par.txt. Information about group membership of each of the subbasins is supplied in the file CatchGroup.txt.

Table. Description of data used, dependence and where to find it.

Description	**Index symbol**	**Range**	**Data values**	**Data file**
subbasins	i	1,...,ni		
catchment descriptors	j	1,...,nj	x(i,j)	CatchDes.txt
groups of subbasin	k	1,...,nk	k(i)	CatchGroup.txt
coefficient of equation			c(k,m,j)	reg_par.txt
model parameters	m	1,...,nm	$y\left(i,m\right)=\sum_{j=1}^{nj} c\left(k\left(i\right),m,j\right)\times x\left(i,j\right)$	

The following parameters are possible to estimate: `lp`, `cevpam`, `cevpph`, `rivvel`, `damp`, `tcalt`, `tcelevadd`, `tempcorr`, `pcelevmax`, `pcelevadd`, `pcelevth`, `cevpcorr`, `rrcscorr`, `rrcs3`, `pcurain`, and `pcusnow`. For description of the parameters see par.txt.

Example

A model with two subbasins (i=1,2) of area 20.5 resp 10.5 km2 (catchment descriptor 2) and slope 0.01 resp 0.02 (catchment descriptor 3). Two parameters (rivvel and gratk) are regionalised, rivvel depending on slope and gratk depending on area. The subbasins are grouped together and use the same coefficients of regression equation.

CatchDes.txt:

```
1  20.5  0.01
1  10.5  0.02
```

reg_par.txt:

```
2
rivvel  0.5  1
rivvel  1    3
gratk   1    0.5
gratk   1    2
```

CatchGroup.txt:

```
1
1
```

This give the parameter values for subbasin 1: rivvel = 0.5*1+1*0.01 = 0.51 and gratk = 1*1+0.5*20.5 = 11.25 and for subbasin 2: rivvel = 0.5*1+1*0.02 = 0.52 and gratk = 1*1+0.5*10.5 = 6.25

Reference

Hundecha, Y. Arheimer, B., Donnelly, C. and I. Pechlivanidis, 2016. A regional parameter estimation scheme for a pan-European multi-basin model. JoH:Regional Studies, 6:90-111. doi:10.1016/j.ejrh.2016.04.002