ohd.hseb.dhm.specs.utils.BasinStructureSpecifications

Connectivity

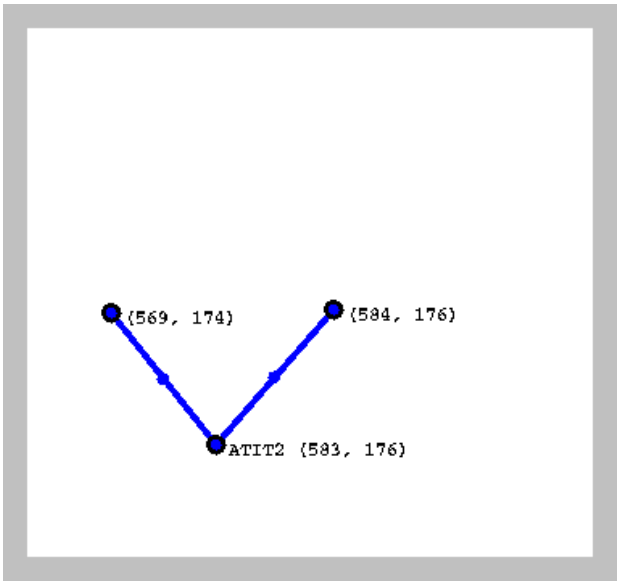
There are two forms of connectivity in DHM:
1. connecting channel reaches (cells) within a basin
2. connecting channel reaches (cells) in separate basins

Connecting channel reaches within a basin

The hydrologic connection between channel reaches (or cells) in a basin is specified in the connectivity file. Each cell can have 0 - 8 upstream cells. Below is an example of a connectivity file with one basin (ATIT2) defined

connectivity file contents	TEXT_SEQ NUM_HEADER_REC 1 2 COL 390 ROW 347 LLX 308 LLY 49 URX 697 URY 395 DATA_HRAP ATIT2 1 2 5.3500 583 176 0 2 Rv 1 305 342 5.1766 584 176 1 2 Rv 1 261 222 5.3493 569 174 2 -4 Rv 1 305 342 5.1766 583 176

The basin (shown below) contains 3 cells with the outlet at HRAP coordinate (583,176)



In this case, only the outlet coordinate (583,176) has upstream coordinates

channel connectivity between coordinates in basin	ATIT2
coordinate	upstream coordinates
(583, 176)	[(569, 174), (584, 176)]
(584,176)	[]
(569, 174)	[]

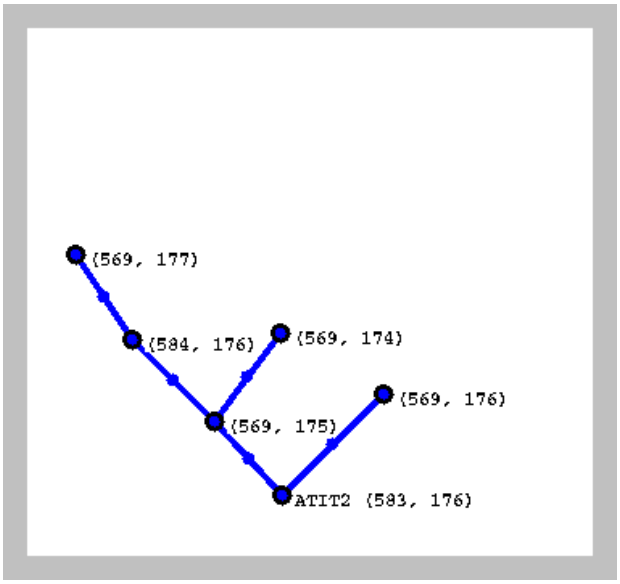
A more complicated connectivity file

The connectivity file below still only has one basin, but it consists of 6 cells

connectivity file contents

```
TEXT_SEQ
NUM_HEADER_REC    1 2
COL   390
ROW   347
LLX   308
LLY    49
URX   697
URY   395
DATA_HRAP
ATIT2      1       5    5.3500  583  176
     0     1 Rv    1 305 342  5.1766 569 177
     1     3 Rv    1 305 342  5.1766 584 176
     2     3 Rv    1 261 222  5.3493 569 174
     3     5 Rv    1 261 222  5.3493 569 175
     4     5 Rv    1 261 222  5.3493 569 176
     5    -4 Rv    1 261 222  5.3493 583 176
```

The outlet for ATIT2 (shown graphically below) has 2 cells immediately upstream (569, 175) and (569, 176) and coordinate (569, 175) also has 2 upstream coordinates



In addition to the outlet (583, 176), 2 other coordinates have upstream coordinates. The other coordinates are identified in DHM as "headwater cells"

channel connectivity between coordinates in basin	ATIT2
coordinate	upstream coordinates
(583, 176)	[(569, 176), (569, 175)]
(584,176)	[(569, 177)]
(569, 174)	[]
(569, 175)	[(569, 174), (584, 176)]
(569, 176)	[]
(569, 177)	[]

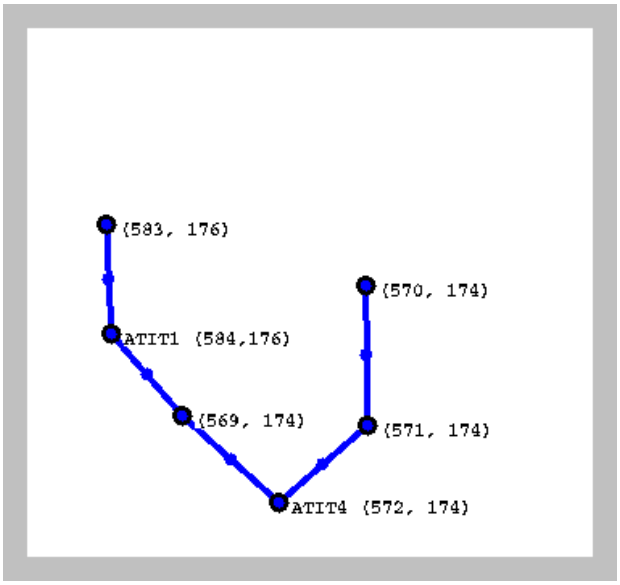
Multiple basins in a connectivity file is also supported

The connectivity file below has basins defined. The outlet for ATIT1 is at HRAP coordinate (584, 176) and for ATIT4 the outlet is at (572, 174)

connectivity file contents	TEXT_SEQ NUM_HEADER_REC 0 0 COL 0 ROW 0 LLX 0 LLY 0 URX 0 URY 0 DATA_HRAP ATIT1 1 1 5.3500 584 176 ATIT4 1 5 5.3500 572 174 0 1 Rv 1 305 342 5.1766 583 176

```
     1      2 Rv     1 305 342  5.1766 584 176
     2      5 Rv     1 305 342  5.1766 569 174
     3      4 Rv     1 261 222  5.3493 570 174
     4      5 Rv     1 261 222  5.3493 571 174
     5     -4 Rv     1 261 222  5.3493 572 174
```

The graphical description of the connectivity file shows basin ATIT1 is immediately upstream of basin ATIT4



ATIT1 contains 2 HRAP coordinates and ATIT4 has 4

basin contents		
basin name	outlet	coordinates
ATIT1	(584, 176)	[(583, 176), (584, 176)]
ATIT4	(572, 174)	[(569, 174), (572, 174), (570, 174), (571, 174)]

Connecting channel reaches across basins

When modeling downstream basins (e.g. ATIT4), the coordinate where the upstream basin(s) drains into the downstream basin (i.e. inlet coordinate) is determined through the connectivity file.

basin connections		
basin name	upstream basin name	inlet coordinates
ATIT4	ATIT1	[(569, 174)]

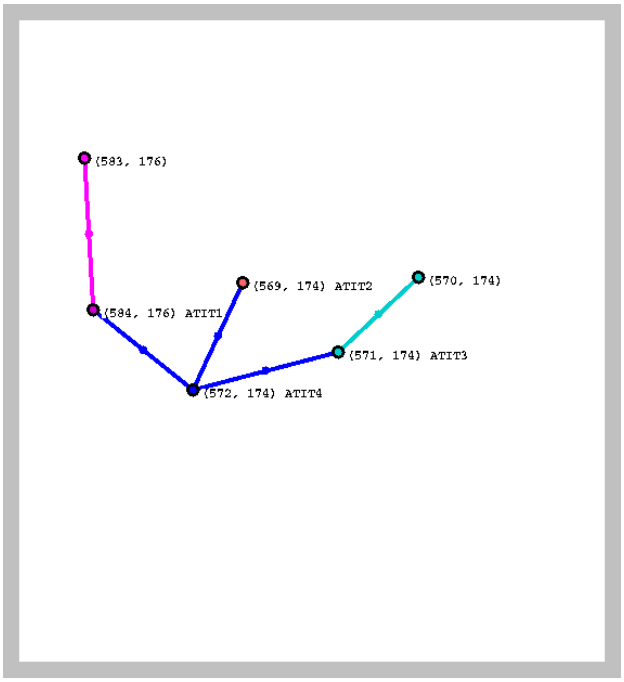
Multiple upstream basins is also supported

In cases where a basin has multiple upstream basins, there may/may not be multiple inlet coordinates.

connectivity file contents

```
TEXT_SEQ
NUM_HEADER_REC     0 0
COL    0
ROW    0
LLX    0
LLY    0
URX    0
URY    0
DATA_HRAP
ATIT1       1       1     5.3500  584  176
ATIT2       1       2     5.3500  569 174
ATIT3       1       4     5.3500  571 174
ATIT4       1       5     5.3500  572  174
     0      1 Rv     1 305 342  5.1766 583 176
     1      5 Rv     1 305 342  5.1766 584 176
     2      5 Rv     1 305 342  5.1766 569 174
     3      4 Rv     1 261 222  5.3493 570 174
     4      5 Rv     1 261 222  5.3493 571 174
     5     -4 Rv     1 261 222  5.3493 572 174
```

In the following case there are 4 basins defined in the connectivity file (ATIT1 - ATIT4). ATIT2 and ATIT4 contain 1 pixel each and ATIT1 and ATIT3 have 2 pixels.



ATIT1, ATIT2, and ATIT3 drain into ATIT4 at the same inlet coordinate (572,174).

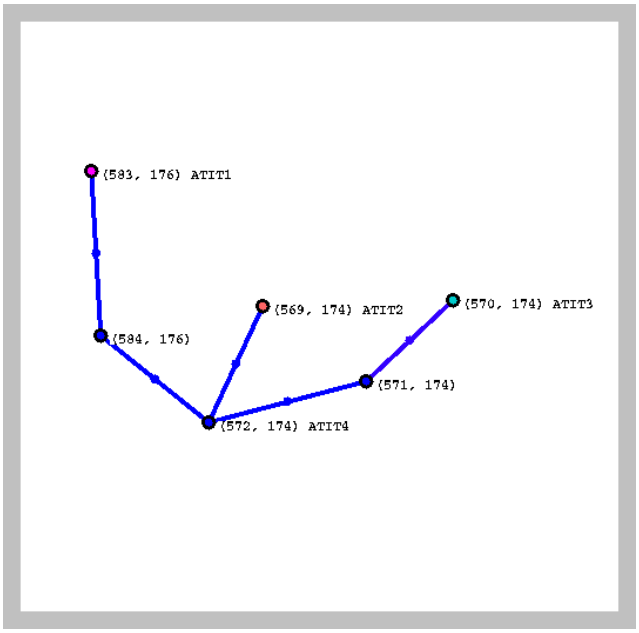
basin connections		
basin name	upstream basin name	inlet coordinates
ATIT4	ATIT1, ATIT2, ATIT3	[(572, 174)]

Multiple Inlets

In the following case there 4 basins defined in the connectivity file (ATIT1 - ATIT4). ATIT1, ATIT2 and ATIT3 contain 1 pixel each and ATIT4 has 3 pixels.

connectivity file contents

```
TEXT_SEQ
NUM_HEADER_REC     0 0
COL    0
ROW    0
LLX    0
LLY    0
URX    0
URY    0
DATA_HRAP
ATIT1       1       0     5.3500  583 176
ATIT2       1       2     5.3500  569 174
ATIT3       1       3     5.3500  570 174
ATIT4       1       6     5.3500  573 174
     0      1 Rv     1 305 342  5.1766 583 176
     1      6 Rv     1 305 342  5.1766 584 176
     2      5 Rv     1 305 342  5.1766 569 174
     3      4 Rv     1 261 222  5.3493 570 174
     4      6 Rv     1 261 222  5.3493 571 174
     5      6 Rv     1 261 222  5.3493 572 174
     6     -4 Rv     1 261 222  5.3493 573 174
```



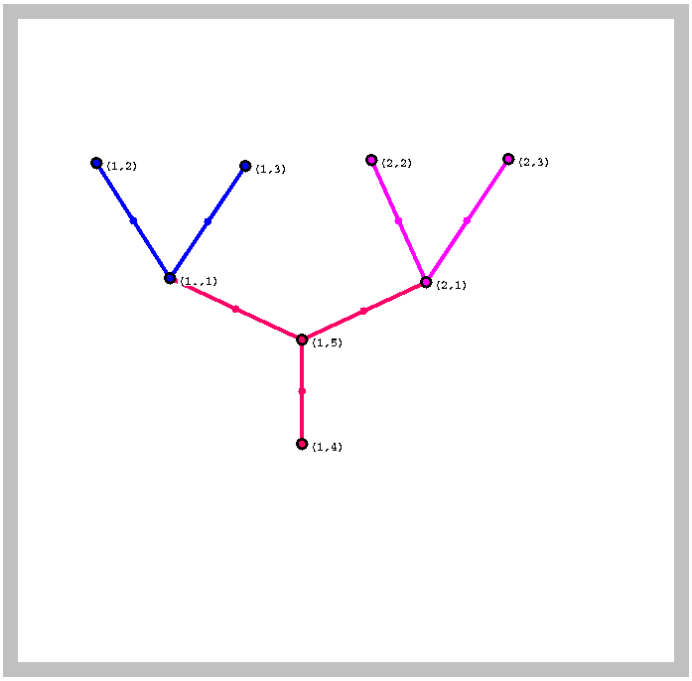
ATIT1, ATIT2, and ATIT3 drain into ATIT4 at (572,174)

basin connections		
basin name	upstream basin name	inlet coordinates
ATIT4	ATIT1, ATIT3, ATIT2	[(572, 174), (571, 174), (584, 176)]

Computing Upstream Channel Flow

The connection between channel reaches is used to compute upstream channel flow. The most upstream channel reaches (headwater channel reaches) have no upstream flow, but headwater channel reaches in downstream basins do.

Non-headwater channel reaches receive flow from all upstream reaches. The flow is a simple sum. For example, for the following set of basins



The 2 headwater basins (blue and pink) have the following connectivity

UpstreamFlowSpecifications	
define channel reach flow connections	
channel reach coordinate	coordinates for upstream channel reaches
(1,1)	(1,2), (1,3)
(1,2)	
(1,3)	

(2,1)	(2,2), (2,3)
(2,2)	
(2,3)	

with the following flows

UpstreamFlowSpecifications		
define channel reach flows		
coordinate	hour	flow
(1,2)	0	1.4
(1,3)	0	0.75
(1,1)	0	2.50
(2,2)	0	2.4
(2,3)	0	1.75
(2,1)	0	1.50
(1,5)	0	1.00

and the downstream basin (in red) has the following connectivity for the cells in it

UpstreamFlowSpecifications	
define channel reach flow connections	
channel reach coordinate	coordinates for upstream channel reaches
(1,4)	(1,5)
(1,5)	

and the connection between the 2 headwater basins and the 1 downstream basin is

UpstreamFlowSpecifications			
headwater basin with outlet coordinate	(2,1)	flows into downstream basin at coordinate	(1,5)
headwater basin with outlet coordinate	(1,1)	flows into downstream basin at coordinate	(1,5)

For the given basin connectivity and flows, the following must be true for headwater cells:

UpstreamFlowSpecifications		
upstream flow		
reach at	time	flow

(1,2)	0	0
(1,3)	0	0
(1,5)	0	4.0

and the non-headwater channel reach flows are:

UpstreamFlowSpecifications		
upstream flow		
reach at	time	flow
(1,1)	0	2.15
(2,1)	0	4.15
(1,4)	0	1.0