

Memo

To
To whom it may concern

Date generated: 2017-09-24	Reference 003	Number of pages 7
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Subject D-Flow 1D NetCDF-format; CF-1.6 UGRID-1.0/Deltares-0.8		
Copy to —		

1 Network1D (map) nc-file

...

```
double s1(time, nMeshNodes):
    coordinates = 'mesh1D_node_x mesh1D_node_y'
    location = 'node' // /
    long_name = 'water level'
    mesh = 'mesh1D' // \_ this is UGRID location pointing to mesh1D topology
    standard_name = 'sea_surface_height_above_geoid'
    units = 'm'
double u(time, nMeshEdges)
    coordinates = 'mesh1D_edge_x mesh1D_edge_y' // this is CF location sufficient to plot ma
    location = 'edge' // /
    long_name = 'velocity along branch'
    mesh = 'mesh1D' // \_ this is UGRID location pointing to mesh1D topology
    standard_name = 'sea_water_speed' // not quite correct because it's not the magnitude,
                                     but signed scalar velocity
    units = 'm s-1'
```

...

D-Flow 1D history nc-file

To be added station locations, see for an example the D-Flow FM history file.

...

```
double s1(time=ntimes, stations=nstations);
    coordinates = "station_x station_y"
    long_name = "water level"
    standard_name = "sea_surface_height_above_geoid"
    units = "m"
```

```
double u(time=ntimes, stations=nstations);
    coordinates = "station_xu station_yu"
    long_name = "velocity along branch"
    standard_name = "sea_water_speed"
    units = "m s-1"
```

...



Note: The coordinates of the station does not necessarily have the same coordinates as the mesh or network.

2 Example based on [Figure 1](#)

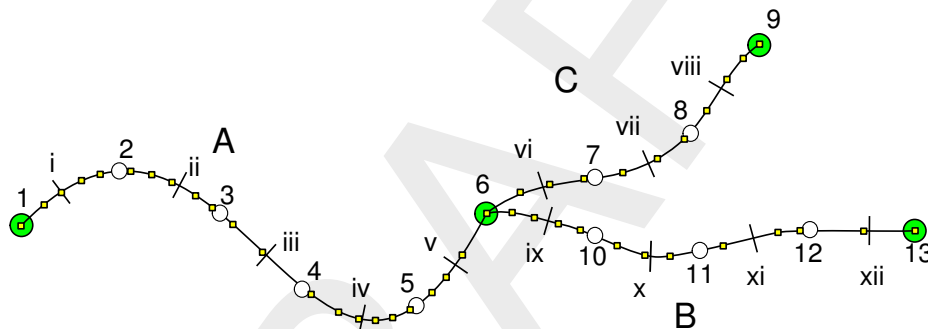


Figure 1: Simple network; 3 branches (A, B, C); 13 nodes (ζ -points, latin numbers), 12 edges (u -points; roman numbers), 44 network nodes (yellow squares)

Dimensions

nNetworkBranches = 3
nNetworkNodes = 4
nBranchPointsTotal = 46
nGeomPoints = 44
nMeshNodes = 13 (13=6+5+4-(3-1); 3=branches at node 6)
nMeshEdges = 12 (12=5+4+3); edges are between ζ -points

Geometry

network1D_geom_x(nNetworkNodes)

x_1, ..., x_44

network1D_geom_y(nNetworkNodes)

y_1, ..., y_44

Network nodes

network1D_nodes_x(nNetworkNodes)

-200, 2200, 4100, 3500

network1D_nodes_y(nNetworkNodes)

725, 725, 700, 1600

network1D_edge_nodes(nNetworkBranches,Two)

1 2
2 3
2 4

Network geometry (i.e. branch)

network1D_branch_geometry(nBranchPointsTotal)

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 22, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44

Note that the node number 22 appear three times in this array.

network1D_branch_geometry_stop(nNetworkBranches)

22, 34, 45

Pointing to the last geometry node of a branch, so branch 2 is defined by the geometry nodes: 23 (=22+1) to 34

Numerical discretization

mesh1D_geometry_id(nMeshNodes)

A, A, A, A, A, A, C, C, C, B, B, B, B

mesh1D_geometry_offset(nMeshNodes)

0, 500, 1000, 1500, 2000, 2500 (on branche A, 6 nodes)

700, 1400, 2100 (on branche B, 4 nodes; without node 6)

400, 800, 1200, 1600 (on branche C, 3 nodes; without node 6)

mesh1D_edge_nodes(nMeshEdges,Two)

1 2
2 3
3 4
4 5
5 6
6 7
7 8
8 9
6 10



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12 13

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3 Example of a ncdump-file based on [Figure 1](#)

```

netcdf dflow1d_ugrid_map {
dimensions:
    nNetworkBranches = 3 ;
    nNetworkNodes = 4 ;
    nBranchPointsTotal = 46 ;
    nGeomPoints = 44 ;
    nMeshNodes = 13 ;
    nMeshEdges = 12 ;
    time = UNLIMITED ; // (2 currently)
    Two = 2 ;
variables:
    uint network1D ;
        network1D:cf_role = "mesh_topology" ;
        network1D:edge_dimension = "nNetworkBranches" ;
        network1D:edge_geometry = "network1D_branch_geometry" ;
        network1D:edge_node_connectivity = "network1D_branch_end_nodes" ;
        network1D:node_coordinates = "network1D_nodes_x network1D_nodes_y" ;
        network1D:node_dimension = "nNetworkNodes" ;
        network1D:topology_dimension = 1 ;
    double network1D_nodes_x(nNetworkNodes) ;
        network1D_nodes_x:standard_name = "projection_x_coordinate" ;
        network1D_nodes_x:units = "m" ;
    double network1D_nodes_y(nNetworkNodes) ;
        network1D_nodes_y:standard_name = "projection_y_coordinate" ;
        network1D_nodes_y:units = "m" ;
    uint network1D_branch_end_nodes(nNetworkBranches, Two) ;
        network1D_branch_end_nodes:cf_role = "edge_node_connectivity" ;
        network1D_branch_end_nodes:long_name = "maps every branch to its two end nodes" ;
        network1D_branch_end_nodes:start_index = 1 ;
    uint network1D_branch_geometry(nBranchPointsTotal) ;
        network1D_branch_geometry:longname = "maps every branch to its support points" ;
        network1D_branch_geometry:geom_coordinates = "network1D_geom_x network1D_geom_y" ;
        network1D_branch_geometry:geom_dimension = "nNetworkBranches" ;
        network1D_branch_geometry:geom_type = "linestring" ;
        network1D_branch_geometry:start_index = 1 ;
    double network1D_branch_geometry_stop(nNetworkBranches) ;
        network1D_branch_geometry_stop:contiguous_ragged_dimension = "network1D_branch_geome
    double network1D_geom_x(nGeomPoints) ;
        network1D_geom_x:standard_name = "projection_x_coordinate" ;
        network1D_geom_x:units = "m" ;
    double network1D_geom_y(nGeomPoints) ;
        network1D_geom_y:standard_name = "projection_y_coordinate" ;
        network1D_geom_y:units = "m" ;
    uint mesh1D ;
        mesh1D:cf_role = "mesh_topology" ;
        mesh1D:coordinate_space = "network1D" ;
        mesh1D:edge_dimension = "nMeshEdges" ;
        mesh1D:edge_node_connectivity = "mesh1D_edge_nodes" ;
        mesh1D:node_dimension = "nMeshNodes" ;
        mesh1D:node_coordinates = "mesh1D_geometry_id mesh1D_geometry_offset" ;
        mesh1D:topology_dimension = 1 ;
    uint mesh1D_geometry_id(nMeshNodes) ;
        mesh1D_geometry_id:cf_role = "feature_index" ;
        mesh1D_geometry_id:long_name = "number of branch (geometry) on which node is located
        mesh1D_geometry_id:start_index = 1 ;

```



```

double mesh1D_geometry_offset(nMeshNodes) ;
    mesh1D_geometry_offset:cf_role = "coordinate_on_feature" ;
    mesh1D_geometry_offset:long_name = "chainage of mesh node along the branch" ;
    mesh1D_geometry_offset:units = "m" ;
double mesh1D_edge_nodes(nMeshEdges, Two) ;
    mesh1D_edge_nodes:cf_role = "edge_node_connectivity" ;
    mesh1D_edge_nodes:long_name = "maps every edge to the two nodes that it connects" ;
    mesh1D_edge_nodes:start_index = 1 ;
double time(time) ;
    time:standard_time = "time" ;
    time:units = "seconds since 2017-01-01 00:00:00" ;
double s1(time, nMeshNodes) ;
    s1:location = "node" ;
    s1:long_name = "water level" ;
    s1:mesh = "mesh1D" ;
    s1:standard_name = "sea_surface_height_above_geoid" ;
    s1:units = "m" ;
double u(time, nMeshEdges) ;
    u:location = "edge" ;
    u:long_name = "velocity along branch" ;
    u:mesh = "mesh1D" ;
    u:standard_name = "sea_water_speed" ;
    u:units = "m s-1" ;

// global attributes:
    :Conventions = "CF-1.6 UGRID-1.0/Deltares-0.91" ;
    :history = "Created on 2017-01-12 20:08:08.107000 D-Flow 1D" ;
    :institution = "Deltares" ;
    :reference = "http://www.deltares.nl" ;
    :source = "Python program to test layout of a D-Flow 1D model with three branches" ;
data:

network1D = _ ;

network1D_nodes_x = -200, 2200, 4100, 3500 ;

network1D_nodes_y = 725, 725, 700, 1600 ;

network1D_branch_end_nodes =
    1, 6,
    6, 13,
    6, 9 ;

network1D_branch_geometry = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14,
    15, 16, 17, 18, 19, 20, 21, 22, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31,
    32, 33, 34, 22, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44 ;

network1D_branch_geometry_stop = 21, 34, 45 ;

network1D_geom_x = -187.96667, -127.96887, -53.84786, 56.174104, 187.13333,
    352.5, 529.96667, 683.23333, 828.43333, 892.96667, 993.8, 1082.5333,
    1219.6667, 1405.2, 1492.2591, 1598.5306, 1712.2164, 1818.4835, 1912.3747,
    2007.9644, 2094.9, 2195.7333, 2269.2456, 2381.5612, 2460.2412, 2577.8276,
    2774.8643, 2911.5187, 3029.1051, 3235.6759, 3438.7319, 3582.0791,
    3817.2519, 4071.4928, 2275.9165, 2377.6129, 2539.6914, 2739.9061,
    2901.9847, 3041.8172, 3140.3355, 3226.4949, 3321.8353, 3445.4246 ;

network1D_geom_y = 720.81667, 802.67261, 879.96131, 968.25292, 1039.45,

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```

1079.7833, 1063.65, 995.08333, 861.98333, 773.25, 652.25, 539.31667,
406.21667, 293.28333, 265.90693, 260.14026, 273.32123, 301.64228,
343.82527, 427.37378, 547.38333, 708.71667, 705.99709, 676.04627,
633.74441, 567.00618, 519.33601, 506.62397, 522.51403, 576.54021,
655.98306, 684.59259, 690.94861, 690.94861, 802.179, 862.56121,
900.69734, 938.83347, 1005.5717, 1116.8021, 1237.5665, 1367.1587,
1480.1547, 1540.1838 ;

mesh1D = _ ;

mesh1D_geometry_id = 1, 1, 1, 1, 1, 1, 3, 3, 3, 2, 2, 2, 2 ;

mesh1D_geometry_offset = 0, 500, 1000, 1500, 2000, 2500, 700, 1400, 2100,
400, 800, 1200, 1600 ;

mesh1D_edge_nodes =
1, 2,
2, 3,
3, 4,
4, 5,
5, 6,
6, 7,
7, 8,
8, 9,
6, 10,
10, 11,
11, 12,
12, 13 ;

time = 60, 120 ;

s1 =
0.11, 0.12, 0.13, 0.14, 0.15, 0.16, 0.17, 0.18, 0.19, 0.2, 0.21, 0.22, 0.23,
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 ;

u =
0.105, 0.125, 0.135, 0.145, 0.155, 0.165, 0.175, 0.185, 0.195, 0.205,
0.215, 0.225,
1.5, 2.5, 3.5, 4.5, 5.5, 6.5, 7.5, 8.5, 9.5, 10.5, 11.5, 12.5 ;
}

```