

# Memo

To  
To whom it may concern

<b>Date</b> generated: 2018-06-17	<b>Reference</b> 003	<b>Number of pages</b> 12
<b>From</b> Jan Mooiman, Arthur van Dam, Bert Jagers	<b>Direct line</b> +31 (0)88 335 8568	<b>E-mail</b> jan.mooiman@deltares.nl, arthur.vandam@deltares.nl, bert.jagers@deltares.nl
<b>Subject</b> D-Flow 1D NetCDF-format; CF-1.6 UGRID-1.0/Deltares-0.8		
<b>Copy to</b> —		

---

## Contents

1	Network1D (map) nc-file	1
2	D-Flow 1D history nc-file	2
3	Example based on Figure 1	3
3.1	Network nodes	3
3.2	Geometry	3
4	Numerical discretization	4
5	Example based on Figure 2	4
6	Example of ncdump-file based on Figure 2	6

## List of Tables

1	1D2D Link table based on Figure 2	5
---	-----------------------------------	---

## List of Figures

1	Simple 1D network	3
2	Composite mesh (1D and 2D)	4

## 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 markers
    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'
...

```

## 2 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.

## 3 Example based on Figure 1

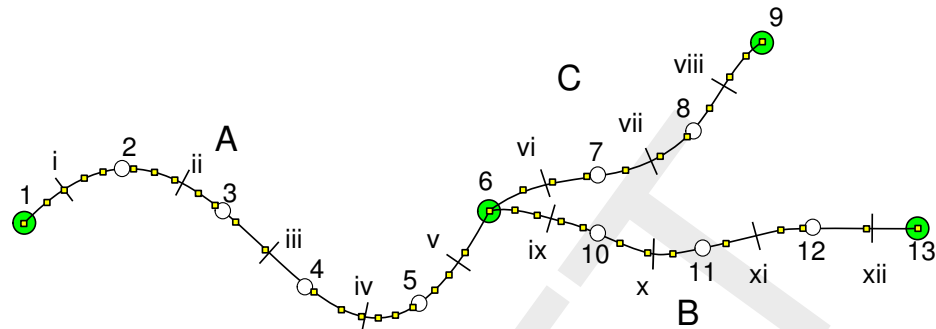


Figure 1: Simple 1D network; 3 branches (A, B, C); 13 nodes ( $\zeta$ -points, latin numbers), 12 edges ( $u$ -points; roman numbers), 44 network nodes (yellow squares)

## Dimensions

nNetworkBranches = 3  
 nNetworkNodes = 4  
 nBranchPointsTotal = 46  
 nGeomPoints = 44  
 nMeshNodes = 13 ( $13=6+5+4-(3-1)$ ; 3 branches are connected to node 6)  
 nMeshEdges = 12 ( $12=5+4+3$ ); edges are between  $\zeta$ -points

### 3.1 Network nodes

**network1D\_nodes\_x(nNetworkNodes)**

-187.96667, 2195.7333, 4071.4928, 3445.4246

**network1D\_nodes\_y(nNetworkNodes)**

720.81667, 708.71667, 690.94861, 1540.1838

**network1D\_edge\_nodes(nNetworkBranches,Two)**

1 2  
 2 3  
 2 4

### 3.2 Geometry

**network1D\_part\_node\_count(nNetworkBranches)**

22, 13, 11

So the branches contain the following geometry points:

Branch A: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

**Date** generated: 2018-06-17      **Reference** 003      **Page** 4/12

Branch B: 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34,

Branch C: 22, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44

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

**network1D\_geom\_x(nNetworkNodes)**

x\_1, ..., x\_46

**network1D\_geom\_y(nNetworkNodes)**

y\_1, ..., y\_46

## 4 Numerical discretization

**mesh1D\_nodes\_branch\_id(nMeshNodes)**

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

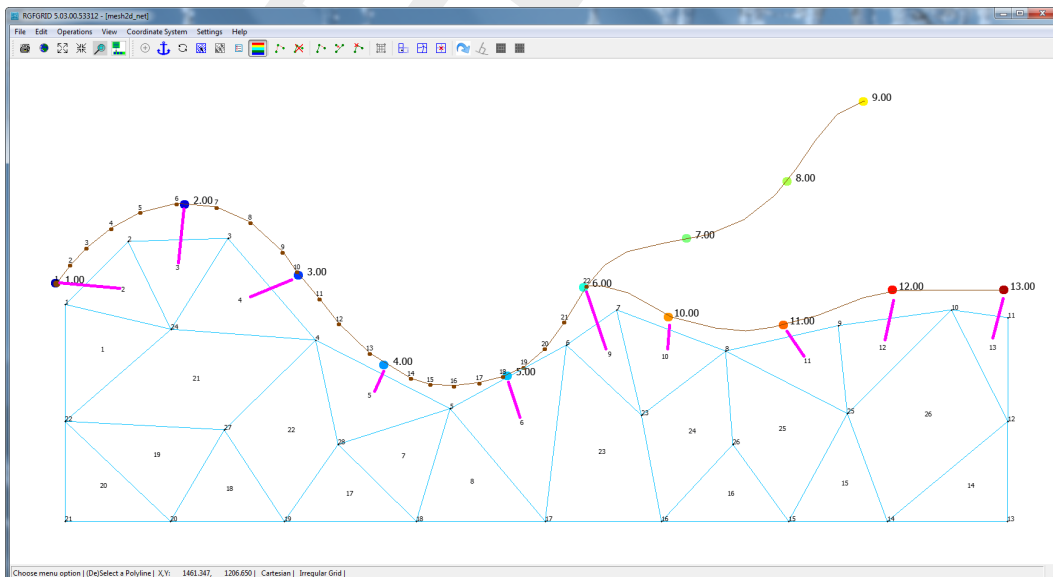
**mesh1D\_nodes\_branch\_offset(nMeshNodes)**

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)

## 5 Example based on Figure 2



*Figure 2: Composite mesh (1D and 2D),*

*1D Mesh: coloured dots (=computational 1D mesh),  $\zeta$ -points; numbered dots, 1d network geometry for branch A (Figure 1).*

*2D Mesh: light blue with node and face numbers.*

*1D2D connections are pink coloured.*

## 1D2D-links

1D2D-links are defined between de computational nodes of the 1D Mesh ( $\zeta$ -points) and the faces of the 2D Mesh ( $\zeta$ -points). The link table for [Figure 2](#) read:

*Table 1: 1D2D Link table based on Figure 2*

1d node	2d face
1	2
2	3
3	4
4	5
5	6
6	9
10	10
11	11
12	12
13	13

## 6 Example of ncdump-file based on Figure 2

```

netcdf ugrid_1d2d_map {
dimensions:
nNetworkBranches = 3 ;
nNetworkNodes = 4 ;
nGeometryNodes = 46 ;
nMesh1DNodes = 13 ;
nMesh1DEdges = 12 ;
max_nMesh2D_face_nodes = 4 ;
nMesh2D_edge = 53 ;
nMesh2D_face = 26 ;
nMesh2D_node = 28 ;
nlinks_1d2d = 10 ;
time = UNLIMITED ; // (2 currently)
Two = 2 ;
variables:
uint network1D ;
network1D:cf_role = "mesh_topology" ;
network1D:edge_dimension = "nNetworkBranches" ;
network1D:edge_geometry = "network1D_geometry" ;
network1D:edge_node_connectivity = "network1D_edge_nodes" ;
network1D:long_name = "Network topology" ;
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:long_name = "x coordinates of the network connection nodes" ;
network1D_nodes_x:units = "m" ;
double network1D_nodes_y(nNetworkNodes) ;
network1D_nodes_y:standard_name = "projection_y_coordinate" ;
network1D_nodes_y:long_name = "y coordinates of the network connection nodes" ;
network1D_nodes_y:units = "m" ;
uint network1D_geometry ;
network1D_geometry:geometry_type = "multiline" ;
network1D_geometry:long_name = "1D Geometry" ;
network1D_geometry:node_count = "nGeometryNodes" ;
network1D_geometry:part_node_count = "network1D_part_node_count" ;
network1D_geometry:node_coordinates = "network1D_geom_x network1D_geom_y" ;
uint network1D_edge_nodes(nNetworkBranches, Two) ;
network1D_edge_nodes:cf_role = "edge_node_connectivity" ;
network1D_edge_nodes:long_name = "start and end nodes of each branch in the network" ;
network1D_edge_nodes:start_index = 1 ;
uint network1D_part_node_count(nNetworkBranches) ;
network1D_part_node_count:long_name = "number of geometry nodes per branch" ;
double network1D_geom_x(nGeometryNodes) ;
network1D_geom_x:cf_role = "geometry_x_node" ;
network1D_geom_x:standard_name = "projection_x_coordinate" ;
network1D_geom_x:long_name = "x coordinates of the branch geometries" ;
network1D_geom_x:units = "m" ;
double network1D_geom_y(nGeometryNodes) ;
network1D_geom_y:cf_role = "geometry_y_node" ;
network1D_geom_y:standard_name = "projection_y_coordinate" ;
network1D_geom_y:long_name = "y coordinates of the branch geometries" ;
network1D_geom_y:units = "m" ;
uint mesh1D ;

```

```

mesh1D:cf_role = "mesh_topology" ;
mesh1D:coordinate_space = "network1D" ;
mesh1D:edge_dimension = "nMesh1DEdges" ;
mesh1D:edge_node_connectivity = "mesh1D_edge_nodes" ;
mesh1D:long_name = "Mesh 1D" ;
mesh1D:node_coordinates = "mesh1D_nodes_branch_id mesh1D_nodes_branch_offset" ;
mesh1D:node_dimension = "nMesh1DNodes" ;
mesh1D:topology_dimension = 1 ;
uint mesh1D_nodes_branch_id(nMesh1DNodes) ;
mesh1D_nodes_branch_id:cf_role = "feature_index" ;
mesh1D_nodes_branch_id:long_name = "number of branch on which node is located" ;
double mesh1D_nodes_branch_offset(nMesh1DNodes) ;
mesh1D_nodes_branch_offset:cf_role = "coordinate_on_feature" ;
mesh1D_nodes_branch_offset:long_name = "offset along the branch at which the node is located" ;
mesh1D_nodes_branch_offset:units = "m" ;
uint Mesh2D ;
Mesh2D:cf_role = "mesh_topology" ;
Mesh2D:edge_coordinates = "Mesh2D_edge_x Mesh2D_edge_y" ;
Mesh2D:edge_dimension = "nMesh2D_edge" ;
Mesh2D:edge_face_connectivity = "Mesh2D_edge_faces" ;
Mesh2D:edge_node_connectivity = "Mesh2D_edge_nodes" ;
Mesh2D:face_coordinates = "Mesh2D_face_x Mesh2D_face_y" ;
Mesh2D:face_dimension = "nMesh2D_face" ;
Mesh2D:face_edge_connectivity = "Mesh2D_face_edges" ;
Mesh2D:face_face_connectivity = "Mesh2D_face_face" ;
Mesh2D:face_node_connectivity = "Mesh2D_face_nodes" ;
Mesh2D:long_name = "Mesh 2D" ;
Mesh2D:max_face_nodes_dimension = "max_nMeshFaceNodes" ;
Mesh2D:node_coordinates = "Mesh2D_node_x Mesh2D_node_y" ;
Mesh2D:node_dimension = "nMesh2D_node" ;
Mesh2D:topology_dimension = 2 ;
double Mesh2D_node_x(nMesh2D_node) ;
Mesh2D_node_x:standard_name = "projection_x_coordinate" ;
Mesh2D_node_x:units = "m" ;
double Mesh2D_node_y(nMesh2D_node) ;
Mesh2D_node_y:standard_name = "projection_y_coordinate" ;
Mesh2D_node_y:units = "m" ;
double Mesh2D_edge_x(nMesh2D_edge) ;
Mesh2D_edge_x:standard_name = "projection_x_coordinate" ;
Mesh2D_edge_x:units = "m" ;
double Mesh2D_edge_y(nMesh2D_edge) ;
Mesh2D_edge_y:standard_name = "projection_y_coordinate" ;
Mesh2D_edge_y:units = "m" ;
double Mesh2D_edge_nodes(nMesh2D_edge, Two) ;
Mesh2D_edge_nodes:cf_role = "edge_node_connectivity" ;
Mesh2D_edge_nodes:long_name = "maps every edge to the two nodes that it connects" ;
Mesh2D_edge_nodes:start_index = 1 ;
double Mesh2D_face_nodes(nMesh2D_face, max_nMesh2D_face_nodes) ;
Mesh2D_face_nodes:_FillValue = 0. ;
Mesh2D_face_nodes:cf_role = "face_node_connectivity" ;
Mesh2D_face_nodes:long_name = "maps every face to the nodes that it defines" ;
Mesh2D_face_nodes:start_index = 1 ;
uint composite_mesh ;
composite_mesh:cf_role = "mesh_topology_parent" ;
composite_mesh:meshes = "mesh1D mesh2D" ;
composite_mesh:mesh_contact = "link1d2d" ;
uint link1d2d(nlinks_1d2d, Two) ;
link1d2d:cf_role = "mesh_topology_contact" ;

```



<b>Date</b>	<b>Reference</b>	<b>Page</b>
generated: 2018-06-17	003	8/12

```

link1d2d:contact = "mesh1D:node mesh2D:face" ;
link1d2d:start_index = 1 ;
double time(time) ;
time:standard_time = "time" ;
time:units = "seconds since 2017-01-01 00:00:00" ;
double s1_1d(time, nMesh1DNodes) ;
s1_1d:location = "node" ;
s1_1d:long_name = "water level" ;
s1_1d:mesh = "mesh1D" ;
s1_1d:standard_name = "sea_surface_height_above_geoid" ;
s1_1d:units = "m" ;
double u_1d(time, nMesh1DEdges) ;
u_1d:location = "edge" ;
u_1d:long_name = "velocity along branch" ;
u_1d:mesh = "mesh1D" ;
u_1d:standard_name = "sea_water_speed" ;
u_1d:units = "m s-1" ;
double s1_2d(time, nMesh2D_face) ;
s1_2d:coordinates = "Mesh2D_face_x Mesh2D_face_y" ;
s1_2d:location = "face" ;
s1_2d:long_name = "water level" ;
s1_2d:mesh = "Mesh2D" ;
s1_2d:standard_name = "sea_surface_height_above_geoid" ;
s1_2d:units = "m" ;
double u_2d(time, nMesh2D_edge) ;
u_2d:coordinates = "Mesh2D_edge_x Mesh2D_edge_y" ;
u_2d:location = "edge" ;
u_2d:long_name = "normal velocity at edge" ;
u_2d:mesh = "Mesh2D" ;
u_2d:standard_name = "sea_water_speed" ;
u_2d:units = "m s-1" ;

// global attributes:
:Conventions = "CF-1.8 UGRID-1.0/Deltares-0.9" ;
:history = "Created on 2017-11-18 20:50:29.618000 D-Flow 1D, D-Flow FM. 1D2D coupling" ;
:institution = "Deltares" ;
:reference = "http://www.deltares.nl" ;
:source = "Python program to test layout of a D-Flow 1D, D-Flow FM" ;
data:

network1D = _ ;

network1D_nodes_x = -187.96667, 2195.7333, 4071.4928, 3445.4246 ;

network1D_nodes_y = 720.81667, 708.71667, 690.94861, 1540.1838 ;

network1D_geometry = _ ;

network1D_edge_nodes =
1, 2,
2, 3,
2, 4 ;

network1D_part_node_count = 22, 13, 11 ;

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, 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, 2195.7333, 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,  
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, 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, 708.71667,  
802.179, 862.56121, 900.69734, 938.83347, 1005.5717, 1116.8021,  
1237.5665, 1367.1587, 1480.1547, 1540.1838 ;

mesh1D = \_ ;

mesh1D\_nodes\_branch\_id = 1, 1, 1, 1, 1, 1, 3, 3, 3, 2, 2, 2, 2 ;

mesh1D\_nodes\_branch\_offset = 0, 500, 1000, 1500, 2000, 2500, 700, 1400,  
2100, 400, 800, 1200, 1600 ;

Mesh2D = \_ ;

Mesh2D\_node\_x = -150, 133.043016423945, 581.589811881954, 976.640200542219,  
1581.56110817825, 2104.17985151006, 2330.51080334667, 2820.20868095679,  
3326.36699142775, 3836.64041011393, 4091.3328, 4091.0588, 4087.6891,  
3547.526, 3104.2863, 2530.6819, 2009.2233, 1428.1695, 835.9416,  
321.93246, -150, -150, 2441.32387428041, 326.036595922787,  
3368.4335297957, 2852.91575366228, 564.605213864027, 1077.48494483683 ;

Mesh2D\_node\_y = 625.39432, 908.781962364921, 921.127287010554,  
464.350275122123, 155.717158981291, 443.774734046067, 600.148846224089,  
414.968976539589, 530.1920065655, 600.148846224089, 565.79906,  
99.9999999999999, -350, -350, -350, -350, -350, -350, -350, -350,  
99.9999999999999, 125.838619350021, 513.501770748115, 134.310966738994,  
-5.00908866931604, 62.2847173147688, -3.38148493072237 ;

Mesh2D\_edge\_x = 3963.98660505697, 3963.84960505697, 4091.1958,  
2217.34532742836, 2272.75186289524, 2385.91733881354, 2630.7662776186,  
2575.35974215173, 2056.70157575503, -8.4784917880275, 88.0182979613934,  
229.539806173366, 3325.90615, 3457.97976489785, 3236.35991489785,  
2836.56221730954, 4089.37395, 3819.2924, 3817.60755, 357.316414152949,  
453.81320390237, -150, 85.96623, 85.96623, 2978.60102683114,  
2691.79882683114, 2817.4841, 2486.00288714021, 3347.40026061173,  
3073.28783619227, 3094.32110537625, 578.93703, 700.273406932013,  
443.268836932014, 2269.9526, -150, 88.0182979613934, 207.302606932014,  
956.713272418414, 651.338398232503, 779.115006212086, 1718.6964,  
1795.39220408913, 1504.86530408912, 1132.05555, 1252.82722241841,  
1329.52302650754, 1027.06257268952, 770.622707203123, 1279.10065436023,  
1842.87047984415, 3602.53696995482, 3581.50370077084 ;

Mesh2D\_edge\_y = 582.973953112045, 350.074423112044, 332.89953,  
521.961790135078, 284.806676698044, 362.993732787055, 270.403797944805,  
507.558911381839, 46.8873670230335, 767.088141182461, 569.448045374058,  
711.141866556518, -350, -107.844516630503, -107.844516630503,  
204.979943935137, -125, -125, -350, 914.954624687738, 717.314528879334,  
-125, -350, -125, -177.504544334658, -177.504544334658, -350,



Date  
generated: 2018-06-17

Reference  
003

Page  
10/12

-112.080690324989, 332.251486652247, 472.580491552545, 274.639971639292,  
-350, -143.857641342616, -143.857641342616, -350, 362.69716,  
306.750885374057, 81.1423586573843, -176.690742465361, 488.926022935119,  
692.738781066338, -350, -97.1414205093546, -97.1414205093546, -350,  
-176.690742465361, 76.1678370252842, 230.4843950957, 263.317496218446,  
310.033717051707, 299.745946513679, 367.229906481542, 565.170426394795 ;

Mesh2D\_edge\_nodes =

11, 10,  
10, 12,  
12, 11,  
7, 6,  
6, 23,  
23, 7,  
23, 8,  
8, 7,  
6, 17,  
2, 1,  
1, 24,  
24, 2,  
15, 14,  
14, 25,  
25, 15,  
26, 8,  
13, 12,  
12, 14,  
14, 13,  
3, 2,  
24, 3,  
22, 21,  
21, 20,  
20, 22,  
26, 15,  
26, 16,  
16, 15,  
23, 16,  
25, 9,  
9, 8,  
8, 25,  
20, 19,  
19, 27,  
27, 20,  
17, 16,  
1, 22,  
22, 24,  
27, 22,  
19, 28,  
24, 4,  
4, 3,  
18, 17,  
17, 5,  
5, 18,  
19, 18,  
18, 28,  
5, 28,  
28, 4,  
4, 27,  
5, 4,

DRAFT



**Date**  
generated: 2018-06-17

**Reference**  
003

**Page**  
11/12

6, 5,  
25, 10,  
10, 9 ;

Mesh2D\_face\_nodes =

1, 22, 24, \_,  
1, 24, 2, \_,  
2, 24, 3, \_,  
3, 24, 4, \_,  
4, 28, 5, \_,  
5, 17, 6, \_,  
5, 28, 18, \_,  
5, 18, 17, \_,  
6, 23, 7, \_,  
7, 23, 8, \_,  
8, 25, 9, \_,  
9, 25, 10, \_,  
10, 12, 11, \_,  
12, 14, 13, \_,  
14, 25, 15, \_,  
15, 26, 16, \_,  
18, 28, 19, \_,  
19, 27, 20, \_,  
20, 27, 22, \_,  
20, 22, 21, \_,  
4, 24, 22, 27,  
4, 27, 19, 28,  
6, 17, 16, 23,  
8, 23, 16, 26,  
8, 26, 15, 25,  
10, 25, 14, 12 ;

composite\_mesh = \_ ;

link1d2d =

1, 2,  
2, 3,  
3, 4,  
4, 5,  
5, 6,  
6, 9,  
10, 10,  
11, 11,  
12, 12,  
13, 13 ;

time = 60, 120 ;

s1\_1d =

1, 1.3333333333333333, 1.6666666666666667, 2, 2.3333333333333333,  
2.6666666666666667, 3, 3.3333333333333333, 3.6666666666666667, 4,  
4.3333333333333333, 4.6666666666666667, 5,  
3, 3.3333333333333333, 3.6666666666666667, 4, 4.3333333333333333,  
4.6666666666666667, 5, 5.3333333333333333, 5.6666666666666667, 6,  
6.3333333333333333, 6.6666666666666667, 7 ;

u\_1d =

1, 1.3636363636363636, 1.7272727272727273, 2.0909090909090909, 2.4545454545454545,



Date  
generated: 2018-06-17

Reference  
003

Page  
12/12

2.81818181818182, 3.18181818181818, 3.54545454545455, 3.90909090909091,  
4.27272727272727, 4.63636363636364, 5,  
3, 3.36363636363636, 3.72727272727273, 4.09090909090909, 4.45454545454546,  
4.81818181818182, 5.18181818181818, 5.54545454545455, 5.90909090909091,  
6.27272727272727, 6.63636363636364, 7 ;

s1\_2d =  
2, 2.16, 2.32, 2.48, 2.64, 2.8, 2.96, 3.12, 3.28, 3.44, 3.6, 3.76, 3.92,  
4.08, 4.24, 4.4, 4.56, 4.72, 4.88, 5.04, 5.2, 5.36, 5.52, 5.68, 5.84, 6,  
4, 4.16, 4.32, 4.48, 4.64, 4.8, 4.96, 5.12, 5.28, 5.44, 5.6, 5.76, 5.92,  
6.08, 6.24, 6.4, 6.56, 6.72, 6.88, 7.04, 7.2, 7.36, 7.52, 7.68, 7.84, 8 ;

u\_2d =  
2, 2.07692307692308, 2.15384615384615, 2.23076923076923, 2.30769230769231,  
2.38461538461538, 2.46153846153846, 2.53846153846154, 2.61538461538462,  
2.69230769230769, 2.76923076923077, 2.84615384615385, 2.92307692307692,  
3, 3.07692307692308, 3.15384615384615, 3.23076923076923,  
3.30769230769231, 3.38461538461538, 3.46153846153846, 3.53846153846154,  
3.61538461538462, 3.69230769230769, 3.76923076923077, 3.84615384615385,  
3.92307692307692, 4, 4.07692307692308, 4.15384615384615,  
4.23076923076923, 4.30769230769231, 4.38461538461539, 4.46153846153846,  
4.53846153846154, 4.61538461538462, 4.69230769230769, 4.76923076923077,  
4.84615384615385, 4.92307692307692, 5, 5.07692307692308,  
5.15384615384615, 5.23076923076923, 5.30769230769231, 5.38461538461539,  
5.46153846153846, 5.53846153846154, 5.61538461538462, 5.69230769230769,  
5.76923076923077, 5.84615384615385, 5.92307692307692, 6,  
4, 4.07692307692308, 4.15384615384615, 4.23076923076923, 4.30769230769231,  
4.38461538461539, 4.46153846153846, 4.53846153846154, 4.61538461538462,  
4.69230769230769, 4.76923076923077, 4.84615384615385, 4.92307692307692,  
5, 5.07692307692308, 5.15384615384615, 5.23076923076923,  
5.30769230769231, 5.38461538461539, 5.46153846153846, 5.53846153846154,  
5.61538461538462, 5.69230769230769, 5.76923076923077, 5.84615384615385,  
5.92307692307692, 6, 6.07692307692308, 6.15384615384615,  
6.23076923076923, 6.30769230769231, 6.38461538461539, 6.46153846153846,  
6.53846153846154, 6.61538461538462, 6.69230769230769, 6.76923076923077,  
6.84615384615385, 6.92307692307692, 7, 7.07692307692308,  
7.15384615384615, 7.23076923076923, 7.30769230769231, 7.38461538461539,  
7.46153846153846, 7.53846153846154, 7.61538461538462, 7.69230769230769,  
7.76923076923077, 7.84615384615385, 7.92307692307692, 8 ;  
}