



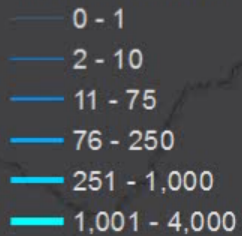
Simple Geometries in NetCDF

Tim Whiteaker – The University of Texas at Austin
2017 Advancing NetCDF Workshop
Boulder, CO

Motivation

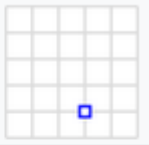
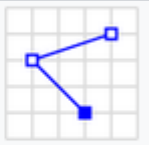
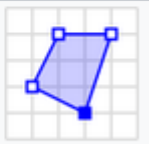
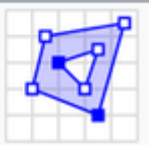
2015-10-20

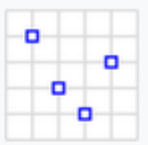
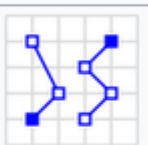
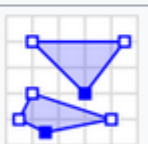
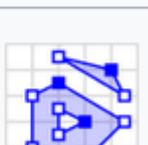
Streamflow (cms)



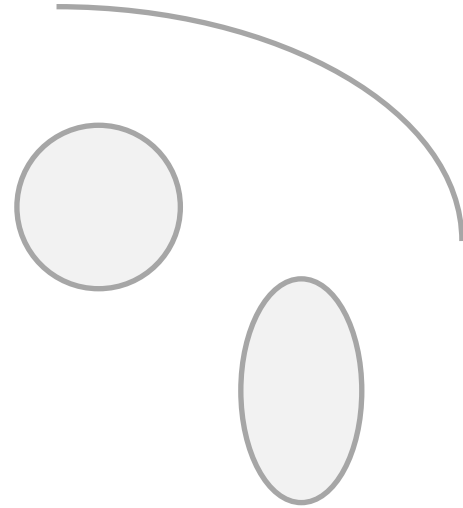
Geometry Types

Included

Type	
Point	
LineString	
Polygon	
	

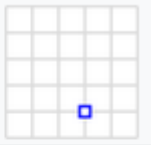
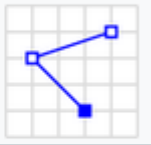
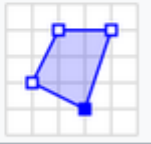
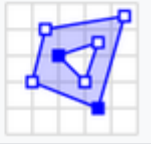
Type	
MultiPoint	
MultiLineString	
MultiPolygon	
	

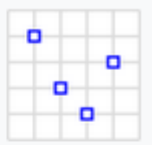
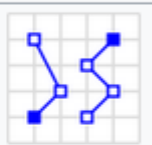
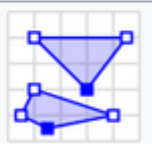
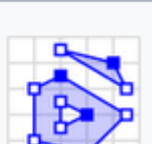
Not Included



Geometry Types

Included

Type	
Point	
LineString	
Polygon	
	


Type	
MultiPoint	
MultiLineString	
MultiPolygon	
	


Compatible With

- Well-known Text geometry primitives
- OGC Simple Features
- GeoJSON
- Shapefile
- Various geospatial databases

Some examples

Two locations where temperature is measured:

 $(0, 90)$ – at north pole

 $(0, 0)$ – at equator

How it works -- a point example



NetCDF File

time

lat

lon

temperature

geometry =
geometry_container

geometry_container

geometry_type = point
node_coordinates = x y

x


0, 0

y

0, 90

Legend

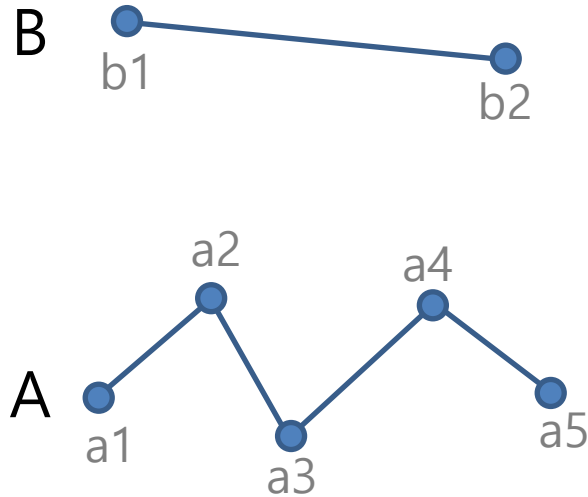
 Old Stuff

 Geometry Stuff

Two Line Features



How to deal with different node counts

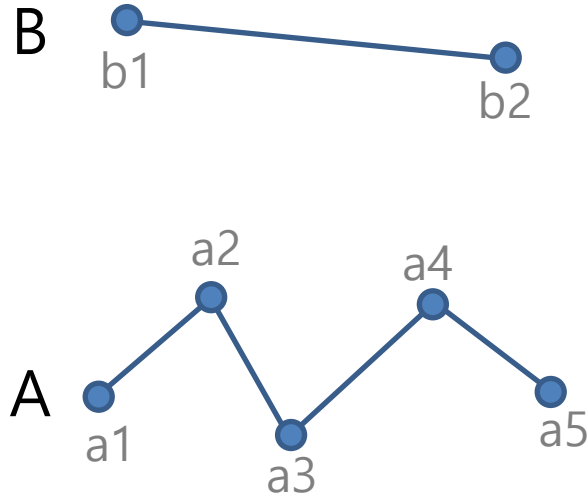


X Variable (2 by 5 array)

Feature A	Feature B
a1	b1
a2	b2
a3	
a4	
a5	

This is inefficient

Contiguous Ragged Arrays



Values

X
a1
a2
a3
a4
a5
b1
b2

Counts

Node Count
5
2

Line example



NetCDF File

time

lat

lon

temperature

geometry =
geometry_container

geometry_container

geometry_type = line
node_coordinates = x y
node_count = node_count

x

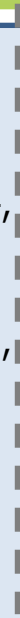
0, 1, 2, 3, 4, 0, 2

y

2, 3, 1, 3, 2, 8, 7

node_count

5, 2



Two Multilines

B



← two parts

A



← one part

Multiline example



NetCDF File

time

lat

lon

temperature

geometry =
geometry_container

geometry_container

geometry_type = multiline
node_coordinates = x y
node_count = node_count
part_node_count = part_node_count

x

y

node_count

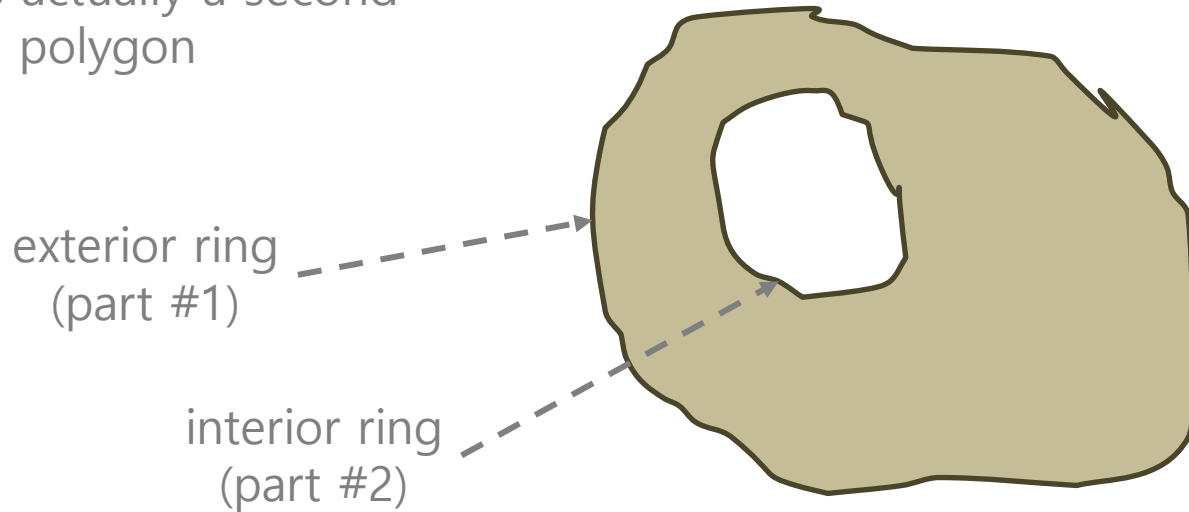
5, 4

part_node_count

5, 2, 2

A Polygon

The hole is actually a second part to the polygon



Polygon example (with holes)



NetCDF File

time

lat

lon

temperature

geometry =
geometry_container

geometry_container

geometry_type = polygon
node_coordinates = x y
node_count = node_count
part_node_count = part_node_count
interior_ring = interior_ring

x

y

0, 1

interior_ring
(yes or no)

node_count

part_node_count

Wouldn't it be cool
if this was in the
CF Conventions

Timeline for Getting into CF (1.8)

May, 2016

September

February, 2017

April

June

August



GitHub repo for simple geoms in netCDF

Has wiki and Python example

Uses coordinate index like UGRID

A second repo for R also created

Request for feedback sent to CF-Metadata mailing list

AGU poster

Proposal sent to CF-Metadata mailing list

Major revisions in our GitHub repo based on feedback

Dropped coordinate index variable

Pull request to cf-conventions on GitHub

Chapter 7 - cells
EC All-hands poster

2nd pull request to accommodate GitHub workflow

Each sentence on its own line

trac ticket #164

<https://github.com/cf-convention/cf-conventions/pull/115>

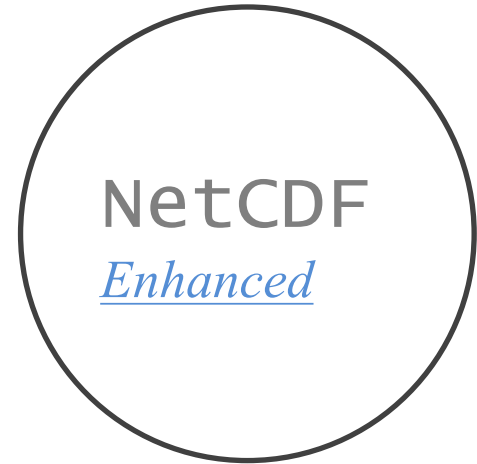
Next Steps



Persevere



Update



Explore

Geometry and the Enhanced Data Model

- VLEN
 - Eliminates need for contiguous ragged arrays
 - Eliminates node count variable

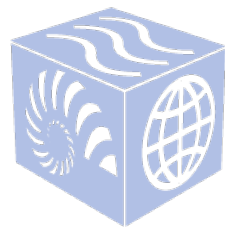
x {0, 1, 2, 3, 4}, {0, 2}

y {2, 3, 1, 3, 2}, {8, 7}

- Groups
 - Could store each feature in its own group
 - Could store parts as VLENs, eliminating node counts and part node counts

Acknowledgments

CF Community



EarthCube

Dave Blodgett

Ben Koziol

Bert Jagers

David Hassell

Jonathan Gregory

Mark Hedley

Bob Simons

Chris Little

Gray Beal

Martin Jukes

Want To Contribute?

- Wiki and Python implementation
<https://github.com/twhiteaker/netCDF-CF-simple-geometry>
- R implementation
<https://github.com/dblodgett-usgs/NCDFSG>
- Pull request to cf-conventions
<https://github.com/cf-convention/cf-conventions/pull/115>
- tim@utexas.edu