

# OpenGIS Workshop. Gridded data

Giorgio Santinelli

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# Definition

Multidimensional rectangular array of grid points containing values?

# Features of gridded data

## Features

Format

Dimensionality

Spacing

Number and type of values stores

# Applications

Data world

Data exploration

Data dissemination

# Applications

## Data world

Data exploration

Data dissemination

## Models

Numerical modelling...

Meteorology/Oceanography/Climate

Finite volume/difference methods

# Data grids

# Data grids

- Dataset type?
- Main variables?
- Number of dimensions?



# Data grids

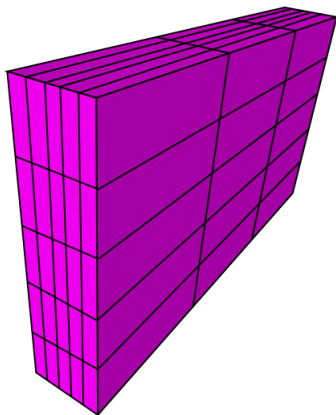
- Dataset type?
- Main variables?
- Number of dimensions?
- Showing concentration plots for given time and space
- Showing inflows from rivers of nutrients a user defined stretches / patches
- Calculate spatially distributed data products

# Grids (math)

A grid usually refers to two or more infinite sets of evenly-spaced parallel lines at particular angles to each other in a plane, or the intersections of such lines.

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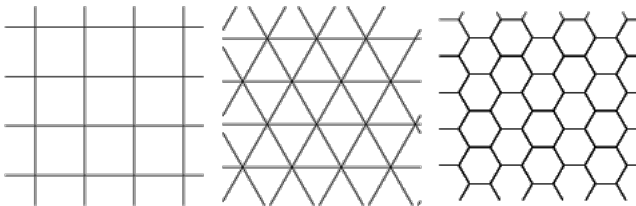


# Regular grids

Tessellation of regular polygons

# Regular grids

## Tessellation of regular polygons

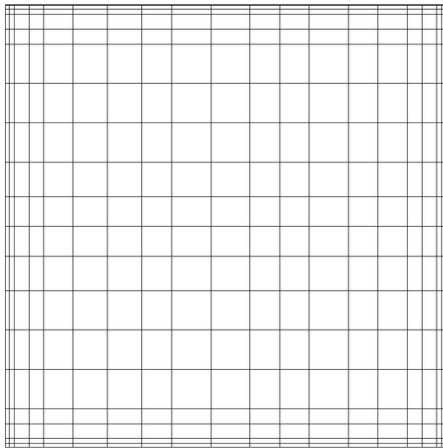


# Rectilinear grids

Congruent Tessellation.  
Uniform?

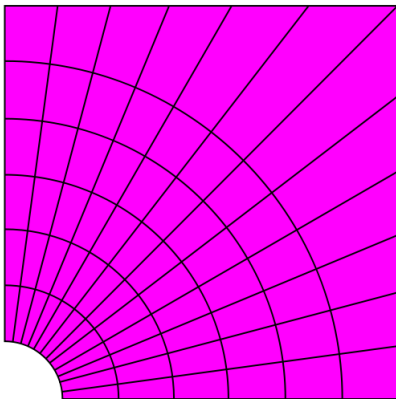
# Rectilinear grids

Congruent Tessellation.  
Uniform?



# Rectilinear grids

Congruent Tessellation. Curvilinear grids



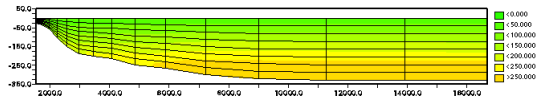
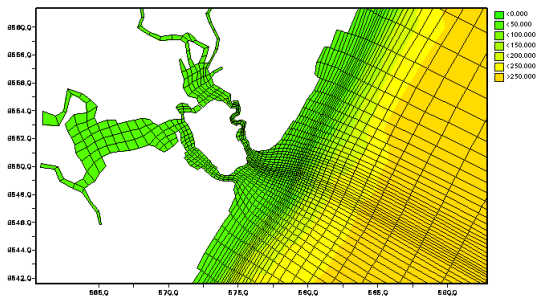


# Delft3d grids

Congruent Tessellation.

# Delft3d grids

## Congruent Tessellation. Delft3D

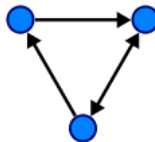


# Unstructured grids

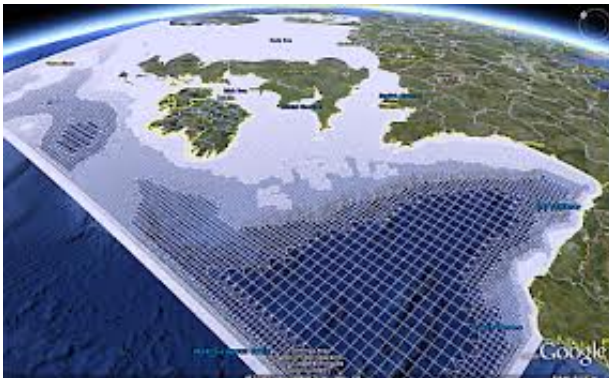
Irregular tessellation of simple shapes

# Unstructured grids

Irregular tessellation of simple shapes  
Similarity with graph data structure



# Unstructured grids: FEWS



# Unstructured grids: D-Flow FM

# Unstructured grids: D-Flow FM

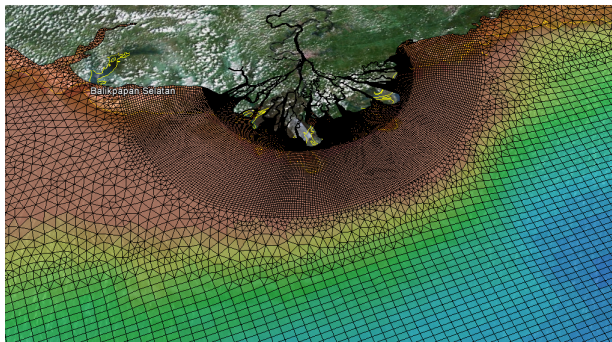
**Delft Software Days**  
Edition 2014

27 October – 7 November



# Unstructured grids: D-Flow FM

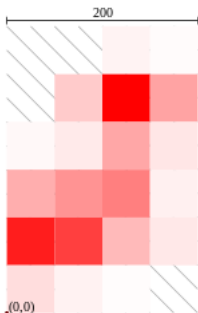
...FM stands for flexible mesh





# Working with Raster

**Grid image**



**Values**

	25	75	125	175
275	NA	NA	5	2
225	NA	20	100	36
175	3	8	35	10
125	32	42	50	6
75	88	75	27	9
25	13	5	1	NA

**ASCII grid format**

```
ncols           4
nrows           6
xllcorner       0.0
yllcorner       0.0
cellsize        50.0
NODATA_value   -9999
-9999 -9999 5 2
-9999 20 100 36
 3 8 35 10
32 42 50 6
88 75 27 9
13 5 1 -9999
```

# WMS

openlayers WMS  
NOAA WMS

# gdal library

## gdal

Gdal is a translator library for raster and vector geospatial data formats

Features

# gdal library

## gdal

Gdal is a translator library for raster and vector geospatial data formats

Features Raster utility programs:

gdalinfo, gdal\_translate, gdaladdo, gdalwarp, ...

Vector utility programs:

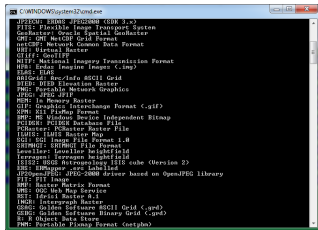
ogrinfo, ogr2ogr, ogrtindex, ...

gdal webpage

QGIS uses it in the back-end.

# gdal in other languages

- Shell (cross-platform)



```
C:\WINDOWS\System32\cmd.exe
GDAL: GDAL (GDAL)
FILE: File-like Image Transport System
GeoStructure: Oracle Spatial GeoStructure
GMT: GMT NetCDF Grid Format
HDFCDF: Network Common Data Format
UHDF: Virtual Raster
CITR: CITRIS
MIF: National Imagery Transmission Format
HFA: Erdas Imagine Image (.img)
HEAL: HEAL
S57: S57 (.s57)
S57TAB: S57 into ASCII Grid
STER: UTM Elevation Raster
PNG: Portable Network Graphics
JPEG: JPEG JFIF
PNG16: PNG16 Raster
CIT: Graphics Interchange Format (.gif)
SHP: ESRI Shape Format
BMP: MS Windows Bitmap Independent Bitmap
SDBASE: SQLite Database File
PCRaster: PCRaster Raster File
LITCUB: LITCUB Raster Map
SGI: SGI Image File Format 1.0
SERIALIZED: Serialized File Format
Laweller: Laweller Neighbourfield
LITCUB: Litcub Neighbourfield
LITCUB2: Litcub Neighbourfield (Version 2)
GSD: GeoTIFF
JPEGOpenJPEG: JPEG-2000 driver based on OpenJPEG library
FIT: FIT Image
MNF: Raster Matrix Format
MNF: MNF Map Service
ZST: Zonal Raster R-1
INM: Intergraph Raster
CEM: Golden Software MCCI Grid (.gpd)
CEM: Golden Software Binary Grid (.gpd)
E: E Object Data Store
TMT: Portable Mosaic Format (cptm)
```

# gdal in other languages

- Shell (cross-platform)

```
C:\WINDOWS\System32\cmd.exe
JP2KIO: JPEG2000 (SRM 2.0)
FILE: File-like Image Transport System
GeoSecret: Oracle Spatial GeoSecret
GNT: GNT NetCDF Grid Format
HRTSIO: Network Common Data Format
URT: Virtual Raster
CHIPS: CHIPS
NIIF: National Imagery Transmission Format
HFA: Erdas Imagine Image (.img)
EARS: EARS
BRGEO: Arc-Info ASCII Grid
DTED: DTED Elevation Raster
PNG: Portable Network Graphics
JP2C: JP2C JPIP
RCT: Raster Raster
GIF: Graphics Interchange Format (.gif)
SMI: SMI FileMap Format
BMP: MS Windows Bitmap Independent Bitmap
SDBASE: SDBASE Database File
PCRaster: PCRaster Raster File
IRTIO: IRTIO Raster Map
SGI: SGI Image File Format 1.0
SRTMIO: SRTMIO File Format
Lzweller: Lzweller ImageField
IRTIO: IRTIO ImageField
IRTIO: IRTIO ImageField (Version 2)
SDB: SDBASE arc labeled
JP2OpenJPEG: JP2-2000 driver based on OpenJPEG library
FIT: FIT Image
SHP: Raster Matrix Format
UNL: UNL Map Service
ZST: Zstandard Raster
IMG3: Intergraph Raster
CSWIG: Golden Software ASCII Grid (.gpd)
CSWIG: Golden Software Binary Grid (.gbd)
E: R Object Data Store
TML: Portable Mosaic Format (cmtm)
```

## Bindings:

- C++
- Python osgeo
- R rgdal
- Matlab MEXGDAL
- ...

# Working with NetCDF



# Working with NetCDF



- File Format



# Working with NetCDF



- File Format
- Library

# Working with NetCDF



- File Format
- Library
- Interface

# Working with NetCDF

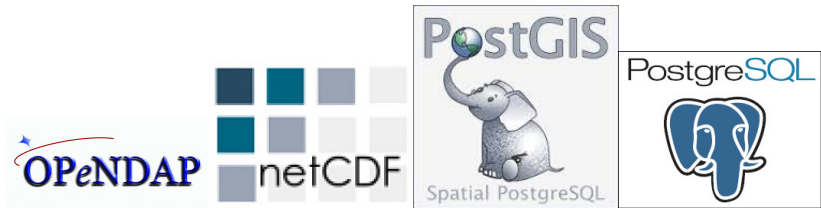


- File Format
- Library
- Interface

General information on NetCDF are available.

# Working with NetCDF

Openearth.eu



Deltares

# CF Conventions

NetCDF Climate and Forecast Metadata Conventions  
cfconventions

# OET & NetCDF

Links in OET:

Python:

[OET python nc](#), [OET python tutorial](#)

Matlab:

[OET matlab nc](#), [OET matlab tutorial](#)

# Opendap

It strongly depends on the language. Many tutorials are available on line. Creating netCDF files that are fully self-descriptive and comply with the CF convention is not trivial

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It strongly depends on the language. Many tutorials are available on line. Creating netCDF files that are fully self-descriptive and comply with the CF convention is not trivial

As a start you could use OET netcdfkickstarter.  
kickstarter wiki page  
netcdfkickstarter



# Opendap

## Browse

- Deltares OPeNDAP server <http://opendap.deltares.nl/>
- List of OPeNDAP servers worldwide (remote servers)

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- Deltares OPeNDAP server <http://opendap.deltares.nl/>
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[opendap.deltares.nl](http://opendap.deltares.nl)

# Tutorials

OET OpenGIS

[bit.ly/gisworkshop](http://bit.ly/gisworkshop)