WCS versus OPeNDAP

Making model results available through the internet.

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September 14, 2011

Introduction

Fedor Baart

PhD thesis: Confidence in morpological forecasts

This research

http://citg.tudelft.nl http://www.knmi.nl
http://www.rijkswaterstaat.nl http://www.deltares.nl
http://www.openearth.nl http://www.micore.eu

TUDelft Deltares Enabling Delta Life Rijkswaterstaat Ministerie van Infrastructuur en Milieu
micore

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1. Model examples
2. Store and provide
3. Challenges
4. WCS and OPeNDAP
5. Recommendations

Outline

1 Model examples

2 Store and provide

3 Challenges

4 WCS and OPeNDAP

5 Recommendations

Operational modelling

Forecasts

Predicting coastal changes 3 days ahead.

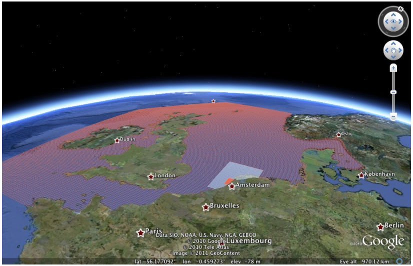


Figure: Operational model for coastal morphology (Baart et al 2009)

Open Source models

Delft3D

Open source modules: FLOW, MOR, WAVE.

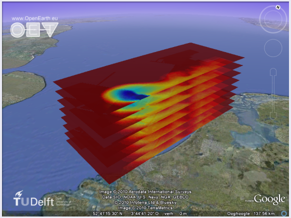
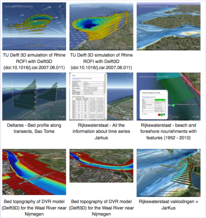

www.OpenEarth.eu
TUDelft
Image © 2010 Aerodata International Surveys
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2010 Infoterra Ltd & Bluesky
Image © 2010 TerraMetrics
52°41'15.30" N 3°44'41.20" O verh. 0 m
Ooghoogte 137.56 km
Google

Figure: Delft3D simulation of Rhine rofi, source: De Boer, http://oss.deltares.nl

OpenEarth

Collaboration to share data model and tools.



TU Delft 3D simulation of Rhine ROFI with Delft3D (doi:10.1016/j.csr.2007.06.011)

TU Delft 3D simulation of Rhine ROFI with Delft3D (doi:10.1016/j.csr.2007.06.011)

Deltares - Bed profile along transects, Sao Tome

Rijkswaterstaat - All the information about time series Jarkus

Rijkswaterstaat - beach and foreshore nourishments with features (1952 - 2010)

Bed topography of DVR model (Delft3D) for the Waal River near Nijmegen

Bed topography of DVR model (Delft3D) for the Waal River near Nijmegen

Rijkswaterstaat vaklodingen + JarKus

Figure: Visualizations made with OpenEarthTools, http://www.openearth.eu

Operational modelling

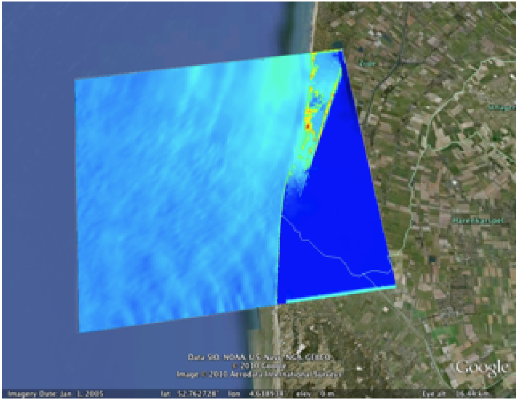

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2010 Google
Image © 2010 Aerodata International Surveys
Google
Imagery Date: Jan 1, 2005
lat 52.762728° lon 4.618591° elev 0 m
Eye alt 16.44 km

Figure: Forecasting water levels and currents nearshore and erosion

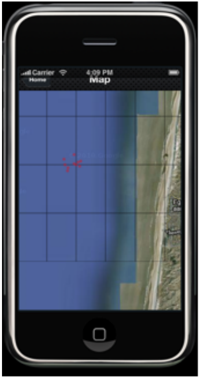
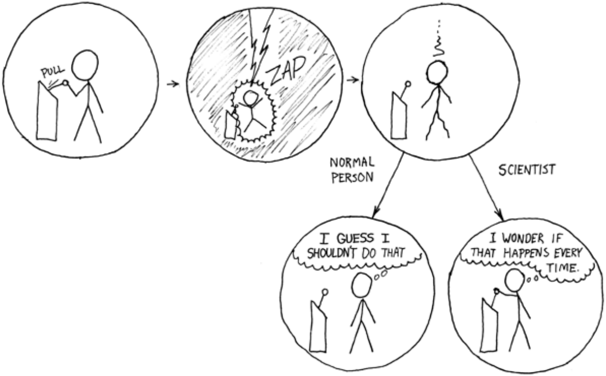


Figure: Swimmer simulator

Figure: XBeach model of Petten met hyperstorm ($p < {}^{1}/_{10000}$).

End users

Scientists	Can consume data using scripts
Analysts	Can use programs and click buttons
Government	Can print a webpage


PULL
ZAP
NORMAL PERSON
SCIENTIST
I GUESS I SHOULDN'T DO THAT
I WONDER IF THAT HAPPENS EVERY TIME.

src:xkcd.com/242

Goal

Make these model results available to end-users.

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Architecture

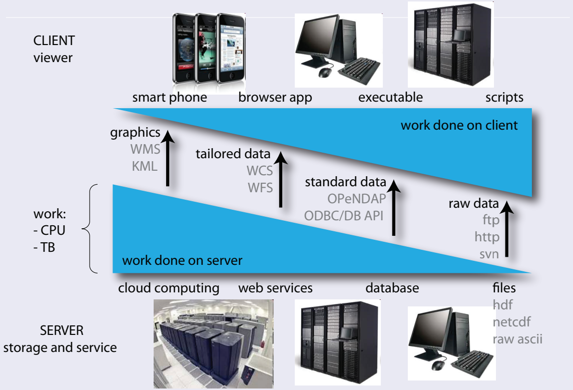

Figure: Provide different users with different access

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The gridded view of the modeler

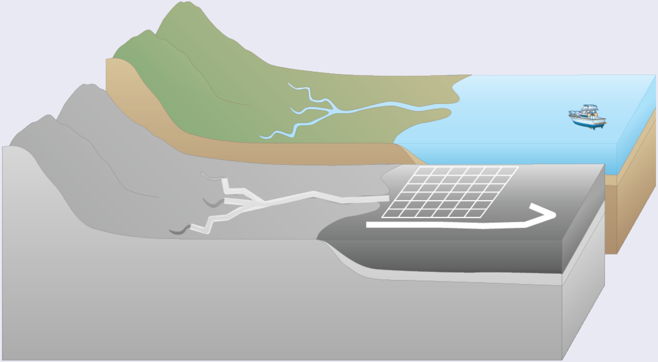

Figure: The world is discretized

Unstructured grid

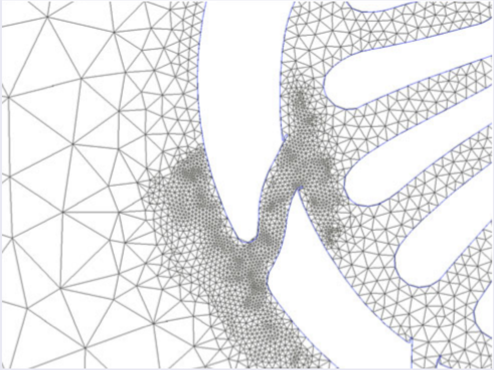

Figure: Grid consists of triangles, rectangles, pentagons, . . .

Staggering

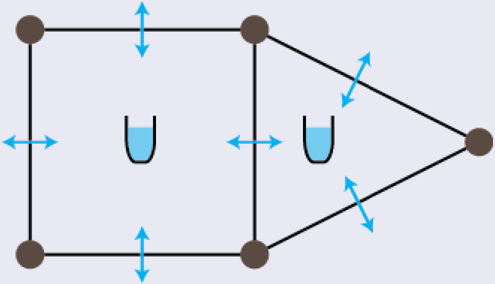

Figure: Not all quantities are stored on the same location.

Vertical refererence layers

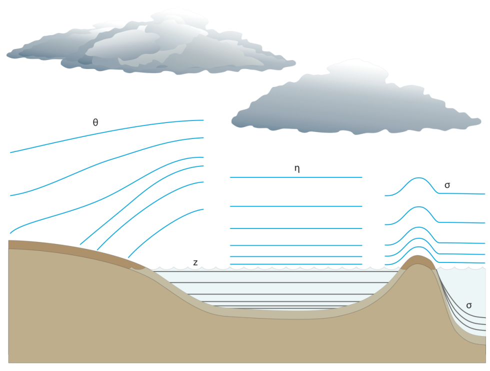

Figure: Different types of vertical coordinates

Multidimensionality

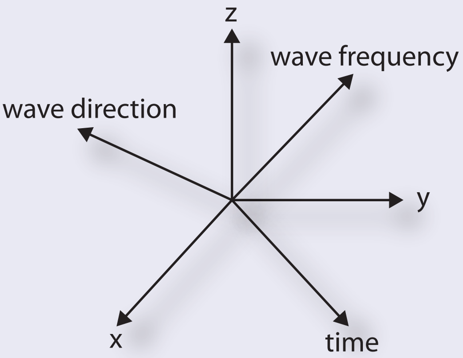

Figure: Model results often have more dimensions

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Feature comparison

	OPeNDAP	WCS
Querying	index	coordinate
Reprojection	no	yes
Dimensionality	n	4 (x,y,z,t)
Metadata	CF Convention	OWS Common
Unstructured grids	possible, not standardized	standardized, not possible
Response type	arrays + attributes	xml + file

Performance comparison

Setup

Geoserver 2.1 rc5 WCS

Thredds 4.2 OPeNDAP

760x360 grid, 1 variable

Query: All data

Response times

Geoserver: 2.4s +- 0.6s

Thredds: 0.15s +- 0.2s

Usability experiment

Setup

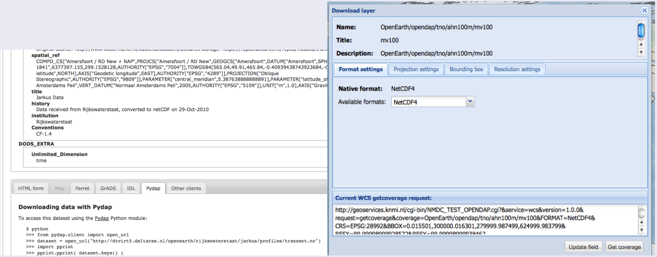
subjects	students with 6 months scripting experience
exclusion	used OPeNDAP or WCS
datasets	cloud coverage (MSGCPP), altitude map (AHN)
servers	Thredds OPeNDAP, Adaguc WCS
assignment 1	What is the mean cloud coverage at your location?
assignment 2	What is the altitude of your location?

Usability experiment

Results

1. Users want to put a url into a browser.
2. Users get the wrong results.
3. Index based querying is too difficult for users with little programming experience.

URL builder



Original source: http://www.watermark.nl/kustenzeebodem/ Deltares storage: https://repos.deltares.nl/repos/mcdata/trun

spatial_ref
COMPD_CS["Amersfoort / RD New + NAP",PROJCS["Amersfoort / RD New",GEOGCS["Amersfoort",DATUM["Amersfoort",SPH
1841",6377397.155,299.1528128,AUTHORITY["EPSG","7004"]],TOWGS84[565.04,49.91,465.84,-0.40939438743923684,-0
latitude",NORTH],AXIS["Geodetic longitude",EAST],AUTHORITY["EPSG","4289"]],PROJECTION["Oblique
Stereographic",AUTHORITY["EPSG","9809"]],PARAMETER["central_meridian",5.387638888888891],PARAMETER["latitude_of
Amsterdams Peil",VERT_DATUM["Normaal Amsterdams Peil",2005,AUTHORITY["EPSG","5109"]],UNIT["m",1.0],AXIS["Gravit

title
Jarkus Data

history
Data received from Rijkswaterstaat, converted to netCDF on 29-Oct-2010

institution
Rijkswaterstaat

Conventions
CF-1.4

DODS_EXTRA

Unlimited_Dimension
time

Downloading data with Pydap

To access this dataset using the Pydap Python module:

```
$ python
>>> from pydap.client import open_url
>>> dataset = open_url("http://dtvirt5.deltares.nl/openearth/rijkswaterstaat/jarkus/profiles/transect.nc")
>>> import pprint
>>> pprint.pprint( dataset.keys() )
```

Download layer

Name: OpenEarth/opendap/tno/ahn100m/mv100

Title: mv100

Description: OpenEarth/opendap/tno/ahn100m/mv100

Native format: NetCDF4

Available formats: NetCDF4

Current WCS getcoverage request:

```
http://geoservices.knmi.nl/cgi-bin/NMDC_TEST_OPENDAP.cgi?&service=wcs&version=1.0.0&
request=getcoverage&coverage=OpenEarth/opendap/tno/ahn100m/mv100&FORMAT=NetCDF4&
CRS=EPSG:28992&BBOX=0.015501,300000.016301,279999.987499,624999.983799&
RESX=99.99999999285728RESY=99.99999999938462
```

Figure: This works.

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storage	Use NetCDF as model output format.
architecture	Use layered approach for different users.
performance	Custom WCS service for high performance (ADAGUC).
unstructured grid	Proposol for CF convention (Jagers and van Dam)
metadata	Inspire in NetCDF convention (ADAGUC)
metadata	Metadata propogation through the layers.
usability	Help users with URL builders for services.
visualize	bitbucket.org/SiggyF/html5overlay