ADCIRC
XDMF
eXtensible Data Model and Format

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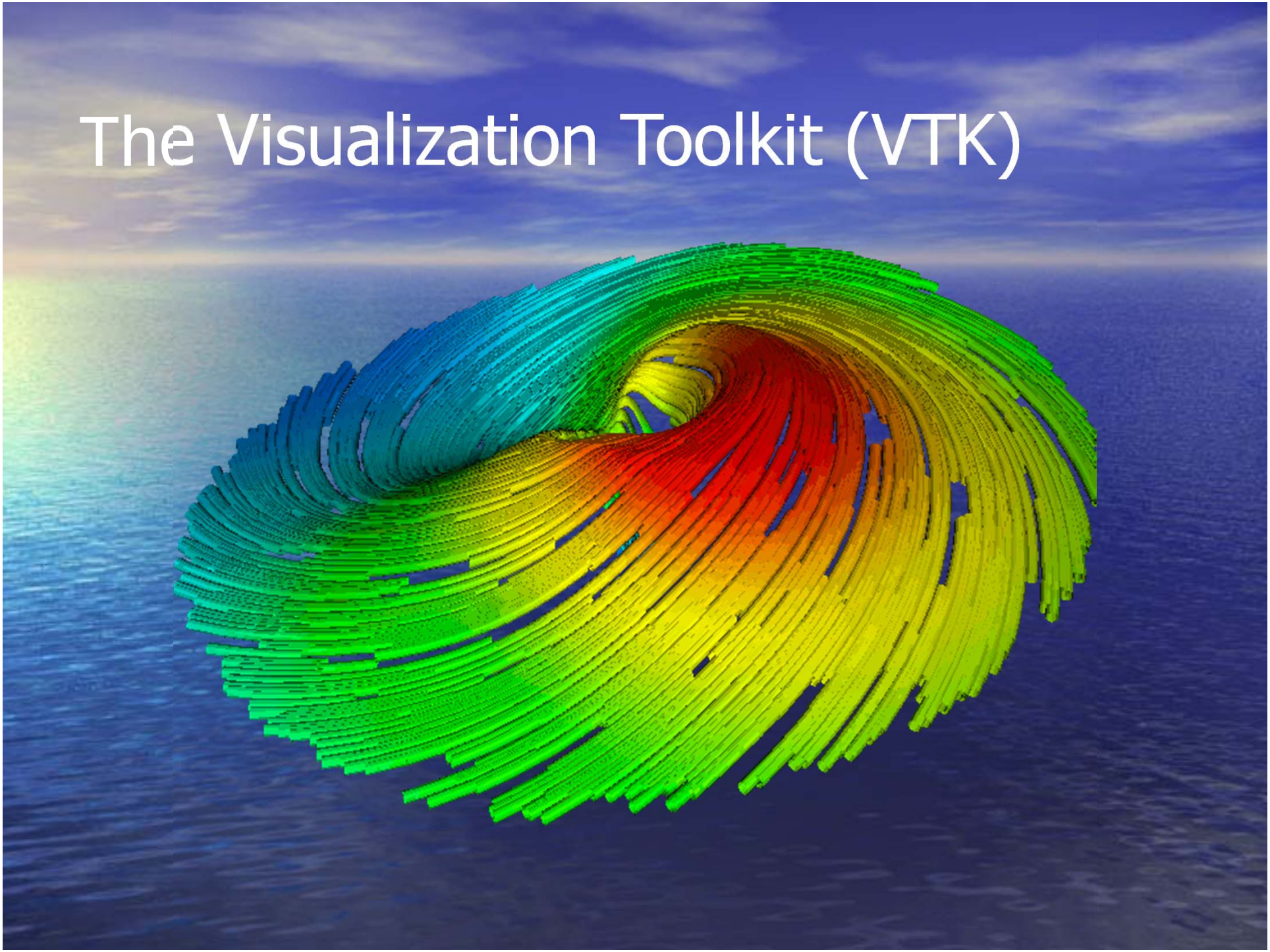
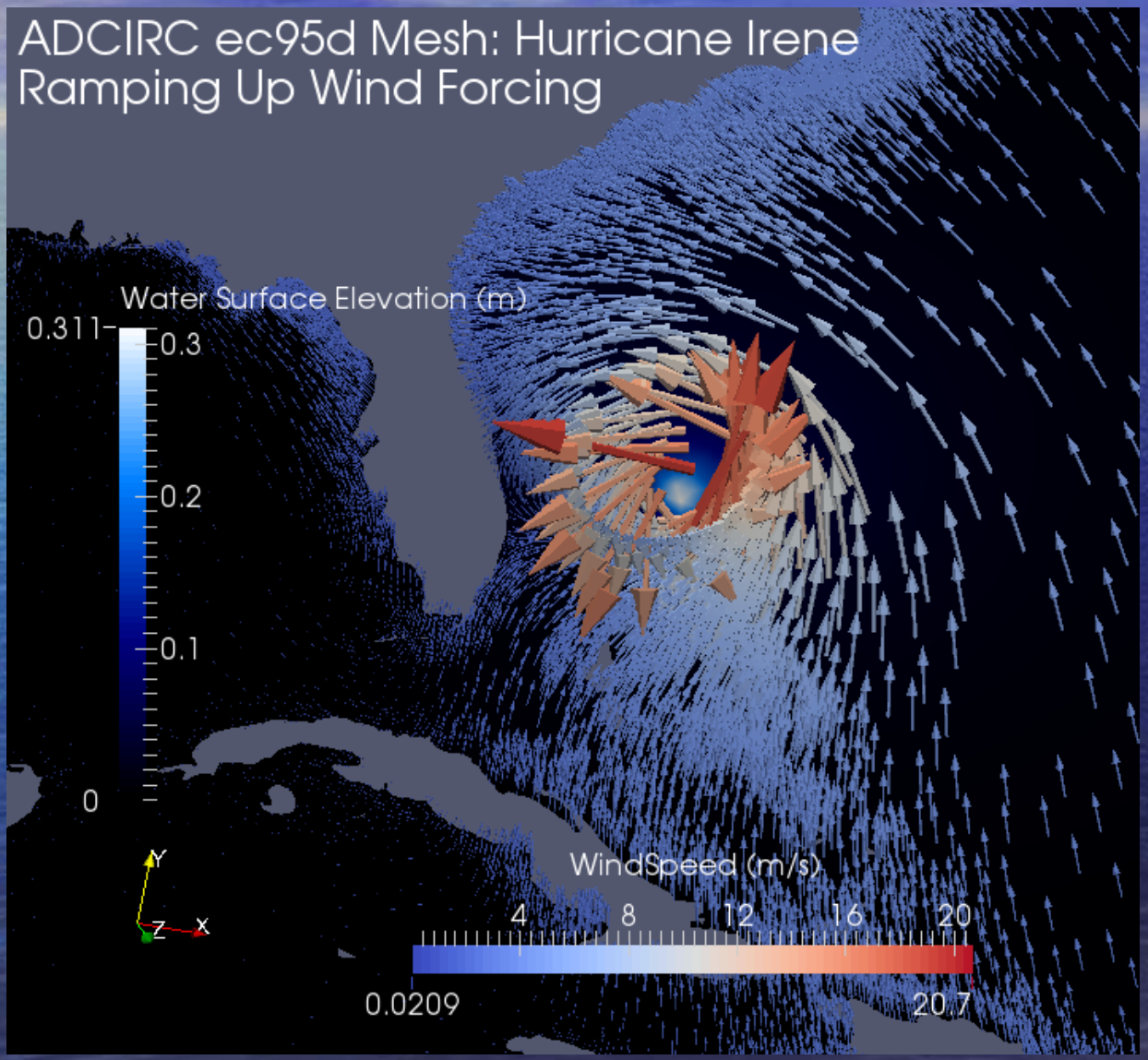
The Visualization Toolkit (VTK)



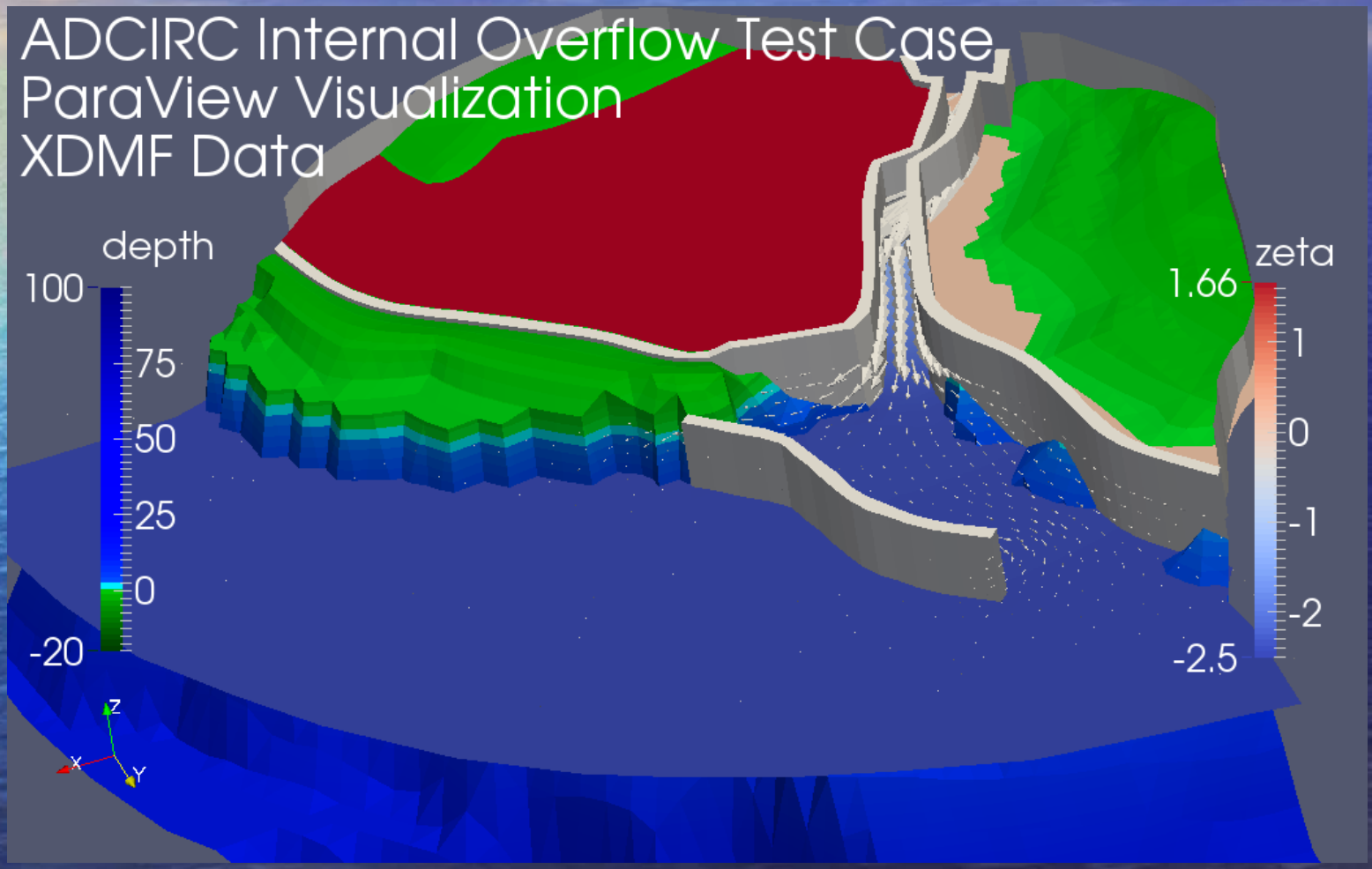
Paraview


ADCIRC ec95d Mesh: Hurricane Irene
Ramping Up Wind Forcing
Water Surface Elevation (m)
0.311
0.3
0.2
0.1
0
Y
Z
X
WindSpeed (m/s)
4
8
12
16
20
0.0209
20.7

Paraview File Formats

- Paraview Native Format?
- VTU: VTK Unstructured mesh
- Conversion is ascii-to-ascii
- Prefer not to be stranded in specific format

3D View of Bathy/Topo/Mesh



XDMF Format

- Hierarchical Data Format (HDF5)
  - Heavy Data (binary)
  - Simple structure
- Extensible Markup Language (XML)
  - Ascii text
  - Describes the heavy data

Commonality with NetCDF

- NetCDF4 uses HDF5 underneath
- Now available as native output format from ADCIRC
- Specifically formatted HDF5

XDMF XML Example

```
<?xml version="1.0" encoding="utf-8"?>
<Xdmf xmlns:xi="http://www.w3.org/2001/XInclude" Version="2.1">
  <Domain>
    <Grid Name="Quarter Annular Grid">
        <Geometry Type="XY">
           <DataItem DataType="Float"
                     Dimensions="126"
                     Format="HDF"
                     Precision="8">fort.63.h5:Data0</DataItem>
        </Geometry>
        <Topology Dimensions="96" Type="Triangle">
          <DataItem DataType="Int"
                    Dimensions="288" Format="HDF" Precision="4">
                    fort.63.h5:Data1</DataItem>
        </Topology>
        <Attribute Center="Node" Name="depth" Type="Scalar">
          <Information Name="variable_name" Value="depth"/>
          <DataItem DataType="Float"
                    Dimensions="63"
                    Format="HDF" Precision="8">
                    fort.63.h5:Data2</DataItem>
        </Attribute>
```

XDMF Model

- Explicitly represents structure
  - Data has a physical domain
  - Unstructured Mesh
  - Structured Grid
  - Spatial Grid Collections
  - Temporal Grid Collections
- Domain and Data inseparable

XDMF Native Data Types

- Linear
  - Polyvertex
  - Triangle
  - Wedge
- Quadratic
  - Tri_6
  - Wedge_15

First Cut: NetCDF4 + XML

- Generate NetCDF4 as usual
  - Native ADCIRC output
  - Or post processing step: adcirc2netcdf
- Run additional utility: generateXDMF.F
  - Creates corresponding XML
  - Runs fast
- Now load into Paraview

XDMF2 API

- Army Research Lab
- C++ library
- Wrapped with Fortran interface
- Cmake build system (cross platform)
- Call subroutines within application
- Write light and heavy data

Implementation in ADCIRC

- Read XDMF
  - Mesh file and nodal attributes file
  - Serial and parallel (adcprep)
- Write output in XDMF
  - Write mesh and data to output
  - Serial and parallel (writer processors)

Standalone Utilities

- Convert files, include metadata
- Adcirc2xdmf.f90
- Xdmf2adcirc.f90
- Mesh file
- Output files
- Nodal attribute files

ADCIRC Refactoring

- The read_input.F interleaved
  - Reading fort.15 control file
  - Reading fort.14 mesh file
  - Initialization
- Separated reading and initialization
- Command line argument to specify mesh file format

XDMF2 Status

- Available on xdmf2 branch
- Workflow: merge, test, fix, test, commit
- API experience informs utility code
- Continue to improve the NetCDF4/XDMF connectivity
- Long term vision
  - One file format
  - Complies with many standards


Demonstration