3D Visualization of ultra-fine ICON Climate Simulations

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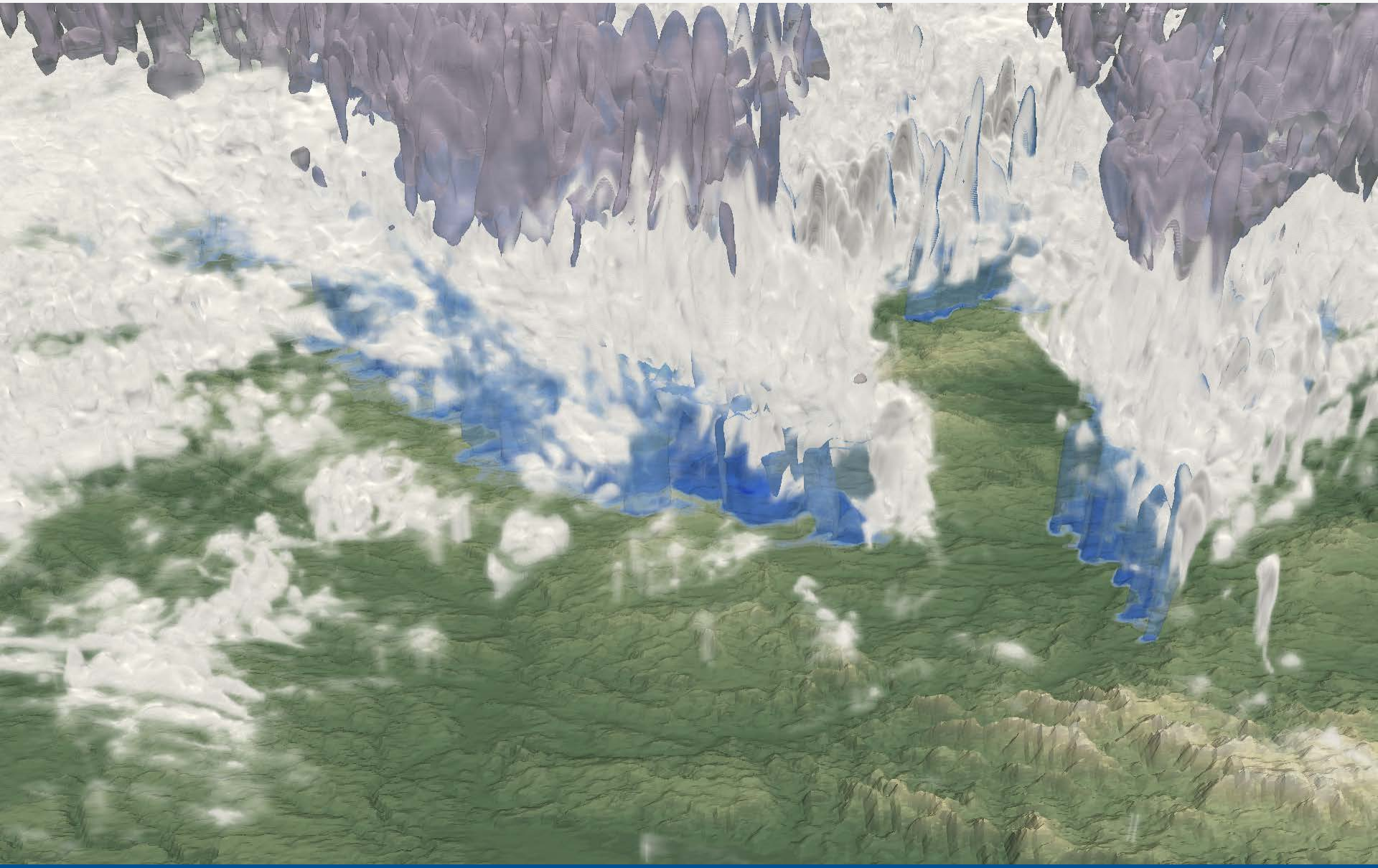
Cloud Resolving Simulation over Germany



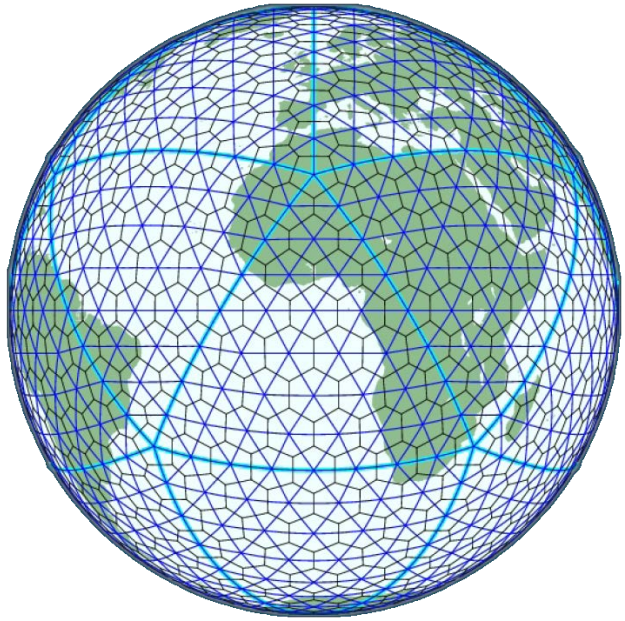
ICON Model and Data

- **ICO**sahedral **N**on-hydrostatic grid

- Atmosphere and Ocean
- Ocean – 10km resolution

  (3.8 million cells / 64 levels)
- HD(CP)^2 – 120m resolution

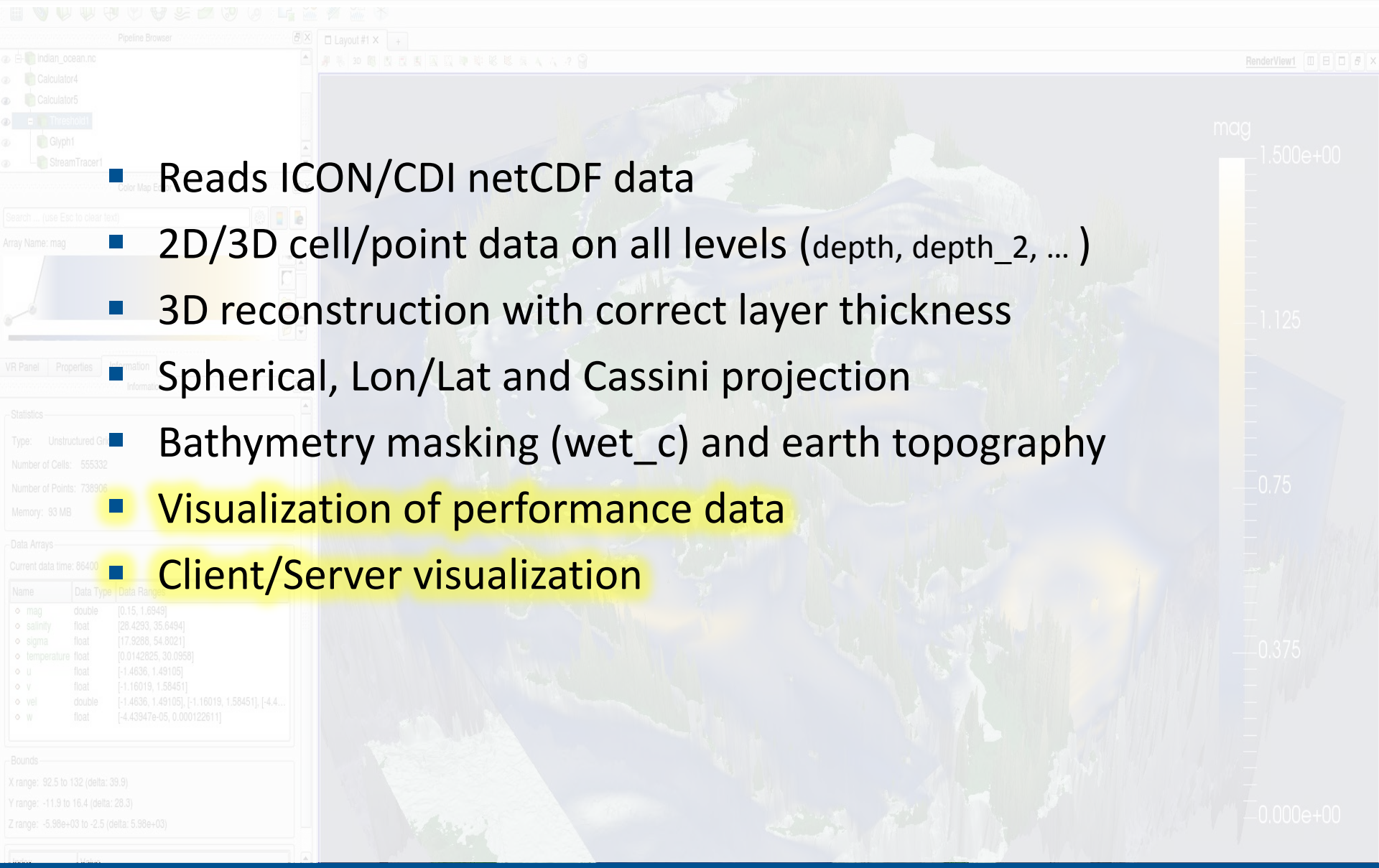
  (22.5 million cells / 150 levels)



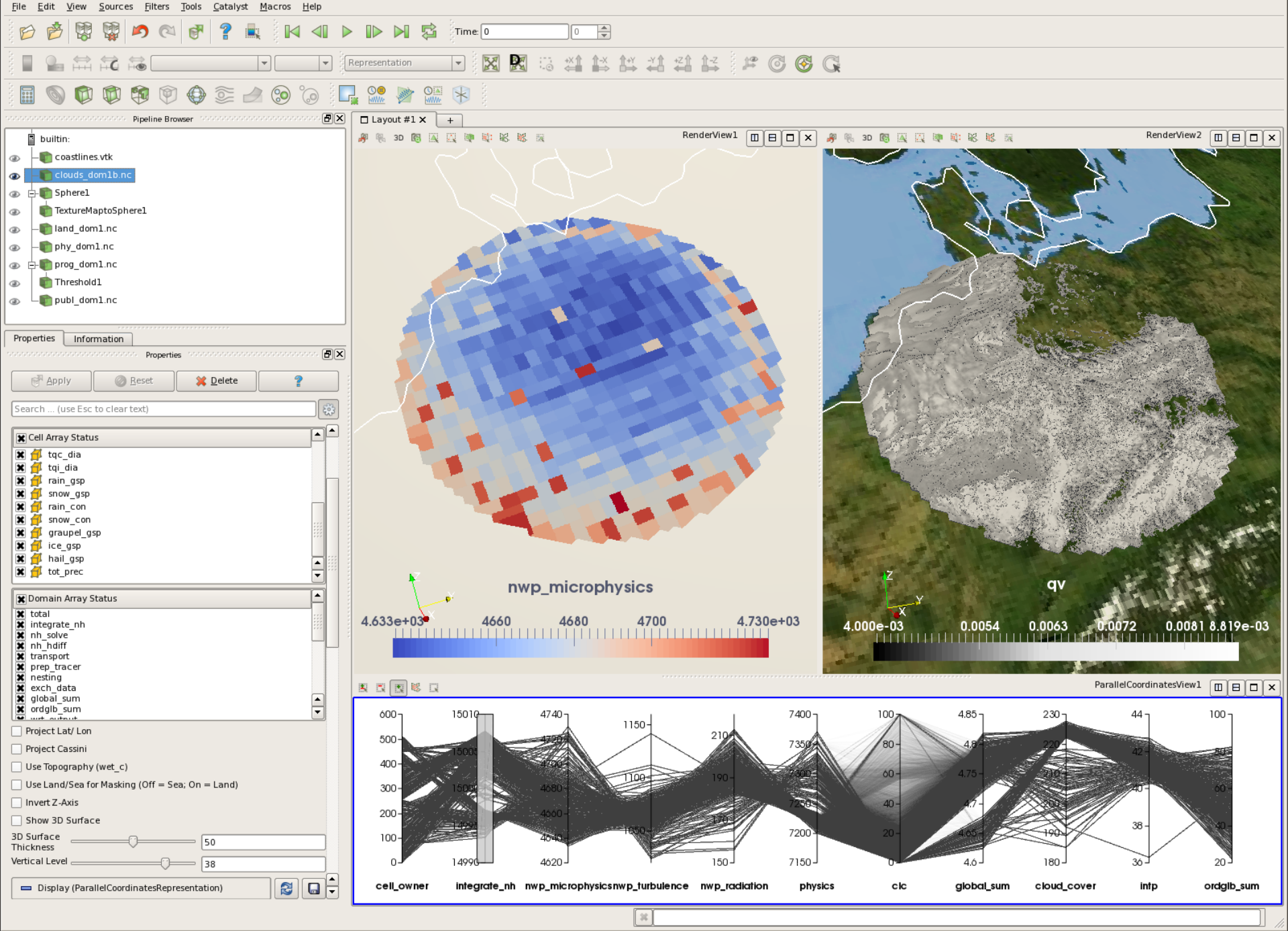
HD(CP)^2

High definition clouds and precipitation for advancing climate prediction

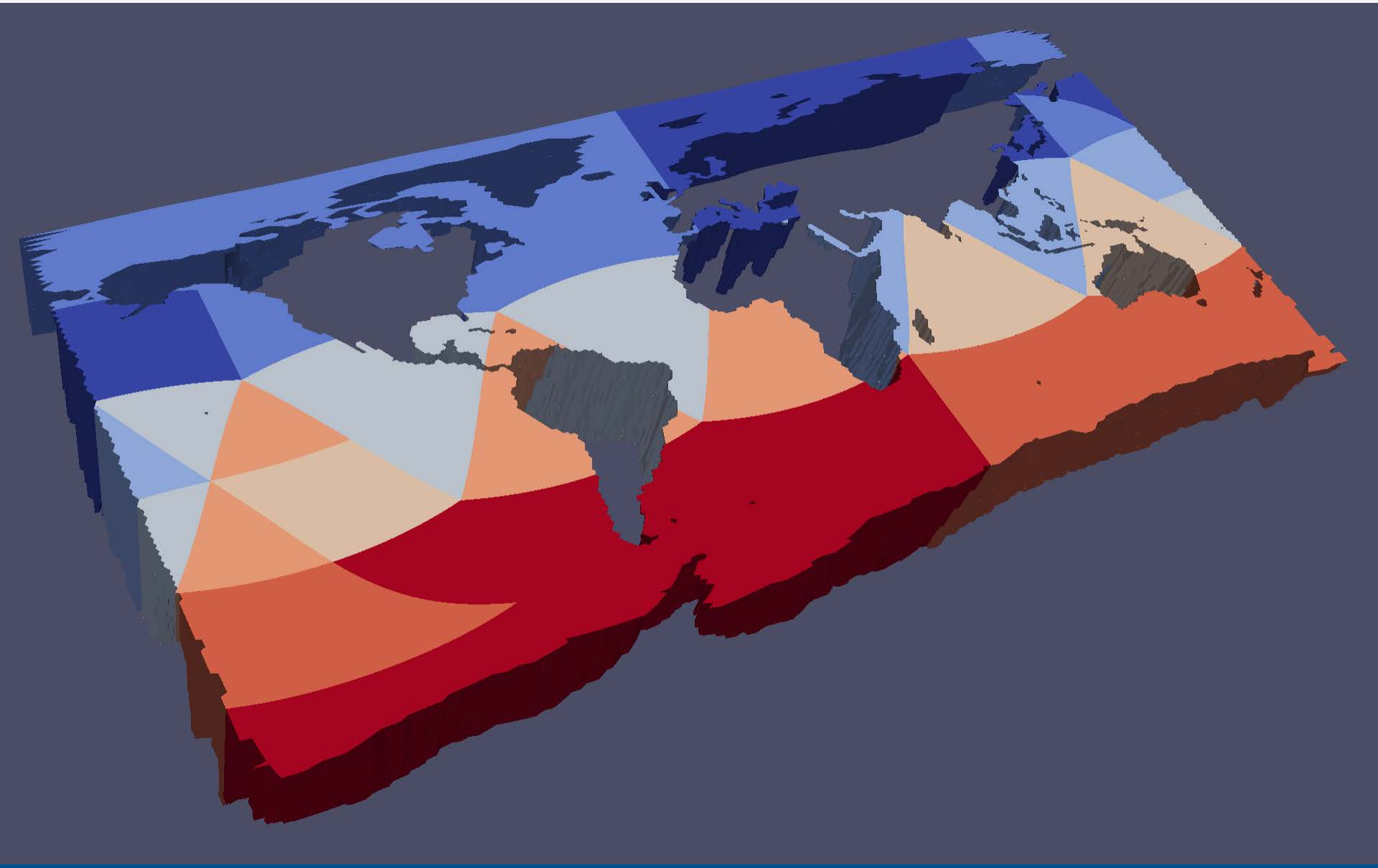
ICON Reader for ParaView



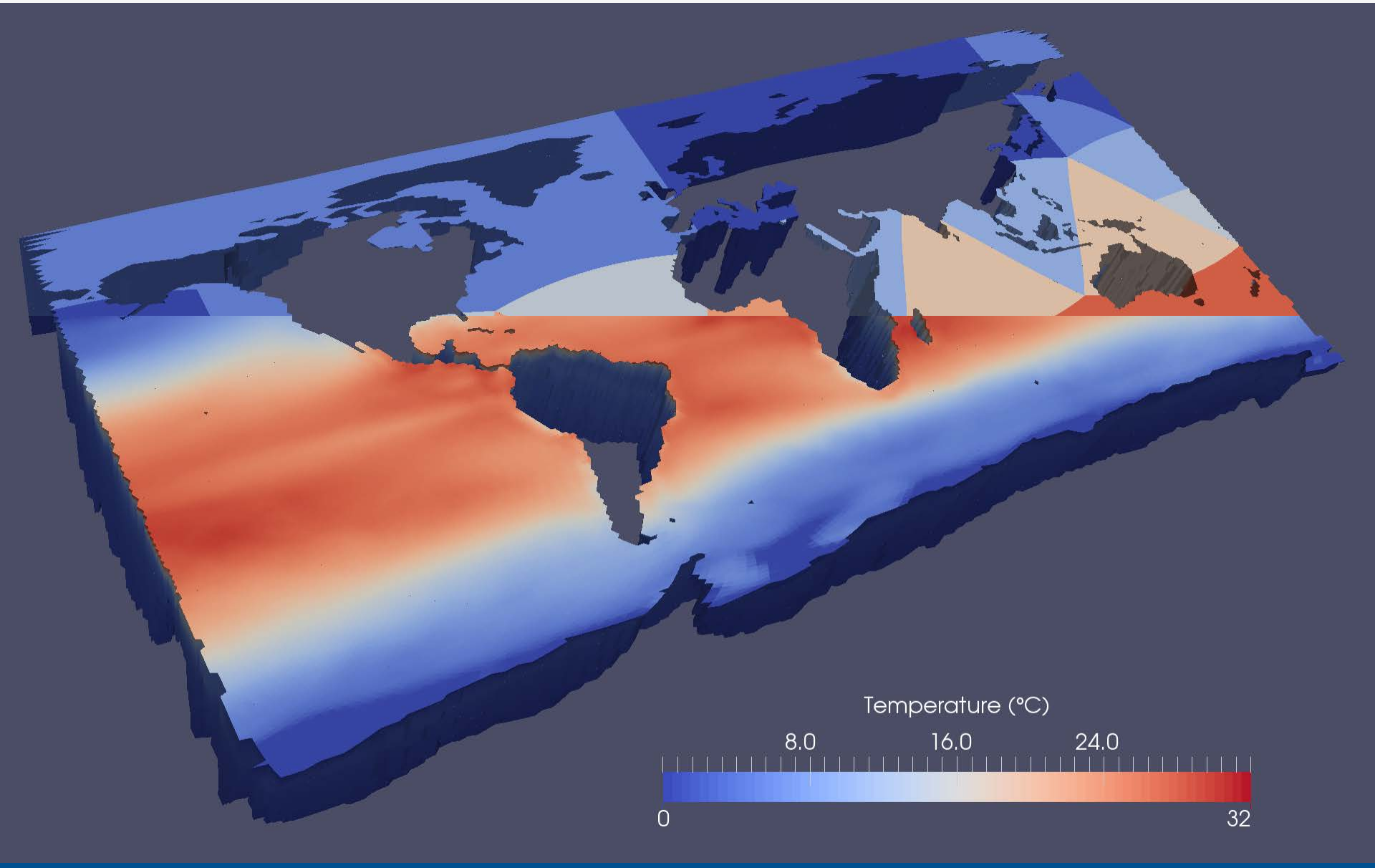
- Reads ICON/CDI netCDF data
- 2D/3D cell/point data on all levels (depth, depth_2, …)
- 3D reconstruction with correct layer thickness
- Spherical, Lon/Lat and Cassini projection
- Bathymetry masking (wet_c) and earth topography
- Visualization of performance data
- Client/Server visualization


File Edit View Sources Filters Tools Catalyst Macros Help
Time: 0
Representation
Pipeline Browser
builtin:
coastlines.vtk
clouds_dom1b.nc
Sphere1
TextureMaptoSphere1
land_dom1.nc
phy_dom1.nc
prog_dom1.nc
Threshold1
publ_dom1.nc
Properties
Information
Properties
Apply
Reset
Delete
Search ... (use Esc to clear text)
Cell Array Status
tqc_dia
tqi_dia
rain_gsp
snow_gsp
rain_con
snow_con
graupel_gsp
ice_gsp
hail_gsp
tot_prec
Domain Array Status
total
integrate_nh
nh_solve
nh_hdiff
transport
prep_tracer
nesting
exch_data
global_sum
ordglb_sum
Project Lat/ Lon
Project Cassini
Use Topography (wet_c)
Use Land/Sea for Masking (Off = Sea; On = Land)
Invert Z-Axis
Show 3D Surface
3D Surface Thickness
50
Vertical Level
38
Display (ParallelCoordinatesRepresentation)
Layout #1
RenderView1
nwp_microphysics
4.633e+03
4660
4680
4700
4.730e+03
RenderView2
qv
4.000e-03
0.0054
0.0063
0.0072
0.0081
8.819e-03
ParallelCoordinatesView1
cell_owner
integrate_nh
nwp_microphysics
nwp_turbulence
nwp_radiation
physics
clc
global_sum
cloud_cover
intp
ordglb_sum

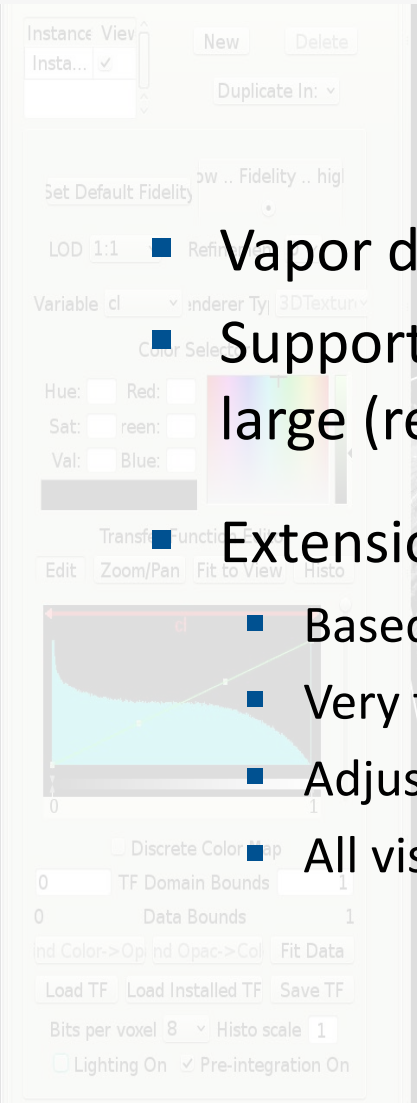
Client/Server Visualization



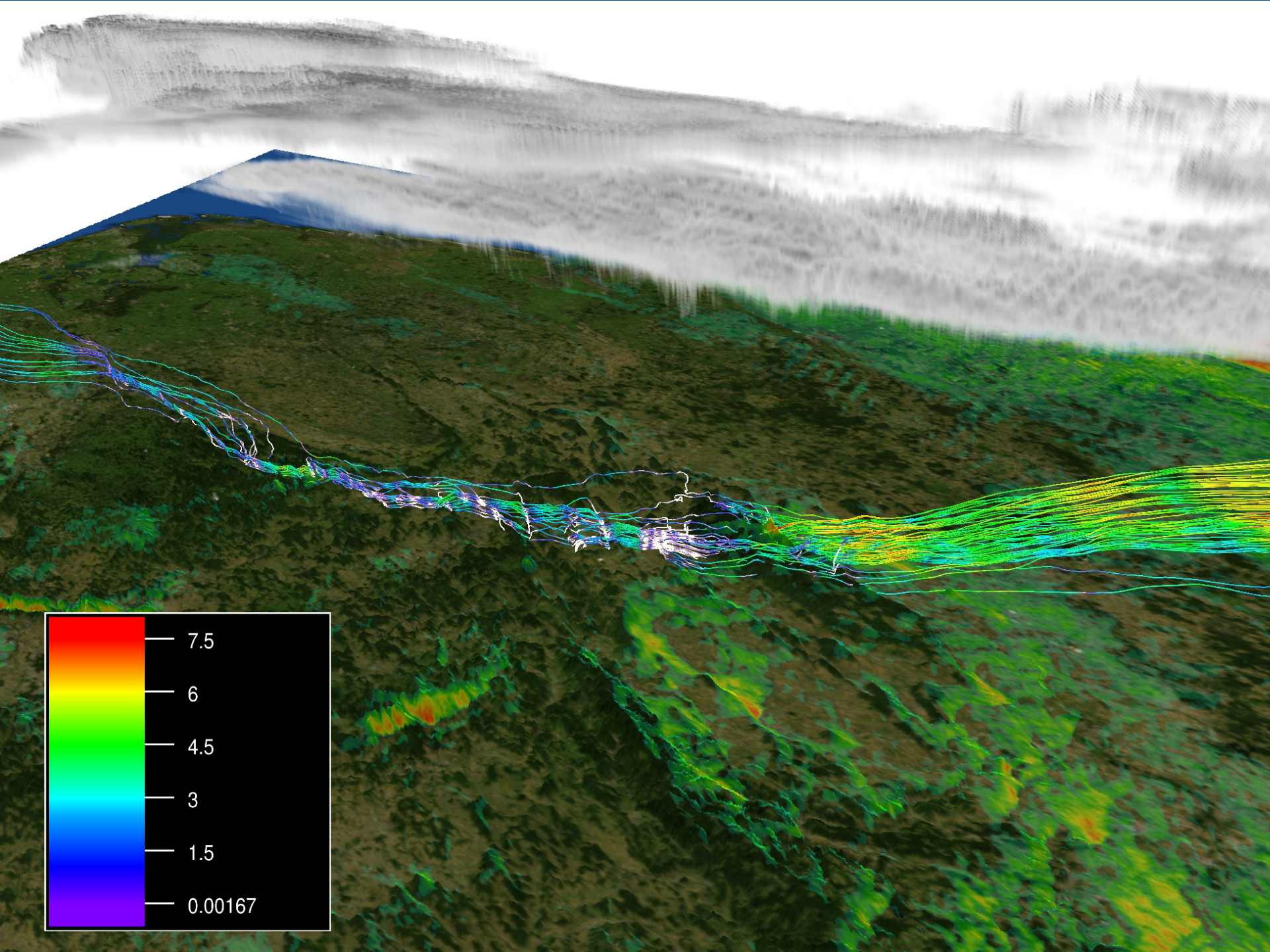
Client/Server Visualization



ICON Reader for Vapor



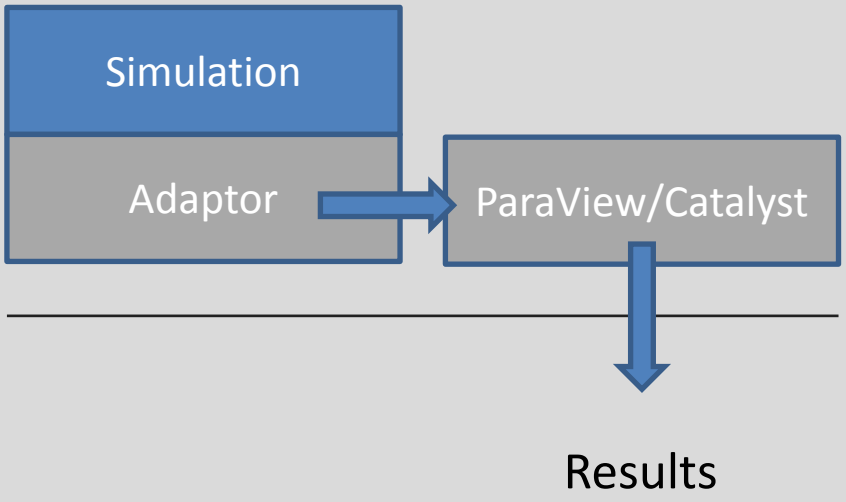
- Vapor developed at NCAR (open source)
- Supports wavelet compression and LoD rendering for very large (rectilinear) data sets
- Extension for ICON/MPAS data
  - Based on ICON ParaView plugin
  - Very fast on-the-fly resampling of ICON/MPAS data to regular grid
  - Adjustable under/oversampling
  - All visualization methods can be used


7.5
6
4.5
3
1.5
0.00167

Visualization of large Data Sets

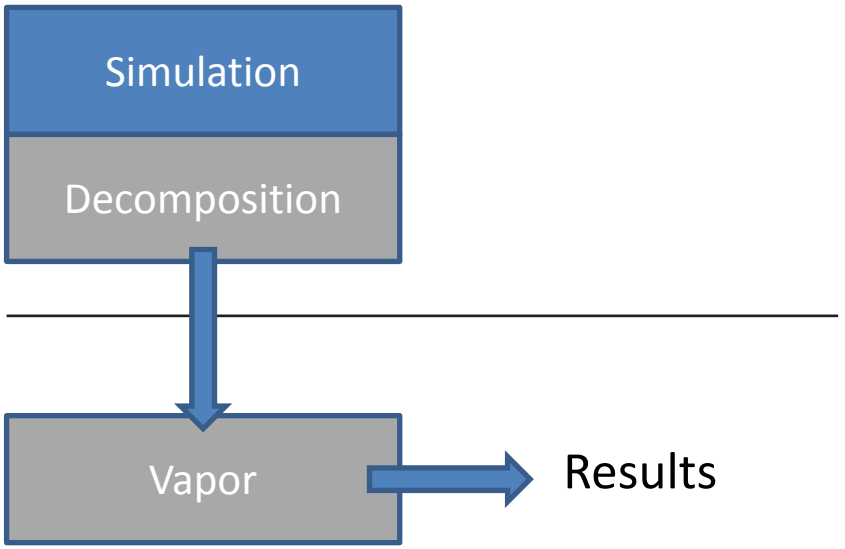
in-situ Visualization

(ParaView/Catalyst)



in-situ Compression

(Vapor)



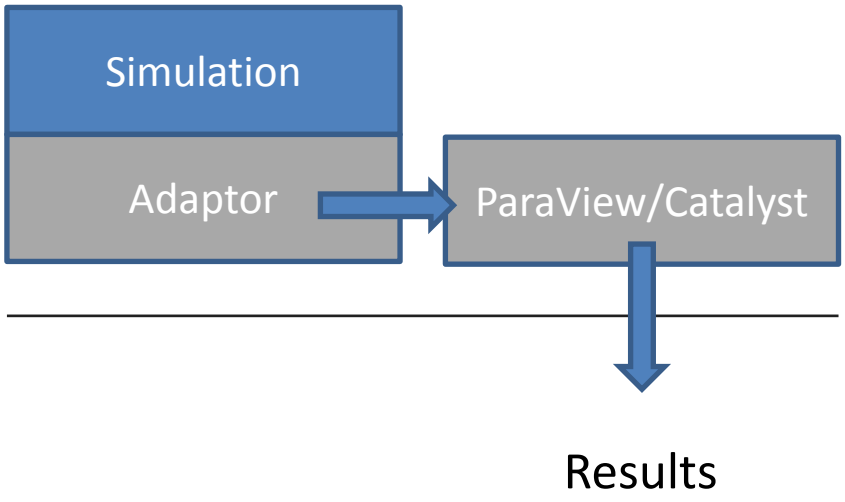
In-Situ Visualization with ParaView/Catalyst

- **Visualization** alongside running simulation
- Adaptor required that connects ICON (simulation model) and ParaView
- Possibilities for co-processing:
  - Batch-visualization using pre-defined Python scripts
  - Live visualization within a client/server setting

Visualization of large Data Sets

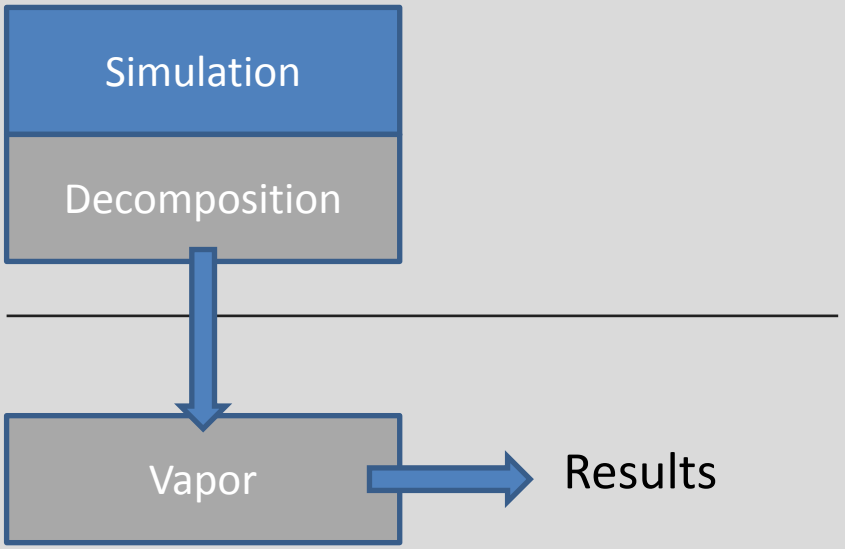
in-situ Visualization

(ParaView/Catalyst)



in-situ Compression

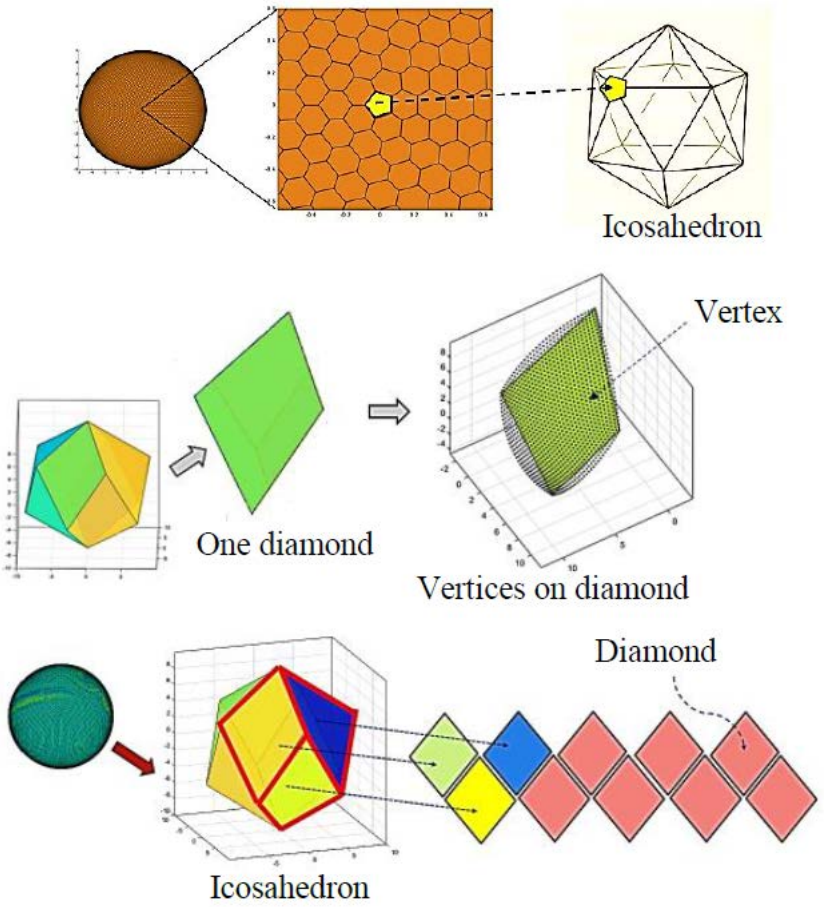
(Vapor)

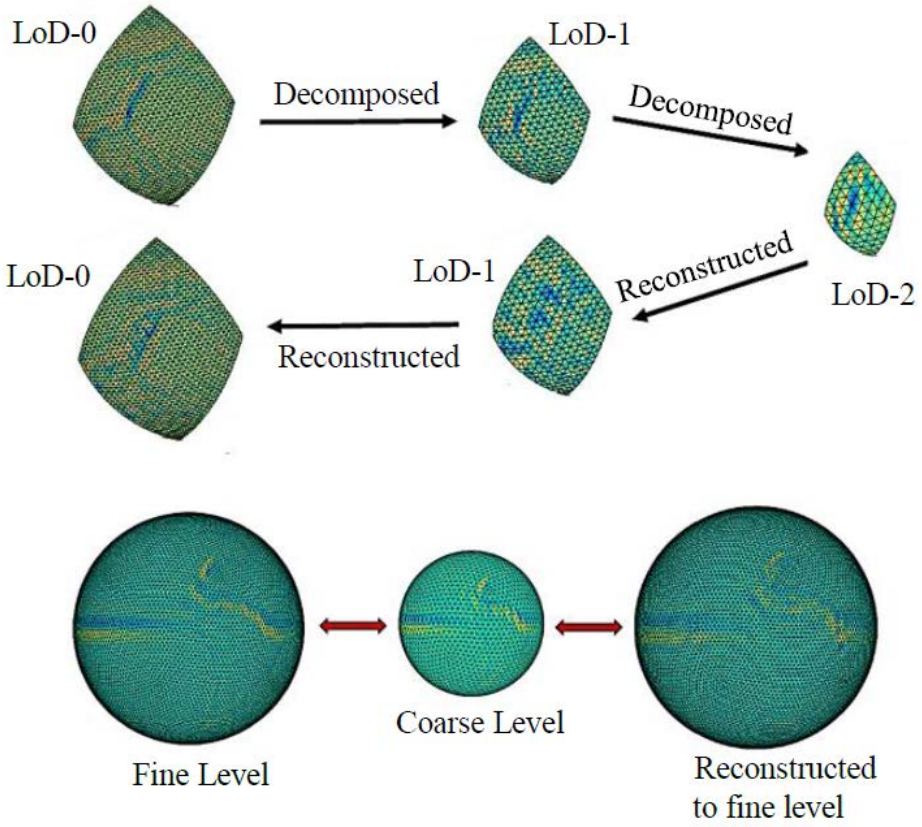


In-Situ Compression with Vapor

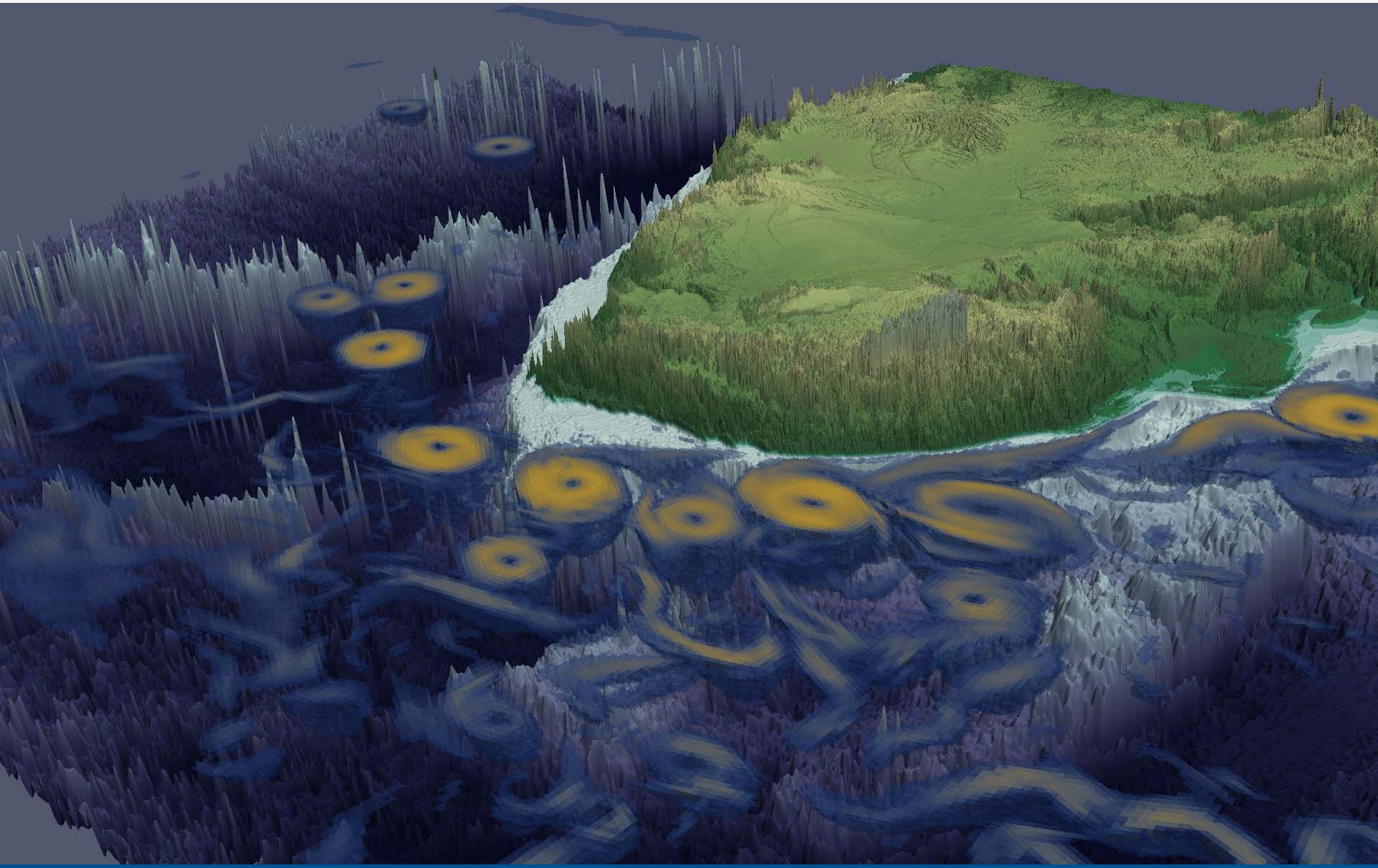
- **Compression** alongside running simulation
- Level of Detail based visualization
- Wavelet decomposition & lossless compression as C++ module connects with simulation model
- Further requirement: Extension of Vapor to visualize unstructured grids (ICON, MPAS)

Wavelet Decomposition





Agulhas Current



Thank you …

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