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# VAPOR Spherical Data Instructions

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Version 1.2

This document describes the process for visualizing data on spherical grids. Vapor provides volume rendering support for data defined on spherical grid geometries.

**Note:** flow visualization (i.e., streamlines and streaklines) is not currently supported for spherical grids.

Note: the information in this document pertains to VAPOR version 1.2.x only.

## Data

A spherical grid data set is indicated by the VDF `CoordinateSystem` keyword having a value of "spherical". This keyword can be specified when creating a .vdf file via the `vdfcreate "-coordsystem"` option.

The 3-element `Metadata DimensionLength` attribute specifies the dimension, in grid points, of the spherical data set. Dimensions are always specified in order of the fastest to slowest varying coordinate axes. By default the fastest varying dimension is longitude, followed by latitude, and then radius. Thus, for example, a dimension of 256x128x64 indicates a grid with 256 points in longitude, 128 points in latitude, and 64 points in the radial dimension. Furthermore, longitude increases from West to East, latitude from North to South, and radius from inner to outer.

If the data are not organized with longitude varying fastest, (followed by latitude then radius) the VDF `GridPermutation` keyword may be used to indicate a non-standard order: a permutation of the default order. This keyword can be specified when creating a .vdf file via the `vdfcreate "-order"` option. The `GridElement` keyword specifies a three-element, integer vector whose contents define a permutation of the data order. Longitude is mapped to 0, latitude to 1, and radius to 2. Thus the default permutation is the vector: 0 1 2. If data are organized with radius varying fastest and longitude slowest, for example, the permutation vector 2 1 0 should be used.

Physical extents of data are specified with the six-element VDF `Extents` keyword. This keyword can be specified when creating a .vdf file via the `vdfcreate "-extents"` keyword. Angular measures are specified in degrees, and radius is unit-less. The first three elements of the vector specify the minimum data extent, the last three specify the maximum data extent. Ordering within the three-element min and max subvectors is determined by the `GridPermutation` keyword. For example, under the default permutation {0, 1, 2} the min and max longitude are given by `v [0]` and `v[4]`, respectively. If the permutation is {2,1,0} the values `v [0]`, and `v[4]` would give the min and max radial extents, respectively. The default extents are:

minimum longitude =  $-180 + (360 / NX/2)$   
maximum longitude =  $180 - (360 / NX/2)$   
minimum latitude =  $-90 + (180 / NY/2)$   
maximum latitude =  $90 - (180 / NY/2)$   
minimum radius = 0.0  
maximum radius = 0.5

Where NX and NY are the dimension, in grid points, of the longitude and latitude coordinates, respectively.

Finally, the 3-element VDF "PeriodicBoundary" keyword determines the periodicity of the data boundaries. This keyword can be specified when creating a .vdf file via the vdfcreate "-periodic" keyword. The ordering of the elements for this keyword is subject to the GridPermutation keyword. Under the default permutation (0,1,2) the periodicity is (1,1,0). That is, the longitude and latitude boundaries are considered periodic. Specifying a periodic radial boundary has no meaning and is presently ignored.

### **Examples**

Given data on a spherical shell with radius from 0.75 to 1.0 and dimensions 64x180x360 (radius x latitude x longitude) the vdfcreate command would be:

```
vdfcreate -dimensio 64x180x360 -order 2:1:0 -periodic 0:1:1  
-extents 0.75:-89.5:-179.5:1.0:89.5:179.5 ...
```

Given the Eastern hemisphere of a solid sphere with dimensions 180x180x64 (longitude x latitude x radius) the vdfcreate command would be:

```
vdfcreate -dimensio 180x180x64 -order 0:1:2 -periodic 0:1:0  
-extents 0.0:-89.5:0:1.0:89.5:180.0 ...
```

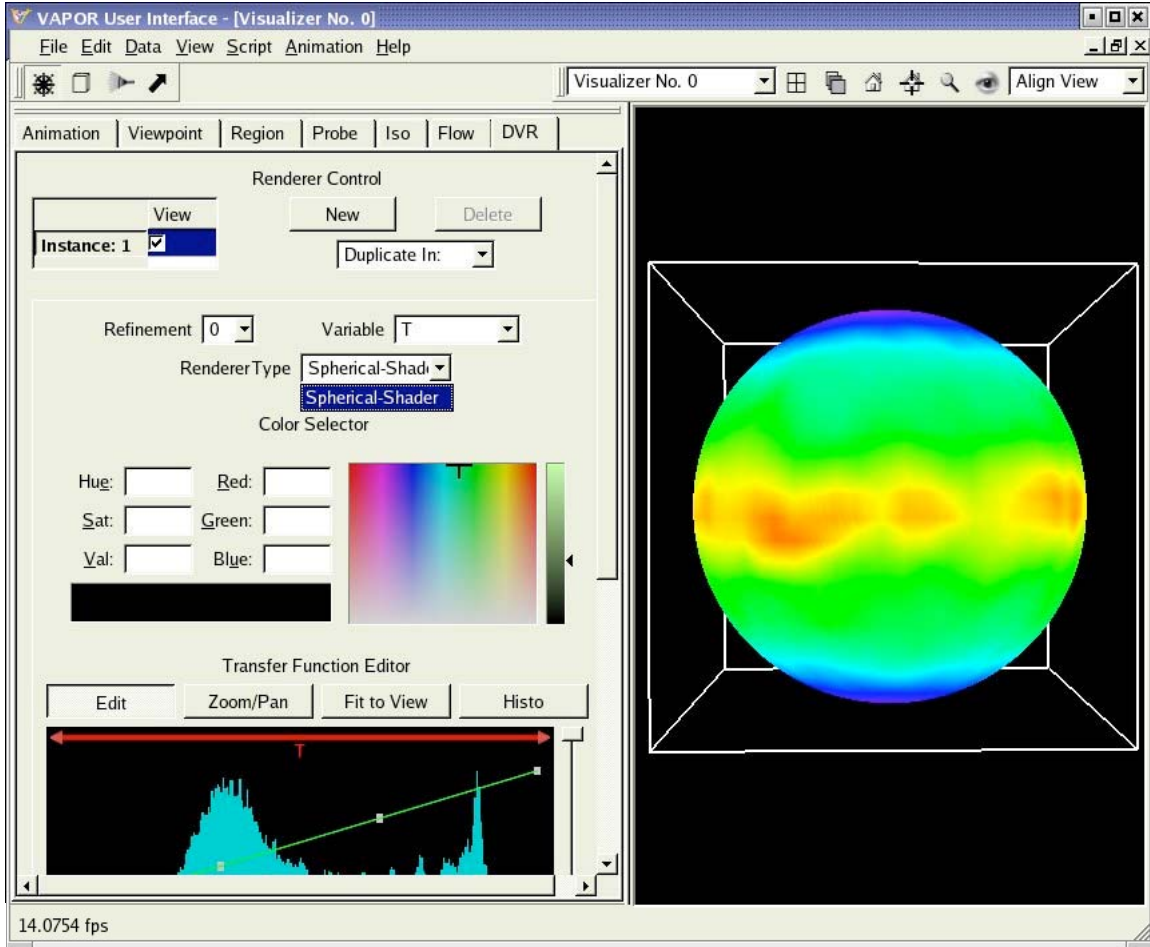
## **Visualization**

When a spherical metadata file (indicated by the VDF CoordinateSystem keyword having a value of "spherical") is loaded, the spherical volume rendering engine, Spherical-Shader, should become available in Render Type menu on the DVR panel. Enabling the DVR instance, should produce a rendering of the data on its spherical geometry. The default orientation (-Z) looks down the North pole.

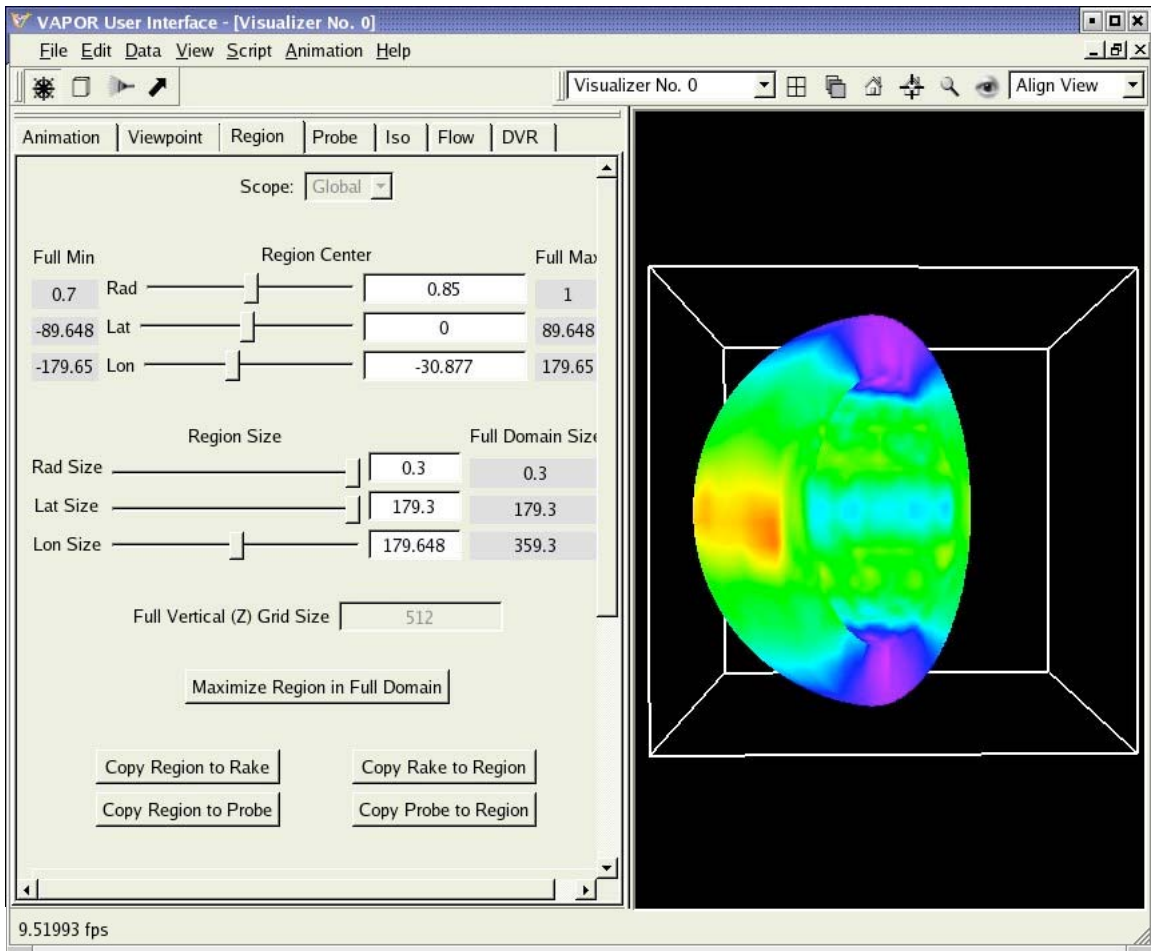
**Note:** The Spherical-Shader is only supported on programmable graphics cards that provide 3D texture support (see FAQ for more information on recommended graphics hardware).

**Note:** Vapor does not currently support the cartesian volume rendering engines (i.e., 3DTexture, 3DTexture-Shader, and Volumizer) for spherical data. Rendering the spherical data with longitude, latitude, and radius aligned along the Cartesian axes,

currently requires a metadata file with the VDF CoordinateSystem keyword having a value of "cartesian".



The Region panel can be used to specify a region of interest within the full spherical data extents. The region center and region size are specified in spherical coordinates (longitude, latitude, and radius).



**Note:** The Flow and and Probe panel are NOT currently supported for spherical data.