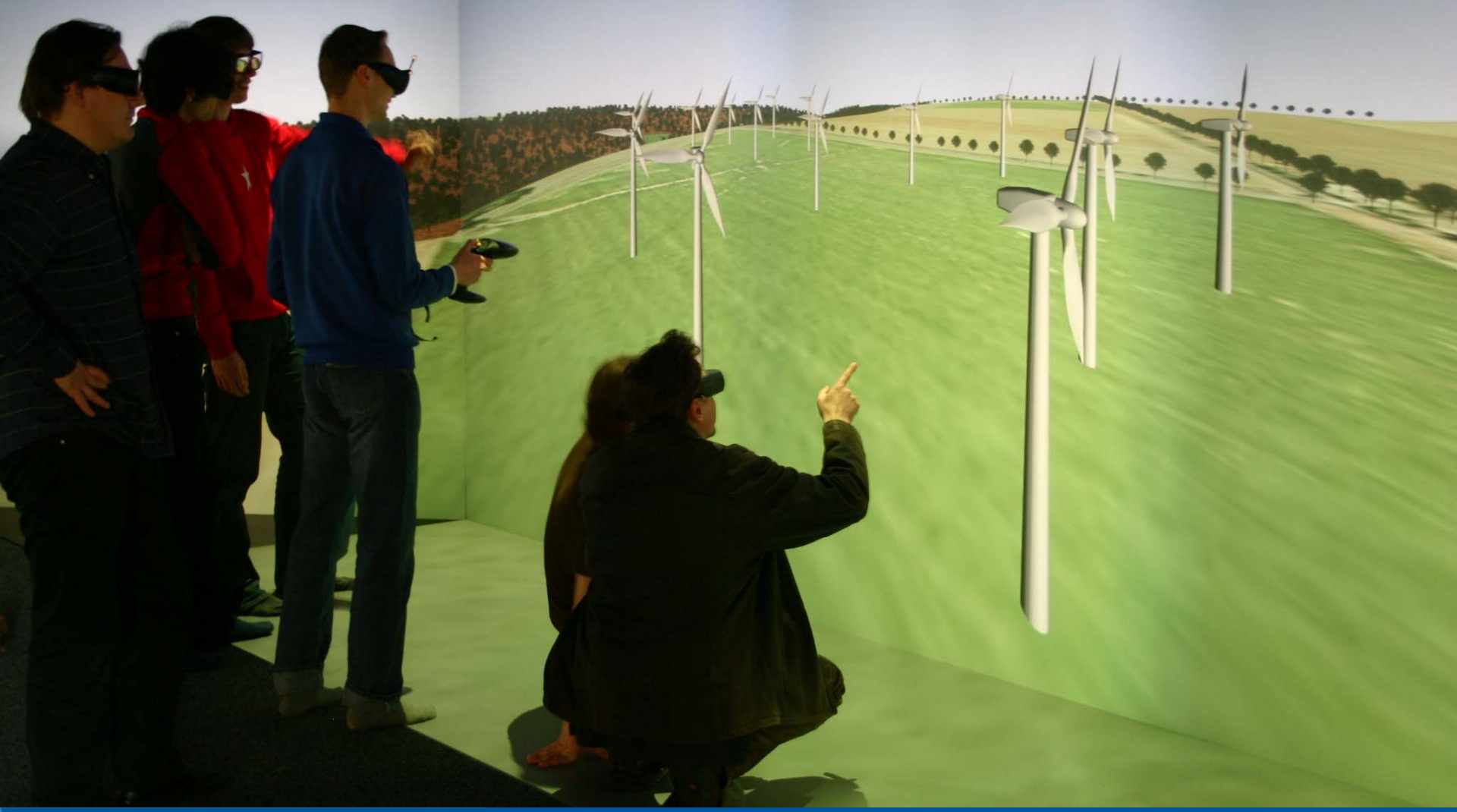


Landscape Visualization in High Resolution Stereoscopic Visualization Environments, Dr. Björn Zehner

Given at the „Digital Design in Landscape Architecture 2008“ Conference in Dessau, Germany, May 2008

bjoern.zehner@ufz.de, bzehner@gmx.de

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

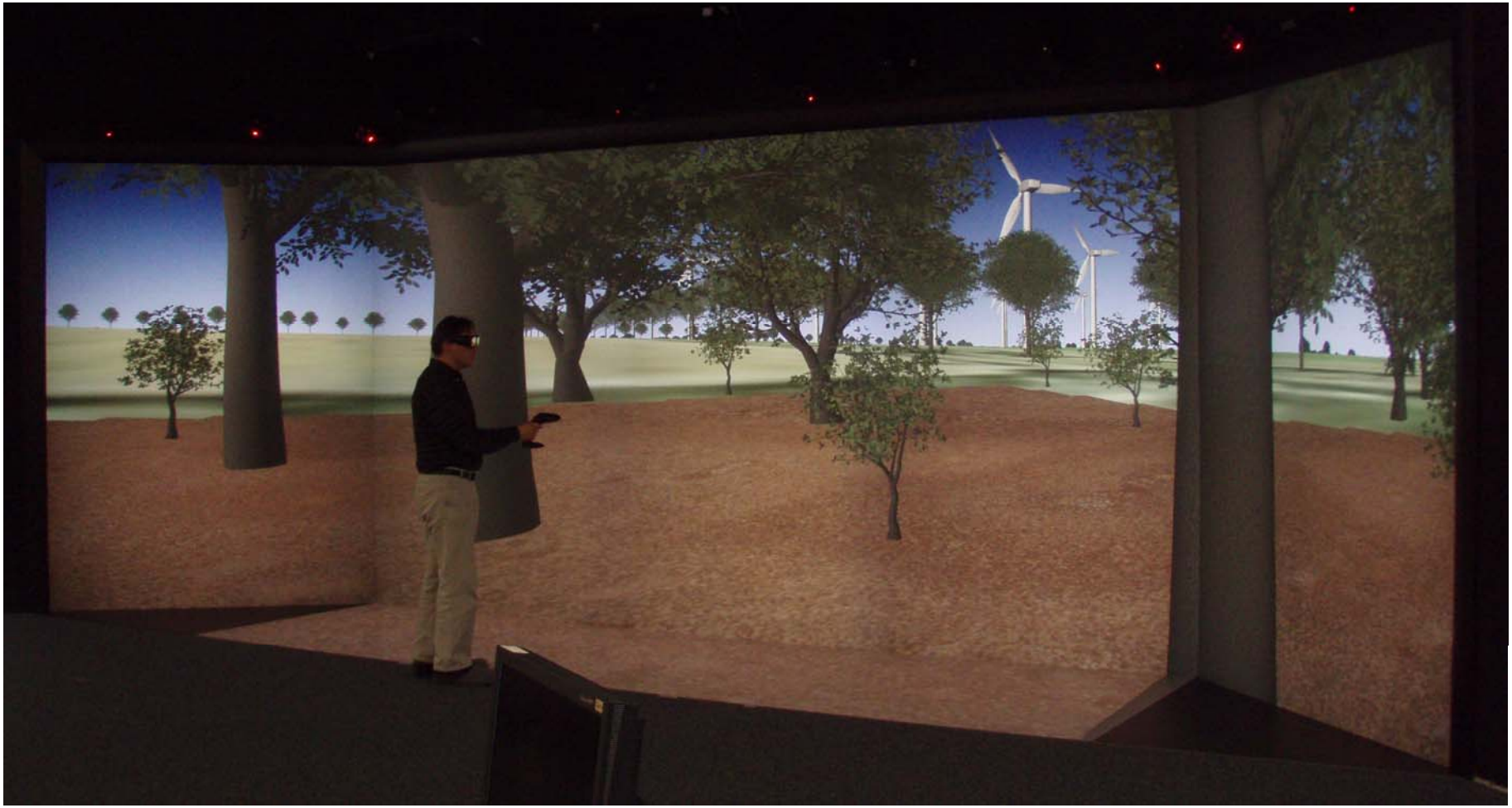
Motivation

Evaluation of the user's preferences regarding the Placement of wind-turbines using choice experiments. Example: What do you prefer for getting a certain Amount of energy ?

- 20 80m high wind-turbines or 10 120m high ?
- Place them in the forest or on open field ?

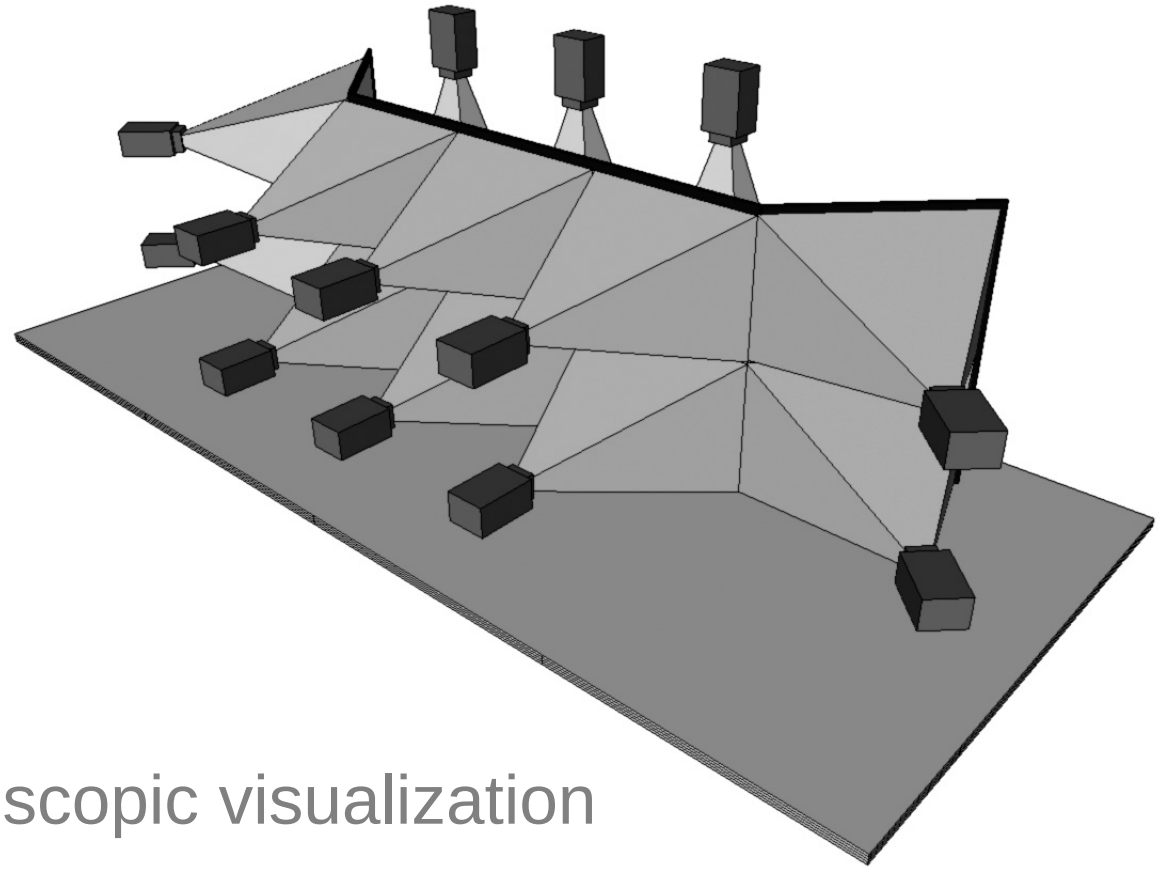
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

UFZ’s Visualization Center



HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

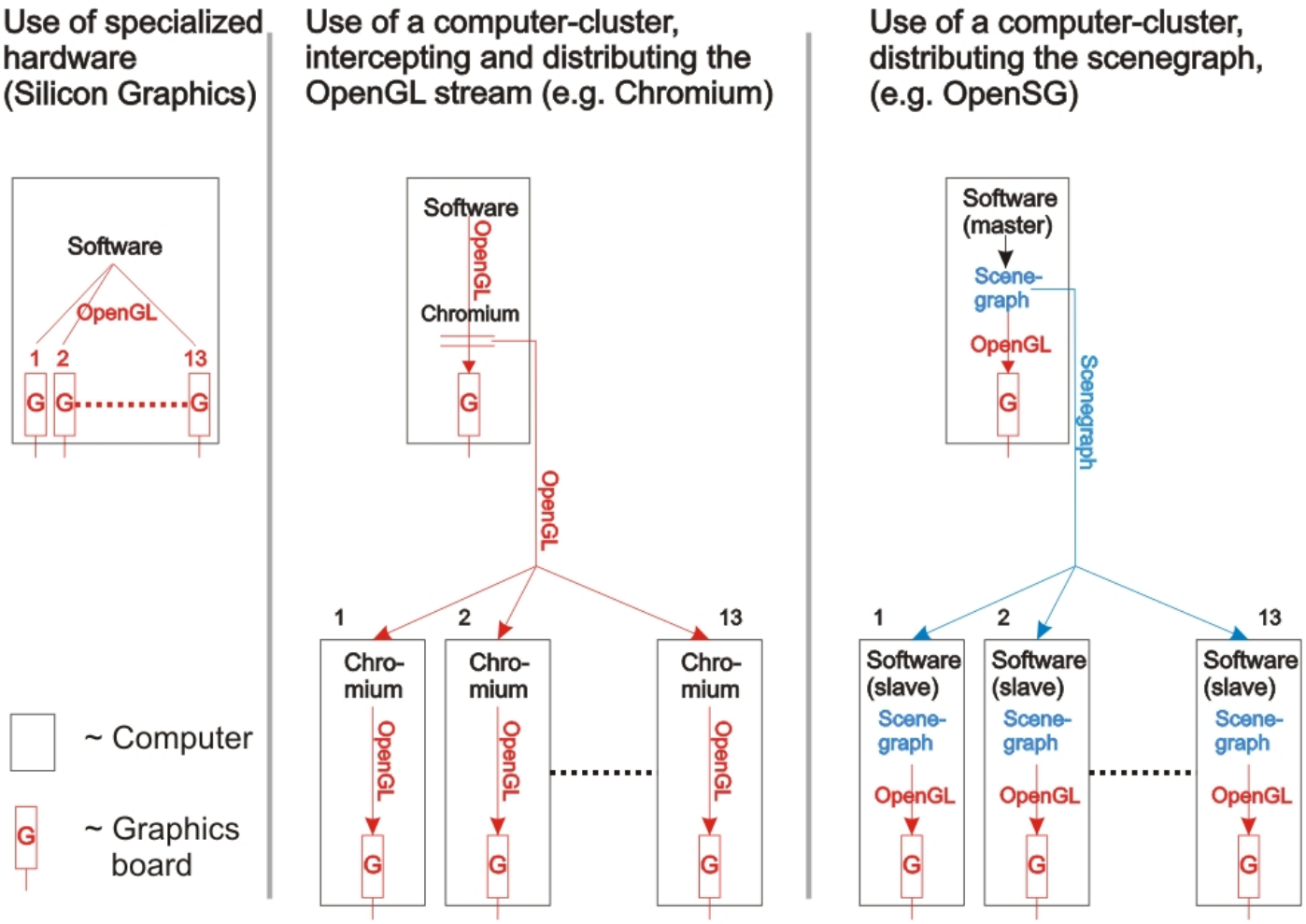
UFZ's Visualization Center



- Stereoscopic visualization
- Tracking

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Different options to run such a system



HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

OpenSG against Chromium

Chromium

Pros:

+ Transparent for application
+ Use of existing applications possible

Cons:

- Sending the OpenGL stream from the master to all slave nodes generates high network traffic

OpenSG

Pros:

+ After scenegraph has been send to all slave nodes low network traffic

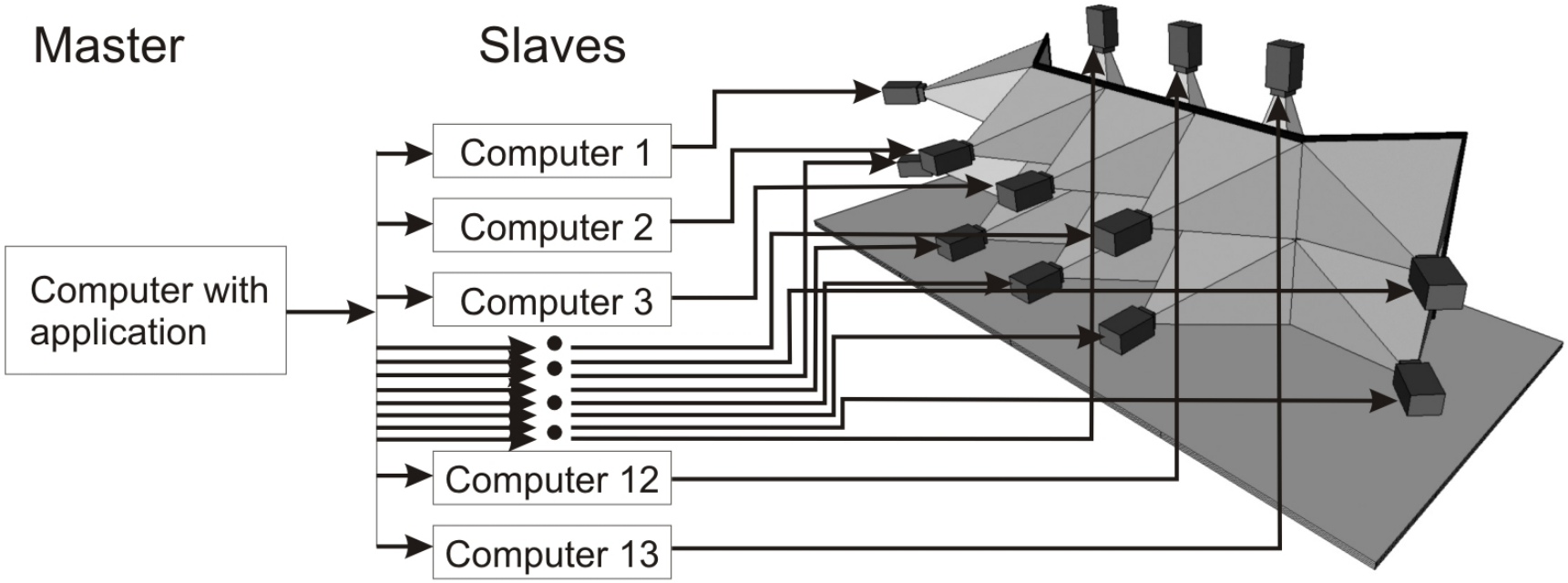
Cons:

-Rendering backend of software needs to be reimplemented

-Size of scene is limited by main memory of the computer

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

UFZ's Visualization Center



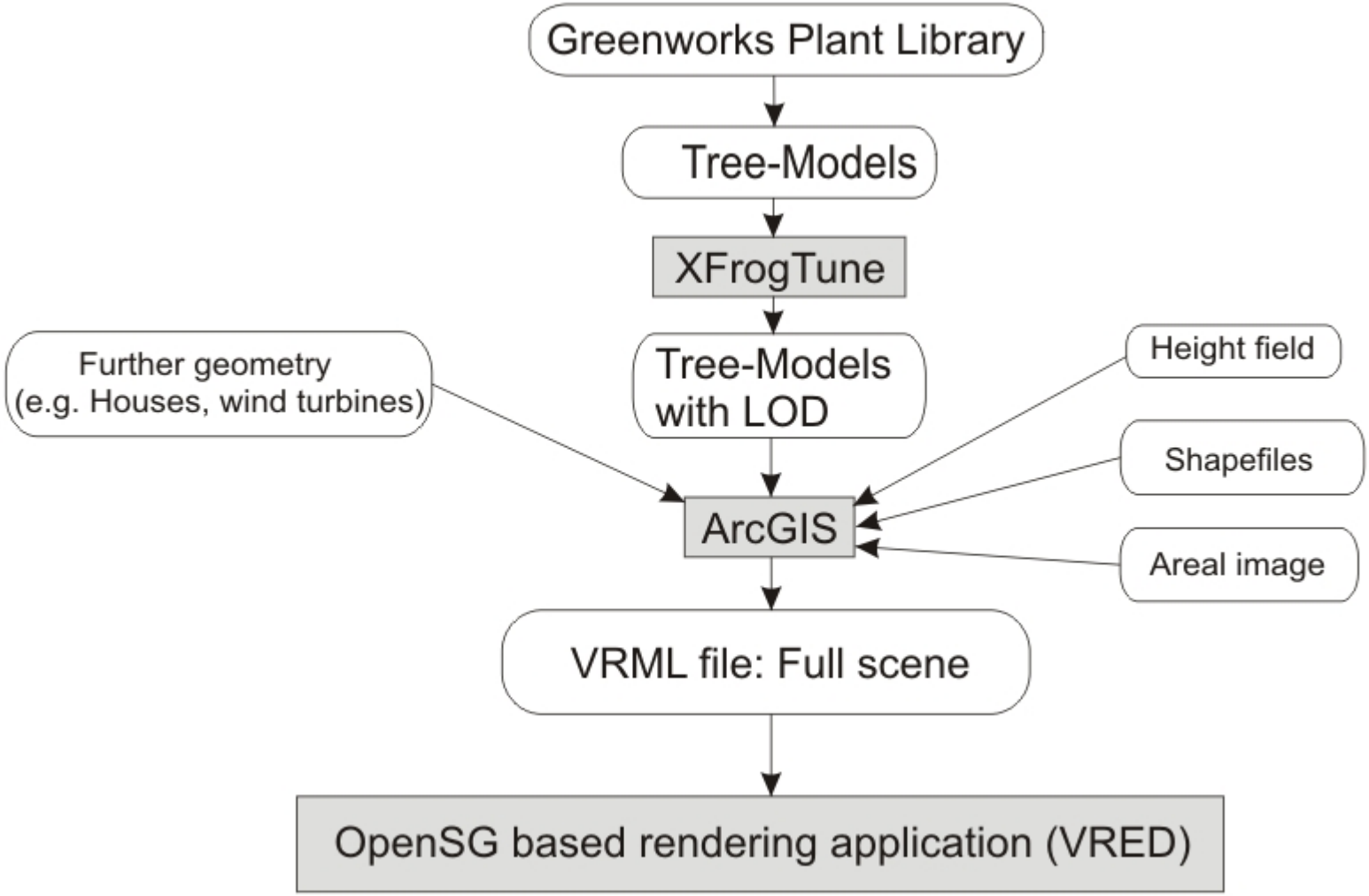
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Main contents required

- Terrain with texture to represent the ground
- Trees in very large numbers (XFrogPlants libraries)
- Geometric models, e.g. houses, wind-turbines …

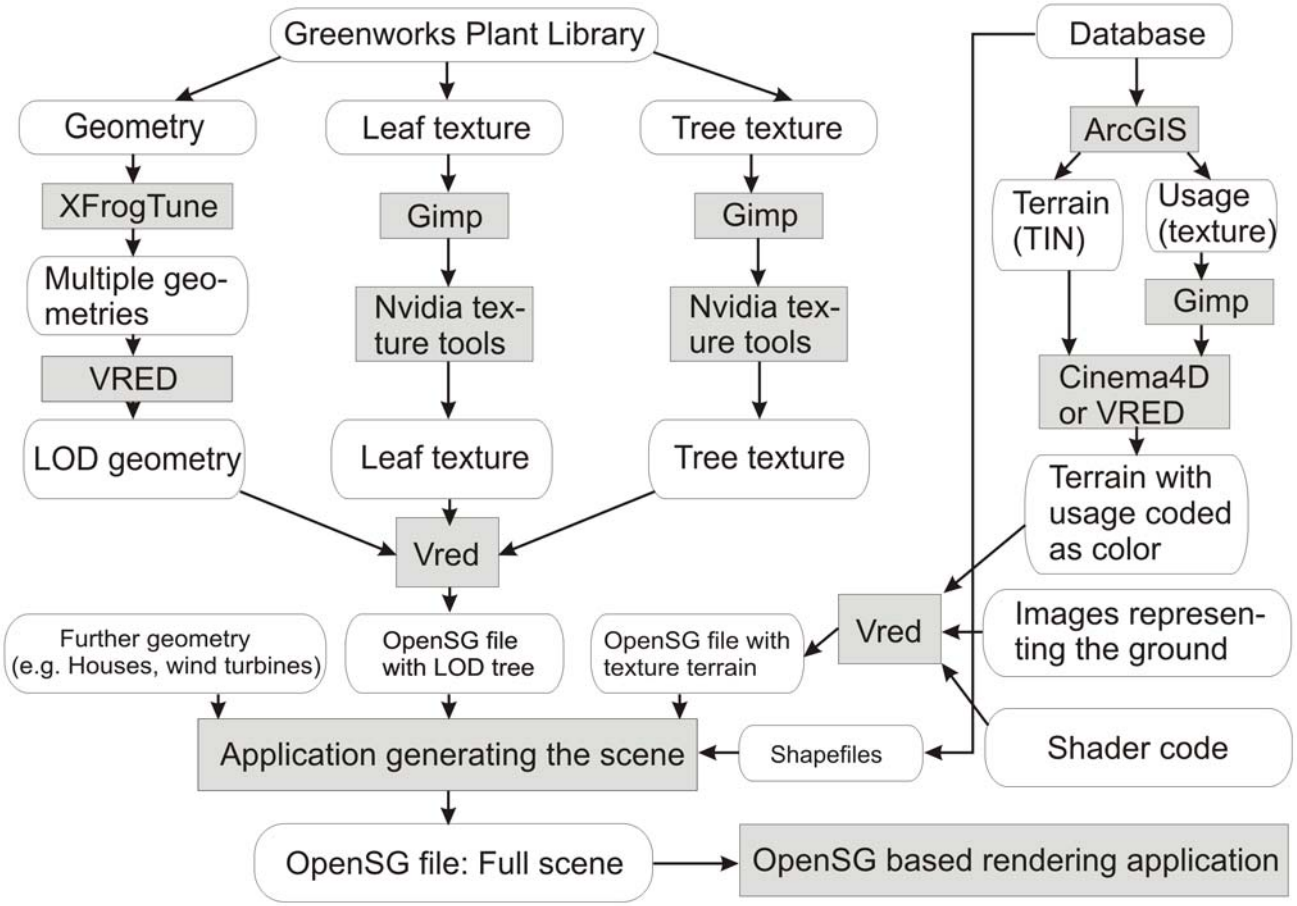
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Initial assumption for the workflow



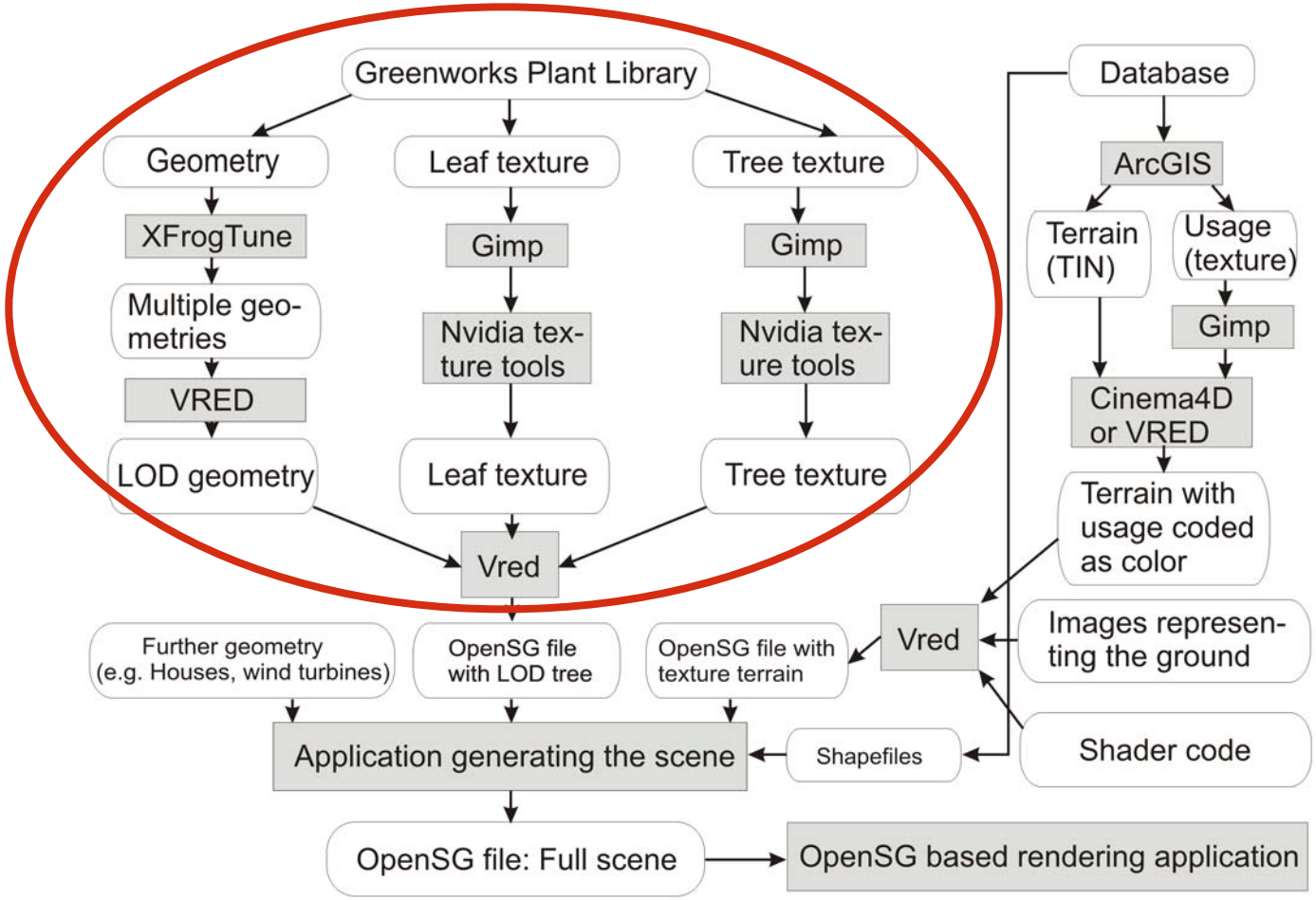
CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Final workflow



HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Processing single trees (LOD etc.)



HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, LOD generation for trunk and branches

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, LOD generation for leaves

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

With increasing viewer-to-leaf distance the screenspace of the leaves becomes smaller and OpenGL must downsample (filter) the images.

If no series of images is provided this is done automatically, making the leaves more and more transparent.

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

Tree becomes translucent at a distance

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

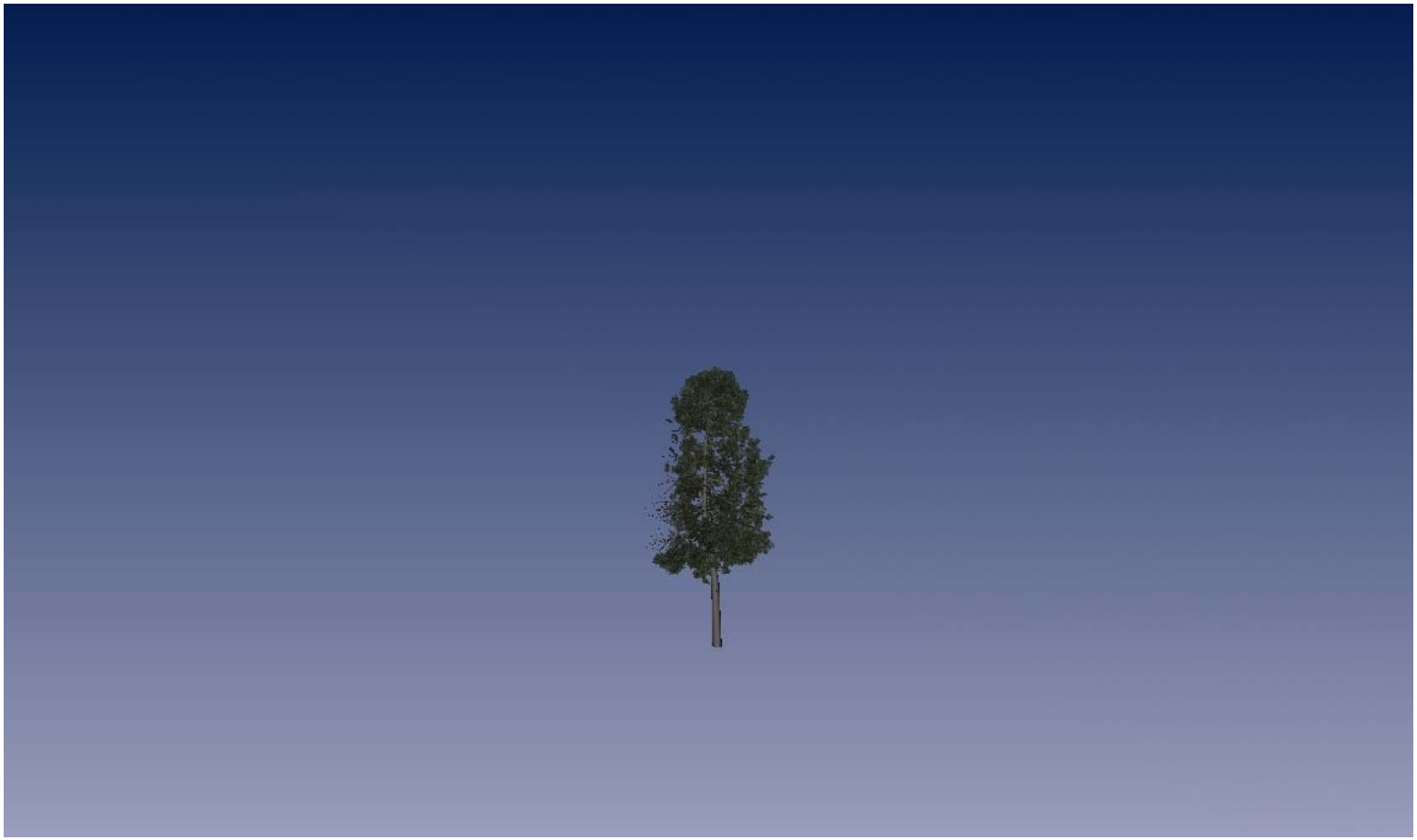
XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem



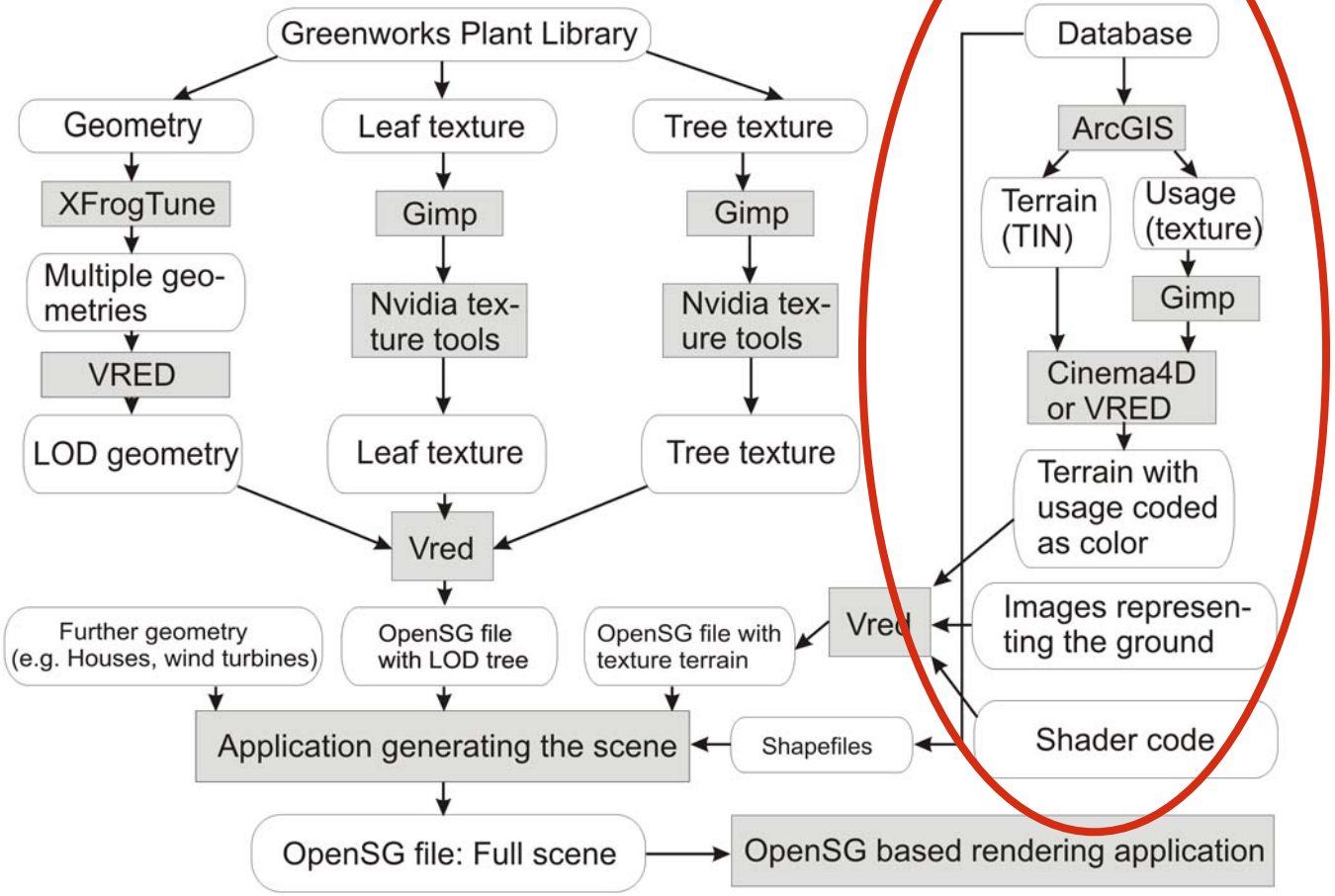
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

XFrogTune, mipmapping problem

Tree stays opaque at a distance

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Assembling the terrain (ground)



Problems with areal image as ground

- In forest regions the floor would show trees from top
- Low resolution in the near field

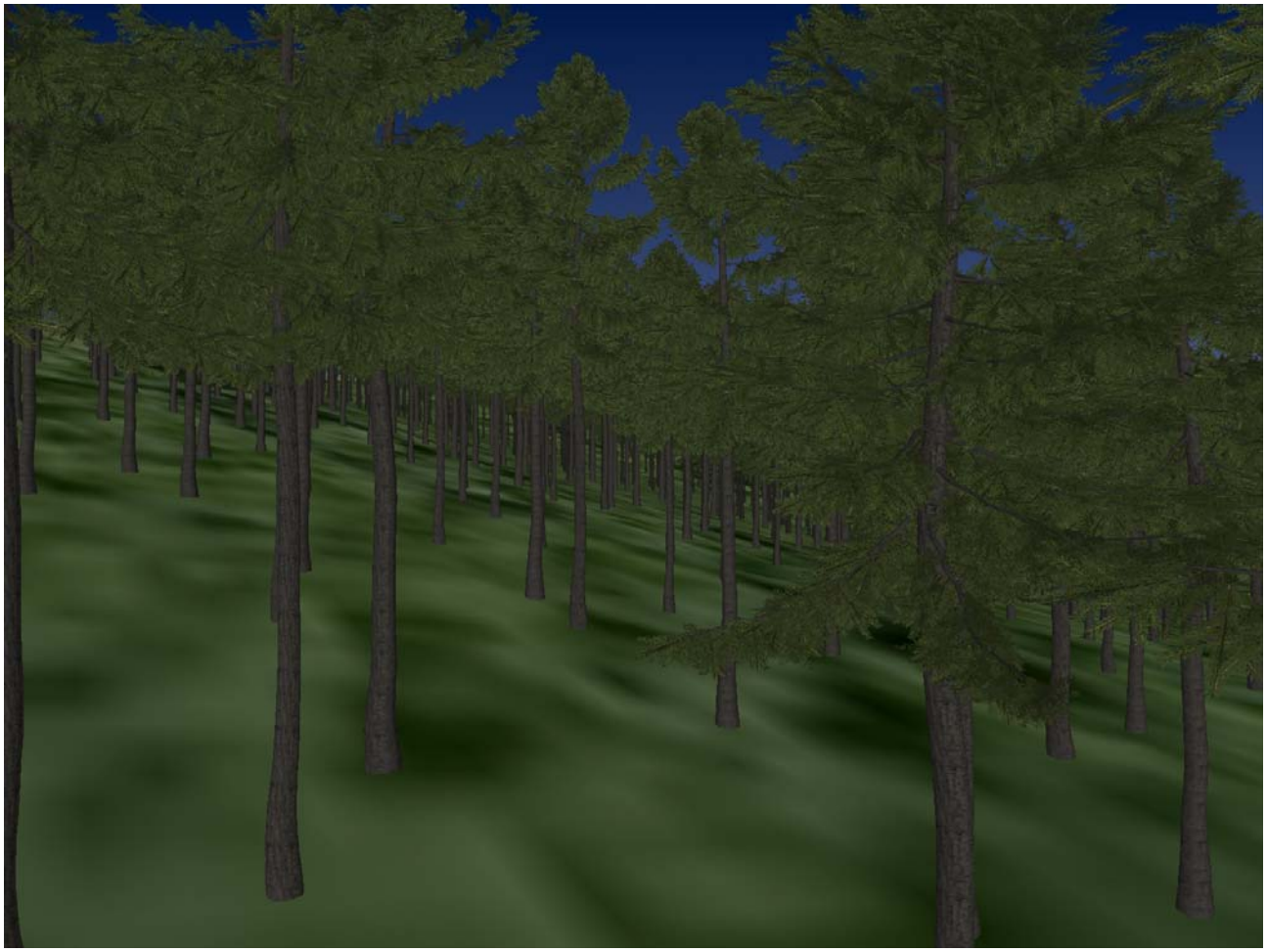
2925 x 2775 Meter

1625 x 1544 Pixel

=> One Pixel ~ 1.8 Meter

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Forest with areal image as ground

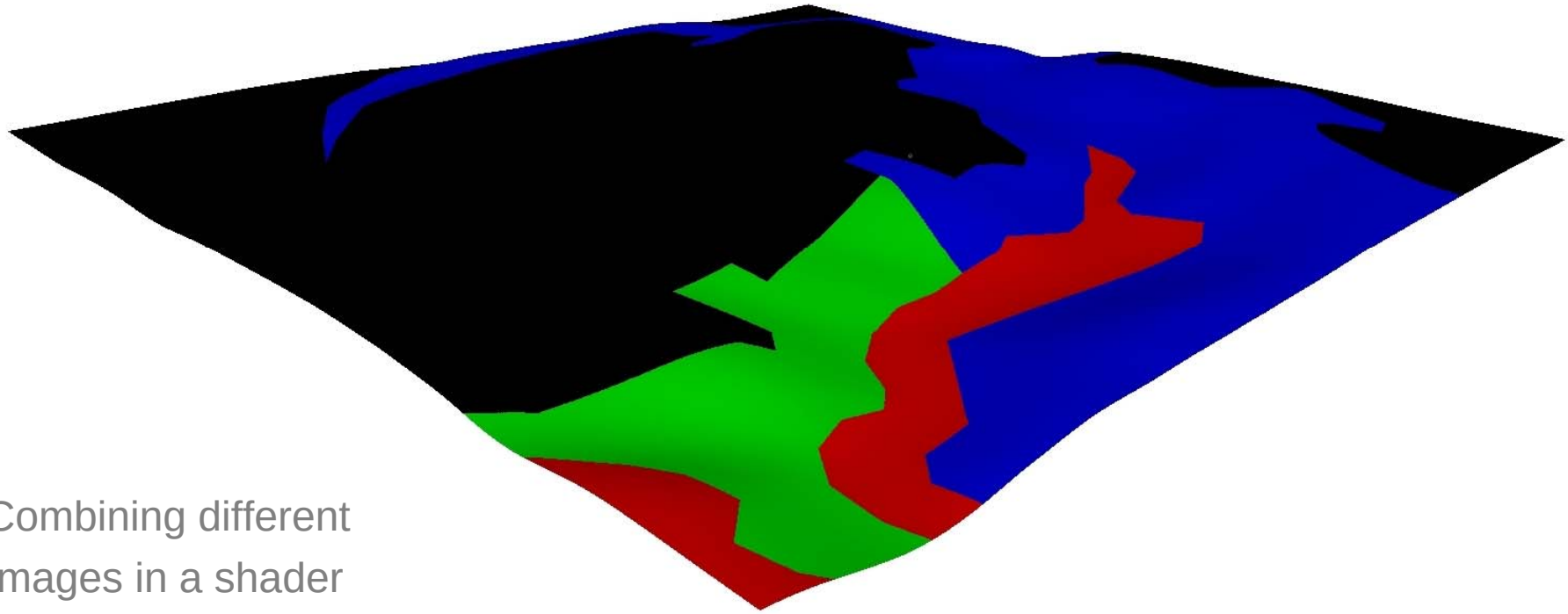


HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Forest with perlin noise image as ground

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Terrain with image containing usage



Combining different
Images in a shader

color.rgb = code.rgb

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Terrain with areal image

Combining different
Images in a shader

color.rgb = (code.r + code.g + code.b + code.a) * areal.rgb

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

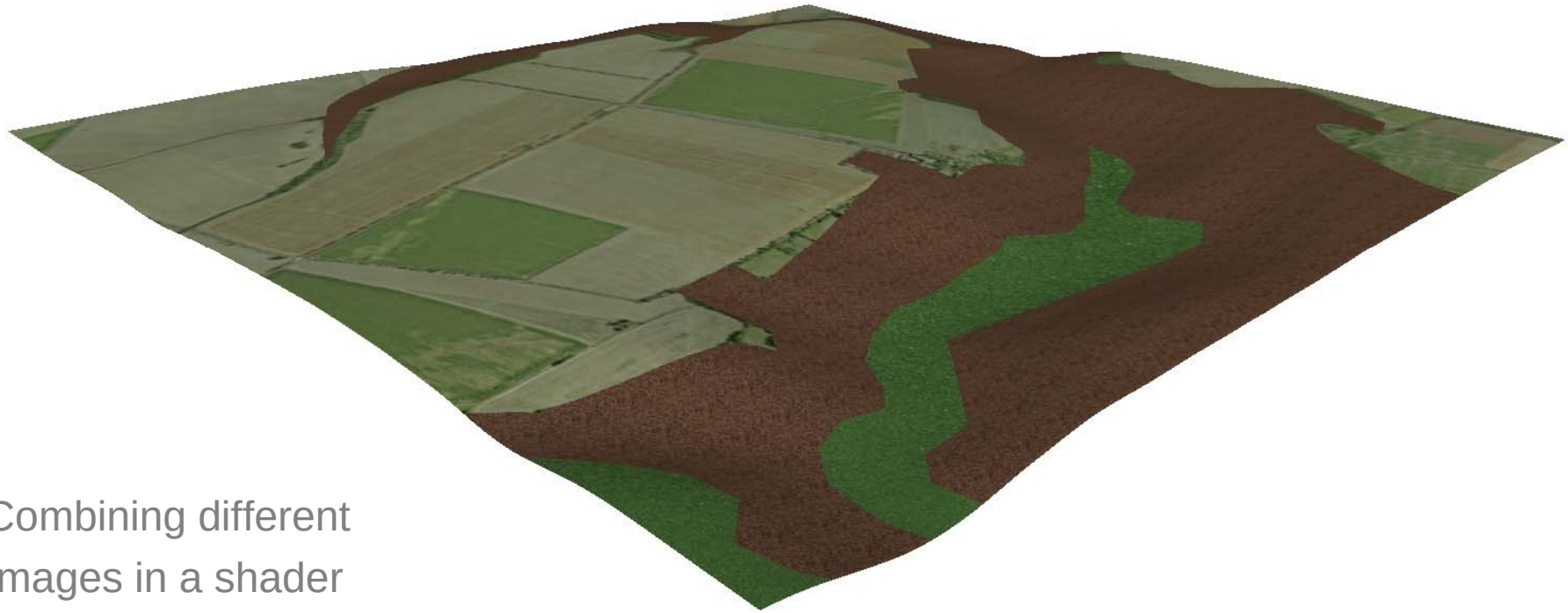
Using a noise image as forest ground

Combining different
Images in a shader

color.rgb = (code.r + code.a) * areal.rgb + (code.g + code.b) * forestground.rgb

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Using a noise image as lawn



Combining different
Images in a shader

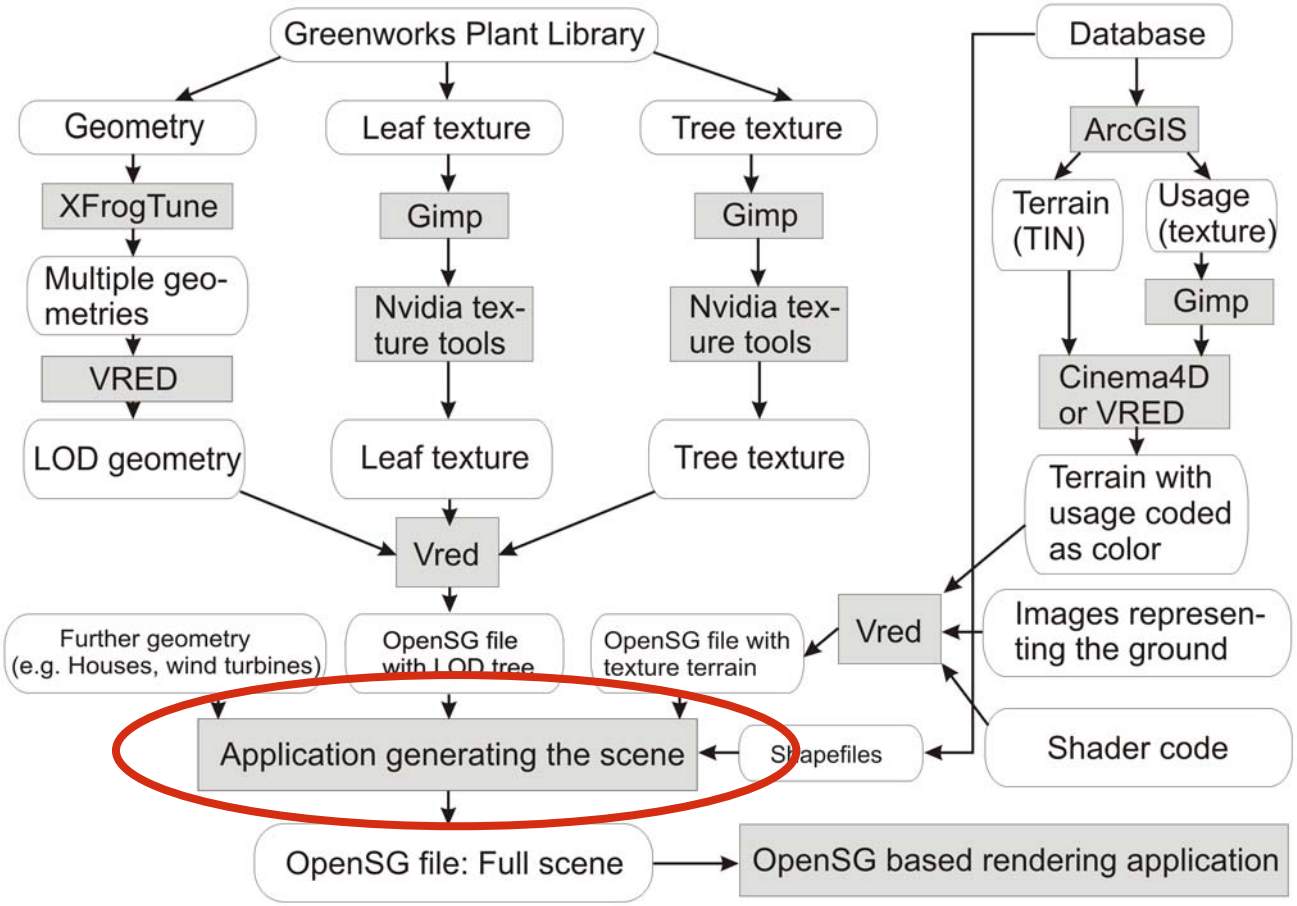
color.rgb = (code.a) * areal.rgb + (code.g + code.b) * forestground.rgb
+ code.r * lawnground.rgb

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Adding the geometry

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Assembling the scene



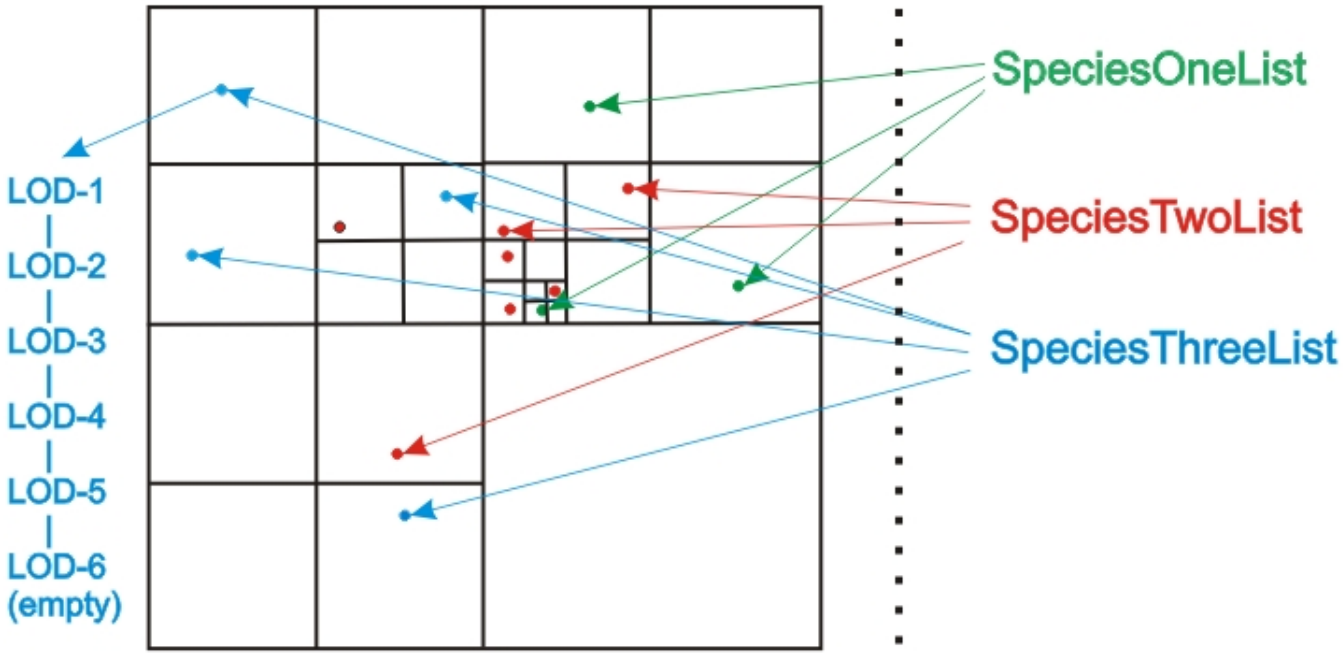
Scenegraph-structure for a forest

Geometry (Trees), organized in a quadtree like structure.

Visible if (dist < 150m)

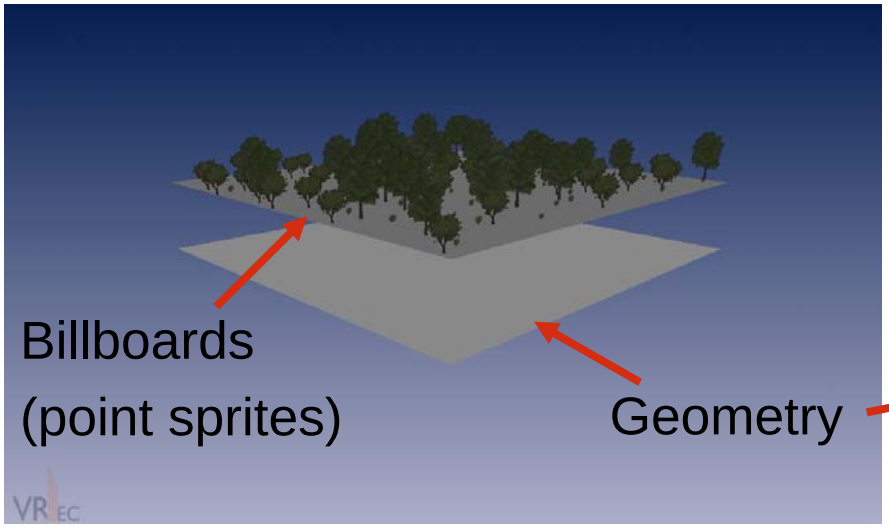
Billboards (organized as list, rendered as point sprites).

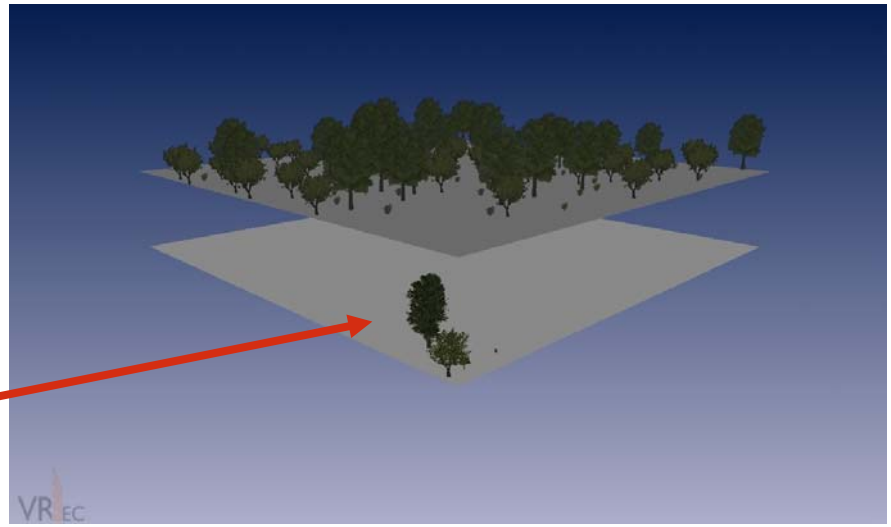
Visible if (dist > 150m)

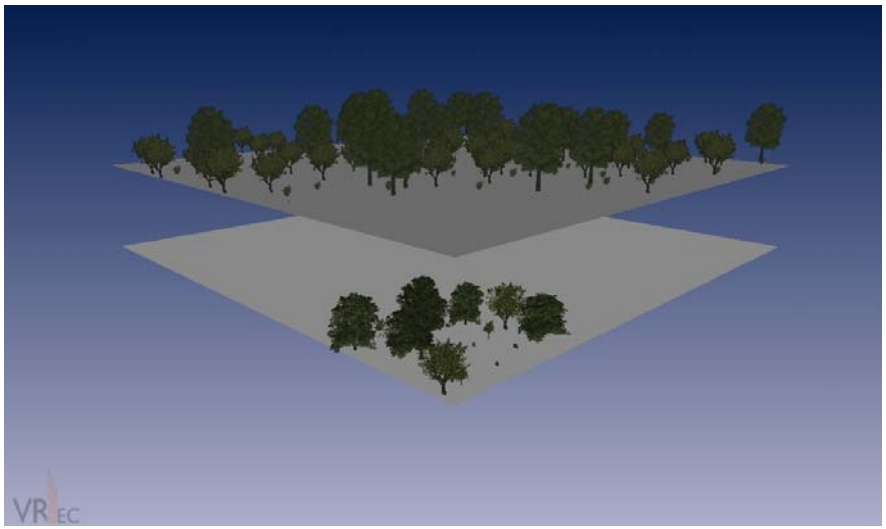


HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

From billboards to geometry (shematic)

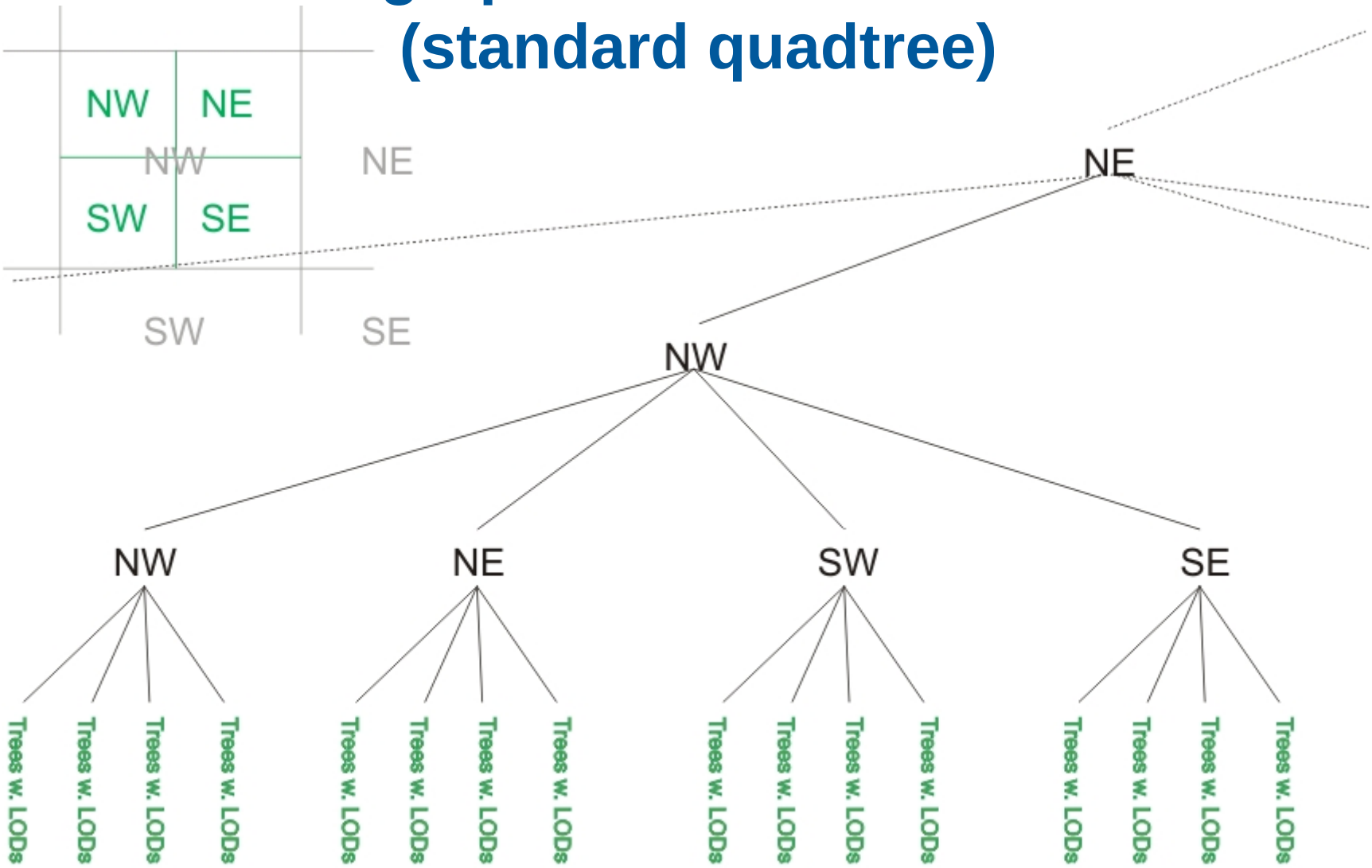




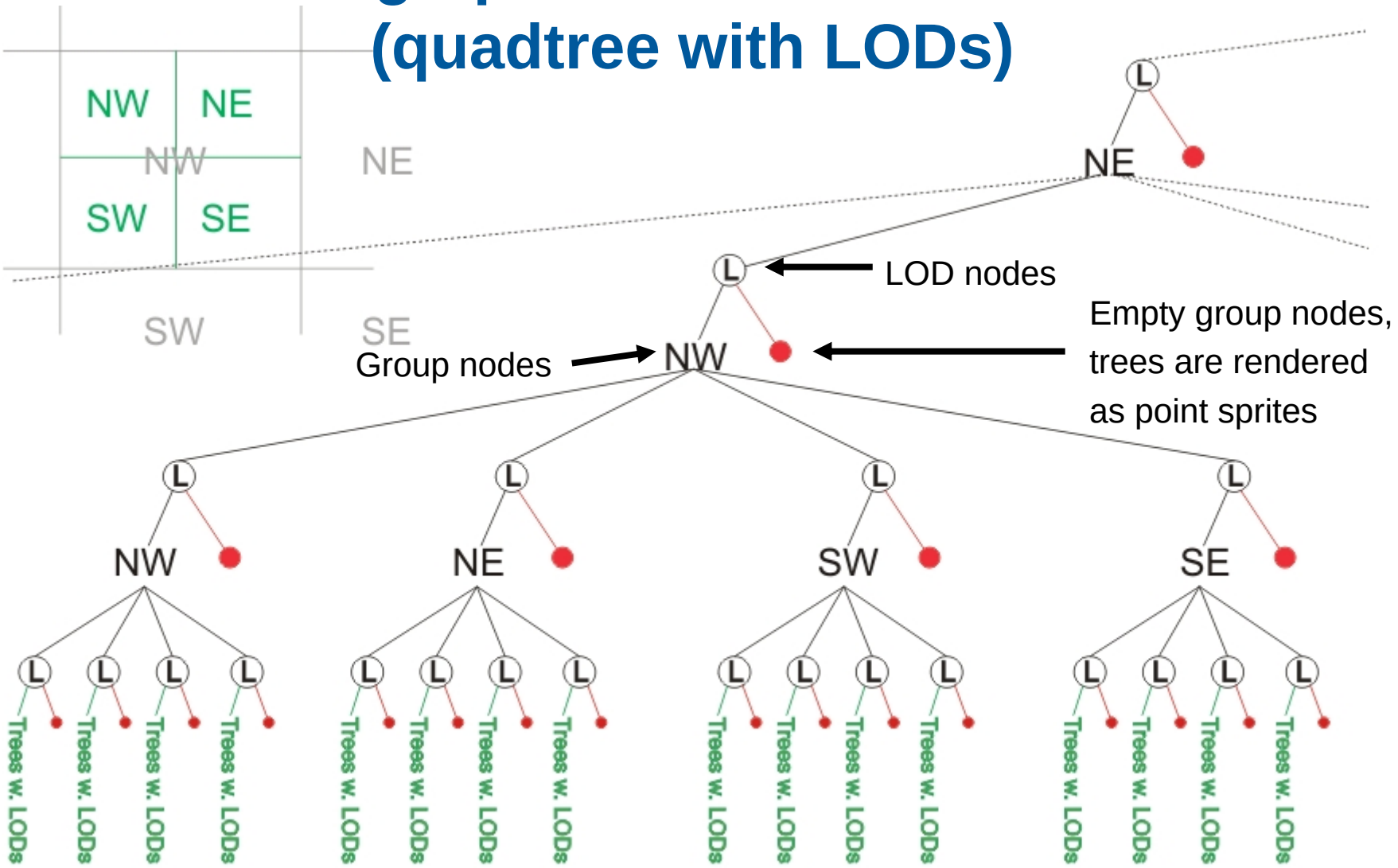


HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

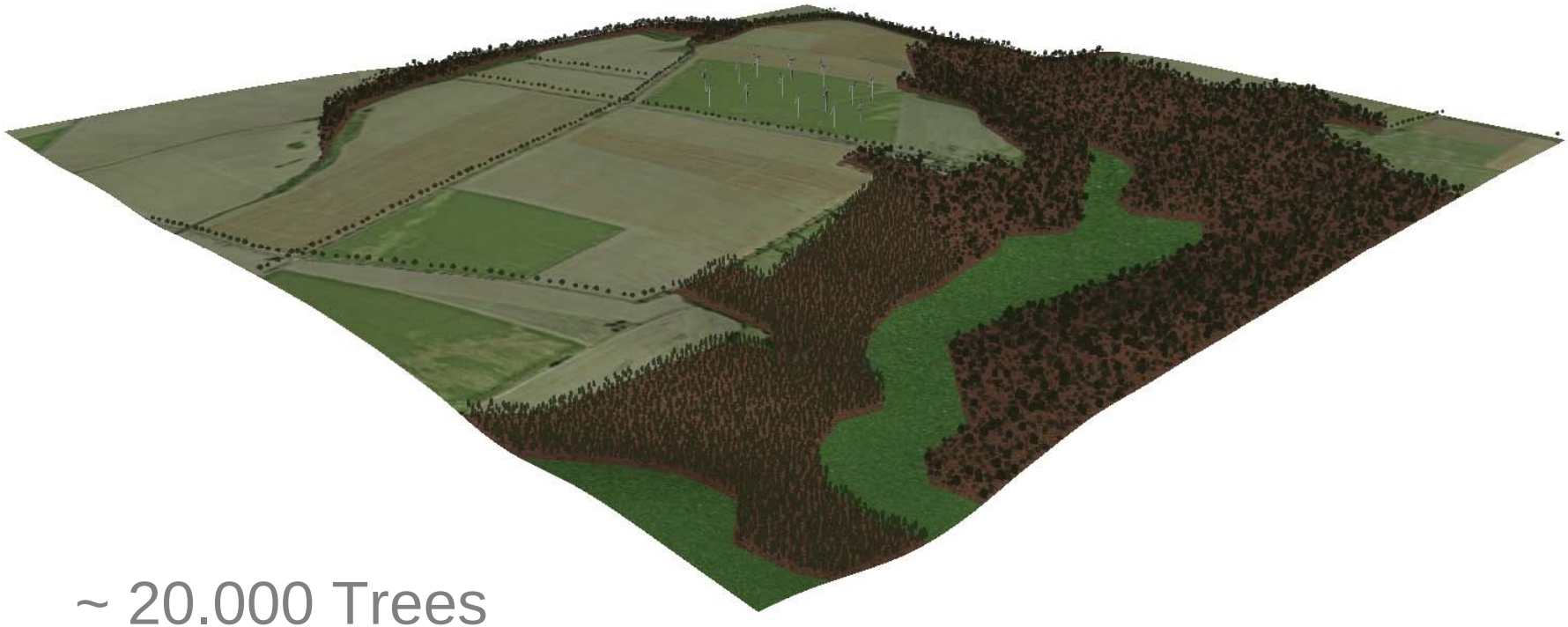
Scenegraph-structure for a forest (standard quadtree)



Scenegraph-structure for a forest (quadtree with LODs)



Final scene



~ 20.000 Trees

~ 1 GByte

~ 15-20 frames/second

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ