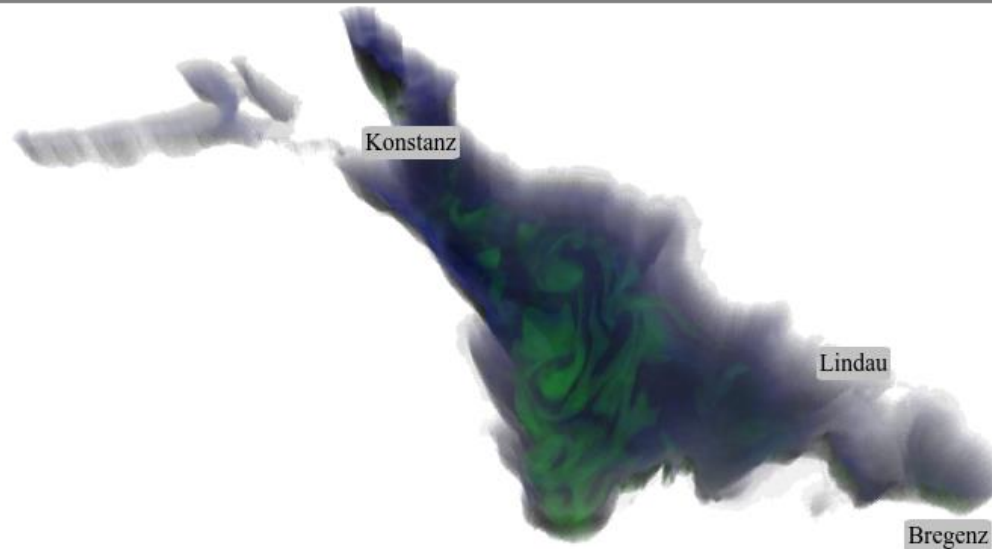


3D Volume Visualization of Environmental Data in the Web

Eric Braun

Institute for Applied Computer Science - KIT



Motivation: Data



Internet of Things



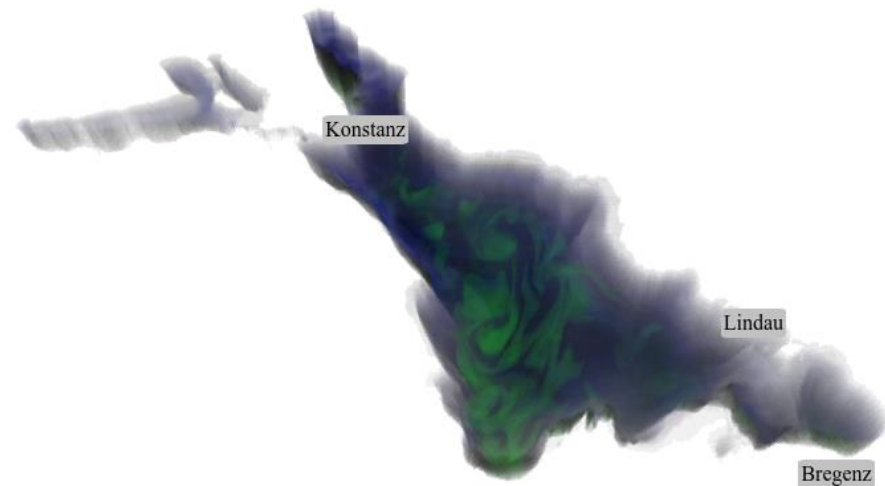
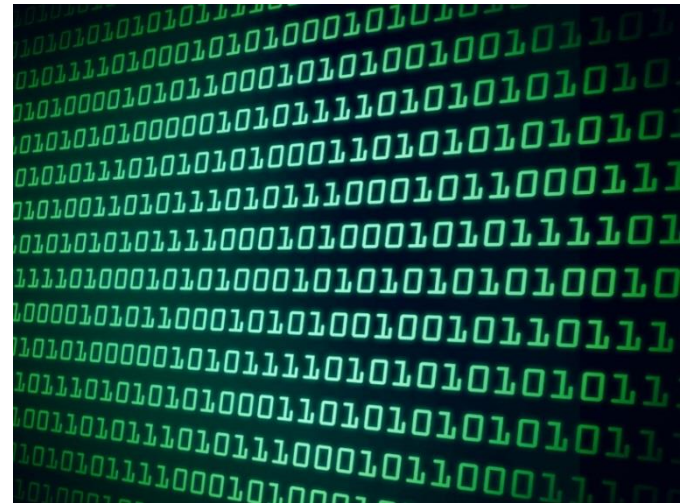
Big Data



faster Internet access



visualizations needed



Motivation: Web Visualization

- should work on all devices
- operation system independent
- no installation required



Motivation: Existing Visualizations



chart, map visualizations...

JavaScript libraries: Highcharts, amCharts...

New requirements:



3D data sets



3D visualization



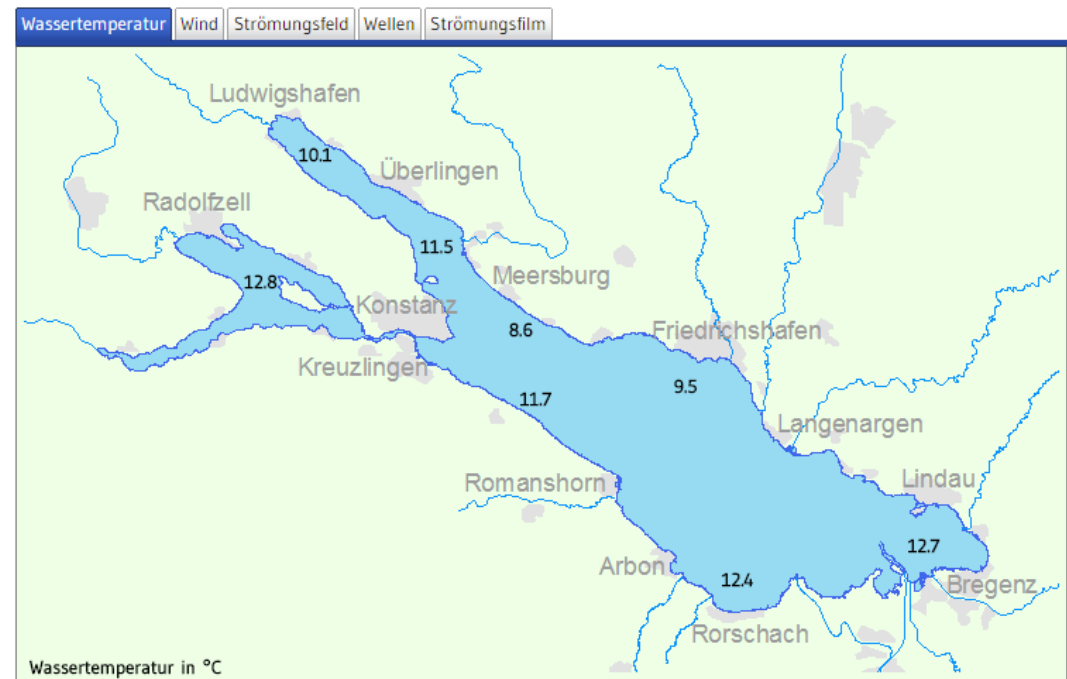
interactivity



customizability

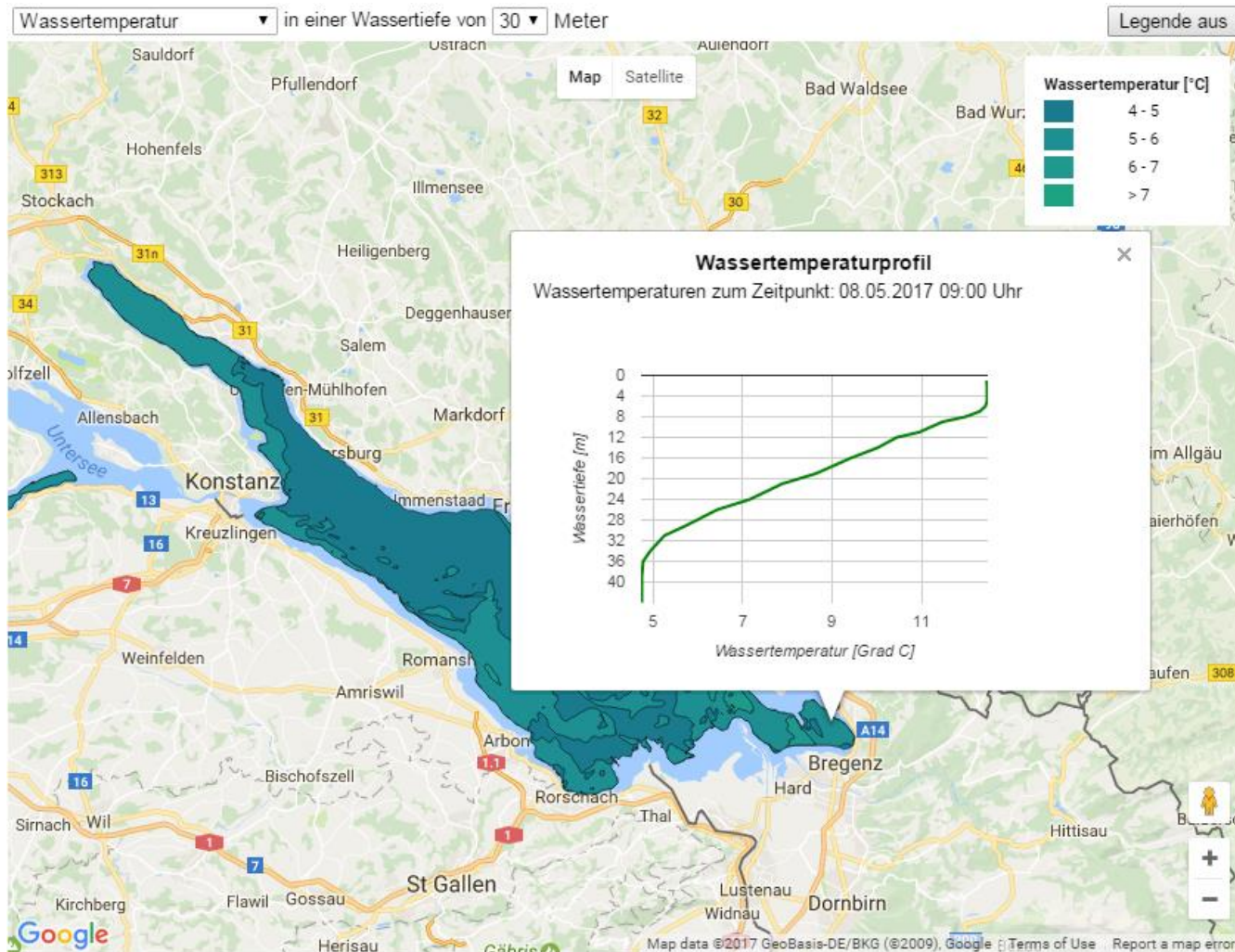
Analysis: Project BodenseeOnline

- research project 2005 – 2008
 - visualize information about the Lake Constance
- *LUBW* hosts the website
- *Kobus and Partner* runs the simulations
- additional project partners



<https://www.lubw.baden-wuerttemberg.de/wasser/bodenseeonline>

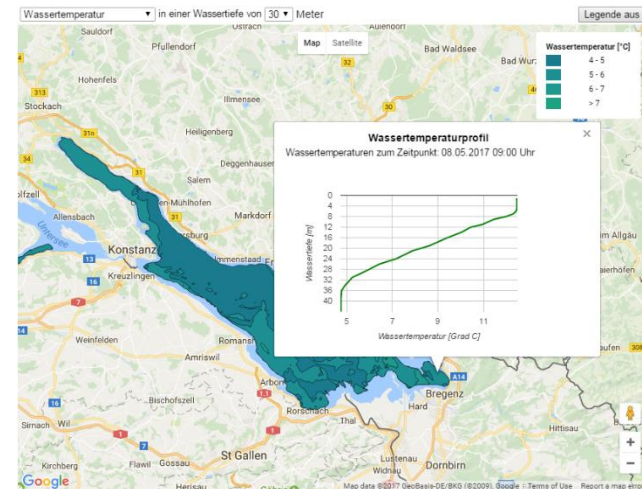
Analysis: Project BodenseeOnline



<https://www.lubw.baden-wuerttemberg.de/wasser/bodenseeonline>

Analysis: Project BodenseeOnline

- ✗ 1D/2D visualization
 - e.g. temperature at a specific point (1D)
 - e.g. temperature at a specific depth (2D)
- ✗ static colors
 - not suitable for every user
- ✗ limited interactivity
 - multiple layers or comparison of data at different points



Requirements

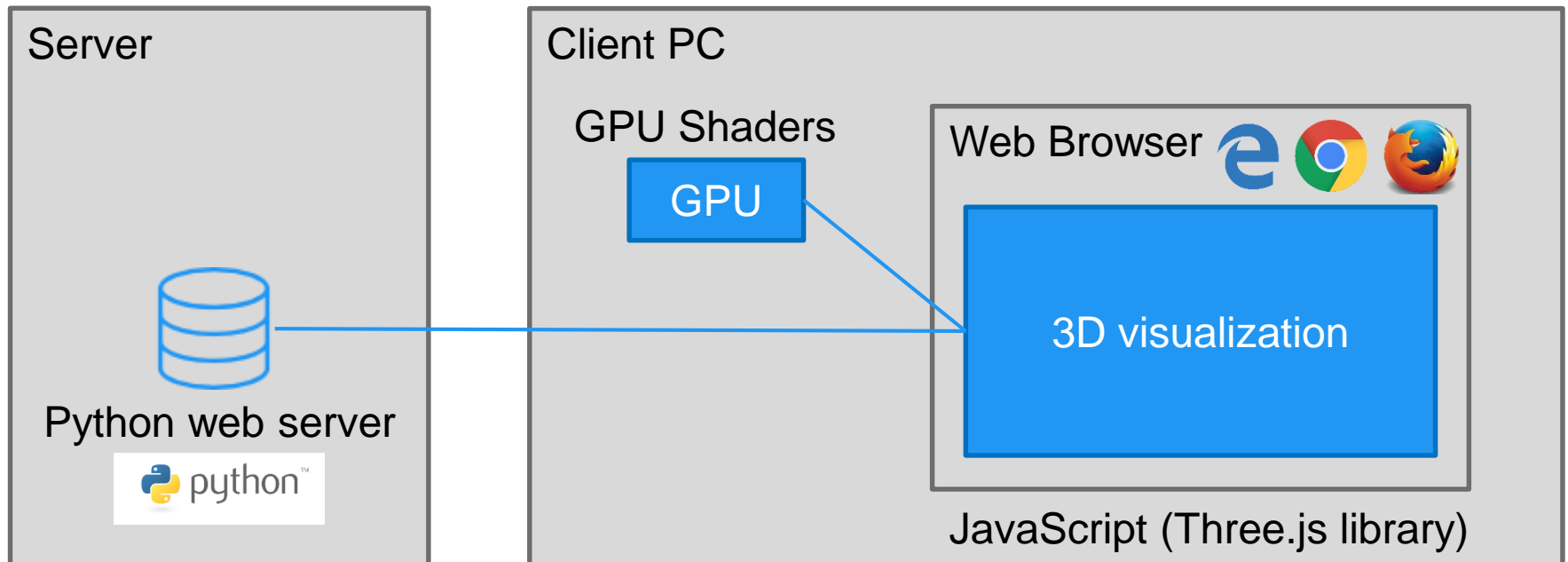
 3D data sets

 3D visualization

 interactivity

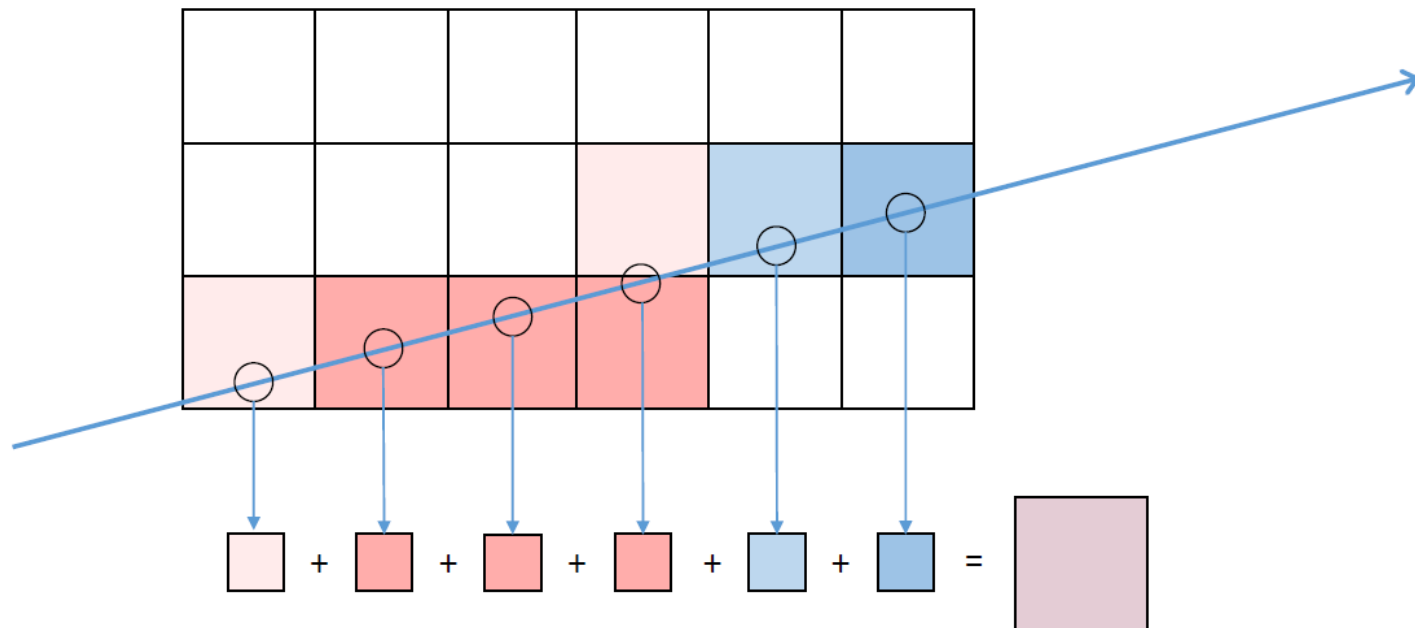
 customizability

Concept: Architecture



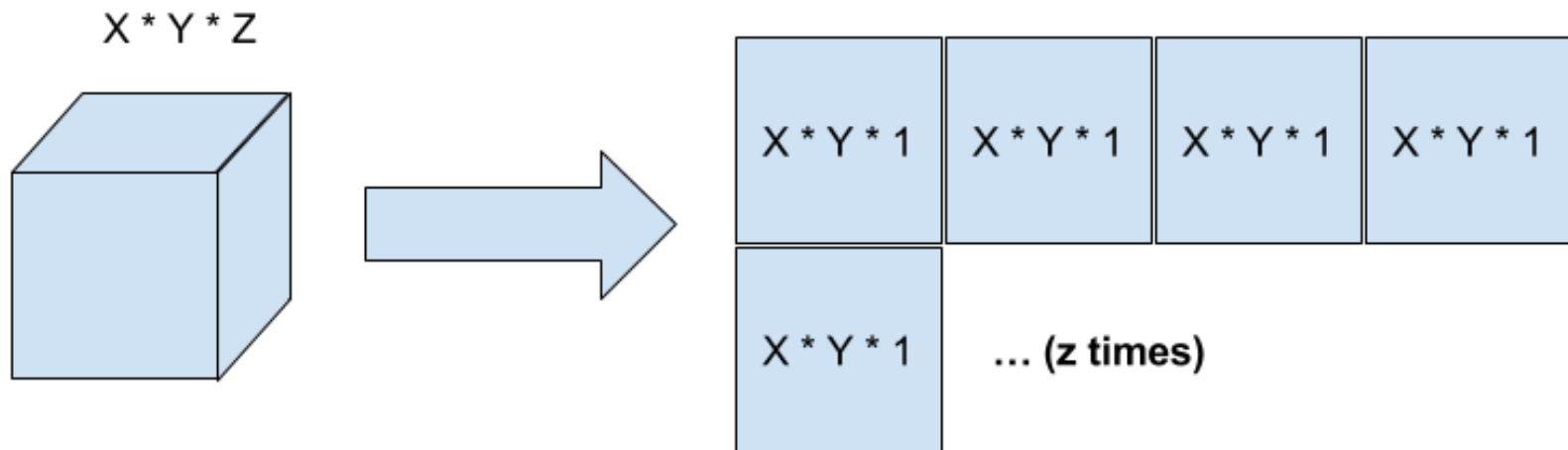
Concept: 3D Volume Visualization

- technique: ray marching
- for every pixel
 - cast ray through the volume
 - collect values along the ray
 - compute resulting color

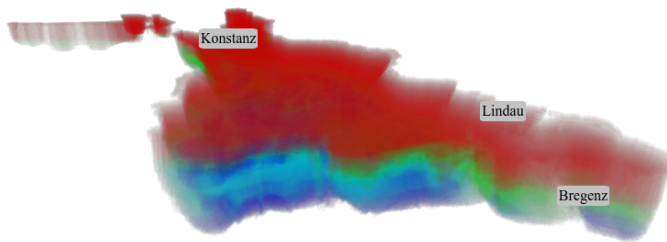


Concept: WebGL

- OpenGL in the browser (currently: ES 2.0 2007)
- supported by modern browsers and devices with GPU
- 3D textures not supported yet



Prototype: First Screenshot



profile **reset** ▾

type **TEMPERATURE** ▾

maxHighlight 0.05

minHighlight 0.03

stepSize 0.7

maxSteps 400

alphaFactor 0.03

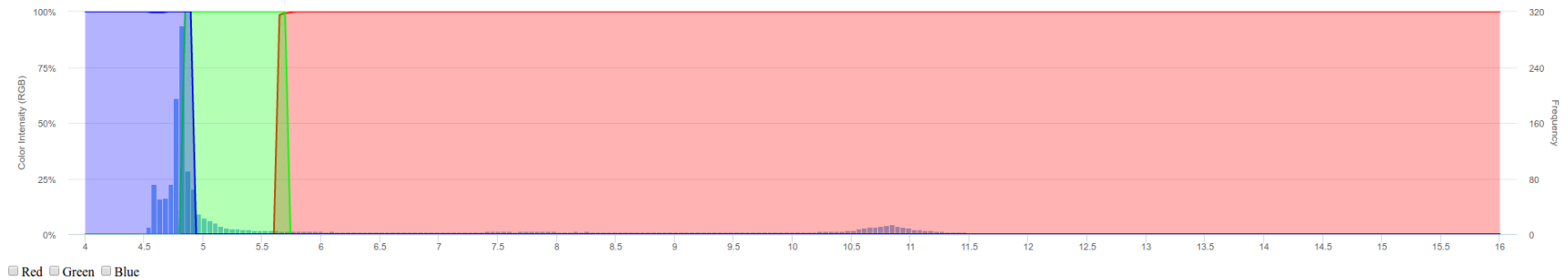
showDebugObject

showCityLabels

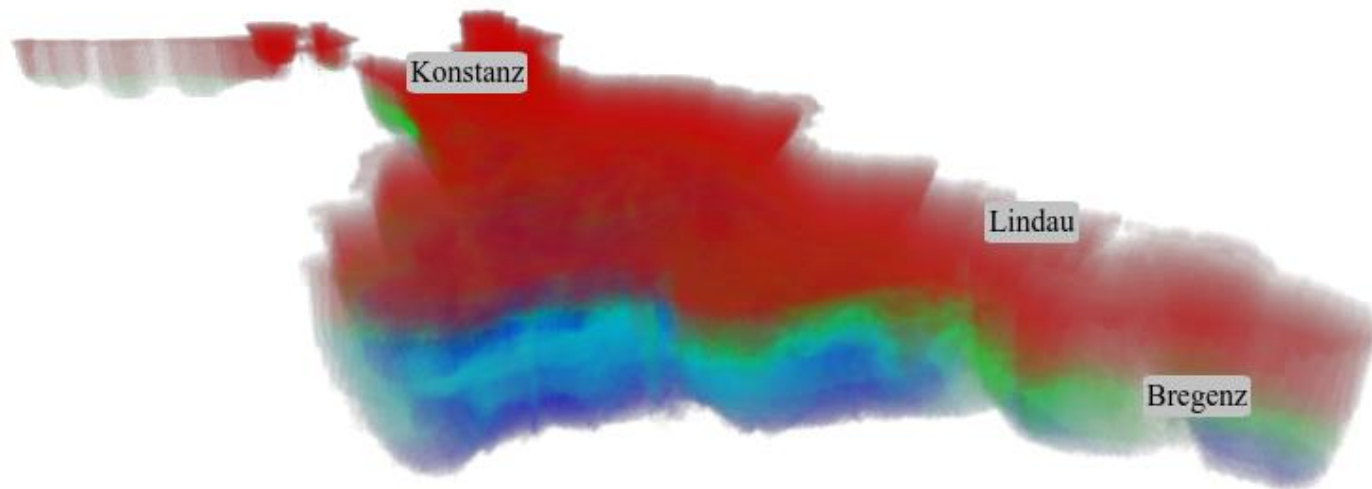
applyTransferFu...

Close Controls

Colors and Histogram

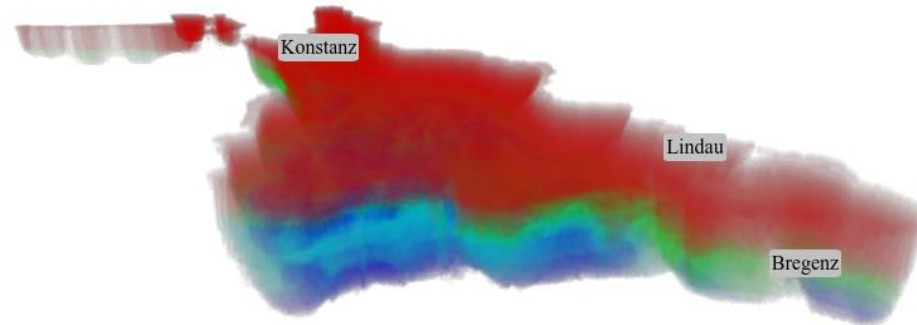


Prototype: First Screenshot

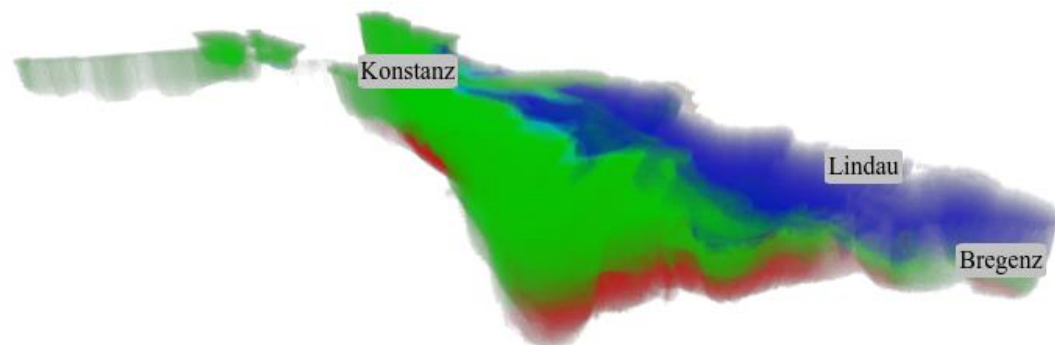


Prototype: Different Substances

■ Temperature:

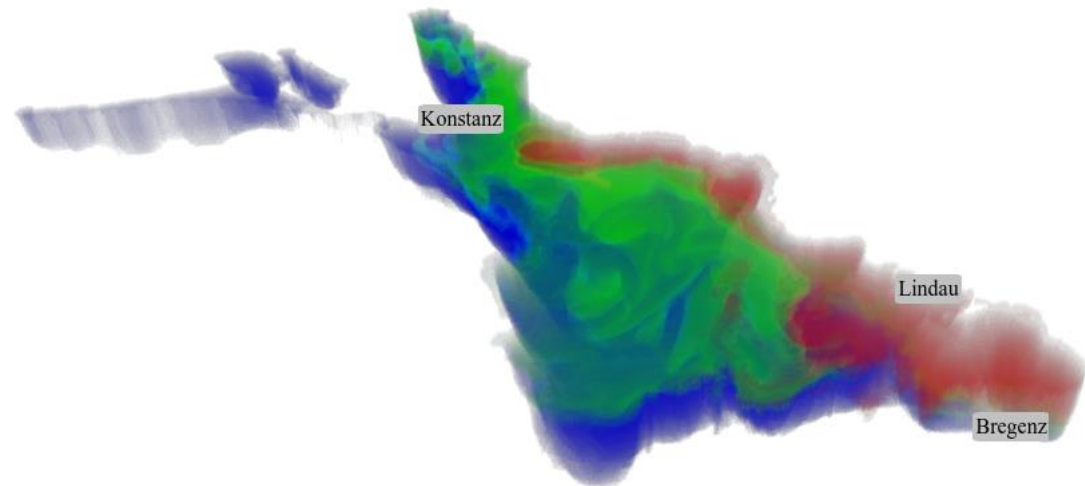


■ Salinity:

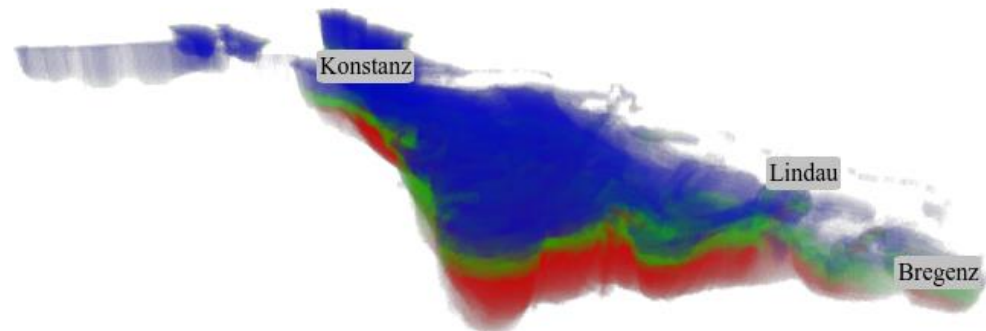


Prototype: Different Substances

■ Tracer (River Rhein):



■ Phosphate:

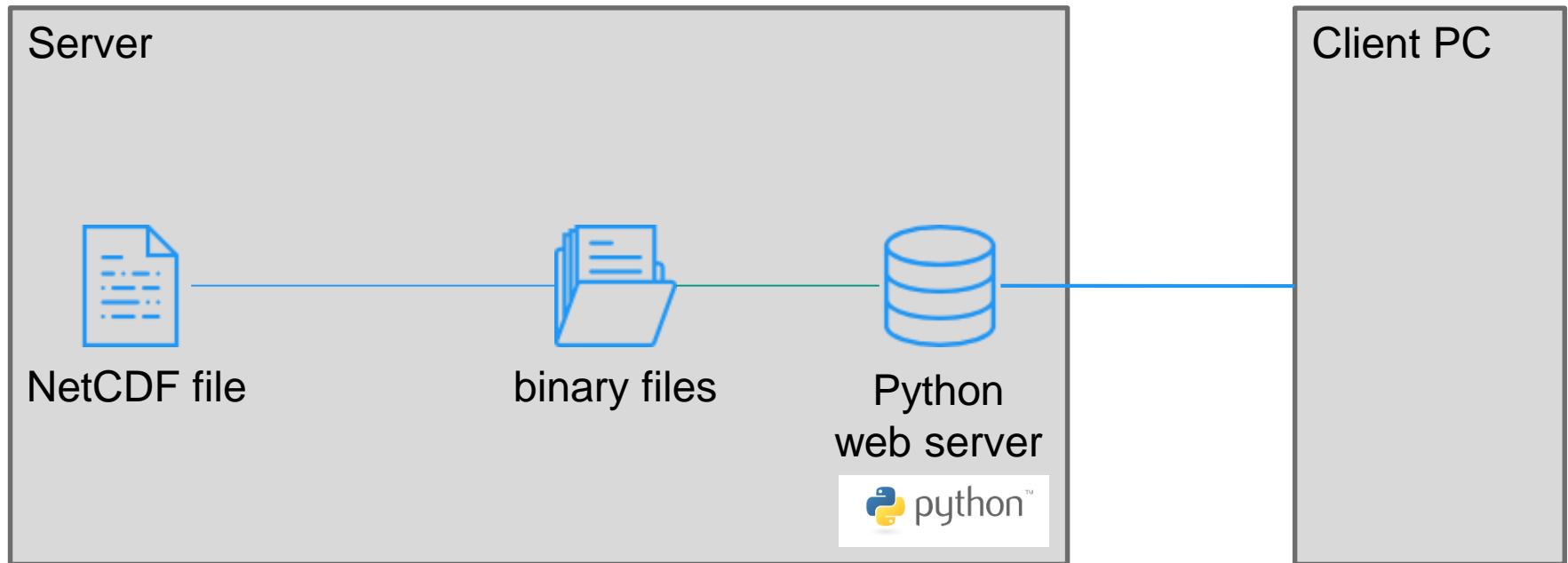


Prototype: Different Substances

- Suspended Matter
- Flow of Water
- Chlorophyll
- Dissolved Oxygen

Concept: Data Management

- NetCDF file as exchange format
- precompute into binary files
- data is served by a Python web server



Concept: FlexVis

- visualization framework
- easier to customize
- simplifies connection to data sources
- no programming required

FlexVis 1.0 Data Sources Templates Instances

Name
Lake Constance Volume Visualization

Volume Visualization ▼

Data Source Instances

Name	Data Source	Parameters
<input type="checkbox"/>	lakeCons lake volume ▼	CONFIG PARAMETERS

✎

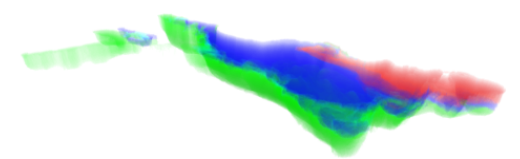
Template Parameters

Name	Value
stepSize	0.7
alphaFactor	0.03
showSettingsPanel	false
controlCamera	true
maxSteps	400
showColorPanel	false

Data Mappings

Data Source	Data Slot Id	Data Set Id
APPLY		

Preview



Summary

- BodenseeOnline project
- 3D volume visualization using WebGL
- visualization of different substances
- special data management needed
- FlexVis supported

Outlook

- improve algorithm
- user-friendly version of the color mapping UI
- updated data management
 - different data resolutions
 - maybe even adaptive resolutions for an area of focus
- implement animation

Thank you for your attention.

further questions: eric.braun2@kit.edu

Sources

- Icons made by Freepik from www.flaticon.com
- Icons made by Madebyoliver <http://www.flaticon.com>
- Icons made by Eleonor Wang <http://www.flaticon.com>
- <https://www.python.org/community/logos/>
- <http://logok.org/edge-logo/>
- <http://logok.org/chrome-logo/>
- <http://logok.org/firefox-logo/>