3D-Visualization of large datasets in a Web browser ?

André Schaaff[1], Jérôme Desroziers[2], Nicolas Adam[3], Malek El Ouerghi[3], Pierre Lespingal[3], Arnaud Steinmetz[3], Nicolas Deparis[1], Sébastien Derriere[1], Nicolas Gillet[1], Dominique Aubert[1], Pierre Ocvirk[1], François-Xavier Pineau[1]

Observatoire astronomique de Strasbourg, UMR 7550, F-67000 Strasbourg, France[1]
Telecom Nancy, France[2], E.N.S.I.I.E. Strasbourg, France[3]

IVOA Santiago 2017
Apps Session 2

CENTRE DE DONNÉES ASTRONOMIQUES DE STRASBOURG

IVOA

Asterics
Astronomy ESFRI & Research Infrastructure Cluster

Related at ADASS conferences

- *Immersive 3D Visualization of Astronomical Data*, ADASS XXIV Calgary (oral)
- *Visualization of astronomical data in a Web browser*, ADASS XXV Sydney (poster)
- *Affordable Immersive Visualization of Astronomical Data*, ADASS XXV Sydney (BoF with Kai P.)
- *3D-Visualization of large datasets in a Web browser, focus on the server side*, ADASS XXVII Santiago (poster)

Credits for all the simulation data:
EMMA: an AMR cosmological simulation code with radiative transfer, D. Aubert, N. Deparis, P. Ocvirk

First fruits

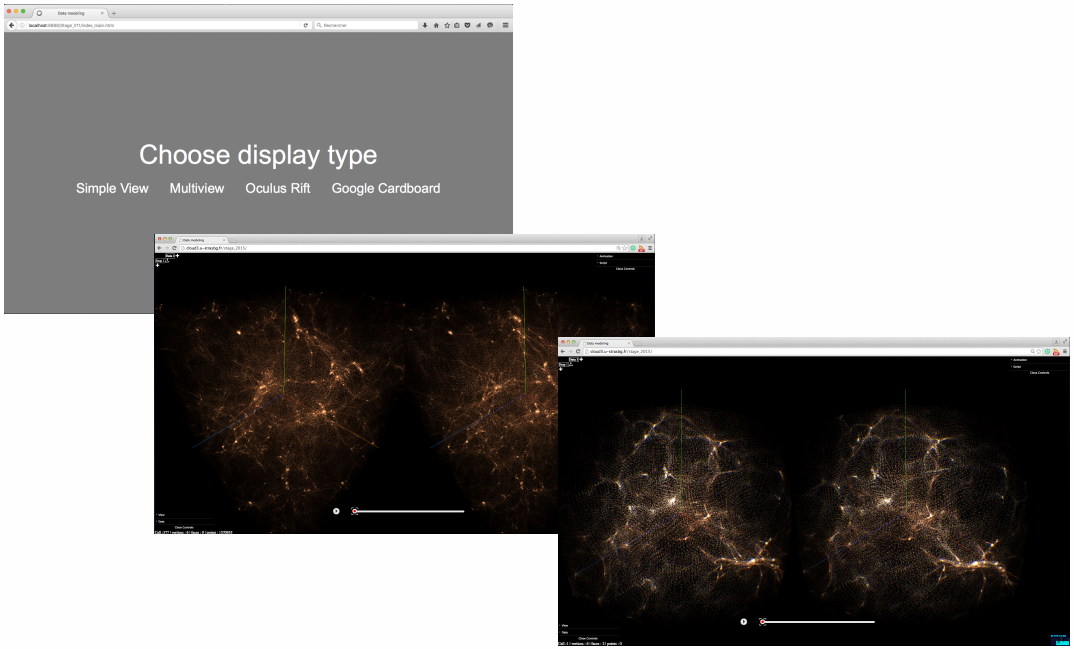
- 2014: work around Virtual Reality to visualize astronomical data (use cases: simulation & VizieR data) with OpenGL & Oculus SDK => development time, not easy to reuse it

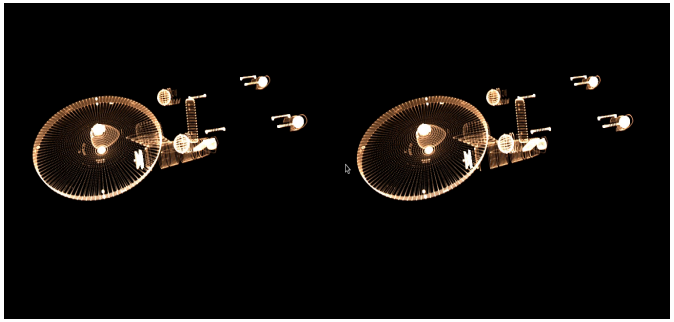
- 2015: first prototype of a more general tool, usable as is to visualize 3D data in a Web browser, based on Javascript / WebGL, the VR is seen as an additional feature, mainly for outreach
  - Octrees on the client side to enable a smoothie navigation
  - Able to read several data formats, wrapper templates to read other formats

First fruits (2)

– VR capabilities

- Firefox Nightly build + moz://a VR / Oculus Rift
- Google Cardboard view
- How to interact ? a pad ? gesture ? voice ?

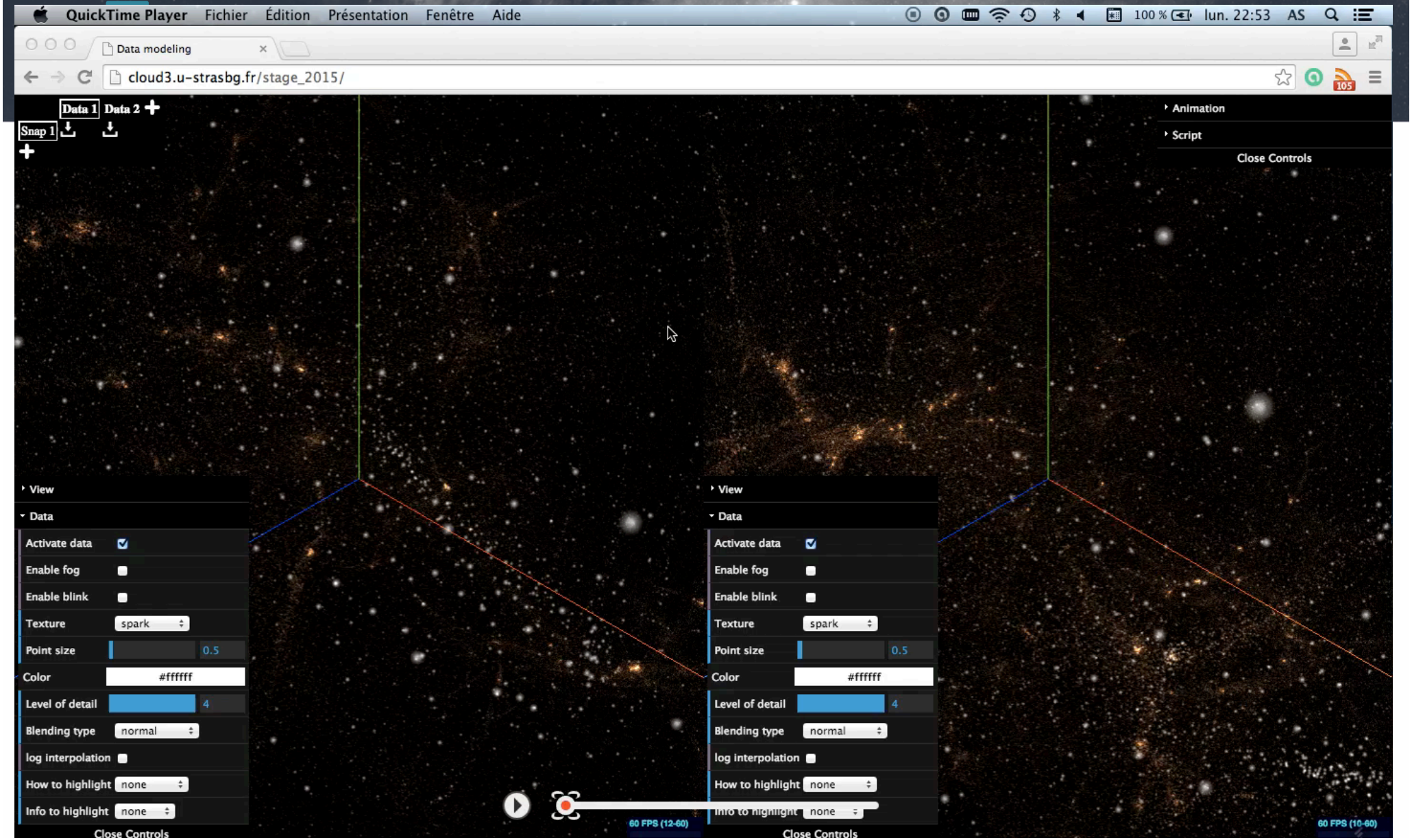




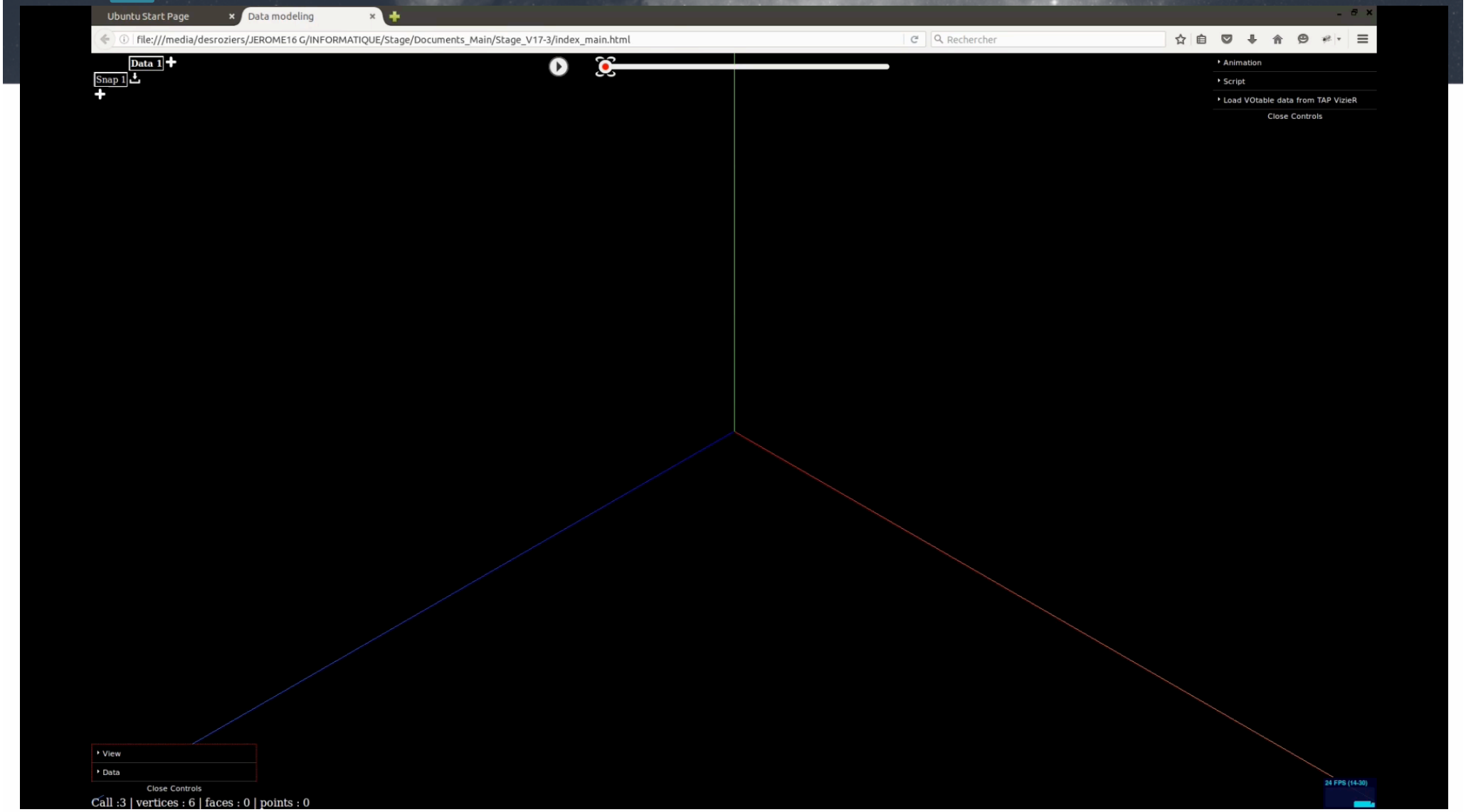
Remark

- Why simulation data ?
  - Large datasets
  - Scripts / tools to generate videos, to extract subsets but not affordable way to navigate in the whole datasets and to select a subset
  - How to share the data with colleagues from other labs ?
  - How to publish a (dynamic) subset in a Web browser ?
  - => good use case

In the the early weeks…



In the the early months…

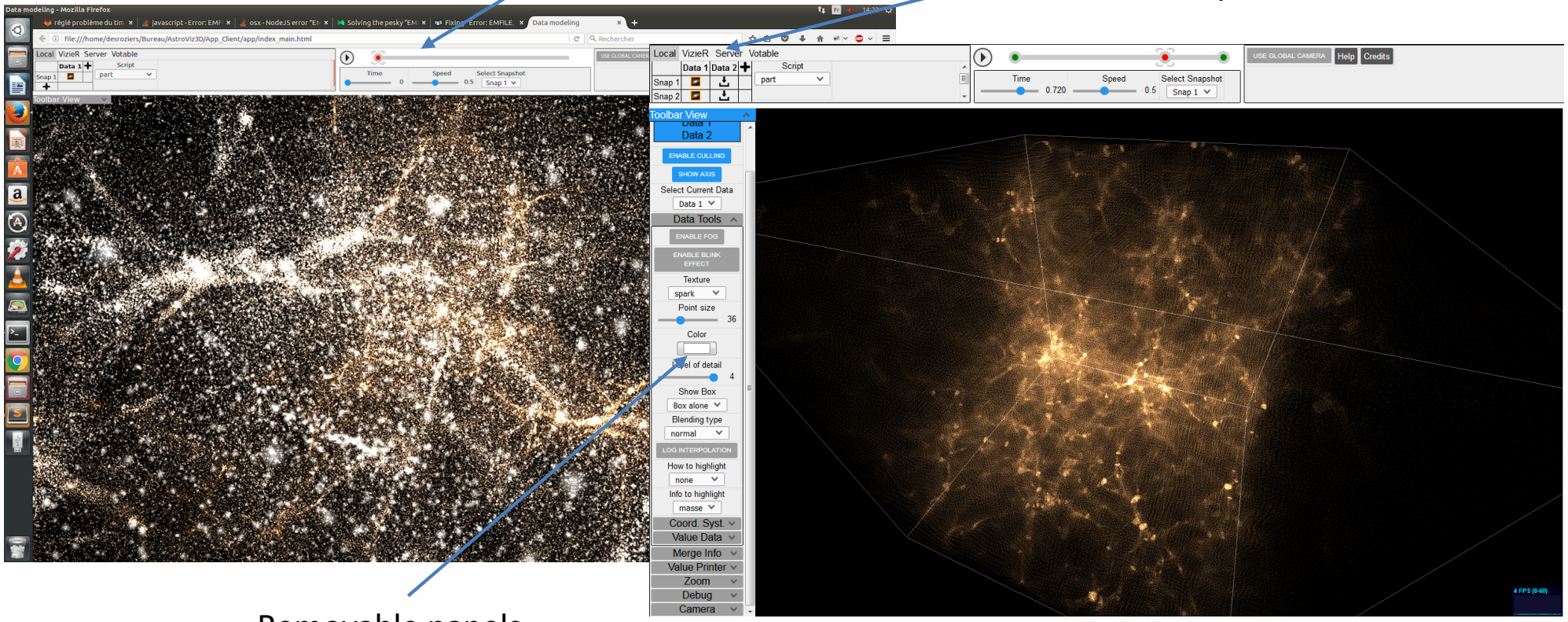


Going further…

- 2016: more sophisticated and flexible user interface

Slide-show

Data in several formats, TAP VizieR queries, VOTable, etc.



Removable panels

Illustration

- Multiview with selection, information display, …

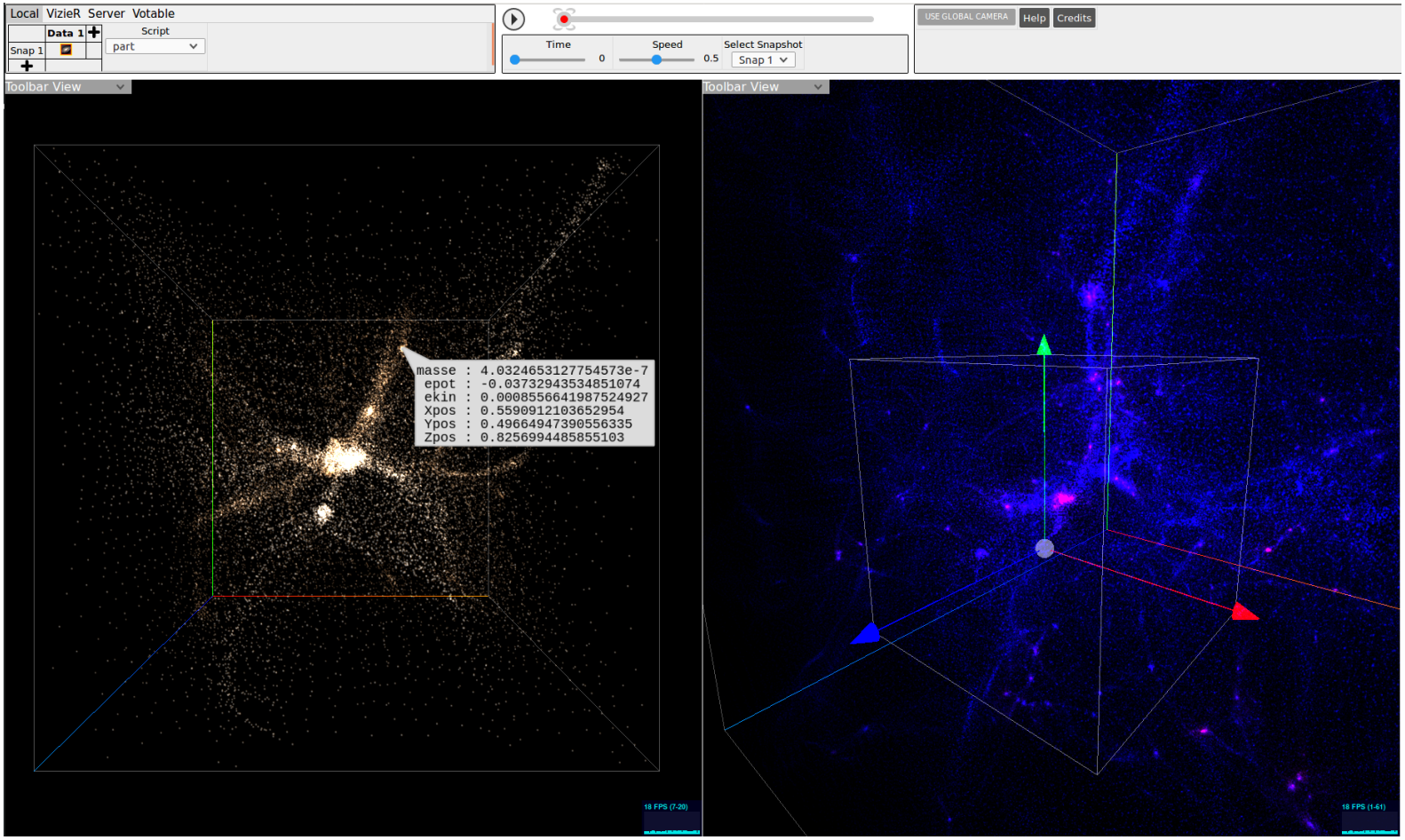


Illustration (2)

- Selection with different coordinate systems…

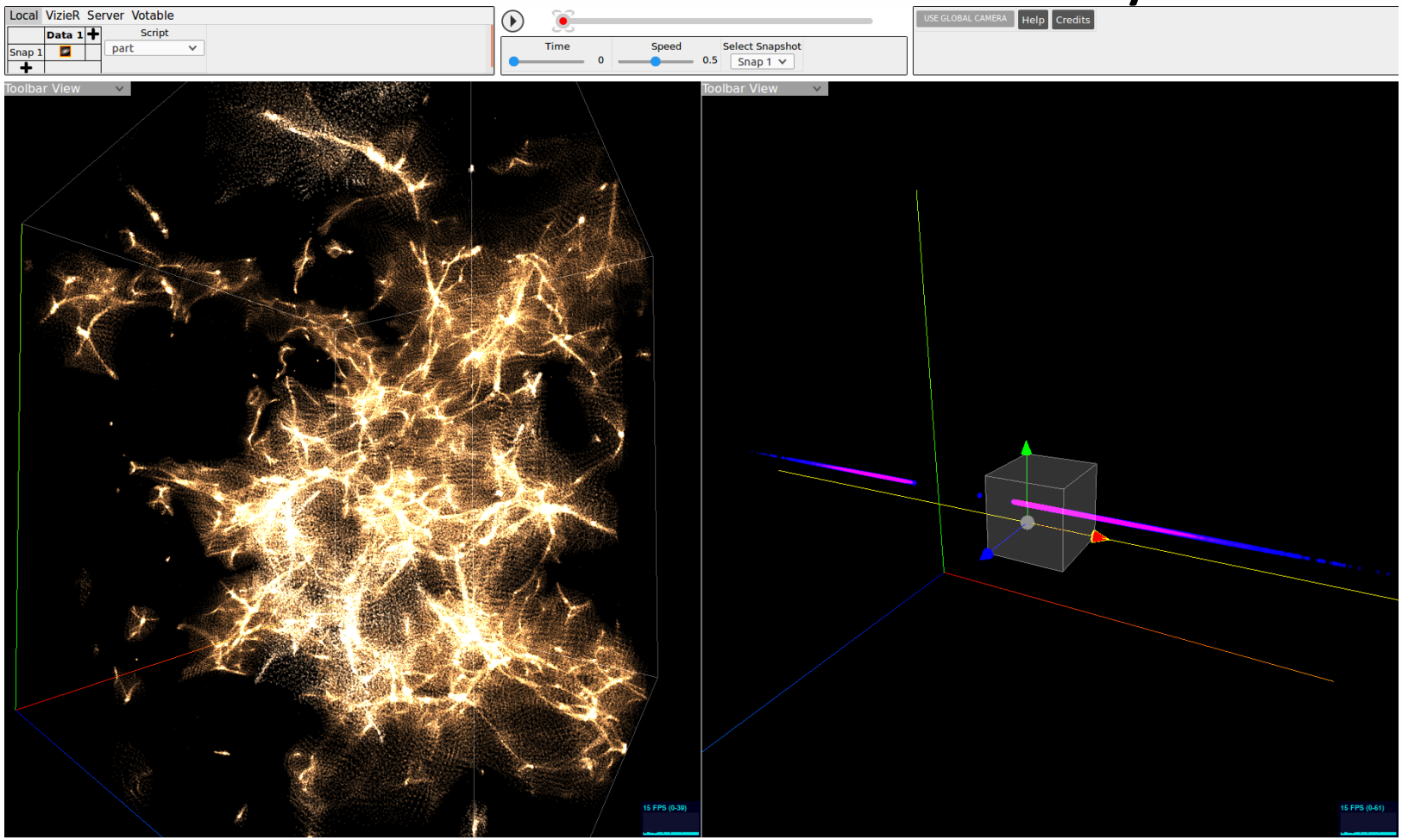
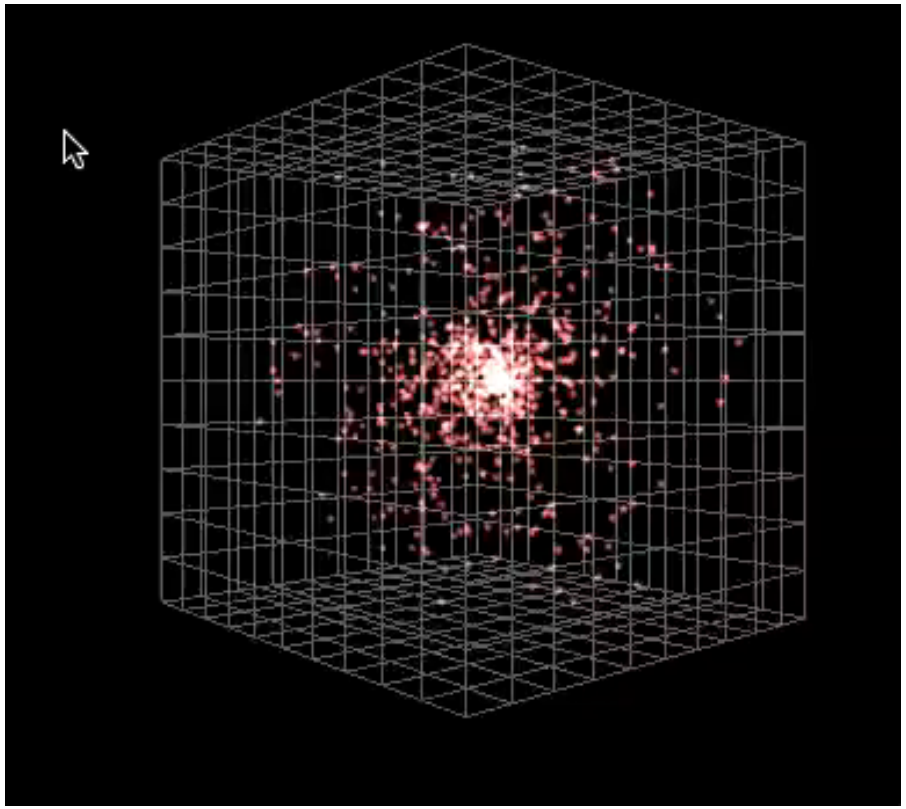


Illustration (2)

- It is possible to create animation to include in a Web page



Multi-datasets in the same view

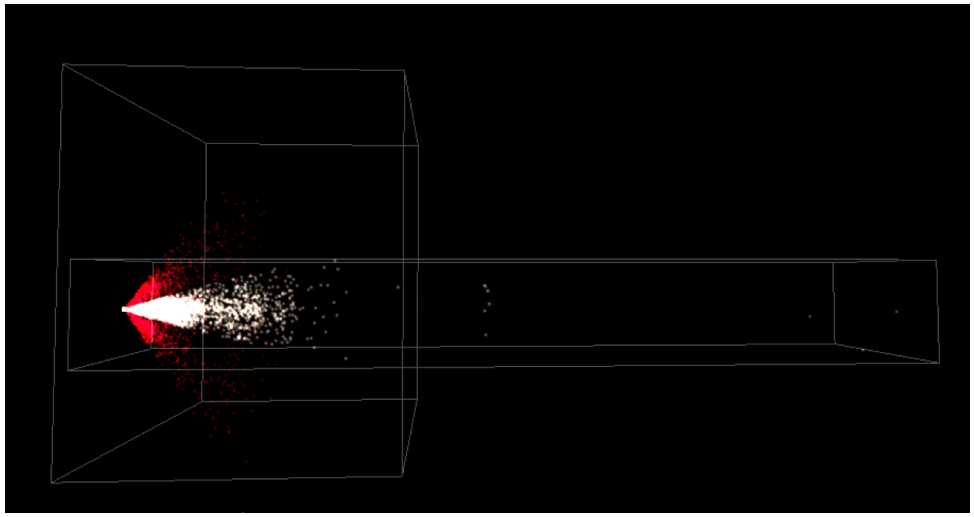
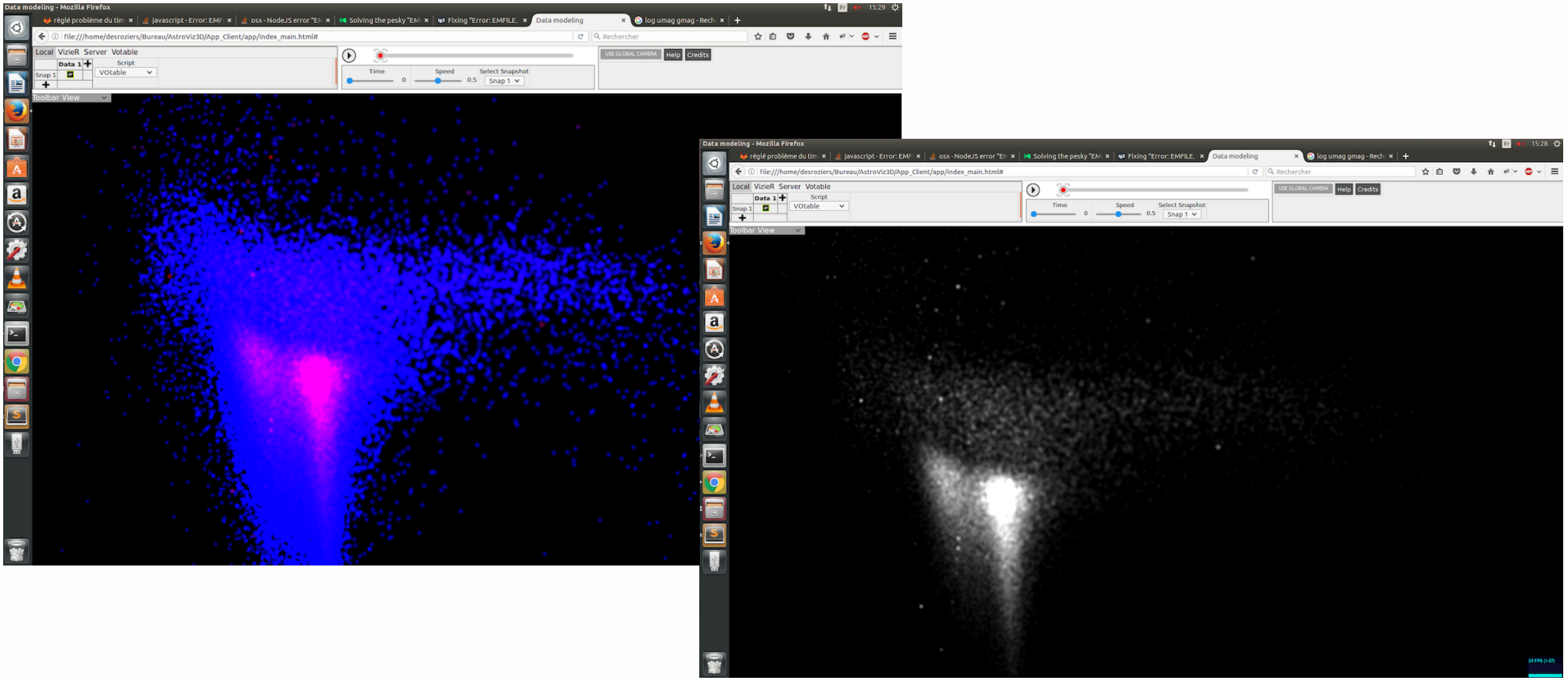


Illustration (3)

- Open to other data…

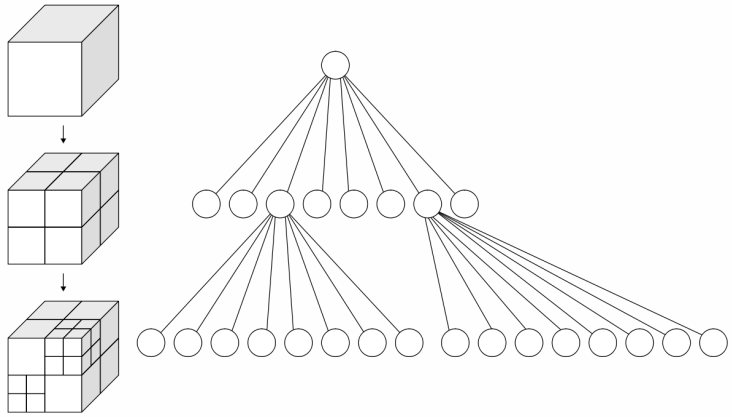


Going further… (2)

- 2016: first work on the server side to enable the visualization of larger datasets:
  - Use case: 4096^3 simulation data cube (a few TBs, Emma simulation)
    - Other scale
    - How to deal with this volume ?
  - => data on a server, idea: progressive visualization on the client side ("à la HiPS" but for cubes with all-directions visualization)

Remark

- The client side is working with octrees
- The client already offers 2 views and an interaction between them to select a subset to visualize
- => easy to adapt it to work with a server



Remark (2)

- Reuse of the concept of octrees on the server side
- How to store it in an efficient way ?
- Experiments with
  - a NoSQL database
  - PostgreSQL / PointCloud
  - Without a database, binary / no binary
  - Different ways to index the data
  - Etc.

Server side

- The current choice is based on a simple file storage system
- The initial dataset is divided in sub-cubes and stored in binary
- Degraded views are generated and are used depending of the level of zoom

Next steps

- Looking for other use cases
- Continuous work to improve the performances on both client (tracing, etc.) & server side (but keep the client usable alone)
- New features
- Prepare the future, after WebGL
- Open to the community when ready ?