

OpenVDB at DWA

DreamWorks Animation

Jeff Budsberg

FX Lead

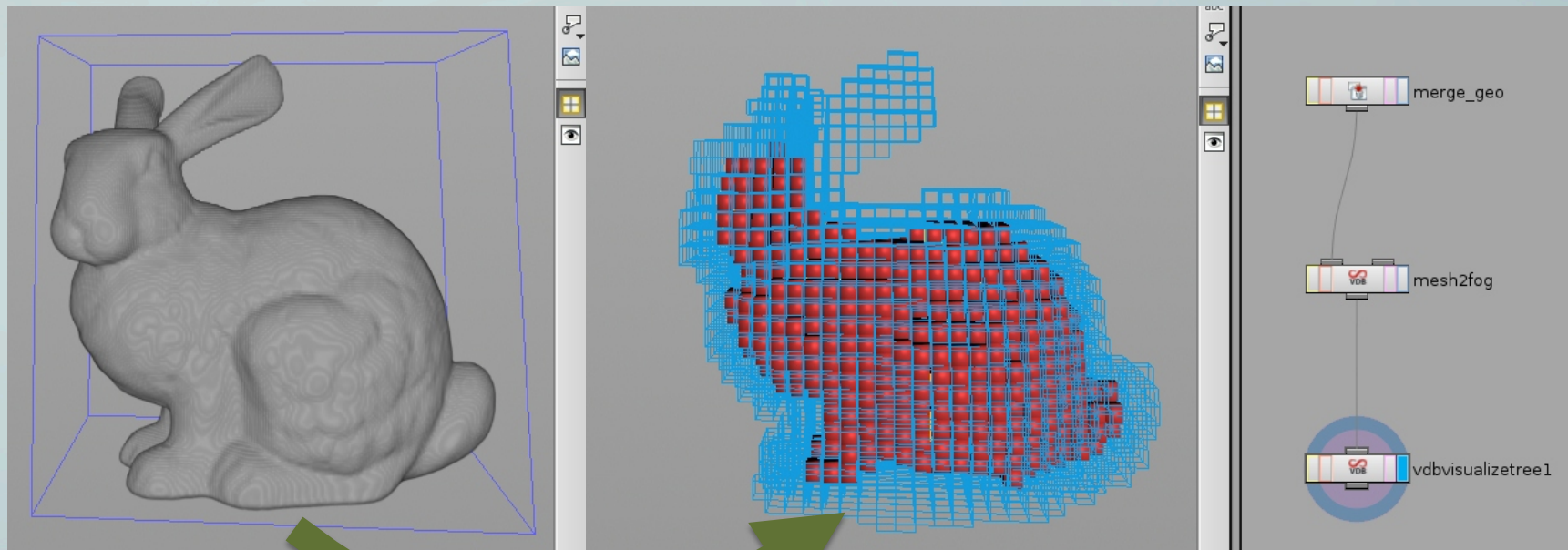
Talk overview

- Toolset
 - Houdini SOPs
- Applications
 - Clouds
 - Liquids
 - Advection
 - Fluids
 - Deformation
 - Fracture
 - Visualization

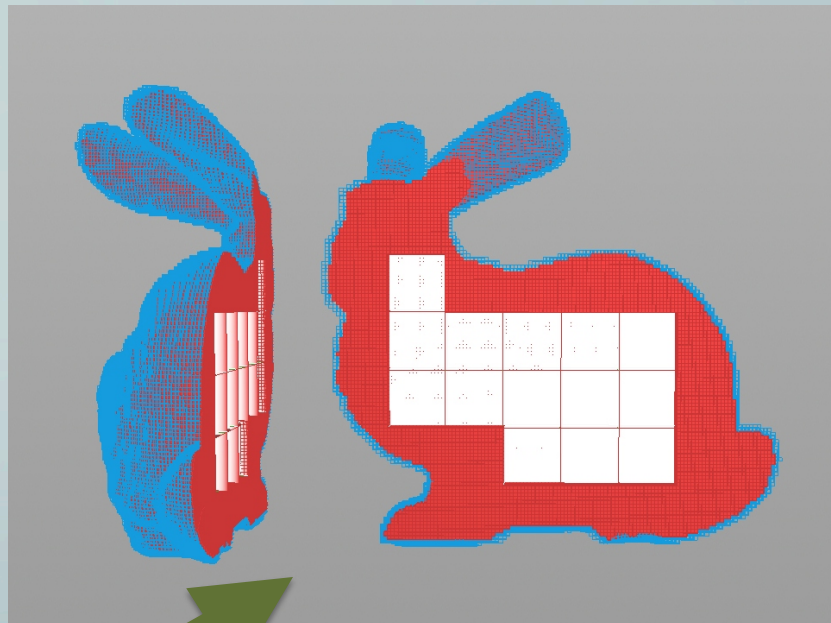
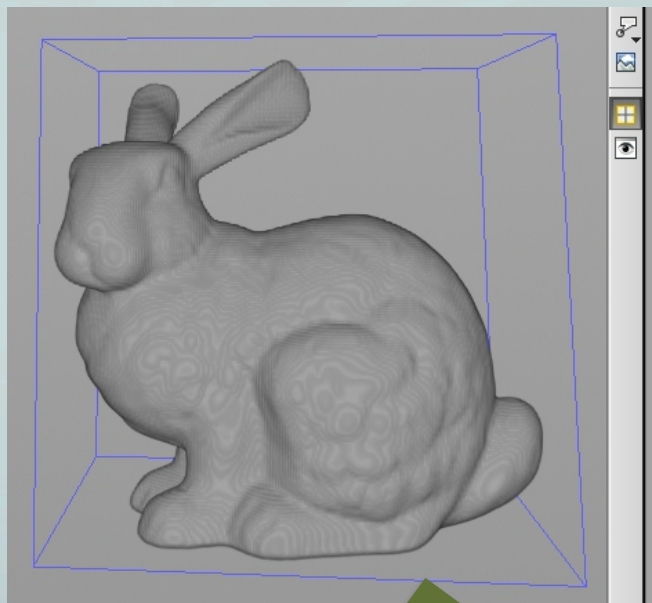
Toolset

- Exposed as a collection of Houdini SOPs
- A first-class citizen as a primitive
- At DWA
 - Native Houdini SOPs
 - OpenVDB
 - Custom production nodes

Volume Creation



Volume Creation



Volume Creation

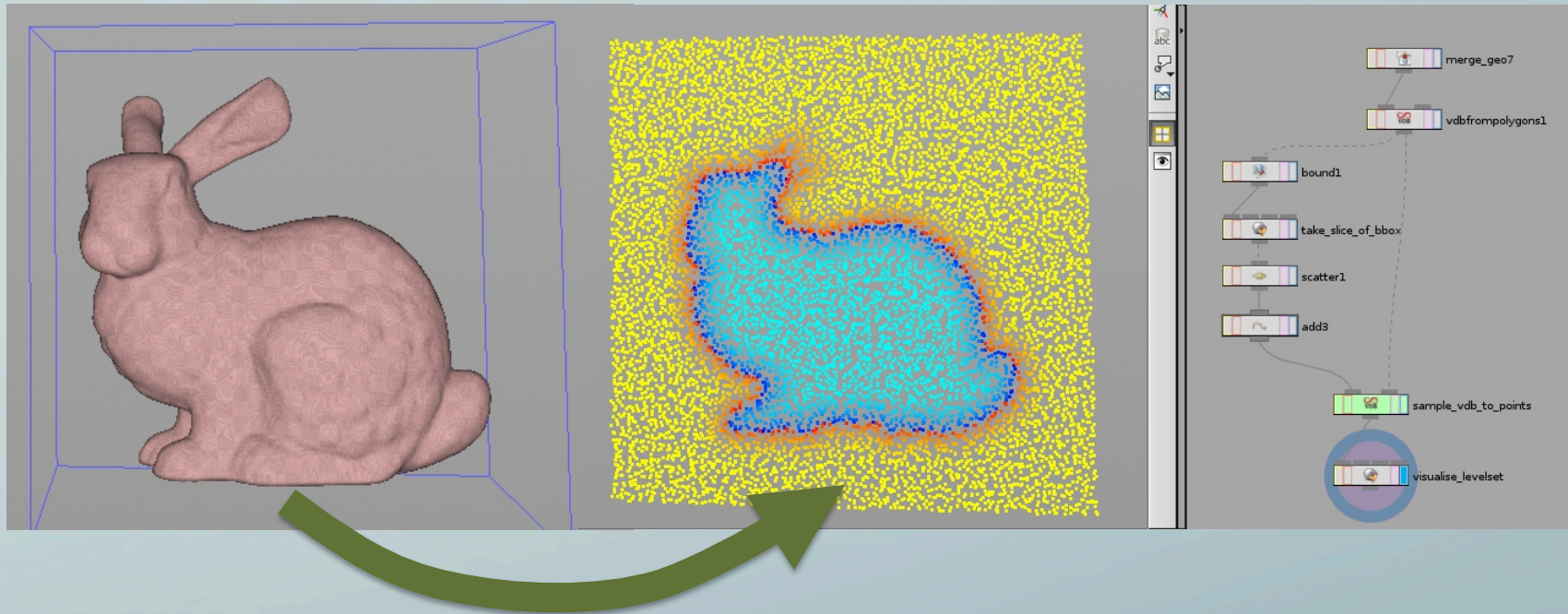
The image shows a software interface for creating VDB volumes. The top window, titled 'vdb1', contains settings for a volume named 'density'. It has a 'Number of Grids' set to 1, 'Enable' checked, 'Class' set to 'Fog Volume', 'Type' set to 'Float' (32-bit), and 'Background Value' set to 0. The 'Voxel Size' is set to 0.1. Below this, there are radio buttons for 'Voxel Size', 'Frustum', and 'From Camera'. Two large green arrows point from the 'density' volume settings in the top window to the 'density' row in the 'Geometry Spreadsheet: mesh2' window below. The spreadsheet shows the volume's properties in a table format.

Geometry Spreadsheet: mesh2

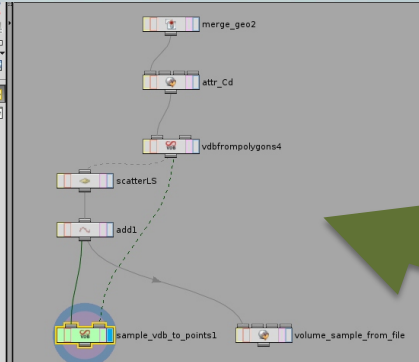
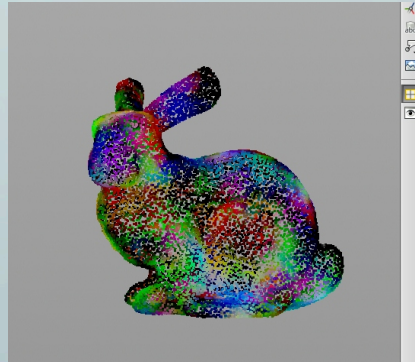
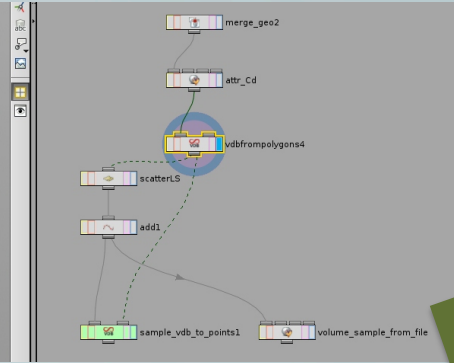
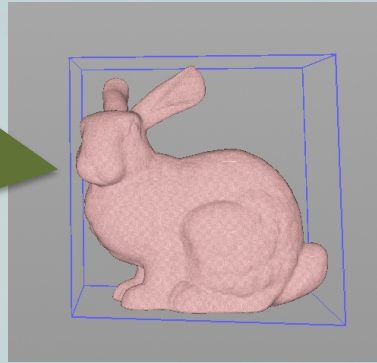
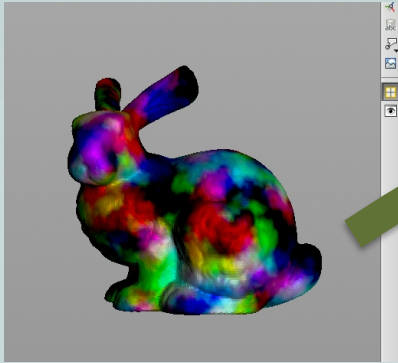
Node: mesh2fog

	name	intrinsic:activevoxelcount	intrinsic:background	intrinsic:typename	intrinsic:vdb_class
0	density	1736456	0	VDB	fog volume

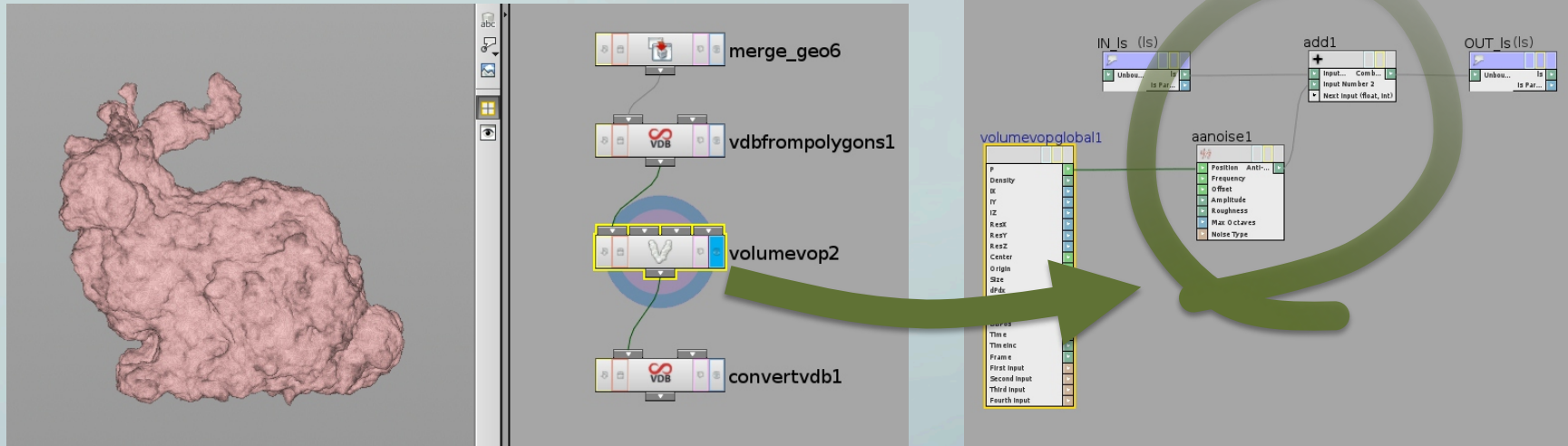
Level Sets



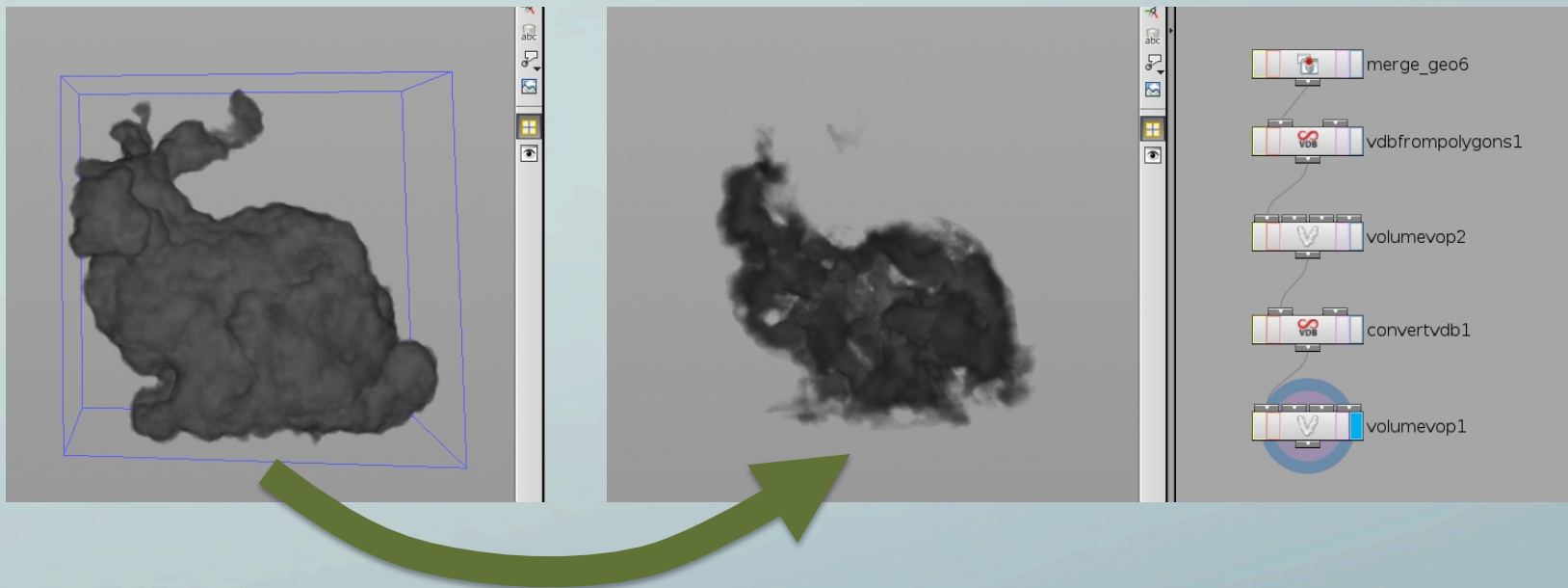
Arbitrary Grids



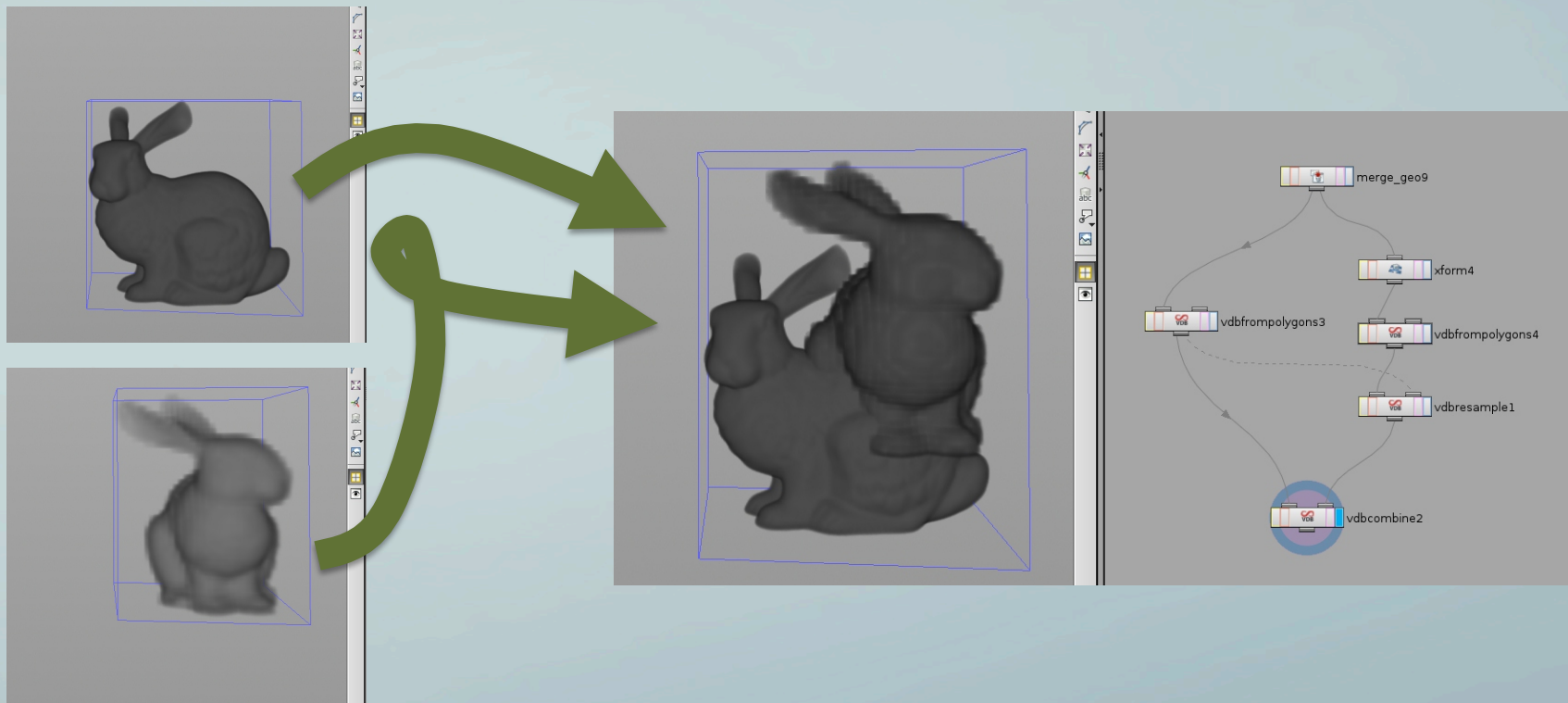
LS Manipulation



LS to Fog



Combining Grids



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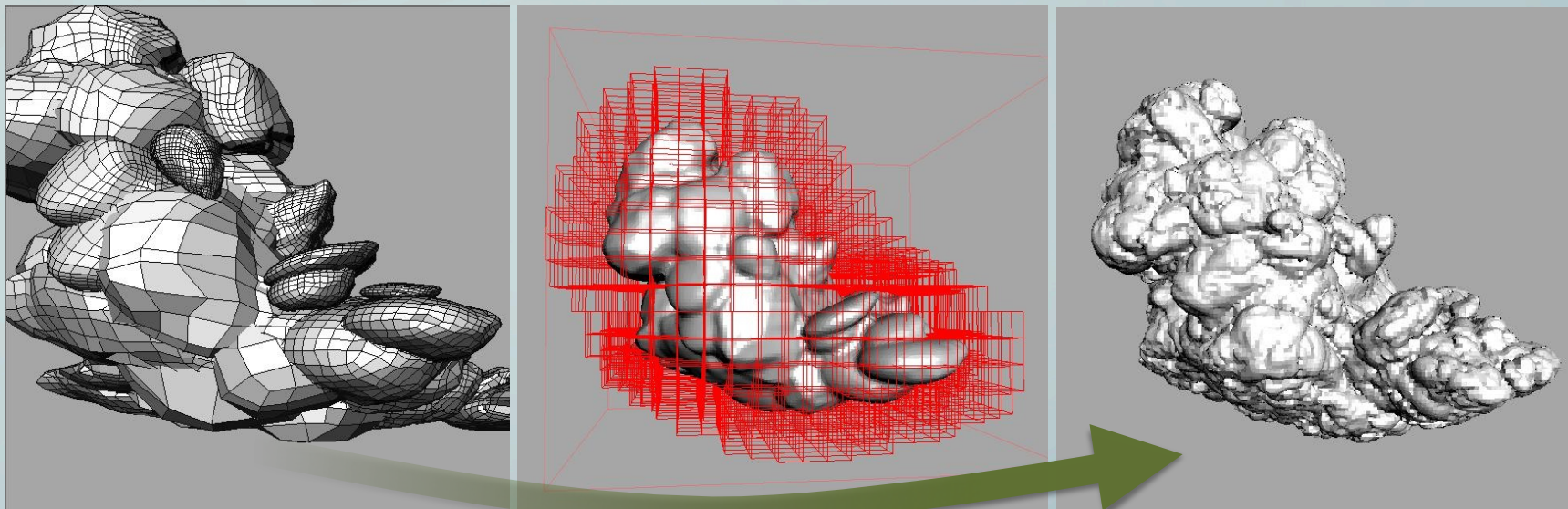
Clouds



Clouds

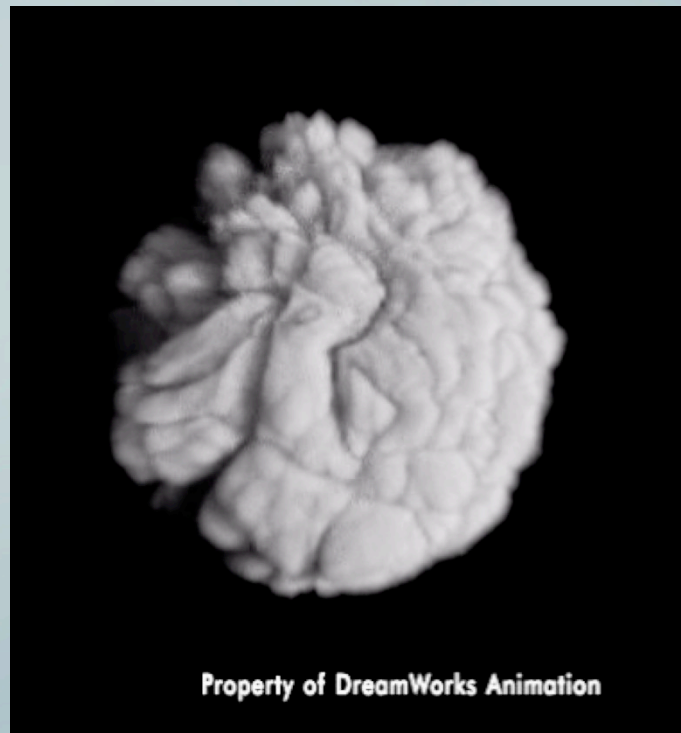
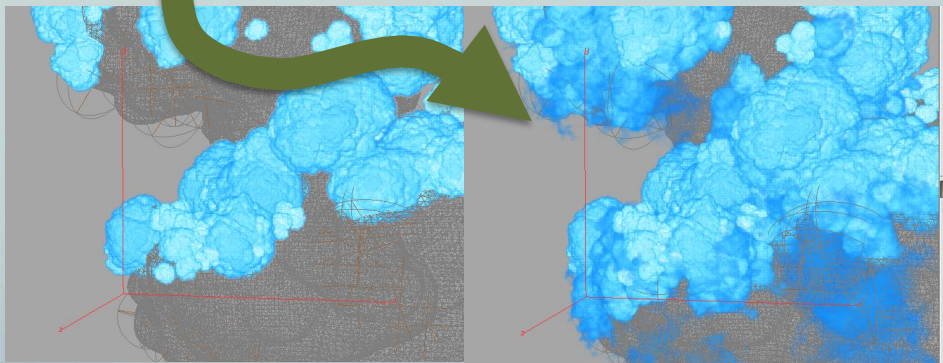
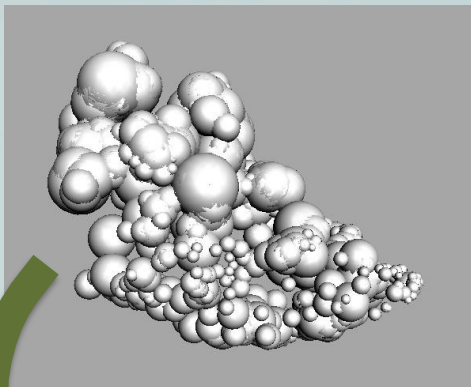


Cloud Modeling

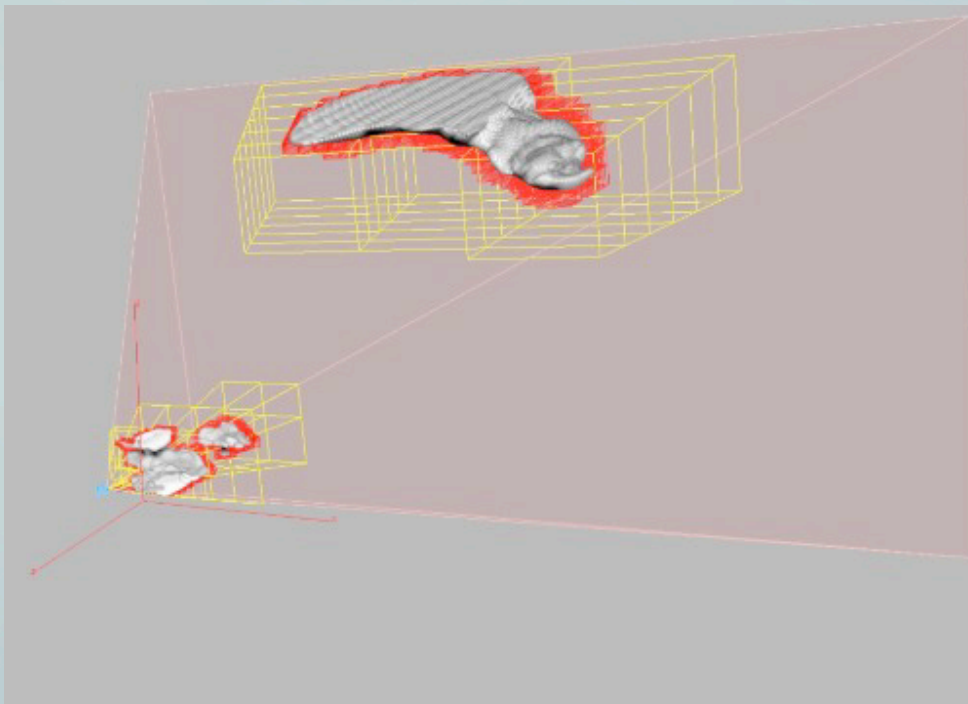


Miller, B., Museth, K., Penney, D. and Bin Zafar, N. Cloud modeling and rendering for Puss in Boots.
ACM Siggraph Talks, 2012

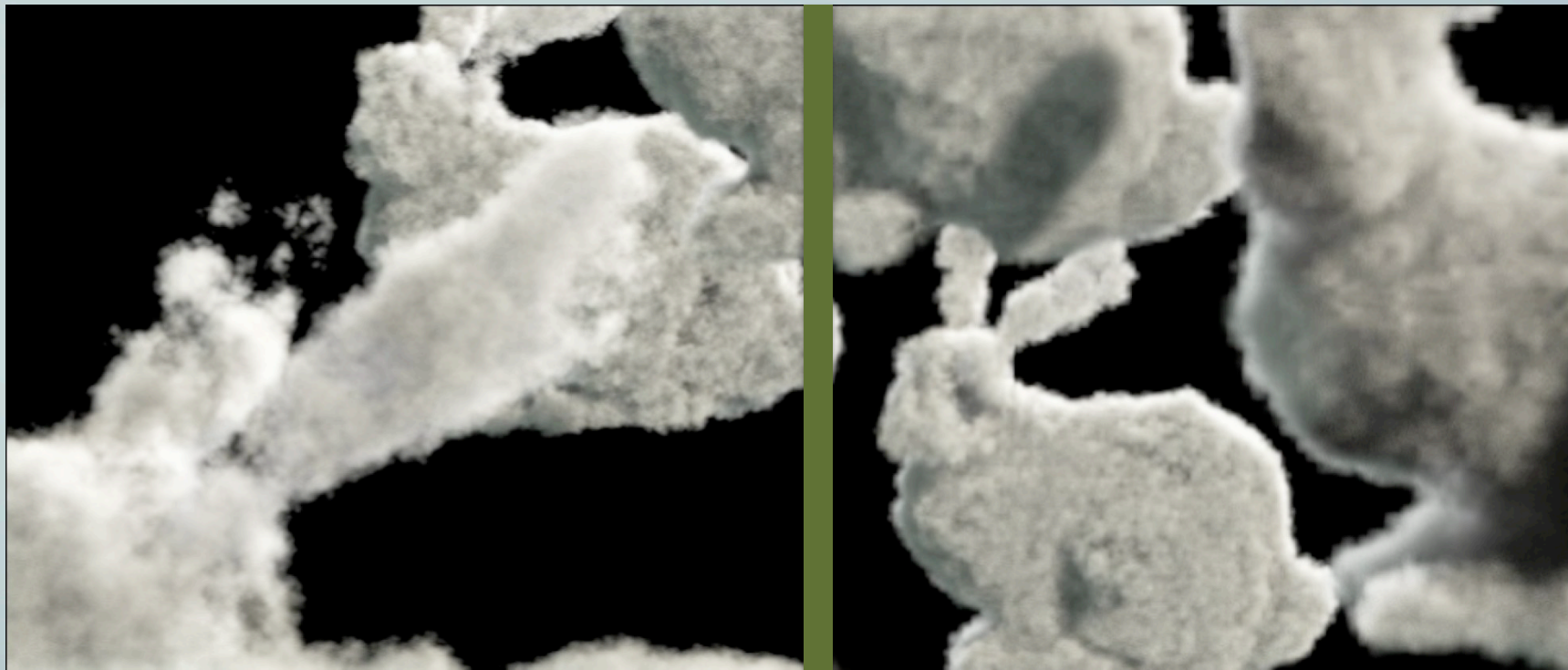
Spherical Pyroclasts



Frustum Buffer



Frustum Buffer



Liquids



Budsberg, J., Losure, M., Museth, K., Baer, M. Liquids in The Croods. DigiPro, 2013

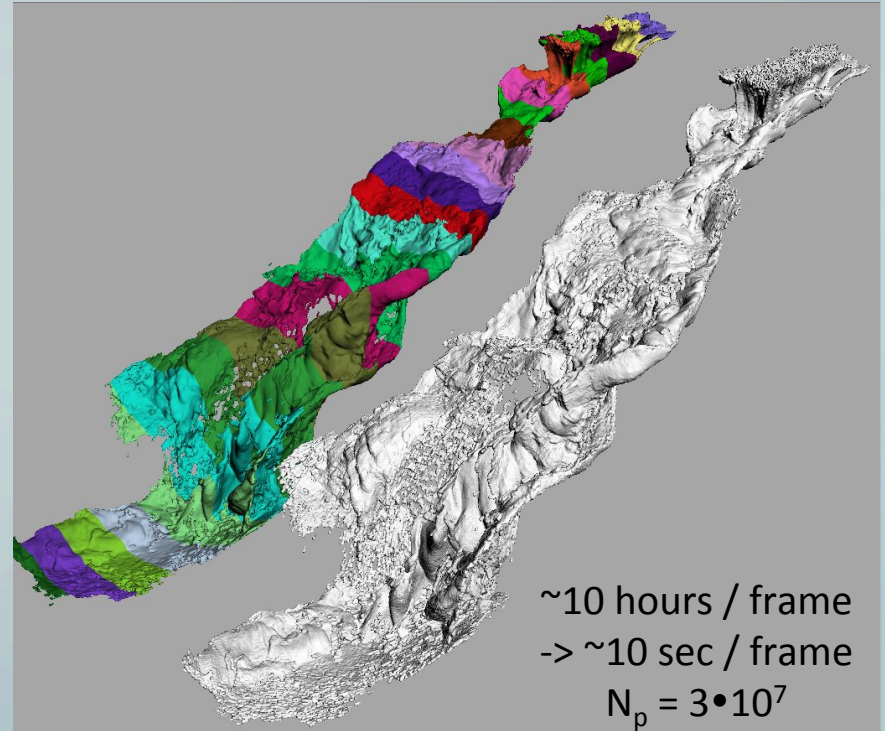
Liquids



Budsberg, J., Losure, M., Museth, K., Baer, M. Liquids in The Croods. DigiPro, 2013

Particle Surfacing

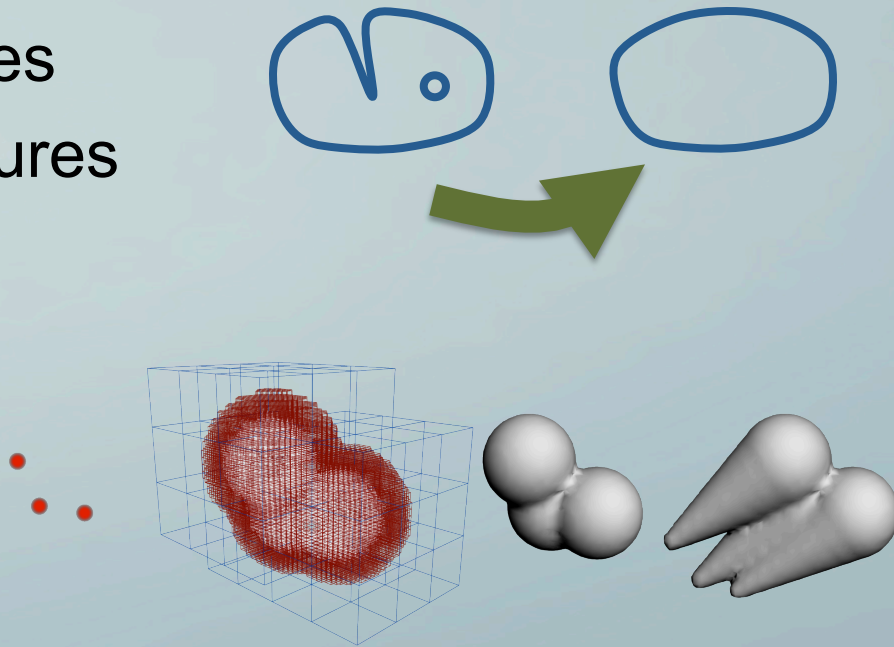
- Monolithic solutions inadequate



~10 hours / frame
-> ~10 sec / frame
 $N_p = 3 \cdot 10^7$

Particle Surfacing

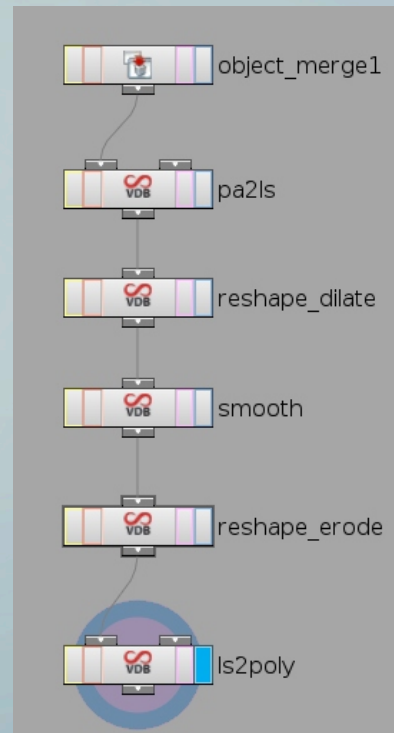
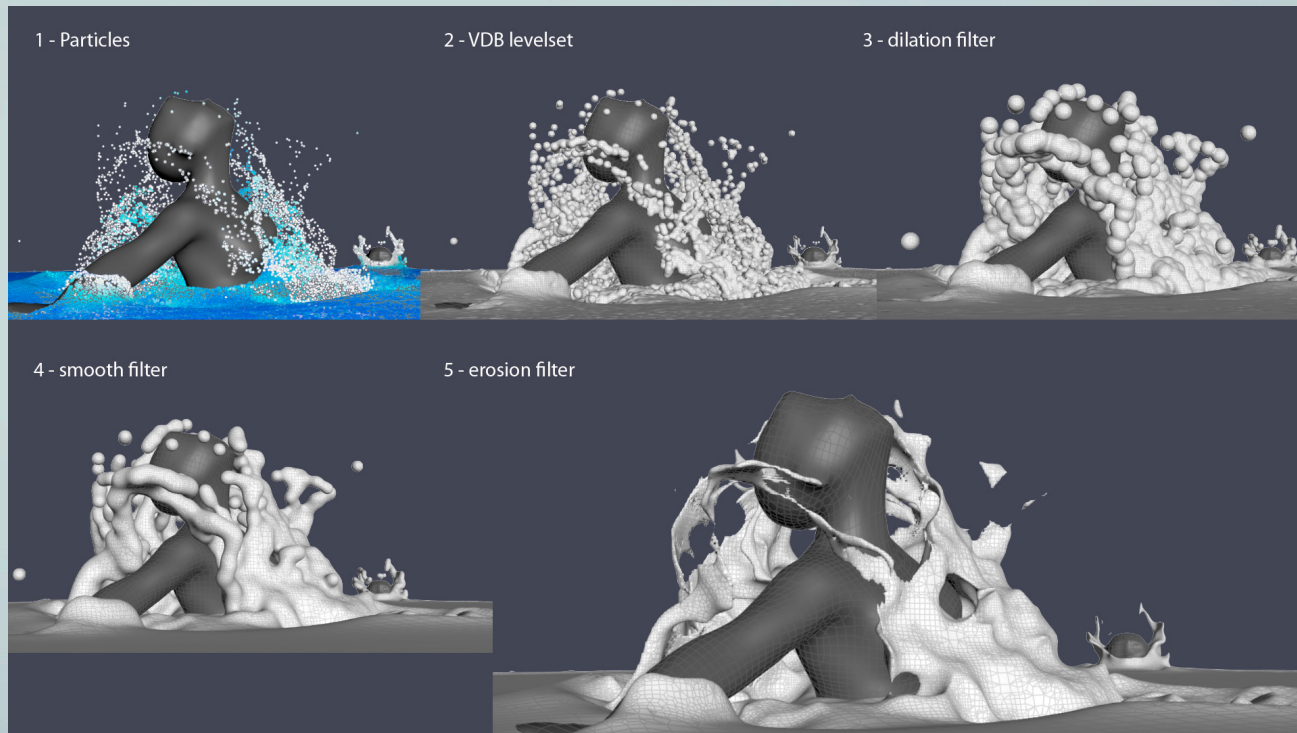
- Artists want control
 - Remove artifacts / holes
 - Accentuate sharp features
 - Smooth flat areas
- And make it fast!



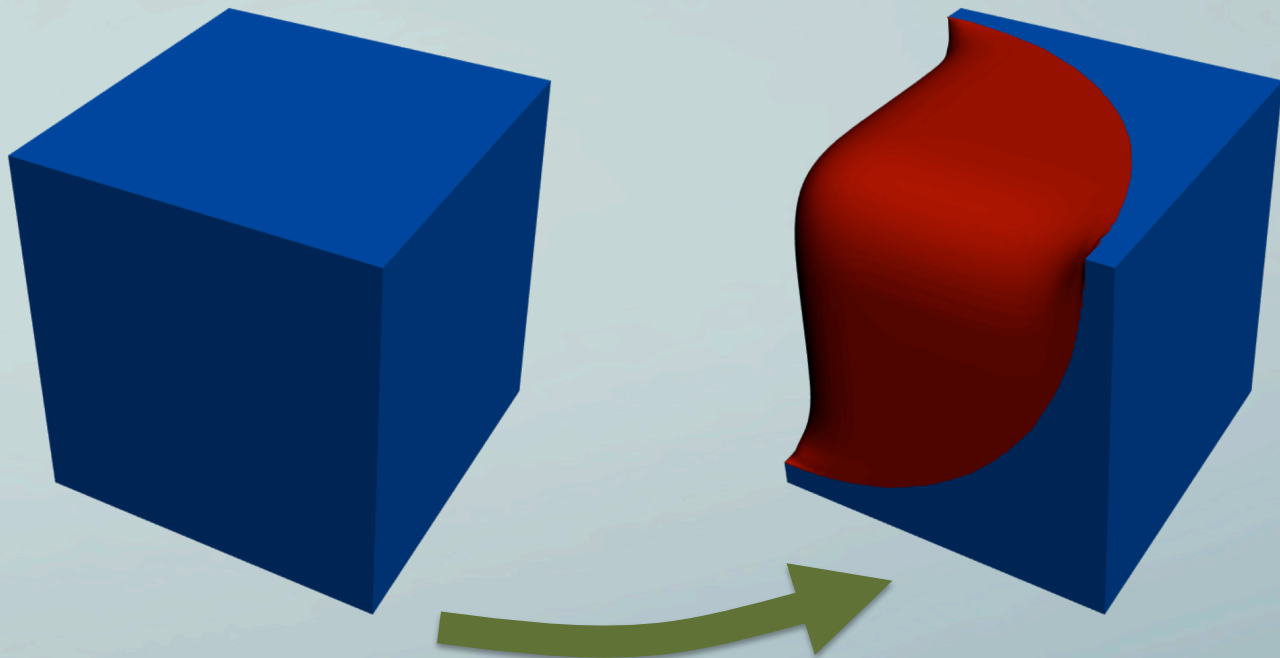
Particle to LS



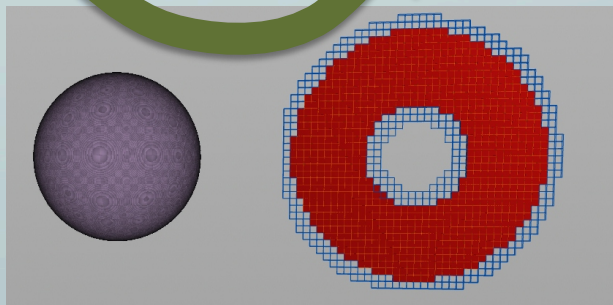
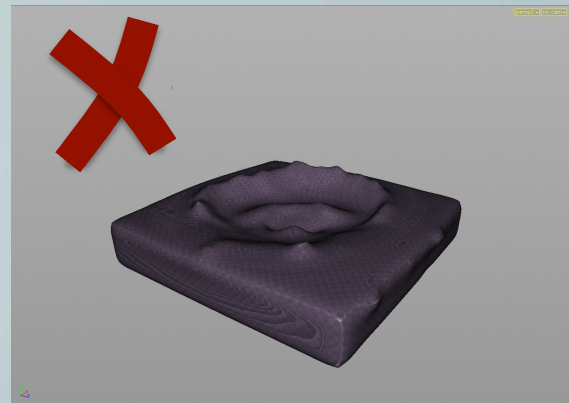
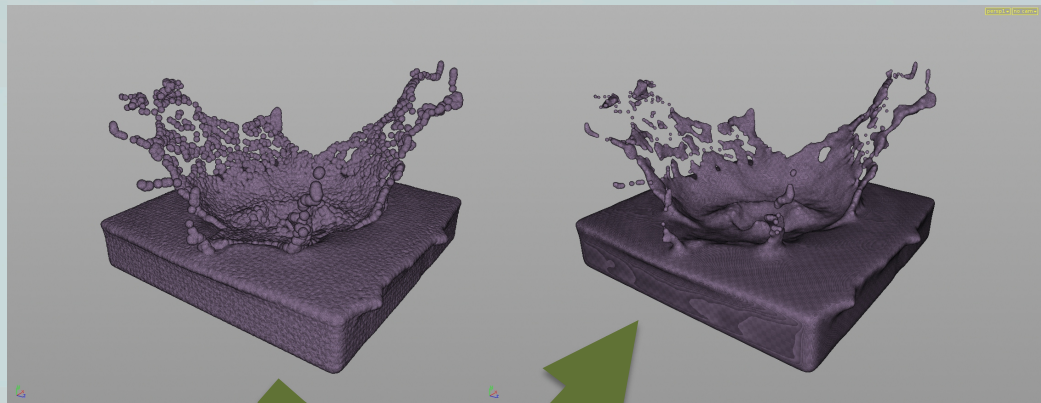
LS Filtering / Morphological Ops



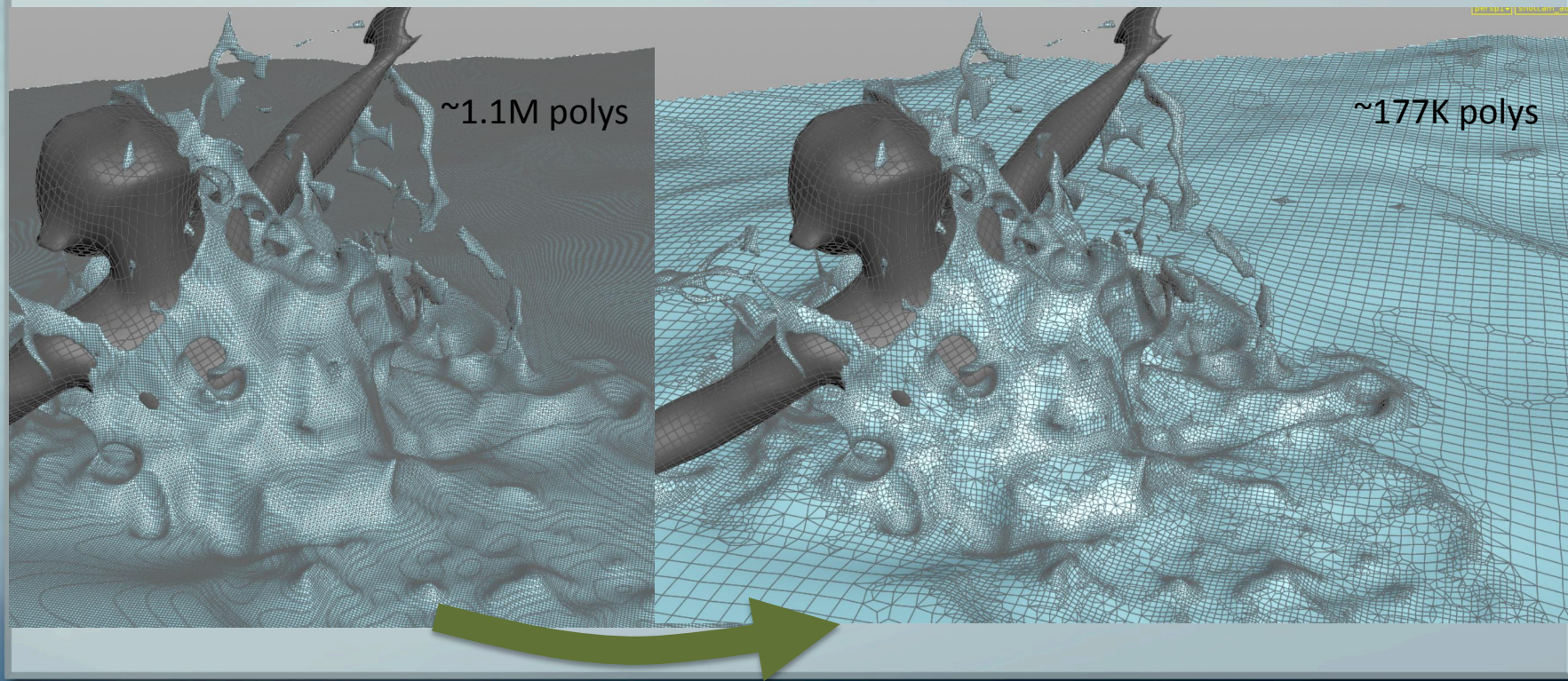
LS Filtering / Morphological Ops



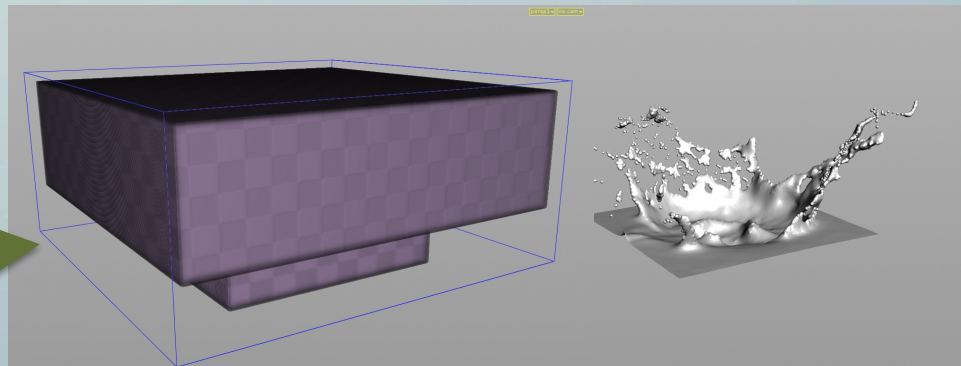
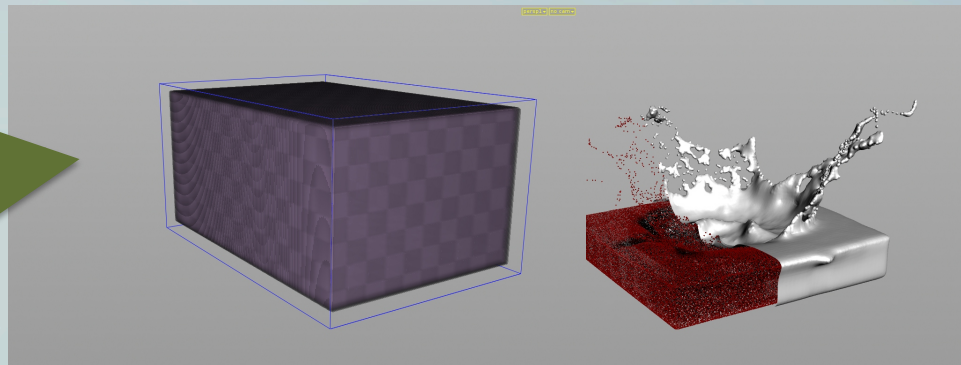
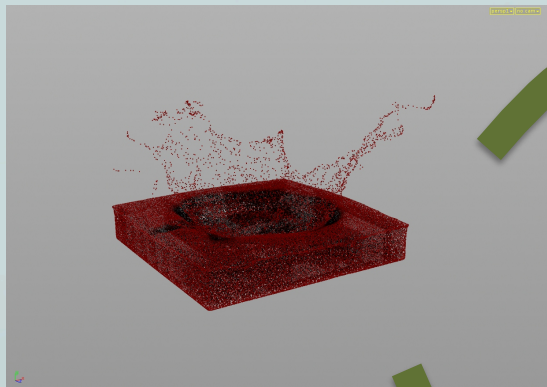
LS Filtering / Morphological Ops



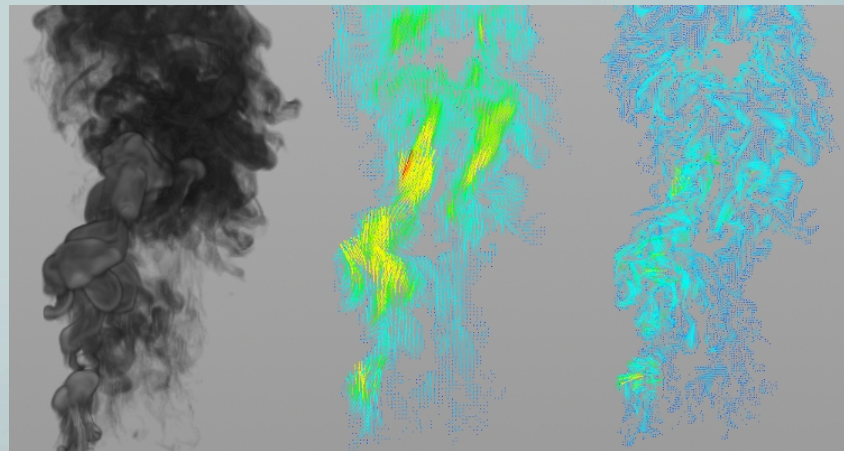
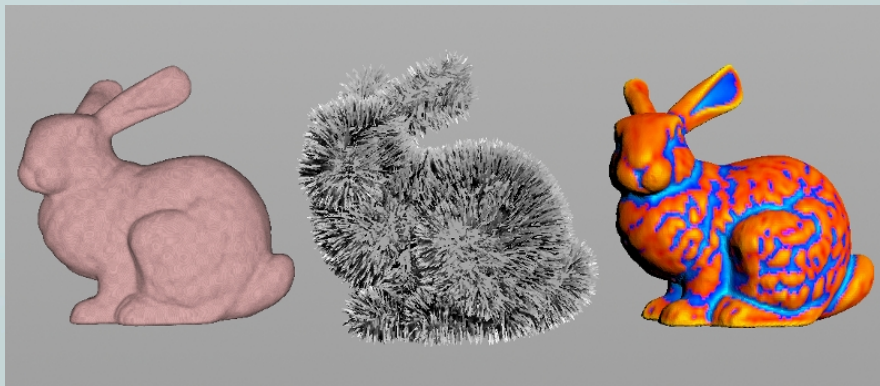
Adaptive meshing



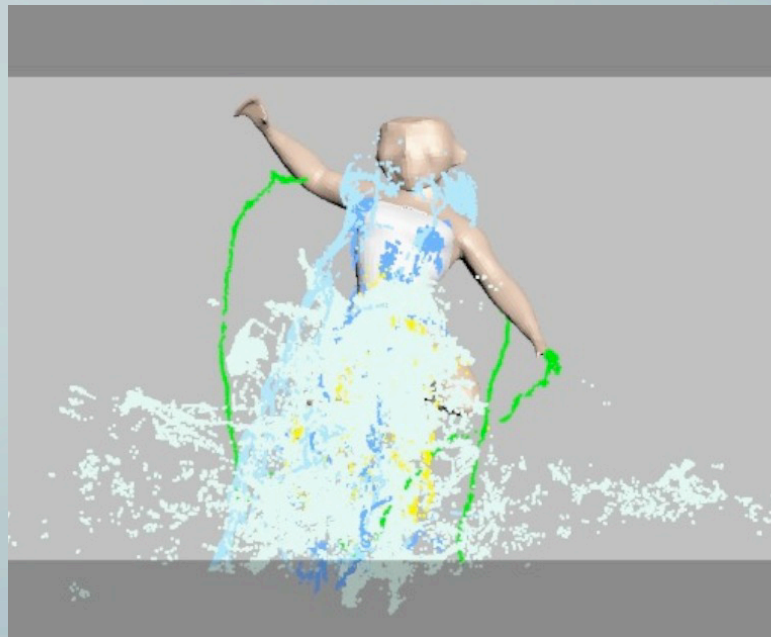
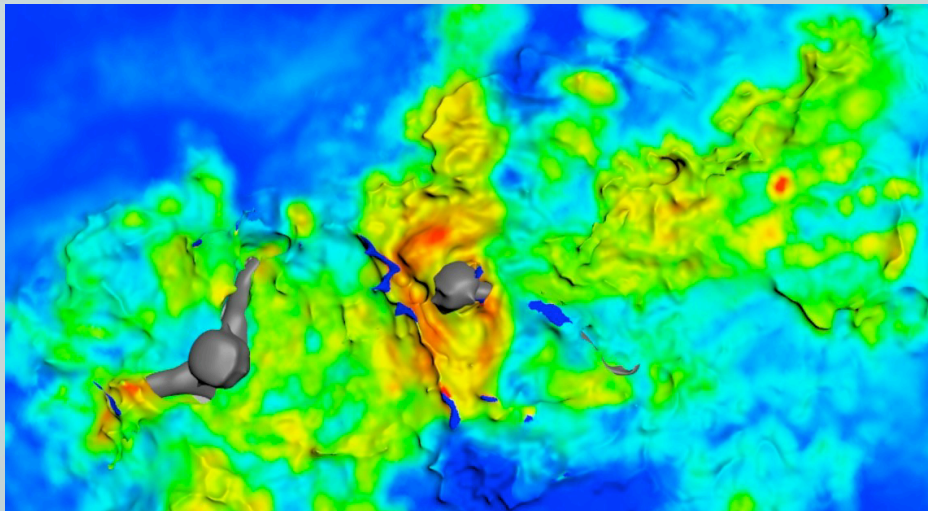
Masked meshing



Grid Analysis



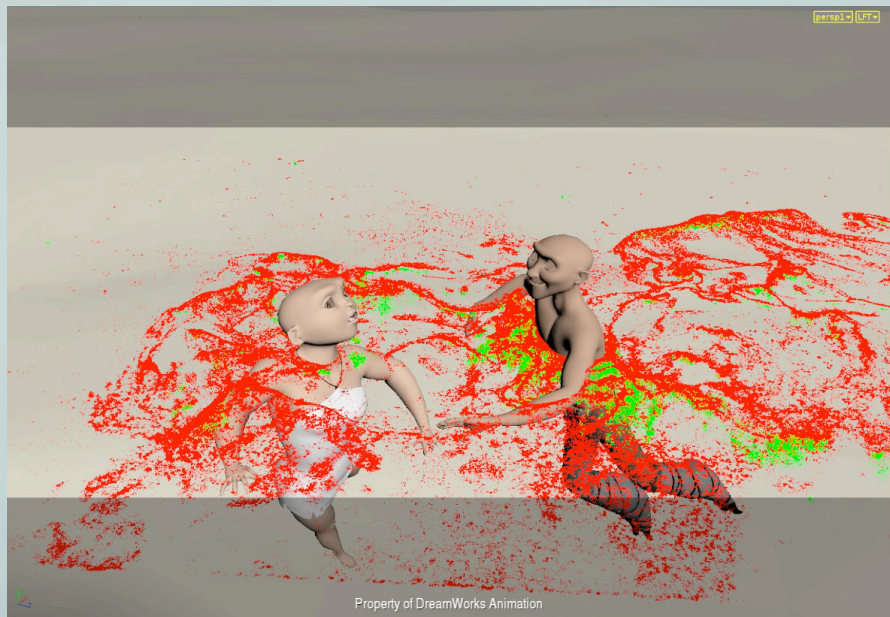
Grid Analysis



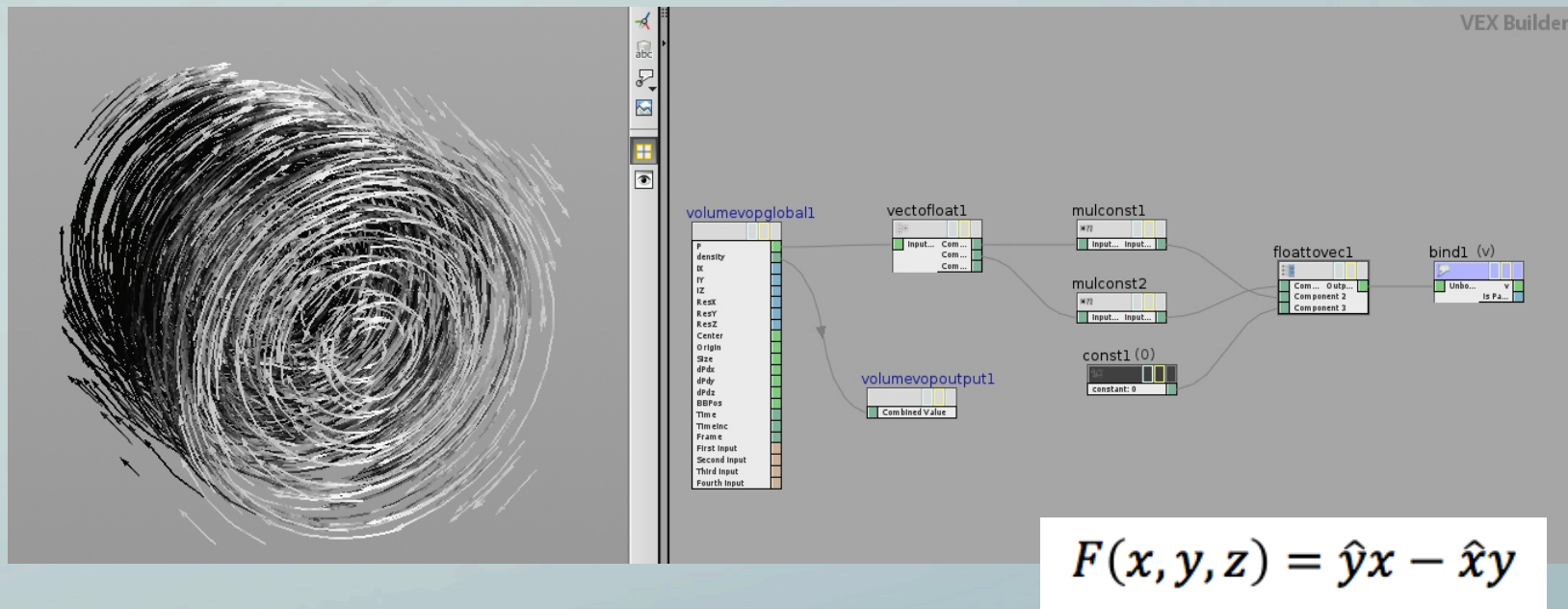
Grid Analysis



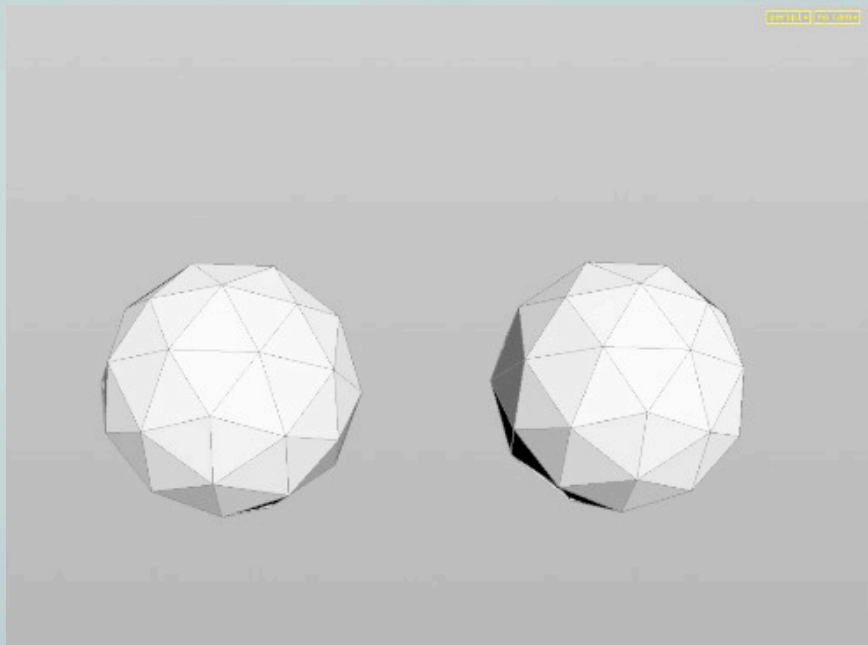
Constrained advection



Vector Fields

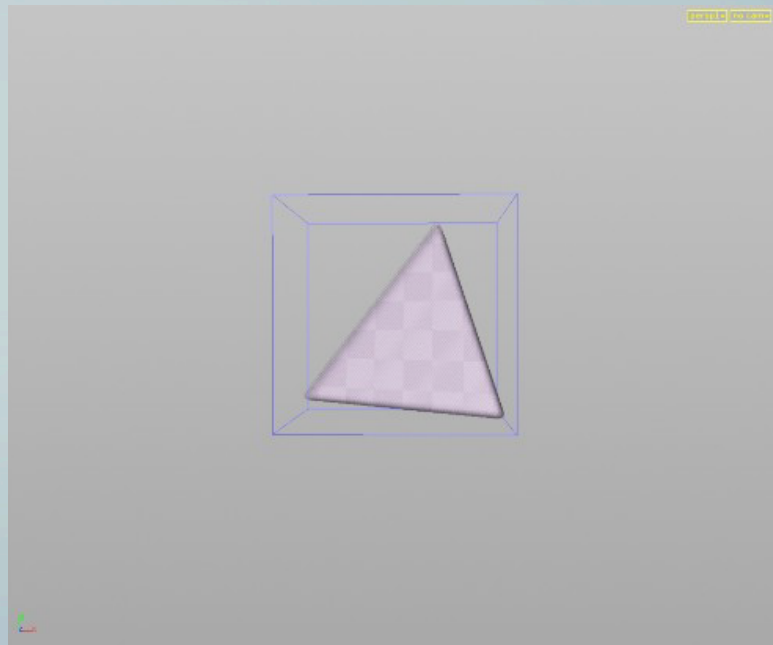


Advection



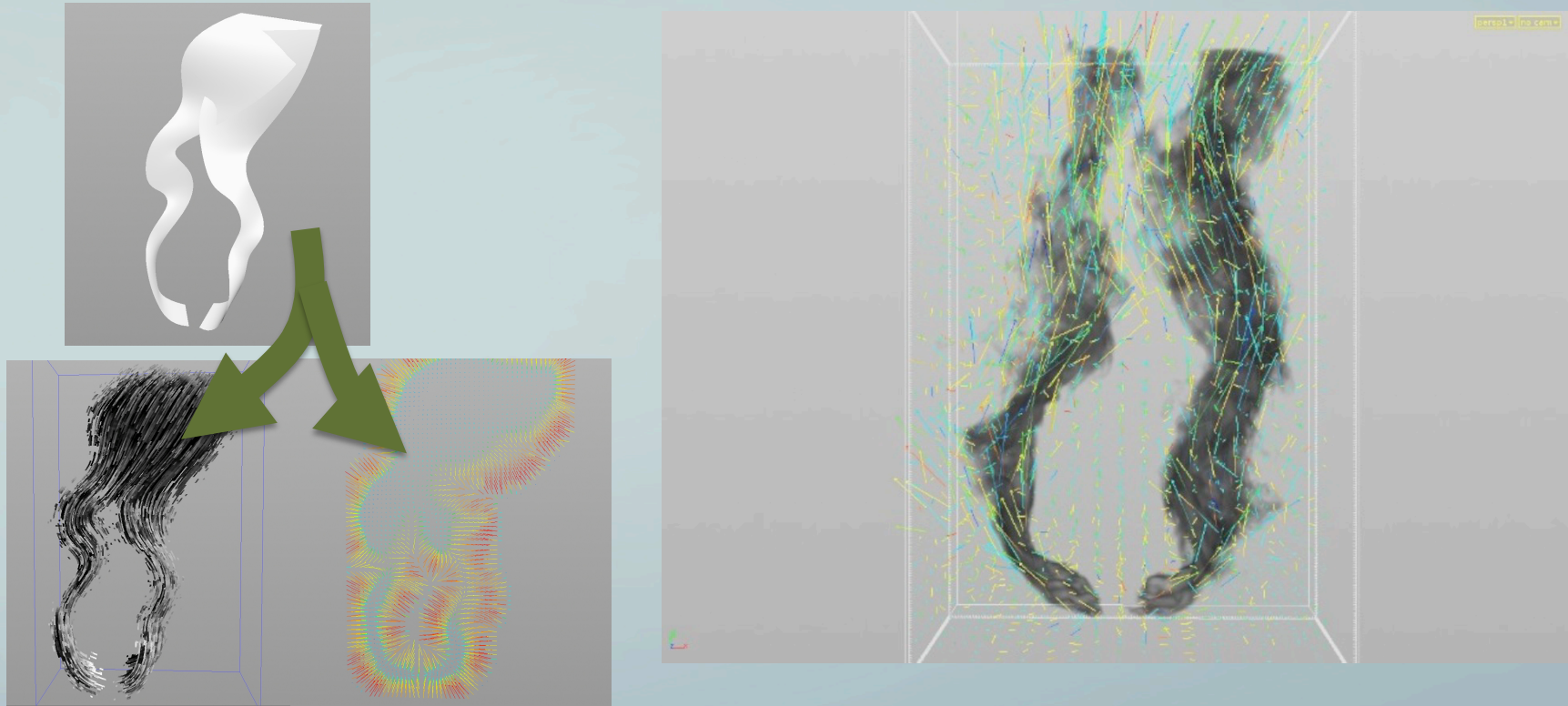
Forward Euler

Runge-Kutta 4th order



Level Set

Flow fields

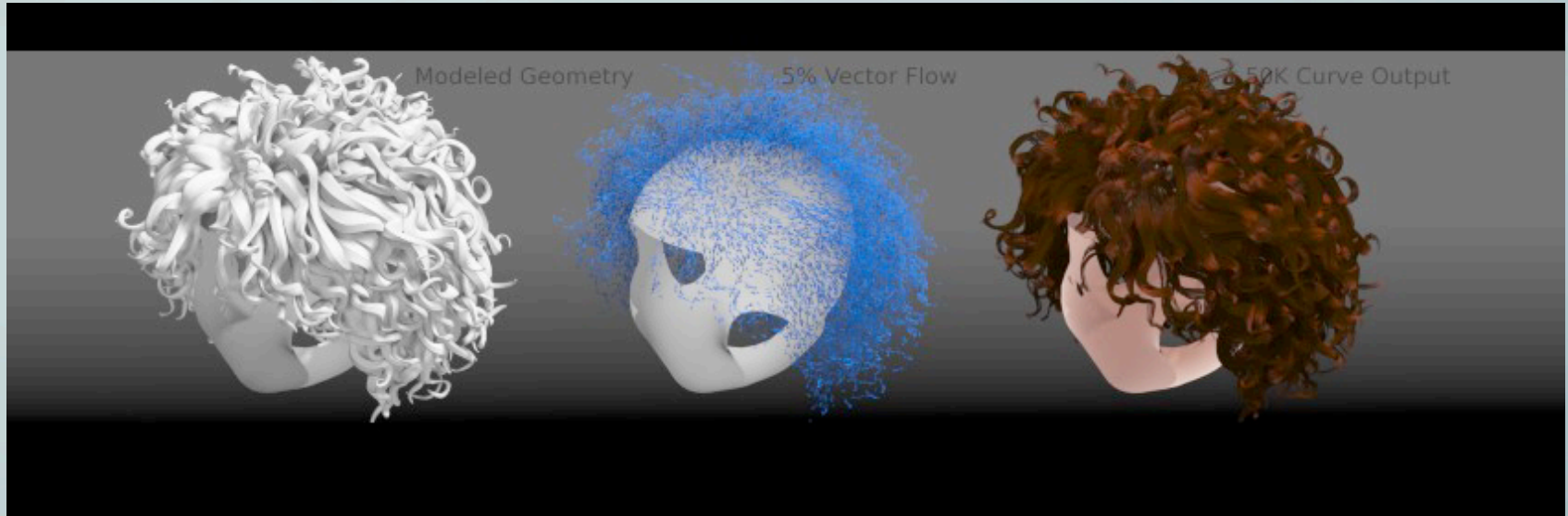


Flow fields



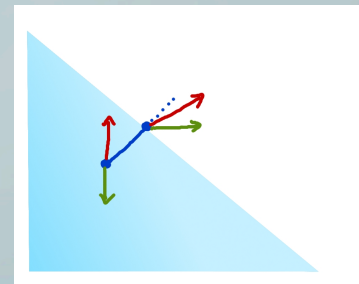
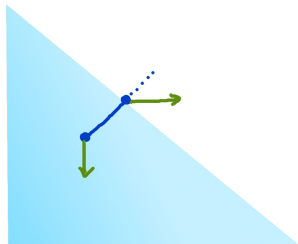
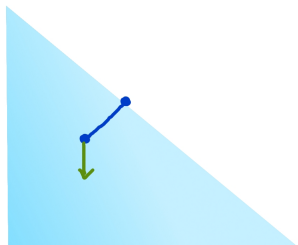
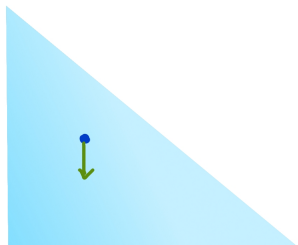
- Lipton, D., Museth, K., and Sutherland, B. Jack's Frost: Controllable Magic Frost Sim. for Rise of The Guardians.

Flow fields

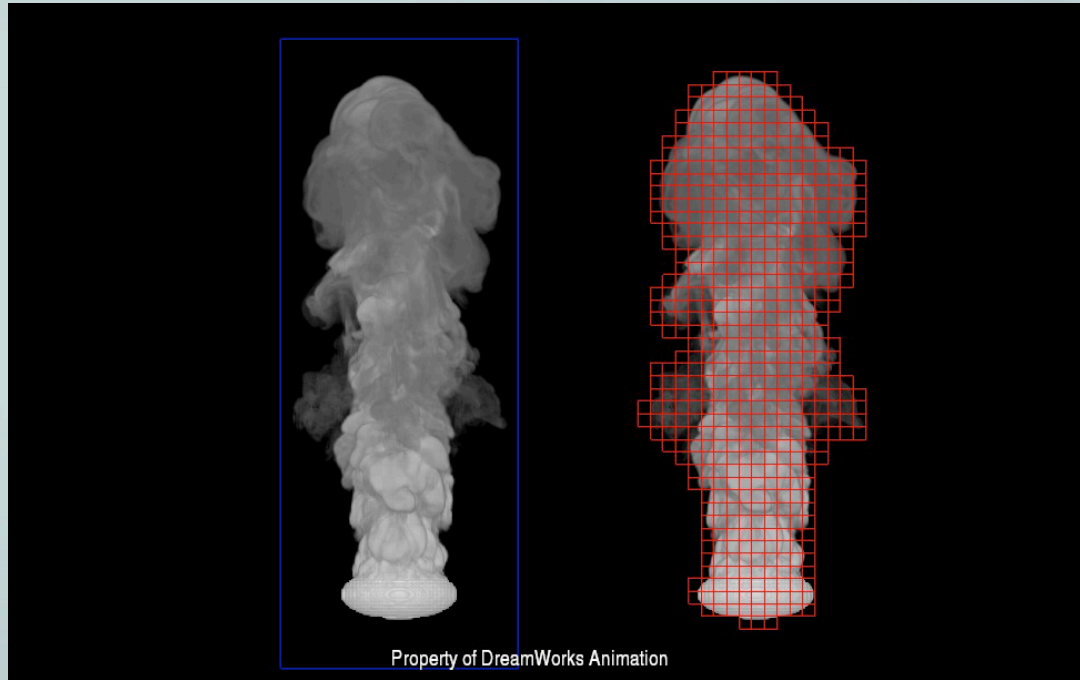


- Ghoniem, A. and Museth, K. Hair growth by means of sparse volumetric modeling and advection.

Collisions



Fluid simulation

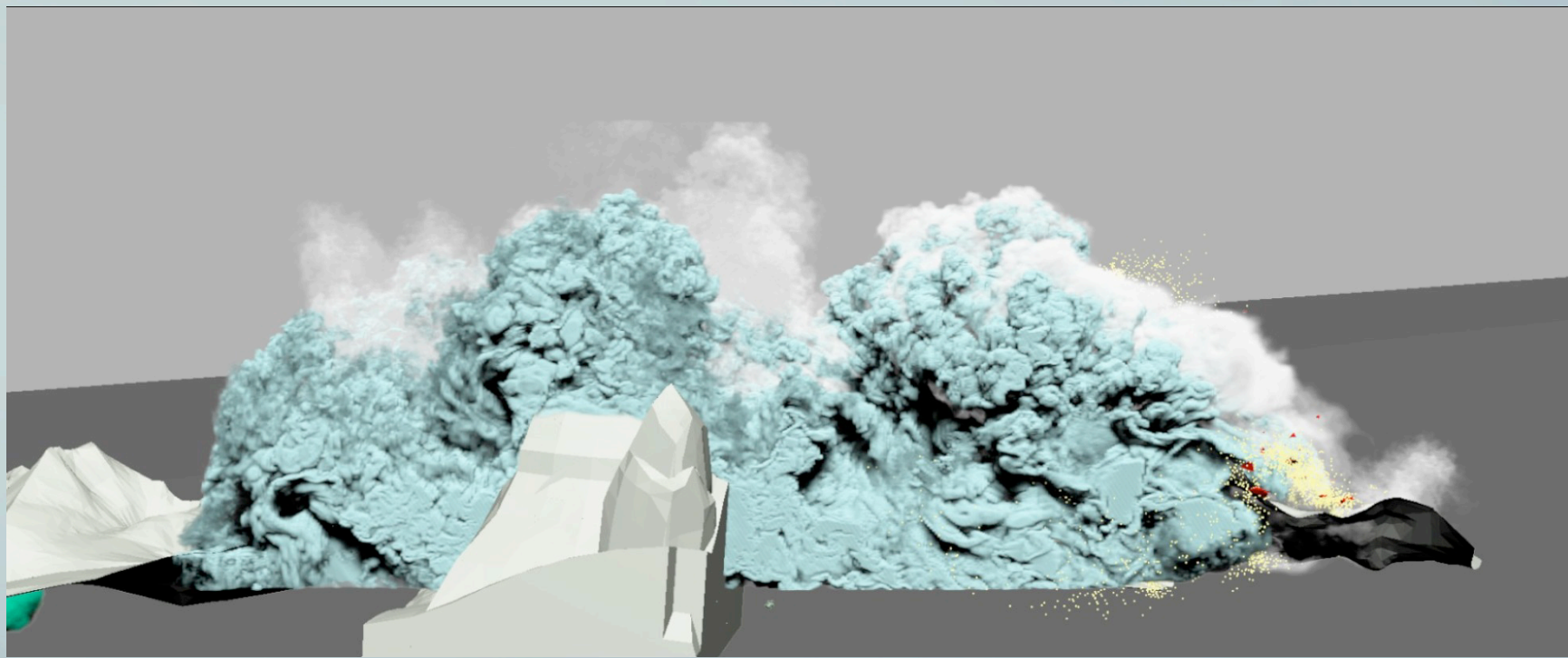


Henderson, R. Scalable fluid simulation in linear time on shared memory multiprocessors. DigiPro, 2012

Fluid simulation



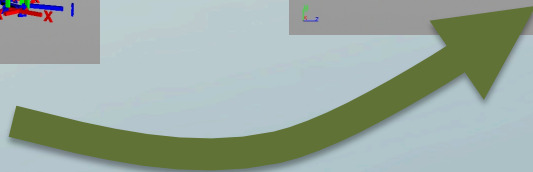
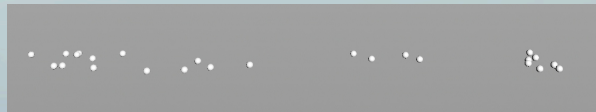
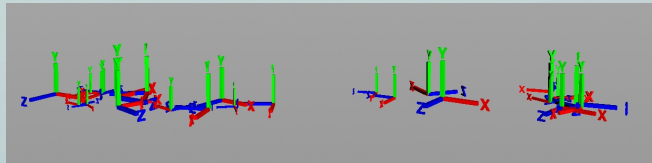
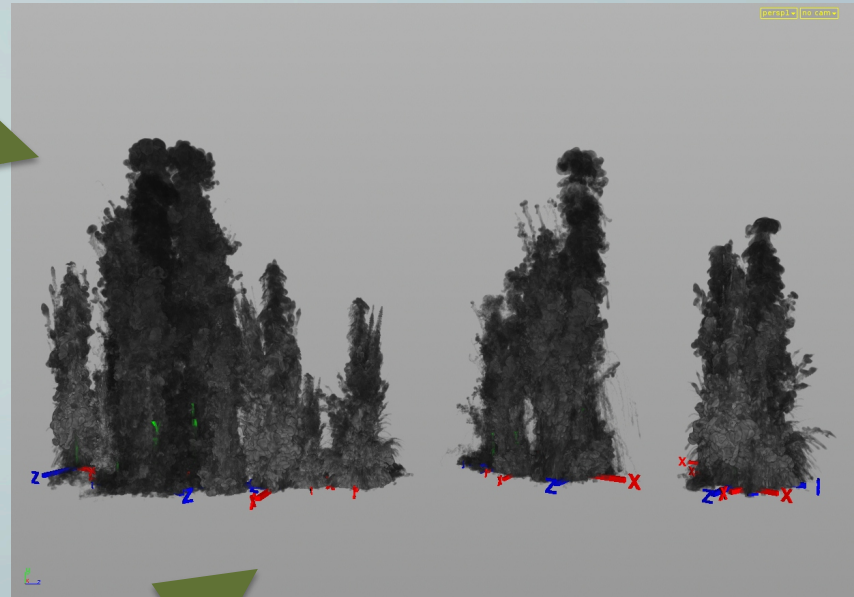
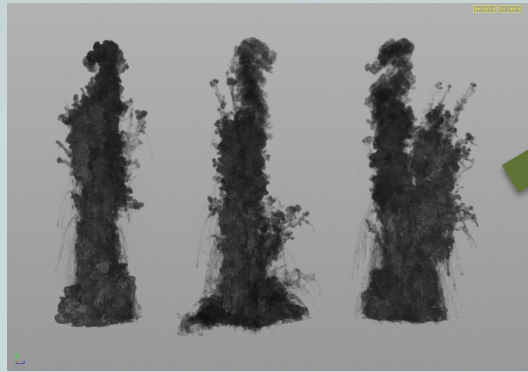
Fluid simulation



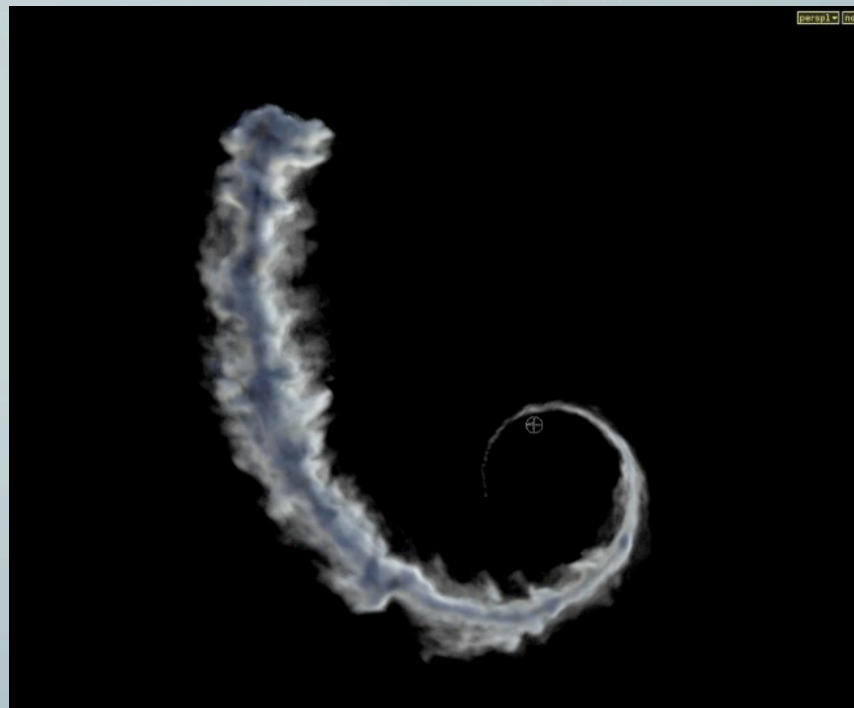
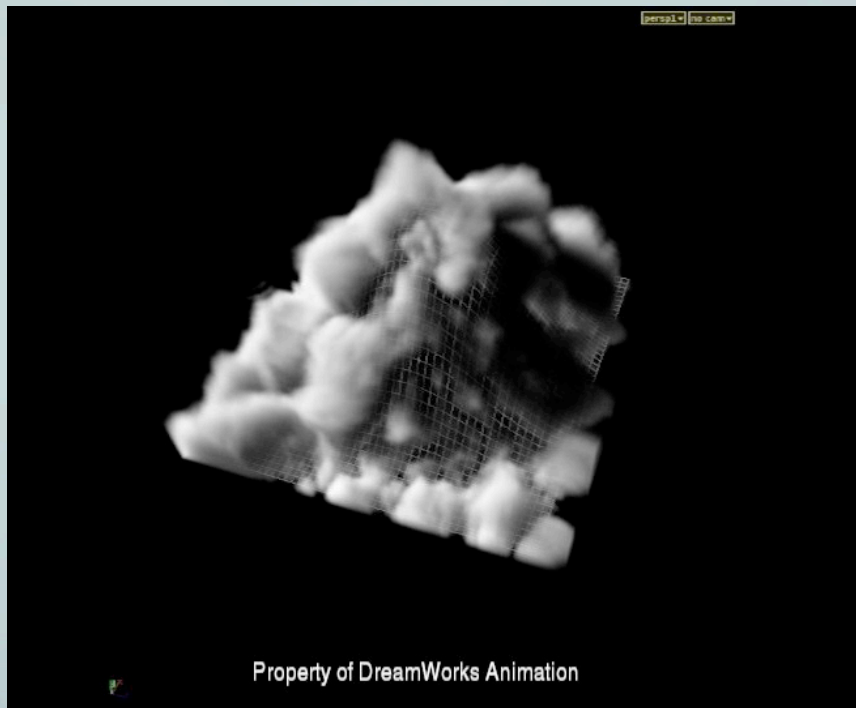
Fluid simulation



Volume stamping



Volume deformation



Volume deformation



Fracture



Property of DreamWorks Animation

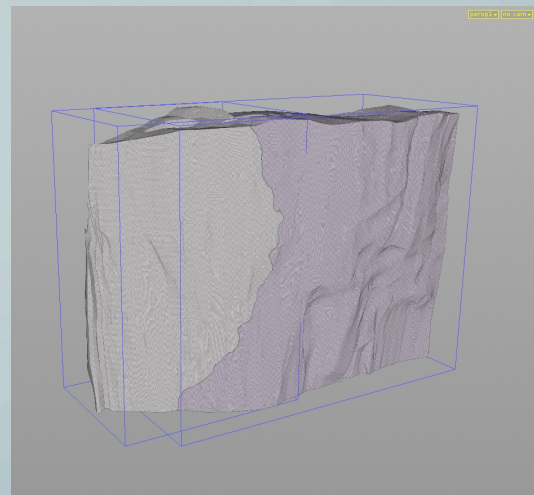
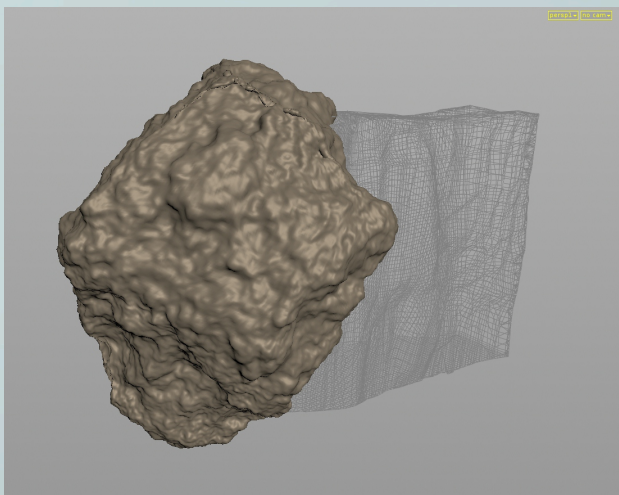
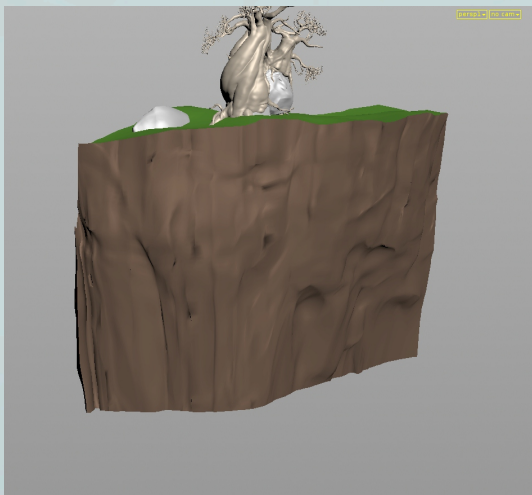
Alden, M., Melich, G. and Museth, K. Efficient and seamless volumetric fracture. ACM Siggraph Talks, 2012

Fracture

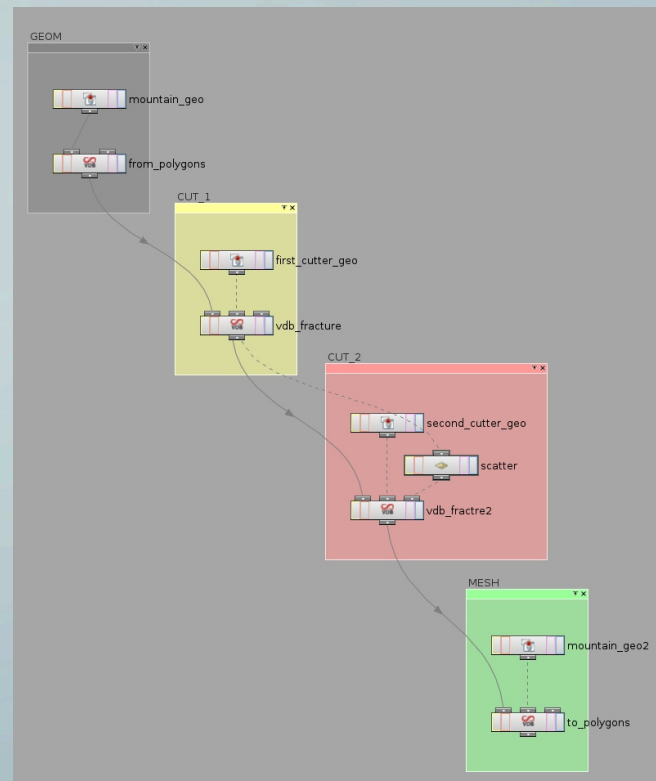
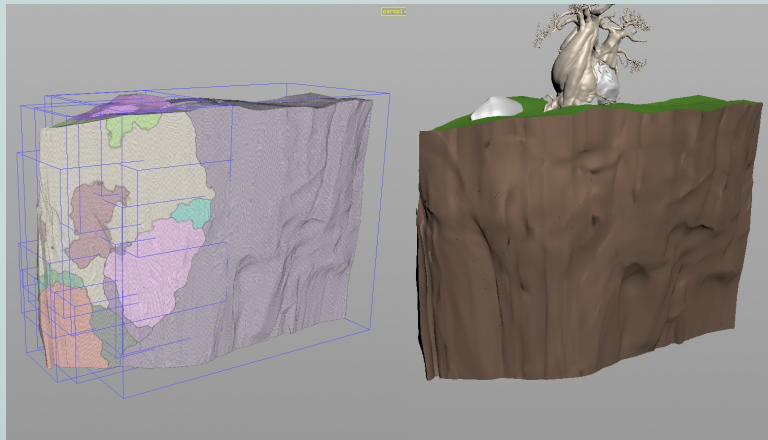
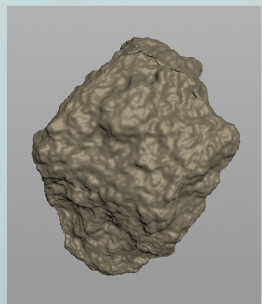
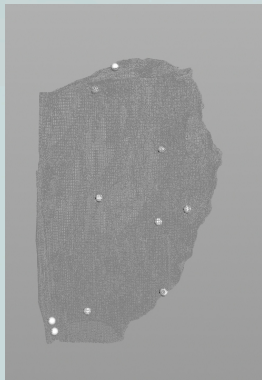


Alden, M., Melich, G. and Museth, K. Efficient and seamless volumetric fracture. ACM Siggraph Talks, 2012

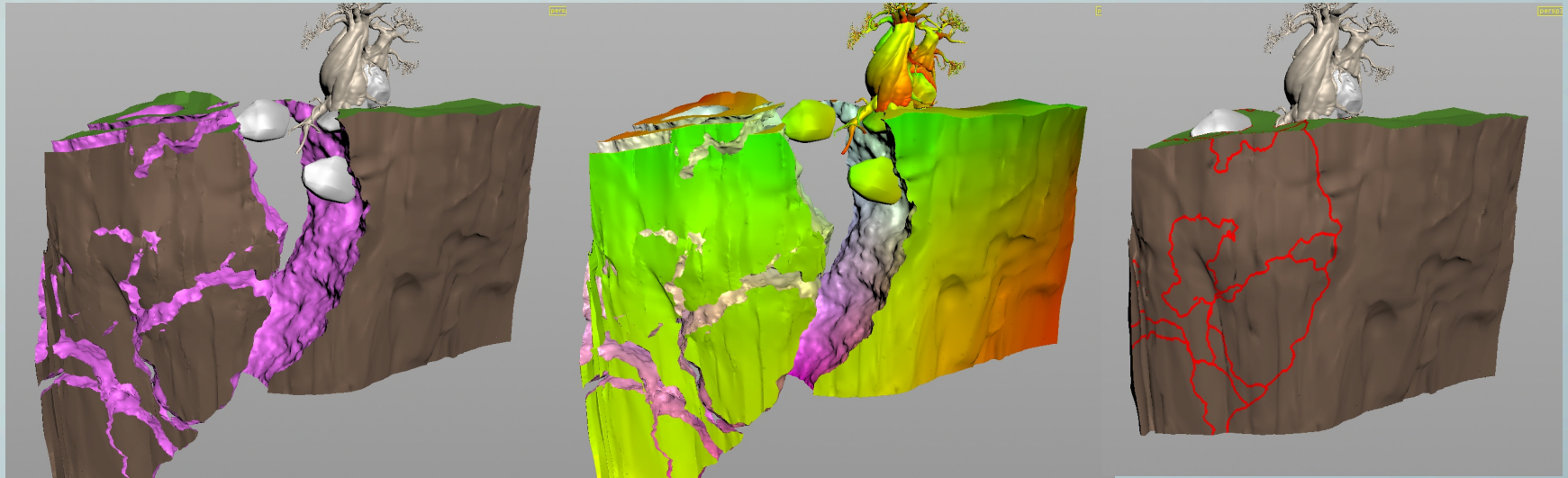
Fracture



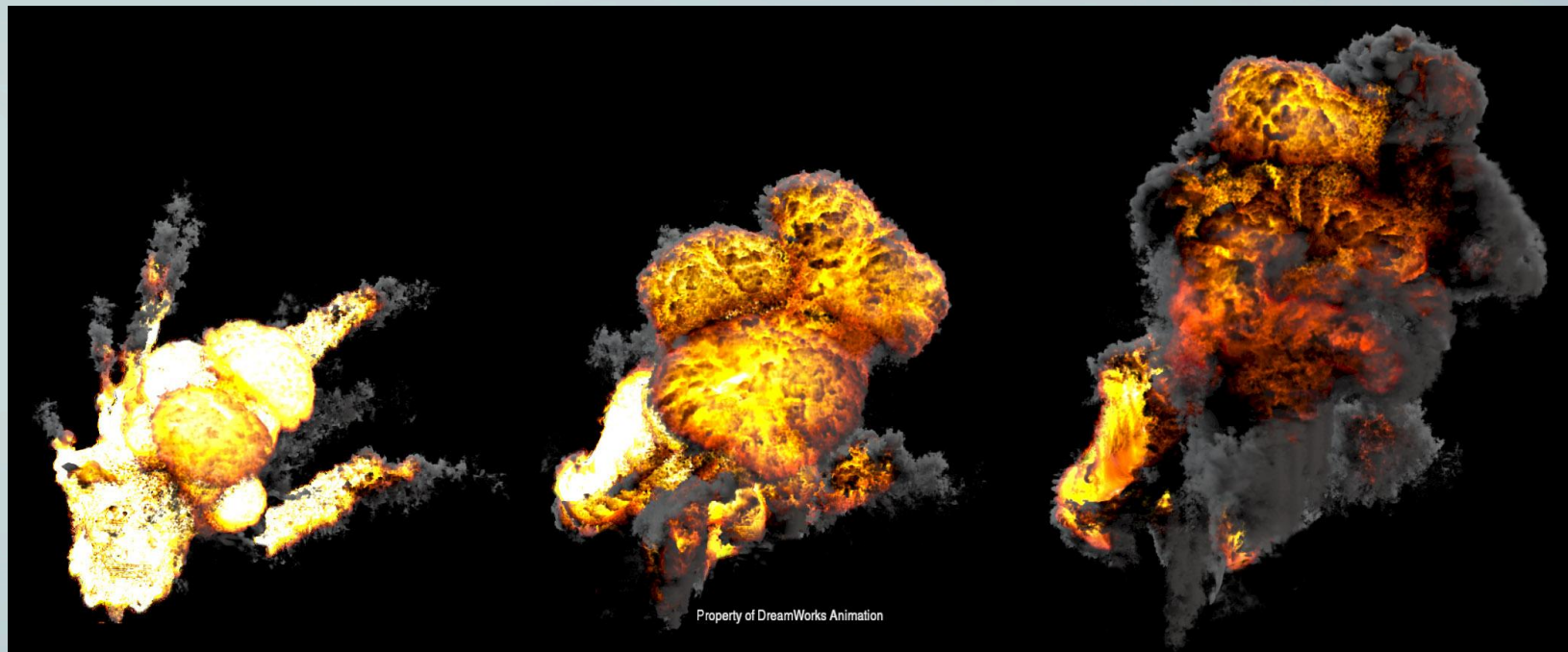
Fracture



Fracture

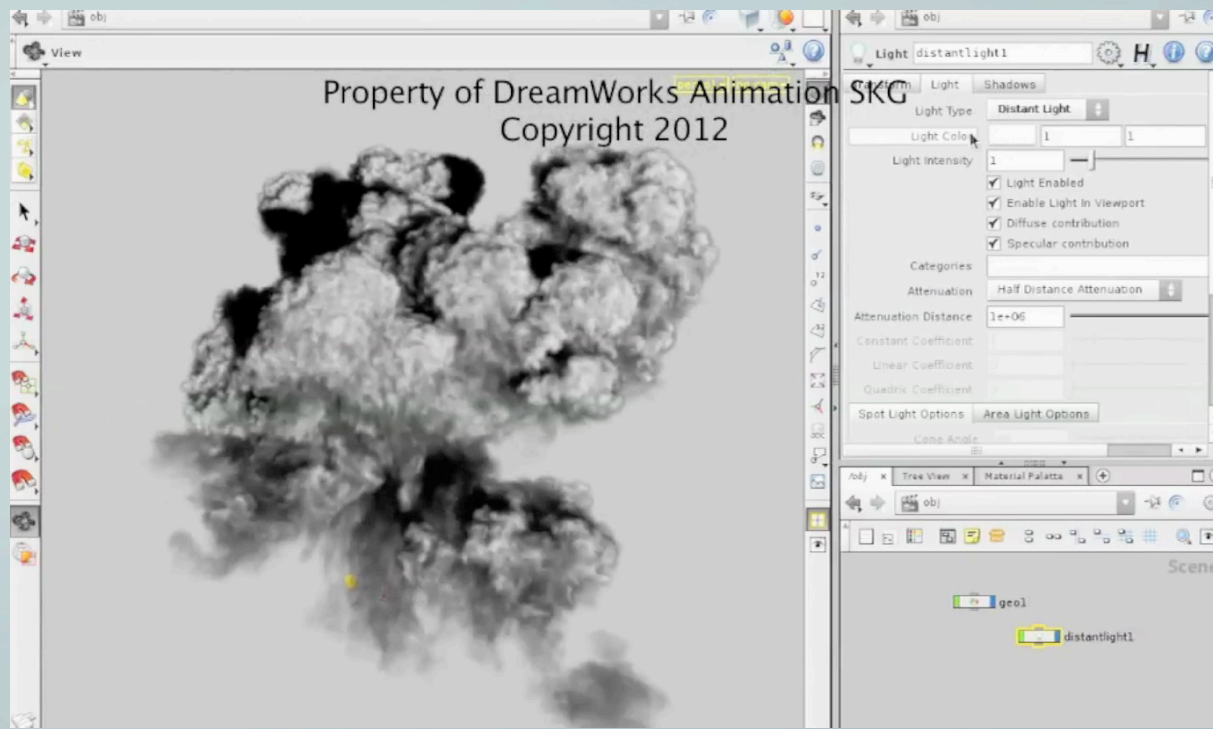


Visualization



Matthews, M. Amorphous: An OpenGL Sparse Volume Renderer. ACM Siggraph Talks, 2012

Visualization



Conclusion

- Modular Houdini toolset in SOPs
- Fast & efficient operations on huge datasets
- Easy to make new tools!
- Tons of applications

Thanks!

FX R+D

Ron Henderson
Mark Matthews
Nafees Bin Zafar
Patrick Kelly
Devon Penney
Michael Losure
Brett Miller
Matt Titus
Can Yuksel
Jason Mayer
Matt Baer

Questions?

Forget to ask something?

www.openvdb.org/forum