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Title: Summer of Storyboards

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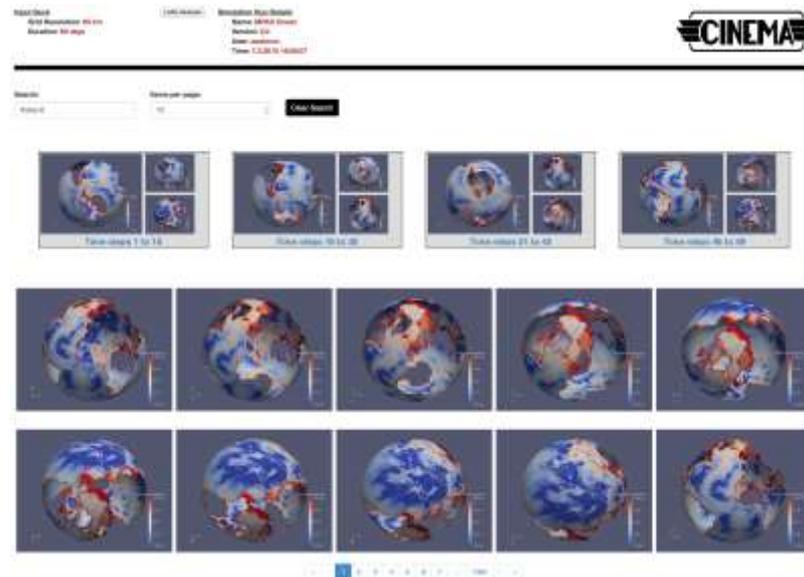
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# Summer Of Storyboards

Uzma Shaikh, Purdue University

# Cinema Web Interface

- Global View – Generalized or Holistic View of the System
- Web Interface – Specified View of the System



# Summer of Storyboards

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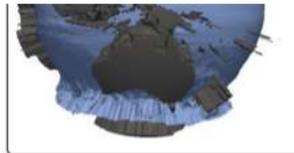
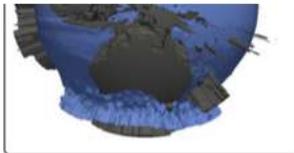
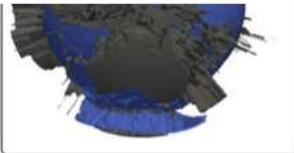
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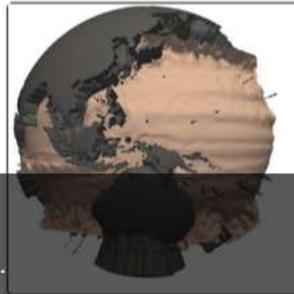
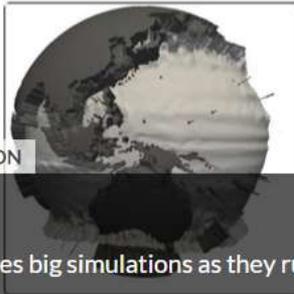
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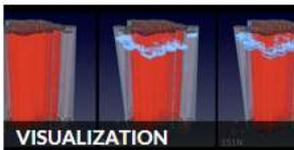
## Picture show

The Cinema project visualizes big simulations as they run.



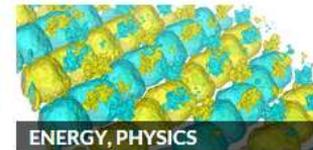
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VISUALIZATION

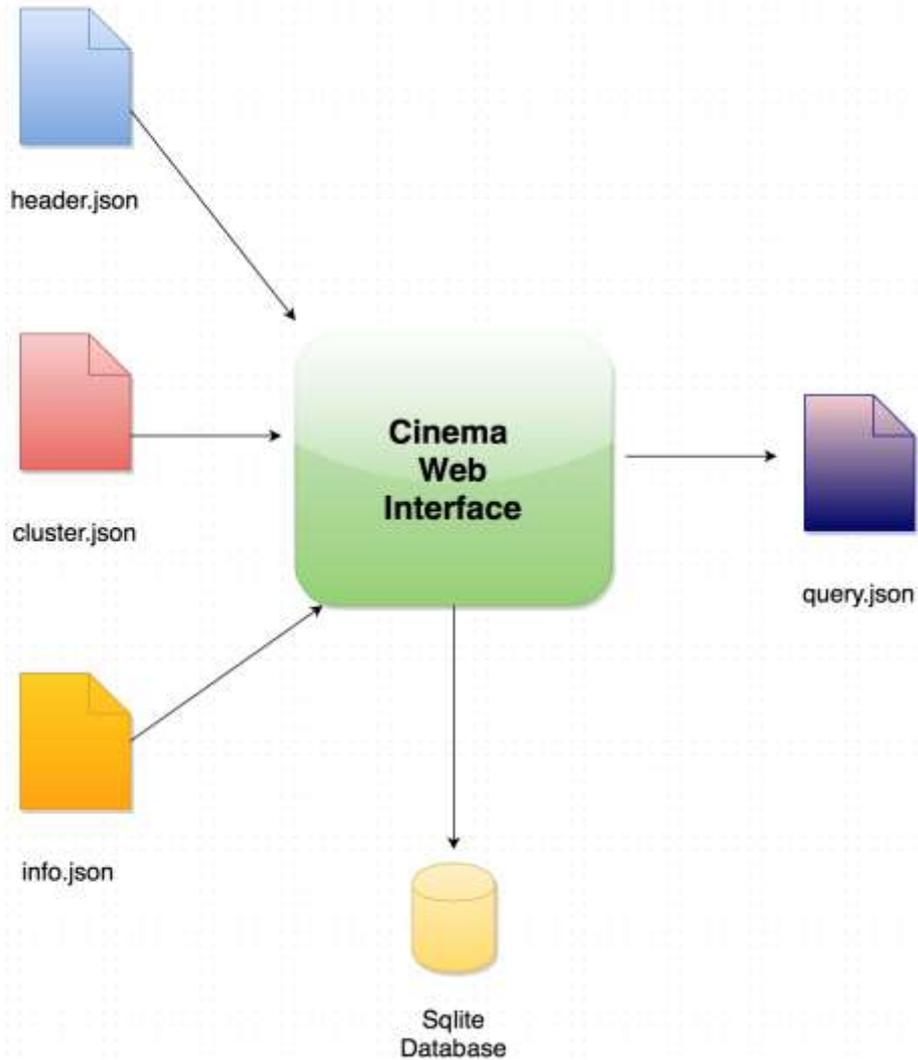
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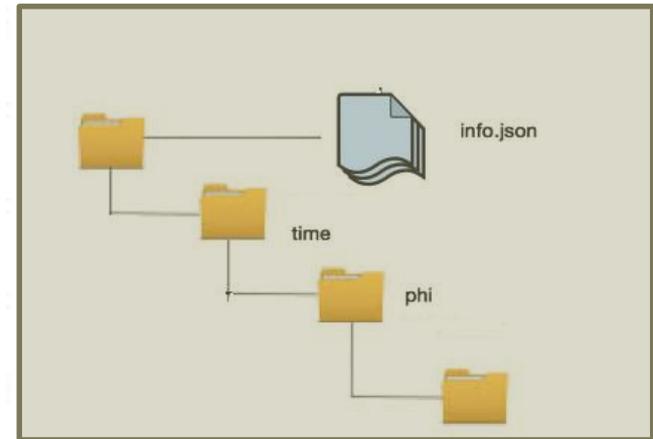
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# Interfaces

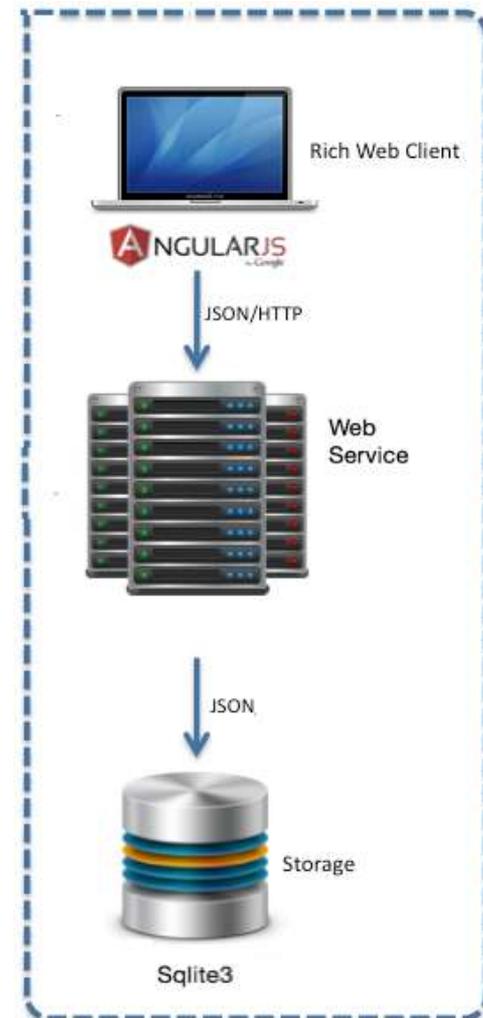


Cinema – info.json Structure



# Components of the system

- Front-end: AngularJS
  - open-source web application framework
  - Extends the HTML vocabulary
- Backend: Restful Web Service
- SQLite database
  - Store the metadata
  - Store the cluster information
  - Store the simulation run information
  - Store search results



# Google Image Search Results

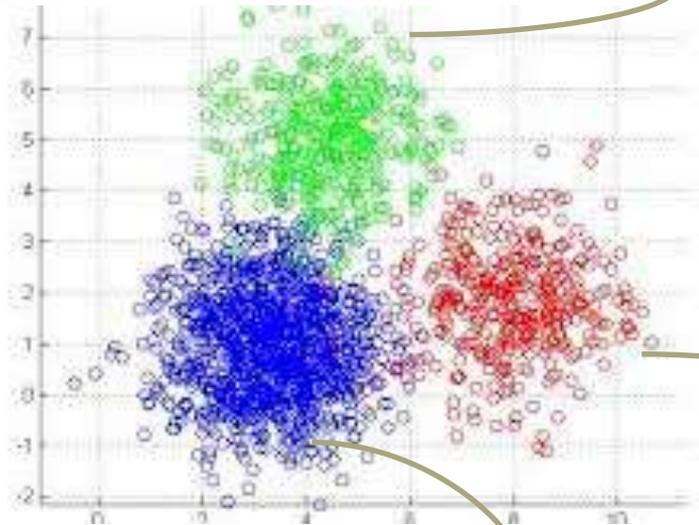
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# K-means clustering algorithm



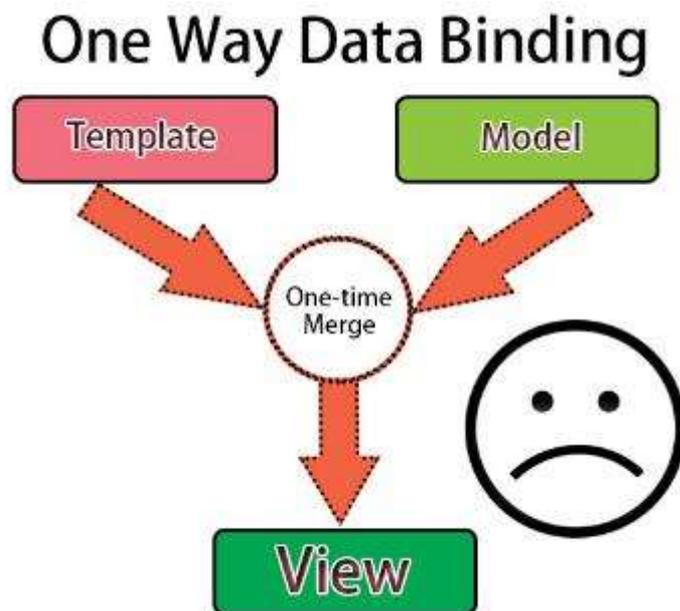
Medium  
Temperature  
Cluster

High  
Temperature  
Cluster

Low  
Temperature  
Cluster

# Problem with one way binding

- Generally, in most systems, data binding occurs only in one direction.
- After a one-time merge, changes made in the model in order to constantly sync the model with the view and the view with the model.
- Developers need to manually manipulate the elements and attributes of DOM.

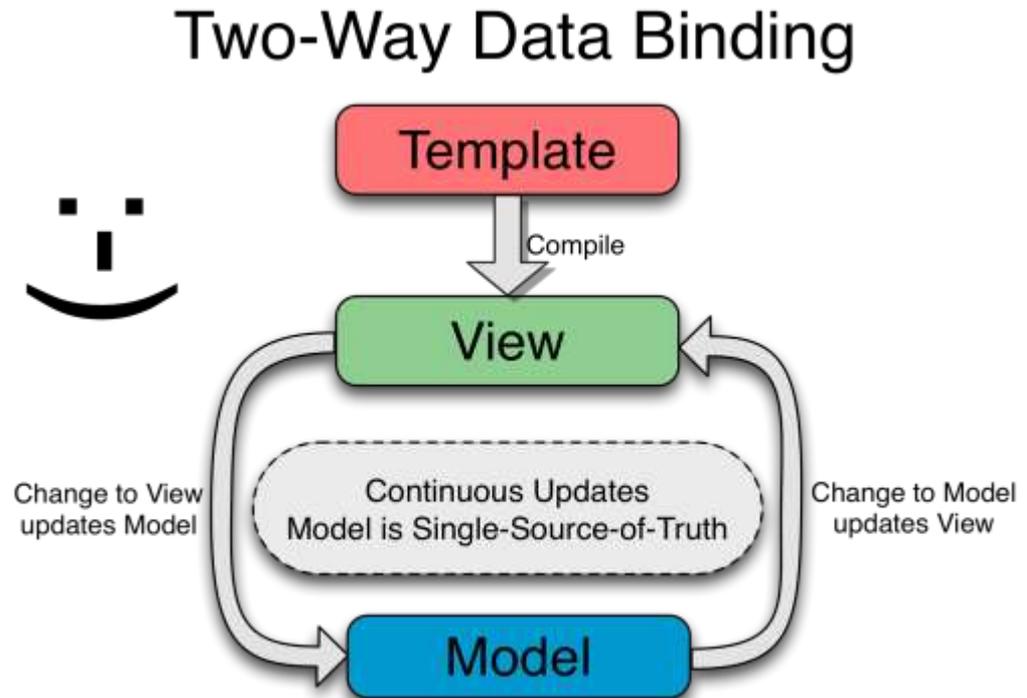


# AngularJS – Two way data binding

Two-way binding means:

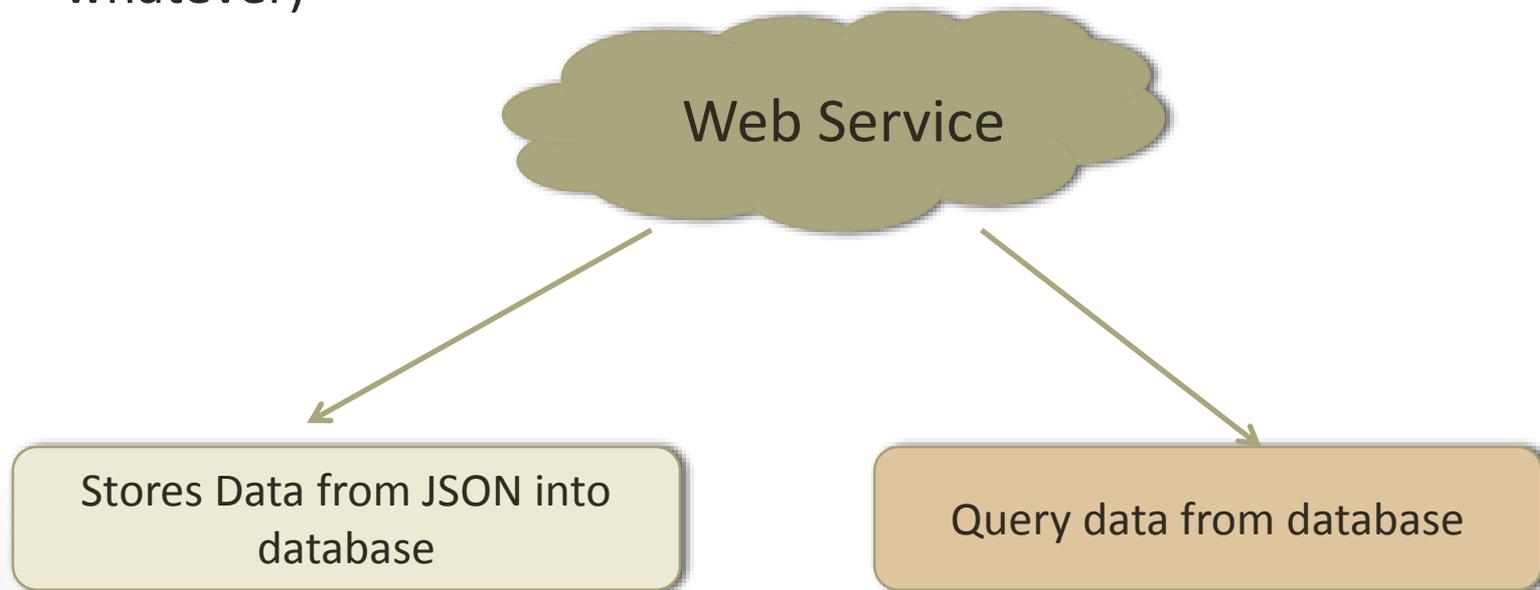
- Any data-related changes affecting the model are *immediately propagated* to the matching view(s)
- Any changes made in the view(s) (say, by the user) are *immediately reflected* in the underlying model.

When app data changes, so does the UI, and conversely.



# Restful Web Service

- Lightweight, scalable and relies upon the HTTP standard to do it's work.
- It is format-agnostic(meaning you can use XML, JSON, HTML, whatever)



Input Deck

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Name: MPAS Sim  
Version: 4.5  
User: seatmon

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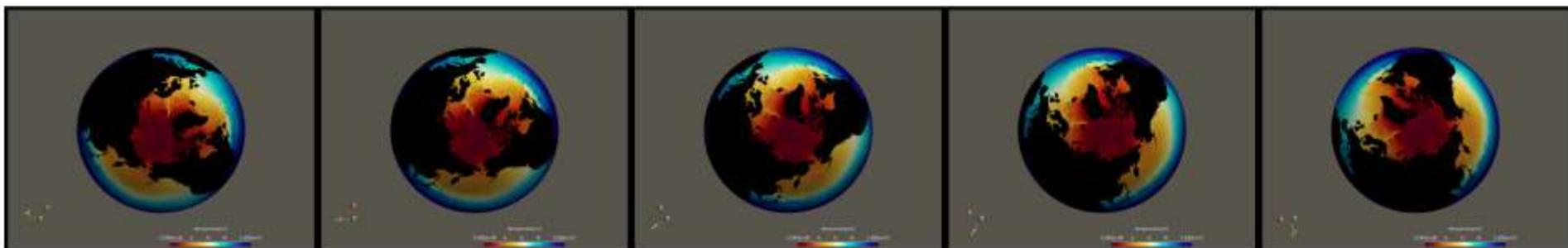
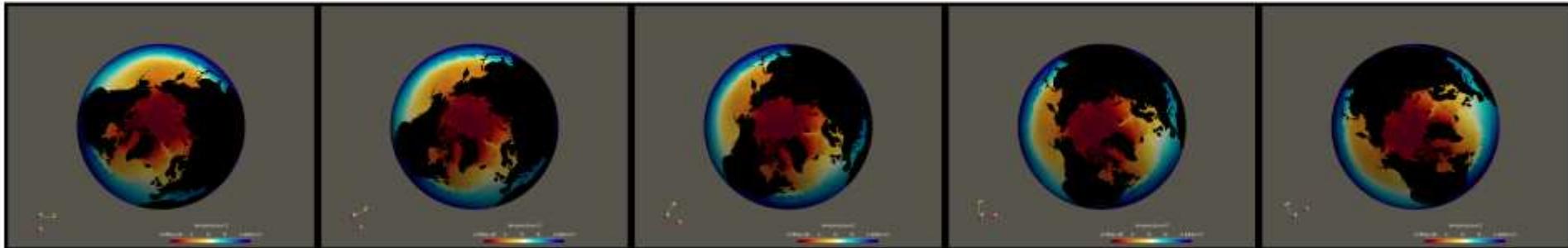
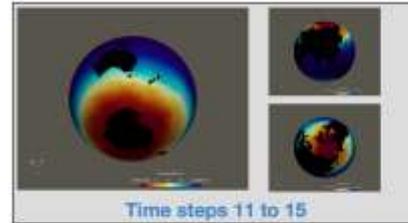
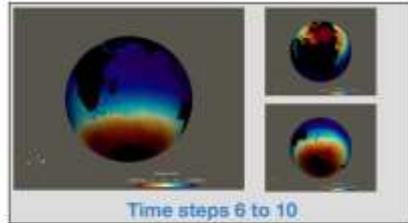
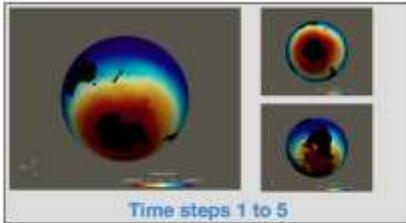
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Clear Search

Interactive Viewer





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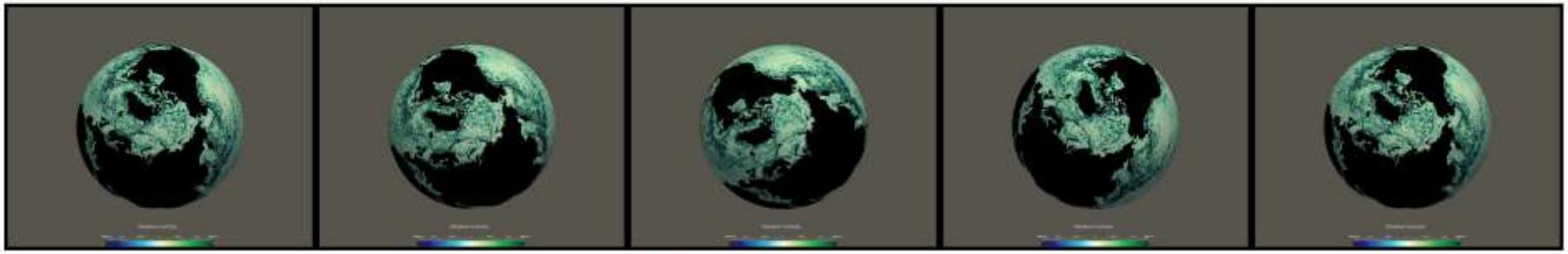
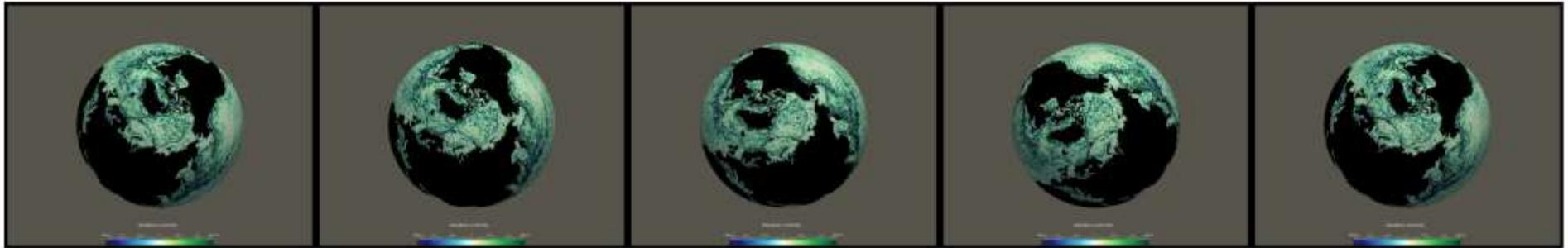
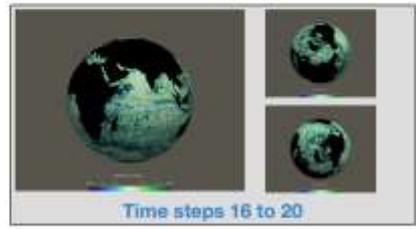
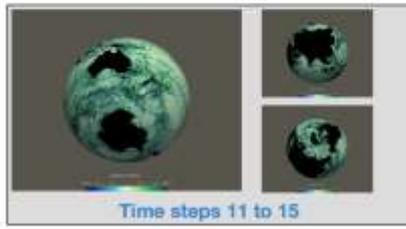
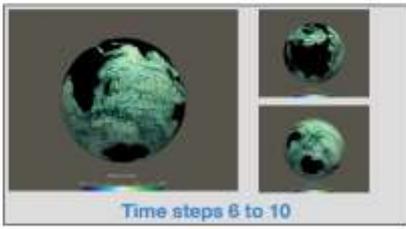
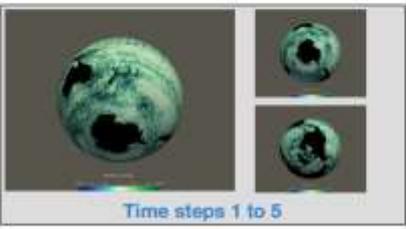
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Search:

Items per page:

Clear Search

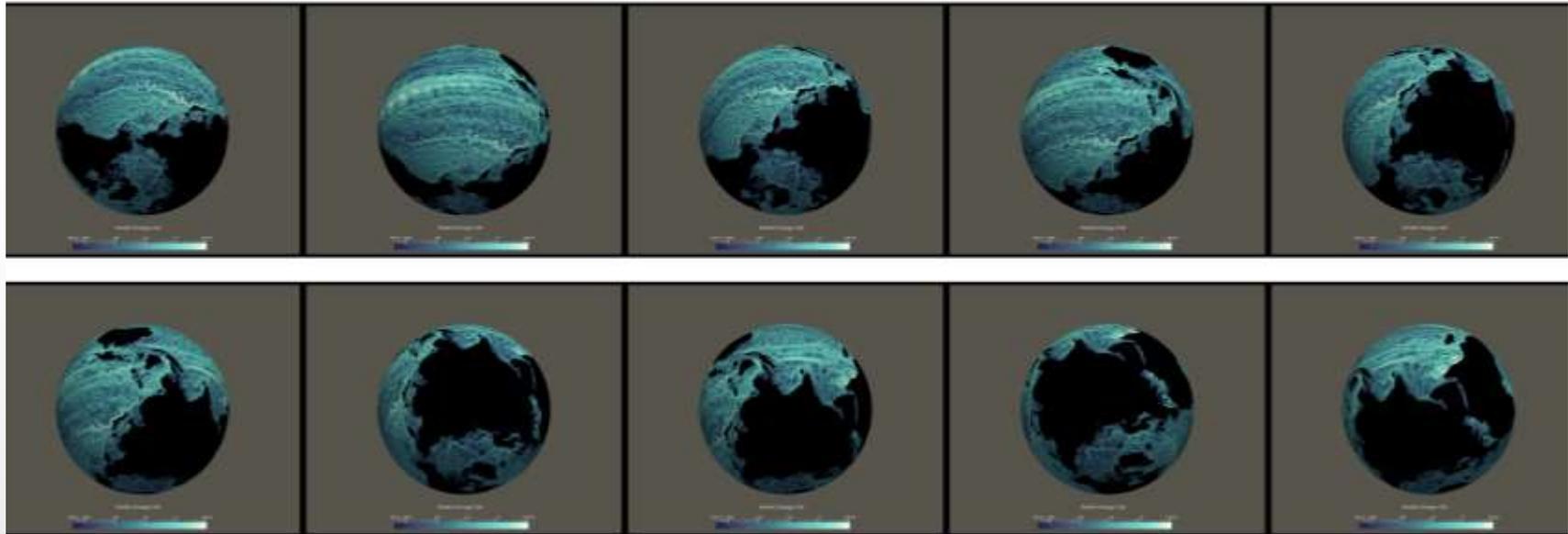
Interactive Viewer



# Cinema Database - Kinetic Energy



dt:  Items per page:



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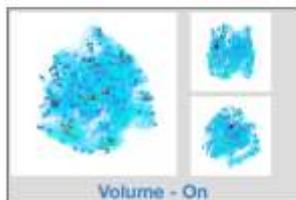
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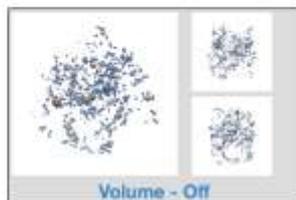
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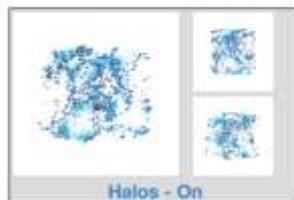
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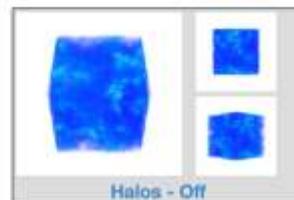
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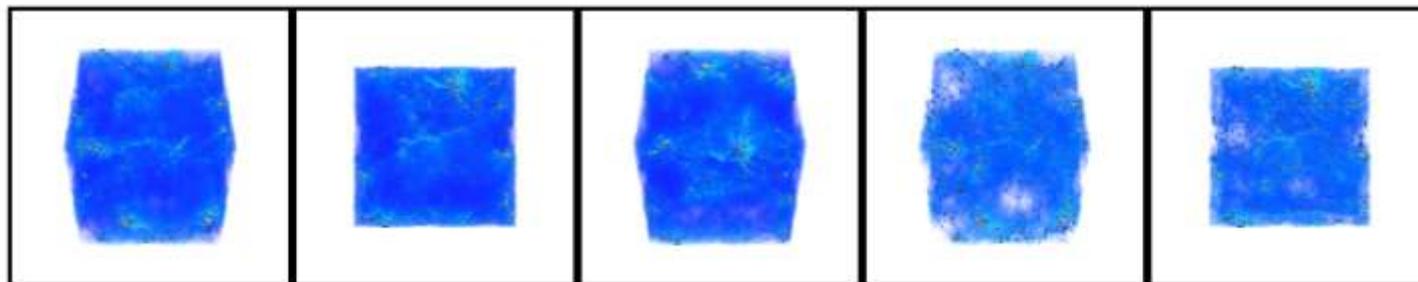
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Halos - On



Halos - Off



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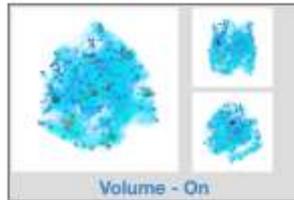
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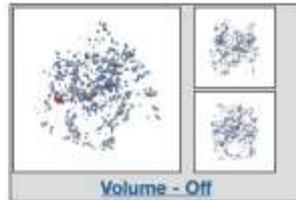
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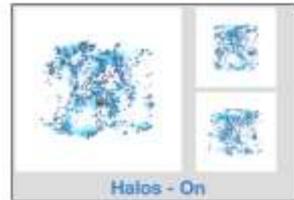
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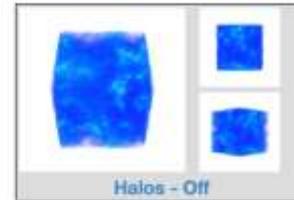
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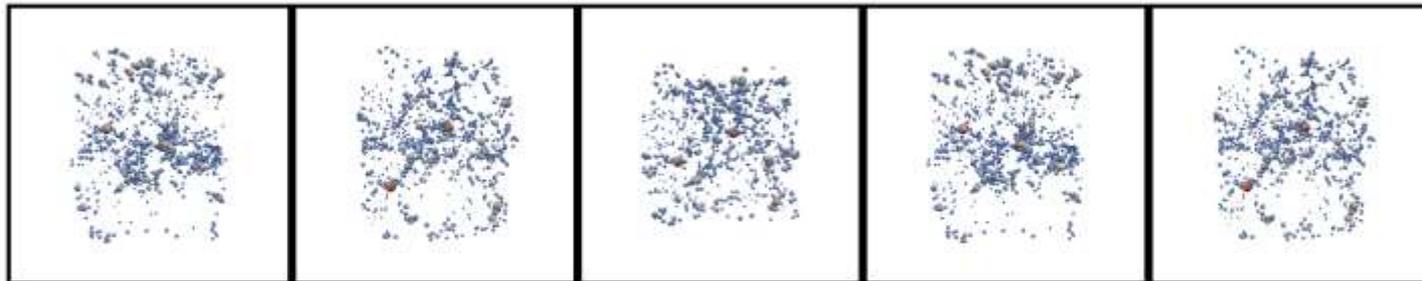
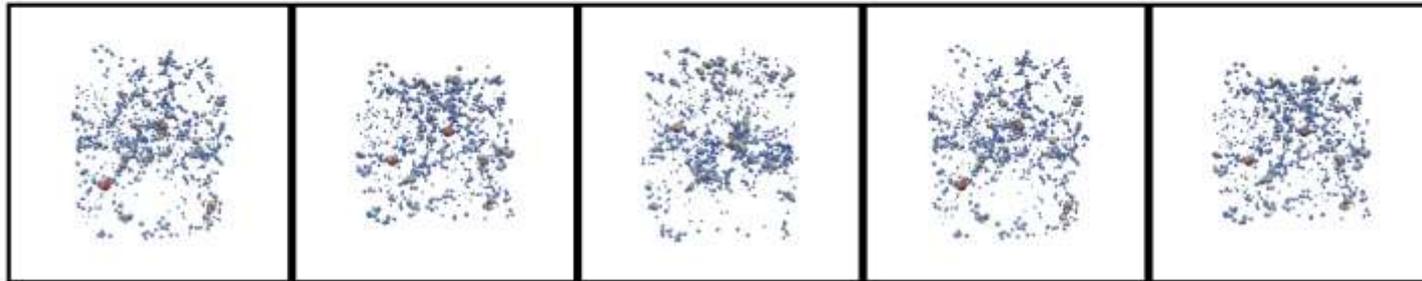
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Halos - On



Halos - Off



Input Deck

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Version: 2.5  
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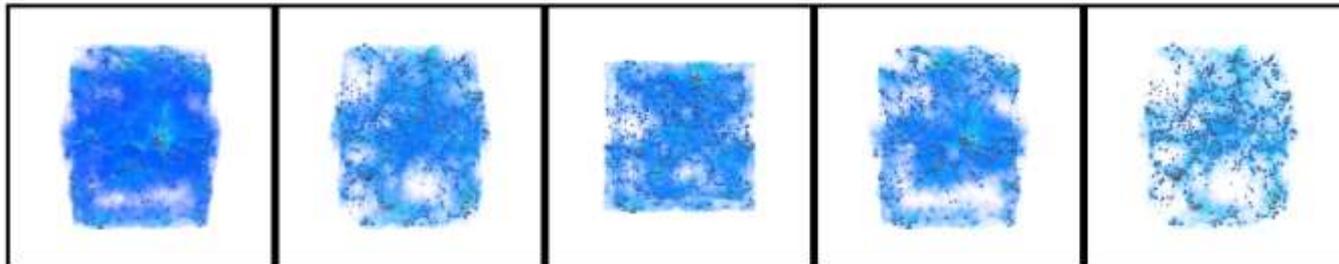
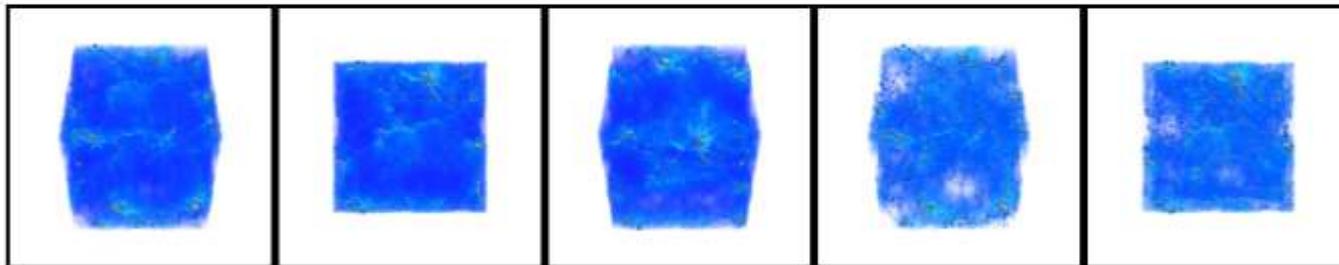
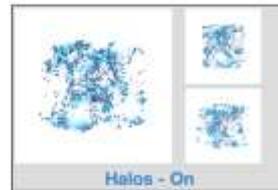
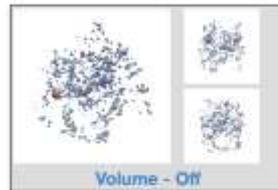
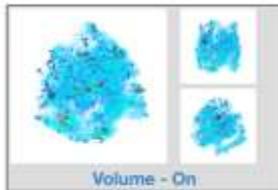
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Clear Search

Interactive Viewer



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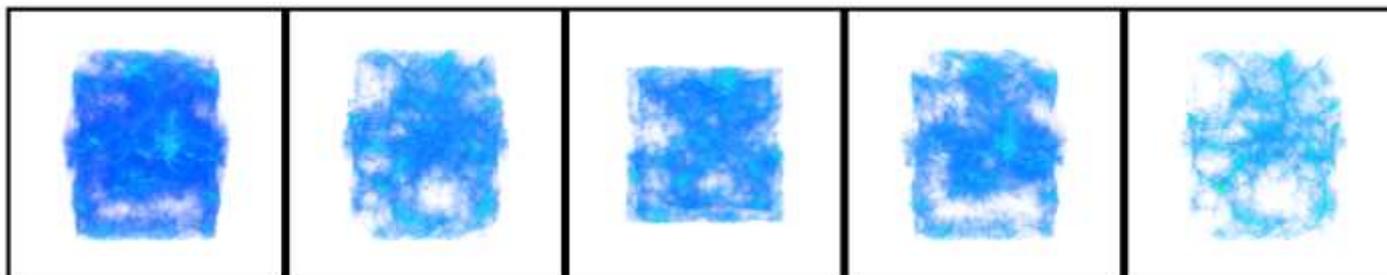
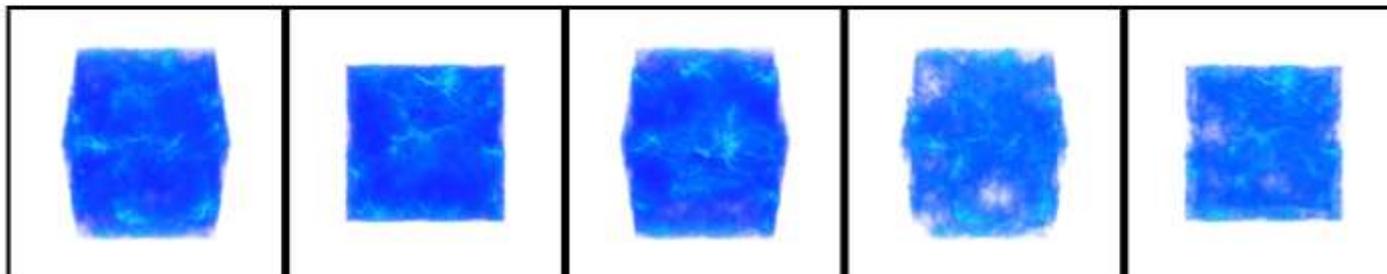
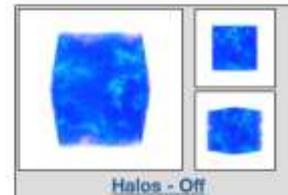
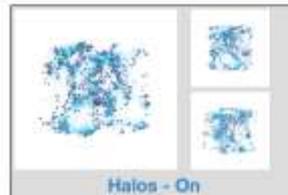
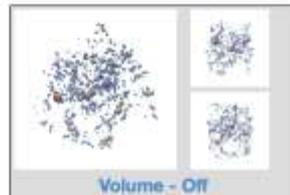
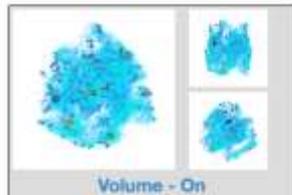
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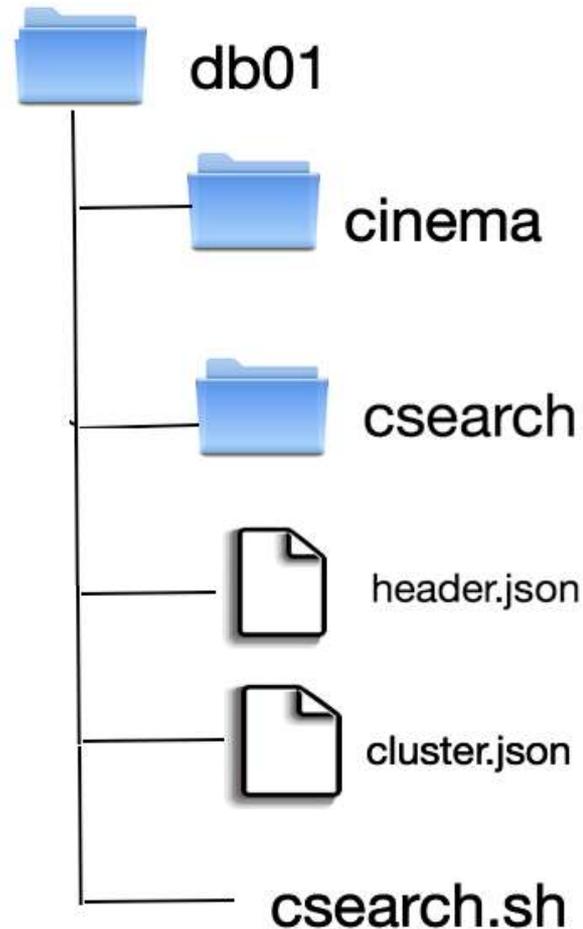
Clear Search

Interactive Viewer



# Current Deployment Scenario

- Installer is available on Hobo
- Directory Structure



# Poster - Annual Student Symposium

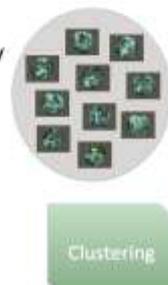
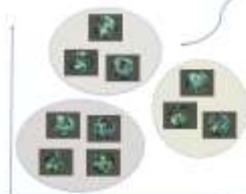


## Background & Motivation

- Large-scale scientific simulations generate massive amounts of data, which can be a bottleneck for scientific discovery.
- Scientific simulations have evolved to extreme scale, making it increasingly difficult to perform post-processing due to limited data movement speeds and space.
- It is critical for scientists to be able to interact with the data produced so as to obtain meaningful insights.
- "Cinema" achieves extreme scale in situ visualization by adopting an image-based approach for storing large-scale simulation data.
- Our application provides an interface to the Cinema database, allowing the scientist to view, cluster, query, and analyze images by leveraging the associated metadata.

## Clustering

- Images are grouped based on physical variables such as temperature and pressure using the k-means clustering algorithm.
- Clustering of the database allows the scientist to recognize the underlying groups produced by the data set and the features associated with each group.
- The algorithm clusters the images by any number of physical variables represented by the database.



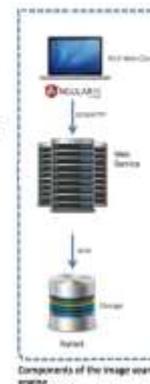
## Content Based Search

- The Content-Based Image Retrieval algorithm returns images of interest using similarity search.
- The user selects an initial 'query image' from the Cinema database and marks a section of the image that contains the region of interest (a).
- The program will then return a set of images that contain the features initially selected with the area of interest delineated (b).
- Using this algorithm and given the series of time step-data available in the Cinema database, the user can track trends in lifetimes of features of interest.



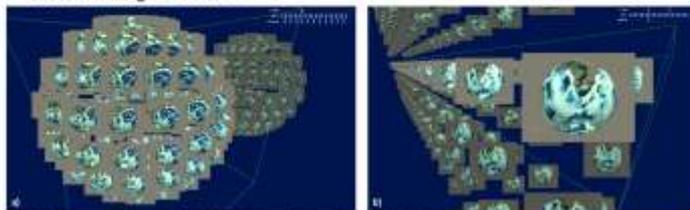
## Meta Data Search

- Our framework provides a mechanism allowing the scientists to query the data by leveraging the metadata associated with the images.
- The scientist can look at the images with common features for the purpose of data analysis.
- The web interface is composed of
  - A front-end built with AngularJS
  - A back-end: a Restful web service using a SQLite database.



## Global View

- The global view provides the scientist with an overview of all images in the database.
- By flying through the virtual image space and trying out different image alignments, the database can be explored in an intuitive way. Images are aligned by customizable context-dependent transformations of input dimensions such as time or viewpoint.
- Results of image classification and reduction operations can directly affect how images are viewed.



MPAS-Ocean images aligned by transforming their 2 theta input dimensions into spherical (a) and cartesian (b) coordinates.



## Web Interface



Search engine showing the image search results for the given query

## ACKNOWLEDGEMENTS:

We would like to thank Francesca Samsel, Jonathan Woodring and Arnold Eatmon.



LA-UR-15-25736

# Future/Ongoing Work

- Integrate with Divya's work – Provide the content based search in the web interface.
- Provide an interface to allow querying multiple Cinema databases.
- Work on deploying the application into some kind of production, where it is accessible to all
- Pilot testing with climate scientists to get feedback for improvements/changes.