



NASA Goddard Space Flight Center

Scientific Visualization Studio

NASA's Scientific Visualization Studio

Horace Mitchell

with lots of help from

***Tom Bridgman , Randy Jones, Alex Kekesi , Kevin Mahoney,
Marte Newcombe, Lori Perkins, Greg Shirah, Stuart Snodgrass ,
Eric Sokolowsky, Cindy Starr, Joycelyn Thomson, Jim Williams***



The Scientific Visualization Studio

- **Founded in 1988 as a movie-making facility for scientists at NASA Goddard Space Flight Center**
- **Primarily focused on the creation of animations and images from remote sensing and model data**
- **Some development work on real-time visualization applications and systems, usually for specific venues**
 - **GLOBE on-line visualization system**
 - **“Earth Today” exhibit at Smithsonian Air & Space**
 - **Digital Earth program**
- **In 1997, the SVS began a major project to produce visualization products specifically for NASA outreach**
 - ***significant aspects of this project will be described here***



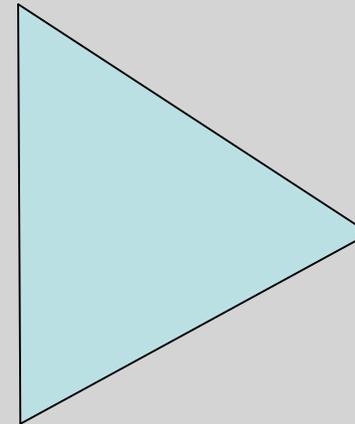
NASA Earth Science Media Project

Official Goal: *To disseminate knowledge of Earth Science Enterprise missions to the widest practicable audience*

Unofficial goal: *To weave Earth Science images into the everyday fabric of American life*

Our unique approach was to use a tripod of individuals, each of whom could represent an important aspect of the outreach

Scientist - *The Story*



Producer -
The Customer

Visualizer - *The Impact*



Customer: Who do we aim for?

- Broadcast news media - (national, local, cable)
- Independent producers (PBS, Discovery)
- Web media outlets (CNN.com, etc.)
- Education content providers
- Museums and other informal education outlets
- General public
- Potential users of NASA Earth Science data products
- Internal requests (HQ, Congress, OSTP)

Strategy: How do we do it?

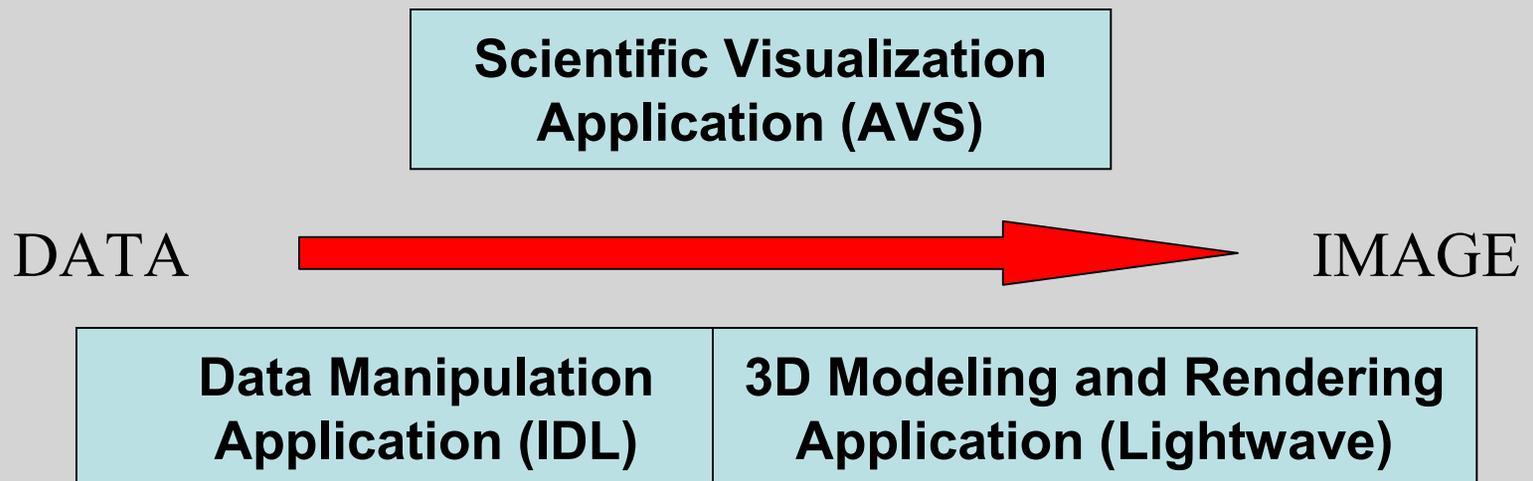
- Produce and distribute **absolutely compelling** visuals to communicate the success and excitement of NASA's results
- Select **newsworthy** topics that target the media and generate demand from other customers
- Produce products that are useful to the **entire spectrum** of our customers



Visualization Technology

As the requirement for compelling, high-quality visuals developed, the SVS changed its application base from traditional Scientific Visualization to a broader base:

- *Robust applications to manipulate and transform data*
- *Applications producing the highest quality output with distributed rendering*





El Niño Products

- **Our first major success came during the 1997-998 El Niño**
- **NASA's Earth Science researchers were fielding a significant number of media requests about the causes of El Niño**
- **The scientist provided the data and the content requirements for animations to be used on-air to explain El Niño**
- **The visualizer designed the look of the visual products and updated the products as new data became available**
- **The producer critiqued the product for public accessibility and orchestrated the media releases and live shot campaigns**



Pipelines

- Certain specialized products have achieved a level of popularity and immediacy that requires them to be produced very rapidly for breaking news stories
- When this occurs, we develop a *Pipeline*:
 - a defined set of procedures to produce a well-defined product on a set schedule
- Example: TRMM 3D Hurricanes
 - TRMM's precipitation radar takes 3D measurements of precipitation in the tropics
 - When notified in the morning of a significant hurricane or cyclone, the TRMM pipeline allows the combination of TRMM PR and GOES IR cloud imagery to produce a finished animation of storm data for that evening's news broadcasts.



TRMM Pipeline: a documented set of procedures, utilities, and data used to produce a final product

To determine if there is a storm and which satellites see it: http://kauai.nrlmry.navy.mil/tc-bin/tc_home

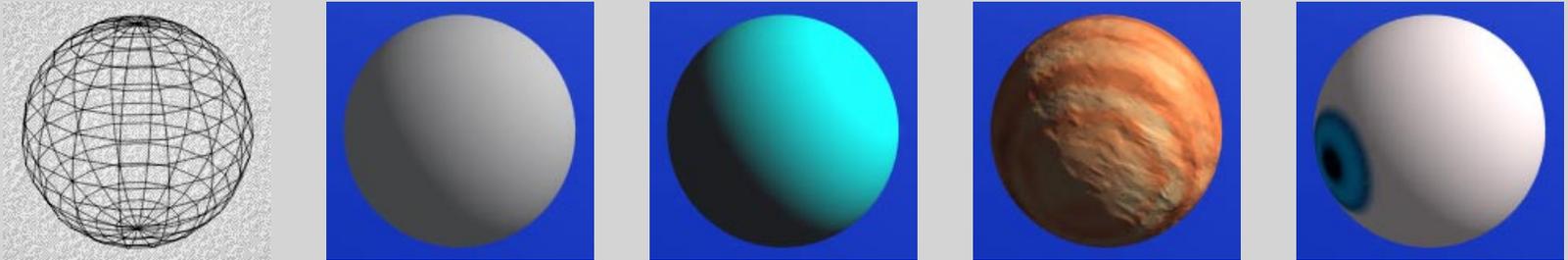
To process the TRMM Real-Time Data:

-
1. write orbit down - on the quicklook, look where the swath crosses the equator
 - ...
 4. ftp trmmrt.gsfc.nasa.gov
 - ...
 15. IDL> .run trmm_visu
 - ...
 20. Retrieve images from GOES for context: <http://rsd.gsfc.nasa.gov/goes/>
 - ...
 22. Current configuration is located at /svs/projects/trmm/idl/
 - ...
 24. IDL>.run trmm_ctrl
 - ...
 28. Startup LightWave 3D; Load scene file generated above
 - ...
 31. Send mpeg and images to earthobservatory for their Natural Hazards section.



Procedural Shaders

In a 3D visualization program, a **shader** determines what the surface of an object looks like. Simple shaders add lighting, colors, textures, and imagery:



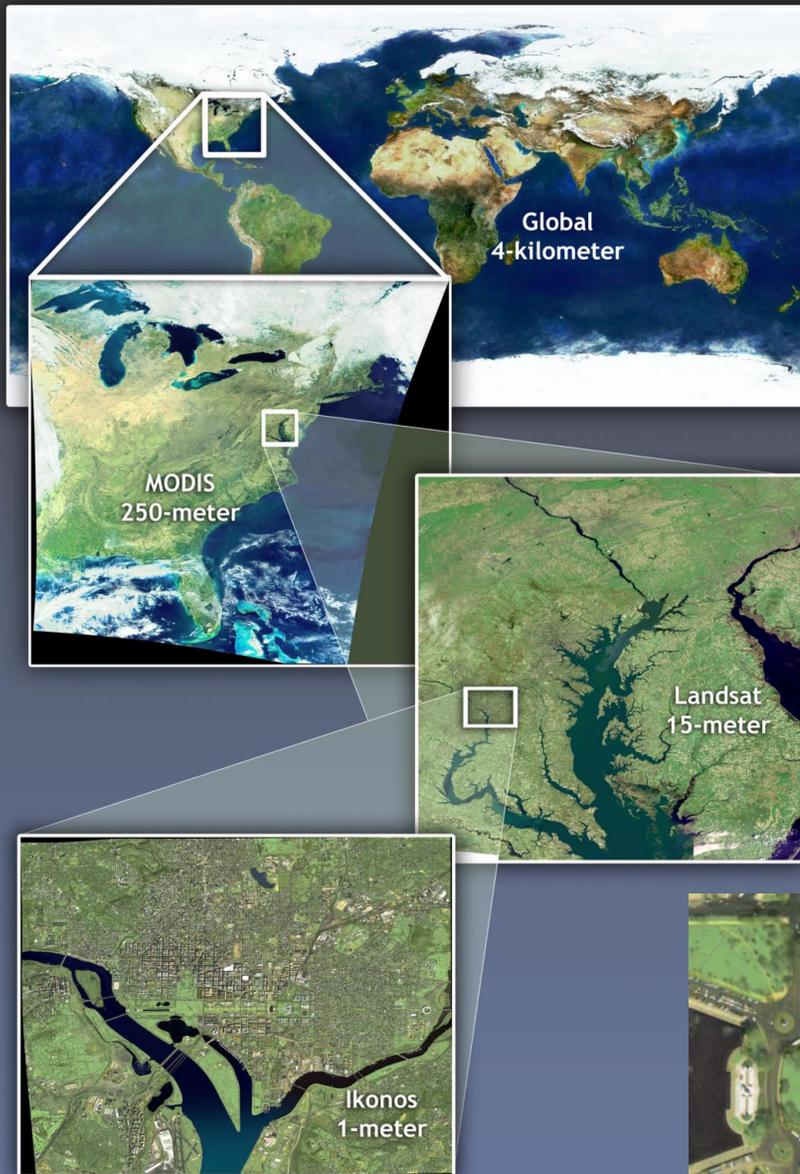
A critical change in our processes was the move to **Renderman** software and the ability to use **procedural** shaders.

A procedural shader is a user-written program that calculates what a point on an object looks like. It adds enormous flexibility and is routinely used within the computer graphics industry for solving difficult problems, such as realistic fur and hair.



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In 2000, the NASA Landsat Project Scientist asked the SVS to create a zoom from the ground to space out of satellite data to illustrate the scales at which remote sensing data is acquired.

The primary data sets to be used were:

- Terra/MODIS at 4000 meter resolution
- Terra/MODIS at 250 meter resolution
 - Landsat at 15 meter resolution
 - IKONOS at 1 meter resolution

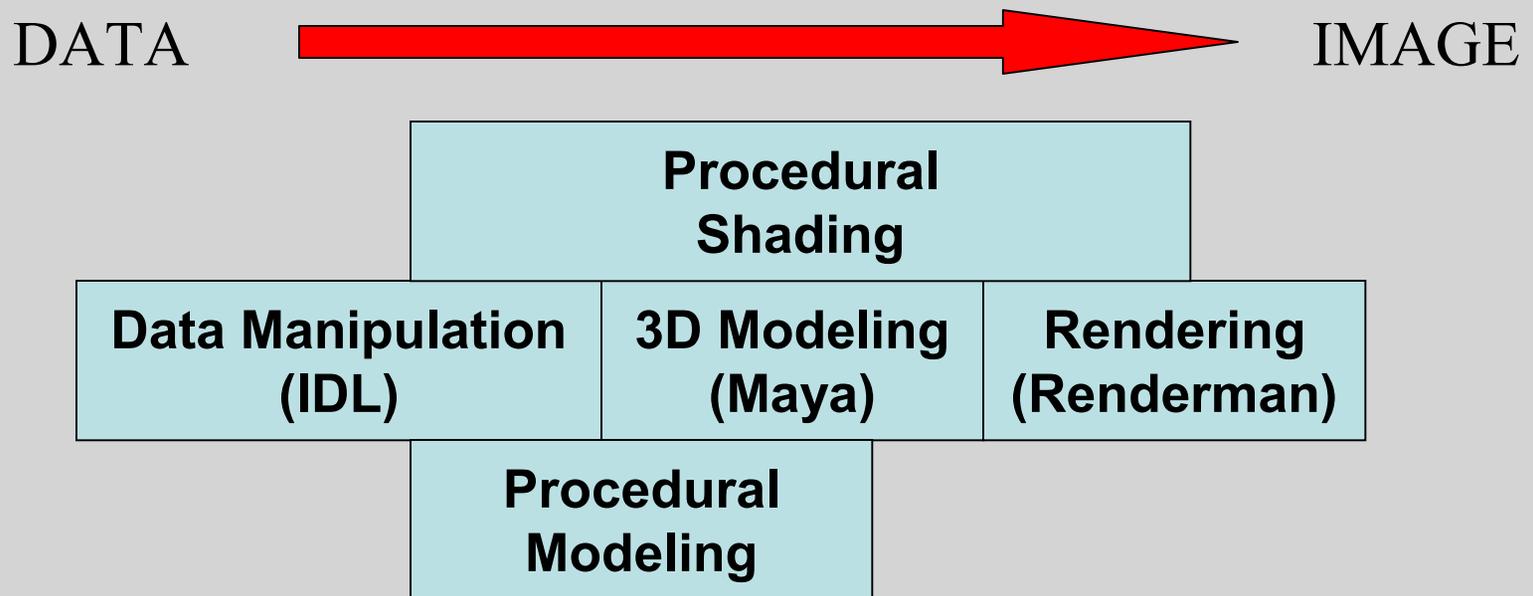
The precise registration and image control required for this project made procedural shaders a necessity





Visualization Technology

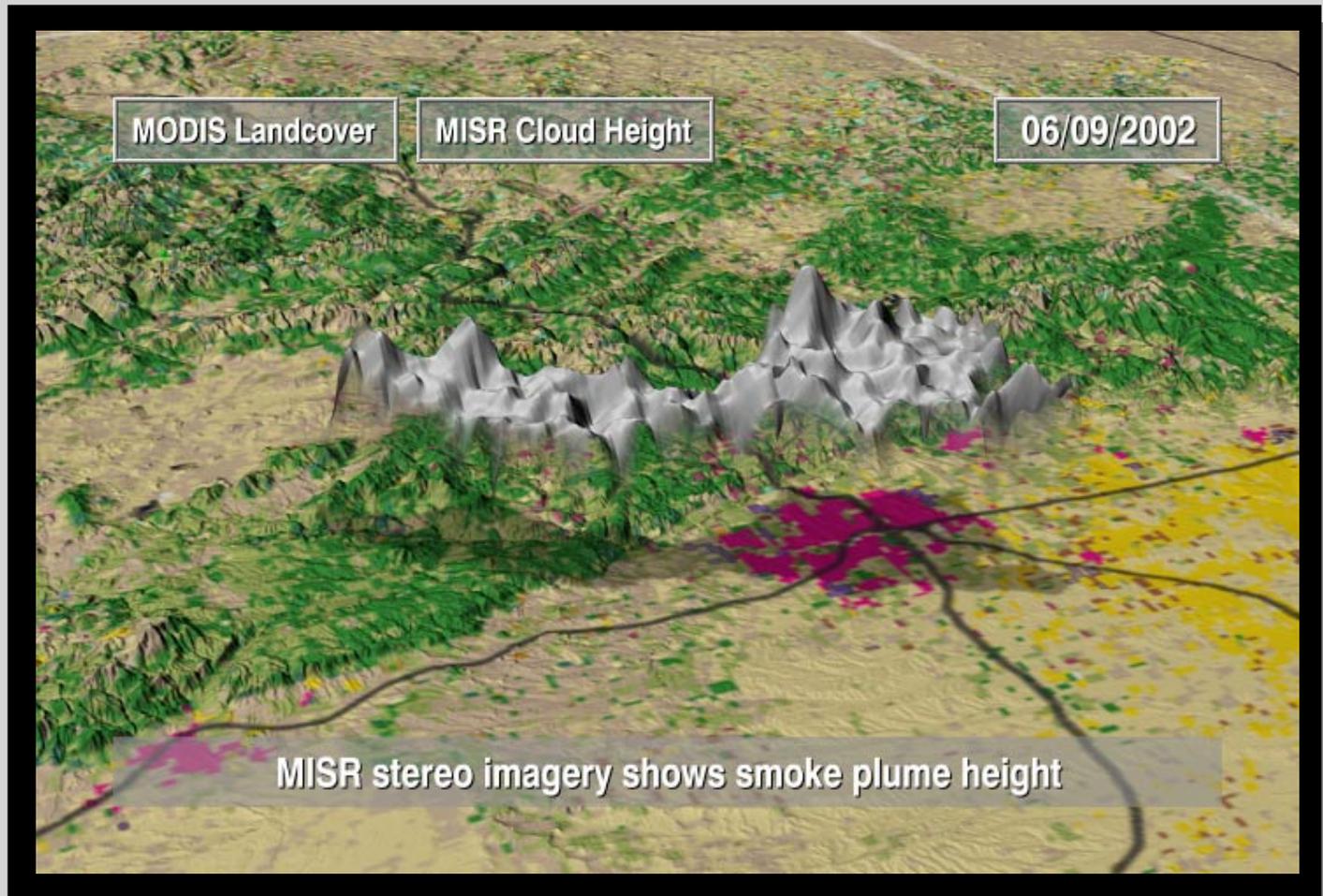
Requirements for high-performance, large data volume visualizations have now led us into our next stage of visualization technology: **Procedural plug-ins**





Compositing:

for more complex animations, each element is rendered as a separate layer so element timing can be adjusted easily



Come see this 5-minute animation of fire-related data at the NASA EOSDIS booth



The SVS Web Archive ***<http://svs.gsfc.nasa.gov>***

- **The SVS Web archive was designed as a public repository for as much of the imagery and associated metadata as could be captured during the animation process**
- **Since the SVS operates in a shared UNIX environment, an integrated system was created to allow each visualizer to control and update both the media and metadata files which would migrate to the public web site upon project completion**
- **Python-based processes turn these files into web pages and various search and index pages**



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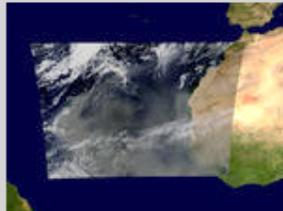
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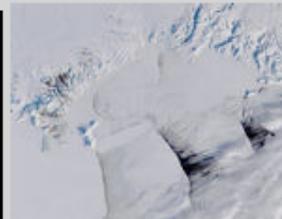
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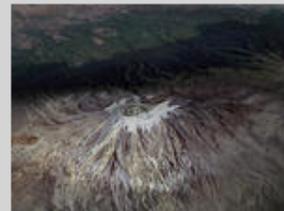
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All of them are available on this site.

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Looking for glacier:

There are 32 exact matches for glacier.

2482 [Byrd Glacier Exhibit](#)

Animation depicting a virtual view of the Byrd Glacier model

2344 [Pine Island Iceberg Formation](#)

This is a time series animation starting on September 8, 2001 and ending on Nov 12, 2001. It shows the transform

2146 [AGU Press Briefing May 29th: Global Land Ice Measurements from Space. \(Dobbin Glacier Zoom 2\)](#)

Taking a closer look at Dobbin Glacier.

2145 [AGU Press Briefing May 29th: Global Land Ice Measurements from Space. \(Dobbin Glacier Zoom\)](#)

Zooming down to the Dobbin Glacier in Alaska.

2102 [Iceland Glacier Recession 1997 to 2000](#)

Zoom down to area of recession and transition from 1997 to 2000

2101 [Iceland Glacier Recession 1973 to 2000, Glacier Terminus contrast emphasized](#)

Glacier Recession 1973 to 2000 Movie

2100 [Light Iceland Glacier Recession 1973 to 2000](#)

Glacier Recession years 1973 to 2000

2074 [ASTER Dataset Zoom Down](#)

Flying over an Aster data set of the Pine Island Glacier crack. The dataset was taken back in December 12th, of

2070 [ASTER Dataset Flyover](#)

Flying over an Aster data set of the Pine Island Glacier crack. The dataset was taken back in December 12th, of

2069 [Zoom down to the Pine Island Glacier](#)

A faster zoom down to Antarctica's Pine Island Glacier where a crack has formed, minus the second zoom. Using 00 and 1/4/01

2068 [Zoom down to the Pine Island Glacier \(faster\)](#)

A faster zoom down to Antarctica's Pine Island Glacier where a crack has formed. Using Landsat 7 data showing

2067 [Zoom Down to the Pine Island Glacier](#)

A slow zoom down to Antarctica's Pine Island Glacier where a crack has formed. Using Landsat 7 data showing

1384 [Changes in Glacier Bay: Johns Hopkins Glacier](#)

Changes in Glacier Bay's Johns Hopkins Glacier from 1973 to 1986

0992 [Antarctica: Lambert Glacier Fly-over](#)

Classroom Animation of Lambert Glacier




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2482 [Byrd Glacier Exhibit](#)

2384 [Pine Island Iceberg Formation](#)

2384 [Pine Island Iceberg Formation](#)

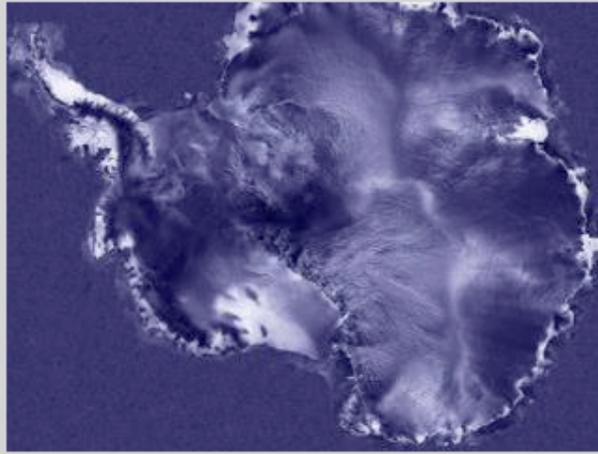
This is a time series animation starting on September 8, 2001 and ending on Nov 12, 2001. It shows the transform

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Pine Island Iceberg Formation

This animation is a sequence showing the formation of the Pine Island iceberg. This animation is a series of [MISR](#) images on top of the continental Radarsat view of Antarctica.



This is a time series animation starting on September 8, 2001 and ending on Nov 12, 2001. It shows the transformation of a glacier into an iceberg.

[View the entire online movie.](#)
 320x240 MPEG-1, 1 MB
[Click here for information on how to view this media element.](#)

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November 11, 2001

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November 12, 2001

[View the print resolution image](#)
2880x1944 TIFF, 16 MB

Video ID: [SVS2002-0008](#)

Animator: [Lori Perkins](#)

Date Completed: 01/15/2002

Duration: 320 frames, 10.0 seconds

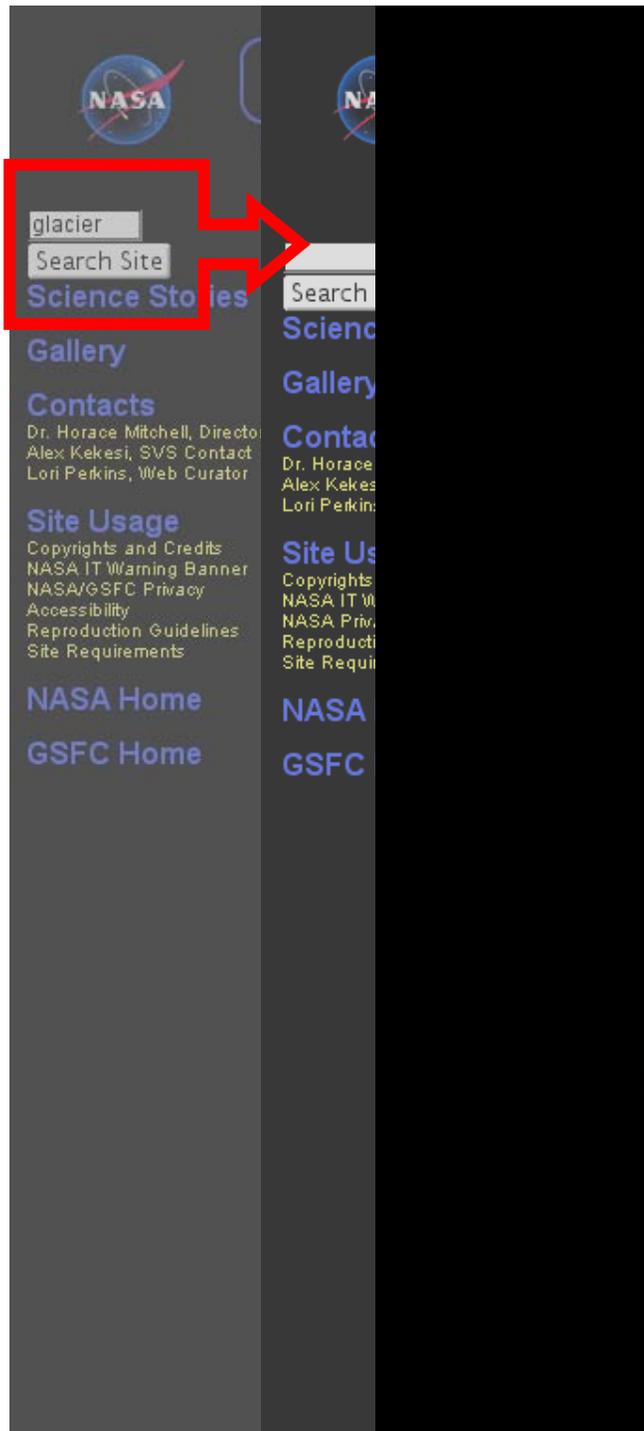
Scientist: Bob Bindschadler (NASA/GSFC), Dave Diner (NASA/JPL)

Instrument: Terra/MISR, RADARSAT-1/SAR

Data Collected: RADARSAT: 1997/09/26-1997/11/04, Terra/MISR: 2001/09/08-2001/11/12

Animation Series: [Antarctica](#)

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<!-- Version 1.0b - October 2000 -->
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  <!-- Video ID Format = SVSyyyy-nnnn -->
  <!-- where yyyy is current year -->
  <videoid>SVS2002-0008</videoid>
  <!-- Video Time codes -->
  <!-- Format: HH:MM:SS:FF -->
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  <endtimecode>01:01:21:28</endtimecode>
  <!-- Place title of animation here -->
  <title>Pine Island Iceberg Formation</title>
  <!-- Enter a description of the animation here. -->
  <!-- Note that this information will appear on any -->
  <!-- public web page generated for this animation -->
  <abstract>This animation is a sequence showing the formatio
    of MISR images on top of the continental Radarsat view of A
  <!-- Animator/Visualizer(s) who developed this product
  <animator>Lori Perkins</animator>
  <writer />
  <narrator />
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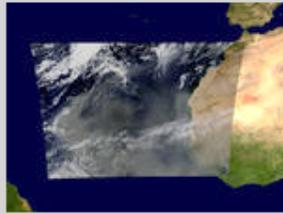
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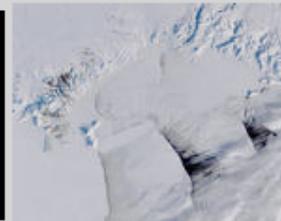
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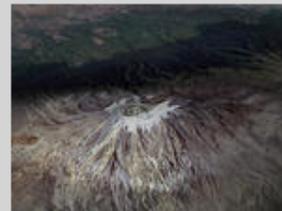
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- [2414](#) AIRS Volumetric Cloud Data (Fly Out)
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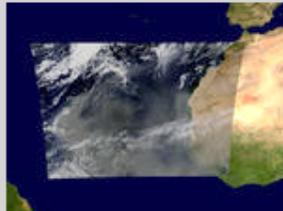
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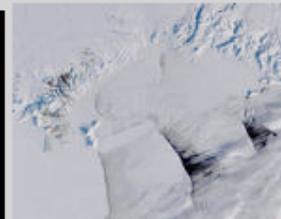
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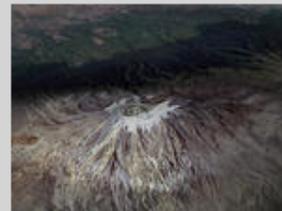
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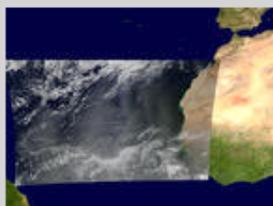
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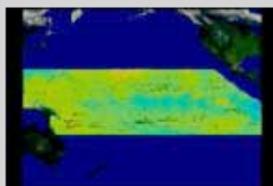
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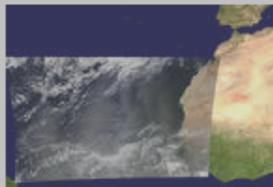
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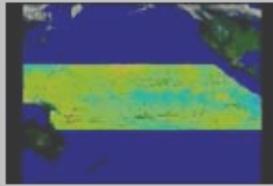
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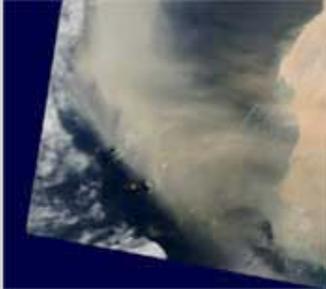
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March 10, 2003 - (date of web publication)

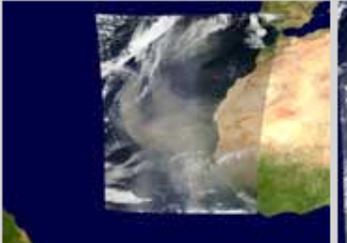
Saharan Dust Off West Africa

An intense African dust storm sent a massive dust plume west above the African deserts and then out across the Atlantic, reaching blooms in the Gulf of Mexico, and the decline of the coral reef

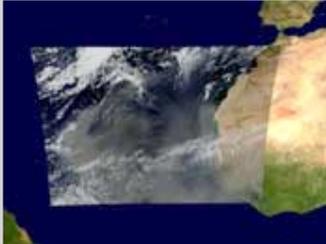
These March 2 and 4 true-color images, acquired by the MODIS, show dust plumes (light brown) blowing westward over a span of days d



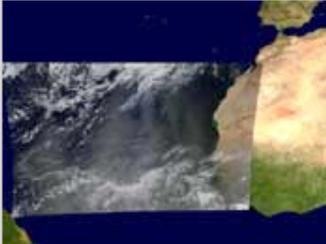
March 02, 2003
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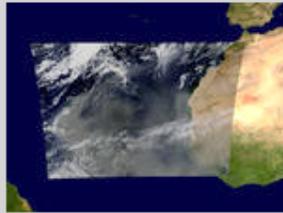
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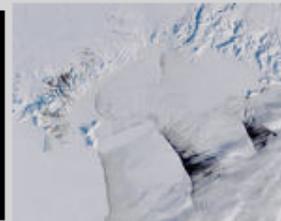
"What's New?"



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[North Atlantic
Oscillation](#)
02/25/2003



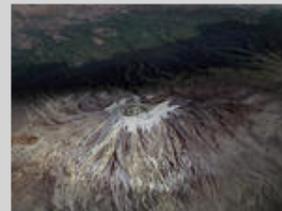
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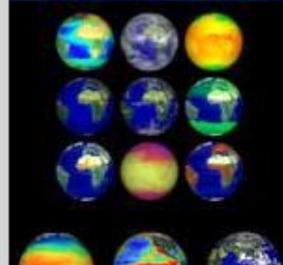
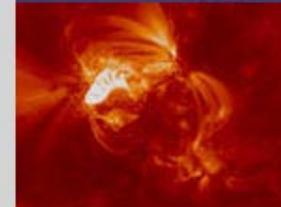
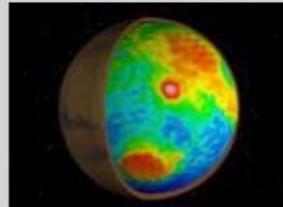
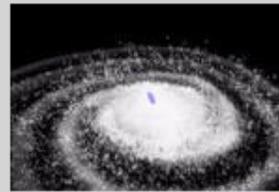
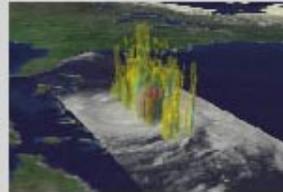
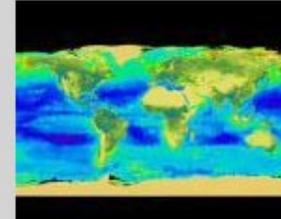
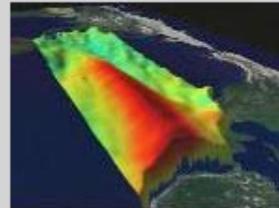
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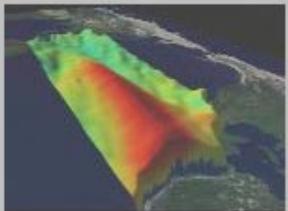
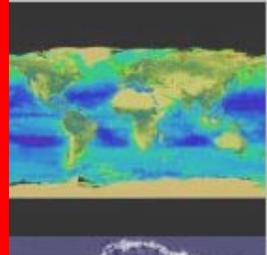
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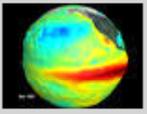
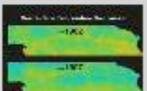
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El Niño and La Niña

El Nino and La Nina are more known more generically as ENSO (El Nino/Southern Oscillation) events.

SVS	(ID:002646) El Niño-La Niña Cross-section of Temperature and Height Anomalies: June, 1998.
	(ID:002626) El Nino 'Golfball' for National Geographic's Atlas of the Oceans
	(ID:002057) El Niño-La Niña Sea Surface Temperature Anomalies from NSIPP: January 1998 through September 2001
	(ID:001370) El Niño Zoom to Cross-section of Temperature and Height Anomalies: July 1997 through October 1998
	(ID:001369) El Niño Sea Surface Temperature Anomaly Comparison: 1982/1983 to 1997/1998



Linkages

A number of projects are under development to automatically link the SVS database to larger repositories of image and outreach material



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Issues to be resolved

- How to serve up full resolution movies that can be used by both the public and third-party producers
- How to improve linkages to fulfillment sites



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Tape Title	Record ID	Date Produced
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2002 EARTH SCIENCE VIDEOTAPES

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NASA Data Indicates El Nino Will Intensify and Move East	G02-092	01/03/03
Take Two: International Ozone Campaign Returns to Arctic Circle	G02-090	01/06/03
Lasers on Ice: ICESat Begins Its Mission	G02-085	11/27/02
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