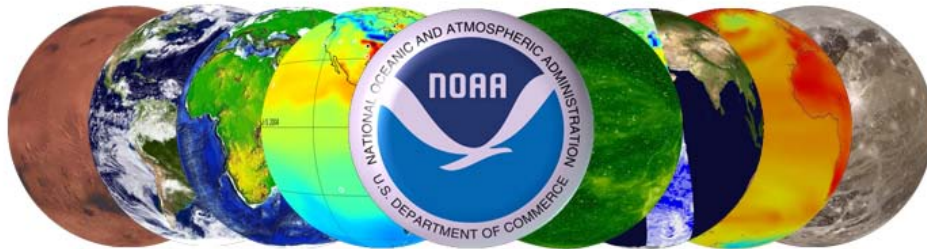# Science On a Sphere®

Users Guide &

Training Manual

Last Updated July 2011

Science On a Sphere® Training Manual
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<u>Overview of Training:</u>

During the setup week for the sphere, NOAA provides Science On a Sphere® system training. SOS system training consists of five separate sessions. There is some overlap between each of the sessions. Each session lasts anywhere from one to two hours.

The five sessions are:

- **Projector Alignment**
- **Operation and Systems Administration**
- **Overview and Basic System Use**
- **Presenter Training and Dataset Overview**
- **Content Creation***

*Note that Overview and Basic System Use is a prerequisite to the session on Content Creation.

All sessions are taught using the actual sphere system (limited hands-on), so the classes cannot be taught in parallel. Class sizes are variable depending on the interest and usually start by the second day of the setup and wrap up by the end of the third day.

Projector Alignment

Projector alignment training usually occurs during the second day of setup. Typically, the site personnel who are responsible for projector alignment are also involved with the SOS setup. Alignment training usually happens on the morning of day two of the SOS setup and is two hours in length.

What is projector alignment training? The SOS system uses four projectors to display data onto the surface of the sphere. The projectors are positioned around the sphere, 90 degrees apart from each other with respect to the center of the sphere. Each projector is responsible for its quadrant of the sphere. Light from adjacent projectors overlaps and makes an edge. These edges need to align very closely to achieve a single unified, global sphere image. This edge is also called the blending area. We call the process of creating a seamless edge blend: projector alignment. The instructor will lead a group through the steps required to perform the projector alignment.

Operation and Systems Administration

This session is intended for the Systems Administrators or IT professionals who will be responsible for maintaining the software and hardware for the SOS system. These individuals will be the primary point of contact for system issues, questions, and problem resolution. The operations and systems administration training typically occurs on day two and is one hour in length.

In this session, we cover a basic system overview as well as a description of the computer components. We go into a detailed discussion of how the pieces fit together and interact. We allocate plenty of time for questions and answers.

Overview and Basic System Use

This session is useful for individuals who will use the system on a daily basis. It is ideal for individuals who are responsible for bringing up the system in the morning and shutting down the system at night. It is also important for people who will be docents with the sphere to attend this training session. Overview and Basic System Use Training typically occurs on day two and is usually one and a half hours in length. *This session is a prerequisite for the Content Creation training session.*

In addition to the basic functionality of the system, we will cover how content is organized, how to use the system to display data, how to create new play lists and edit old ones, how to use the remote control, and how to give presentations. Also, during this session the trainer will provide a broad overview of the scientific data sets that are available on the system.

Presenter Training and Dataset Overview

This session covers much of the same information that is presented in the Overview and Basic System Use session. The level of detail, however, is not as in depth, making this appropriate for presenters and docents. In order to target the audience of presenters and docents, this session involves a demonstration of Science On a Sphere given by a NOAA trainer. The demonstration lasts about 40 minutes and includes many datasets from the SOS catalog. The goal of this session is to show museum staff how to use SOS as a presentation tool for audiences (field trips, scheduled presentations, etc). This is also a good time for any museum staff interested in the new exhibit to see it on display.

Also during this session, the NOAA trainer will give an educational overview of the diverse set of SOS datasets that come preloaded on Science On a Sphere ranging from Earth Science data of the oceans to the planets of the solar system. The features of the online dataset catalog will be described so that museum docents will know what data is available to them. This session is on the afternoon of the third day and is typically one hour.

Content Creation

The Content Creation training session is intended for individuals who will create content for the sphere and for people who will work with others to create sphere content. It is also a useful session for people that will be docents with the sphere. The Content Creation training session occurs after the Overview and Basic System Use session. It is on day three and is typically one and a half to two hours in length.

During this session, the instructor will go into greater detail on the data organization, preferred file formats and how the system interacts with data. Also, all of the options and special features in the playlists will be covered. There will be discussion on how to best go about integrating new content onto the sphere. The instructor will also show the students the steps required to get their own content (both still images and time series) onto the sphere. Individuals are encouraged to bring sample content to try out (NOTE: please review the on-line FAQ on data formats and the Content Creation page first!)

Projector Alignment

In order to optimize the appearance of Science On a Sphere, it is important to have the sphere properly aligned. Because of this, it is suggested that more than one person at the site learns how to align the sphere. For directions with pictures, visit: http://sos.noaa.gov/support/projector_alignment.html
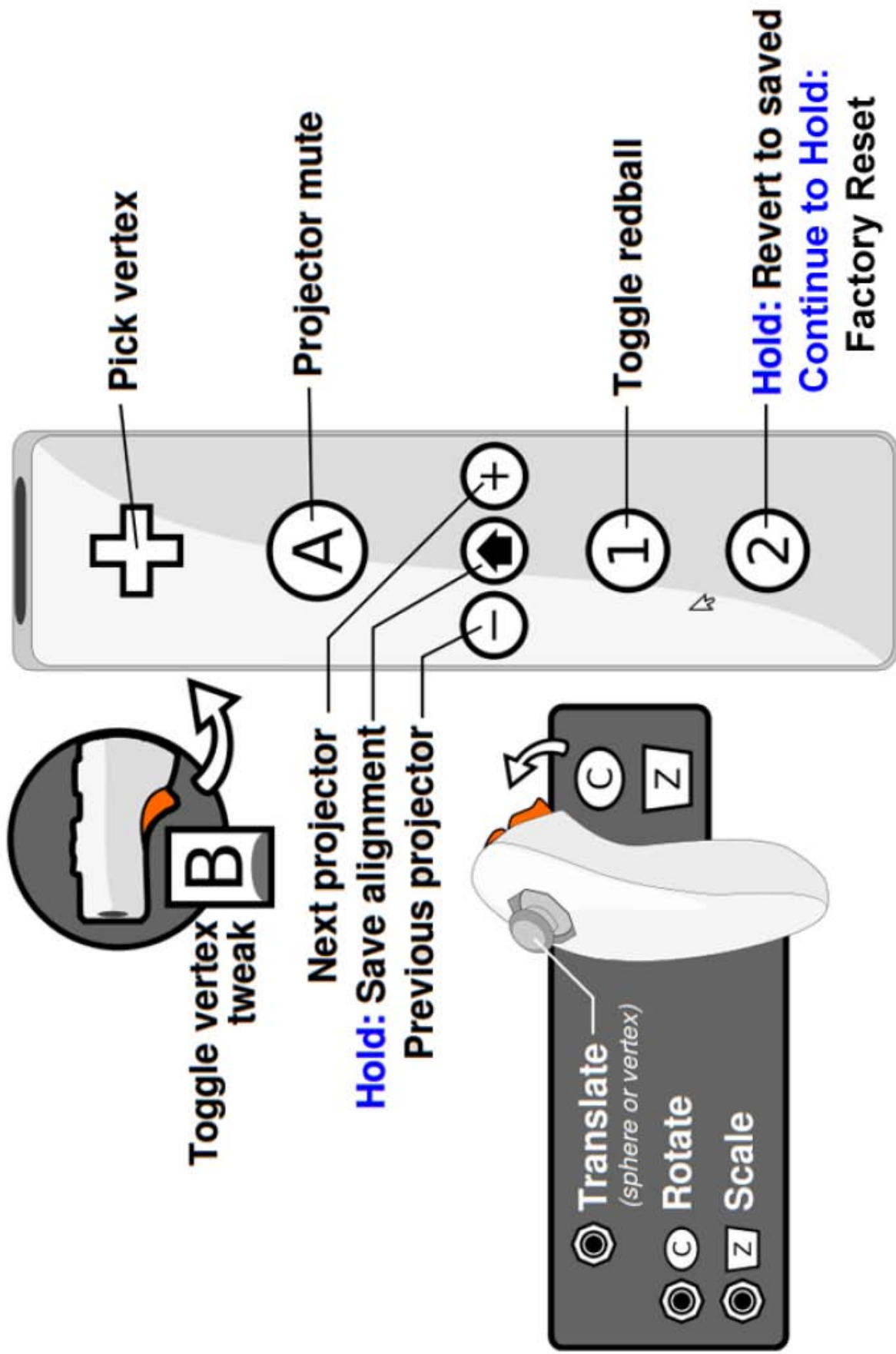
How to Align the Sphere

To align the sphere, turn on the system as if you were going to do a demo. All of the computers and projectors need to be on. Open the SOS Stream GUI and connect the Wiimote. To connect the Wiimote, press any button on the remote. Once the remote is connected, open the alignment software using the "Alignment" icon on the desktop. This will launch your standard web browser with the alignment software. Clicking on the link that says "Alignment" will open a window that allows you to start alignment. In this window, click "Start Alignment" and then select "Red grid (coarse)" to begin. You will need the nunchuk attachment for the Wii remote when aligning the sphere.

There are two main modes for aligning the sphere, "Projector Alignment" and "Vertex Tweaking." If you are aligning the sphere for the very first time, or if it is really out of alignment, then start with the Projector Alignment. If you are just tweaking the alignment, then start with Vertex Tweaking.

The first step in Projector Alignment uses the "Red Ball." To turn the Red Ball on or off, press "1" on the Wii remote. When you are using the red ball, you only need one projector on at a time. You can toggle the projectors on and off using the Wii remote. The "+" and "-" buttons allow you to select the projector that you are working with. The four blue lights at the bottom of the remote indicate which projector is selected. To turn a projector on or off, make sure it's the selected projector then press the "A" button. The goal when using the red ball is to have the red cover the surface of the sphere and not overshoot the sphere on any side. You also don't what to see any cyan on the sphere. You can adjust the position and size of the red ball by using the buttons on the remote. The image can be adjusted in three different modes: translation, scale, and rotation. To use translation mode use the joystick on the nunchuk. In translation mode, moving the joystick moves the image left, right, up and down. To use the scale mode, hold the "Z" button while using the joystick.   In scale mode, up on the joystick makes the image taller, down on the joystick makes the image squatter, right on the joystick makes the image wider, and left on the joystick makes the image thinner. To use the rotation mode, hold the "C" button while using the joystick. In rotation mode, the joystick can be used to rotate the image as necessary.

When using the red ball, don't stay in one place. It is important to make sure that the image is evenly positioned on the sphere, so you will have to walk around to see both sides of the sphere. You want everything to be as uniform as possible. Sometimes it is helpful to make the red ball small so that you can center it on the sphere. Once it is centered, then you can expand it until it covers the quadrant of the sphere that you are looking at. The red ball alignment is just the first pass at aligning the sphere, so it doesn't have to be absolutely perfect.

Alignment Mode

Pick vertex

Projector mute

Toggle redball

Hold: Revert to saved
Continue to Hold:
Factory Reset

Toggle vertex
tweak

Next projector

Hold: Save alignment

Previous projector

Translate
(sphere or vertex)

Rotate

Scale

B

Once you are satisfied with the red ball alignment it is probably a good idea to press "Save alignment." All of the changes that you make to the projectors are only saved when you initiate it. To save, hold the "Home" button (the little button between the "-" and "+" buttons). A message will appear on the sphere telling you that alignment has been saved. If you make changes that you don't want to keep, holding the "2" button will load in the settings from the last time that you saved the alignment. It doesn't hurt to save the alignment several times throughout the alignment process to make sure that all of your adjustments are saved every step of the way.

The next step in Projector Alignment utilizes the Red Grid. When you turn the red ball off, the red grid should be displayed. Once the red grid is on the sphere, the goal is to have the grid line up between the projectors so that it looks like one seamless image. You can again turn the projectors on and off by pressing "A". You will want all of the projectors on most of the time when working with the Red Grid. Adjust the image just as you did with the Red Ball, working to create a seamless image. You don't have to get the lines absolutely perfect in Projector Alignment because you will do the fine tuning with Vertex Tweaking.

Once the image is fairly close to being seamless, turn on Vertex Tweaking by pressing "B" on the Wii remote. The selected projector should display a grid with the numbers 1-9 on the sphere. Use the D-pad on the remote to move around the grid. When you have a number selected, you can use the joystick to stretch the image up, down, left and right. The image will only stretch near the selected number, so if a whole side needs to move left, then you need to stretch it at the top, middle and bottom. It is sometimes confusing as to which line is being projected from which projector, so it is helpful to toggle the adjacent projectors on and off to differentiate between the lines. Also, if two lines are separated that shouldn't be, it is good to move each of them half way and have them meet in the middle rather than moving one line all the way to the other.

Once all of the lines meet in the grid, save the alignment. To perfect your alignment, you can load "Red Grid (fine)" from the alignment window, which has higher resolution and thinner lines. You will probably have to make some additional adjustments when you put the high resolution grid up. Follow the same steps as when "Red Grid (coarse)" was used. When you are satisfied with your alignment, save the alignment for a final time and then make sure that you turn off the vertex tweaking. If you don't turn off the vertex tweaking before stopping the alignment, the grid will stay on the sphere even when datasets are shown. To finish, press "Stop Alignment" in the same window where you selected the grids to use. When you stop alignment, your remote should return to its normal mode where the buttons are used to control the playlist and tilt the sphere.

You will only want to use the "Factory Reset" if you physically move your projectors or if the alignment is really off. In order to do a factory reset, hold the "2" button for six seconds. You will lose all of your current settings if you reset to factory defaults, so make sure you are careful to only press it when you mean to.

Projector alignment can be a tricky process and is best learned in a hands-on manner. Be patient and remember to walk around the sphere a lot to make sure that you can see everything as you are making adjustments. You will be rewarded for all of your effort because a well aligned sphere looks great!

Operation and System Administration

This section is intended for System's Administrators and others that have responsibility for maintaining the hardware and software components of the Science On a Sphere system (SOS).

Overview

SOS is a collection of hardware that integrates computers and video projectors to display animated images onto the surface of a large sphere. Taken in pieces, the system consists of a sphere situated in a room, surrounded by four video projectors. The video projectors are connected and driven by the primary computer. Each projector is responsible for its own quadrant of the sphere. The computer has two graphics cards to support the four projectors and a third graphics card to run the user interface. The computer pulls in content, usually some type of planetary content, renders it to an Earth projection, subsets it, and upon command displays it onto the sphere. The projectors are numbered one through four. The computer is responsible for many things, namely among them: running the main user interface to the system, real time data collection, and providing the interface to the automation control protocol. All of the computers use the Linux operating system Ubuntu. Most sites buy a "hot" spare that is identical to the primary computer in terms of hardware, as a backup system. All of the software that drives and controls the SOS system is written and maintained by NOAA.

System Specifications

The computer in the SOS system is a standard computer system with high-end graphics hardware. The system is generally specified so that both the primary and spare computers are identical from a hardware perspective to allow easy swapping of components (in case of system failures).

Projectors are usually specified so that they work well in high duty hour environments. Mostly, projectors classified as "board room" projectors meet this requirement. These projectors typically have multiple fans to provide adequate cooling during the day. The projectors are also specified so that they produce a high light output (LUMENS), mostly in the range of 3500 to 5000 LUMENS. The supported resolution for the projectors should be at least 1024x768.

Network

The computers are connected via a gigabit network to enable high speed communication and data transport. The primary and spare computers reside in a private, non-routable network space (usually in the 10.x.x.x network range). The primary computer, however, also usually sits on the border between the private SOS network and the sites local Intranet. The primary computer sits at the border of the network to enable outside access for remote systems administration, software updates, and to pull down real time data from the NOAA servers. While the local, private SOS network is gigabit, the external connection can be whatever the local site supports in their network infrastructure. If supported by the projector infrastructure, the projectors can also be connected to the private network to allow for remote power on/off.

Backups
      The computers are set to run backup scripts early every morning to push data
from the primary computer to the spare computer.   In general all of the data that comes
with the system can be retrieved from NOAA, however, there are some data files that are
site specific. Here are some examples of site specific data: the custom playlist data in the
SOS home directory, the alignment configuration files that are in the home directory, any
custom or local site content that was developed and installed on the system.
      All of these files are synced on the computers, so that there is a backup copy on
the spare computer and so that in the case of failure, the spare computer is an exact
duplicate of the primary computer. Sites are still encouraged to back up data on a
separate system. Generally, the playlist and alignment data are a few megabytes (usually
much less). In terms of content, only the content developed by the site needs to be
backed up. All of the content that comes preloaded on the system is always available
from NOAA. The custom content can sometimes be many gigabytes, but is definitely
worth backing up.

Power Down Schedule
      Generally, it is recommended that the entire SOS cluster remain powered up all of
the time in order to receive real time data. The projectors only need to be on during
operation and should be powered down to save lamp life when not in use. If a system
power down is required, then it is recommended to halt the SOS software, then power off
each computer (a single press of the power button starts a graceful clean shutdown).

System Maintenance
      Projector alignment should be checked frequently (once a week ideally) to ensure
that the system is aligned properly. Usually, the system only gets out of alignment when
there has been some disturbance to the projectors.   It is recommended to check it weekly
just to ensure that the system is displaying data in an optimal manor. If the alignment is
really off, it will be visible in the display of datasets.

Projector Filters and Lamps
      Projector lamps are one of the main consumables for SOS. A typical projector
lamp lasts anywhere from 1500 to 3000 hours. The image quality of the system should
be checked on occasion.   As a projector lamps ages, it will start to dim or show discolor
and then in many cases, suddenly go out.   In some cases the projector will turn on a lamp
warning light indicating a new lamp is needed. It's a good idea to have a spare lamp on
hand in case of a sudden failure.   In general, it is suggested to follow the manufactures
recommendations on lamp replacement.   When lamps are replaced because of age, it is
recommended to replace all of them at the same time, since the color and intensity
difference between an old lamp and a new lamp will make the sphere visualization look
bad. Projector alignment will need to be adjusted after replacing the lamps.
      Projector filters should be checked monthly to ensure proper airflow. At
minimum, every quarter, but that depends largely on the projectors environment. Dusty
areas require more frequent filter cleaning.   Dirty filters reduce cooling capacity and
shorten projector lamp life. This is probably the most important of the maintenance tasks
to perform.

Computer Maintenance

The SOS systems are like any other computer system. In general they run and run without the need for maintenance. Ubuntu releases operating system patches frequently and patches that affect security should be applied as needed. If NOAA comes across an operating system patch that adversely affects system operation, sites will be informed through the SOS Forum.

Periodically, software upgrades from NOAA for the SOS software will be distributed. The SOS software upgrades will also appear in the Ubuntu Update Manager. It is up to each site to decide if they want to install the upgrade. An announcement with full instructions for the upgrade and the new features available through the upgrade will be posted to the SOS Yahoo Forum when available.

User Accounts

Every process that runs under Linux must have a user id. The SOS system uses two user id's: sos, and sosdemo. The user id sos is an administrative account that has the ability to download new data, run the alignment software, install updates and manage the real-time data downloads. The user id sosdemo is used for day to day system operation and running the SOS software. The user sosdemo does not have permission to delete data, edit the software or run alignment. This user is intended to serve as a "safe" mode, where the computer operator will be able to do very little damage to the software or the data. Administrators of Linux sometimes need access to the super user account (equivalent to the Windows "administrator" privileges). The super user account in Linux is called "root". The password is set at machine installation and can be changed locally at the site. It is generally considered safer, or at least a better practice, to not use root directly, but rather use the "sudo" command that temporarily raises a normal users privilege to root for the duration of a single command. Only the sos user has sudo privileges.

Remote Login

In order facilitate support, maintenance, and troubleshooting, the SOS computers come loaded with a program called TeamViewer. This program allows the SOS support team to logon remotely to the SOS computers and temporarily take over the desktop. The site must launch the software and provide log in information to the SOS team in order for us to logon. The SOS team will only log in at the request of the site and at a schedule time when it is convenient for the site.

Overview and Basic System Use

The Science On a Sphere® software has evolved over time with the goal of being intuitive and easy to use. This session is meant to familiarize users with the basics of the Science On a Sphere® system.

Starting Up the System and Shutting it Off

When you turn on the primary computer, it will automatically log into the user sosdemo. The spare computer doesn't have to be on, but it is recommended to leave it on for backup purposes. If you want to change users you will have to log out and then log in using your user name and password. There is an icon that looks like a power button in the top right menu bar for logging in and out.

Once you are logged in, find the icon on the Desktop labeled "SOS Start" and double click it. This will bring up the Science On a Sphere® interface, called the SOS Stream GUI, which is needed to run Science On a Sphere®. If you are going to be giving a presentation, the projectors must also be turned on. If the projectors have networking capability, there will be an icon on the desktop that can be used for turning the projectors on and off. If not, use the provided remote to turn on each of the projectors.

To shut the system off use the icon that looks like a power button in the top right menu bar. This lists many options including log out, shut down, and reboot. Typing "sudo shutdown -h now" to shutdown or "sudo reboot" to reboot in a terminal also works. To force a sudden power off hold the power button for 5 seconds. This last option is to be used only as a last resort.

SOS Stream GUI

The SOS Stream GUI is what you will use to open playlists and give presentations. At the top of SOS Stream GUI you will see four menus: "SOS," "File," "Library," and "Controls." There are also buttons similar to those on a VCR that allow you to control the opened playlist.

Opening a Playlist

A generic playlist, called normal-demo.sos, is automatically opened when the SOS Stream GUI is started. To open a saved playlist, click on the "File" menu and select "Open Playlist." In the window that appears, select the playlist that you would like to use. All of the playlists are saved in the directory **/home/sos/sosrc** for the user sos and **/home/sosdemo/sosrc** for the user sosdemo. If a playlist contains errors, a warning message will pop up with the names of the offending datasets and the paths that they use. Clicking on a dataset in the playlist will load it on the sphere. The dataset bar will turn yellow while loading, then turn green if it loads properly or red if it is unable to load.

If you make changes to your playlist while it is open, it will not automatically reflect those changes. You will need to reload the playlist by clicking the "Reload Current Playlist" button in the "File" menu.

Using a Playlist

Once a playlist is open, there are several options for using it. The first is to set the system on autorun mode. In this mode, the system will run through the playlist on an automatic timer. To turn on autorun, click "Autorun" under the "File" menu. In autorun

mode, the system will display each dataset for a default three minutes unless otherwise specified in the playlist. The second option is to control the playlist from the primary computer. To do this you can use the buttons across the top of the window, the commands in the "Control" menu or the keyboard. The buttons across the top of the window are similar to those on a VCR. There is a timeline across the top with a slider bar to indicate the frame number of the dataset. You can move the slider bar around with the mouse to fast forward or fast backward through the dataset. The commands in the "Control" menu provide all the same functions as the buttons across the top. The controls for the keyboard are listed the right side of the commands in the "Control" menu. The most common keyboard commands are the up and down arrows that allow you to move through the selected playlist, and the space bar which pauses and plays the datasets. The third way to control the playlist is using the remote control. The controls for the remote are explained in the image on the next page.

For more information about a particular dataset, click the "Details" button in the SOS Stream GUI when the dataset is loaded. This was open a window with all the parameters that are set for this dataset. To find a particular dataset, use the Search Bar at the bottom of the SOS Stream GUI to browse through the whole library. A new playlist will open with all the datasets that match your search. To return to your original playlist, simply clear the Search Bar. By default, the search is based on the title of the datasets, but under the advanced search, you can search by title, keywords, and all parameters. To open the advanced search, click on the "+" in the Search Bar.
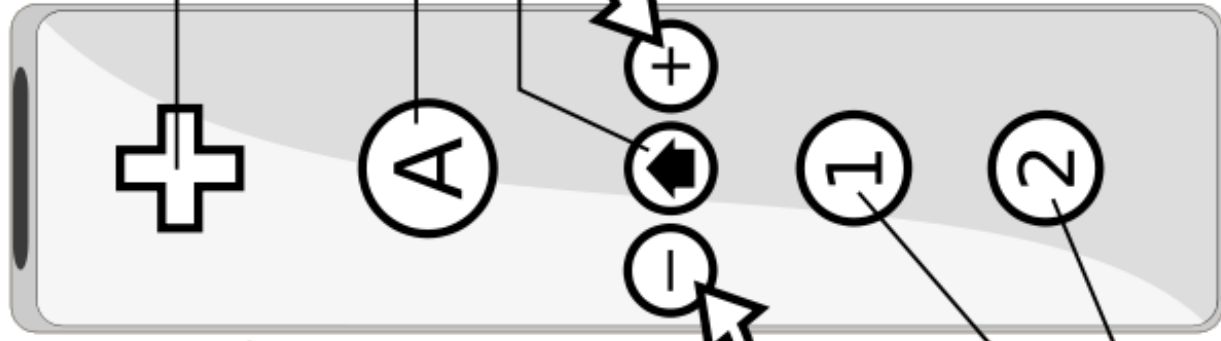
Using the Wii Remote

The Wii remote is a great tool for docents to use while giving live presentations. Before the remote can be used, it has to be paired to the computer. Remotes only have to be paired once. To pair a remote, launch the SOS Stream GUI. In the upper right hand menu bar an Earth icon should appear. Use this to launch the Wii remote software and in the window that pops up, select "Pair a Wiimote". Another pop up window will appear giving you instructions to press the red button on the back of the remote. After that, the address of the Wii remote is permanently stored and should appear in the top window of the Wii remote software. Only remotes that are paired will connect to the system. After pairing, the remote will need to be connected to the software.   In order to connect the remote, start the SOS Stream GUI (if it's not already open), and then press any button on the remote. After pressing any button, you should see the blue lights flashing at the bottom of the remote. Once the remote is connected it will vibrate once and one blue light will be on. If the remote won't work, close the SOS Stream GUI and restart it. Try connecting the remote again. If it still won't connect, try unplugging the Bluetooth dongle and trying again.

If there is no Wii charger, turn the remote off between uses to preserve the battery life. Use the power button in the top corner to turn it off. To turn it on, press any button. The remotes will stay connected as long as the SOS Stream GUI is open. Any time the SOS Stream GUI is closed, the remotes will disconnect and will have to be reconnected when the SOS Stream GUI is opened. The remotes will also disconnect if they go outside of the range of the Bluetooth dongle. The range will vary depending on the particular dongle that is used and the location of the dongle. In ideal conditions, the Bluetooth signal typically extends up to 100 feet.

Tilt (x, y)

Toggle z-rotation

Reset sphere tilt

Step forward
Hold: Fast forward x2
B + : Fast forward x4

Play / pause
A B : Rotate (z)
Roll

Step backward
Hold: Rewind x2
B − : Rewind x4

Next clip
Previous clip

Functions of the Remote
        All of the functions most commonly used during a presentation are available through the use the remote. You can then use the remote to navigate through the playlist. The "1" button will load the next dataset and the "2" button will load the previous dataset. Use the "B" button to pause and play a dataset. To step backward or forward frame by frame use the "-" or "+" buttons respectively. To fast forward or fast backward slowly hold the "+" or "-" buttons respectively.   To fast forward or fast backward quickly, hold the "B" button while pressing the "+" or "-" buttons respectively. To toggle the z-rotation on and off, use the "A" button. All of the buttons are very responsive and one light press is all that is needed.
        The Wii remote can also be used to tilt and position the image on the sphere. The left and right arrows tilt the dataset on its x-axis, the up and down arrows tilt the dataset on its y-axis. (*NOTE – the orientation of the x and y axis is not the same for all datasets*) To rotate the sphere on the z-axis, hold down the "A" and "B" button while rotating your wrist in the desired direction of rotation.   If you want to reload the dataset in its original orientation, press the "Home" button.

Organization of Data
        Before you make playlists, it's helpful to understand how the data is organized. All of the Science On a Sphere® datasets are put into one of the five main categories. These categories are:

- Astronomy
- Atmosphere
- Land
- Models and Simulations
- Oceans

There is also an "Extras" category that contains assorted clips and videos that don't fit into the above categories. Within each category there are many datasets. While there are some datasets that could fit into multiple categories, we keep them in just one category to remove redundancy. A full list of all of the datasets available in the categories is available on the SOS website at: http://sos.noaa.gov/datasets/
        Every category has a directory that contains a folder for each dataset in that category. The dataset folders contain all of the data and information that you need to put the dataset up on the sphere. You will see all of these directories at /shared/sos/media/ on each computer. Each dataset folder contains (if available):

- Texture file (if still image)
- Folder with raw images named for the size of the images
- An equatorial cylindrical equidistant video (.mp4) of the data
- Text file labeled labels.txt
- Text file labeled playlist.sos
- Color bars and other supporting images
- Media folder with thumbnails, videos, and supporting documents

A uniform naming convention has been used among the folders. Images that are projected onto the sphere are named for their size, movies that are projected onto the sphere are named for their dataset name and size, all labels are named labels.txt etc. This has been done to make it easy for the user to know what is available in each folder.

Datasets that are related to one another are all grouped into one folder. Each dataset still has its own folder, but then those folders are all put into one folder. For instance, in the "atmosphere" category there is an "aerosol" folder. This "aerosol" folder contains three folders, one for each of our related aerosol datasets.

Two Types of Datasets

There are two main types of datasets, textures and time series. Textures are the simpler of the two. They consist of one still image that can be set to rotate around the sphere. A good example of a texture is Mars. In the Mars folder you will find just one image, named for its size, which is projected on the sphere. Often, the textures are available in several different resolutions. As the resolution increases, so does the loading time on the sphere. Textures can be rotated in any way using the functions either in the "Control" menu or on the remote.

The second type of dataset is a time series. An example of a time series is the Indian Ocean Tsunami; you can watch the waves propagate across the globe. There are several different ways that time series work. In its raw form a time series is a collection of images. The images are named numerically, in ascending order. All of these images are in a folder named for the size of images. These images can be used to display the dataset on the sphere. The raw images can be converted to a MPEG4 as well. MPEG4s are named for the dataset and the resolution of the movie. This is the preferred format for showing time series because the system can play the MPEG4 files at a faster frame rate than the image sequences. The MPEG4s and raw images can also be set to rotate while they are animating through a feature in the playlist and a button on the remote.

NOTE: Even if you make an MPEG4, it's good to keep the raw data available.

Playlist.sos

Within each dataset folder is a text file named playlist.sos. This file is used to specify how the data is displayed on the sphere. There is a fairly strict format that must be followed within the playlist.sos file. Any specifications that are made in the playlist.sos will be used in all of the playlists that include that dataset. Here are the parameters that can be included in the playlist.sos file:

include = Include a play list snippet for a data set.
        list snippet must contain only a single clip. Usually included
        from the data directory where it resides.

name = Name show on menu (must specify)
        Name or label for the playlist entry. The name is used as text for the
        play list item button on sos_stream_gui

rename = Over ride "name ="

This is a way to over ride the "name=" from an included play list

data = /path/to/data/directory (must specify)
    For time series data, the /path needs to end in /path/P1,
    if opengl = 1, then it must end in a ".jpg" or some other
    image file name.
datadir = Depricated keyword. Replaced by the new keyword "data ="

background = path to a single frame of data
    Specifies the path to a background image (e.g. such as a topography image).
    Can be used in conjunction with "data=", where the "data=" specifies a time
    sequence of cylindrical data files that have an alpha transparency channel
    set (usually .png files). This gives a basic overlay capability.

fps = frames per second (30 if not specified)
    How quickly the animation sequences through data frames

pip = /path/to/embeded/image
    The pip, is an image or MPEG4 file that will appear in a picture
    in a picture window on the sphere. The pip window appears based on
    the values set by the other pip control keywords. Multiple pip's may
    be specified

pipstyle = projector or globe or room
    Projector is default, where the pip is replicated and placed with the default
    position in front of each projector. A pipstyle of globe places one pip on
    the globe, by default with a latitude and longitude of both zero. As the
    sphere is tilted and rotated, this pip moves with the globe. A pipstyle
    of room places one pip on the globe, by default with latitude and longitude
    both zero. As the sphere is tilted and rotated, this pip remains stationary
    relative to the room, with the sphere data sliding underneath it.

pipcoords = lat,lon
    This moves the pip from its defualt position. There must be no white space in
    the lat,lon specification. This is similar to setting pipvertical and
    piphorizontal values, but here the pipi shape remains constant as it moves
    up and down. Using the pipvertical parameter, the sides of the pip follow
    lines of latitude, which distorts the true shape of the pip as it moves
    up and down. Both approaches can be useful.

pipfps = pip playback speed in frames per second for mpeg pips
    The default pip fps is now read from the pipi video mpeg file. This allows
    one to override that internal value.

piptimer = 10
    Length of time pip is displayed excluding fadein/fadeout (seconds)

Use a value of 0 for "duration of clip."

pipdelay = 5
    Time delay before pip is displayed (seconds)

pipwidth = 45
    Width in degrees of longitude

pipheight = 45
    Height in degrees of longitude

pipalpha = 0.8
    Opacity of pip over underlying image

pipfadein = 1
    Length of time pip takes to fade in (seconds)

pipfadeout = 2.5
    Length of time pip takes to fade out (seconds)

pipvertical = -10
    Vertical position of pip center above equator (degrees)

piphorizontal = 0
    Horizontal position of pip center east of projector
    subpoint (degrees)

duration = repeat time in seconds for entire clip, including PIPs.
    The timing of pips is no unrelated to the underlying dataset. The underlying
    data loops, and dwells may apply to the first and last frame as it loops, but
    the pip timing is unaffected by that. To make the pips loop as well, set the
    duration to the desired repeat time, in seconds. The default duration is 24
    hours.

firstdwell = number in millisecond
lastdwell = number in millisecond
    firstdwell and lastdwell. Specify time in milliseconds that
    the animation will stop on the first and last frame.
    Defaults to 0 milliseconds.

startframe = [some frame number] (default is 1 if not specified)
    Trim a long animation. If specified, the animation will only display frames
    beginning at "startframe" and going through "endframe".

endframe = [some frame number] (default is the last frame)
    Trim a long animation. If specified, the animation will only display frames

beginning at "startframe" and going through "endframe". Endframe values can
be absolute frame numbers, or if they are negative, the frame number is relative
to the end of the animation. The endframe can also be the key value of "end" to
specify the end of the animation

stopframe = some frame number
Stop animating when the animation reaches this frame number

animate = [0 | 1]
(if 0, then don't immediately start animating when
item is loaded (must hit play). Otherwise, automatically
animate when playlist entry loads.   In auto presentation mode,
always animate, even if animate = 0

skip = n (where n is the skip factor for a directory of files.
skip = 1 will skip every other file in a animation,
skip = 2 will play every third file, etc).
As skip gets bigger, total files animated over, goes down.

label = [default (displays frame filename) | /path/to/labels.txt]
No labels will show, if not specified, otherwise the label file contains on line
per frame of that animation. This is usually used to specify a data/time stamp for
a frame sequence. Label files are ignored for singe texture clips.

labelColor = R, G, B, Alpha ("White" if not specified)
(also can use symbolic names: white, black, red, green, blue)

labelposition = [default | x,y (range from -1, -1 ~ 1, 1)]
(-0.3, -0.5 if not specified)

audio = /path/to/audio/file (no audio if not specified)
The audio file can be anything that Linux audio player "Mplayer" can decode.
Examples of
valid audio file formats are: .mp3, .wav, .ogg, or .mp4

tiltx = number of degrees of tilt in x-axis.
tiltx only works if the data specifies a cylindrical data set (either in
mp4 or an image sequence)
tilty = number of degrees of tilt in y-axis.
tilty only works if the data specifies a cylindrical data set (either in
mp4 or an image sequence)
tiltz = number of degrees of tilt in z-axis.
tiltz only works if the data specifies a cylindrical data set (either in
mp4 or an image sequence)

zrotationenable = [0 | 1]

An SOS data set (time series data) can be rotated while the data is animating through time. Only supports animating around the z-axis (generally the axis that passes through the north and south poles.
Zrotation only works if the data specifies a cylindrical data set (either in mp4 or an image sequence)

zfps = frames per second (default 50)
    Rate at which the zrotation feature animates. Only valid if zrotationenable is 1

zrotationangle = angle in degrees (.1 degrees by default)
    Number of degrees of rotation for each time step during the zrotation.
    Only valid if zrotationenable is 1

timer = number of seconds (180 sec if not specified)
    timer is used in "auto presentation mode only".
    Specfies how long to play a presentation.

script = filename
    Run the specified script (or executable) when the clip is started. The script will be killed when the system plays the next clip. This provides a way of coordinating arbitrary additional activities with the clip. The script may also connect back to the SOS automation control interface to control the system with timing not otherwise achievable via the playlist keywords.

opengl = [true | 1 | 0] (Depricated keyword)
    This keyword is no longer used and this capability is figured out dynamically based on the value of "data="

slide = /path/to/slide/image
    slide show image come via the 2nd port of Graphic Card to side wall projector or big screen monitor.

category = "a string identifier"
    Categorization of this data, used to populate the library

keywords = comma separated list of keywords
    keywords to aid in searching

publisher = a string identifier
    The name of the person or organization who published this data

creator = a string identifier
    The name of the person or organization who created this data

Because all of the data is stored in the same folder as the playlist.sos file, it is not necessary to include the entire path to the file. You only need to include the data name.

For example, to include labels all you need to type is *label = labels.txt*. If the data is stored in another location, then the path needs to be included. For example, *label = /shared/sos/media/atmosphere/dataset/labels.txt*

A typical playlist.sos file will not include all of these parameters. At very minimum, "name" and "data" must be included. It is also recommended to always include keywords, publisher, creator, and category. Also, anything with a "#" in front of it is commented out and won't affect how the dataset is displayed. If the data was taken from online, it is often useful to include the web address of the data's original location.
There can be multiple playlist.sos files in one folder for different versions of the dataset. The file names simply need to start with playlist and end with sos. For example you could have playlist.sos, playlist_with_audio.sos, and playlist_extra_labels.sos all in the same folder.

Playlist Format
A playlist is an ordered list of datasets. It is often helpful to think of a SOS playlist as a music playlist in iTunes. Playlists can be saved and repeatedly used. Different playlists can be made for different presentations or shows. Also, docents can have their own playlists. All playlist file names have to end with the extension .sos and are stored in either /home/sos/sosrc or /home/sosdemo/sosrc depending on the user. The basic format of a playlist is a file that points to all of the playlist.sos files that are in the dataset folder. For example, here is a playlist that includes three datasets:

include = /shared/sos/media/oceans/indian_tsunami/playlist.sos
include = /shared/sos/media/astronomy/xray_sun/playlist.sos
include = /shared/sos/media/models/ipcc_temp/gfdl/playlist.sos

Each "include" is used to point to a different dataset. This example playlist includes the Indian Ocean Tsunami, the X-Ray Sun and the GFDL Temperature Change Model. All of the information about the labels, color bars and timing is saved in each of the separate playlist.sos files. The nice thing about this format is that everyone's playlists will be using the same versions of the data. However, if you do want to edit some of the options for a dataset, within only your personal playlist, you can do that. Simply include the changes in your demo playlist under the include. For example, if you want a faster rotation rate on the sun and a longer lastdwell for the tsunami in your playlist, you can change it like this:

include = /shared/sos/media/oceans/indian_tsunami/playlist.sos
lastdwell = 7000
include = /shared/sos/media/astronomy/xray_sun/playlist.sos
fps = 50
include = /shared/sos/media/models/ipcc_temp/gfdl/playlist.sos

Making a Playlist
There are two basic ways to make a playlist. The first is to manually type the playlist in a text editor and save the file with a .sos extension in either /home/sos/sosrc or

/home/sosdemo/sosrc depending on the user. For this you will need to know the path to each of the datasets on your computer. There is also a playlist editor that you can use to make your playlist. This is the simpler option because you don't need to know the location of the datasets on the computer. The editor is a drop and drag program that lets you drop and drag datasets into your playlist and then rearrange them as you please. The playlist editor can be launched from the "Playlist Editor" icon on the Desktop, or through the SOS Stream GUI with the "Edit Playlists" option under "File."

The Playlist Editor has two main tabs at the top, "Playlists" and "Clip Library." The Playlist tab has a list of all the playlists on the left and shows the contents of a selected playlist in the main window. The Clip Library shows the data categories on the left and has all the datasets in a selected category in the main window. To create a new playlist, click "New Playlist" under the Playlists tab. Give it an appropriate name (avoid using spaces and special characters in Linux) and press enter. The playlist will be automatically alphabetized with the other playlists. Find yours and then double click on the name to open it in a new window. Then select the Clip Library tab and drag the desired clips into the playlist that was opened in a new window. There is a search option in the playlist editor to help you find the desired datasets. Entire playlists can also be dragged into a new playlist. To edit a clip, select the "Edit Clip" button and make adjustments as desired.

One important note about the playlist editor is that it saves continuously, so there is no "Save" button. This means that you can view your playlist as you create it in the SOS Stream GUI by using the "Reload current playlist" button under "File". When the playlist editor is closed, a prompt appears that asks if the changes should be saved. This is the only time to undo any changes that have been made.

Giving a Presentation
Presentations with Science On a Sphere® can take on several different formats. The simplest is autorun. In the autorun mode, the system displays each dataset for three minutes (if not specified otherwise) before moving on to the next in the playlist. This is a good option when a docent is not available to lead a presentation. If this format is used, it's nice to have supporting audio or text so that the audience knows what they are looking at. There are audio tracks available with a limited number of datasets. The available audio tracks are in the dataset folders.

Side wall projectors or flat screen televisions can be linked to the Science On a Sphere® software to sync a PowerPoint presentation with a SOS demo. This can be used to display supporting information for each dataset, which is particularly useful in autorun mode. In addition to the PowerPoint software, there is also kiosk software available to accompany SOS. There are several different kiosks available, but they are generally very similar. They typically utilize a touch screen monitor that allows visitors to select which datasets they would like to view and provides a description of each of the datasets.

The preferred way to present Science On a Sphere® is with a live presenter to lead the audience through a playlist. The presenter can either be around to answer questions as visitors wander through or lead a structured presentation on a schedule. The length of a presentation can vary widely depending on the audience and topic. A standard presentation at the Planet Theater at NOAA in Boulder, CO is 30 – 45 minutes

and includes 10 datasets on average. Presentations in a museum setting tend to be shorted, focused presentations with less datasets.

Many sites give live presentations with the sphere throughout the day, and in between presentations leave the sphere on autorun. Presentations can be broad and include datasets from all of the categories, or narrowly focused on a topic such as climate change or the solar system. The type of programming is entirely up to the users.

Another aspect of the presentation that needs to be considered is if the audience will sit in one location or move about the sphere. With the rotation capabilities of SOS, it is possible to have your audience seated on one side of the sphere and rotate all of the datasets to be ideally positioned in front of them. The second option is to have the audience walk around to different sides of the sphere, rather than rotating the data. There are pro's and con's to both options, so it's up to the users to decide which option best fits their needs. Be aware that sometimes your audience will be distributed around the sphere and they will not all be able to see the same thing at the same time. In this case, it's helpful to allow a dataset to play through several times, rotating it so that everyone gets to see everything.

Session 4
Presenter Training and Dataset Overview

One of the most compelling ways for audiences to view Science On a Sphere® is through a guided presentation by a docent. Well informed docents are able to point out features in the various datasets and stress a "take-home" message for audiences to grasp. It is important that docents know how to use the system and also understand the science that they are presenting.

<u>Starting the System</u>

The computers will typically be on all the time and logged into an "sosdemo" account. If the SOS Stream GUI is not open, do so by double clicking the "Start SOS" icon on the desktop. This will launch the SOS Stream GUI which is the interface for controlling the SOS system. Next, connect the Wii remote by pressing any button on the remote. The lights on the bottom of the remote will flash until the remote connects. You can tell when it's connected because it will buzz once and then one light will remain on.

The SOS Stream GUI automatically opens a playlist titled normal-demo.sos. If you want to use a different playlist, select "Open Playlist" under "File" and find the playlist that you prefer. You are now ready to start your presentation. You can use either the remote or the keyboard to control the system. (see pages 10-12 for the functions of the remote and keyboard and pages 19-20 for how to make your own playlist)

<u>Presentation with Science On a Sphere</u>

During the installation week, a NOAA trainer will give a 20 – 40 minute presentation with the sphere to demonstrate one method for using the sphere. Typically guided presentations can last anywhere from 15 – 60 minutes depending on your audience. The presentation can either be a broad overview of everything that is available on Science On a Sphere from astronomy to hurricanes and ocean currents, or can focus on specific topic such as climate change or a tour of the solar system.

Many museums develop several different presentations that cover topics of interest for their museum's audience. The NOAA trainer will give a broad overview presentation just to highlight some of the most compelling datasets that come with the sphere. The trainer will also be available for questions about any of the datasets. All of the datasets have documentation online (sos.noaa.gov/datasets) that provide details of the dataset.

<u>Dataset Overview</u>

It is helpful for presenters to know what is available to them when they are developing their own playlists. The data is organized into five main categories: atmosphere, astronomy, land, oceans, and models and simulations. There is also an additional category of extras which includes movies and other assorted datasets. The "Library" tab in the SOS Stream GUI provides a playlist for each category and is a great way to browse all of the available datasets.

Session 5
Content Creation

Knowing how to create and add content to your Science On a Sphere® allows your site to have the latest and most up-to-date datasets. Members of the SOS Users Collaborative Network often share content that they create with the other SOS sites. This session is meant to familiarize users with the process of adding new content and creating content. All of the datasets are owned by the user sos and cannot be edited or deleted by the user sosdemo. There is one folder in /shared/sos/media/ called site-custom where the user sosdemo can add, delete and edit content that is created by the site. For any modifications to the content from NOAA, you must be logged in as the user sos.

Data Organization

As covered in a previous section, each dataset has its own folder that contains all of the pieces that are needed to display the dataset on the sphere. The only two pieces that you must absolutely have to use a dataset is the image or images/mp4 and a playlist.sos file. All of the other pieces, such as the labels and color bars, are optional, but nice to have. Every folder is stored in one of six categories. It is recommended that any new datasets developed by your site be stored in a separate folder, named after your location or institution. This way you can keep track of which datasets are local to your site and which are provided by NOAA. In some cases, it is useful to create a folder called "Proto" or "Prototype" where you can store new datasets that you are working on.

Types of Datasets

We've already that mentioned that there are two main types of datasets: textures and time series. Textures are a single, static image that can be set to rotate on the sphere. Texture datasets are relatively simple to make because you only have one image to work with. You can set the rotation rate of a texture by setting the frames per second (fps) setting in the playlist.sos file. Making a time series can be a little more difficult. There is no limit on the number of images that you include in a time series, except for available disk space. You can animate the time series at any rate, but 30 frames per second is the recommended speed. We try to create our data so that they look smooth and animate well at 30 fps. The frame rate is sometimes limited based on the pixel resolution of the data and the type of data. It is important to keep this in mind when creating a time series so that you make enough images to ensure that the dataset plays for a reasonable length. If you only make 30 images, then it will only take one second to loop through the dataset at 30 frames per second. The optimal playback speed is chosen based on the number of frames and the degree of change between each data frame in the sequence. To get smooth animations the changes between each frame should be small and the playback speed high. If a dataset is coarse, then it might animate better at a slower frame rate such as 10 – 15 fps.

For making time series, you should consider using a background image that you can then layer data on top of. You have to use PNG's if you are going to do this because they allow for transparency. This provides a great way to save disk space, because you only need one background image. The images that have data are much smaller files.
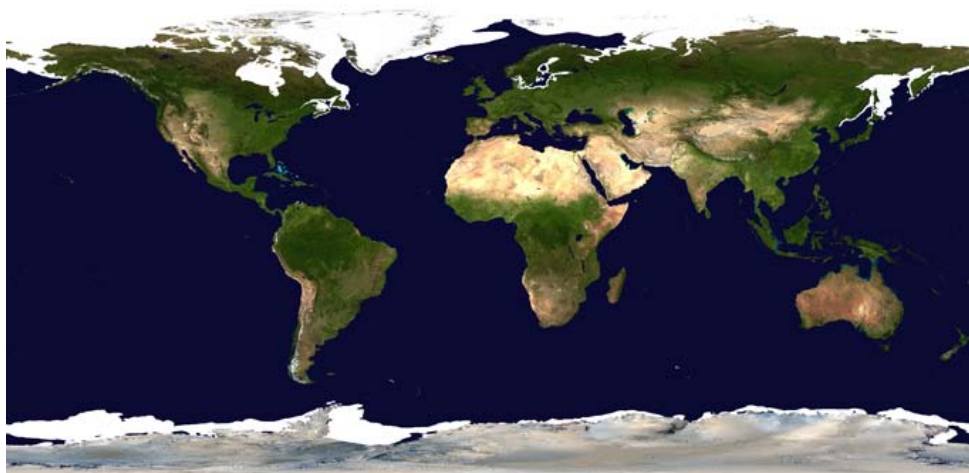
Here is an example of a background image and a transparent data frame that you can layer on top of one another:

Sea ice concentration image with transparent background
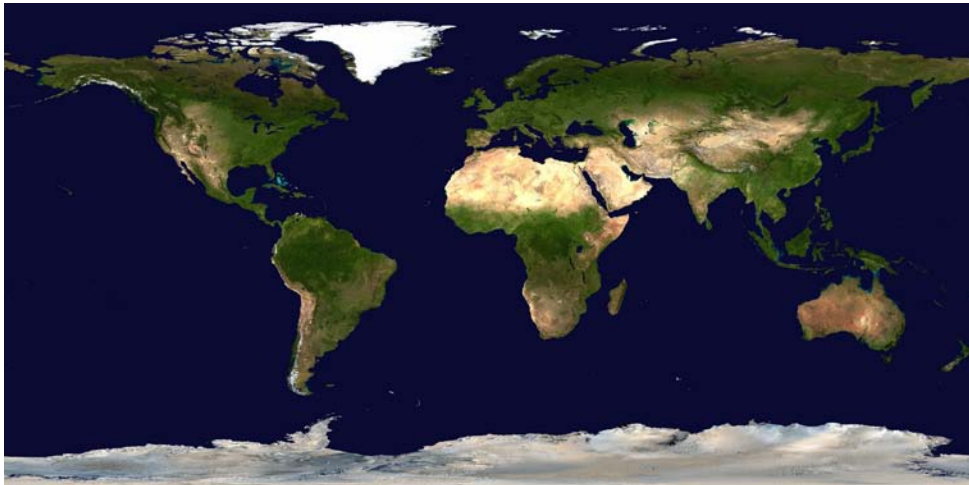
Background base map for the sea ice concentration data

Sea ice concentration image layered on top of background base map.

File Format

In order for the data to wrap properly around the sphere, it is imperative that you follow the specifications for the data format closely. Images in the wrong projection format will project on the sphere, but they won't look good. The images need to be plotted using the Equatorial Cylindrical Equidistant (ECE) projection. An ECE projection is commonly referred to as a simple lat/lon grid, where the image is a standard cartographic map projection that is twice as wide as it is tall (rectangular). For textures, 2048x1024 is the suggested minimum size, though 4096x2048 is recommended to optimize the appearance of the image on the sphere. For animations, 2048x1024 is the recommended size. The SOS system is fairly flexible as to what file formats it can handle. It will accept most common format such as GIF, JPEG, PNG, TIF, etc for textures. We prefer JPEG or PNG. If you want to use a background image and then layer data on top of it, then you should use PNG because it allows for transparency. For animations, the only acceptable format is MP4. It is important that the data fill the entire image space. If there are borders or extra space around the edges then a seam will appear on the sphere with spots on the poles.

For texture data you just need one image. To be consistent with the organization, the texture images that you create should be named for their size. For a time series you need a sequence of images. The image file names should sort in ascending order from earliest to latest. To do this, we usually use the date of the image in the name of the file or embed a frame number in the file name, with a sufficient number of leading zeros where necessary to sort correctly. When you create a time series, the images should be kept in a folder named for the images' size.

System Interactions with Data

When a dataset is projected on the sphere, you are really looking at four images that have been merged together seamlessly around the sphere. The Science On a Sphere® software splits the ECE images that you load using the SOS Stream GUI into four disk images every time you load a new dataset on to the sphere. Because all of the work is done by the software automatically, you don't need to do anything except point the system to where the data is located by creating a playlist.

Tools to Create Datasets

Because Science On a Sphere® uses common image and video formats, you can use many tools to create and edit datasets. Some of the common tools used are Photoshop, FinalCut Pro, ImageMagick, GIMP, etc. You can use whatever you have available and are comfortable using. A program like FinalCut Pro can be used to add transitions, special effects and other computer graphic techniques. At a higher level, tools like IDL, AWIPS, McIDAS, and other image analysis applications are typically used to create imagery from scientific datasets. As an example, we have used AWIPS (Advanced Weather Information Processing System) to create images from numerical forecast models. A graphics designer can use a 3D modeling application, such as 3D Studio, to create advanced visualizations for SOS.

<u>Options in the Playlist</u>

You can optimize how a dataset is displayed by understanding all of the options that are available to you in the playlist.sos files. You can do much more than simply display the dataset. All of the functions available in the playlist are listed above in the Overview and Basic System Use section (page 14-18). Now we will go over how to best use all of these functions available.

For a texture dataset, there are only a few options that you need to consider. When a texture dataset is initially loaded on the sphere, you can set whether you want it to rotate immediately or only after play is pressed. The function "animate" in the playlist controls this. If "animate" is not included in the playlist, then the default is for the dataset to automatically start rotating. "animate" can be set to either 0 or 1. 0 will prevent the dataset from animating until play is pressed, and 1 will cause the dataset to start rotating immediately when loaded. Another common function used with textures is the tilt option. For instance, we have our Earth textures set to load at a 23.5° tilt to resemble the Earth's actual tilt. This is also useful if you are loading a dataset that highlights the poles, which are hard to see if there is no tilt. To set the tilt, use "tiltx," tilty," and "titlz" to the number of degrees that you want each axis tilted. The tilt can be positive or negative.

For a time series, you have all of the options mentioned for the texture, plus many more. Rather than causing a dataset to rotate, "animate" causes a time series to start animating, but the functionality is the same. The default is for the dataset to start animating immediately. When a presentation is docent-led, it is often helpful to have the time series animate only after play has been pressed. This gives the docent time to provide background information about the dataset and explain what is going to happen. (In autorun mode "animate" is automatically set to 1 regardless of what is in the playlist.) Another option is to set "firstdwell," which is an amount of time that the system lingers on the first frame before animating. The default is zero seconds. The time is listed in milliseconds, so "firstdwell = 4000" will dwell on the first frame for 4 seconds. You can also dwell on the last frame by setting "lastdwell." When "lastdwell" is not set, the dataset loops continuously without pausing. Especially with model data, it is nice to set "lastdwell" so that the audience can get a good look at the last frame before the dataset loops again. If you want to pause the animation on a specific frame, you can set "stopframe" to the frame number that you want the animation to stop on. It will stop on the specified frame and then continue to animate through the rest of the animation when play is pressed.

With particularly long datasets it's sometimes nice to show only a piece of the dataset. You can do that by setting the "startframe" and "endframe" to the frame numbers that you want to start and end on. An example of when to use this would be if you just want to show a loop of Hurricane Katrina, not the entire 2005 season. You would use the 2005 Hurricane dataset, but set the "startframe" and "endframe" so that only the piece of the dataset when Hurricane Katrina was visible is shown. The "endframe" can be a negative number, which counts back from the end. Another way to shorten a dataset is to set the "skip" option, which allows you to set a skip factor. When

"skip" is set to one, it skips every other image, and when it's set two, it skips every third image.

Another option that you have for times series is to not only have them animating, but also rotating. For example, the default for the Indian Ocean Tsunami dataset is for the base image to stay stationary while the waves propagate across the ocean. This means that only the audience standing in front of the Indian Ocean can see the waves. When "zrotationenable" is set to 1, then the dataset will rotate about its z axis while it animates. You can also use "zfps" and "zrotationangle" to set the frames per second rate for the dataset and the angle at which the dataset rotates. Make sure that you set your "zfps" at a rate that allows your audience to still grasp what they are looking at before it rotates out of site. For especially busy animations, it could be distracting to the audience to see both the animation and the rotation.

There are also some functions in the playlist that should be specified when using auto run. Auto run mode cycles through the datasets in a playlist automatically, showing each dataset for a specific amount of time. You can specify the amount of time each dataset is shown by setting "timer" to the number of seconds desired. If this is not specified, then each dataset is shown for 180 seconds. If "timer" is specified and you are not showing the playlist in autorun more, then "timer" will be ignored. It's important to use "timer" when you also have accompanying audio tracks so that the dataset is shown for the length of the audio track. You will want to make sure that the audio is synced with the playlist. You can set audio for each dataset by specifying the desired track with the "audio" keyword. The audio tracks must be compatible with the Linux Mplayer such as .mp3, .mp4, .wav, or .ogg. Audio tracks are available from NOAA for a limited number of datasets. They provide a good way to give your audience information when a docent is not available.

Picture in a Picture

Picture in a Picture (pip) allows you display single pictures (any of the previously mentioned image formats works), a directory of images, or videos (MPEG4 only) on top of any dataset. This feature can be used to display any image, but is commonly used to display color bars, charts and graphs, and other images that supply supplemental information. Also, you can have multiple pips which can be either displayed all at once, or set to run like a slide show on the sphere. For example, there is a Mars dataset that has all of the landing sites on Mars labeled. To compliment this, pips are set to cycle through a slide show of images taken from different exploration trips to Mars. Images that you are going to use as pips can be stored in the dataset folder that they go with. When a pip is included, there are several options that you have to set.

There are three different styles for pips: projector, room, and globe. "Projector" is the default, where the pip is replicated and placed with the default position in front of each projector. A "pipstyle" of "globe" places one pip on the globe, by default with latitude and longitude both zero. As the sphere is tilted and rotated, this pip moves with the globe. This allows you to use pips as geo-referenced markers. A "pipstyle" of "room" places one pip on the globe, by default with latitude and longitude both zero. As the sphere is tilted and rotated, this pip remains stationary relative to the room, with the sphere data sliding underneath it.

The "piptimer" has to be set (in seconds) so that the system knows how long to display the pip. If the "piptimer" is set to 0, then the pip will be displayed for the duration of the dataset. You can delay the appearance of a pip by using "pipdelay," which is in seconds. Rather than having the pips appear abruptly, you can use the "pipfadein" and "pipfadeout" to fade the pip in and out in a specified number of seconds. The time to fade in and out a pip is excluded in the total amount of time allotted in for the "piptimer." By default, a series of pips will play through only once. You can set "duration" to a given number of seconds and the pips and underlying dataset will loop based on the set duration.

In order for the pip to be an appropriate size for the sphere and in the proper proportions, you have to set the "pipwidth" and "pipheight." The width and height are measured in degrees latitude and longitude. If you set just the height or the width, the software will automatically scale the image. If you are using "pipstyle" "projector" you won't want to make your pip more than 90 degrees wide because the pip appears four times (once for each projector) and it will start to overlap. In addition to the pip size, you will also need to determine where you want it displayed on the sphere. If nothing is specified, then the pip will appear in the middle of each of the projector views. To adjust the position of the pip, use "pipvertical" and "piphorizontal." Both of these are in degrees. "pipvertical" is the vertical position of the image relative to the equator, with positive degrees above the equator. Be careful as you move the pip up and down as images near the poles become warped. The horizontal position is relative to the center of the projector, with positive degrees east of the project. An alternative to using "pipvertical" and piphorizontal" is to use "pipcoords," which is set in degrees latitude and longitude. The benefit of using "pipcoords" is that there is no warping of the images, even near the poles. "pipcoords" is also used with "pipstyle" "room" and "globe" to position the pip.

When a pip is a mp4 file, the default playback speed is the frame rate of the dataset on which it is overlaid. If you want to control the frame rate of the pip, then use "pipfps" to set a new frame rate. The final option to set with a pip is "pipalpha," or opacity. If not specified, the pip shows up opaque. If you don't want your pip to completely block the underlying image you can adjust the opacity of the image from 0, which is completely transparent to 1, which is completely opaque.

Labels and Color bars

Labels and color bars can be in the raw images or projected on top of them externally. It is recommended that you do not add the labels and color bars directly to the images that you create. By keeping them as external images, you have much more flexibility with their size and position within the playlist.sos file. If you do choose to put you labels and color bars directly on the images that you create, make sure that you make them big enough so that they are legible on the sphere and that they are far enough from the poles that they don't get too warped.

One of the nice things about keeping the labels and color bars external is that they don't move as you rotate a dataset. They stay in the same position relative to the projectors. Labels and color bars that are part of the image rotate with the image, which can cause viewing trouble for the audience as you move the sphere about. Within the playlist.sos file you can set the position using "labelposition," which is set by the x and y

position as a pair of coordinates (x,y). Both x and y can vary from -1 to 1. The default position is (-0.3, -0.5). The label color can be changed with "labelColor" which can be set to R, G, B, Alpha, (or the symbolic names: white, black, red, green, blue…). The default color for the labels is white. While you can change the position and color, you cannot change the size or font.

The labels are a simple text file that contains one line for each image in the dataset. If you have labels for a times series that contains 2000 images, then you need a text file that has 2000 lines. In the playlist.sos file, if *label = default*, then the image file names appear as the labels on the sphere. You can easily create your labels using any text editor. The label file is stored in the dataset folder and is named labels.txt. Typically the labels contain the date and maybe a title. Here are some examples of labels.txt files:

```
07/24/2004 06:45
07/24/2004 07:15
07/24/2004 07:45
07/24/2004 08:15
07/24/2004 08:45
07/24/2004 09:15
07/24/2004 09:45
07/24/2004 10:15
07/24/2004 10:45
07/24/2004 11:15
07/24/2004 11:45
07/24/2004 12:15
```

```
SSEC 08/31/2005 Katrina
SSEC 08/31/2005 Katrina
SSEC 08/31/2005 Katrina
SSEC 08/31/2005 Katrina
SSEC 08/31/2005 Maria Katrina
SSEC 09/01/2005 Maria
SSEC 09/01/2005 Maria
SSEC 09/01/2005 Maria
SSEC 09/01/2005 Maria
SSEC 09/01/2005 Maria
SSEC 09/01/2005 Maria
SSEC 09/01/2005 Maria
```

If you don't want to include the title in your labels file, then you can make an image of title that you can include as a pip. This allows you to choose the font and color scheme of your choosing when you make the title image. This is also a nice option because then you don't need to insert the title into every line of your labels file. Here is an example of a title that was made into an image for pip:

There is a lot of flexibility with the color bars. They are inserted into the playlist.sos file as a pip. Using this function, you can not only set the position, size and transparency, but also when the color bar appears, how long it stays visible, and how quickly it fades in and out. The color bars can be any common image format such as GIF, JPEG, PNG, TIF, etc. Color bars are generally named color_bar in order to keep all of the various images in the file separate.

Playlist Editor

All of the above features for the playlist.sos file can also be used within the playlist editor. When you use the playlist editor, changes you make will affect only your individual playlist that you are editing. Any edits that you make with the playlist editor

will overwrite in your individual playlist the existing settings that are in the playlist.sos file. The playlist.sos file is the master copy of how the dataset is displayed, so if you make changes in the playlist.sos files, the changes will appear in everyone's playlists. To edit a dataset with the playlist editor, simply double click on a dataset in your playlist editor to open a window that has all of the options listed or select a dataset in your playlist and click the "Edit Clip" button at the top of the window. There are three tabs across the window that will pop up: "Sphere Display," "Commentary," and "Picture in Picture."

Under "Sphere Display," you can set the display options, such as animation speed, tilt, endframe, and stopframe. In "Commentary," you can add an audio file and any notes that you want linked to the dataset, and the "Picture in Picture" tab allows you to add new pips.

Adding New Datasets

The SOS computers are configured to download new content from the NOAA FTP server once a week and update the library catalog in the SOS Stream GUI. Make sure to check often to see what is new. A list of new datasets is available on the SOS website in the Datasets section under "Recently Added!"

For new datasets created by your site, there are just a couple of steps to follow to get the dataset on the sphere. First you need to find a place to store the file on the primary computer, such as your site's personal folder in /shared/sos/media. At very minimum the folder you create for a new dataset should contain the raw image or images or mp4 and a playlist.sos file. Make sure that the playlist.sos file is written according to the playlist format listed in the Overview and Basic System Use section. You can use existing playlist.sos files as an example for new playlist.sos files. These can be created using the text editor that is available on the computer. Remember that the playlist.sos file is used in all of the playlists that contain the dataset, so set it how everyone will want to use it. You can personalize it within your own playlists. If you have any other pieces such as labels or color bars or pips, those should go in the folder as well.

In the playlist.sos file, make sure to specify the category. The SOS software uses the category in the playlist.sos file as a tag to populate the library in the SOS Stream GUI. For example, every dataset that has atmosphere listed as its category in its playlist.sos file will appear in the atmosphere playlist in the library. If you forget to specify a category for a dataset, then it will be put into an uncategorized category in the library.

To view your new dataset you can either make a playlist that contains it, or you can update the library and find it the category that you specified. It is a good idea to view and tweak a dataset before using it in a demo, especially it's you've added labels, color bars or pips. Make sure that everything looks good and appears when and where you want it too.

Real-time Datasets

There is a collection of over 30 real-time datasets that are provided by NOAA. Because these datasets tend to be quite large and internet speeds vary from site to site, the SOS computers come configured to download just the five most popular datasets. Typically sites are set to download real-time data either every hour or every three hours. The frequency of the downloads, and the amount of real-time datasets downloaded can be

adjusted for each site.   In /shared/sos/media/playlists are various real-time dataset playlists that vary from just a few datasets to all of the real-time datasets. You can also create your own playlist of the real-time datasets that your site is interested in using. A crontab is then used to keep all of the real-time datasets in your playlist up to date. For more information on the crontab, visit: http://sos.noaa.gov/support/flash/

Sharing Datasets
        If your site does not have the necessary tools or the expertise to create datasets, you can still get new datasets. NOAA is constantly adding new datasets to their library that are available. The SOS computer is set to download any new datasets once a week from the NOAA FTP server. Collaboration with other Science On a Sphere® users is encouraged and recommended. This is a good way to get help making new datasets. Check out the list of other SOS sites here. Sites are also encouraged to provide the datasets that they create to the NOAA library so that all of the other SOS sites can use them as well. A SOS users group, noaasos, has been created as a Yahoo Group. This is a place to ask questions, get advice and work with other sites. To join, please provide your email address to the NOAA SOS team in Boulder, CO.

Appendix A

Helpful Links

Science On a Sphere® Website: http://sos.noaa.gov/

SOS Video Tutorials: http://sos.noaa.gov/support/flash/

Public FTP site: ftp://public.sos.noaa.gov/

Private FTP site: ftp://ftp.sos.noaa.gov/

Playlist Format: http://sos.noaa.gov/docs/pl_3_2_x.html

Existing Sites: http://sos.noaa.gov/news/sos_sites.html

Content Creation: http://sos.noaa.gov/docs/content_creation.html

Science On a Sphere® FAQ: http://sos.noaa.gov/docs/faq.html

SOS How To: http://sos.noaa.gov/support/howto.html

Ubuntu Linux Website: http://www.ubuntu.com/

SOS Yahoo Users Group: http://tech.groups.yahoo.com/group/noaasos/