OLTARIS User Guide

[Note: The user guide has been updated for the most recent update to the website. However, some of the figures near the end of the document have not been updated. The information is still relevant, but the images may not match exactly what is seen on the site.]

Introduction

On-Line Tool for the Assessment of Radiation in Space (OLTARIS) is a internet-based tool that assesses the effects of space radiation to humans and electronics in items such as spacecraft, habitats, rovers, and spacesuits. This document explains how to input data, perform assessments, and examine results using the web-based user interface.

The OLTARIS architecture is divided into two main parts, the website, in which users interact through a browser, and the execution environment, where the computations are performed. The website is built primarily with standard open source components. The execution environment is primarily FORTRAN executables tied together with some scripts running on a computational cluster. Data is passed between the web server and the cluster using XML files.

OLTARIS requires a browser (Firefox, Chrome, and Safari have been tested) with JavaScript support. The login system requires that the browser's settings are set to allow cookies. It is sufficient to only enable "session" cookies and the cookies will only exist in the browser's memory until the user closes the browser or logs off OLTARIS.

Registration

User Accounts

Users need to register on OLTARIS and have the account activated before they can enter the website. This is done for security. Once the user account has been activated by the site administrator, the user can login and start using the tools.

Home Page

The home page is at https://oltaris.nasa.gov/. The home page is used for logging on to OLTARIS. The home page also contains links for registering for a user account, changing the user's password, and viewing documentation. Beneath the login form and links is posted general information about system requirements, general use, current capabilities and a list of known issues.

Site Administrator

The NASA Official link that is located in the footer of each OLTARIS web page is an email link to the site administrator.

Registering for an account

The register link, *Sign up*, on the OLTARIS home page brings up a form for requesting an OLTARIS user-account. The form provides the information that the site administrator needs to determine that a person qualifies for an account. The form is also the mechanism through which the user specifies a user name and password for the account. The user receives an auto-reply to confirm receipt of the application. The site administrator reviews and verifies the registration and gets the necessary security approvals. If approved, the user receives an email from the site administrator announcing that the account is activated.

Logging on to OLTARIS

The user logs on to OLTARIS from the home page by entering a user name and a password.

Changing a Password

The *Forgot your password?* link is on the home page. The user is prompted to enter the email address used to set up the account and then a link will be sent to that email address that can be accessed to change the password.

Forgotten User Name

The *Forgot your user name?* link is on the home page. The user is prompted to enter the email address used to set up the account, then the correct user name will be mailed to them.

General Usage

Screen Layout

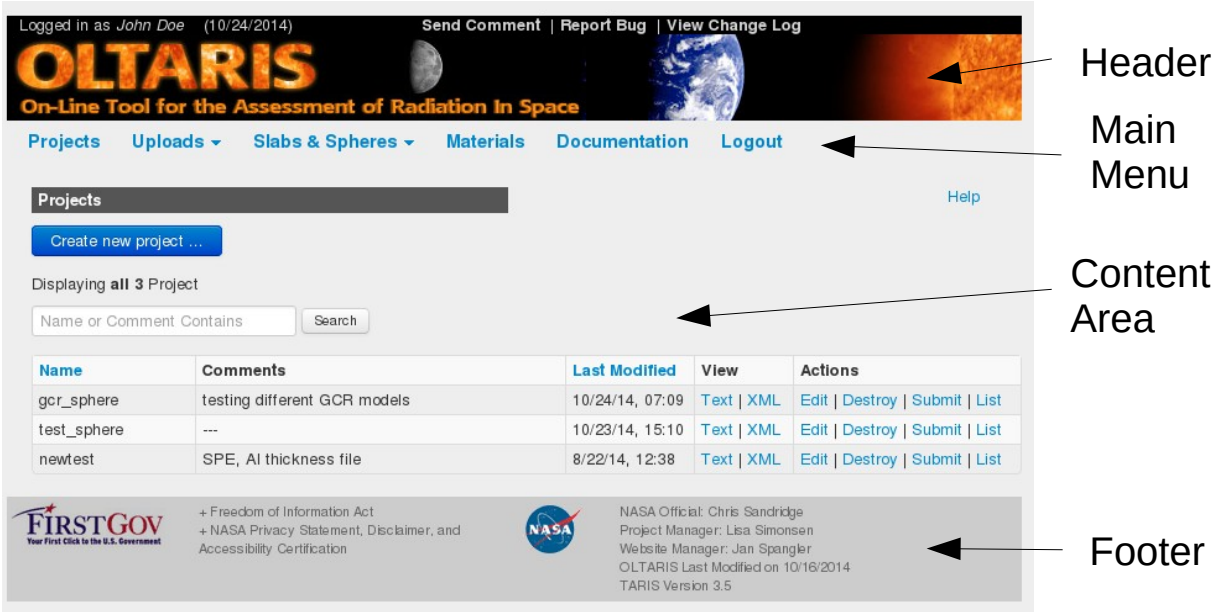


Figure 1: Screen Layout

Header Area

At the top of the page header is the name of the user that is logged in and the current date. Below that are 3 links:

Send Comment	Email link for contacting the site administrator.
Report Bug	Email link for reporting issues that the user feels is a bug in the product.
View Change Log	Brings up a log or record of changes made to the website, including records such as bug fixes, new features, etc.

Main Menu

The main menu is arranged as a series of tabs and pull-down menus. Selections from the main menu send the user to different modules (i.e., main sections) of the OLTARIS website. When the user logs in, they start on the Project page.

Content Area

This area provides screens in which users can create and interact with their data. Every screen has one or more help links, indicated with a 'Help' along the right margin. Selection of a help

link brings up a window that contains the most up-to-date usage information. Some areas also have a 'Reference' link that brings up more detailed information about the models and gives the users lists of publications pertaining to the specific model. Error messages and warnings are usually displayed at the top of the content area.

Footer

The footer contains email links to the NASA Official (see section on site administrator), the Project Manager, and the Website Manager. The footer also displays the date that the OLTARIS website was last modified and the release number of the TARIS FORTRAN code running on the computational cluster. This version number is also saved with the results as the jobs are run.

Data

Data Types

There are 5 main categories of user data:

Data Type	Description
Projects	Projects are the top-level containers for radiation analyses. Each project includes a definition of the radiation environment, a geometry selection, and a selection of desired responses.
Jobs	A job is an instantiation of a project that is packaged for processing. Jobs are created whenever a project is submitted for processing. Multiple jobs can be associated with the same project.
Uploads	An upload can be a space vehicle thickness distributions or a user-generated spacecraft trajectory.
Slabs & Spheres	User-defined slab and sphere geometries.
Materials	User-defined materials.

Data is presented to the user in lists. For example, as shown in Figure 2, selection of Projects from the main menu would cause all of the user's projects to be displayed as entries in a list:

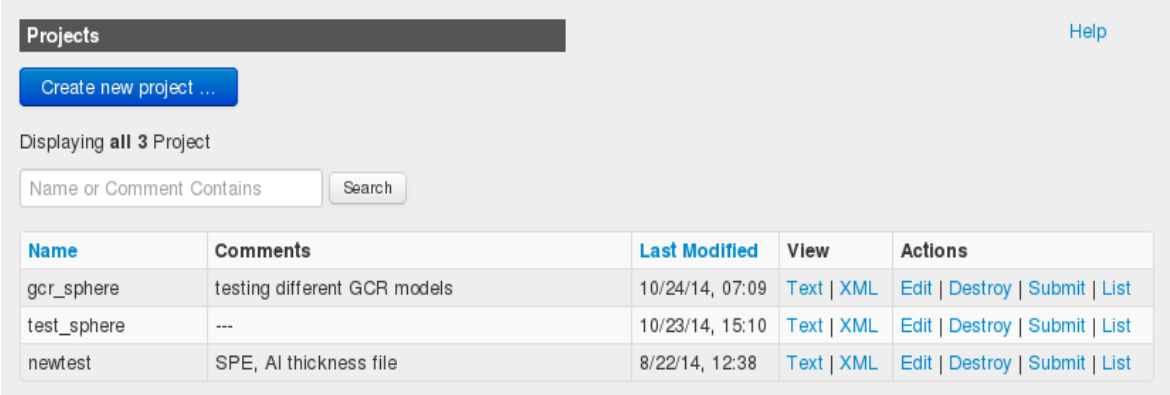


Figure 2: Projects List

The user can list any category of data through selection of the corresponding item from the main menu. The only exception is the Jobs List which is linked to from within the Projects Module.

Data Lists

Data lists all have a similar format:

Column	Description
Name and Comments	The name and comments fields allow the user to categorize projects as they wish. Hovering the mouse over the text and left-clicking lets the user edit the name or comments inline.
Last Modified	The date and time at which any attribute of the data object was last modified.
View	Selection of the Text link displays a user friendly summary of the project. Selection the XML link displays the XML description of the project. The View column only appears in the Projects list.
Actions	This column contains links for updating the state of the data object such as edit, delete, etc.

Lists are ordered by the last modified date but default but can also be ordered by name by selecting the column heading. Lists with many entries are paginated (i.e., the list is split over several pages) such that there are no more than 15 entries per page. Next and Previous links at the top of a paginated list cycle the user through the different pages. The search box which

appears above the data list is used to filter which objects are displayed in the list. Only those objects that contain the search term in either the name or comments field will appear in the list.

User-defined Data vs. OLTARIS-supplied Data

The thickness distributions and materials lists contain both user-defined data and OLTARIS-supplied data. OLTARIS-supplied data are designated with an asterisk '*' and are listed after all the user-owned data. For example, as shown in Figure 3, the user's thickness distributions are listed first and the OLTARIS-supplied thickness distributions are next and marked with an asterisk. User-defined data are data objects that are created by the user and can be edited, viewed, and deleted. OLTARIS-supplied data can only be viewed or referenced in other data.

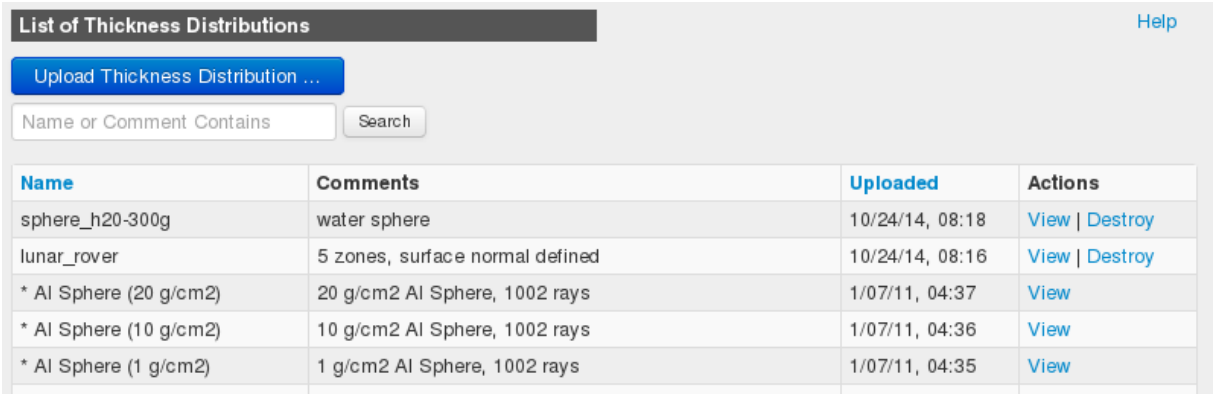


Figure 3: Thickness Distribution List contains both user-defined and OLTARIS-supplied data objects.

Creating New Data Objects

New data objects are created by clicking on the button that appears above the data list. For example, as shown in Figure 2, selection of the 'Create New Project …' button redirects the user to a form for defining the different aspects of a radiation analysis. Submission of the form returns the user to the list. The newly created object appears as the first item in the data list.

Editing Data Objects

Selection of the edit link redirects the user to a form that can be used to edit the data object.

Delete Data Objects

Selection of the destroy link deletes a data object. For most data objects, the user is asked to confirm the delete.

OLTARIS Modules

This section describes the major modules of the OLTARIS website. Modules are entered by selecting items from the tabs across the top.

Projects

Each project is the complete encapsulation of a radiation analysis; it includes the definition of the radiation environment, the selection of a thickness distribution or slab, and a selection of desired responses. The Projects Module allows the user to create new projects, edit existing projects, submit new jobs to the compute cluster, and access the results of previous jobs. A job is an instantiation of a project that is packaged for processing. When a new project is created, the user works from the top down to define the different aspects of the problem. Once the project is saved, the user is returned to the Projects List or can submit a job to the compute cluster.

Once a job is submitted, the user can check on the status of the job from the Jobs List for the project. Also, when a job is complete, an email will be sent to the user from the grid scheduler. Once the job is complete, the user can view the results by selecting the Show Results link for the completed job in the Jobs List.

Project List

The user interface for the Projects List is as described in the General Usage section of this document. There are 4 links in the Actions column:

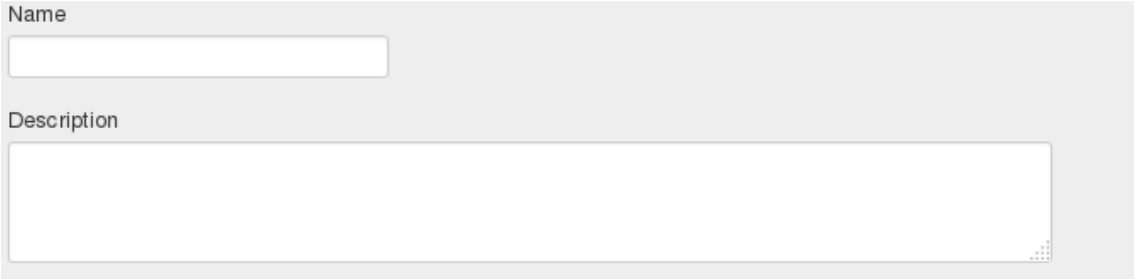
Link	Description
Edit	Redirects the user to a form for editing the project.
Destroy	Deletes the project.
Submit	Once a project is fully defined, it is ready to be submitted to the computational grid for processing. The Submit link redirects the user to a form that lets the user enter a name for identifying the job within OLTARIS and comments. Submission of the form sends the job to the grid scheduler and then redirects the user to the Projects List. A message box appears at the top of the Content Area. The message informs the user whether OLTARIS was successful in submitting the job to the grid scheduler.
List	Redirects the user to the Jobs List. This list will contain all the jobs that have been submitted for that particular project. If no jobs have been submitted, the List Jobs link is not displayed.

The button above the Projects List redirects the user to the form for creating a new project. The forms that are used for creating and editing projects have identical formats.

Form for Creating and Editing Projects

Name and Comments

At the top of the form are input areas for entering a project name and comments:



The Project Name must have between 4 and 30 characters, and it cannot contain white-space or any special characters. Entry of comments is optional.

Environment Selection

This section of the Project Form is for defining the project's external environment. If no environment has been selected, the user will be presented the following display:

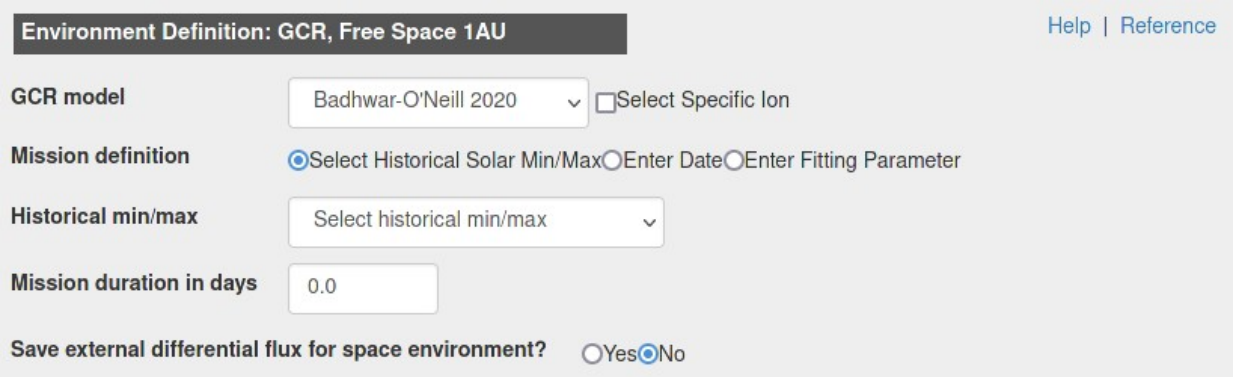
Selecting the pull-down menu, there will be a list of options that are described in further detail below. These environments are currently available on OLTARIS:

Environment	**Description**
GCR, Free Space 1 AU	Free space galactic cosmic ray environment at 1 AU.
GCR, Lunar Surface	Free space galactic cosmic ray environment at 1 AU for each ray emanating from free space to the target point. Surface-pointing rays are exposed the the albedo computed by applying the free-space GCR to the lunar regolith in a 3D transport run. Lunar-surface environments can only be run with thickness distributions.
GCR, Mars Surface	The Mars surface boundary condition is computed with a 3D solution of the GCR applied to the combined atmosphere and regolith with a target point 1 meter above the surface. The resulting point flux is then scaled by 1/2 and applied isotropically to the vehicle thickness distribution.
SPE, Free Space 1 AU	Free space solar particle event environment at 1 AU.

SPE, Lunar Surface	Free space solar particle event environment at 1 AU for each ray emanating from free space to the target point. For each ray emanating from the lunar surface to the target point, the external environment is assumed to be zero since the albedo is negligable. Lunar-surface environments can only be run with thickness distributions.
SPE, Mars Surface	The Mars surface boundary condition is computed with a 3D solution of the SPE applied to the combined atmosphere and regolith with a target point 1 meter above the surface. The resulting point flux is then scaled by 1/2 and applied isotropically to the vehicle thickness distribution.
Earth Orbit / Trajectories	GCR environment with altitude and inclination dependent cutoff, trapped protons, and albedo neutrons.

Free-Space GCR Environments

The sub-form for entering a GCR environment looks like this:



The user first selects which GCR model to use from the pull-down menu. The current default is the Badhwar-O'Neill 2020 model, but the user can also select from several other models. The user can select to have only one specific ion of the GCR environment applied by selecting the check-box 'Select Specific Ion', then selecting which ion is desired in the pull-down menu that appears.

The mission definition has 3 options:

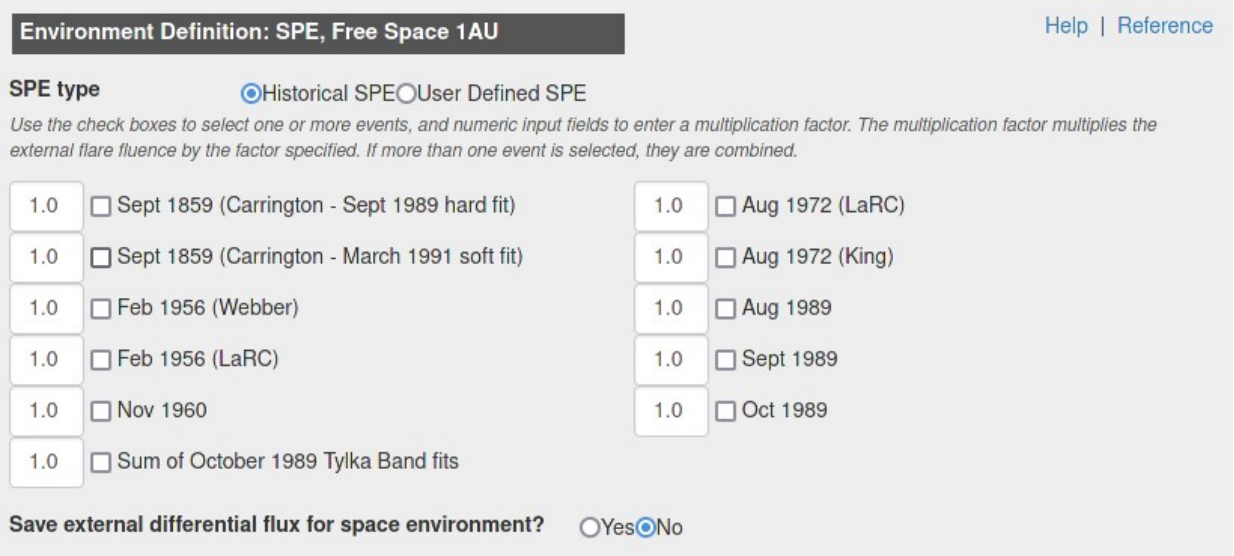
- If the "Select Historical Solar Min/Max" radio button is selected, the user chooses a historical solar minimum or solar maximum and enters the mission duration in days to define the mission length.
- If the "Enter Date" radio button is selected, the user enters a start and end date for the mission. The "Duration in Days" field will either display the length of the mission if start and end dates are given, or it can be used to specify the length of a mission if only a start date is given.
- If the "Enter Fitting Parameter" radio button is selected, the user enters the appropriate fitting parameter depending on which GCR model is chosen and a mission duration in days.

In all 3 cases, mission duration can be entered in fractions of a day. For example, 2.5 would specify 2 days and 12 hours. Results will be returned in totals for the entire mission duration and as rates per day and per year.

At the bottom of the sub-form, the user can select the “Yes” radio button after ‘Save external differential flux for space environment’ to have the computed environment returned with the results.

Free-Space SPE Environments

The sub-form for an SPE environment looks like this:



There are two main options for defining an SPE environment:

- If the “Historical SPE” radio button is selected, the user chooses any combination of events to include in the total SPE environment. Multiplication factors can also be entered to reduce or increase the spectrum of a particular event. If more than one SPE is selected, the spectra are summed.
- If the “User Defined SPE” radio button is selected, the user is provided a second set of radio buttons for selecting one of several curve fits for defining the SPE: Weibull, Exponential in Energy, Exponential in Rigidity or Band Function. Once a curve fit is selected, the equation will be displayed and the user is provided input fields for entering appropriate parameters as indicated in the equation.

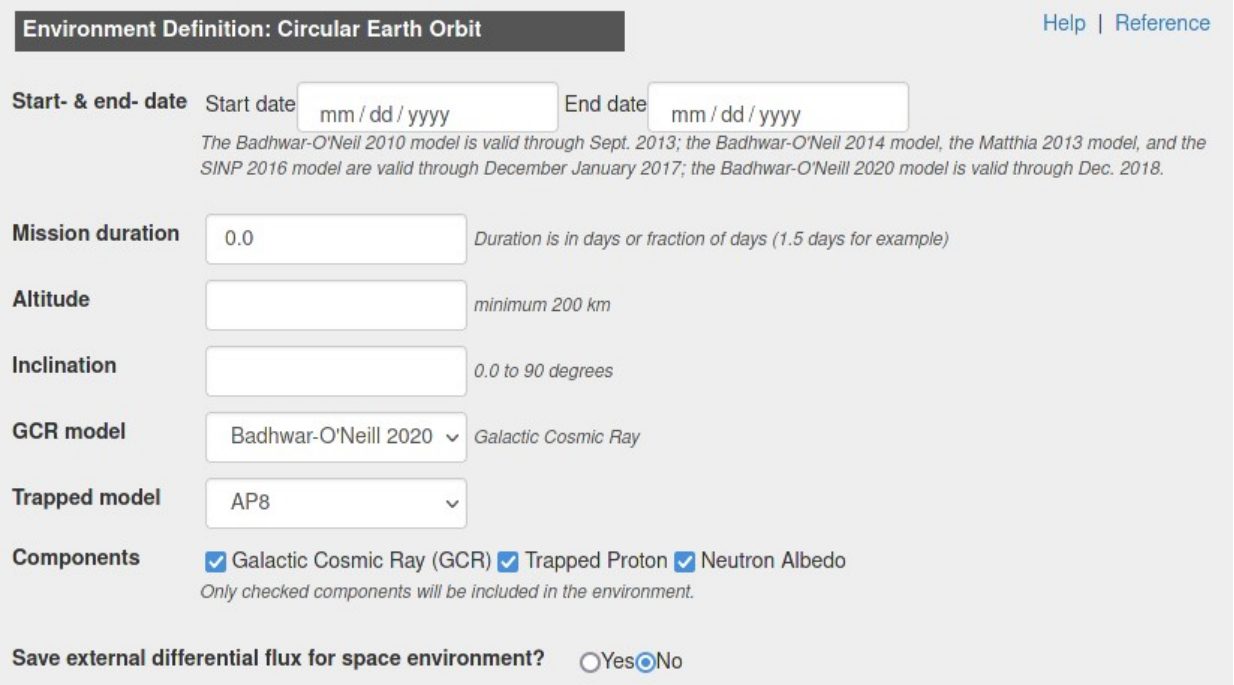
Earth Orbit Environments

There are two menu options for creating Earth-orbit environments, Circular Earth Orbit or User Trajectory. The first computes day averaged circular orbits based on altitude, inclination and date. The second uses a user-uploaded trajectory to compute an averaged environment over the

entire trajectory or at every point in the trajectory when the job is submitted as a 'point-by-point' analysis.

Circular Earth Orbit

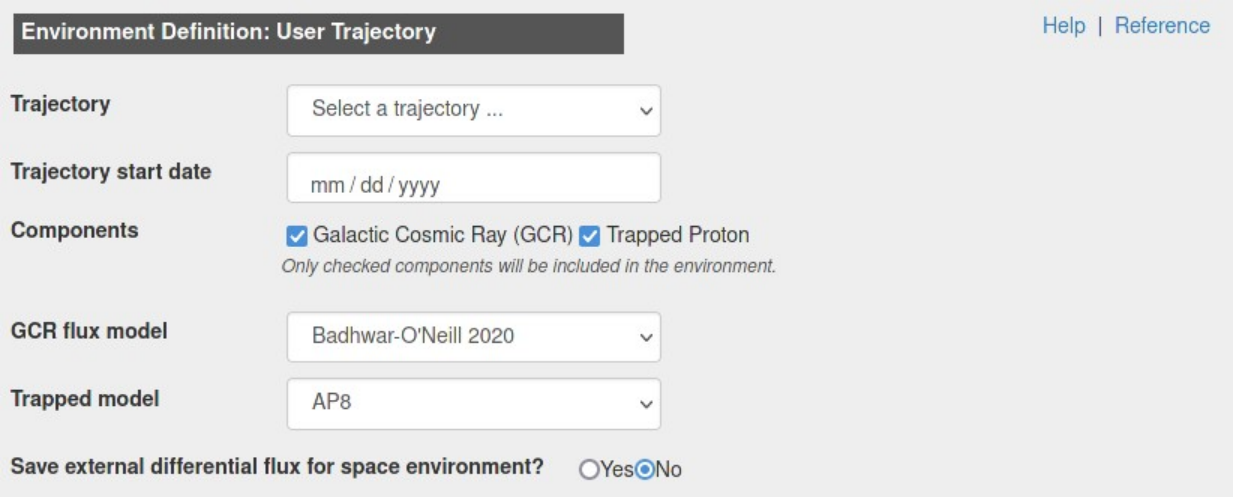
The form for the circular Earth orbit environment is shown below:



The user selects the start and end dates (or start date and mission duration), the altitude, inclination, and which components to include in the environment. If GCR is selected, the user can choose which GCR model to use. If trapped is selected, then user can select either AP8 or AP9. The AP9 model is the most recent trapped model, but it's averaged over several solar cycles, thus dates are irrelevant and will be grayed out (along with unselecting GCR and Neutron Albedo).

User Trajectory

The form this environment is shown below:

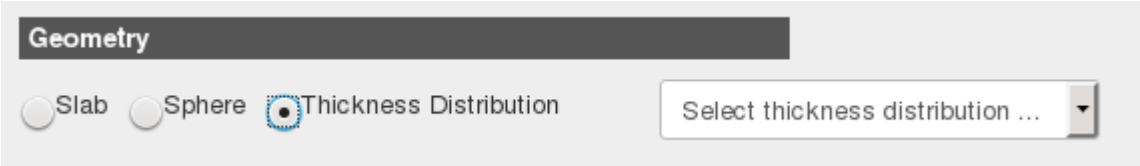


The user will first have to have uploaded one or more trajectories under the tab titled 'Uploads/Trajectories.' Once that is done, the user can select which trajectory to use in the pull-down menu. If there is a start date included in the trajectory, that date will be filled in automatically in the next field, which can then be changed if desired. This allows the same trajectory to be used for multiple mission analyses. The user chooses which components to include and which GCR and trapped models are desired. If AP9 is chosen, the date is grayed out and GCR is unselected. The neutron albedo is not available for user trajectories.

When jobs are submitted, they will have the option to send either as an ‘averaged trajectory’ or ‘point-by-point’. Averaged trajectories compute a boundary environment averaged over the entire use trajectory and responses are returned over the entire duration. Point-by-point jobs compute the boundary environment and response at each point in the trajectory, then return the results in tables vs. time. The point-by-point jobs will take much longer to run and can create very large data sets, especially if spectral responses are selected (e.g. flux, LET). The user should only send point-by-point jobs for trajectories with a few hundred points or less. It is also recommended on only choose non-spectral responses, like dose or dose equivalent.

Geometry Selection

The “Geometry” section of the Project Form is used to select a slab, a sphere, or a thickness distribution for the project geometry:



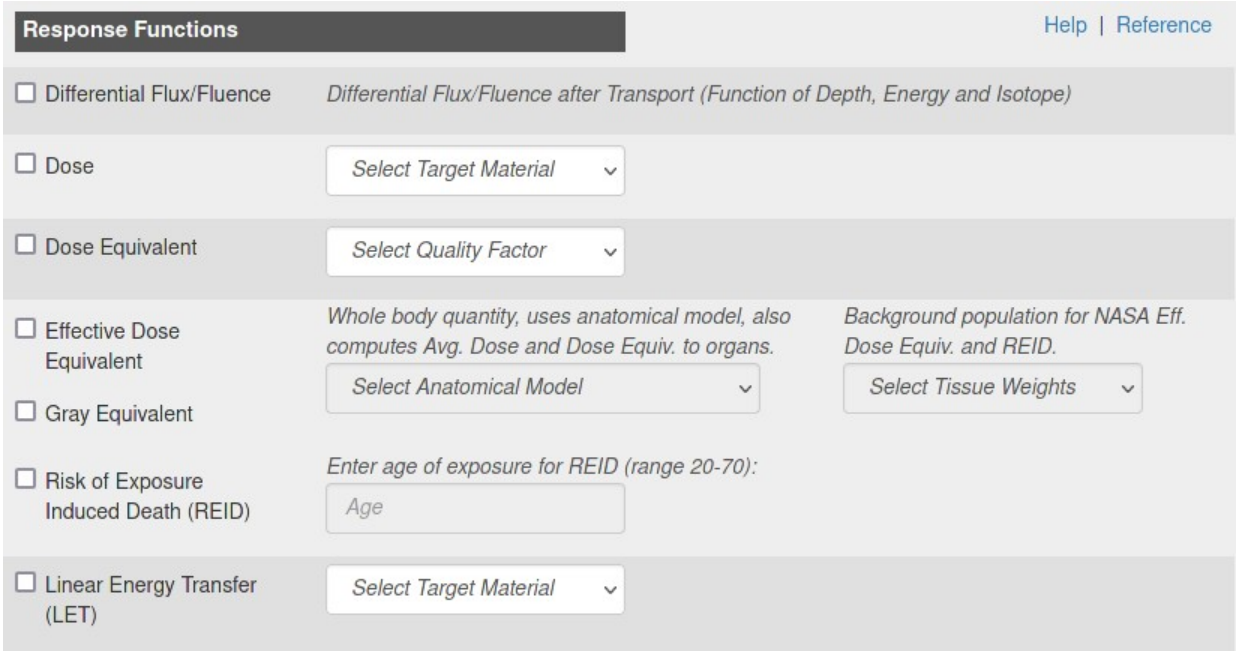
Selection of a radio button will populate a drop-down menu with the available choices. The type of geometry that is selected determines which type of transport will be used during the radiation analysis. Slab geometries are near limitless combinations of materials and layers in any order to which the external environment, or boundary condition, is transported from face to face using 3D transport. Responses are returned at the interface between each layer and after the final layer, the target.

Spheres are defined the same as slabs in that any number of materials and any number of layers can be defined. This can be imagined as taking that layering and rotating around a target point to represent the sphere. The advantage of the sphere geometry is that whole-body response quantities can be computed. In this case, the flux/fluence is computed at the center of the sphere using 3D transport, then resulting flux/fluence is applied isotropically to the chosen body model using 1D transport. This represents an orientation averaged, or spinning astronaut, response.

Thickness distributions can represent complex geometries and are processed using either 1D or 3D processing. The 1D processing is interpolation-based and is limited to 3 material types (2 + tissue if a whole body response is required) or less. In this case straight ahead transport is performed on a spatial grid for each material type in every combination but always in the same order of materials. This array of fluxes is then used to compute different response vs. depth tables, which are then used to compute the response along each ray by interpolation. Like material types are automatically collapsed together for the response vs. depth computations. For example, if a thickness distribution has many layers of aluminum and poly and are mixed together, all of the aluminum layers are collapsed as the first layer, then all of the poly layers are collapsed as the second layer along each ray. Thickness distributions with more than 3 material types must be processed using full 3D transport.

Response Selection

This section of the Project Form is for selecting the response functions to be evaluated and returned to the user:



Just about any combination of response functions can be chosen for most combinations of environment and geometry. However, there are some cases where the responses are limited. If that is the case, the user will not be able to select the response. The following table has a description of the responses.

Response	**Description**
Differential Flux/Fluence	This response is the output of the transport calculation at the target.
Dose	Dose in tissue or silicon (selected in pull-down) at the target.
Dose Equivalent	Dose equivalent using either ICRP 60 or NASA Q (selected in pull-down) quality factors.
Effective Dose Equivalent	This whole body response requires the choice of one of the available anatomical models - the Computerized Anatomical Female (CAF), Computerized Anatomical Male (CAM), Male Adult voXel model (MAX), or Female Adult voXel model (FAX). The body models are added to the user defined geometry during the run. The thickness distribution must include either one or five target points. If one point is defined, all the body points are added to the one target point. If 5 points are given, it is assumed that they are defined properly for a 5-zone calculation. In this case, the body points are summed to the closest of the 5 target points. By default,

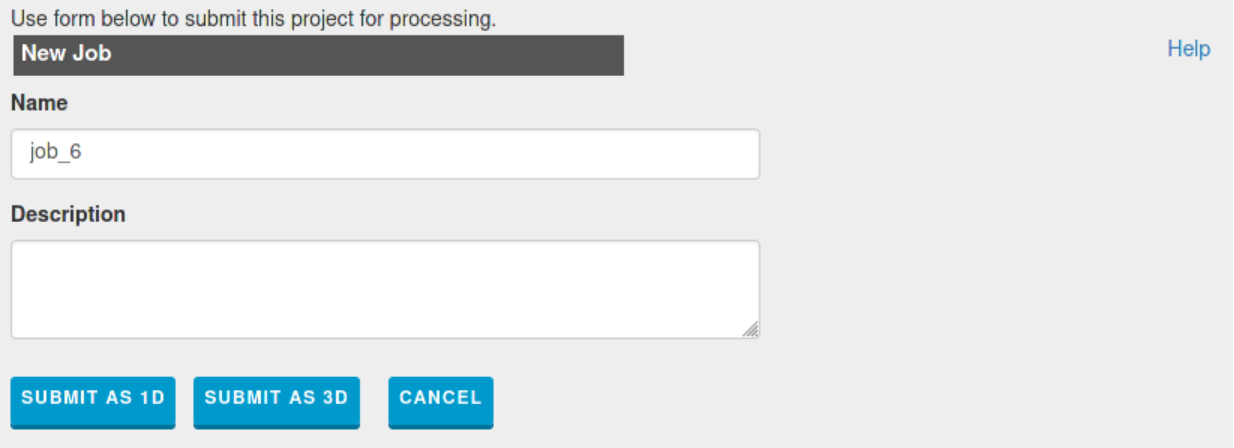
	calculation uses the ICRP 60 quality factors and NCRP 132 tissue weighting factors. However, if the NASA Q quality factors are chosen for Dosd Equivalent, then the NASA Q tissue weights are used. In addition, for NASA Q, the user must select which background population is to be used. This calculation also returns the effective dose equivalent (and dose, if selected) averaged to each of the body organs, including averaged skin, Blood Forming Organs (BFO), and lens.
Gray Equivalent	This computes the PEL (Permissible Exposure Limit) quantities for Lens, Skin, BFO, CNS (Hippocampus), and CNS (Z>10) (Hippocampus). The user must select a body model.
Risk of Exposure Induced Death (REID)	This runs the NASA Cancer Risk Model which is a probabalistic calculation that accounts for uncertainties in radiobiology and epidemiology. It returns both the REID and the Risk of Exposure Induced Cancer (REIC). The user must select a body model, a background population, and age at exposure. See 'Help' link next to results to get an explanation of the returned values.
Linear Energy Transfer (LET)	This response computes both differential and integral flux/ fluence vs. LET and depth (a spatial grid for each material) or at a point for the vehicle thickness distribution. A drop-down menu lets the user specify whether LET-related calculations use tissue or silicon as the target material.

Saving the Project

Two buttons are at the bottom of the project form, 'Create project,' or 'Cancel.' The button labeled Create project (or Update project if the user is editing an existing project) is used to save a project to the database. If any errors occur during the save, one or more error messages will be displayed at the top of the Content Area. The user is prompted to correct the entries in the Project Form that are in error. If the save is successful, the user will be shown the project summary and given the option to either return to the project list, submit the job, or edit the job. The Cancel button redirects the user to the Projects List.

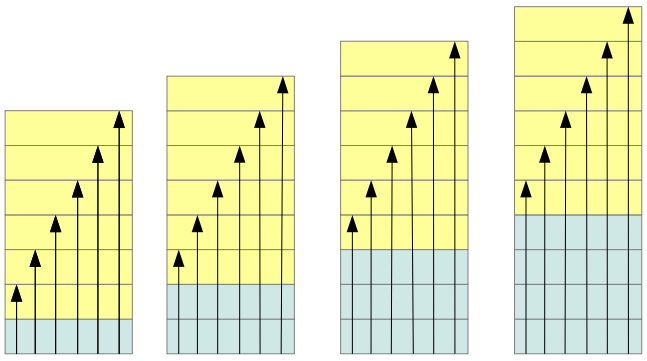
Submitting a Job for Processing

A project can include multiple jobs so that if the user wants to change particular elements of the project, say select a different environment or response, the user can do so and create an additional job that can be submitted under that same project. Jobs can be submitted from the summary page or the projects page. After selecting the Submit button/link, the user will be shown a form for most jobs similar to this:



The job name will be filled in but can be updated by the user. The Comments box can be used to enter notes specific to this job. Then the user can send the job for processing by selecting one of the submit buttons. Slabs and sphere geometries will only have one button for submitting as they always run using 3D transport.

Thickness distributions can be processed using either 1D or 3D transport. The 1D process is for thickness distribution which have three material types or less (two material types if a body model response is selected, since tissue will be added as a required material type). They are processed using an interpolation based method where like material types are grouped together, then 1D transport is run on various combinations of thicknesses of each material to create an interpolation table. The spatial grid of thicknesses depends on the type of boundary condition applied. The figure below shows a representation of two materials and the arrows represent 1-D transport runs from the boundary through the various thicknesses.



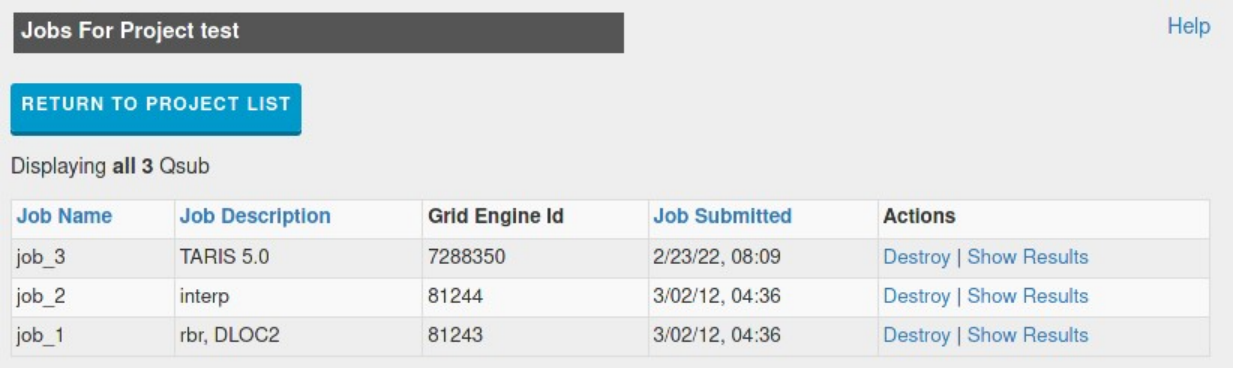
These response vs. depth tables are generated for flux/fluence, dose, dose equivalent, and LET, if they are selected as responses, and they are returned in the results under the heading 'Interpolation Tables.' The target response is then computed by computing the response along each ray using these interpolation tables and then integrating over all the rays (sum then divide by the number of rays).

3D processing of thickness distributions requires that distribution is defined using true length units as opposed to areal densities (e.g. g/cm2). The distribution also requires and additional attribute which indicates which material (part) contains the target. If the thickness distribution doesn't meet these requirements, the option to send for 3D processing isn't given. Also, since 3D processing of thickness distributions requires considerable computational resources, special account permissions are necessary before the option is available. Those who do not yet have permission will see the comment "If you would like to submit thickness distributions for 3D transport, send a request to c.a.sandridge@nasa.gov." Once the permission is applied to the account, the user will be given the option to send for 3D processing for all valid thickness distributions going forward. Please don't hesitate to ask for this privileged, we just want to make sure the users are aware of the resources involved and that their work really needs 3D processing. If whole body responses are requested, the vehicle target is computed using 3D transport, then the selected body phantom is processed using 1D transport.

Projects which require a user-supplied trajectory have two options for sending the job, either 'Averaged Trajectory' or 'Point-by-Point Trajectory.' In the former, the external environment (boundary condition) is computed at each trajectory point and integrated to obtain an average environment. The average environment is then run as a single job to provide total response quantities (and averaged per-day rates) for the entire trajectory. If instead the project is submitted as a 'Point-by-Point Trajectory' then the external environment is computed at *each* trajectory point and run as a separate job. The results are then combined and returned as a function of time along the trajectory. These submissions can take much longer to run since there are as many jobs as there are time steps in the trajectory. The results files can also get quite large if desired responses include spectral data, such as boundary condition flux, flux after transport, or LET. It is best to start with a smaller number of points in the trajectory to get a feel for run time and the resulting data size. The status of this run cannot be checked; an email will be sent when the post-processing is complete.

Jobs List

Selection of a List Job link from the Projects List redirects the user to a list of all the jobs that have been submitted for a particular project.



Job Name	Job Description	Grid Engine Id	Job Submitted	Actions
job_3	TARIS 5.0	7288350	2/23/22, 08:09	Destroy | Show Results
job_2	interp	81244	3/02/12, 04:36	Destroy | Show Results
job_1	rbr, DLOC2	81243	3/02/12, 04:36	Destroy | Show Results

Above the Jobs List is a button for redirecting the user back to the Projects List. The user interface for the Jobs List is the same as is described in the General Usage section of this document. Listed below are attributes and links that are specific to the Jobs List:

Attribute or Link	**Description**
Grid Engine Id	This is the unique identifier that is assigned by the grid scheduler when the job is submitted. When the job completes, the email that is sent to the user uses this id to identify the job.
Job Submitted	This is the date and time that the job was submitted.
Destroy	Selection of this link deletes the job and its results. Deletion of a pending or active job does not remove it from the grid queue or stop it from running. You must contact the site administrators in order to stop a job that has already been submitted. This can be done by selecting the 'Send Comment' link at the top of the page.
Status	This link is for monitoring a job while it is running. The status of the job is displayed at the top of the content area in a box outlined in red. The status information includes the CPU time used by the batch job and the batch job state. When the job is complete, this link will turn to Show Results after the page has been refreshed. The user will also get an email from the grid scheduler after the job is finished. If the job fails, the email will have an Exit Status of 1 and the Job Status link will not change to Show Results. If this should happen, please send the gridengine id in an email to the site administrators using the Report Bug link at the top of the page.
Show Results	This link redirects the user to the Results Page

Results Page

The format of the Results Page will vary depending on the project's environment definition and response selection. The following example shows the Results Page that was generated for a GCR project:

Project Summary

Project:	test	
Environment:	Galactic Cosmic Ray (GCR), Free Space 1AU	
	GCR Model	BO-20
	Event	1977 Solar Min (DSNE)
	Mission Duration	5.0 days
Geometry	STS_dlocPB2 (512 rays in thickness distributuion)	
Grid engine id:	7288350	
TARIS version	5.0	

Mission Totals

Mission Duration = 5.0 Days

Data	Total	Unit
Dose at point 1	2.065E+00	mGy
Dose equivalent at point 1	9.658E+00	mSv

Mission Rates

Data	Per day	Per year	Unit	Link
Dose at point 1	4.130E-01	1.508E+02	mGy	Sphere Viewer
Dose equivalent at point 1	1.932E+00	7.051E+02	mSv	Sphere Viewer

Project Summary

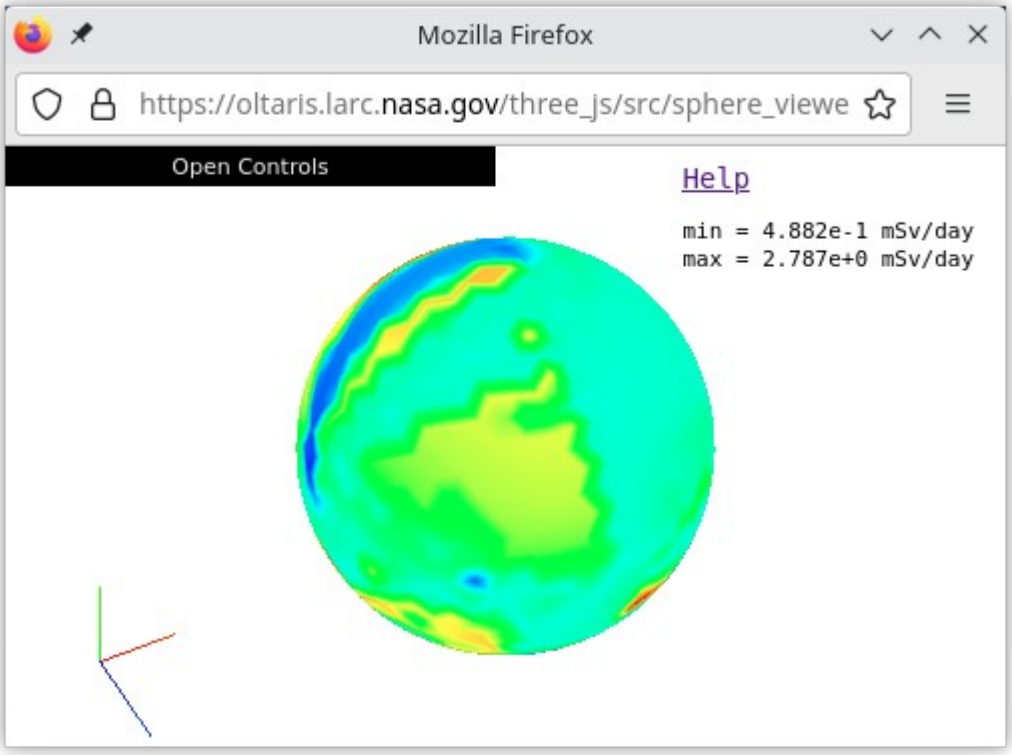
The Project Summary captures a project's attributes at the time the project was submitted to the cluster. If the project has been edited since then, the attributes in the project summary may differ from the project's current attributes. The intention of showing the summary is to document the inputs that yielded the results shown on the current Results Page. The project summary contains the Grid Engine ID, which is the job number run on the compute cluster. This number is needed if you want to ask questions about a particular job. Please include this in the email. The TARIS version is the tagged version of the code/data running on the cluster when the job was run. If changes are made to the code running on the cluster such that some results could change, then a new version is tagged and noted in the Change Log on the website.

The Point Data Section of the Results Page

Point data for the entire mission duration is under the heading "Mission Totals". If the project's environment is EO, there are potentially extra tables where the data is broken down by component: one table of values for GCR effects only and another table of values for Trapped Proton and Neutron Albedo Effects only. If the project is a Lunar surface GCR, there will also

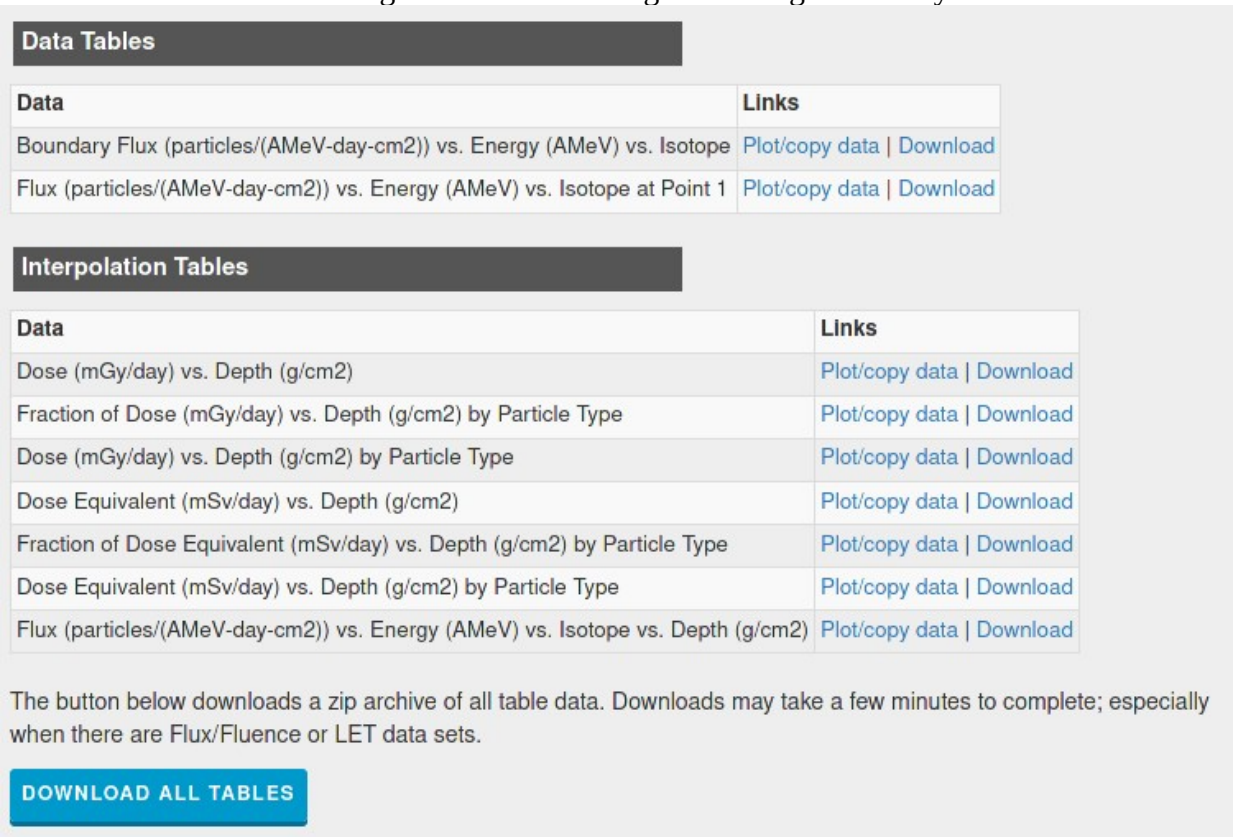
be two sets of results, one for the free-space GCR part, one for the albedo part. Non-SPE cases will also have a “Mission Rates” section, where the per-day and per-year rates are listed.

Point data is displayed for the entire mission duration. If effective dose is computed, the results are broken down to list the organ averaged dose equivalent to each organ and then the whole body effective dose equivalent as a separate quantity. Most point data can be better interpreted by viewing the directional contributions on a sphere. Selection of the Sphere Viewer link opens a pop-up window that contains the directional contributions shown as colors on a sphere. The axes displayed are related to the vehicle thickness distribution used in the calculation. The sphere can be rotated and the color fringes can be altered. Clicking on the ‘?’ displays a help screen for the viewer.



The Table Data Section of the Results Page

This section of the Results Page is for downloading or viewing table/array results.



Data Tables

Data	Links
Boundary Flux (particles/(AMeV-day-cm2)) vs. Energy (AMeV) vs. Isotope	Plot/copy data | Download
Flux (particles/(AMeV-day-cm2)) vs. Energy (AMeV) vs. Isotope at Point 1	Plot/copy data | Download

Interpolation Tables

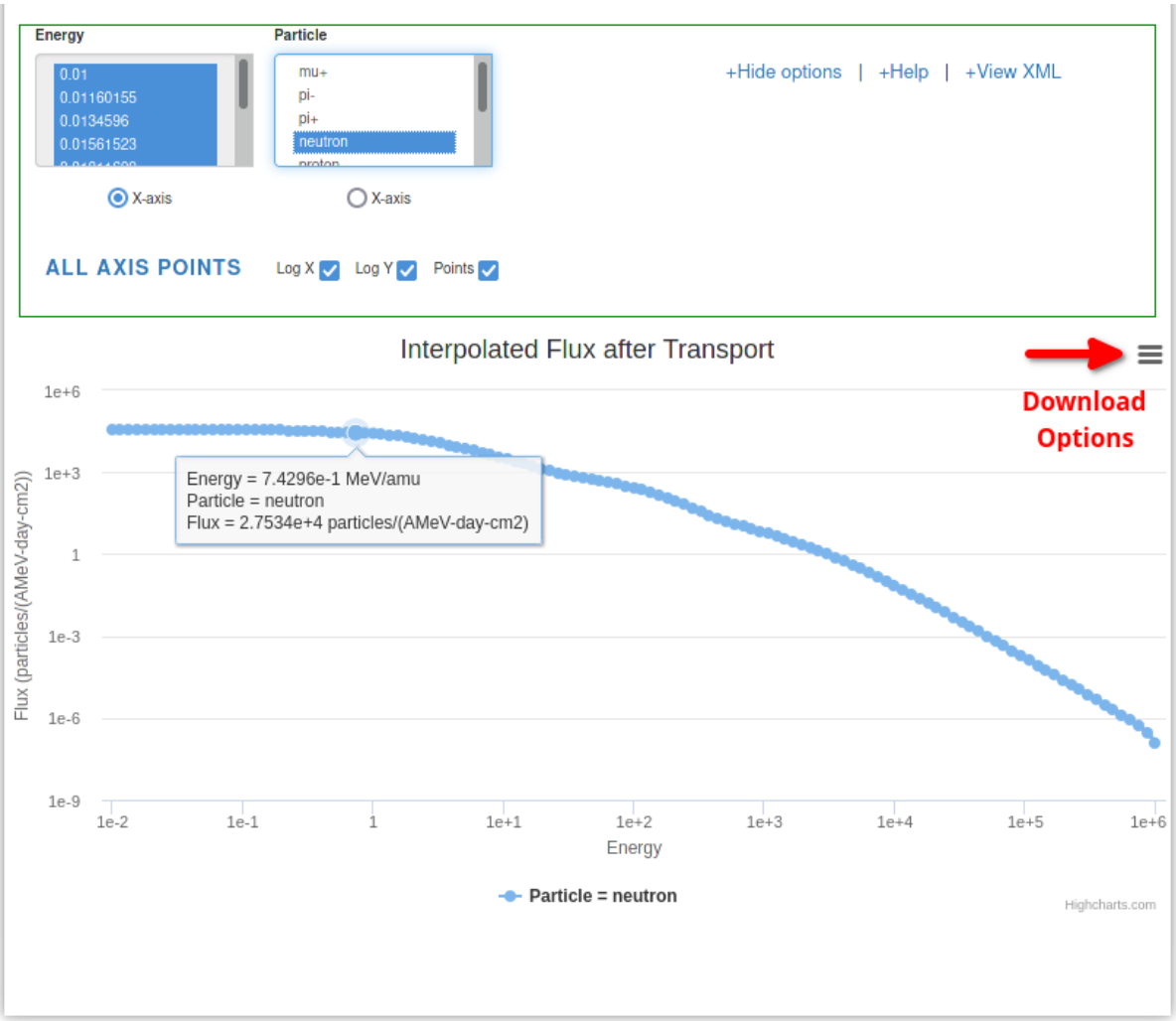
Data	Links
Dose (mGy/day) vs. Depth (g/cm2)	Plot/copy data | Download
Fraction of Dose (mGy/day) vs. Depth (g/cm2) by Particle Type	Plot/copy data | Download
Dose (mGy/day) vs. Depth (g/cm2) by Particle Type	Plot/copy data | Download
Dose Equivalent (mSv/day) vs. Depth (g/cm2)	Plot/copy data | Download
Fraction of Dose Equivalent (mSv/day) vs. Depth (g/cm2) by Particle Type	Plot/copy data | Download
Dose Equivalent (mSv/day) vs. Depth (g/cm2) by Particle Type	Plot/copy data | Download
Flux (particles/(AMeV-day-cm2)) vs. Energy (AMeV) vs. Isotope vs. Depth (g/cm2)	Plot/copy data | Download

The button below downloads a zip archive of all table data. Downloads may take a few minutes to complete; especially when there are Flux/Fluence or LET data sets.

DOWNLOAD ALL TABLES

Tables are split into two sections, the first are the spectral data, like the external environment (boundary) flux, the flux after transport, and LET, which are listed under ‘Data Tables.’ Next, if the job was a thickness distribution sent for 1D processing, are the interpolation tables generated to compute the response at the target, which are listed under ‘Interpolation Tables.’ The tables have links to open a plot window or to download the data in an ASCII file. Multidimensional array data in the file will be in column-major order. The Download All Tables button will return a zip file with all the tables from the run.

The Plot link opens a separate window to view the selected table data. Selection of the Help button in the Plot Window displays usage information. There is also a button, indicated with the red arrow, which allows the user to download the current plot data in various formats.


Energy
Particle
0.01
0.01160155
0.0134596
0.01561523
mu+
pi-
pi+
neutron
+Hide options | +Help | +View XML
X-axis
X-axis
ALL AXIS POINTS
Log X
Log Y
Points
Interpolated Flux after Transport
Download Options
Energy = 7.4296e-1 MeV/amu
Particle = neutron
Flux = 2.7534e+4 particles/(AMeV-day-cm2)
Flux (particles/(AMeV-day-cm2))
1e+6
1e+3
1
1e-3
1e-6
1e-9
1e-2
1e-1
1
1e+1
1e+2
1e+3
1e+4
1e+5
1e+6
Energy
Particle = neutron
Highcharts.com

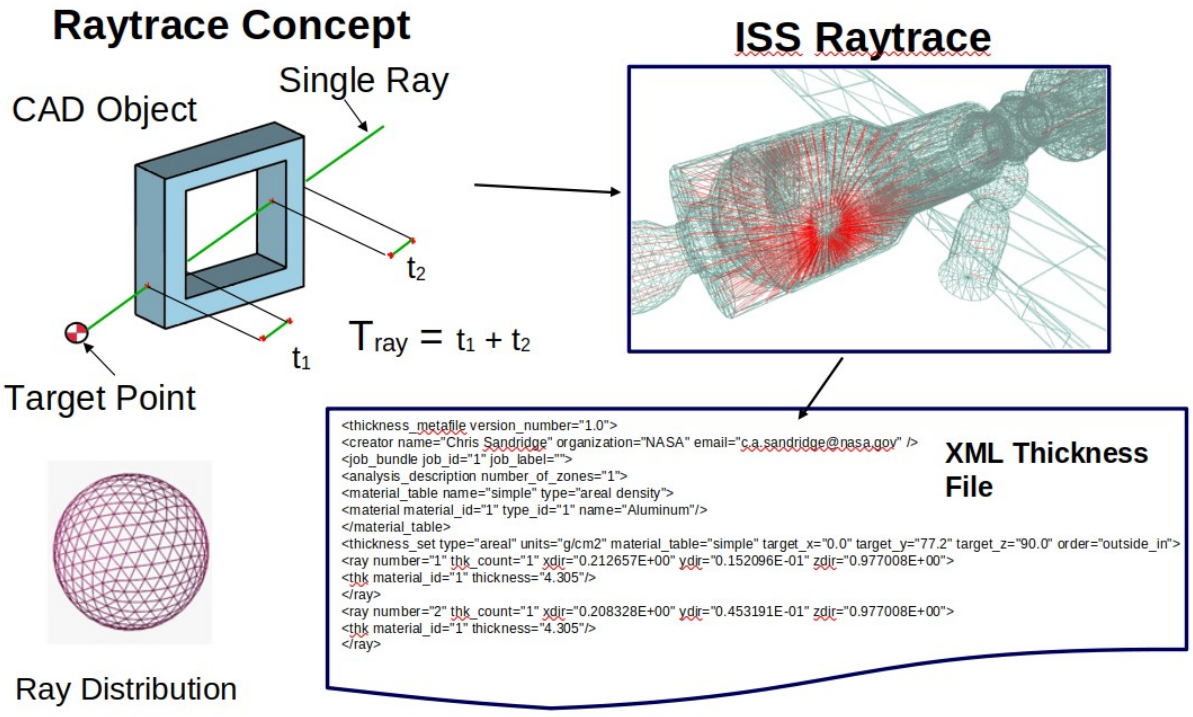
Uploads → Thickness Distributions

The Thickness Distributions Module presents a list of the user's current thickness distributions and allows the user to upload new ones. Once a thickness distribution is uploaded, it can be selected for a project from the Projects Module. Thickness distributions are uploaded to the site in the form of an XML file. A document describing the format of the file and sample files can be downloaded from the Thickness Distributions page. The user can also download a phantom CAD object that represents a human geometry. This can be positioned and oriented in the user's CAD software to help select the proper target points in their vehicle geometry for computation of effective dose responses.

Overview

Ray tracing process

Thickness distributions are computed using a process called ray tracing. Ray tracing uses a directionally distributed set of rays emanating from the same point to determine how much material is surrounding that point in each ray direction. The point source of the rays is commonly called a Target Point. The intersections of the rays and the various components of the vehicle CAD model are used to determine the along-ray thicknesses of the components, which are stored along with their associated material types. The figure below shows a singe ray intercept with a CAD object, the combined rays (shown in red) of intersecting rays in an ISS model, a ray distribution and and example XML file.



Supported materials for interpolation-based transport

Interpolation-based transport (1D) generally supports three materials - aluminum, polyethylene, and tissue – in the vehicle raytrace. For example, one ray could intersect a human being, which would be a thickness of tissue, followed by some shielding material, which could be polyethylene, and then the vehicle structural components, which could be a thickness of aluminum. The user can substitute their own materials by re-defining the material type ids in the XML file. Rays typically intersect multiple objects, so there can be many separate material thicknesses along each ray. OLTARIS sorts and combines these thicknesses so that the outermost layer of shielding is composed of all the collected aluminum thicknesses along that ray, the next layer of shielding represents the total thickness of polyethylene along that ray and the innermost layer represents the total amount of tissue along that ray. If a thickness distribution is analyzed using 3D transport, no collapsing of like material types occurs.

Supported ray distributions

Any angular distribution of rays can be used, as long as they are distributed evenly enough that each ray can be considered to represent an equal solid angle of shielding surrounding its target point. However, to compute a whole body response, the user will need to use one of the many ray distributions that are available for download from the Thickness Distributions page. Those currently available include distributions with 42, 492, 512, 968, 1002, 4002, 9002, or 10,000 rays.

Phantom orientation

If the user needs to take into account a specific body phantom orientation with respect to their vehicle, OLTARIS provides a process that makes this possible. To calculate an effective dose, OLTARIS combines uploaded vehicle thickness distributions with pre-computed body phantom thickness distributions. The process used to combine these distributions provides the ability to analyze a specific body orientation relative to a vehicle shielding model and the ability to capture the local variation of radiation intensity inside the vehicle. This local variation could be due to variations in the amount of shielding surrounding different regions of the vehicle interior and might, for example, yield a situation in which the phantom’s head was more lightly shielded than its feet.

In order to accurately represent the user’s desired phantom orientation within a vehicle model, the user will need to download one of two specially developed CAD models from the OLTARIS web site. These CAD models are proxies for the male and female body phantoms that are available for use in OLTARIS. The user will need to load this model into their CAD soft ware, as a new component in their shielding model. The models have been made available in an IGES (Initial Graphics Exchange Specification) file format to gain broad compatibility with the widest possible array of CAD software. Each body phantom proxy CAD model includes eight reference points.

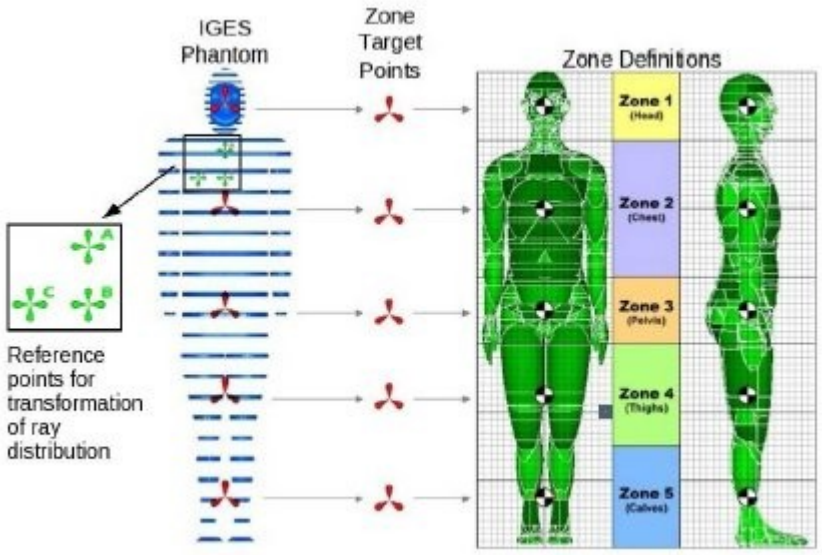


Figure 4 Body Phantom Zone Points

The three points used to establish the phantom orientation have been colored green and labeled "A", "B", and "C" (see Figure 4). Once oriented, the records the (x, y, z) coordinates of these three points, taking care to use the same reference coordinate system that will be used for ray tracing. The coordinates of these three points can be entered into a form on the OLTARIS website to generate a custom ray distribution, rotated to take the phantom orientation into account. The form used to create these ray distributions is accessed from the Thickness Distributions page. The user should use this ray distribution to ray trace vehicle thickness distributions that correspond to that phantom orientation.

The other five reference points included with each IGES phantom proxy are colored red and are used to capture the effects of shielding variation within the vehicle interior. These five points correspond to five body zones, as shown in Figure 4. To use this feature, the user will need to perform five separate vehicle ray traces and calculate five separate vehicle thickness distributions, each centered on one of the red zone target points. The effective whole-body dose equivalent calculation within OLTARIS uses tissue thickness distributions based upon hundreds of target points that are distributed throughout the body phantom in specific tissues. OLTARIS will add the vehicle thickness distribution closest to each of the zone's tissue thickness distributions to get the total shielding around each body point. The user does not have to use the five target points, as one target point can be used in which all of the body points are added to the single vehicle thickness distribution. However, a single target point will be less accurate than the five target point case, as the local variations in the vehicle shielding may be significant.

Web Site Specifics

Thickness Distributions List

User-uploaded distributions are listed first, followed by the OLTARIS-supplied thickness distributions, which are indicated with an asterisk '*'. The user interface for the Thickness Distributions List is the same as described in the General Usage section of this document.

A note about the view link: Selection of the view link redirects the browser to display a thickness distribution in raw XML. These xml files tend to be large and can be slow to load. Also, the browser's back button must be used to return to the Thickness Distributions List. Select the 'Upload Thickness Distribution' to take you to the form for browsing a file on your client for upload. During the upload, OLTARIS will check to validate that the uploaded file is a properly composed thickness file and report back any errors found.

Downloads for Creating Thickness Distributions

Link	Description
Human Phantom Overview	This link downloads a pdf or PowerPoint file that contains a description of the overall process of adding a human phantom into an uploaded space vehicle shielding distribution, to enable the calculation of whole body effective dose.
Download Thickness Metafile Description	This link downloads a pdf file that contains a description of the XML format required for uploading thickness distributions to OLTARIS.
Download Example Thickness Metafiles	This link downloads a zip file containing example thickness distributions in XML format. These files can be used as a model for the user's own thickness files.
Download Phantom Geometries	This link downloads an IGES representation of the phantom that can be oriented in the user's vehicle. After the phantom has been oriented, the user will have to return to the Thickness Distributions Module and download a rotated ray distribution.
Download Un-rotated Ray Distribution	This link redirects to a form for downloading one of the eight available ray distributions. The images link on the form displays pictures of the available downloads. The ray distribution files are selected from a drop-down menu.
Download Rotated Ray Distribution	This link redirects to a form that lets the user download a rotated ray-distribution that is oriented so that vehicle can be ray-traced in the same coordinate system as the phantom. The images link on the form displays pictures of the available downloads. The ray distribution files are selected from a drop-down menu. The form also contains fields for entering the x-, y-, z-coordinates in the vehicle coordinate system. These points uniquely determine the position and orientation of the phantom within a vehicle model.

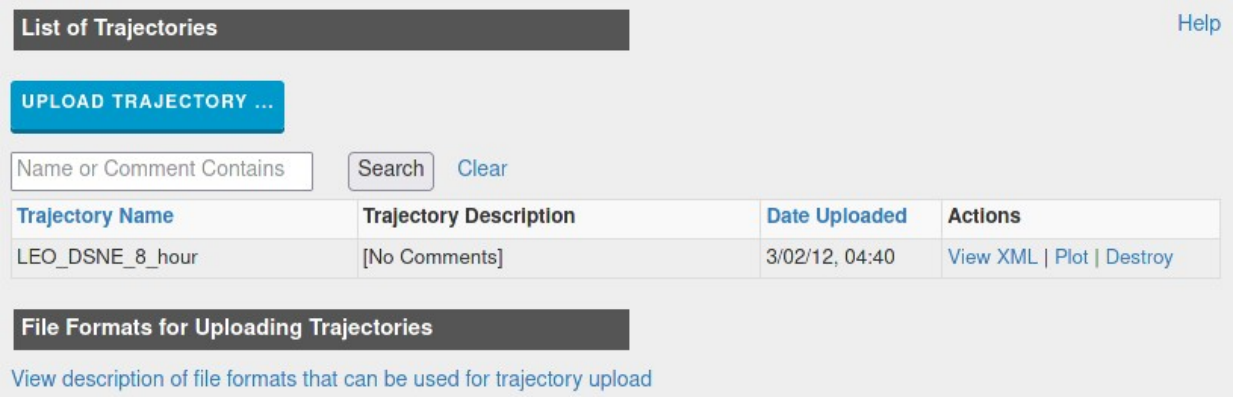
User Defined Materials and Thickness Distributions

The user can refer to a custom material defined under the OLTARIS 'Materials' tab in a thickness distribution. Details can be found in the Thickness Metafile Format Description document, but the specific element needed for this is the *material_type_define* element. This is

used to define which material cross sections are used for a specific *type_id* indicated on a *material_id* element.

Uploads → Trajectories

The Trajectories Module can be used to upload a trajectory file corresponding to an orbit around Earth. Upon selection of Uploads->Trajectories from the OLTARIS main menu, the user is presented a list of files that have already been uploaded and a button for uploading new trajectory files.



File Formats for Uploading Trajectories

At the bottom of the main page of the Trajectory module is a link for displaying a document that describes the file formats that can be used to upload a trajectory. Each format is described in detail and example files are provided for each format.

Form for Uploading a Trajectory

Select the "Upload a Trajectory ..." button at the top of the main page of the Trajectories Module to bring up the form for uploading a trajectory file. Follow these steps to upload a trajectory:

1. Enter comments relevant to the trajectory in the textbox at the top of the form. Entry of comments is optional.
2. Click on "Browse" and navigate to the saved file on your computer. Note, the file must have the one of the two valid extensions, either .xml or .geo.
3. Click "Open".
4. Click "Upload Trajectory File".
5. If the upload is successful, the user is redirected back to the main page of the Trajectories Module. An entry for the newly uploaded trajectory appears at the top of the list of trajectories. If the upload is unsuccessful, then an error message is displayed at the top of the upload form.

The Trajectory Viewer

The plot link that is associated with each entry in the Trajectory List brings up a tool for visualizing the trajectory against a 2D Google Map of Earth or as a time series. If the trajectory is large, there are widgets for viewing just a portion of the trajectory on the 2D map.

How to Use a Trajectory in a Project

Once a trajectory is uploaded, it can be applied to a project by following these steps:

1. Click on the "Add another project ..." button at the top of the Projects main page to redirect the display to the form for creating a new project; and then click on the "Earth Orbit/ Trajectories" button to redirect the display to the form for creating earth orbit environments.

2. Click on the "User Trajectory" button on the Earth Orbit/ Trajectories form. This causes a pull-down menu of uploaded trajectories to be added to the form. Choose a trajectory from the menu. The "Start Date" selector will be updated if the chosen trajectory file specifies a mission start-date. The start date can be changed in the form if desired, that way the same trajectory can be used for different periods in the solar cycle without having to upload another trajectory.

3. Finish filling out the Earth Orbit/ Trajectories form and then click on save button. Note that Neutron Albedo isn't supported and is grayed out..

4. Save the project after you are done filling out the new Project form.

5. Click on the "+Submit Job" link that is associated with the project that was created in the previous step.

6. Submit job by clicking on either the "Submit as averaged trajectory" button or the "Submit as point-by-point trajectory" button.

7. If a job is submitted as an average trajectory, the status of that job can be checked as with any other type of job. If the job is submitted as a point-by-point trajectory, there is no mechanism for checking the status. The user will get an email when the post-processing is complete.

[Note, figures past this point have not been updated for latest release of the website. However, the operation is similar to what is shown/described.]

Slabs and Spheres

Although OLTARIS provides a few predefined materials, the user will in most cases first define the materials he or she wants to use in the Materials Module. Once a material is defined, the

user then goes to the Slabs/Spheres Module and defines a layup of any thickness of material, in any order the user chooses. This capability is useful for comparing new material or structural concepts. Once a slab/sphere is created, it can be selected for a project from the Projects Module.

Slabs/Sheres List

The user interface for the Slabs and Spheres List is as described in the General Usage section of this document. There are 3 action links:

Link	Description
Show	This link redirects to a page that displays the slab/sphere's composition; i.e., the number of layers, material type of each layer, thickness of each layer and total thickness. Layers are presented in a sortable list. Layers can be dragged up and down the list to change their order both on the page and in the slab/sphere. To drag, the user left clicks on the layer and drags the layer to its new destination.
Edit	This link redirects to the form for editing a slab.
Destroy	This link deletes a slab/sphere definition. Note, a slab/sphere cannot be deleted if it is referenced by one or more projects. In this case, a warning will be displayed at the top of the Content Area. The warning will identify which projects reference the slab/sphere.

The button above the Slab/Sphere List redirects the browser to the form for creating a new slab or sphere. Identical forms are used for creating and editing slabs/spheres.

Form for Creating and Editing Slabs/Sheres

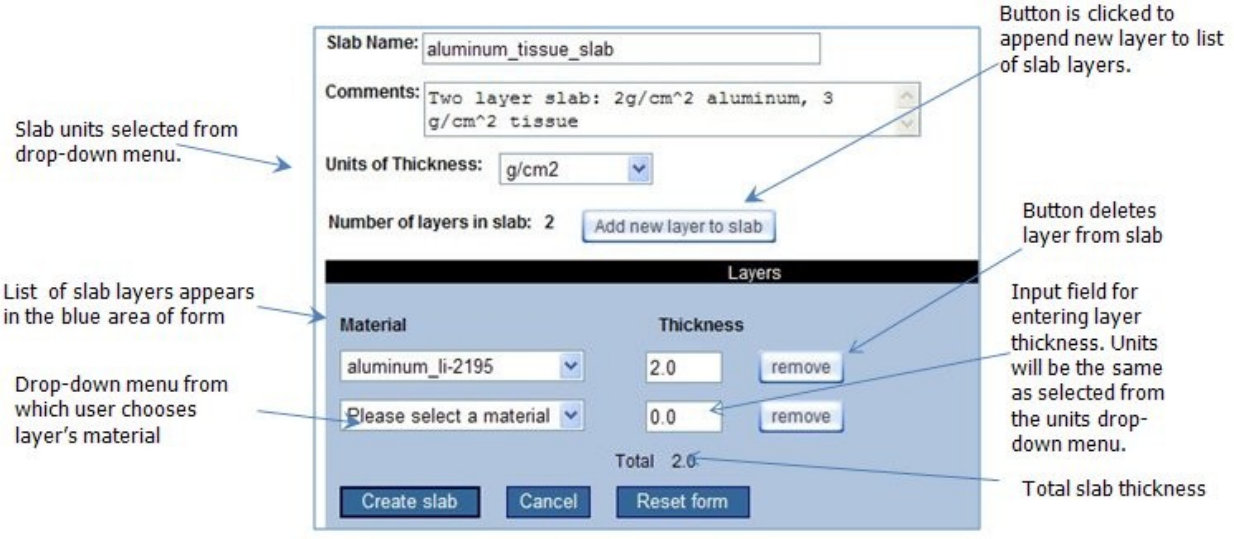


Figure 5 Form for creating and editing slabs.

The Slabs Form is used to define the necessary attributes of a slab/sphere including the name, number of layers, material type of each layer, thickness of each layer, and units of thickness. Comments are optional. The total thickness of the slab (or sphere radius) is updated as the thickness of each layer is entered.

A Note on Units: units are selected in the drop down menu at the top. Ultimately, all thickness units are converted to cm for the transport procedure and response function calculations. Plots and output data files with spatial information are also given in cm.

Materials

The user defines a material by entering the material's mass percentage, its molecular mass percentage, or its chemical formula. After the material is defined, the user can submit the material definition to the computational grid so that material cross sections can be computed for later use. The user receives email notification when the processing of the material is complete and the material cross sections are available.

Once a material is defined, the user can go to the Slab/Sphere Module and assign that material to layers. The name of the material will appear in the drop-down menu of materials associated with each layer (see Figure 5) in the Slab/Sphere Form. Slabs/Sheres referencing that material can also be selected for a project. It is not until the user submits the project to the grid scheduler that OLTARIS checks that the cross-sections have been computed for the material. If no cross-sections are available for one or more materials that are referenced by the project, a warning is displayed that identifies the materials for which no cross-sections have been generated.

User-defined materials can also be used in thickness distributions by using the material name in the material_type_define element of the XML file.

At this time, only naturally occurring isotopes, except for Neon, can be used to define a material. Neon and Boron-10 cannot be used; Boron-11 is assumed to be the naturally occurring isotope for Boron.

OLTARIS only accounts for nuclear and atomic interactions in the transport of charged and neutral particles through bulk matter. Therefore, molecular interactions, bond structures, etc. are neglected and the following molecular formulas are considered equivalent: C8Co2(O8) = C8CoO16.

Materials List

The user interface for the Material List is as described in the General Usage section of this document. Figure 6 shows a screen capture of part of one user's list:

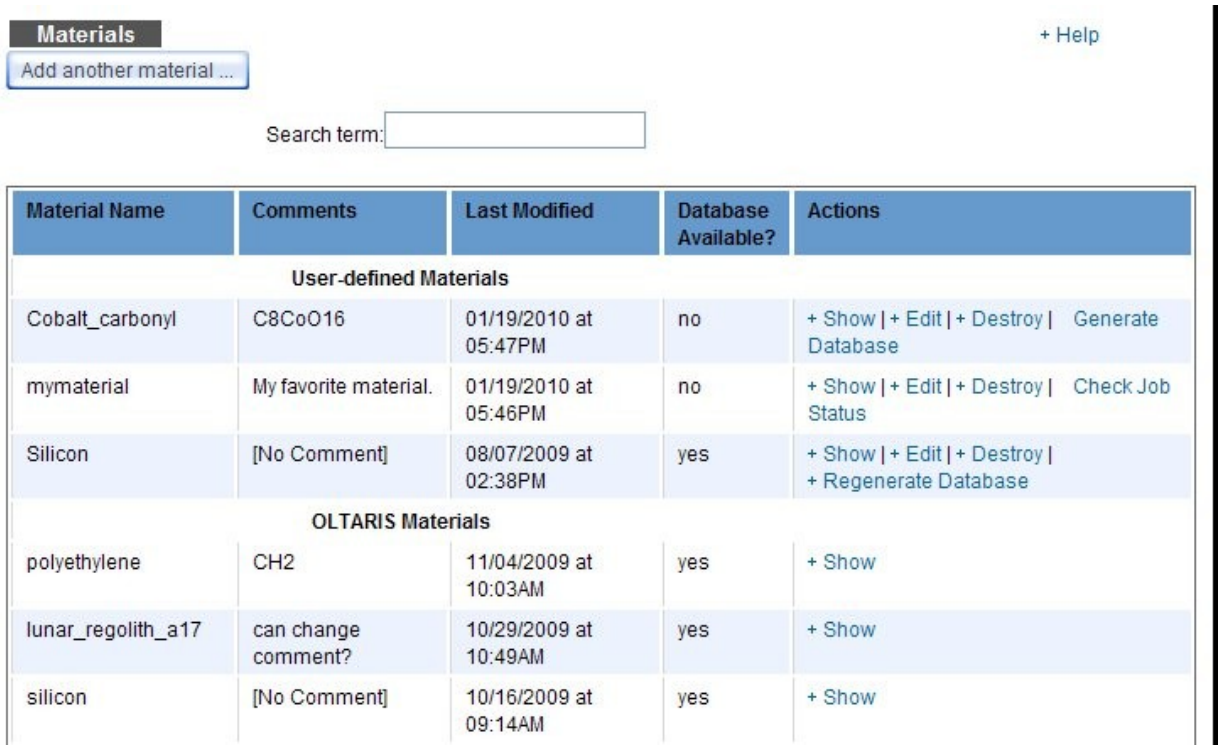


Figure 6 Materials List

The fourth column of the Material List is titled “Database Available?” A yes in this column indicates that the cross-sections for this material have been generated and no indicates that they have not been generated.

There are 5 links that appear in the column that is titled “Actions”:

Link	**Description**
Show	This link redirects to a page that displays a summary of the material composition. The summary displays the material definition, density and density units.
Edit	This link redirects to a form that can be used to edit the material’s composition.
Destroy	This link deletes a material. A material cannot be deleted if it is currently used in a slab definition. The slab would have to be changed or deleted before the material can be deleted.
Generate Database	This link submits a material to the grid scheduler so that cross sections can be generated. A message is displayed at the top of the Content Area informing the user that the job was sent and the link will change to Check Job Status. An email is sent from the grid manager to the user when the job is finishes.

Regenerate Database	This link re-submits a material to the computational grid so that the material cross sections can be re-computed. The user needs to re-generate a material's cross section after a material's attributes, other than name and comments, are changed.
Check Job Status	This link shows the status of the grid job that is computing the cross-section database. If the message indicates No Jobs Pending, then the job is no longer running and the "Database Available?" column should indicate yes. If it doesn't, then the database generation failed and the user should submit a bug report. Once the job has completed successfully, this link will change to Regenerate Database.

Form for Creating Materials

The button labeled "Add another material …" links to the form for creating materials. There are three ways to define a material – Elemental Mass Percentage, Molecular Mass Percentage, and Chemical Formula. The user must select one to start as shown in Figure 7. Density units can be selected in the drop down menu. Ultimately, all density units are converted to g/cm3.

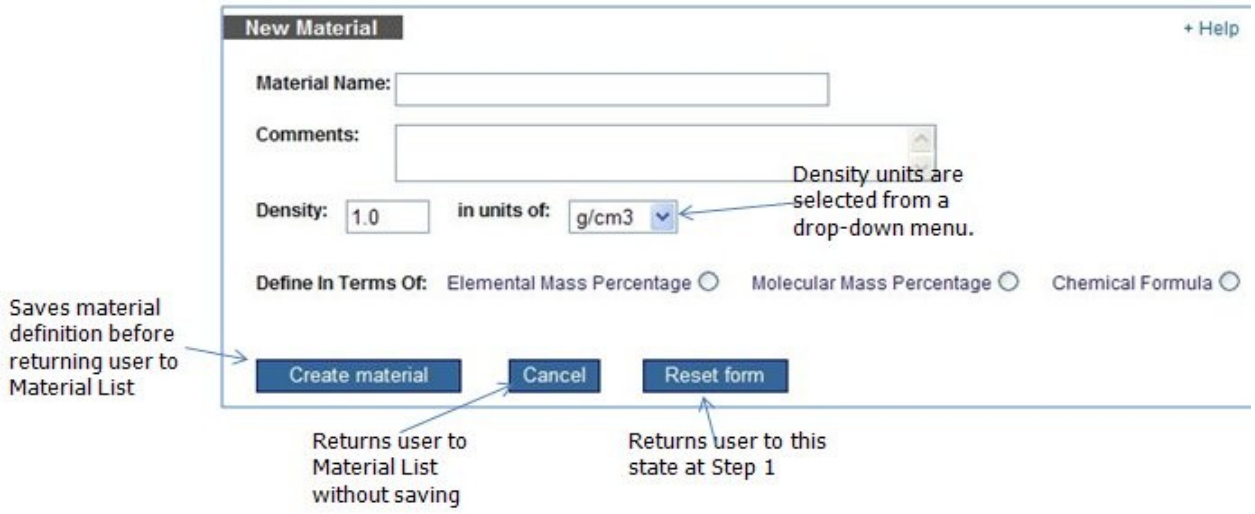


Figure 7 Step 1 is to choose the Definition Style

The screen will change depending on the Definition Style that is selected. Figure 8 shows an example screen for Elemental Mass Percentage. The user must know the mass, charge and mass percentage of each element in the material. Only naturally occurring elements can be used at this time. The sum of all percentages must add up to 100.

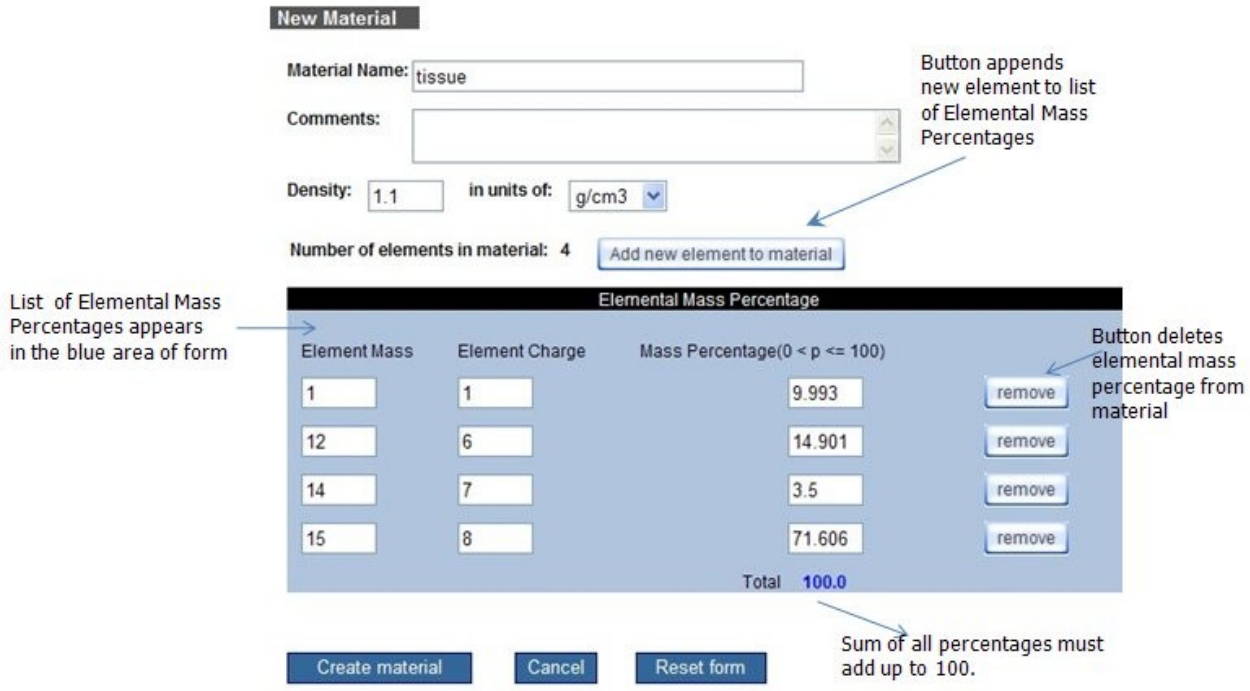


Figure 8 Example of screen for Elemental Mass Percentage

Figure 9 shows an example screen for the Molecular Mass Percentage definition style. The user enters the chemical formula and mass percentage of each molecule in the material. Formulas are input by entering the chemical symbols of each constituent element followed by the number of atoms. Formulas are input using plain text. The show formula button lets the user view the formula with atomic number indicated using a subscript. Although not shown in Figure 9, there is a blue box at the bottom of the screen that has some example chemical formulae to help the user figure out the input format.

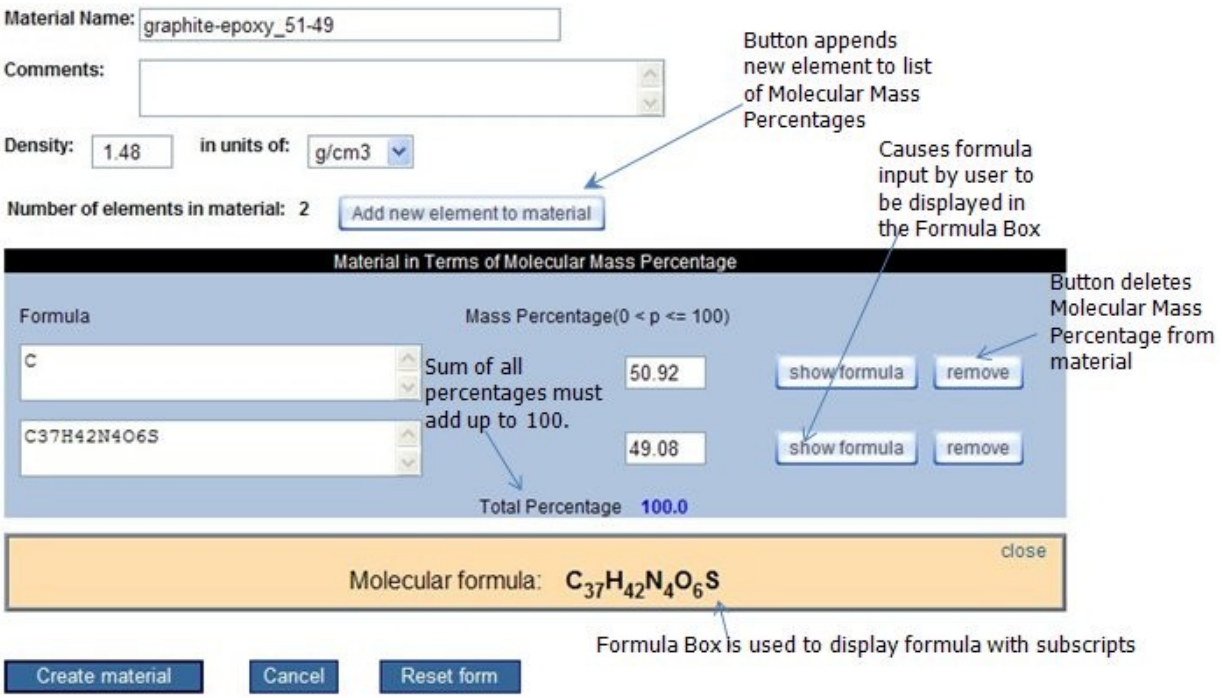
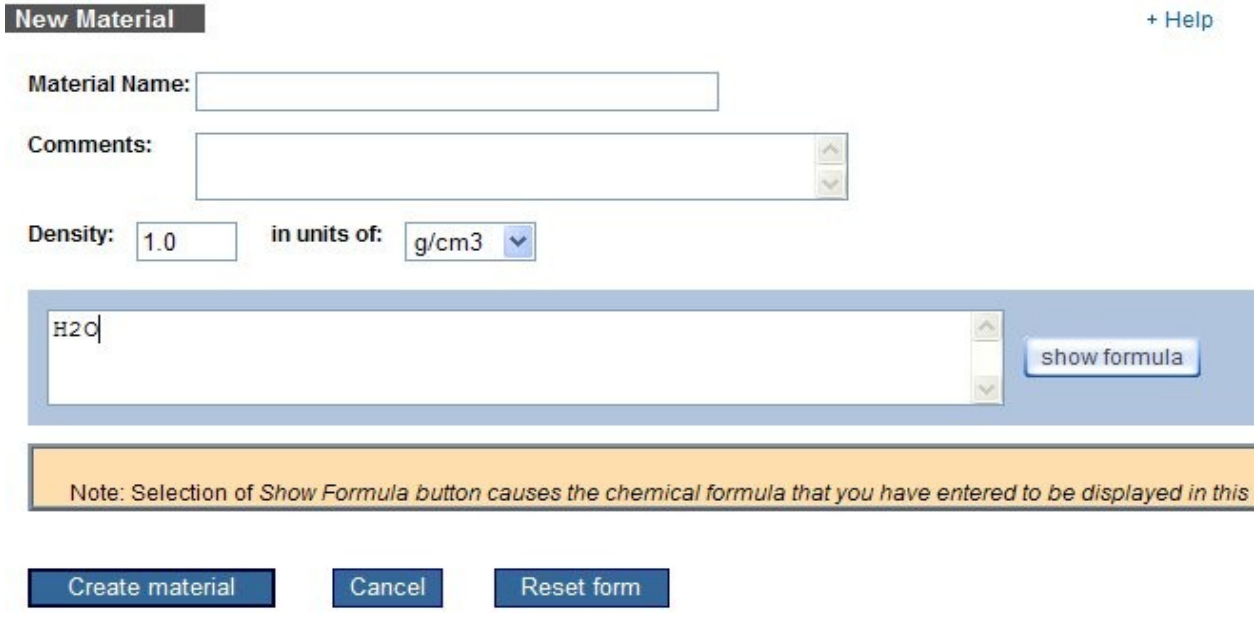


Figure 9 Example screen for Molecular Mass Percentage

The figure below shows an example screen for the Chemical Formula definition style. This form operates similarly to the one for Molecular Mass Percentages except that only one formula is entered.



Form for Editing Materials

The form for editing a material definition is same one as is used for creation. The difference is that the user skips the first step because the definition style is fixed after creation. Changing any part of the material definition (except name and comments) invalidates any existing cross-sections for the material. They will need to be re-generated.

Documentation

This module contains links for downloading user documentation and various reports. The second link is for a technical publication that is now quite old. Some of the info is still relevant, but info on more recent models/methods is listed in the Change Log. There are also links to some other websites that have further background information or alternative models.

Log Out

Logging out from OLTARIS is done explicitly by selection of the Log Out item from the Main Menu. It can also be done implicitly, such as by powering the machine off or closing the web browser window. The OLTARIS login system uses a session-only cookie to authenticate the user. When the user logs out, this session-only cookie is deleted from the user's computer. As a security precaution, one should not rely on implicit means of logging out of OLTARIS, especially not on a public computer; instead one should explicitly log out and wait for the confirmation that this request has taken place.