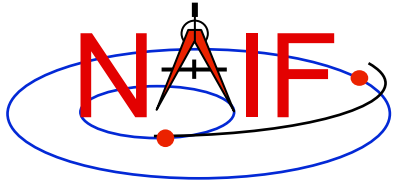


Navigation and Ancillary Information Facility

# Obtaining SPICE Components Offered by NAIF and Horizons

## Emphasis on Kernels

April 2016

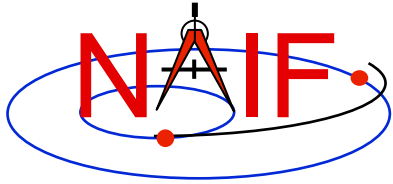


# Overview

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Navigation and Ancillary Information Facility

- **Many SPICE products are available from the NAIF server**
  - These are mostly products produced at JPL by NAIF
  - Access is available using the http or ftp protocol
  - See the next page for URLs
- **SPICE products made by other organizations are controlled by those organizations**
  - Some may be available from the NAIF server
  - Some may be available at other public servers, or on restricted servers, or not at all
  - Unfortunately there is no simple rule set to describe what may be found where
  - As a general rule, NAIF has no cognizance of these products
- **Horizons is an on-line natural body ephemeris generator**
  - Use it to generate up-to-date SPKs for comets and asteroids



# NAIF Server HTTP URLs

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Navigation and Ancillary Information Facility

- **NAIF home page**

<http://naif.jpl.nasa.gov>

- Here you may access all official SPICE products produced by NAIF
  - kernels (generic, mission operations, and PDS archived ancillary data)
  - software (Toolkits and individual utility programs)
  - documents
  - tutorials
  - programming lessons
  - problem solving tips
  - rules about using SPICE
  - links to useful resources
  - access to the WebGeocalc tool
  - access to the Cosmographia visualization program

- **SPICE announcements (by NAIF)**

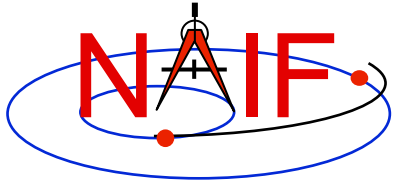
[https://naif.jpl.nasa.gov/mailman/listinfo/spice\\_announce](https://naif.jpl.nasa.gov/mailman/listinfo/spice_announce)

For use by NAIF staff in making assorted announcements.

- **SPICE discussion (by anyone)**

[https://naif.jpl.nasa.gov/mailman/listinfo/spice\\_discussion](https://naif.jpl.nasa.gov/mailman/listinfo/spice_discussion)

For use by SPICE users who wish to talk to other SPICE users  
(Don't use this if you have questions for NAIF staff)

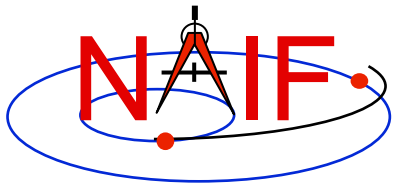


# Getting SPICE Kernels

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Navigation and Ancillary Information Facility

- **The remaining charts discuss where to find the various categories of SPICE kernel files**
  - **Operational flight project kernels**
    - » For (mostly JPL) active flight projects
  - **PDS archived kernels**
    - » Those formally delivered to and accepted by the NAIF Node of NASA's Planetary Data System
  - **Generic kernels**
    - » Used by many flight projects and other endeavors
    - » Some of these are also available in the other two categories



# Obtaining Operational Flight Project Kernels - 1

## Navigation and Ancillary Information Facility

Operational Flight Project Kernels and Assorted Other Project Kernels

Kernels for currently active missions **where NAIF produces the kernels** or otherwise has access to them, kernels from some pre-SPICE era missions, and miscellaneous other mission kernels may be obtained from the NAIF server using the links below. Included under this category are some kernels from past missions that have not yet been archived in the PDS.

- [Heliophysics Missions](#)
- [Mercury Missions](#)
- [Venus Missions](#)
- [Earth Missions](#)
- [Lunar Missions](#)
- [Mars Missions](#)
- [Outer Planet Missions](#)
- [Comet and Asteroid Missions](#)
- [Astrophysics Missions](#)

Please note that kernels produced by agencies other than JPL are usually available only at those agencies, and may not be available to other than the flight project's team members. (By agreement between ESA and NASA, kernels for a few ESA-sponsored missions are mirrored at NAIF for the convenience of U.S. participating scientists.)

PDS Nodes: Atmospheres Geosciences Imaging NAIF PPI Rings Small Bodies

**FIRSTGOV**  
Your First Click to the U.S. Government

Clearance: CL#05-2438  
Site Manager: Charles Acton  
NASA Official: William Knopf  
Webmaster: Ron Baalke  
Last Updated: 26 Feb 2014

1 - Select the mission class of interest

2a - Select the project name to get access to the kernels folder for that project. (see next page)

NAIF Data

The number of files for each SPICE kernel type is shown in the table below for the missions specified. An asterisk (\*) indicates that one or more non-kernel files are also present; usually this is an 'aareadme' file that explains the kernel file naming convention. The count of the number of kernels is made ONLY in the primary directory; in some cases there are additional kernels in a subdirectory (for instance, older versions of kernels that have been replaced with newer versions).

**Outer Planet Missions**

Mission	ck	ek	fk	ik	lsk	pck	sck	spk
<a href="#">CASSINI*</a>	5058*	473*	23*	13*	4*	352*	114*	4146*
<a href="#">GALILEO*</a>	26	0		7	2	3	1	12*
<a href="#">JUNO*</a>	222*		3*	11*	2*	3*	3*	178*
<a href="#">NEW HORIZONS*</a>								
<a href="#">PIONEER 10*</a>								1
<a href="#">PIONEER 11</a>								2*
<a href="#">VOYAGER 1, 2*</a>	10		2	4	0*	0*	2	9*

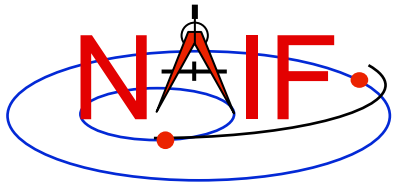
PDS Nodes: Atmospheres Geosciences Imaging NAIF PPI Rings Small Bodies

**FIRSTGOV**  
Your First Click to the U.S. Government

Clearance: CL#05-2438  
Site Manager: Charles Acton  
NASA Official: William Knopf  
Webmaster: Ron Baalke  
Last Updated: 10 Oct 2014

2b - Select the kernel type to get access to all kernels of that type for that project. The number tells how many kernels of that type are available. (see next page)

- Or -



# Obtaining Operational Flight Project Kernels - 2

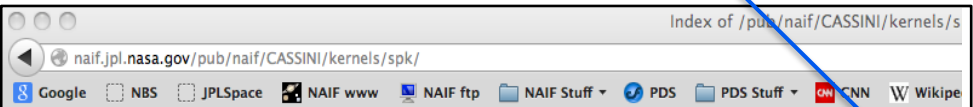
## Navigation and Ancillary Information Facility

Access to all kernels for the named project

Access to kernels of the selected type for the named project

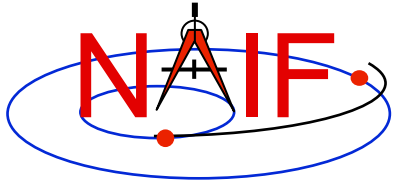
### Index of /pub/naif/CASSINI/kernels

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
<a href="#">Parent Directory</a>	-	-	-
<a href="#">aareadme.txt</a>	11-Mar-2004 14:39	400	
<a href="#">ck/</a>	04-Mar-2013 09:58	-	
<a href="#">ek/</a>	05-Feb-2013 12:24	-	
<a href="#">fk/</a>	11-May-2009 12:04	-	
<a href="#">ik/</a>	07-Nov-2008 09:32	-	
<a href="#">lsk/</a>	10-Sep-2012 12:47	-	
<a href="#">pck/</a>	09-Jan-2013 21:03	-	
<a href="#">sclk/</a>	08-Feb-2013 18:47	-	
<a href="#">spk/</a>	05-Mar-2013 15:50	-	



### Index of /pub/naif/CASSINI/kernels/spk

<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
<a href="#">Parent Directory</a>	-	-	-
<a href="#">000202R_SK_LP0_V1P32.bsp</a>	21-Feb-2002 13:02	238K	SPK file
<a href="#">000202R_SK_LP0_V1P32.bsp.lbl</a>	21-Feb-2002 13:02	2.3K	Detached file label (plain text)
<a href="#">000202R_SK_V1P32_V2P12.bsp</a>	21-Feb-2002 13:02	502K	
<a href="#">000202R_SK_V1P32_V2P12.bsp.lbl</a>	21-Feb-2002 13:02	2.6K	
<a href="#">000202R_SK_V2P12_EP15.bsp</a>	21-Feb-2002 13:02	198K	
<a href="#">000202R_SK_V2P12_EP15.bsp.lbl</a>	21-Feb-2002 13:02	2.5K	
<a href="#">000203_SE_JUP156.bsp</a>	21-Feb-2002 13:03	4.9M	
<a href="#">000203_SE_JUP156.bsp.lbl</a>	21-Feb-2002 13:03	3.2K	
<a href="#">000331RB_SK_V1P32_V2P12.bsp</a>	16-Jun-2005 13:02	623K	
<a href="#">000331RB_SK_V1P32_V2P12.bsp.lbl</a>	16-Jun-2005 13:02	5.2K	
<a href="#">000331R_SK_LP0_V1P32.bsp</a>	21-Feb-2002 13:03	307K	
<a href="#">000331R_SK_LP0_V1P32.bsp.lbl</a>	21-Feb-2002 13:03	3.9K	
<a href="#">000331R_SK_V1P32_V2P12.bsp</a>	21-Feb-2002 13:03	622K	
<a href="#">000331R_SK_V1P32_V2P12.bsp.lbl</a>	21-Feb-2002 13:03	3.9K	
⋮	21-Feb-2002 13:03	218K	
⋮	21-Feb-2002 13:03	3.6K	
<a href="#">aareadme.txt</a>			Description of file naming scheme

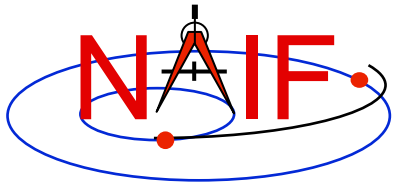


# Obtaining PDS Archived Kernels

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Navigation and Ancillary Information Facility

- **The best method for obtaining PDS archived kernels is directly from the NAIF server.**
  - Complete SPICE data sets exist on the NAIF server fully expanded—not bundled in a Zip or tar file
  - Unless you have reason to do otherwise, download the entire archival data set using the ftp URL
    - » That way you'll get all the latest data, the associated “furnsh kernels”, and the best documentation.
  - If the data set is large and you need only a portion of it based on start/stop time, use the “subsetter” link to obtain the smaller amount of data needed.
  
- **A pictorial example is shown on the next page**



# Obtaining Archived Kernels from the NAIF Server - 1

## Navigation and Ancillary Information Facility

Mission Name	Archive Readme	Archive Link	PDS3 or PDS4	Data Size (GB)	Start Time	Stop Time	Subset Link
Cassini Orbiter	<a href="#">readme</a>	<a href="#">link</a>	3	47.4	1997-10-15	2014-09-30	<a href="#">subset</a>
Clementine	<a href="#">readme</a>	<a href="#">link</a>	3	0.8	1994-01-26	1994-05-07	<a href="#">subset</a>
DAWN	<a href="#">readme</a>	<a href="#">link</a>	3	13.5	2007-09-27	2012-09-13	<a href="#">subset</a>
Deep Impact	<a href="#">readme</a>	<a href="#">link</a>	3	0.7	2005-01-12	2005-08-09	<a href="#">subset</a>
Deep Space 1	<a href="#">readme</a>	<a href="#">link</a>	3	0.9	1998-10-24	2001-12-18	<a href="#">subset</a>
EPOXI	<a href="#">readme</a>	<a href="#">link</a>	3	1.0	2005-08-23	2011-03-01	<a href="#">subset</a>
GRAIL	<a href="#">readme</a>	<a href="#">link</a>	3	4.3	2011-09-10	2012-12-17	<a href="#">subset</a>
Hayabusa	<a href="#">readme</a>	<a href="#">link</a>	3	0.3	2005-09-11	2005-11-19	<a href="#">subset</a>

Index of [ftp://naif.jpl.nasa.gov/pub/naif/pds/data/co-s\\_j\\_e\\_v-spice-6-v1.0/cosp\\_1000/](ftp://naif.jpl.nasa.gov/pub/naif/pds/data/co-s_j_e_v-spice-6-v1.0/cosp_1000/)

[Up to higher level directory](#)

**Name**

- [aareadme.htm](#)
- [aareadme.lbl](#)
- [aareadme.txt](#)
- [catalog](#)
- [data](#)
- [document](#)
- [errata.txt](#)
- [extras](#)
- [index](#)
- [software](#)
- [voldesc.cat](#)

[Up to higher level directory](#)

**Name**

- [ck](#)
- [ek](#)
- [fk](#)
- [ik](#)
- [lsk](#)
- [pck](#)
- [sclk](#)
- [spk](#)

[Up to higher level directory](#)

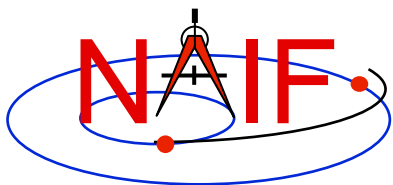
**Name**

- [ckextra](#)
- [extrinfo.txt](#)
- [mk](#)
- [orbnum](#)

If you select “PDS SPICE Archives” on the NAIF web page you can follow a path like this one.

- You can use the ftp URL along with Unix “wget” or the FileZilla tool, or some other equivalent, to download the entire data set—recommended, if not too large! Otherwise see the next page.
- Or you can select specific kernels from the kernel folders, and/or “furnsh” meta- kernels and other items from the extras folder





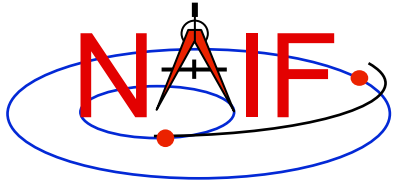
# Obtaining Archived Kernels from the NAIF Server - 2

## Navigation and Ancillary Information Facility

Mission Name	Archive Readme	Archive Link	PDS3 or PDS4	Data Size (GB)	Start Time	Stop Time	Subset Link
Cassini Orbiter	<a href="#">readme</a>	<a href="#">link</a>	3	47.4	1997-10-15	2014-09-30	<a href="#">subset</a>
Clementine	<a href="#">readme</a>	<a href="#">link</a>	3	0.8	1994-01-26	1994-05-07	<a href="#">subset</a>
DAWN	<a href="#">readme</a>	<a href="#">link</a>	3	13.5	2007-09-27	2012-09-13	<a href="#">subset</a>
Deep Impact	<a href="#">readme</a>	<a href="#">link</a>	3	0.7	2005-01-12	2005-08-09	<a href="#">subset</a>
Deep Space 1	<a href="#">readme</a>	<a href="#">link</a>	3	0.9	1998-10-24	2001-12-18	<a href="#">subset</a>
EPOXI	<a href="#">readme</a>	<a href="#">link</a>	3	1.0	2005-08-23	2011-03-01	<a href="#">subset</a>
GRAIL	<a href="#">readme</a>	<a href="#">link</a>	3	4.3	2011-09-10	2012-12-17	<a href="#">subset</a>
Hayabusa	<a href="#">readme</a>	<a href="#">link</a>	3	0.3	2005-09-11	2005-11-19	<a href="#">subset</a>
Lunar Reconnaissance Orbiter	<a href="#">readme</a>	<a href="#">link</a>	3	201.2	2009-06-18	2015-03-15	<a href="#">subset</a>

For “large” data sets that might take a long time to download, if you really need just a subset of the data covering a limited amount of time you should use the “Subset Link” for the data set of interest.

This process will automatically select just the kernels that fall within or overlap the time bounds you specify, construct a new “FURNISH” kernel(s) containing the names of this subset of kernels (thus making it easy for you to load the subset into your program), and create a custom wget script you may use to download these files to your computer.

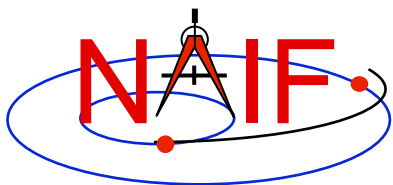


# Downloading Archived Kernels from the NAIF Server

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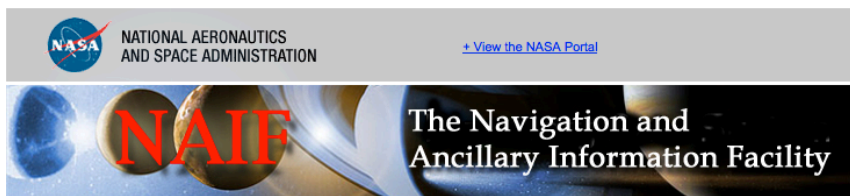
Navigation and Ancillary Information Facility

- **Use GNU's wget or FileZilla or a similar utility to download the complete SPICE data set**
  - Possible wget usage, and an example using Deep Impact
    - » `wget -m -nH --cut-dirs=5 -nv` (insert the URL of the "Volume FTP Link" for the SPICE data set here). For example:
      - `wget -m -nH --cut-dirs=5 -nv ftp://naif.jpl.nasa.gov/pub/naif/pds/data/di-c-spice-6-v1.0/disp_1000/`
  - FileZilla info
    - » [http://filezilla-project.org/client\\_features.php](http://filezilla-project.org/client_features.php)



# Obtaining Generic Kernels

## Navigation and Ancillary Information Facility



- Home
- Announcements
- About SPICE
- About NAIF
- Data**
- Toolkit
- Utilities
- WebGeocalc
- Cosmographia
- Documentation

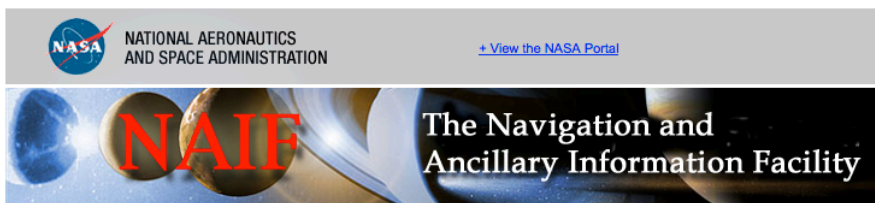
### SPICE Data (SPICE Kernels)

If you are not already familiar with how to use SPICE data, usually called "kernels," take a moment to read about [using SPICE data](#).

Three categories of SPICE data, often referred to as kernels, are available from this website. You should carefully read about all three of these categories using the links below in order to find the best data for your needs.

- [PDS Archived SPICE Data Sets](#)
- [Operational Flight Projects Kernels and Other Non-archived Project Kernels](#)
- **[Generic Kernels](#)**

Generic kernels are just a few clicks away...



- Home
- Announcements
- About SPICE
- About NAIF
- Data**
- Toolkit

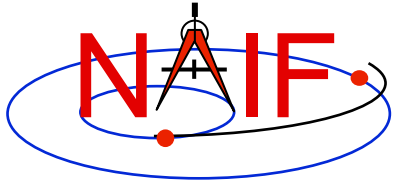
### Generic Kernels

SPICE kernels that exist independent of any particular flight project are called generic Kernels. These may be obtained from the

**[generic kernels](#)**

## Index of /pub/naif/generic\_kernels

Name	Last modified	Size	Description
<a href="#">Parent Directory</a>		-	
<a href="#">aareadme.txt</a>	26-Jul-2013 15:28	3.6K	
<a href="#">dsk/</a>	25-Jun-2015 17:54	-	
<a href="#">fk/</a>	02-Apr-2007 17:57	-	
<a href="#">lsk/</a>	05-Jan-2015 11:22	-	
<a href="#">pck/</a>	29-Feb-2016 17:07	-	
<a href="#">spk/</a>	29-Aug-2013 14:25	-	
<a href="#">stars/</a>	15-Feb-2007 17:36	-	



# Horizons

Navigation and Ancillary Information Facility

- **Horizons is an on-line ephemeris generator for natural bodies (and more)**
  - Operated by JPL's Solar System Dynamics Group
- **Of primary interest to SPICE users is its ability to generate up-to-date SPK files for comets and asteroids**
  - Horizons home:
    - » <http://ssd.jpl.nasa.gov/?horizons>
  - Horizons web interface for manual generation of small body SPKs:
    - » <http://ssd.jpl.nasa.gov/x/spk.html>
  - Horizons telnet interface for automated (programmatic) generation of small body SPKs:
    - » `telnet ssd.jpl.nasa.gov 6775`
    - » For example script look at:
      - [ftp://ssd.jpl.nasa.gov/pub/ssd/smb\\_spk](ftp://ssd.jpl.nasa.gov/pub/ssd/smb_spk)