

AIRS SRF File Format

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Abstract

We define an HDF 4 data format for AIRS spectral response functions (SRFs). The use of HDF makes the data portable and to some extent self-documenting, as HDF attributes are used to include version, author, general comments, and descriptions of the individual data objects in the file. The format is relatively simple, and the data can be read directly with the HDF library routines, or extracted in binary or ASCII formats with simple HDF utilities. Forthcoming documents will describe how these SRFs were measured and provide estimates of their accuracy.

1 The SRF File Format

AIRS has 2378 spectral channels, so the SRF file contains 2378 distinct spectral response functions, currently tabulated at 471 points. The SRF file contains a set of data arrays and descriptive attributes, including both general comments and a short description of each data array. The data arrays can be summarized as

chanid	2378 x 1	int16	AIRS channel ID's
freq	2378 x 1	float64	SRF center frequencies
fwgrid	1 x 471	float32	SRF tabulation points
srfval	2378 x 471	float32	SRF values
width	2378 x 1	float32	SRF widths

HDF 4 stores data in row order; for languages which store data in column order, such as Fortran or Matlab, the dimension lists will be reversed, so that, e.g., srfval will be a 471 x 2378 element array. A more detailed description of the arrays is as follows.

chanid is an integer array that contains the spectral channel identities as referenced in the AIRS HDF product files. Note that these are **not** the Lockheed Martin channel IDs used during AIRS calibration.

freq is the frequency of the nominal center points of the SRFs, i.e., the wavenumber for fwgrid = 0, see equation 1, below. These nominal center values are from an intermediate stage of the SRF modeling, and may not correspond exactly to peaks, integral centers, or midpoints of the line through the full width at half max of the tabulated SRFs.

fwgrid is a scaled frequency grid for tabulation of the SRFs, in units of the full width at half max. The grid extends far enough into the wings of the SRF for accurate radiative transfer calculations. fwgrid is not tabulated at a regular spacing; points are spaced closer together where the SRFs have greater variability.

srfval are the values of the SRFs peak-normalized to unity

width are the full widths at half max of the SRFs, in wavenumbers

The fwgrid vector can be converted to a frequency grid in wavenumbers,

$$\text{freqgrid} = (\text{fwgrid} \times \text{width}) + \text{freq} \quad (1)$$

The resulting freqgrid will not be at a regular spacing; if desired, srfval can be linearly interpolated to a finer, regular grid. Do not extrapolate the SRF beyond the endpoints of fwgrid.

The SRF file includes unit attributes for each array, and the following general attributes.

author gives contact information for questions about the SRFs

version is the version number we have assigned to the SRFs in the file

comment is a short description on how to construct the SRFs in a form usable for convolutions with monochromatic radiance or transmittance data

2 Reading the SRF File

The HDF SRF data can be read in several ways. The data format used for the SRFs is relatively simple, and the data can be read with the HDF “SD” library routines without too much difficulty, either directly, in C or Fortran, or via HDF library call wrappers, as provided by Matlab and IDL.

A Matlab SRF reader, h4sd2mat.m, is available; it needs an auxiliary function sdsid2mat.m, both of which are part of a high-level toolkit for reading and writing HDF 4 from Matlab. The function h4sd2mat.m is a general purpose procedure for reading HDF SD data which can be used to read the AIRS SRFs.

As an alternative to reading the files directly, the HDF 4 utility “hdp”, available as part of the HDF distribution, can be used to dump the array data in ASCII or binary formats. For example, to extract the srfval array from the sample SRF HDF file in binary format, the command would be

```
hdp dumsds -b -n srfval srftablesV10.hdf > srfval.bin
```

The same array can be dumped in ASCII format with the command

```
hdp dumpsds -dx -n srfval srftablesV10.hdf > srfval.asc
```

The ASCII representation will result in a larger file, and may be less accurate; but there are times when it might be convenient. After the dump, data in either format can be read as usual; for example, the ASCII data can be read in Fortran with the following statements. Note that from Fortran we read the data with the dimension list flipped.

```
real srf(471,2378)
read *, srf
```

The hdp utility can also be used to examine dimensions and attributes; the command for this, for the example SRF file, would be

```
hdp dumpsds -h srftablesV10.hdf
```

A pre-compiled version of the hdp program is available for most popular operating systems from the HDF 4 home page, <http://hdf.ncsa.uiuc.edu/hdf4.html>

In the HDF representation, arrays in the file should be accessed by their names, as given above, rather than by their SDS indices. It is the name that is bound to the desired data, not any particular SDS index, which simply reflects the order in which the arrays were written. (It is OK to use an SDS index if it is gotten from a name, e.g. by the HDF routine `sdnametoindex`.)

3 The SRF V1.0 File

At present a single SRF file is available for downloading. This file, at <http://asl.umbc.edu/pub/airs/srf/srftablesV10.hdf>, contains the AIRS SRFs that will be used at-launch. These SRFs assume that the spectral location of these channels is identical to what was measured during the pre-launch AIRS calibration at a nominal spectrometer temperature of 155K. We do not expect AIRS to necessarily settle in at this temperature after launch, so these SRFs will most likely be incorrectly placed. In addition, the AIRS spectrometer contains low amplitude fringing caused by the entrance aperture interference filters. These fringes do affect the SRFs

to a very small degree, but are not included in the SRFs in the above file because we will not know the location of these fringes on each SRF until after launch.

4 The SRF File for July 20, 2002

July 20, 2002 was the first “focus day” for analysis of AIRS data. The file <http://asl.umbc.edu/pub/airs/srf/srftables-020720v2.hdf> contains the SRF appropriate for that day. Note that this file can be downloaded using ftp as well, same location. The SRFs in this file *do* not contain the small fringing effects.

5 The SRF File for AIRS Data After August 18, 2002

AIRS went through a de-frost cycle in August 2002, and afterwards the instrument temperature was re-adjusted to a value that can be potentially held for a long time period. These changes resulted in new channel center frequencies, and new positions for the fringes. At this time, every attempt will be made to keep AIRS configured so that these SRFs are correct. During the AIRS validation phase further analysis of the applicability of these SRFs to AIRS will be carried out.

The file <http://asl.umbc.edu/pub/airs/srf/srftables-020818v1.hdf> contains the SRF appropriate from August 18, 2002 and beyond. Note that this file can be downloaded using ftp as well, same location. The SRFs in this file *do* contain the small fringing effects. The fringe phase was determined in-orbit during calibration testing.

6 Links

- SRF files are available for downloading at <http://asl.umbc.edu/pub/airs/srf> or via ftp at <ftp://asl.umbc.edu/pub/airs/srf>.
- The most recent version of this document is available at <http://asl.umbc.edu/pub/airs/srf/srfhdf.html>;

a pdf version available at
<http://asl.umbc.edu/pub/airs/srf/srfhdf.pdf>.

- A high-level toolkit is available for reading and writing HDF 4 from Matlab. The function `h4sd2mat.m` there is a general purpose procedure for reading HDF SD data, which can be used for reading the AIRS SRFs.
- The HDF 4 home page, <http://hdf.ncsa.uiuc.edu/hdf4.html>, is the authoritative source for the HDF libraries, documentation, and utilities.