# The IRAS 9P Images Collection

This data set description was prepared by Stephanie McLaughlin and is based on the documentation provided by Russell Walker and included in this archive.

## Data Set Overview

This data set contains radiance and noise maps based on reprocessed images of comet 9P/Tempel 1 acquired by IRAS during months before and after its perihelion on July 9, 1983. The purpose of this data set is to archive the maps that will be used for photometry of the dust coma of Tempel 1, in support of the NASA Deep Impact Mission.

IRAS spent the majority of its observing time in the survey mode that systematically mapped the sky with a series of overlapping and confirming scans (Wheelock et al. 1994 [WHEELOCKETAL1994]). However, IRAS also devoted time to making point observations of selected fields of interest (Young et al. 1985 [YOUNGETAL1985]). IRAS observations were acquired by its Focal Plane Array, a multi-wavelength detector with spectral bands centered nominally at 12, 25, 60, and 100 microns (Beichman et al. 1988[BEICHMANETAL1988]).

To support analysis of the dust coma of comet 9P/Tempel 1, Russell Walker queried the IRAS data archives held at the Infrared Processing and Analysis Center (IPAC). He determined that the IRAS Additional/Pointed Observations (AO) and the IRAS Sky Survey Atlas (ISSA) contained mages of the comet. He extracted both sets of observations, then pplied a different method to each set to produce the radiance and noise maps. Walker also extracted images from the ISSA Reject Set, contaminated by zodiacal light, that show the dust trail of Tempel 1. These trail images are included in this data set as JPEG files for future reference.

## Additional (Pointed) Observations

### Processing

This data set contains the radiance and noise maps for reprocessed AO observations at 12, 25, 60, and 100 microns for the following five combinations of IRAS satellite observation plans (SOP) and observation numbers (OBS):

| SOP | OBS | UTC Date |
|---|---|---|
| 287 | 13 | 1983-06-18, pre-perihelion |
| 407 | 12 | 1983-08-17, post-perihelion |
| 407 | 43 | 1983-08-17, post-perihelion |
| 509 | 40 | 1983-10-07, post-perihelion |
| 510 | 22 | 1983-10-08, post-perihelion |

Perihelion occurred at UTC 1983-07-09T19:08:11 (Julian date 2445525.2973512). The explanatory supplement for AO provides tables that further describe the details of the observations.

Images of the comet were selected from the IRAS AO archive, then processed by IPAC's HIRES, LAUNDR, and YORIC algorithms to construct resolution-enhanced, co-added, images of the observed fields (Melnyk and Rice 1991 [MELNYK&RICE1991], Melynk 1990[MELNYK1990], and Aumann et al. 1990 [AUMANNETAL1990]).

The IPAC YORIC algorithm uses an iterative process to make progressively better models of the sky. Surface brightness (radiance) and noise maps were produced for 20 iterations. For this data set, the first iteration and final, best, twentieth iteration of the radiance and noise maps were provided for each AO and spectral band combination. For each radiance map, the effective resolution table generated by YORIC was provided. These tables show how the effective resolution or beam size varies across the final reprocessed image.

All AO radiance and noise images are 241 x 241 square, 15-arcsecond pixels. Each image size is about 1 degree by 1 degree but the IRAS scan is only about 30 arcminutes wide and therefore does not fill the image area. Image array elements that lie outside the scanned area havea value of -9999.0.

The comet is not centered in an AO image. The B1950_RIGHT_ASCENSION and B1950_DECLINATION in the PDS label identify the location of the target. The images have a Plate Carree projection for right ascension and declination. For a discussion of Plate Carree, see Calabretta and Greisen 2002 [CALABRETTA&GREIS2002] and Greisen and Calabretta 2002 [GREISEN&CALABRET2002].

A detailed description of the reduction methodology is describedin the explanatory supplement included with this data set. PDS strongly recommends all users read the supplement before using this data set.

### Parameters

The naming convention for the radiance and noise map images is sSOP_oOBS_BANDum_ITERATION_TYPE.fit, where SOP is the satellite operations plan number, OBS is the observation number, BAND is the band wavelength in microns, ITERATION is the processing iteration number, and TYPE identifies a radiance or noise map. A similar naming convention is used for the effective resolution tables: sSOP_oOBS_BANDum_ITERATION_effres.tab.

Radiance and noise map images are in units of in-band radiance, Watts/cm^2/steradian. The noise maps provide the standard deviation of contributions to each pixel and can be used to the show the relative noise across an image. The noise maps do not give the absolute level of the photometric noise.

## Sky Survey Scans

### Processing

This data set contains radiance and noise maps reconstructed from sets of Survey Scans at 12, 25, 60, and 100 microns. The IRAS mean satellite operations plan (SOP) number identifies a specific survey scan:

| Mean SOP | Mean UTC Date |
|---|---|
| 339 | 1983-07-14, post-perihelion |
| 368 | 1983-07-28, post-perihelion |
| 389 | 1983-08-08, post-perihelion |
| 421 | 1983-08-24, post-perihelion |
| 493 | 1983-09-28, post-perihelion |

Perihelion occurred at UTC 1983-07-09T19:08:11 (Julian date 2445525.2973512). The Explanatory Supplement for Survey Scans document, archived with this data set, provides tables that further describe the details of the observations.

IRAS spent the majority of its observing time in the survey mode that systematically mapped the sky with a series of overlapping and confirming scans. This redundancy can be used to produce an image of fainter limiting magnitudes to improve the spatial resolution in the scanned fields.

Walker searched the ISSA and identified scans which contained Tempel 1. He developed and used a computer algorithm based on the Maximum Correlation Method (Aumann et al. 1990 [AUMANNETAL1990]) and similar to the IPAC HIRES program (Melynk and Rice, 1991 [MELNYK&RICE1991]), to construct radiance and noise maps from sets of overlapping scans. The major departure from the IPAC scheme occurs when the coordinates of each data sample are transformed to a moving Sun-referenced coordinate system with the comet at the origin.

Like the IPAC scheme, the algorithm iteratively builds better sky models, saving statistics relating to pixel noise and convergence for each iteration. A typical image will converge after 15 to 40 iterations. The radiance and noise maps from the first iteration and the final, best iteration were provided for survey scan and band combination. The radiance maps are surface brightness images. The noise maps are images of the standard deviation of the radiance in a pixel as a result of averaging overlapping detector samples.

All ISSA radiance and noise maps are 150 x 75 pixels. The square, 24-arcsecond pixels yield an image size of about 1.0 x 0.5 degrees. The images were constructed by referencing the samples to the orbital position of the comet at the time of the sample. Thus, the comet is always located in the center of the image. Since a map was constructed from several scans, it is a time-averaged image of the emission history of the comet.

A detailed description of the reduction methodology is described in the explanatory supplement included with this data set. PDS strongly recommends all users read the supplement before using this data set.

**Parameters**

The naming convention for ISSA radiance and noise maps is sSOP_BANDum_ITERATION_TYPE.fit where SOP is the satellite operations plan number, BAND is the band wavelength in microns, ITERATION is the processing iteration number, and TYPE identifies a radiance or noise map.

The radiance and noise map images are in units of in-band radiance, Watts/cm^2/steradian. The noise maps provide the standard deviation of contributions to each pixel and can be used to the show the relative noise across an image. The noise maps do not give the absolute level of the photometric noise.

## Data

The AO and ISSA radiance and noise images are provided as FITS files with attached FITS headers and detached PDS labels. The AO effective resolution data are provided as fixed-width, ASCII tables with detached PDS labels.

## Ancillary Data

While searching the ISSA, 56 images that show the dust trail of comet 9P/Tempel 1 were discovered and extracted. Mark Sykes (PDS-SBN) concluded that the reduction level of these data is such that the images should not be used for surface photometry of the trail. Therefore, the images were converted from FITS to JPEG and included in this data set only as documentation for future reference.

## Coordinate System

For OA images, the coordinate system is FK4, equatorial right ascension and declination in the B1950 coordinate frame. North is up and East is to the left when an AO image is displayed using the values for SAMPLE_DISPLAY_DIRECTION and LINE_DISPLAY_DIRECTION. The projected direction to the Sun is towards the upper left corner of the image.

For ISSA images, the coordinate system is solar elongation and inclination of the observation which is the natural coordinate system for IRAS. Solar elongation is the angle between the lineof site and the Sun. Inclination is the azimuth angle about the Earth-Sun axis (that is, the angle between the ecliptic plane and the plane containing the Earth, Sun, and observing direction). The inclination, measured when facing the Sun, increases clockwise, from 0 to 360 degrees, around the Earth-Sun axis. An inclination of 0 degrees indicates IRAS is looking at the ecliptic plane and in the direction opposite to the motion of the Earth. The inclination is 90 degrees when IRAS is over north ecliptic pole and 180 degrees when IRAS is looking at the ecliptic plane in the direction of the motion of the Earth. The inclination angle increases opposite the direction of IRAS's polar orbit about Earth. The documentation for the survey scans includes an illustration of this IRAS-specific coordinate system.

North is down and East is to the right when an ISSA image is displayed using the values for SAMPLE_DISPLAY_DIRECTION and LINE_DISPLAY_DIRECTION. The projected direction to the Sun is towards the lower right corner of the image.

**Media/Format**

This data set is released as a logical data volume.