



# IceBridge KT19 IR Surface Temperature, Version 1

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## USER GUIDE

### How to Cite These Data

As a condition of using these data, you must include a citation:

Bennett, R. & Studinger, M. (2012, updated 2020). *IceBridge KT19 IR Surface Temperature* (IAKST1B, Version 1) [Data set]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. <https://doi.org/10.5067/I883KXU7ZO8O> [Date Accessed]

FOR QUESTIONS ABOUT THESE DATA, CONTACT [NSIDC@NSIDC.ORG](mailto:NSIDC@NSIDC.ORG)

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/IAKST1B>



National Snow and Ice Data Center

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# 1 DETAILED DATA DESCRIPTION

## 1.1 Format

The KT19 data files are in ASCII text format with each row of the file corresponding to a separate measurement record.

Each data file is paired with an associated XML file, which contains additional metadata. DC-8 platform data are from the NSRC team, while data from the P-3 and all other platforms are from the ATM team.

## 1.2 File and Directory Structure

Example file names:

IAKST1B\_KT19\_PROCESSED\_20121012\_120453.txt

IAKST1B\_KT19\_PROCESSED\_20121012\_120453.txt.xml

Files are named according to the following convention, which is described in more detail in Table 1:

IAKST1B\_KT19\_PROCESSED\_YYYYMMDD\_hhmmss.xxx

Table 1. File Naming Convention

Variable	Description
IAKST1B	Data set ID
KT19_PROCESSED	KT19 Level-1B processed data file
YYYY	Four-digit year of survey
MM	Two-digit month of survey
DD	Two-digit day of survey
hh	Two-digit hour for start of log file
mm	Two-digit minute for start of log file
ss	Two-digit second for start of log file
.xxx	Indicates ASCII text file (.txt), or xml file (.txt.xml)

All dates and times included in the filenames are based on machine local time.

**Note:** The time stamp in the file name does not necessarily reflect the start time of the data. The time stamps within the data files (Seconds\_Of\_Day) are the only reliable way to determine the start and stop times of each survey.

## 1.3 Spatial Coverage

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Spatial coverage includes Arctic and Antarctic sea and land ice.

### Arctic / Greenland:

Southernmost Latitude: 60° N

Northernmost Latitude: 90° N

Westernmost Longitude: 180° W

Easternmost Longitude: 180° E

### Antarctic:

Southernmost Latitude: 90° S

Northernmost Latitude: 53° S

Westernmost Longitude: 180° W

Easternmost Longitude: 180° E

### 1.3.1 Spatial Resolution

The KT19 sensor is fitted with a lens that has a two degree field of view. At 450 m above ground level, this produces an optical measurement footprint on the ground that is approximately 15 m in diameter. At a nominal aircraft speed of 125 m/s and a sampling frequency of 10 Hz, the centers of two consecutive spots will be 12.5 m apart along the aircraft ground track.

### 1.3.2 Projection and Grid Description

The KT19 data incorporate a GPS location that is referenced to the WGS 84 datum.

## 1.4 Temporal Information

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### 1.4.1 Temporal Coverage

12 October 2011 to 17 May 2019

### 1.4.2 Temporal Resolution

IceBridge campaigns were conducted on an annually repeating basis. Arctic and Greenland campaigns were typically conducted during March, April, and May; Antarctic campaigns were typically conducted during October and November.

KT19 surface temperature measurements were collected for every science flight in the NASA IceBridge Arctic campaigns beginning on 12 October 2011. The KT19 collected surface temperature measurements at 10 Hz for the duration of each flight.

**Note:** Data collected on 5 and 6 March 2012 are from test flights.

## 1.5 Parameter or Variable

The KT19.85 sensor provides a measurement of the surface temperature of an object in degrees Celsius. For compensation purposes, the sensor also provides a measurement of its internal temperature, in degrees Celsius, which may vary as much as 30°C throughout the course of a flight. The surface temperature measurement provided has not had any correction applied for changes in internal temperature.

### 1.5.1 Parameter Description

Each row of the KT19 ASCII data file corresponds to a separate measurement record. The data file contains eight columns of data, with each column corresponding to a different variable describing the measurement, as shown in Table 2.

The files also contain a number of header lines, each one beginning with a hashtag (#) to identify it as part of the header. The header contains the settings used for acquisition (emissivity, response time, temperature units, etc.) and the last header line describes the information found in each column of the data.

Table 2. Parameter Description

Parameter	Description	Units
Year	Year of measurement	Years
Day_Of_Year	Day of year of measurement	Days
Seconds_Of_Day	Seconds of day of measurement (UTC)	Seconds
Latitude	Latitude of GPS antenna	Decimal degrees
Longitude	Longitude of GPS antenna	Decimal degrees
Aircraft_Altitude_Above_Ellipsoid	Height of GPS antenna above WGS84 ellipsoid	Meters
KT19_Temperature	Surface temperature measured by the KT19	Degrees Celsius
KT19_Internal_Temperature	KT19 instrument internal temperature	Degrees Celsius

## 1.5.2 Sample Data Record

Below is a list of the header and the first ten records from the data

file IAKST1B\_KT19\_PROCESSED\_20120323\_195720.txt. The eight comma-separated fields in each record correspond to the parameters described in Table 2.

```
# KT19 Processed Output File
#
# Acquisition Start (UTC, machine time): 2012/03/23 19:57:20
#
# KT19 Settings:
#   Emissivity constant: 0.97
#   Temperature Units: C
#   Response Time: 0.3 sec
#   Ambient Measurement: Internal Reference
#
# Year,Day_Of_Year,Seconds_Of_Day,Latitude(Deg),Longitude(Deg),
# Aircraft_Altitude_Above_Ellipsoid(m),KT19_Temperature (C),
# KT19_Internal_Temperature(C)
2012,83,57499.60,79.210522,251.533821,1577.58,-35.22,-9.32
2012,83,57499.70,79.210436,251.534272,1577.57,-34.26,-9.32
2012,83,57499.80,79.210348,251.534722,1577.56,-36.04,-9.32
2012,83,57499.90,79.210261,251.535173,1577.55,-37.44,-9.32
2012,83,57500.00,79.210175,251.535624,1577.54,-38.76,-9.32
2012,83,57500.10,79.210088,251.536074,1577.52,-38.56,-9.32
2012,83,57500.20,79.210001,251.536524,1577.52,-37.08,-9.32
2012,83,57500.30,79.209914,251.536975,1577.50,-36.50,-9.32
2012,83,57500.40,79.209827,251.537425,1577.49,-38.29,-9.32
2012,83,57500.50,79.209741,251.537876,1577.49,-36.03,-9.32
```

Figure 1. Sample data record from the file IAKST1B\_KT19\_PROCESSED\_20120323\_195720.txt.

## 2 SOFTWARE AND TOOLS

### 2.1 Software and Tools

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The data files may be opened using any software capable of reading ASCII text data.

## 3 DATA ACQUISITION AND PROCESSING

Data collection for the KT19 data takes place on a CappuccinoPC mini-PC running Ubuntu 10.4. The computer communicates with the KT19 sensor over the RS-232 interface, and with a GPS-logging computer over Ethernet. The combination of these two data streams provides geolocated surface temperature measurements.

## 3.1 Data Acquisition Methods

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The collection and logging of the KT19 data is managed by a python script called `KTlogger.py`. After the KT19 sensor is powered on, the script issues initialization commands to the sensor to set the temperature units, response time, reference temperature method, and emissivity constant. After that, the script begins the data collection loop, which queries the KT19 sensor at 10 Hz for the surface temperature, and at 0.5 Hz for internal temperature. This script also communicates with a separate GPS logging machine onboard the ATM GPS rack, which is running a program called `linlogger`. The `linlogger` program broadcasts a real-time GPS message over Ethernet at 2 Hz. All of the messages returned from the KT19, as well as the real-time GPS messages, are time-stamped with machine local time and written to a log file as they arrive.

## 3.2 Derivation Techniques and Algorithms

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No special algorithms or techniques are used in the processing of the KT19 data set.

### 3.2.1 Processing Steps

A processing script called `KTproc.py` loads in all of the collected data from a flight and linearly interpolates the measurements to the frequency at which the KT19 surface measurements were collected. The interpolation uses the machine local-time stamp as the independent variable.

### 3.2.2 Errors and Limitations

On a few flights, the KT19.85 sensor would return an empty string when queried for a temperature measurement. As soon as the operator identified this error, the data file would be closed, power would be cycled to the sensor, and a new data file started. Therefore, some flights have more than one data file.

The Heitronics KT19 Infrared Radiation Pyrometer is a nadir-viewing optical instrument, so it will measure the temperature of the first surface that appears below the aircraft. As long as no clouds are between the aircraft and the ice below, the surface measurement will correspond to the ice surface. However, if any clouds appear between the aircraft and the ice surface, then the KT19 temperature measurement will correspond to the clouds. The KT19 data set does not contain any information about the presence of clouds. A secondary data set, such as IceBridge DMS L1B Geolocated and Orthorectified Images or IceBridge CAMBOT L1B Geolocated Images, can be used to identify the objects that were measured by the KT19.

### 3.3 Sensor or Instrument Description

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The Heitronics KT19 Infrared Radiation Pyrometer measures infrared radiation wavelengths between 9.6 and 11.5 microns.

For all Arctic and Antarctic campaign data collected prior to 2012, the emissivity constant was set to 1.0. However, published values for the emissivity of snow and sea ice are around 0.97. Thus, for campaigns beginning in 2012, the emissivity constant was set to 0.97.

By assuming an emissivity of 0.97, a reasonable estimate for most sea and land ice, the radiation measurement can be directly converted to a measurement of the target's surface temperature. The KT19.85 model is designed for long-distance measurement of water, ice, and clouds, and has an effective measurement range from -50°C to 200°C, with a resolution of 0.01°C. The lens has a two degree field-of-view, which yields a 15-meter viewing footprint on the ground at 450 m above ground level. The response time of the KT19 detector is nominally set to 0.3 s to provide a good balance between measurement sensitivity and noise reduction for a measurement frequency of 10 Hz. For instrument accuracy and other instrument specifications, see the Wintronic KT19 Series II Infrared Thermometer website.

## 4 RELATED DATA SETS

- [IceBridge CAMBOT L1B Geolocated Images](#)
- [IceBridge DMS L1B Geolocated and Orthorectified Images](#)
- [IceBridge NSERC L1B Geolocated Meteorologic and Surface Temperature Data](#)

## 5 ACKNOWLEDGMENTS

The KT19 data are collected by the National Suborbital Research Center (NSRC) and by the Airborne Topographic Mapper (ATM) team at the NASA/Wallops Flight Facility.

The ATM project team would like to acknowledge the dedicated NASA P-3 flight crew, whose efforts allowed the safe and efficient collection of this data over some of the most isolated and extreme regions on this planet.

## 6 DOCUMENT INFORMATION

### 6.1 Publication Date

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January 2017



## 6.2 Date Last Updated

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March 2025