ICON Data Product 2.2: Cardinal Vector Winds

This document describes the data product for ICON MIGHTI Cardinal Vector Winds (DP 2.2), which is in NetCDF4 format.

This data product contains cardinal (i.e., zonal and meridional) thermospheric winds obtained by combining Level 2.1 (line-of-sight winds) from MIGHTI A and MIGHTI B. The cardinal winds are given as a function of time (spanning 24 hours) and altitude (spanning nominally 90-300 km). There is one file per emission color (red or green).

Cardinal wind observations are enabled by the 90-degree offset between the two MIGHTI sensors. First, MIGHTI A measures a wind component along its line of sight. Five to eight minutes later, depending on tangent point altitude, the spacecraft has moved to a position such that MIGHTI B measures a nearly orthogonal wind component at approximately the same location. A coordinate rotation is performed on the two line-of-sight components to obtain the northward and eastward components reported in this file. The assumption is that the thermospheric wind has not changed during this interval. Because the Level 2.1 data are naturally on an irregular grid, they are first interpolated to a regular grid of longitude and altitude before the coordinate rotation is performed. See Harding et al. [2017, doi:10.1007/s11214-017-0359-3] for more details of the Level 2.2 algorithm.

NetCDF files contain **variables** and the **dimensions** over which those variables are defined. First, the dimensions are defined, then all variables in the file are described.

Dimensions

The dimensions used by the variables in this file are given below, along with nominal sizes. Note that the size may vary from file to file. For example, the "Epoch" dimension, which describes the number of time samples contained in this file, will likely have a varying size.

Dimension Name	Nominal Size
EPOCH	2900
N_FLAGS	10
ICON_L2_MIGHTI_GREEN_ALTITUDE	82

Variables

Variables in this file are listed below. First, the most important variables (the "data" variables) are described, followed by the "support_data" variables, and finally the "metadata" variables. The variables classified as "ignore_data" are not shown.

data

Variable Name	Description	Units	Dimensions
ICON_L2_MIGHTI_GREEN_ZONAL_WIND	Zonal component of the horizontal wind. Positive Eastward. The zonal (positive eastward) and meridional (positive northward) winds are the primary data product in this file. They are defined on a grid with dimensions of time and altitude, spanning 24 hours and nominally 90-300 km (150-300 km for the red channel). The altitude, time, latitude and longitude corresponding to each point in the grid are given by other variables in this file. It should be noted that while each measurement is ascribed to a particular latitude, longitude, altitude, and time, it is actually an average over many hundreds of kilometers horizontally and 2.5-30 kilometers vertically (depending on the binning). It also assumes stationarity over the 5-8 minutes between the MIGHTI-A and B measurements used for each point. See Harding et al. [2017, doi:10.1007/s11214-017-0359-3] for a more complete discussion of the inversion algorithm.	m/s	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_MERIDIONAL_WIND	Meridional component of the horizontal wind. Positive Northward. The zonal (positive eastward) and meridional (positive northward) winds are the primary data product in this file. They are defined on a grid with dimensions of time and altitude, spanning 24 hours and nominally 90-300 km (150-300 km for the red channel). The altitude, time, latitude and longitude corresponding to each point in the grid are given by other variables in this file. It should be noted that while each measurement is ascribed to a particular latitude, longitude, altitude, and time, it is actually an average over many hundreds of kilometers horizontally and 2.5-30 kilometers vertically (depending on the binning). It also assumes stationarity over the 5-8 minutes between the MIGHTI-A and B measurements used for each point. See Harding et al. [2017, doi:10.1007/s11214-017-0359-3] for a more complete discussion of the inversion algorithm.	m/s	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE

Variable Name	Description	Units	Dimensions
ICON_L2_MIGHTI_GREEN_ZONAL_WIND_ERROR	Error in the zonal wind estimate. The statistical (1-sigma) error in the zonal wind, propagated from the error in the L2.1 (line-of-sight wind) files. This is usually dominated by shot noise in the detectors, but also includes the effects of dark and read noise, as well as calibrations errors (e.g., the zero wind calibration), and spacecraft pointing error (which affects the uncertainty in removing the spacecraft velocity from the observed velocity). Other systematic errors or biases may exist (e.g., the effect of gradients along the line of sight) which are not included in this variable.	m/s	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_MERIDIONAL_WIND_ERROR	Error in the meridional wind estimate. The statistical (1-sigma) error in the meridional wind, propagated from the error in the L2.1 (line-of-sight wind) files. This is usually dominated by shot noise in the detectors, but also includes the effects of dark and read noise, as well as calibrations errors (e.g., the zero wind calibration), and spacecraft pointing error (which affects the uncertainty in removing the spacecraft velocity from the observed velocity). Other systematic errors or biases may exist (e.g., the effect of gradients along the line of sight) which are not included in this variable.	m/s	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_WIND_QUALITY	A quantification of the quality, from 0 (Bad) to 1 (Good) NOT YET IMPLEMENTED While the intent is that the WIND_ERROR variable accurately characterizes the statistical error in the wind data, it is possible that systematic errors are present, or that the statistical error estimation is not accurate. If it is suspected that this is the case, the quality will be less than 1.0. If the data are definitely unusable, the the quality will be 0.0 and the sample will be masked. Users should exercise caution when the quality is less than 1.0.	arb	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_FRINGE_AMPLITUDE	Fringe Amplitude An approximate volume emission rate (VER) profile in arbitrary units, estimated by combining MIGHTI-A and MIGHTI-B data. Technically this is not the VER, but rather the amplitude of the fringes, which has a dependence on thermospheric temperature and background emission. Thus, it does not truly represent volume emission rate. However, it is a useful proxy. The units are arbitrary, as the fringe amplitudes are not calibrated. See also variables FRINGE_AMPLITUDE_RELATIVE_DIFFERENCE, FRINGE_AMPLITUDE_A, and FRINGE_AMPLITUDE_B.	arb	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE

support_data

Variable Name	Description	Units	Dimensions
EPOCH	Sample time, average of A and B measurements. Number of msec since Jan 1, 1970. A one-dimensional array defining the time dimension of the two-dimensional data grid (the other dimension being altitude). This is the average of the MIGHTI-A and MIGHTI-B sample times, which differ by 5-8 minutes. The matchup between MIGHTI-A and B happens at slightly different times at different altitudes, a complication which is ignored by this variable. The effect is small (plus or minus 30-60 seconds), but in cases where it is important, it is recommended to use the alternative time variable ICON_L2_MIGHTI_RED/GREEN_TIME, which is two dimensional and captures the variation with altitude.	ms	EPOCH
ICON_L2_MIGHTI_GREEN_TIME	Sample time, midpoint of A and B measurements. Number of msec since Jan 1, 1970. See the notes for the variable EPOCH. This variable is the same as EPOCH but contains a second dimension, which captures the small (30-60 second) variation of time with altitude. For most applications this is expected to be negligible, and EPOCH can be used instead of this variable. Also see the variable TIME_DELTA, which contains the difference between the MIGHTI-A and MIGHTI-B times that contributed to each point. (This variable contains the average).	ms	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_ALTITUDE	WGS84 altitude of each wind sample A one-dimensional array defining the altitude dimension of the data grid (the other dimension being time). For each Level 2.2 file, the altitude grid is defined based on the minimum and maximum altitudes, (and highest resolution) in the Level 2.1 (line-of-sight wind) files. Altitude is defined using the WGS84 ellipsoid.	m	ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_LONGITUDE	WGS84 longitude of each wind sample A two-dimensional array defining the longitude (0-360 deg) of the two-dimensional data grid. In the initial implementation, the longitude is constant with altitude, but this may change in the future to capture the slight (few deg) variation with altitude. Longitude is defined using the WGS84 ellipsoid. It should be noted that while a single longitude value is given for each point, the observation is inherently a horizontal average over many hundreds of kilometers.	deg	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_LATITUDE	WGS84 latitude of each wind sample A two-dimensional array defining the latitude of the two-dimensional data grid. The latitude varies only slightly (a few deg) with altitude, but this variation is included. Latitude is defined using the WGS84 ellipsoid. It should be noted that while a single longitude value is given for each point, the observation is inherently a horizontal average over many hundreds of kilometers.	deg	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE

Variable Name	Description	Units	Dimensions
ICON_L2_MIGHTI_GREEN_TIME_DELTA	Difference between MIGHTI-A and B times contributing to each point To determine the cardinal wind at each point, a MIGHTI-A line-of-sight wind is combined with a MIGHTI-B line-of-sight wind from several minutes later. This variable contains this time difference for every point. During standard operations, this variable should be positive, but can potentially become negative during conjugate operations or when ICON is observing to the south.	s	EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE

metadata

Variable Name	Description	Units	Dimensions
ICON_L2_MIGHTI_GREEN_FRINGE_AMPLITUDE_A	Fringe Amplitude from MIGHTI-A See FRINGE_AMPLITUDE. This variable contains the fringe amplitude measured by MIGHTI-A, interpolated to the reconstruction grid. This is one of two variables used to create FRINGE_AMPLITUDE. When A and B are significantly different, large gradients are suspected, and the quality is reduced.		EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_FRINGE_AMPLITUDE_B	Fringe Amplitude from MIGHTI-B See FRINGE_AMPLITUDE. This variable contains the fringe amplitude measured by MIGHTI-B, interpolated to the reconstruction grid. This is one of two variables used to create FRINGE_AMPLITUDE. When A and B are significantly different, large gradients are suspected, and the quality is reduced.		EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE
ICON_L2_MIGHTI_GREEN_FRINGE_AMPLITUDE_RELATIVE_DIFFERENCE	Difference in MIGHTI A and B's amplitude estimates, divided by the mean The absolute value of the difference between FRINGE_AMPLITUDE_A and FRINGE_AMPLITUDE_B, divided by the average. Ideally, MIGHTI A and B should measure the same amplitude. When they do not, this is an indication of potential violations of the spherical symmetry assumption inherent to the inversion. This is the quantity used to determine if spherical asymmetry flag is raised.		EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE

Variable Name	Description	Units	Dimensions
ICON_L2_MIGHTI_GREEN_ERROR_FLAG	Error flags. Descriptions of each flag are below. This variable provides information on why the QUALITY code is reduced. Ten error flags can exist for each grid point, each either 0 or 1. More than one flag can be raised per point. This variable is a three-dimensional array with dimensions time, altitude, and number of flags. 0 = missing MIGHTI A file 1 = missing MIGHTI B file 2 = A signal too weak 3 = B signal too weak 4 = A did not sample this altitude 5 = B did not sample this altitude 6 = A sample exists but is NaN 7 = B sample exists but is NaN 8 = Spherical asymmetry: A and B VER estimates disagree 9 = Unknown Error		EPOCH, ICON_L2_MIGHTI_GREEN_ALTITUDE, N_FLAGS

This document was automatically generated on 2018-03-19 11:44 using the file:
ICON_L2_MIGHTI_Vector-Wind-Green_2017-05-29_v01r000.NC
Software version: ICON SDC > ICON UIUC MIGHTI L2.2 Processor v1.03