

# Binary 3D Data Cube Format for E-fields

## Version 2

Version 1: Adam B. Birchfield, Texas A&M University, 3/24/2017

Version 2: Adam B. Birchfield, Thomas J. Overbye, Texas A&M University, January 2020

This document describes the Version 2 data format for \*.b3d files which hold two-dimensional, time-varying data (i.e., 3D data) such as electric fields. It is a binary format which uses little-endian order. The types allowed are: unsigned 32-bit integers (UINT), bytes, single-precision 32-bit floating-point numbers (SINGLE), and double-precision 64-bit floating-point numbers (DOUBLE). In addition, the metadata is specified with single-byte ASCII null-terminated strings. All new code should use version 2 as its default. The version 1 format is given below, but as of January 2020 version 1 is deprecated.

Name	Bytes	Type	Description	Example
KEY	4	UINT	Use decimal code 34280 to confirm the file type.	Hex: E8 85 00 00
VERSION	4	UINT	Use decimal code 2 for this current version	Hex: 01 00
META_STRINGS	4	UINT	Number of strings in the metadata section	6
(Metadata)	variable	ASCII Strings	META_STRINGS number of ASCII strings terminated with 1-byte null characters.	“test_meta\0”
FLOAT_CHANNELS	4	UINT	Number of floating point number channels at each point. For data with X and Y directional E-fields, this value will be 2. Convention will be to put X first and then Y.	Hex: 02 00
BYTE_CHANNELS	4	UNIT	Number of byte channels at each point. Usually this value is either zero or one to indicate a quality flag byte	Hex: 01 00
LOC_FORMAT	4	UNIT	Used to indicate the location format. In version 2 this value should be either 0 or 1. If zero the point locations are specified by a grid with the next six SINGLE fields. This was the only approach used in Version 1. If the LOC_FORMAT is 1 then the points are specified by UNIT number of points and then three DOUBLE location fields for each point.	
LON_0	4	SINGLE	Longitude of first point in degrees (only if LOCATION FORMAT = 0)	-112.0
LON_STEP	4	SINGLE	Longitude step in degrees (only if LOCATION FORMAT = 0)	0.5
LON_POINTS	4	UINT	Number of longitude points	30

			(only if LOCATION FORMAT = 0)	
LAT_0	4	SINGLE	Latitude of first point in degrees (only if LOCATION FORMAT = 0)	40.0
LAT_STEP	4	SINGLE	Latitude step in degrees (only if LOCATION FORMAT = 0)	0.5
LAT_POINTS	4	UINT	Number of latitude points (only if LOCATION FORMAT = 0)	25
NUM_POINTS	4	UNIT	Number of point locations. Each point location is specified by three FLOATs with details in the next row. (only if LOCATION FORMAT = 1)	125
(Location Data Section)	variable	DOUBLES	If the LOC_FORMAT = 1 this section contains the point locations, with each point specified by three DOUBLES. The first DOUBLE gives the point's longitude in degrees, the second DOUBLE gives the point's latitude in degrees, and the third DOUBLE gives the distance to the nearest measurement station in km. Hence the third float is used to indicate if a point has been interpolated. If the point corresponds to a measurement station then this field should be 0. If the measurement station location is unknown, then the value should be less than zero.	
TIME_0	4	UINT	Seconds of first time point, using midnight 1/1/1970 as epoch, not counting leap seconds. (Same as IEEE Std. C37.118.2-2011)	5/7/2016 00:00:00 = 1,462,665,600
TIME_STEP	4	UINT	Constant time step in milliseconds. If set to zero, indicates variable time step (see below).	10,000
TIME_POINTS	4	UINT	Number of time points	25,920
(Variable time points)	variable	UINTs	If TIME_STEP > 0, this section will be skipped. Otherwise, the section consists of TIME_POINTS number of 4-byte UINTs, giving the time in milliseconds of each point since TIME_0.	
(Data Section)	variable	FLOATs	<p>This section contains the actual data. The section contains (FLOAT_CHANNEL*4 + BYTE_CHANNEL) * NUM_POINTS * TIME_POINTS bytes.</p> <p>If LOC_FORMAT = 0 then NUM_POINTS is automatically set from the grid values. The first element is at TIME_0, LAT_0, LON_0, and the first FLOAT channel. Then the rest of the FLOAT_CHANNELS are given for this location and time followed by the BYTE_CHANNELS. Then the data for the next point is given. If LOC_FORMAT is zero then the grid points are given by latitude rows so the next point would be LAT_0, LON_1, continuing for all the longitude points in the row; then the next row of latitude will be given, still at the same time point.</p> <p>Once all the data for the first time point is given, the second time point will be given in the same way, continuing to the end of the time series.</p> <p>Note that for electric fields the convention is to record the data in units of V/km.</p>	

# Binary 3D Data Cube Format for E-fields

## Version 1

Adam B. Birchfield, Texas A&M University, 3/24/2017

This document describes the version 1 data format for \*.b3d files which hold two-dimensional, time-varying data such as electric fields. It is a binary format which uses little-endian order. The types allowed are: unsigned 32-bit integers (UINT), and single-precision 32-bit floating-point numbers (FLOAT). In addition, the metadata is specified with single-byte ASCII null-terminated strings. All new code should implement version 2, given above.

Name	Bytes	Type	Description	Example
KEY	4	UINT	Use decimal code 34280 to confirm the file type.	Hex: E8 85 00 00
VERSION	4	UINT	Use decimal code 1 for this current version	Hex: 01 00
META_STRINGS	4	UINT	Number of strings in the metadata section	6
(Metadata)	variable	ASCII Strings	META_STRINGS number of ASCII strings terminated with 1-byte null characters.	"test_meta\0"
CHANNELS	4	UINT	Number of channels at each point. For data with X and Y directional E-fields, this value will be 2. Convention will be to put X first and then Y.	Hex: 02 00
LON_0	4	FLOAT	Longitude of first point in degrees	-112.0
LON_STEP	4	FLOAT	Longitude step in degrees	0.5
LON_POINTS	4	UINT	Number of longitude points	30
LAT_0	4	FLOAT	Latitude of first point in degrees	40.0
LAT_STEP	4	FLOAT	Latitude step in degrees	0.5
LAT_POINTS	4	UINT	Number of latitude points	25
TIME_0	4	UINT	Seconds of first time point, using midnight 1/1/1970 as epoch, not counting leap seconds. (Same as IEEE Std. C37.118.2-2011)	5/7/2016 00:00:00 = 1,462,665,600
TIME_STEP	4	UINT	Constant time step in milliseconds. If set to zero, indicates variable time step (see below).	10,000
TIME_POINTS	4	UINT	Number of time points	25,920
(Variable time points)	variable	UINTs	If TIME_STEP > 0, this section will be skipped. Otherwise, the section consists of TIME_POINTS number of 4-byte UINTs, giving the time in milliseconds of each point since TIME_0.	
(Data section)	variable	FLOATs	This section contains the actual data. The section contains CHANNELS*LON_POINTS*LAT_POINTS*TIME_POINTS number of 4-byte elements of type FLOAT. The first element is at TIME_0, LAT_0, LON_0, and the first channel. Then the rest of the channels are given for that location and time. Then the next longitude point is given, continuing along LAT_0 until there are CHANNELS*LON_POINTS elements. Then the next row of latitude will be given, still at the same time point. Each row of latitude will be added until there are CHANNELS*LON_POINTS*LAT_POINTS elements. Once all the data for the first time point is given, the second time point will be given in the same way, continuing to the end of the time series. Note that for electric fields the convention is to record the data in units of V/km.	

