

An FST to Vis5D Data Converter (v1.1.0)

Unix name fst2v5d

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This manual describes how to use the FST to v5d Data Converter to create input files for the Vis5D (or Vis5D+) visual imaging software from RPN Standard Files (FST).

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1 Overview

The FST to v5d Data Converter (fst2v5d) was originally developed at McGill University, starting in 2003. The intention of the converter is to provide an easy mechanism by which to convert data stored in the RPN Standard File format (see [Section 1.1 \[What is FST\], page 1](#)) to the v5d format which can be directly ingested into the Vis5D (see [Section 1.2 \[What is Vis5D\], page 1](#)) visualization package.

As noted in the licensing and copying agreement (see [Appendix A \[Copying Conditions\], page 4](#)) we encourage all users of this software to become developers and to contribute to the evolution of the package. Please share any improvements that you develop so that others may benefit from your efforts.

1.1 What is FST Format?

Development of the RPN Standard File (FST) data format began at Recherche en Prévision Numerique (RPN) in the late 1970's. Michel Valin, from the Section Informatique of RPN, a subunit of the Meteorological Service of Canada (MSC), produced the first FST software in 1980. For the end-user, the appearance of the FST is that of a flat-file database structure. A single file contains numerous records which hold 1, 2, or 3D data grids and self-describing information about the field.

Most of the developments made at the MSC since that time have been based on FST-formatted files. However, their scope beyond the Canadian meteorological community is limited. For this reason, little to no interfacing with existing packages has been performed. A thorough set of FST-related routines are contained in the RPN Library (ARMNLIB). These routines provide easy access to the file contents and to the wide variety of mapping and projection parameters available in this flexible storage format.

A complete description of the FST file format and the utilities which can be used to manipulate and view their contents is contained in a 1992 technical document entitled "An Introduction to RPN Standard Files" by Yves Chartier. An updated version of this handbook is available online at www.cmc.ec.gc.ca/rpn/modcom/si/utilities which contains some of the more applicable points of the manual. Although the user of the fst2v5d package requires no working knowledge of the FST file format, it is likely that most people who work with this file format will become familiar with it over time.

1.2 What is Vis5D?

Vis5D is a 5-dimensional visualization package originally developed by the Visualization Project (www.ssec.wisc.edu/~billh/vis.html) at the University of Wisconsin-Madison Space Science and Engineering Center (SSEC) by Bill Hibbard, Johan Kellum, Brian Paul and others. Original support for the project came from NASA and the EPA. Full three-dimensional rendering can be animated (hence the fourth dimension) and applied to multiple fields (fifth dimension), producing images of outstanding quality and versatility.

As a state-of-the-art visualization tool, the fields displayed in Vis5D allow the analyst to obtain information and identify details which remain hidden on conventional 2D plots. Far

from being a way to produce pretty pictures for presentations, Vis5D is a tool for education and diagnosis.

The free OpenGL-based Vis5D+ (vis5d.sourceforge.net) volumetric visualization package provides enhancements and developments on Vis5D. The maintainers of the Vis5D+ package are Steven Johnson and Jim Edwards. Several developers and users mailing lists are now maintained for the project, which is under active development.

1.3 What does fst2v5d do?

The `fst2v5d` package allows the user to easily convert between the FST data format and the v5d data format read by Vis5D. It sounds like a pretty simple job, until one starts to have to worry about the differences in the map projections available to the FST user and those understood by Vis5D. Although the idea is to someday have a plethora of grid inputs available in Vis5D, in reality the options are limited to many of the more common map projections.

A large part of the job of the FST to v5d Data Converter is therefore to remap the input data onto a projection that Vis5D will be able to understand. For example, if an input rotated mercator projection (an E-grid for those familiar with FST file nomenclature) is detected by `fst2v5d`, it is the job of the utility to determine the smallest possible lat/long projection specifications which will allow for the complete description of the grid. Clearly, this will mean that the end product will be a lat/long grid with datapoints mapped on a rotated subdomain whose boundaries extend just to the edge of the full domain. To account for the change in resolution experienced during the rotation, the final resolution of the large lat/long grid will be somewhat higher than that of the input rotated mercator domain in order to preserve the details of the input field.

All of the projection transformations are performed using the `ezscint` package developed by Yves Chartier at RPN. A bicubic interpolation routine is used for all interpolations, and a minimum-valued extrapolation algorithm is applied beyond the boundaries of the input domain (having the effect of creating “water” fields in the periphery).

If the input file provided by the user contains orographic and land/sea mask information (the ME and MG fields, respectively in FST file notation) then `fst2v5d` creates topography fields for direct ingestion into the Vis5D system. If multiple orographic fields are found (e.g. if there is a “growing” orographic component in the input fields) then a series of topography files are generated. By default, these files are given the same name as the requested output file with a “.topo” appended to the output name. If multiple topographical files are produced, then the numbers 00-99 are appended to the extension. This allows users to plot data along with the topography fields that are native to the generating system rather than those stored in the default EARTH.TOPO file provided with Vis5D+.

1.4 How do I run it?

The invocation of `fst2v5d` is straight forward perhaps to the point of being somewhat limiting. The command line argument structure of the original skeleton conversion programs in Vis5D+ was maintained, so two supplemental arguments are required for execution. The first is the input (FST) file name and the second is the output (v5d) file name. For example:

```
fst2v5d input.fst output.v5d
```

will convert the data contained within the `input.fst` file to produce the `output.v5d` file, which can then be read directly by Vis5D. If the `input.fst` file contains orographical information (and preferably land/sea mask information as well, otherwise `fst2v5d` has to guess on water extent), then a second output file `output.v5d.topo` is produced. If the package discovers multiple orographical fields in the input data, then the `XX`th field in the input file will become the `output.v5d.topoXX` output topography file. Note that the loading of the second topography file is then as simple as:

```
vis5d output.v5d -topo ../output.v5d.topo01
```

where the `...` string represents the absolute path of the topography file directory. This is required because Vis5D will look in a shared directory for topography unless the absolute path is specified.

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