Introduction to the IDL application in the Weather

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Abstract—It mainly introduce a ideal tool that the IDL as the meteorological data analysis, visualization expression of meteorological data set and weather data analysis platform for cross-platform application in the field of climate science data(measured rainfall isoline, 4D meteorological data platform, two and three-dimensional isoline, doppler radar). It has an advanced and integrated development environment which involves multitudinous weather data analysis toolkits and application of high-speed meteorological three-dimensional graphics display technology, large sets of visualization, interactive data analysis. In a word, the meteorological department scientific research becomes fast and effective in meteorology data processing because of IDL’s application.

Keywords—Data component; IDL; Meteorological data visualization; Data interaction

I. INTRODUCTION

IDL [1] is a programming language of data analysis and visualization application which invented by the American company ITT. At first the original intention is to help climate scientists analysis the data from meteorological satellite. It can converts the vast meteorological data to graphics in the late 1970s , then IDL is widely used in weather forecast and complex weather statistics. As the fourth generation of scientific computing visualization language [2], it not only help the user to establish the IDE development environment of visual programming environment but also to provide plenty of programming tools and the built-in math library meteorological forecast [3] analysis function, moreover it greatly reduce the workload of meteorological data image visualization development. the program wrote by IDL can run in other platforms with change infrequently, which makes meteorological data monitoring system flexible involuntary.

II. IDL’S ADVANTAGE IN THE FIELD OF WEATHER SCIENCE DATA

A. Support luxurious meteorological data format

A large number of data in different formats will be used in meteorological science research, IDL can storage these data effectively and express corresponding meteorological data graphical visualization to developers exactly.IDL provides a mass of meteorological data tools which can be readed and wrote, supports common data format reading and writing directly, such as general image data format (DCM, JPEG2000, TIFF/Geo , TIFF , etc.). It also support some scientific meteorological data format(HDF, CDF, NCDF, etc) that widely used in the US national oceanic and atmospheric administration institutions.

B. Meteorological data analysis, the weather chart data statistics

IDL integrates perfect meteorological data analysis, data statistics, image processing software package, it provides the intelligent tool—iTools which combine a series of interactive graphics display high quality tools with data analysis and visualization function. Futhermore the iTools intelligence tool can interactively display image and contour data of meteorological information. The project using the traditional C or Fortran language needed for days or weeks can be done in a matter of hours if we use IDL.

C. Capabilities of advanced meteorological contour 2D and 3D data interactive image visualization

From simple two-dimensional chart (drawing from multi-dimensional surface, contour image display) to the use of OpenGL [4] hardware acceleration for interactive meteorological satellite cloud three-dimensional image browsing. Moreover, it can support the multiprocessor render body data rapidly. Luxuriant meteorological data visualization effect got easily because of using IDL. Considering the heavy and complicated of meteorological data, IDL adopt process design and give full play to the multiple processing functions on the processor system. In addition its built-in meteorological data processing support powerful scientific computing with very few lines of IDL code, however other language do barely about the meteorological data of image visual function [5].

So as a powerful tool, it has been used for analysising the meteorological satellitedata for a long time. And it becomes the most preferred language used by climate scientists, which is known as the "milestones NASA" in recent 40 years. Meteorological satellite is equipped with multi-channel high resolution radiometer, infrared spectrometer and microwave radiometer meteorological remote sensors. It can measure the global cloud cover, wind, parameters such as pressure, temperature and humidity. What’s more, it obtain global meteorological data for providing a global meteorological information. The second generation of polar orbit meteorological satellite—FY – 3 weather satellite [6] make a great step on the basis of the FY- 1 meteorological satellite. The specific requirement is to solve three-dimensional.
atmospheric detection, improving the global information obtaining ability greatly and further improving the cloud area remote sensing ability thus they can obtain global, all-weather, three-dimensional, quantitative and multispectral atmospheric parameters. The application of FY - 3 meteorological satellite mainly includes three aspects:

1). Providing global uniform resolution of meteorological parameters for medium-term numerical weather prediction
2). Providing various meteorological and geophysical parameters for climate prediction through researching the relation between global change and climate change
3). Providing meteorological information in any areas of the world For a variety of professional activities

III.IDL APPLICATION IN THE WEATHER

A. The IDL application in scientists measured the global precipitation

Global precipitation observation is an international satellite network which cooperated by the Japan aerospace exploration agency and NASA together, it provides the next generation of rain and snow observed. The concept of global precipitation observation center deployed on a core satellite which carry advanced satellite/radiometer system. The system can measure space and also can be used as a reference standard. The purpose is to merge all of space and ground-based measurement information available to develop high resolution, near real-time global precipitation data of the product with a series of research and the business of the satellite rainfall observation as a standard. Through these improved measurement, GPM tasks will help us to advance our understanding of the earth's water and energy cycle. Through improving the extreme events of natural risk and hazard prediction, we can use accurate and timely rainfall information ability to benefit society.

GPM will provide a complete coverage of higher precision and the dynamic range of global precipitation measurement for studying the rainfall, at the same time, the IDL module build tools such as the structure of language libraries, file access, data analysis and visualization toolkit library which could help scientists to study it. GPM improve weather and rainfall forecast by the instantaneous rainfall data assimilation.GPM will provide more advanced scientific contribution and social benefits compared to the TRMM. It can improve the understanding of the earth's hydrologic cycle and related to climate change as well as the full understanding of climate sensitivity. At the same time its expanded the monitoring and the ability to predict extreme weather events such as hurricane.

B. 4 D meteorological data visualization platform

1) The development purpose of 4D meteorological data visualization platform

With the increase of the meteorological data redundancy and data explosion, today the existing tools rarely to fusing, processing and interpreting meteorological data. The amount of data collected by satellites and other means is huge including meteorological data in any fields of science. NOAA successfully launched a polar orbit satellite on October 28, 2011. It continue to increase the meteorological data sources. Related meteorological researchers worry about the weather forecasters and their forecast tool can carry such a large amount of data especially when the major weather events occurs. In order to apply IDL more effectively and mitigate large pressure of meteorological data derived from meteorological data explosion, 4D meteorological data visualization platform is developed by NWS.

2) The formation of 4 D meteorological data sets and applications

A study is conducting from the national weather service to the federal aviation administration government offices in the United States. They hope to merge various meteorological data to set up an integrated meteorological data warehouse management platform in order to strengthen the cooperation of distributed meteorological information based on network, moreover they also make meteorological monitoring dynamic decisions. Visibility cause disorder of some factors (cloud, rain and snow) and meteorological characteristics (convection, ice, snow, cloud screen visibility, wind speed and direction, etc.) will be described in 3 D space. Time is joined the meteorological data in the model as the fourth dimension which forms the 4D meteorological data sets, meteorological data demonstrate diagram as shown in figure 1, it makes the original characteristic parameters with time characteristics.4D data set which be stored in the server can set out through a service oriented architecture distributed system. In this way, the meteorology experts provide technical support for federal aviation administration through determining each cycle of meteorological data.

C. IDL meteorological contour data of 2- 3D visualization

The platform get the weather data (mainly isoline under different height) multidimensional visual image display, the figure 2 is provided by the meteorological department the contour of the two-dimensional figure which is 500 pa and 1000 pa on July 30, 2003, 8 pm. We can from the top, low, before, after, left, right, six view direction to watch visual images at the control modules of this platform, the figure 3 is different height field contour of two 3 D display which equips any highly and angle off the meteorological data of 3D simulation at the same time. We can use the mouse control
casual observation images from any angle, so that we could analyze weather data visualization and make an accurate prediction of weather through the integration of two 3D GIS technology. The program language of IDL realize the GIS 3D drawing of contour map, and then put the existing meteorological data (3D contour) loaded into the meteorological and display in the form of graphical visualization. Finally it achieved the integration of two 3D GIS meteorological data.

DIDL read date and visualization of the new generation doppler weather radar data

CINRAD/CC weather radar is a new generation of C band coherent doppler weather radar that China meteorological administration use it for domestic meteorological operational network detection. It monitor the scope of the heavy rain and tropical cyclones within 400 km. And it can also monitor dragon volume, strong hail cloud, hail and other medium and small scale weather phenomena in the distance of greater than 200 km. The scope of the radial velocity measurement to achieve + 36 m/s. CINRAD/CC type weather radar body scan data finished nine times nine elevation scanning in 5 minutes. Each layer including the echo intensity (Z) and radial velocity (V), velocity spectrum width (W), there are 512 radial, each radial store 500 Z, 500 V, 500 W when radar scanning each layer.IDL include data display and analysis function through reading echo intensity 9 layer, and then 3D interpolation. radar three-dimensional data display as shown in figure 5.IDL read and display radar data simply and quickly what’s more it also analysis radar data. the body of data display as shown in figure 4, it uses function(OPENER READU) read binary files 2013081416.02 V, the first reads a header file which stored in a binary file for acquiring CINRAD/CC type weather radar data description information, such as radar's longitude and latitude, observation starting time, echo types, the antenna elevation Angle, whether correction, etc.

IV. CONCLUSION

This article mainly introduce the IDL application in the weather especially in scientists measured the global precipitation, the application of 4D meteorological data visualization platform, doppler weather radar and 3D visualization.IDL can be used in the field of 2D meteorological and multidimensional meteorological data visualization,3D cloud meteorological graphical modeling, scientific data read meteorological cloud data because of the IDL powerful meteorological data analysis,which makes tens of thousands of meteorological data researchers, engineers and programmers quicken the process of meteorological research.
REFERENCES

[7] Xian Feng Li. The research of meteorological observation data graphics base on Web and IDL. Meteorological hydrological Marine instruments, 2014.09
[8] Yan Li Feng Huang. The object of field visualization and the applications based on the meteorological element scalar. Meteorological science, 2001.03
[9] Yi Yu Lu, Xin Min Tang. 4D track forecast based on dynamic weather forecast data. Aerospace computing technology, 2013.06