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## **A DATABASE FOR PROPAGATION MODELS**

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### **1. Introduction**

In June 1991, a paper at the fifteenth NASA Propagation Experimenters Meeting (NAPEX XV) was presented outlining the development of a database for propagation models. The database is designed to allow the scientists and experimenters in the propagation field to process their data through any known and accepted propagation model. The architecture of the database also incorporates the possibility of changing the standard models in the database to fit the scientist's or the experimenter's needs. The database not only provides powerful software to process the data generated by the experiments, but is also a time- and energy-saving tool for plotting results, generating tables and producing impressive and crisp hard copy for presentation and filing.

### **2. Database Development**

Currently the database is under development for microcomputers using the EXCEL spreadsheet base. The main program and the subroutines necessary to produce the desired actions are written in the EXCEL macro language. This language has developed enough to produce almost any desirable result in the database. The EXCEL language is not a compiler-based language, and consequently, compared with such languages, it is a bit slow in executing large programs; however, the line-by-line interpretation mode of the language, does give it a distinct advantage in that the language allows the user to enter a new formula at any place in the program and the program is able to execute that formula. This ability of the program is very useful if the user

wants to change the given model to suit particular needs.

The database currently has six major categories into which all the propagation models are subdivided. These categories are ionospheric propagation models, tropospheric propagation models, land mobile propagation models, effects of small particles on propagation, rain models, and radio noise models. When the program is started, EXCEL's excellent display capability shows the user the six categories and lets the user select one. The category may be selected by using the mouse pointing device or the computer keyboard. As soon as the category is selected, subcategories for the selected category are shown in a dialogue box. Subcategories of the selected subcategory are shown for the user to select, and the process goes on until no more subcategories are left to choose from. At this level (using EXCEL's dialogue box capability) the model is displayed to the user with the necessary parameter definitions and a brief description.

To help the user in selecting the values for the parameters, a set of default values is shown. The user can provide new values for the parameters, keep the default values, or provide some new values while keeping the remaining default values. The user is also provided with the opportunity to change the model itself as long as the original variables of the model are preserved in the database. This process can be used to provide the user the opportunity to process the data with two or more models and to compare the results.

The data that are to be processed by the model can be provided in two different ways. The user may supply the data on a floppy disk or the data may be placed on the computer hard disk if there is enough space available on the hard disk. The advantage of using the hard disk is that the response time of the model utilizing the data is reduced considerably as compared to that of a model using data from a floppy disk. Also, along with every model, default data are included in the database so that users can compare results obtained from their data with standard results. The output of the data is in the form of tables which are plotted using EXCEL's very good plotting

capability. The plotting is first done according to the defaults set in the program and the user is then given a chance to change the appearance of the plot if that is desired. The graphs, the tables and the plots generated by the database program can be stored on the computer hard disk or the floppy for later use. The output can also be printed to produce hard copy.

### **3. Future Expansions and Efforts**

The current development of the database by means of EXCEL spreadsheet software has been

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entirely satisfactory, and there is no reason to believe that EXCEL may fail in some way and halt the development of the database; however, one should always leave the doors open for newer and better possibilities. At the beginning, EXCEL was selected for the development of the database software because it was indeed the best choice at that time. Even today the choice would still be the same; however, in this fast-developing computer software world, new and better software comes into existence with dramatic speed. One such EXCEL competitor worth noting is the WINDOWS programming environment using a C compiler. It is claimed that WINDOWS software can produce anything that EXCEL can produce—and more. The basis of this claim being that EXCEL's underlying language is C. The substantial development of the WINDOWS environment and the C compiler during recent times makes a comparison between the EXCEL and WINDOWS environments essential.

Since EXCEL is a higher level language than the C language, it is considerably easier to use; however, the range of EXCEL actions is restricted to the functions included in the EXCEL language and those are a subset of C language functions and WINDOWS functions. This limitation can severely restrict the ability and imagination of an experienced programmer developing the database software. Another advantage of the WINDOWS environment with the C

language is that even though the developer of the database will need the WINDOWS software

user does not have to procure WINDOWS software exclusively for the use of the database. Another obvious advantage of using the C compiler in the WINDOWS environment is that the execution time will be faster than EXCEL's execution time. This may be worth consideration when one is using the database with large data files.

It is almost certain that, as time passes, the WINDOWS programming environment and the C compiler software will further mature and will have better functionality. At the present time, EXCEL is easier to program with and sufficient to produce the database; however, the WINDOWS environment has matured enough to produce the entire database in it. If the database is programmed properly in the WINDOWS environment, the results can be quite impressive and the database produced can be quite easy to use. The transition from the EXCEL to the WINDOWS environment would not be entirely painless. A lot of programming would have to be done, and some innovative approaches would be needed. One such needed innovative technique would be the dynamic formula change, i.e., the user-made change to the propagation model while the program is running. The action is not directly feasible in a compiler-based software, because the compiler compiles the program first and then executes it; hence, after the compilation is done the code cannot introduce anything new to execute. There are indirect ways to circumvent this problem, such as writing a small compiler anticipating the needs of the user and including it in the database, etc. All of these methods need additional programming. Another problem with the WINDOWS environment is that it is only available for the IBM compatible personal computer at this time, and no equivalent version for Macintosh computers is available.

#### **4. Conclusions**

The development of the database for propagation models is going through the usual decision-making process. It is felt that proper steps have been taken and will result in the finished product in the near future. The finished database will have all the necessary bells and whistles and good graphics capability. A beta copy will be sent to a few selected members of the propagation

community to seek their advice, criticism and approval. This will be done when about 50 percent of the work is completed, providing enough time to the developer of the software to implement the suggested changes. Even when the programming is completed, the architecture will be open ended, allowing new additions such as new models and help subroutines, quite easily.

#### REFERENCES

A. V. Kantak "Database for Propagation Models," Fifteenth NASA Propagation Experiments Meeting, held in London, Canada, June 28-29, 1991, F. Davarian, Ed. JPL Publication 91-31, Jet Propulsion Laboratory, Pasadena, California, July 1, 1991.