A PC-based weather data bank for crop growth modelling

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Abstract

One of the problems existing for many crop modellers and researchers in water-related fields in South Africa has been the difficulty in day-to-day access of detailed, country-wide weather data, which, to date, have been stored almost exclusively on large mainframes. The new generation of more powerful personal computers (PCs) and the host of related software has made the option of weather data storage at microcomputer level distinctly feasible. With these considerations in mind, a weather data bank framework was created on an 80386 microcomputer using an intelligent data base development system (DATAEASE). This was designed as a simple, menu-based structure with ease-of-use being the prime objective.

Daily weather data for some 280 South African weather stations were downloaded from a Burroughs mainframe, screened for errors, and imported to the PC weather data bank. Modules created within the data bank included those functions necessary for searching and extracting weather data selectively and quickly. A weather station information directory was added, together with a built-in search-by-coordinate routine.

Importation of DOS ASCII files is one of the features used for updating the weather data bank. Exportation of selected records to a DOS file is another of the data bank functions. The normal range of standard data base procedures exist, such as those needed for maintenance and system configuration.

Several supporting computer programs were developed in PASCAL. These included a comprehensive weather data capture system, a program producing summary tables for any weather station on the bank, and a crop model data preparation program. The latter features routines for infilling of missing weather observations, as well as one for generating typical weather data for the last part of a growing season. Together with a suitable crop growth model, typical weather data can be used in the field of crop yield and maturity date forecasting.

Future enhancements to the system include the possible incorporation of a stochastic climate model for supplementing weather records, and the inclusion of a routine for the estimation of evaporation values for the same reason.

Introduction

With its inherent unpredictability, weather plays a central role in agricultural planning in our predominantly semi-arid country. As De Jager and Schulze (1977) point out, "Physiographic, technological and human factors aside, climate largely determines what crops can be grown, where they are best grown, when they should be grown and what reliability of yields can be expected". Answers to these questions can be sought by using a crop growth computer model. Weather data are hence an essential input to any of these programs. Apart from crop modelling applications, timely and efficient access to historical climate data would benefit farmers, businesses and individuals with operational decision-making such as timing of field work, pesticide applications and irrigation (Reinke and Taylor, 1991).

Considering her vast area and relatively sparse population density, South Africa is blessed with extensive weather data resources. Up till now, weather data here have been stored primarily on large mainframe computers, with the processing power and memory capabilities necessary for dealing with large amounts of daily data. The mainframe data banks include, to date, those of the Soil and Irrigation Research Institute (SIRI), the Weather Bureau and that of the Computing Centre for Water Research (CCWR). However, often the only way the so-called man in the street has had access to these data has been through someone with access to the relevant mainframe via a terminal, or by way of summary reports such as those published regularly by SIRI and the Weather Bureau. While summarised data certainly have their uses, there are many applications, such as crop modelling, which require easy access to the detailed daily data themselves.

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The second drawback in having most of the weather data on mainframe computer only, is that many computer models are designed for use on microcomputers. Examples of these in the crop modelling field are NTRM (Shaffer and Larson, 1987), CORNF (Stapper and Arkin, 1980), PUTU (De Jager and Lourens, 1991), the IBSNAT family of models (IBSNAT Project, 1989) and AUSIM (McCown and Williams, 1989). The problem in using mainframe weather data as inputs to PC-based software is that the procedure for data extraction and transmission of files to PC hard disk is often relatively long and complicated. Communications software such as HANDSHAKE (a registered trademark of MasterLink Corp.) is required, together with the necessary hardware. This is an expensive and somewhat cumbersome option, and requires a fair amount of computer expertise.

The vast improvement in the processing power and storage capabilities of microcomputers in recent years has made the development of a PC-based weather data bank a feasible proposition. Storing weather data efficiently on a PC can have several advantages. Developing software on a microcomputer is relatively simple compared with many mainframes. Development environments such as TURBO PASCAL (a registered trademark of Borland International Inc.) are fast and easy to use (Radford and Haigh, 1986). Also, there are a wealth of "packages" for data analysis, graphics etc. available at the PC level. Furthermore, many millions of computer users are conversant with the PC operating system. PC processors are now very fast — an 80386 machine compares favourably with some mainframes. Finally, the advantage of using a PC to store, access and analyse weather data is that it is inexpensive to purchase, as well as to operate.

Bearing the above points in mind, it was decided to develop an efficient means of storage of daily weather data at PC level. The chief consideration in this exercise was that the system had to be very easy to use for updating, summarising and extracting the various data for modelling purposes and otherwise.