Internet Applications For Agrometeorological Products

– Experiences From Europe **

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Abstract

Internet represents the suitable tool to disseminate information among a wide range of users in real time. In the last few years a large number of agrometeorological products were available on the web, elaborating information concerning the condition of many processes of agricultural system. Data, models, warnings, advises can be provided to the users, in order to support their decision making and so reducing the quantity of high cost and pollutant chemical and energetic inputs. The present situation in Europe has been analysed and the results are summarised in this paper. The considered processes, the required input data and models, the needed interaction with the users, the main outputs and the final users are considered and discussed.

Introduction

Usually farmers have to make decisions in condition of risks or uncertainties due to the high level of complexity of the agricultural systems. Many production factors are not defined and they are outside of the farmer control. In the last few years the changing in the international markets and the technological innovation have modify the agricultural production, increasing the complexity of decision making. A higher number of topics have to be considered to elaborate the best decisions: biology, agronomy, marketing, legislation, etc. (Orlandini and Cappugi, 2002).

Accordingly, the lack of precise information increases the level of uncertainty in farm management. To overcome these problems, farmers have increased the level of energetic and chemical inputs above the real system requirements with the aim of decreasing the variability of quality and quantity of final yield. Unfortunately, the real consequence of this strategy has been the reduction of potential farmer income and the increasing of environmental impact (Travis et al., 1992).

A solution to interrupt this negative trend is to substitute expensive and pollutant chemical and energetic inputs with elaborated information of high quality. In this way it is possible to decrease the risk of the uncertainties of farmer decision making and thus to minimise the excess of input application, as well as to increase the potential income for farmers activity (Maracchi, 2001).

In such a perspective, agrometeorologically based decision support system can provide a wide range of suitable information for the farmers (Silver, 1991). Many processes of agricultural system can be analysed according to the relationships with weather variables: crop growth and development, quality and quantity of yield, crop protection, water requirements, etc. Thus their dynamics can be described allowing to simulate and forecast the main elements, with a real benefit for

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the decision making and farm management, both for tactical and strategic purposes (Seeley, 1994).

Internet applications

The agrometeorologically based decision support system should satisfy the following criteria (Zadoks and Rabbinge, 1989):

- Simplicity
- Time efficiency
- Reliability
- Solidity
- Updating facility
- Upgrading facility

To satisfy these criteria, agrometeorological information should be elaborated at regional level and then disseminated to the users in good time. Among the advanced technologies available in the world today, INTERNET represents the suitable tool to reach these goals. Many are the advantages of using Internet to elaborate and disseminate information in the field of agrometeorology products:

- Fast utilisation of information
- Interaction and feedback with the users
- Immediate display of the information
- Facilitate understanding of advises and warnings
- Increasing of computer use by the farmers
- Reduction of information production costs
- Fast upgrading and updating
- Continuous check of system performances
- Application of multimedia tools (text, graphic, map, figure, audio, video, etc.)

In the last few years an increasingly interest on this subject has been observed and a big number or Internet applications for agrometeorological purposes has been realised. Among the countries, but also within the same country, different applications have been realised, characterised by a different structure and organisation. To describe the present situation the main experiences in Europe have been analysed and the results are discussed in this paper.

Agrometeorological Products – Experiences From Europe

The following points characterise the structure and the organisation of the applications available in Europe:

- Private or public organisation
- Type of information (weather forecast, irrigation, crop protection, phenology, soil ploughing, haymaking, etc.)
- Additional information (job opportunities, lows, research programs, etc.)
- Availability of agrometeorological data (numerical or graphical display or possibility to download them)
- Simulation and forecast models (application or possibility to download them)

- Type of access (free, registration, password)
- Access free of charge or by payment
- Timestep of updating of information and data
- Temporal resolution (hourly, daily, weekly, etc.)
- Spatial resolution (micro, meso or macroscale) and use of interpolation methods to prepare thematic maps
- Feedback and interaction with the users
- Type of users (farmers, technicians, public administrator, etc.)
- Language (only national language or also International ones)
- Use of remote sensing
- Use of weather numerical models

Agrometeorological data

A large number of applications can support agricultural activity by providing weather data. Data can be displayed in numerical and graphical format (free of charge) and in some cases data can be also downloaded in ASCII or EXCEL files (usually in this case by payment). Hourly values and daily (weekly or monthly) mean, maximum and minimum values are generally presented (Fig. 1). Other elaborations can also be provided (generally on demand), such as degree day accumulation, etc., for specific aims. In few cases data can be generated by using numerical weather models, so allowing the creation of territorial maps (Fig. 2). In some cases remote sensing techniques (radar or satellite) can be applied to create maps of precipitation, temperature, etc.

Information for crop protection

In many cases agrometeorological data, crop monitoring and simulation models are the bases for the elaboration of information concerning the development of pathogens or insects. User feedback is generally required to input field data and to choose the input data file, so improving simulation models performance. Numerical or graphical outputs can be provided (Fig. 3), with special warnings when the risk level is above the pesticide application threshold. Strategies for pesticide application can be proposed, according to traditional, integrated or biological crop protection methods (Orlandini, 1998). In some cases models can be downloaded to run the simulation using the farm personal computer. When input data are created by using interpolation methods (also by applying numerical weather model or remote sensing), risk maps can be produced for the whole analysed region (Fig. 4).

Information for crop irrigation

After crop protection, the management of crop watering represents a very frequently provided product. Also in this case, agrometeorological data, crop monitoring, user feedback and simulation models are the bases for the elaboration of information concerning water balance and so crop water requirements (Fig. 5). The consideration previously proposed for crop protection can be considered also in this case, as concerning the characteristics of the outputs and the possibility of displaying critical period for crop water availability. The possibility of downloading the models is available as well (Fig. 6). When input data are created by numerical weather models or remote sensing, risk maps can be produced.

Information for crop development and growth

Available in a lower number of Internet applications is the information concerning the crop growth and development. By using models, field monitoring and weather data, a wide range of processes are considered, such as phenology of crop, harvest management, quality and quantity of yield. Crop maps can be used to show the regional dynamics of crop growth and development (Fig. 7). In many cases, output crop data can be used as input of crop protection and irrigation agrometeorological products.

Weather forecast and additional information

Frequently weather forecast represents the only information provided by the agrometeorological Internet applications. Weather forecast may be available at local level, but it is also presented for the whole country or for the entire world (Fig. 8). Weather forecasts are generally provided for a period ranged from one to three days in a detailed format. One week is the limit for presenting weather conditions trend. Numerical weather forecast model can be used to create territorial maps of agrometeorological variables, used as input of simulation models.

In few cases agrometeorological variables are used to give information on soil ploughing, haymaking, use of fertilisation. Additional information can be also concerned with job opportunities, special lows, newsletter, technical news, etc., also depending on the degree of feedback or interaction with the users. Links with other agrometeorological WEB sites can be provided.

Conclusions

The results of this study emphasised the wide range of agrometeorological products based on Internet available in Europe. They are proposed to support the activity of different categories of end users. Agrometeorological technical information, advises and warning are elaborated for farmers, technicians of extension services and public administrators. Weather data interest a wider target, including sport, tourism, traffic, transport. University sites are specially prepared for researchers and students.

A particular attention should be addressed to the characteristics of the output and the possibility of using multimedia tools to give a complete picture of agricultural system conditions. To involve the final users in the elaboration of agrometeorological products, all the tools to increase the interaction and the feedback should be applied.

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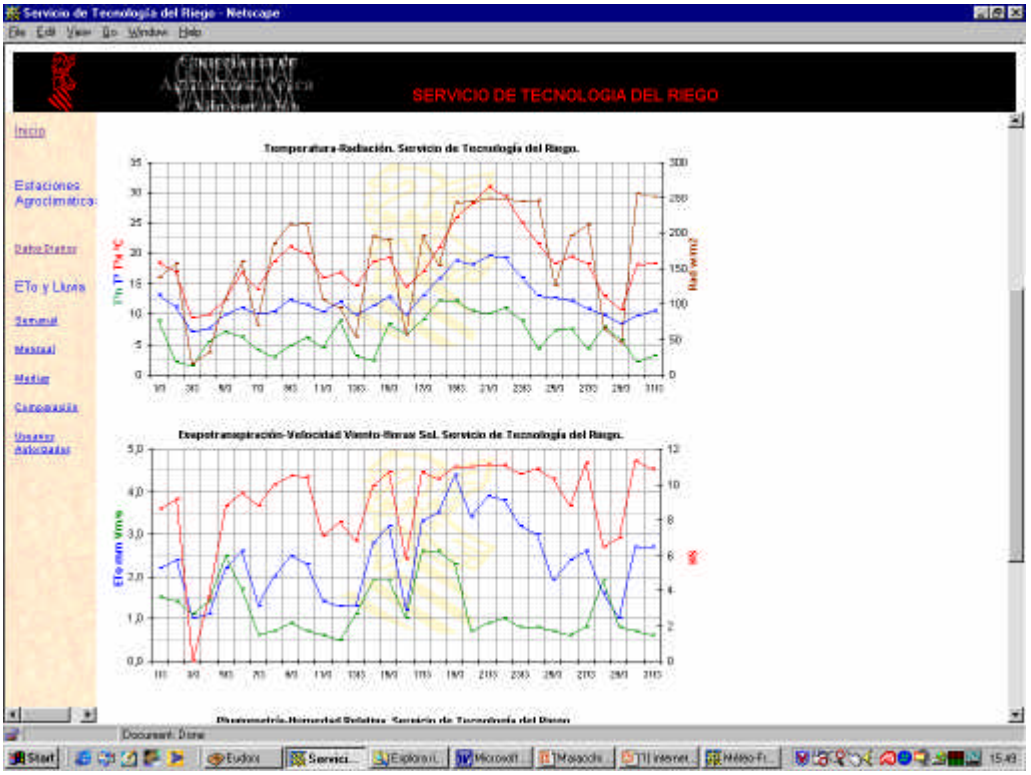

Figure 1 – Graphics of agrometeorological data (www.ivia.es/estacion).

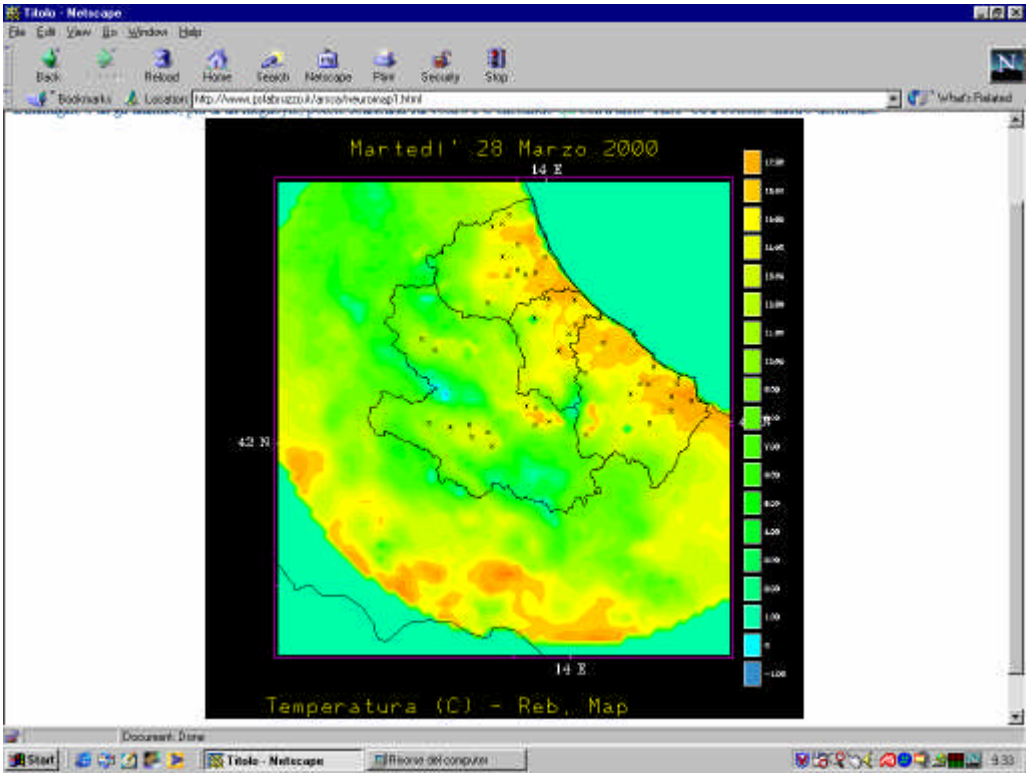

Figure 2 – Creation of weather variable map starting from local measurements, by using a cluster of Artificial Neural Networks (www.pstabruzzo.it/arssa/neuromap1.html).

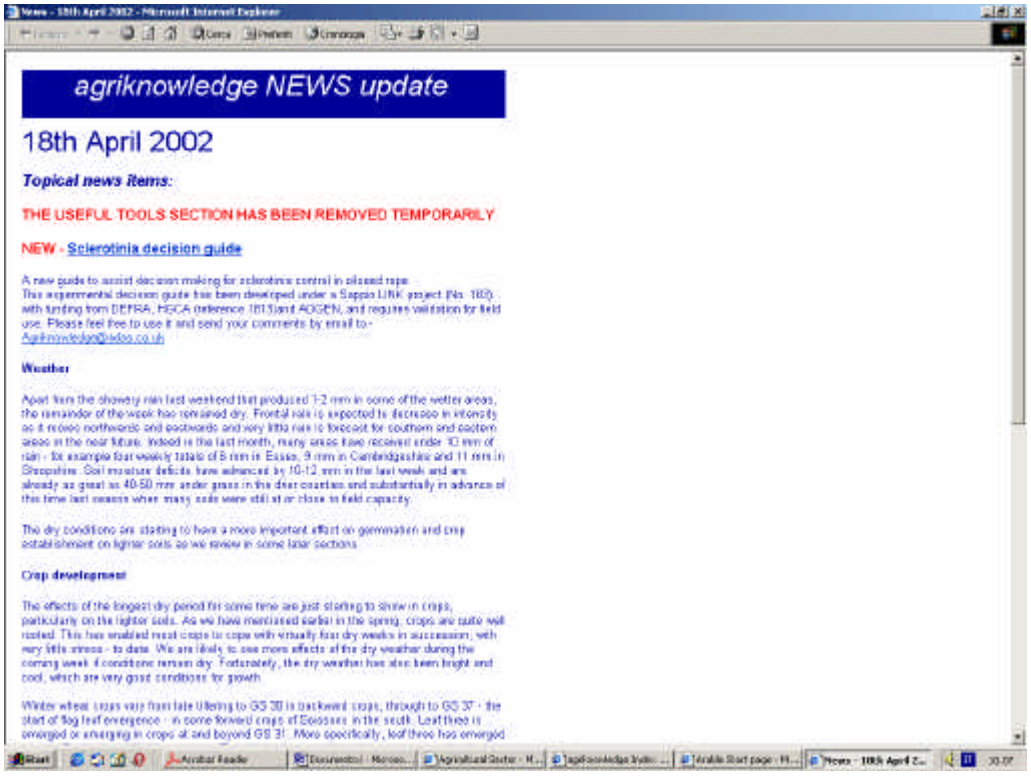

Figure 3 – Bulletin for Sclerotinia crop protection management (www.agriknoledge.co.uk).

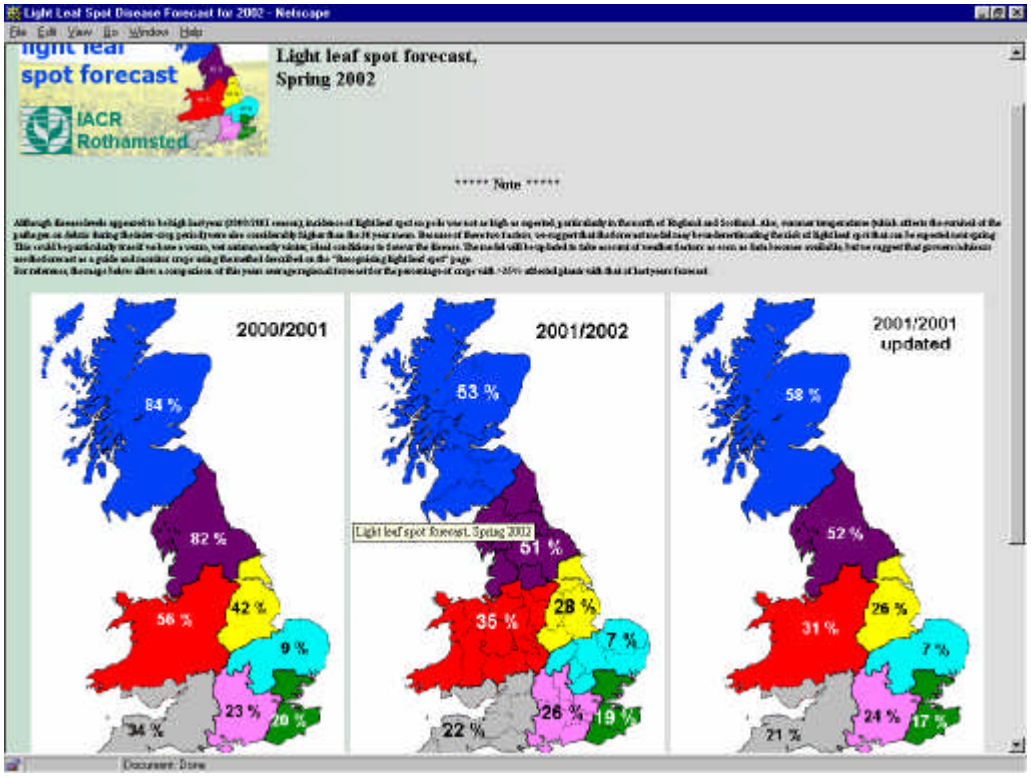

Figure 4 – Maps of light leaf spot forecast (www3.res.bbsrc.ac.uk/leafspot).

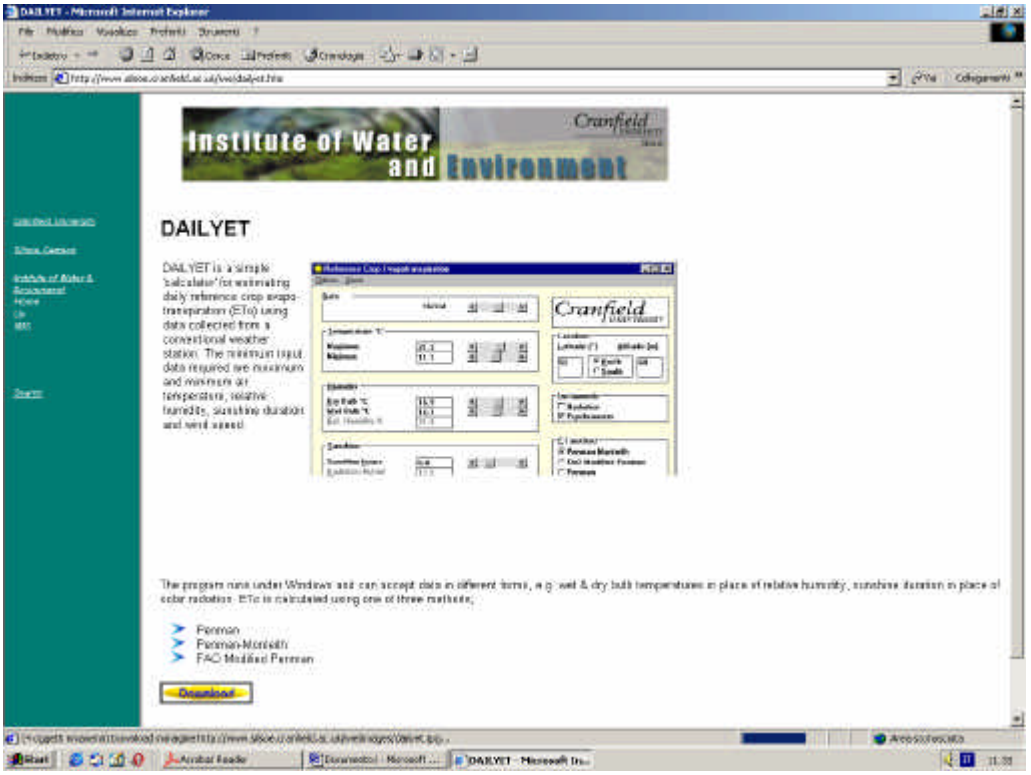

Figure 5 – Estimation of Potential Evapotranspiration (www.silsoe.cranfield.ac.uk/iwe/dailyet.htm).

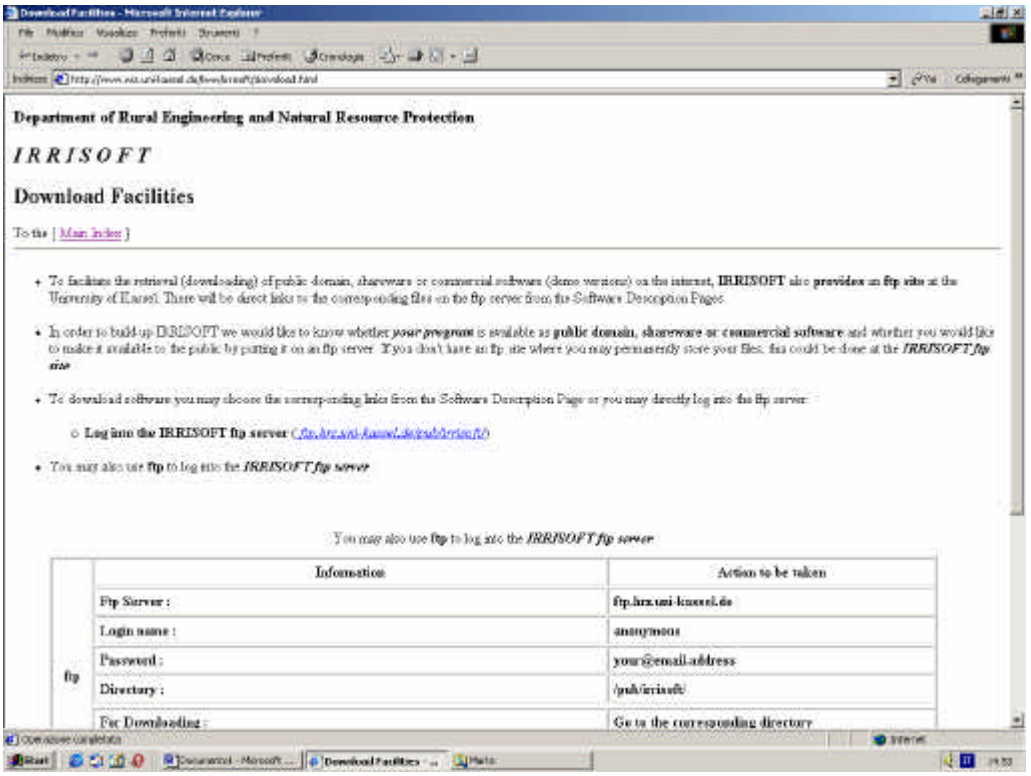

Figure 6 – Download of IRRISOFT program for irrigation management in Germany (www.wiz.uni-kassel.de/kww/irrisoft/download.html).

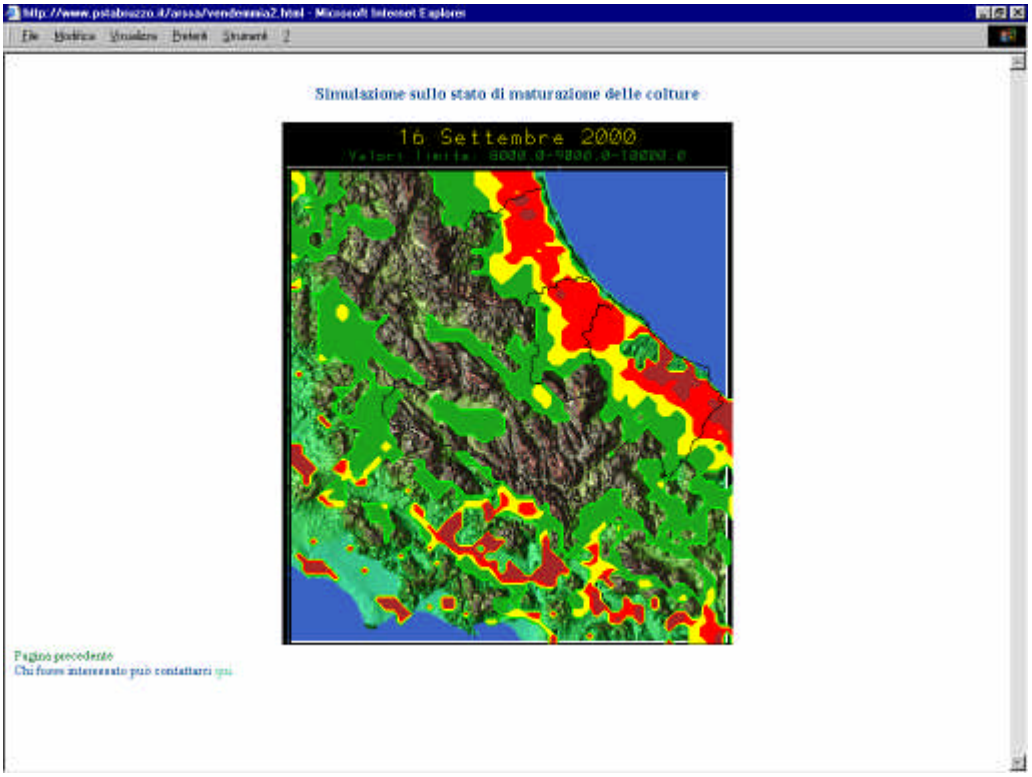

Figure 7 – Map of ripening period based on thermal pattern (www.pstabruzzo.it/arssa/vendemmia2.html).

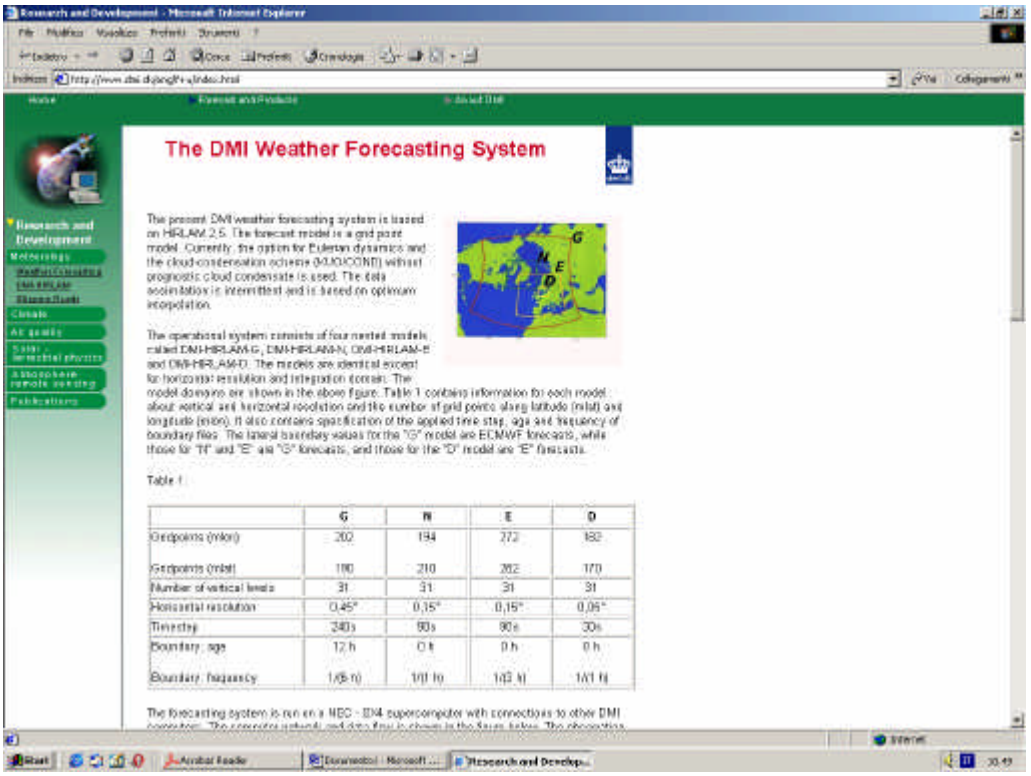

Figure 8 – Weather forecast page in Denmark (www.dmi.dk/eng/f+u/index.html).