EuroBlight tool for the comparison of late blight sub-models - Status and perspectives

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SUMMARY
Partners from the EuroBlight network, with support from ENDURE, created a freely available platform that allows testing and comparing weather-based late blight models (www.euroblight.net). The platform contains extensive weather data: hourly data from many European Union countries, both north and south, between 2006 and 2009. It also contains seven different weather based late blight sub-models. Most recently, biological data for verification were uploaded from monitoring of field experiments and potato fields around Europe. The results from different models for disease risk or, infection risk give similar but by no means identical results. The tool is intended to improve the quality of existing sub-models and it will be used to analyse the weather based risk of late blight development in different regions of Europe and beyond.

KEYWORDS:
DSS, weather data, infection risk, EuroBlight, sub-models

INTRODUCTION
Weather based sub-models are key components in many decision support systems aiming at controlling pests and diseases and minimizing pesticide use. The evolving biology of pest and diseases in combination with changing climates calls for continuous testing and improvement of existing and new weather based sub-models. In the EU.NET.ICP project several DSS's were tested in field trials in Europe (Hansen *et al.*, 2002; Hansen *et al.,* 2001; Dowley *et al.*, 2005). It was concluded that: It was not possible to build one European DSS, it was difficult to compare whole systems in the trials and it was recommended to do comparisons on sub-model level. The ENDURE NoE supported the development of such a generic modelling platform now implemented on the EuroBlight research platform (www.euroblight.net) and introduced in this article.

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METHODS

A generic modelling platform was developed for the comparison and test of weather based late blight sub-models. An interactive web page in www.euroblight.net allows users to select the location, (period of the) year and the sub-models for comparison (fig. 1). It is possible to select the number of sub-models to be included and also the RH Threshold (85, 88 or 90%) to be used in the model calculations. Finally it is possible to add biological data to the graphics if available. Primary weather data, model calculations for Infection pressure, WURCP and SMITH Criteria as calculated for Lelystad (NL), 2009 is given in fig. 1. For model description see Table 1.

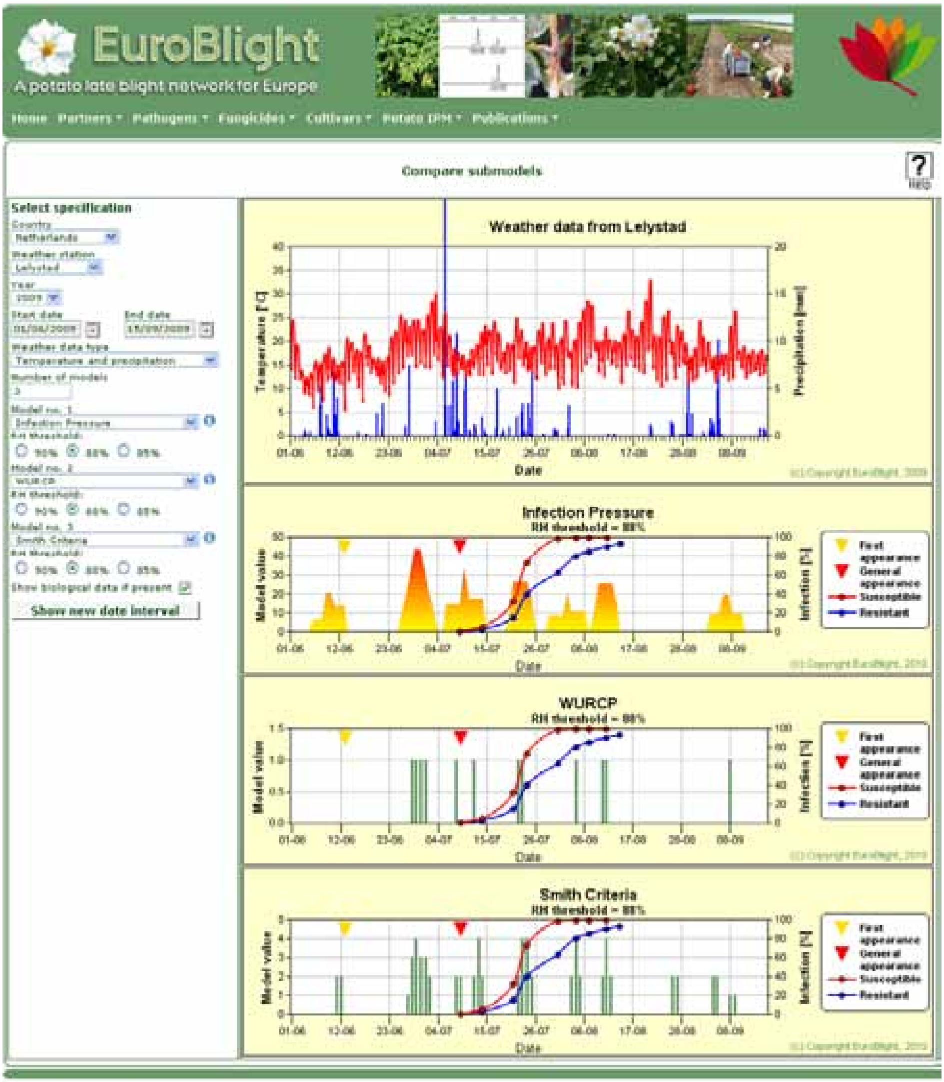


Figure 1. *Interactive Graphic Analysis Tool in EuroBlight. Left: Interactive selections of country, station, start and end date, number of models to show and settings of parameters i.e. RH threshold used in models. Right, from top: Hourly temperature and precipitation and the blight risk according to Infection pressure, WURCP and SMITH Criteria at Lelystad, 2009. The sub-models are described in Table 1.*

The following data were sampled:

Weather data: hourly data for temperature, relative humidity and rain from 15 EU countries, 2006-2009.

Sub-models output: PLANT-Plus disease risk, ProPhy disease pressure, Blight Management infection pressure, Blight Watch, Smith criteria, WURCP infection event, Contact Fungicide degradation. For PLANT Plus and ProPhy, the owner of these models, DACOM and AGROVISION, calculated results and only model outputs were stored in the database. All remaining models were reprogrammed on the platform.

Biological data: Surveillance data as "Date for first infection in early or covered potatoes" and "Date when 5 or more conventional fields were infected". Data for disease progress curves in susceptible and moderate resistant cultivars were collated from field experiments.

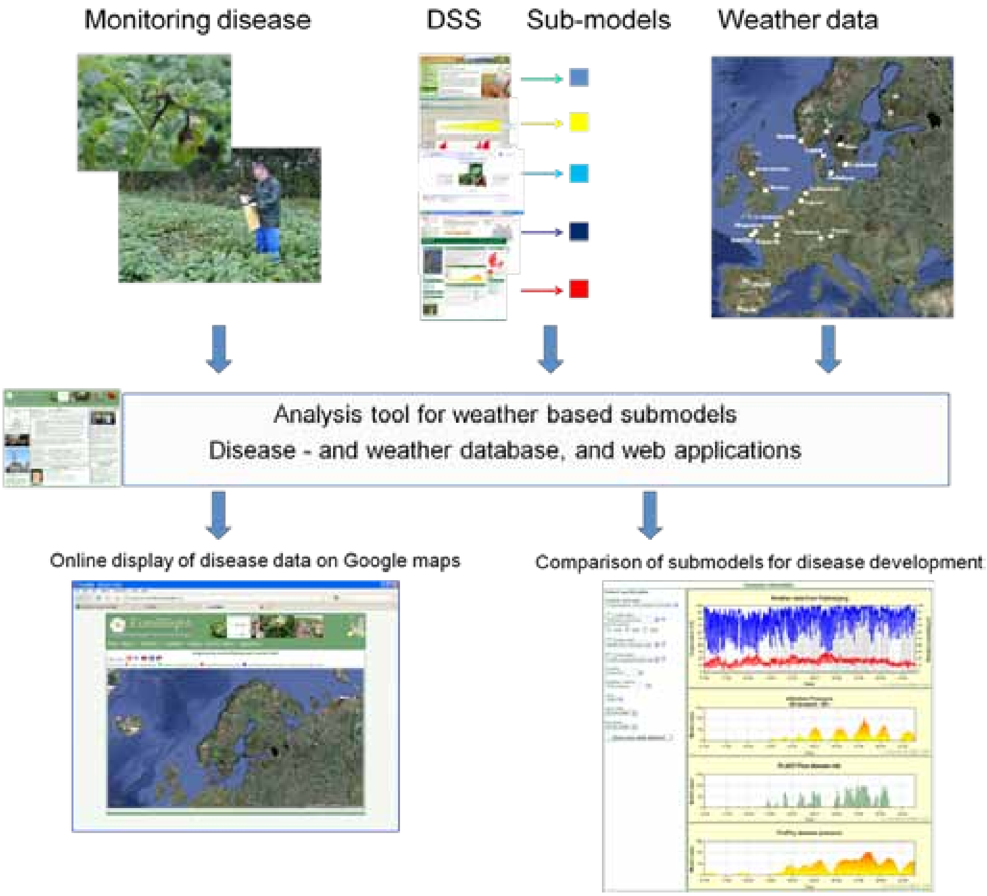


Figure 2. *Framework and dataflow on the blight risk sub-models test and development platform in EuroBlight. Three weather based sub-models are used for demonstration and calculations in this article and the methods are described briefly in Table 1. Other models and methods are presented on www.euroblight.net*

Table 1. *Description of sub-models presented and used in this article. Further information at www.euroblight.net.*

Sub-model name	Description
WURCP **Contact:** Geert Kessel	WURCP calculates critical periods, i.e. days with a very high risk of infection of your crop. WURCP assumes the presence of latently infected tissue in the surroundings of, but outside your field. For a critical period to occur, three sub-processes of the infection cycle have to be fully completed in sequence: formation of sporangia, dispersal of sporangia and infection. The algorithms calculating development rates for each of these processes are based on Crosier 1934.
Infection pressure **Contact:** Jens G. Hansen	The infection pressure is a running sum of sporulation hours during a 5-day window including current date, 2-day weather forecast and two days of historic weather. Sporulation hours is defined as number of hours in periods of 10 or more hours when RH>88% and temperature at the same time is between 10°C and 24°C. HSPO is 5, if there is 10 consecutive hours of RH>88% and the temperature in 5 of those humid hours are above 10°C. During a high infection pressure it is expected that there is risk of both sporulation and infection. Infection pressure: < 20 is low; 20 - 40 moderate and > 40 is high.
Smith criteria **Contact:** Ian Barrie	A full Smith Period has occurred if, on each of 2 consecutive days: i) the minimum air temperature was at least 10 °C, and, ii) there were a minimum of 11 hours with a relative humidity of at least 90% .Within the calculation there is a provision for a 'near miss'. This occurs when the temperature criterion has been satisfied but the number of hours with a high relative humidity totalled only 10 hours on one or both days. Smith Criteria is calculated on a daily basis (10:00 previous day to 09:00 current day) and then calculated the running sum for two days (current day + previous day). This means that the Smith criteria index ranges between 1 and 4, corresponding to 1, one day near miss, 2, one day Smith or two days with a near miss, 3, a Smith day and a near miss; and finally 4, a full Smith.

Seventeen stations were used in the analysis of seasonal blight risk and the comparison of blight risk, 2006-2009 (Fig 3 and 4): St Eloy, FR, Tylstrup and Flakkebjerg, DK, Lindloh and Mathau, DE Valthermond and Lelystad, NL, Belfast, NI, Reckenholz and Payerne, CH, Dundee, SC, Ås and Særheim, NO, Skara, SE, Bonin, PL and Capofiume and Riposto, IT.

RESULTS

During this preliminary phase of analysing data we found some general results:

- Results from different models for disease risk, or, infection risk give similar but by no means identical results (not published). These differences will be analysed in a European context aiming at improving crop protection strategies in different regions of Europe.
- There was a good correspondence between calculation of blight weather with indices like infection pressure, WURCP and Smith Criteria and biological data sampled in surveillance networks and from field trials. Example: In 2008, late blight appeared one month earlier in the Central and Western part of Europe than in North and East Europe. This difference is very well indicated in the calculation of Infection pressure in the same regions of Europe (Figure 5).
- Comparing the years 2006-2009 and using WURCP as a blight risk indicator show, that 2007 was calculated with the highest and 2009 with the lowest seasonal blight risk as a mean of 17 selected weather stations in Europe (fig 3.)

- The year 2006 was characterized by low weather based risk of blight in the first part of season and a very high risk in August and September compared to the other years. The year 2007 was characterized by a relatively high risk in June and July and medium risk in August and September. "2007 was the worst year for foliar blight in Scotland for decades. One explanation for the severe blight in 2007 is the concentration of Smith Periods early in the growing season." (Hansen *et al.* 2009)(fig. 4)

More biological data are needed to allow a solid validation of the models as the core component behind spray decisions.

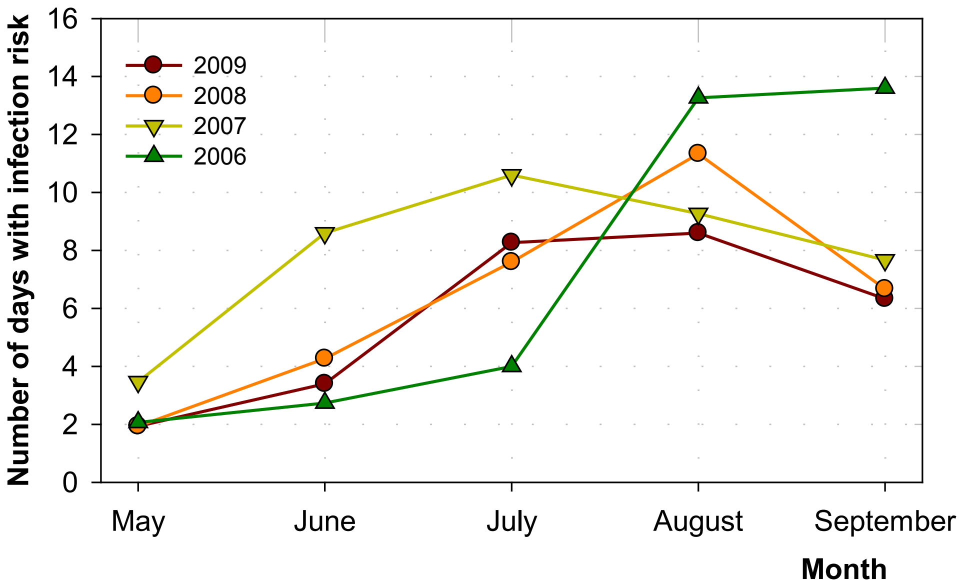


Figure 3. *The number of days with infection risk (according to WURCP) by month for 2006-2009, average of 17 weather stations in Europe.*

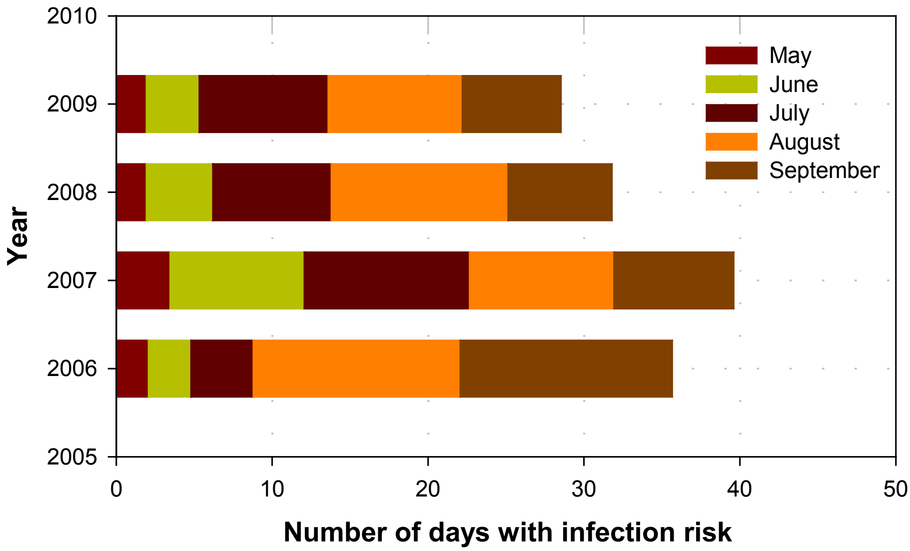
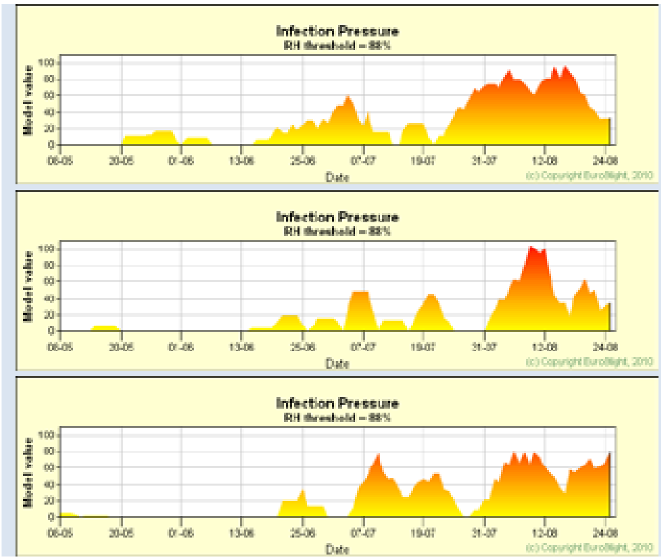


Figure 4. *The number of days with infection risk (according to WURCP) by year for 2006-2009, average of 17 weather stations in Europe.*

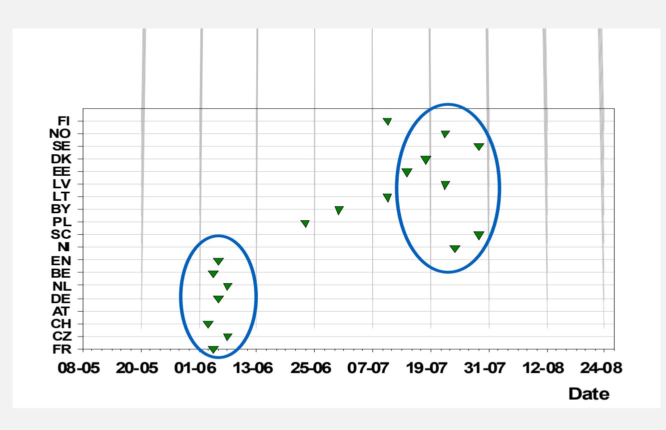


Infection pressure, 2008, at stations:

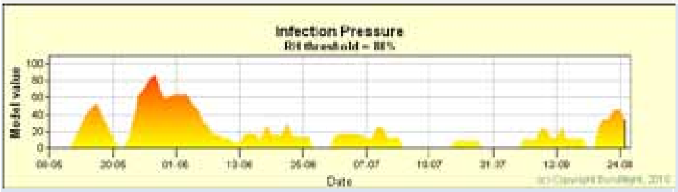
Belfast – Northern Ireland

Skara - Sweden

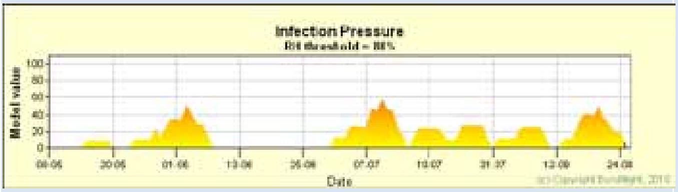
Tylstrup - Denmark



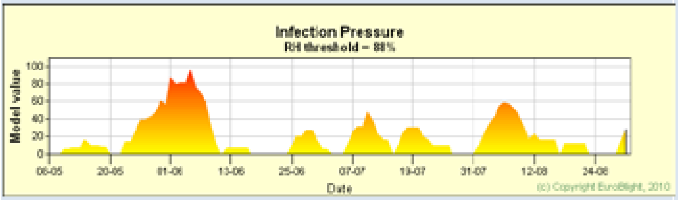
Date when attacks in 5 or more conventional potato fields were reported in 19 European countries, in 2008



Infection pressure, 2008, at stations: **Marham - England**



Boigneville - France



Lelystad – The Netherlands

Figure 5. *Infection pressure at selected stations compared with biological data as "Date when 5 or more conventional fields were infected" at country level.*

DISCUSSION AND CONCLUSIONS

The new online test and development platform for blight models allows any user to compare for themselves the weather based sub-models currently available on the platform. By uploading biological data and weather data, and then comparing the output from all models available it is possible to identify the regional risk for late blight as well as which of the methods might be useful for use in a DSS adapted to regional conditions.

The next step will be to compare the sub-models in more detail and secondly to include biological data from more regions in Europe. More weather based sub-models will be added to the platform i.e. a tuber blight sub-model, and simple DSSs can be constructed using the models in the toolbox, which is aimed at integrating and improving both existing and new DSS in Europe. Future possibilities include developing this platform for other pathosystems and using the platform to analyse the impact of climate change on late blight control in Europe.

We propose that calculations of blight weather from weather stations in 2-3- important potato regions per country should replace the one national figure for weather based blight risk used so far in the country reports (Hansen *et al.*, 2009).

LITERATURE

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