Agriculture

Overview

Climatological data are essential for agriculture's needs. Such data are collected mainly by means of surface meteorological stations. However, real-time and nowcasted data provided by weather radar seems very useful as well.

Precipitation measurements are the most important radar-based data for agriculture. They can help improve plant disease warnings, determine leaf wetness duration in fruit orchards or support decision making in spreading out pesticides. Radar data may warn against severe types of precipitation like hail or heavy storms. Moreover, radar echoes from insects are found to be very important data.

The most evident advantages of the weather radar data are:

overall view of the intensity, amount and type of the precipitation in terms of its severity in real-time,

a reliable forecast of the upcoming rain (up to 1 to 2 hours),

possibility of recognition and analysis of insect echo.

Data usefulness

- Nowcasted and forecasted meteorological maps for specific domain: ground precipitation, type of precipitation (especially hail), wind field in mesoscale resolution.
- Radar reflectivity data to observe echoes from insects (especially from polarimetric radars).

Examples of implementations

Evaluation of the risk triggered by heavy rain

The advantages of using weather radar measurements can be found in numerous specific agricultural applications. The benefits are especially observed in an improved management of irrigation, the evaluation of field practicability, the evaluation of the risk of bogging a machine in a parcel, the evaluation of the risk of scavenging of intrans, an improved management of the fertilizer input, thereby limiting the aquifer pollution, the diagnosis of the risk of crop disease caused by excessive humidity (mildew, fusaria, septoria, etc.) and the appropriate triggering of treatments, and a more reliable utilization of agronomical models.

Taking account of growing importance of sustainable development, the use of exact data about the actual rainfall over a parcel makes the recommendations to the farmer more reliable and improves confidence in agronomical models.

Insect migration warning

In Finland a pilot alarm system for insect migration using weather radars has been developed jointly by Finnish Meteorological Institute (FMI), MTT Agrifood Research Finland,

and University of Helsinki (Markkula et al., 2008a; Pylkkö et al., 2008). The main focus is on the harmful insects can cause substantial losses if farmers are not able to protect their crops on time. It is essential to forecast the timing and amount of local pests. Weather radar measurements both Doppler and polarimetric are employed to monitor insect migrations. From Doppler observations the average direction and speed can be computed, and the polarimetric measurements make the identification of echo source more accurate. The warning system consists of automatic calculation of insect migration probability, its subjective control and correction tools, and finally the dissemination to the users via web interface (Fig. 1) and SMS messages (Fig. 2). The warning is given for seven counties in Southern Finland. The severity of the warning is given as probability class.

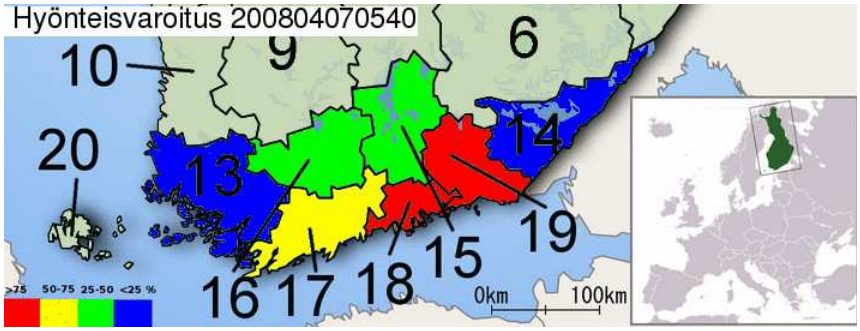

Fig. 1. Example of the warning map available on webpage (Pylkkö et al., 2008).

Fig. 2. Example of the radar animations using WAP service and SMS product for insect warning (Pylkkö et al., 2008).

For the purpose of detection of insect-generated echoes data from polarimetric radar are especially useful (Leskinen, 2008). Fig. 3 shows vertical cross-section of reflectivity Z and differential reflectivity ZDR measured by Kumpula radar (Finland). A rain shower is detected with its top about 6 km above the ground, while the insect migration below 2 km (Markkula et al., 2008b). The differential reflectivity of the precipitation cell is clearly separated from that of the insects.

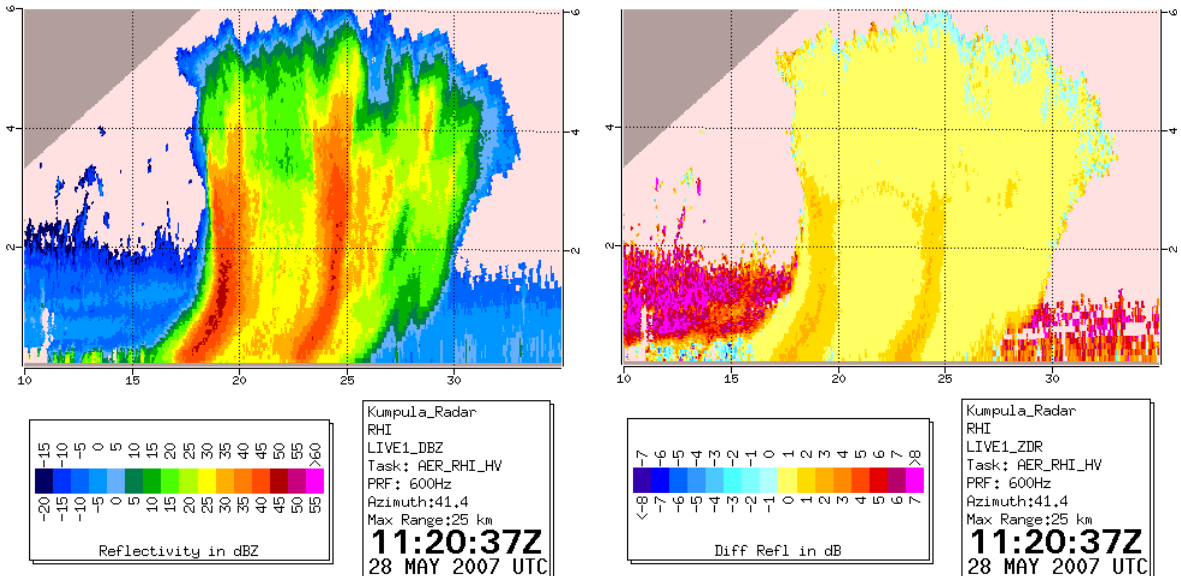

Fig. 3. Example of radar data cross-section of insect migration: classical reflectivity (on the left) and differential reflectivity from polarimetric radar (on the right) (Markkula et al., 2008b).

Literature

Leskinen, M., 2008. Observed polarimetric signals of insects. *Proceedings of ERAD 2008*.

Markkula, I., Leskinen, M., Pylkkö, P., Koistinen, J., Ooperi, S., Tiilikkala, K., Ojanen, H., and Raiskio, S., 2008a. Early warning system for insect migration using weather radars. *Zemdirbyste-Agriculture*, 95, 110–115.

Markkula, I., Ojanen, H., Tiilikkala, K., Raiskio, S., Pylkkö, P., Koistinen, J., Leskinen, M., and Ooperi, S., 2008b. Insect migration case study by polarimetric radar. *Proceedings of ERAD 2008*.

Pylkkö, P., Koistinen, J., Markkula, I., Ojanen, H., Tiilikkala, K., Raiskio, S., Leskinen, M., and Ooperi, S., 2008. Alarm system for insect migration using weather radars. *Proceedings of ERAD 2008*.