Baltic Sea Region
Programme 2007–2013
Part-financed by the European Union
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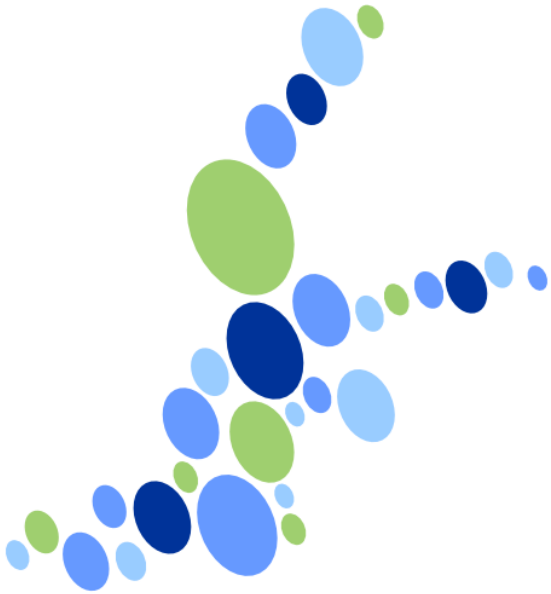

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Expectations of weather radar data end-user: short summary of BALTRAD WP7 and BALTRAD+ WP4 investigations

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Reports

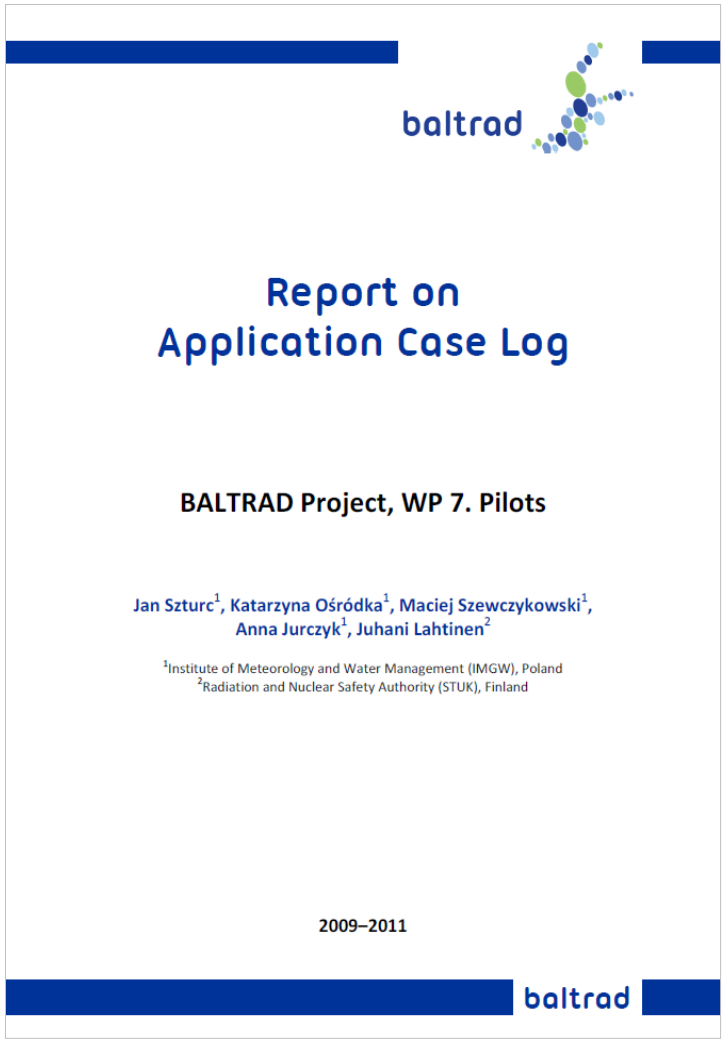
This presentation has been prepared in the frame of BALTRAD+ Project as part of work carried out in Work Package 4 “Pilot investment and real-world use”. It is partially based on the earlier works in the frame of BALTRAD Project:

- Report BALTRAD W701 “Definition of the target end-users”.
- Report BALTRAD W702 “The end-users requirements and expectations” (based on questionnaire).
- Report BALTRAD W703 on Application Case Log.
- Presentations during the following BALTRAD events: (i) End-User Workshop, 26 October 2010, Aalborg, Denmark, (ii) BALTRAD Final Seminar, 7 December 2011, Tallinn, Estonia.
- Research papers.

General expectations of different target group of end-users of weather radar data

Group of end-users	Needed radar-based meteorological fields	Optimal data format	Need for radar-based forecasts
Hydrologists (flood protection)	Ground precipitation	Numerical: as input to rainfall-runoff model	Yes
Meteorologists (numerical weather prediction)	Radar reflectivity	Numerical: as input to NWP model	No
Air traffic control	All hazardous phenomena	Graphical, numerical	Yes
Local rescue services (fire, flood, etc.)	Ground precipitation and wind	Graphical	Yes
Road and railway control and protection	Ground precipitation (snow)	Graphical	Yes
Radiation	Precipitation and wind	Graphical	Yes
Hydropower industry	Ground precipitation	Numerical	No (too short lead time)
Urban water management	Ground precipitation	Numerical	Yes
Agriculture	Ground precipitation	Graphical, numerical	No (too short lead time)
Ecology	Ground precipitation and wind	Graphical, numerical	No
Research community	All	All	No
Education	All	Graphical	No
Mass media	Ground precipitation and wind	Graphical	Yes

Example



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.

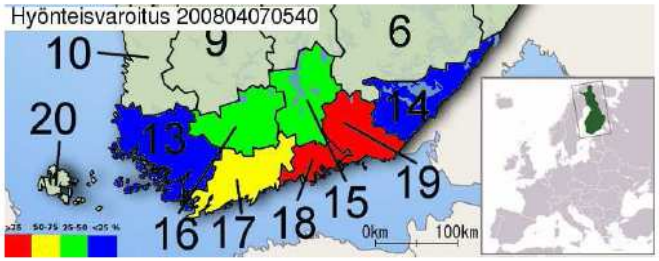


Fig. 1. Example of the warning map available on webpage (Pylkkö et al., 2008).

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.

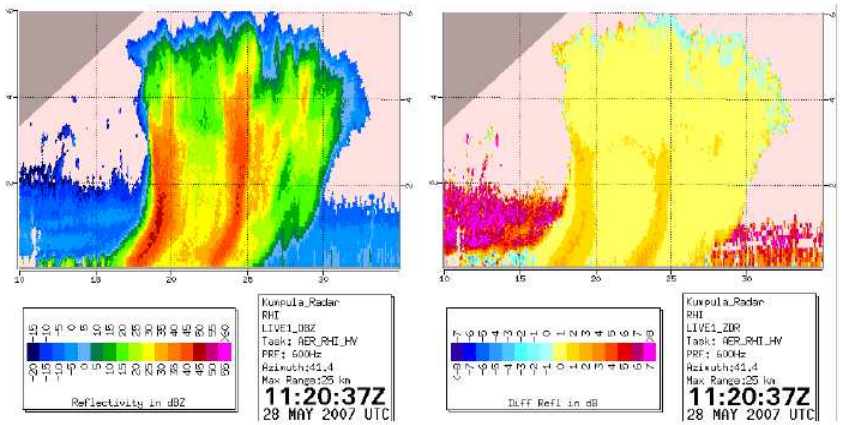


Fig. 3. Example of radar data cross-section of insect migration: classical reflectivity (on the left) and differential reflectivity from polarimetric radar (on the right) (Markkula et al., 2008b).

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*.

Questionnaire

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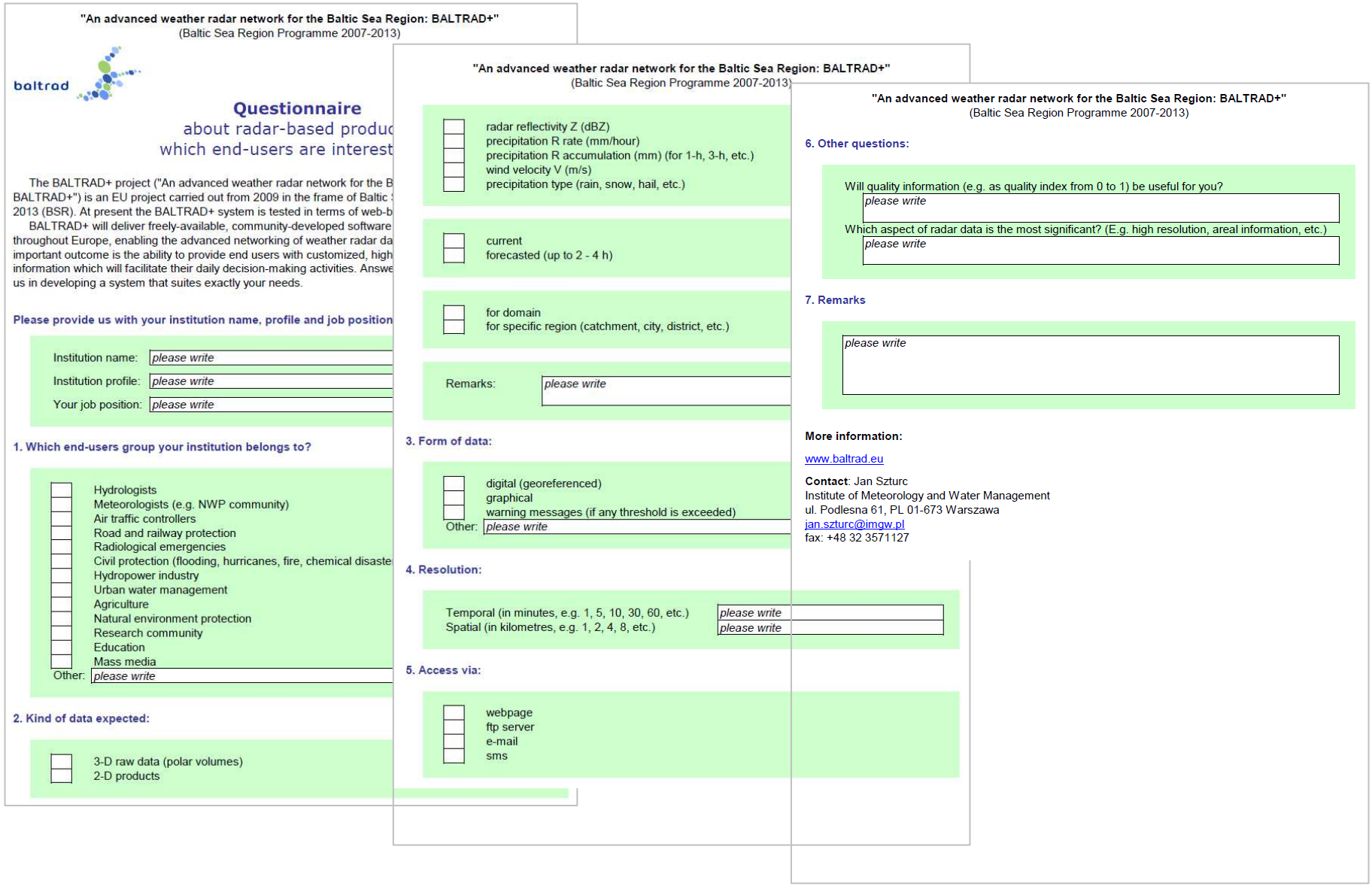

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Questionnaire
about radar-based produc
which end-users are interest

The BALTRAD+ project ("An advanced weather radar network for the B
BALTRAD+") is an EU project carried out from 2009 in the frame of Baltic
2013 (BSR). At present the BALTRAD+ system is tested in terms of web-b
BALTRAD+ will deliver freely-available, community-developed software
throughout Europe, enabling the advanced networking of weather radar da
important outcome is the ability to provide end users with customized, high
information which will facilitate their daily decision-making activities. Answe
us in developing a system that suites exactly your needs.

Please provide us with your institution name, profile and job position

Institution name: *please write*
Institution profile: *please write*
Your job position: *please write*

1. Which end-users group your institution belongs to?

- ☐ Hydrologists
- ☐ Meteorologists (e.g. NWP community)
- ☐ Air traffic controllers
- ☐ Road and railway protection
- ☐ Radiological emergencies
- ☐ Civil protection (flooding, hurricanes, fire, chemical disaste
- ☐ Hydropower industry
- ☐ Urban water management
- ☐ Agriculture
- ☐ Natural environment protection
- ☐ Research community
- ☐ Education
- ☐ Mass media

Other: *please write*

2. Kind of data expected:

- ☐ 3-D raw data (polar volumes)
- ☐ 2-D products

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- ☐ radar reflectivity Z (dBZ)
- ☐ precipitation R rate (mm/hour)
- ☐ precipitation R accumulation (mm) (for 1-h, 3-h, etc.)
- ☐ wind velocity V (m/s)
- ☐ precipitation type (rain, snow, hail, etc.)

- ☐ current
- ☐ forecasted (up to 2 - 4 h)

- ☐ for domain
- ☐ for specific region (catchment, city, district, etc.)

Remarks: *please write*

3. Form of data:

- ☐ digital (georeferenced)
- ☐ graphical
- ☐ warning messages (if any threshold is exceeded)

Other: *please write*

4. Resolution:

Temporal (in minutes, e.g. 1, 5, 10, 30, 60, etc.) *please write*
Spatial (in kilometres, e.g. 1, 2, 4, 8, etc.) *please write*

5. Access via:

- ☐ webpage
- ☐ ftp server
- ☐ e-mail
- ☐ sms

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6. Other questions:

Will quality information (e.g. as quality index from 0 to 1) be useful for you?
please write

Which aspect of radar data is the most significant? (E.g. high resolution, areal information, etc.)
please write

7. Remarks

please write

More information:

www.baltrad.eu

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Draft catalogue of products

Kind of data	Product	Form of data	End user groups
3-D data	Volumes of radar reflectivity *Z* and radial Doppler velocity *V*	numerical	Meteorologists, research, air traffic control
		graphical	Education, mass media
2-D precipitation products	Surface precipitation rate and accumulation *R*	numerical	Hydrologists, meteorologists, hydropower, urban water, ecology, research
		graphical	Radiation, agriculture, education, mass media, road and railway protection
	Type of surface precipitation *R*	numerical	Rescue services, research
		graphical	Radiation, agriculture, road and railway protection
	Nowcasting of surface precipitation *R*	numerical	Hydrologists, hydropower, urban water, research
		graphical	Radiation, road and railway protection , agriculture
2-D Doppler (wind) products	Surface wind velocity and direction $\mathbf{V}$	numerical	Research, agriculture, rescue services
		graphical	Radiation, education, mass media
	Nowcasting of surface wind $\mathbf{V}$	numerical	Research, rescue services
		graphical	Radiation, agriculture

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Draft catalogue of products

Specific user's dedicated products

For example:

♦ 3-D hazard index for air traffic control based on 3-D data *Z* and *V* determined from multi-phenomena algorithms (e.g. Ośródka et al., 2010) and more detailed information about particular meteorological fields [for air traffic control].

♦ Biological echo detection based on 3-D data *Z* and *V*, especially from dual-polarimetric radars (e.g. Pylkkö et al., 2008) [for agriculture].

♦ Products for mass media and wide range of public (animated, colourful, etc.) (e.g. Celano et al., 2008) [for education and mass media].

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End-users' expectations
(preliminary results)

- Hydrologists are more interested in forecasts than observed radar data. They still consider rain gauge network as more reliable data source, especially in case of the dense network.
- National meteorological services are interested in certain domains whereas other institutions (administrative, authority) in region or catchment-related data.
- Generally numerical information is desired as the most effective and flexible. Only in small number of cases other forms like graphical or text message (e.g. warning) are useful.

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End-users' expectations
(preliminary results)

♦ Scientific users are more interested in extremely high resolution data (1 to 5 minutes and 1 km) whereas for operational users slightly lower resolution is satisfactory (up to 10 minutes and 1-2 km).

♦ First of all the automatic way of data delivery is expected, such as through webpage or FTP protocol. Other ways of access to the data that require any activity from the user are not found useful.

♦ Quality information about radar data is highly desired. However it must be clearly and precisely defined in order to be understood.

♦ The most significant aspects of radar information for users are (i) high spatial and temporal resolution, and (ii) availability of relatively trustworthy spatial information.

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Thank you for your attention!