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The flood in 1997 has been one of the biggest disasters in Poland in the last two centuries. The extend of flooded areas has been the great interest of the government.

Due to unfavourable weather conditions, Landsat, SPOT and IRS were unable to photograph successfully flooded area. This time, European Space Agency satellite – ERS-2 has provided full set of images over the flooded part of Poland. One of the images obtained on 15 July has been used in this project for the evaluation of the maximum extent of flood. Some agriculture areas were flooded and in some other agriculture fields soil moisture content was very high exceeding the soil capacity. Discovering the areas of excessive soil moisture has become very important task demanded by farmers and local governements. It has been proved that the same amount of rainfall could not cause flood in the areas where there is the deficit in soil moisture, while in the other areas where soil has already been filled with water and the storage capacity has been close to zero the same amount of rainfall causes flood. The information about soil moisture has been important not only for agricultural prognosis, but also could be the essential information for the flood forecast in order to determine the extent of saturation of the watershed and for partitioning of rainfall into surface runoff and infiltration. The research has been undertaken in 1998. In July 1998 and 1999 the ground observation have been carried out in order to develop the method of soil moisture estimates. The measurements of soil moisture and vegetation parameters have been done for the area of 100x100 km^2 covering the whole ERS scene. On radar images, it is generally difficult to separate the backscattered components related to surface roughness, vegetation cover and soil moisture. To calculate soil moisture the crop type and the crop status must be similar in order to avoid vegetation surface roughness variations. These variations can be expressed by LAI (Leaf Area Index) values, which reflect geometrical properties of an object. The correlation between soil moisture and backscattering coefficient has been performed according to distinguished LAI classes: LAI < 2, LAI 2-3, LAI >4 (Gruszczynska et all 1998).

The Figure 1 presents the relation between backscattering coefficient and soil moisture under cereals for LAI higher than 4. The correlation coefficient equals to 0.82. The high value of LAI indicates that the soil is completely covered by vegetation (heading stage). In this case the vegetation surface is smooth, decreasing the influence of roughness on backscattering coefficient $\sigma°$ which depends mainly on soil moisture. At the heading stage of vegetation development there is the highest relation between soil moisture and vegetation moisture what strengthens the relationship between backscattering coefficient and soil moisture value.

Application of satellite images obtained in the microwave spectrum for the assessment of soil moisture condition gives the great advantage in monitoring of agricultural area any time during the vegetation season, Dabrowska-Zielinska et all 1997. Figure 2 presents the sums of precipitation for the first decade of July for the year 1997 and 1999. Precipitation has been measured at four meteorological stations at the

region where flood occurred. In some of the areas the decade sum of precipitation has been higher than 160 mm during 1997. However it has been presented that at the station Zielona Gora the precipitation has not been noted high and were even higher in 1999 at the considered time of investigations.
It has been assumed that the same type of crop covered agricultural fields in 1997 as in 1999 (crop rotation). During the measurements session in 20.07.99 the observation covered soil moisture and vegetation measurements. It has been also assumed that the vegetation in the same periods of observation has been in the same stage of development. On the basis of these assumptions the developed soil moisture models have been applied for different type of crop using backscattering coefficient calculated from ERS-2 SAR. As the result, soil moisture has been obtained for each of agriculture field. Figure 3 presents the distribution of bacscattering coefficient for 15.07.97 and 20 07 99. The values for 15 07 97 were higher indicating higher soil moisture. Figure 4 presents the difference between bacscattering coefficients in 1997 and 1999 and the difference between soil moisture obtained from the models for 1997 and measured at the field in 1999. The differences of 4 dB have been noted for the difference in soil moisture of 30mm. These large differences of soil moisture occurred even for the distant areas from the river bed.
The research has proved that SAR images could deliver important information about the floods and soil moisture not only for the deficit of moisture but also for its excessive amount. Extensive cloud cover, usually prevailing during flood periods, seriously limits the usefulness of satellite images obtained in optical spectrum. In such cases the evaluation of flood event can only be based on images taken in microwave portion of electromagnetic spectrum.

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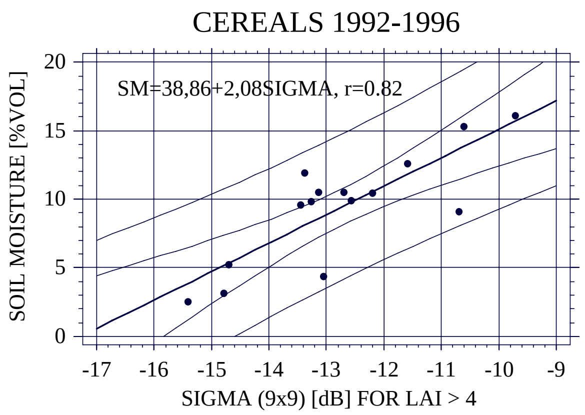
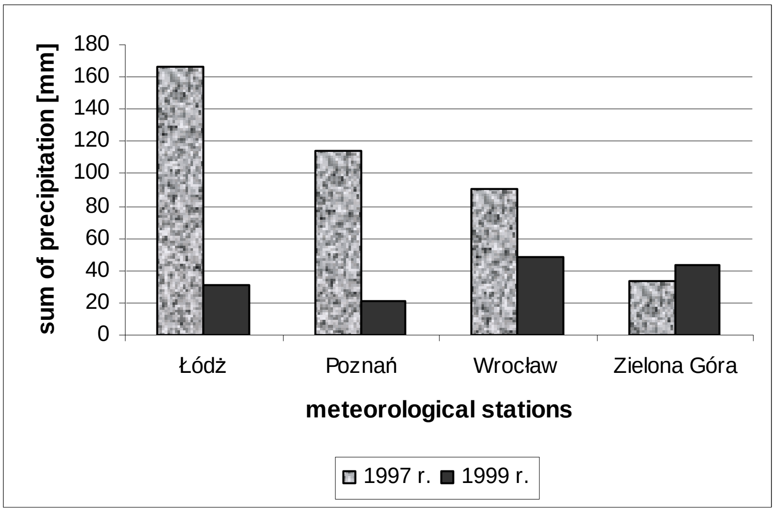
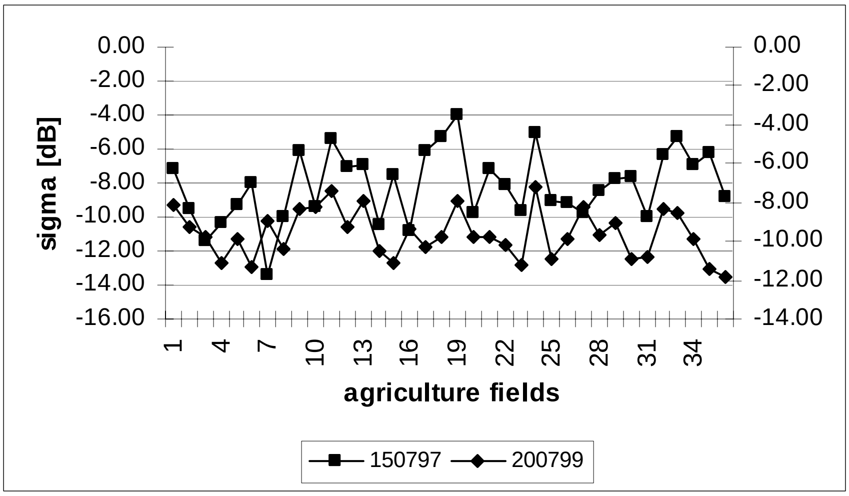


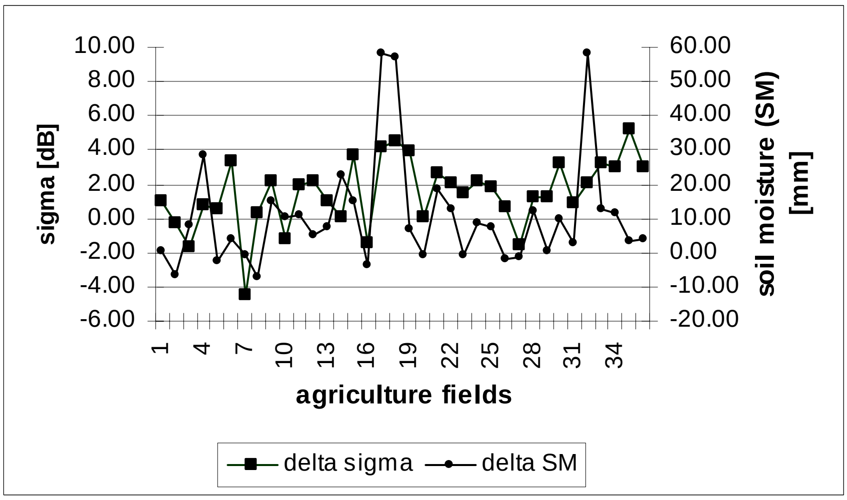
Fig.1. Relation between volumetric soil moisture measured at the test site and backscattering coefficient (SIGMA) calculated from ERS-2 SAR data for cereals for LAI > 4.



Sums of precipitation



Bacscattering coefficients for 1997 and 1999



Differences of bacscattering coefficients and soil moisture for 1997 and 1999