Dynamic behaviour of combine yield measurement systems investigated on a test stand

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Local yield data and yield maps have become a key element of precision farming. They deliver input information for the determination of management zones and are a tool to evaluate the results of site specific farming. Today all manufacturers of combine harvesters are producing and selling yield measurement systems for their products and also first systems are available for choppers and root crops. Because yield measurement systems for combines are on the market now since nearly 10 years, a number of investigations on their accuracy has been made and published (Auernhammer et al. 1993, Macy et al. 1994, Grisson et al. 1999, Demmel 2001). Most of these investigations have tried to get information on the measurement accuracy of the systems in the field under real work. To gain this information they have counter weighed tank loads of the combines (Auernhammer et al.- 1994, AL-Mahasneh et Colvin 2000). Other groups have investigated the influence of isolated different errors sources on test rigs or test stands (Steinmayr et al. 2001, Demmel 2001). A small number of engineers has tried to compare the yield readings of the measurement systems with the yields of reference plots directly beside the track of the combines (Searcy 1998). Following this activities the American Society of Agricultural Engineers therefore is defined an ASAE Standard for testing yield measurement systems. But all of this published investigations only give information on the overall accuracy of the systems based on different types of aggregating or accumulating procedures . To get an information on the quality of yield data from a yield measurement systems also their dynamic behaviour is very important because yield data and yield maps should deliver a picture of the changes in the field. Slow or fast, smooth or sharp changes in yield while the combine is driving through the field in a first and major step are smoothed by the combine and its threshing mechanism. The important question is how are the measurement systems reacting on the remaining changes? How are their dynamic behaviour? This important question cannot be answered in the field because the changes in the yield are not defined or know. Therefore the only way to get information is to run dynamic tests on the test stand with different pattern or shapes of mass flow changes. Three different shapes of mass flow changes for yield measurement systems have been proposed: "Ramp flow", "step flow" and "alternating flow". On the test stand for combine yield measurement systems at the Technical University of Munich three different yield measurement systems for combine harvesters have been investigated with these three proposed procedures and different tilt (side hill) angles. As expected they have shown different behaviour. They are reacting with different delays and in different speeds on the changes in the mass flow. In the proposed presentation the test stand, the testing procedures and the results of the tests on the dynamic behaviour of yield measurement systems will be described. The consequences on the possibility to create yield maps will be discussed. Based on the results the authors will try to define requirements for improvements of the dynamic behaviour of yield measurement systems for combine harvesters.