ATTACHING MULTIPLE CONDUCTIVITY METERS TO AN ATV TO SPEED UP PRECISION AGRICULTURE SOIL SURVEYS

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ABSTRACT

Ground conductivity meters are used in a number of precision agriculture applications, including the estimation of water content, nutrient levels, salinity and depth of topsoil. Typically the Geonics EM38 conductivity meter, and to a lesser extent the EM31, are used for soil surveys. Most conductivity surveys involve towing a ground conductivity meter behind an all-terrain vehicle (ATV). In some situations, such as rutted or sloping fields, it is preferable to mount the conductivity meter directly to the ATV. In this case the conductivity meter must be attached to the ATV in such a way that interference from the metal in the ATV is minimal. In some cases a soil survey requires collecting data from two conductivity meters, each of which has a different depth of penetration. Attaching both instruments to the ATV, and carrying out the survey in one pass, can substantially reduce survey time and expense. In order to carry out such a survey, not only must the interference from the ATV be minimal, but the two instruments must not interfere with one another. We have developed methods that allow us to use booms to attach to an ATV, with minimal interference, an EM38 and EM31. We have also developed interference correction methods to remove residual interference from the ATV on both the EM38 and EM31 instruments. In addition, we have measured the interference effects of the EM38 and EM31 on each other, and determined inter-instrument spacing and transmitter-receiver orientations that reduce mutual interference to a low level. These techniques allow us to attach one or both instruments to an ATV and survey a field in a single pass.

Keywords: Precision agriculture, electrical conductivity, interference

INTRODUCTION

Electrical conductivity has been used to estimate water content, salinity, nutrient levels, and depth of topsoil. Ground conductivity meters are typically placed on a sled or in a cart, and towed behind a vehicle. Surveys conducted in this manner are subject to measurement errors due to changes in instrument height and orientation as the sled or cart is pulled over stubble or ruts. Such errors can be reduced if the conductivity meter is directly attached to the ATV. This method will work only if the interference from the metal in the ATV is small. Some soil surveys involve collecting data from two conductivity meters, each of which has a different depth of penetration. Such a survey can be conducted in one pass by attaching both instruments to the ATV. In this case the instruments must be positioned in such a way that they do not interfere with one another. We have developed methods that allow us to use booms to attach, with minimal interference, two ground conductivity meters to an ATV.

MATERIALS AND METHODS

Our tests were carried out using the Geonics EM38 and EM31 ground conductivity meters. We measured interference effects between the instruments by first placing the EM38 on the ground and measuring the apparent conductivity. We then placed the EM31 at different distances from the EM38, and varied the transmitter-receiver orientations of the EM31. We recorded the EM38 readings for each change of distance and orientation of the EM31 and calculated the resulting measurement error. We then repeated the process and determined the EM31 measurement error due to the presence of the EM38. We estimated interference effects from the metal in the ATV on each instrument by measuring the apparent conductivity at both ground level and at different heights at a single location. We then brought the ATV closer and closer to the instrument, and recorded measurement errors due to interference from the metal in the ATV.

RESULTS AND DISCUSSION

Mutual interference between the EM38 and EM31 was small as long as the transmitter of one instrument was not close to the receiver of the other instrument. The metal in the ATV had a greater effect on the EM38 than on the EM31 readings. The amount of error due to the metal in an ATV will depend on the model of ATV to which the instruments are attached. In our case we placed the EM38 in an adjustable boom in front of the ATV. The distance between the EM38 and the front of the ATV varied between 1.5 and 2 m depending on the height of the EM38. The interference error due to the ATV was a linear function of the height of the EM38. This error can be removed from the EM38 data prior to interpreting the data. The level of interference of the ATV on the EM31 varied with the height of the EM31 and at what location it was placed relative to the ATV. We mounted the ATV at a height of 1 m above the ground, and 0.9 m to the side of the ATV. Residual interference errors were removed as for the EM38. These techniques have enabled us to attach both instruments to an ATV and survey a field in a single pass.