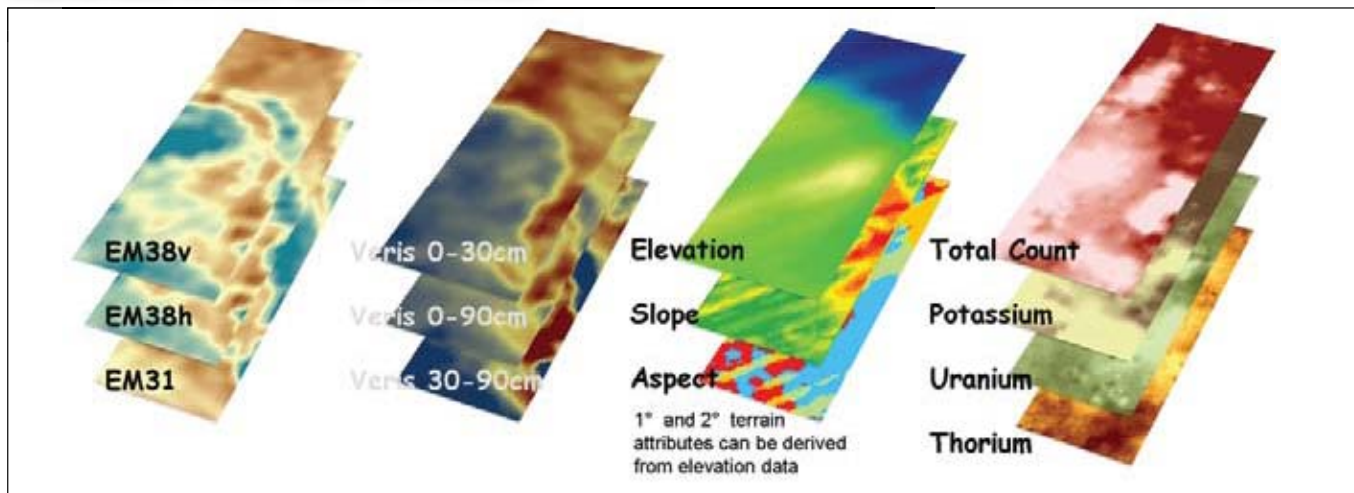


## Advances in soil data collection



**Figure 2. An example of the different data layers that can be obtained from the multi-sensor platform. From the left:  $EC_e$  data from the Geonics sensors,  $EC_a$  data from the Veris 3100 sensor, elevation and terrain attributes from the carrier-phase GPS and the region of interests from the gamma-radiometer. Some of the data show similar patterns (eg. the Geonics and Veris 31000, which both map  $EC_e$ ) and some show different patterns (eg. the gamma-radiometrics and  $EC_e$  data). These differences and similarities can be used to help identify underlying soil properties and processes.**

- On-the-go electrochemical sensors are now commercially available for mapping topsoil pH but are not currently widely used. There are other electrochemical sensors under development for soil ions such as N, P and K.

All the sensors listed can be mounted on a vehicle and run on-the-go in a field. Therefore, since different soil properties can be inferred from the different sensors, it makes sense to run multiple sensors on the one vehicle when conducting an on-the-go soil survey.

Figures 1 and 2 illustrate the multi-sensor platform produced for the project and the type of data layers that can be produced after one pass of the platform.

There is no doubt  $EC_a$  data is valuable and has had a dramatic impact on the way growers look at their soils and soil spatial variability. However, it is important to understand that  $EC_a$  is not the complete answer. In the coming years more and more real-time on-the-go soil sensors will be available and commercially used. This will help growers attain an even greater understanding of the productivity of their soil systems.

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# Confused terms

The terms EMI (electromagnetic induction) EM38 and soil  $EC_a$  (apparent electrical conductivity) are often used interchangeably but are not the same. The term, EM38, only refers to data collected by an instrument made by Geonics Ltd, Canada ([www.geonics.com](http://www.geonics.com)), which measures the third term,  $EC_a$ , to a depth of about 1 to 2m. While the Geonics EM38 is the most common instrument used for  $EC_a$  surveys, it is by no means the only one.

On-the-go  $EC_a$  surveys are possible with a variety of instruments from several different manufacturers including DUALEM ([www.duallem.com](http://www.duallem.com)), GEM ([www.geophex.com](http://www.geophex.com)), Geocarta (<http://geocarta.sa.free.fr>) and Veris Technologies ([www.veristech.com](http://www.veristech.com)). It is worthwhile having a look at these web pages to see the different approaches and depths of penetration of these systems.

Four key factors influence soil  $EC_a$

- 1) Moisture content – soil with a high moisture content will have a higher EMI/ $EC_a$  than the same soil with a lower moisture content;
- 2) Salt content – just as salty water is a better conductor than fresh water, a soil with a high salt content will have a higher EMI/ $EC_a$  than the same soil with a low salt content;
- 3) Clay content – soils with a high clay content have a higher EMI/ $EC_a$  than sandy soils due to:
  - a) high charge holding capacity of clay particles,
  - b) higher total porosity,
  - c) generally higher water holding capacity;
- 4) Bulk density – soils with a higher bulk density generally have a higher EMI/ $EC_a$  than soils with a lower bulk density.