CROP TREATMENT COMPATIBILITY

CROSS REFERENCE TO RELATED APPLICATIONS (CONTINUATION-IN-PART)

This application claims priority and is a continuation-in-part to the co-pending U.S. patent application Ser. No. 12/911,046, entitled "Wide-area Agricultural Monitoring and Prediction," by Robert Lindores, et al., with filing date Oct. 25, 2010, and assigned to the assignee of the present patent application.

CROSS REFERENCE TO RELATED U.S. APPLICATIONS

This Application is related to U.S. patent application Ser. No. 13/280,298 by Robert Lindores, filed on Oct. 24, 2011, entitled "WIDE-AREA AGRICULTURAL MONITORING AND PREDICTION," and assigned to the assignee of the present patent application.

This Application is related to U.S. patent application Ser. No. 13/280,306 by Robert Lindores et al., filed on Oct. 24, 2011, entitled "EXCHANGING WATER ALLOCATION CREDITS," and assigned to the assignee of the present patent application.

This Application is related to U.S. patent application Ser. No. 13/280,312 by Robert Lindores., filed on Oct. 24, 2011, entitled "CROP CHARACTERISTIC ESTIMATION," and assigned to the assignee of the present patent application.

This Application is related to U.S. patent application Ser. No. 13/280,315 by Robert Lindores, filed on Oct. 24, 2011, entitled "WATER EROSION MANAGEMENT INCORPORATING TOPOGRAPHY, SOIL TYPE, AND WEATHER STATISTICS," and assigned to the assignee of the present patent application.

BACKGROUND

A modern crop farm may be thought of as a complex biochemical factory optimized to produce corn, wheat, soybeans or countless other products, as efficiently as possible. The days of planting in spring and waiting until fall harvest to assess results are long gone. Instead, today's best farmers try to use all available data to monitor and promote plant growth throughout a growing season. Farmers influence their crops through the application of fertilizers, growth regulators, harvest aids, fungicides, herbicides and pesticides. Precise crop monitoring—to help decide quantity, location and timing of field applications—has a profound effect on cost, crop yield and pollution. Normalized difference vegetative index (NDVI) is an example of a popular crop metric.

NDVI is based on differences in optical reflectivity of plants and dirt at different wavelengths. Dirt reflects more visible (VIS) red light than near-infrared (NIR) light, while plants reflect more NIR than VIS. Chlorophyll in plants is a strong absorber of visible red light; hence, plants' characteristic green color.

$$NVDI = \frac{r_{NIR} - r_{VIS}}{r_{NIR} + r_{VIS}},$$

where r is reflectivity measured at the wavelength indicated by the subscript. Typically, NIR is around 770 nm while VIS is around 660 nm. In various agricultural applications, NDVI correlates well with biomass, plant height, nitrogen content or frost damage.

Farmers use NDVI measurements to decide when and how much fertilizer to apply. Early in a growing season it may be hard to gauge how much fertilizer plants will need over the course of their growth. Too late in the season, the opportunity to supply missing nutrients may be lost. Thus the more measurements are available during a season, the better.

A crop's yield potential is the best yield obtainable for a particular plant type in a particular field and climate. Farmers often apply a high dose of fertilizer, e.g., nitrogen, to a small part of a field, the so-called "N-rich strip". This area has enough nitrogen to ensure that nitrogen deficiency does not retard plant growth. NDVI measurements on plants in other parts of the field are compared with those from the N-rich strip to see if more nitrogen is needed to help the field keep up with the strip.

The consequences of applying either too much or too little nitrogen to a field can be severe. With too little nitrogen the crop may not achieve its potential and profit may be left "on the table." Too much nitrogen, on the other hand, wastes money and may cause unnecessary pollution during rain run-off. Given imperfect information, farmers tend to over apply fertilizer to avoid the risk of an underperforming crop. Thus, more precise and accurate plant growth measurements save farmers money and prevent pollution by reducing the need for over application.

NDVI measurements may be obtained from various sensor platforms, each with inherent strengths and weaknesses. Aerial imaging such as satellite or atmospheric imaging can quickly generate NDVI maps that cover wide areas. However, satellites depend on the sun to illuminate their subjects and the sun is rarely, if ever, directly overhead a field when a satellite acquires an image. Satellite imagery is also affected by atmospheric phenomena such as clouds and haze. These effects lead to an unknown bias or offset in NDVI readings obtained by satellites or airplanes. Relative measurements within an image are useful, but comparisons between images, especially those taken under different conditions or at different times, may not be meaningful.

Local NDVI measurements may be obtained with ground based systems such as the Trimble Navigation "GreenSeeker". A GreenSeeker is an active sensor system that has its own light source that is scanned approximately one meter away from plant canopy. The light source is modulated to eliminate interference from ambient light. Visible and near-infrared reflectivity are measured from illumination that is scanned over a field. Ground-based sensors like the GreenSeeker can be mounted on tractors, spray booms or center-pivot irrigation booms to scan an entire field. (GreenSeekers and other ground-based sensors may also be hand-held and, optionally, used with portable positioning and data collection devices such as laptop computers, portable digital assistants, smart phones or dedicated data controllers.) Active, ground-based sensors provide absolute measurements that may be compared with other measurements obtained at different times, day or night. It does take time, however, to scan the sensors over fields of interest.

BRIEF DESCRIPTION OF THE DRAWINGS

Unless noted, the drawings referred to in this brief description of drawings should be understood as not being drawn to scale.

FIG. **1** shows a schematic map of nine farm fields with management zones, according to various embodiments.

FIG. **2** shows one of the fields of FIG. **1** in greater detail, according to various embodiments.