Using Space Technology to Verify Water Use

The Department of Water Affairs and Forestry can now literally with the click of a computer button access information about South African irrigators. Johan Wentzel and Julian Conrad** tell the story.*

A 1998 LANDSAT satellite image on which the pivots can be seen. The farm boundaries are shown in yellow.

The National Water Act of 1998 states that water rights that were exercised in October 1998 would be regarded as lawful use. This implies that an irrigator can carry on with their activities unless there is reason to believe that the resource is over allocated. In that instance, the Department of Water Affairs and Forestry will implement a process of Compulsory Licensing. This is a process that is carried out in conjunction with the irrigators and will not be discussed further in this article. If a user wants to expand their existing irrigation activities, which requires increased water usage, they must apply for a license to do so.

In order to assess the water use situation and to quantify the amount of water actually used, a process was initiated where all water users were required to **register** their use. This information is required to assess the current use of the water resource and will also be used for billing purposes. This process is not the same as the **licensing** process.

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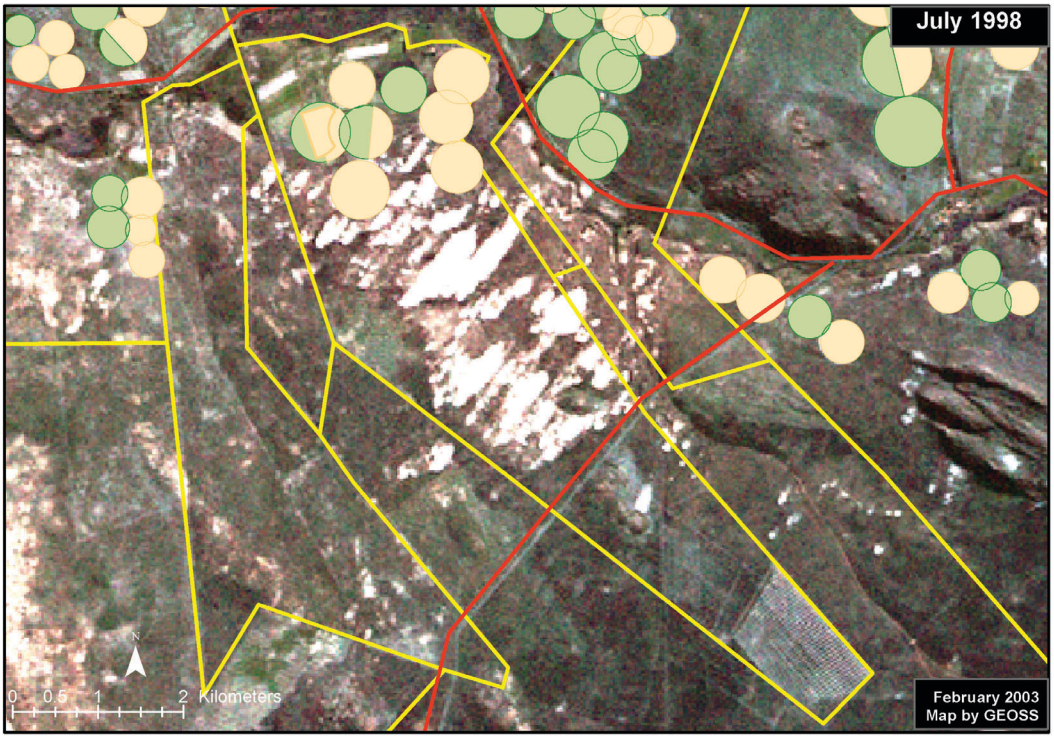


The green circles on this picture indicates the active circles and the white ones the inactive circles. This image was captured in 1998 and reflects the existing lawful users.

The registration information, which includes the user's personal details as well as their water use, is subsequently captured electronically and a database called WARMS, was created within the Department of Water Affairs and Forestry to manage this information.

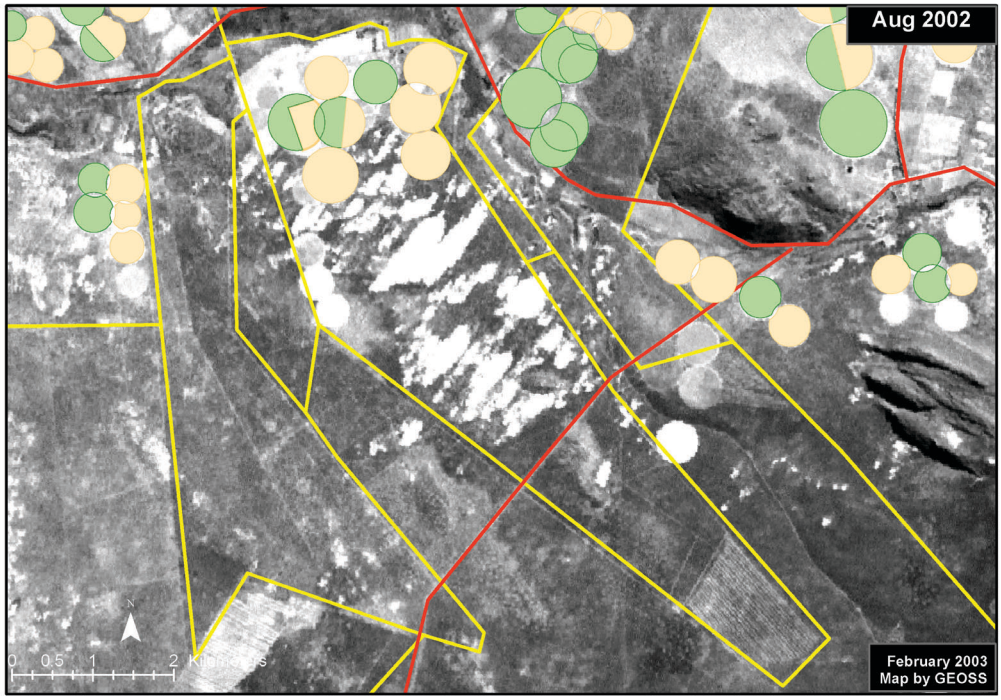
The next phase, which is happening now, is to verify this information. It is important that this validation be done on an independent platform. For practical reasons, it is not possible for officials to visit every user to verify their use.

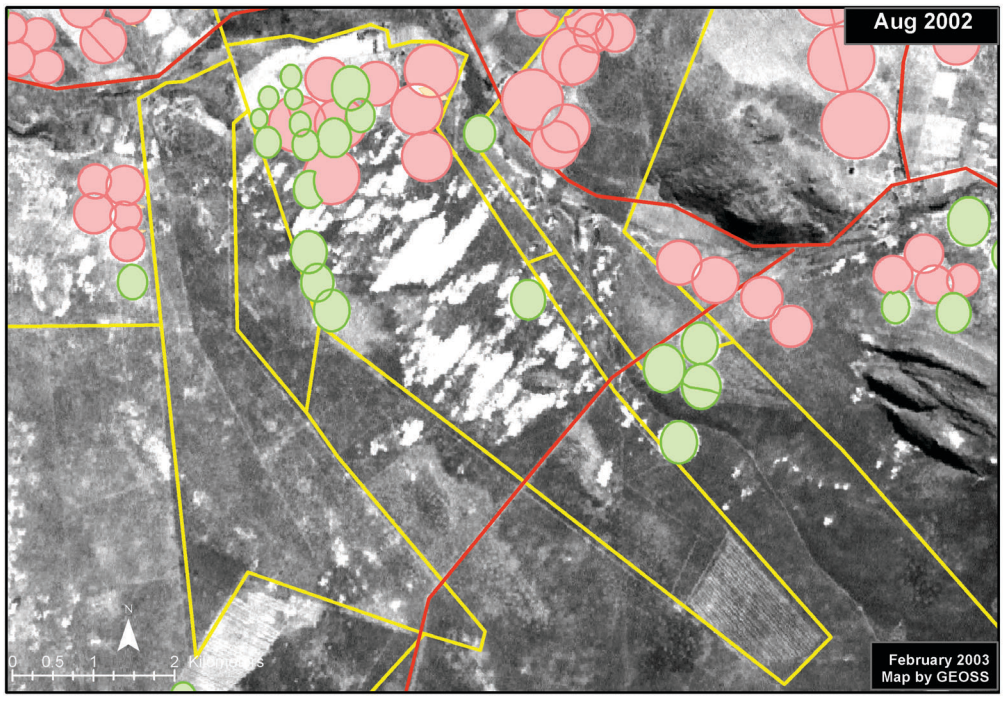
The most cost-effective way this can be done is with the aid of satellite images which have a high enough resolution so that centre-pivots can be identified with a fair degree of accuracy. There are two main sources of satellite images namely SPOT and LANDSAT. SPOT images have a higher resolution, but are very expensive and will only be utilised where very detailed information is required. The Department is currently using LANDSAT images for the verification process. The first LANDSAT satellite was launched in 1972 and the most recent, LANDSAT 7, was launched on April, 1999. The earlier satellites did not have a very good resolution, but from about 1984, the resolution of the satellite images improved to the extent that the information can be utilised for the verification process. The resolution with LANDSAT 7, for instance is 30 m (multi-spectral) and 15 m (panchromatic). Satellite images consist of multi-spectral bands, where a band is a slice of wavelengths from the electromagnetic spectrum. All objects that reflect green light for instance, will be captured in one band. (the colour *per se* is not captured, only the frequency). These spectral bands can then be manipulated electronically to highlight certain features on the earth's surface, such as centre-pivots.

The information from the WARMS database was linked to the national farm coverage of the Department of Land Affairs. The picture on p..... illustrates farm boundaries superimposed on a LANDSAT 7 image.

It is now possible to display this information on a computer. If one "clicks" on a particular farm, it is possible to see immediately who the owner is and look at their registration details. The actual pivots are captured and the area of the pivots calculated. By comparing the area with crops that are registered, it is possible to calculate a water use per centre-pivot. This can be compared to the value that was registered. The picture below shows a 1998 satellite image and superimposed on that the pivots that were electronically captured.

In order to establish expansion that has taken place since 1998, the latest satellite images were obtained and put through the same process.





A comparative view (1998 irrigation circles in red and post-1998 irrigation circles in green)

The picture below illustrates the differences. The circles coloured in red also appeared on the 1998 satellite images and the circles coloured green have been developed since 1998. With a "click" of a button the details of a farmer where expansion has taken place, can be accessed and this information captured separately. This will then be followed up and if there is no justification for this expansion, the irrigator will be requested to stop his activities immediately or face prosecution.

This is the most cost-effective way to verify use and to keep track of developments taking place. The LANDSAT satellite takes the same picture every sixteen days, which implies that this approach can also be used in future to ensure that users don't exceed their allocations. For further information, please do not hesitate to contact the authors.