GNSS for Ethiopia's Sustainable Develop

by Hugh Anderson and Jacques Malaprade

The River Nile has sustained life in North Africa for millennia, during which time Egypt has successfully tapped into this resource. But in the area of the headwaters of the Blue Nile, Ethiopia has lacked the infrastructure to harness the river's potential. In order to redress this imbalance the Ministry of Water and Energy for the Republic of Ethiopia commissioned a feasibility study for 800 km² (198,000 acs) of net irrigation development in three schemes, which required a total study or search area of 1,700 km² (420,000 acs)in Ethiopia's Nile basin. The project was funded by the World Bank and is being undertaken by UK based consultancy company Halcrow, who mapped the river catchment areas of Megech, Upper Beles and Negeso using Leica Geosystems GNSS equipment and stereo photogrammetry from satellite imagery.

The work areas were mostly in beautiful mountain landscapes, with the largest of the three schemes in the Upper Beles, west of Lake Tana, where the team could feel the temperature rising as they descended down the winding road into the valley. Disease was also present in the form of malaria and parasites such as tapeworms and giardia, with the added possibility of snakebites and scorpion stings, which could be fatal. Access to the Upper Beles landscape of rolling hills and mountains provided another challenge as teams would walk some 25 km (16 mi) a day in temperatures up to 40 °C, with changes in altitude of some 600 m (2.000 ft). Accommodation in the bush was basic and primitive and the team soon realized they lacked many things we take for granted, such as electricity, clean running water, clean washing and toilet facilities.

In these conditions the last thing that the team wanted to think about was the reliability of their survey equipment and the Leica GPS1200 and Leica GPS900 instruments did not let them down. Traditionally, one would consider airborne LiDAR or aerial photogrammetry for a survey of such large size in the terrain and location of Ethiopia. However, this would have been costly and there was also the problem of getting permission to fly in Ethiopian airspace, complicated by administrative barriers and security risks.

Research on methods to survey vast inaccessible areas of the globe brought up the possible use of 0.5 m (19.7 in) resolution satellite imagery using stereo-photogrammetric processing, which could be used to survey ground levels to under 0.32 m (12.6 in) accuracy in height. This would mean changing the survey methodology to make use of Ground Control Points in selected areas of the imagery to accurately

Halcrow and the Nile basin project

With over 6,000 employees operating worldwide through a network of 98 offices, Halcrow is a global multi-disciplinary consultancy which delivers services for developing infrastructure and buildings, topographical mapping, in shore hydrography, Geographical Information Systems (GIS) analysis, and software support.

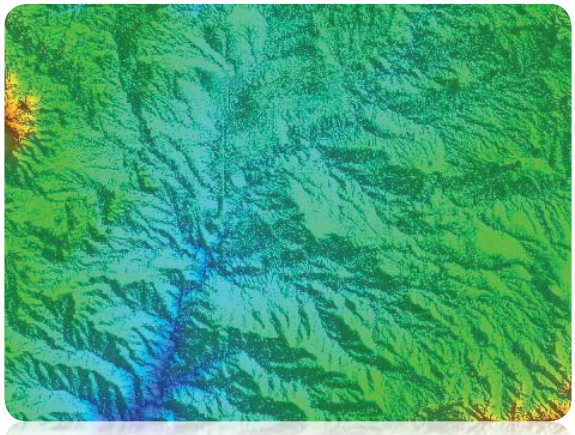
Halcrow's involvement in the Nile basin project is the latest in a series of significant commissions recently undertaken in Ethiopia, including the Awash basin flood control and catchment management project as well as the Rift Valley lakes basin development plan.

More information: http://www.halcrow.com

resect the satellite positions. After a trial area was processed and the results compared with previously surveyed ground heights, a decision was made to purchase imagery for all the areas.

As far as the team were aware, this is the first time that an area of this size had been surveyed using satellite imagery to such a high accuracy. Previous surveys at similar accuracies were for only one image pair, whereas the Beles survey contained 30 image pairs.

The decision was made to complete the survey with terrestrial methods using long range GPS-RTK. Leica GPS1200 and Leica GPS900 instruments were used for geodetic control surveys, tying in to the IGS network and local country datums and map projections to provide photogrammetric ground control points for the stereo satellite imagery. The Leica Geosystems GNSS instruments were chosen, as they were rugged enough to withstand the tough physical environment. At the same time they provided the team with peace of mind about reliability and accuracy of data, critical aspects when working in such demanding conditions. The Leica Geosystems instruments were also easy and quick to learn which helped when training the local Ethiopian team.



Satellite image used as reference for GPS surveying.

As a result of this project the Halcrow team have learned new skills with respect to photogrammetric mapping from satellite imagery, the Ethiopian surveyors have learnt new surveying skills with Leica GNSS and the local people in Ethiopia will benefit from the design of irrigation projects that could feed future generations.

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