A Far-Southern Comet Survey

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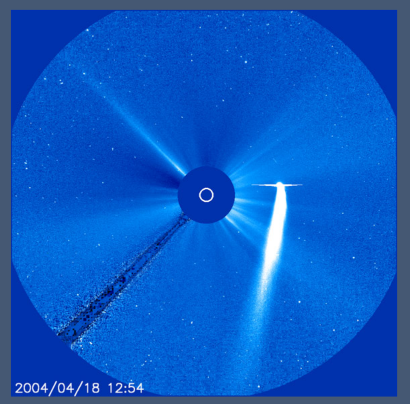
Motivations

Comets have brought organic molecules that are used in processes of life and are the source of the biosphere of Earth, allowing life to emerge as quickly as possible (Deslemme 1999).

Comets pose a risk of impact with Earth and have larger kinetic energies per unit mass than asteroids. Comets contribute a significant share of the impact hazard for Earth (Chapman & Morrison 1994).

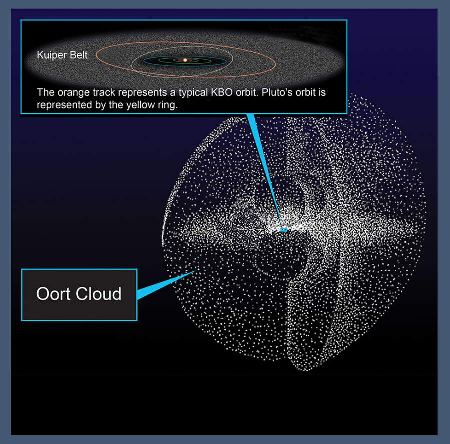
Comets are discovered by both amateur and professional astronomers alike.

The *Solar and Heliospheric Observatory* (SOHO), which has the main purpose of observing the Sun for space weather predictions, has discovered over 3,000 comets since its launch in 1995. SOHO, however, does not have the ability to observe comets that do not get extremely close to the Sun.



The *Panoramic Survey Telescope and Rapid Response System* (Pan-STARRS), is currently the largest sky survey in the world, with the primary goal to detect Near-Earth-Objects (NEOs) that could be potentially hazardous to Earth. However, the survey can only see the sky north of declination -47.5˚.

Long-period comets exist in large numbers in the Oort Cloud and are randomly oriented on the celestial sphere (de Prater & Lissauer 2011). This makes them equally as likely to be seen anywhere in the night sky. It is therefore possible to contribute to the search for comets by looking anywhere others are not.
As Pan-STARRS cannot see the far south and comets are distributed over the entire sky, it is reasonable to contribute to the comet search by surveying the far-southern sky.



Methodology

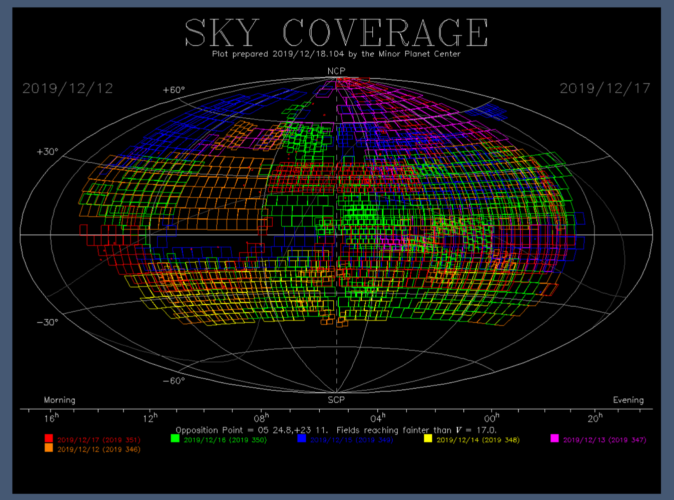
The most convenient access to telescopes in the southern hemisphere is through the iTelescope network, a not-for-profit organization that allows public access to a series of telescopes via the internet.

The most efficient telescope on the network was determined by comparing three properties:

- area of the sky covered per image
- limiting magnitude
- cost per imaging time

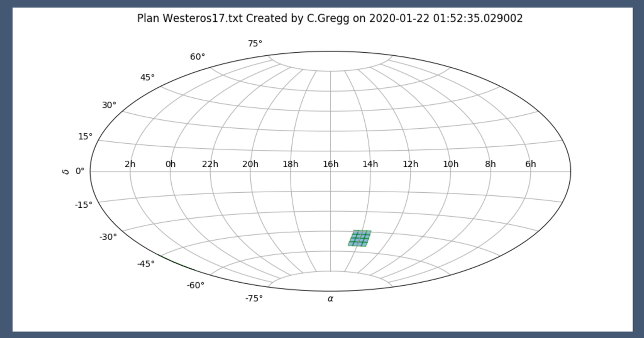
The most efficient imaging technique was with Telescope-9 (T9) in Siding Springs Observatory, Australia, which costed the least per area of the sky covered per image but still detecting sources to an apparent magnitude of 17 with a signal-to-noise ratio (SNR) of 5.

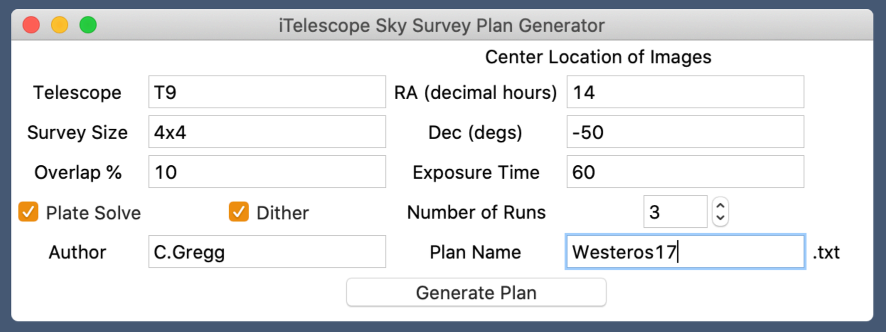
This is a 127mm refractor, with a field-of-view of 188.91" by 188.91", totaling about 9.8 squared degrees of the sky per image.

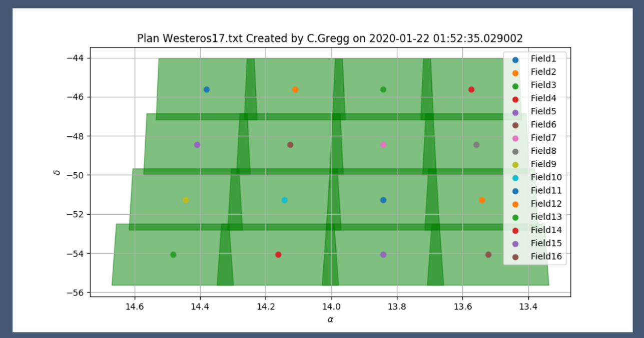


Each night's survey will consist of a 4-by-4 grid of images with 60 second exposures, repeated 3 times on the same area of the sky, to look for moving sources. The Sky Coverage Plots tool, by the Minor Planet Center is used to ensure the area of the sky the images are taken do not overlap with other capable sky surveys within 5 days.

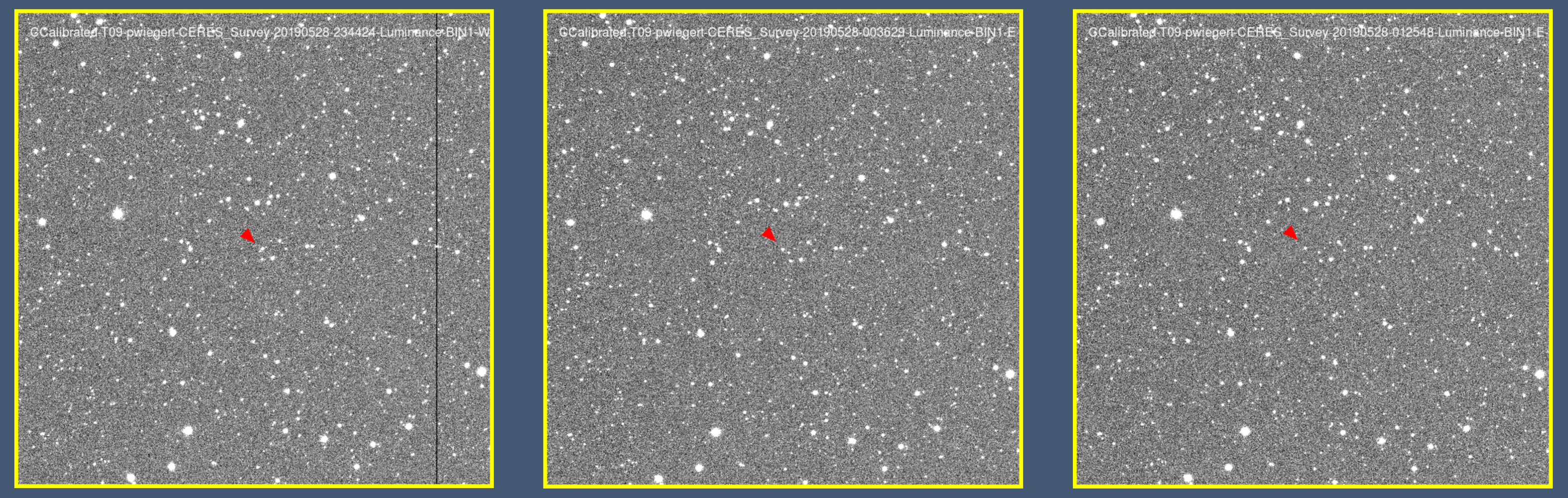
A PYTHON code was created to easily create a text file that iTelescope can read and tell the telescope how to take the images needed.





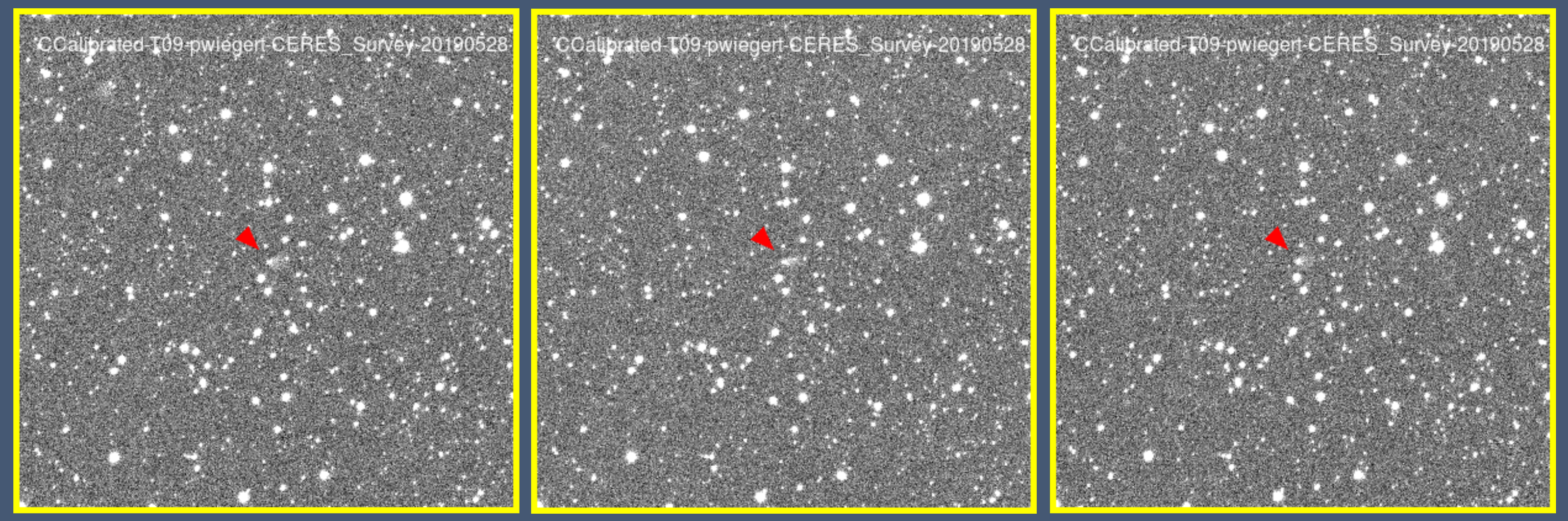


Each field of 3 images is run through a pre-existing PYTHON program created by my supervisor, Dr. Paul Wiegert (Wiegert et al., 2007). Possible moving sources are saved as candidates and are individually looked at by the user to determine if they are real.



Results and Discussion

The first 'protoype' survey was aimed at Ceres to ensure moving sources were being identified and allowed adjustments to be made to the detection program. This gave ~84% detection rate with the expected asteroids in this area of the sky. The most significant result was the following:



This was reported to the MPC as an unknown comet and proved the capabilities of the far-southern survey.

Since then, 30 survey image sets have been taken in the southern sky.

No more comets have been found.

References

Chapman, C. R., & Morrison, D. (1994).Impacts on the Earth by asteroids and comets:assessing the hazard. Nature, 367(6458), 33–40. doi: 10.1038/367033a0

Delsemme, A.H., 1999. Cometary Origin of the Biosphere. Icarus, vol. 146, pp. 313-325. doi:10.1006/icar.2000.6404

Wiegert, P., Balam, D., Moss, A., Veillet, C., Connors, M., & Shelton, I. (2007). Evidence for a Color Dependence n the Size Distribution of Main-Belt Asteroids. The Astronomical Journal, 133(4), 1609–1614. doi: 10.1086/512128

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