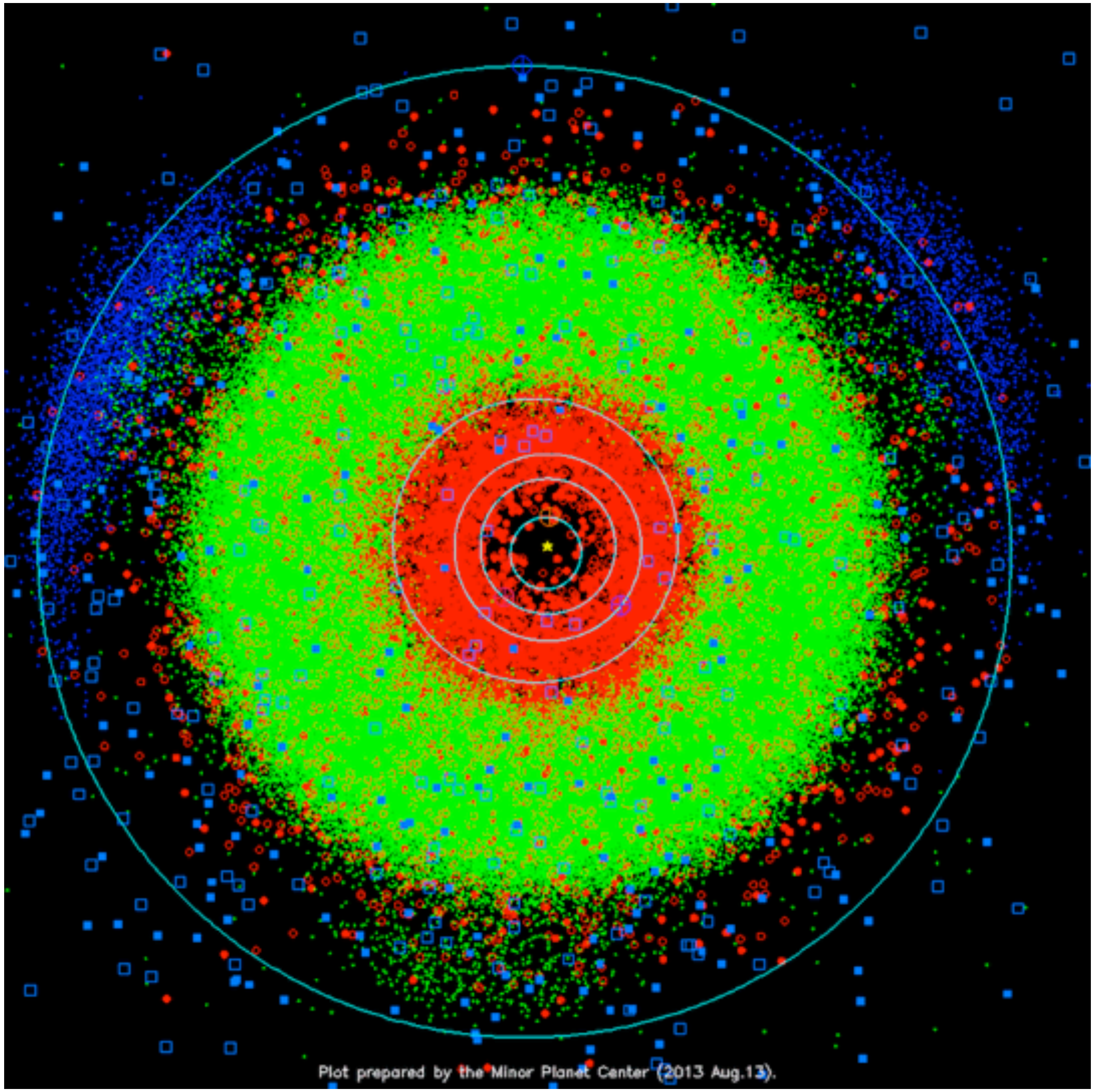
Solar System Science with a GWEM optical facility

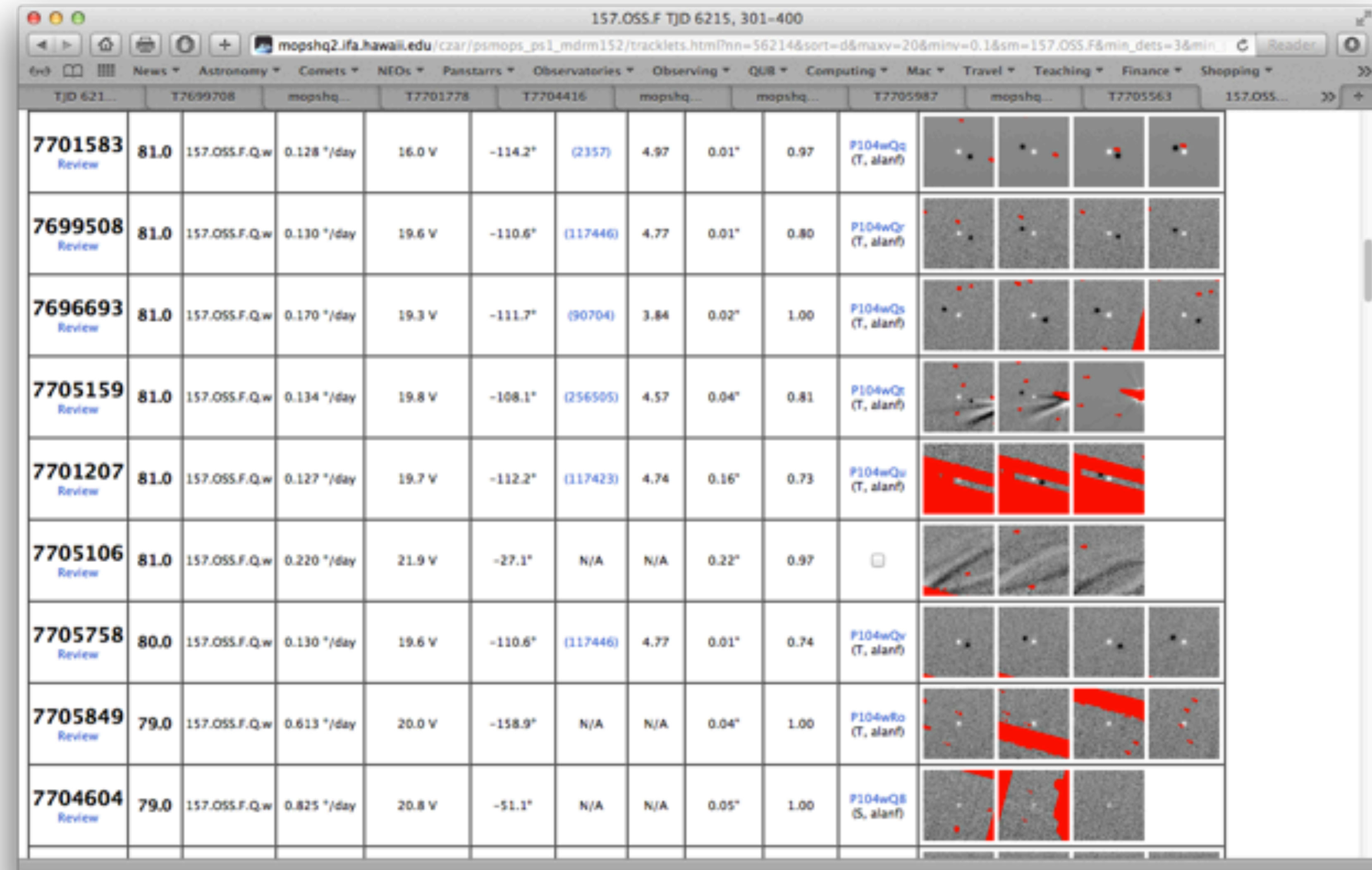
Alan Fitzsimmons, Queen's University Belfast

Assume:

- Solar-System is a driver for regular non-GWEM operations (cadence, depth).
- Current/planned Near-Earth Object surveys for 2017 timeframe are operational.
- ATLAS-like capabilities $V_{lim} \simeq 20$



Moving Object Processing System



MOPS developed for PS1 system, used by TALCS, WISE,ATLAS. (Denneau et al. 2013),

Takes transient detections, links them to produce "tracklets" of individual objects.

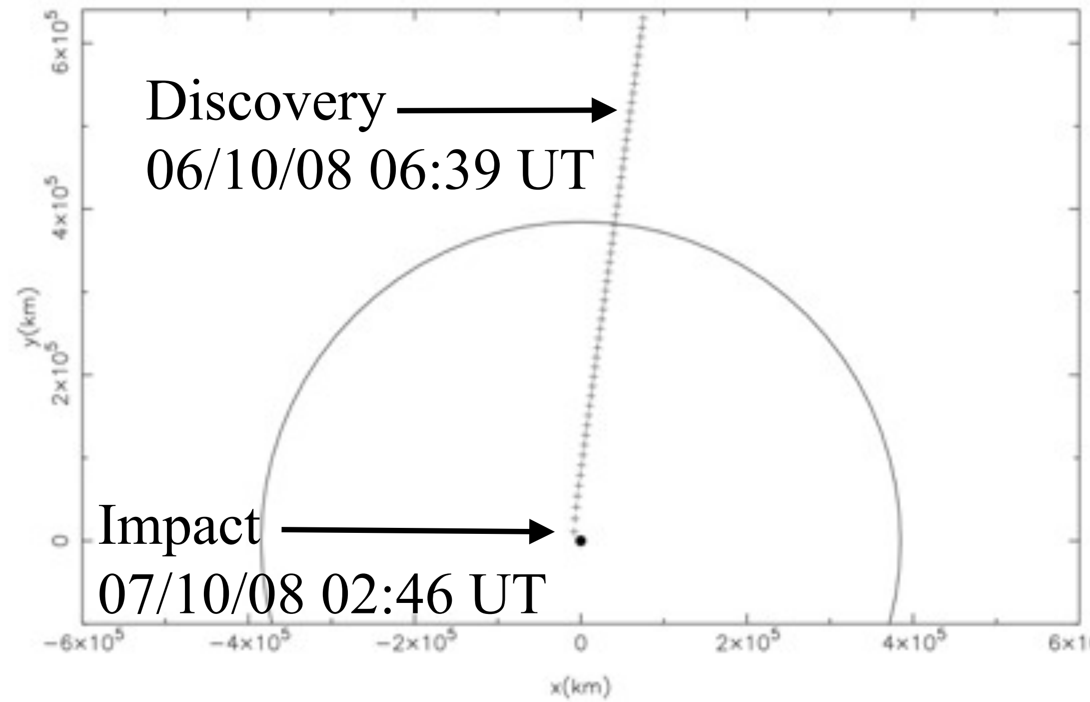
Automatic identification of known objects and estimation of detection efficiencies.

For unknowns estimates likely class of object and provides initial orbit determination.

1. Detection of Final-trajectory NEOs

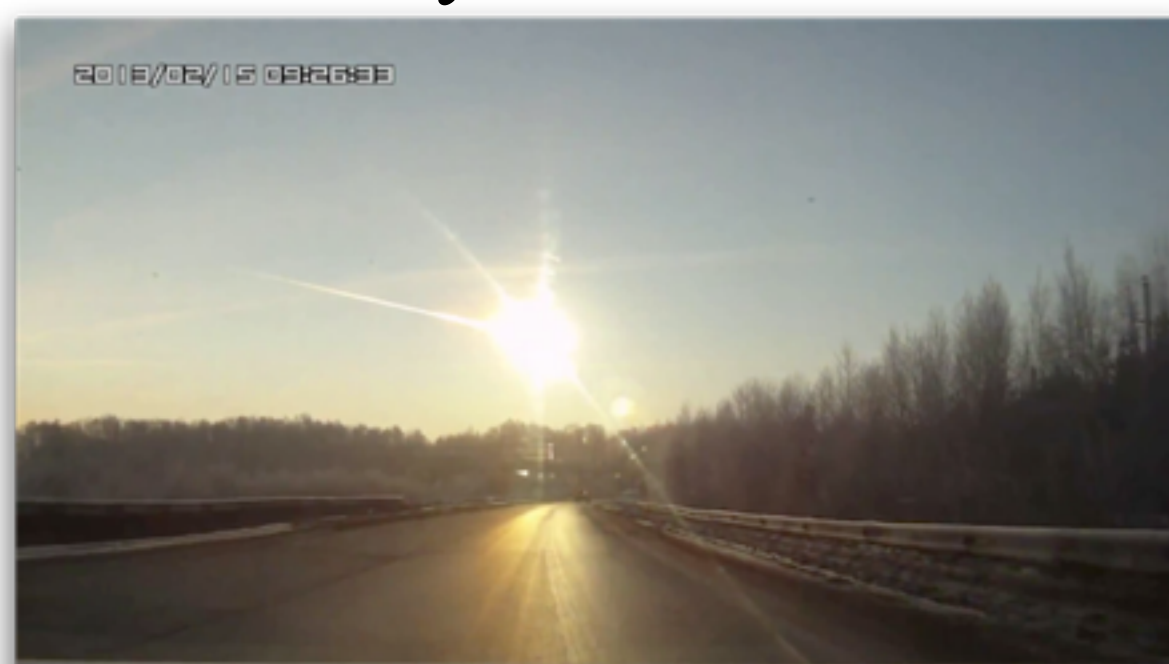
Carancas 2007

2008 TC3



Indonesia 2009

Chelyabinsk 2015



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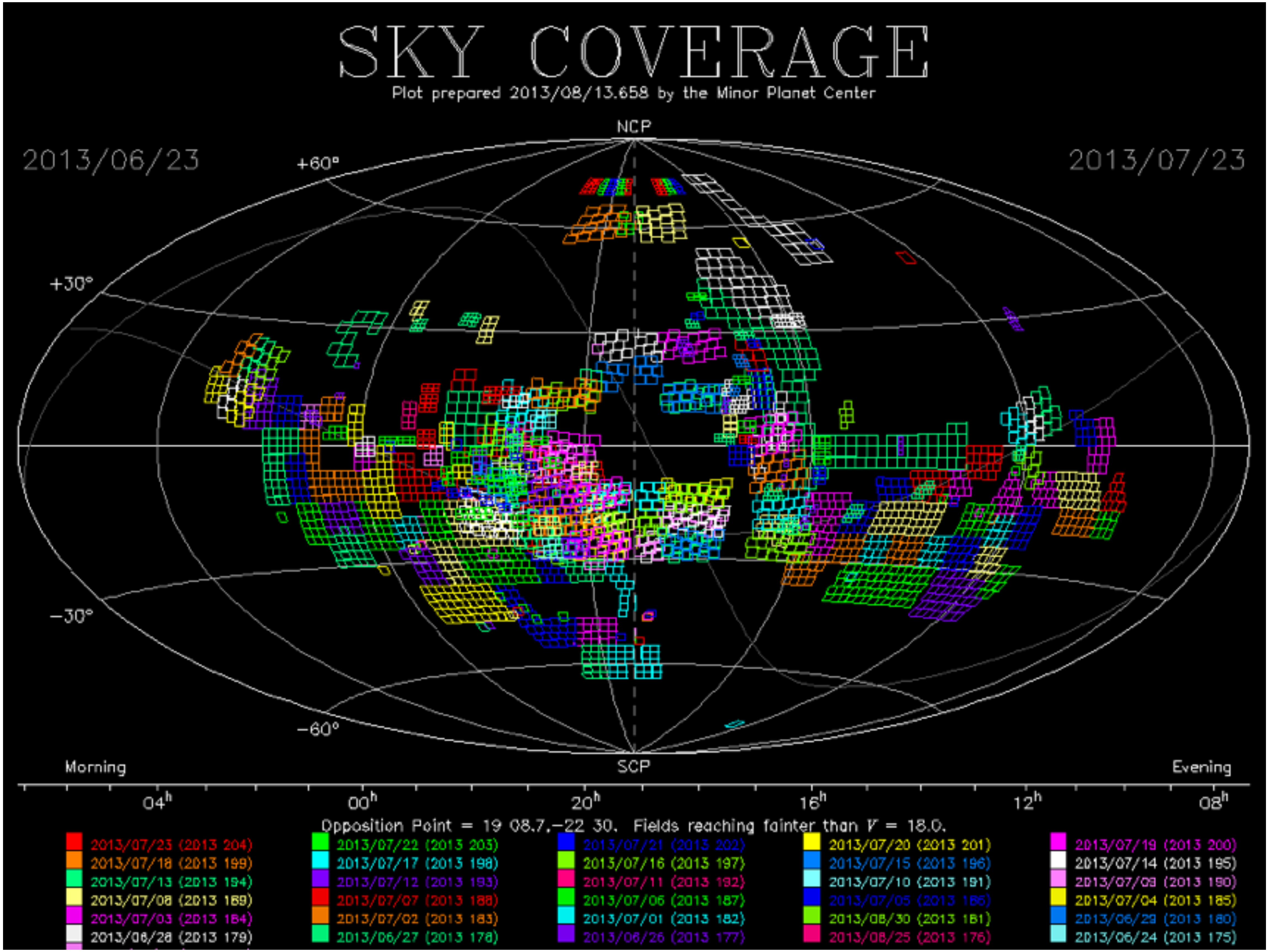

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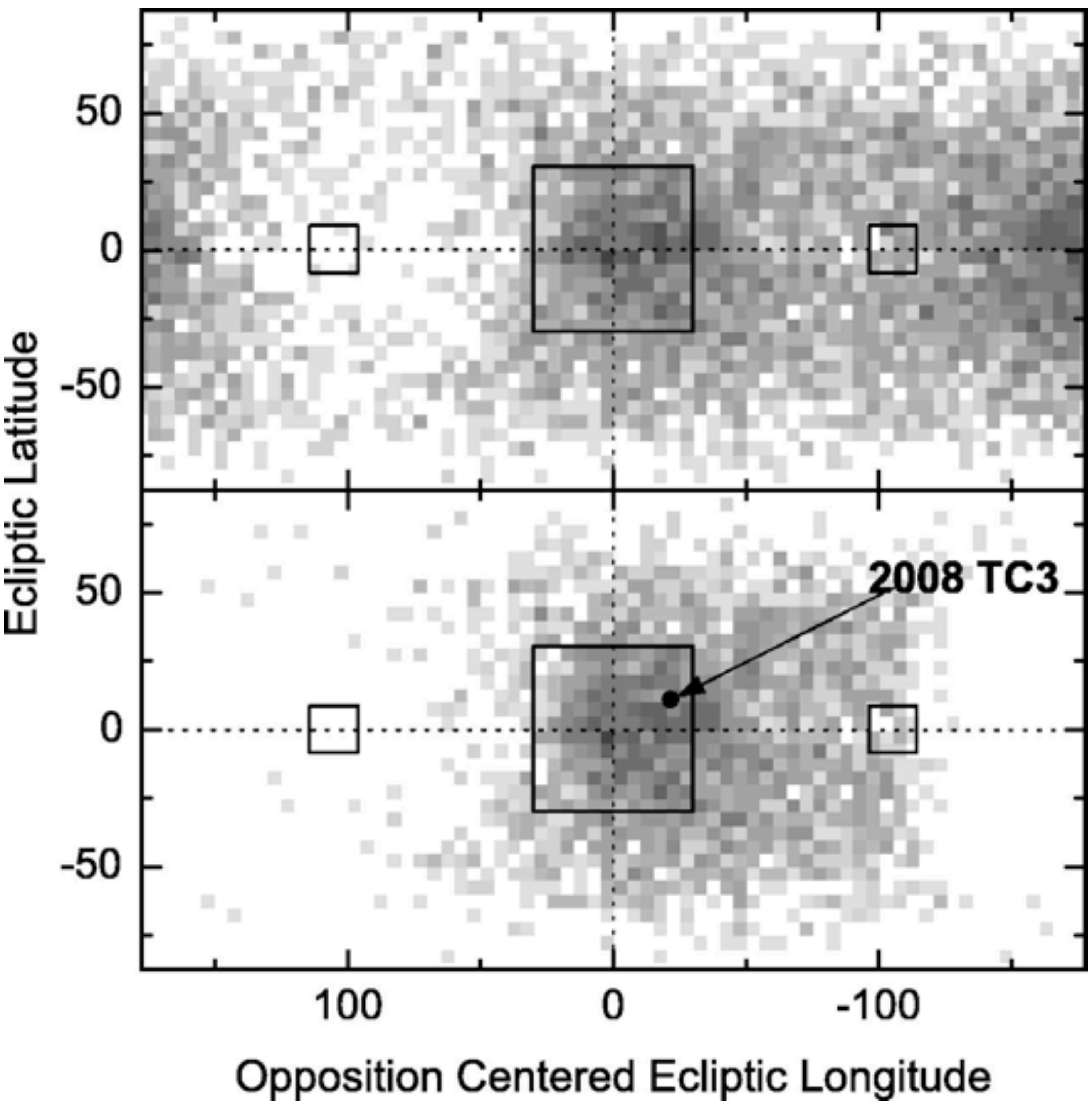


All-sky coverage is necessary to detect NEOs within ~1 Lunar Distance.

A UK GWEM facility would add longitude coverage to ATLAS, discovering ~1m-20m NEOs and allowing orbit refinement for new objects.

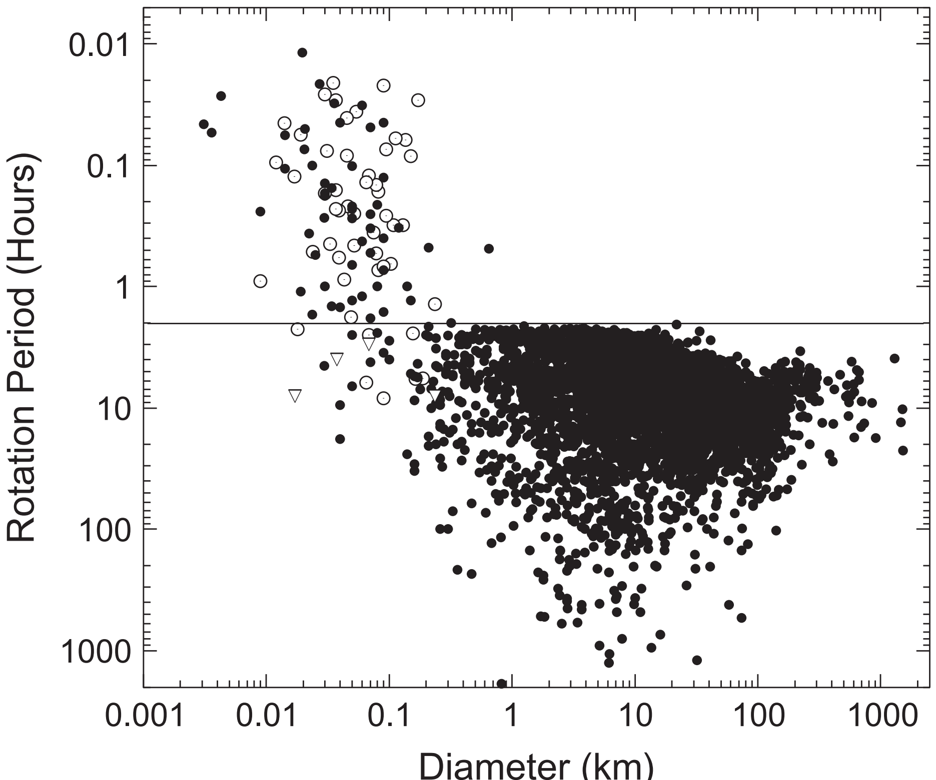
$V \simeq 20$ allows:

$D = 10m \leq 2$ days impact warning

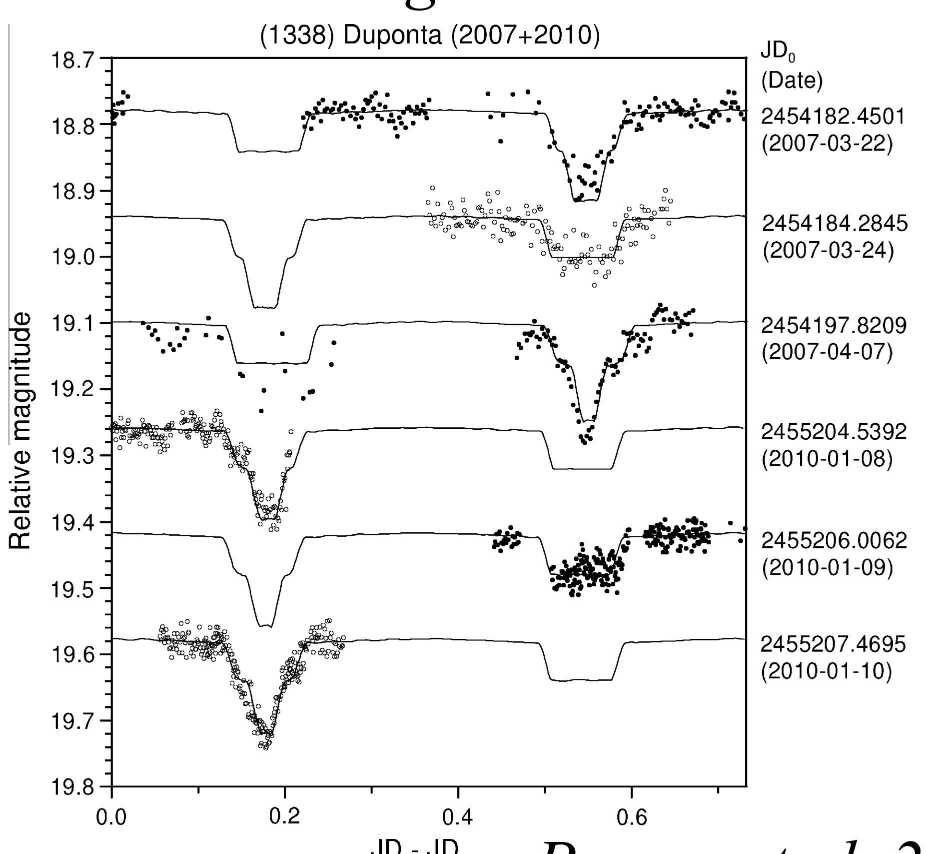
$D = 50m \leq 12$ days impact warning

Top: Simulated positions of objects 1 day from impact
Bottom: 3-m objects with V<22.7 (Veres et al. 2009)

2. Asteroid Lightcurves - Binaries, Spin-up and Collisions



Hergenrother et al. 2012



Pravec et al. 2012

~4500 asteroids with lightcurves to date.

Science to be done depends on cadence + sky coverage.

Requires near-ecliptic fields.

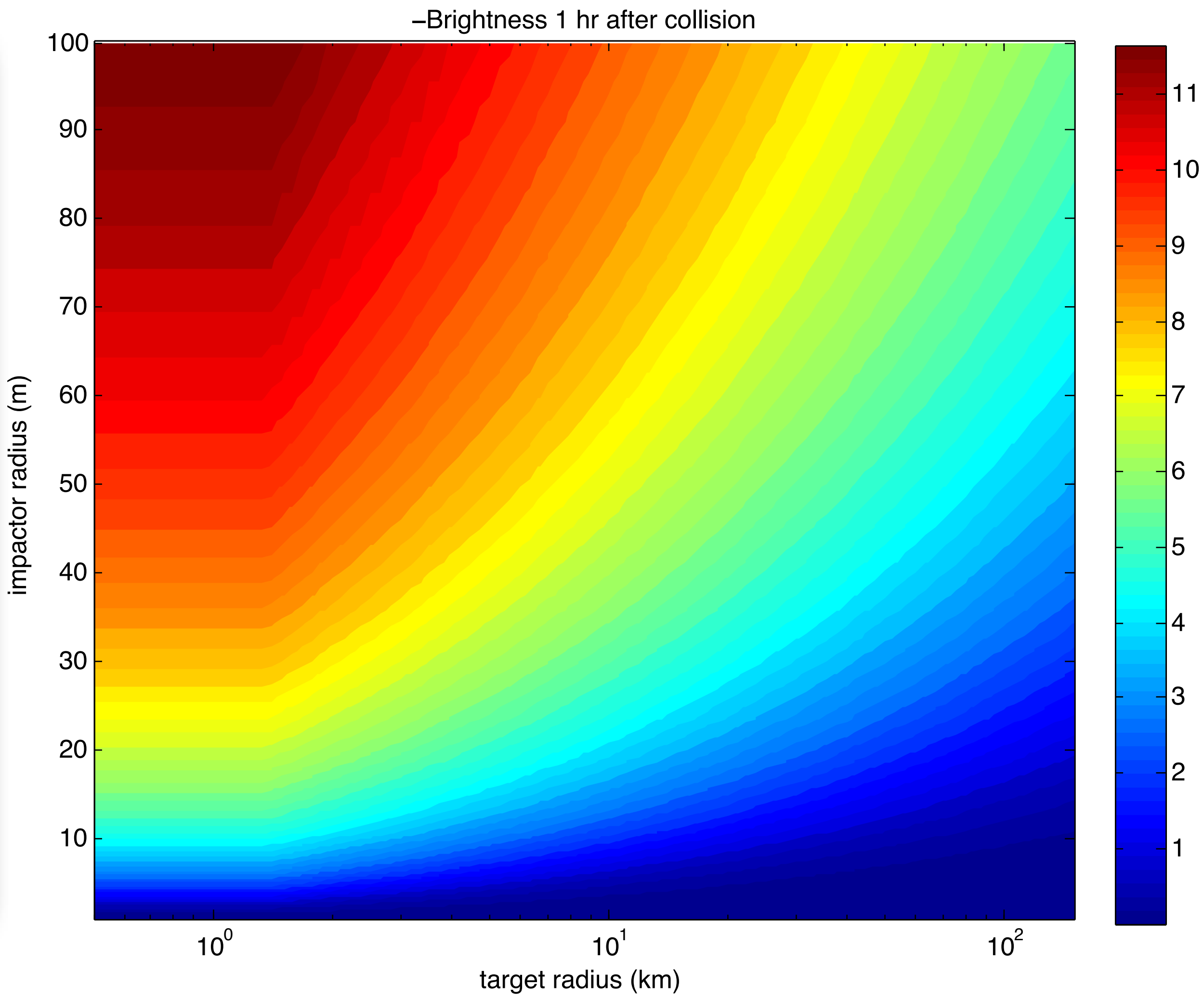
Lower cadence + all-sky gives sparse lightcurves on 10^4 - 10^5 asteroids (ATLAS).

Fast cadence + low coverage gives detailed lightcurves on ~10^3 asteroids.

2. Asteroid Lightcurves - Binaries, Spin-up and Collisions

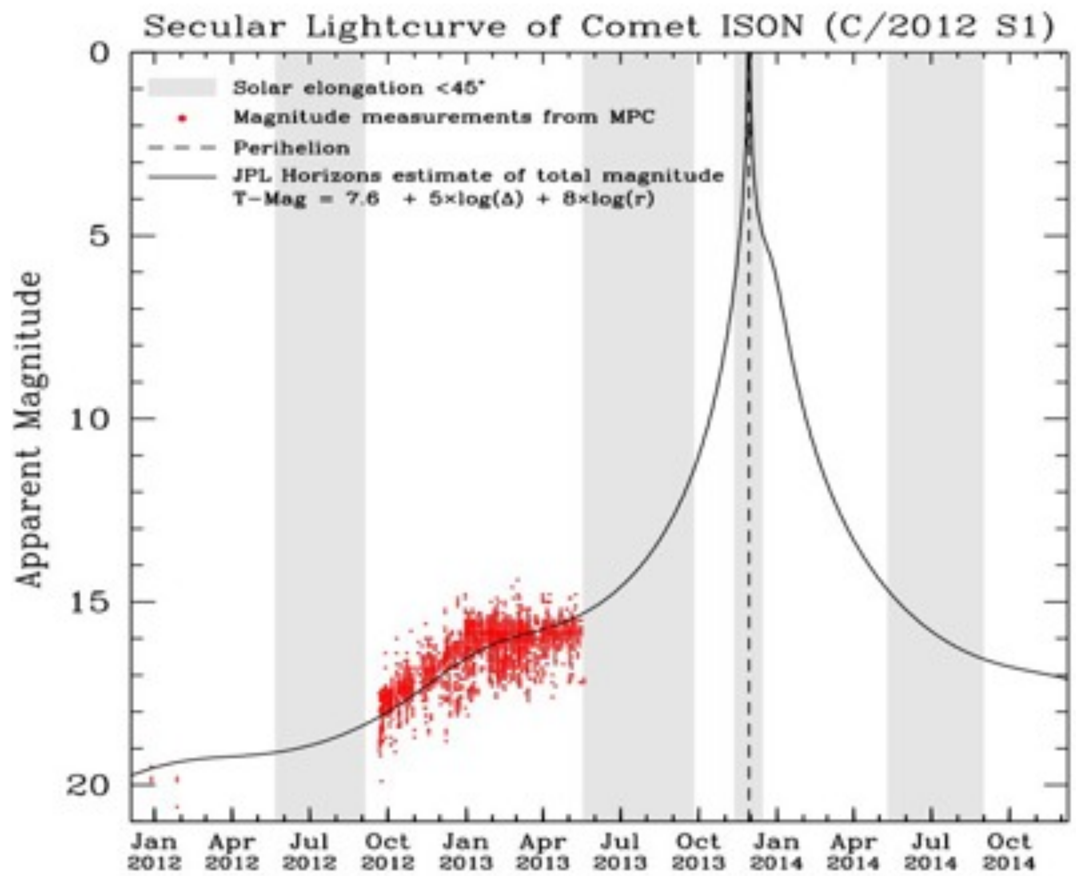
Larson et al. 2010

(596) Scheila ~1 week after collision.

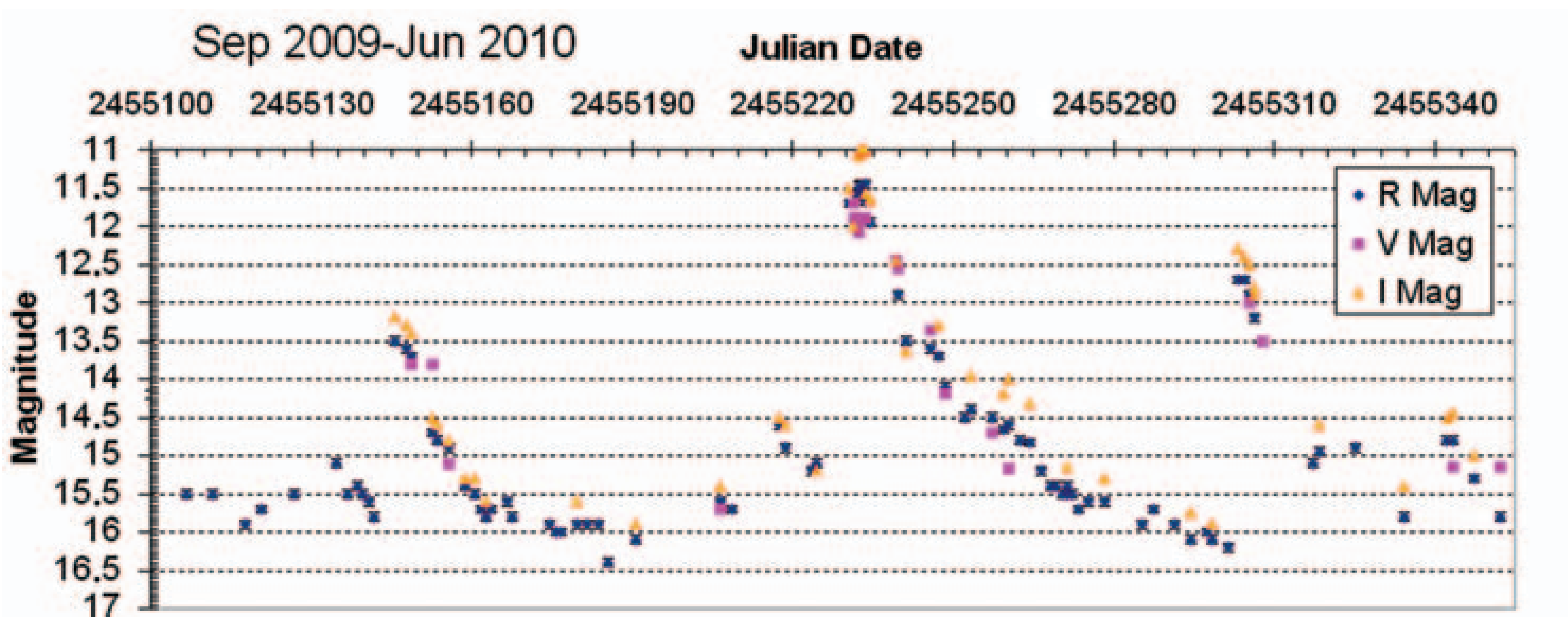


Predicted magnitude increase 1 hour after impact by small asteroid.

3. Comet Lightcurves - Lifetimes and Outbursts



Battams 2013 (http://sungrazer.nrl.navy.mil)



29P: Trigo-Rodriguez et al. 2010

> 30 comets/night

Accurate mass-loss estimates of active comets throughout the Solar System.

Possible ~daily monitoring around the orbit.

What fraction of comets suffer regular significant outbursts, and how do these correlate with orbit and evolution?

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Software already exists for moving object detection (MOPS), being optimised for ATLAS.

Possible science programmes include:

1. Discovery and tracking of cis-lunar and sub-lunar small NEOs.

2. Discovery of binary asteroids, YORP targets and collisions via lightcurve measurements of $>10^3 - 10^4$ asteroids.

3. Activity monitoring of $\sim 10^2$ comets, outburst fractions and accurate sublimation profiles.