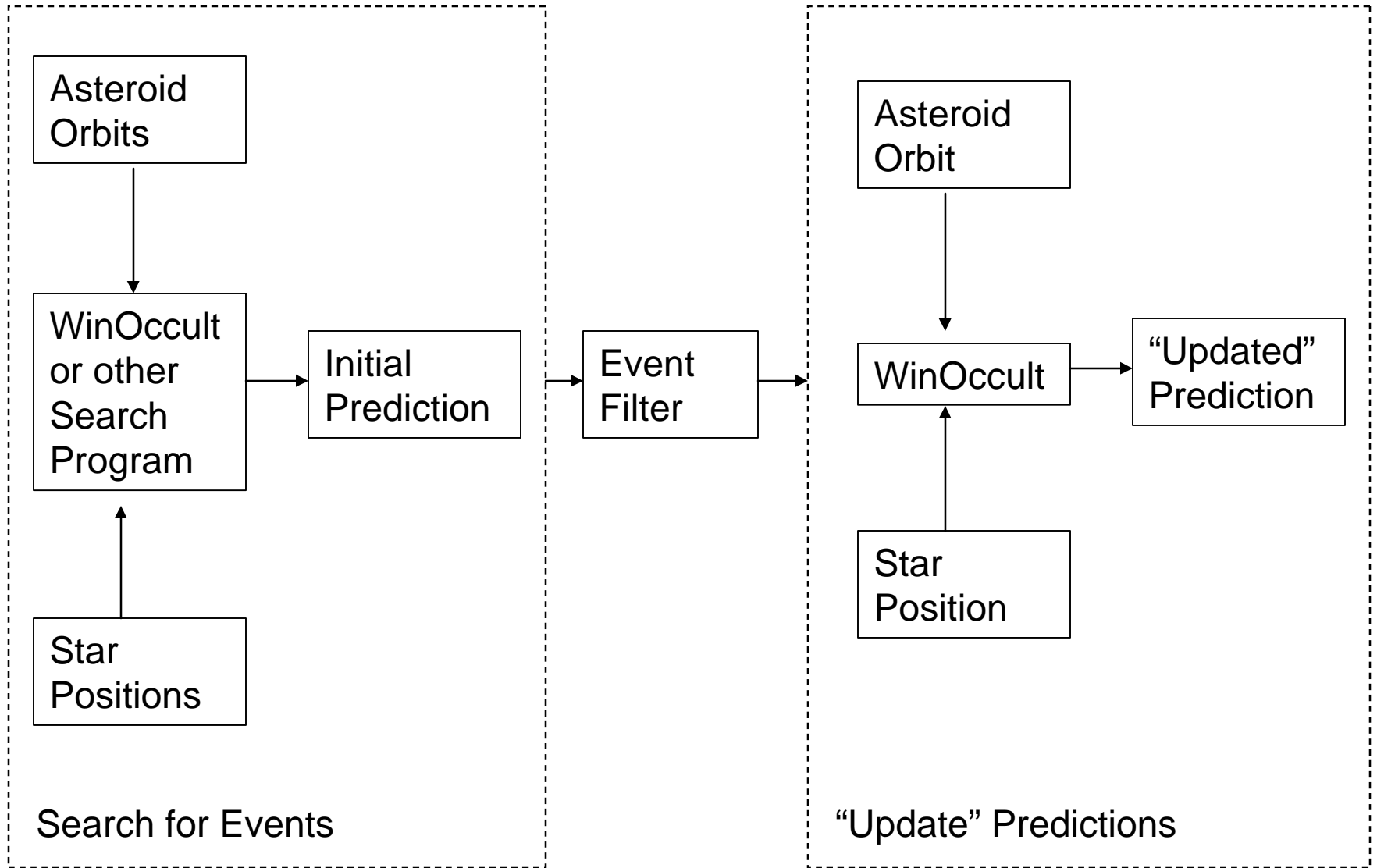


# Asteroid Occultation Prediction Process

# Asteroid Occultation Prediction Process Overview



# Searchers

- **Edwin Goffin**

- Asteroids: 40km or larger diameter plus some distant objects.
- Orbits: computed by Goffin
- Star Catalog: Compiled catalog primarily based on Tycho2 + TAC plus additional positional info from FK6, Hipparcos, and other source catalogs. Magnitude limit of about 12.
- Timing: 2005 search posted by Jun 2004
- Coverage: Worldwide

# Searchers

- **Scott Donnell / Derek Breit**

- Asteroids: 10km or larger
- Orbits: Recent astorb.dat
- Star Catalog: WinOccult Tycho2 (Tycho2 + Hipparcos + UCAC2). Mag limit of about 12.
- Timing: Searches 3 month window one or two months in advance.
- Coverage: Worldwide

# Searchers

- **Takashi Setoguchi**
  - Asteroids: probably 15km or larger
  - Orbits: Computed by Setoguchi
  - Star Catalog: Tycho2 + Hip + UCAC2
  - Uses his own search program
  - Timing: One month search window one month in advance.
  - Coverage: Japan

# Searchers

- Denis Denissenko
  - Asteroids: probably 15km minimum
  - Orbits: from astorb.dat
  - Star Catalog: Occult Tycho2 plus UCAC2 stars down to mag 13
  - Searches far into the future for spectacular events
  - Searches several months out for interesting events over Russia and other parts of the world.

# Event Filtering

- Goffin: Update all except Europe
- Donnell & Setoguchi
  - North America: all events that meet Dunham's Criteria
  - Japan: all events that meet Dunham's Criteria
  - Australia: "better" events that meet Dunham's Criteria
  - Other locations: only the really good events.

# Dunham's Criteria

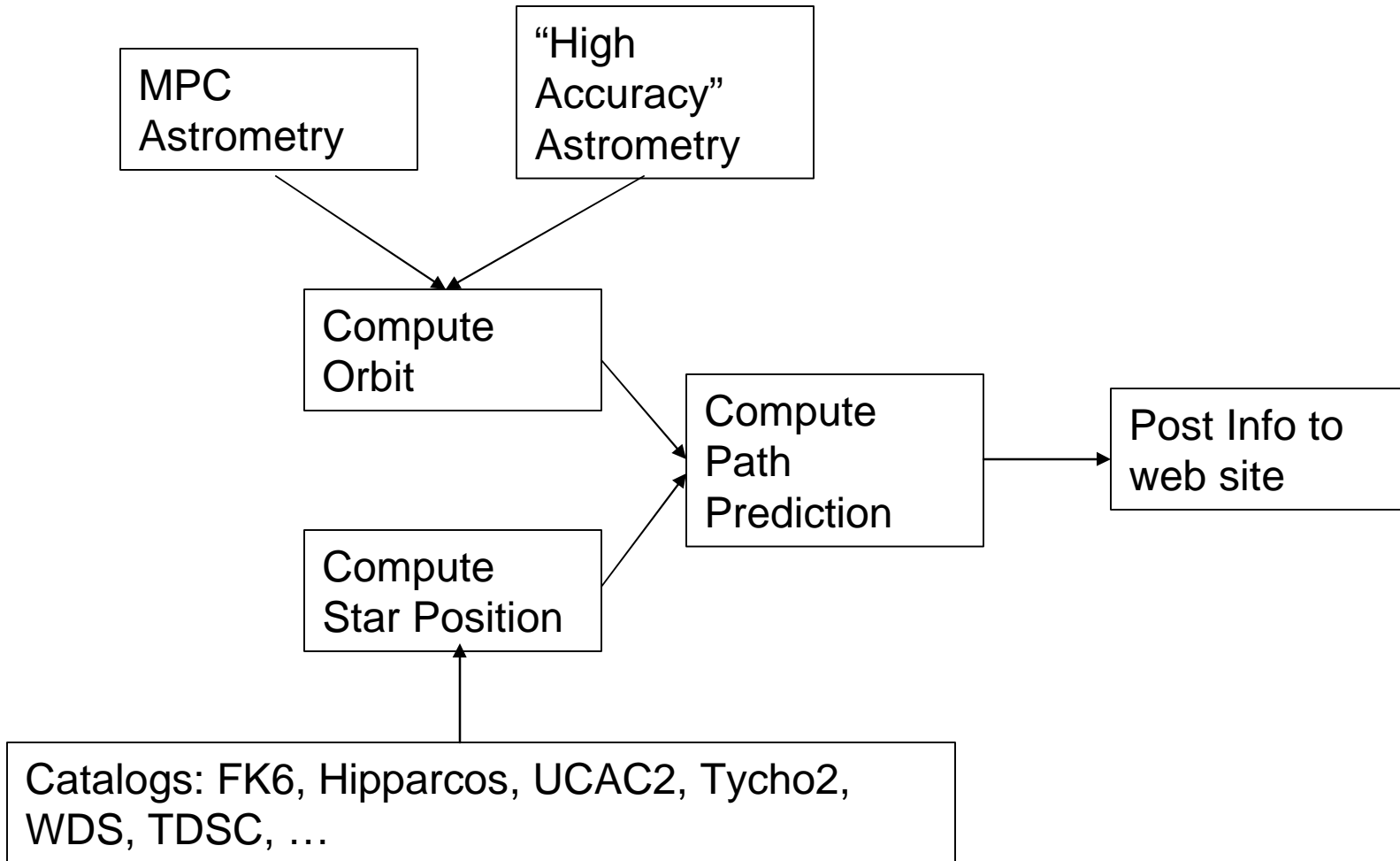
Star Magnitude Lower Limit	Star Magnitude Upper Limit	Asteroid Minimum Subtended Angle (mas)	Minimum Duration (sec)	Minimum Magnitude Drop	Maximum Asteroid Number
None	6.5	None <sup>1</sup>	0.33	0.5 <sup>2</sup>	None
6.5	8.5	10 <sup>1</sup>	0.33	0.5 <sup>2</sup>	2000 <sup>3</sup>
8.5	9.5	10 <sup>1</sup>	0.5	0.5 <sup>2</sup>	2000 <sup>3</sup>
9.5	10.5	20 <sup>1</sup>	0.5	0.5 <sup>2</sup>	2000 <sup>3</sup>
10.5	11.5	20 <sup>1</sup>	1.0	0.5 <sup>2</sup>	2000 <sup>3</sup>
11.5	12.5	40 <sup>1</sup>	1.0	0.5 <sup>2</sup>	2000 <sup>3</sup>

1. No minimum subtended angle when asteroid diameter greater than 200 km.
2. Minimum magnitude drop 0.2 for subtended angles greater than 60 mas.
3. 2060 Chiron and 5145 Pholus not filtered out.

# Update Timing

- First update approximately one month prior to the event
- Subsequent updates approximately one week prior to the event

# Update Process



# Computing Orbits

- Astrometry
  - All MPC data after 1900 (usually via AstDys)
  - All FASTT data (email 7 to 10 days before the event)
  - All other “High Accuracy” astrometry: Bill Owen/TMO, Gordon Garradd, Robert McNaught/Siding Springs, Manek/Ondrejov, Behrend/Geneva, Sposetti/Gnosca, Behrend/La Silla

# Computing Orbits

- Orbit fits computed with OrbFit software
  - freeware from <http://newton.dm.unipi.it/orbfit/>
  - Newest version is Unix only but source code is available for port to Windows
  - Supports weighting of astrometry via apriori RMS estimates
  - Computes a positional uncertainty statistic
  - Can include up to five asteroids as potential perturbers
  - Uses JPL 405 ephemeris

# Computing Orbits

- **Orbit Fit Computation**

- Let Orbitfit assign a default weight to all “normal” data (typically 1” apriori RMS for recent observations).
- Assign 0.12” to 0.35” apriori RMS to all “high accuracy” data.
- Include perturbations from all planets and the moon
- Include the following asteroids as potential perturbers: (1) Ceres, (2) Pallas, (4) Vesta, (10) Hygiea, (11) Parthenope
- Compute orbital elements for approximate central time of event
- Compute positional uncertainty for approximate central time of event

# Computing Star Position

- “Research” star positional info
  - Gather data from available catalogs
  - Look for problem areas: double stars, lack of proper motion estimate, unusually high uncertainties.
  - Be careful of proper motions in Hipparcos – only uses short time span of Hipparcos mission.
  - Use UCAC2 position whenever available – even Hipparcos stars
  - Double stars: look for existing orbit data or use individual positions from Hip or TDSC when available.
- Compute Star Position at time of event
  - Proper motion, parallax, radial velocity

# Compute Path Prediction

- WinOccult for path prediction
  - Input asteroid orbit in “user elements” file
  - Input star position as “one-off” star catalog position
  - Compute global view of path
  - Compute individual maps for areas with known observers
  - Compute lat/long path info

# Generate Prediction Output

- Event / Path Summary File
- Event HTML file for web
- Star Charts (via Guide)
- Detailed maps (via MapPoint)

# Post Info to Web

- Generate summary tables for future and past events
- Upload individual event files to web
- Upload summary tables to web

# Issues

- Double stars are time consuming
- Close encounters with perturbing asteroids in Orbit
- Better RMS/Weighting methodology

# Future Work

- Map base interface for website
- Continue to work on issues
- More “automation” => more productivity => post more events (geographic & time period & criteria)
- Interactive features for website
  - “monitored” events
  - Personalized event info