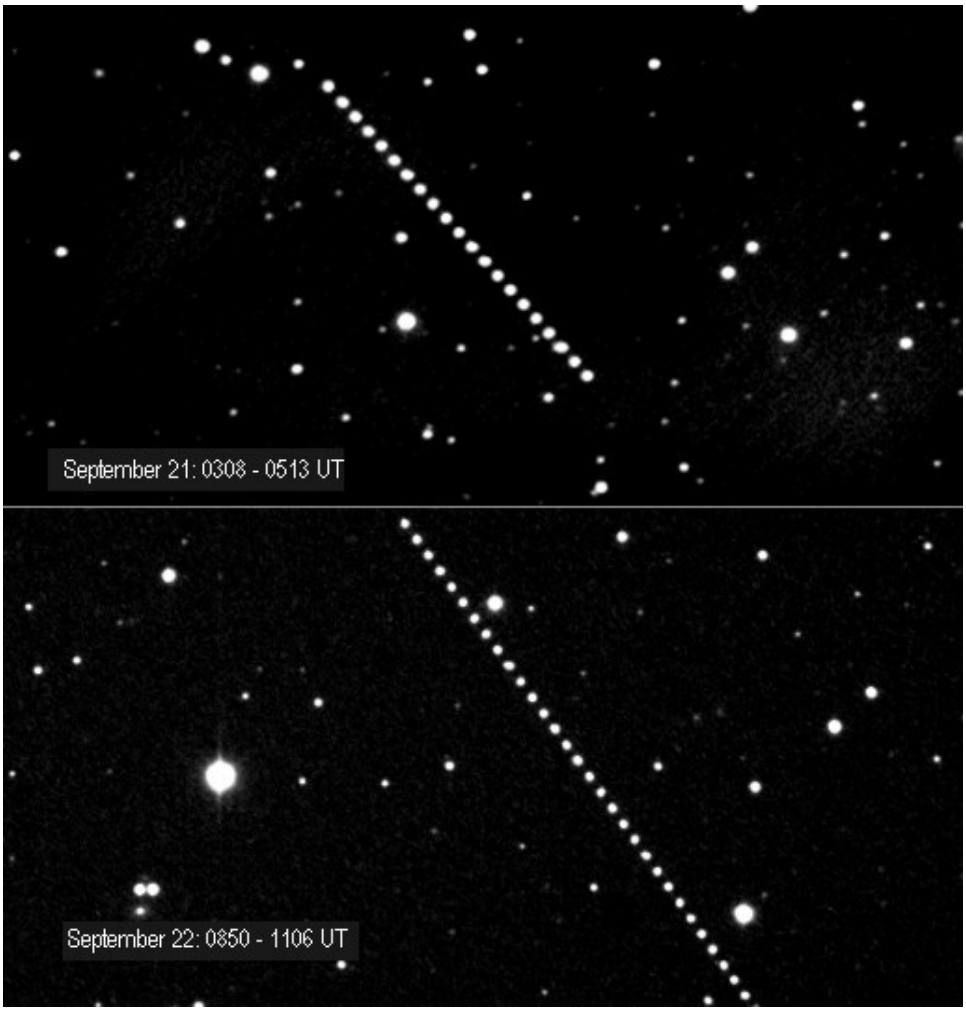
WHAM!

Toutatis Comes to Portland



Asteroid Toutatis Nears Planet Earth
Image Credit & Copyright: Top: John Chumack / Bottom: Juergen Wolf

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Toutatis Comes to Portland

R. J. Robbins

On Wednesday, 29 September 2004, asteroid Toutatis came within one million miles of Earth — the closest predicted approach of a sizable asteroid or comet in this century. In Earth's sky, Toutatis appeared only as a faint, starlike, but rapidly moving object. Even so, asteroid 4179 Toutatis was still bright enough to see in small telescopes. Astronomers John Chumack, observing near Dayton Ohio, and Juergen Wolf from near Palo Alto, California, produced composite images showing the progress of the asteroid (seen as a series of dots) against a background of distant stars (frontispiece). Their multiple exposures span a two-hour period on two different days about a week before the asteroid's record close approach, which tracked through night skies south of the celestial equator.

From a distance of one million miles or about four times the Earth-Moon distance, Earth would appear to be nearly the size of the full moon in the asteroid's sky, as suggested in Figure 1.

Toutatis is in an eccentric four-year orbit which moves it from the asteroid belt between Mars and Jupiter to just inside Earth's orbit. When the Earth passed near it in 1992 Toutatis was imaged by radar and seen to be two irregularly shaped lumps, perhaps joined by a narrow neck. This bizarre object is up to 1.5 miles wide, 3 miles long, and is tumbling through space. Studies of Toutatis and other Earth-crossing asteroids help reveal connections between the Solar System's meteorites, main-belt asteroids and comets. These asteroids also offer tantalizing targets for robotic exploration and, over time, represent potential collision hazards for planet Earth.

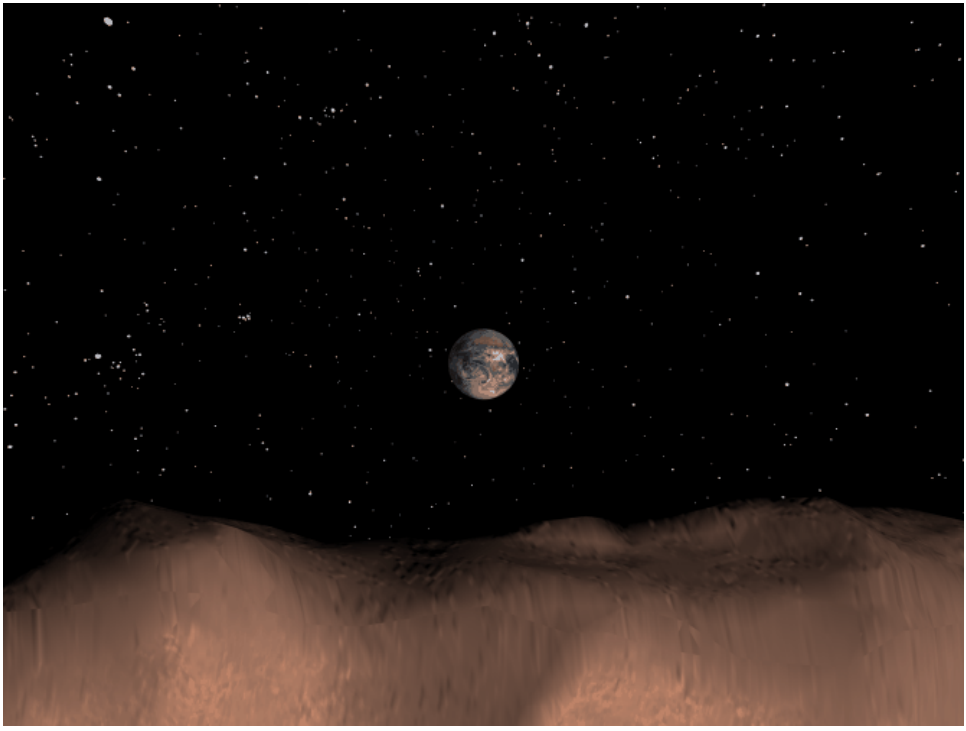

Figure 1. View of Earth from Asteroid Toutatis
Illustration Credit: E. De Jong and S. Suzuki, JPL, NASA

Should Toutatis collide with the Earth, the results would be devastating. A web site in Arizona[1] offers tools to calculate the results of impacts of various bodies on Earth.

If a Toutatis-like object were to hit Portland, Oregon, the energy of the impact would be equal to approximately 13 million megatons. That's equivalent to just about a billion Hiroshima-sized bombs, all going off simultaneously in downtown Portland.

Conclusion: Portland would be inconvenienced. Specifically, in a few seconds Portland would be replaced by a hole two-thirds of a mile deep and 45 miles in diameter.

[1] http://www.lpl.arizona.edu/impacteffects

The calculator also does some assessment of what that impact would look like to people in Seattle, 150 miles to the north. At a distance, the effects of such impacts fall into four categories: (1) thermal radiation: Seattle will feel some heat directly, (2) seismic effects: the ground will shake, (3) ejecta: hot stuff will land on Seattle, and (4) air blast: it will get breezy.

Seattle:

Thermal Radiation:

The impact will produce a visible fireball with an actual radius of approximately 40 miles. From the Seattle vantage point the fireball will appear to be 43.6 times bigger than the sun and will release a radiant flux (i.e., local heat) 184 times greater than the sun. The initial radiant flux will arrive 3.18 seconds after impact and the thermal irradiation will last about 90 seconds. During that period, exposed wood, cloth, and paper will ignite. Trees and grass will ignite. Exposed humans will experience third-degree burns over the south-facing portions of their bodies.

Seismic Effects:

Sixty seconds after impact (with 30 more seconds of thermal irradiation to go) the seismic effects will arrive as a Richter 9.3 quake, centered where Portland used to be. While Seattle is burning it will also get a good shaking. Well-designed buildings will do more or less OK, but significant damage will occur to older buildings, with chimneys and walls falling.

Ejecta:

Ejecta (parts of what used to be Portland) will start arriving 264 seconds after impact. The average chunk size will be about 3/4 of an inch in diameter and will be hot. The hot ejecta will quickly accumulate to a depth of almost three feet.

Air Blast:

> Seattlites will only have to sit under the hot ejecta amongst the flaming trees, grass, and buildings for a little over fifteen minutes, because at 976 seconds after impact the air blast will arrive. The wind speed of approximately 834 miles per hour will rearrange the ejecta, as well as most everything else. Almost all wood or masonry buildings will collapse or otherwise be destroyed. Steel frame buildings will have their walls blown off, their contents blown out, and their frames severely distorted. Highway truss bridges will collapse. All small objects (with "small" defined as including things from pebbles to humans to semi-trucks) will be blown about violently. Ninety percent or more of trees will be blown down; those not blown down will be stripped of leaves and branches.

Net effects: most of the humans and animals in Washington, Oregon, and Northern California will die in the first half hour. Many of the survivors will die over the next few days, as food and water will be almost non-existent and the impediments to delivering aid will be great. All overland routes of transportation will have been destroyed and fine ash will make helicopter and other aircraft operation difficult if not impossible. Help will not be on the way, at least not any time soon. Ninety percent of the economic resources in these three states will be destroyed. Neighboring states will be damaged, but less significantly.

Bottom line: Seattlites had better hope it hits LA. At that distance Seattle would get no thermal radiation and less than five inches of ejecta, most of which would be fairly fine. The air blast would take almost two hours to get to Seattle and when it arrived the wind speed would be less than 50 miles an hour. The seismic effects of the 9.3 Richter in LA wouldn't be much by the time they traveled that far north. Dishes would rattle and people on the upper floors of buildings might feel a rolling motion.