UPDATE ON THE NEOWISE MISSION: FINDING AND CHARACTERIZING MINOR PLANETS. A. Mainzer[1], J. Masiero[1], R. M. Cutri[2], T. Grav[3], E. Kramer[1], E. L. Wright[4], [1]Jet Propulsion Laboratory/California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, [2]IPAC/California Institute of Technology, Pasadena, CA; [3]Planetary Science Institute, Tucson, AZ; Department of Physics & Astronomy, [4]University of California, Los Angeles, CA

Introduction: NASA's Near-Earth Object Wide-field Infrared Survey Explorer (NEOWISE; [1]) has recently completed its fifth year of surveying the inner solar system for near-Earth objects (NEOs) and more distant minor planets using its two infrared channels operating at 3.4 and 4.6 microns (denoted W1 and W2 respectively). These data allow for characterization of basic physical properties such as effective spherical diameter and, when corresponding visible light observations are available, geometric visible albedo. Launched in late 2009 into a Sun-synchronous low-Earth orbit, the NEOWISE spacecraft began its operational life as the Wide-field Infrared Survey Explorer (WISE) mission with two additional channels operating at 12 and 22 microns (denoted W3 and W4 [2]). The solid hydrogen cryostat that cooled the telescope and W3 and W4 channels was depleted after exceeding its planned lifetime in August 2010, leaving the W1 and W2 channels still operational. In 2013, the spacecraft was renamed NEOWISE and dedicated to the detection and characterization of NEOs as part of NASA's portfolio of planetary defense projects. To date, nearly 170,000 minor planets have been detected at some point during the WISE/NEOWISE missions, including nearly 200 comets and over 1000 NEOs. The mission has completed 11 full coverages of the entire sky, resulting in a large database of multi-epoch images and extracted source lists that serve a wide variety of scientific applications.

Results: Since the damage caused by a potential impactor scales as its kinetic energy, which in turn scales as diameter cubed, it is important to measure NEO sizes accurately. Because of the wide range of NEO albedos, the range of effective sizes inferred from visible light measurements alone tend to be large; however, more accurate estimates of diameters can be obtained using methods such as thermal infrared radiometry. To that end, much work has focused on applying the popular and computationally inexpensive Near-Earth Asteroid Thermal Model (NEATM [3]) to the WISE/NEOWISE data to compute diameters, albedos, and beaming parameters for this large dataset (see e.g. [4, 5, 6]). On average, the WISE/NEOWISE observing cadence results in ~10-12 exposures per minor planet imaged simultaneously in both bands separated by ~3 hours. In cases where two or more thermally dominated bands (one of which is near the peak of the object's blackbody emission) are available with good signal-to-noise ratios, modest phase angles, and reasonable coverage of the rotational lightcurve, effective spherical diameter determinations can be as good as ~10% can be achieved (see Figure 1 [7, 8]). With shorter wavelength data on the Wien side of the blackbody curve, diameter estimates are less accurate but still usually better than those made from visible measurements alone.

The combination of multiple epochs of thermal infrared data taken at different viewing geometries enables the use of more sophisticated thermophysical models that can determine additional quantities such as rotational state and thermal inertia [9, 10, 11, 12]. Because the WISE/NEOWISE mission has been observing over a number of years, many thousands of objects now have more than one epoch of observations.

Conclusions: The WISE/NEOWISE mission is subject to seasonable heating, and its orbital plane is shifting. At some point, it will no longer be possible to continue survey operations due to the impingement of scattered light or rising temperatures. Nevertheless, the mission has returned a wealth of data on the distribution of sizes and albedos of various minor planet populations throughout the inner solar system, providing clues to their origins and migration. Future work is focusing on extracting additional detections of minor planets from the dataset using improved algorithms for identifying moving objects and by stacking individual exposures along the predicted locations of known objects in their comoving reference frames. Both techniques should additional measurements of diameters and albedos for objects about which little would otherwise be known.

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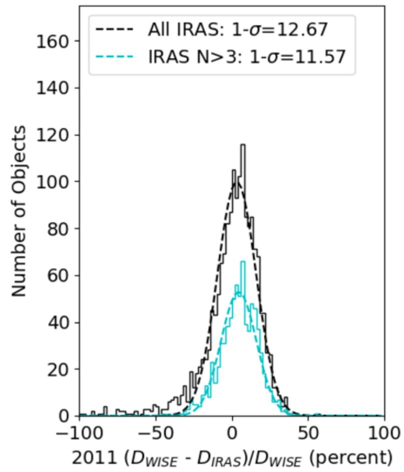

Figure 1. Diameters from thermal fits from WISE/NEOWISE closely match those derived using IRAS data [7, 8]. Discrepancies are larger when IRAS data with fewer than four detections per object are considered; WISE observations typically contain ~10-12 detections per object spread over ~36 hours.