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ASSESSING THE VULNERABILITIES OF THE MEERKAT ASTEROID GUARD

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New asteroids and comets are continuously being discovered in the night sky. Such objects need prompt follow-up before they are lost, so that an early and reliable computation of the impact probability can be completed. Here we present the Meerkat Asteroid Guard [1], an automated imminent impact warning service developed and operated at the ESA NEO Coordination Centre.

Meerkat continually downloads tracklets for unconfirmed near-Earth objects from the NEO Confirmation Page. For many of these new objects, the observation arc length is short. While the object's plane of sky position and motion may be known with sufficient accuracy, the remaining two parameters required to describe the orbit, the topocentric range and range rate, are not. Such short arcs lead to severe errors and degeneracies in traditional orbit determination methods. To overcome this, we employ the method of systematic ranging [2] [3], whereby a grid of topocentric range and range rates have their orbits fitted with associated error. From this error we derive a posterior probability distribution. By scanning a suitably dense grid, we can produce a statistical description of the most likely orbital solutions, and derive important information such as estimated size and impact probability. Meerkat operates 24/7, delivering warnings of imminent impactors and close approaches via email to subscribed users.

Over its three-year operational lifetime, Meerkat has successfully issued alerts for the past seven imminent impactors, from 2022 EB5 to most recently 2024 XA1. These alerts were vital for coordinating follow-up observations and preparing local authorities for fireball events. Fig. 1 shows the impact plot issued in the Meerkat email alert for 2024 XA1 after the first 8 observations.

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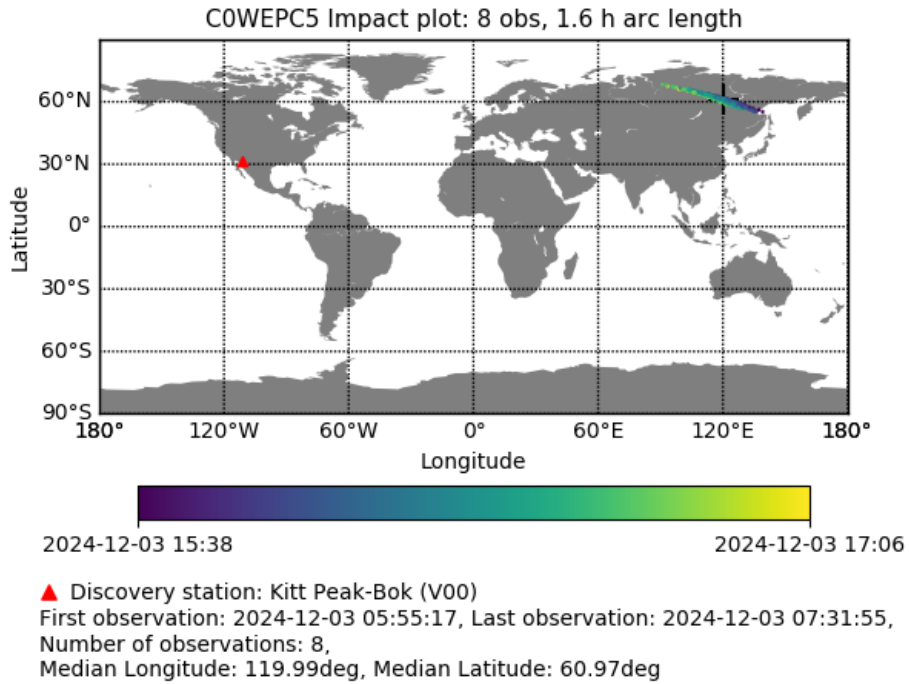


Figure 1: Meerkat impact plot showing times and locations of impacting Monte Carlo samples for 2024 XA1 (temporary designation: C0WEPC5).

The importance of an imminent impactor warning system cannot be overstated. With the advent of new surveys from ESA Flyeye, the Vera Rubin Observatory and NEO Surveyor, the number of new detections is predicted to increase dramatically. To ensure our readiness, this work evaluates the performance of Meerkat against a large dataset of real and simulated observations. We explore how our systematic ranging algorithm can be configured to optimise solution speed and accuracy. False positive alerts and anomalous results are investigated to find potential causes. This work is necessary to ensure our systems have been rigorously tested and are fully prepared for the large data influx anticipated in the coming decade.

Comments:

(Oral presentation preferred over Poster)

References

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