Jupiter-family comets in near-Earth orbits: Dynamical histories and potential source regions

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We analyze the dynamical histories of a sample of 58 Jupiter-family comets (JFCs) coming close to the Earth, namely with perihelion distances $q < 1.3$ au at the time of their discovery. We carry out orbit integrations for these objects for 10^4 yr in the past and in the future, considering the orbital elements provided by the NASA/JPL Small Body Database, and 50 clones of each comet whose orbital elements were taken randomly within their error bars. We find that most orbits are chaotic, where comets are subject to frequent close encounters with Jupiter. Therefore, it is difficult to follow accurately the trajectory of a given comet beyond a few hundred years. We then define a *likely dynamical path*, which is computed as the average of the orbits of a given comet and the set of 50 clones. In particular we measure the degree of instability of a comet orbit by the time it takes the average perihelion distance q of a comet and its 50 clones to decrease by 1 au previous to the discovery time. We define this time scale as the *capture time* within the near-Earth region. We find that most JFCs have short capture times, of a few hundred to a couple of thousands of years, suggesting a recent incorporation to the near-Earth region. This is what one should expect for bodies whose typical lifetimes as active comets should not exceed a few 10^3 yr. This behavior is in sharp contrast with near-Earth asteroids that show more stable orbits with much longer residence times in the near-Earth region. The most likely source region of most JFCs is the transneptunian region. On the other hand, we find that a few JFCs move on stable orbits over the studied period with capture times $> 10^4$ yr. These objects might have a different source region, probably the outer asteroid belt or the Jupiter Trojans.

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