Amenable category of three-manifolds

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A closed topological n-manifold M^n is of *ame*–category $\leq k$ if it can be covered by k open subsets such that for each path-component W of the subsets the image of its fundamental group $\pi(W) \to \pi(M^n)$ is an amenable group. $cat_{ame}(M^n)$ is the smallest number k such that M^n admits such a covering. For $n = 3$, M^3 has *ame*-category ≤ 4. We characterize all closed 3-manifolds of *ame*-category 1, 2, and 3.