The Johannsen-Psaltis spacetime is a perturbation of the Kerr spacetime designed to avoid pathologies like naked singularities and closed timelike curves. This spacetime depends not only on the mass and the spin of the central object, but also on extra parameters, making the spacetime deviate from Kerr; in this work we consider only the lowest order physically meaningful extra parameter. In this thesis we summarize the basics of the theory of regular and chaotic dynamics and we use numerical examples to show that geodesic motion in this spacetime can exhibit chaotic behavior. We study the corresponding phase space by using Poincaré sections and rotation numbers to show chaotic behavior both directly and indirectly (e.g. Birkhoff chains), and we use Lyapunov exponents to directly estimate the sensitivity to initial conditions for chaotic orbits.