Comment on npg-2021-34
Anonymous Referee #1

Referee comment on "Lévy-noise versus Gaussian-noise-induced Transitions in the Ghil-Sellers Energy Balance Model" by Valerio Lucarini et al., Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2021-34-RC1, 2021

This work is very interesting. For this `spatial' energy balance model in terms of a stochastic partial differential equation, the authors have developed stochastic dynamical systems tools (mean residence time, most probable transition paths) to investigate the climate evolution and to detect novel residence (around a distinguished climate regime) and transition (between metastable climate states, e.g., warm and snowball states) features of this system. Taking non-Gaussian Levy fluctuations into account is of special importance.

Unlike the finite dimensional cases, here we do not have the deterministic partial differential equation describing the mean residence time. Thus the authors have developed direct numerical algorithms for computing the mean residence time and the most probable transition pathway from one climate regime to another.

This work should be accepted with minor corrections.

Specific comments:

1. Page 11: In the left of Eq.(15), would it be better if $x_M(t)$ is changed to $T_m(t)$?

2. The first paragraph of Page 12, the expression of set $\alpha$ better be $\alpha=\{0.5, 1, 1.5, 2\}$, not open set ($\langle$)?