We would like to express gratitude to the Referees for the detailed and precise analysis of our manuscript that contributes towards its improvement. We have taken all of the comments into account in the revision (changes appear in red type) and explain this in detail in the following sections.

1 Technical comments from Reviewer 1

Question 1: In the work, the symbol V has two different meanings. One is the volume in Figure 1, the other is the potential function on Page 5.

Answer: The volume of the compartments in Figure 1 was designated as V_c.

Question 2: In stochastic differential equation (9), you can add the initial condition $Y_0 = y_0$. On the second line from the bottom of Page 7, the generator should be $Au = \lim_{t\to 0} \frac{\mathbb{E}u(y_t)-u(y_0)}{t}$.

Answer: The initial condition $Y_0 = y_0$ is added to the equation (9). The generator on line 165 is corrected as suggested.

Question 3: In the manuscript, the authors adopted the αstable non-Gaussian Lévy noise to model the extreme events? Can you give the comparison between the Brownian motion and Lévy flight?

Answer: We compare the processes in the end of the section 2.1.1.

Question 4: In equation (14), what is the definition of I?

Answer: The definition of indicator function I is given by equation (15).

Question 5: In Section 2.1.5, what is the definition of $p_i(y), m, M$? Could you represent the definition of stochastic basin of attraction to the one-dimensional case since that the escape boundary only has two direction in the one-dimension. The work "Y. Zheng, L. Serdukova, J. Duan, J. Kurths, Transitions in a genetic transcriptional regulatory system under Lévy motion, Sci. Rep. 6 (2016) 29274." also introduces the stochastic basin of attraction, which can be added to the references.

Answer: In Section 2.1.5 the definition of stochastic basin of attraction is adapted to the one-dimensional case and the measures of m and M are specified. The work of Y. Zheng is added to the references line 355.

Question 6: In the manuscript, the authors show the three concepts, mean residence time, first passage probability and stochastic basin of attraction to perform the stability analysis. Could you show us how to solve the non local equations (14) (15) and (17)?

Answer: At the end of section 2.1.3 we describe the numerical method that we use to solve these equations.

2 Technical comments from Reviewer 2

Question 1: Title: The model does not represent the global thermohaline circulation but the Atlantic MOC.

Answer: We have made proposed amendments to both the title and the text.

Question 2: l17: Tides are no part of the THC. l27: There is no surplus of precipitation over evaporation at low latitudes, except in a small zone near the equator (ITCZ).

Answer: The suggested changes are introduced in the lines 16 and 26.

Question 3:There should be a justification that the variability in the freshwater forcing can be represented by an α-stable process. Here, the time scale considered is important: when focus is on Dansgaard-Oeschger (DO) events (e.g. Ditlevsen 1999), this is a different issue that when the stability of the present-day MOC is considered. As for the latter case, many observations and model results (reanalyses, CMIP6) are available for justification.

Answer: We consult the publications (bibliography line 372) and introduce the suggested justification on lines 55-60.

Question 4: The new aspects in this paper, in relation to the one just published (Tesfay et al., 2020 in the reference list), should be clarified as the same model and same noise are investigated.

Answer: This clarification is included on page 3 in the first paragraph.

Question 5: l72: $\Delta\rho$ should be divided by ρ_0. l99: β is no restoration "tensility" but a ratio of a diffusive and a restoring time scale. l101: definition of μ^2 is wrong. l105, 107: $dt \to d\tau$. l129: the relation between the amplitude of dL_t and F is missing.

Answer: The respective corrections were introduced in the equations (2), (6) and (7).

Question 6: Fig. 6 contains no probability distributions as for each curve the integral is not 1.

Answer: Figure 6 has been replaced according to the suggestion.

Question 7: The methodology in section 2.1 should be better explained and only provide well explained mathematical results with reference to the mathematical details. It appears now to have been copied from a mathematics paper with many symbols unexplained. At line 130, there is a reference to a "Methods" section which is not there.

Answer: All mathematical concepts were described in more detail in section 3, on pages 7, 8 and 9.

Question 8: Section 3: I would suggest to split the results into two sections: (i) DO transitions. Connect the results to the Ditlevsen (1999) analysis and proposed noise structure. Can the α-stable noise better describe the transition behavior (as in the proxy data), than just Brownian noise? (ii) Present-day MOC. Is the transition probability of a MOC transition increased under climate change, when incorporating an α-stable process in the freshwater flux noise?

Answer: To make the proposed comparison (α-stable vs Brownian noise) we should include the parameter $\alpha = 2$ (which corresponds to the Brownian case) in the simulations of stochastic perturbations. We leave this option for future studies.

Question 9: Improve also the interpretation of the results: in the present text, lines 209-210, lines 222-223, lines 267-268 and lines 277-281 make no sense.

Answer: Reading more articles about timescales of AMOC decline, AMOC response to fresh water forcing and stability of AMOC off-state we try to improve the interpretation of the results, see the changes

made in the section 4.