

Nonlin. Processes Geophys. Discuss., community comment CC1
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Comment on npg-2021-9

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Community comment on "Identification of linear response functions from arbitrary perturbation experiments in the presence of noise – Part 1: Method development and toy model demonstration" by Guilherme L. Torres Mendonça et al., Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2021-9-CC1>, 2021

Dear authors,

I have greatly appreciated your paper and the idea behind it. The application developed in Part II is also very interesting. I have a comment I would recommend you to consider. When you introduce Eqs. 7 and 8 you are making the (very important) assumption that all the eigenvalues of the unperturbed transfer operator are real, whereas they are in general complex (with each complex number accompanied by its conjugate). Complex conjugate pairs allow for the presence of oscillating terms in the Green function. You might see a longer explanation of this in Tantet et al. 2020 and Lucarini 2018.. In other terms, you are allowing for purely relaxation behaviour in your system. This might well work out fine for some applications, but not on other ones (where more complex feedbacks are present).

Best Regards,

Valerio Lucarini

Tantet, A., Chekroun, M.D., Neelin, J.D. *et al.* Ruelle–Pollicott Resonances of Stochastic Systems in Reduced State Space. Part III: Application to the Cane–Zebiak Model of the El Niño–Southern Oscillation. *J Stat Phys* **179**, 1449–1474 (2020). <https://doi.org/10.1007/s10955-019-02444-8>

Lucarini, V. Revising and Extending the Linear Response Theory for Statistical Mechanical Systems: Evaluating Observables as Predictors and Predictands. *J Stat Phys* **173**, 1698–1721 (2018). <https://doi.org/10.1007/s10955-018-2151-5>