Nonlin. Processes Geophys. Discuss.,
https://doi.org/10.5194/npg-2018-28-RC2, 2018

Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Climatic responses to systematic time variations of parameters: A dynamical approach" *by* Catherine Nicolis

Anonymous Referee #2

Received and published: 11 July 2018

This manuscript explores the climate response to a linearly time varying parameter in general non-linear dynamical systems and in particular for a few examples of low-order models for the atmosphere-climate system. Three cases are distinguished: periodic dynamics that appear through Hopf bifurcations, chaotic dynamics using the Lorenz model for convection, and transitions between different equilibrium states which appear sometimes as back-to-back saddle node bifurcations or as limit points. The manuscript is generally well written and easy to follow. It relates to characterizing the climate response to time varying perturbations such as the atmospheric CO_2 concentration, which in typical climate model experiments is instantaneously doubled or quadrupled. In this study (and in reality) the CO_2 concentrations is however increasing in time and will lead to time dependent response in the climate system. For gen-

eral dynamical systems different types of tipping have been defined, such as purely bifurcation related tipping (corresponding to the 'static' case described here) and rate-dependent tipping (where a parameter varies in time), see Ashwin et al. 2012, http://doi.org/10.1098/rsta.2011.0306. I would suggest to relate the systems described here to these cases, at least in the discussion. Moreover, linear response theory has recently been explored to determine the transient climate response from idealized experiments where the parameter (CO_2) is instantaneously doubled (e.g. Lucarini 2012, http://doi.org/10.1007/s10955-012-0422-0). Would it be possible to derive from the setting described in this article conditions under which such a linear response would be valid?

Interactive comment on Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2018-28, 2018.