nature portfolio

https://doi.org/10.1038/s41558-021-01097-4

Supplementary information

Observation-based early-warning signals for a collapse of the Atlantic Meridional Overturning Circulation

In the format provided by the authors and unedited

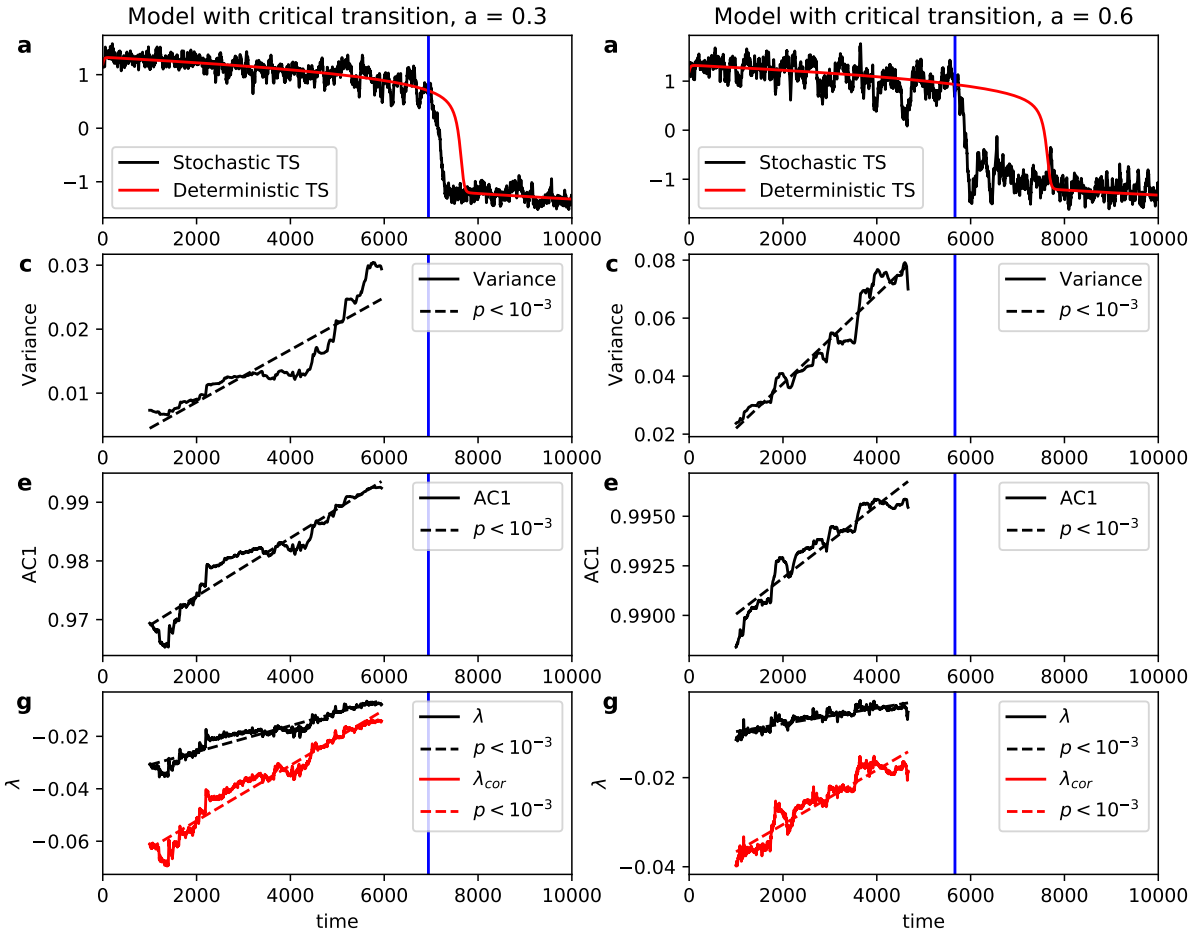
Supplementary Information for "Observation-based early-warning signals for a collapse of the Atlantic Meridional Overturning Circulation"

Niklas Boers*[1,2,3]

[1]Department of Mathematics and Computer Science, Freie Universität Berlin, Germany.
[2]Potsdam Institute of Climate Impact Research, Potsdam, Germany.
[3]Department of Mathematics and Global Systems Institute, University of Exeter, UK

This supplementary information file contains Supplementary Figure S1.

*Corresponding Author: Niklas Boers, Potsdam Institute for Climate Impact Research, Telegrafenberg A31, 14473 Potsdam, Germany; Email: boers@pik-potsdam.de



Supplementary Figure S1: Early-warning signals in the presence of autocorrelated noise forcing. **a** Simulated time series from the nonlinear model $dx/dt = -x^3 + x - T + \eta(t)$ (black), with correlated noise $\eta(t)$ with $\sigma = 0.2$, fixed AR(1) coefficient $a = 0.3$, and control parameter T linearly increasing from $T = -1$ to $T = +1$. The timing of the critical transition is indicated by the blue vertical line. A corresponding time series obtained by simulating the model without noise forcing, which represents the nonlinear trend that is used to detrend the stochastic time series, is shown in red for comparison. **b** Same as (a) but for AR(1) coefficient of the driving noise fixed to $a = 0.6$ for comparison. **c** Variance of the time series shown in (a) with nonlinear trend removed. **d** Variance of the time series shown in (b) with nonlinear trend removed. **e** Lag-one autocorrelation (AC1) of the time series shown in (a) with nonlinear trend removed. **f** AC1 of the time series shown in (b) with nonlinear trend removed. **g** The restoring rate λ of the time series shown in (a) with nonlinear trend removed, estimated under the assumption of Gaussian white noise (black), and assuming autocorrelated noise (red). **h** The restoring rate λ of the time series shown in (b) with nonlinear trend removed, estimated under the assumption of Gaussian white noise (black) and assuming autocorrelated noise (red). Note that all four considered indicators of critical slowing down show significant increases, thus providing reliable EWS also in the presented case of correlated noise with fixed σ and AR(1) coefficient. All EWS indicators are estimated in sliding windows of size $w = 2000$ integration time steps. The first and last $w/2 = 1000$ time steps are omitted to assure that each sliding window has the same number of data points (see Methods).