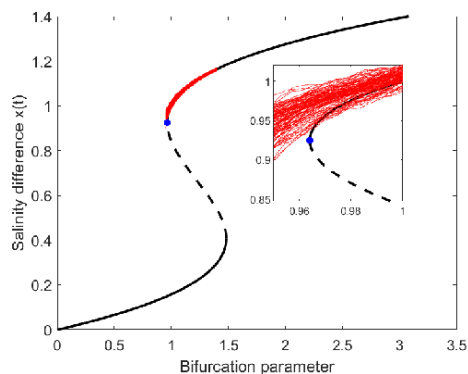


June 22, 2023  
 Talk at 15:15  
 in P 603  
 refreshment afterwards



**Jun. Prof. Dr. Alexandra Neamtu**  
 Universität Konstanz

### Early-warning signs and finite-time Lyapunov exponents for dynamical systems driven by non-Markovian processes



Contact:  
 M. Fuchs, 4678

Warning signs for bifurcation points (or critical transitions) have been very actively studied. Although the theory has been applied successfully in models and in experiments for many complex systems such as for tipping in climate systems, there are ongoing debates as to when warning signs can be extracted from data. In this work, we shed light on this debate by considering different types of underlying noise. Thereby, we significantly advance the general theory of warning signs for nonlinear stochastic dynamics. We consider non-Markovian systems including colored noise and  $\alpha$ -regular Volterra processes (of which fractional Brownian motion and the Rosenblatt process are special cases). We prove that early warning scaling laws can disappear completely or drastically change their exponent based upon the parameters controlling the noise process. We demonstrate our results numerically in the context of a box model of the Atlantic Meridional Overturning Circulation and observe a close agreement of the numerical rates with the theoretically proven ones. We also discuss an alternative viewpoint on stochastic bifurcations for non-Markovian processes using finite-time Lyapunov exponents. This talk is based on joint works with Christian Kuehn and Kerstin Lux (both TU Munich) and Dirk Blömker (University of Augsburg).

