

Eawag Seminar Invitation

Tipping Point Analysis of Dynamical Systems, With Applications in Geophysics and Environmental Sciences

Speaker **Dr. Valerie Livina**

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When **September 30, 11.00 – 12.00 a.m.**

Where **Forum Chriesbach C20, Eawag Dübendorf**

Abstract We study time series using the tipping point analysis techniques for anticipation, detection, and forecast of tipping points in a dynamical system. The methodology combines degenerate fingerprinting and potential analysis. Degenerate fingerprinting indicator is a dynamically derived lag-1 autocorrelation, ACF (or, alternatively, short-range scaling exponent of Detrended Fluctuation Analysis, DFA [1]), which monitors short-term memory in a series. When such values rise monotonically, this indicates an upcoming transition or bifurcation in a series and can be used for early warning signals analysis. The potential analysis detects a transition or bifurcation in a series at the time when it happens, which is illustrated in a special contour plot mapping the potential dynamics of the system [2-6].

Potential analysis is also used in forecasting time series by extrapolation of Chebyshev approximation coefficients of the kernel distribution, with reconstruction of correlations in the data [6]. The methodology has been extensively tested on artificial data and on various geophysical, ecological and industrial sensor datasets [2-10], and proved to be applicable to trajectories of dynamical systems of arbitrary origin [11].

References: [1] Livina and Lenton, GRL 2007; [2] Livina et al, Climate of the Past 2010; [3] Livina et al, Climate Dynamics 2011; [4] Livina et al, Physica A 2012; [5] Livina and Lenton, Cryosphere 2012; [6] Livina et al, Physica A 2013; [7] Livina et al, Journal of Civil Structural Health Monitoring, 2014; [8] Kefi et al, PLoS ONE 2014; [9] Livina et al, Chaos 2015; [10] Perry et al, Smart Materials and Structures, 2016; [11] Vaz Martins et al, PRE 2010.