# CLIMATE TIME SERIES: SIGNAL, NOISE AND ADDITIVITY

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Climatological time series (temperature, precipitation etc.) arise from three sources:

- Instrumental measurements

- Reconstructions from proxies, e.g. tree rings, ice cores, historical records...

- Computer simulations from climate models: 3D dynamical systems, in principle deterministic

In all three variability is assumed to be decomposable as climate signal + internal variability, the latter being "noise" produced by the internal dynamics of the system. The signal is the effect of external input into the system, forcings, e.g. volcanic eruptions, greenhouse gas emissions, solar activity (sunspots). Climate model simulations may be run using only one forcing, or perhaps a subset of known forcings. Climate scientists often use such simulations in an attempt to detect the effects of a particular forcing in the actual climate (instrumental or reconstructed). A common assumption in such studies is that the forcing effects in the simulations are additive, so that up to internal variability the effect of several forcings may be obtained from simulations using only one forcing at the time.

Is the additivity assumption true? I will discuss several different approaches to this question.

**Keywords:** Climate time series, Climate model simulation, Additivity, Forcing.