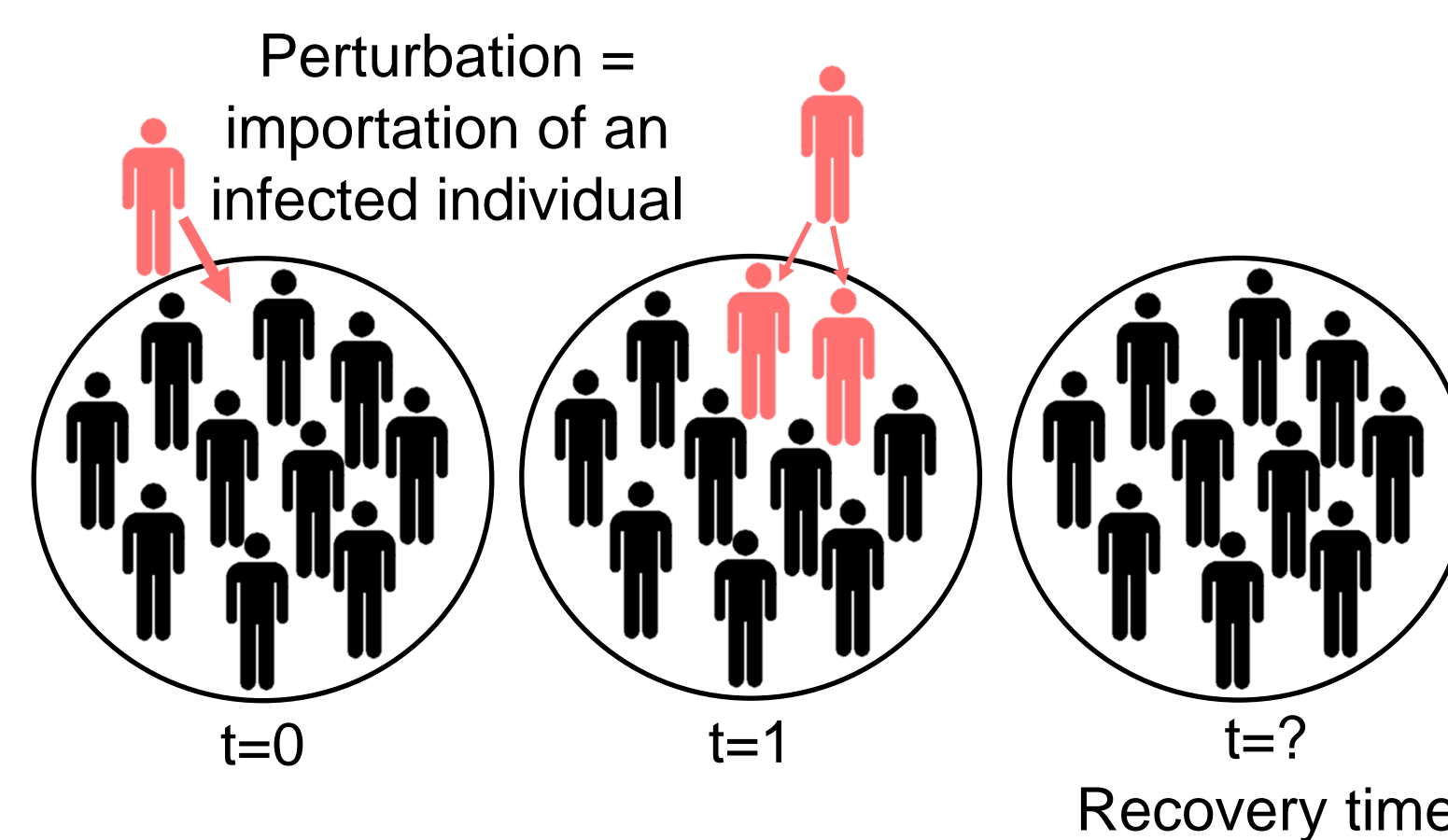
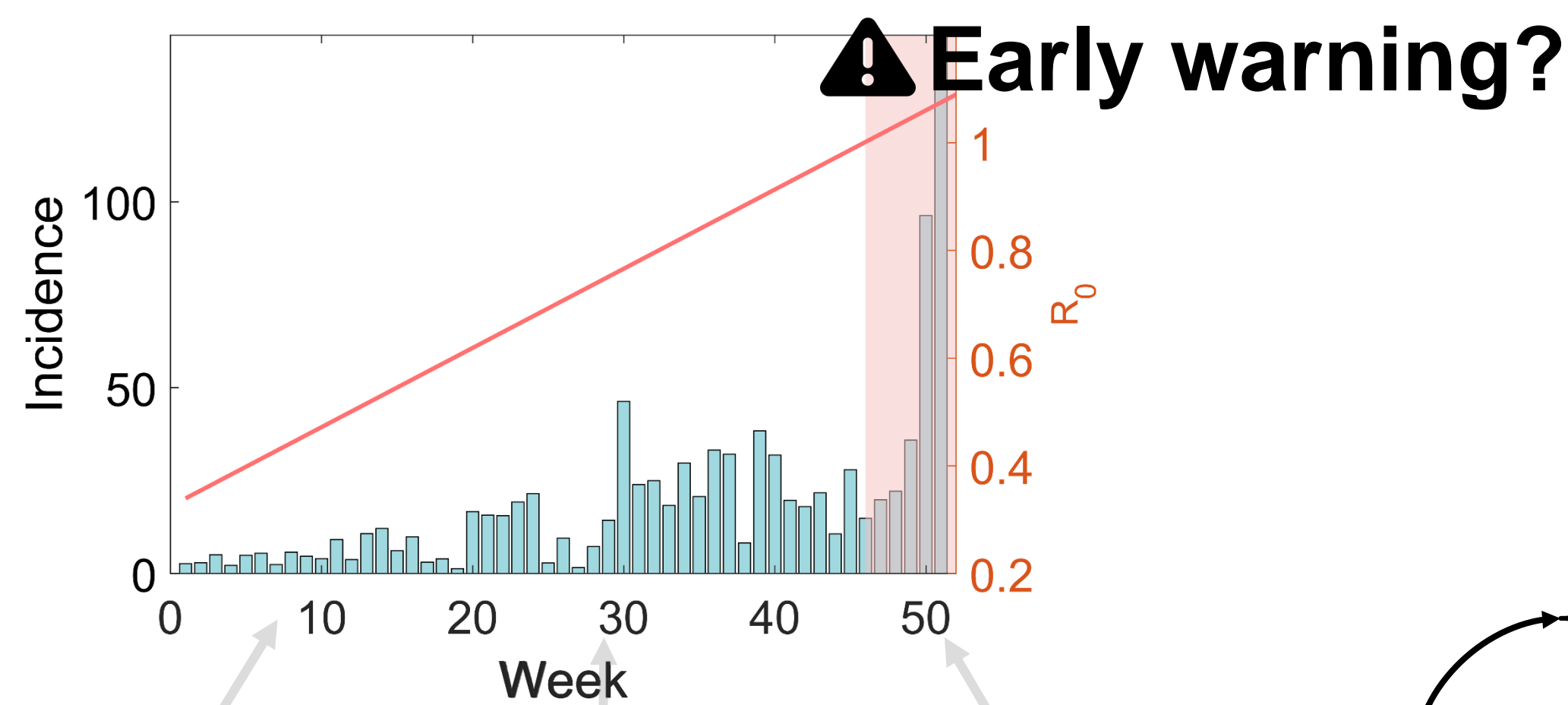


More than the sum of its parts: the value of multiple data types in early warning for West Nile virus outbreaks

Clara Delecroix, Ingrid van de Leemput, Egbert van Nes, Marten Scheffer, Quirine Ten Bosch
Wageningen University and Research, the Netherlands

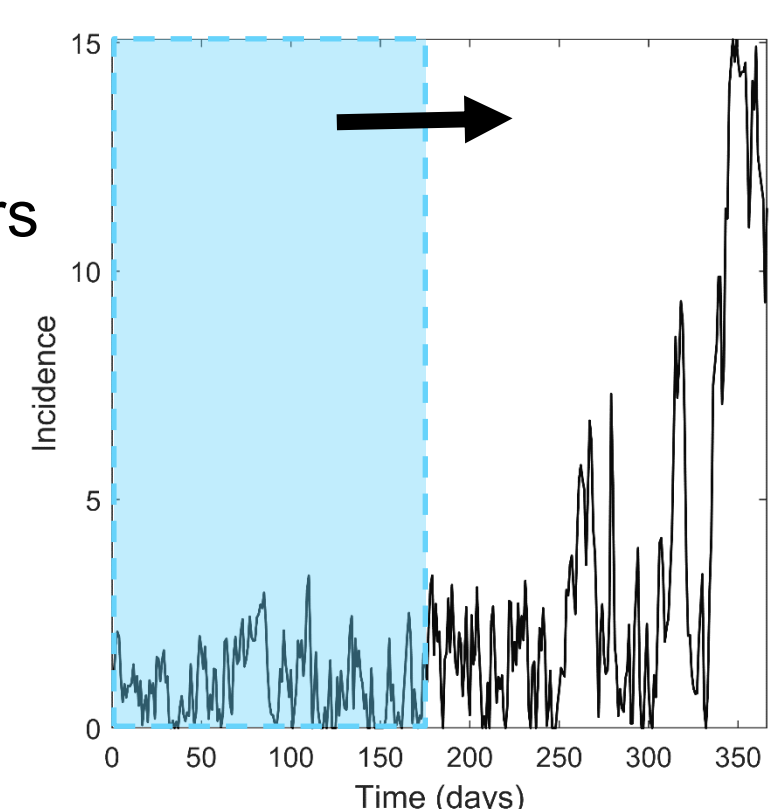
Resilience indicators to anticipate epidemics

Epidemic caused by a slow increase in R_0 , i.e.
 - decrease in vaccination rate
 - increasingly suitable climatic conditions for the pathogen
 - immunity escape caused by mutations

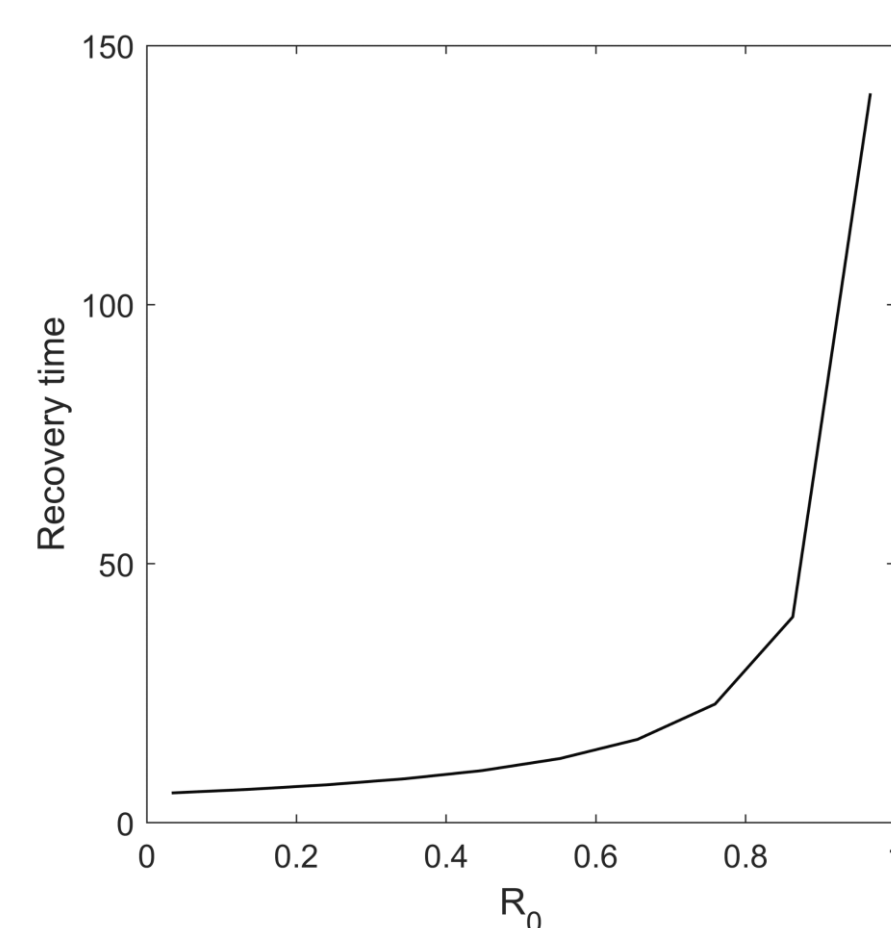
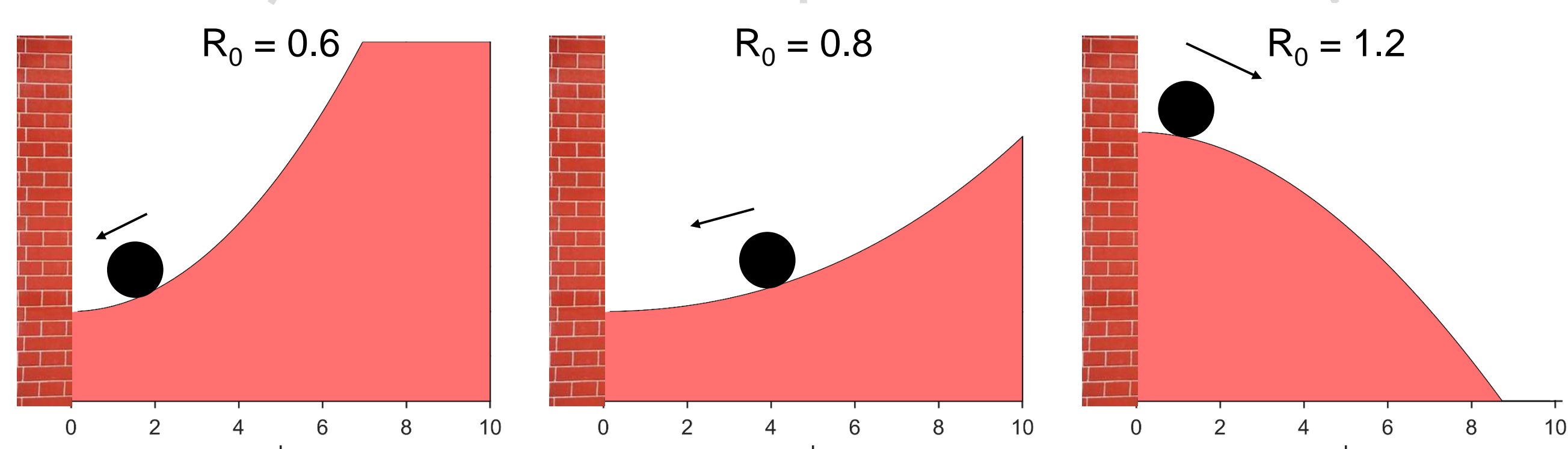


Since the recovery time cannot be calculated in practice, we use **resilience indicators** (i.e. autocorrelation, variance) as proxies

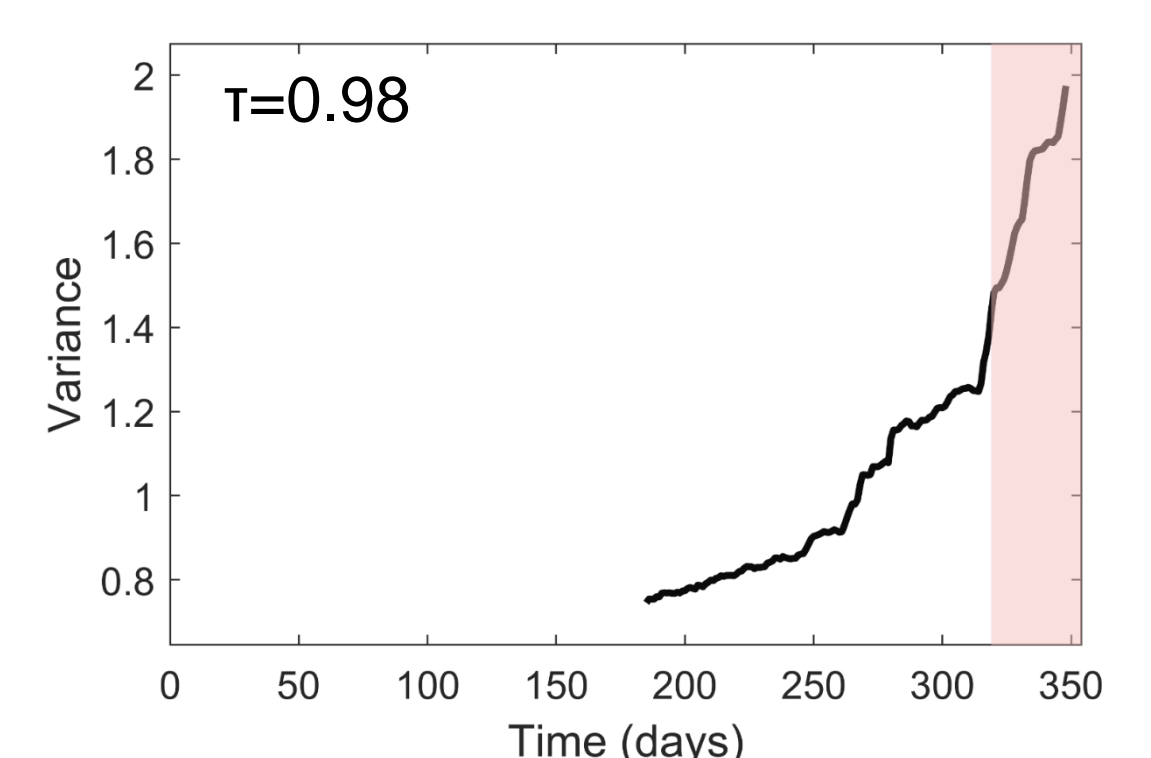
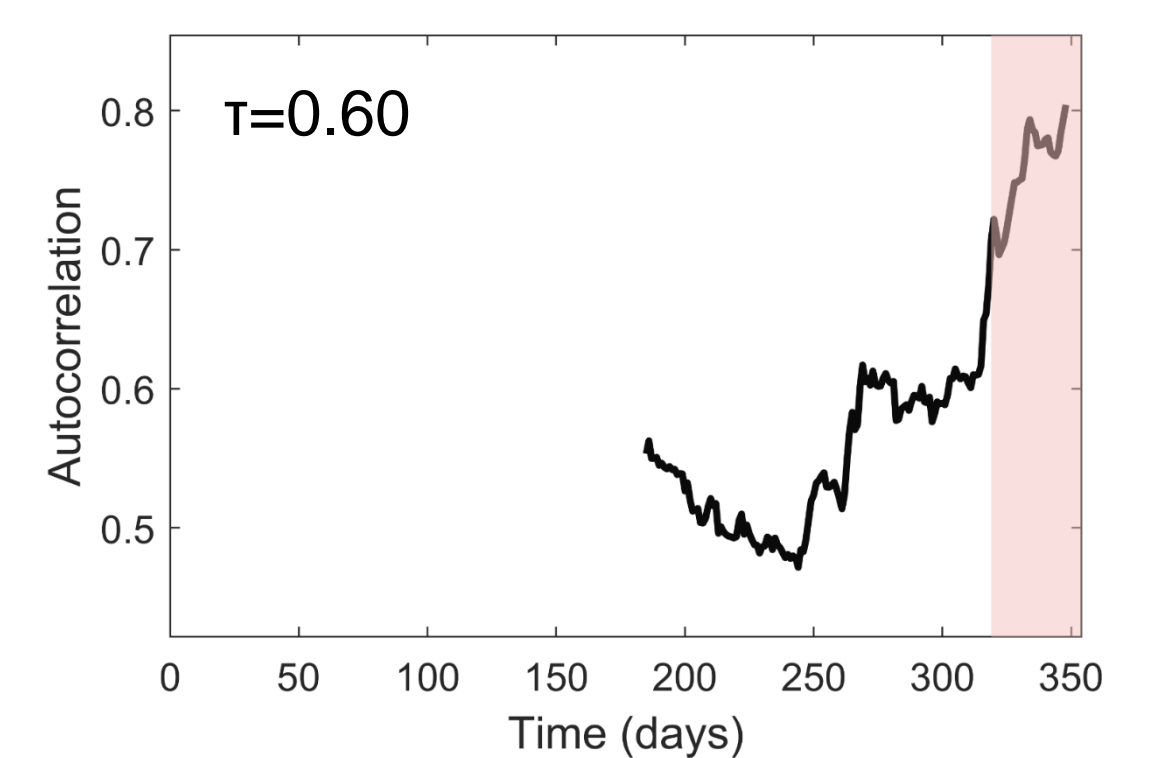
A moving window is used to assess the trend in the indicators



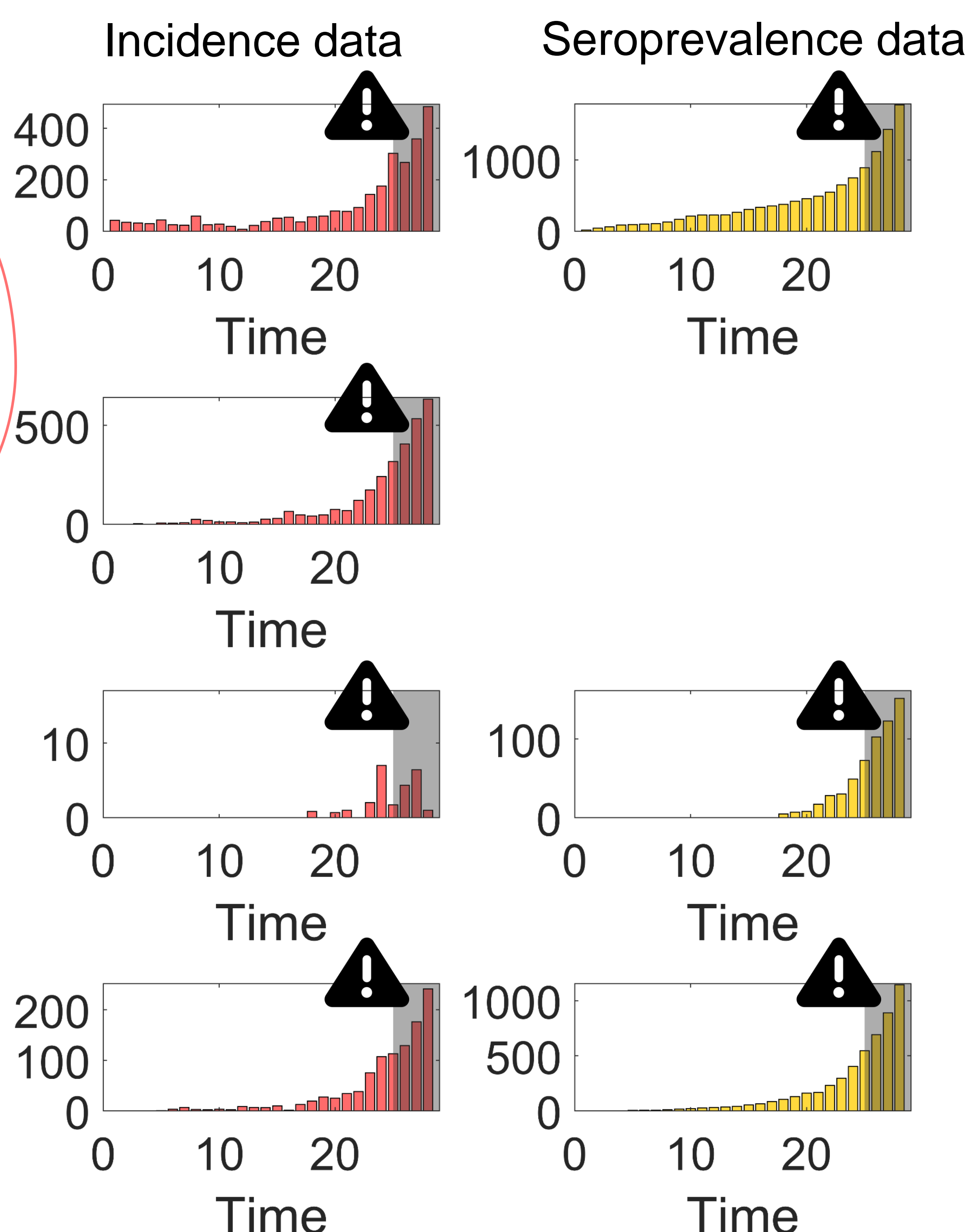
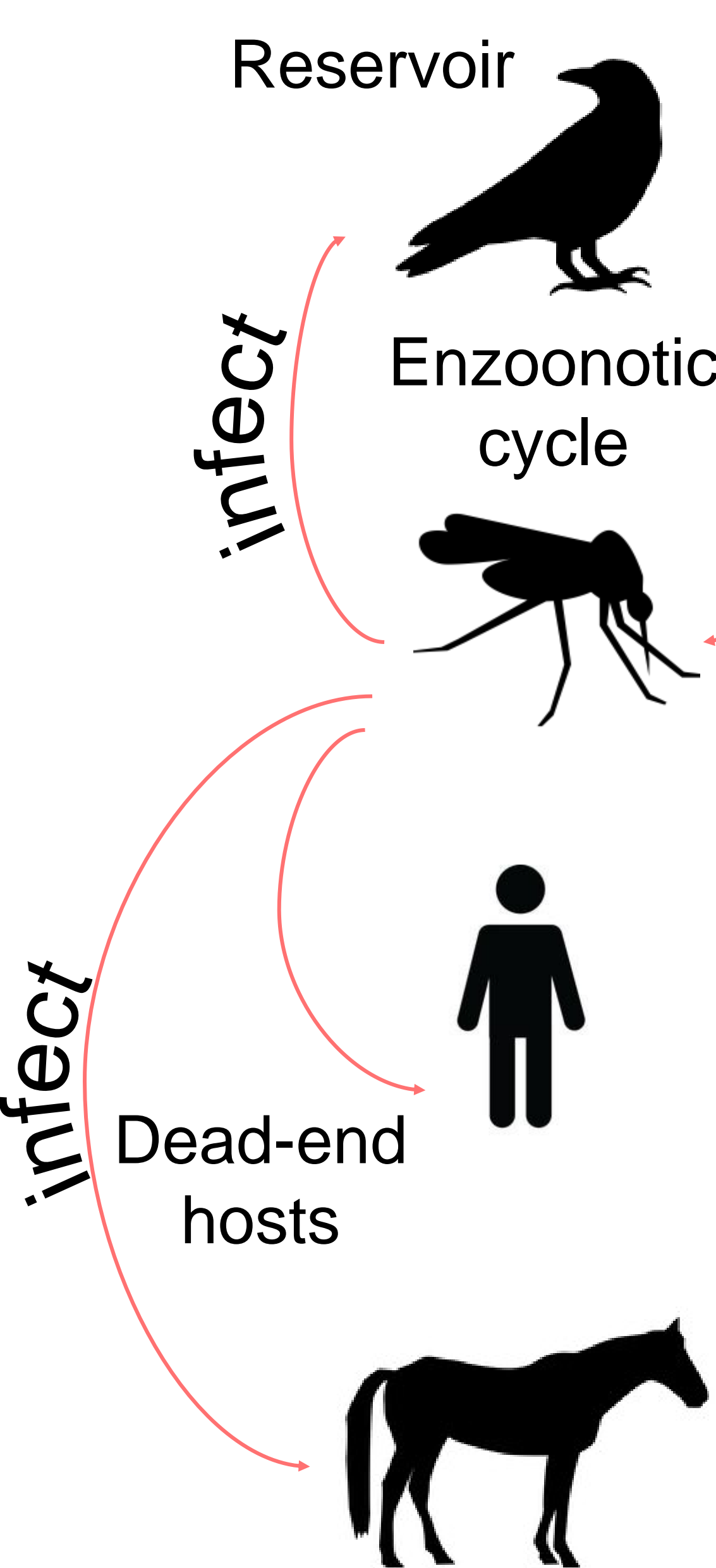
Phenomenon of **Critical Slowing Down (CSD)**:
 loss of **resilience**, i.e. ability to recover from **external perturbations**



- + Data driven, generic method
Few pre-processing steps
- Only applicable in certain situations
Requires long, high-resolution time series



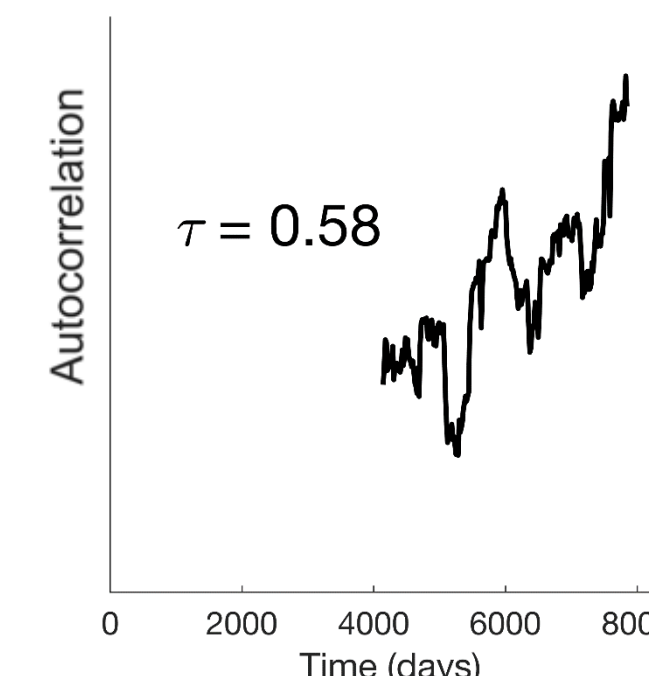
Early warning signals of West Nile Virus outbreaks: combining multiple data types



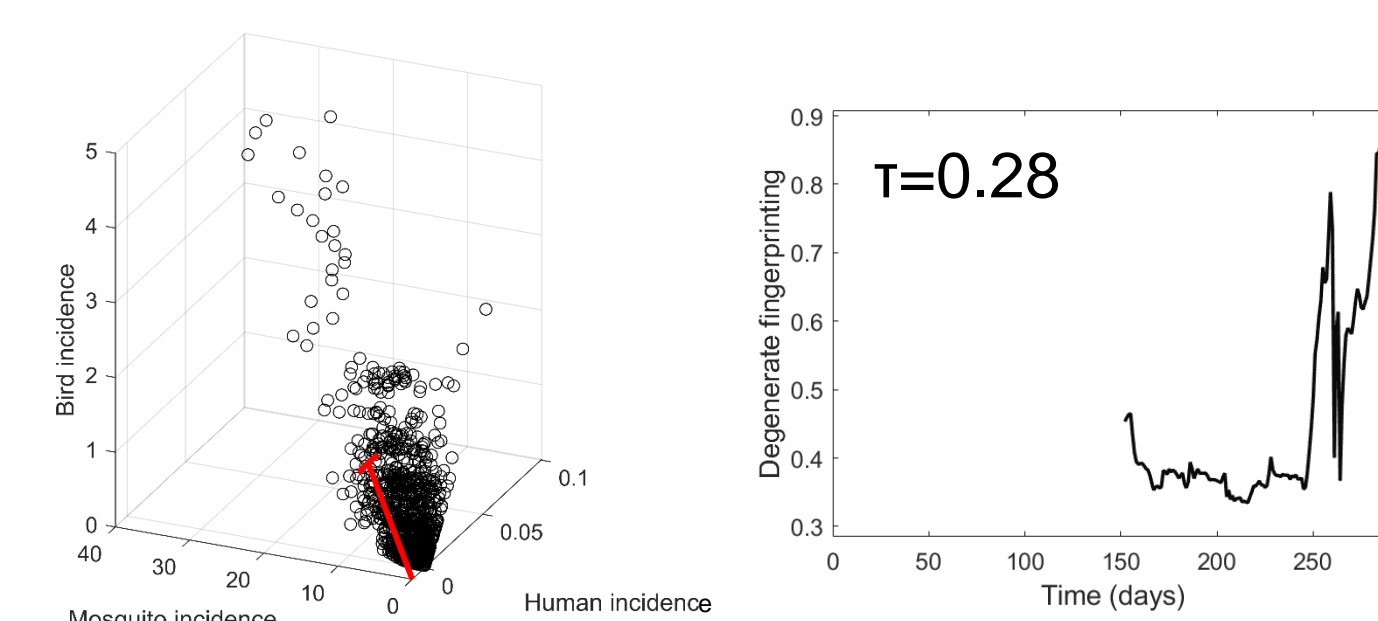
Combine different data types to improve the early-warnings?

Hypothesis: combining data from multiple species/sources will improve the performance of early-warnings, and reduce data requirements (resolution and length of time series)

Univariate indicators
 Information contained in one time series



Multivariate indicators
 Combine the information contained in several time series, sometimes using dimension reduction techniques (PCA, MAF)



Univariate scenarios: One single time series. 7 scenarios

Multivariate scenarios: Combination of 3 to 4 time series. 4 scenarios

	Incidence data				Seroprevalence data		
	Human	Mosquito	Bird	Horse	Human	Bird	Horse
Scenario 1	X	X	X	X			
Scenario 2					X	X	X
Scenario 3	X			X	X		X
Scenario 4		X	X			X	

