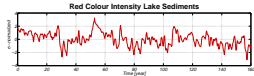
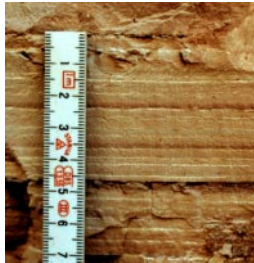


El Niño Impact on Lake Deposits in NW Argentina 30 000 ^{14}C Years Ago

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Photograph and time series of varved lake sediments from the location of El Paso with cyclic occurrence of dark red colouration reflecting enhanced precipitation.

Lake deposits at location of El Paso (Santa Maria Basin, NW Argentina) and an age of 30 000 ^{14}C years show a characteristic colouration structure. Because of terrific geological conditions one can use the **red colour** intensity of these varved sediments as a precipitation time series and for analysis of the climate conditions 30 000 ^{14}C years ago. We have investigated this palaeo-precipitation in order to find the impact of the El Niño on the weather at this area in the past.

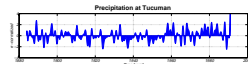
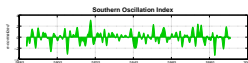
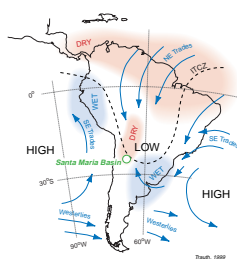
Present-day South American climate is influenced mainly by the **El Niño/ Southern Oscillation (ENSO)**. Its impact results in a wide and extremely variability in local rainfall. The present-day rainfall in the study area decreases during the El Niño phase and increases during the La Niña phase. The ENSO is mostly characterized by an index called Southern Oscillation Index (SOI).

Climate processes are highly **complex and nonstationary systems**. Therefore, modern methods of nonlinear data analysis are used.

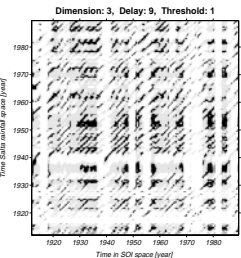
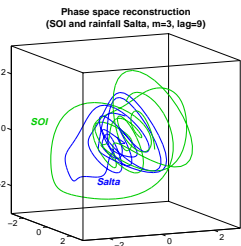
We have improved the method of **cross recurrence plots** in order to compare the present-day and past data. This method compares phase space trajectories of two systems. Similar states are represented by black points in a matrix, the cross recurrence plot. We use the longer diagonals to define some measures of similarity (recurrence rate, determinism, averaged diagonal line length etc.). High values in the introduced parameters represent high similarity between the systems.

Applying the method of cross recurrence plots on present-day precipitation data (Tucuman, Salta and Jujuy), palaeo-precipitation (red colour intensity of varved lake sediments EPI160) and Southern Oscillation Index we have found out a **similar dynamics** in the red colour intensity of the layered sediments as in the present-day precipitation data. The quantitative analysis reveals a **significant influence** of ENSO on the palaeo-precipitation, which obtains the impact of northeasterly trade winds in the past.

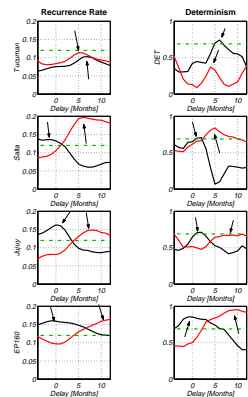
ENSO Impact on Rainfall in South America



Precipitation anomaly during El Niño, major airflow patterns and time series of SOI and present-day rainfall (Tucuman).



Exemplary phase space reconstruction and cross recurrence plot of Southern Oscillation Index and Salta rainfall. Black points represent the vicinity of the both phase space trajectories and diagonal obtain a similar state progress.



Quantitative analysis of cross recurrence plots for comparison of the dynamics of ENSO with present-day and palaeo-rainfall. Maxima reveal a high similarity in the dynamics and green lines represent the 5% quantile levels.

References: MARWAN, N., Trauth, M.H., Kurths, J.: Nonlinear time series analysis on present-day and Pleistocene data from the NW Argentine Andes, submitted to: JGR Atmospheres, January 2001