Space-Time Kriging of Precipitation Reconstructed at 12-km Grid Intervals from Tree-Ring Records

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Understanding and preparing for future hydroclimatic variability greatly benefits from long (i.e., multi-century) records at seasonal to annual time steps that have been gridded at km-scale spatial intervals over a geographic region. Kriging is a geostatistical technique commonly used for optimal interpolation of environmental data, and space-time geostatistical models can improve kriging estimates when long temporal sequences of observations exist at relatively few points on the landscape. Here I present how a network of 22 tree-ring chronologies from single-leaf pinyon (Pinus monophylla) in the central Great Basin of North America was used to extend hydroclimatic records both temporally and spatially. First, the Line of Organic Correlation (LOC) method was used to reconstruct October-May total precipitation anomalies at each tree-ring site, as these ecotonal environments at the lower forest border are typically moisture limited. Individual site reconstructions were then combined using a hierarchical model of spatio-temporal kriging that produced annual anomaly maps on a 12x12 km grid during the period in common among all chronologies (1650-1976). Hydro-climatic episodes were numerically identified and modeled using their duration, magnitude, and peak. Spatial patterns were more variable during wet years than during dry years, and the evolution of drought episodes over space and time could be visualized and quantified. The most remarkable episode in the entire reconstruction was the early 1900s pluvial, followed by the late 1800s drought. The 1930s 'Dust Bowl' drought was among the top ten hydroclimatic episodes in the past few centuries. These results directly address the needs of water and natural resource managers with respect to planning for 'worst case' scenarios of drought duration and magnitude at the watershed level.

The absolute Cr isotopic ratios of the components of carbonaceous chondrites

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Non linear isotopic anomalies are common for Cr in carbonaceous chondrites at the mineral scale where percent level variations are common for ^{54}Cr [1,2]. When these anomalies are small relative to the dispersion of mass discrimination during TIMS measurements, the identity of the anomalous isotope(s) is not unambiguous. For the stepwise dissolution fraction of C1 and C2 carbonaceous chondrites former experiments designate ^{54}Cr as the major varying isotope and ^{53}Cr as varying only according to ^{53}Mn decay. Nevertheless below about 10 ε variations some effects can still be present on the two normalizing isotopes ^{52}Cr and ^{50}Cr. As evaporation and condensation in the forming solar system is a credible possibility, significant fractionation can also be present between the components that constitute carbonaceous chondrites. We address this issue in this presentation.

In Orgueil, Tagish Lake, Tafassasset and Paris, dissolution fractions in which non-mass-dependent ^{54}Cr effects can spread up to close to 2% [1-3] were investigated. A Neptune MC-ICPMS was used in the medium resolution mode (M/ΔM~5000) to avoid interferences from Ar compounds in the Cr mass range. ^{53}Cr/^{52}Cr ratios are measured within a 0.05 δ (permil deviation relative to NIST 979). Radiogenic contributions on ^{53}Cr can be substracted using the TIMS data obtained on the same Cr fractions.

^{53}Cr/^{52}Cr ratios in fractions from stepwise dissolution in C1 and C2 chondrites [1-3] are identical to their respective whole rocks within 0.1 δ. This implies that despite large differences in ^{54}Cr the other three isotope: ^{50}Cr, ^{52}Cr and ^{53}Cr are initially in identical proportions in all the mineral fractions investigated with the present procedure. At present, carbonaceous chondrites seem to contain only only two primordial Cr isotopic components: one with normal ^{50}Cr, ^{52}Cr, ^{53}Cr and a deficit in ^{54}Cr, and a second one which consists of pure ^{54}Cr. Data on new, recently found carbonaceous chondrites will also be presented [4].

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