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Network stability criteria derived from coupled EOF-Allan variance analysis

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A key element of an ITRF realization based on time series of coordinates of space geodetic stations is the identification of a stable core network for each technique. Various quality criteria may be considered to this effect. We propose a selection process based on the non linear behaviour of the stations. The major component in the station motions being classically modelled as a linear motion, the proposed protocol is based on the spectral evaluation of the seasonal and other perturbations. The 3D geodetic station position signal is submitted to principal component analysis (PCA) in the time domain. This is similar to a common practice of geophysics, where geographically weighted PCAs are used, which normally are referred to as empirical orthogonal functions (EOFs). The EOFs can be regarded as a kind of eigenvectors, which are aligned so that the leading EOFs describe the temporally coherent pattern that maximises its variance. Then the spectral behaviour of the derived EOFs is characterized by their Allan variance for a one-year sampling time. The protocol is applied to time series of station coordinates obtained from several space geodetic techniques. Station stability indices and weighting factors are derived. Technique specific spectral density laws of the non linear station motions are identified. The impact on the stability evaluation is investigated. Checks are performed on the basis of time series of Helmert transformations for colocation networks.