Abstract. In this paper we present a conceptual framework that relates precipitation, subsurface soil moisture, and streamflow at long time scales such as years. More specifically, we focus on the effects of weather low frequency components that are reflected in precipitation series, and the effects of surface and subsurface storages on groundwater and streamflow variability. We show that for natural watersheds, the underlying variability and persistence characteristics of annual groundwater storage and annual streamflow processes, are directly related to the storage characteristics of the basin, such as surface and subsurface storages, and the effect of weather variability. Particularly, we argue that the persistence observed in annual streamflow series is made up of both a “high frequency” (year to year) persistence due to land surface and subsurface storages that brings an autoregressive type of persistence, and a “low frequency” (multiyear) component in the form of random shifts in the mean level of precipitation.