Earth Systems Science in the Stars

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NASA is currently studying telescope concepts whose goals include the characterization of planets that have a size and instellation that is similar to modern-day Earth. This characterization will primarily come in the form of specroscopic data, which will allow us to detect major atmospheric species, create crude longitudinal maps of oceans and continents, and search for biologically-produced gases and surface features. The aseessment of data from these missions – and particualrly the assessment of whether or not exoplanets contian global biospheres – will be highly informed by Earth history, and the systems science that has resulted from our study of it. We must leverage our understanding of Earth systems science to understand the complex interactions on an exoplanet's biosphere, atmosphere, hydrosphere, geosphere, and cryosphere. In turn, the analyses of the data we receive from these future missions – which could observe up to 60 potentially "Earth-like" worlds – will revolutionize our understanding of Earth system science. In this talk, we will review methodoligical tools with heritage in Earth systems science that will be essential to our study of rocky exoplanets. We will also discuss specific lessons from Earth history, and how they are already informing the design of telescopes that plan to search for signs of life on exoplanets. Finally, we will discuss the dangers of being "Earth chauvunists" that are not able to assess the range of conditions exoplanets will exhibit, which will undoubtedly be broader than the diverse environments expressed in the history of our home world.