2017 SSRI Fitzsimmons Lectures

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Reconstructing Past Climates: The View From Underground

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The global instrumental record of Earth's surface temperature at annual resolution extends back only to the mid-to-late 19th century. Climate proxies, such as historical agricultural records, tree ring growth, coral growth, ice cores, lake sediment varves, and several others have enabled the reconstruction of annual temperature variability back several hundred to a few thousand years prior to the instrumental record. In the late 20th century a new source of information about past climate was recognized: the temperature of the rocks beneath the surface as measured in deep boreholes. These subsurface temperatures can be analyzed to reconstruct the surface temperature history at the borehole site. The lecture will include a discussion of (1) how present-day temperatures in a borehole can yield information about the temperature history at the surface, (2) non-climatic factors that can influence subsurface temperatures, (3) how well subsurface temperatures track air temperatures, and (4) how geothermal reconstructions compare with reconstructions using other proxies. Analysis of more than 800 borehole records from all the continents show that five centuries ago Earth's average surface temperature was about 1 Celsius degree cooler than the present- day surface temperature. Fully half of the warming since 1500 occurred in the 20th century.