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A re-examination of Antarctic primary nitrogen sources

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The quantitative analysis of trace chemical constituents in aged ice fields is now recognized as a scientific methodology that can lead to major insights related to both climate trends and significant shifts in planetary geophysical features (e.g., volcanic eruptions). The resulting chemical ”fingerprints” can involve several chemical elements as well as compounds. The latter includes species that contain nitrogen. Historically, however, the information derived from nitrogen has never proven to be of great value as a chemical proxy, primarily because the sources of this species have never been convincingly identified. From Antarctic studies in the late seventies and early eighties, several investigators proposed that the dominate source of nitrogen found in ice cores was that resulting from nitrogen fixation in the upper atmosphere. Thus, the fluctuations observed in its levels were thought to reflect shifts in solar activity. This tentative conclusion was later refuted by other studies with the latter suggesting that perhaps tropospheric lightning might be the dominant source, with smaller contributions coming from the lower stratosphere. Still more recently, some carefully executed isotopic studies have provided evidence that intrusions from the stratosphere and/or sedimentation of PSCs most likely make up some modest fraction of the nitrate observed in plateau ice. Here, the authors will explore, via modeling results, some quite new thinking on plateau sources of nitrogen. These results will be based on some rather revealing new unpublished atmospheric nitrogen data sets, as well as an older one that has remained unnoticed.