Avoiding bias in reconstructing the largest observable scales from partial-sky data

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Obscuration due to Galactic emission complicates the extraction of information from cosmological surveys, and requires some combination of the (typically imperfect) modeling and subtraction of foregrounds, or the removal of part of the sky. This particularly affects the extraction of information from the largest observable scales. Maximum-likelihood estimators for reconstructing the full-sky spherical harmonic coefficients from partial-sky maps have recently been shown to be susceptible to contamination from within the sky cut, arising due to the necessity to band-limit the data by smoothing prior to reconstruction. Using the WMAP 7-year data, we investigate modified implementations of such estimators which are robust to the leakage of contaminants from within masked regions. We provide a measure, based on the expected amplitude of residual foregrounds, for selecting the most appropriate estimator for the task at hand. We explain why the related quadratic maximum-likelihood estimator of the angular power spectrum does not suffer from smoothing-induced bias.

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