A user parameter-free diagonal-loading scheme for clutter rejection on radar wind profilers

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We present a novel method for the automatic determination of the diagonal-loading level for robust adaptive beamforming on radar wind profilers. This method balances the degradation of the signal-to-interference ratio with that of the signal-to-noise ratio to maximize the detectability of the backscattered signals. Because radial wind velocities are usually estimated from the first moment of the spectrum of backscattered echoes, both the residual ground clutter and any increase in noise level degrade the detectability of atmospheric echoes. The proposed algorithm evaluates the power spectral density of the residual clutter and increased noise to determine the optimal diagonal-loading level by balancing these two factors. The results of numerical simulation show that, without the need to specify any user parameters, the proposed algorithm is stable and more effective at maximizing the signal-to-interference ratio than the conventional norm-constrained diagonal-loading approach. The stability and clutter suppression capability of the proposed algorithm are examined using data from the Program of the Antarctic Syowa mesosphere-stratosphere-troposphere/incoherent scatter radar.