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Sodar errors from the return signal drifting outside the receiver beam

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Sodars transmit sound upward in a narrow beam. This sound is known to drift downwind but, since the angular pattern for back-scatter is not very directional, scattered sound is received by the narrow beam receiver. For a conventional sodar, the change in scattering angle due to wind drift causes only a small change in Doppler shift for individual acoustic ray paths. However, when the angular pattern of transmission and the angular pattern of reception are taken into account, there can be a substantial bias in the beam-averaged Doppler shift. This effect, not previously studied, leads to errors in estimated winds. It also contributes to limiting the vertical height range over which useful wind data is obtained. The errors are wind-direction dependent, and so can masquerade as 'random' noise in a sodar evaluation against mast instruments. This wind drift bias is dependent on the design of the transmitter and receiver beam patterns. Two non-conventional sodar designs show these errors more strongly. The first is the phased-array bistatic sodar in which the transmitter and receiver are separated by around 40m. The magnitude of the Doppler shift from receivers placed on either side of the vertical transmitted beam is quite different, and corrections need to be applied. The other non-conventional sodar is the new urban sodar, described in another EMS presentation, which has very narrow receiver beams. In this case wind drift corrections are also required. In both cases the corrections are shown to lead to much improved wind estimation.