

1 Ground clutter

In contrast to anomalous propagation (AP, see Section ??) echoes and other spurious echo types, ground clutter occurs independently of propagation conditions and can be both permanent and severe. However, ground clutter mostly manifests itself through local features, whereas AP echoes can occur anywhere in the radar coverage area. Ground clutter occurrence depends on how well a radar is sited, how its scan strategy is configured, if the radar has Doppler capabilities, and if so, how well the Doppler clutter suppression performs.

In good conditions, ground clutter is almost exclusively caused by sidelobe radiation in a local area near the radar (Figure 1a). In worse conditions, such as in areas with complex topography (Figure 2a), the lower part of the radar beam may radiate hilltops or mountains on a permanent basis, generating very strong echoes.

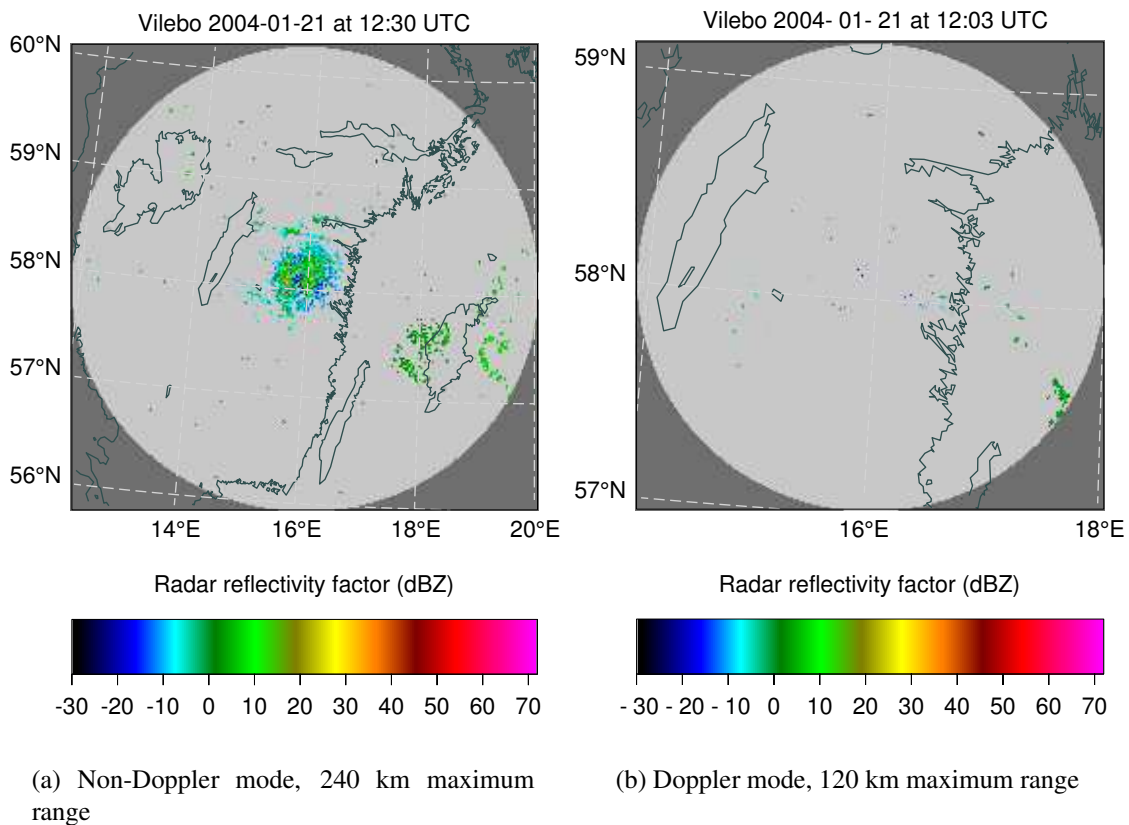


Figure 1: Vilebo. Ground clutter seen near the radar in non-Doppler mode (a) is easily removed through Doppler filtering (b). Snow showers can be seen over Gotland.

In order to minimize the effects of ground clutter, intelligent siting is important. An antenna placement located just above a canopy of coniferous forest or bushes is an effective means of minimizing the effects of sidelobe returns.

Effective Doppler signal processing, and example of which is given in Figure 1b to only half the radar's operational range, is also a common and standard method of minimizing ground clutter (Koistinen 1997). Even in less favourable conditions, Doppler processing

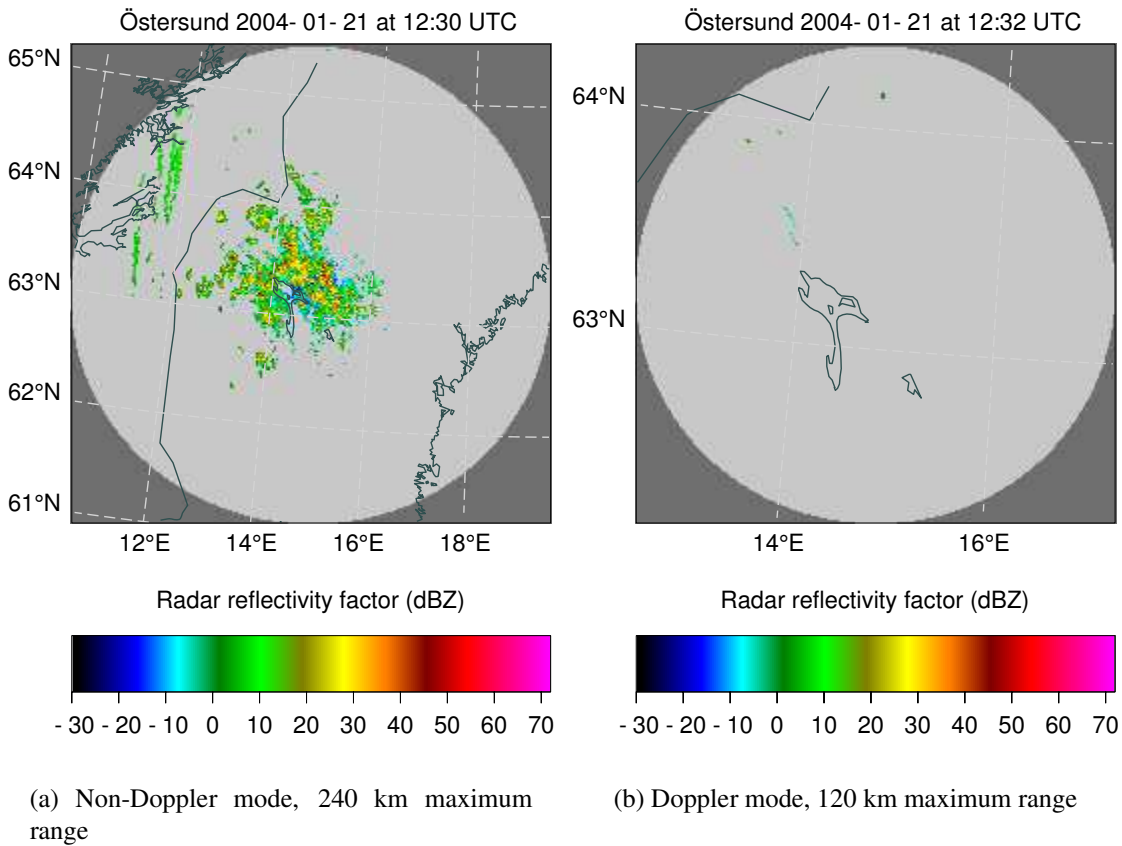


Figure 2: Östersund. Severe ground clutter seen in non-Doppler mode (a) is effectively removed using Doppler filtering (b).

is effective (Figure 2b). Image analysis techniques, e.g. Koistinen et al. (2003), show potential in identifying and removing specific categories of non-precipitation echoes, among them ground clutter. Multisource methods, e.g. Michelson and Sunhede (2004), should only be considered in this context as a means of removing any residual ground clutter which signal processing and image analysis techniques leave behind.

2 References

- Koistinen, J., 1997. Clutter cancellation and the capabilities of modern Doppler radars. Proc. COST 75 Workshop on Doppler Weather Radar. European Commission, Luxembourg. pp. 7-11.
- Koistinen, J., Michelson, D. B., Hohti, H., and Peura, M., 2003. Operational Measurement of Precipitation in Cold Climates. In Meischner, P. (Ed.), *Advanced Applications of Weather Radar*, Chapter 3. Springer. 340 pp.
- Michelson, D. B. and Sunhede, D., 2004. Spurious weather radar echo identification and removal using multisource temperature information. *Meteorol. Appl.* 11(1), 1–14.