E region echo velocity and ExB as inferred from Stokkseyri observations

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The relationship between the velocity of E region HF echoes and the ExB electron flow velocity is investigated by considering data collected by the Stokkseyri SuperDARN radar roughly along the ExB direction. Stokkseyri simultaneous observations of short-range, E region echoes and adjacent far-range, F region echoes are considered. From the velocities of F region echoes, an effective ExB drift vector is inferred. Two classes of events are considered in detail, the high and low velocity echoes. Both types of echoes show velocities smaller than the ExB drift, with the ratio of the high (low) velocity echoes to the ExB magnitude of ~ 0.3 (~ 0.2). This has been shown by considering observations only in several beams along the ExB and by considering data in all beams, i.e. including directions almost perpendicular to the flow. Both classes of echoes show a cosine type variation of the velocity with the flow angle. Some minor differences in echo parameters for these two classes have been identified. It is shown that the high velocity echoes can be explained in terms of the Farley-Buneman plasma instability and the irregularity velocity saturation at the ion-acoustic speed, but only if echo detection from the electrojet bottom side is assumed. A similar explanation cannot be applied to the low velocity echoes; it is argued that these echoes are likely coming from the electrojet bottom side, where the velocity of electrojet irregularities can be depressed because of collisional effects on the Farley-Buneman instability or because other types of instabilities are operational at these heights. Finally, it is shown that the velocity of the shortest range echoes are very likely received at large off-perpendicular aspect angles and cannot be explained by the velocity of the ion motion in an electric field. It is argued that the neutral wind can significantly affect the velocity of these echoes.