

## ***Interactive comment on “Calibration and validation of the advanced E-Region Wind Interferometer” by S. K. Kristoffersen et al.***

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This paper describes the calibration and validation of E-region wind measurements from ERWIN II, a field-widened Michelson Doppler optical interferometer located at Eureka, Nunavut, Canada. Compared to its predecessor ERWIN I employs an imaging detector and a modified telescope enabling the instrument to view multiple sky locations simultaneously thereby increasing the efficiency of the instrument. The primary focus of the paper is the calibration and validation of atmospheric winds as measured from three different emissions, oxygen green line O[1S], OH and O<sub>2</sub>, each of which probes slightly different E-region altitudes. I enjoyed reading the paper. The near-theoretical precision obtained is a testament to the power of carefully calibrated optical

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Doppler measurements. Each of the important instrumental effects that must be determined to achieve high precision (zero phase, thermal drift, and phase variation across the field) are addressed in detail. The paper is definitely suitable for publication.

Aside from some minor points, indicated later, I have only two main issues to raise with the paper.

1) In section 6 the authors attempt to compare the precision of ERWIN II with other ground-based wind measuring instruments. They correctly state that such comparisons are not straightforward. Comparing instruments with different etendues, measuring different source brightnesses, designed for potentially different objectives, utilizing different observation geometries, and at different stages of development is problematic at best. Although the authors don't state this, my concern is that this section may be misinterpreted as implying that the stepped Michelson technique employed by ERWIN II is superior to the others in their comparison. At a minimum, a fairer comparison would start with source brightness and the etendues of each of the optical measurements which determines how many photons are ultimately detected by each, which something not addressed in the paper. Even that would not address some subtle aspects of a general comparison. For example, when measuring time varying sources or observation geometries, simultaneous rather than scanned techniques are likely to result in smaller systematic errors. Although it is tempting to try to determine the “best technique” to measure atmospheric winds, each measurement problem presents its own subtleties which will determine which measurement technique is best fit to the problem.

2) Equations 4 and 14 indicate that the theoretical performance of the wind precision requires knowledge of the source brightness in photons,  $I_0$  (equation 4), or  $I$  (equation 14). Although figure 7 implies that these values are known they are not indicated anywhere in the paper. A figure showing representative brightness values for the three emissions would be useful. Minor points:

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1) The term irradiance is used for source brightness throughout the paper (e.g. pg 8274 equation 1). From the context provided by equations 4 and 14, this should be “total number of photons detected” rather than irradiance which is an SI unit measured in W/m<sup>2</sup>.

2) One of the roles intended for the calibration lamps was to determine the background phase for each of the emissions. The paper suggests that these data were not sufficient so data from a cloudy night was used for this measurement. It would be useful if the paper discussed potential reasons for the failure of the calibration lamps to provide a suitable background phase (e.g. non-uniform filling?, difference in wavelength? something else?).

3) Using differences between opposite cardinal point to determine horizontal and vertical winds assumes a non-divergent wind field (see equations 5, 6, 7, 8 and 10). This should be explicitly stated. Also is such an assumption justified?

4) Both degrees and radians are used to indicate instrumental phases and drifts (compare figures 2, 5 and 6). Comparing these would be easier for the reader if either radians or degrees, not both were used throughout.

5) Page 8288 line 6, “Figure 6 gives” should be “Figure 5 gives”.

6) Grammar issues: Page 8289 line 22 “is” should be “are” and “it was” should be “they were”.

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Interactive comment on Atmos. Meas. Tech. Discuss., 5, 8271, 2012.