

Review of “Temperature profiling at the American WAKE Experiment (AWAKEN): methodology and uncertainty quantification” by Letizia et al.”

The manuscript provides an overview on temperature profiling from ground-based spectral infrared radiance observations using the rather novel ASSIST instrument and covers both, a comprehensive uncertainty analysis of the instrument itself and the TROPoe temperature profile retrieval algorithm, as well as the analysis of nearly one year of multi-site ASSIST temperature profiling during the AWAKEN campaign.

The manuscript is rather long, but the presented information justifies its length. It is in general well structured and well written and can be considered for publication in WES after addressing a few minor comments.

Thanks for the supportive feedback and the thoughtful review of our paper. The reviewer raised valuable points that we addressed as described below.

Line 51: opening “ (“ missing for the citations

Fixed.

First paragraph section 2 methods: The manuscript would highly benefit from a better and more detailed introduction of the ASSIST system

We included a concise but exhaustive description of the ASSIST in Sect. 2.1:

The ASSIST is a hyperspectral infrared spectrometer that resolves the downwelling radiation in the wavenumber range 525-3300 cm⁻¹ with a spectral resolution of about 0.5 cm⁻¹. It shares many similarities with the older Atmospheric Emitted Radiance Interferometer (AERI, Knuteson et al., 2004a). In fact, the core instrument is a Fourier transform interferometer of the Michelson type. The online radiometric calibration is carried out by rotating a scene mirror that alternates views of two blackbodies and the sky. One blackbody is thermally regulated and the other is allowed to drift according to the ambient conditions, and both act as known sources of emission in the linear calibration process. The ASSIST is able to generate an independent spectral radiance estimation every 14 s during sky views. High spectral accuracy is obtained thanks to a stable laser source that triggers the sampling of the raw interferogram at precise intervals along the mirror path. The interested reader is referred to Michaud-Belleau et al. (2025); Letizia et al. (2025) for more details.

Lines 85/86: “TROPoe utilizes a spectrally-resolved and extensively validated radiative transfer model (Turner et al., 2004; Clough et al., 2005; Mlawer and Turner, 2016) to simulate

the spectral radiance that is associated with a given temperature profile”; I think it is not only the temperature profile, but also the humidity profile that plays a role here, right?

Correct. We fixed that line by adding:

“...thermodynamic profile (mainly temperature and water vapor content)”

Line 224: “and exhibits a gradual monotonic trend with height”; what is the reason for this increase with height? Mainly the increase in range gate length/probe volume with altitude, or are there other effects in play?

The increase of the total error (noise+smoothing) with height is a well-established theoretical result in atmospheric sounding. However, the trend of the noise-only contribution has been shown very few times (e.g., Rodgers 2000, Fig. 3.6) and has a less consistent behavior with height. We hypothesize that one of the reasons why the noise error increases with height is the relatively lower signal-to-noise ratio in channels that are more transparent to infrared radiation. Transparent in the context of ground-based thermodynamic profiling also means carrying information from higher altitudes. Another reason could be the formulation of the numerical solution algorithm, which anchors the estimated profiles using first observations closer to the ground, thus reducing the noise-induced uncertainty at lower altitudes.

First par section 3.3., starting with line 244, description of the mast measurement setup; I miss here a bit more detailed description of the temperature measurement system; are the differences based on thermocouples? Which type is the absolute temperature sensor at 3 m?

The sensors for both absolute and differential temperature measurement are platinum RTD. We now say at Line 262:

“The total error of the temperature profiles is quantified through a comparison with the temperature readings of the Resistance Temperature Detector (RTD) platinum probes installed on the M5 tower. Specifically, the temperature profile is reconstructed by combining the absolute temperature measured by the RTD at 3 m and differential temperature measurements still from RTD pairs between 3 and 38, 38 and 87, and 87 and 122 m.”

Line 293: “For an ergodic, horizontally homogeneous field, this reads...”; Is this assumption generally valid? I would expect this maybe in neutral and partially stable conditions, but not necessarily for daytime convective situations.

This is an interesting subtlety. During the daytime, there are persistent thermal plumes that may invalidate horizontal homogeneity for short periods of time. However, since we have no

reason to believe that at the experimental site convective cells form consistently at specific locations, we can still assume that the expected value of the structure function is independent of the direction. Omni-directionality is the only simplification used in Eq. 4. This is not too important, considering that later on we select only data within a 40-degree wind sector.

Fig. 16 f: Do you have any idea/hypothesis, why the distribution for the data at the site North is considerably broader compared to South and Middle? That site seems to have a different microclimate compared to the two others (see also some of the following comments)

Good catch, this is something we forgot to address. We now added at Line 453:

“The North site is practically unbiased, but shows slightly more scattering, possibly due to its proximity to the turbines, which may result in increased turbulence levels.”

Figures 17 a-c indicate that it is station North causing the differences/deviations

We now clarify at Line 469:

“The previously observed bias at the South and Middle sites cancels out in Fig. 17d, but contributes to shifting the peak of the PDF in the other cases.”

Fig 18: Again, North shows a distinct differing behavior

True, although it is merely a shift of the stability-dependent biases while the trend with stability (the main focus of this figure) is still consistent with the other sites. We chose to omit this last point for brevity.

Fig. 20: In all plots before the order was different: south-middle-north....., which feels a bit inconsistent; but I fully understand the point to plot the Northernmost station on top....

Correct observation, we keep it consistent with the “physical location” of the sites, like we did in the Fig.6.

Line 651 references: “XXXX-XXXXX” should there be another report identifier?

The reference has been updated (it was under review).

Final curiosity question: have there been deployed passive microwave radiometers for temperature profiling in parallel during AWAKEN, and if yes are there any plans to compare both methods?

We have not at AWAKEN, but other researchers in our team have made this comparison in the past (e.g., [Blumberg et al., 2017](#), [Turner and Lohnert, 2021](#), [Bianco et al., 2024](#)). Conclusions: the infrared part of the spectrum has more information content, which leads

to generally smaller errors and better vertical resolution. However, MWR can see better through clouds.