This paper discusses an aircraft tunable laser spectrometer titled Hygrometer for Atmospheric Investigations (HAI) for in situ water vapor and total water measurements. The paper discusses the four separate measurements that HAI provides via two independent diode lasers (1.4 and 2.6 μm) and two different analysis cells (open and closed path). The authors discuss how HAI will improve upon present field instruments and show some flight data.

Major Issues:

1) The purpose of this manuscript is unclear.

The present paper has 'multi-phase' in its title but does not discuss HAI total water components in sufficient detail. Such details are necessary to understand how the effectiveness of HAI multi-phase measurements. Total water measurements present new challenges such as particle enhancement factors and memory effects that require careful study – and none of that is presented in this manuscript.

Rather, this paper is about how the methodology of multi-channel water measurements provide a more accurate water vapor measurement than prior art. In this light, there is clearer justification for this manuscript – i.e. that measuring water vapor simultaneously via two different wavelengths and two different analysis cells helps constrain measurement uncertainty. However, the authors need to re-write the body of the manuscript to discuss this in more detail. For instance, the Harvard HHH and total water instrument provide a multi-channel measurement but that is not discussed in this manuscript. Also, past aircraft measurements involved multiple instruments on one aircraft – how does HAI do better than these experiments?

2) The term 'calibration-free' is misleading and the authors do not prove HAI is 'calibration-free'.

At the percent or better level (accuracy and/or repeatability), even first-principles, direct absorption measurements need to consider instrumental artifacts such as detector non-linearity and low-pass filtering of the detector signal. Both of these artifacts can be misinterpreted as using the wrong line-shape algorithm. In this way, a first-principles methodology might be more prone to error than one that lumps all translation factors into one multi-parameter function.

It will take some work to prove a system to be 'calibration-free'. Such proof would be measuring a known concentration if non-stick gas (methane for the 1.4 μm channel) at several different concentrations, then repeating this for different temperatures the detector and filtering electronics will encounter.

3) Lines 638-650 have incomplete information and need to be better researched and re-written.

There are at least two other open path aircraft instruments not listed here: DLH (Disken et al.) and HHH (Harvard Anderson Group). Moreover, JLH (part c of author's list) has flown more than 200 times and there is a wealth of information on how it performed against other water instruments and satellite retrievals.

Minor issues:

1) The entire paper needs to be edited to be less conversational. For example, don't use phrases like "Of course" and re-write the sentence in lines 226-228 to be less conversational.

2) Correct spelling of 'Herriott'

3) Define 't' in equation 1.