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Interactive comment on "Time Series Analysis of Ground-Based Microwave Measurements at K- and V-Bands to Detect Temporal Changes in Water Vapor and Temperature Profiles" *by* Sibananda Panda et al.

Sibananda Panda et al.

swaroop.sahoo769@gmail.com

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The authors would like to thank the reviewer for his comments due to which the manuscripts quality has improved.

The reponse to the reviewer's comments as well as the updated paper are attached.

Please also note the supplement to this comment:
http://www.geosci-instrum-method-data-syst-discuss.net/gi-2016-16/gi-2016-16-AC3-supplement.pdf

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., doi:10.5194/gi-2016-16, 2016.

Referee #3

Response to Reviewer Comments

The authors would like to thank the reviewer for the comments which have significantly improved the quality of the paper.

1) To improve the dissemination of the manuscript, please add a paragraph describing the physical phenomenon at the basis of the sensing.

Response: The authors have added the following paragraph to the paper in Section 3.1.

Remote sensing of water vapor and temperature is based on the measurement of microwave radiation emitted by water vapor and oxygen molecules. The emission and absorption of microwave radiation due to water vapor and oxygen in each tropospheric layer change the microwave radiation that reaches the ground. This variation in radiation is due to the concentration of water vapor in the atmosphere and the temperature at various altitudes. Therefore, these microwave radiation reaching the ground are source of information about the humidity distribution and temperature variation in the atmosphere at different heights.

Measurement of this radiation at the weak water humdity absorption line (centred at 22.235 GHz) is used for the sensing of water vapor profile variation. This is based on humidity absorption line broadening. This broadening is due to motion of the water molecules and their collisions with other water molecules and is known as pressure broadening. Thus change in pressure has a significant impact on the width of the absorption lines as well as the absorption values. So, a decrease in the atmospheric pressure reduces the line width and increases the water vapor absorption line strength which is most prominent at 22.235 GHz (the center of the absorption line). Therefore, closer the proximity of the measurement frequency to the weak water vapor resonance frequency higher the sensitivity to water vapor at high altitudes. As the pressure increases the absorption line widens resulting in reduced sensitivity to water vapor at high altitudes. However, frequencies farther away from the center frequency are more sensitive to water vapor changes close to ground level. This is again proven by the weighting functions at various frequencies. Weighting functions closest to the water vapor resonance frequencies are almost twice more sensitive to water vapor at 8 km than near ground level. While frequencies further way from the resonance peak are most sensitive to changes close to ground level. Therefore, a combination of various frequency measurements is able to detect the profile information about water vapor.

Similarly, microwave radiation from oxygen at the 60 GHz absorption complex can be used for retrieving temperature profile information because atmospheric absorption in the 50-75 GHz range is primarily due to oxygen molecules. The absorption due to oxygen molecule is due to magnetic moment 33 spin-rotational lines between 51.5-67.9 GHz. These spin-rotational lines blend together at lower altitude due to the pressure broadening of the lines. This blended absorption lines has a shape similar to an absorption band centered at 60 GHz. However, the absorption line intensity is not the simple addition of isolated line intensities but the "overlap interference" which gives rise to a very complex absorption band called the

Fig. 1.