

Date: September 9, 2016

Manuscript #: amt-2016-217

Manuscript title: ***Combining METEOSAT-10 satellite image data with GPS tropospheric path delays to estimate regional Integrated Water Vapor (IWV) distribution***

Brief Summary of the Manuscript

This manuscript attempts to estimate the IWV around the Israel peninsula by combining ground-based GPS-derived IWV with METEOSAT-10 IR surface temperature observations. An empirical relationship between METEOSAT-10 pixels and GPS IWV is derived, in order to exploit the potential of METEOSAT-10 observations to provide a complementary observational data set to ground-based GPS stations. The expected analysis could provide a novel technique to remotely sense from space-based platforms the IWV, not only over land regions but also over oceanic locations.

Major Comments:

- 1) The manuscript lacks motivation/objectivity: The authors need to establish the motivation for and objectives of this study. The use of ground-based GPS receivers to retrieve IWV is a well-established technique, and therefore its application to the Israel peninsula does not provide a significant science contribution. What is unique in this analysis? And why this analysis needs to be done?
- 2) The methodology needs explanation: The scientific merit and novelty of this study is the calibration of the METEOSAT-10 satellite observations to infer IWV, which I find quite interesting because it has never been done before. That said, I would like to see a detailed focus/explanation as of how the calibration happens.
- 3) Line 132: The elevation cut-off angle is routinely set to 10° . Why did the authors decide to use a cut-off angle of 7° ? How would their results change if higher elevation angle were used? Does the elevation angle affect the sampling rate of the ground-based GPS receivers? What is the quality of the surface temperature observations of the METEOSAT-10 satellite?
- 4) Line 200: The water vapor distribution is quite variable over horizontal scales. Why do the authors assume a uniform distribution of IWV? This seems to be a critical component of the calibration process. How does non-uniformity impact the derivation of Equations (3–8)? What is the sensitivity of equation (9) to the choice of values in equations (3–7)?
- 5) Figure 4: The linear regression between the METEOSAT-10 and IMS? The blue line fit does not seem optimal. I notice that the slope of the fit should be smaller with a y-intercept around ~ 297.5 K.
- 6) Figure 8: What are the 1-sigma uncertainty errors of the fit?
- 7) The statistical sampling is rather small and does not guarantee statistical significance.
- 8) How does METEOSAT-10 IWV look like under cloudy conditions?
- 9) Line 172: What does the surface temperature error of 2°C introduce to IWV?

Minor Comments:

- a) **Line 26**: IWV is mostly due the boundary layer water vapor. It does not tell us anything about dynamical processes in the upper troposphere. I consider revising this statement, or remove it complete it because it appears to be out of context.
- b) **Line 319**: The statement about the upper air conditions is out of context.
- c) **Line 31**: Should read: “network”
- d) **Line 53**: Should read: “temperature”
- e) **Line 59**: Should read: “manifests”
- f) **Line 78**: Should read: “characterize”
- g) **Line 35**: Should read: “...bent...”
- h) Mention that radiosondes are limited over land regions.
- i) Mention that radiosondes are radiation-contaminated in the upper troposphere.
- j) **Line 84**: Should read: “signals”, “therefore”
- k) **Line 85**: Should read: “are slowed down”

- l) **Line 96:** Should read: “continuously”
- m) **Line 96-97:** The sentence is incomplete. There is something missing. Please, re-write.
- n) **Line 153:** Should read: “represents”. Also, define what you mean by “nearest”.
- o) **Lines 154-156:** Current RO missions do not use closed loop tracking. Please, re-write this section.
- p) **Line 187:** Should read “represents”
- q) Define all variables: k , L , l , β , α in the equations. Also, consider re-writing equation (9), because the alphas are inter-mixed.
- r) **Line 273:** Should read “techniques”
- s) **Line 293:** Should read “it”
- t) **Line 314:** Should read “needed”