A Global Evaluation of Daily to Seasonal Aerosol and Water Vapor Relationships Using a Combination of AERONET and NAAPS Reanalysis Data

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The paper comprehensively examines the relationships between column-integrated Aerosol Optical Depth (AOD) and column-integrated precipitable water (PW) over the globe on seasonal and daily timescales using ground-based AERONET sun photometer measurements and NAAPS-RA model fields.

Primary findings reported include:

- Positive relationships are common and significant on daily and seasonal scales, often for pollution and dust
- Negative relationships are less common, but are robust features when they occur such as associated with biomass burning events
- Synoptic meteorology such as mid latitude frontal systems, large anticyclones, ITCZ and monsoon circulations are responsible for large scale patterns of positive relationships between AOD and PW
- Stronger AOD and PW relationships were observed in the free troposphere and found to be consistent with large-scale transport processes
- Hygroscopic growth of aerosols size related to increased AOD was further found to be consistent with broad areas of high PW, and was noted to have a large influence on observed co-variability between the two observables
- For dust dominated episodes especially in arid air masses, the co-variability between AOD and PW is significant – but hygroscopic growth does not appear to be a factor
- These findings broadly affirmed conditions by which the co-variance with PW and AOD signals are robust and allow PW to be a predictor of AOD transport

Overall Assessment: Publish with minor technical corrections

Strengths:

The study is built upon the long, well-characterized and extensive AERONET ground-based measurement record (> 20 years) with the NAAPS-RA state-of-the-art model system that incorporates MODIS and MISR AOD satellite records (>15 years) with the full array of conventional global meteorological temperature, humidity, and wind observations through the Navy's operational forecasting system.

The references are comprehensive and provide a fair assessment of the state of knowledge on the measurement systems and related processes that influence AOD and PW relationships.

The approach is sound and based upon statistical analyses that are straightforward and easy to comprehend, and thereby, extend insight gained from each observational record. The study

further seeks to understand regional and seasonal scale features, yet, examined shorter term fluctuations to ensure that relationships identified between AOD and PW tracked each other as postulated for the larger variations.

The interpretation of the statistical findings are grounded in knowledge of aerosol sources, instrument performance, and model capabilities and do not reach beyond confidence estimates provided by statistical metrics.

The paper is lucid and flows well. It provides a healthy balance between details on the study approach and findings on AOD and PW relationships.

Weakness:

The figures are very small and details are difficult to read in print versions. When viewed on a screen with zoom capabilities, the figures are mostly legible and highlight 2d structures as described in the text. The labels, however, need to be revised to be readable in a print version – unless print versions are no longer a priority.

A few minor text changes are suggested below.

- Introduce the definition of ABF on page 6
- Clarify the timeframe for appearance of the negative correlation in spring/summer months (page 11). Is this boreal spring/summer?