The Journal of Open Source Software

Precipitable-Water Model Analysis Tool: An open source package for studying precipitable water

Spencer Riley[*1] **and Vicki Kelsey**[†2]

1 Physics Department, New Mexico Institute of Mining and Technology **2** Atmospheric and Environmental Sciences Program, South Dakota School of Mines and Technology

This is a draft

DOI: DOIunavailable

Software

- Review
- Repository
- Archive

Editor: Pending Editor

Reviewers:

- @Pending Reviewers

Submitted: N/A
Published: N/A

License
Authors of papers retain copyright and release the work under a Creative Commons Attribution 4.0 International License (CC BY 4.0).

Summary

In this paper we will adapt a common definition of precipitable water vapor (PWV) as defined by (get citation) which states that PWV is the integrated amount of water vapor for a vertical column of air with height from the surface to the top of the atmosphere. The Precipitable-Water Model Analysis Tool (PMAT) is a utility designed to analyze the relationship between zenith clear sky temperature and precipitable water vapor and develop correlation profiles for this relationship. This relationship has been well documented and defined in both South-Central New Mexico (Kelsey et al., 2021) and Eastern Texas (Mims et al., 2011).

Statement of Need

PMAT has been developed to address the need for an easy-to-use workflow to generate correlation profiles of a specific region. With a defined relationship between the atmospheric brightness temperature and the PWV, precipitation forcasts can be improved.

Software Architecture and Design

The PMAT suite is designed to be divided into modules, each of the different components handles a unique task. There are currently four primary modules: Deployment, Data Import, Data Analysis, and the Classical Support Vector Machine module. Together the four modules can pre-process data collected in the field and aggregate with selected atmospheric science databases, process the data, conduct primary analysis functions, and then visualize the results (Riley & Kelsey, 2021).

Prerequisites for the full deployment of PMAT are minimal but do exist. There are two major requirements that need to be fulfilled:

(1) A data file consisting of manual (or automated) measurements that include ground and sky temperatures in addition to time and date stamps and the visual condition of the sky (either clear sky or overcast)

(2) A configuration file that details the sensor information, site IDs that are needed to retrieve the atmospheric data from the NOAA database, and analysis parameters.

Deployment Module

The Deployment module utilizes a docker environment to run the remaining workflow. There are currently two methods to interface with PMAT through the Deployment Module, the first

*corresponding author
†co-first author

is through GitHub and the second involves a local installation of Docker.

Data Import Module

The Data Import module consists of a Python script to pull and organize data that are required to complete the analysis. The Python script will first read-in the aforementioned data file and then aquisition atmospheric data from the University of Wyoming Upper Air batabase, which contains the measurements conducted by radiosondes at National Weather Service sites, and the NOAA database. From these sources we collect PWV measurements from the radiosondes and surface relative humidity from NOAA.

Data Analysis Module

The function of the analysis component of PMAT is to present the relationship between PWV and zenith sky temperature in terms of statistics and regression. The PWV and temperature subsets of the data undergo a linearization in the form of

$$\log(\text{PWV}) = \log(a) + bT_b, \tag{1}$$

Classical Support Vector Machine Module

The final module that is packaged into the PMAT suite is a supervised machine learning algorithm.

Acknowledgements

References

Kelsey, V., Riley, S., & Minschwaner, K. (2021). Atmospheric precipitable water and its correlation with clear sky infrared temperature observations. *Atmospheric Measurement Techniques Discussions*, *2021*, 1–19. https://doi.org/10.5194/amt-2021-130

Mims, F. M., Chambers, L. H., & Brooks, D. R. (2011). Measuring total column water vapor by pointing an infrared thermometer at the sky. *Bams*, *92*(10), 1311–1320. https://doi.org/10.1175/2011bams3215.1

Riley, S., & Kelsey, V. (2021). Precipitable-water model analysis tool. In *GitHub repository*. GitHub. https://github.com/physicsgoddess1972/Precipitable-Water-Model