Validation of water vapor from GOME-2 satellite instrument against reference GPS data at the Iberian Peninsula

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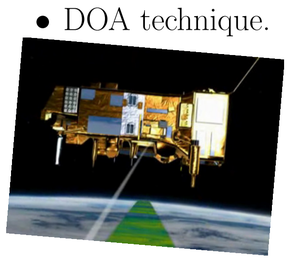
This work was supported by the Spanish Ministry of Economy and Competitiveness through project CGL2014-56255-C2.

Introduction

Water vapor plays a fundamental role in atmospheric processes (radiative transfer, energy transport, greenhouse effect, and so on). However, it is one of the most variable gases in the atmosphere, both temporally and spatially. Thus, it is difficult to provide good measurements of the integrated water vapor (IWV).
Among the numerous methods for IWV retrieval, GPS has proven to be one of the most reliable. Low costs of GPS receivers allow to have dense networks of these devices. However, GPS networks spatial resolution is not enough for applications like weather forecast or global climate studies. In those cases, satellite measurements seem to be more suitable. Nevertheless, satellite measurements have two problems: the temporal resolution (polar orbiting satellites overpass the Iberian Peninsula once or twice a day) and the unreliability of measurements under cloudy conditions.
Thus, in this work the satellite instrument Global Ozone Monitoring Experiment - 2 (GOME-2) has been validated using GPS ground-based stations as reference. Nine stations were selected in the interior of the Iberian Peninsula in the period 2007-2012.

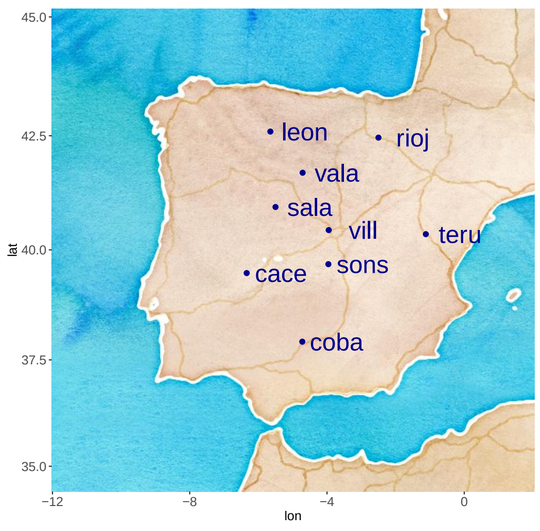
GOME-2

- Ozone profile, integrated water vapor, sulfur dioxide, ...
- Covers Earth surface in 1.5 days
- Pixel resolution: 80 × 40km
- GOME Data Processor (GDP) by DLR-IMF
- DOA technique.



GPS stations

- Instituto Geográfico Nacional ⇒ EUREF
- Measurement of ZTD ⇒ IWV
- Temperature and pressure from AEMET ⇒ Interpolation
- Cloud free conditions



Methodology

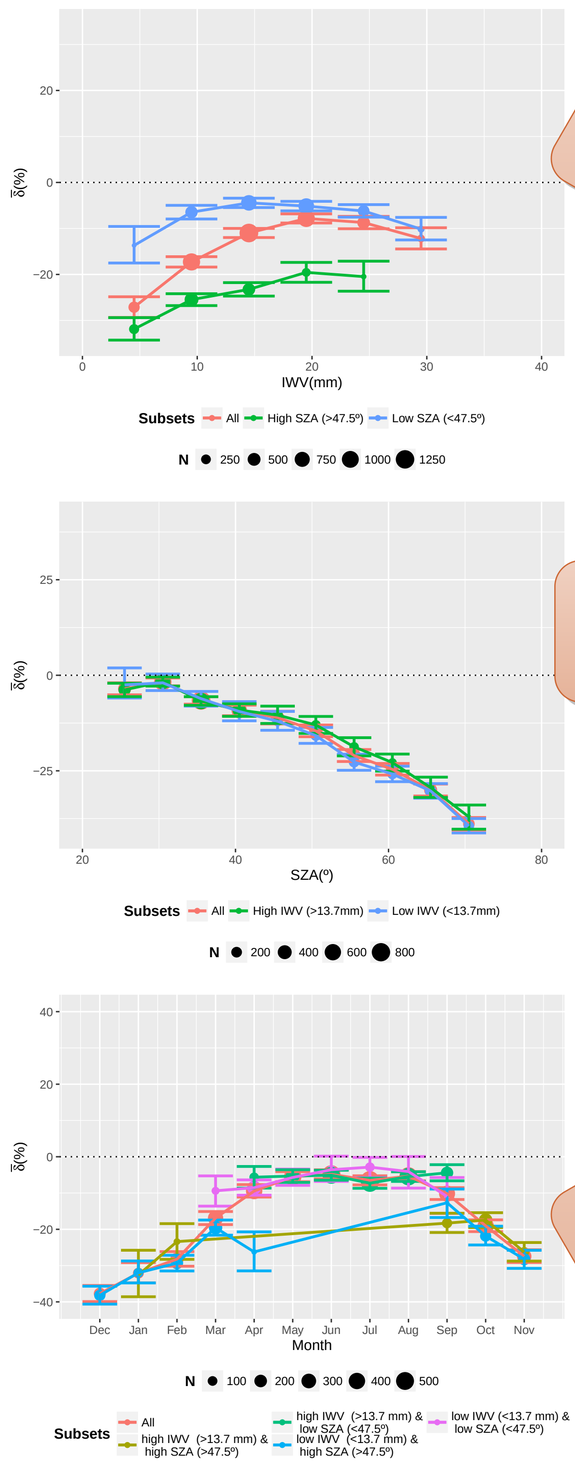
$$\delta_i = 100 \cdot \frac{w_i^{\text{sat}} - w_i^{\text{GPS}}}{w_i^{\text{GPS}}}$$

- index i = certain location and time
- w = IWV measured by satellite or GPS.

* **Median:** $\overline{\delta}$

* **Interquartile range:** IQR[δ]

Results - Dependence of $\overline{\delta}$ with variables

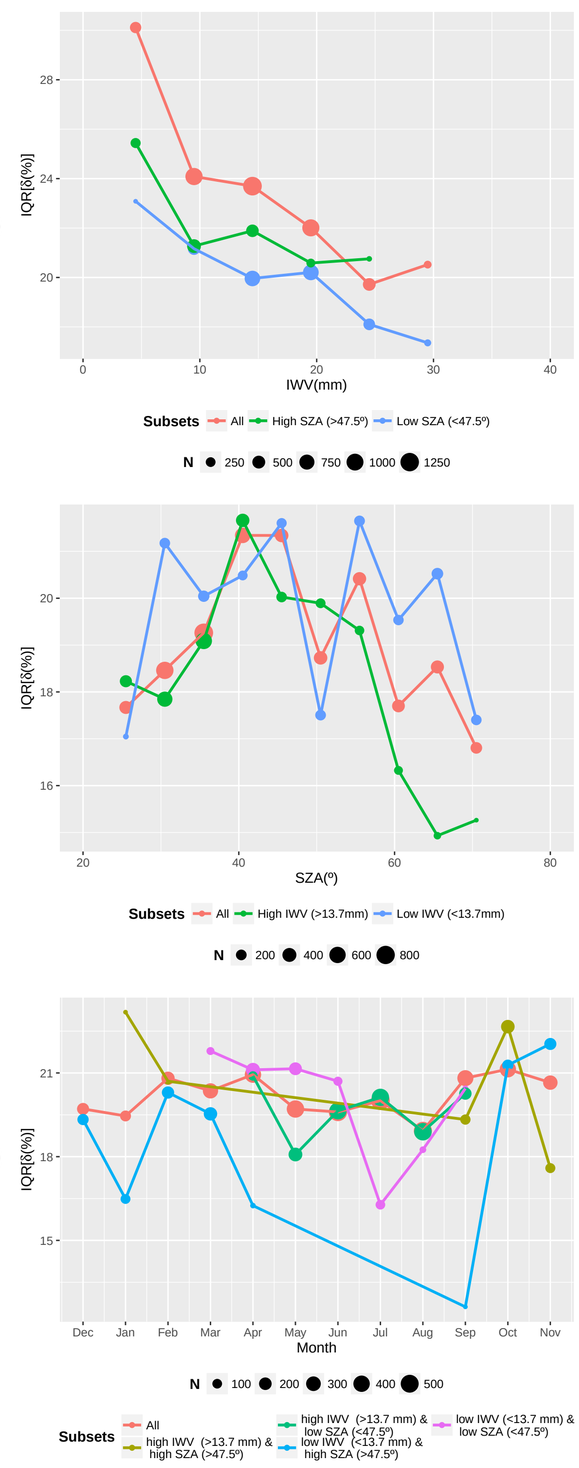


IWV dependence

SZA dependence

Seasonal dependence

Results - Dependence of IQR[δ] with variables



Conclusions

1. **Low IWV data performs worse than high: there is more underestimation (negative median) and higher variability (higher IQR).**
2. **GOME-2 tends to underestimate IWV, specially when it is small and/or SZA is high. The influence of SZA in this underestimation is very strong.**
3. **Variability (IQR) decreases with increasing IWV, but it does not have a clear dependence on SZA.**
4. **Seasonal behaviour clearly influenced by SZA and IWV values throughout the year. GOME-2 measurements at summer perform better than at winter.**