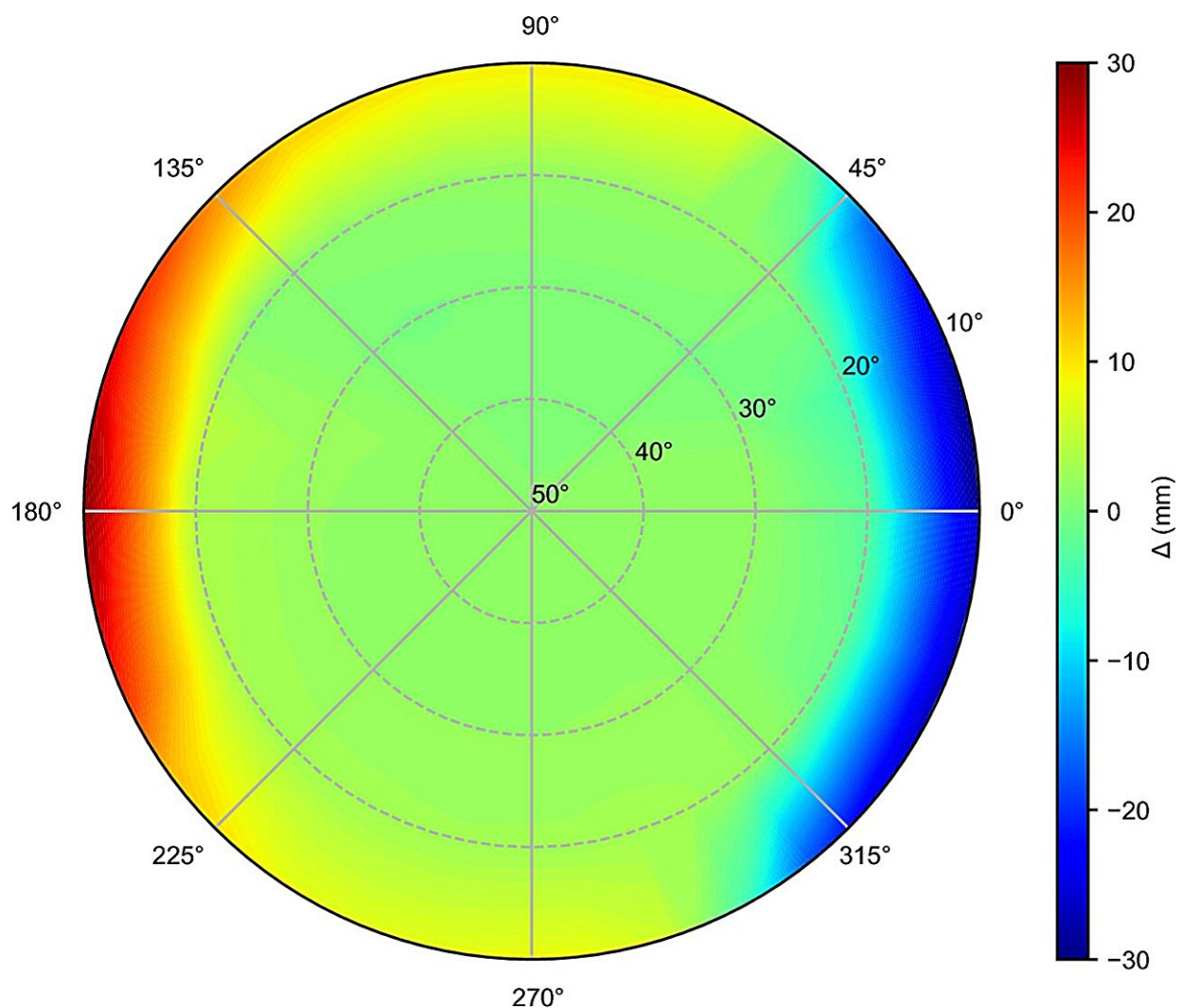


Study uncovers the non-isotropic nature of tropospheric delay for high-precision GNSS positioning

January 22 2024



The radial axis represents the elevation angle, the azimuth angle is represented by the angular axis, and the color represents the values of non-isotropic (Δ),

which is the difference between the SPD at different azimuth angles and the average SPD at the same elevation angle. Considering the elevation angle range of 10° – 20° , it can be observed that the tropospheric delay values exhibit some variation within four azimuth angle intervals: 45° – 135° , 225° – 315° , 315° – 45° , and 135° – 225° . More specifically, the values within the 45° – 135° and 225° – 315° intervals are similar, while the 315° – 45° and 135° – 225° intervals display noticeable disparities compared to the other intervals. Credit: *Satellite Navigation* (2024). DOI: 10.1186/s43020-023-00122-5

Global navigation satellite systems (GNSSs) provide invaluable positioning data for countless applications, from everyday navigation to scientific research. Tropospheric delays, caused by the refractive properties of the atmosphere, significantly impact the accuracy of GNSS positioning.

The [standard practice](#) of multiplying Zenith Tropospheric Delay (ZTD) by a Mapping Function (MF) to derive SPD operates under an assumption of atmospheric isotropy, limiting precision in GNSS applications.

[In study](#) published in the journal *Satellite Navigation*, researchers from Shandong University of Science and Technology introduce a novel concept that SPDs are non-isotropic with respect to azimuth angles, departing from traditional isotropic and anisotropic assumptions.

They utilized three different mapping functions and conducted evaluations at five International GNSS Service (IGS) stations, employing the ray-tracing method as a benchmark.

The study compared SPD accuracy using Vienna Mapping Function 3 (VMF3) and found the smallest residual between VMF3-derived SPDs and ray-traced SPDs. Surprisingly, introducing a horizontal gradient

correction for azimuth-dependent SPD variations showed no significant improvement in accuracy.

Dr. Ying Xu, the leading researcher of this study, said, "This revelation of non-isotropic tropospheric delays is a game-changer for high-precision GNSS applications. By acknowledging and understanding these variations across azimuth angles, we can develop more accurate models, significantly enhancing the reliability of GNSS positioning systems."

The discovery of non-isotropic behavior in SPD across different azimuth angles highlights a pivotal aspect previously overlooked in tropospheric delay modeling.

This insight challenges existing methodologies and suggests the need for new models that accurately represent the complex dynamics of the troposphere. Such advancements are crucial for applications requiring high-precision GNSS positioning, such as geodesy, [navigation](#), and atmospheric sciences.

More information: Ying Xu et al, An initial investigation of the non-isotropic feature of GNSS tropospheric delay, *Satellite Navigation* (2024). [DOI: 10.1186/s43020-023-00122-5](https://doi.org/10.1186/s43020-023-00122-5)

Provided by TranSpread

Citation: Study uncovers the non-isotropic nature of tropospheric delay for high-precision GNSS positioning (2024, January 22) retrieved 2 May 2024 from <https://phys.org/news/2024-01-uncovers-isotropic-nature-tropospheric-delay.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.