

Hasegawa, S. and Yamada, T. J.: Spatial Distribution and Long-Term Changes in Surface Air and Wet-Bulb Temperature Thresholds for Classifying Cold-Season Precipitation Phase across Japan, EGU sphere [preprint], <https://doi.org/10.5194/egusphere-2026-4046>, 2026.

Among the numerous factors influencing water balance and energy budgets, the form of precipitation plays a critical role. Historically, surface air temperature thresholds were used exclusively to determine whether precipitation fell as rain, snow, or a transitional phase. However, recent advancements have led to the adoption of wet-bulb temperature thresholds, as they implicitly account for atmospheric humidity. Despite this progression, the author notes that spatial and long-term variations in wet-bulb thresholds remain under-researched, leaving a significant gap in establishing concrete regional findings in Japan. To address this limitation, this study utilizes hourly meteorological observations—specifically surface air temperature measured at a **height of 1.5 meters**—from 158 stations across Japan, spanning a 35-year period from 1989 to 2024. By investigating these thresholds, the authors aim to provide insights into Japan's specific hydro-climatic dynamics. Based on the current version of the manuscript, the following points are brought forward for further discussion.

1. In Equation 3, the definition of the variable e is ambiguous. Assuming Equation 3 represents an optimization or minimization function, e likely denotes the observed (actual) vapor pressure. It appears the authors are determining the wet-bulb temperature by minimizing the absolute difference between the observed vapor pressure and the computed vapor pressure—derived by substituting Equation 2 into Equation 1—subject to a convergence threshold of 0.001 hPa. However, the current manuscript does not clearly articulate this methodology. The authors must explicitly state the underlying mechanism of this optimization step.

2. While modern computing power allows for mathematical precision to an arbitrary number of decimal places, numerical thresholds in modeling must align with the physical precision of instrumental measurements.

- 2.1 The authors set a strict minimization threshold of **0.001 hPa** [line 119] for vapor pressure in Equation 3. However, this choice appears somewhat arbitrary and requires a robust physical justification. Is a precision of 0.001 hPa achievable or meaningful given the standard tolerance and precision of modern field instrumentation? The authors must address this limitation and justify the threshold from an instrumental and observational perspective.

- 2.2 Furthermore, the optimization or minimization algorithm (i.e., Equation 3) yields a wet-bulb temperature (T_w) that can extend to an arbitrary number of decimal places within the computational model. Such high mathematical precision may not be physically justified when compared to standard surface air temperature observations.

- 2.3 Of greater concern is that the authors subsequently round the optimized temperature to two decimal places. This truncation risks introducing a rounding error that could effectively override or reverse the strict threshold set during the minimization process, rendering the optimization mathematically inconsistent. For example, if the algorithm outputs a temperature of **10.1245 °C** and it is rounded to **10.12 °C**, reverse-engineering this rounded value back into the physical equations might reveal an effective threshold closer to **0.008 hPa** rather than the stated 0.001 hPa. The authors need to clarify

whether the mathematical formulation inherently constrains the wet-bulb temperature to a specific precision that prevents this decoupling. If it does not, they must reconcile the precision of the optimization threshold with the final rounding of the output variables to ensure physical and numerical consistency.

3. Hydrology and Earth System Sciences (HESS) caters to a broad audience across various sub-disciplines of water science. While Sprung's and Tetens' formulae are foundational to specific sub-fields, they are not universally known (unlike fundamental physics equations such as Newton's second law). Therefore, the authors must provide citations for both Sprung's and Tetens' formulae [line 105].

4. Because saturation vapor pressure is already defined in line 108, redefining it in line 112 is redundant. The authors should simply use the previously established symbol or refer to it textually as "saturation water-vapor pressure."

5. Given that HESS is a high-impact journal, the application of empirical equations requires rigorous scrutiny regarding regional validity. The parameters A , a , and b in Equations 1 and 2 are empirical. Consequently, using their default or literature values without assessing their applicability to the specific climatic conditions of Japan may introduce systemic biases. An analytical examination of Equation 2 reveals critical mathematical constraints governed by the exponent of 10:

When the exponent is less than 1, the wet-bulb temperature is bounded such that it is less than $b / (a - 1)$. Conversely, when the exponent exceeds 1, the wet-bulb temperature becomes greater than $b / (a - 1)$. The authors must evaluate these mathematical boundaries against observed air temperatures to validate whether the empirical parameters A , a , and b are physically sound and justified for this study's geographic scope.

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PROFESSIONAL SUMMARY

Computational Hydrologist, Systems Architect, and Environmental Modeler with a proven track record of engineering high-velocity software and mathematical solutions to complex catchment anomalies. Expert in continental-scale hydrological datasets, Physics-Informed Machine Learning, and high-resolution gridded watershed frameworks. Core contributions include solo-engineering the foundational spatial integration of the multi-million-element USGS NHDPlus dataset into the United States national grid using Soil and Water Assessment Tool (SWAT), and serving as the principal technical architect behind the 3D mathematical physics modeling for Singapore's sovereign urban stormwater initiatives.

CORE TECHNICAL COMPETENCIES

Hydroinformatics Frameworks: Expert in orchestrating multi-scale water frameworks and hydroinformatics pipelines using engines like SWAT.

Geospatial Engineering: Full-stack development across ESRI enterprise ecosystems and advanced open-source spatial stacks.

Intelligent Modeling: Design and deployment of Physics-Informed Machine Learning models.

Advanced Analytics: Production-grade integration of spatio-temporal statistical pipelines, custom APIs, and advanced clustering matrices.

CONCISE CAREER TRAJECTORY & IMPACT

- **One Tool Any Country (OTAC) Global Framework (Ongoing):** Conceptualized and independently developing a multi-year global Python framework fusing surface/groundwater, water quality, and climate science with GCMs, satellite imagery, and advanced ML pipelines.
- **Continental-Scale Big Data Integration:** Executed the integration of the multi-million-element **USGS NHDPlus** watershed dataset into the United States national grid using the **SWAT**.
- **Enterprise Software Engineering Support:** Engineered custom codebase workarounds for enterprise clients directly at **ESRI Headquarters (Redlands, CA)**.
- **Sovereign Infrastructure Modeling:** Modeled 3D rain garden physics at the **National University of Singapore (NUS)**, directly defining Singapore's National Bioretention Guidelines.
- **Academic Instruction:** Delivered advanced undergraduate engineering curriculum covering core disciplines in hydrology, hydraulics, and fluid mechanics.

SCIENTIFIC SERVICE & GOVERNANCE

- **Interactive Scientific Peer Review:** Contribute analytical commentaries within the interactive open-access review platforms of **Hydrology and Earth System Sciences (HESS / European Geosciences Union)**, driving technical accountability in climate and hydrological literature (e.g., *hess-2023-275*).
- **Selected Peer-Reviewed Publication:** Mylevaganam, S., Srinivasan, R., & Singh, V. (2015). Ecohydrologically Driven Catchment Evaluation and Prioritization. *Open Journal of Applied Sciences*, 5, 325-334.

EDUCATION & CREDENTIALS

M.S. in Spatial Science (Hydrology) | Texas A&M University, USA

- MS GPA: 4.0/4.0 | Doctoral Coursework GPA: 3.78/4.0

M.Eng. in Water Engineering and Management | Asian Institute of Technology, Thailand

- Coursework GPA: 3.83/4.0 | Research GPA: 4.0/4.0

B.Sc. Eng. in Civil Engineering | University of Moratuwa, Sri Lanka

- GPA: 3.86/4.0 | First Class Honors