INFORMATION ON DOCTORAL THESIS

1. Full name: Phạm Văn Tiến

2. Sex: Male

3. Date of birth: 10/05/1982

4. Place of birth: Bac Ninh province

5. Admission decision number 1194/QĐ-ĐHKHTN dated 05/05/2021 by Rector of the University of Science, Vietnam National University

6. Changes in academic process: Extension documents number 4828/QD-DHKHTN dated December 21, 2024 by Rector of the University of Science, extending the term from January 1, 2025, to December 31, 2025; Extension documents number 5257/QD-DHKHTN dated December 31, 2025 by Rector of the University of Science, extending the term from January 1, 2026, to December 31, 2026.

7. Official thesis title: Study on the influence of hydrodynamic factors on coastal inundation in the coastal area of Thanh Hoa province.

8. Major: Oceanography

9. Code: 09440228.01

10. Supervisors:

1) Assoc. Prof. Dr. Nguyen Ba Thuy

2) Assoc. Prof. Dr. Nguyen Kim Cuong

11. Summary of the new findings of the thesis:

The thesis focuses on assessing the interaction of hydrodynamic factors, including tides, waves, and storm surges, along the western coast of the Gulf of Tonkin, and their combined impact with river discharge on coastal flooding in Thanh Hoa Province. Regarding the methodology, the study utilizes the SuWAT numerical model to simulate tidal dynamics, storm surges, ocean waves, and flooding processes, while employing statistical analysis techniques for data processing and interpretation.

The main results achieved by the thesis include:

(1) The study identified the patterns and quantified the nonlinear interaction processes among tides, storm surges, and waves along the western coast of the Gulf of Tonkin under the impact of typhoons ranging from Beaufort scale 9 to 17 (super typhoons). The results indicate that nonlinear interactions are directly proportional to storm intensity. Specifically, compared to the mean tide phase, storm surges are higher when landfall occurs during low tide and lower during high tide. The discrepancy between peak storm surges at low and high tides relative to the mean tide phase increases progressively with storm intensity. Using a track similar to Typhoon Doksuri (September 2017) at super typhoon intensity, the maximum surge difference between landfall at low tide and mean tide is approximately 0.33 m (8.1%) at Hon La, near the landfall center. In contrast to storm surges, the significant wave height is greater when

the storm makes landfall during high tide. The maximum difference in the significant wave height exhibits a similar trend to storm surge, both increasing with storm intensity. At Hon La, the maximum significant wave height for landfall during high tide increases by approximately 0.46 m (13.3%) compared to the mean tide phase. Notably, waves significantly enhance the peak storm surge, contributing an additional 1.4 m (32.7%) compared to cases excluding wave effects during low tide; conversely, storm surges also increase the significant wave height by 0.95 m (24.4%) compared to cases without surge considerations during the high tide phase.

(2) The extent of coastal flooding in Thanh Hoa Province is governed by the river-sea interaction process. By quantifying the combined effects of tides, storm surges, storm-induced waves, and river discharge for Typhoon Doksuri (September 2017), the study highlights significant fluctuations in flooding severity across various scenarios. Specifically, when the typhoon makes landfall during the high tide phase, the total flooded area reaches 28.3 km², an increase of more than 28% compared to the low tide phase (22.1 km²). If the impact of waves is incorporated, the flooded area expands to 30.5 km² (a 7.8% increase relative to the case without wave effects). Notably, when river discharge is integrated, the flooded area reaches 38.4 km² (a 35.7% increase relative to the case without river discharge effects).

(3) The assessment of coastal flooding risks for Thanh Hoa under climate change scenarios indicates that, compared to the current climate period, the future periods (2051 and 2110) will see an increased frequency of intense storms (category 12 and above on the Beaufort scale), along with a southward shift in storm tracks. The flooded area is projected to increase in proportion to storm intensity in both periods. Notably, the existing sea dyke system, which is currently capable of withstanding storms below category 12, will lose its protective capacity against such intensities in the future due to mean sea level rise. In the absence of infrastructure upgrades, category 15 storm landfall scenarios in 2050 and 2110 would result in 48.6% and 66.0% of the coastal mainland from Hau Loc to Sam Son being inundated, respectively, as the total water level exceeds the dyke crest elevation.

New points of the thesis:

(1) The study identified and quantified the nonlinear interactions among tides, storm surges, and waves along the western coast of the Gulf of Tonkin under typhoon conditions ranging from category 9 storms to category 17 super typhoons on the Beaufort scale. The results show that nonlinear interactions are directly proportional to storm intensity.

(2) The thesis has overcome the limitations of previous studies by applying a spatially varying roughness coefficient field, constructed from high-resolution Land Use/Land Cover (LULC) data. This improvement helps to more realistically simulate the coastal flooding phenomenon under the impact of the river-sea interaction process.

(3) The study has quantified the combined influence of hydrodynamic factors (tides, storm surges, waves, and river discharge) on the coastal flooding phenomenon in Thanh Hoa province through the case of Typhoon Doksuri (2017). Simultaneously,

the thesis has assessed the risk of flooding in the present and future (years 2050, 2110) under the impact of climate change scenarios and sea-level rise.

Scientific and practical significance of the thesis:

Researching the interaction between tides, waves, and storm surges and the resulting coastal flooding has scientific significance in evaluating the causes, mechanisms, and quantifying the role of each factor in surge height, wave height, and the extent and depth of coastal flooding. The research results of the thesis have further clarified the influence of the interaction between marine dynamic factors on wave height and the magnitude of storm surges in the western coastal area of the Gulf of Tonkin with various landfalling storm levels. The flooding mechanism and the contribution of each component to flooding in coastal Thanh Hoa have been quantified for a real storm situation, and the coastal flood risk has been assessed for strong/super typhoon landfalls in the context of sea-level rise due to climate change in the region.

One of the dangerous consequences of storms is the rising sea level causing coastal flooding; therefore, understanding the causes, mechanisms, and quantifying the role of each impacting factor, as well as assessing flood risks in the context of climate change and sea-level rise, is very meaningful for the planning and response to coastal flooding in Thanh Hoa province.

12. Further research directions:

Future studies should integrate additional hydraulic, urban hydrological, and wave overtopping models to more accurately assess flood risks for areas located behind sea dykes. Implementing coastal flood risk assessments in high-risk coastal areas to inform planning and disaster response is essential. In this regard, adaptation measures for the sea dyke system (upgrading, reinforcing dykes, or non-structural solutions) must be proactively incorporated into the risk assessment framework.

13. Thesis-related publications:

International journals:

(1) Pham Van Tien, Nguyen Ba Thuy, Sooyoul Kim, Nguyen Kim Cuong, Pham Khanh Ngoc, Mai Van Khiem, Lars Robert Hole (2025), “Impact of the interaction of surge, wave, and tide on the surge and wave on the northern coast of Vietnam for a marine storm surge and wave forecast system”, Regional Studies in Marine Science, Vol. 87, 104234, https://doi.org/10.1016/j.rsma.2025.104234.

(2) Nguyen Ba Thuy, Pham Van Tien, Nguyen Kim Cuong, Pham Khanh Ngoc, Vu Hai Dang, Le Dinh Quyet, Sooyoul Kim, Cecilie Wettre, Lars Robert Hole (2025), “Numerical analysis of the abnormal water level rise phenomenon on the west coast of Ca Mau Peninsula, Vietnam”, Front. Built Environ. 11:1536113, https://doi.org/10.3389/fbuil.2025.1536113.

Domestic journals:

(1) Nguyen Ba Thuy, Pham Van Tien, Nguyen Kim Cuong, Vu Hai Dang, Bui Manh Ha, Duong Ngoc Tien (2025), "Observations and Numerical Simulation of Storm

Surge during Typhoon Kajiki (August 2025), "VNU Journal of Science: Earth and Environmental Sciences, Vol. 41, No. 1S, 2025, pp16-27 (Vietnamese).

(2) Pham Van Tien, Nguyen Ba Thuy, Nguyen Kim Cuong, Vu Hai Dang, Bui Manh Ha, Nguyen Phuong Anh, Sooyoul Kim, Lars Robert Hole (2026), "Effects of tides, waves, and sea dikes on storm surge-induced coastal flooding in the Thanh Hoa region", Vietnam Journal of Marine Science and Technology, 26(1), 21–34, https://doi.org/10.15625/1859-3097/23504 (Accepted: 6 September 2025).

(3) Pham Van Tien, Tran Thi Thuy Linh, Pham Khanh Ngoc, Bui Manh Ha, Nguyen Ba Thuy (2023), "Initial results of coastal inundation in Thanh Hoa coastal area due to storm surge", Meteorological Journal: 752, pp 87-96 (Vietnamese).

(4) Pham Van Tien, Pham Khanh Ngoc, Pham Quoc Hung, Nguyen Kim Cuong, Nguyen Ba Thuy (2021), "Effect of waves during the storm on coastal inundation in Thai Binh province", Meteorological Journal: 724, pp 72-81 (Vietnamese).

International and domestic conferences:

(1) Pham Van Tien, Nguyen Ba Thuy, Pham Khanh Ngoc, Bui Manh Ha, Vu Hai Dang, Nguyen Kim Cuong, Nguyen Viet Hang (2023), “Interaction of surge and wave on strong/super typhoon in the northern coastal area of Vietnam”, The international conference on earth and environmental sciences, mining for digital transformation, green development and response to global change - GREEN EME 2023. December 29, 2023 in Ho Chi Minh City, tr. 292-320.

(2) Pham Van Tien, Nguyen Ba Thuy, Nguyen Kim Cuong, Le Quoc Huy (2023), "Effects of wave and river discharge interaction on total water level of the Ma river estuary", The 25th national Scientific Conference on Meteorology, Hydrology, Environment and Climate Change, Jun, 2023 (Vietnamese).

(3) Pham Van Tien, Nguyen Ba Thuy, Nguyen Kim Cuong (2022), "Simulation surge and waves during the typhoon Doksuri in 2017", Proceedings the international conference on “Bien Dong 2022”. Nha Trang September 2022, pp 756-762 (Vietnamese).

Hanoi, May 5th, 2026

On behalf of academic supervisors **PhD. Student**

Assoc. Prof. Dr. Nguyen Ba Thuy Pham Van Tien