TẠP CHÍ KHOA HỌC
TRƯỜNG ĐẠI HỌC SƯ PHẠM TP HỒ CHÍ MINH
Tập 20, Số 3 (2023): 400-413
Website: https://journal.hcmue.edu.vn
ISSN: 2734-9918

HO CHI MINH CITY UNIVERSITY OF EDUCATION
JOURNAL OF SCIENCE
Vol. 20, No. 3 (2023): 400-413
https://doi.org/10.54607/hcmue.js.20.3.3552(2023)

**Research Article**

# SPATIAL-TEMPORAL VARIABILITY ASSESSMENT OF TEMPERATURE BASED ON CLIMATE CHANGE SCENARIOS IN BAC GIANG PROVINCE

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*Received: July 29, 2022; Revised: September 24, 2022; Accepted: September 26, 2022*

**ABSTRACT**

*Located in the northern midland and mountainous region, Bac Giang's economy depends on natural conditions, especially agriculture, forestry, and tourism. Thus, climate change has significantly impacted the province's socio-economy. This correlational study finds a correlation between time and temperature factors. However, the variation trend of the annual average maximum or minimum temperature is more common than that of the annual average temperature. The trend of changes in the temperature factors is highest in the western territories of the province and lowest in the high terrain in the eastern part of the province, in mountainous districts. The research results will be used for the next local climate change response plan to ensure the sustainable socio-economic development of the province.*

***Keywords:*** annual average minimum temperature; annual average maximum temperature; climate change; variation trend of temperature

## 1. Introduction

Along with all the natural ingredients on Earth, the climate is also naturally changing. Climate change "is a change of climate over a long period of time due to the effects of natural conditions and human activities, manifested by global warming, sea level rise and increase in extreme hydro-meteorological phenomena" (Congress Office, 2018). Today, climate change is happening faster than in the past, mainly because human production activities have emitted large amounts of greenhouse gases.

According to IPCC's SRCCL and SROCC reports, between 2005 and 2016, the global average temperature increased by about $0.87^0$C compared to pre-industrial times. In the last four decades alone, the highest global average temperature has been recorded since 1850

***Cite this article as:*** Nguyen Thi Ha, Dao Ngoc Hung, & Phan Van Phu (2023). Spatial-temporal variability assessment of temperature based on climate change scenarios in Bac Giang Province. *Ho Chi Minh City University of Education Journal of Science, 20*(3), 400-413.

(IPCC, 2019, 2020). According to the Intergovernmental Panel on Climate Change (IPCC), by 2017, the average temperature on Earth had increased by about $1^0$C compared to pre-industrial times (1850-1900) (Change, 2021). Research by Fawzy et al. (2020) indicates that if greenhouse gas emissions continue at the present rate, the average temperature on Earth in the period 2030-2052 will increase by about 1.0°C and can go up to 1.5$^o$C compared to pre-industrial times.

Warming effects can be observed in many places, from rising sea levels and melting snow to changing weather patterns. Climate change is already affecting ecosystems and freshwater supplies, affecting human health, possibly reducing terrestrial water storage, and increasing droughts in many regions, especially those in the Southern Hemisphere (Pokhrel et al., 2021).

Transport is considered a barrier to mitigating climate change, is responsible for about 23% of worldwide energy-related $CO_2$ emissions, and is expected to double by 2050 (Creutzig et al., 2015). Research by Vijaya, Iniyan, and Goic (2012) evaluates climate change mitigation measures, focusing on carbon sequestration and clean development mechanisms. Research by Creutzig et al. (2015) also shows that forests are now absorbing billions of tons of $CO_2$ globally each year. Forests can contribute to protecting against climate change through carbon sequestration while providing significant benefits to the environment, economy, and social culture.

Bac Giang is a province in Vietnam's northern midland and mountainous region. The study of Ngo (2018) analyzed the change in some climatic factors (temperature, rainfall) in the area of Duc Thang commune, Hiep Hoa district, Bac Giang province over 50 years (1961 - 2010). Research shows that, in 50 years (1961 - 2010), the total annual rainfall tends to decrease. In the dry season, there is little rain, but there are days with over 100 mm of rain occurring locally. As a result, temperature tends to increase, with the average increase from $0.07 \div 0.075$ $^0$C/year. The heat is getting longer and longer, the number of episodes is more, occurs locally and has a complicated development, and the number of hot days is more intense. Research by Dao et al. (2022) evaluated the differentiation of the trend of temperature change in the context of climate change in Bac Giang province from 1970-2014. The research results show that the variation trend of the annual average temperature of Bac Giang is expected in the range of 0.012 - 018 $^0$C/year, while the trend of the annual absolute maximum temperature is up to 0.028 - 0.032 $^0$C/year, about two times higher than the trend of the annual average temperature. The study also shows that the variation trend of the annual average temperature and the annual absolute maximum temperature has the same covariance: the lowest in the western region and the highest in the east of the study territory.

Bac Giang's economy has developed rapidly in recent years, including the significant contribution of lychee. The study by Dao (2012) analyzed and pointed out the territories of Bac Giang with favorable climatic conditions for lychee development through the use of the

statistical probability method. Lychee plants have a high yield only when the weather is dry and cold, below $15^0$C during the flowering period (Dao & Ngo, 2002). Research by Vu (2021) has shown that climate change may affect the local lychee yield.

Thus, there have been many studies on climate change in Bac Giang. However, geographical research to assess the differentiation of future climate variation trends is a new research direction in Bac Giang. The research results can be used as a basis for orientations for an effective response strategy to climate change in the next period to rationally use natural resources, ensuring the implementation of the province's socio-economic sustainable development goals.

## 2. Data and methods

### *2.1. Study area*

Bac Giang has a natural area of 3,895.9 km², accounting for 1.2% of the country's natural area. In 2021, Bac Giang had an estimated average population of 1,875,238 people, is the most populous province, and had the top economic scale in the Northern Midlands and Mountains. Bac Giang is also the province with the 10th largest economic growth rate and 15th out of 63 provinces in gross domestic product (GRDP). In 2021, Bac Giang GRDP at current prices was estimated at VND 129,836.7 billion, up 7.82% over the previous year. GRDP per capita is 2,950 USD (Bac Giang Statistical Office, 2022). Bac Giang's economy has developed very rapidly in recent years. However, many economic activities have been negatively impacting the environment, increasing the number of greenhouse gases that cause climate change, such as industry, agriculture, tourism, and transportation. On the other hand, climate change also affects economic activities, especially those vulnerable to climate change, such as agriculture, forestry, tourism.

### *2.2. Data*

To assess the future climate variation trend for Bac Giang, the study uses forecast data from four meteorological stations in Bac Giang province (Bac Giang, Hiep Hoa, Luc Ngan, and Son Dong stations) with the following input factors: annual average temperature, annual average minimum temperature, and annual average maximum temperature of the period of 2025-2054 according to the scenario of climate change and sea level rise for Vietnam in 2020. In addition, to serve the research and assessment of the variation of the trend of temperature change, we used the data of meteorological stations around Bac Giang, including stations: Thai Nguyen, Huu Lung, Dinh Lap, Hai Duong, Chi Linh, Uong Bi, and Bai Chay.

***Table 1.*** *List of meteorological stations used for data*

| No | Meteorological station name | Province | Latitude | Longitude | Altitude above sea level (m) |
|---|---|---|---|---|---|
| 1 | Bac Giang | Bac Giang | 21°17’ | 106°12’ | 7 |
| 2 | Hiep Hoa | | 21°22’ | 105°58’ | 21 |
| 3 | Son Đong | | 21°20’ | 106°50’ | 59 |
| 4 | Luc Ngan | | 21°22’ | 106°33’ | 15 |
| 5 | Thai Nguyen | Thai Nguyen | 21°35’ | 105°50’ | 36 |
| 6 | Huu Lung | Lang Son | 21°30’ | 106°21’ | 36 |
| 7 | Đinh Lap | | 21°32’ | 107°06’ | 19 |
| 8 | Hai Duong | Hai Duong | 20°57’ | 106°18’ | 2 |
| 9 | Chi Linh | | 21°07’ | 106°23’ | 33 |
| 10 | Uong Bi | Quang Ninh | 21°02’ | 106°45’ | 4 |
| 11 | Bai Chay | | 20°58’ | 107°04’ | 36 |

*Source: Hydrometeorological Data and Information Cente*

### *2.3. Method*

- ***Correlation***

To determine the variation trend of some climate factors such as temperature over time series: $\{y_t\} = y_1, y_2, \cdots y_{n-1}, y_n$, it is necessary to perform the following two steps:

1) Test the correlation between meteorological factors y and t according to the formula:

$$r = \frac{\overline{y * t} - \bar{y} * \bar{t}}{\sqrt{\overline{y^2} - (\bar{y})^2} * \sqrt{\overline{t^2} - (\bar{t})^2}}$$

In which: y is the climate factor; t is the time; r is the correlation coefficient (Nguyen, Tran & Ngo, 2014).

***Table 2.*** *Thresholds for indicators of a correlation coefficient*

| Correlation coefficient r | Range of values |
|---|---|
| Weak | r < 0,5 |
| Moderate | 0,5 ≤ r < 0,7 |
| Relatively strong | 0,7 ≤ r < 0,9 |
| Strong | 0,9 ≤ r < 1 |
| Functional correlation | r = 1 |

2) Regression equation

If r > 0.7 or $r^2 > 0.5$, then it makes sense to build a regression equation and trend line. The linear regression equation reflecting the variation of that phenomenon over time is calculated by the following formula:

$$y_t = at + b$$

In which: $a = \frac{\overline{y*t} - \bar{y}*\bar{t}}{\overline{t^2} - (\bar{t})^2}$; $b = \bar{y} - a\bar{t}$ (Nguyen, Tran & Ngo, 2014)

## 3. Results and discussion

### *3.1. Variation trend of annual average temperature*

According to the RCP 4.5 scenario, in the middle of the 21st century (2025-2054), the annual average temperature in Bac Giang province has an expected increase from 0.948÷1.029$^0$C. The annual average temperature in the whole territory tends to change markedly. At Bac Giang station, the annual average temperature tends to increase the highest by 0.0343$^0$C/year; at Hiep Hoa station, the annual average temperature tends to increase by 0.0341$^0$C/year; at Luc Ngan station, the annual average temperature tends to increase by 0.0324$^0$C/year; At Son Dong station, the average annual temperature tends to increase the lowest by 0.0316$^0$C/year (Figure 1).

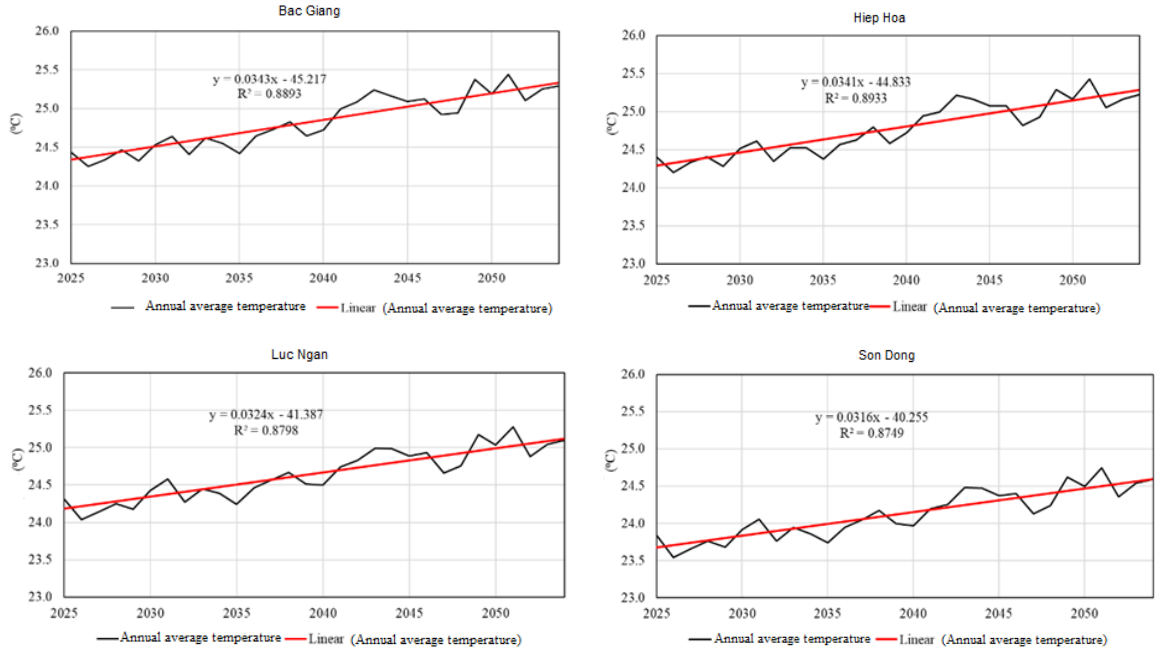



***Figure 1.*** *Variation trend of annual average temperature ($^0$C) in Bac Giang province by RCP4.5 scenario*

In the middle of the 21st century, the annual average temperature in Bac Giang province of the RCP 8.5 scenario has a higher increase than that of the RCP 4.5 scenario, which is typical from 1.092÷1.125$^0$C. At Bac Giang station, the annual average temperature tends to increase by 0.0370$^0$C/year; at Hiep Hoa station, the annual average temperature tends to increase by 0.0375$^0$C/year; at Luc Ngan station, the annual average temperature tends to increase by 0.0364$^0$C/year; at Son Dong station, the average annual temperature tends to increase by 0.0367$^0$C/year (Figure 2).

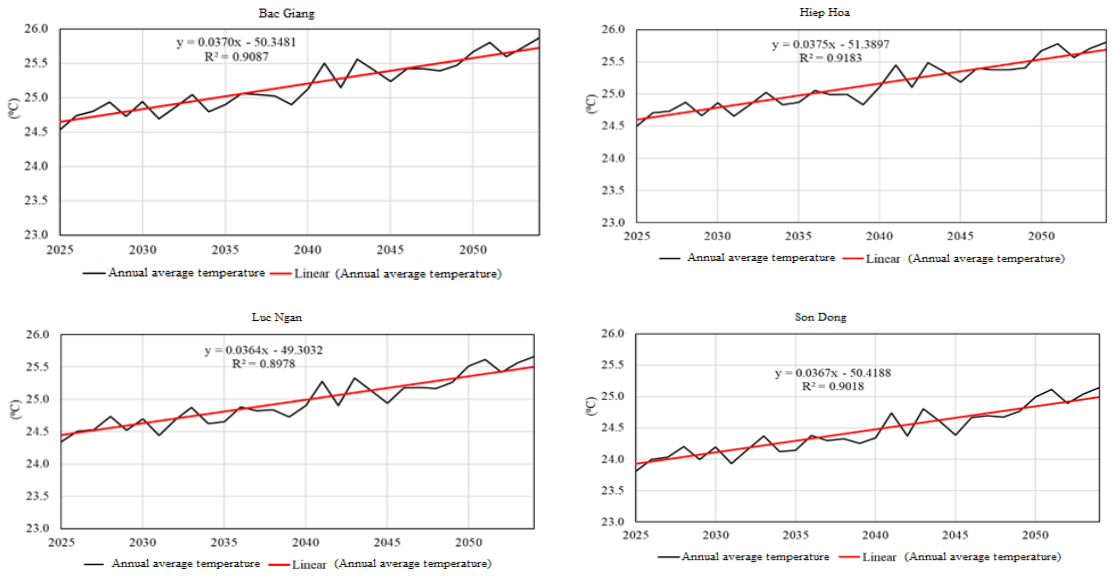
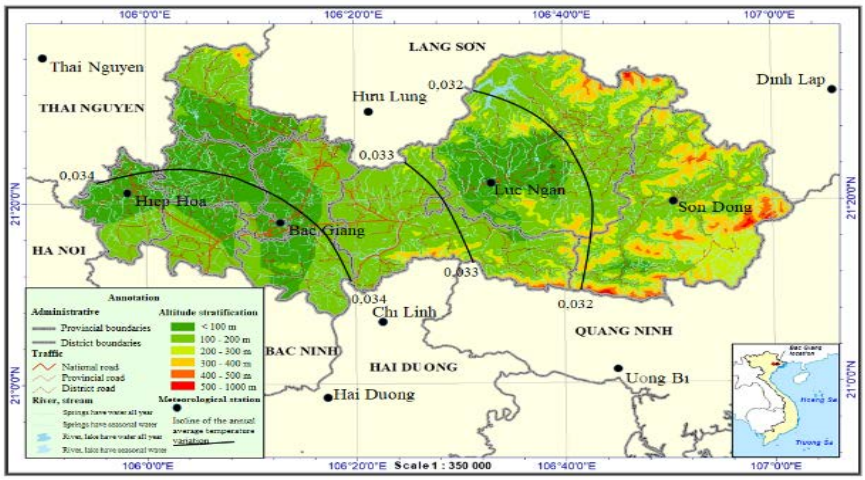



***Figure 2.*** *Variation trend of annual average temperature ($^0$C) in Bac Giang province by RCP8.5 scenario*

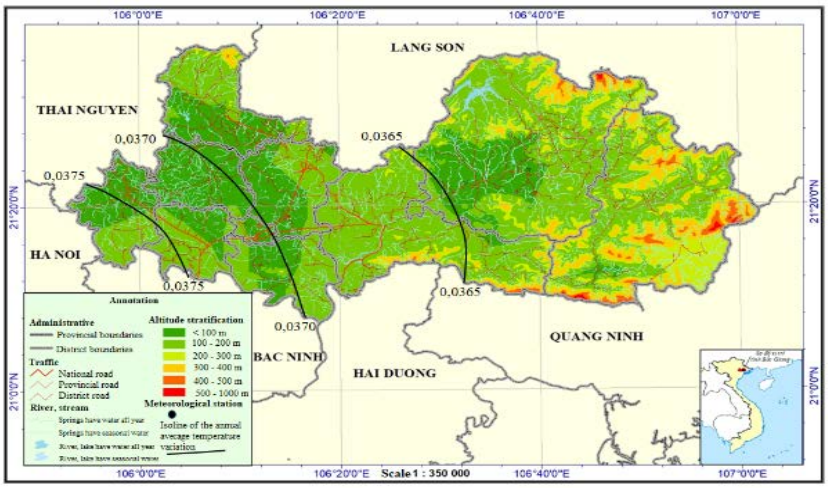
Thus, the variation trend of the annual average temperature in Bac Giang province is evident. The increase in the annual average temperature of the RCP 8.5 scenario is higher than that of the RCP 4.5 scenario.

Spatially the variation in the annual average temperature is shown in Figure 3. According to both the RCP 4.5 and RCP 8.5 scenarios of Bac Giang, the annual average temperature tends to change in the lowland and low hills in the west and southwest and gradually decreases in the mountains in the east and northeast. Specifically:

- For the RCP 4.5 scenario, the annual average temperature increases by about 0.034$^0$C/year in the west and 0.032$^0$C/year in the east of the territory.
- For the RCP 8.5 scenario, the annual average temperature increases by 0.0375$^0$C ÷ 0,0370$^0$C /year in the west and 0.0365$^0$C/year in the east of the territory.




***a)*** *by RCP4.5 scenario*




***b)*** *by RCP8.5 scenario*

***Figure 3.*** *Variation of annual average temperature ($^0$C) in Bac Giang province*

### *3.2. Extreme temperature*

- **Variation trend of annual average maximum temperature**

According to the RCP 4.5 scenario, in the middle of the 21st century, the annual average maximum temperature in the whole study area will increase from 1.221$^0$C ÷ 1.278$^o$C during 30 years. At Bac Giang station, the annual average maximum temperature will increase by 0.0422$^0$C/year; at Hiep Hoa station, the annual average maximum temperature will increase by 0.0426$^0$C/year; at Luc Ngan station, the annual average maximum temperature will increase by 0.0400$^0$C/year; At Son Dong station, the annual average maximum temperature will increase by 0.0407$^0$C/year (Figure 4).

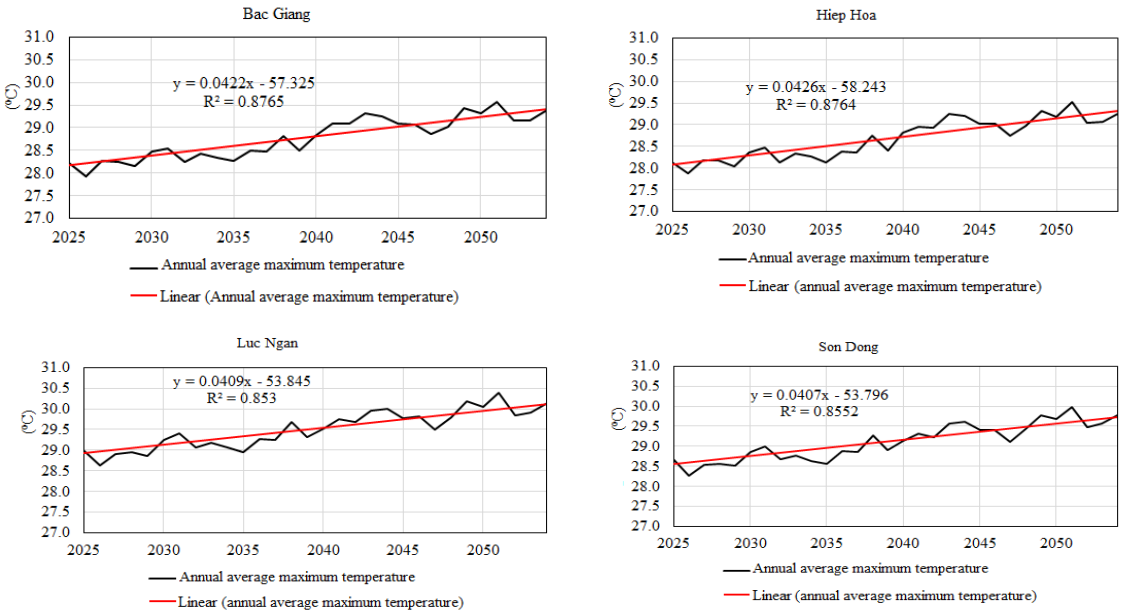



***Figure 4.*** *Variation trend of annual average maximum temperature ($^0$C) in Bac Giang province by RCP4.5 scenario*

According to the RCP 8.5 scenario, the annual average maximum temperature in Bac Giang will increase from $1.146^0$C ÷ $1.203^o$C in the period 2025-2054. At Bac Giang station, the annual average maximum temperature will increase by $0.0400^0$C/year; at Hiep Hoa station, the annual average maximum temperature will increase by $0.0401^0$C/year; at Luc Ngan station, the annual average maximum temperature will increase by $0.0382^0$C/year; At Son Dong station, the annual average maximum temperature will increase by $0.0389^0$C/year (Figure 5).

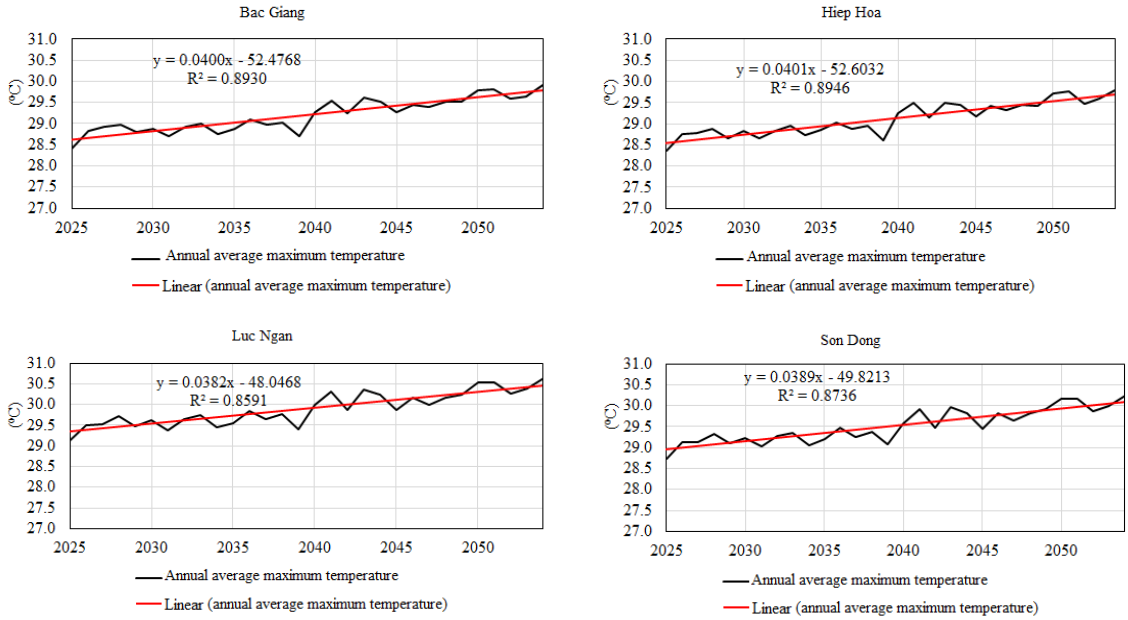
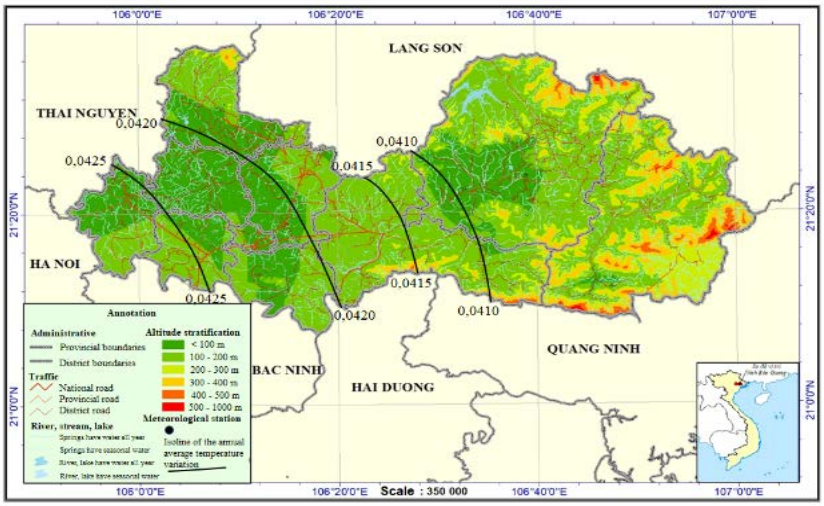



***Figure 5.*** *Variation trend of annual average maximum temperature ($^0$C) in Bac Giang province by RCP8.5 scenario*

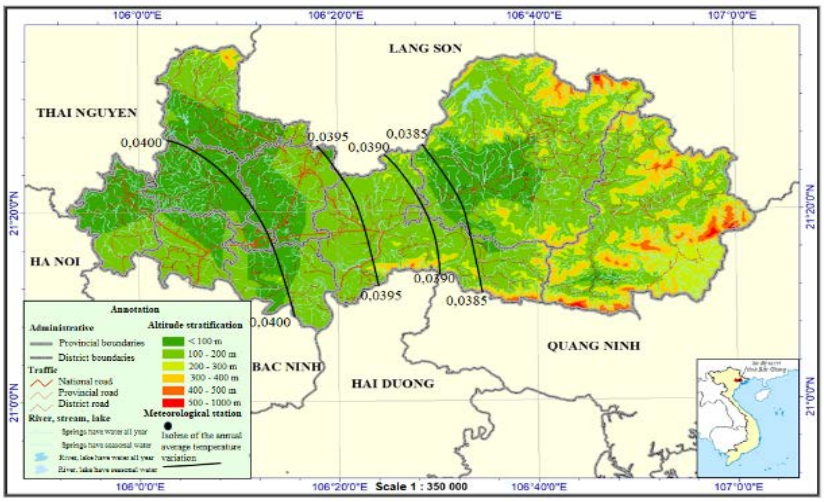
Thus, by the middle of the 21st century in Bac Giang, the growth rate and increasing trend of annual average maximum temperature by the RCP 8.5 scenario is lower than that of the RCP 4.5 scenario (but not significantly). However, the actual temperature measurement value according to the RCP 8.5 scenario is still higher than that of the RCP 4.5 scenario.

Figure 6 shows the clear spatial differentiation of the annual average maximum temperature variation trend in Bac Giang province. According to both RCP 4.5 and RCP 8.5 scenarios, the annual average maximum temperature in Bac Giang increases gradually from the east to the west of the territory:

- With the RCP 4.5 scenario, the variation trend of annual average maximum temperature in the eastern region of Bac Giang province will increase by about $0.0410^0$C/year; in some districts of the western region, such as Hiep Hoa, Yen Dung, the variation trend is higher, by about $0.0420^0$C ÷ $0.0425^0$C/year.
- With the RCP 8.5 scenario, the annual average maximum temperature will increase by about $0.0385^0$C/year in the east and about $0.0389^0$C ÷ $0.0400^0$C/year in the western part of the territory.




***a)*** *by RCP4.5 scenario*




***b)*** *by RCP8.5 scenario*

***Figure 6.*** *Variation of annual average maximum temperature ($^0$C) in Bac Giang province*

- **Variation trend of annual average minimum temperature**

According to the RCP 4.5 and RCP 8.5 scenarios, the annual average minimum temperature tends to increase markedly throughout Bac Giang province.

According to the RCP 4.5 scenario, the annual average minimum temperature in the study area will increase from 0.807$^0$C ÷ 0.873$^o$C during 30 years (2025 – 2054). At Bac Giang station, the annual average minimum temperature will increase by 0.0290$^0$C/year; at Hiep Hoa station, the annual average minimum temperature will increase by 0.0291$^0$C/year; at Luc Ngan station, the annual average minimum temperature will increase by 0.0280$^0$C/year; At Son Dong station, the annual average minimum temperature will increase by 0.0269$^0$C/year (Figure 7).

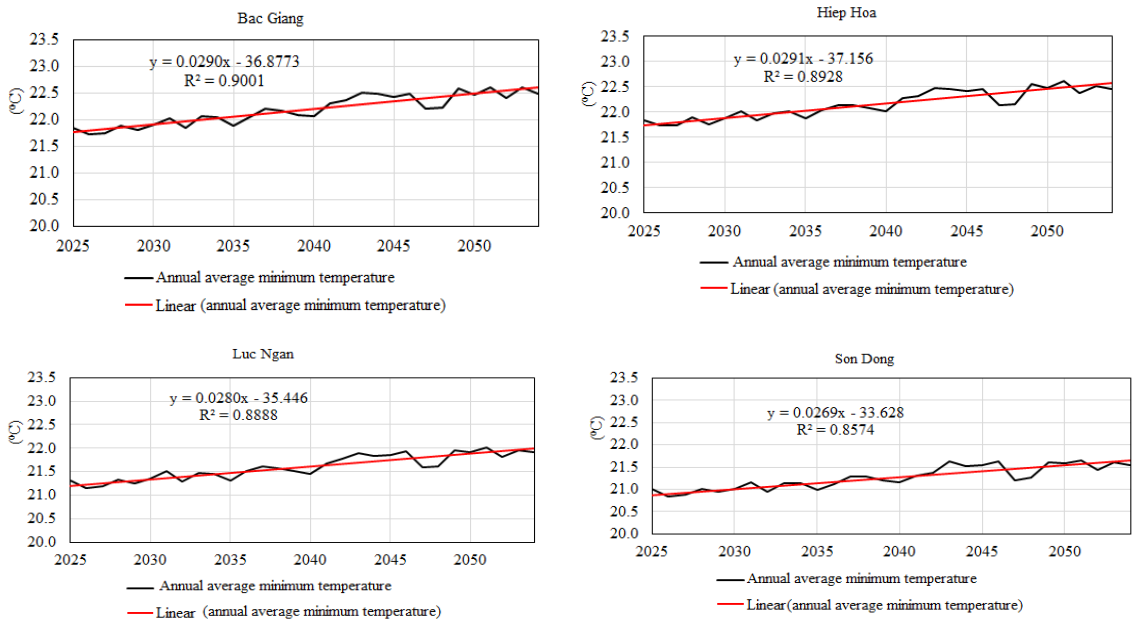



***Figure 7.*** *Variation trend of annual average minimum temperature ($^0$C) in Bac Giang province by RCP4.5 scenario*

According to the RCP 8.5 scenario, the annual average minimum temperature in Bac Giang province will increase from 1.101$^0$C ÷ 1.110$^o$C in 2025 – 2054. The annual average minimum temperature growth rate does not differ much by space. In 30 years (2025-2054), the annual average minimum temperature tends to increase by 0.0370$^0$C/year at Bac Giang station, 0.0369$^0$C/year at Hiep Hoa station, 0.0367$^0$C/year at Luc Ngan station and 0.0368$^0$C/year at Son Dong station (Figure 8).

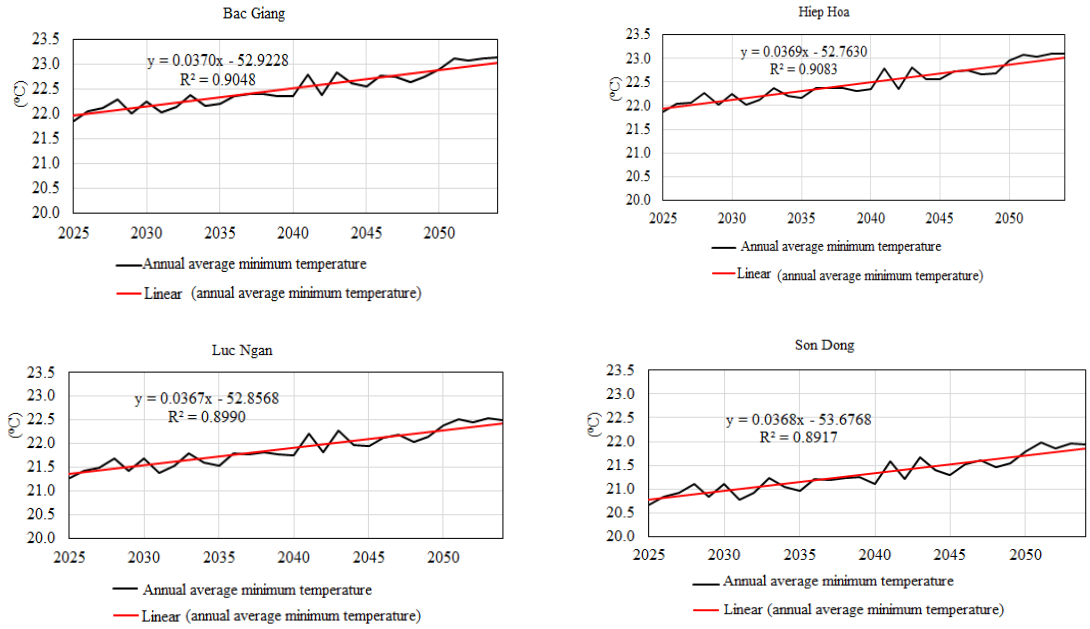



***Figure 8.*** *Variation trend of annual average minimum temperature ($^0$C) in Bac Giang province by RCP8.5 scenario*

Thus, the growth rate of the annual average minimum temperature increase of the RCP 8.5 scenario is higher than that of the RCP 4.5 scenario, but the distribution of variation trend of the RCP 8.5 scenario is not as precise as that of the RCP 4.5 scenario.

Figure 9 shows the spatial differentiation of the annual average minimum temperature variation trend in Bac Giang province by the RCP 4.5 scenario. The annual average minimum temperature tends to change at $0.029^0$C/year in the west and decrease to about $0.0270^0$C/year in the east of the territory.

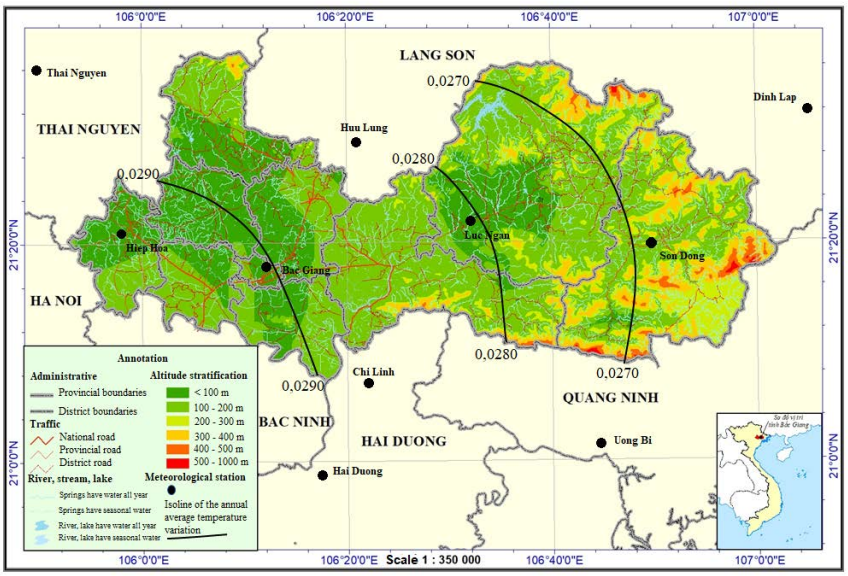



***Figure 9.*** *Variation of annual average minimum temperature ($^0$C) in Bac Giang province by RCP4.5 scenario*

### *3.3. Confidence level for the temperature scenario*

According to both RCP 4.5 and RCP 8.5 scenarios in Bac Giang, the correlation coefficients ($R^2$) of climate factors (annual average temperature, annual average maximum temperature, annual average minimum temperature) are in the range of 0.852 - 0.918. This shows a good correlation between temperature factor and time. Thus, it makes sense to build a regression equation. The data source of the study is taken from the scenario of climate change and sea level rise for Vietnam by day in the period 2016-2099. Therefore, the results of the temperature scenario are reliable and can be used to assess the variation trend of temperature in the context of climate change in the future for Bac Giang (although this calculation result may not precisely coincide with the average value calculated for the whole North of Vietnam as in the climate change scenario of the Ministry of Natural Resources and Environment).

### *3.4. Discussion*

It can be seen that in Bac Giang, the future variation trend of the annual average temperature, annual average maximum temperature, and annual average minimum

temperature has the same uniformity: the lowest in the eastern part, the highest in the western part of the study territory. We also see an increasing trend in both annual average temperature, annual average maximum temperature, and annual average minimum temperature in the study territory for both RCP 4.5 and RCP 8.5 scenarios. While the variation trend of future annual average temperature is only in the range of 0.0316 - $0.0343^0$C/year for the RCP 4.5 scenario and 0.0364 - $0.0375^0$C/year for the RCP 8.5 scenario, the trend of the annual average maximum temperature is higher, up to 0.0400 - $0.0426^0$C/year and 0.0382 - $0.0400^0$C/year, respectively; the trend of the annual average minimum temperature is lower, respectively 0.0269 - $0.0291^0$C/year and 0.0367 - $0.0370^0$C/year. The study also shows a good correlation between temperature factor and time as well as the reliability of the temperature scenario for Bac Giang in the future. Climate change is happening. The climate is getting hotter and hotter. It would be flawed if we only relied on average temperature values to assess the impact of climate change. The days of extreme weather will have the most significant impact on human health and the development of organisms.

## 4. Conclusions

Using quantitative research methods, the study showed that in Bac Giang, the variation trend of annual average temperature in the future is common from 0.0316 - $0.0343^0$C/year for the RCP 4.5 scenario and 0.0364 - $0.0375^0$C/year for RCP 8.5 scenario. According to space, the variation trend of annual average temperature gradually increases from the eastern region to the western part of the province.

The annual average maximum temperature tends to vary from 0.0400 - $0.0426^0$C/year for the RCP 4.5 and 0.0382 - $0.0400^0$C/year for the RCP 8.5 scenario. The variation trend of the annual average maximum temperature gradually decreases from the lowland areas in the west to the midland and mountainous areas in the east of the study territory.

The annual average minimum temperature tends to vary from 0,0269 - $0,0291^0$C/year for the RCP 4.5 and 0,0367 - $0,0370^0$C/year for the RCP 8.5 scenario. The variation trend of the annual average minimum temperature gradually decreases from the west to the east of the study territory.

In the variation trend of temperature factors, the variation trend of annual average maximum temperature is the largest under both RCP 4.5 and RCP 8.5 scenarios.

The temperature scenario for Bac Giang is very reliable. Therefore, the change in temperature factor, especially extreme temperatures in the future, will strongly affect the change in the natural environment and socio-economic activities, especially for agriculture, and services of the locals. Based on the research results, it can be seen that in Bac Giang, subtropical crops will reduce yield because of climate warming. Therefore, the province should pay attention to developing tropical crops in the future.

Research results can be a good source of data for managers and people, thereby proposing reasonable solutions to use natural resources and protect the environment, ensuring the implementation of sustainable socio-economic development goals of the province.

❖ ***Conflict of Interest:*** *Authors have no conflict of interest to declare.*

**REFERENCES**

Bac Giang Statistical Office. (2022). *Statistical Yearbook of Bac Giang 2021*. Statistical Publishing House.

Canadell, J. G., & Raupach, M. R. (2008). Managing forests for climate change mitigation. *Science, 320*(5882), 1456-1457.

Change (2021). *Intergovernmental Panel On Climate Agenda*. AR6 Climate Change 2021: The Physical Science Basis.

Congress Office (2018). *Law on Meteorology and Hydrology*. Hanoi.

Creutzig, Felix J., Patrick, E., Oreane, Y. M., Linus, V. V., Detlef, P. M., & David, M., Jan (2015). *Transport: A roadblock to climate change mitigation?* Science, *350*(6263), 911-912.

Dao, N. H. (2012). *Evaluation of climatic conditions for lychee development in Bac Giang province*. Proceedings of the 6th National Scientific Conference on Geography, 553-558.

Dao, N. H., Nguyen, T. H., Nguyen, T. L., & Nguyen, T. L. (2022), Assessment of the difference of temperature change in the context of climate change in Bac Giang province. *HNUE Journal of Science, 67*(1), 156-164.

Dao, T. V., & Ngo, X. B. (2002), *Fruit tree*. Thai Nguyen University of Agriculture & Forestry.

Fawzy, S. O., Ahmed I. D., John R., & David W. (2020). *Strategies for mitigation of climate change: a review.* Environmental Chemistry Letters, 1-26.

Hampe, A., & Petit, R. J. (2005), *Conserving biodiversity under climate change: the rear edge matters. 8*(5), 461-467.

IPCC (2019). *Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC)*, IPCC.

IPCC (2020). *Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (SRCCL)*.

Ngo, T. T. H. (2018). *Research on communication solutions to raise awareness about climate change for the community in Duc Thang commune, Hiep Hoa district, Bac Giang province: Master thesis. Climate change*, Vietnam National University, Hanoi.

Nguyen C. V., Tran T. N., & Ngo V. T. (2014). *Textbook of Probability theory and mathematical statistics*. National Economics University Publishing house.

Pokhrel, Yadu F., Farshid S., Yusuke B., Julien B., …, Lukas (2021). *Global terrestrial water storage and drought severity under climate change, 11*(3), 226-233.

Patz, Jonathan A. E., Paul R. B., Thomas A. B., & John M. J. (1996). *Global climate change and emerging infectious diseases, 275*(3), 217-223.

Patz, J. A. (2021), *Health Risks of Climate Change and Health Benefits from Solving the Global Climate Crisis,* in *World Scientific Encyclopedia of Climate Change: Case Studies of Climate Risk, Action, and Opportunity Volume 1*. World Scientific, 199-206.

Vijaya V. S., Iniyan, S., & Goic, R. (2012). *A review of climate change, mitigation and adaptation, 16*(1), 878-897.

Vu T. H. (2021). *Applying technological advances to improve the ability to flower and set lychee under climate change conditions*. Vietnam National University of Agriculture.

Zhao, Hongwei Y., Meile S., Maryna W., Henry C. L., …, Carolien O. (2021). *Impacts of nitrogen pollution on corals in the context of global climate change and potential strategies to conserve coral reefs.* Science of the Total Environment, p. 145017.

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# ĐÁNH GIÁ SỰ PHÂN HOÁ VỀ MỨC ĐỘ BIẾN ĐỔI CỦA NHIỆT ĐỘ THEO KỊCH BẢN BIẾN ĐỔI KHÍ HẬU TẠI TỈNH BẮC GIANG

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*Ngày nhận bài: 29-7-2022; ngày nhận bài sửa: 24-9-2022; ngày duyệt đăng: 26-9-2022*

## TÓM TẮT

*Nằm ở vùng Trung du và miền núi phía Bắc, nền kinh tế Bắc Giang còn phụ thuộc vào tự nhiên, đặc biệt là nông – lâm nghiệp, du lịch. Do đó, biến đổi khí hậu đã và đang tác động lớn đến kinh tế – xã hội của tỉnh. Sử dụng phương pháp đánh giá tương quan và xây dựng phương trình hồi quy, chúng tôi nhận thấy có mối tương quan tốt giữa thời gian và các yếu tố nhiệt độ. Tuy nhiên, xu thế biến đổi nhiệt độ tối cao hoặc tối thấp trung bình năm phổ biến ở mức cao hơn so với nhiệt độ trung bình năm. Xu thế biến đổi các yếu tố nhiệt độ cao nhất ở phía Tây và thấp nhất ở các huyện miền núi phía Đông tỉnh. Kết quả này sẽ là cơ sở định hướng cho kế hoạch ứng phó với biến đổi khí hậu giai đoạn tiếp theo tại địa phương.*

***Từ khóa:*** nhiệt độ tối thấp trung bình năm; nhiệt độ tối cao trung bình năm; biến đổi khí hậu; xu thế biến đổi của nhiệt độ