

# CLIMATE CHANGE AND THE FREQUENCY OF SQUALLS ON THE TERRITORY OF THE NORTH-WESTERN BLACK SEA REGION

Agayar E.V., Zhuk D.O.

Odessa State Environmental University, Ukraine

## Introduction

A squall is a sharp short-term increase in the wind, accompanied by changes in its direction and is a vortex with a horizontal axis developing under the influence of mesoscale atmospheric convection. Squalls are local and have a short-time influence, therefore they are difficult to register by standard methods. The fact of the phenomenon is often recorded only after its termination, with the help of data from remote sensing of the Earth from space. The accuracy of forecasting squalls by modern methods is still insufficient. In addition, there are practically no methods for forecasting disastrous squalls [1]. Therefore, researches on squalls are continuing around the world, forecasting methods are being developed and perfected.

Geographical position of the south of Ukraine, synoptic processes and a variety of climatic conditions contribute to the frequent occurrence of severe convective phenomena and creating the extraordinary complexity of their distribution in space and time. These include meteorological phenomena like squall, hail, thunderstorms, heavy rains and tornado. In recent years, due to significant climate change frequency of these events has increased. In some cases, they are catastrophic and cause significant damage to the economy, infrastructure and population.

## Objectives

The purpose of the study is to determine the spatio-temporal regularity of the formation of the squall on the North-Western Black Sea coast, on the example of three regions: Odessa, Mykolaiv and Kherson, in the period from 2006 to 2020. As well as their frequency and intensity against the background of global climate change.

## Materials and Methods

Storm warning data of the Hydrometeorological Center of the Black and Azov Seas from 2006-2020 in the Odessa, Nikolaev and Kherson regions.

- physical and statistical analysis;
- synoptic and climatic analysis;
- geographic information on meteorological values.

## Conclusion

During the study period (2006-2020), there is a clear trend towards an increase in the number of cases with squalls of varying intensity throughout the North-Western Black Sea region. Most likely, this is due to an increase in the frequency of occurrence of meridional processes and, as a consequence, active cyclogenesis in the south of Ukraine.

## References

1. Markowski P.M., Richardson Y.P. Tornado genesis: Our current understanding, forecasting considerations, and questions to guide future research // Atmospheric Research. Vol. 93. 2009. P. 3-10.
2. . Natural meteorological phenomena on the territory of Ukraine for the last twenty years [1986 - 2005] / Ed. VM Lipinsky, VI Osadchy, VM Babichenko. - Kyiv: Nika-Center Publishing House. 2006. 312 p.
3. Lipinsky V.M., Osadchiy V.I., Babichenko V.M. Activation of natural meteorological phenomena on the territory of Ukraine - a manifestation of global climate change // Ukrainian hydrometeorological journal.. - 2007. - No. 2. - S. 11-20.

## Contact Information

Odessa State Environmental University, L'vovskaya str.15, Odessa, 65016, Ukraine  
E-mail: agayarellina@gmail.com

## Results

During period from 2006–2020 there was an increase in the number of squalls on the territory of the North-Western Black Sea region in comparison with previous years. If for fifteen years from 1991 to 2005, according to [2], an average of 28 squall cases were observed, then for 2006–2020, according to the data of storm warnings from the HMC BAS it was 261.

The largest number of squalls in all three regions was observed in 2010 (43), but the maximum number of squall situations per year was noted in 2013 in the Odessa region - 25 cases. The minimum recurrence rate of squalls falls on the Kherson region, where the maximum annual rates during the study period did not exceed 7 cases (2010). In the Nikolaev region, the frequency of squalls varied from 1 to 13 cases (2010) (Fig. 1).

Depending on the synoptic situation, both macro- and mesoscale squalls can occur at any time of the year. But the most favorable conditions for their formation are observed in the warm half of the year from April to October. In the annual course, squalls are characterized by a maximum in summer. On the territory of the North-Western Black Sea region, they were most often observed in July with a frequency of 38.3%, slightly less in June -32%, but in the Kherson region squalls were more often observed in June (13 cases).

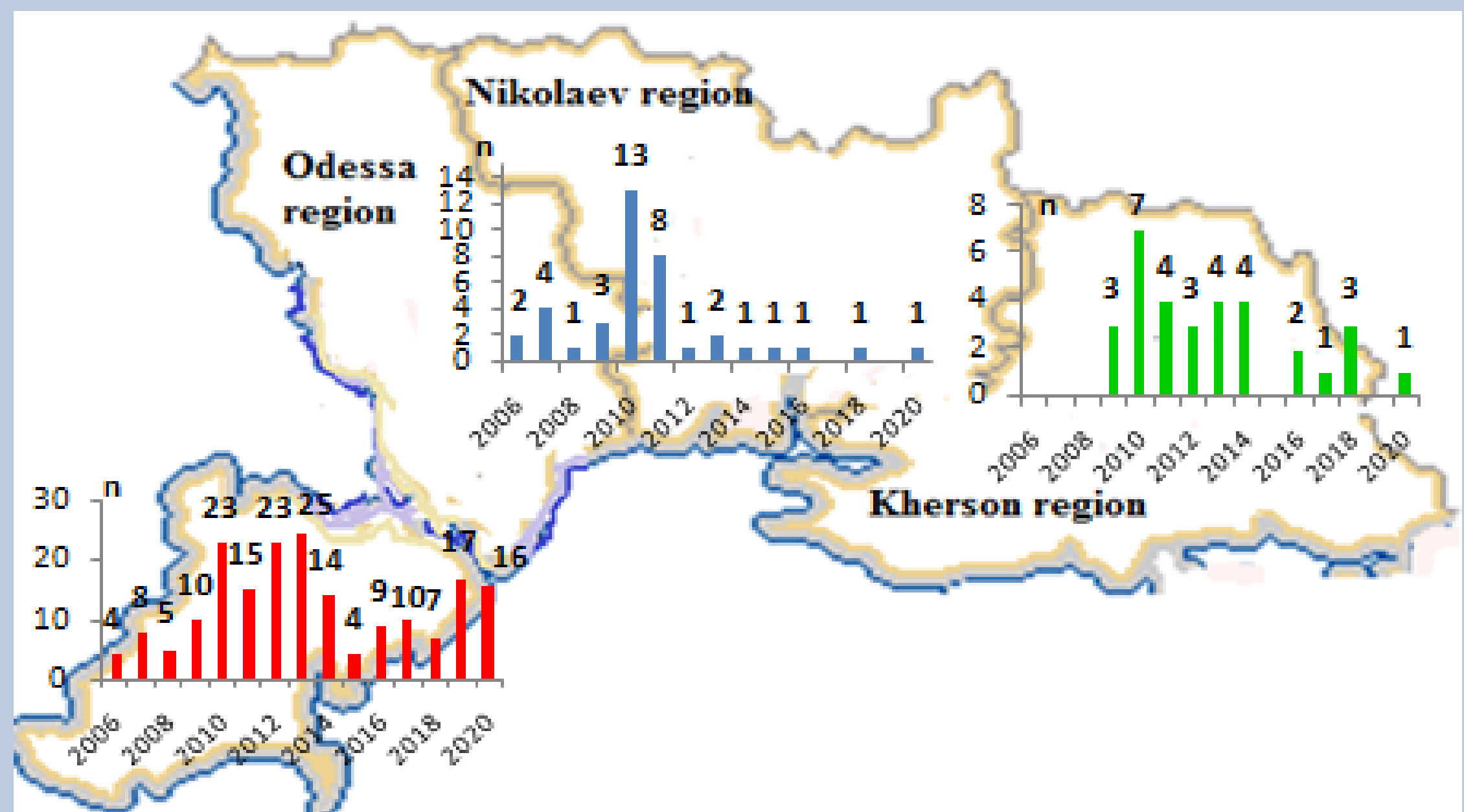


Fig. 1. The number of cases of squalls on the territory of Nikolaev, Odessa and Kherson regions by years. 2006-2020.

The minimum frequency of occurrence of squall formation for the period under consideration in the warm season was observed in August - 15.5%. In the spring, the largest number of squall was in May - 11.5%, 77% of which was observed in the Odessa region. In September squalls were recorded in the Nikolaev and Odessa regions, and in October there was only one squall in the Odessa region (Fig. 2).

In the study of squall formation processes, data on the maximum wind speed during a squall, which determine the degree of its danger, are of great importance. Squalls with a speed of up to 15 m / s in the south of Ukraine were observed in 15% of all cases. The highest frequency of squalls observed in wind velocity gradation of 15-24 m/s, i.e. squalls first hazard level - 81%. Severe meteorological phenomena II and III level rarely recorded, only 4% of cases. (Fig. 3).

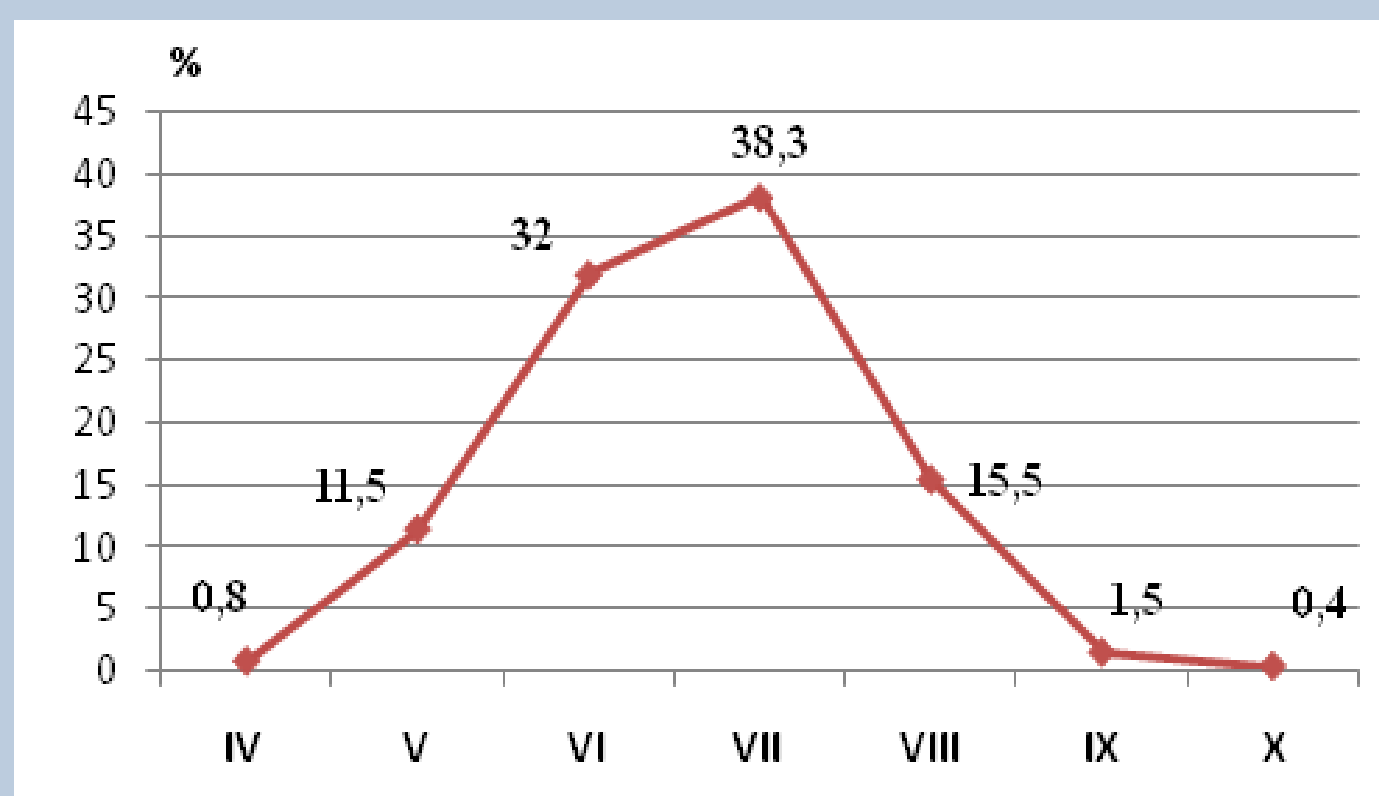


Fig.2. Frequency of the squall (%) for the warm period of 2006-2020.

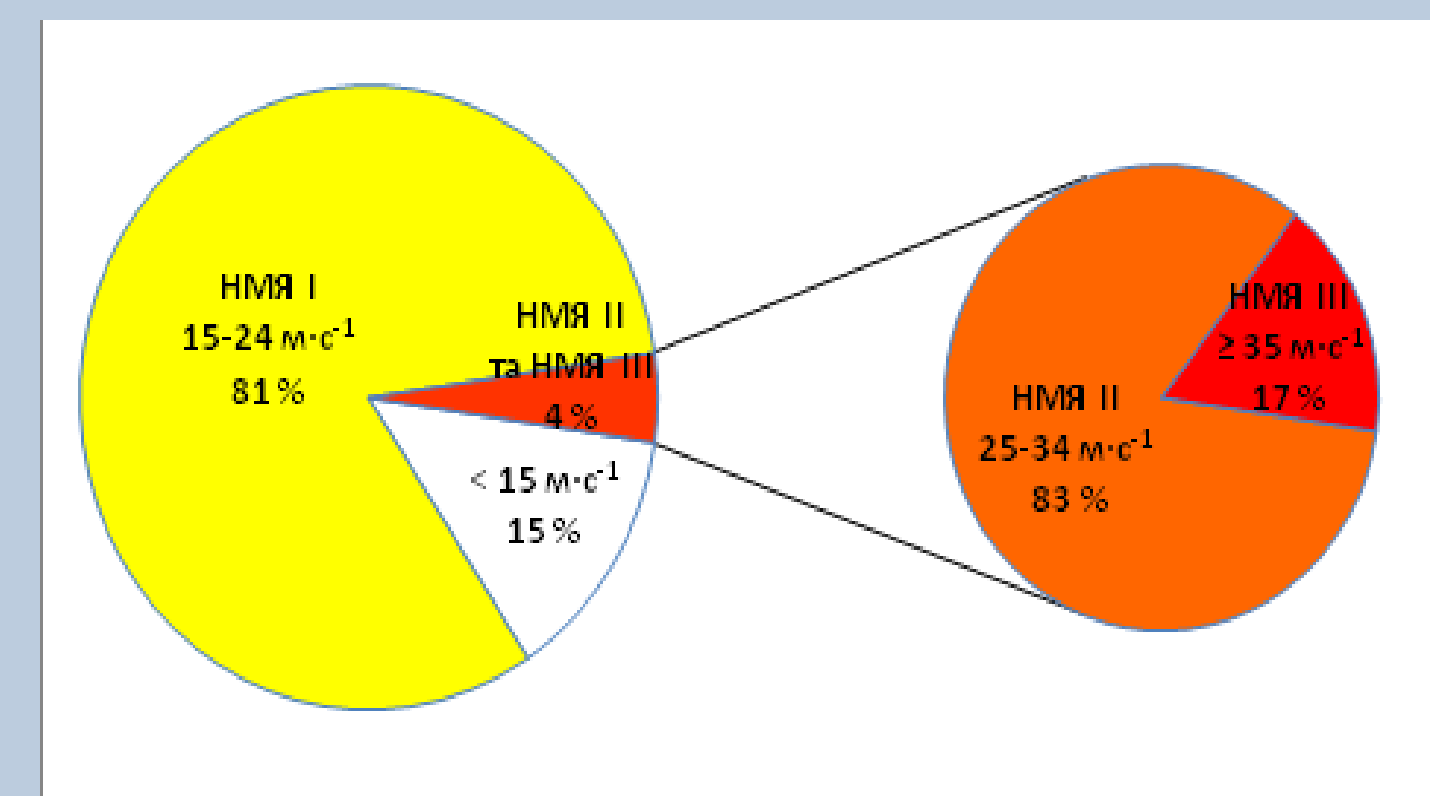


Fig. 3. Distribution of the frequency of squalls in the south-west of Ukraine for the period 2006-2020 by intensity