THE PREVAILING WIND DIRECTION AT THE ODESA-OBSERVATORY STATION AND ITS DYNAMICS IN THE CONTEXT OF MODERN CLIMATE CHANGE

Oleh Prokofiev*[1,2]*, PhD, Associate Professor,
Liudmyla Goncharova[1]*, PhD, Associate Professor,*
Vadim Chernyshov[1]*, graduate student*

[1]Odesa I. I. Mechnikov National University, Ukraine
[2]Institute of Climate-Smart Agriculture of the National Academy of Agrarian Sciences of Ukraine, Ukraine

Problem statement. The wind regime is one of the key factors determining the safety and efficiency of maritime transportation. For Odesa, where port infrastructure plays a crucial role in the local economy, changes in wind intensity or direction can have significant consequences. A comprehensive study of Odesa's wind regime holds great strategic importance. It not only helps reduce environmental, economic, and social risks but also enables the region to adapt to climate change, preserve its natural potential, optimize resource use, and ensure sustainable development in the future.

The **initial data** used in this study include the average frequency of wind direction occurrence as a percentage of the total number of observations for each month and year, excluding calm conditions. These values were calculated for the two most recent climatic norm periods (1961-1990 and 1991-2020). All source data were obtained from the climate cadastres of Ukraine.

Based on the data on the average frequency of wind direction, a wind roses have been constructed for each month of the year as well as for annual average values. Let us analyze the obtained results.

In January, during the first climatic norm period, the prevailing wind direction was north (19%). During the second climatic norm period, the north direction remained dominant (20%). Similarly, to the previous period, the southeast direction had the lowest frequency (5%). Thus, no significant changes in the prevailing wind direction were observed in January.

In February, during the first climatic norm period, a change in the prevailing wind direction is observed: the northeast direction becomes dominant with a probability of 20%, while the north direction remains highly frequent (19%), The southeast direction has the lowest frequency, like January (6%).

During the second climatic norm period, another shift occurs, with the north direction becoming the prevailing one again (19%). Thus, in February, a transition in the dominant wind direction is recorded-from northeast (first climatic norm) to north (second climatic norm). In March, during the first period, the north direction remains dominant (19%), with the northeast wind also showing a high frequency (18%). The southeast direction remains the least

frequent (8%). In the second climatic norm period, the north wind continues to prevail (19%), but the frequency of the northeast direction significantly decreases to 13%. Thus, in March, as in January, no changes in the prevailing wind direction are observed.

In April, a significant restructuring of the near-surface wind field occurs. During the first climatic norm period, the south wind direction dominates (23%). The frequency of all other directions is significantly lower, ranging from 10% (southeast) to 16% (north). In the second climatic norm period, the south direction remains dominant (22%). Thus, in April, as in March, no change in the prevailing wind direction is observed at the Odesa-Observatory station.

The April wind direction distribution remains unchanged in May as well. The prevailing wind direction does not shift between the two periods at Odesa-Observatory, with the south wind continuing to be dominant throughout the entire observation period. In June, a shift in the prevailing wind direction is recorded: from south (22% in the first period) to northwest (21% in the second period). In July, no changes in the prevailing wind direction.

However, in August, the prevailing wind direction shifts from north (23% in the first period) to northwest (22% in the second period). Similarly, in September, the prevailing wind at Odesa-Observatory changes from north and west (which had equal frequency in the first period) to northwest (in the second period). In October, similar to September, a shift in the prevailing wind direction is recorded at Odesa-Observatory, changing from north (1961-1990) to northwest (1991-2020). In November, no change in the prevailing wind direction is observed; throughout the entire observation period, the west wind remains dominant. In the last month of the year (December), the wind direction distribution remains unchanged, with the west wind continuing to be the dominant direction throughout the observation period.

Now, let’s analyze the annual distribution of wind direction frequencies across compass points for the two climatic norm periods and its dynamics. During the first climatic norm period (1961-1990), the north wind direction prevailed throughout the year with a probability of 18%. The west (15%) and northwest (14%) wind directions also showed relatively high frequencies. During the 1991-2020 the prevailing wind direction shifted to northwest, with a frequency of 17%. In this period, north (16%) and west (15%) wind components also maintained high frequencies throughout the year.

The analysis of the prevailing wind direction dynamics at Odesa-Observatory has revealed a disruption in the stability of the wind regime and a change in the prevailing wind direction during 1991-2020. The conducted study has revealed the impact of climate change on local atmospheric circulation, which may have significant consequences for coastal infrastructure, maritime activities, and regional climate adaptation strategies. Understanding these changes is crucial for developing effective measures to mitigate potential risks and ensure the sustainable development of the region.