



INTRODUCTION

Cyclones are the main synoptic processes, which determine the complicated weather conditions and precipitation regime in the middle latitudes. Intensity of cyclonic activity in the center of Europe depends on dynamics of main baric centers in atmosphere of the North Atlantic (described by NAO) and location of main tropospheric flows. Therefore the current climate changes might influence to trajectories and intensity of cyclones.

The Republic of Belarus is located in the center of Eastern Europe, therefore most of cyclones in this part of the continent are passing over its territory.

For the territory of Eastern Europe, as well as for Belarus, three main types of cyclone trajectories are characteristic: west, north-west and south cyclones. First of them are formed under the zonal type of atmospheric circulation, the rest – under the meridional atmospheric processes.

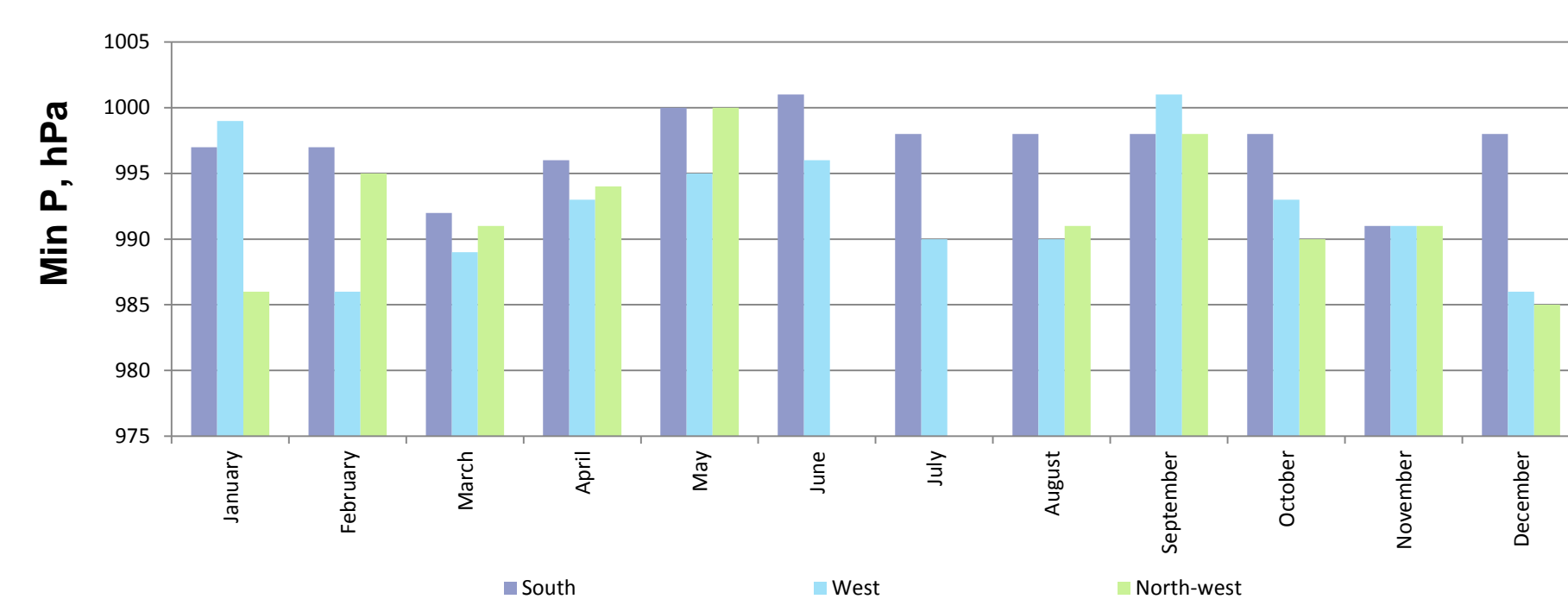
OBJECTIVE OF STUDY

The main objective of the study is analysis of trajectories and frequency of cyclones, which moved by the territory of Belarus during the period of 1995-2015. At present, there is not enough climatic information about these processes.

DATA AND METHODS

We used two types of data. For the period 1995-2003 - ECMWF ERA-Interim Reanalysis (1.5×1.5°), interval 6h; 2004-2015 – surface pressure field of Offenbach weather center (Germany), interval 6h. The obtained results we visualized on the basis of a graphic package GMT (Generic Mapping Tools) (<http://gmt.soest.hawaii.edu/>).

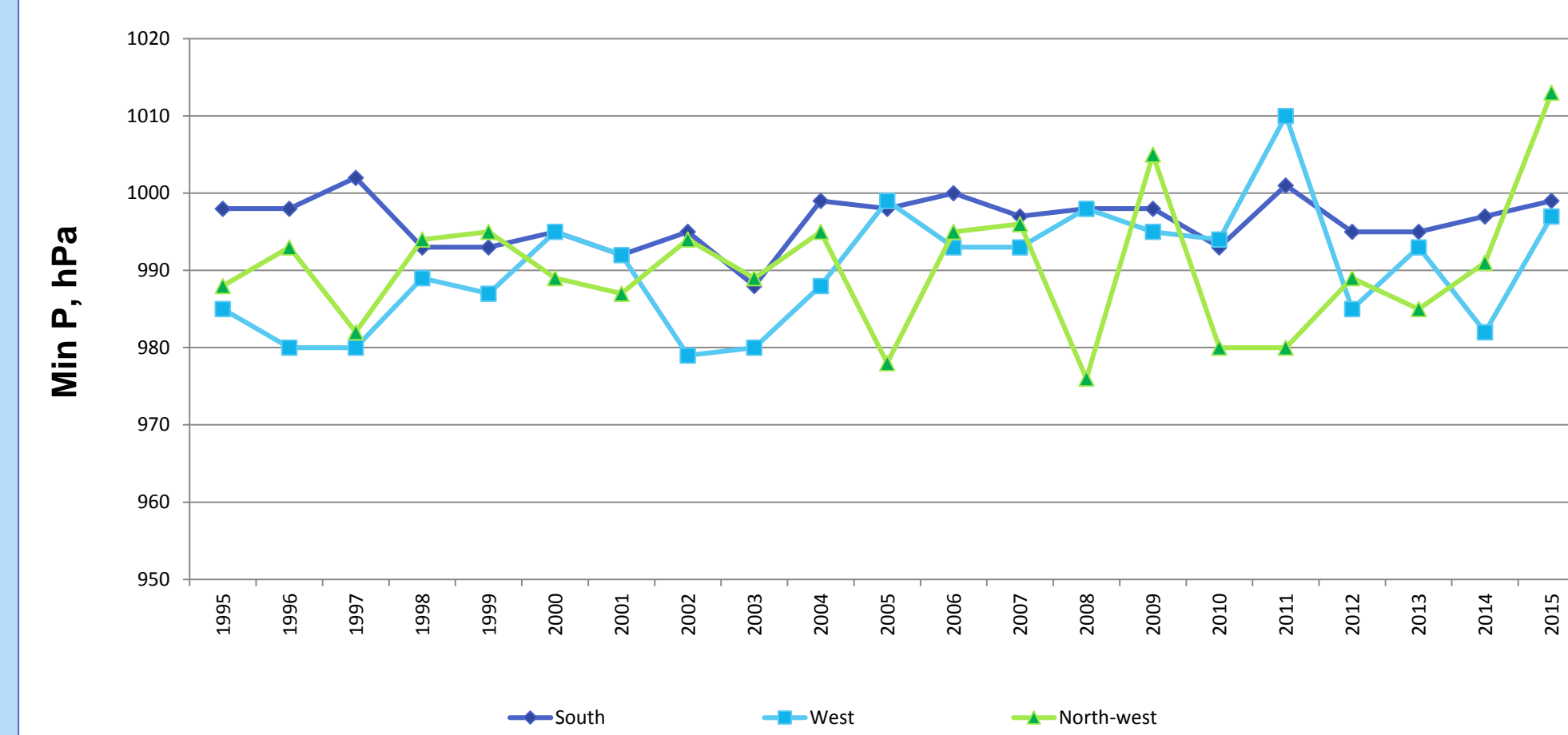
Seasonal variability of pressure in cyclones over Belarus (1995-2015)



RESULTS OF STUDY

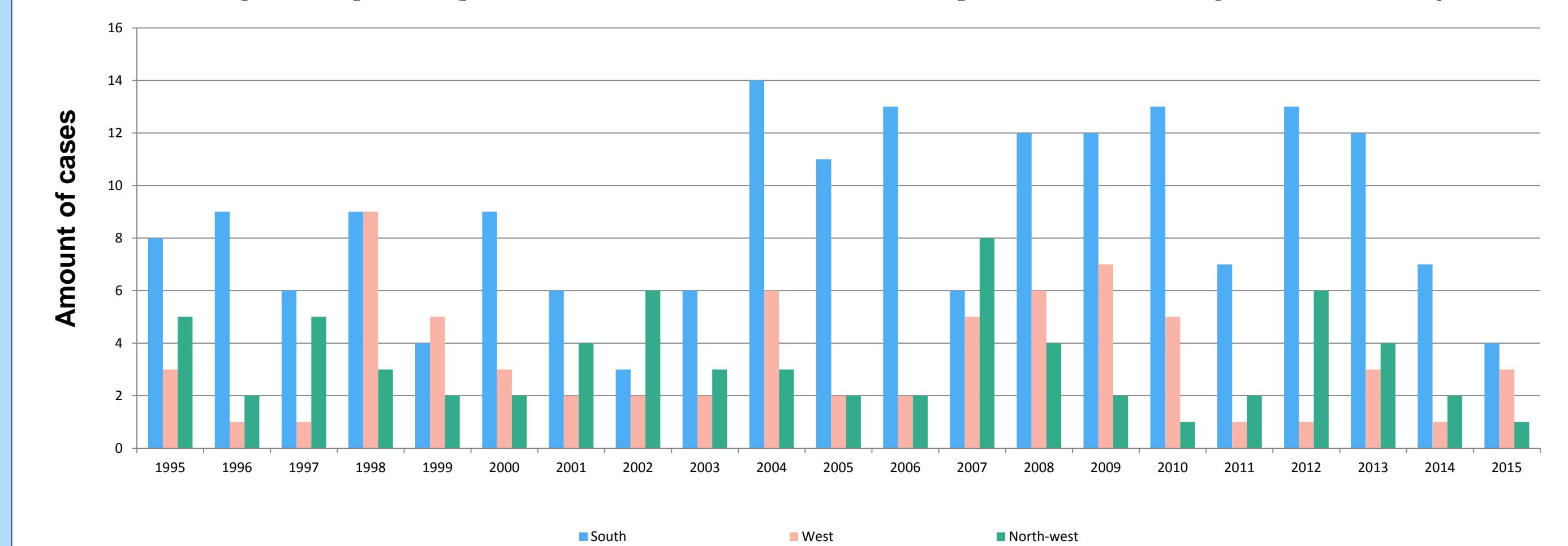
During the studied period 329 cyclones moved over the territory of Belarus. So, about 15-16 cyclones per year affected the weather conditions. 22% were of western and northwestern types of cyclones separately, 56% constituted southern cyclones. The maximum number of all types of cyclones (21-23 cases per year) observed in 1998, 2004, 2008 and 2009. Minimum of cyclone activity (about 10 cases) was in 2015.

Interannual variability of pressure in cyclones over Belarus (1995-2015)

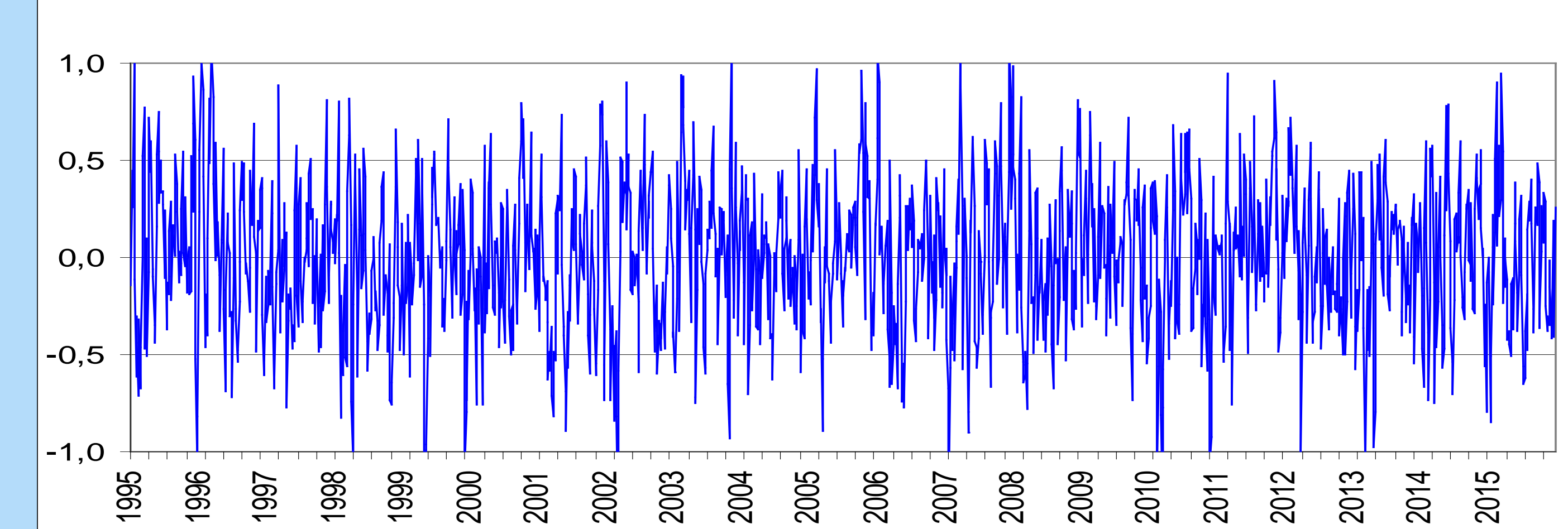


Mean pressure in the center of cyclones over the territory of Belarus composed about 992 hPa for the western and northwestern types and about 997 hPa for the southern cyclones.

Frequency of cyclones over the territory of Belarus (1995-2015)

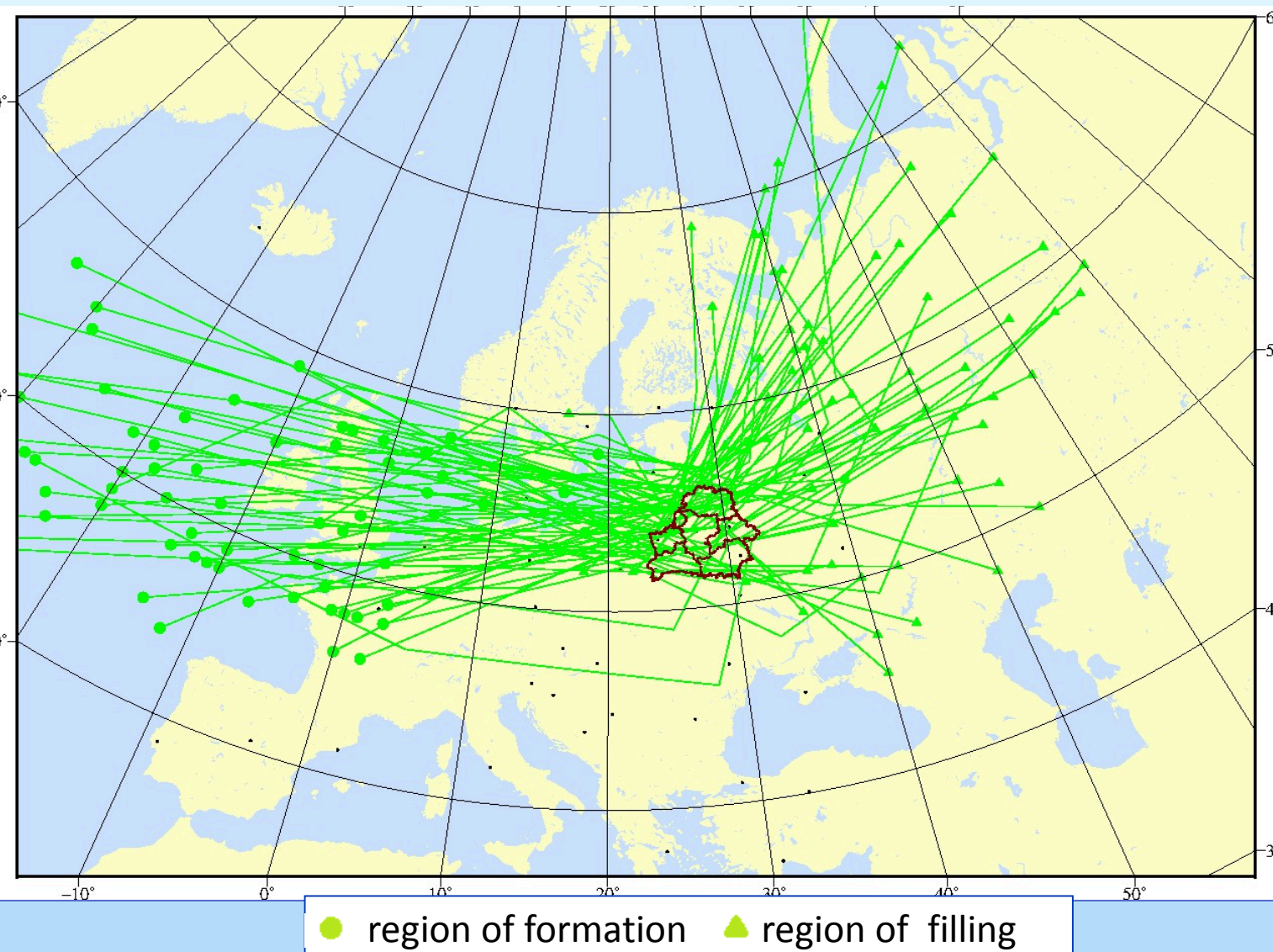


ECBI-1995-2015

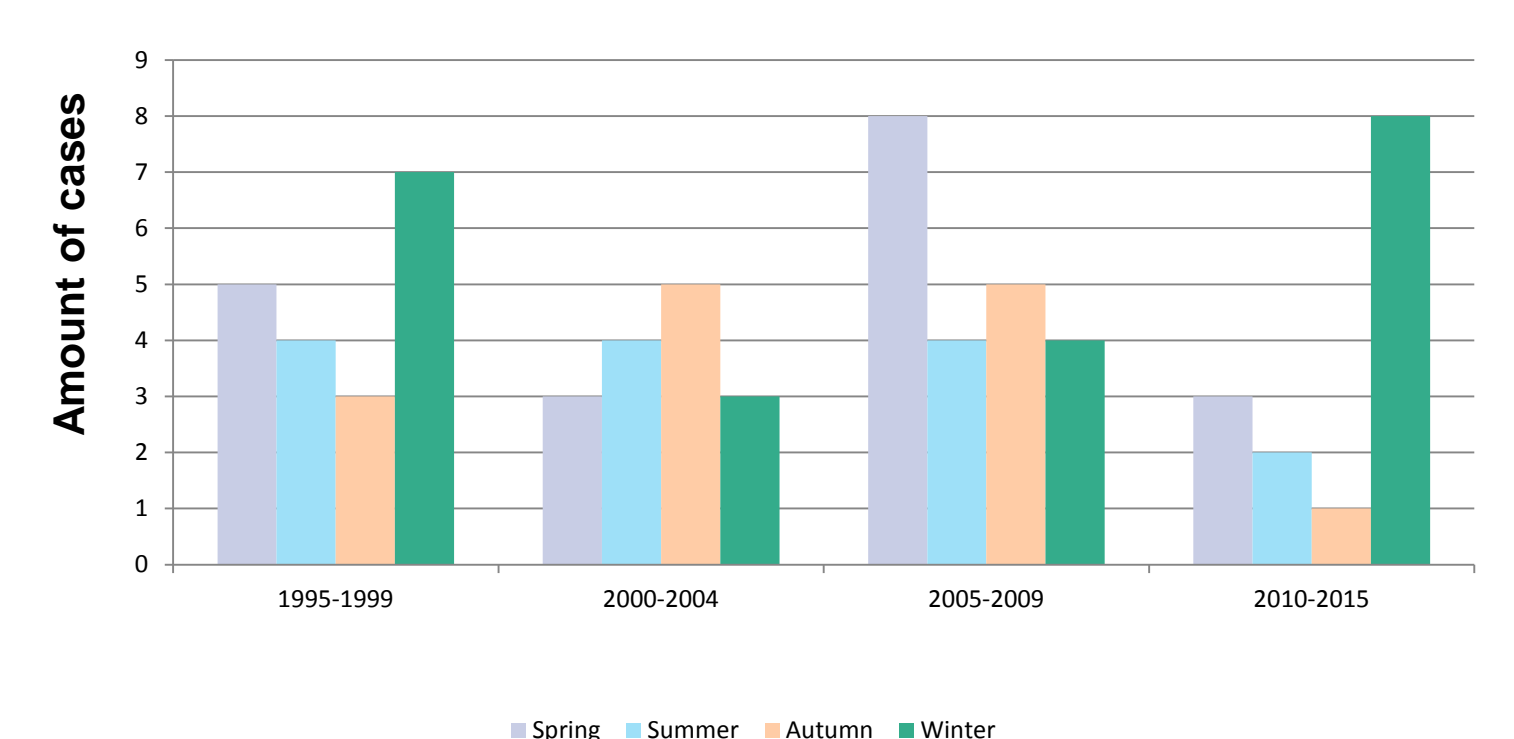


WEST CYCLONES

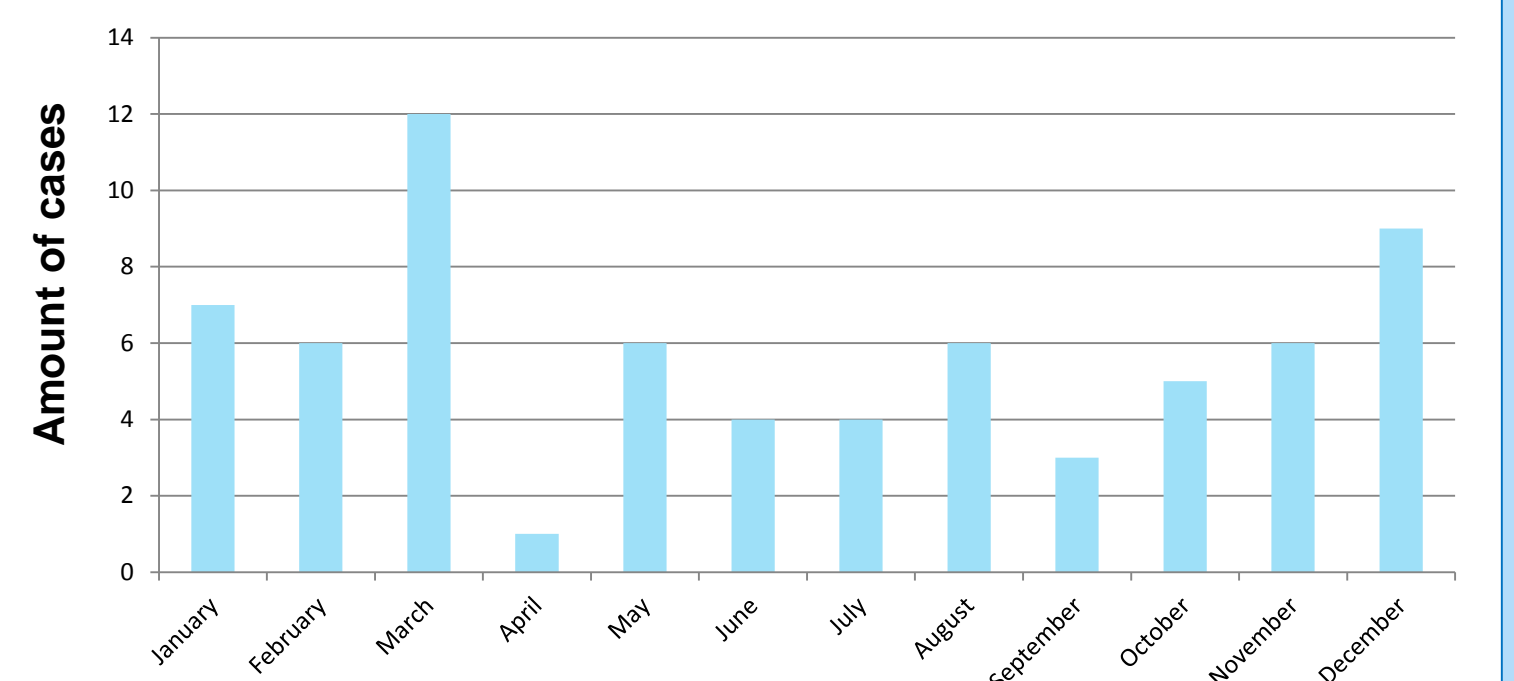
Trajectories of cyclones through the territory of Belarus (1995-2015)



Interannual variability of west cyclones frequency in certain periods

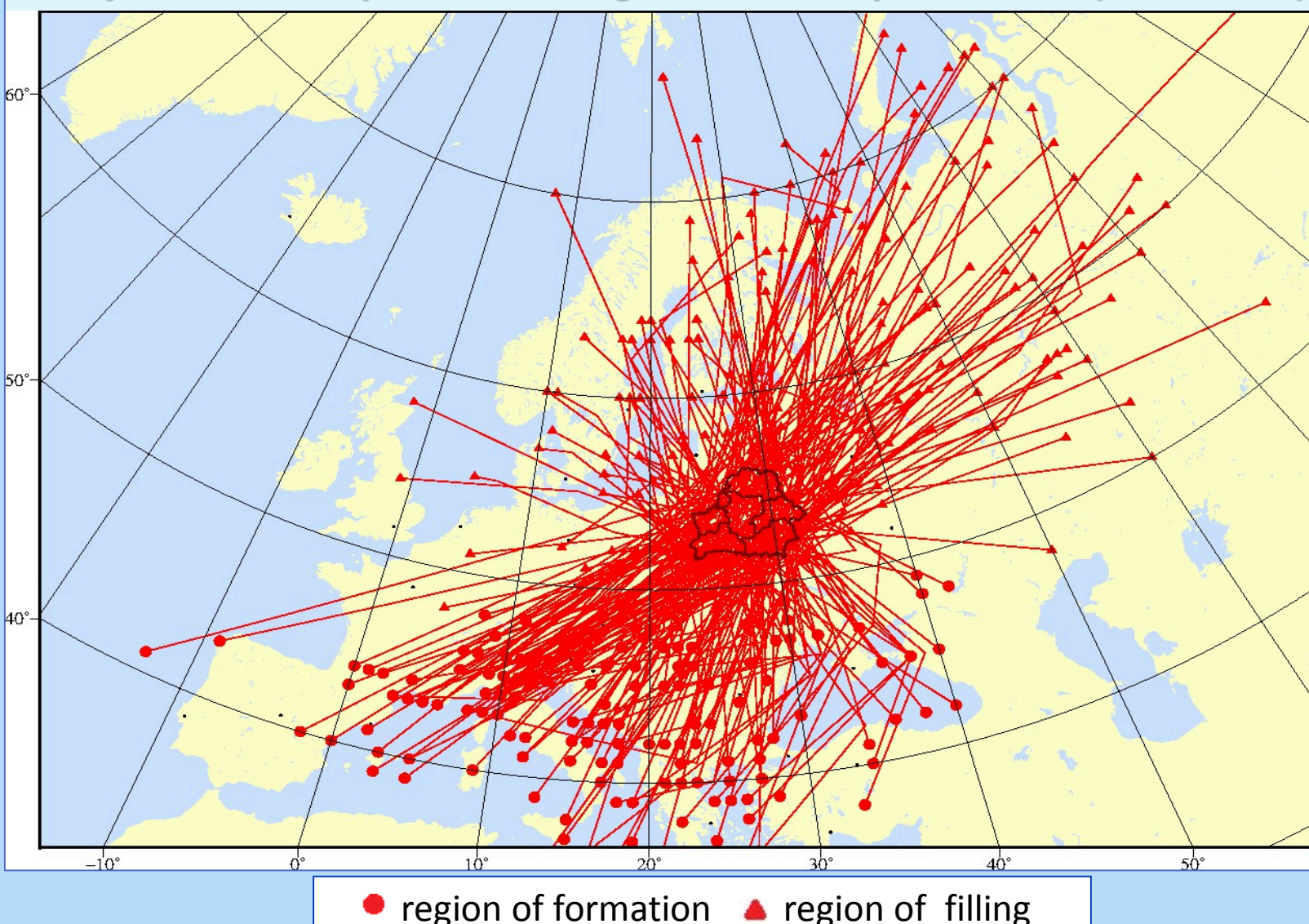


Frequency of west cyclones over Belarus (1995-2015)

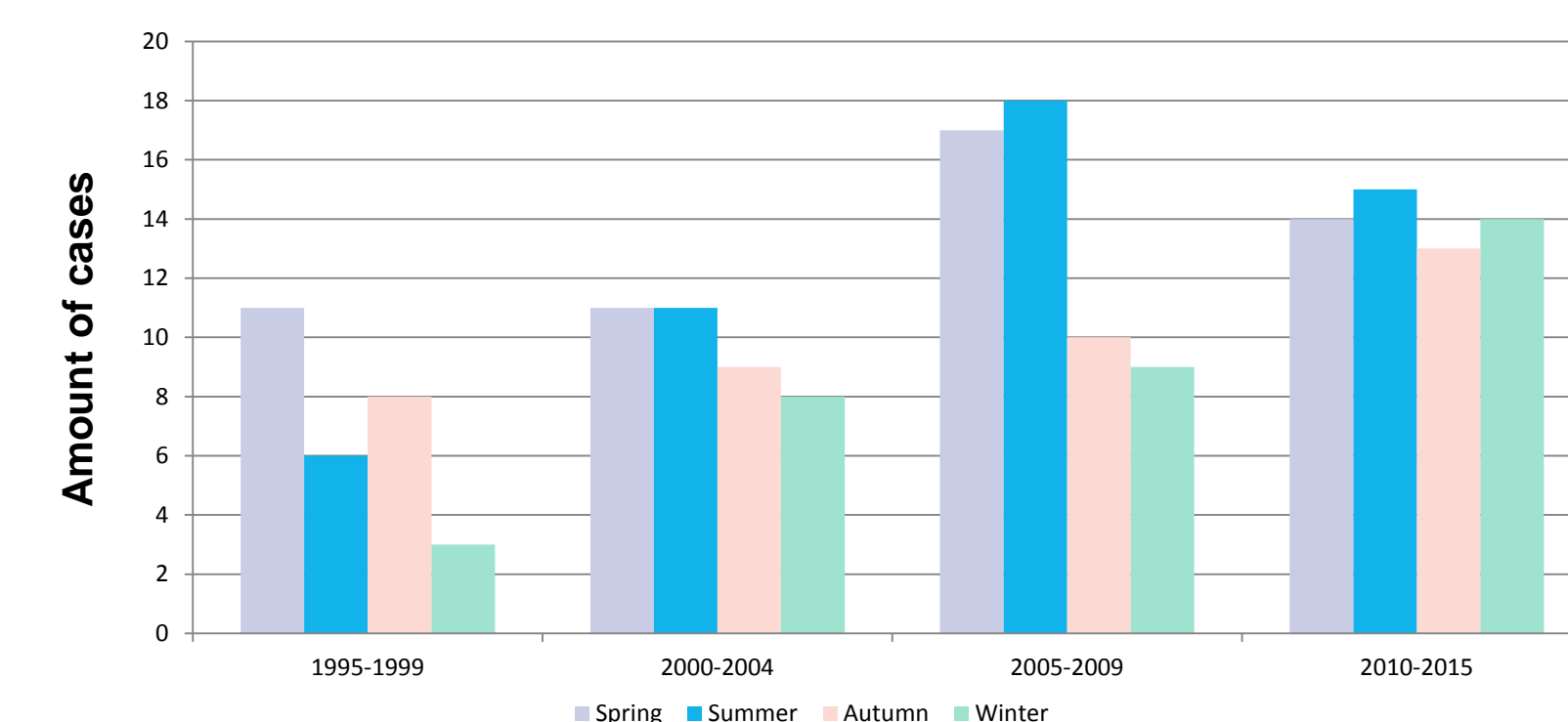


SOUTH CYCLONES

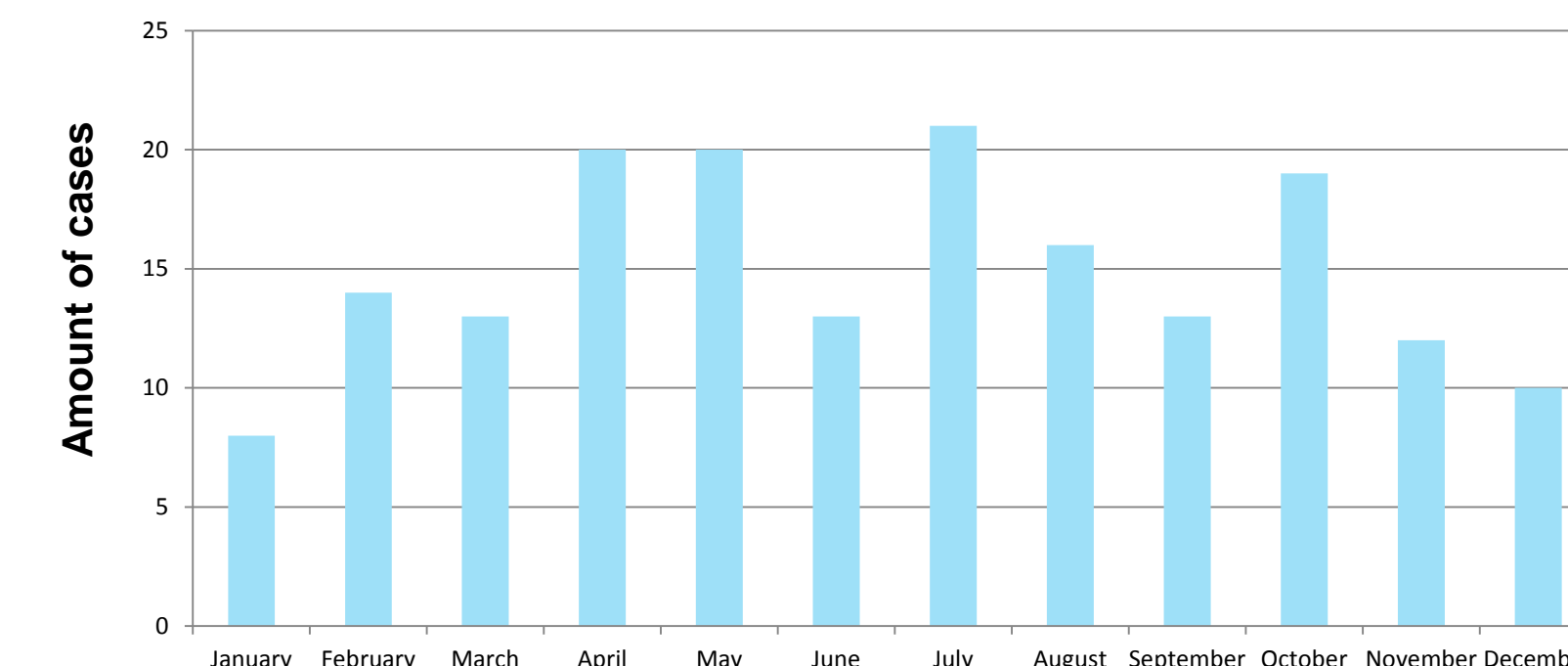
Trajectories of cyclones through the territory of Belarus (1995-2015)



Interannual variability of south cyclones frequency in certain periods

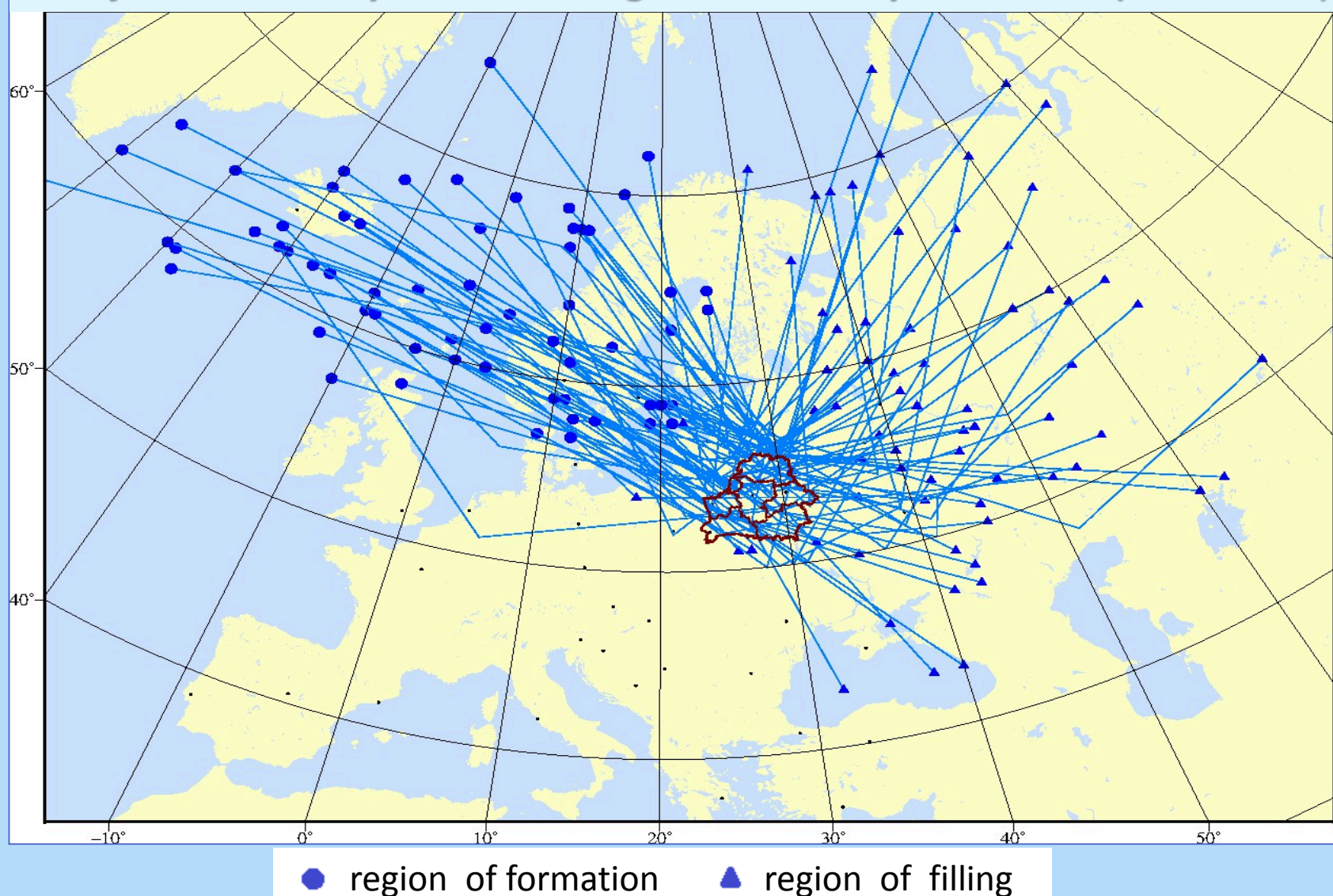


Frequency of south cyclones over Belarus (1995-2015)

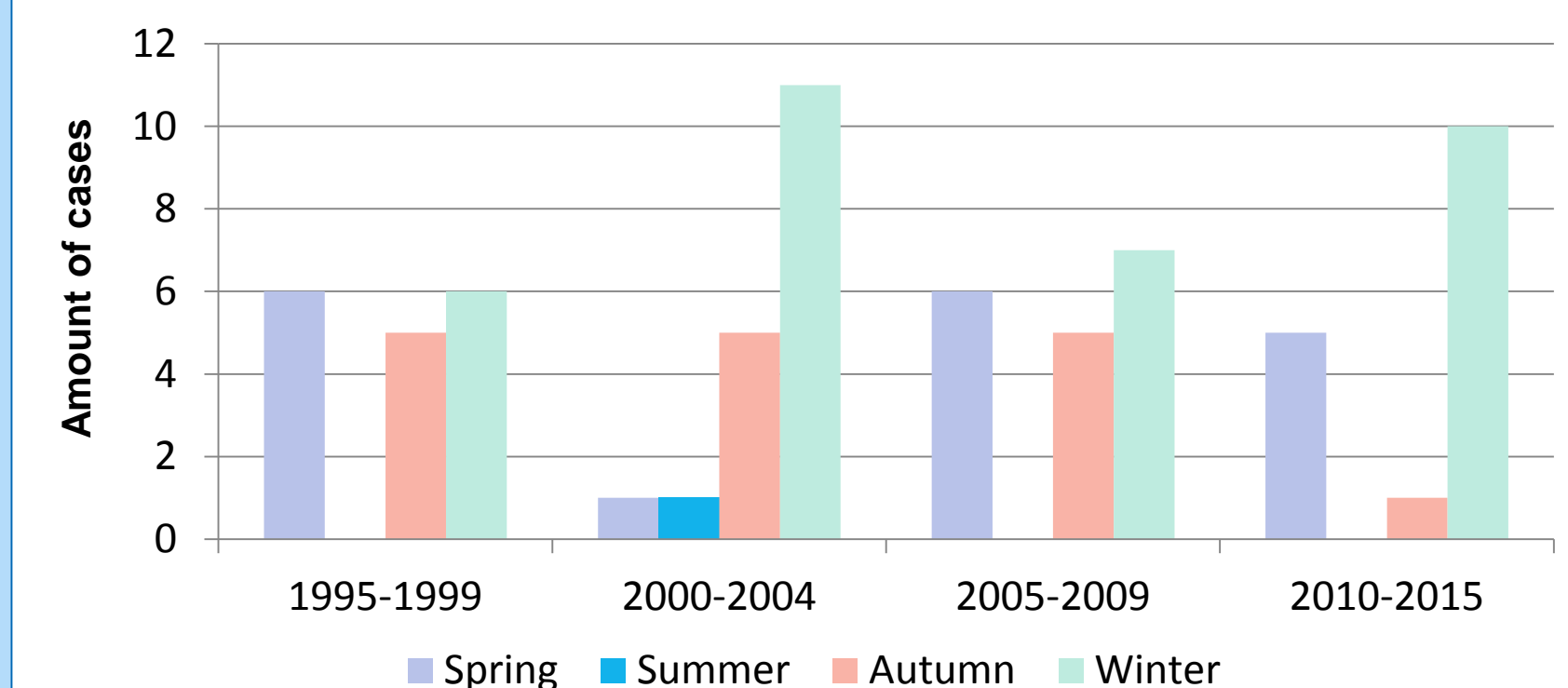


NORTH-WEST CYCLONES

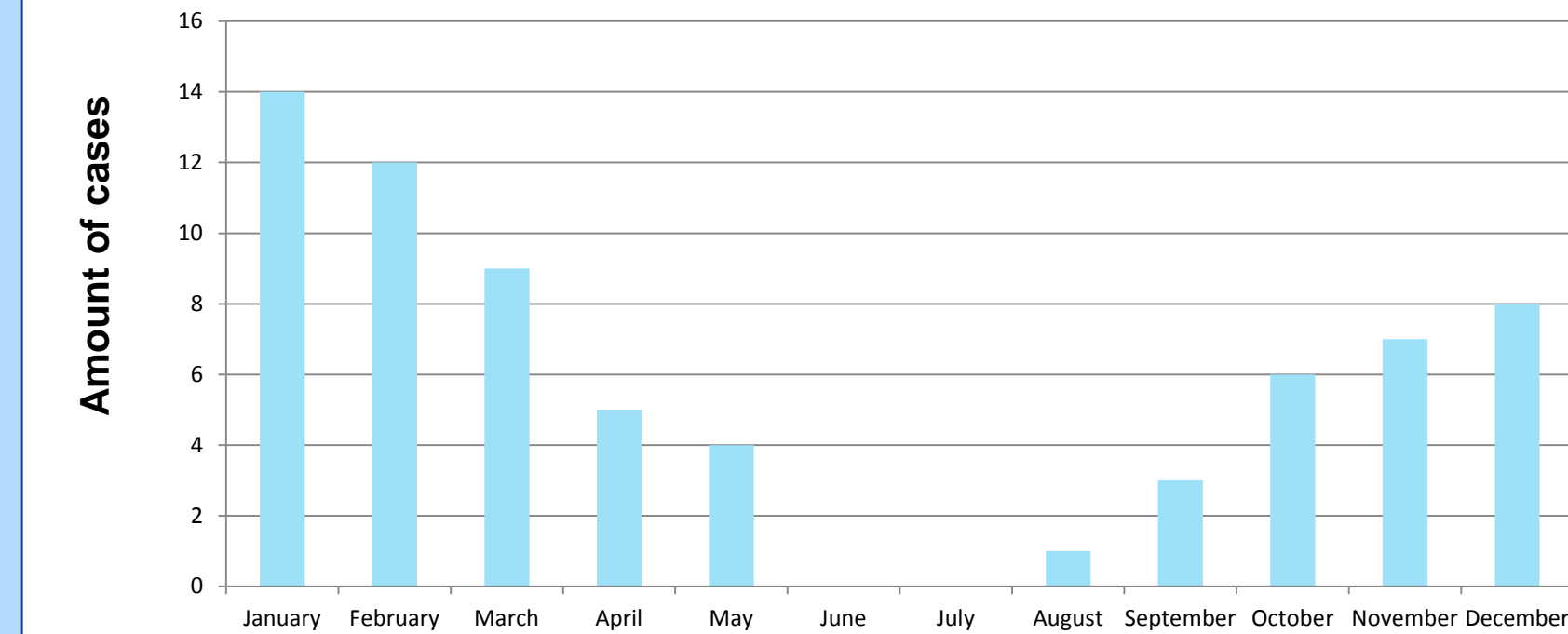
Trajectories of cyclones through the territory of Belarus (1995-2015)



Interannual variability of north-west cyclones frequency in certain periods



Frequency of north-west cyclones over Belarus (1995-2015)



The western cyclones frequently moved over the territory of Belarus in March and in December. The north-western cyclones most observed in January and in February. The amount of southern cyclones more evenly distributed within a year. The most cases observed in warm season – in July, April and May. Minimum of southern cyclones occurred in January and December.

The most of western cyclones, which moved over the territory of Belarus formed between 50N and 60N over regions of the Northwest Atlantic, the British Isles, the North Sea and south of the Baltic Sea. The main feature of these cyclones is a change of trajectories after the crossing of Belarus, further the most of cyclones turned toward northeast, but few number moved southward. The southern cyclones came to the territory of Belarus from all the Mediterranean regions, the Balkan Peninsula, the Black Sea and from Ukraine. The northwestern cyclones generally formed over the Norwegian Sea and moved through Scandinavia to the territory of Belarus, where the significant part of them turned toward northeast.

The evaluation of zonal flow using the ECBI (European Continental Blocking Index, Semenova, 2013) showed that most part of west cyclones (78%) shifted under the stable west flow (ECBI<0) and without blocking episodes over Eastern Europe during the studied period. 13% cases of west cyclones were accompanied by a rearrangement of the high-altitude field from meridional to zonal flow and vice versa. North-western cyclones (60% cases) moved to the territory of Eastern Europe with the predominance of west flow on high-altitude field. However, the rest of them formed under the blocking processes (ECBI>0), or were accompanied under the meridional rearrangement of the high-altitude field of pressure. South cyclones (38% cases) went to the territory of Eastern Europe under the blocking processes, 45% of cyclones moved under the stable zonal flow. And 16% cases of south cyclones were accompanied by a rearrangement of the high-altitude field of pressure, that was revealed by the sign change of blocking index ECBI.

CONCLUSIONS

Thus, the study showed, that cyclonic activity over the territory of Belarus under current climate conditions was very intensive that indicated by high frequency of cyclones.

Meridional circulation is a pattern, which occurred often over the Eastern Europe in current period. In the limiting cases, formation and movement of cyclones by quasi-meridional trajectories indicated the end of blocking of atmospheric flow. It follows that the blocking processes were also observed often over the Eastern Europe during the study period.

In the near future, we plan to assess the grade of zonality flow (using the blocking index ECBI) and set when blocking actually begins in the synoptic concept. Moreover, we will calculate the intensity of blocking (for all types of cyclones), dividing the gradation of the index ECBI.

References

- Semenova I.G. (2013). Regional atmospheric blocking in the drought periods in Ukraine. Journal of Earth Science and Engineering. V.3 (5). P. 341-348