Effects of North Atlantic Oscillation on spatiotemporal variations of total ozone over Europe

Valeriy N. Khokhlov[1], Alexander V. Glushkov[2] and Nataliya S. Loboda[1]

[1] Hydrometeorological Institute; [2] Institute of Applied Mathematics; OSEU, Lvovskaya str. 15, Odessa 65016, Ukraine.
E-mail: vkhokhlov@ukr.net

Objectives:

- to detail NAO-induced variations of total ozone;
- to estimate time lags for the response of total ozone on the variability of the NAO.

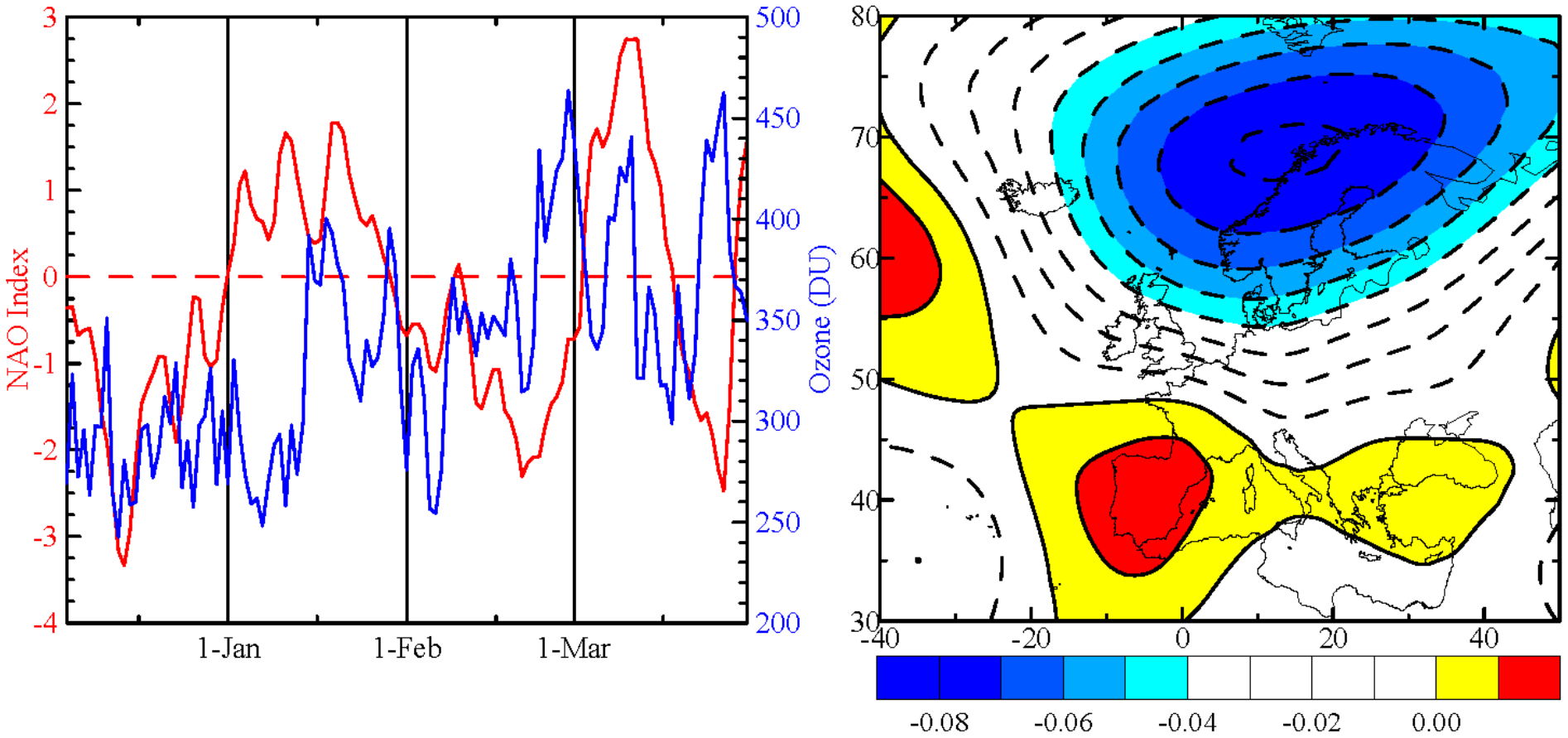
Data:

- daily NAO index;
- daily total ozone at sites in Europe.

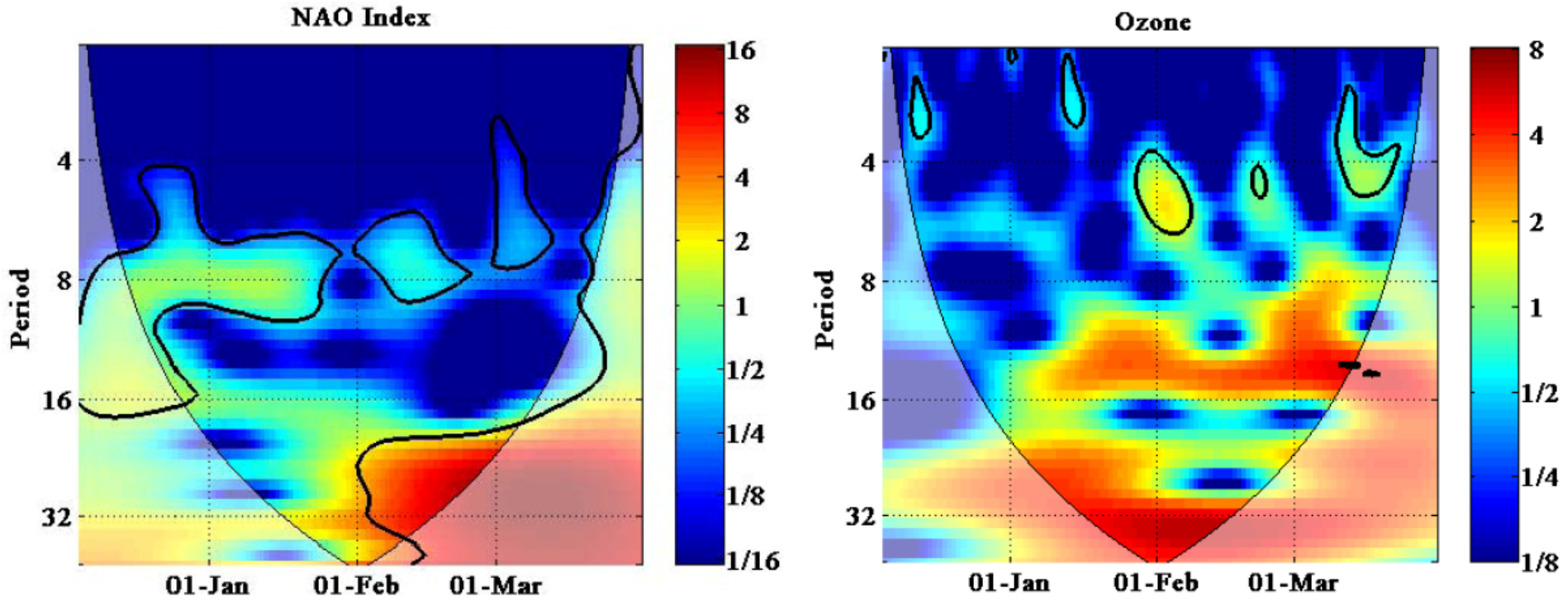
Methodology:

cross wavelet transform.

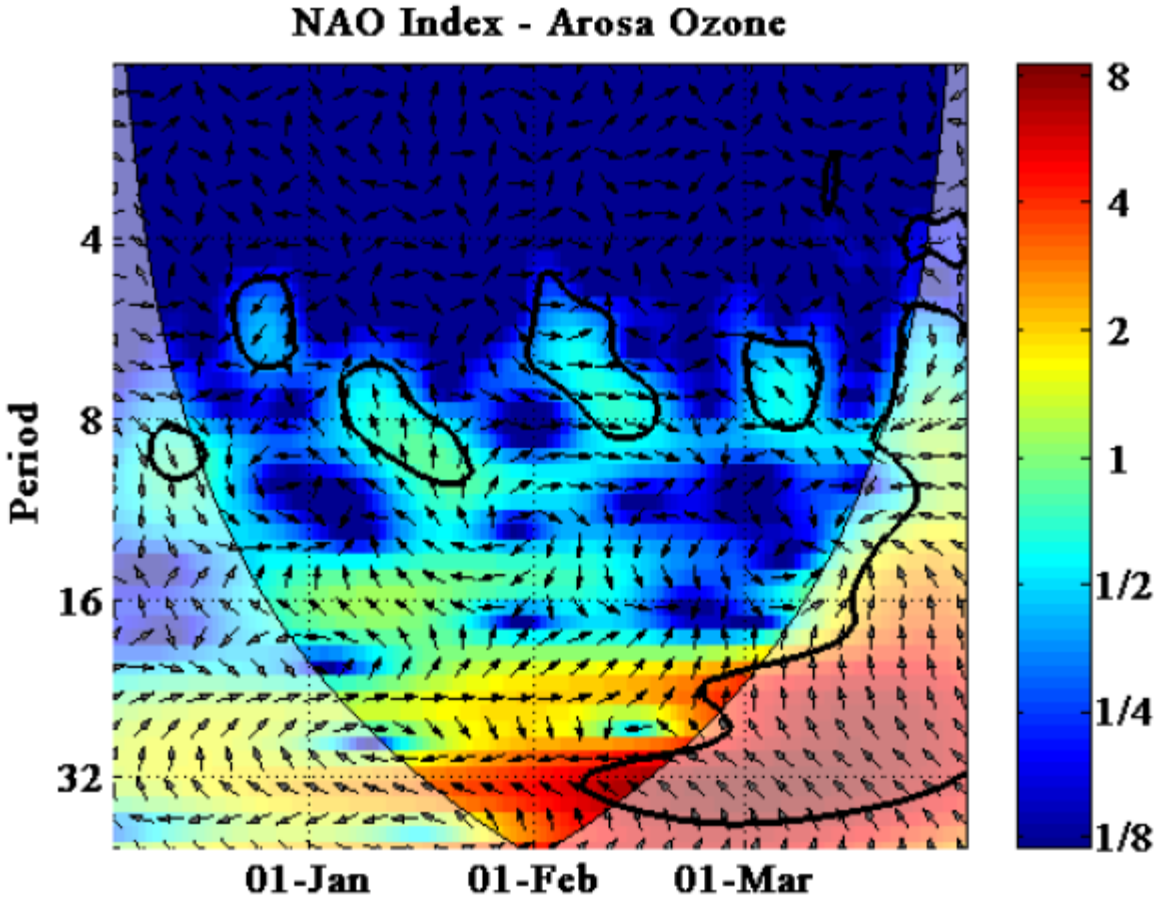
The cross wavelet transform is an approach providing the information about relationships in time-frequency space and phase angle statistics between two time series.



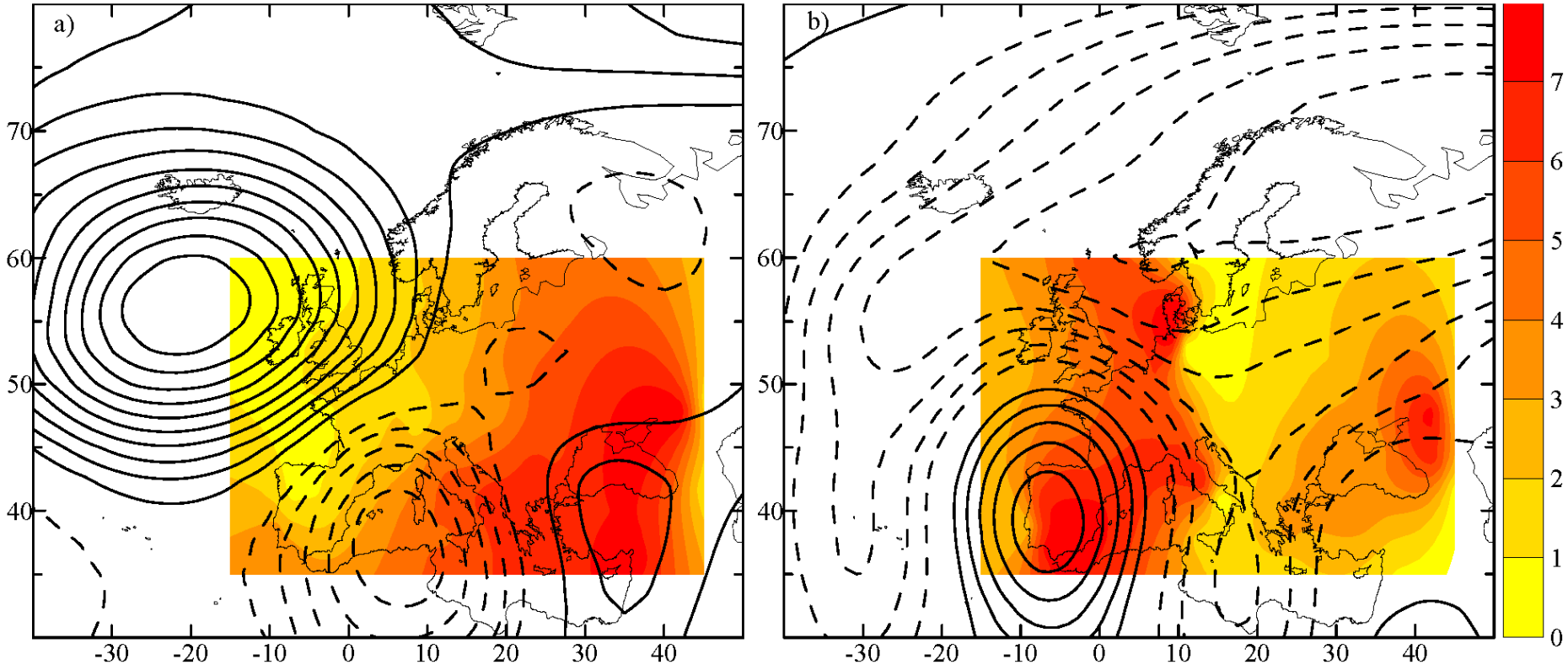
The NAO index and Arosa total ozone (r = 0.09), and PC1 for H_{500} height (variation = 24%) for DJFM of 2003.



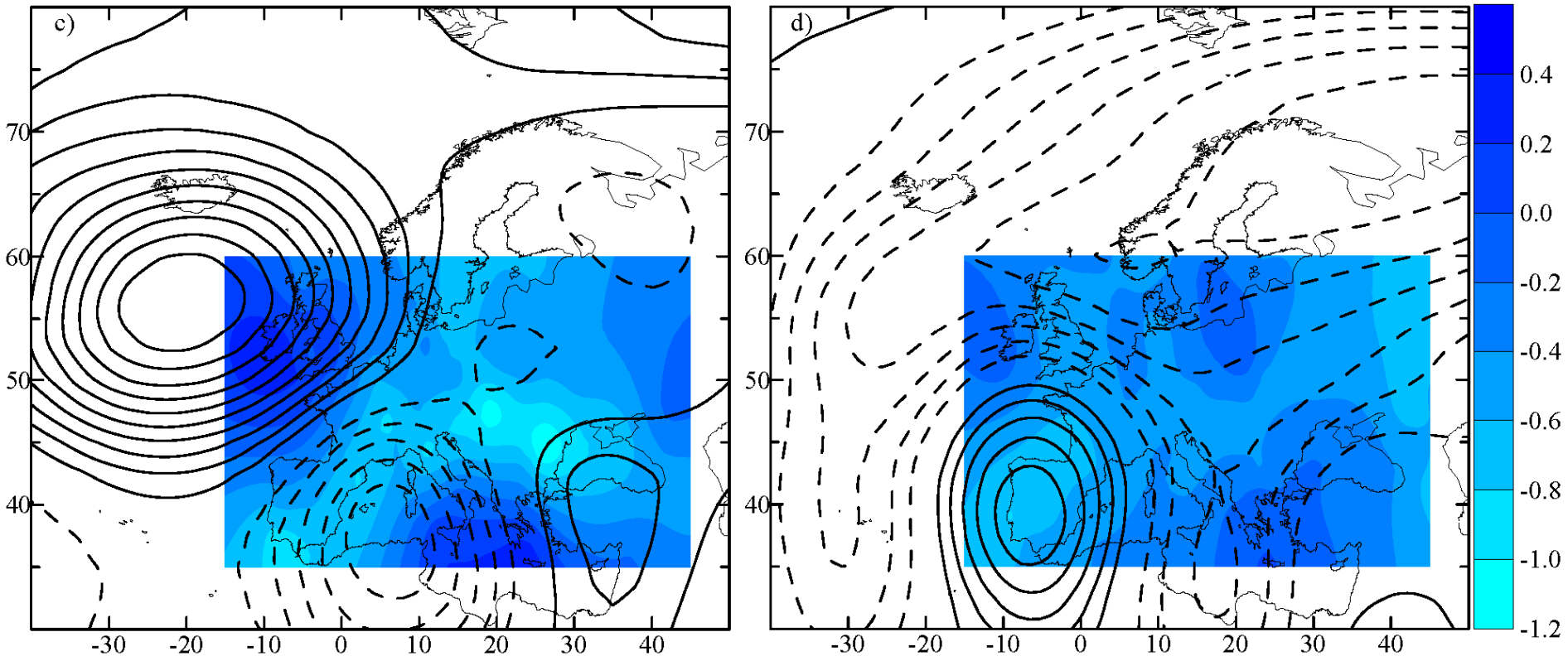
Continuous wavelet power spectra. The thick black contour designates the 5% significance level against red noise and the cone of influence (COI) where edge effects might distort the picture is shown as a lighter shade.



Cross wavelet transform of the NAO index and Arosa total ozone.
The 5% significance level against white noise is shown as a thick contour.
The relative phase relationship is shown as arrows (with in-phase pointing right, anti-phase pointing left, and Arosa total ozone leading NAO index by 90° pointing straight down).



Time lags (days) for the response of total ozone on the variability of the NAO during negative (left) and positive (right) phase of NAO.



Cross wavelet power of the NAO index and total ozone over Europe during negative (left) and positive (right) phase of NAO.

Conclusions:

First, continuous wavelet transform displays significant variations of NAO at synoptic time scales, and there is significant cross wavelet power for total ozone of many European sites at those time scales. Second, there is distinct feature of NAO-induced variations of ozone at synoptic time scales: these variations show some time lag depending on distance from main center of action in North Atlantic, and cross wavelet power is determined by a sign of pressure anomaly in the main center of action in North Atlantic.