International Cooperative Programmes on
Assessment and Monitoring of Air Pollution on Rivers and Lakes

Joint 34th ICP Waters and 26th ICP IM Task Force Meeting

ASSESSMENT OF ACCUMULATION AND SPATIAL DISTRIBUTION OF NITROGEN AND SULFUR DIOXIDES IN ATMOSPHERE OF THE NORTHERN PART OF ARMENIA (*INCLUDING DEBED RIVER BASIN*) AND POTENTIAL POPULATION HEALTH RISK

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Case study

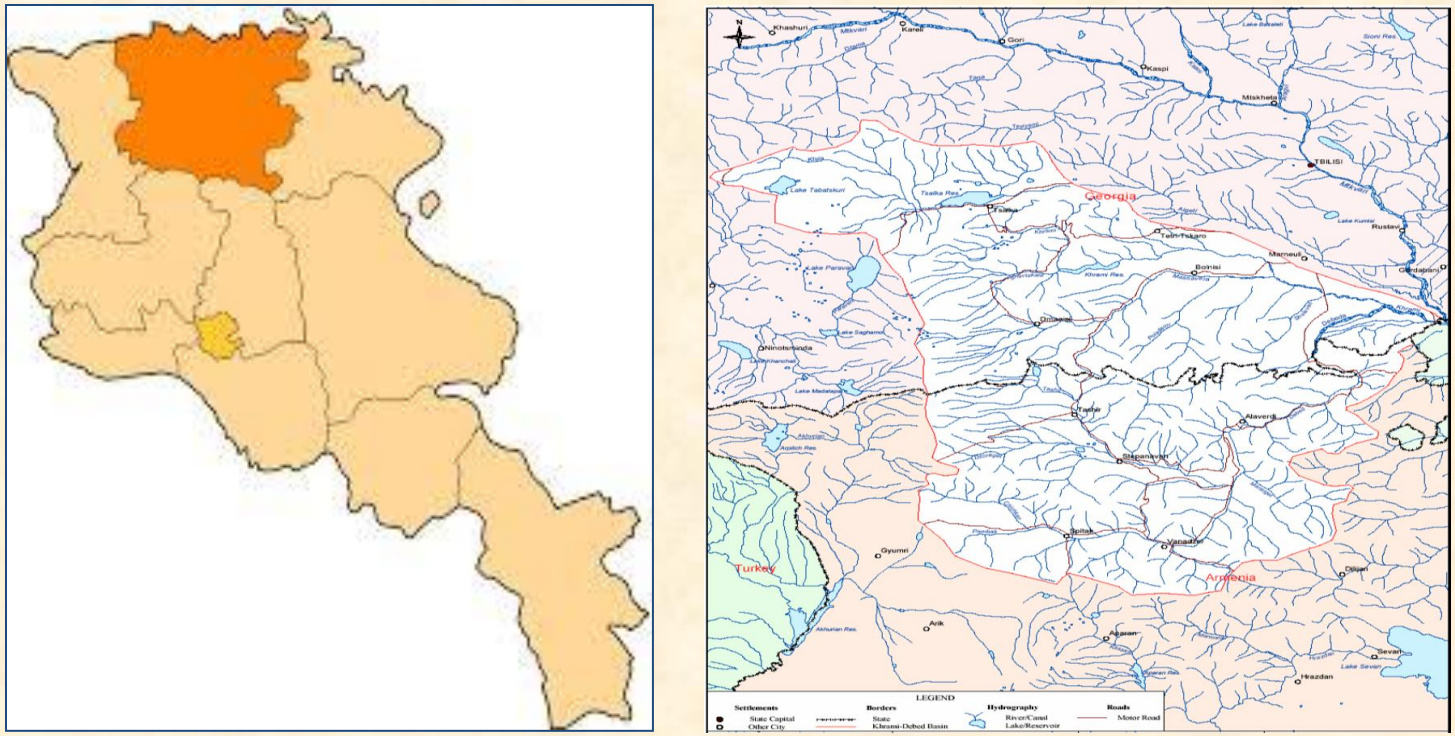


Fig.1. Location of Lori Region of Armenia and Debed River Network location within Armenia and Georgia

Lori Region of Armenia

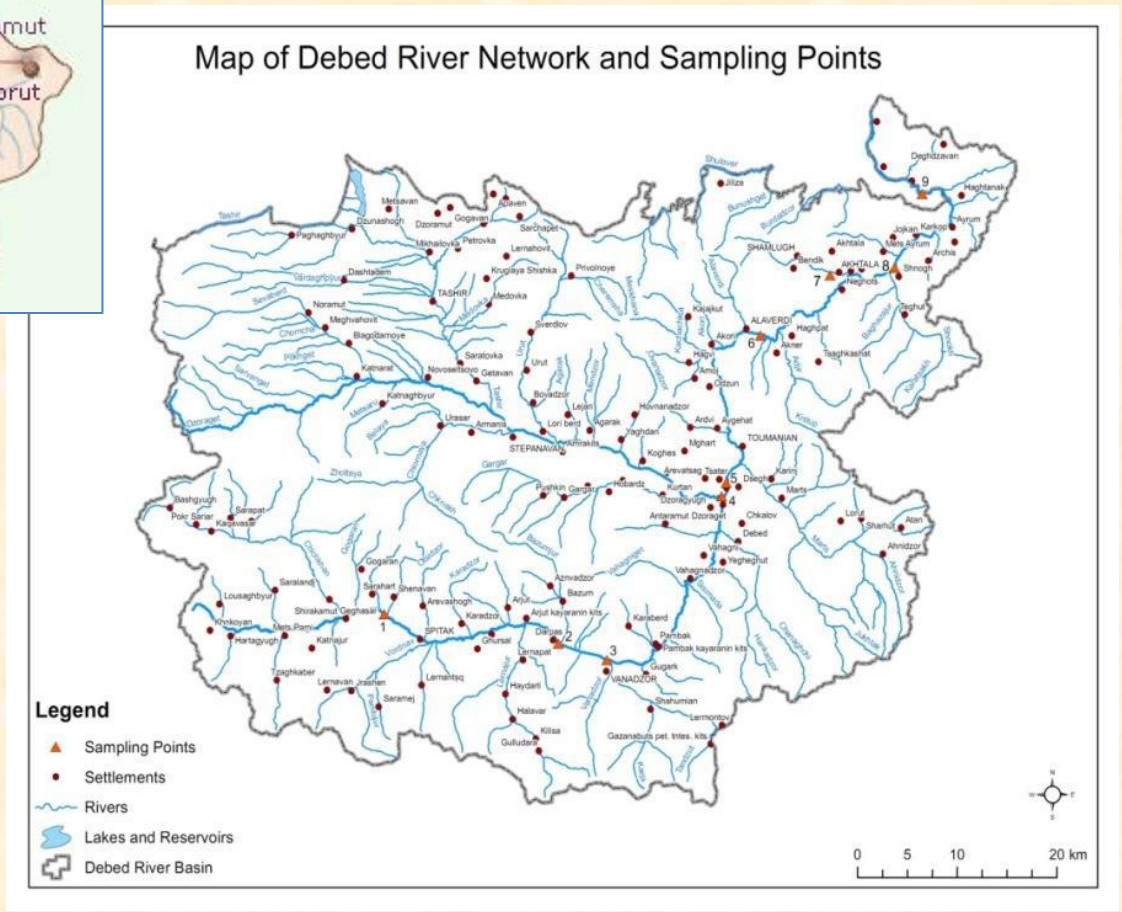


Fig.2. Hydrological Map of Debed River and monitoring sites.

Methods

Spatial distribution of air pollutions within the studied territory was build on data of satellite spectrometer EOS/OMI, which runs within the range of 0,27-0,5 km, has spectral resolution of 0,45-1,0 nm and enables measuring the atmosphere content in wide range of 2600km with spatial resolution of 13×24 km [Levelt et al., 2006].

Land verification metering of the atmosphere surface layer were performed in two monitoring sites near the city of Alaverdi and passive monitoring data (more than 50 points) on monthly basis between 2004 and 2014 [Environmental Impacts Monitoring Center reports for 2004-2014]

Results

Spatial distribution of the characteristics of dynamics of nitrogen dioxide content in surface atmosphere of Debed River catchment area between 2004 and 2014

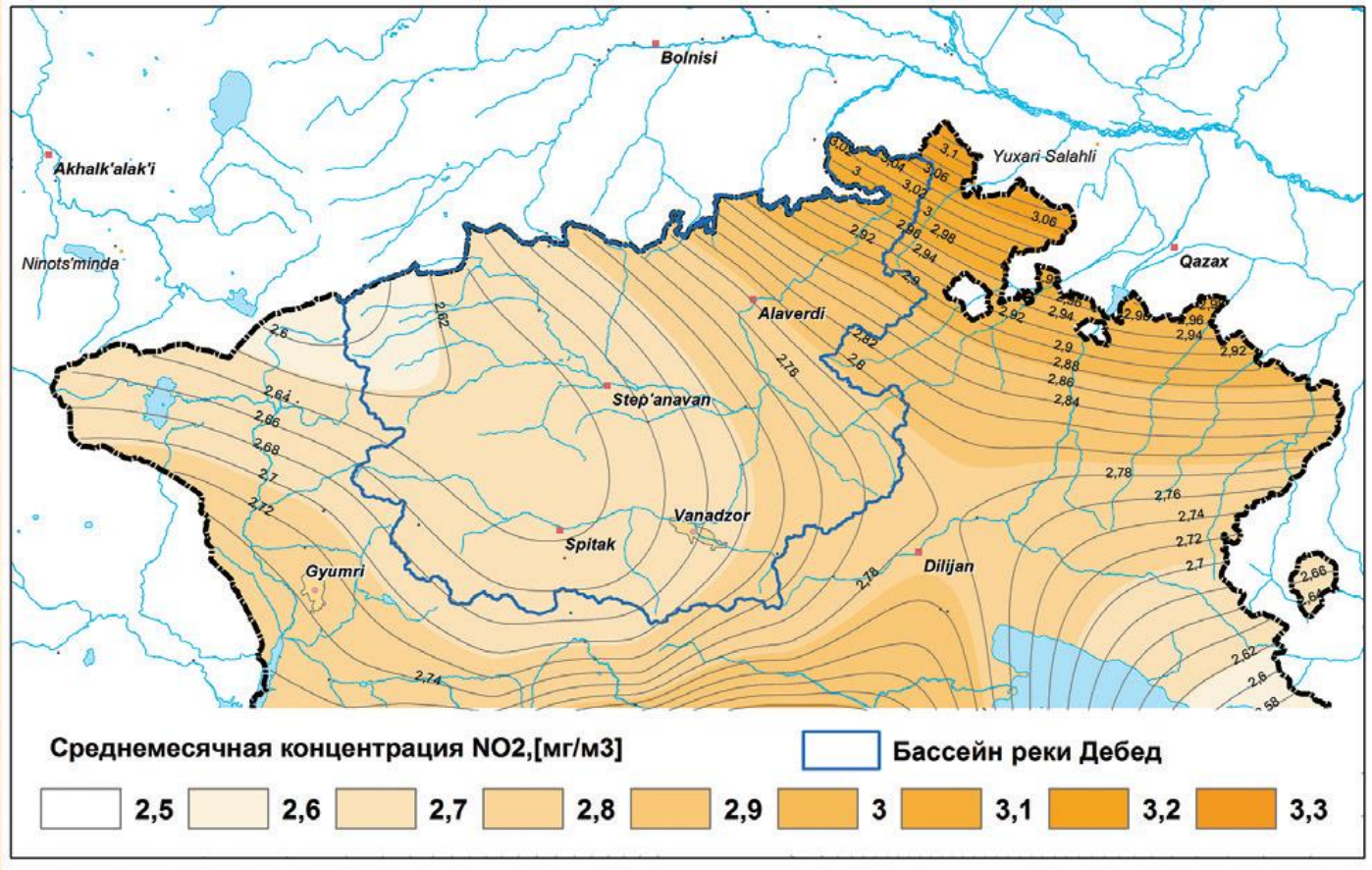


Fig. 3. – average concentration (mg/m^3)

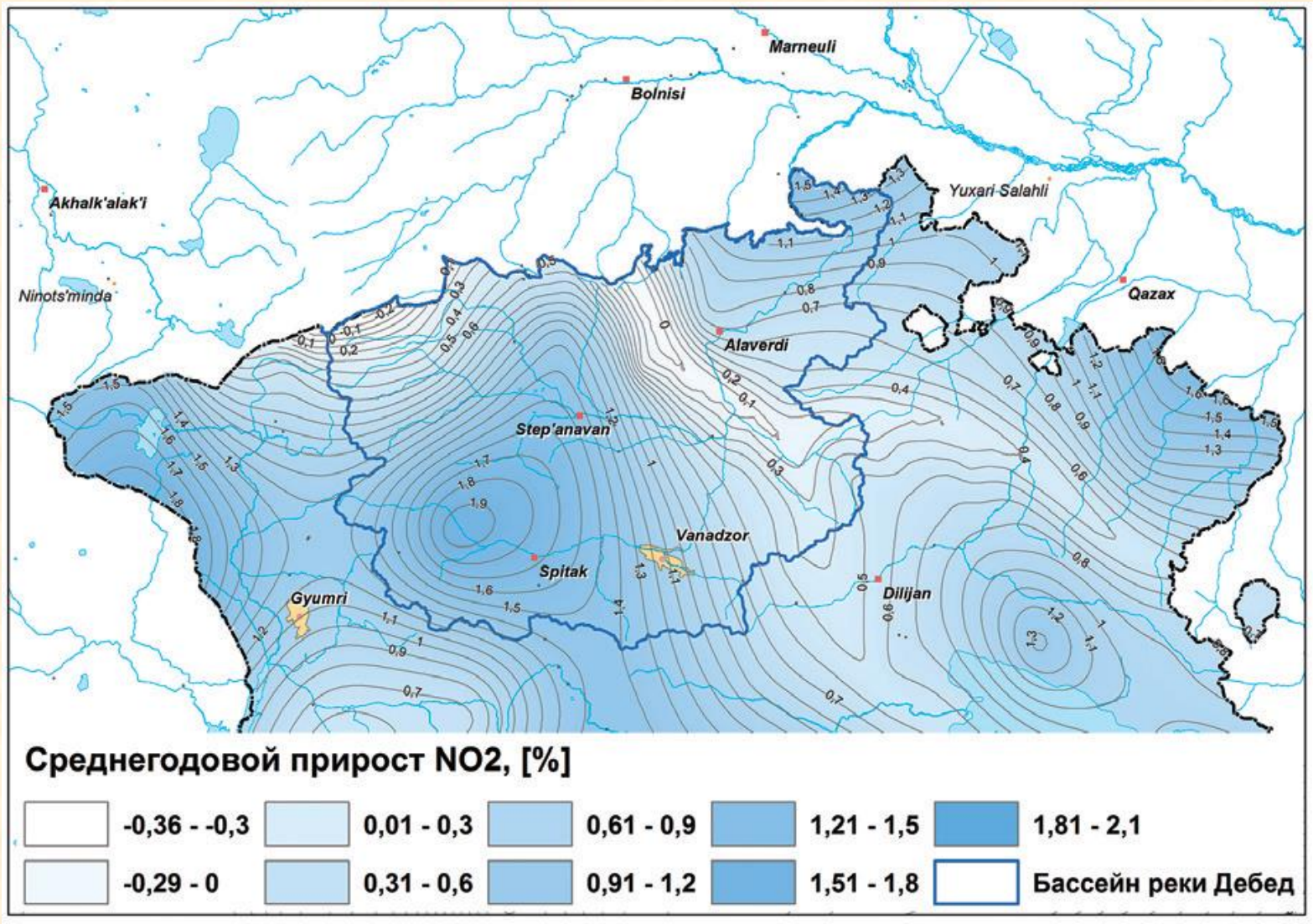


Fig.4– average annual concentration increment (mg/m^3)

Spatial distribution of the characteristics of dynamics of sulfur dioxide content in the ambient air of Debed River catchment area for 2004 -2014

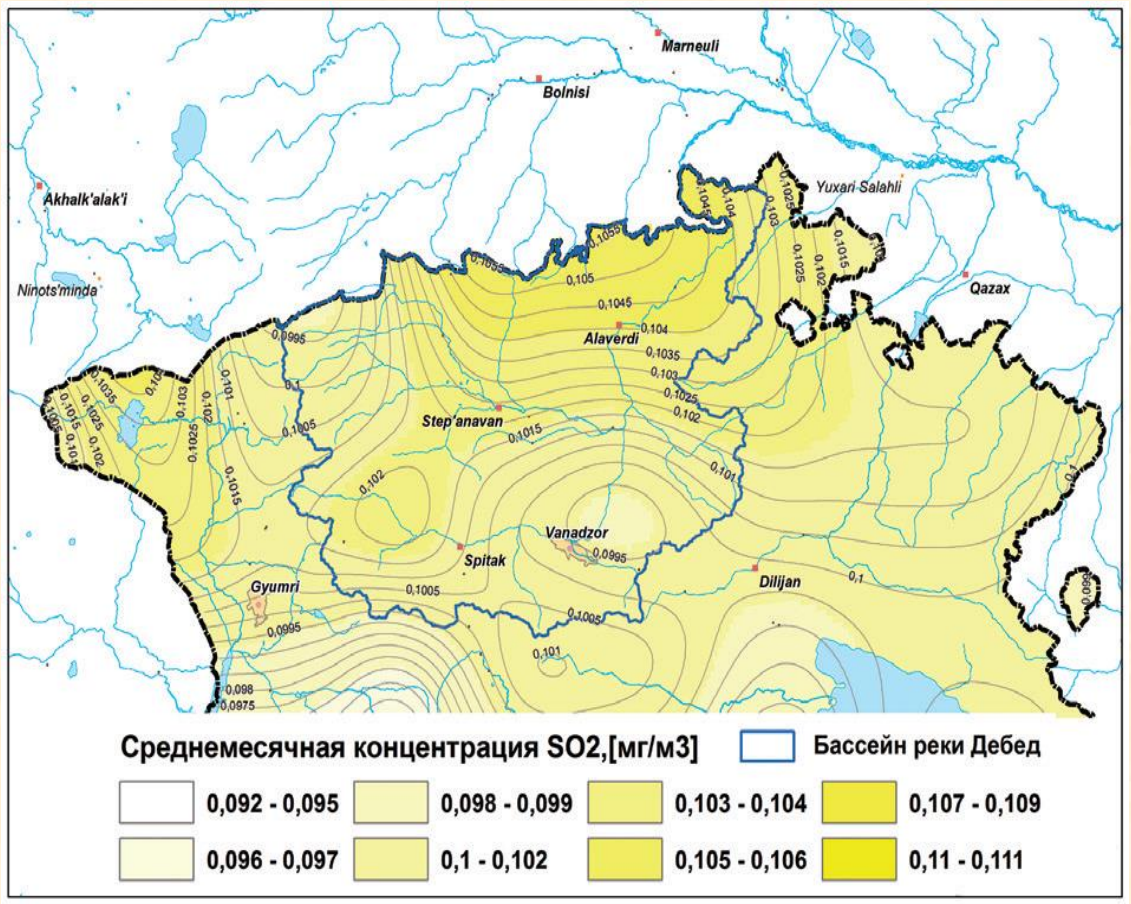


Fig.5 -average concentration (mg/m^3)

Analysis of the maps on the distribution of parameters of time-series of nitrogen dioxide and sulfur dioxide concentrations in the surface atmosphere for the studied territory identify relatively low concentrations of nitrogen dioxide and **high contents of sulfur dioxide, exceeding the maximum acceptable concentration (MAC).**

In some areas, the average value of the concentration of sulfur dioxide in the atmospheric surface layer **exceeds MAC 10-11 times reaching 0,570mg/m3.**

Analysis of the maps on the spatial distribution of dynamics of sulfur dioxide ***in the ambient air*** led to a number of conclusions.

- Concentration growth tendency is observed towards the western direction from the town of Alaverdi, i.e. west from main pollution sources, including Alaverdi copper smelting plant.
- Pollution risk of territories near the city of Stepanavan and Spitak towns is high. This pattern is the result of systematic air shift to the west.

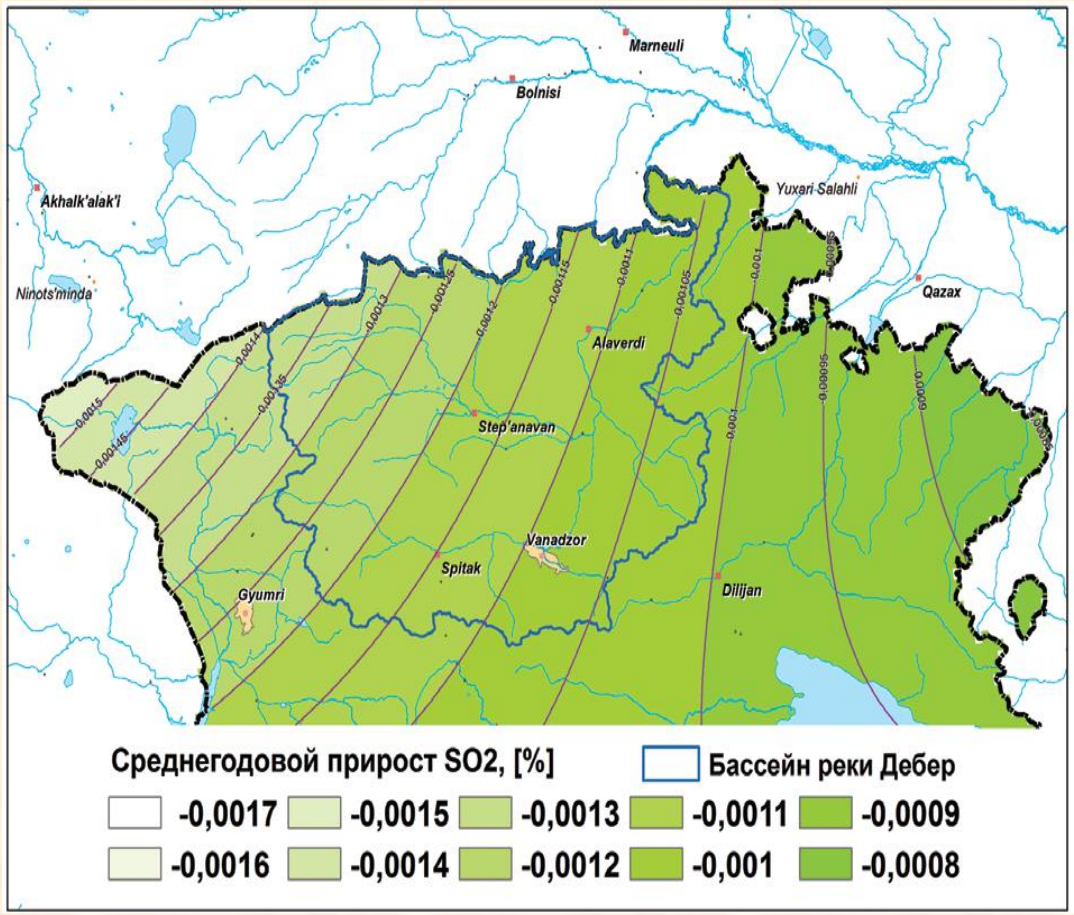


Fig.6 – average annual concentration increment (mg/m^3)

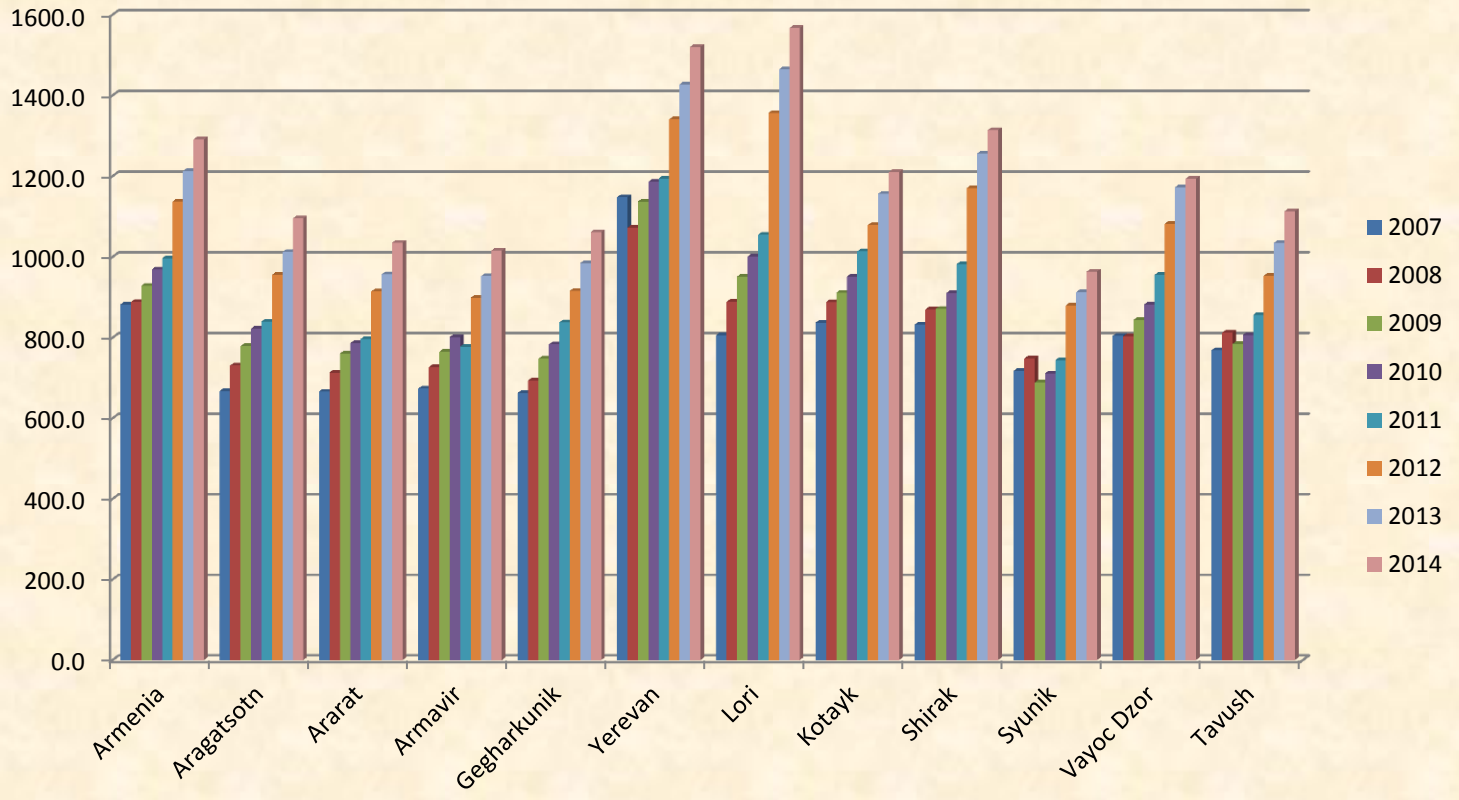


Fig. 7. Prevalence of cancer morbidity across regions of Armenia, 2007-2014 (per 100 000 population)

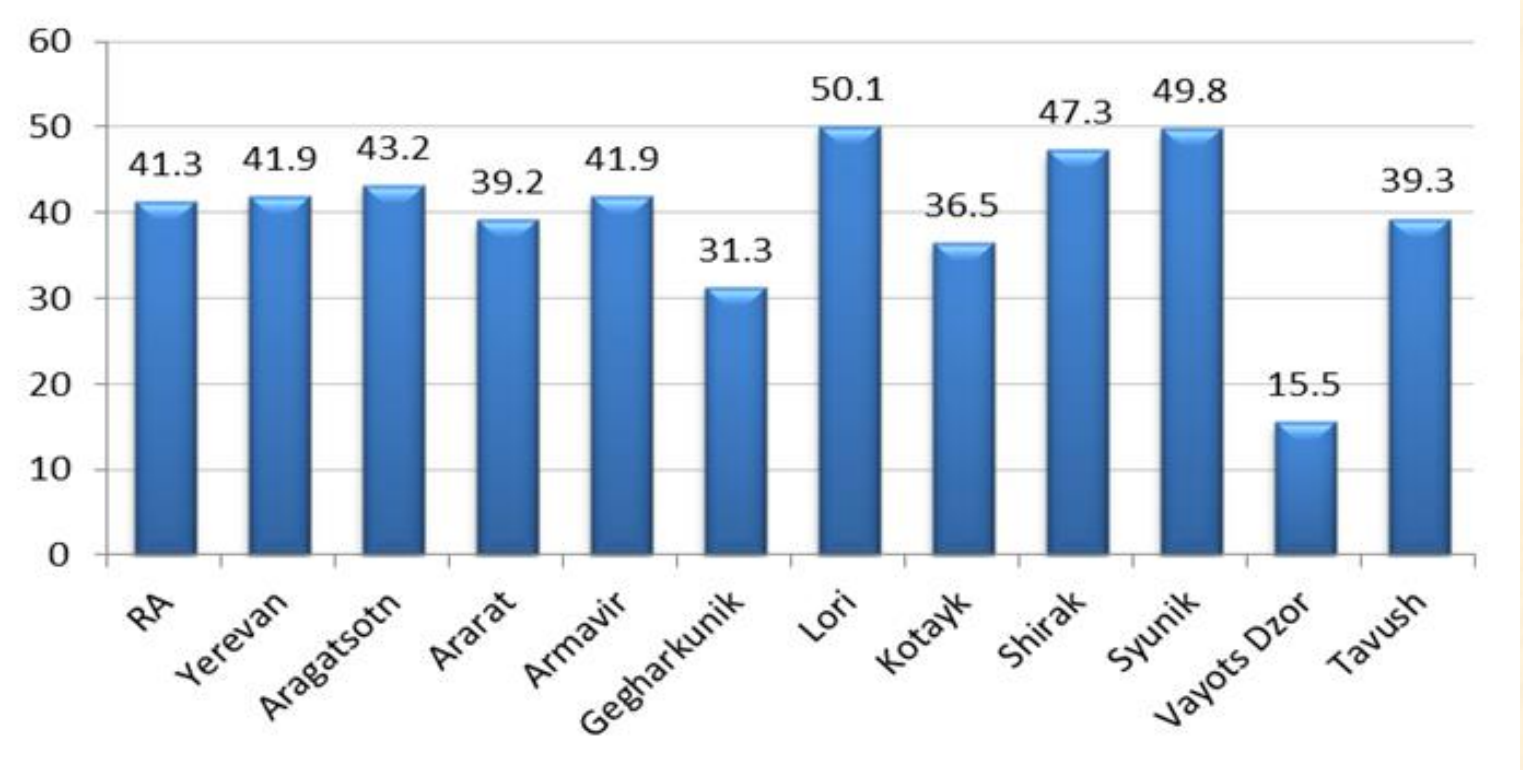


Fig.8.Prevalence of lung cancer morbidity across regions of Armenia, 2014 (per 100 000 population)

If compare the figures the matching of the total cancer morbidity growth trend in Lori and the growth tendency of sulfur dioxide in the air should be attributed to the increase of the level of this pollutant and the increase of morbidity rate to west from Alaverdi.

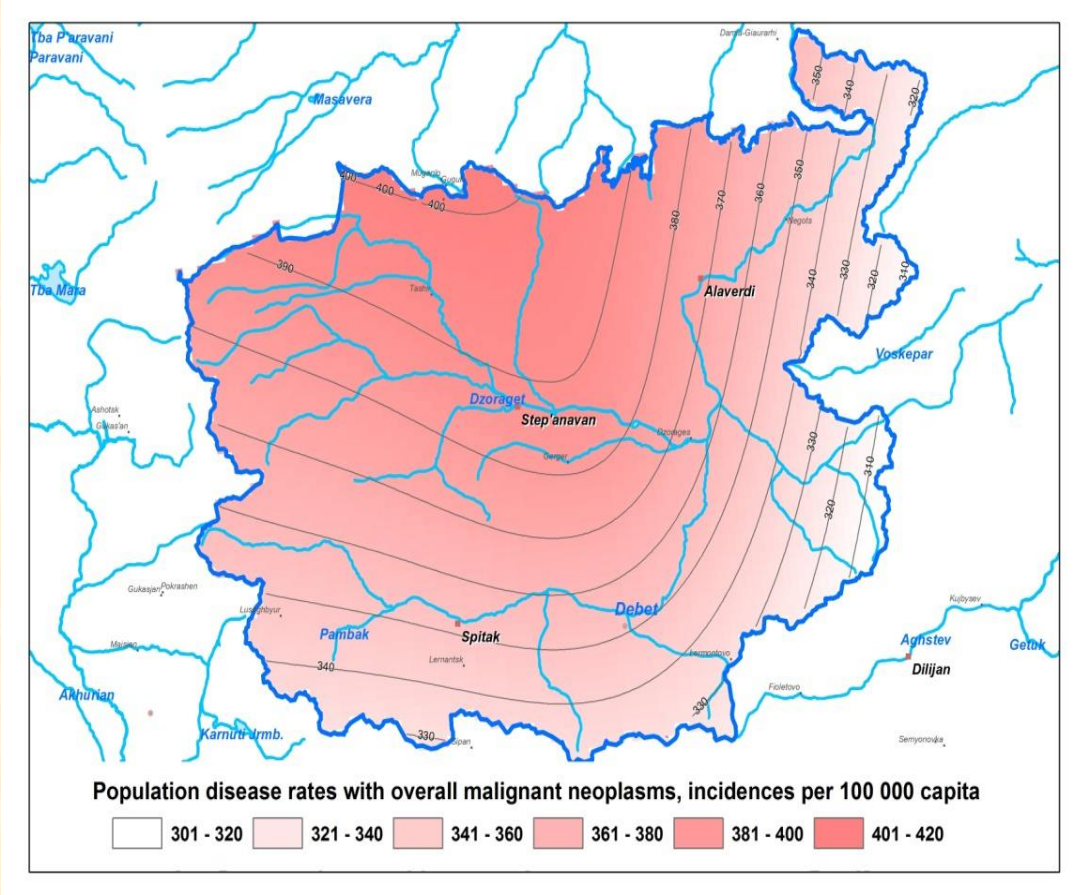
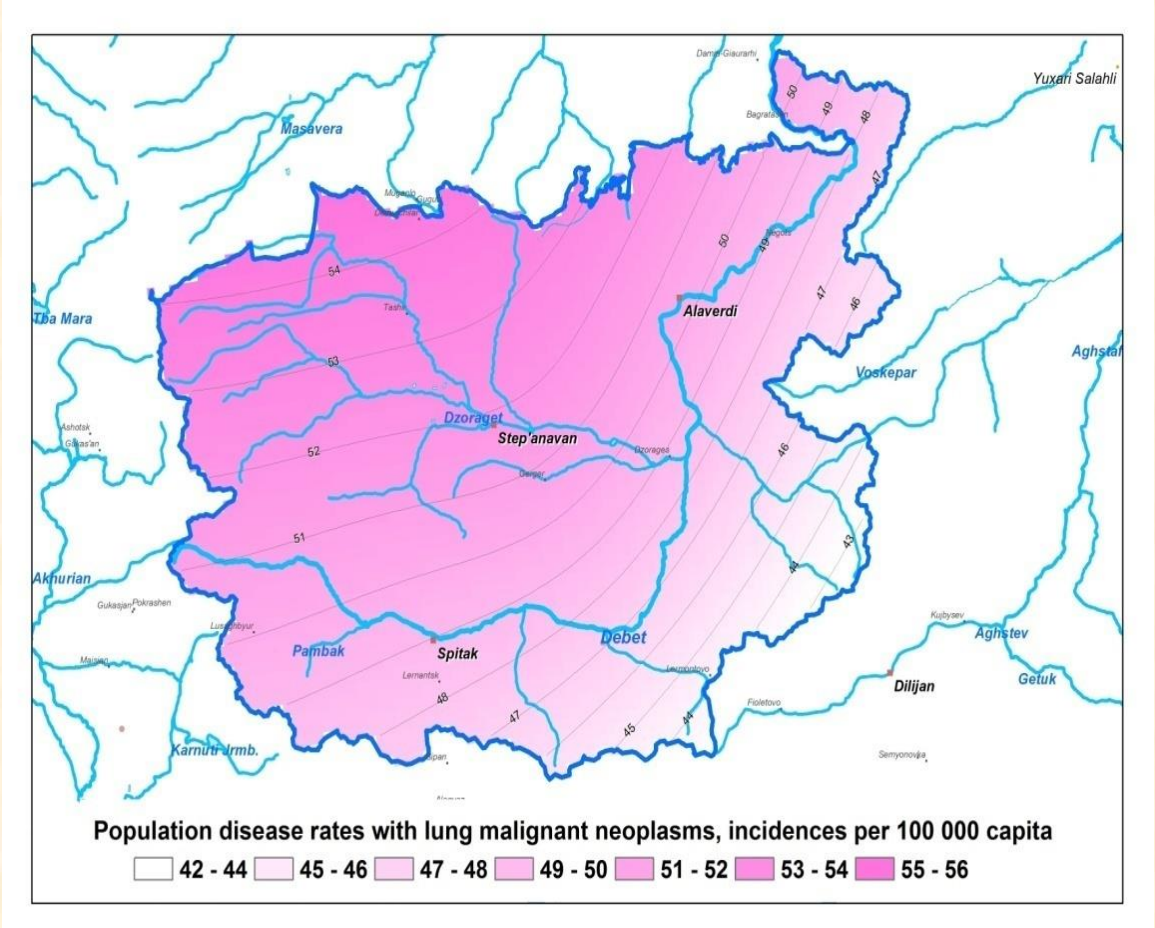


Fig.9. Spatial distribution of malignant neoplasms in limits of Debed River basin (Lori region)



Comparison of relevant figures pinpoints that the high lung cancer morbidity rate detected in Lori region is consistent with relatively high indicators of sulfur dioxide, which show similar growth tendency to the west from the source of pollution (Alaverdi town) towards Shirak region.

Fig.10. Spatial distribution of lung cancer morbidity in limits of Debed River basin (Lori region)

Conclusions

So, analysis of spatial distribution of the studied indicators make believe that there is certain correlation between distribution of sulfur dioxide in the air and cancer morbidity in Armenia.

Thus, a general conclusion can be made that running mining plant in Debed River catchment area leads to pollution of lower troposphere and surface air of the territories located in Lori region and to the west of indicated factory and covering most part of Lori and Shirak, which can lead to the development of cancer in the population of these regions.

It is planned to continue the in-depth study of the issue in the future and to conduct a follow-up analysis of potential correlations and the degree of influence of the air polluted with sulfur dioxide on the incidence of malignancies.

Publications:

Nalbandyan, M. A, Andreasyan, D. M. Assessing the Impact of Carcinogenic Heavy Metals of Drinking Water on the Prevalence of Malignant Neoplasms in the Regions of Armenia**.** Proceedings of the International Workshop on *Oncogenic Pathways and Antitumor Responses, Athens, Greece, 2014, pp.59.*

Nalbandyan M. A.,Andreasyan, D. M. Malignant Neoplasms Prevalence Interrelation with the Presence of Heavy Metals in Drinking Water Armenia's Population among. *Second International Conference "Evidence-based medicine: from theory to practice." Armenian Medical Journal of Abstracts, Yerevan, 2015, pp. 77-80*

Nalbandyan M. A.,Andreasyan, D. M. Interdependence Between Lead in Drinking Water and the Prevalence of Malignant Neoplasms in the all Regions of Armenia. *Scientific Medical Journal, number 11.01, Yerevan, 2016. pp.54-59*

S.A. Stankevich, M.A. Nalbandyan, D.M. Andreasyan, O.V. Titarenko. Nitrogen and sulphur dioxide accumulation, spatial distribution and transportation in the atmosphere of Debed River basin and correlated public health risks analysis using satellite measurements. Journal: *Modern problems of remote sensing of the Earth from space. Web of Science, Scopus. 2017. V. 14. № 2. pp. 240–249*

ADOPTION OF DIRECTIVE (EU) 2016/2284 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL IN ARMENIA

Approve on the Draft Law of the Republic of Armenia on November 24, 2017 on ratification between the European Union and the European Community and the Member States of the European Atomic Energy Community on the one hand and the Armenia on the other hand, the **"Agreement on Comprehensive and Extent Partnership"** legislative initiative (**March 23, 2018)**

2. Submit the legislative initiative of the Government of the Republic of Armenia to the National Assembly of the Republic of Armenia.

3. The environmental part (including the obligations under the **DIRECTIVE (EU) 2016/2284 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL)** is considering now by the Ministry of Nature Protection for further ratification in frame of **"Agreement on Comprehensive and Extent Partnership"** legislative initiative.