EGU General Assembly 2020

Estimation of the total wet sulfur and nitrogen deposition as a part of pollution balance in the south of the Russian Far East based on the monitoring data

Online | 4–8 May 2020

Sergey A. Gromov[1,2]
(sergey.gromov@igce.ru)

Dmitry A. Galushin[1]
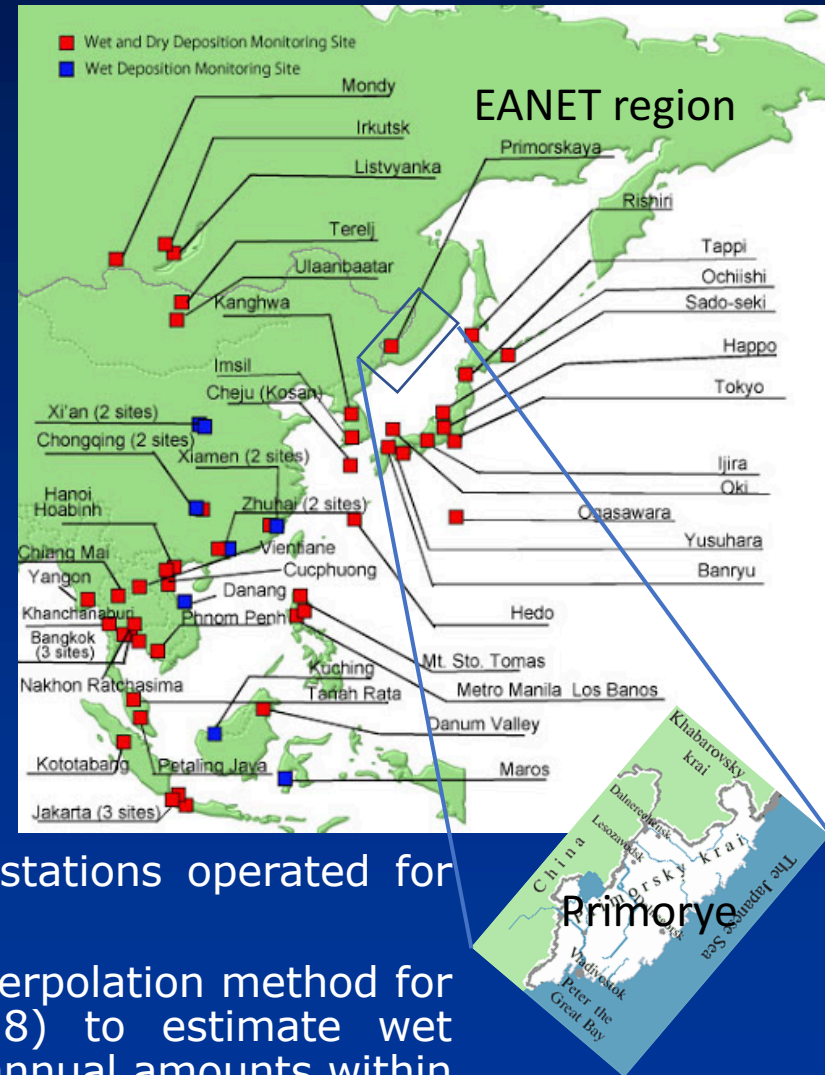Ekaterina A. Zhadanovskaya[1]

[1]Yu. A. Izrael Institute of Global Climate and Ecology (IGCE),
[2]Institute of Geography, Russian Academy of Sciences (IGRAS),
Moscow, Russian Federation

IGCE

IGRAS

INTRODUCTION

➤ The regional biogeochemical studies become one of the priority researches in the EANET network (2019) as well as evaluating the state of acid deposition and related air pollution within the vast East Asia region.

➤ The total deposition of airborne sulfur and nitrogen is estimated as a part of their atmospheric balances for a large region under the transboundary flux influence.

➤ We combined data from two networks developed to monitor the acidifying substances in precipitation in the southern Russian Far East (Primorye):

  • international atmospheric monitoring sites of EANET and WMO-GAW;

  • Russian national precipitation chemistry stations operated for more than 30 years.

➤ Our study focuses on applying the spatial interpolation method for the multiyear monitoring data (2013-2018) to estimate wet deposition fluxes of SO4 and NO3 and their annual amounts within Primorye region.


EANET. 2019. Fourth Report for Policy Makers (RPM4): Towards Clean Air for Sustainable Future in East Asia through Collaborative Activities. 50 p.

STUDY AREA AND DATA

Primorye Territory: around 165,000 sq.km

The distance between northern and southern extremities is 900 km along the meridian; between western and eastern extremities it is 430 km along the parallel of latitude.
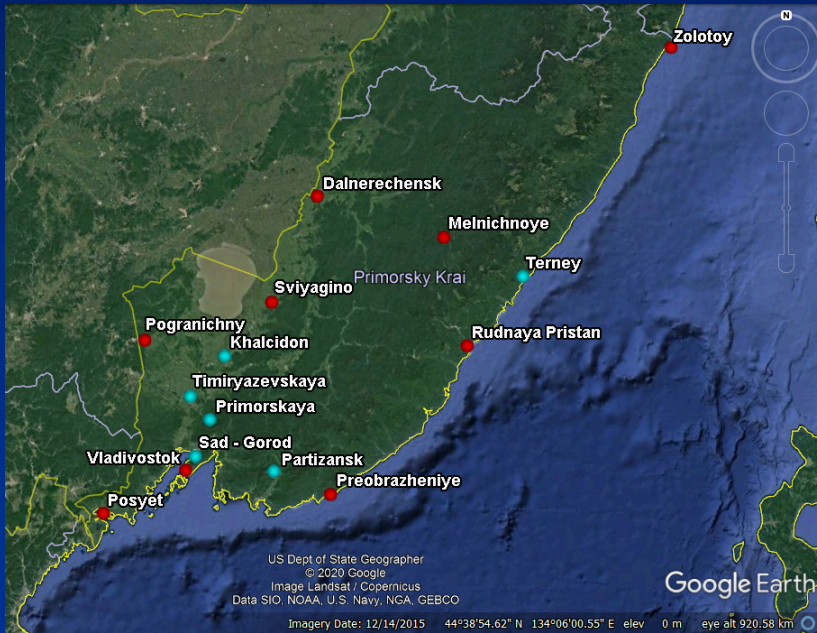
Weather stations (WS) is marked in red;
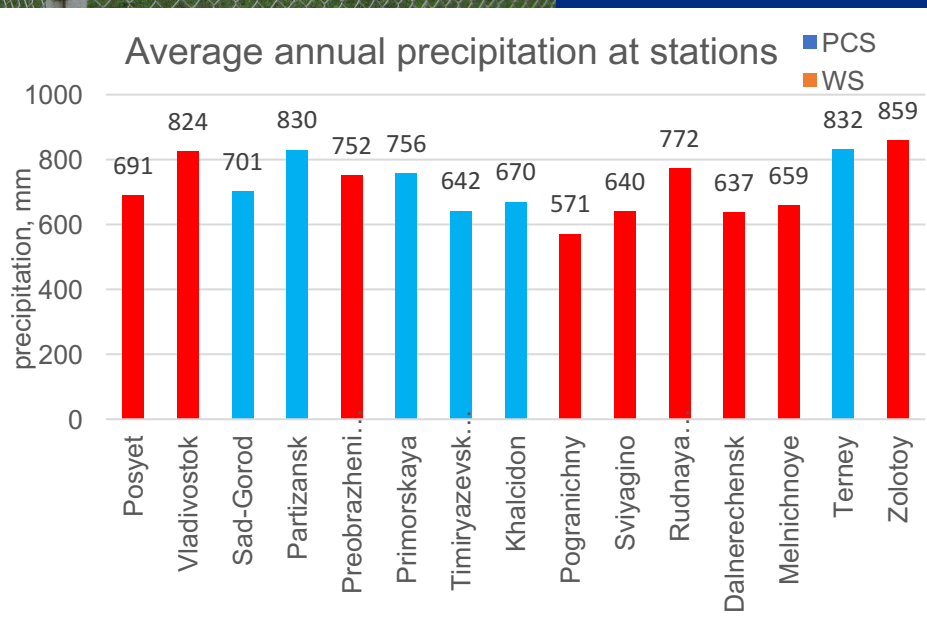Precipitation Chemistry stations (PCS) is marked in blue.
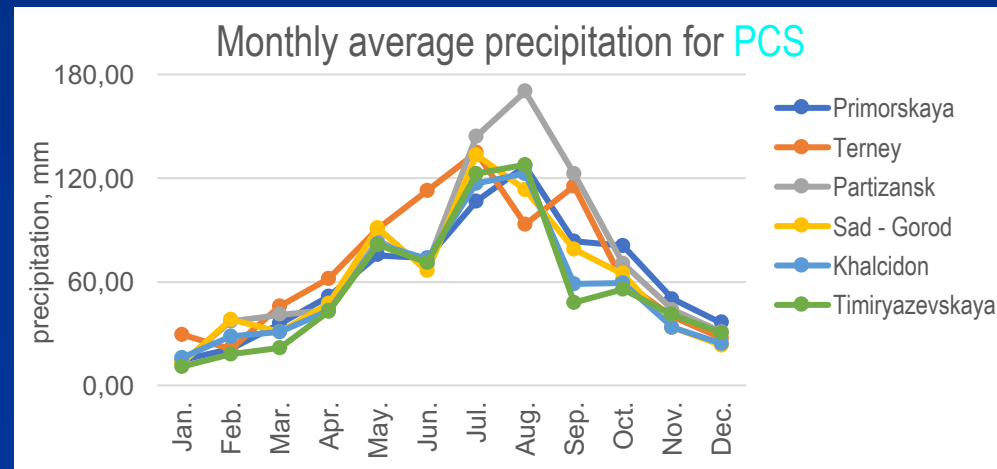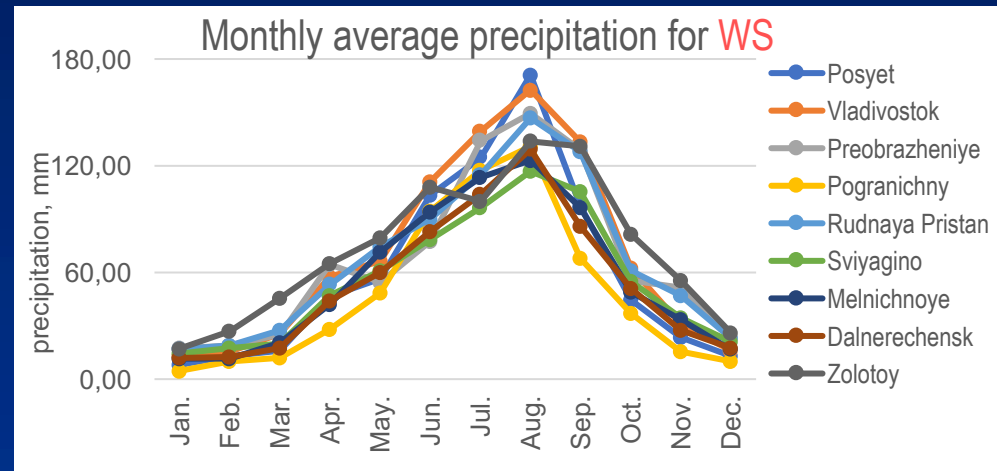
PRECIPITATION CHEMICAL STATIONS

EANET, WMO-GAW and Rus PC:

Regular meteorological data – daily;
Precipitation sampling – daily (EANET),
 weekly (GAW) or monthly (Rus PC stations);
Chemical compounds – anions (SO_4^{2-}, NO_3^-, Cl^-, HCO_3^-, NO_2^-, F^-, Br^-), cations (NH_4^+, Na^+, K^+, Ca^{2+}, Mg^{2+}) and pH, EC

Weather stations (national meteorological service)

Regular meteorological data only – daily *or* auto-recording (10 min to 1 hr)

Precipitation amounts are measured on both types of stations

Average annual precipitation at stations

■ PCS
■ WS

precipitation, mm

| Station	Value
Posyet	691
Vladivostok	824
Sad-Gorod	701
Partizansk	830
Preobrazheni..	752
Primorskaya	756
Timiryazevsk..	642
Khalcidon	670
Pogranichny	571
Sviyagino	640
Rudnaya..	772
Dalnerechensk	637
Melnichnoye	659
Terney	832
Zolotoy	859

IGCE   IGRAS

4

CALCULATION OF WET DEPOSITION FLUXES

I. Spatial interpolation of multi-year (2013-2018) average SO_4 and NO_3 concentrations at PC-stations to estimate the SO_4 and NO_3 concentrations at W-stations;

II. Calculation of wet SO_4 and NO_3 deposition fluxes for the full set of stations;

III. Spatial interpolation of calculated flux values for the regular grid within the Primorye region;

IV. Calculation of the total wet sulfur and nitrogen deposition for the region as a sum of deposition fluxes calculated for each cell.

IGCE   IGRAS

ALGORITHM: STEP I

Method of spatial interpolation is thin plate spline (TPS).

The results of PCS data (blue points) interpolation at WS (red points) are given in parentheses.

6
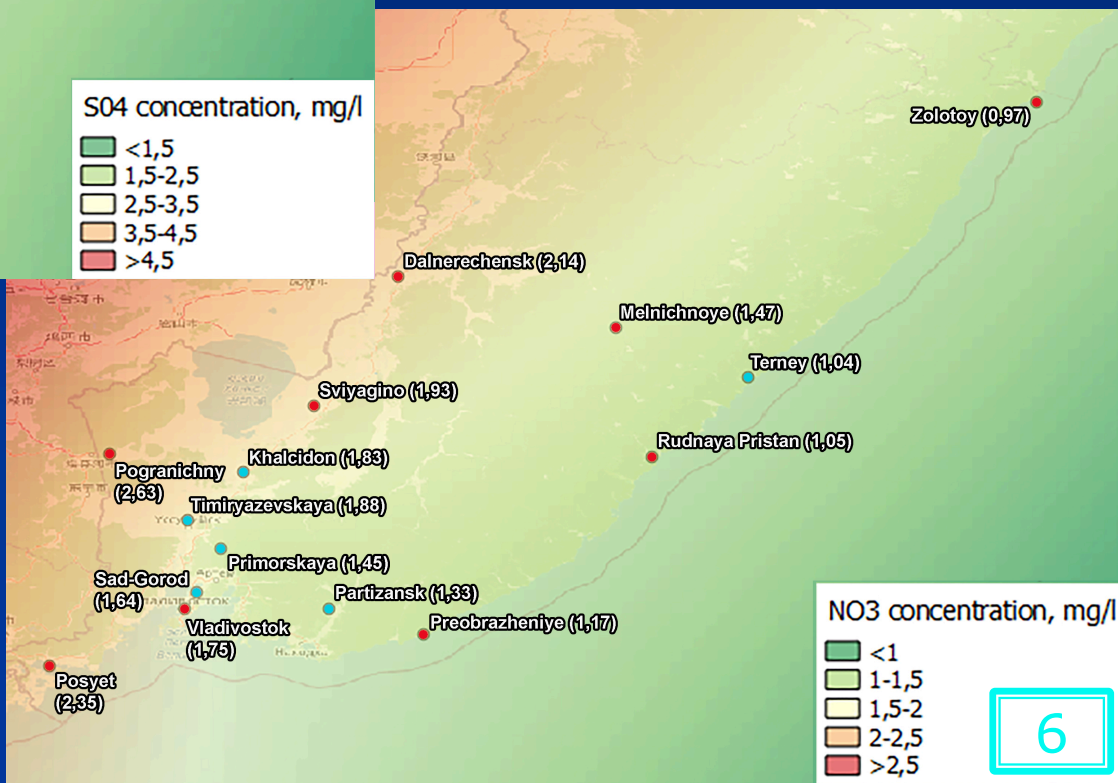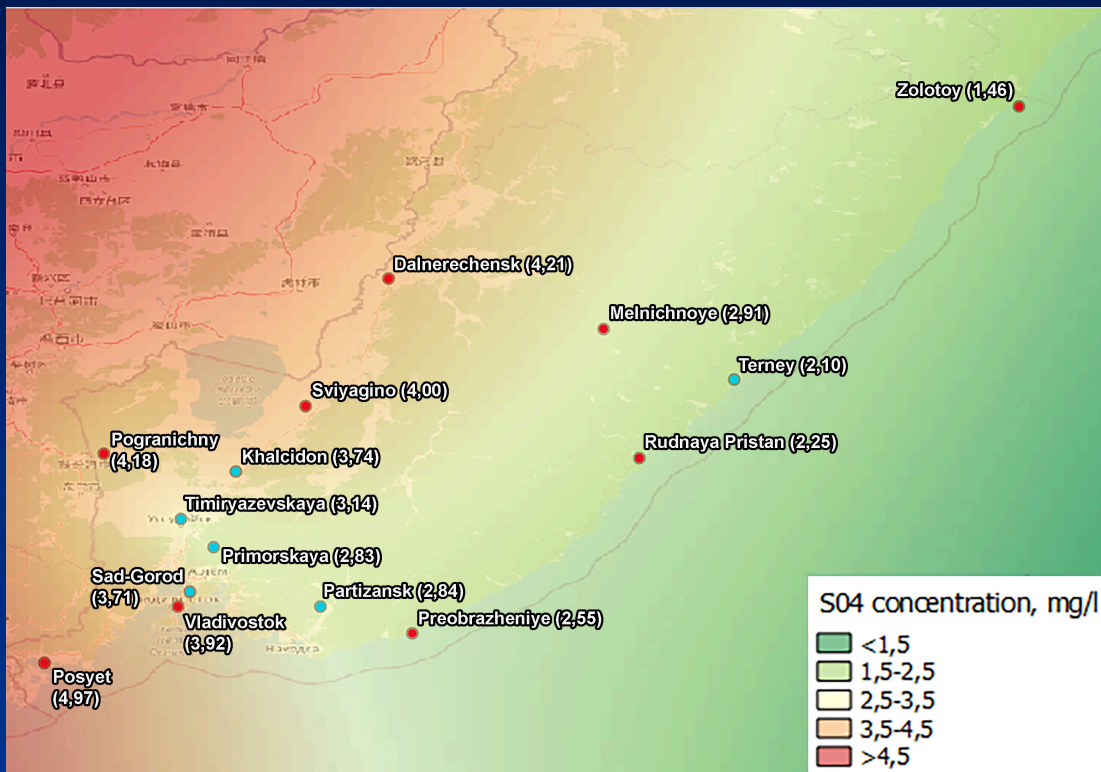
ALGORITHM: STEP II, III

	Stations	Annual precipitation, mm	Average concentrations		Annual flux, g/sq.m	
			SO4, mg/l	NO3, mg/l	SO4	NO3
PCS	Sad - Gorod	701	3,71	1,64	2,60	1,15
	Partizansk	830	2,84	1,33	2,36	1,10
	Primorskaya	756	2,83	1,45	2,14	1,10
	Timiryazevskaya	642	3,14	1,88	2,02	1,21
	Khalcidon	670	3,74	1,83	2,51	1,23
	Terney	833	2,10	1,04	1,75	0,87
WS	Zolotoy	859	1,46	0,97	1,25	0,83
	Rudnaya Pristan	772	2,25	1,05	1,74	0,81
	Preobrazheniye	752	2,55	1,17	1,92	0,88
	Vladivostok	824	3,92	1,75	3,23	1,44
	Posyet	691	4,97	2,35	3,43	1,62
	Pogranichny	571	4,18	2,63	2,39	1,50
	Sviyagino	640	4,00	1,93	2,56	1,23
	Dalnerechensk	637	4,21	2,14	2,68	1,36
	Melnichnoye	659	2,91	1,47	1,92	0,97

TPS interpolation SO$_4$

TPS interpolation NO$_3$

7
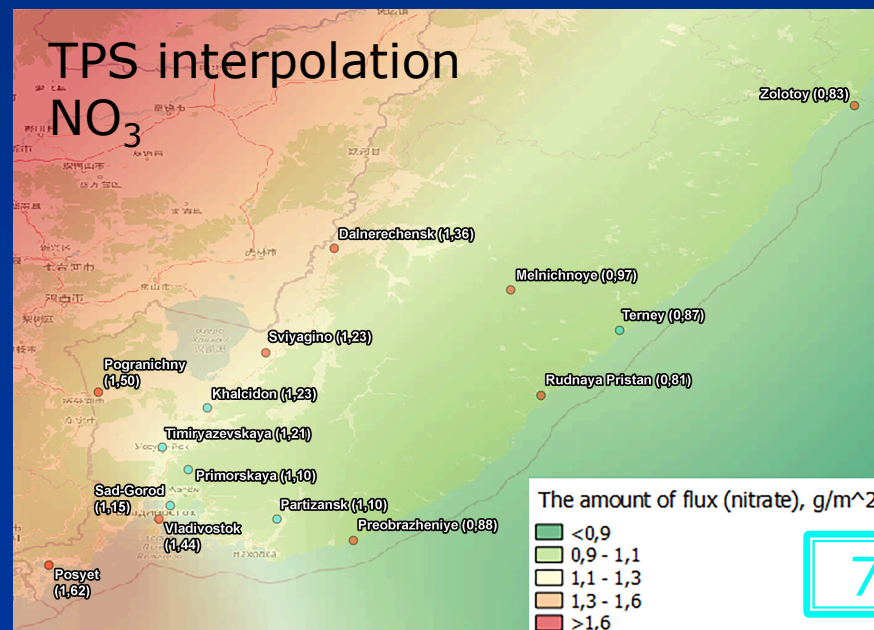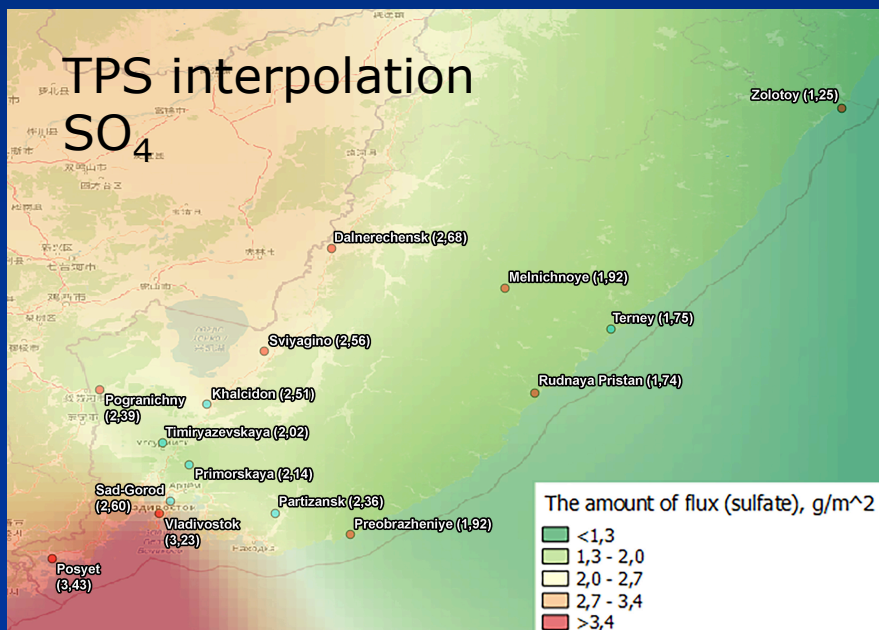
ALGORITHM: STEP III, IV

The size of each cell is 84-km by 84-km
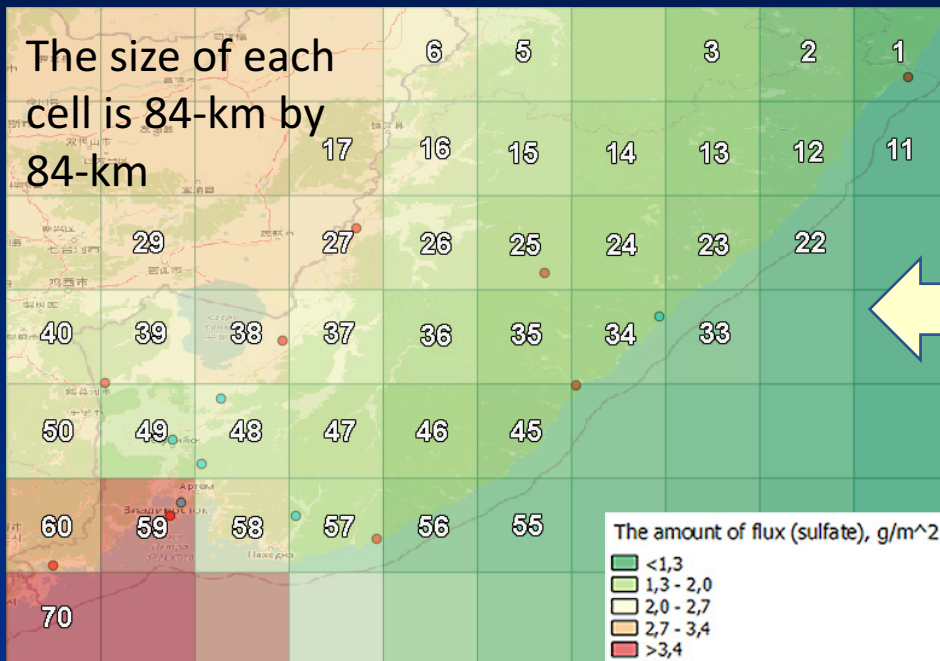
Annual wet deposition amount per year within the Primorye region:

SO$_4$, thou. tons	S, thou. tons
333,0	110,9

The amount of flux (sulfate), g/m^2
- <1,3
- 1,3 - 2,0
- 2,0 - 2,7
- 2,7 - 3,4
- >3,4

Annual wet deposition amount per year within the Primorye region:

NO$_3$, thou. tons	N, thou. tons
170,5	38,5

The amount of flux (nitrate), g/m^2
- <0,9
- 0,9 - 1,1
- 1,1 - 1,3
- 1,3 - 1,6
- >1,6