AN ADAPTED ACCUMULATED WINTER SEASON SEVERITY INDEX (AWSSI) FOR LITHUANIAN WINTER EVALUATION

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Kilometru priekyje

How severe was this winter?

How to evaluate winter severity objectively?

Lithuania in 2015 –

Lithuanian national winter road maintenance manual included a winter adversity index

(in Lithuanian – "Žiemos sunkumo indeksas" or ŽSI)

Which took into account number of days when air temperature was around 0°C, precipitation, snowstorm and freezing rain events.

However, multiple problems surfaced:

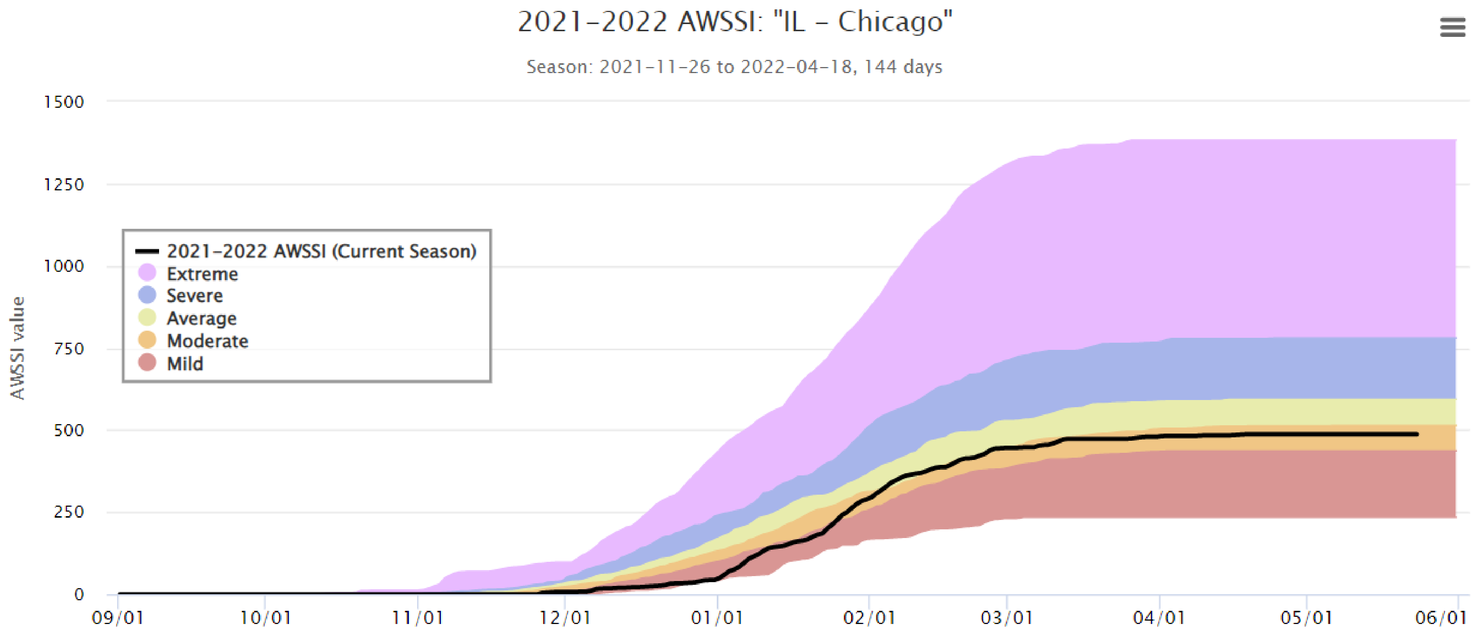
- Sensitive to climate change
- Inaccurate
- Does not correspond with winter maintenance data
- Needs to be calculated using observed winter phenomena data
- Number of suitable meteorological weather stations is decreasing

AWSSI:

ACCUMULATED WINTER SEASON SEVERITY INDEX

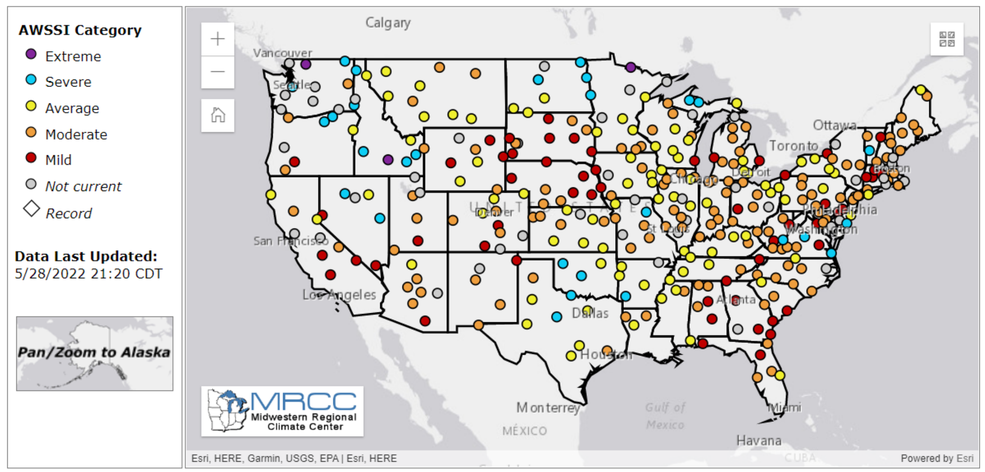
Goals of the AWSSI

1. Objectively index winter conditions
2. Use commonly available data—max/min temperature, snowfall, and snow depth or precipitation
3. Create a historical database of AWSSI for any location with daily temperature, snow, and precipitation data
4. Allow comparisons of season to season severity at one location in the context of the climatology of that location or between locations
5. Use as a baseline to scale subjective impacts such as those to snow removal, commerce, and transportation
6. Apply to multiple users and their needs



AWSSI Point Thresholds

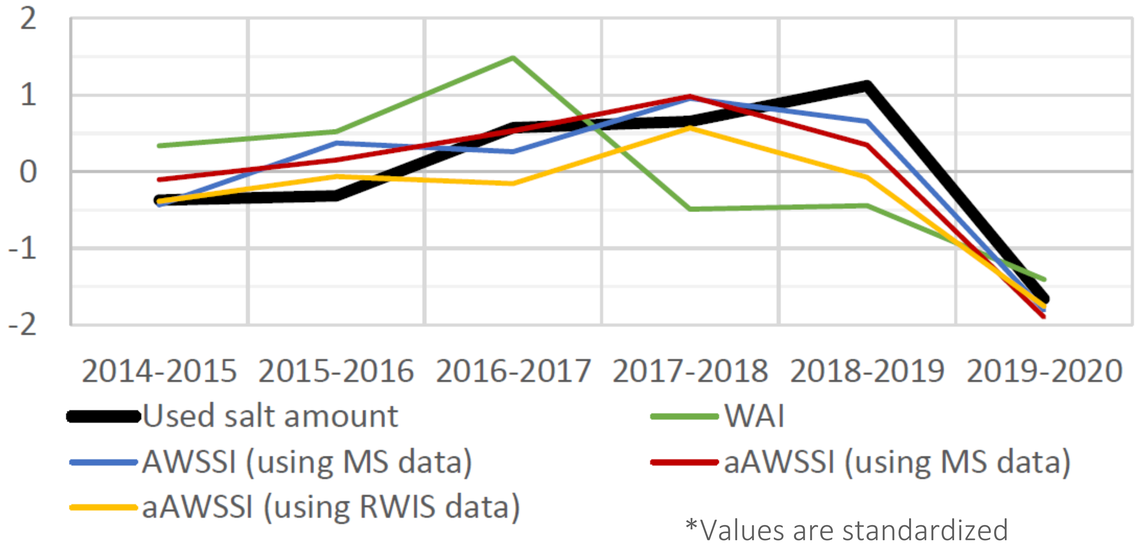
Points	Temperature (°F) Max	Min	Snow (in) Fall	Depth
1	25 to 32	25 to 32	0.1 to 0.9	1
2	20 to 24	20 to 24	1.0 to 1.9	2
3	15 to 19	15 to 19	2.0 to 2.9	3
4	10 to 14	10 to 14	3.0 to 3.9	4 to 5
5	5 to 9	5 to 9	-	6 to 8
6	0 to 4	0 to 4	4.0 to 4.9	9 to 11
7	-1 to -5	-1 to -5	5.0 to 5.9	12 to 14
8	-6 to -10	-6 to -10	-	15 to 17
9	-11 to -15	-11 to -15	6.0 to 6.9	18 to 23
10	-16 to -20	-16 to -20	7.0 to 7.9	24 to 35
11	-	-21 to -25	-	-
12	-	-	8.0 to 8.9	-
13	-	-	9.0 to 9.9	-
14	-	-	10.0 to 11.9	-
15	<-20	-26 to -35	-	36+
18	-	-	12.0 to 14.9	-
20	-	<-35	-	-
22	-	-	15.0 to 17.9	-
26	-	-	18.0 to 23.9	-
36	-	-	24.0 to 29.9	-
45	-		>=30.0	-



https://mrcc.purdue.edu/research/awssi/indexAwssi.jsp

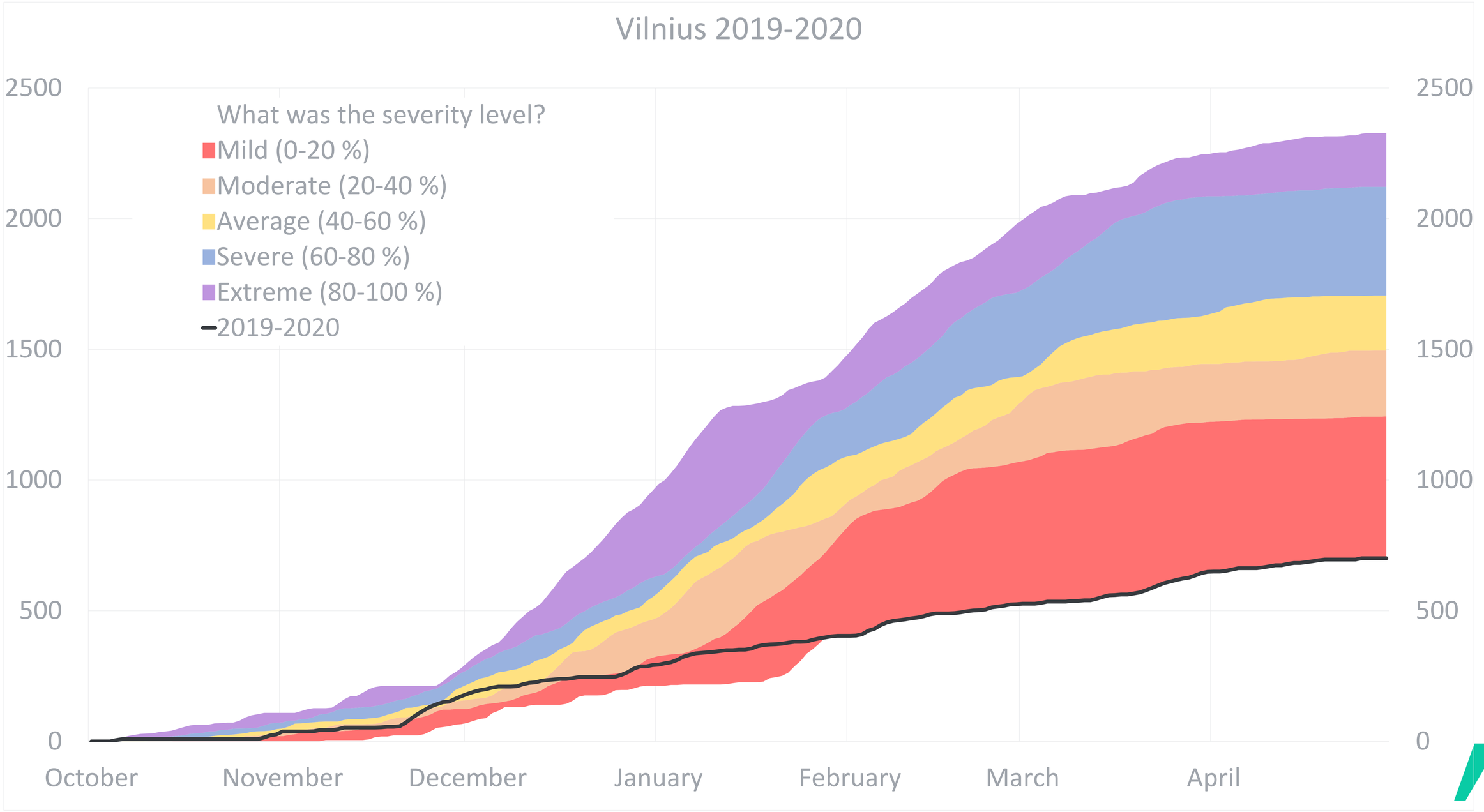
Adaptation of AWSSI to Lithuanian climate (aAWSSI)

1. Abandon the snow depth indicator. Daily precipitation accumulation when air temperature is ≤ 2 °C will be used.
2. Change units of measurement: for air temperature, from Fahrenheit (°F) to Celsius (°C); for snow, from inches (in) to millimeters (mm).
3. Modify the estimates of air temperature and snowfall to reflect the climatic conditions in Lithuania.

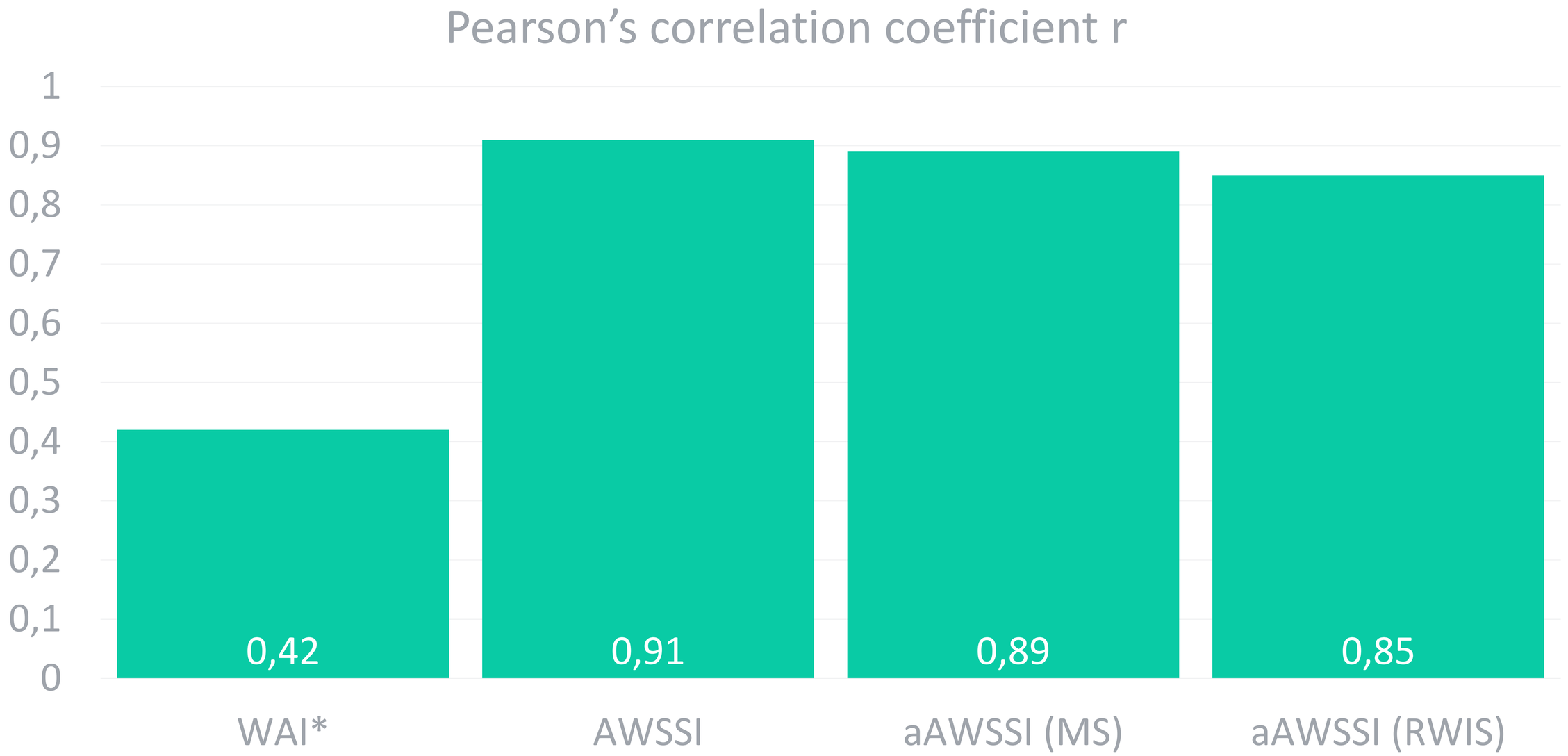


*Values are standardized

Max. air temperature, °C			Min. air temperature, °C			Accumulated precipitation, mm (when air temp. ≤ 2°C)		
From	To	Score	From	To	Score	From	To	Score
...	-28.7	65	...	-41.7	56	0	0.2	0
-28.7	-28.2	58	-41.7	-41.5	50	0.2	0.6	1
-28.2	-27.3	51	-41.5	-41.1	44	0.6	0.8	2
-27.3	-26	44	-41.1	-40.4	38	0.8	1.3	3
-26	-23.9	38	-40.4	-39.1	33	1.3	1.8	4
-23.9	-20.5	32	-39.1	-36.2	28	1.8	2.4	5
-20.5	-15.1	26	-36.2	-29.8	23	2.4	3	6
-15.1	-9.9	19	-29.8	-21.5	19	3	3.7	7
-9.9	-7.3	15	-21.5	-16.7	16	3.7	4.5	8
-7.3	-4.5	13	-16.7	-11.4	14	4.5	5.7	9
-4.5	-2.8	11	-11.4	-8.1	12	5.7	7.5	10
-2.8	-1.5	9	-8.1	-5.8	10	7.5	9.3	12
-1.5	-0.5	8	-5.8	-4	9	9.3	13.2	14
-0.5	0.3	7	-4	-2.6	7	13.2	18.5	17
0.3	1	5	-2.6	-1.4	6	18.5	23.6	22
1	1.7	4	-1.4	-0.4	5	23.6	28.5	32
1.7	2.4	3	-0.4	0.6	4	28.5	33.3	41
2.4	2.9	2	0.6	1.1	3	33.3	38.1	51
2.9	3.4	1	1.1	1.6	2	38.1	42.7	61
3.4	3.7	1	1.6	1.8	1	42.7	47.2	71
3.7	3.8	0	1.8	1.9	0	47.2	51.8	81
						51.8	56.2	91
						56.2	60.6	92
						60.6	65	101
						65	73	111
						73	...	130


Vilnius 2019-2020
What was the severity level?
Mild (0-20 %)
Moderate (20-40 %)
Average (40-60 %)
Severe (60-80 %)
Extreme (80-100 %)
2019-2020
2500
2000
1500
1000
500
0
October
November
December
January
February
March
April

How well indices correlate with the amount of used salt?



*not statistically significant, when α = 0,05

So we started thinking… how can we use aAWSSI?

1. Insurance product:

Extreme winter → receive a payout

2. Internal evaluations:

Extreme winter → added salary

Mild winter → reduced salary

How we transformed aAWSSI even more

1. The historical database is limited to 10 years
   - ✓ Less sensitive to climate change
   - ✓ Fits the existing RWIS database
2. Each sub-unit has been assigned 3-5 RWIS stations
   - ✓ If the unit has more available stations – the chosen ones reflect the general climate of that area
   - ✓ The chance of missing data is lower
3. the final aAWSSI was calculated as the average of those RWIS data
   - ✓ Averaging index data reduces the risks of having incorrect measurements

Pearson's correlation coefficient r of aAWSSI and...

Unit No.	Kilometers	Fuel	Salt	Brine	Vehicle working hours
1	0,39	0,59	0,97	0,81	-0,10
2	0,84	0,85	0,92	0,85	-0,23
3	0,72	0,81	0,93	0,82	-0,20
4	0,51	0,68	0,96	0,84	-0,17
5	0,62	0,67	0,93	0,90	-0,49
6	0,77	0,85	0,94	0,85	-0,37
7	0,75	0,81	0,81	0,90	-0,33
8	0,51	0,69	0,92	0,85	-0,08
9	0,40	0,51	0,90	0,85	-0,29
10	-0,05	0,31	0,90	0,91	-0,43
11	0,74	0,74	0,91	0,90	-0,37
12	0,55	0,68	0,94	0,89	-0,28
13	0,36	0,61	0,94	0,94	-0,17
14	0,75	0,74	0,85	0,88	-0,02
15	0,54	0,63	0,88	0,67	-0,41
16	0,52	0,76	0,92	0,83	-0,23
17	0,77	0,87	0,98	0,87	0,07
18	0,69	0,79	0,91	0,91	0,04
19	0,48	0,69	0,96	0,86	-0,06
20	0,48	0,63	0,90	0,95	-0,36
21	0,56	0,85	0,93	0,75	-0,22
Country average	0,62	0,75	0,95	0,94	-0,27

Thank you!