



Use of weekly weather regimes to estimate the cost of winter service in Iceland

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1. Introduction

Daily cost data from the Icelandic Road Administration for 2011 - 2015 was analysed and compared to weather data using climate reanalysis for the period 1961 - 2010. Six different regimes have been defined based on Hovmöller's method. Each week was sorted to its respective regime and cost data for each of the regime was calculated. The winter service cost is highly dependent on each regime, up to 6 times lower for the most favorable one compared to the roughest one. By using ECMWF ERA-20C [1] reanalysis and comparing it to the short sample of cost data it is possible to project in situ winter service costs all the way back to 1900.

3. Icelandic Road and Coastal Administration cost data

The Icelandic Road and Coastal Administration (Vegagerðin) splits Iceland in four regions. In one of the regions, the southwest they log their costs for each day. The majority of their service is in that region. It contains Reykjavík, the only city in the country as well as most of the bigger towns and villages. Iceland's biggest airport is in this region as well. The inhabitants in the region are around 250.000.

The cost data includes daily costs 2011 - 2015 due to monitoring of the roads, snow removal and salt usage. The roads have different service levels. Snow removal and de-icing is the only service on most of the roads, but most of the costs occur due to the main roads within the city, the road connecting the city to the airport and a mountain pass just outside of Reykjavík. It is assumed that the maintenance did not change in quantity during the sample period.

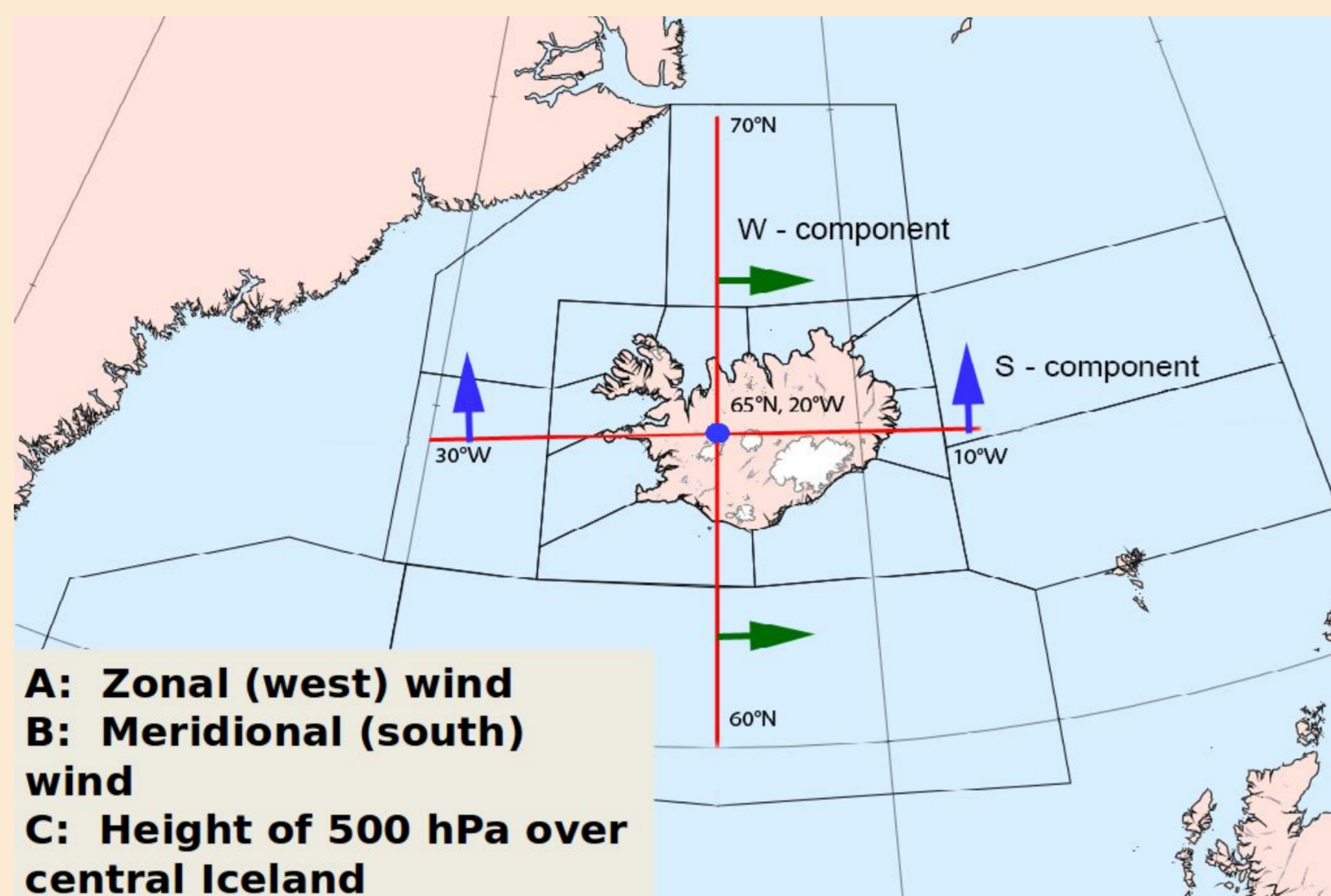


Fig. 1. The points and components used in the Hovmöller analysis.



Fig. 4. The southwestern region where cost data is available

2. The Hovmöller method

The Hovmöller method was developed in the 1950's by the Swedish meteorologist Ernst Hovmöller. He classified how to use weather types based on the circulation pattern for employing parameters such as temperature and precipitation. There are three conceivable Hovmöller parameters:

- Zonal (west) component of the wind at 500 hPa in a cross section 70N-60N along the 20W longitude.
- Meridional (south) component of the wind at 500 hPa in a cross section 30W-10W along the 65°N latitude.
- Height of the 500 hPa at 65N-20W [2].

This way, the fields are parameterized into three very simple components which form a parameter space (Figure 1). The 33rd and 66th terciles is calculated for each of the components, A, B and C respectively. Using the percentiles it is possible to classify a given week. There are $(3 \times 3 \times 3) = 27$ classes, which are all "semi" equal [3]. The winter is defined from around November 25th until end of March containing 18 - 19 weeks in total. All weeks start on a Monday and end on Sunday.

Each of the classes is categorized into one of six different regimes. Each regime describes a certain type of weather pattern. As it turns out the cost of the road service varies heavily with the regimes.

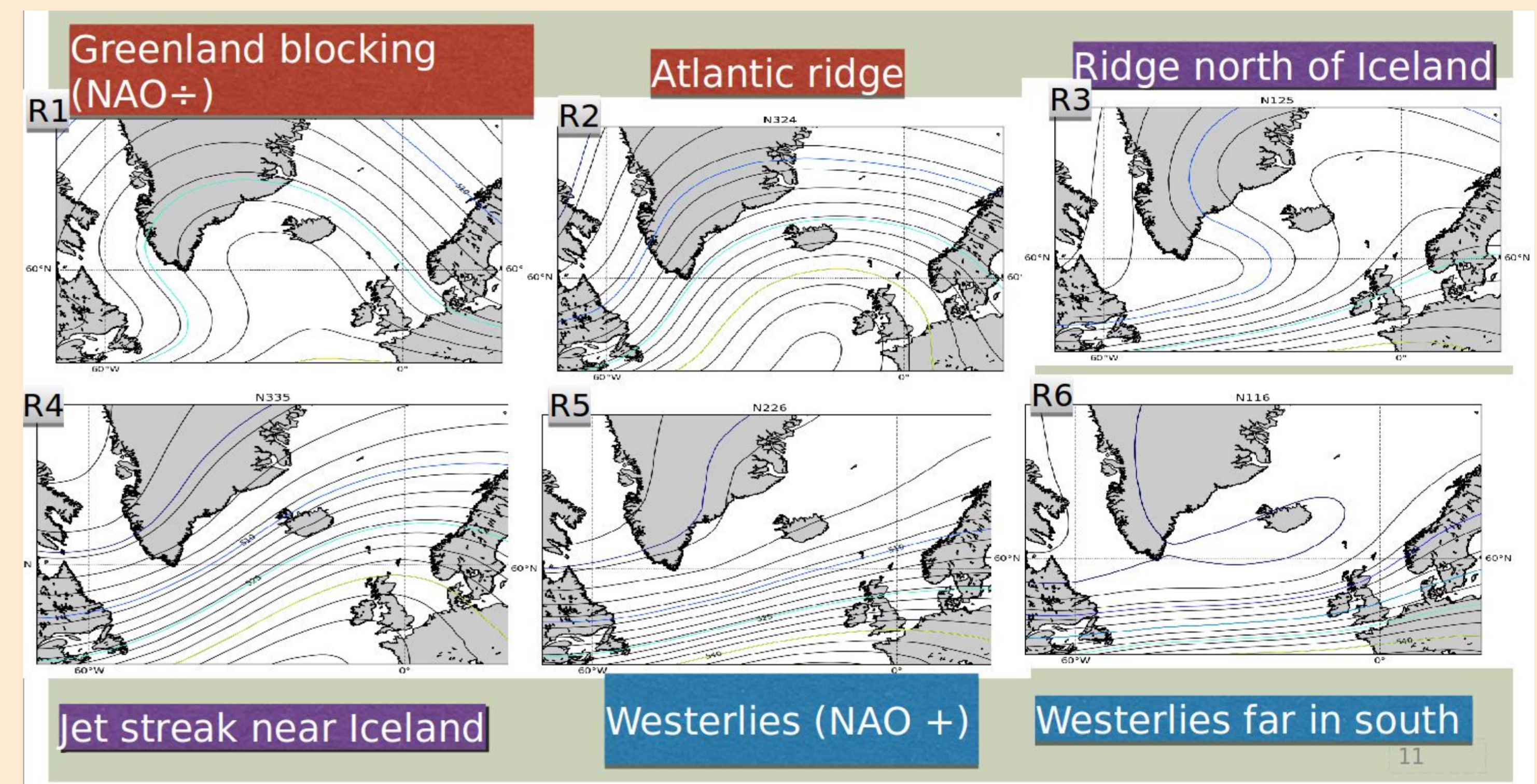


Fig. 2. Average geopotential height for each of the 6 regimes in the region surrounding Iceland.

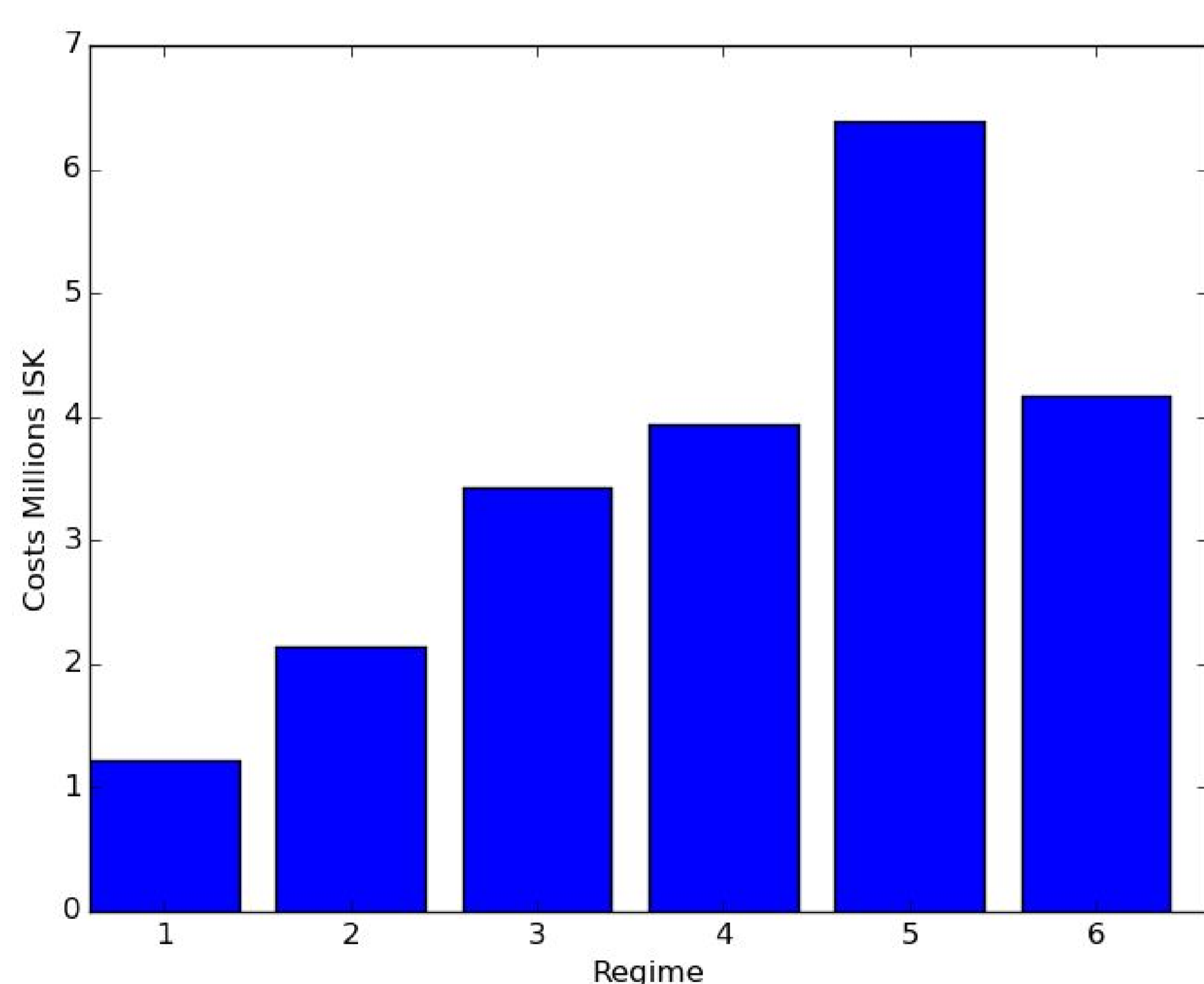


Fig. 3. Costs of winter service for each of the 6 regimes.

Table 1. Number of weeks by winter weather regimes 2008 -2015

Number of weeks by Weather regimes						
winter	R1	R2	R3	R4	R5	R6
2008-2009	4	6	5	1	1	1
2009-2010	12	5	2	0	0	0
2010-2011	4	4	4	2	3	1
2011-2012	1	6	0	2	6	3
2012-2013	6	6	4	1	0	1
2013-2014	1	3	8	1	2	3
2014-2015	2	3	0	2	8	3

4. Using the Hovmöller method for road service cost analysis

The average costs of winter service as well as driven kilometers have been calculated for the 6 regimes (Figure 3). The costs vary heavily with the regimes. With the highest cost in regime 5 being more than five times higher than the cost in regime 1.

Using the reanalysis data from ECMWF [1] the class and regime has been found for every winter week back to 1900. For each of the weeks the costs were assumed to be the average cost of that regime using the available data. That way the costs for each winter have been estimated (Figure 5).

5. Results

The difference in costs in the regimes is large, and so are driven kilometers. This method can be useful to estimate how much maintenance would be needed for a given winter, instead of applying various winter indexes. There does not seem to be any trend at all when the estimated data from 1900 is analysed. The costs variability from year to year is high and an expensive year can follow a cheap one.

The analysis was made with only five years of cost data that is assumed of high quality. That creates some uncertainty regarding the accuracy of the study.

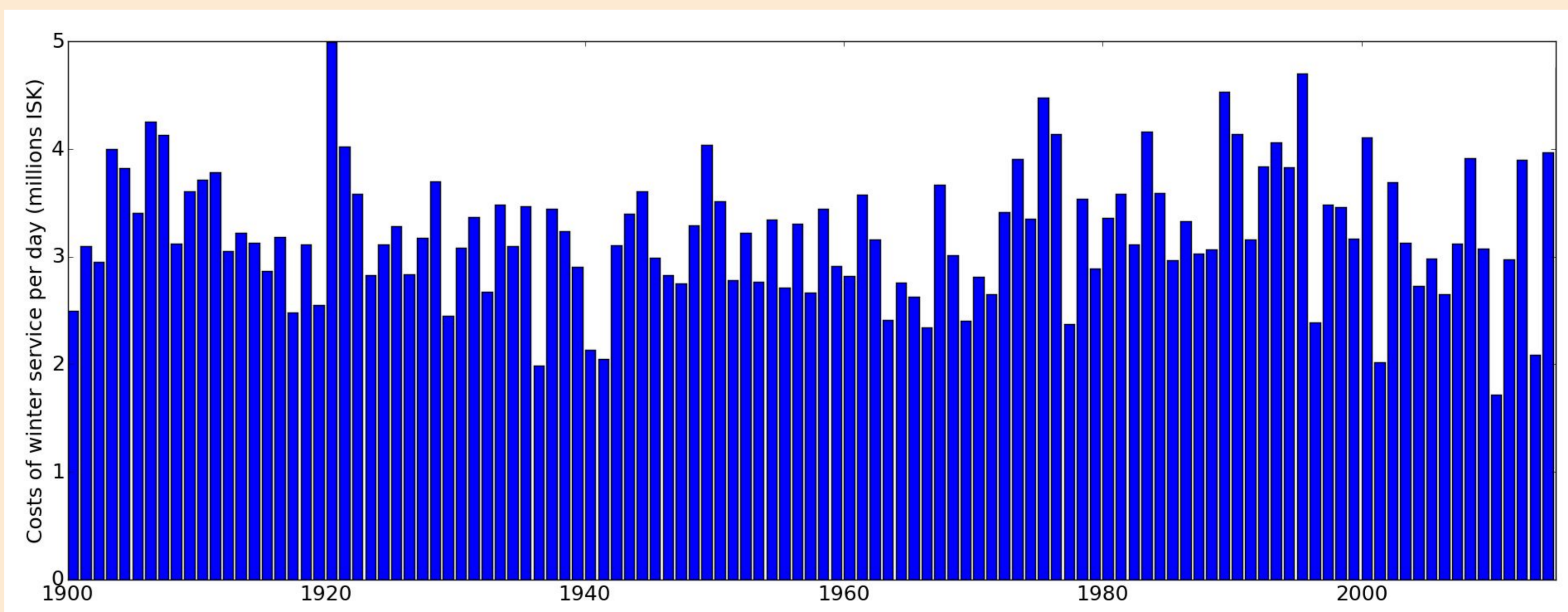


Fig. 5. Estimated average daily costs of the winter service for the period 1900 - 2014.

6. References

- European Centre for Medium-Range Weather Forecasts. ECMWF ERA-20C Reanalysis data.
- Hovmöller, E. "Climatological information on Iceland." United Nations report no. TAO/ICE/4, 115 p. 1960.
- Eliasson Á., Sveinbjörnsson E. A Severe in-cloud icing episode in Iceland 2013 - 2014 - Weather pattern background. Proceedings International Workshop on Atmospheric icing of Structure. 2015

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