

# Frost rings in spruce wood on the upper tree-line on the South Ural Mountains

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## Aim:

To characterize environmental conditions of upper tree-line South Ural mountains using frost rings in spruce wood.

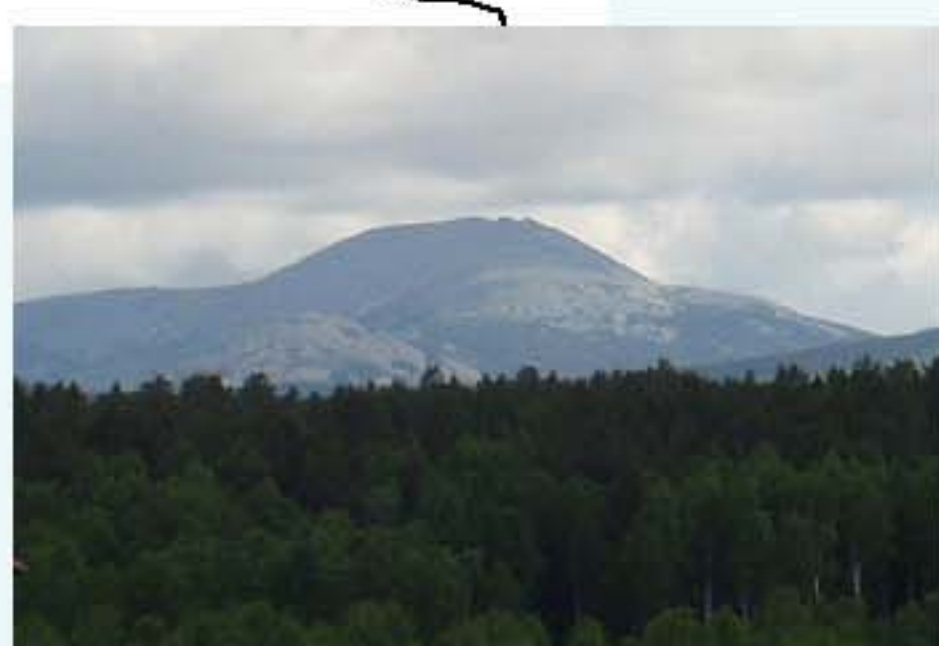
To compare age structure of spruce forest and frequency of frosts on three levels.



**Research area**  
M1: South-west slope of Maliy Iremel  
M3: South slope of Maliy Iremel  
B: North slope of Bolshoy Iremel  
Upper tree line, forest-tundra ecotone.

M1: South-west slope of Maliy Iremel

1360 m a.s.l. Single trees. 1 level.  
1300 m a.s.l. Sparse growth trees. 3 level.  
1260 m a.s.l. Spruce forest, 5 level.



M3: South slope of Maliy Iremel

## Object:

1052 various age *Picea obovata* trees. Cores at 0.2 m above ground level. Samples have from 10 up to 110 tree rings.



LW - frost ring in latewood

## Frost rings:

Form under the influence of spring (in earlywood) and summer (in latewood) frosts.

EW - frost ring in earlywood



Total amount damaged trees increases down to slope, except South one.

Table 1. Spatio-temporal distribution of frost rings on 3 profiles.

Year	m1-1		m1-3		m1-5		m3-1		m3-3		m3-5		b1		b3		b5		
	ew	lw	ew	lw	ew	lw	ew	lw	ew	lw	ew	lw	ew	lw	ew	lw	ew	lw	
2004																			
2003																			
2002																			
2001	+						+												
2000									+										
1999	+		+		+		+		+				+		+		+		
1998																		+	
1997									+						+			+	+
1996																			
1995	+		+				+		+	+			+		+		+		
1994									+	+									+
1993	+	+	+	+					+	+	+					+		+	
1992							+			+	+					+			
1991																			
1990																			
1989							+												
1988										+									
1987										+									+
1986	+									+									+
1985										+									
1984	+		+							+									+
1983			+				+			+				+		+		+	
1982	+		+				+		+	+	+		+	+				+	
1981										+									
1980										+								+	+
1979	+						+		+					+					
1978	+						+			+							+	+	+
1977																			
1976																			
1975							+			+				+			+	+	+
1974										+							+		+
1973										+							+		+
1972										+							+		+
1971										+							+		+
1970	+		+				+		+	+	+		+	+		+	+	+	+
1969			+				+		+	+	+		+	+		+	+	+	+
1968			+				+		+	+	+		+	+		+	+	+	+
1967	+		+				+		+	+	+		+	+		+	+	+	+
1966	+		+				+		+	+	+		+	+		+	+	+	+
1965	+		+				+		+	+	+		+	+		+	+	+	+
1964	+		+				+		+	+	+		+	+		+	+	+	+
1963	+						+		+	+	+		+	+		+	+	+	+
1962	+						+		+	+	+		+	+		+	+	+	+
1961	+		+				+		+	+	+		+	+		+	+	+	+
1960	+		+				+		+	+	+		+	+		+	+	+	+