

WILL WARMER WINTERS INDUCE MORE FOREST AND CROP PESTS IN SWITZERLAND?

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CONTEXT

With current global warming, recent winters have often been milder in Switzerland than they were in previous decades and should still become more so in the coming decades. Some insect species sensitive to winter extreme cold events could increase their survival rates during the cold season. Forest pests, such as pine processionary moth (*Thaumetopoea pityocampa*), green spruce aphid (*Elatobium abietinum*), and some crop pests, such as southern green stink bug (*Nezara viridula*) and South American tomato moth (*Tuta absoluta*), could overwinter more easily in Switzerland. These species are affected by temperatures below -12°C (*Thaumetopoea pityocampa*, *Elatobium abietinum*) to below -8°C (*Nezara viridula*) and to long freezing periods (*Tuta absoluta*).



AIMS

This research aims to determine to what extent the evolution of winter minimum temperatures could increase the winter survival rate of some pest species in various places in Switzerland.

METHODS

- We used daily minimum temperatures from the period 1980-2019 using 67 meteorological stations located at elevations ranging from 203 to 2283 m asl in Switzerland.
- We used two climatic scenarios (RCP2.6 & RCP8.5) from the CH2018 dataset to analyse daily minimum temperatures over the period 2020-2099 at the same 67 locations.
- We analysed winter minimum temperatures, the number of days with minimum temperatures below 0°C , -8°C and -12°C and the frequency of winters with at least one day below these thresholds ($T_{\min} < -8^{\circ}\text{C}$ & $T_{\min} < -12^{\circ}\text{C}$).

RESULT 1: TRENDS IN NUMBER OF COLD DAYS

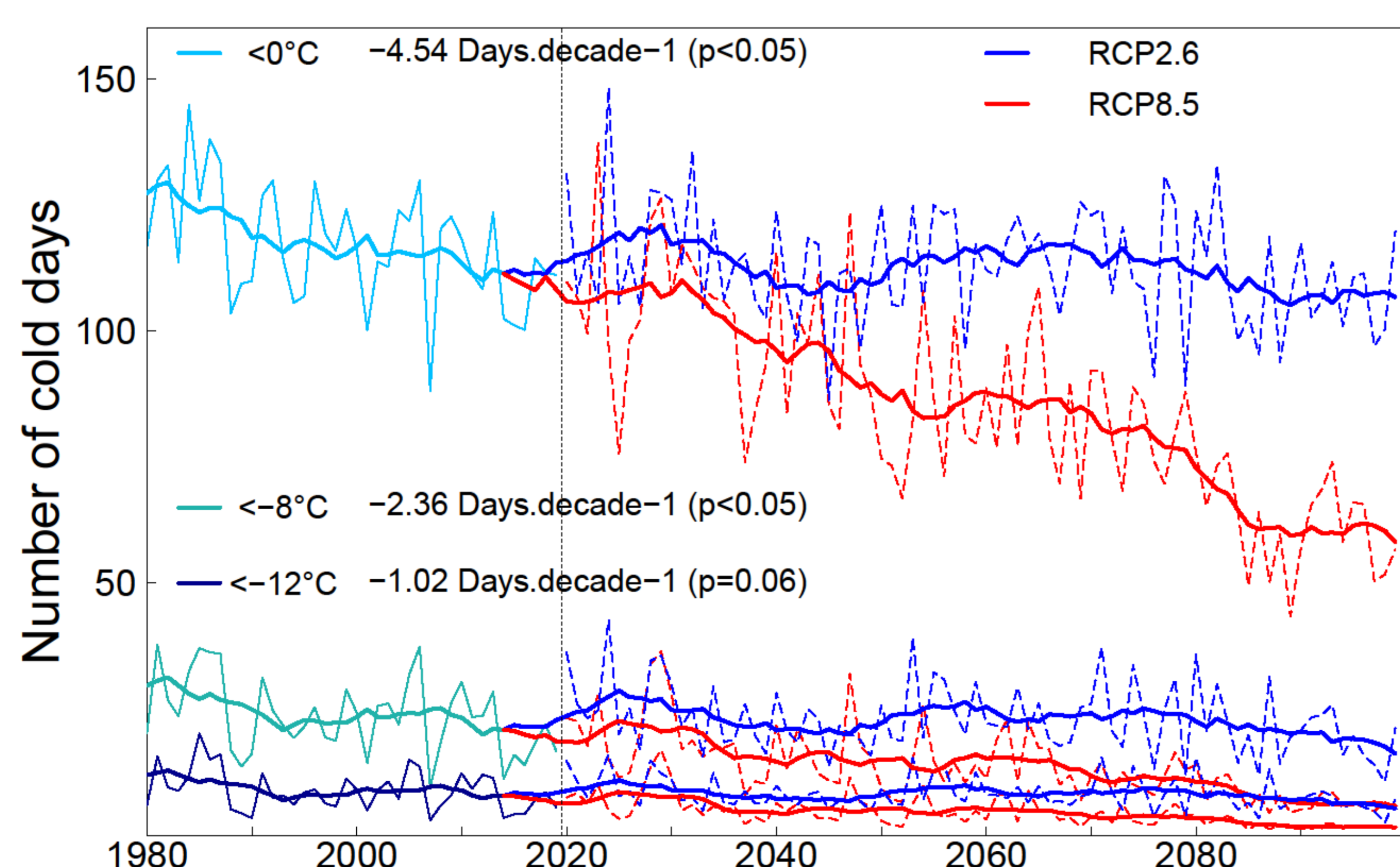


Figure 1: number of cold days (0°C, -8°C & -12°C) per year over the 67 stations.

RESULT 2: FREQUENCY OF WINTERS WITH AT LEAST ONE COLD DAY

Frequency of winters with at least one cold day (-8°C)					
	1980-2019	2035-2064		2070-2099	
		RCP8.5	RCP2.6	RCP8.5	RCP2.6
South of the Alps	42%	29%	47%	13%	36%
<math><500\text{ m}</math>	80%	57%	83%	27%	68%
500-800 m	95%	81%	96%	52%	87%
800-1100 m	100%	99%	100%	98%	100%
1100-1400 m	100%	97%	100%	86%	100%
1400-1700 m	100%	99%	100%	88%	100%
>1700 m	100%	100%	100%	100%	100%

Frequency of winters with at least one cold day (-12°C)					
	1980-2019	2035-2064		2070-2099	
		RCP8.5	RCP2.6	RCP8.5	RCP2.6
South of the Alps	10%	5%	7%	3%	5%
<math><500\text{ m}</math>	41%	17%	29%	6%	25%
500-800 m	63%	33%	54%	15%	44%
800-1100 m	93%	82%	99%	49%	89%
1100-1400 m	89%	71%	93%	45%	80%
1400-1700 m	91%	69%	90%	40%	80%
>1700 m	100%	97%	100%	83%	97%

→ The frequency of winters with at least one day below -8°C could fall to one winter out of four at elevations below 500 m and to one out of two from 500 to 800 m by the end of the century.

→ The frequency of winters with at least one day below -12°C could fall to less than one winter out of two up to 1700 m by the end of the century.

CONCLUSIONS - PERSPECTIVES

- ✓ The frequency of cold days has been decreasing in Switzerland over the last 40 years even though winter minimum temperatures have been increasing less than yearly minimum temperatures.
- ✓ By the end of the 21st Century, occurrences of temperatures below -12°C could become irregular up to 1700 m and winters with temperatures below -8°C could become rare at lower elevations in Switzerland.
- ✓ As a consequence, some crop pests could overwinter more easily on the Swiss Plateau, and some forest pests could reach higher elevations in mountain areas.