



Good Morning!



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Impact of climate on growth and mortality of trees in the Black Forest

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Location of the Black Forest





View to the Black Forest



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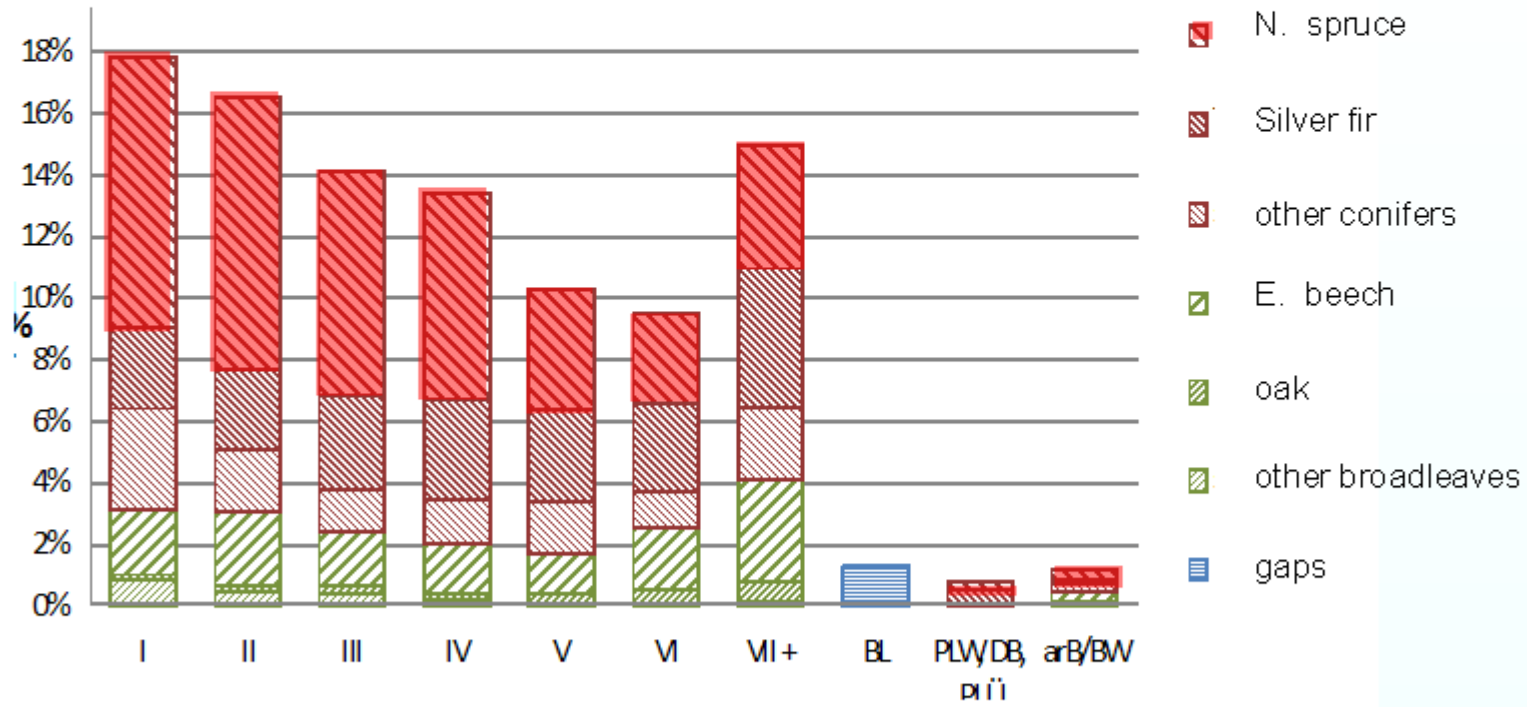




Area of Norway spruce in the Black Forest



tree species - and age distributon (public forest) 1961-70

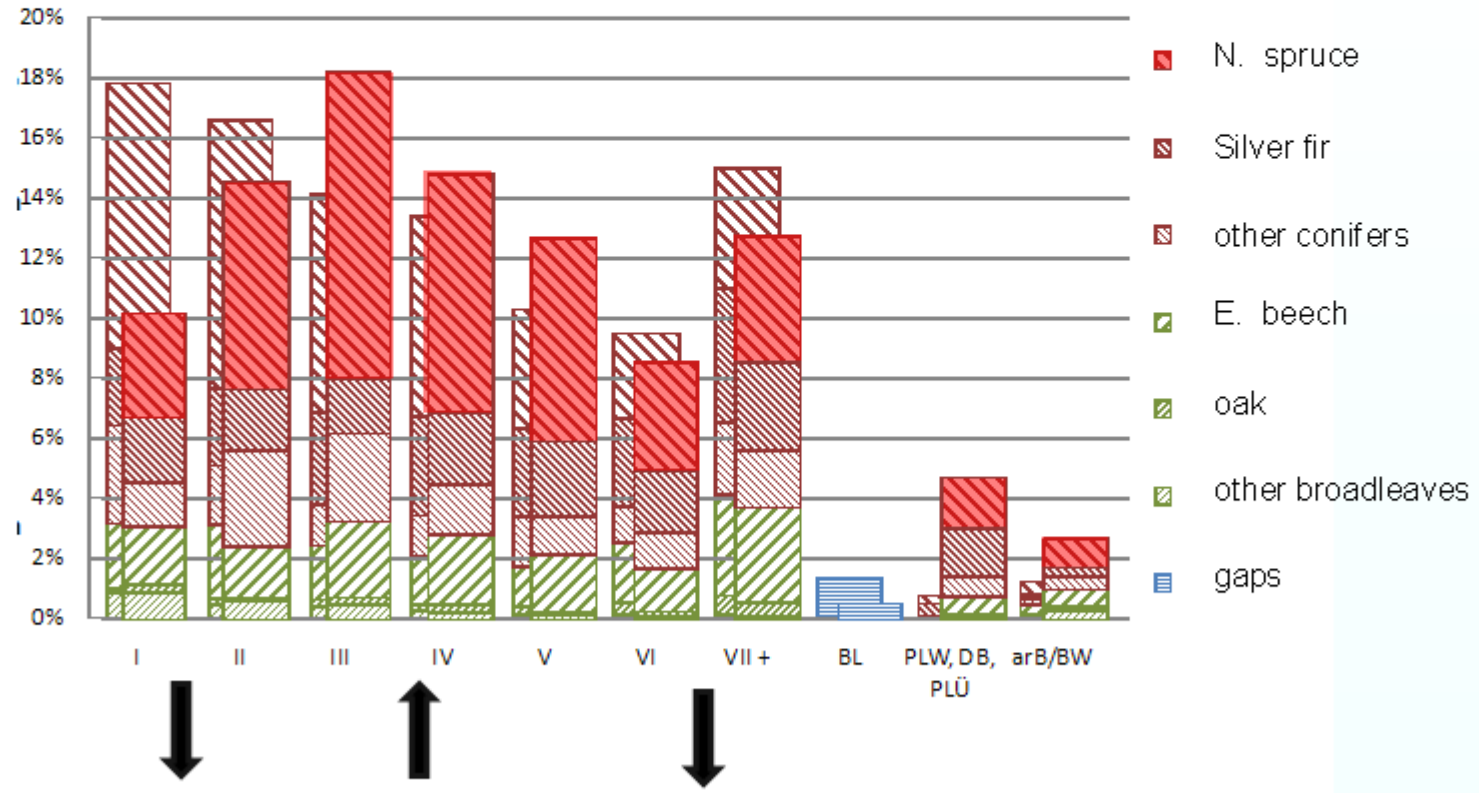




Area of Norway spruce in the Black Forest



tree species - and age distributon
(public forest) 1961-70 and 1991-2000

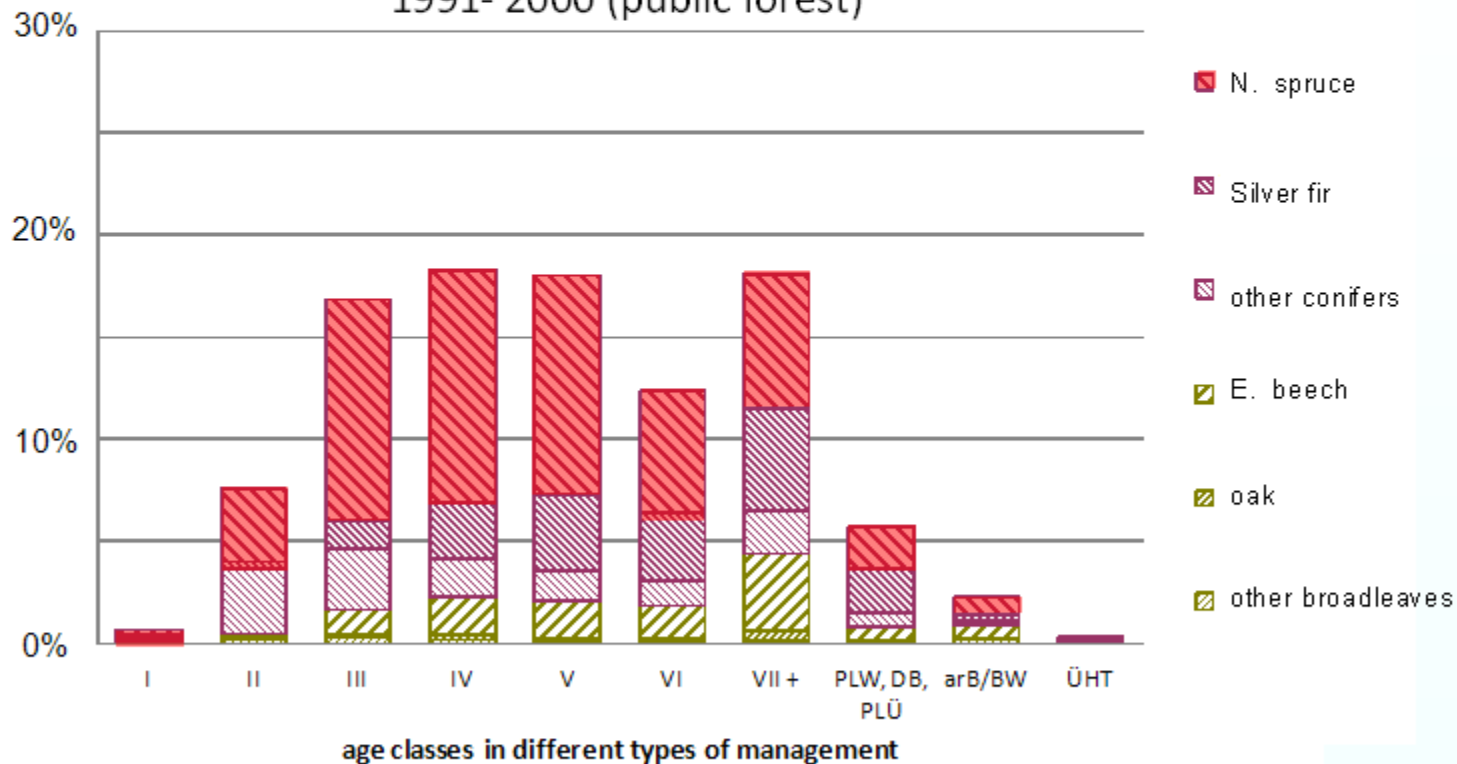




Growing stock of Norway spruce in the Black Forest

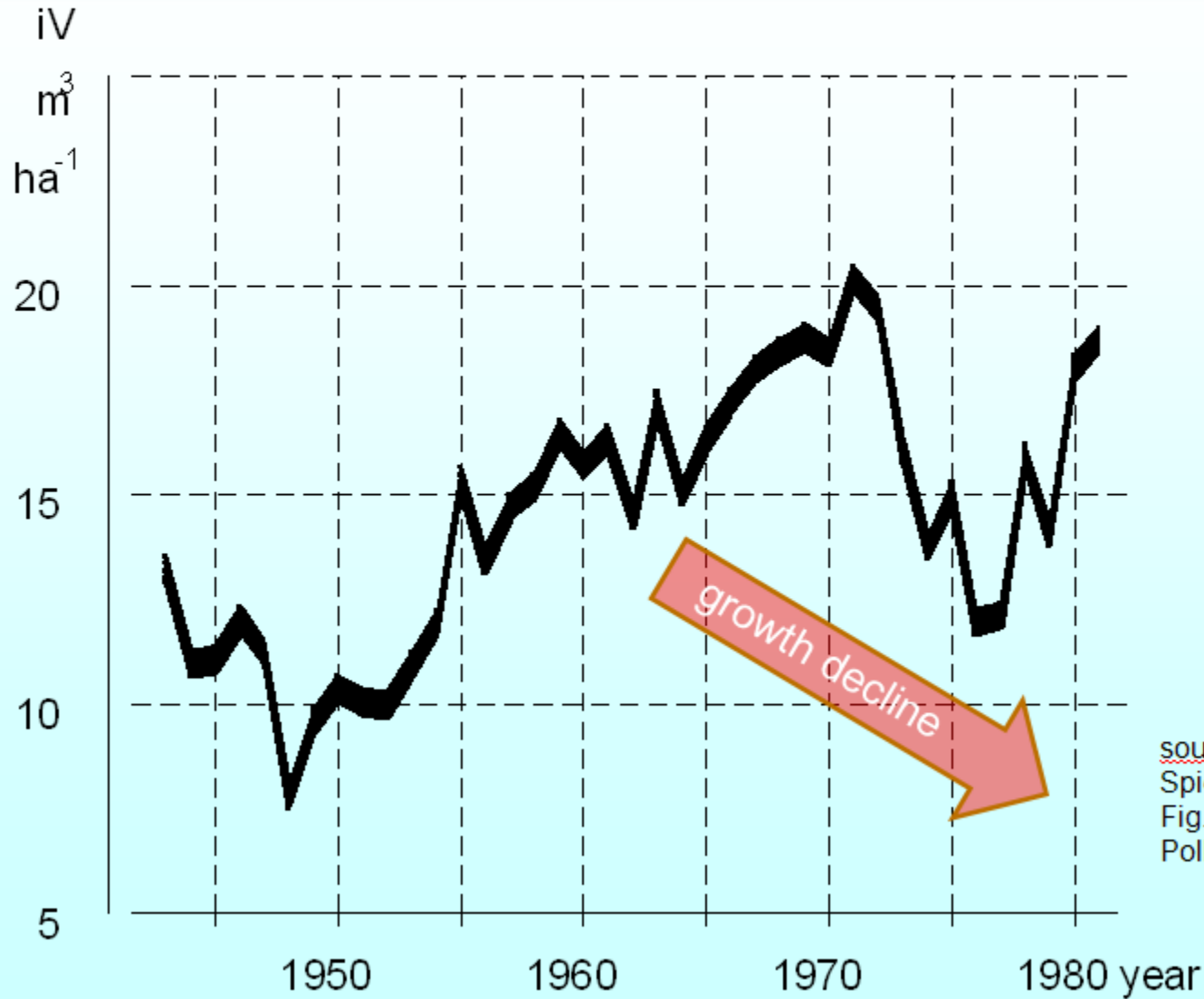


growing stock of the tree species in the Black Forest
1991- 2000 (public forest)





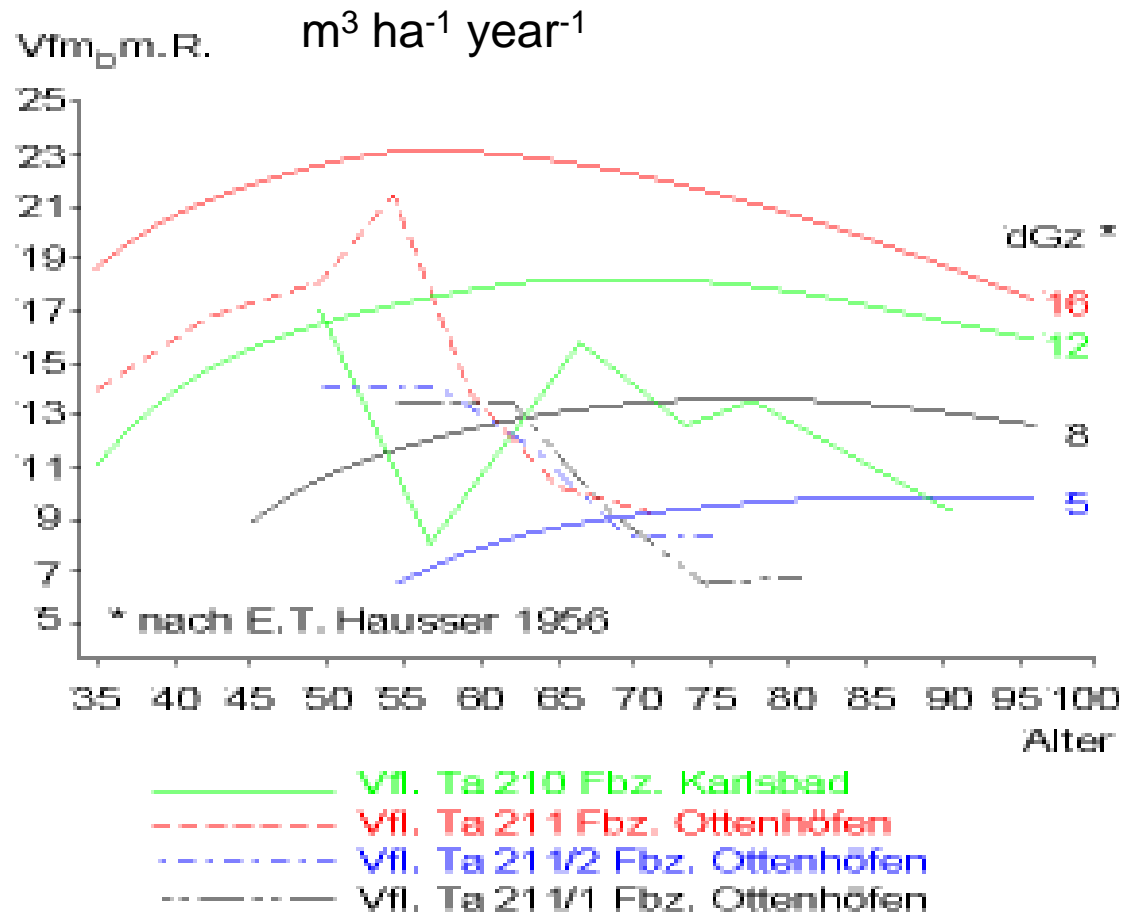
Growth of Norway spruce in the Black Forest



source:
Spiecker 1990/91:
Fig. 1 in Water, Air and Soil
Pollution 54, 247-256



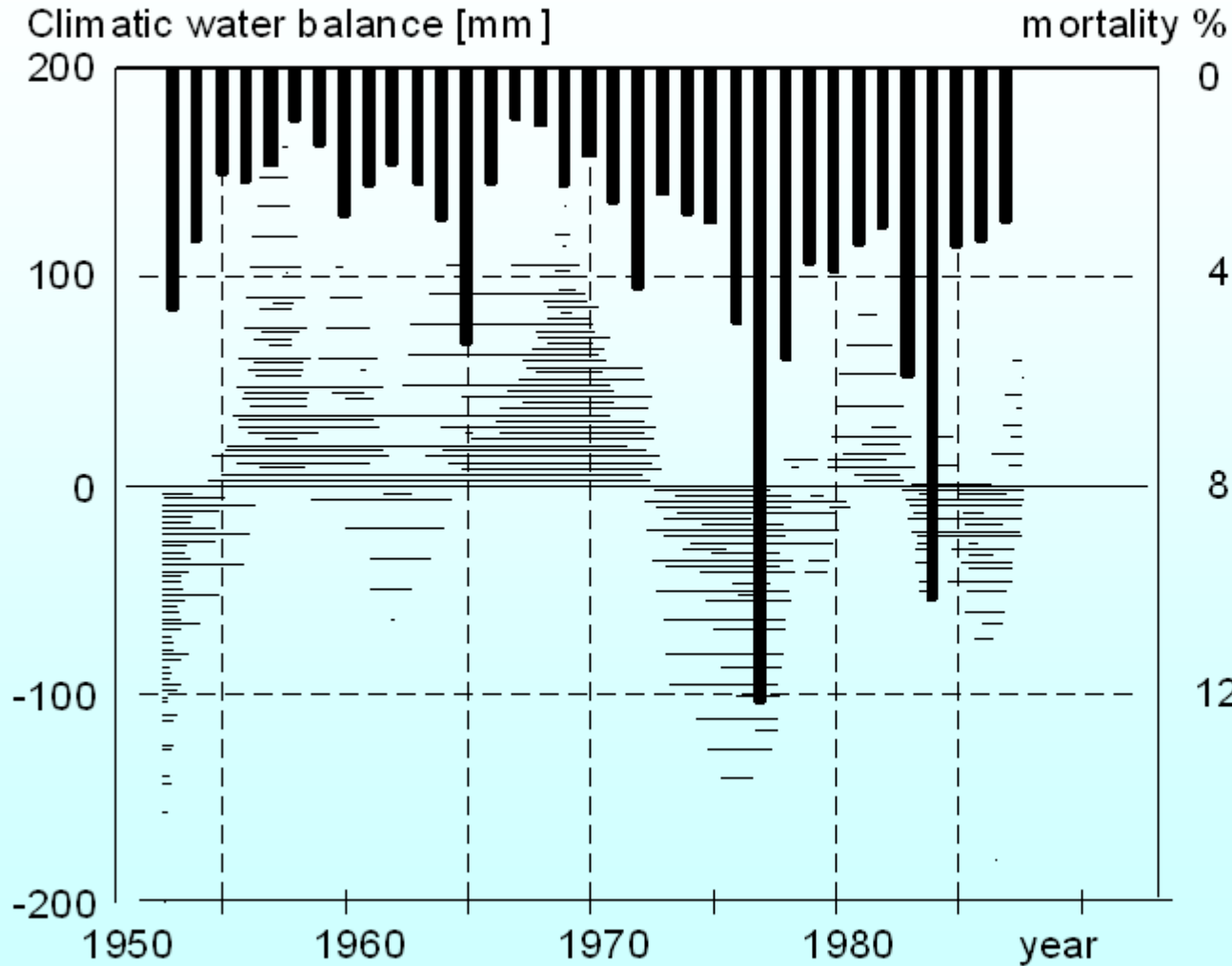
growth decline



Kenk et al. 1984



Growth of Norway spruce in the Black Forest



0 trees killed by insects, fungi, pollution & by drought expressed in % of the allowable cut

4

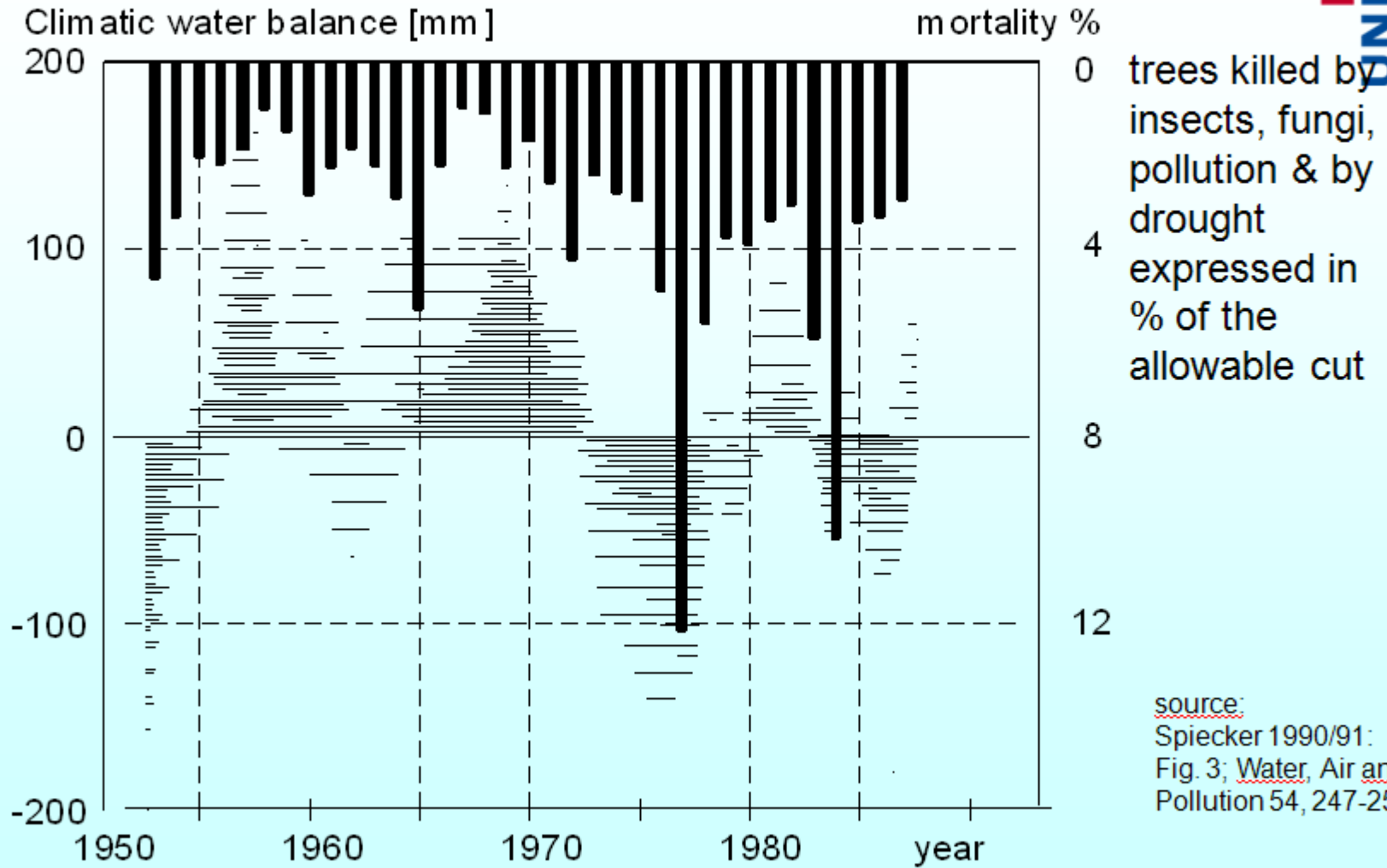
8

12

source:
Spiecker 1990/91:
Fig. 3; Water, Air and Soil
Pollution 54, 247-256

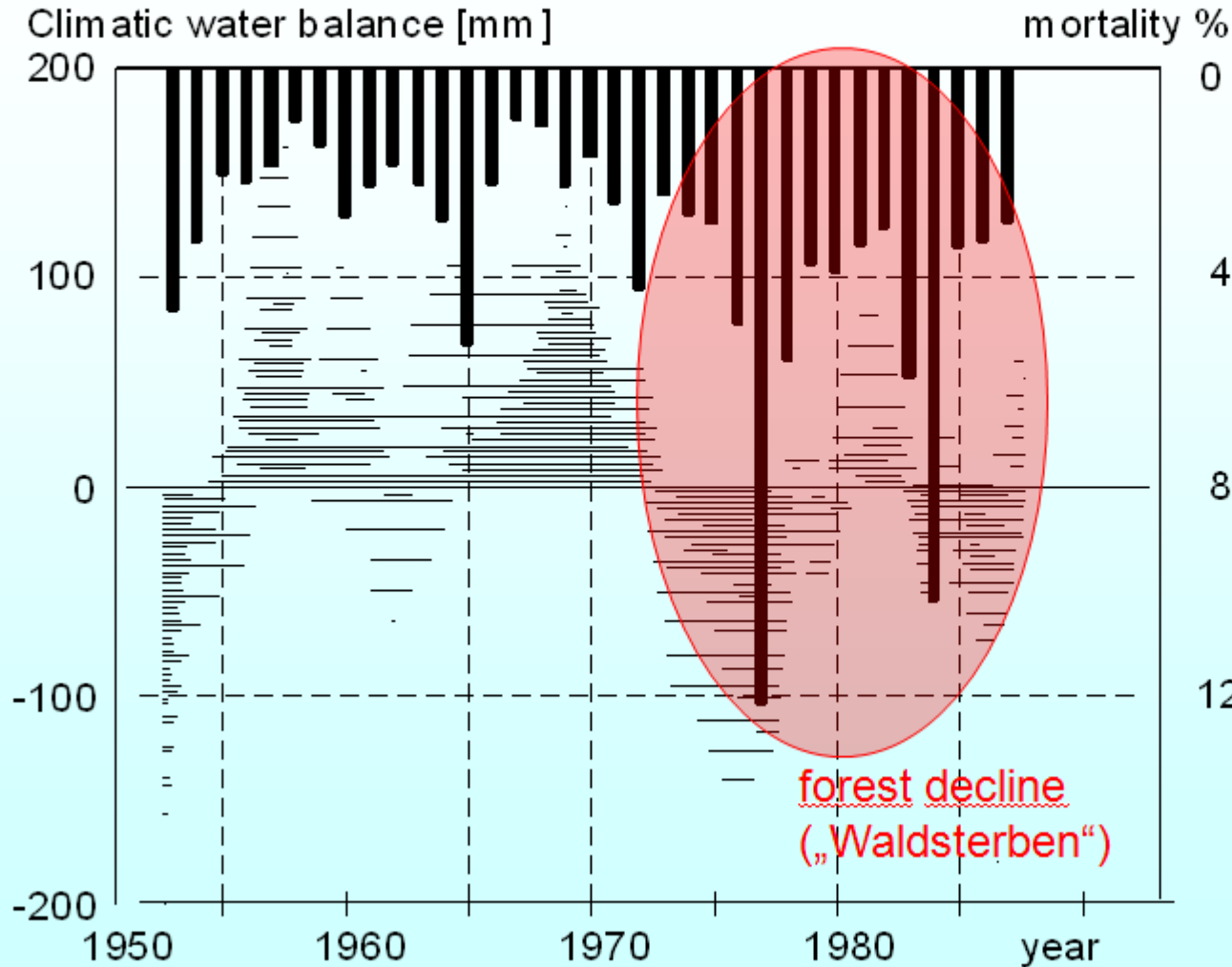


Growth of Norway spruce in the Black Forest





Growth of Norway spruce in the Black Forest



0 trees killed by insects, fungi, pollution & by drought expressed in % of the allowable cut

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12

source:
Spiecker 1990/91:
Fig. 3; Water, Air and Soil
Pollution 54, 247-256

Forest Decline “Waldsterben”

Discussion started in the Black Forest



DER SPIEGEL 47/1981



DER SPIEGEL 51/1984





Forest Decline “Waldsterben”

Discussion started in the Black Forest



What caused this „forest decline“
In the Black Forest?

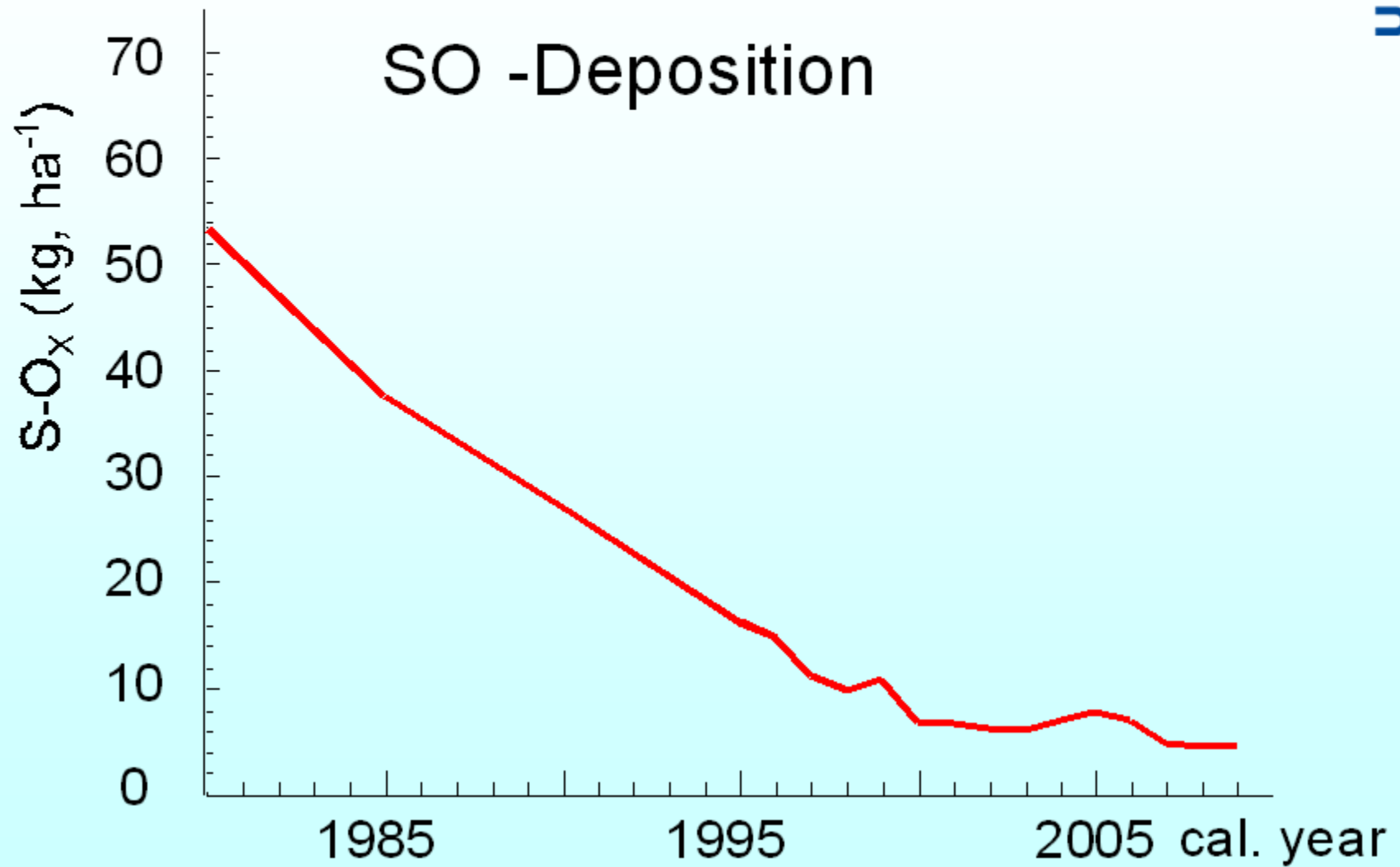
- air pollution?
- other causes?

Have the observed changes be
misinterpreted as “Waldsterben”?

Was it an exceptional decline at all?

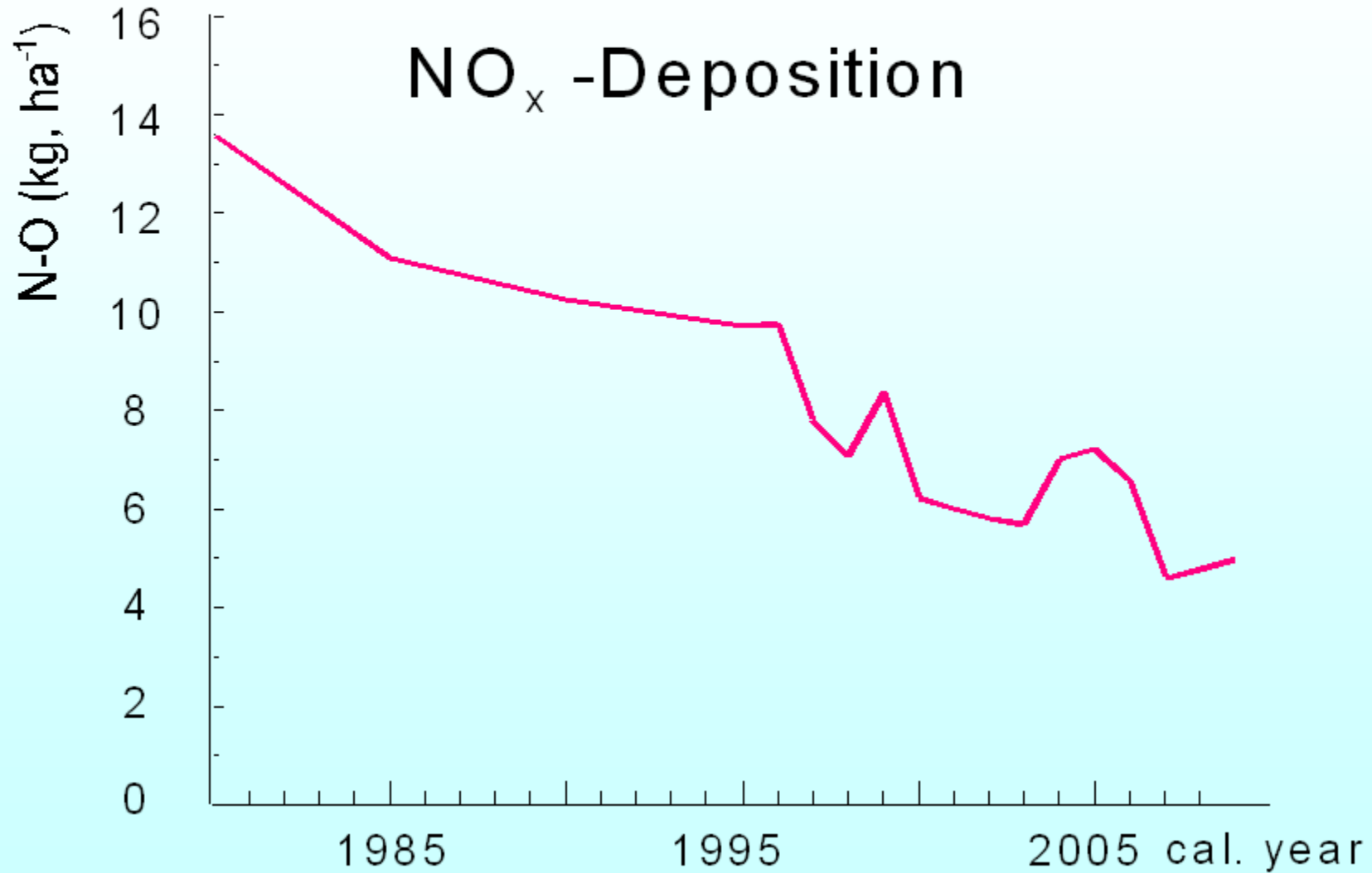


Air pollution in the Black Forest



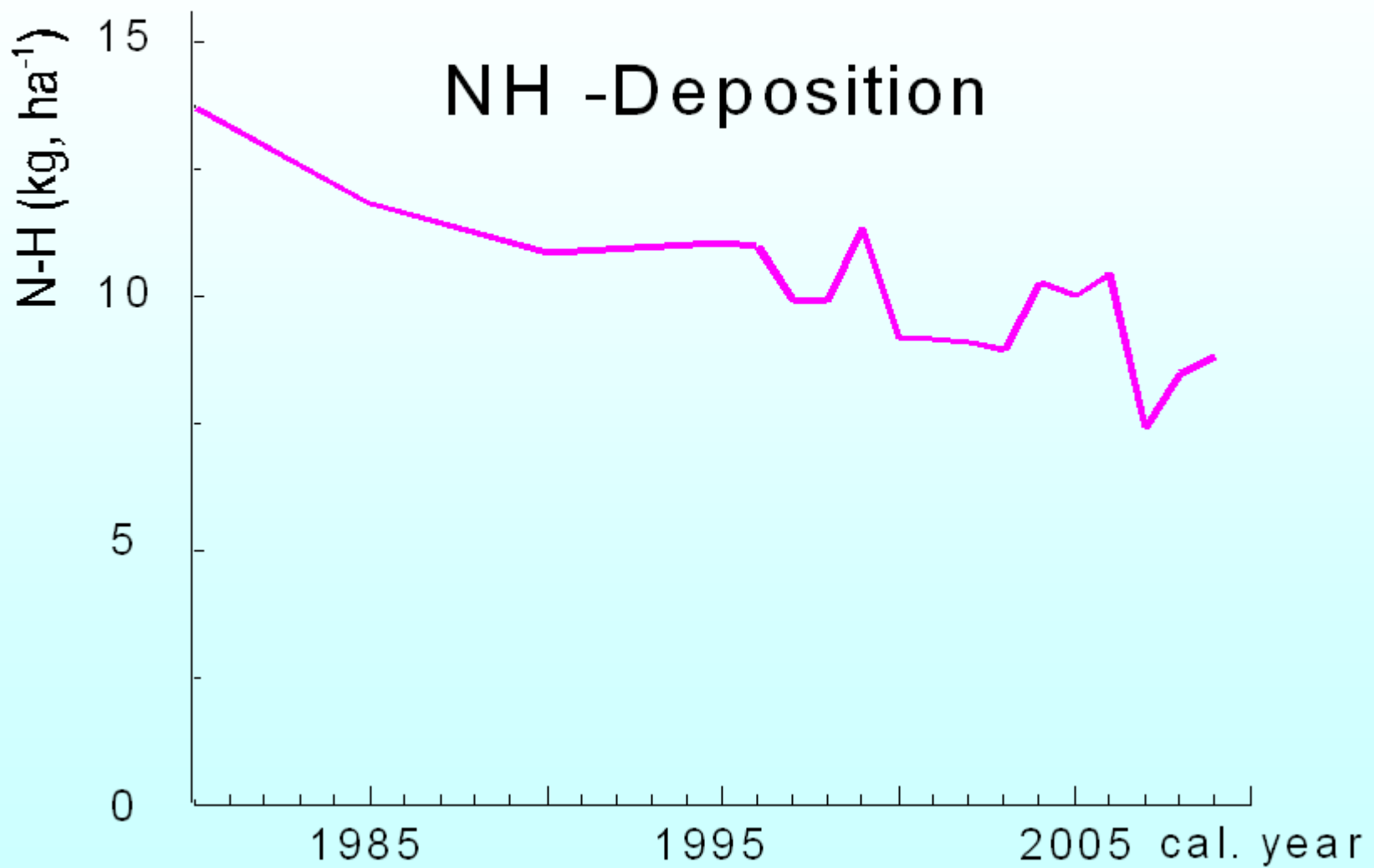


Air pollution in the Black Forest





Air pollution in the Black Forest



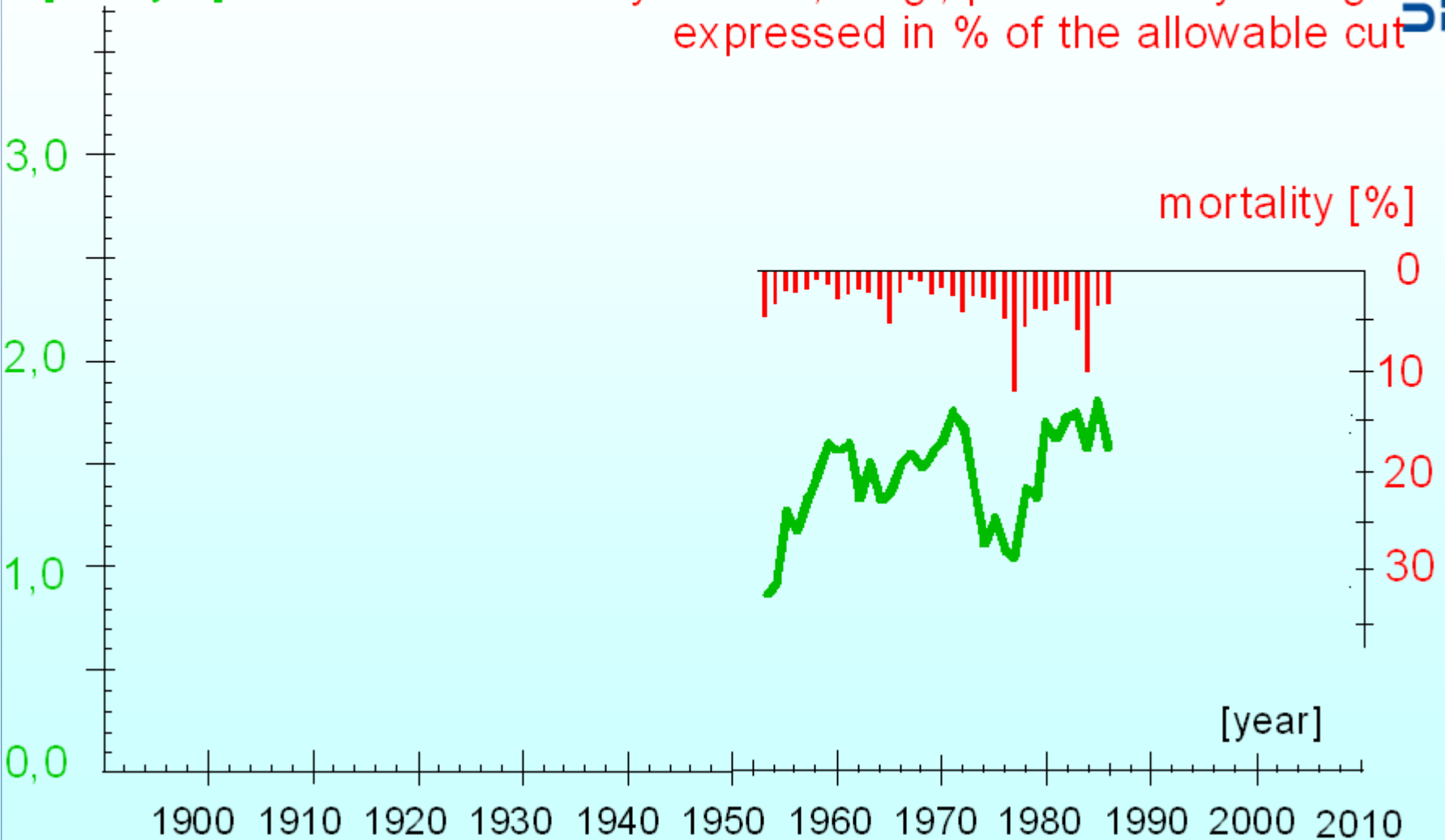


Growth and mortality in the Black Forest



ir [mm yr⁻¹]

trees killed by insects, fungi, pollution & by drought
expressed in % of the allowable cut

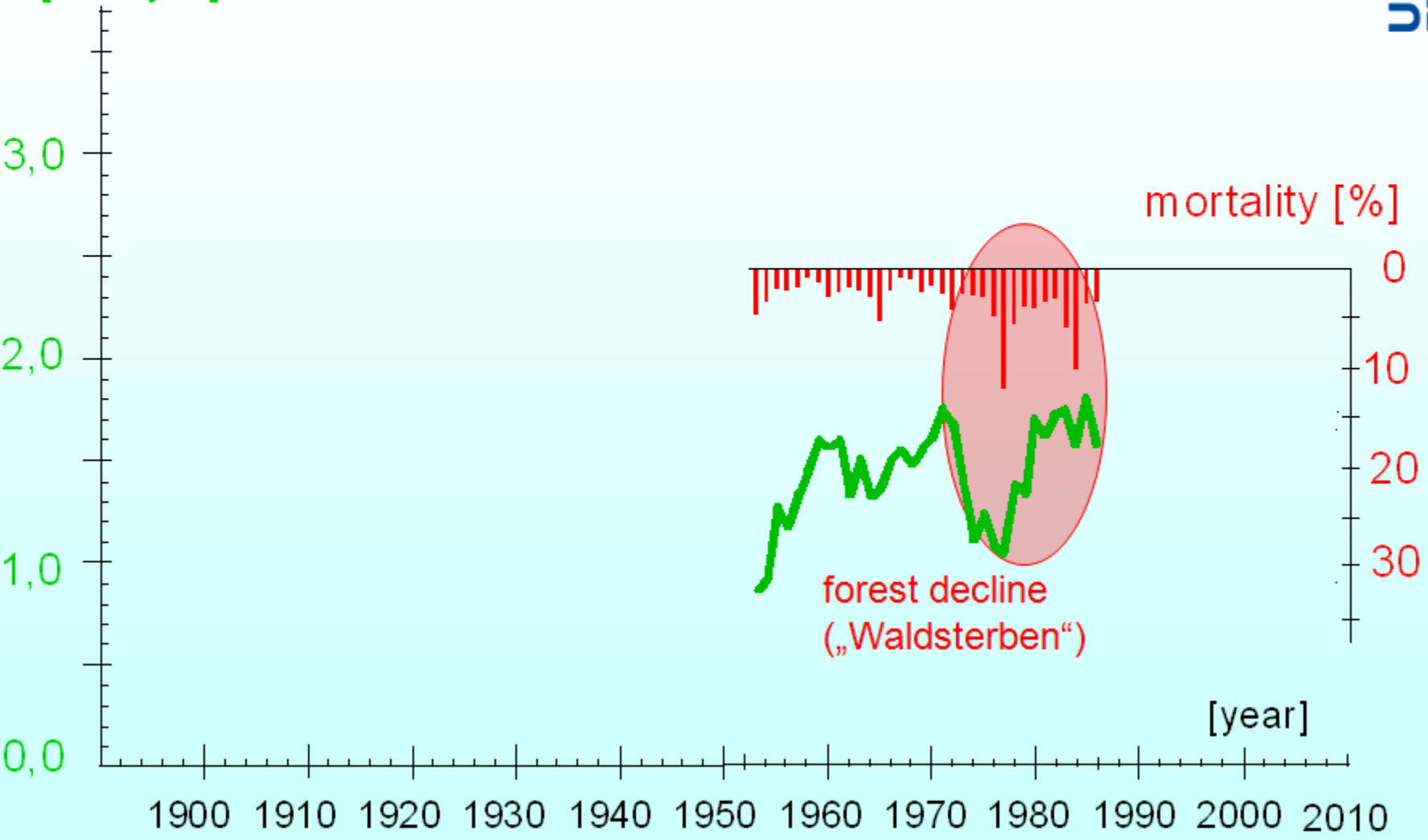




Forest decline: "Waldsterben" in the Black Forest



ir [mm yr⁻¹]





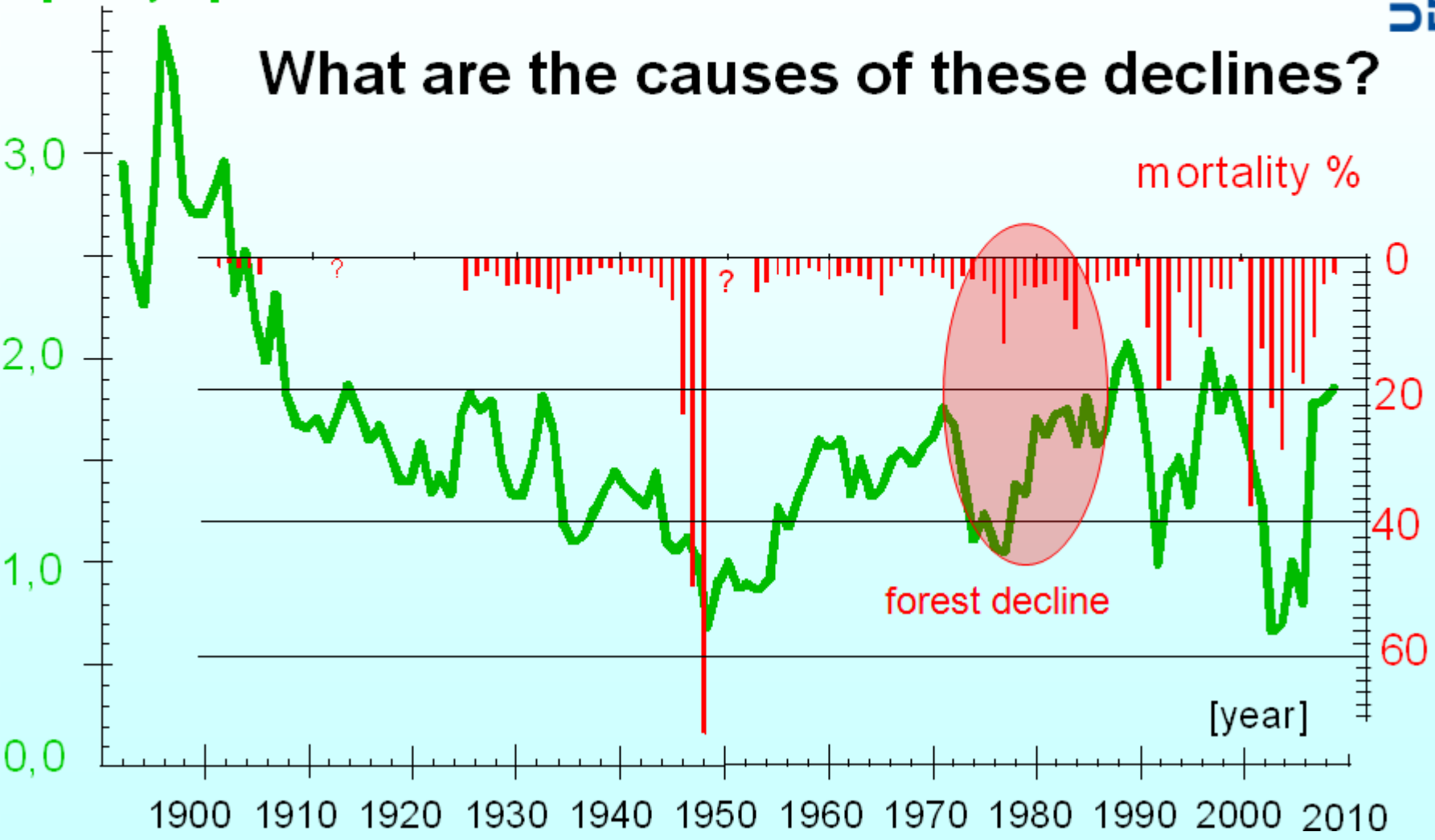
Other periods show more severe declines!



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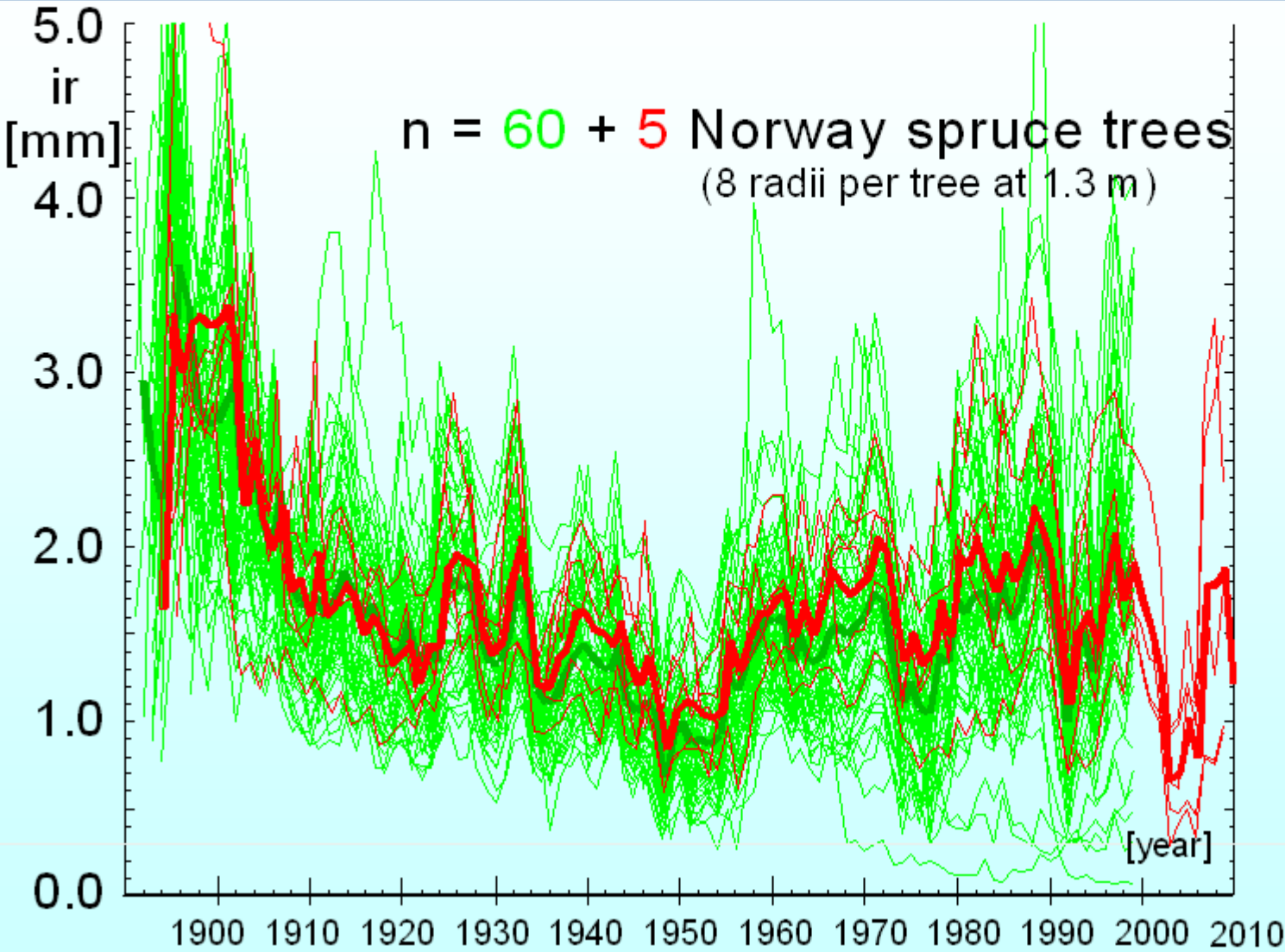
ir [mm yr⁻¹]

What are the causes of these declines?



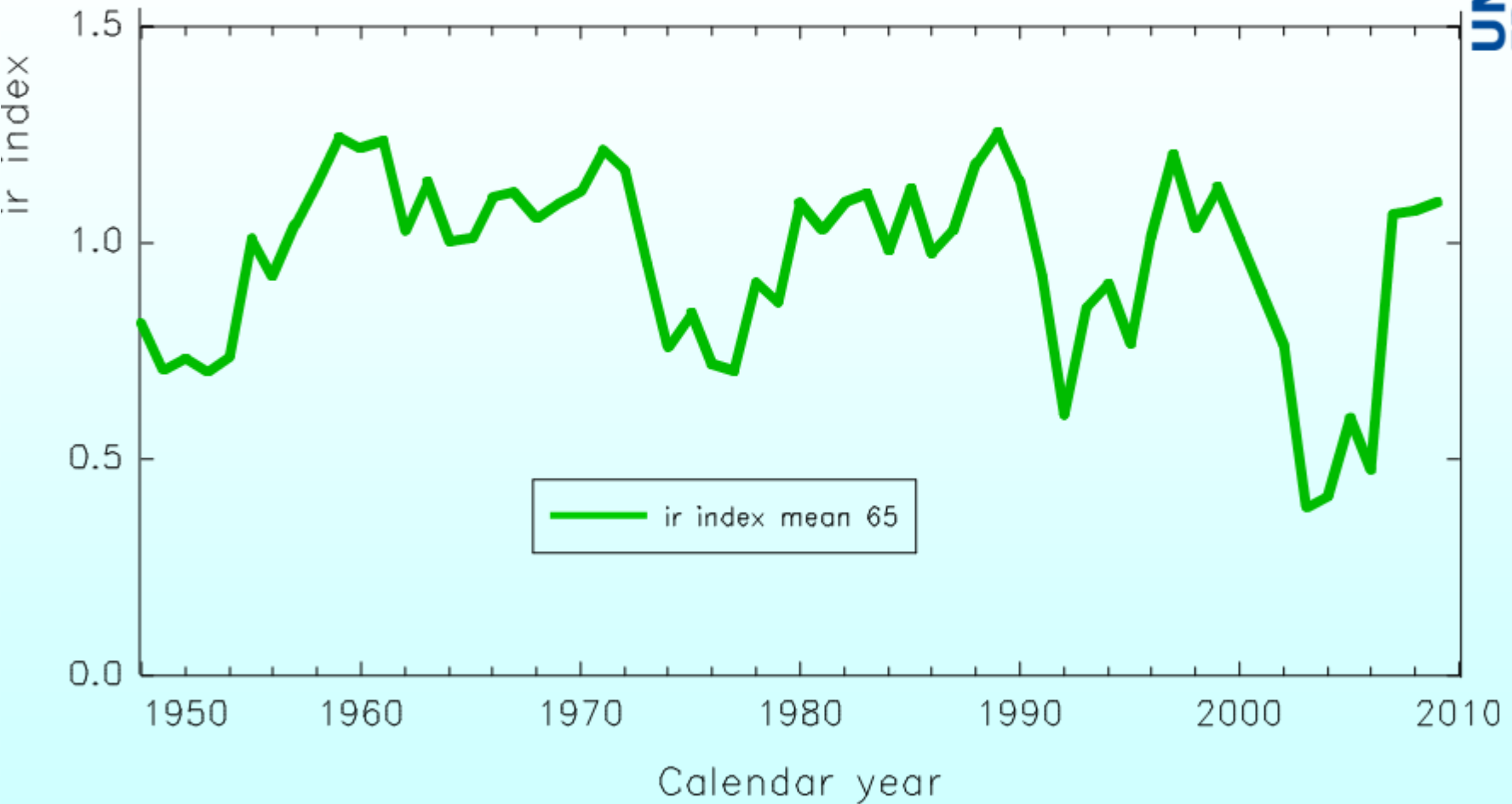


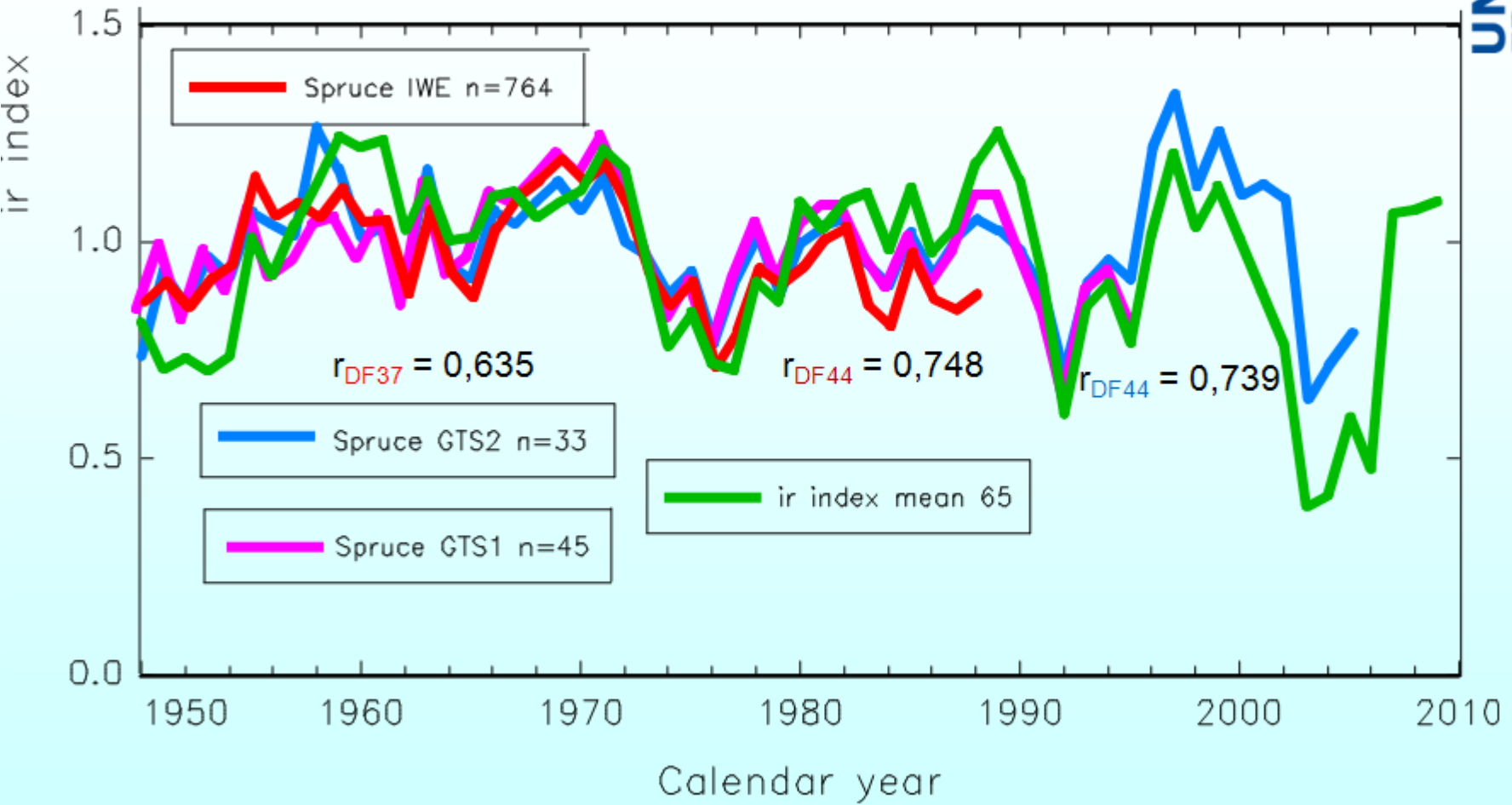
The growth data





standardized annual radial growth of 65 Norway spruce trees



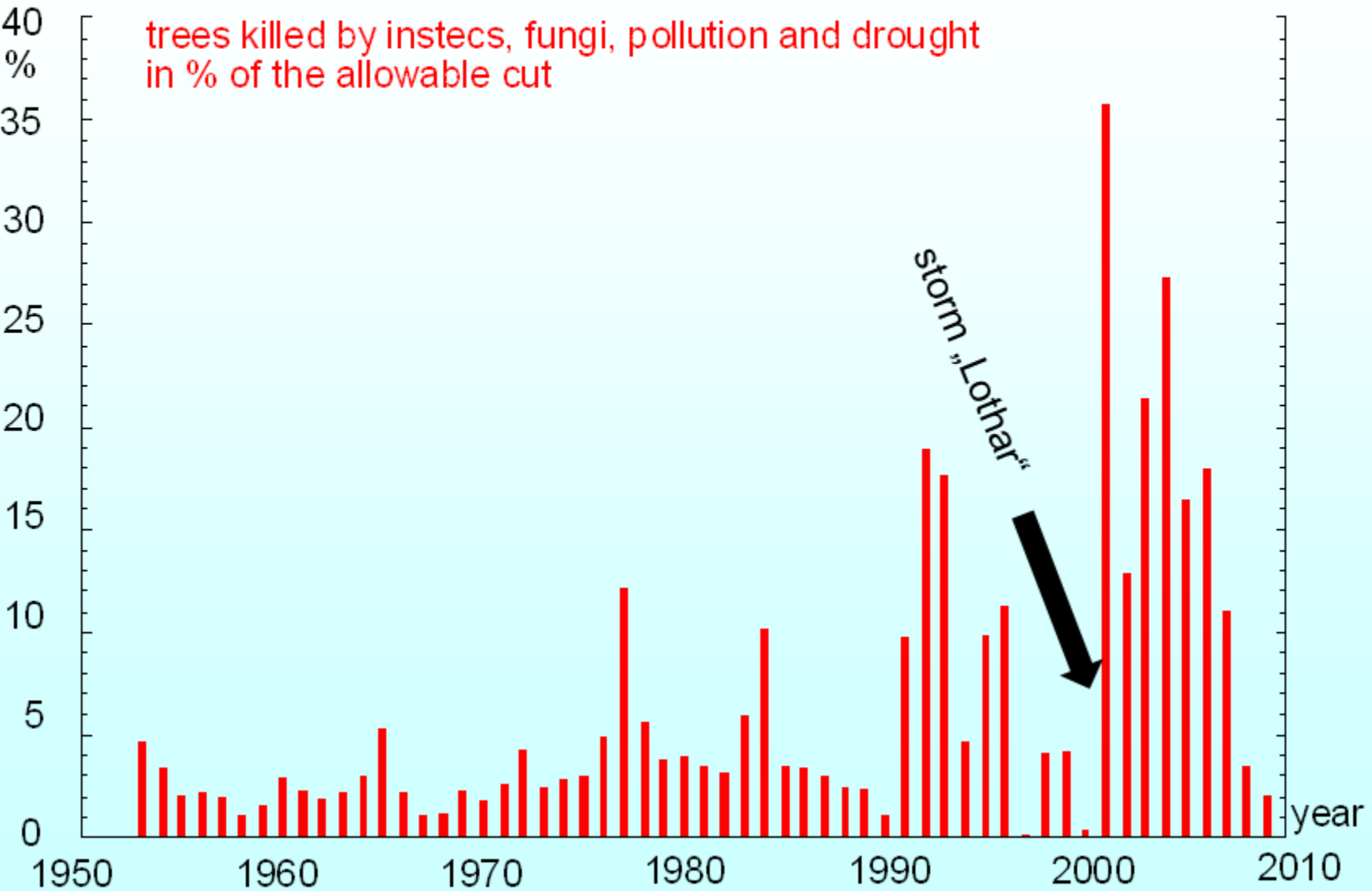


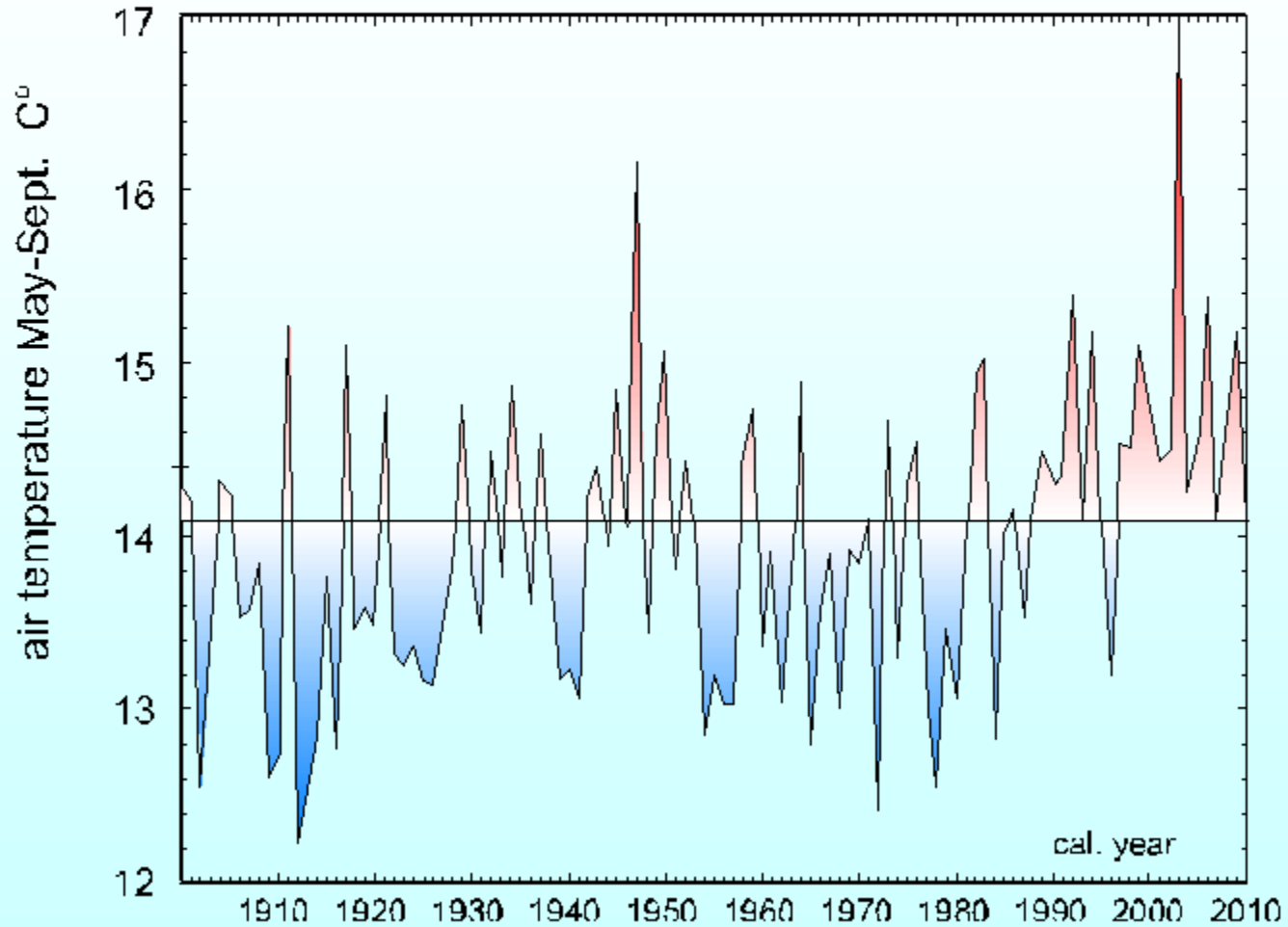


mortality



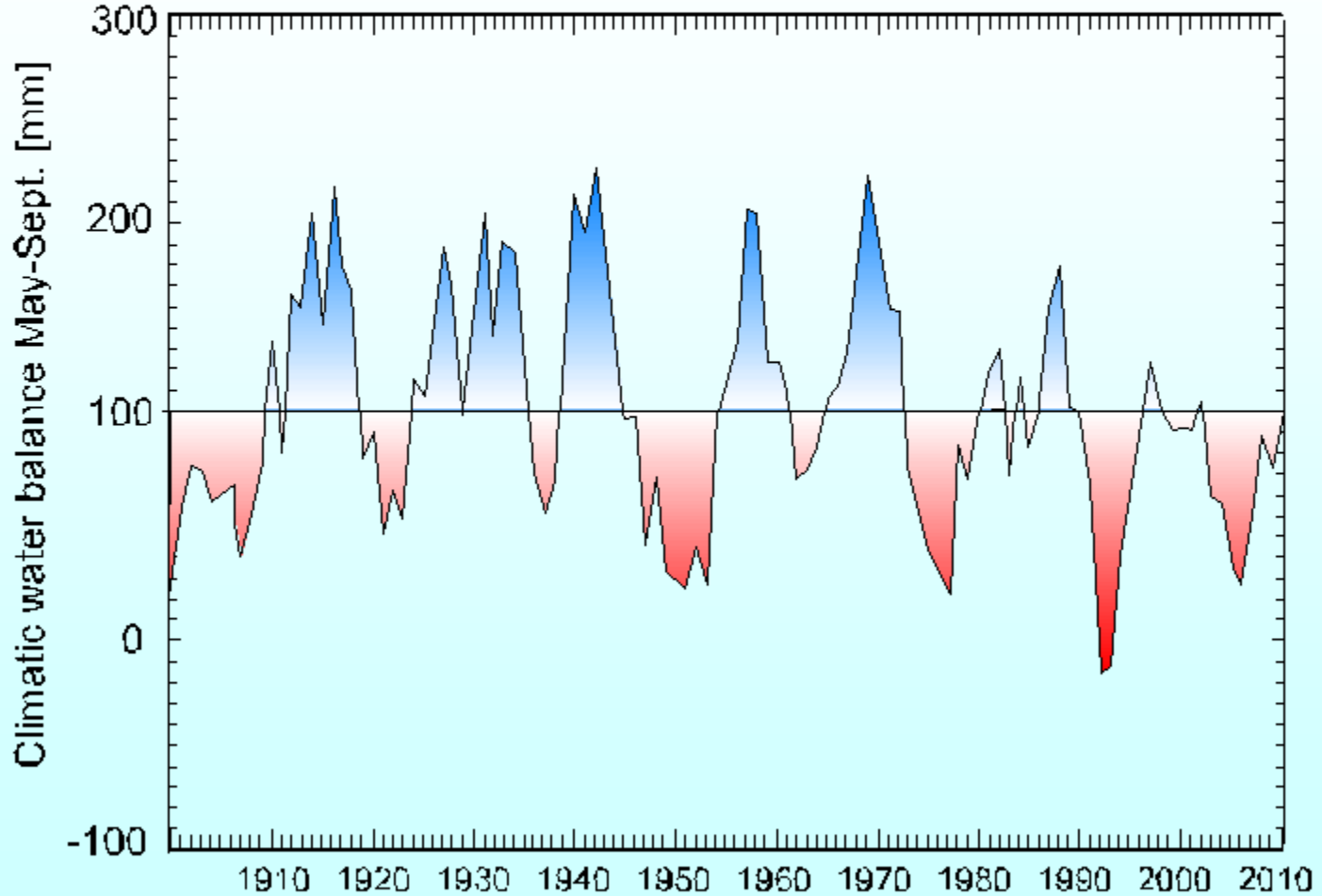
trees killed by insects, fungi, pollution and drought
in % of the allowable cut

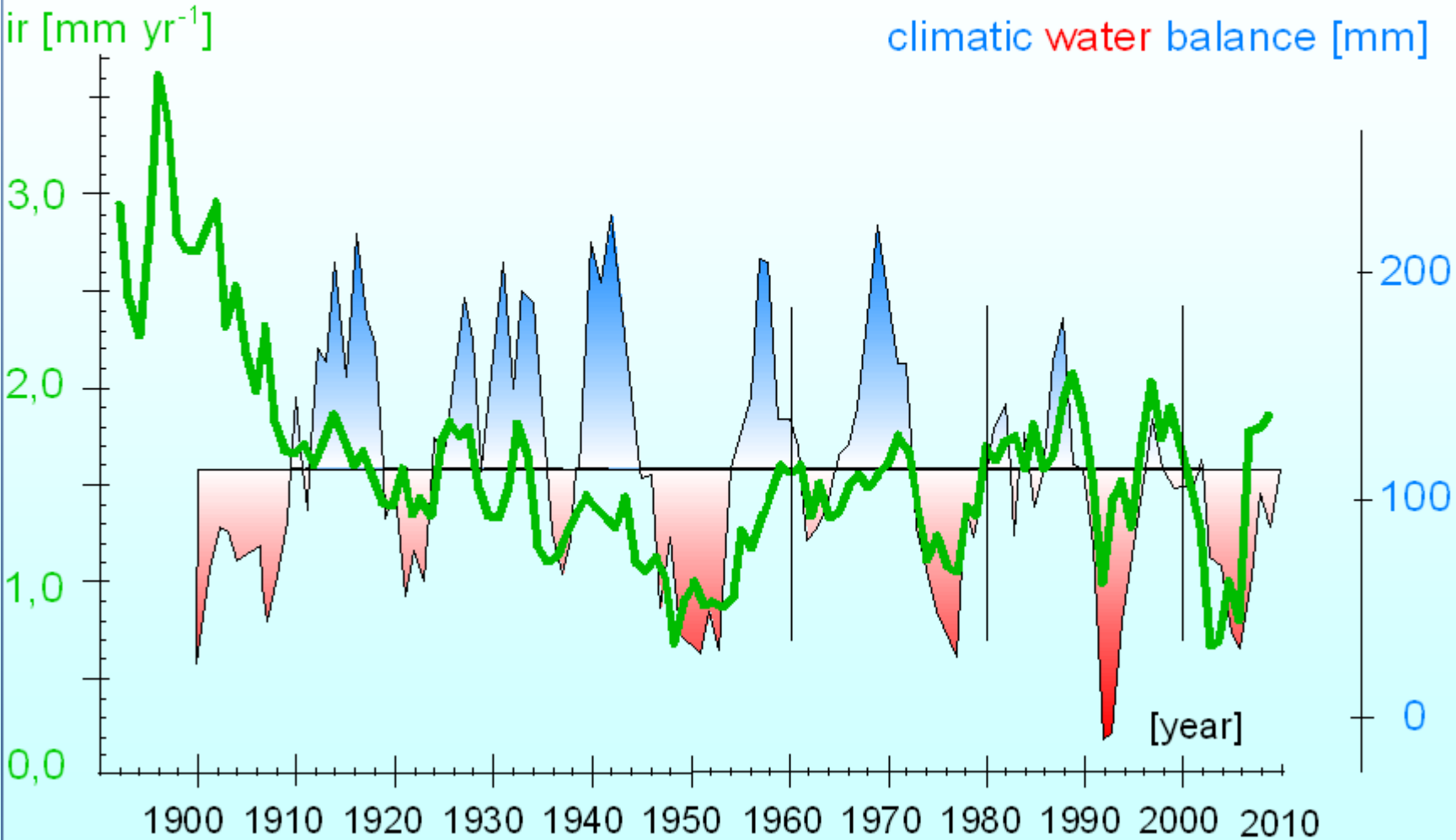






climatic water balance: vegetation period May – Sept.





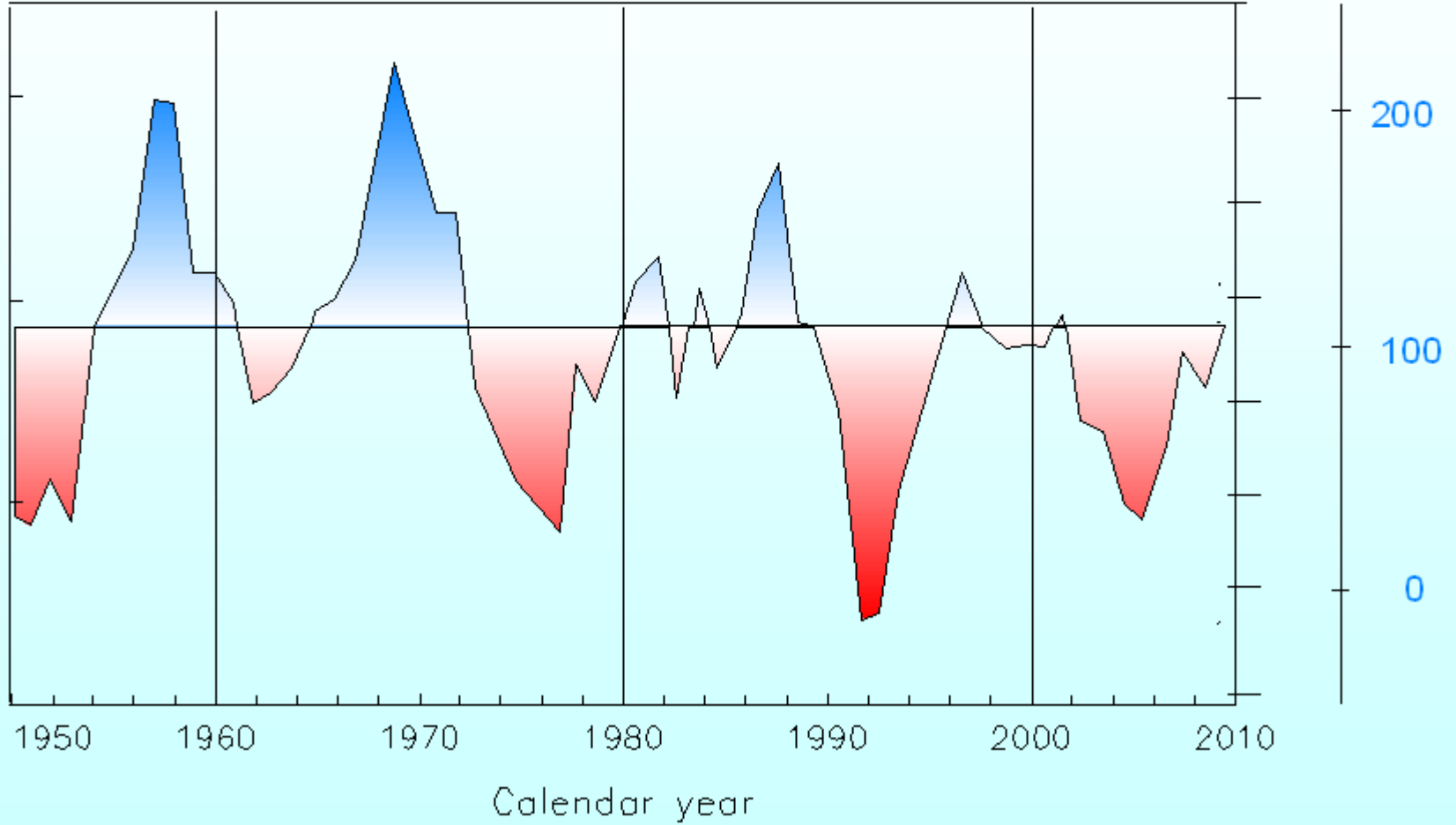


climatic water balance

running average of the last 5 years



Climatic water balance [mm]



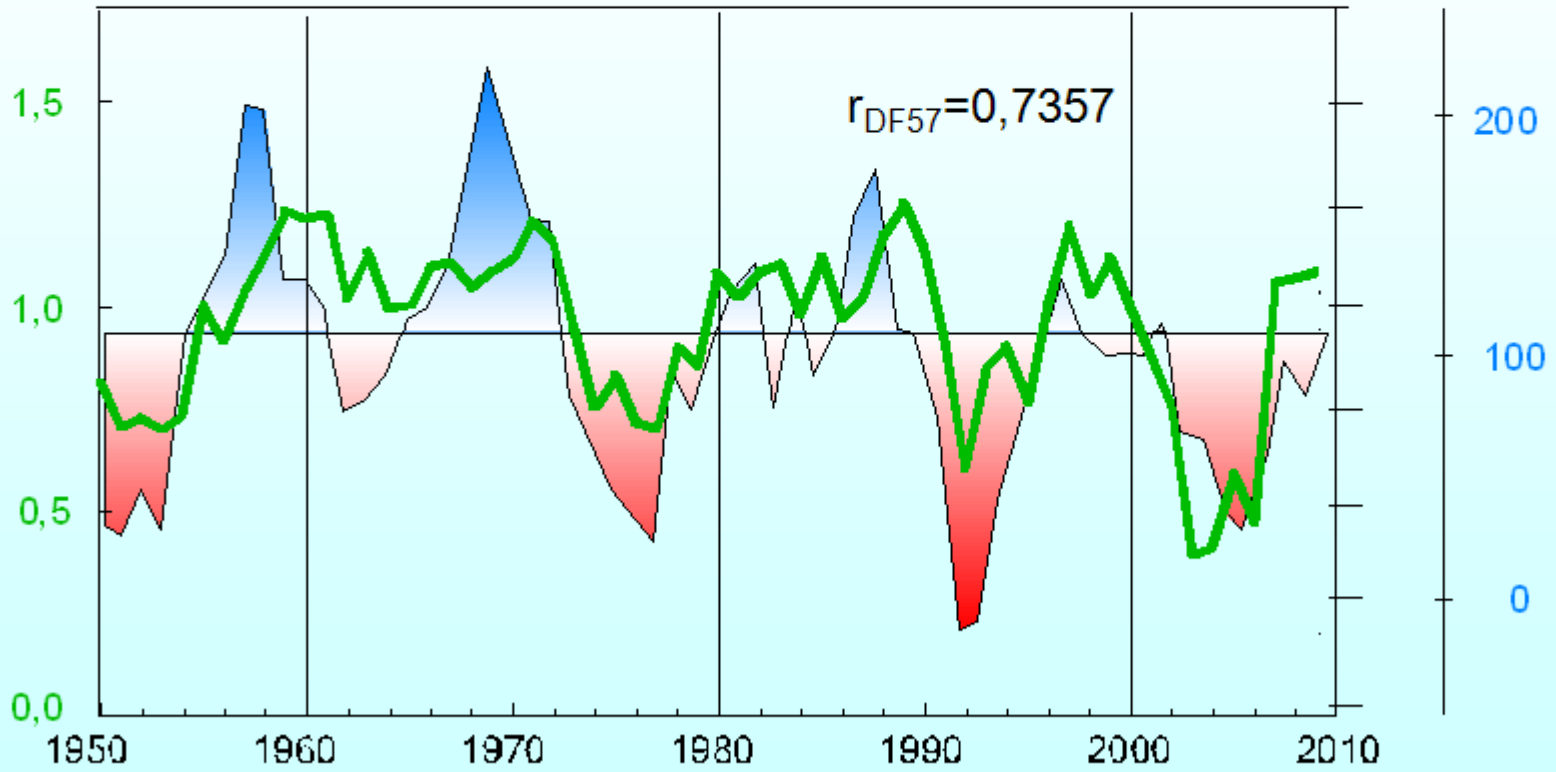


growth and climatic water balance



ir -index

Climatic water balance [mm]



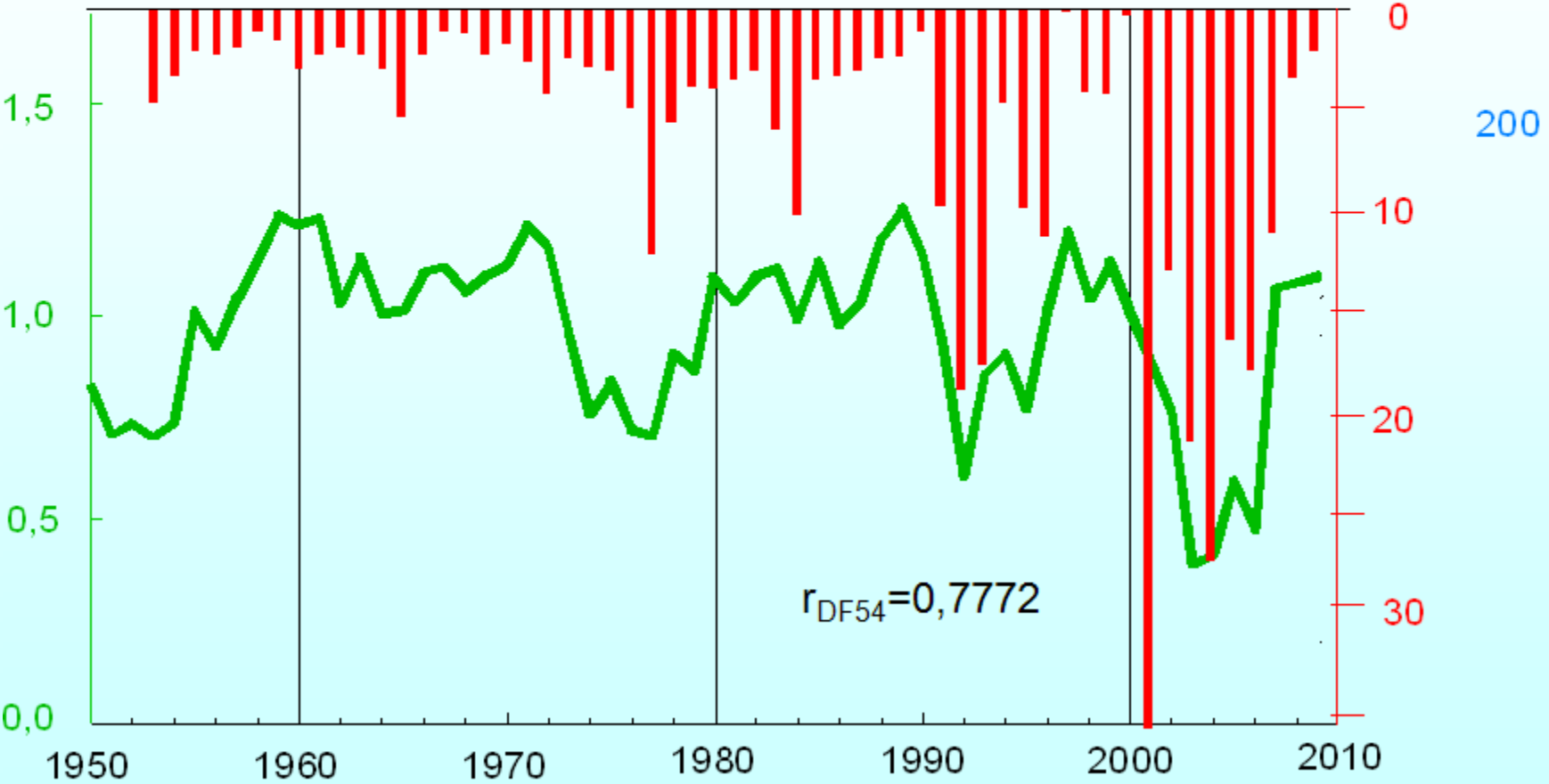


growth and mortality



ir -index

mortality %





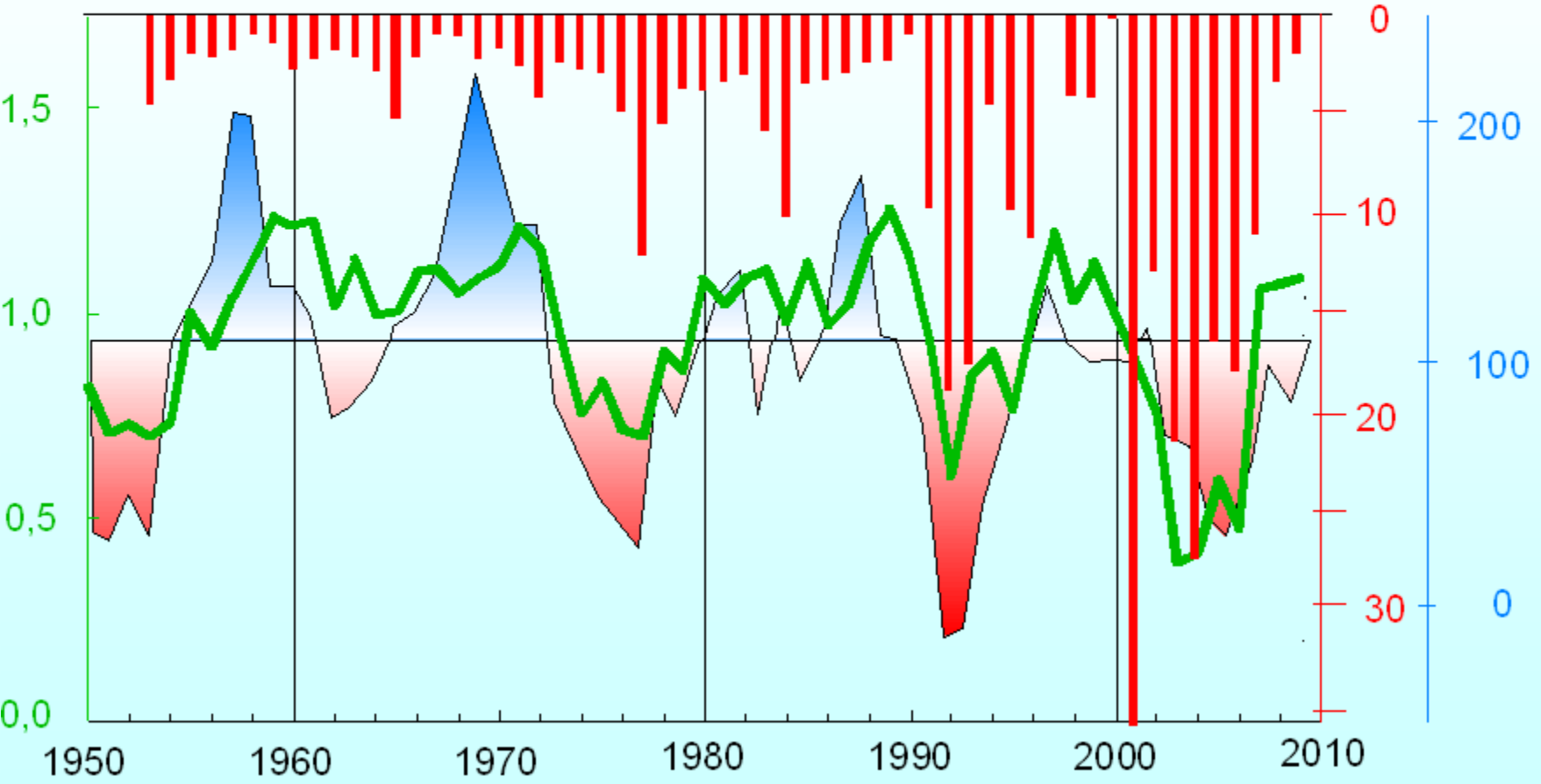
growth, mortality and climatic water balance



ir -index

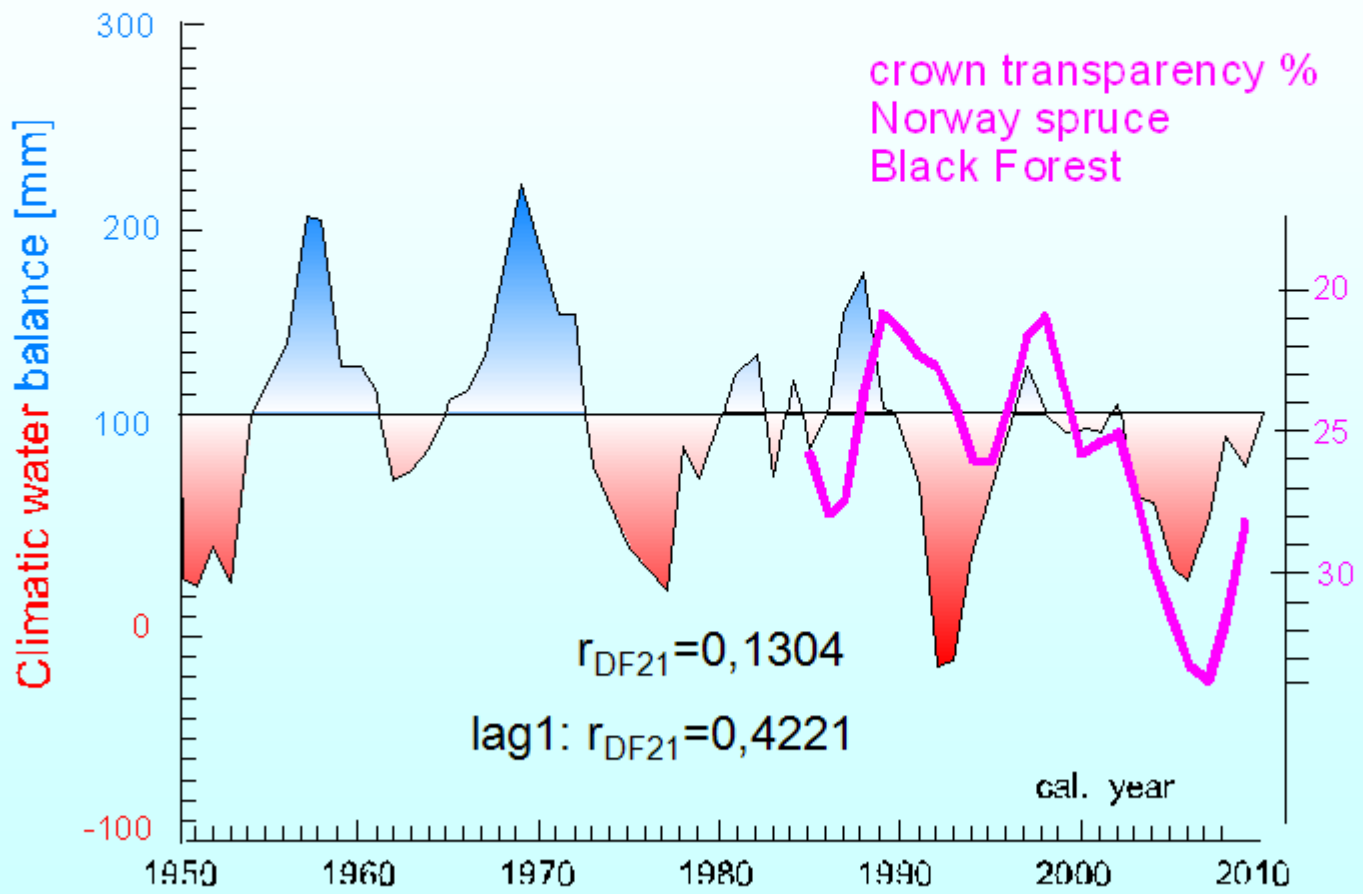
Climatic water balance [mm]

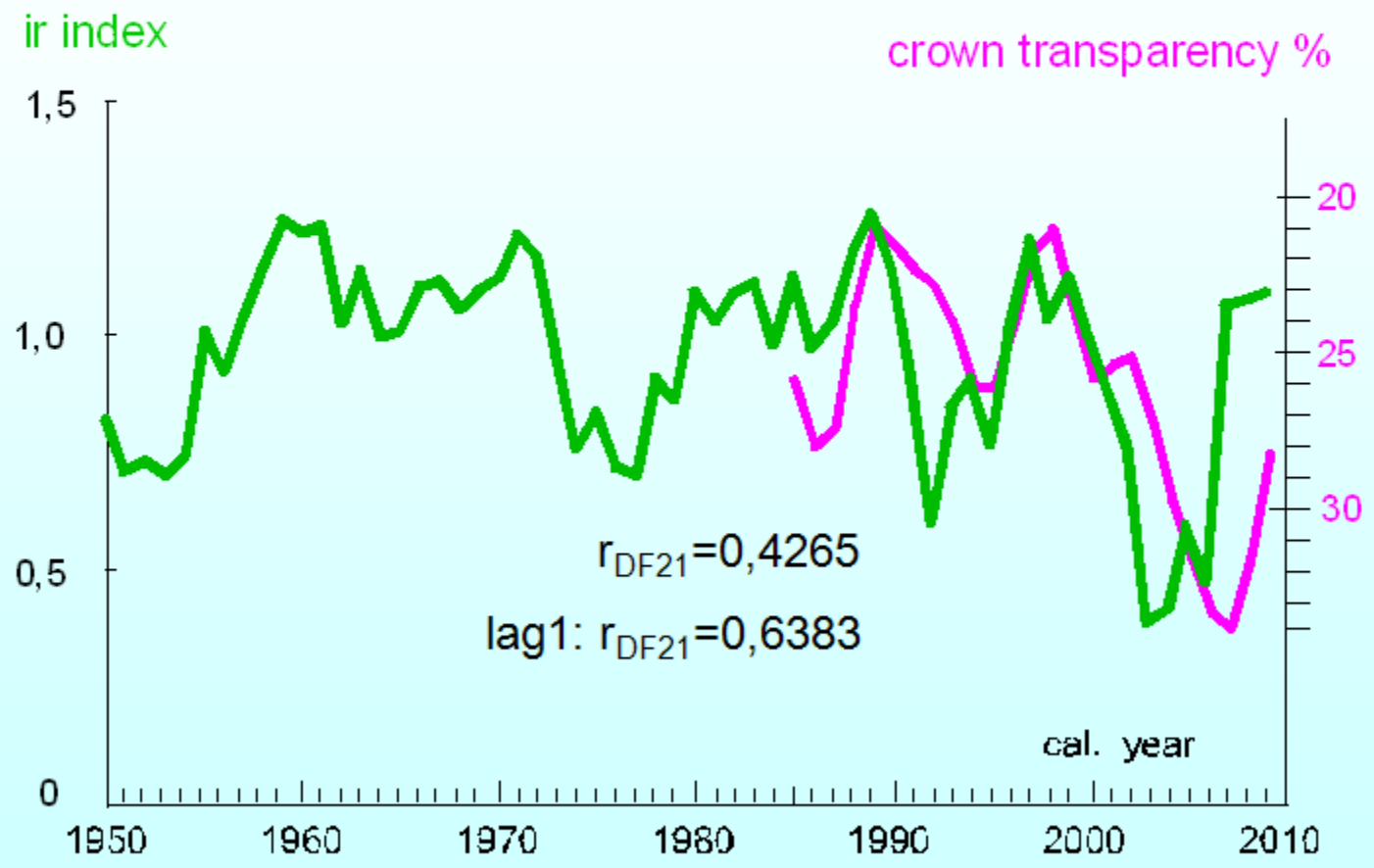
mortality %





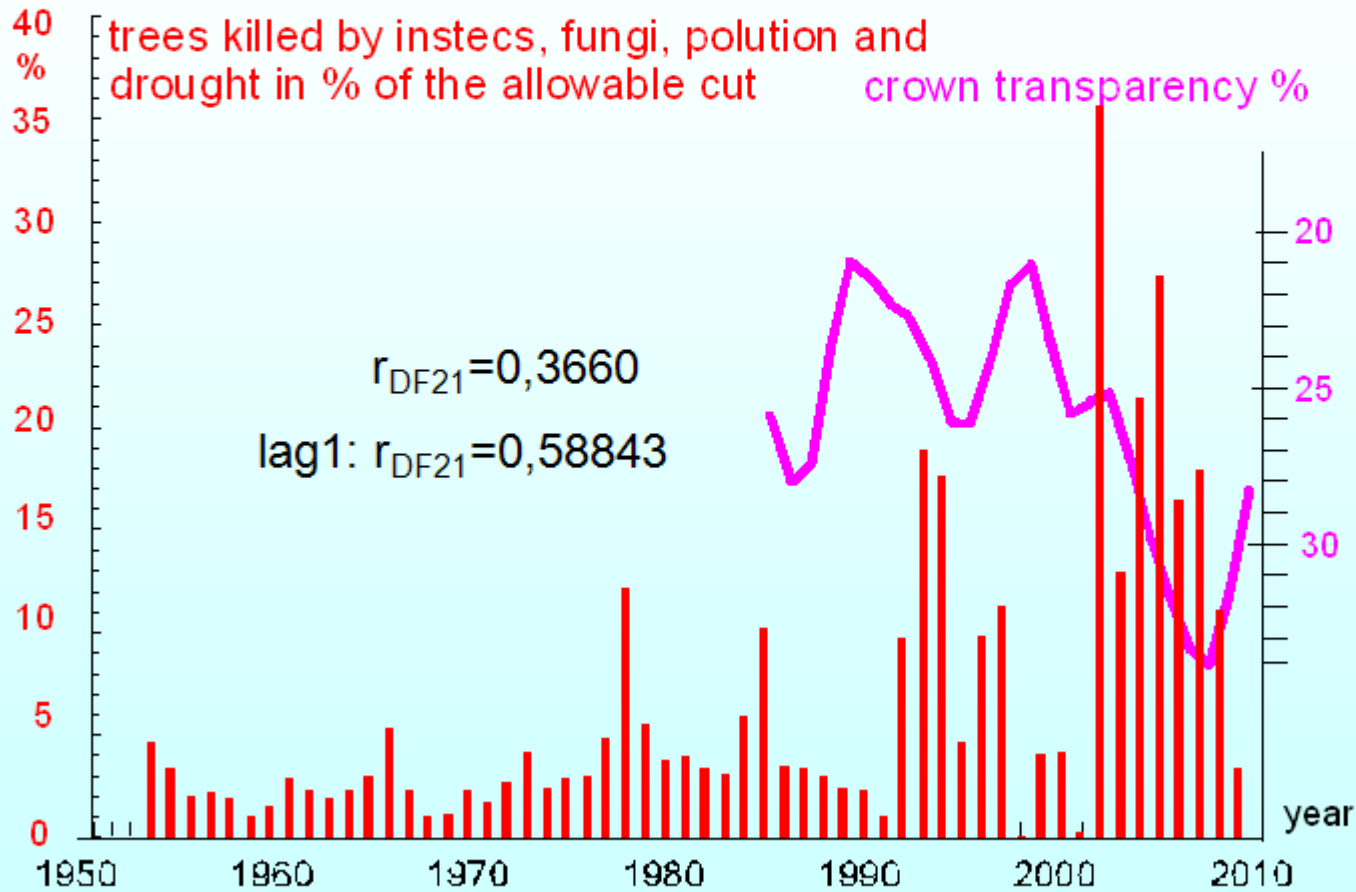
climatic water balance and crown transparency







crown transparency and mortality





The **climatic water balance** has been a driving factor for:

- radial growth
- mortality
and
- crown transparency

Between these 4 parameters exists a close correlation!



Short- and medium-term growth variation can be explained to a large extent by the variation of the climatic water balance. It is important to distinguish between these variations and long-term trends.

The long-term trend of increasing productivity of many sites in Europe during the last 50 years may have been caused by other factors e.g. nitrogen deposition (see: Kahle et al. 2008).



The forest decline observed in the years 1976-1985 in the Black Forest was less severe than in other years before and after the discussion of the “Waldsterben”.

The occurrence of mortality in this period can be explained to a large extent by the climatic water balance.



Thank you for your attention!



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