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Modeling crop overwintering

Focus on survival

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Modelling of crop survival

Air temperature, snow cover



Crown temperature

detailed models of
snow dynamics vs.

semi-empirical models



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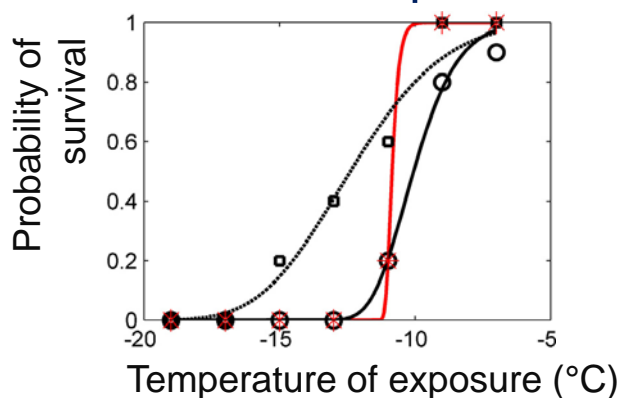
Acclimation and deacclimation

Crop tolerable temperature
generally expressed as temperature
lethal for 50% of the individuals, LT50
(e.g., Fowler 1999, Le Comte 2003, Bergjord
et al. 2008)

Low temperature damage



Within-crop variability in response

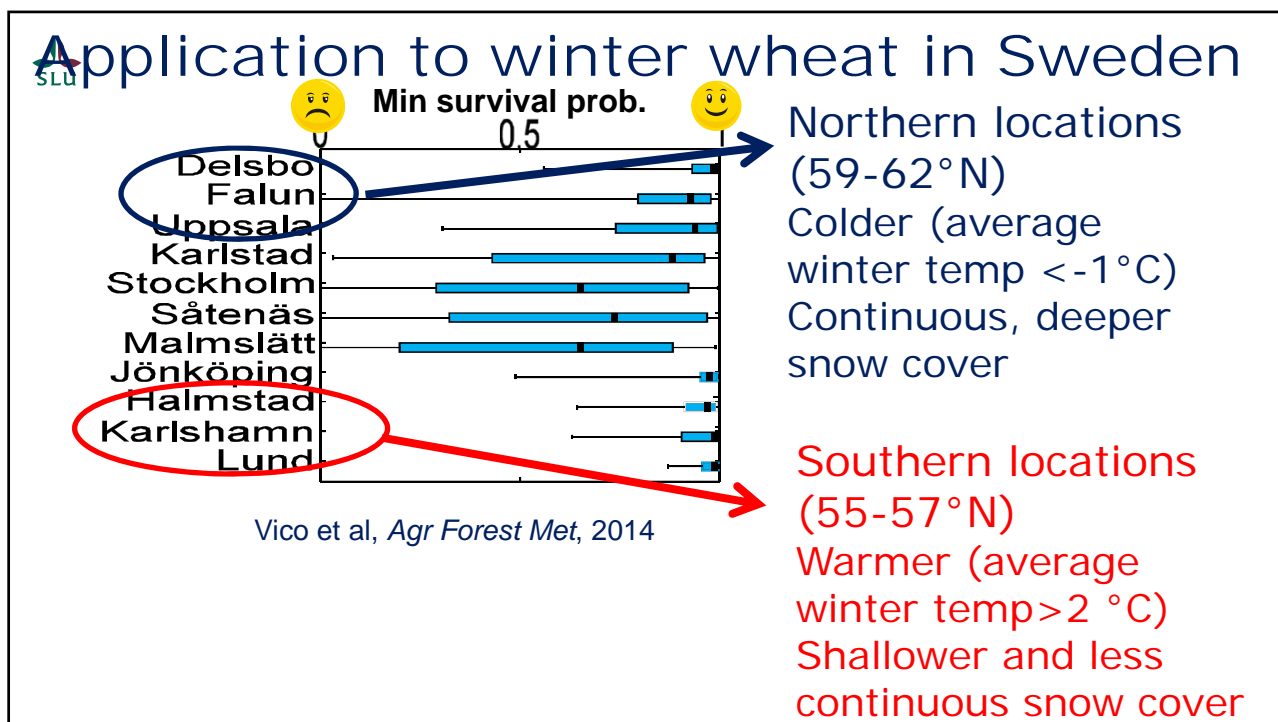
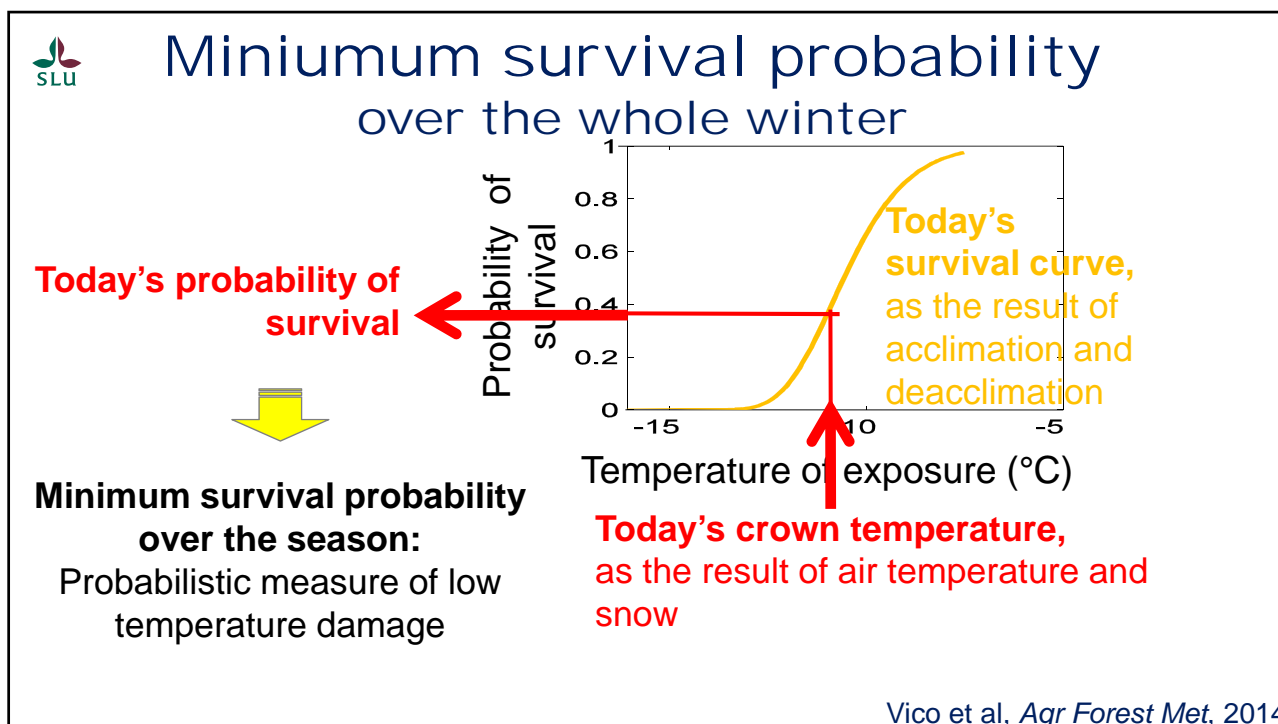


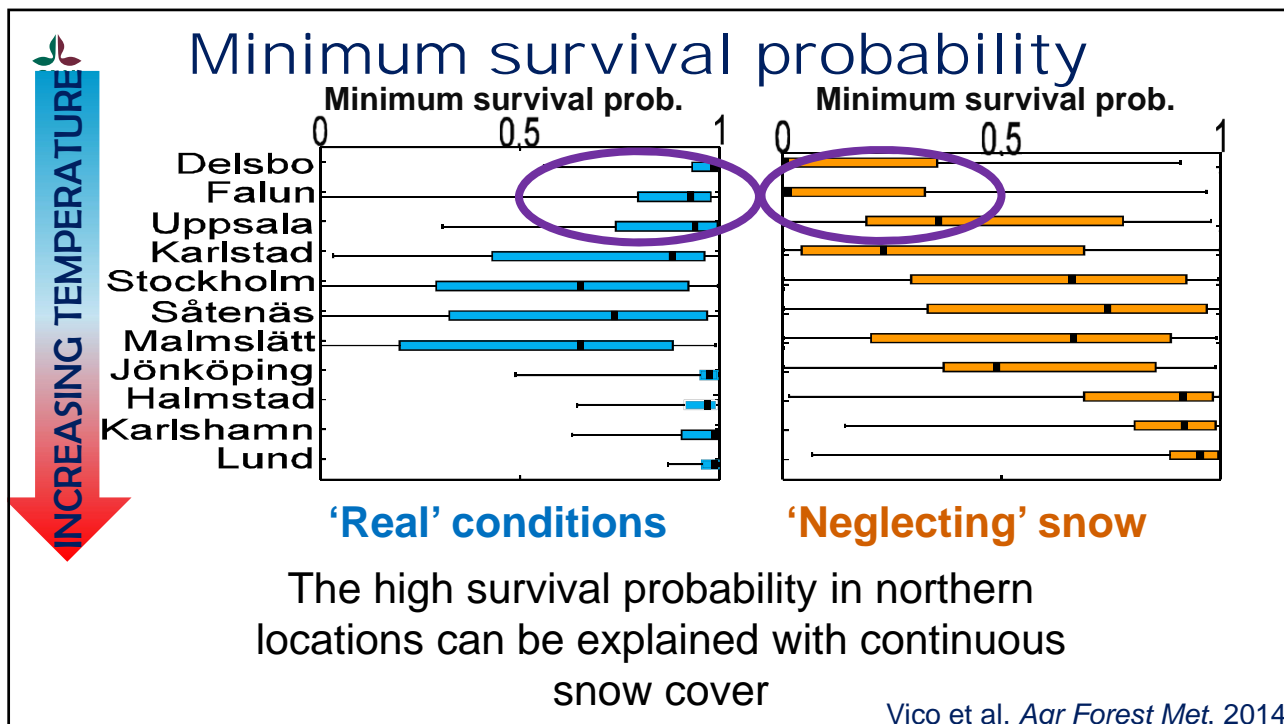
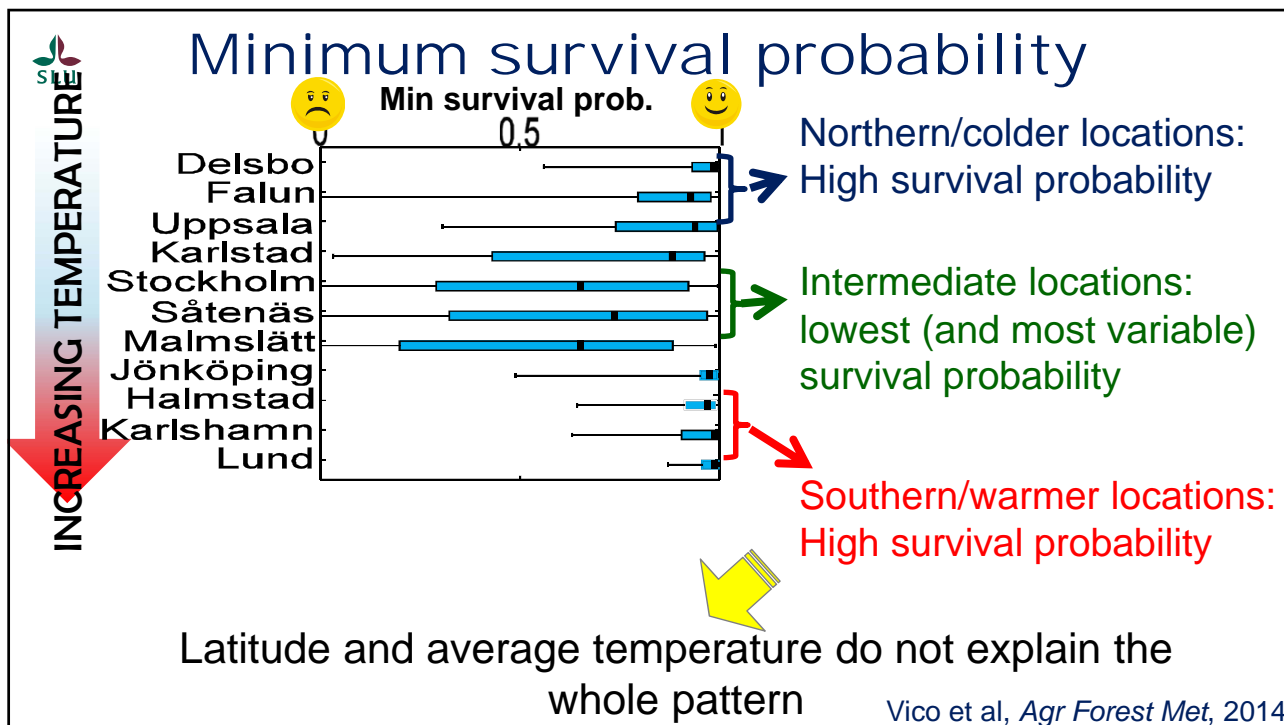
Vico et al, *Agr Forest Met*, 2014

Regrowth tests show that crop
response to low temperature is **not**
threshold like

Reconstruct the fraction of surviving
plants, by including the shape of the
survival curve

Obtain practical information
e.g. under which conditions 10% of
the plants are lethally damaged







Snow manipulation experiment



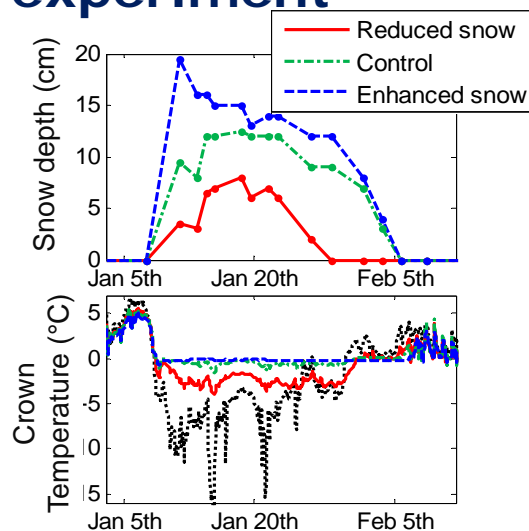
- Ultuna, Winters 2013-2014, 2014-2015
- Two winter wheat varieties: Olivin and Björka
- Snow treatments: 'ambient', 'reduced'
- Three harvests: late fall, early spring, late spring
- Continuous measurements: soil temperature, snow depth



Snow manipulation experiment

EFFECT ON GROWING CONDITIONS

Snow manipulation created different growing conditions (when snow was present)





Snow manipulation experiment

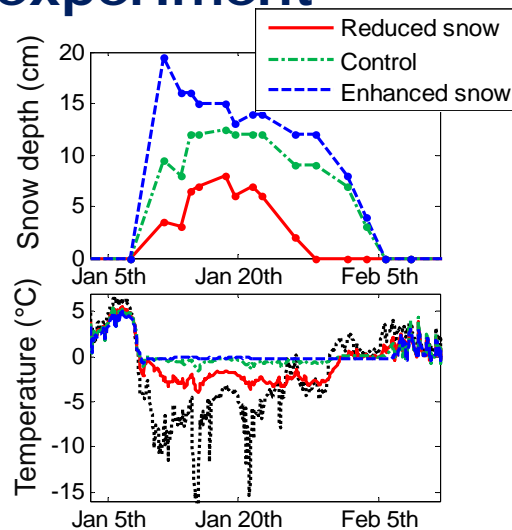
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EFFECT ON WINTER WHEAT

In 2013-2014, no significant effect of snow treatment or variety on

- survival rate
- plant biomass and early vigor



Conclusions and implications

Snow plays a crucial role on

- crop sensed temperature
- acclimation and deacclimation
- survival



Effect of climate change may be positive or negative depending on the interplay between air temperature and snow

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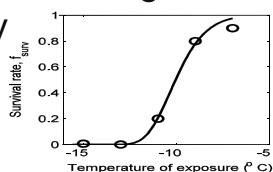
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The shape of the probability of survival curve impacts the extent of lethal damage in a complex way



This aspect must be considered to

- determine the survival rate
- assess if a change in variety can offset the effects of climate change



Combine survival with plant resource storage and spring vigor

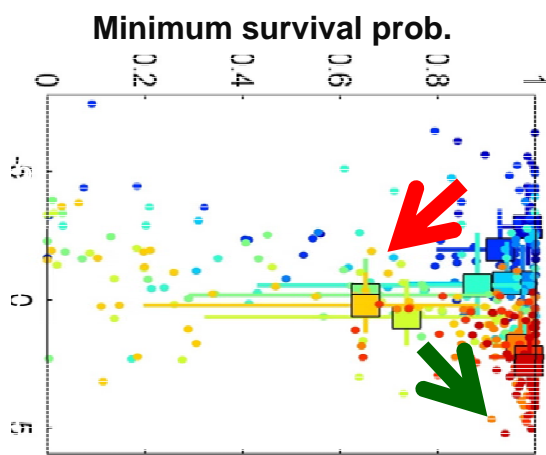
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EFFECT OF CLIMATE CHANGE

'Space x time' substitution

Mean winter average daily temp. (°C)



The same increase in temperature...

enhances risk of winter damage in currently colder locations

reduces risk of winter damage in warmer location (where snow is already insufficient)