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## Climate change impact on crop pest – case study Colorado potato beetle

Research for future potato production and consumption  
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## Colorado Potato Beetle (CPB), *Leptinotarsa decemlineata* Say

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- Both *larvae* and *adults* feed on foliage and if left without countermeasures, complete defoliation of plants may occur



Life stages of Colorado potato beetle photographs:

- by D.Cappaert, Michigan State University
- by J.Castner, University of Florida
- by L.J.Buss, University of Florida



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- **Temperature dependent life cycle**



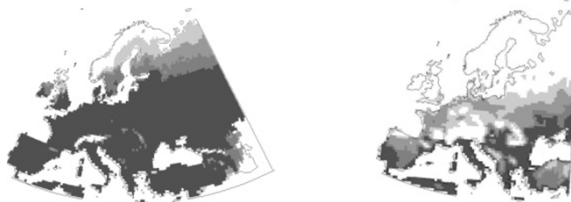
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One generation

Two generations



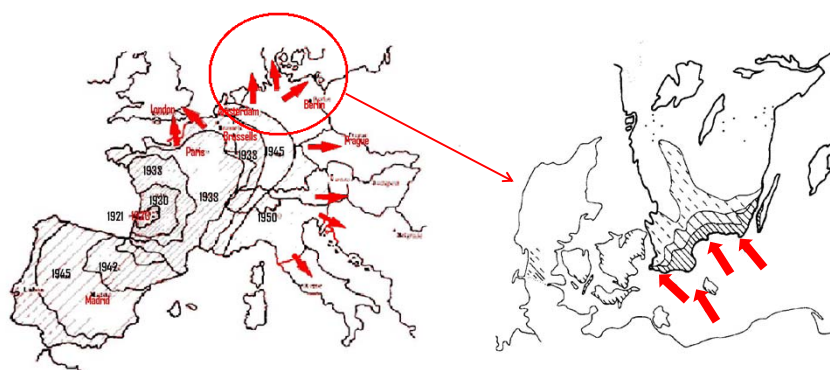
Number of years during 1975-2000

GCB (2013) 19, 1043-1055



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## CPB migration



Agricultural insect pests of the tropics and their control By Dennis S. Hill (1975)

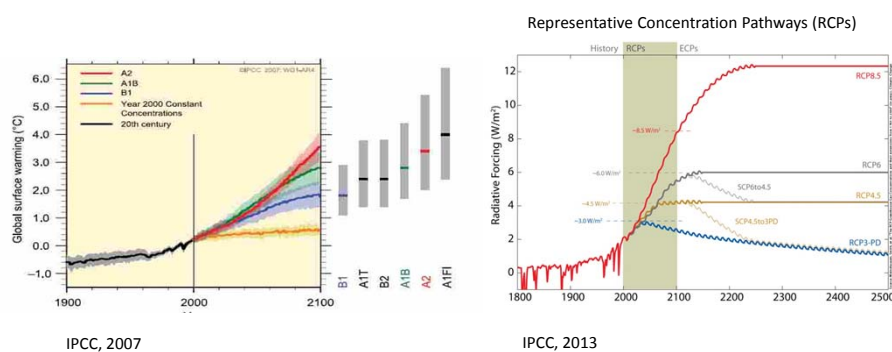
Gränso G. (1980) Control measures towards colorado beetle eradication in Sweden. *EPPD Bulletin*, 10, 499-505.



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## Climate Change

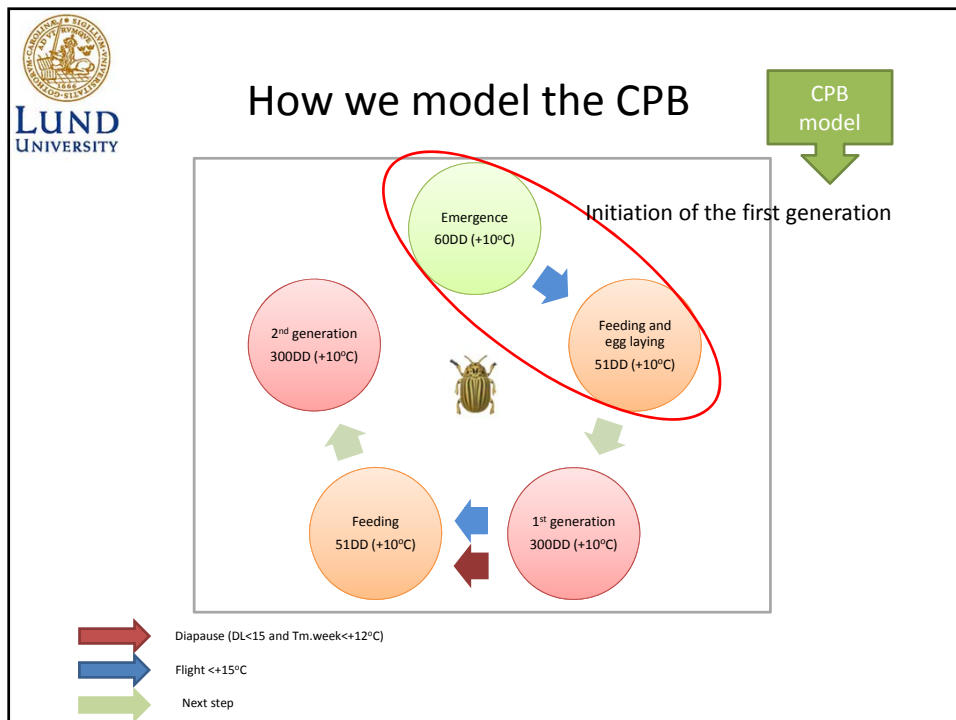
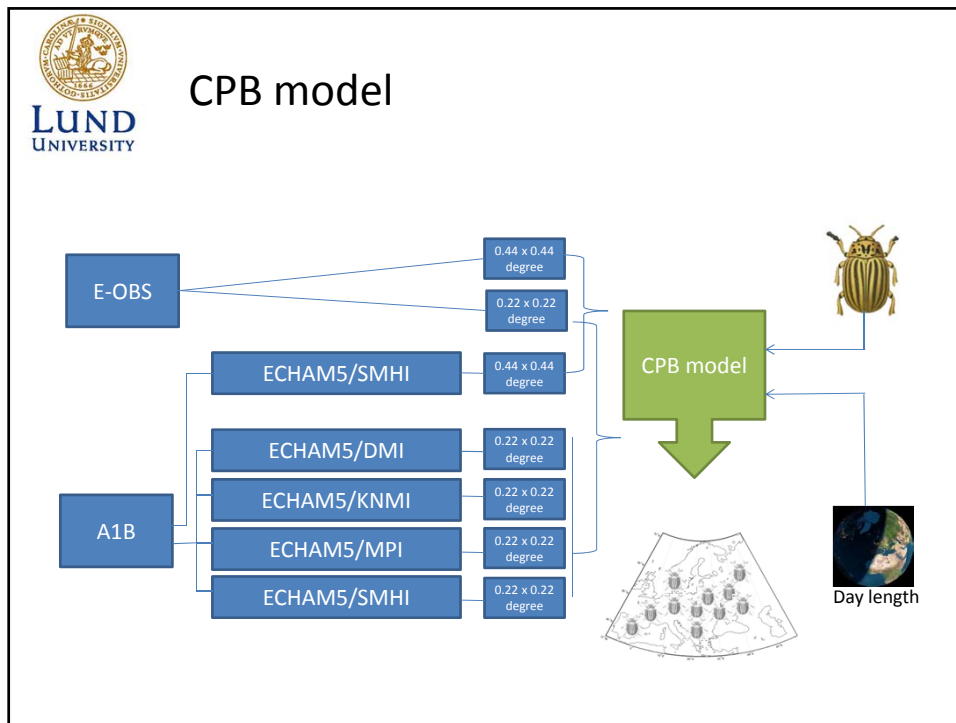
- A future temperature rise may have severe impacts on the functioning of North European agricultural ecosystems. For example, as the European northern latitudes are getting warmer, agricultural crops may be increasingly exposed to attacks by temperature dependent insect pests.



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## Aim

- The aim of this project was to estimate the climate change impact on the Colorado potato beetle by assessing:
  - initiation of the first generation
  - completed development of the first and second generation
  - potential distribution
- Two complementary measures
  - Timing (day of the year)
  - Frequency (how many years)





# How we model the CPB

## Degree Day Calculation

Day (DOY)	Temperature °C	Developmental Threshold (D.T.)	Degree Day (DD)
1	9	10	0
2	10	10	0
3	12	10	2
4	15	10	5
<b>Total</b>			<b>7</b>



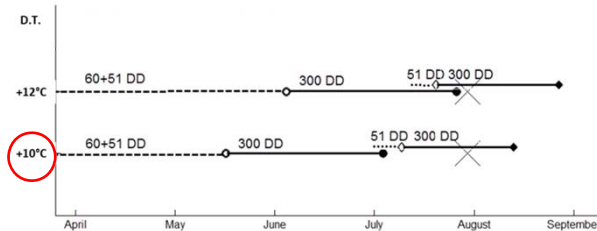
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## Degree Day Calculation

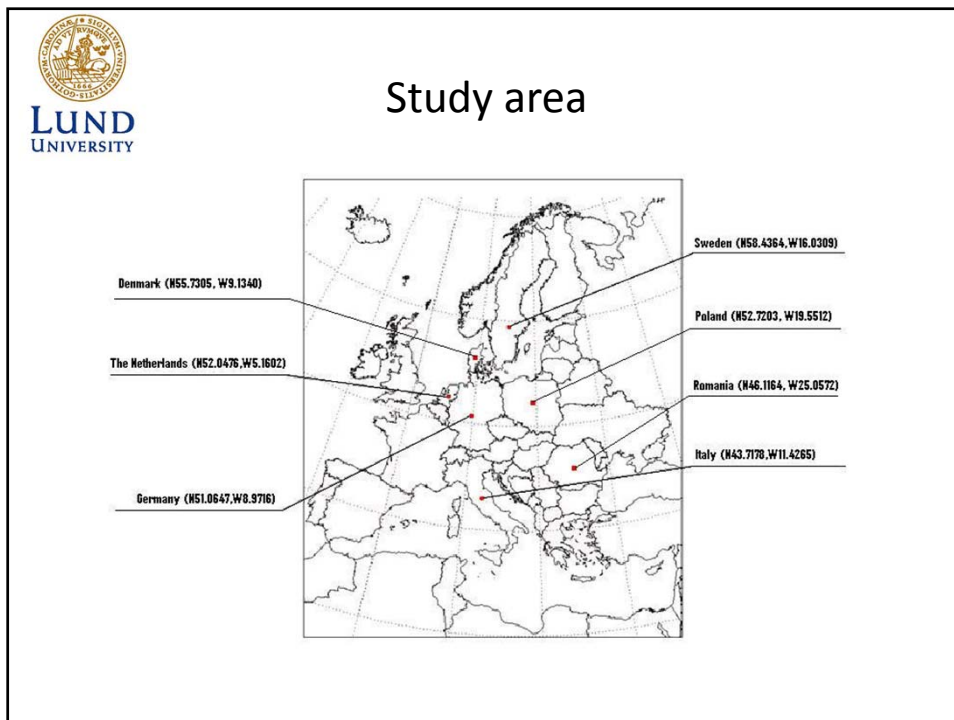
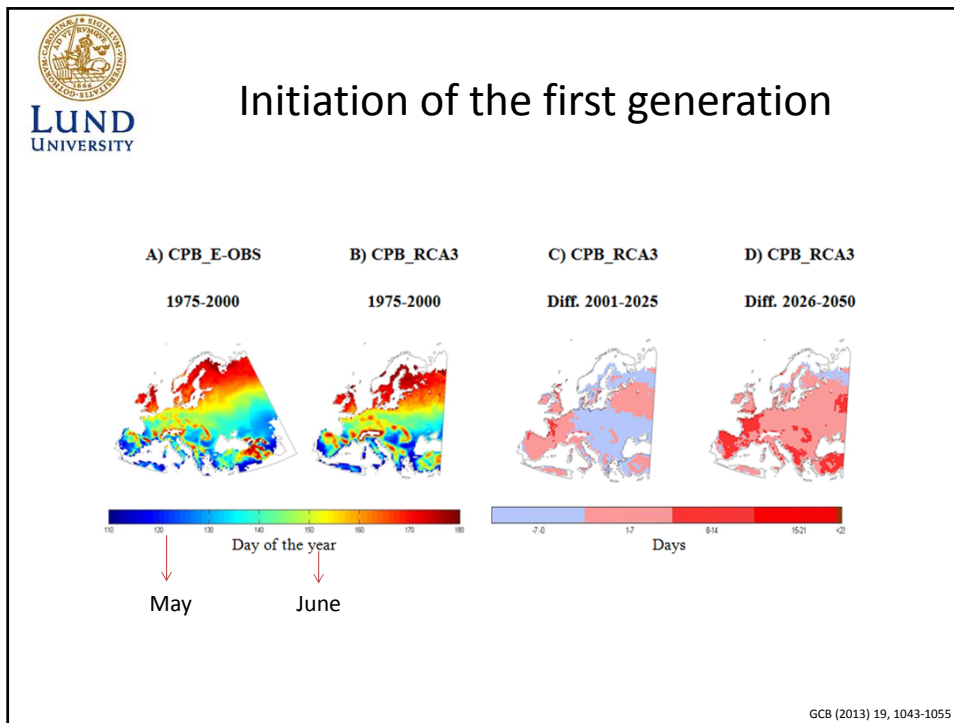
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### Sensitivity analysis

Two temperature thresholds (+10°C, +12°C)



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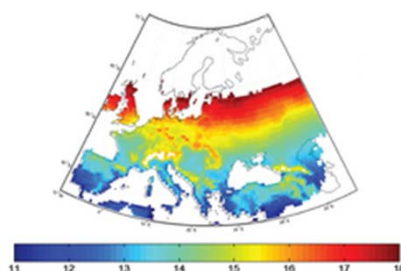


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## Diapause initiation

The maps show the day length of the earliest day during late summer in 1961–1990 when the thermal sum for the rest of the year was just sufficient for development of a new generation up to the stage able to survive winter.

Developmental threshold +10 °C



Day length (h)

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## Conclusions

- This study indicated that a warmer climate will increase the risk of a northward spread of the Colorado potato beetle.
- Areas within the current distribution limits may experience an additional generation per year.
- Earlier planting may help to control establishment of permanent population, i.e. countermeasure planning
- The model projection are influenced by parameter settings and uncertainties associated with climate modelling.



