



To what extent can silviculture drive adaptability to changes in disturbance regimes ?

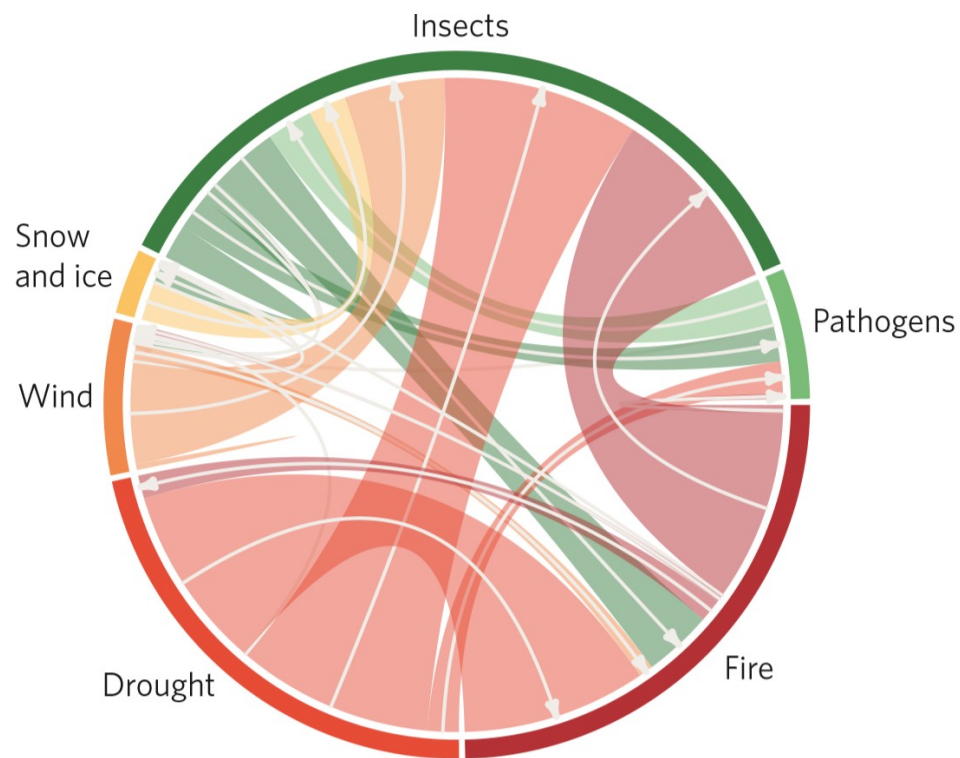
Formalizing a disturbance impact regime for integration into a demo-genetic model

Victor Fririon,

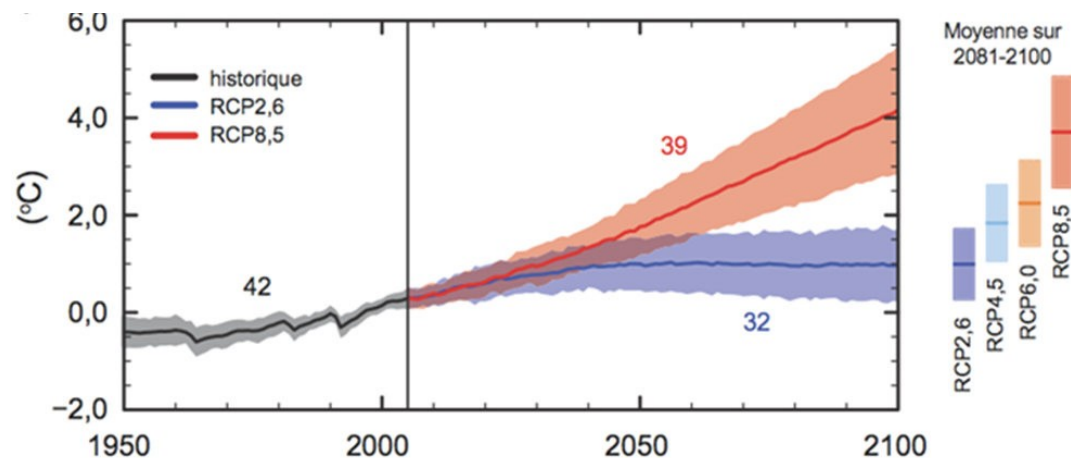
Under the direction of François Lefèvre, Sylvie Muratorio and Hendrik Davi,

URFM – INRAE PACA

A changing world: Risks linked to disturbances regimes changes

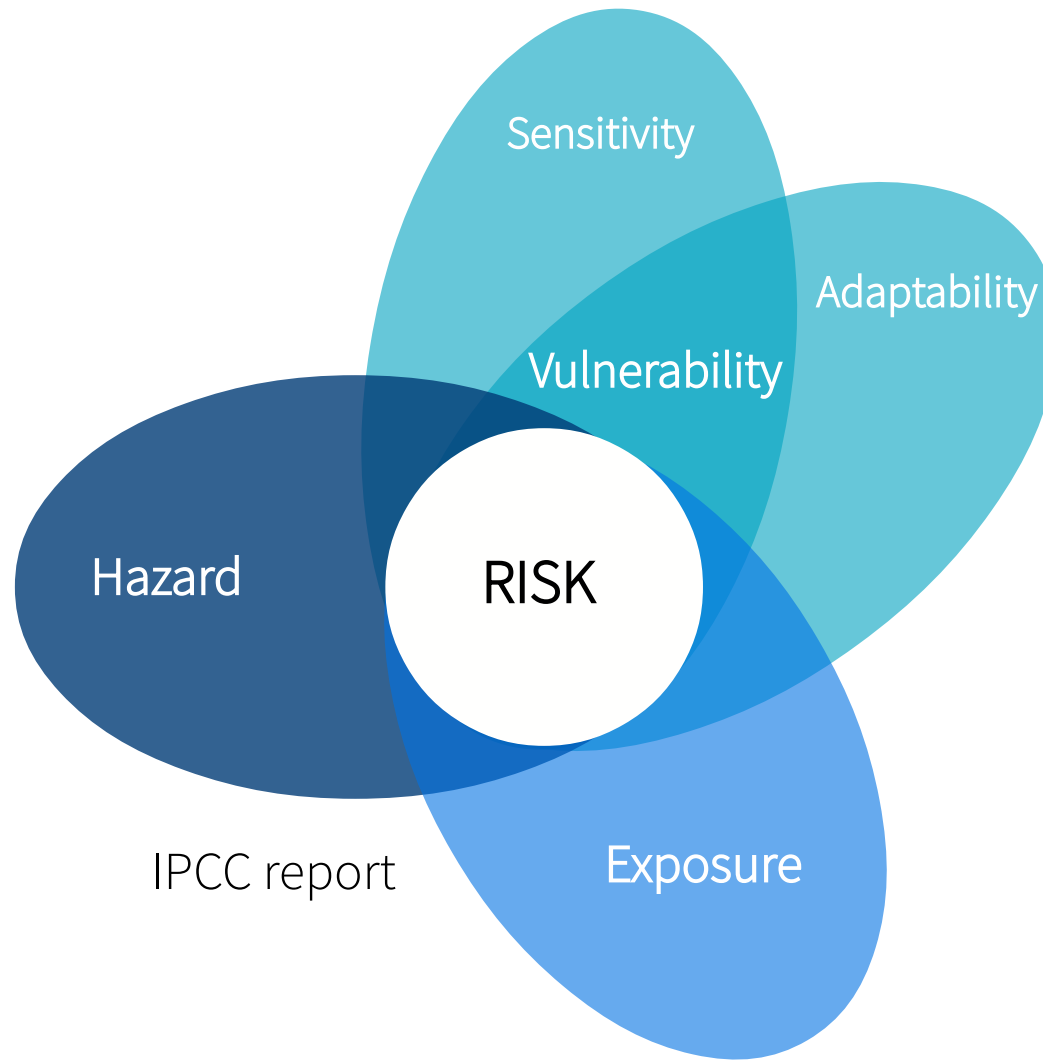


Seidl et al. 2017

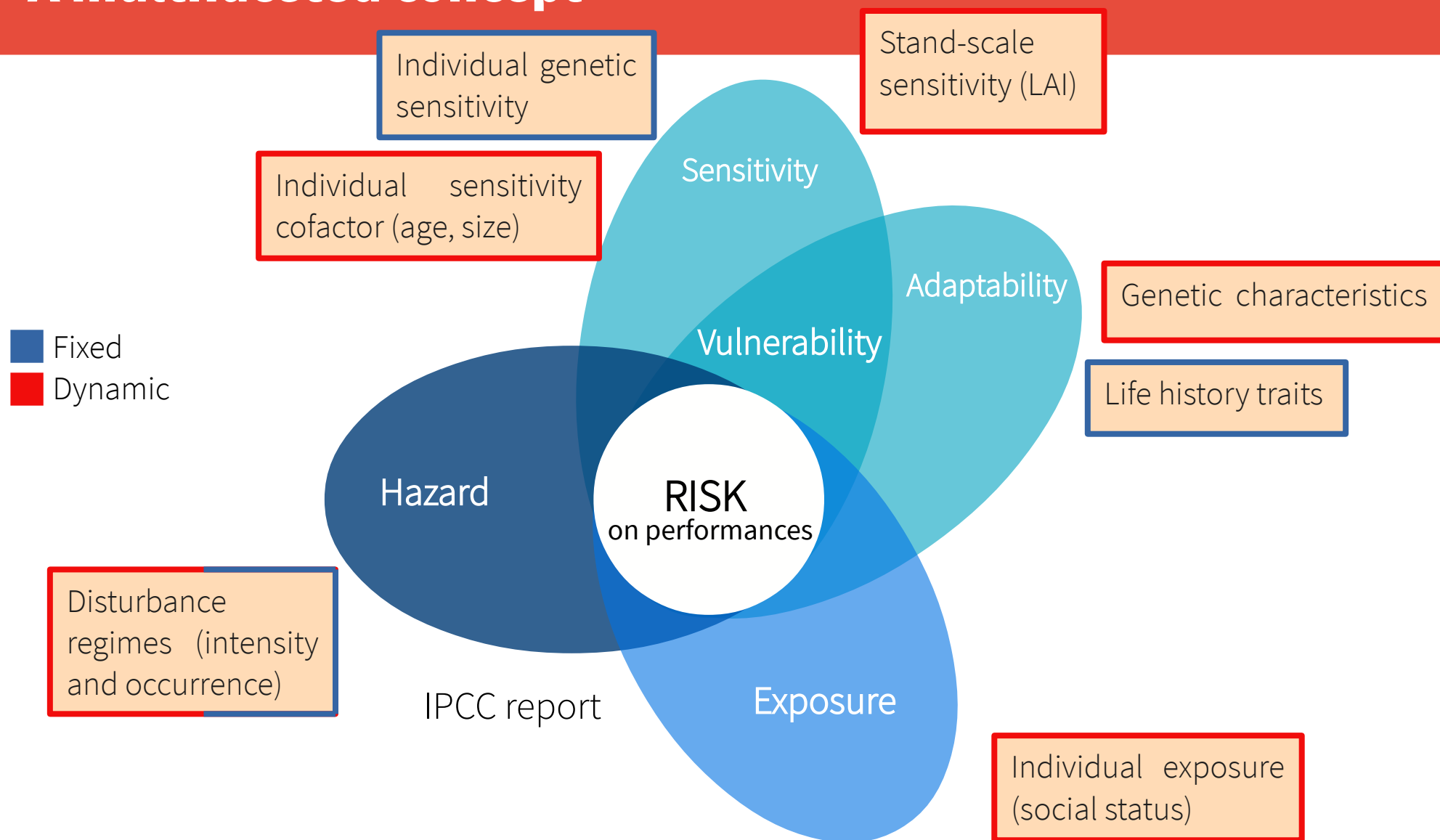


- Changes in disturbances regimes will have major but partially unpredictable impacts.
- Assuming the limits of our knowledge, we have to apply an evolution-oriented forest management.
- There is a risk of demographic and genetic collapse for stands.

The risk: A multifaceted concept



The risk: A multifaceted concept



Objectives

The management × disturbance × genetic interactions

Better understand the effects of the management × disturbances × genetic interactions on the adaptability and performance of stands:

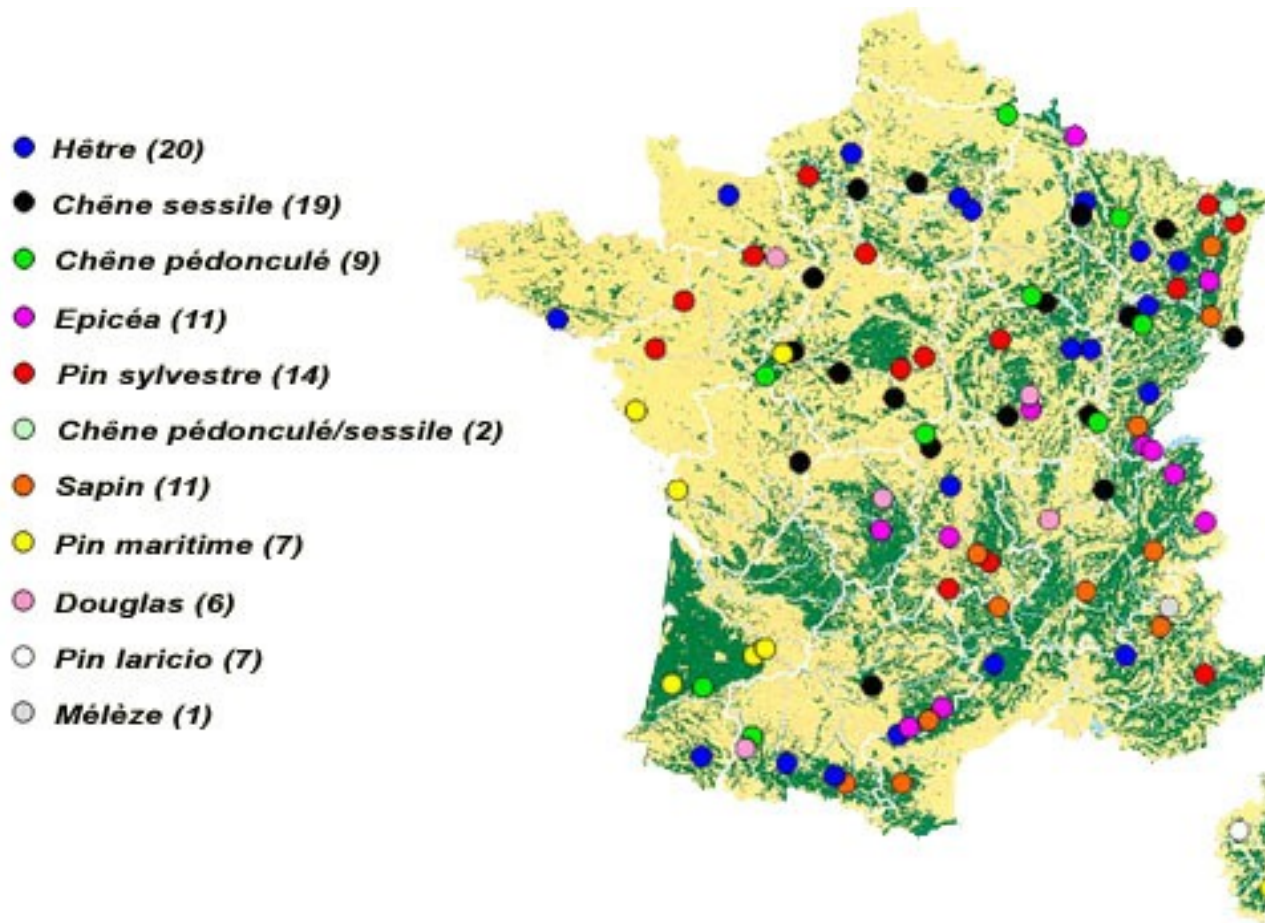
- How to define and quantify each of the risk components?
- How to implement the risk as a demographic impact regime into a demographic model?



Daniel Miller, USDA Forest Service

A Douglas fir study

Datas from Renecofor / ICP Forests

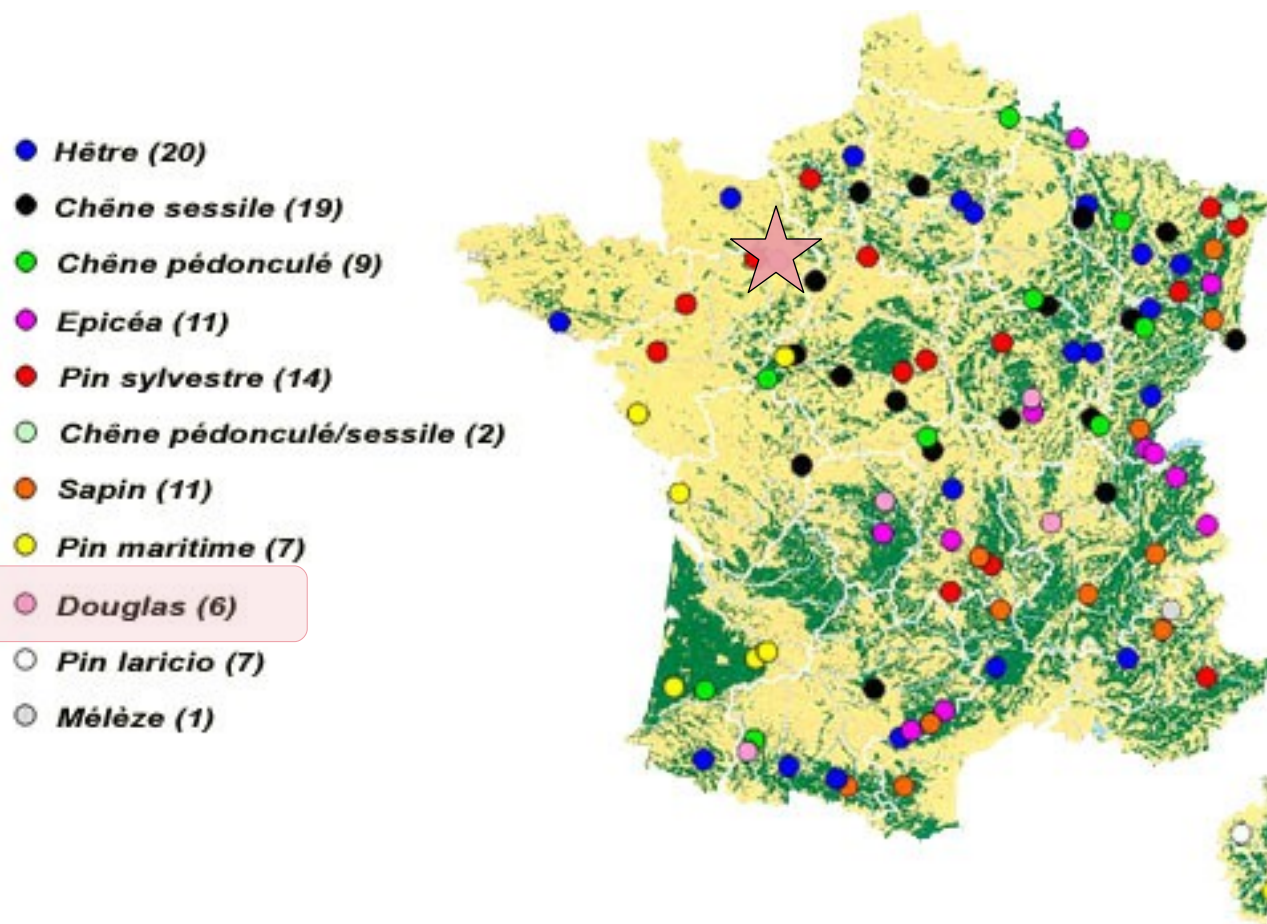


The National Network for long-term monitoring of forests ecosystems :

- Created by the French National Forestry Office (ONF)
- 102 permanent sites where monitoring is planned over at least 30 years.

A Douglas fir study

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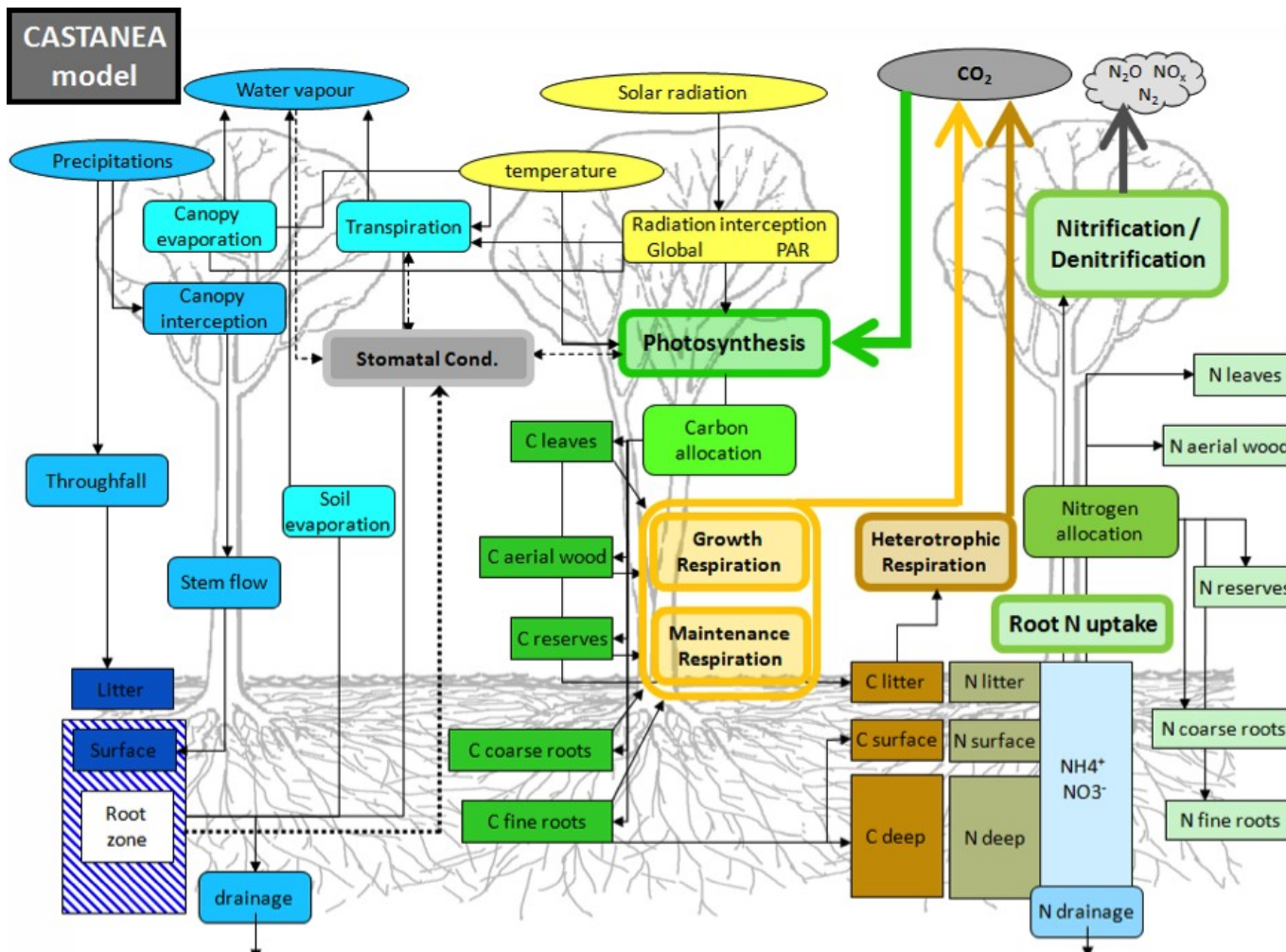


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Impact regime

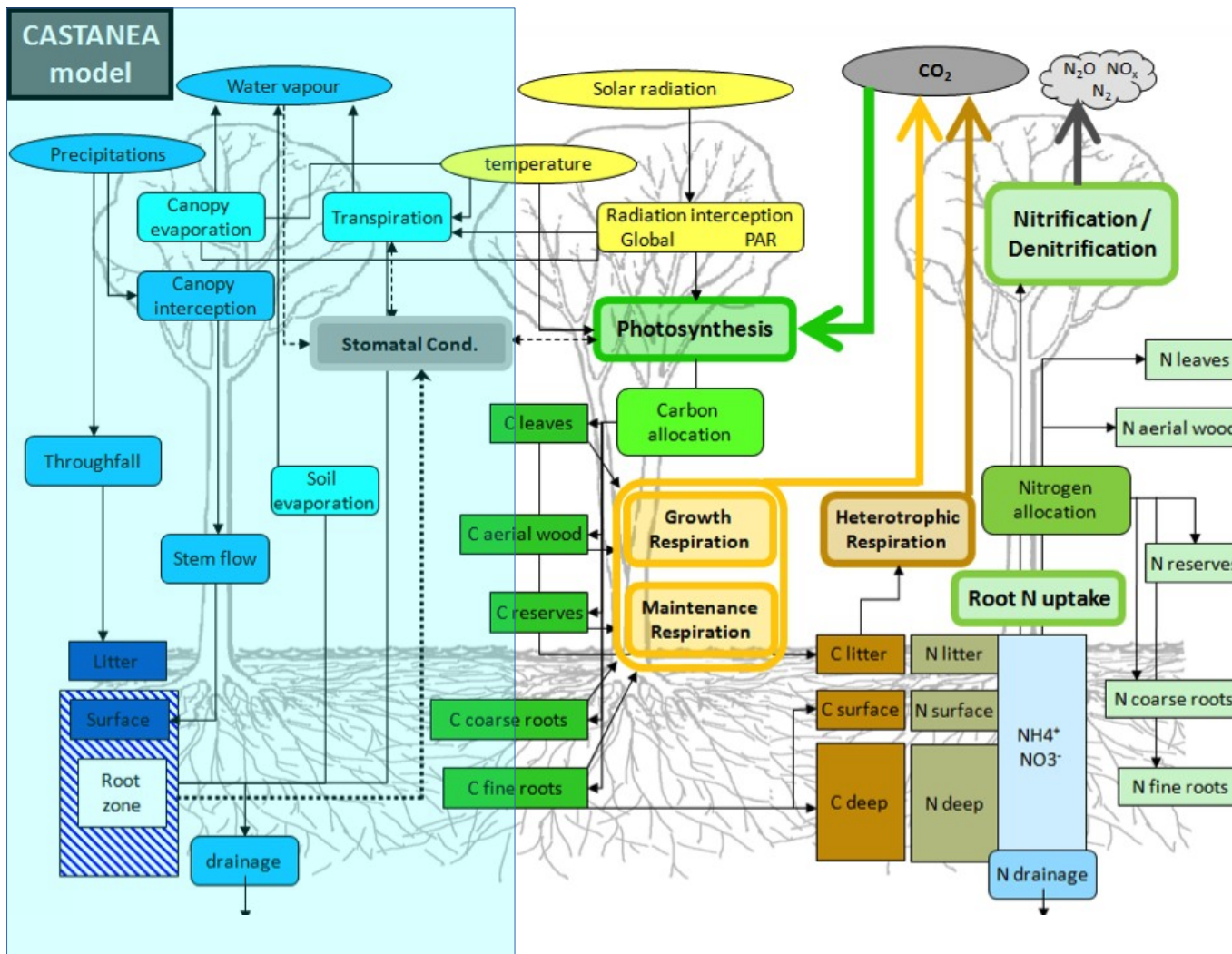
Quantify disturbance regimes and stand-scale sensitivity



How to quantify disturbance regimes? The case of a drought

Impact regime

Quantify disturbance regimes and stand-scale sensitivity

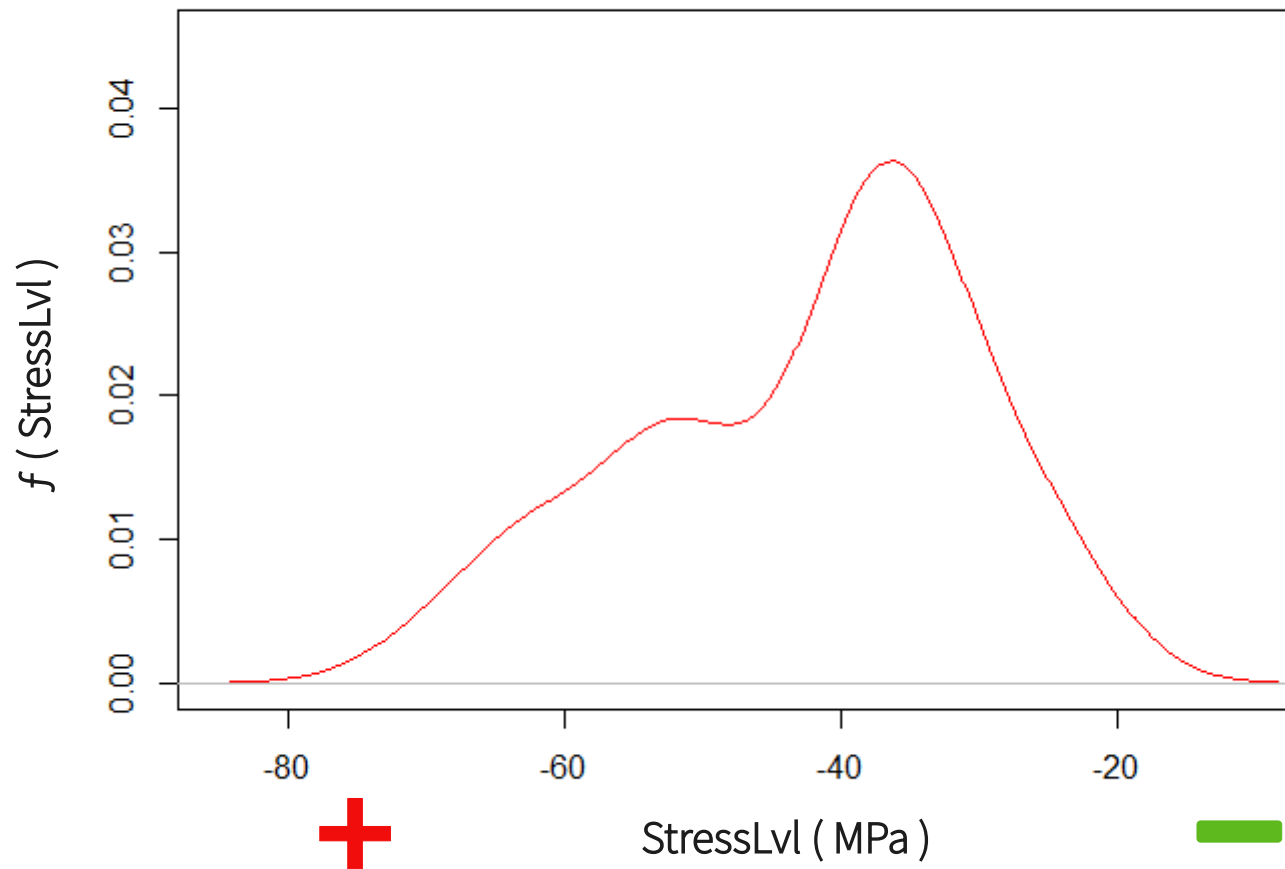


How to quantify disturbance regimes? The case of a drought

- Castanea: a process-based model used to estimate an annual time scale index relative to soil drought: StressLvl (Palmer index)

Impact regime

Quantify disturbance regimes and stand-scale sensitivity

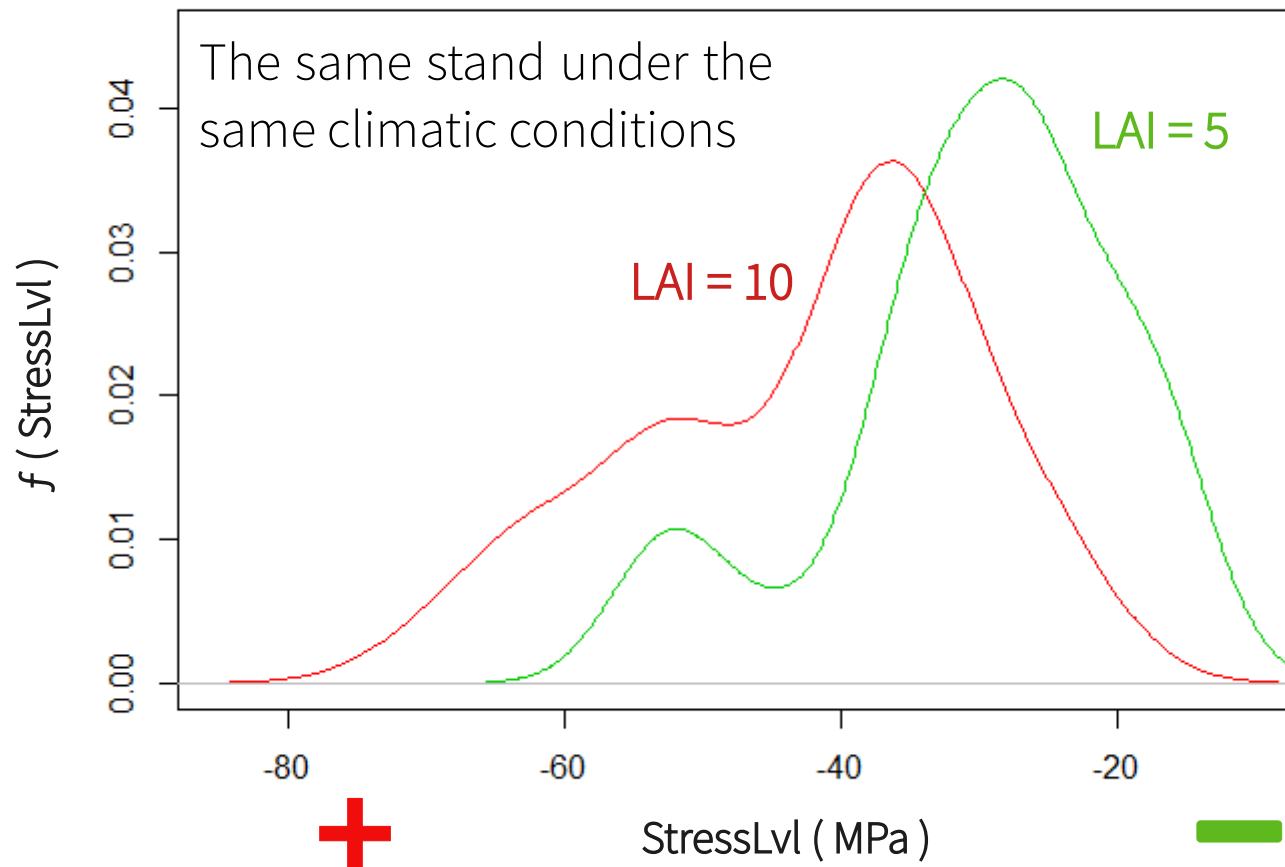


How to quantify disturbance regimes? The case of a drought

- Castanea: a process-based model used to estimate an annual time scale index relative to soil drought: StressLvl (Palmer index)
- A probability density function which can generate disturbance regimes

Impact regime

Quantify disturbance regimes and stand-scale sensitivity



How to quantify disturbance regimes? The case of a drought

- Castanea: a process-based model used to estimate an annual time scale index relative to soil drought: StressLvl (Palmer index)
- A probability density function which can generate disturbance regimes
- An index that integrate stand-level sensitivity which evolve with stand dynamic

Impact regime

Conceptualize traits under genetic control

Constraints for traits under genetic control

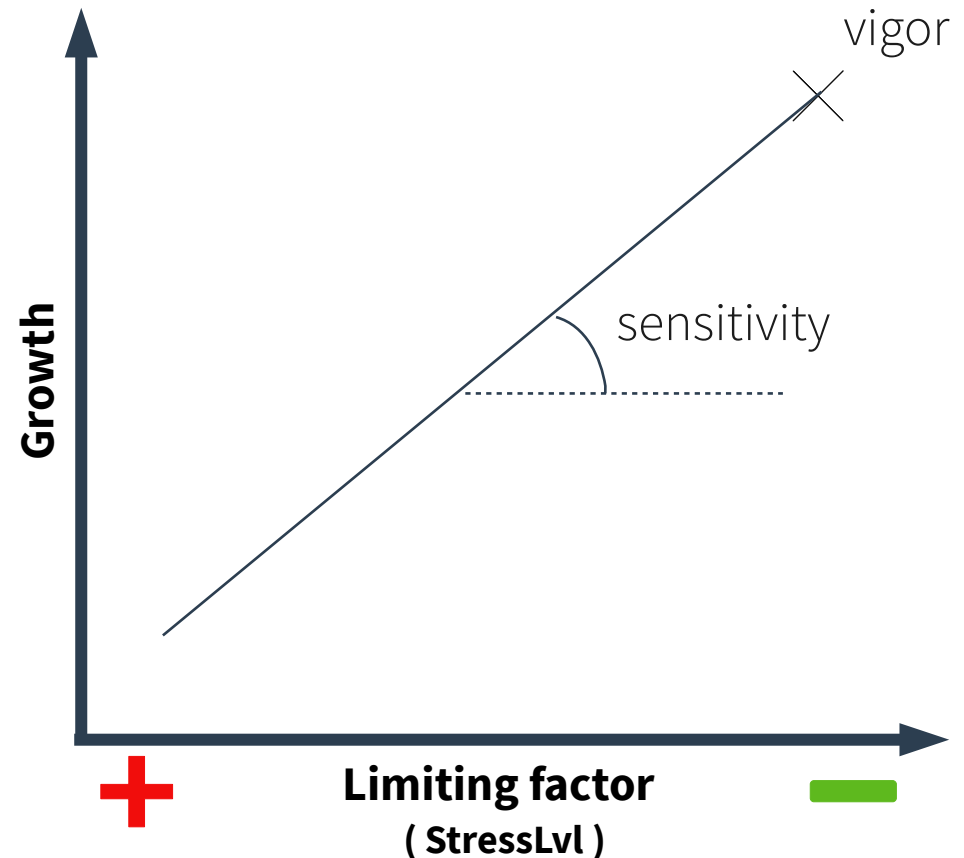
- Conceptualizing a low number of parameters under genetic control
- Parameters fixed and independent of trees size and stand dynamic
- Parameters adapted for an additive implementation of genetic

Impact regime

Conceptualize traits under genetic control

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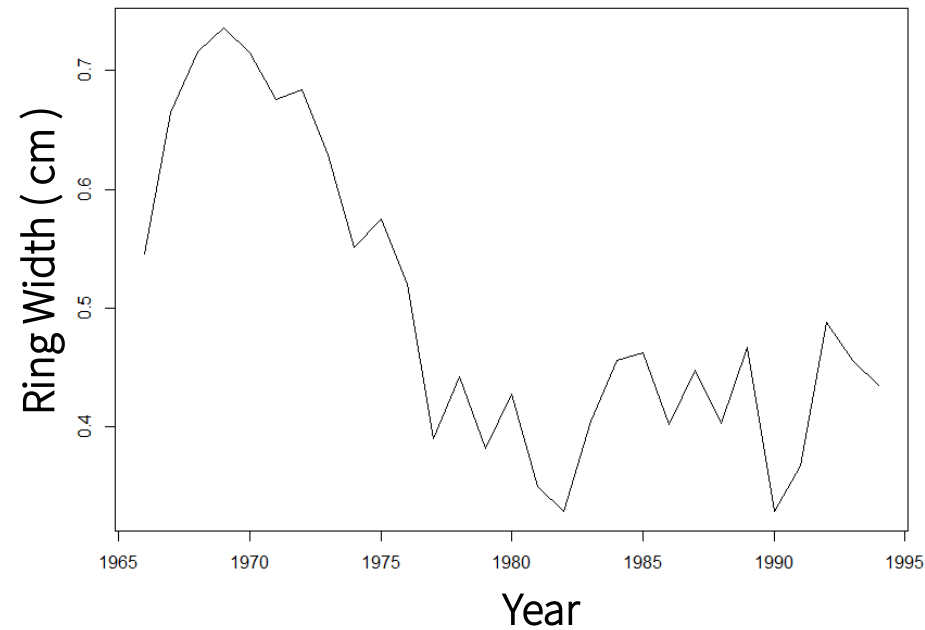
➡ An individual growth reaction norm model

Impact regime

Quantify the individual sensitivities

Tree core data detrending to study the *Growth ~ Climate* relationship

A classical dendrochronology method : cubic spline detrending

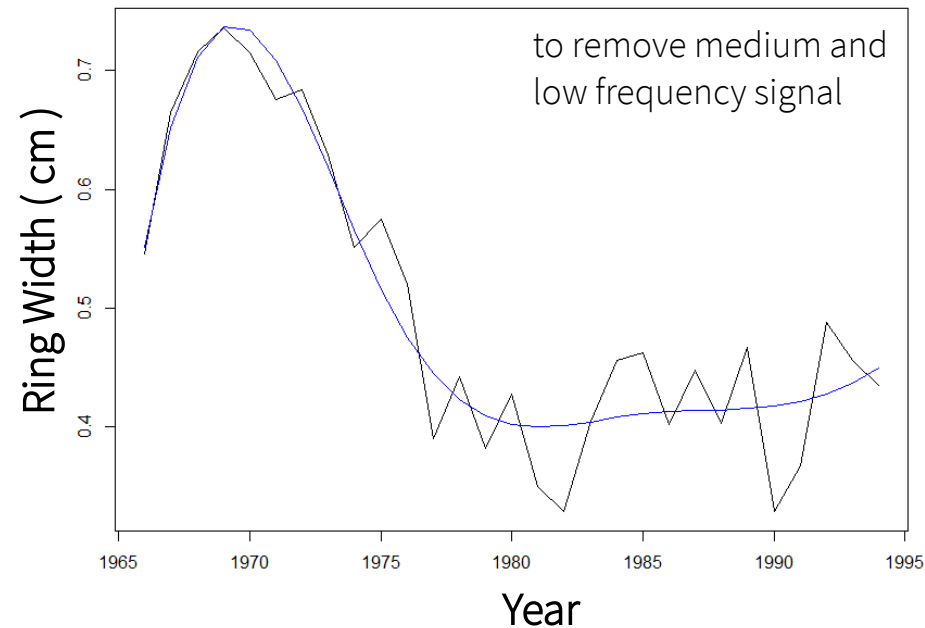


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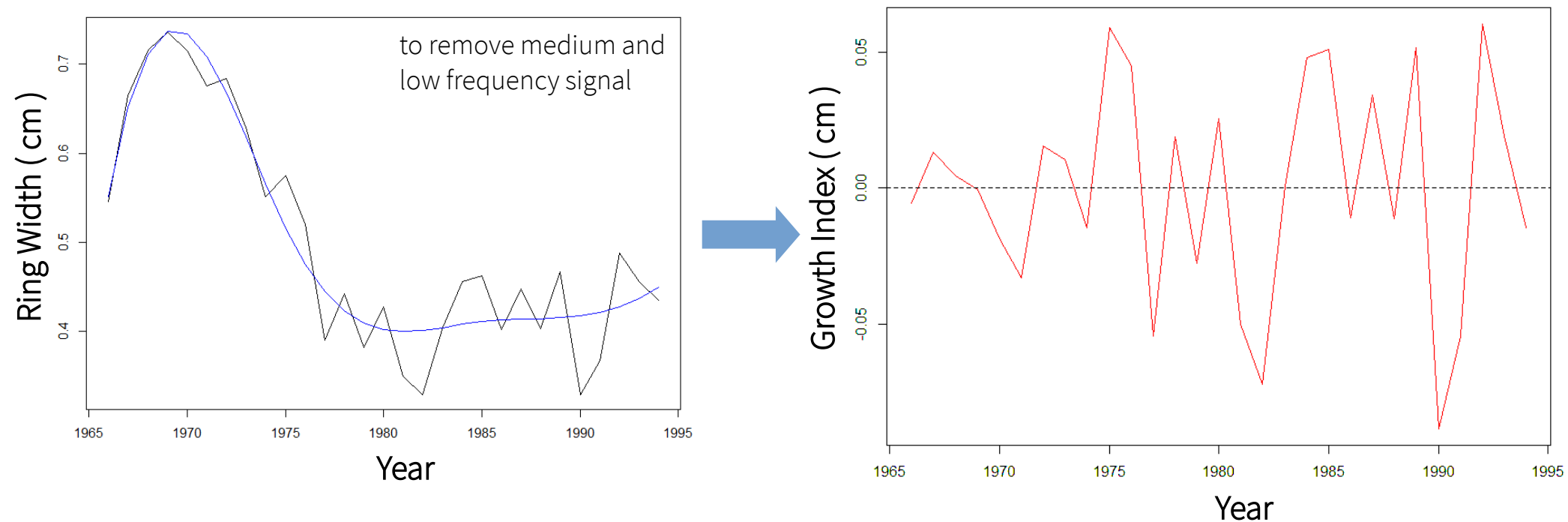


Impact regime

Quantify the individual sensitivities

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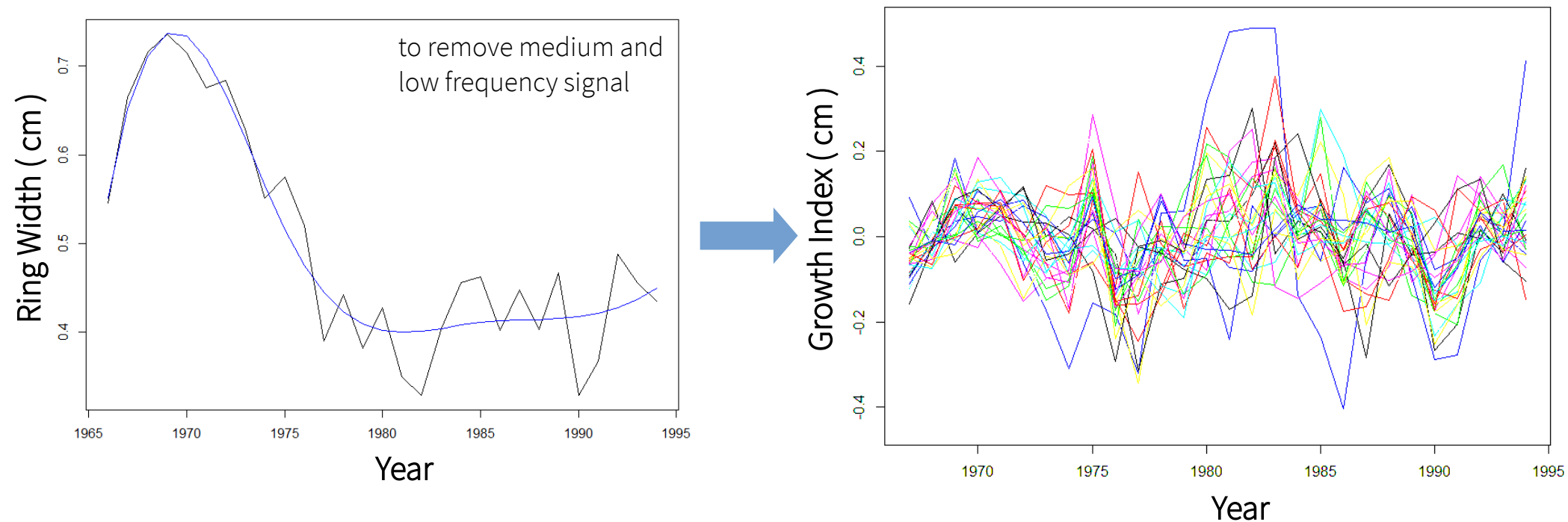


Impact regime

Quantify the individual sensitivities

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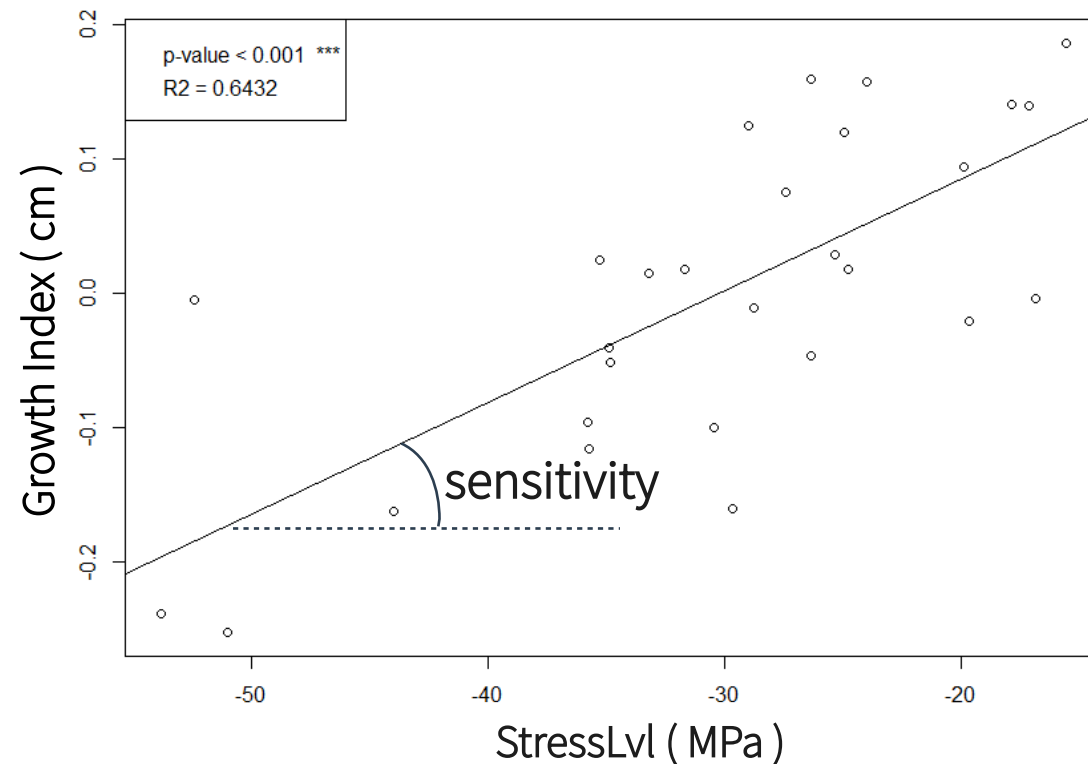
A classical dendrochronology method : cubic spline detrending



All individual annual growth variations (30) related to climate

Impact regime

Quantify the individual sensitivities

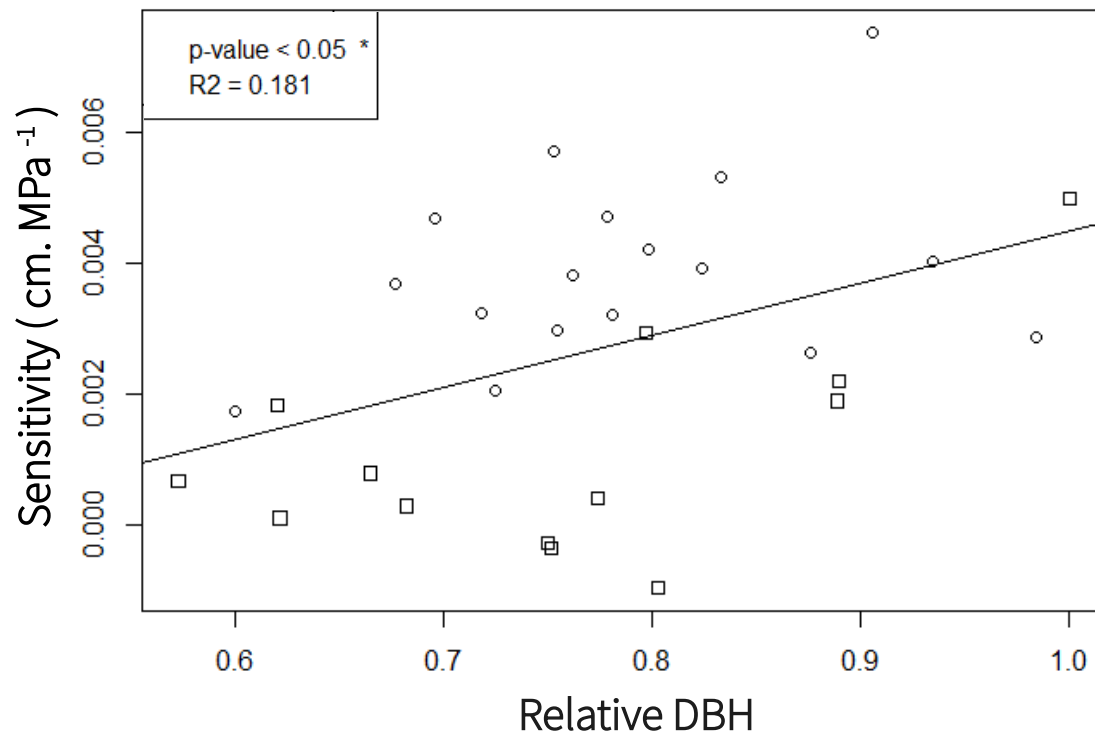


Estimation of the individual sensitivity

- The individual sensitivity: the regression coefficients of the *Growth index* ~ *StressLvl* relationship

Impact regime

Quantify the individual sensitivities

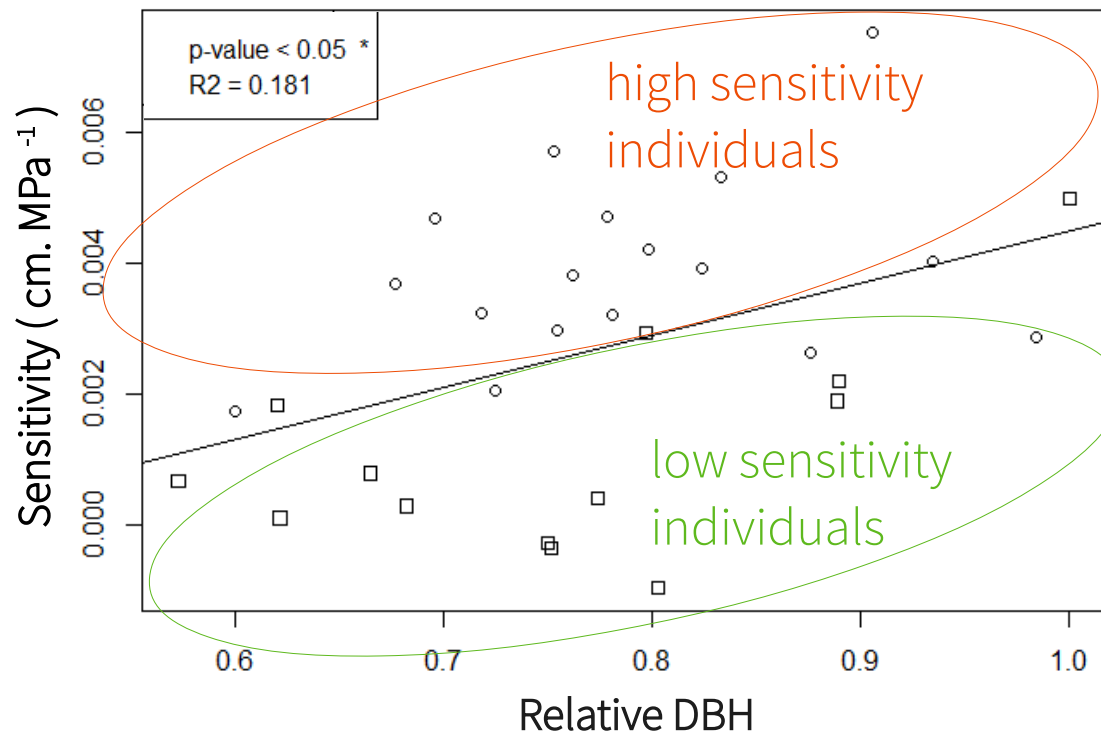


Estimation of the individual sensitivity

- The individual sensitivity: the regression coefficients of the *Growth index* ~ *StressLvl* relationship
- A DBH effect on the individual sensitivity: exposure or sensitivity cofactor?

Impact regime

Quantify the individual sensitivities



Estimation of the individual sensitivity

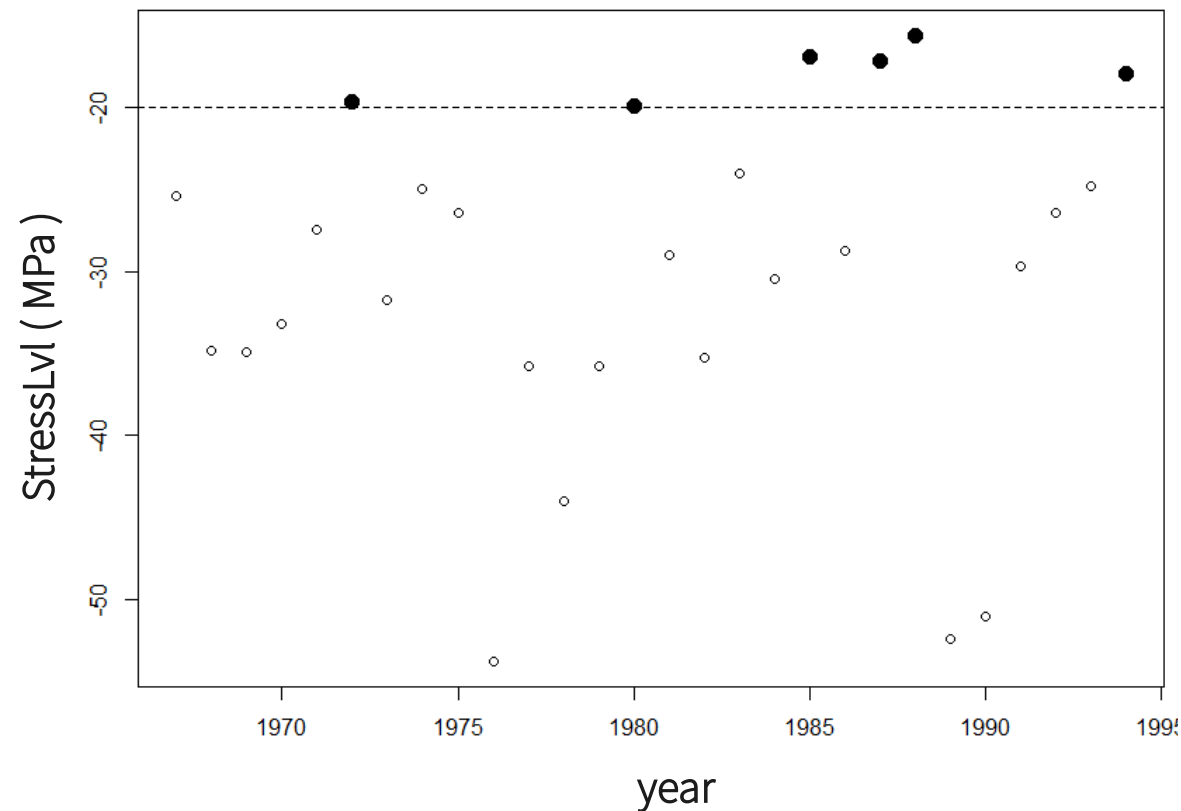
- The individual sensitivity: the regression coefficients of the *Growth index* ~ *StressLvl* relationship
- A DBH effect on the individual sensitivity: exposure or sensitivity cofactor?
- This effect has been removed as we want parameters independent of the size.

Impact regime

Quantify the individual vigor

Estimation of the vigor

- The vigor concept: the individual growth efficiency in undisturbed years

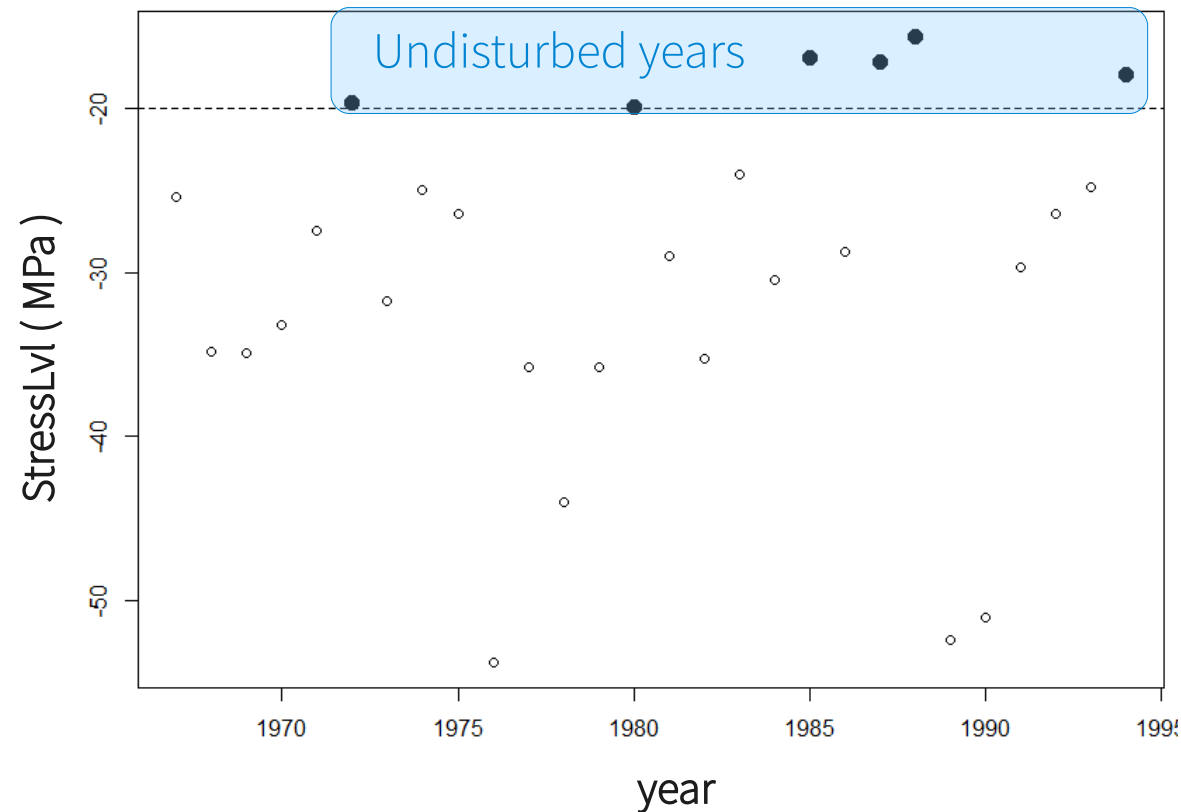


Impact regime

Quantify the individual vigor

Estimation of the vigor

- The vigor concept: the individual growth efficiency in undisturbed years
- A threshold to minimize the StressLvl while maximizing the number of years taken into account

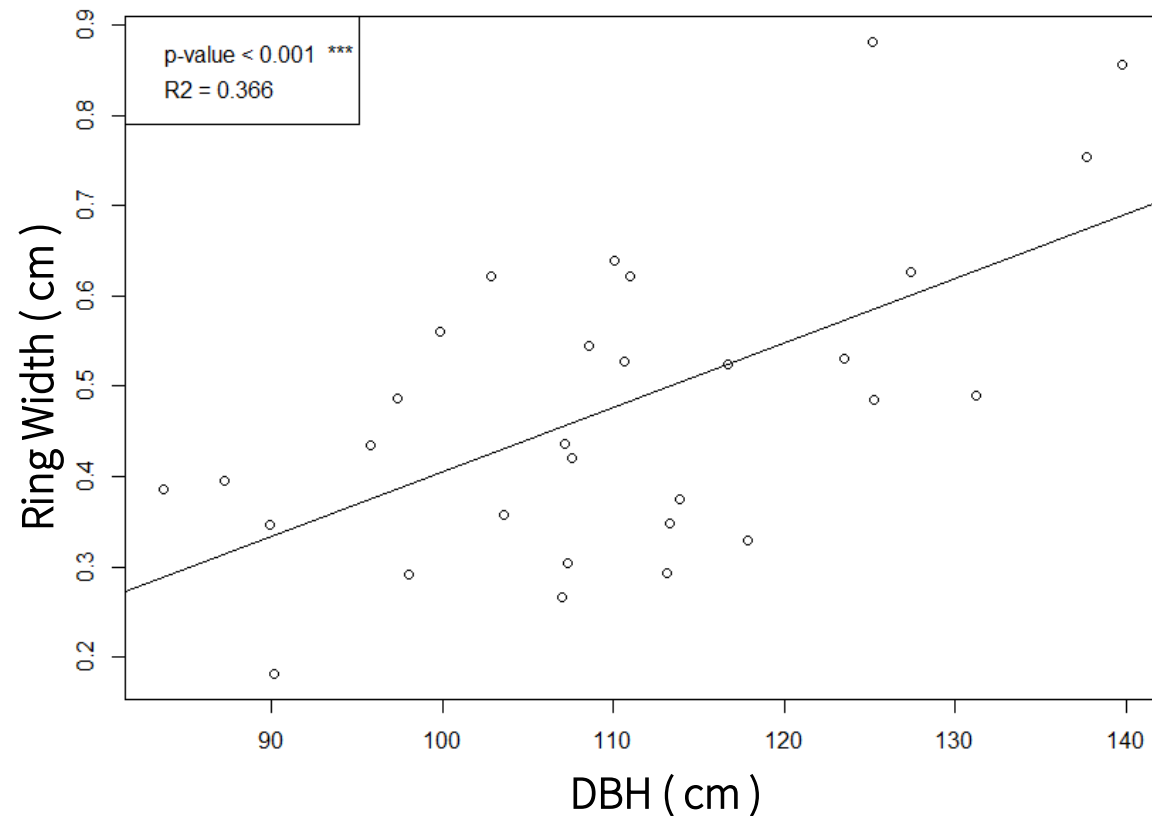


Impact regime

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Estimation of the vigor

- The vigor concept: the individual growth efficiency in undisturbed years
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- For each selected year (6), the residuals of the $RW \sim DBH$ relationship are extracted and averaged over the selected years.

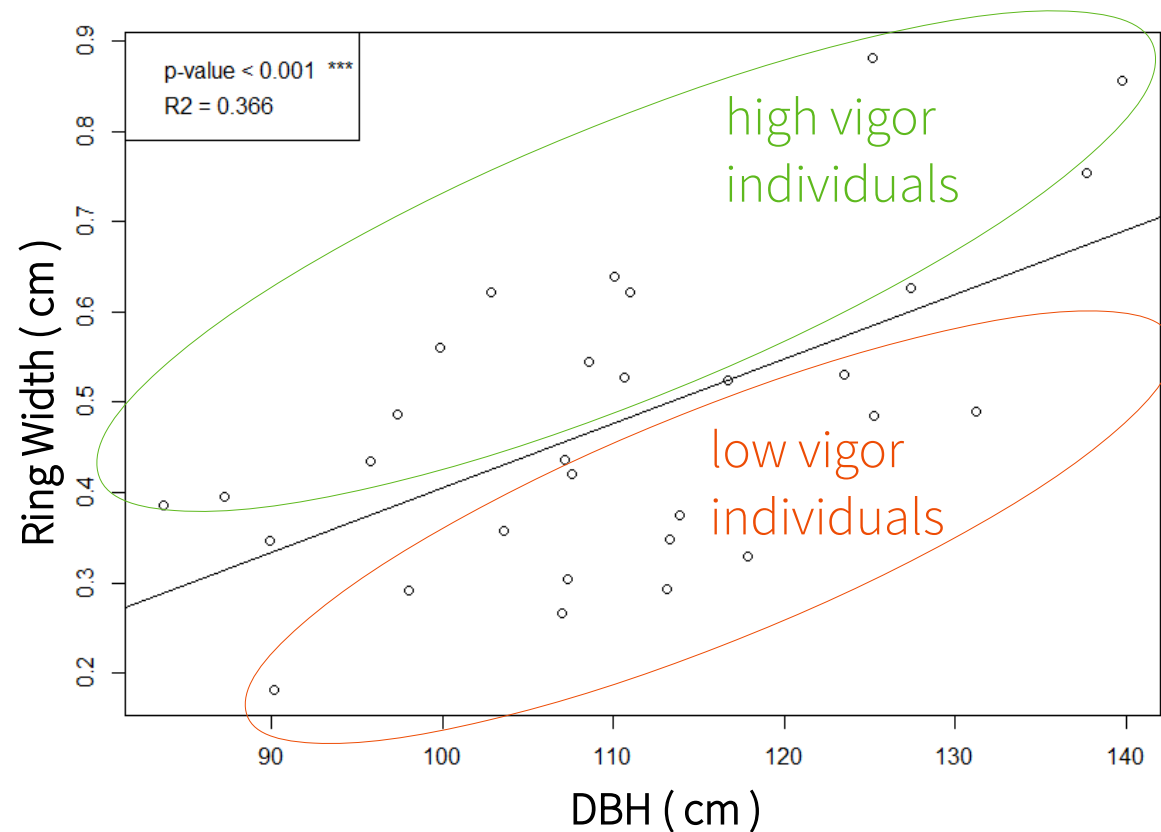


Impact regime

Quantify the individual vigor

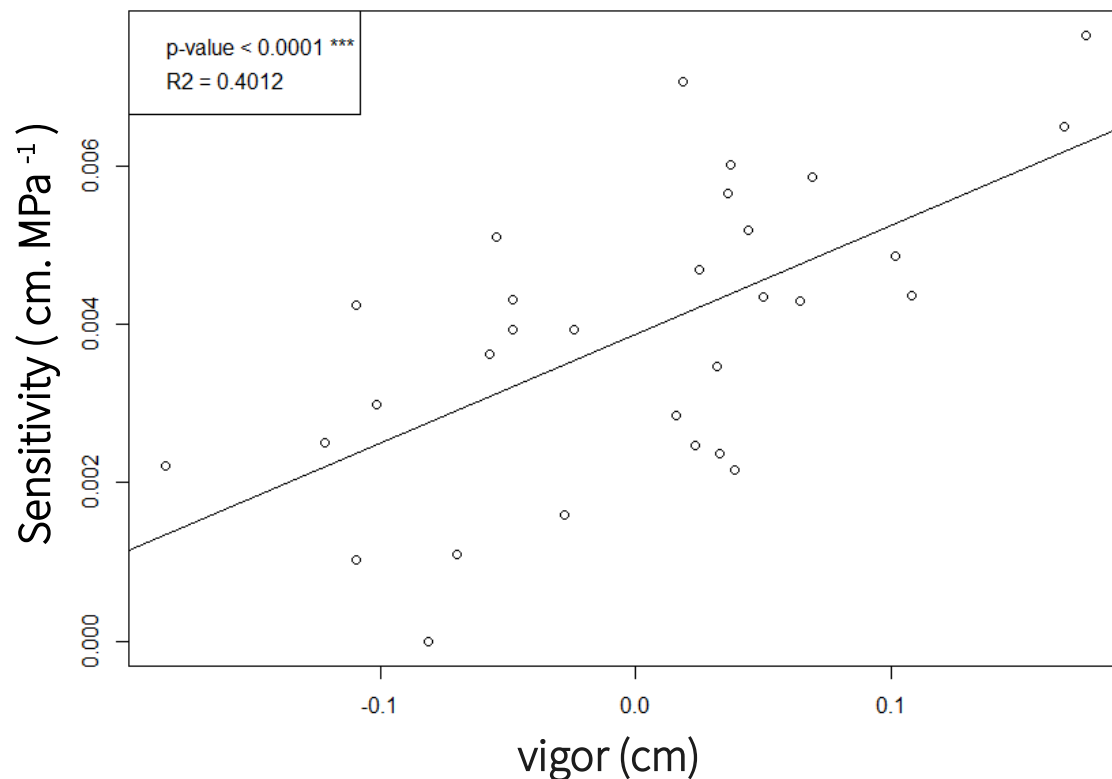
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Impact regime

Trees profiling and *vigor* ~ *sensitivity* relationship

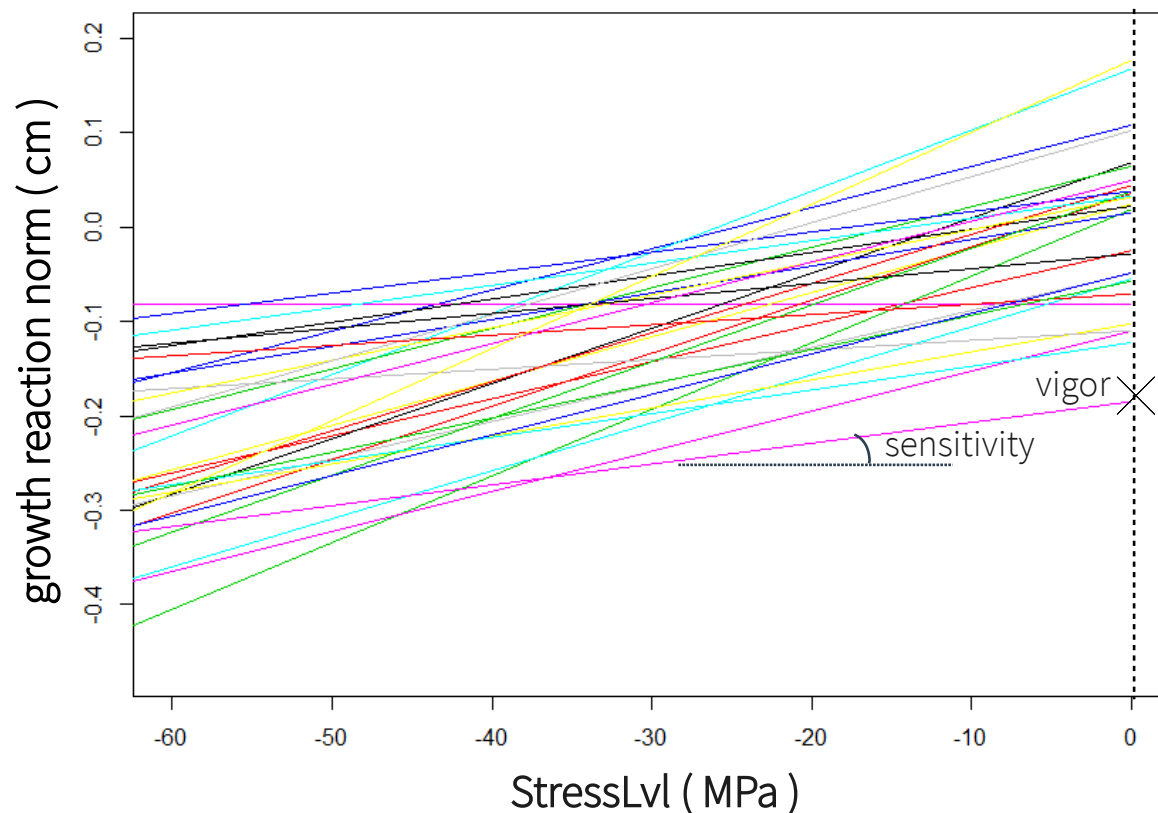


Trees profiling : Individual reaction norms of growth

- Reminder: each tree is described with its sensitivity and its vigor.
- There is a trade-off between sensitivity and vigor.

Impact regime

Trees profiling and *vigor* ~ *sensitivity* relationship



Trees profiling : Individual reaction norms of growth

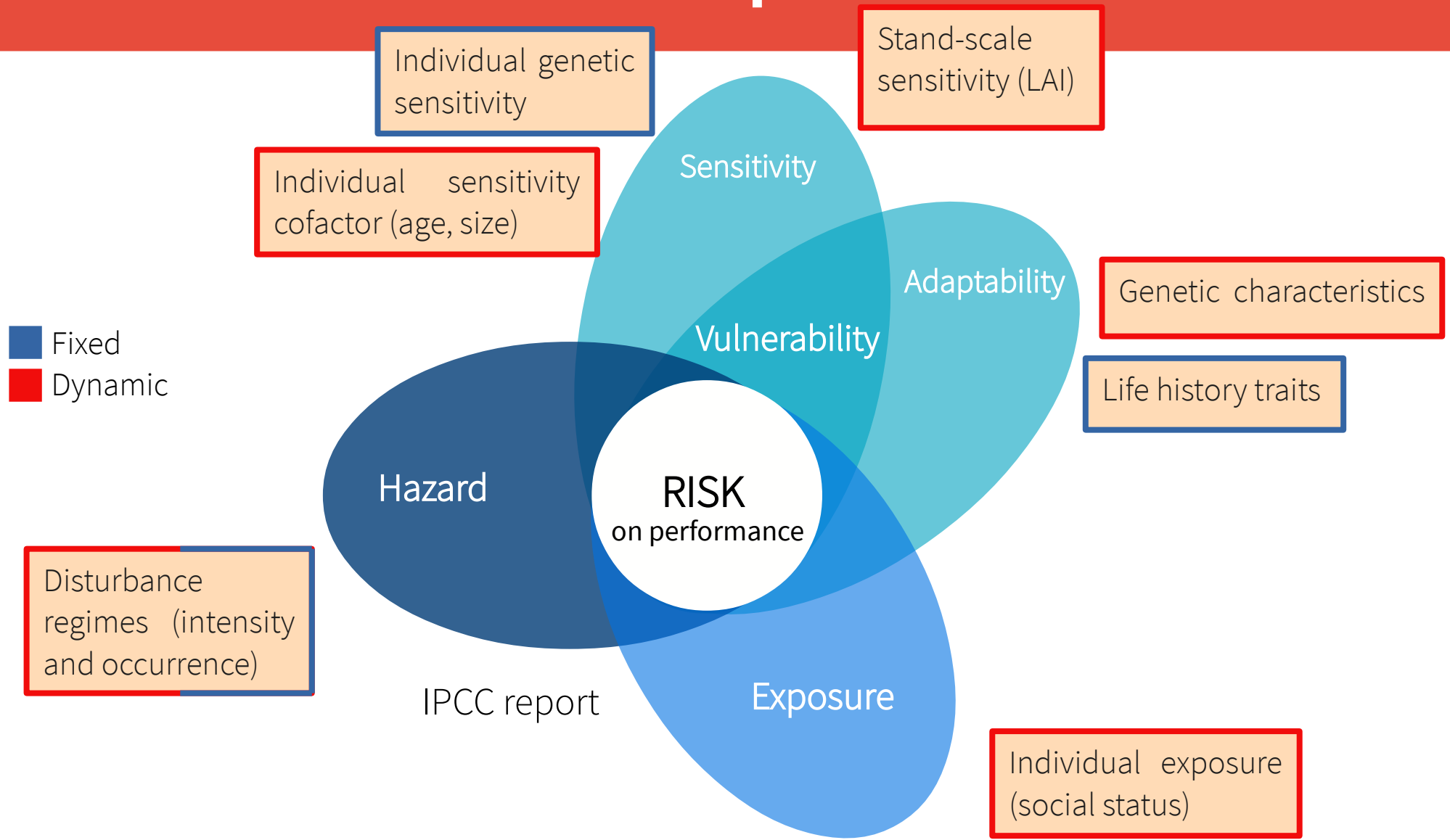
- Reminder: each tree is described with its sensitivity and its vigor.
- There is a trade-off between sensitivity and vigor.
- Each individual can be represented by a growth reaction norm.



An individual growth reaction norm model

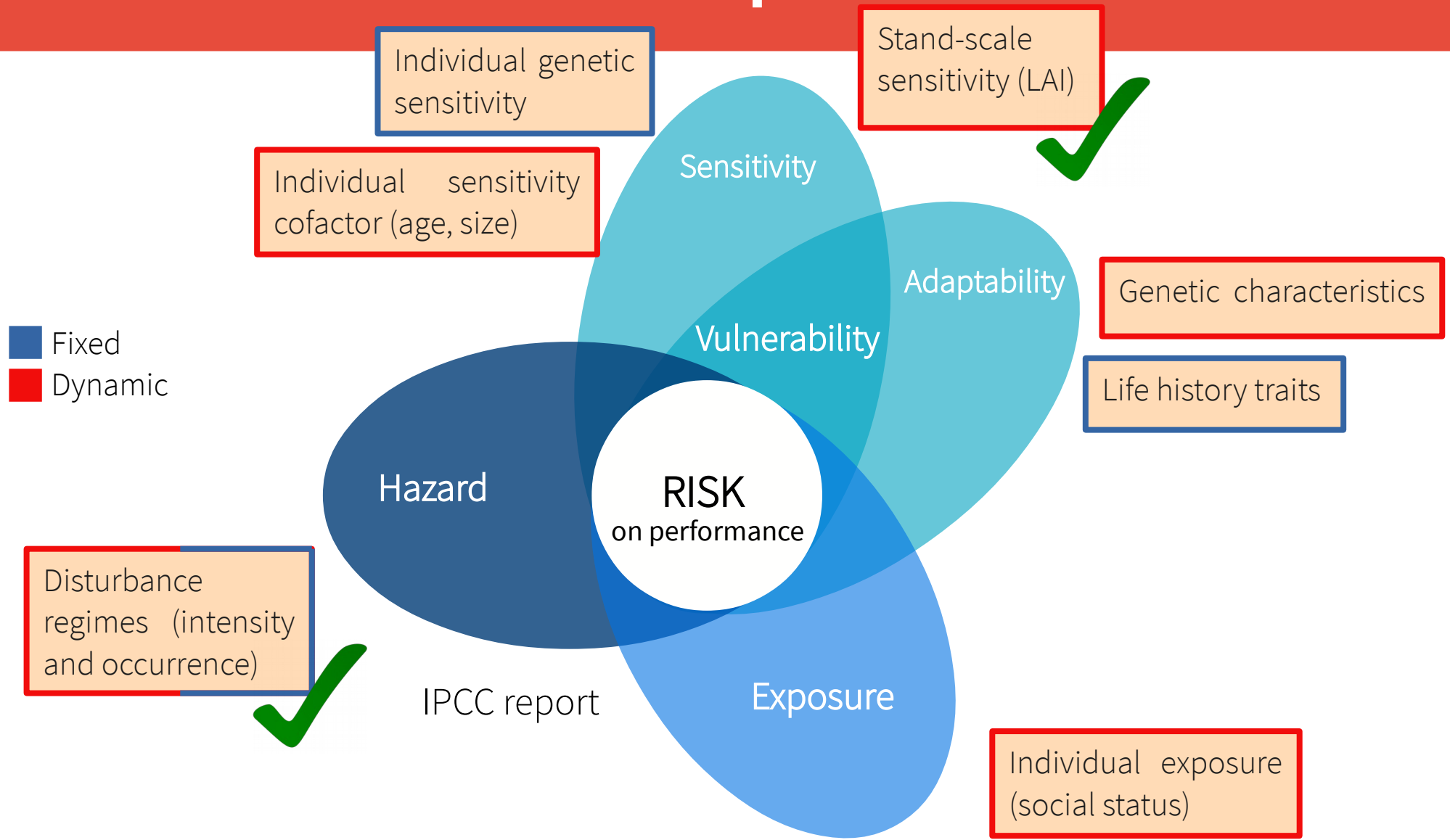
Conclusion

The risk: a multifaceted concept



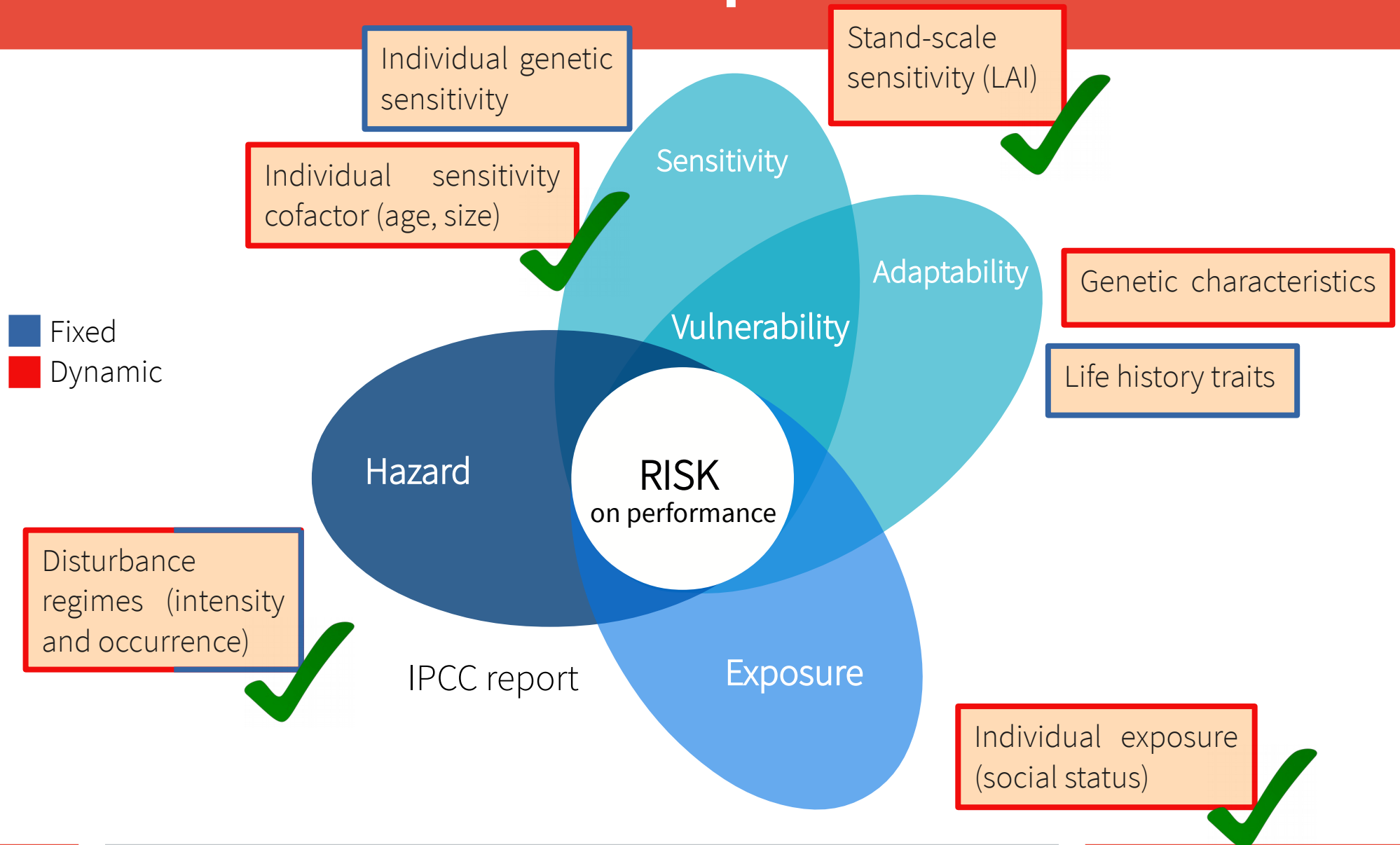
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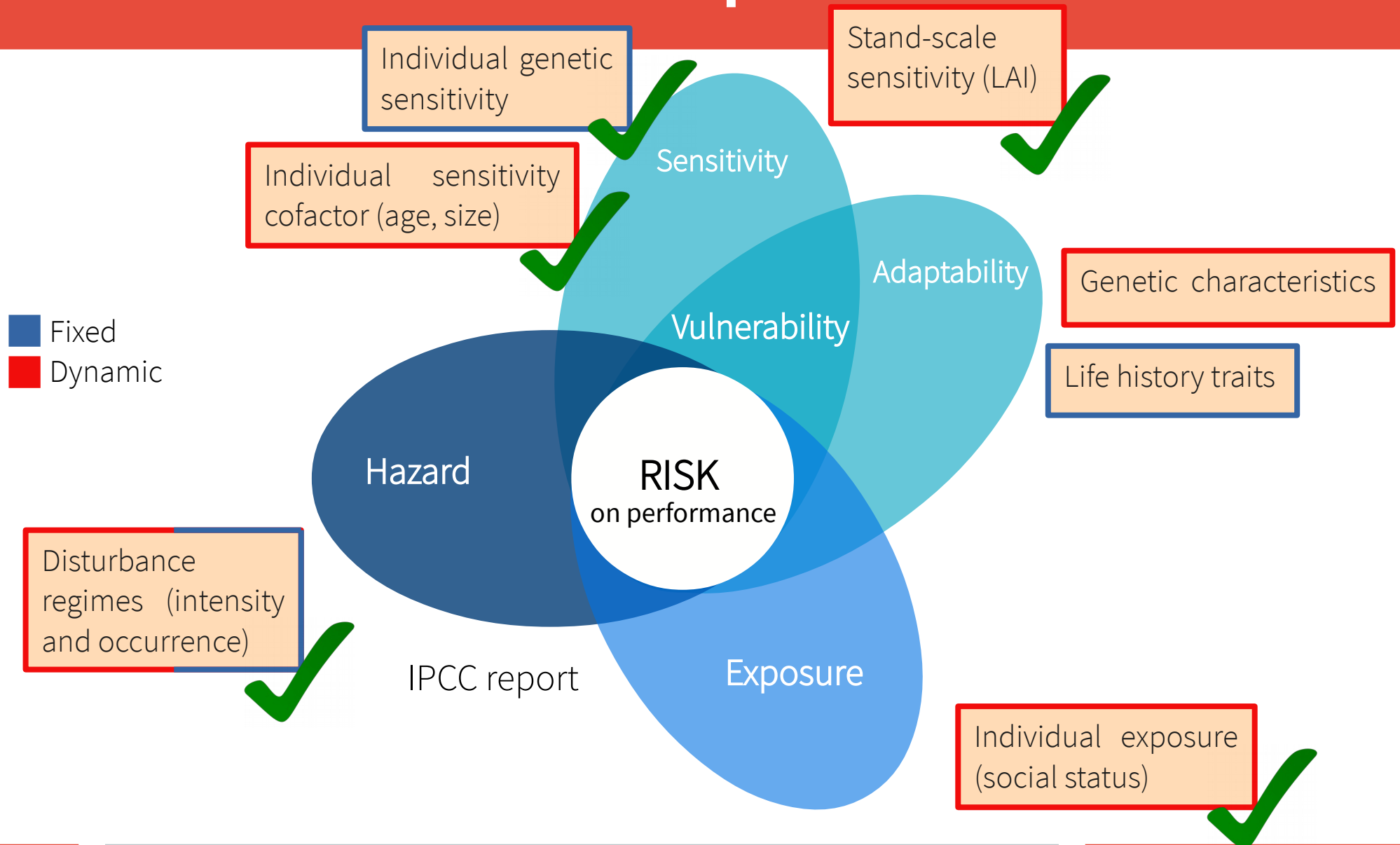
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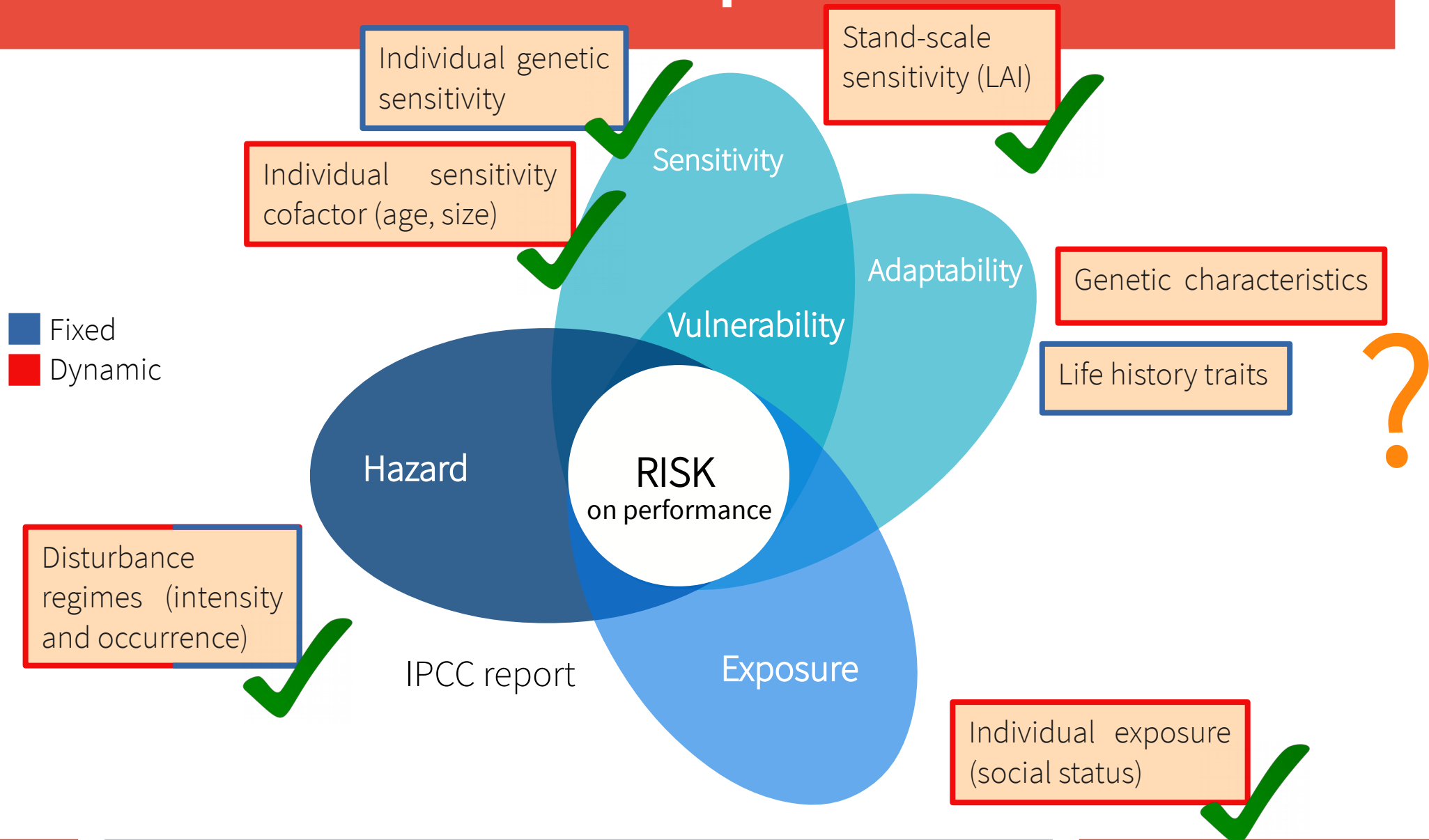
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Conclusion

Prospect: a demo-genetic modelling approach

Forestry practices:

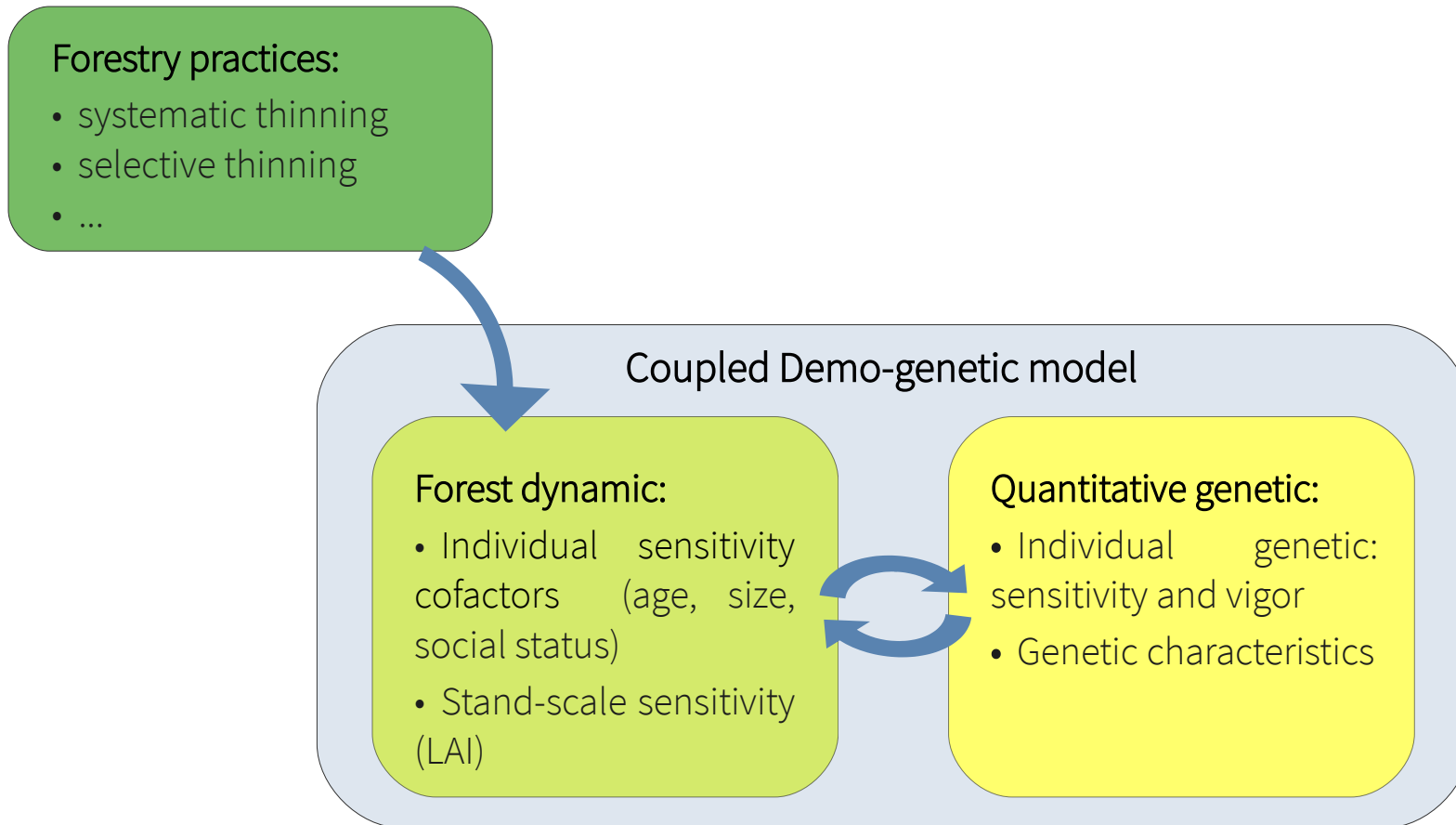
- systematic thinning
- selective thinning
- ...

Forest dynamic:

- Individual sensitivity cofactors (age, size, social status)
- Stand-scale sensitivity (LAI)

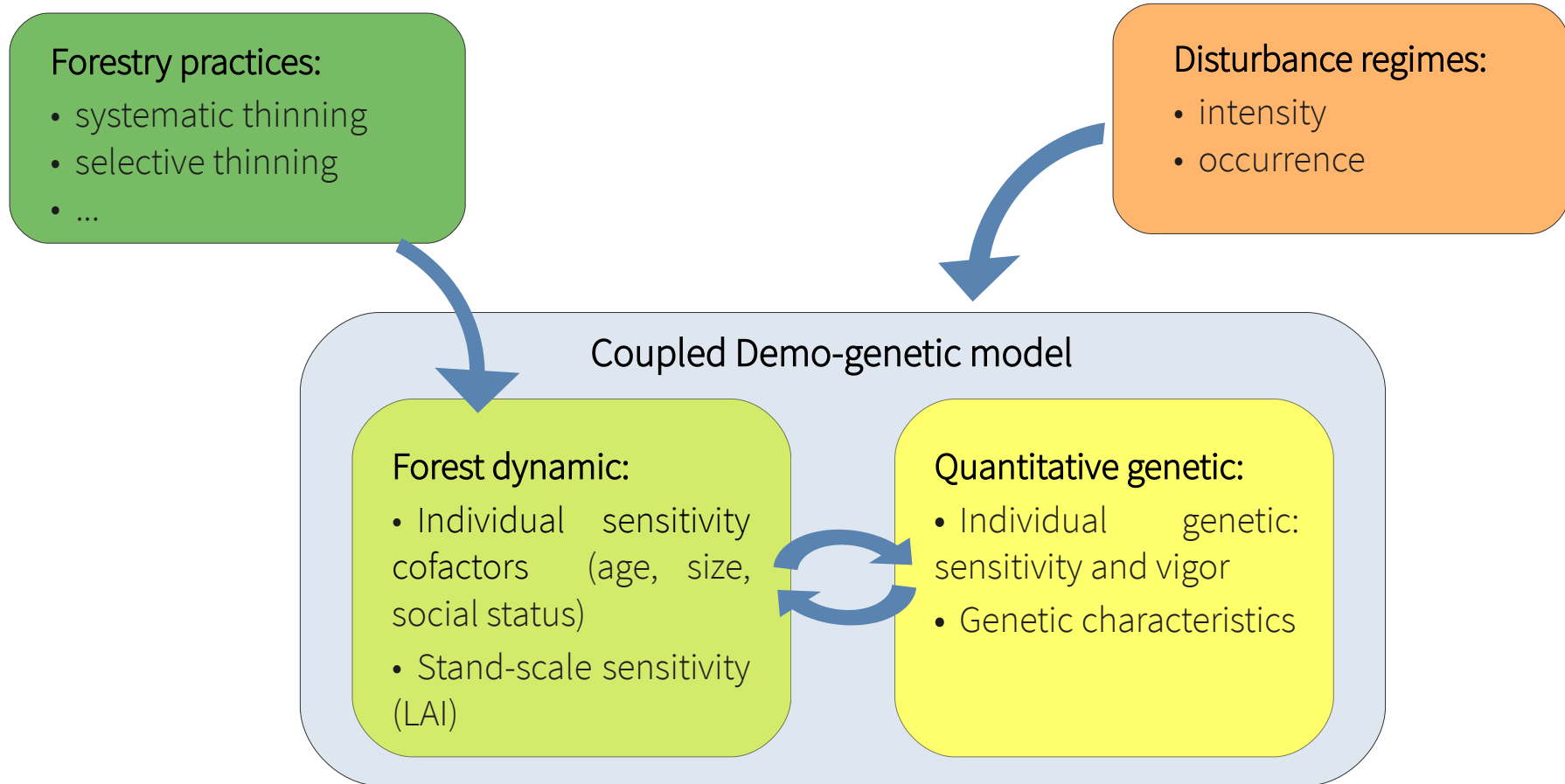
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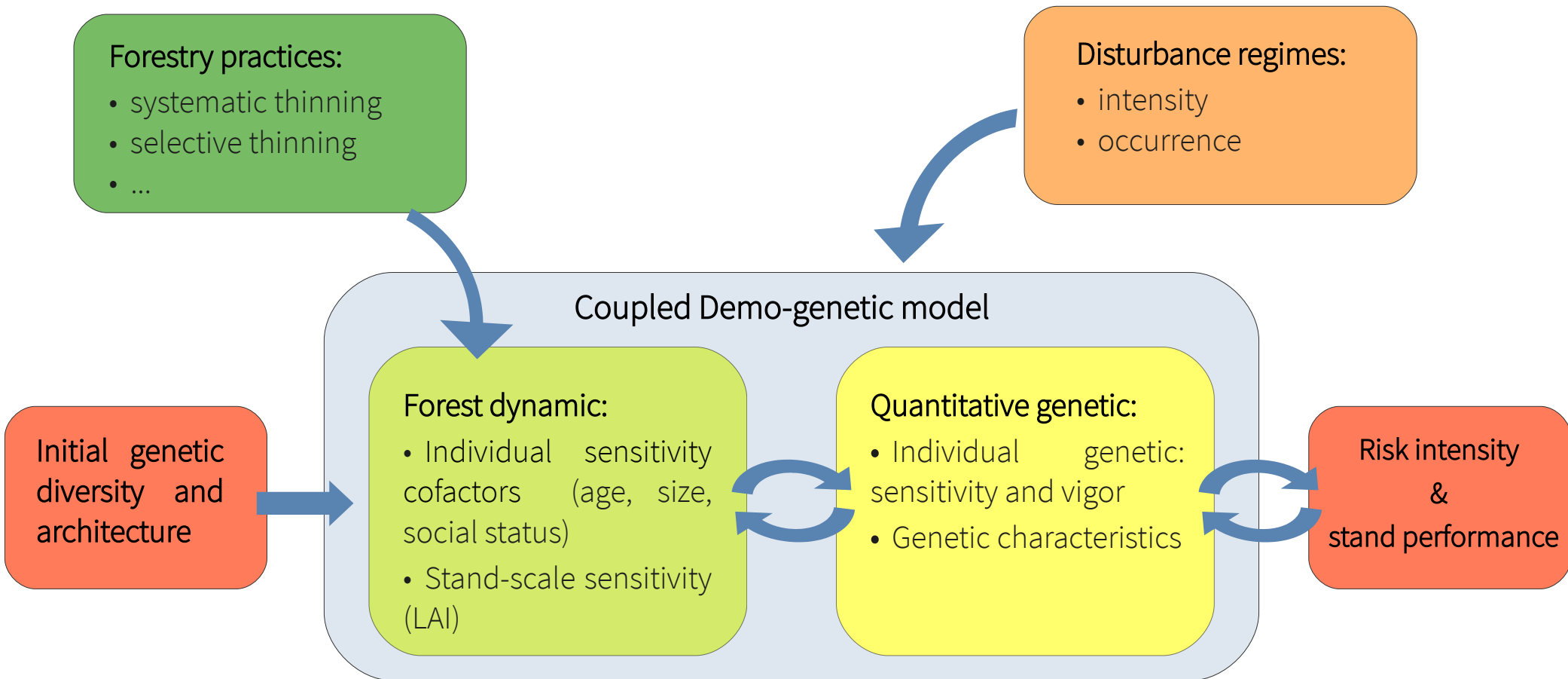
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Formalizing a disturbance impact regime for integration into
a demo-genetic model

Thank you

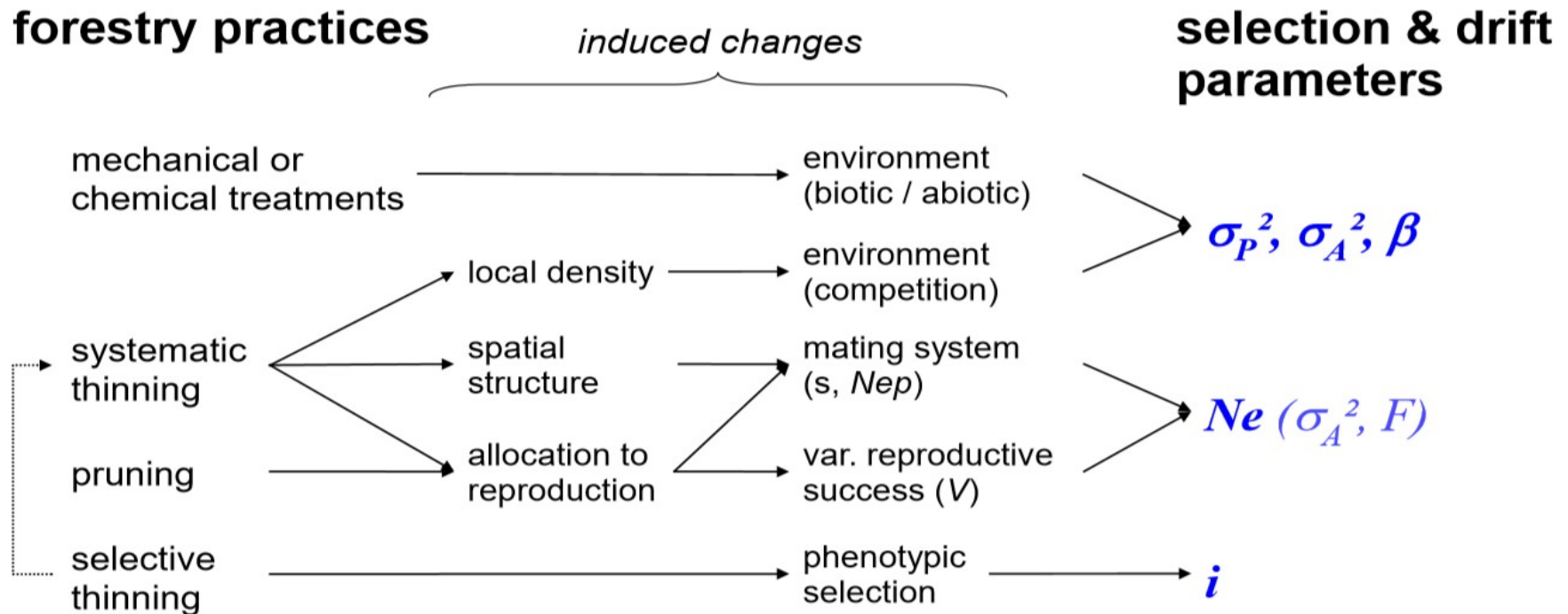
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Evolution-oriented forest management: Management by and for evolutionary process

management by and for evolutionary processes



Lefèvre et al. 2014