Setting thresholds for good status in marine ecosystem management

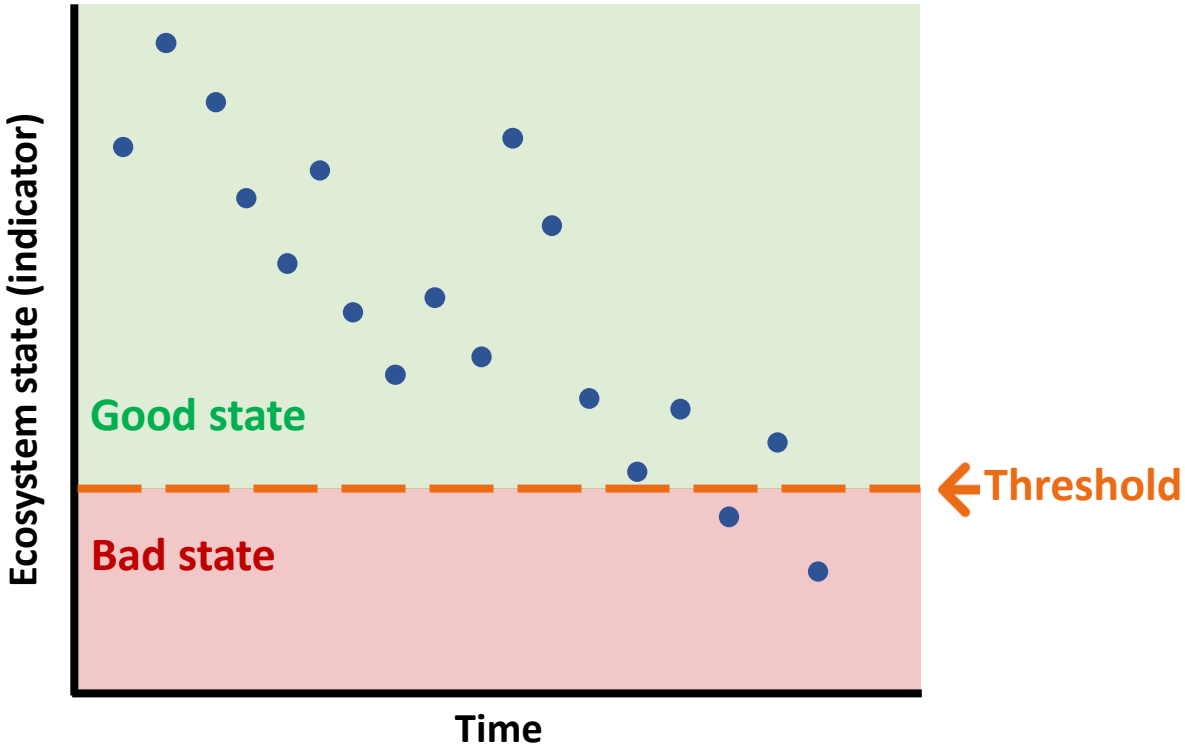
Lorna McKellar

Prof Jan Geert Hiddink, Dr Abigail McQuatters-Gollop, Dr Tomas Chaigneau, Dr Ian Gloyne-Phillips, Sally Kazer, Dr Cristina Herbon, Dr Sebastian Valanko, Dr Jörn Schmidt

What are thresholds?

Values which distinguish between good and bad ecosystem states

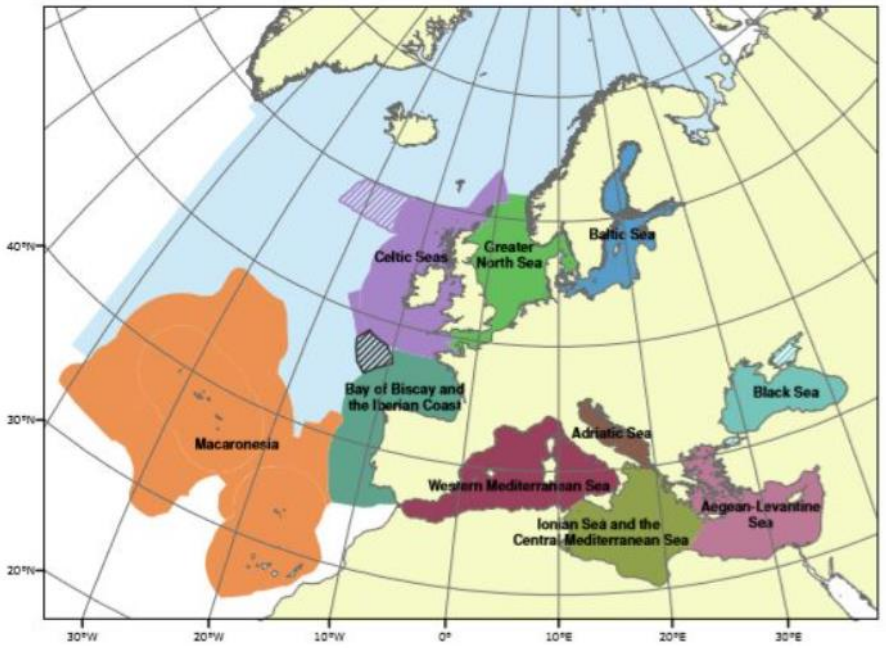
Indicators used as a measure of ecosystem condition



Why are thresholds important?

MSFD & UKMS achieve Good Environmental Status by 2030

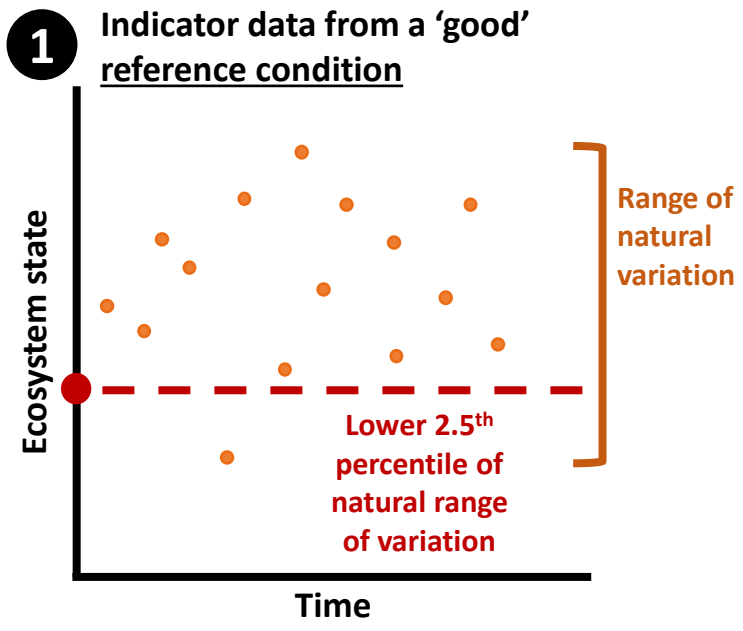
UK Environment Act achieve favourable condition in MPAs by 2042

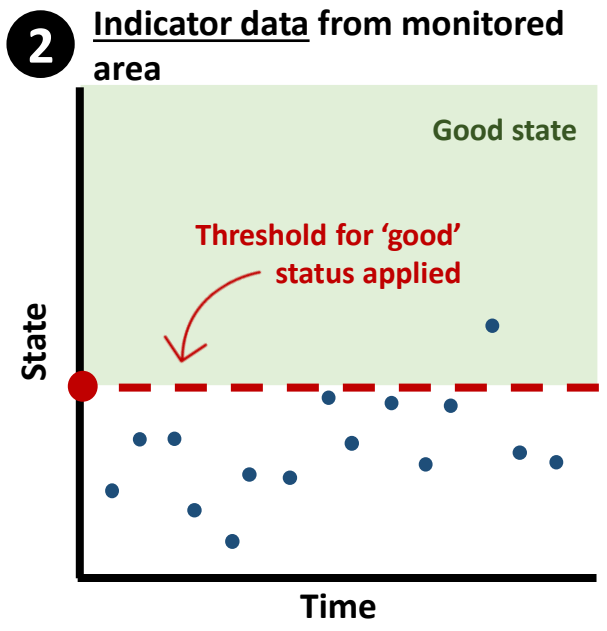


(European Commission, 2020)

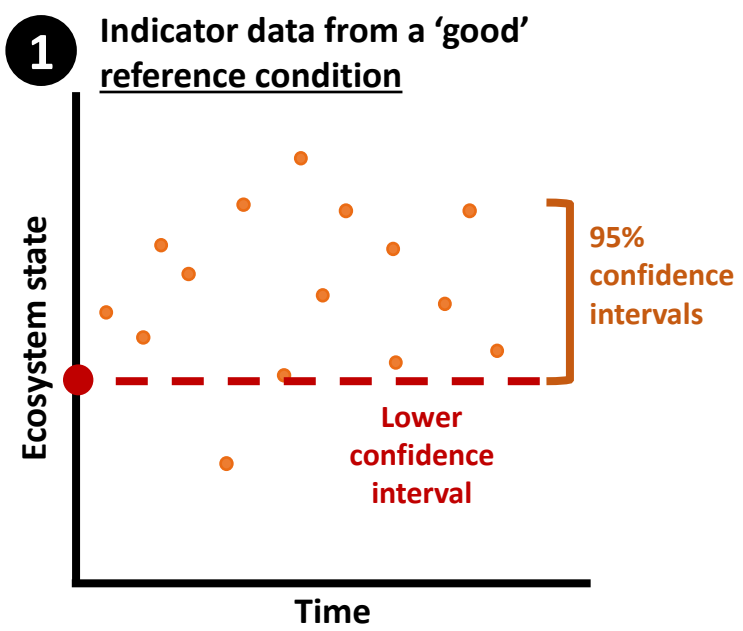
Methods: reference condition data

Range of natural variation



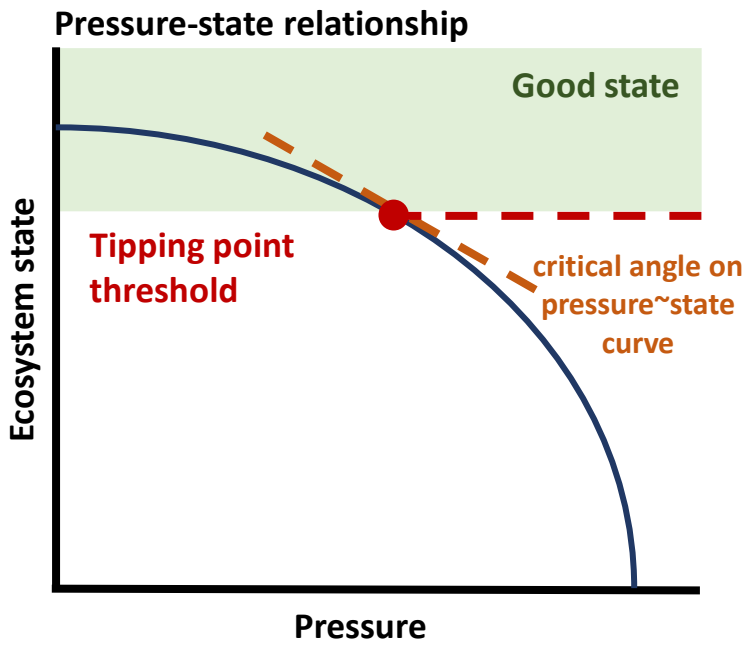


Statistically detectable change

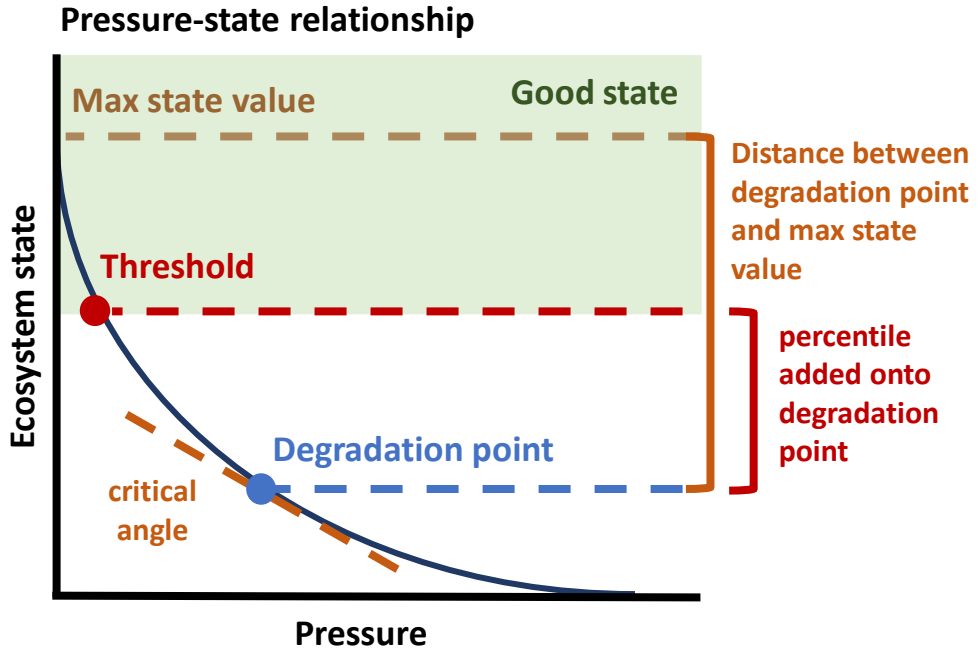


Methods: pressure-state data

Tipping points



Distance to degradation



Evaluating methods

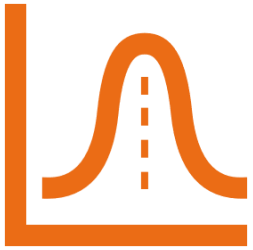
1 **Evaluating frameworks against**

Statistical robustness

Ecologically meaningful

Socio-economic

Evaluating methods



Statistical robustness

?

type of pressure-state relationship

?

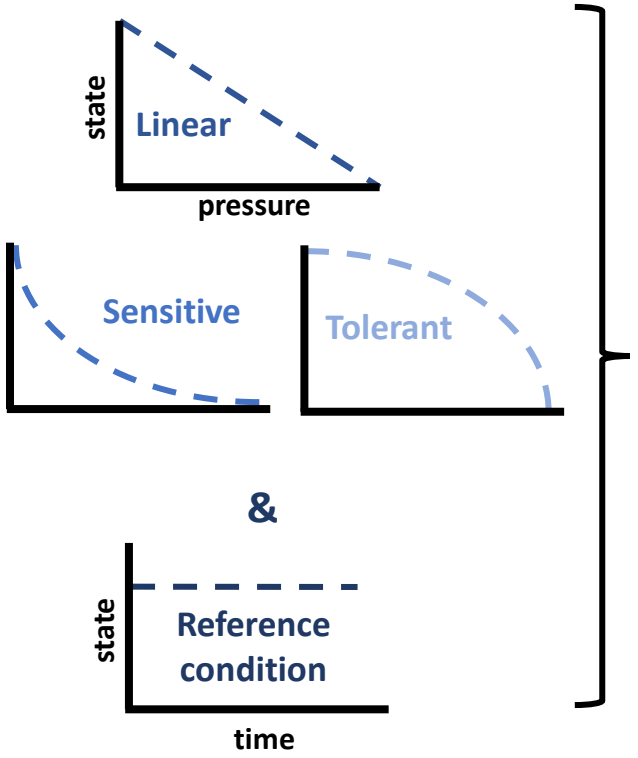
varying sampling noise

?

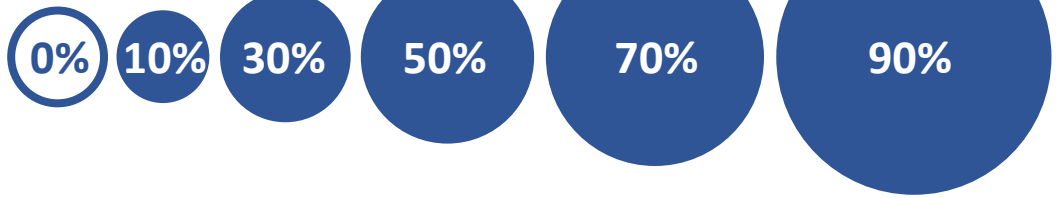
different sample sizes

Methods: simulated ‘indicator’ data

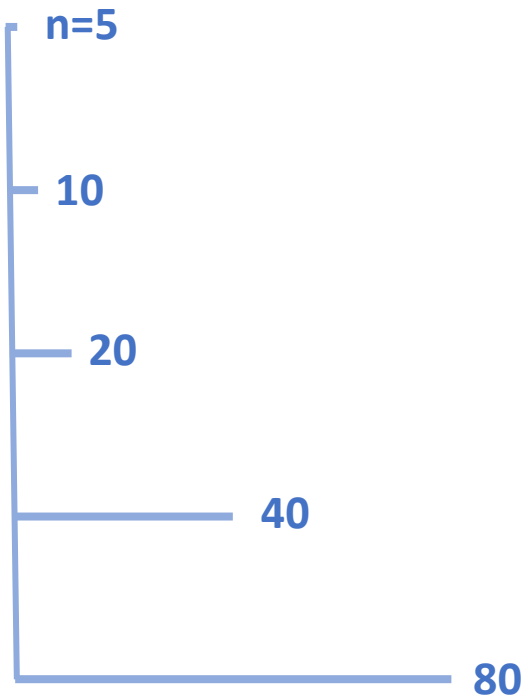
3 x pressure-state relationships

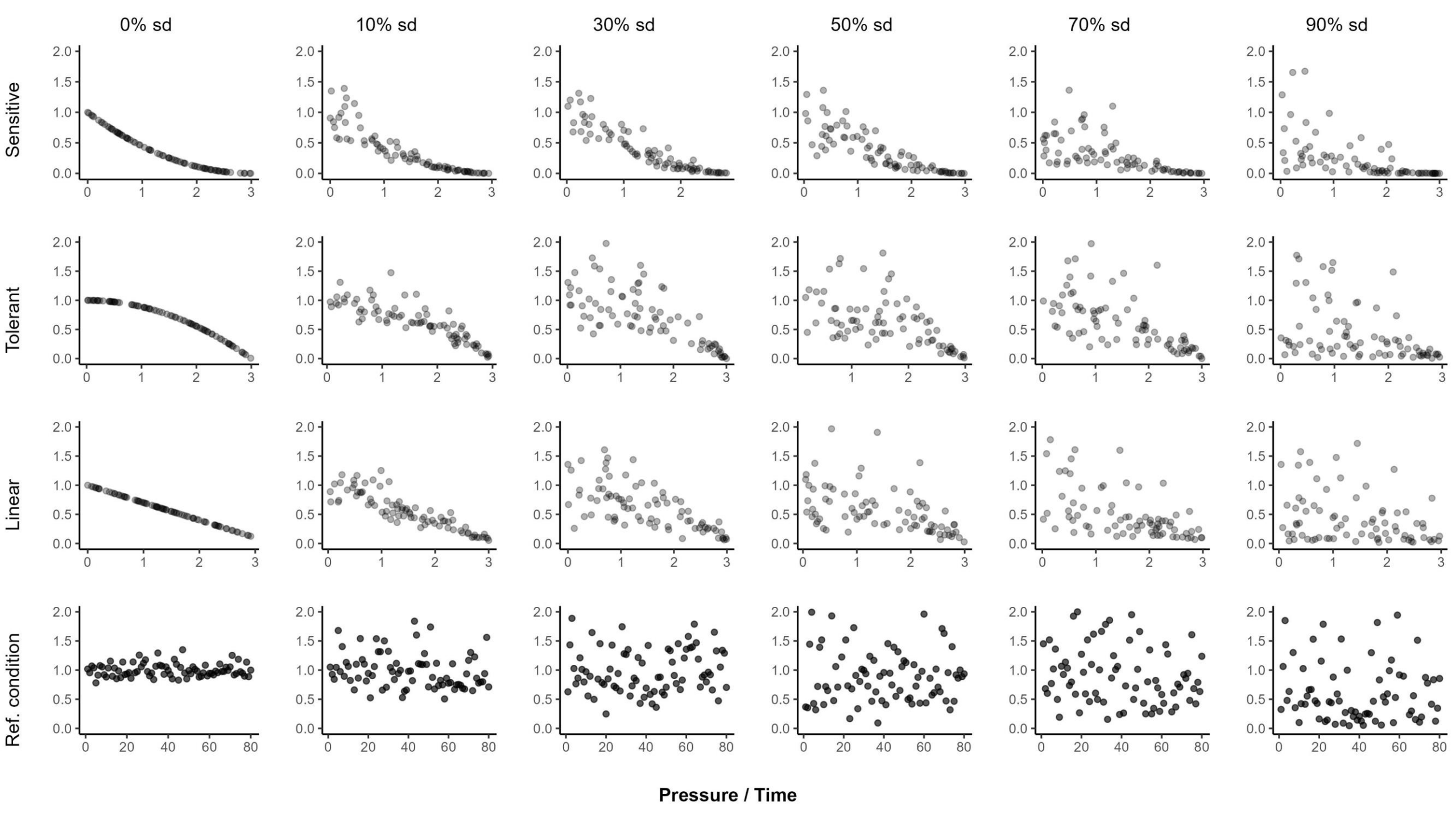


6 x levels of added noise



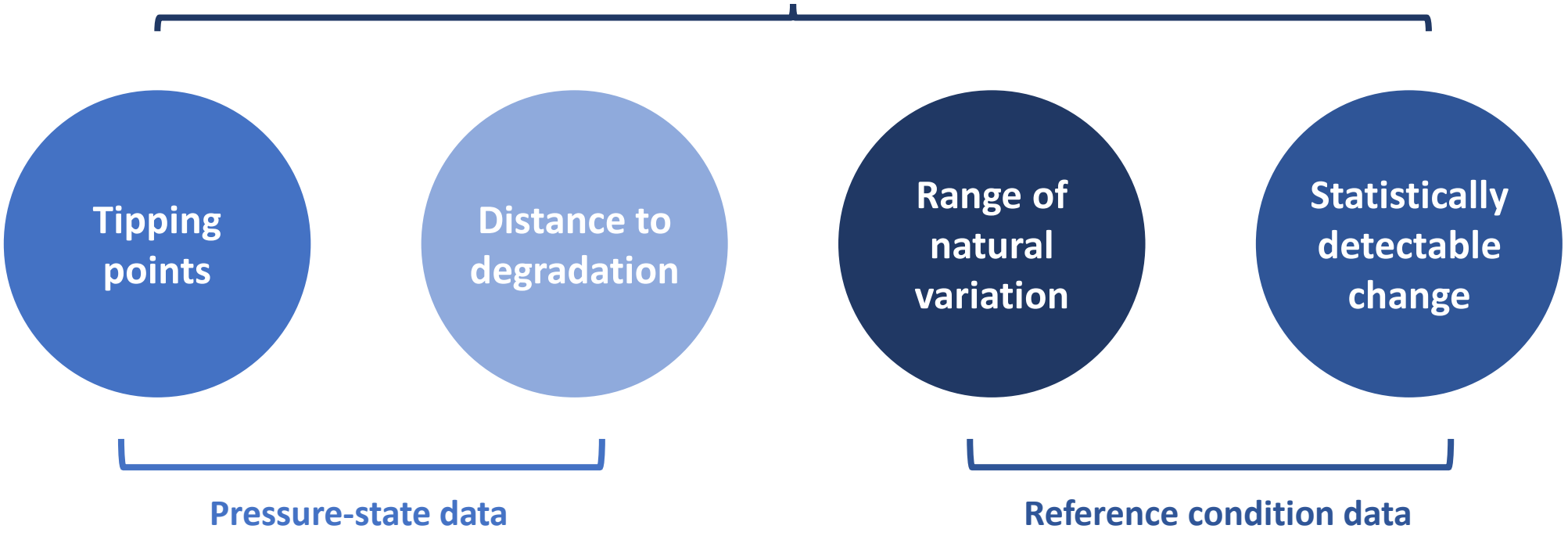
6 x sample sizes

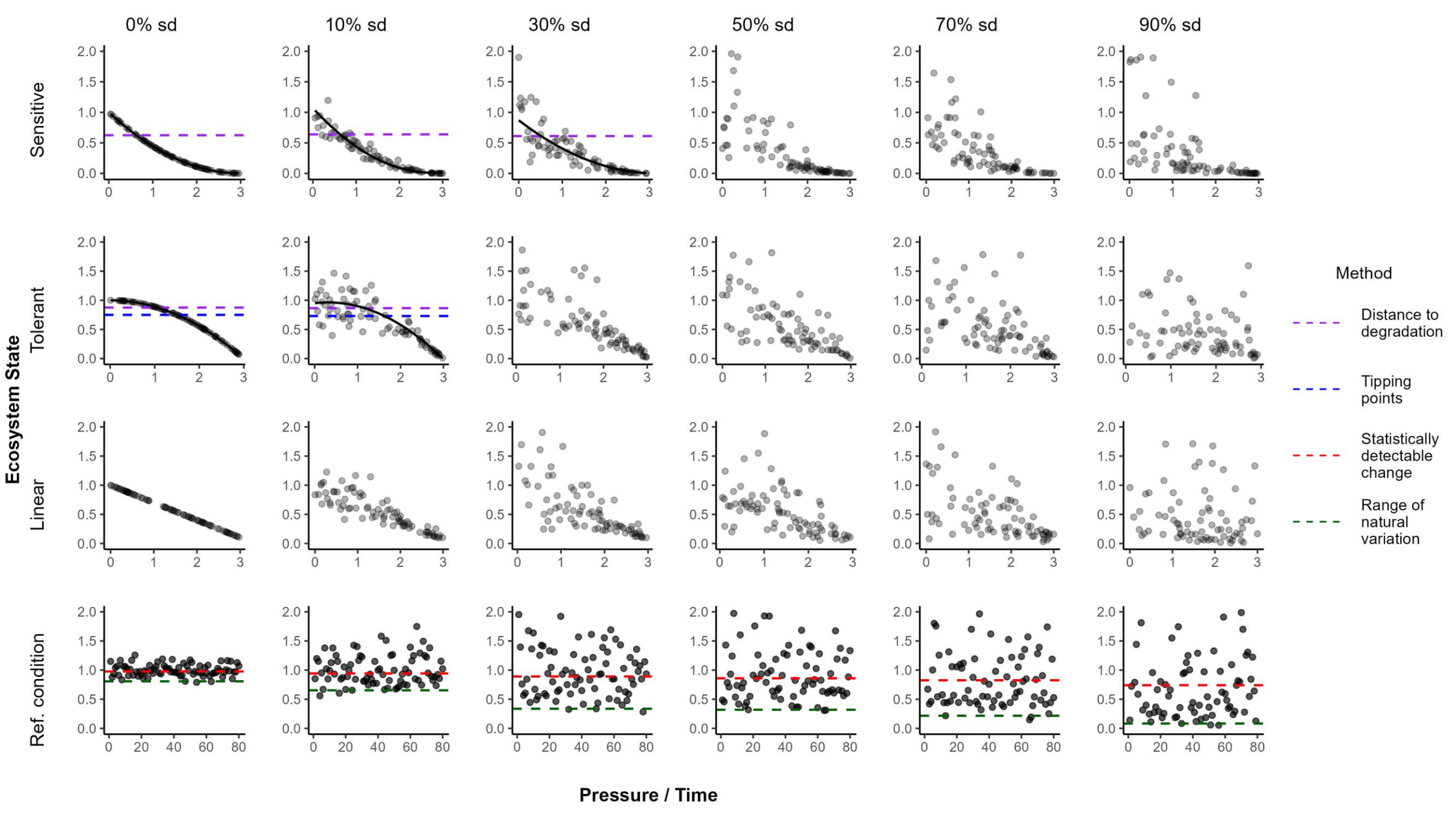



0% sd
10% sd
30% sd
50% sd
70% sd
90% sd
Sensitive
Tolerant
Linear
Ref. condition
Pressure / Time

Methods

Four methods to estimate thresholds (WKBENTH2, 2022; Hiddink et al., 2023)




0% sd
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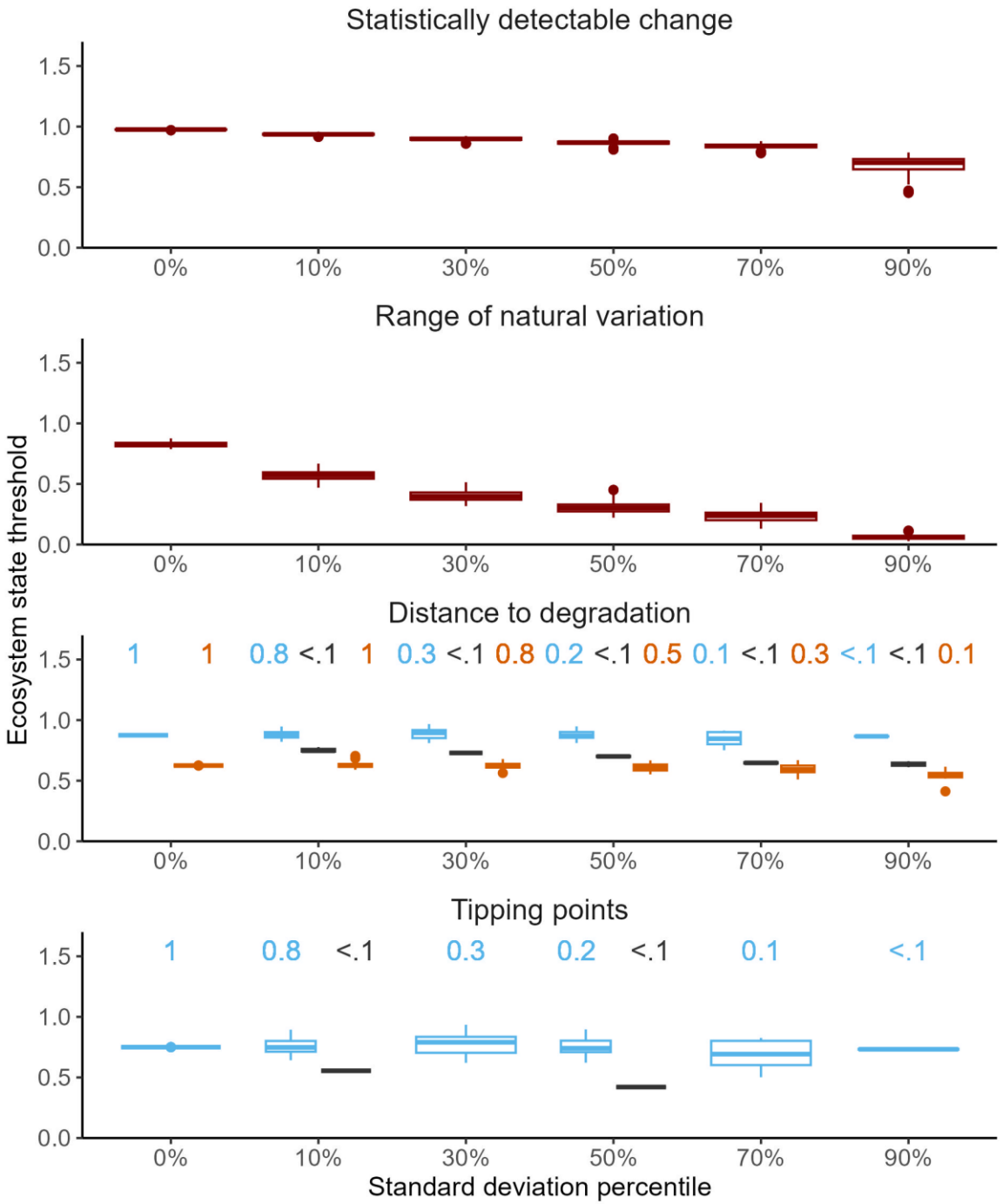
Ecosystem State
Pressure / Time
Method
Distance to degradation
Tipping points
Statistically detectable change
Range of natural variation



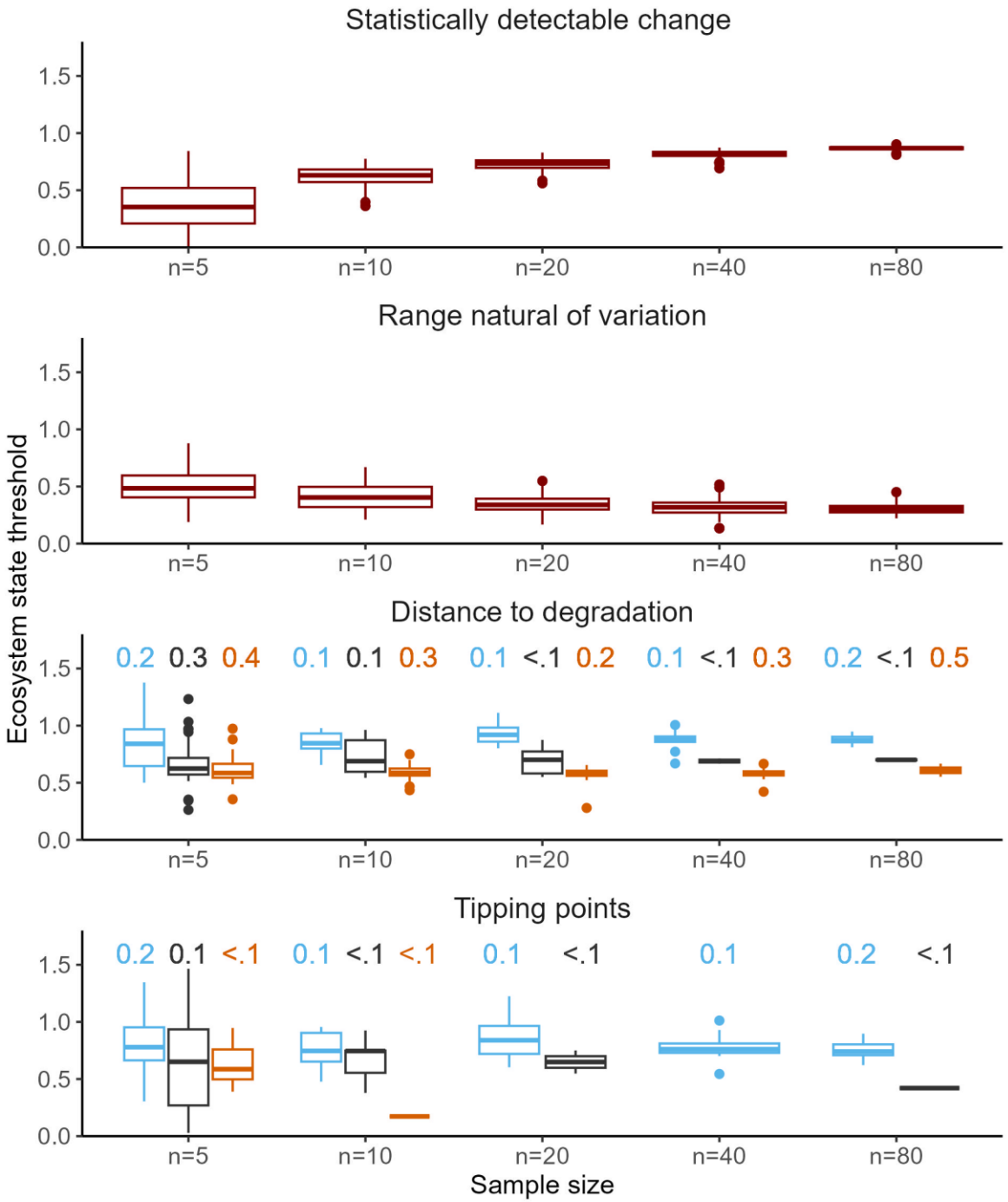
Pressure-state relationship

- tolerant
- linear
- sensitive
- ref. condition

sample size: n=80

thresholds decline with noisy data

low fitting rates with minimal noise



Pressure-state relationship
- tolerant
- linear
- sensitive
- ref.condition

thresholds decline at low sample sizes

lower thresholds for sensitive indicators

standard deviation percentile: 50%

Recommendations for setting thresholds

Methods using pressure-state data are more accurate

Tipping points

Distance to degradation

But… are highly data-dependent

Methods using reference conditions are more reliable

Range of natural variation

Statistically detectable change

But… depend on accurate reference conditions

Methods using reference conditions more reliable with limited data availability

Thank you

Lorna McKellar

@Lorna_McKellar

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