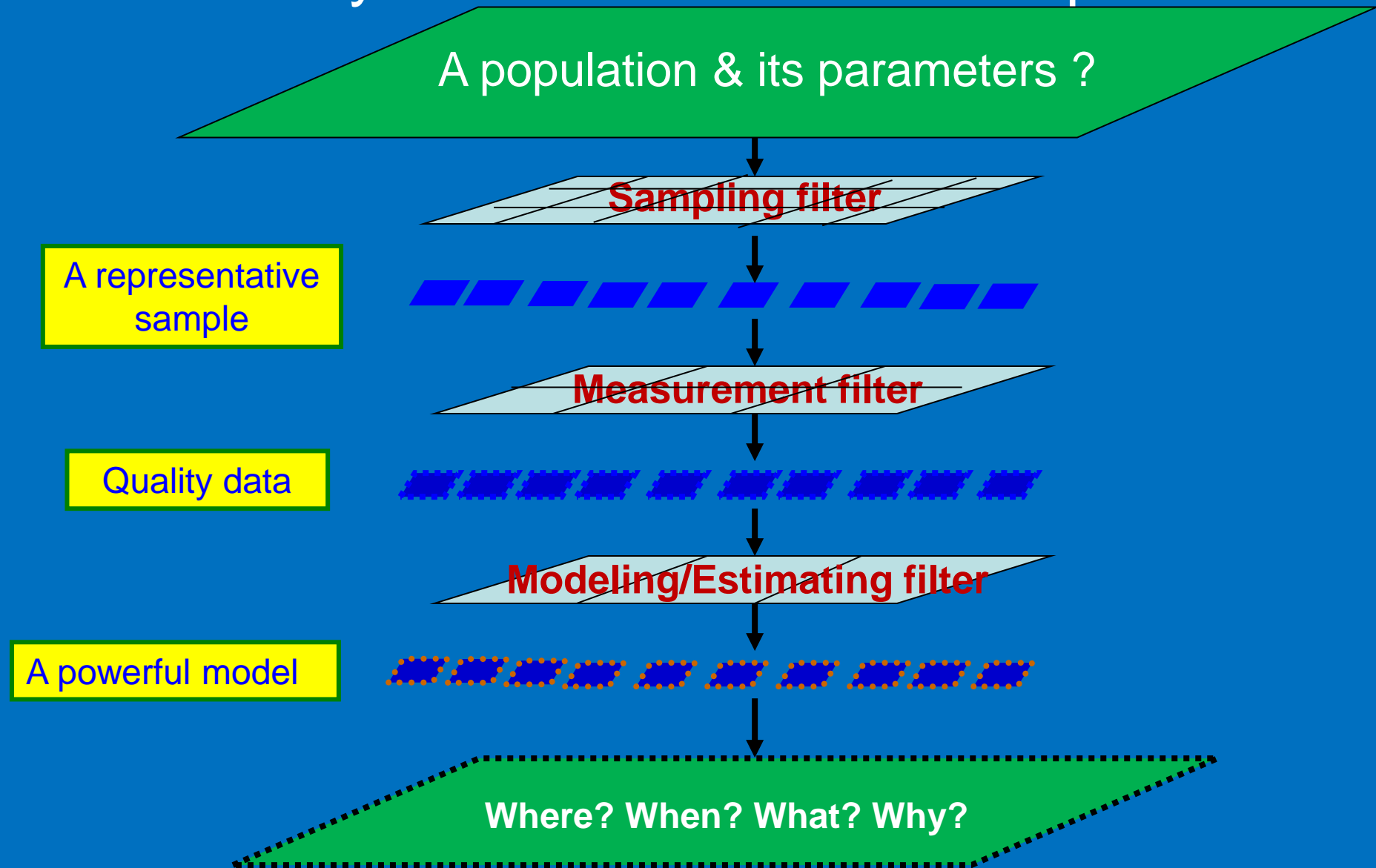# Environmental factors that drive the emergence and severity of infection from *Lecanosticta acicula* across Alabama

Joseph Z. Fan, Lori Eckhardt, Lana Narine
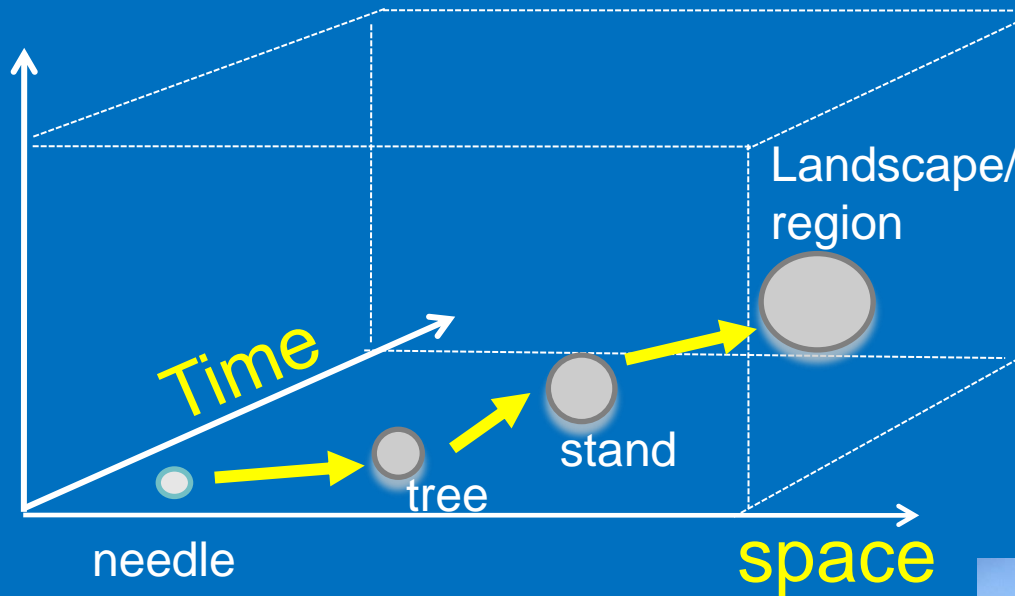
College of Forestry, Wildlife and Environment
Auburn University

Spatial modeling of the emergence and severity of BSNB infection and spread
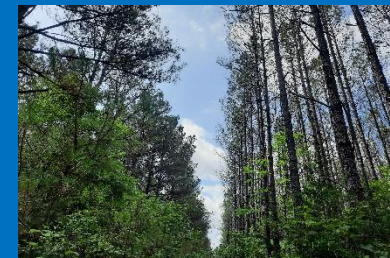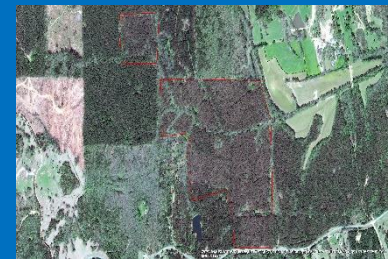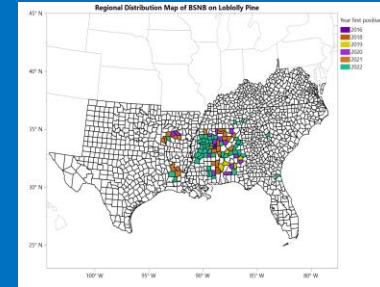
Ecological hierarchy of BSNB infection and spread

Organization level

Time

space

Landscape/region

stand

tree

needle

(adapted from Wu 2006)

(Photos from Jaesoon Hwang)
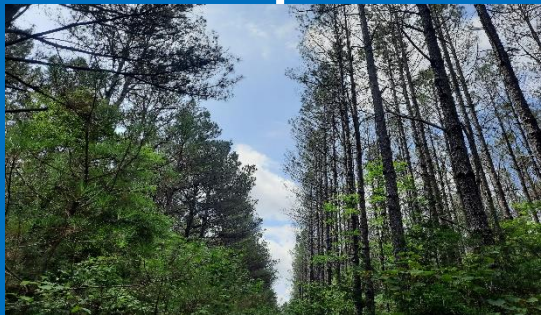
A conceptual model of BSNB and tree mortality: Environmental factors and interactions

Tree mortality

crown dieback

Needle infection

Predisposing factors
site/stand conditions
genetic factors
tree age, nutritional status

BSNB & tree mortality

Driving/inciting factors
wind
rainfall
climatic factors

Contributing factors
fire
human management
drought
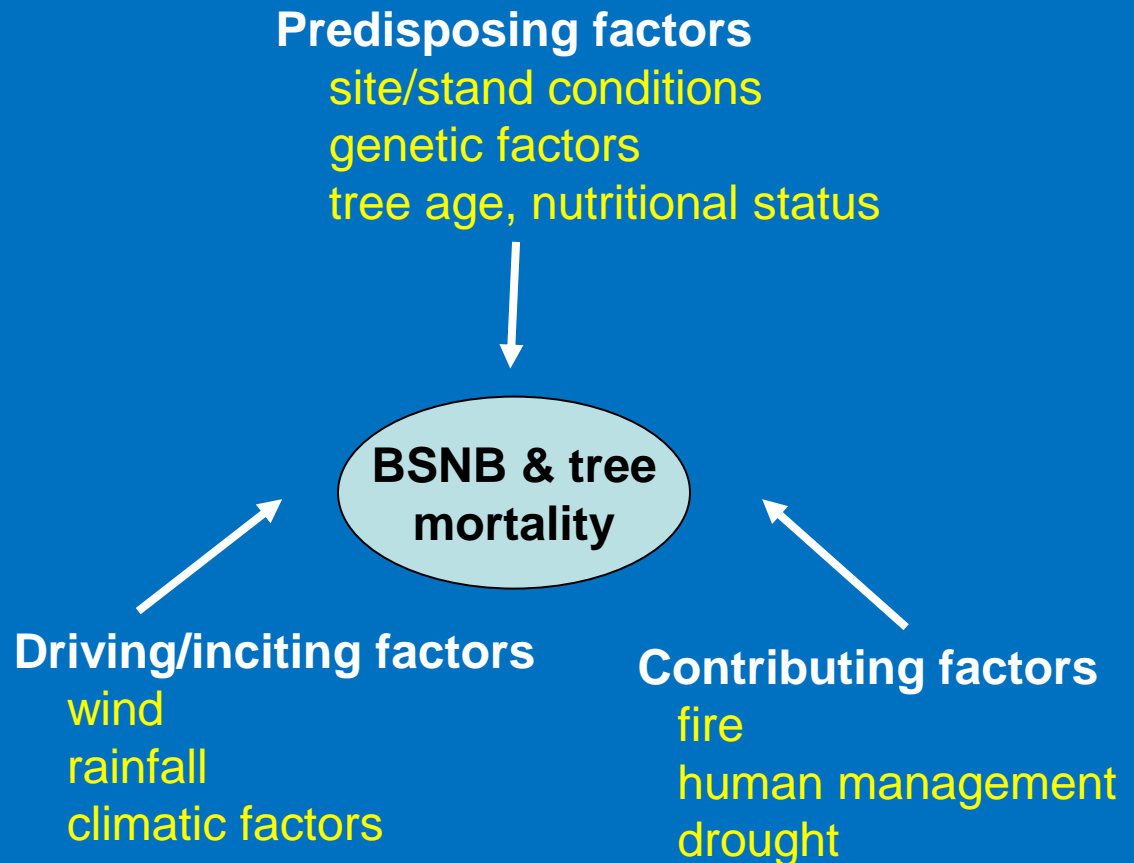
A conceptual model for tree mortality to short- and long-term environmental stresses (Pederson 1998): temporal dynamics at the tree and stand level
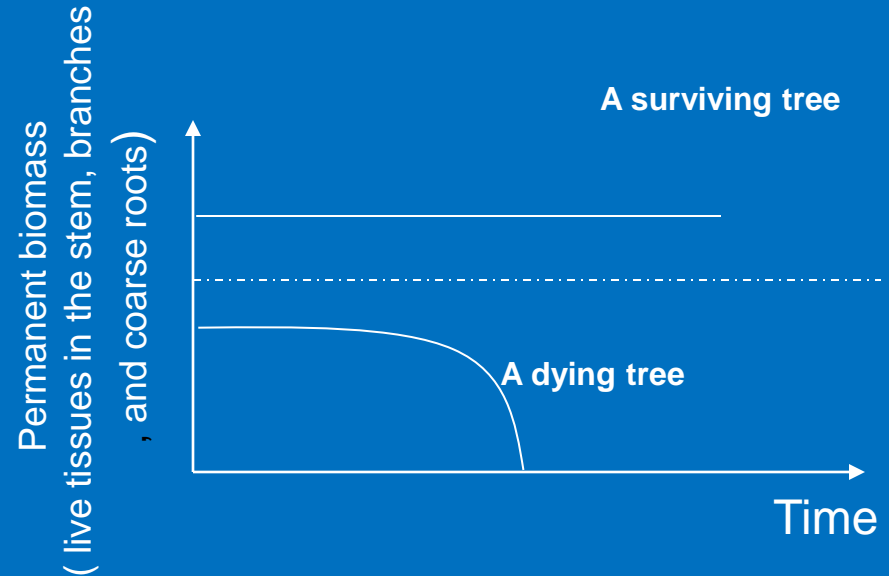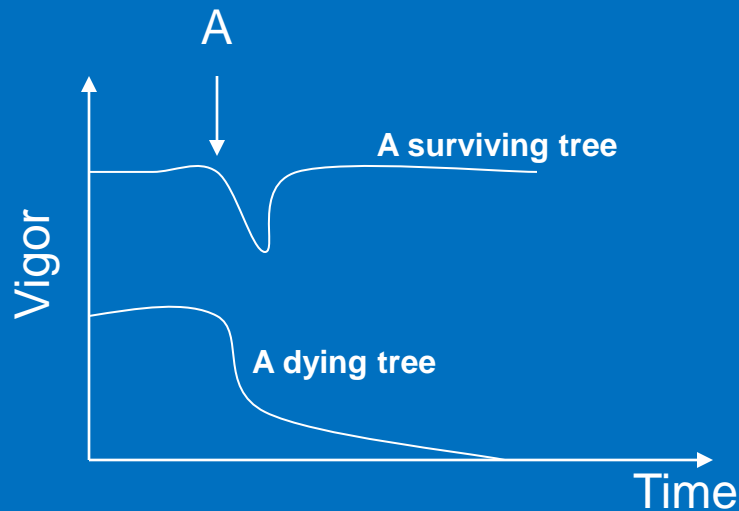
Predisposing factors (long-term):

A---Inciting factors (short-term):

Vigor: carbon available for defense and repair

Permanent biomass: live tissues

A conceptual model of BSNB infection and spread: spatial patterns of infected trees

Long-term monitoring of BSNB
spatiotemporal dynamics at the tree, stand, landscape level

Multiscale hierarchical spatial models

Ecological hierarchy, scale and scaling

```
┌─────────────────────────────────────────────────┐
│              Intrinsic scale                     │
│  (scale at which pattern or process operates)    │
└─────────────────────────────────────────────────┘
                        │
                        ▼
┌─────────────────────────────────────────────────┐
│             Observational scale                  │
│  (scale of measurement /sampling/experiment)     │
└─────────────────────────────────────────────────┘
                        ▲
                        ▼
        ┌───────────────────────────────┐
        │        Modeling scale         │
        │   (scale of modeling/analysis)│
        └───────────────────────────────┘
                        ▲
                        ▼
┌─────────────────────────────────────────────────┐
│           Policy /management scale               │
│ (scale of policy-making or planning/management)  │
└─────────────────────────────────────────────────┘
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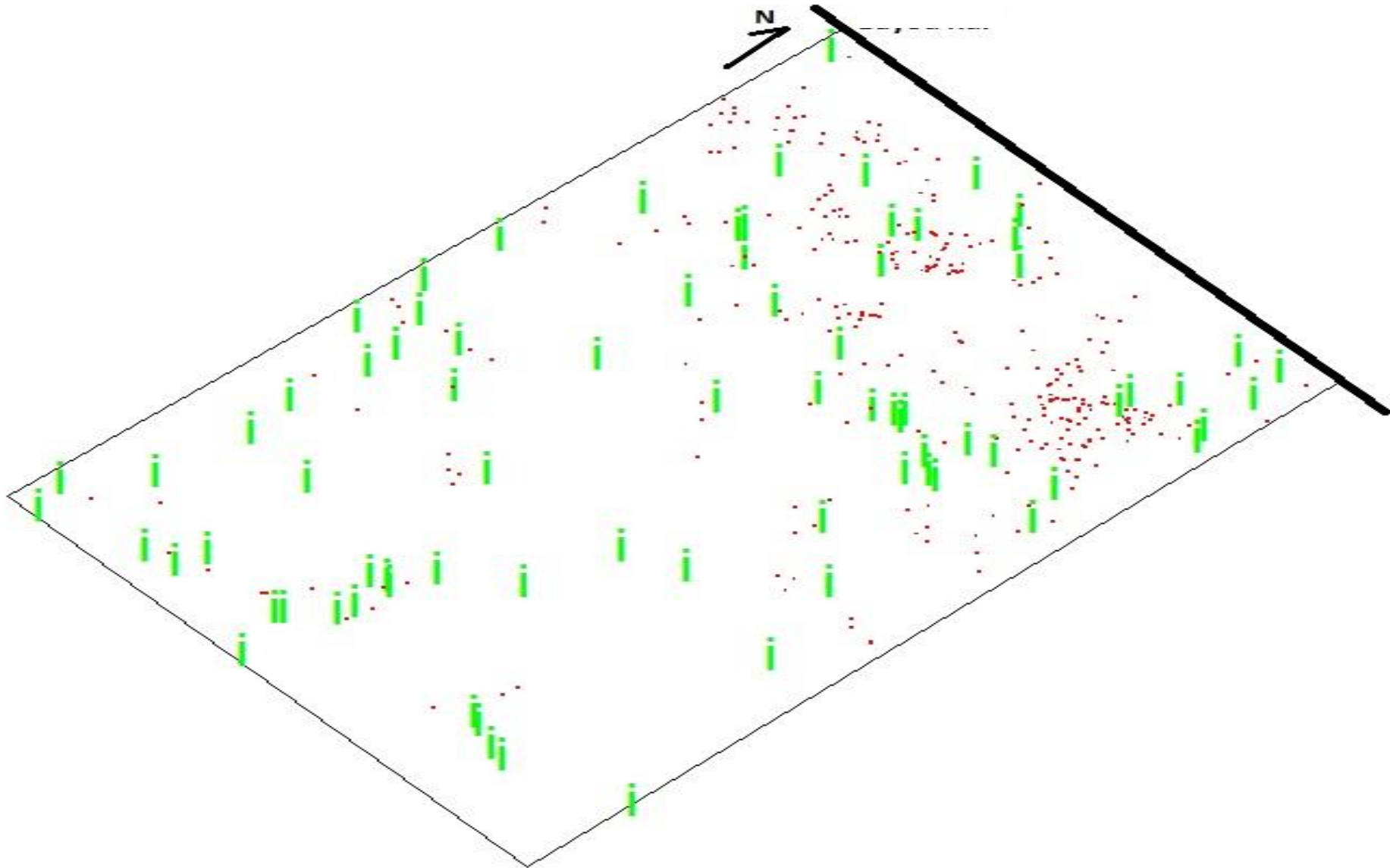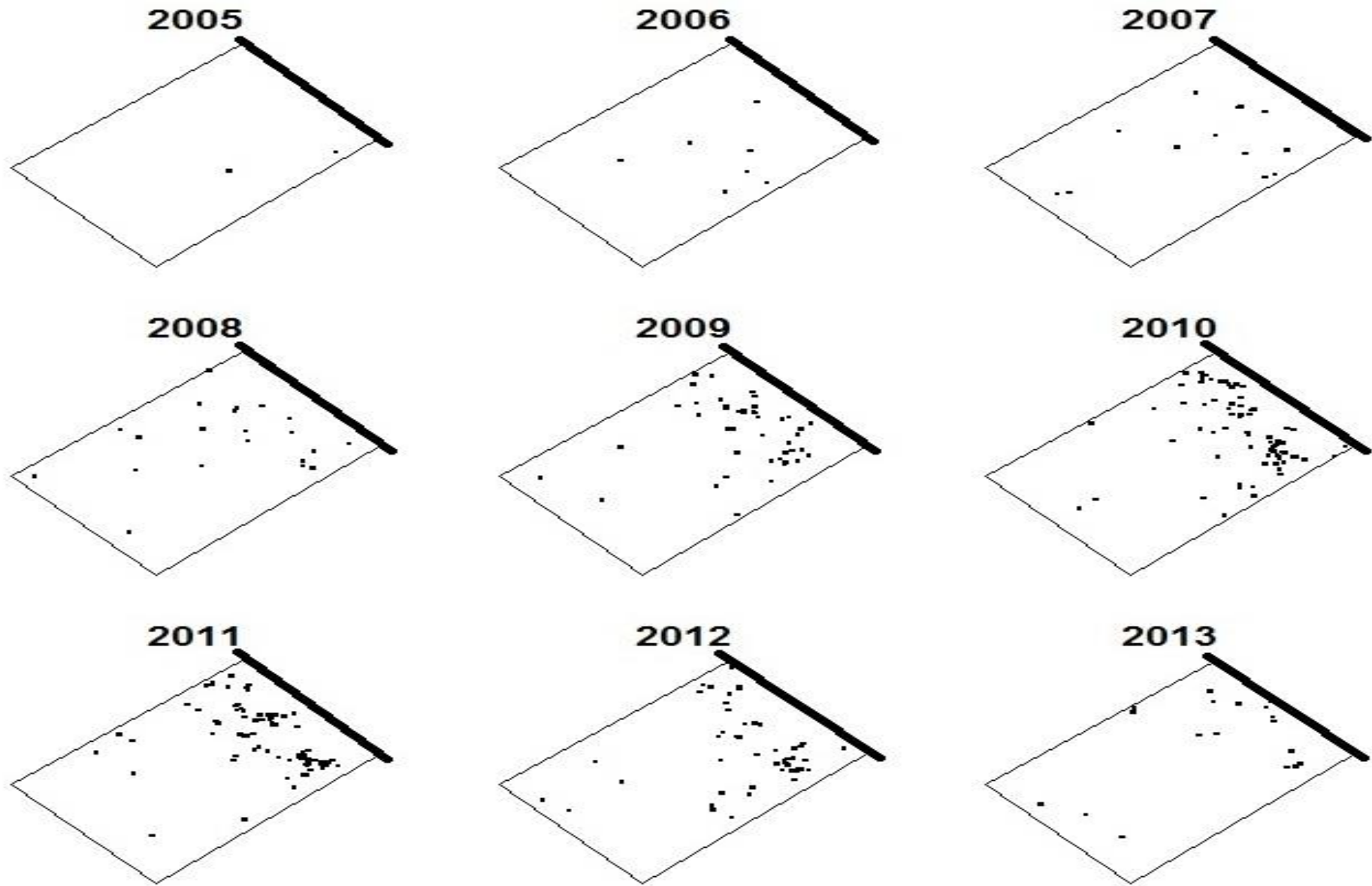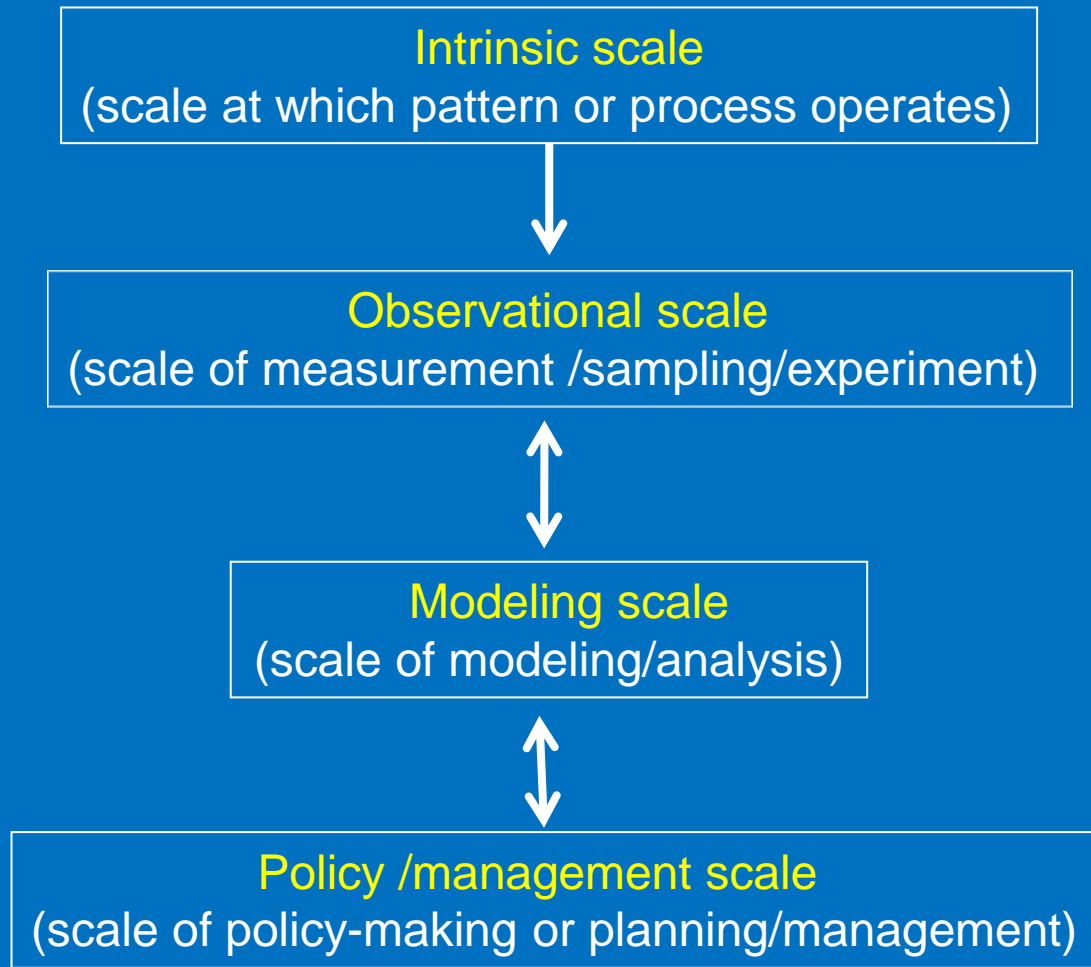
(Adapted from Wu 2006)

Prospective vs. retrospective methods

Contributing factors

1. Prospective- "Permanent plot monitoring"

Predisposing factors

Driving (climatic) factors

2. Retrospective- "Space-for- time"

Natural disturbance ⟷ Human activities

Landscape/ecosystem matrix

wind rainfall

Mapped data **+** Spatial modeling

Where, When, What, Why of BSNB?
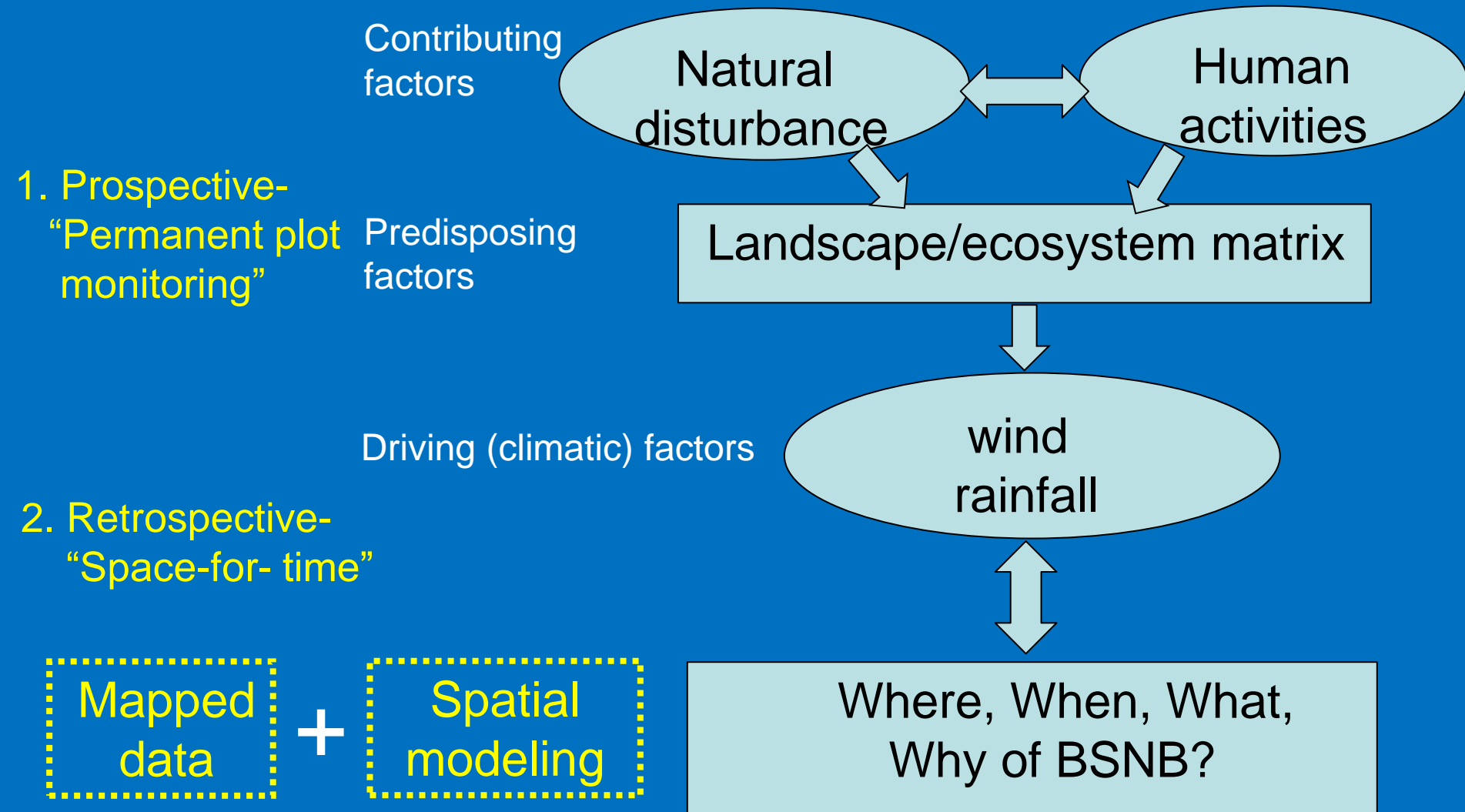
Summary

1) **Spatial patterns: Predisposing factors: landscape /stand composition and structure, tree age, nutritional status, etc.**

➡️ **Mapping & quantifying theoretical tree & stand hazards**

2) **Temporal dynamics**

- **Driving/inciting factors + contributing factors: natural and human disturbances**

➡️ **Projecting realized severity and dynamics**

3) **Spatiotemporal dynamics &Management Implications**

- **Prescribed burn**
- **Thinning**
- **Mitigation measures**

Questions?