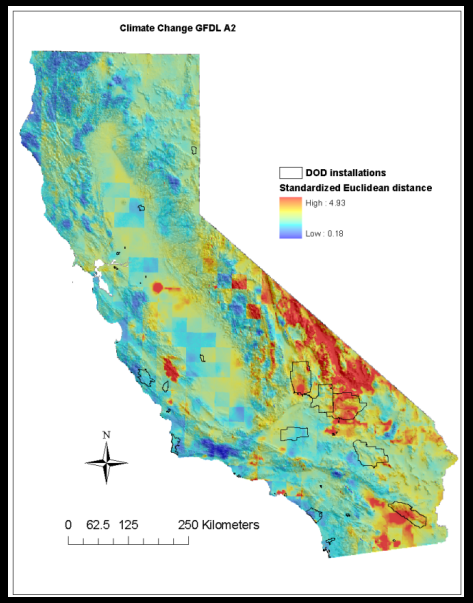
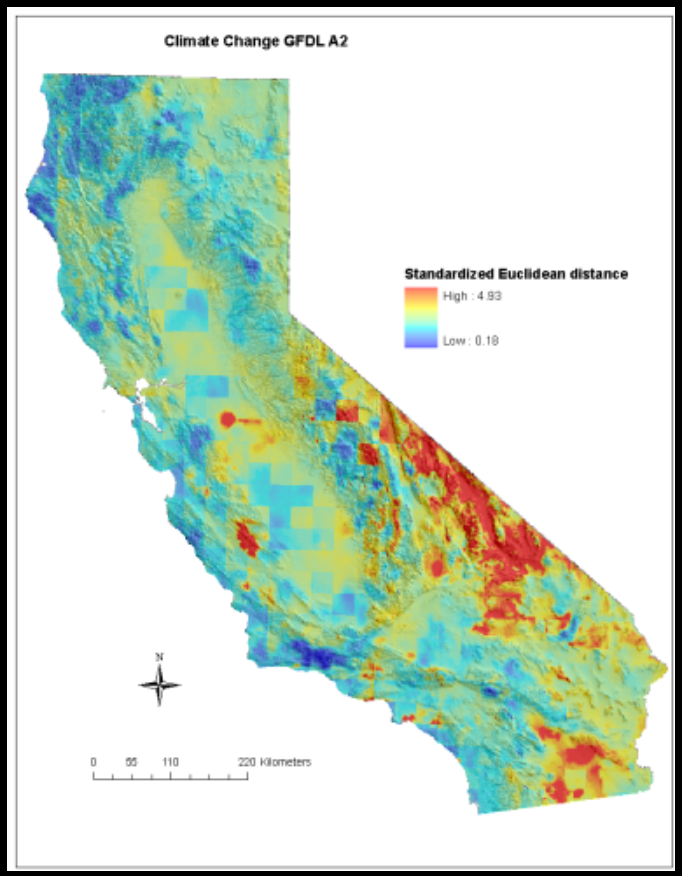
Elements of a Vulnerability Assessment: Exposure



Climate Change Exposure

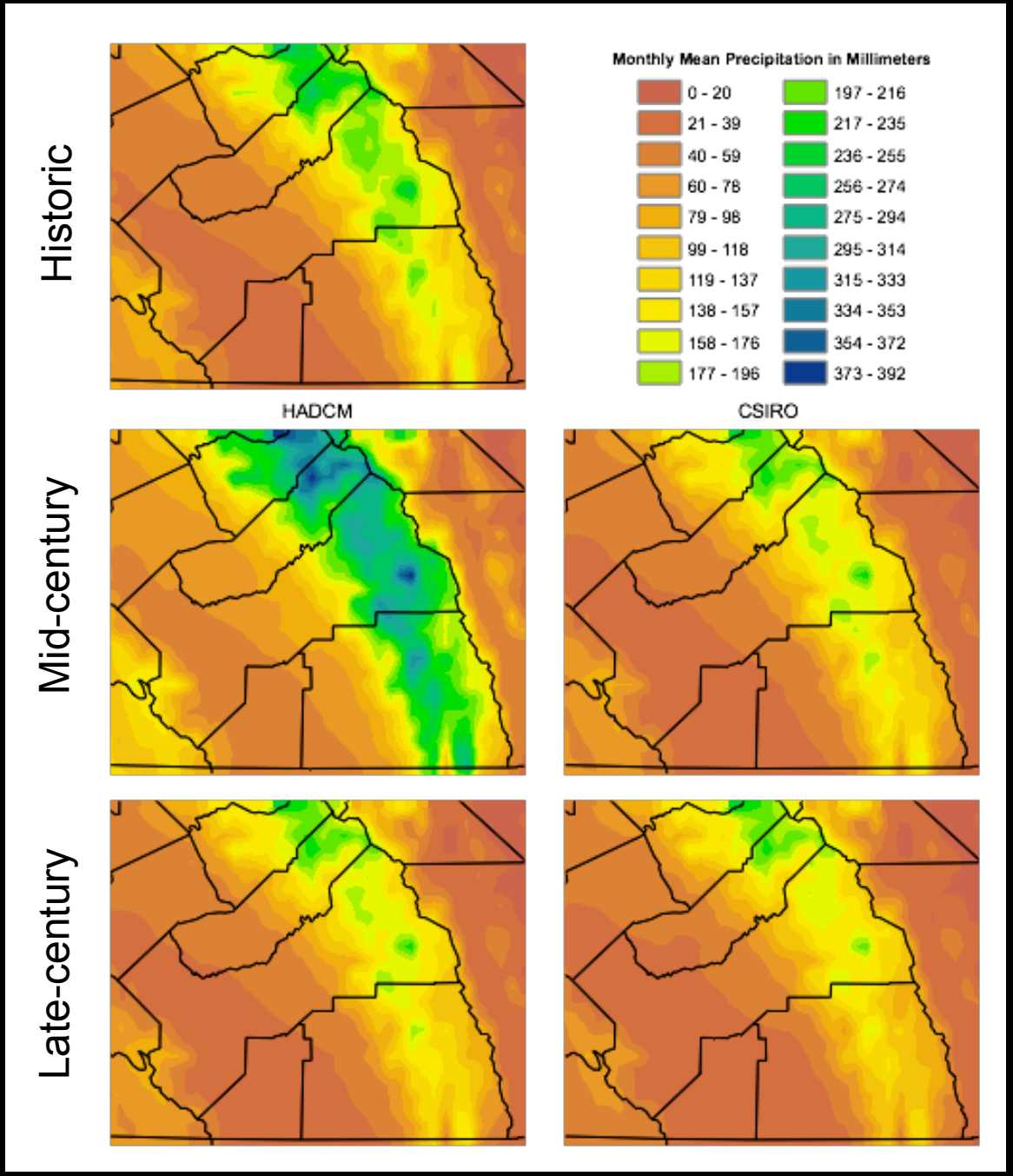
Measure of how much of a change in climate or other secondary factors a species or system is likely to experience

- Direct factors
  - Shifts in temperature, precipitation
  - Seasonality and extremes more important than averages
  - Historical inter-annual variation
- Indirect factors
  - Sea level rise
  - Soil moisture
  - Species distributions



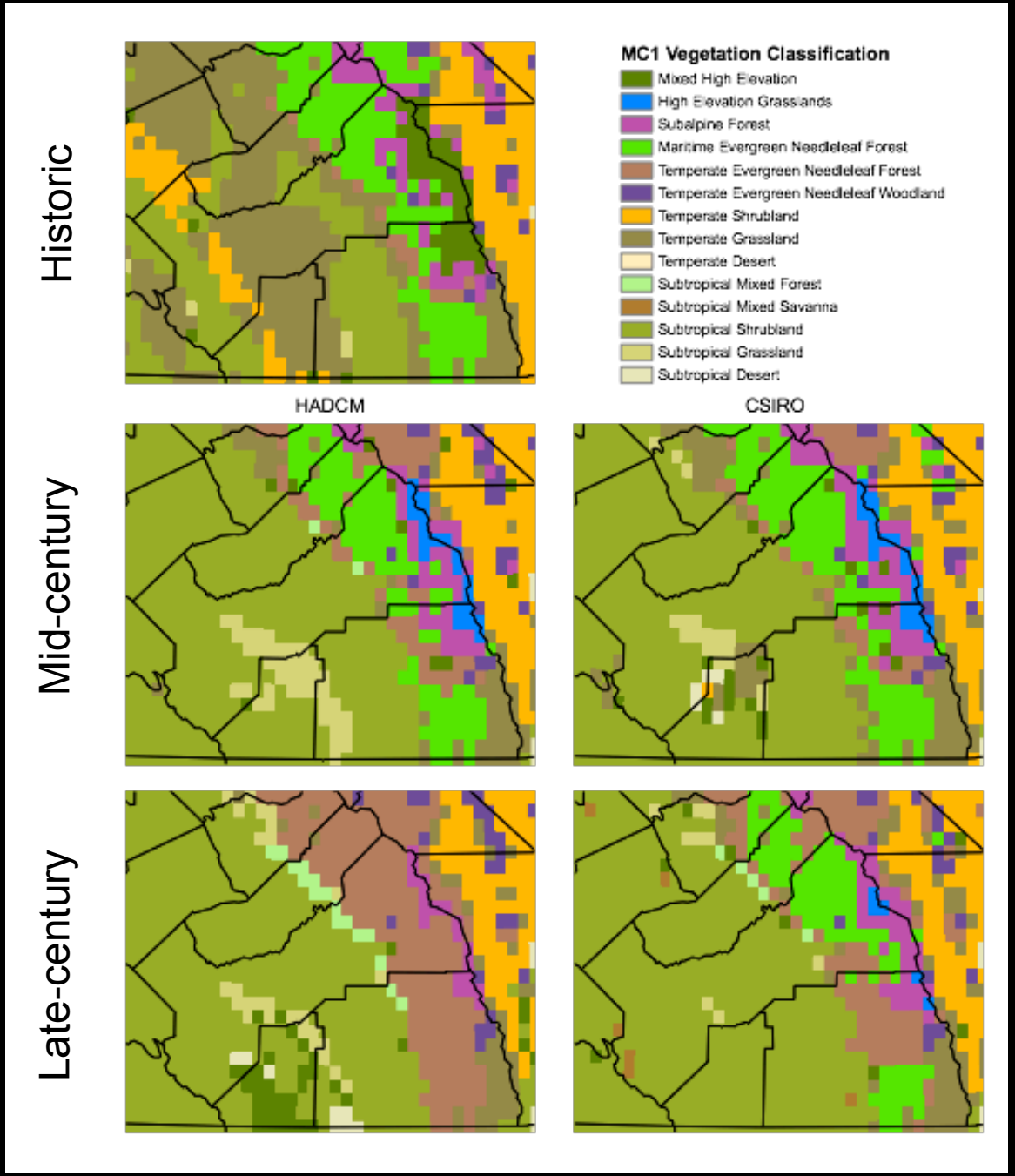
EXPOSURE

- Direct



EXPOSURE

- Indirect

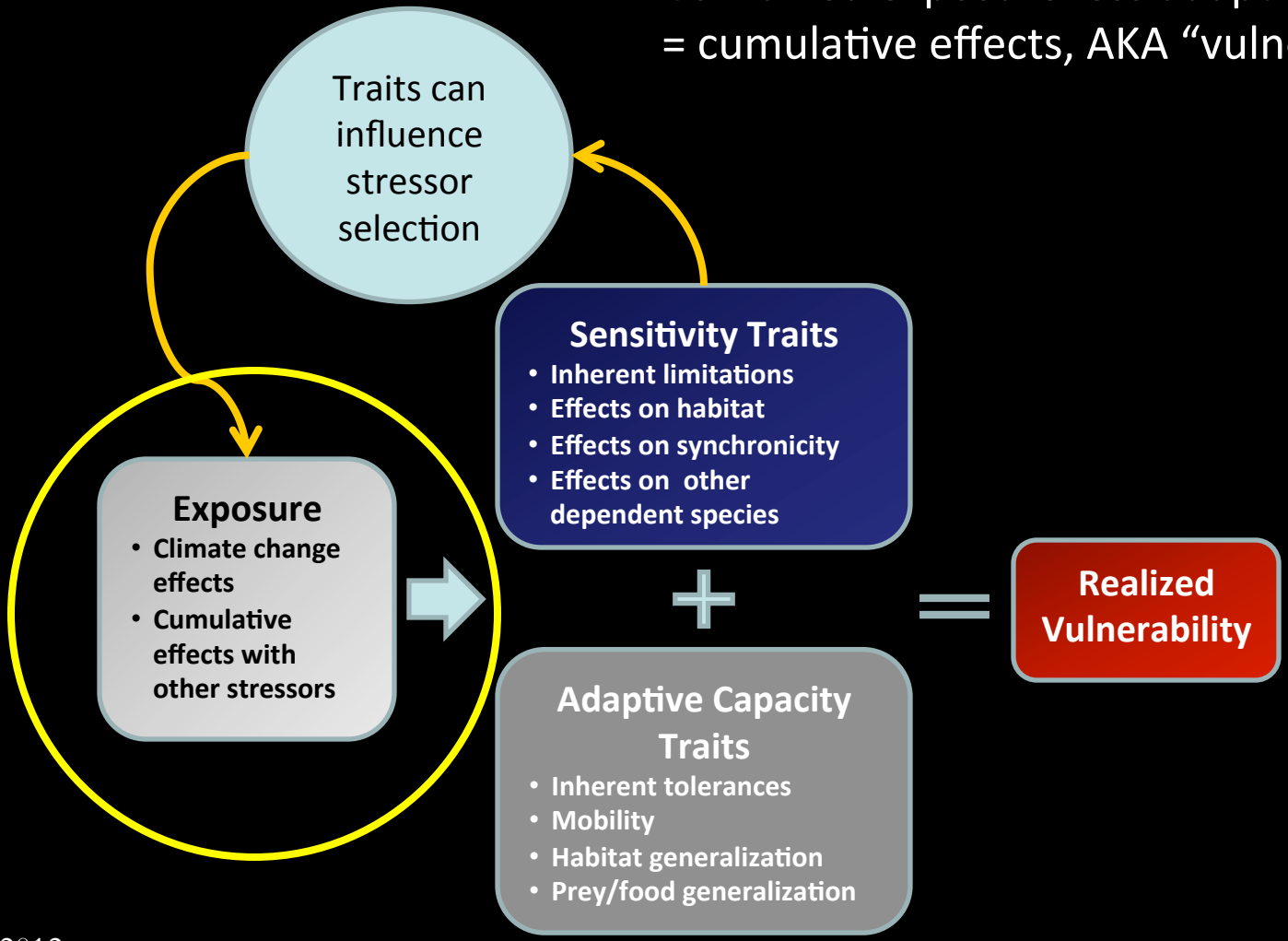


Human response to climate change

Human response to climate change

Vulnerability Model

Combined exposure less adaptive capacity
= cumulative effects, AKA “vulnerability”



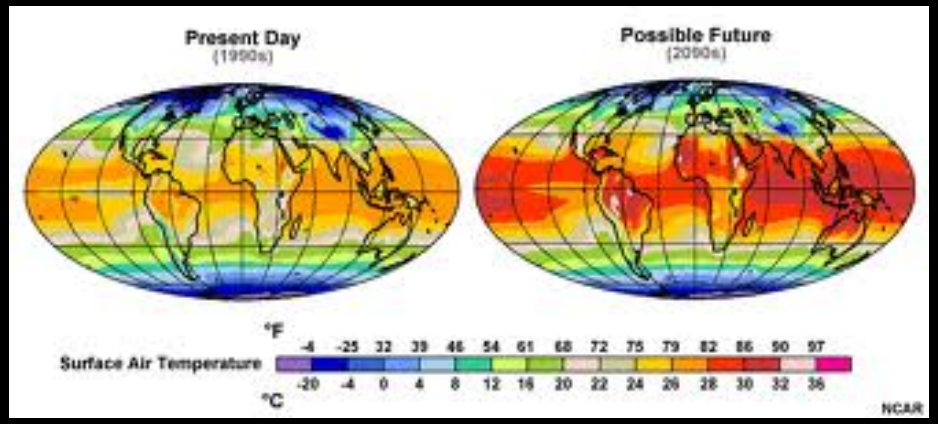
Crist et al. 2012

Sources & Differences in Climate Change Data

- All climate change data come from Global Climate Models (GCMs)
- Downscaled CC data are now ubiquitous but not standardized, use different methods and produce different variables
- Future forecasts don't come with probabilities
  - Ensembles
  - Scenario planning

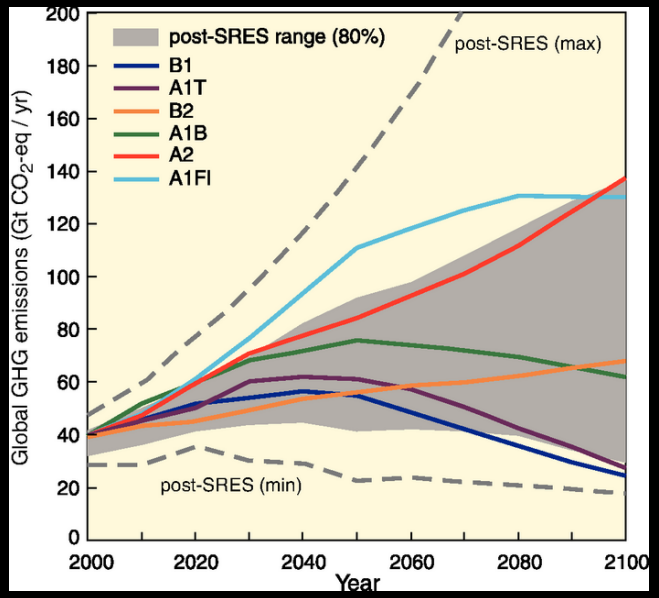
Global Climate Models (GCMs)

- Global climate models
  - Describe complex interaction between atmosphere, cryosphere, oceans, land, and biosphere
  - Large-scale (~100 km^2 but getting better)
  - Confidence higher in near term
  - Based on complex social interactions

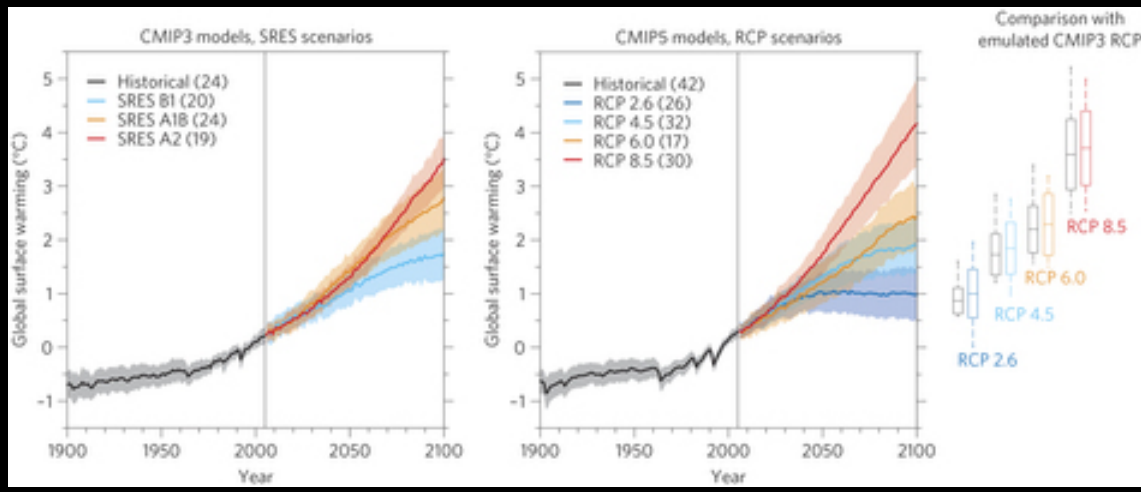


Which Emissions Scenarios to Use?

- Factors to consider
  - Length of your planning horizon
  - Sensitivity of key species or processes
  - Relationship to current trends
  - Level of acceptable risk



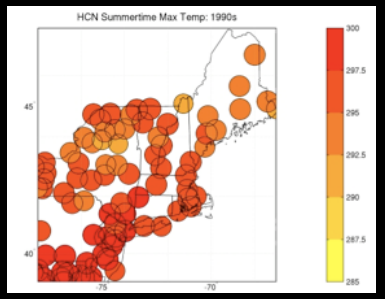
- Level of detail
  - Specific numbers
  - A range of numbers
  - Directionality



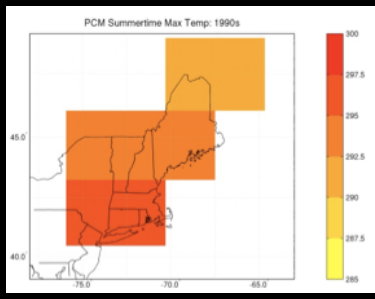
Is Downscaled Information Necessary?

- Factors to consider
  - Scale of area being managed
  - Complexity of area being managed
  - Does it affect the outcome?
- Benefits and limitations
  - Data often more relevant for management scale
  - False sense of accuracy
  - Sometimes used as a reason for inaction

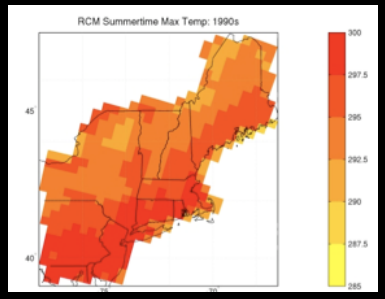
Observations



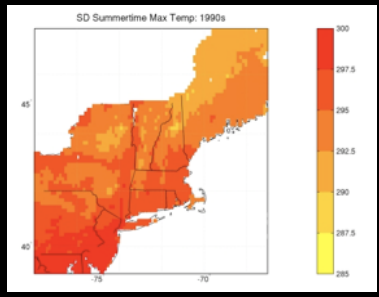
Global Model



Dynamical Downscale



Statistical Downscale

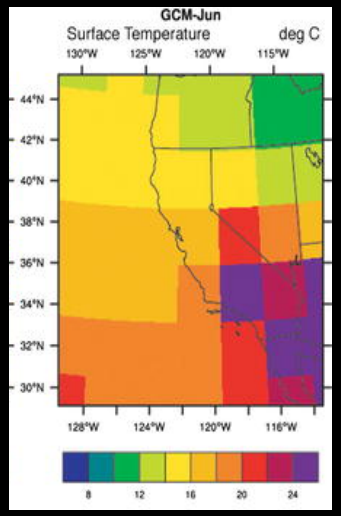


Downscaling GCMs

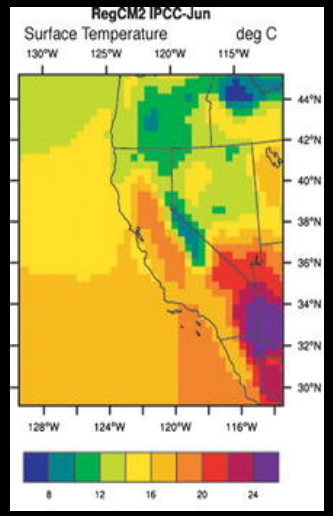
- Using models (and sometimes observations) to convert GCM data to smaller grid sizes (50 – 1 km^2)

- Multiple techniques available
  - Dynamic (expensive, less common)
  - Statistical (more common)
  - Change-factor (Delta method)

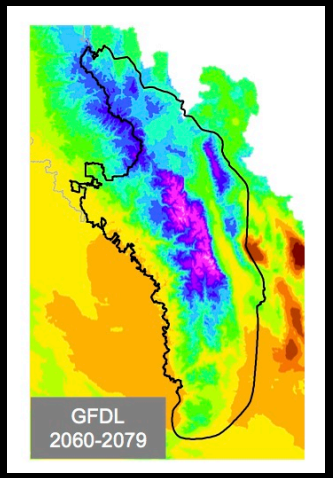
General Circulation Model (GCM): 2-3°



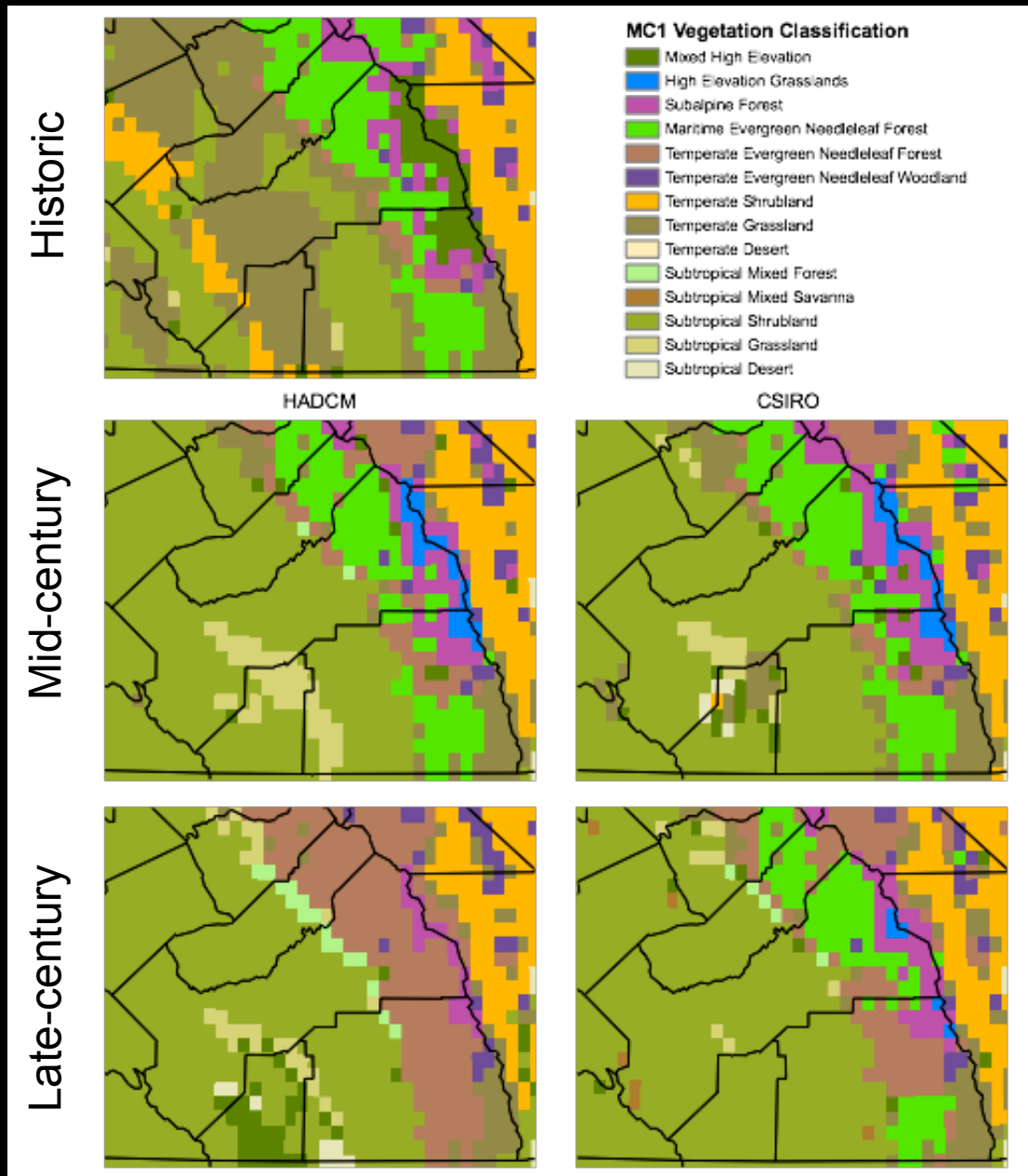
Regional Climate Model (RCM): 30 km



Downscaled General Circulation Model (GCM): 800m

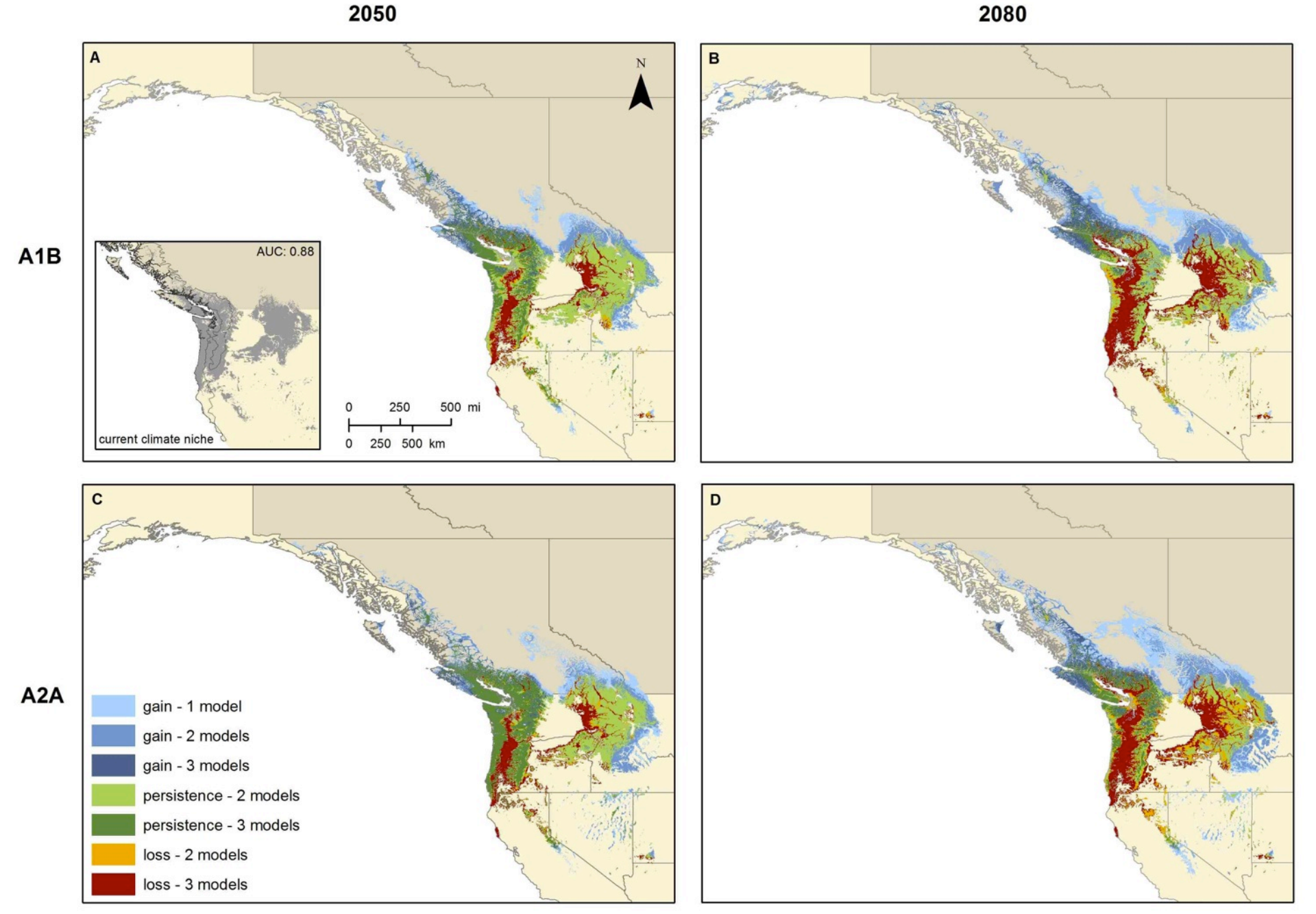


Functional model – MC1



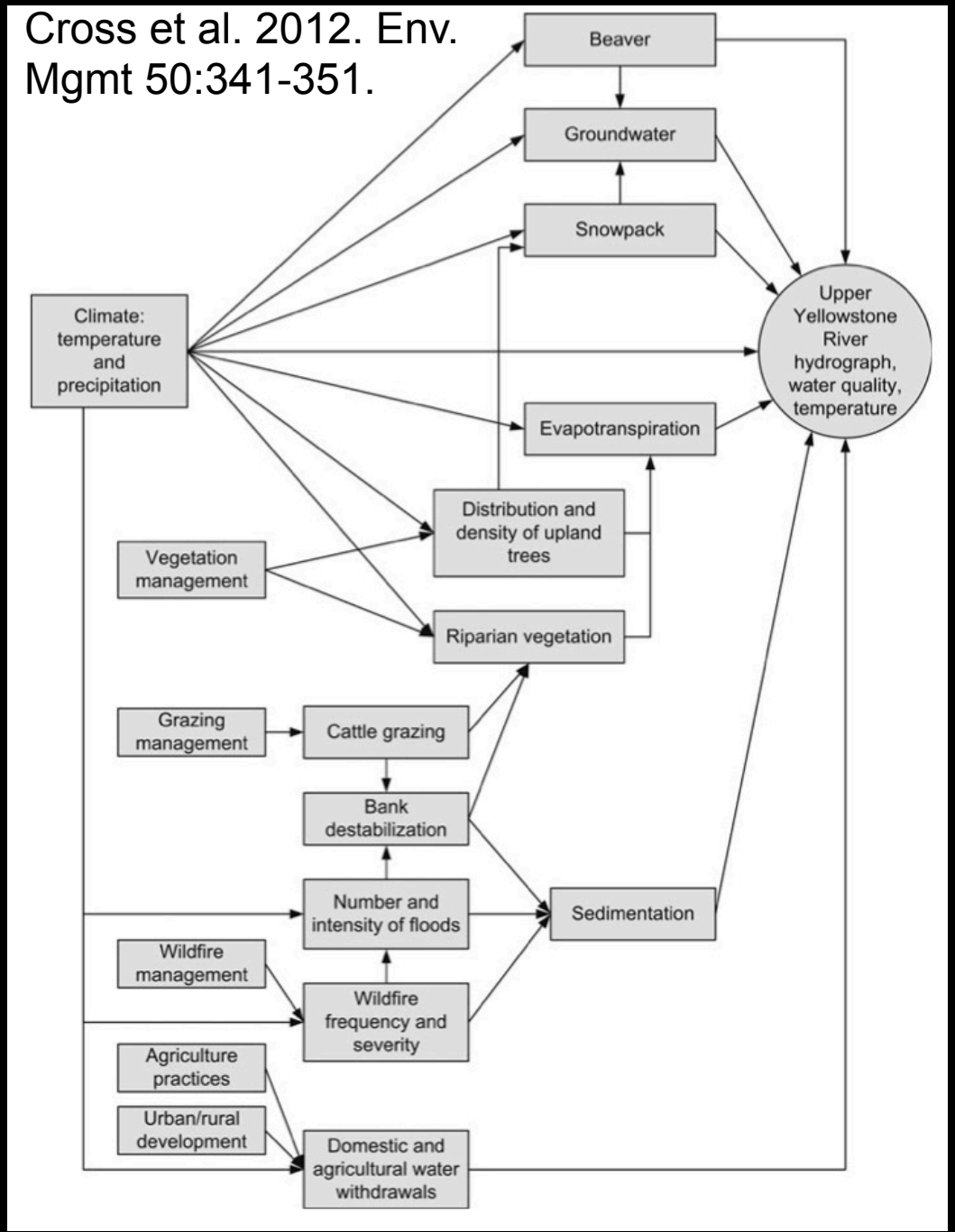
CLIMATE ENVELOPE MODEL

GRAND FIR



Adaptation for Conservation Targets (ACT) Framework

Cross et al. 2012. Env. Mgmt 50:341-351.



Expert opinion

Non-climate Stressors Exposure

Important because they decrease integrity making resources less resilient to climate change (ALSO traditional conservation concerns)

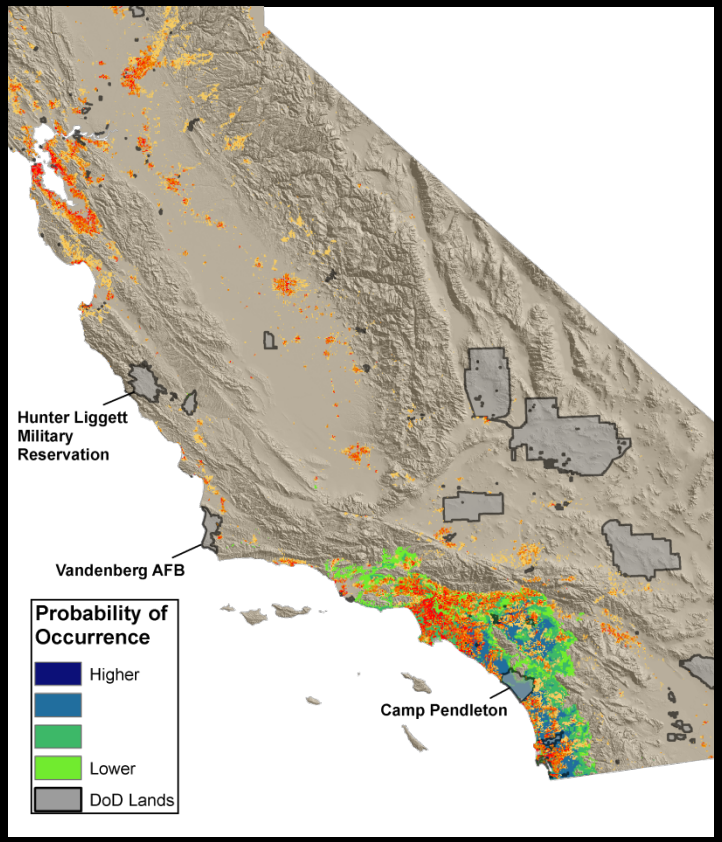
Examples

- Development (e.g. power lines, roads, houses)
- Management practices
- Invasive species spread

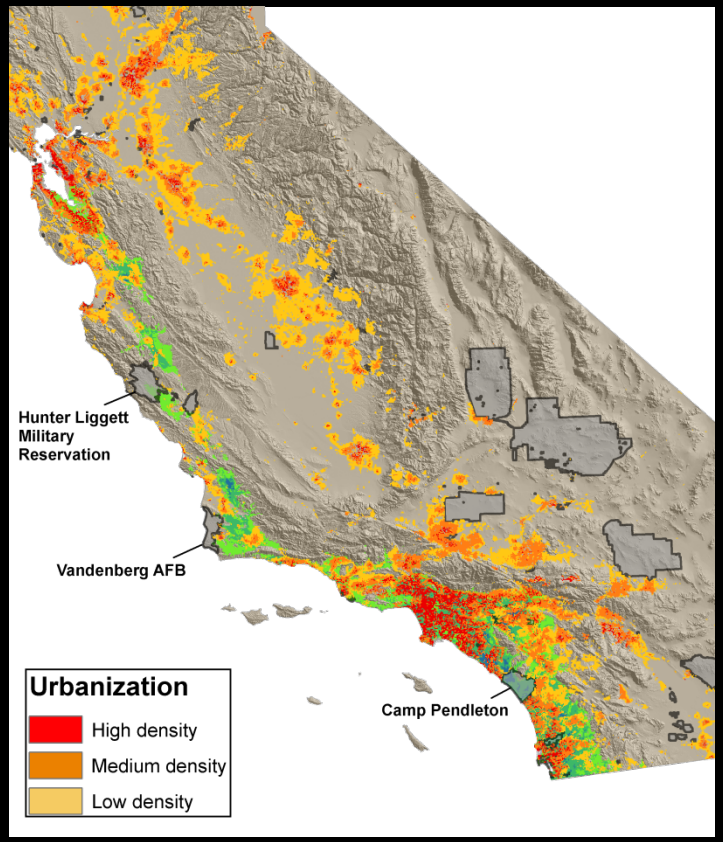
Non-climate Stressors Exposure

California Gnatcatcher

2010



2070



Refugia

Study area boundary

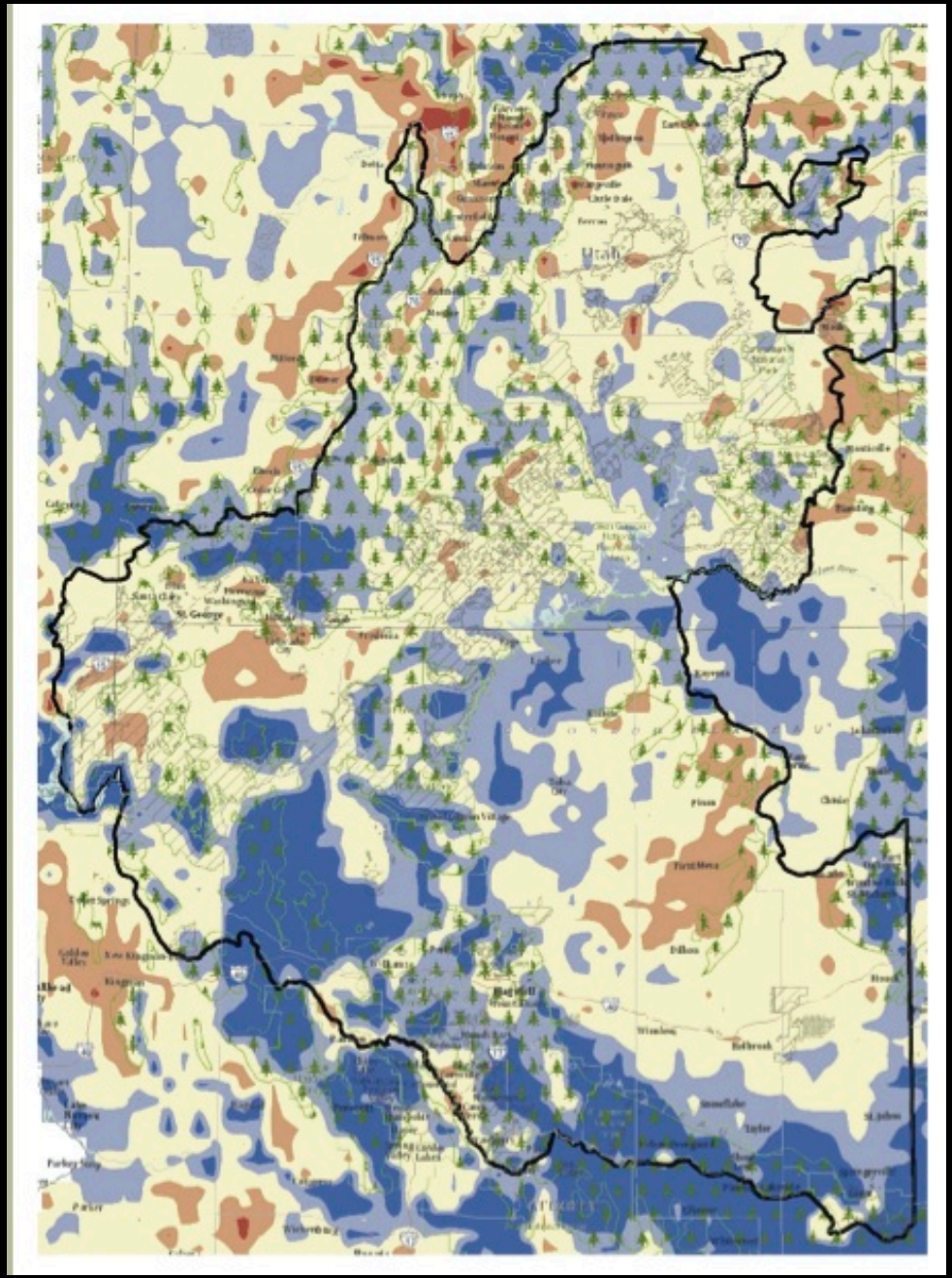
Forested areas

Current protected areas

Combined landscape condition, climate stability, and terrestrial vertebrate species richness

High landscape intactness, stable climate, and high species richness

Low landscape intactness, unstable climate, and low species richness



Some Options for Determining Exposure

- Simple overlay model (what effects may this resource be subject to) – visual or quantitative
- Cumulative effects assessment (what parts of the resource's distribution will be subject to what combinations of stressors)
- Climate analogues: Where is current climate the closest match for future climate?

Break-out: Assessing Exposure