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The Nature Conservancy

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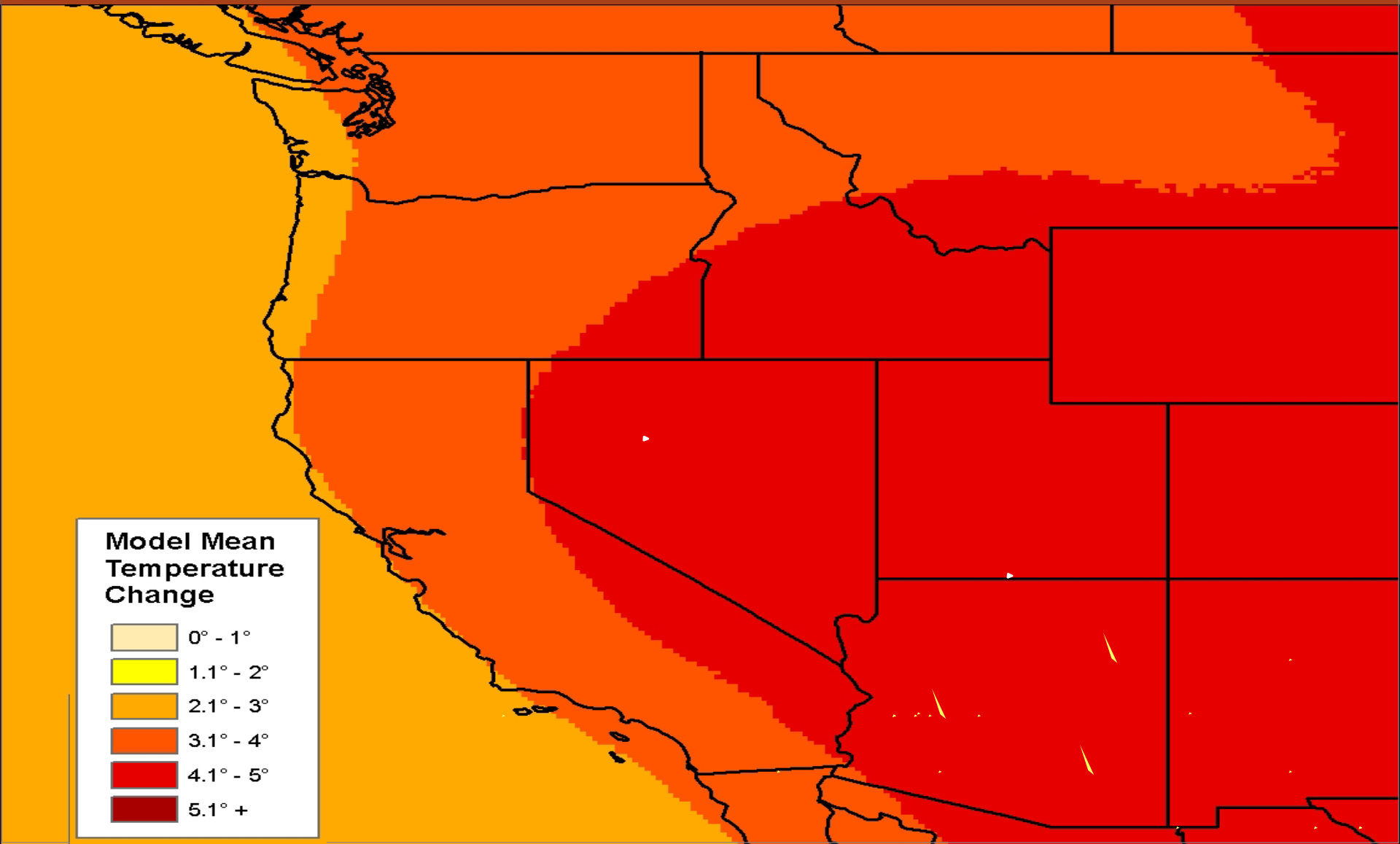
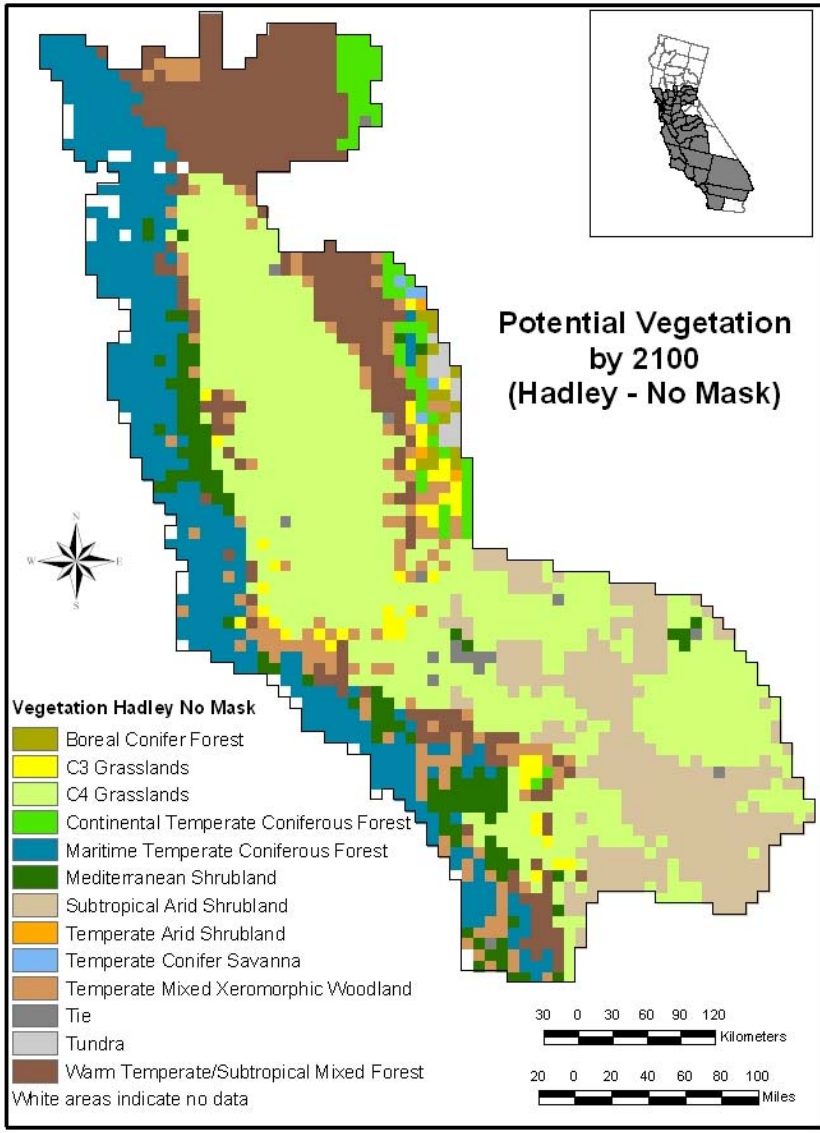


# ecological impacts observable

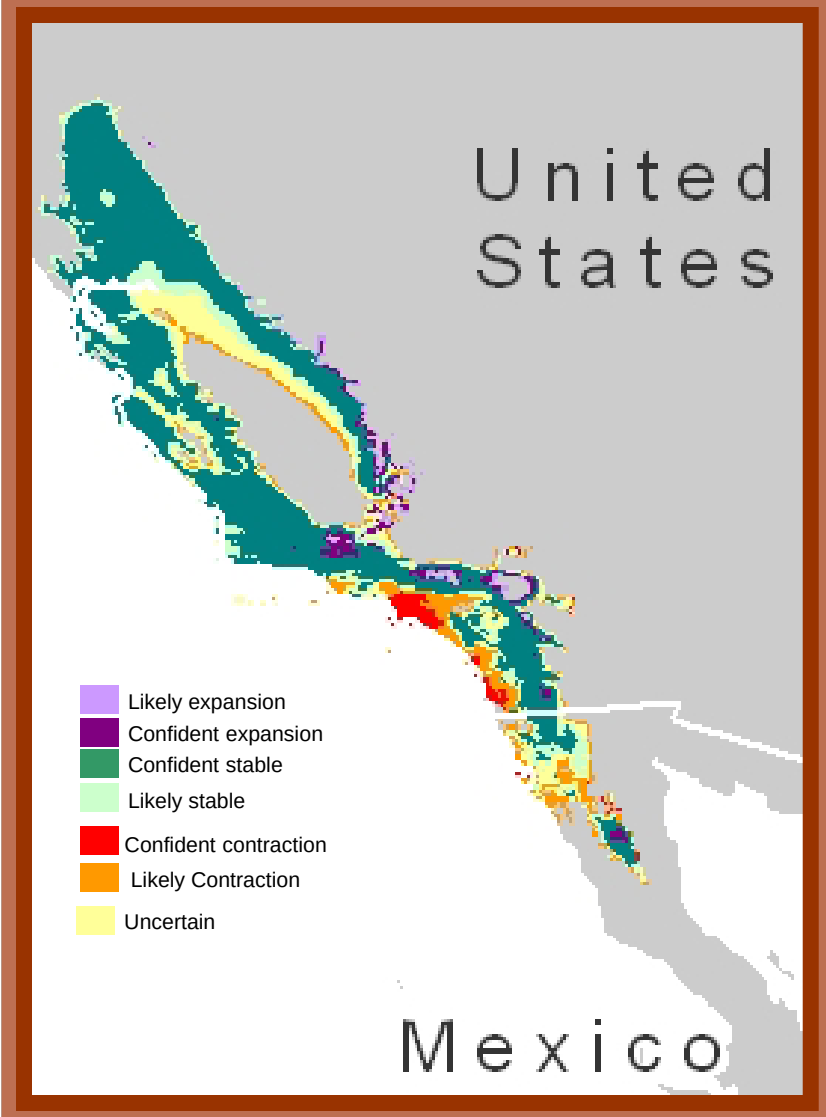
- Observable responses to climate change: timing of growing season length, phenology, primary productivity, species distribution and diversity
- California: 70% of 23 butterflies advanced 1st spring flight by 24 days (Forister & Shapiro 2003)
- Plants in Southern California moved upslope by average of 65m in 30 years (Kelly & Goulden 2008)

# impact/vulnerability studies

- Shifts in ecosystems, increased fire (Lenihan et al. 2008)
- Shifts in plant distribution and diversity (Loarie et al. 2008)
- Survival of endemic species dependent on dispersibilty (Levinsky et al. 2007)



# adaptation of California species and systems




- What do we do in California?
- How do we use the climate impact information to manage and adapt?
- How do we use the uncertainty to our advantage?
- How do we manage risk in the context of the goals ywe are trying to achieve?

# Adaptation research goals

- Fully recognizes the information needs of managers
- Addresses management goals and targets of relevant state agencies
- Provides guidance on use of vulnerability information to achieve management goals, including uncertainty of outcomes and managing risk
- Fully identifies and addresses the steps of an adaptation framework for resource management decision-making
- Defines set of standard impact assessment methodologies including defining GCMs &emissions scenarios appropriately applied to California and most reasonably bounding the range of future climate outcomes
- Conducts climate impacts/vulnerability modeling at relevant spatial and temporal scales to capture the biological processes of concern and scale of management
- Develops adaptation strategies and associated costs for decision-making
- Develops a body of information that is readily accessible to resource manages and decision makers

# two areas of investigation

- Impact/vulnerability research
- Management adaptation research

# gaps in adaptation research

- Impacts/vulnerability research – focus on innovation and not utility, need both
  - Lots of impacts studies, no guidance on how to utilize the information
  - Climate change and vulnerability information not at the spatial and temporal scale of resource management decision-making and goal-setting
  - Analyses on uncertainty and risk with interpretation for use by rsource managers
- Management adaptation research – scarce for adaptation ecological systems
  - Understanding climate change uncertainty, impacts/vulnerability of management targets
  - Assessing risk to current goals
  - Developing adaptation strategies and adaptive cpapcity to reduce risk
  - Modifying goal setting and planning processes to adaptively incorporate climate impacts into adaptive management
  - Understanding costs of adaptation

# impacts/vulnerability research areas

- *Monitoring for change and developing data availability at management scales*
- *Improving understanding of vulnerability across relevant targets for management of resources*
- *Improving understanding of multiple, interacting stressor influences on vulnerability of the species/system of concern.*
- *Determining distributional/abundance impacts across a range relevant to management*
- *Understanding vulnerabilities under extreme events.*

# impacts/vulnerability research areas

- *Monitoring for change, developing data availability at management scales*
  - Develop monitoring programs to establish baselines and test effectiveness of adaptation strategies
  - Develop regional climate models parameterized for California for use in impact/vulnerability studies at scales relevant to management.
  - Test modeled range shifts with historical and current species observations, and monitoring plans for areas where species are predicted to be extirpated
  - Historical validation of AOGCM performance in California, with climate variables that are relevant to resource management (e.g. tmax in the summer, tmin in the summer, evapotranspiration, seasonality of precipitation)
  - Use historical baseline observational data and species modeling to calibrate and test projections about climate change impacts on species distribution and abundance in the future

# impacts/vulnerability research areas

- *Improving understanding of vulnerability across relevant targets for management of resources*
  - Develop methodologies to integrate process-based and species-based models and applying them to California management areas
- *Improving understanding of multiple, interacting stressor influences on vulnerability of the species/system of concern.*
  - Develop impact assessment of multiple interacting stressors on vulnerability of the State's natural resources, particularly focused on land use change, fire and invasive species and their interaction with species-responses to climate change
- *Determining distributional/abundance impacts across a range relevant to management*
- *Understanding vulnerabilities under extreme events.*

# management adaptation research areas

- *Developing a research process that explicitly engages resource managers in identification and development of research needs*
- *Developing a body of vulnerability and adaptation information that is readily accessible to resource manages and decision makers*
- *Understanding impact of management action on vulnerability outcomes*
- *Developing approach for understanding vulnerabilities in context of managing risk*
- *Developing adaptive strategies to meet the goals, understanding the limits of adaptations strategies and developing process to adaptively reassess goals.*
- *Identify opportunities for modifying goals/policies/regulatory frameworks to allow for increasing adaptive capacity*

# management adaptation research areas

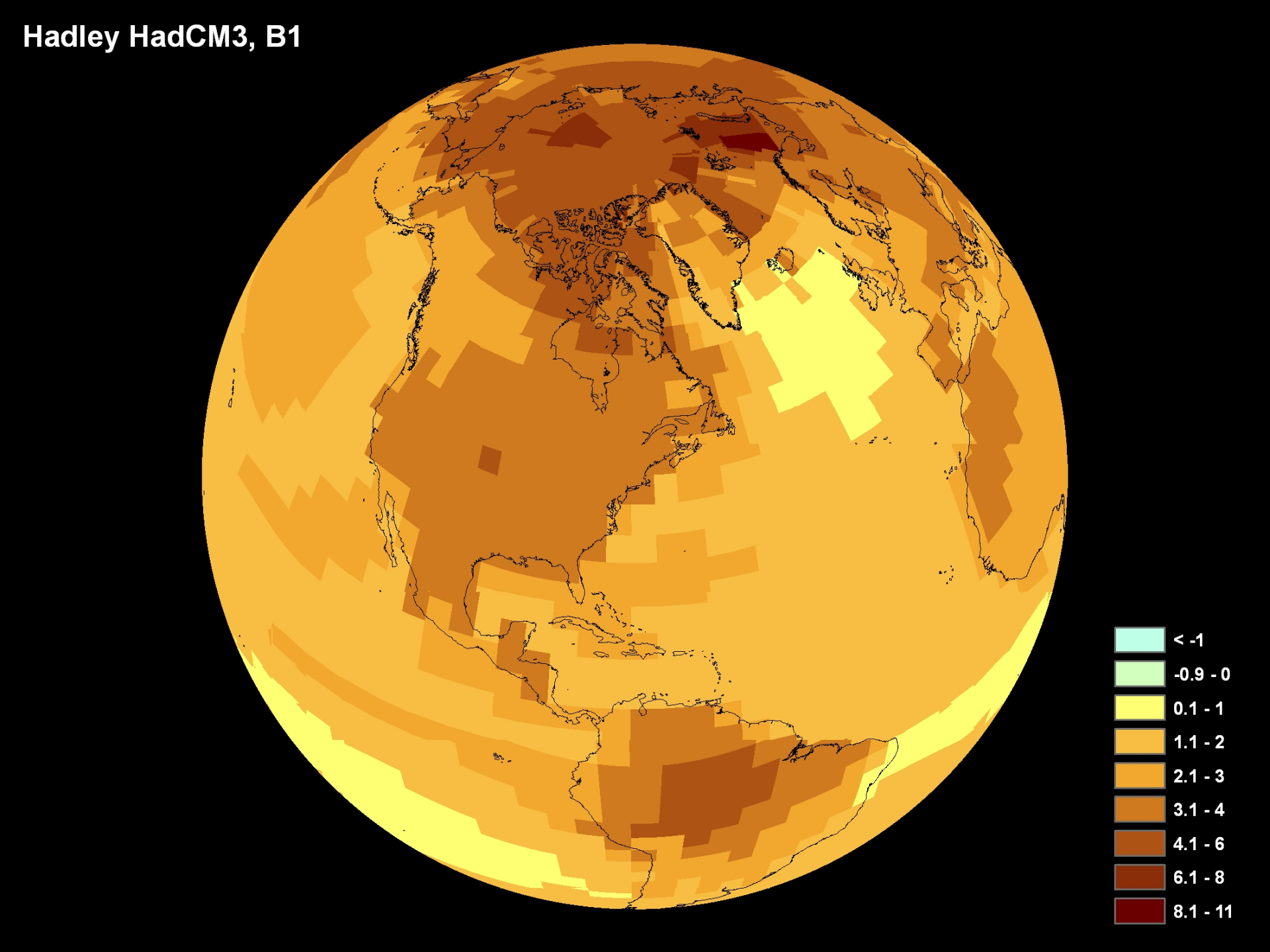
- *Developing a research process that explicitly engages resource managers in identification and development of research needs*
- *Developing a body of vulnerability and adaptation information that is readily accessible to resource manages and decision makers*
  - Develop web-based public databases for dissemination of research results and guidance on how to incorporate results into management practice to enhance adaptive capabilities.
- *Understanding impact of management action on vulnerability outcomes*
  - Conduct an assessment to establish which management practices enhance or decrease species/system resilience under climate change and how each might need to adapt to allow to increase adaptive capacity

# management adaptation research areas

- *Developing approach for understanding vulnerabilities in context of managing risk*
  - Guidance on the use the interpretation of climate change impacts and vulnerabilities assessment, including uncertainty of outcomes, with respect to meeting management goals. Design of programmatic outreach to disseminate findings

# management adaptation research areas

- *Developing adaptive strategies to meet the goals, understanding the limits of adaptations strategies and developing process to adaptively reassess goals*.
  - Develop understanding  of the implications of hotspots of genetic diversity for meeting long-term biodiversity goals
  - Develop methodologies and case studies for applying species-specific impact studies to resource planning and implementation
  - Develop methodologies that prioritize development of protected areas that for sustaining existing species across an climatic gradient, incorporate important corridors for species/system movement, and targets  processes that sustain biodiversity (including evolutionary processes)
  - Develop methodologies to integrate vulnerability information from finer-scale modeling and experiments with the planning-scale methods for the development of short- and long-term priorities
  - Develop methodologies for assessing adaptation costs for alternative conservation strategies and triage criteria
- *Identify opportunities for modifying goals/policies/regulatory frameworks to allow for increasing adaptive capacity*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