Integrated Landscape Monitoring Great Basin Pilot

February 6, 2007

U.S. Department of the Interior
U.S. Geological Survey

GBILM Goals

- Develop interdisciplinary team
- Initiated as new work
- Test concepts and develop tools to....
  - Reconcile site-specific actions/events with landscape-scale processes and functions
  - Analyze monitoring data to understand change at multiple scales
  - Develop predictive capability for landscape change
  - Develop or refine monitoring strategies

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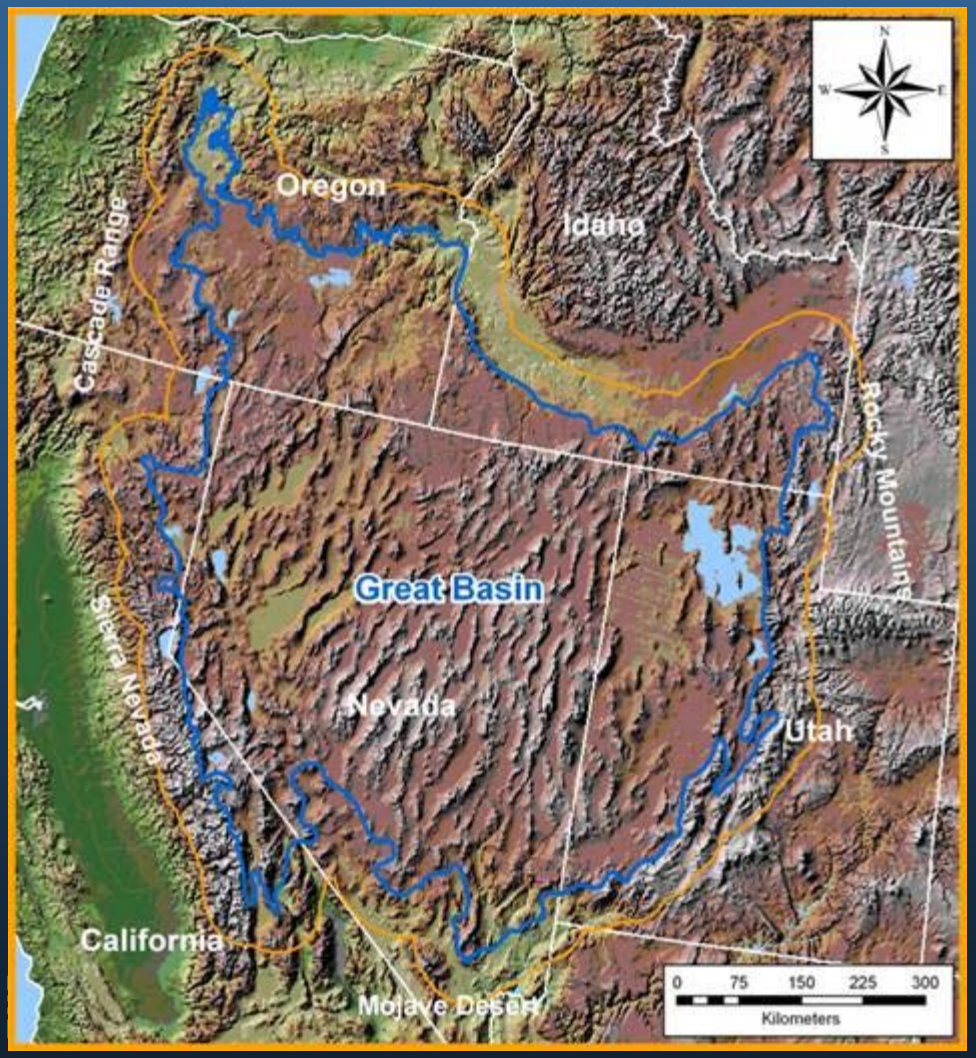
The Great Basin



- Over 111 million acres
- 78% public lands
- Five western states
- N-S Mountain ranges
- Varied altitudinal changes
- Water drains inland

Blue boundary – GB boundary
Orange boundary – GB with 50 m buffer

The Great Basin - Ecology

- Varied and extreme climate
- Topography creates elevation gradients
- Incised by rare but critical riparian areas
- Uniquely adapted plants and animals
- 73% of endemic plants – imperiled
- Species of concern (e.g., sage-grouse, pygmy rabbit, Brewer's sparrow, Virgin River chub)
- 54% of remaining sagebrush

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The Great Basin - Land Uses

- Agriculture and livestock grazing
- Mineral and energy extraction
- Surface- and ground-water development
- Urban expansion

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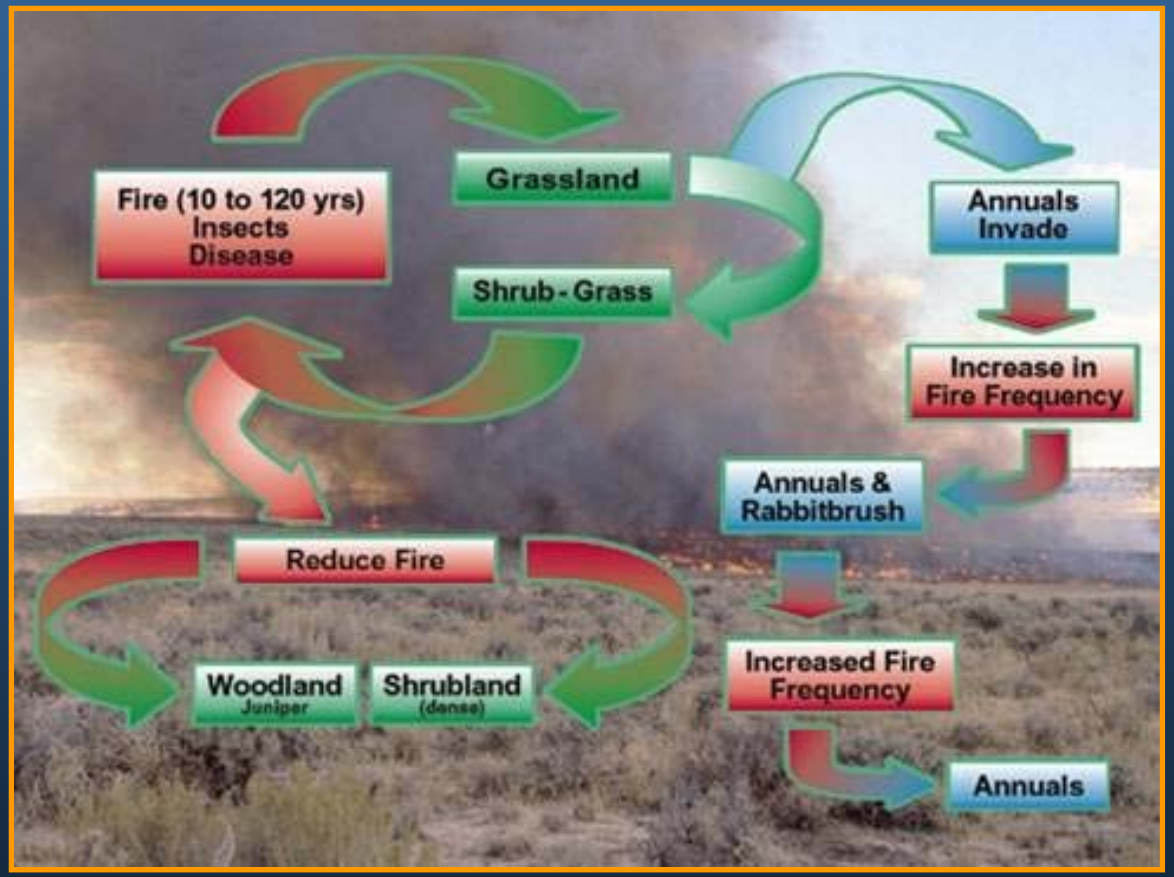
Current Fire Cycle

- Fire cycle:
  - Historic: 70-100 yrs
  - Current: 7-10yrs
- Relationship of invasive species and fire cycle
- Over 25% of basin burned in last decade



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Water Demand

- NV: 9 inches/year
  - 90% goes to evaporation/transpiration
  - 10% to streams and GW recharge
- Public water use tripled since 1970
- Las Vegas:
  - SNVWA applications for full perennial GW yield
  - 220 mile proposed pipeline to move GW
- Leaves little or no water for springs, wetlands, phreatophytes, etc.
- Some basins are in overdraft (e.g., Diamond Valley)

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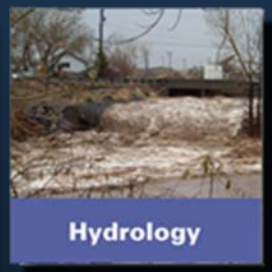
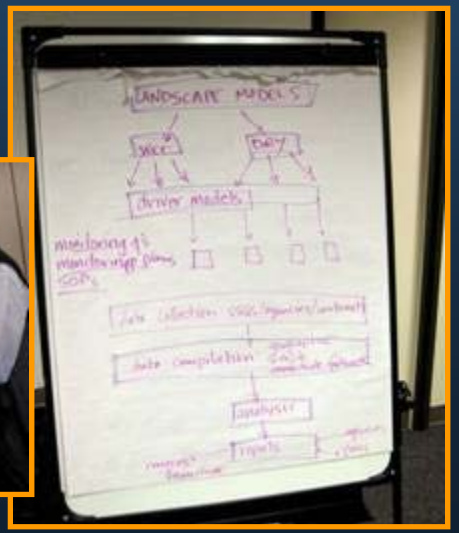
GBILM - Phased Approach (FY2006)

- Establish interdisciplinary team
  - Biology, Geography, Geology, Water, and Geospatial Information Office
  - BLM, NPS, and EPA
- Establish Internal Web Site (*my.usgs.gov*)
- Understand ongoing research and monitoring efforts
- Develop project scope



Phased Approach (FY2006-07)

- Develop conceptual models
- Identify and prioritize ecosystem drivers
- Develop and prioritize management questions
- Develop pilot projects to address management questions
- Identify data gaps
- Conduct stakeholder outreach



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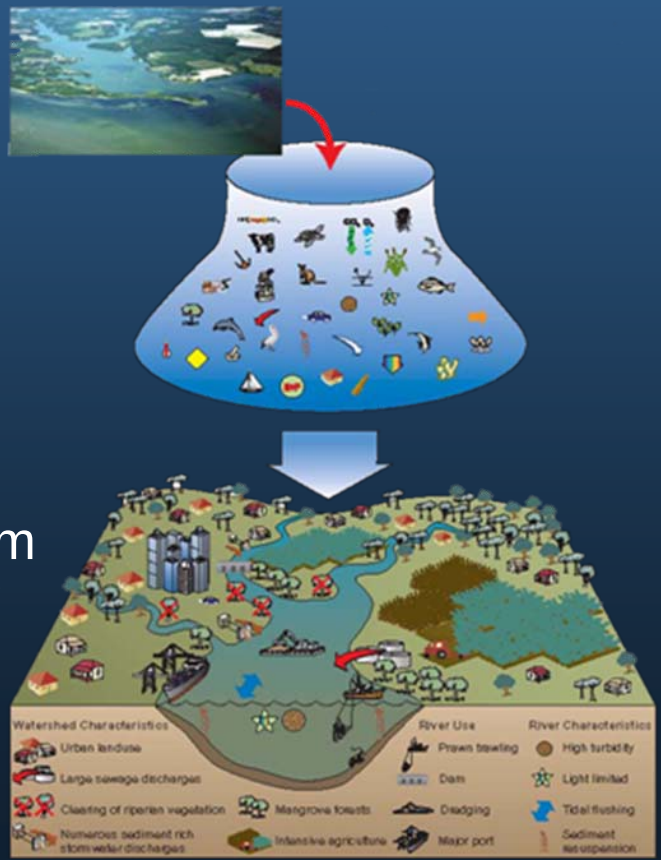
Conceptual Models: Tools for Understanding

- Describes key ecological components and relationship between them
- Used for planning, communicating, and prioritizing
- GBILM Models:
  - Characterize landscape function
  - Identify ecological processes
  - Develop/prioritize management issues
  - Inform monitoring strategy development
  - Identify gaps in understanding of ecosystem function



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Conceptual Models: Hierarchical Approach

Framework Model: Wet, Dry, Atmospheric, Human Social Systems

System Models

Atmospheric | Dry | Wet | Human Social Systems

Control Models

Sagebrush Steppe | Salt Desert Steppe | Pinyon-Juniper | Alpine | Coniferous

Stressor Models

Fire/grazing interactions

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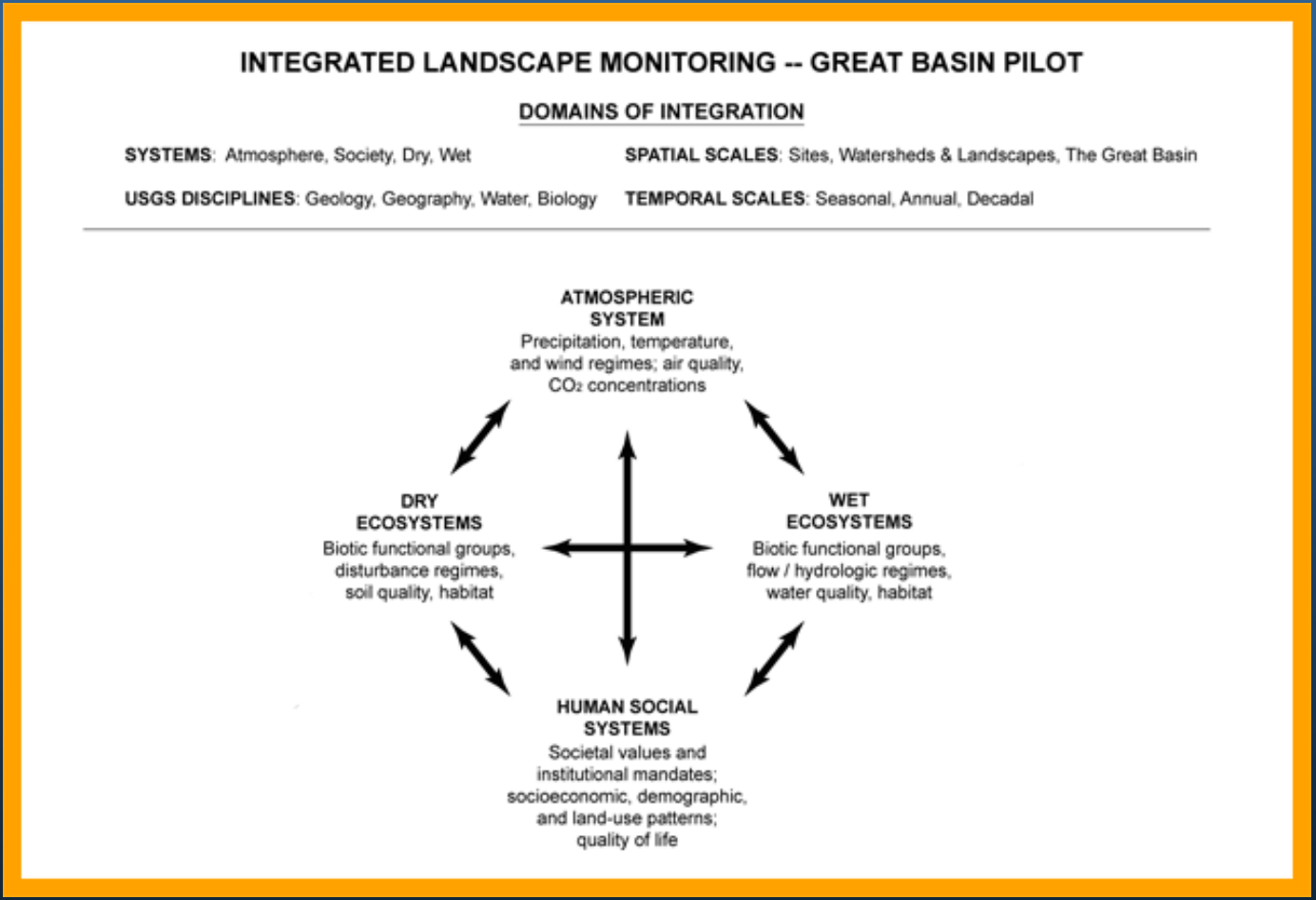
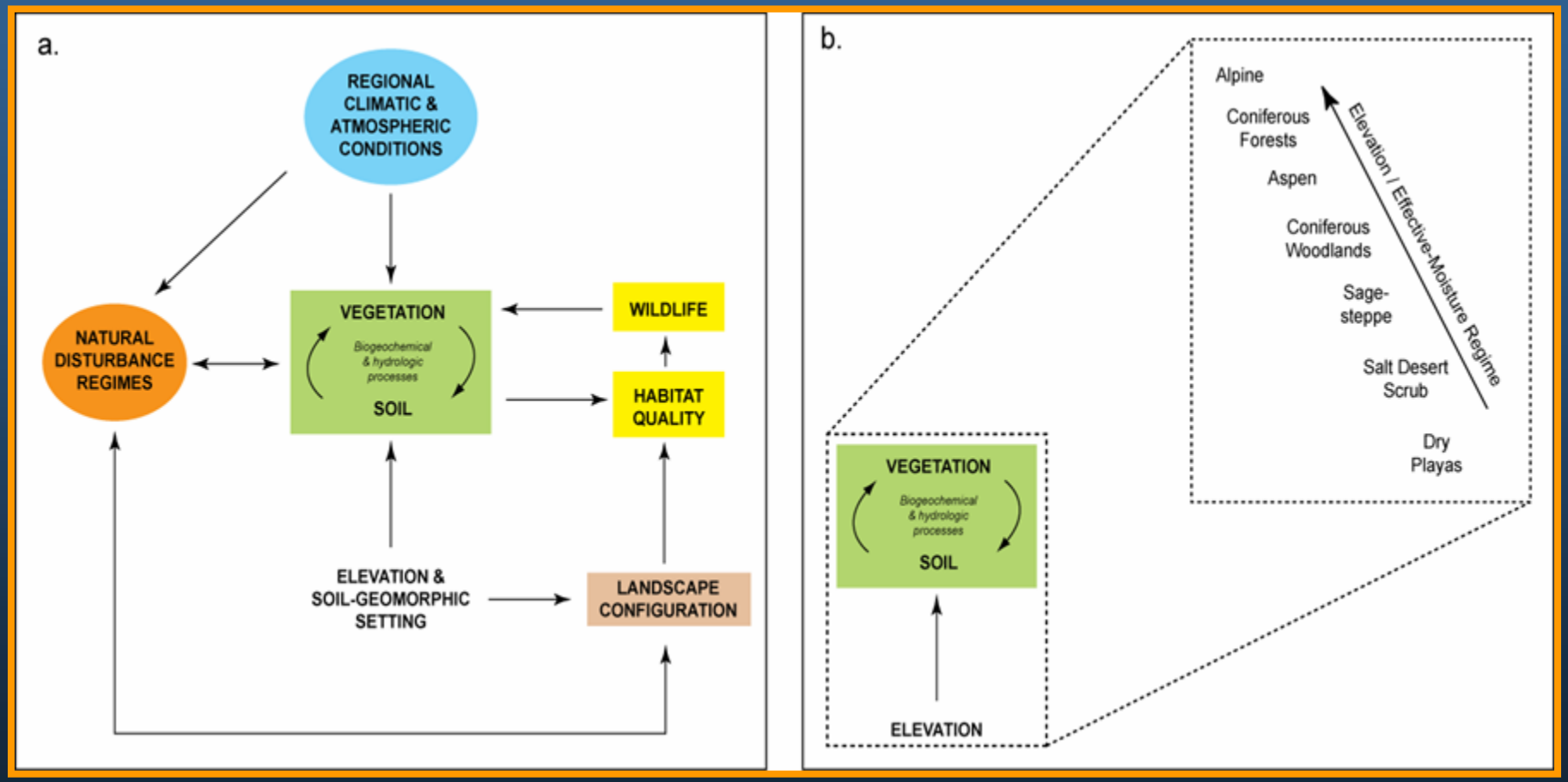
Conceptual Models: Hierarchical Approach

Framework Model: Including Wet, Dry, Atmospheric and Human Social Systems



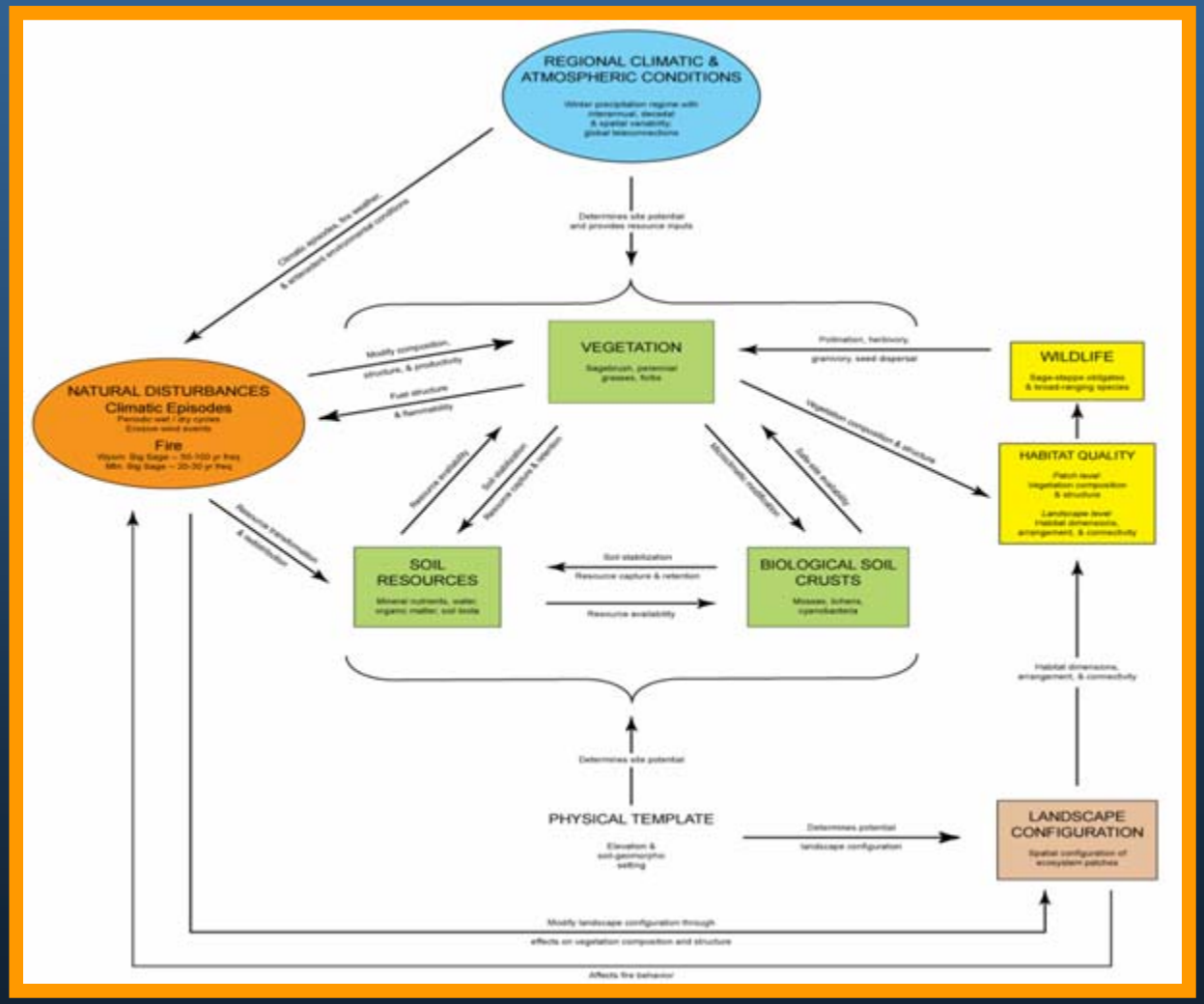
Conceptual Models: Hierarchical Approach

Systems Model: Dry System



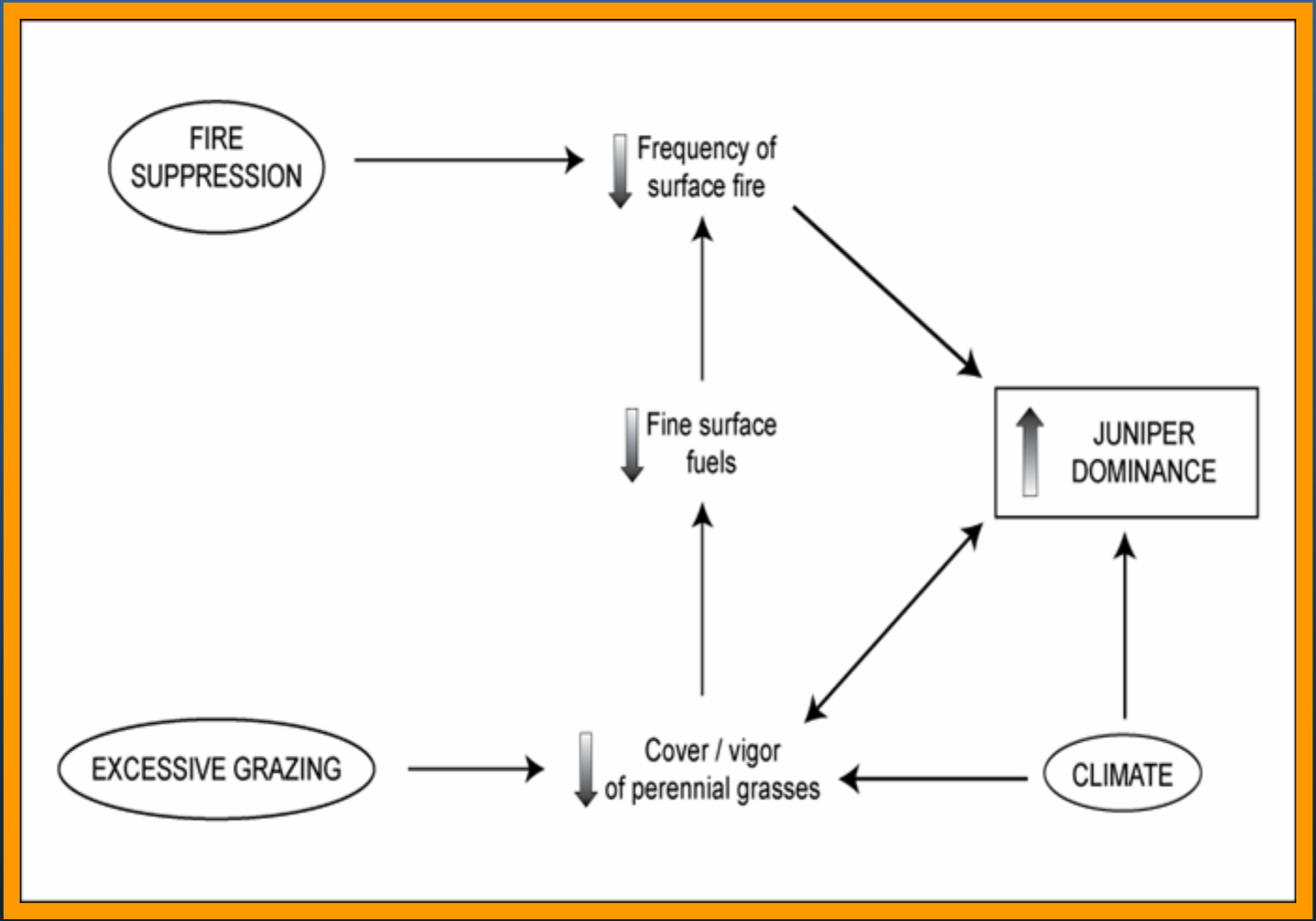
Conceptual Models: Hierarchical Approach

Control Model: Sagebrush steppe ecosystems (Dry System)



Conceptual Models: Hierarchical Approach

Stressor Model: Fire and Grazing Interactions



Ecosystem Drivers

"Ecosystem drivers are any natural or human-induced factor that directly or indirectly causes a change in an ecosystem."

Carpenter et al., 2006

Invasive species

Agriculture

Erosion

Altered Flow Regime

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Identification of Drivers: Iterative Process

- Drivers used in models to explain impacts on systems
- Over 30 drivers identified (e.g., climate change, fire, grazing)
- Prioritized and linked ecosystem drivers to system components in models
- Developed management questions
- Proposed hypothesis
- Vet outcomes with land management representatives

Vetting outcomes before land management representatives helped the GBILM team to identify priority drivers.

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Drivers of Change: Wet System

- Water Extraction*
- Flow Regime
- Livestock Grazing
- Invasive Exotics
- Climate Change & Variability

Drivers of Change: Dry System

- Fire Regime
- Invasives-Fire Interaction*
- Livestock Grazing
- Land Treatments*
- Climate Change & Variability
- Motor Vehicle Use

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Three Priority Drivers

- Water Extraction (Wet System)
- Fire and Invasive Species Interaction (Dry System)
- Land Treatments (Dry System)

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Management Questions

- Why develop management questions?
  - Foundation for landscape monitoring program
  - Reflect real-life needs of our management partners
  - Bring focus and relevance to our work
  - Provide basis for evaluating interactions among management actions, other environmental factors, and landscape change
- Develop example projects to test our approach

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Our 4-Step Approach

- Develop questions
- Data mining and evaluation
- Data analysis to assess status and trends, and predict change
- Management application of results

Example 1: Water Extraction Project

Title: Potential Phreatophytic Land Cover in the Great Basin and Relationship to Groundwater Withdrawals

Key Management Questions:

- How will increased water extraction impact phreatophytes?
- Can phreatophytic communities serve as an indicator of impacted groundwater systems?
- How will water extraction impact these phreatophytic communities?

Approach

- Collect data layers for geomorphology, vegetation, elevation, and hydrology.
- Develop and run spatial analysis model.
- Conduct analyses to detect temporal changes in water level within ground-water systems.

Expected Products:

- Map of potential phreatophytic land cover of Great Basin
- Map(s) of change in Great Basin's ground-water levels
- Manuscript describing use of phreatophytic communities as indicators of change in ground-water levels to identify areas at risk

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Phase 1 Product: Mapping Methodology

- Compile datasets for analysis and geographic reference
- Coordinate data layers and establish GIS
- Identify species with potential for phreatophytic behavior
- Identify landforms most conducive to phreatophytic behavior
- Identify Shrub Map land-cover classes dominated by potential phreatophytes

Ecosystem classes and associated phreatophytic species

ES#	Ecosystem Class	Phreatophytic & Potential Phreatophytic Species
12	Inter-Mountain Basins Active and Stabilized Dune	Big Sagebush; Greasewood, Saltbush; Sacaton
14	Inter-Mountain Basins Greasewood Wash	Greasewood, patches of Saltgrass Meadow
15	Inter-Mountain Basins Playa	Greasewood, Pickleweed, Saltgrass; Saltbush
18	North American Warm Desert Active and Stabilized Dune	Saltbush;Mesquite
20	North American Warm Desert Wash	Greasewood; Catclaw; Desertbroom (Baccharis); Desertwillow; Butternut/Nogal/Walnut; Mesquite
22	North American Warm Desert Playa	Pickleweed; Seepweed/Saltwort/Iodineweed/Inkweed; Saltgrass; Sacaton; Saltbush
23	Rocky Mountain Aspen Forest and Woodland	quaking Aspen
54	Inter-Mountain Basins Big Sagebrush Shrubland	Big Sagebush; Juniper; Greasewood; Saltbush
70	Sonora-Mojave Desert Mixed Salt Desert Shrub	Saltbush; Pickleweed; Glasswort; Seepweed/Saltwort/Iodineweed/Inkweed; Sacaton; Saltgrass
96	Inter-Mountain Basins Greasewood Flat	Greasewood; Saltbush; Sacaton; Saltgrass
98	North American Warm Desert Riparian Mesquite Bosque	Mesquite; Arrowweed; Willow
100	North American Arid West Emergent Marsh	Tule; Desertrush/Wirerush/Wiregrass
102	Rocky Mountain Alpine-Montane Wet Meadow	Willow; Sedge (Carex)
103	Temperate Pacific Montane Wet Meadow	Tule; Willow; Sedge (Carex)
105	Mediterranean California Subalpine-Montane Fen	Sedge (Carex)
142	Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub Steppe	Big Sagebush
149	Inter-Mountain Basins Big Sagebrush Shrubland SSP. Tridentata	Big Sagebush; Juniper; Greasewood; Saltbush
150	Inter-Mountain Basins Big Sagebrush Steppe SSP. Tridentata	Big Sagebush
151	Northern Rocky Mountain Lower Montane-Foothill Deciduous Shrubland	Wildrose
161	Mediterranean Californian Alkali Marsh	Saltgrass; Wirerush/Wiregrass; Tule; Saltbush
169	North Pacific Bog and Fen	Sedge (Carex)
199	Temperate Pacific Freshwater Emergent Marsh	Tule; Wiregrass/Wirerush
291	Riparian	*no species info*
304	Invasive Southwest Riparian Woodland Shrubland	Salt Cedar (Tamarisk)

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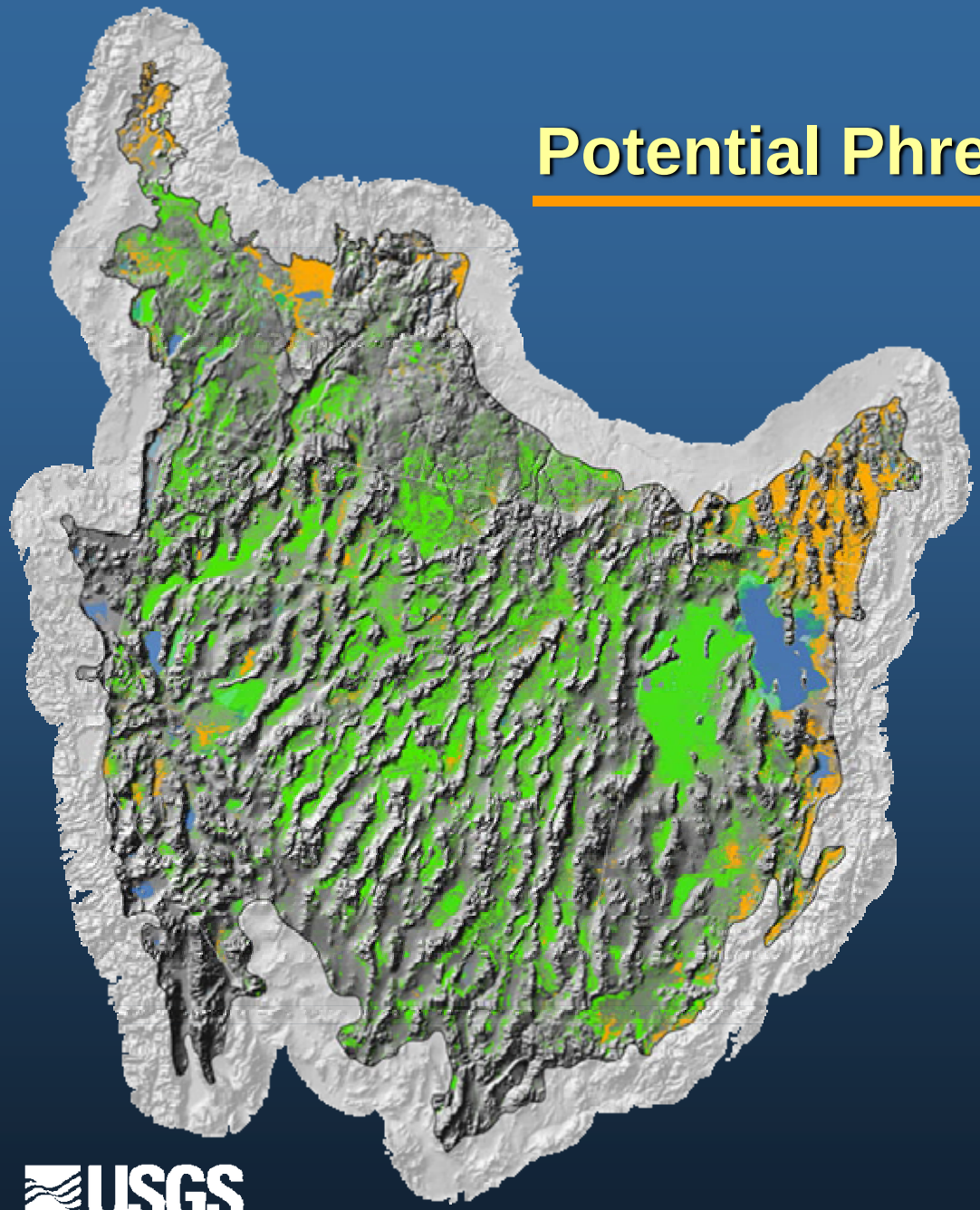
Potential Phreatophytic Land Cover



Potential phreatophytic land cover

Waterbodies

Agricultural land cover

Map scale is 1:1,500,000

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Example 2: Fire and Invasive Species

Title: Fire Regimes in the Great Basin: Spatio-temporal Correlates and Future Scenarios

Key Management Questions:

- How should land managers prioritize efforts to manage fire regimes with the goal of retaining and restoring desired plant communities in the Great Basin?

Approach

- Describe spatial and temporal patterns of fire by producing maps and graphing fire distributions over time.
- Evaluate hypotheses on how invasives alter fire regimes.
- Develop monitoring tools to assess changes in fire regimes and vegetation conditions.

Expected Products:

- Maps/spatial data
- Trends and threats assessment for altered fire regimes
- Land management recommendations
- Manuscripts

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Example 3: Land Treatments

Title: Assessment of Land Treatments to Understand Vegetation and Wildlife Habitat Trajectories in the Great Basin

Key Management Questions:

- Are different land treatments moving vegetation communities toward desired conditions and how are they influencing vegetation and wildlife habitats?
- How and where can land managers use land treatments for multiple objectives, including maintaining and restoring habitat and associated wildlife?

Approach:

- Acquire existing data on treatments from 1950 to present.
- Develop predictive models on effects of treatments on wildlife habitats.
- Refine models and provide information on vegetation trends.

Expected Products:

- Database with spatial data linked to treatment information
- Maps of land treatments across the Great Basin
- Manuscripts on monitoring approaches and effects of land treatments on sage-brush habitat connectivity

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Partner Outreach

- Partners as GBILM team members
- Information sharing
- Proactive outreach and involvement
  - Leadership meetings with partner agency leaders
  - Workshops
  - Information dissemination
  - Communicating results and establishing long-term program

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Project Schedule: Phase 1 (FY 2006)

Focus

- Develop pilot project strategy
  - Organize interdisciplinary team
  - Invite DOI agency representation
  - Identify agency monitoring needs
  - Develop conceptual models
  - Identify and prioritize drivers
  - Develop Pilot focus on existing data

Products

- Create internal website
- Develop fact sheet
- Poster

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Project Schedule: Phase 2 (FY 2007)

Focus

- Proactive outreach to partners on drivers, questions, and data
- Develop example projects
- Mine, evaluate, analyze existing data
- Conduct assessments of status and trends of existing data
- Refine conceptual models

Products

- Project Plan
- Conceptual model report
- Revised fact sheet
- Stakeholder strategy
- Study plans
- Assessment reports from existing data
- Maps
- Public web site

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Funding and In-kind Commitments from USGS Disciplines*

- *Biology*
  - FY06 $75,000 new allocation, plus substantial in-kind
    $100,000 Ecosystem mapping
  - FY07 $75,000 new allocation, plus substantial in-kind
- *Geography*
  - FY06 $75,000 in-kind from Geographic Analysis Monitoring Program
    $10,000 charged to Biology allocation
  - FY07 $75,000 in-kind from Geographic Analysis Monitoring Program
- *Geology*
  - FY06 $25,000 in-kind; $20,000 charged to Biology allocation
  - FY07 ?
- *Geospatial Information Office (GIO)*
  - FY06 $4,688 in-kind from CTM & Geospatial Program Office
    $16,000 in-kind from Enterprise Information Program
  - FY07 ?
- *Water*
  - FY06 $20,000 new allocation, plus in-kind
  - FY07 $20,000 new allocation, plus in-kind

*Most of the support to GBILM has been as in-kind commitment of salary time

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Project Schedule: Phase 3 (FY 2008)

Focus

- Conduct assessments of status and trends of existing data
- Predictions of landscape change based on historic trends and environmental factors
- Initiate development of monitoring approaches
- Explore and pursue other management questions

Products

- Assessment reports from existing data
- Report of predictions for selected drivers
- Analytical tools for managers
- Study plans for additional management questions
- Research proposals to fill identified data gaps

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Project Schedule: Phase 4 (FY 2009-?)

Focus

- Develop and test monitoring methods, protocols and sampling designs
- Finalize monitoring and implement long-term landscape monitoring
- Expand to other drivers and management questions

Products

- Monitoring methods, protocols, sampling designs
- New data sets on web
- Published, coordinated monitoring plans and protocols
- Assessment reports on additional management questions
- Analytical tools for managers to analyze management scenarios and set priorities

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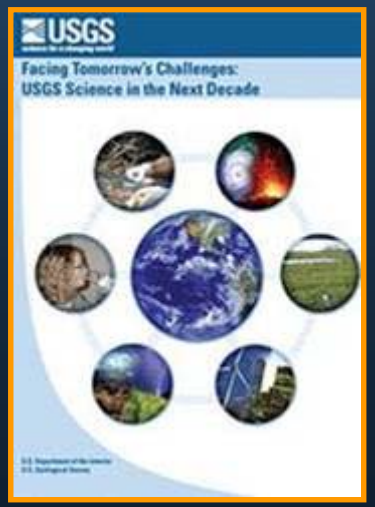
USGS Science Strategy

- *Understanding Ecosystems and Predicting Ecosystem Change*
  - Identify ecosystems vulnerable to change from climate, land use
  - Conduct long-term research, monitoring, and modeling to understand variability at different scales
  - Forecast responses to stressors
  - Assess success of restoration techniques
  - Develop multi-partner assessment of status and trends
- *Water Census of the US*
  - Determine changes over time in response to climate, land use/land cover
- *National Hazards*
  - Prevention of catastrophic wildfires through understanding changing fire conditions
- *Climate Variability and Change*
  - Expand understanding of climate change and effects on ecosystems
  - Develop predictive models and decision-support tools for managers
- *Energy and Minerals*
  - Evaluate impacts of energy development on ecosystem processes



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Long-term Value: Pilot to Program

- Build understanding of ecosystem processes
- Identifies change in a highly variable and complex region
- Inform management issues and practices at landscape scales
- Develop long-term monitoring strategies
- Ultimately, provide a predictive capability of landscape change

Krissy Bush

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