

Moving Forward: Frameworks for Effective Climate Adaptation

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Pinyon mortality at Bandelier National Monument.

Photo: Craig Allen



What should we do?

Pinyon mortality at Bandelier National Monument.

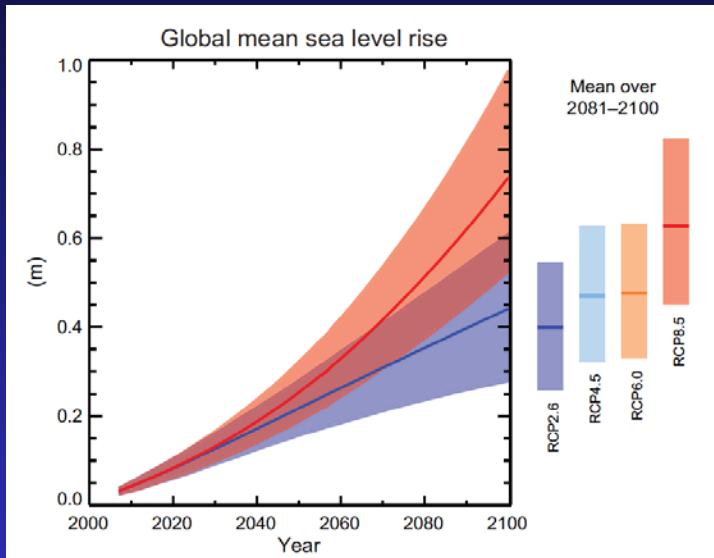
Photo: Craig Allen

Mitigation: Addresses causes of CC. Focus on reducing GHGs.

Adaptation: Adjusting to and coping with actual or expected climate changes. Focus on preparing for and managing CC.



Challenges



(IPCC 2013)

- Time horizon longer than planning and management horizons
- Relevant areas larger than management units
- Uncertainty in science (climate change, ecological response) and management effectiveness
- Coordination among management units, jurisdictions, stakeholders
- Approaches and methods are rapidly evolving

Planning for CC adaptation is different

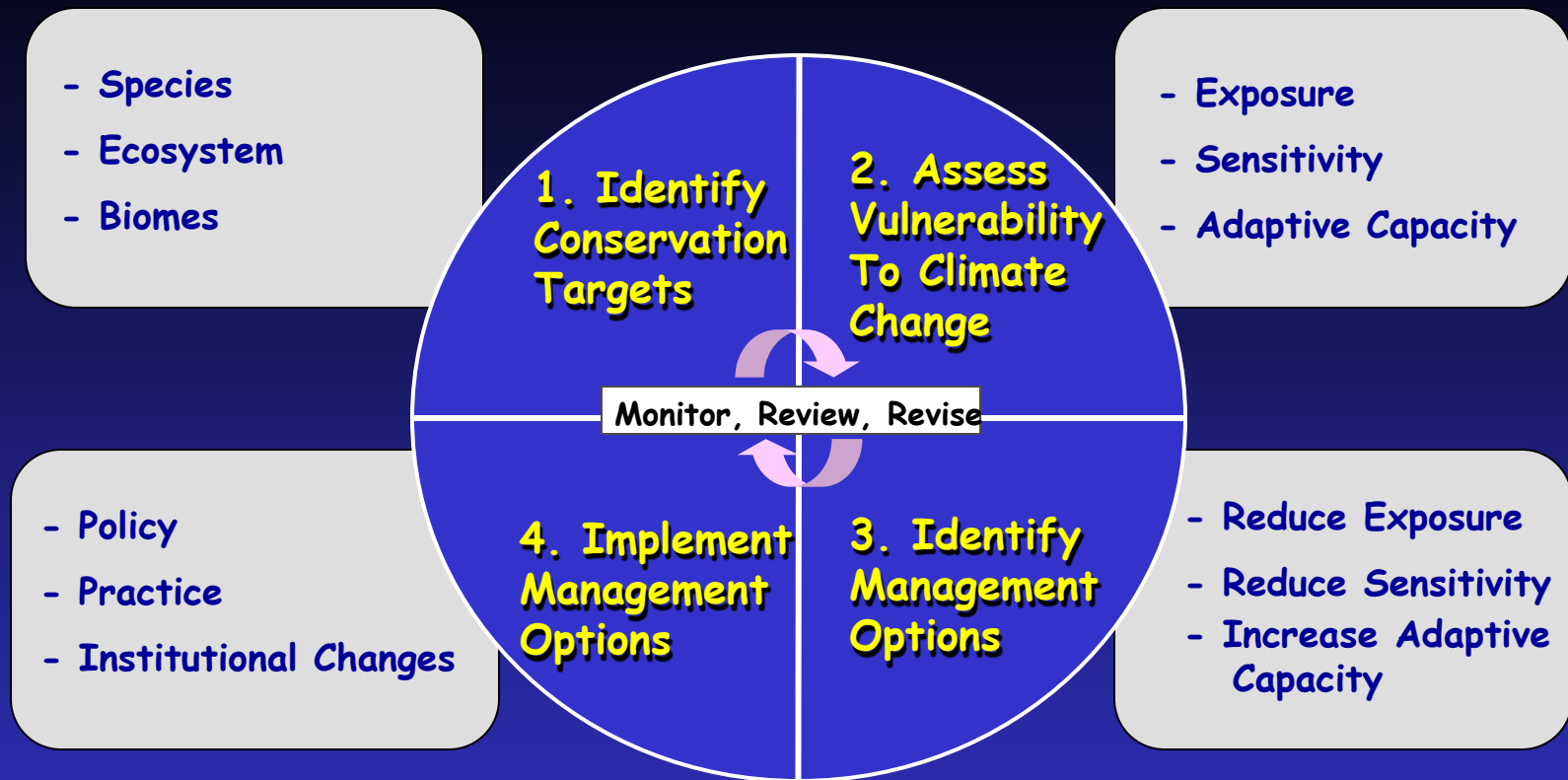
What constitutes an effective adaptation framework?

- Sufficiently comprehensive & simple
- Right-scaled and scalable
- Logical and intuitive
- "Connect the dots"
- Easily incorporates existing capital**

** processes, knowledge, expertise

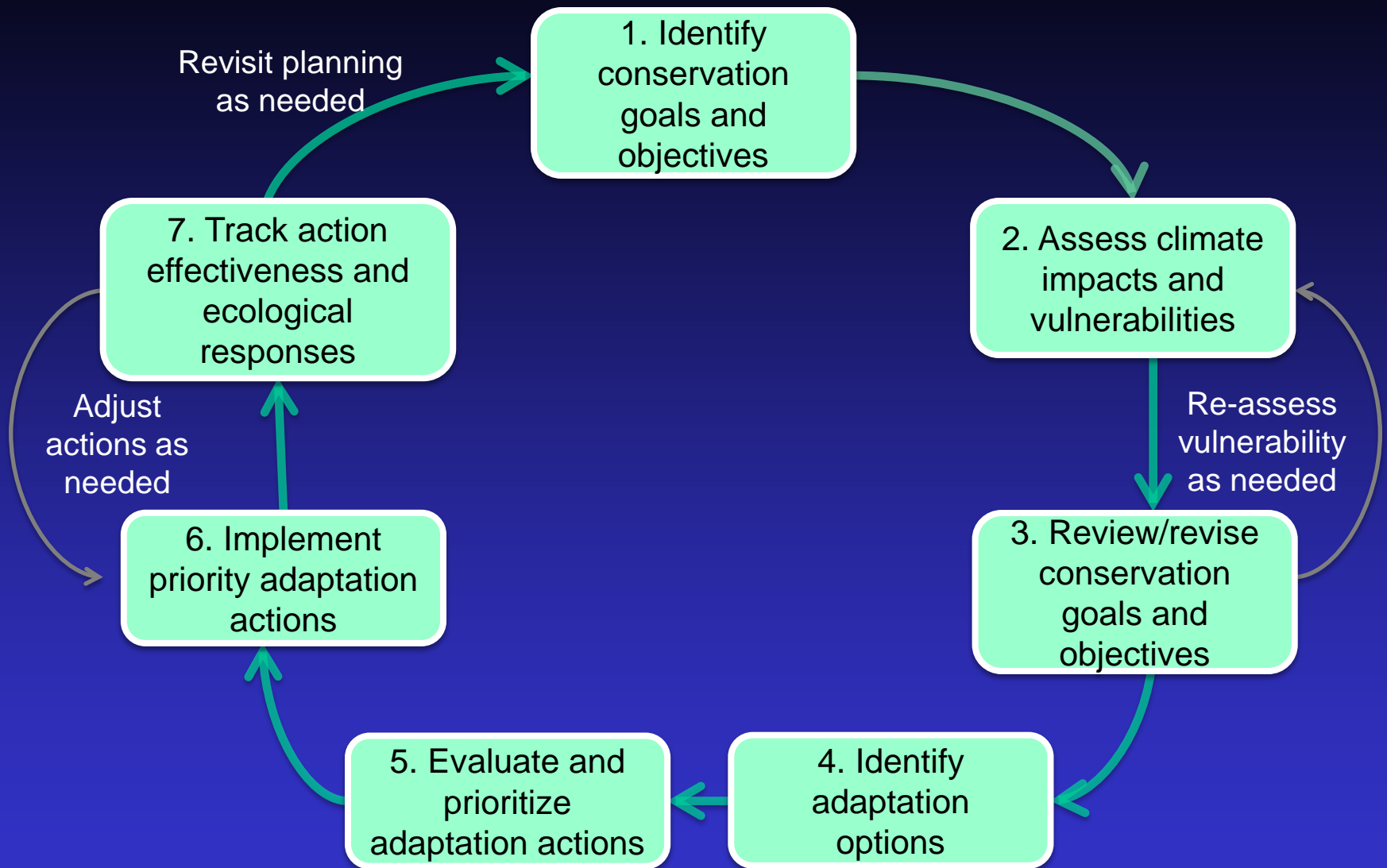


(Stein & Glick 2011 Chpt 1 *in* Scanning the Conservation Horizon)



(Stein & Glick 2011 Chpt 1 *in* Scanning the Conservation Horizon)

Generalized Adaptation Framework



Adaptation Approaches

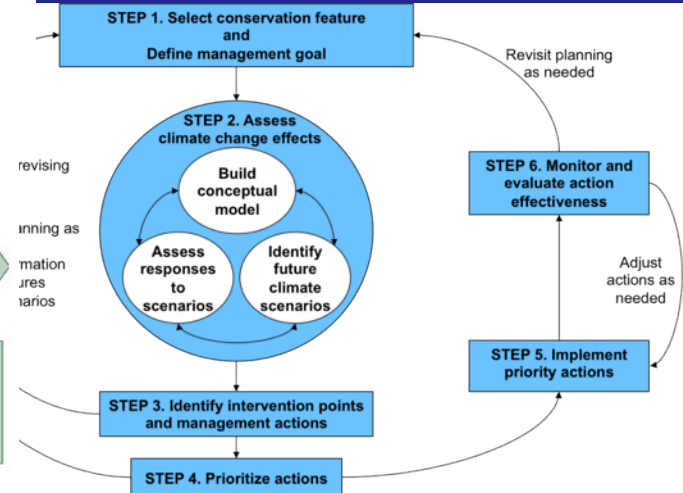
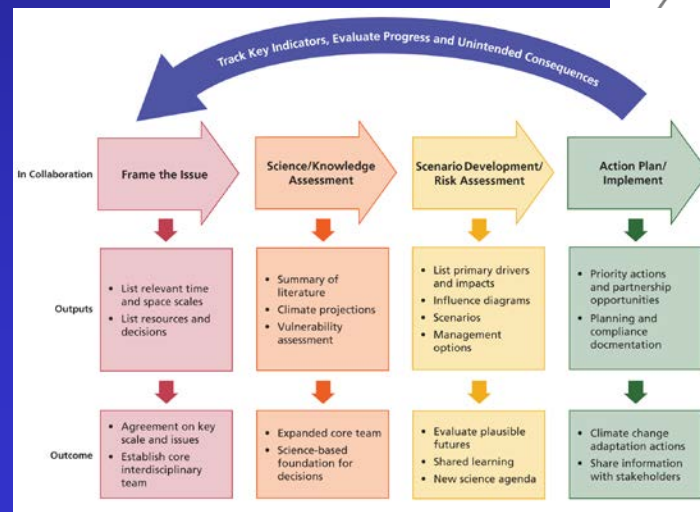
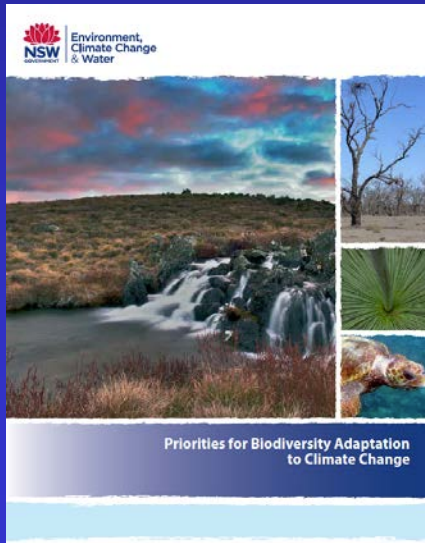
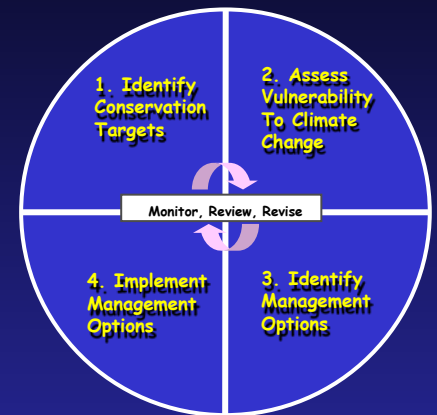
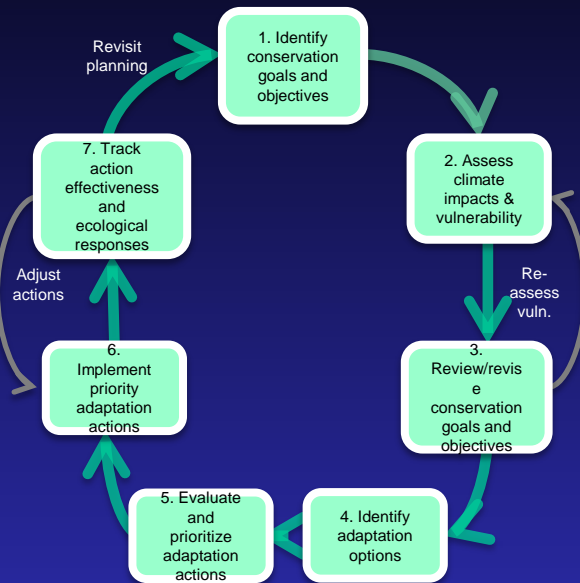
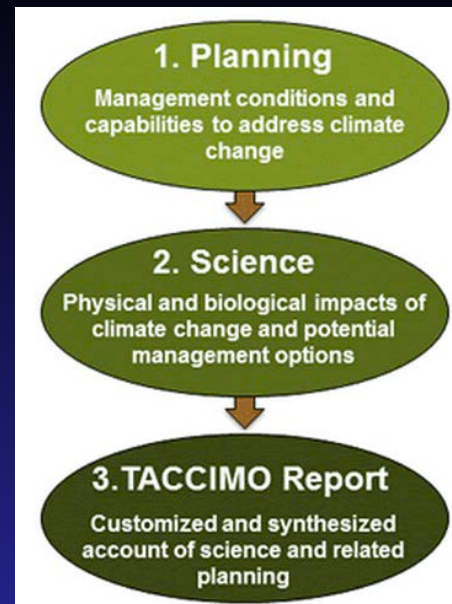


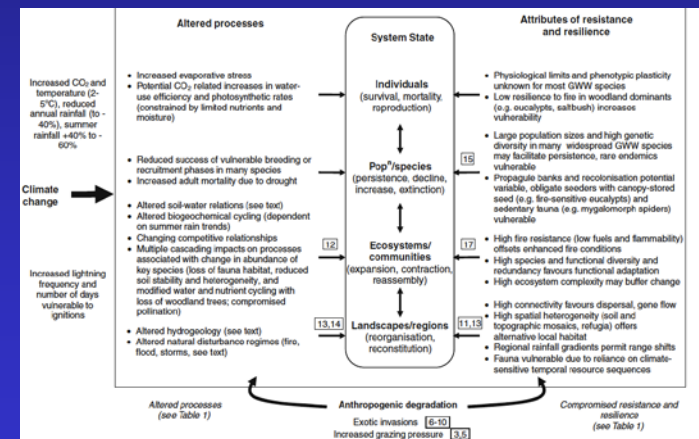
Table 5.1 from Glick & Cross (2014; Climate Smart chpt 5.)

Approach	Purpose and key features	Spatial scale ^a	Starting point	Effort/Cost ^b	Institutional affiliation	References			
Adaptation for Conservation Targets (ACT) Framework	Stepwise process for developing actions to achieve climate-informed conservation goals for specific species, ecological processes, or ecosystems	Site, Landscape	Management targets, goals, or activities	Time: low/moderate Expertise: moderate Cost: low/moderate	NCEAS Climate Change & Wildlife Conservation working group; Wildlife Conservation Society;	Cross et al. 2012b, 2013			
			Approach	Purpose and key features	Spatial scale ^a	Starting point	Effort/Cost ^b	Institutional affiliation	References
Awareness to Action (A2A)	Adaptation planning services to develop climate change adaptation plans focused on specific regions, species, or ecosystems	Site, Landscape	Decision Framework for Climate Change Adaptation	Decision tree that identifies and prioritizes actions to increase the adaptive capacity of species	Site, Landscape	Particular species and species distribution/bioclimatic envelope model	Time: low/moderate Expertise: moderate Cost: low/moderate	NERC Centre for Ecology & Hydrology; UK Population Biology Network	Oliver et al. 2012
Climate Change Adaptation Framework for Ecosystems	Stepwise process for integrating climate into natural resource management for many species and ecosystems	Landscape	National Park Service Scenario Planning	Scenario planning process to address climate-related uncertainties in managing species, ecosystems, cultural and recreational resources	Site, Landscape	Potential climate-related changes	Time: moderate Expertise: moderate Cost: moderate	National Park Service	Weeks et al. 2011, Rose and Star 2013
Climate Change Response Framework	Stepwise process for integrating climate into forest planning and management for forest species and ecosystems	Site, Landscape	North Cascadia and Olympic Peninsula Adaptation Partnership	Science-management partnership for assessing vulnerability and developing adaptation options for species and ecosystems across federal land management units	Landscape	Potential climate-related changes	Time: moderate/high Expertise: moderate Cost: moderate	U.S. Forest Service and National Park Service	Raymond et al. 2013, Littell et al. 2012, Halofsky et al. 2011
Climate Project Screening Tool	Questionnaire-based tool to explore options for ameliorating climate effects on forest resource management projects	Site	Open Standards for the Practice of Conservation	Incorporation of climate into a structured conservation planning process for specific species or ecosystems	Site, Landscape	Management targets, goals or activities	Time: moderate Expertise: moderate Cost: moderate	Conservation Measures Partnership	CMP 2013
Climate-Ready Estuaries Expert Elicitation Approach	Expert elicitation approach for assessing vulnerabilities and identifying adaptation options	Site, Landscape	Refuge Vulnerability Assessment and Alternatives	Stepwise process for spatially explicit assessment of a refuge's vulnerability to climate change and other stressors, and identification of adaptation options	Site, Landscape	Either management concerns or potential climate-related changes	Time: moderate/high Expertise: high Cost: moderate/high	NatureServe	Crist et al. 2012a, 2012b
Climate-Smart Coastal Restoration Planning	Stepwise framework for the design and implementation of climate-smart coastal restoration projects in the Great Lakes	Site	Template for Assessing Climate Change Impacts and Management Options (TACCIMO)	Web-based tool that synthesizes published research on climate impacts and adaptation options relevant to forest planning and management	Site, State, Landscape	Potential climate-related changes	Time: low Expertise: low Cost: low	U.S. Forest Service	Treasure et al. 2014
ClimateWise	Stepwise process for developing adaptation strategies and actions coordinated across local ecosystem and human community concerns	Site, Landscape							
Conservation Action Planning for Climate Change	Stepwise process for integrating climate into existing plans developed using the Conservation Action Planning (CAP) process for specific species or ecosystems	Site	Yale Framework	Guidance for selecting assessment and modeling strategies relevant to specific conservation and resource management needs	Site; Landscape	Matrix of adaptation options at different ecological	Time: low/moderate/high Expertise: moderate/high Cost: moderate/high	Yale School of Forestry	Schmitz et al. In press

TACCIMO



Change-resilience framework



"Adaptation Lite"

TACCIMO - Template for Assessing Climate Change Impacts and Management Options (USFS - <http://www.taccimo.sgcp.ncsu.edu/>)

TACCIMO
Template for Assessing Climate Change Impacts and Management Options

[ABOUT](#) [EXPLORE](#) [GENERATE A REPORT](#) [CONTACT US](#)

About TACCIMO

New and Improved Literature Explorer Available - TACCIMO is excited to announce the availability of a [beta version of the literature explorer application](#). The new version offers improved functionality for users and a streamlined content management system that will enable developers to add new literature more quickly. The current version of TACCIMO will remain available during beta testing, **but only the new beta version will reflect literature updates effective June 1, 2014.**

The Template for Assessing Climate Change Impacts and Management Options (TACCIMO) is a web-based tool that connects forest planning to current climate change science. The formation of TACCIMO was rooted in the need for a standardized, credible, and concise science delivery tool relevant to forest planning and management.

What TACCIMO Delivers - Access to the most current climate change projections and science, including the likely range of projected future climate for any state, county, or National Forest and dynamically linked peer-reviewed scientific statements describing effects and management adaption options. For Forest Service users, TACCIMO additionally connects climate change science with relevant planning language.

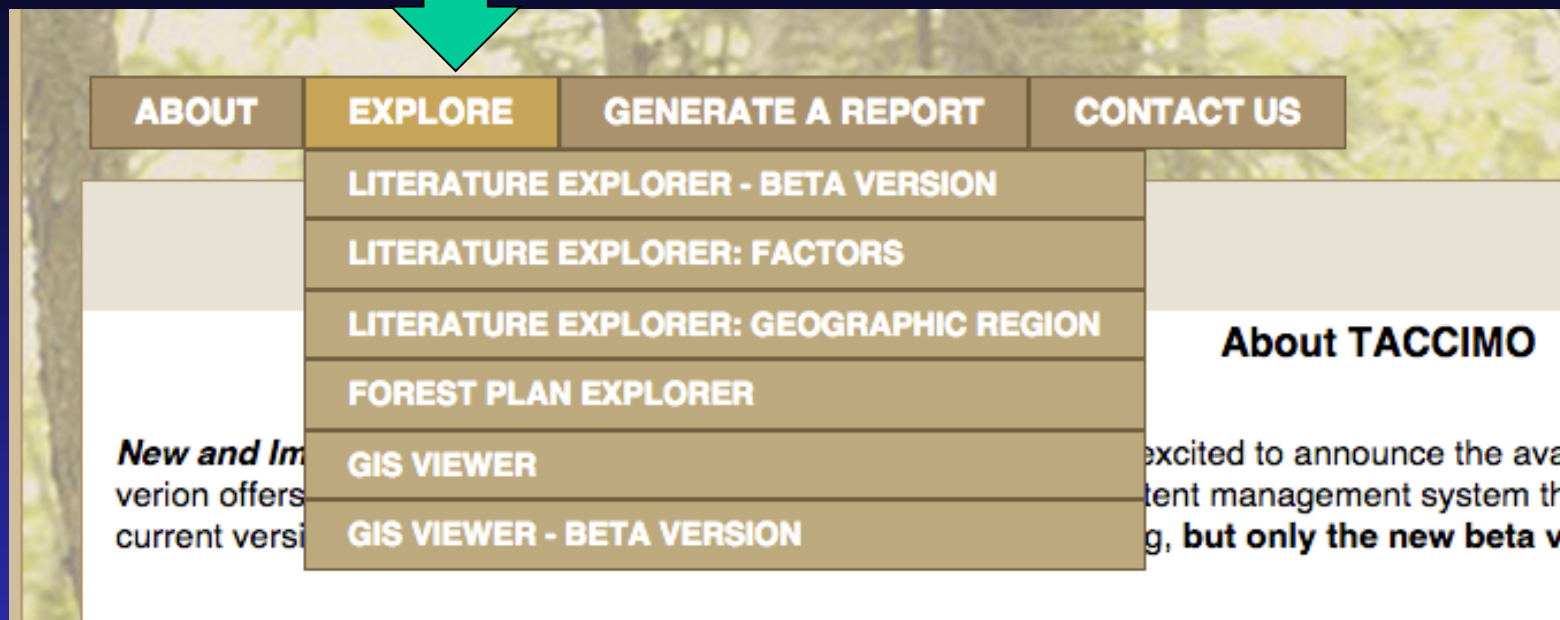
Who Should Use TACCIMO - Federal, state, and private land managers with diverse information needs related to climate change. Certain content is developed specifically for USDA Forest Service planners to assist with climate change analysis for projects and forest plan revisions.

Who Is Developing TACCIMO - USDA Forest Service scientists from both the Eastern and Western Forest Environmental Threat Assessment Centers and forest planners from the Southern and Pacific Southwest Regions of the National Forest System.

1. Planning
Management conditions and capabilities to address climate change

2. Science
Physical and biological impacts of climate change and potential management options

3. TACCIMO Report
Customized and synthesized account of science and related planning



<http://www.taccimo.sgcp.ncsu.edu>



ABOUT	EXPLORE	GENERATE A REPORT	CONTACT US
		CLIMATE REPORT	
		LITERATURE REPORT	
		LITERATURE AND PLANNING REPORT	
		PLANNING REPORT	
		CUSTOM REPORTS-BETA VERSION	

About TACCIMO

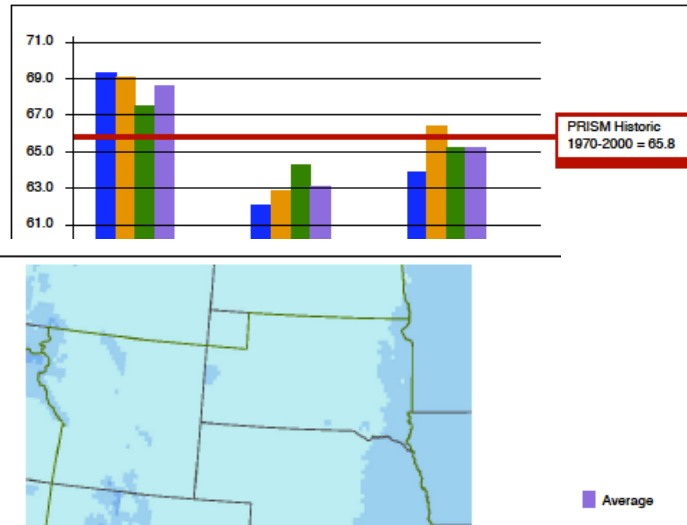
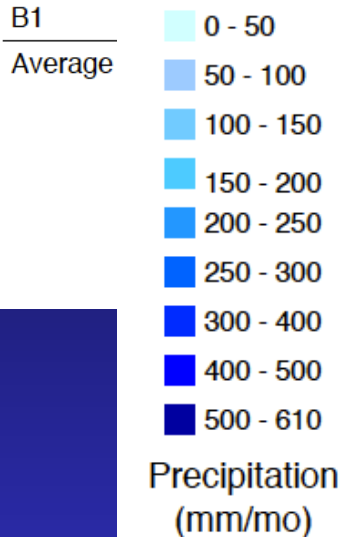
New and Improved Literature to announce the availability of the new version offers improved functionality for users and a streamlined content management system that the current version of TACCIMO will remain available during beta testing, but only the new beta version

<http://www.taccimo.sgcp.ncsu.edu>

Table 3.

National average precipitation by GCM and SRES (mm, monthly average spanning 2009-2099, multiply by 12 to get annual total)

SRES/GCM	CGCM3.1	CM2.0	HadCM3.1
A2	69.3	62.1	63.9
A1B	69.1	62.9	66.4



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Step 1: Select Factor: Climate Trends; Fire; Forest H... Step 2: Select Category: Exotic Insect Pests; General In...
 Step 3: Select Region: National; R2 & R4: Mountain W... Step 4: Select Resolution: General; Moderately Specific; S...
 8 of 63 Export to the selected format Export

Fire-induced tree mortality is recognized as an important ecosystem process that varies among tree species (Ryan and Reinhardt 1988) and is influenced by patterns of fire severity (Glitzenstein et al. 1995, Kobziar et al. 2006) and fuel consumption (Stephens and Finney 2002) as well as postfire bark beetle dynamics (McHugh and Kolb 2003, Parker et al. 2006, Fettig et al. 2007). Fire-killed trees are important habitat for wildlife (Farris and Zack 2005) and the resulting gaps in the canopy result in accelerated growth of remaining trees and provide sites for tree regeneration and the establishment of a diverse understory of grasses, forbs, and shrubs (Cooper 1960, Brockway and Lewis 1997, Keeley and Stephenson 2000, Agee and Lolley 2006, Moghaddas et al. 2008).

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In a climate change scenario of warmer and dryer future climates, one could expect slower rates of decomposition, more frequent drought conditions, and consequently, more fires in post-outbreak stands.

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Management Options

Source

When a species has already changed one or more characteristics of the fire regime, the altered regime needs to be evaluated for its potential to have negative effects on natural resources, local economies, and public

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Getting Started in TACCIMO:

TACCIMO Overview Video	Provides general overview of the TACCIMO application.
TACCIMO Factsheet	Provides a downloadable factsheet covering key aspects of TACCIMO.
How to Use TACCIMO	Comprehensive User Guide, Quick Start Guides, and set of short introductory videos.
Content Sources	Current list of peer-reviewed Content Sources included in TACCIMO.

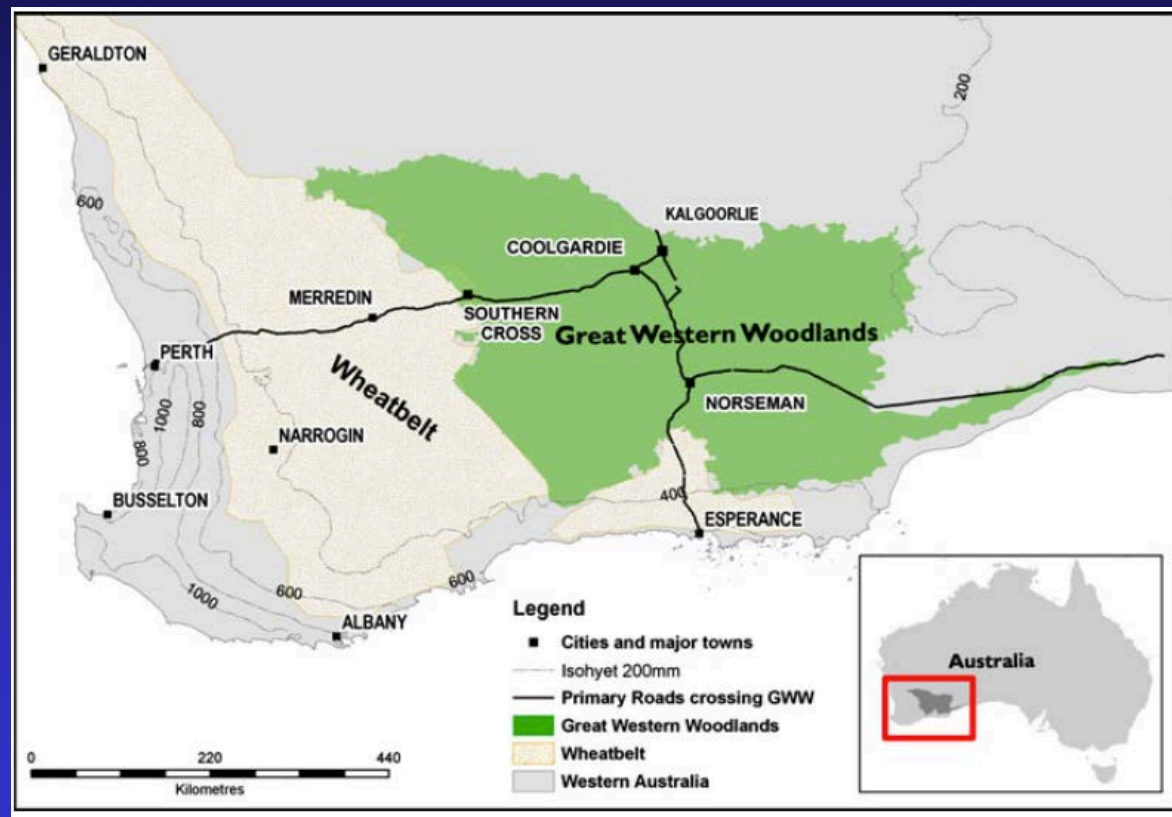
- Free
- Fast
- Focused on USA forests
- Directed to USFS needs but very useful to others

<http://www.taccimo.sgcp.ncsu.edu/>

UKCIP Wizard: <http://www.ukcip.org.uk/wizard/>

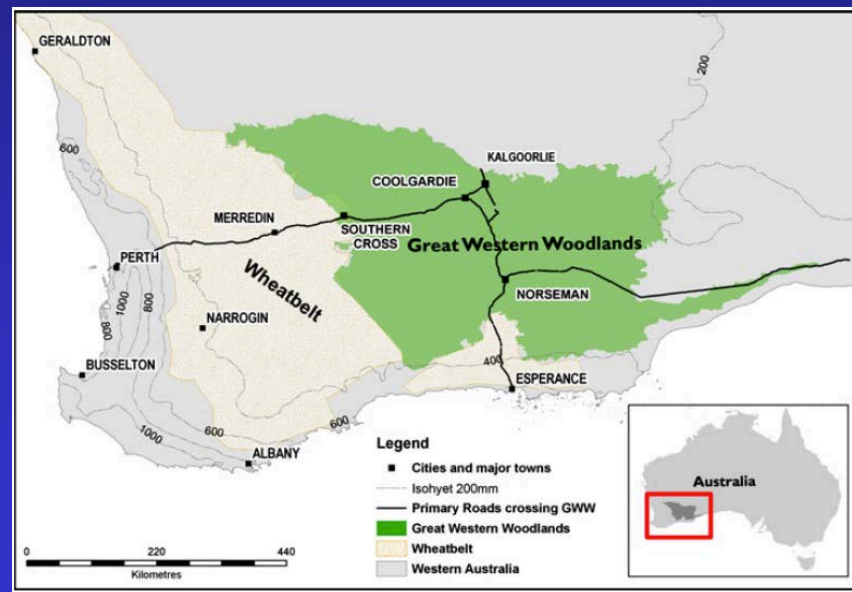
Prober et al. 2012 - Change-resilience framework

Mediterranean-climate woodland Great Western Woodlands



Focus on:

- Achieving defined, climate-informed goals
- Biome to regional scale
- Resistance and resilience to CC
- Multi-level, hierarchical interactions
- Expertise of stakeholders -> 3-day workshop with + follow-up



Mitigate altered processes Management interventions to facilitate climate adaptation Enhance/maintain resilience/resistance

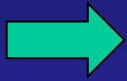
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graph LR; CC[Climate Change] --> Box; subgraph Box [ ]; direction TB; subgraph Header [ ]; direction LR; S1[System processes that may be altered by CC]; S2[System State]; S3[Attributes of resistance & resilience that affect response to change]; end; end; MI[Management interventions to facilitate climate adaptation] --> Box; AD[Anthropogenic degradation] --> Box; MA[Enhance/maintain resilience/resistance] --> Box; Box --> MA; Box --> MI;
```

**System
processes that
may be altered
by CC**

System State

**Attributes of resistance &
resilience that affect
response to change**

Climate
Change



Anthropogenic degradation



(Simplified from
Prober et al 2012)

Features of the change-resilience framework:

- Clear link to CC impacts
- Emphasis on interactions (~ indirect effects)
- Focus on "adaptive capacity"
- Straight-forward process
- Excellent use of right-scaled science
- ID & evaluation of practical management options

Prober, S. M., K. R. Thiele, P. W. Rundel, (15 co-authors), and A. Watson. 2012. Facilitating adaptation of biodiversity to climate change: a conceptual framework applied to the world's largest Mediterranean-climate woodland.

Climatic Change **110**:227-248. DOI 10.1007/s10584-011-0092-y

Framework principles that enhance climate adaptation:

- Support Climate Smart principles
- Leverage knowledge and expertise
- Build on existing tools & processes
- Enhance capacity at every opportunity
- View adaptation as a path, not an end
- *Get started now!*

Forthcoming: IUCN Best Practice Guide for PA Climate Adaptation.
Sat 5:30-7 pm Pavilion, Tues 7-9 pm 3A2

Questions?



A few good resources

Forthcoming: IUCN Best Practice Guide for PA Climate Adaptation.

Sat 5-7 pm, Tues 7-9 pm

Publications:

Moser & Boykoff. 2013. Climate change and successful adaptation: The scope of the challenge. Pages 1-33 *in* Moser & Boykoff, editors. Successful Adaptation to Climate Change: Linking Science and Practice in a Rapidly Changing World. Routledge, London.

Preston et al. 2011. Climate adaptation planning in practice: an evaluation of adaptation plans from three developed nations. *Mitigation and Adaptation Strategies for Global Change* **16**:407-438.

Prober, S. M., et al. 2012. Facilitating adaptation of biodiversity to climate change: a conceptual framework applied to the world's largest Mediterranean-climate woodland. *Climatic Change* **110**:227-248.

Stein et al. (eds.). 2014. Climate-smart conservation: Putting adaptation principles into practice. National Wildlife Federation, Wash., D.C.

Web Sites:

UKCIP -- <http://www.ukcip.org.uk/>

TACCIMO - <http://www.taccimo.sgcp.ncsu.edu/>

Multi-scale assessment of vulnerability

	Species	Ecological System	LCC-Scale
Exposure	CC Projections; TOPS variables	CC Projections; TOPS variables	CC Projections; TOPS variables
Sensitivity	SDMs; Life history traits	Climate variation; LPJ modeling	Biome BGC responses; NPP controls
Adaptive Capacity	Species & habitat traits; Life history traits	Connectivity; Refugia; Topography	ES diversity; Connectivity; Land forms

Match adaptation approach to situation & resources:

- Time
- Money
- Existing knowledge
- Expertise
- Management capacity

Many activities are opportunistic