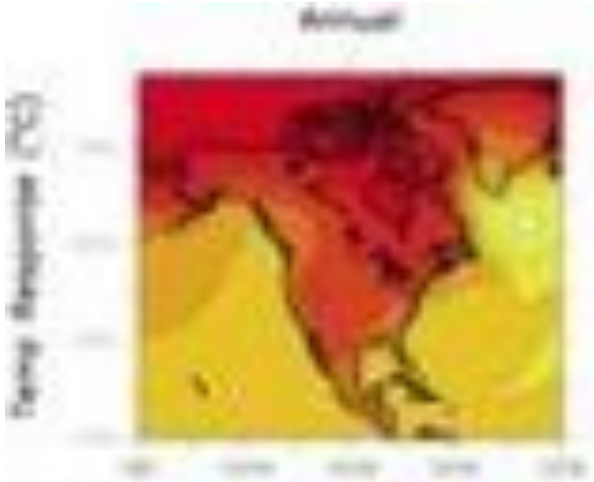
Climate Change Scenario Planning

Crown Managers Partnership

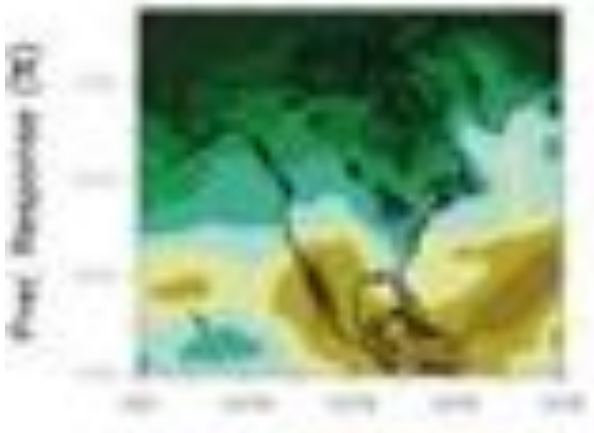
CMP Annual Forum Rockies

4/14/2010

Climate Predictions for North America

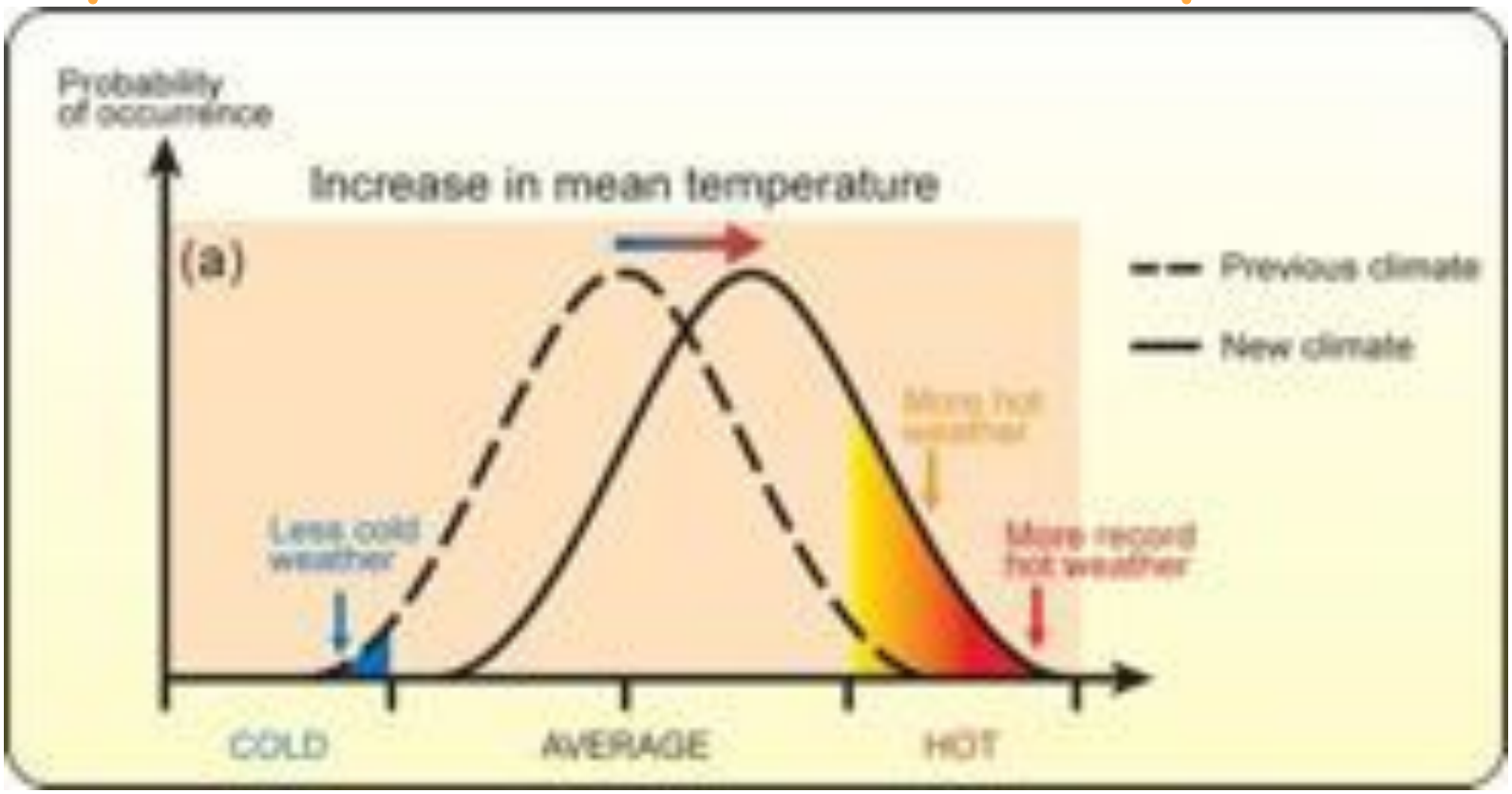


Continued temperature increases **highly likely** (“virtually certain”) in western North America based on agreement among models runs and fundamental knowledge of key physical processes.



Relatively **low confidence** in forecast precipitation changes because of disagreement between models and the complexity of underlying processes. For CoC—more confidence in winter predictions, less in spring/summer/fall.

Expect Increases in Extreme Temperatures



More hot days, fewer cold days

More heat waves, fewer cold outbreaks

Mountain pine beetle will dramatically alter Western conifer forests

Widespread epidemics driven by warmer temperatures
Tree's natural defenses reduced by drought
Unprecedented (?) in extent, rate of spread and severity

Warmer temperatures increase wildfire

- 6x increase in area burned since 1986
- Higher spring and summer temp plus earlier snow melt
- New paradigm for wild land fire

Westerling et al. 2006;
see also McKenzie et al. 2004

Grinnell Glacier

from the summit of Mt. Gould

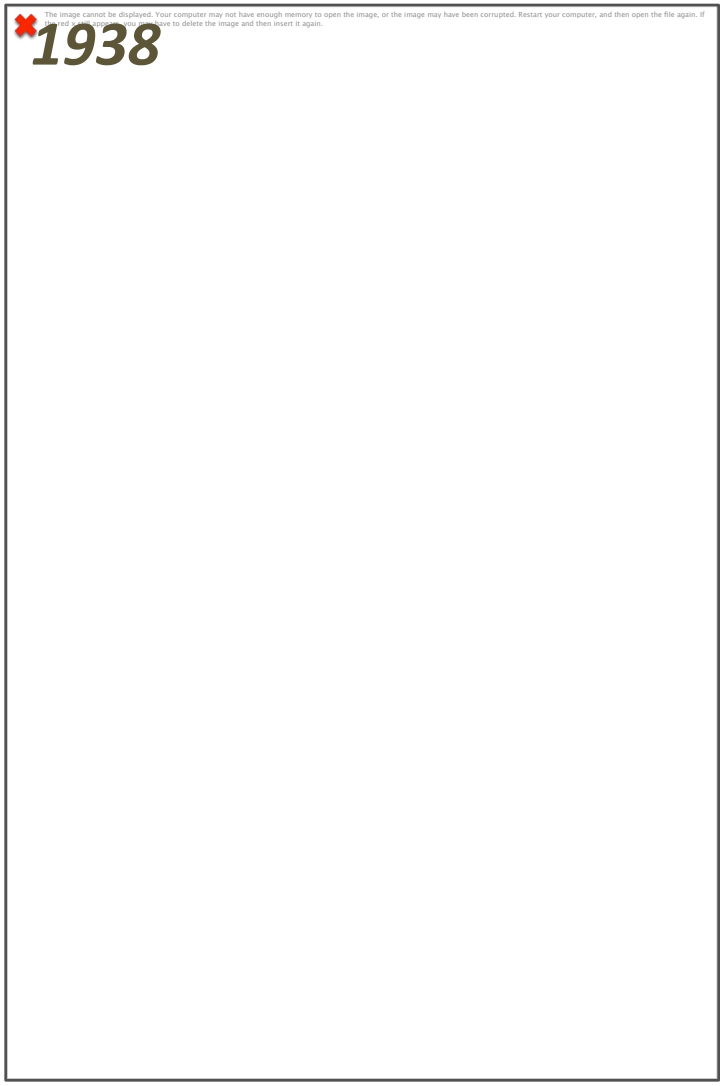
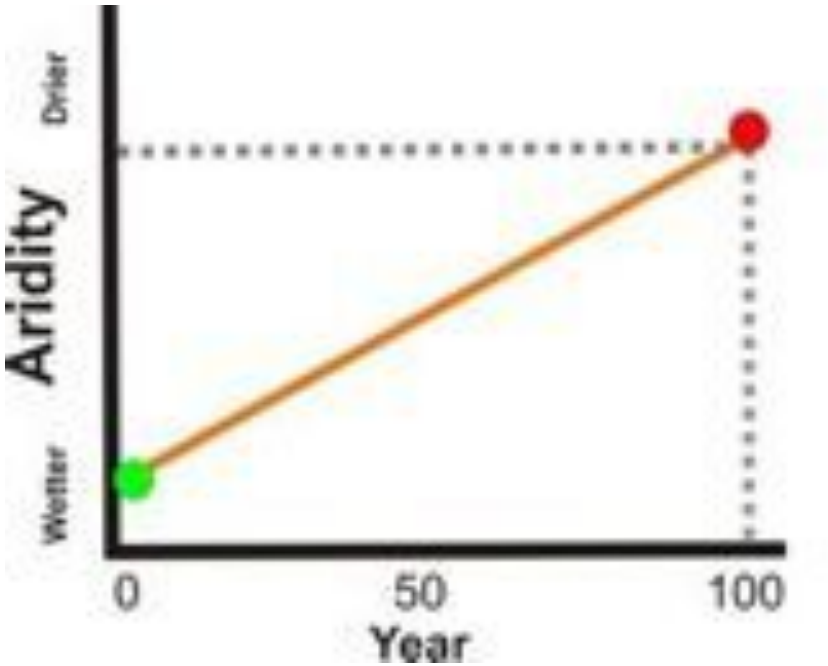


Photo by TJ Hileman, GNP Archives

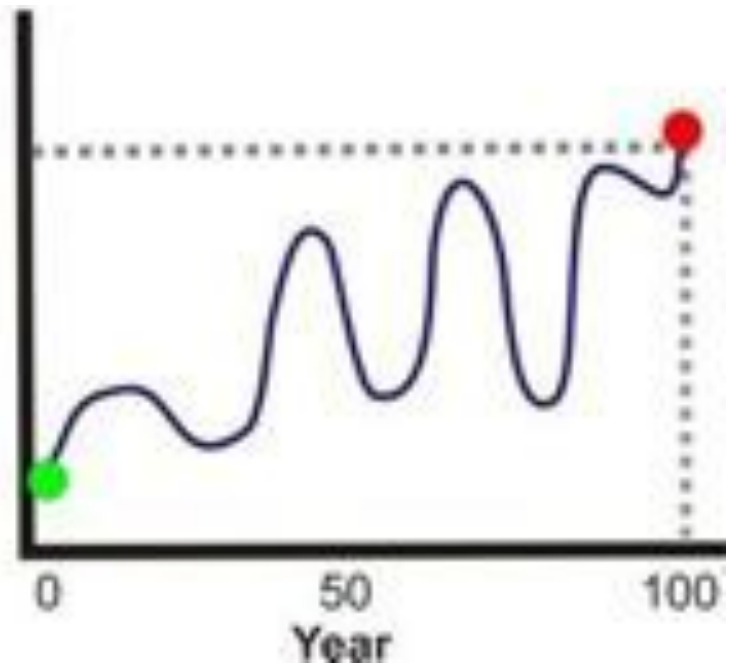
photo by L Bengtson, USGS

What do we know?

Future Climate = Natural Variability + Warming



We tend to think of future climate change as a simple linear trend…



Future climate will be a combination of human-induced trends and natural variability

Gray et al. (2006), *Ecology* 87:1124-1130

Definitions: Mitigation vs Adaptation

Mitigation = intervention to reduce the anthropogenic forcing of the climate system; includes reducing GHGs and emissions and enhancing GHG sinks

Adaptation = Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Definitions: Mitigation vs Adaptation

Mitigation = removing the cause of a problem. For CC, any action that reduces the concentration of GHGs in the atmosphere

Adaptation = an adjustment or coping strategy. For CC, actions that allow organisms or humans systems to endure or survive

- ***Organisms*** can *adapt in place* by evolving new capacities or changing behaviors OR they can *move to a new location*
- ***Human adaptation*** involves making different choices to protect what's important to us

  Facilities / structures → protection / rethinking design; location

  Landscape / ecosystems → protection / promoting resilience

Adaptation Planning: Building a management toolkit

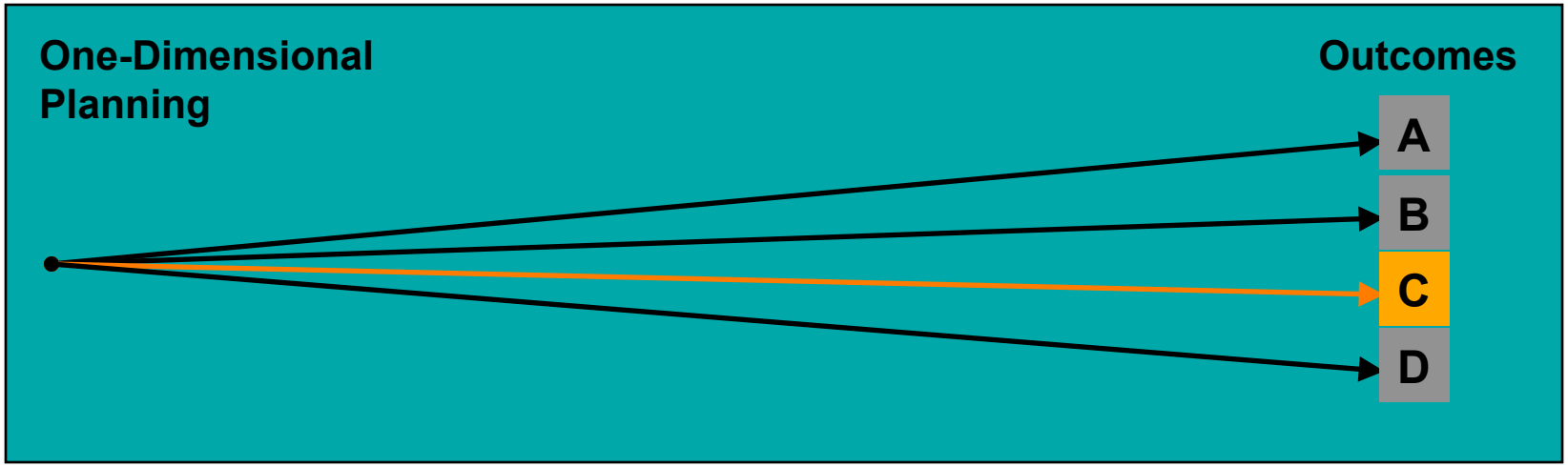
Begin looking at how to incorporate climate change into landscape planning

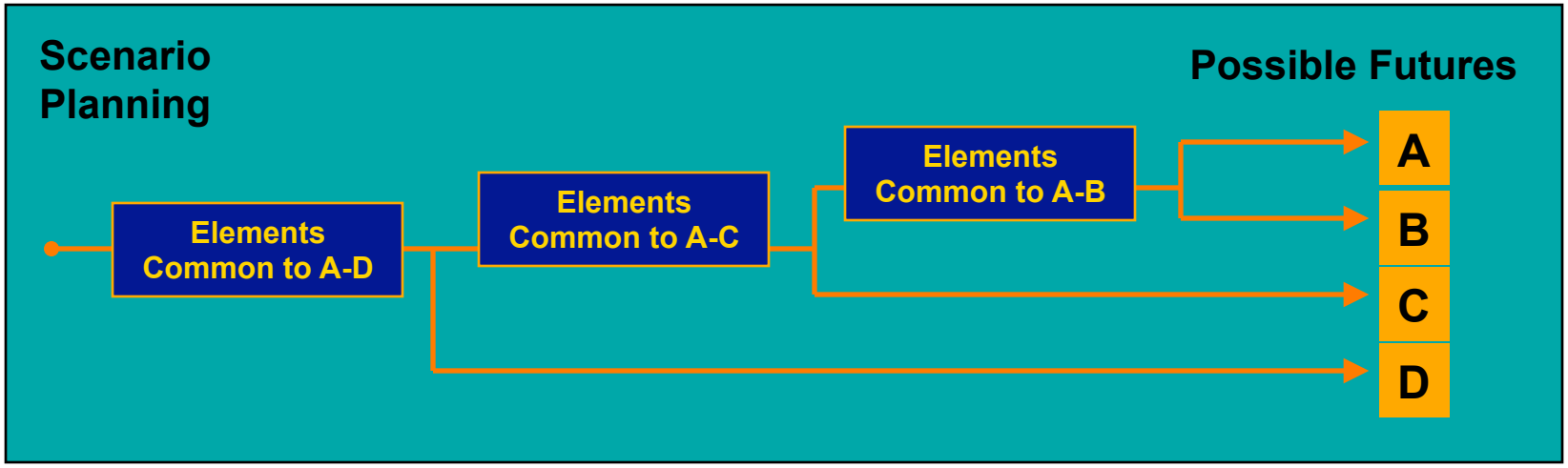
- Scenario Planning as a tool for evaluating where you are and where you want to go – long-term strategic planning
- Scenarios are not predictions or forecasts, nor a method for arriving at the most likely future
- Adaptive Management and Hedging options for helping to get there

Explaining Scenarios: Description

- **Scenarios are stories about tomorrow that can help you make better decisions today**

One-Dimensional Planning vs. Robust Planning





What are Scenarios?

Scenarios Are:

- **A tool for long-term strategic planning**
- **Compelling narratives of alternative environments in which decisions may be played out**
- **Coherent, internally consistent, and plausible**

Scenarios Are Not:

- **Predictions or Forecasts**
- **A method for arriving at the "most likely" future**

Climate Change Drivers

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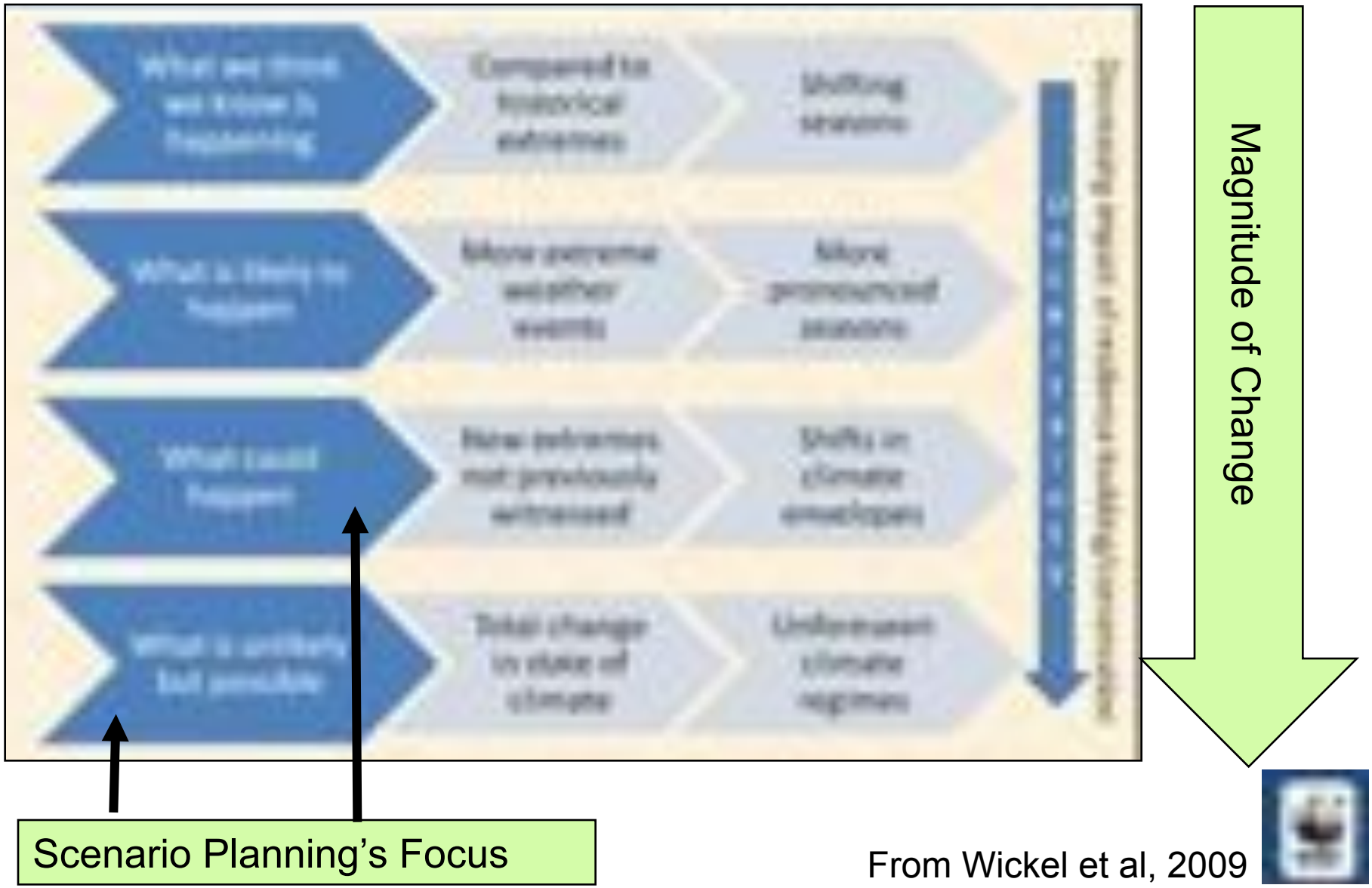
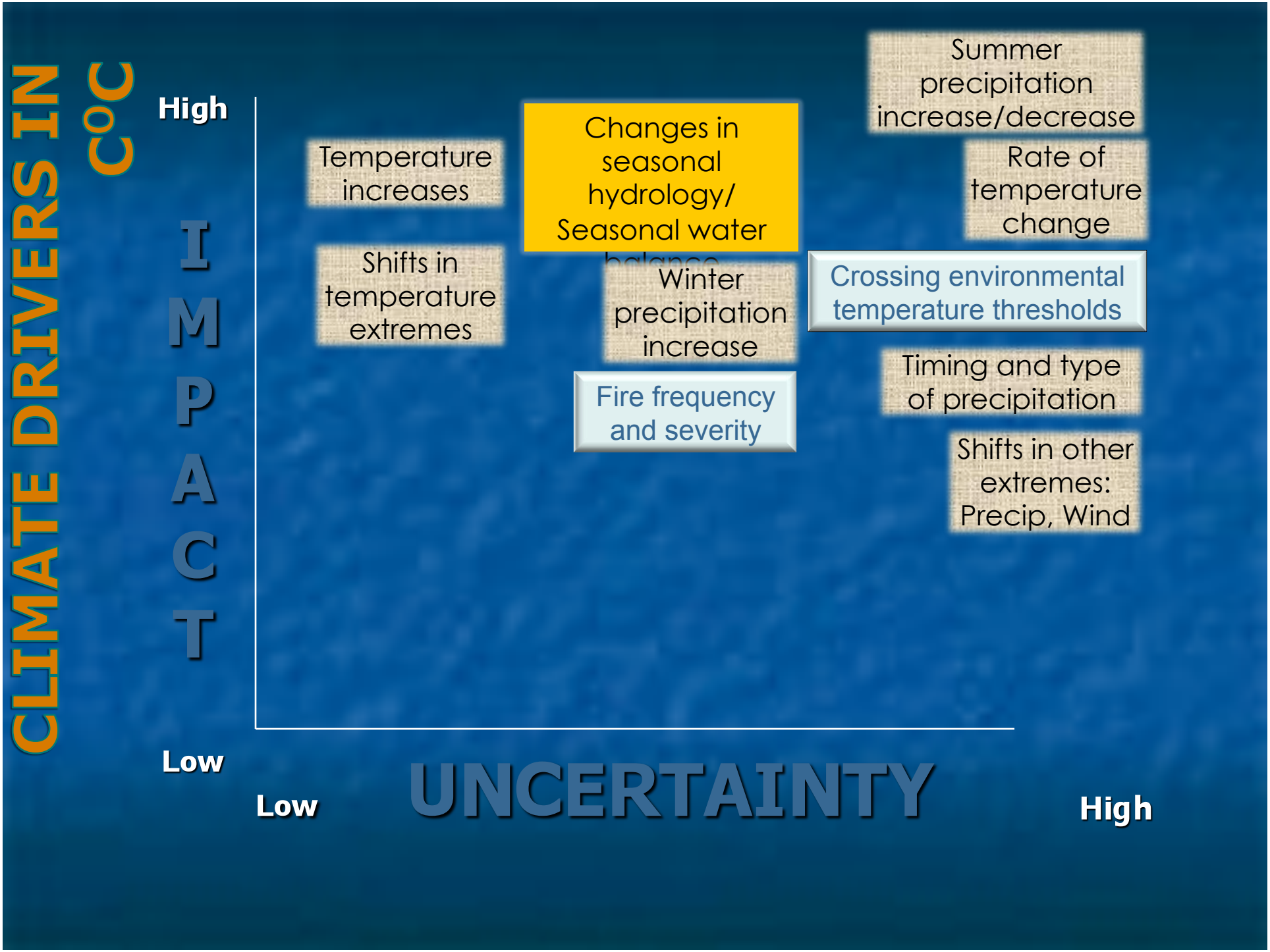
The Adaptation Challenge



From Wickel et al, 2009


CLIMATE DRIVERS IN C°C
IMPACT
High
Low
Low
UNCERTAINTY
High
Temperature increases
Changes in seasonal hydrology/ Seasonal water
Summer precipitation increase/decrease
Rate of temperature change
Shifts in temperature extremes
Winter precipitation increase
Crossing environmental temperature thresholds
Timing and type of precipitation
Fire frequency and severity
Shifts in other extremes: Precip, Wind

CoC Climate Axes

SSF precip increase

PRECIPITATION

SSF precip decrease

NON-WINTER

RATE OF CHANGE OF TEMPERATURE INCREASE

Gradual/ Uniform

Rapid / Abrupt

Climate Complacency

-PDO moderation in early decades
- warmer, more humid & dynamic system
- increased storminess
- droughts are generally intra-annual
- overall increase in productivity
- fires more isolated in time, space

Volatile Surprise

- dynamic and volatile climate: intra- and inter-annual
- hydrologic flashiness: rain-on-snow; storms year-round
- water stresses often moderate at local levels
- significant chances of intense intra-annual drought
- rapid ecological responses
- emergence of novel ecosystems

Colorado Creeps North

- overall drier climate in non-winter months
- recurring summer/fall moisture stress: streams, meadows, wetlands
- fire regime changes: higher severity, extent, frequency
- with every disturbance, shift to drier ecosystems
- eventual regional change favoring shrubs and grasslands

Race to Refuge

- rapid warming & decrease in non-winter precipitation
- rain/snow ratio changes dramatically at low- & mid-elevations
- substantial risk of rain-on-snow events
- water stress severe, region-wide, unrelenting
- epic fire regimes: region-wide, firestorms
- ecosystems in great transition: drought, fire, disease, pests, exotic species
- unrelenting assault on infrastructure: rain-on-snow , fire, rain-on-snow after fire

FOR ALL QUADRANTS: *Temperatures increasing; Temperature extremes increasing; Environmental thresholds exceeded; Winter precipitation stable or increasing ; Earlier spring runoff; Growing season & Fire season extended; Phenological mismatches*

Simple Scenario Descriptions

Race to refuge – rapid temp rise, decrease in summer precip, strong leadership, strong societal concern

Colorado creeps north – moderate temp. rise, increase in non-winter precip; strong leadership, weak societal concern

Climate complacency – moderate temp rise, increase in non-winter precip; weak leadership, weak societal concern

One-Dimensional Planning vs. Robust Planning