

Adapting Water Resources to Climate Change

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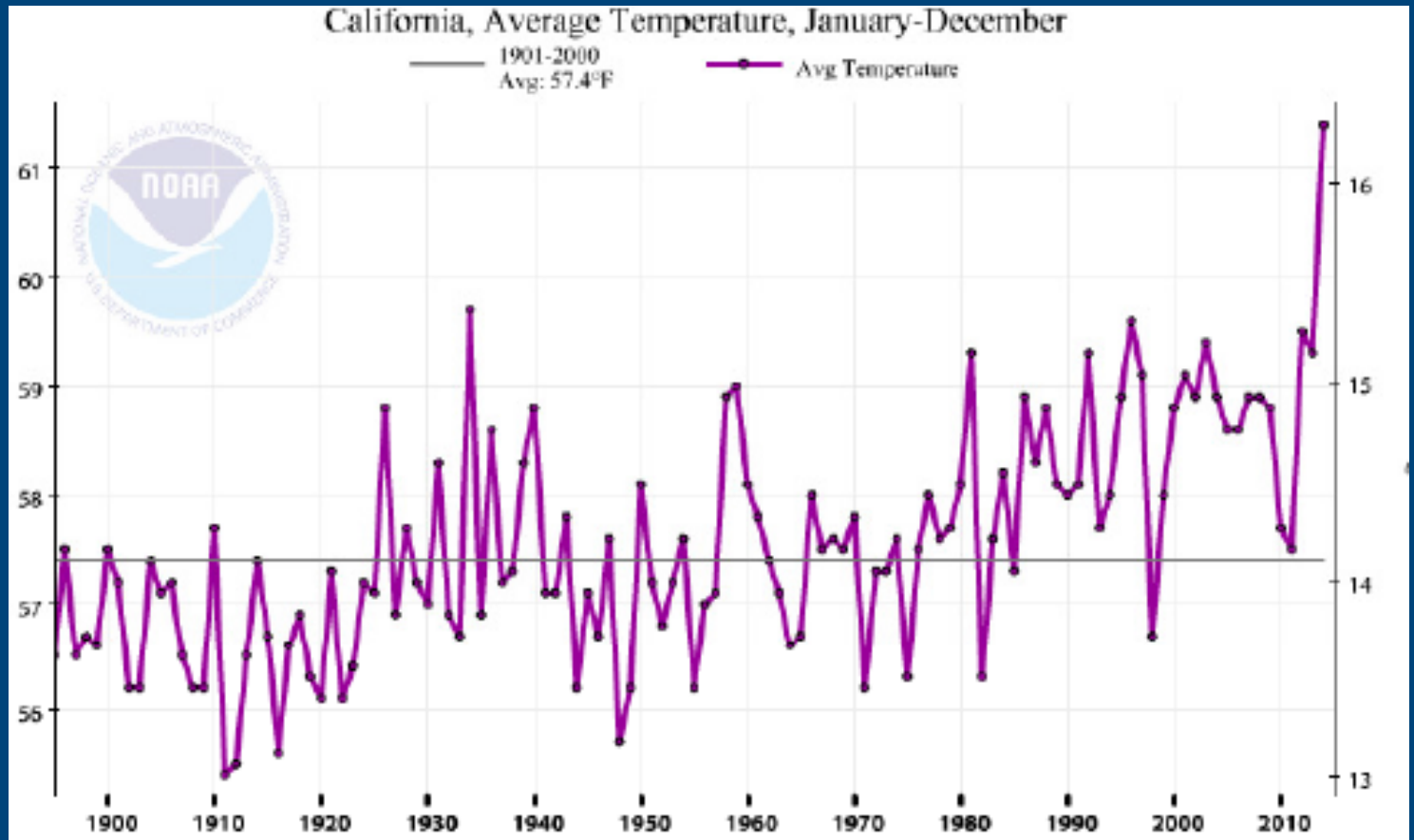
Our Water Future
Santa Cruz
April 8, 2015



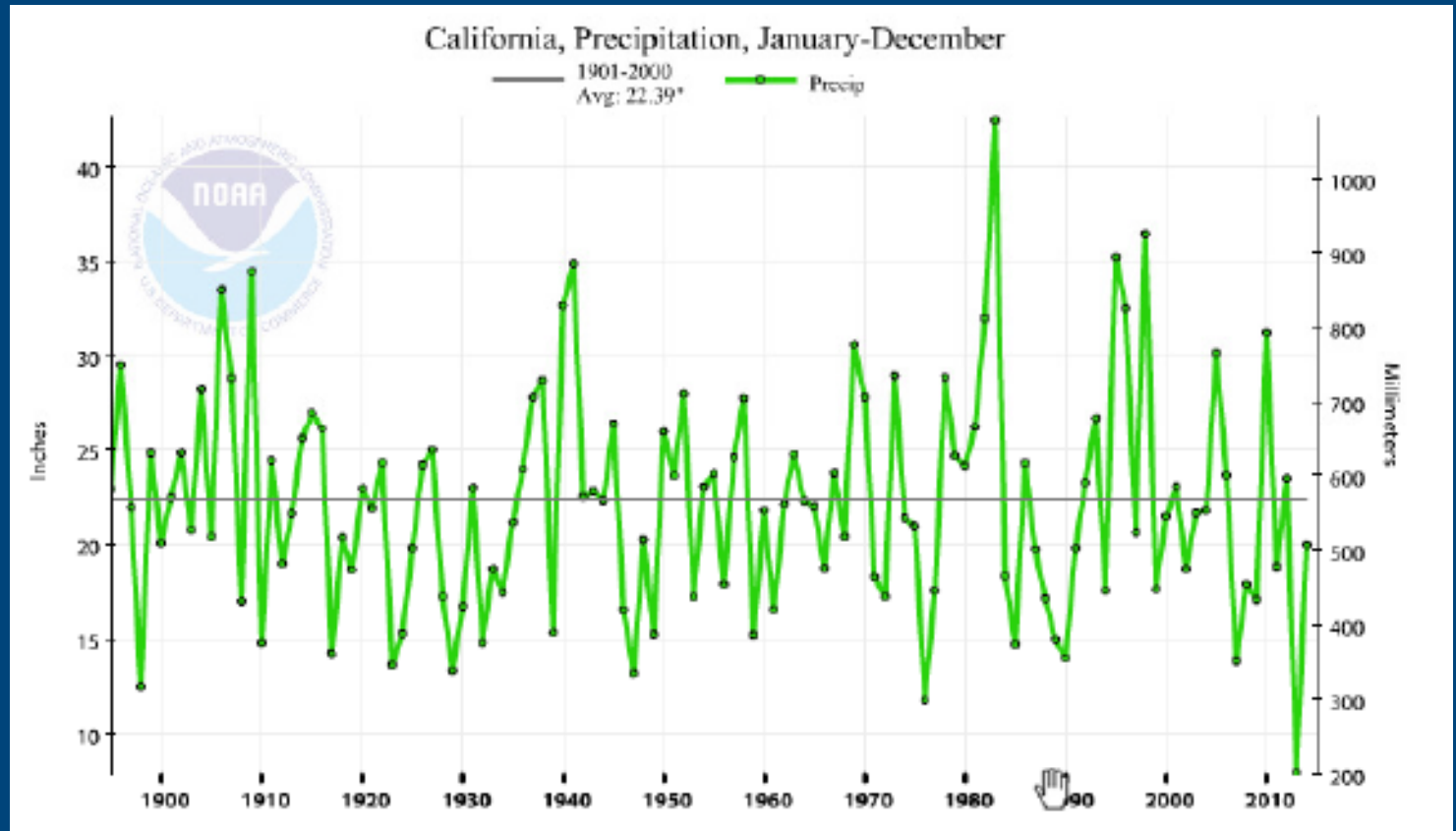
What I Will Cover

- What has been happening to California's climate?
 - Implications for water resources
- What is projected for the future?
- How do we adapt given that:
 - We know climate change will happen
 - But we cannot forecast exactly how climate will change

California is Getting Warmer



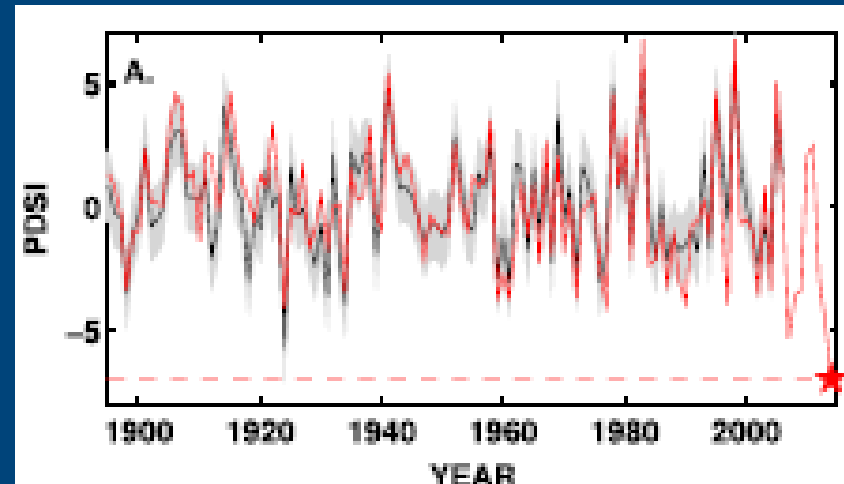
Precipitation is More Complex



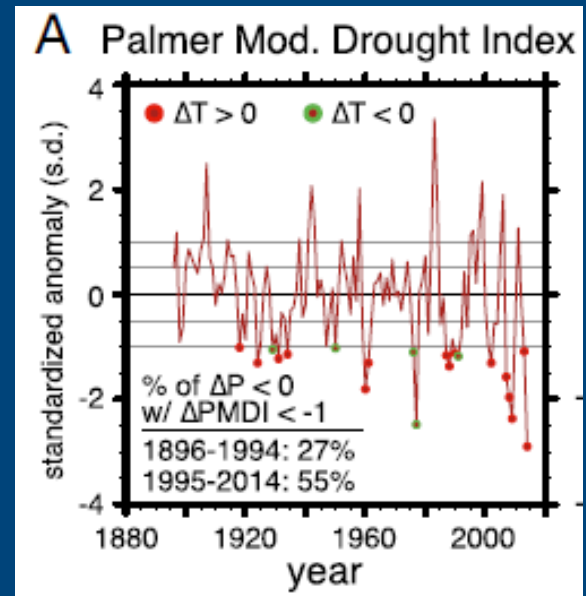
Current Drought

Recent literature

- Recent California precipitation is within natural variability
- Temperatures are very high
- Could be* that higher temperatures are making droughts much more severe
- That has implications for the future



Griffin and Anchukaitis, 2014



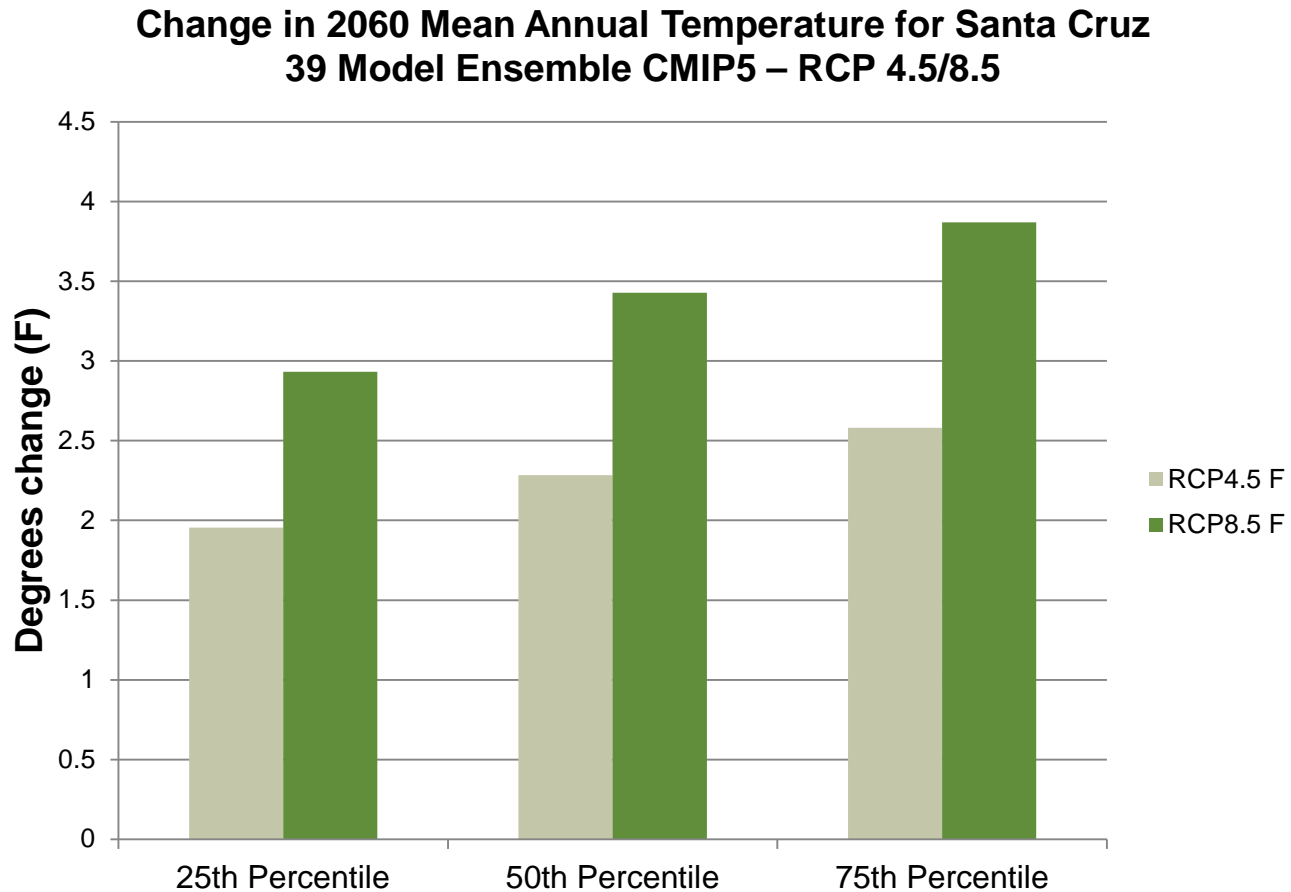
Diffenbaugh et al., 2015



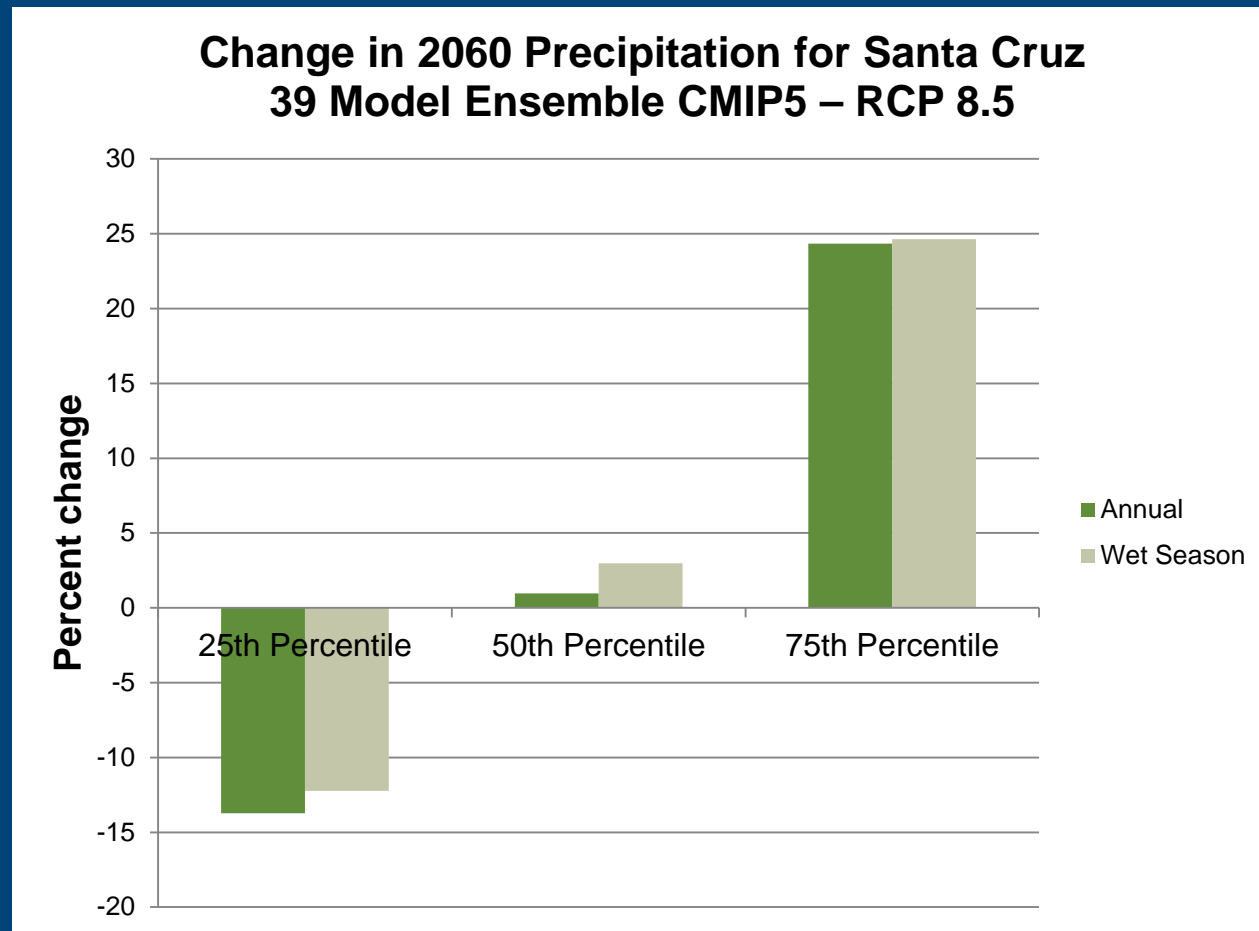
What Do We Expect in the Future?

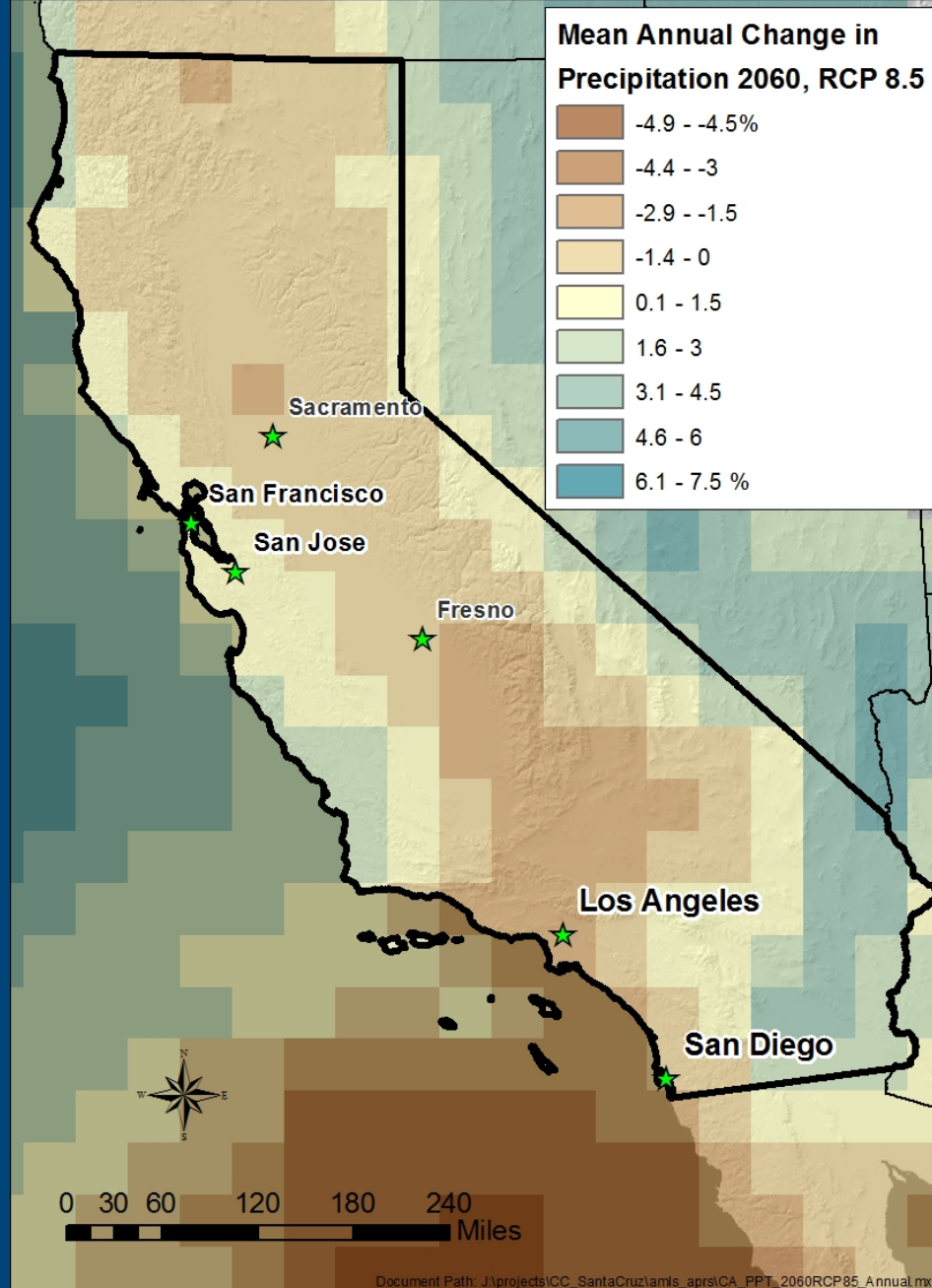
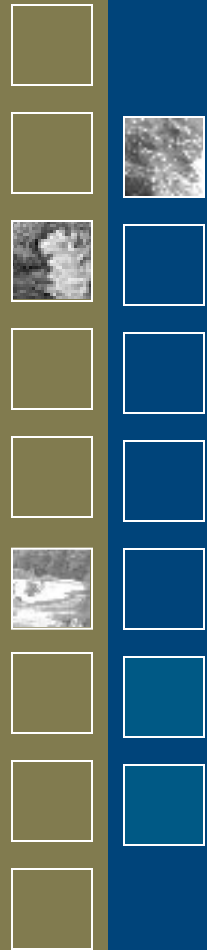
- More warming is virtually certain
 - Some is “baked in”
 - GHG emissions still rising
 - 2014 global emissions a sign of hope
 - We can do a lot to slow this down!
- A warmer California is highly likely
- What about precipitation?

Temperature Projections for Santa Cruz



Precipitation Projections for Santa Cruz







The 21st Century in California

- Warmer
- Quite possibly drier
- Temperature rise alone may have significant challenges for water supplies



How Do We Adapt?



What Do We Know and Not Know?

- The climate IS changing
- But we cannot say exactly how it will change





What Do We Know?

- We know certain climate variables will rise
 - Temperature
 - Sea level
 - Hydrological cycle – that means:
 - More intense precipitation



What Do We Not Know?

- For those climate variables that will rise
 - We cannot predict the magnitude of change
 - Global temperatures are projected to rise about 3 to 11°F by 2100
 - Sea level rise 1 to 6 ft.
- We do not know if precipitation in the Santa Cruz area will rise or fall
 - Much of California is projected to have less precipitation
- Change in variability uncertain

Implications for Water Supply in California

- Because of higher temperatures
 - More demand for water
 - More evaporation
 - More precipitation falling as rain
- Sea level rise
 - Salinity in coastal aquifers
- Decrease in supply seems more likely than not



Also, There Are Surprises and Extreme Events





We Need to Prepare for Current and Future Risks – Some Key Principles

- Economic efficiency
 - Roughly benefits should justify costs
- Risk management
 - Consider probabilities and consequences
- Address current problems
 - Efficient use of natural resources
 - Pollution control
- Mainstreaming
 - Try to use existing governing processes to the extent appropriate and effective



Basic Choices for Adaptation

- Reactive adaptation
 - We've handled changes before
- Address current problems
 - Many changes are needed to improve management that will also help us adapt to climate change
- Make incremental changes
 - Marginal changes in size and types of infrastructure, institutions, etc., to anticipate climate change
- Plan and allow for change
- Transformation
 - Fundamental changes



Given the Uncertainties

- It would be better to be react to climate change as it happens
 - Wait for climate to change and then do what is needed
 - Farmers can change crops as the climate changes
 - Best adaptation is to design systems to be reactive

Why a Reactive Approach Will Not Work

- Potential for Catastrophe
 - Loss of life
 - Economic harm
- Long-term decisions
- Missed opportunities





Address Current Problems and Challenges

- Improve natural resource management
 - Conservation?
 - Increase supplies?
- Select approaches that
 - Make sense under current climate
 - *And* under possible future climates
- *No regrets*

Incremental Adjustments

Building or rebuilding infrastructure

- Make it a little bigger or better
- Makes the most sense when
 - The direction of change is known
 - Incremental costs are low
 - Downsides are low





Allow for Management Change Over Time

- Adaptive management

- Make decisions that can be changed or adjusted as conditions change
- Monitoring and evaluation are needed

- Adaptive pathways

- Think through what decisions may be needed over time
 - Some decisions can be made in the future
 - Look for pathways that can carry forward for decades

Transformation

- Make significant changes
 - Institutions
 - Livelihoods
 - Location
- This one is hardest
- Are these changes made in anticipation of or after their need is obvious?



Whatever You Do

- Remember the climate is changing
 - Apply the climate change lens
 - “Should we do something different because the climate is changing?”





THANK YOU!

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