



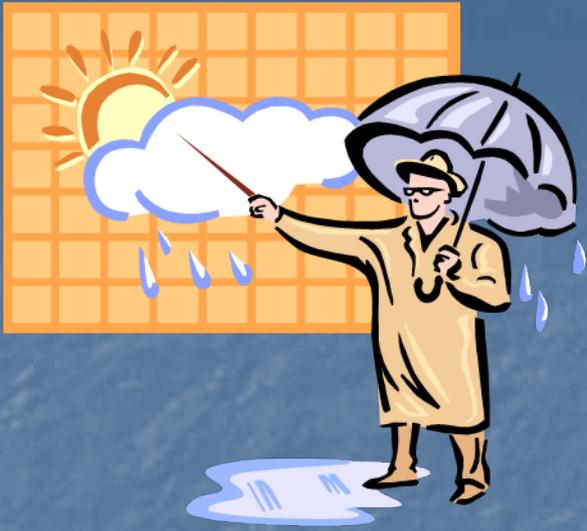
Climate Change Research Needs for Water Resources

PIER-EA Discussion Paper

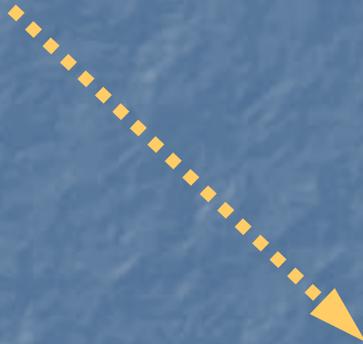
August 25, 2008

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Climate Change Scientists



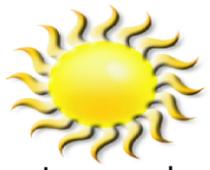
Water Resources Decision Makers 2



Climate Change Scientists



Water Resources Decision Makers



Increased
air temperature

Climate Change Effects on Water Resources

Total precipitation may increase or decrease



More precipitation as rain than snow
due to higher temperatures

Less snowpack

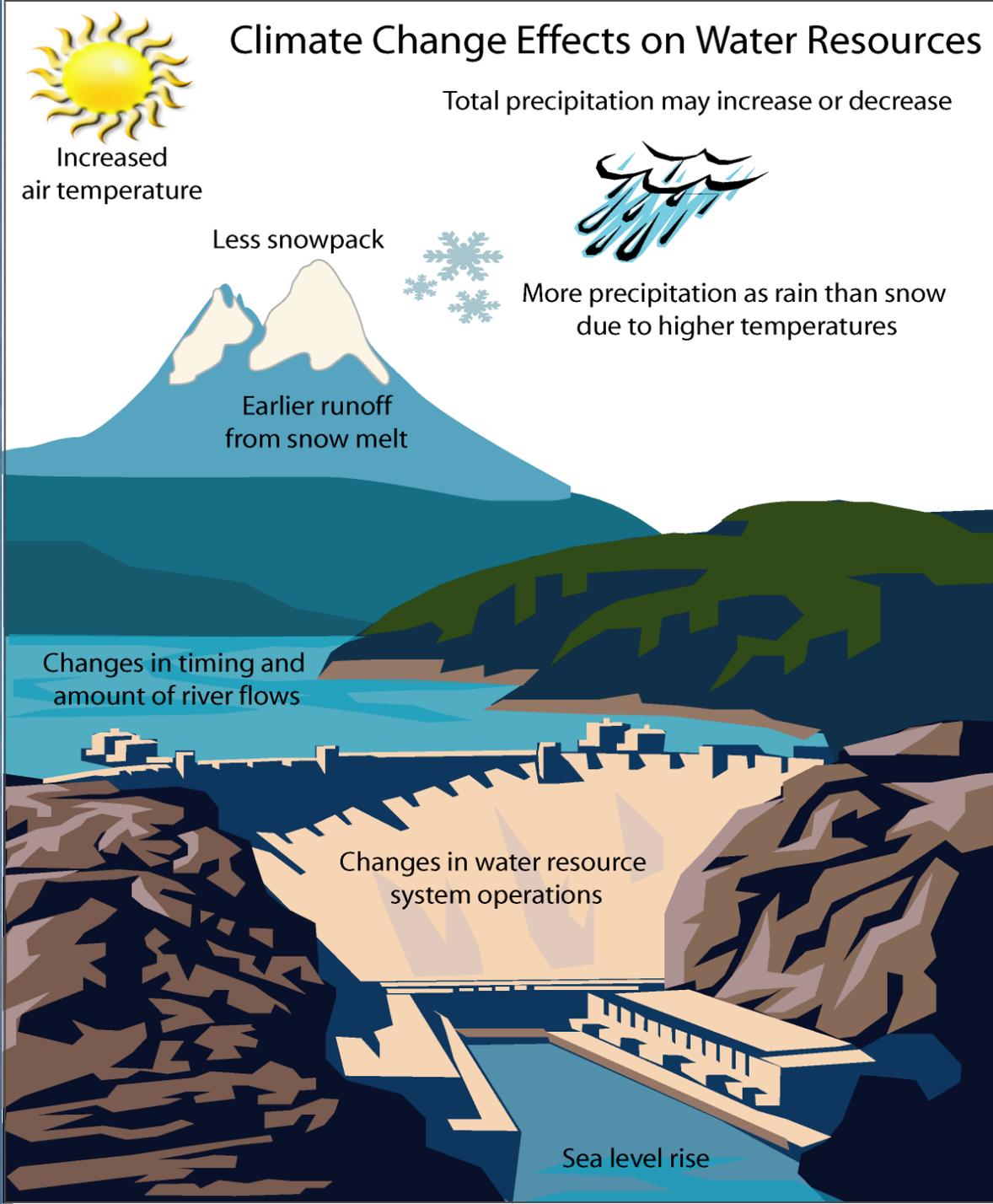


Earlier runoff
from snow melt

Changes in timing and
amount of river flows

Changes in water resource
system operations

Sea level rise



Water Resources Impacts

- Water Supplies
- Water Demands
- Water Quality
- Ecosystems
- System Operations
- Flood Management





UNCERTAINTY

Climate Projections

Water cycle changes

Converting GCM data
to regional scales

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Ecosystem response

Future water demands

Sea level rise

Adaptation Strategies

Changes in societal values

Monitor key hydrologic variables



- Precipitation
- Air temperature
- Snowfall/ water content
- Runoff
- Sea-level rise
- Evapotranspiration

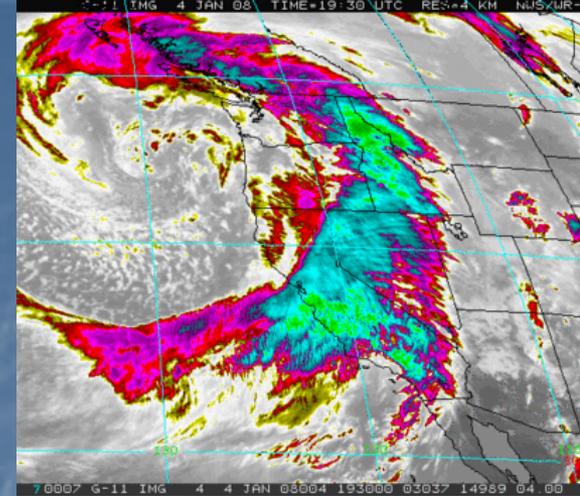
Long-term records of observed data are extremely important!!

Monitoring

- Improve understanding of physical processes
 - Sea level rise vs. subsidence
 - Transition zone between snow and rain dominated portions of watersheds
 - Snowpack and groundwater recharge
 - Land cover and ecosystem responses to climate change
- Explore monitoring methods
 - Satellite data
 - New methods and technologies

Storms

- Evaluate science of storm formation and storm tracks in the Pacific
- Improving understanding of how El Niño Southern Oscillation (ENSO) events and other decadal-scale patterns affect winter precipitation
- Expand modeling of climate related to storms
- Improve forecasting tools that span from the weather domain (7-10 days) to seasons or years



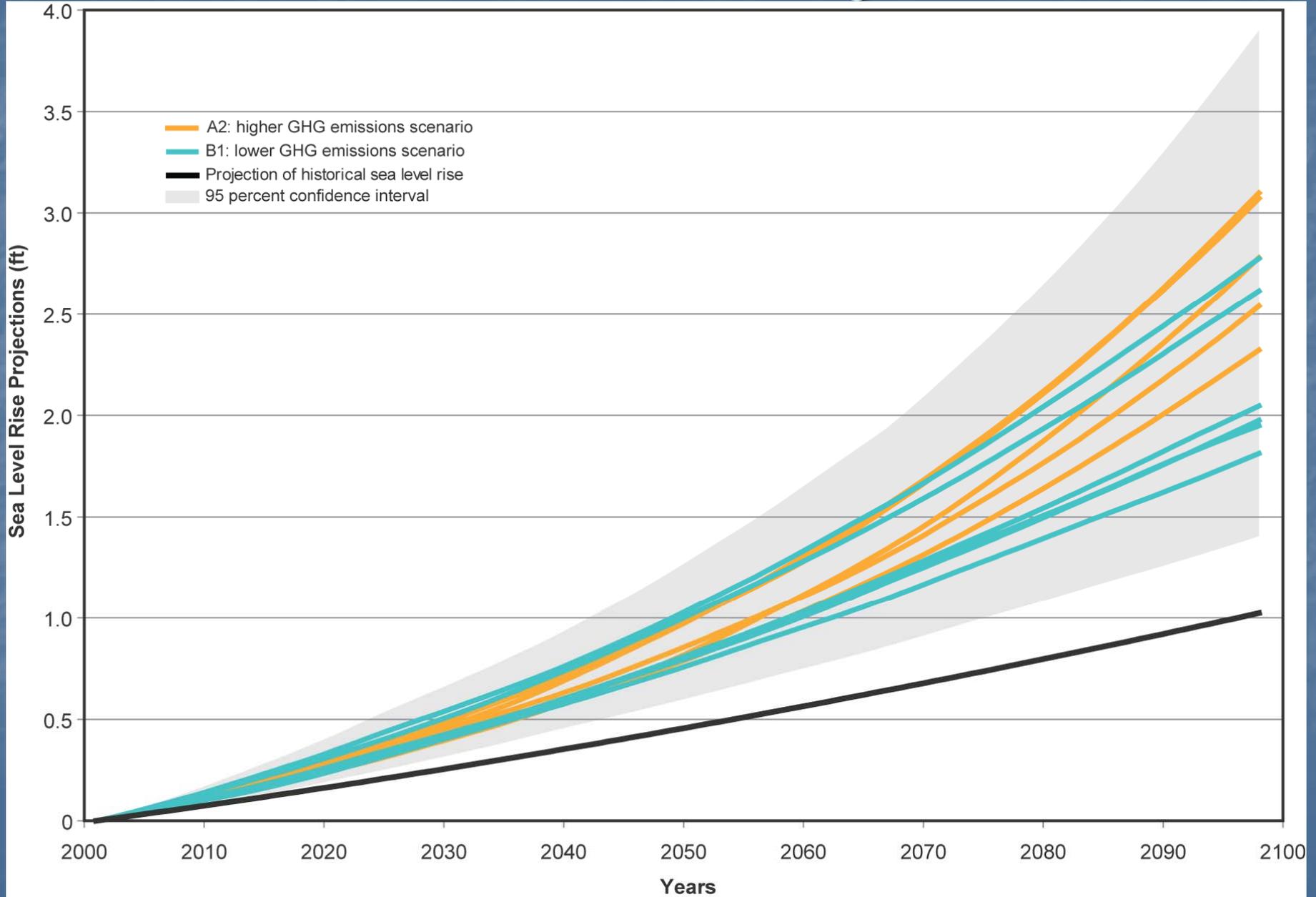
Future Projections

- Climate Change
 - Model regional-scale changes in climate through both large-scale GCMs and downscaled/regional models
 - Develop methods for simulating climate change at finer spatial and temporal scales
 - Apply dynamical downscaling for California
- Demographics
 - Improve estimates of future population and land use
 - Societal values
 - More information on uncertainties

Future Projection Uncertainty

- Guidance needed from scientists on
 - Relative likelihoods of future GHG emissions scenarios
 - Ability of different GCMs to represent California's climate
 - Uncertainties in sea-level rise projections and their associated assumptions
 - How are uncertainties related to each other?
Is there a compounding effect or a mitigating effect?
 - Appropriate uses of climate change data

Sea Level Rise Projections



Data Availability

- Create or enhance existing archives
- Provide data at spatial and temporal scales needed for decision making
- Increase the number of variables available in these archives

Impacts of Climate Change

- Water cycle
 - Amount, timing and form of precipitation
 - Changes in variability and extreme events
- Hydrologic impacts on ecosystems
 - Flows and water quality
 - Riparian resources
 - Inland and coastal wetlands including vernal pools
 - Forests
- Timing and amount of hydroelectric generation
- Urban and agricultural water & energy demands
- Economics

Sea Level Rise



- Expand research on impacts of sea-level rise on water-related resources
 - coastal aquifers
 - saltwater intrusion
 - saltwater/freshwater marsh ecosystems
 - Delta levee stability
- Develop tools to assess these potential impacts
- Encourage a National Research Council (NRC) or similar science review of sea level rise issues

Decision Support

- Evaluate State and Federal system management responses to climate change
 - Reservoir and delivery operating rules and system changes
 - Water allocation
- Guidelines for analyzing extreme events
- Jointly incorporate paleo-climate, instrumental measurements, and projected climate into the planning process
- How do various analysis choices affect the final information provided for decision making?

Management Issues

- Planning horizons
- Guidelines for incorporating climate change into Integrated Regional Water Resources Management Plans
- Develop linkage between local, regional, and global scale actions, and their consequences



Public Health



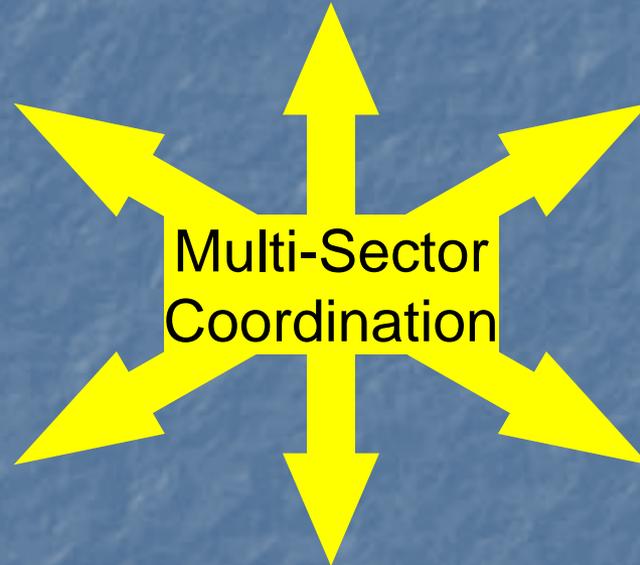
Water



Forestry



Energy



Agriculture



Environment

Adaptation Strategies

- Integrate and coordinate mitigation and adaptation measures
- Review the advantages and disadvantages of existing water policies in helping to adapt to climate changes
- Explore ways to incorporate adaptation into planning processes
- Develop and test adaptation strategies. Assess:
 - Trade-offs
 - Flexibility of existing water systems
 - Possible changes in operations, regulations or infrastructure
 - Economic tools as adaptation strategies



Thank You!