# CLIMATE CHANGE RESEARCH AT THE SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT AUTHORITY

## Presentation to the American Academy of Environmental Engineers and Scientists

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# WHAT IS SCCWRP?

- **Joint Powers Agency**
  - Founded in 1969
- **Our mission: Provide an unbiased scientific foundation for ambient water quality management in California**
  - We don’t do policy
  - We don’t do regulation
  - However, we judge success on whether our science is being used by those who do policy and regulation
- **Member organizations include city, county, state, and federal agencies**
  - Unique combination of regulators and dischargers

# MEMBER ORGANIZATIONS

## Wastewater utilities

Los Angeles County Sanitation Districts

City of Los Angeles

Orange County Sanitation District

City of San Diego

## Stormwater management agencies

Ventura County Watershed Protection Division

Los Angeles County Flood Control District

Orange County Public Works

County of San Diego

## Regulatory and management oversight

San Diego Regional Water Quality Board

Santa Ana Regional Water Quality Board

Los Angeles Regional Water Quality Board

State Water Resources Control Board

U.S. Environmental Protection Agency

California Ocean Protection Council

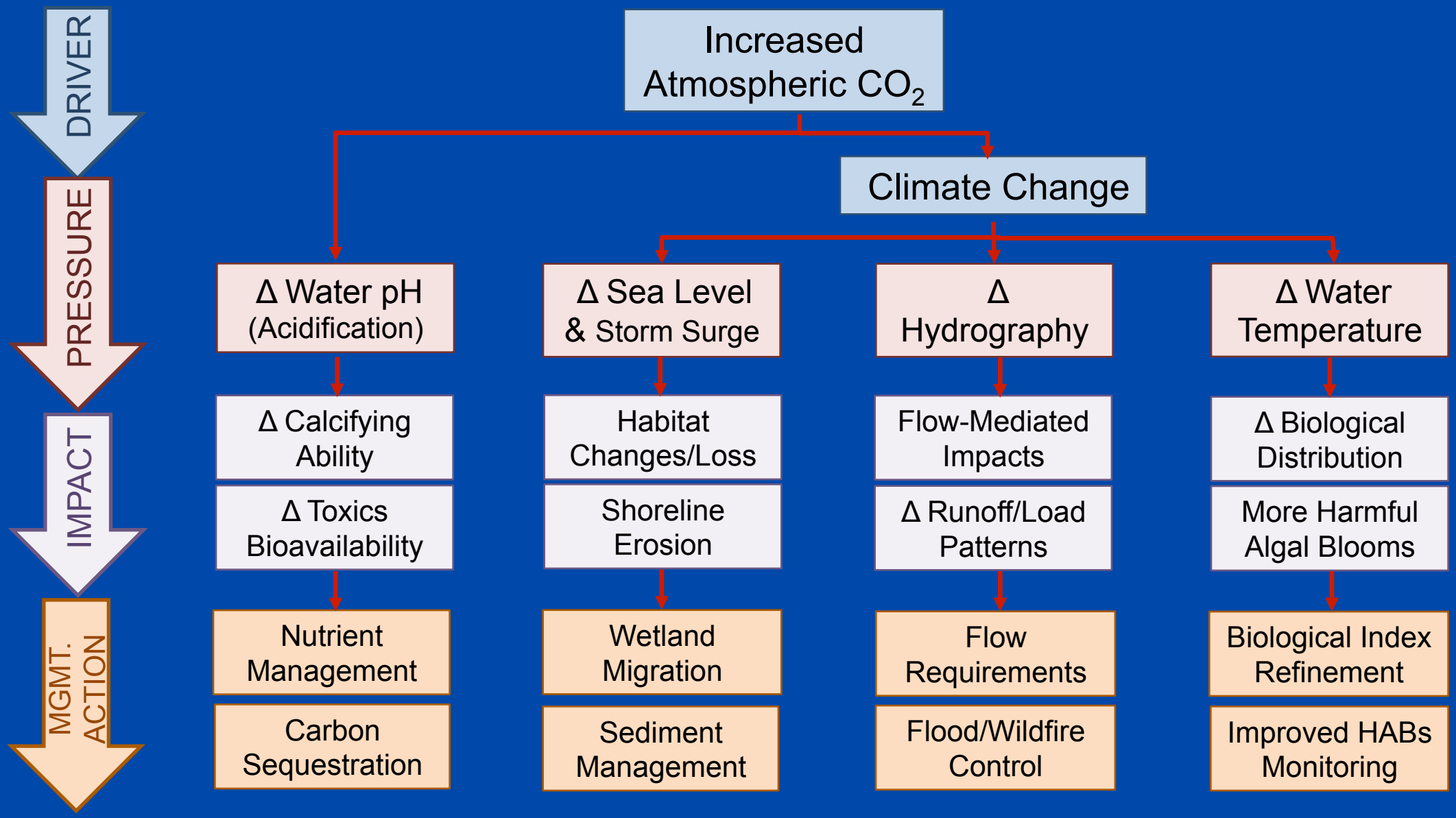
# SCCWRP COMMISSION

- **Governing board that includes leaders from each member agency**
  - Meets quarterly
- **They are supported by the Commission's Technical Advisory Group**
  - Lead scientists from each member agency
  - They meet about eight times per year and help guide our research priorities
- **The Commission and CTAG are a powerful interface between science and management**
  - The real strength of the organization

# RESEARCH THEMES

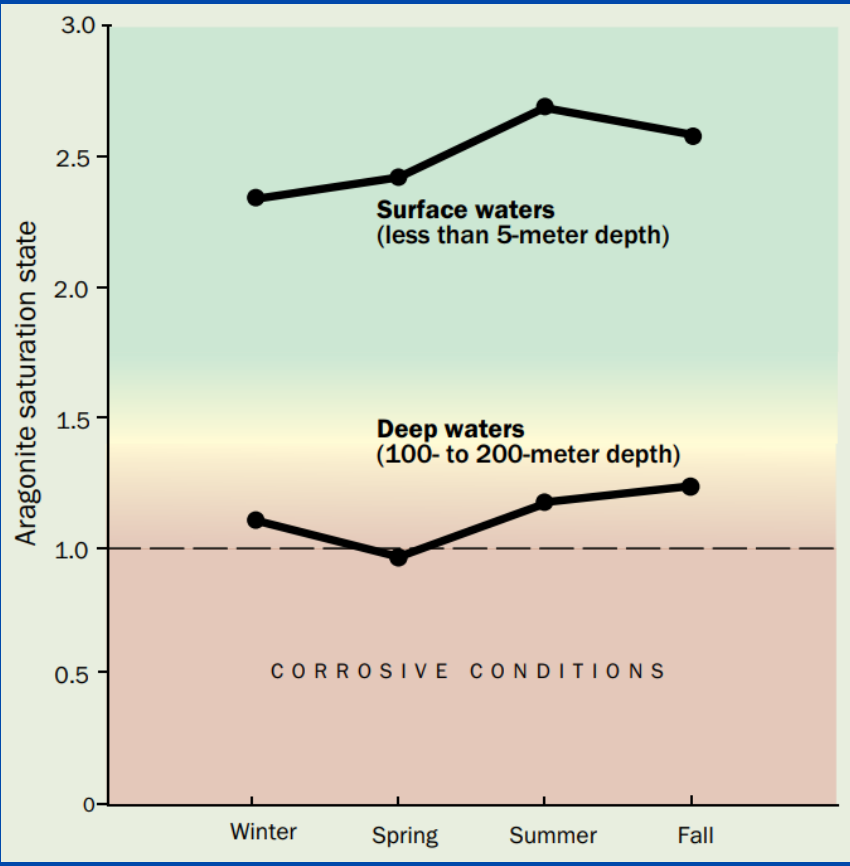
- **Bioassessment**
  - Index development
  - Casual assessment
  - Genomics
- **Eutrophication**
  - Nutrient targets
  - Harmful algae
- **Ecohydrology**
- **Contaminants of Emerging Concern**
  - Non-targeted analysis
  - Cell-line assays
  - Microplastics
- **Microbial Water Quality**
  - Genomic method development
  - Source identification
  - QMRA
  - Antibiotic resistance
- **Climate Change**
  - Acidification
  - Sea level rise
- **Sediment Quality**
  - Direct effects
  - Food web models
- **Regional Monitoring**
- **BMP Performance**

# CONCEPTUAL MODEL



# OCEAN ACIDIFICATION

- **This is a defining ocean health concern for my generation**
  - This stress operates at a west-coast wide scale (or larger)
  - Recovery past a tipping point may not be possible because of that spatial scale of impact
- **The southern California ocean is acidifying**
  - We are already seeing effects on shelled organisms
- **We are only beginning to think about this from a science and management perspective**
  - We don't have acidification management targets
  - Don't know what local management actions are likely to be meaningful in context of a global atmospheric driver



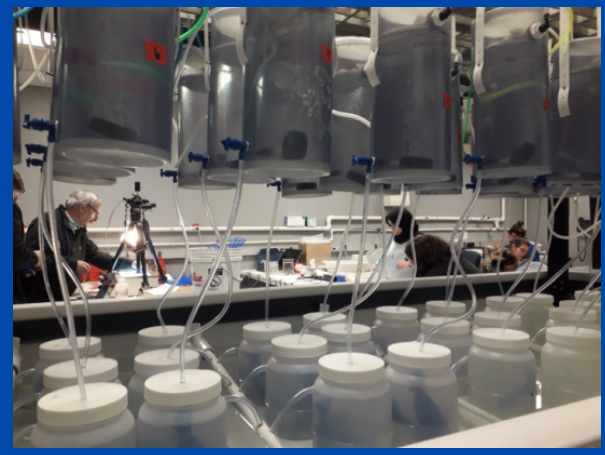

**SoCal's deep coastal waters are already corrosive**

- Corrosive conditions = Seawater with aragonite saturation state <1.0

# SCCWRP'S OCEAN ACIDIFICATION INVESTMENTS

- **Regional monitoring to assess trends in ocean carbon chemistry**
  - Coordinated with NOAA's west coast-wide surveys so we can place SoCal condition into context
  - Includes biological measurements to look at acidification effects on shells and physiology

- **Laboratory experiments to determine organism sensitivity**
  - Needed for developing acidification management targets
  - We recently built a state-of-the-art dynamic exposure laboratory that allows us to independently vary $CO_2$, oxygen, temperature and salinity
  - Improves on historical static testing by evaluating real-world exposure conditions



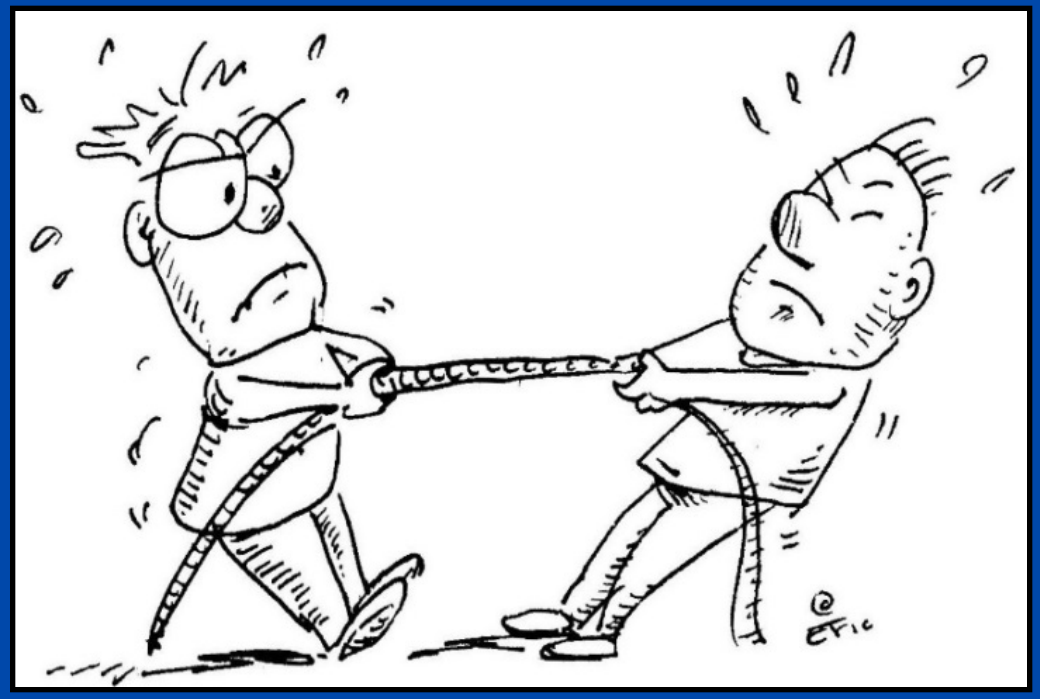
- **Ocean chemistry models that will help us assess California's future management options**
  - How much can seagrass sequestration reduce the problem?
  - Are local nutrient and carbon inputs are managerially meaningful?

# OCEAN MODELING

- **Question: To what extent do nutrient inputs from land-based sources affect local hypoxia, acidification and harmful algal blooms?**

## Two opposing views

California coastal waters are dominated by upwelling; therefore, anthropogenic nutrients are not a primary driver



Local anthropogenic inputs can exacerbate global drivers, potentially pushing dissolved oxygen and pH to ecological tipping points

# MODELING AS A SOLUTION

- **Coupled physical-biogeochemical models can provide us answers**
  - Physical model describes ocean circulation
    - How long do the local nutrient sources stick around?
  - Biogeochemical model describes how quickly the nutrients turn into algae and later into $CO_2$
    - Does it happen fast enough to make a difference locally?

- **66 million cells operating at 15 minute increments**
  - Takes a month of supercomputer time to do a single, one-year simulation

- **This is one of SCCWRP's biggest research investments at the moment**
  - Our member agencies are matching this with big investments in moorings and other data to help us parameterize and validate the model

# OTHER USES OF OCEAN MODELING

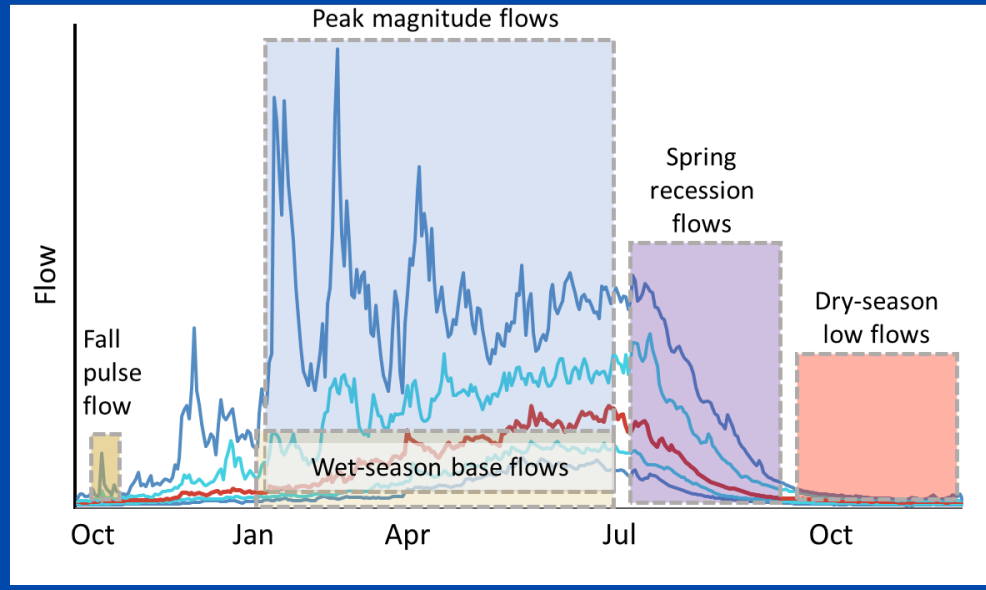
- **Vulnerability assessment**
  - Which habitats are most likely to acidify, with or without local nutrient inputs
- **Mitigation assessment**
  - We have a project to assess how much kelp growth, and where, would be effective at mitigating acidification effects
- **Tracking ocean inputs**
  - Tracking fate of different types of plastic inputs
- **Outfall plume mapping**
  - Particularly valuable for predicting future plume conditions as plant operations change or outfalls are relocated

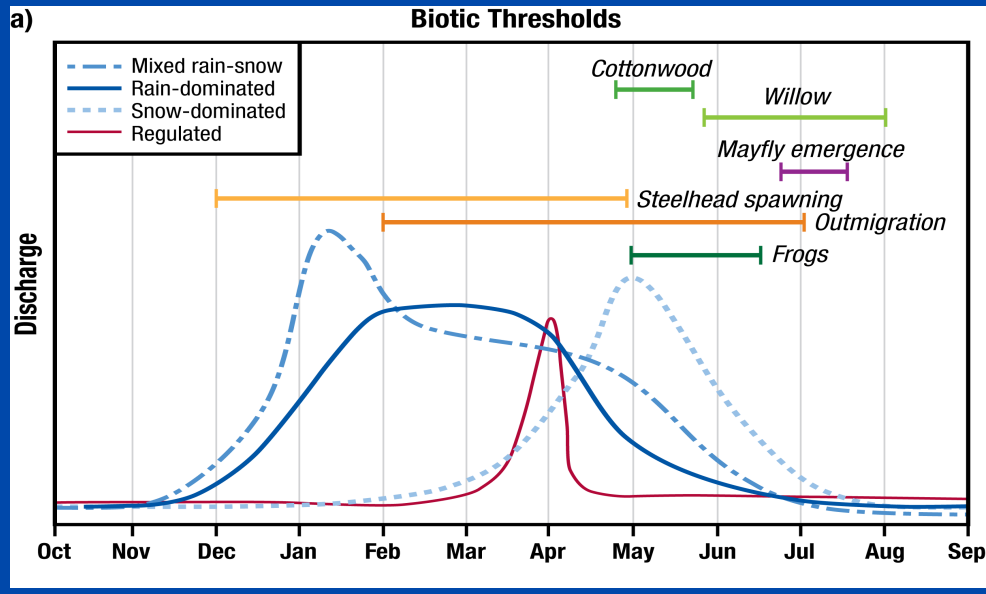
# CLIMATE CHANGE AFFECTS HYDROGRAPHY

- **Climate change drives hydrographic change**
  - Rainfall patterns will change, with but fewer more intense rainfall events likely
  - Snowmelt patterns will change, with more runoff in the spring and less in the summer
  - Higher temperature will lead to more evaporation and fewer stream pools
- **There are also changes in the demand portfolio**
  - Reuse lessens the flow discharge to streams
  - Conservation leads to reduced overwatering of lawns and less flow to streams
  - Recapture through groundwater recharge means less water for downstream flow
- **These factors demand definition of flow needs for streams**
  - SCCWRP is helping California determine biological flow needs

# A BROAD SUITE OF FLOW METRICS

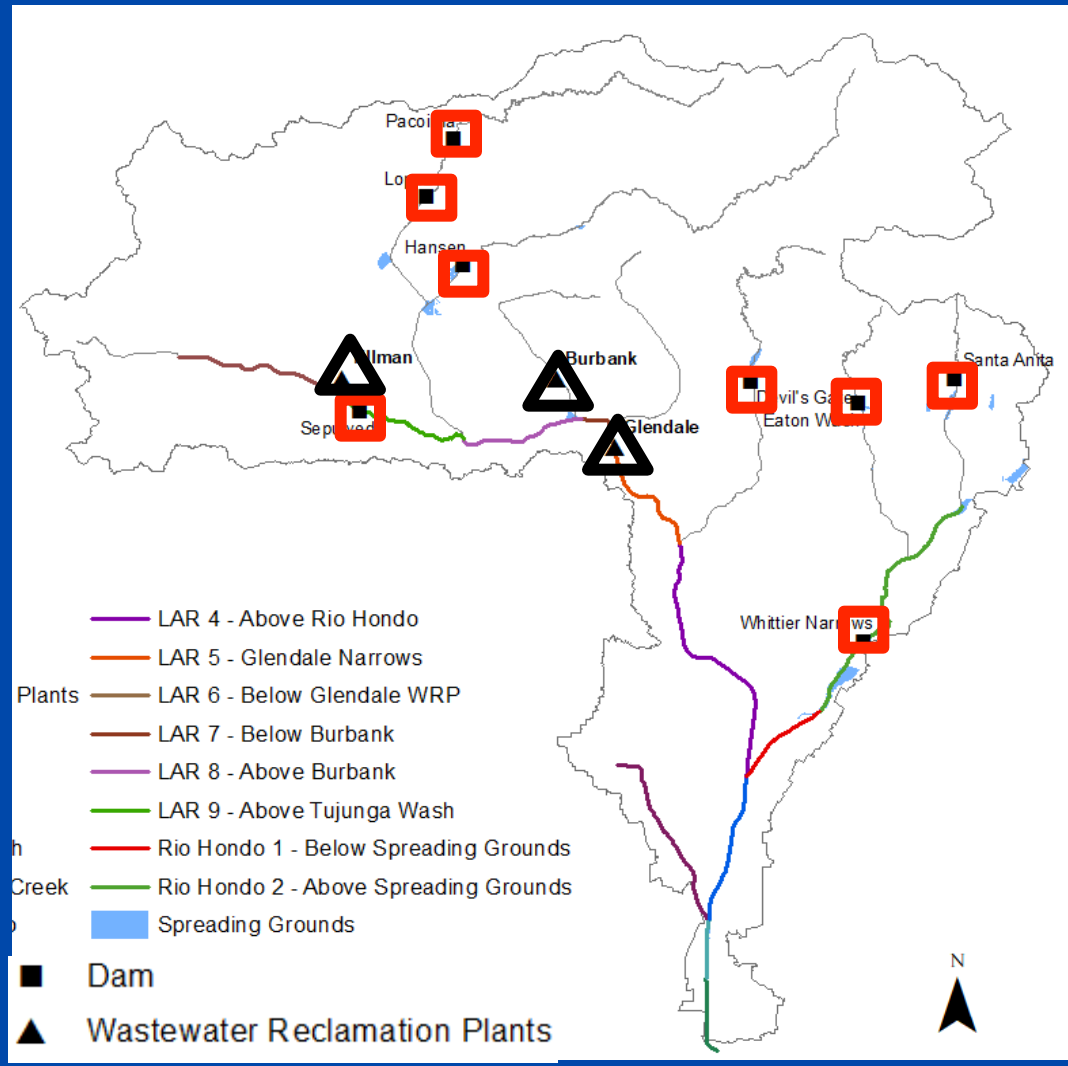
- **Magnitude**
  - Streamflow (mean, max)
  - Median annual number of high flow events
- **Variability**
  - Median percent daily change in streamflow
  - Interannual variability (min, max, median)
- **Duration**
  - Storm flow recession
  - Duration above baseflow
- **Timing**
  - Month of minimum streamflow
  - Frequency of high flow events



# REGULATORY FLOW IMPLICATIONS

- **State Water Board has an interesting paradox**
  - They support both maximizing use of recycled water and protection of instream beneficial uses
  - This potential conflict is recognized in the new recycled water policy
  - Wastewater change petitions (1211 Order) are being submitted
- **Particularly interesting in the Los Angeles River where three POTWs are planning 1211 petitions**
- **Even more complicated when you consider dam operations**
  - Not just how much flow to release, but the seasonal timing of that release



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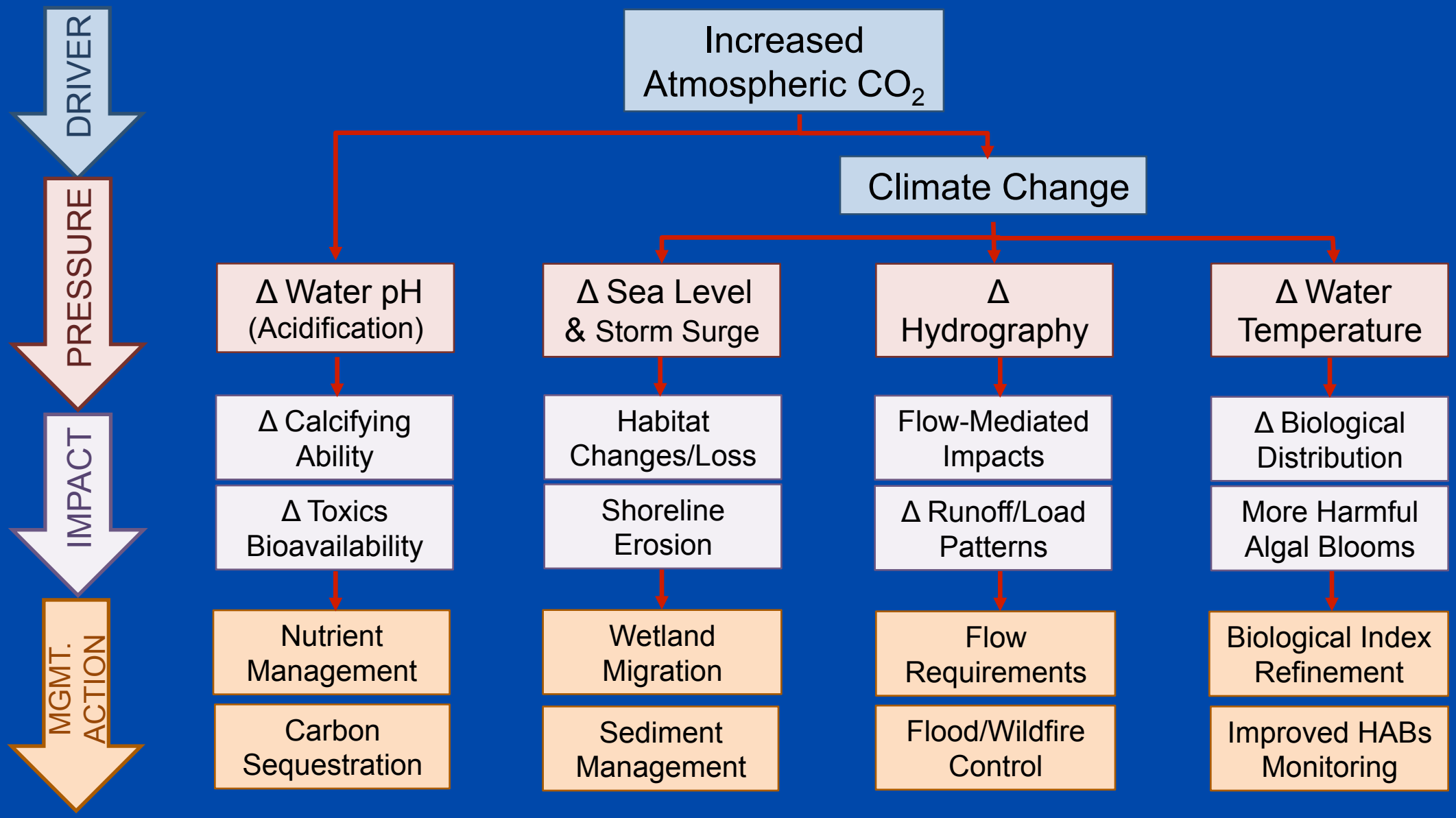

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