THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

Decision Support, Visualizations, and GeoPortal

Water Web Services Jamboree, University of Texas at Austin

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Northrop Grumman Information Systems

Four Operating Sectors at a Glance

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Aerospace Systems

Airborne Ground Surveillance / C2

C4ISR

Directed Energy Systems

Electronic Combat Operations

Environmental & Space Science Satellite Systems

Global / Theater Strike Systems

ISR Satellite Systems

Large Scale Systems Integration

MILSATCOM Systems

Missile Defense Satellite Systems

Naval BMC2

Strategic Space Systems

Unmanned Systems

Electronic Systems

Air Defense Systems

C4ISR Networked Systems

EO/IR Targeting & Surveillance

Marine & Undersea Systems

Navigation & Positioning Systems

Propulsion & Power Generation

Radar Sensors & Systems

RF/IR Countermeasures

Space Sensors

Information Systems

Command & Control Systems

Communications

Cybersecurity

Enterprise Systems and Security

Federal, State/Local & Commercial

Health IT

Homeland Security

Intelligence

Intelligence, Surveillance & Reconnaissance Systems

IT/Network Outsourcing

Technical Services

Aircraft Subsystem/Component Sustainment & Modernization

Aircraft System/Platform Sustainment & Modernization

Defense and Government Services

Ground Vehicle Reconstitution

Integrated Logistics and Modernization

Irregular Warfare/Quick Reaction Capability

Live, Virtual and Constructive Domains

Nuclear Security Services

Technical and Operational Training Support

Training Solutions

Changing Environmental Conditions Impact All Facets of Human Existence

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Energy

Heating/Cooling Degree Days
Electricity/Natural Gas consumption
Renewables location

National Security

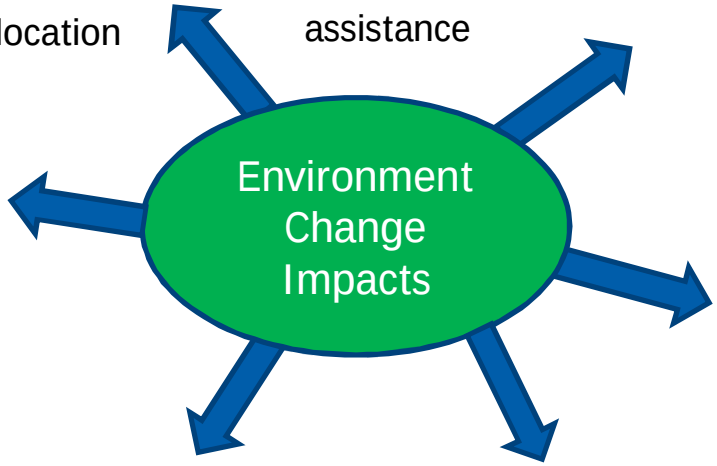
Amplifies stress on weaker nations
Generates geopolitical instability
Increases need for humanitarian assistance

Water

Fresh water availability
Water consumption
Depth of snowpack
Precipitation evaporation
Precipitation trends

Public Health

Heat stress index
Heat wave frequency
Risk for occurrence of vector-borne diseases



Agriculture

Growing season days
Soil moisture deficit
Crop yield trends
Field irrigation efficiency

Sustainability

Anthropogenic impact
Air, water, waste, impact
Controls and compliance

Transportation

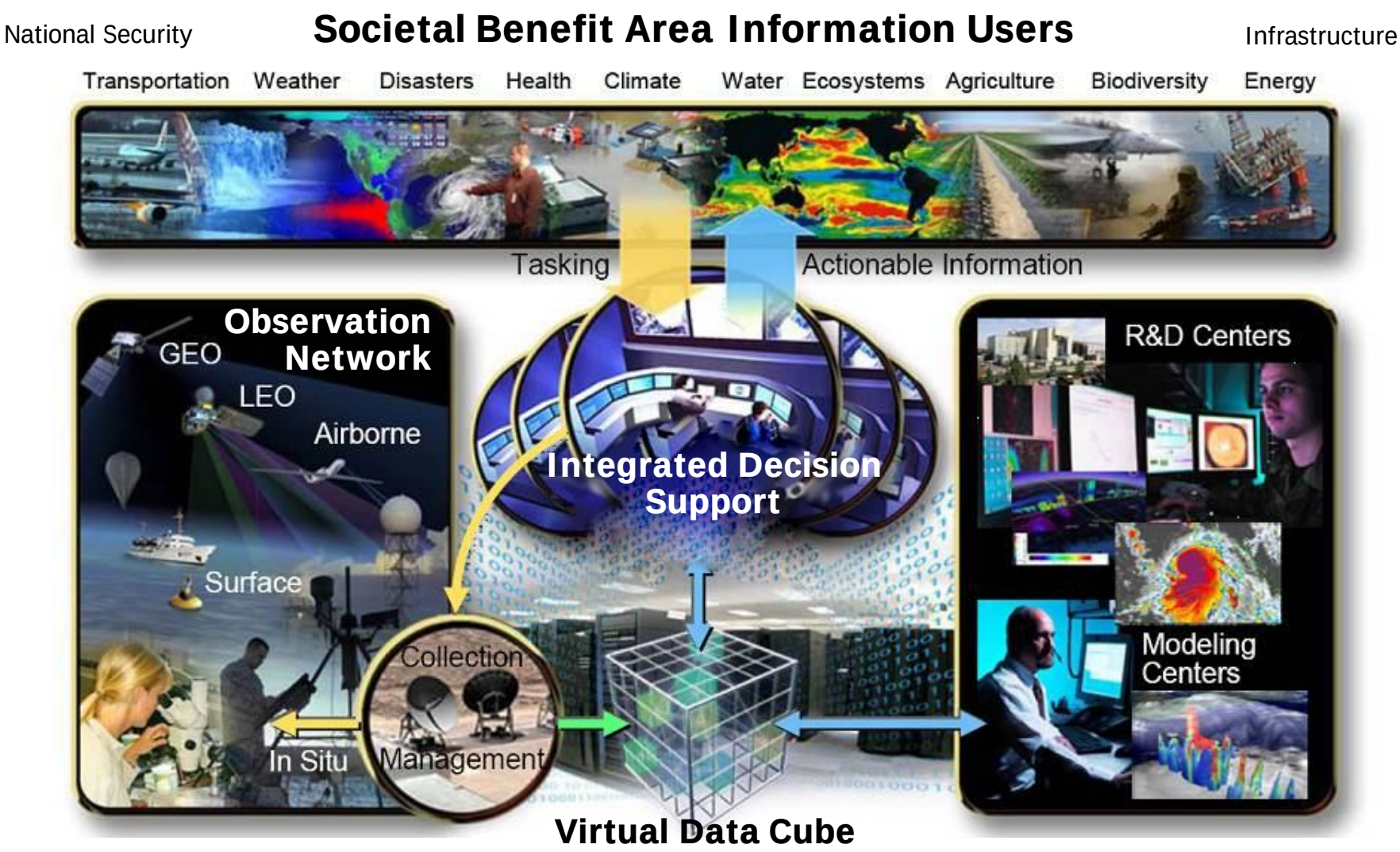
Sea level rise impact on ports and shipping
Food vs Fuel biofuels

Disaster Management

Extreme precipitation events
Extreme temperature events
Storm Surge/Floods

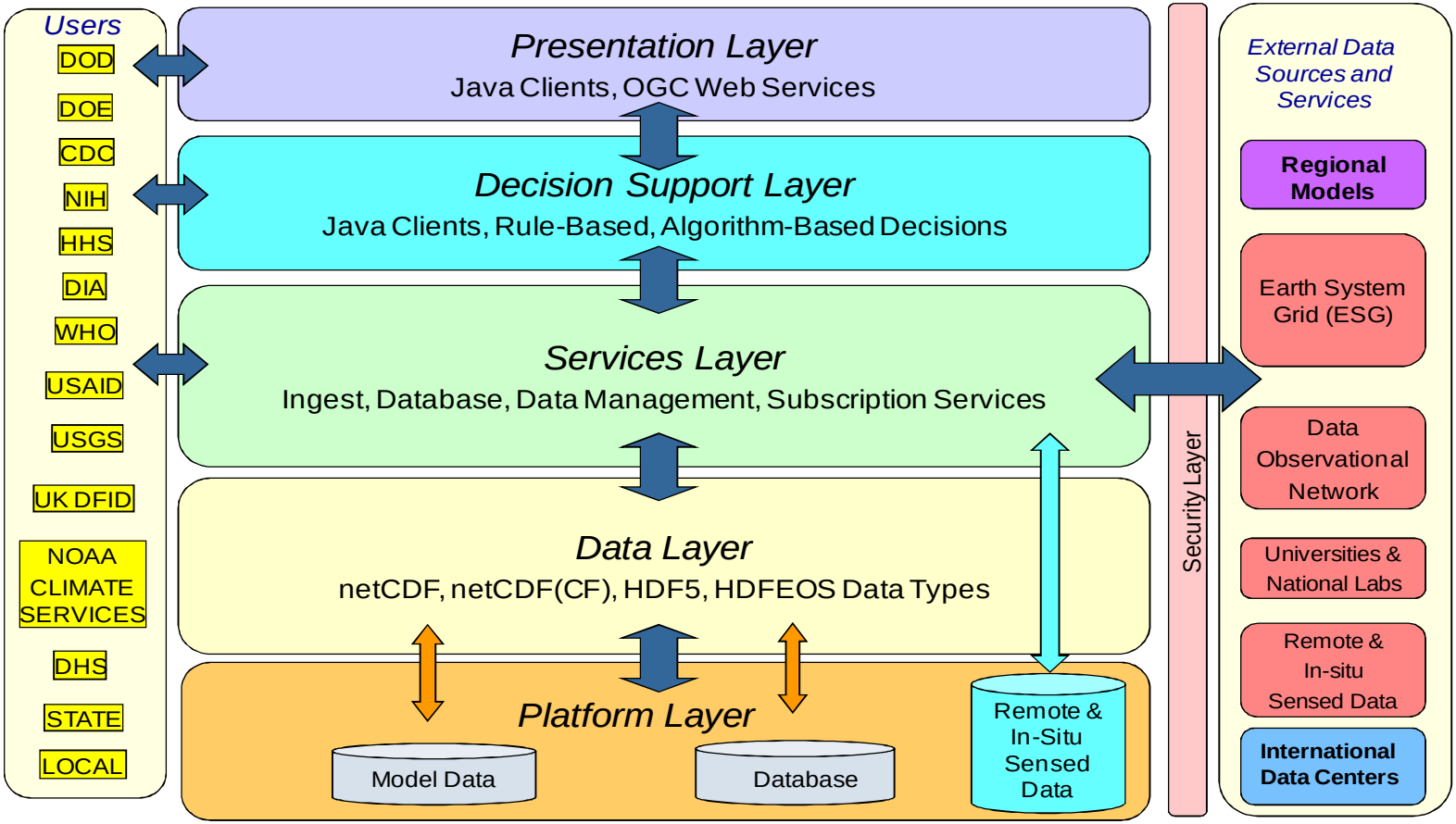
Stakeholders need reliable and robust decision support systems

Integrated Decision Support: Bringing Science to Society



Decision Support framework designed for Climate Change Adaptation and Risk Assessment

GeoPortal Technology: Service-Oriented Architecture



GeoPortal Features

Cutting edge application of technology (i.e. Internet 2, ArcGIS server)	Critical science data formats supported (netCDF, HDF5, GRIB, BUFR)	Includes ESRI ArcGIS custom capabilities to visualize climate and weather data products (collaborative effort between ESRI and NG)

Geospatial Portal and Environmental Intelligence Toolkit

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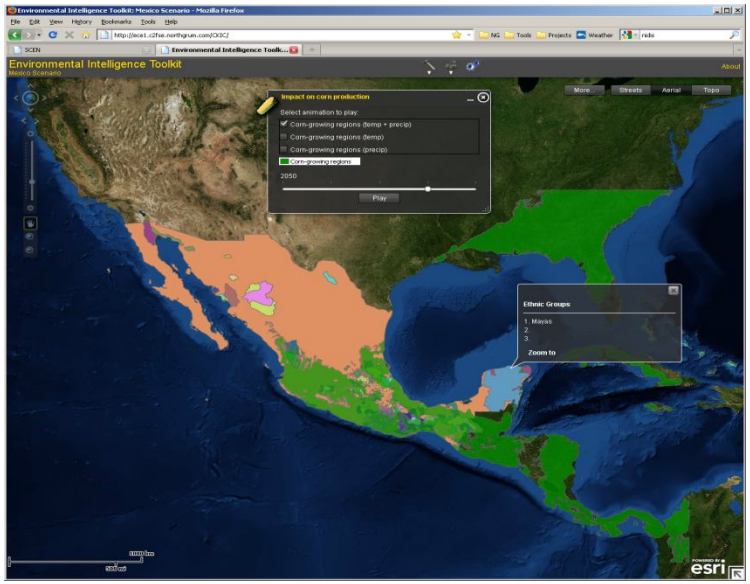
Features

- Optimized ingest, cataloging, search and selection of information products
- Streamlined approach to data management and Service Oriented Architecture
- Fusion of disparate data-sets (internal/external, science/demographic)
- ESRI ArcGIS and GeoServer custom visualization capabilities

Benefits

- Web-based access to actionable information
- Ease of navigation to locate and display value-added information products
- Flexible analytics to enable dynamic impact analysis ("what-if" scenarios)
- Real time data ingest for emergency response



The web-based Geoportal enables stakeholders to search, retrieve and visualize geo-referenced environmental information coupled with demographic data

Water – Regional Climate Change Signature

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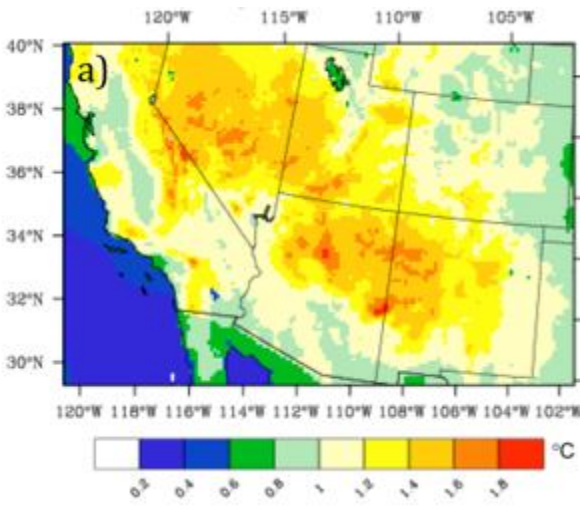
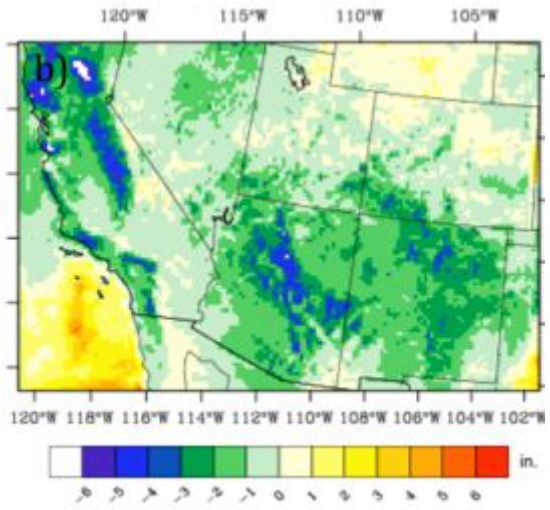
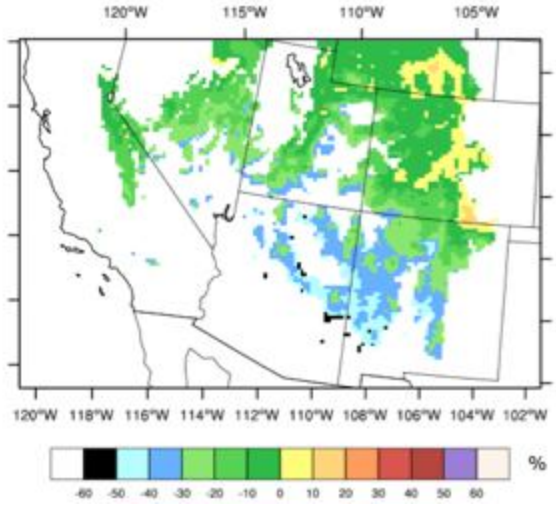
Annual average temperature difference (2030s – 2000s)



Annual average precipitation difference (2030s – 2000s)



Annual average accumulated snow relative change (2030s – 2000s)

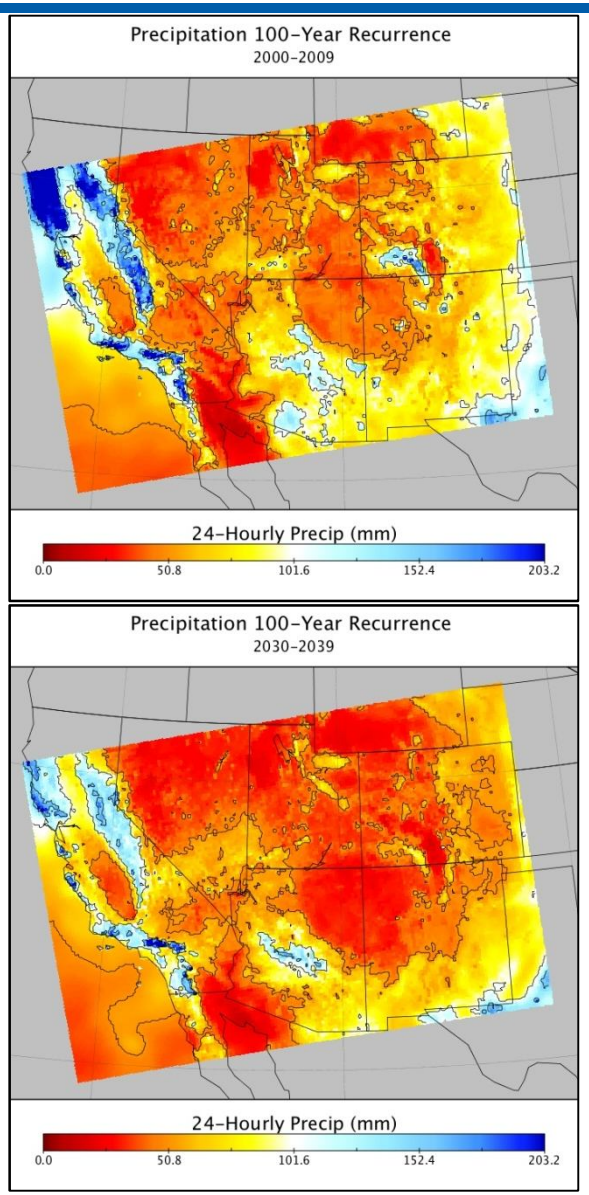


- From a climate change perspective only, the availability of water resources in the SW is driven by changes in precipitation, temperature, and snowpack patterns.
- This depiction shows that temperatures in the 2030's will increase relative to today.
- At the same time, annual precipitation is decreasing over the same region.
- Finally, we see that the snowpack is decreasing - especially in the mountain areas.

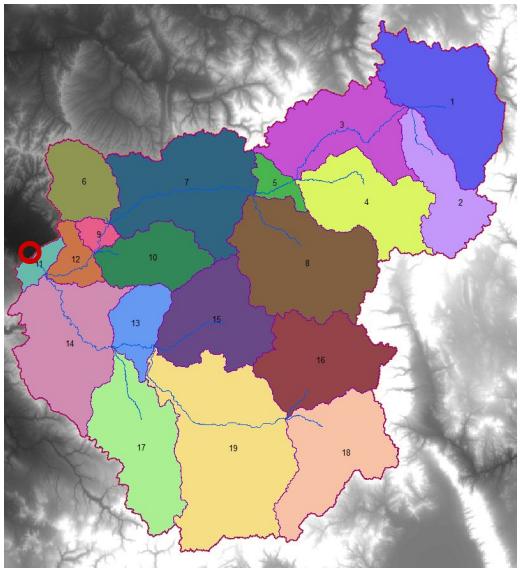
Decrease in precipitation and annual accumulated snow may have important implications on seasonal dynamics of the freshwater availability, hydropower generation and snow-related recreational activities.

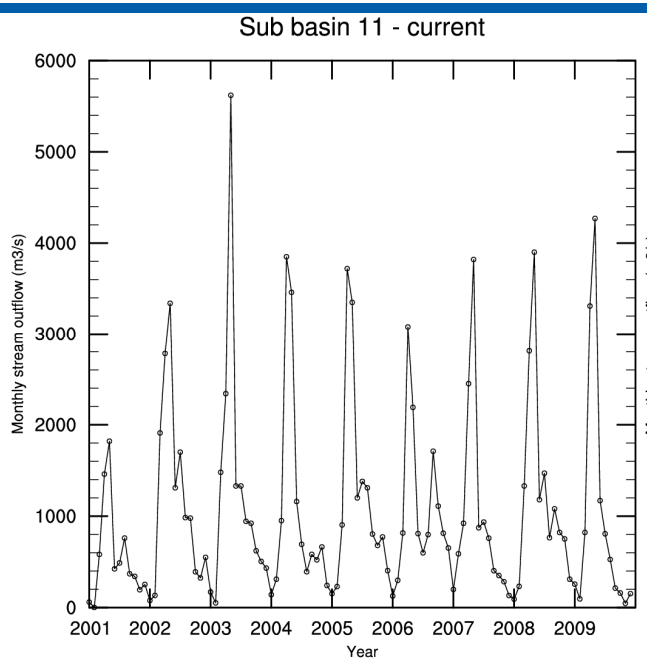
Precipitation Modeling -- Extremes

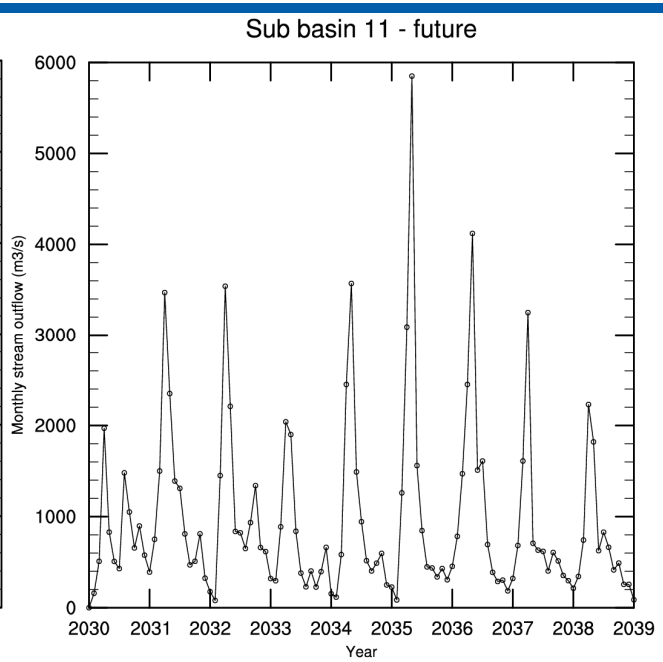
- The maximum precipitation amount that falls within a 24-hour period in a 12 km cell once in 100 years is a measure of the likelihood of extreme events.
- These are valuable for infrastructure planning and risks assessment
- Statistical processing using Extreme Value Theory allows these parameters to be estimated from even short period model runs, such as ten-year ensembles.
- Future climate in the SW US may hold marked declines in extreme precipitation events in the Sierra Nevada mountains. This has potential to reduce flood threats in the San-Joaquin and Sacramento River delta region, even as sea level rise flooding threats increase.

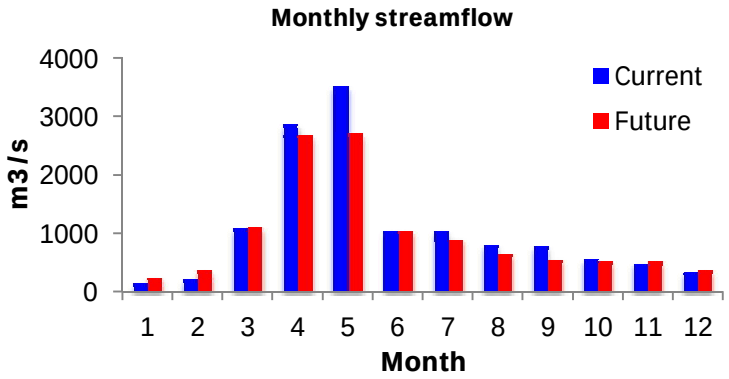


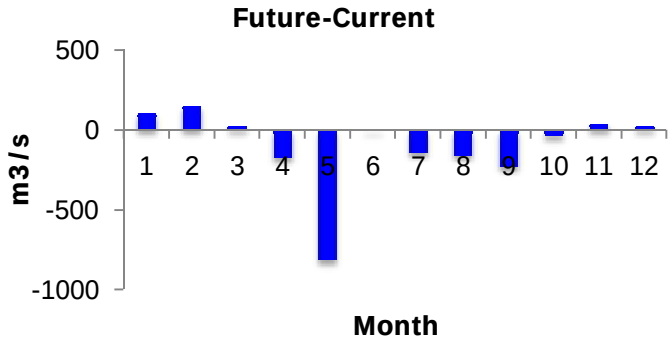
Water: Model Predictions
Colorado River Basin











Colorado River Basin is losing its ability to support human populations, power generation and agriculture

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