



# LINKING DOWNSCALED GLOBAL CLIMATE MODELS TO PLANNING LEVEL ECOSYSTEM MODELS

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**THE WATER INSTITUTE  
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- Jordan Fischbach (RAND)
- Gordon Thomson (CB&I)
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- Zach Cobell (Arcadis)
- John Atkinson (Arcadis)
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# ACKNOWLEDGEMENTS

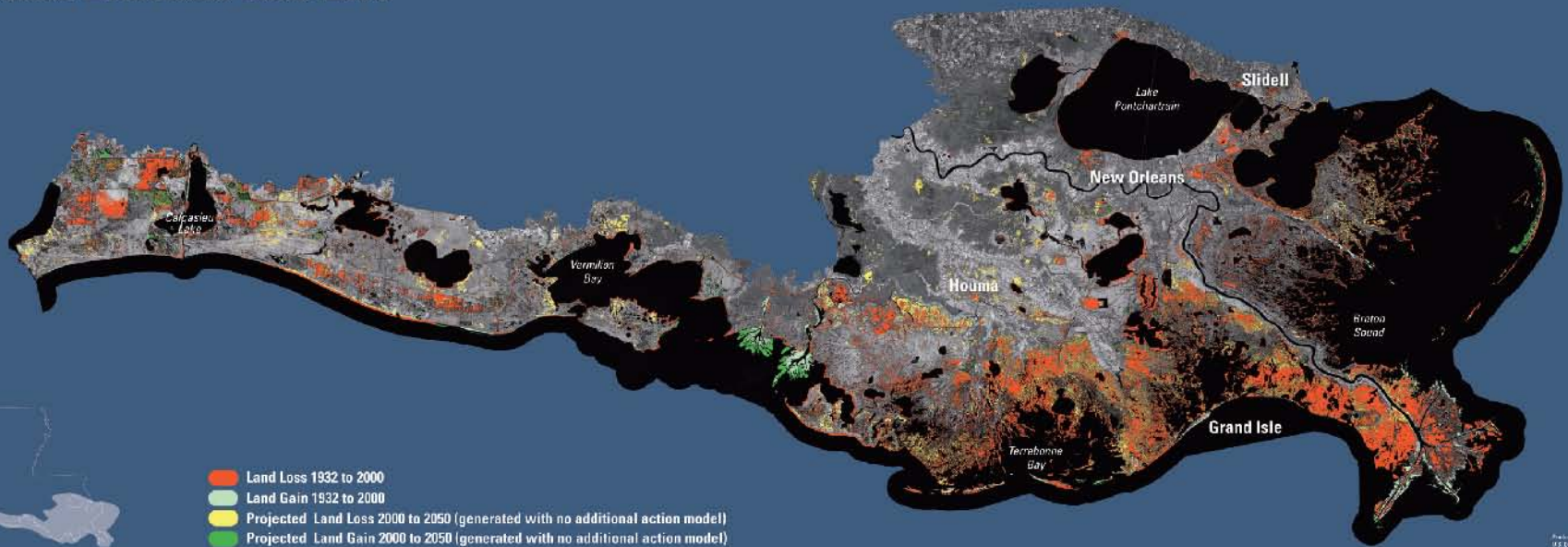


# MASTER PLAN BACKGROUND

- Coastal land loss in Louisiana
  - 1900 sq km from 1932-2000
  - 56 sq km/year from 1984-2010



## Coastal Louisiana Land Loss

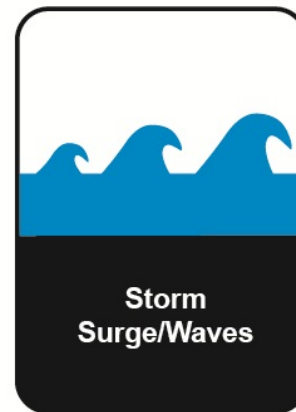
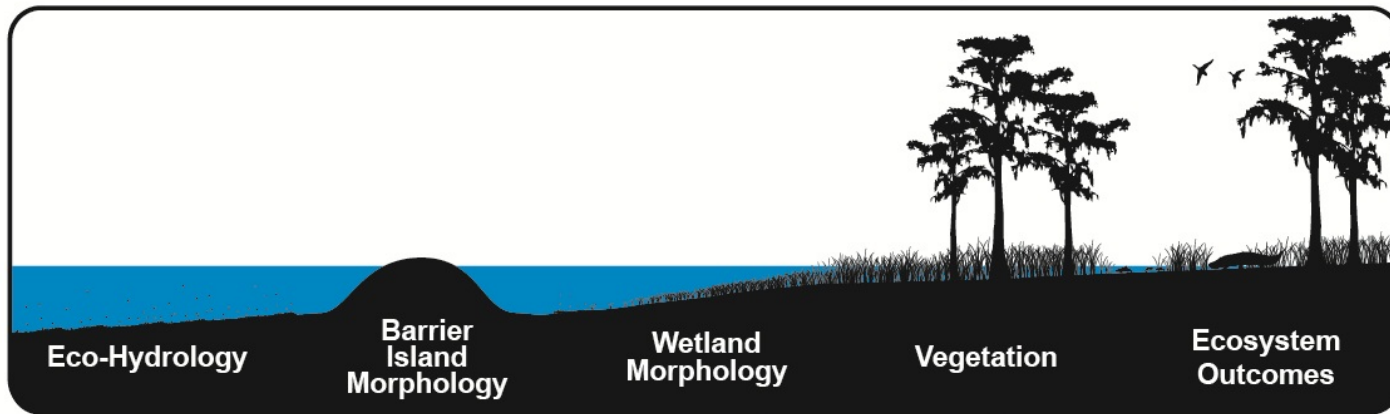


Produced by  
F. S. Chaplin, J. S. Turner,  
U.S. Geological Survey  
Map of Louisiana, Louisiana  
1:100,000, 11/01/01  
11/01/01

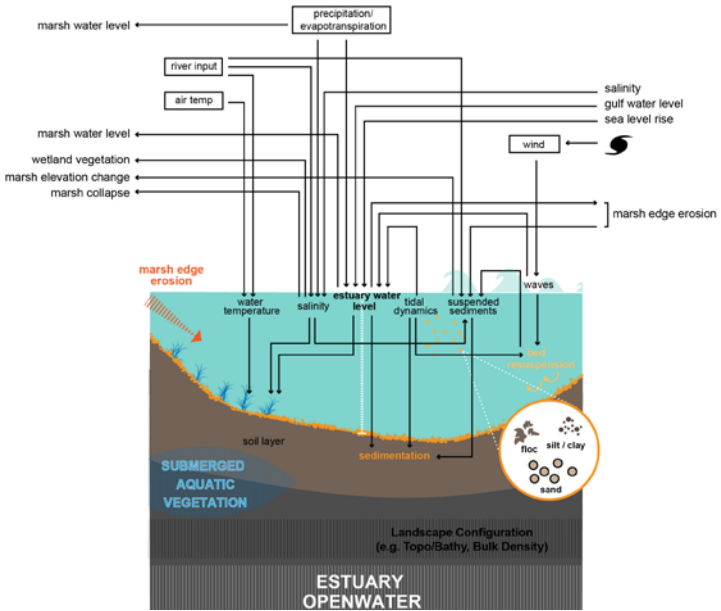




# 2017 MASTER PLAN INTEGRATED COMPARTMENT MODEL (ICM)



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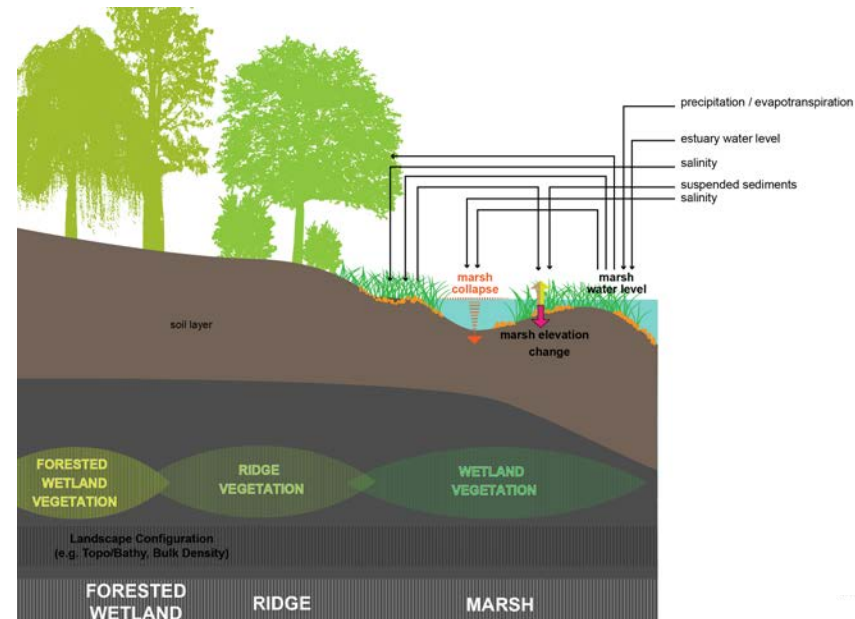
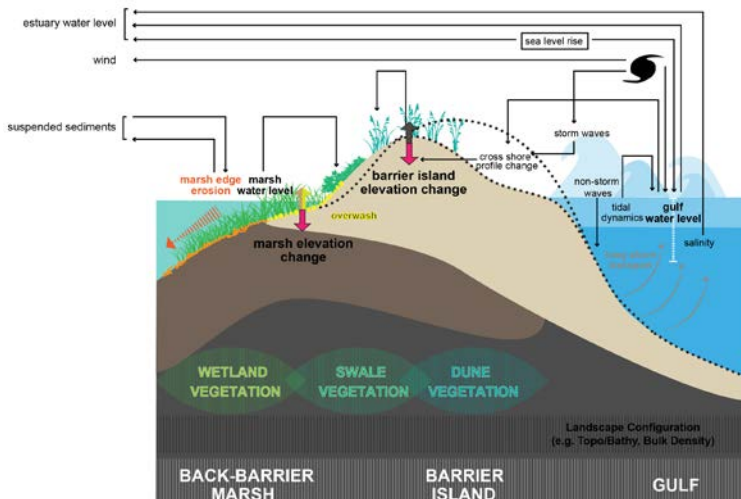


## Estuary and Open Water Processes

- Hydrodynamics
  - Water quality
  - Sedimentation
  - Bed resuspension
- ## Wetland and Vegetation Processes
- Sediment distribution
  - Wetland elevation change
  - Wetland area change
  - Marsh collapse
  - Marsh edge erosion
  - Storm effects
  - Coastal vegetation

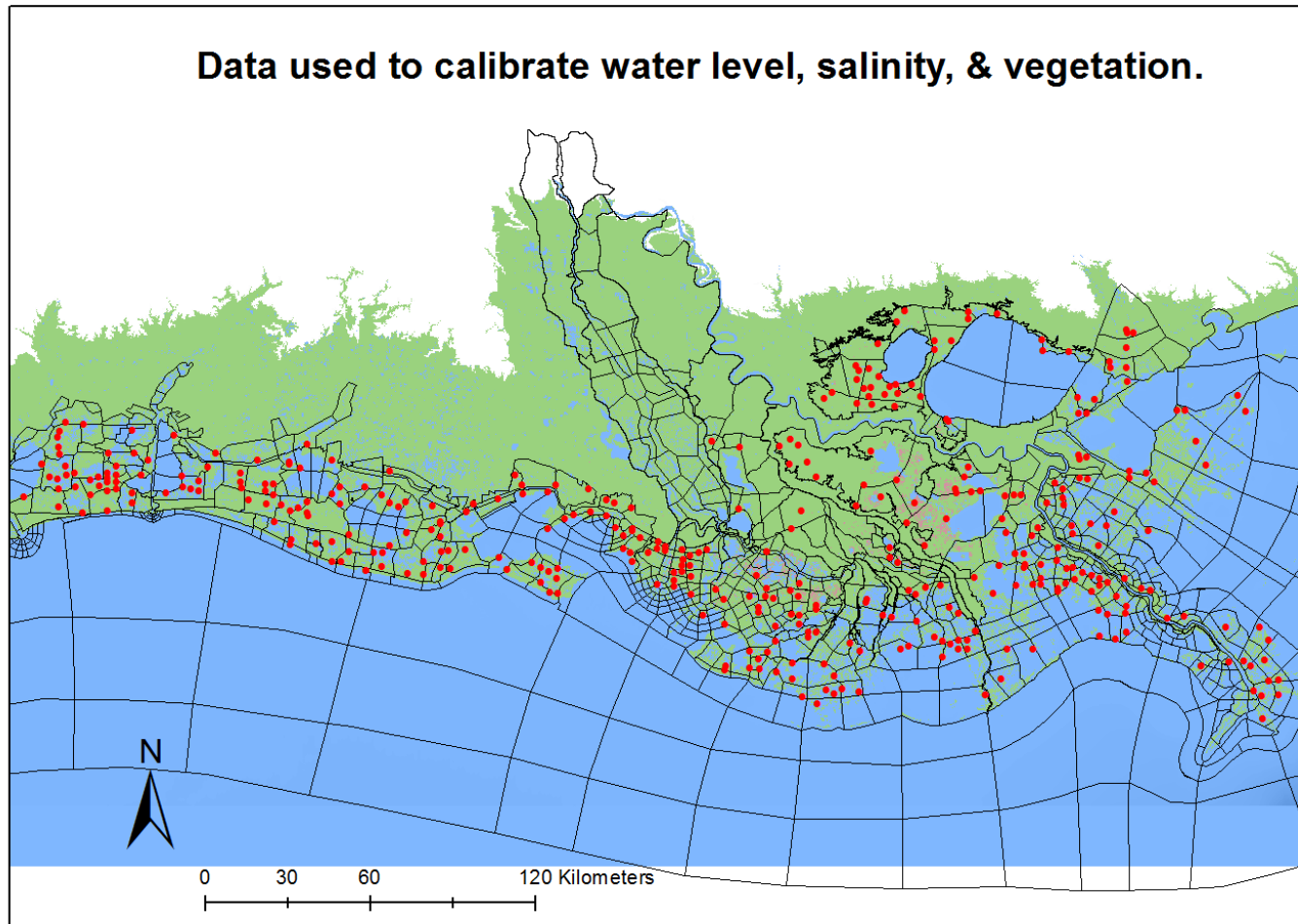
## Barrier Island Processes

- Island elevation change
- Breaching
- Overwash / cross shore profile change
- Longshore transport
- Wave transformation
- Storm effects (SBEACH)
- Back-barrier marsh, dune and swale vegetation



# 2017 MASTER PLAN INTEGRATED COMPARTMENT MODEL (ICM)

## 2017 Coastal Master Plan Integrated Compartment Model Coastwide Reference Monitoring System (CRMS)



# DOWNSCALED CLIMATE DATA

Downscaled climate model data readily available online from USGS Geo Data Portal

- Easy to use web interface
- Download full datasets, or spatially averaged

Data is then easily manipulated

- standard NetCDF tools
- File Array Notation (FAN V 2.0)
- simple Python/NumPy scripts


## Welcome to the USGS Geo Data Portal

This page is a catalog of the datasets that have been tested to work well for access with the Geo Data Portal (GDP). Select a dataset below to see more details and access it.

**For more information about the GDP, please visit the documentation home here.**

The increasing availability of downscaled climate projections and other large data products that summarize or predict climate and land use conditions, is making use of these data more common in research and management. Scientists and decision makers often need to construct ensembles and compare climate hindcasts and future projections for particular spatial areas. These tasks generally require an investigator to procure all datasets of interest en masse, integrate the various data formats and representations into commonly accessible and comparable formats, and then extract the subsets of the datasets that are actually of interest. This process can be challenging and time intensive due to data-transfer, -storage, and(or) -processing limits, or unfamiliarity with methods of accessing climate and land use data. Data management for modeling and assessing the impacts of future climate conditions is also becoming increasingly expensive due to the size of the datasets. The Geo Data Portal addresses these limitations, making access to numerous climate datasets for particular areas of interest a simple and efficient task.

Submit Job for Processing

Spatial	Selected AOI
Select or upload an area of interest and select features.	
Selected Area of Interest	
Selected Attribute	
Number of Selected Values	
0	
<a href="#">Edit Spatial</a>	
Data Detail	Dataset Metadata
Select at least one variable Set a start and end date.	<b>Title</b> USGS Dynamical Downscaled Regional Climate

<http://cida.usgs.gov/gdp/>

[www.unidata.ucar.edu/software/netcdf/fan\\_utils.html](http://www.unidata.ucar.edu/software/netcdf/fan_utils.html)



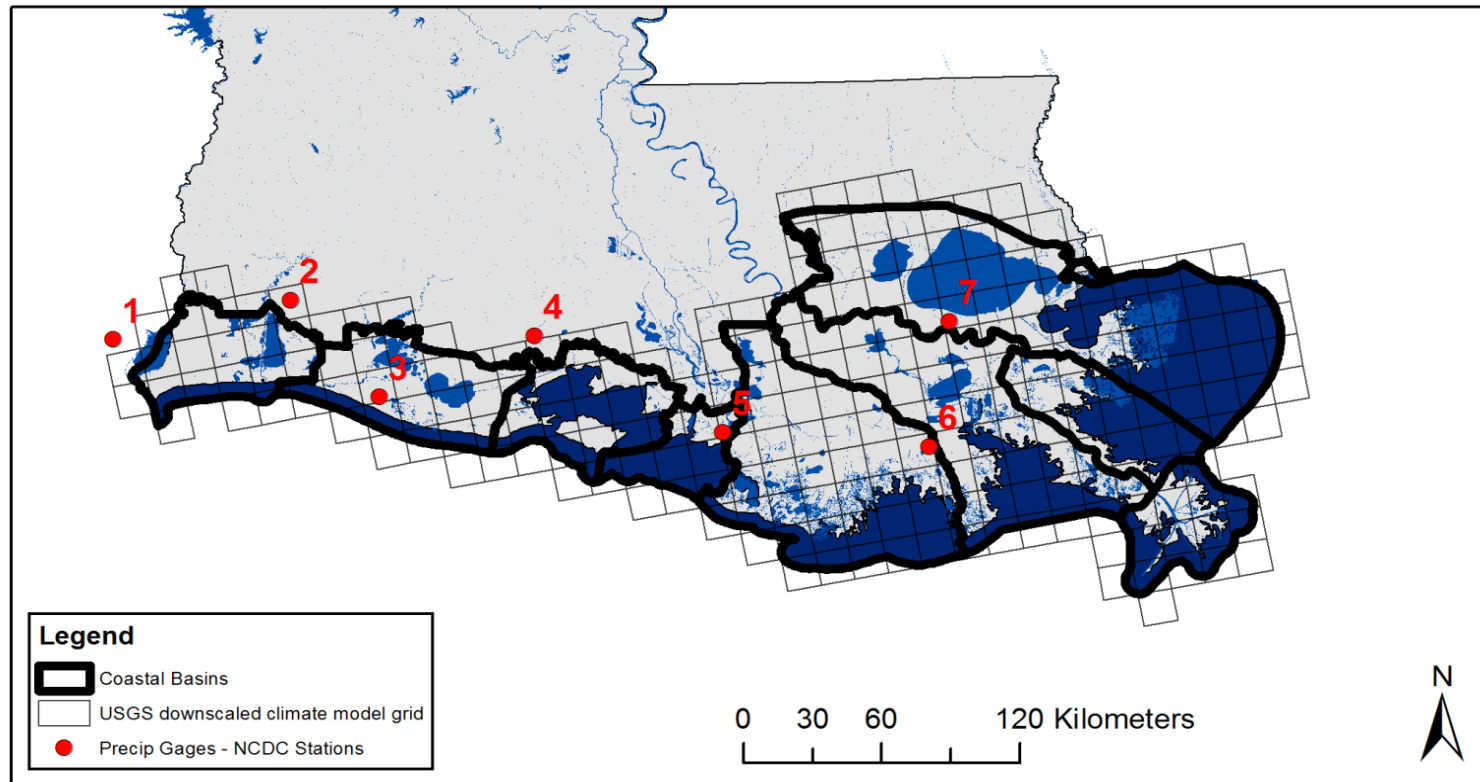


# DOWNSCALED CLIMATE DATA

- USGS Dynamical Downscaled Daily Regional Climate V1.0 – Eastern North America
- Multiple datasets available:
  - All use the same regional climate model (RegCM3)
  - All use same emissions scenario (A2 from IPCC AR 4)
  - Different general circulation models used:
    - USGS GENMOM
    - GFDL CM2.0
    - MPI ECHAM5
- Other downscaled datasets are available (e.g. statistically downscaled), but spatial and temporal coverages are not consistent across datasets



# DOWNSCALED CLIMATE DATA

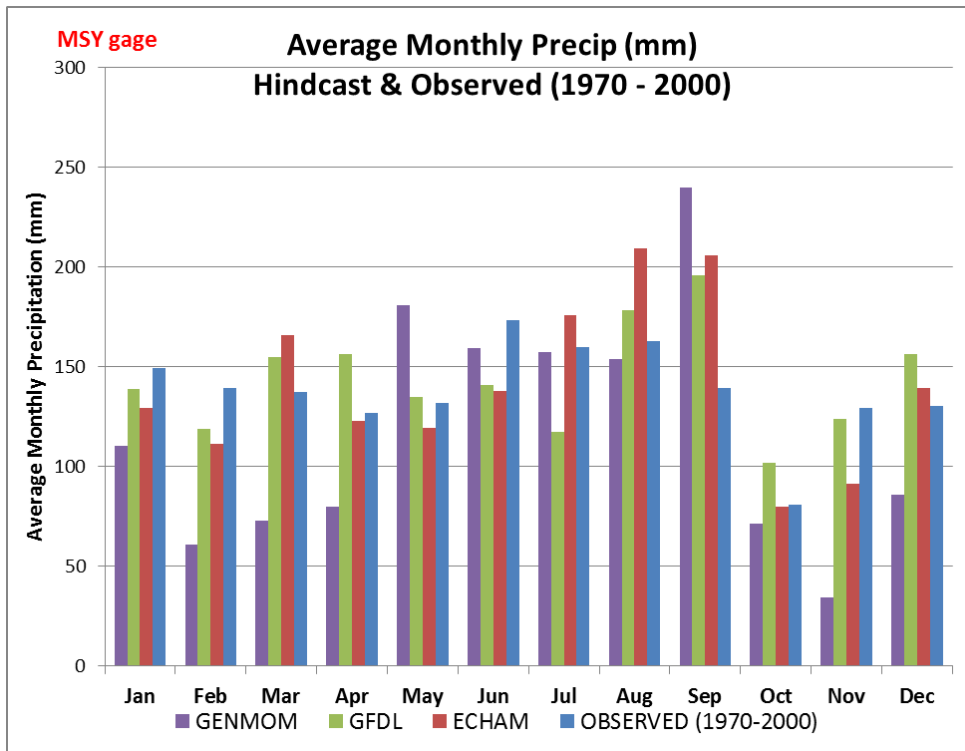


GCM used as boundary in RegCM3	Hindcast Period	Projected Period
GFDL	1970-1999	2040-2069
ECHAM	1970-1999	2020-2099
GENMOM	1980-1999	2020-2080



# PRECIPITATION HINDCAST

Gage-to-hindcast comparison completed at seven locations across model domain

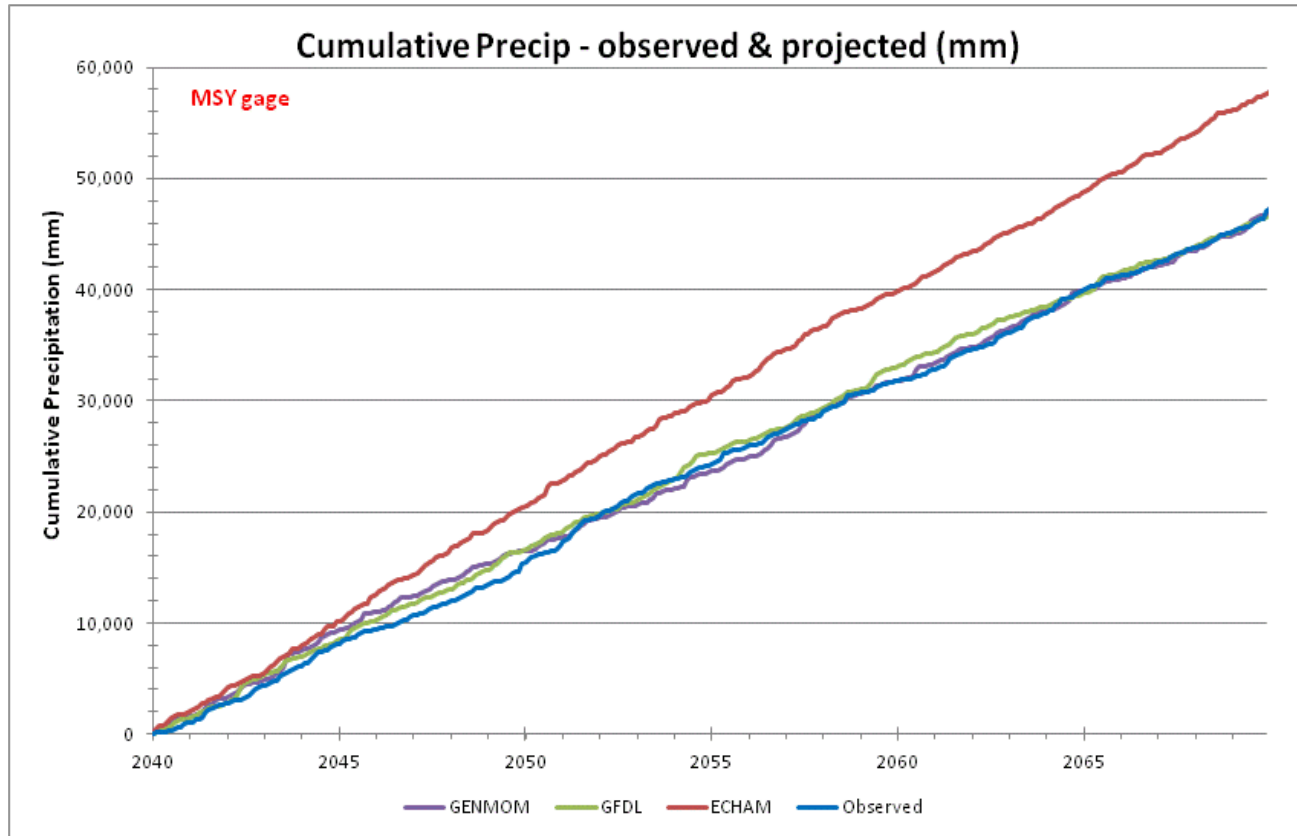


Percent difference between hindcast and observed rainfall at MSY

	1980-1999		1970-1999
	GENMOM	GFDL	ECHAM
Jan	-30%	-7%	-14%
Feb	-58%	-15%	-20%
Mar	-47%	13%	21%
Apr	-42%	23%	-3%
May	45%	2%	-9%
Jun	-18%	-19%	-20%
Jul	-2%	-26%	10%
Aug	6%	10%	29%
Sep	99%	41%	48%
Oct	-11%	26%	-1%
Nov	-72%	-4%	-29%
Dec	-30%	20%	7%

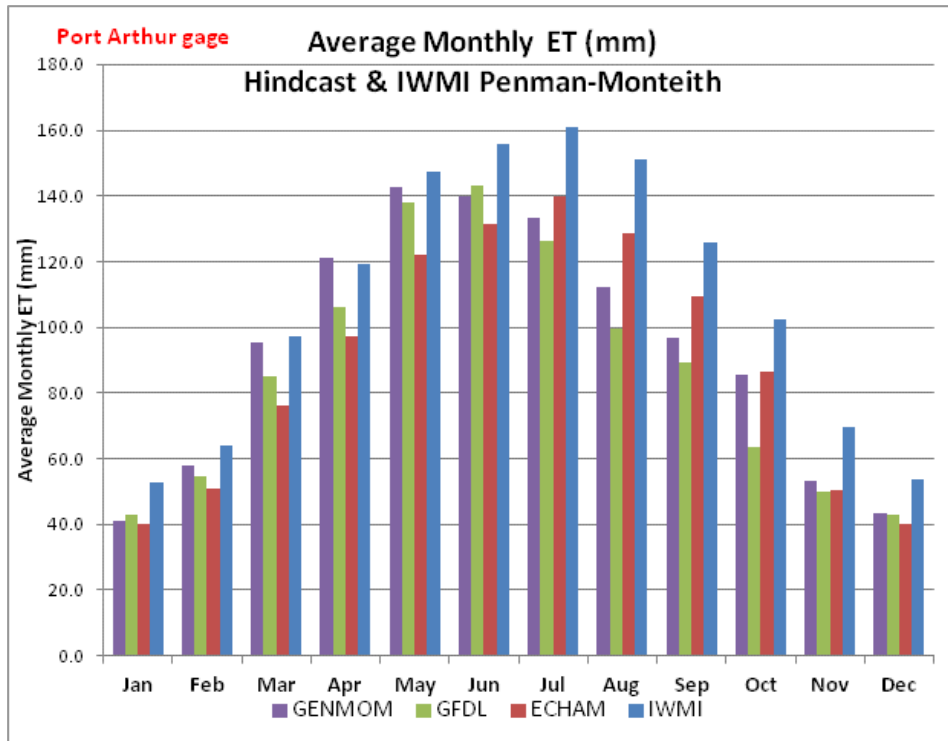


# PRECIPITATION PROJECTION



# EVAPOTRANSPIRATION HINDCAST

PET-to-hindcast comparison completed at seven locations across model domain

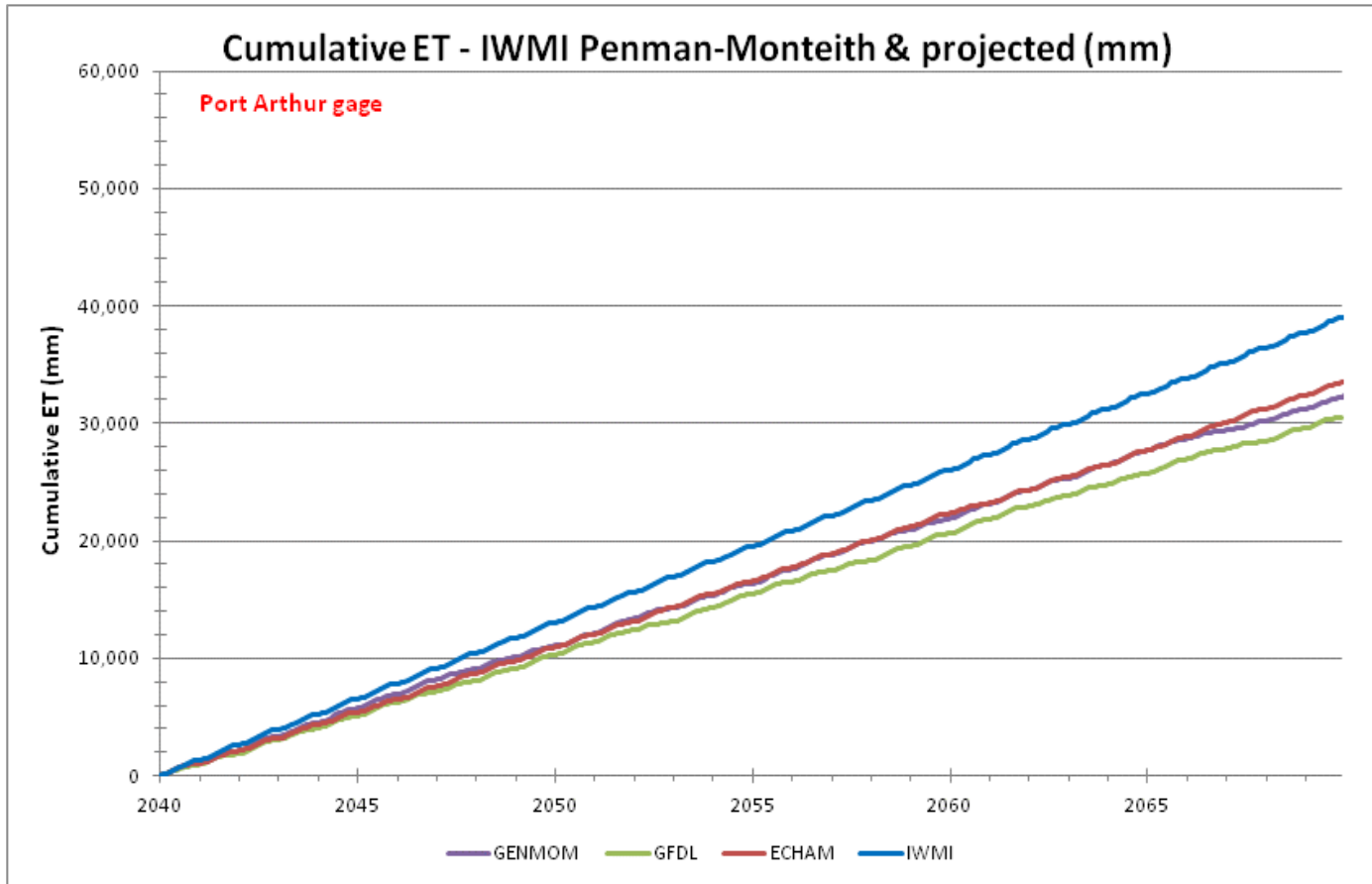


Percent difference between hindcast and observed rainfall at MSY

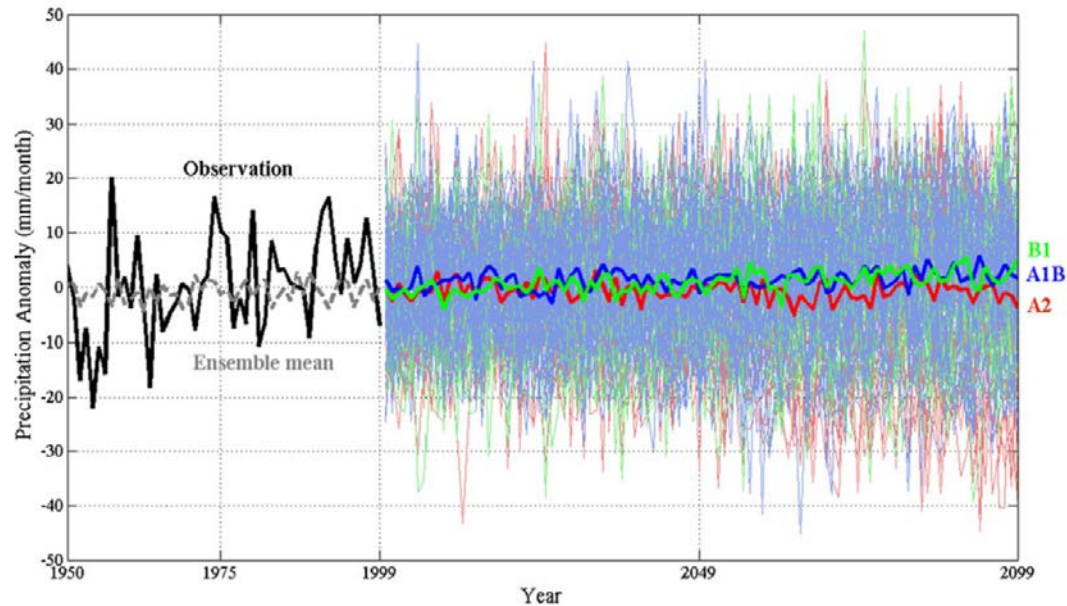
	1980-1999		1970-1999
	GENMOM	GFDL	ECHAM
Jan	-22%	-19%	-24%
Feb	-10%	-15%	-21%
Mar	-2%	-12%	-21%
Apr	2%	-11%	-18%
May	-3%	-6%	-17%
Jun	-10%	-8%	-16%
Jul	-17%	-21%	-13%
Aug	-26%	-34%	-15%
Sep	-23%	-29%	-13%
Oct	-16%	-38%	-15%
Nov	-23%	-29%	-28%



# EVAPOTRANSPIRATION PROJECTION



# DOWNSCALED CLIMATE DATA



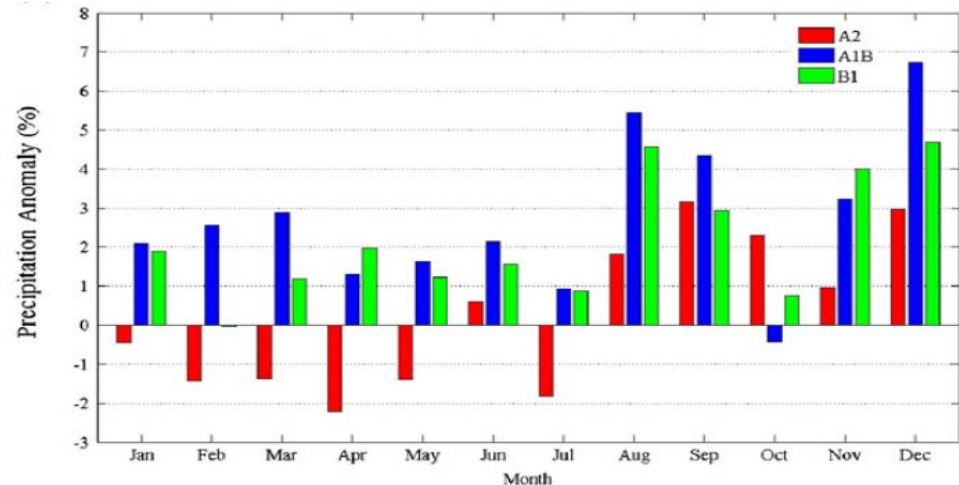
Projected precipitation anomalies (relative to 1950-1999 mean) in the Southeastern U.S. from ensemble downscaled datasets for three emission scenarios

A2 = high emissions path

A1B = middle emissions path

B1 = low emissions path

Images from Liu et al., 2012



# 2017 MASTER PLAN ENVIRONMENTAL SCENARIOS PLAUSIBLE RANGES

Variable	2012 Coastal Master Plan	2017 Coastal Master Plan
Eustatic Sea Level Rise	0.16 to 0.65 m over 50 years	0.14 to 0.83 m over 50 years
Subsidence	0 to 35 mm/yr; varies spatially	Same as 2012
Precipitation	Historical monthly accumulations (+/- 1 SD), 1961-1990; varies spatially (8 points from gridded data field)	-5% to +14% of 50-yr observed cumulative
Evapo-transpiration	Historical monthly average (+/-1 SD); varies spatially (10 points taken from existing data)	-30% to historic 50-yr observed



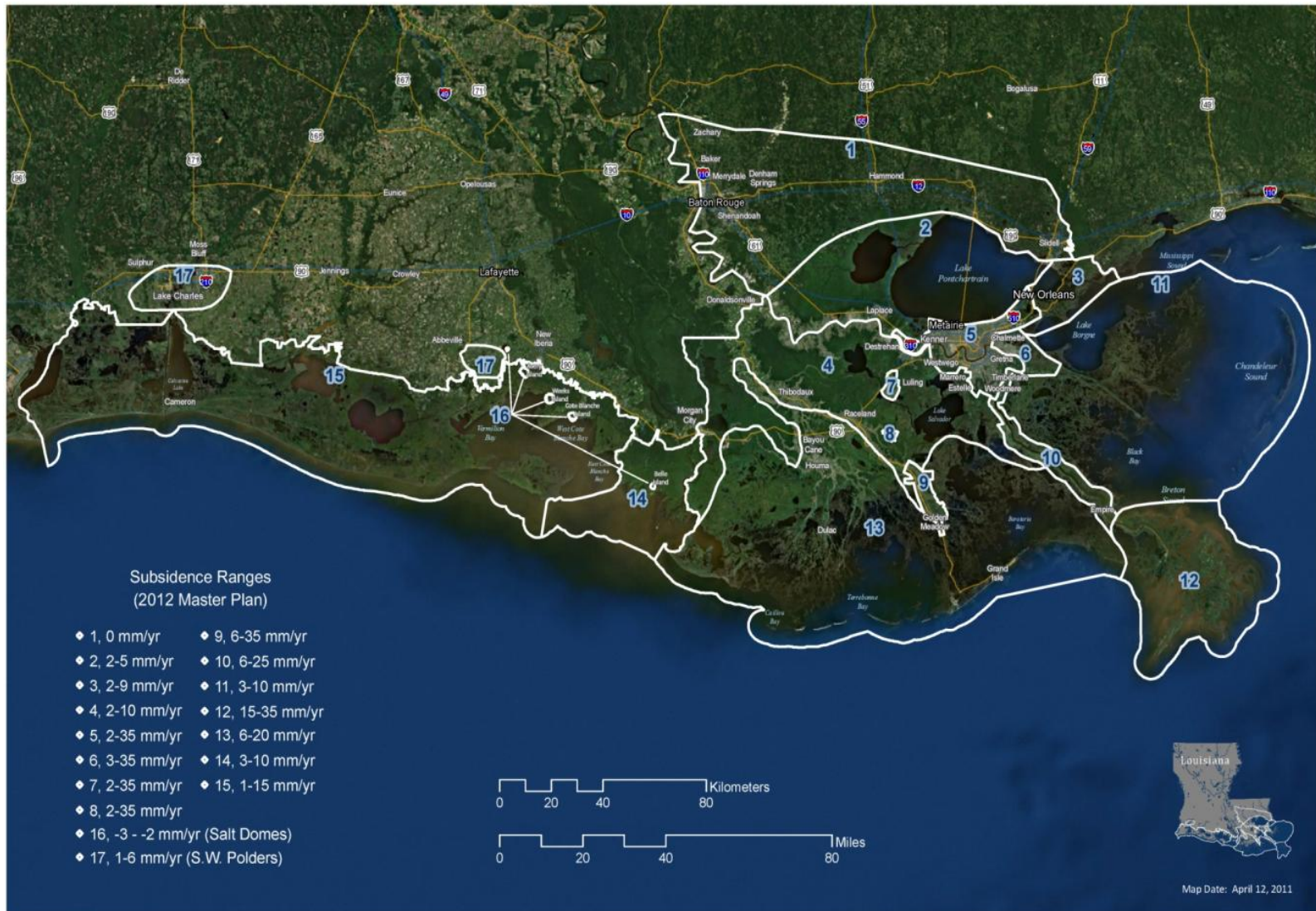


# RUN MATRIX EXAMPLE

Run ID	Precipitation	ET	ESLR (m/50 years)	Subsidence	Number of Storms	Number of Major Storms
S20 (base)	Historical (mid)	Historical (high)	0.22 (low)	20% of range (low)	23 (High)	11 (Low)
S21	Historical (mid)	Historical (high)	0.43 (mid)	20% of range (low)	23 (High)	11 (Low)
S22	Historical (mid)	Historical (high)	0.43 (mid)	50% of range (mid)	23 (High)	11 (Low)
S24	Historical (mid)	Historical (high)	0.83 (high)	50% of range (mid)	23 (High)	11 (Low)
S26	Historical (mid)	Historical (high)	0.22 (low)	50% of range (mid)	23 (High)	11 (Low)
S27	Historical (mid)	Historical (high)	0.22 (low)	75% of range (high)	23 (High)	11 (Low)
S30	GENMOM (low)	Historical (high)	0.22 (low)	20% of range (low)	23 (High)	11 (Low)
S33	ECHAM (high)	GENMOM (low)	0.22 (low)	20% of range (low)	23 (High)	11 (Low)
S36	Historical (mid)	Historical (high)	0.22 (low)	20% of range (low)	17 (Low)	8 (Low)
S39	Historical (mid)	Historical (high)	0.22 (low)	20% of range (low)	23 (High)	18 (High)
S62	GENMOM (low)	Historical (high)	0.43 (mid)	20% of range (low)	23 (High)	18 (High)
S65	GENMOM (low)	Historical (high)	0.43 (mid)	50% of range (mid)	23 (High)	18 (High)
S68	GENMOM (low)	Historical (high)	0.83 (high)	75% of range (high)	23 (High)	18 (High)
S76	Historical (mid)	Historical (high)	0.43 (mid)	75% of range (high)	23 (High)	11 (Low)
S77	Historical (mid)	Historical (high)	0.83 (high)	20% of range (low)	23 (High)	11 (Low)

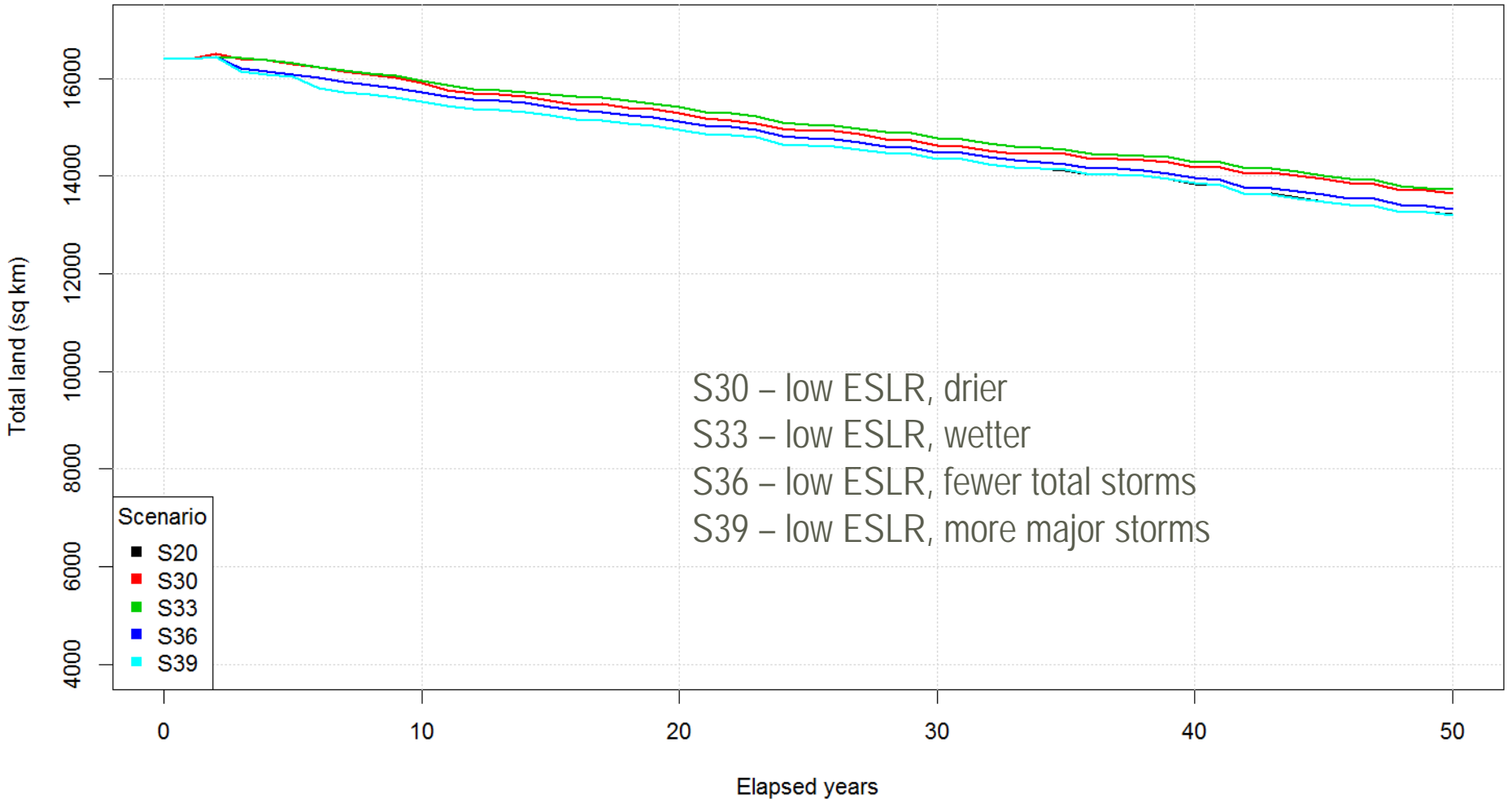


# 2017 MASTER PLAN ENVIRONMENTAL SCENARIOS



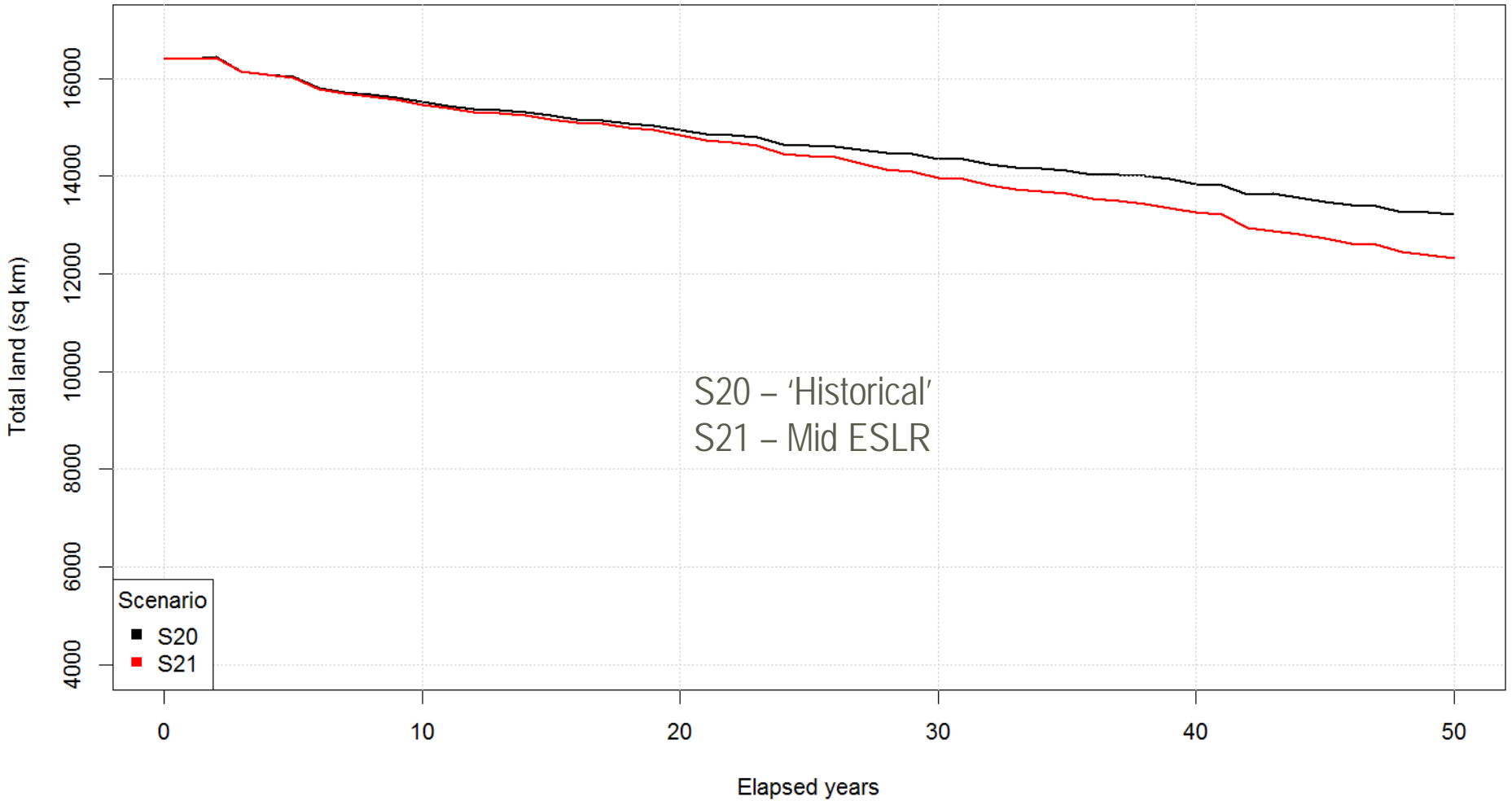
# SENSITIVITY TEST - PRECIP, ET, STORMS

Total land in Sq. Km across all Ecoregions for various scenarios



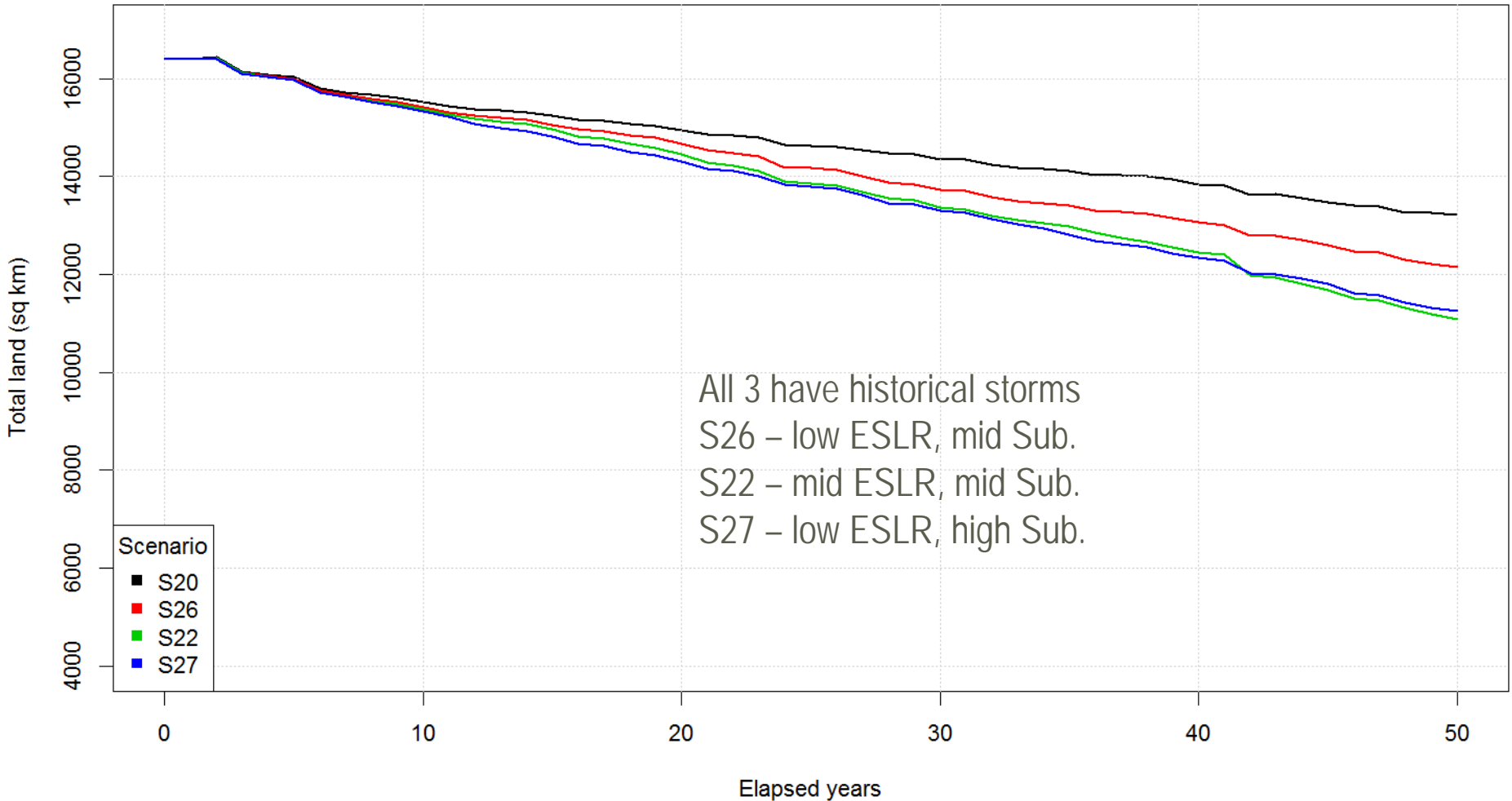
# SENSITIVITY TEST - EUSTATIC SEA LEVEL RISE

Total land in Sq. Km across all Ecoregions for various scenarios



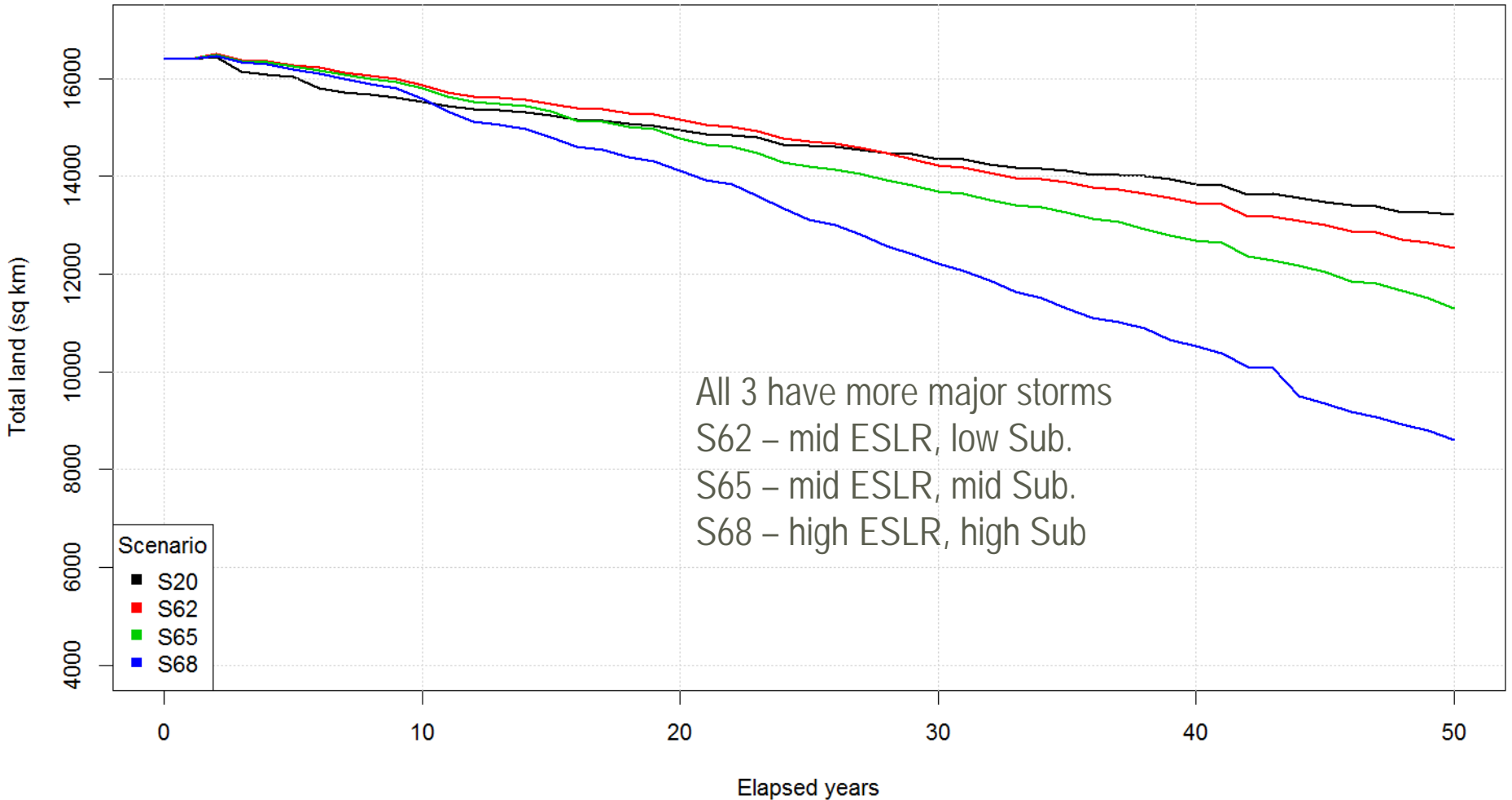
# SENSITIVITY TEST - ESLR VS SUBSIDENCE

Total land in Sq. Km across all Ecoregions for various scenarios



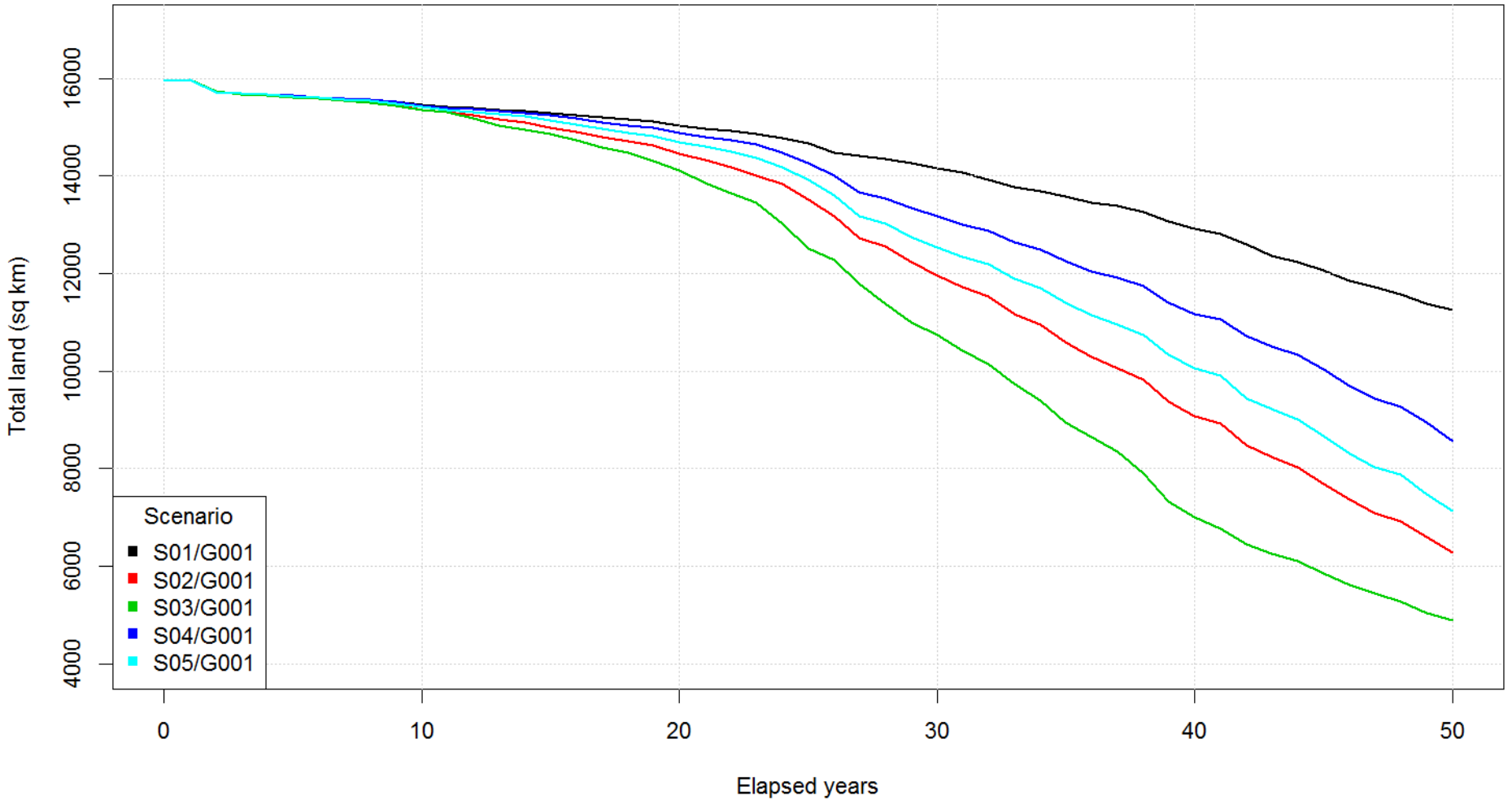
# SENSITIVITY TEST – ESLR + SUBSIDENCE

Total land in Sq. Km across all Ecoregions for various scenarios



# FUTURE WITHOUT ACTION 5 CANDIDATE SCENARIOS

Total land in Sq. Km across all Ecoregions for various scenarios



# 2017 MASTER PLAN ENVIRONMENTAL SCENARIOS

Scenario	Precip	ET	ESLR (m/50yr)	Subsidence	Overall Storm Frequency	Average Storm Intensity
	ICM Scenarios				CLARA Scenarios	
2017 Coastal Master Plan						
Low	>Historical	<Historical	0.43	20% of range	-28%	+10.0%
Medium	>Historical	Historical	0.63	20% of range	-14%	+12.5%
High	Historical	Historical	0.83	50% of range	0%	+15.0%
Compared to 2012 Coastal Master Plan						
Moderate	>Historical	Historical	0.27	20% of range	0%	+10.0%
Less Optimistic	Historical	>Historical	0.45	50% of range	+2.5%	+20.0%





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Current Coastal Master Plan  
2017 Coastal Master Plan Process  
**Technical Analysis**  
Flood Risk and Resilience Program  
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### Technical Analysis

#### Model Improvement Plan

The 2012 Coastal Master Plan was based on state-of-the-art science and analysis, and the 2017 effort builds upon this further. The modeling process provides a holistic understanding of our coastal environment today and the changes we can expect over the next 50 years. CPRA, The Water Institute of the Gulf, and a team of over 50 additional experts developed the Model Improvement Plan to guide refinements and advancement to the models that would be used for the 2017 Coastal Master Plan. Changes from the 2012 Coastal Master Plan models can be characterized into three broad categories: development of new process-based algorithms (e.g., sediment distribution), integration of landscape and ecosystem model codes into a single common framework (e.g., the Integrated Compartment Model), and increased resolution of model grids (e.g., eco-hydrology and risk assessment).

To view the Model Improvement Plan, please [click here](#).

#### Technical Modeling Reports

The technical reports documenting the models used to evaluate projects and alternatives for the 2017 Coastal Master Plan are linked below. This information will be comprised in the master plan's Appendix C - Modeling, which has five chapters - Introduction, Future Scenarios, Modeling Components and Overview, Master Plan Model Results, and Use of Model Outputs and Conclusions.

Reports available on CPRA's website: <http://coastal.la.gov/a-common-vision/2017-master-plan-update/technical-analysis/>



# CONCLUSIONS

- Downscaled climate data from GCM output are now readily available for use via the USGS Geo Data Portal
- Multiple model projections available
- Only one emissions pathway available
- Gridded rainfall, many times, is preferable for modeling purposes than gage data
- Future projections of rainfall, ET and other environmental drivers (temperature, etc) can be consistently developed as compared to generic assumptions related to historic records
- Provides a consistent methodology for comparison across scenarios





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THANK YOU

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