LINKING DOWNSCALED GLOBAL CLIMATE MODELS TO PLANNING LEVEL ECOSYSTEM MODELS

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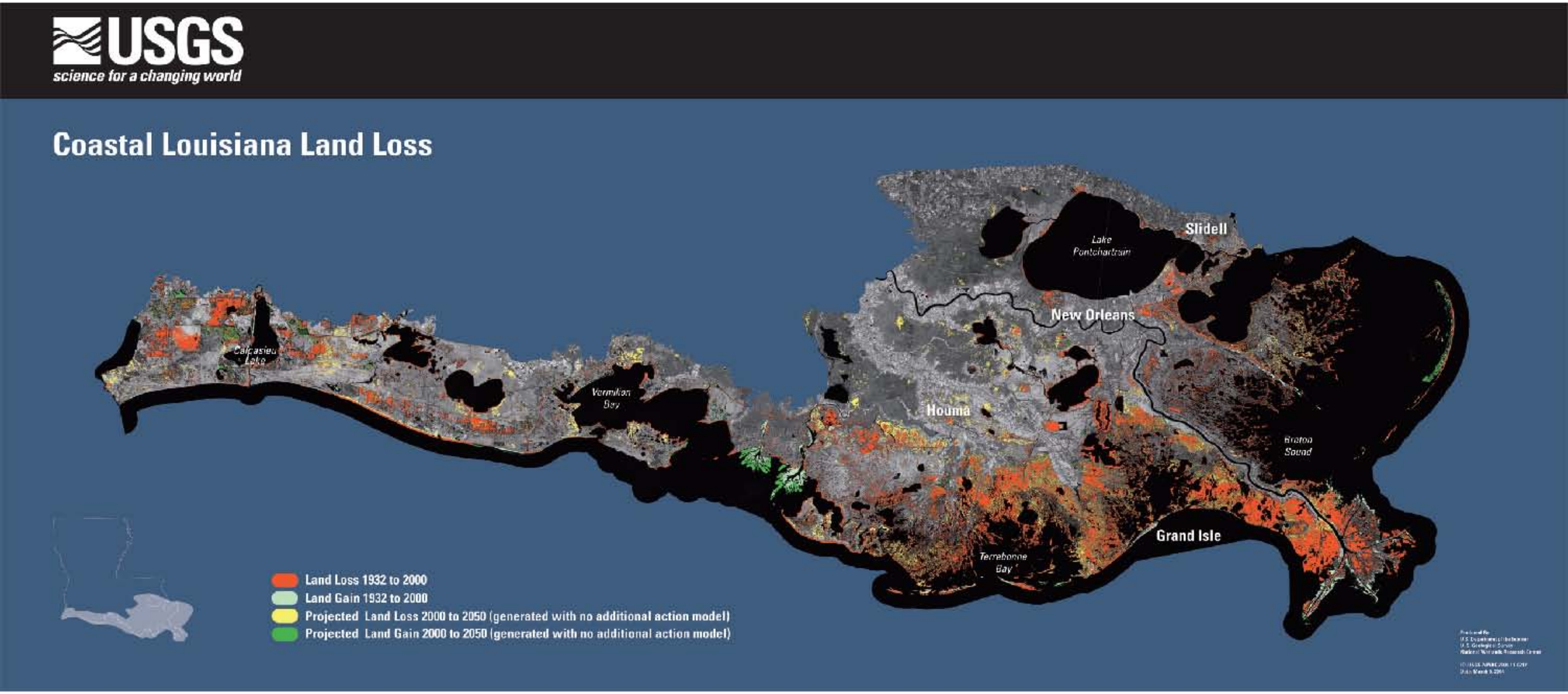
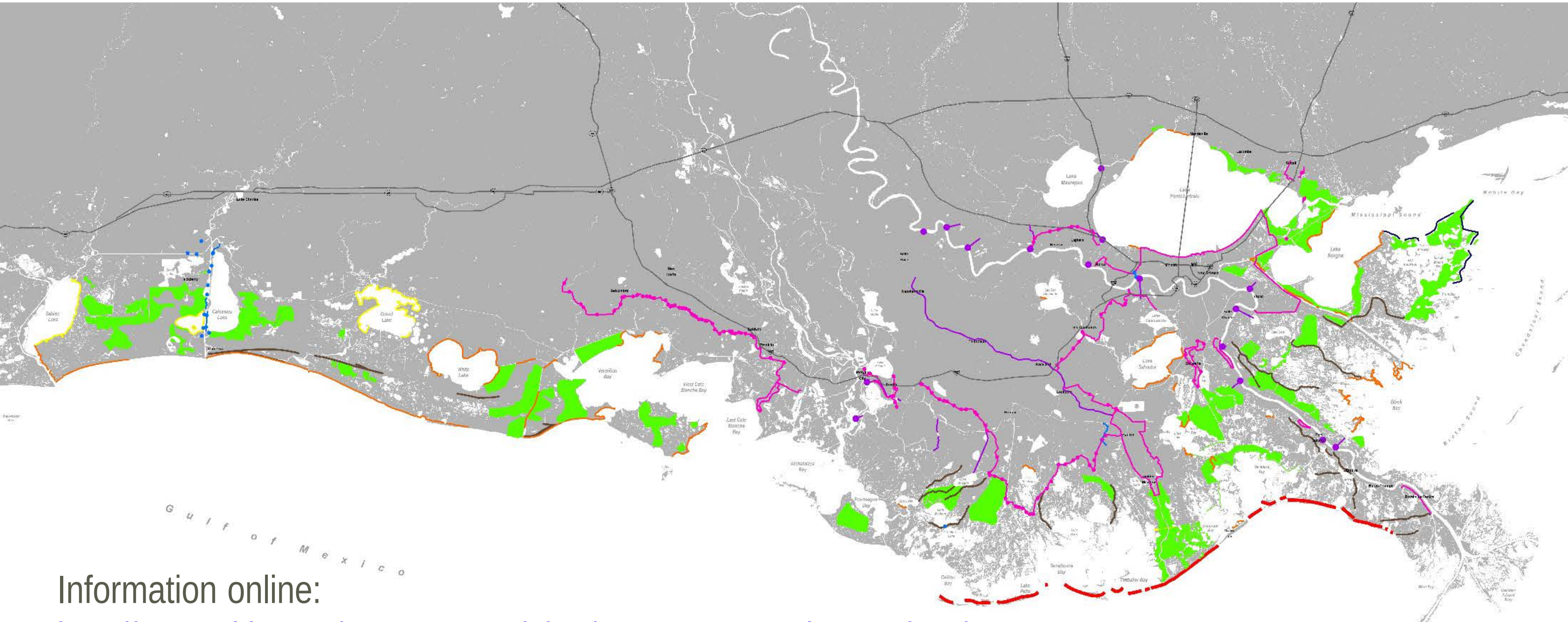
MASTER PLAN BACKGROUND

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



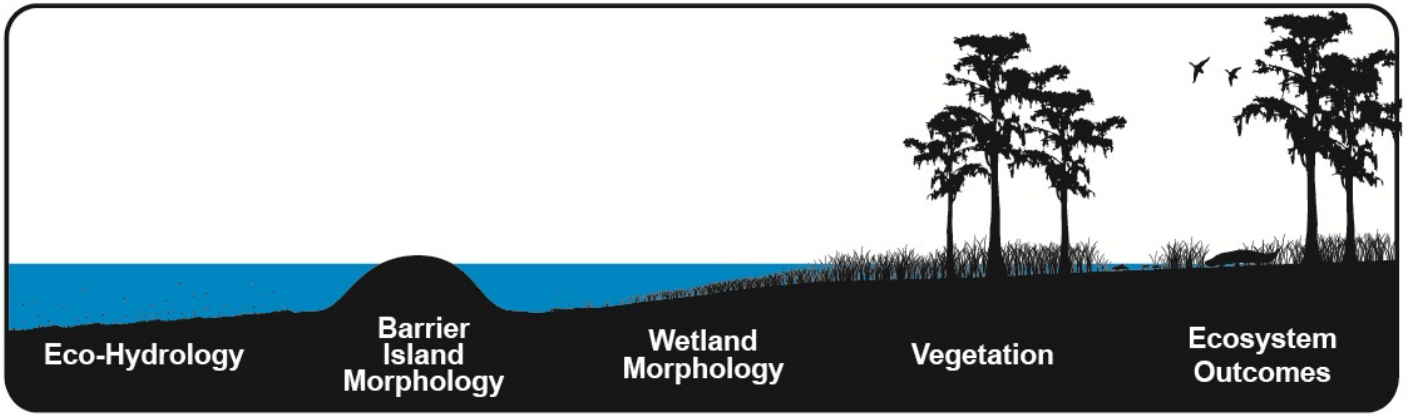
MASTER PLAN BACKGROUND

- 50 year, $50 billion comprehensive engineering plan
  - Restoration & protection projects

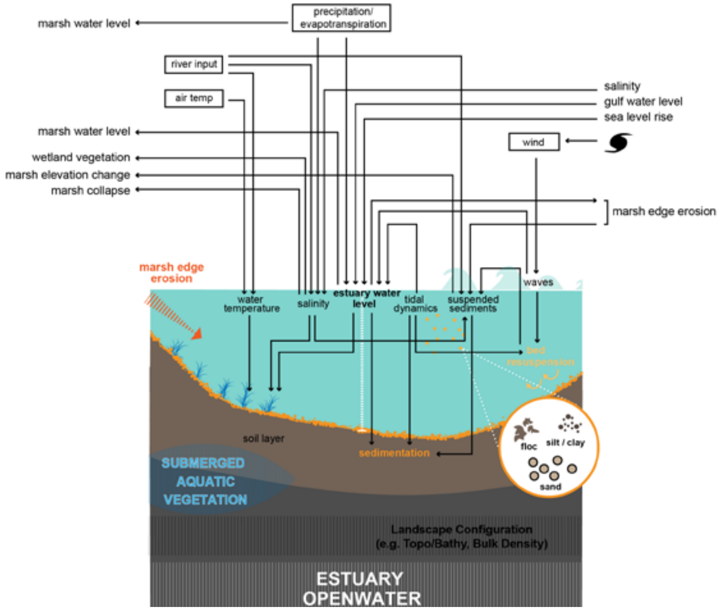


Information online:
http://coastal.la.gov/a-common-vision/2017-master-plan-update/

2017 MASTER PLAN INTEGRATED COMPARTMENT MODEL (ICM)



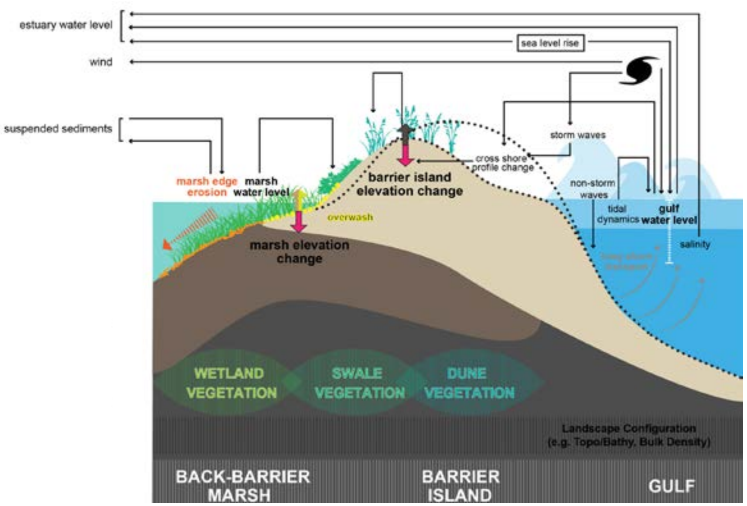
2017 MASTER PLAN INTEGRATED COMPARTMENT MODEL (ICM)

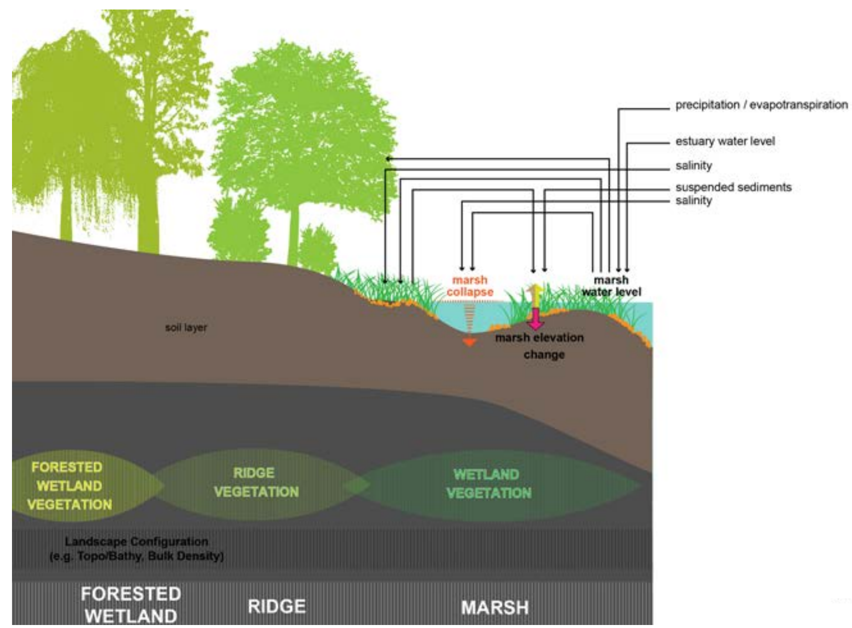


Estuary and Open Water Processes
- Hydrodynamics
- Water quality
- Sedimentation
- Bed resuspension

Wetland and Vegetation Processes
- Sediment distribution
- Wetland elevation change
- Wetland area change
- Marsh collapse
- Marsh edge erosion
- Storm effects
- Coastal vegetation

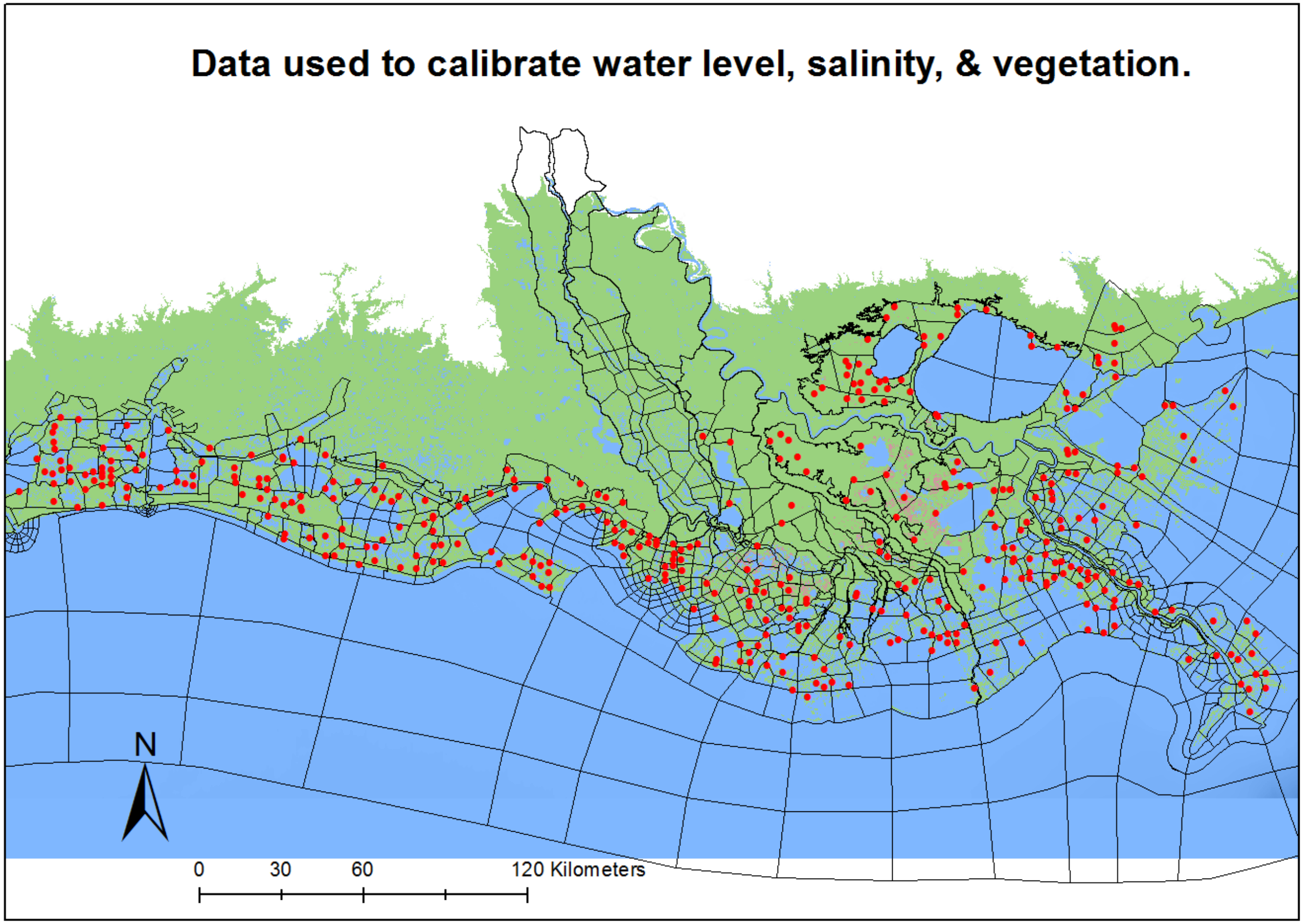
Barrier Island Processes
- Island elevation change
- Breaching
- Overwash / cross shore profile change
- Longshore transport
- Wave transformation
- Storm effects (SBEACH)
- Back-barrier marsh, dune and swale vegetation





2017 MASTER PLAN INTEGRATED COMPARTMENT MODEL (ICM)

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



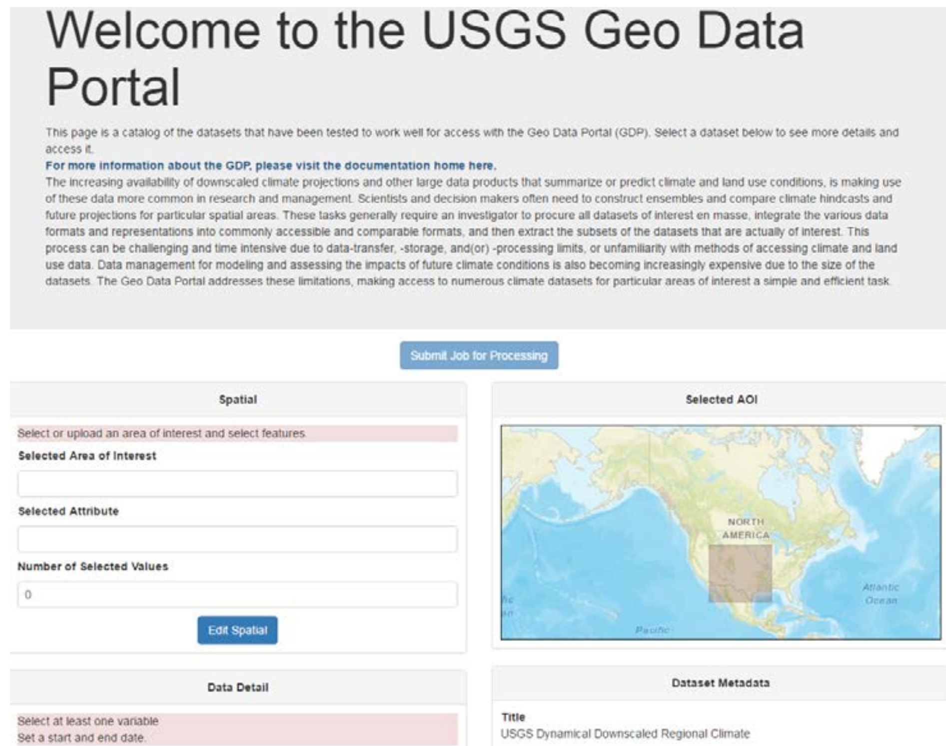
DOWNSCALED CLIMATE DATA

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



http://cida.usgs.gov/gdp/
www.unidata.ucar.edu/software/netcdf/fan_utils.html

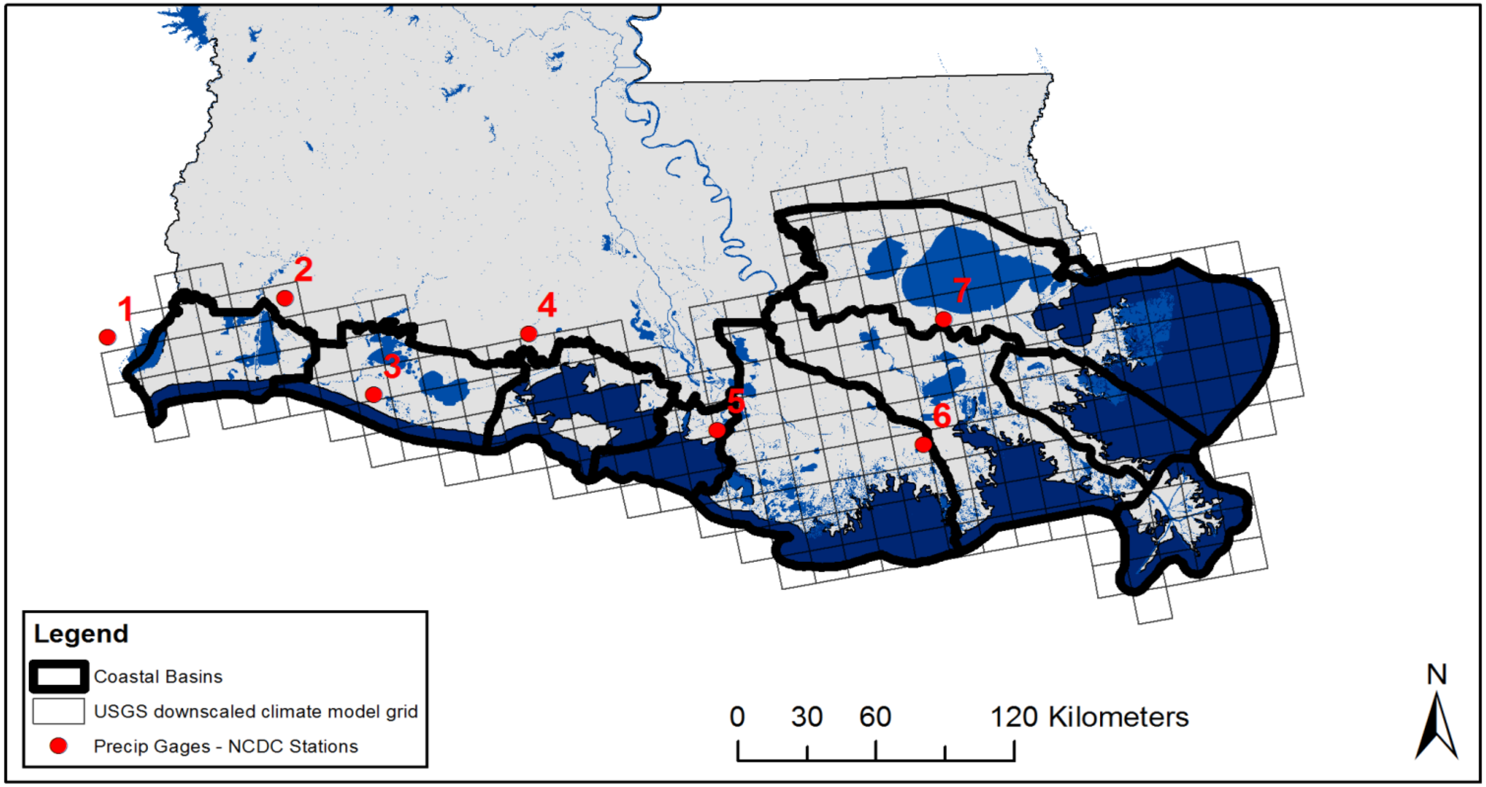
DOWNSCALED CLIMATE DATA

- 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

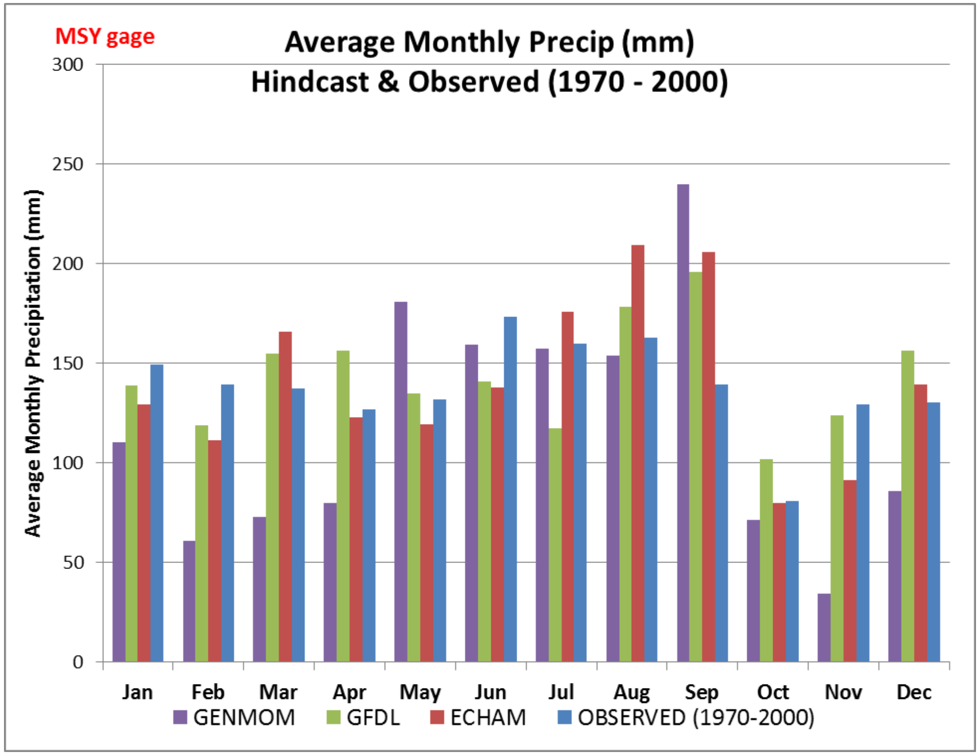
DOWNSCALED CLIMATE DATA



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

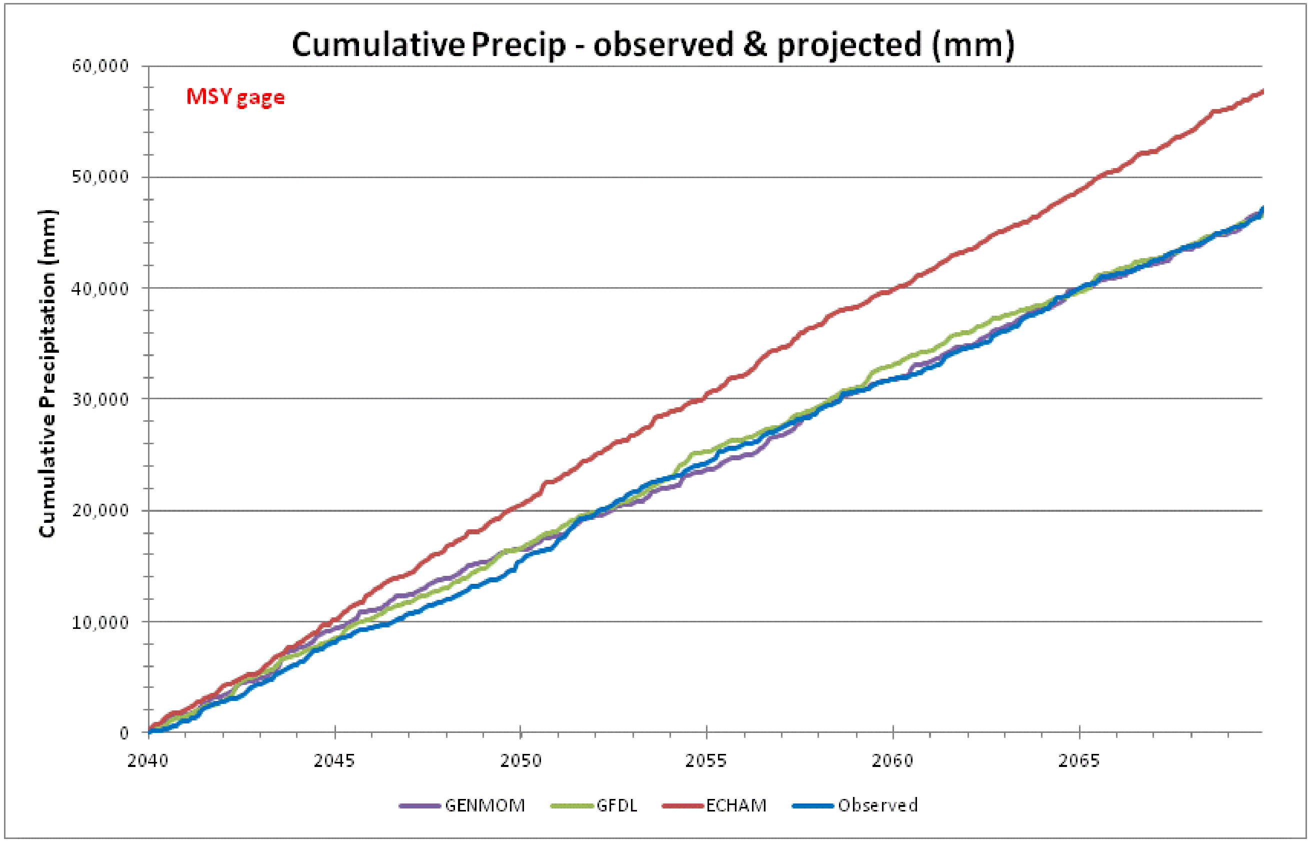
Gage-to-hindcast comparsion completed at seven locations across model domain



Percent difference between hindcast and observed rainfall at MSY

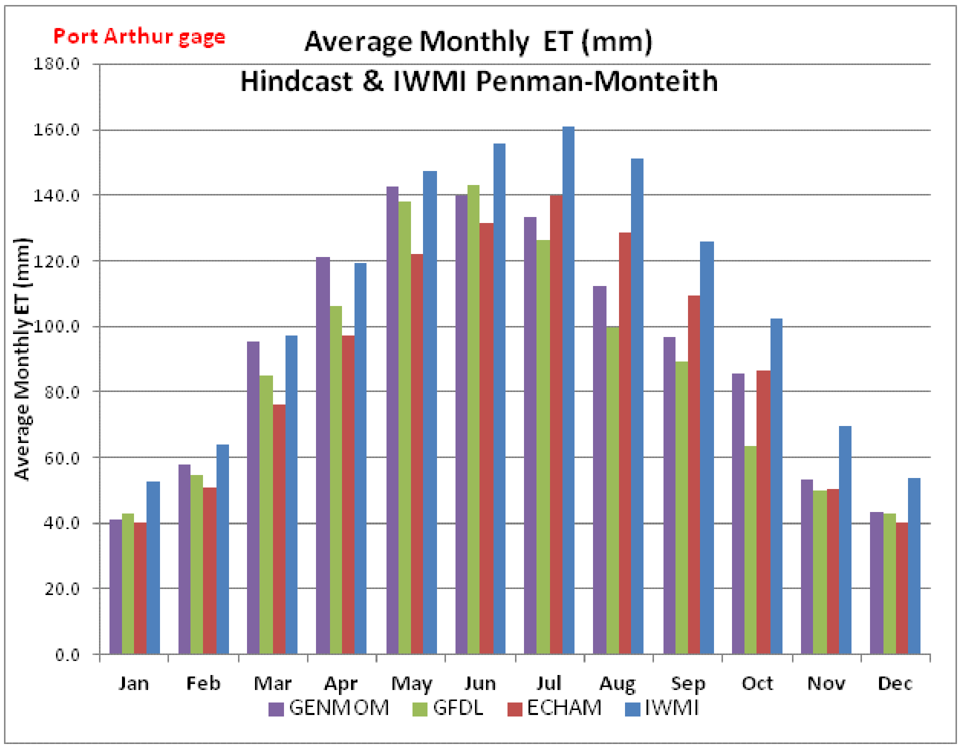
	1980-1999	1970-1999	
	GENMOM	GFDL	ECHAM
Jan	-30%	-7%	-14%
Feb	-58%	-15%	-20%
Mar	-47%	13%	21%
Apr	-42%	23%	-3%
May	45%	2%	-9%
Jun	-18%	-19%	-20%
Jul	-2%	-26%	10%
Aug	6%	10%	29%
Sep	99%	41%	48%
Oct	-11%	26%	-1%
Nov	-72%	-4%	-29%
Dec	-30%	20%	7%

PRECIPITATION PROJECTION



EVAPOTRANSPIRATION HINDCAST

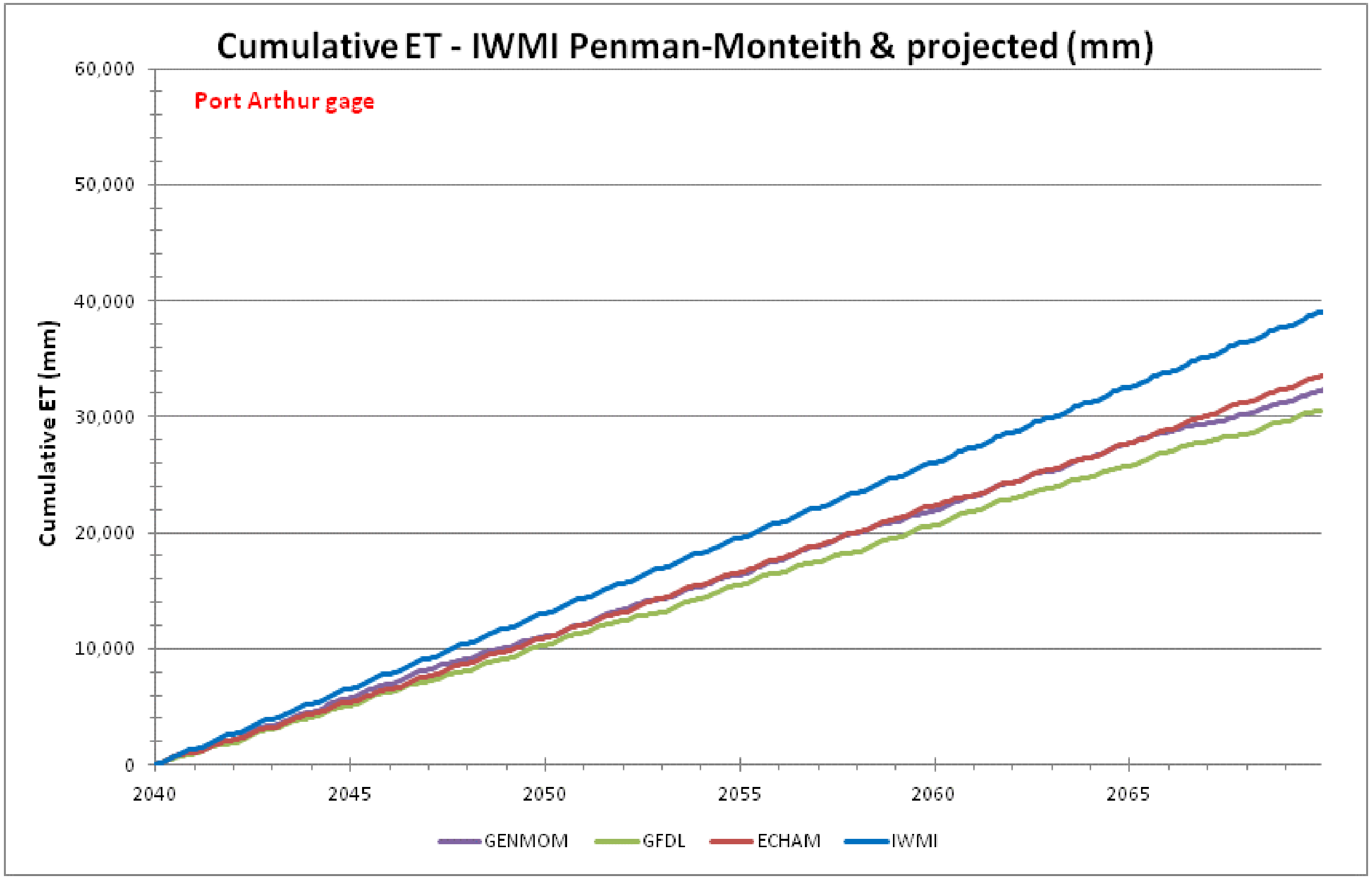
PET-to-hindcast comparsion completed at seven locations across model domain



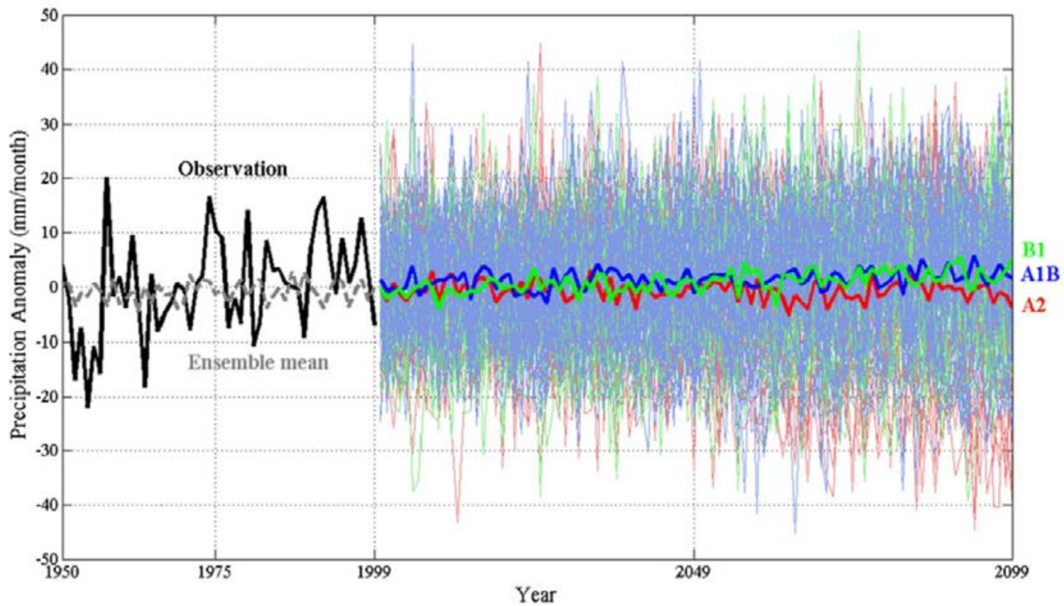
Percent difference between hindcast and observed rainfall at MSY

	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



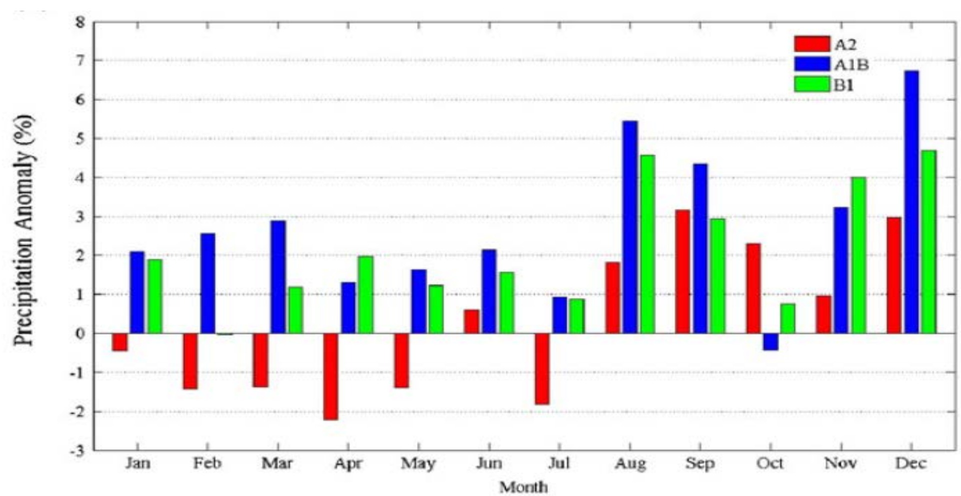
Projected precipitation anomalies (relative to 1950-1999 mean) in the Southeastern U.S. from ensemble downscaled datasets for three emission scenarios

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

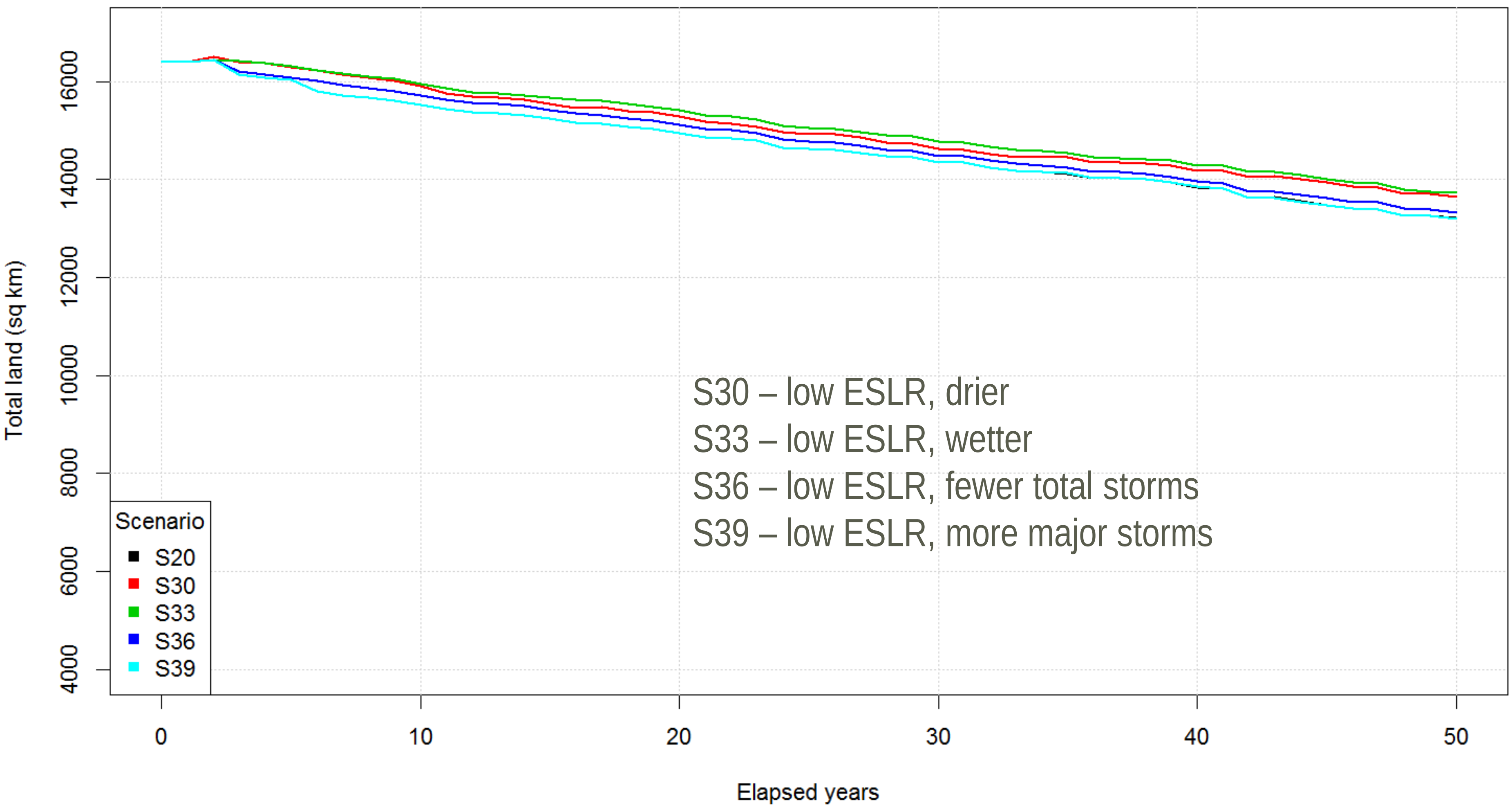
RUN MATRIX EXAMPLE

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)

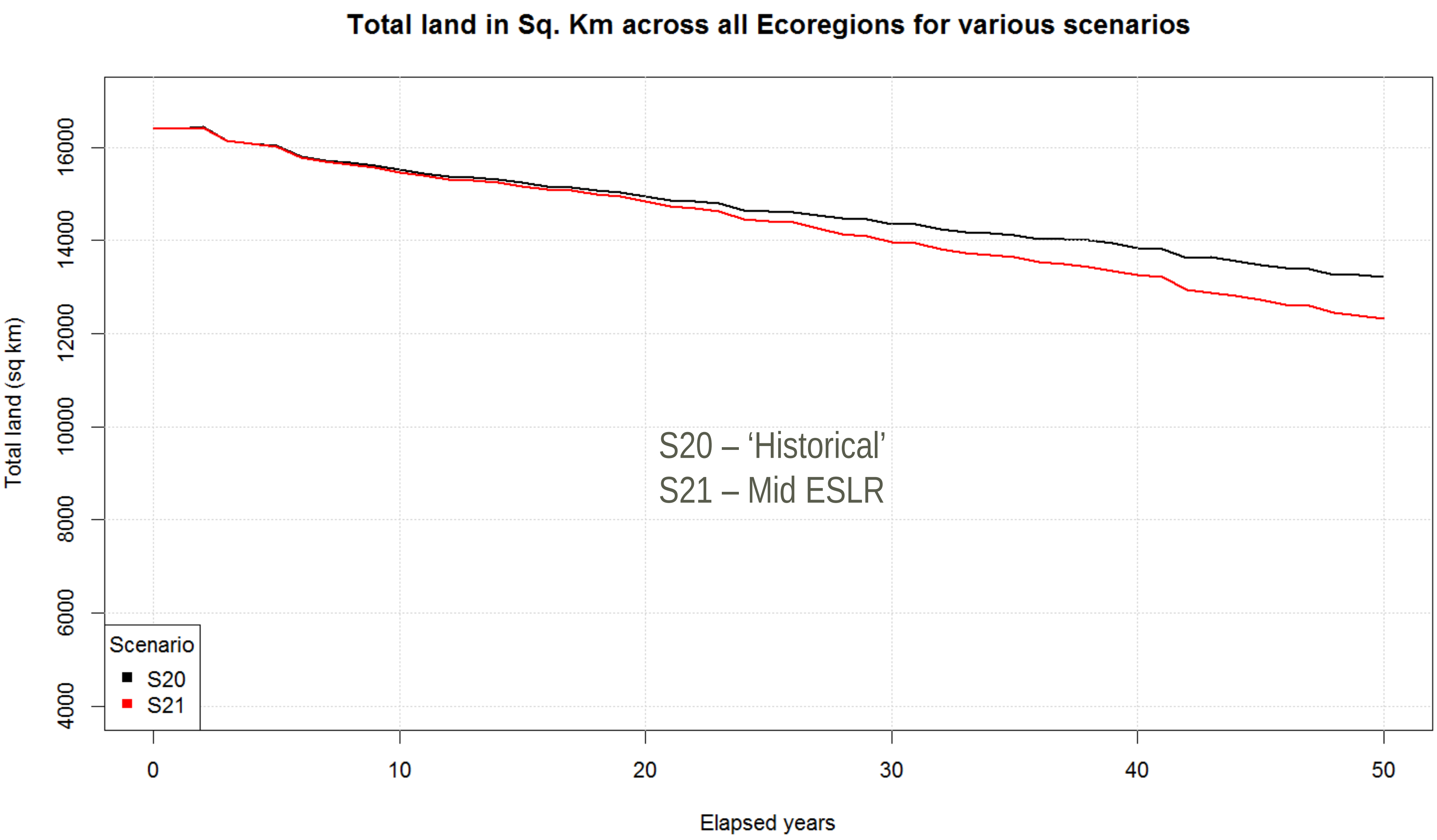
2017 MASTER PLAN ENVIRONMENTAL SCENARIOS

SENSITIVITY TEST – PRECIP, ET, STORMS

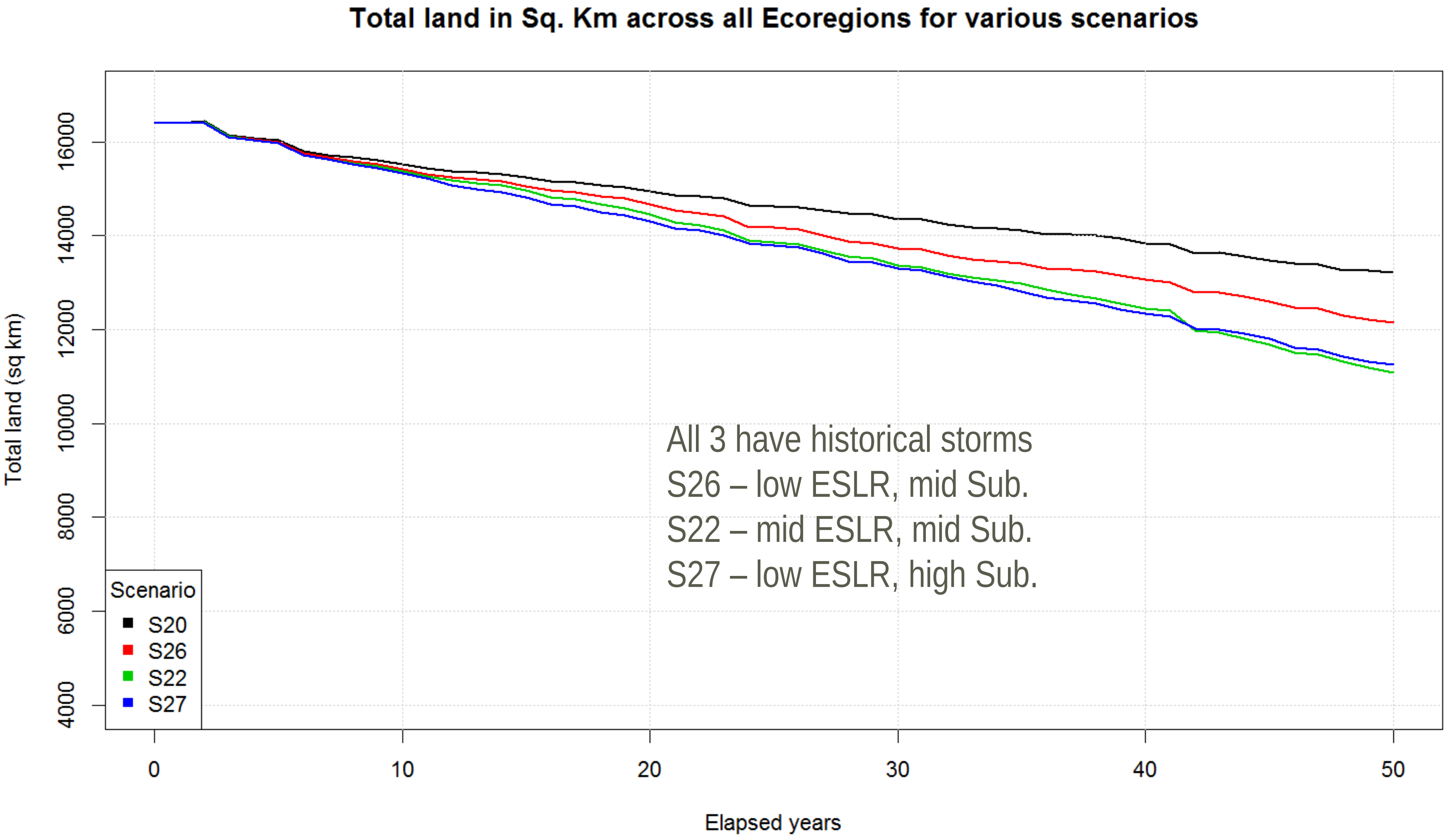
Total land in Sq. Km across all Ecoregions for various scenarios



SENSITIVITY TEST – EUSTATIC SEA LEVEL RISE

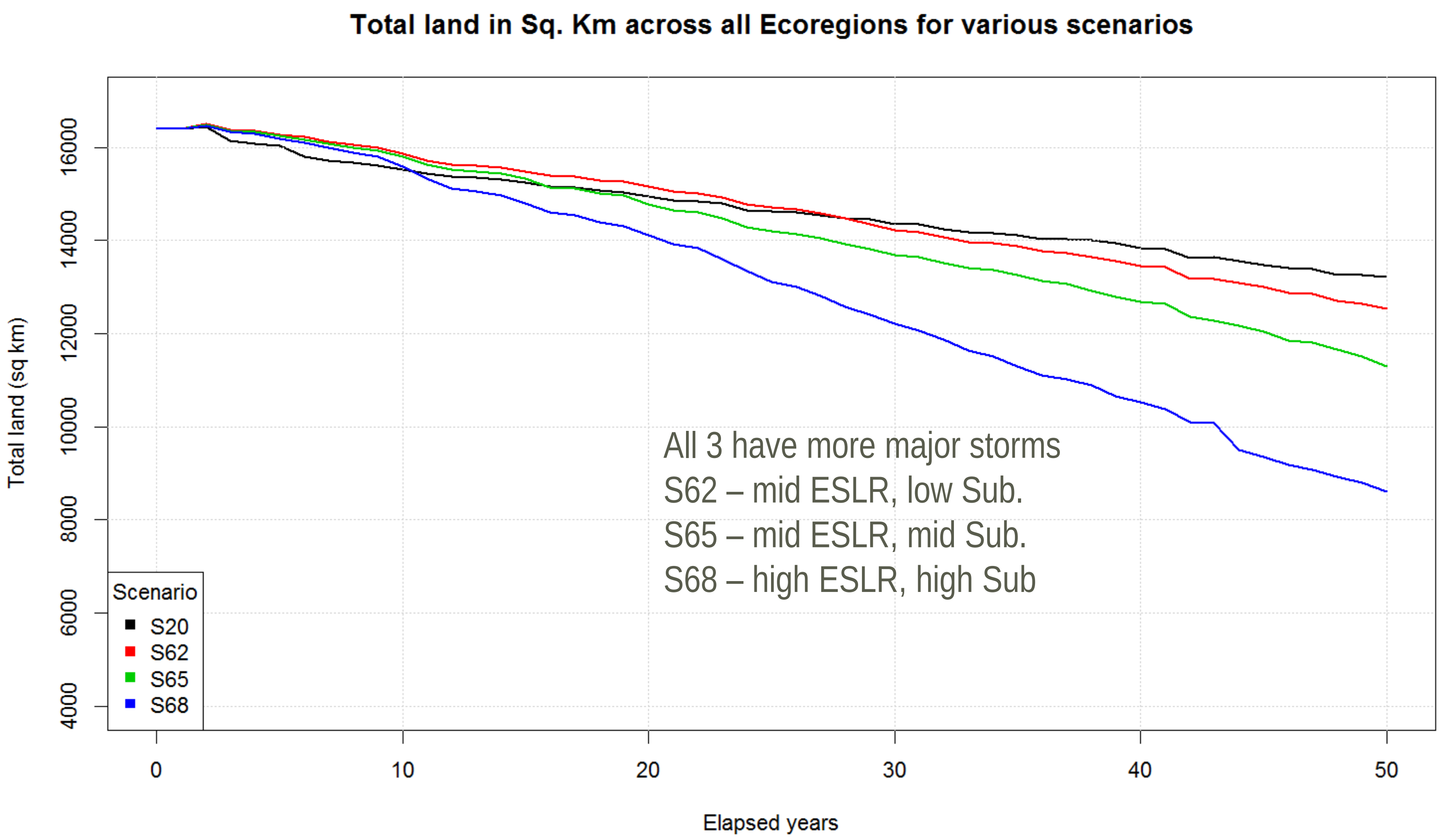


SENSITIVITY TEST – ESLR VS SUBSIDENCE

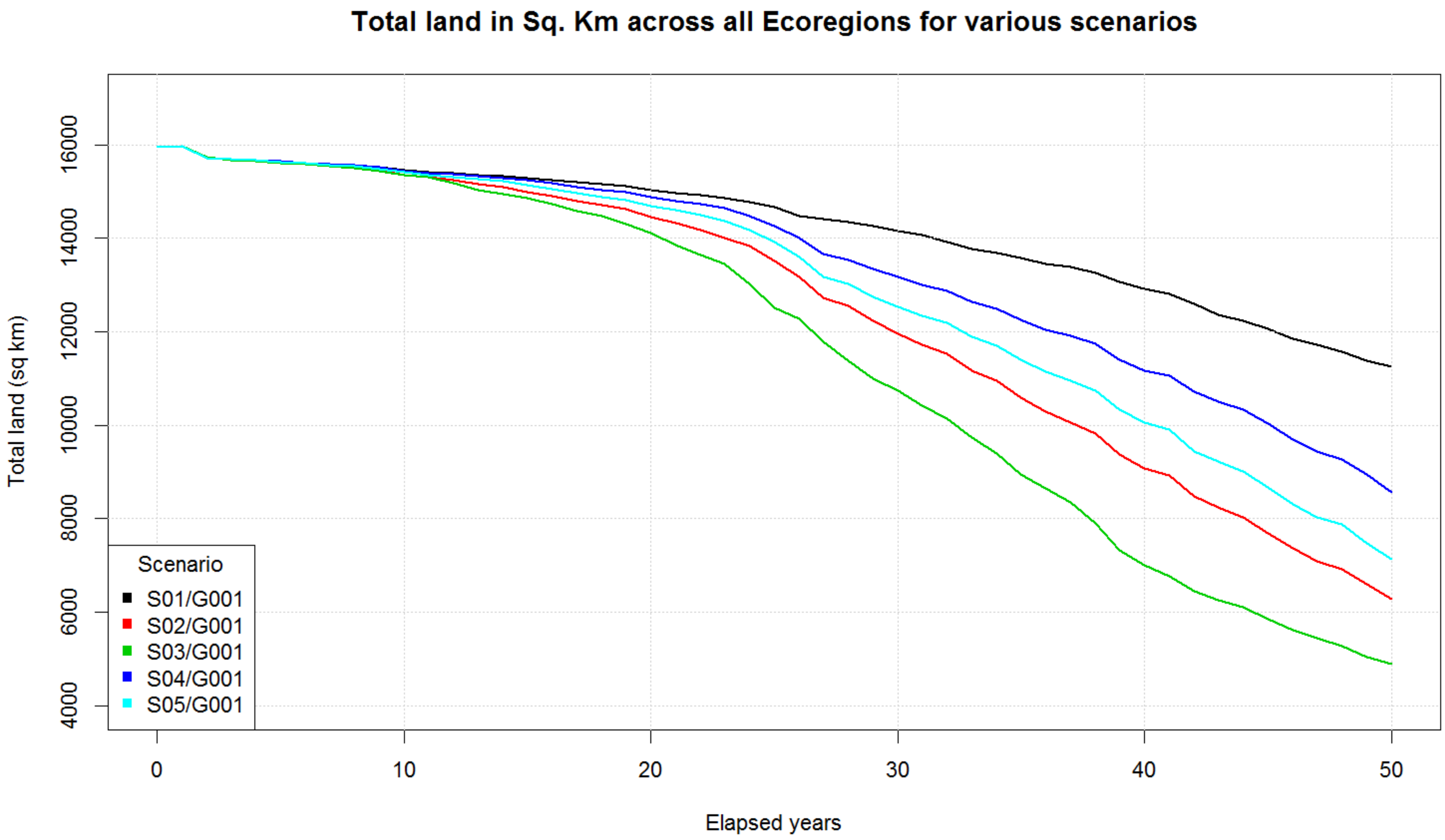


All 3 have historical storms
S26 – low ESLR, mid Sub.
S22 – mid ESLR, mid Sub.
S27 – low ESLR, high Sub.

SENSITIVITY TEST – ESLR + SUBSIDENCE

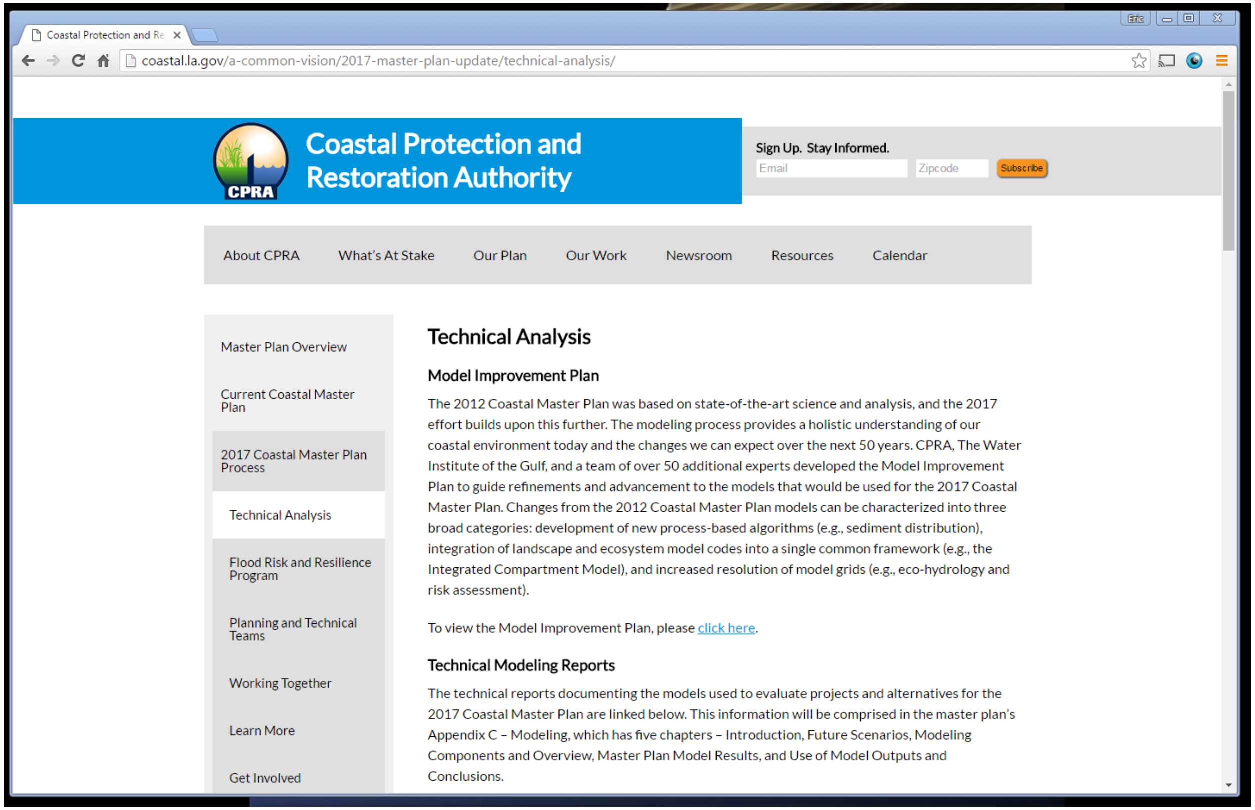


FUTURE WITHOUT ACTION
5 CANDIDATE SCENARIOS



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%



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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