# South Atlantic Climate Vulnerability

## with comments on changing distributions and essential habitats

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**Southeast Fisheries Science Center**
**National Marine Fisheries Service**

**Habitat Advisory Panel Meeting**
**South Atlantic Fishery Management Council**
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# What is a CVA and how does it work?

A method that uses expert elicitation and climate projections to assess a species' **exposure** and **sensitivity** to expected climate change. This provides a measure of relative **vulnerability** for the species to climate change.

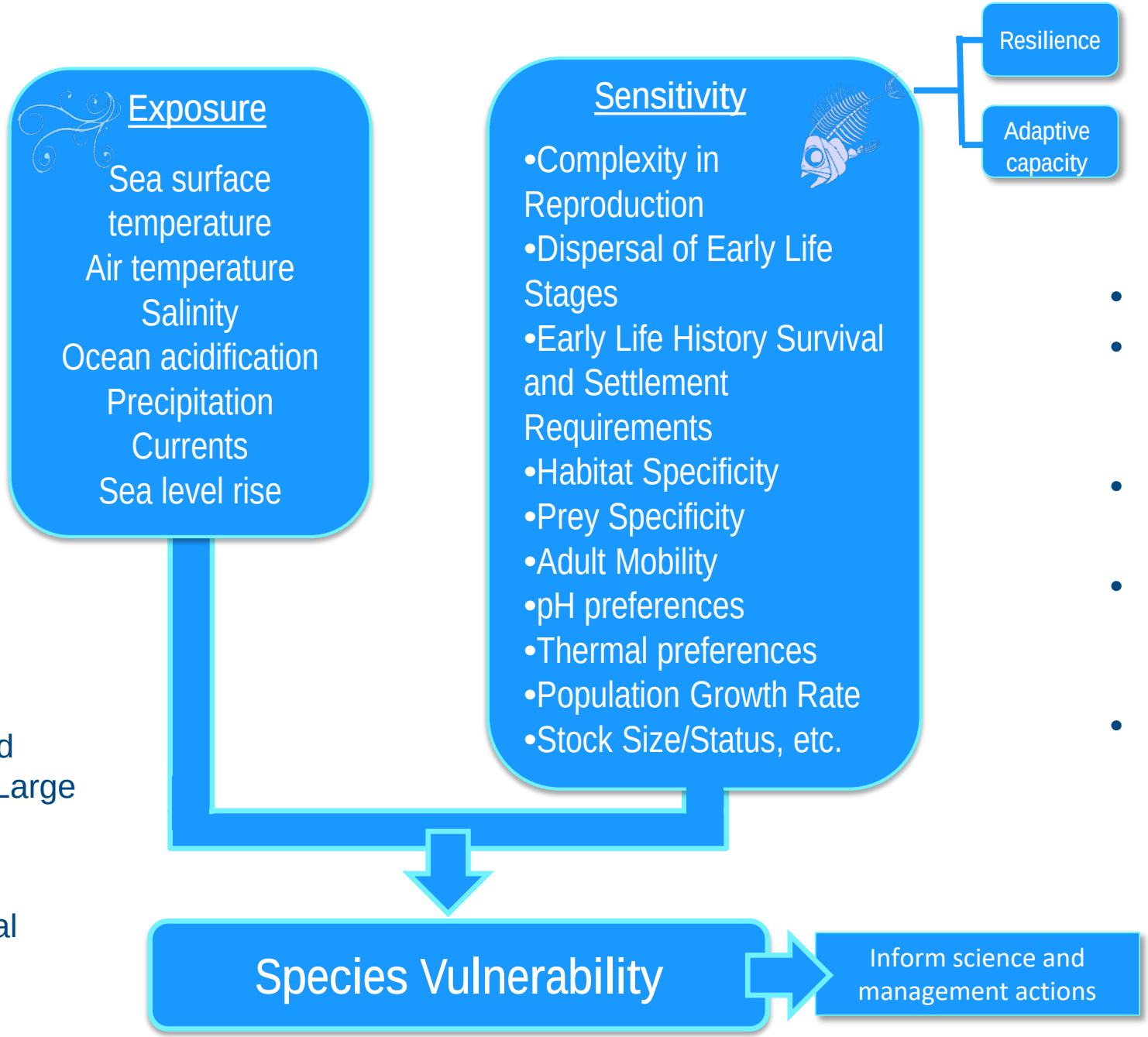
**Vulnerability** is related to reductions in a species' productivity and/or abundance in response to climate change.

**Exposure** – Level of **environmental conditions** derived from the output of an ensemble of climate models.

**Sensitivity** – An assessment of a set of **life history traits** with respect to extremes for that trait (e.g., generalists versus specialists with respect to feeding)

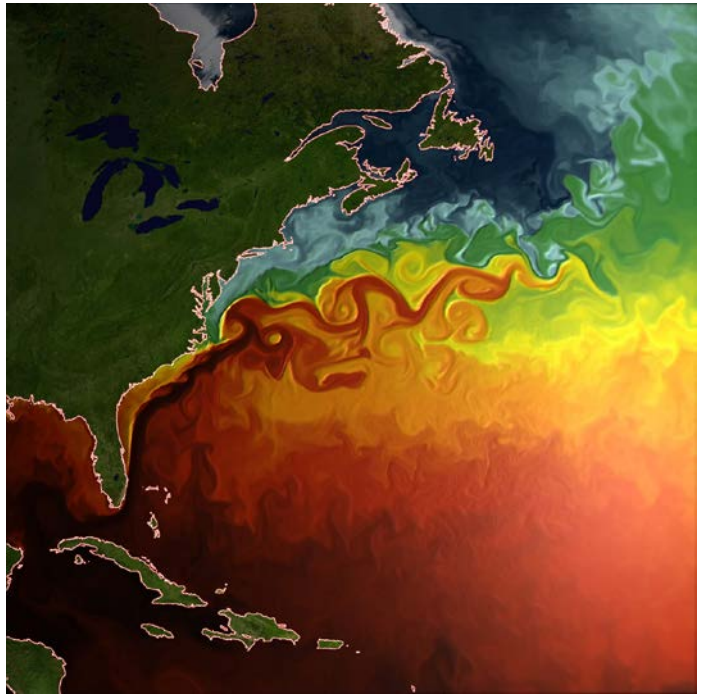
**Vulnerability** – Relative degree of change (reduction) in a species ' productivity and/or abundance.

- **Quantitative**
- Climate model data
- Estimate of species distribution?
- Which emissions assumptions?
- Time frames for reference period and projection period? (Large blocks.)
- Which environmental factors?




- **Qualitative**
- Guided expert judgement. & group discussions
- Which species?
- What is known about life history and ecology?
- What is known in specific areas?

# South Atlantic Climate Vulnerability Assessment



**New Options:**
- CMIP6/Other
- Downscaling
- Multiple SSPs
- Multiple time periods

| Decision Points | Implementation |
|---|---|
| Project Scope | 71 species / 7 environmental variables / 12 life history traits / SA-LME domain |
| Model Selection | CMIP5 – RCP 8.5 |
| Temporal Scale | 1956-2005 Historical Period; 2006-2005 Future Period |
| Sensitivity Attributes | 12 Standard Attributes Used |
| **Manuscript** | **NOAA Technical Memo (Available)** |

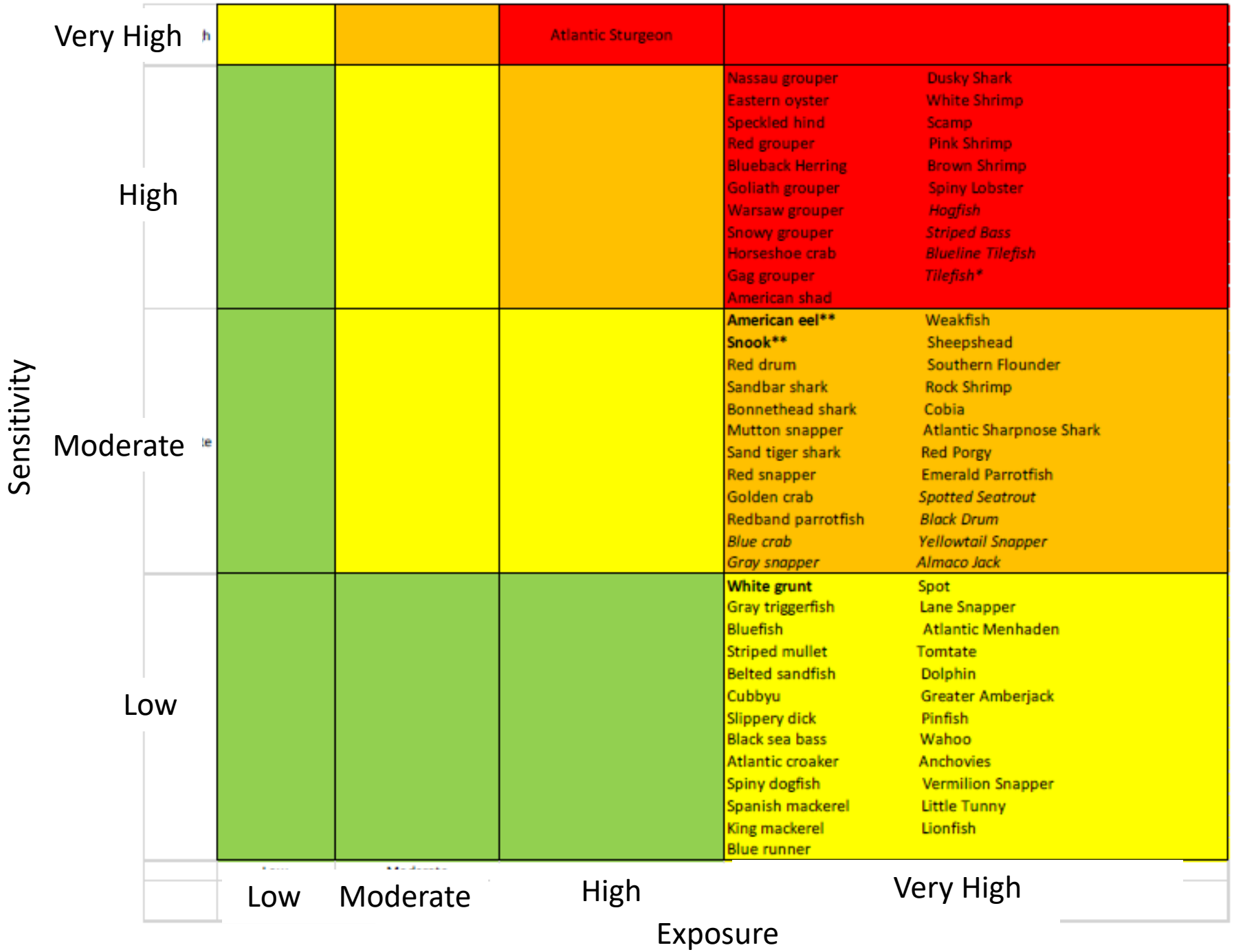
# Major Exposure Factors and Biological Sensitivities

| | Considered | Most Influential |
|---|---|---|
| **Environmental Factors** | • SST<br>• Air Temp<br>• Salinity<br>• Ocean acidification<br>• Precipitation<br>• Currents<br>• SLR | • **SST**<br>• **Salinity**<br>• **Ocean acidification** |
| **Biological Traits** | • Habitat Specificity<br>• Adult mobility<br>• Early life stage dispersal<br>• Complexity in reproductive cycle<br>• Sensitivity to ocean acidification<br>• Sensitivity to temperature<br>• Prey Specificity<br>• Population growth rate<br>• Stock size Status<br>• Other stressors | • **Population growth rate**<br>• **Stock size Status** |

# Results Summary

- **<u>Environmental</u> exposure is mostly VERY HIGH**
- **<u>Biological</u> sensitivity VARIES**
- **NO SPECIES has LOW overall VULNERABILITY**

- Species are in rank order
- Details regarding potential category shifts in TM



# Climate Vulnerability and Species Distribution Change

| Overall, Climate, Vulnerability | Low | Moderate | High | V.High |
|---|---|---|---|---|
| Very, High | Atlantic Sturgeon, Eastern Oyster, American Shad, Spiny Lobster, Horseshoe Crab | Nassau Grouper, Gag, Speckled Hind, Pink Shrimp, Red Grouper, Brown Shrimp, Blueback Herring, Scamp, Goliath Grouper, Hogfish, Warsaw Grouper, Blueline Tilefish, Snowy Grouper, Golden Tilefish | Dusky Shark, White Shrimp, Striped Bass | |
| High | Golden Crab, Rock Shrimp | Blue Crab, Redband Parrotfish, Sheepshead, Emerald Parrotfish, Spotted Seatrout, Yellowtail Snapper | American Eel, Weakfish, Red Drum, Southern Flounder, Sandbar Shark, Cobia, Bonnethead, Atlantic Sharpnose Shark, Mutton Snapper, Red Porgy, Sand Tiger Shark, Black Drum, Red Snapper, Almaco Jack, Gray Snapper, Bluefish, | |
| Moderate | | Belted Sandfish, Cubbyu, Slippery Dick | Snook, Lane Snapper, White Grunt, Atlantic Menhaden, Gray Triggerfish, Tomtate, Striped Mullet, Greater Amberjack, Black Seabass, Pinfish, Atlantic Croaker, Wahoo, Spiny Dogfish, Anchovies, Spanish Mackerel, Vermilion Snapper, King Mackerel, Little Tunny, Blue Runner, Lionfish, Spot | Dolphin |
| Low | | | | |

Potential, for, Species, Distribution, Change

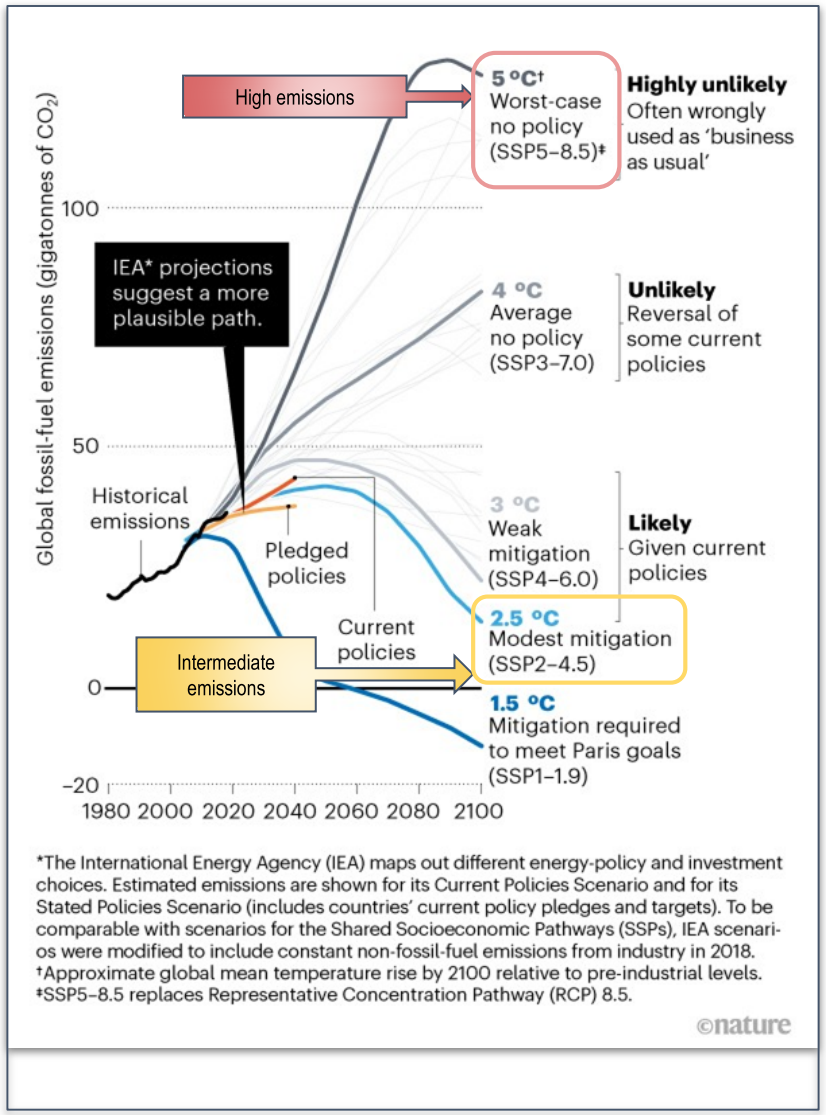
**LOW/Moderate potential to move** and **Very High climate vulnerability**

**HIGH/Very High potential to move** and **Moderate climate vulnerability**

# Additional EFH Considerations

- Are highly vulnerable species dependent on highly vulnerable habitat at one or more life history stages?
- Will currently designated EFH change markedly as physical and chemical conditions shift?
- Is there a need to identify areas outside the current designations that will offer EFH in the future?
- Are those areas outside of existing management boundaries?
- How will species distributions change and what are the time scales involved?
- Would some other set of decisions in CVA set-up provide additional insight (more/less risk adverse)?

# Additional EFH Considerations




- **Which emissions assumptions are you comfortable with for the process at hand?**
- **Is you time frame measured on multiple years or multiple decade?**
- **What reference period (baseline) would you want to compare change against?**

# Some of the new options

- **CMIP6 is available now and becoming better understood**
- **Multiple emissions frameworks (SSPs) to choose from.**
- **Multiple reference and projection period time frames.**

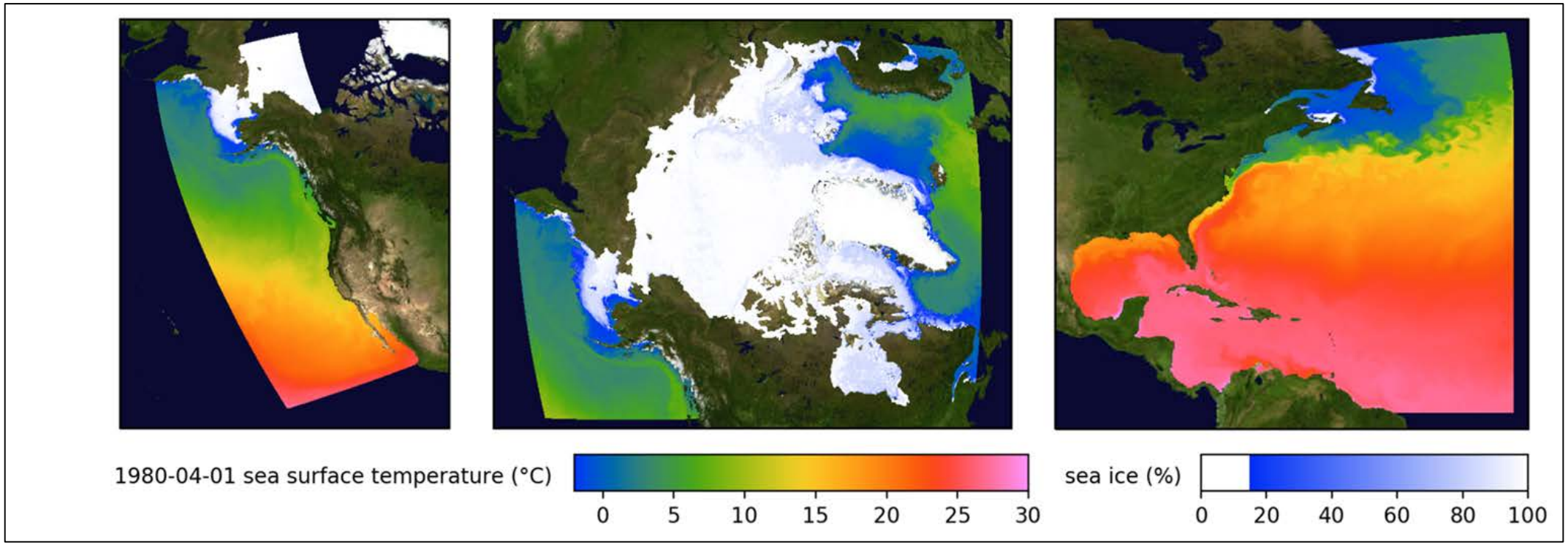
- **Choose from a pallet of options for any given use case?**

| | Near term, 2021–2040 | | Mid-term, 2041–2060 | | Long-term, 2081–2100 | |
|---|---|---|---|---|---|---|
| Scenario | Best estimate (C) | *Very likely* range (C) | Best estimate (C) | *Very likely* range (C) | Best estimate (C) | *Very likely* range (C) |
| SSP1–1.9 | 1.5 | 1.2 to 1.7 | 1.6 | 1.2 to 2.0 | 1.4 | 1.0 to 1.8 |
| SSP1–2.6 | 1.5 | 1.2 to 1.8 | 1.7 | 1.3 to 2.2 | 1.8 | 1.3 to 2.4 |
| SSP2–4.5 | 1.5 | 1.2 to 1.8 | 2.0 | 1.6 to 2.5 | 2.7 | 2.1 to 3.5 |
| SSP3–7.0 | 1.5 | 1.2 to 1.8 | 2.1 | 1.7 to 2.6 | 3.6 | 2.8 to 4.6 |
| SSP5–8.5 | 1.6 | 1.3 to 1.9 | 2.4 | 1.9 to 3.0 | 4.4 | 3.3 to 5.7 |

AR6 assessed warming projections for each of the five core emissions scenarios in the near-, mid- and long term.
Source: IPCC (2021) Table SPM.1

# Where things may go

- **Climate, Ecosystem and Fisheries Initiative will offer new regionally-focused climate model products.**
- **Next-Gen Assessment processes may be a combination of traditional CVAs and Dynamic Ocean Modeling approaches.**




Prototype MOM6 coast-wide domains for seasons to decades **(Great Lakes, Pacific Islands in progress)**

# Thank you!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## Happy to take questions if there’s time!

# What is CEFI?

**Cross-NOAA effort to provide climate-informed advice** for marine resource management and community adaptation.

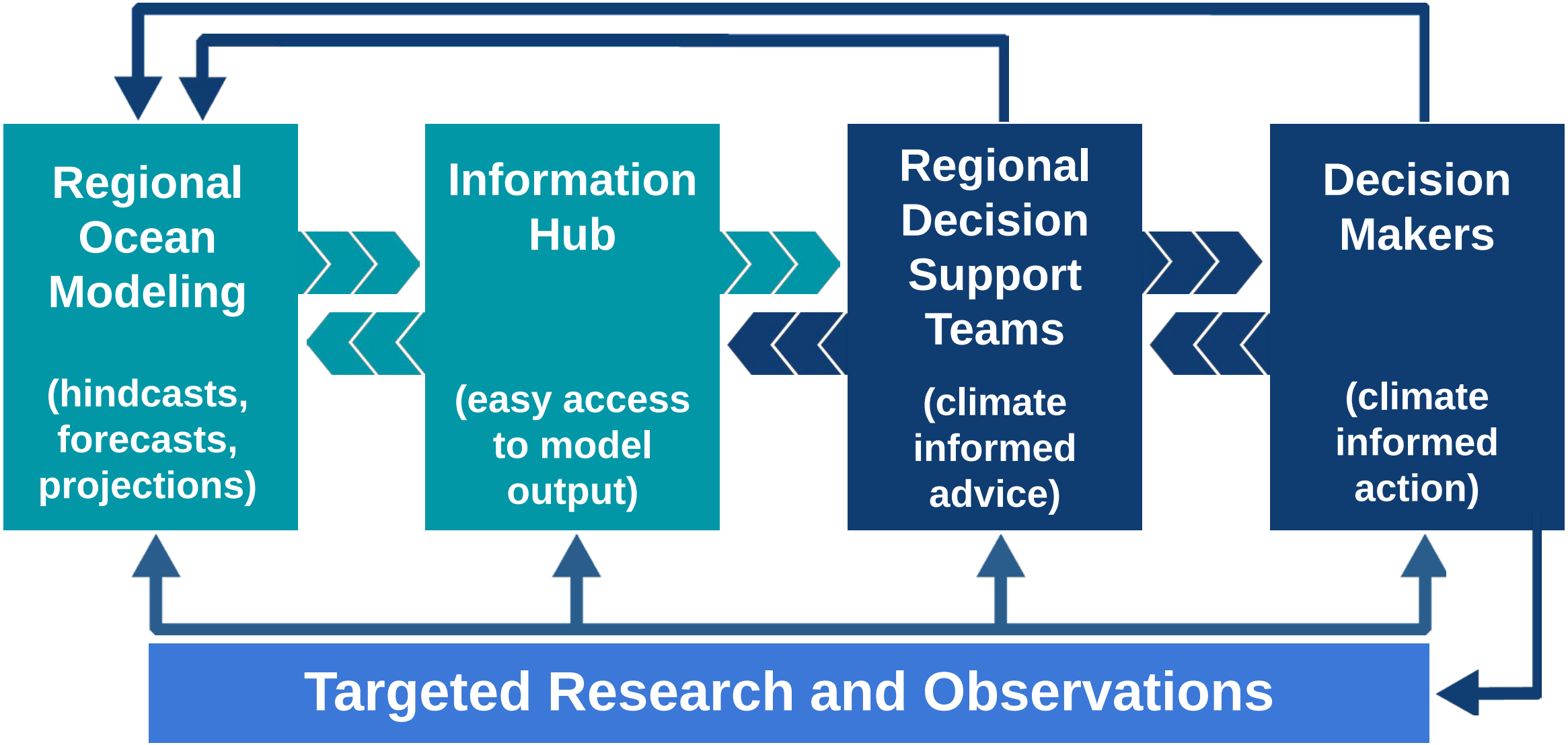
**Builds on existing NOAA investments** in research, modeling, and decision-making.

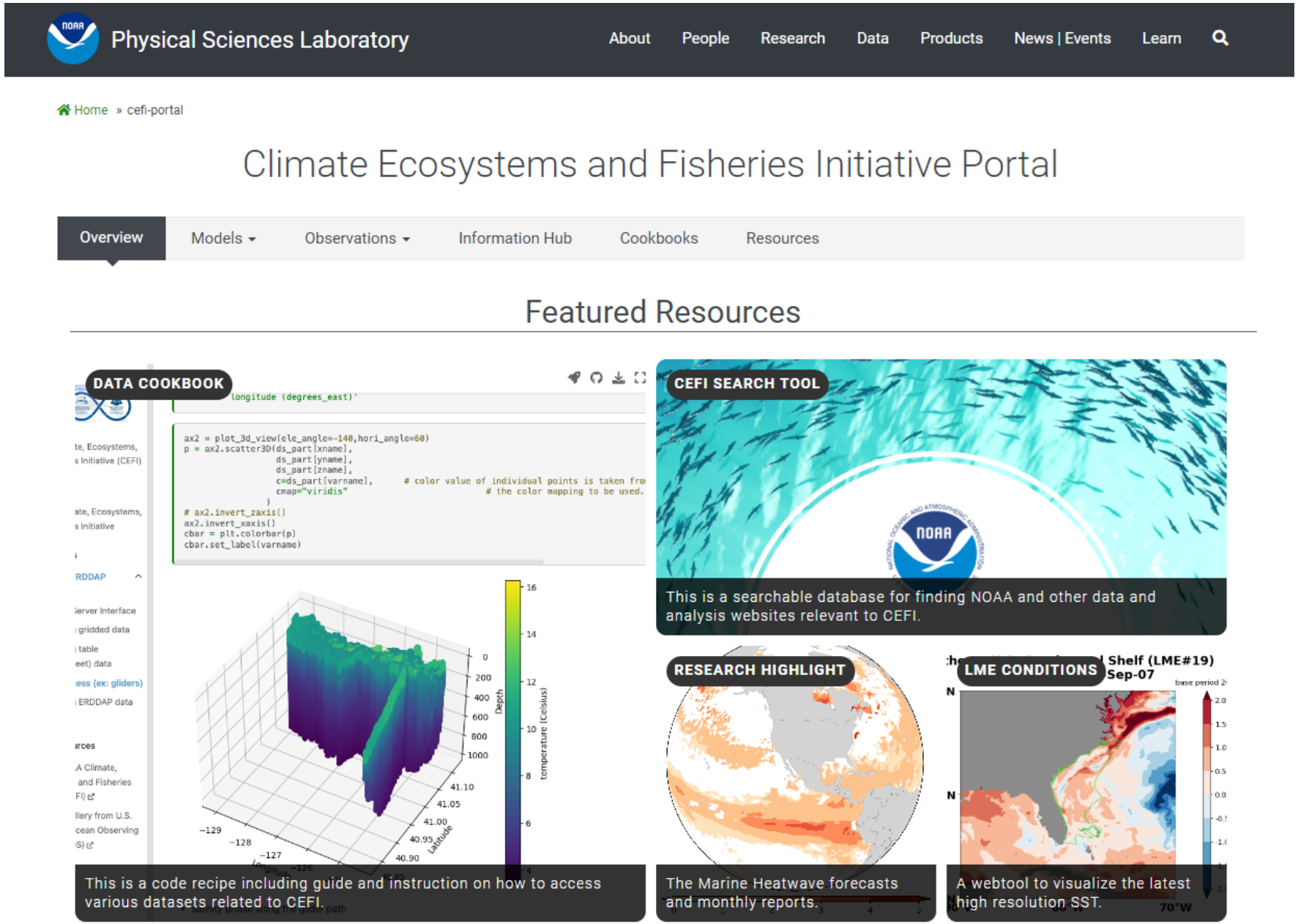
**End-to-end decision support system** to address four requirements for establishing regular climate-informed information delivery & decision making

1. **Reliable delivery** of robust ocean forecasts and projections.
2. **Operational production** of climate-informed advice (ecosystem projections, risk assessments and adaptation strategies).
3. **Increased decision maker capacity** to use climate advice.
4. **Targeted research & observations** for validation & innovation.

Improved planning for extreme events & long term changes

# CEFI Decision Support System





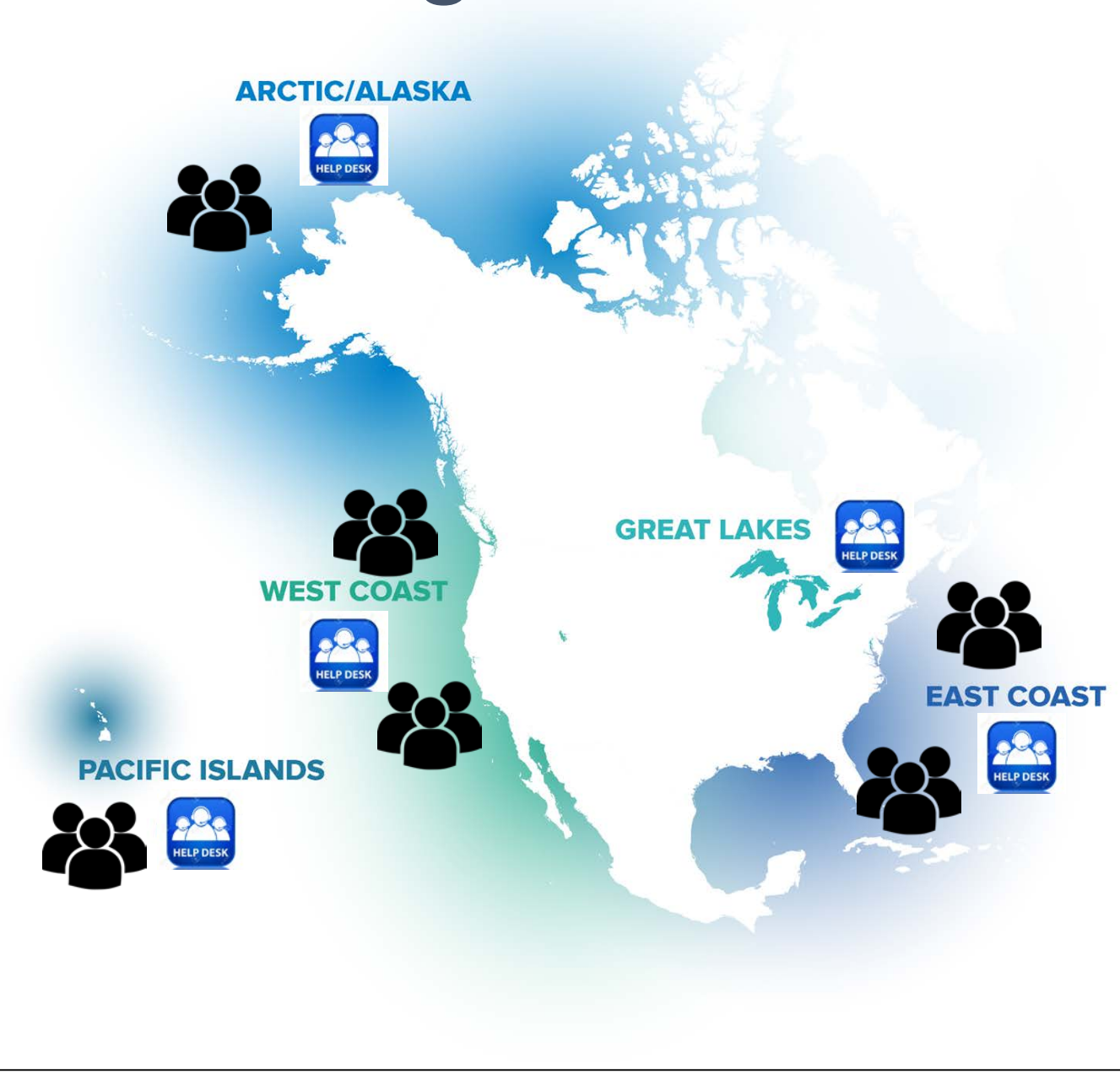

https://psl.noaa.gov/cefi_portal/#overview

# CEFI Regional Teams

## Regional Ocean Modeling Teams

HELP DESK

Customize MOM6 regional ocean projections for NMFS & other users

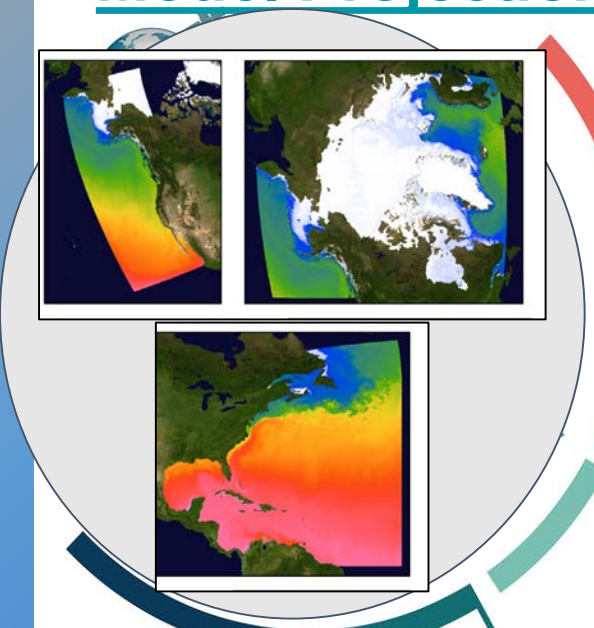



## Regional Decision Support Teams

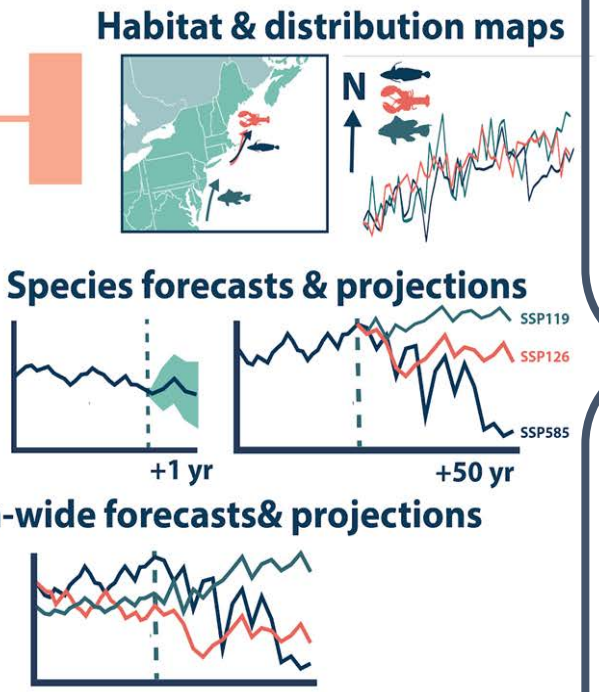
Produce ecological projections and info for stock, risk & strategy assessments

# CEFI Decision Support System

## Regional Ocean Model Projections



## Regional Decision Support Team Products



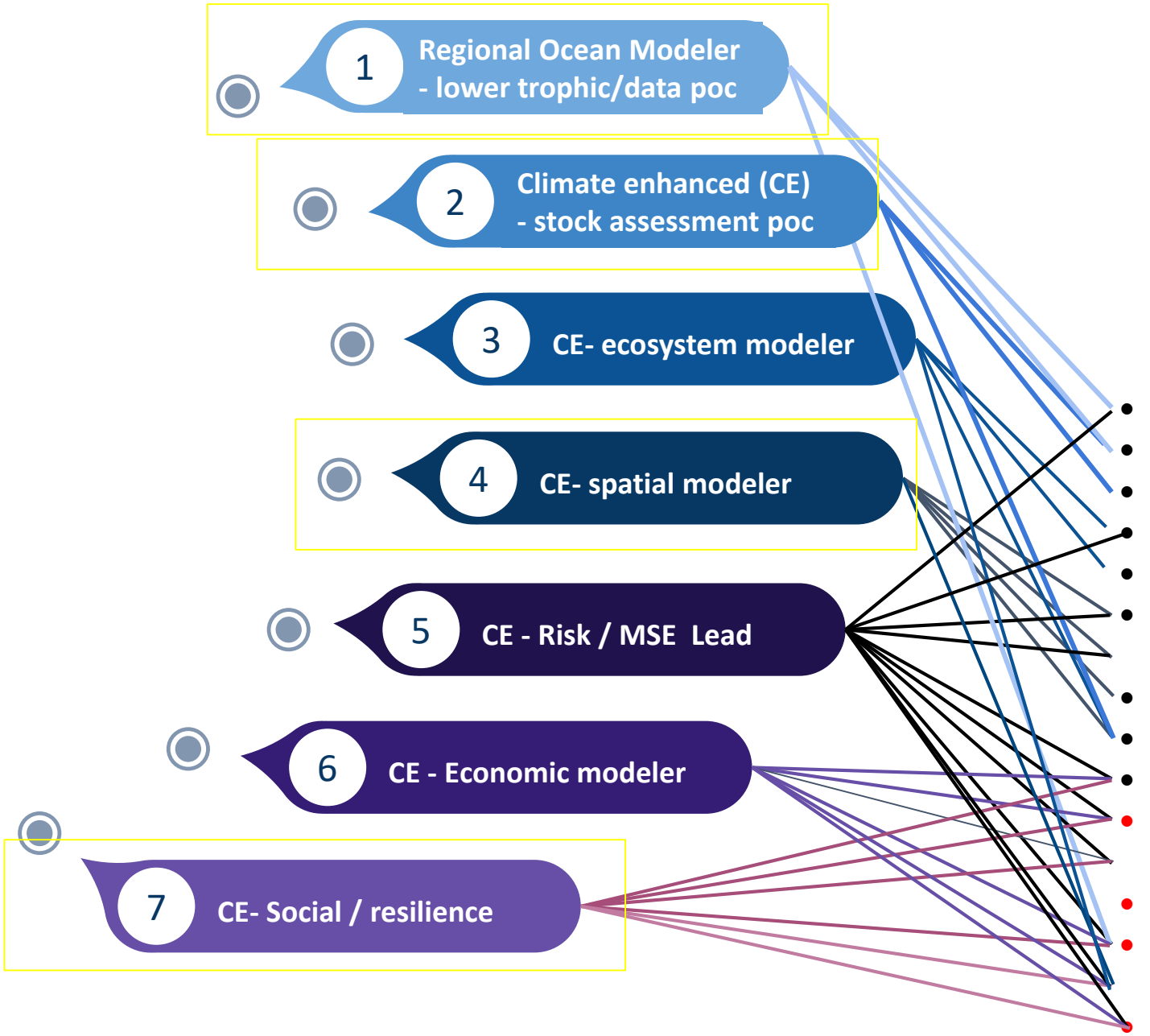

## Advice Pathways

- Stock Assessmts
- Socio-Econ Assessmts
- Ecosystem Assessmts
- Risk Assessmts
- Scenario Planning
- Strategy Evaluations

## Regional Applications

- Rapid responses
- Fisheries strategies
- Recovery plans
- Community adaptation

# How will the CEFI Decision Support Teams work?




**Examples of climate-informed decision support tools produced for/with existing SCenter programs**

- Eco-climate hindcasts, forecasts, projections
- Climate-linked stock assessments
- Climate-informed targets & reference points
- Risk tables
- Tipping point detection and risk
- Near-real time protected spp / bycatch risk maps
- Projected species hot-spots
- Future climate refugia (spatial)
- Species risk profiles
- **Management strategy evaluations & Community resilience strategies**
- **Adaptation feasibility & effectiveness analyses**
- **Contingency and emergency planning and response**
- **Dynamic management tools**

# SE Region CEFI Updates

Developments still in progress:

- **SEFSC/SERO:** SE Decision Support Team, 4 positions, mix of FTEs and affiliates: Regional Ocean Modeler, Climate Enhanced (CE) Stock Assessment & Management Strategy Coordinator, CE Social/Resilience Modeler, CE Spatial Modeler

  - 6 initial projects: Development of climate-informed fishery management advice;
  - Development of climate indicators for inclusion in SEFSC Ecosystem Status Reports;
  - Stakeholder outreach and participatory research on social-ecological systems;
  - Understanding and predicting management implications of species distribution shifts;
  - Design climate-ready surveys in partnership with the NEFSC to furnish data for the CEFI East Coast Regional Ocean Modeling Team;
  - Coral conservation - OA and temperature projections