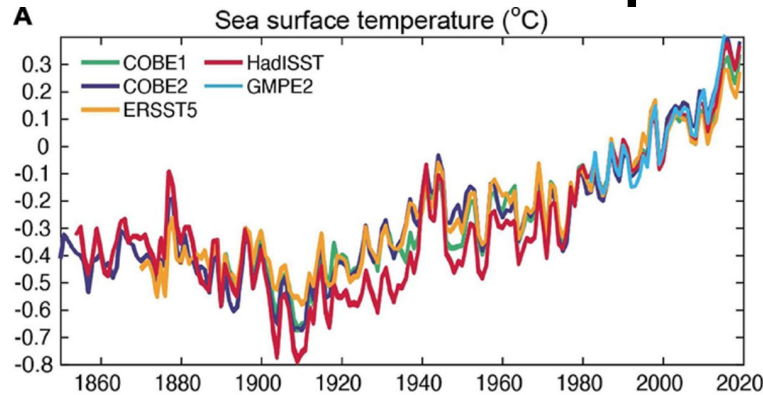


# Building a Climate change appendix for the PFMC's California Current Ecosystem Status Report (ESR)



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# Why?

## Ecosystem Advisory Subpanel, March 2021, Agenda item I.2.b, Supplemental EAS Report 1

*It could prove helpful to evaluate which indicators in the California Current Ecosystem Status Report are sufficient and useful for tracking the effects of climate change and whether there is need to develop new or different indicators as part of this initiative or as part of the California Current Ecosystem Status Report process. A project or process led by the EAS/Ecosystem Workgroup or another Council group could focus on user/managerial indicators – as opposed to just Scientific and Statistical Committee-vetted indicators – around climate. Such a process could be revisited every 3-5 years to keep pace with climate change.*

# How?

1 . Creation of ESR climate change appendix:

First version, March 2022, written by subset of the IEA team.

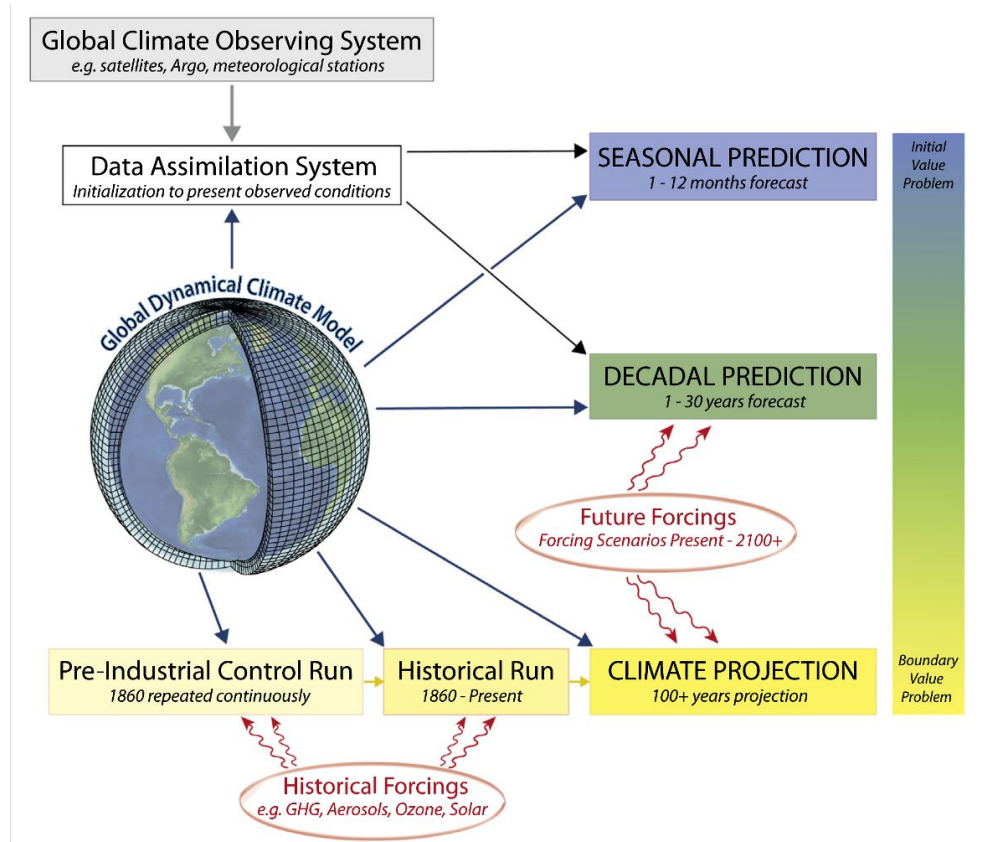
[\(https://www.pcouncil.org/documents/2022/02/h-2-a-cciea-team-report-1-2021-2022-california-current-ecosystem-status-report-and-appendices.pdf/\)](https://www.pcouncil.org/documents/2022/02/h-2-a-cciea-team-report-1-2021-2022-california-current-ecosystem-status-report-and-appendices.pdf/)

2. Series of meetings with larger IEA climate team (biweekly from June-Sept)

3. Presentation of “what can we realistically do?” at Sept. council meeting

4. Revised appendix for March 2023 council meeting (as part of ESR)

# What? Prediction vs Projection



# Prediction vs Projection

Skill is assessed differently for predictions and projections

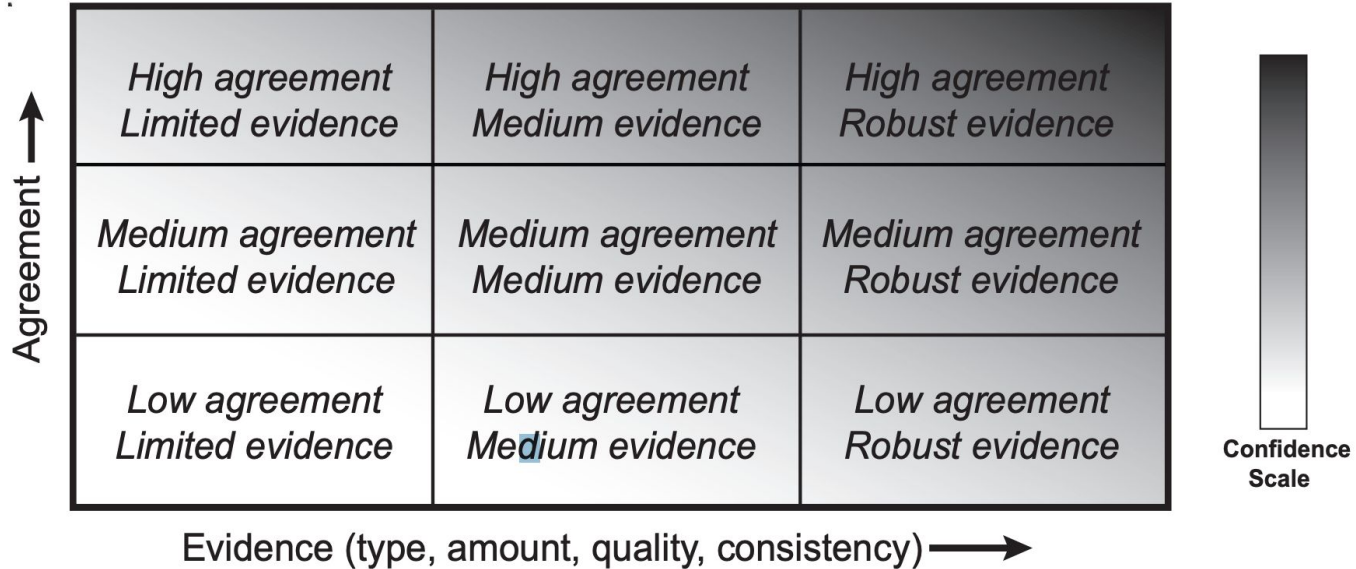
## Climate Predictions

- Retrospective forecasts enable **quantitative skill assessment** – test how well past conditions could have been predicted

## Climate Projections

- **Model evaluation** - Can the model represent the historical climate mean state and variability?
- **Model evaluation** - Can the model represent key processes governing climate sensitivity
- **Uncertainty** - How confident are we in the direction of change due to the forced climate signal?

# Introduction Summary: Confidence/Uncertainty



**Figure 1:** A depiction of evidence and agreement statements and their relationship to confidence. Confidence increases towards the top-right corner as suggested by the increasing strength of shading. Generally, evidence is most robust when there are multiple, consistent independent lines of high-quality evidence.

(source: IPCC AR5)

# Introduction Summary: Confidence

Table E1: Examples of expected estimates of forecast confidence for different types of indices.

Confidence level: **High Confidence**, **Moderate Confidence**, **Low Confidence**

Index	Description	Nowcast/ hindcast	Seasonal Forecast	Decadal Forecast	Climate Projection
Type I	Very well sampled, most dynamics understood (i.e. some physical indices), model can reproduce historical patterns, high retrospective forecast skill	High Confidence	Moderate Confidence	Moderate Confidence	High Confidence
Type II	Well sampled, some dynamics understood, impacts of long-term change can be estimated (i.e. some biological and biogeochemical indices), model can reproduce historical patterns, some retrospective forecast skill	High Confidence	Moderate Confidence	Low Confidence	Moderate Confidence
Type III	Not well sampled (hard to conduct or delayed sample processing), dynamics poorly understood (i.e. many biological and fisheries indices)no/low retrospective forecast skill	Moderate Confidence	Low Confidence	Low Confidence	Low Confidence

# Prognosis: what a climate appendix could be -

## Three sections:

- 1. Operational Part, “On Tap Indices”:**
  - > Presentation of tried-and-true indices, high confidence, vetted
- 2. Hot-Topics:**
  - > Indices to address current issues, may or may not be vetted
- 3. Cutting Edge:**
  - > Presentation of newly developed items that might be useful for future work, e.g. bring new items to the table to see if council has interest



# Example: “On Tap” indices

Index	Type of Forecast	Requirements
Habitat Compression Index	Not currently done, but could be if coupled with forecast models (e.g.WCOFS)	Effort to link to forward models
Groundfish SDMs	to 2100 with various model forcing	Needs input on species focus and metrics to track
CPS SDMs	to 2100 with various model forcing	Needs input on species focus and metrics to track
WCOFS	physical data, possibly some biological, days to weeks	operational
JSCOPE	phys and bio data, days to months	operational

\*NOTE: various indices may have additional requirements in terms of funding for those that produce/update etc. the data

# Example: “Hot Topic” indices

Index	Type of Forecast	Requirements
Heatwave index	days to a week, based on trends, several months using MJ forecast tool	web maintenance
HMS distributions	Projections, no plan on regular updates. Projections to 2100	evaluation of modeled results
port responses to climate	Backwards-looking, shock/event specific, no plan on regular updates	linkage to forward models

# Example: “Cutting edge” indices

Index	Type of Forecast	Requirements
Environmental Niche Affinity	could generate short term (1-2 year) forecasts via time series models with high confidence	linking with models
Sardine Subpop habitat	Projections, no plan on regular updates. Model development and evaluation on historical period relied on obs and ROMS reanalysis/ROMS-NEMURO hindcast, up to 2100	model evaluation
PNW contribution to sardines	""	""
albacore habitat	Projections, no plan on regular updates. Model development and evaluation on historical period relied on obs and ROMS reanalysis/ROMS-NEMURO hindcast, up to 2100	model evaluation
Climate envelope, novel habitat	Projections, no plan on regular updates. Input from UCSC ROMS/NEMURO downscaling	evaluation of model results

# What do we currently have in the ESR?

Index	Source	Currently Forecasted?	Forecastable?
ONI	NOAA climate center/ERDDAP	no	with ROMS
PDO	Mantua	no	with ROMS
NPGO	DiLorenzo	no	with ROMS
CUTI	Jacox	no	with ROMS
BEUTI	Jacox	no	with ROMS
HCI	ERDDAP	no	with ROMS
O2 at NHL	NWFSC	no	JSCOPE?
Aragonite NHL	NWFSC	no	JSCOPE?
Snow water Eq		no	??
NW Stream Flow		no	??
Copepods and Krill	NWFSC	no	NO
Forage Dynamics	NWFSC/SWFSC trawls	no	SDMs?
Juvenile Salmon	NWFSC	no	??
HMS diets	SWFSC/NWFSC	no	SDMs of prey
Marmine mammals (pups)	SWFSC/NWFSC	no	SMDs or prey projections
Whale entanglement		no	HCI or other
Seabird abundances		no	???
HABS	SWFSC/NWFSC	no - model nowcast	with ROMS etc.
Fishery landings		no	with SDM projections
Appendix materials: additional basic physical properties	NWFSC/SWFSC	no	with ROMS etc.

# Take home messages

1. We have a lot of indices that are **not** forecast, ***but could be***
2. We rapidly identified that we have some very short term *predictions*, and many long term *projections*, but few if any ***medium range predictions*** (1-2 years)
3. We have people that would like to tackle some of this work
  - a. They don't have time (retask? How? New money?)
  - b. Need to connect fishery sci with modelers (academic)
4. ***Scale your expectations accordingly***