Comparing large-scale environmental indices used as covariates in Pacific salmon models

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Our Journey So Far

Improvised data mgmt. approach for a large project
- Survey data for Yukon Chinook run reconstruction
- 40+ stock surveys
- 30 contributors from 11 organizations

Why did it work so well?

Human-centered design of information systems (IS)
- In real world, most IS don't work as promised
- Design should make it easy for people, not optimal for computers

How to share the ideas?

Worked Example: Open-source data repository of env. covariates (**PSEC**)
- 9 data sets
- 58 usable covariates
- Version control
- Data descriptions
- Discussion threads

What next?

- Explore the data sets
- Expand coverage
- Streamline data updates
- Improve metadata
- Resolve open questions

Most Fun … *Least Fun*

So Many Questions, So Many Variations

What is the biological rationale?

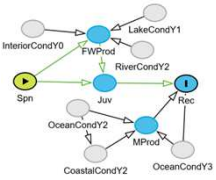
Which one?	Which version?	Which covariate?	Match up How?	Response Variable?
PDO	**ER SSTv5**	Mean of Nov-Mar	Winter Before Ocean Entry	Total adult Recruits
NPGO	**OI SSTv2**			
MEI	**NCEI**	Sum of May-Sep	Summer of Ocean Entry	Smolt to Adult Survival
NPI	**Mantua**			
ONI	Others			
Etc.				

Without understanding the causal pathways:
- Correlations and autocorrelations can mess up estimates
- Forks and colliders in pathways can mess up estimates
- Inconsistent results across publications can't be resolved
- Models break down when indices head into uncharted territory

Tools

Rubber duck technique

DAGs for causal inference



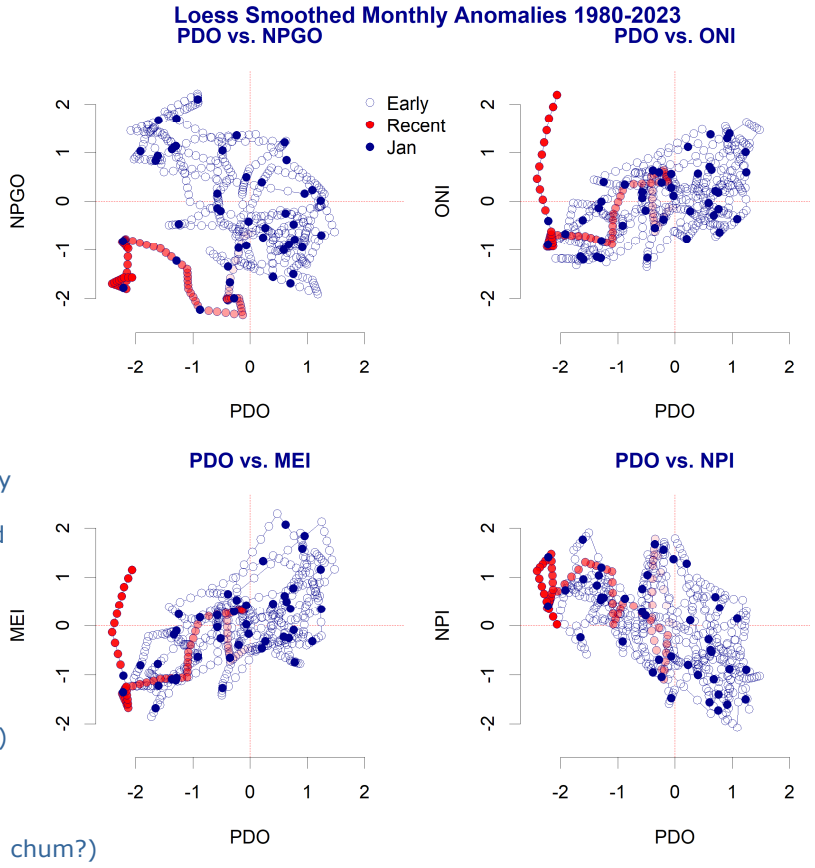
Make the data tangible

Go to the repo for explanations, data, code, references, and to leave comments

solv-code.github.io/PacSalmonEnvCov

Deep Dive into Large-Scale Ocean Indices

INDEX	DESCRIPTION
MEI	Multivariate El Niño-Southern Oscillation (ENSO) Index. Combines pressure, sea-surface temperature (SST), wind, and radiation.
NPGO	North Pacific Gyre Oscillation. Uses sea surface height variations as a proxy for nutrient fluctuations that affect primary production.
NPI	North Pacific Index. Captures atmospheric pressure variations, which in turn are linked to sea surface temperature.
ONI	Oceanic Niño Index. Uses SST anomalies from running average (detrended) for the east-central equatorial Pacific
PDO	Pacific Decadal Oscillation. North Pacific SST anomalies relative to global avg SST.



Observations
- These indices are not independent variables, but they capture different aspects of ocean condition
- NPGO and PDO: negative corr. for ~40 years, started to flip 5-6 years ago
- ONI/MEI and PDO: positive corr. for ~40 years, started to flip last year
- NPI and PDO: negative corr. for ~40 years, may be starting to flip this year.

Approaches to consider
- Alternative derived covariates (e.g., loess smoothing)
- Alternative salmon-specific indices from components
- Dynamic downscaling (requires finer scale models)
- Statistical downscaling (observed relationships)
- General guidelines (High-altitude sockeye vs. coastal chum?)