

Seasonal to multi-annual marine ecosystem predictions

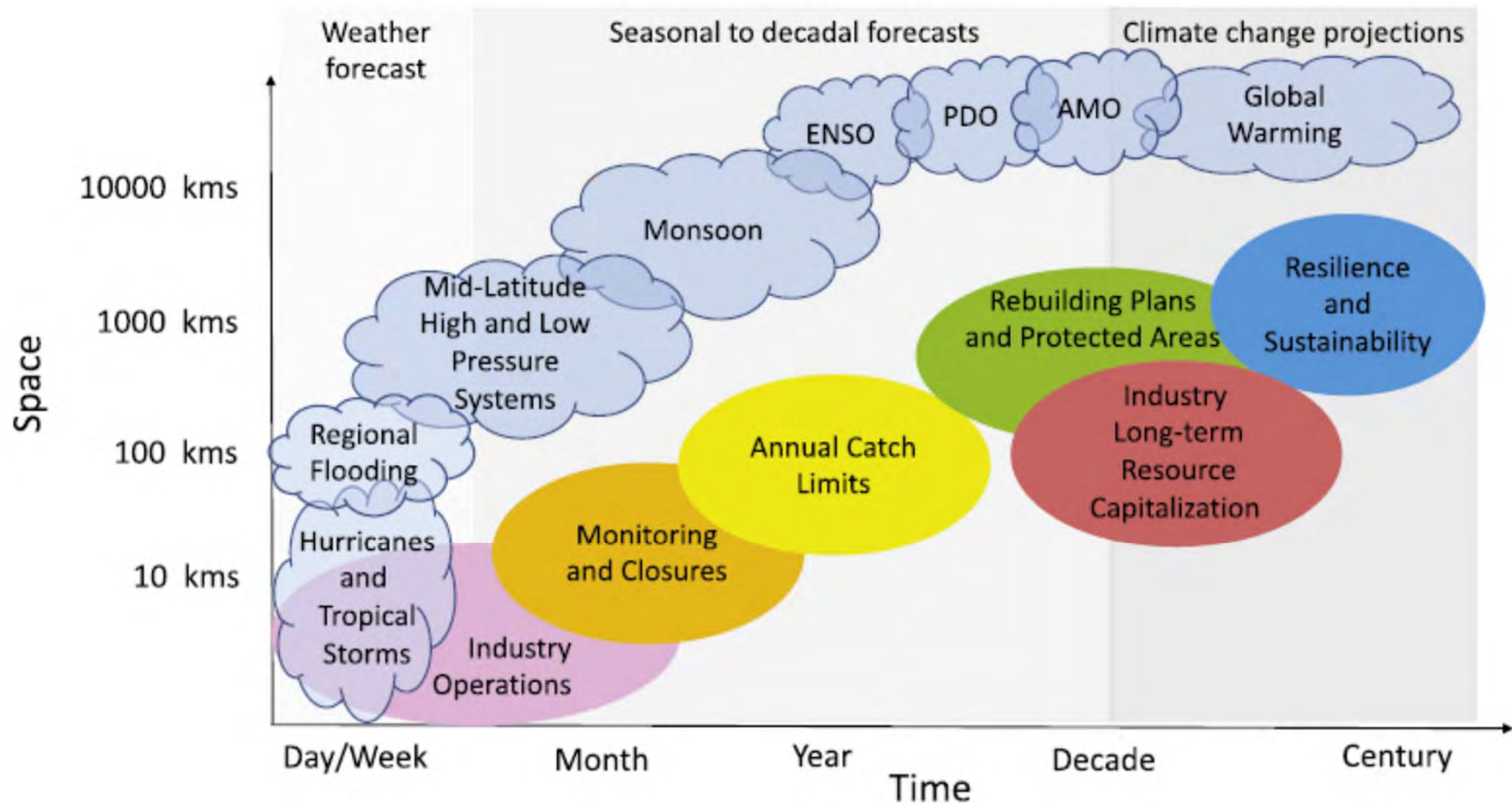
Presented by Charles Stock

Geophysical Fluid Dynamics Laboratory Review

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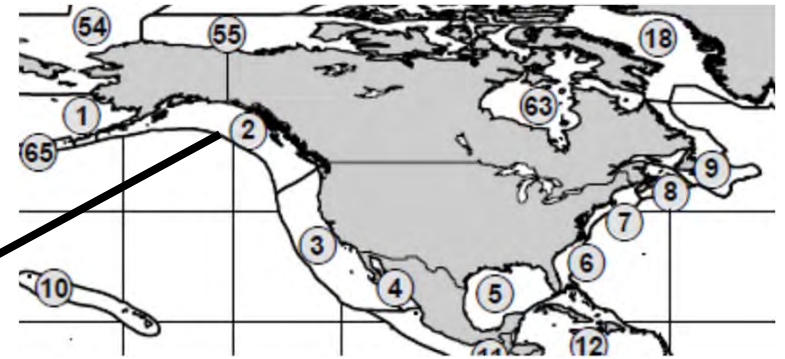
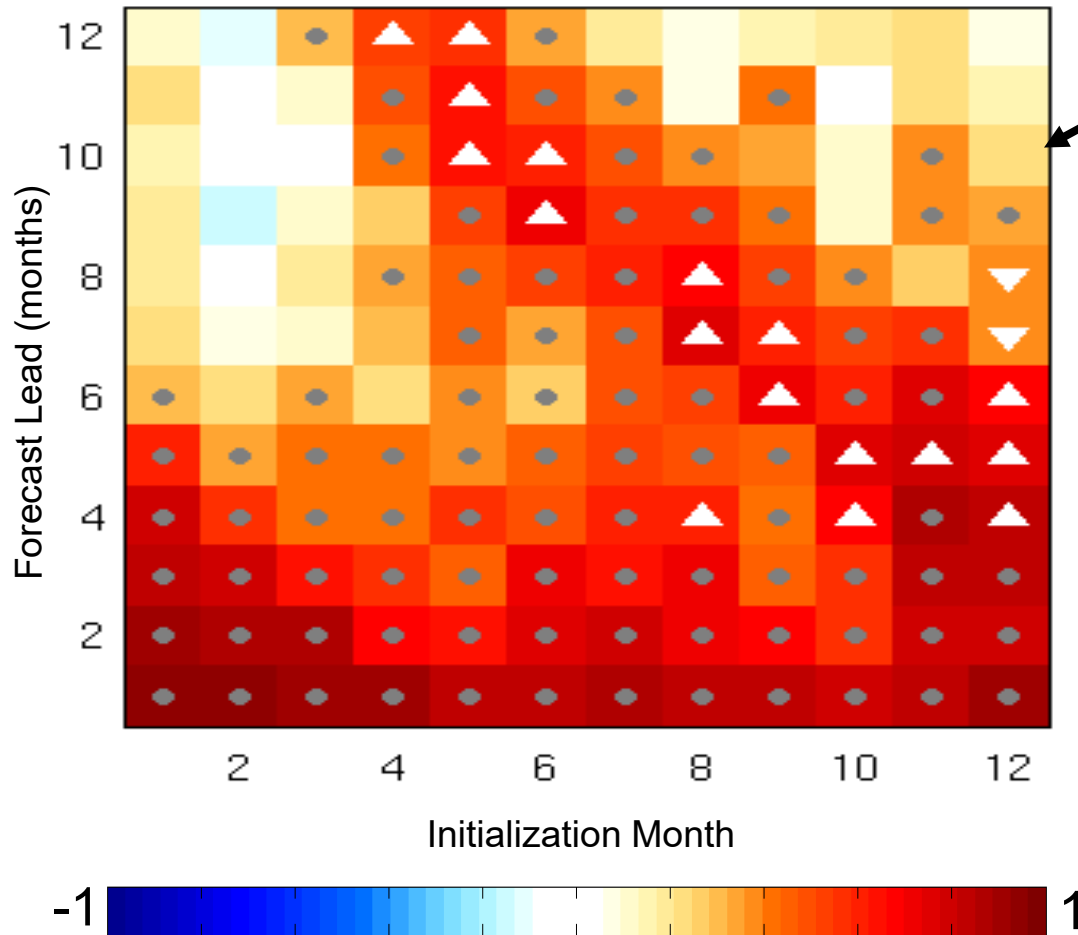
Marine resource decisions across time scales



Tomassi et al., 2017. Managing living marine resources in a dynamic environment: the role of seasonal to decadal climate forecasts. *Progress in Oceanography*, 152, 15-49.

Seasonal SST anomaly predictions coastal ecosystems

Gulf of Alaska SST prediction

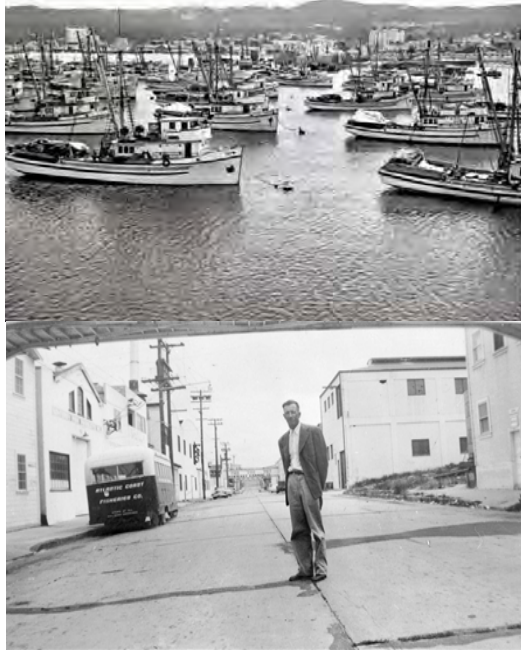


- Significant ACC
- △ Significant ACC (> 0.5) that also significantly exceeds persistence
- ▽ Significant ACC (< 0.5) that also significantly exceeds persistence

Stock et al. 2015. Seasonal SST anomaly predictions for coastal ecosystems. *Prog. in Oceanog.* 137. 219-236.

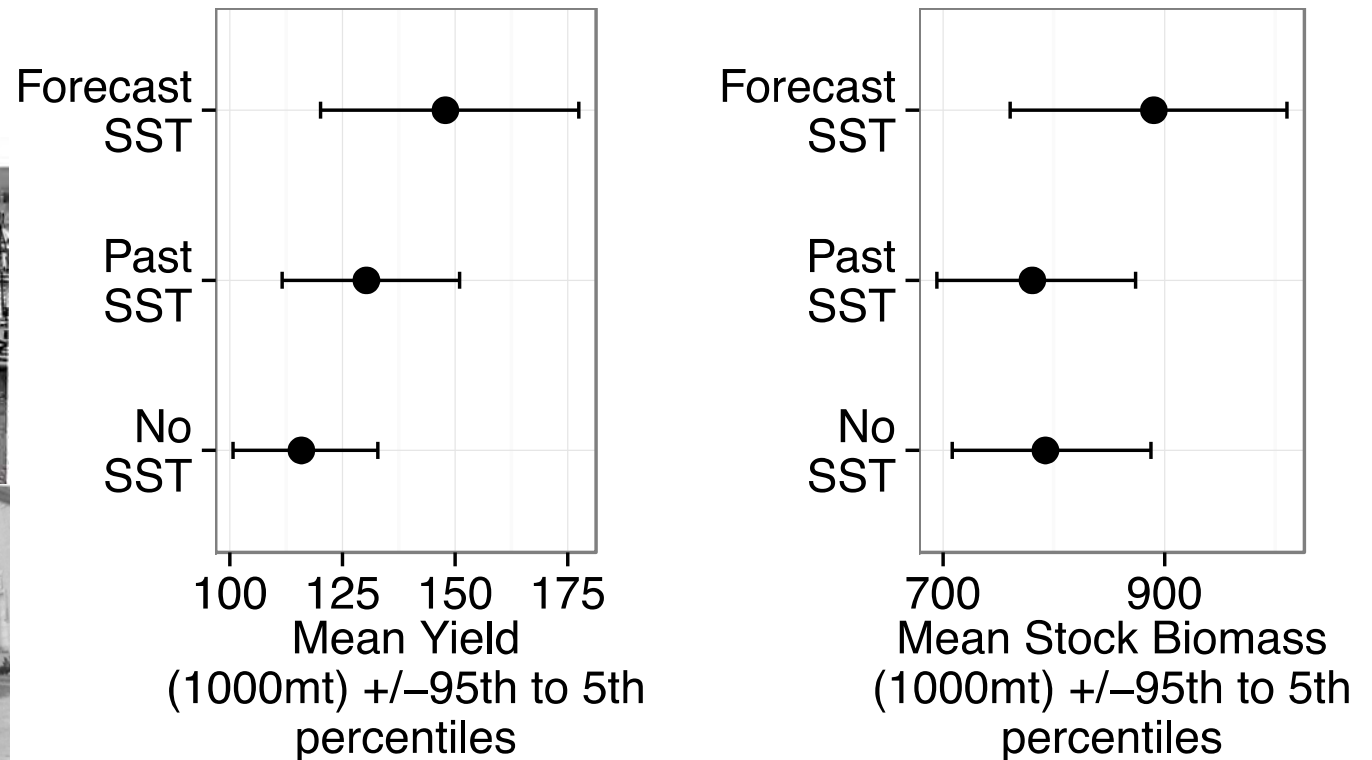
(also: Herveiux et al. 2017; *Clim. Dyn.*; Jacox et al. 2017. *Clim Dyn*; Jacox et al. 2019. *Frontiers in Marine Science*)

Higher yield & biomass w/dynamic management



End of an Era - Cannery Row.1950

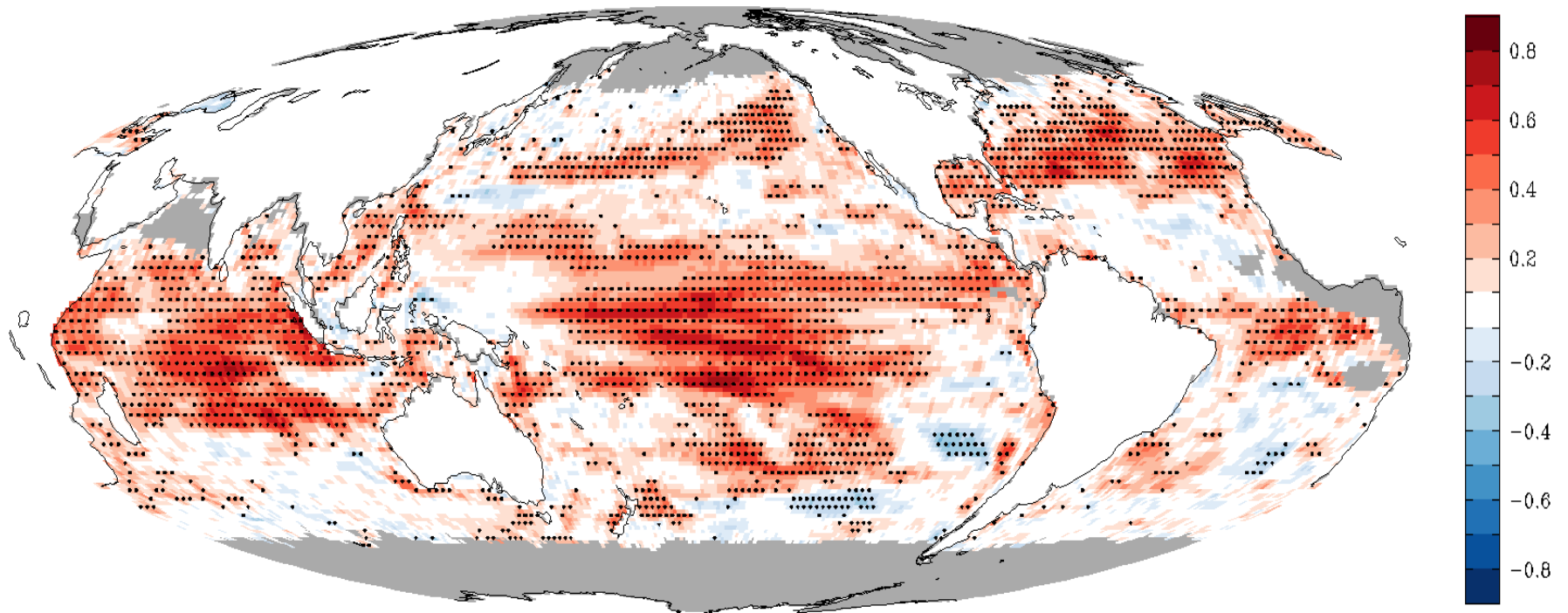
Pacific Sardine Yield and Stock Biomass



Tommasi et al., 2017; Improved management of small pelagic fisheries through seasonal climate prediction. *Ecological Applications*. 27 (2), 378-388

Predicting ocean ecosystems

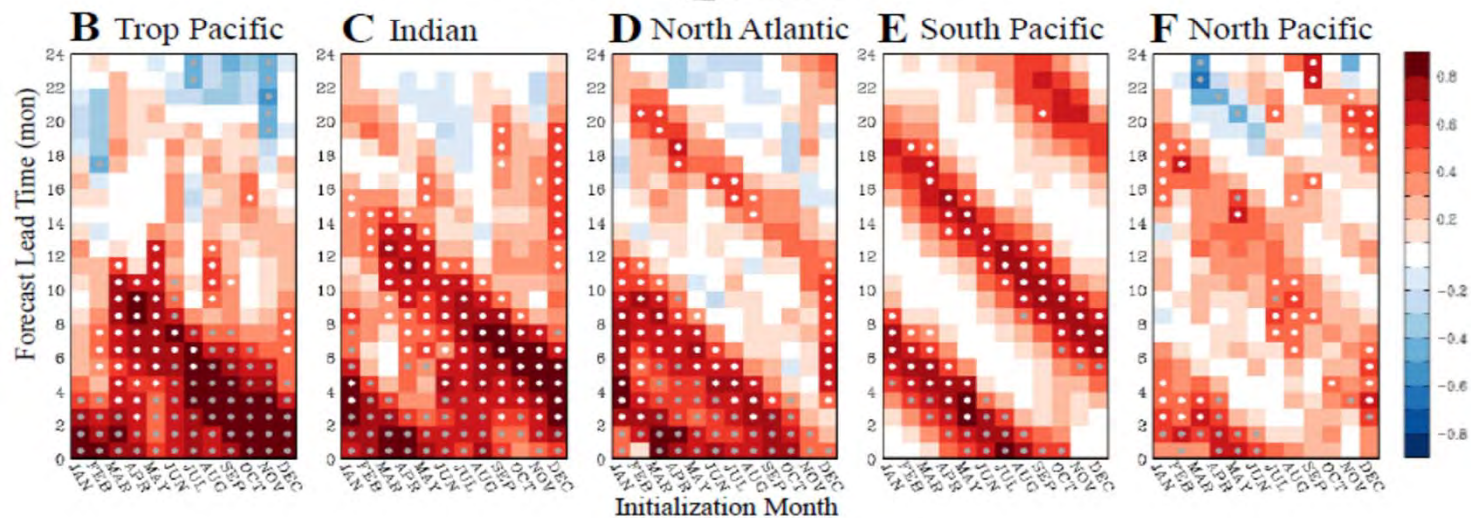
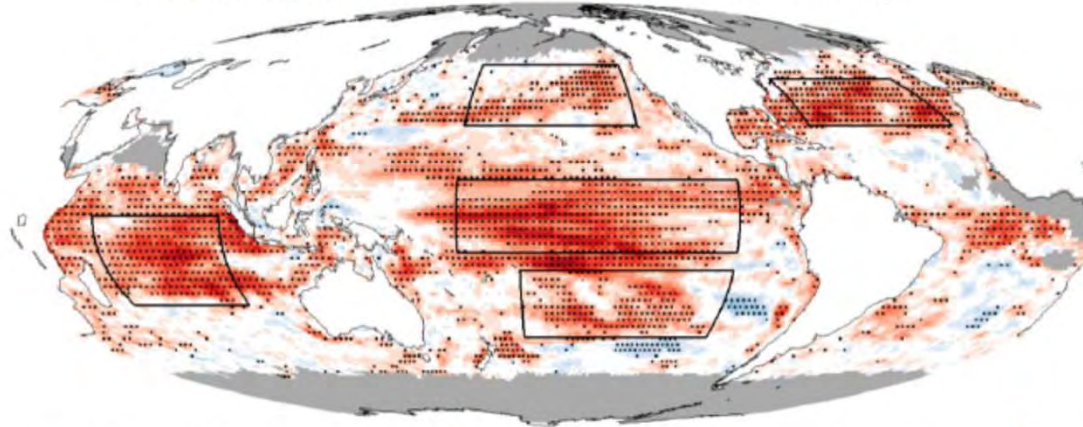
Chlorophyll anomaly prediction skill (1-3 month lead)



Park et al., 2019. Seasonal to multiannual marine ecosystem prediction with a global Earth system model. *Science*. 365 (6450) 284-288.

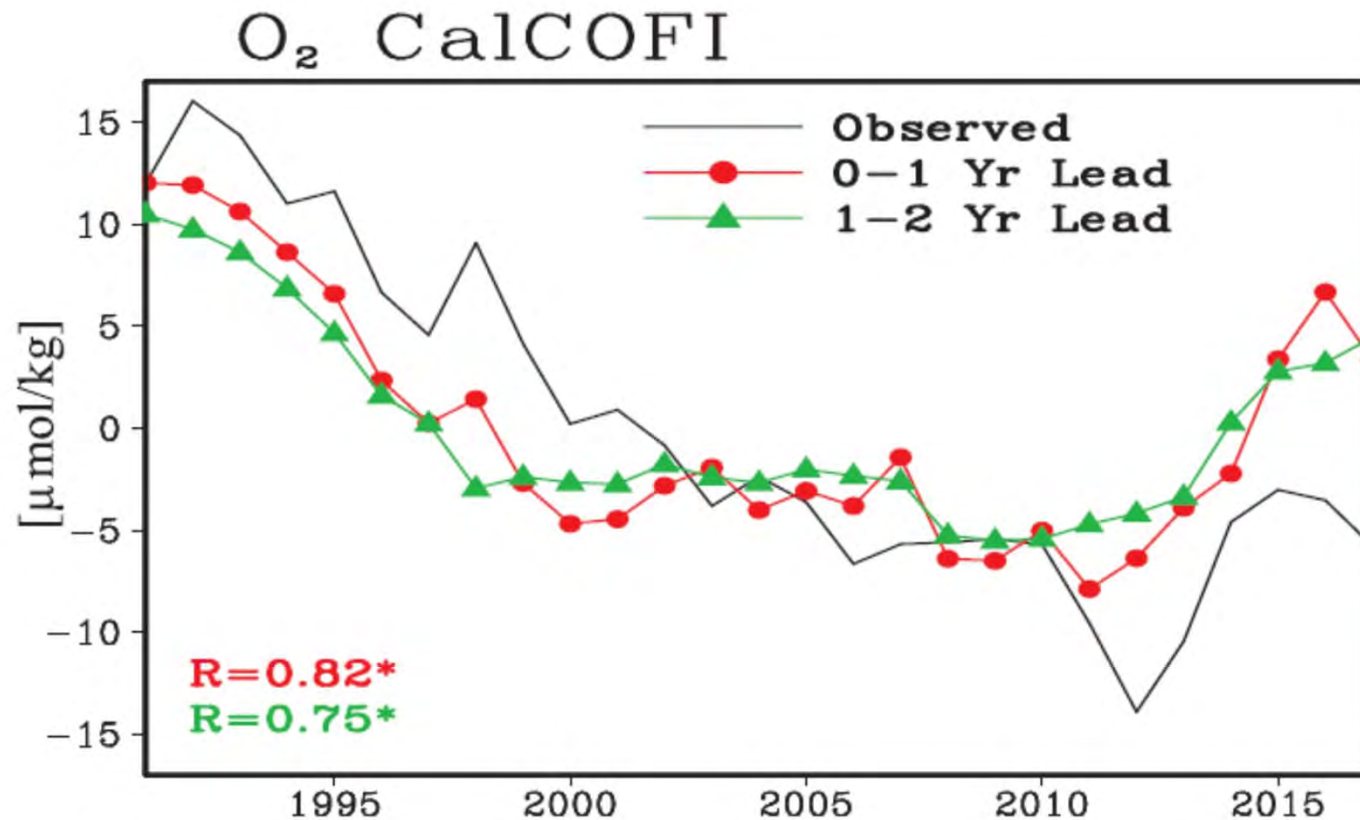
Skillful chlorophyll prediction beyond 1 year

A Chlorophyll Prediction Skill (Lead Time: 1-3 mon)



Park et al., 2019. Seasonal to multiannual marine ecosystem prediction with a global Earth system model. *Science*. 365 (6450) 284-288.

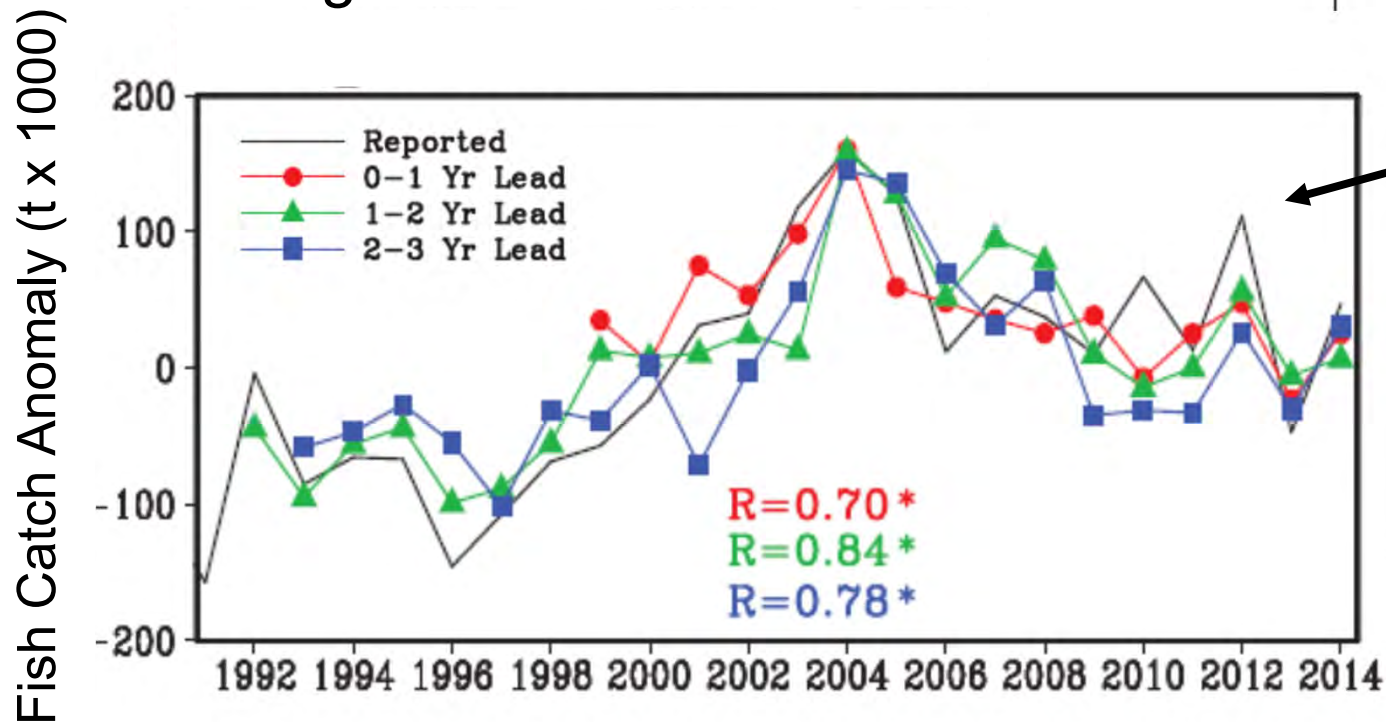
Extending to other ecosystem stressors



Park et al., 2019. Seasonal to multiannual marine ecosystem prediction with a global Earth system model. *Science*. 365 (6450) 284-288.

Sardines again, but this time with chlorophyll

Agulhas Current Fisheries Catch



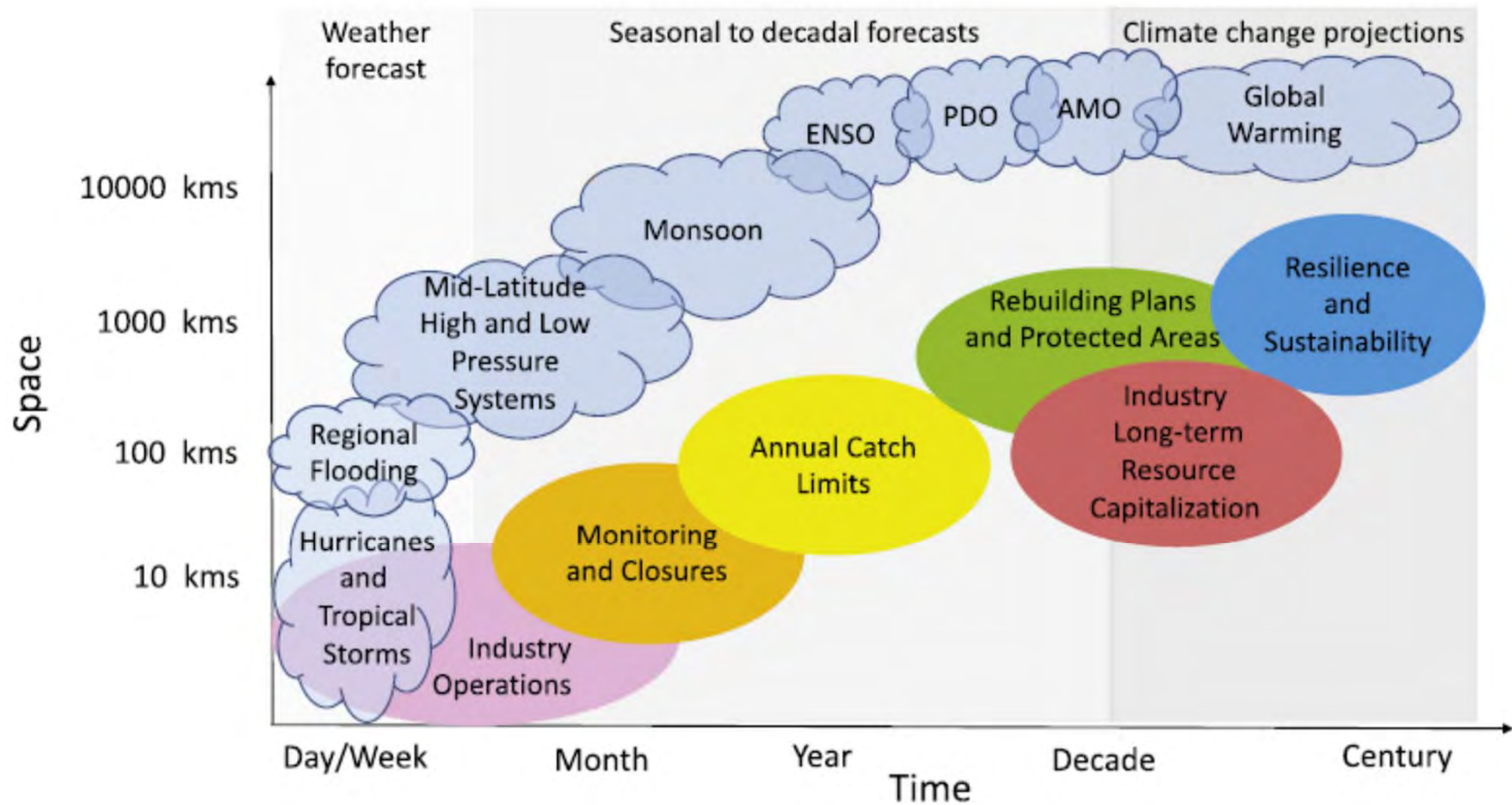
Park et al., 2019. Seasonal to multiannual marine ecosystem prediction with a global Earth system model. *Science*. 365 (6450) 284-288.

Future Plans & Challenges

- Integration of ocean biogeochemistry with SPEAR climate modeling system
- Biogeochemical data assimilation (ocean color, BGC-Argo)
- Downscaling to coastal ecosystems and estuaries
 - Ross et al., submitted. Estuarine forecasts at weather to subseasonal timescales. JGR-Oceans.
 - MOM6 regional capacity for shelf-scale predictions
- Multi-annual to decadal predictions to inform shifting fisheries ranges
 - Tommasi et al., 2017. Multi-annual climate predictions for fisheries. *Frontiers in Marine Science*.
 - Tanaka et al. (submitted). Prospects for prediction of multi-annual fisheries range expansion and contraction. *Ecological Applications*.



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