Climate change and wind intensification in coastal upwelling ecosystems

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 coastal upwelling systems = ~2% of the surface area of the global ocean, but provide ~20% of wild marine-capture fisheries



Regional upwelling



Ecological impacts: Why we care about upwelling

Optimal Environmental Window hypothesis

productivity



based on Cury and Roy 1989

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Need more nutrients



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Spatial variability in upwelling



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May 2014, Mendocino Head, CA



Eastern Boundary Current Systems



Global Climate Change and Intensification of Coastal Ocean Upwelling

Andrew Bakun

(1990)

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strengthening of the thermal Low \rightarrow

stronger pressure gradients \rightarrow

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differential heating of air over land relative to the ocean \rightarrow

strengthening of the thermal Low \rightarrow

stronger pressure gradients \rightarrow

more wind/upwelling

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Sydeman et al. Science July 4, 2014

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 represented analyses of 198 wind trend series from 1950-2010

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 H: Results "consistent" with Bakun's hypothesis:
 intensification of upwelling-favorable winds given global warming

 Metric: wind trends scored as consistent or inconsistent with BH

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- inconsistent = decrease in winds

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Variation in data sets:

- Eastern Boundary Current System
- "season" (annual or summer season)

 data type (observed measurements or re-analysis/modeled wind)

latitude of observation























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Upwelling-favorable winds are increasing
 Dependent on system and data type

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 Strongest results for California Current, where there is the most data