Climate Change & Coastal Upwelling Drivers

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Third International Symposium
Effects of Climate change on the World’s Ocean

\ Santos City, Brazil
\ March, 2015
bakun hypothesis

poleward migration of pressure systems

Bakun et al. 2015
Bakun, 1990

image by Bakun et al. 2015

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Trends consistent with Bakun hypothesis of increasing upwelling favorable winds

18 studies
187 records (non-ind)

+ others that support it
  + Barton et al. 2014
  + Cropper et al. 2014
  + Alves et al. 2013
  + Bylhouwer et al. 2013
  + de Castro et al. 2014
  + Jacox et al. 2014
  + Stocker et al. 2013
20th century reanalysis SLP climatologies

may-july

1940-2010

dec-feb

may-july

1940-2010

dec-feb
Surface Air Temperature trends, 1940-2010

may-july

\[ \circ{C}/\text{decade} \]

dec-feb
Sea Level Pressure trends, 1940-2010

may-july

dec-fcb

hPa/decade
Correlation SAT-SLP, 1940-2010

Correlation (SAT, SLP) – cali

Correlation (SAT, SLP) – humb

Correlation (SAT, SLP) – cana

Correlation (SAT, SLP) – beng

p < 0.05
poleward migration of pressure systems
Rykaczewski et al., submitted

Winds causes the upwelling season to start earlier, end later and last longer. The increase in coastal upwelling under climate change is also linked to conditions to upwelling regions, thus increasing...
wind trends by latitude in meta-analysis
- IPCC AR4 models (3rd generation)
- poleward expansion of hadley cells:
  - poleward displacement of subduction cells (ocean high pressure systems)
  - poleward expansion of mid-latitude dry zones (thermal low pressure systems)

Expansion of the Hadley cell under global warming

Jian Lu, Gabriel A. Vecchi, and Thomas Reichler

SLP climatologies for peak upwelling season

20th century reanalysis
SLP linear trends: 1940-2013

may

December

hPa/decade
decadal variability in pressure systems
correlation between wind and pressure systems

**OH:** ocean high pressure system

**CTL:** thermal low pressure system

García-Reyes et al., 2014
correlation between wind and pressure systems
summary

- bakun hypothesis:
  - consistent with data in last decades, but mechanism not supported

- poleward migration of pressure systems:
  - not observed in past data
  - large multi-decadal variability

- higher impact of eastern side of ocean highs
bakun hypothesis:
- consistent with data in last decades, but mechanism not supported

poleward migration of pressure systems:
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higher impact of eastern side of ocean highs

**next step:** change on coastal pressure gradients in relation to both pressure systems