

An Examination of Long-Term Upwelling Transition Date on the Oregon/Washington Coast

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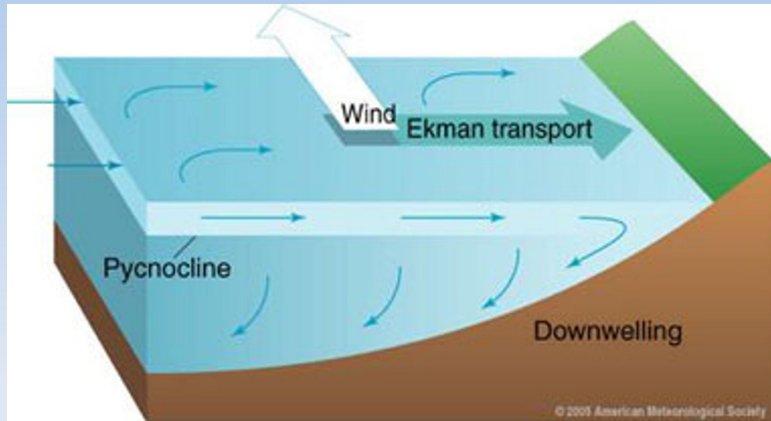
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Columbia River Estuary Conference

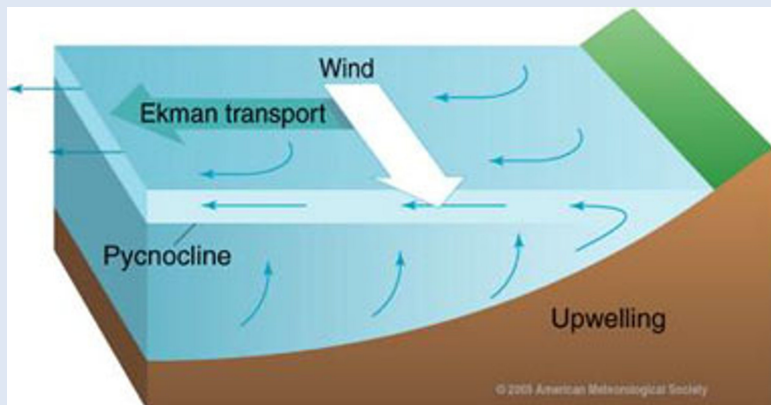
17 May, 2012

Upwelling and the Coastal Upwelling Index (CUI)

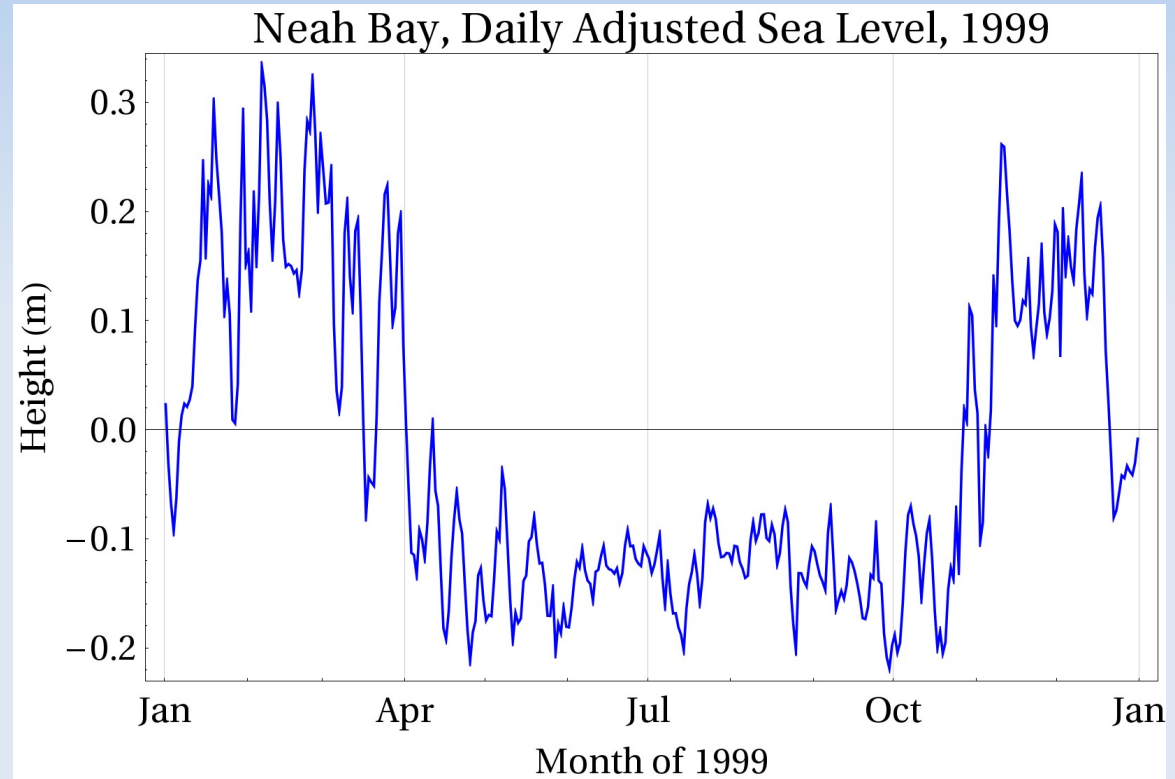
Downwelling



Upwelling:



Sea Level Response



Coastal Upwelling Index : Volume transport per 100 m of coast, in a local cross shore / along shore reference frame.

Background : Current Data and Methods

- High resolution (4 / day) CUI is currently limited to 1967-present.
- Estimates of transition dates are restricted to the same 1967-present time period.
- All methods of determining CUI transitions are somewhat subjective. Some years (even in the PNW) particularly problematic.

The purpose of this work is to extend time coverage, and reduce the need for judgement in determining transition dates.

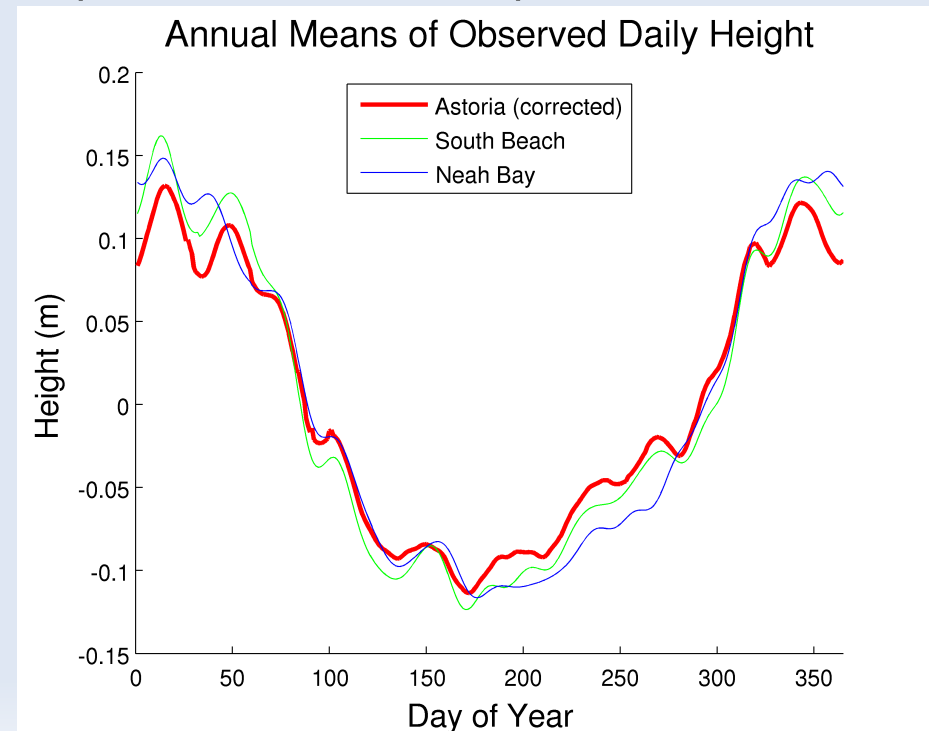
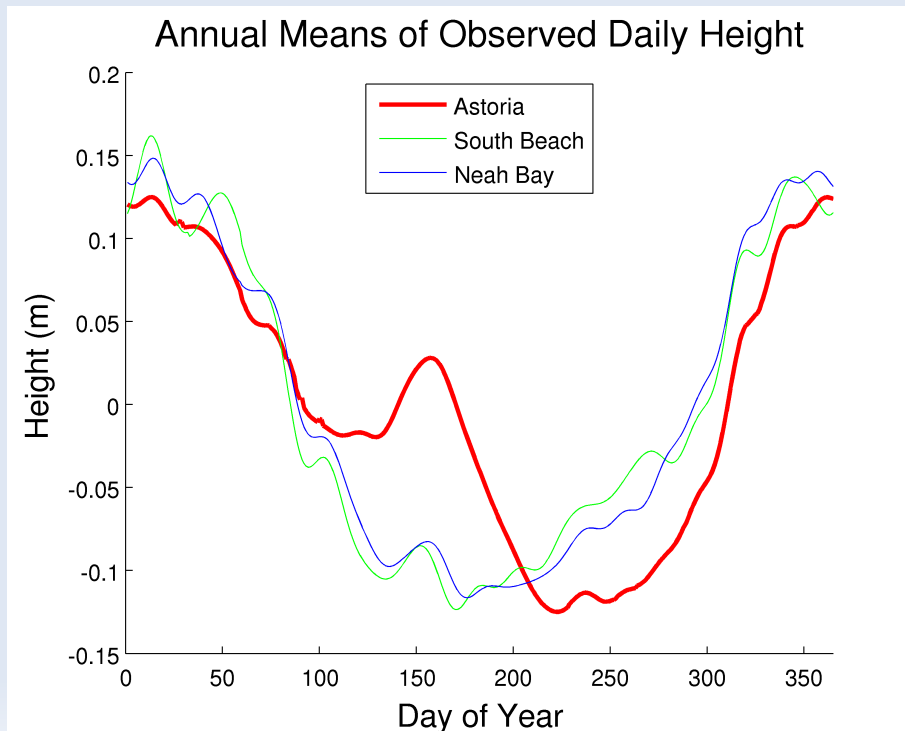
”New” data

- Tidal data (8 PNW stations with 75+ years of data).
- Columbia River Flow (1878 - present)
- 20th Century Climate Reanalysis, V2: most atmospheric variables, 4/day, 2 degree grid, 1871-2008 :

CUI may be computed from geopotential height or surface winds.

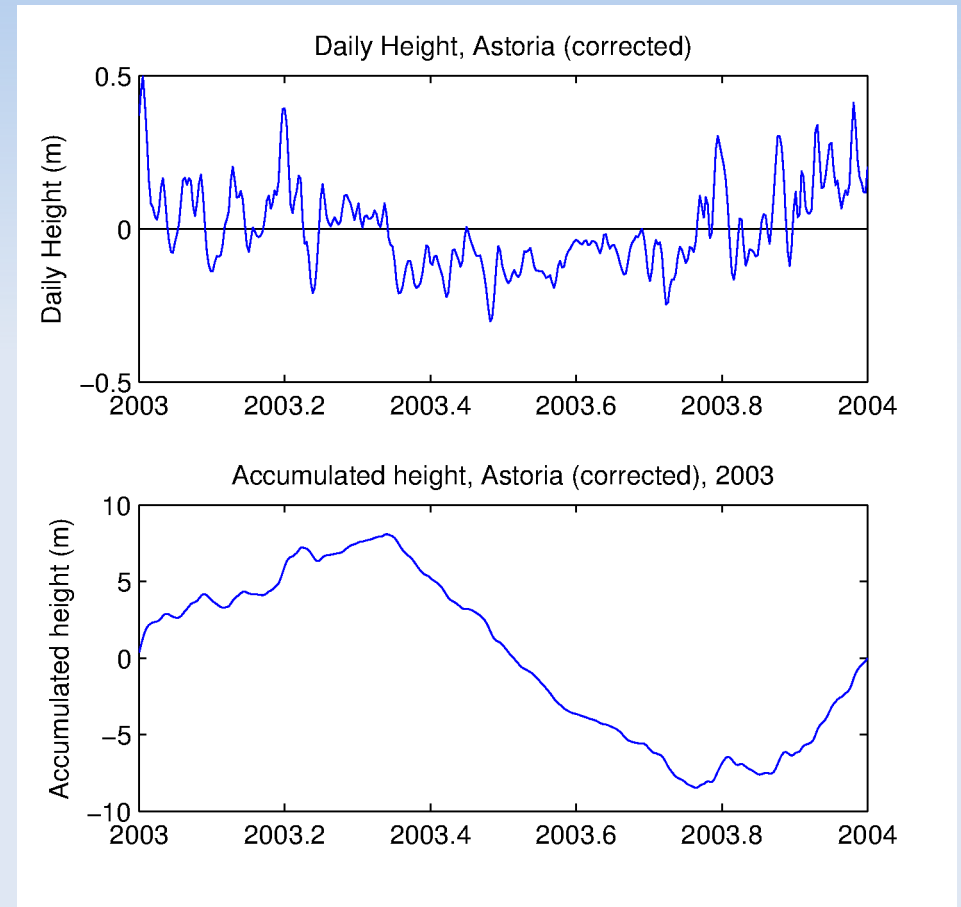
New Methods (1)

- Use an extended version of the model of Kukulka and Jay (2002a,b) to remove Columbia River flow effects from the Astoria tidal record
 - Height = Linear function of Flow, Cross-shore CUI, Barometric Pressure, Friction
 - Allows use of Astoria record (1925 – present).



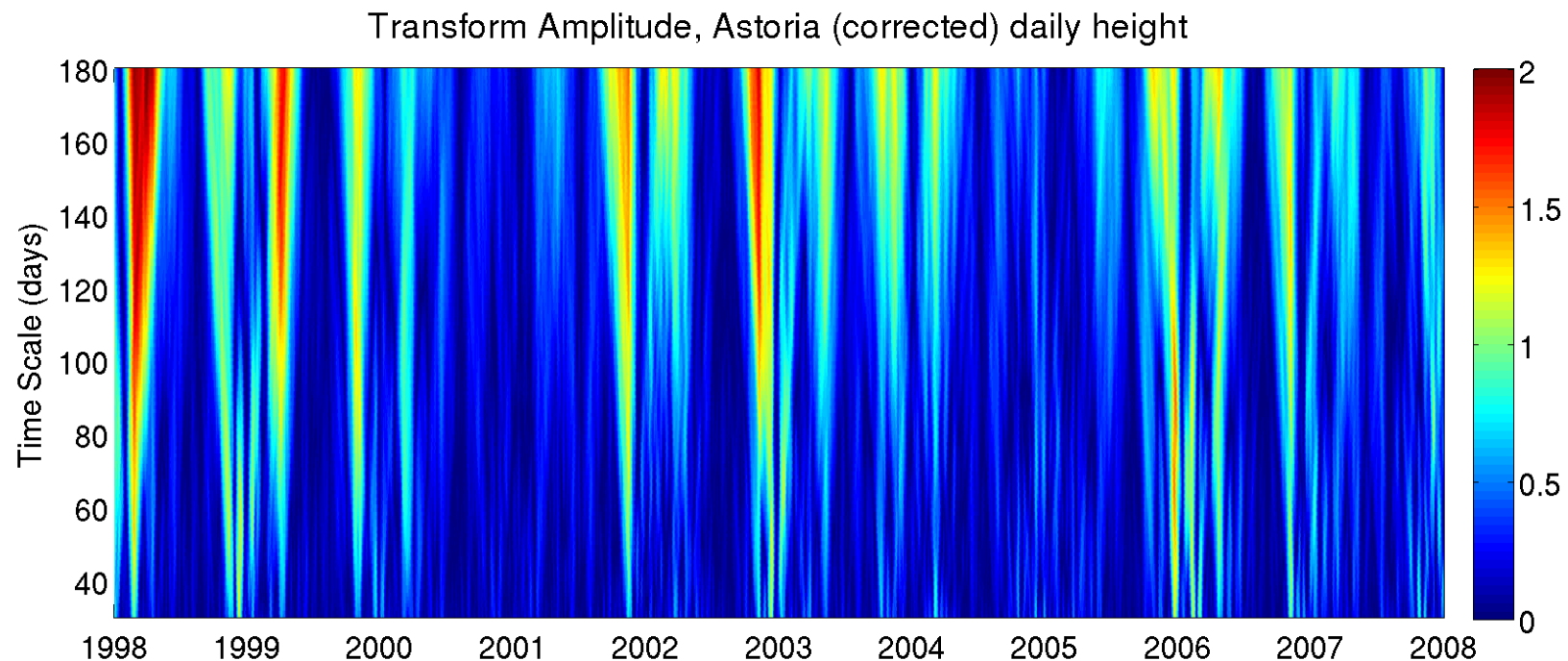
New Methods (2)

- Accumulated SLH, Cross-shore CUI
 - Transition dates are easier to determine from the accumulated signal.

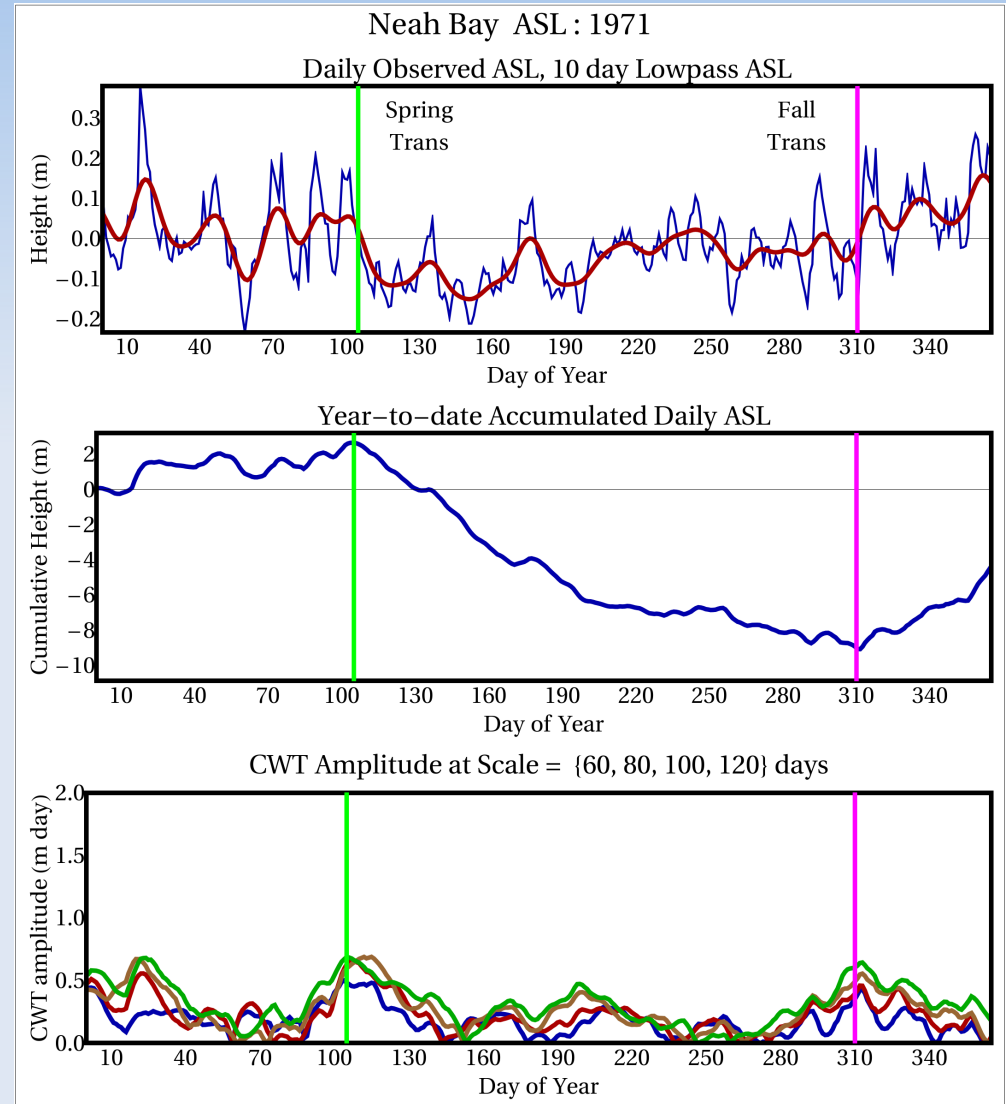
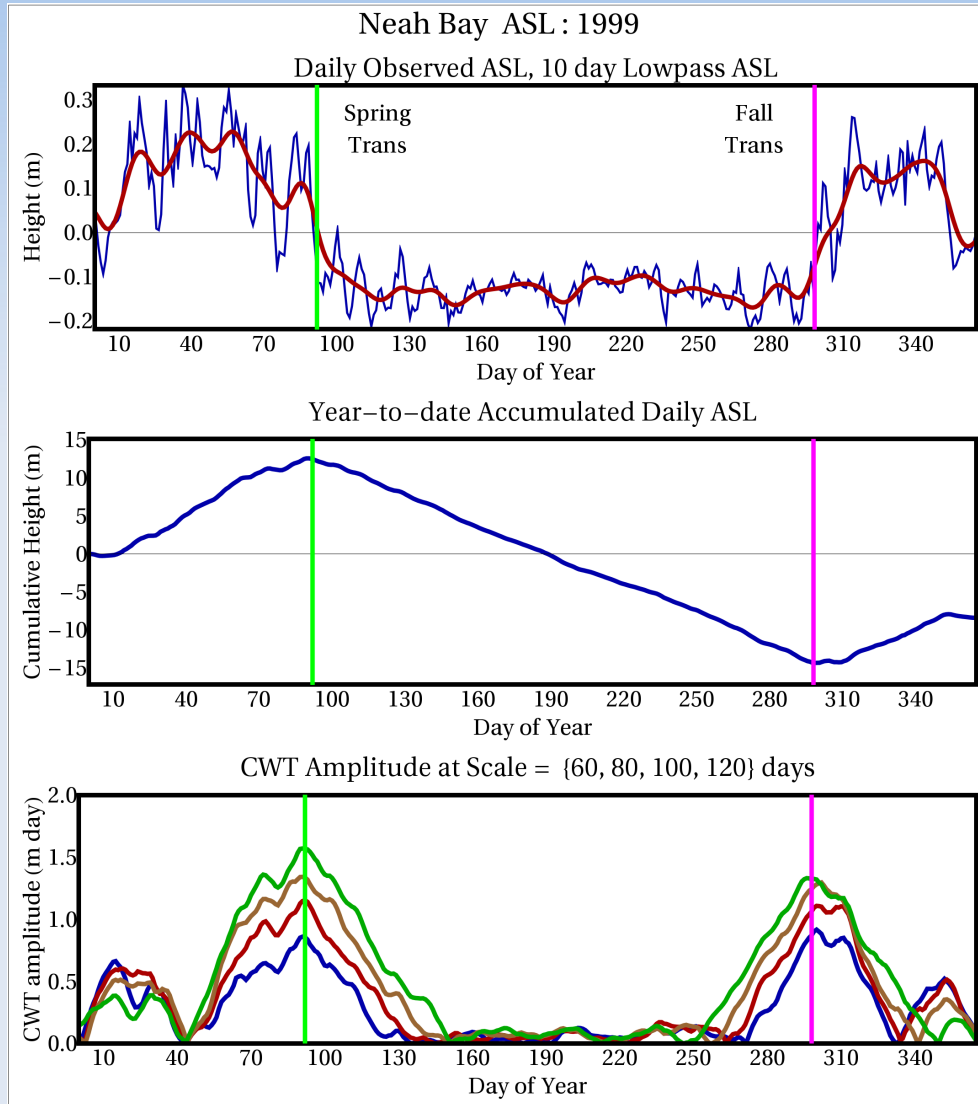


New Methods (2)

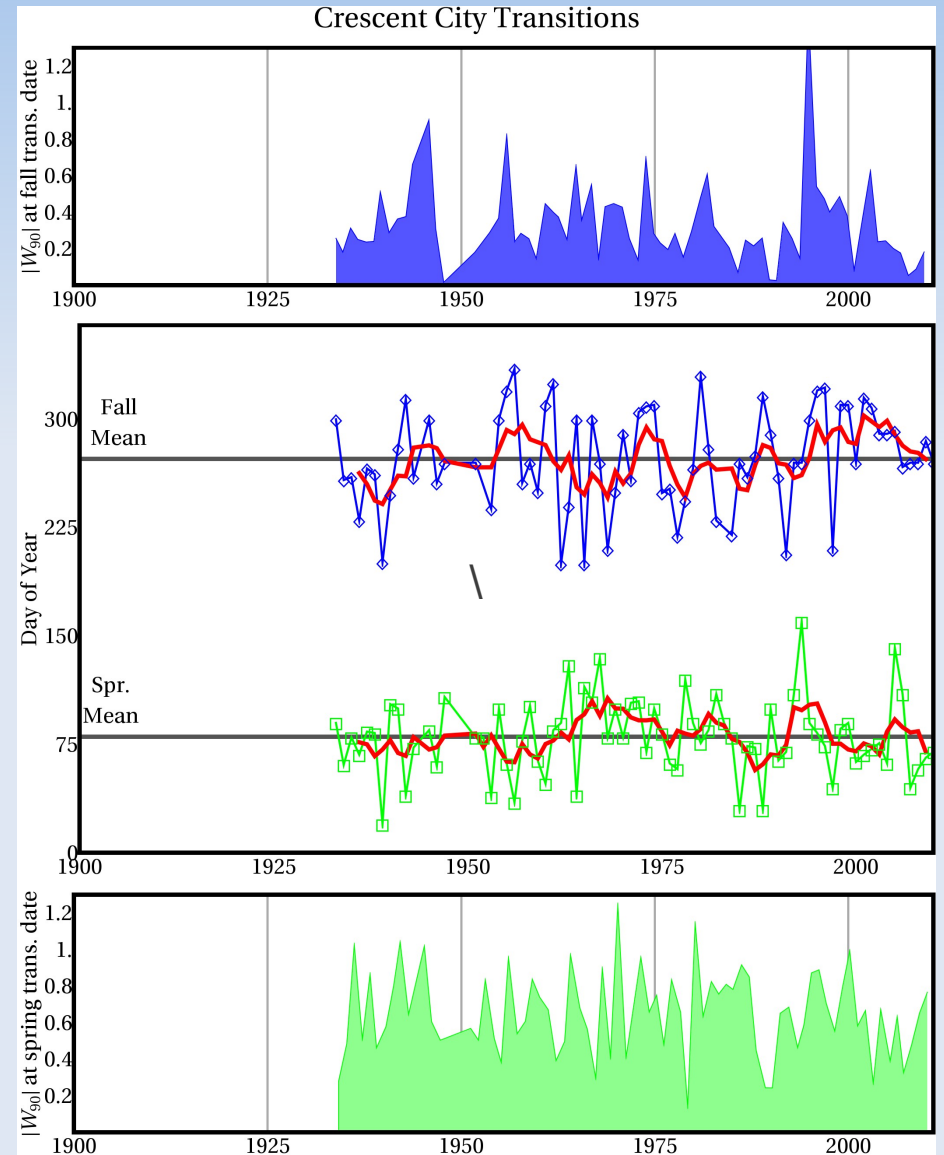
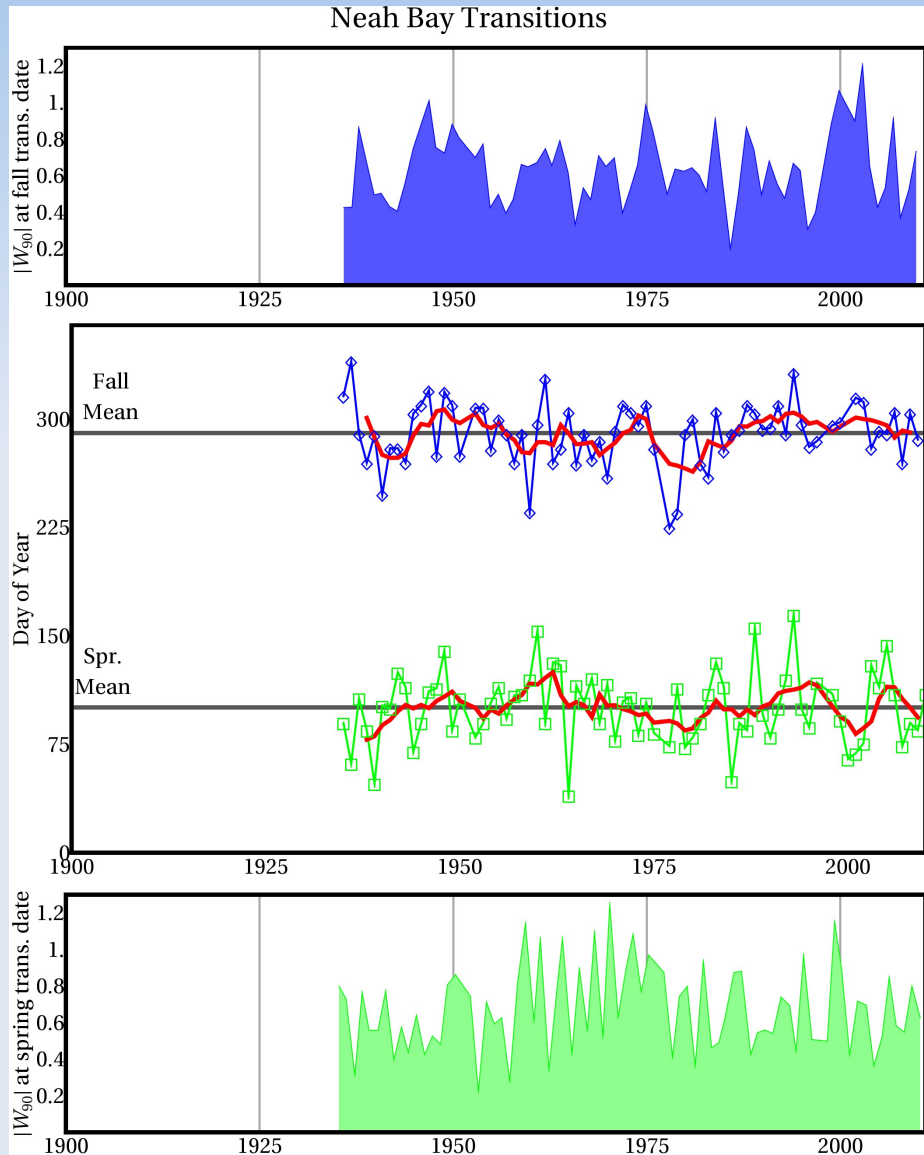
- Wavelet based method
 - A step-form "mother" wavelet produces high value for higher values for step-like changes in the signal.



Detection Methods : Strong and weak years.

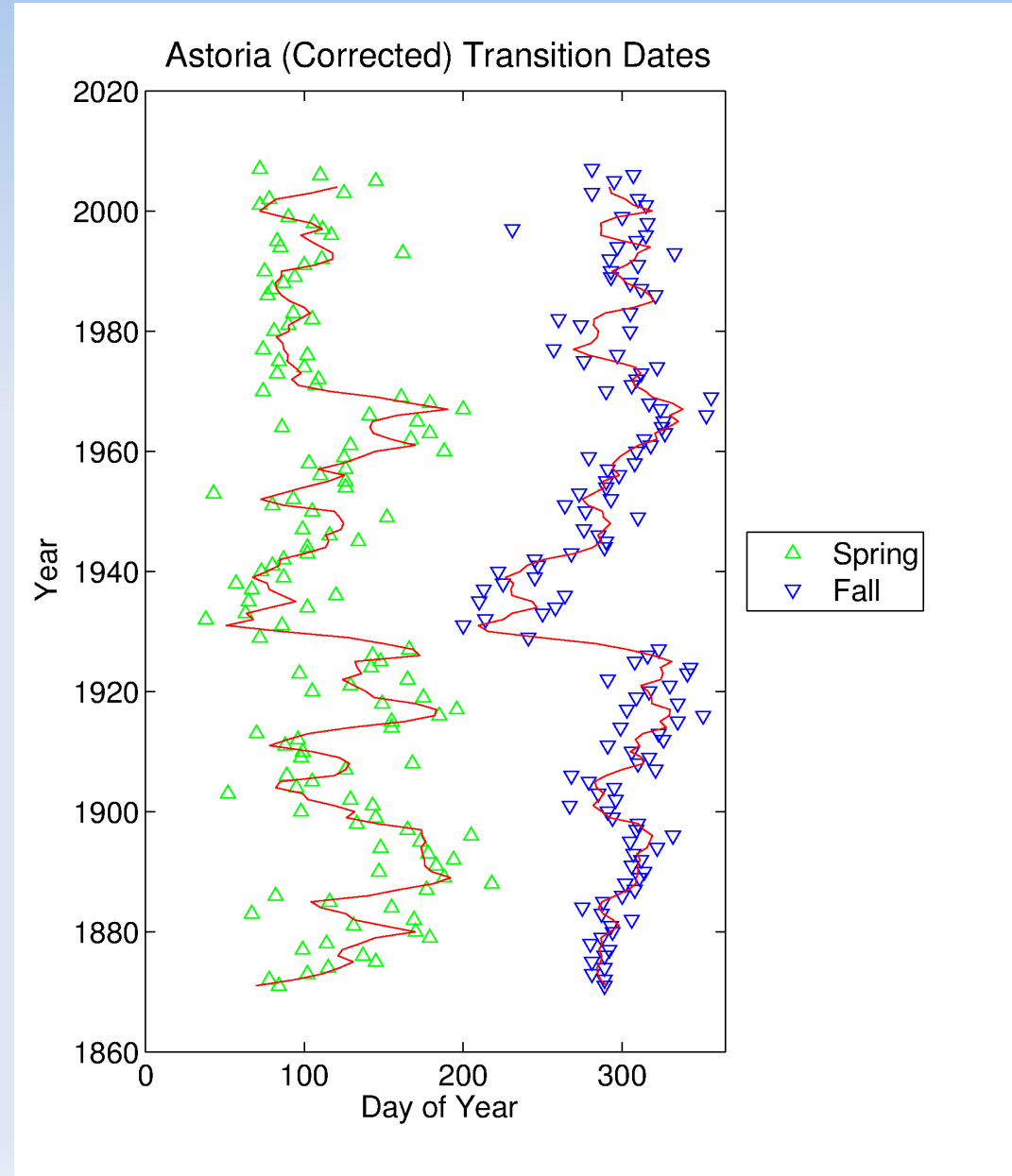


Synthesis : Long Term Upwelling Behavior



Synthesis

Estimated Spring and Fall
Transition dates, Astoria, Oregon



Synthesis

- An extension of the model of Kukulka and Jay allows removal of flow effects from the Astoria tidal record, and use of Astoria for determining transition dates.
- Recently completed climate reanalysis allows estimation of CUI from 1871 – present, extending the CUI dataset by 96 years.
- Wavelet and accumulated CUI, SLH based methods are used to estimate transition dates from 1871 - present
- The analyses show that not all transitions are created equal, even in the Oregon / Washington region.

Synthesis

- Key findings :
 - A Coastal Upwelling Index has been calculated for 1871-2008 from climate reanalysis data.
 - Methods have been developed to reduce the subjectivity in determination of transition dates.
 - Estimated transition dates have been tabulated for 1871-present (results are preliminary).

Synthesis

- Management implications :
 - Longer term climate data for the coastal ocean is becoming available.
- Data (Analysis) gaps :
 - PSU group (David Jay, Stefan Talke) are working on discovering and digitizing old tidal records. "Older" data of PNW coastal or Columbia River locations could help us.
 - I would be interested in biological data that would help draw connections between the ecosystem physics and biology.
 - We've just begun to look at long-term upwelling behavior. Stay tuned.

Acknowledgements

- This research was funded by the Bonneville Power Administration and NOAA Fisheries (project Estuarine Habitat and Juvenile Salmon; Current and Historic Linkages in the Lower Columbia River) and the NSF (project RISE, River Influences on Shelf Ecosystems, OCE 0239072).
- 20th Century Reanalysis V2 data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado, USA, from their Web site at <http://www.esrl.noaa.gov/psd/>