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How did a large-scale climate anomaly impact phytoplankton blooms in Puget Sound in 2015?

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Background

What can we learn from large scale climate anomalies?


In 2015 we observed changes in marine water quality due to the large-scale climate anomaly ‘The Blob’ – a mass of warm water that entered Puget Sound in the fall of 2014. In conjunction with the Blob, higher than normal air temperatures altered patterns of river discharge in 2015, changing water column stratification and salinity. Changes to hydrological patterns in Puget Sound have the ability to influence nutrient levels and water column stratification, indirectly affecting the timing and amplitude of phytoplankton blooms.

By comparing 2015 marine water quality data to baseline conditions (1999-2008), this study explores how the following played a role in altering the timing and magnitude of phytoplankton blooms in 2015:

1) The physical environment
2) River discharge
3) Nutrient cycling

Regional Differences in Phytoplankton Blooms in 2015

Factors Influencing Phytoplankton Blooms

1. The Physical Environment

- Long-term monitoring stations are visited monthly via floatplane and boat.
- Standard operating procedures are followed for seawater sampling, analysis and data QA/QC.
- Data collected from Central and South Sound in 2015 was compared to an established historic baseline (1999-2008).
- ‘Heat’ maps were generated to show anomalies in 2015 water quality data.

Methods

- Water quality data was collected monthly at Puget Sound stations.
- Spring Bloom: Earlier timing, higher amplitude
- Summer Bloom: Expected timing, higher amplitude
- Summer Bloom: Earlier timing, expected amplitude

2. River Flow

The Fraser River in Canada is the largest contributor of fresh water to the Salish Sea. Changes in the Fraser River discharge alter the two later exchange of water flowing between Puget Sound and the Pacific Ocean phytoplankton blooms are indirectly affected by river through changes in the physical and chemical environment.

Winter/Spring
- Premature river discharge
- Stronger stratification levels in Central Sound

Summer
- Lower levels of salinity in both regions
- Higher levels of salinity in both regions

South Sound was less affected by stratification likely due to tidal mixing.

3. Nutrient Cycling

In the summer months, higher amounts of reduced nitrogen (low NO3/DIN ratio) were present in both Central and South Sound. This suggests that more nitrogen was being recycled in the water column compared to previous years.

Conclusions

- Large-scale climate anomalies provide useful information about how warming global and ocean temperatures will impact phytoplankton blooms in Puget Sound.
- Regions in Puget Sound may respond differently to future climate impacts.
- More research on lower trophic level food web dynamics is needed to understand how ecosystem functioning in Puget Sound is affected by changes in the timing and amplitude of phytoplankton blooms.

References


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