Detecting phytoplankton dynamics in the central Benguela current upwelling ecosystem off Namibia by using in situ chlorophyll-α measurements.

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Objectives

• Longterm variability of chlorophyll [ ]

• Quantifying phytoplankton blooms

• Seasonality of phytoplankton blooms/peaks
Methods/Data

- Depth (db)
- Distance offshore (nm)
- Measure chlorophyll a
- 10AU Field Fluorometer

Graph showing data with depth and distance offshore.
Temperature
(15m & 10nm station)
Temperature (Seasonality)

Summer
- Stratified
- >16°C
- Strong thermocline

Autum/Winter
- Mixed
- 13°-16°C

Upwelling
- Mixed
- < 13°C

Summer
- Stratified
- Weak Thermocline
• Variability high
• Decrease in chlorophyll offshore direction
• 2nm station not as high as expected (mixing/turbulents/waves)
• 5-20nm stations similar biomass (highest production)
• 30-70nm stations (lowest production)
Longterm trend/variability

- Interannual variability high
- not a significant trend
Phytoplankton Blooms

**Major Blooms**

**Minor Blooms**

**Raw Readings**

<table>
<thead>
<tr>
<th></th>
<th>Major Blooms</th>
<th>Minor Blooms</th>
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<tbody>
<tr>
<td>Raw Readings</td>
<td>18.4 µg/L</td>
<td>12.9 µg/L</td>
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**Define Blooms**

- Constant threshold value
  - Mean (12 years) + 2SD’s = MajBl
  - MinBl = Remove MajBl & recalculate as above

**Constant threshold** = understanding the long term changes in biomass

*(Kim et al, 2009)*
**Major Blooms**

**Minor Blooms**

| Raw Readings | 18.4 µg/L | 12.9 µg/L |

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**Defined Blooms**

Constant threshold value
- Mean + 2SD’s, above the long term mean (12 years) = MajBl
- MinBl = Remove MajBl & recalculate as above

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**Constant threshold** = understanding the long term changes in biomass

*(Kim et al, 2009)*
Climatology of Chl [ ]

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<td>Median</td>
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<td>9.96 µg/L</td>
<td>8.12 µg/L</td>
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**LATE SUMMER PEAKS**
- Larger bloom
- Spread over larger area
- Major peak is sub-surface

**SPRING PEAKS**
- Sub-surface
- Spread almost homogenically

**EARLY SUMMER PEAKS**
- Closer to the surface
- January ????

Peaks
- April/May (summer/Autum)
- August (Spring Bloom)
- December (Beginning summer)
Summary

- Inshore stations showed significant similarities
  - High Chl [ ] inner shelf
  - Low Chl [ ] offshore
  - Variability of Chl is high

Blooms
Not high frequency of major blooms as well as minor blooms (missing data)
Initiation of blooms does not end up in a Minor Bloom or Major Bloom

Seasonality
April/May Peak (Late summer)
- Not a direct consequence of upwelling but rather the breakdown of the thermocline due to cooling of the atmospheric system
- Largest blooms
- Largest contributor to annual biomass
- Sub-surface blooms

August Peak (Upwelling)
- Directly due to upwelling
- Biomass lower
- Mixing high
- Sub-surface Chl maxima (minor bloom)

December Peak (Early Summer)
- Closer to the surface