Harmful Algal Blooms – Tools available for forecasting

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Acknowledgements

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Photo credit: IMOS/CSIRO
What is the goal?

Scientific understanding?
- Parameterized integrated biological/physical/ecological models
- Lots of field/lab data (time/space) required to achieve for one species.
  - Integrated 3D high res shelf/coastal physical model
  - **HAB species models - growth, life-cycle, toxicity (culture/field data)**
  - Biogeochemical parameters/constraints?
- Great......if we can fund it!!

Informing and managing response?
- Management industry action/responses usually highly constrained
  - Open/close? Harvest/not harvest? feed/stop feeding?
  - Operational forecasting models
    - Machine learning/evolutionary models (can inform process models)
    - Correlative, minimal subset of informative spatial/time-series data
    - If condition A, B and C, then bloom risk up/down, 80% risk of bloom etc.

Data needs to be useful/interpretable by end-users
- Decision-support systems for managers and industry
HABs forecasting examples around the world

- HAB-OFS (NOAA) use satellite, in situ and modelling
- NE USA use ROMS with coupled biological models and distribution of *A. fundyense* cysts
- CenCOOS Central and Northern California Ocean Observing System use modelling and in situ obs
- Asimuth in Europe use satellite, models and in-situ obs.
Based on in situ ocean measurements, remote sensing and modelled data, regional model nested in a larger shelf scale model for advective blooms and local models for in situ blooms. Scientific assessment on likelihood is manual. In situ measurements include current biotoxin levels and trends, historical for the week assessed, spatial information on HAB taxa. Remote sensing satellite measurements include Chla, SST. Models: volumetric fluxes, langrangian particle trajectories, water column structure.

Fig. 2. Simple conceptual model of HAB transport pathways from shelf waters into Bantry Bay, southwest Ireland (sensu Raine, 2014, Fig. 9). (A) Presents a simplified view of the offshore–onshore wind driven water advection of *Pseudo-nitzschia*, (B) Presents a simplified view of the offshore–onshore wind driven water advection of *Dinophysis*. 
• Short term predictions rely on expert opinion
• Information given to stakeholders on a bulletin
Ocean News

Rottnest Swim Forecast

Madeleine Cahill
22 February, 2017

The forecast for the Rottnest swim this Saturday is for southward currents getting stronger throughout the day, particularly near Rottnest Island. So at this point, our advice is to stay close to the northern buoys, throughout the race, particularly those swimmers who will still be in the water after 11am. Winds are expected to be light and from the north-east. You can optimise your swim time based on the ocean current predictions by the Oceans Institute of the University of Western Australia. The ocean forecast depends on the weather forecast, which may change. Our last update is Friday morning. [more]
Tools in Tasmania
SOUTH-EAST TASMANIA HYDRODYNAMIC MODELLING

SETAS Model

Model Grid
Resolution: 300 to 2500 m

Model Bathymetry

Depth (m)

Friars
Offshore Bdry.
S.E. TASMANIA NEAR REAL-TIME HYDRODYNAMIC MODELLING

OceanMAPS

1000 27 Feb 2017 +10

Surface Current 0.5 m/s

Temperature

16 18 20

43° S

43°30′ S

44° S

146°30′ E 147° E 147°30′ E 148° E

SETAS

0100 27 Feb 2017 +10

Surface Current 0.5 m/s

Temperature

16 18 20

43° S

43°30′ S

44° S

146°30′ E 147° E 147°30′ E 148° E

Last updated: 03 Mar 2017 15:40:46
SOUTH-EAST TASMANIA HYDRODYNAMIC MODELLING

STORM Model

Model Grid
Resolution: 120 to 600 m

Model Bathymetry
S.E. TASMANIA NEAR REAL-TIME HYDRODYNAMIC MODELLING

SETAS

Temperature

16  18  20

Current 0.5 m/s

147° E  147°30' E  148° E

0100 25 Feb 2017 +10

NRT

Temperature

16  18  20

Current 0.5 m/s

147° E  147°30' E  148° E

0100 25 Feb 2017 +10

STORM

Temperature

16  18  20

Current 0.5 m/s

147° E  147°30' E  148° E

0100 25 Feb 2017 +10

Last updated: 01-Mar-2017 09:47:41
S.E. TASMANIA NEAR REAL-TIME BIOGEOCHEMICAL MODELLING

Chlorophyll (mg/m³)

Surface Current 1 m/s

DIN (mgN/m³)

Surface Current 1 m/s

0500 11 Nov 2012 +10

Last updated: 09-May-2013 14:53:22
Surface Chlorophyll & Nitrogen
SOUTH-EAST TASMANIA HYDRODYNAMIC MODELLING

PITTWATER Model

Model Grid
Lagoon Resolution: 40 m

Model Bathymetry
EAST TASMANIA HYDRODYNAMIC MODELLING

ETAS Model

Model Grid
Resolution: 500-2000 m

Model Bathymetry

Depth (m)
-3000 -1500 0
S.E. TASMANIA HYDRODYNAMIC MODELLING

MARIA Model

Last updated: 06-Mar-2017 14:34:08
MODIS derived chlorophyll-a

- Evaluated a variety of atmospheric correction and chlorophyll-a algorithm combinations.
- In-situ chlorophyll-a data sourced from integrated marine observing system (IMOS).
- Image processing chains implemented using SeaDAS 7 software
MODIS derived chlorophyll-a

Key findings

• MUMM atmospheric correction provided best chlorophyll retrievals

• High-resolution processing (D) negatively affected chlorophyll retrieval accuracy

• Some indication for regional tuning of fluorescence line height retrievals (C)
Data available

- Weather obs (BOM)
- River flows (DPIPWE)
- Ocean circulation (BOM and IMOS)
- Storm Bay research (2010-15, IMAS)
- ‘State of the Derwent’ (Tas EPA)
- Storm Bay and MAI moorings (IMOS)
- Satellite data (SST, OC, SSH, IMOS)
- Other?
Realtime forecasting system? - BeachWatch

“Some options for a Storm Bay data portal and forecasting service”
– Adam Main Tasmanian Salmon Growers Association
IMOS is a national collaborative research infrastructure, supported by Australian Government. It is led by University of Tasmania in partnership with the Australian marine & climate science community.

www.imos.org.au

The Operators of the IMOS infrastructure are: