MEAP-TT Seminar

2 September 2026

14:00 – 15:00 UTC

Participation:

No	First name	Last name	Affiliation
1	Kunal	Chakraborty	INCOIS
2	Zheng	Chen	HKUST
3	Stefano	Ciavatta	MOi
4	Susan	Kay	Met Office
5	Helen	Powley	PML
6	Kirsten	Wilmer-Becker	Met Office
7	Liuqian	Yu	HKUST

Executive summary

Liuqian Yu presented evidence that the expansion of oyster farming in Deep Bay, Hong Kong, is the primary cause of the collapse of the bay's historic summer phytoplankton bloom. Combining long-term monitoring data with a coupled biogeochemical and oyster growth model, the study demonstrated that neither changes in nutrients, turbidity nor temperature could explain the observed changes, whereas increased oyster grazing successfully reproduced the shift in phytoplankton seasonality.

Discussion focused on the implications for oyster-farming carrying capacity, ecosystem management, and future model development. Planned work includes evaluating optimal oyster stocking densities, incorporating carbon and carbonate chemistry into the model, and assessing shellfish cultivation as a potential tool for managing eutrophication.

The meeting also discussed plans for the 2027 INCOIS-hosted Summer School in Hyderabad and agreed to separate future scientific seminars from task-team business meetings to encourage wider participation and outreach.

Scientific Presentation: Oyster Farming and Phytoplankton Dynamics in Deep Bay

Key Findings

Long-Term Environmental Change

- Deep Bay is a highly eutrophic, shallow estuary influenced by the Pearl River and local river systems.
- Long-term monitoring data from Hong Kong's marine monitoring programme (76 stations, ~40 parameters) show a major change in phytoplankton seasonality over the last decade.

- While most Hong Kong waters continue to exhibit a summer chlorophyll peak, Deep Bay's historical June-July bloom has largely disappeared, leaving only a smaller spring peak.

Assessment of Environmental Drivers

Analysis of potential bottom-up controls showed:

- Temperature has remained relatively stable.
- Turbidity has declined due to reduced sediment inputs from upstream dam construction.
- Nitrogen and phosphate concentrations have decreased but remain high.
- Light availability remains more important than nutrient limitation for phytoplankton growth.

These environmental changes alone could not explain the observed loss of the summer bloom.

Oyster Farming Expansion

- Oyster farming expanded substantially from approximately **3.8 km^2 to 13.6 km^2** since 2013.
- A coupled biogeochemical and Dynamic Energy Budget model was developed to simulate interactions between nutrients, plankton, detritus and oyster populations.

Model Attribution Results

The modelling demonstrated that:

- Historical phytoplankton seasonality can be reproduced under earlier oyster-farming conditions.
- Simulations without oysters retained the summer phytoplankton peak.
- Changes in nutrient or turbidity forcing alone did not reproduce observed trends.
- Increased oyster density successfully reproduced the observed decline in summer chlorophyll.

The study concluded that oyster-farm expansion is the only tested process capable of explaining the observed phytoplankton changes and appears to have a stronger influence than recent bottom-up environmental changes.

Discussion

Oyster Yield and Carrying Capacity

Participants discussed whether increasing oyster densities may now be reducing food availability for oysters themselves.

Key points included:

- Oysters are generally harvested during January-February.
- Farmers report that waters are no longer as productive ("fat") as in the past.
- Increased oyster density may be creating competition for food resources.
- A carrying-capacity assessment is planned to identify sustainable and potentially optimal stocking levels.

Data Limitations

- Reliable information on oyster numbers and production remains limited.
- Current estimates rely partly on discussions with local farmers.
- Data uncertainty is a major challenge for future management assessments.

Nutrient Management Scenarios

The group discussed whether nutrient enrichment could support oyster production.

Liuqian noted that:

- Nutrient concentrations remain high despite reductions.
- Dissolved inorganic nitrogen already exceeds regional water-quality targets.
- Phytoplankton growth appears close to nutrient saturation.
- Additional nutrient increases are therefore unlikely to substantially increase phytoplankton biomass.

Future Research Directions

Model Development

Future work will:

- Incorporate carbon-cycle processes.
- Include carbonate chemistry and shell formation dynamics.
- Assess impacts of ocean acidification and declining pH on oyster growth.
- Improve understanding of oyster impacts on ecosystem biogeochemistry.

Reservoir Applications

Liuqian reported interest from the Hong Kong Water Supplies Department in evaluating shellfish cultivation within drinking-water reservoirs.

Potential objectives include:

- Reducing algal blooms
- Improving water quality
- Lowering water-treatment costs

Coastal Eutrophication Management

The team also plans to examine shellfish farming expansion along the wider China coast to determine whether cultivation could serve as a complementary management measure alongside land-based nutrient reductions.

Summer School Update

Kirsten provided an update on plans for the **Operational Oceanography and Biogeochemistry Summer School**:

- Proposed dates: **September 2027**
- Venue: **INCOIS, Hyderabad, India**
- Marine biogeochemistry will form part of the programme.
- Participants were invited to suggest suitable lecturers and communities to engage.
- Organisers are considering developing lecture materials into papers and a summer-school publication/book to ensure long-term accessibility.

Seminar Format and Outreach

The group agreed to revise the seminar format from October onwards.

Agreed Changes

- Scientific seminars will be separated from task-team business meetings.
- Seminars will be open to a broader community beyond task-team membership.
- Invitations will be shared widely across relevant scientific networks.
- Recordings will continue to be made available for those unable to attend live.

Outreach Opportunities

Participants suggested using wider OceanPredict-related communities and professional networks to increase participation and visibility.

Actions

Action	Lead
Provide suggestions for summer-school lecturers in marine biogeochemistry	All / Liuqian Yu
Implement separate seminar and task-team meeting format beginning in October	Kirsten, Liuqian Yu
Expand seminar advertising and outreach to broader scientific communities	Kirsten, Liuqian Yu

Overall Conclusion

The presentation provided strong evidence that oyster-farm expansion has fundamentally altered phytoplankton dynamics in Deep Bay through top-down grazing pressure. The work highlights the potential for shellfish cultivation to significantly influence coastal ecosystem functioning and provides a foundation for future assessments of sustainable aquaculture, eutrophication management, and ecosystem-based coastal planning.