Phenology and climate change

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New Zealand's specialist land-based university.

LINCOLN UNIVERSITY
TE WHARE WĀNAKA O AORAKI

PHENOLOGY

- Study of stages of growth and development in the life cycle of living organisms

García de Cortázar-Atauri, I.

- Temperature is a key driver of phenology

PHENOLOGY AND CLIMATE CHANGE

Nature's clock by Nevit Dilmen - Own Animation, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=1364532

THE "SO WHAT?"

- Biodiversity variable
- Need to understand the change in timing of life cycle events of the plant in response to climate change

THE IMPORTANCE OF HISTORICAL PHENOLOGICAL OBSERVATIONS

LONG TERM DATA SERIES – LESSONS FROM ABROAD

Over 70 years:

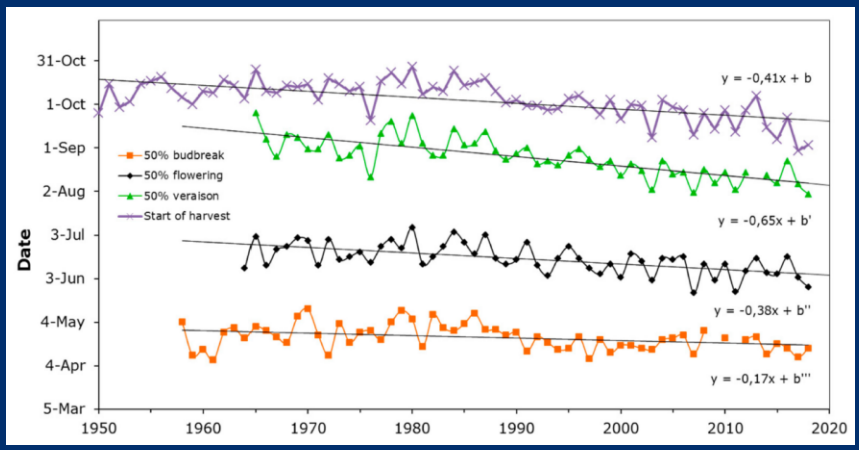
-25 days

-39 days

-23 days

-10 days

Riesling in Alsace



Since 1989:

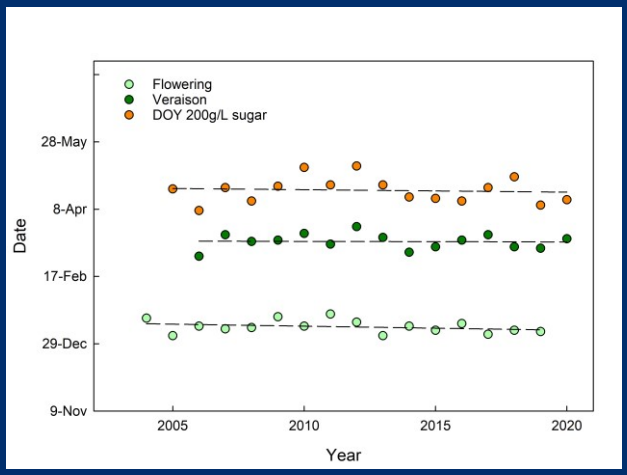
-6 days/ 10 years

- 3 days/ 10 years

van Leeuwen, C., Destrac-Irvine, A., Dubernet, M., Duchêne, E., Gowdy, M., Marguerit, E., Pieri, P., Parker, A. K., de Rességuier, L., & Ollat, N. (2019)(2017).

CLOSER TO HOME…

Sauvignon blanc, Oyster bay, Marlborough



-2 days/ 10 years

- 0.4 days/ 10 years

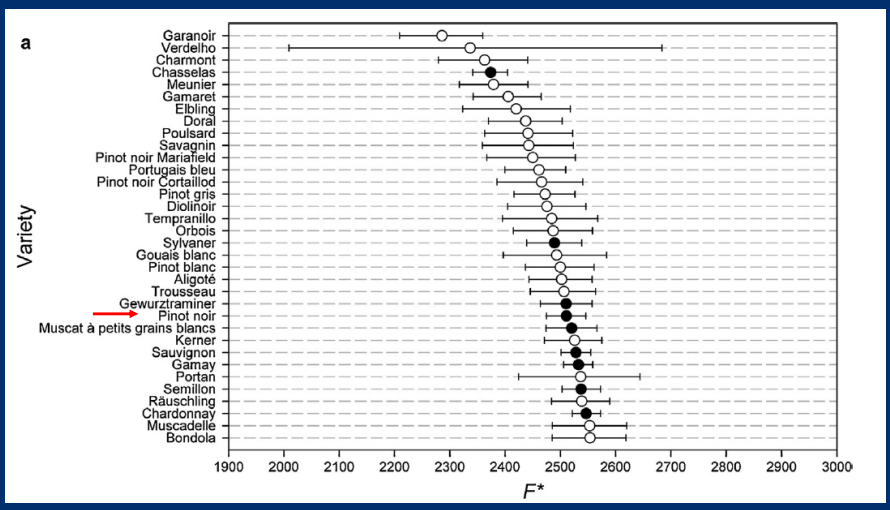
- 3 days/ 10 years

Adapted from Parker, A.K., García de Cortázar-Atauri, I., Trought, M.C.T., Destrac, A., Agnew, R., Sturman, A., & van Leeuwen, C. (submitted OENO-One, 2020)

THE IMPORTANCE OF PHENOLOGICAL MODELS

GRAPEVINE FLOWERING VERAISON MODEL

Veraison



Thermal time (GDDs)

Parker, A.K. et al. (2013)

"GDD" model

Starts 29 August

Base temperature of 0°C

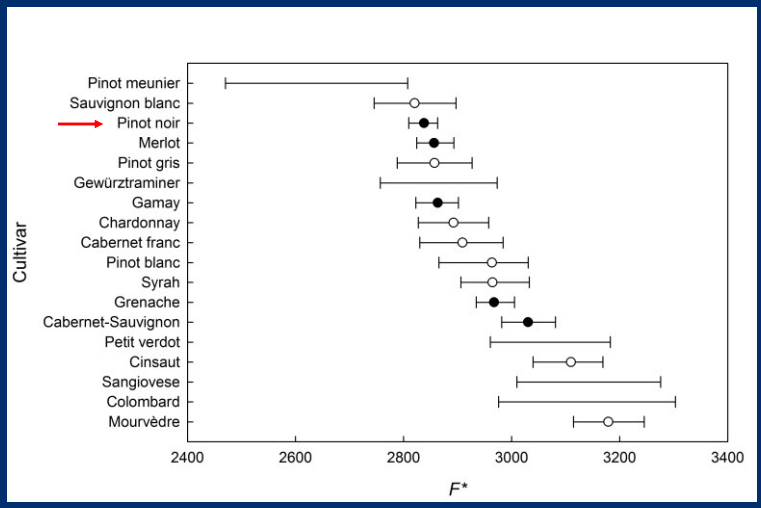
Classified:

95 varieties for flowering

104 varieties for veraison

GRAPEVINE SUGAR RIPENESS MODEL

200g/L sugar



"GDD" model

Starts 30 September

Base temperature of 0°C

Classified:

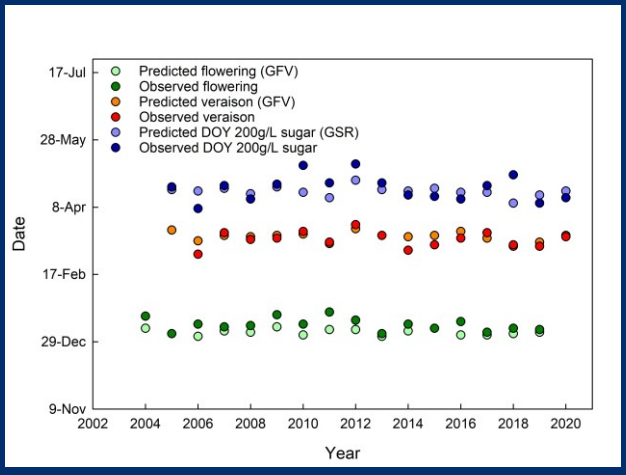
170g/L, 180g/L, 200g/L, 210g/L, 220g/L sugar

Up to 65 varieties

Parker, A.K. et al. (2013)

PREDICTING THE PAST TO PRESENT DAY

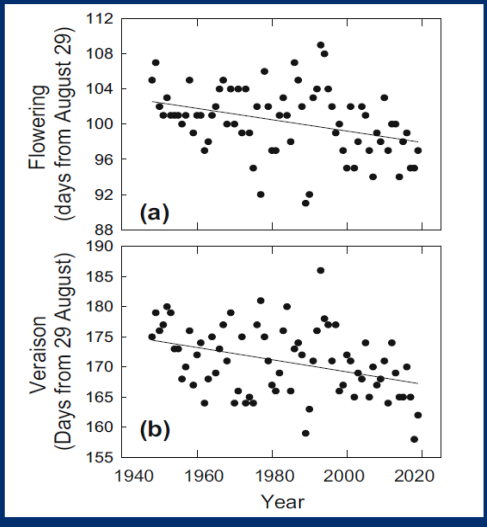
Sauvignon blanc, Oyster bay, Marlborough



Parker, A.K., García de Cortázar-Atauri, I., Trought, M.C.T., Destrac, A., Agnew, R., Sturman, A., & van Leeuwen, C. (submitted OENO-One, 2020)

PREDICTING THE PAST TO PRESENT DAY

Climate data from Marlborough Regional Station (1947-2019)



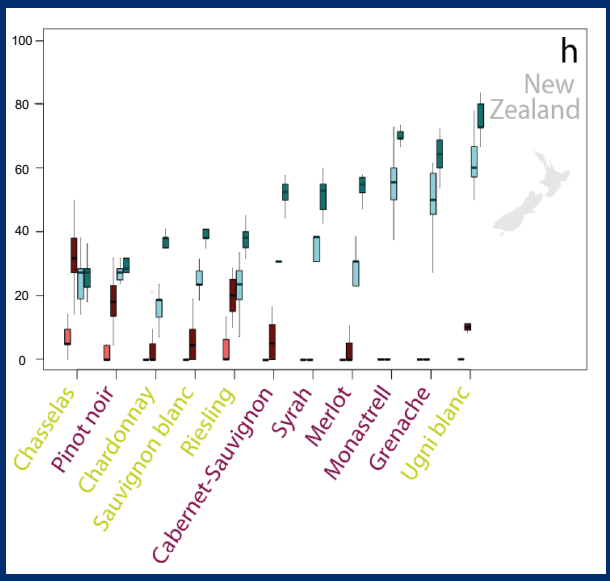
-0.7 days/ 10 years

-1 / 10 years

Salinger, M. J., Diamond, H. J., Behrens, E., Fernandez, D., Fitzharris, B. B., Herold, N., Johnstone, P., Kerckhoffs, H., Mullan, A. B., Parker, A. K., Renwick, J., Scofield, C., Siano, A., Smith, R. O., South, P. M., Sutton, P. J., Teixeira, E., Thomsen, M. S., & Trought, M. C. T. (2020).

CLIMATE CHANGE
WHAT DOES THE FUTURE LOOK LIKE?

THE FUTURE?



Decrease in suitability at 2°C warming

Decrease in suitability at 4°C warming

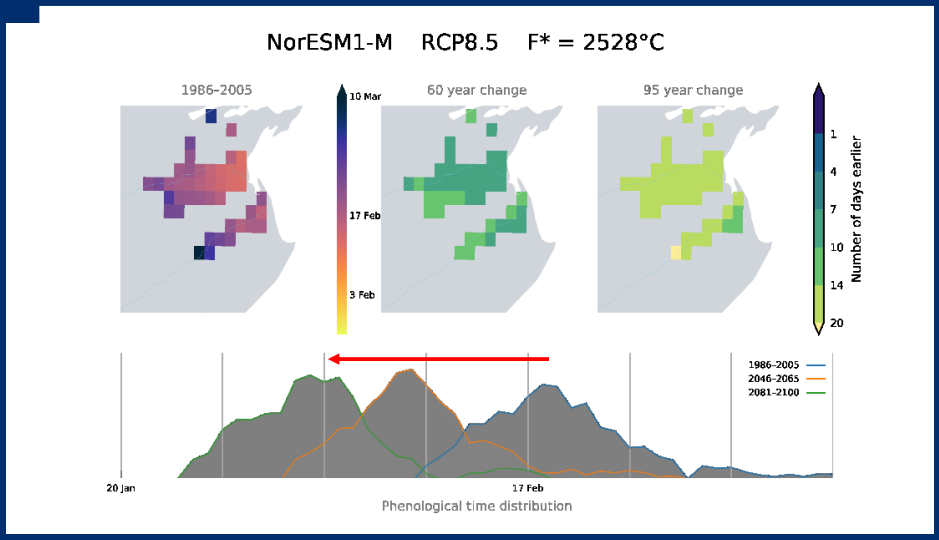
Increase in suitability at 2°C warming

Increase in suitability at 4°C warming

Morales-Castilla, I., García de Cortázar-Atauri, I., Cook, B. I., Lacombe, T., Parker, A., van Leeuwen, C., Nicholas, K. A., & Wolkovich, E. M. (2020). Diversity buffers winegrowing regions from climate change losses. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(6), 2864-2869. doi:10.1073/pnas.1906731117

THE FUTURE?

Sauvignon blanc veraison, Marlborough

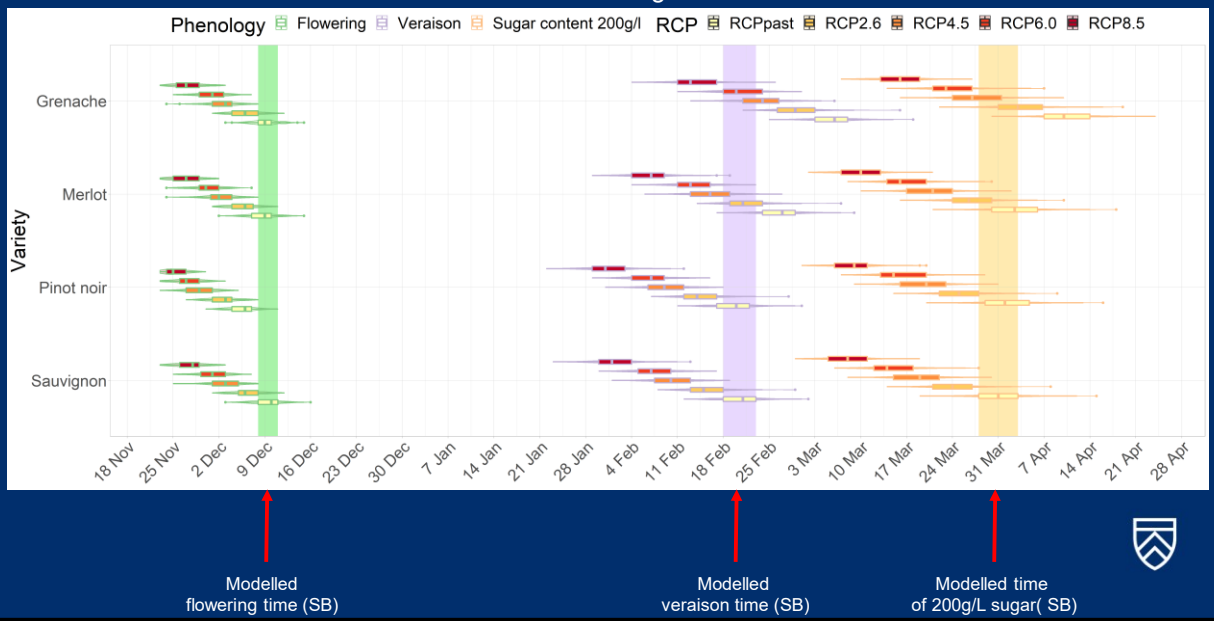


Ausseil, A., Law, R., Parker, A.K., Teixeira, E., & Sood, A. (in preparation)

THE FUTURE?

Marlborough

Ausseil, A., Law, R., Parker, A.K., Teixeira, E., & Sood, A. (in preparation)



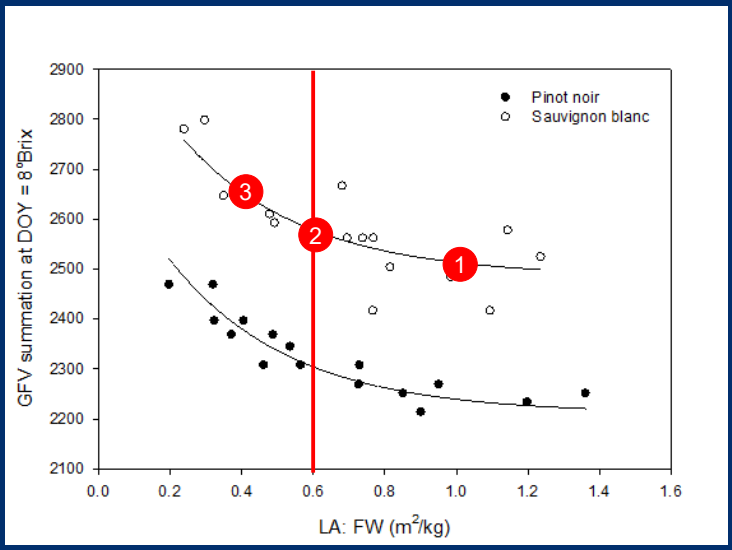
Modelled flowering time (SB)

Modelled veraison time (SB)

Modelled time of 200g/L sugar(SB)

ADAPTING TO CLIMATE CHANGE

COMBINING PHENOLOGY MODELS WITH ADAPTATION STRATEGIES



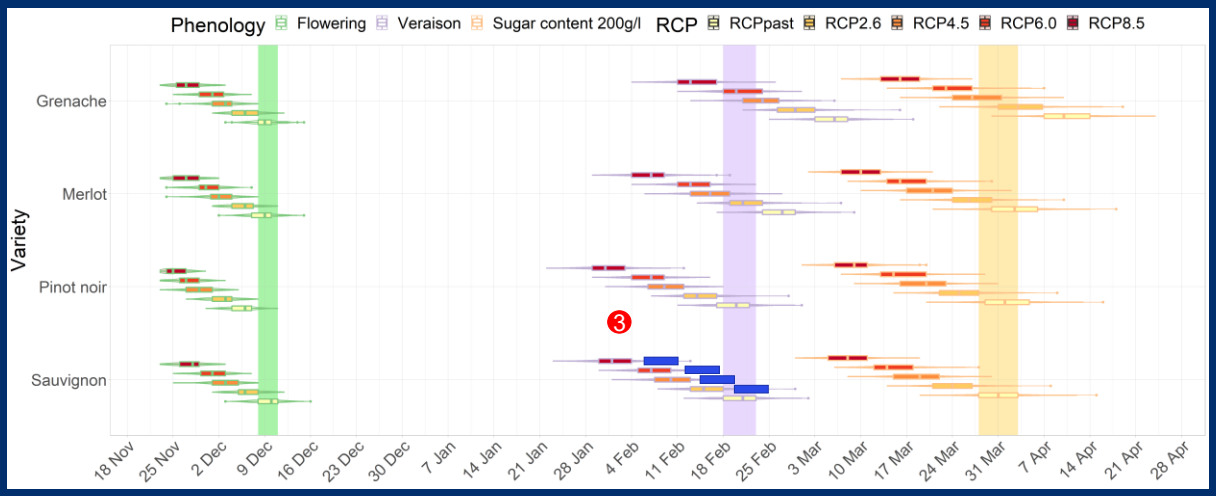
Parker, A., (2012)

Average temperature of 17°C

2 Delay of 3.8 days

3 Delay of 8.3 days

COMBINING PHENOLOGY MODELS WITH ADAPTATION STRATEGIES



2 LA:FW ratio 0.6 m^2/kg = Delay of 3.8 days in veraison

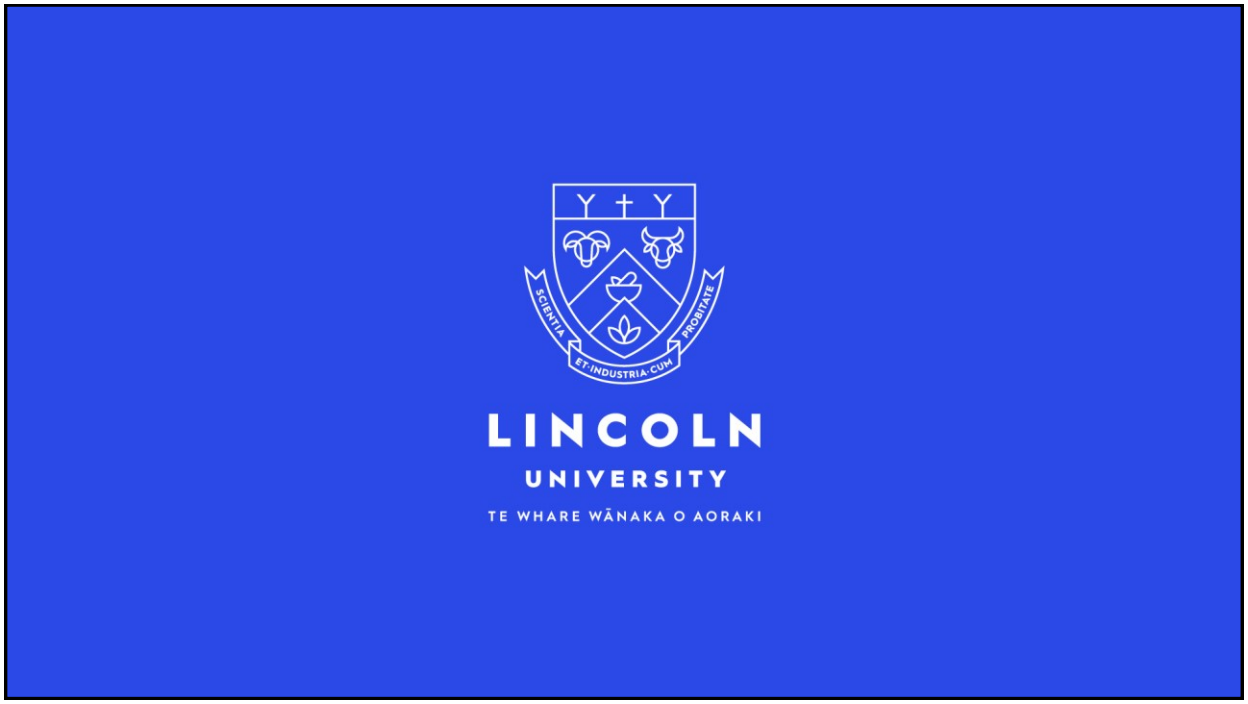
3 LA:FW ratio of 0.4 m^2/kg = Delay of 8.3 days in veraison

FOOD FOR THOUGHT

- Phenology and historical records are important
- Backbone to understand adaptation
- Need to also consider the ecosystem
- Mitigation

ACKNOWLEDGEMENTS

- Co-authors on all publications
- All data providers in France for various research outputs presented today
- Data for the Oyster Bay site, involving Plant & Food Research, New Zealand Winegrowers, Quality New Zealand Wines (UOAX0404), and staff of the wine company involved in data collection.
- The Agricultural and Marketing Research and Development Trust, New Zealand, for the scholarship to Dr Amber Parker
- Bordeaux Sciences Agro ISVV - UMR EGFV
- Lincoln University
- Acknowledgements from publications: The Precision Grape Yield Analyser (GYA) science research programme led by Lincoln Agritech Limited; University of Canterbury; Plant and Food Research; CSIRO; Endeavour programme (LVLX1601); Bragato Research Institute (BRI); Marchal and S. Dedet, Institut National de la Recherche Agronomique Domaine de Vassal Grape Repository; T. J. Davies;A. K. Ettinger; Harvard Research Computing for computing facilities; Postdoctoral fellowship by University of Alcala´ ; Spanish Ministry of Science and Innovation (Grant CGL2017-86926-P to M. A´ . Rodrıguez); LACCAVE 2 project (towards integrated viticultural systems resilient to climate change); French National Research Agency (ANR) in the frame of the Investments for the future Programme, within the Cluster of Excellence; Conseil Interprofessionnel des Vines de Bordeaux (CIVB); the regional government of Aquitaine (Conseil Régional d'Aquitaine); COTE (ANR-10-LABX-45); Unité Expérimentale de la Grande Ferrade (F-33883 Villenave d'Ornon) in managing the VitAdapt and GreAdapt experiments; TEMPO French Network; Dr Trevor Chinn; Dr Elizabeth (Betty) Batham; Dr Doug Mackie; Jaco Swart; Salmon Farm Manager, Sanfords; Colleagues and volunteers who have maintained and contributed to the New Zealand marine and climate data;Ms Noga Yoselevich;MBIE funded Coastal Acidification: Rate, Impacts and Management (CARIM) project, provided by Kim Currie;Deep South National Science Challenge.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