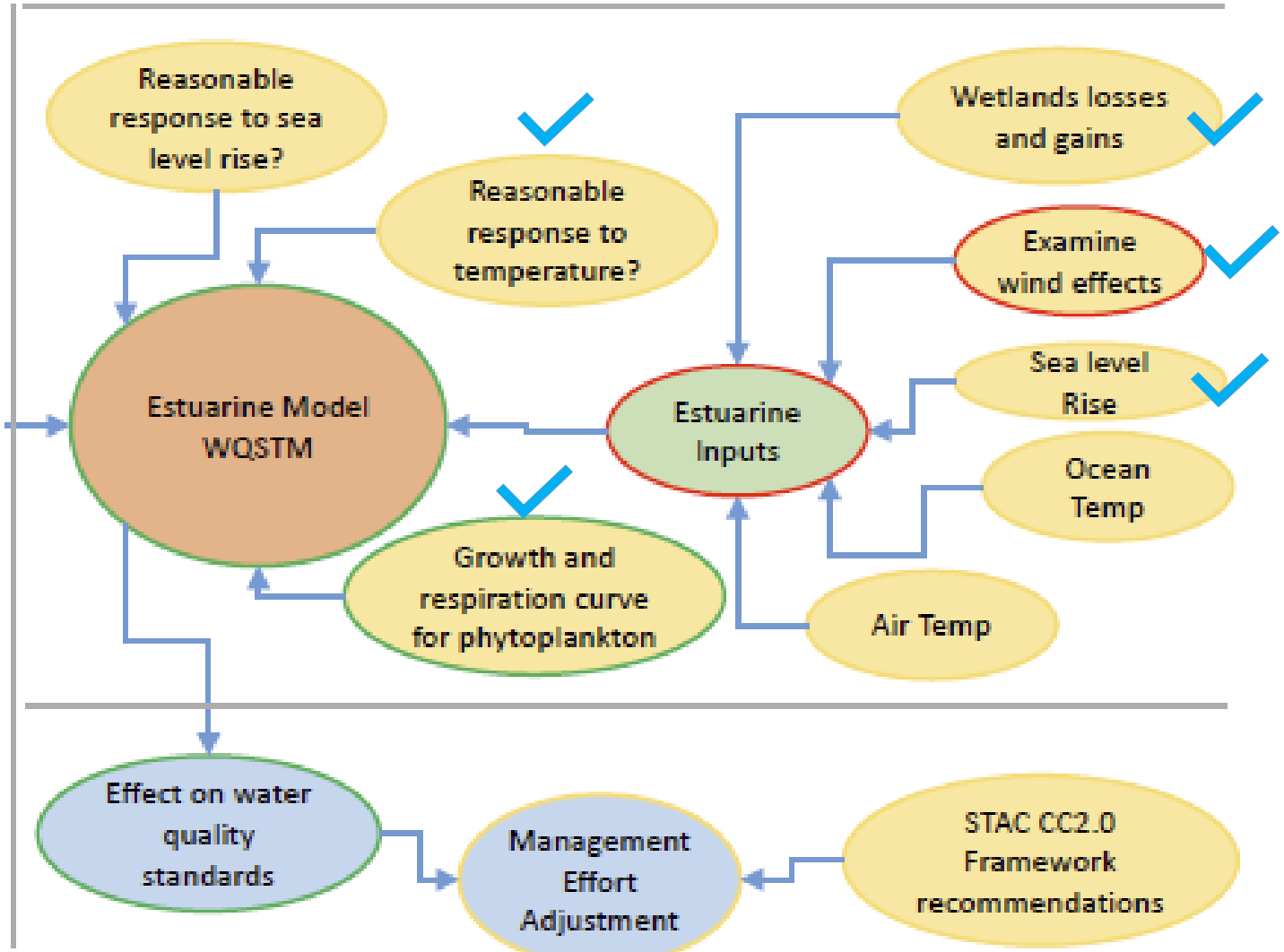
Progress in WQSTM Climate Change Analyses

Richard Tian and CBPO modeling team

Modeling Conference Call
05/30/2019
Annapolis

Outline

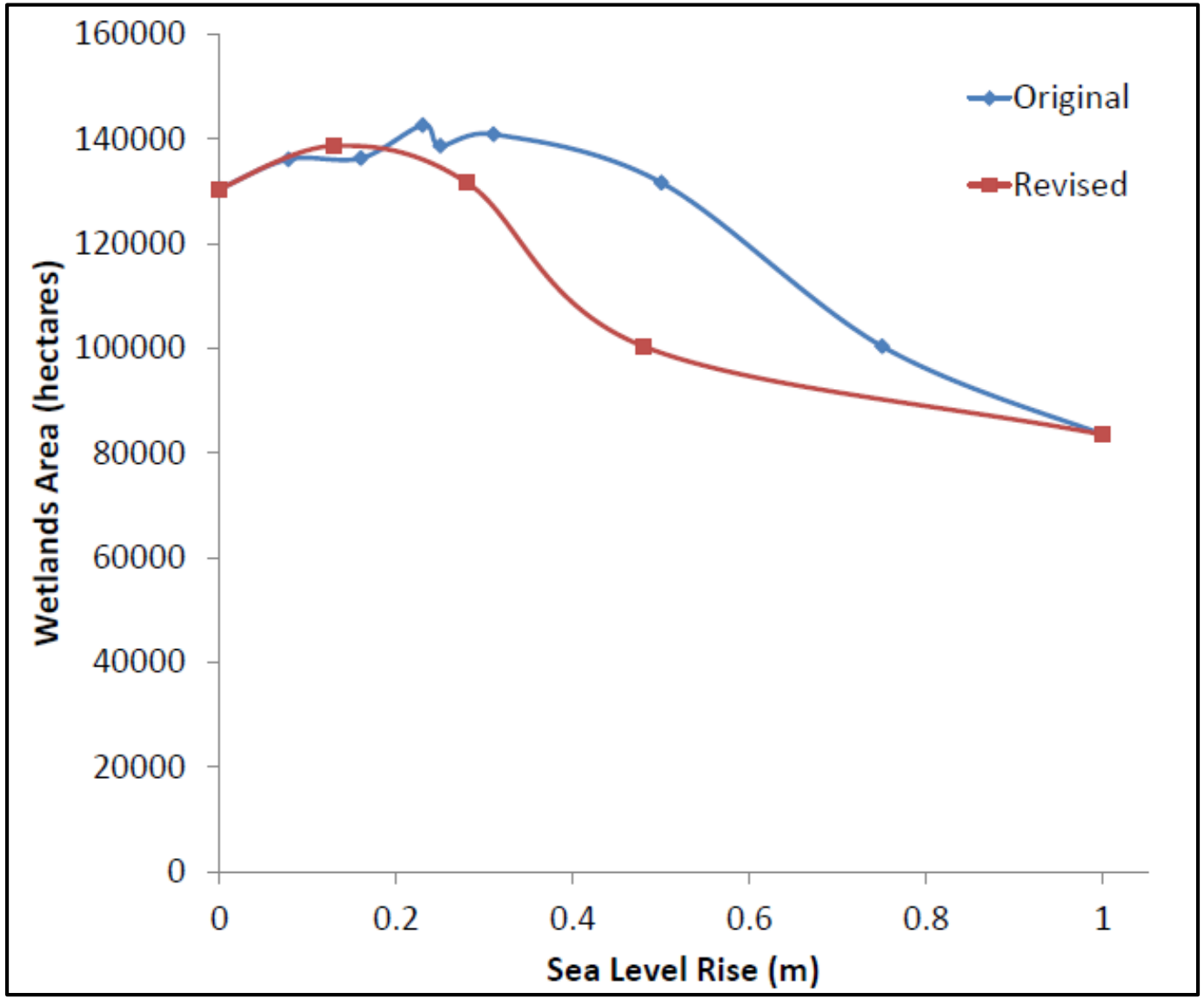


From Gary Shenk

Wetland revision

Carl Cerco:
I am attaching a figure of wetlands area vs sea level rise. The "original" line mixes two SLAMM scenarios and incorporates an error on my part in terms of the "1 m by 2100 scenario." The "revised" line is the "1 m by 2100" scenario only and is, I believe, correct.

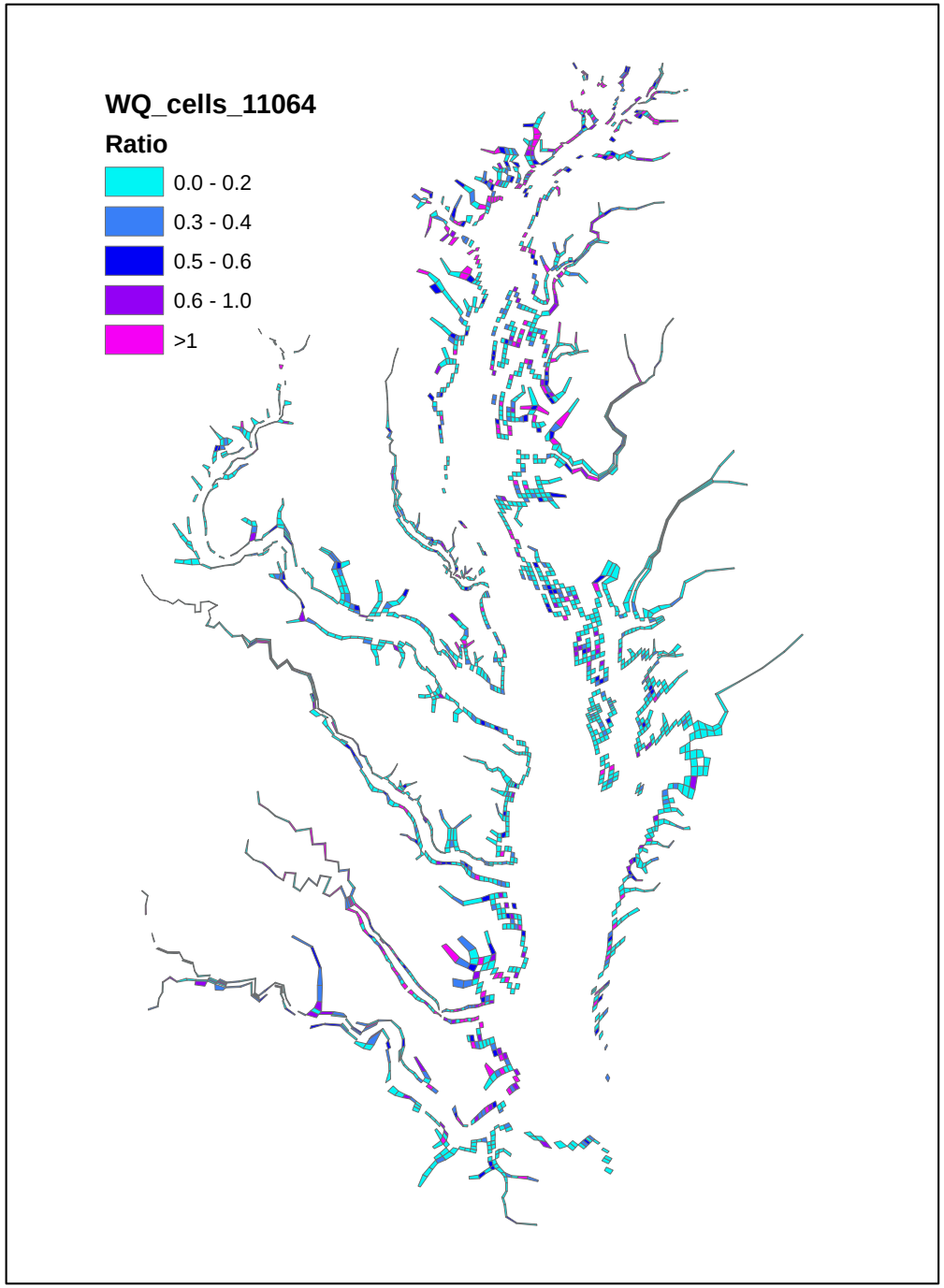
Integrated wetland acreage



Existing wetland

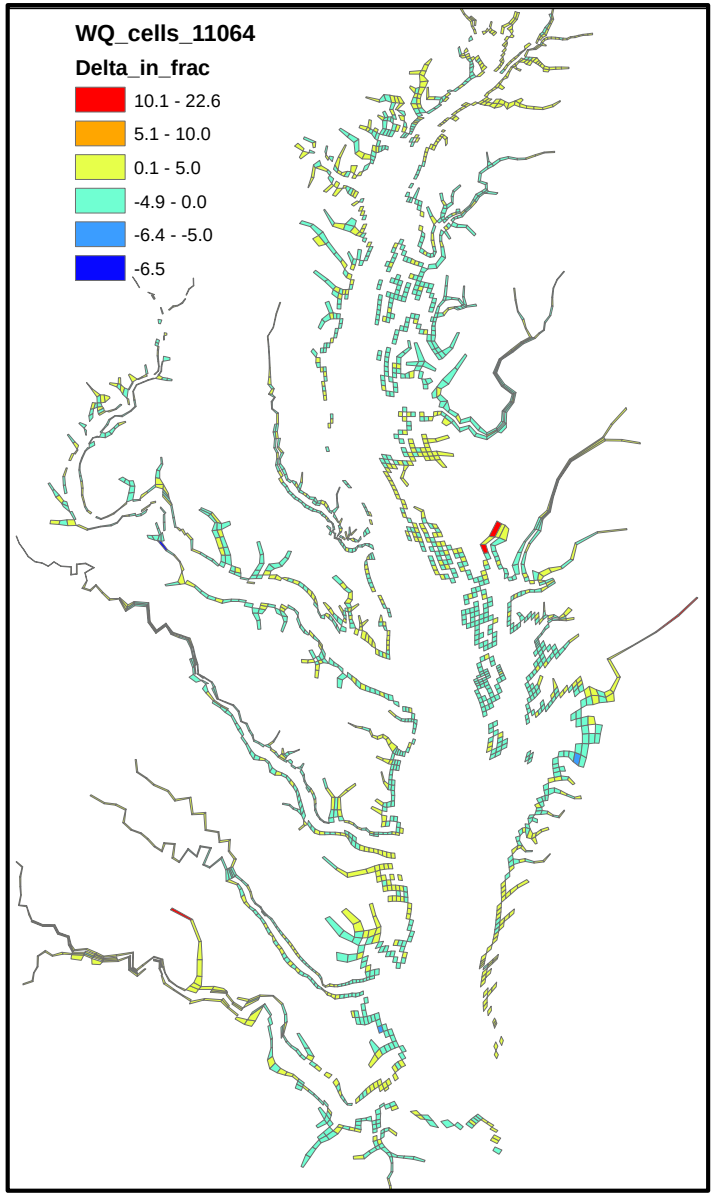
(in fraction of cell size)

- **Everywhere, more so on the eastern shore and the upper Bay.**
- **Can be > 1**

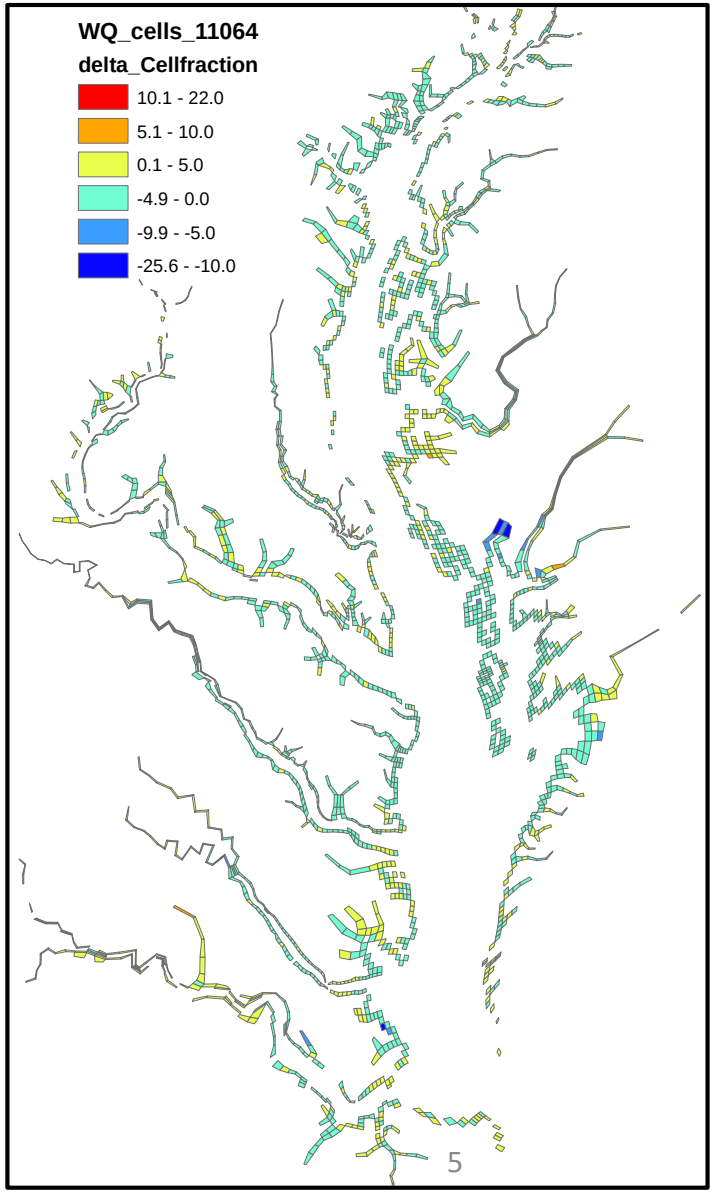


From Carl Cerco

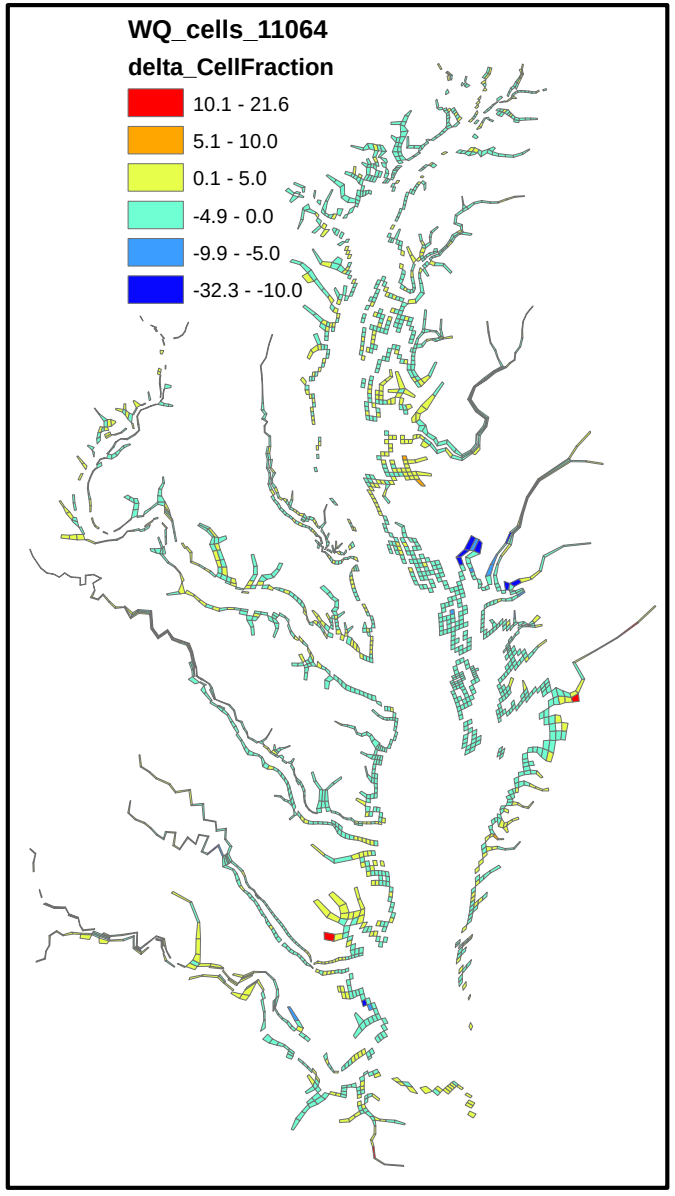
Wetland change by 2025 (SLR 22cm (in fraction of cell size)



Wetland change by 2055 (SLR 53cm (in fraction of cell size)



Wetland change by 2100 (SLR 100cm in fraction of cell size)



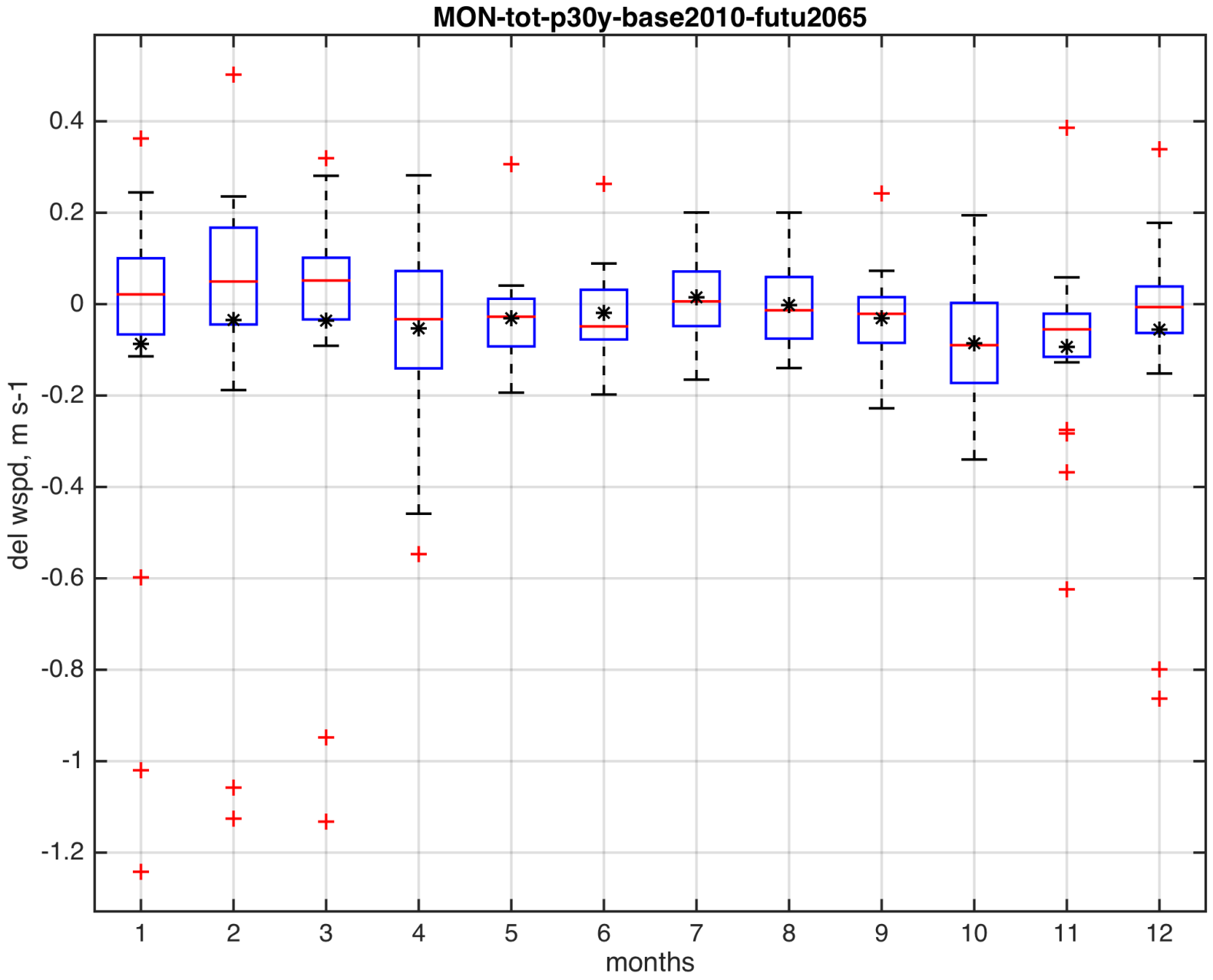
List of CMIP5 GCMs used in MACA wind speed projection (20 GCMs)

Model Name	Model Country	Model Agency	Atmosphere Resolution(Lon x Lat)	Ensemble Used
bcc-csm1-1	China	Beijing Climate Center, China Meteorological Administration	2.8 deg x 2.8 deg	r1i1p1
bcc-csm1-1-m	China	Beijing Climate Center, China Meteorological Administration	1.12 deg x 1.12 deg	r1i1p1
BNU-ESM	China	College of Global Change and Earth System Science, Beijing Normal University, China	2.8 deg x 2.8 deg	r1i1p1
CanESM2	Canada	Canadian Centre for Climate Modeling and Analysis	2.8 deg x 2.8 deg	r1i1p1
CCSM4	USA	National Center of Atmospheric Research, USA	1.25 deg x 0.94 deg	r6i1p1
CNRM-CM5	France	National Centre of Meteorological Research, France	1.4 deg x 1.4 deg	r1i1p1
CSIRO-Mk3-6-0	Australia	Commonwealth Scientific and Industrial Research Organization/Queensland Climate Change Centre of Excellence, Australia	1.8 deg x 1.8 deg	r1i1p1
GFDL-ESM2M	USA	NOAA Geophysical Fluid Dynamics Laboratory, USA	2.5 deg x 2.0 deg	r1i1p1
GFDL-ESM2G	USA	NOAA Geophysical Fluid Dynamics Laboratory, USA	2.5 deg x 2.0 deg	r1i1p1
HadGEM2-ES	United Kingdom	Met Office Hadley Center, UK	1.88 deg x 1.25 deg	r1i1p1
HadGEM2-CC	United Kingdom	Met Office Hadley Center, UK	1.88 deg x 1.25 deg	r1i1p1
inmcm4	Russia	Institute for Numerical Mathematics, Russia	2.0 deg x 1.5 deg	r1i1p1
IPSL-CM5A-LR	France	Institut Pierre Simon Laplace, France	3.75 deg x 1.8 deg	r1i1p1
IPSL-CM5A-MR	France	Institut Pierre Simon Laplace, France	2.5 deg x 1.25 deg	r1i1p1
IPSL-CM5B-LR	France	Institut Pierre Simon Laplace, France	2.75 deg x 1.8 deg	r1i1p1
MIROC5	Japan	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies,and Japan Agency for Marine-Earth Science and Technology	1.4 deg x 1.4 deg	r1i1p1
MIROC-ESM	Japan	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies	2.8 deg x 2.8 deg	r1i1p1
MIROC-ESM-CHEM	Japan	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies	2.8 deg x 2.8 deg	r1i1p1
MRI-CGCM3	Japan	Meteorological Research Institute, Japan	1.1 deg x 1.1 deg	r1i1p1
NorESM1-M	Norway	Norwegian Climate Center, Norway	2.5 deg x 1.9 deg	r1i1p1

From Maria Herrmann

Wind change by 2050

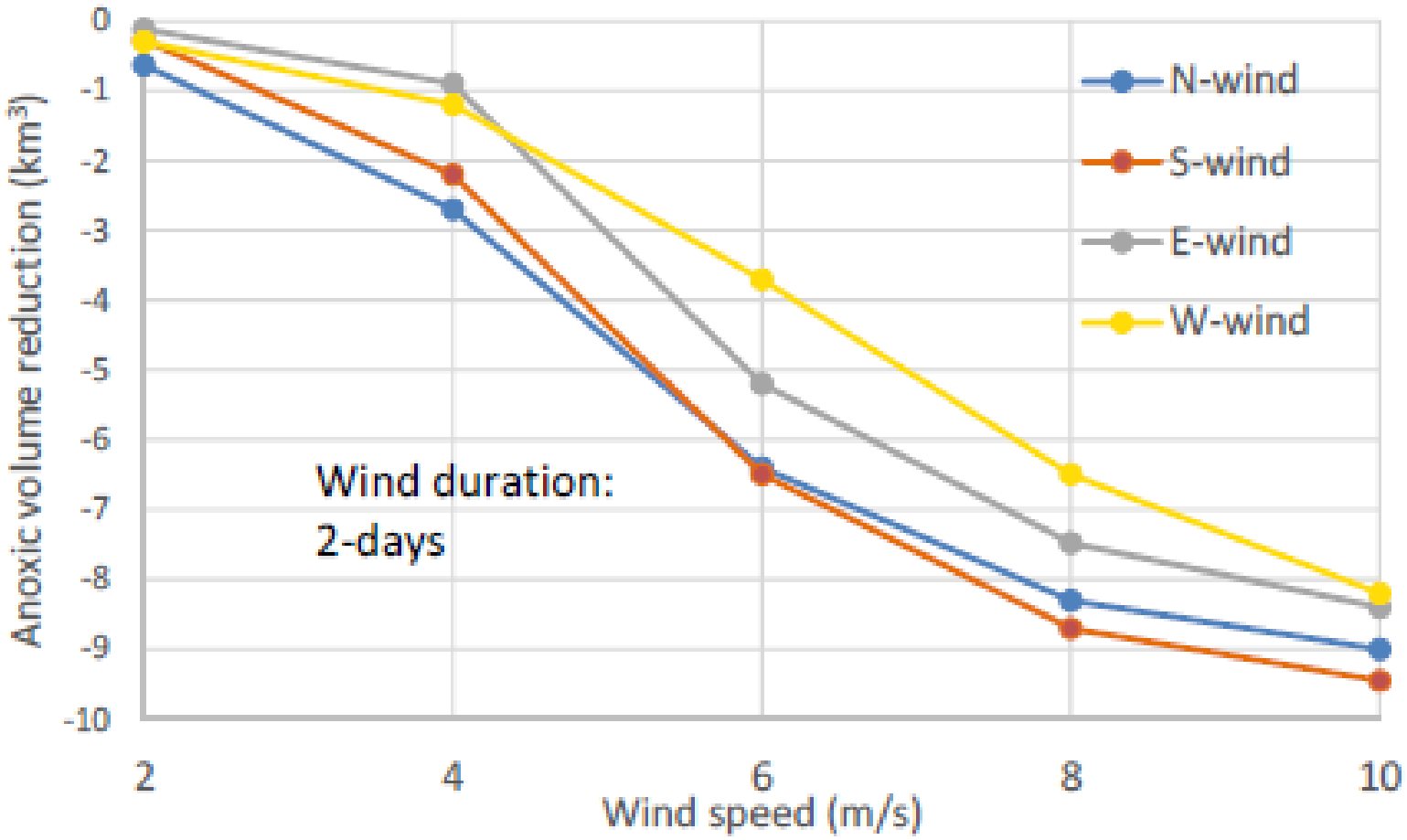
Only a few centimeters per second



From Maria Herrmann

Effect of wind speed on hypoxia volume in Chesapeake Bay

- **Wind of 2 m/s does not have significant impact on hypoxia, >4 m/s have.**
- **Only a few cm/s change under climate change condition.**
- **Therefore, a minor issue that will not be investigated at this point.**



Wang et al., 2016

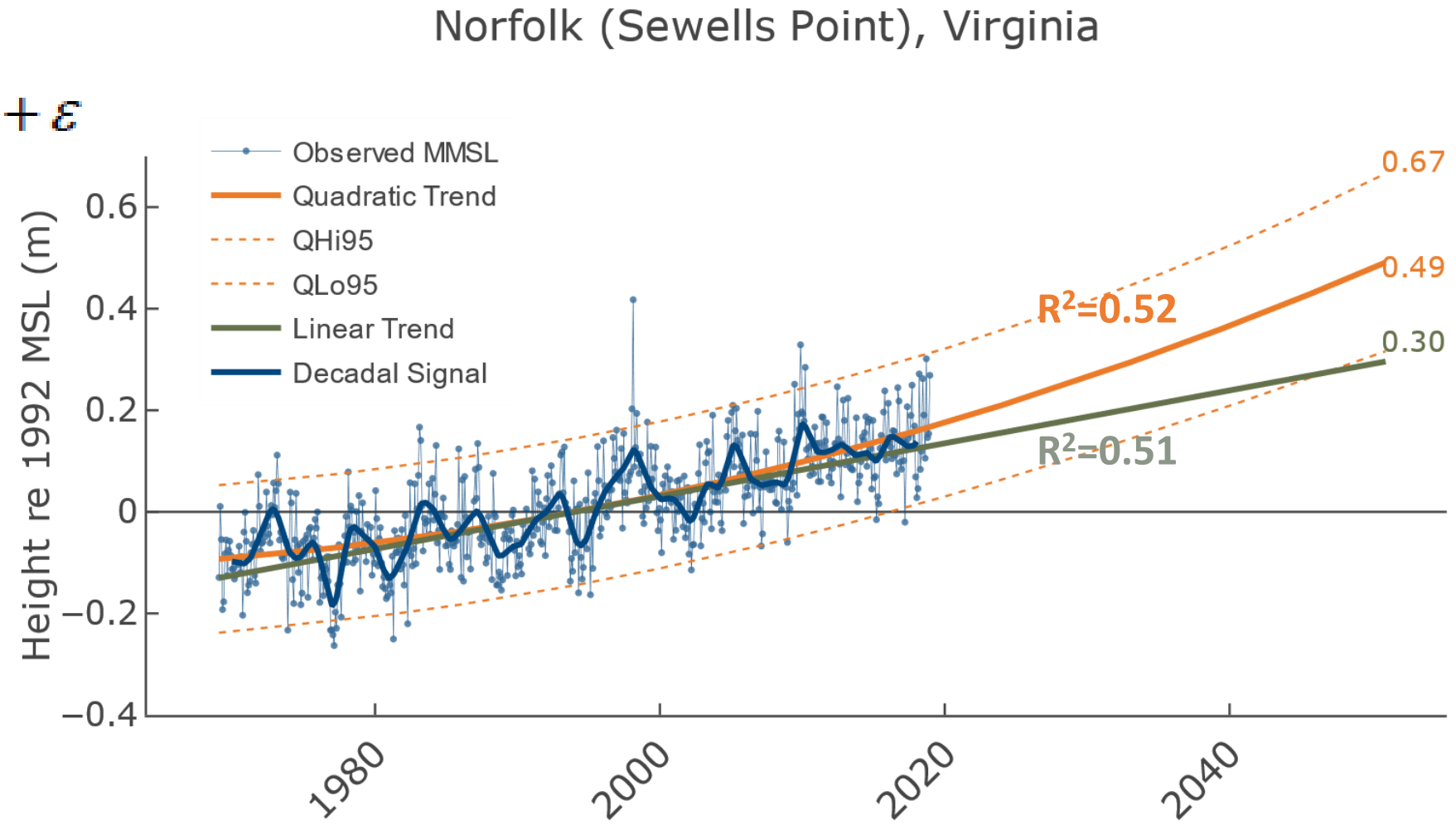
Quadratic function projection, Norfolk

$$h = \beta_0 + \beta_1 t + \tfrac{1}{2}\beta_2 t^2 + \varepsilon$$

β_1 = 5.203 mm/yr

β_2 = 0.12 mm/yr^2

(with 2018 data.
Boon, Mitchel and others)



https://www.vims.edu/research/products/slrc/localities/norfolkva/index.php

Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites (Kopp et al. 2014)

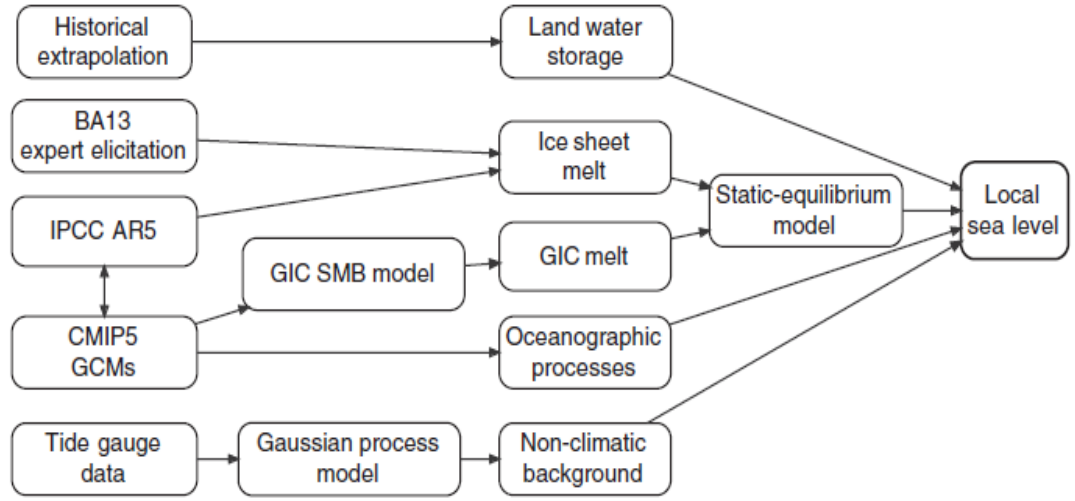
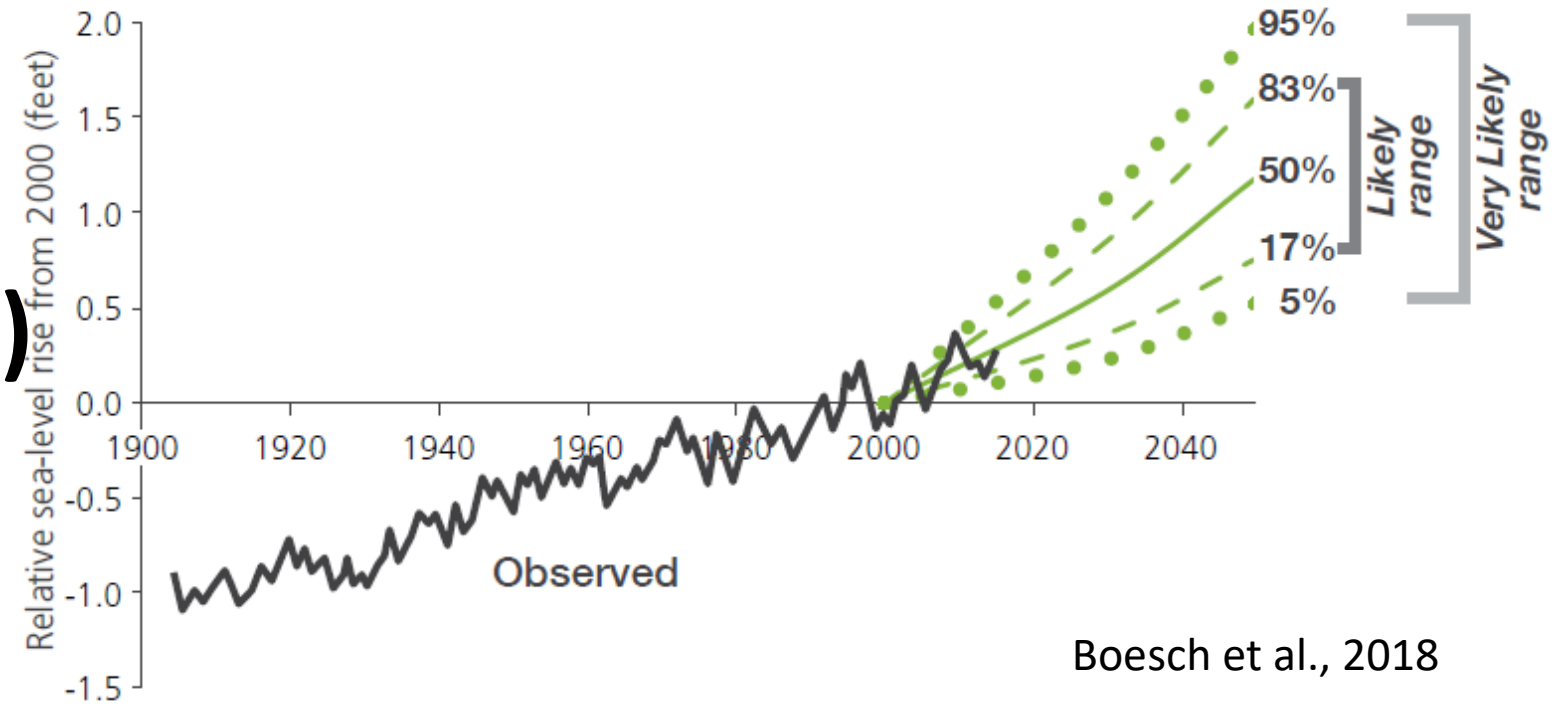


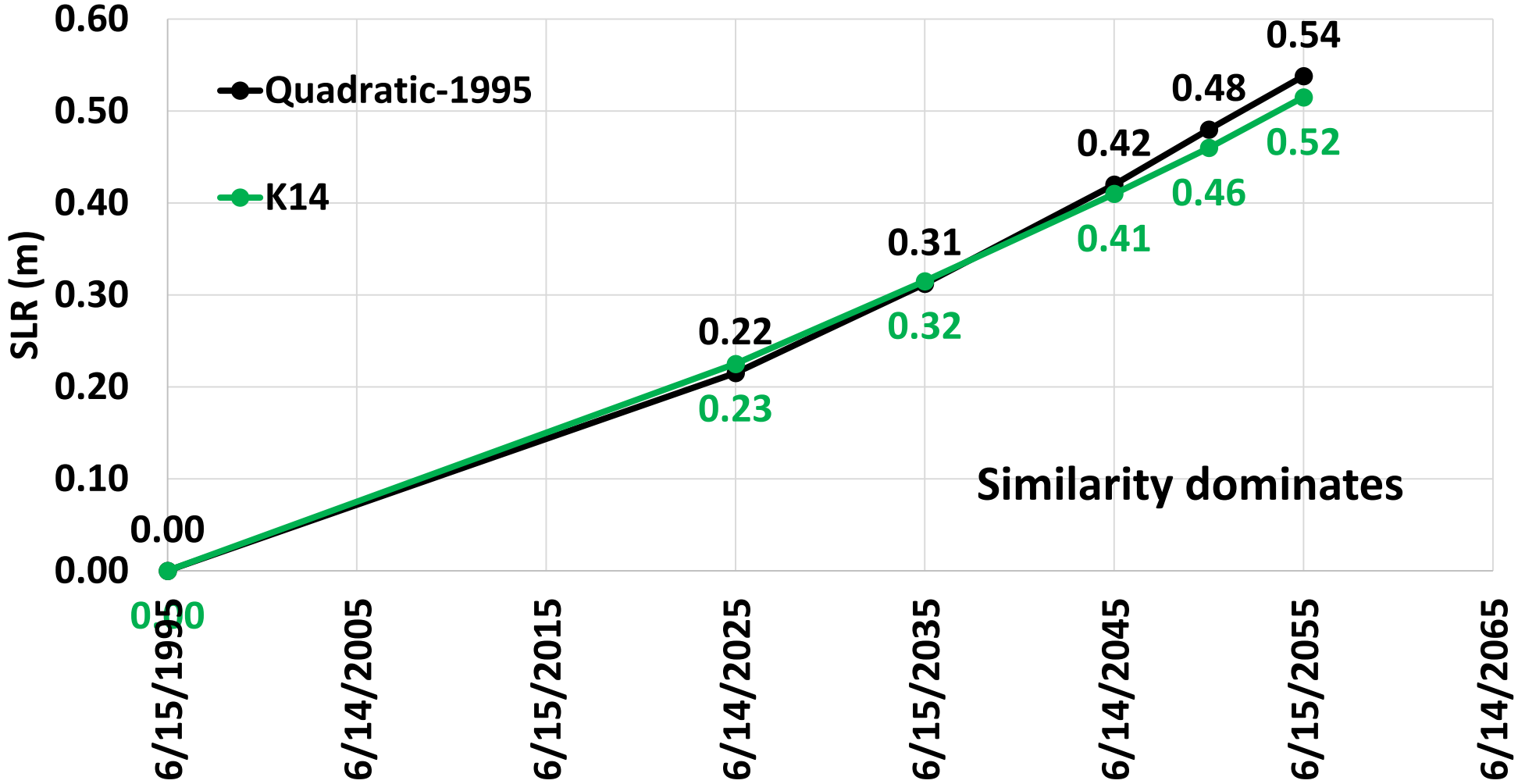
Figure 1. Logical flow of sources of information used in local sea-level projections. GCMs, global climate models; GIC, glaciers and ice caps; SMB: surface mass balance.



BA13: *Bamber and Aspinall* [2013].
GIC: glacier and ice cap.
SMB: surface mass balance.

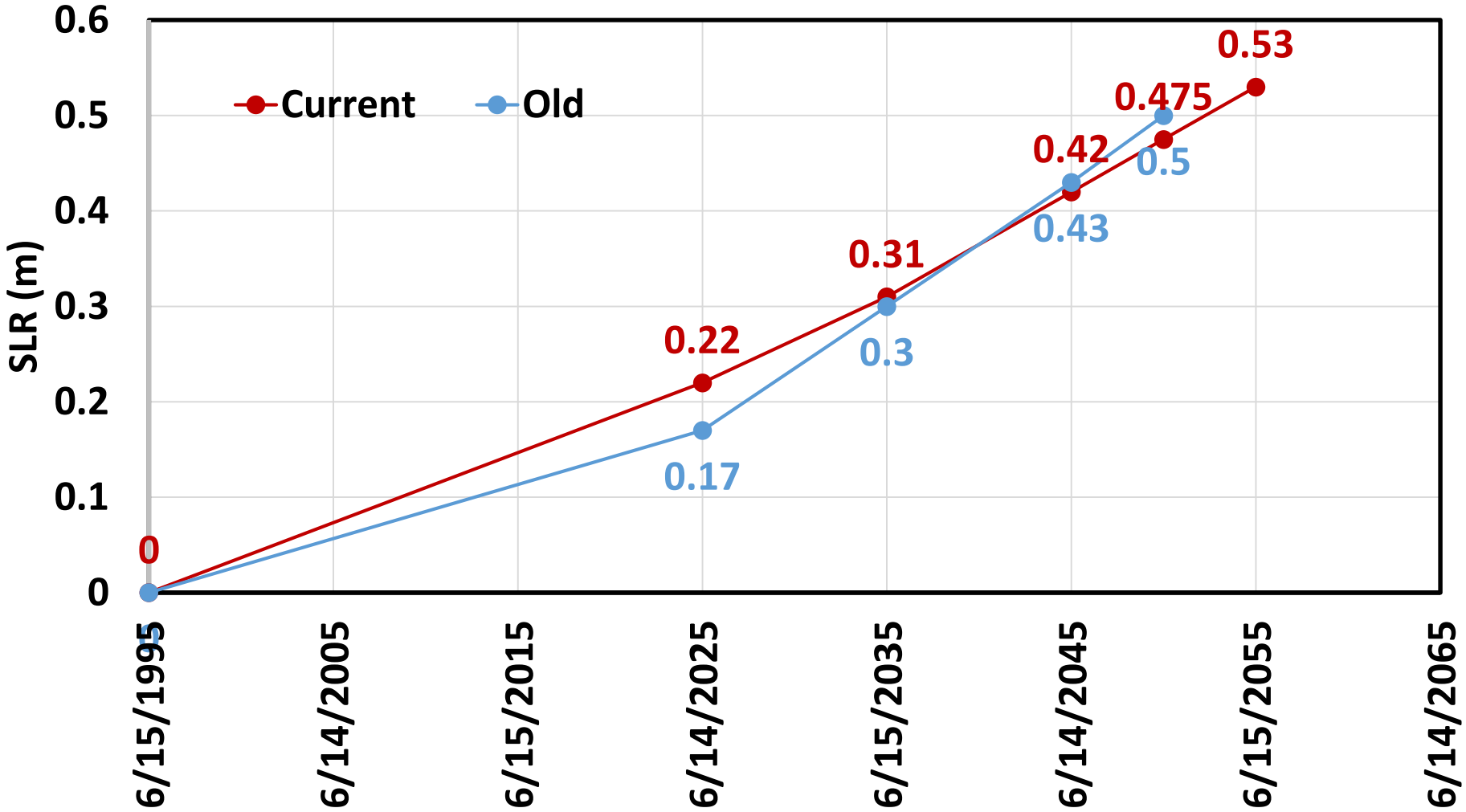
Boesch et al., 2018

SLR future projection-Sewells Point



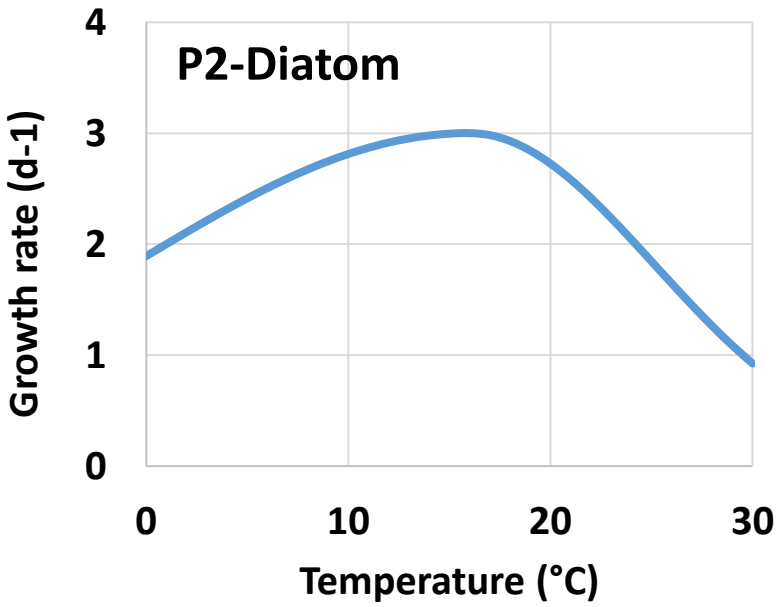
SLR future projection-Sewells Point

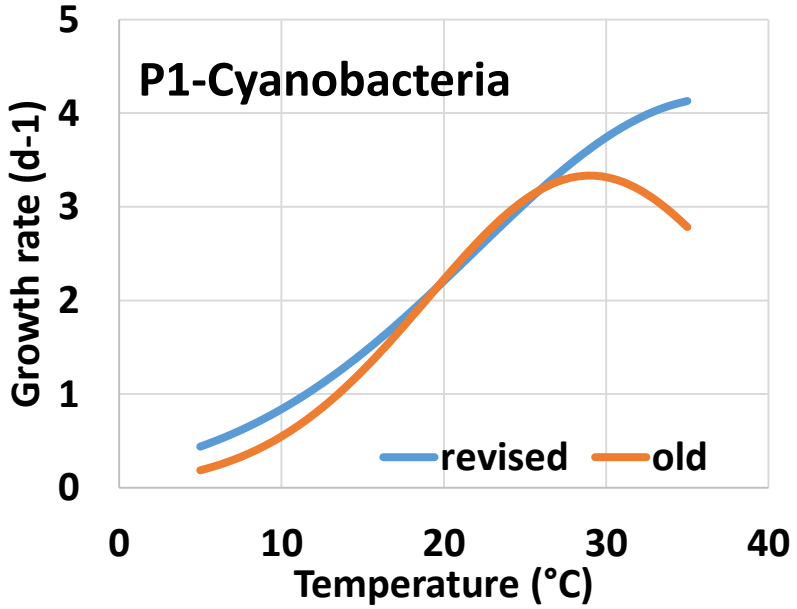
(Average between quadratic and K14 projections, based on recommendation of Climate Resiliency Group)

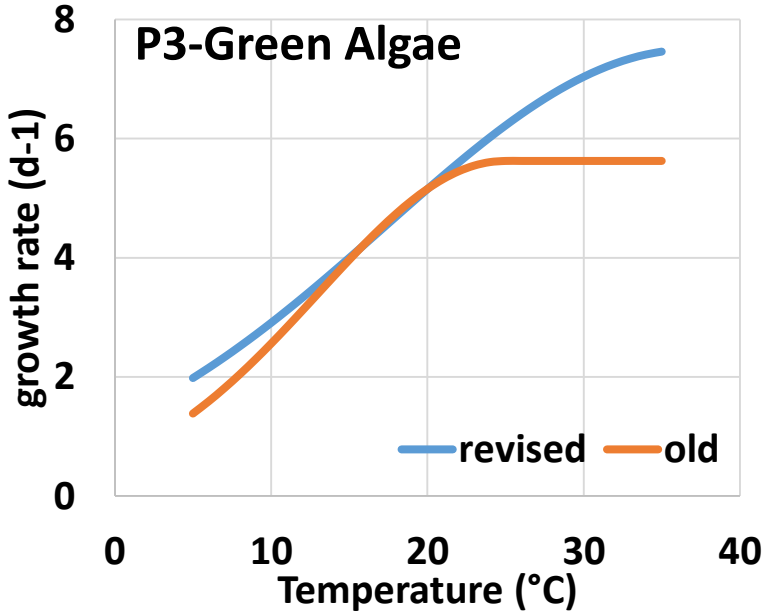


Revised temperature control on phytoplankton growth rate

$$f(T)=\begin{cases} e^{-k1(T-Topt)^2}, T \le T_{opt} \\ e^{-k2(T-Topt)^2}, T > T_{opt} \end{cases}$$







SATC recommendation

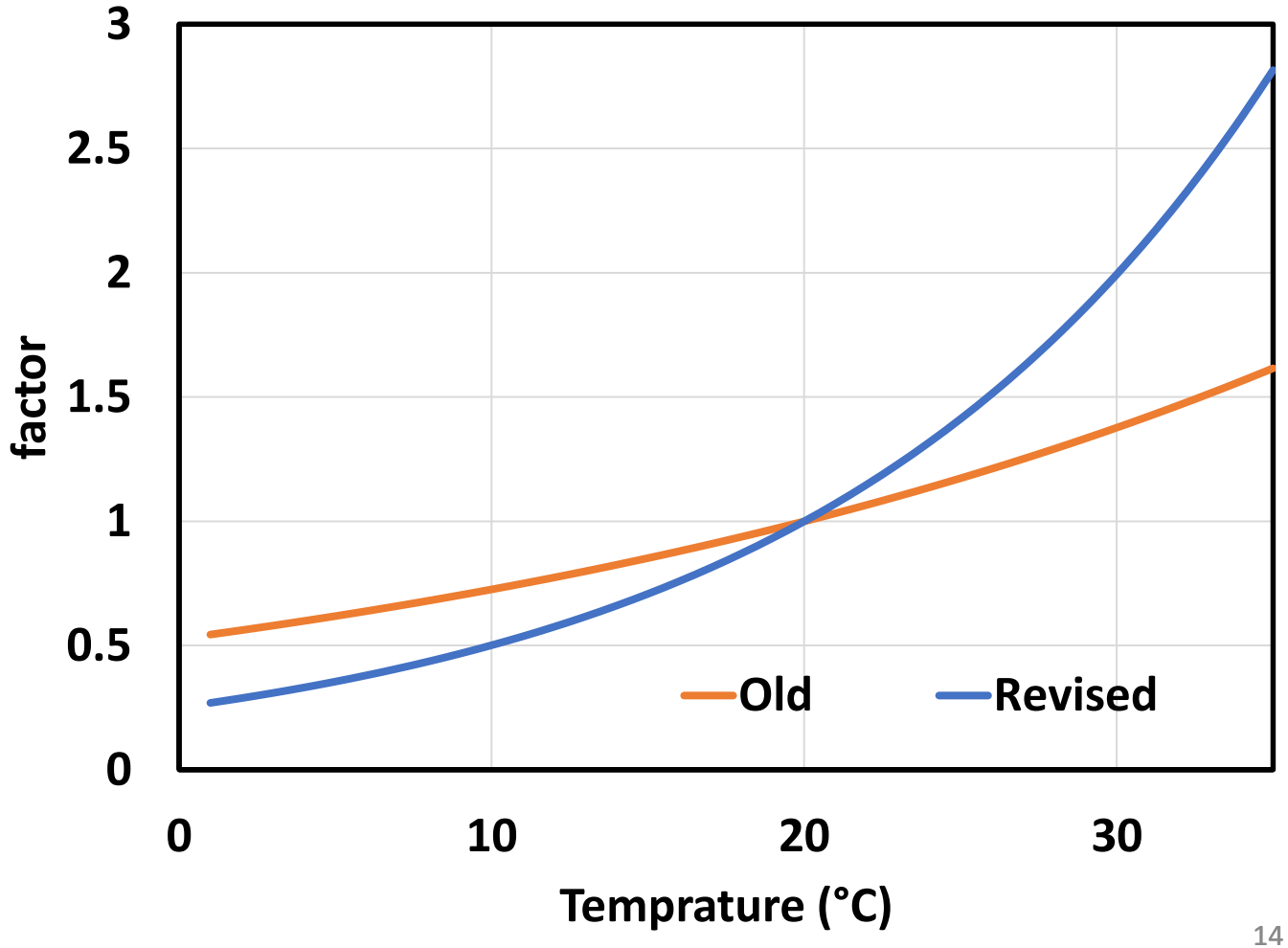
From Carl Cerco

Revised temperature control on phytoplankton respiration

$$a_{res} = \alpha_r B e^{kr(T - To)}$$

Old: kr=0.0322
Revised: kr = 0.069

STAC recommendation



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