

Modeling climate change effects on Delta phytoplankton in CASCaDE II

Lisa Lucas, USGS
Wim Kimmerer, SF State Univ.
Hans Los, Deltares



Image Courtesy Mick van der Wegen

10095 ft

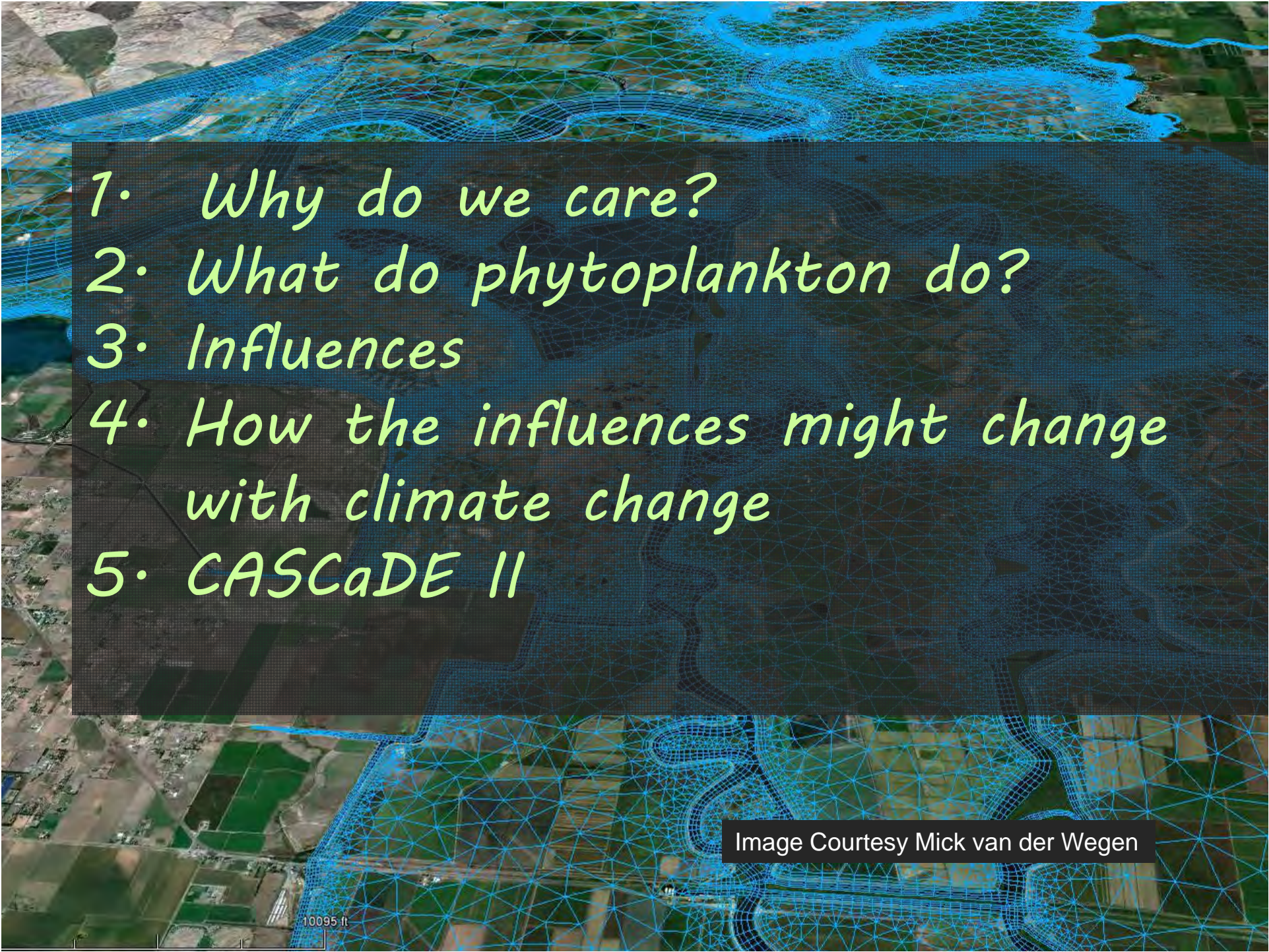
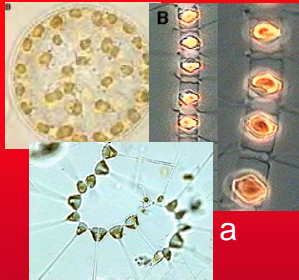
- 
1. *Why do we care?*
 2. *What do phytoplankton do?*
 3. *Influences*
 4. *How the influences might change with climate change*
 5. *CASCaDE II*

Image Courtesy Mick van der Wegen

*Why do we care about
phytoplankton????*

*Phytoplankton production is the dominant energy source to the Delta's pelagic food web**

Phytoplankton
(food for zooplankton)



Zooplankton
(food for small fish)



*Hungry, bummed
out zooplankter*

Threatened
fish



Delta smelt

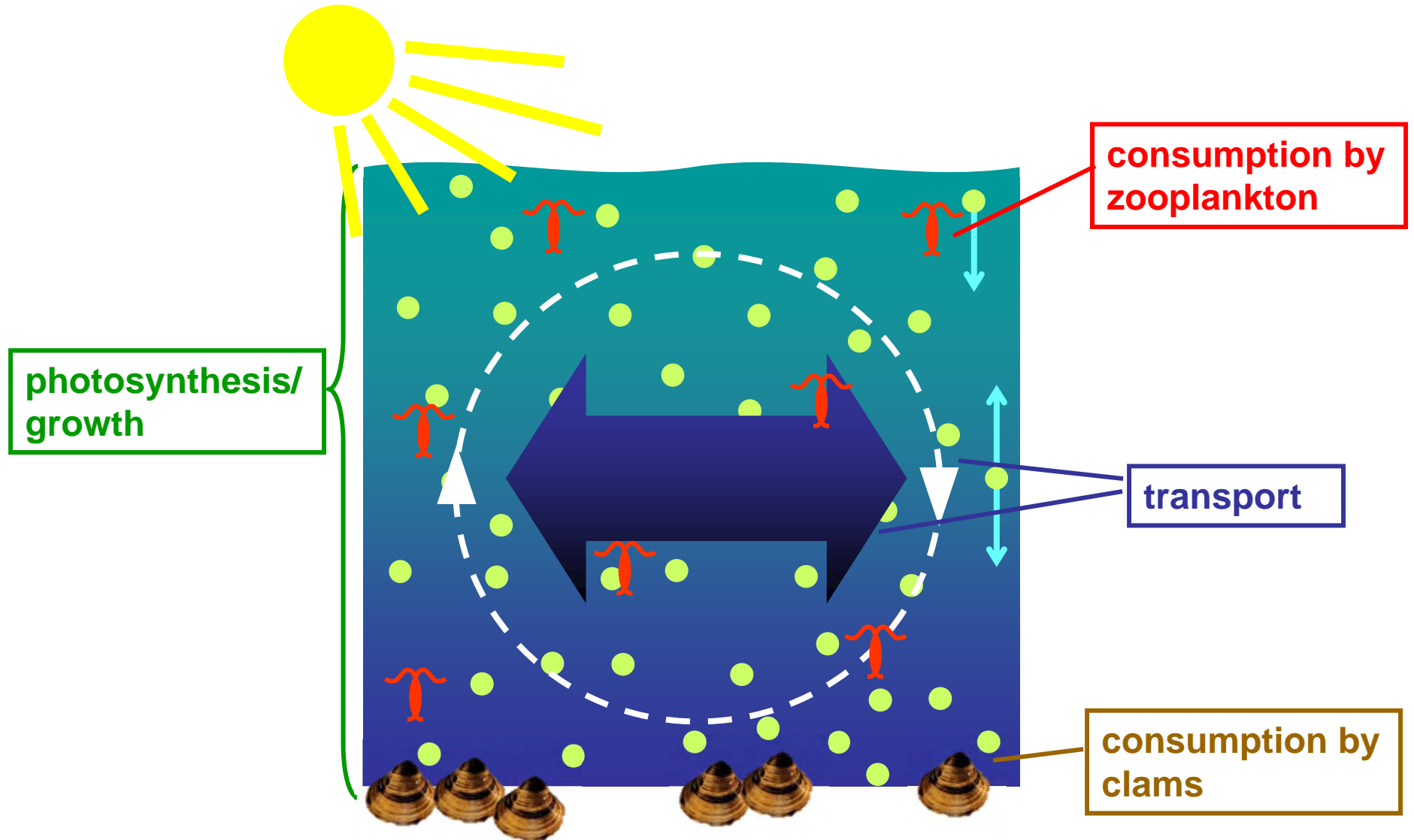
Hungry, lonely fish

*Mueller-Solger et al. 2002, Sobczak et al. 2002

a: http://www.smhi.se/oceanografi/oce_info_data/plankton_checklist/ssshome.htm

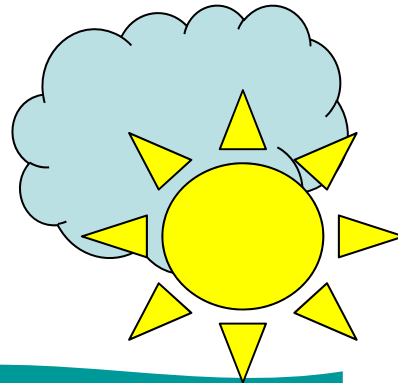
What do phytoplankton do????

Those things phytoplankton do



*What are major the influences
on Delta phytoplankton????*

Growth



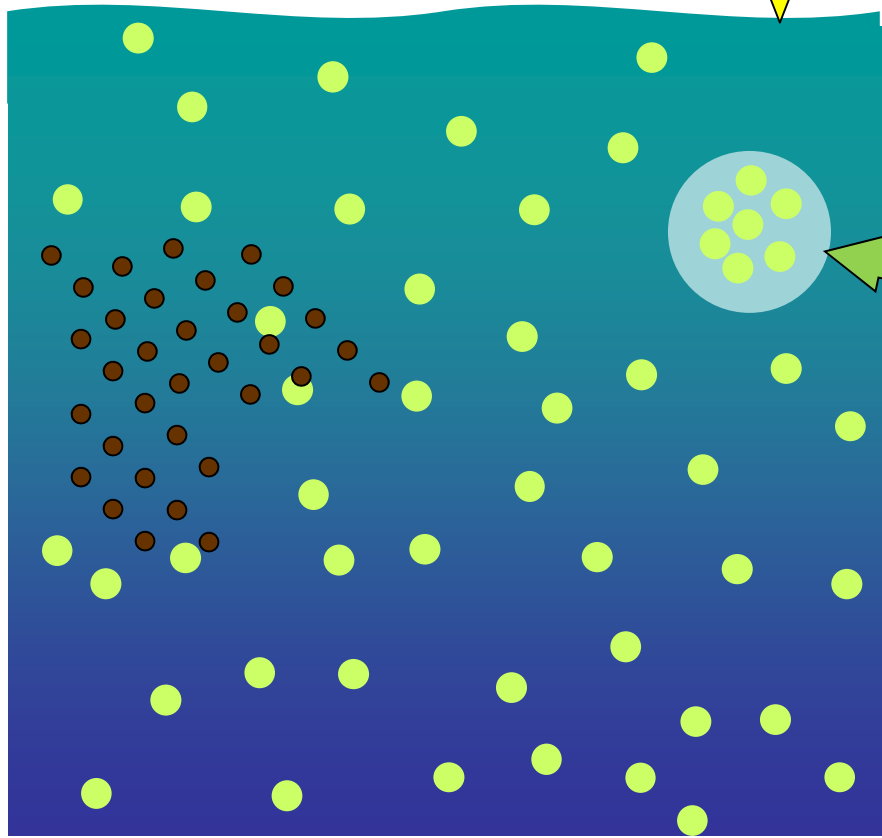
light
(PAR) =
f(solar
radiation)

water
temp. =
f(air temp.,
solar rad.,
etc)

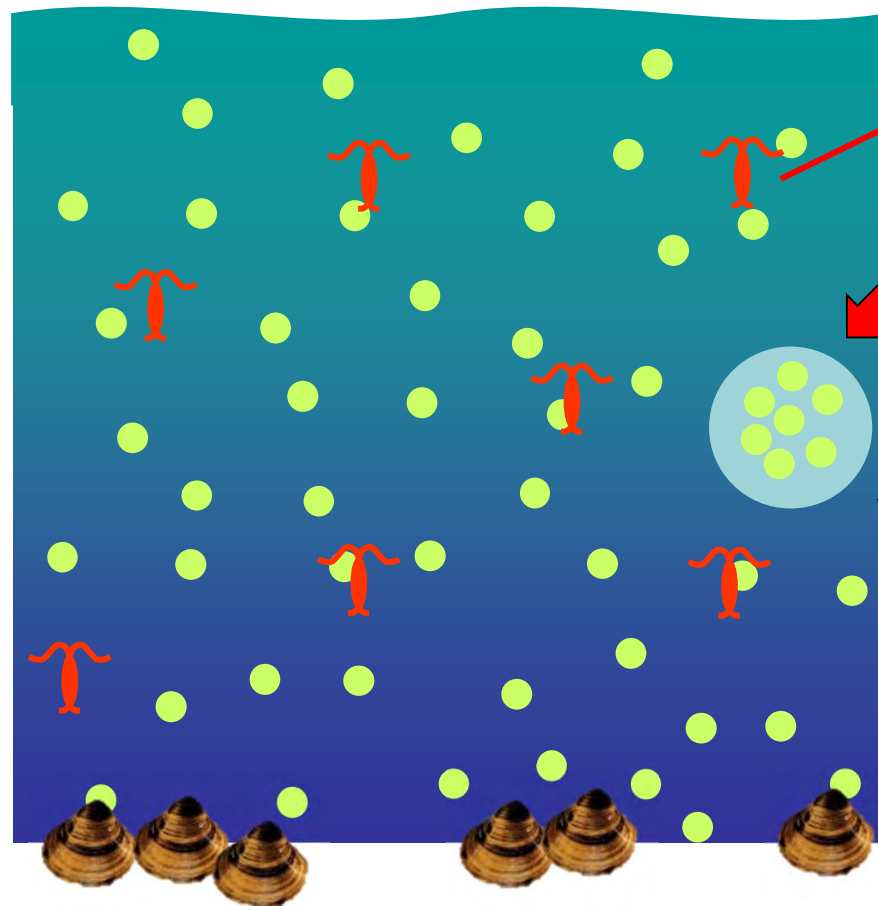
growth

light
extinction =
f (suspended
sediment,
phytoplankton
biomass,
dissolved)

nutrients
(N, P, Si)



Consumption



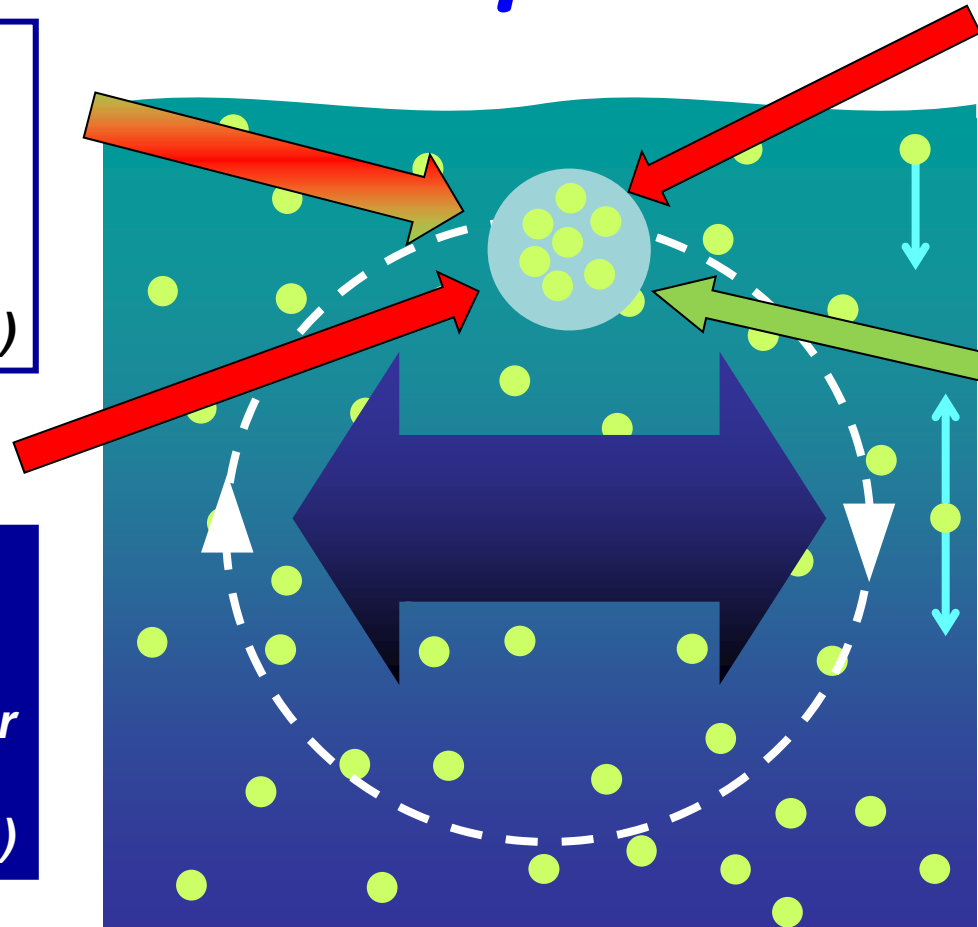
pelagic (water column) grazing =
f (zooplankton biomass, water temp., cell size, predation, ...)

benthic (bottom) grazing =
f (clam biomass, water temp., water depth, mixing, stratification, food...)

Transport

horizontal circulation=
f (river flow, tides, wind, horizontal density variations)

vertical mixing=
f (tides, wind, river flow, vertical density variations)

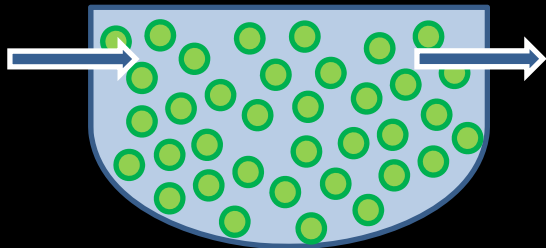


sinking =
f (species, environmental conditions)

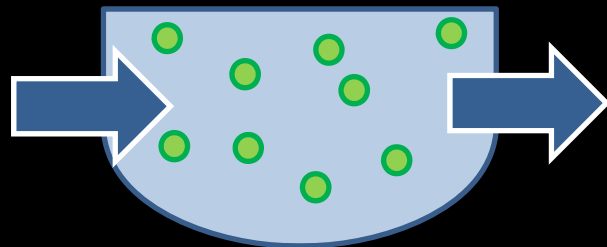
motility/ buoyancy=
f (species, environmental conditions)

Residence time is a double-edged sword

If growth > loss

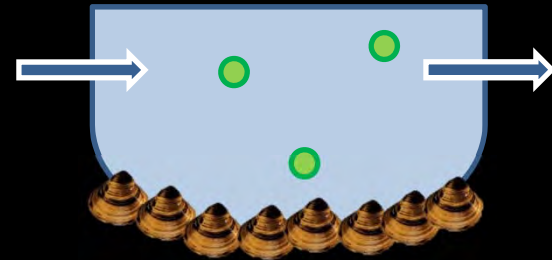


slow flow, long residence time

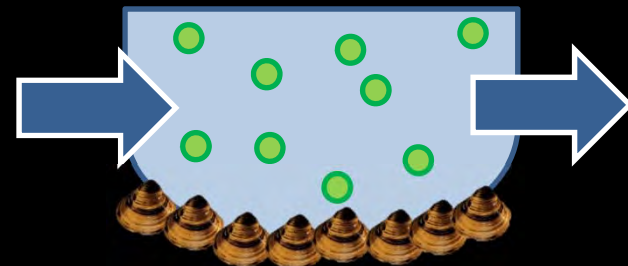


fast flow, short residence time

If loss > growth

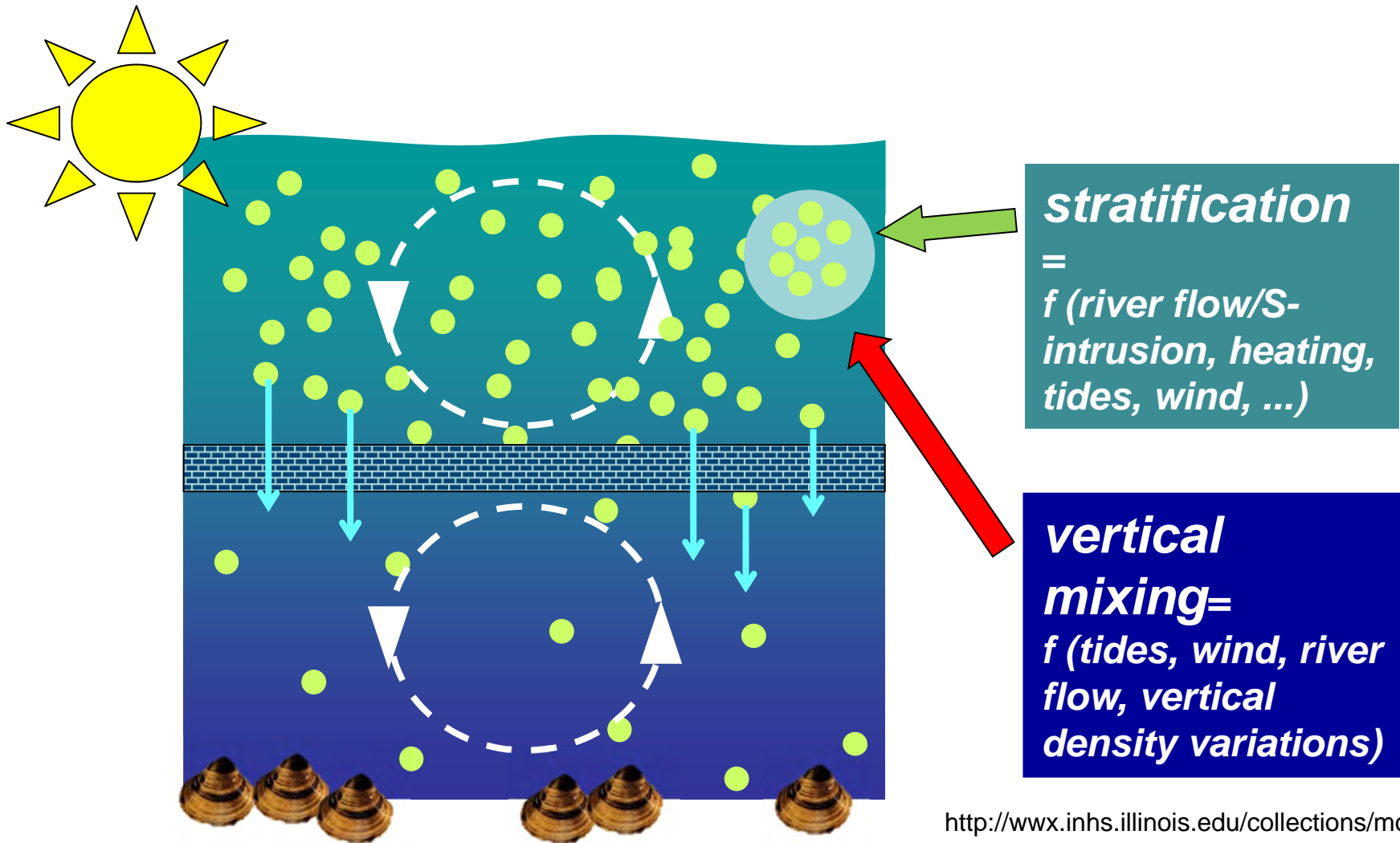


slow flow, long residence time



fast flow, short residence time

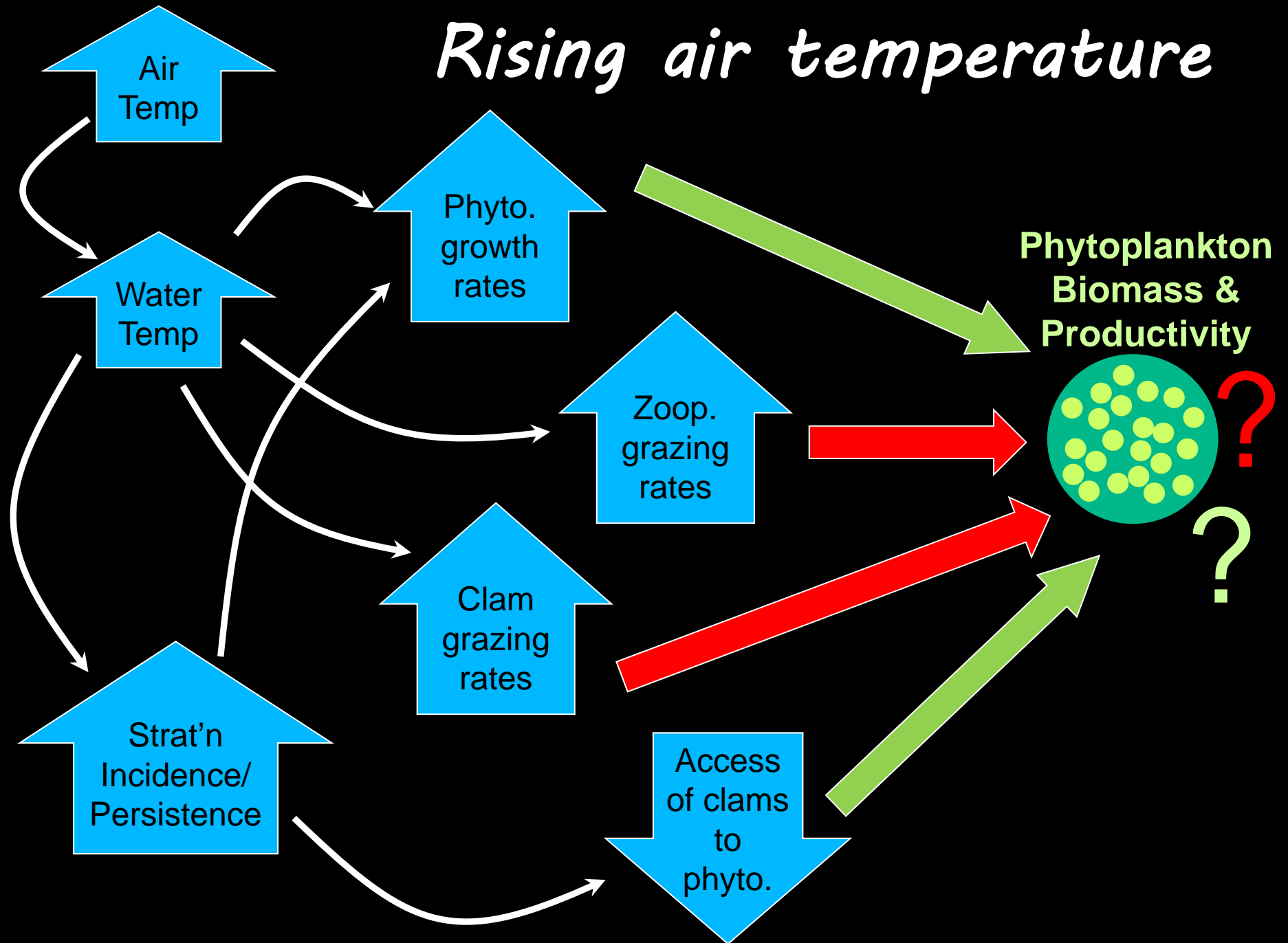
Turbulent mixing vs Density stratification



*How might those influences
shift with climate change???*

(Conceptual models)

Rising air temperature



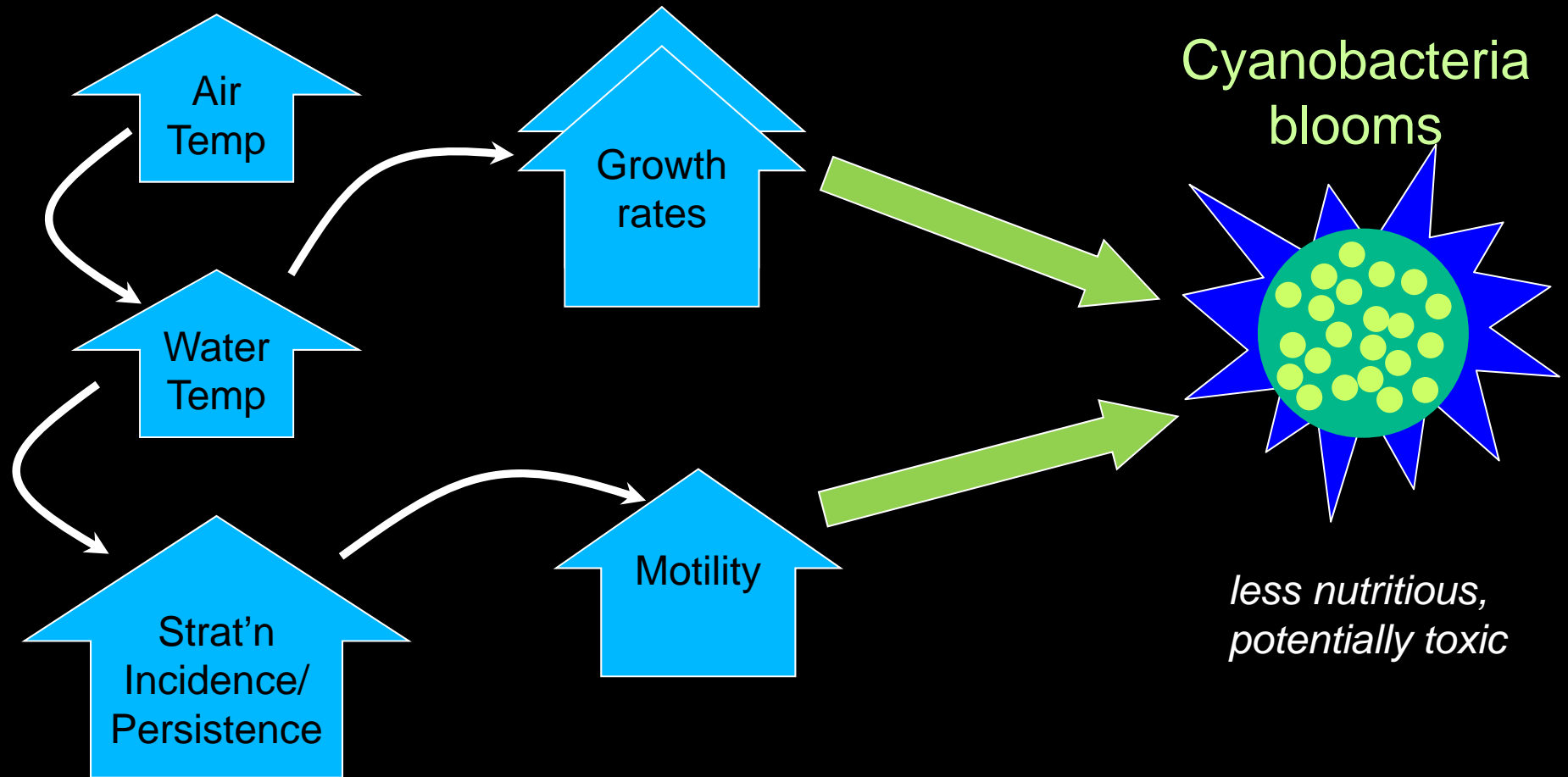
CLIMATE

Blooms Like It Hot

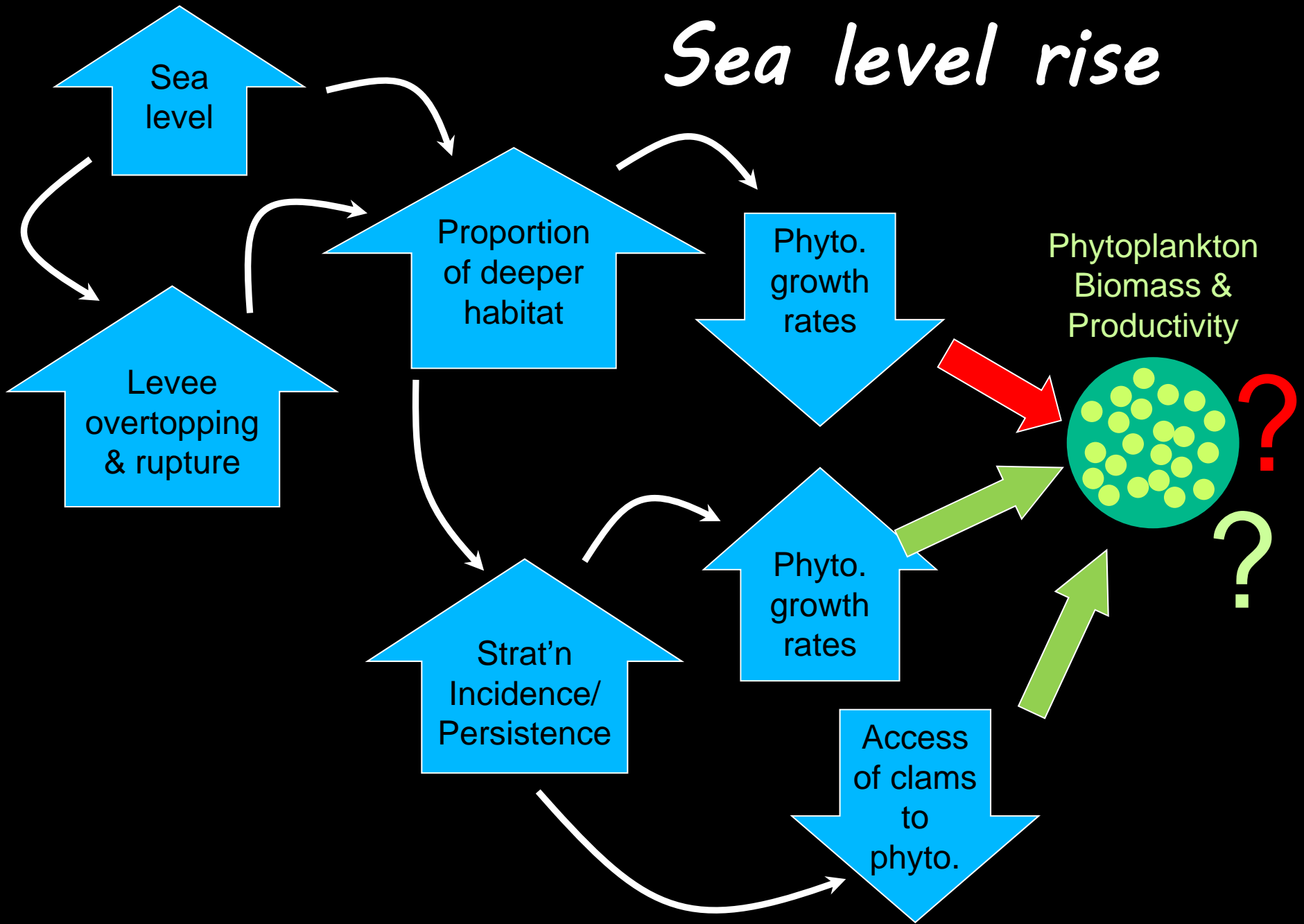
Hans W. Paerl¹ and Jef Huisman²

A link exists between global warming and the worldwide proliferation of harmful cyanobacterial blooms.

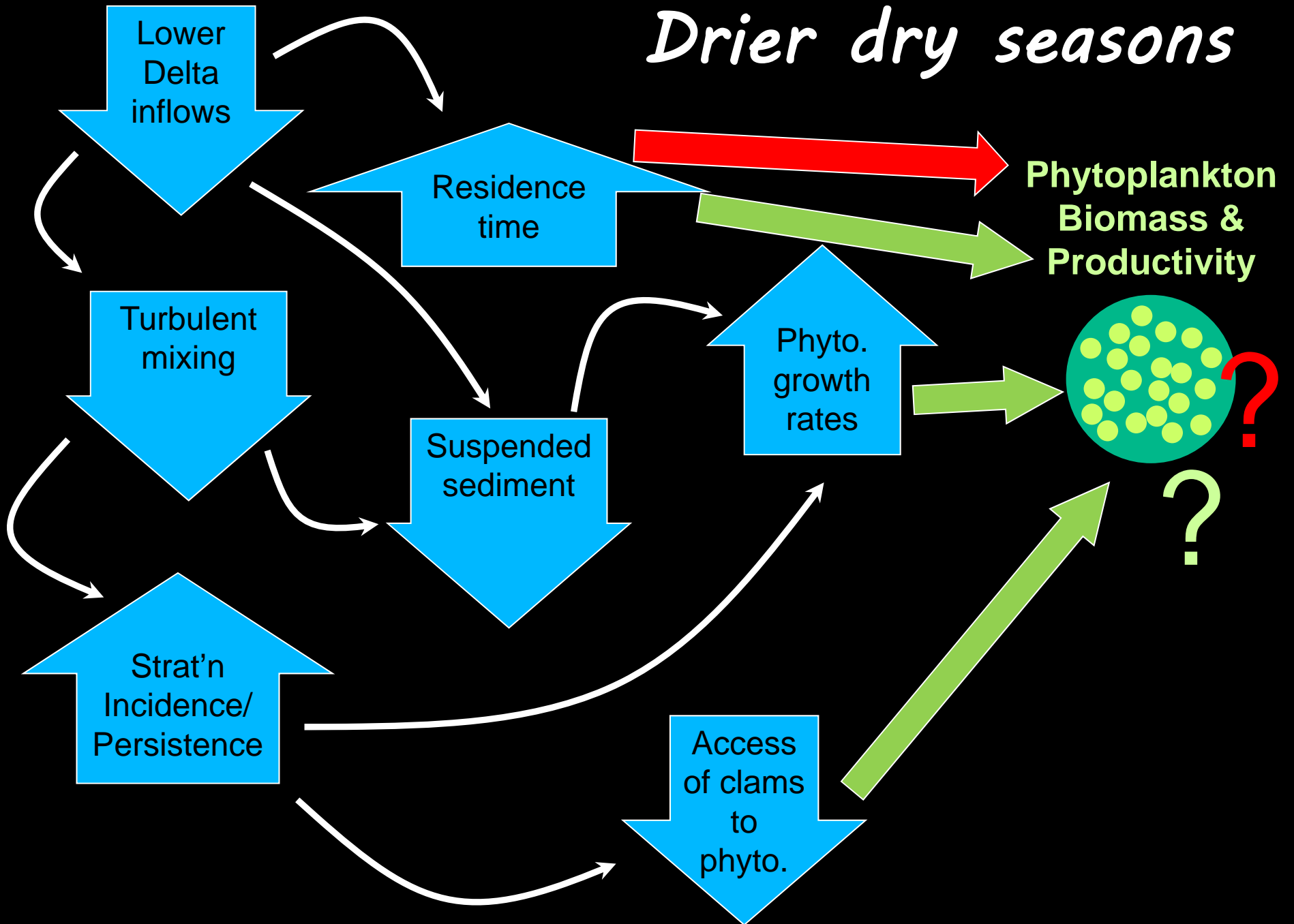
www.sciencemag.org **SCIENCE** VOL 320 4 APRIL 2008
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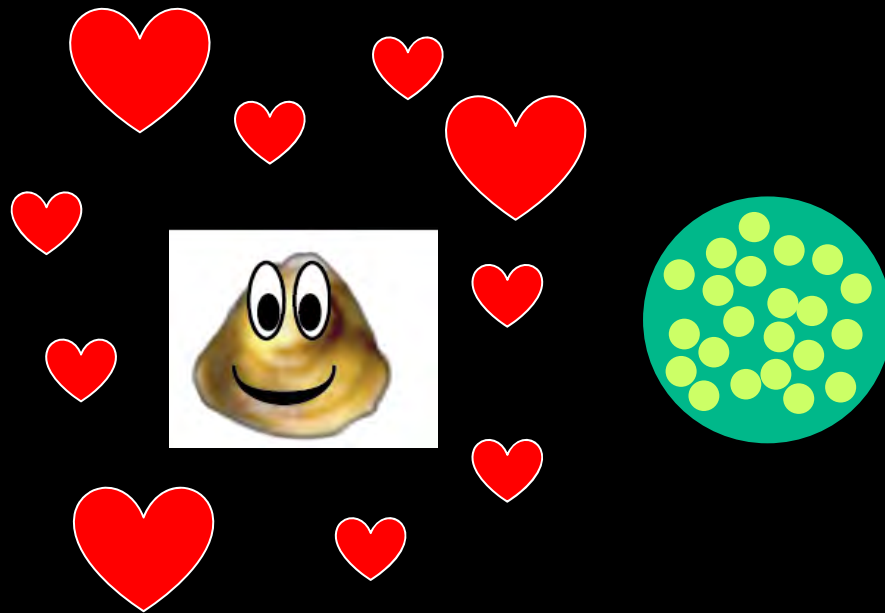
Sea level rise



Drier dry seasons



A little detail



If more phytoplankton is created, then more clams might be created as well!

Other climate influences

- wind ?
- solar radiation ?
- salinity intrusion

Other climate influences

- wind ?
- solar radiation ?
- salinity intrusion

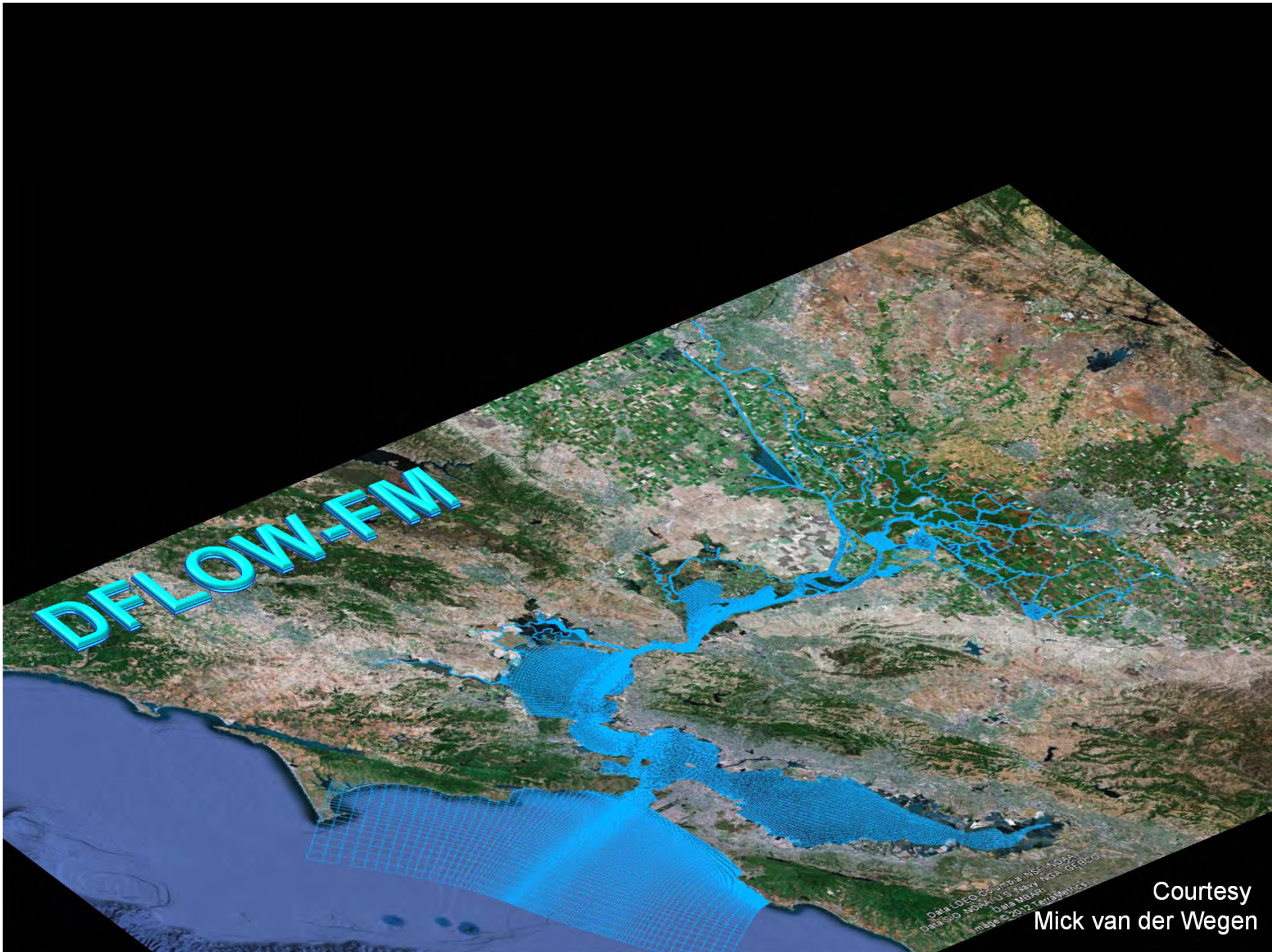
Other interacting influences

- tunnels
- earthquake induced levee breaches & multiple flooded islands
- ecosystem restoration
- long-term sediment decline
- other exotic species
- interactions with ocean
- nutrient management

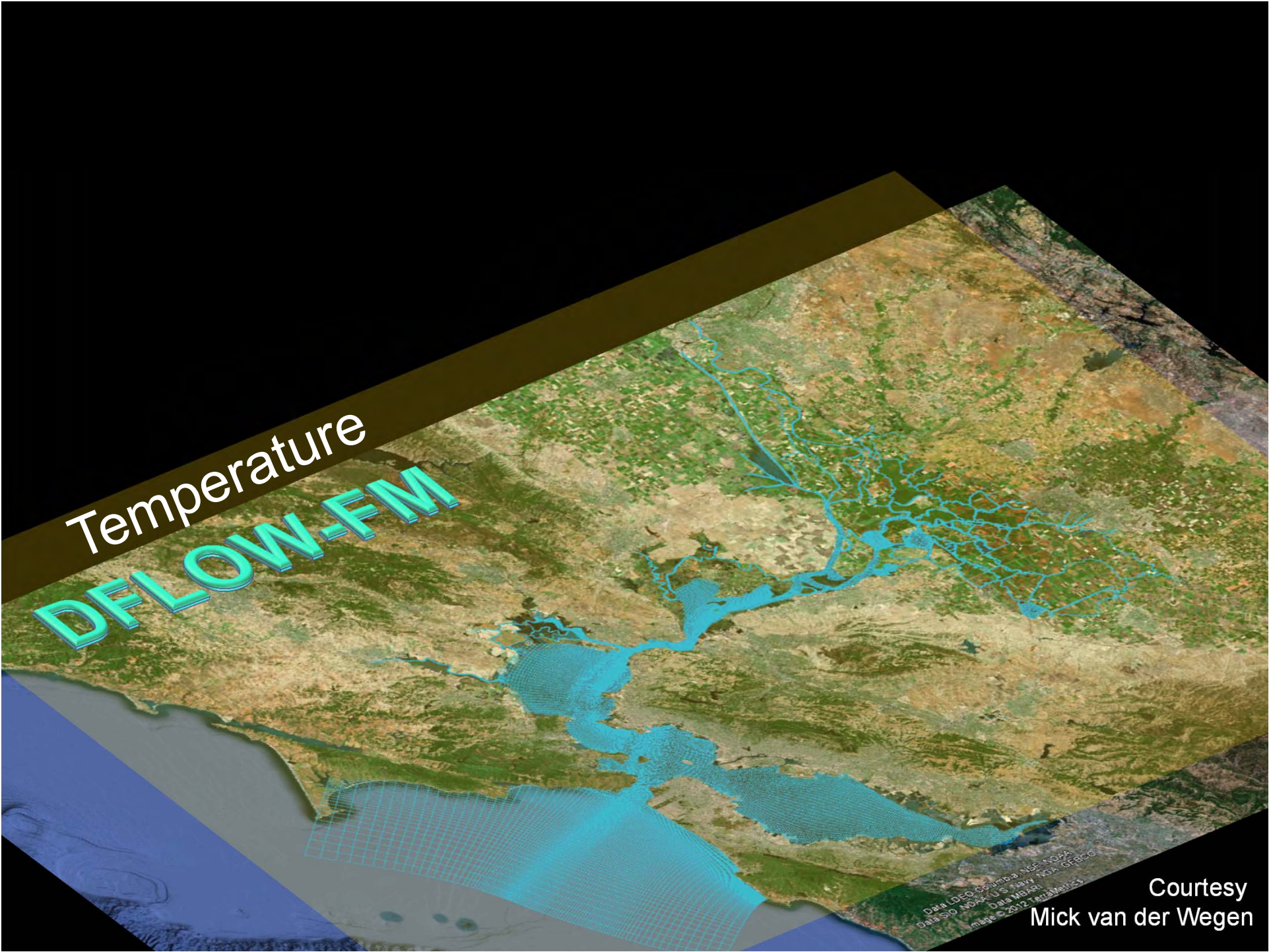
*What are we doing about this
in CASCaDE II?*

(in progress)

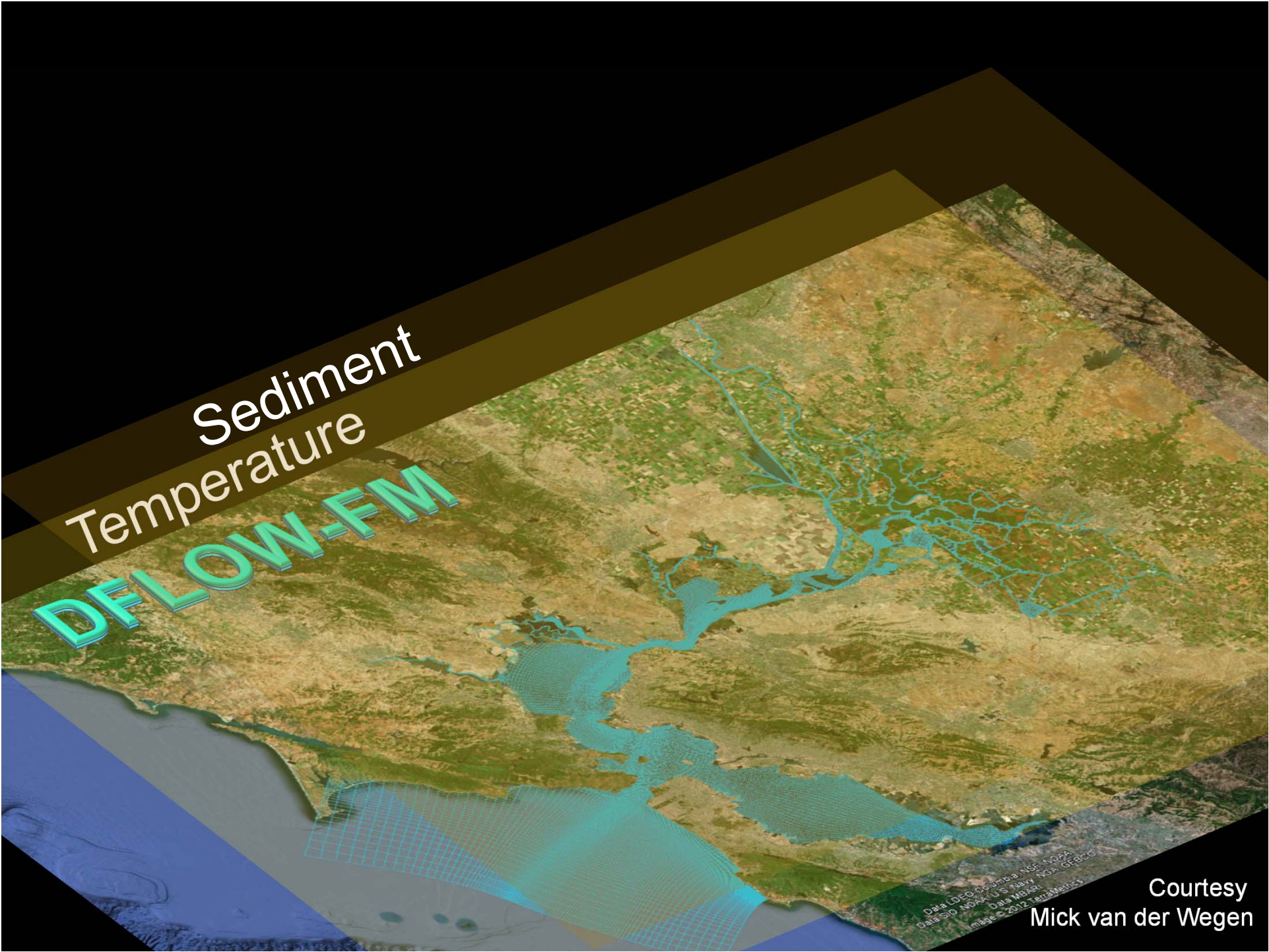
How might phytoplankton biomass and productivity in the Delta change in response to changing climate & physical configuration?



Courtesy
Mick van der Wegen



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Mick van der Wegen

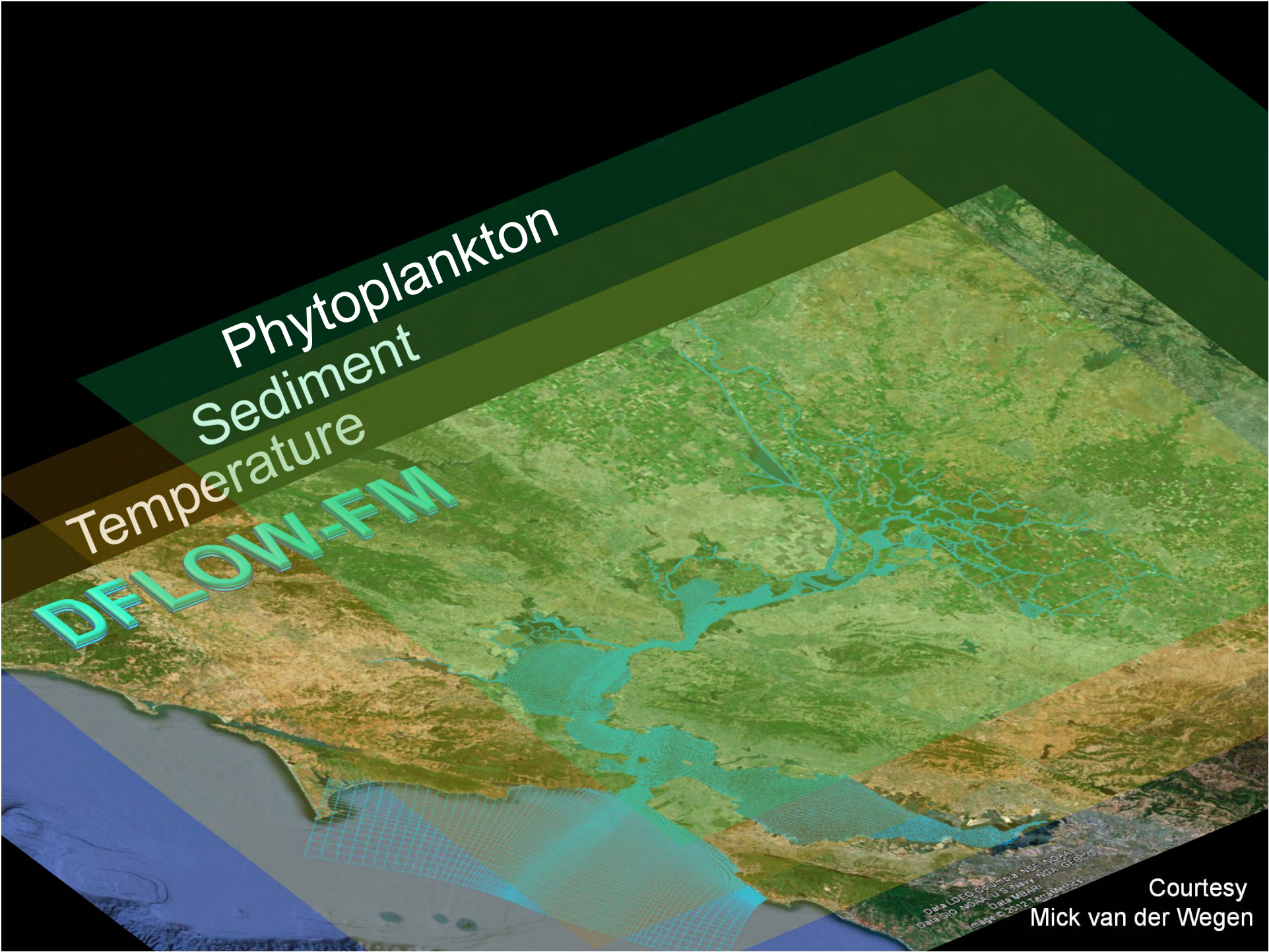


Sediment
Temperature

DELOW-FM

Data CDEG Columbia NSF NOAA
Data SIO NOAA US Navy NSA GEBCO
Data WRI
Image © 2012 TerraMetrics

Courtesy
Mick van der Wegen

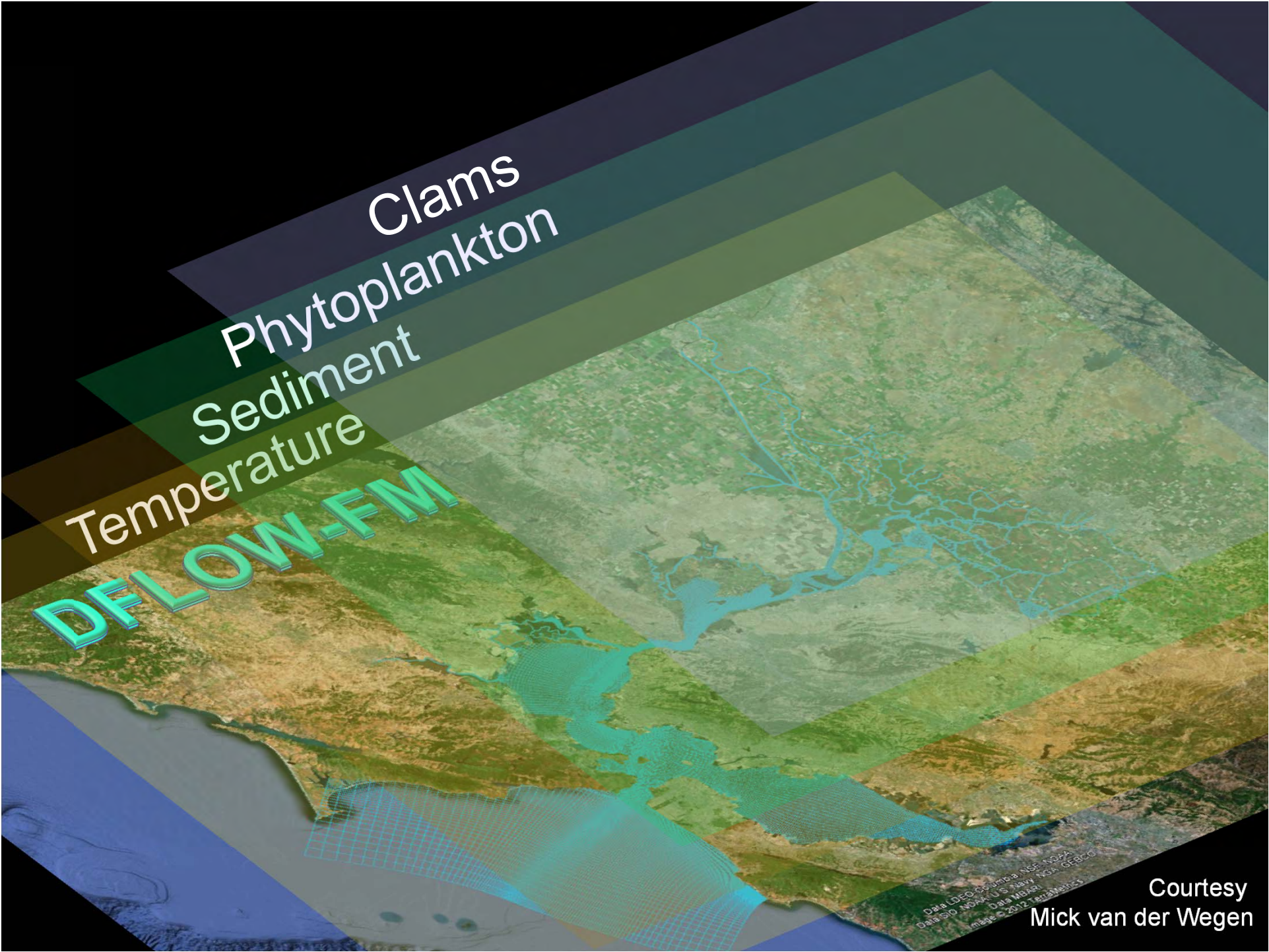


Phytoplankton
Sediment
Temperature

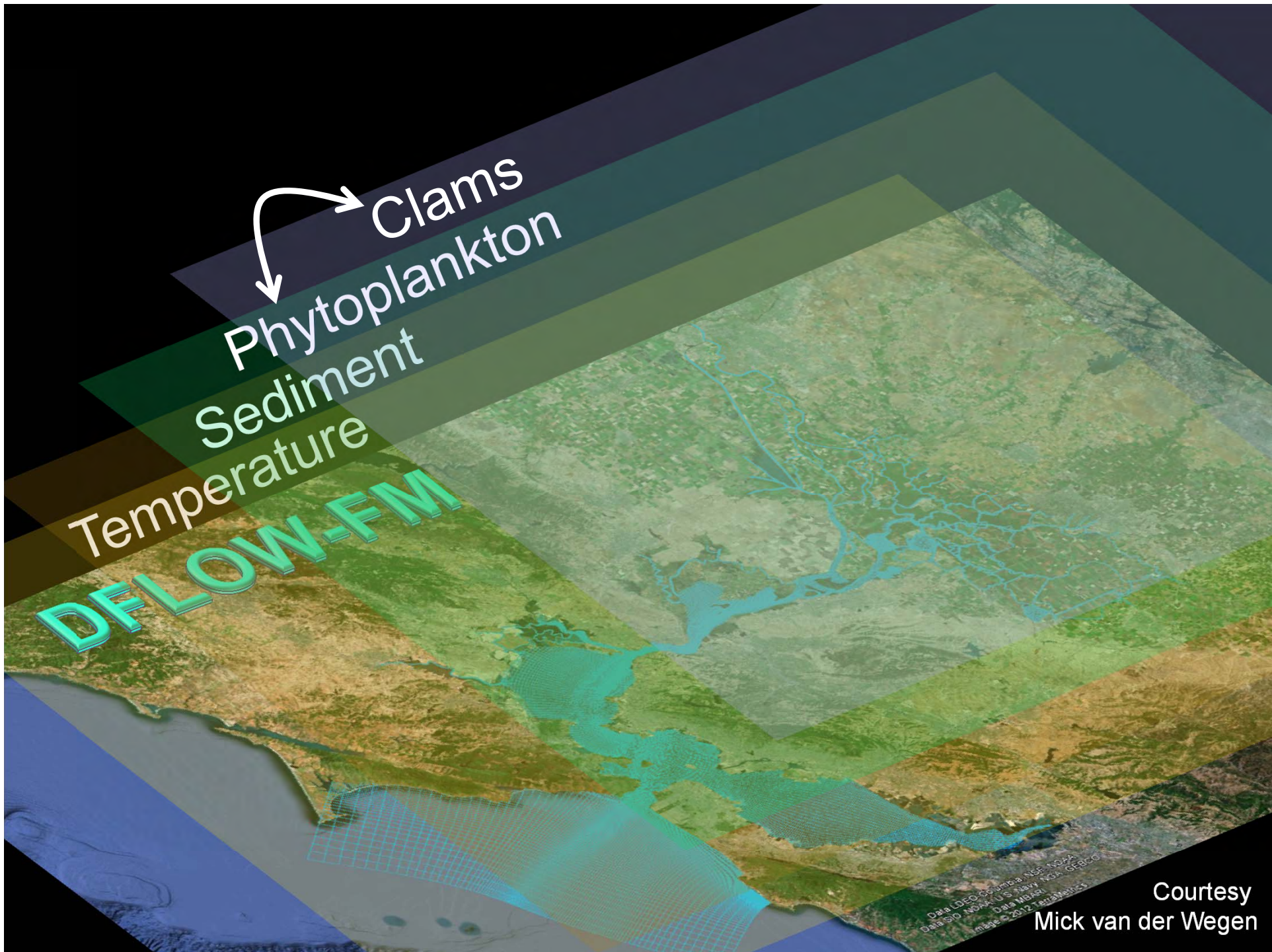
DELOW-FM

Data CDEQ, Columbia NSF, NOAA
Data SIO, NOAA, US Army, NASA, GEBCO
Data NOAA
Image © 2012 Terratechics

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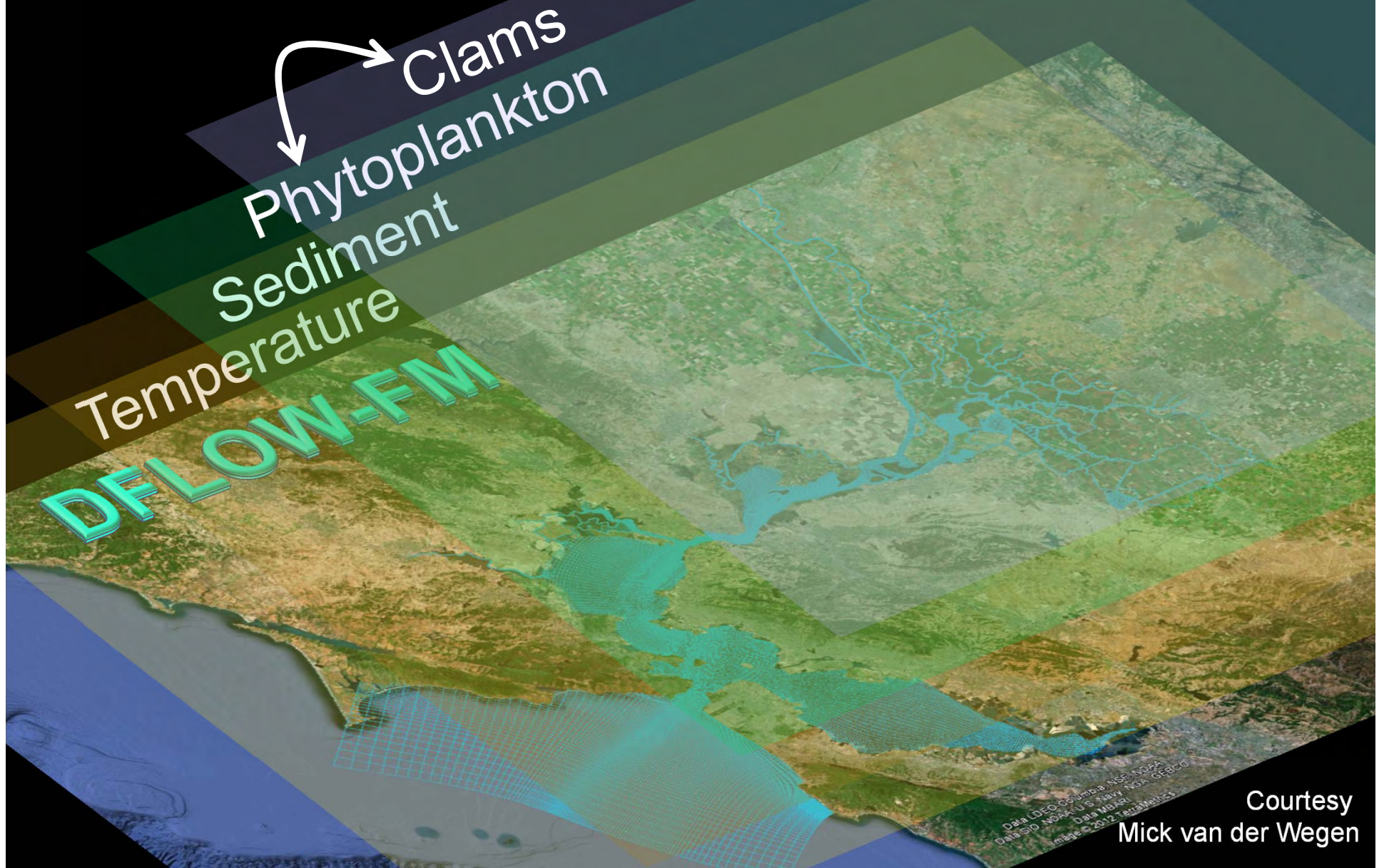


Courtesy
Mick van der Wegen



Courtesy
Mick van der Wegen

DELWAQ-BLOOM-DEB-HABITAT



Courtesy
Mick van der Wegen

Conclusions

1. Phytoplankton are a nexus amongst numerous physical, biological and chemical influences
2. Potential influences of climate change could increase OR decrease phytoplankton productivity
3. Climate change will interact with other large, ongoing forces on system

Thank you



National Research Program
Priority Ecosystem Science
Toxic Substances & Hydrology



Delta Stewardship Council/
Delta Science Program

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