Discovering the Relationship between Plankton Community Composition and Global Climate Functions

Transcript

For Kassondra Watson's PSU Student Research Symposium presentation

hi how's everybody doing
uh thank you for being here my name is
Kassondra watson and i'm glad to be here
too
i'm pretty excited to have this
opportunity to present
about what i've been working on for the
past eight months uh discovering the
relationship between
plankton community composition and
global climate functions
in real time with nasa's
future plankton aerosols clouds and
ecosystems
mission which is also known as pace
um i am a i am a student researcher
with ann thompson's lab the microbial
oceanography lab
and i've been doing that for about a
year i'm also a biology student
at psu so here's a brief overview of
my topics today so first i'll give you
and i
i'll explain what my fellowship award
was
and what i have to what i propose to do
for it

and then i get to then i'll get to give
you some background information about
phytoplankton
remote sensing and ocean color and
that'll lead me into
a major problem that a lot of
oceanographers are facing right now
and then i can talk about pace some more
and i can tell you about how
i think it will help solve some of those
problems
and then go into some applications pace
so uh the student academic research
review
fellowship award was granted to me
from the oregon's nasa space grant
consortium
in september and so my proposed topic
for a 10-page research review is what
will the
nasa's peace mission reveal about the
relationship between
phytoplankton community composition
carbon cycling and
climate change and so this has actually
been a lot of work and
a lot of new i've gained a lot of new
skills
um so what are phytoplankton anyway
so phytoplankton fido means plant-like
because they're photosynthetic
and plankton means drifter because
they're subject to the movement of
the water in which they live um they're
usually microscopic

single-celled organisms i have a couple
examples on this slide here so
if you've ever heard of diatomaceous
earth that's going to be the silica
cell walls of this diatom which is a
type of algae
it's actually a rather large sized
phytoplankton one of the
largest or it is the largest group
and then on the total counterpart of
that
one of the smallest phytoplankton is
known as prochlorococcus
my advisor ann thompson focuses on a lot
of her research on
prochlorococcus and this image was taken
by her and mad props for being able to
get a photo
of cell division right there great
um so the thing that really that unites
all phytoplankton is that they're
photosynthetic
right so they all have the ability to
take the sunlight's energy and use it to
break the bond between carbon and oxygen
from carbon dioxide in the air and so
they use that carbon
and they assimilate it into their own
bodies and
use it for their own cellular processes
and so they really
are there are the ones fixing carbon
from the atmosphere and putting it into
the food chain so they're really the
foundation of the food web in

marine ecosystems this image here i
don't really
think it's important for you to know all
the acronyms and numbers
i just think it is very helpful
explaining
a really important process called the
biological carbon pump
so i really just want you to look at so
this is the surface
ocean where the phytoplankton are they
get eaten by
zooplankton that are a little deeper
and then eventually these things will
either aggregate together
and sink or larger and larger and larger
organisms will eat them
and accumulate that carbon and as they
accumulate it up the food chain they're
going to be going down
in depths and so the most efficient way
really to get
the greenhouse gas carbon dioxide out of
our atmosphere
is with the biological carbon pump
here there's also a microbial carbon
pump or microbial loop but i don't have
time to talk about it unfortunately
um so some things i'm really interested
in is how plankton communities
change over time and space so
seasonally there's always going to be
changes if it's warmer
there's more sunlight um and also brings
in new nutrients

um with seasonal ships so
that's that plays a large role
ecological classic
and ecological interactions like
competition predator prey
but um particularly mutual symbiosis and
and even more so endosymbiosis it's
actually
very very very prevalent among
phytoplankton and
microbes in general um
some potentially human-caused
human factors that could influence
plankton communities
are ocean temperatures ocean acidity
ocean acidity can actually could
potentially eliminate some types of
phytoplankton that are really important
pollution puts in tons and tons of
nutrients so
that can lead to huge blooms that sounds
really great
lots of carbon right and no actually
kills everything else that's in there so
and that creates
harmful algal blooms often and that'll
often lead to
waters that don't have any oxygen in
them so it's really important there is
dissolved oxygen
in waters for the communities so
this animation i think is a really
beautiful representation of
the flow and the changes in
plankton community compositions

throughout space and time
so up here is a venn diagram so if you
have this light blue you have
one main type of plankton you have this
darker blue
it's another con coccolithophores
yellow is going to be diatoms and red is
going to be dinoflagellates these
this light blue is uh picoplankton which
includes the procore caucus so
if you can see these overlay colors that
means there's more than one of these
types of plankton in the same place at
the same time
this whitish peach color here that means
that all four
types of phytoplankton are in the same
spot
so we're starting in 1997 in january
so you can really see this yellow
changing as we move into the summer
and then when we get into winter it gets
really yellow in the south
um so that's moving like some of those
factors that i just discussed
so that's going to be your seasonal
changes the amount of light
and temperatures and these the
rivers that flow into here oftentimes in
springs or right when it's starting to
get warm you get a lot more river
flow into the oceans which brings tons
of nutrients
as well and so what
my main focus here is that global

changes can impact community composition
and plankton community shifts can
influence global conditions
as well and then those
two things are also going to change how
efficient the biological
carbon pump is so now i get to talk
about ocean current
i actually have some fun things to do
right now
so i want you to think about
now this is blue
this isn't um extremely accurate but
imagine that we're just seeing one band
of color
and so this is what you could see if you
could only see blue
if if you had a
lot of phytoplankton pigments like
you see in this region
of this figure it might look
it might look something
so this one's really
it goes from kind of a brownish color
and it's
really a it's much of a gradient but
we're going from sand land terrestrial
zones
and going into shallow waters where we
get some of that
bluish green and then when there's tons
of plankton
we see a lot of their pigments in the
water and then
when it's just dissolved matter like and

try this
or or whatever whatever other dissolved
matter um you'll get kind of this
lighter shade of
of blue and in deep waters you're gonna
get the darkest blues
and so i also set up this little
this graph from chen blankenship that
was originally just these um just these
lines showing chlorophyll a b d and
f and what this is should be absorbance
i believe
on the y axis here um and so
i overlapped this gradient of colors
just to give you an idea of where each
color sits on
the spectrum of light because that's
really the most important part
of ocean color so remote sensing remote
sensing is really just
the instrumentation that is on
satellites and ceramic sensing
used for ocean color and the united
states has all been done through
nasa so the first one began in 1978
so if you see here these are like the
bands that i was just talking about so
in 1978 we can see
this color
[Music]
this color and
[Music]
it's enough hot you know when you put it
up i have a lot more colors going on
over here

every time we've kind of accumulated
more and more bands and been able to see
more details but
even still we really have quite a range
that we're not able to
see so the big problem
that i see in microbial oceanography
is that the global climate is
really limited because the current
satellite data
it says a little about plankton
community composition it reads
chlorophyll as one
chlorophyll and it might not even detect
some chlorophylls but it lumps all
plankton together
so you know there's plankton there right
of linkedin there but you don't know who
they are
who there are more of or less of or how
things are
changing at all and so that brings me
back to
the biological carbon pump again this is
a similar figure from the same paper of
from xanadol
and i really just wanted to remind you
of how carbon moves from the atmosphere
through phytoplankton through
zooplankton
and down down the food chain
and deeper and deeper and if it reaches
the ocean floor it can stay there for
thousands of years
so that will lead to a pace peace

plankton aerosol clouds and
ecosystems is going to be launching in
next year the year after it's going to
have hyperspectral resolution which is
what i'm most excited about
that means that instead of having bands
bands
seeing the whole range of the color
spectrum and actually more than what our
eyes can see so we're going from
uv light to near infrared um
it's also going to be using lidar which
instead of reading
the reflectance from the sun which
i don't know if anybody's ever had to
deal with
this collectively
[Music]
uh and so using lidar it uses lasers it
can measure the amount of light it sends
down and how much light is sent back up
in what wavelengths
and it also has two polar polarimeters
which also increase or also decrease the
amount of reflectance
and and increase the um
the resolution uh it also will be
orbiting
the earth in two days so things i think
are really cool about it
beyond the tech stuff is it'll be able
to see
down to about a thousand meters in the
ocean which is incredible
um cloud composition atmosphere

composition
the role of it's going to be seeing
aerosols and
we'll be able to follow them through the
carbon cycle and see how
important there they are and um and then
air quality as well
but what i'm most excited about is being
able to distinguish
with pigments find different ratios so
each different plankton
has different ratios of chlorophylls
and we'll be able to use those unique
fingerprint
pigments so to speak to identify
who's there and when and in real time so
it's really
quite exciting and just as a nice
reminder this is the most recent
satellite
and that's been used in ocean color so
you only get
um you only get four readouts here
eight because we're looking at two
different things but then what
case would see is just that whole
spectrum's
really quite amazing some applications
are are that
will be able to monitor community
changes over time
will be able to correlate with
um with data collected on the ground or
in the water i should say
and we'll be

able to detect harmful algal blooms
we might be able to use this information
for rehabilitating dead zones in the
ocean
um and bio reheating to
bioengineer and so there's really just a
lot of capabilities
a lot of possibilities in our future
with peace and with that i'd just like
to say thank you
and i any feedback you give me is
more than welcome i appreciate you
watching my presentation and i hope
you learned something and gave an
appreciation for phytoplankton
um i did want to say that all my visuals
came from nasa.gov or
or my own or are cited
thank you and have a great summer