

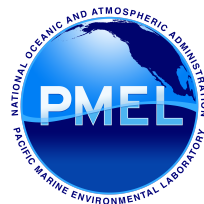


PMEL

Pacific Marine Environmental Laboratory

Climate Research Ocean Climate Stations PI: Meghan Cronin

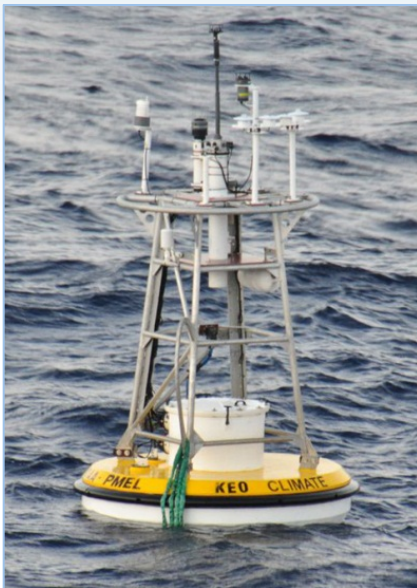
Co-PIs: Adrienne Sutton, Nick Bond, Chris Meinig, Dongxiao Zhang





Background

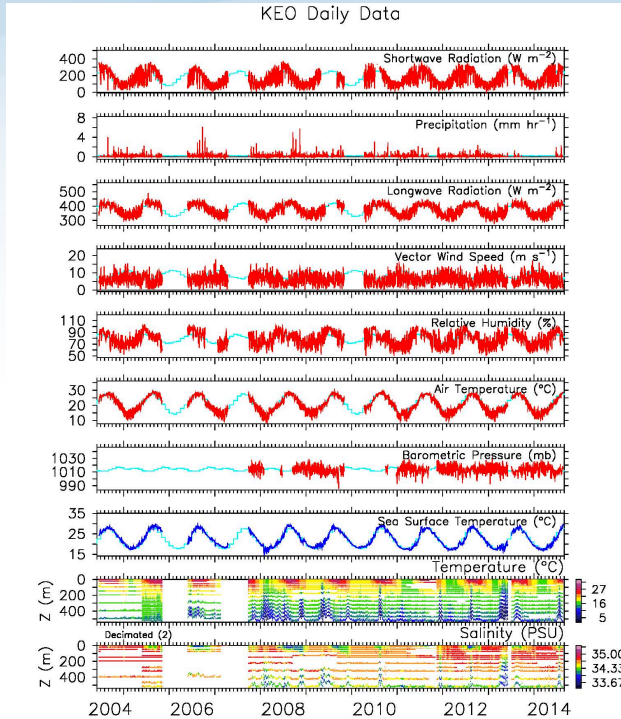
Ocean Climate Stations are moored buoys, designed for harsh conditions of the North Pacific, that carry a suite of meteorological, physical and biogeochemical sensors.





Quality / Performance / Relevance

OCS data are used across the world



OCS Project Office/PMEL/NOAA

Aug 22 2014

OCS Webpage Hits in FY13: 197,000

Data and text downloads in FY13: 170 GB

Data Download Requests in FY13: 221, yielding 610 data files to users in US, Japan, Canada, UK, Australia, Spain, China, Taiwan, Russia

Data access: GTS, OCS webpages, OceanSITES GDACS

Usage Descriptions (volunteered) in FY13: “model and satellite data validation”, “sensor and parameter verification [winds, lidar, flux]”, “research [wave studies, physical-biological coupling, air-sea interactions, wind calculations]”, “student project”...

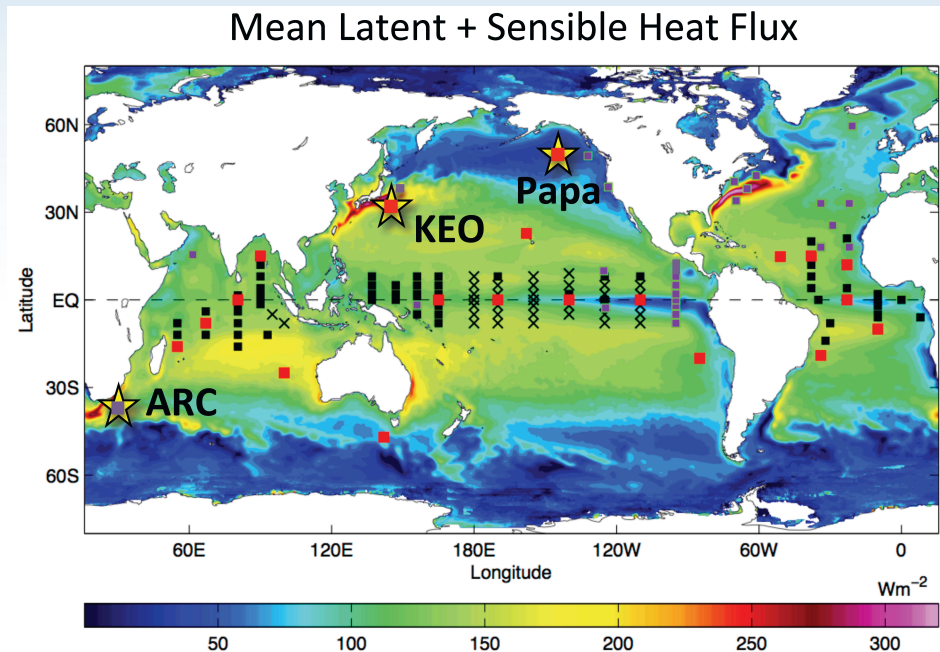
<http://www.pmel.noaa.gov/OCS/>

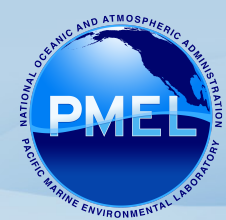
Performance

OCS moorings contribute to the global network of OceanSITES time series reference sites

- ★ OCS moorings: Full flux (Heat, Moisture, Momentum, CO₂)
- Active Full Heat Flux (also CO₂ flux at some)
- Archived Full Heat Flux
- Active Partial Heat Flux (No LWR)
- x Active Partial Heat Flux (No LWR or SWR)

Base figure courtesy L. Yu (WHOI)





Ocean Climate Stations

Contributing to NOAA's Goals

Directly:

- Weather Ready Nation
- Climate Adaptation and Mitigation

Through Leveraged Partnerships within PMEL:

- Resilient Coastal Communities & Economies
- Healthy Oceans





Ocean Climate Stations

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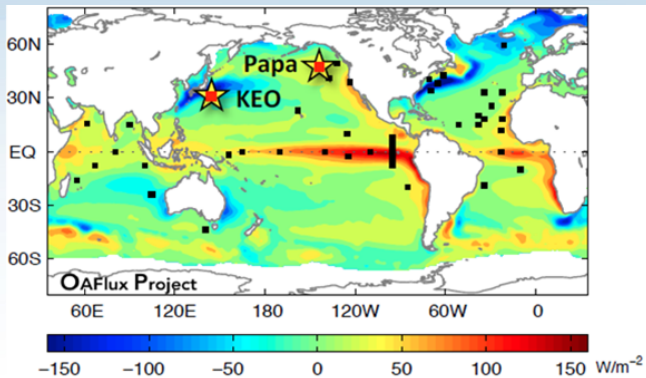


Relevance to NOAA Goal:

Weather Ready Nation: Improving Weather Models

Mean of 11 products' Mean Net Sfc Heat Flux

- All Qnet buoys (historic and active. Not all are in OS network)



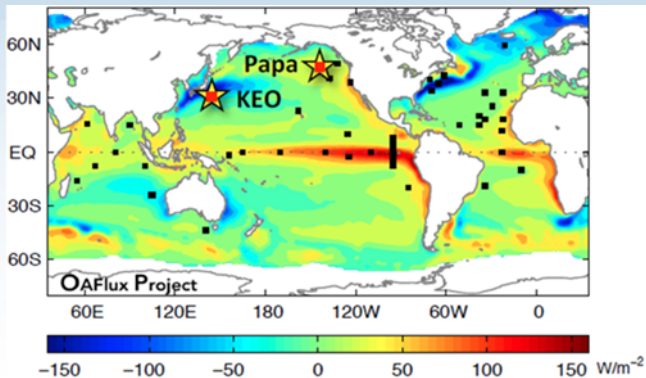
11 Model and Satellite Products:
OAFlex, NOC2, ERAinterim, MERRA,
CFSR, ERA40, NCEP1, NCEP2,
CORE2, ISCCP, NASA/SRB, CERES

Courtesy L. Yu (WHOI)

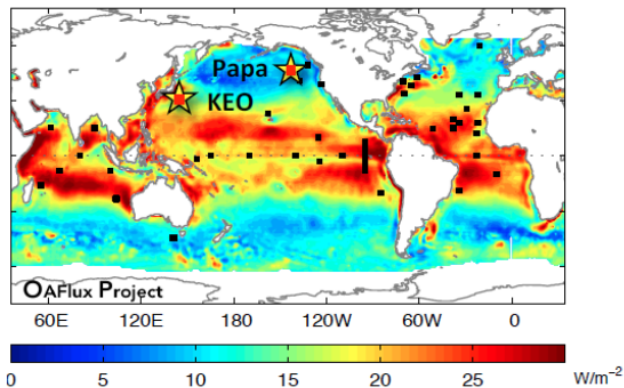
Relevance to NOAA Goal: *Weather Ready Nation: Improving Weather Models*

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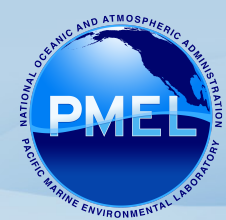
STD of 11 products' Mean Net Sfc Heat Flux



11 Model and Satellite Products:
OAFflux, NOC2, ERAinterim, MERRA, CFSR, ERA40, NCEP1, NCEP2, CORE2, ISCCP, NASA/SRB, CERES

Courtesy L. Yu (WHOI)

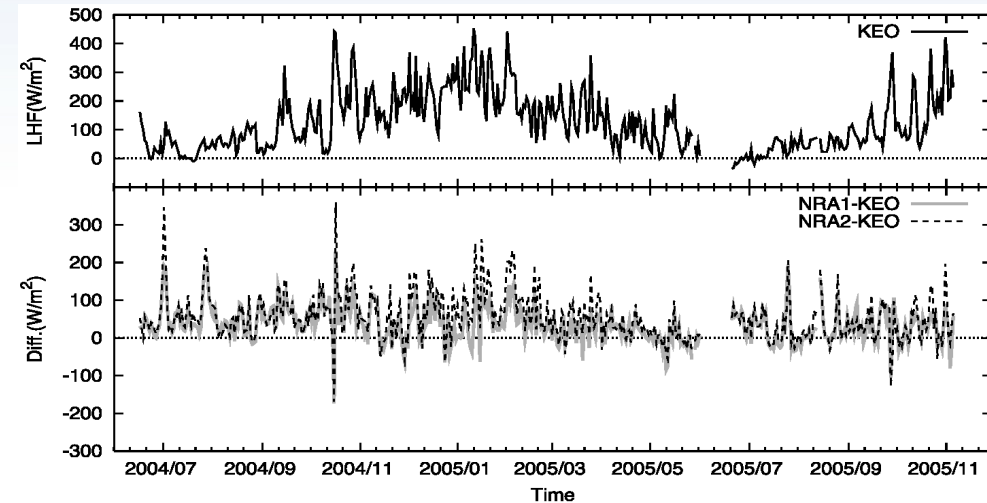
Yikes!
*Which product is correct?
Why do they differ?
How can we improve these models?*



Relevance to NOAA Goal:

Weather Ready Nation: Improving Weather Models

With funding from NOAA CPO, co-PI Dongxiao Zhang will use KEO and Papa data to assess new Numerical Weather Prediction products and make recommendations for how to improve them.



Kubota et al. JGR 2008: Surface heat fluxes from the NCEP/NCAR and NCEP/DOE reanalyses at the KEO buoy

KEO Latent Heat Flux uncertainty is 10–15 W/m²

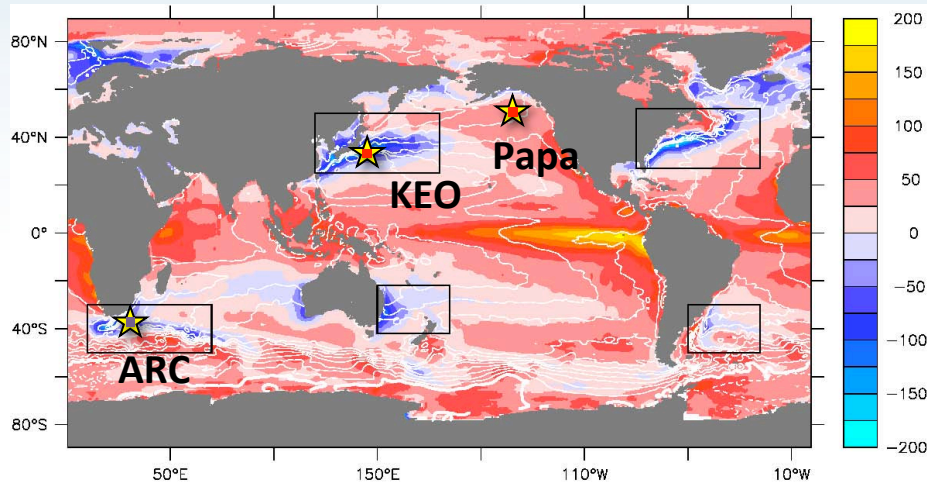
Mean bias in NCEP/NCAR Reanalysis (NRA1) Latent Heat Flux is 41 W/m²

Mean bias in NCEP/DOE Reanalysis (NRA2) Latent Heat Flux is 62 W/m² (yikes!)

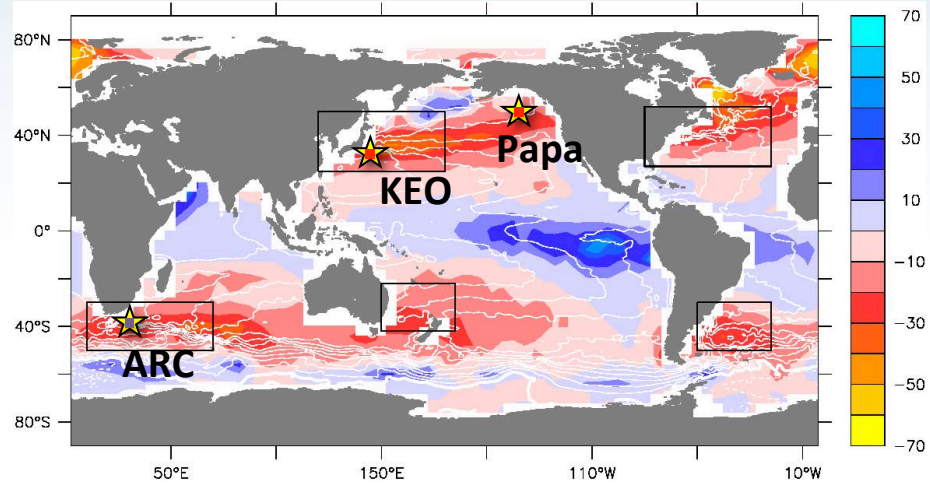
Have recommendations been implemented in CFSR? Is CFSR improved?

Quality Data / Quality Science

Need long, high resolution time series to resolve air-sea interaction climate signals



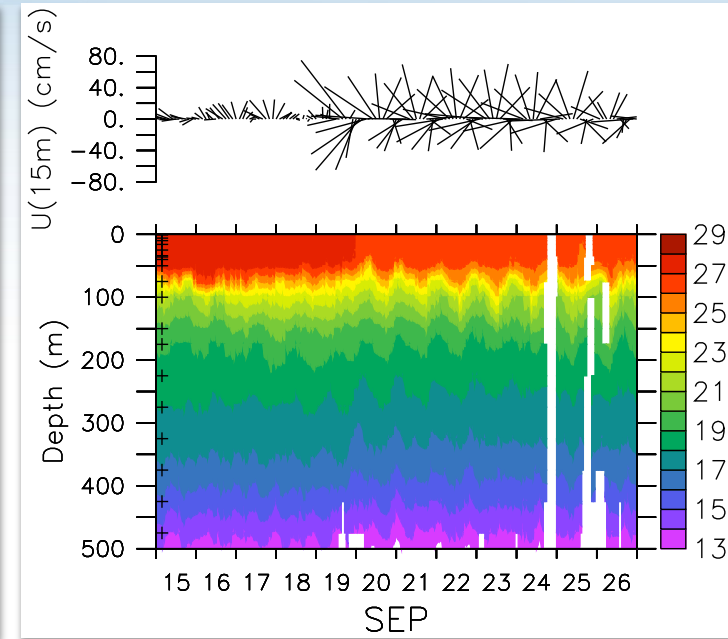
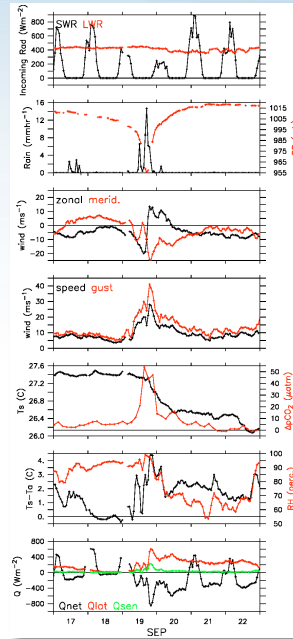
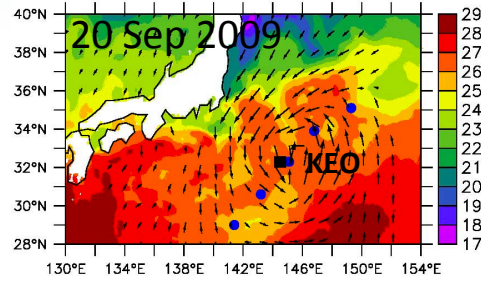
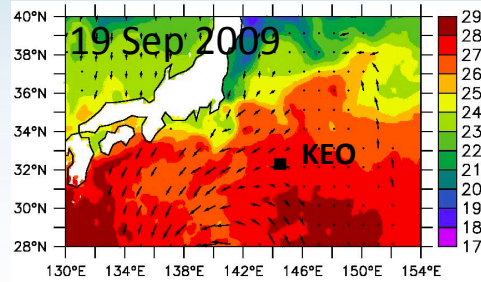
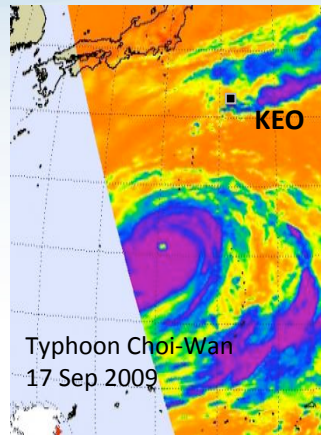
Mean Net Surface Heat Flux (Wm^{-2})



Mean CO_2 flux ($\text{grams C m}^{-2} \text{yr}^{-1}$)

Quality Data / Quality Science

KEO is a typhoon buoy. Typhoons are part of climatology.



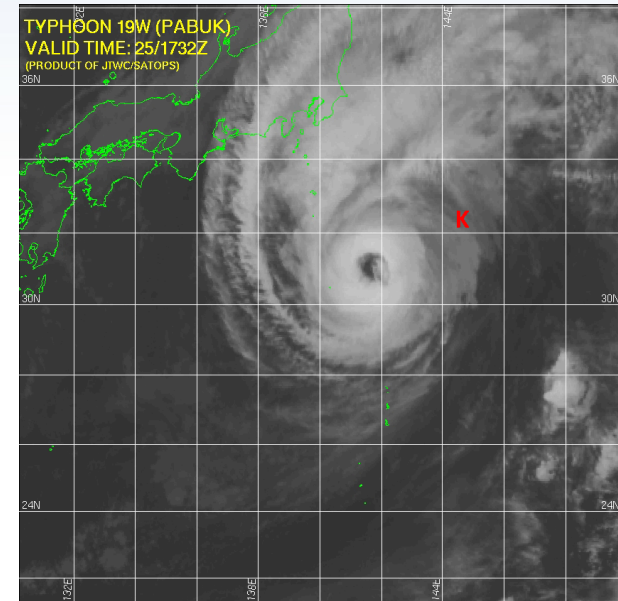
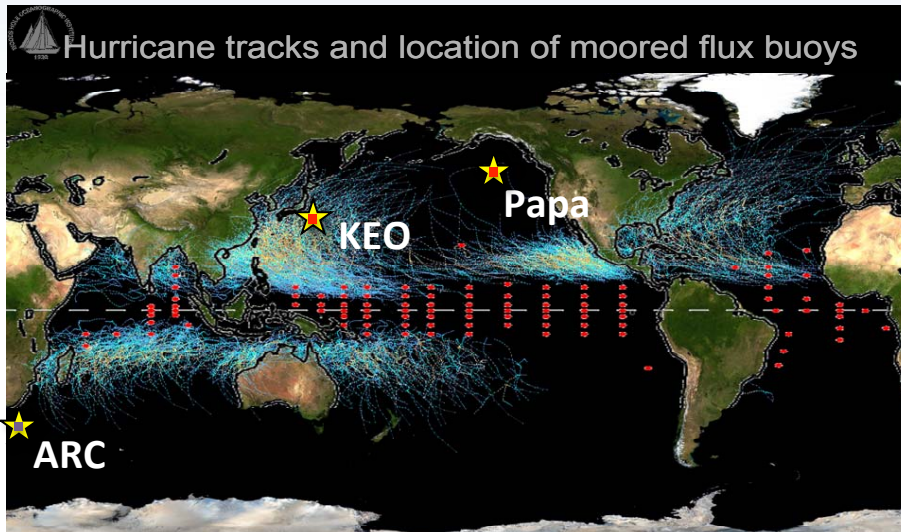
Bond et al. JGR 2011: Upper-ocean response to typhoon Choi-Wan as measured by the Kuroshio Extension Observatory (KEO) mooring



Relevance to NOAA Goal:

Weather Ready Nation: Improving hurricane forecasts

With funding from Sandy Supplemental, Dr. Nick Bond will run realtime typhoon forecasting exercises with NCEP EMC to evaluate value of realtime high resolution (e.g. KEO) data for validating forecasts.





Ocean Climate Stations

Contributing to NOAA's Goals

Directly:

- Weather Ready Nation
 - *Improved Weather Prediction Models and Hurricane Forecasts*
- Climate Adaptation and Mitigation
 - *Improved Understanding of Climate Processes*

Through Leveraged Partnerships within PMEL:

- Resilient Coastal Communities & Economies
- Healthy Oceans



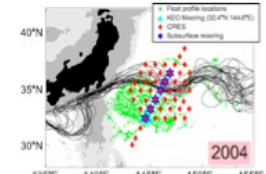
Performance

KEO: A series of process studies

Research Timeline at the Kuroshio Extension Observatory



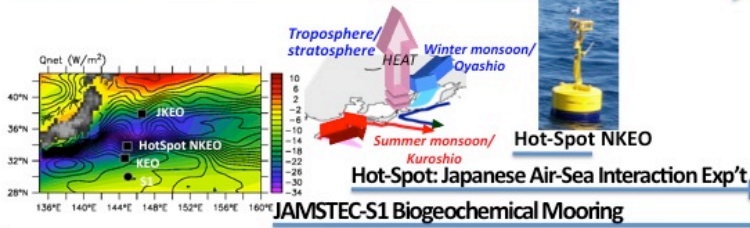
OCS KEO Mooring Deployments



NSF Kuroshio Extension System Study (KESS)



JAMSTEC-KEO



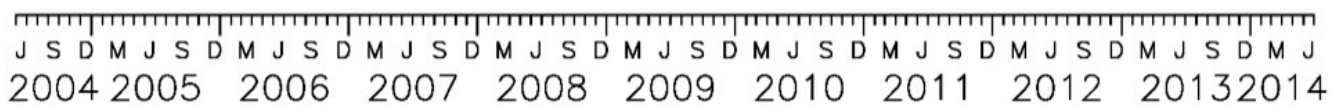
JAMSTEC-S1 Biogeochemical Mooring

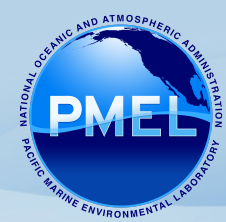
Kuroshio Extension System Study (KESS): A NSF-funded process study involving PIs from WHOI, URI, Scripps, UH. 2004-2006.

JKEO: JAMSTEC-KEO mooring

Hot-Spot: A 1-Billion Yen Japanese Climate Study 2011-2015.

More than 35 refereed KEO papers





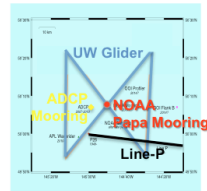
Performance

Station Papa: A series of process studies

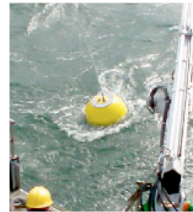
Research Timeline at Ocean Station Papa



OCS Station Papa Mooring



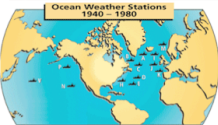
NSF Carbon Cycle Process Study



Wave Mooring: NSF Impact of Waves on Ocean Mixed Layer Study



NSF OOI Global Node



Weather Ship P



Canadian DFO P-Line Program

North Pacific Carbon Cycle Experiment: UW, PMEL 2007-9

Full water column current experiment: UW, PMEL, UVic 2008-2010

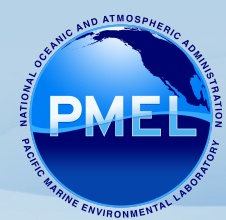
Surface wave mooring: UW APL 2010-

NSF OOI Global Node: 2013-

More than 20 refereed NOAA Station Papa papers

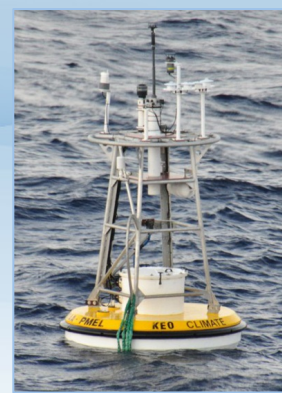


<http://www.pmel.noaa.gov/OCS/>



Ocean Climate Stations

Contributing to NOAA's Goals

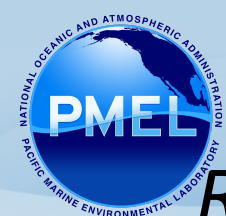


Directly:

- Weather Ready Nation
 - *Improved Weather Prediction Models and Hurricane Forecasts*
- Climate Adaptation and Mitigation
 - *Improved Understanding of Climate Processes*

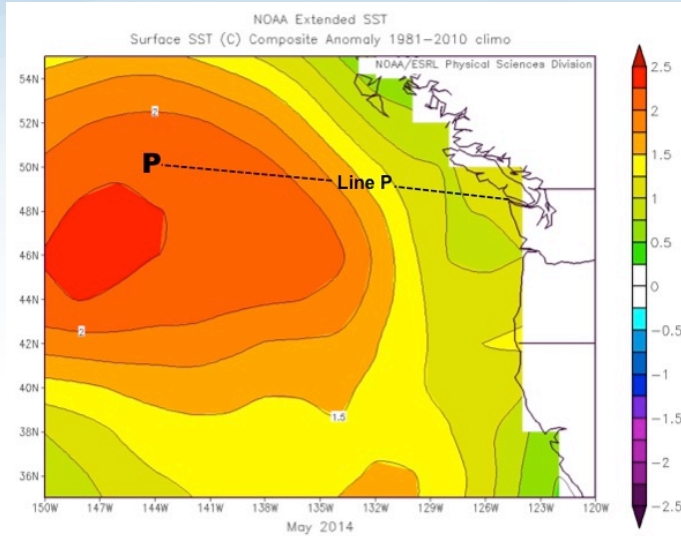
Through Leveraged Partnerships within PMEL:

- Resilient Coastal Communities & Economies
 - *co-PI (Nick Bond) Office of WA State Climatologist*
- Healthy Oceans
 - *co-PI (Adrienne Sutton) Ocean Acidification Network*

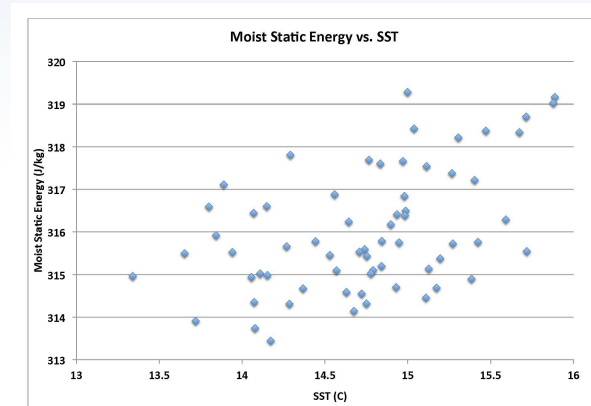


Relevance to NOAA Goal:

Resilient Coastal Communities and Economies



PAPA data is being used to monitor and understand “The Blob”, a historic warm anomaly occurring in the NE Pacific.

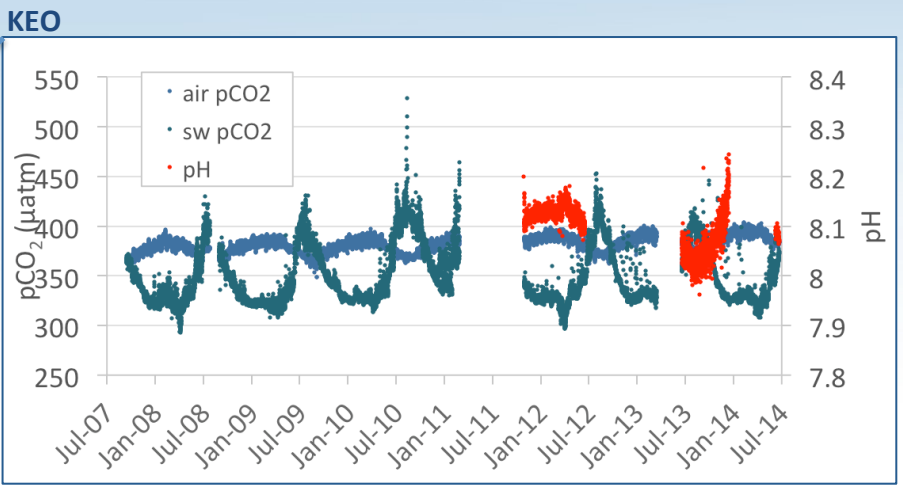
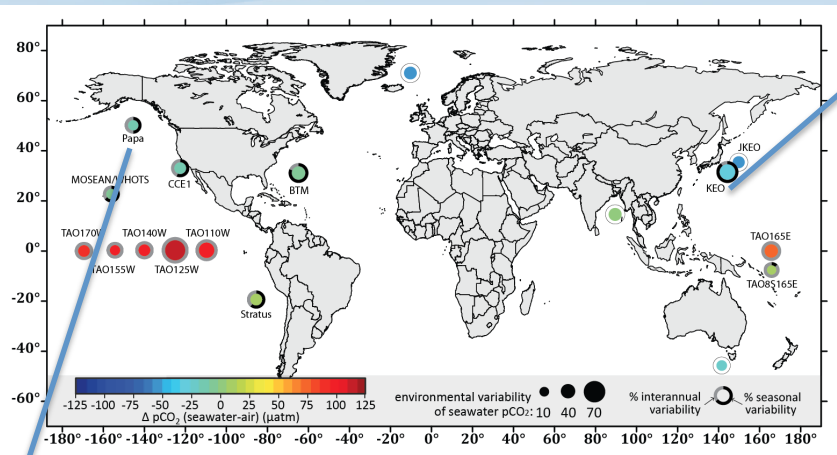


Office of the Washington State Climatologist
Co-PI Nick Bond, WA State Climatologist

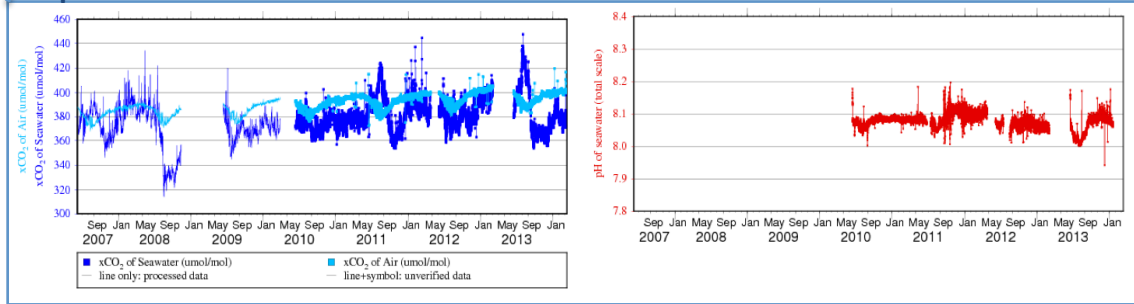
NE Pacific SST anomalies affect summertime PNW atmospheric boundary layer properties.

Relevance to NOAA Goal:

Healthy Oceans: Ocean acidification and CO₂



Papa



Ocean uptake of CO₂ has large temporal and spatial variability. The large uptake of CO₂ at KEO is observed primarily during winter.



Future Directions

Long, ongoing time series of ground truth observations are vital for assessing ever changing models, satellites and data products.

KEO is a typhoon buoy! KEO and Papa are ideally suited for analyzing and improving our understanding of extreme air-sea interaction events.

By having co-located physical, meteorological, biogeochemical measurements, the Ocean Climate Station data bring new dimensions to the disciplinary sciences and greater understanding of the climate system.