

# Evaluating the role of seasonal freshwater flux variability on the anomalous 2016 seasonal freshening of ocean surface water in the SPURS-2 region

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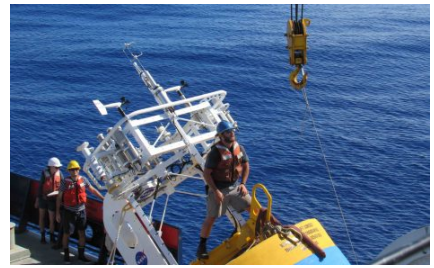
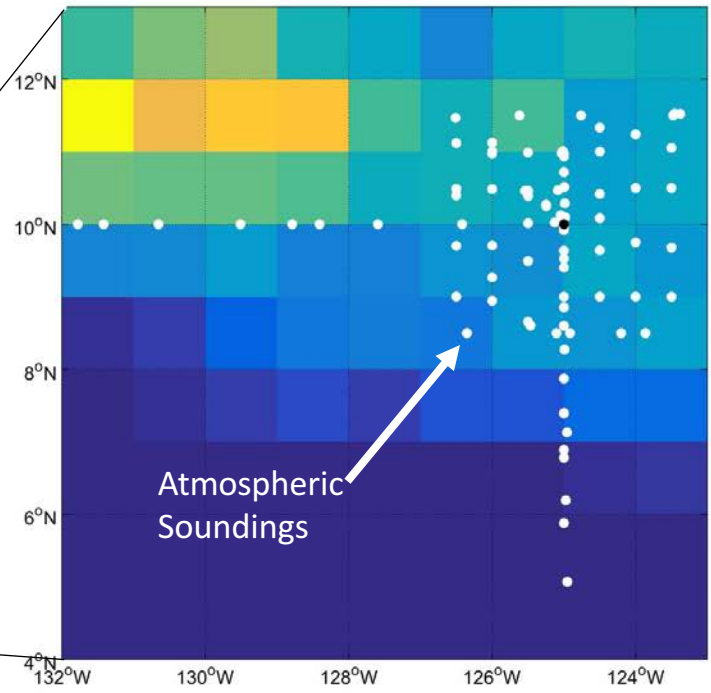
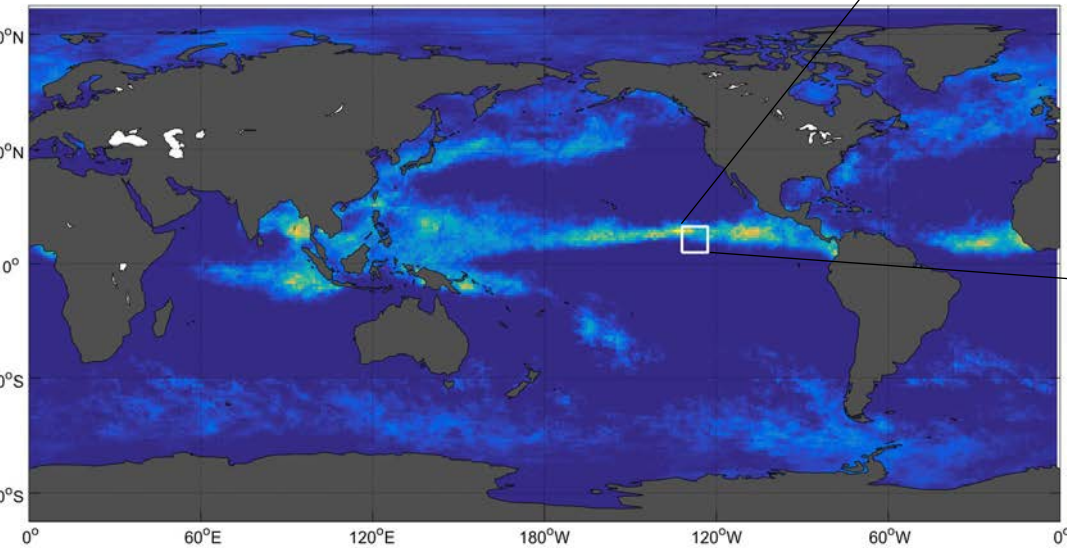
Global Ocean Salinity and the Water Cycle Workshop  
at Woods Hole Oceanographic Institution, Woods Hole, Mass., USA  
May 22-26, 2017

Image Source: Shades of Blue, SPURS-2 Notes from the Field

# NASA SPURS-2 (Salinity Processes in the Upper Ocean Regional Study -2)

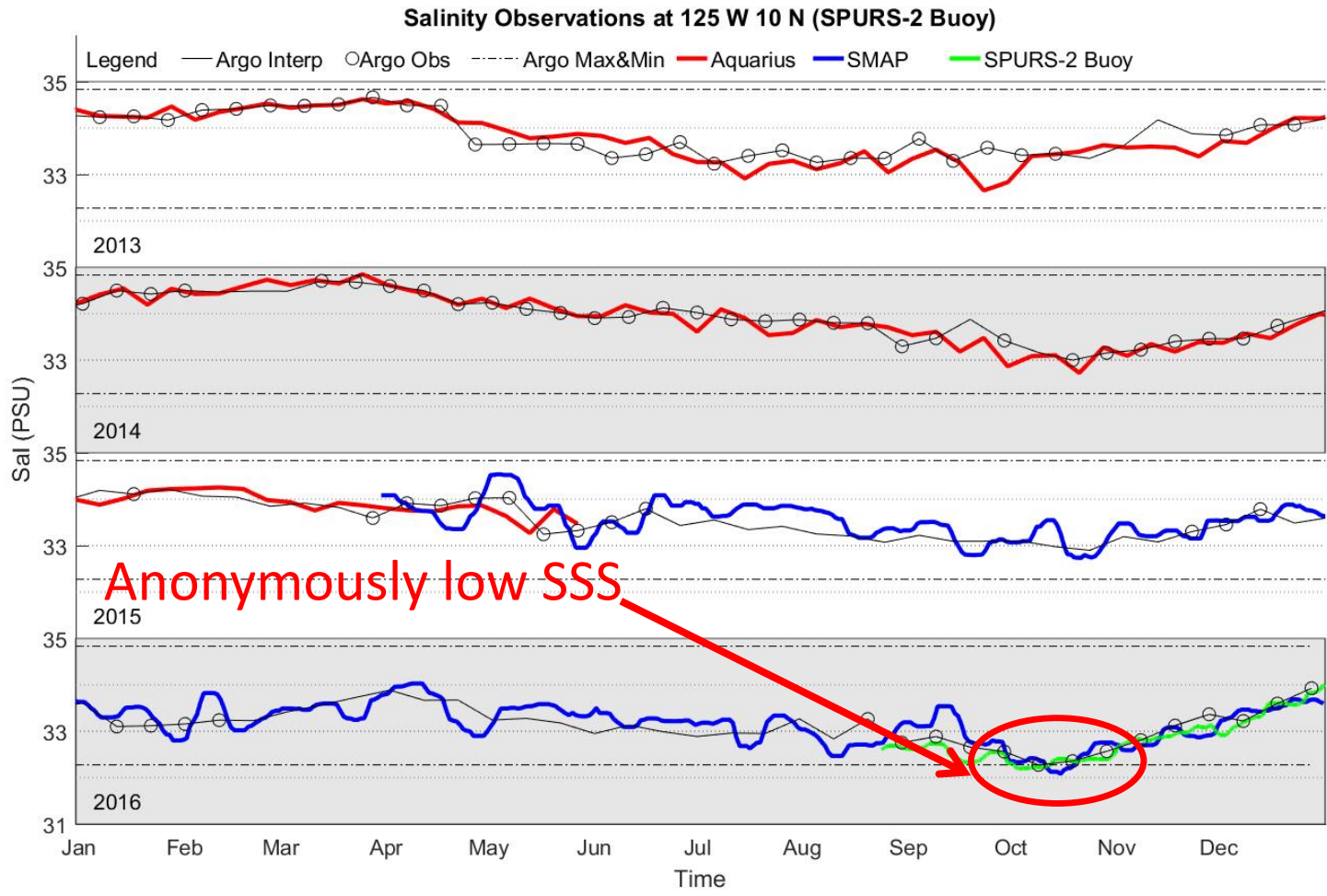
To study the fate of fresh water (Precipitation)

- In the Intertropical Convergence Zone (ITCZ)
- Cruise dates: August – September 2016
- WHOI Buoy Mooring at 10°N, 125°W
- Atmosphere and ocean observation
- Other resources deployed as well



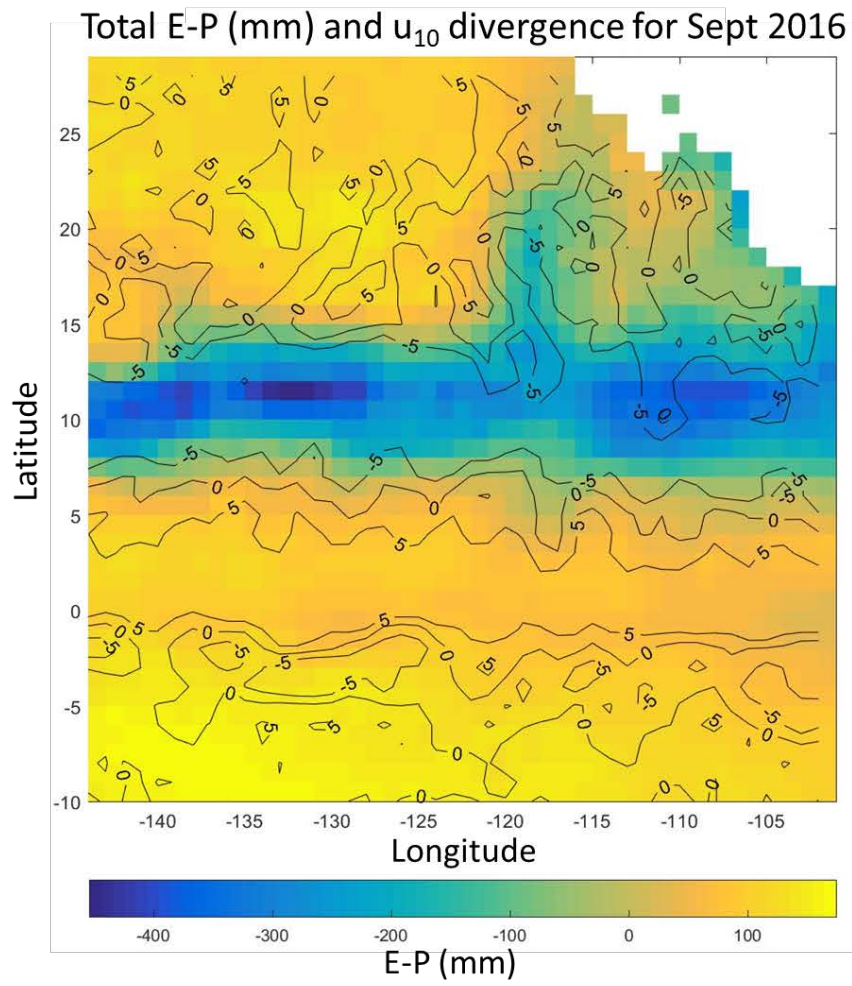
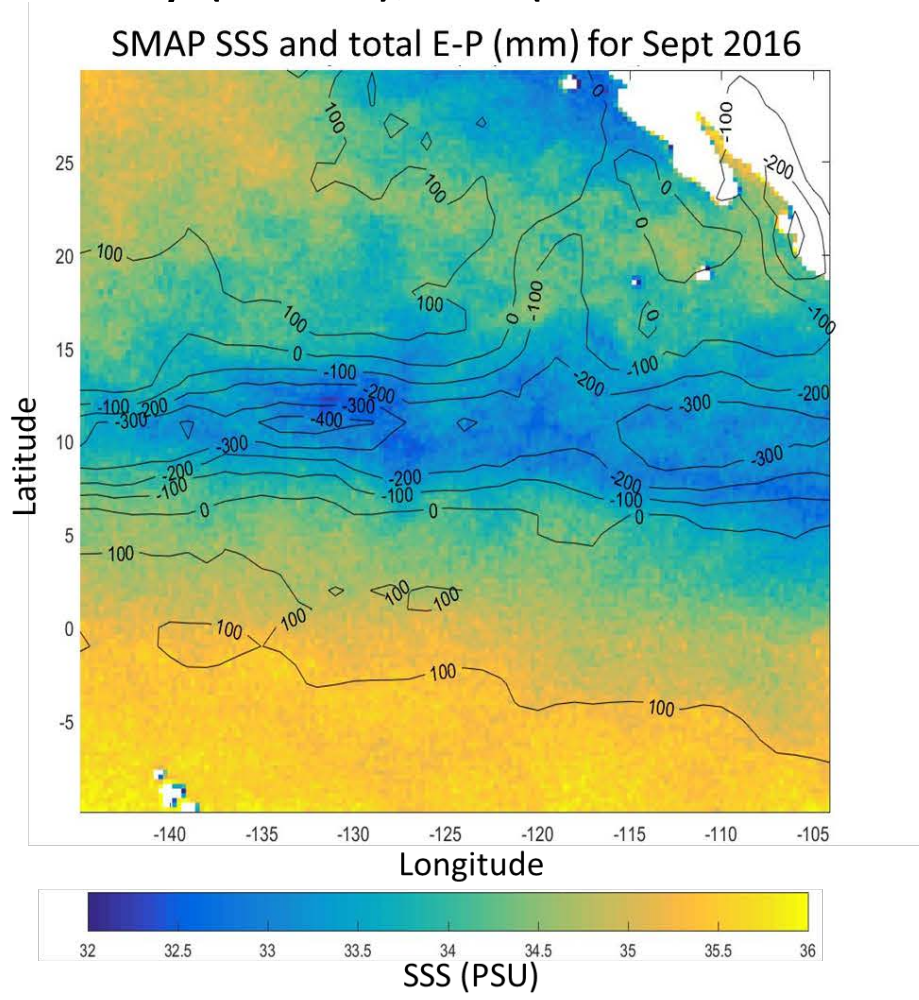
# Salinity observations:

- Argo (black) - Aquarius (red) - SMAP (blue) - SPURS-2 Buoy (green)





# Salinity (SMAP), E-P (SeaFlux – GPCP), and Divergence (ASCAT)



# Convergence is related to precipitation

## Basic water vapor conservation recycling model

$$\cancel{\frac{\partial W}{\partial t}} + \frac{\partial(uW)}{\partial x} + \frac{\partial(vW)}{\partial y} = E - P$$

Small

Divergence Term  
(negative convergence)

Dominguez et al. 2006

W is the precipitable water vapor in the atmosphere (SeaFlux & Soundings)

P is precipitation (GPCP)

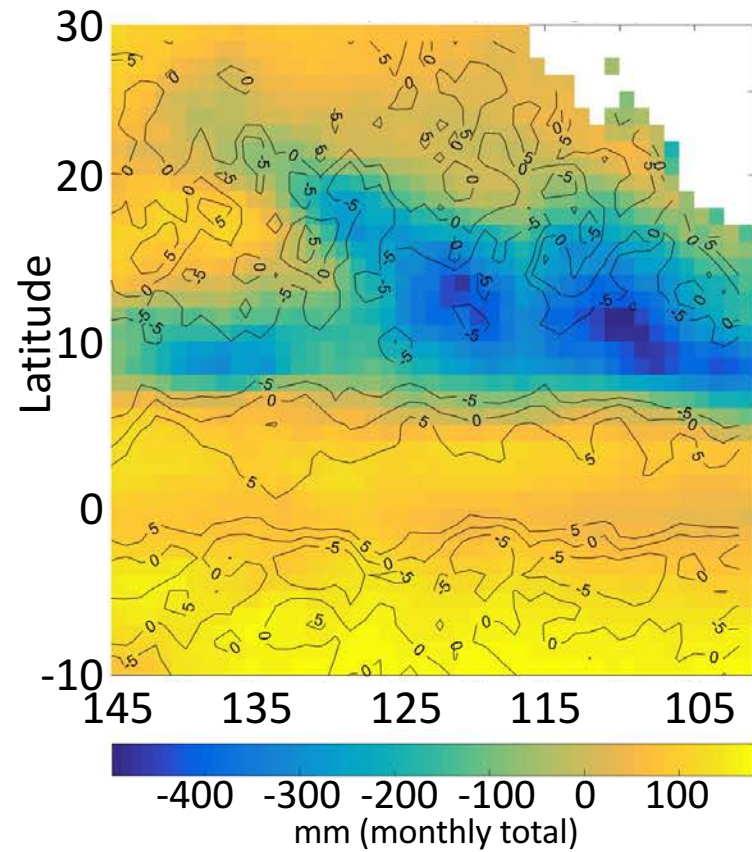
E is Evaporation (SeaFlux)

u,v are the moisture-weighted velocities that contain both the mean and eddy components for zonal and meridional wind speeds (ASCAT)

July 2016

Total E-P (color)

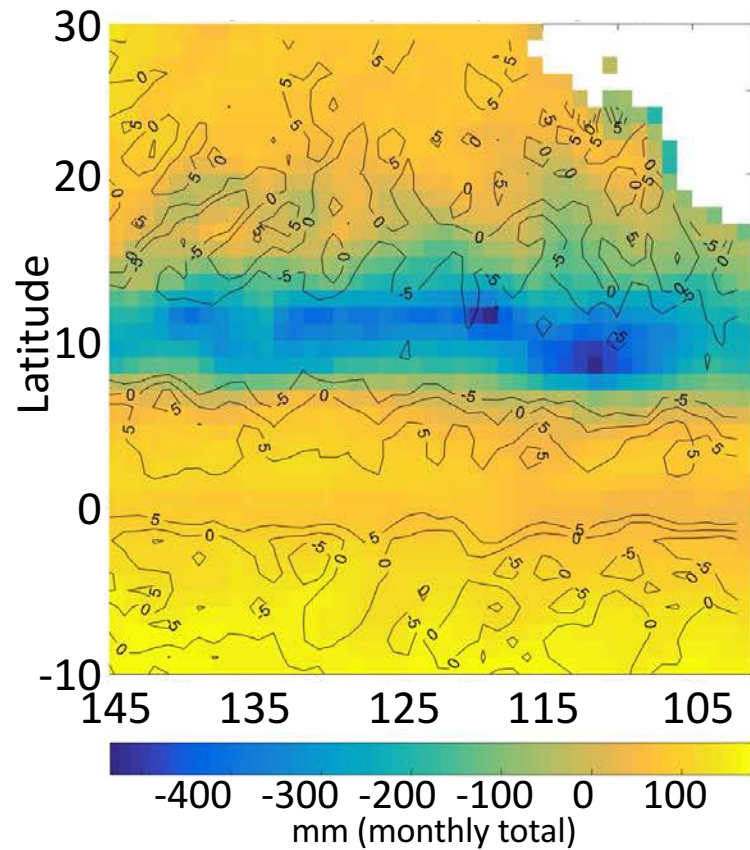
Wind Divergence (contour)  
Divergence\* $10^6$



August 2016

Total E-P (color)

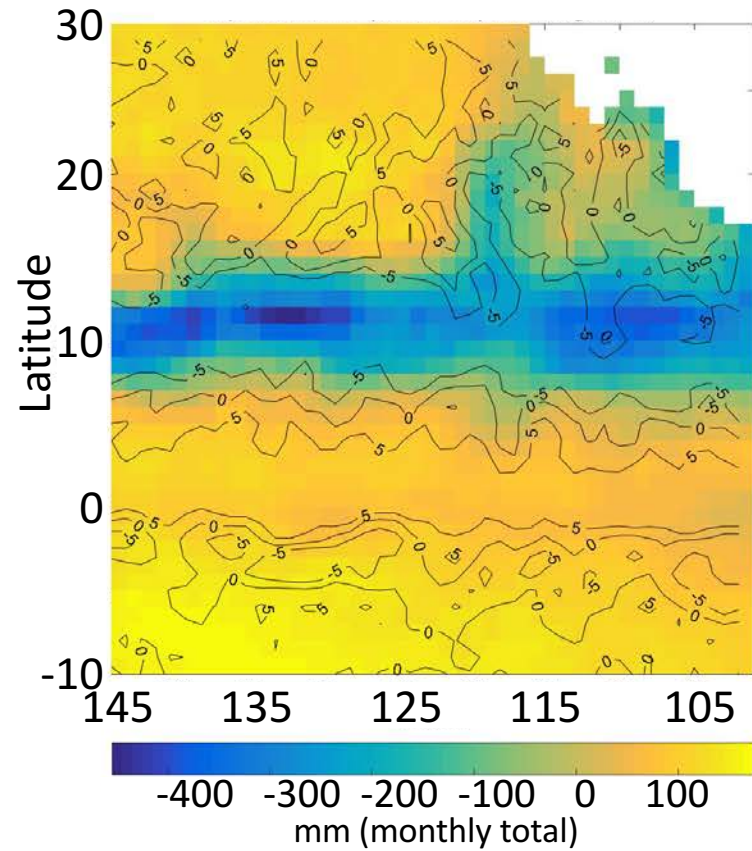
Wind Divergence (contour)  
Divergence \*  $10^6$



September 2016

Total E-P (color)

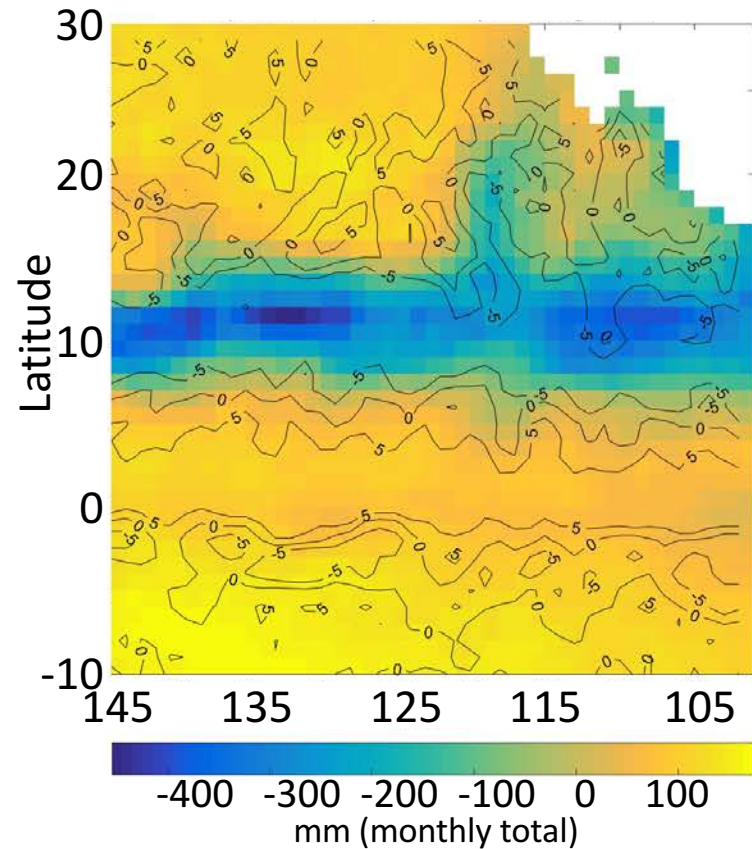
Wind Divergence (contour)  
Divergence\* $10^6$

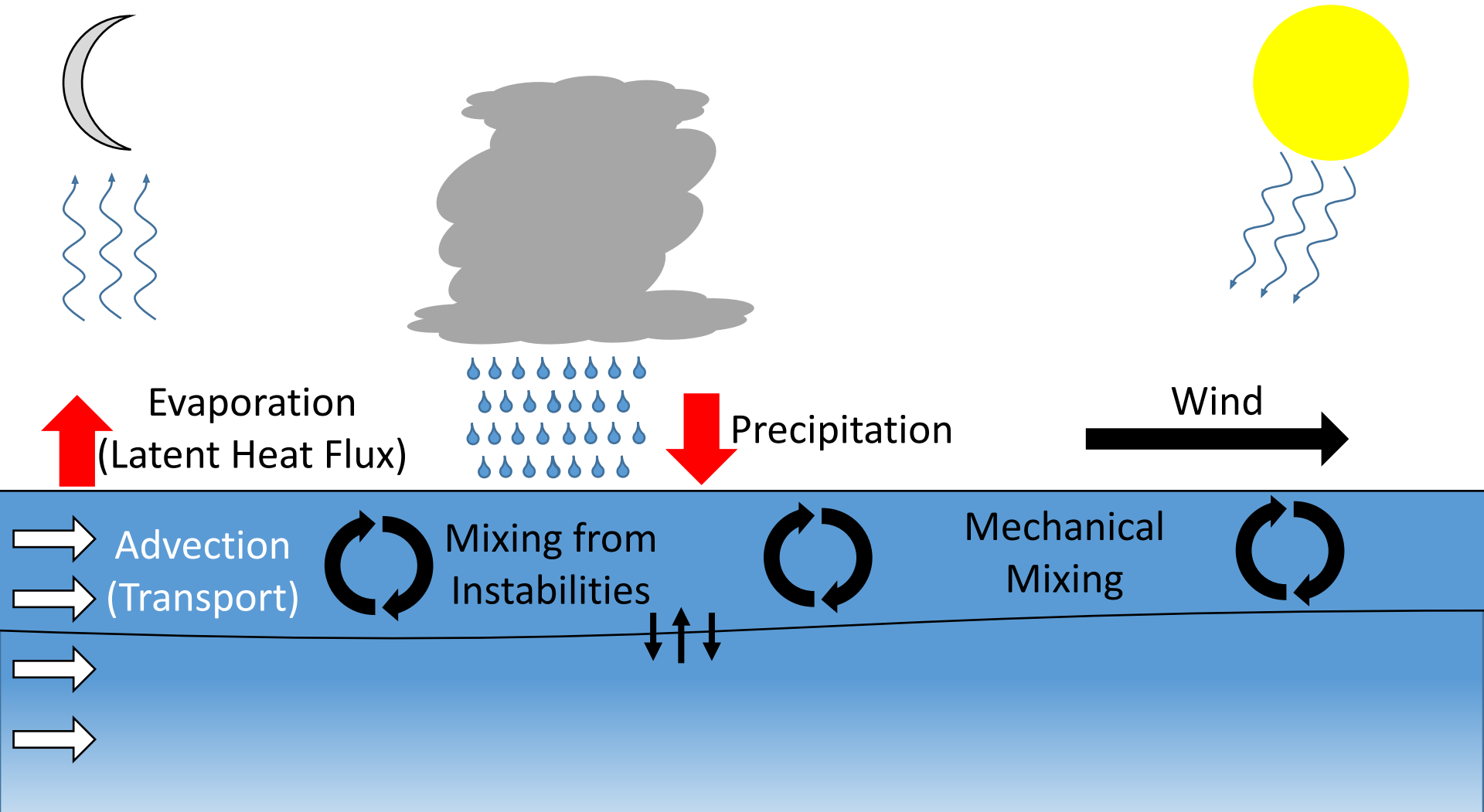




We are within a factor of 3-4  
of closing the moisture budget

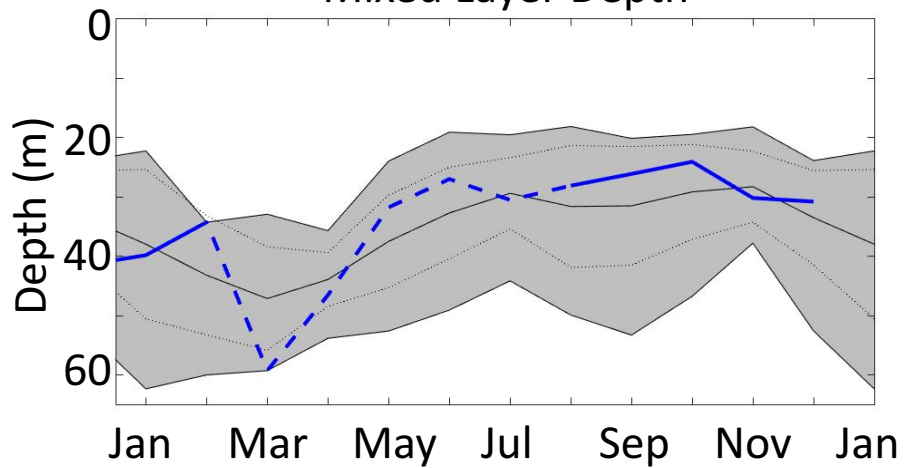
But what about the Salinity?



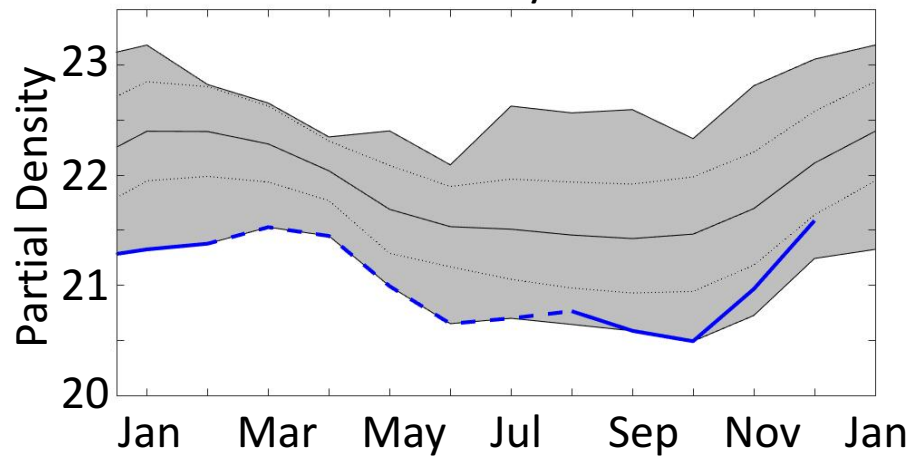


# ARGO observations 2001 – 2016 at SPURS-2 Buoy

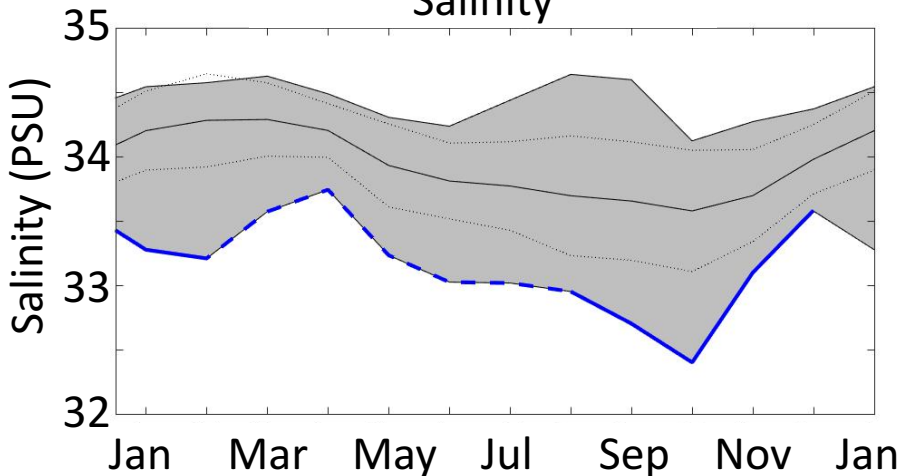
## Mixed Layer Depth



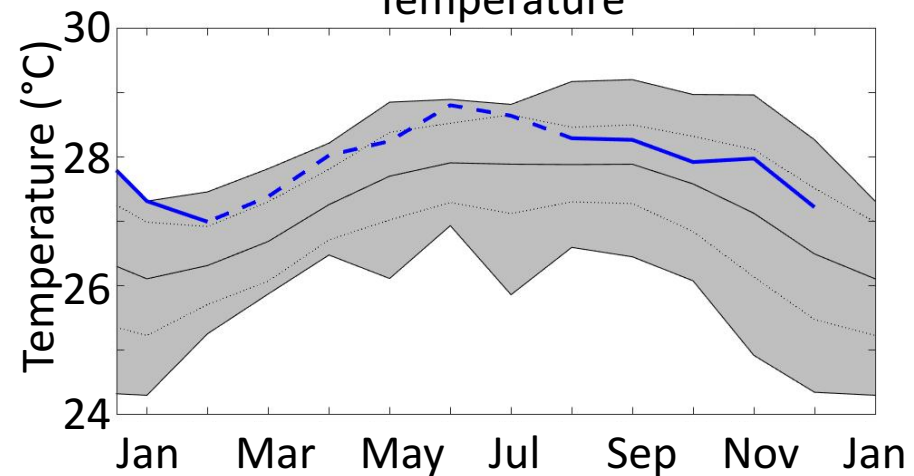
## Density



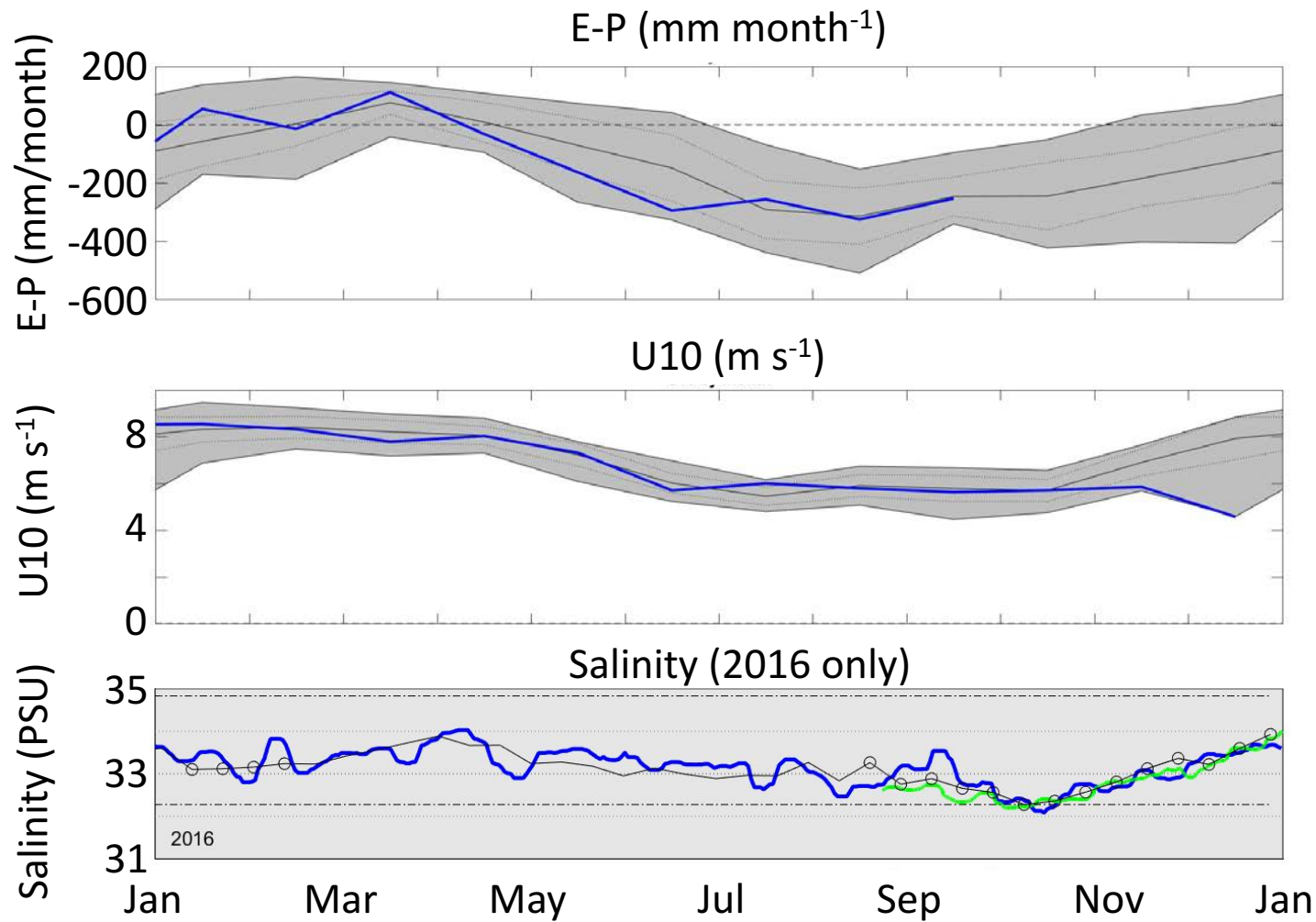
## Salinity



## Temperature

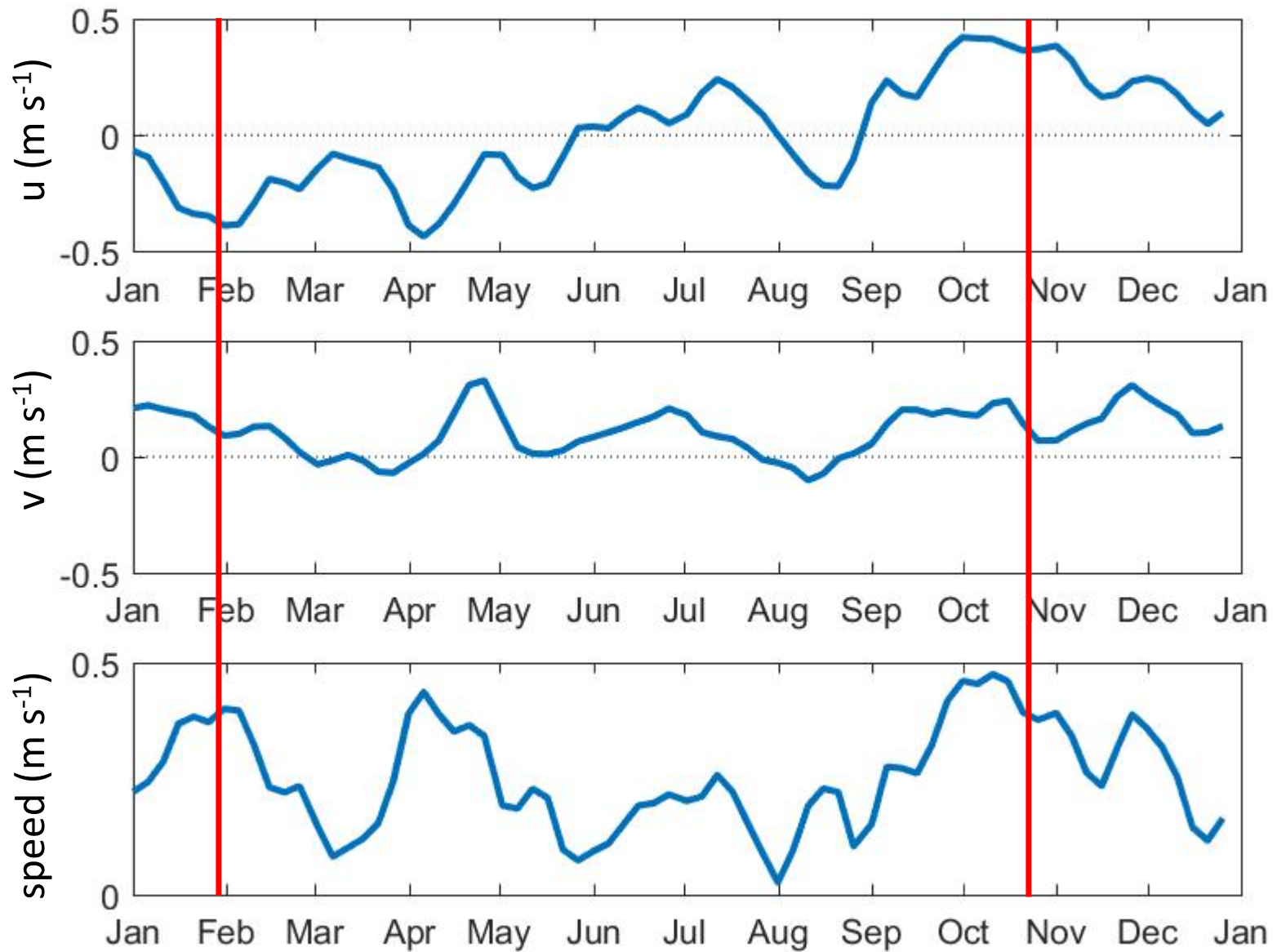


E-P



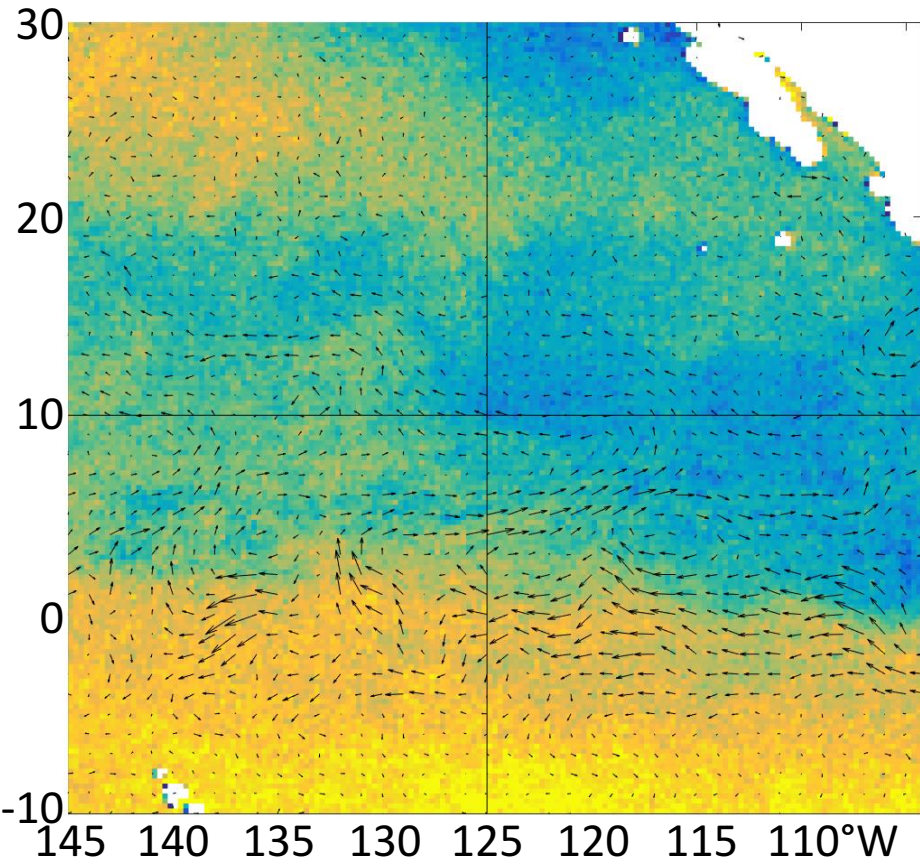


# Advection: OSCAR Currents for 2016

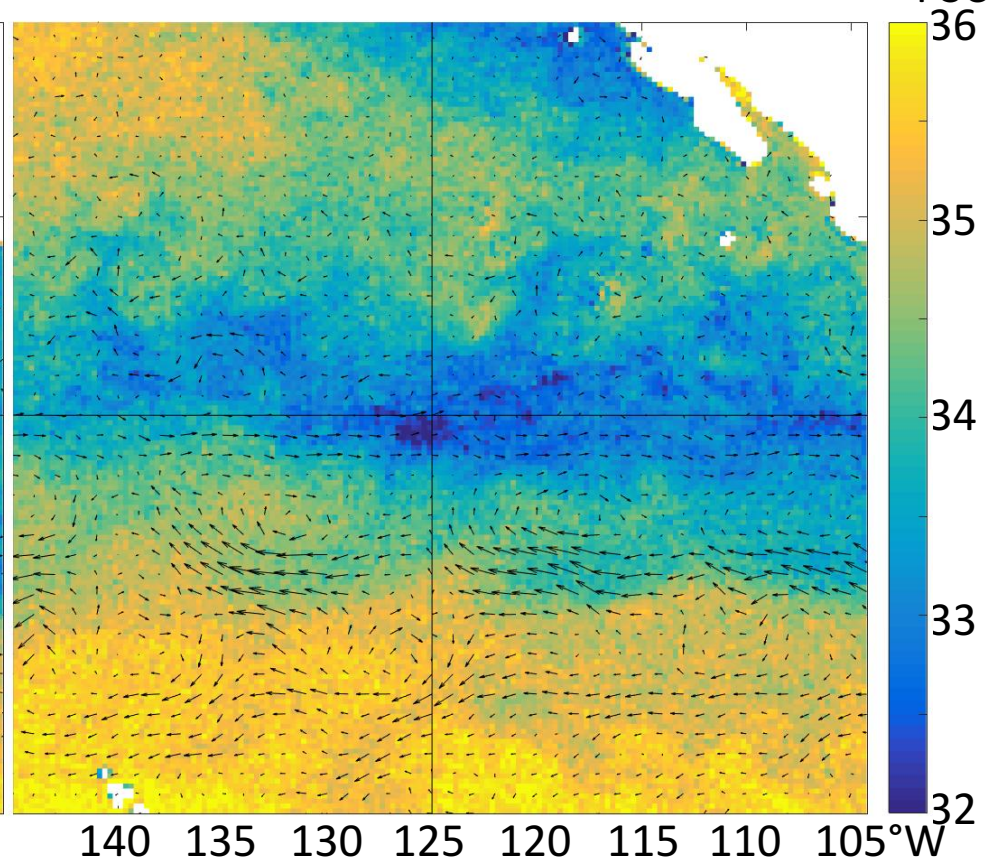


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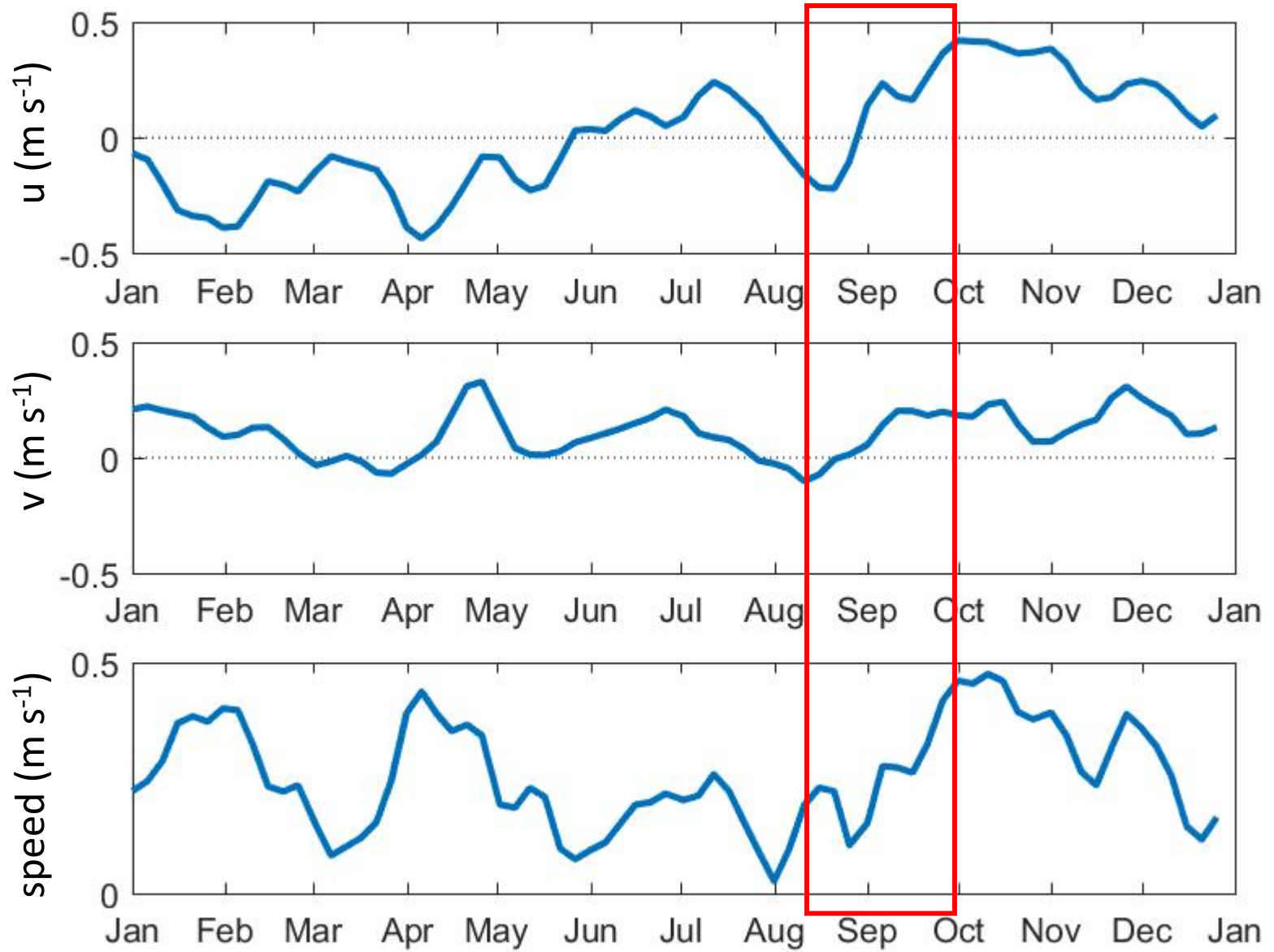
SMAP 26-Jan-2016



SMAP 21-Oct-2016



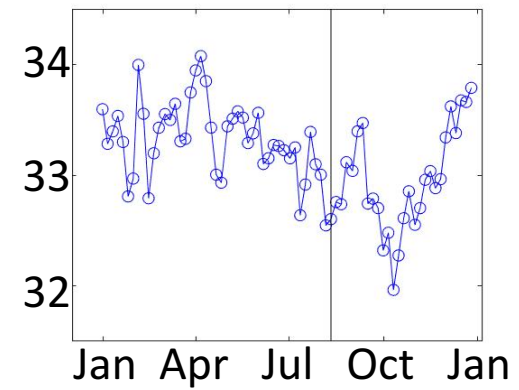
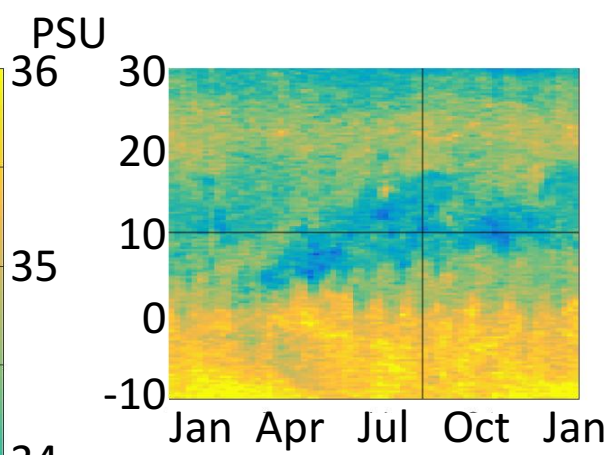
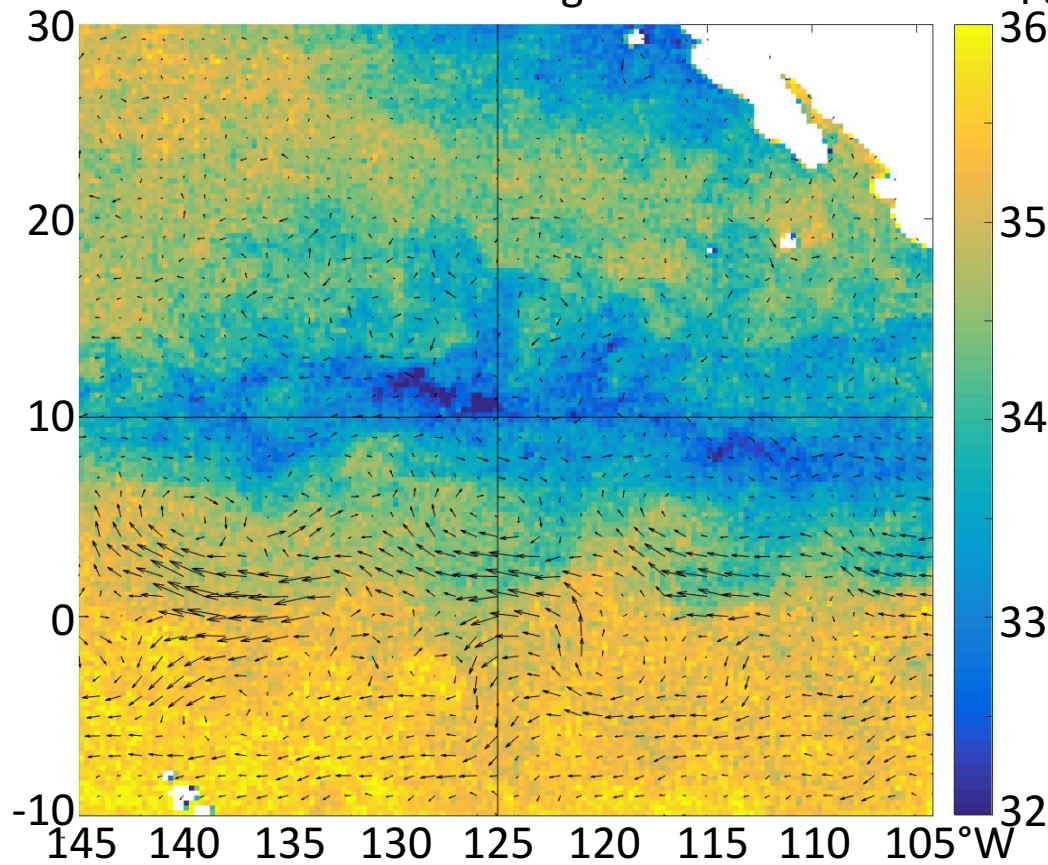
# Advection: OSCAR Currents for 2016





# Advection

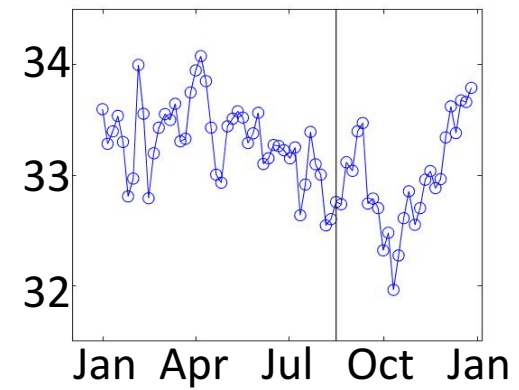
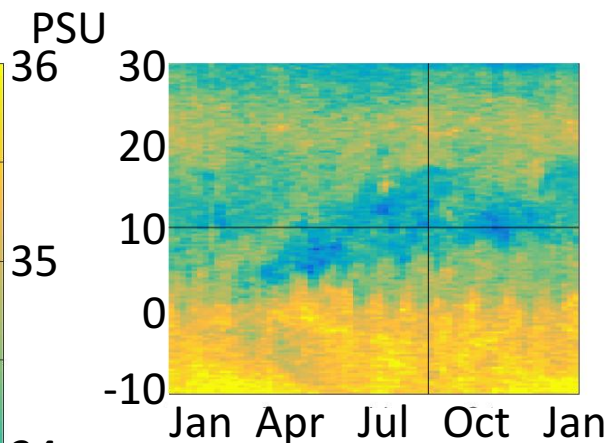
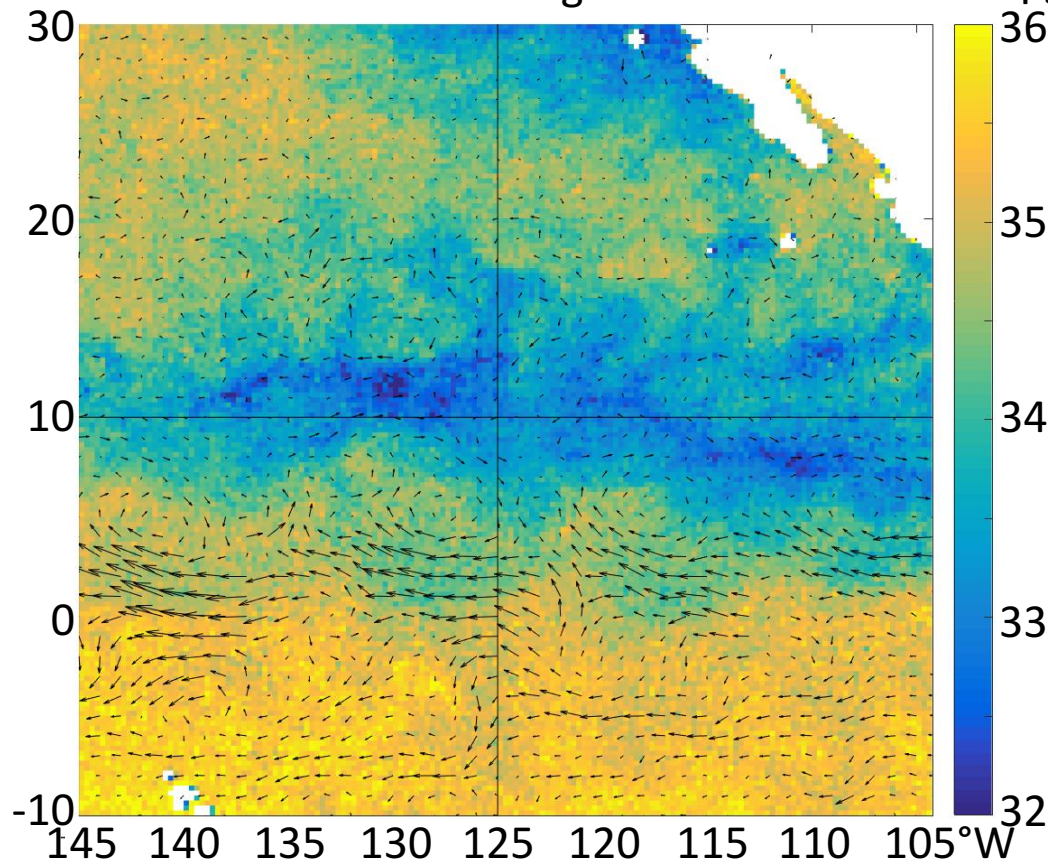
SMAP 11-Aug-2016





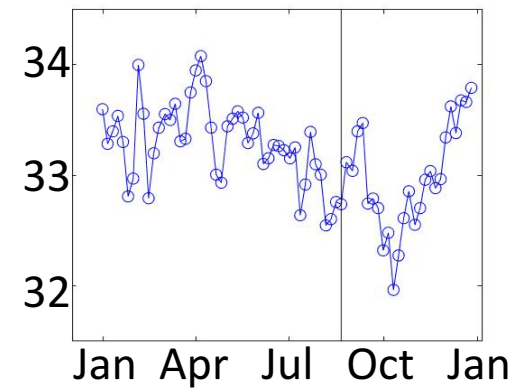
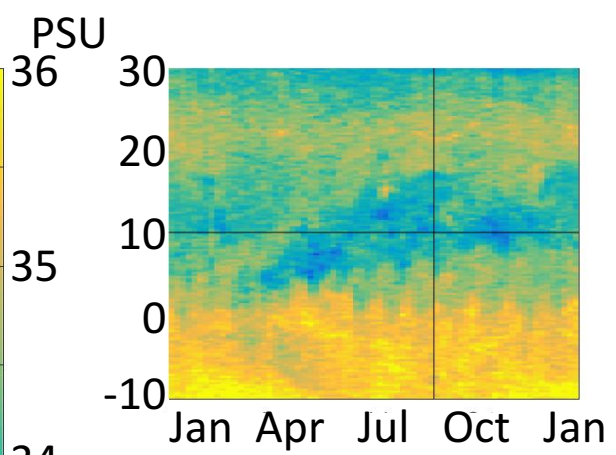
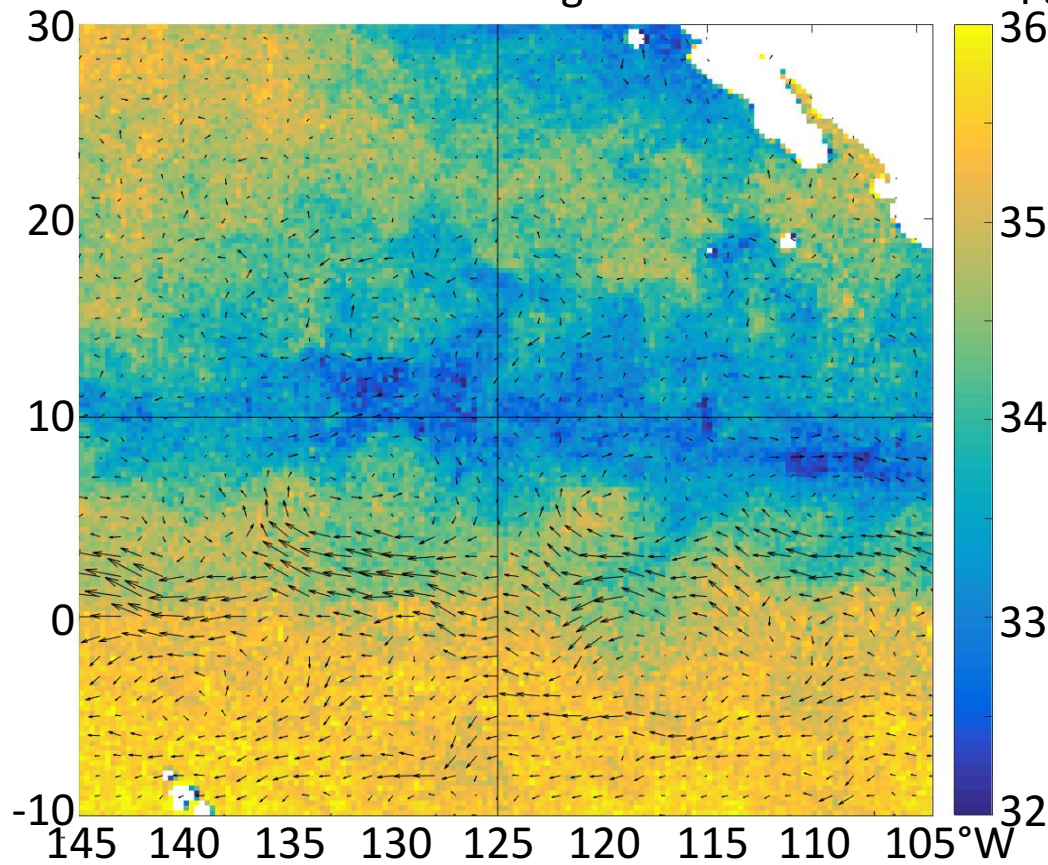
# Advection

SMAP 16-Aug-2016



# Advection

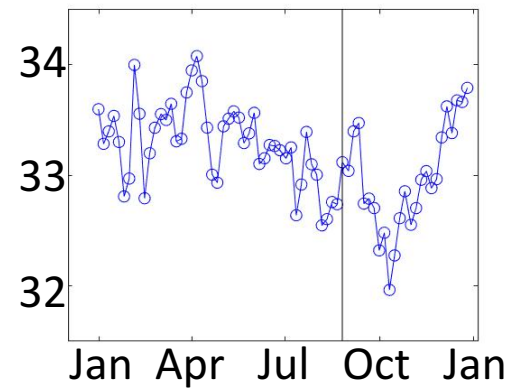
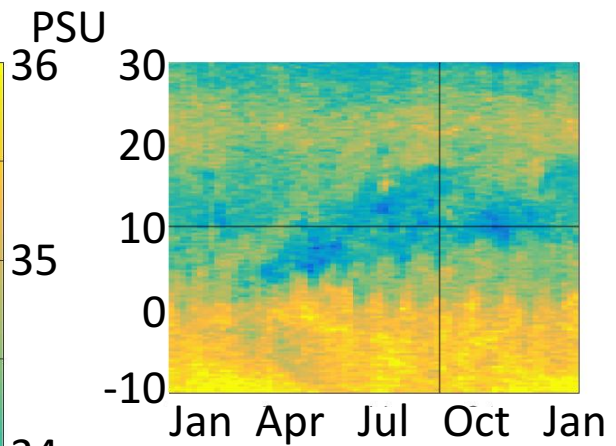
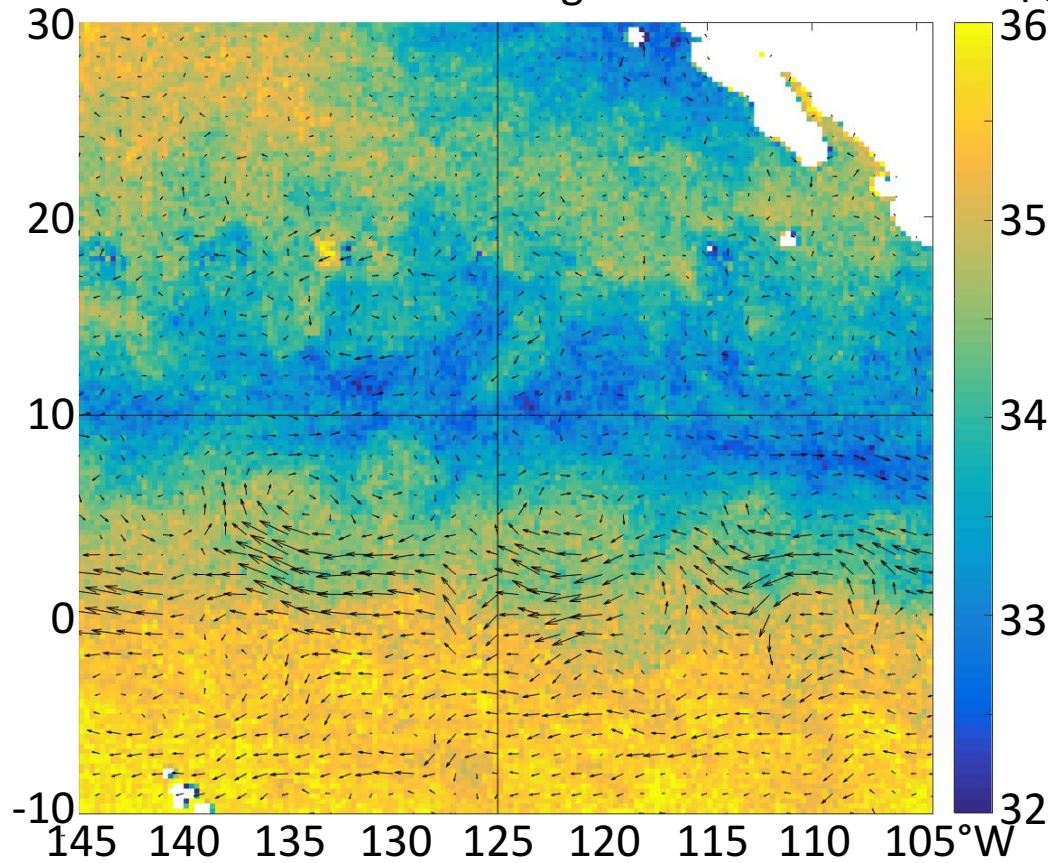
SMAP 21-Aug-2016





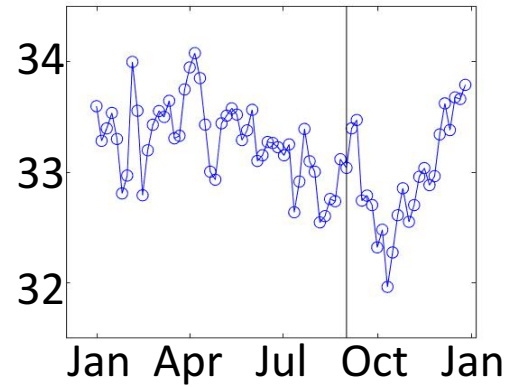
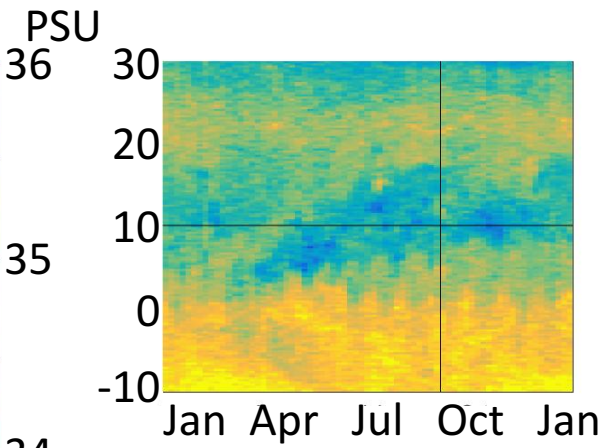
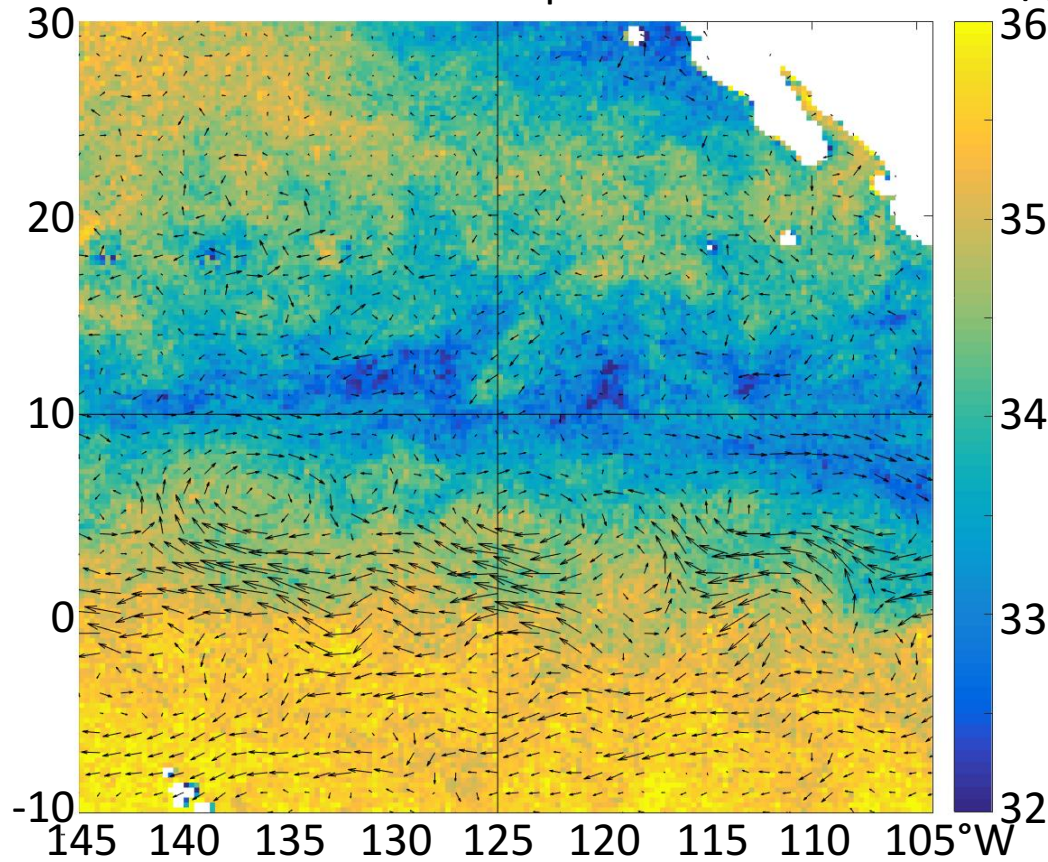
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SMAP 26-Aug-2016



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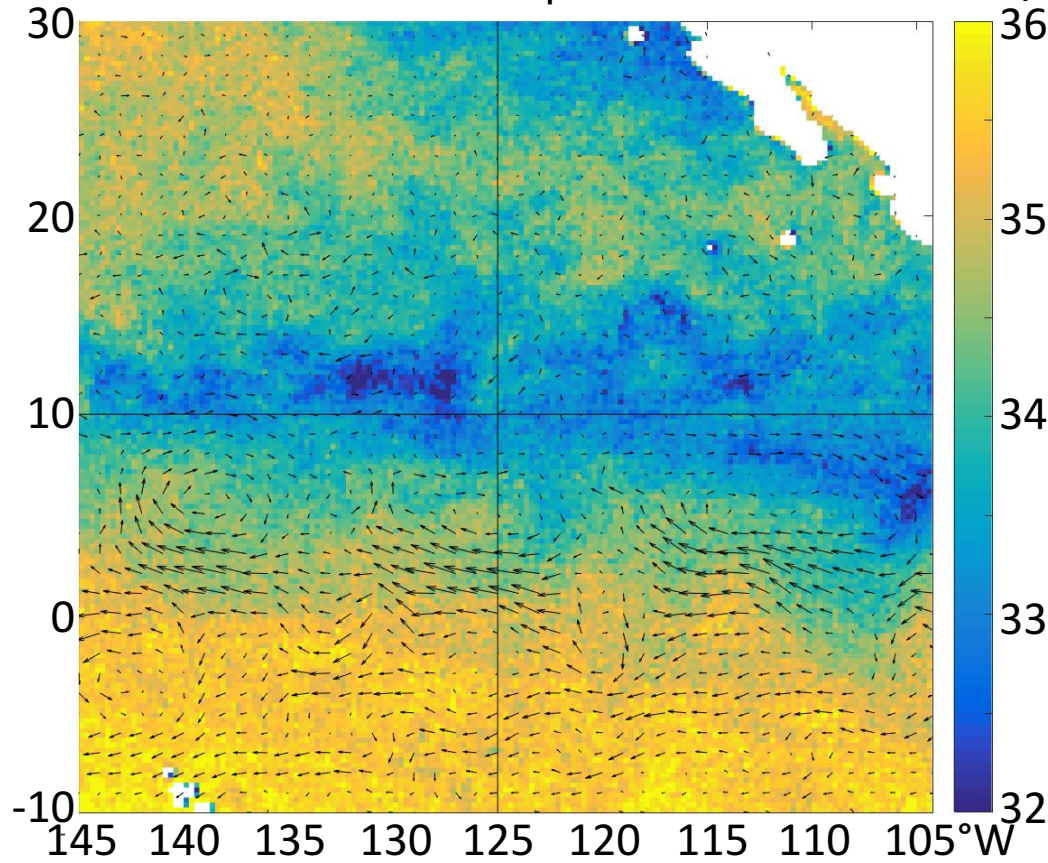
SMAP 1-Sep-2016



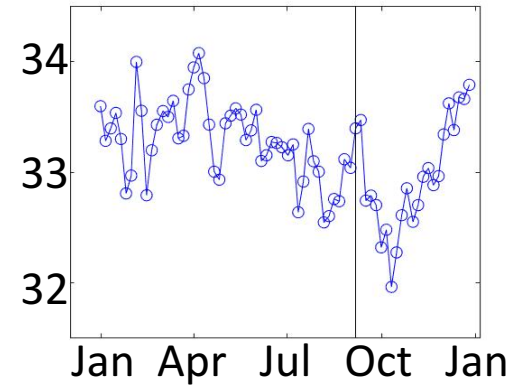
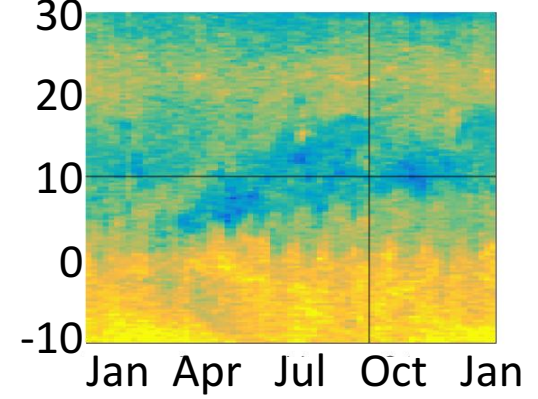


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SMAP 6-Sep-2016

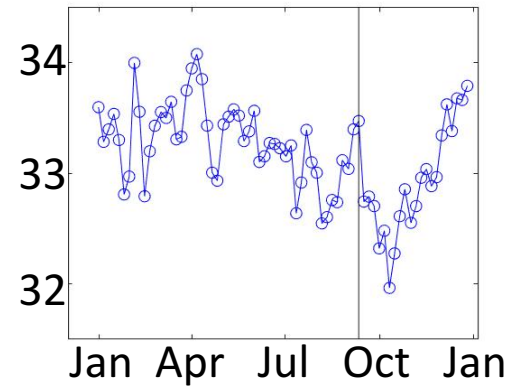
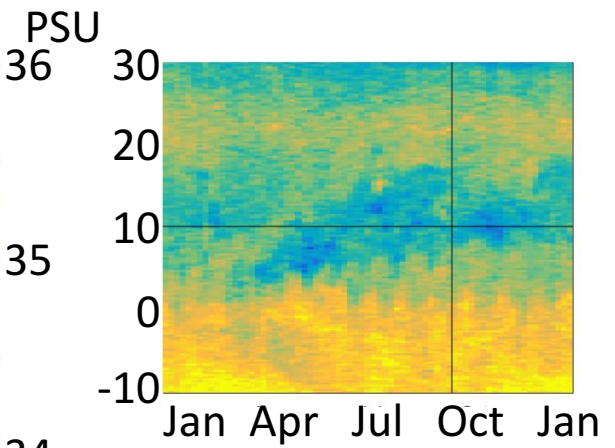
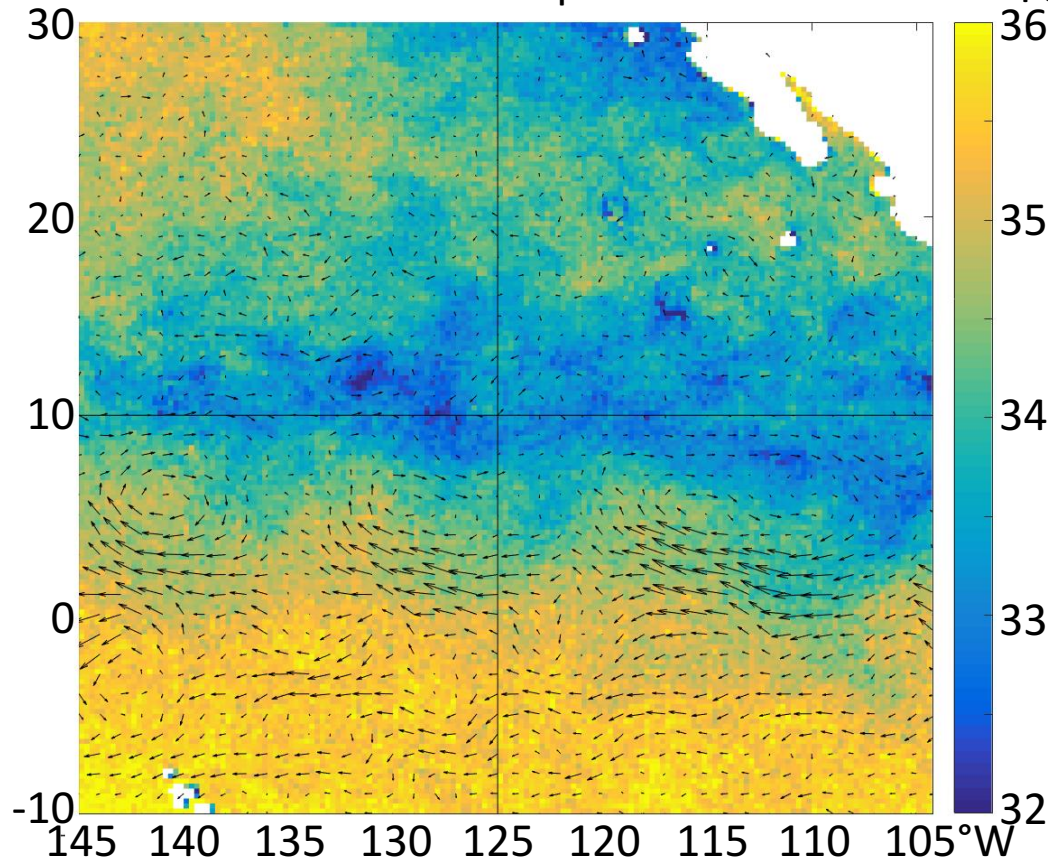


PSU



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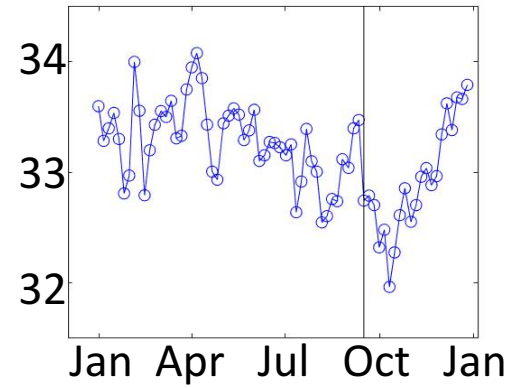
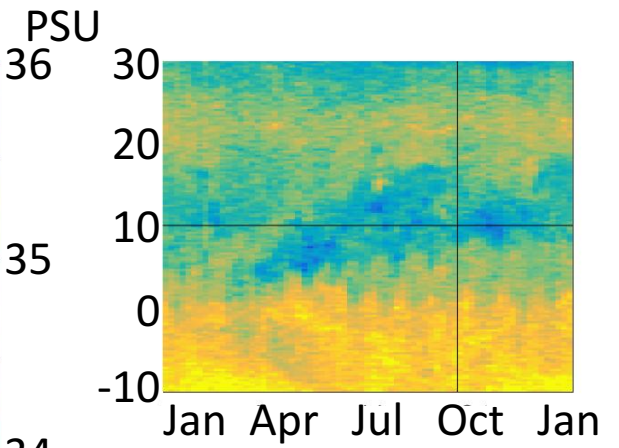
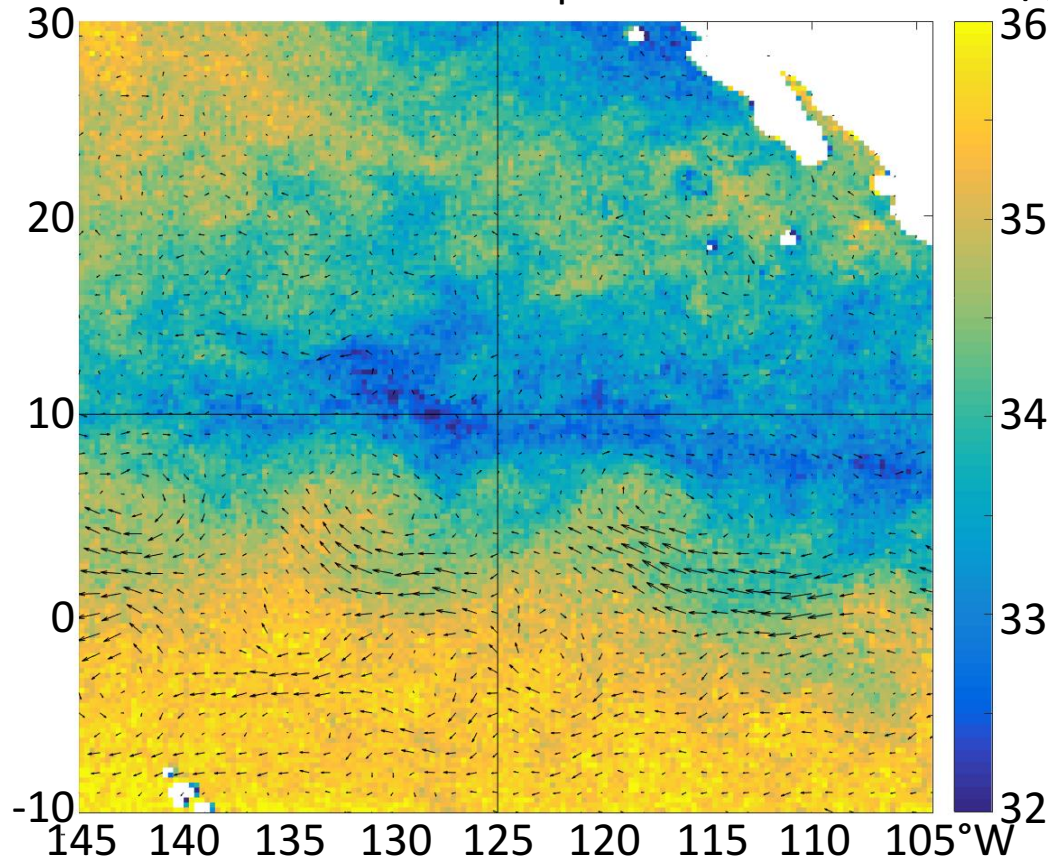
SMAP 11-Sep-2016





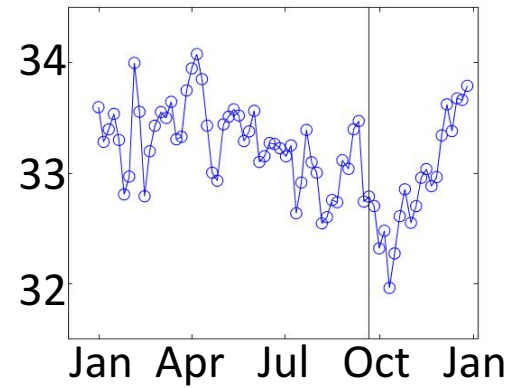
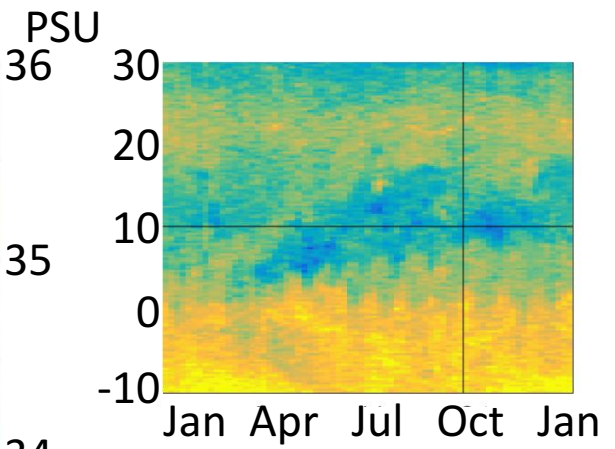
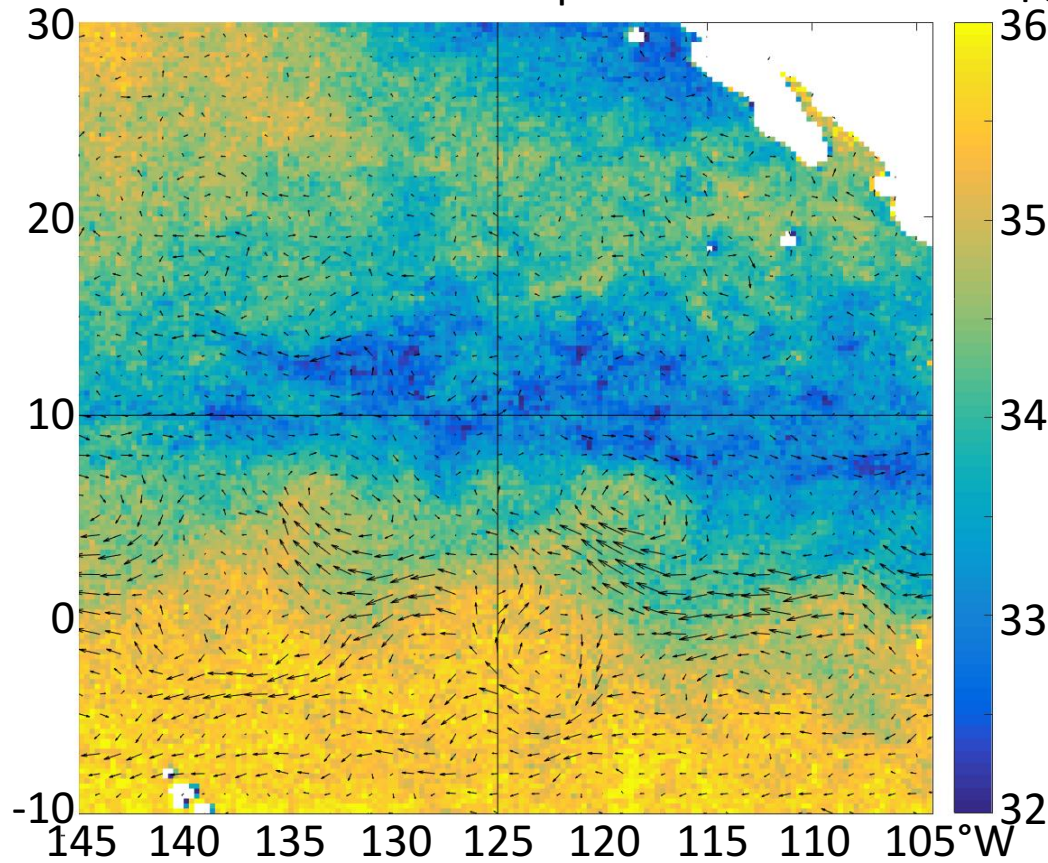
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SMAP 16-Sep-2016



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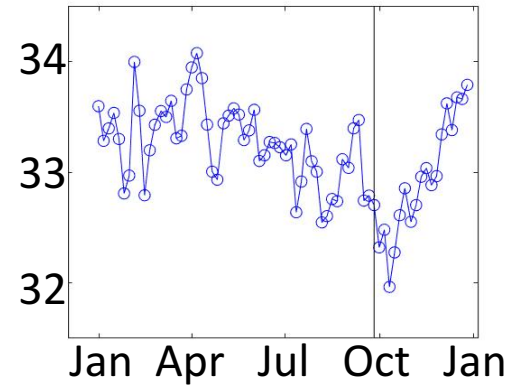
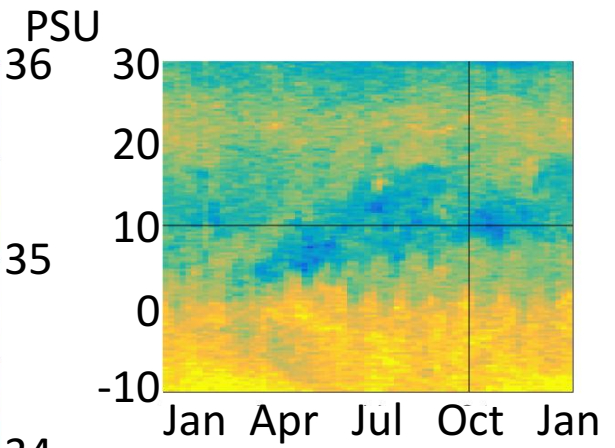
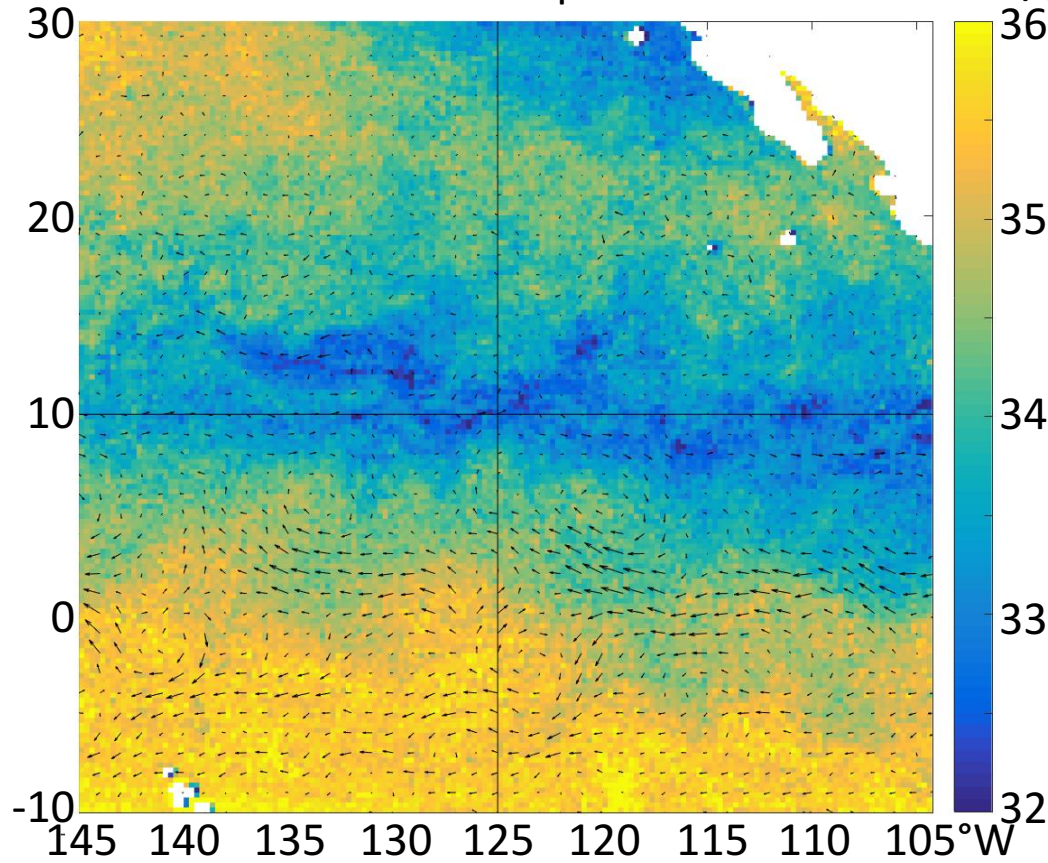
SMAP 21-Sep-2016





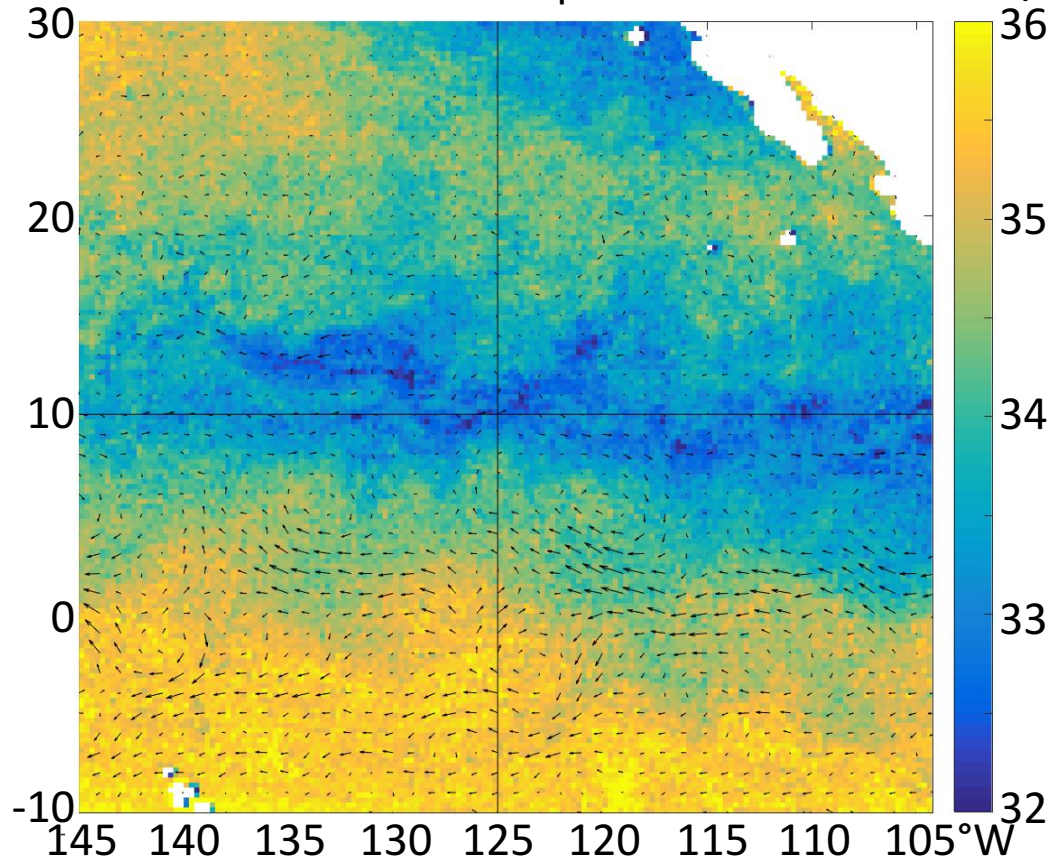
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SMAP 26-Sep-2016

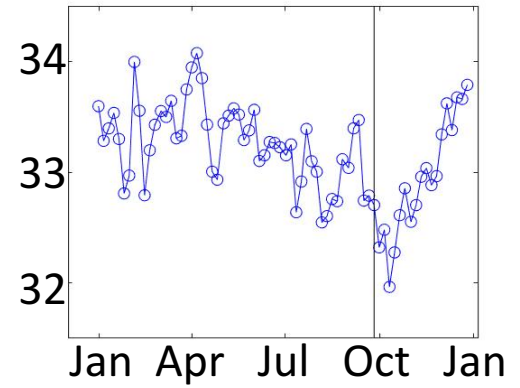
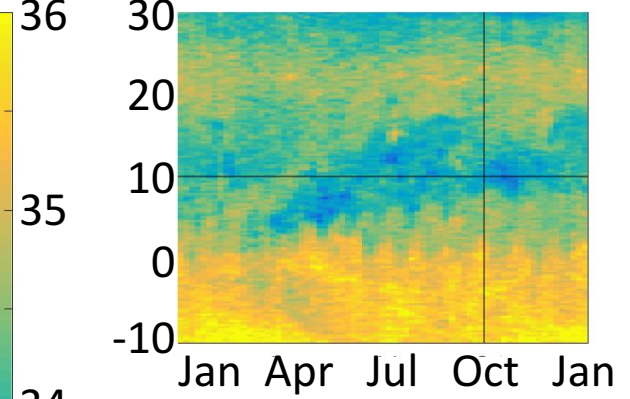


# Advection

SMAP 26-Sep-2016



PSU



## Conclusions

- Available salinity sensor data all match up reasonably well
- Interpolation of ARGO Salinity fields is a reasonable estimate
- Interpolation of ARGO Density, Mixed Layer Depth, and Temperature is suspect
- E – P and  $u_{10}$  divergence match spatially very well on a monthly time scale
- Still working on closing the moisture budget
- Currents and Advection affect local SSS

## Future Plans

- Closing the moisture budget is needed to address other physical mechanisms
- Evaluate how well  $u_{10}$  compares to the integrated winds from the budget model
- SPURS-2 soundings provide wind and moisture profiles for comparisons to  $u_{10}$
- Extend this analysis to reanalysis models such as MERRA-2, ERA-Interim, NCEP-NCAR
- Extend the moisture budget calculations with new data when they arrive

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