



# **Science I: Mean sea level monitoring: how to reconcile altimetry, tide gauges, land motion and other in situ observations?**

Chairs: Eric Leuliette, Christopher Watson

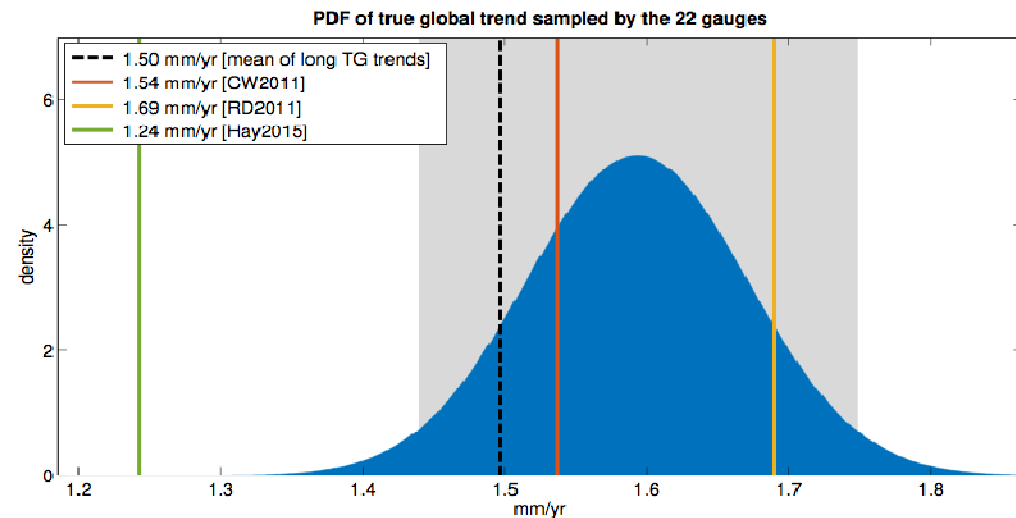
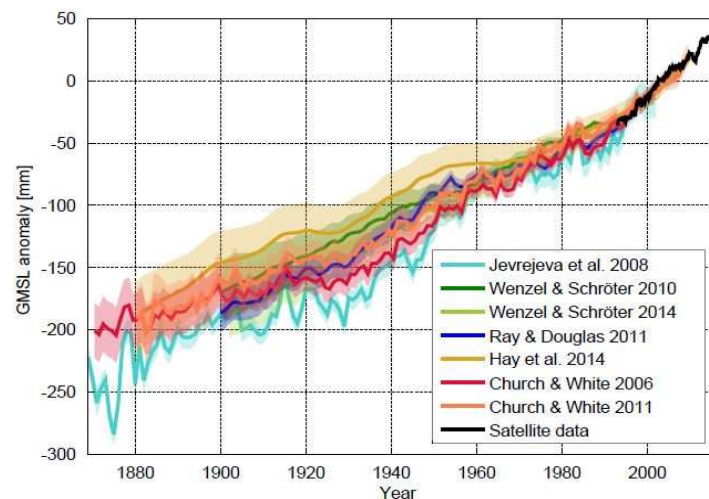
# Science 1: Session Summary

- The session had the goal of showcasing research that has a focus on using altimetry, tide gauges, land motion and other in situ measurements for the purpose of estimating changes in global mean sea level.
- **1 keynote presentation, 7 oral presentations and 7 posters, all well attended!**

## Selected Highlights:

### 20<sup>th</sup> Century GMSL: (Keynote by Ben Hamlington)

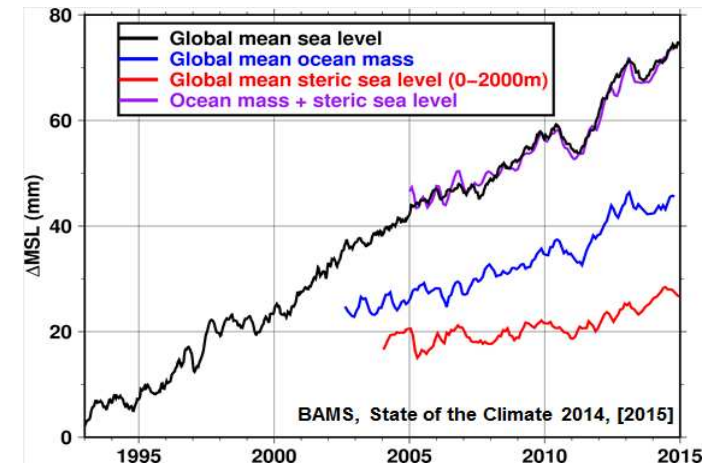
Interesting investigation into what the tide gauge network can tell us about GMSL change over the 20<sup>th</sup> C, with a focus on investigating the effects of network selection and land motion.



## Budget / Altimeter / Tide Gauge Comparisons:

(Talks by Prandi, Watson, Leuliette, Pragge)

- Leuliette presented work on the closure of the sea level budget since the ARGO and GRACE observations began
- Pradi / Watson / Pragge presented some of the subtleties (including land motion uncertainties) behind the altimeter v tide gauge comparison technique used to assess systematic error in the altimetry. See further in the cal/val summary.



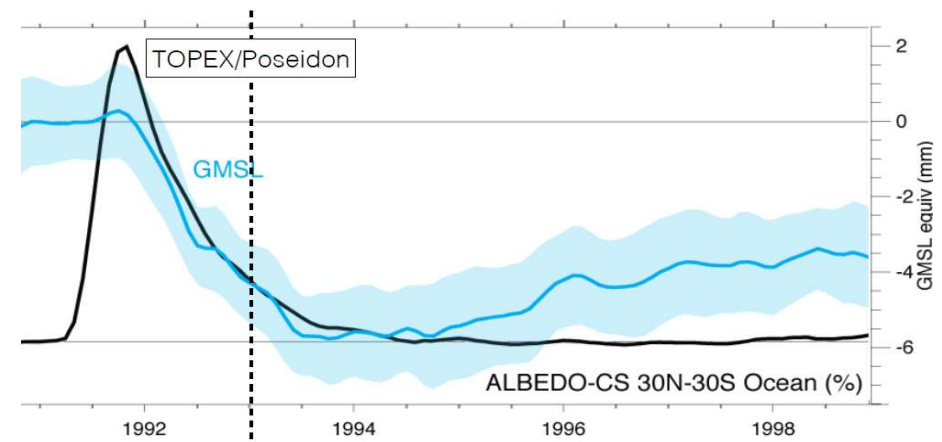
## Vertical Land Motion (VLM): (Talk by Santamaría-Gómez)

- ULR6 to be released on the SONEI site soon. Insight into the evolving ability to infer VLM at tide gauges using satellite positioning techniques.
- **New IAG Joint Working Group 3.2** on “Vertical motion of the Earth’s crust and sea-level change”. [Alvaro.SantamariaGomez@utas.edu.au](mailto:Alvaro.SantamariaGomez@utas.edu.au)

## Decadal variation in GMSL:

(Talks by Fasullo and Fu)

- Interesting work by Fasullo et al on the potential effect of the eruption of Mt. Pinatubo in masking the acceleration in GMSL over the altimeter era.
- Fu highlighted some salient points about the level of uncertainty in decadal trends in GMSL.





## **Science II: Mesoscale and sub-mesoscale ocean processes: current understanding and preparation for SWOT**

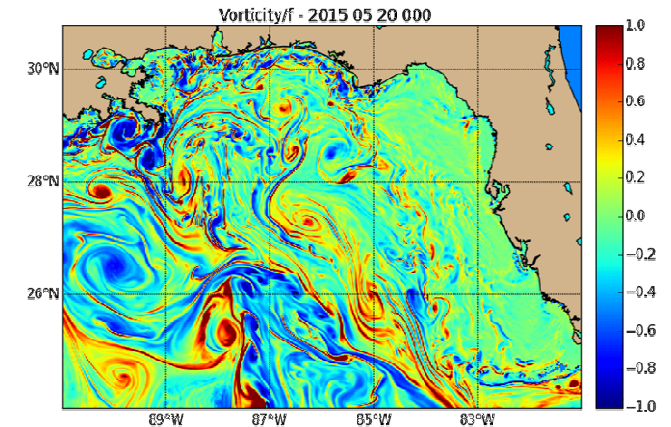
**Chairs :** Lee-Lueng Fu, Rosemary Morrow

7 oral presentations , 15 posters

# 1) Observational capabilities of meso-submesoscale: Towards SWOT

## Understanding the SSH observational capabilities at submesoscales using OGCMs

- Different dynamical operators to link subsurface structure (T, S, V,  $\zeta$ ) to SSH (sQG, balance operators, ...) (*Jacobs, Qiu*)
- 2D reconstruction (*Ubelmann*)

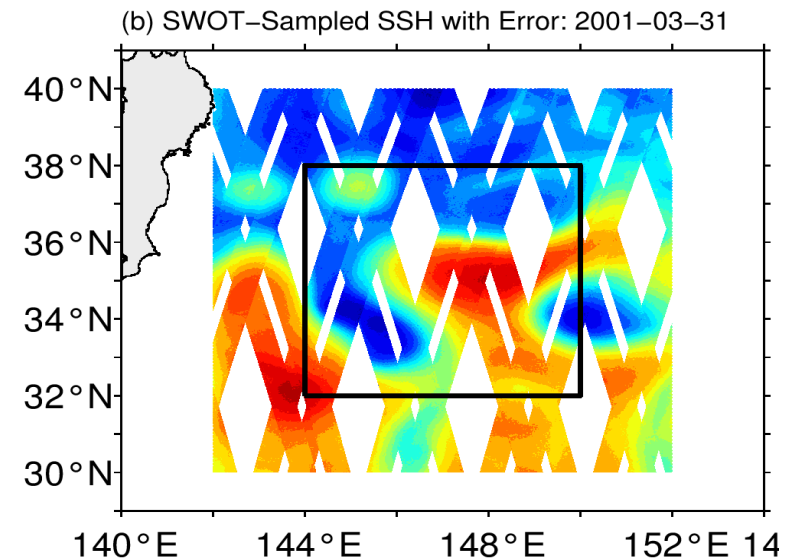


Credit : G. Jacobs

## Understanding the impact of errors

- Impact of 3D velocity field reconstructions using the SWOT simulator sampling and errors (*Qiu*)
- Impact of SWOT errors limits SSH resolution (15 km); velocity (40 km) & Relative vorticity (50-60 km) (*Chelton*)

+ Posters (Toublanc, Girton, D'Ovidio, Le Sommer)



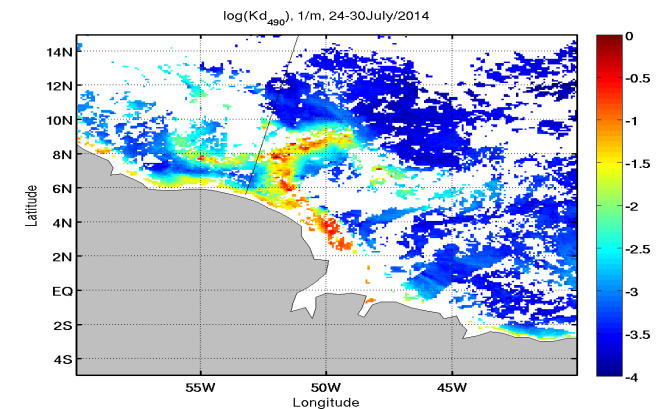
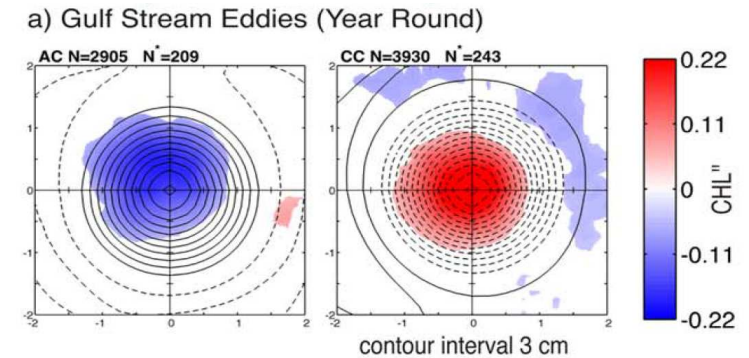
Credit : B. Qiu



## 2) Today's Mesoscale observability & applications

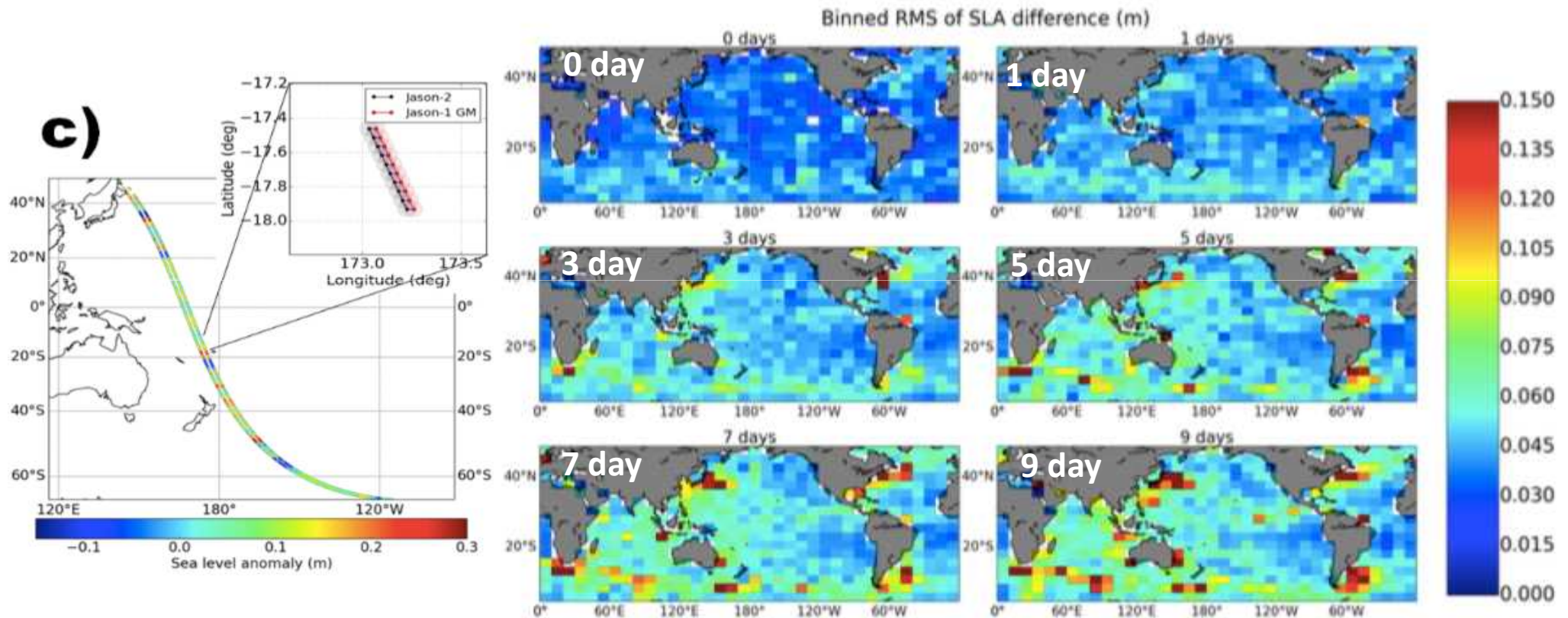
- Composites of Mesoscale eddies reveal **physical-biological interactions** in different regions, based on satellite observations and eddy resolving models. (*McGillicuddy*)
- **Regional data assimilation** schemes resolving mesoscale dynamics : example in the Luzon Strait: (*Zavala-Garay*)
- Role of mesoscale dynamics in **Amazon freshwater plume** extension & their role in modulating hurricanes (*Carton*)
- A **frontal eddy** intensively sampled at sea and overflown by SARAL (*Griffin*)

+ Posters (Dohan, Beron-Vera, Maximenko, Melnichenko, Strub, Morrow, Pascual, Quilfen)



### 3) Rapid meso and submesoscale processes

- Barotropic Rossby waves (*Farrar*)
- Data set of J1G-J2 overlapping tracks at 0-10 days (*Dibarboure*)



**Recommendation :** Set up an OSTST CalVal group to discuss spatial validation of alongtrack data from 50-100 km wavelength (J2-J3, S3-SAR, CR2-SAR, Saral,...) & in preparation for J-CS & SWOT 2D CalVal



# **Science III: Large scale and global change ocean processes: the ocean's role in climate**

**Chairs : Dean Roemmich, Thierry Penduff**

1 keynote — 6 talks — 20 posters

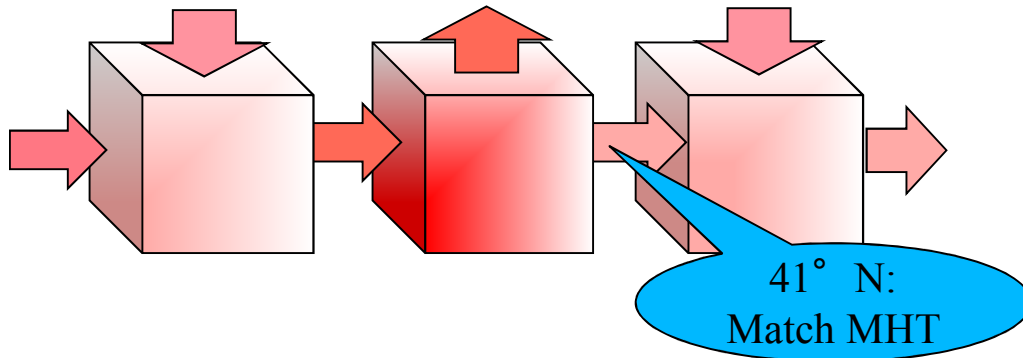


# Heat and Freshwater Convergence Anomalies in the Atlantic Ocean Inferred from Observations

Kathryn Kelly

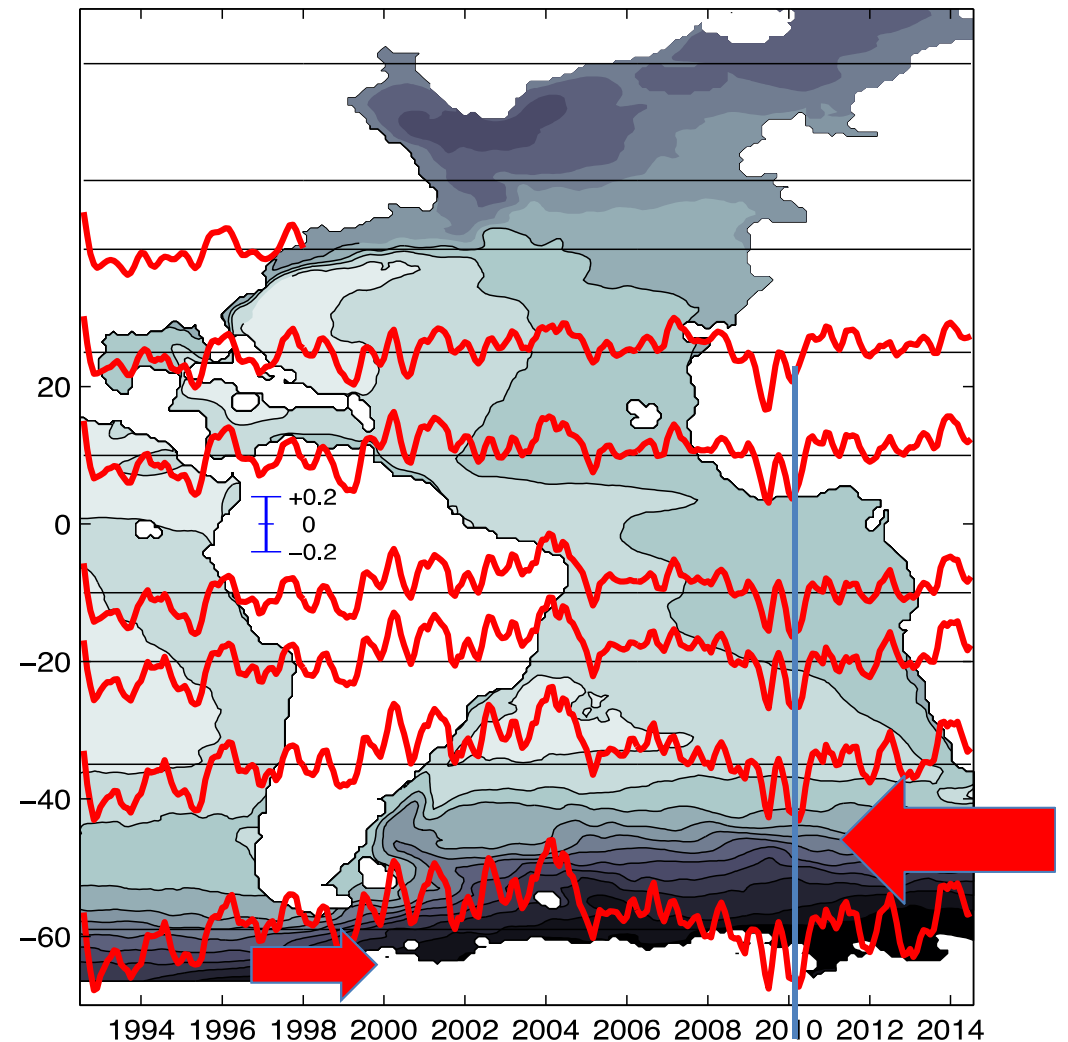
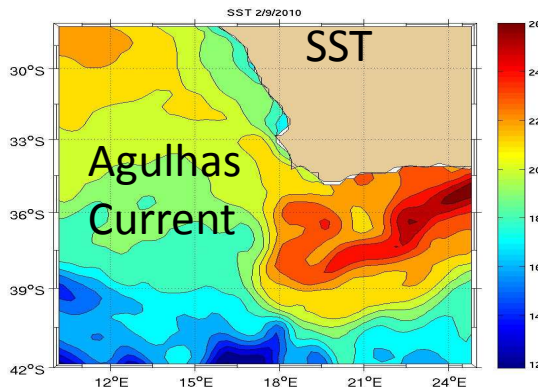
Kyla Drushka

LuAnne Thompson



MHT anomalies derived from Qnet & T.  
Latitudinally-coherent signals.  
Where do interannual MHT anomalies  
originate?

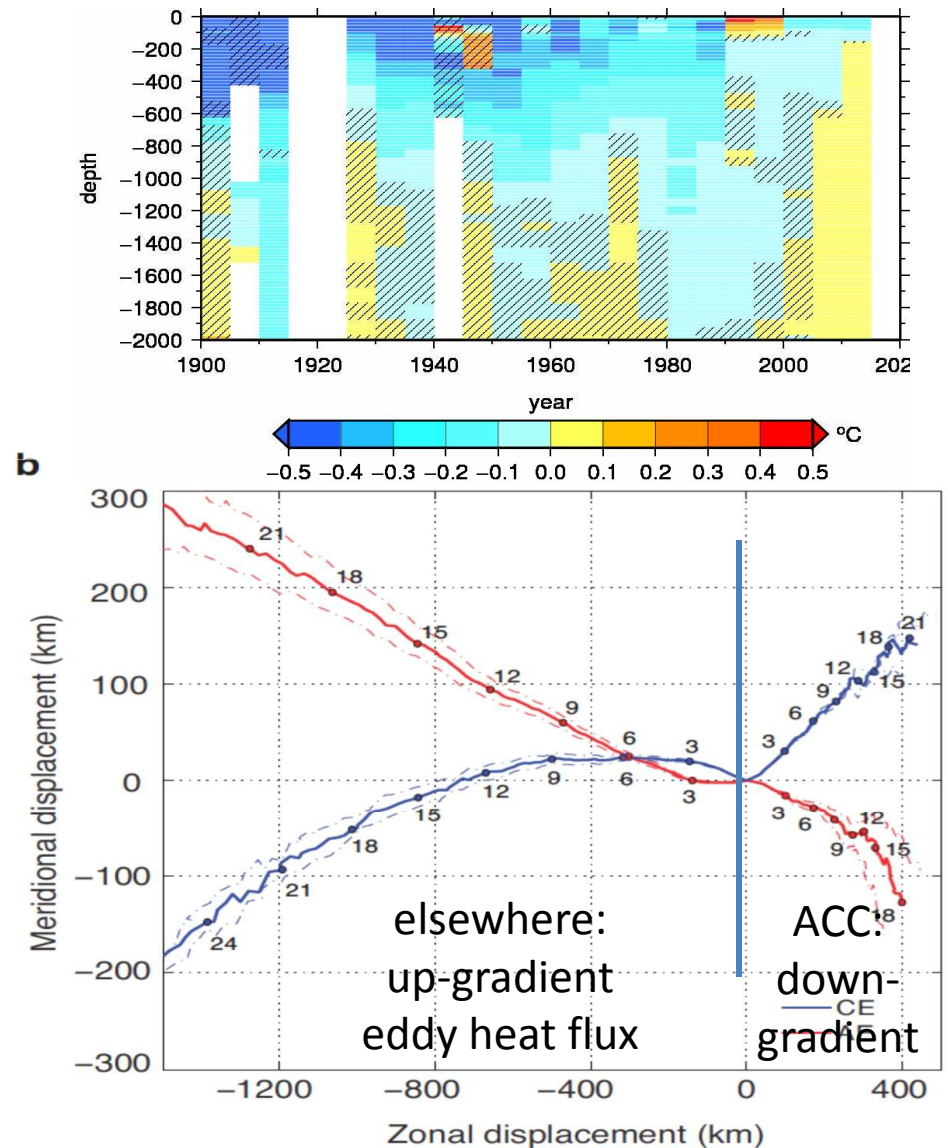
- no obvious propagation
- South Atlantic?



# Mean structure, long-term change and eddy motions in the Southern Ocean: A perspective from altimetry, Argo and state estimation

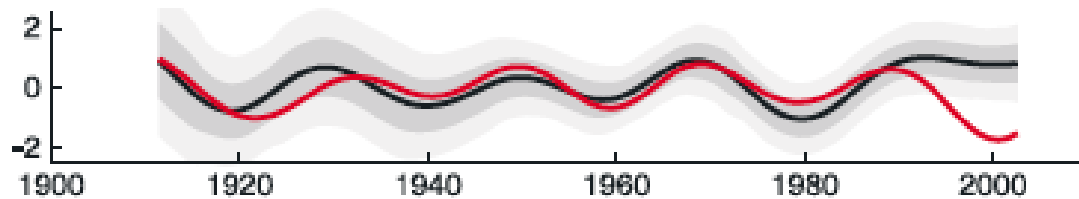
Sarah Gille  
Uriel Zajackovski  
Matt Mazloff

- SSH anomalies well correlated with sub-surface anomalies, in principle provide a means to refine reference mean field against which century-scale temperature changes are evaluated, albeit possibly introducing more noise than benefit....
- Southern Ocean warming persistent throughout 20th century.
- Eastward-moving Southern Ocean eddies result in poleward heat transport across the ACC—may help to explain mechanisms governing observed warming in Southern Ocean.

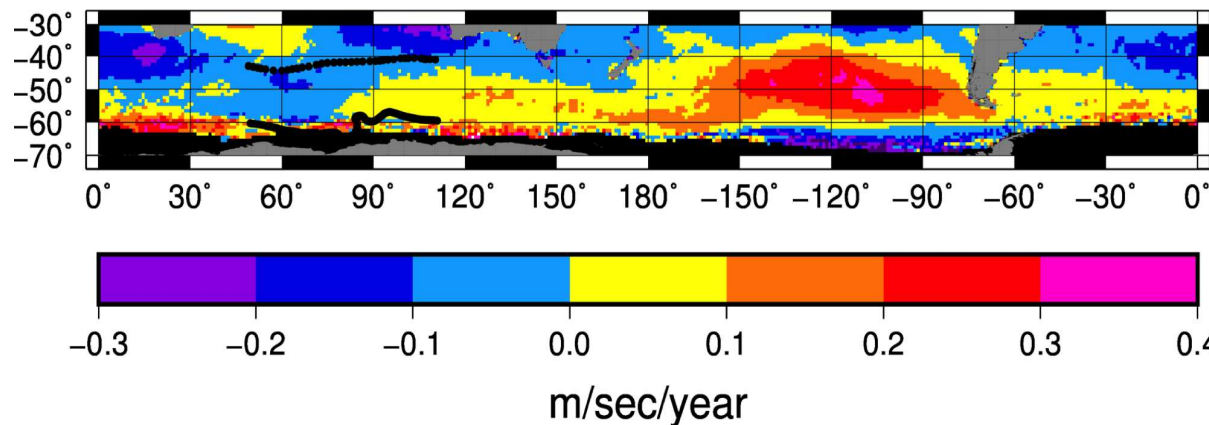


# Low-Frequency Transport Variability in the Southern Ocean: The Importance of Regional Variations

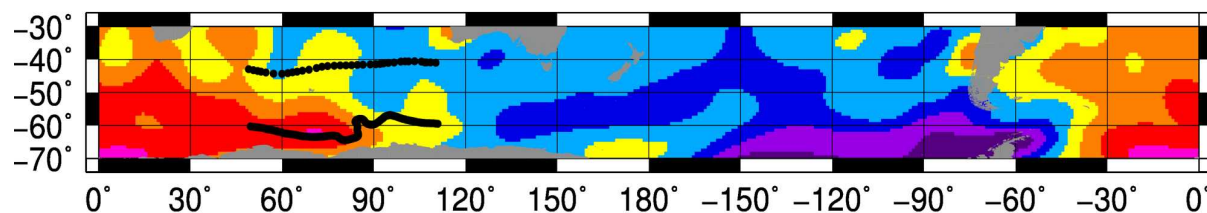
Don Chambers,  
Michael Kosempa  
Jessica Makowski



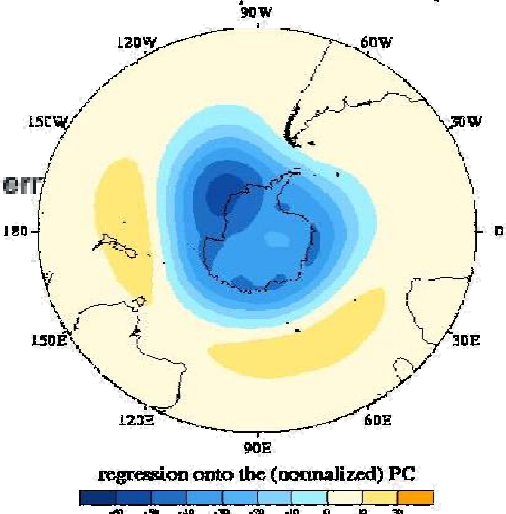
a) Trends in Zonal Wind Speed (CCMP)



b) Trends in OBP (GRACE)



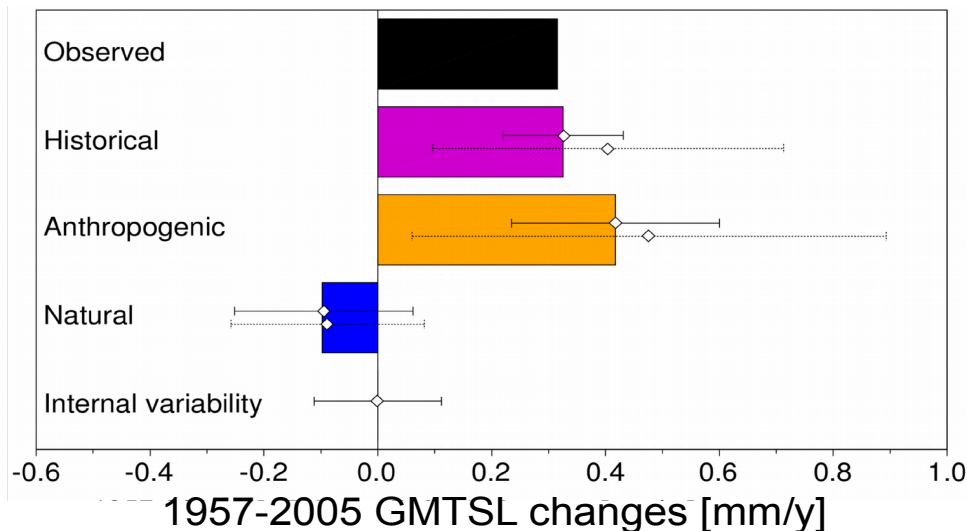
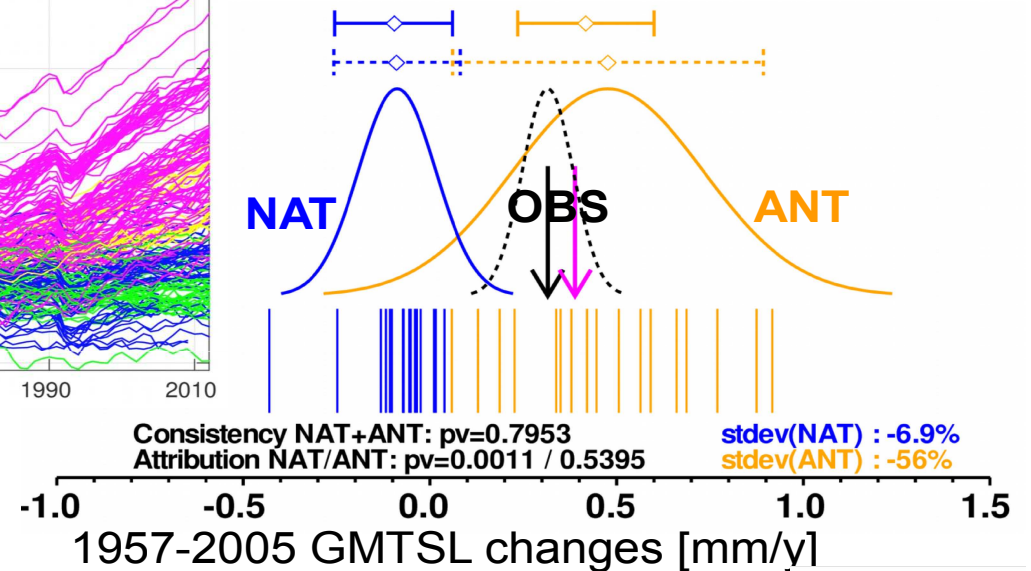
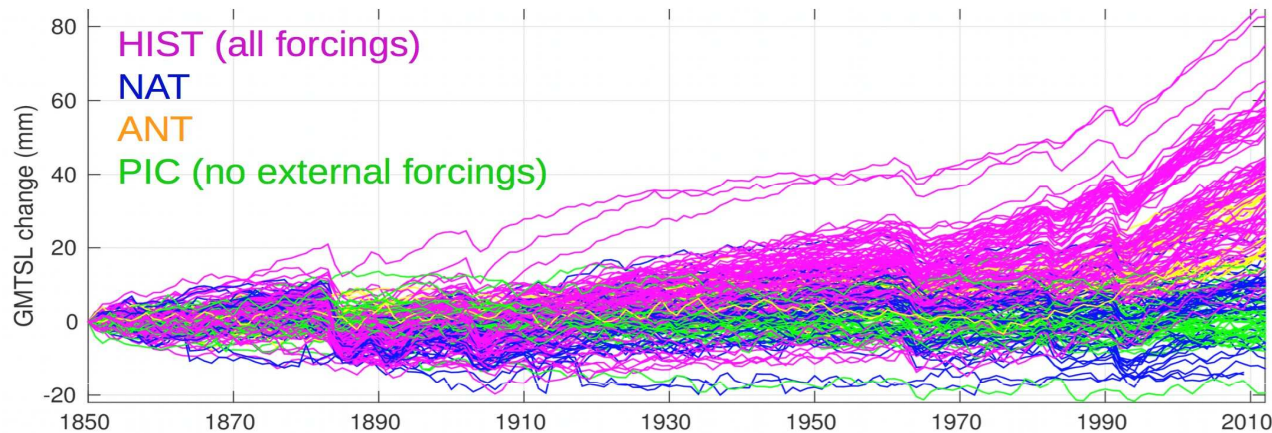
EOF 1 of SH extratropical 850 hPa Z (meters)



- Significant decadal-scale variability in Southern Ocean
- Different sign of trend in Indian Ocean, South Pacific
- Can we really measure climate-related transport change in the ACC using only repeat hydrogr. transects across Drake Passage?

# A new approach to detection and attribution of ocean thermal expansion

E. Charles,  
B. Meyssignac  
A. Ribes



*Contribution of each forcing and associated uncertainties issued from multi-model mean (dotted lines) and from D&A best estimators (continuous lines)*



# Is anthropogenic sea level fingerprint already detectable in the Pacific Ocean over the altimetry era?

H. PALANISAMY, B. MEYSSIGNAC, A. CAZENAVE  
T. DELCROIX  
LEGOS, Toulouse, France

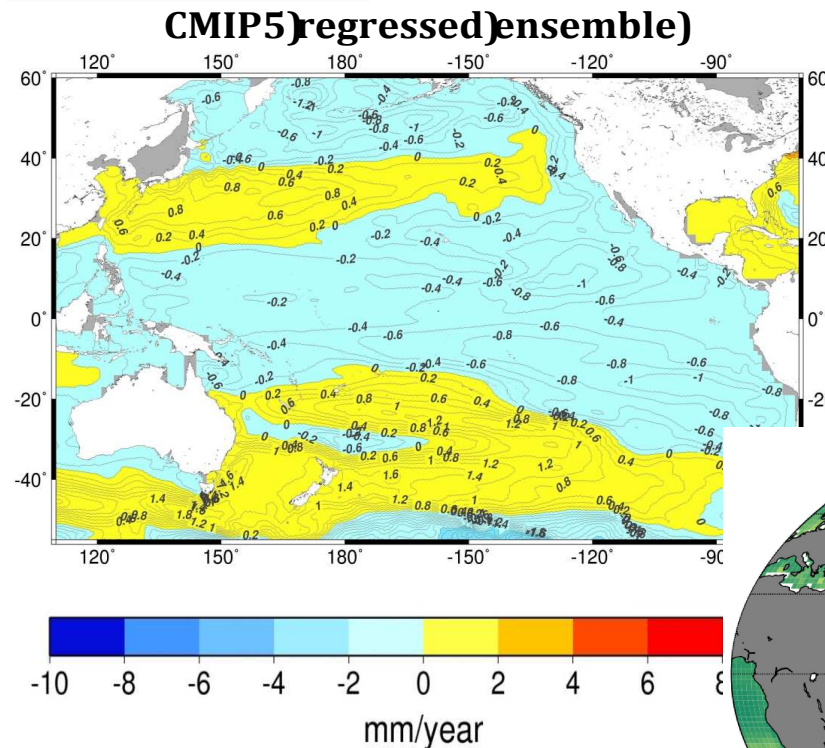
## The role of anthropogenic forcing??

53 RCP8.5  
coupled  
CMIP5 runs

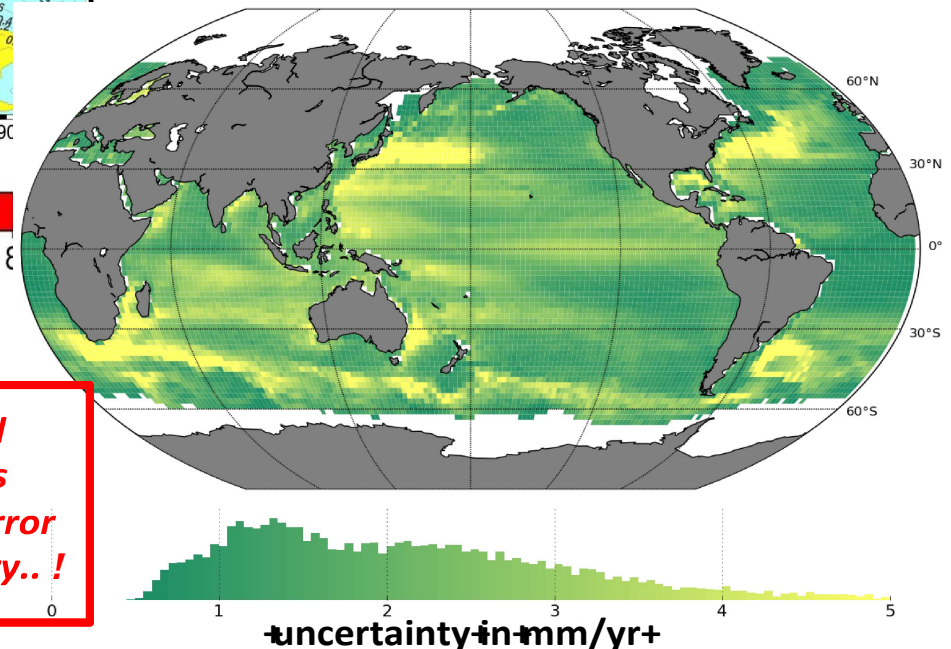
21 models

Remove PDO  
footprint

Remove  
Modoki El  
Niño



Expected uncertainty in altimetry trend)  
see talk of Prandi et al.))



**CMIP5 based externally forced sea level trend amplitude in the tropical Pacific is significantly lower than the expected error in trend patterns from satellite altimetry.. !**

# The impacts of ENSO/PDO on regional sea level change: After 20 years, are we finally seeing a change in the pattern of Pacific sea level change?

R. S. Nerem  
B. Hamlington  
Mark Merrifield  
Phillip Thompson

- Tropical Pacific 1993-2013 sea level change pattern is changing.
- Ongoing ENSO or also a switch in PDO phase? won't be known for a few years.
- If the latter, rates of sea level rise along the coast of California are expected to increase dramatically over the next decade as it recovers from an  $\sim 7$  cm sea level deficit.
- If the PDO switches phase and we begin to average out decadal variability in Pacific sea level, there will likely be a residual pattern of sea level change due to climate change.

