



Upper-ocean stratification from drifters for SMOS/Aquarius cal-val

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The issues

- **5%** of tropics with large daily SST cycles (larger than 0.5°C amplitude; 2%, $> 1.5^{\circ}\text{C}$)

Impact on SMOS retrievals? Daily SSS?

- **1%** of data in the tropics with large fresh water input from rainfall (10% in wet areas).

What is the near surface stratification and residual effects on SSS?

Earlier studies (Henocq et al., 2010) show gradients between 1-m and 10-m.

Can we access the 0 to 1-m from drifters?





The early SVP drifter models (in 2005)



- PacificGyre (SBE 37 SI)



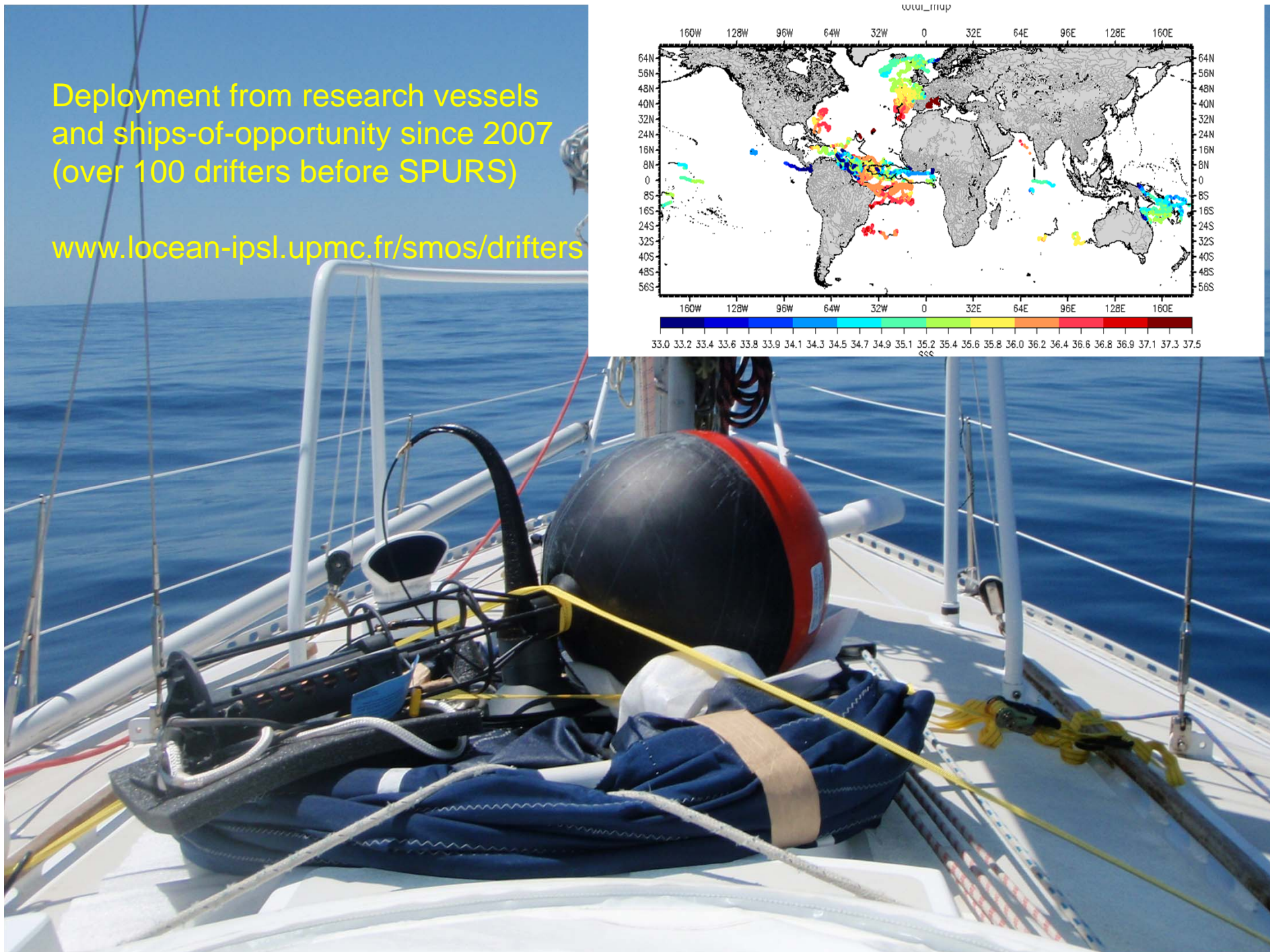
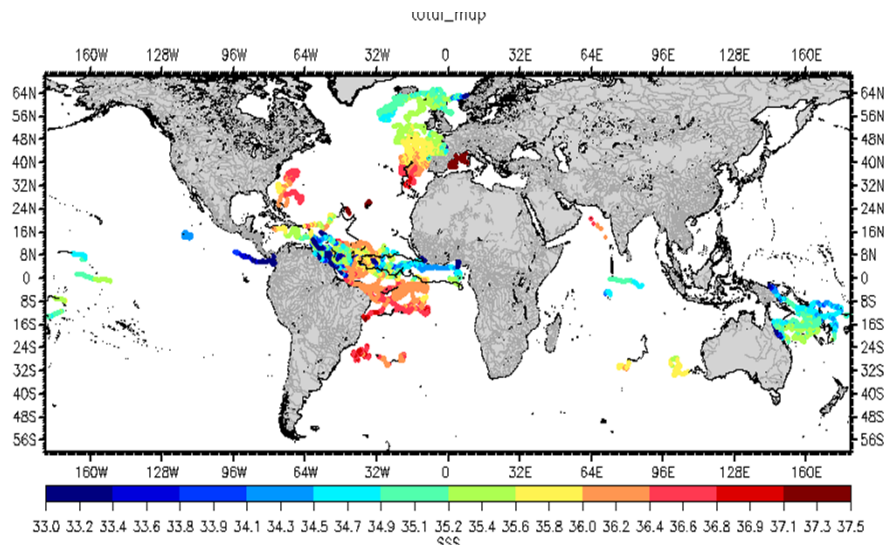
- Metocean (SBE 47)

Since then, C/T SeaBird sensors are all unpumped SBE 37 SI sensors;
Also, comments on difference in T and C depths resulted in some small
changes (sensors now closer) **T, C close to 40-50 cm**

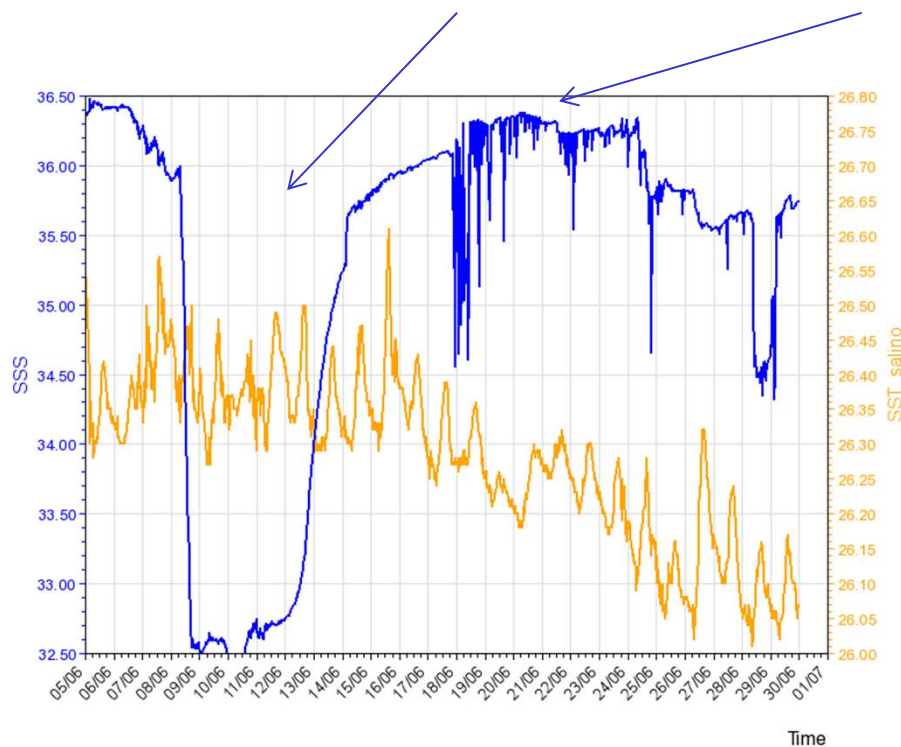
Changes in drogue attachment + possibility of **SST (near 15-17 cm)**
or SLP measurement (Metocean or PacificGyre);

Deployment from research vessels
and ships-of-opportunity since 2007
(over 100 drifters before SPURS)

www.locean-ipsl.upmc.fr/smos/drifters

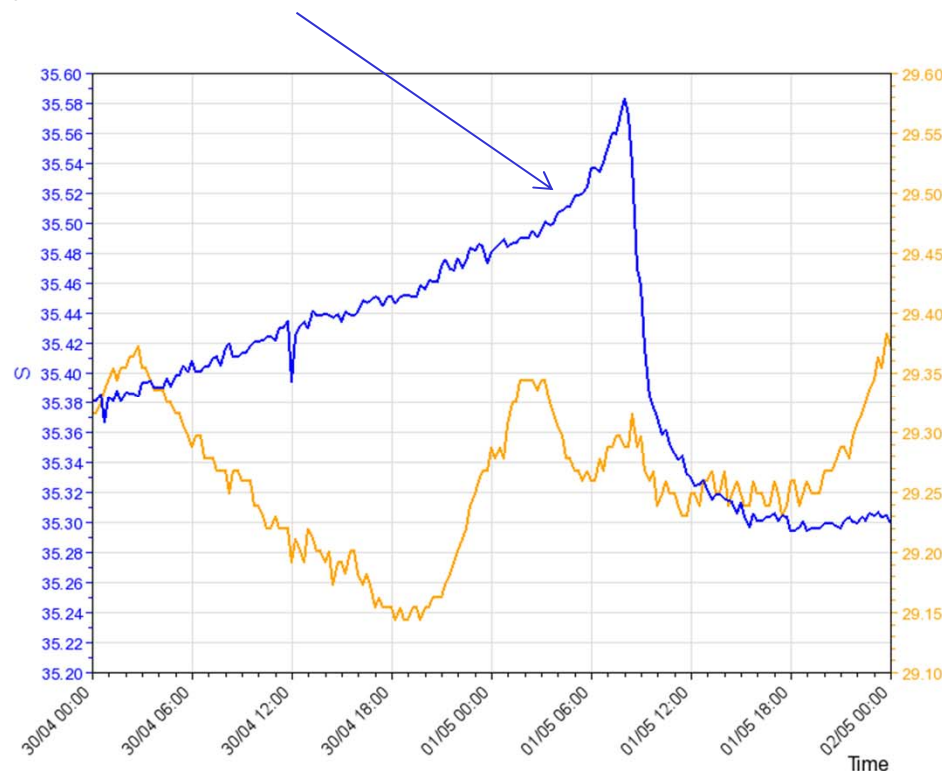


Data present variability, which can be
 Either suspicious , ‘noisy’, or correct...



Tropical Atlantic near 10-15°W 5-10°S

Removed by our quality control



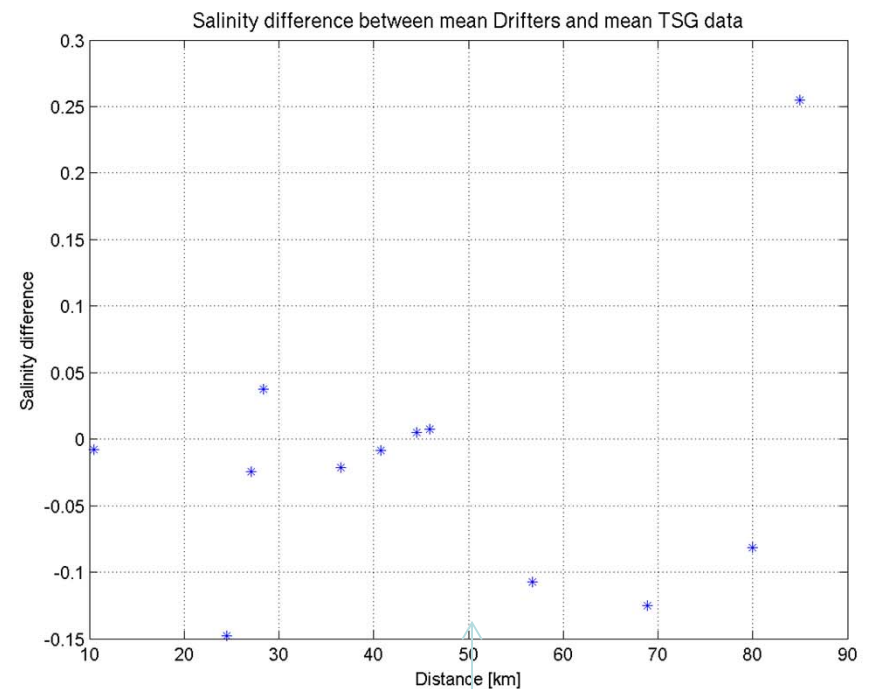
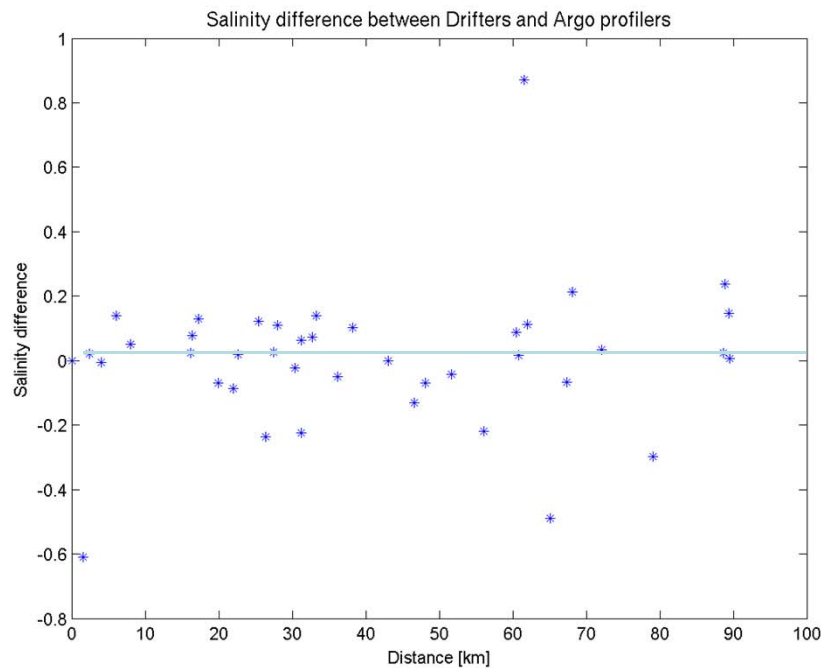
tropical Pacific 20°S

kept!

Comparison with SVP-S Argo + TSG ORE SSS

Example of South Pacific eastern subtropical gyre

Is there stratification between 40-cm and 5-m?



Dry region:
Positive near-surface gradient?

Rain/fresh water stratif-

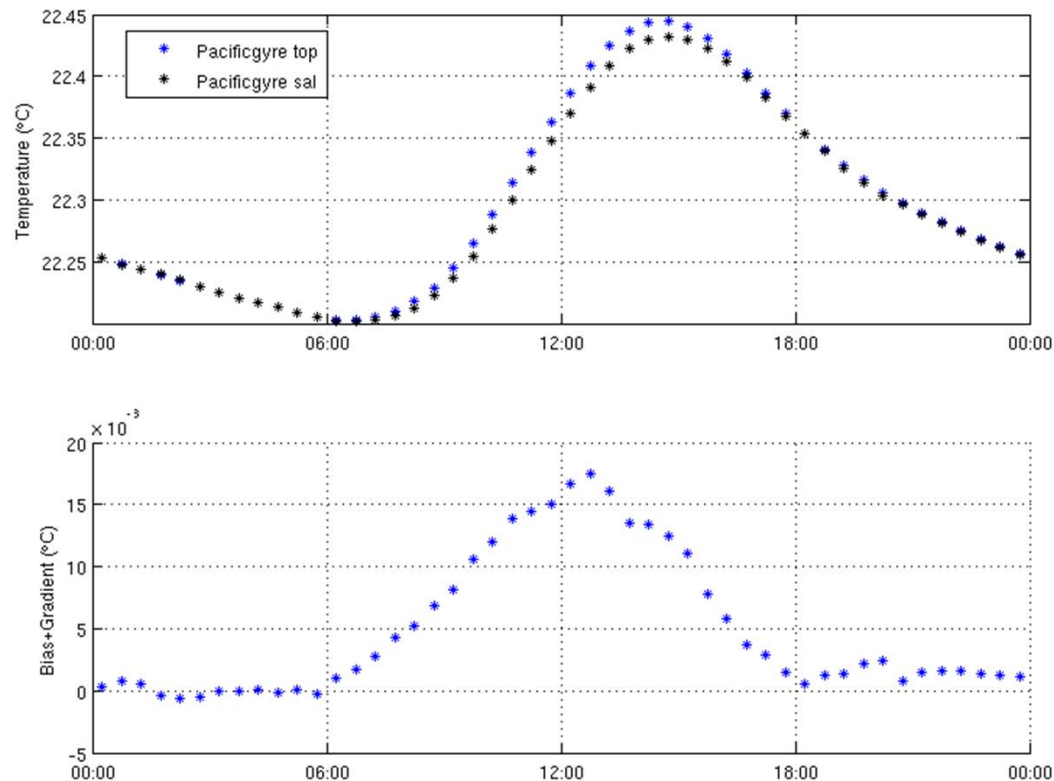
Courtesy of Meike-Sean Martins and Detlef Stammer (ZMAW)



Temperature stratification – daily cycle

T_{top} and T_{sal}

- T_{top} at 17 cm; T_{sal} at 43 cm (Pacificgyre) or 62 cm (Metocean)



6pm-6am
Average 0.15°C
No strat between
T_{top} and T_{sal}

Reverdin et al.,
JGR, 2013



T or S stratification?

- Comparison of T(17 cm) and T(43 cm) (different classes)

In add., C (cell at 39 cm)

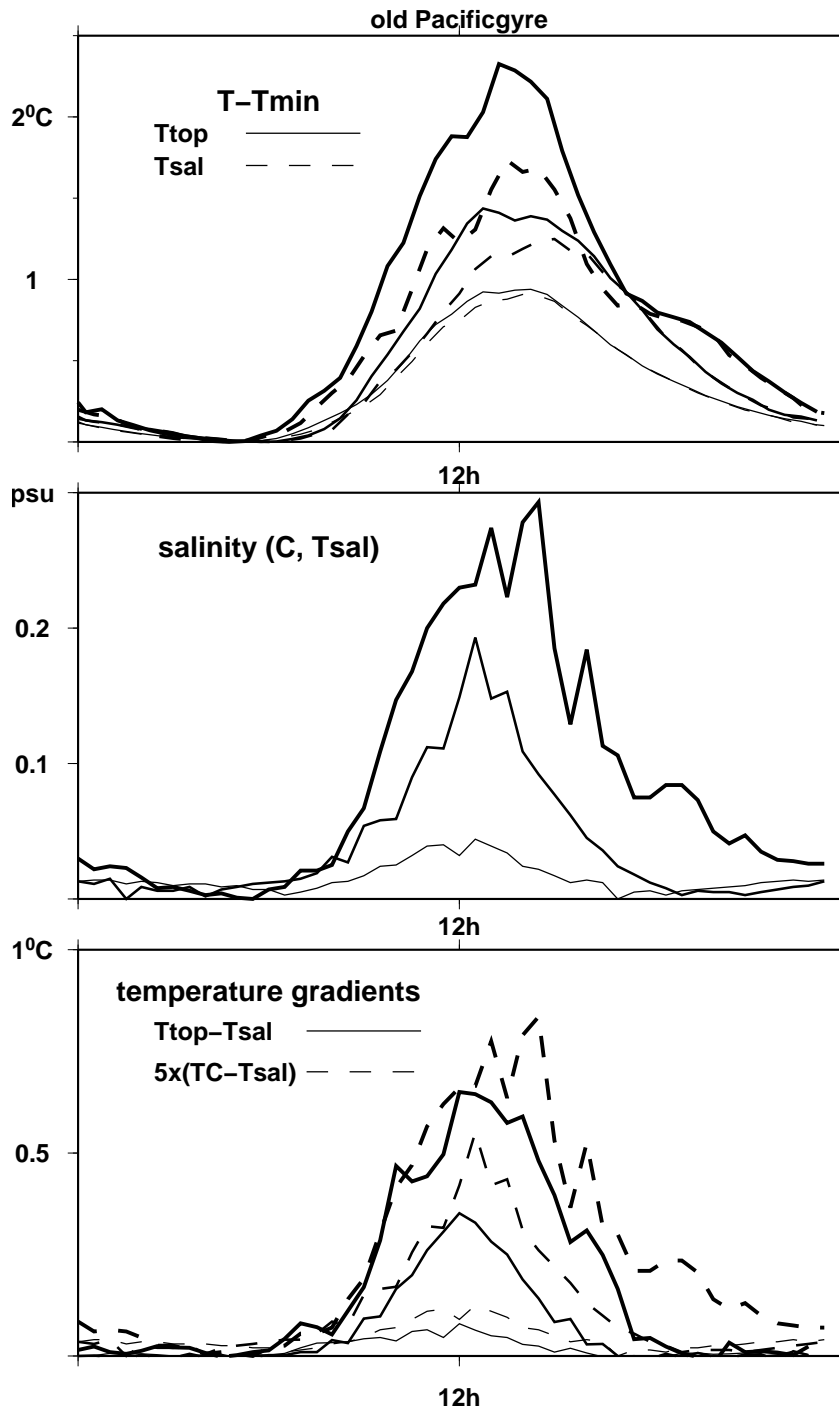
- either S(C, T=Tsal)

- or TC(C, S=cst)

(usually, a better assumption at this depth; except evening

large cycles $S_{6pm} - S_{6am} =$

0.05 psu)

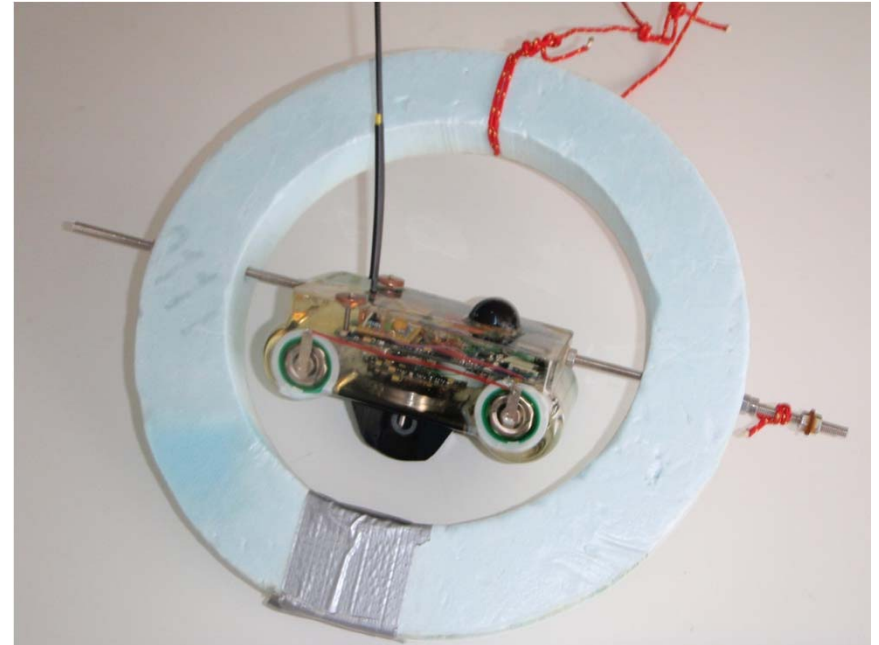


Floates to measure **C,T closer to the surface**
(and other parameters: SLP, wave spectra)



surplax

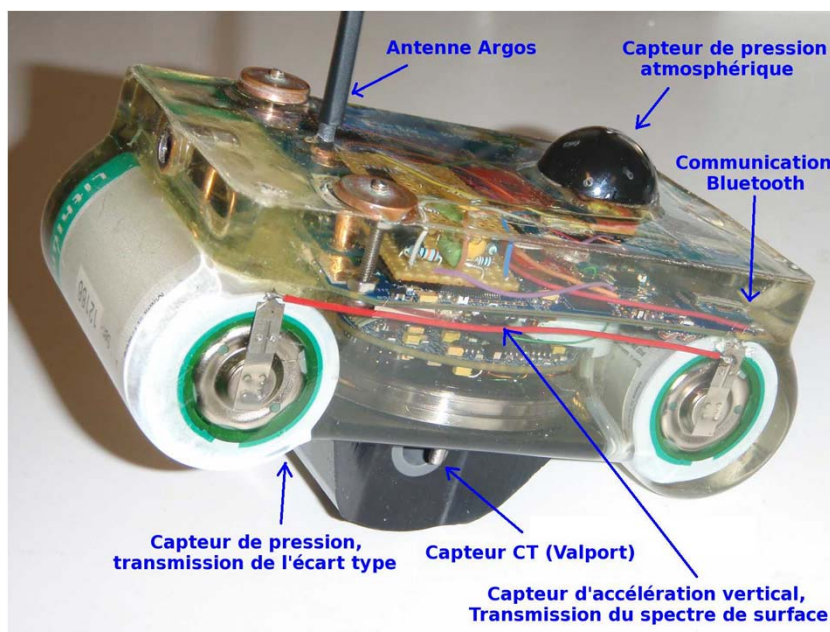
surpact



Serve to validate C,T from SVP drifters
Provide stratification data
(+ met info for surpact)

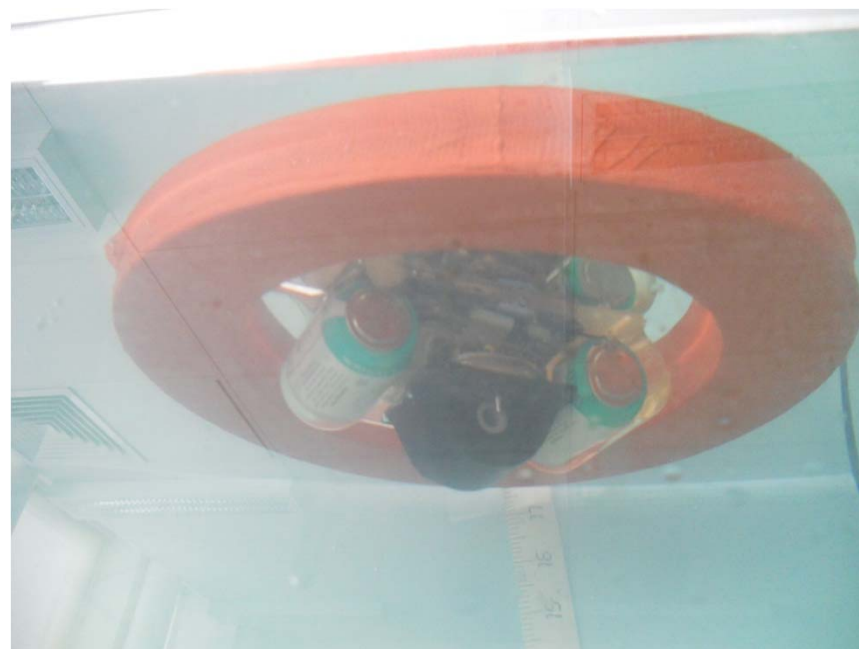


Surpact: a wave-rider



LOCEAN (Reverdin et al., 2013)
Developed with SMRU
Test Deployments in Fromvar/ Banyuls,
Prototypes Pirata et Pandora
First long deployments Strasse/SPURS

Reverdin et al., Oceanography, april 2013





Wave spectra example of set-up (deployment > 4 mois in sub-tropical NA (SPURS))

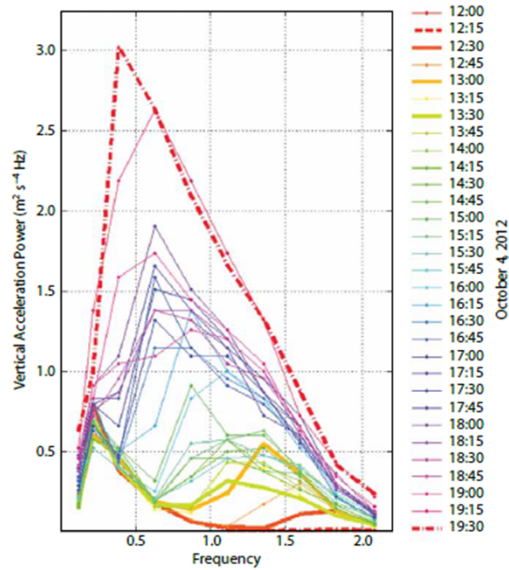
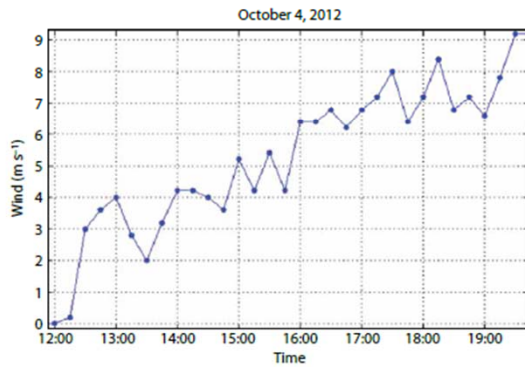
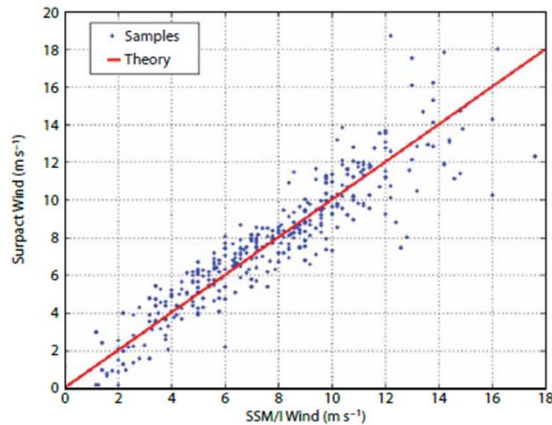


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Retrieved winds



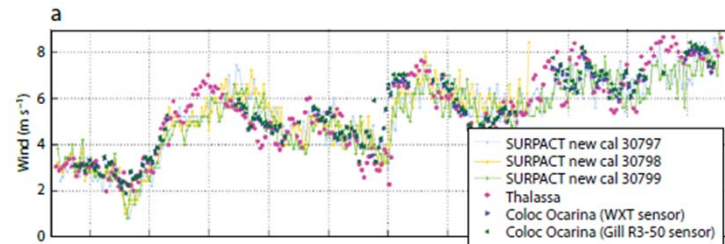
Scattering 0.85 m/s for WS 4 to 7 m/s & 1.4 m/s for WS 8 to 11 m/s wrt SSMIS/wind retrieval (100 days)



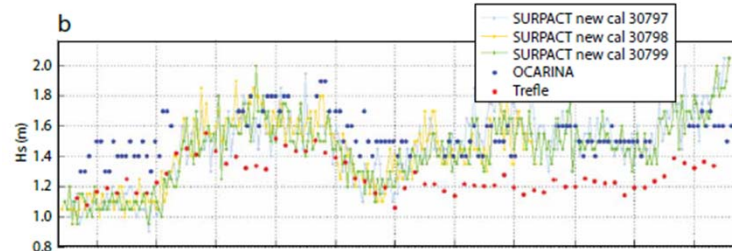
Strasse – time series 4



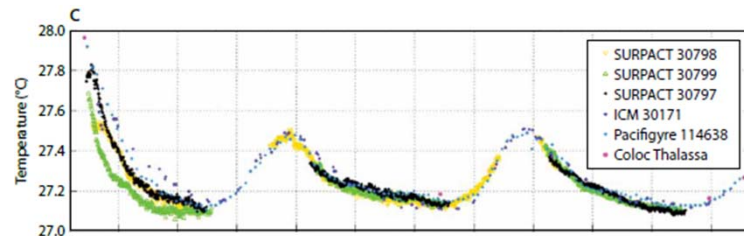
Wind



Wave height

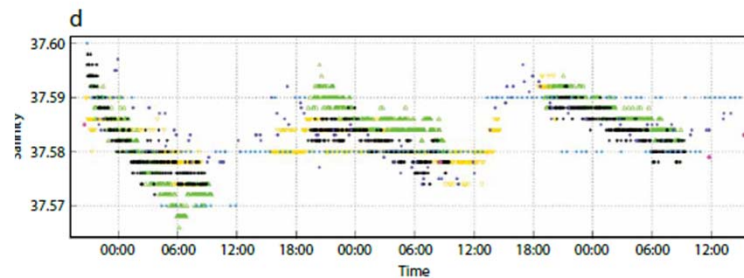


T



Weak daily SST cycle
0.01 psu daily SSS cycle
(down to 1-2 meters)

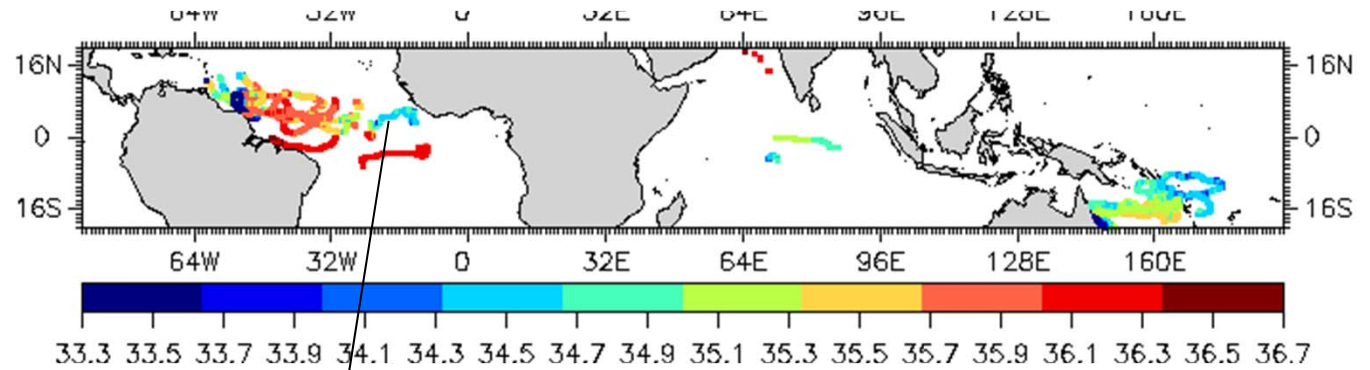
S



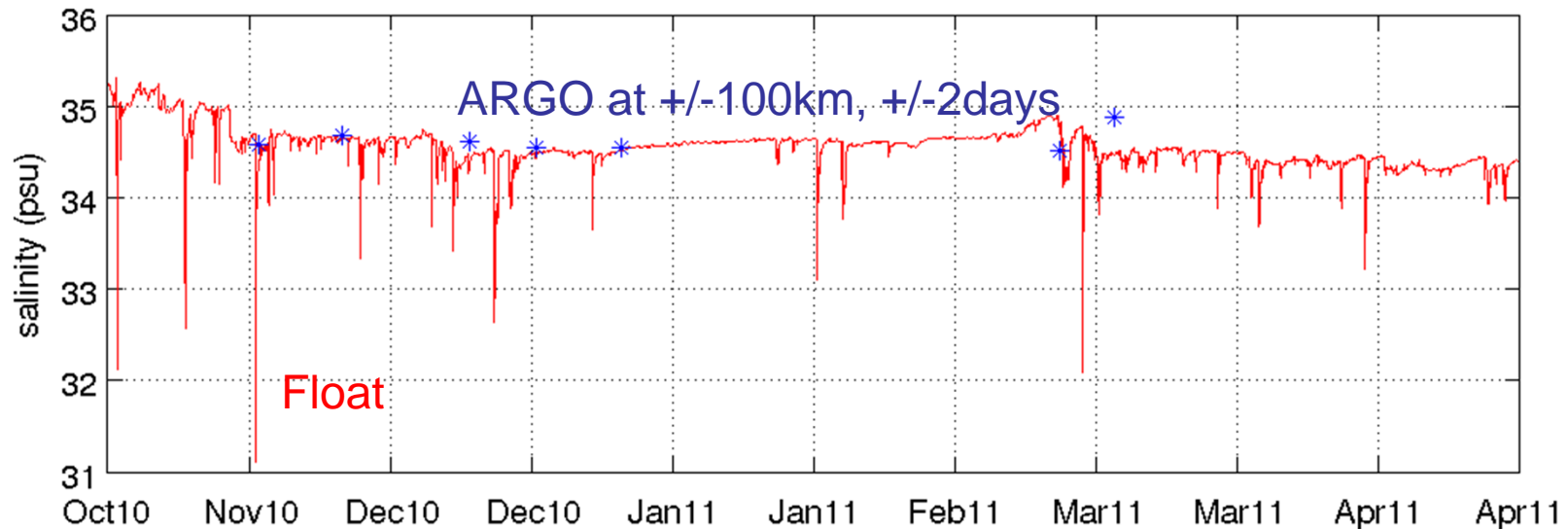
• Pacific Gyre
(SBE 37 SI)



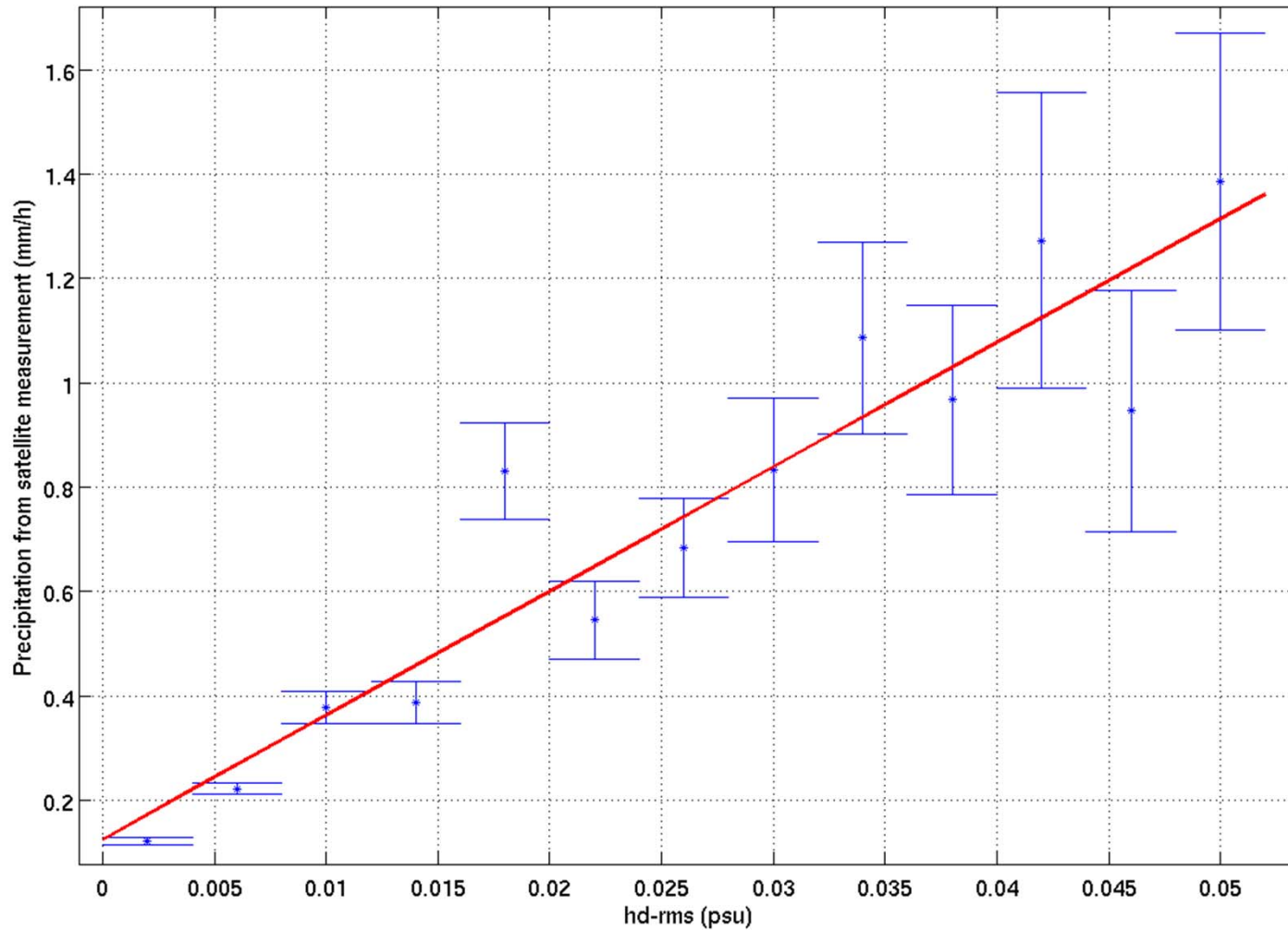
SVP drifter (~40cm depth)



SSS freshenings near Atlantic ITCZ
Associated with rainfall (not seen in Argo)



S(40 cm) variability related to rainfall (SPCZ)

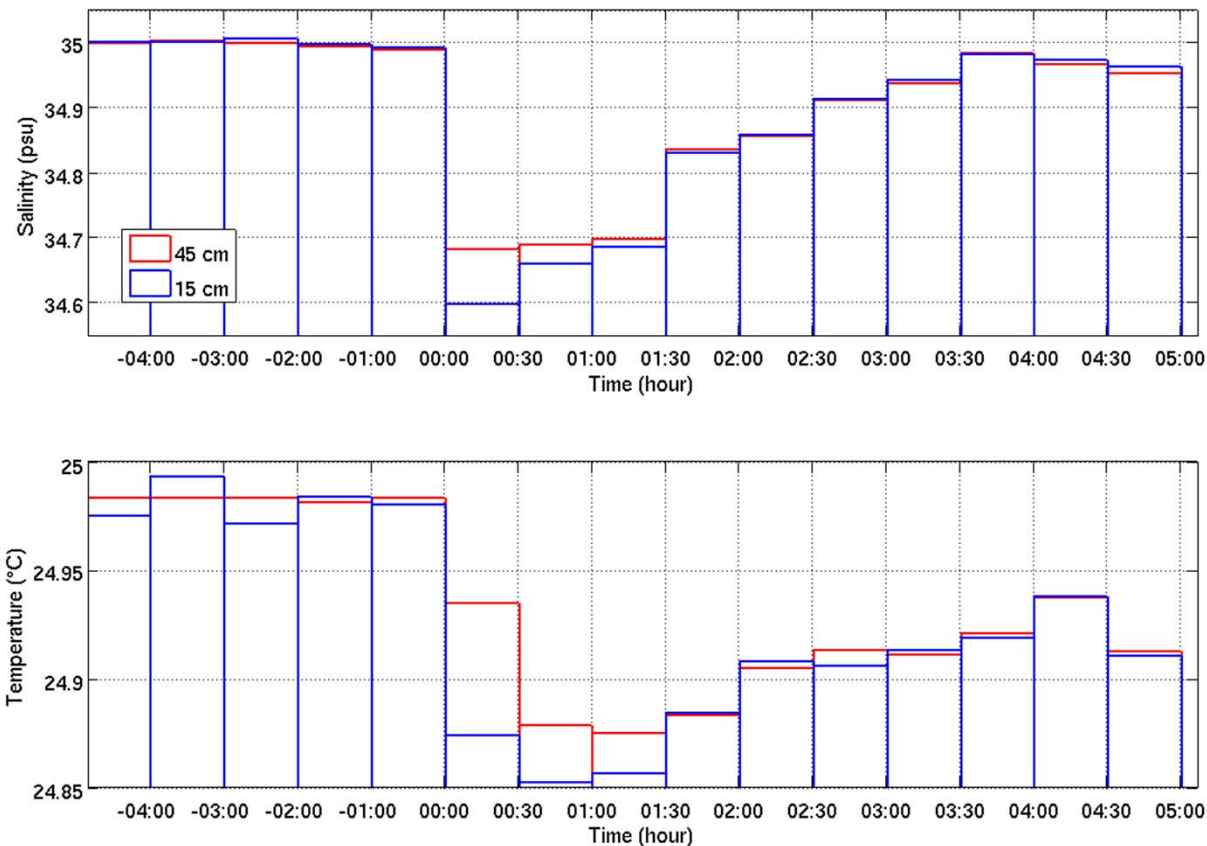


Implies decrease of S(40-cm) during rainfall by >0.05 psu in this SPCZ region



S(15-cm) – S(45-cm)

17 events SVP-BS / Surplis



Individual rain events : 25% more at 15-cm, but for less than an hour
(also, T decrease and stratification)

Wind retrievals during Rain events; S stratification

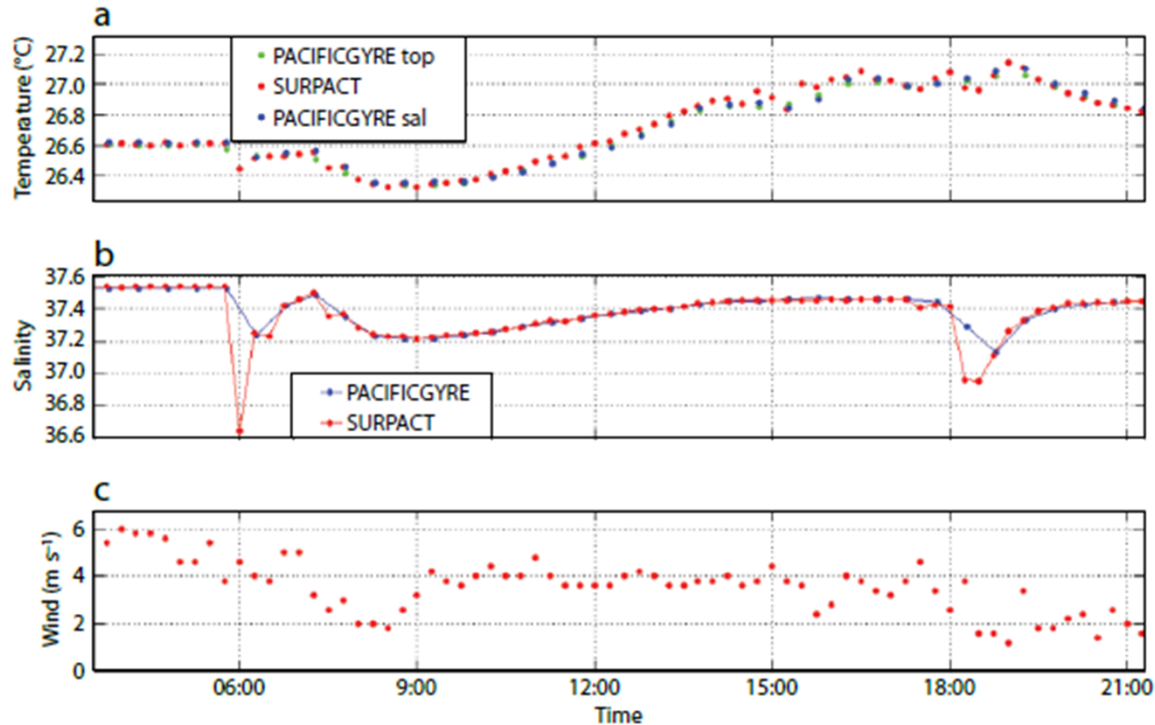
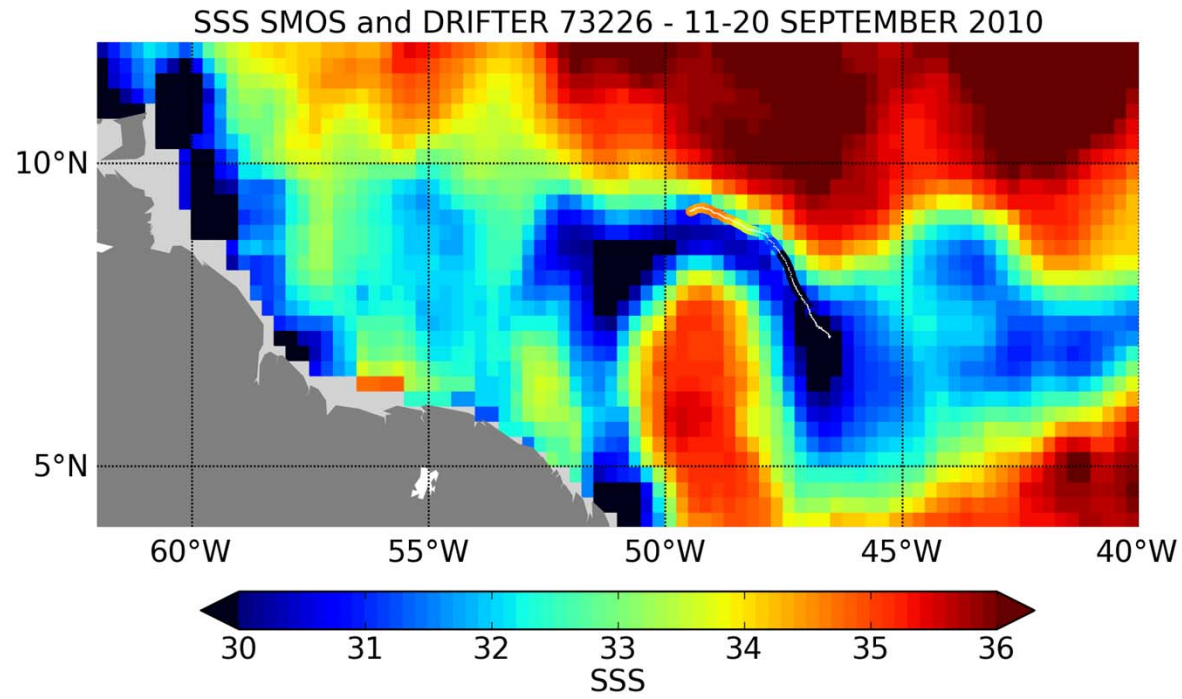


Figure 4. (a) T (temperature) and (b) S (salinity) from Surpact 30798 and attached Pacific Gyre 114638 on September 29, 2012. (c) Estimated wind speeds (time in GMT).

5 cases on this drifter; 2 with weaker wind, one with no change, and two with Stronger wind





September 2010: a case of strong entrainment eastward of low SSS
In retroflection of NECC

Conclusions & Perspectives

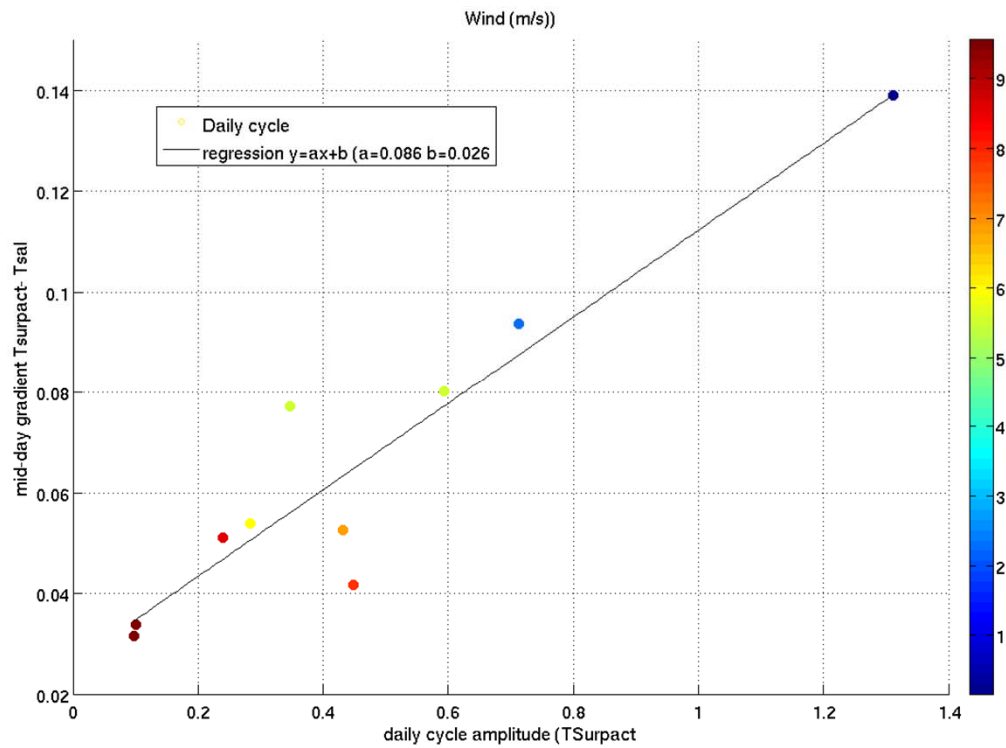


- Multi-sensor Surpact will be useful to estimate stratification with rainfall (both T and S contribute) or daily heating. Near-surface effects; quantitative for freshwater input estimates? But fouling... (deployments wet tropics: PIRATA, others?)
- Top temperature from SST drifters somewhat difficult to interpret for high daily cycles ($> 1.5^{\circ}\text{C}$, 2% of tropical cases), but seems to be mostly real signal in top layer (one PIRATA PG SVP-BS drifter will have internal T). Associated SSS signal?

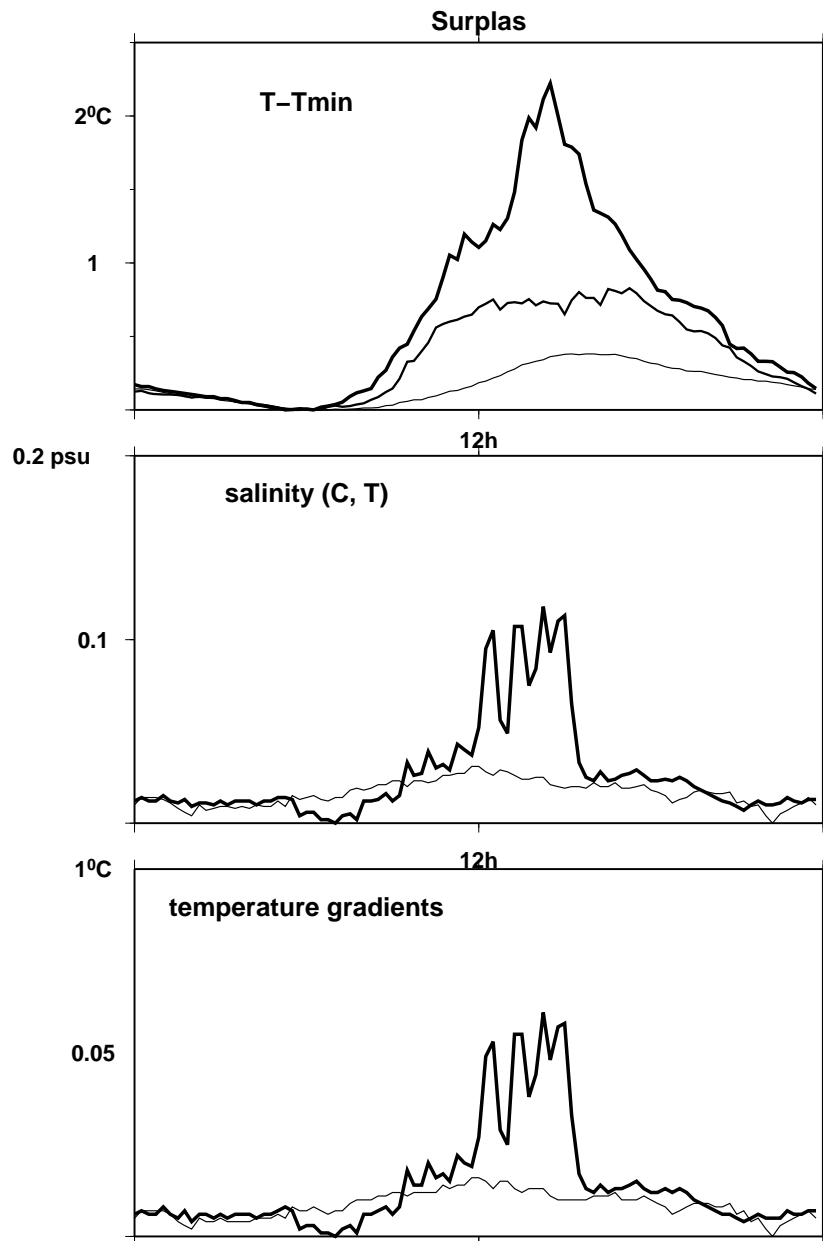
Perspectives

- Analysis SPURS (~90 SVP-S drifters)
- Deployments wet tropics Atlantic + Indian (?) + Amazon-Orinoco (with rainfall rate estimates?)
- SMOS SSS co-locations

- Wind dependency (but here with Tsurpact at 4 cm?)



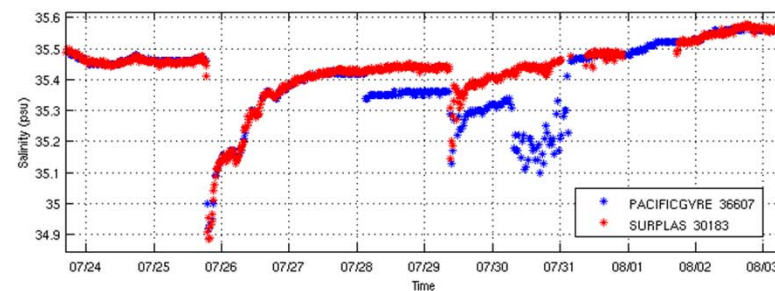
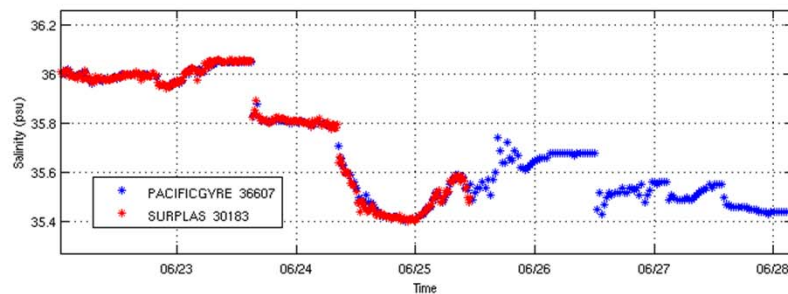
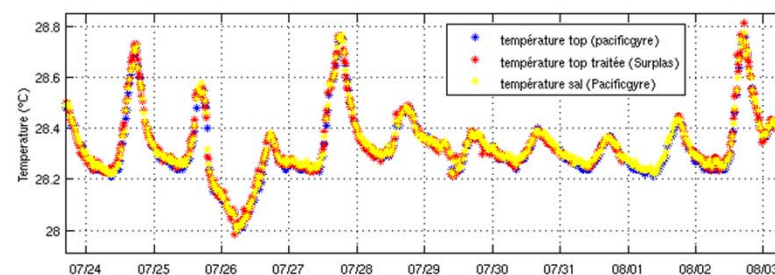
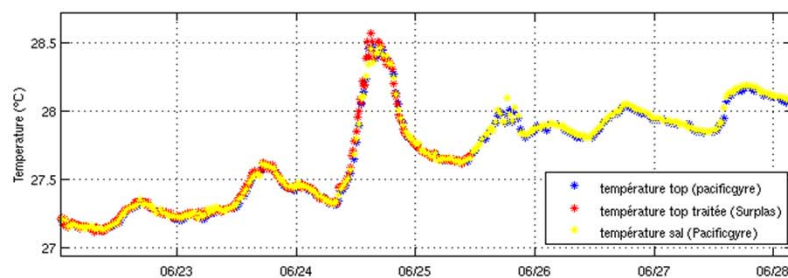
And between 15 and 17 cm (surplus)?

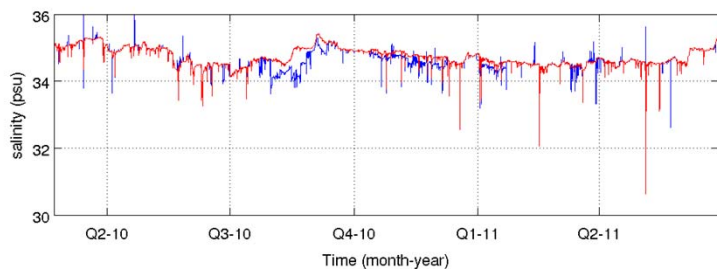


Not many daily cycles with large T
However, Changes in C near 15 cm
Result both from stratification in
 $T(15 \text{ cm}) - T(17 \text{ cm})$ and S

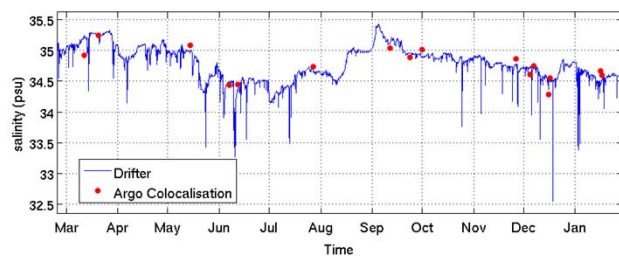
Not easy to interpret because
external grid probably results in
vertical steering

Les sauts et ce qu'on en fait!





Les corrections
Leur précision



Utilisation des flotteurs Argo

