Upper-ocean profiles from Argo

Material from

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- Argo T and S profiles come from SeaBird pumped CTD sensors

- Profiles end before reaching the surface (~4m) because pump is switched off to avoid contaminating the salinity sensor with surface films.

- So Argo misses sampling the layer through which the ocean interacts with the atmosphere.

- Some groups (U. Washington – Steve Riser, UK Met Office) are finding ways to get near surface profiles from Apex floats by collecting un-pumped samples

International co-operation on SST

- Group for High Resolution Sea Surface Temperature (GHRSST)
  - Diurnal variability working group (Merchant)
  - SST validation technical advisory group (Corlett)
- MyOcean (operational oceanography services for Europe)
- New! European Research Network for Estimation from Space of Surface Temperature (ERNESST)
- New! US Interim Sea Surface Temperature Science Team (ISSTST)

Reference datasets for satellite SST validation

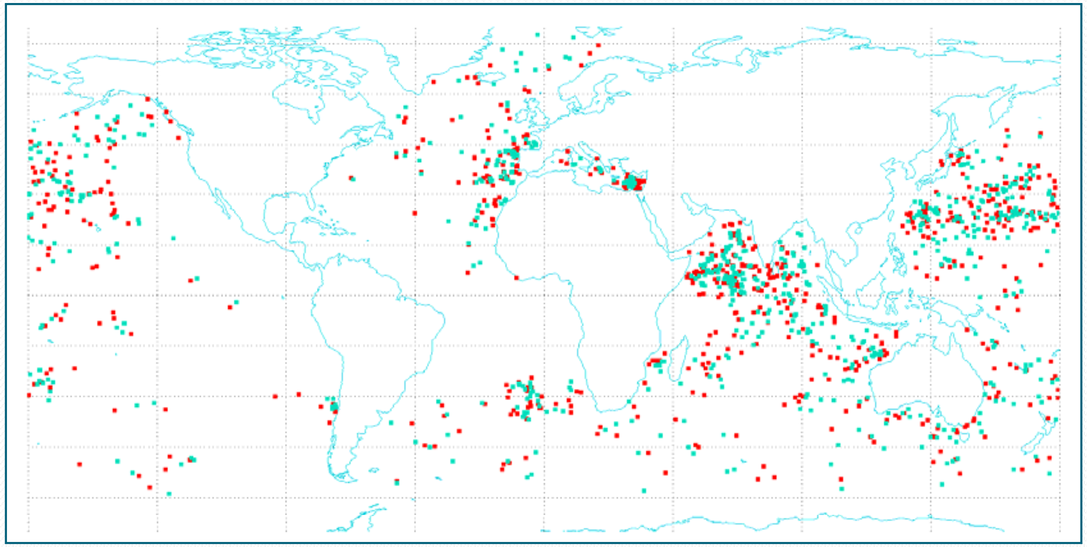
- Drifting buoys
  - Unknown calibration; global data; SST-depth; good (but variable coverage)
- Tropical moored Buoy Array
  - Better calibration; SST-1m; acceptable coverage (influenced by data collection)
- Ship-borne radiometers
  - Traceable to SI; SST-skin; high accuracy; very-poor coverage
- VOS and VOSclim
  - Generally poor coverage; very high uncertainty on single sample
- Coastal moorings
  - Questionable uncertainty; tough areas to validate
- New! Argo 4 m
  - Global; acceptable sampling; very-high accuracy (calibration method to be analysed)

Relative errors of satellites and drifting buoy SST

- AATSR D3 SSTs are the "best" satellite SSTs available and are ±0.13 K
- AVHRR split window will soon give ±0.22 K operationally at M-F
- Drifting buoys (after QC or using robust statistics) seem to give ±0.21 K

- "Received wisdom": buoy thermistors should give ±0.1 K "off the shelf"
  - Optimistic? Beginning-of-life value?
  - Rounding to 0.1 K
  - Point measured at depth being used for 1 km pixel
    - Contribution from geophysical variability?
    - Would we see any difference if buoy calibration were improved?

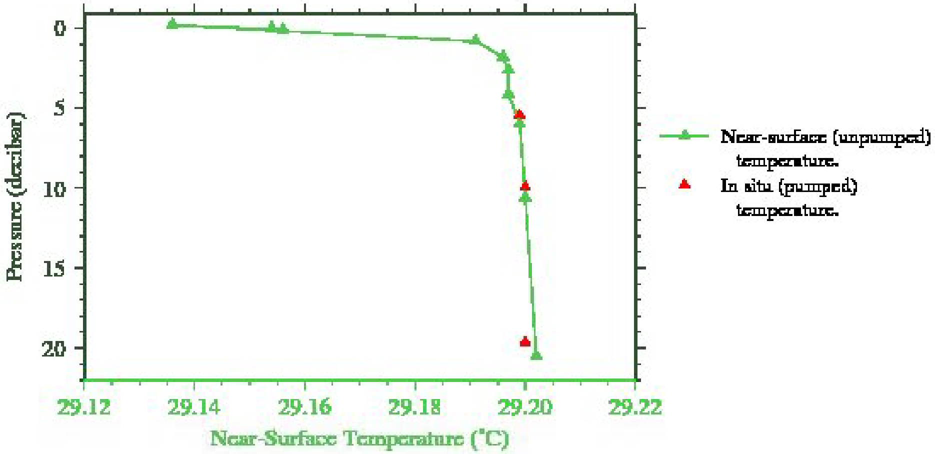
Argo vs. drifting buoy

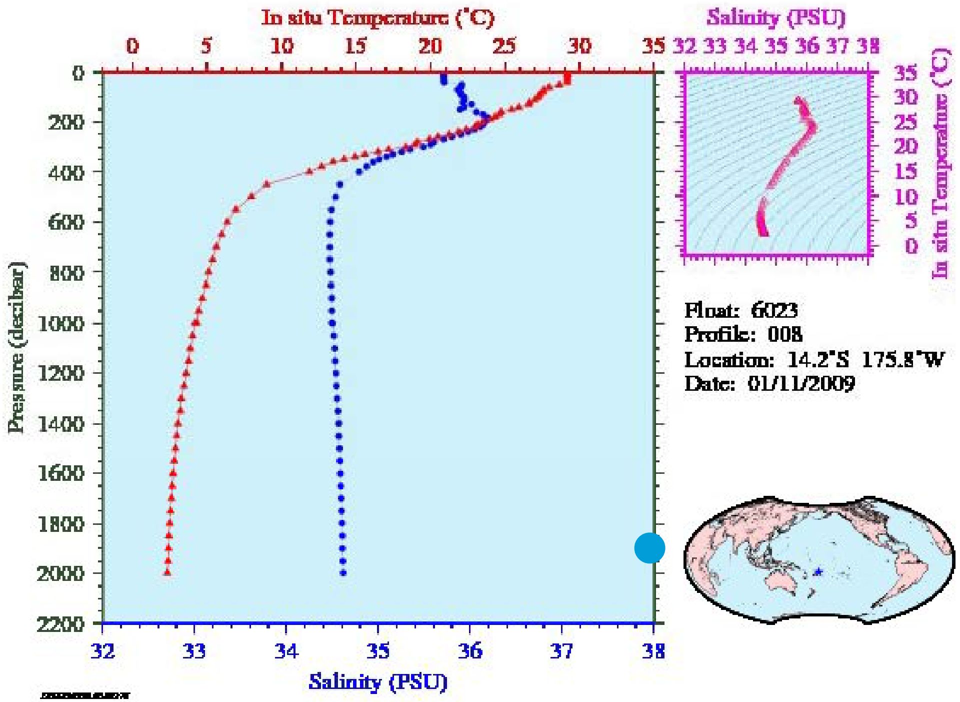


- Argo 4 m depth SST
  Accuracy: ±0.005 K
- Matched with AATSR
- Nearest (in time and space) match with drifting buoy also found
- Argo vs. AATSR: σ = ±0.15 K   DB vs. AATSR: σ = ±0.25 K
- Geophysical (point to pixel) variability is ≤ ±0.095 K
- Implied DB uncertainty excluding point-to-pixel effects is ≥ ±0.20 K

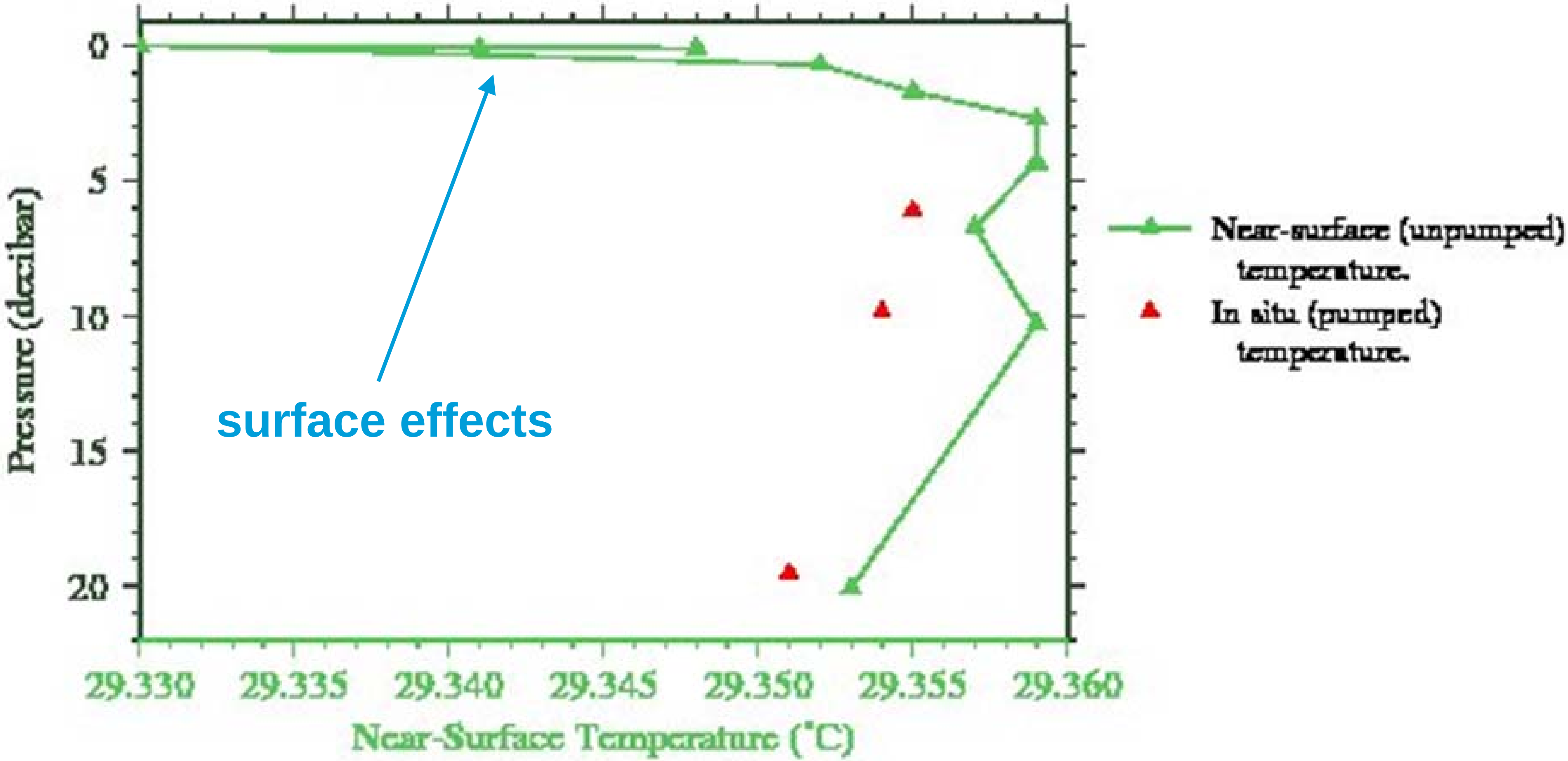
Stephen Riser (1)

- Measuring SST (or near-surface T) from ARGOS floats: 8 points above 4 m
- Negligible energy cost: this requires 1 extra ARGOS message
- Data from UW float 6023 (WMO 5902077) in the Indonesian through-flow
- Potentially a useful addition to the Argo data stream





Stephen Riser (2)

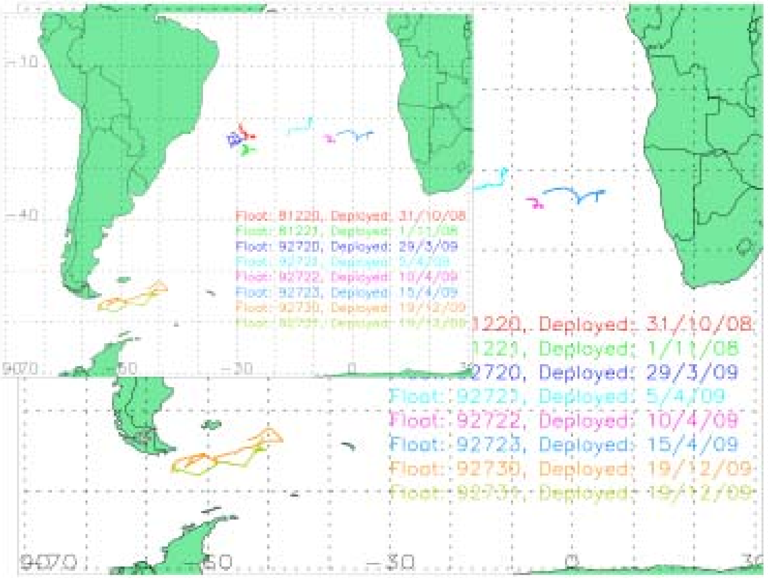


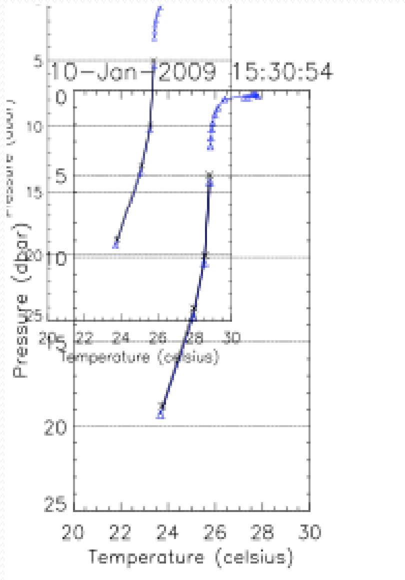
Riser's Summary and Conclusions

- Relatively high-resolution (~10 cm), high accuracy (~0.005 °C) near-surface T measurements can be made from profiling floats.
- Near-surface T measurements can be made using the main float CTD unit, at essentially no extra cost.
- The addition of an auxillary near-surface CTD unit allows the collection of both high resolution, high accuracy near-surface T and S.
- Tests of these devices are now underway (and going well) and in the future it is possible that nearly all Argo floats will have some type of near-surface T capability.

- Caveats: Samples very near the surface require manual editing; all data collected so far are from low latitudes.

UK Data





Float No.	No. of Profiles	Mean	RMS
81220	52	0.0063	0.0211
81221	51	0.0070	0.0254
92720	37	0.0017	0.0152
92721	36	0.0090	0.0242
92722	36	0.0141	0.0493
92723	35	-0.1161	0.1470
92730	10	0.0012	0.0043
92731	10	0.0051	0.0104

Response

- At essentially no cost and rapidly, unpumped T observations within top 4 m could be routinely provided from Argo profilers
- We see considerable potential in this for addressing near-surface stratification and clarifying foundation SST
- But there is a process of learning how to use the near-surface observations required, especially with regard to depth uncertainty

Response

- Iridium-equipped floats could be programmed to give an enhanced near-surface sampling regime
- Again, very low cost to do this, and could be rapid
- We think this would greatly accelerate the scientific exploitation of Argo for near-surface work
- But what the sampling regime should be requires thought

Technical requirements

- Vertical resolution:
  - Goal: 10 cm sampling in upper 3 m with ability to respond to a gradient of 0.1 K cm^{-1}; 50 cm sampling below 3 m
  - Useful: 0.5 m sampling in upper 3 m; 1 m sampling below 3 m
- Depth range:
  - Must capture top ~10 m with high reliability, implying conservative approach to the start of near-surface data collection, e.g. from above ~14 m.
- Accuracy of depth estimate (viewed as crucial):
  - Goal: 2.5 cm in upper 3 m; 10 cm down to 10 m and below
  - Useful: 10 cm in upper 3 m; 15 cm down to 10 m and below
- Accuracy of SST:
  - Maintain SST accuracy requirements of rest of profile in near surface