Air-sea flux measurements by the NOAA surface mooring in the Agulhas Return Current

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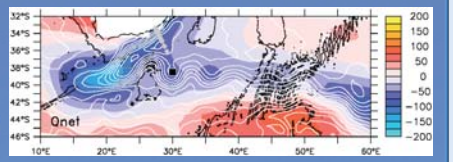
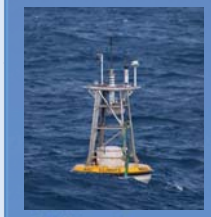
First Deployment

Deployment aboard the R/V ALGOA.

On 30 Nov 2010, a NOAA moored buoy was deployed at 38.5°S, 30°E on the edge of the warm Agulhas Return Current (ARC) southeast of South Africa in the region of large oceanic surface heat loss.



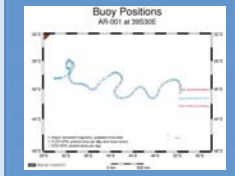
Mean net surface heat loss to the atmosphere in units W/m2 in colors, with mean sea surface height contours overlaid. The ARC mooring is shown as a black square. Agulhas Current Transport (ACT) moorings are shown in grey.

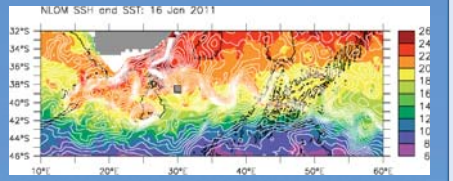


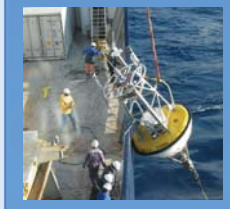
The ARC mooring.

The mooring carried sensors to monitor air-sea exchanges of heat, moisture, momentum, and carbon dioxide; surface and near surface temperature and salinity, and currents at 15 m.

On 12 Jan 2011, the mooring began hopping and on 16 Jan 2011, the mooring line broke 1400 m below the surface. Measured surface currents were only moderately strong (< 1.15 m/s). It is believed that the bottom currents must have exceeded 0.3 m/s.







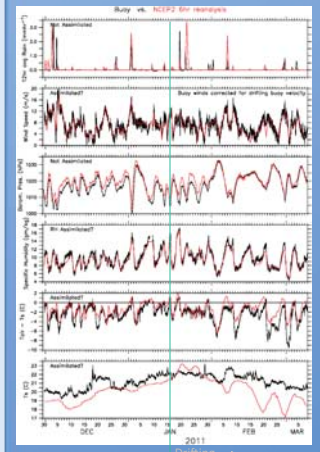
The drifting buoy and all its sensors were recovered by the R/V MARION DUFRESNE on 8 Mar 2011.

The bitter end of the line shows evidence of a sharp cut. Shark bite?

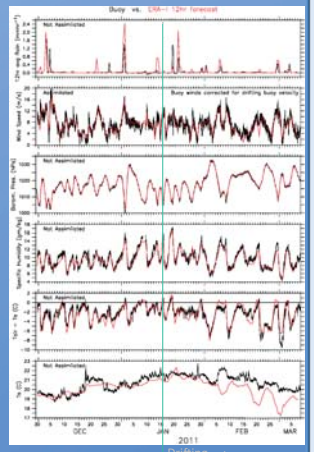
Data

ARC data can be used to assess Numerical Weather Prediction Models (NWP), including the ECMWF Reanalysis Interim (ERA-I) and the NCEP Reanalysis 2 shown below.

Although the ARC buoy WMO number identifies itself as a reference station, the data centers did not withhold the data from their assimilation. Therefore the ARC data are not purely independent.

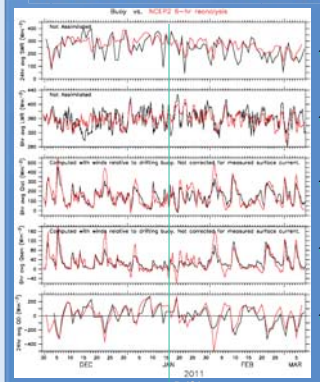


Drifting · >



Drifting · >

Both products capture rain events remarkably well.
Wind is assimilated. Its agreement is perhaps not surprising.
SST, however, has large biases in the NWP products.
The heat fluxes below are quite good, considering the biases in SST.



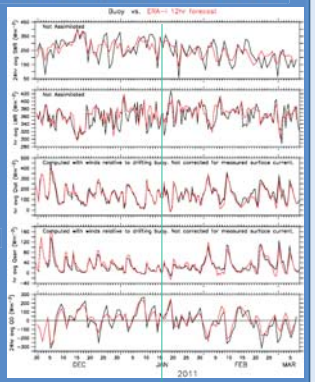
Solar Radiation
Bias = 24 W/m²
Bias = 4 W/m²

IR Radiation
Bias = -3 W/m²
Bias = 5 W/m²

Latent Heat Flux
Bias = 4 W/m²
Bias = -5 W/m²

Sensible Heat Flux
Bias = -1 W/m²
Bias = 1 W/m²

Net Sfc Heat Flux
Bias = 18 W/m²
Bias = 14 W/m²



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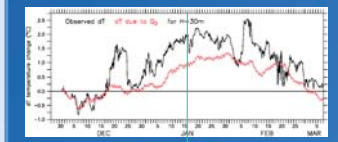
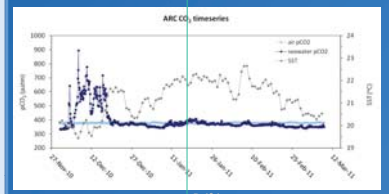
Data (cont.)



Except when large eddies passed by in late Dec 2010 and early Feb 2011, much of the thermal change appears to be due to net surface heat fluxes.

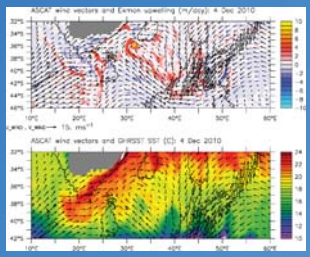


Drifting · >

Very large CO_2 outgassing is seen in early Dec. During most of the rest of the record, CO_2 is absorbed by the ocean.

The largest outgassing occurred on Dec 4 and 7, 2010, when Ekman upwelling occur locally due to a passing storm.

SST-induced wind variations can also give rise to very large Ekman upwelling.



The Future

In the future we hope to redeploy the NOAA moored buoy into a new location along 38°E, where the ocean still warms the atmosphere, but surface and deep currents are weaker.

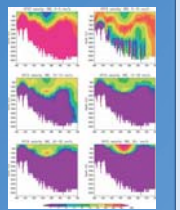


Figure courtesy Tomoki Tozuka (Univ. Tokyo)

Acknowledgements

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