larger than the total current $I_t/2-I_s$ at point (2). A higher current amplitude decreases the modulus of the superconducting order parameter $|\psi|$, as illustrated in Fig. 4. For an integer Φ/Φ_0, the shielding current $I_s=0$ and we observe a symmetrical pattern for the order parameter in both branches of the loop (Fig. 4*a*). As the unbalance between the real flux Φ and the nearest integer flux $n\Phi_0$ increases, the shielding current increases and produces a suppression of $|\psi|$ in the branch where I_s and I_t are added and an enhancement of $|\psi|$ where I_s and I_t are substracted (Fig. 4*b*). In the vicinity of the half-integer flux (Fig. 4*c*) this interference of I_s and I_t creates a 'self-made weak link' in one branch, which jumps into the other branch (Fig. 4*d*) as soon as $\Phi/\Phi_0>0.5$. The oscillatory behaviour of I_c in a mesoscopic superconducting loop may therefore be related to the creation of a region with a strongly reduced $|\psi|$ value ('weak-link'), switching between the two branches. This area plays the role of an artificial weak link in a conventional SQUID. Because of the phase coherence in the mesoscopic loop, the appearance of the 'weak-link' in one branch will simultaneously reduce the supercurrent in the second branch. □

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Evidence for the importance of bubbles in increasing air–sea gas flux

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Two models have been proposed to account for gas exchang between the atmosphere and the oceans: one involves direct transport of the gas through a surface boundary layer[1]; the other also includes a substantial enhancement of the gas flux due to bubbles formed by breaking waves[2,3]. In a long time-series of dissolved oxygen measurements, Wallace and Wirick[4] observed sharply increased fluxes that seemed to be associated with wave activity. But the lack of vertical resolution meant that they could not rule out water advection and entrainment, rather than bubble-mediated air injection, as the cause of the increased flux. They were also unable to calculate transfer coefficients. Here we report simultaneous *in situ* observations from a vertical array of dissolved-gas sensors and a variety of other instruments during a single storm event. Our results confirm the importance of bubbles for the

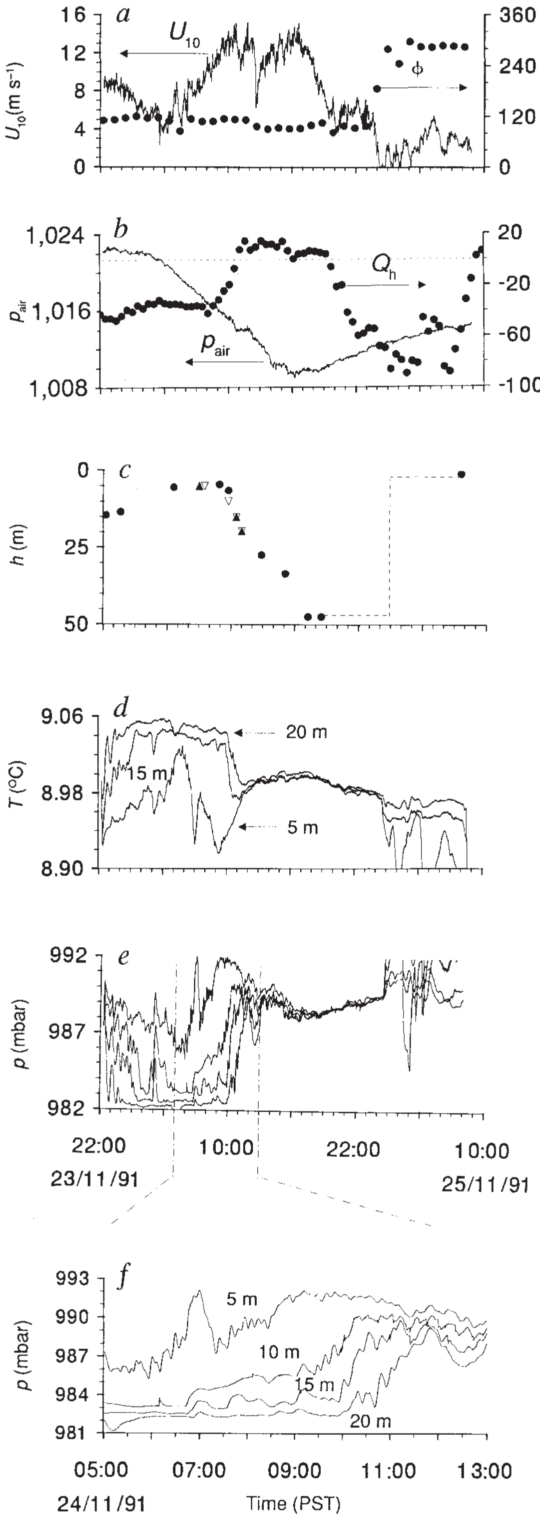

FIG. 1 Time series of observations in Georgia Strait (23–25 November 1991, 49° 46′ N, 124° 45′ W) showing (*a*) wind speed U_{10} (left) adjusted to 10 m and (right) wind direction ϕ; (*b*) air pressure p_{air} (left) and air–sea heat flux Q_h (right); (*c*) mixed layer depth inferred from salinity/temperature profiles (●), moored thermistors (▲) and gas tension sensors (△); (*d*) water temperature at 5, 15 and 20 m; (*e*) gas tension at 5, 10, 15 and 20 m; and (*f*) an expansion of (*e*) showing progressive incorporation of sensors into the deepening mixed layer. The sensors are estimated[17] to have an uncertainty in absolute measurement of 0.4%; corresponding d.c. offsets were applied to match gas tension within the well-mixed layer at 2000 h. A temperature sensitivity of 0.2 mbar over the observed temperature range was also found. Wind speed and mixed layer depth are estimated to have an uncertainty of ±10%; water temperature is accurate to 0.02 °C.

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