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P1.11 AN INTEGRATED AIRBORNE MEASUREMENT SYSTEM FOR THE DETERMINATION OF ATMOSPHERIC TURBULENCE AND OCEAN SURFACE WAVE FIELD PROPERTIES

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1. INTRODUCTION

A small single-engine research aircraft has been used in numerous air-sea interaction research studies to investigate the spatial variation of both the marine atmospheric boundary layer and the ocean surface wave field. The integrated instrument suite of *in situ* sensors carried by a LongEZ (registration N3R) airplane is used to measure mean properties of the atmosphere as well as turbulent fluxes of heat, moisture, and momentum. These data are coupled with remote sensor measurements of the ocean surface, such as sea surface temperature, wave height, length, slope, and phase. This integrated measurement platform is a powerful tool to directly examine mass, momentum and energy exchange processes occurring across the air-sea interface.

2. AIRCRAFT

Over the last ten years, N3R (Fig. 1) has been used in a number of air-sea interaction research studies (Crawford et al. 1993, Crescenti et al. 1999; Vogel and Crawford 1999; French et al. 2000; Mourad et al. 2000; Vandemark et al. 2001). N3R is set apart from other airborne measurement platforms for a number of reasons.

Fig. 1. N3R in flight during a research mission.

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The LongEZ was designed in the early 1980's as a high-performance sport aircraft. N3R is a custom-built aircraft licensed by the Federal Aviation Administration (FAA) under an experimental amateur- built airworthiness category. It is a safe and reliable aircraft with exceptional performance characteristics. The differences of N3R from that of other single-engine aircraft are visually apparent. Unlike most aircraft that are constructed with metal, N3R is fabricated from a lighter and stronger fiberglass and foam composite. Another important difference is that the engine is mounted on the rear of the airframe. The large main laminar-flow wing is set back further than that of conventional aircraft. Vertical winglets found on either end of the main wing enhance aircraft lift. A smaller second wing (canard) is found near the nose of the aircraft. This forward lifting surface is designed to increase aircraft stability and to prevent the main wing from stalling.

An important characteristic of an aircraft with a pusher engine and a canard is that it responds to turbulence far less than conventional aircraft with the same wing loading (weight per unit area). Since the canard contributes to both lift and stability, it can be heavily loaded relative to the main wing. For conventional aircraft with a rear-mounted elevator, an upward wind gust will tend to make the aircraft pitch up. This increases the lift generated by the wings and amplifies the aircraft response to an upward wind gust. In contrast, canard aircraft have their elevators forward of their center of gravity. The same upward wind gust will push the canard elevator up which results in a compensating downward pitch response. Aircraft pitch response to either upward or downward wind gusts is opposed to the gust direction, thus giving canard-type aircraft their superior turbulent response characteristics.

A canard aircraft is also stall-resistant. As the angle of attack on the airplane is increased, the canard loses lift before the main wing. This causes the nose to drop, which decreases the angle of attack, thereby providing automatic stall recovery without allowing the main wing to stall.

8. SUMMARY

The N3R integrated airborne measurement system is capable of acquiring high-fidelity atmospheric turbulence and ocean surface wave field data. N3R is a high-utility aircraft that is an ideal platform to carry state-of-the science *in situ* and remote sensors. These data are being used to advance our understanding of air-sea interaction.