



POLAR SCIENCE  
FOR PLANET EARTH

# THE USE OF UNMANNED AIRCRAFT SYSTEMS IN ANTARCTICA



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# THE USE OF UNMANNED AIRCRAFT SYSTEMS IN ANTARCTICA

- **Introduction to Antarctica**
- **Infrastructure**
- **Manned aircraft**
- **Use of aircraft**
- **Use of UAS**
- **UAS for Antarctica**



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# **THE USE OF UNMANNED AIRCRAFT SYSTEMS IN ANTARCTICA**

## **Antarctica**

- **Continent for science covered by the Antarctic Treaty**
- **UK sovereign claim is frozen**
- **Scientists and up to 30,000 tourists visit each year**

## **BAS**

- **Maintains the UK's presence in Antarctica**
- **Undertakes a multi-disciplinary science programme**
- **Collaborates with other nations working in Antarctica for science and logistic purposes**

## JAMES CLARK ROSS



## RRS ERNEST SHACKLETON



- Two ice-strengthened ocean-going vessels.
- Provide logistic support and deliver under way science



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## HALLEY



## ROTHERA



- Five stations in the Antarctic area
- Rothera has runway, fuel farm and hangar



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## DASH 7



- Wheels only operation
- Cargo door, extended range

## TWIN OTTER



- Four Twin Otters
- Ski equipped
- Field deployment
- Airborne survey



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# MANNED AIRCRAFT IN ANTARCTICA

## Weaknesses

- Limited survey operations
- Flying hour constraints
- Summer only operation
- Lengthy process for fitting instrumentation and survey systems

## Strengths

- Can be used for logistics as well as survey
- Flexible deployment



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## AIRBORNE SURVEY IN ANTARCTICA



- Geophysical Survey
- Ice depth radar
- Magnetic Survey
- Gravimeter



- Meteorological Survey
- Temperature, pressure humidity sensors
- Radiometers
- Cloud physics probe
- Turbulence probe



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## AIRBORNE SURVEY IN ANTARCTICA

- **Photography and mapping**
- **Lidars – height measurements, terrain mapping**
- **Animal surveys**
- **Transport of spores and bacteria**



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## AIRBORNE SURVEY IN ANTARCTICA

- Airborne Survey
- Logistics deployment
  - Field parties
  - Field camps
  - Fuel
- Runways
  - Hard
  - Field
  - Blue Ice

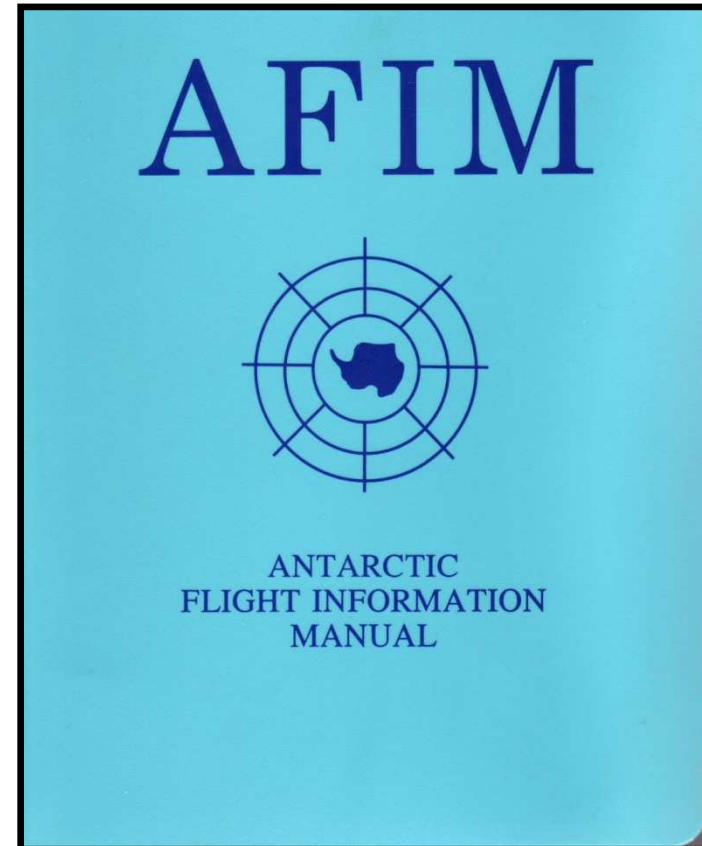


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## OPERATIONAL ACTIVITY



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## USE OF UAS IN ANTARCTICA

- **Potentially operate in remote areas**
- **Less constraints on flying hours**
- **Operation during the winter**
- **Instrumentation fit simplified**
- **Lower cost?**
- **Flight operations in uncongested area**
- **Supply of fuel**



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## IS IT POSSIBLE TO REPLACE AIRCRAFT WITH UAS IN ANTARCTICA?



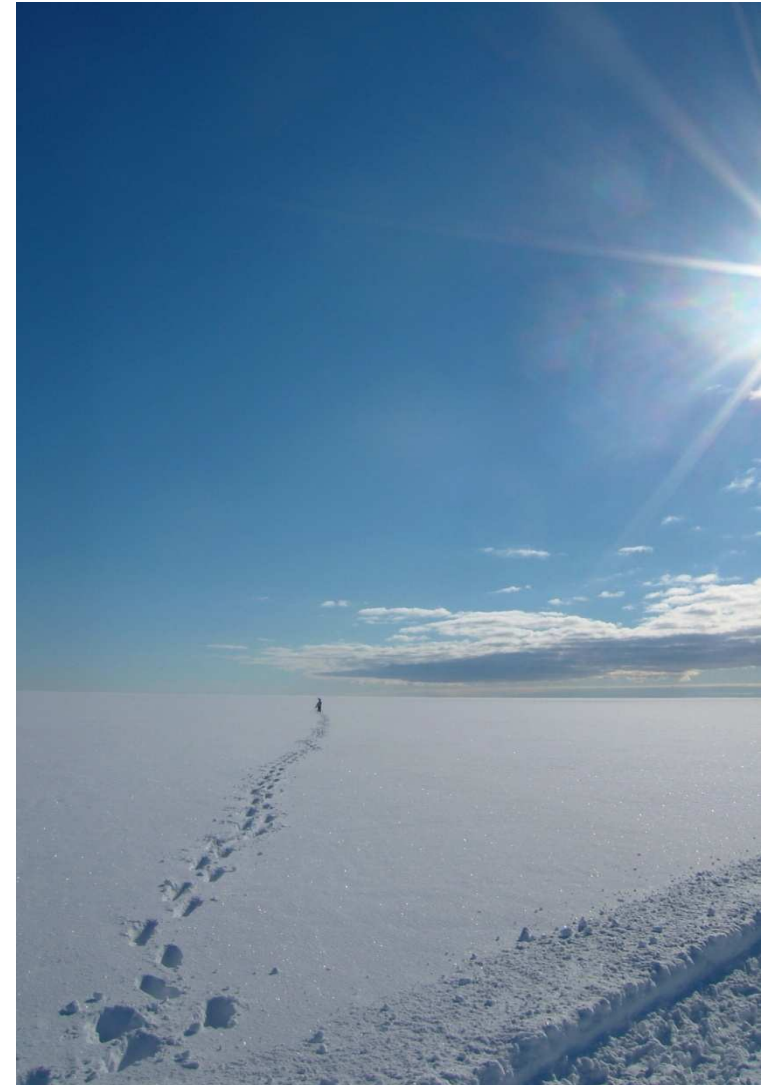
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## A POLAR UAS FOR BOUNDARY-LAYER PHYSICS

Sea-ice dynamics are a significant uncertainty in existing climate models. The interaction of the atmosphere with sea-ice, especially heat flux, is poorly understood. We require *in situ* winter – time measurements of **turbulent fluxes** over forming and melting sea-ice for improving model parameterisations.



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## THE SYSTEM

The UAS requirements were:

- A robust airframe that would operate down to  $-30^{\circ}\text{C}$
- Autonomous avionics able to operate out of contact.
- A turbulence instrumentation set capable of measuring covariance (winds and temperature)

Additional Requirements:

- Dedicated operator and semi-dedicated flight team
- Off-station facilities



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## THE SYSTEM

Marionics GmbH

- Carolo T200 fibre glass air frame, twin-prop electric using LiPo batteries. **1 hour duration, 18 kg, hand launch.**

- "Mavionics" GPS waypoint following avionics with wi-fi LAN to ground control. **Manual take-off and landing**

- M<sup>2</sup>AV pitot-tube wind sensor and foil-mounted platinum resistance thermometer. **Tested during summer in Germany**

Additional items

- Project leader (PSA) with **no pilot skills**
- K24 Snocat. **no wi-fi facilities**



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# THE UNMANNED AERIAL SYSTEM (UAS) AT WINDY CREEK, BRUNT ICE SHELF

## K24, Mission Control



## Ground station



## VHF Voice



## Pilot



## UAV



GHZ LAN

UHF r/c



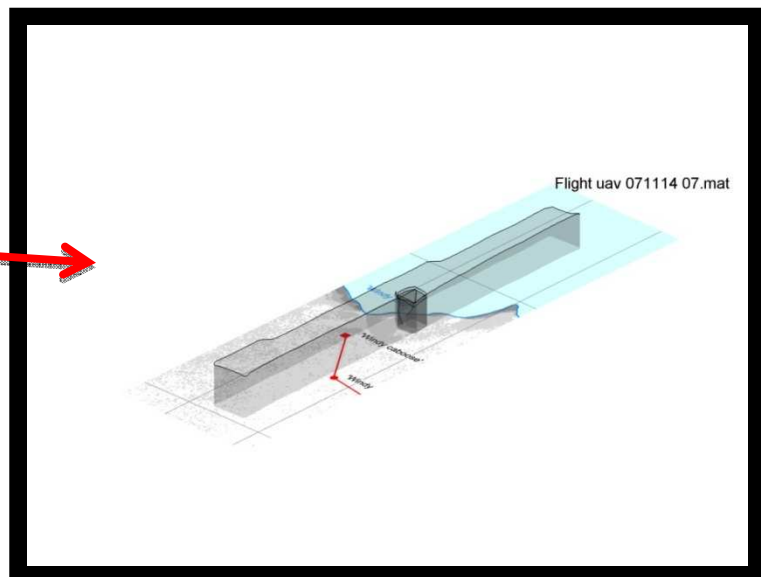
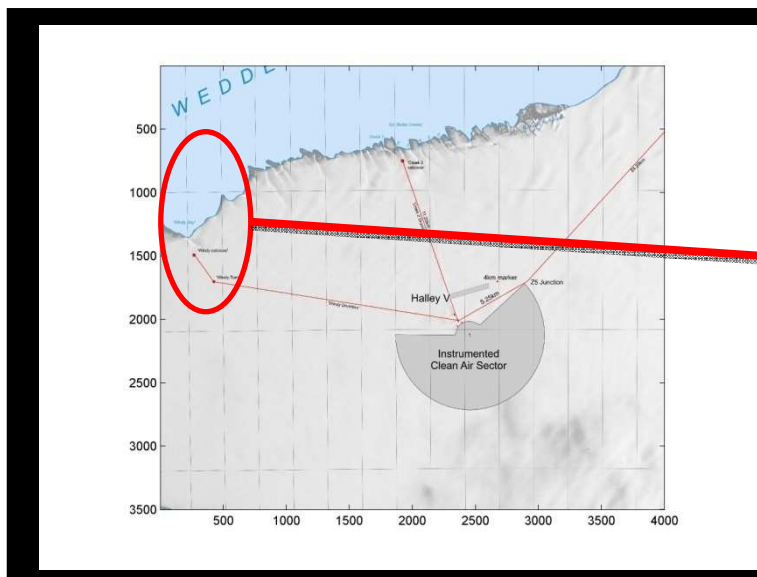
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# The Field Campaign: Stage II

## Sea-ice flights



One airframe + instrumentation loss: icing of static pressure wind speed sensor over sea-ice caused over-speed on landing.

Low-level-jet tested on each flight with vertical box. Flights over solid ice (no open water).

4 fully autonomous, instrumented flights over sea-ice, each flight with 2 legs over sea-ice, two over shelf ice, differing altitude.



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# NORWEGIAN-US SCIENTIFIC TRAVERSE OF ANTARCTICA



- UAS deployed during traverse
- Meteorological instruments
- Radar Sounder – C band
- Digital camera
- GPS and other sensors



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# THE USE OF UNMANNED AIRCRAFT SYSTEMS IN ANTARCTICA

- Ideal Platform
- Multirole and over-winter capability
- Purchase / lease options
- Industry / User collaboration



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An aerial photograph of a vast, snow-covered mountain range. The terrain is rugged, with numerous peaks and ridges covered in white snow. The sky is a clear, pale blue. In the upper right corner, the underside of an airplane wing is visible, showing structural details and a fuel tank. The text "ANY QUESTIONS?" is centered in the middle of the image in a bold, black, sans-serif font.

**ANY QUESTIONS?**