Research Aircraft in Oceanography and Air-Sea Interaction

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Research Areas

- Ocean
  - Surface and sub-surface temperatures
  - Currents
  - Waves, radar backscatter
  - Deployment
- Marine Atmosphere
  - Surface fluxes: momentum, heat, water vapor, trace gases
  - Spray, radiative transfer

Early History

- Odd Dahl, circa 1925. Expedition of R/V *Maud.* Aircraft, Curtis Jenny, launched off ship onto the ice for meteorological soundings. Also, one aircraft for transport during the year-long expedition.
- Rossby, Lange, Draper, circa 1932, MIT. Single-engine aircraft for soundings at Boston.

for personnel, it might be mentioned that the amount paid to relief pilots is now $5 to $7 per ascent.

The Running Expenses were:

Cessna airplane bought for $1,200 sold for 600		$ 600
Liability Insurance for 7 months		135
Storage of plane and daily service of mechanic—6½ months per $35		228
Seven 25-hour checks on engine (average price $22)		154
Top overhaul		79
Repairs on plane and engine, caused by regular use		218
Installation and repairs on instruments (including supplies which became worthless after the plane was taken out of service, such as meteorograph brackets, etc.)		208
Gas and oil		441
Office material, furniture, telephone, hydrogen, oxygen, dry ice, photo material, etc.		147
		$1,370
Expenses, mainly repairs, caused by an emergency landing		154
Total Running Expenses		$1,624
Meteorological instruments:		
Two Bosch airplane meteorographs	$237	
Pressure-temperature chamber built at Massachusetts Institute of Technology	150	
Humidity calibration apparatus	10	
Ventilation shelter built at Massachusetts Institute of Technology	40	
	$437	
Depreciation for one year		$87
Flying instruments:		
Artificial Horizon		
Altimeter		
Bank and Turn indicator		
Cup-speedometer		
Wing thermometer		
Gyro compass		
Climb indicator		
Radio set and shielding		
Oxygen device		
Parachute	$1,110	
Depreciation for one year		$ 262
Total depreciation of equipment		$ 349
Pay to spare pilots and assistants		$ 292
Total expenses		$3,265

With a total amount of $3,265, which covered all expenses including the airplane and a five years' depreciation of all instruments the Massachusetts Institute of Technology "small plane station" carried out within six months 168 ascents to an average altitude of 4,670 m. This gives an average total expense of $19.43 for one flight.

B. Measurements of Temperature

Surface air temperatures are usually measured with standard mercury thermometers which are protected from radiation and kept properly ventilated. Temperatures of the free atmosphere are normally recorded with the aid of bimetal elements. What really is determined in both cases is not the air temperature but the temperature of the mercury or the bimetal. We assume that air temperature and instrument temperature are sufficiently equal. They never are absolutely the same when the air temperature is changing, since a heat transfer from the air to the instrument has to take place in order to change the instrument temperature accordingly and since this heat flow is possible only when

Lange and Draper (Rossby) 1934. MIT Cessna

Cost: $19.34 per sounding!

WWII

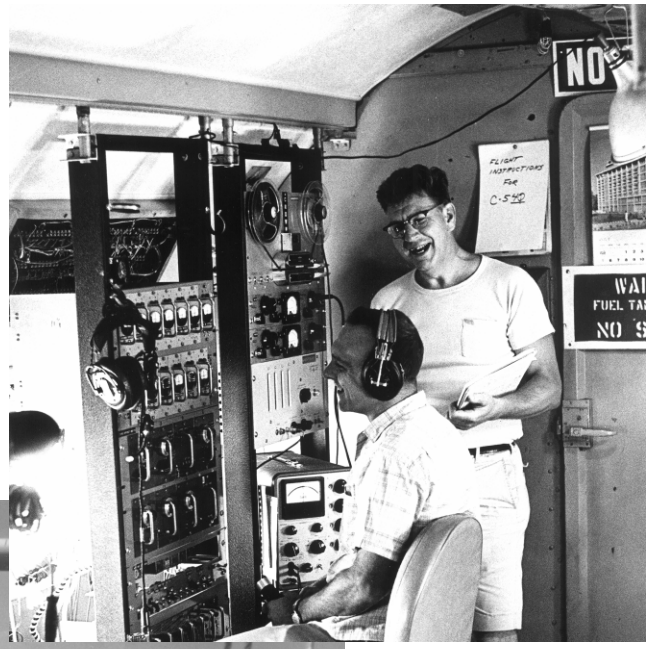
- Radar Ducting. Navy PBY bailed to MIT. Irving Katz develops airborne wet/dry bulb psychrometer
- ASW
- Wyman-Woodcock Expedition, Caribbean, 1946

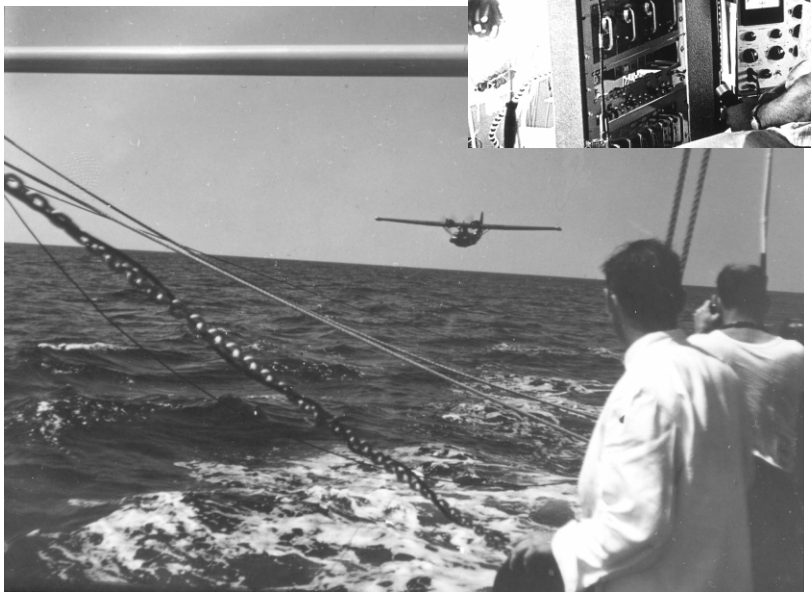
Woods Hole Oceanographic

- Andy Bunker hired to work-up Wyman-Woodcock Expedition data, 1946.
- Bunker instruments planes for air-sea interaction fluxes and cloud photography.
- Stommel flies infrared thermometer over Gulf Stream fronts.

WHOI Aircraft: 1945-1970

- Stinson
- PBY6A
- R-4D (DC3)
- Heliocourier
- C-54Q (DC4)





Scripps

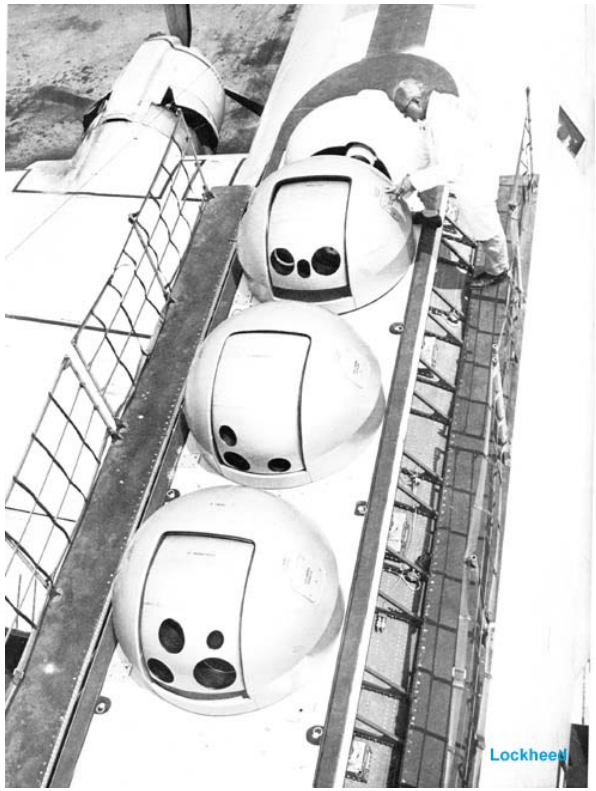
- Gifford Ewing, Carl Hubbs, ~1950. Whale survey from Ewing's private plane.
- DC3 McAlister and McLeish, 1968. Two-wavelength IR total surface heat flux.
- Cessna 337 Davis, 1980s. Track Lagrangian drifters off California coast.
- UAV Ramanthan, 2006. Asian Brown Cloud.

NOAA

- DC6 Air-Sea Interaction Lab. McFadden, Bean, BOMEX
- WP3D (2) 1975
- C130
- Twin Otters, helos

Navy- NRL

- Connies EC-121 1963
- SB2 Tracker
- P3s: RP3As, P3Cs, P3Ds (1 w/NCAR Eldora)
- King Air



< P2V
"Sniffer"
(sub exhaust)

CIRPAS

- Twin Otter
- Cessna

NCAR

- Queen Airs (2), King Air
- Electra
- EC130Q
- GV

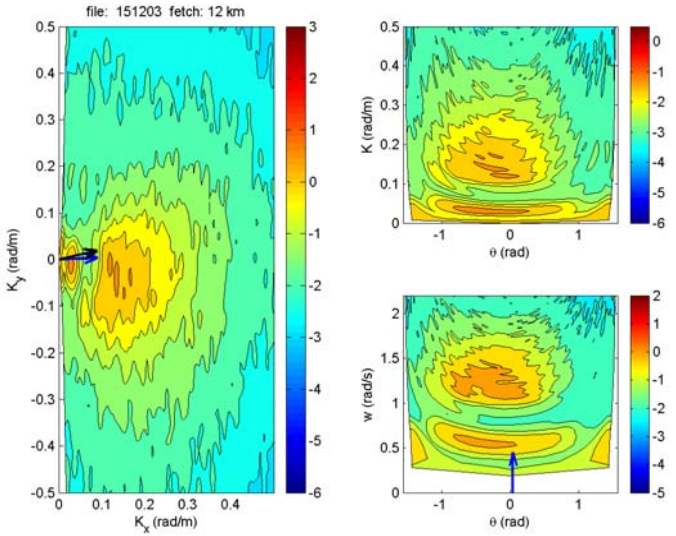
NASA

- CV990/DC8
- C130B/P3B

Jackson, Walsh: Radar Imaging Waves

Fuk Li: QuickScat

Krabill, Yungle, Sonntag: Laser Wave Spectra



Other Aircraft

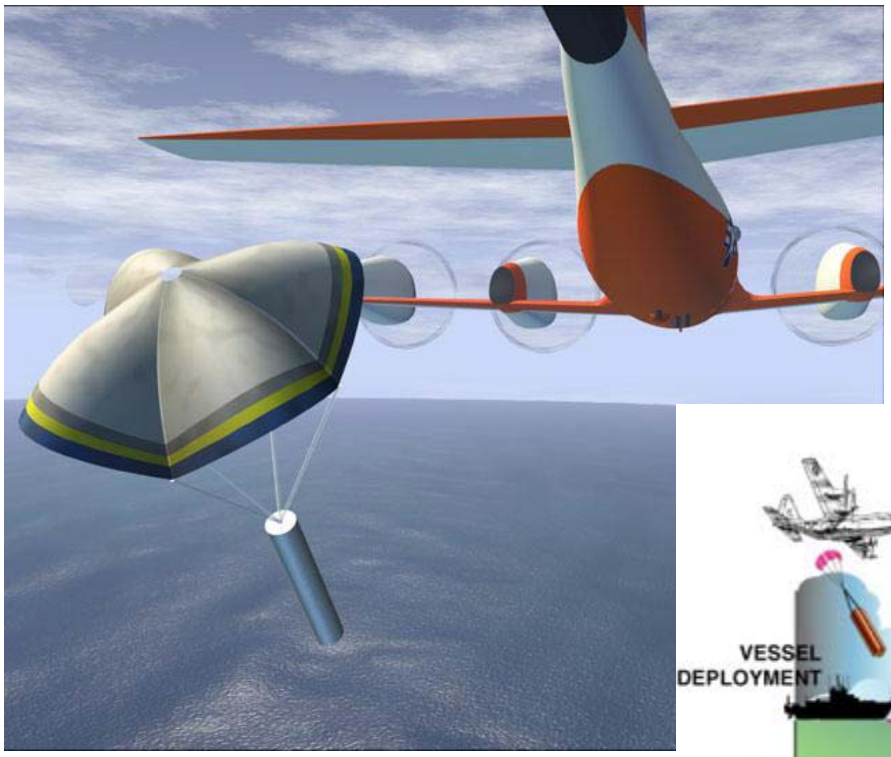
Bane's Seneca

Peter Hobbs 1936-2005

Tim Crawford 1948-2002

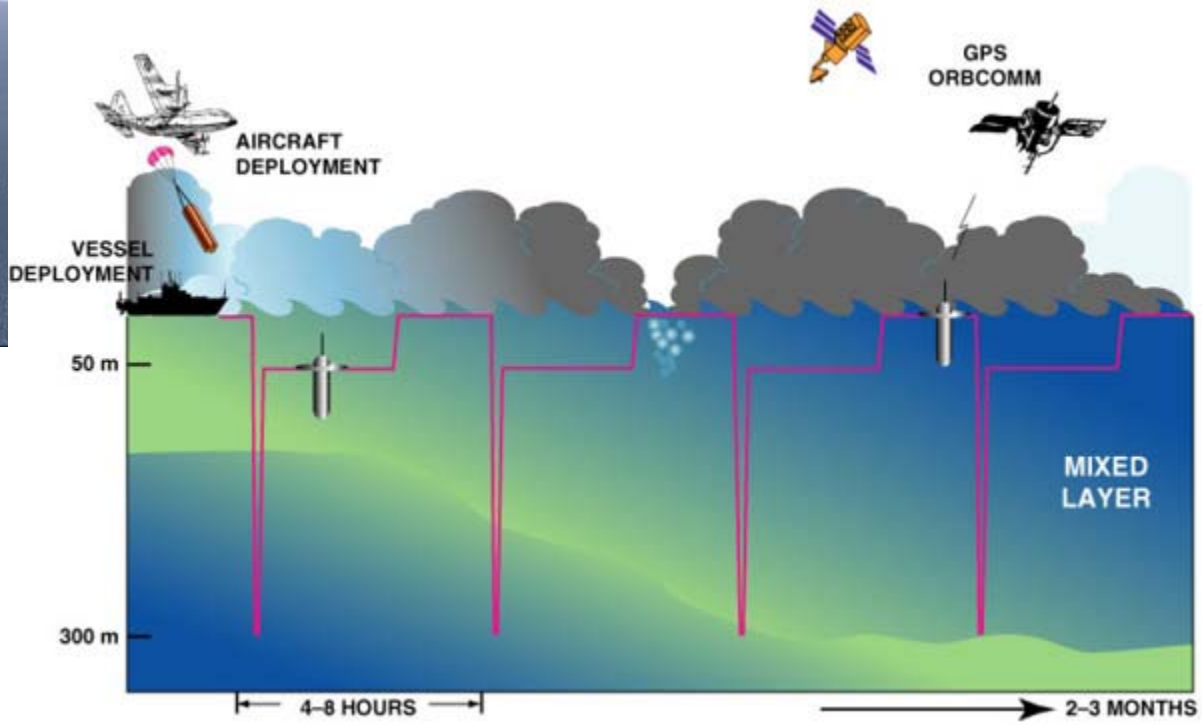
Sky Arrow

Airborne Expendables



< AXBT, Sonobuoy, AXCM, DWS

Floats and Drifters: C130J



UAVs

Unmanned Aerial Vehicle	Endurance (Hours)	Payload Weight (Pounds)	Altitude Capability Feet	Costing Info
Aerosonde	40 hrs.	2.2 lbs.	20,000 ft.	Yes
Altus2	24 hrs.	330 lbs.	65,000 ft.	No
BQM-34	1.25 hrs.	470 lbs.	60,000 ft.	No
Exdrone	2.5 hr.	25 lbs	10,000 ft.	No
Global Hawk	42 hrs.	1,960 lbs.	65,000 ft.	No
Gnat 750	48 hrs.	140 lbs.	25,000 ft.	Yes
Pioneer	5.5 hrs.	75 lbs.	12,000 ft.	No
Shadow 200	4 hrs.	50 lbs.	15,000 ft.	No

Retired

- NCAR Electra, King Air
- NASA C130B
- NASA Wallops Electra, P3A

Recently Added

- NCAR GV
- NOAA G4, P3C
- NRL King Air (2)

Present Fleet

- NOAA WP3D (2 +1), Twin Otters
- NCAR EC130Q, GV, UW King Air
- NRL P3s, King Airs
- CIRPAS Twin Otter
- NASA P3B, High Altitude
- USAFR C130Js - Deployment

Future Research

- Air-Sea at high winds
- Hurricane wind-wave coupling
- “Local” remote sensing from aircraft
- Aerosols, gas transfer

New Areas

- Southern hemisphere
- Deployment of floats/drifters
  - Remote areas
  - Coordinated with airborne science
- UAVs

Summary

- Aircraft have a long history of use in oceanography and related disciplines.
- Aircraft will continue to be a viable platform for research over the oceans.
- New applications will emerge.
- New platforms (UAVs, etc.) will continue to be developed.