RESEARCH PLAN

FR 9/95

Sail	Darwin	1000	Tuesday 21 November 1995
Arrive	Darwin	1200	Wednesday 6 December 1995

Maritime Continental Thunderstorms Experiment (MCTEX)
Air - Sea Interactions

Principal Investigators
Dr Frank Bradley
Centre for Environmental Mechanics

Dr Brian Sanderson
Bureau of Meteorology Research Centre

Prof. Ian Young
Dept. Civil and Maritime Engineering
University College, UNSW

September 1995

FRANKLIN

Research Plan
Cruise FR 9/95

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Itinerary

Sail from Darwin at 1000 on Tuesday 21 November 1995
Arrive at Darwin at 1200 on Wednesday 6 December 1995

Principal Investigators

Dr. Frank Bradley
Centre For Environmental Mechanics,
CSIRO, GPO Box 821 Canberra, ACT 2601
Ph: (06) 246 5575
Fax: (06) 246 5560

Dr. Brian Sanderson
Bureau of Meteorology Research Centre,
GPO Box 1289K, Melbourne, Vic. 3001
Ph: (03) 9669 4268
Fax: (03) 0660 6600

Prof. Ian Young
Dept. Civil and Maritime Engineering,
University College, UNSW,
Northcott Drive, Canberra, ACT 2699
Ph: (06) 268 8336
Fax: (06) 268 8337

MCTEX Overview

The Maritime Continental Thunderstorm Experiment (MCTEX) is to be held 13 November to 10 December 1995 over Bathurst and Melville Islands, located approximately 50 km off the coast of Australia's Northern Territory. Deep convective systems develop over these islands about 8 days out of 10 at this time of the year. The thunderstorms develop over fixed locations and exhibit a full lifecycle representative of mesoscale convective processes, including: the

development of shallow non-precipitating convection within the planetary boundary layer, the transition to deep precipitating systems, the merger of systems and subsequent development of squall lines oriented perpendicular to the low-level shear. MCTEX will provide a focused, detailed examination of the convective systems, from their origins to their final decay as they propagate off the islands.

The MCTEX measurement network consists of: 15 automatic weather stations, a D-scale raingauge network, surface energy budget station, electrification observations, rawinsondes, AIR Tethersonde, 3 beam doppler profiler with RASS, doppler profilers, balloon microphysical observations, aircraft-based measurements, BMRC Doppler/polarised radar, CSIRO Lidar, cloud radar, and ship-based measurements from Franklin. Darwin will have an S-Band satellite receiver so that NOAA AVHRR and TOVS data will be available by direct readout.

The MCTEX is an international, multi-agency project with participants from: Australia, USA, Japan and New Zealand.

Cruise Objectives

1. Measure air-sea fluxes of heat, water and momentum. These measurements are made in the context of land/sea breezes associated with daytime convection over Tiwi Islands and night-time convection over Beagle Gulf. These shipboard measurements are complemented by landbased flux measurements on the Tiwi Islands and airborne measurements during MCTEX intensive operation periods (IOP's). Combined these data sets provide contraints for modelling and analysing major convective activity nover the Tiwi Islands.
2. Compare ship-board flux/radiation measurements with those made from FIAMS Cessna 340A II and the Insitu Aerosonde Mark I.
3. Measure velocity, temperature, salinity and transmissivity structure of the water column and the water column response to the fluxes measured above.
4. Measure fine-scale temperature/salinity structure associated with the cool-skin and diurnal surface warming in the top two metres of the water column, to test parameterizations of the phenomena developed during TOGA COARE.
5. Measure sea waves using directional and nondirectional waverider buoys. Our objective is to complement waverider data with radar, ship and aerosonde wind observations to determine generation and dissipation of sea waves. MAL HERON AND ANDREW'S WAVE/CURRENT OBS??
6. Measure the decay of convective systems as they propagate from over land to over the ocean.

Outline of Cruise Activities

18-20/11/95 Install and test scientific equipment with ship at the dock. Power will be required.
21-22/11/95 Testing of communications with shore-based radar site and the opperational office at Darwin. Deploy wave rider buoys at sites marked M1, M2, and M3 in Figure 1. Depth surveys following the solid line along the moorings, the heavy dashed box in central Beagle Gulf, and the dashed line across the mouth of Beagle Gulf. Sea trials of flux, radiation, ADCP, thermosalinograph, radio receiving equipment for waverider buoys, etc.
22/11-4/12/95 Main observational period: measure surface fluxes, water column structure (including fine-structure), and wave field as per a programme determined one day at a time in order to comply with the rest of the MCTEX observational strategy and to make the best use of forecast weather conditions.
5/11/95 Recover waverider buoys, beginning 0700. Continue water column and flux measurements.
6/11/95 Flux measurements in the morning, return to Darwin.

Observational Strategy and Daily Operational Schedules

The MCTEX is a many facetted project. Daily operational plans will be reviewed and decided by the Scientific Steering Committee (SSC) and Director of Daily Operations (DDO). The basic strategy is to concentrate operations into 10 Intensive Operational Period's (IOP's) over the duration of MCTEX. On IOP days the ship will be instructed to carry out operations according to either Plan1 or Plan2 below. On non-IOP days activities will be according to one of Plan2 to Plan5 below.

Plan 1. Make flux and radiation measurements in the vicinity of station F1 (nominal position chosen to be in an area of low spatial gradients as shown on Figure 1) for a period beginning at 0700 h and extending until the end of the nominally 5 hour aircraft mission. The FIAMS Cessna will make transects across the Tiwi Islands repeatedly passing by the ship. The ship must be steaming into the wind at a relative wind speed of about 3 knots to measure fluxes. This will require an adaptive cruise pattern depending upon the wind and Cessna flight path. Communications with the Cessna will be via a low-powered hand-held radio.

Plan 2. This plan is the one we expect to follow most often. Timing of activities will be subject to modification depending upon timing of convective activity so the times below are nominal.
2000-0900: T/S water column structure (CTD or SEASOAR) and air-sea fluxes will be measured {\bf within} the box delineated by the heavy dashed lines in Figure 1. Again the exact cruise path will be dependent upon wind direction and its extent within the dashed area will be limited to ensure two complete circuits in the alloted time. Ship

observations will be augmented by the **Doppler / polarised radar** in order to study convection over Beagle Gulf.

0900-1300: Air-sea fluxes will be measured in the vicinity of thewaverider moorings.
1300-1430: SEASOAR tow along the line of wave rider moorings.Continue monitoring fluxes as conditions allow.
1400-1800: Monitor air-sea fluxes along the line of moorings.Maintain close communications with the radar station regarding any convection propagating fromthe Tiwi Islands to the vicinity of the waverider moorings. Before the storm hits the winds will be weak westerly. When the storm hits winds will change to strong easterly and the ship will have to change course in order to stay headed into thewind. The aim will be to time the ships passage so the storm hitswhen the ship is coincident with the directional waverider buoy at M2. A high repeat rate of surface scans by the **Doppler / polarised radar** will be required to determine both components of the surface wind field in this period when squall lines can pass over the moorings.
1800-2000: Subsequent to the passage of the storm there will be a second SEASOAR tow along the line of moorings.
2000-2100: Review of days activities and report to DDO.

Plan 3. Ocean skin-layer measurements using `Silverfish' would be made in calm wind conditions preferably catching a complete day-night cycle of stratification and destratification.

Plan 4. In order to determine environmental conditions at theboundary of our main study area (Beagle Gulf) we will make night-time transects of mouth of Beagle Gulf using SEASOAR and measuring fluxes. These transects will be optimally timed early and late in the cruise and will be scheduled for two nights when the following day is scheduled a non-IOP day and the prognosis is for little night-time convection.

Plan 5. The lowest priority item will be one night-time partial survey of SST and fluxes around the Western end of Bathurst Island. Again, this mission will only be scheduled if the following day isscheduled as a non-IOP day.

Note 1. Water velocity will be measured throughout the cruise using the ships ADCP or a replacement ADCP with higher vertical resolution. These measurements are required to estimate horizontal fluxes and interpret water column T/S structure. Similarly the ships meteorological station, thermosalinograph, reference irradiance, heading and navigation will be logged throughout the cruise. Data transmitted from the waverider buoys will be logged whenever the ship is within radio range, which will be most of the time.

Note 2. Advice to/from shore based MCTEX personnel will be communicated with the ship as follows:
(1) IOP/non-IOP plans from the Director of Daily Operations and activity reports to the DDO.
(2) The regional centre will provide forecasts of the likelihood of night-time convection in the Beagle Gulf or continental storms propagating off the mainland.
(3) Discussion of development of afternoon convective activity with the Doppler/polarised radar site on Bathurst Island.

Note 3. Frequent shore communications will be required. These will be carried out using analogue cell phones as far as possible. The ships analogue cell phone will be used for Facsimilie communications and a second analogue cell phone will be used for voice communications. The INMARSAT facsimilie service and ships radiotelephone will be used in case of breakdowns in cell phone communications.

Note 4. Whenever possible we will make comparisons between flux measurements from the ship and those from the Cessna as the Cessna crosses the Beagle Gulf going either to or from other missions.

ORV Equipment Required

- SEASOAR with deflector and transmissivity, radiometer, temperature and salinity sensors.
- Reference irradiance system.
- Ships meteorological station, syphon rain Gauge, long/short wave radiometer with data taker.
- CTP profiler.
- Acoustic doppler current profiler.
- Thermosalinograph, ships heading and navigation (GPS).
- Boom for mounting turbulence flux measuring equipment.
- Sliding boom on foredeck to trial surface temperature sensor.
- Ships analogue cell phone, and Facsimilie machine.
- INMARSAT FAX, and radiotelephone.

User supplied equipment

- 3 wave rider buoys with associated receivers and moorings including 1 directional mooring (Ian Young).
- Sonic anemometer, fast-response humidiometer and equipment to measure motion of the instrumentation (Ian Young and Frank Bradley).
- Equipment for measuring the bulk heat, humidity and momentum fluxes as well as radiation and rainfall (Frank Bradley).

- Silverfish fast-response temperature and salinity profiler (Frank Bradley).
- Several personal computers.
- Analogue cell phone.

Scientific Party

Dr. Brian Sanderson,	BMRC, Chief Scientist
Dr. Frank Bradley,	CEM, CSIRO
Dr. Gary Miller,	CEM, CSIRO
Ms. Marion Tait,	Flinders University of South Australia
Mr. Jimmie Phang,	BMRC
Mr. Lindsay Pender,	CSIRO ORV
Mr. Dave Edwards,	CSIRO ORV, Cruise Manager
Mr. Ian Helmond,	CSIRO ORV
Mr. Ron Plaschke,	CSIRO ORV

This cruise plan is in accordance with the directions of the National Facility Steering committee for the oceanographic research vessel *Franklin.*

C B Fandry
CSIRO Division of Oceanography

G W Paltridge
National Facility Steering Committee

September 1995

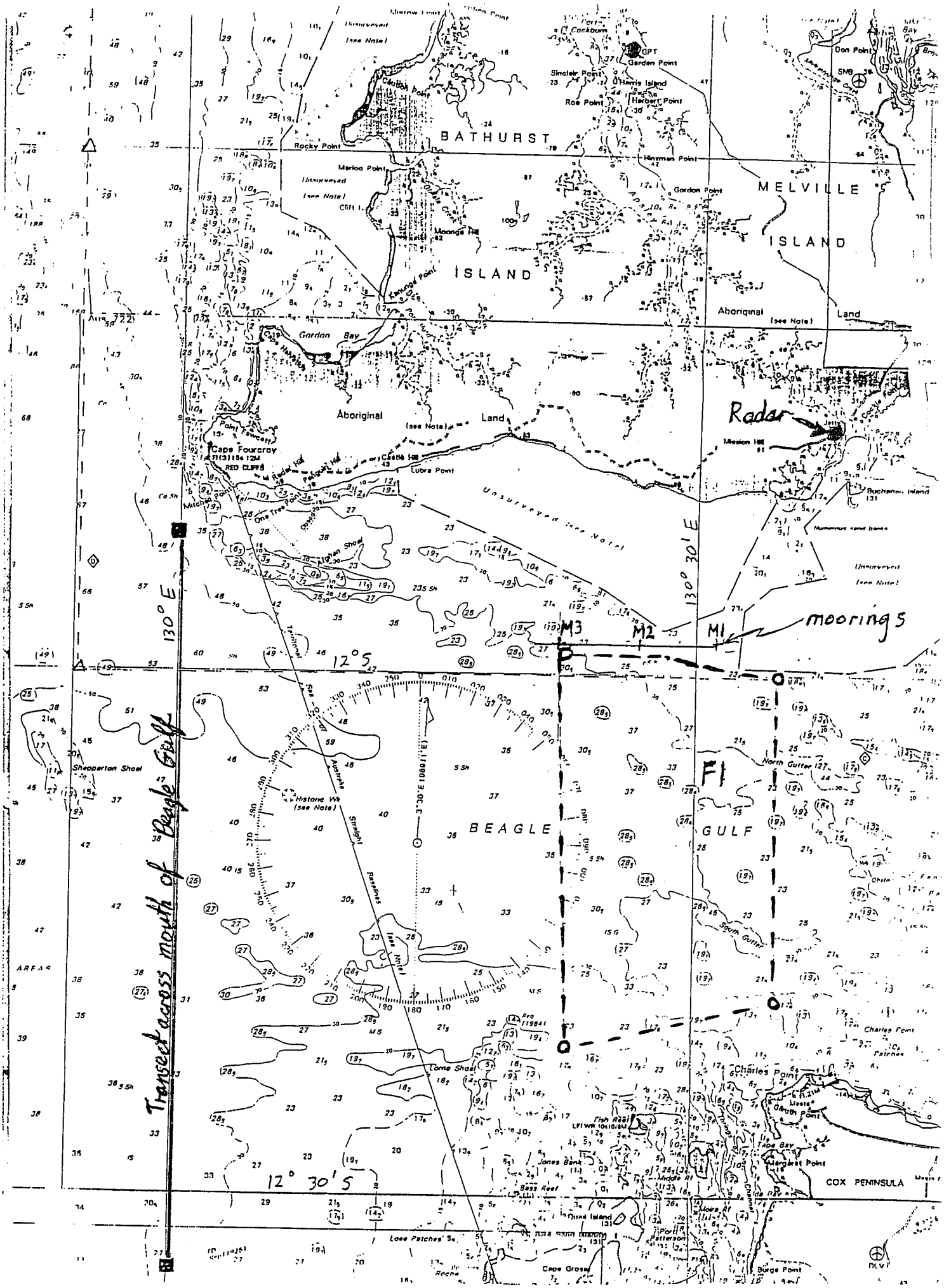
BATHURST
ISLAND
MELVILLE
ISLAND
Aboriginal Land
(see Note)
Gordon Bay
Cape Fourcroy
Lubra Point
Radar
Mission Hill
Unsurveyed (see Note)
130° E
130° 30' E
12° 5
12° 30' S
M3
M2
M1
moorings
Transect across mouth of Beagle Gulf
BEAGLE
GULF
Shoppenton Shoal
Historic Wk (see Note)
Straight Passages
North Gutter
South Gutter
Charles Point
Tame Shoal
Jones Bank
Bass Reef
COX PENINSULA
Cape Gross
Burge Point

Figure 1