BOREAS
Experiment Plan

BOREAL ECOSYSTEM - ATMOSPHERE STUDY

BOREAS

Chapter 5-7
Aircraft Operations
Field Campaign Summaries
Emergency Procedures

May 1996 Version 2.0

BOREAS Executive Summary

This document is the Experiment Plan (EXPLAN-96) for BOREAS field operations to be conducted in 1996 (BOREAS-96). This work will consist primarily of a set of extended eddy correlation (H, LE CO_2) measurements at a number of tower flux sites from March through November 1996, supported by ecophysiological, hydrological, and biogeochemical observations. There will be a small winter campaign (FFC-W) to explore the physics of remote sensing over snow-covered forests, and three growing season field campaigns (thaw, midsummer, fall) in which the bulk of the in situ measurements and aircraft operations (airborne remote sensing and flux measurements will be concentrated.

Chapter 1 reviews the science issues and objectives of BOREAS; the overall design of the field observation component of BOREAS; the field operations and some preliminary results from BOREAS-94; and the shortcomings of the BOREAS-94 data set. The last item provides the motivation for the return to the field; i.e. for BOREAS-96.

Chapter 2 reviews the analyses and planning activities that took place in the period 1994-1995. These resulted in three white papers which are summarized in the text.

Chapter 3 describes the field operations planned for BOREAS-96. These are based directly on the requirements from the white papers summarized in Chapter 2. Chapter 3 is divided into six sections: overview; monitoring; NSA growing season studies; SSA growing season studies; and AFM and RSS growing season activities.

Chapter 4 describes operations procedures; the facilities to be made available by the project; and the schedules for site support.

Chapter 5 describes the aircraft operations. Complete summaries of all the mission plans for all the BOREAS-96 aircraft are included.

Chapter 6 provides a "quick look" summary of field campaign objectives, including tables showing which teams and aircraft will be present during IFC's.

Chapter 7 describes emergency procedures in case of accidents in the field.

Appendices A-H contain further details on investigator contact information; shipping and customs; data documentation; references; satellite overpass schedules; team activity write-ups; directions to BOREAS auxiliary sites, and an acronym list.

BOREAS Experiment Plan 1996

Table of Contents

5.0 Aircraft Operations

Appendices A-H

5.0 AIRCRAFT OPERATIONS

5.1 Overview of Schedule and Operations

5.1.1 Overview of field campaign tasks

Table 5.1.1 is a quick reference to the timing and scope of the field campaigns. Activities for each field campaign are summarized in Chapter 6.

Table 5.1.1
Dates, durations, activities and aircraft associated with BOREAS field campaigns.

	Start Date	End Date	Duration (days)	Activities	Aircraft
FFC-W	2/27/96 58	3/15/96 75	18	Snow remote sensing ~ 4 teams.	ER-2, C-130Q, Eyeball
IFC-1	4/02/96 93	4/28/96 109	27	Spring processes	Eyeball
IFC-2	7/09/96 191	8/09/96 222	32	Mid-Season Processes; RSS, AFM as well as surface teams	ER-2, C-130Q, Chieftain, Twin Otter, Eyeball (DC-8)
IFC-3	10/01/96 275	10/20/96 295	20	Fall processes; AFM work	Eyeball

5.1.2 Operations Management: roles and responsibilities

Aircraft operations planning procedures are laid out in section 4.1.5. The responsibilities of aircraft managers are listed in section 4.1.3.7. The aircraft radio net is described in section 4.1.6.1.

Each aircraft pilot is responsible for keeping the aircraft manager/PI informed as to the state of the aircraft readiness, hours remaining and significant scheduling considerations, e.g. time remaining to inspection, crew rest requirements, etc.

5.1.2.1 Phone Calls

The following phone calls must be made by the aircraft manager or pilot to BOREAS Ops before missions:

-- leaving hotel/residence for airport.
-- 'Ready to go', i.e. just prior to walking out to the aircraft.
-- 'Take off'; if manager remains at airport.

Thereafter, during the mission, contact is maintained with the aircraft by radio (122.7), see lists of calls in section 5.1.2.2.

After the mission, the aircraft manager or pilot should phone Ops and provide the following information to the MM.

- -- Mission duration, take off and landing times - mission type
- -- Accomplishments/problems
- -- Near-term status of aircraft or crew (e.g. 'ready to go again in one hour').

For aircraft that have the possibility of a repeat mission that day, crews should not disperse until after this call has been made.

The NASA ER-2, which is always based a great distance from the BOREAS region, is the exception to the above format. The MM and ER-2 manager will communicate before the FFC/IFC to finalize the sequence of telephone calls and go/no-go decisions. These are expected to follow the procedures worked out in BOREAS-94.

Day before flight

~ 2000Z: MM contacts ER-2 manager, or vice versa. Soft go/no-go for ER-2 based on WX forecast.

0300Z: After BOG meeting, MM updates ER-2 manager, if necessary.

Day of flight

1200Z (L-3): (Take-off minus 3 hours). Update for go-ahead on fueling.

1330Z (L-1): Update for go on pilot suit-up.

ER-2 Contact Phone Numbers (FFC-W)

Gary Shelton(Manager)	(Ames)	415-604-5344
	(Home)	415-728-7633
Jan Nystrom (Pilot)	(Ames)	415-604-5904

Thereafter, the phone calls or sequence is the same as above for other aircraft from 'Take off' onwards.

5.1.2.2 Radio Calls

Most aircraft operations will be coordinated by the MM from the hot SAHQ by telephone and the aircraft radio net. Occasionally, operations over a study area may be coordinated by an MM or designee of the MM from an aircraft holding above the study area. The call-sign of this aircraft is 'EYEBALL'.

The pilot and/or aircraft manager shall ensure that the following radio contacts are made with the SAHQ/Eyeball.

- 'wheels up', if within radio range.
- 'site approach', when within radio range giving position, altitude, intentions and ETA on-site.
- 'east/west route entry/exit'. When a flux aircraft enters or exits a low level route, the route and direction must be pre-announced.
- 'start of work' in the study area.
- movement from one surface target to another.
- 'site exit'.

The NASA ER-2 is the obvious exception to the above format, see also section 5.1.2.1. The ER-2 pilot is requested to make the following two calls:

Site entry: ER-2 pilot contacts BOREAS Ops (122.7); reports status and start of data acquisition.

Site exit: ER-2 pilot reports site exit; ETA for home base.

Within the study areas, aircraft should call out their positions relative to familiar landmarks or to the YPA or YTH VOR/DME NAVAIDS as required or on request, see figures 5.1.2.2. Low-flying aircraft out of range of the VOR/DME should use LORAN or GPS to provide the same information, i.e. 'virtual' VOR/DME positions. This information will also be used by BOREAS-Ops to give advisories to non-BOREAS traffic transiting the study areas.

Figures 5.1.2.2 show the BOREAS TF and auxiliary sites by Category for each study area, with the VOR/DME grids overlaid; note that DME arcs are shown in conventional nautical miles. Site categories define the priority of a site as a remote sensing target.

Clean copies of figures 5.1.2.2 can be obtained from BORIS.

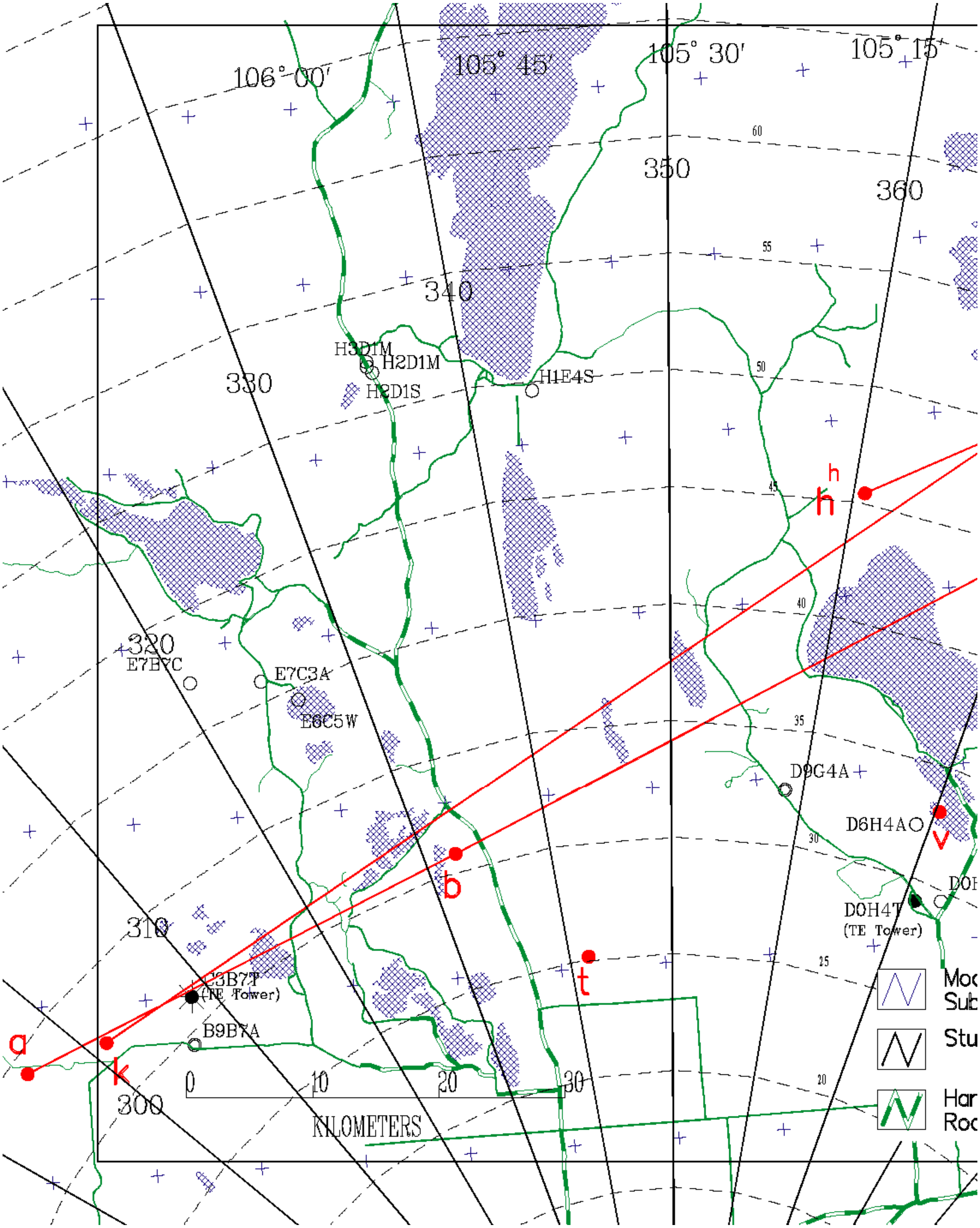

Figure 5.1.2.2 SSA showing BOREAS sites and YPA VOR/DME overlay.

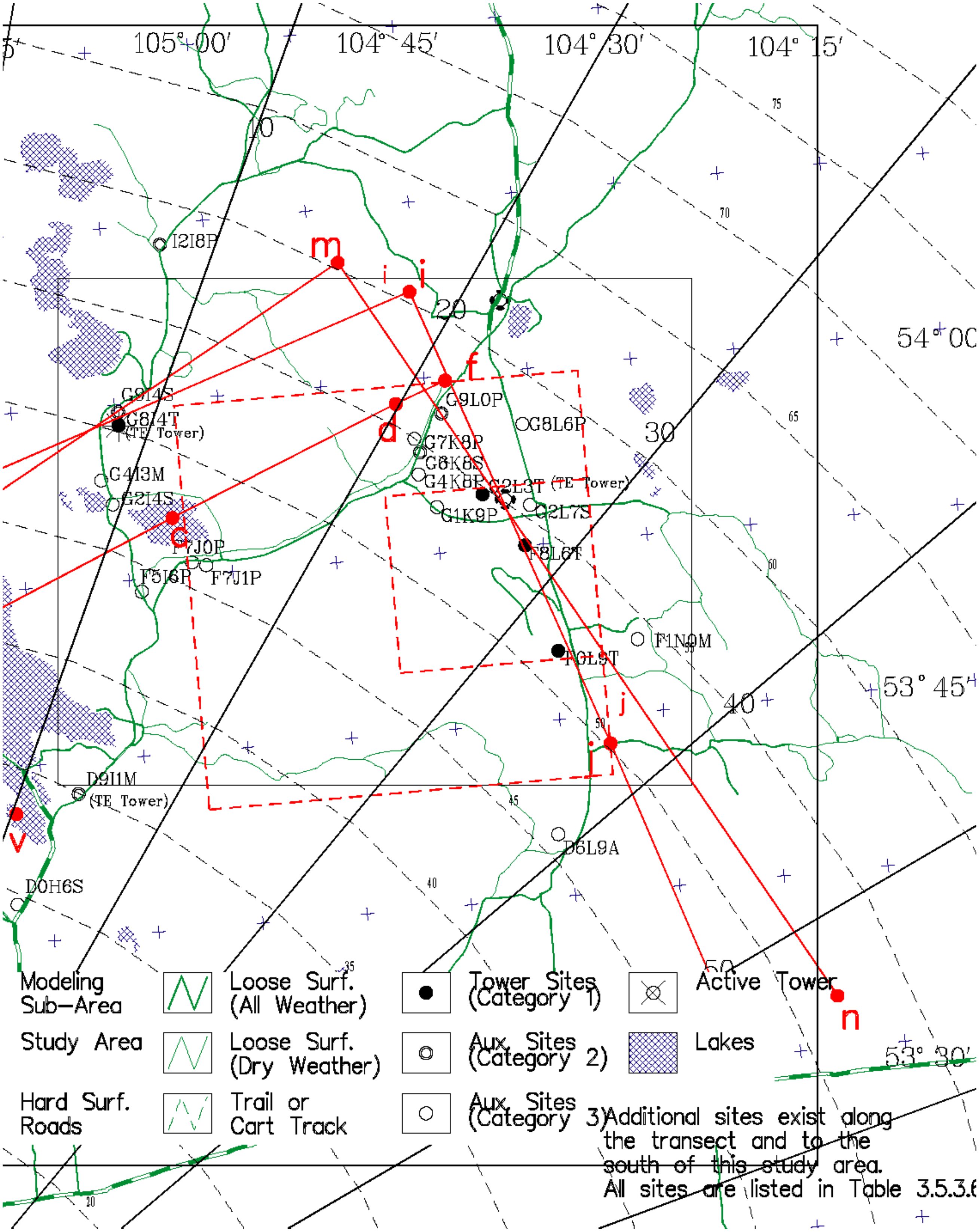

Figure 5.1.2.2 SSA showing BOREAS sites and YPA VOR/DME overlay (cont.)

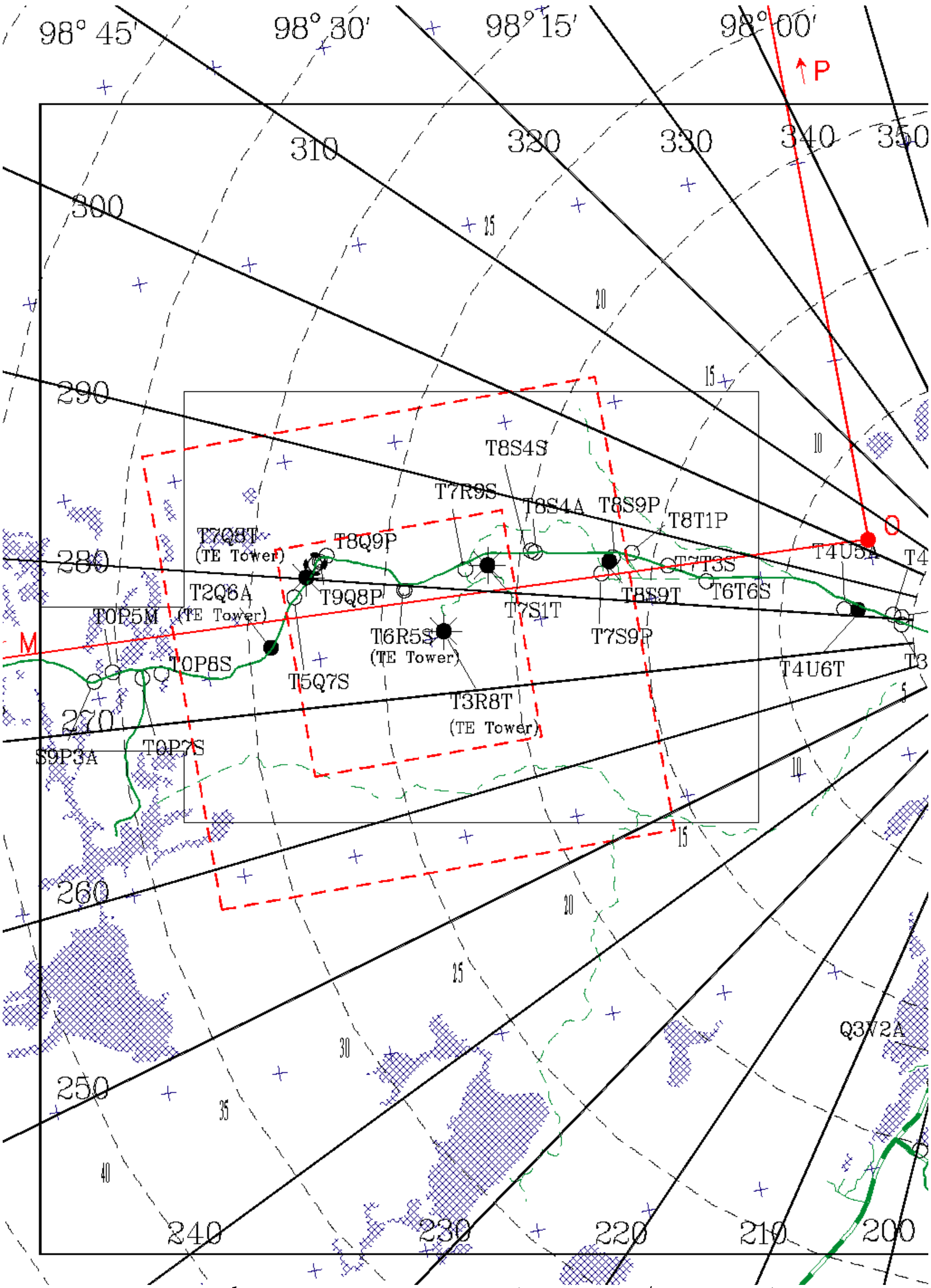

Figure 5.1.2.2 NSA showing BOREAS sites and YTH VOR/DME overlay.

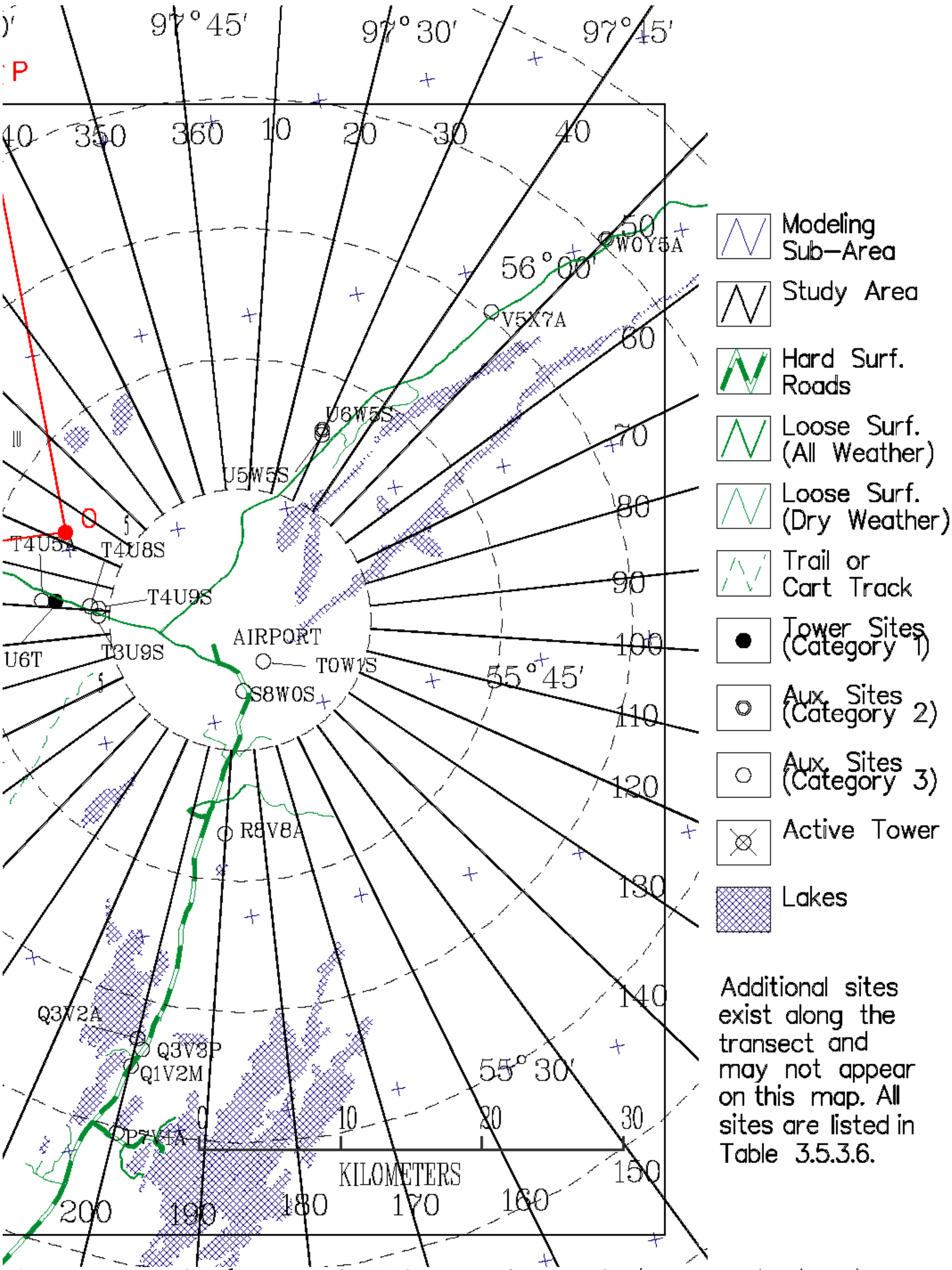

Figure 5.1.2.2 NSA showing BOREAS sites and YTH VOR/DME overlay (cont.)

5.1.3 Flight Hours and Basing

Table 5.1.3a shows the flight hours available to each aircraft by field campaign. Table 5.1.3b lists the deployment airports to be used by each aircraft. Transit times between the deployment airports and the study areas must be allocated against 'site hours' shown in Table 5.1.3a.

Table 5.1.3a
Flight Hours Available to BOREAS -96 by Field Campaign

Ferry hours refer to transits from the aircraft home base to and from the deployment airport. Site hours refer to research flight hours and transits from the deployment airports to and from the study areas.

	FFC-W		IFC-1		IFC-2		IFC-3	
Aircraft	**Ferry**	**Site**	**Ferry**	**Site**	**Ferry**	**Site**	**Ferry**	**Site**
RC (C-130)	15	15			15	35		
RD (DC-8)					?	?		
RE (ER-2)	6	2			10	6		
RP (Chieftain)					10	30		
FT (Twin Otter)					22	70		
FB Eyeball)		10		10		20		10

Table 5.1.3b
Deployment Airports for the BOREAS-96 Aircraft

Aircraft	**FFC-W**	**IFC-1**	**IFC-2**	**IFC-3**
RC (C-130)	YPA		YPA,YTH	
RD (DC-8)			YXE?	
RE (ER-2)	NUQ		GEG	
RP (Chieftain)			YPA, YTH	
FT (Twin Otter)			YPA,YTH	
RB (Eyeball)	YPA, YTH	YPA, YTH	YPA, YTH	YPA, YTH

YPA = Prince Albert
YPA*= Prince Albert and Candle Lake
YTH = Thompson
YXE = Saskatoon
NUQ = Moffett Field
GEG = Spokane

5.1.4 Mission Allocation Strategies

Table 5.1.4 summarizes the approximate percentage of total flight hours that should be dedicated to particular mission types for each aircraft.

Table 5.1.4a
Percentage of site hours to be allocated to different mission types by each remote sensing aircraft.

Aircraft	Mission Type								
	Snow		TF/Aux. Sites		Mapping		Special		Transect
RC	SN --	SS 40	TN 20	TS 30	---	--	-- --	-- --	RT 10
RD	-- --	-- --	BN	BS 30	MN	MS 30	FS 30	-- --	RT 10
RE	-- --	SS 30	-- --	-- --	MN 20	MS 30	-- --	-- --	RT 20
RP			TN 30	TS 40	-- --	-- --	TB 20	-- --	RT 10

Table 5.1.4b
Percentage of site research aircraft hours to be allocated to each flux aircraft mission type.

Aircraft	Missions					
	CS,N	**TS,N**	**RT**	**LS,N**	**GS,N**	**VS,N**
FT	25	25	10	10	20	10
FB	--	--	--	--	--	100

5.2 Mission Plans

This section summarizes individual mission plans by aircraft.

Aircraft representatives are referred to previous sections for further information on mission plan submission/approval (4.1.5); aircraft operations protocols (5.1.2); and communications (4.1.6).

Each aircraft mission in BOREAS is assigned a four letter identifier which includes information on:

First Letter:	The type of mission (remote sensing or flux measurement)
Second Letter:	Aircraft type/identification (see Table 5.2a)
Third Letter:	Specific mission objective (see Table 5.2.b)
Fourth Letter:	Mission target area

The mission identifiers are listed by aircraft type in Table 5.2b. Table 5.2c provides a quick reference for decoding mission identifiers. For example, 'RC-SN' translates to:

R:	Remote sensing aircraft
C:	C-130
T:	ASAS data acquisition over TF sites.
N:	NSA

The missions for each aircraft are covered in the subsections 5.2.x. The cognizant investigator for each aircraft (see Table 5.2a) is responsible for informing BOREAS about any changes in aircraft status or proposed mission profiles.

Table 5.2a
Aircraft in BOREAS

Aircraft/ Mission Identifier	Aircraft Type	Tail Number/ Call Sign	Instruments	Cognizant Investigator	Team
Remote Sensing					
RC	C-130Q	NASA-427	ASAS, Photo	Irons	RSS-2
RD	DC-8	NASA-717	AIRSAR	Ranson	RSS-15
RE	ER-2	NASA-706	AVIRIS, MAS	Green/Ranson	RSS-18
RP	Chieftain	C-GCJX 'Trilium 103'	CASI	Miller	RSS-19
Flux					
FT	Twin Otter (DH-6)	C-FPOK 'Research 7'	Flux; H,LE,CO_2,τ	McPherson	AFM-4
FB	PA-34 C-172/C-182	C-GPFK 'Eyeball'	CO_2 profiles	Sellers	AFM-14

Table 5.2b
Mission Summaries for BOREAS Aircraft

I. Remote Sensing Aircraft

Aircraft	Mission Identifier	Duration (hours)	Mission Summary
C-130Q	RC-SN	2.0	NSA TF sites during FFC-W(snow)/ASAS
	RC-SS	2.5	SSA TF sites during FFC-W(snow)/ASAS
	RC-TN	2.0	NSA TF sites ASAS
	RC-TS	3.5	SSA TF sites ASAS,
	RC-RT	2.0	Transect between SSA & NSA aligned with AFM Regional transect; ASAS
DC-8	RD-MS	3.0	AIRSAR SSA Modeling Grid Mosaic
	RD-MN	2 .0	AIRSAR NSA Modeling Grid Mosaic
	RD-RT	1 .0	AIRSAR SSA to NSA AFM Transect
	RD-BS	1.7	AIRSAR SSA Baseline
	RD-BN	1 .0	AIRSAR NSA Baseline with 43° angle
	RD-IS	1.0	AIRSAR SSA Baseline with 25° angle
	RD-DS	1.7	AIRSAR SSA Baseline pre-dawn
ER-2	RE-MS	6.0	Mapping of SSA, AVIRIS, MAS
	RE-MN	8.0	Mapping of NSA, transect, AVIRIS, MAS
Chieftain	RP-TS	2.0	Mapping of SSA TF and aux sites
	RP-TN	2.0	Mapping of NSA TF and aux sites
	RP-RT	3.5	Regional transect, line segments
	RP-XB	3.0	Tundra transect from NSA

II. Flux Aircraft

Table 5.2b
Mission Summaries for BOREAS Aircraft (times are approximate)

Aircraft	Mission Identifier	Duration	Mission Summary
DH-6	FT-CS	2.0	Candle Lake runs
(Twin Otter)	FT-TS,N	1.0 - 1.5	Site specific (TF site)
	FT-LS,N	1.5 - 2.5	Mini, meso transect (SSA, NSA)
	FT-GS,N	2.5 - 3.0	Grids and stacks (SSA, NSA)
	FT-PS,N	2.5 - 3.0	Budget box pattern(SSA, NSA)
	FT-HS,N	2.5 - 3.0	Stacks and Tees (SSA, NSA)
	FT-FS,N	0.5 - 1.0	Flights of two (SSA, NSA)
	FT-ZS	0.2	Low level routes (SSA)
	FT-VS	3.0	CO_2 profiles
PA-34 or	FB-ES, N	1.0 - 4.0	Site recce/forward air traffic/birddog
C-172/C-182	FB-VS, N	3.0	CO_2 profiles

Table 5.2c
Reference table for decoding BOREAS aircraft mission identifiers (e.g. RC-MN = R: remote sensing aircraft; C: C-130 - M: Mapping mission; N: - NSA)

First Letter Mission Type	Second Letter Aircraft Type	Third Letter Mission Objective	Location
R: Remote Sensing	C: C-130 D: DC-8 E: ER-2 P: Chieftain	B: Radar or microwave baseline D: Like B, predawn F: Fire lines in SSA I: Like B, 25 degree incidence M: Mapping R: Regional S: Snow survey T: Tower or aux site (optical) U: Special snow survey (ER-2) W: Soil moisture survey X: Tundra transect	N: NSA S: SSA T: Transect B: Tundra
F: Flux Measurement	B: Eyeball T: Twin Otter	C: Candle Lake Run E: Site Reconnaissance F: flights of two G: Grids/stacks H: Stacks/tees L: Regional/mini transect P: Budget box pattern R: Regional transect T: TF site specific run V: CO_2 profiles Z: Low-level routes	N: NSA S: SSA T: Transect B: Tundra

5.2.1 C-130 (RC)

The major objectives are to obtain (1) multi-angle ASAS data over Tower Flux and other selected sites, and (2) some ASAS data on a regional transect between the study areas. The look angles to be used correspond to the MISR look angles (within limits): +70˚, +60˚, +45˚, +26˚, nadir, -26˚, -45˚, and -55˚. All C-130 missions are dependent on clear-sky conditions (no more than 5-10 % cloud cover). During the FFC-W, the C-130 will be based in Prince Albert; for IFC-2, the C-130 will fly first to Prince Albert and base in the SSA for a few days to fly off the RC-TS and RC-TN missions. If the RC-TS missions are completed, basing out of Thompson should be considered to finish off the RC-TN tasks, if weather and/or smoke appear to reduce our chances of completing RC-TN's from Prince Albert.

Flight schedules will be determined during the evening BOG meetings by onsite Team members, air crews, and relevant ground teams. Weather forecasts, morning weather conditions and where necessary, on site reconnaissance (birddog) by Eyeball, will be used to make daily go or no-go decisions. If skies are sufficiently clear in the morning, all ASAS missions will take off as early as possible in the morning, determined by any solar zenith angle limitations. Flightline orientations for ASAS lines will depend on solar azimuth at the time of acquisition. Targets of opportunity and simultaneous overflights with other platforms will also be discussed and finalized at the evening BOG meetings.

Generally, two hours prior to a planned take-off, the RC crew will get an update at their hotel or designated contact point on mission status from Ops. About 30 minutes before take-off, the crew will contact Ops from the ASAS room at Athabaska, prior to walking out to the aircraft for engine start.

Details of the C-130 missions are given below in Sections 5.2.1.1. - 5.2.1.4

5.2.1.1 RC-SN and RC-SS: Snow Missions in FFC-W

The C-130 will base at Prince Albert for the entire duration of FFC-W. The C-130 will fly ASAS missions at an altitude of about 16,500 feet above ground level (AGL) over several Tower Flux sites in the SSA. In addition, ASAS will acquire several targets for calibration. The prioritized list of sites and flightline orientations relative to the solar principal plane (SPP) are as follows:

SSA: RC-SS

(1)	Old Black Spruce	Parallel, and oblique to SPP
(2)	Old Jack Pine	Parallel, and oblique to SPP
(3)	Old Aspen	Parallel, and oblique to SPP
(4)	Agricultural Site	Parallel, and oblique to SPP
(5)	Namekus Lake	Parallel, and oblique to SPP

ASAS missions in the SSA will coordinate with HYD-3, RSS-1 (PARABOLA).

The NSA TF sites are low priority targets (see 3.6.3).

NSA: RC-SN

(1)	Old Black Spruce	Parallel, and oblique to SPP
(2)	Fen	Parallel, and oblique to SPP
(3)	Old Jack Pine	Parallel, and oblique to SPP
(4)	Young Jack Pine	Parallel, and oblique to SPP
(5)	Old Aspen (TE)	Parallel, and oblique to SPP

These snow missions depend on snow conditions at each site, with a minimum threshold requirement of 25mm SWE (snow water equivalent) over most of a 1 sq. km patch. During transit between the study areas, a regional transect (RC-RT) aligned with the AFM (FE-RT) regional transect may be executed if time permits.

See figures 5.2.1.1a and 5.2.1.1b for the RC-SN and RC-SS snow missions.

5.2.1.2 RC-TN and RC-TS: ASAS Mission Over TF Sites

During IFC-2, multiangle, multispectral ASAS images will be acquired over all five permanent Tower Flux sites and the agricultural/pasture site in the SSA, and all four Tower Flux sites and the TE-OA site in the NSA, at an altitude of 16,500 feet AGL. If time permits, multi-angle ASAS data will be acquired over one or more auxilliary site. ASAS flightlines will consist of up to three different flightlines (each about 35-40 km long) oriented parallel to the solar principal plane, oblique to the solar principal plane, and perpedicular to the solar principal plane. This last line (perpendicular) may be dropped altogether from the plan, depending on the availability of flight hours. ASAS also plans to collect data over targets of opportunity such as the AVIRIS calibration site (north of the Prince Albert Airport) and water (Namekus Lake in the SSA and Birch Tree Lake in the NSA). In the SSA, highest priority will be given to the Tower Flux sites where PARABOLA data (RSS-1) are being acquired, i.e. SSA-OA, SSA-OBS, SSA-OJP. RC flights will be simultaneous with RE (ER-2) missions where possible.

See figures 5.2.1.2a for RC-TN and RC-TS missions.

5.2.1.3 RC-RT: Regional transect; ASAS

ASAS data will be acquired at an altitude of approximately 24,000 feet AGL along a regional transect between the two study areas. The transect is aligned with the AFM (Fx-RT) regional transect but is displaced 2 km to the west to

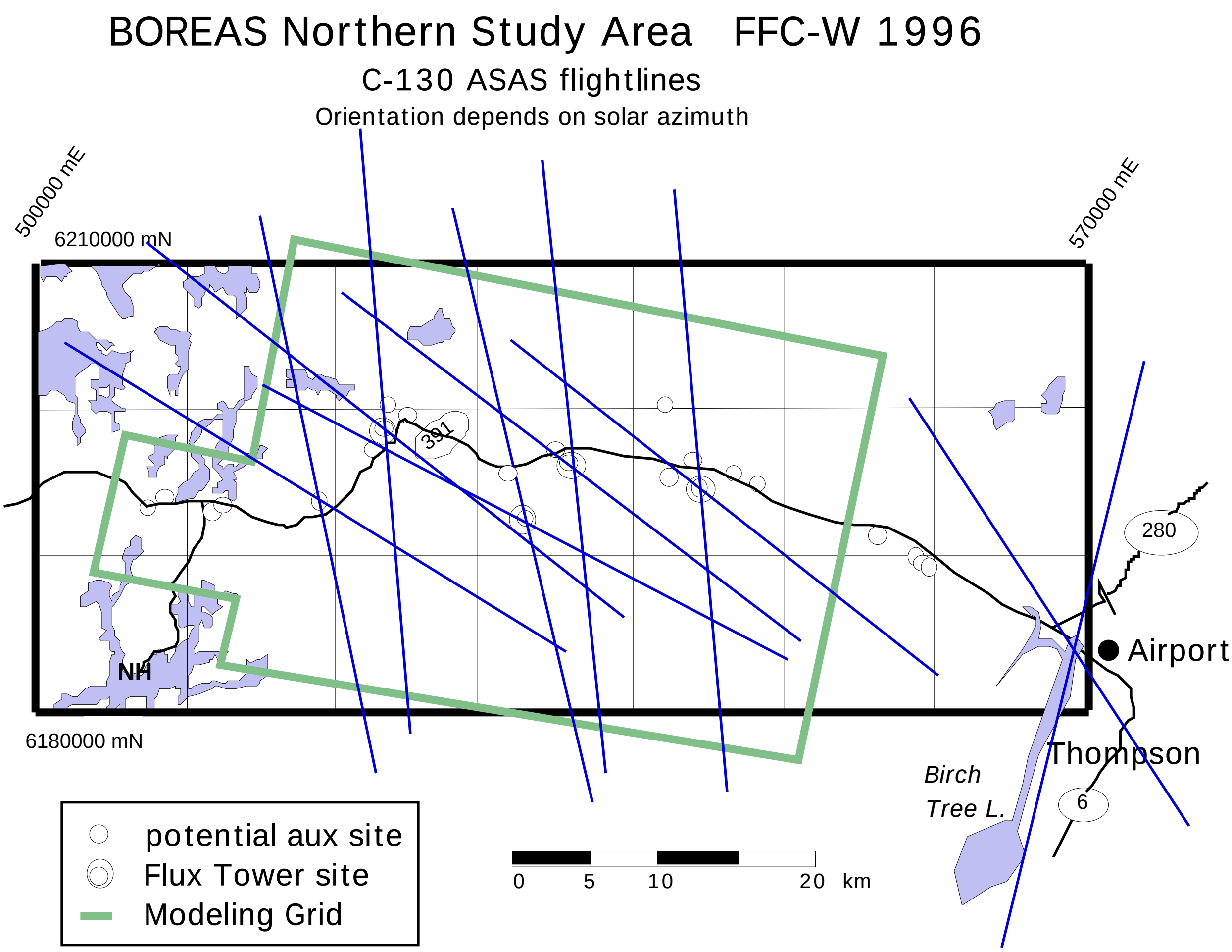

Figure 5.2.1.1a RC-SN: C-130 Snow Mission in FFC-W for NSA.

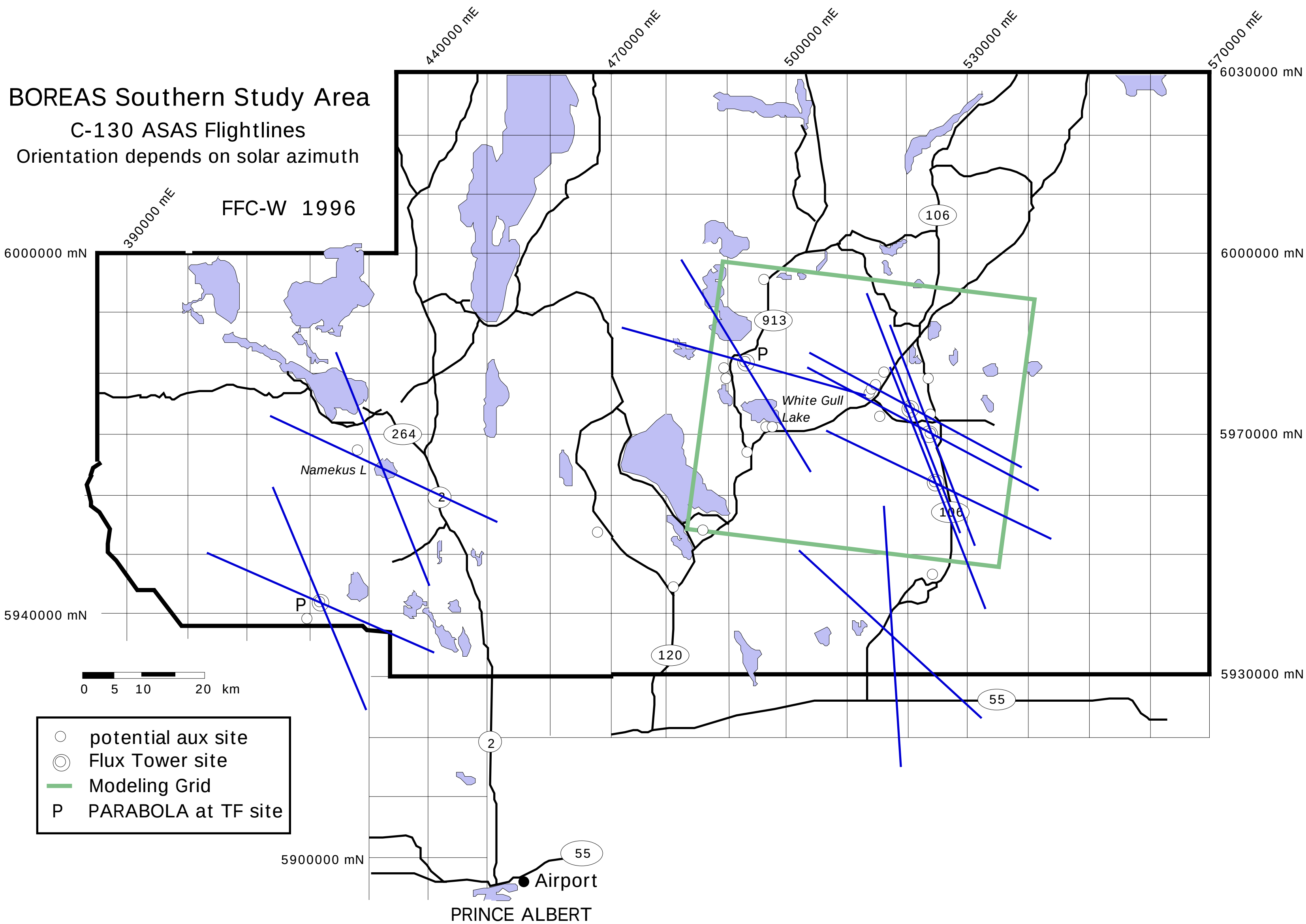

Figure 5.2.1.1b RC-RS: C-130 Snow Mission in FFC-W for SSA.

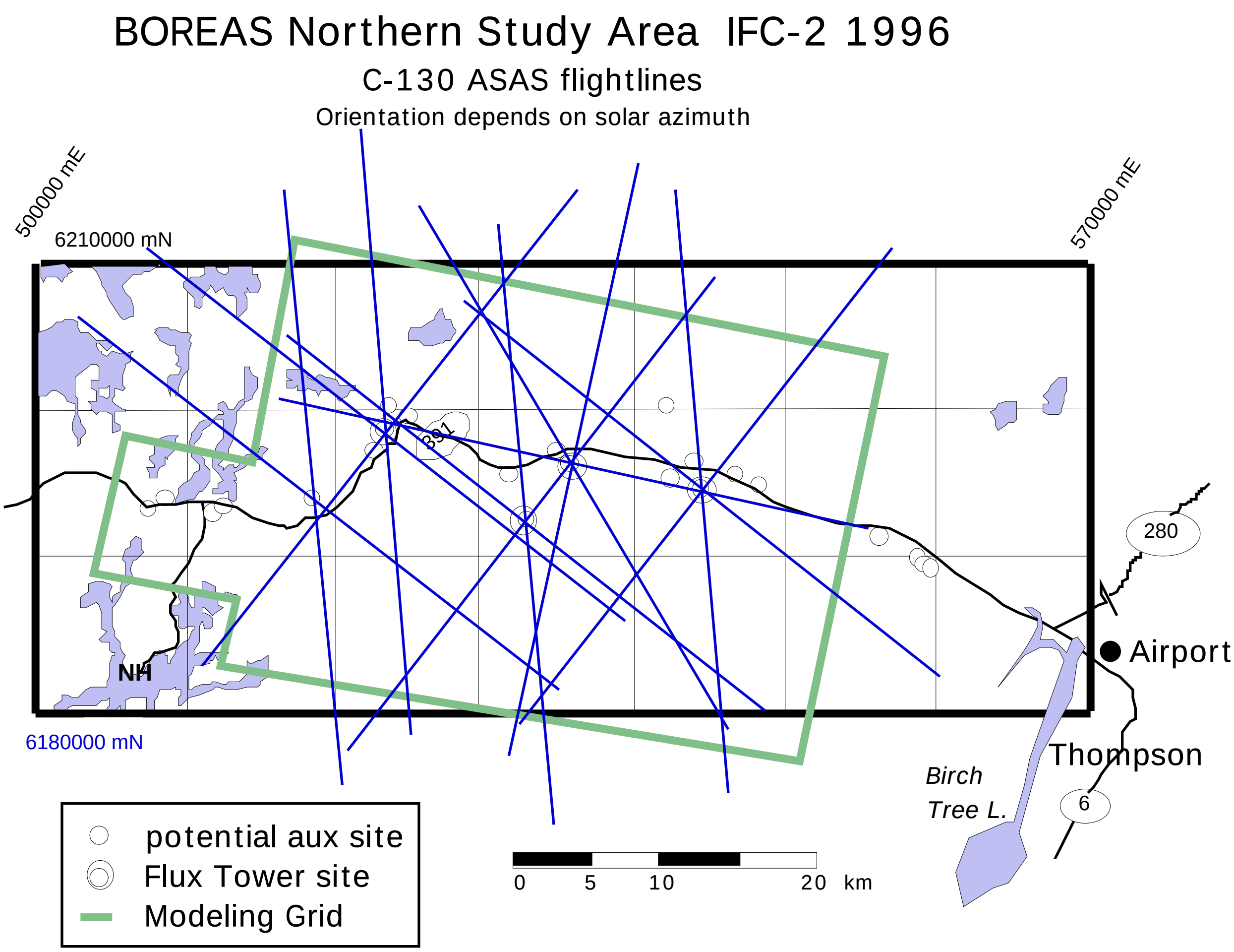

Figure 5.2.1.2a RC-TN: C-130 Missions over TF sites in NSA.

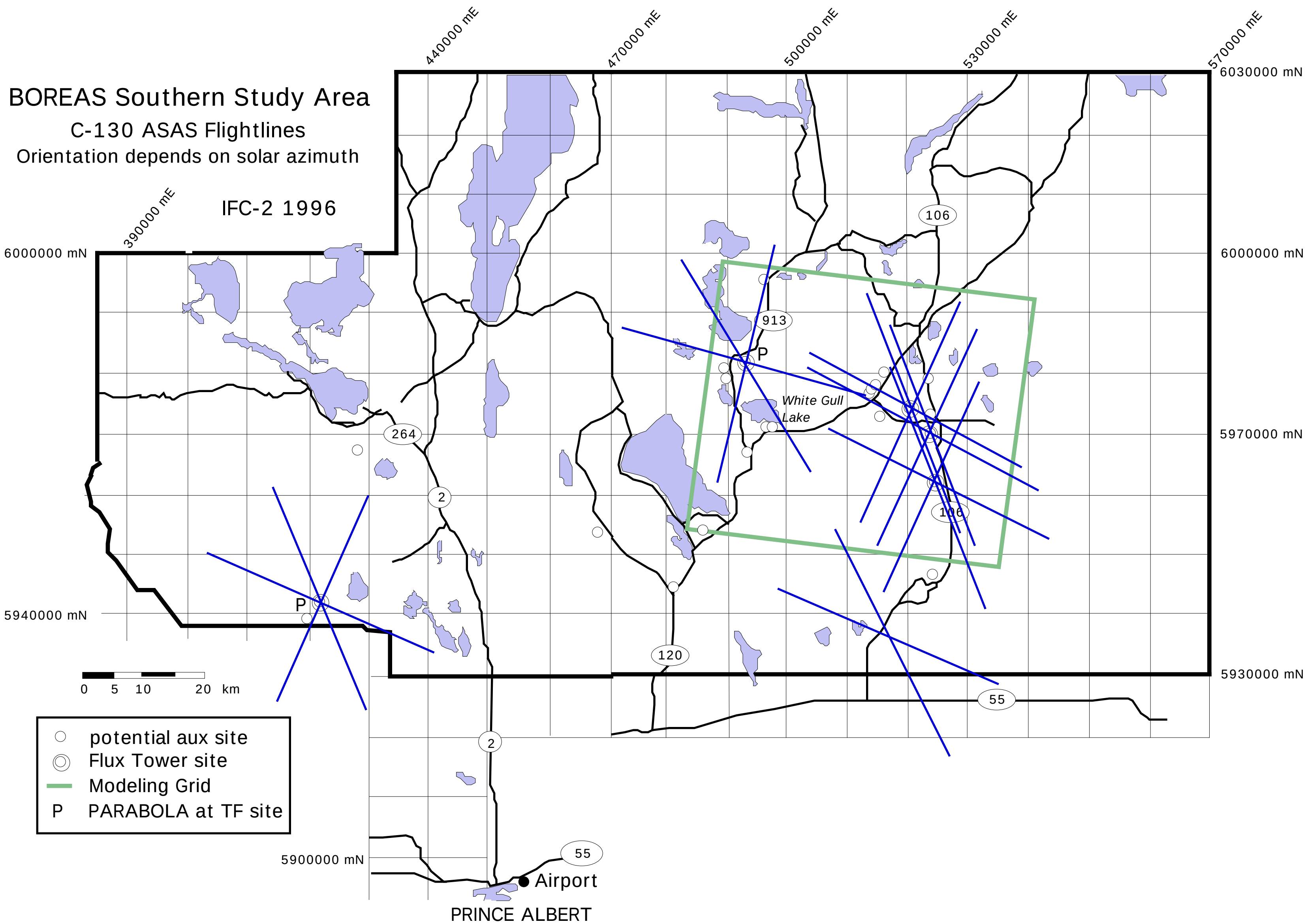

Figure 5.2.1.2b RC-SS: C-130 Missions over TF sites in SSA.

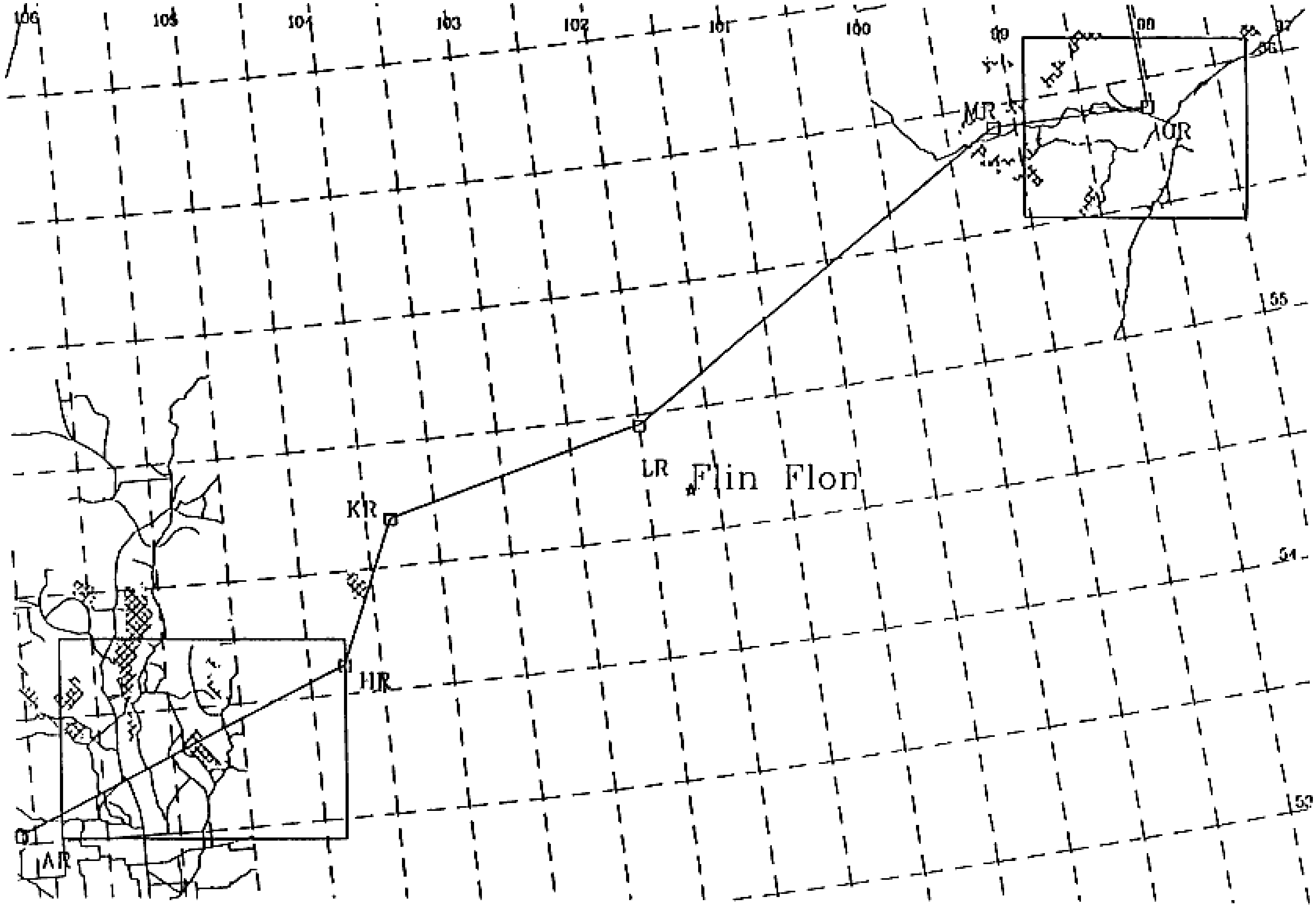

Figure 5.2.1.3 RC-RT: C-130 Regional Transect

Table 5.2.1.3
Waypoints for all remote sensing regional transect missions (Rx-RT).
These points are displaced 2 km to the west of equivalent Fx-RT transect waypoints to place the center of the remotely sensed footprint upwind of the flux transect, see figure 5.2.5.3, table 5.2.5b.

Waypoint	Lat.	Long.
AR	53° 32.0'	-106° 35.8'
HR	54° 07.0'	-104° 15.3'
KR	54° 41.7'	-103° 49.4'
LR	54° 57.3'	-101° 59.9'
MR	55° 54.8'	-99° 09.4'
OR	55° 53.2'	-98° 01.9'
PR	60° 30.0'	-98° 02.2'
QR	60° 30.0'	-95° 32.2'
RR	59° 00.0'	-95° 32.1'

provide better coverage of the WAB contributing to Fx-RT (assuming westerly winds).

See figure 5.2.1.3 for the RC-RT mission.

5.2.2 DC-8 (RD)

Objectives: There is a chance that the NASA DC-8 equipped with AIRSAR will fly over the SSA in June 1996. Primary objectives of DC-8 AIRSAR data acquisitions are to provide multifrequency, multipolarization SAR data for mapping above ground woody biomass, component biomass estimation (RSS-15), estimation of soil and canopy moisture (RSS-16) and phenologic event determination including freeze/thaw and leaf on/off (RSS-17).

Instruments: JPL AIRSAR - Three frequency (0.44GHz, 1.25GHz, 5.6GHz) quadpolarized synthetic aperture radar.

Mission Planning: Flights will be planned in advance with modifications required due to weather (e.g., heavy rain) coordinated between on-site investigators and air crews. During IFC-93, and 1994 FFC-T, IFC-1, IFC-2, IFC-3, the NASA/JPL AIRSAR collected data over both BOREAS sites and the transect in between. full area coverage was obtained and synoptic mosaics were also developed by JPL. As in 1994 the 1996 missions emphasize the tower flux sites and modeling grid areas. In addition, extra flightlines have been added to acquire data over areas burned by wildfires in 1995 near the SSA.

Table 5.2.2a
BOREAS-96 DC-8 AIRSAR Flight Time Estimates

June 1996	
Moffett Field to Saskatoon Local Saskatoon flights	= 2.50 hours
1 Mosaic of SSA modeling grids + transects (RD-MS, RD-BS,RD-TR,RD-MN)	= 6.20 hours
1 baseline (no transects) (RD-BS,RD-BN)	= 3.25 hours
1 Mosaic of SSA modeling grid + burn swaths (RD-MS,RD-FS)	= 3.00 hours (estimated)
Saskatoon to Moffett Field	= 2.50 hours

Mission Scenarios: The current 1996 flight schedule for DC-8 has the AIRSAR flying the continental US for a few days in June (probably 6/9-13/96). A piggy-back mission on an existing flight is the most likely possibility. The AIRSAR will arrive over SSA and fly TBD scenarios at 26000 feet altitude. Centerpoint or target illumination angles will be fixed at 43˚, except for separate lines flown at incidence angle of 25˚. Sufficient on-board quick-look products are to be generated to assure data quality. See Figures 5.2.2 for flight line maps. Time estimates of anticipated AIRSAR mission scenarios are provided in Table 5.2.2.a.

5.2.2.1 RD-MS: SSA Modeling Grid Mosaic

Fly SSA modeling grid site as north-parallel lines with headings of 124˚ or 304˚ with sufficient overlap that each strip is imaged with incidence angles between 30˚ and 60˚. (See flight lines SSA 124-n and SSA 304-n on Figure 5.2.2.a).

5.2.2.2 RD-MN: NSA Modeling Grid Mosaic

Fly NSA modeling grid as three parallel east-west or west passes with sufficient overlap that each strip is imaged with incidence angles between 30˚ and 60˚ (See flight lines NSA 117-n, 297-n on Figure 5.2.2.b).

5.2.2.3 RD-RT: Regional Transect

Fly remote sensing, transect parallel to AFM transect, acquire data between Old Aspen Site in SSA and Young Jack Pine in NSA. Be sure to acquire data over auxiliary sites near Flin Flon.

5.2.2.4 RD-BS: Baseline Radar Mapping, SSA

Fly two passes each over OBS, OA and YJP sites. (See flight lines, SSA-OA 268-1, SSA-OBS 92-1, SSA-OBS 271-1, SSA-Fen/SSA-OJP 161-1 and SSA-Fen/SSA-OJP 341-1 on Figure 5.2.2a).

5.2.2.5 RD-FS: 'Fire' lines, SSA

Two lines over burned areas north of SSA, close to intersection of Routes 106 and 913; line numbers SSA 124-1 through 125-5; and SSA 304-1 through 304-4, see figure 5.2.2.a.

5.2.2.6 RD-BN: Baseline Radar Mapping, NSA

Fly two passes each over OBS , OJP and YJP sites. (See flight lines Tower Flux 101-1 and Tower Flux 284-1 on Figure 5.2.2b).

5.2.2.7 RD-IS: Multiangle radar passes, SSA

Multiangle radar passes, SSA. Fly parallel passes over SSA TF sites (use baseline flight patterns) to acquire additional illumination angle of 25^o.

5.2.2.8 RD-DS: Predawn radar mapping, SSA

Predawn radar mapping, SSA. Fly two passes each over OBS, OA, OJP and YJP sites at illumination angle of 43^o. These flights to precede RD-BS or RD-MS flight in afternoon of same day.

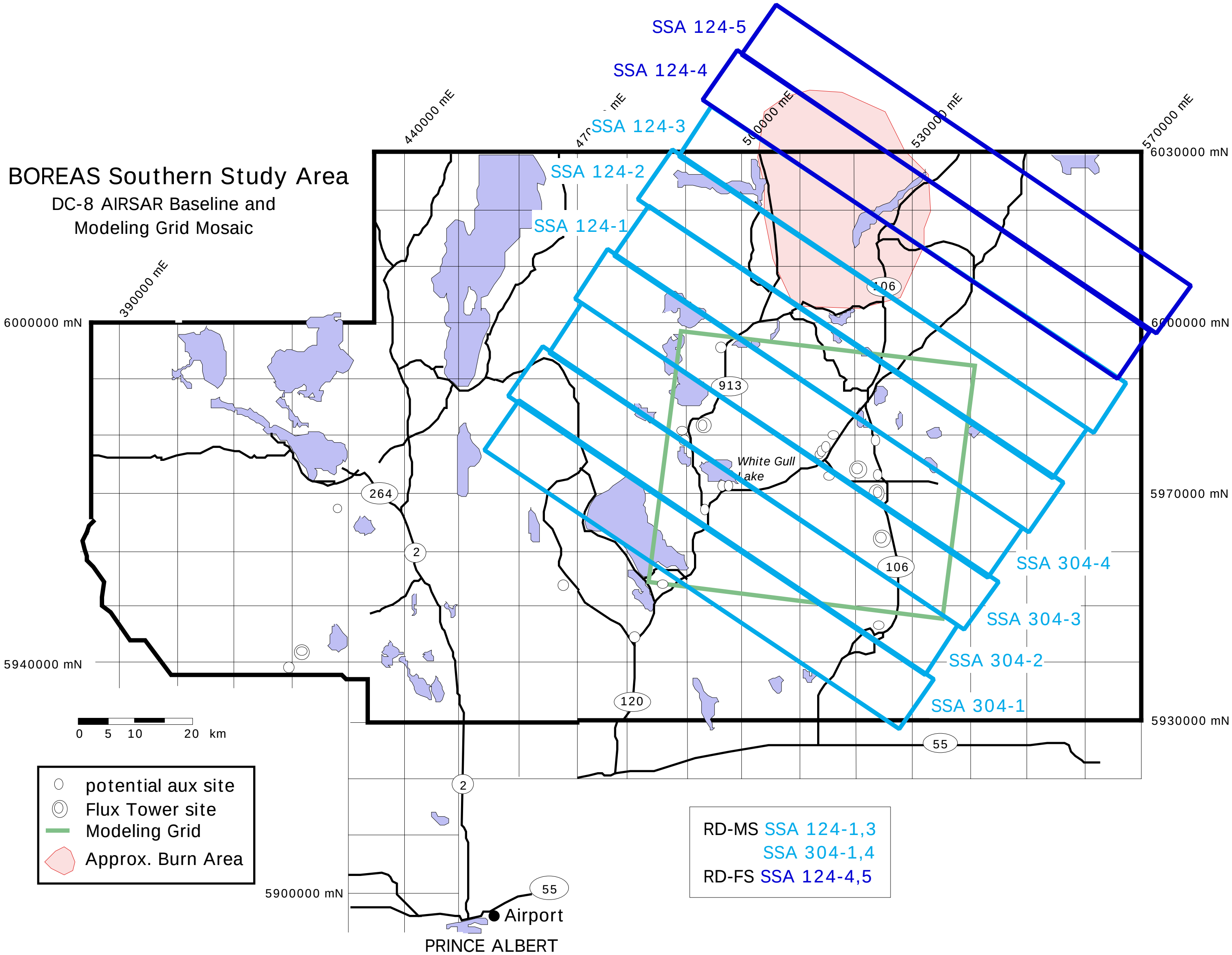

Figure 5.2.2.a DC-8 SSA, Modeling GRid Mosaic (RD-MS), Baseline (RD-BS), and "Fire" (RD-FS) Flight Lines.

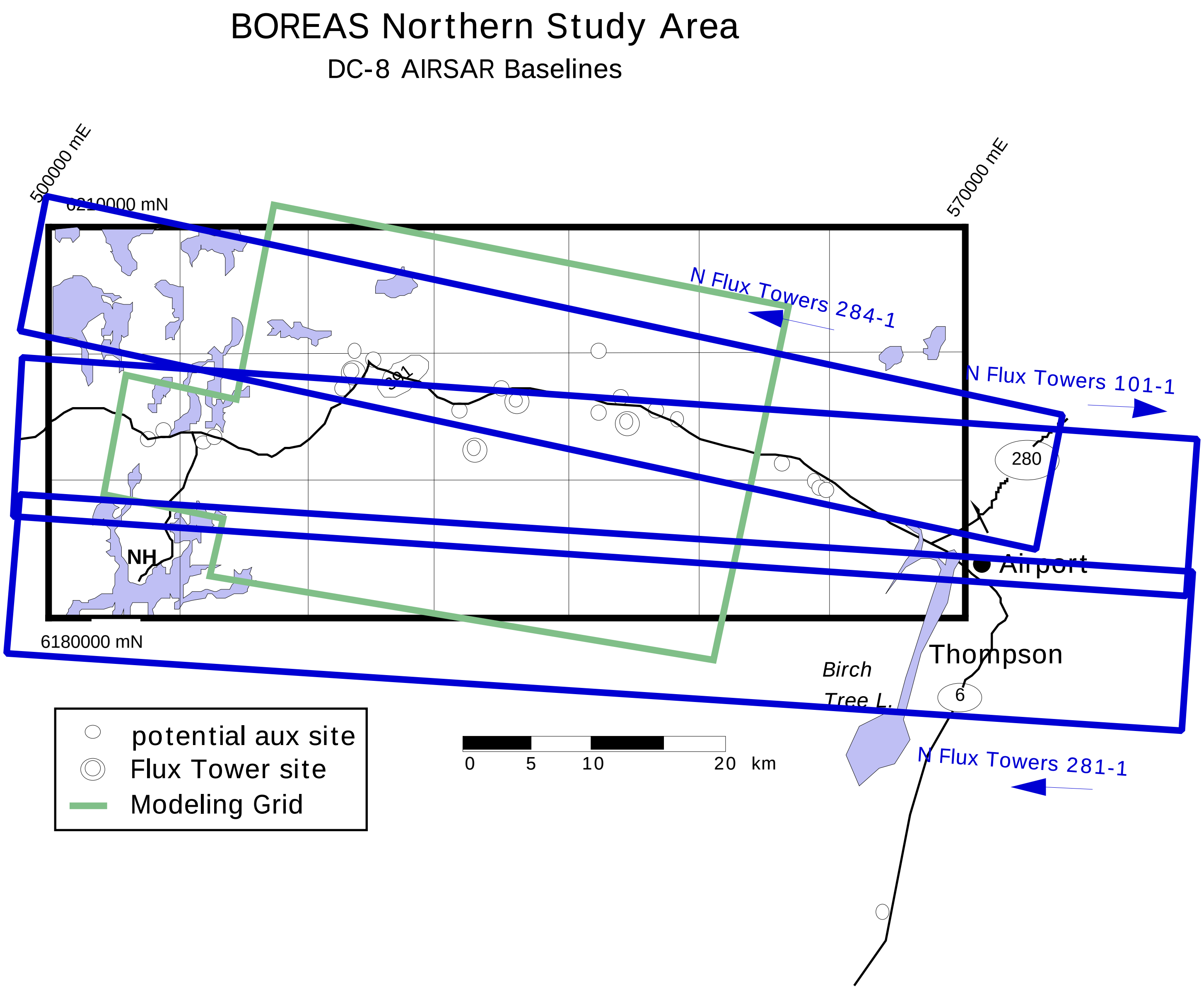

Figure 5.2.2.b DC-8 NSA, Modeling and Grid Mosaic (RD-MN) and Baseline (RD-BS) Flight Lines.

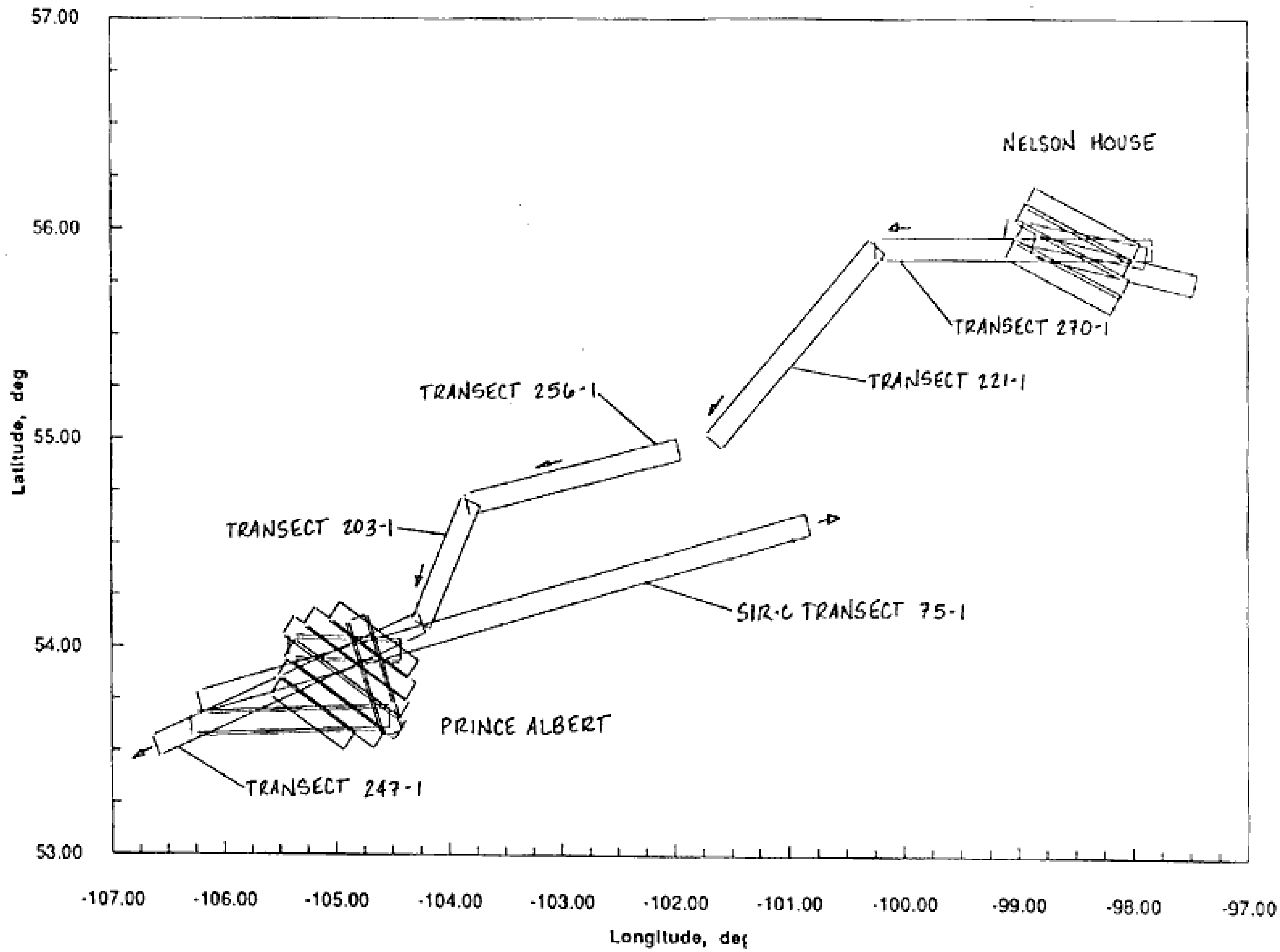

Figure 5.2.2.c Diagram of DC-8 flightlines including RD-RT and SIR-C/XSAR transect.

5.2.3 ER-2 (RE)

The ER-2 can carry the AVIRIS and/or MAS instruments. The AVIRIS data can be combined to simulate MODIS data out to 2.5 microns. The version of MAS available to BOREAS-96 will not have the blue band.

The missions and instrument combinations for the ER-2 in BOREAS-96 are given in table 5.2.3.

Table 5.2.3
ER-2 Missions for BOREAS-96

Field Campaign	Dates	Instruments	Primary Missions	Basing
FFC-W (One mission)	3/2-3/12	AVIRIS	RE-MS	Moffett (NUQ)
IFC-2 (Two missions)	7/31-8/20	AVIRIS, MAS	RE-MS RE-MN, RE-RT	Spokane (GEG)

Descriptions of all possible BOREAS-96 ER-2 missions are given in the subsections below.

5.2.3.1 RE-MS: Mapping of SSA

Partial AVIRIS mosaic coverage of the east and west portions of the SSA is planned (See Figures 5.2.5.2a and b) for FFC-W (see 3.6.3); complete coverage is planned for IFC-2. Note that lines I and J have been extended southwards since BOREAS-94. The areas will be flown in north-south strips. Flights are desired with a solar zenith angle of 60^o or better.

5.2.3.2 RE-MN: Mapping of NSA, Transect

In IFC-2, AVIRIS will be flown to get complete coverage of the NSA and portions of the transect (see RC-RT and Figure 5.2.5.3).

5.2.3.3 RE-SS: Snow over flights of SSA during single pass AVIRIS

Two flight lines were requested by Bert Davis (HYD-3) to cover snow conditions early in FFC-T in BOREAS-94. These lines are back-ups for BOREAS-96.

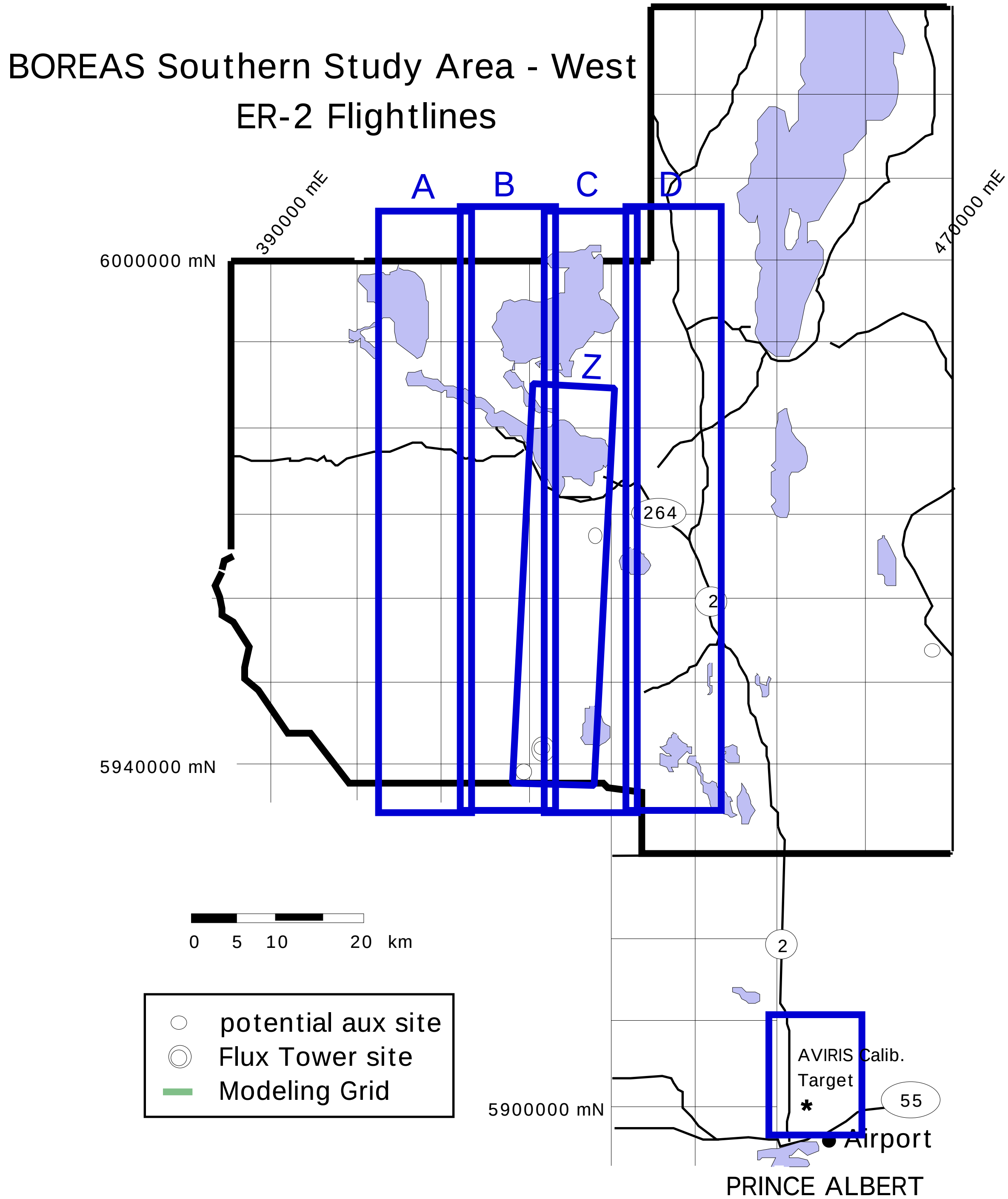

Figure 5.2.3.1a West SSA ER-2 AVIRIS flight lines (RE-SS, RE-MS, Davis)

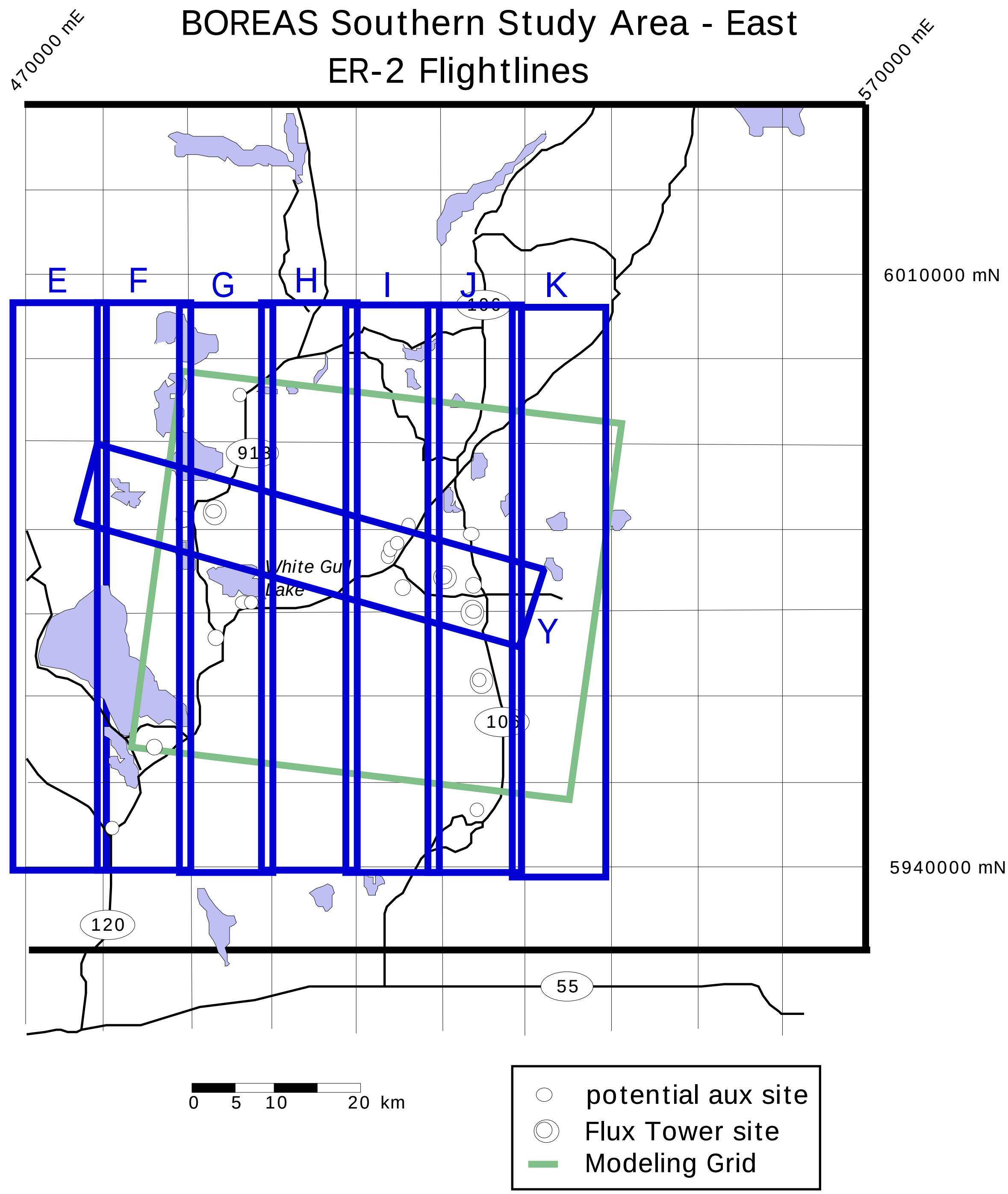

Figure 5.2.3.1b East SSA ER-2 AVIRIS flight lines (RE-SS, RE-MS, Davis)

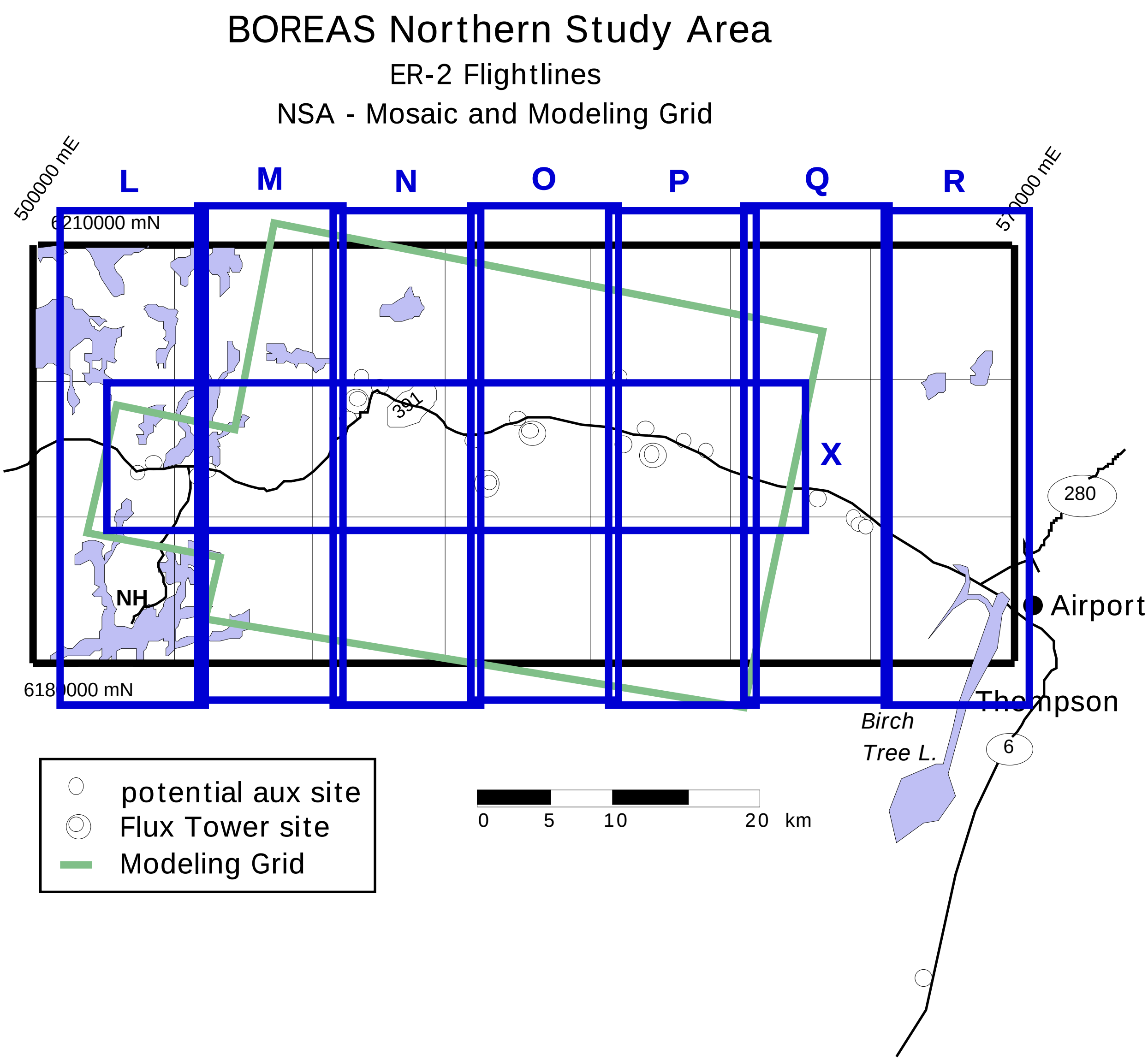

Figure 5.2.3.2 NSA ER-2 AVIRIS flight lines for NSA portion of RE-MN and RE-SN (Davis)

5.2.4 Chieftain (RP)

The Chieftain is equipped with the Compact Airborne Spectrographic Imager (CASI) which has upwelling and downwelling irradiance probes, track recovery monochrome video camera, GPS, pitch and roll gyro. CASI has been upgraded to 1m resolution.

Mission Planning: CASI missions will be flown in IFC-2 and will include (i) line image segments up to 20 km in length over auxiliary sites at both NSA and SSA, (ii) line image segments along the transect between study areas, across lakes at SSA, and (iii) multi-altitude and multi-view frame images over flux towers sites, calibration sites, and selected auxiliary sites at both NSA and SSA. Flight planning will be done by designated on-site RSS-19 team leader in conjunction with Chieftain Mission Manager and the aircrew. Missions will be finalized with BOREAS Operations (evening meetings). During IFCs, plans are to be finalized by BOG, generally the evening before the planned mission. Weather conditions will be used for go or no-go decisions, with clear sky conditions being the normal requirement but possible missions also under complete cloud cover with no precipitation. Similarly, weather conditions and forecast will be used to determine transect deployment.

Operations

Basing: 7/7/96 at YPA; transect flight to YTH;
7/15/96 base at YTH to 8/7/96

Flight Plans: Altitudes: 8000' agl., 5500' agl., 2000'agl., 500'agl.

(i) RP-TS Tower/Aux Sites - multi-view and nadir imagery
Priority (Hi-to-Low): OBS, OJP, OA, Ag. site, RSS-19 Cal. Site, YJP, Fen, Selected Aux. sites (nadir imagery only)
Coordination with PARABOLA and with ASAS, as feasible.

(ii) RP-TN - Tower Aux Sites, multi-view and nadir imagery
Priority (Hi-to-Low): OBS, OJP, OA, YJP, Fen, selected aux sites and burn sites (nadir imagery only)
Coordination with ASAS, as feasible.

(iii) RP-RT: Spatial Mode Nadir Imagery
Transect AFM. Modified ET transect AR-HR-KR-LR-MR-OR to be flown at 8000 ft AGL.

(iv) Tundra transect: a transect will be flown north out of Thompson into the tundra, most likely at 8000 ft AGL

The missions will be executed as follows:

- Pre-flight checks of instruments and aircraft, check-in with SAHQ one hour before scheduled take-off.

- Transit to sites and collect data along pre-selected mission flight lines, and/or multi-altitude mission over specific study sites (e.g., flux towers and calibration sites). Altitudes will vary from 500 to 10,000 feet agl.

- Flights may be scheduled under a variety of flight conditions since the aircraft will be flying VFR and will be in radio contact with SAHQ.

- Return to airfield, check in with SAHQ, and then review airborne imagery and do data tape backups.

5.2.4.1 RP-TS: Tower/Auxiliary Sites, SSA

At SSA there will be data collections which focus on (i) Flux Tower Sites, (ii) selected Auxiliary Sites, (iii) the RSS-19 Ground Calibration Sites, and (iv) Lake Image Transects. These are described below.

(i) <u>Flux Tower Sites</u>

(a) Multi-view BDRF Data - Hyperspectral mode (72 channels)
Multi-view imagery over each site @ 5500ft AGL at 3 solar azimuths (i.e. parallel to solar plane (+45˚, 30, 15, 0, -15, -30˚ view angles), perpendicular (+30, 0, -30˚ view angles) and at 45˚ azimuth to solar plane (+45˚ , 0, -30˚ view angles)
(Swath 800 m; pixels: 2 m x 8 m; 72 channels @ spectral resolution 7.8 nm).

(b) Canopy Biogeochemistry - Spectral mode (288 channels)
    (i) imagery in solar plan nadir viewing @ 5500 feet AGL
    (ii) imagery in solar plan nadir viewing @ 3800ft AGL to minimize effects of understory and constant pixel size compared to 5500ft
    (Swath 1024 m, pixels: 2 m x 12.7 m).

(c) Site Mapping: Spatial mode (15 MODIS channels 1-4; 8-18; Image collection in solar plane, viewing nadir
    (i) single pass @ 5500 ft agl directly over tower.
    (Swath 1024 m, pixels: 2 m x 3 m).
    (ii) three passes @ 2000 ft agl: directly over tower, displaced 300m to east of tower to provide anti-WAB coverage, and displaced 300m to west of tower to provide WAB coverage
    (Swath: 370 m; pixels: 0.8 m x 1.2 m).

(d) Direct PAR and Albedo - Hyperspectral mode (72 channels)

Hyperspectral imagery, nadir viewing, directly over tower site in solar plane @ 500 ft.
(Swath: 93 m; pixels: 0.18 x 8 m)

(ii) Auxiliary Site Imagery - Spatial Mode (15 MODIS channels: 1-4, 8-18) at selected auxiliary sites in solar plane, viewing nadir
(Swath 1024 m; Pixels: 2 m x 3 m)

(iii) RSS-19 YPA Airport Calibration Target: Hyperspectral mode (72 channels) multiple altitude passes (500, 1000, 3000, 5000 ft AGL) for atmospheric vertical profile.

(iv) Lake Image Transects - Hyperspectral Mode
For Waskesiu and Candle Lake - nadir viewing @ 5500ft AGL in fixes morning, noon or afternoon transect lines, selected for approximately solar plane alignment and overflights for TE-15 lake in-situ measurements
(Swath 800 m; Pixels: 2 m x 10.7 m; 72 channels @ spectral resolution 7.8 nm)

5.2.4.2 RP-TN: Tower/Auxiliary Sites, NSA

At NSA there will be data collections which follows that described for items (i) and (ii) of RP-TS.

5.2.4.3 RP-RT: Coverage of regional transect

Spatial Mode (15 MODIS channels: 1-4; 8-18) - nadir viewing @ 8000ft AGL along modified RT Transect
AR-HR-KR-LR-MR-OR
(Swath 1500 m; Pixels: 2.9 m x 4 m)

Image data collection on the remote sensing modified Rx-RT transect AR-HR-KR-LR-MR-OR (same as Figure 5.2.1.3) will be as follows:
Priority 1: Spatial Model, nadir-viewing @ 8000 feet agl. (Swath 1500 m; pixels: 2.9 m x 5.1 m)
Priority 2: Hyperspectral model nadir imagery @ 8,000 feet (Swath 1160 m; pixels: 2.9 m x 11.7 m).

5.2.5 Flight Plans for Flux Aircraft Operations

There will be only one 'true' flux aircraft in BOREAS-96; the Canadian Twin Otter (FT). The support aircraft 'Eyeball' (FB) will be equipped to measure CO_2 concentrations and will be used to characterize CO_2 profiles and transects.

The flux aircraft missions for BOREAS-96 follow the plans developed as part of BOREAS-94. The missions have been broken down into "generic" groups, with one or more specific flight designs per group. The groups and their abbreviations are listed in Table 5.2.5a.

Table 5.2.5a
Abbreviations for Flux Missions

Abbreviation	Mission Summary	Section
CS	Candle Lake runs	5.2.5.1
TS,N	Site-specific, multiple passes with relatively short runs, generally over TF sites	5.2.5.2
RT	Regional transects (SSA-NSA and beyond)	5.2.5.3
LS,N	Mini- or Meso-transects, covering greater variety at surface than TS,N	5.2.5.4
GS,N	Grids and stacks, together or separately PS,N - Budget box pattern	5.2.5.5
PS,N	Budget Box Pattern	5.2.5.6
HS,N	Stacks and Tees	5.2.5.7
FS,N	Flights-of-two (formation flights for intercomparisons)	5.2.5.8
ZS	Low-level routes (SSA)	5.2.5.9
VS,N	CO_2 Profiles	5.2.5.10
ES,N	Site/Wx recce; birddog	5.2.5.11

These missions are described in detail below. The following points apply to all the missions.

<u>Soundings</u>: Soundings by individual aircraft may be added to or included in many of the flight patterns described here. For example, soundings are needed just prior to patterns PS,N; GS,N; and HS,N in order to choose flight level and in VS, N in any case. The soundings will typically extend from near the surface to above the boundary layer, e.g., from 50 m to 2000+ m agl.

<u>Time-centered patterns</u>: Several of the patterns described (PS,N; GS,N) refer to "time-centered" sequencing. For example, if the pattern includes horizontal passes at three sequential altitudes 1, 2, and 3, then a time-centered flight would be 1-2-3-3-2-1 or 3-2-1-1-2-3. This allows removal of first-order changes with time in post-flight processing, with equal sampling at each level. For application examples, see Betts et al., 1990, Bound. Layer Meteor., 50, 109-137.

<u>Waypoints</u>: In many of the patterns waypoints will be given as letters, rather than with fully listed latitudes and longitudes, to avoid unnecessary repetition and to ease the task of editing and correction as the patterns evolve in the field, see Tables 5.2.5b and 5.2.5c.

5.2.5.1 Fx-CS: Candle Lake Runs

Objectives:
The mission profiles are shown in figure 5.2.5.1. This path was used extensively in BOREAS-94 as an SSA-scale transect which covers a variety of surface types. The path is included in several of the specific flight patterns, with the intent that it serve the additional purpose of helping tie the different aircraft platforms and different aircraft flight patterns together for purposes of analysis.

General:
Preferred weather is clear conditions, or at least late morning prior to ABL cloud development. Endpoints for the run could be either b-c, or extended to a-d (to cover a significant portion of aspen and black spruce), see table 5.2.5b. Pass a-d goes directly over the SSA-OA TF site. Pass 'a-d' takes 0-6 hours; pass 'b-c' takes 1-2 hours (FT). Altitudes vary but 20 m is a good average.

5.2.5.2 Fx-TS, Fx-TN: Site-Specific, Short Passes

Tables 5.2.5b and 5.2.5.2 contain endpoints and comments for these flight legs. Mission profiles are shown in Figures 5.2.5.2a and 5.2.5.2b. The objective is to compare aircraft and tower measurements, with aircraft coverage limited to a homogeneous area surrounding and representative of the TF site. Obviously this may restrict application to a subset of the TF sites. Footprint studies under varying wind directions, varying ground conditions, varying cloud cover, etc. with "ground truth" data near the center of the surface area.

TS,N-1:
Repeated, straight-line, constant-altitude passes, usually centered on a TF site. The length will depend on the site, as it should be as homogeneous as possible and representative of the environment being sampled by the tower. Lengths of 10 km have been discussed, allowing multiple repeats (reduction of sampling uncertainty) in reasonably short time intervals. The flight leg would typically be oriented cross-wind, if allowed by the surface cover. In some instances other orientations may be dictated by the extent of the surface cover. For 6 passes over a 10 km leg, including turns, approximate time is 0.38 h for FT.

TS,N-2:
Repeated, constant-altitude "+" pattern centered on a specific site (usually a TF site), with the legs oriented along- and cross-wind. Again, lengths of 10 km have been discussed, allowing multiple repeats (reduction of sampling uncertainty) in reasonably short time intervals. For 3 "+"s, with a reverse heading pass on each leg (12 passes total), including turns, approximate time is 0.9 h for FT. Again, the orientation of the flight legs will depend on the wind direction and extent of surface cover.

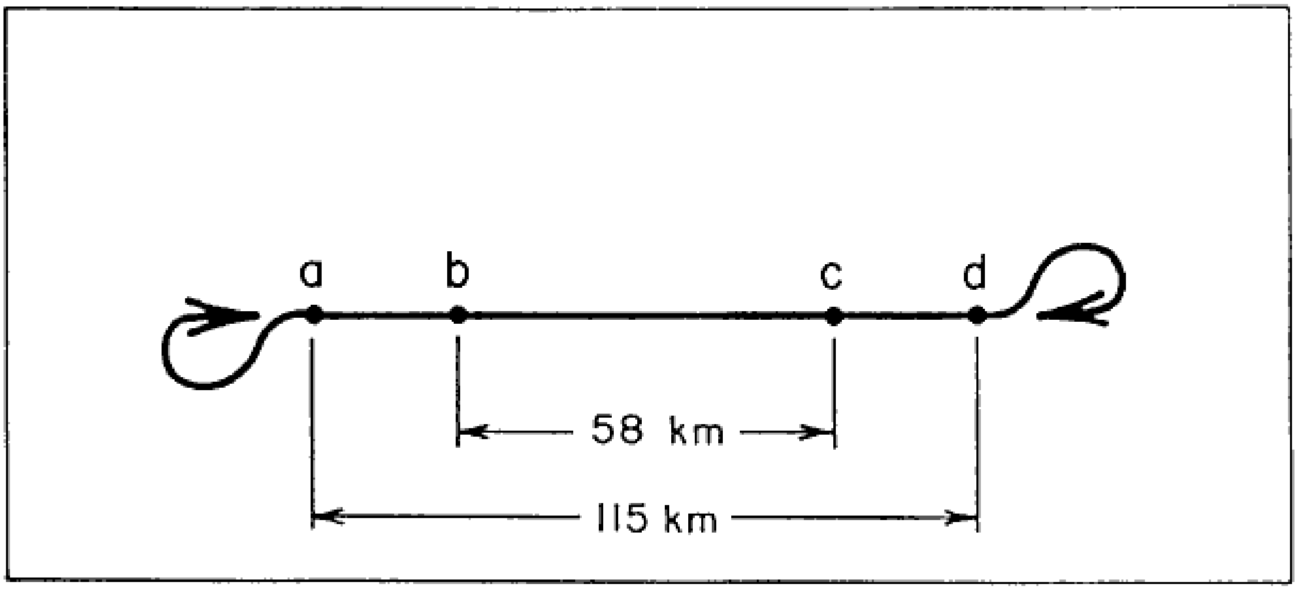

Figure 5.2.5.1: Fx-CS: Flux aircraft Candle Lake Runs

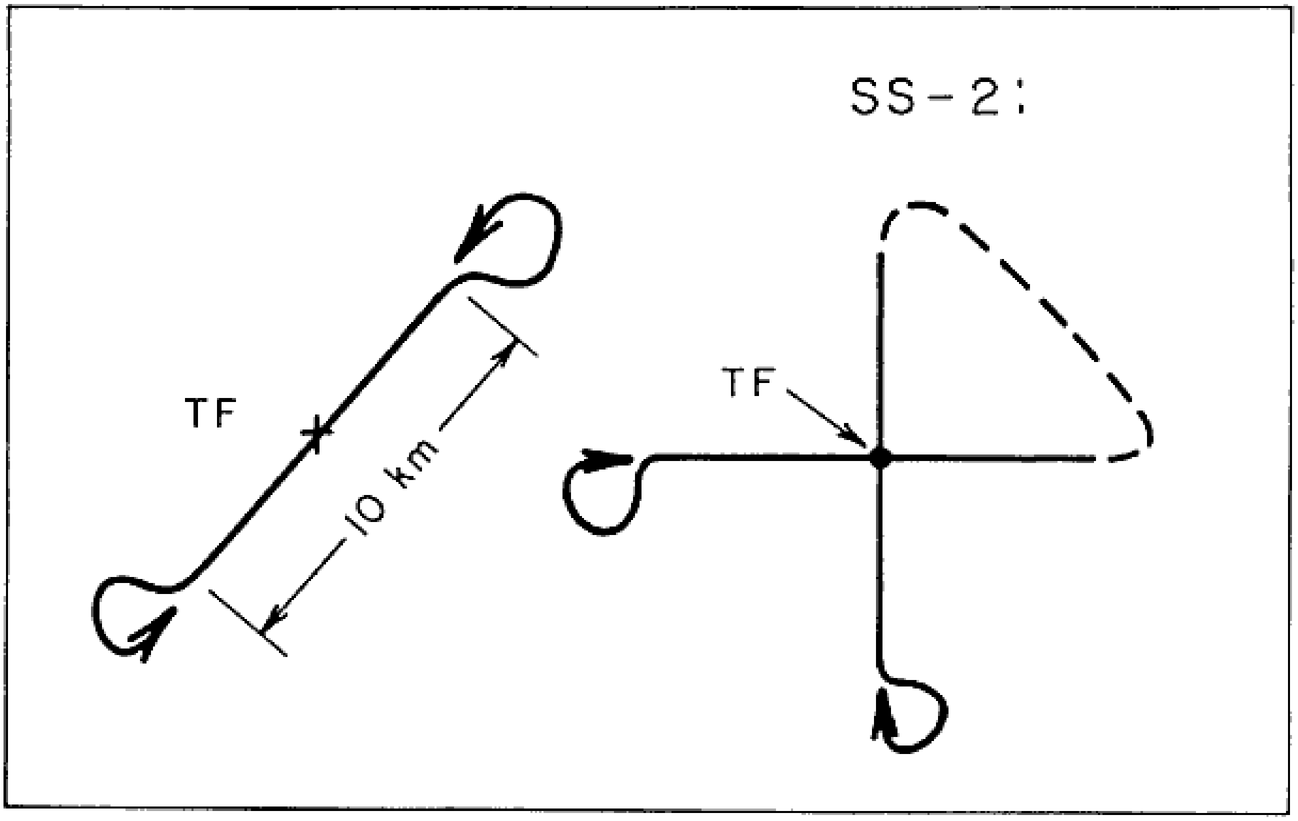

Figure 5.2.5.2a: Fx-TS, Fx-TN: Flux Mission, Site Specific (over a TF Site)

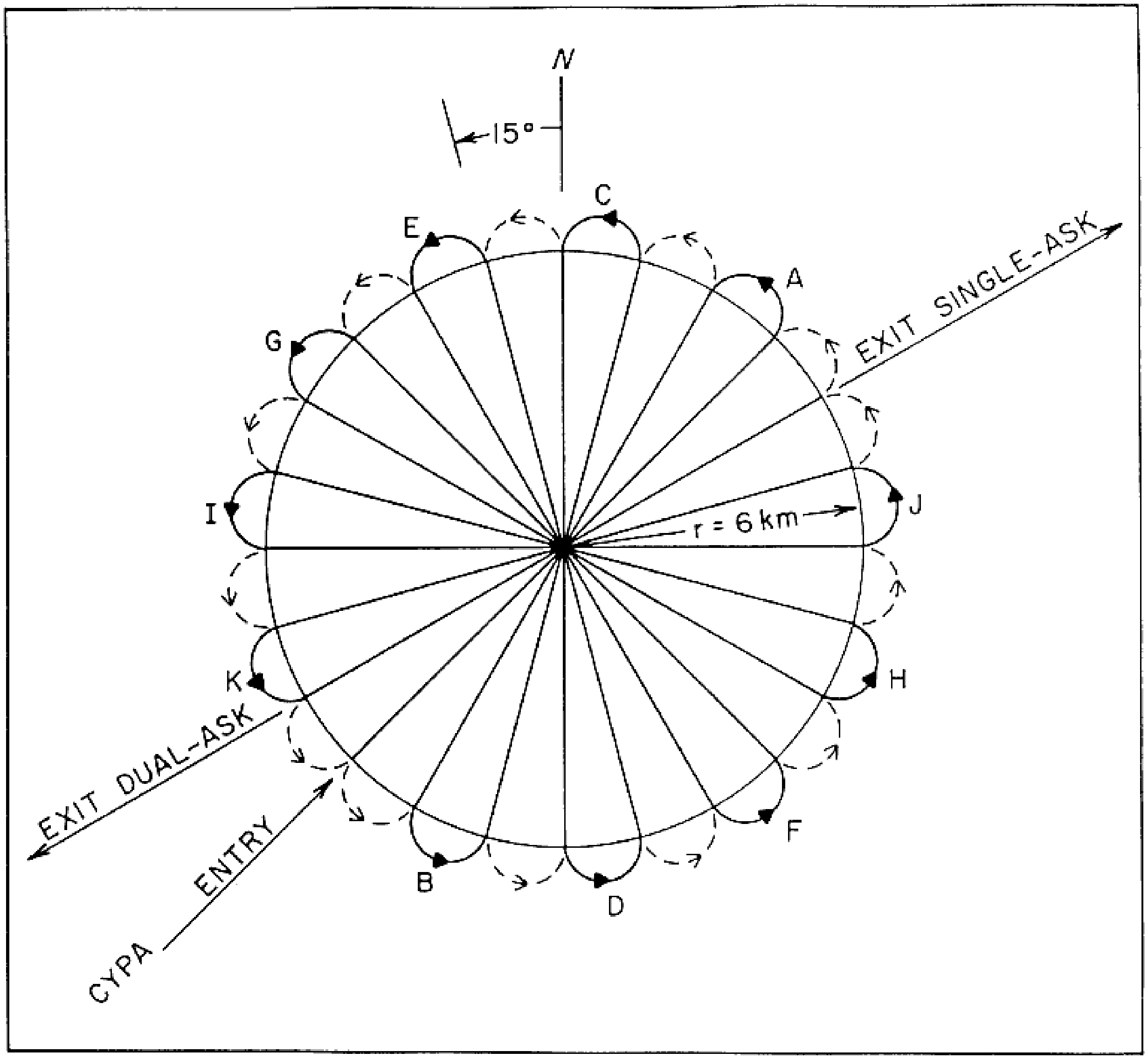

Figure 5.2.5.2b: **Fx-TS,N-3 and Tx-TS,N-4: Site-specific asterisk flux mission**

Table 5.2.5b
Flux Aircraft Waypoints

Pt.	Lat.	Long.
A	53d32.0'	106d34.0'
C	53d37.8"	-106d11.4' (same as PANP-OA)
G	53d55.6'	-104d59.7'
H	54d07.0'	-104d13.5'
K	54d41.7'	-103d47.5'
L	54d57.3'	-101d58.0'
M	55d54.8'	-99d07.5'
O	55d53.2'	-98d00.0'
P	60d30.0'	98d00.0'
Q	60d30.0'	-95d30.0'
R	59d00.0'	-95d30.0'
CH	58d44.5'	-94d04.0' (Churchill airport)
a	53d34.7'	-106d23.8'
b	53d42.8'	-105d52.0'
c	53d55.0'	-105d04.0'
d	53d59.0'	-104d47.2'
f	53d59.8'	-104d43.5'
g	53d32.0'	-104d27.6'
h	53d56.8'	-105d20.5'
i	54d03.7'	-104d45.5'
j	53d43.8'	-104d34.0'
k	53d35.8'	-106d18.0'
m	54d05.2'	-104d50.5'
n	53d32.2'	-104d19.5'
s	53d17.0'	-105d43.0'
t	53d38.0'	-105d43.0'
u	53d17.0'	-105d32.0'
v	53d43.0'	-105d17.0'

Coordinates used for the TF sites in preparing the aircraft paths and waypoints were:

N/S	Site	Lat.	Long.
N	OJP	55d55.8'	-98d37.2'
N	OBS	55d52.8'	-98d28.8'
N	Fen	55d55.2'	-98d25.2'
N	YJP	55d54.0'	98d17.4'
S	OA	53d37.8'	-106d11.4'
S	BS	53d59.4'	-105d07.2'
S	Fen	53d48.0'	-104d37.2'
S	OJP	53d55.2'	-104d41.4'
S	YJP	53d52.8'	-104d39.0'

TS,N-3
Asterisk pattern as illustrated, yielding 12 flight legs @ 12 km, crossing a central point at azimuth intervals of 15 degrees. Flight time about 1.5 hours.

TS,N-4:
Repeat TS,N--3 so that each azimuth is traversed along reversed headings, resulting in 24 flight legs @ 12 km. Flight time about 3 hours.

The waypoints used by flux aircraft in BOREAS-94 for several specific sites and areas are shown in Table 5.2.5.2. They are presented here as examples and/or candidates for TS,N-1 type runs. Note that all were established with LORAN-C and were refined with GPS and other information before and during BOREAS-94.

Table 5.2.5.2
Waypoints for Fx-TS,N Missions

	Waypoint 1		Waypoint 2		
Site	Lat.	Long.	Lat.	Long.	Comments
NSA-OBS	55°52.5'	-98°22.5'	55°52.4'	-98°34.0'	~12 km good sfc.
NSA-OJP	55°55.6'	-98°37.7'	55°56.6'	-98°36.2'	~3 km homog. veg.-doubtful for TN
NSA-Burn	55°49.7'	-98°19.4'	55°48.8'	-98°41.0'	~23 km burned with center spot OBS
NSA-Burn	55°49.7'	-98°19.4'	55°51.6'	-98°30.0'	~11 km, all burned
NSA-YJP	55°53.8'	-98°16.4'	55°54.2'	-98°18.8'	< 3 km, marg. for flux
SSA-OA	53°34.9'	-106°16.8'	53°38.4'	-106°09.6'	~11 km homogeneous vegetation
SSA-Fen	53°47.5'	-104°37.3'	53°49.6'	-146°37.8'	Only 4 km, but flown at lower altitude
SSA-OBS	53°59.0'	-105°08.2'	53°57.8'	-104°56.0'	14.5 km, mostly spruce, tower near west end
SSA-OJP	53°53.6'	-104°44.2'	53°56.0'	-104°39.5'	Only 6 km homog, so marginal for TS

5.2.5.3 FX-RT: Regional Transects

Objectives:
Measure trans-boreal gradients. Examine large variety of surface characteristics, stemming from vegetation, land type (dry, bog, lake), land use (primitive, logged, burned), all with application to scaling up and down across the range of scales to be sampled in BOREAS.

RT-1:
Waypoints as follows:

This transect was designed by and often used by the NCAR Electra (FE) in BOREAS-96, see figure 5.2.5.3.

Near Sask-A-(SSA-OA)-(abcd)-H-K-L-M-O-tundra

An abbreviated version (waypoints 'A' through 'O') was used during inter-study area ferries by the other flux aircraft.

This pattern cuts across SSA along the Candle Lake (CS) path, directly across the SSA-OA TF site, then turns northerly at a point east of the Narrow Hills Park, and passes directly through NSA very close to all four TF sites. The length A-O is over 700 km. These waypoints are referred to as "big Alpha", "Big Bravo", etc.

5.2.5.4 Fx-LS, Fx-LN : Mini-/Meso-Scale Transects and L-shaped Patterns

Objectives: Flight plans for the LS,N patterns are shown in Fig. 5.2.5.4. These paths were designed in BOREAS-94 to be long enough to cover a variety of surface characteristics (like the CS run), e.g., over various TFs and along segments covered by other flight plans (like the Electra Transects), but over "short" enough distances to be sampled several times and/or be moveable, to take advantage of what we learn about ground cover, land use, seasonal changes, etc. These patterns are ideal for footprint studies, where we examine flight-level vs. surface variability to understand the surface sources and their integration/mixing in the atmosphere. They will also be used to examine flight-level flux variability under changing degrees of cloudiness and changing cloud positions.

General: Flight levels will range from about 50 m to the top of the ABL.

Note: Waypoints here are given as lower case letters. The corresponding latitude and longitude values are contained in the table at the start of this section. In radio communications, these waypoints are referred to as "little Alpha", "little Mike", etc.

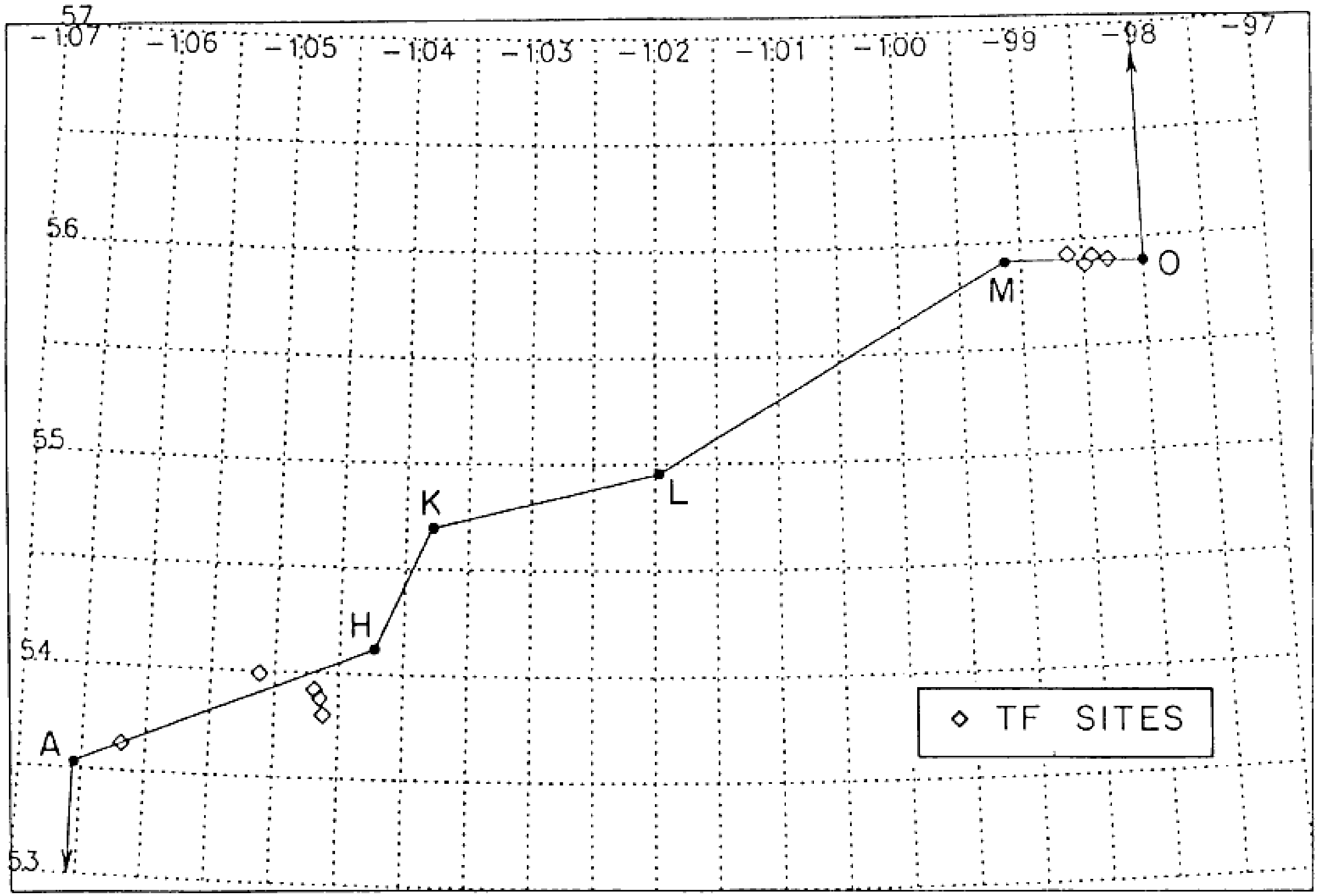

Figure 5.2.5.3: FE-RT: Electra Regional Transect

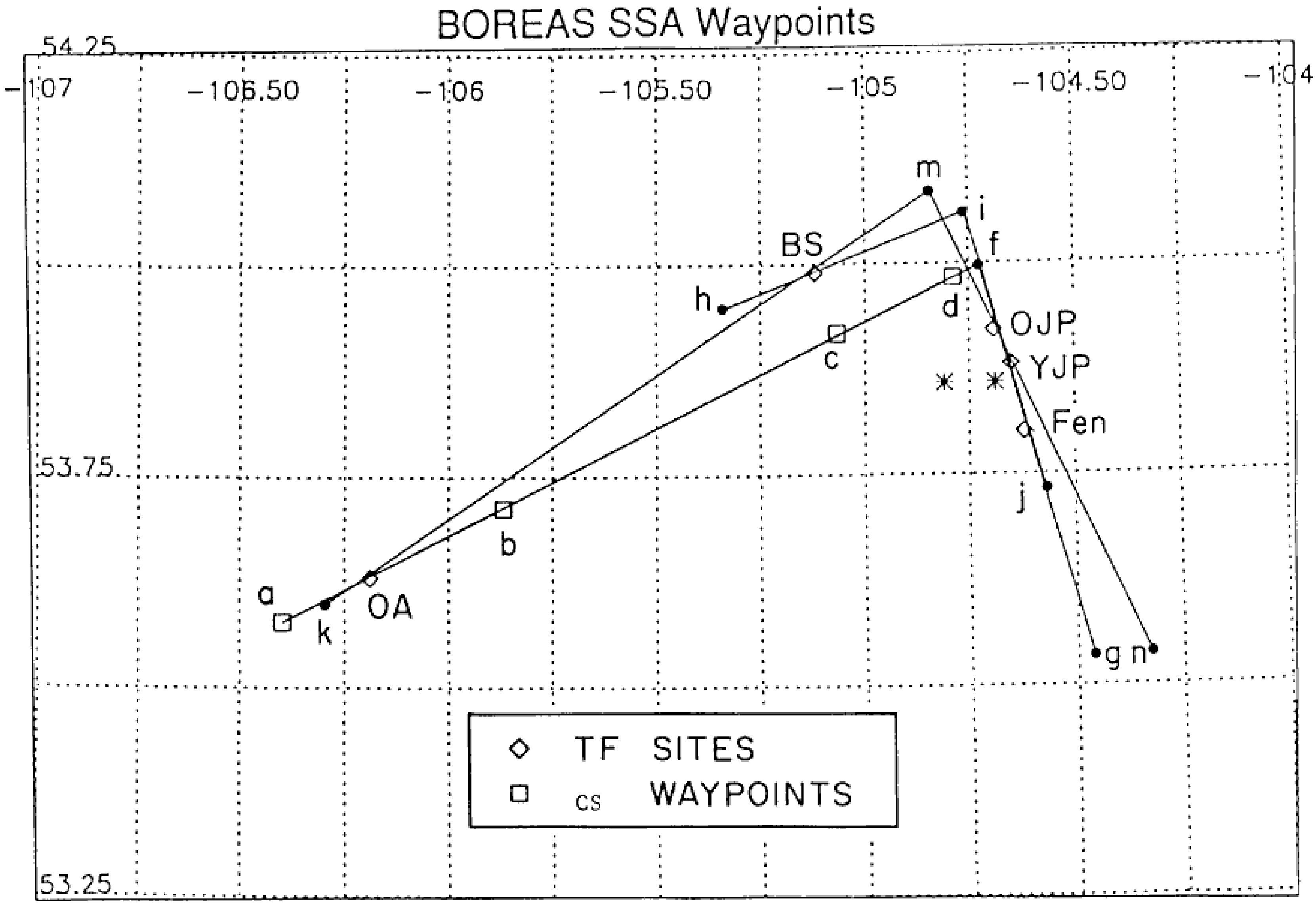

Figure 5.2.5.4: Fx-LS, Fx-LN: Mesoscale Transects.

LS,N-1: In the SSA, this is designed to cover a transect similar to CS and pass close to or over three TF sites (OJP, YJP, Fen) as an "L". Total length is about 180 km. One-way flight time, including turns, is about 1.0 h for FT.

LS,N-2:
Designed as path h-i-j, which passes over or near four of the SSA TF sites (OBS, OJP, YJP, Fen). Total length is about 80 km. One-way flight time, including turn, is about 0.37 h for FT.

LS,N-3:
Designed as path k-m-n, which passes over the SSA TF sites OA, OBS, OJP, and YJP and not too far from the Fen site, as an "L". Total length is about 180 km. One-way flight time, including turn, is about 0.9 h for FT.

LS,N-4:
Path from near Prince Albert airport to area near the OA TF site, using waypoints s and t (lower case). Intended as a site-entry path into the western part of the SSA, it should provide a good sample of the agriculture/agriculture + forest pattern of the southern boreal forest "boundary." The path length is about 39 km (0.2 h for FT).

LS,N-5:
Another site entry, from near Prince Albert airport to the center of SSA near Candle Lake, using waypoints u and v (lower case). Again, this is intended to provide a sample of the ag/forest transition. The path length is about 52 km (0.3 h for FT).

LS,N-6:
Generic "L", with coordinates chosen for desired targets.

LS,N-7:
Generic straight line pass (transect), with coordinates chosen for desired target.

5.2.5.5 Fx-GS, Fx-GN: Grid and Stack

Objectives:
Mission plans are shown in Figure 5.2.5.5. Measure horizontal and vertical gradients simultaneously, e.g., for ABL budget studies, by using two aircraft. Mapping aerial heterogeneities, to examine correlations between flight level and surface variations (re: footprints, modeling, scaling). In BOREAS-94, the AFM-4 team used tower-released tracer (sampled by aircraft in stack) to examine over-forest diffusion in conditions of different ABL stability. Very relevant to footprint studies.

General:

The patterns will be oriented North South or East-West, parallel or orthogonal to lines of latitude and longitude. The FT grids are patterns of nine parallel lines flown at 100' agl, 2 km spacing covering an area of 16 x 16 km. The area enclosing the grids (North-South lines shown only) are shown in figures 5.2.5.5a for the SSA and 5.2.5.5b for the NSA. Grid centerpoints are given in Table 5.2.5.5.

Aircraft	Study Area	Latitude	Longitude	Grid Type
FT, FL	SSA NSA	53˚ 51.5' 55˚ 52.5'	104˚ 41.25' 98˚ 31.5'	16x16 km 9 lines 2km spacing 100' agl
FK (BOREAS-94)	SSA NSA	53˚ 51.5 55˚ 52.5	104˚ 48.6' 98˚ 31.5'	32x32 km 9 lines 4 km spacing 200' agl

Table 5.2.5.5 Grid locations (center points) and location for flux aircraft in BOREAS. Note that the FK lines coincide with alternate FT, FL lines (see also figures 5.2.5.5a, b).

Figure 5.2.1.5.5c shows a grids and stacks flight pattern. In BOREAS-96, this was sometimes performed using two flux aircraft, one for the grid and one for the stacks.

5.2.5.6 Fx-PS, Fx-PN: Budget Box Patterns

Objectives:
Mission profile is shown in Figure 5.2.5.6. Gain estimates of all dominant terms in the ABL budget equations for scalar quantities, to examine degree of closure, degree of error, and relative importance of advective and flux divergence processes.

General:
Best flown with stack lines on box sides normal to mean wind. Covers flight levels from 50+ m to 1000+m. Operational conditions that should be met for this pattern include: clear skies, or at least radiationally uniform skies, steady winds (speed < 10 m/s, steady direction), no fronts or thunderstorms near the project area, TF sites fully operational.

Times:
If box is 30 km on each horizontal side, and the pattern is flown with 4 levels in complete time-centered fashion (up, across, down, up, back, down), the total distance is about 540 km plus turns. Estimated time is 3+h for the FT.

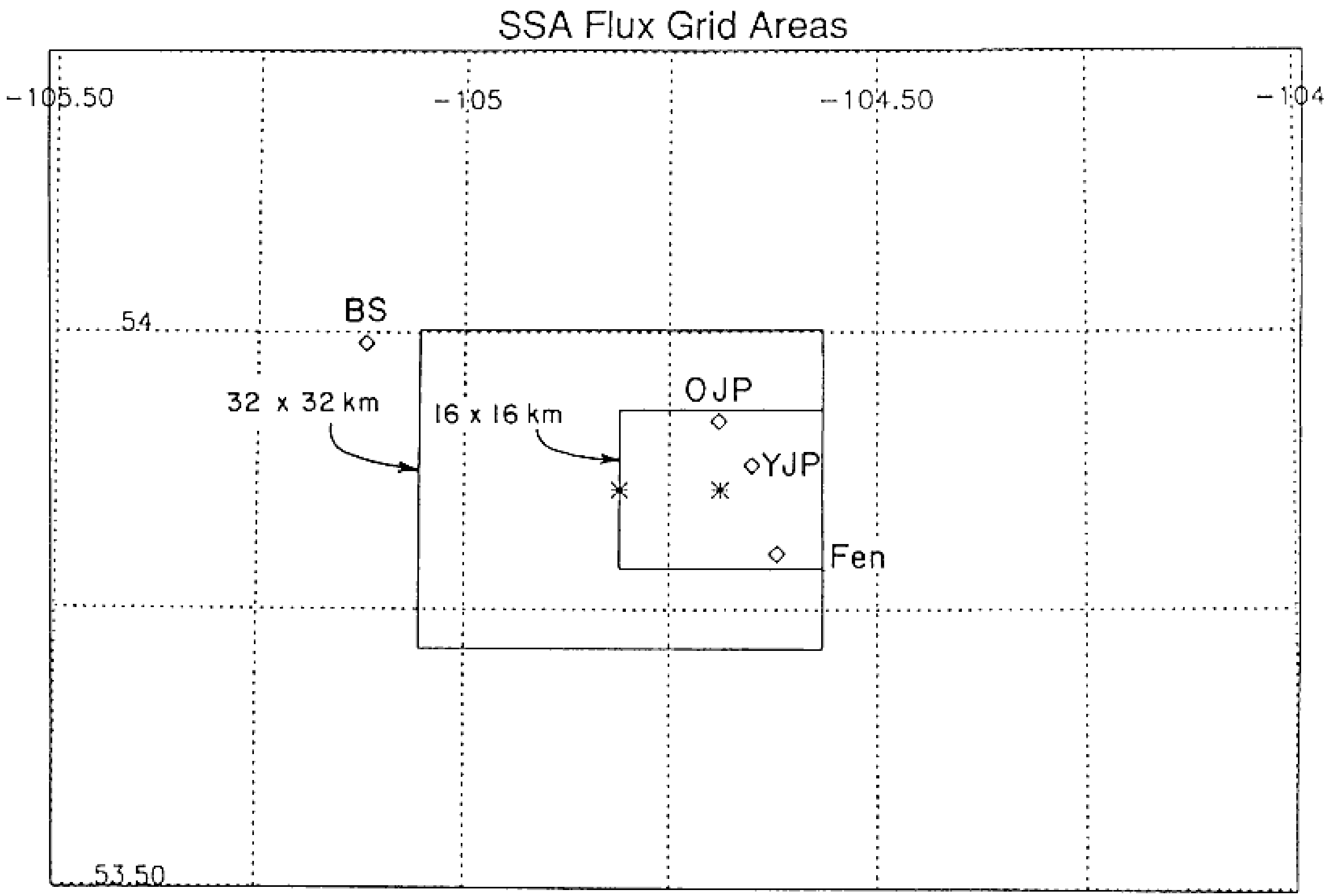

Figure 5.2.5.5a: Fx-GS: Grid patterns flown by FT, FL (small pattern) and FK (large pattern) in the SSA.

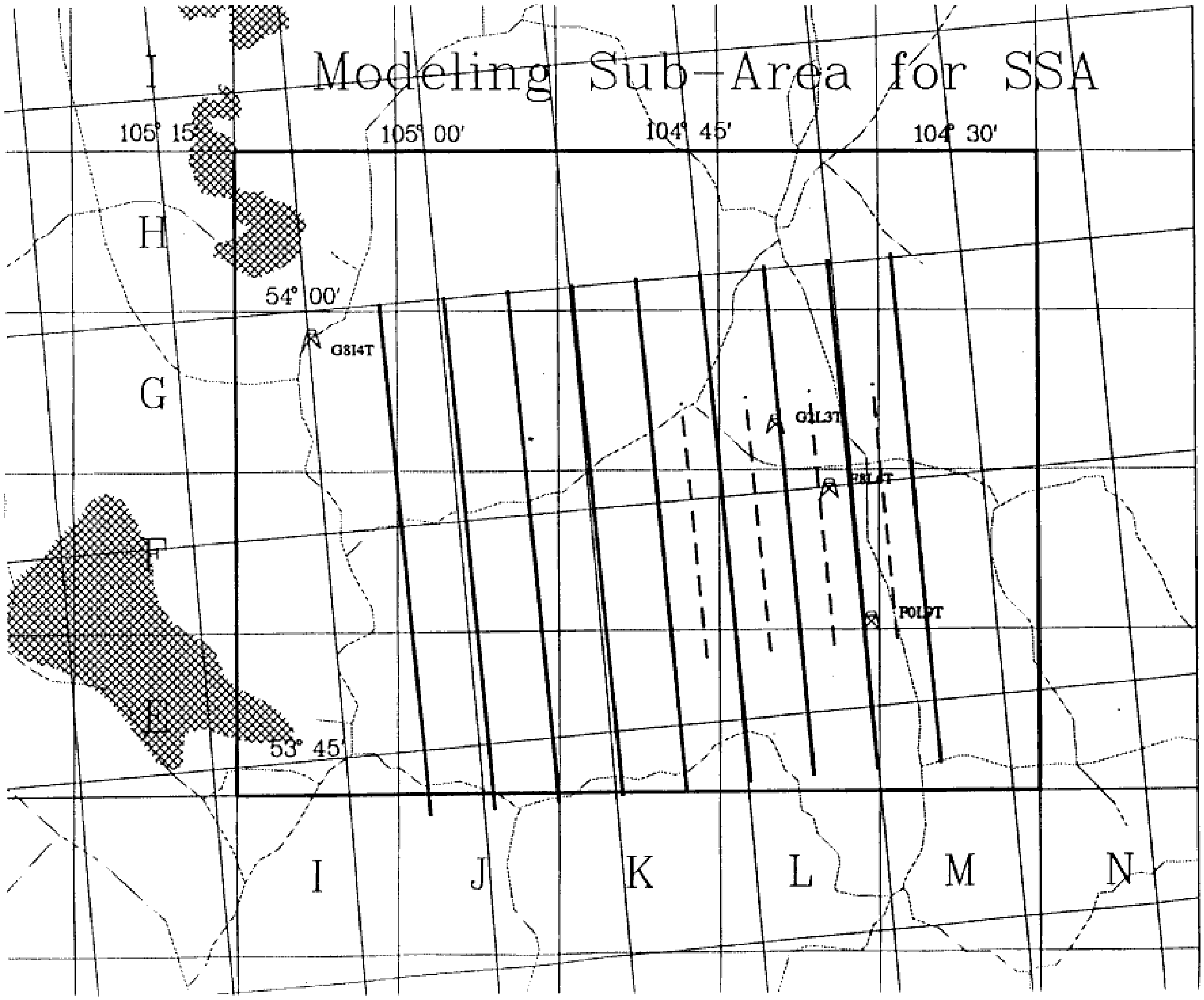

Figure 5.2.5.5a: Fx-GN: Grid patterns flown by FT, FL (small pattern) and FK (large pattern) in the SSA (cont.).

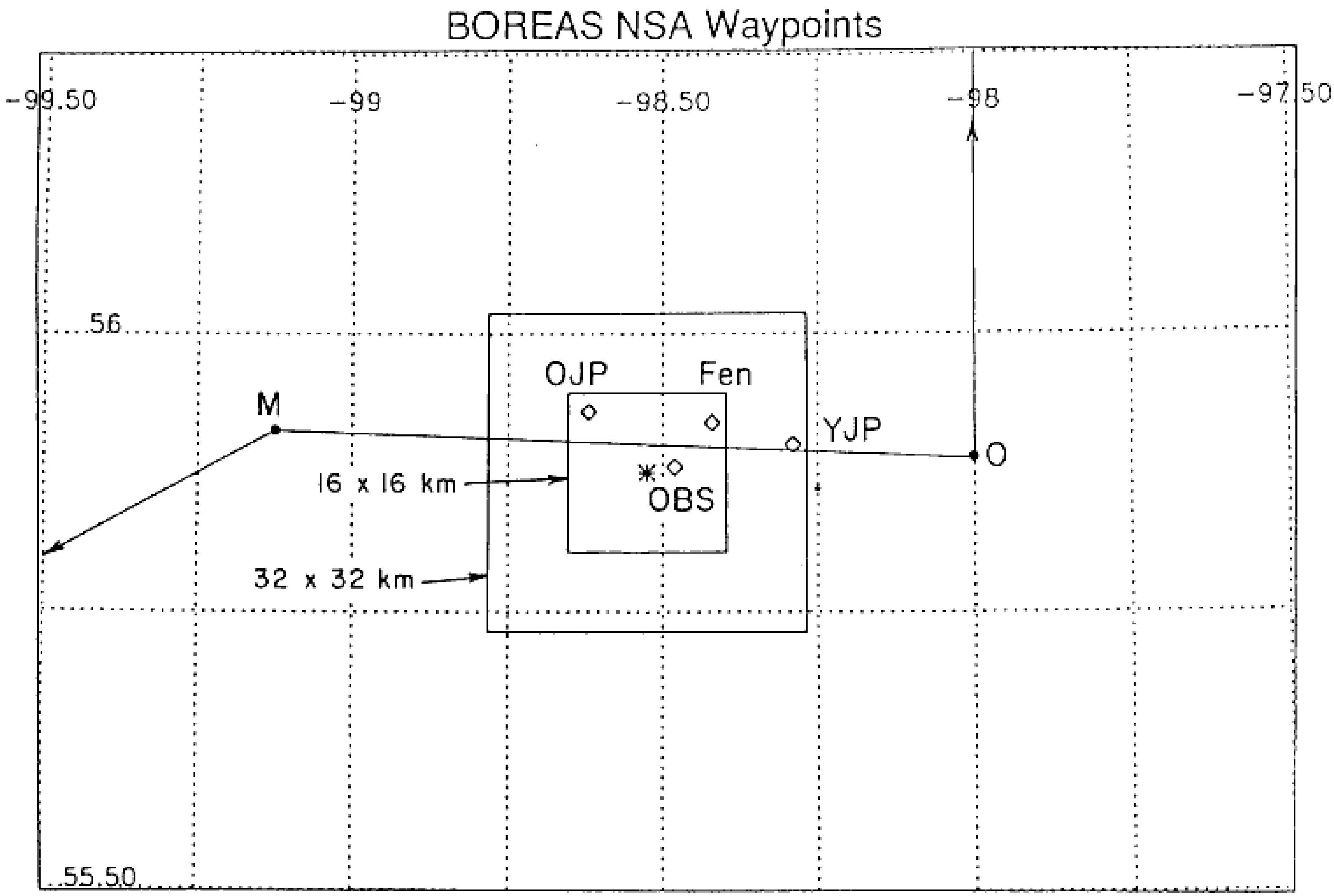

Figure 5.2.5.5b: Fx-GN: Grid patterns flown by FT, FL (small patterns) and FK (large patterns) in the NSA.

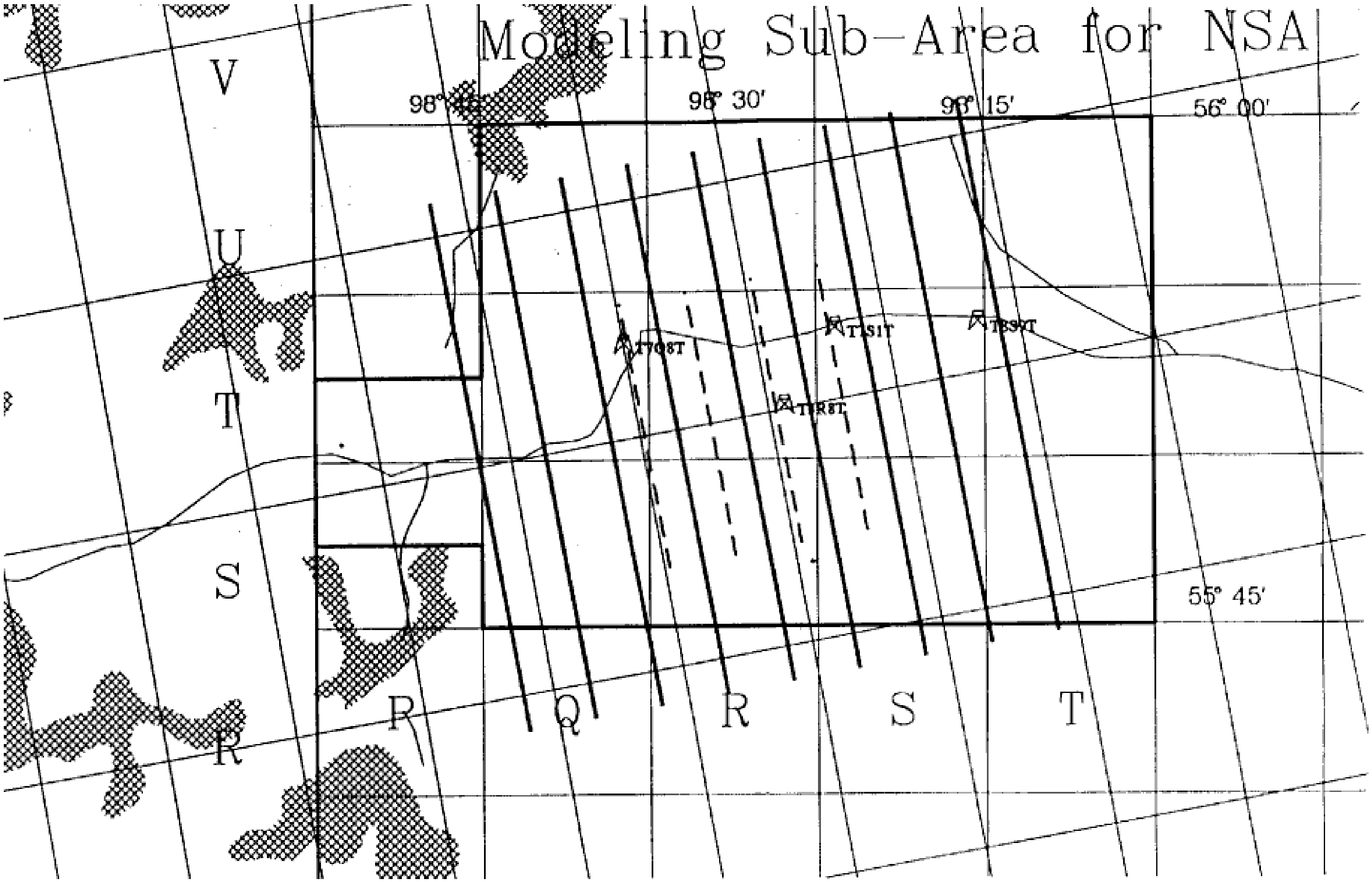

Figure 5.2.5.5b: Fx-GS: Grid patterns flown by FT, FL (small patterns) and FK (large patterns) in the NSA (cont.)

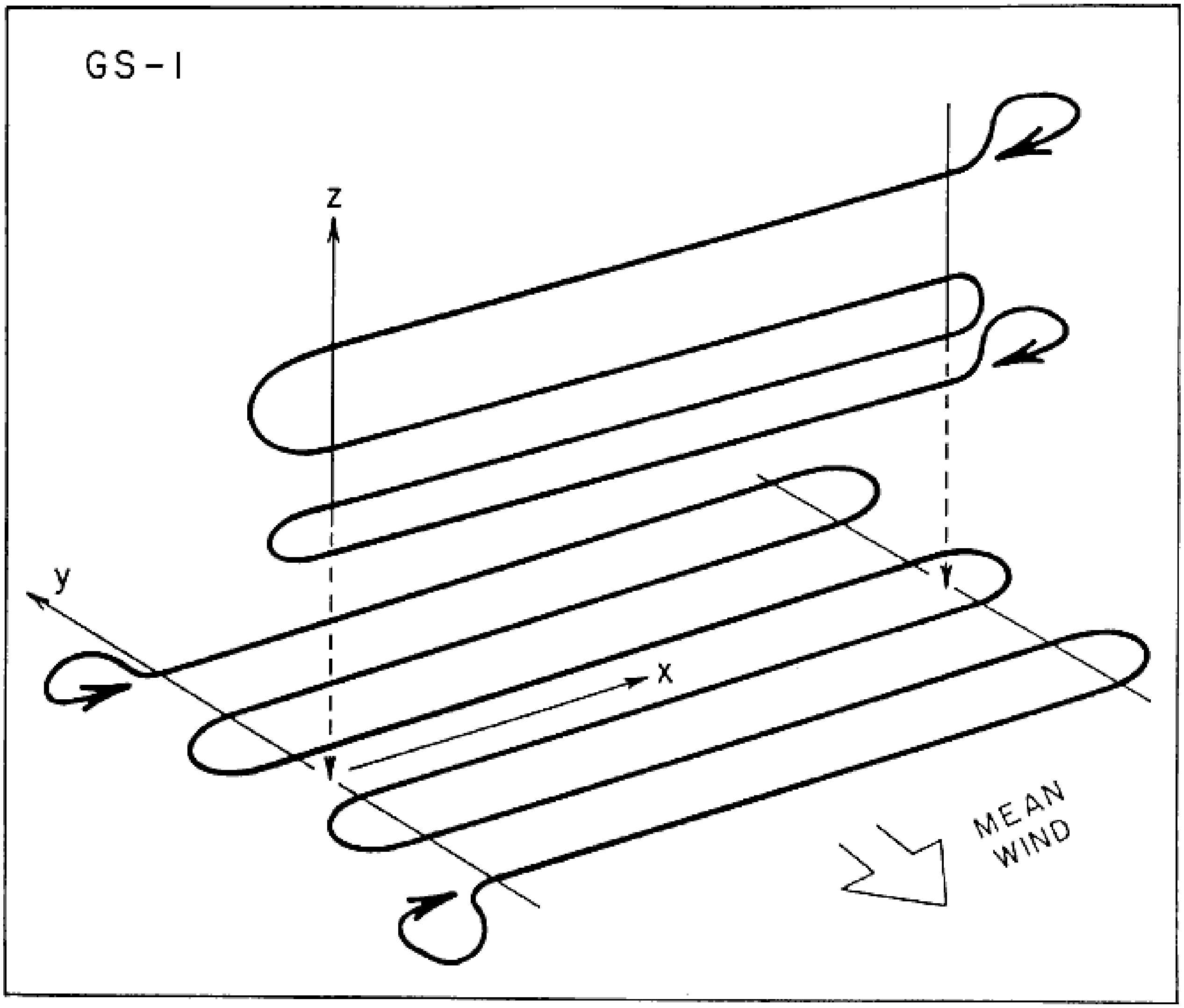

Figure 5.2.5.5c: Fx-GS and Fx-GN: Flux Aircraft Missions; Grids and Stacks

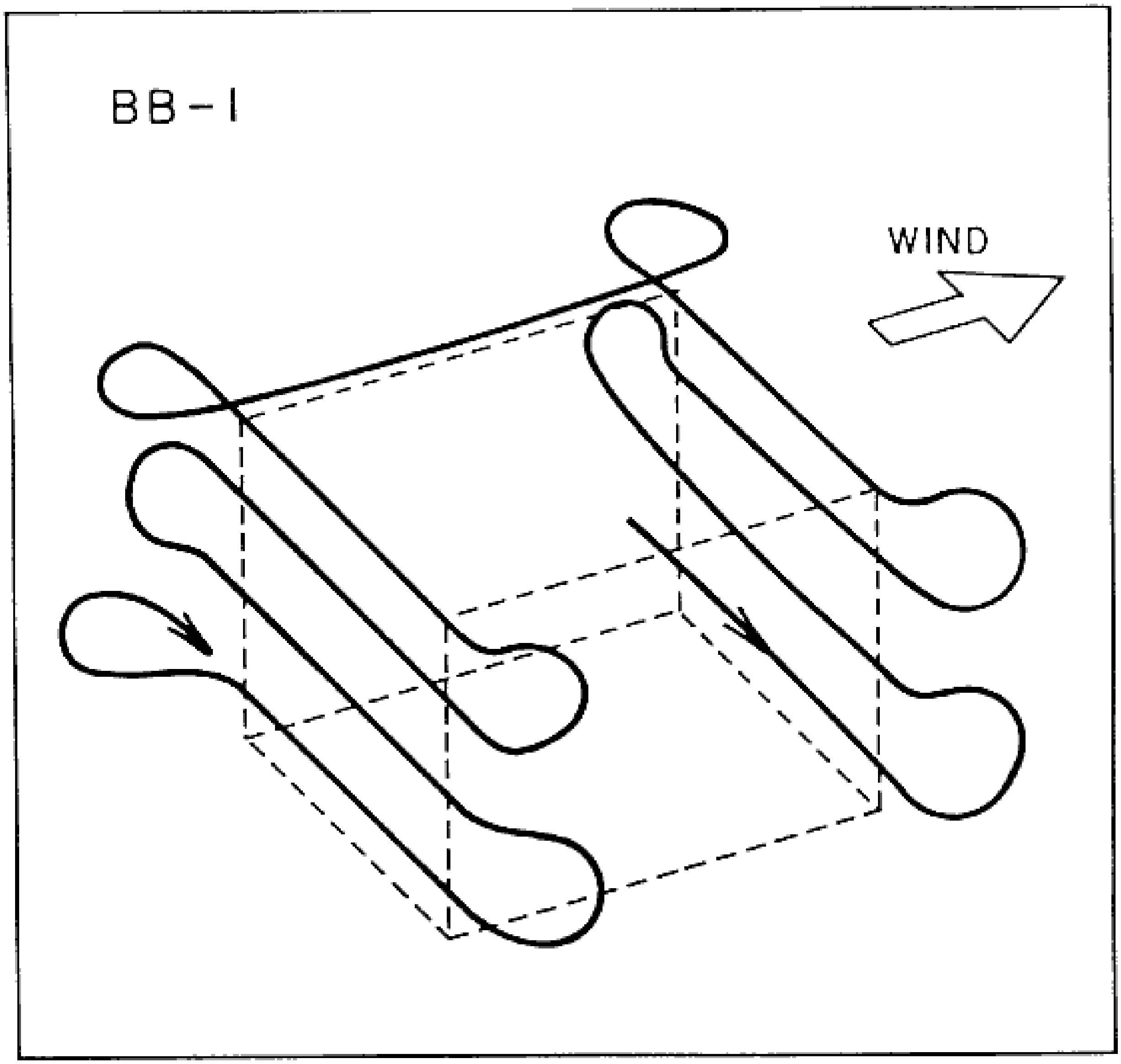

Figure 5.2.5.6: Fx-PS, Fx-PN: Flux Aircraft Mission, 'Budget Box Patterns'

5.2.5.7 Fx-HS, Fx-HN: Stacks and Tees

Objectives:
Mission profiles are shown in Figures 5.2.5.7. Gain estimates of all dominant terms in the ABL budget equations, to examine degree of closure, degree of error, and relative importance of advective and flux-divergence processes.

General:
Best flown with stack lines on box sides normal and parallel to mean wind. Covers flight levels from 50+ m to 1000+m

Times:
If pattern is 30 km on each horizontal side, and is flown at 3 levels in time centered fashion (up "L"s then down "L"s), the total distance is about 360 km plus turns. Estimated time is 2.4 h for the FT.

HS,N-1:
A stack of "L"s, flown time-centered, as illustrated.

HS,N-2:
A stack of "+"s or "T"s, flown time-centered, as illustrated. One disadvantage to this pattern is the extra time spent traversing between the points of the "+".

5.2.5.8 Fx-FS, Fx-FN: Flights-of-Two

Objectives:
Valuable wing-to-wing intercomparisons between the flux aircraft. Vital for quality control and error assessment.

General:
Sites, altitudes, patterns flexible, but chosen whenever possible to coincide with patterns already defined and in use.

FS,N-1:
Wing-to-wing, preferably along paths parallel to then normal to mean wind, with reverse-heading passes in each case. Also desirable to have more than one altitude. In BOREAS-94, the only practical combinations for this pattern, due to the wide range of airspeeds, were FL+FT, FT+FK and FK+FE. In BOREAS-96, this will be done with FT+FB for CO_2 concentration comparisons.

FS,N-2
Successive runs by two aircraft down the same flight path(s),in quick succession. This may be demanded by flight safety for cases of low altitudes, speed mismatches and turbulent conditions.

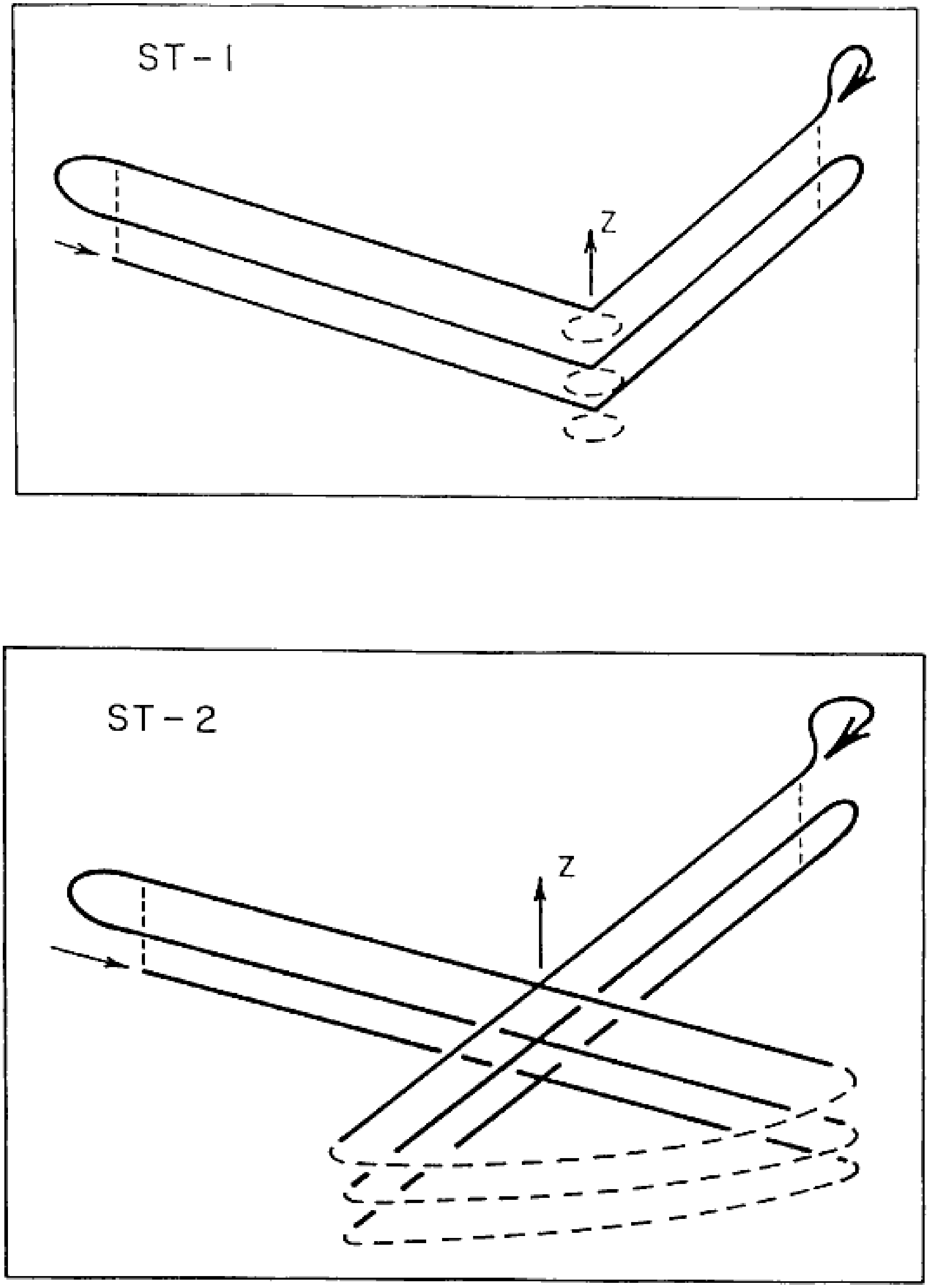

Figure 5.2.5.7: Fx-HS, Fx-HN: Flux Aircraft Mission, 'Stacks and Tees'

5.2.5.9: Fx-ZS: SSA Low-Level Route

A low-level route has been laid out between the Prince Albert area and the southern part of the SSA, see Figure 5.2.5.9. This route is designed to provide a long run over agriculture, ending in a forested area. The route avoids settlements and heavy livestock-raising areas and was flown many times in BOREAS-94 at low altitude (FT). Letters have been sent to over 100 landowners living under or near the route; aircrews will be notified immediately if any complaints filter back to BOREAS.

Flux aircraft teams must be careful about using this route. Please use the following precautions:

- Announce route entry and exit.
- One-way traffic in a route at any given time.
- Notify Ops of any new obstructions or areas of dense livestock near the route.

5.2.5.10. Fx-VS,N: CO_2 profiles

The flux aircraft will carry out soundings to provide CO_2 profile and transect information. These should be done near the midday period (preferably early afternoon) and will include runs past an active TF site, at tower-top level, to provide a comparison with the in situ measurements. The sounding should extend to above the ABL cloud layer, or 10000', whichever is greater. Figure 5.2.5.10 shows the scheme flown by FB in FFC-W. The first sounding to 10000' was carried out over a TF site (SSA-OBS in FFC-W). This was followed by a 50 nm transect upwind and another sounding. After a return to the TF site, another sounding is performed followed by low-level passes near the tower. Then, the aircraft flies downwind to catch up with the airmass sampled in the first sounding, and carries out a fourth sounding. The time for this mission is about 3.2 hours for FB in the SSA.

5.2.5.11 FB-ES,N: Site recce, forward air traffic/birddog

The 'Eyeball' aircraft is primarily used for supporting experiment operations, such as site reconnaissance and birddog-type work, i.e. scoping out weather conditions over the site prior to committing other research aircraft.

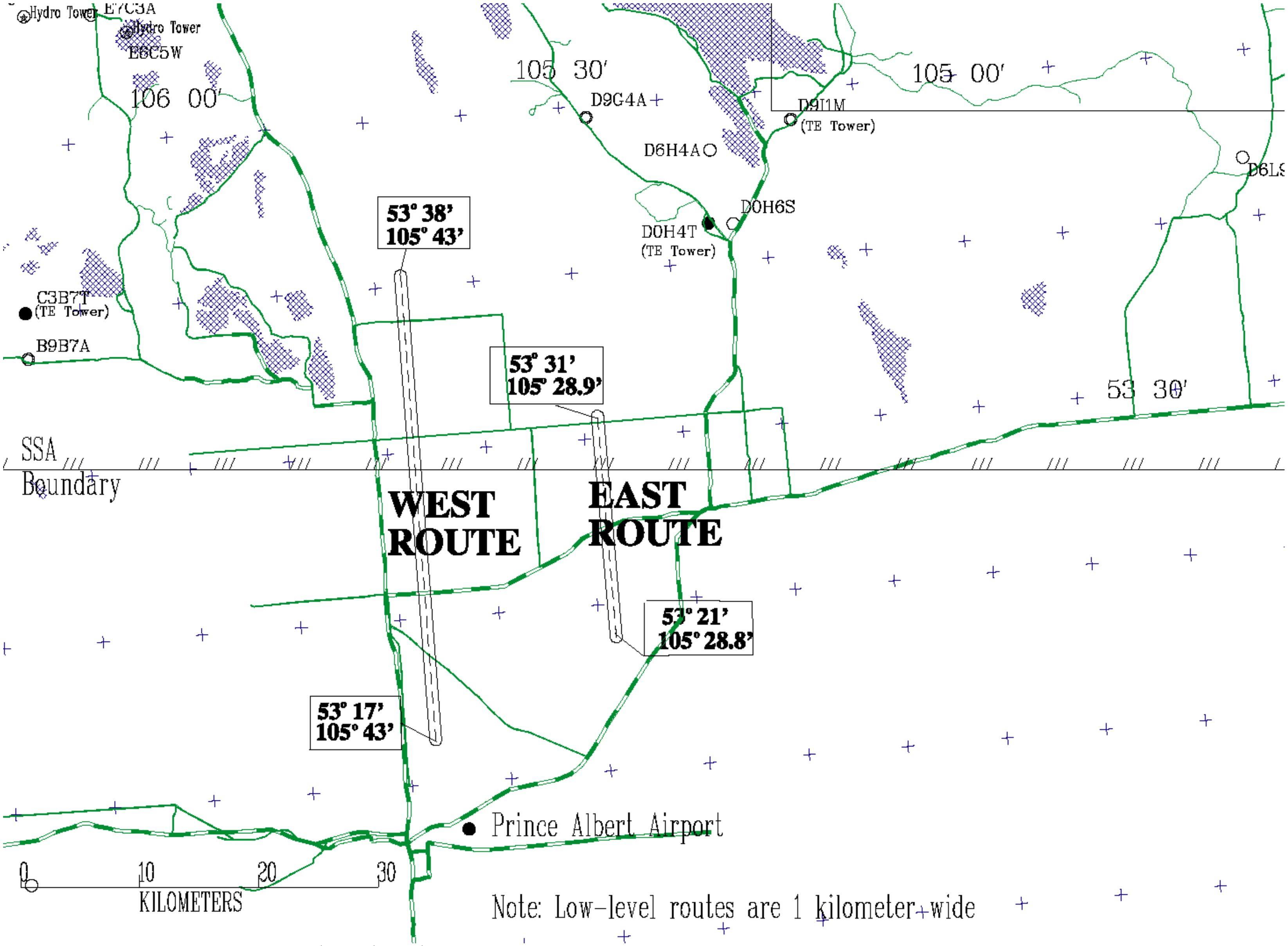

Figure 5.2.5.9: Fx-ZS: SSA low-level

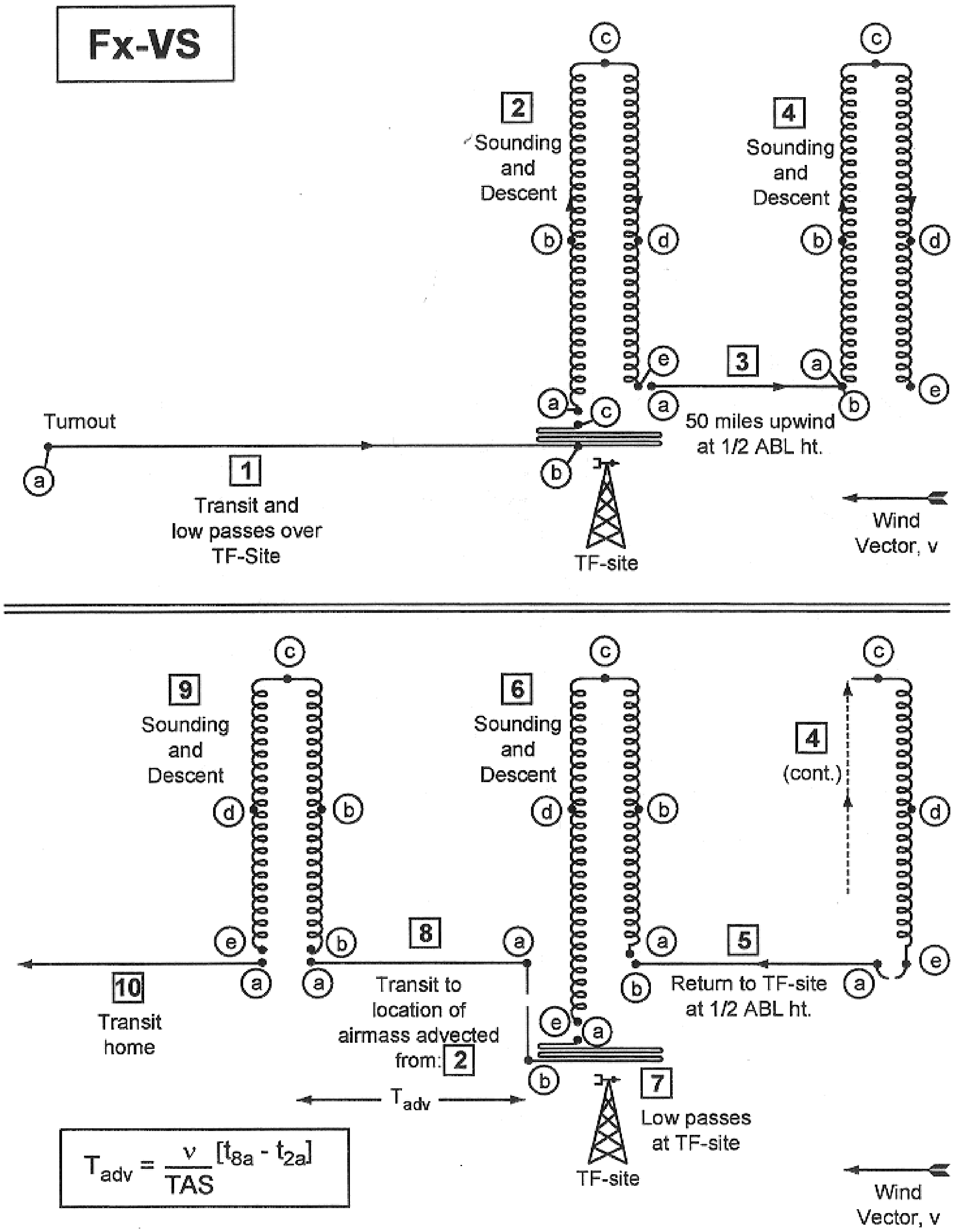

Figure 5.2.5.10 Fx-VS,N: CO_2 Profile Measurements

6.0 FIELD CAMPAIGN SUMMARIES

This chapter provides quick-look summaries of science teams and aircraft that will be available for each field campaign, and also the relevant satellite overpass schedules.

6.1 FFC-W: Winter Campaign [2/27-3/15/96]

FFC-W is focused on winter remote sensing processes. Operations will be coordinated out of the SSA-Ops, starting with an evening briefing meeting at 2000 LT on 2/26/96. There will be a telecon connection to the Marlboro Inn in Prince Albert to allow the C-130 crew and Prince Albert-based investigators to participate. Communication with the ER-2 crew will follow the protocols outlined in 4.1.5 and 5.1.2.

The SSA radio net will be working by 2/25/96.

The surface teams (RSS-1 and HYD-3) will be assisted by Paula Pacholek (PANP) and BOREAS staffers to get on site. There will be at least one Skidoo-type vehicle available for access to SSA-OA (PANP/AES property) and arrangements will be made for another to work in the Candle Lake area (SSA-OBS, SSA-OJP).

Regular radio contact with Ops is a must. Besides safety considerations, flight hours on the C-130 are limited and so early warning of problems with equipment (RSS-1) or local weather conditions should be passed across as quickly as possible. Keys for the SSA huts will be concealed near the huts (ask Ops). The huts will have their heat and power on and emergency equipment installed.

Aircraft availability and satellite schedules are given in table 6.1a; science team participation is shown in table 6.1b. Figure 6.1 shows the solar zenith angles for FFC-W for some of the SSA TF sites. Note that AVIRIS requires a solar zenith angle of 60^{o} or better. It is therefore planned to have RC and RE site entries at around 1800 GMT.

NOTE: The RSS-1 experiments are very sensitive to snow conditions at the site.

DO NOT WALK ANYWHERE NEAR THE AREA UNDER THE RADIATION TRAMWAYS OF SSA-OBS, SSA-OJP, SSA-OA.

Table 6.1a Overview of FFC-W

February-March 1996

Date Day of Year	Start	27 58	28 59	29 60	1 61	2 62	3 63	4 64	5 65	6 66	7 67	8 68	9 69	10 70	11 71	12 72	13 73	14 74	15 75	End
Landsat																				
SSA			**5**																**5**	
TW												**5**								
TE														**5**						
NSA							**5**													
SPOT																				
NSA East		**2**	**2**		**3**	**3**	**2**	**2**		**3**	**3**	**2**	**2**		**3**	**3**		**2**		
NSA West		**2**	**2**		**3**	**3**	**2**	**2**		**3**	**3**	**2**	**2**		**3**	**3**		**2**		
SSA East		**2**		**3**	**3**	**2**	**2**		**3**	**3**	**2**	**2**		**3**	**3**		**2**			**3**
SSA West		**2**		**3**	**3**	**2**	**2**		**3**	**3**	**2**	**2**		**3**	**3**		**2**			**3**
ER-2 (RE)						X	X	X	X	X	X	X	X	X	X	X	X	X	X	
C-130 (RC)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
DC-8 (RD)																				
Chieftain (RP)																				
Twin Otter (FT)																				
EYEBALL (FB)		X	X	X	X	X	X	X	X	X										
Radiosondes																				
Mission Manager																				
NSA																				
SSA		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

Table 6.1b FFC-W Team Science Summary

Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
AFM							A A							*									
TF			A						SE														
TE																							
TGB																							
HYD			*		*																		
RSS	*	*									A *			G				S					
Ops	*																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Key

* Participation in FC in NSA
* Participation in FC in NSA

A Automatic data acqusition, with occasional site visit
SE Experiment set-up in late March
G GOES data acquisition
S Support for AVIRIS (RE)

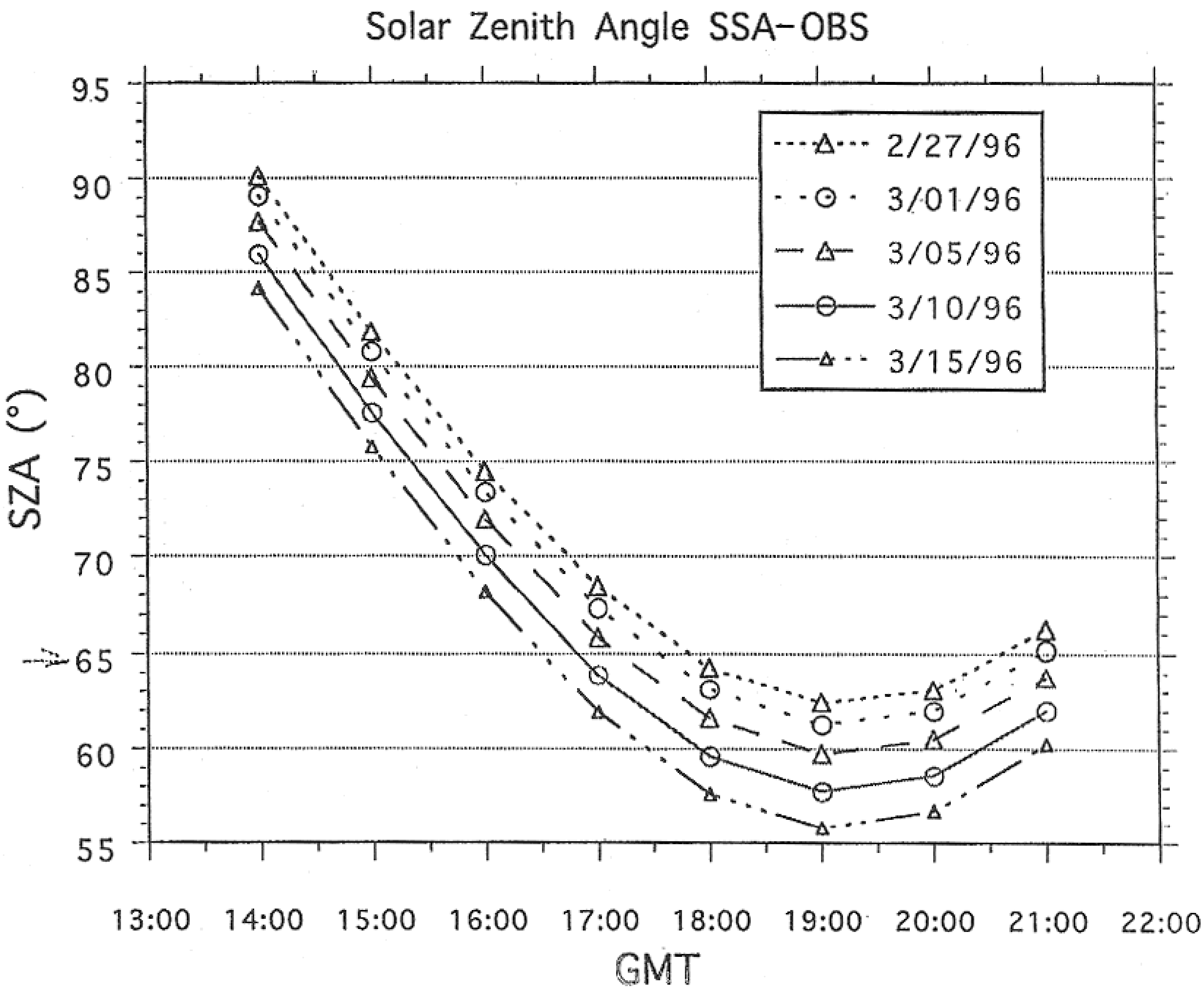

Figure 6.1 Solar zenith angles during FFC-W for SSA TF sites.

6.2 IFC-1: Thaw/Post-Thaw Campaign [04/02-28/96]

IFC-1 is focused on monitoring physiological processes and surface-atmosphere fluxes during the thaw/post-thaw period.

The SSA-OBS and SSA-OA sites will become active around 3/23/96 and 4/15/96, respectively. The teams (TF-9, TF-1) will be on site a few days before these dates for set up. Support will be provided by a BOREAS staffer (Hodkinson/Nelson) in late March and by Ops and PANP from early April onwards, see figure 4.2.

The NSA-OBS site will be continuing to run through at least 11/30/96. NSA-OJP should be working by 4/16/96 and NSA-Fen should be up shortly after that. BOREAS staffers (Hodkinson/Nelson) will help with set up in early April; NSA-Ops will take over around 4/15/96.

Various TE and TGB teams will be conducting in situ measurements during IFC-1, which is staggered between the SSA (04/02-23/96) and the NSA (04/16-28/96). There will be no aircraft operations except for Eyeball (FB) flights. Tables 6.1a, b summarizes activities.

Table 6.2a Overview of IFC-1

April 1996

Date Day of Year	Start	2 93	3 94	4 95	5 96	6 97	7 98	8 99	9 100	10 101	11 102	12 103	13 104	14 105	15 106	16 107	17 108	18 109	19 110	20 111	21 112	22 113	23 114	24 115	25 116	26 117	27 118	28 119	End
Landsat																													
SSA																5													
TW								5																5					
TE										5																5			
NSA			5																5										
SPOT																													
NSA East		3	2	2		3	3		2			3		2			3		2	2		3	3	2	2		3	3	2
NSA West		3	2	2		3	3		2			3		2			3		2	2		3	3	2	2		3	3	2
SSA East		2	2		3	3		2			3		2			3		2	2		3	3	2	2		3	3	2	2
SSA West		2	2		3	3		2			3		2			3		2	2		3	3	2	2		3	3	2	2
ER-2 (RE)																													
C-130 (RC)																													
DC-8 (RD)																													
Chieftain (RP)																													
Twin Otter (FT)																													
EYEBALL (FB)													X	X	X	X	X					X	X	X	X	X	X	X	
Radiosondes																													
Ops																													
NSA										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
SSA		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						

Table 6.2b IFC-1 '96 Team Science Summary

Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
AFM							A A							* *									
TF	* (lower)		A				* (lower)	*	* (lower)	*													
TE		* *		* *		* *	* (lower)			* (lower)	* (lower)												
TGB	*		*	*								* *											
HYD	* *		* *						* *														
RSS											A A			G									
Ops	* *																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Key

* (upper) Participation in FC in NSA
* (lower) Participation in FC in NSA

A Automatic data acqusition, with occasional site visit
SE Experiment set-up
G GOES data acquisition

6.3 IFC-2: Mid-growing season [7/9-8/9/96]

IFC-2 is focused on (i) energy-water-carbon exchange processes within the canopy-soil system, (ii) surface-ABL exchange mechanisms and (iii) optical remote sensing.

The TF, TE, TGB and HYD activities initiated in IFC-1 will be extended in IFC-2. Several coordinated flux/chambers experiments will be conducted using cooperative teams drawn from all four groups.

Airborne flux measurements will be provided by the Twin Otter (FT), supported by Eyeball (FB) for concentration measurements. Intensive radiosonde sequences (up to 6/day) will be launched from Thompson (NSA) and Candle Lake (SSA).

The NASA C-130Q (RC) equipped with ASAS; the ER-2 (RE) equipped with AVIRIS and MAS; and the Canadian Chieftain (RP) equipped with CASI will acquire optical data over both study areas. (The NASA DC-8 (RD) may take data over the SSA in June 1996.)

IFC-2 will be the most active IFC of BOREAS-96. Tables 6.3a, b summarize activities.

Table 6.3a Overview of IFC-2 Part 1
July 1996

Date Day of Year	Start	8 190	9 191	10 192	11 193	12 194	13 195	14 196	15 197	16 198	17 199	18 200	19 201	20 202	21 203	22 204	23 205	24 206	25 207	26 208	27 209	28 210	29 211	30 212	31 213
Landsat																									
SSA															5										
TW								5																5	
TE										5															
NSA			5																5						
SPOT																									
NSA East			3	3	2	2		3	3	2	2		3	3		2			3		2			3	
NSA West			3	3	2	2		3	3	2	2		3	3		2			3		2			3	
SSA East			3	2	2		3	3	2	2		3	3		2			3		2			3		2
SSA West			3	2	2		3	3	2	2		3	3		2			3		2			3		2
ER-2 (RE)																									X
C-130 (RC)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DC-8 (RD)																									
Chieftain (RP)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Twin Otter (FT)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
EYEBALL (FB)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Radiosondes			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ops																									
NSA			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SSA			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 6.3a Overview of IFC-2 Part 2
August 1996

Date Day of Year	1 214	2 215	3 216	4 217	5 218	6 219	7 220	8 221	9 222	10 223	11 224	12 225	13 226	14 227	15 228	16 229	17 230	18 231	19 232	20 233	End
Landsat																					
SSA						5															
TW															5						
TE	5																5				
NSA										5											
SPOT																					
NSA East	2	2		3	3	2	2		3	3	2	2		3	3		2			3	
NSA West	2	2		3	3	2	2		3	3	2	2		3	3		2			3	
SSA East	2		3	3	2	2		3	3		2		3	3		2			3		2
SSA West	2		3	3	2	2		3	3		2		3	3		2			3		2
ER-2 (RE)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
C-130 (RC)	X	X	X	X	X	X	X	X	X												
DC-8 (RD)																					
Chieftain (RP)	X	X	X	X	X	X	X														
Twin Otter (FT)	X	X	X	X	X	X	X	X	X												
EYEBALL (FB)	X	X	X	X	X	X	X	X	X												
Radiosondes	X	X	X	X	X	X	X	X	X												
Ops																					
NSA	X	X	X	X	X	X	X	X	X												
SSA	X	X	X	X	X	X	X	X	X												

Table 6.3b IFC-2 '96 Team Science Summary

Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
AFM				* *	* *		A A	* *					T	* *									
TF	*	*	A				*	*	*	*													
TE		* *		* *	*	* *	*			*	*	*											* *
TGB	*		*	*																			
HYD	* *							*	* *														
RSS	*	* *					*				A A			G	* *			S	* *				
Ops	* *																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Key

*	Participation in FC in NSA
*	Participation in FC in NSA

A Automatic data acqusition, with occasional site visit

SE Experiment set-up in late March

G GOES data acquisition

S Support for AVIRIS (RE)

T Support for Twin Otter

6.4 IFC-3: Fall Campaign [10/01-20/96]

IFC-3 is focused on (i) energy-water-carbon fluxes and exchange processes in the canopy-soil system and (ii) surface-ABL exchange mechanisms.

The TF teams will continue to measure fluxes right through the end of November. During IFC-3 (10/01-20/96), several TE and TGB teams will conduct in situ experiments similar to these done in IFC-2, but at a lower intensity.

Radiosondes will be launched from the NSA and SSA during the IFC. Tables 6.4a, b summarize activities.

Table 6.4a Overview of IFC-3
October 1996

Date Day of Year	Start	1 275	2 276	3 277	4 278	5 279	6 280	7 281	8 282	9 283	10 284	11 285	12 286	13 287	14 288	15 289	16 290	17 291	18 292	19 293	20 294	End
Landsat																						
SSA										5												
TW			5																5			
TE					5																5	
NSA														5								
SPOT																						
NSA East		3	2	2		3	3		2			3		2			3		2	2		3
NSA West		3	2	2		3	3		2			3		2			3		2	2		3
SSA East		2	2		3	3		2			3		2			3		2	2		3	3
SSA West		2	2		3	3		2			3		2			3		2	2		3	3
ER-2 (RE)																						
C-130 (RC)																						
DC-8 (RD)																						
Chieftain (RP)																						
Twin Otter (FT)																						
EYEBALL (FB)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Radiosondes		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Ops																						
NSA		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
SSA		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

Table 6.4b IFC-3 '96 Team Science Summary

Team	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
AFM					* *		A A							* *									
TF	*		A					*	*	*													
TE		* *		* *		* *	*			*	*												
TGB	*		*	*								* *											
HYD	* *								* *														
RSS											A A			G									
Ops																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Key

* Participation in FC in NSA
* Participation in FC in NSA

A Automatic data acqusition, with occasional site visit
SE Experiment set-up in late March
G GOES data acquisition

7.0 EMERGENCY PROCEDURES

7.1 Northern Study Area (NSA)

NSA

The areas covered in this guide are:

1. **MEDEVAC**; instructions on procedures for contacting emergency services and guiding them to the site.

2. **RADIO-PHONE LINK**; how to connect to the telephone system using your hand-held radio.

3. **OTHER NUMBERS**; Towing, hospitals, etc.

1.	MEDEVAC

A COPY OF THIS PACKAGE IS WITH THOMPSON EMERGENCY SERVICES

Call BOREAS Operations and give location and other details. If you cannot contact BOREAS Operations, use your radio to make an emergency phone call, (see section 2).

Most of the BOREAS NSA sites are off Route 391. Three sites are close to Route 391 for helicopter or road ambulance pickup; one is some distance from the road (old black spruce) and has direct helicopter access. Details of road and trail access are provided below.

Milepost distances are provided for road access to the Tower Flux sites in the table below. **Site entrances are marked by 4"x4" posts about 7' tall and are clearly visible from Rt. 391**. The marker posts are bright green, with orange stripes at the top, and an identifying number. The number reflects mile posts distance, in kilometers from Thompson.

VOR/DME (aviation navigational aid) numbers are provided for helicopter access. Note that the "road access" VOR/DME co-ordinates correspond to the milepost locations.

SITE NAME	SITE POSITION VOR-DME	ROAD ACCESS VOR-DME	MARKER POSTS (km)	
Young Jack Pine-YJP	280-16.5	**281-16.3**	38.9	1
Fen-Fen	280-21.1	**281-21.2**	47.6	2
Old Black Spruce-OBS	**270-22.6**	276-23.4	52.9	3
Old Jack Pine-OJP	278-28.6	**278-27.6**	61.6	4

MM OR SAM RESPONSE TO A BOREAS CALL FOR MEDEVAC

(1) Determine whether the medevac can be done by road ambulance or Helicopter.

(2) If road ambulance, call Thompson emergency services at 677-7911 and direct dispatcher to the site. The service has a copy of a map of the NSA and instructions on how to get to the Tower Flux (TF) sites.

(3) If a helicopter is required, call the Thompson emergency services number anyway so they can ready a trauma team if necessary. Ask them where and when the helicopter should pick up the trauma team. Tell them that you will then try to get a helicopter from Canadian Helicopters or Custom Helicopters. Then call:

Canadian Helicopters:	778-5049, 778-5962 office hours
	778,8991, 778-7196 otherwise
Custom Helicopters:	677-3720, 677-9525 office hours
	677-3566, 778-7745, 677-9731 otherwise

Tell them:

(a) Where the patient is to be picked up, give site name and VOR/DME co-ordinates. The best helo pick-up points are the road access for YJP, FEN and OJP. The on-site pad is best for OBS. The VOR/DME coordinates for these best pickup points are marked in bold above.
(b) Where to pick up the trauma team if they are available.
(c) Where to pick up a BOREAS guide if necessary (i.e. at BOREAS-Study Area Headquarters (SAHQ) at the provincial site at Thompson Airport).

Payment details are to be worked out after the medevac. No committments can be made by the Mission Manager (MM) or Study Area Manager (SAM) for a given individual. It all depends on insurance, nationality, etc. Don't worry, they will get paid.

2. RADIO-PHONE LINK

You can use your radio to make an emergency call:

- Select Channel 3
- Hold key down, transmit for 5 seconds.
- Manitoba Tel Operator will come on line. If operator does not come on line, then remove the antenna from your radio and hook into the tree antenna that is located on some Northern Flux Tower sites. If you are not at a site with an antenna, then walk to an area of higher elevation, or climb a tree, tower, hut, or vehicle and retransmit. Operator will ask for registry and code number.
- Respond: Prince Albert Registry, code number JW2 9062.
- Give operator the number you want to call (Thompson Emergency Services is 677-7911)

3. OTHER NUMBERS

Hospital	677-2381
Towing	778-8290
Weather Office	677-4969

7.2 Southern Study Area (SSA)

SSA

The areas covered in this guide are:

1. **MEDEVAC**; instructions on procedures for contacting emergency services and guiding them to the site.

2. **RADIO-PHONE LINK**; how to connect to the telephone system using your hand-held radio.

3. Emergency radio monitoring.

4. **OTHER NUMBERS**; Towing, hospitals, etc.

1.	MEDEVAC

A COPY OF THIS PACKAGE IS WITH PRINCE ALBERT EMERGENCY SERVICES

Call BOREAS Study Area Headquarters (SAHQ) and give location and other details. If you cannot contact BOREAS SAHQ, use your radio to make an emergency phone call, (see section 2 on next page).

There are five principal BOREAS sites to the north of Prince Albert, each of which has a tower structure, instrument huts and trail access from the nearest road. One site (Old Aspen - OA) is in the Southern end of Prince Albert National Park and the other four (Old Jack Pine - OJP; Young Jack Pine - YJP; Fen - Fen; Old Black Spruce - OBS) are located in the Candle Lake area. All of the sites have helicopter access and the Candle Lake sites are all located close to roads. Details of road and trail access are provided in the attachment.

Site entrances from the roads are marked by 4"x4" posts about 7' tall and are clearly visible from the road. The posts are bright green, with orange stripes at the top and an identifying number.

VOR/DME (aviation navigational aid) numbers are provided for helicopter access. Note that the "road access" VOR/DME co-ordinates correspond to the road trail junctions referred to in the package.

SITE NAME	SITE POSITION VOR-DME	ROAD ACCESS VOR-DME
Old Aspen - OA	308-31	303-29
Fen - Fen	032-52	033-52
Young Jack Pine - YJP	031-54	031-55
Old Jack Pine - OJP	028-55	029-56
Old Black Spruce - OBS	011-50	010-51

MM or SAM RESPONSE TO A BOREAS CALL FOR MEDEVAC

(1) Determine whether the medevac can be done by road ambulance or Helo. (The OA site has a very long access trail so ambulance access may be impractical. There is a clearing just to the east of the OA - tower for Helo access. The Candle Lake sites are more easy to access by road but are roughly one hours drive from Prince Albert).

(2) If road ambulance, call Prince Albert emergency services, 764-6455 and direct dispatcher to the site. The service has a copy of a map of the SSA and instructions on how to get to the TF sites.

(3) If Helo is required, call the Prince Albert Emergency number (764-6455) anyway so they can ready a trauma team if necessary. Ask them where and when the Helo should pick up the trauma team. Tell them that you will then try to get a helicopter from Athabaska Airways. Then call Athabaska Airways, 764-1404. If there is no immediate answer wait for the taped message which will give the emergency (overnight) number.

Tell them:

(a) Where the patient is to be picked up, give site name and VOR/DME co-ordinates. The best helo pick-up points are the road access for YJP, FEN and OBS and in clearings to the east of OJP and OA.
(b) Where to pick up the trauma team if they are available.
(c) Where to pick up a BOREAS guide if necessary (at SAHQ in Candle Lake.

Payment details are to be worked out after the medevac. No committments can be made by the Mission Manager (MM) or Study Area Manager (SAM) for a given individual. It all depends on insurance, nationality, etc. Don't worry, they will get paid.

2.	RADIO-PHONE LINK

You can use your radio to make an emergency call: NOTE: Coverage is limited; see diagram:

- Select Sasktel channel
  3 if in the Prince Albert National Park (PANP)
- 11or 13 if in Candle Lake or White Gull Basin Area.
- Hold key down, transmit for 5 seconds.
- Operator will come on line and will ask for registry and code number. If operator does not come on line, go to an area of higher elevation, or climb a tree, tower, hut, or vehicle and retransmit.
- Respond: Prince Albert Registry, code JW2 9062.
- Give operator number (P.A. Emergency Services is 764-6455)

3.	EMERGENCY RADIO MONITORING

The radio is monitored 24 hours a day by the Radio Branch in Prince Albert and by the Fire Management Control Center during the daylighted hours. If you are out of telephone range or the BOREAS Operations is not responding, you may call out for emergency help until one of the above agencies responds. The Radio Branch has a copy of the BOREAS Tower Flux sites and can assist you in getting emergency help.

4.	OTHER NUMBERS

Hospitals	764-1551, 922-2605
Towing (Candle Lake)	929-4662 (W)
	929-3149 (H)
(Caribou Creek)	426-2067

Notes

Notes

Notes

Notes