日本のSuperDARN発展史
History and progress of Japanese SuperDARN project

佐藤夏雄（国立極地研究所）
Natsuo Sato (NIPR)

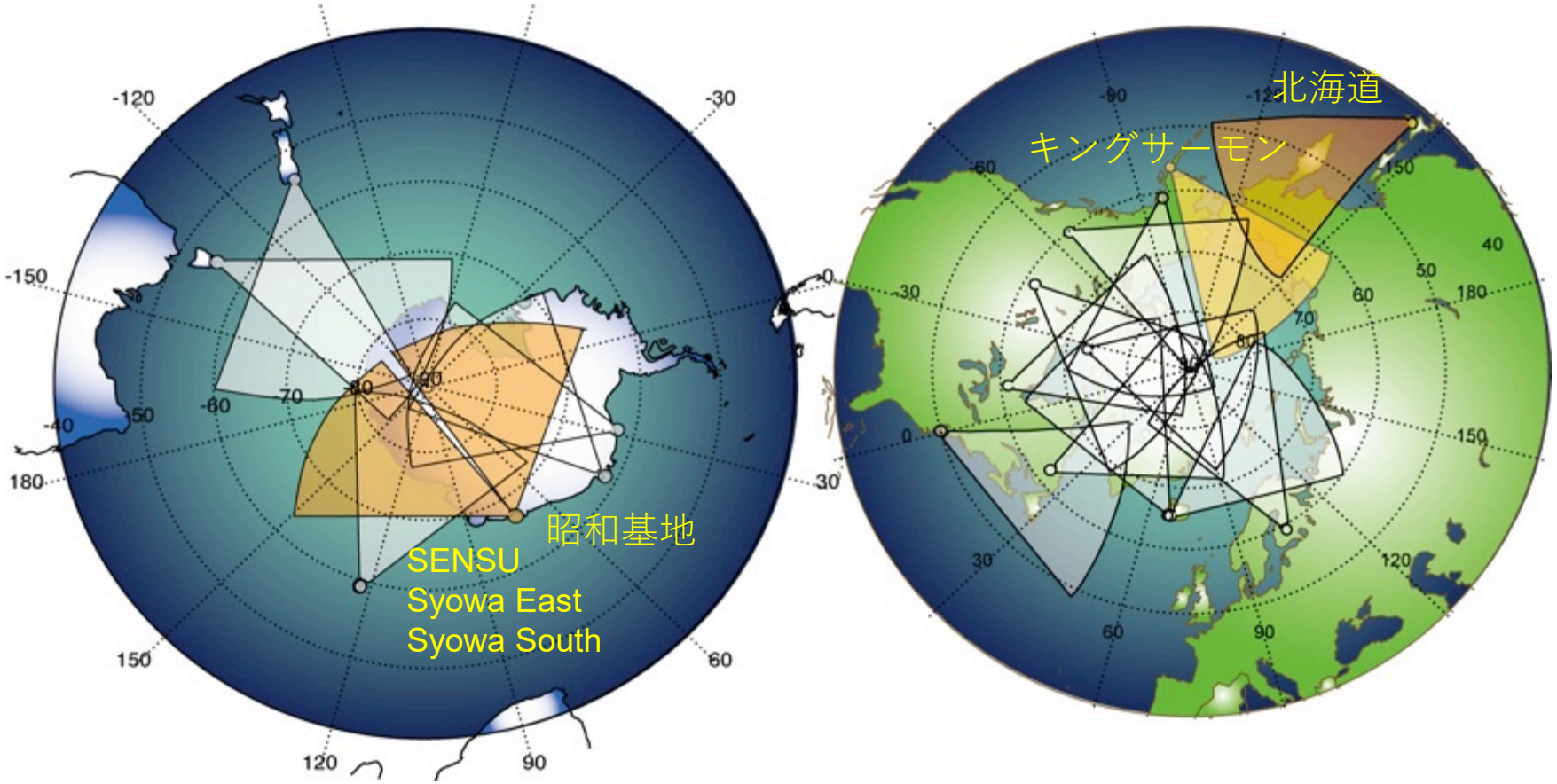
SuperDARN
国際大型短波レーダー網

＊国際SuperDARNは両極域の大部分をカバーした大型短波レーダーネットワーク
＊8～20MHzの電波を発射し、電離層からの反射波を「通年・連続的」に受信
＊エコー強度、ドプラー速度、スペクトル幅の情報が得られる
＊全て共通の仕様で製造され、共通の観測制御プログラムで稼働している為、各レーダーのデータは完全に互換性がとれ、データの相互利用が極めて容易

日本のSuperDARNレーダー

SuperDARN

Super Dual Auroral Radar Network



日本のSuperDARNレーダー

国際SuperDARNレーダーの発展

～日本のSuperDARNプロジェクトの発展史～

History and progress of Japanese SuperDARN project

冊子題名（案）

「日本のSuperDARNレーダー発展史」

著者

佐藤夏雄、小川忠彦、山岸久雄、行松彰、菊池崇、野崎、長妻努、西谷望、（著者追加）

掲載骨子（案）

1. HFレーダーの原理と観測手法
   1-1. HFレーダーの原理
   1-2. 観測手法の研究上の利点

2. SuperDARNの創成
   2-1. 創世期
   ＊STAREレーダー
   2-2. 国際SuperDARNの発足
   ＊研究目的
   ＊発足までの経過
   ＊発足ワークショップ
   ＊PI合意書の発効

3. 昭和基地レーダーの設置
　＊経緯
　＊主な観測成果
　＊現状と将来計画

4. アラスカ・キングサーモンレーダー
　＊経緯
　＊主な観測成果
　＊現状と将来計画

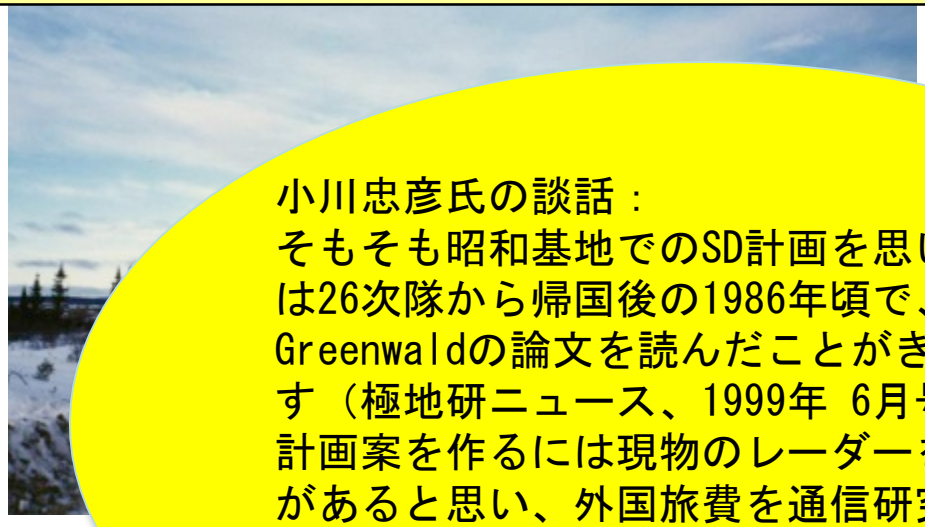
5. 北海道レーダー
　＊経緯
　＊主な観測成果
　＊現状と将来計画

6.国際SuperDARNの発展の歴史
　8.1 レーダー配備の歴史
　8.2 主な成果と研究成果論文数、引用数の歴史
　8.3 国際SD Workshop開催地の遍歴

7. 国際SuperDARNの将来展望

昭和基地レーダーの始まり:1988年

Dr. Ogawa visited APL and Goose Bay Radar Site in November 1988



小川忠彦氏の談話：
そもそも昭和基地でのSD計画を思い立ったのは26次隊から帰国後の1986年頃で、多分Greenwaldの論文を読んだことがきっかけです（極地研ニュース、1999年 6月号）。
計画案を作るには現物のレーダーを見る必要があると思い、外国旅費を通信研究所に要求したところ、運良く予算がつき、
APLに一ヶ月ほど滞在し、その間にGoose Bayレーダーを見学できました。

主な経過：1988年

Ogawa　提案 (1988年極地研関係者への説明用)

昭和基地大型短波レーダ計画について

1988.12.14
通信総合研究所
小川　忠彦

1．はじめに

南極STEP計画(1990-1995)の一環として、昭和基地に大型短波レーダ(8-20 MHz)を設置し、既存のVHF レーダ(50/120 MHz)では観測できない極冠帯やカスプ領域の電離層プラズマ運動の観測計画を提案している（第11回[1988]，12回[1989]極域における電離圏磁気圏総合観測シンポジウム）。このような短波レーダは1983年からカナダのGoose Bay で、また、1988年初頭からは米国／ＮＳＦの援助を受けて南極のHalley Bayで稼働中で、着々と成果が出つつあり、その有効性は証明済みである。更に、目下フランスがカナダのSchefferville に建設中であるが、今の所、稼働の見通しはない、とのことである。

筆者は、科学技術庁の援助で、1988年11月に米国（Johns Hopkins Univ./Applied Physics Laboratory ：ＡＰＬ）とカナダ（Labrador/Goose Bay）に出張し、昭和基地短波レーダ計画について、ＡＰＬのDr.Greenwald(Goose BayレーダのＰＩ）とDr.Baker、および英国／British Antarctic Survey（ＢＡＳ）のDr. Dudeney (Halley Bay レーダのＰＩ）と議論し、また種々の技術情報を入手したので、その概要を以下にまとめる。ＡＰＬとＢＡＳは、STEP期間中の衛星群による国際共同観測（ISTP）に呼応する観点から、できれば１９９２年初頭からの昭和レーダの観測開始を希望している。

主な経過:1988年

Ogawa氏の　極地研究所への提案メモ(1988)

ＤＡＲＮ会議：

ＳＴＥＰでは多数の衛星が配置される予定であるが、これに呼応した地上観測として、極域の短波レーダ観測ネットワークが重要視されている。ＮＡＳＡは、ＳＴＥＰでＧＧＳ(Global Geospace Study) という地上観測プログラムを実施するが、その中に、短波レーダによる観測研究を目的とするＤＡＲＮ（Dual Auroral Radar Network ; Principal Investigatorは米国 Johns Hopkins大学のDr.Greenwald）という計画がある。Greenwald から、昭和基地短波レーダもこれに参加して欲しい、という申入れが口頭で来ている。さらに、1989年４月に英国ケンブリッジ市においてＤＡＲＮ会議を開くので、極地研の関係者and/or筆者が是非参加して日本の計画を発表するとともに、日本－米国－英国間の研究協力について話し合いを持ちたい、という依頼も受けた。極地研の関係者は是非派遣すべきであると思う。

昭和基地レーダーの始まり：1988/1989年

February 1989
Proposal of HF radar experiment to NIPR
as one of the projects at Syowa Station
during the STEP period (1990 -1995)

日経新聞
1989年
2月11日

南極昭和基地に
大型短波レーダー

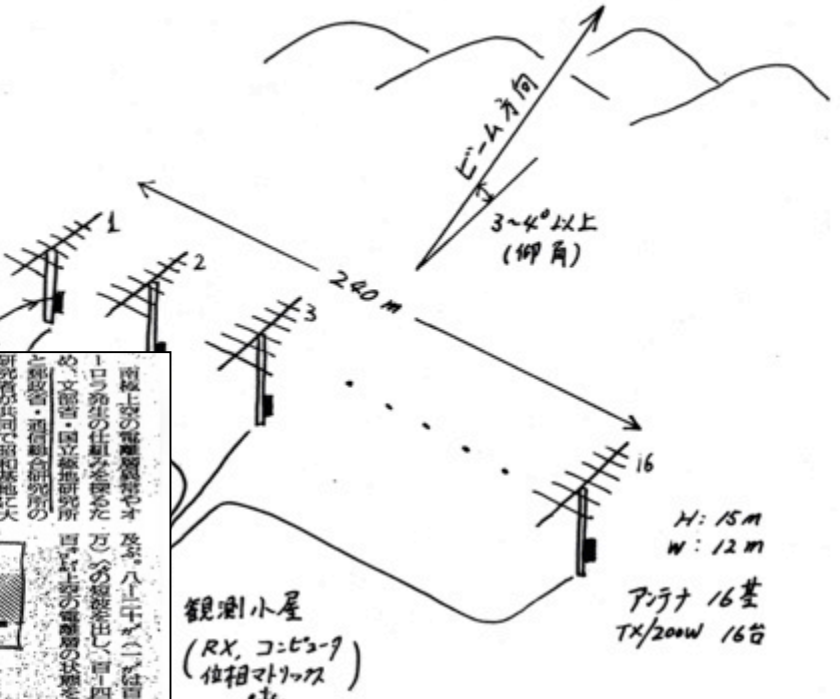
電離層異常など探る

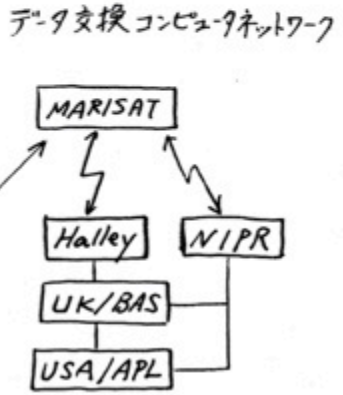
南極上空の電離層異常やオーロラの発生の仕組みを探るため、文部省・国立極地研究所と郵政省・通信総合研究所の研究者が共同で昭和基地に大型短波レーダーを建設する計画をまとめた。九〇年からスタートする科学衛星などを使った国際共同研究「ステップ計画」に参加する欧米研究者からの強い要請にこたえたもので、九一年初めの完成を目指している。

このレーダーはテレビ受信用アンテナに似た巨大アンテナ（高さ十五m、最大幅十二m）を二百四十m間隔で十六基並べた「フェーズド・アレイ型レーダー」。全長は二百四十mにおよぶ。八十二mヘルツ（一メガは百万）への短波を出し、百一四百キロ上空の電離層の状態を観測する。

地球のまわりは地球自身が（つくる強い磁場（磁気圏）でおおわれており、南極や北極は磁力線（磁界を形づくる力）を供給あらしの発生の仕組みの出入り口にあたる。このため南極上空の電離層を調べれば地球周囲の磁気圏の様子もわかり、電波障害の原因となる発光するオーロラのメカニズム解明も期待できるという。

北極側にはカナダ・グリーンランドの間のレーダー施設がある。南極では八八年一月に英国南極調査所（BAS）がハレーベイ基地に同タイプのレーダーを設置、昭和基地にレーダーを設置すれば二点から同じ電離層を観測して精度を向上できるため、BAS などの研究者が日本に対して早期建設を要望していた。九〇年から日米が順次打ち上げる「GEOTAIL」など磁気圏観測衛星を利用して、地上基地局とデータ交換のネットワークをつくれる計画もあり「磁気圏の解明が進む」と関係者は話している。





主な経過：1989年（Greenwaldから平澤先生への招待状）

THE JOHNS HOPKINS UNIVERSITY
APPLIED PHYSICS LABORATORY
Johns Hopkins Road, Laurel, Maryland 20707-6099
Telephone: (301) 953-5000 and 792-5000

February 24, 1989

Dr. T. Hirasawa
National Institute of Polar Research
9-10 Kaga 1-chrome
Itabasi-ku
Tokyo 173
Japan

Dear Dr. Hirasawa,

After a long period of waiting and much effort on the part of many scientists, the satellite mission known as ISTP/GGS has become a funded program. The satellites are being built, and in the early to mid-nineties they will be launched. Our goal is to use the data from these satellites and the ground-based coherent radar network, known to NASA as DARN, to provide new understanding of fundamental magnetospheric and ionospheric processes.

The original DARN proposal was based upon a global network of pairs of coherent VHF radars. Advances in technology and understanding over the past decade have resulted in new types of HF coher
probing the ionosphere to very high
altitudes. These HF radar sy
Labrador, Schefferville, Que
come to my attention tha
development by the Nati
is to be situated at
important complement t
the DARN experiment. N
of the Halley radar, but
doppler measurements in the la
will provide reliable plasma convec

It is important to consider how the new
incorporated into the original DARN concept. For this reason, and also to reacquaint ourselves with the proposal that was written so many years ago, we are planning a two day meeting of the DARN team (co-investigators and/or designated interested parties) to be held in Cambridge, England on 24-25 April. Since a Japanese HF radar at Syowa would add significantly to the contributions of the DARN experiment to ISTP/GGS, I would like to invite you and Dr. T. Ogawa of the Japanese Radio Research Laboratory to attend this meeting and participate in the discussion. I also hope that you might be able to give the DARN investigators an update on your development plans at that time. If you are agreeable with this suggestion, I would plan to include your contribution on the first day of the meeting.

I believe that attendance at this meeting will be beneficial to you as well as to members of the DARN team. Not only will we see old faces, but we may be able to develop a global strategy of coherent radar observations that could be put into effect even before the launch of the first GGS spacecraft.

Local arrangements for the meeting are being handled by Dr. John R. Dudeney of the British Antarctic Survey. The meeting will be held at BAS. John is endeavoring to arrange modest, moderately-priced hotel or guest house accommodations for between 20 to 30 pounds sterling per night including bed and breakfast. If you prefer more luxurious lodging at a higher price, John can arrange this too. John is also making arrangements for a special dinner on Monday evening. Please notify John by February 28 of your preference in accommodations, the specific nights that you will require accommodations, the number in your party and your interest in the Monday dinner. Write to John at this address:

British Antarctic Survey
National Environment Research Council
Madingly Road
Cambridge, CB3 0ET, England.

Alternatively, you can reach John in the following ways:

Telephone: 01144-223-61188.

ile: 223-62616

CAM G)

for Dudeney]

Dudeney of the time that you will
ise, you can write to me at APL, call
511303 (APL JHU LAUR).

I am looking forwa u in Cambridge.

With best regards,

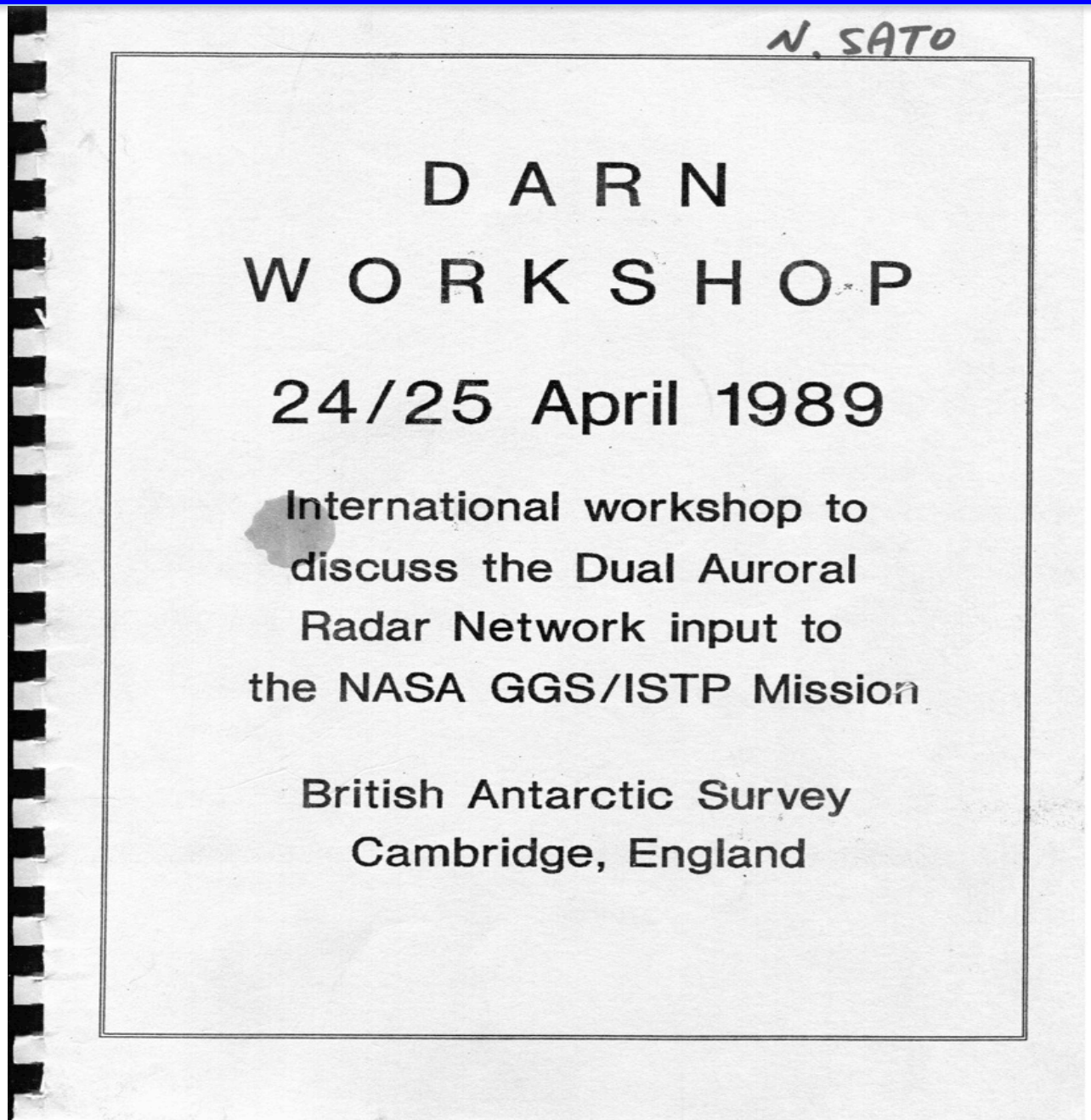
Ray Greenwald

Raymond A. Greenwald

RAG:me

Greenwaldから平澤先生へ昭和レーダーの設置と１９８９年４月開催のDARN会議参加の招待状

主な経過：DARN Workshop April 1989 at Cambridge



主な経過：DARN Workshop April 1989 at Cambridge

Summary of the DARN Workshop
24-25 April 1989
Held at the British Antarctic Survey
Cambridge, England

I. Purpose of the Workshop

The enumerated goals of the workshop are given in the following list:

1. Define the scientific problems to be studied with coherent radars.
2. Specify the physical parameters we wish to derive with the radars.
3. Determine which parameters to submit to the GGS data base.
   a) Determine the Key parameters
   b) Define event data (if possible)
4. Specify the format of the submitted data
   a) Determine the spatial resolution
   b) Determine the temporal resolution
5. Specify the parameters we wish to get from the GGS data base.
6. Determine the pathways by which data will be submitted to the CDHF (Central Data Handling Facility).
7. Schedule future activities for the DARN project.
8. Come up with a new Acronym to replace DARN.

Participants

NAME	E-Mail Address
Kile Baker	SPAN APLSP::BAKER
Stan Cowley	contact via Mervyn Freeman
John Dudeney	JANET UK.AC.NBS.VC::U_JRD SPAN ECD1::323BAS, or STAR::"U_JRD%VC.NBS.AC.UK@FORSYTHE.STANFORD.EDU"
Mervyn Freeman	JANET FREEMAN@UK.AC.IC.PH.SPVA SPAN STAR::"FREEMAN%SPVA.PH.IC.AC.UK@FORSYTHE.STANFORD.EDU"
Ray Greenwald	SPAN APLSP::GREENWALD
Christian Hanuise	SPAN (contact via J.-P. Villain)
Robert Hunsucker	SPAN FRED::HNSCKR
John Kelly	INTERNET KELLY@KL.SRI.COM SPAN STAR::"KELLY%KL.SRI.COM@FORSYTHE.STANFORD.EDU"
Mark Lester	JANET M.LESTER@UK.AC.LEICESTER.SABRE M.LESTER@UK.AC.LEICESTER.VAXC SPAN STAR::"M.LESTER%VAXC.LEICESTER.AC.UK@FORSYTHE.STANFORD.EDU"

主な経過：DARN Workshop April 1989 at Cambridge

FUTURE DIRECTIONS

- Transmitter upgrade will begin this summer. The new transmitters will provide greater reliability and increased transmitting power at the higher operating frequencies.

- PACE will be part of the ground based system for the ISTP/GGS project. The coherent scatter radar observations for ISTP are known as DARN (Dual Auroral Radar Network). The PACE radars will be complemented by the STARE radars (Germany and Finland), the SABRE radar (UK), the SHERPA radar (Schefferville, Quebec), and the BARS radar (Canada) and probably a new HF radar which will be built at Syowa, Antarctica (Japan).

主な経過：DARN Workshop April 1989 at Cambridge

II. Scientific Goals of the Ground Based Experiments

A. Sondrestrom Incoherent Scatter Radar - presented by John Kelly

The Sondrestrom radar will be running some special modes which will be coordinated with the POLAR satellite. These modes are:
1) Long term experiments when POLAR is at Apogee. The radar will run for about 8 hours on 6 consecutive days.
2) Short term experiments when POLAR is at Perigee. The radar will run for about 2 hours on 6 consecutive days.

Some of the experiments will be designed to look for the ground signature of FTEs. These experiments will also need to use the solar wind and IMF data from the WIND satellite.

A microVAX at Sondrestrom will process the radar data. The data will then be transferred to the CDHF either by modem or by satellite. This can be done shortly after an experiment has been run. If the data are not to be transmitted via modem or satellite, it will require 2-3 weeks to get the data from Sondrestrom to SRI and then to the CDHF.

B. SESAME - presented by John Dudeney

The SESAME project is described in Appendix A.

C. CANOPUS - presented by Allen McNamara

The CANOPUS project is described in Appendix A. Note that the principal investigator for CANOPUS has been changed. The new PI is Gordon Rostoker.

D. DARN - presented by Ray Greenwald

The Dual Auroral Radar Network (DARN) consists of several independent coherent scatter radars. These radars are briefly described in the following pages.

E. DARN scientific objectives - discussion

1. High-Latitude Convection (large scale)

a) How is the flow excited by solar wind/magnetosphere coupling at the magnetopause? How is the flow excited following southward turnings of IMF, and how does it decay after northward turnings? - This will require DARN + solar wind/IMF data. It would also be useful to have incoherent scatter radar data and data from magnetometer chains.

b) Are the signatures of individual boundary layer processes visible in the flow data? What are the signatures of patchy/time-dependent reconnection, Kelvin-Helmholtz waves and pressure pulses? - This will require DARN + Solar wind/IMF data + Cluster Magnetopause data.

c) How does the flow evolve on the nightside during substorms and how does it relate to the concurrent behavior of the magnetotail? - This will require DARN + Solar wind/IMF + Geotail. It would also be useful to have Cluster plasma sphere data and incoherent scatter radar data.

2. High Latitude Electrodynamics. How does the global convection pattern relate to:

a) Auroral particle precipitation
b) Ionospheric structure
c) Field Aligned Current systems

Requires DARN + Solar Wind/IMF + POLAR + GEOTAIL. It may also be useful to have Freja (Viking II) data and magnetometer chain data.

3. Mechanisms of irregularity formation and dissipation. Where do irregularities occur and why? How do the properties of the ionosphere (e.g. T_e and T_i, chemistry) and the ionosphere-thermosphere coupling influence the formation of irregularities? Should we expect to see irregularities form at conjugate locations? What is the coupling between the microscale mechanisms and the global response? What are the geophysical implications?

4. MHD wave structure and its relation to large-scale flow patterns. What is the conjugate connection for the various MHD phenomena? - Requires DARN + ground magnetometer networks. By using BARS and STARE you can do dawn-dusk and noon-midnight comparisons. GEOTAIL data when the satellite is in its near earth orbit should also be useful.

主な経過：DARN Workshop April 1989 at Cambridge

5. Sources and Propagation of gravity waves. What is the coupling between ionosphere and thermosphere. - Requires DARN. Incoherent Scatter radar data would also be useful. Observed data should be useful inputs to theoretical modeling of thermosphere/ionosphere system.

III. Recent Results

Reproductions of the viewgraphs used in the presentations are given in Appendix B.

A. SABRE - presentations by Chris Thomas and Mark Lester

B. E-Region theory - presented by T. Robinson

C. HF Radar Observations of Ion-Acoustic and EIC Waves - presented by J.-P. Villain

D. STARE - presented by Erling Nielsen
The "old STARE" system was turned off in March of this year (1989). The system is being upgraded and should become operational again in July. The description of STARE II will be found in Appendix C.

E. EISCAT - presented by Stan Cowley

F. PACE - presented by J. Dudeney, R. Greenwald, K. Baker and M. Pinnock.
1) Overview of PACE - John Dudeney
2) Highlights from Goose Bay - Ray Greenwald
3) Response of Cusp Convection to the IMF - Kile Baker
4) Patchy Reconnection observed at Halley Bay - Mike Pinnock

G. PRISM - presented by C. Hanuise

IV. Plans for the Future

A. SESAME - John Dudeney presented a plan for the location of Automated Geophysical Observatories (AGOs) which would give nearly complete coverage of the auroral zone and polar cap in Antarctica.

B. STARE II - presented by Walter Schmidt
Plans for the upgraded version of the STARE radar, known as STARE II are described in Appendix C.

C. Syowa, Antarctica - letter from T. Hirasawa and T. Ogawa
The National Institute of Polar Research together with the Communications Research Laboratory is planning tobuild an HF-radar similar to the Halley radar at the Japanese Antarctic research station, Syowa. A letter describing these plans is reproduced in Appendix C.

D. Upgrades to the PACE radars
No presentation was given at the DARN meeting about the future plans for the PACE radars (Goose Bay and Halley Bay). However, several improvements are planned and are expected to be in place by early 1992. The plans are summarized in Appnedix C.

V. Ground Based Data within ISTP

A. NASA plans - presented by Rusty Whitman

The material presented by Rusty will be found in Appendix D. There were several additional points made during his presentation and they are summarized here:

1. There will be no Key parameters from SOHO or Cluster.

2. There will be no real-time data from GEOTAIL, but tape dumps will be available with a few hours delay.

3. Data distribution will be on optical disk (probably) and the distributed data will include ALL Key parameters.

4. PIs can request extra copies of the distributed data and can specify who these extra copies should be sent to.

5. Key parameter files should run for 24 hours, from midnight to midnight (UT).

主な経過：1989年
SyowaレーダーのOgawa提案

- Japanese Contribution to High-Latitude HF Radar Network -

A PLAN OF HF RADAR EXPERIMENT AT SYOWA STATION, ANTARCTICA

Takeo HIRASAWA

National Institute of Polar Research

9-10, Kaga 1 Itabashi-ku, Tokyo 173, Japan.

Tadahiko OGAWA

Communications Research Laboratory, Ministry of Posts and Telecommunications

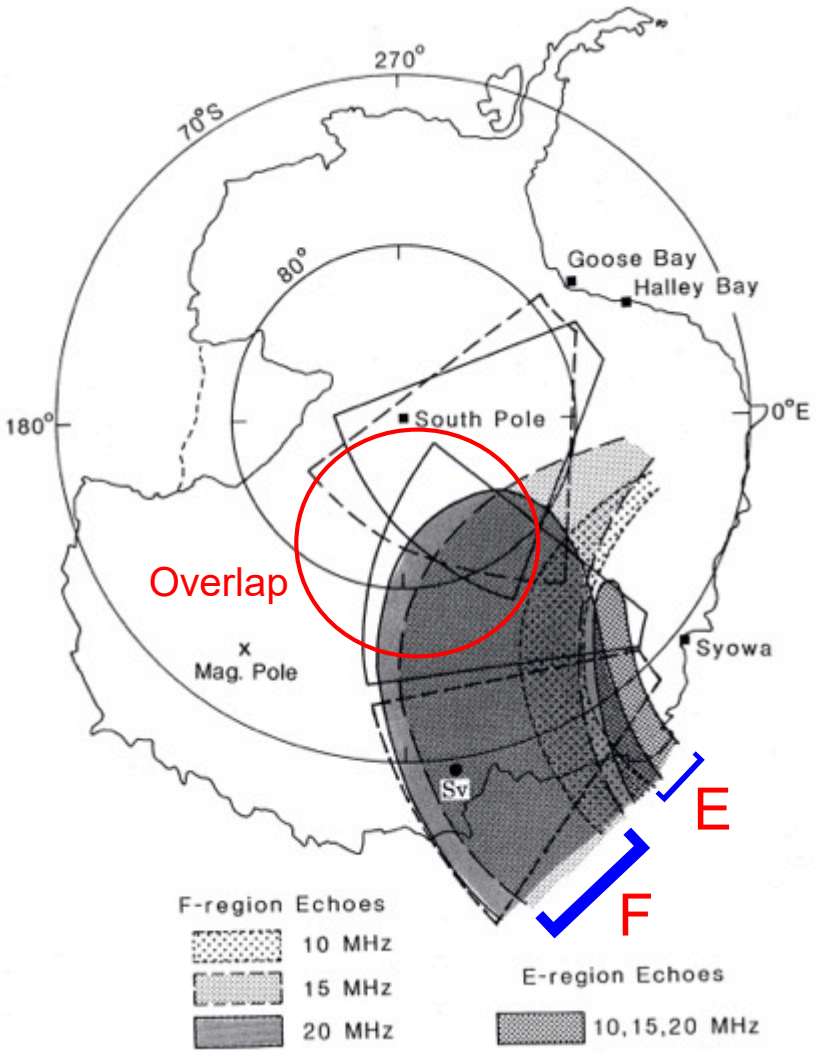
2-1 Nukui-Kitamachi 4, Koganei, Tokyo 184, Japan.

As one of ground-based upper atmosphere observations at a Japanese Antarctic station, Syowa Station (geographic coordinates, 69.00°S, 39.58°E; magnetic coordinates, 66.12°S, 70.71°E; L=6.10), during the forthcoming STEP period (1990-1995), an HF radar experiment for exploring the high-latitude ionosphere is proposed.

Two auroral VHF Doppler radars (50 and 112 MHz) are in operation at Syowa Station for detecting radio auroras in the E-region at slant ranges of 250-400 km. In principle these VHF radars, however, are not applicable to the regions beyond 400 km, that is, the cleft and polar cap regions far poleward of Syowa Station. In order to overcome this defect, we are planning to construct an HF radar capable of detecting back-scattered ionospheric echoes from ranges between 300 and a few thousand kilometers.

An HF radar measures back-scattered power and Doppler spectrum originated from the ionospheric E- and F-region irregularities. Its usefulness for studying plasma convection in the polar cap, cleft and auroral regions, and irregularity production and dissipation mechanisms has already been demonstrated with the HF radars at Goose Bay in Canada and Halley Bay in

(Ogawa et al., 1990)



Sv: EISCAT Svalbard Radar

主な経過：1989年

Working Agreement

添付資料－1

PI間の合意書(案)

7. Term of Agreement

All three parties agree to operate this agreement in a spirit of goodwill and conciliation, bearing in mind the harsh and unpredictable environments in which the three radars will be operated. This agreement will remain in force for so long as the three radars are funded by the sponsoring organisations.

Alterations to this working agreement can only be made by mutual consent of the three PI's.

Signed:	Signed:	Signed:
Prof T Hirasawa	Dr J R Dudeney	Dr R A Greenwald
Date:	Date:	Date:

contractual arrangements agreed between NIPR and ARL for the provision of the Syowa radar system.

主な経過：1989年

Syowaレーダーのプロジェクトチームメンバー

Organization of the Syowa Station HF Radar Experiment

Principal Investigator: Prof. Takeo Hirasawa (National Institute of Polar Research, Japan)

Co-Investigators: Dr. Tadahiko Ogawa (Communications Research Laboratory, Japan)

Prof. Masaki Ejiri (NIPR)

Prof. Natsuo Sato (NIPR)

Dr. Hisao Yamagishi(NIPR)

Dr. Ryoichi Fujii (NIPR)

Mr. Kiyoshi Igarashi (CRL)

主な経過：１９８９年１２月？

佐藤夏雄と藤井良一がAPL訪問：１９８９年１２月？
目的：レーダーの具体的導入（購入）交渉

Greenwald, Dudeny, Pinockが同席

交渉決裂

APL:軍の研究所＝＞　民間商社との取引はダメ
NIPR:国の機関＝＞APLとの直接取引はダメ

解決策

APLが回路図等の詳細情報を提供する＝＞　**国内メーカで製作**（山岸氏中心）

＊1989年、SuperDARNレーダーを製作する3年次の予算が認められた。

＊SuperDARNレーダーを作るには、同レーダーの開発元であるJHU/APLに発注するのが最も早道であったが、事務手続き上の困難があり、国内メーカーに発注することになった。

＊製作の過程では、母子里観測所での開発経験がたいへん役に立った。

＊昭和基地レーダーでは観測視野を大きく広げるため、地磁気の南方向を観測する**Syowa Southレーダー**と、地磁気の東方向を観測する**Syowa Eastレーダーの2基構成**とした。

＊両レーダーの観測視野は『**SENSU**』とした

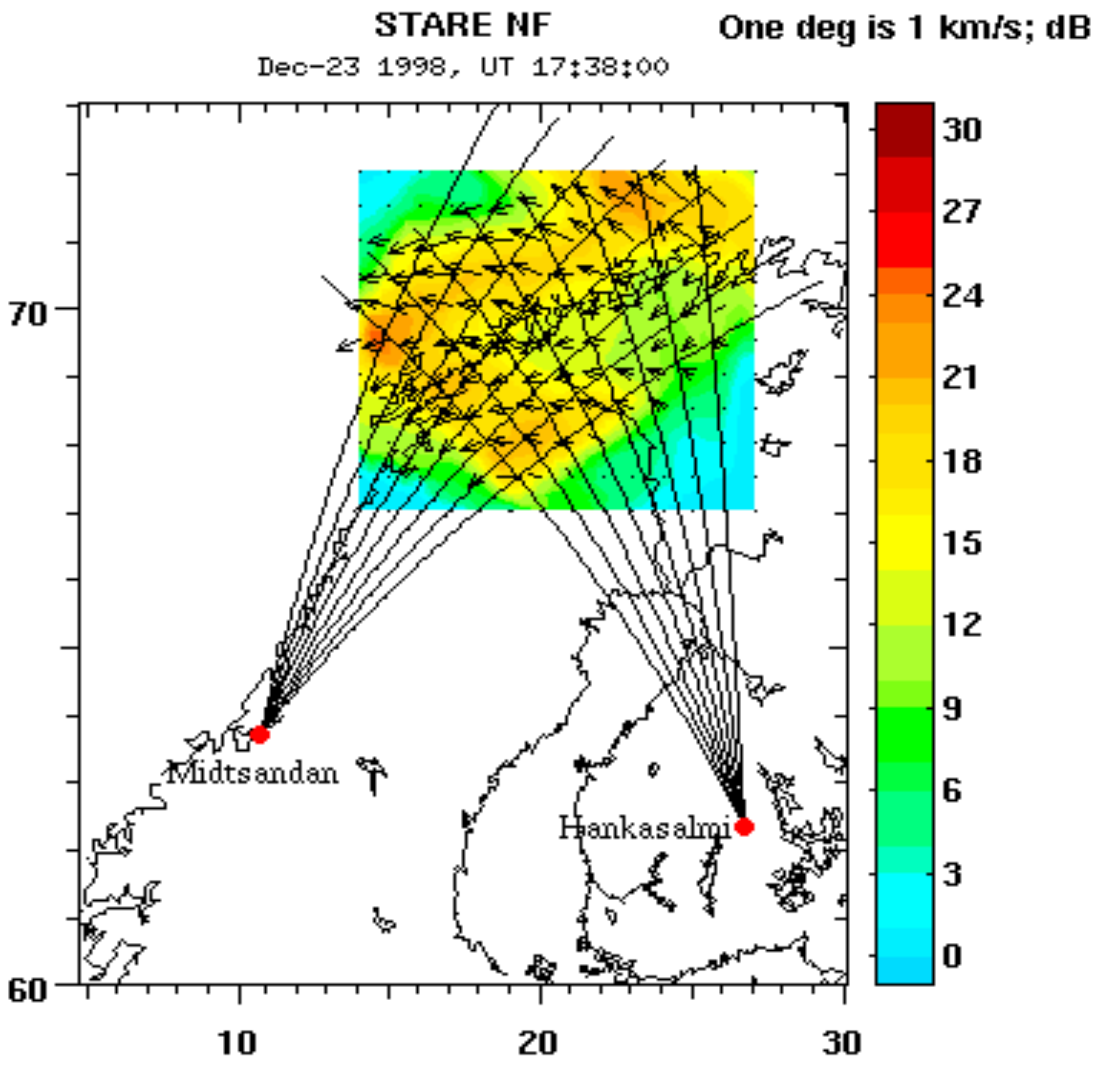
☆1995年には昭和基地を含む8基のSuperDARNレーダーが設置された。

☆この年、これらのレーダーを運営する研究組織の代表者7名は共同研究協定を結び、国際SuperDARN計画が発足した

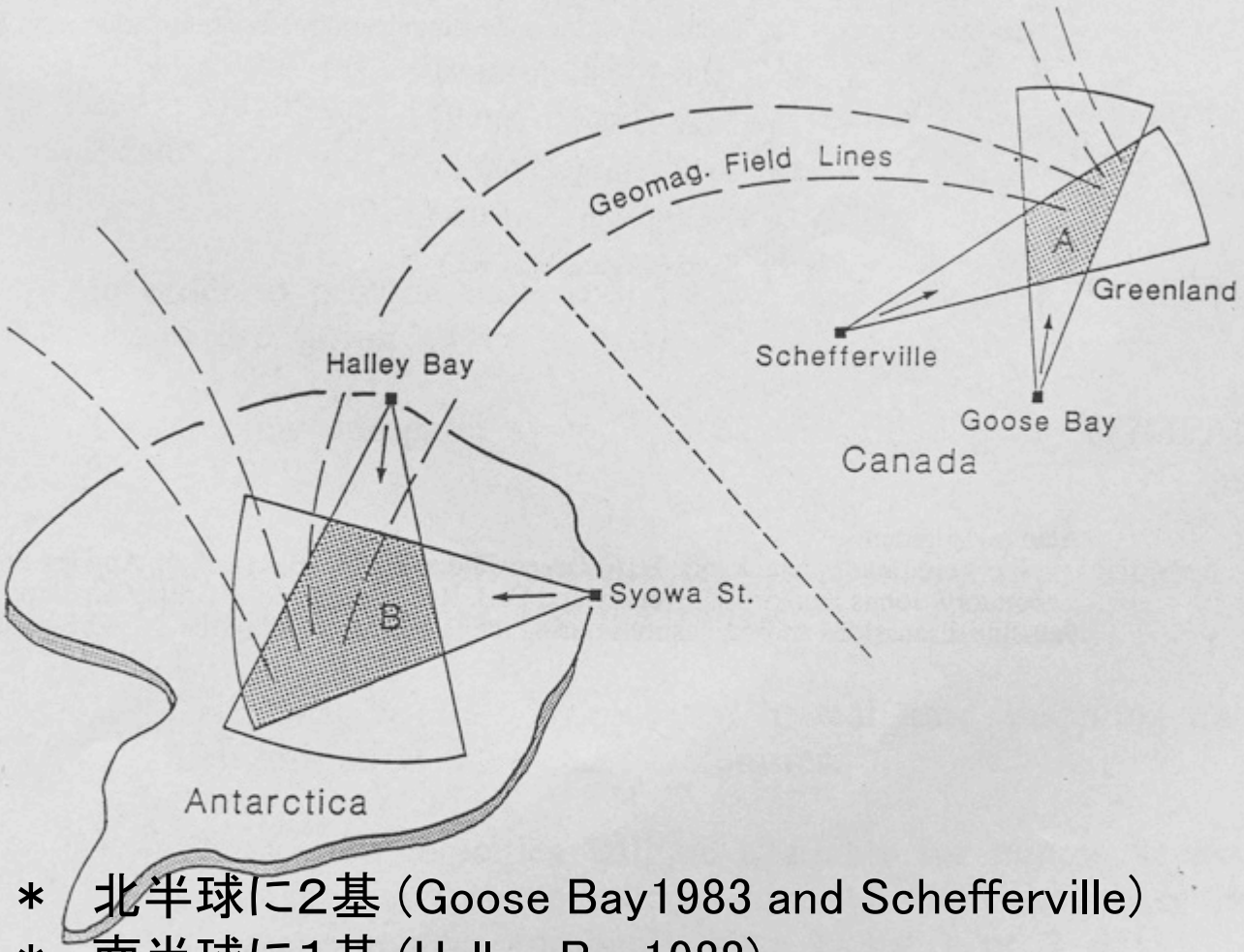
☆昭和基地での建設は山岸氏が主に担当した
＊経緯や苦労などは
=>　この内容は山岸氏が執筆
☆ソフトは行松さんが担当

SuperDARN レーダー網の推移

STAREレーダーの観測データ例



１９８９年代のレーダー配置図

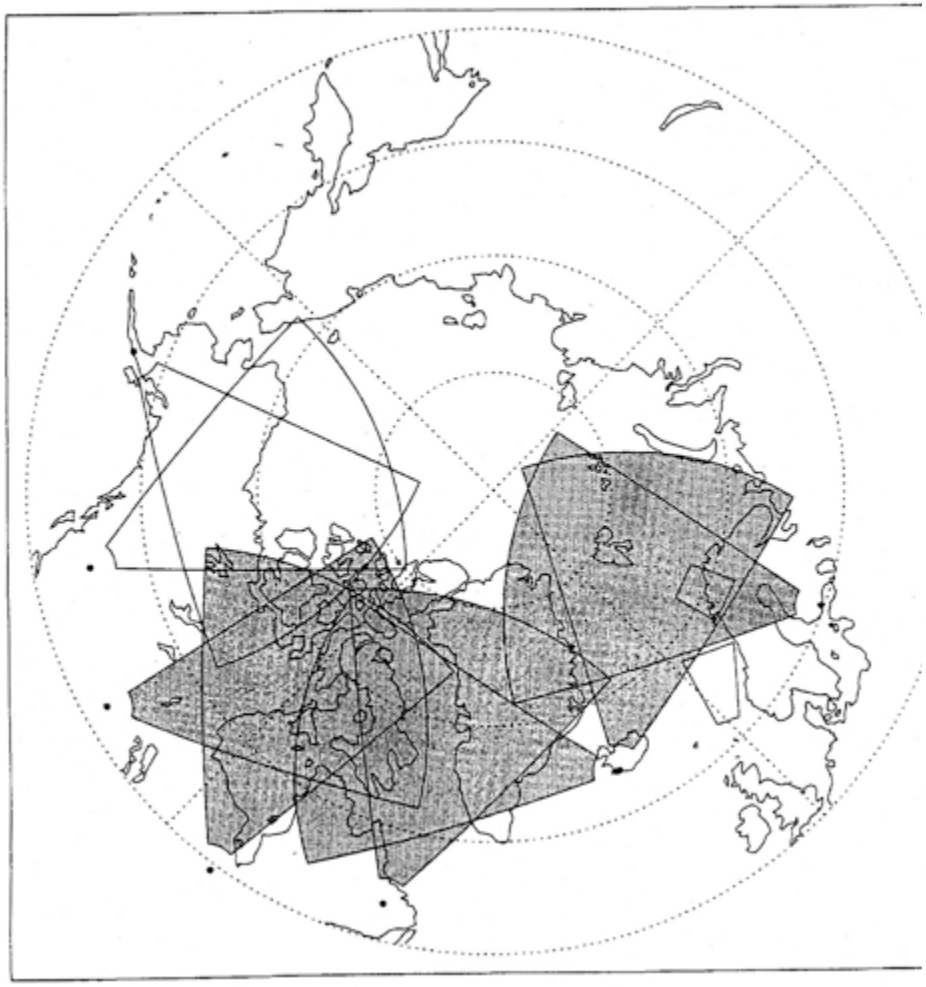


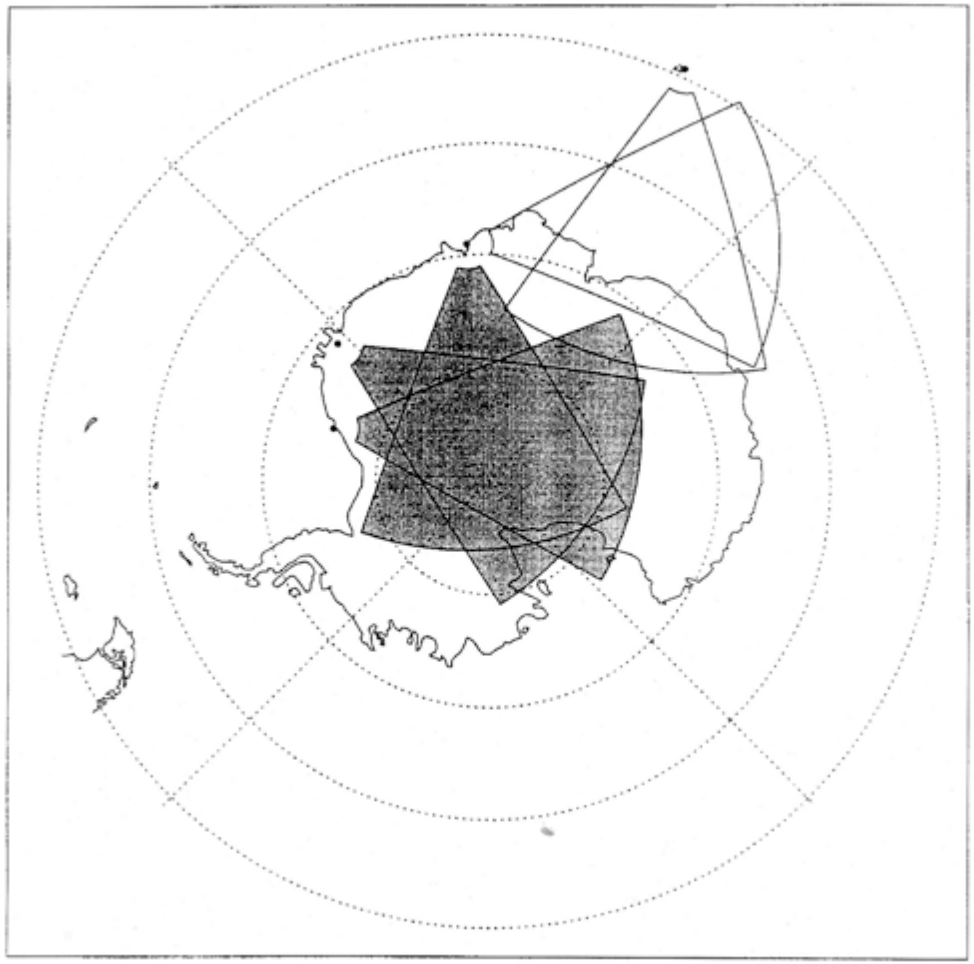
＊　北半球に2基 (Goose Bay1983 and Schefferville)
＊　南半球に1基 (Halley Bay1988)

(Ogawa et al., 1989)

Fig. 2. Schematic illustration of viewing areas by Antarctic twin HF radars (B) and Canadian twin HF radars (A). A and B make a geomagnetically conjugate pair.

１９９５年代のレーダー配置図：Greenwald論文





Greenwald et al., Space Science Review (1995)

白抜きは計画中のレーダー

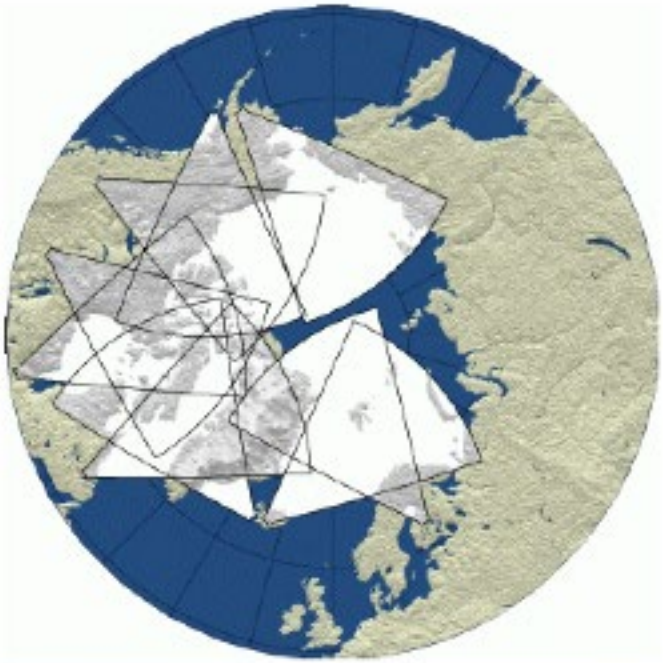
＊この時点では、キングサーモン、北海道レーダーは記載が無い

２００４年代のレーダー配置図

SuperDARN

Super Dual Auroral Radar Network

An International Radar Network for Studying the
Earth's Upper Atmosphere, Ionosphere, and Connection into Space



２００７年：Chisham論文レーダー

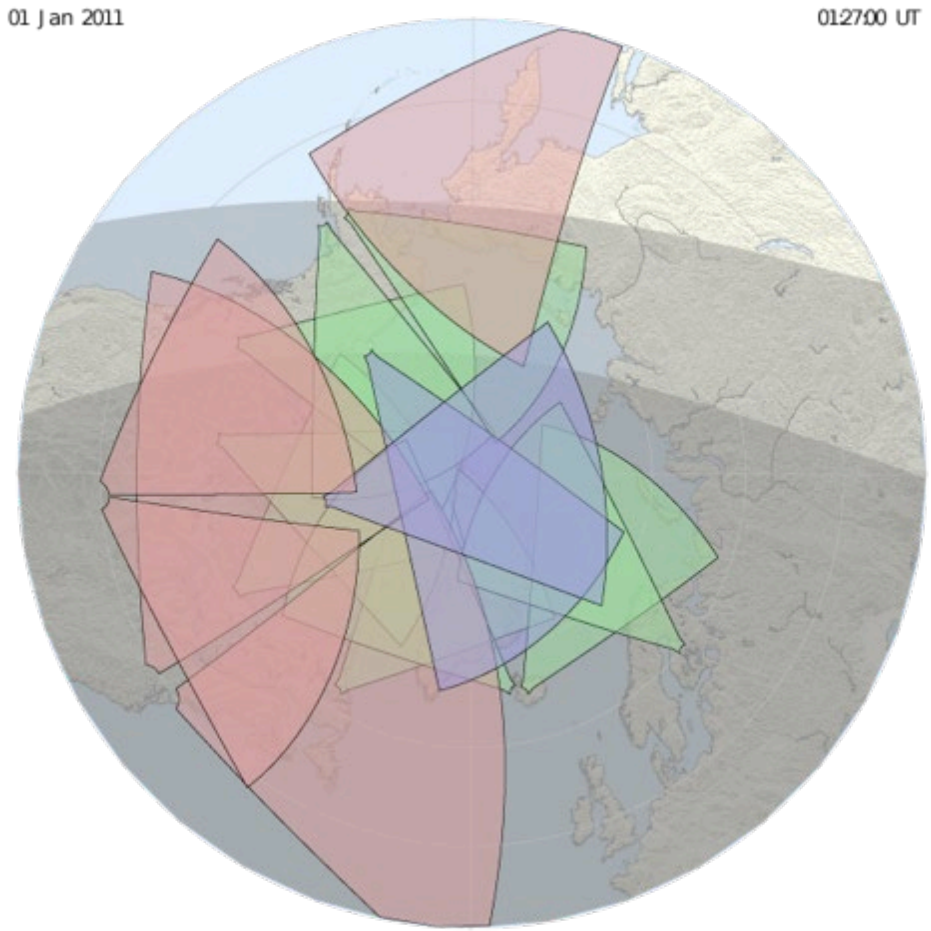
Table 1 Details of all the current SuperDARN radars

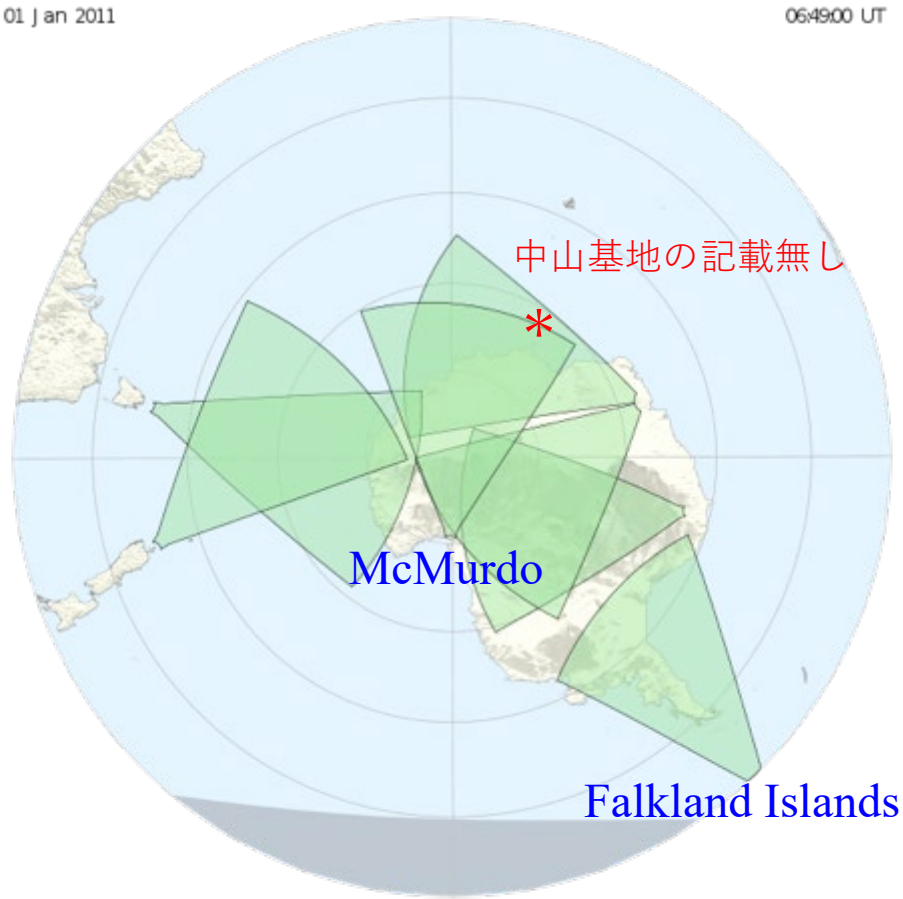
Current SuperDARN Radars					
Radar name	Code		Commenced operation	Geographic co-ordinates	
	Old	New		Latitude	Longitude
Northern hemisphere					
Goose Bay	g	gbr	Oct 1983	53.32° N	60.46° W
Kapuskasing	k	kap	Sep 1993	49.39° N	82.32° W
Saskatoon	t	sas	Sep 1993	52.16° N	106.53° W
Iceland West (Stokkseyri)	w	sto	Aug 1994	63.86° N	22.02° W
CUTLASS Finland (Hankasalmi)	f	han	Jun 1995	62.32° N	26.61° E
CUTLASS Iceland East (Pykkvibaer)	e	pyk	Nov 1995	63.86° N	19.20° W
Kodiak	a	kod	Jan 2000	57.60° N	152.20° W
Prince George	b	pgr	Mar 2000	53.98° N	122.59° W
King Salmon	c	ksr	Oct 2001	58.68° N	156.65° W
Wallops Island	i	wal	Jun 2005	37.93° N	75.47° W
Rankin Inlet	–	rkn	May 2006	62.82° N	93.11° W
Southern hemisphere					
Halley (SHARE)	h	hal	Jan 1988	72.52° S	26.63° W
Syowa South	j	sys	Feb 1995	69.00° S	39.58° E
Sanae (SHARE)	d	san	Feb 1997	71.68° S	2.85° W
Syowa East	n	sye	Feb 1997	69.01° S	39.61° E
Kerguelen	p	ker	Jun 2000	49.35° S	70.26° E
TIGER Tasmania	r	tig	Jan 2001	43.38° S	147.23° E
TIGER Unwin	u	unw	Nov 2004	46.51° S	168.38° E

２０１１年時点でのレーダー配置図

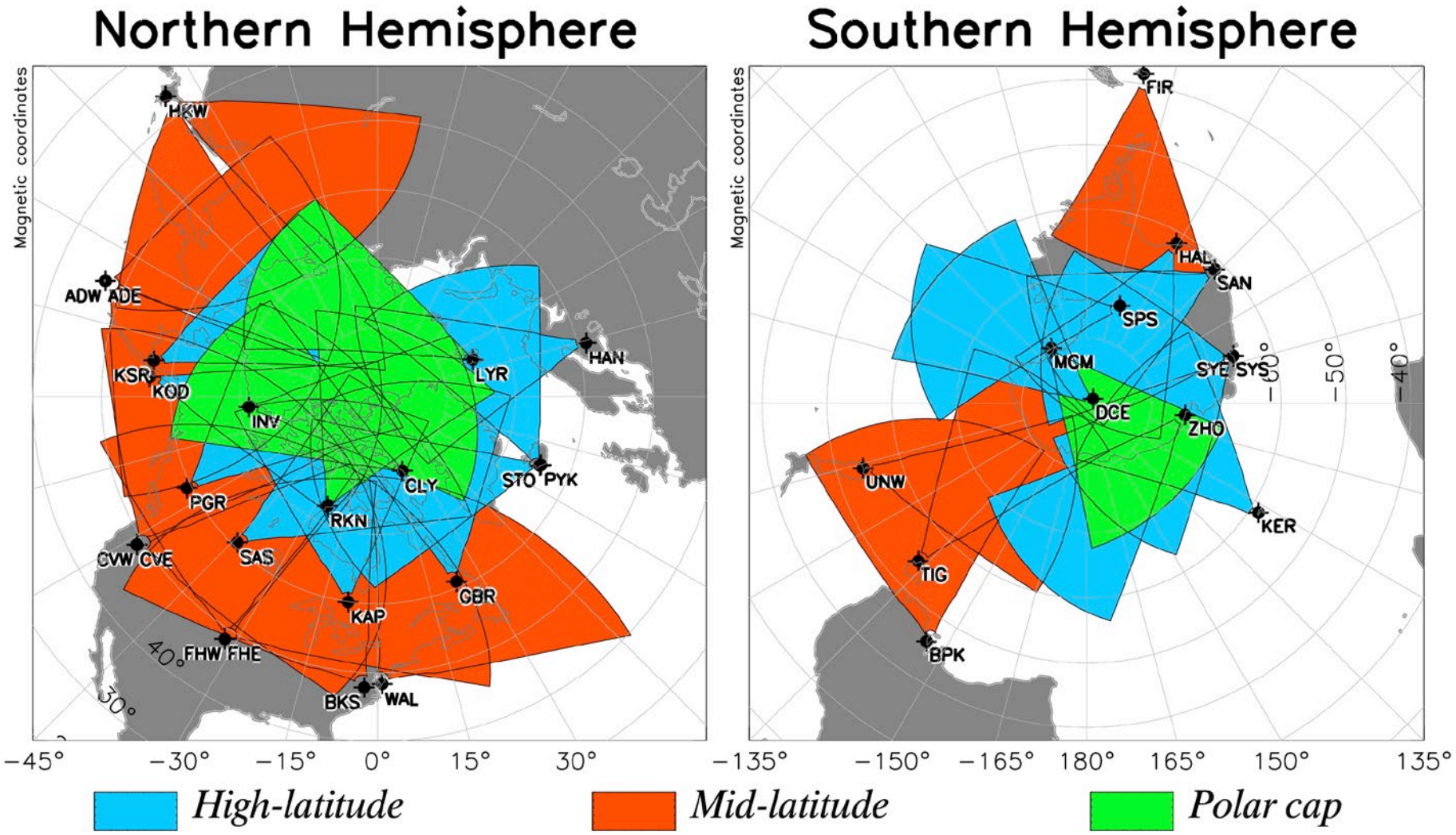
北半球

南半球





２０１8年現在のレーダー配置図



SuperDARNレーダーの観測視野
北半球(23基）　南半球（13基）

SuperDARN Workshopの推移

１９９５年：国際SuperDARNの創設

N. SATO

Report on the SuperDARN Workshop

Cambridge, UK - 2/3/4 May 1995

Natural Environment Research Council
British Antarctic Survey, High Cross, Madingley Rd., Cambridge, CB3 0ET, U.K.

1995 SUPERDARN WORKSHOP
MADINGLEY HALL
1 - 4 May 1995

PROGRAMME

TUESDAY 2 MAY 1995

Session 1:

0900	WELCOME - J R Dudeney
0915	OBJECTIVES OF THE MEETING - R A Greenwald

Session 2: Chairman: M Pinnock

0930	RADAR STATUS REPORTS

5 minute sessions for each radar group except Australians (10 minutes).

Saskatoon APL - Goose Bay, Kapuskasing Stokkseyri Leicester - CUTLASS Halley	M Pinnock *(BAS)*
Vesleskarvet Syowa east and west Kerguelen	N Sato/H Yamagishi *(NIPR)*
Australian radar initiative (10 mins)	P Dyson *(LTU)*
1030	COFFEE

Session 3: Chairman: A S Rodger

1100	SCIENCE STATUS REPORTS (WORK in PROGRESS)

Presentations of science work areas by each institute, limited to 10 minutes per institute.

French	J-C Cerisier *(CETP)*
Japanese,	N Sato *(NIPR)*

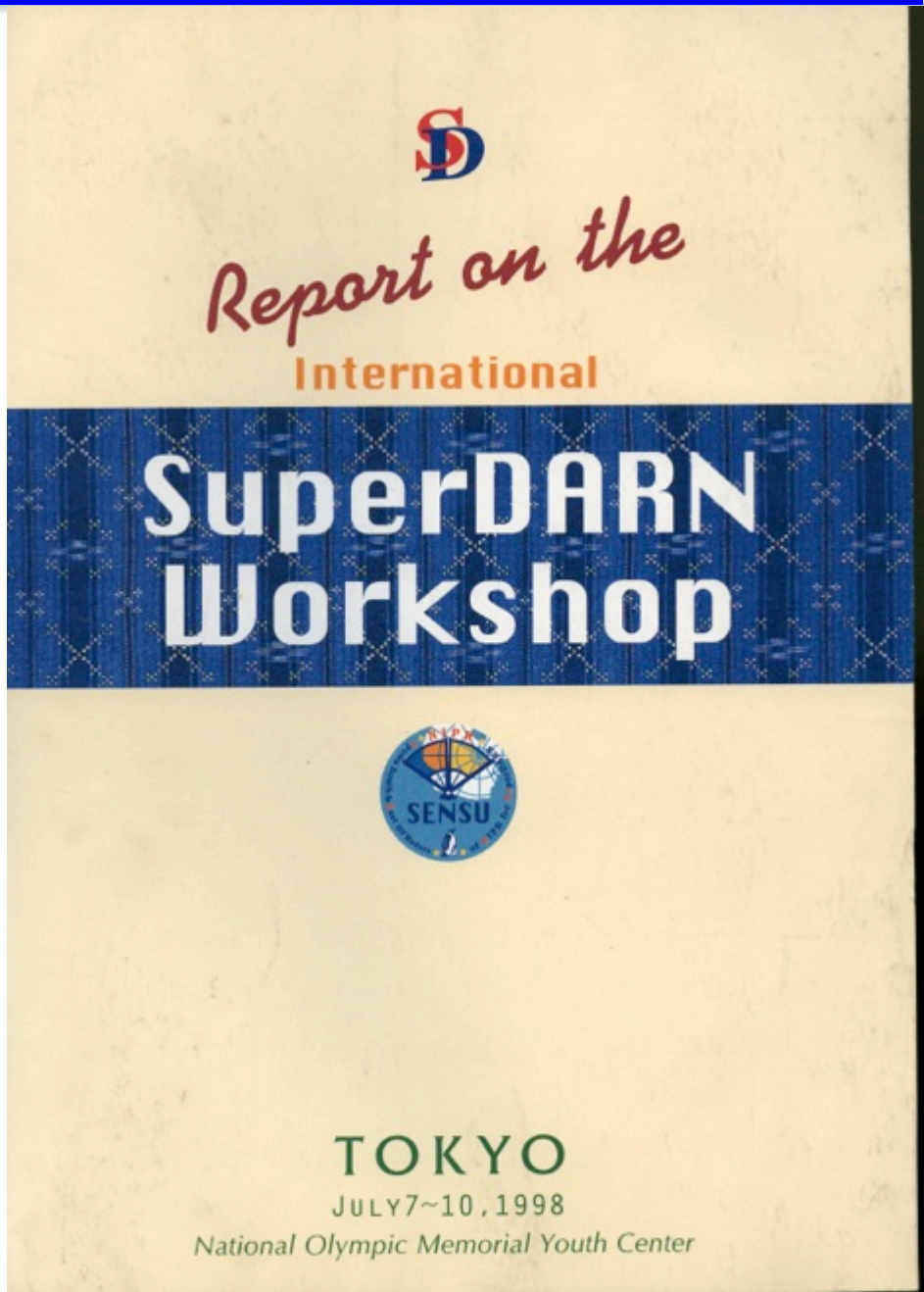
1995年：SuperDARN発足ワークショップ

1997年：南ア_ SuperDARNワークショップ

SuperDARN 97

12–15 May 1997
Itala Game Reserve
South Africa

1998年：東京SuperDARNワークショップ

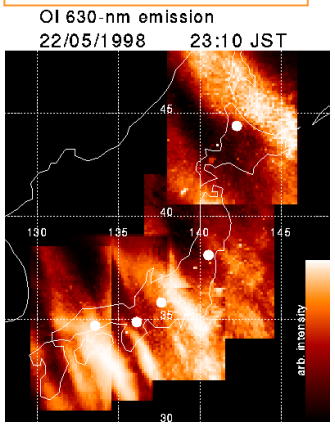


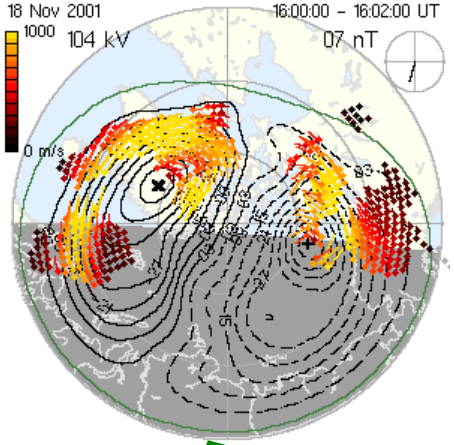
1998年：東京SuperDARNワークショップ

NICT キングサーモン(アラスカ）レーダー （2001年10月稼働）

北海道-陸別SuperDARNレーダー（2006年11月稼働）

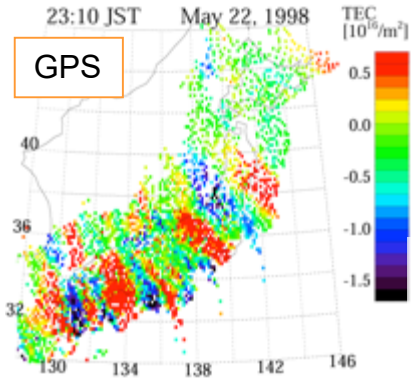
大気光イメージング

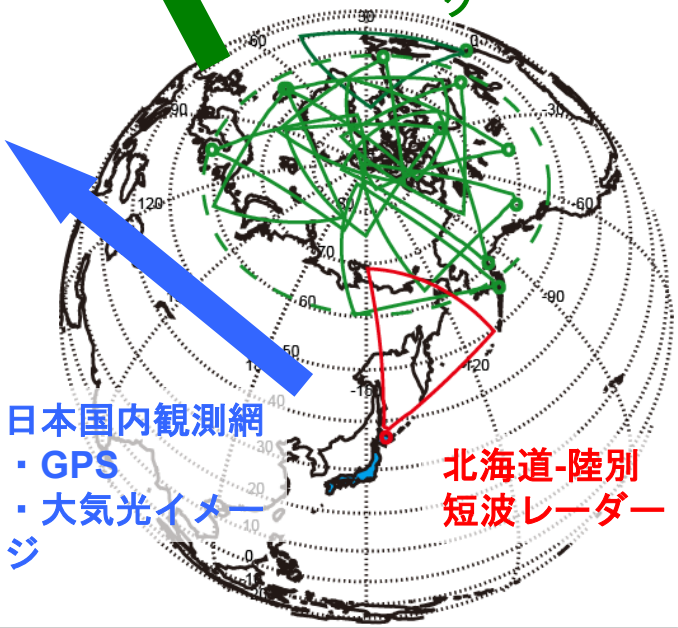




極域短波レーダーネットワーク

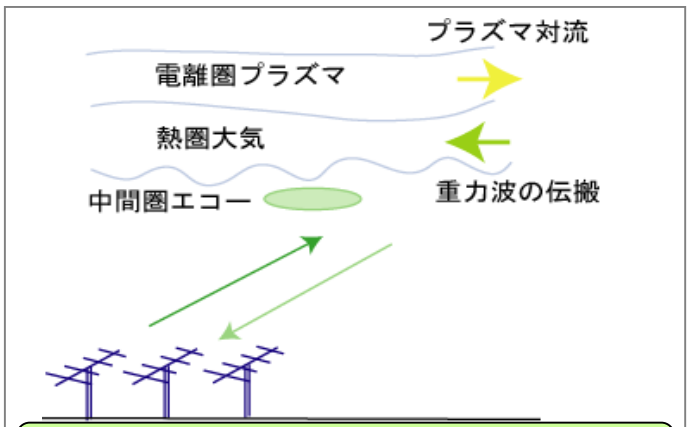
GPS





日本国内観測網
・GPS
・大気光イメージ

北海道-陸別
短波レーダー



電離圏・熱圏・中間圏にわたる観測

従来の観測空白域をカバー
高緯度と中緯度を結ぶ領域のダイナミクスの統一的な解明

2007年：北海道SuperDARNワークショップ

日本のSuperDARN発展史のまとめ

１９８８年：昭和基地レーダーの小川提案
１９８９年：英国BASで開催されたDARN会議で昭和レーダー計画発表
１９８９年：昭和基地レーダーの予算獲得
１９９０年：２基のレーダーを配備する方針
１９９３年：第３４次隊で設置予定場所の整地開始
１９９５年：第３７次隊で第一レーダーを設置
１９９５年：ケンブリッジでSuperDARN発足のPI署名
１９９７年：第３９次隊で第二レーダーを設置
１９９８年：東京SuperDARNワークショップ開催
２００１年：アラスカ・キングサーモンレーダー稼働
２００６年：北海道東レーダー稼働
２００７年：北海道SuperDARNワークショップ開催
２０14年：北海道西レーダー稼働
２０19年：NICT SuperDARNワークショップ開催

冊子題名（案）

「日本のSuperDARNレーダー発展史」

著者
佐藤夏雄、小川忠彦、山岸久雄、行松彰、菊池崇、野崎、西谷望、
長妻努、（著者追加）

掲載骨子（案）

1. HFレーダーの原理と観測手法
   1-1. HFレーダーの原理
   1-2. 観測手法の研究上の利点
2. SuperDARNの創成
   2-1. 創世期
   ＊STAREレーダー
   2-2. 国際SuperDARNの発足
   ＊研究目的
   ＊発足までの経過
   ＊発足ワークショップ
   ＊PI合意書の発効
3. 昭和基地レーダー設置
   ＊経緯
   ＊主な観測成果
   ＊現状と将来計画
4. アラスカ・キングサーモンレーダー
   ＊経緯
   ＊主な観測成果
   ＊現状と将来計画
5. 北海道レーダー
   ＊経緯
   ＊主な観測成果
   ＊現状と将来計画
6.国際SuperDARNの発展の歴史
   8.1 レーダー配備の歴史
   8.2 主な成果と論文数の歴史
   8.3 国際SD Workshop開催地の遍歴
7. 国際SuperDARNの将来展望

日本のSuperDARN発展史のまとめ方

今後の流れ

執筆担当者を決める

共著者からの情報提供

2019　SD Workshop発表準備

2019　SD Workshopで発表

佐藤が執筆のたたき台を提示

各担当者の執筆開始

まとめ作業

完成