



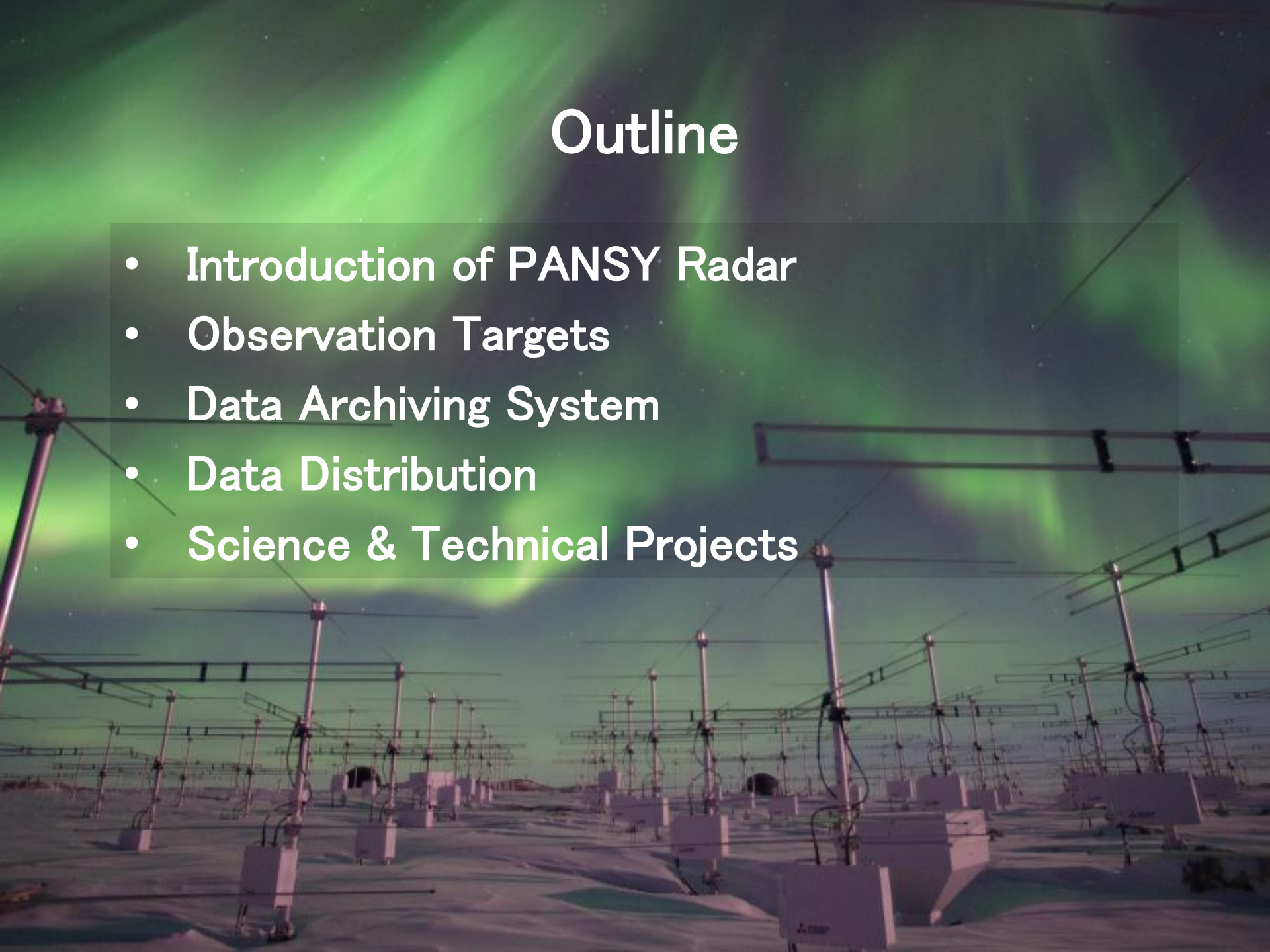
Science Projects of PANSY Radar

Koji Nishimura^{1, 2, 3}

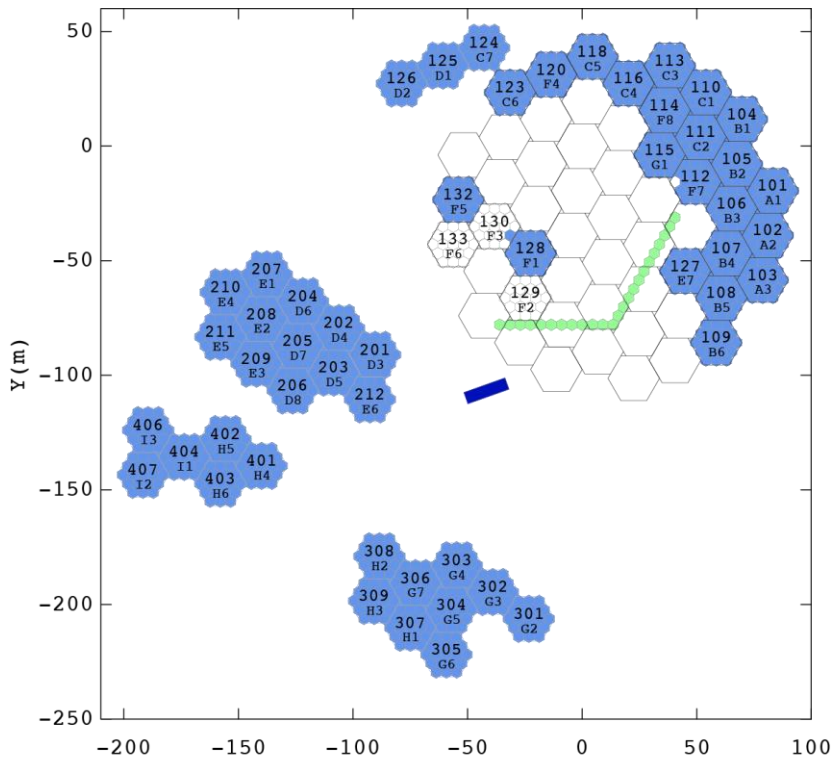
1. Polar Environment Data Science Center, ROIS
2. National Institute Polar Research
3. Graduate University for Advanced Studies

Outline

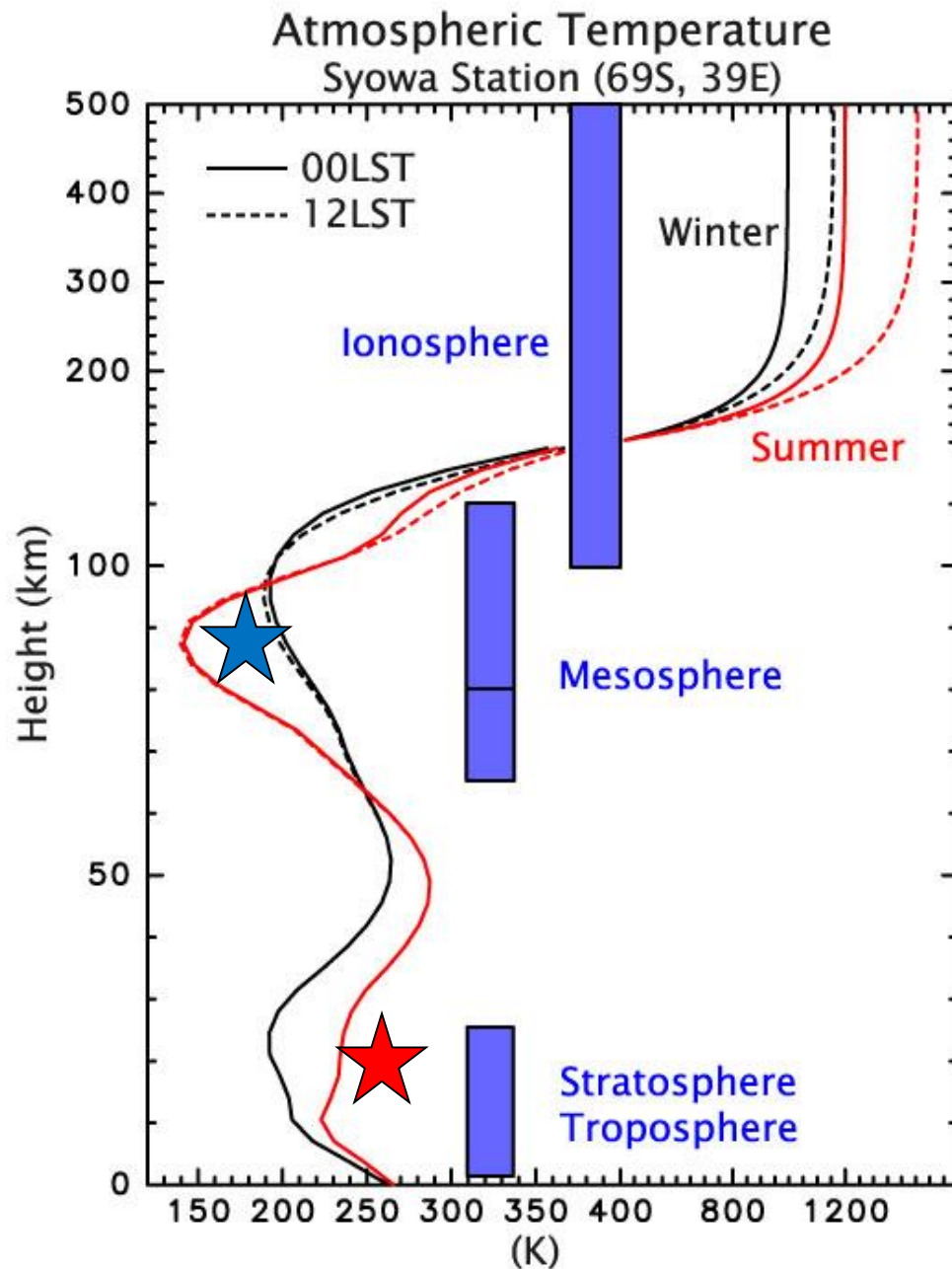
- Introduction of PANSY Radar
- Observation Targets
- Data Archiving System
- Data Distribution
- Science & Technical Projects



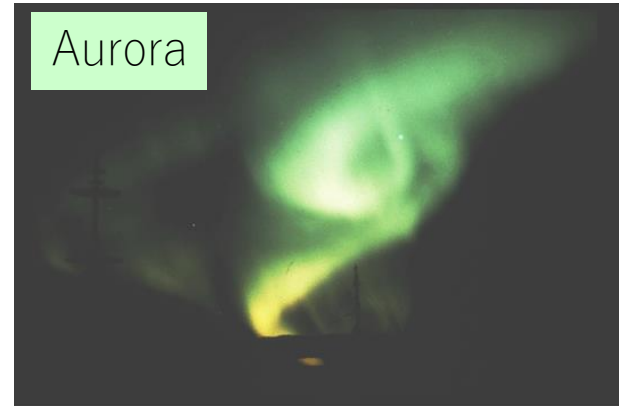
Antenna arrangement has been changed in 2012
to avoid severe snow accumulation.



Temperature Profile above Syowa Sta.



Aurora



PMC



PSC



PANSY Radar & the Data Archiving System

PANSY Radar

Antennas & Power Amps:

Main 1045

FAI (Aux) 24

Aperture 18326 m²

Transmital Pow.

at peak: 500kW

on ave: 25kW

Frequency: 47.0 ± 0.5 MHz

Digital Receiver:

Main: 55 ch

FAI Aux: 8 ch

Radar Output

Data Rate

Regular: 4.3 GByte/day

High-Speed: 1.0 TByte/day

Data Archiving System (PANDA)

At Syowa, PANSY Obs. hut:

Sever: 14

Storage: 500 TByte

At Syowa, Data Proc. Bldg:

Sever: 4

Storage: 200 TByte

At NIPR (Tachikawa Campus)

Server: 9

Storage: 400 TByte

At Univ. Tokyo

Sever: some

Storage: 500 TByte

At Kyoto Univ.

Storage: 100 TByte

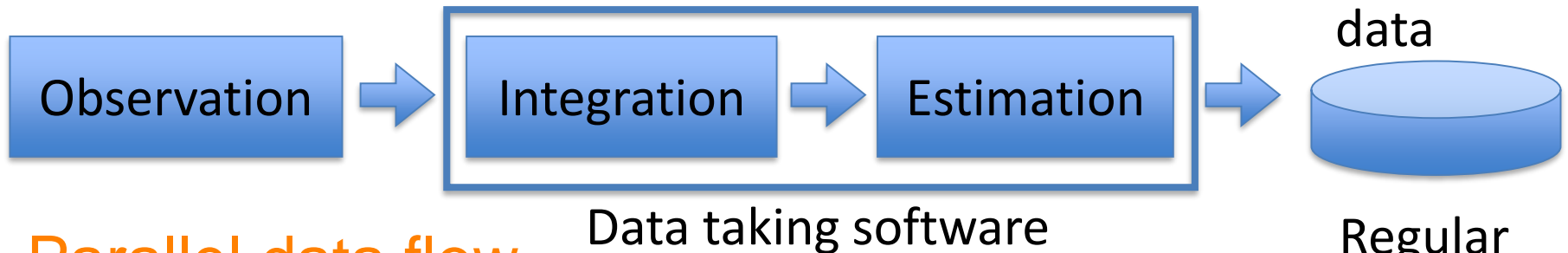
Reduce data are transferred through the satellite.

The full data set is transported on RAID HDDs by the ship once a year.

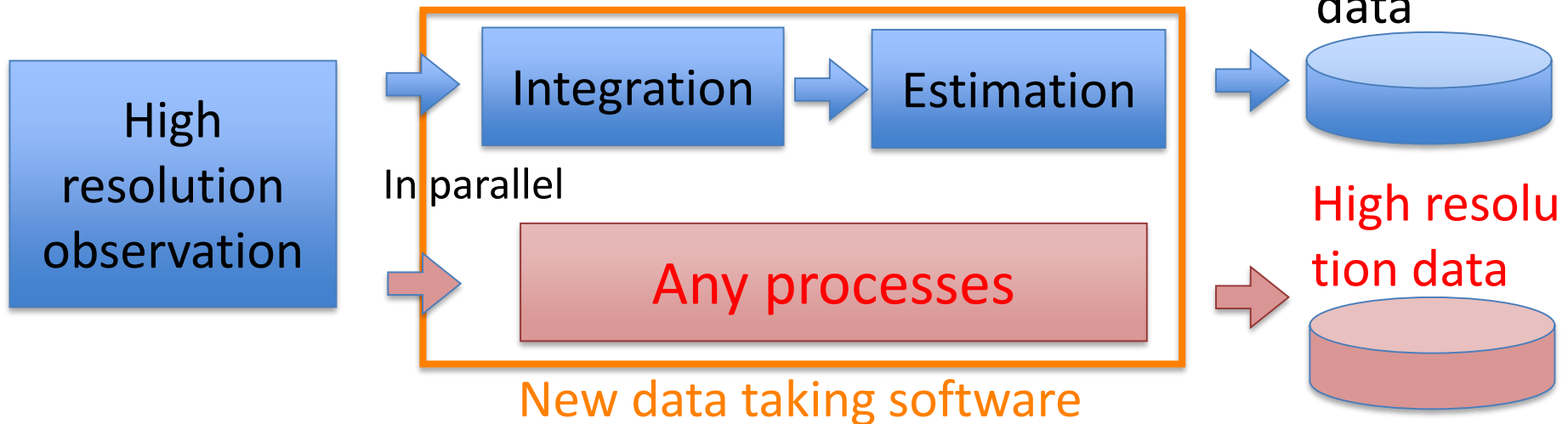
Real Time Data Processing System

Multiple data processing scheme can be applied realtime in parallel.

Ordinary data flow



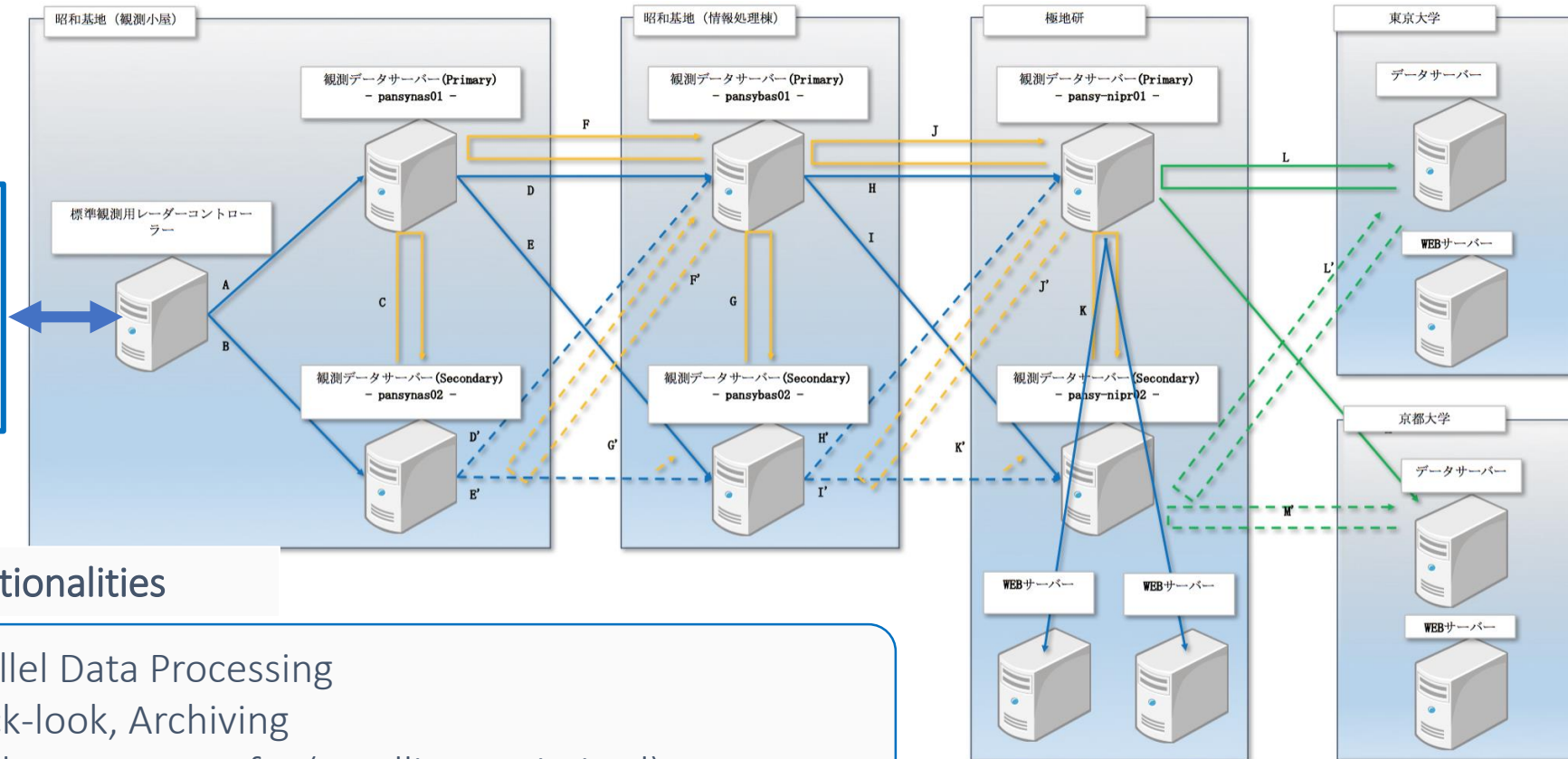
Parallel data flow



To be performed with 44-core computers from December 2019.

PANSY Archiving System (PANDA)

RADAR



Functionalities

- Parallel Data Processing
- Quick-look, Archiving
- Synchronous Transfer (Satellite-Optimized)
- Automatic Re-Route in Error
- Automatic Consistency Check
- Automatic Recovery
- Database Management
- Web-based GUI
- Search & Display

Typical Data Processing Scheme

in Syowa Station

Observation (Radar)

0th Stage Data (Time Series)

PANDA System

1st Stage Data (Time Series)

3MB/min@Regular Obs.

Realtime Data Processing

HDDs are hand-carried to Japan.

2nd Stage Data
(Integrated Spectra)

Integrates to 400kB/min

Quick-Look
Images

QL Snap-shot images
Quick Physical Estimate
Daily, Weekly, Monthly

Transfer via Satellite, Distributed
Archive, QL WEB

Synchronous Transfer
Distributed Data Management

3rd Stage Data (Physical Value)

Public on the web site

in Japan

Quick-Look Viewer (Time-Height Section)

PANSY QuickLook
for Real Time and Archived Data

[Spectra](#) [Time-Height](#) [Observation List](#) [Observation Timeline](#) [Status](#) [Logout](#)

► Time-Height Images

Find Images By Date

2017 ▼

December ▼

Su	Mo	Tu	We	Th	Fr	Sa
26	27	28	29	30	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

< Prev

Day ▼

Next >

↻ Latest

☒ Auto Refresh

▼ Observation Status

Not in Observation

Parameter

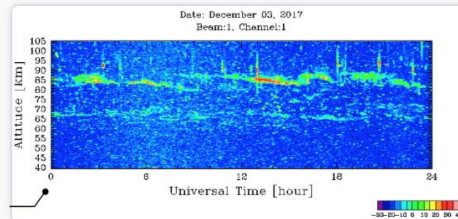
mes800hr1+r,mes800hr1 - dopplfit ▼

Observation Time (UT)

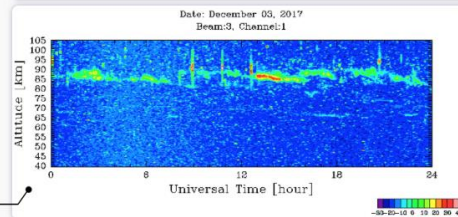
02-Dec-2017 23:55:09 - 04-Dec-2017 00:06:18

▼ Beam Echo Images ▲

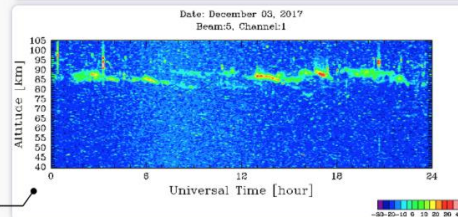
Zenith Beam



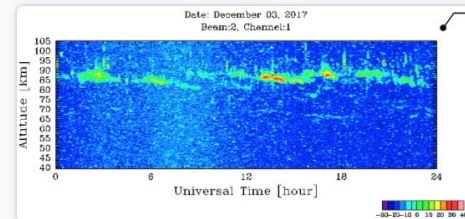
East Beam



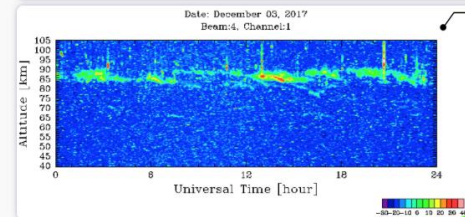
Beam



North Beam



South Beam



QL Viewer

(System Status Monitor)

▼ Observation Data Flow ^

```
graph LR; pansy01 -- QL --> pansynas03; pansy01 -- Archive --> pansynas03; pansy01 -- Raw Archive --> pansynas02; pansynas03 -- Archive --> pansybas01; pansynas03 -- QL --> pansybas01; pansynas02 -- Archive --> pansybas01; pansynas02 -- QL --> pansybas01; pansynas02 -- Archive --> pansybas02; pansybas01 -- Archive --> pansynipr01; pansybas01 -- QL --> pansynipr01; pansybas01 -- Archive(Sync) --> pansynipr01; pansybas01 -- Archive(Sync) --> pansynipr02; pansybas01 -- Archive(Sync) --> pansynipr03; pansybas01 -- Archive(Sync) --> pansybas02; pansynipr01 -- Archive --> pansynipr02; pansynipr01 -- QL --> pansynipr02; pansynipr01 -- Archive(Sync) --> pansynipr02; pansynipr01 -- Archive(Sync) --> pansynipr03; pansynipr01 -- Archive(Sync) --> pansybas02; pansynipr02 -- Archive(Sync) --> pansynipr03; pansynipr02 -- Archive(Sync) --> pansybas02; pansynipr03 -- Archive(Sync) --> pansybas02;
```

▼ Status Details ^

▼ pansy01 - up ^

Process	Run Status	Process Status	Connection Status				Latest Data
			Server Name	Status	Last Connected Time (UT)		
panda_obsarchiver	up - normal	normal	-	-	-		-
panda_obsarchiver_rawdata	up - normal	normal	-	-	-		-
panda_obstransmitter	up - normal	normal	pansynas03	connected	05-Dec-2017 05:24:23		/data/Archive/2017/20171204.194113_st320nc3_001.tar
panda_obstransmitter_rawdata	up - normal	normal	pansynas02	connected	05-Dec-2017 05:24:50		/data/RawArchive/2017/20171205.045021.tar
panda_obssweeper	up - normal	normal	pansynas03	connected	05-Dec-2017 04:39:50		-
panda_obssweeper_rawdata	up - normal	normal	pansynas02	connected	05-Dec-2017 04:56:10		-


- Connected (Transfer A to B)
- Connected (Download from B to A)
- Unconnected (Reserve Route)
- Disconnected (Error)
- Connected (on Reserve Route)

Data Sharing

- Processed wind estimates (6-hourly) are open to the public on the web site.

<http://pansy.eps.s.u-tokyo.ac.jp/data/>

- This will be upgraded to 30-min resolution next year, and the DOIs will be tagged.




南極昭和基地大型大気レーダー計画
Program of the Antarctic Syowa MST/IS Radar

[▶ English](#)
[お問い合わせ](#)

HOME	About PANSY PANSYについて	Research Topics 研究課題
Publications 成果	Members メンバー	Installation 設置の様子
Data 観測データ		

HOME > 観測データ



PANSYの観測データ

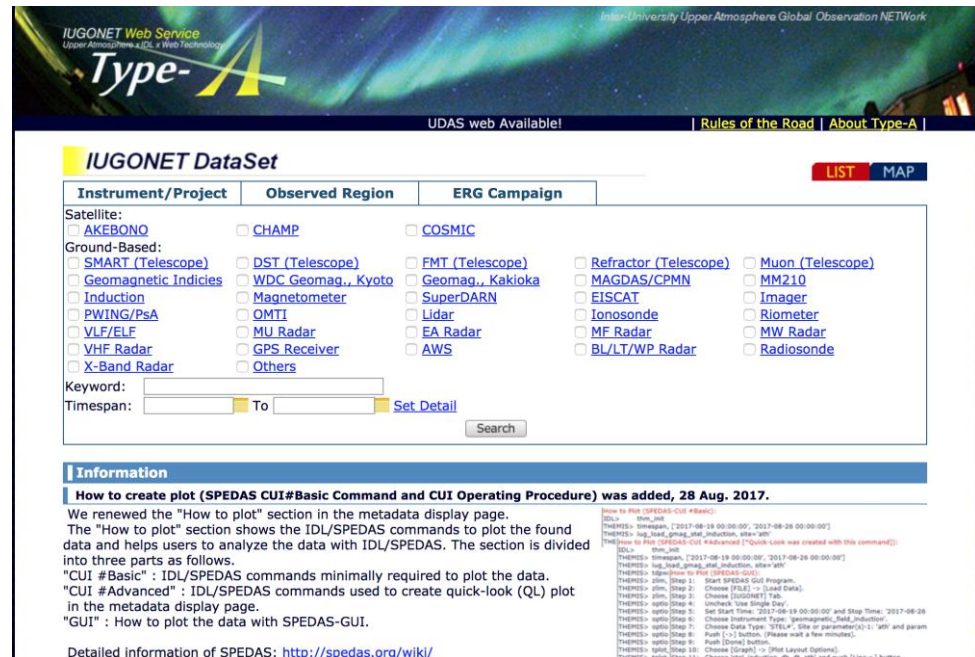
2017年

Jan. 2017	Feb. 2017	Mar. 2017
1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20	11 12 13 14 15 16 17 18 19 20	11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30	21 22 23 24 25 26 27 28	21 22 23 24 25 26 27 28 29 30
31		31
Apr. 2017	May 2017	Jun. 2017
1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20	11 12 13 14 15 16 17 18 19 20	11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30	21 22 23 24 25 26 27 28 29 30	21 22 23 24 25 26 27 28 29 30
	31	
Jul. 2017	Aug. 2017	Sep. 2017
1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20	11 12 13 14 15 16 17 18 19 20	11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30	21 22 23 24 25 26 27 28 29 30	21 22 23 24 25 26 27 28 29 30
31	31	

Data Distribution

IUGONET (www.iugonet.org)
Metadata database

- Data currently in public are to be registered to IUGONET by Mar 2018.
- Further coming data will also be registered as it will be in public on the web site.



IUGONET Web Service
Upper Atmosphere & IGC - Web Technology
Type-A

UDAS web Available! | Rules of the Road | About Type-A

IUGONET DataSet

Instrument/Project **Observed Region** **ERG Campaign**

Satellite: ☐ AKEBONO ☐ CHAMP ☐ COSMIC

Ground-Based: ☐ SMART (Telescope) ☐ DST (Telescope) ☐ FMT (Telescope) ☐ Refractor (Telescope) ☐ Muon (Telescope)

☐ Geomagnetic Indices ☐ WDC Geomag., Kyoto ☐ Geomag., Kakioka ☐ MAGDAS/CPMN ☐ MM210

☐ Induction ☐ Magnetometer ☐ SuperDARN ☐ EISCAT ☐ Imager

☐ PWING/PsA ☐ OMTI ☐ Lidar ☐ Ionosonde ☐ Riometer

☐ VLF/ELF ☐ MU Radar ☐ EA Radar ☐ MF Radar ☐ MW Radar

☐ VHF Radar ☐ GPS Receiver ☐ AWS ☐ BL/LT/WP Radar ☐ Radiosonde

☐ X-Band Radar ☐ Others

Keyword:

Timespan: To [Set Detail](#)

Information

How to create plot (SPEDAS CUI#Basic Command and CUI Operating Procedure) was added, 28 Aug. 2017.

We renewed the "How to plot" section in the metadata display page. The "How to plot" section shows the IDL/SPEDAS commands to plot the found data and helps users to analyze the data with IDL/SPEDAS. The section is divided into three parts as follows.

"CUI #Basic" : IDL/SPEDAS commands minimally required to plot the data.

"CUI #Advanced" : IDL/SPEDAS commands used to create quick-look (QL) plot in the metadata display page.

"GUI" : How to plot the data with SPEDAS-GUI.

Detailed information of SPEDAS: <http://spedas.org/wiki/>

Data Publication Web Site (in preparation)

Administration Side

PANSY Data Archive
About Policy Description Login [guest mode]

home > PANSY MST observation data > Download of PANSY MST observation data

Download of PANSY MST observation data

May, 2015 Stratosphere/Troposphere

Login by approved login is required for download.

Day	Region	Version	3min	30min
1	st	1.0	CSV NetCDF	CSV NetCDF
2	st	1.0	CSV NetCDF	CSV NetCDF
3	st	1.0	CSV NetCDF	CSV NetCDF
4	st	1.0	CSV NetCDF	CSV NetCDF
5	st	1.0	CSV NetCDF	CSV NetCDF
6	st	1.0	CSV NetCDF	CSV NetCDF
7	st	1.0	CSV NetCDF	CSV NetCDF
8	st	1.0	CSV NetCDF	CSV NetCDF
9	st	1.0	CSV NetCDF	CSV NetCDF
10	st	1.0	CSV NetCDF	CSV NetCDF
11	st	1.0	CSV NetCDF	CSV NetCDF
12	st	1.0	CSV NetCDF	CSV NetCDF
9	st	1.0	CSV NetCDF	CSV NetCDF
10	st	1.0	CSV NetCDF	CSV NetCDF
11	st	1.0	CSV NetCDF	CSV NetCDF
12	st	1.0	CSV NetCDF	CSV NetCDF
13	st	1.0	CSV NetCDF	CSV NetCDF
14	st	1.0	CSV NetCDF	CSV NetCDF
15	st	1.0	CSV NetCDF	CSV NetCDF
16	st	1.0	CSV NetCDF	CSV NetCDF

PANSY Data Archive
About Policy Description Login [guest mode]

home > PANSY MST observation data

PANSY MST observation data

2015

1	2	3	4	5	6	7	8	9	10	11	12
	st	st	st	st	st	st	st	st	st	st	st
	m	m	m	m	m	m	m	m	m	m	m

Public Side

PANSY Data Archive
About Policy Description Logout [User : root]

home > User page > Upload release data

Upload release data

[Select file](#) [Upload](#)

Filename	Region	Time interval	Version	yyyyMMdd	Extension
st_30_V010_20150101.nc	st	30	010	2015/01/01	nc
st_30_V010_20150101.zip	st	30	010	2015/01/01	zip
st_30_V010_20150102.nc	st	30	010	2015/01/02	nc
st_30_V010_20150102.zip	st	30	010	2015/01/02	zip
st_30_V010_20150103.nc	st	30	010	2015/01/03	nc
st_30_V010_20150103.zip	st	30	010	2015/01/03	zip
st_30_V010_20150104.nc	st	30	010	2015/01/04	nc
st_30_V010_20150104.zip	st	30	010	2015/01/04	zip
st_30_V010_20150105.nc					
st_30_V010_20150105.zip					

PANSY Data Archive
About Policy Description Logout [User : root]

home > Management users information > User information

User information

Login ID: root [Initialize password](#)

First Name: Manager E-mail: master@dummy.com

Last Name: System Evening Phone: 000-0000-0000

Purpose of using data: システム管理専用アカウント

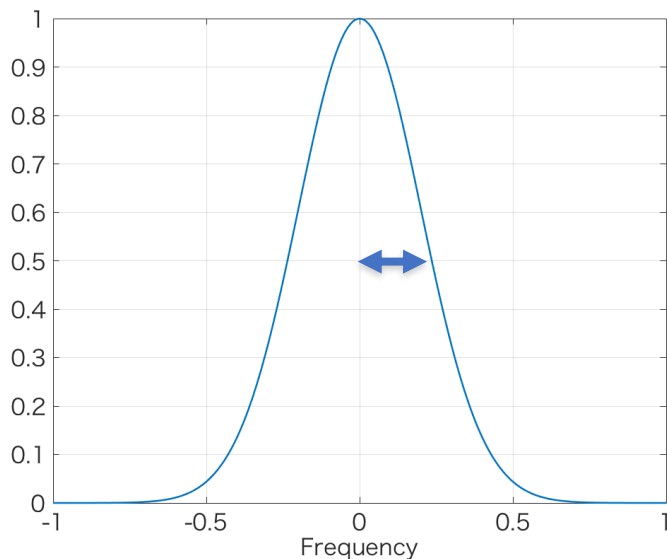
The Company: Country:

Postal Code: Address:

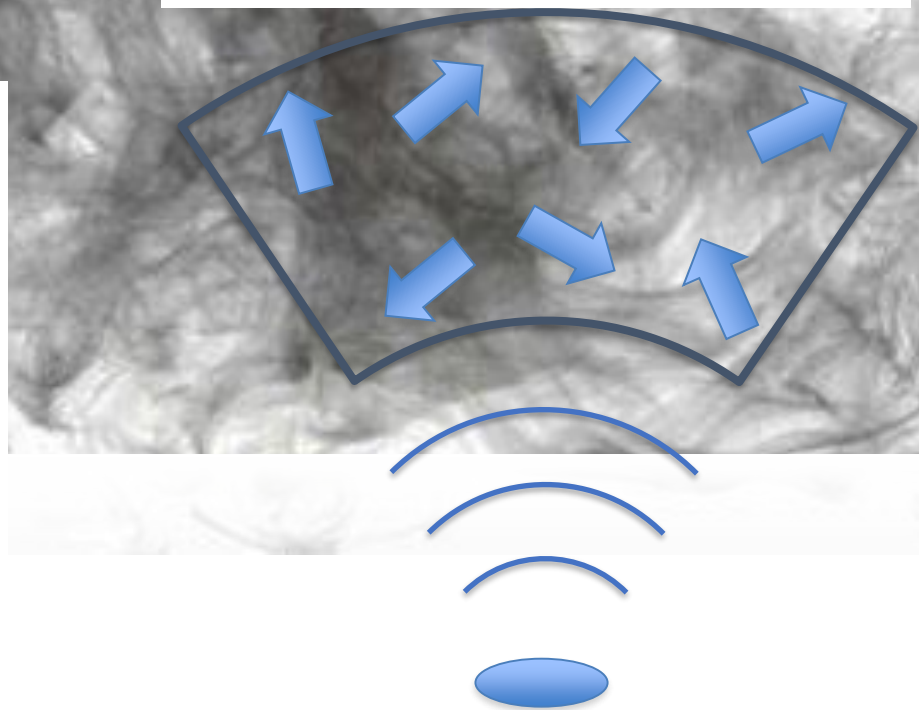
風速スペクトルと乱流パラメータ

乱流による速度分散がスペクトルの広がり to 寄与する

風速スペクトル



散乱ボリューム内の乱流

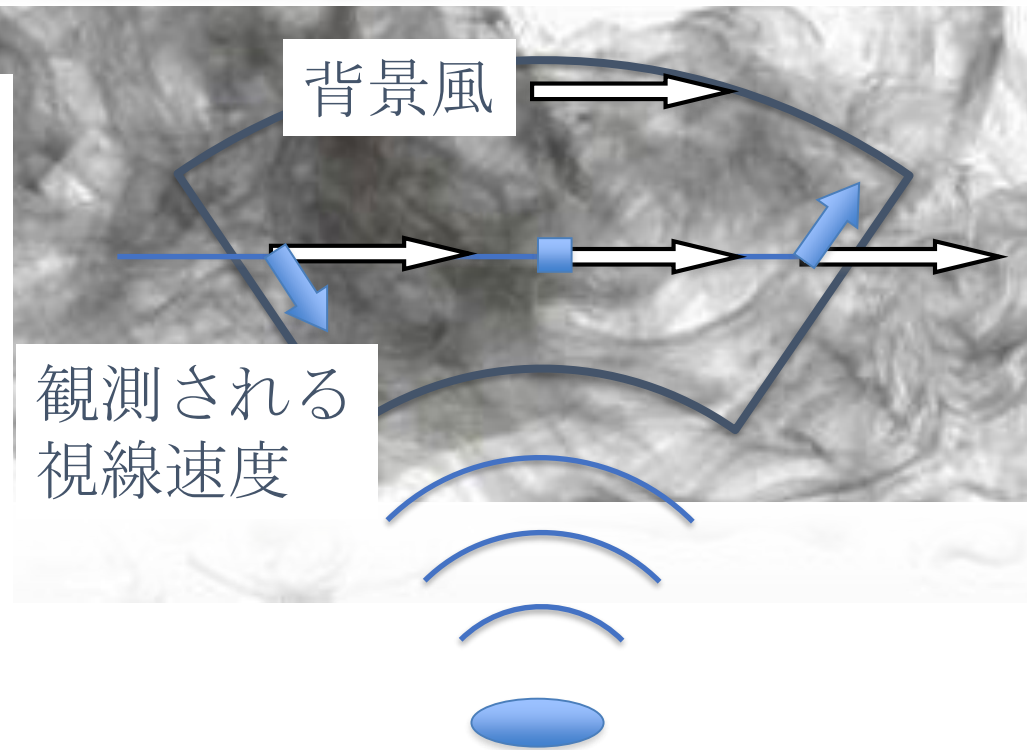
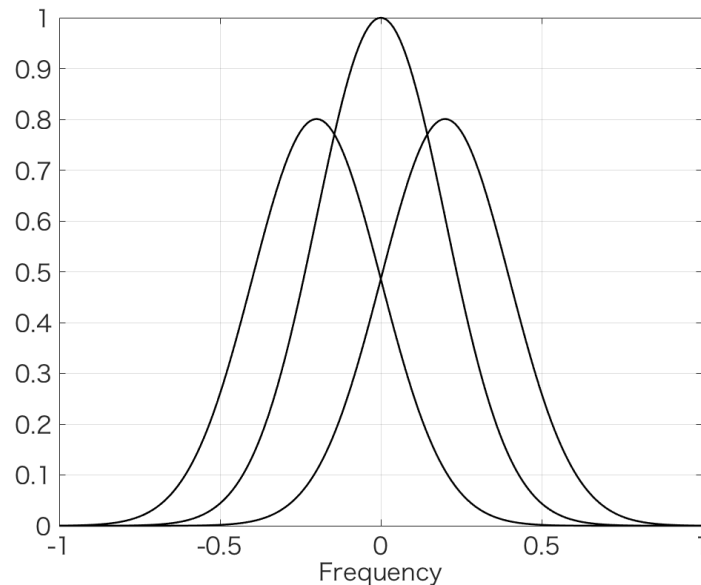


エネルギー消散率 ε が $\sigma_T^2 = K\varepsilon^{2/3}$ から求まる

ビームブロードニング

一様な背景風がビーム広がりのためにスペクトル幅に寄与

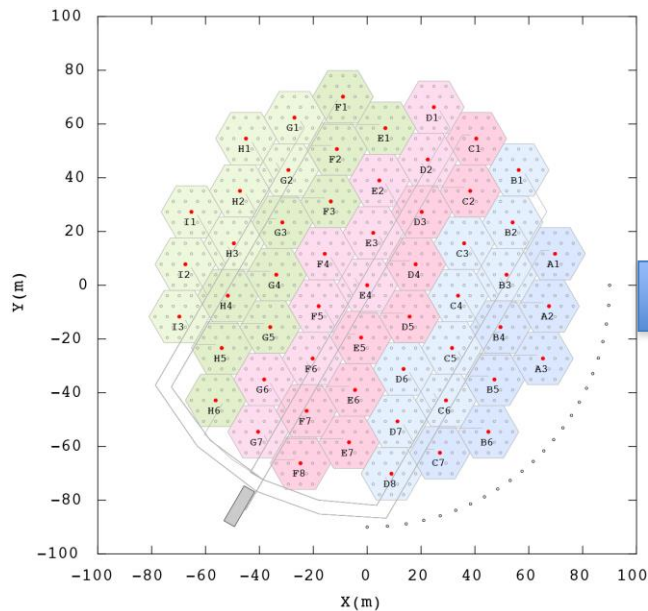
風速スペクトル



この効果が非常に大きく乱流パラメータを得るためには除去する必要がある．ビーム形状と風速で決まる．

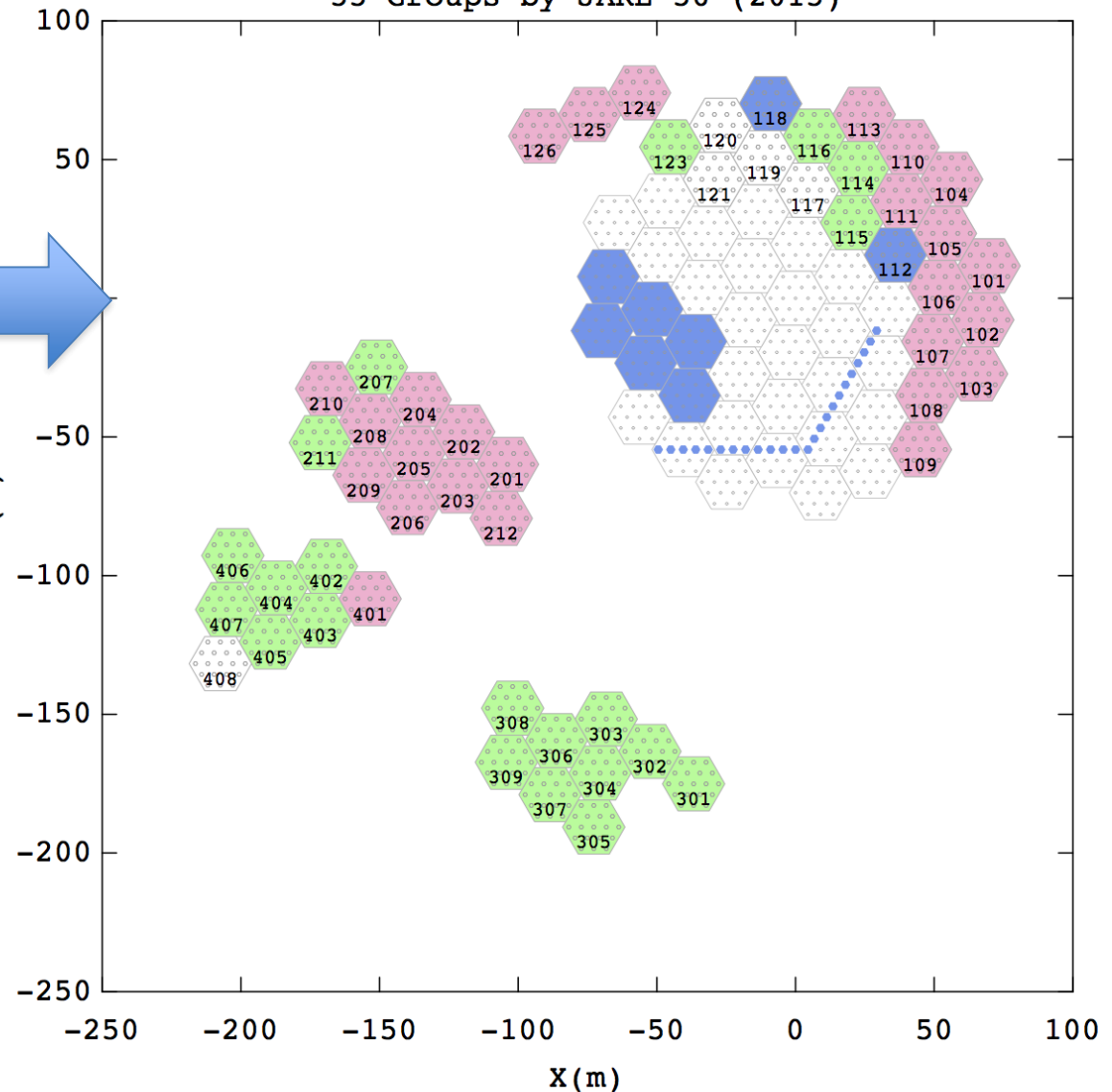
PANSYのアンテナレイアウト

2011



オリジナル配列

55 Groups by JARE 56 (2015)



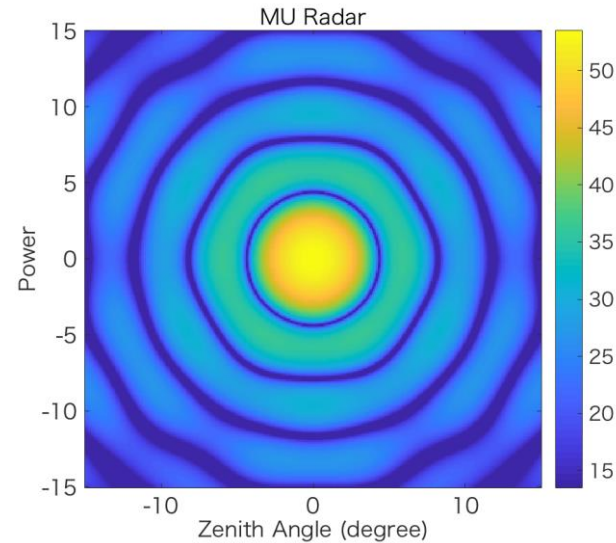
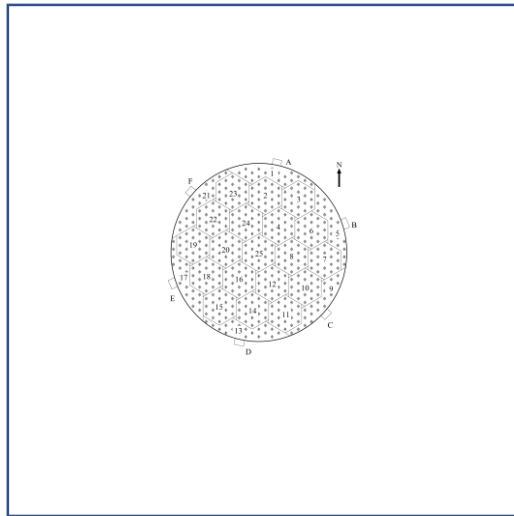
雪による埋没を避けるため2012年に大幅にレイアウトを変更

PANSYのアンテナレイアウト

アンテナ配置

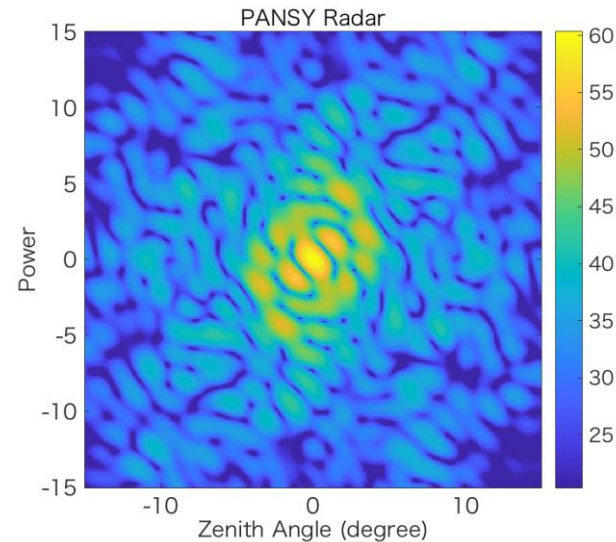
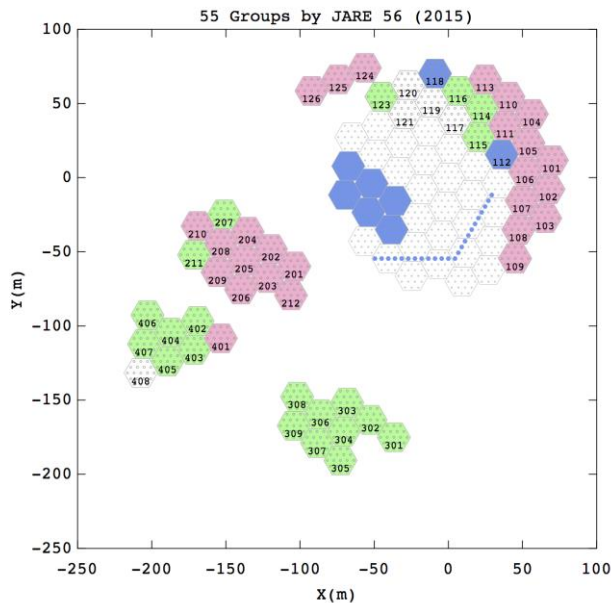
ビームパターン

MULレーダー



サイドローブ小
対称性高

PANSYレーダー



サイドローブ高
対称性低

フィールドグリッド化

受信信号を離散形式で定式化

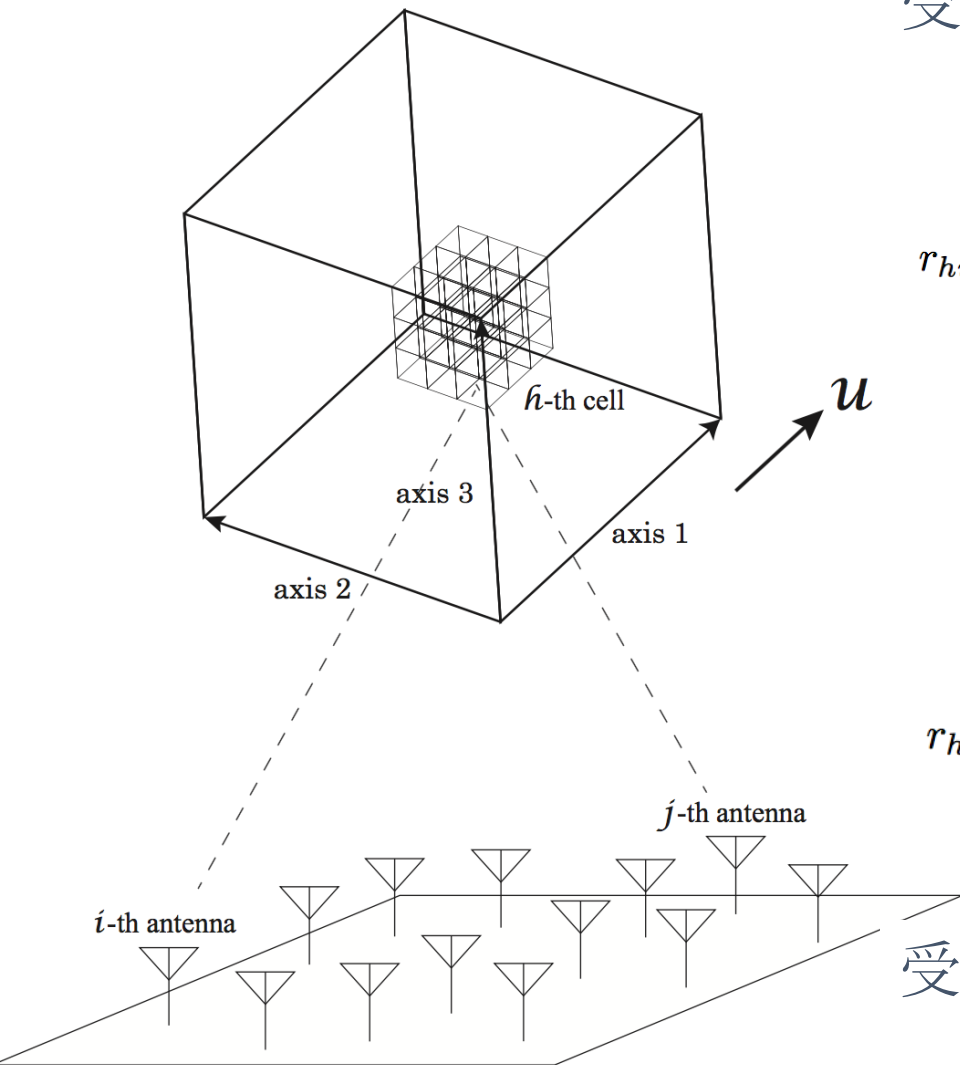
p : 送信フィルター (送信波形)

q : 受信フィルター

$$\begin{aligned}
 r_{hij}(t_n) &= \int_0^{t_\Delta} f_h \left(t_n + T - \frac{|\mathbf{x}_h - \mathbf{x}_i|}{c} \right) \\
 &\quad p_i \left(T - \frac{|\mathbf{x}_h(t_n) - \mathbf{x}_i| + |\mathbf{x}_h(t_n) - \mathbf{x}_j|}{c} \right) \\
 &\quad q_j \left(T - \frac{2R}{c} \right) dT. \\
 &= f_h(t_n) \int_0^{t_\Delta} p_i (T - T_{hij}(t_n)) q_j (T - T_R) dT. \\
 r_h(t_n) &= f_h(t_n) \sum_i^{N_{\text{ant}}} \sum_j^{N_{\text{ant}}} g_{hij}(t_n) \\
 &= f_h(t_n) g_h(t_n),
 \end{aligned}$$

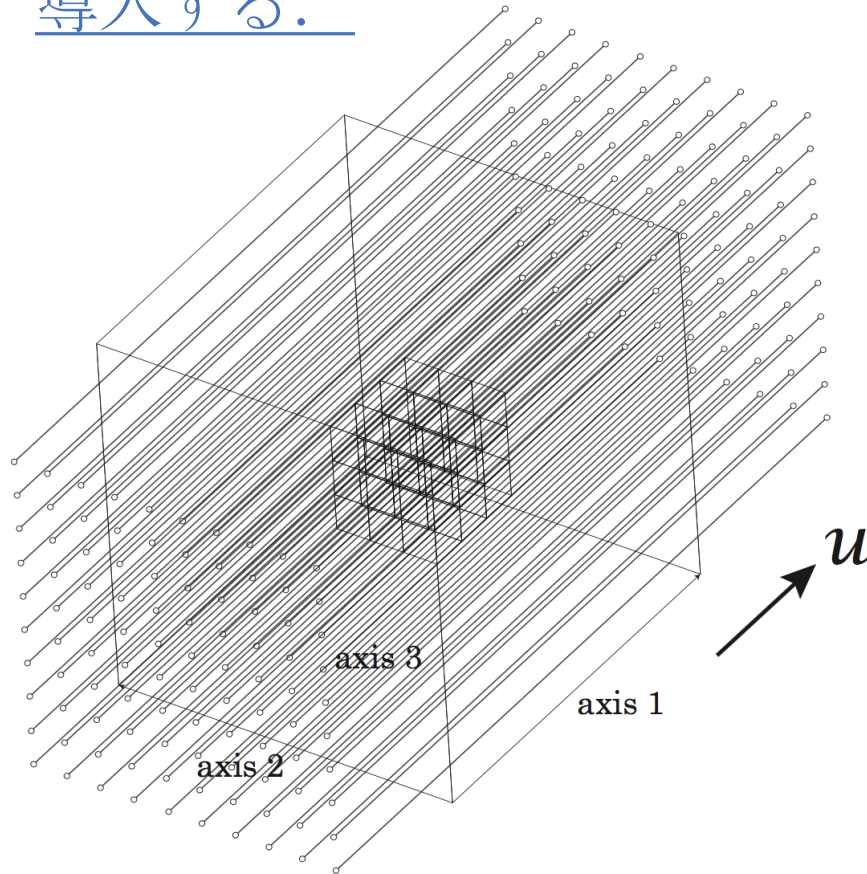
受信信号 $r(t)$ は,

$$r(t) = \sum_h f_h(t) g_h(t).$$



1次元スペクトル観測理論

風速ベクトルに沿って空間を1次元化し、スライス毎の $f(\mathbf{x}, t)$ の独立性の仮定を導入する。



ビーム全体のACFを
スライス毎のACFの和として

$$G(\tau) = \sum_m \sum_l G_{lm}(\tau)$$

where

$$G_{lm}(\tau) = \sum_k g_{lm}^* \left(t + \frac{kL}{|u|} \right) g_{lm} \left(t + \frac{kL}{|u|} + \tau \right)$$

と定義すると、
受信信号のACF（の期待値）は

$$R(\tau) = F(\tau) G(\tau) W(\tau)$$

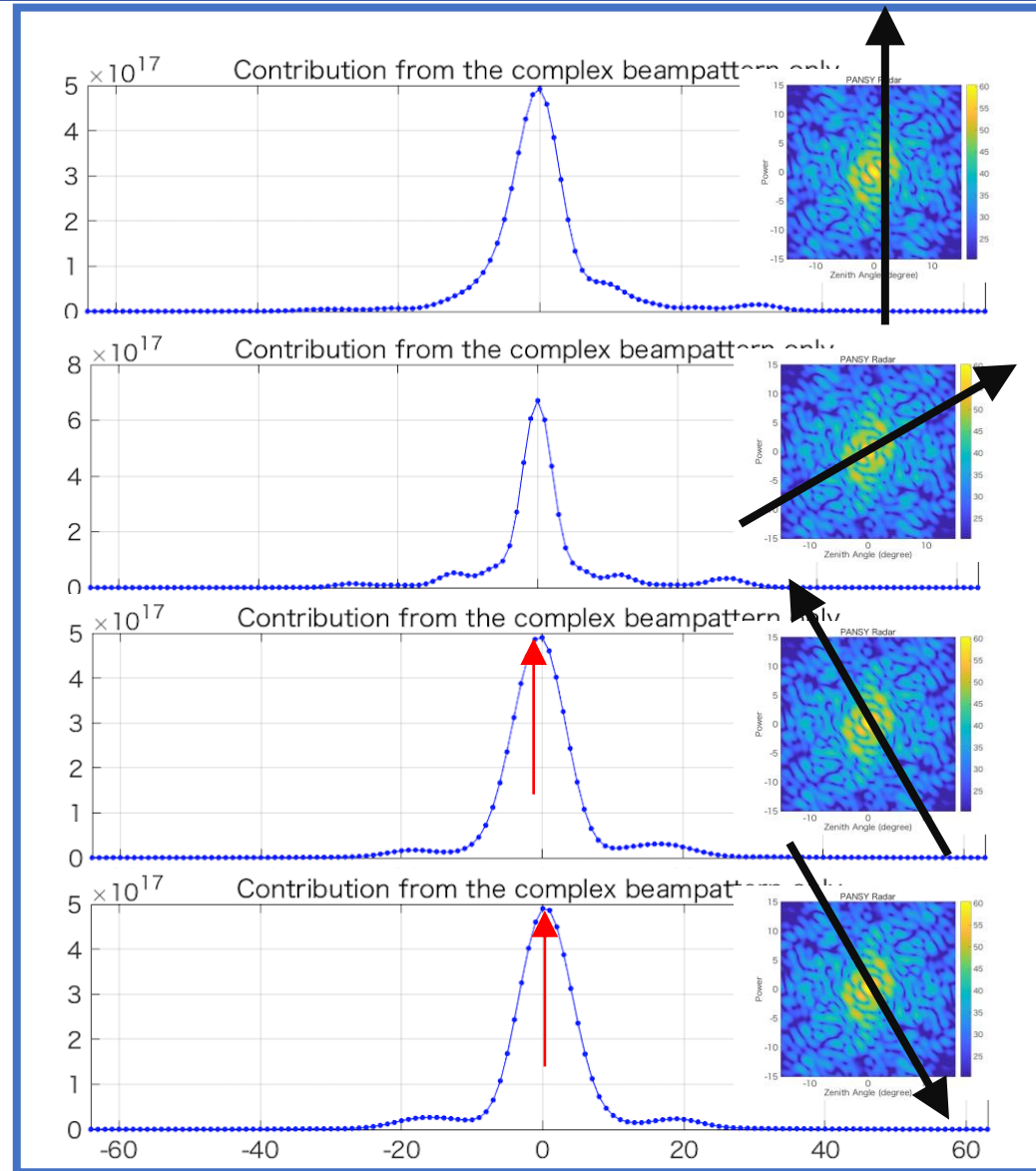
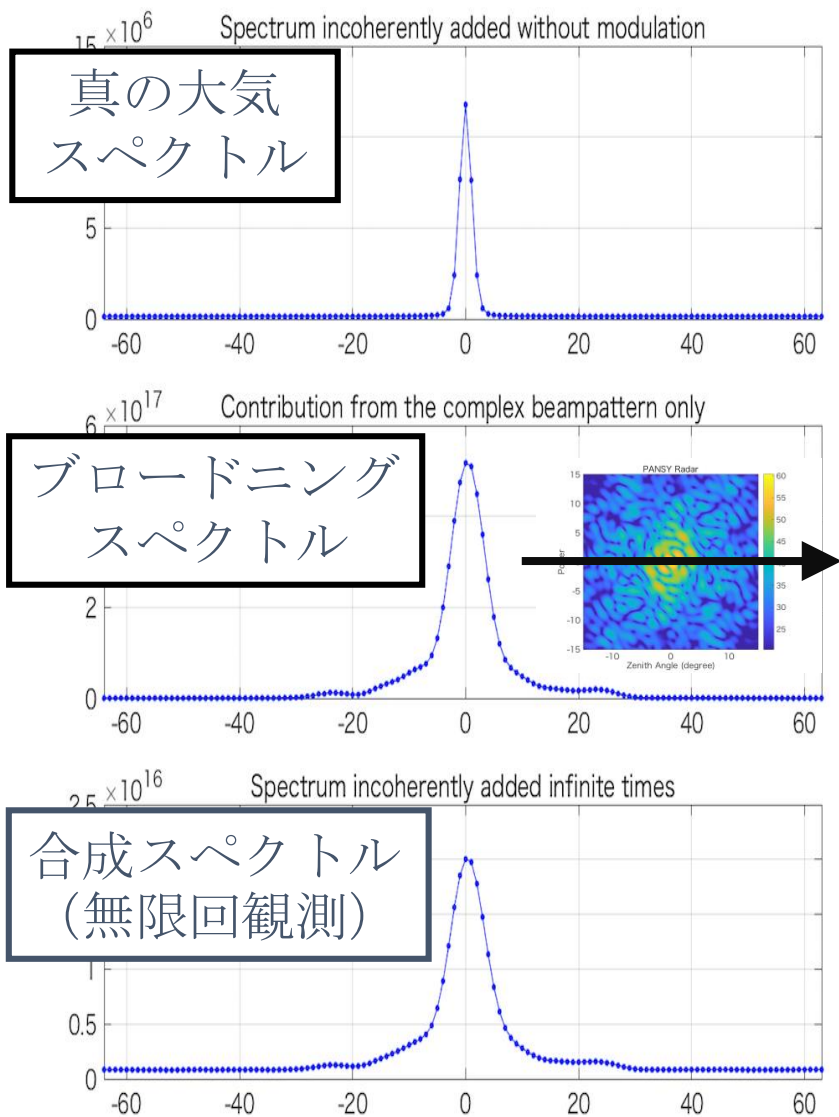
F: 乱流ACF（スペクトルのFT）

G: ビームフィールドACF

W: 時間窓ACF

となることが示される。

ブロードニングの風速方位角依存性



方位により幅が異なるだけでなく、周波数オフセットも存在する。

パラメータ推定：パワースペクトルの確率分布

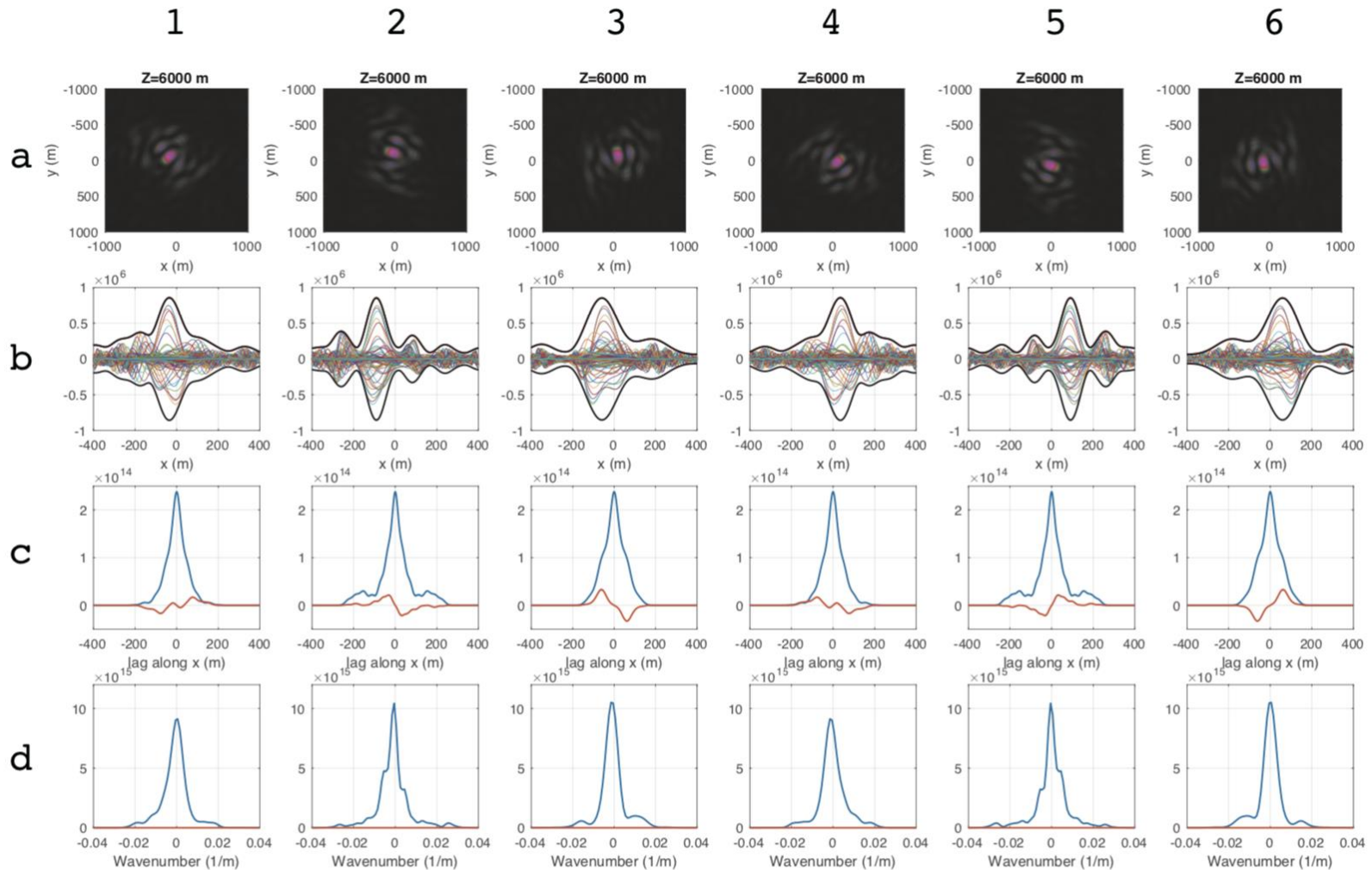
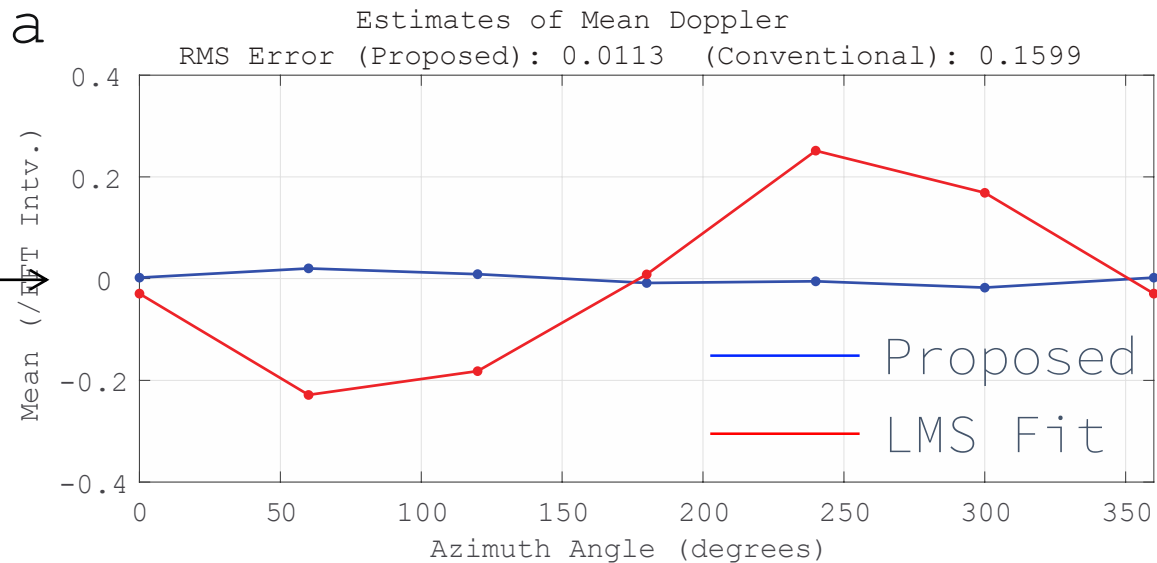


Fig. 5. Complex beam patterns, $G(\tau)$ and $\mathcal{F}[G(\tau)]$, at height $z=6000$ m, calculated with respect to PANSY radar, are plotted. Columns 1–6 are associated with an azimuthal rotation angle of 0° , 60° , 120° , \dots , 300° , respectively. Rows: (a) Complex beam pattern intensity and color are given by amplitude and phase, respectively. When the rotation angle is 0° , the x -axis agrees with the physical x -axis. (b) Sections of the complex beam patterns plotted in Row (a). Thin colored lines show the x -sections at different y intercepts. Thick black lines show their RMS envelopes. (c) Sum of ACFs of the sections of the complex beam pattern, $G(\tau)$ in the text, but plotted as functions of the distance in meter unit along the x -axis. Blue and red lines indicate the real and imaginary parts, respectively. (d) The Fourier transforms of the $G(\tau)$ shown in Row (c), $\mathcal{F}[G(\tau)]$ are plotted as functions of wavenumber (1/m). The wavenumber can be converted to velocity simply by multiplying $|u|$.

デブロードニングシミュレーション結果

ドップラーシフト
推定値

真値



スペクトル幅
推定値

真値

