No. １７８

２０１９年１１月２７日

地磁気世界資料解析センター News

１． 新着地磁気データ

前回ニュース（2019 年 9 月 30 日発行、No.177）以降入手、または、当センターで入力したデータのうち、オンラインデータ以外の主なものは以下のとおりです。

オンライン利用データの詳細は（**http://wdc.kugi.kyoto-u.ac.jp/catmap/index-j.html**）を、観測所名の省略記号等については、観測所カタログ（**http://wdc.kugi.kyoto-u.ac.jp/catmap/obs-j.html**）をご参照ください。

また、先週の新着オンライン利用可データは、（**http://wdc.kugi.kyoto-u.ac.jp/wdc/onnew/onnew-j.html**）で御覧になれ、ほぼ 2 ヶ月前までさかのぼることもできます。

Newly Arrived Data

（１） Kp index：(**http://wdc.kugi.kyoto-u.ac.jp/kp/index-j.html**)　(Sep.-Nov., 2019)

２． ASY/SYM 指数

2019 年 10 月の ASY/SYM 指数を算出し、ホームページに載せました。

http://wdc.kugi.kyoto-u.ac.jp/aeasy/index-j.html

３． PDF 版観測所データ全カタログの更新

PDF 版観測所データ全カタログ 2019 年 11 月 (No. 31''')が利用可能となりました。

http://wdc.kugi.kyoto-u.ac.jp/wdc/pdf/Catalogue/Catalogue.pdf

ただし、印刷出版予定はありませんので必要な場合には上記 PDF ファイルを印刷願います。なお、随時追加/更新がありますので最新の状況については、毎週更新されるカタログを下記 URL から検索願います。

http://wdc.kugi.kyoto-u.ac.jp/catmap/index-j.html

４． Visiting DACGSM from SANSA

The Data Analysis Center for Geomagnetism and Space Magnetism sent an invitation to SANSA Space Science to visit Kyoto and deliver a talk, and since Data Management is my field of expertise and the discussion points fell within my wheelhouse, I was in the fortunate position to accept the invitation. Having never visited Japan before, I was both nervous and excited to see your beautiful country. Kyoto is indeed a magnificent city and has a rich cultural heritage. The city also has many hidden gems, from its temples to its parks and I was thrilled and honoured to see some of these beautiful sites.

My hosts H. Toh-san and S. Taguchi-san were very kind and made sure I was well cared for and I found the University staff to be very thoughtful and helpful. I came to deliver a presentation to students at Kyoto University on the work that we do at SANSA Space Science and my role there as a Data Acquisition Practitioner. I also undertook discussions with DACGSM to ensure our past, present and future collaboration through our Memorandum of Understanding is held in good standing

The South African National Space Agency (SANSA) came into being during December 2010, but South Africa has long been a part of the international space efforts, in fact, we have provided satellite tracking, telemetry and command, launch support, in-orbit testing, mission control and space navigation from our Space Operations Programme since the 1950s. We have also been observing the Earth's magnetic field at stations around Southern Africa for the last 80 years. SANSA's instrumentation network is internationally recognised for measuring the space environment from the ground, which is far more cost-effective than measuring from space. Our end goal is to promote and support industrial development in space technologies, build human capital and provide important national services. Much of this work involves monitoring the Earth and our surrounding environment and using the collected data to ensure that navigation, communication technology, and weather forecasting services function as intended.

The Earth Observation Programme collects, processes, archives, and disseminates Earth observation data (principally from satellites) to support policy-making, decision-making, economic growth and sustainable development in South Africa. These type of data services and products help with environmental and resource management, disaster and health management.

The Space Engineering Programme develops, builds and tests systems and sub-systems for satellites. The aim is to develop and launch South Africa's own satellites while growing the human and technological capacity for satellite development, and supporting a native South African satellite industry.

The Space Operations Programme provides state-of-the-art, globally competitive ground station facilities and services for global launch activities whilst ensuring the presence of a world-class ground station on the African continent, and has been providing these services since the 1950s.

The Space Science Programme, based in Hermanus, South Africa, operates in a magnetically clean environment. Hermanus is a small town which possesses a train station which has luckily never been used, as trains generate magnetic fields. Also the underlying geology of the area consists exclusively of Table Mountain sandstone which has negligibly small magnetic gradients. SANSA Space Science provides some core functions to our national defence force as well as private aviation companies. A magnetically clean area also has important uses in the maritime sector, space weather applications, space industry applications, and in predicting environmental hazards. But SANSA Space Science is also a blue skies research institution. It addresses new phenomena while it pushes the frontiers of knowledge generation. Blue Skies-type of research is associated with fundamental and basic research programmes. Who knows where or how this type of research will be used in the future.

The Space Science Programme hosts the only Space Weather Warning Centre in Africa, providing early warnings and forecasts on space weather activity for public and private sector clients. This helps protect satellite technology, as well as communication and navigation systems in aviation and defence.

The Space Science Programme operates a wide range of infrastructure across southern Africa and in Antarctica, all dedicated to studying the Earth's magnetic field, the Sun and the near-space environment. Space Science has installed, maintained, and monitors 85 field instruments of 26 different types. Some of these instruments are placed on our research bases in Antarctica, and on Marion and Gough Islands. They provide valuable space science data for national and international research. Antarctica, in particular, is the perfect place to observe space due to the clean environment and the fact that the magnetic lines converge on the South Pole.

Marion and Gough Islands are ideally situated to observe the South Atlantic Anamoly, which is a near-Earth region where the Earth’s magnetic field is significantly weaker. This leads to an increased flux of energetic particles in this region and exposes orbiting satellites to higher-than-usual levels of radiation. Our geomagnetic field data are extensively used in international research projects ranging from the physics of the geo-dynamo to studies of the near-Earth space environment. We also participate in international projects involving Satellite missions like Ørsted, CHAMP and SWARM and the Cluster mission to study the interaction of the solar wind with the magnetosphere.

Magnetic observatories are specially designed and carefully operated facilities that provide accurate data over long periods of time. The construction of buildings within a magnetic observatory must be non-magnetic in nature, and the type of activity conducted within the observatory requires an understanding of the impact on the environment. Currently, Hermanus (HER), Hartebeesthoek (HBK), Tsumeb (TSU) and Keetmanshoop (KMH) are INTERMAGNET observatories. (INTErnational Real-time MAGnetic Observatory NETwork) observatories.

All of our INTERMAGNET Observatory sites have the following instruments: fluxgate magnetometers (1-minute instrument), Lemi25 (1-second instruments), an Overhauser (Absolute instrument measuring Total Field) and will shortly be acquiring a DTU (Danish technical university 1-second instrument). Our raw data coordinate system is aligned in HDZ configuration.

We are in the process of upgrading our geomagnetic stations. We are including a 1-second temporal resolution instrument, DTU, but ensuring redundancy by keeping the 1-minute sensors. This will provide useful points of comparison. Our upgrade includes looking at stabilising the temperature inside the huts. We are building a pyramid type oven with insulation bricks and then actively heating the inside to a temperature above the seasonal maximum so that the sensor remains at a constant temperature in the hopes of eliminating temperature biases. We are doing the same for electronics.

The relationship with Data Analysis Center for Geomagnetism and Space Magnetism started with an agreement from around 1992 whereby a fluxgate magnetometer was provided with a higher than normal resolution than our observatory grade (40nT/mV sensitivity scale as opposed to 150nT/mV) and data was supplied for the calculating of the Dst Network.

Dst is a measurement of the equatorial ring current variations. It has long been known that the horizontal component, H, of the geomagnetic field is depressed during periods of great magnetic disturbances and that the recovery to its average level is gradual. These studies have shown that at equatorial and mid-latitudes the decrease in H during a magnetic storm can approximately be represented by a uniform magnetic field parallel to the geomagnetic dipole axis and directed toward the south. The magnitude of this disturbance field varies with storm-time, defined as the time measured from the storm onset. The onset of a magnetic storm is often characterized by a global sudden increase in H. It is produced with a 1-h time resolution and is continuous in time back to 1957. The Dst index is commonly used as an indicator of geomagnetic activity, including identification of storms, which have a critical influence on particle populations, satellites and other human activity in space. For the derivation of the Dst index four magnetic observatories, Hermanus (South Africa), Kakioka (Japan), Honolulu (Hawaii), and San Juan (Puerto Rico) are used. These observatories were chosen on the basis of the quality of observation and for the reason that their locations are sufficiently distant from the auroral and equatorial electrojets and that they are distributed in longitude as evenly as possible.

SANDIMS stands for the South African National Geophysical Data and Instrumentation Management System. SANSA operates a vast array of instruments across southern Africa and the Southern Ocean, the oldest of which has been in operation since 1841. These instruments have produced a staggering amount of data over the years, and of course, all the data can be provisioned in SANDIMS. SANDIMS collects, archives and distributes the ground-based space data recorded by the geophysical network and there is a possibility to host mirror databases of international networks. The portal has been designed in a way to open data to researchers, as well as to generate revenue through commercial partnerships.

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6 November 2019

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Assoc. Prof. / Deputy Director
World Data Center for Geomagnetism
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Dear Prof Toh

Re: Message of appreciation from South African National Space Agency (SANSA)

On behalf of SANSA, I would like to thank you for inviting and hosting Kate Niemantinga from SANSA at your facility during October 2019.

The feedback from the trip given to us by Ms Niemantinga showed that this was a valuable experience for her, and will go some way to strengthen the partnership between SANSA and the Data Analysis Center for Geomagnetism and Space Magnetism.

We sincerely hope that the visit was also valuable to your team.

Please pass on our appreciation to the team members involved in ensuring that this trip was valuable.

Yours Sincerely

Lee-Anne McKinnell
Managing Director Space Science
South African National Space Agency (SANSA)

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<SANSA からの感謝状＞

The National Equipment Programme supplied us with a grant to purchase the equipment necessary for SANDIMS. We have mostly used open-source software including the following technologies: ZFS File System, Python, web2py and PostgreSQL. While Python is discussed as a data science tool, it is also a programming language used in the development of applications. Web2Py is a free open source full-stack framework for rapid development of fast, scalable,secure and portable database-driven web-based applications. Web2py allows web developers to program dynamic web content using Python. We used a PostgreSQL database because it is open-sourced and it can run dynamic websites and web apps as a LAMP stack option. It also supports JSON for non-relational queries. It can also be integrated with mathematical software like Matlab and R. PostgreSQL offers powerful GIS which is called "PostGIS". This extension provides hundreds of functions to process geometric data in different formats. PostGIS is highly standard compliant. Moreover, by using both QGIS or GeoServer, the Open Source community provides the easiest method to handle Geodata.

A Data Custodian’s role is to ensure the integrity of the data. It is important that data custodians are transparent about the quality of their data to enable the data users to determine whether the data will meet the purpose of their project. Part of this would be the curation of our collected data. This process involves checking the data for completeness, and ensuring quality, as well as creating metadata. Metadata are an increasingly important aspect of data provision, both for the Institution and for other data providers. Metadata are information about data; they are the "who, what, when, where, why and how" of a data set. They describe the content, quality, originator, and other characteristics of a data set that help users understand the nature of that data set and how to use it.

Since the advent of the space age in 1957, South Africa has established a reputation for accuracy and reliability in the international space community. We also have a long-standing history of supplying high-quality geomagnetic data to the international scientific community. Today, SANSA is using the benefits of space science and technology to help grow and develop the African region as we move into the fourth industrial revolution.

I would like to take this opportunity to extend my sincere gratitude to the Data Analysis Center for Geomagnetism and Space Magnetism for extending the invitation and hope we shall have many more decades of successful collaboration.

（Katherine Jane Niemantinga – South African National Space Agency）

４．白須賀のこと他

地磁気偏角を鍵にして伊能忠敬の磁針測量方位角原簿・国宝「山島方位記四」から位置を解析復元した全国二例目の科学的「伊能忠敬地図測量地点」石碑(緯度経度秒単位以下表示は全国初)が静岡県湖西市の東海道五十三次三十二番白須賀宿に地元の方々の尽力で建立。

「伊能忠敬地図測量地点」石碑が東海道の浜名湖の西の白須賀宿の東の丘の上の伊能忠敬の測量実施地点詳細解析位置から市道を挟んで南の真愛保育園入口に建立されました。　伊能忠敬の白須賀での測量を支援指揮して三角法等も学習していた名主で国学者本居宣長の愛弟子の夏目甕麿の顕彰会の皆様により白須賀小学校の明治開校時の校門石柱を使用して建立され、10 月 4 日、影山剛士市長他が出席で除幕式が行われました。（中日新聞 **https://www.chunichi.co.jp/article/shizuoka/tokai-news/CK2019110502000077.html**）

＜写真１：
伊能忠敬地図測量地点、
享和三年(一八〇三年)三月二十八日＞

＜写真２：
令和元年(二〇一九年五月五日
夏目甕麿顕彰会之建　海抜 72 米＞

＜写真３：
北緯 34°41’22.31″
東経 137°30’8.47″
探究者堺市辻本元博＞

尚、解析の鍵となるこの地点の 1803 年の地磁気偏角の解析値は平均 0° 07‘33″W と判明。
秒単位以下 2 位(緯度方向 25.5cm 経度方向 30.8m)は計算値。
「伊能忠敬地図測量地点」石碑は伊能の全国測量と東海道の白須賀宿の学術を物語る記念碑になると同時に真愛保育園、白須賀幼稚園、白須賀小中学校に近く、夢多き子供達は幼児のときから日本と世界に科学の恩恵をもたらした「伊能忠敬地図測量地点」石碑と緯度経度秒単位以下の数値を見て日々勉強することになる。

<伊能測量時 1801～1805 年時点の地磁気偏角 0° は太平洋岸では浜名湖付近になる>
エクセルで同時解析した 1803 年の白須賀の地磁気偏角は 0° 07’W。1801 年銚子犬若岬 0° 24’E、江戸深川 1801 年 1802 年平均 0° 19’E、0° 14’ E(江戸は大谷亮吉)、1803 年白須賀 0° 07’W、1805 年知多半島師崎 0° 14’W と西へ行くほどに西偏を増し、1805 年瀬戸内海沿岸東部では 1° W 近くなる。当時の東海、近畿地方の年変化を 0° 02’西偏増程度とすれば浜名湖のすぐ東の 1805 年浜松市佐鳴での解析値 0° 07’W を 1803 年に換算すると 1803 年浜松市佐鳴 0° 03'W 程度となり、白須賀 0° 07’W と続く。

<京都大学大学院地磁気世界資料解析センターの学振推薦と地元の協力>
白須賀の解析は京都大学地磁気解析センターの家森俊彦先生のご推薦で平成 18 年度(2006)日本学術振興会奨励研究の中で現地を訪れ、禮雲寺加藤憲学ご住職様にご協力を賜った。

<地磁気偏角による測量実施地点の逆算の原理の解析エクセル>
ある測量実施地点に於けるその時点の磁針測量方位角に含まれる地磁気偏角は本来一定であり、国宝の伊能忠敬磁針測量方位角原簿「山島方位記」に記載の各測量対象への磁針測量方位角から真方位角を差し引いた地磁気偏角が限りなく一定に近くなる測量実施地点詳細解析位置を逆算する連続計算と文系研究法との照合で下記の通り高精度解析が実現した。

辻本がコンピューター技師面谷明俊氏に内容を説明し、編集を依頼し、共同作成した「山島方位記」解析エクセルを使用。地磁気センターニュース 119 号 6.「表計算ソフトを使用した『山島方位記』からの地磁気

表 1. 表 2. 国宝「山島方位記　四」白須賀止宿上の畑　丑一分五リ　のエクセルによる解析

測定基点			
方位記名	白須賀止宿上の畑(丑一分五リ)	対象点までの平均距離（L）	31.751 km
現在地名	湖西市白須賀	誤差半径（L*sin2σ）	198.8 m

測定基点経緯度	度	分	秒
北緯	34	41	22.31
東経	137	30	8.47
	計	有効	使用
測定目標地点数	10	10	10
測定数	47	47	47

止宿大村庄左衛門宅の東の山上消防団第四分団詰所前の湖西市道裏通線の拡幅前の旧里道部分が測量実施地点
享和三年三月二十八日
1803.5.19
2014.2019辻本元博

磁針方位-真方位角	偏	度	分	秒
（件数）				10
平均	西	0	7	33.126
2乗平均平方根		0	13	8.74722
標準偏差(σ)		0	10	45.5997
西方向最大偏角差	西	0	23	10.7241
東方向最大偏角差	東	0	7	12.2977

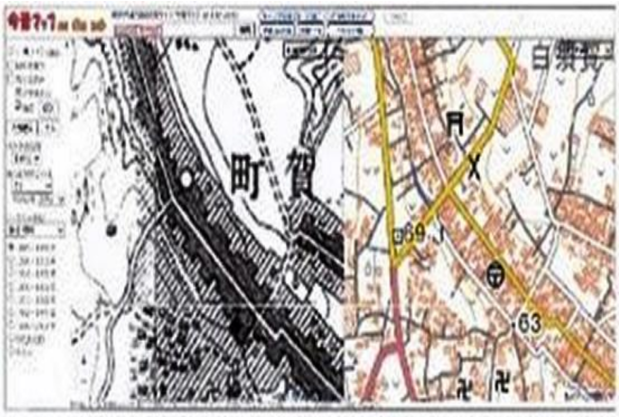
測定目標地点		平均磁針方位					真方位角			磁針方位-真方位角				
NO	目標地点名	度	分	秒	NO	目標名(現在)	度	分	秒	偏	度	分	秒	距離km
1	粟山	71	40	0	1	粟ヶ岳532掛川市倉真	71	47	12.30	東	0	7	12.30	54.40
2	富士山	55	57	24	2	富士山剣ヶ峯3775	55	59	10.39	東	0	1	46.39	134.31
3	田原山サスカケ山	266	38	0	3	衣笠山215田原市田原	266	23	45.50	西	0	14	14.50	24.10
4	三州山序の口	313	8	50	4	豊橋市大岩町257.5二川駅北側	313	12	19.83	東	0	3	29.83	7.45
5	本坂峠	356	51	12	5	坊ヶ峰446.2本坂峠	356	35	26.75	西	0	15	45.25	12.49
6	稲砂山	23	32	12	6	富幕山563.5三ヶ日町	23	35	13.13	東	0	3	1.13	19.38
7	カンザ山	349	54	0	7	嵩山170.7湖西市新所	349	30	49.28	西	0	23	10.72	5.53
8	赤坂山序の口	304	26	36	8	遠望峰山の443峰蒲郡市柏原町	304	25	4.63	西	0	1	31.37	32.86
9	立岩	324	25	0	9	豊橋市雲谷町新所原駅立岩84.1	324	7	44.66	西	0	17	15.34	4.96
10	田原蔵王	269	4	45	10	蔵王山250.4田原市片浜	268	45	41.27	西	0	19	3.73	22.02

＜表１：山島方位記　記録解析＞

		北緯			東経			基点からの距離
NO	名称	度	分	秒	度	分	秒	(km)
1	粟ヶ岳532掛川市倉真	34	50	29.39	138	4	2.48	54.40
2	富士山剣ヶ峯3775	35	21	38.31	138	43	38.45	134.31
3	衣笠山215田原市田原	34	40	32.12	137	14	23.47	24.10
4	豊橋市大岩町257.5二川駅北側	34	44	7.84	137	26	34.92	7.45
5	坊ヶ峰446.2本坂峠	34	48	7.04	137	29	39.24	12.49
6	富幕山563.5三ヶ日町	34	50	58.63	137	35	13.76	19.38
7	嵩山170.7湖西市新所	34	44	18.7	137	29	28.92	5.53
8	遠望峰山の443峰蒲郡市柏原町	34	51	23.67	137	12	21.45	32.86
9	豊橋市雲谷町新所原駅立岩84.1	34	43	32.63	137	28	14.32	4.96
10	蔵王山250.4田原市片浜	34	41	6.01	137	15	43.5	22.02

＜表２：測定目標地点経緯度＞

＜図１：静岡県湖西市白須賀（地理院地図）＞



＜図２：埼玉大学今昔マップ 1889～1890 年白須賀＞

＜図３：国宝　「山島方位記　四」
白須賀止宿上畑部分 伊能忠敬記念館蔵＞

＜図４：本陣跡石碑・伊能忠敬測量実施地点
詳細位置・伊能忠敬地図測量地点碑位置図＞

（辻本 元博）