Joint DLR-INTA

Scientific Announcement of Opportunity

German Aerospace Center (DLR)

Spanish National Institute of Aerospace Technology (INTA)

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DOCUMENT PREPARATION

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DOCUMENT CHANGE CONTROL

This document is under configuration control. Latest changes to the document are listed first.

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1 ACRONYMS

AO	Announcement of Opportunity
EULA	End user license agreement
DLR	German Aerospace Center
INTA	Spanish National Institute of Aerospace Technology
PAZ	Spanish Synthetic Aperture Radar in X-band
PI	Principal Investigator
PAZ	PAZ is the Spanish Earth Observation Satellite using Synthetic Aperture Radar in X-band
SAR	Synthetic Aperture Radar
SC	ScanSAR
SL	Spotlight
SM	Stripmap
ST	Staring Spotlight
TSX	TerraSAR-X: is the German Earth Observation Satellite using Synthetic Aperture Radar in X-band
TDX	TanDEM-X: stands for TerraSAR-X add-on for Digital Elevation Measurement

2 PURPOSE AND SCOPE OF THE CALL

This call is intended to explore the scientific benefits of TerraSAR-X / TanDEM-X and PAZ constellation, including optimized revisit time and increased acquisition capacity.

The data combination of 3 almost identical satellites for scientific purposes is a unique data acquisition opportunity and opens a wide range of new applications, by the combination of monostatic and bistatic images.

Different scenarios can be considered:

- acquisition of pursuit monostatic data sets (Combination of PAZ and one out of TerraSAR-X or TanDEM-X), which can be utilized for e.g. repeat pass interferometry; (repeat pass of 4-7 days).
- combination of all 3 satellites will allow the derivation of 2 pursuit monostatic pairs (PAZ-TerraSAR-X, PAZ-TanDEM-X)

- and 1 bistatic image pair (TerraSAR-X-TanDEM-X) for advanced studies. The latter will e.g. allow interferometry studies of temporal decorrelation for natural targets, or allow the derivation of change detection products, or pseudo-quadpol data sets.

3 ONLINE PROPOSAL SUBMISSION WEBSITES

It has to be considered that although this is a Joint Announcement of Opportunity, interested researchers shall send their scientific proposals to both Institutions, DLR and INTA. Each institution will independently evaluate the proposals and provide their approvals.

The TerraSAR-X proposal must be sent in a pre-defined format by Email to tsx.science@dlr.de . Templates are available at http://sss.terrasar-x.dlr.de/ .

To access TanDEM-X data, the secure online submission website is: https://tandemx-science.dlr.de/

To access PAZ-science data, the secure online submission website is: https://www.inta.es/paz-ciencia/en/AO/ao-003//

4 APPLICABLE DOCUMENTS

Reference	Title
AD- 1	All Documents available on the TerraSAR-X science server (http://sss.terrasar-x.dlr.de)
AD-2	All Documents available on the TanDEM-X science server (https://tandemx-science.dlr.de/)
AD-3	All Documents available on the INTA science server (https://www.inta.es/paz-ciencia/en/paz-science-activities/)
AD-4	Alberto Alonso-González, Member, IEEE, Nuria Gimeno Martínez, Irena Hajnsek, Fellow, IEEE, Patricia Cifuentes Revenga, María José González Bonilla, Christo Grigorov, Achim Roth, Ursula Marschalk, Nuria Casal Vázquez, Juan Manuel Cuerda, Marcos Gracía Rodríguez and Alberto Moreira, Fellow, IEEE, Joint PAZ & TanDEM-X Mission Interferometric Experiments: Performance and Products in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, accepted

5 DESCRIPTION OF THE JOINT ANNOUNCEMENT OF OPPORTUNITY

5.1 Objectives of the Joint DLR and INTA Opportunity

This call is intended to explore the synergies between the two German satellites of the TerraSAR-X/TanDEM-X mission and the Spanish PAZ mission. Since the three platforms are almost identical and they were launched in the same orbital plane (offset 98.18º in true anomaly) comparable images of the same area under the same geometry may be regularly acquired by both systems. This allows the simultaneous use of both missions for building larger time series and improving the revisit time of 11 days for each mission up to 4 or 7 days while combining both.

The goal of this AO is to promote the scientific use of the experimental-campaign data for the development of time-frequent monitoring methods, algorithm evolution and innovative application that are having tighter requirements in terms of revisit time or temporal coverage.

5.2 General Guidelines

The Joint TerraSAR-X / TanDEM-X / PAZ call is based on the reception and approval of Scientific Proposals.

Although it is a common AO, interested research teams shall submit their proposal to both, DLR and INTA, for the independent revision of each institution as well as the signature of PAZ EULA (for the use of PAZ scientific products).

Despite of the project approval, project acquisitions are dependent on specific mission restrictions, such as specific scientific quota or commercial priority. Area of interest can be selected from the reference test sites specified in section 5 of this document, but is not restricted to the references.

5.3 Schedule

The joint TerraSAR-X / TanDEM-X / PAZ announcement of opportunity is expected to be open in 2021, starting in May the 4th.

The AO proposal submission will end with December 31th, 2021.

The evaluation of each proposal will start as soon as they are received by each entity.

5.4 Promotion of the results

In accordance with the objectives of this TerraSAR-X, TanDEM-X, PAZ initiative, both, DLR and INTA intend to promote scientific results.

In this way, proposers must agree and commit to report the results of their project in scientific or technical publications, to provide an annual progress report to INTA and a final report to DLR and INTA and acknowledge the scientific DLR and INTA programs appropriately.

6 ISSUES APPLICABLE TO THE INDIVIDUAL MISSIONS

6.1 DLR

The TerraSAR-X and TanDEM-X satellites are owned and operated by DLR. The commercial exploitation rights are exclusively granted to Airbus. DLR is also responsible for the scientific utilization of the data. Both satellites carry a high frequency X-band Synthetic Aperture Radar (SAR) sensor that can be operated in different modes and polarizations. The Spotlight-, Stripmap- and ScanSAR- TerraSAR-X modes provide high resolution SAR images for detailed analysis as well as wide swath data whenever a larger coverage is required. Operationally imaging is possible in single and dual polarization. A more detailed description of the TerraSAR-X operating modes can be found in the Basic Product Description (see http://sss.terrasar-x.dlr.de/).

TanDEM-X with its single pass interferometric mode provides high resolution stripmap and spotlight co-registered SAR data for digital elevation model derivation and other application related to the interferometric coherence.

The main objective of this call is the joint evaluation of TerraSAR-X / TanDEM-X data with PAZ data. Scientific requests addressing monostatic acquisitions of just one of the two TSX and TDX satellites need to submit a TerraSAR-X proposal while bi-static acquisitions of both satellites will be provided via a TanDEM-X proposal. The status “Scientific Use” needs to be gained via the proposal submission and evaluation process. The corresponding criteria are described in chapter 6.1.3.

6.1.1 TerraSAR-X AO

The TerraSAR-X proposal must be sent in a pre-defined format by Email to tsx.science@dlr.de . Templates are available at http://sss.terrasar-x.dlr.de/.
The proposal should clearly describe the intended research, the scientific benefit, the contribution to the mission objectives, the required data and the acquisition plan. In particular the following information should be provided:

- **Template for personal data**:
  - General information about the PI and the person authorised to sign the license agreement and to confirm the funding;
  - the list of all Co-Is and the team organization;
- **Template for proposed research project**:
  - the innovation of the proposed activity and the contribution to the mission objectives;
  - a detailed description of the intended work;
  - the work plan and schedule;
  - the data requirements;
  - information demonstrating the coverage of the “scientific use” criteria (see 6.1.3); and
  - the proposal type (related AO) shall be set to **Joint TSX/PAZ AO**

Each proposal will go through a scientific and technical evaluation. The scientific benefit and the synergistic utilization with PAZ will be judged. Additionally, the data requirements and the fulfillment of the scientific use criteria are checked. As a result of the evaluation process a user account will be created for each accepted proposal and the announced quota will be assigned. The investigator shall be informed about the evaluation within 2 months after submission.

Electronically delivered data will be provided **free of charge**. No other delivery media are supported.

6.1.2 TanDEM-X AO

The data request for TanDEM-X need to be send through an online system. Please go to the https://tandemx-science.dlr.de/ and register first, then please open the general proposal and select the type of proposal indicated with **'Joint PAZ-TanDEM-X Experiment'** and fill your data request. The online form will guide you through several sections, that you will need to fill.

The registration on the TanDEM-X website is displayed in the sidebar and is named Register User Access as an Investigator. After registration you will receive the login information and you will have access to the online data request page. Please select from the side bar CoSSC Proposal and select the bottom Create CoSSC Proposal.

You will immediately be directed to the online proposal submission form with the following items:

- Cover Page: Please enter here the title of the proposal, the application domain, the type of proposal **'Joint PAZ-TanDEM-X Experiment'** and a short geographical description.
- General Proposal Description: In this section please describe in short, the motivation and the main purpose of using the data. This abstract can be published and be visible to each Principle Investigator.
- Detailed Proposal Description: A detailed description of the motivation and purpose of the data usage is requested.
- Data Requirements: On a geographical map the coordinated (either as a point or frame) of the requested testsite can be added and the possible TanDEM-X frames at different incidence angles are displayed. The frames can be then selected from the proposal submitter.
- Overview: Provides you an overview of the filled text and the requested data.
- Final Submission: At the end everything can be submitted.

The same as for TerraSAR-X each proposal will go through a scientific and technical evaluation. The scientific benefit and the synergistic utilization with PAZ will be judged. Additionally, the data requirements and the fulfillment of the scientific use criteria are checked. As a result of the evaluation process a user account will be created for each accepted proposal and the announced

quota will be assigned. The investigator shall be informed about the evaluation within 2 months after submission. All electronically delivered data will be provided **free of charge**. No other delivery media are supported.

6.1.3 Scientific Use Criteria

Every use of TerraSAR-X and TanDEM-X data and products for basic and application-oriented research by national or international research establishments or through government sponsored projects is considered scientific, non-commercial use, including the development of future applications for scientific and/or operational use.

Every utilization of TerraSAR-X/TanDEM-X data/products that is not targeting the commercial use with profit orientation is a scientific use. This includes the use of TerraSAR-X/TanDEM-X data/products:

- by educational (schools, universities, etc.) and research institutions (DLR, ESA, NASA, etc.),
- for preparation and execution of government financed education-, research- and development-programs,
- for preparation and execution of data exchange with international partners of the FRG to support research- and educational programs,
- for demonstration of new applications for potential users,
- for use within the TerraSAR-X/TanDEM-X project (calibration, validation, quality assurance, public outreach, experimental instrument operations, etc.).

Scientific Users:

- will be generally provided with data/products via a selection process (e.g. an Announcement of Opportunity (AO) for the Scientific Exploitation of TanDEM-X / TerraSAR-X data).
- are required to follow the license agreement for use of TanDEM-X / TerraSAR-X data.
- must not hand over the TanDEM-X / TerraSAR-X data/products or derived products (to the extent that the contribution of TanDEM-X / TerraSAR-X is substantial and recognisable) to third parties without authorization by DLR.

6.1.4 Security regulations

The provision of TerraSAR-X and TanDEM-X data are governed by national security regulations. These regulations might affect the location of the test site, the acquisition time and the persons involved. DLR will be obliged to verify the sensitivity of data requests. The sensitivity check will be performed in two steps:

- The proposal evaluation includes the verification of the investigators and the team members.

- The main sensitivity check will be applied to each order and will comprise location, time and the persons involved.

In case of sensitivity of an order DLR needs to apply for authorization of distribution by a state authority to be determined. This means that orders still can be rejected even for accepted proposals.

6.2 INTA

PAZ mission is the radar element of the National Program for Earth Observation by Satellite (PNOTS) for the development, operation and exploitation of space sensors for Earth observation by developing and operation of the observation satellites PAZ and INGENIO, with radar and optical payloads, respectively.

The PAZ satellite was launched on February 22nd, 2018 from the Vandenberg air base (California) aboard a Falcon 9 rocket. After the initial LEOP phase, the commissioning phase began on April 3rd, extending 5 months until September 6th, at which time the system was officially declared operational.

The Space Segment of PAZ mission is owned by Hisdesat Servicios Estratégicos S.A., the mission operator. PAZ platform is an heritage of TANDEM-X having a new front end developed by AIRBUS Spain. Main payload is a synthetic aperture radar (SAR) operating in X-band at 9.65GHz with up to 300Mhz of bandwidth and versatile modes of operation configurable from the ground.

PAZ Ground Segment is property of INTA, responsible for its development and maintenance. INTA is also in charge of the science activities of PAZ mission, including scientific exploitation.

Current nominal modes are Stripmap, ScanSAR (4 and 6 beams), Spotlight, High Resolution Spotlight and Staring Spotlight.

6.2.1 PAZ Scientific Exploitation

The objective of INTA with the PAZ Scientific Exploitation is the implementation of a system for the use of PAZ image products with a scientific objective, to promote the promotion of SAR technology and its applications to national and international entities dedicated to research.

The primary objectives of the scientific exploitation of PAZ are:

- Development of new methods, techniques and algorithms for the processing of L1B products and SAR calibration.
- Fusion of data, considering image products from different spaceborne or airborne SAR sensors, and fusion of PAZ images with other images from optical sensors.
- Exploitation of products, via means of, among others:
    - Development of applications to expand the use of PAZ products, with special emphasis on those oriented to crisis management.

- Use of the polarimetric and interferometric capabilities of PAZ.
- Application of PAZ products to monitoring, including urban areas, land cover and vegetation and hydrological resources, among others.
- Obtention of derived parameters from PAZ L1B products.

The BOE of November 23, 2018 includes the Agreement between the National Institute of Aerospace Technology "Esteban Terradas" and Hisdesat Servicios Estratégicos, SA, for the realization of science activities during the mission of the satellite PAZ, starting on January 1st of 2019.

This Agreement includes the establishment of a quota for the use of the PAZ satellite of 5 daily acquisitions by INTA for its scientific use. All the acquisitions will be property of HISDESAT and the distribution of images to third parties will include the License Agreement with the End User (EULA) that HISDESAT provides (https://www.inta.es/paz-ciencia/en/AO/ao-documents/).

6.2.2 PAZ AO

Proposals responding to DLR-INTA Joint Announcement of Opportunity will be sent to INTA via PAZ-Science Activities website (https://www.inta.es/paz-ciencia/en/AO/ao-003/).

Proposals may be prepared in English, in Word or PDF format and they proposals must contain the sections required in Table 1. The omission of the required information may imply the non-approval of the proposal. INTA scientific team may request the correction of errors after the reception of the proposal.

AO-003 Joint TSX/TDX-PAZ Experiment
1. Identification of the project
• Title of the project. • Scientific objective (150 words). Summary formulation of the project objective. • Identification of the geographic area of interest (selection of the specified Test Sites). • Imaging Mode, Product Type and Polarization. • Duration of the project (Maximum 36 months. This duration can be extended)
2. Project description
• Executive summary (500 words), including the objectives of the research work, main points and milestones. This abstract can be published. • Description of the research team, identifying: • Principal Investigator (including contact e-mail) and other members, including CV and structure of the organization.

• Financing source, which ensures the viability and execution of the project. • Definition of the contribution of the project to the objectives of the Joint TSX/TDX-PAZ Experiment. • Definition of expected results and publications. • Definition of the project duration. Identification of the expected delivery dates of progress (bi-annual) and final reports. • Initial description of the image products requested, including: • Justification of the number of products requested • Detailed definition of the test site (Test Site ID), time range of the acquisition. • Justification of temporary limitations related to the acquisition period (for example, the need for the acquisition to be made in a specific season of the year or the need for a data collection to be acquired with certain periodicity).
3. PAZ Data Requirements
For each requested product: • Identification of the data take acquisition characteristics: • Test Site(s). • Range of dates of interest. As far as possible, the demand for specific dates will be avoided, with the indication of months or range of months of interest being preferable. • Imaging mode (SM / SL / HS / ST / SC (4 or 6 beams) • Satellite path (ascending / descending / both) • Polarization o Single (HH / HV / VV) o Dual (HHVV / HHHV / VVVH) • Incidence angle (Full performance / 15º-60º) • Processing options: o Geometric correction (SSC / MGD / GEC / ECC) o Resolution type for detected products (SE / RE) o Orbit Type (Rapid o Scientific)

TABLE 1. PAZ PROPOSAL TEMPLATE

Each proposal will go through a scientific and technical evaluation. The scientific benefit and the synergistic utilization with TSX and TDX will be judged. Additionally, the data requirements and the fulfilment of the scientific use criteria are checked:

- Proposals meet the objectives of the PAZ Scientific Exploitation.
- Investigators do not have a commercial purpose.
- Project establishes a work plan, working team and funding clear and convenient to achieve the project objectives.
- Proposals defines viable data take acquisitions, not having conflicts with commercial or national security interests.

The investigator shall be informed about the evaluation within 2 months after submission.

All proposals received within the period identified in the announcement will be evaluated by the scientific committee of PAZ. The result of the evaluation may be:

- **Approved**. It means the start of the project, with the signing of PAZ end user license agreement with the end user (EULA), which confirms:
    - The intention to execute the project.
    - The availability of financing to carry out the project.
    - The work team that will work on the project, including their CVs.
    - Acceptance of the quantity of products to be provided and the method of delivery.
    - Acceptance of reporting and publishing results.
    - Acceptance of the use of the data according to the terms and conditions stipulated in the use agreement.
- **Denied**. In case the proposal does not meet the evaluation criteria.
- **Need to be rectified**. In this case INTA will communicate to the Principal Investigator the information needed and a re-evaluation will be performed.

6.2.3 Scientific User Criteria

PAZ scientific exploitation is devoted to provide basic products, with the goal of the promotion of SAR technology and its applications to national and international research entities. In this way Scientific Users shall submit a scientific project covering the definition of the objectives and identifying that the utilization of PAZ products that is not intended to the commercial use with profit orientation but is a scientific use. This includes the use of PAZ products:

- by educational and research institutions,
- for preparation and execution of government financed education-, research- and development-programs,
- for demonstration of new applications for potential users,

- for use within the PAZ project (calibration, validation, quality assurance, public outreach, experimental instrument operations, etc.).

Interested investigators will have to respond to this Announcement of Opportunity by means of a Project Proposal submission which defines the scientific work to be carried out and. Proposals will be reviewed by INTA PAZ Science Team. The proposals that obtain the status of approved will receive the EULA that the principal investigator must sign as a starting point for the project. This signature will stablish the launch of the project, starting the acquisition and dissemination of the corresponding PAZ products according to the definition contained in the proposal.

6.2.4 Security Regulations

All the acquisitions will be property of HISDESAT and a final use license will be provided to INTA. The distribution of images to third parties will include the License Agreement with the End User (EULA) that HISDESAT provides.

The requested acquisitions will be checked against the sensitivity filter defined by the Ministry of Defense.

7 TEST SITES Opportunities

In this section specific data acquisition sites are listed where data of the corresponding mission have data already acquired over a longer time frame.

Investigators are requested to prepare their proposals taking into account these specific sites, but also other test sites can be considered. The selection of the test sites can favour the approval of the proposal.

The test sites are defined by means of the following items:

- Test site identifier
- Reference coordinates
- Main application field
- Mission.

Note that **Mission field** refers to the existence of catalogue data already acquired by the specified mission (TerraSAR-X, TanDEM-X and/or PAZ). All the specified test sites can be requested for future acquisitions to be performed by TerraSAR-X, TanDEM-X or PAZ.

Id	Test site	Coordinates	Application Area	Mission
01	Barrax Spain Mixed Agriculture	(39.067181, -2.158813)	Agriculture	TDX, PAZ
02	Demmin Agriculture	(53.989766, 13.258538)	Agriculture	TSX, TDX, PAZ
03	BareSalar Uyuni	(-20.199024,-67.693419)	Agriculture, Salar Lake	TSX, PAZ
04	Salamanca Spain	(40.696958, -5.471790)	Agriculture	PAZ
05	Injune	(-25.295572, 147.654970)	Forest	TDX
06	Krueger National Park	(-24.811668, 31.657104)	Forest	TDX
07	Krycklan	(64.220550, 19.897878)	Forest	TSX, TDX
08	La Selva	(10.420900, -84.022400)	Forest	TDX
09	Remningstorp	(58.462020, 13.628747)	Forest	TSX, TDX
10	Sevilla Spain Rice Agriculture	(37.085858, -6.116638)	Agriculture	TSX, TDX, PAZ
11	Tapajos	(-3.114800, -54.955000)	Forest	TDX, PAZ
12	Tasmania North East Forest	(-41.679705, 147.854858)	Forest	TDX

13	Rascafría, Spain	(40.889809, -3.891349)	Forest	PAZ
14	Wallerfing Agriculture	(48.745270, 12.831000)	Agriculture	TDX
15	Breidamerkurjokull	(64.147125, -16.369136)	Vulcano	TSX, TDX
16	Colima Vulcano	(19.451053, -103.748971)	Vulcano	TSX
17	El Hierro	(27.743100, -18.012772)	Vulcano	PAZ
18	Etna	(37.740313, 14.983292)	Vulcano	TSX, TDX
19	Grimsvotn and Skafta Cauldrons	(64.433236, -17.510343)	Vulcano	TSX
20	Kilauea East Rift Zone	(19.371721, -155.047302)	Vulcano	TDX
21	Kilauea summit	(19.414307, -155.273209)	Vulcano	TDX, PAZ
22	Merapi Vulcano	(-7.636427, 110.425632)	Vulcano	TSX, TDX, PAZ
23	Piton de la Fournaise	(-21.249702, 55.730896)	Vulcano	TSX, TDX, PAZ
24	Shiveluch Vulcano	(56.653333, 161.360000)	Vulcano	TSX
25	Soufriere Hills Vulcano	(16.740000, -62.187000)	Vulcano	TSX
26	Asal Fault	(11.583633, 42.499237)	Vulcano	TDX
27	Tenerife	(28.271246,-16.642632)	Vulcano	PAZ
28	La Palma	(28.719000,-17.874114)	Vulcano	PAZ
29	Lanzarote	(28.998685,-13.752219)	Vulcano	TSX, PAZ
30	MountSt. Helens	(46.200000,-122.188000)	Vulcano	TSX, PAZ
31	Yellowstone caldera	(44.412896,-110.730248)	Vulcano	TSX, PAZ
32	Norris Yellowstone	(44.729000,-110.706000)	Vulcano	TSX, PAZ
33	Mount Pelee_Martinique	(14.809197,-61.166425)	Vulcano	PAZ
34	The Quill_ St. Eustatius	(17.477778,-62.959722)	Vulcano	PAZ
35	La grande Soufriere_Guadeloupe	(16.044600,-61.664200)	Vulcano	TSX, PAZ

36	Mount Scenery_Saba	(17.635000,-63.239167)	Vulcano	PAZ
37	Alert Sea Ice ascending orbit 133	(82.656652, -62.731934)	Sea Ice	TDX
38	Aletsch Glacier	(46.502173, 8.033752)	Glacier	TDX
39	Antarctic Peninsula Mid West	(-64.599004, -60.859433)	Glacier	TSX
40	Antarctic Peninsula North East	(-63.984254, -58.773919)	Glacier	TSX
41	Antarctic Peninsula South	(-66.739902, -66.115723)	Glacier	TSX
42	Antarctic Peninsula South West	(-65.436773, -62.890346)	Glacier	TSX
43	Antarctic Pensinsula Mid East	(-64.315565, -59.875401)	Glacier	TSX
44	Barrow Sea Ice	(71.467252, -156.952921)	Sea Ice	TSX, TDX
45	Caspian Sea	(40.248351, 50.698833)	Sea Ice	PAZ
46	Baltic Sea Sea	(59.994035, 29.966484)	Sea Ice	PAZ
47	Columbia Glacier	(61.378305, -147.062988)	Glacier	TSX
48	Hellheim Glacier	(66.460000, -38.310000)	Glacier	TSX, TDX
49	Hellheim Glacier Dual Pol	(66.377100, -38.248900)	Glacier	TDX
50	Jakobshavn Glacier	(69.117569, -49.570313)	Glacier	TSX, TDX
51	Jakobshavn Inland Glacier	(69.140000, -49.000000)	Glacier	TSX, TDX
52	Kangerdlugssuaq Glacier	(68.668000, -32.853000)	Glacier	TSX, TDX
53	Oetztal, Austria	(46.902008, 10.858955)	Glacier	TSX
54	Petermann Glacier	(80.722458, -60.281640)	Glacier	TSX, TDX, PAZ
55	Pine Island Glacier Mid	(-75.198609, -99.536260)	Glacier	TSX
56	Pine Island Glacier North	(-75.196072, -98.088726)	Glacier	TSX
57	Pine Island Glacier South	(-75.243818, -100.563795)	Glacier	TSX
58	Russell Glacier	(67.041000, -49.834000)	Glacier	TDX

59	Thwaites Glacier North	(-75.305306, -106.861204)	Glacier	TSX, TDX
60	Narsap Sermia	(64.660000,-49.905600)	Glacier	PAZ
61	Johnsons Livingstone Antartic	(-62.669452,-60.349901)	Glacier	PAZ
62	Samoylov, Lena River	(72.379989, 126.469459)	Permafrost	TSX, TDX
63	Herschel Island, Canada	(69.573669, -139.095840)	Permafrost, Snow	TSX, TDX
64	Deception Island Antartic	(-62.977010,-60.675404)	Snow, Vulcano	TSX, PAZ
65	Gulmarg_Indian Himalaya	(34.055444, 74.390944)	Snow	PAZ
66	Burwa_Indian Himalaya	(32.355194, 77.126417)	Snow	PAZ