

# SCIENTIFIC EXPEDITION FROM PERU TO THE ANTARCTICA



Foto: Fabian Brondi.

## SCIENTIFIC ADVANCES OF ANTAR XXVII TECHNICAL RESULTS 2020

- DIRECCIÓN GENERAL DE SOBERANÍA, LÍMITES Y ASUNTOS ANTÁRTICOS
- DIRECCIÓN DE ASUNTOS ANTÁRTICOS

2020





# SCIENTIFIC EXPEDITION FROM PERU TO THE ANTARCTICA

SCIENTIFIC ADVANCES OF ANTAR XXVII

TECHNICAL RESULTS 2020

MINISTERIO DE RELACIONES EXTERIORES

DIRECCIÓN DE SOBERANÍA, LÍMITES Y ASUNTOS ANTÁRTICOS

DIRECCIÓN DE ASUNTOS ANTÁRTICOS

COORDINADORA DE LA PUBLICACIÓN

Dra. Elizabeth Silvestre Espinoza

RESPONSABLE DE LA REDACCIÓN

Dra. Elizabeth Silvestre Espinoza

AUTORES

Silvestre, E.E., Bello Ch.C., Londoño B.P., Gamarra S.D.

REVISIÓN Y EDICIÓN

Dra. Elizabeth Silvestre Espinoza

Mc. David Gamarra Silva

FOTO DE PORTADA

Estación Científica Antártica – “Machu Picchu” Foto: Fabian Brondi

COLABORADORES

Enrique Franco, Francis López, Ismael Grau, Marcela De Los Ríos,  
Mirtha Arbulú,

Hecho el Depósito Legal en la Biblioteca Nacional del Perú No. xxxxxx

ISBN: xxxxxxxxxxx

IMPRESIÓN

Corporación Gráfica Kadte S.A.C.

Teléfono: 265 7065

FECHA DE EDICIÓN

Setiembre 2020







# SCIENTIFIC EXPEDITION FROM PERU TO THE ANTARCTICA

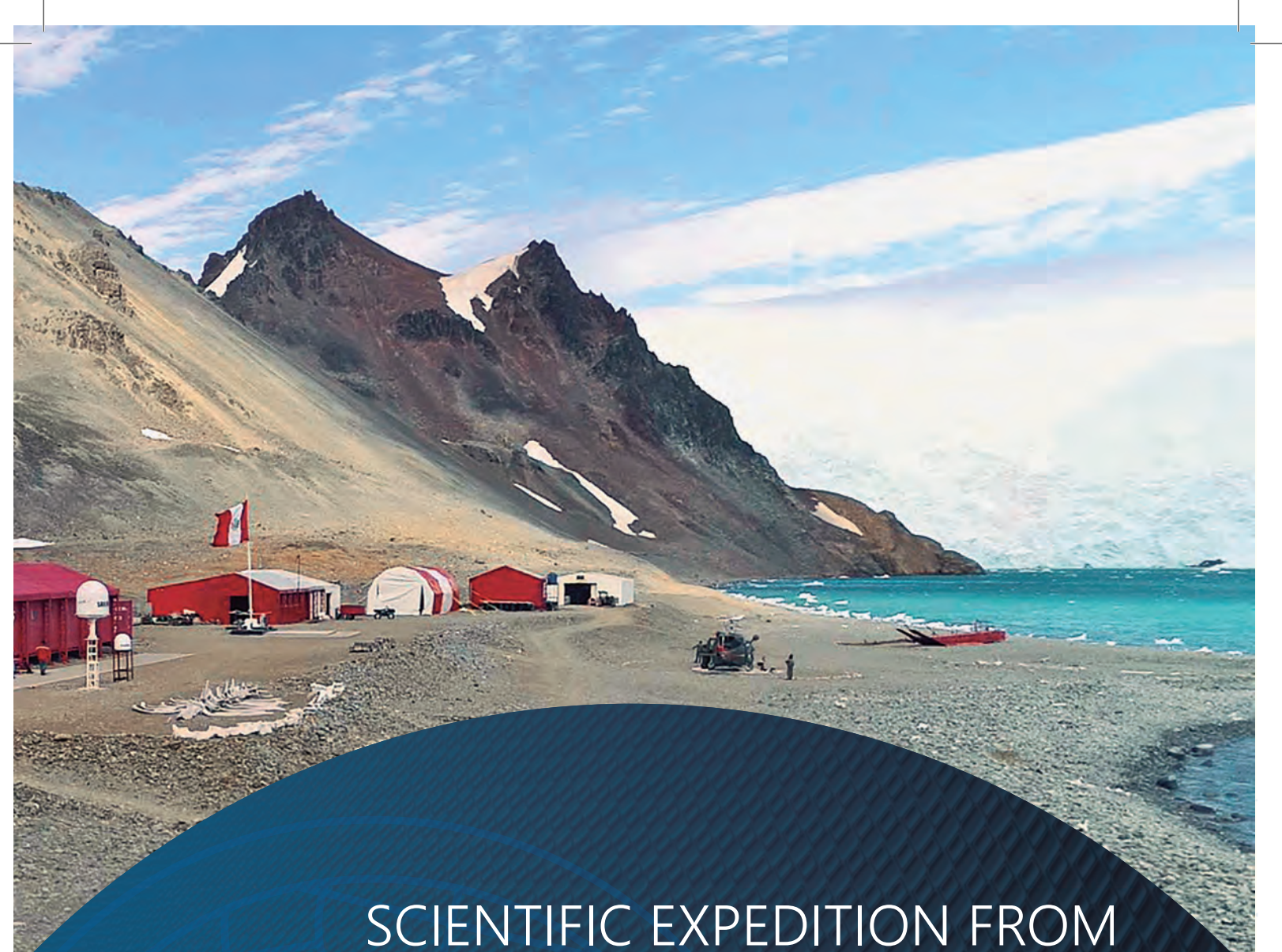
## SCIENTIFIC ADVANCES OF ANTAR XXVII TECHNICAL RESULTS 2020

- DIRECCIÓN GENERAL DE SOBERANÍA,  
LÍMITES Y ASUNTOS ANTÁRTICOS
- DIRECCIÓN DE ASUNTOS ANTÁRTICOS









# SCIENTIFIC EXPEDITION FROM PERU TO THE ANTARCTICA

## TWENTY-SEVENTH EXPEDITION OF PERU TO THE ANTARCTICA ANTAR XXVII

SCIENTIFIC ADVANCES OF ANTAR XXVII  
TECHNICAL RESULTS 2020



Ministerio  
de Relaciones Exteriores







# TWENTY-SEVENTH EXPEDITION OF PERU TO THE ANTARCTICA ANTAR XXVII



PERÚ

Ministerio  
de Relaciones Exteriores



MINISTRY OF FOREIGN AFFAIRS - GOVERNING BODY

**MARIO JUVENAL LOPEZ CHÁVARRI**

Minister of Foreign Affairs

**MANUEL GERARDO TALAVERA ESPINAR**

Vice Minister of Foreign Affairs

**AUGUSTO ARZUBIAGA SCHEUCH**

Director General for Sovereignty, Boundaries and Antarctic Affairs

**DAVID GUILLERMO GAMARRA SILVA**

Director of Antarctic Affairs





# PRESENTATION

In 1988, Peru made its first expedition to the white continent and in 1989 built the Antarctic Scientific Station “Machu Picchu” (ECAMP), located on King George Island, Antarctica. In 2019, with the ANTAR XXVII expedition, thirty-one years of sustained research were completed, which has done nothing but ratify and consolidate Peru’s consultative status in the Antarctic Treaty.

In the ANTAR XXVII expedition, it carried out in two stages: the first began on Dec 22, 2019, to Jan 27, 2020; and the second began on Jan 28 to Mar 5, 2020. Both stages were carried out at ECAMP and on the Peruvian Navy Ship (BAP) “Carrasco”, a research vessel with polar capacity. In which 75 national and 24 foreign expedition members participated.

The ANTAR XXVII had the participation of 21 national entities that include universities, public research institutes (PRIs) and entities of the Ministry of Defense, who were in charge of logistical support for transportation and the development of research projects. Twenty-four research projects were developed, 45% developed by universities and 40% by PRIs. From an international point of view, the scientific collaboration initiated with eight countries.







The projects developed are related to the evaluation of the accelerated retreat of glaciers and its relationship with climate change; environmental quality focused on the evaluation of atmospheric and water pollution; the identification of micro and macroplastics in biotic and abiotic components in the Antarctic peninsula. Likewise, other projects are related to the behaviour of marine biodiversity and the Antarctic seabed, with the aim of understanding evolution over time.

The physical and dynamic processes of the Bransfield Strait related to oceanography were monitored using the equipment of the BAP Carrasco, in order to understand ocean circulation and its relationship with the dynamic and physical behaviour of the atmosphere, the El Niño and La Niña phenomenon, and climate change. Information gathering was started to understand the geological and geomorphological processes related to permafrost, the vibrational situation on the surface and the behaviour of the volcanoes on the seabed. Also, the potential of tourism in Antarctica was evaluated. The support of the activities about the planned projects was meteorological monitoring and forecasting.

In this document, we present technical results of the scientific progress that achieved the projects of each participating institution. The scientific results will be published in indexed journals, to contribute to science and positioning Peru as a consultative part of the Antarctic Treaty.



# TWENTY-SEVENTH EXPEDITION OF PERU TO THE ANTARCTICA ANTAR XXVII

## PARTICIPATING INSTITUTIONS

Autoridad Nacional del Agua - ANA  
Ministry of Agriculture and Irrigation



Dirección de Meteorología Aeronáutica  
de la Fuerza Aérea del Perú - DIRMA  
Ministry of Defence



Comisión Nacional de Desarrollo  
Aeroespacial - CONIDA  
Ministry of Defence



Dirección de Hidrografía y  
Navegación - DHN  
Ministry of Defence



Instituto Geográfico Nacional - IGN  
Ministry of Defence



Instituto Geofísico del Perú - IGP  
Ministry of the Environment



Instituto Geológico, Minero y  
Metalúrgico - INGEMMET  
Ministry of Energy and Mines







Instituto Nacional de Investigación en Glaciares  
y Ecosistemas de  
Montaña - INAIGEM  
Ministry of the Environment



Instituto Peruano de Energía Nuclear - IPEN  
Ministry of Energy and Mines



Instituto del Mar del Perú - IMARPE  
Ministry of Production



Servicio Nacional de Meteorología e  
Hidrología - SENAMHI  
Ministry of the Environment



Universidad Católica de  
Santa María - UCSM



Universidad del Sagrado  
Corazón de Jesús - UNIFE



Universidad Nacional del  
Centro del Perú - UNCP



Universidad Nacional de San Agustín  
de Arequipa - UNSA



Universidad San Ignacio  
de Loyola - USIL



Universidad de Ingeniería  
y Tecnología - UTEC



Servicio Nacional de Áreas Protegidas  
Naturales Protegidas por el Estado - SERNANP  
Ministry of Agriculture and Irrigation



Antarctic Operations Company  
Peruvian Army



Directorate of Hydrography and Navigation -DHN-  
Peruvian Navy



Air Group 3  
Peruvian Air Force





# SCIENTIFIC ADVANCES OF ANTAR XXVII

## TECHNICAL RESULTS

## ANTAR XXVII SCIENTIFIC RESEARCH PROJECTS

### GENERATION OF GLACIER VOLUMETRY, USING RPA TECHNOLOGY

INSTITUTO GEOGRÁFICO NACIONAL - IGN

Principal investigator	MSc. Fabián Brondi Rueda
Research team	Raúl Olivar Yallico, Alexis Camargo Pumahuacre
Expeditionaries	Raúl Olivar Yallico, Alexis Camargo Pumahuacre

### STRUCTURE AND DYNAMICS OF CIRCULATION IN THE BRANSFIELD STRAIT

INSTITUTO GEOFÍSICO DEL PERÚ- IGP

Principal investigator	Dra. Ivonne Montes
Research team	Kobi Mosquera, Boris Dewitte <sup>1,2,3</sup> , Luis Bravo <sup>4</sup>
Expeditionaries	Kobi Mosquera, Ivonne Montes

### STUDY OF THE PELAGIC ECOSYSTEM IN THE BRANSFIELD STRAIT AND SURROUNDING OF THE PILOTO PARDO ISLANDS

INSTITUTO DEL MAR DEL PERÚ - IMARPE

Principal investigator	Dra. Ana Alegre Norza Sior
Research team	Andrés Chipolini
Expeditionaries	Regina Aguilar Arakaki, Ana Alegre Norza Sior, Wilson Carhuapoma Bernabé, Andrés Chipolini Montenegro, Jonathan Correa Acosta, Gustavo Cuadros Caballero, Augusto Franco García, María Andrea Meza Torres, Luz Ximena Orosco Montenegro, Marissela Pozada Herrera, Roberto Quesquén Liza, Javier Quiñones Dávila, Cinthya Romero Moreno, Cecilia Roque García, José Salcedo Rodríguez, Javier Sánchez Espinoza, Luis Vásquez Espinoza.

### STUDY OF THE ENVIRONMENT IN THE MACKELLAR INLET, ADMIRALTY BAY AND BRANSFIELD STRAIT

INSTITUTO DEL MAR DEL PERÚ - IMARPE

Principal investigator	MSc. Piero Villegas Apaza
Research team	Ricardo Dioses Avellaneda, Carlos Martínez Gamboa
Expeditionaries	Ricardo Dioses Avellaneda, Carlos Martínez Gamboa

<sup>1</sup> Centro de Estudios Avanzado en Zonas Áridas (CEAZA), Coquimbo, Chile.

<sup>2</sup> Departamento de Biología, Facultad de Ciencias del Mar, Universidad Católica del Norte, Coquimbo, Chile.

<sup>3,4</sup> Millennium Nucleus for Ecology and Sustainable Management of Oceanic Islands (ESMOI), Coquimbo, Chile

<sup>4</sup> Laboratoire d'Etudes en Géophysique et Océanographie Spatiales, Toulouse, France



## SOCIAL, ECONOMIC AND ENVIRONMENTAL CONTRIBUTION IN THE CONSERVATION AND LOSS OF MARINE BIODIVERSITY DUE TO GLACIER RETROCESS IN THE ANTARCTIC PENINSULA (PANT\_BIOGLACIAR)

INSTITUTO NACIONAL DE INVESTIGACIÓN EN GLACIARES Y ECOSISTEMAS DE MONTAÑA - INAIGEM

Principal investigator	Dr. Pedro Miguel Tapia Ormeño (e)
Research team	Gisella Orjeda Fernández, Carolyn Eyles <sup>5</sup> , Rodrigo Narro Pérez <sup>5</sup> , Yuri Hooker Mantilla <sup>6</sup> , Adriana Gonzales Pestana <sup>6</sup> , Víctor Pacora Suarez <sup>7</sup> , Milena Arias Schreiber <sup>8</sup> , Edwin Anibal Loarte Cadenas, Katy Medina, Luzmila Dávila Roller, Gina Osorio
Expeditionaries	Edwin Anibal Loarte Cadenas, Katy Damacia Medina Marcos, Mayra Doris Mejía Camones, Yuri Hooker Mantilla, Adriana Gonzales Pestana

## EVOLUTION OF SUBMARINE VOLCANISM IN THE BRANSFIELD STRAIT: RELATIONSHIP OF HYDROTHERMAL EMANATIONS WITH BIODIVERSITY AND CLIMATE CHANGE - ORCA MULTINATIONAL CRUISE

INSTITUTO GEOLÓGICO MINERO Y METALÚRGICO - INGEMMET

Principal investigator	MSc. Luis Cerpa
Research team	Natalia Venturini <sup>9</sup> , Aldo Indacochea <sup>10</sup> , Constanza Ricaurte <sup>11</sup> , Luis Somoza <sup>12</sup> , Ximena Contardo <sup>13</sup> , Cristian Rodrigo <sup>13</sup> , Rodrigo González <sup>14</sup> , Silvia Rosas <sup>15</sup> , Bernhard Dold <sup>15</sup>
Expeditionaries	Luis Cerpa Cornejo, Natalia Venturini, Constanza Ricaurte, Adriana Tuduri, Sofia Santos, Magnolia Murics Riaño, Silvio Andrés Ordoñez Zuñiga, Keyssi Alain Rodriguez Flores, Ulrike Inge Tarazona Janampa, Raul Mauricio Olaechea Alejo, Álvaro Martín Arteaga Bengoa, José Manuel Herrera Nizama, Maryuri Edith Nole Valdez, Dante Soberón Ortiz, Alonso Arturo Marchena Campos, Víctor Raúl Poma LLantoy, Blanca Silvia Rosas Lizárraga, Bernhard Stefan Dold, Eduardo Jesús Tirado Dávila, Alison Giomara Bedoya Campoverde, Jhoselyn Mariangela Paredes Zavala, Mariagracia Díaz Gutiérrez, Gino Osses, Erick Cinfuentes, Angélica Varas Villalobos, Cristina de Ignacio San José, María Asensio Ramos, Santiago Golmayo Flethes, Alejandra Páscale, Mauricio Faraone, Louise Julie Delhaye, Jacobus Engelbrecht.

<sup>5</sup> McMaster University

<sup>6</sup> Laboratorio de Biología Marina – UPCH

<sup>7</sup> Universidad Nacional de Ingeniería

<sup>8</sup> University of Gothenburg

<sup>9</sup> Universidad de la República – Uruguay

<sup>10</sup> Universidad Científica del Sur

<sup>11</sup> Instituto de Investigaciones Marinas y Costeras José Benito Vives de Andrés - INVEMAR

<sup>12</sup> Instituto Geológico Minero de España – IGME

<sup>13</sup> Universidad Andres Bello – Chile

<sup>14</sup> Universidad Católica del Norte – Chile

<sup>15</sup> Pontificia Universidad Católica del Perú



## STUDY OF THE PERMAFROST IN THE SURROUNDINGS OF THE "MACHU PICCHU" SCIENTIFIC STATION, KING GEORGE ISLAND, ANTARCTIC PENINSULA

INSTITUTO GEOLÓGICO MINERO Y METALÚRGICO - INGEMMET

Principal investigator	•	Ing. Baclimer Quispe Yanapa
Research team	•	Wai Long Ng, Gonzalo Luna <sup>16</sup> , Vladimir Aquino <sup>17</sup>
Expeditionaries	•	Baclimer Quispe Yanapa

## EVOLUTION OF THE DOMEYKO GLACIER BASED ON GEOMORPHOLOGICAL RECORDS IN MACKELLAR INLET, KING GEORGE ISLAND, ANTARCTICA

INSTITUTO GEOLÓGICO MINERO Y METALÚRGICO - INGEMMET

Principal investigator	•	Estibene Pool Vásquez Choque
Research team	•	Ing. Gonzalo Luna
Expeditionaries	•	Estibene Pool Vásquez Choque

## STUDY OF ENVIRONMENTAL VIBRATION AND ITS CORRELATION WITH LITHOSTRATIGRAPHY AND PERMAFROST IN THE MACHU PICCHU ANTARCTIC SCIENTIFIC STATION AND SURROUNDINGS, KING GEORGE ISLAND, ANTARCTICA

INSTITUTO GEOLÓGICO MINERO Y METALÚRGICO - INGEMMET

Principal investigator	•	Dra. Yanet Antayhua Vera
Research team	•	José Calderón Vilca, Wai Long Cutipa, Antonio Correia, Javier Almendros
Expeditionaries	•	José Javier Calderón Vilca, Antonio Correia

## GEOLOGICAL EVOLUTION OF ADMIRALTY BAY, KING GEORGE ISLAND AND HOPE BAY, ANTARCTIC PENINSULA

INSTITUTO GEOLÓGICO MINERO Y METALÚRGICO - INGEMMET

Principal investigator	•	MSc. Luis Cerpa Cornejo
Research team	•	Alejandra Pascale , Mauricio Faraone , Maryuri Nole, Dante Soberon
Expeditionaries	•	Luis Cerpa, Maryuri Nole Vásquez, Alexandra Tuduri, Dante Soberón, Mauricio Faraone

## METAGENOMIC ANALYSIS OF THE ANTARCTIC KRILL MICROBIOTA (*EUPHAUSIA SUPERBA*) AND ITS RELATIONSHIP WITH CLIMATE CHANGE

INSTITUTO PERUANO DE ENERGÍA NUCLEAR - IPEN

Principal investigator	•	Blgo. Ángel J. Montes Osorio
Research team	•	MSc. Juan Agapito Javier A. Sánchez Espinoza, Antonio A. Cuba Martínez y Dany M. Ulloa Espejo
Expeditionaries	•	Ángel J. Montes Osorio

<sup>16</sup> Universidad Nacional San Antonio Abad del Cusco - UNSAAC

<sup>17</sup> Universidad Nacional Mayor de San Marcos - UNMSM

<sup>18</sup> Universidad Nacional San Antonio Abad del Cusco - UNSAAC

<sup>19</sup> Universidad de Évora - Portugal

<sup>20</sup> Universidad de Granada - España

<sup>21</sup> Dirección Nacional de Minería y Geología de Uruguay

<sup>22</sup> Dirección Nacional de Minería y Geología de Uruguay

<sup>23</sup> Instituto del Mar del Perú - IMARPE



**RADIOLOGICAL CHARACTERIZATION OF SEDIMENTS EXTRACTED FROM THE DEEP SEA IN BRANSFIELD STRAIT AND ENVIRONMENTAL SAMPLES AT ECAMP**

INSTITUTO PERUANO DE ENERGÍA NUCLEAR - IPEN

Principal investigator	MSc. Pablo Antonio Mendoza Hidalgo
Research team	Víctor Poma, Jorge Martínez, Kevin Mego <sup>24</sup>
Expeditionaries	Víctor Raúl Poma Llantoy

**DEVELOPMENT OF SPACE CLIMATE STATION IN "MACHU PICCHU" ANTARCTIC SCIENTIFIC STATION**

COMISIÓN NACIONAL DE INVESTIGACIÓN Y DESARROLLO AEROSPAZIAL - CONIDA

Principal investigator	Ing. Luis Javier Otiniano Ormachea
Research team	Jorge Samanes, César Castromonte <sup>25</sup>
Expeditionaries	Luis Javier Otiniano Ormachea

**STUDY OF OCEAN CIRCULATION AROUND SOUTH SHETLAND ISLANDS AND ELEPHANT ISLAND, AND ITS CONNECTION WITH PERUVIAN COAST AND PHENOMENONS EL NIÑO AND LA NIÑA**

DIRECCIÓN DE HIDROGRAFÍA Y NAVEGACIÓN - DHN

Principal investigator	Ing. Rina Gabriel Valverde
Research team	Roberto Chauca, Emanuel Guzmán, Carmela Ramos, Carol Estrada Ludeña, Gerardo Ramírez Rosario, Juan Sarazú, Eduardo Choque Arias
Expeditionaries	Roberto Chaca Hoyos, Roger Salazar Rojas

**MARINE CIRCULATION STUDY TO DETERMINE TRAJECTORY OF POSSIBLE POLLUTING ELEMENTS IN ADMIRALTY BAY BY LAGRANGIAN APPROACH**

DIRECCIÓN DE HIDROGRAFÍA Y NAVEGACIÓN - DHN

Principal investigator	Mg. Emanuel Guzmán Zorrilla
Research team	Carmela Ramos Orlandino, Juan José Sarazú Cotirna, Eduardo Choque Arias, Fernando Guzmán Contreras, Carmela Ramos, Juan Sarazú, Rina Gabriel, Roberto Chauca, Eduardo Choque, Fernando Guzmán
Expeditionaries	Joel Carlos Bruno Soldevilla, José Santana Castañeda, Moisés Molina Vicharra, Iván Jiménez Ríos

**STUDY OF BEHAVIOR OF WEATHER VARIABLES FOR FORECASTS IN ADMIRALTY BAY**

DIRECCIÓN DE METEOROLOGÍA AERONÁUTICA DE LA FUERZA AÉREA DEL PERÚ - DIRMA

Principal investigator	Cap. Kristian Carlos Guillén Cueva
Research team	Frank Giovanni Vega Abad, Nilo Andía Oscoco, Juan Carlos Jiménez Cerrón
Expeditionaries	Kristian Guillén Cueva, Nilo Andía Oscoco, Juan Carlos Jiménez Cerrón

<sup>24</sup> Universidad Nacional Mayor de San Marcos (UNMSM)

<sup>25</sup> Universidad Nacional de Ingeniería (UNI)



## COMPARISON OF GLACIER DYNAMICS AND EVOLUTION IN THE ANTARCTICA AND PERUVIAN TROPICAL GLACIERS

SERVICIO NACIONAL DE METEOROLOGÍA E HIDROLOGÍA DEL PERÚ Y AUTORIDAD NACIONAL DEL AGUA SENAMHI/ANA

Principal investigator	•	Dr. Wilson Suarez (SENAMHI) / Ing. Nelson Santillán (ANA)
Research team	•	Alejo Cochachin (ANA), Gilbert Gonzales (ANA), Sandro Arias (SENAMHI) Rolando Cruz (ANA)
Expeditionaries	•	Wilson Suarez Alayza, Rolando Cruz, Joe Quijano

## CHARACTERIZATION OF MACRO AND MICROPLASTICS IN HYDROBIOLOGICAL RESOURCES AND SEDIMENTS OF THE ECOSYSTEM OF ADMIRALTY BAY (KING GEORGE ISLAND) AND BRANSFIELD STRAIT, AND IDENTIFICATION OF MACROPLASTICS IN THE SEAFLOOR OF ANTARCTIC PENINSULA

UNIVERSIDAD CATÓLICA SANTA MARÍA - UCSM

Principal investigator	•	MSc. Jhoselyn Paredes Zavala
Research team	•	Jhoselyn Paredes Zavala, Jaime Cárdenas García, Alexandra Sánchez-Moreno del Castillo, Karen Ordoñez Rivera, Antonella Delgado Cárdenas, Mariagracia Díaz Gutiérrez, Anny Infa Cahuina, Sara Espinoza Puma
Expeditionaries	•	Jhoselyn Paredes Zavala, Mariagracia Díaz Gutiérrez, Antonella Delgado Cárdenas, Alexandra Sánchez-Moreno del Castillo

## EVALUATION OF TRANSPORTATION OF ATMOSPHERIC AEROSOLS AND THEIR DEPOSITION ON SNOW TO ESTIMATE THE EFFECT ON ITS THAWING: PERUVIAN ANDES AND ANTARCTICA CASES

UNIVERSIDAD NACIONAL DEL CENTRO DEL PERÚ - UNCP

Principal investigator	•	MSc. José Eduardo Pomalaya Valdez
Research team	•	José Pomalaya Valdez, Violeta Quispe Coquil, Wilfredo Ramírez, Ever Ingaruca, Daniel Álvarez Tolentino, Alfonso Torre Vitor, Luis Suarez Salas <sup>26</sup> , Christian Torres <sup>27</sup> , Boris Barja <sup>28</sup> , y Eder Bayer Maier
Expeditionaries	•	Daniel Álvarez Tolentino, Alfonso Torre Vitor

## BALANCE OF VITAMIN C SUPPLEMENTATION IN EXPEDITIONARIES OF ANTAR XXVII, AND THE ASSESSMENT OF MACROALGAE NUTRITIONAL CONTENT OF ADMIRALTY BAY, KING GEORGE ISLAND

UNIVERSIDAD FEMENINA DEL SAGRADO CORAZÓN- UNIFE

Principal investigator	•	Lic. Giannina La Torre Gallardo
Research team	•	Giannina La Torre Gallardo, Marinalva Santos Bandy, Mirtha Yarlequé Chocas, Yadira Jiménez Arrunátegui
Expeditionaries	•	Giannina La Torre Gallardo

<sup>26</sup> Instituto Geofísico del Perú- IGP

<sup>27</sup> Universidad Federal de Rio Grande (Brasil)

<sup>28</sup> Universidad de Magallanes (Chile)



## **DETERMINATION AND DISTRIBUTION OF HEAVY METALS AND ORGANIC POLLUTANTS FROM BIOTIC AND ABIOTIC COMPONENT OF SUBMAREAL AND COASTAL ECOSYSTEMS FROM MARINE AREA NEAR "MACHU PICCHU" STATION**

UNIVERSIDAD NACIONAL SAN AGUSTIN DE AREQUIPA - UNSA

Principal investigator

Dr. Graciano A. Del Carpio Tejada

Research team

Graciano A. Del Carpio Tejada, Marcos S. Ríos Morales, Ulrich Zanabria Alarcón

Expeditionaries

Graciano A. Del Carpio Tejada

## **EVALUATION OF MICROPLASTICS FROM ABIOTIC AND BIOTIC COMPONENTS IN ADMIRALTY BAY**

UNIVERSIDAD SAN IGNACIO DE LOYOLA - USIL

Principal investigator

MSc. Luis Santillán Corrales

Research team

Miguel Mucha Torre, Gabriel de la Torre Picho, Diana Dioses Salinas, Miguel Ángel Saldaña<sup>29</sup>

Expeditionaries

Luis Santillán Corrales

## **HYDRODYNAMIC STUDY OF SEA CURRENTS AROUND OF SOUTH SHETLAND ISLANDS**

UNIVERSIDAD DE INGENIERÍA Y TECNOLOGÍA - UTEC

Principal investigator

Dr. Jorge D. Abad Cueva

Research team

Jorge D. Abad, Henry Valverde, Leo Guerrero, Tania Rojas

Expeditionaries

Henry Valverde Azaña

## **TOURISM IN ANTARCTICA**

Principal investigator

MSc. Juan Carlos Heaton

Research team

MSc Mariana Ríos - Programa Antártico de Uruguay

Expeditionaries

Juan Carlos Heaton

<sup>29</sup> Laboratory of Biomarkers of Aquatic Contamination and Immunochemistry, Department of Biochemistry, Federal University of Santa Catarina, UFSC, Florianópolis, SC, Brazil





# GLACIERS ON REY JORGE ISLAND, ANTARCTIC PENINSULA

On King George Island (Antarctic Peninsula), the Znosko glacier is located, which is the object of study to understand the dynamics of glacial retreat and its relationship with the impacts of climate change in Antarctica and Peru.

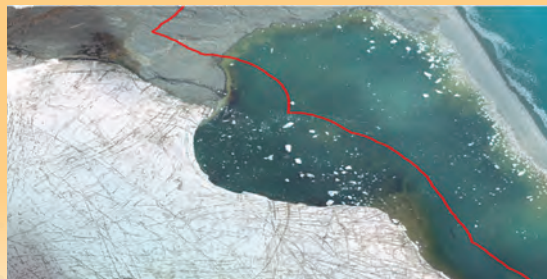
Remotely Piloted Aircraft (RPA), under the responsibility of the National Geographic Institute (IGN), was used to observe changes in Znosko glacier (Figure 1a and 1b). These results were accepted at the 9th Scientific Committee on Antarctic Research (SCAR) Open Science Conference



Figure 1a. RPA observations of Znosko glacier during ANTAR XXVI (source: IGN).



Figure 1b. RPA observations of Znosko glacier during ANTAR XXVII (source: IGN).



Likewise, the Znosko glacier was explored using GeoRadar by National Meteorology and Hydrology Service (SENAMHI) in conjunction with National Water Authority (ANA), to study the dynamics of its retreat (Figure 2). These results will be analyzed to be published in an indexed journal. Preliminary results were accepted at the 9th Scientific Committee on Antarctic Research (SCAR) Open Science Conference.

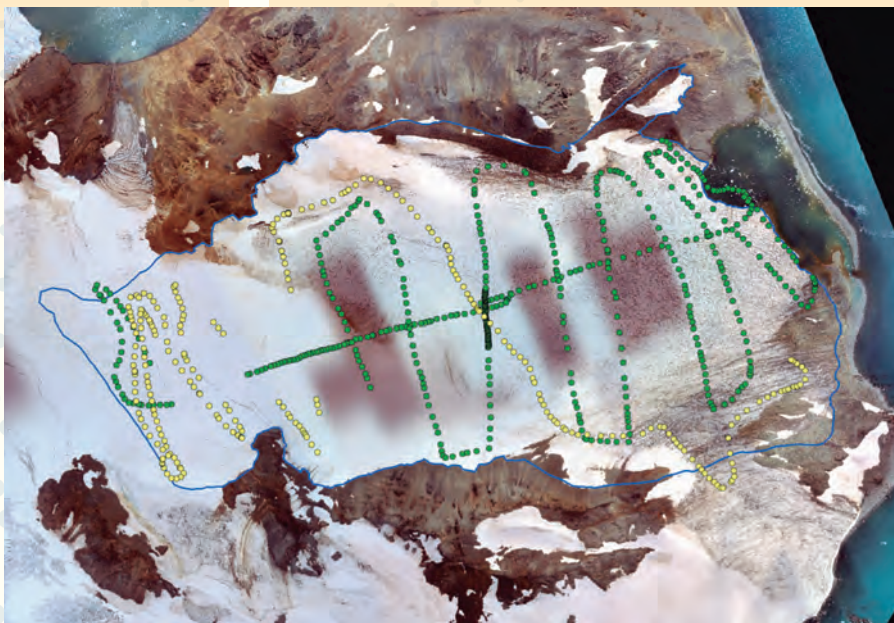


Figure 2. Exploration by GeoRadar of Znosko glacier in ANTAR XXVI (green lines) and ANTAR XXVII expedition (yellow lines). (Source: SENAMHI/ANA)



# ENVIRONMENTAL QUALITY ON KING GEORGE ISLAND, ANTARCTIC PENINSULA

The expedition members of the **Santa Maria Catholic University (UCSM)** of Arequipa carried out studies to identify atmospheric, micro and macroplastic pollutants in Admiralty Bay and the vicinity of ECAMP (King George Island, Antarctica). (Figure 3).



Figure 3. Macroplastics found in the vicinity of "Machu Picchu" Antarctic Scientific Station (Source: UCSM)

In ECAMP Research Laboratory, soil samples obtained in its vicinity (Admiralty Bay) were analyzed. UCSM's expeditionaries identified a variety of plastic filaments (Figure 4).

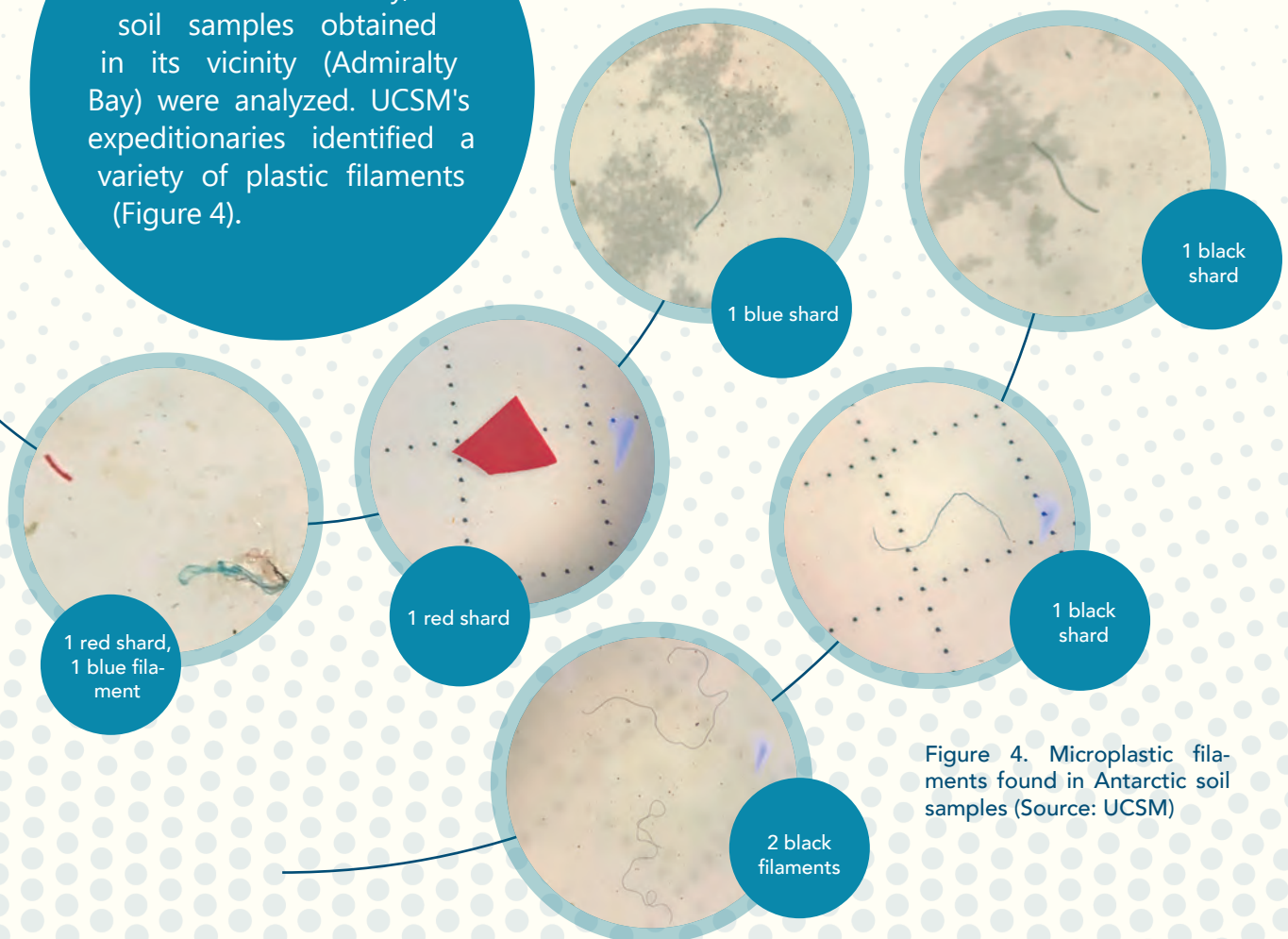


Figure 4. Microplastic filaments found in Antarctic soil samples (Source: UCSM)



Al analizarse los componentes bióticos, relacionados con las fecas de pingüinos y lobos marinos a cargo de la **Universidad San Ignacio de Loyola (USIL)**, se identificaron filamentos de microplásticos (Figura 5).

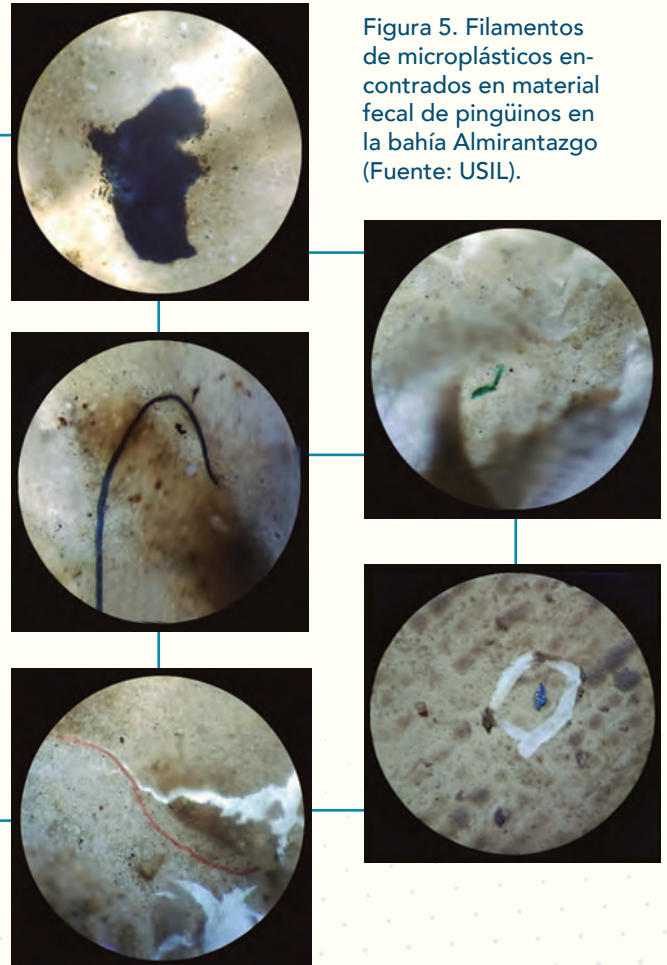
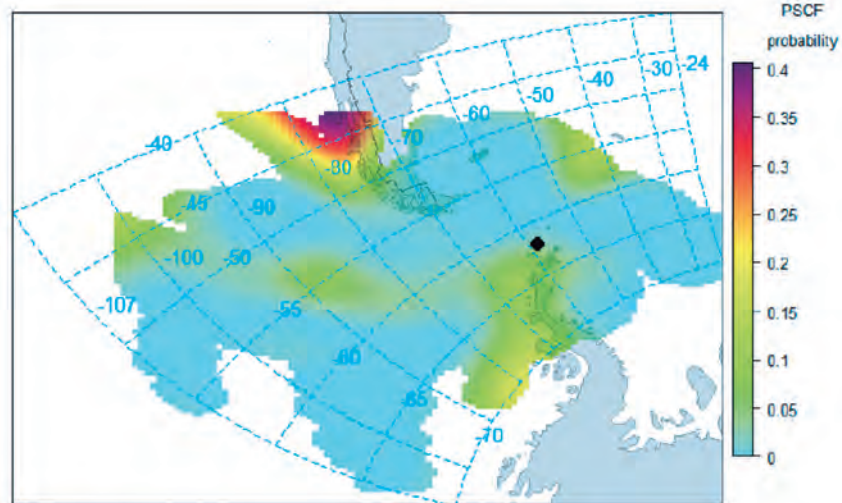


Figura 5. Filamentos de microplásticos encontrados en material fecal de pingüinos en la bahía Almirantazgo (Fuente: USIL).

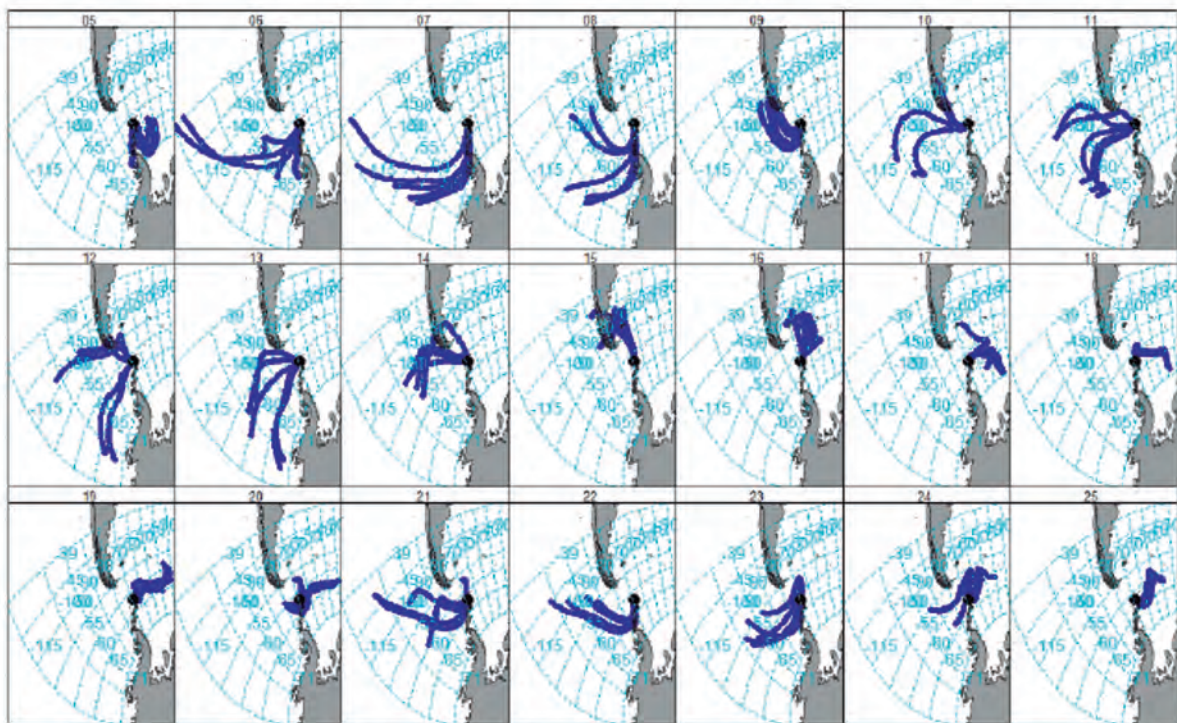
La **Universidad Nacional del Centro del Perú (UNCP)**, estimó la procedencia de material particulado hacia la Antártida (Figura 6) y la variación de las trayectorias de esos contaminantes atmosféricos (Figura 7).



Posibles zonas de procedencia de partículas (10 de febrero) durante la expedición ANTAR XXVII en el ECAMP

Figura 6. Posibles zonas de procedencia de contaminantes atmosféricos en forma de partículas observadas durante la expedición ANTAR XXVII (fuente: UNCP).





Variación de trayectorias por día durante la expedición ANTAR XXVII en el ECAMP

Figura 7. Variación de trayectorias de partículas por día observados durante la expedición ANTAR XXVII (Fuente: UNCP).

La **Universidad Nacional de San Agustín de Arequipa (UNSA)** tomó muestras para determinar metales pesados en componentes bióticos y abióticos, cuyo procesamiento será realizado en sus laboratorios.

El **Instituto Nacional de Energía Nuclear (IPEN)**, analizó sedimentos extraídos del fondo marino en el estrecho de Bransfield con la finalidad de determinar la existencia de isótopos radiactivos de origen natural o artificial. Los resultados muestran la existencia de tritio en sedimentos del fondo marino (Figura 8).

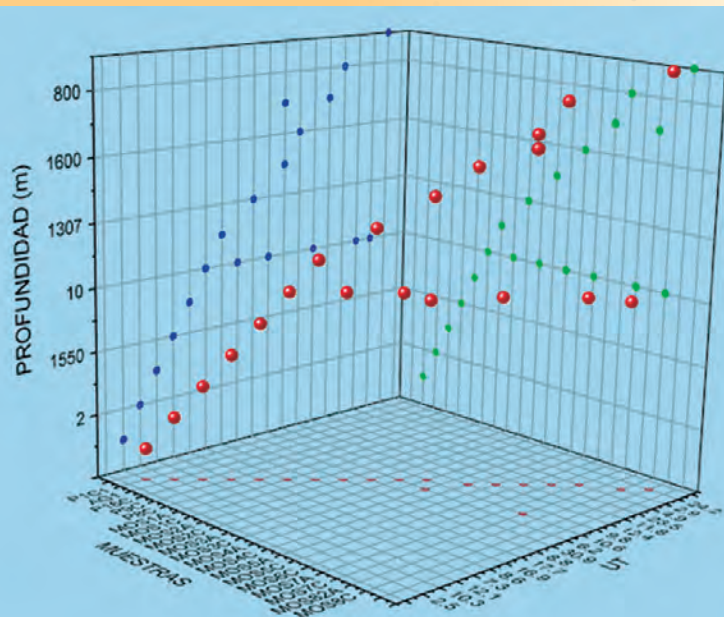


Figura 8. Distribución espacial de las unidades tritadas de tritio a diferentes profundidades. (Fuente: IPEN).



# MARINE AND TERRESTRIAL BIODIVERSITY IN ANTARCTICA

Marine Institute of Peru (IMARPE) monitored the distribution of Krill (*Euphausia superba*), the results were compared with previous monitoring, observing higher concentrations of krill in ANTAR XXVII (2019/20), followed by ANTAR XXVI (2018/19) and ANTAR XXV (2017/18). (Figure 9).

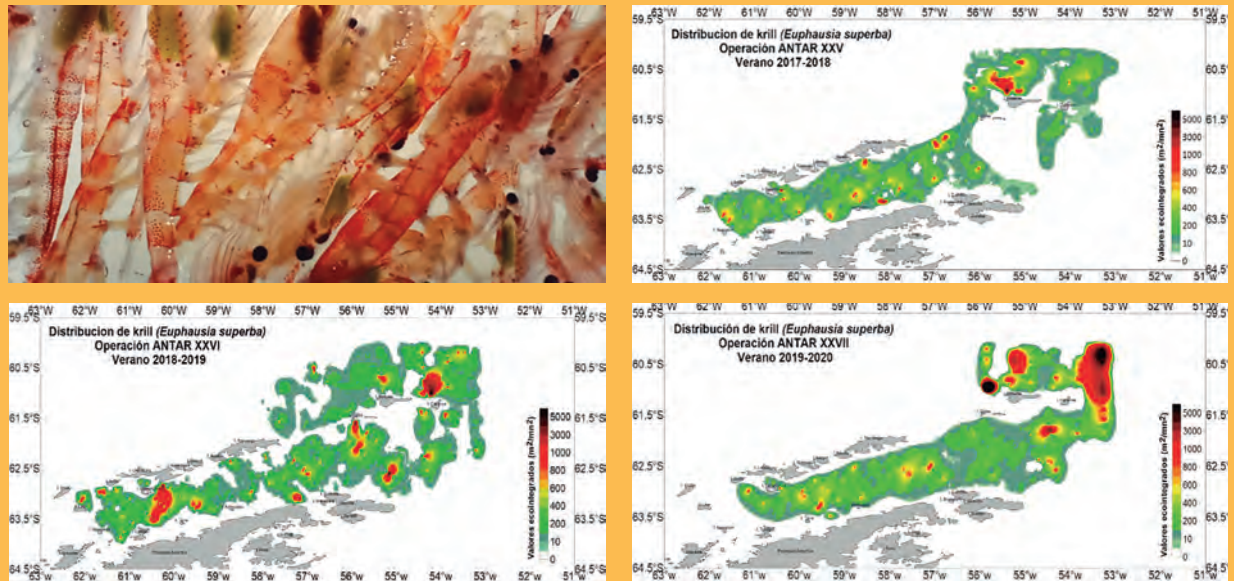


Figure 9. Krill (*Euphausia Superba*). distribution. (a) ANTAR XXV, (b) ANTAR XXVI, (c) ANTAR XXVII.

In addition, birds census was performed by IMARPE. The results were compared with previous monitoring, observing a notable decrease (Figure 10).

Campaign	Species	Number of individual
ANTAR XXV	26	8802
ANTAR XXVI	26	3122
ANTAR XXVII	26	1182



Southern Fulmar (*Fulmarus glacialisoides*)



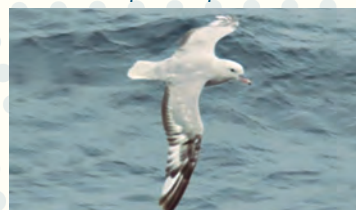
White-chinned, Black or Westland Petrel (*Procellaria aequinoctialis*)



Cape petrel (*Daption capense*).



Gentoo penguin (*Pygoscelis papua*).



Northern giant petrel (*Macronectes halli*).



Black-browed albatross (*Thalassarche melanophris*).

Figure 10: Birds in Antarctica.



Also, a total of 186 sightings of marine mammals were recorded by IMARPE, identifying 145 individuals of different species such as: humpback whale (*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), minke whale (*Balaenoptera bonaerensis*), orca (*Orcinus orca*) and antarctic fur seal (*Arctocephalus gazella*). (Figure 11). These sightings are intended to determine the relationship between the abundance and distribution of birds, mammals and krill.



Humpback whale (*Megaptera novaeangliae*).

Orca (*Orcinus orca*).

Humpback whale (*Megaptera novaeangliae*).

Antarctic fur seal (*Arctocephalus gazella*).

The Women's University of the Sacred Heart (UNIFE) collected seaweed along the coast of Admiralty Bay, and in the vicinity of ECAMP and Arctowski station (Poland) in order to perform an analysis of the macro-nutrient content (Figure 12).



Figure 12: collection place Seaweed collected along the coast of Admiralty Bay.

The National Institute for Research on Glaciers and Mountain Ecosystems (INAI-GEM) carried out the study of the marine biodiversity that exist on the antarctic seabed. Different families were observed, among them: poriferans, ascidians, cnidarians, echinoderms, molluscs, isopods, nemertines and polychaetes (Figure 13).

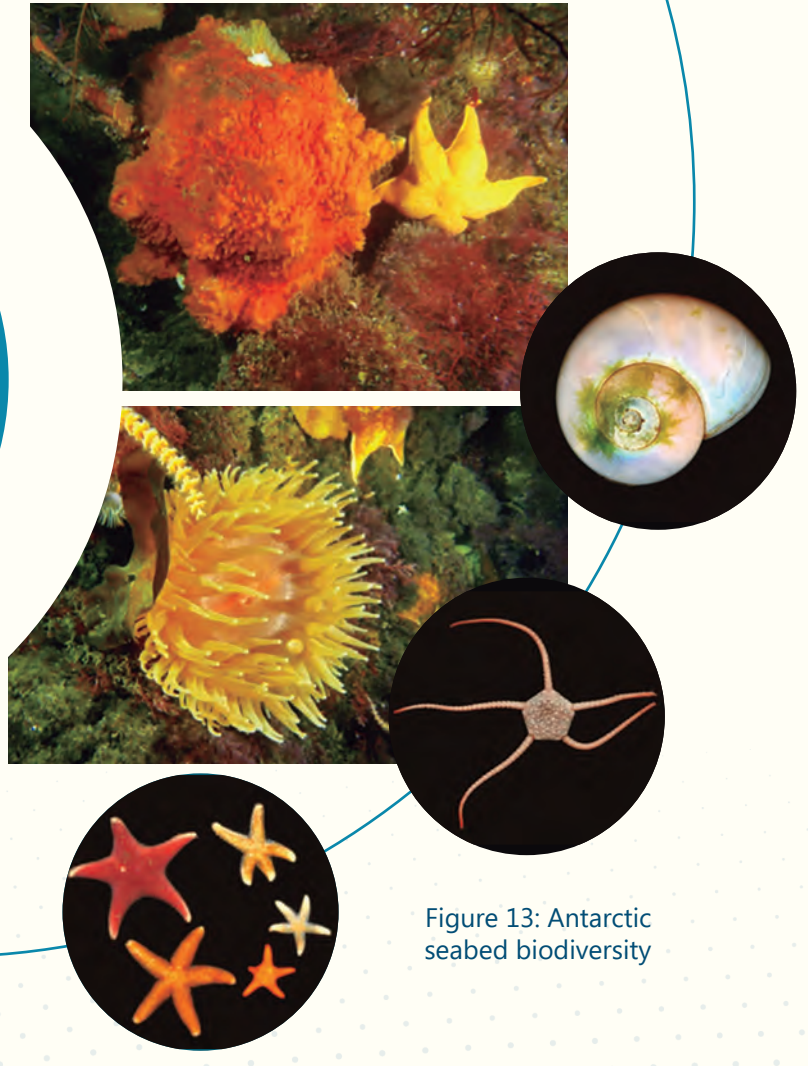


Figure 13: Antarctic seabed biodiversity

The National Institute of Nuclear Energy (IPEN) collected Krill samples in order to determine their gastric microbiota composition through a metagenomic analysis and relate it to the main environmental parameters. The collected samples will be evaluated in the IPEN laboratories.

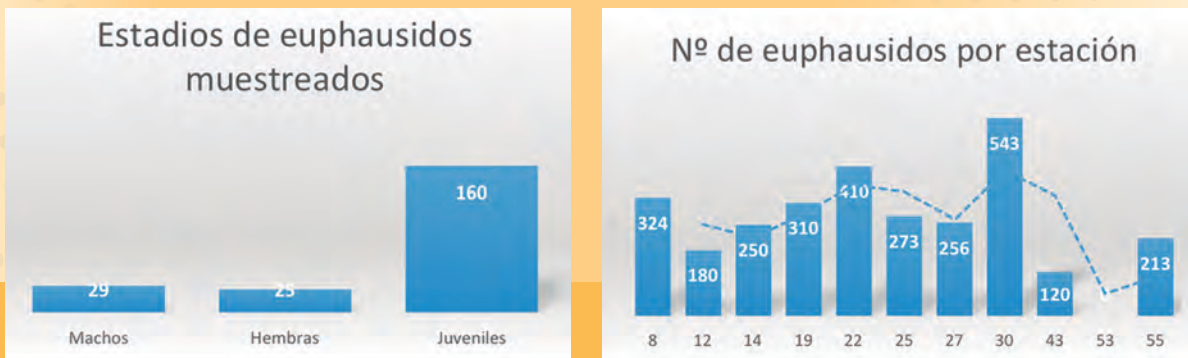


Figura 14: *Euphasia superba* (Krill) sampling for metagenomic analysis. Euphausiids stage



# PHYSICAL AND DYNAMIC PROCESSES IN ANTARCTICA

Physical and dynamic parameters are required to understand the physical and dynamical oceanography of the Southern Ocean. The Geophysical Institute of Peru (IGP) (Figure 15) obtained vertical profiles of water column temperature and salinity in the Bransfield Strait.

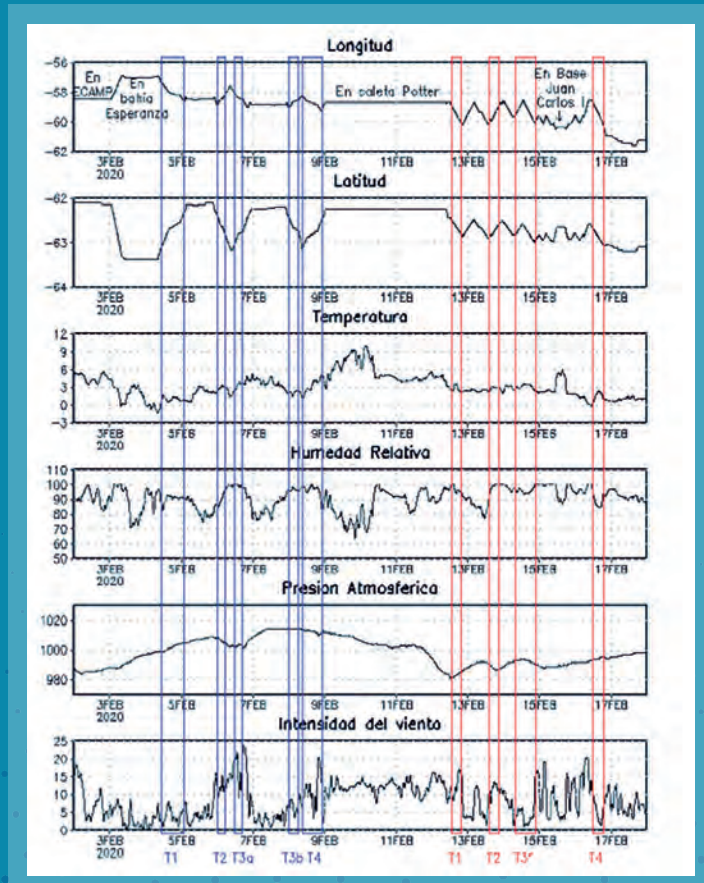
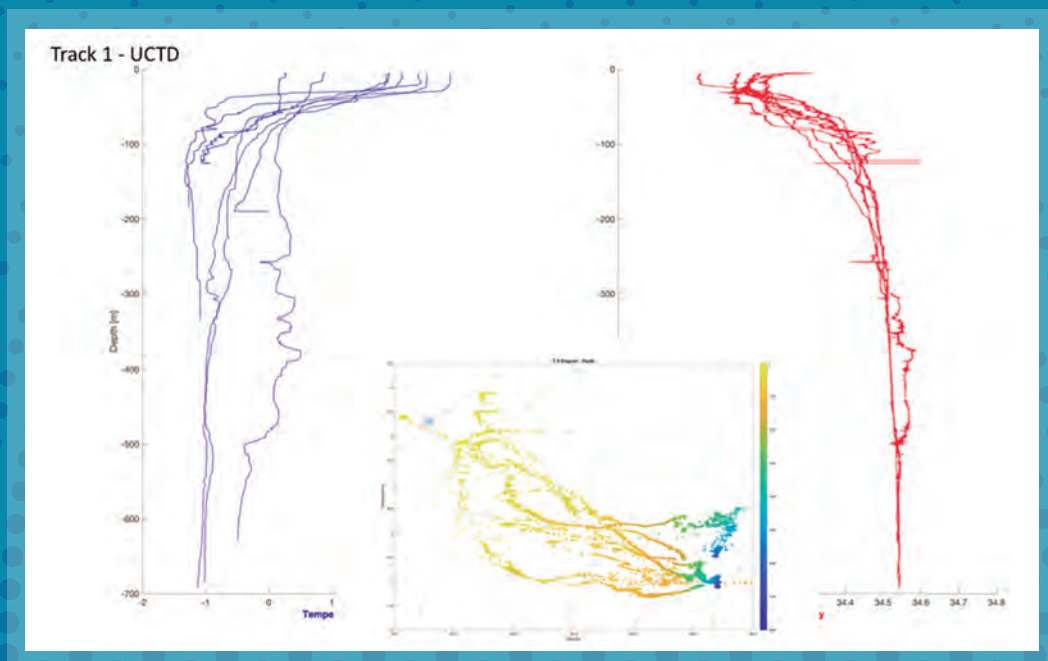


Figure 15. Vertical distribution of physical variables





IMARPE compared the spatial distribution of sea temperature (Figure 16) and salinity (Figure 17) in Bransfield Strait at different depths with information observed in previous expeditions.

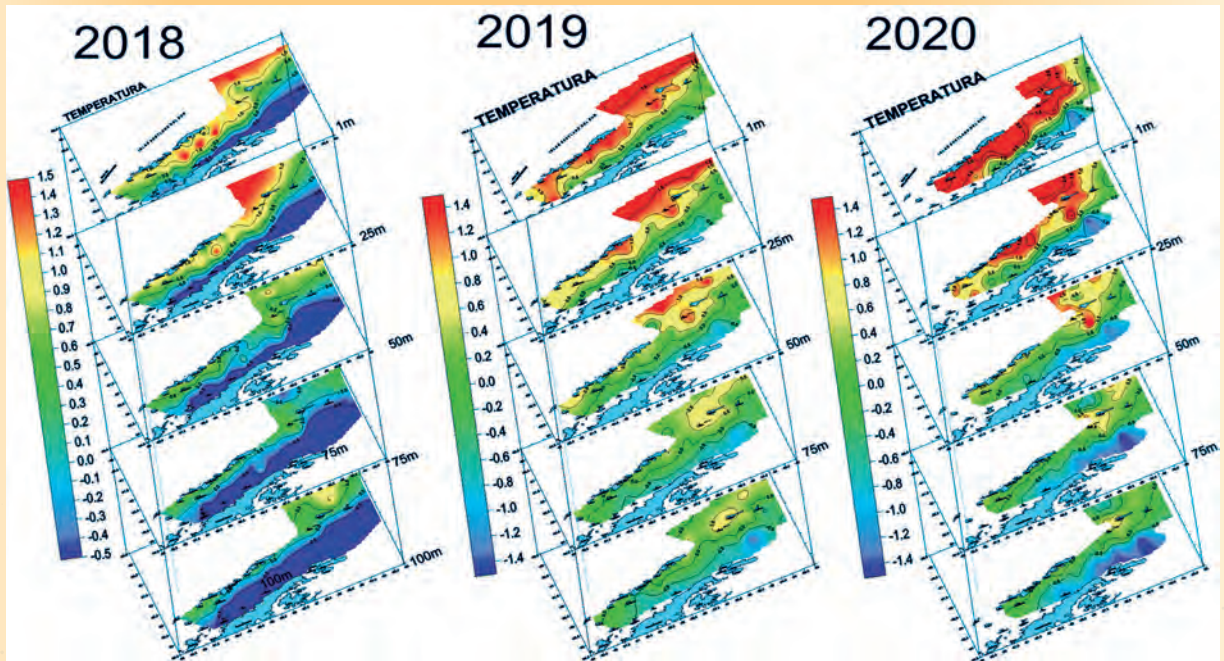


Figure 16. Spatial distribution of sea temperature in Antarctica.

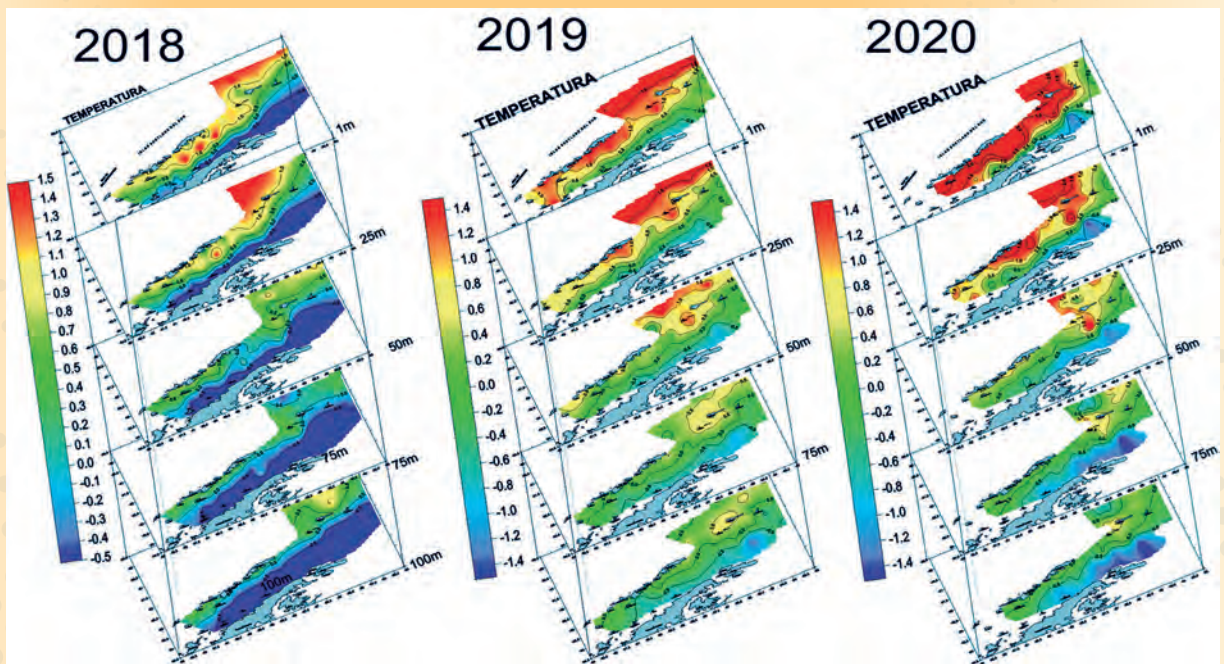
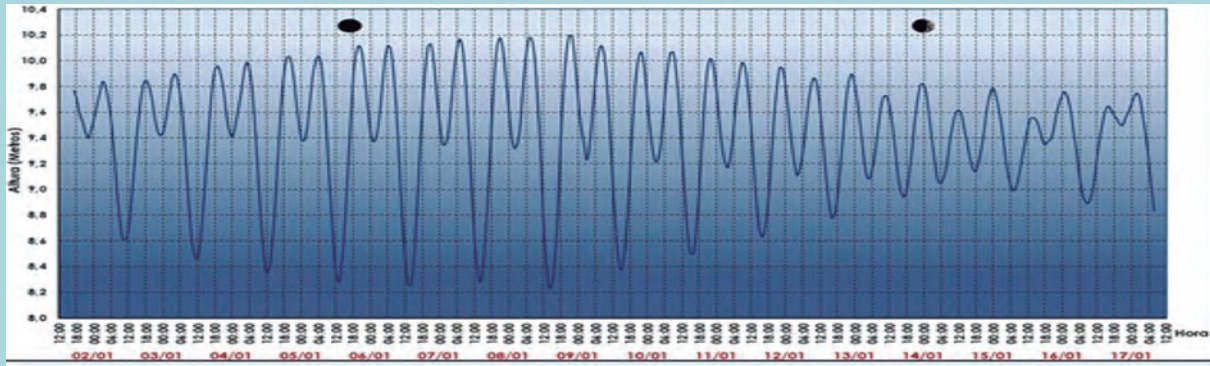


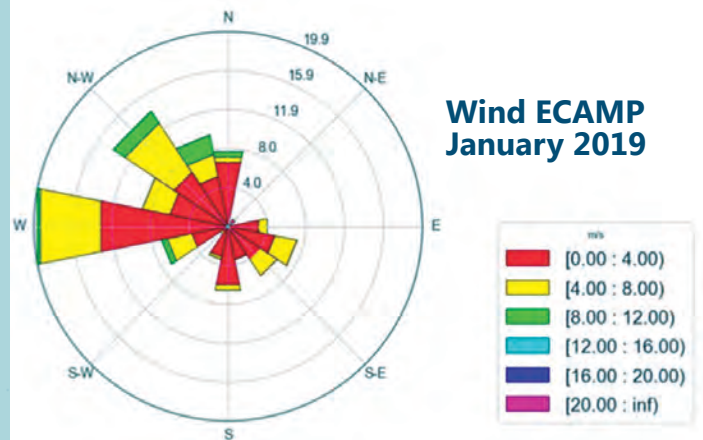
Figure 17. Spatial distribution of salinity at different depths in Antarctica.



## SEA LEVEL JANUARY 2019



The relationship between wind records and sea level variations is examined to describe Admiralty Bay dynamics by the Directorate of Hydrography and Navigation (DHN) of the Peruvian Navy. In addition, it was compared with the data obtained in the ANTAR XXVI (Figure 18).



## SEA LEVEL JANUARY 2020

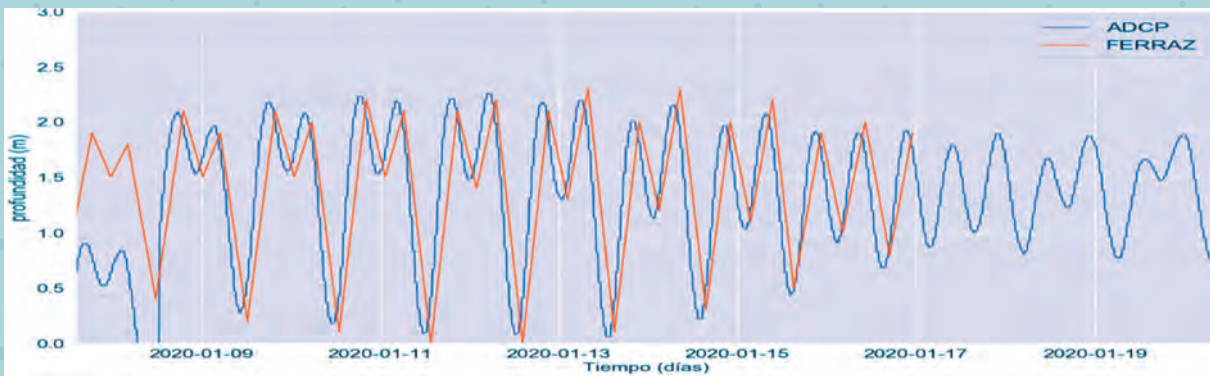
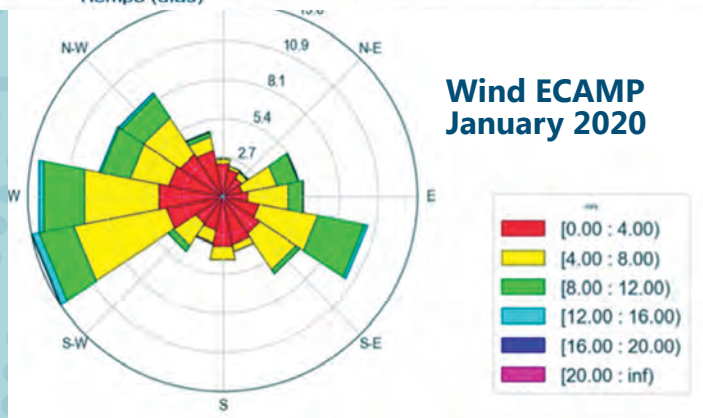


Figure 18: Sea Level and wind direction during ANTAR XXVI (2018/19) and ANTAR XXVII (2019/20).



The University of Engineering and Technology (UTEC) collected wind speed and sea surface temperature data from Bransfield Strait, to model its oceanographic dynamic. Their first results are displayed in Figure 19.

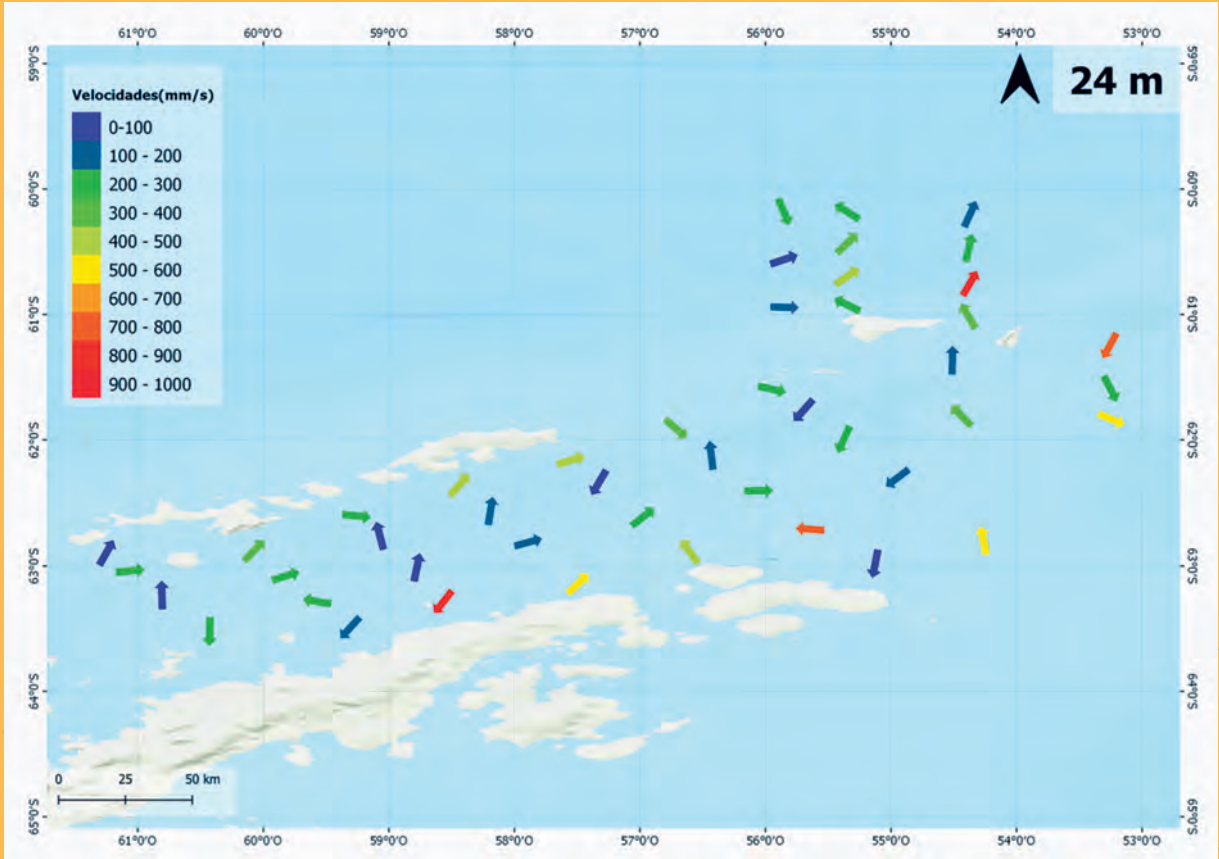
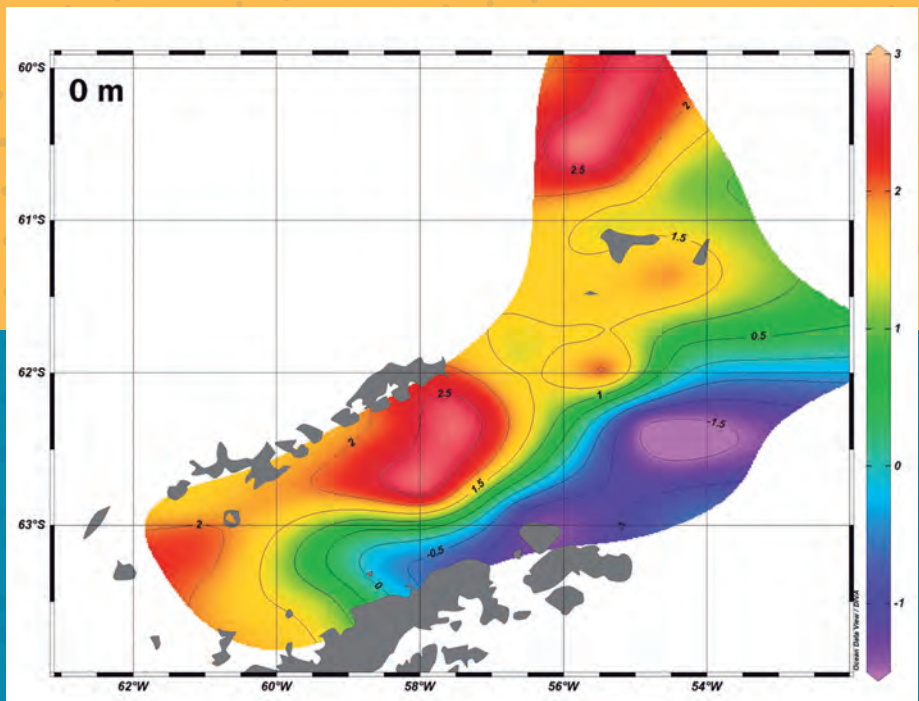


Figure 19: Wind speed and sea surface temperature from Bransfield Strait.





# GEOLOGY AND GEOMORPHOLOGY IN ANTARCTICA

The Geological, Mining and Metallurgic Institute (INGEMMET) conducted studies on permafrost (soil that is permanently frozen but not permanently covered in ice or snow) on the proximities of ECAMP. The first results show a decrease in permafrost from the year 2019 to 2020 (Figure 20).

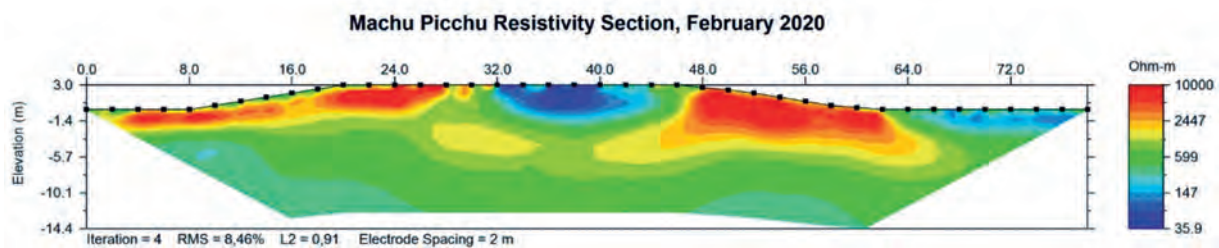
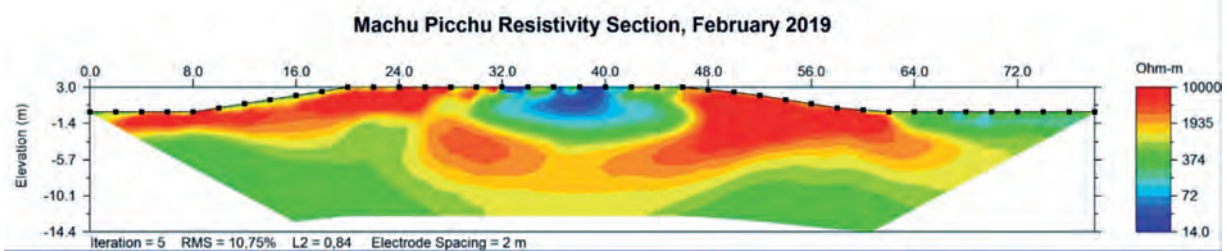


Figure 20. Comparison of permafrost (in red) on ECAMP (Source: INGEMMET)

Likewise, INGEMMET collected data in the Domeyko glacier, located in the proximity of the ECAMP, in order to understand its geomorphology.



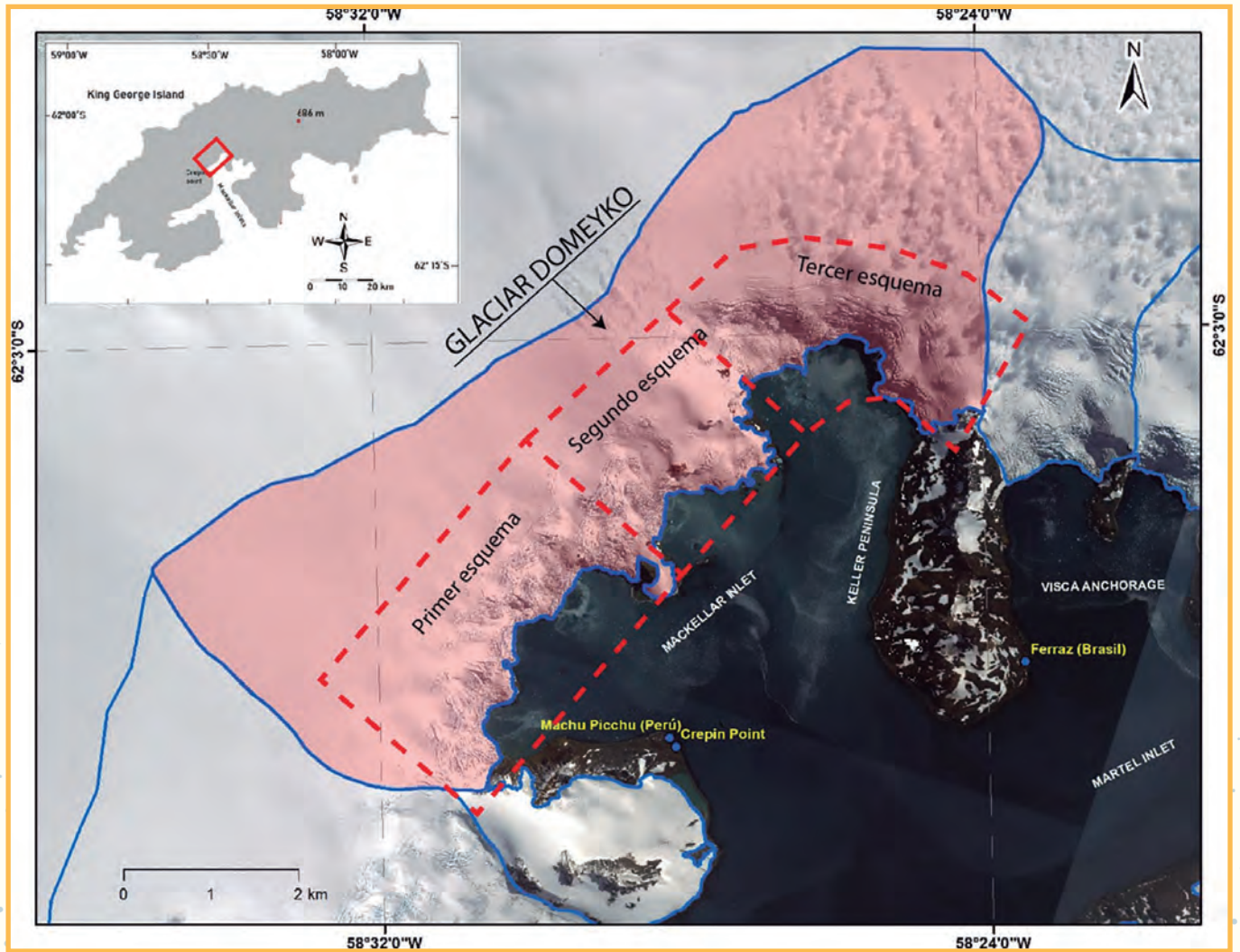


Figure 21. Monitoring conducted in the Domeyko Glacier during ANTAR XXVII (Source: INGEMMET)





INGEMMET collected data on soil stability in Almirantazgo bay in the ECAMP surroundings, utilizing seismic equipment to find the relation between vibrations that are reflected in stratigraphy and climate change (Figure 22).

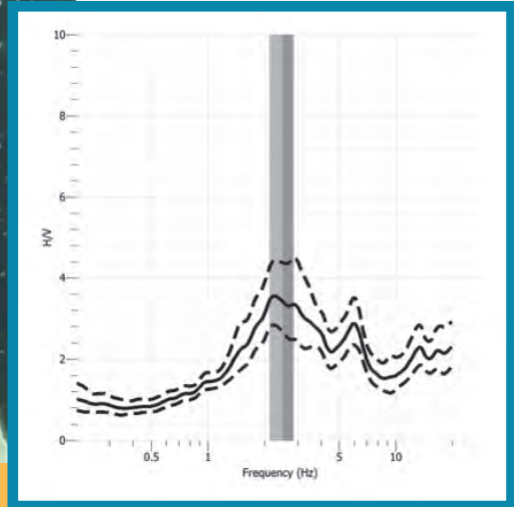
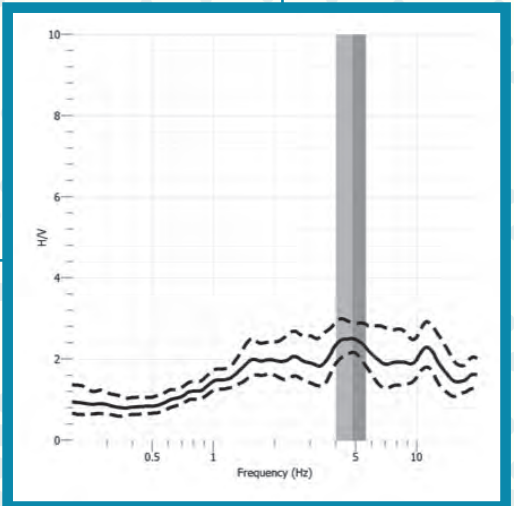
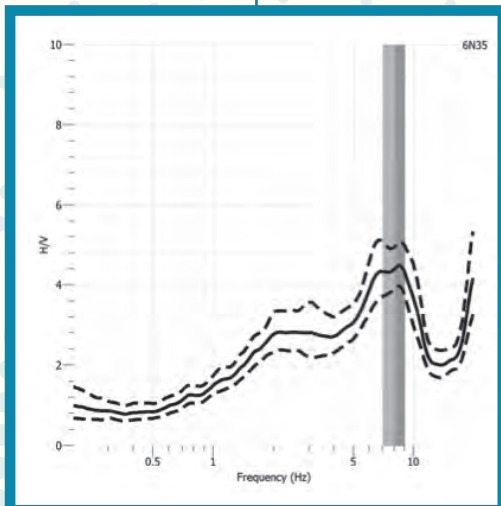
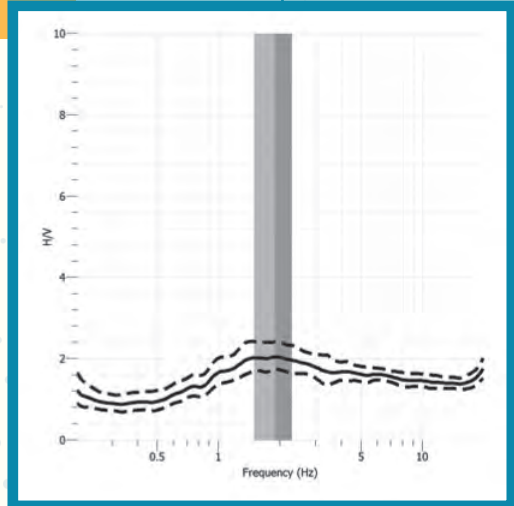
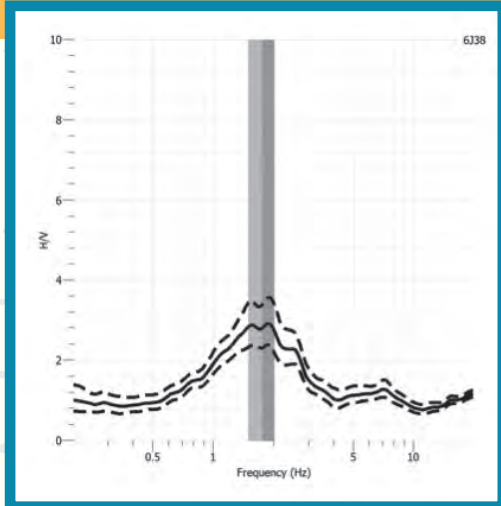


Figure 22. Vibrational behavior in the ECAMP surroundings (Source: INGEMMET)



**INGEMMET**, collected information on deposits and physical parameters from biological and microbiological communities. As well as samples to characterize morphology and composition of underwater volcanoes on South Shetland Islands and the Antarctic Peninsula (Figure 23). The goal of this study is to find the relation between volcanism hydrothermal emanations and climate change.

In the same way, **INGEMMET** collected different types of rock samples in Rey Jorge Island and the Esperanza bay in the Antarctic Peninsula for their evolutionary analysis (Figure 24).

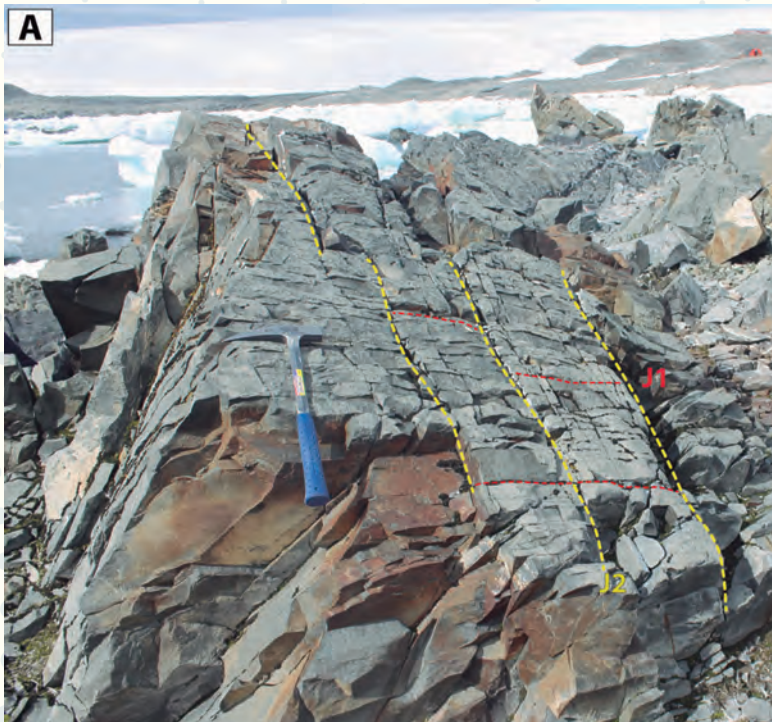
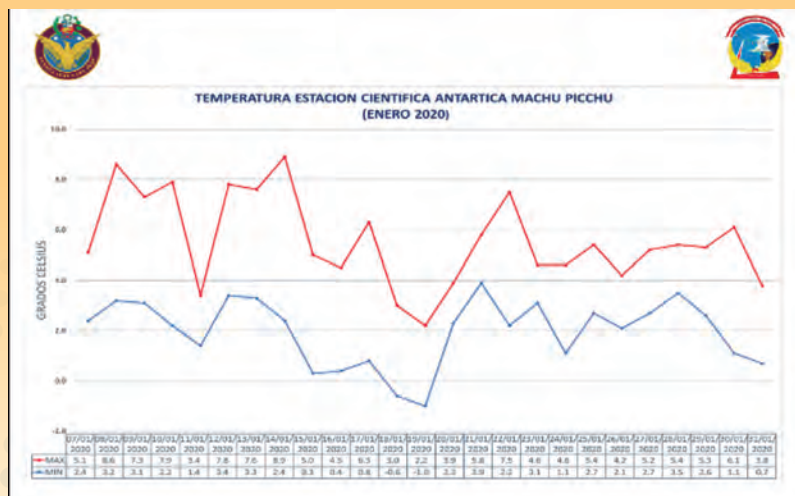
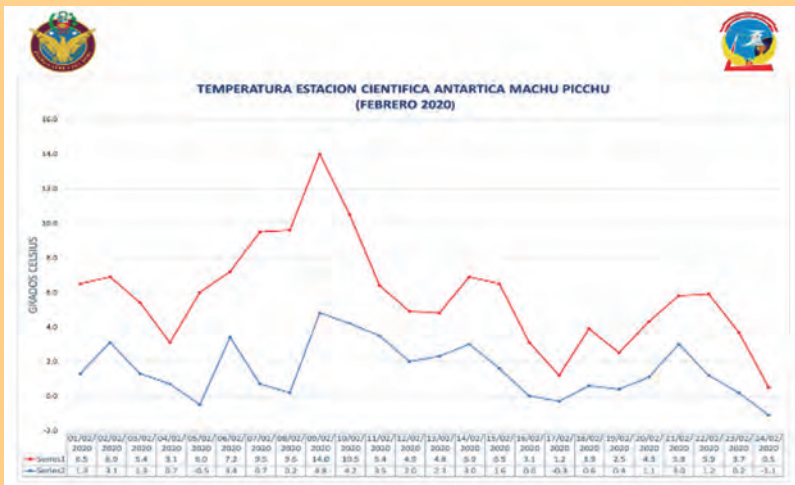
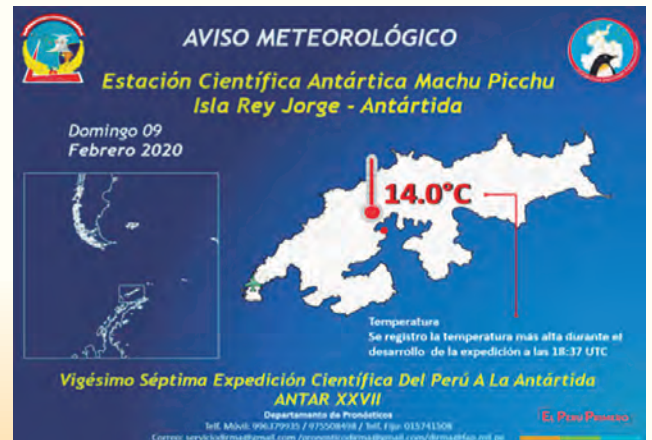


Figure 24 Geological information gathering (Source: INGEMMET)



# METEOROLOGY AND FORECAST IN THE SCIENTIFIC STATION "MACHU PICCHU"



The activities carried out in the ECAMP were planned taking into account the atmospheric behavior. These were in charge of the Directorate of Aeronautical Meteorology (DIRMA) of the Peruvian Air Force. The behavior of the air temperature in the ECAMP can be observed in Figure 25.

Figure 25. Behavior of air temperature in the ECAMP (Source: DIRMA)

# TOURISM IN ANTARCTICA

Given the recent interest in Antarctica and the tourist activities made by other countries, the **National Service of Protected Areas (SERNANP)** participated in the ANTAR XXVII expedition with the goal of evaluating the area. As well as contributing in improving the way that tourism is realized in the frame of the Antarctic Treaty. Additionally **SERNANP** in January of 2020 design a methodological proposal (Figure 26).

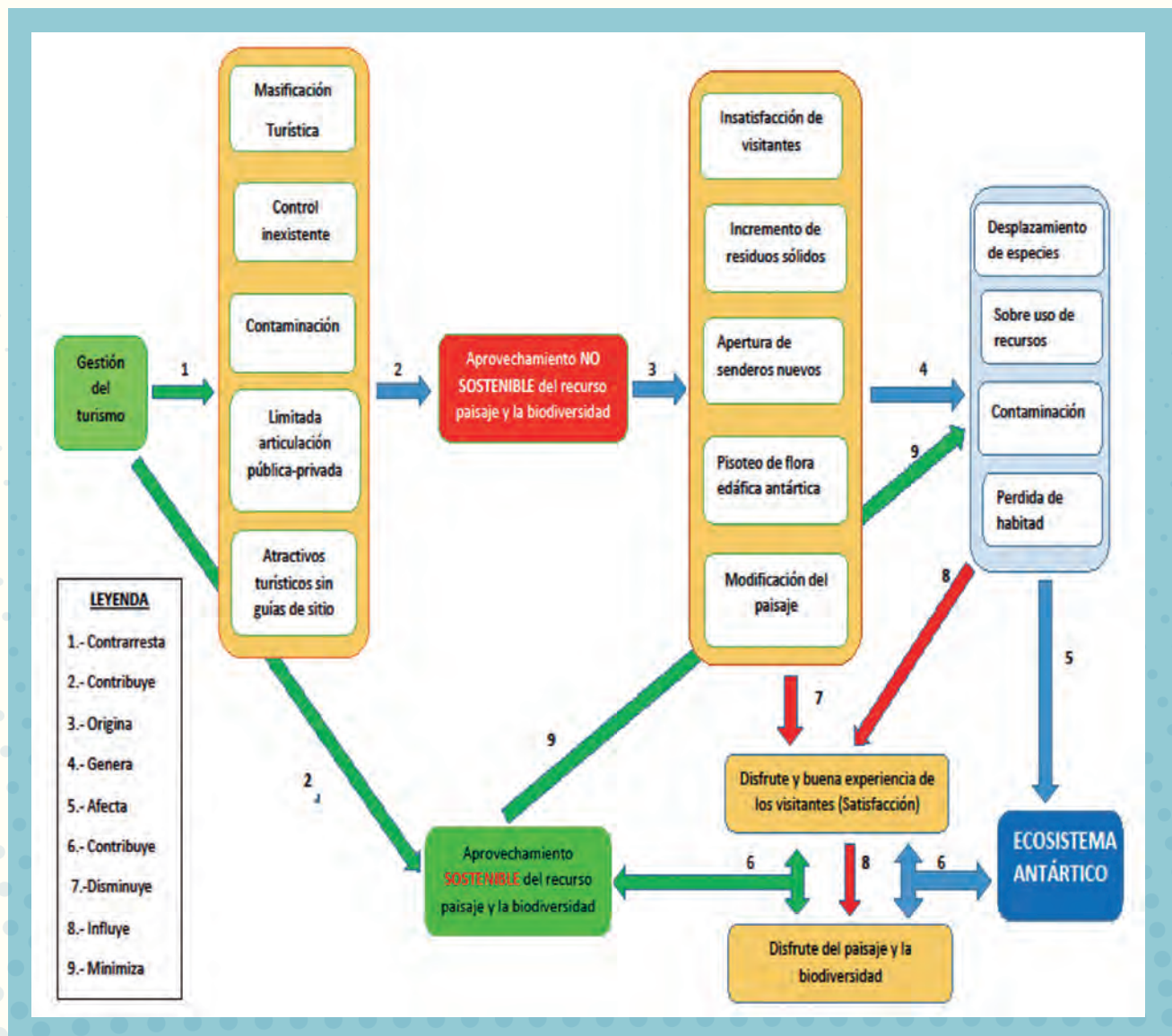


Figure 26. Proposal of the Conceptual Model for the management of tourism in the Fildes Peninsula - Antarctic (Source: SERNANP).





## LOGISTICAL SUPPORT FOR THE REALIZATION OF ANTAR XXVII

The ministry of defense (MINDEF) through the participation of its three armed institutes has provided logistical support transporting personnel, material and equipment to Antarctica, as well as backing the development of various research projects.



The **Company of Antarctic Operations (COA)** of the Peruvian Army Army (Figure 27) was in charge of maintenance and functioning/operation of the ECAMP. Located in the Almirantazgo bay, Rey Jorge Island, Antarctic Peninsula (Figure 28). The operational functioning of the Station allowed the realization of various investigations made in the surroundings. Furthermore, the expeditionary personnel from the COA was in charge of security, risk prevention and transport of scientific expeditions during the development of activities on the Station exterior.



La compañía de Operaciones Antárticas (COA) del Ejército Peruano en la expedición ANTAR XXVII.



La COA es el responsable de que la ECAMP este operativa durante los ANTARS.





Logistical support  
of the COA in the  
different studies  
at Antarctic sea.



The COA during the withdrawal of a Zodiac boat after the support of research studies in the Antarctic sea.





The **Directorate of Hydrography and Navigation (DHN)** of the Peruvian Navy was in charge of operating the Vessel with Polar Capacity BAP "Carrasco" (Figure 31). This allowed the development of two scientific cruises in the Bransfield straight, Almirantazgo bay and Esperanza bay with the transporting of scientific expeditionaries and facilitation of equipment, materials and on board laboratories, as well as transporting all expeditionaries from Punta Arenas to the ECAMP.



Figure 31. Vessel of the Peruvian Navy (BAP) "Carrasco"



The Peruvian Air Force (FAP), through operating the Hercules L-100 (Figure 32) allowed the entrance of personnel from Lima to Antarctica and vice versa. Furthermore, with the BELL-212 helicopter it was possible to photograph areas of the Znosko glacier supporting the research projects, as well as supporting adjoining Antarctic stations through the implementation of SAR (Search and Rescue) operations for the evacuation of personnel in the event of an emergency or incident.



Peruvian Air Force on their way to ANTAR XXVII.



FAP preparing to provide support to the development of research projects Figure 35. FAP mid flight in the Antarctic airspace in ANTAR XXVII.





## **DIVISION OF ANTARCTIC AFFAIRS**

### **DIRECTOR**

MC. David Guillermo Gamarra Silva

### **SCIENTIFIC TEAM**

Ph.D Elizabeth Silvestre Espinoza

MSc. Cinthya Elizabeth Bello Chirinos

MSc. Rubén Pablo Londoño Bailon

### **ADMINISTRATIVE SUPPORT TEAM**

Sra. Beatriz Marcela De los Ríos Robles

Abg. Enrique Rafael Franco Moreno

### **PLANNING AND BUDGET**

Econ. Mirtha Olga Arbulú Chanduvil

### **LOGISTICAL SUPPORT**

Sr. Ismael Eduardo Grau Enciso

### **DIFFUSION**

Lic. Francis Israel López Ortega

### **COORDINATION, REVISION AND EDITION**

Ph.D Elizabeth Silvestre Espinoza



