



SCAR Visiting Scholar Scheme

Report



International
Science Council

Reactivation of the Larsen B Embayment Glaciers, and Climate-driven Sea Ice Patterns in the 2022 and 2023 Record Southern Sea Ice Minima

Visit to Buenos Aires and Instituto Antartico Argentino (IAA) and Servicio Hydrografico Naval (SHN).



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Dates of Visit

05 May 2023 – 20 May 2023

Summary of Visit

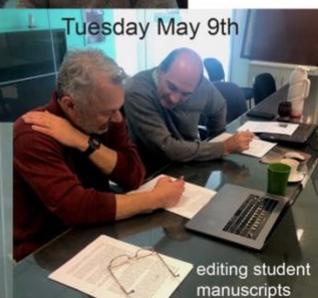
The purpose of the visit is to prepare for potential field work in the Larsen B embayment region, with the goals of using in situ photography (stationary cameras and drones) to analyze calving styles, track ongoing elevation and ice flow velocity changes, and possibly measure the present-day ocean properties of the water adjacent to the glaciers. Additionally, the recent extreme low summer sea ice extent in the Southern Ocean has raised interest in understanding the causes of the reduced ice cover and investigating the possibility that low sea ice and reduced fast ice will lead to increased glacier mass loss as this protective fringe is removed for long periods in late summer. Two lectures summarizing current research topics on the Larsen B and Antarctic sea ice (mine, my students', and the global community in general) were planned, one at IAA and one at SHN. In addition, the visit is intended to provide support for the students of both Dr. Sebastián Marinsek (Ms. Iliana Margonari), and Capitán Alvaro Scardilli and Dr. Sandra Barreira (Ms. Mariana Scilingo), and my own student (Naomi Ochwat) investigating various aspects of the glacier – sea-ice – ocean system. I planned to introduce possible techniques and instruments for field work for the IAA and SHN groups and potentially apply them during subsequent field work in the 2023-2024 or 2024-2025 seasons.

Prior to the visit, the timing of the talks and the goals of the several meetings were arranged with Ing. Sebastián Marinsek, Capitán Alvaro Scardilli, and Dr. Sandra Barreira through several emails beginning in March 2023.

Travel to Buenos Aires was by United flight 819, which arrived on the evening of May 6th after some delays. Sunday, May 7th, was a day of preparation and settling into the kitchenette hotel room (Argenta Suites Belgrano).

On Monday May 8th, I arrived at IAA at 9:15 am and met with Ing. Marinsek and Dr. Juan-Manuel Lirio, the director of earth sciences for IAA, for several hours, discussing the goals of the field work, the necessary approvals, the intent to support both graduate students involved (Naomi Ochwat, of University of Colorado Boulder Ph.D. candidate, and Liliانا Margonari of IAA, Ph.D.

student). We also discussed the likely logistical plans. The proposed field work would investigate the area at the newly retreated front of Crane Glacier with several instruments, landing at a known outcrop next to the ice front (previously visited by helicopter in 2013, see photograph). We intend to install one or more automated cameras, conduct some drone photography flights along the ice cliff face, collect rock samples uphill from the outcrop site for cosmogenic age dating, and collect ocean depth soundings and DTS thermal profiles from a helicopter operating over the fjord if the pilots can support that. In the afternoon I wrote to the SHN group and set up a plan for both the lecture at SHN headquarters and visits with Capitán Scardilli and Dr. Barreira.



Tuesday May 9th Ing. Sebastián Marinsek and I carefully reviewed and edited draft manuscripts from the two students on the topic of the Larsen B outlet glacier re-activation. We concluded that both papers could be published with their current scope and topics and agreed to share authorship for both papers. The manuscript by Lilliana Margonari focusses on the climate aspects leading to the loss of the fast ice; while the paper by Naomi Ochwat has details on the effect of ocean waves on the fast ice, and the subsequent acceleration and thinning of the glaciers after fast ice loss.

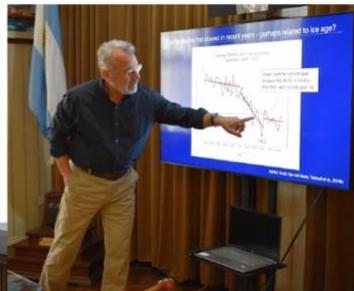
Wednesday May 10th was spent preparing a detailed scientific presentation to be given to the SHN leadership, their oceanographers and meteorologists, and several students in the main office of SHN in southeastern Buenos Aires. The talk centered on recent Southern Ocean sea ice changes and their links to climate trends, and included a review of Arctic sea ice trends, as well as some discussion of the recent re-activation of the Larsen B outlets.



Thursday May 11th --- I presented the talk at SHN headquarters, entitled 'Antarctic Sea Ice, Landfast Ice, and Glacier Stability', at 10:00 am, to an audience of about 25 people.



talk at SHN headquarters



Prior to the talk (on the drive across Buenos Aires in the car), Cpt. Alvaro Scardilli and I began to discuss the SCAR Southern Ocean Research Program committee (we are both new committee members of SORP) and the possibility of collaboration on a project involving data collection from the *Alamirante Irizar* icebreaker and other data sources. This



Thursday May 11th

Álvaro Scardilli

Marianna Scilingo

icebreaker conducts a cruise every year from the northwestern Weddell to the southeast corner near Coates Land, and continues to the front of the Ronne Ice Shelf near Belgrano Station. Routine CTD casts made along this route, combined with under-way data from the ship could be used for student research on Weddell Sea oceanography. At the SHN Headquarters, I met and spoke with Mariana Scilingo about her thoughts on a Ph.D. topic in polar oceanography. I also spoke with oceanographer Michele Baqués about the ocean-related papers cited in the SHN talk and provided her with electronic copies of them.

Following the presentation, Dr. Sandra Barreira and I discussed the potential for her spatial principal components method to analyze the causes and climate linkages of

the 2022 and 2023 record low sea ice extents in the Southern Ocean sea ice over lunch at a nearby restaurant. We set up a plan for a meeting in the second week of the visit.

Friday, May 12, I spent the morning at IAA with Ing. Marinsek reviewing the logistical plan for the field work, which was tentatively approved by the logistical officers in the Argentine Antarctic program. We talked at length about some additional potential for the work within the general scope of the approved logistics. Specifically, the approved plan calls for two helicopters to fly to Matienzo (a summer research station located between the Larsen A and Larsen B embayments) where fuel drums will be staged, and then after re-fueling, on to a smooth-topped hill next to the current ice front at Crane Glacier, suitable for setting up cameras, potentially collecting cosmogenic age dating samples, and for operating a camera drone for photographing the 4 km wide glacier calving front. We are exploring the possibility of having the second helicopter (both are Bell 212s) fly to Foyen Point, and then to the glacier surface, hover very near the surface and allow us to deploy an expendable GPS system for detailed ice motion and tides (data would be uplinked by Iridium); then hover near the water surface (if relatively ice free) a few hundred meters in front of the glacier to collect depth sounder data.

In the afternoon I returned to the hotel room after some shopping and responded to requests from my University, and reviewed a manuscript by my post-doctoral researcher, Dr. Gabi Colláó-Barrios.

On Saturday, I completed the review of the Colláó-Barrios manuscript, on tidal variations in ice flow on Dotson Ice Shelf. Then explored the city area a bit near the hotel. In the afternoon I began a review of another manuscript by a colleague (Pietro Millilo) and his student (N. Maslennikova) on grounding line retreat in the Amundsen Sea Embayment.

On Sunday, May 14th, I was a tourist, using the bus system to reach the north end of the 9th of July Avenue, and walking to El Obelisko, Teatro Colon, other statuary, and the Casa Rosada and Plaza de Mayo.

I returned to IAA on Monday May 15, and met with Ing. Sebastian Marinsek and worked further on planning the field work with two helicopters. We arranged tasks between the two aircraft, and discussed who would do each task, and are considering adding one or two additional field team members. Timing of the field work will likely be within the dates of 10 January to 29 of February (likely 4 weeks in that range). I corresponded with other supporting technicians (UNAVCO and Oregon State University) about potential sensors to apply to the field work goals.

Later that afternoon I developed the talk planned for Wednesday at 10 am for the IAA staff and nearby students at University of San Martin.

My first visit to the downtown office of SHN (e.g., office of Dr. Sandra Barreira and the student Mariana Scilingo) was on Tuesday May 16. Sandra and I discussed an analysis technique for sea ice concentration patterns using spatial principal components and the potential for applying the method to the recent record low sea ice extents of February 2022 and February 2023. Strong patterns (spatial eigen-patterns with strong weightings) exist for both the 2022 and 2023 mid-summer months (JFM) and appear to be correlated with a strong and easterly position of the Amundsen Sea Low. We outlined a plan to continue working on this idea as a possible talk or poster at the upcoming Fall AGU in San Francisco

With Mariana, I discussed several very general things regarding her interest in modelling iceberg motion and impacts on ocean circulation in the Southern Ocean, and then further discussions on applications of remote sensing to polar science in general. We also talked about who she might correspond with (including myself) as she decides on her exact topic for her Ph.D.



The second science talk, entitled “Changes in the Ice Shelves of the Antarctic Peninsula” took place at the IAA office on Wednesday morning, May 17th to about 15

scientists attending. This talk covered my early research beginning around 1992 and reviewed initial IAA work on the region as well. Early evolution of the Larsen A ice shelf, leading to its disintegration in January 1995, was revisited, followed by the application of more satellite imagery (MODIS and Landsat) as the Larsen B Ice Shelf rapidly destabilized, culminating in its disintegration in 2002. The model of melt-driven hydrofracture was described, and the extensive research activity intended to test the



model using drifting icebergs was reviewed. Finally the re-activation of the Larsen B glaciers, after a decade-long stabilization by the continuous presence of landfast ice in the location of the former Larsen B Ice Shelf, was reviewed. This is work now in progress by my student Naomi Ochwat and Sebastián’s student Lilianna Margonari.

On Thursday, May 18th I returned to the SHN office near Retiro in Buenos Aires and had an extensive discussion with Cpt. Alvaro Scardilli regarding possible collaborations on tasks for the Southern Ocean Research Program (SORP), and the upcoming in-person meeting of SORP in Berlin Germany as part of the IUGG meeting in July. We discussed the idea of providing CTD ocean instruments for several countries (not just Argentina) operating research vessels in the Southern Ocean that do not regularly conduct ocean profiling with CTD during re-supply or other logistical cruises. It should be possible to equip these vessels and establish a routine ocean survey. (The Argentine naval icebreaker, *ARA Irizar*, formerly conducted such measurements, but has not done so in the past few years.) Other nations with bases in Antarctica, such as India, Russia, South Africa, Japan, Spain, Chile, may also lack a program of regular data collection during routine cruises. A project to coordinate access to CTD instruments and collect castings data, and assemble the data for research use, could be a useful activity for SORP.

Also at SHN I talked again with Mariana Scilingo regarding potential advisors for her Ph.D., and provided some more background on the application of remote sensing data to Southern Ocean oceanography. I provided several names of people who

might be able to advise her, at AWI in Bremerhavn, at University of East Anglia, and British Antarctic Survey. Later, Dr. Sandra Barreira and I made a plan to discuss a possible AGU talk or poster for the upcoming fall meeting based on her analysis of the recent record low sea ice extent around Antarctica in 2022 and 2023.

The final report draft was prepared on Friday May 19th, as well as some correspondence with the US National Science Foundation. The draft was shared with the group in Argentina for some edits and additions.

Capacity Building, Education and Outreach Activities

The two research summary talks were well-attended by both active researchers and students affiliated with the research groups. But the main focus of the visit was to build a joint research plan for a newly reactivated region of the Antarctic Peninsula, which Argentina is uniquely positioned to support logistically. IAA presented our logistical plan to the relevant components of the Argentine Antarctic logistical groups and received tentative approval for a one-day visit to a key glacier to install several automated instruments. There were several meetings with a student working with SHN scientists, Mariana Scilingo, and correspondence and review of a manuscript by the IAA student Illiana Margonari.

Future Plans

With the IAA group, the field work at Crane Glacier and possible overflights of Hektor Glacier, planned for late January 2024, will be a major focus for the rest of 2023 and early 2024, followed by a peer-reviewed publication. The field work will involve several preparatory steps, such as drone training, and GPS and camera testing, culminating in a day-trip flight to the glacier overlook site and deployment of instruments on the glacier. Remaining funds If it happens, this will be my third field season with IAA in this region. With SHN there is an intent to study sea ice trends in the Antarctic and possibly compose and AGU Fall 2023 Meeting abstract for presentation in San Francisco.