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Winterover scientists in Antarctic Astrophysics

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Abstract. Astronomy in Antarctica is largely carried out in winter, and so winterover scientists are required to run the instruments. A winterover appointment is a unique opportunity for a scientist, but brings challenges for both the scientist and the larger instrument team. We give a brief review of how winterovers work and their experiences. Although recent projects have required less support from winterover scientists, we believe that they will be a feature of Antarctic astronomy and astrophysics into the future.

Keywords. Winterover Scientists, Instrumentation

1. Introduction — who/what are Winterover Scientists?

Winterover scientists have been on the Antarctic continent for more than half a century — the first South Pole winterover crew (1957) included the astronomer Arlo Landolt — but they remain somewhat anomalous in Antarctic science. Antarctic science (glaciology, ecology, geology…) is largely carried out in the summer months by visiting scientists. Year-round research stations usually have skeleton winter crews to maintain the infrastructure for summer operations and sometimes to carry out upgrades or repairs. Some science is year-round (usually monitoring programmes such as meteorology, atmospheric sampling, seismic monitoring…). Antarctic astronomy, however, is largely done in winter: Optical/IR observations need twilight or darkness, and FIR/submm/mm-wave observations require the very low levels of precipitable water vapour (pwv) found only in winter. Therefore, most Antarctic instruments are maintained and upgraded over summer, and carry out science during winter. The winterover scientists who run these telescopes constitute an important resource for their scientific projects.

2. The winterover's view

A winterover appointment is a unique opportunity for a scientist. The challenges are obvious: communications are limited, and physical isolation is absolute; the climate is harsh, with cold temperatures and no daylight. The opportunities, however, are greater than the challenges: The opportunity to work independently, to understand the components, subsystems and systems engineering of a research instrument, and the responsibility of managing such an instrument to maximise the scientific return. In an era of large projects, and larger teams, the winterover scientist's experience is unusual.

3. The project leader's view

From the perspective of the project leader or manager, to whom the winterover is responsible, the effectiveness of winterover personnel in Antarctica follows a quite standard track: The winterover arrives in Summer (usually at the start of the summer season) and quickly learns their way around the project, becoming highly effective. The summer season is usually very busy, and the winterover may be quite tired at the end — but their real job is only just beginning. The effectiveness of the winterover is probably at a peak in the early part of the winter: There are few distractions, they have learned the system, and the environment is still quite benign, with daylight/twilight and fairly warm conditions. For many instruments, this is also a time with a significant workload, as calibration, telescope pointing etc. are carried out to ready the instrument fully for the winter. As the winter goes on, the effectiveness of the winterover steadily declines: The lack of daylight takes a gradual toll on cognitive abilities, and people get more and more tired. This can be a particular problem when significant workload occurs towards the end of the winter. For example, the lowest pwv conditions generally happen in August–September, and so this is when commissioning of THz instrumentation was done at the South Pole. Thus, a peak in the demand on the winterover can coincide with the time when they are at their least effective. The project leader should try to anticipate the likely workload on the winterover and manage that workload, bearing in mind that the winterover is a finite resource.

4. A year in the life of a winterover

We (the authors) both spent winters at the South Pole Station. This section is therefore specific to the South Pole, but should give some idea of winterover life at other stations in Antarctica, and even the Arctic, *mutatis mutandis*.

4.1. *Summer*

Figure 1. On the way to the South Pole Station in an LC-130.

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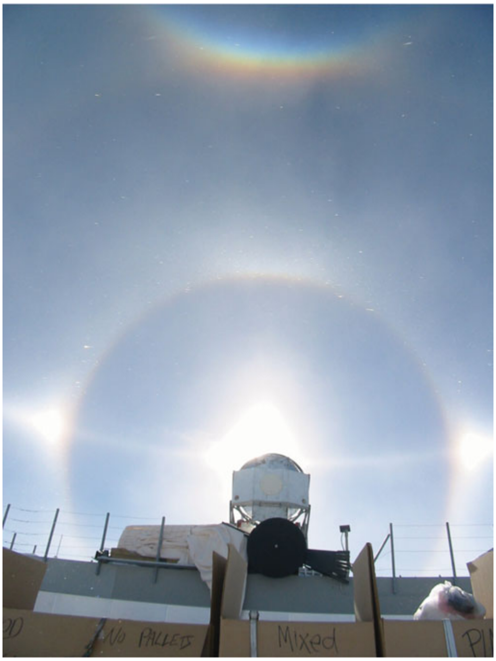

Figure 2. 2003 December 13: A solar halo.

Figure 3. Upgrading old instruments and fitting new instruments: lifting SPIFI onto AST/RO.

The most common pattern for a winterover year is to arrive on station near the start of the Antarctic summer (Fig. 1), so as to spend the summer learning the instrument and getting used to the working environment. The South Pole Station summer (see Fig. 2) starts in late October, and continues to the middle of February. It is used for instrument maintenance and upgrading, including the installation of new instruments (Figs. 3, 4). The fast pace of maintenance and upgrade gives the winterover an excellent, albeit tiring, opportunity to learn the instrument systems. The peak of this activity is in January, when the weather is warmest and logistics are easiest.

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Figure 4. Upgrading old instruments and fitting new instruments: Installing SPIFI.

4.2. *Winter*

The winter season runs for 8–9 months from February to October. In the first phase, both station and instruments are prepared for the winter. This time is generally less favourable for science observations, due to continued daylight (optical/IR) and still-high pwv (sub/mm-wave), so is largely used for calibration, e.g. rebuilding telescope pointing models after summer maintenance.

Figure 5. March: The sun sets near the equinox.

Once the sun is fully set (Fig. 5), the long period of twilight starts. During this time, the weather is getting steadily colder and the pwv is steadily decreasing. This is the start of the core science operations time (Fig. 6), and uptime is at a premium. In the case of equipment failures, the emphasis is on getting the instrument back into operation (Fig. 7), rather than finding a permanent solution. Ideally, the instrument settles into a long winter without incident (Figs. 8, 9).

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Figure 6. April: Delivery of a dewar of liquid helium in the twilight.

Scientific priorities may require complex technical activities in the middle of winter, such as commissioning and testing of THz instruments at the South Pole (Figs. 10, 11).

Figure 7. Telescope repairs in winter.

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Figure 8. June: Midwinter greetings are sent throughout the continent.

Figure 9. Aurora Australis over AST/RO at the South Pole.

As the sun rises, the pwv remains very low, and observations continue all the way into the start of summer. Winterovers usually leave as soon as possible after the station opens, following a short handover to their replacements.

5. Do we still need winterovers?

Over the last few years, winterover scientists have been less involved in Antarctic astrophysics. There are two trends at work here:

(*a*) Many of the operational instruments (e.g. IceCube, SPT…) are designed to work in 'survey mode' rather than 'observatory mode', in which the science programme for the winter is entirely predetermined, and the main job of the winterover is equipment maintenance, rather than science operations — even observation scheduling may not need to be carried out on-site.

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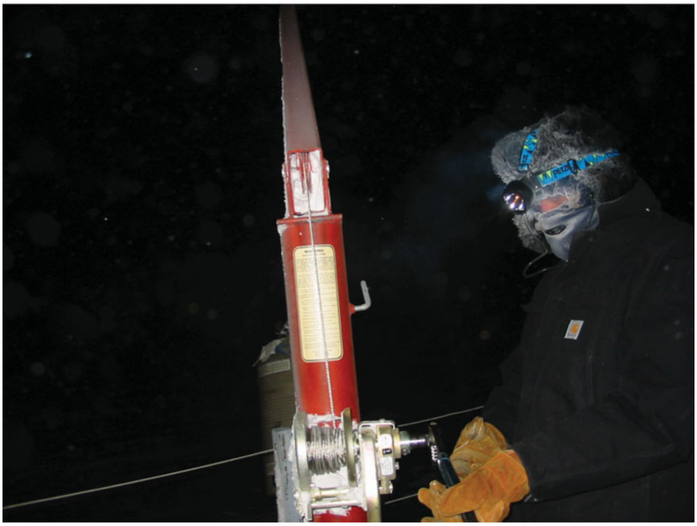

Figure 10. August: Using a crane in winter — compare to summer (Fig. 3).

Figure 11. August: Operating SPIFI in winter — compare to summer (Fig. 4).

(*b*) The development of the PLATO observatories (e.g. Yang *et al.* 2009, Lawrence, Ashley & Storey 2012) to support site-testing and scientific instruments at remote sites, which require no on-site personnel over the winter, and only short servicing missions in summer.

These trends are likely to continue — survey telescopes producing datasets are becoming more and more important to astronomy, and the automation of instruments is likely to increase. However, fully-autonomous instrumentation is probably some way off (see, e.g., Strassmeier *et al.* (2007), Tothill *et al.* (2008) for discussion of instrument automation), and remote operation (similar to that of current survey instruments) is likely to require high-bandwidth communication, of the kind available at the South Pole. As new instruments test the limits of what can be done with current communication bandwidth, (and

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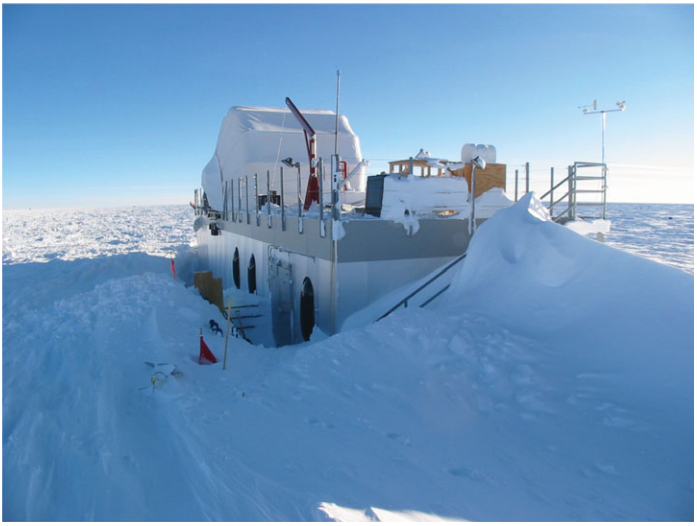

Figure 12. September: The sun rises on the winter's snowdrifts.

Figure 13. October: The first cargo plane of the summer arrives.

some will be built in locations without high-bandwidth communications available) the role of the winterover scientist may become far more important.

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