

**Preliminary Assessment of
environmental impacts for**

MARA
(Moveable Atmospheric Radar for Antarctica)

SWEDARP 2010-11



Figure 1. The MARA antennas at Nordenskiöldbasen.

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1. Conclusion

Having conducted the required analysis of the activity, the Swedish Polar Research Secretariat has come to the conclusion that the environmental impacts associated with MARA (Moveable Atmospheric Radar for Antarctica) at Nordenskiöldbasen in Dronning Maud Land, Antarctica, are likely to be *less than minor or transitory*.

If the activity were not carried out (the 0-alternative) the impacts on the environment would be smaller, but it should be noted that flight operations will take place in the area, and that human-induced impacts must be expected in the area regardless of MARA.

The Swedish Polar Research Secretariat considers that the activity do not justify the preparation of a draft Initial Environmental Evaluation. The secretariat is able to authorize the activity based on this Preliminary Assessment, according to Article 1, §2 in Annex 1, Environmental Protocol to the Antarctic Treaty.

2. Background and scientific purpose

Swedish polar research covers both the Arctic and the Antarctic and includes all fields of science with an emphasis on research related to climate and the environment. Participation in international science programs as well as international collaboration on logistics and other operational matters receive high priority.

Sweden became a consultative party to the Antarctic Treaty in 1988. The Antarctic program has its geographical focus on Dronning Maud Land where Sweden has two summer stations Wasa (at Nordenskiöldbasen, Vestfjella) and Svea (in the Heimefront Range).

MARA – Moveable Atmospheric Radar for Antarctica

Prof. Sheila Kirkwood from the Atmospheric Physics group at Swedish Institute of Space Physics (IRF) set up MARA at Nordenskiöldbasen during SWEDARP 2006/07. The science addressed with the radar includes

- Understanding processes related to aerosol-particles and waves in the polar middle atmosphere by testing theories based on measurements in the Arctic against observations in the distinctly different conditions over Antarctica.
- Understanding the origin and development of tropospheric aerosol particles in the 'clean' air of the Antarctic in comparison with the polluted air of the Arctic. The radar will contribute to accurate back-trajectory calculations for aerosol particles arriving at the measuring site, which are studied by scientists from the Finnish meteorological Institute.
- Improving understanding of the meteorological disturbances which determine weather conditions at Nordenskiöldbasen and neighbouring Antarctic stations.

More information on the project is available at:

http://www.irf.se/program/afp/?dbfile=MARA_AFP_IRF2&dbsec=IPY

2.1 Organisation

Two persons will participate in MARA during SWEDARP 2010/11. The MARA-team will be staying in the Finnish research station Aboa near the Swedish research station Wasa during the period of November 29 – January 30.

The Finnish expedition leader has the overall responsibility to coordinate the expedition, ensuring that the expedition and related activities are in compliance with the Antarctic Treaty System. The legal framework is presented in the “Nordic Environmental Handbook – Antarctic operations” (NEH). All expedition- and project leaders must be familiar with the contents of NEH, and all expeditioners must be aware of existing station routines and guidelines presented in the “Field course handbook” and NEH.

Both MARA participants will take part in preparations during workshops in Finland, including basic environmental education based upon the contents of the NEH and the "Field Course Handbook". At the beginning of the season the expedition leader organizes in-site training on safety, contingency plans and environmental management e.g. waste handling and fuel management at the Nordenskiöldbasen.

2.2 Site description of Basen

The Swedish research station Wasa and the Finnish research station Aboa is located approximately 120 km from the ice edge. The macro fauna at Nordenskiöldbasen is limited to birds. Four species have been observed, see figure 2; the snow petrel *Pagodroma nivea*, south polar skua *Catharacta maccormicki*, Wilson’s storm-petrel *Oceanites oceanicus* and Antarctic petrel *Thalassoica antarctica*. There is a snow petrel nesting area located on the precipice on the western part of Basen, about one kilometre from the station area. The number of breeding snow petrel in 1991 was estimated to 100 pairs.



Antarctic Petrel
(*Thalassoica antarctica*)



South Polar skua
(*Catharacta maccormicki*)



Wilson’s Storm petrel
(*Oceanites oceanicus*)



Snow petrel
(*Pagodroma nivea*)

Figure 2. Birds that have been observed at Wasa and Svea

The flora at Basen consists of mosses and lichens. So far, 23 lichen species, seven lichenicolous fungi and three mosses have been discovered at Basen. Microfauna have been investigated and are mostly found to inhabit soil material, mosses and lichen. Four species of nematods, sixteen species of rotifers and seven species of tardigrades have been extracted from the samples.

3. ENVIRONMENTAL IMPACT ASSESSMENT

3.1 Atmosphere physics project at Basen

Project title: MARA - Moveable Atmospheric radar for Antarctica (CI: Prof. Sheila Kirkwood)

Scientific Applications: Waves and Aerosol Particles in the Antarctic Mesosphere, Dynamics, seasonal variation and chemistry of the tropospheric Antarctic Aerosol (in cooperation with Finnish Meteorological Institute), Contributions to operational meteorology in the Antarctic.

Methods & material: The radar comprises of an antenna array, transmitter modules, receivers, a computer and cables to connect everything together. The radar is mounted on aluminium pipes on the stony area behind the Finnish research station, Aboa. The antenna array has an area about 50 m x 50 m and consist of a support structure, wires forming a ground plane, active dipole elements and cables. Vertical aluminium pipes at mesh intersections support the active elements, dipoles - each about 3 m long – ca 1,5 m above the ground. Cables and connection boxes is strapped to the support structure. See figure 3 below.



Figure 3. The antennas in the MARA project.

Transmitter frequency is 54.5 MHz. The transmitters, receivers and computer are mounted in standard racks (ca 0,6 x 0,6 x 1 m). These units are housed during operation in a small cabin next to the antenna array. Maximum power consumption is 4 kW.

Environmental impact: The radar measurements per se are not expected to result in any environmental impact besides the power usage. Power will be supplied from the Finnish research station Aboa, power will come from the usage

of diesel generators. The additional consumption of diesel will result in emissions to air and noise generation. The radar operations will be 6-8 weeks with a mean power consumption of less than 1 kW. This means that amount of diesel used is negligible compared to the amounts used for transportation. At the end of the season, all of the radar equipment will be packed ready for transport out from Nordenskiöldbasen. The transport will be arranged to use flights returning empty from Wasa at the start of subsequent seasons. The removal of the antenna array is expected to leave the site as it was in 2006, before the radar was installed. Hence environmental impacts are considered to be less than minor.



Figure 4. View over the MARA antennas.

3.2 Prevention of introduction of non-native species

At Nordenskiöldbasen, no known non-native species has been found. In order to prevent the accidental introduction and spread through human activity of any alien organism or substance that may have an unwanted impact on Antarctic species or ecosystems, SPRS has endorsed SCAR's "Code of Conduct for Field Work: Transfer of Alien Species to Antarctica and sub-Antarctic Islands and Between Location Transfer of Species", see Annex 2.

3.3 The zero alternative

The zero alternatives imply that no activities will be carried out. It is considered to entail no additional consequences for the environment, as opposed to a situation when the areas are visited. This situation, however, will deprive scientist of an important logistical framework, which is necessary in order for them to carry out their research.

3.4 Gaps of information and other uncertainties

Current understanding of many aspects of Antarctic biology and ecology is poor. The identification and classification of Antarctic species, especially invertebrates and micro-organisms, is at a rudimentary stage. Ecological processes that govern life in Antarctic soils, in the Southern Ocean, and at the ice edge are only beginning to be understood. Information on the status and trends of Antarctic fauna and flora is fragmentary at best. More research and monitoring are required to track trends in basic environmental parameters in the Antarctic. Access to and logistics in remote Antarctic areas are a major challenge to research-



ers. New techniques, including remote sensing, and further studies will shed light on these critical areas.



APPENDIX 1 – NEH ENVIRONMENTAL GUIDELINES

- Environmental Code of Conduct

Vegetation (Appendix II of the Protocol refers)

Vegetation is scarce and sensitive. Do not collect or interfere without a permit.

- Avoid trampling
- Do not collect plants or harmfully interfere without a permit
- Be aware of the risk of introducing non-native species

Birds and mammals (Appendix II of the Protocol refers)

Birds and mammals are more stressed than they appear. Taking or interference is not allowed without a permit.

- Keep your distance (do not approach) and be quiet and calm in presence of seabirds and seals.
- Do not use motorized vehicles closer than 200 meters from bird colonies (and be aware that pilots have been advised to keep helicopters/aircraft at a distance of at least 2000 meters from bird colonies)
- Do not handle animals without a permit
- Be aware of the risk of introducing diseases to Antarctic wildlife

Site Management (Appendix III and V of the Protocol refers)

A site should always be left in its natural condition.

- Always bring with you all garbage and other material when you leave a site
- Do not collect fossils and rocks, or in other manners deface the surface, unless for authorized research purposes
- Do not damage or remove historic remains

Waste and Pollutants (Appendix III and IV of the Protocol refers)

No waste is to be left in Antarctica and pollutants are not to be released into the environment

- Minimize waste before you leave for Antarctica by removing unnecessary packaging material
- Separate metal and glass from the waste stream, and dispose of all waste in appropriate designated containers.
- Avoid fuel spills by utilizing absorbents when handling fuel.
- Clean up all fuel spills

Protected Areas (Appendix V of the Protocol refers)

Some sites have been designated as Protected Areas. Do not enter without a permit.

- Protected Areas are protected for a purpose, e.g. for physical/ biological occurrences, scientific value, etc. You should respect this designation.
- Do not enter a protected area without a permit.
- If you have a permit, be sure to adhere to the permit conditions and be sure to bring the permit with you in the field



- Flora, Fauna and the Natural Environment

Human activity can have a large impact on the vulnerable natural environment in Antarctica. Show respect, and do your utmost to ensure that your presence does not harm the environment unnecessarily

Plants

- Plants in Antarctica are rare, fragile and grow slowly. Therefore you should avoid areas where mosses and lichens grow. Use established paths and trails where these exist.
- Establish camps in non-sensitive areas
- It is prohibited to collect plants without a special permit.
- It is prohibited to bring plants to Antarctica except in accordance with a permit.

Animals

- Keep distance to animals, and be quiet and calm in their presence. Be especially alert in periods when animals breed. Do not walk through bird and seal colonies unless you are conducting approved research in the area. Avoid use of motorised vehicles closer than 200 meters from any animal.
- Do not feed, touch or handle birds or seals, or approach or photograph them in ways that cause them to alter their behaviour.
- It is prohibited to collect animals without a special permit
- It is prohibited to bring animals to Antarctica

Natural environment

- Do not paint on rocks or boulders, or in any other manner deface these.
- Avoid collecting or taking away geological specimens as a souvenir, including rocks, bones, fossils.
- When leaving a site it should be left in a natural state. Go thoroughly through the area before you leave, and remove waste and other left behind effects.

Protected areas

- Always check whether there are Antarctic Specially Protected Areas (ASPAs), Antarctic Specially Managed Areas (ASMA), or registered historic sites and monuments in the vicinity.
- Special permits are required for entering or engage in activity in ASPAs. The permit must be with you in the field.
- ASMA and ASPA have management plans. It is your responsibility to familiarise yourself with and adhere to existing requirements and rules for these management plans.
- Cultural remains shall not be damaged, destroyed or removed.



- Waste Management

Waste Minimization

- Minimize purchase of products with plastic, glass or other bulky packaging material.
- Buy durable products instead of disposable products.
- Get rid of unnecessary packaging material (especially plastic) before leaving
- Substitute shredded paper, polystyrene chips, beads and other similar loose packaging material with bubble wrap, cardboard or paper.
- Buy products that easily can be re-used for other purposes.
- Use packaging material that can be re-used.
- Re-use products/material whenever this is practicable.

Environmentally harmful products

- Polychlorinated biphenyls (PCB), non-sterile soil, polystyrene chips/beads and similar forms of packaging material, pesticides are not allowed.
- The use of polyvinylchloride (PVC) products is highly discouraged.
- The introduction of non-native species of animals and plants (including seeds, viruses, bacteria, parasites, fungi and yeast) requires a special permit.
- Hazardous chemicals and products should be treated with special attention so that no emission and dispersal occur.

Waste Removal

- No waste is to be disposed of in Antarctica unless special permission has been granted.
- No open burning of waste is allowed.

Separation of waste

Waste is to be separated into the following categories:

| | |
|--------|--------------------------------|
| BLUE | Metal waste |
| GREEN | Glass waste |
| ORANGE | Mixed combustible solid wastes |
| BLACK | Sewage and food waste |

Sewage

- Discharge of sewage is prohibited under all circumstances unless the project has been granted exemption.
- Under no circumstances must sewage or domestic liquid waste be disposed of in vegetated areas or in areas with discharge to fresh water.

Hazardous waste

- Different categories of hazardous wastes should never be mixed together in the same drum or crate
- Oil-contaminated soil/water/fabric is to be stored in separate containers
- Solids to be combusted
- No burning is allowed
- Radioactive waste
- For both liquid and solid radioactive waste it is essential that the correct information is provided in the labelling of the containers.



APPENDIX 2 – SCAR Code of Conduct for field work:

Transfer of alien species to Antarctica and Sub-Antarctic Islands and between location transfer of species

Risk assessment

As part of the field work planning process the following simple risk assessment is conducted.

Risk assessment questions:

1. Has any equipment/ equipment cases/ field clothing/ boots, planned for use in the subantarctic/Antarctica been used in other natural environments, particularly alpine or polar environments?
2. What are the means needed to clean this equipment/ equipment cases/ clothing/boots?
3. Will the field party be visiting more than one major locality?
4. If yes, how will the field party ensure that equipment/ equipment cases/ clothing/boots do not carry diaspores between sites?

Field work

The following recommendations are made with regard to field work.

Field planning

If field work requires moving between major ice-free localities, aim to conduct field work in low diversity localities before high diversity localities.

Equipment

1. When designing field equipment, reduce the capacity of the equipment to carry additional material and make the equipment easy to clean and sterilize.
2. If equipment can not be cleaned effectively, do not use this equipment between major localities but take multiple sets of equipment (e.g. planktonic nets).
3. Be aware of where equipment cases are stored and that these cases do not accumulate dust or invertebrate infestations.
4. When cleaning items be particularly vigilant in removing soil, seeds and bryophyte propagules (including leaves).