HOVERCRAFT OPERATIONS IN ANTARCTICA
(EXPLOITATION D'AÉROGLISSEURS DANS L'ANTARCTIQUE)

J. Stephen Dibbern, U.S. Army Foreign Science and Technology Center

ABSTRACT

The use of transportation equipment in Antarctica is reviewed and the niche for air cushion vehicles (ACVs) is defined. A review is made of early trials in northern regions and of initial use of ACVs in Antarctica by New Zealand and Japan. The successful use of "Tiger 4" ACVs by the British Antarctic Survey and of the Hoversystem "Husky 1500" by the U.S. National Science Foundation indicates that ACVs are now ready for introduction in the world's harshest environment.

RÉSUMÉ

L'auteur fait une revue des moyens de transport utilisés dans l'Antarctique et y définit le domaine d'utilisation des aéroglisseurs. L'exploitation des aéroglisseurs dans les régions nordiques, leurs premières utilisations dans l'Antarctique par la Nouvelle-Zélande et le Japon y sont décrites. Le succès obtenu par le British Antarctic Survey avec le Tiger 4 et celle du Husky 1500 par la U.S. National Science Foundation, indique que les véhicules à coussin d'air sont maintenant prêts à faire face au pire environnement climatique de la planète.

Hovercraft Operations in Antarctica

J. Stephen Dibbern
US Army Foreign Science & Technology Center
Charlottesville, VA 22901

1.What Else?

The question is, "What else can do the job?" In Antarctica that means a collection of tracked and in some cases wheeled vehicles and of course helicopters. Modern ACVs offer a number of advantages over other transport means during certain times of the year and for certain tasks, but not for everything.

a.Tracks

Tracked vehicles have several drawbacks compared to the ACV. First, they are usually slow by comparison. The faster they are the lower the payload such as with snowmobiles. They are not always as safe as you would wish, particularly over floating ice. They offer a rough ride by comparison and sometimes damage not only scientific specimens but the crews as well. What they can do is go up hills and navigate rough surfaces, neither of which the ACV likes to do. They are also easier to learn to operate.

b.Helicopters

Helicopters on the other hand are extremely difficult to train for both operator and for maintenance which leads to the rather extreme operating costs which are associated with the otherwise ideal machines. Since most are turbine powered they are both short legged and expensive to feed.

c.Tasks

The tasks that have been explored for the ACV so far include; transport of scientific personnel and their supplies and specimens (which are sometimes very fragile) over sea ice and over ice shelves in both the Ross Sea along the Antarctic Peninsula and in East Antarctica. The American program has also included the support of field camps with fuel and supplies as well as the transport of service technicians for remotely sighted equipment. So basically it is scientific and logistic support.

d.Terrain

The terrain (since ACVs don't like hills) is flat; sea ice and ice shelves please, and avoid the pressure ridges! In all over ice applications so far, ice ridges have created the biggest obstacles. The flat ice surfaces allow for very high speeds and heavy payloads but ridging and the need to navigate around it can slow things down or even deny certain areas. Sever weather including high winds, low temperatures, low visibility and snow accumulation add to the problems of operations.

2.Hovercraft on Ice

ACV operations over ice are certainly nothing new since some of the very earliest craft were developed for operations on ice such as Levkov's vehicles in the USSR and Kaario's in Finland. It was not until the first practical craft were produced in the United Kingdom that serious over ice operations began.

a.SR.N5-6

Some of these early operations included SR.N5 and 6 craft which went on trials at such places as Churchill on Hudson Bay in the 1960's and the Northern Transportation Company Ltd and Pacific Hovercraft which operated them in the MacKenzie Delta and the North Slope of Alaska respectively. Meanwhile the British Army was operating their SR.N6's over fjord ice very successfully in Northern Norway. Not to be left out, the US Coast Guard and Navy operated SK-5's at Point Barrow. By the early 70's the US Army was testing an SK-5 on Lake Superior during the winter as well as later at Fort Greeley in the Alaskan interior.

b.Voyageur

The operation by both CAPS and NTCL of the Bell Canada Voyageur was a real milestone for ACV Northern commercial ACV technology. These machines along with an American program on Alaska's North Slope offered the first real demonstration of commercial potential over ice and snow.

The Canadian Coast Guards workhorse Voyageur however, was the real star of the show. The Coast Guard operated their machine over ice in the Great Lakes and in the St. Lawrence River. They were responsible for the development of the high speed icebreaking techniques which they continue to use today with their AP.1-88 the "Waban Aki".

c.Barges

Air cushion barges were used in their earliest stages in polar areas, particularly in the Soviet Union where they continue to be used. The Soviets have made extensive use of barges in their oil extraction industries and as lighterage on their shipping routes across Arctic Russia.

Meanwhile in Canada barges such as the ACT 100 were being developed and the phenomenon of air cushion icebreaking was being discovered- but that is yet another story! In some cases the icebreaking potential was a problem since the rivers in Alaska and the Northwest Territories are used as highways during the winter. This was a problem faced by the D-PAAC when it was used as a self-propelled cargo platform in Alaska.

Other countries such as Finland, Japan and the United Kingdom have operated barges which were designed for cold weather or over ice operations.

3.Antarctic ACVs

a.Sir Vivian Fuchs

Soon after the Churchill trials in the 1960's, Sir Vivian Fuchs, the celebrated Antarctic explorer and by then Director of the British Antarctic Survey, wrote an article for the Polar Record outlining the possibilities of using ACVs in polar regions. The conclusion was that while the theory held great promise, the hardware was not yet up to snuff. (Sound familiar?) The gas turbine in particular was very thirsty.

b.New Zealand Antarctic Research Program

Sometime soon after Fuchs' paper (and here frankly I am at a loss, since much of this is hearsay) it appears that the New

Zealand Antarctic Research Program sent a small inflatable ACV (probably an early Mike Pinder machine) to McMurdo Sound. According to the story told at their base it had three motorcycle engines and was a disaster! Too primitive and fragile for a harsh climate and too small (four seats) for its perceived tasks.

c.Japanese Antarctic Research Expedition

By 1980 it fell to the Japanese to inaugurate the first substantial ACV operation on the Antarctic continent. Mitsui built a machine for the Japanese Antarctic Research Expedition to be used at their base in East Antarctica. This program was reported on by Professor Murao at the meeting several years ago, but the bottom line is that the machine worked (It was gasoline powered) but that it required trained operators and was only considered a prototype of things to come. It was used to transport scientists on sea ice and as a logistics craft from the ship which because of ice conditions could not approach the base. It appears to have been used for either one or two seasons. To date no more has been heard from any follow-up.

4.<u>British Antarctic Survey</u>

a.Problem

Dr. Malcolm Hole is a geologist who works as a field investigator for the British Antarctic Survey (BAS). He was involved in an attempt to do a geological reconnaissance of a series of Nunataks or isolated volcanic island peaks protruding through the Larsen Ice Shelf. The plan was to fly two snowmobiles in a ski equipped Twin Otter the 500 kilometers from the main BAS base at Rothera on the west side of the Antarctic Peninsula to the vicinity of the geological survey on the Larsen Ice Shelf to the east. As the Twin Otter landed the pilot realized that the skis were sinking into waterlogged snow and that large areas of the Ice Shelf were covered with melt water. Dr. Hole's program was set back for a year and he began to search for a means to travel on the water soaked surfaces.

b.Solution

According to Dr. Hole the idea of using a hovercraft surfaced first as a joke in the Rothera bar one evening. In fact, the more they though about it the more sense it made. But the machine had to be small enough to fit into a Twin Otter which is the only aircraft currently in the BAS inventory. The craft selected was the RTK (now Air Vehicles Ltd) Tiger 4 which is one of Mike Pinder's inflatable designs. The hovercraft could be flown to the sight and assembled (inflated) on the spot. Two machines were bought and shipped to the Antarctic for the 1987 season. Although the Tiger 4 is a nominal four-seater, Dr. Hole and his field assistant used the two craft as single seaters. The requirement for safety and survival gear, additional fuel, geological specimens (Rocks are heavy!!) meant that not only was each Tiger 4 reduced to one man but that unlike snowmobile field parties which move men and camps from place to place, the camp had to remain in one spot and they used the hovercrafts speed to transport them out each day to a new area for "geologizing". The two small machines ventured

as far as 92 kilometers out from base each day and they successfully completed all of what they set out to do in 61 field days. By the way, 18 of those days were spent laid up by weather. They used similar weather limits to those that they would have used for the snowmobiles since the limitation was more on work at the sights than on travel. Also 16 days were spent waiting for the "Twin Otter" to come and pick them up. The biggest modification to the craft was the use of a slightly larger Rotax engine, not for extra horsepower but because it is the same engine that all of BAS's 115 snowmobiles use-- they have lots of spares and experience with that particular engine. They were user operated with a minimum of training and a few trial runs on the sea ice around Rothera. At the end of the program the combination lift/propulsion fans were falling apart (one did disintegrate). They were returned to Air Vehicles who have made several modifications and as we speak the two craft are on their way back to Antarctica for use again, probably by biologists on the shifting sea ice around the base this time. So BAS has a new tool, one which they consider to have been very successful.

5. US Antarctic Program

a.Background

The US ACV program's genesis has been fairly well report over the last few years at this meeting by both Harvey Cook and myself. Suffice to say that several years ago studies of the US Antarctic Program's needs for transportation on and around McMurdo Sound revealed a need for a medium sized ACV for use there. The National Science Foundation, through its contractor ITT Antarctic Services, Inc contracted for a hovercraft from Hoversystems, Inc. It was delivery by the yearly resupply ship in February of 1987.

b.Machine

The "Husky" 1500 is powered by a Duetz air cooled diesel engine and has a nominal payload of 1500 kg. In fact, because of extensive modification to the original design the payload has been reduced. The modifications include; a strengthened under hull to allow for ice impacting, full length skids under the craft, extensive crew heating and engine preheating systems, cold compound natural rubber seals and skirts, and a crane designed to lift a 55 gallon (US) oil drum or a snowmobile in or out of the cargo bay.

c.Performance

Most of the details of the craft have already been reported, but it has now completed its first full year of operations and we thought that you might be interested in what it accomplished. First, the bottom line, it did what was expected of it and more. Second, there were problems, but most have been solved and several are currently being fixed. The Husky's design speed is 35 knots which was achieved over ice at 20% below the normal engine speed. Top speeds of over 50 knots were attained and operations were carried out in up to 40 knot winds. A deficiency which became obvious was the need for increased braking. Skirt drag was minimal on ice and snow surfaces and to create enough drag to slow the craft the lift had to be so drastically reduced that solid obstacle

impact became unacceptable. The result was that the crews did a lot of pirouetting to keep speed under control which itself wasted time and reduced block speeds. A reversing propeller is being considered for retrofit to the craft this season.

d.Operations

During its first full year of operations the Husky ran for 300 hours and carried scientists and supplies up to 200 kilometers out onto the Ross Ice Shelf. It operated North of McMurdo Station across the Erebus Glacier Tongue to Cape Evans on Ross Island and as far as New Harbor on the Victoria Land coast. On one occasion the machine remained in the field overnight with the field party that it was sent to support. The scientists used it to haul biological sampling nets and traps, do surveys of animal populations, as a skin diving platform (the divers changing in the comfort of the cabin) and using the onboard crane actually using the craft to pull up instruments from the sea bottom. Support activities included Search and Rescue duty, hauling fuel and supplies to remote field camps, delivery of service technicians to remote equipment, and some demonstration trips. This last function was probably the most productive since few knew what the ACVs capabilities were. The result is that this year the National Science Foundation is flooded with requests from its grantees for the use of the machine.

e.Future

Although the possible modification to instal a reversing propeller is a major one, still the program is considered a startling success. Further modifications have been purchased for a planned deployment onto the Polar Plateau in support of various surveys. Plans call for the machine to be flown via ski equipped C-130 to the South Pole and tested there. The most important aspect of the future is that the craft has proven its efficiency and utility to the scientific community which is asking for more time on the craft than the single machine it can provide. Also, with air cushion technology a better known commodity to the Antarctic community, there are other ACV oriented ideas being discussed for even larger future projects.

6. Summary

Although ACV operations over ice and in polar areas is not a particularly new idea, their successful use in Antarctica is a relatively recent development. Beyond the earlier experiments by New Zealand and the Japanese, the British and American programs illustrate the successful introduction of two distinctly different types of operation. In 1966 Fuchs felt that the hovercraft of the time was not yet ready for introduction into the worlds harshest environment, it should be clear that the craft of today are.

References

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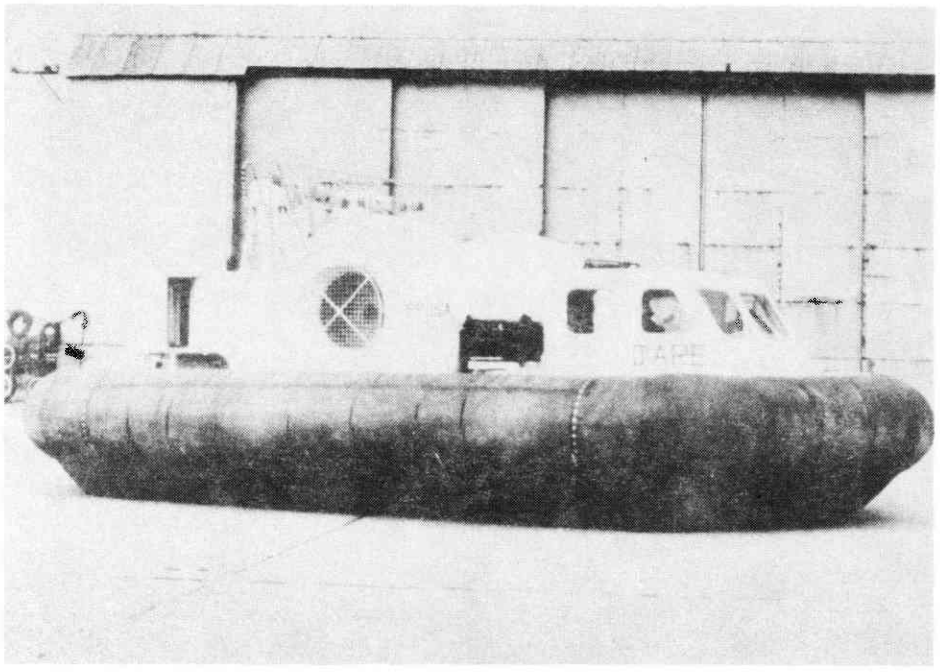
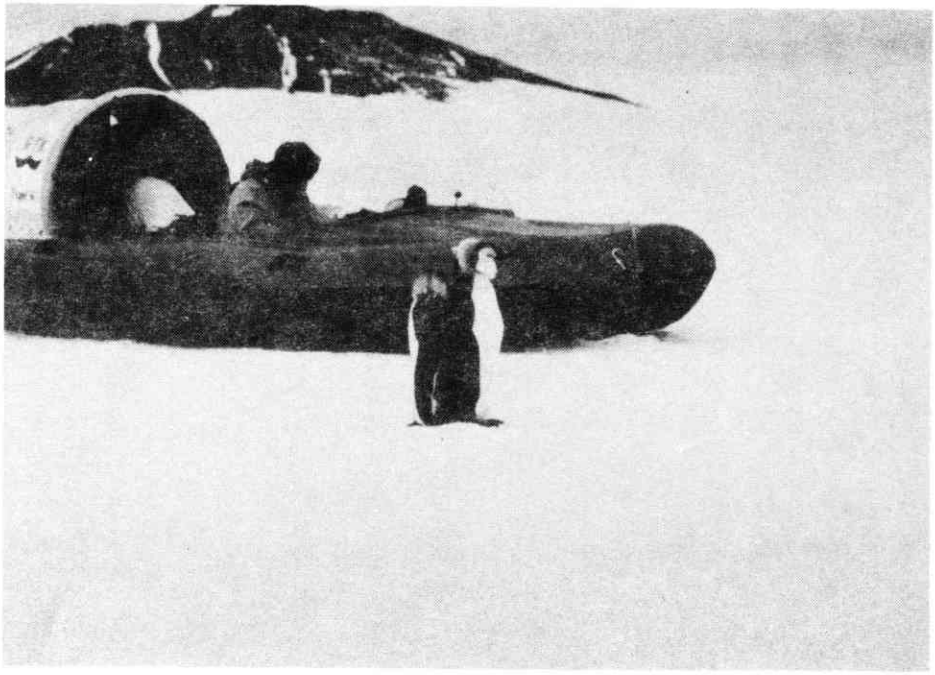
Some Hovercrafts Operated in Antarctica

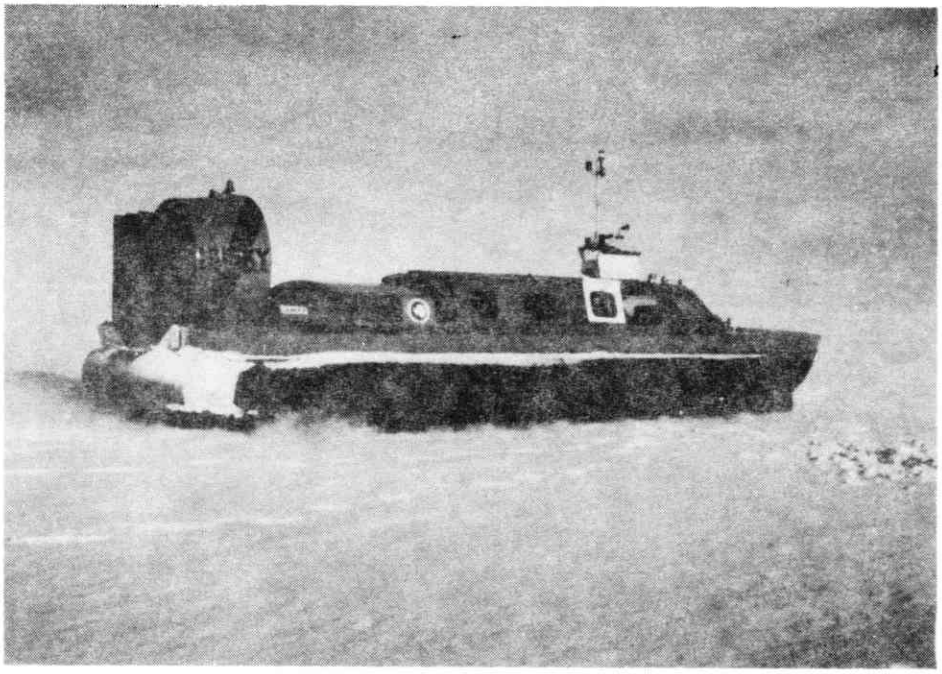


MV-PP05A Polar Terrain Test Craft, Japan
Dim.: 8.1m by 4.8m, load: 0.6t, Max W.: 2.8t

Air Vehicles "Tiger 4" , United Kingdom
Dim.: 5.1m by 2.4m, Load: 325kg, Max. W.: 550 kg



Tiger "4" encounter with locals.



Hover Systems Inc. Husky 1500 TD
Dim.: 10.2m by 3.8m, Load: 1.5t, Max. W.: 3.8t