Backgrounder

August 2000

MANTRA 2000

(Middle Atmosphere Nitrogen TRend Assessment)

On August 29, 2000, the Canadian Space Agency and Environment Canada collaborated on the second flight of the MANTRA balloon over the small Saskatchewan town of Vanscoy. MANTRA's instruments scanned the atmosphere for reactive nitrogen compounds, ozone and aerosol levels. Ozone is helpful at higher altitudes because of its role in blocking harmful ultraviolet rays from the sun but it is a contributor to smog at lower levels. Although the chemistry of ozone depletion and regeneration is a very complex process, nitrous oxide and chlorofluorocarbons (CFCs) are believed to play critical roles in its destruction. Current theories about ozone depletion in the stratosphere only account for one half of the reduction scientists are observing. Over the mid-latitudes of Canada, the ozone layer has thinned by about 10 per cent over the past 20 years.

The MANTRA research project will help scientists determine the effectiveness of the reduction of ozone-depleting chemicals undertaken since the Montreal Protocol, a global agreement to protect the ozone layer. This environmental treaty, initiated in 1987 and since signed by over 160 countries, used scientific research to set limits for the worldwide production of ozone-depleting substances in order to ensure that ozone levels return to normal and do not become threatened again in the future.

The Government of Canada is working with the international scientific community to determine the extent and causes of atmospheric changes that threaten human health and safety. Sound scientific data is essential to finding effective solutions to problems such as depletion of the ozone layer and climate change. Environment Canada's studies of the ozone layer, which began in the 1930s, support a world-wide research and atmospheric monitoring program. Through the leadership of the Canadian Space Agency, Canada is also involved in research to study the ozone layer from space.

The Balloon

The 120,000 cubic metre MANTRA balloon, which is roughly as tall as a 20-storey building, was launched at 2:45 a.m. (Central Standard Time) and reached a maximum altitude of 35 km above the Earth before daybreak. The balloon is so large that it could easily be seen with the naked eye from up to 100 km away. At the peak of its flight, several of the instruments made measurements as they tracked the rising sun. The rest of the day was spent scanning the Earth's horizon through a range of altitudes in order to make precise measurements of ozone and related gases in the Earth's stratosphere. The payload separated from the balloon and began its slow parachute descent, to land at 4:38 p.m. (CST), allowing the team to recover the instruments.

The MANTRA team has gone to great lengths to avoid a repeat of the technical problems experienced with the first mission's pointing system and release mechanism that resulted in

the balloon deviating from its planned course. The balloon was later recovered on Mariehamn Island in Finland with all of its scientific instrumentation intact. For this flight, the MANTRA team used a different release mechanism for the gondola, one that has been used successfully in the past. The new pointing system, based on an Environment Canada-developed ground-based solar tracking system, was developed by engineers at the University of Toronto, and is mechanically more robust and has a much higher level of pointing accuracy than the system used on the 1998 flight. It will allow scientists to measure the composition of the atmosphere from balloons continuously, rather than just at sunrise and sunset as has been the case in the past.

Training Canada's Future Leaders in Space Research

The training of future Canadian space scientists and engineers is an important aspect of the MANTRA program, and significant effort has been made to engage undergraduate and graduate students, as well as post-doctoral fellows and research associates in the project. Balloon programs are ideal for this sort of training because they have many characteristics of a full-fledged space program, but with a more modest cost requirement. The balloon's equipment, although built to a high engineering standard, is not required to withstand the full rigours of a long-duration space flight and therefore some of the manufacturing quality control can be relaxed. In addition, the amount of time needed to complete a balloon program is within the period of study for a higher degree in a university. The students, researchers, and technical staff involved in MANTRA will participate in the preparation of the flight and in the post-flight data reduction. They will acquire transferable scientific, technical, organizational, and communications skills that will be relevant to their future endeavours.

MANTRA is being funded under the Canadian Space Agency's Small Payloads Program and receives additional support from Environment Canada. It also receives indirect support from the Natural Sciences and Engineering Research Council of Canada through its support of University staff and students participating in the project. The Principal Investigator is Kimberly Strong (University of Toronto) and the Environment Canada lead scientist is Tom McElroy. They are supported by Co-Investigators Jim Drummond (University of Toronto), Jack McConnell (York University) and Brian Solheim (CRESTech/York University). Scientific Instrumentation Limited of Saskatoon is the Industrial Partner responsible for providing launch and recovery services and payload engineering support.