Airborne Atmospheric Research

The NRC Institute for Aerospace Research (NRC Aerospace) works with other federal government departments and agencies to address topics of national and global interest such as climate change. These activities are related to in-house airborne in-situ and remote sensing capabilities. The Airborne Research group within NRC Aerospace has for years collaborated with Environment Canada, Transport Canada, and NASA on major international projects using three of its specially equipped aircraft—a Convair-580, Twin Otter, and CT-133—to collect data on air pollution, severe weather, cloud formation and radiative properties, and earth-atmosphere exchange of greenhouse gases.

NRC Convair-580

The NRC Convair 580 is a twin-engine, medium-size, pressurized aircraft capable of long distance operation that can carry several racks of instrumentation and up to a dozen research crew members. It is equipped with state-of-the-art instrumentation for measuring atmospheric state (temperature, pressure, humidity and three-dimensional wind) and aircraft state parameters. The multi-purpose flying laboratory supports diverse national and international collaborative projects, including environmental studies related to low-level smog in urban areas, solar radiation, cloud microphysics, atmospheric chemistry, storm tracking, aircraft icing, aerosol transport, and atmospheric remote sensing.

NRC Convair-580

In summer 2004, the aircraft participated in the International Consortium for Atmospheric Research on Transport and Transformation (ICARTT) project, a major study on the movement of air pollution over eastern North America and North Atlantic Ocean that involved more 500 researchers from five countries. Led by Environment Canada, Canadian scientists used the Convair for two airborne field studies: one out of Cleveland, Ohio to collect data on pollution and clouds at different altitudes on both sides of the border, the other over the Maritime Provinces to measure pollution transported into that region during episodes of intense pollution build-up. Environment Canada is using the data to better understand the effects of climate change and improve regional air quality forecasts.

In an earlier study in 2001, researchers from NRC Aerospace and the NRC Institute for Chemical Process and Environmental Technology collaborated with Environment Canada on the Pacific 2001 Air Quality Study in B.C.'s Fraser Valley. During periods of haze or smog, researchers used the Convair to collect in-situ and remotely sensed meteorological data for the region. The data is being used to support development of air quality models and predict how pollutants develop and dissipate within the region.

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NRC Twin Otter

The NRC Twin Otter aircraft is a fully instrumented airborne platform suitable for conducting a wide range of atmospheric and biospheric studies related to global warming, such as airborne investigations of the sources and sinks of greenhouse gases or the remote sensing of snow and ice cover properties. Research capabilities include measurement of atmospheric fluxes (heat, momentum, water vapour, carbon dioxide, ozone, nitrous oxide, and methane), trace gas and pollution dispersion, and microwave radiation.

The NRC Twin Otter is currently participating in a multi-year collaborative project, called Validation of Snow Cover and Ice Thickness (VSCIT), with Environment Canada that is collecting data on snow cover over different regions of Canada. The latest flights were conducted over northern Manitoba in 2006. Flights in certain parts of Ontario and the Northwest Territories were carried out in previous years. Environment Canada is using the data to improve weather models and assess the effect of global warming on ice breakup and spring runoff.

NRC CT-133

The NRC CT-133 is a rugged, high-performance aircraft capable of low to high-altitude operations in harsh environments. It is currently undergoing retrofits for a project with Transport Canada to obtain data on aircraft emissions from commercial aircraft flying at cruise altitude over Canada. These retrofits include adding pressurized under-wing pods that contain air chemistry instrumentation to measure levels of carbon dioxide, nitrous oxide, other gaseous species, water vapour and particulate matter.

The project was initiated because environmental concerns about the effect of aircraft emissions have grown in recent years. The biggest issues relate to the climatological consequences of emissions resulting from aircraft flying at level cruising altitudes between the upper third of the troposphere through to the lower stratosphere. Transport Canada and the International Civil Aviation Organization are particularly concerned with the entrapment of such emissions in Canada's polar air mass, where there is little latitudinal circulation. When they finally precipitate downwards, the result is ground level pollution and water contamination in the fragile ecologies of northern Canadian tundra and boreal forest regions.

Initial flights will take place along the St. Lawrence Seaway in the main traffic routes between Ottawa and Quebec City. These will be followed up with flights over the initial segment of polar routes arising out of Toronto. Three flight profiles are planned: ground level up to about 28,000 feet, enroute intercept behind individual aircraft at 28,000 to 38,000 feet altitude, and aerial work before and after the daily passage of aircraft through the designated area.

Experience gained from the project will place NRC Aerospace in an ideal position to support future atmospheric research, including a wide-scale emissions data gathering project under consideration by the North American Carbon Program Steering Committee for sometime in 2009.

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February 2007
Aussi offert en français
IAR-FR09e