Annual Performance Report

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Investigation of the Physical Processes Governing Large-scale Tracer Transport in the Stratosphere and Troposphere

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Submitted to

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This report reviews the second year of a three-year research program to investigate the physical mechanisms which underlie the transport of trace constituents in the stratosphere-troposphere system. The primary scientific goal of the research is to identify the processes which transport air masses within the lower stratosphere, particularly between the tropics and middle latitudes. This research is being conducted in collaboration with the Subsonic Assessment (SASS) of the NASA Atmospheric Effects of Radiation Program (AEAP) and the Upper Atmospheric Research Program (UARP). The SASS program seeks to understand the impact of the present and future fleets of conventional jet traffic on the upper troposphere and lower stratosphere, while complementary airborne observations under UARP seek to understand the complex interactions of dynamical and chemical processes that affect the ozone layer. The present investigation contributes to the goals of each of these by diagnosing the history of air parcels intercepted by NASA research aircraft in UARP and AEAP campaigns. This is done by means of a blend of trajectory analyses and tracer correlation techniques.

Currently, Dr. Selkirk is completing work on an investigation of the origins of air parcels observed on the trans-equatorial transits of the NASA ER-2 during the ASHOE/MAESA (Airborne Southern Hemisphere Ozone Expedition/Measurements of the Atmospheric Effects of Stratospheric Aircraft) airborne campaigns in 1994 as well as equatorial flights during the Stratospheric Tracers of Atmospheric Transport (STRAT) missions in 1995 and 1996 and the Polar Ozone Loss in the Arctic Region in Summer (POLARIS) campaign in 1997. The work will be summarized in a paper which will seek to answer questions originally posed in a paper Dr. Selkirk presented to the Spring Meeting of the American Geophysical Union (AGU) in 1996, viz., Are there seasonal differences in the tracer morphology of the subtropical boundary in the lower stratosphere? Does the tropical pipe broaden and contract throughout the year, or does it instead migrate meridionally? What changes occur through the year in the character of inter-species correlations?

Dr. Selkirk made a poster presentation at the AEAP annual meeting in Virginia Beach, VA in March, 1997. The title of the poster was "Vertical structure and origin of subtropical tropopause layers at Hawaii: Observations and trajectory calculations from ASHOE-MAESA and STRAT." A copy of the abstract is attached. Dr. Selkirk provided meteorological and scientific support to the Polar Ozone Loss in the Arctic Regions in Summer (POLARIS) in 1997. The goal of this mission was to better characterize and quantify the ozone losses that occur during the Arctic summer. For this purpose, the

NASA ER-2 aircraft was flown from Fairbanks, Alaska in three separate deployments between April and September 1997. Dr. Selkirk provided meteorological support in Fairbanks during the first two of these missions.

As Co-Investigator with Dr. Anne Thompson of NASA-Goddard, Dr. Selkirk provided meteorological and scientific support to the SASS Ozone and Nitrogen Oxide Experiment (SONEX) in 1997. This entailed 24 days in the field in October and November as well as participation in planning meetings at Ames and Goddard in February and June, respectively. During the nine months leading up to the field mission, Dr. Selkirk devoted much of his time to preparations for the field mission, and in particular played the lead role in developing the rather complicated flight plans required to satisfy the scientific goals of SONEX. Once in the field, in addition to his role in retrieving and interpreting scientific forecast products specifically designed for the mission by him and his colleagues at Ames and Goddard, Dr. Selkirk assisted the Mission Scientists in preparing the final details of the flight plans .