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DEPARTMENT OF PHYSICS AND ATMOSPHERIC SCIENCE

TITLE OF THESIS:	SATELLITE RETRIEVALS OF TOTAL COLUMN WATER VAPOUR AND SURFACE EMISSIVITY DURING ARCTIC WINTER
TIME/DATE:	9:30am, Friday, September 15, 2017
PLACE:	Room 3107, Mona Campbell Building, 1459 LeMarchant Street, Halifax Nova Scotia

EXAMINING COMMITTEE:

Dr. C. Thomas McElroy, Department of Earth and Space Science and Engineering, York University (External Examiner)

Dr. Glen Lesins, Department of Physics and Atmospheric Science, Dalhousie University (Reader)

Dr. Jim Drummond, Department of Physics and Atmospheric Science, Dalhousie University (Reader)

Dr. Thomas J. Duck, Department of Physics and Atmospheric Science, Dalhousie University (Supervisor)

DEPARTMENTAL REPRESENTATIVE:	Dr. Ian Folkins, Department of Atmospheric Science, Dalhousie University
CHAIR:	Dr. Mark Asbridge, PhD Defence Panel, Faculty of Graduate Studies

ABSTRACT

A new water vapour column retrieval using passive microwave satellite measurements is presented for use during the Arctic winter. The retrieval, named PLDC16, uses measurements at the strong 183 GHz water vapour absorption line together with an auxiliary temperature profile and water vapour profile shape. The retrieval can be applied to several microwave instruments providing up to 25 years of Arctic water vapour column measurements.

PLDC16 is evaluated using simulations and real brightness temperatures from the Microwave Humidity Sounder (MHS). RMS deviations from the G-Band Vapor Radiometer (GVR) at Barrow, Alaska were smaller than for other retrieval techniques and satellite instruments. Swath measurements show fine structure that is not seen in reanalyses.

Surface emissivity and reflectance ratios are also retrieved using microwave measurements from the Advanced Technology Microwave Sounder (ATMS), and are validated with aircraft campaign measurements. Maps of reflectance ratio show large spatial and temporal variations across the different Arctic surfaces, particularly over Greenland.

The assumption of specular surface reflection for microwaves is investigated. Differences between large satellite zenith angle and nadir satellite zenith angle water vapour retrievals indicate Lambertian reflection occurs over land and sea ice surfaces while a mixture of specular and Lambertian reflection occurs over open ocean and is applied to PLDC16.

The PLDC16 retrieval is used together with maps of reflectance ratio to obtain pan-Arctic maps of water vapour column. Good agreement is seen with the Arctic radiosonde network and ERA-interim reanalysis, although ERA-interim shows a significant dry bias with respect to PLDC16. Enhanced water vapour over ice leads is also seen.