Séminaire Vendredi 19 Juin 11h15 / Seminar Friday June 19, 11:15 AM

Conférencier/Lecturer: Isztar Zawadzki, McGill University

Sujet/Subject: Data and data assimilation at MRO

Présentation/Presentation: Anglais / English

Lieu/Room: Grande salle du premier étage CMC

Résumé / Abstract:

Since the introduction of weather radar more than a half century ago, the processing of radar observations of the atmosphere has undergone two stages: first, we used a qualitative and subjective interpretation of visual observations on a cathode ray tube displaying in real time returns from precipitation. With the introduction of computers in the late 70s an effort was made to match the skill of subjective visual interpretation by the radar operators using objective data processing. The algorithms for this are based on simple ideas derived from conceptual models of storm structure and storm circulation. For example, to resolve the inherent ambiguity of observing only one component of the 3D air velocity, radar wind profiling is based on the assumption of linear dependence with space of the components of the horizontal air velocity; a Rankine vortex is the geometrical model for tornado or mesocyclone detection; precipitation estimates are still based on Z-R relationships introduced decades ago, and so on.

In the 90s data assimilation was recognized as an opportunity to resolve the limitations and ambiguities of radar surveillance of a limited number of atmospheric variables. This path, initiated some twenty years ago, was slow in producing results with operational potential. At McGill, we have initiated this approach some 15 years ago following a methodology that appeared particularly adequate for operational implementation: assimilation of radar data into a numerical model used as a weak constraint. After several stages of exploration we have now completed a robust assimilation system that is ready for implementation. It incorporates three volumetric scans of radar data, NWP forecasts as a background term and some preliminary estimates of the error structure of all the components of the assimilation system. To follow our long tradition, we are now implementing the system on our S-band radar in a semi-operational real-time manner that will test our approach systematically.

Our first objective is to produce an analysis of the state of the atmosphere so that radar data are replaced by the **Meso-Analysis System** (**MAS**) from which all nowcasting products can be derived. Initially we will derive the analysis state of the atmosphere within a radar range of 150 km using GEM-LAM forecasts as background and model governing equations.

A second line of research led us to describe the error covariance of radar estimates of precipitation, a prerequisite for an operational radar data assimilation at regional scale. We first recognize that the two dominant sources of error are the variable Z-R relationship and the extrapolation of measurements taken at the radar-beam height to ground. Second, we evaluated these two errors separately and assessed their cross correlation. For the error due to the variability of the Z-R relationship we used our disdrometric data collected over ten years. For the extrapolation error we used simulations based on close range reflectivity measurements for which the near ground truth is known. Then, by simulating the measurements at far ranges and comparing the results to the near-ground truth the errors and their spatial structures were derived.

However, assimilation of radar data with their full error covariance matrix without the corresponding forecasting error structure may undermine the purpose of data assimilation. Consequently, we are now proceeding to derive the structure of NWP forecasting errors in precipitation forecasting.