Séminaire Vendredi 10 Octobre 11h00 / Seminar Friday October 10, 11:00 AM

Conférencier/Lecturer: Shaun Lovejoy (Univ. McGill)

Sujet/Subject: The space-time cascade structure of satellite radiances and numerical models of the atmosphere

Présentation/Presentation: Anglais / English

Lieu/Room: Grande salle du premier étage CMC

Résumé / Abstract:

In 1922, Lewis Fry Richardson published the now celebrated book "Weather forecasting by numerical process" in which he daringly proposed that the weather could be forecast by brute force numerical integration of coupled nonlinear partial differential equations. But the father of numerical weather prediction was Janus-faced: his book contains a famous passage in which he proposed that the complex nonlinear atmospheric dynamics cascaded scale after scale from planetary down to small viscous scales. He is also the grandfather of modern cascade models.

The idea of scale by scale simplicity embodied in cascades is in tune with the history of science that shows that once the fundamentals are correctly grasped, that messy complexity generally gives way to simplicity and that simplicity points the way to the future. But are cascades correct?

Over the last five years, profiting from a "golden age" of atmospheric data and of models of unprecedented quality and quantity, my colleagues and I have used TRMM and MTSAT satellite radiances from 10 passive channels ranging from visible to infra red to passive microwave as well as (active) radar reflectivities to show that the atmosphere accurately follows the predictions of cascade models in both the horizontal direction and in time. This allows us to empirically establish space-time ("Stommel") diagrams. We also have used high resolution lidar and drop sonde data to show that the vertical also has a cascade structure.

So which Richardson is right? The father of numerical weather prediction, or the grandfather of cascades? The answer may be both. This is possible because cascade models are specifically designed as phenomenological models of the equations. It turns out that typical numerical models do indeed catch a glimpse of the cascade: today's models apparently capture the first factor of $\approx$100 in scale of a cascade which starts near

planetary scales and apparently continues down to millimetres (a factor of $\approx 10^{10}$). Yet even if the GCM's are consistent with cascades, in time they will receive competition from a new potentially more powerful class of cascade models which directly exploit the scale–by-scale cascade simplicity allowing them to handle a far larger range of scales than is currently possible.