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Analysis of radiance observations

Tuesday, 25 February 2020 09:15 (1 hour)

The primary purpose of this lecture is to explore the implications of the fact that satellites can only measure radiation at the top of the atmosphere and do not measure the geophysical variables we require for NWP (e.g. temperature, humidity and wind). The link between the atmospheric variables and the measured radiances is the radiative transfer equation - the key elements of which are discussed. It is shown how - with careful frequency selection - satellite measurements can be made for which the relationship to geophysical variables is greatly simplified. Despite these simplifications, it is shown that the extraction of detailed profile information from downward looking radiance measurements is a formally ill posed inverse problem.

Data assimilation is introduced as the solution to this inverse problem, where background information and satellite observations are combined to produce a best or optimal estimate of the atmospheric state. The main elements of the assimilation scheme (such as the chain of observation operators for radiances) and its key statistical inputs are examined. In particular, it is shown that incorrect specification of observation errors (R) and background errors (B) can severely limit the successful exploitation of satellite data.

By the end of this lecture you will:

• understand exactly what a satellite actually measures (radiance)
• appreciate the complex relationship between what is measured and what we wish to know for NWP
• how information is extracted from satellite measurements in data assimilation

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