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Theoretical background (1) : What do satellites measure?

Monday, 7 March 2022 10:20 (1h 15m)

The primary purpose of this lecture is 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. For example, in the case of sounding radiances (where the primary absorber is a well mixed gas of known concentration) the relationship reduces to the measured radiance being a broad vertical average of the atmospheric temperature profile. 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. The ways in which retrieval schemes use prior information to make the inverse problem more tractable are discussed as well as how this approach generalises into data assimilation.

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