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Assimilation of water vapour, cloud and precipitation observations in extratropical cyclones

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Microwave radiances sensitive to water vapour, cloud and precipitation are assimilated in all-sky conditions with benefit to ECMWF forecasts into the medium range. In terms of an adjoint-based sensitivity measure (Forecast Sensitivity to Observation impact, FSOI) these observations provide around 20 % of all observational impact on the short-range forecast, so they are now one of the most important parts of the observing system. Every winter there are extratropical cyclones where the all-sky radiances have a disproportionate impact on the 24 h forecast improvement. Examining these case studies, the most influential observations are typically in cloudy regions over ocean when other observations are mostly unavailable. Modern data assimilation systems already provide detailed and accurate short-range forecasts of extratropical cyclones including their cloud and precipitation structures. Hence only small changes are needed between the background forecast and analysis, and these are on scales less than 500 km. However, the all-sky observations are able to make adjustments to cloud and moisture in the vicinity of the warm conveyor belt inflow which lead to significant downstream impacts on the developing extratropical cyclone.

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