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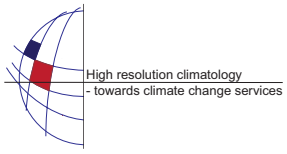

Data denial and IASI data impact experiments for extratropical transition

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Extratropical transition (ET) of tropical cyclones presents a significant challenge to numerical weather forecasts. Small uncertainties in sensitive regions around ET events can lead to large forecast errors. An important source of such uncertainties lies in the insufficient data coverage. Introducing targeted observations into the data assimilation in the vicinity of an ET event or in regions sensitive to fast error growth may have a notable value for a numerical forecast.

An upper bound for the value of additional targeted observations can be gained by denying data and measure the resulting impact on the forecast without these data. This is done under the assumption that the impact of removing information is symmetric to the impact of adding information in the same region.

Data denial experiments using the ECMWF IFS are designed to investigate the value of targeted observations for historical ET cases over the Atlantic. The impact of removing data in specified locations on the forecast for the ET events is examined. Data is denied in sensitive areas determined with singular vectors (SVs) optimized over a 2 day interval for an optimization region over Europe and the deterministic forecast is rerun for 5 days. Furthermore, the influence of observations in the vicinity of the decaying tropical cyclone (TC) and associated with structures inherent to a TC on the forecast is examined by denying data in a rectangular box around the ET. For one case, Hurricane Helene (2006), targeted SVs were calculated and used as data denial regions for new forecasts. The degradation of the forecasts in the different experiments is investigated to consider which region might be most valuable for additional observations. The information content of denying data in SV regions targeted on Helene is compared to that of denying data in the vicinity of the decaying cyclone.

In the second part of this study, we performed experiments for a 20-day period during which 3 TCs underwent ET in the Atlantic using the global weather prediction model ARPEGE of Meteo France. For one experiment the data density was enhanced by a factor of four. In the second experiment all IASI data were denied. The third experiment included 9 further IASI channels which are sensitive to water vapor. The global impact of these experiments was assessed.

The impact of water vapor observations for the ET cases was studied in detail at times shortly before, during or shortly after the respective ET event. The analysis error with the additional water vapor channels was slightly smaller in comparison to that without these channels, especially in the vicinity of the ET events. We found a strong error reduction in the forecasts which were initialized from analyses with reduced errors associated with the ETs over the Atlantic. Over Europe forecast error reductions due to the water vapor channels could be found in the systems which developed downstream of the ET events.