Use of dropsonde data in the global data assimilation of the German Weather Service

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Numerical weather prediction systems require exact three-dimensional global observations of wind, temperature, humidity etc. as initial conditions to achieve a skillful weather forecast. The lack of an adequate observation network over the oceans can result in fast-growing analysis errors leading to poor forecasts of oceanic cyclones such as extra-tropical low pressure systems or severe tropical storms (hurricanes, typhoons). Observation targeting can be a successful concept to provide measurements in data-sparse oceanic areas in cases of tropical storms or in sensitive regions where errors in the initial state are fast-growing. The major observational tool for targeting is a dropsonde, released from aircraft over sensitive areas to measure wind, temperature and humidity profiles.

In preparation for the Atlantic-Thorpex Observing System Test (TOST) experiment (October - December 2003; Truscott, 2003) the German Weather Service (DWD) expended some effort to decode and use dropsonde data in its global assimilation and forecast system. As a first test case, seventy-one dropsonde profiles taken by NASA and NOAA hurricane flight missions on 18 Sept. 2003 over hurricane Isabel shortly before landfall became available over GTS (Fig. 1).

The operational global data assimilation and forecasting system of the DWD was used to assimilate dropsonde wind, temperature and humidity profiles; here, the observation error assigned to the data was unchanged with respect to the radiosonde observations. In order to estimate the potential benefit of dropsonde data, the analysis and forecast was compared to a control run using the operational assimilation and forecast system at DWD, with a variety of conventional (radiosonde, aircraft, synops, buoys) and satellite (SATOB, SATEM) data but without any dropsonde measurements.

The operational analysis without dropsonde data considerably overestimated the surface pressure in the center of hurricane Isabel, and therefore, underestimates the maximum wind speeds (Fig. 2a). Using the temperature, wind and humidity profiles from the dropsondes in the assimilation reduces the surface pressure in the center of hurricane Isabel by more than 20 hPa (Fig. 2b), leading to a more realistic analysed maximum wind speed and a better track and intensity forecast of the tropical storm system after landfall (not shown).

References

Truscott, B., 2003: *Atlantic-Thorpex Observing System Test Project Plan,* EUCOS/SP/105 version 4

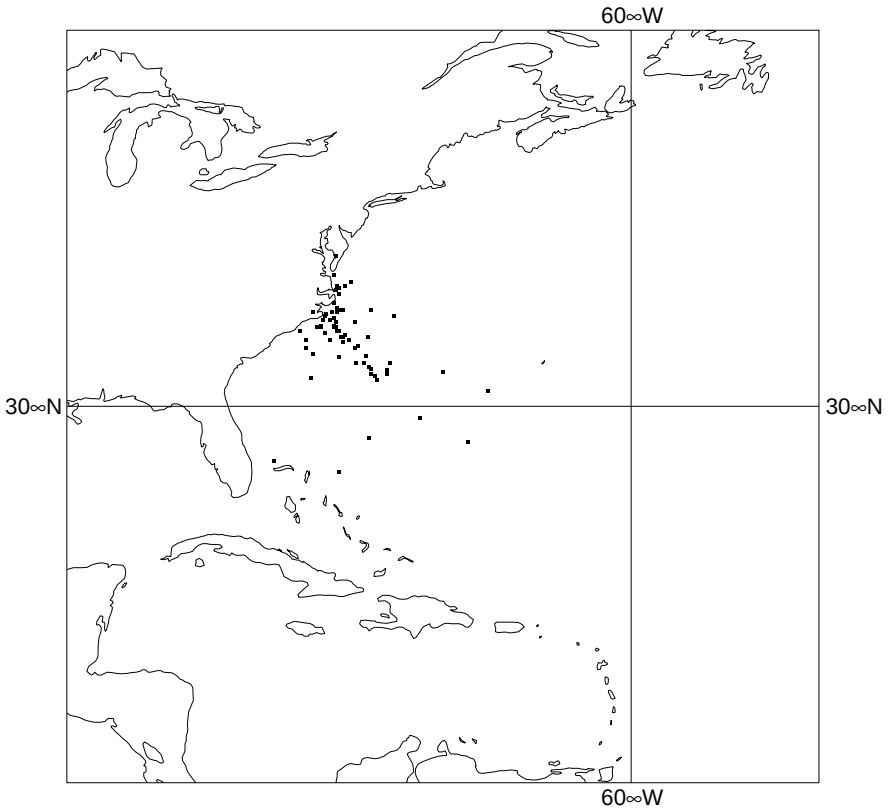

Figure 1: Location of Dropsondes providing data to DWD from 20030918 to 20030919 (black dots).

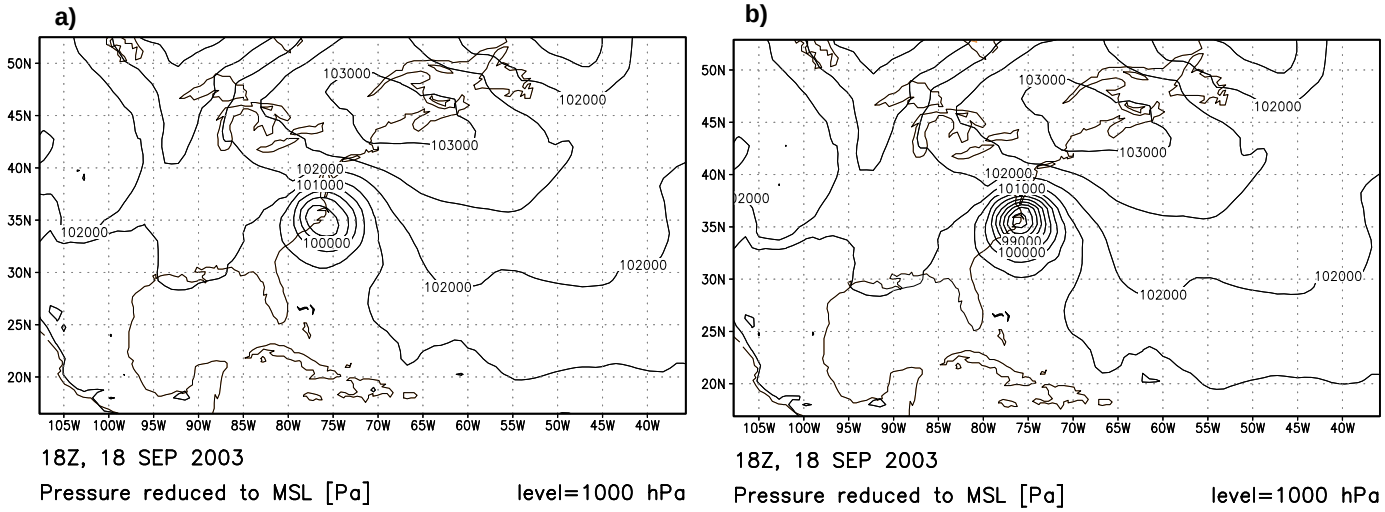

Figure 2: Analyses of sea surface pressure [Pa] at 18.09.2003 18 UTC for (a) the Routine (center pressure < 995 hPa) and (b) an experiment using the dropsonde data (center pressure < 975 hPa) since 20030918 00 UTC.