

Impact of Satellite Observations and Forecast Model Improvements on Tropical Cyclone Track Forecasts

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Observation and Forecast System Experiments

The purpose of this study was to determine the impact that the assimilation of satellite observations and forecast model improvements have had upon the tropical cyclone track forecasting performance of global numerical weather prediction systems.

The current operational NOGAPS/NAVDAS data assimilation system was run with different combinations of observational data and with different configurations of the NOGAPS global spectral model over the period from August 14-September 30, 2004. This was a particularly active period with 12 hurricanes (including Charley, Frances, Ivan, and Jeanne), 5 typhoons, and 7 tropical storms.

Tropical cyclone track forecast error was evaluated.



Observation and Forecast System Experiments

Summary of Experiments

NCNV – Conventional observations only

NATV – NCNV plus AMSU-A radiances

NRPW – NATV plus SSM/I precipitable water

NSPW – NRPW plus satellite feature-track winds

NCTL – NSPW plus scatterometer winds (control system)

NRTR – NCNV plus NESDIS retrievals

NOBG – **NCTL** minus Synthetic TC observations

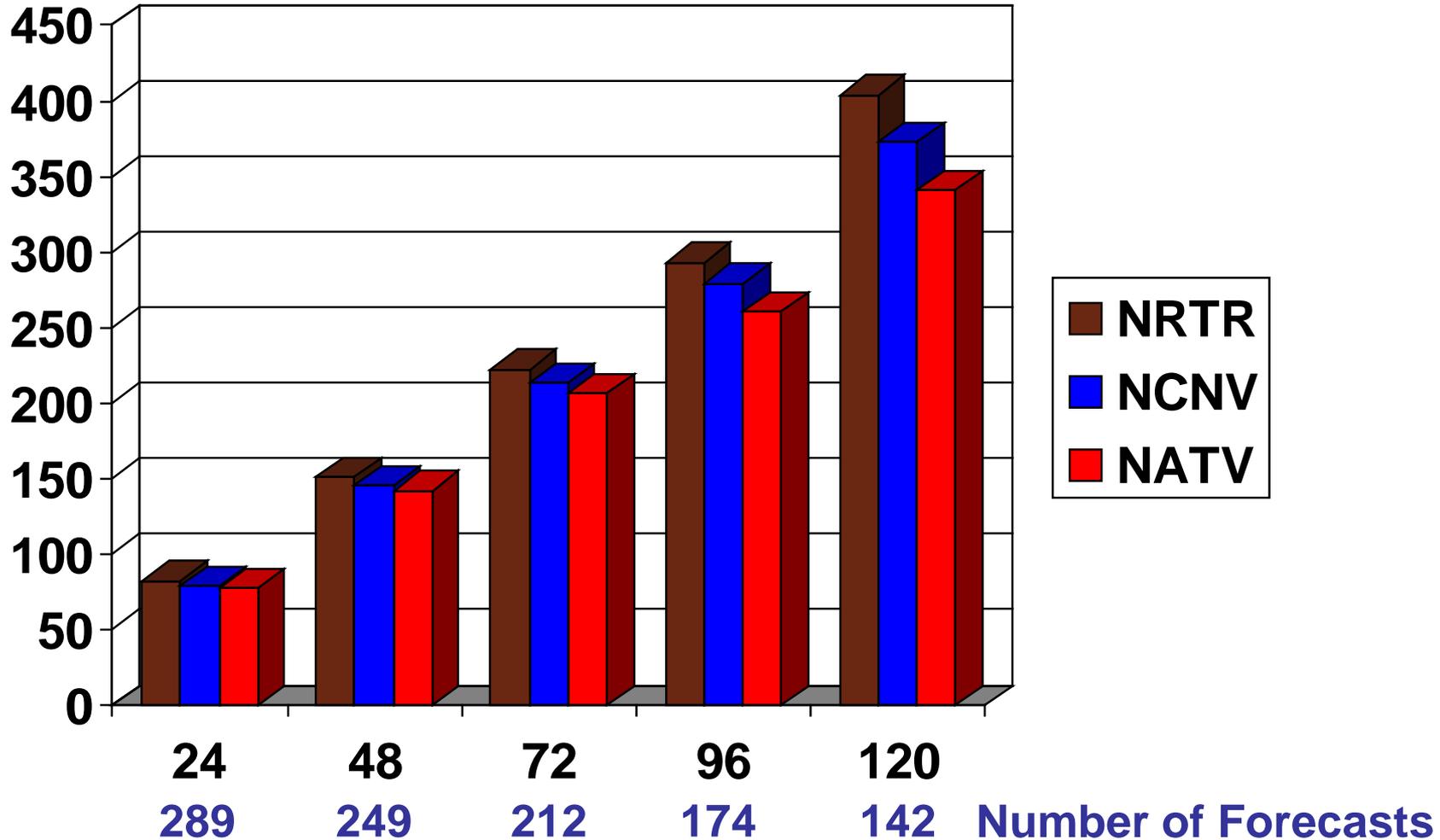
T79L18 and **T159L24** – Relaxed Arakawa Schubert

T159L24E and **T239L30E (NCTL)** - Emanuel

Observation System Experiments



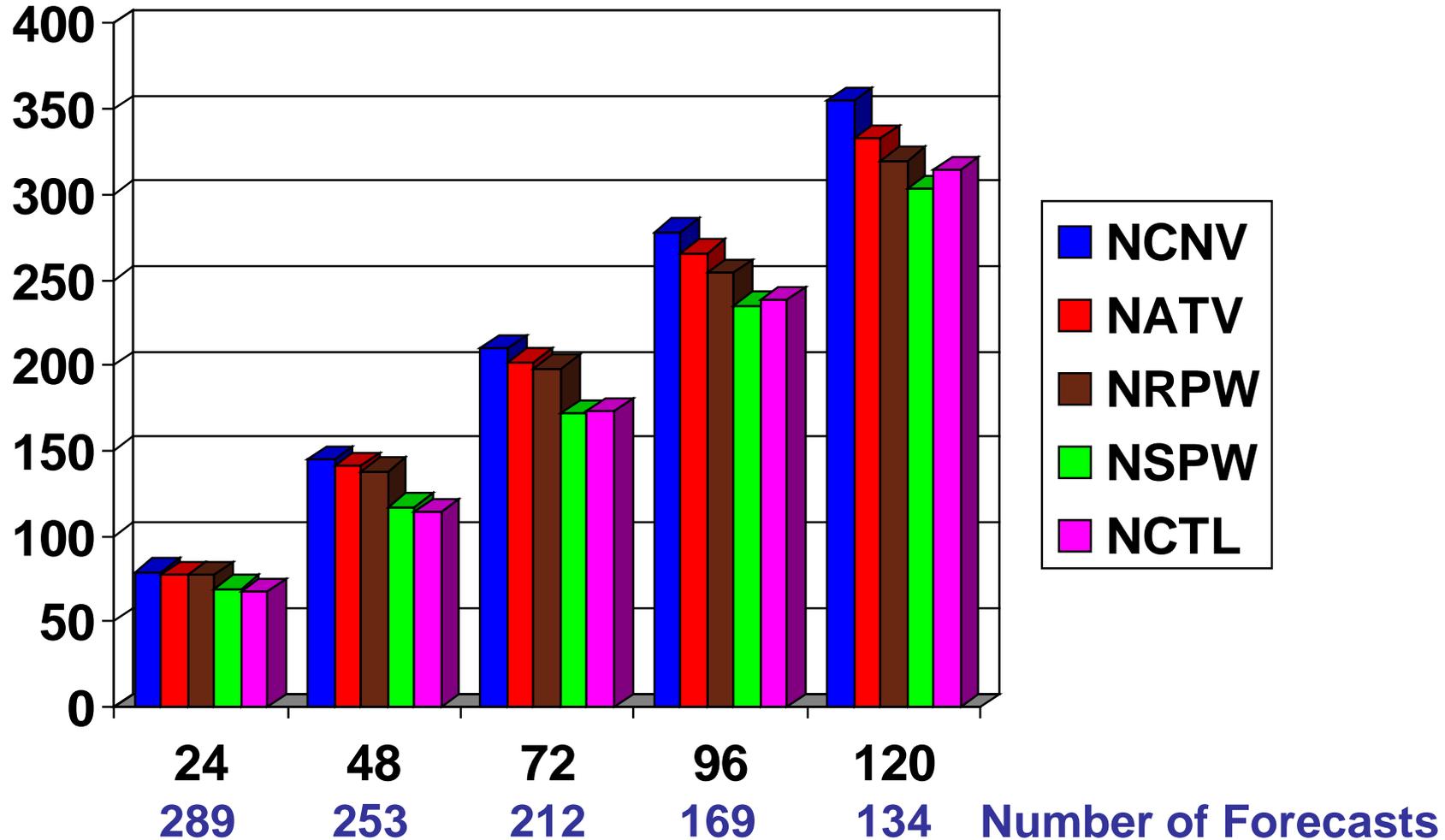
Observation System Experiments TC Forecast Error (nm)





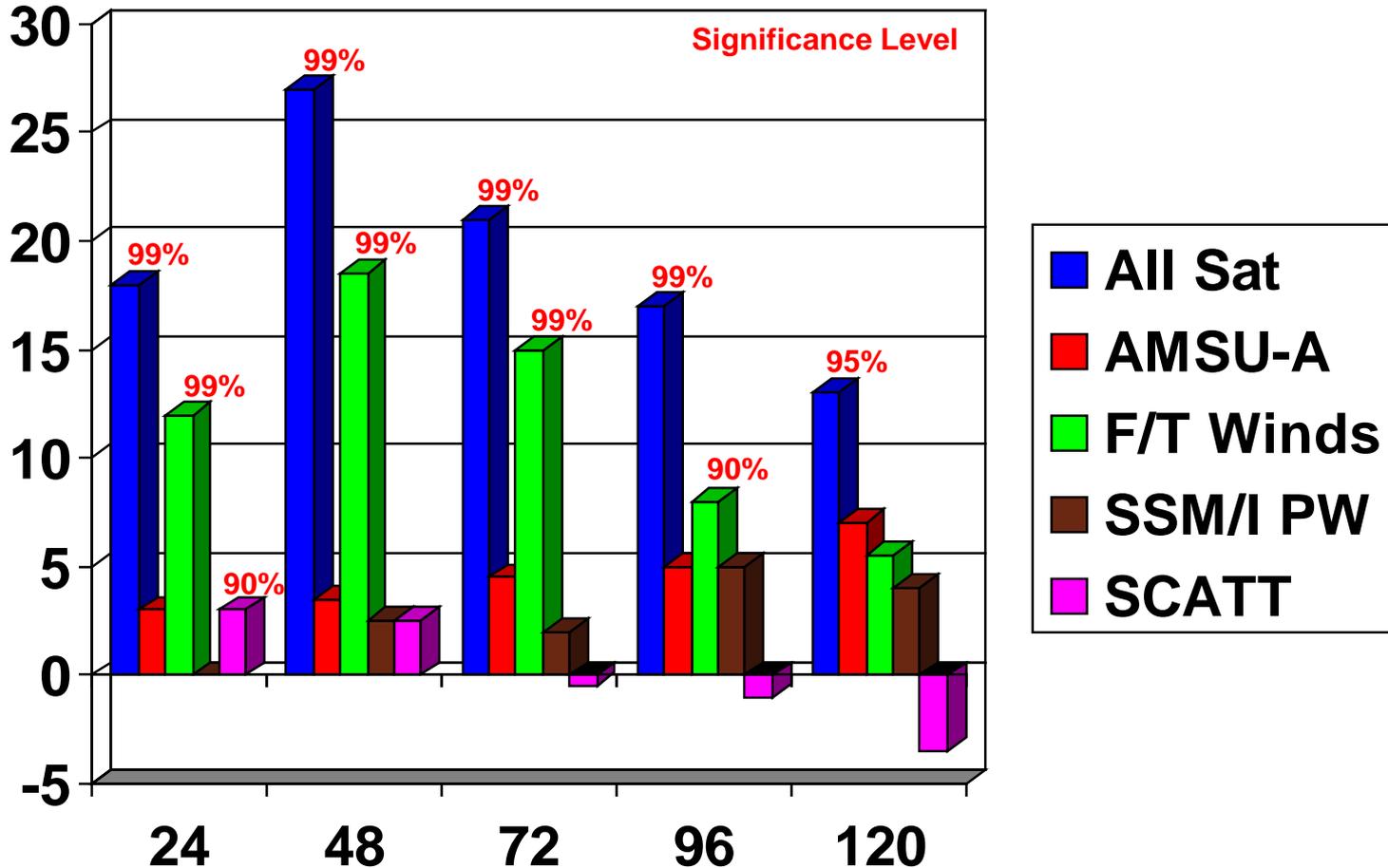
Observation System Experiments

TC Forecast Error (nm)





Observation System Experiments Percent Improvement

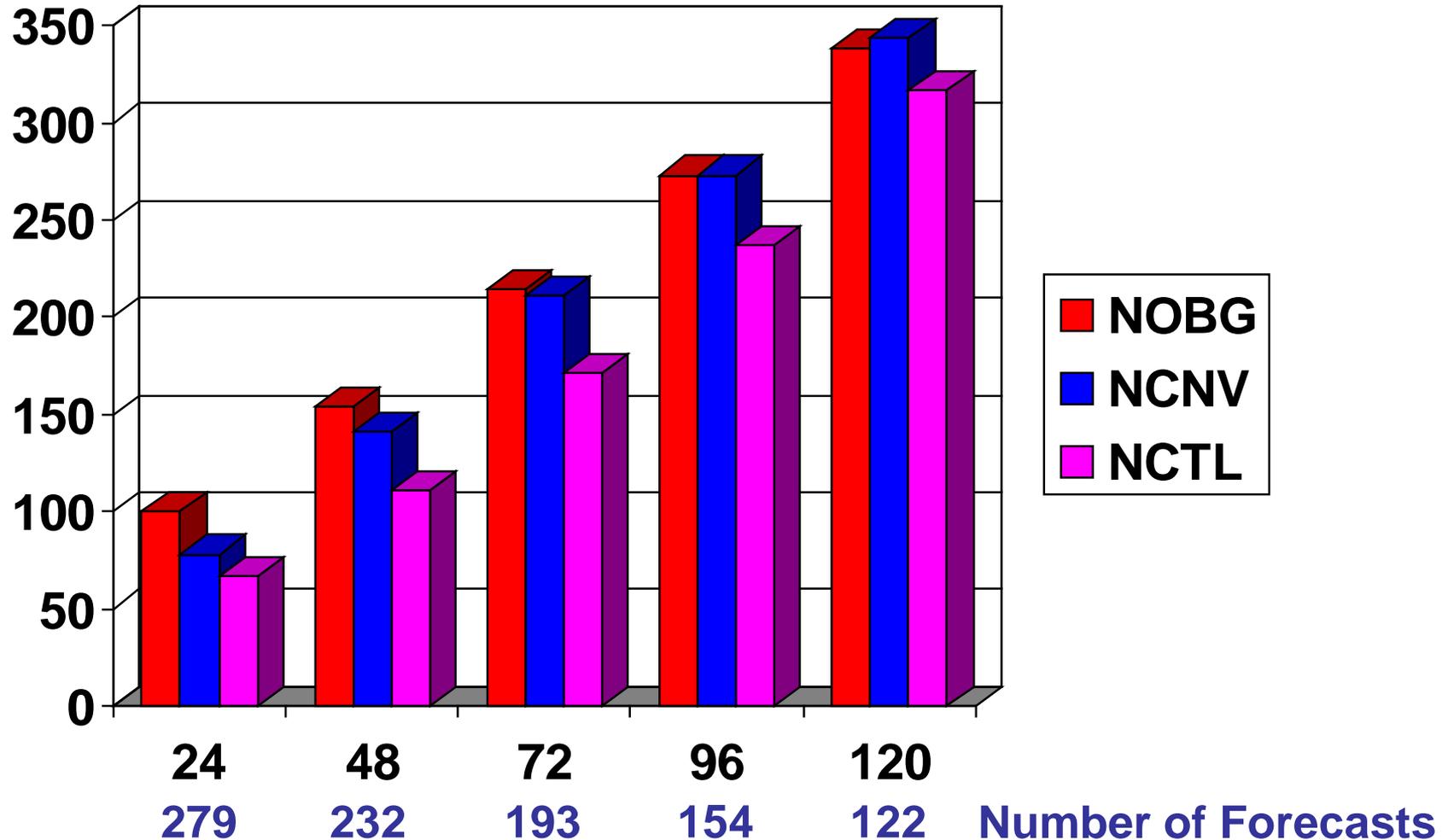


Impact of Synthetic Tropical Cyclone Observations



Observation System Experiments

TC Forecast Error (nm)

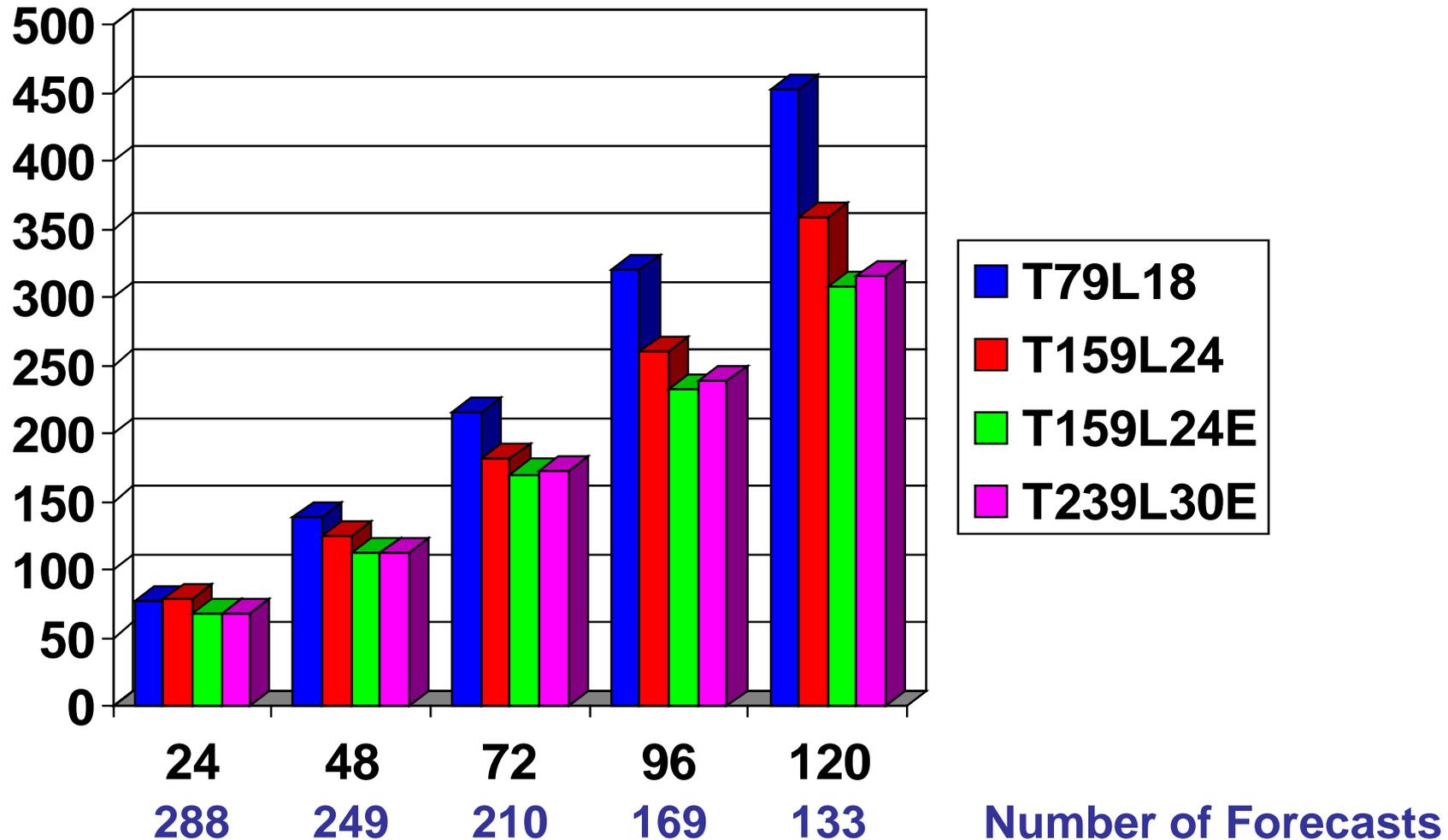


Forecast System Experiments



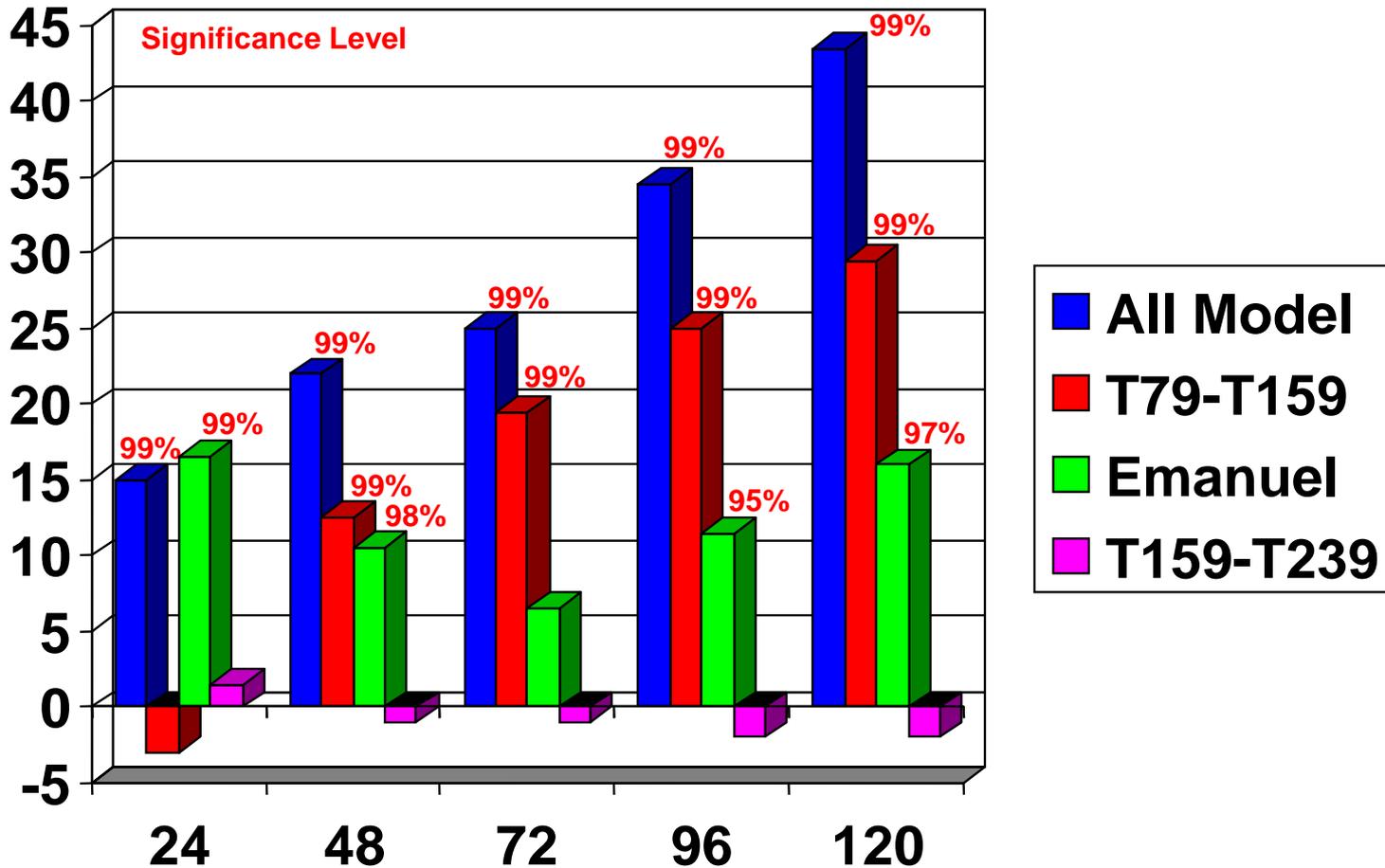
Forecast System Experiments

TC Forecast Error (nm)





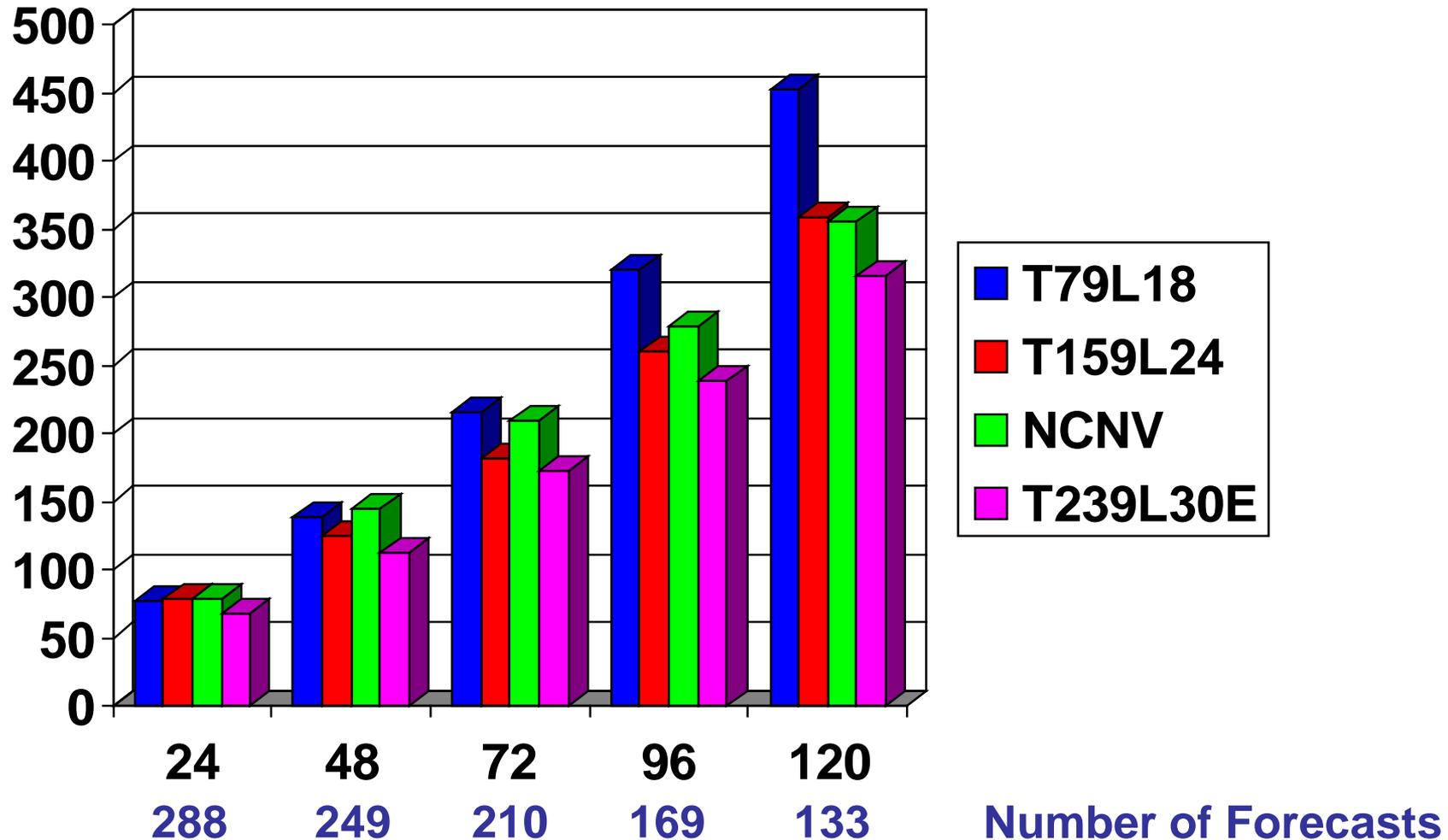
Forecast System Experiments Percent Improvement





Forecast System Experiments

TC Forecast Error (nm)





Summary and Conclusions

The feature-track winds proved to be the most important set of satellite observations. With respect to the other types of satellite observations, the assimilation of feature-track winds had the largest impact at 24 h to 96 h. The assimilation of AMSU-A radiances had the largest impact at 120 h. At all forecast lengths, the assimilation of AMSU-A radiances (NESDIS retrievals) had a positive (negative) impact on TC track forecast skill.

The impact of the assimilation of all satellite observations was comparable to the impact of all forecast model improvements at 24 h to 72 h. At 96 h and 120 h, the impact of the assimilation of all satellite observations was roughly comparable to the impact of replacing the relaxed Arakawa-Schubert convective parameterization with the Emanuel convective parameterization.



Summary and Conclusions

The impact obtained when the forecast model resolution improved from T79L18 to T159L24 increased with increasing forecast length. As a result, the impact of all model improvements was two to three times greater than the impact of the assimilation of all satellite observations at 96 h and 120 h.

The impact of the assimilation of synthetic TC observations was found to be greater than the impact of the assimilation of all satellite observations at 24 h and 48 h and comparable at 72 h and 96 h.

Questions?