Use of CAMEX data sets in an Adaptive Observational Strategy for Hurricane Forecasts

Mrinal K. Biswas and T. N. Krishnamurti
The Florida State University
Tallahassee, FL 32306-4520, USA
biswas@earl.met.fsu.edu

1. Introduction

Ensemble studies have shown that error arising from an NWP model is not homogeneous in space. The predictions will be more sensitive in some areas as compared to others. Earlier researchers have found out that the uncertainty in the initial conditions is mainly responsible for forecast errors. A very high resolution realtime observational system will be very expensive and impractical. The identification of areas from where the analysis errors are large and is bound to play a significant role in the improvement of forecasts. Zhang and Krishnamurti (2000) proposed a simple method that could provide some guidance for aircraft reconnaissance missions to aid hurricane observations.

2. Methodology

This was based on the mapping of the spread of forecast errors from the construction of the variance of a 50-member ensemble with respect to a control run. The variables at locations of maximum variance were back correlated to a 12 hr forecast field (or to a near time field) to locate regions where the errors emanate due to data uncertainties. A next step in the analysis is to introduce new data sets within that targeted area of high correlations. In the present study CAMEX 3 LASE and Dropsondes data sets are used to study the impact of the data using the Adaptive observational strategy. Those targeted data sets are assimilated with those of the control run to obtain a new data analysis.
This appears to be a very powerful strategy for the deployment of adaptive observations.

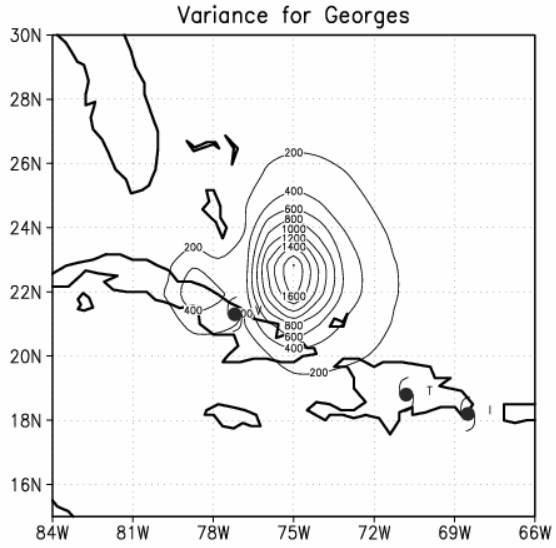
3. Results and Conclusions

We next illustrate the results from one experiment for hurricane Georges (1998). The control initial sates for these experiments were obtained from the operational analysis of ECMWF.

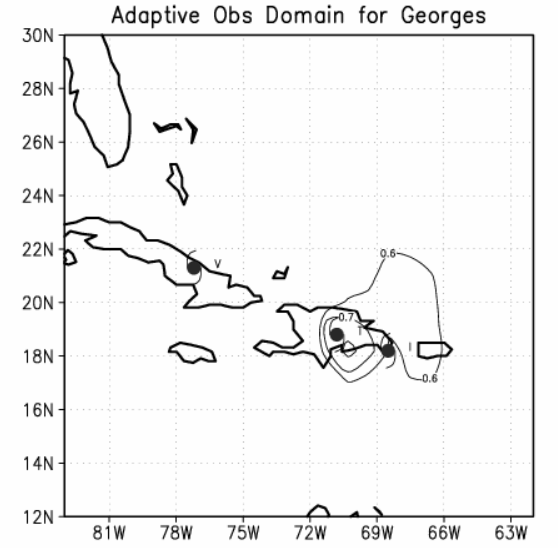
Fig (1a) illustrates the distribution of the variances of forecasted deep layer mean geopotential heights calculated from the ensemble spread of 50 forecast experiments (forecasts of 48 hour duration). These variances cover a region in the vicinity of the hurricanes where the storm was expected to move to in 48 hours. A large spread was noted and this suggests that model forecasts have a considerable sensitivity to the initial states.

The field of back correlation for Georges is illustrated in fig 1b. These are analyzed to locate regions of large correlations that signify possible regions from where the error spread emanates. This identifies a region for targeted observations. Special observations of humidity, wind and temperature (over these region of high back correlations) are assimilated using 3DVAR along with those of the control run data sets to prepare for the adaptive observation based forecast experiments. Fig 1c shows the impact of the new data sets in the area where the back correlation was ≥ 0.6. The Initial time (I), the targeted time (T) and the verification time (V) best track position are shown in the plots for reference. The strength of this study is on the rather simple strategy for the

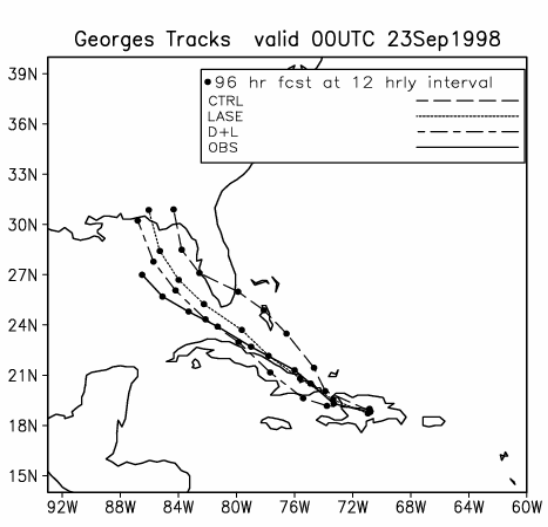
deployment of adaptive observations that have been presented here. The dropsonde plus LASE (D+L) data sets clearly shows a marked improvement over the control experiment which consists of only conventional data.



(Figure 1a)



(Figure 1b)



(Figure 1c)

Figure 1. (a) Forecast error variance field for Georges at 12UTC 24 September 1998. (b) Back correlation field valid 00UTC 23 September 1998. (c) 96 hour forecast at 12 hourly interval starting 00UTC 23 September 1998. CTRL - control forecast, LASE- forecast with only LASE data assimilated, D+L - forecast with Dropwindsondes+LASE data assimilated. The observed (OBS) best track positions are plotted for reference.

The Adaptive observational Strategy, outlined above, has been tested extensively for hurricane forecast improvements (Zhang and Krishnamurti, 2000 and Biswas and Krishnamurti 2005).

References:

Biswas, M. K. and T. N. Krishnamurti, 2005: Adaptive Use of Research Aircraft Data Sets for Hurricane Forecasts, *Submitted to Weather and Forecasting*.

Zhang, Z., and T.N. Krishnamurti, 2000: Adaptive observations for hurricane prediction. *Meteorol. Atmos. Phys*., **74**, 19-35.