Recap of Predictions of September 2009 Arctic Sea Ice Extent

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Our method uses estimates of ice thickness from a coupled ice-ocean model as predictors for a statistical forecast of the Sea Ice Index mean ice extent in September. Fields of ice thickness (H), ice concentration (IC), area with less than 0.40 m thick ice (G0.4m), and area with less than 1.00 m thick ice (G1.0m) are the predictors considered in this forecast. The method is described in Lindsay et al (2008a). The model fields are collapsed to scalar time series by weighting each field with its correlation to the September ice extent (Drobot, 2006). A statistical model is then fit for the years 1987–2008. The performance of each predictor at each lead time from February through August is shown in Figure 1.

In retrospect the mean thickness H was the best predictor from almost all months, particularly early in the season, but the error standard deviation of the prediction equation using H in past years was larger than that for the G1.0m predictor. Unlike last year, the G1.0m predictor was the best every month in terms of the minimum prediction error. This variable measures the fractional area of both open water and thin ice less than 1.0 m thick. The region with the greatest influence in determining the value of this variable, that is where the correlation with the September ice extent is high and where there is a significant anomaly in the G1.0m parameter is in the Beaufort Sea. This region had both high values of the G1.0m parameter and high correlations for it with the September ice extent. As shown in Figure 1, the observed September mean ice extent, 5.36 million sq km, was within the error bars of the predictions except for the short lead times, July and August.

To improve predictions using a statistical approach such as the one we used would require a longer and more accurate record of the seasonal changes in the ice thickness distribution. Unfortunately that is only obtainable through models. New observations can't help much except for driving improvements in the models because they can't give a consistent record of the past behavior of the system. Perhaps a more problematic issue is that the statistical relationships between elements of the system are changing rapidly. Until a new stable regime is established and we can get an adequate number of sample years of this new regime, statistical methods of prediction will be limited in their accuracy. With nonstationary statistics the standard error of the fit over past years is not a good measure of the uncertainty in the prediction.

REFERENCES

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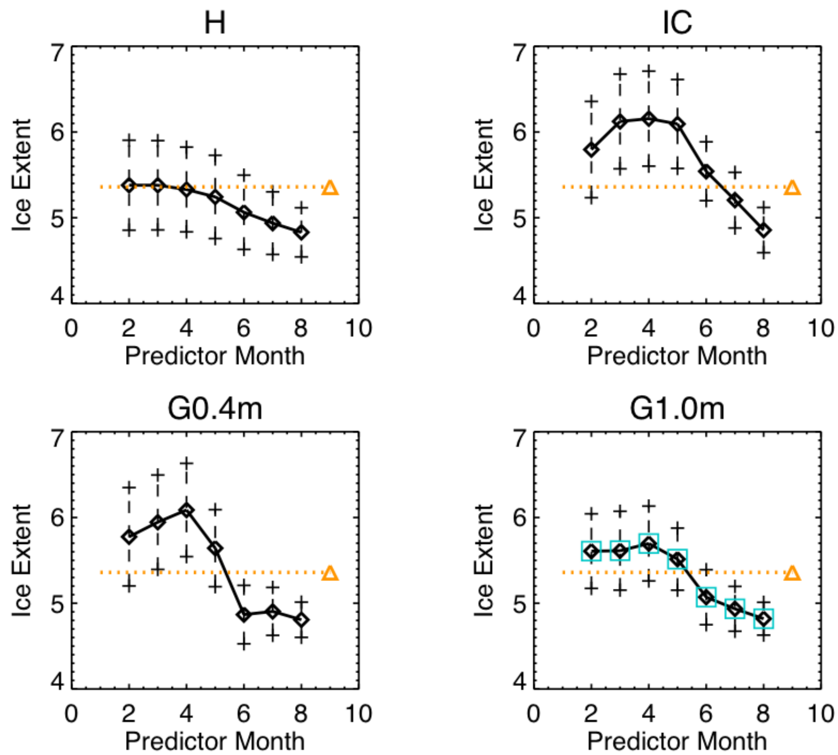

Figure 1. The performance of each predictor in 2009 in predicting the September minimum ice extent (in million sq km) using data through the end of each predictor month. The orange triangle and dotted line is the observed mean September ice extent (5.35 million sq km) from the NSIDC Sea Ice Index web site.

The black lines show the prediction based on each of the four variables for each predictor month back to February. The dashed lines are the prediction uncertainties…the error standard deviations of the linear regression fit. The blue squares in the G1.0m plot show that this variable of the four had the minimum prediction uncertainty in each month and hence was he basis of the value chosen for the prediction at the end of each month.