THE IMPACT ON EOP PREDICTIONS OF AAM FORECASTS FROM THE ECMWF AND NCEP

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1. INTRODUCTION

Predictions of UT1 are improved when dynamical model-based forecasts of the axial component of atmospheric angular momentum (AAM) are used as proxy length-of-day (LOD) forecasts (Freedman et al. 1994; Johnson et al. 2005). For example, the accuracy of JPL's predictions of UT1 are improved by nearly a factor of 2 when AAM forecast data from the National Centers for Environmental Prediction (NCEP) are used. Given the importance of AAM forecasts on the accuracy of UT1 predictions, other sources of AAM forecasts should be sought. Here, the angular momentum of the forecasted wind fields from the European Centre for Medium-Range Weather Forecasts (ECMWF) are computed and used to predict UT1. The results are compared to those obtained using NCEP forecasts.

2. UT1 PREDICTION ERROR

In support of spacecraft navigation, JPL's Kalman Earth Orientation Filter was run 73 times during 19 March 2004 to 22 July 2004 to predict polar motion and UT1. These runs have been re-processed here using the ECMWF forecasts instead of the NCEP forecasts that were used then. Since the angular momentum of only the 5-day wind forecasts from NCEP are used at JPL to predict UT1, only the 5-day wind forecasts from ECMWF are used here. Table 1 gives the error in the resulting predictions of UT1 out to 7 days in the future. This error was determined by comparing the predictions to measurements that were taken at the time the predictions were generated but that were not available until later. As seen in Table 1, if no AAM forecasts are used to predict UT1, the error in the predictions grows rapidly, becoming 33.7 cm after just 7 days. But when AAM forecasts are used, the error is dramatically reduced, becoming only 19.2 cm after 7 days with the NCEP forecasts, and 20.1 cm with the ECMWF forecasts.

To assess the potential impact of oceanic angular momentum (OAM) forecasts on UT1 predictions, an OAM series has been added to the AAM forecasts and the predictions re-generated. Since actual OAM forecasts are not currently available, analyses from the ECCO/JPL data assimilating ocean model kf066b were treated here as if they were forecasts. As seen in Table 1, adding the OAM to the AAM forecasts improves the UT1 predictions, reducing the error of the 7-day prediction from 19.2 cm to 17.9 cm when added to the NCEP AAM forecasts, and from 20.1 cm to 19.4 cm when added to the ECMWF forecasts.

3. DISCUSSION AND SUMMARY

Both the NCEP and ECMWF 5-day wind AAM forecasts agree extremely well with LOD during 19 March 2004 to 22 July 2004, with respective correlations of 0.9879 and 0.9914, and with 97.565% and 96.931% of the observed LOD variance being explained by the NCEP and ECMWF AAM forecasts, respectively. This high degree of agreement allows AAM forecasts to be used as proxy LOD forecasts when predicting UT1.

NCEP and ECMWF 5-day wind AAM forecasts are found to have similar impact on UT1 predictions.

Table 1: UT1 Prediction Error

Forecast Series	Prediction Interval, days							
	0	1	2	3	4	5	6	7
No forecasts	4.1	4.7	5.8	8.5	12.9	18.7	25.7	33.7
NCEP 5-day wind forecasts	4.2	4.7	5.5	6.9	9.0	11.7	15.0	19.2
ECMWF 5-day wind forecasts	4.1	4.7	5.6	7.2	9.6	12.4	15.9	20.1
NCEP 5-day wind forecasts & OAM	4.2	4.7	5.5	6.8	8.7	11.1	14.1	17.9
ECMWF 5-day wind forecasts & OAM	4.1	4.7	5.6	7.2	9.5	12.1	15.4	19.4

Prediction day 0 is the epoch of the last polar motion measurement. The epoch of the last UT1 measurement is typically a few days earlier. Units of UT1 prediction error are cm. 46.3 cm = 1 ms.

ECMWF AAM forecasts would therefore be a valuable additional source of AAM forecasts for predicting UT1 if they could be made available as routinely and rapidly as are the NCEP forecasts. Furthermore, since the ECMWF forecasts extend out to 10 days in the future, whereas the NCEP forecasts extend out to only 7.5 days, using the ECMWF forecasts would improve UT1 predictions beyond 7.5 days.

Adding OAM to AAM forecasts improves the accuracy of the UT1 predictions only slightly. This is to be expected given the high degree of agreement that already exists between LOD and AAM. But adding OAM to AAM forecasts should greatly improve polar motion predictions since the oceans are known to be a major source of polar motion excitation.

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4. REFERENCES

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