

OZONE AND UV FORECAST

Lilia Lemus-Deschamps ^{*1}, Mohar Chattopadhyay², Tim Hume¹, Xiao Yi², Peter Steile², Asri Sulaiman² and Tan Le²
¹Weather and Environmental Prediction (WEP), CAWCR, Bureau of Meteorology, Victoria, Australia
²Australian Community Climate Earth System Simulator (ACCESS), CAWCR, Bureau of Meteorology, Victoria, Australia

1. INTRODUCTION

To alert Australians of possible high levels of ultraviolet radiation (UV), UV Index forecast is issued daily by the Bureau of Meteorology. The UV forecast is used in promotional and educational campaigns for sun-protection. Nevertheless around 380,000 Australians still get skin cancer every year. The UV Index forecast is calculated using meteorological fields from the global numerical weather forecast model, an ozone scheme and a UV radiation code.

With the implementation of the ACCESS modelling system, the interface of the Ozone and UV forecast system to predict the ozone field within the new framework is underway. Here we summarize the current status of the operational system, present some preliminary results from the interface to the ACCESS NWP framework. Results from the "simple-ensemble" Ozone and UV Index forecast approach will be presented as well as future development.

2. OZONE ASSIMILATION AND FORECAST

Total ozone is calculated by assimilation of satellite radiances, a simple univariate statistical interpolation, mapping the ozone into potential vorticity (PV) and predicted fields from the numerical weather forecast model GASP. A pseudo-nudging of OMI total ozone is also applied. The total ozone is input to the UV code. The day-and-time of the year, latitude, longitude, altitude, surface-albedo, ozone absorption dependence on temperature, Rayleigh scattering, solar irradiance, aerosols and clouds are also taken into account to calculate the UV Index (Lemus-Deschamps et al., 1999, 2004).

Within the ACCESS framework, the approach taken is based on the UK Met Office development (Jackson et al., 2007). It includes assimilation of satellite radiances and 3d-Var ozone. The transport scheme has a semi-Lagrangian formulation and no ozone-radiation interaction is included. The initial tests of the ozone assimilation using the new ACCESS framework were run for a resolution N48L50 (288 X 217 grid points and 50 levels) and the ATOVS HIRS-9 channel. The global and Australia region total ozone forecasted distributions, for

* Corresponding author address: Lilia Deschamps, WEP/CAWCR, Bureau of Meteorology, GPO Box 1289, Melbourne 3001, Australia; e-mail: L.Deschamps@bom.gov.au.

28 September 2008, are illustrated in Figure 1 and Figure 2.

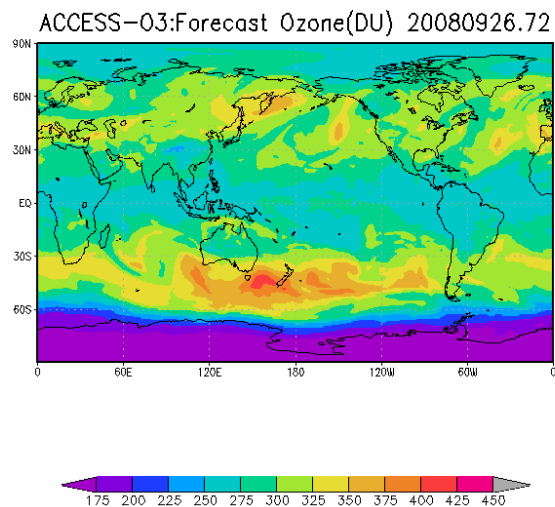


Figure 1. ACCESS-O3 global total ozone forecast for 28 September 2008.

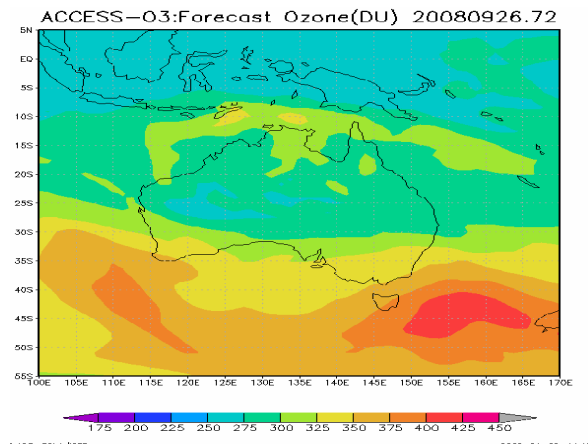


Figure 2. ACCESS-O3 Australia region total ozone forecast for 28 September 2008.

The Antarctic ozone hole is well reproduced by the model (Figure 1).

A second test was performed, for N48L50, in which the photochemical sources and sinks of ozone are parametrized as a function of local ozone mixing ratio, temperature and the overlaying ozone column abundance (Cariolle et al., 1986). Further tests are required in order to investigate the impact of the stratospheric ozone stratospheric chemistry scheme on the ozone representation within the ACCESS framework.

In addition, taking advantage of the increase of satellite ozone measurement available, we are also developing "simple-ensemble" Ozone and UV Index forecast. Satellite's ozone amounts from OMI, TOAST and SMOBA are advected using PV and a gridded operational consensus forecast (gocf) is applied. NCEP ozone forecasts are also input to the gocf ensemble. The gocf-O3 produces weighted averages forecast of gridded ozone fields from an ensemble of bias corrected ozone forecast models.

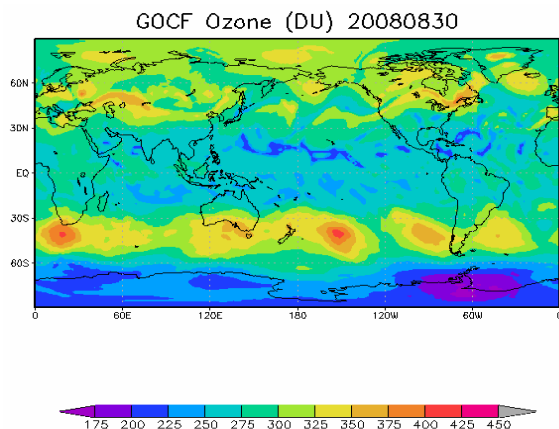


Figure 3. Ozone Gridded operational consensus forecast (DU) for 30 August 2008.

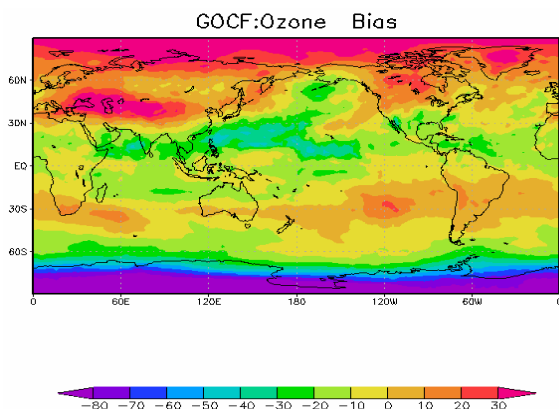


Figure 4. Ozone Gridded operational consensus forecast (DU) Bias August, 2008.

The gocf-O3 global ozone forecast for 30 August 2008 is illustrated in Figure 3. The gocf-ozone-bias for the same day is presented in Figure 4. An ozone 10-20 DU

bias is observed over Australia. The bias observed at the poles may be associated to the lack of data in some of the ensemble members. However further investigation is required.

2.1 Future Work

The next stage in the ozone assimilation and forecast (ACCESS-O3) is to investigate the most efficient way to include the ozone assimilation and forecast in the global NWP ACCESS. One option is to implement the ACCESS-O3 as a separate suite. Another option is to investigate the implementation of the 3dVar ozone within the NWP ACCESS 4Dvar suite. The strain on the computing resources will be considered.

GOCF-O3, the next stage in the development of the gocf-O3 is to replace the advected PV and meteorological NWP fields from GASP with the NWP_ACCESS: UM model ones. Then the gocf will be applied and the results will be assessed.

The ozone forecasts will be validated then, in the final stage, they will be used as input to UV scheme to produce extended UV Index forecasts.

4.3 References

- Jackson D., 2004: Improvements in Ozone Data Assimilation at the Met Office. *Forecast Research Technical Report No. 454*.
- Lemus-Deschamps, L., Rikus, L. and Gies, P., 1999: The operational Australian ultraviolet index forecast 1997. *Meteorol. Appl.*, 6, 241-251.
- Lemus-Deschamps, L., Rikus, L. S.Grainger, Gies, P. Sisson, J. and Li, Z., 2004: UV Index and UV dose distributions for Australia (1997-2001). *Aus.Met.Mag.*, 53, 239-250.