OpenDA applications

OpenDA

Monitoring Air Quality over the North Sea

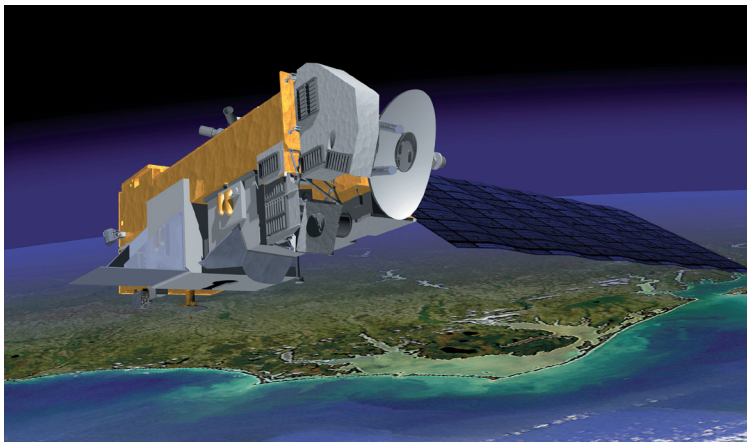

Figure 1: the AURA satellite carrying the OMI instrument

Shipping emissions and air quality

Shipping is a major source of air pollution. According to one investigation, sulphur emissions from ships are the cause of sixty thousand deaths worldwide each year. Therefore, the International Maritime Organization has decided that within so called Emission Control Areas only relatively clean fuel may be used. To determine whether ships comply with this directive, the air quality over Emission Control Areas (in particular the North Sea) should be monitored.

The IMPOSE project

A consortium of BMT ARGOSS, KNMI and VORtech has received a grant from the Dutch Agency for Aerospace Programs, NSO, to develop a system that can monitor the air quality over open sea. The monitoring system is based on satellite observations from the OMI and SCIAMACHY instruments. The OMI instrument provides information on for example NO2 with a full global coverage. The data is available within a single day. However, these observations only provide total amounts of trace gas in the air column, i.e. without vertical resolution. Also, satellites deliver only relatively sparse observations as they fly over the relevant zone only once every 24 hours and clouds may inhibit observations. In order to get both realistic time-interpolation and vertical resolution, the observations are combined with the French Open Source atmospheric chemistry model CHIMERE. OpenDA is the platform that is used for this combination.

The project is challenging because a lot of questions need to be addressed. One issue is the choice of data-assimilation method. As CHIMERE is a computationally demanding model, the data-assimilation method should be highly efficient to avoid excessive computation times. Also, the uncertainty modeling gives rise to a lot of considerations. The desire to get insight in the shipping emissions in particular complicates this issue.

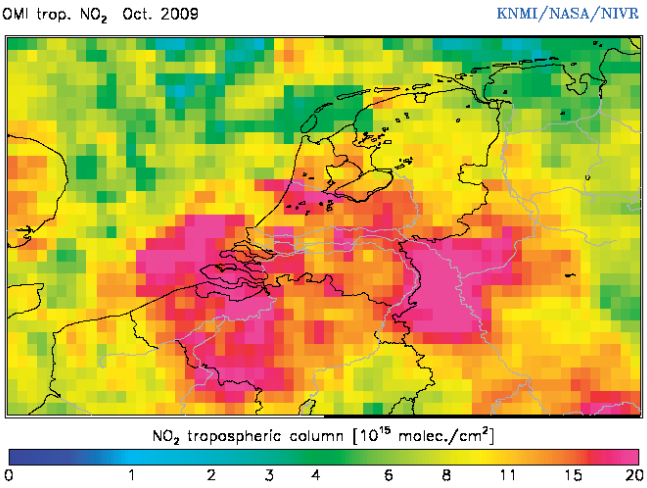

Figure 2: NO2 concentrations in the lower part of the atmosphere as observed by the OMI instrument aboard the AURA satellite, averaged over the month October 2009. The original (non-averaged) data is input to the IMPOSE system. Picture obtained from the Temis website (www.temis.nl).

Results

A working data-assimilation system has been created that assimilates satellite observations in the CHIMERE model. Small modifications to the CHIMERE code had to be made for OpenDA, but such modifications would have had to be made for any other approach to data-assimilation as well. In fact, alterations to the CHIMERE code would have been much more extensive if data-assimilation had been coded straight into the model. The parallel-computing ability of OpenDA allows the use of large clusters to keep the runtime within acceptable limits. As the OpenDA framework is highly modular, it is a significant asset for doing experiments to find the right data-assimilation configuration.

Conclusions

OpenDA is a powerful environment for data-assimilation with large scale models and satellite observations. It can be used to build an operational monitoring system and to configure it such that optimal results can be obtained.

References

www.openda.org