Encouraging Experiences from the use of OpenIFS by Masters Students at the University of Reading

R. S. Plant and S. L. Gray: 14 June 2017.

The OpenIFS programme has allowed the Integrated Forecasting System (IFS) to be made available to external institutes for both research and teaching purposes. At the University of Reading we have been experimenting with its use as a teaching tool for Masters-level students and have been encouraged by the enthusiasm of and benefits for students. It has worked particularly well for intensive small-team projects. We intend to continue developing and innovating our teaching using the model, and to expand its use. Here we describe some of our experiences with OpenIFS, with a focus on the team project.

For one week in February, our Masters students take a break from their normal classes and collaborate in groups of three or four to delve into a research topic. One aim is to build up some confidence and experience in advance of summer dissertation work on individual projects, but the week also supports the development of team-working skills and provides a chance to try something new and different from the rest of the syllabus. We offered two OpenIFS team projects in 2016 and again in 2017 and were oversubscribed, with 11 of the 34 students naming these as their first choice this year.

Each project focussed on a case study of an intense extratropical cyclone: one on storm Nina, a "bomb" event from 10 January 2015, and the other on storm Gertrude, which produced strong winds along the Scandinavian coast on 29 January 2016. On the Monday morning, all of the students were supported to run a 2-day control simulation for their case, and to view and explore their own output using metview. We wanted to find a good balance between students experiencing the process of running a numerical weather forecast, while not overburdening them with a long process of unix environment configuration and technical instruction. In 2016, we perhaps did make the process over-technical and some students were not fully up and running until the end of the day. A more judicious use of scripting this year enabled everyone to get started quickly and kept the enthusiasm high. All of the students gained a good sense of achievement from the hands-on use of a complex forecasting model, a type of model that they had previously only learnt about in traditional lecture settings.

For the remainder of the week, the students assessed the meteorology of their case, making use of the simulation results and any literature and observations that they could find. There was a daily meeting with the supervisor to review progress and share ideas and, at the end of the week, each team co-wrote a report and gave a 20-min presentation of the findings to their peers. The teams were required to devise, perform and assess further experiments with the OpenIFS to deepen their understanding. This year, the group studying storm Nina hypothesized that latent heat release was an important factor in its explosive development and tested this by setting larger or smaller values for the latent heat of vaporisation (Figure 1). The group studying Gertrude focussed on the effects of boundary-layer friction on the strong near-surface winds: in one experiment they switched off the vertical diffusion entirely and thereby convincingly demonstrated to themselves that friction is an important control on storm development (Figure 2).

Student comments this year included *"I really enjoyed using OpenIFS in the Team Project. I've gained skills other than in reading and evaluating research, and personally it's something I would be keen to use in the future, if there's an opportunity to do so. Seems like there's a lot of scope with the model!" and "Personally, I really valued our chance to use OpenIFS, especially as my goal is for a career in forecasting".*

Some students have also been keen to use OpenIFS for dissertation projects, and there are three such projects ongoing over summer 2017, following on from one each in summer 2015 and 2016. Two of the three students who chose dissertation projects using OpenIFS this summer are among the eight students who used it in their team project. The positive responses from students are encouraging us to keep expanding the use of OpenIFS, and there is increasing interest amongst the other academics to do so as well. For the 2017/18 year, there are plans to introduce hands-on modelling for many more of our students by incorporating some OpenIFS work within an MSc module on Forecasting Systems and even within a final-year undergraduate module on Numerical Weather Prediction.

We are very grateful for the invaluable support and advice of Glenn Carver of ECMWF in the use of OpenIFS, and also to Maria Broadbridge (Reading) for installation of the model on our local unix cluster and technical support for its use.

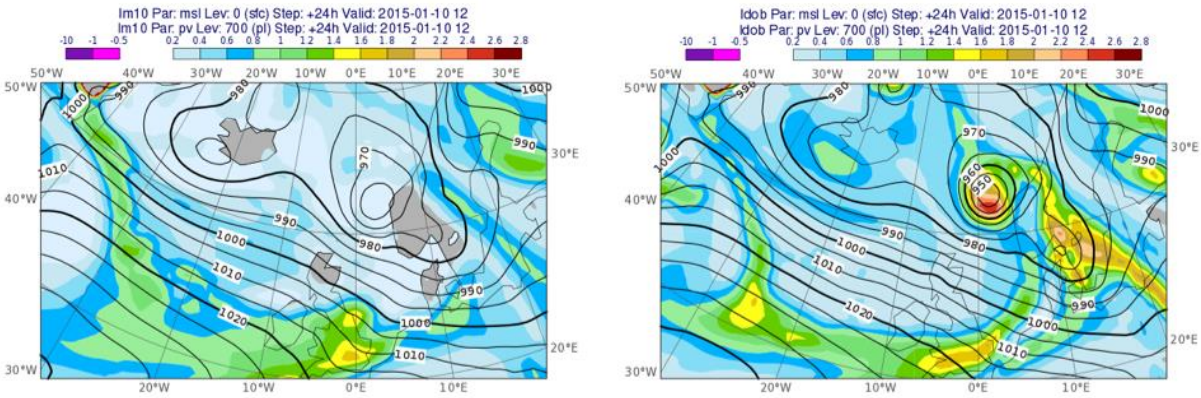

Figure 1: Mean sea-level pressure (contours) and 700-hPa potential vorticity (shaded) for simulations of storm Nina with (left) 10% of and (right) double the default latent heating. Both plots are at the time of the peak intensity of the storm.

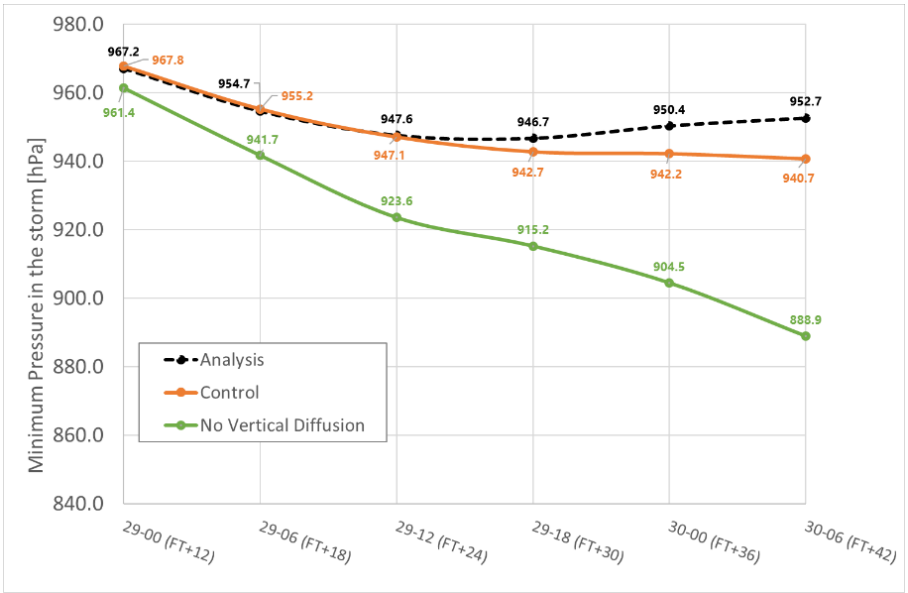

Figure 2: Time series of the mean sea-level pressure at the centre of storm Gertrude from 00 UTC 29 to 06 UTC 30 January 2016 in the analysis (black dashed line) and as simulated by the control configuration of the model (orange line; T+12 to T+42) and a simulation without vertical diffusion (green line).