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Geoscientific Model Development
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Editorial: The publication of geoscientific model developments v1.0

GMD Executive Editors*

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Abstract. In 2008, the first volume of the European Geosciences Union (EGU) journal Geoscientific Model Development (GMD) was published. GMD was founded because we perceived there to be a need for a space to publish comprehensive descriptions of numerical models in the geosciences. The journal is now well established, with the submission rate increasing over time. However, there are several aspects of model publication that we believe could be further improved. In this editorial we assess the lessons learned over the first few years of the journal's life, and describe some changes to GMD's editorial policy, which will ensure that the models and model developments are published in such a way that they are of maximum value to the community.

These changes to editorial policy mostly focus on improving the rigour of the review process through a stricter requirement for access to the materials necessary to test the behaviour of the models.

Throughout this editorial, "must" means that the stated actions are required, and the paper cannot be published without them; "strongly encouraged" means that we encourage the action, but papers can still be published if the criteria are not met; "may" means that the action may be carried out by the authors or referees, if they so wish.

We have reviewed and rationalised the manuscript types into five new categories. For all papers which are primarily based on a specific numerical model, the changes are as follows:

– The paper must be accompanied by the code, or means of accessing the code, for the purpose of peer-review. If the code is normally distributed in a way which could compromise the anonymity of the referees, then the code must be made available to the editor. The referee/editor is not required to review the code in any way, but they may do so if they so wish.

– All papers must include a section at the end of the paper entitled "Code availability". In this section, instructions for obtaining the code (e.g. from a supplement, or from a website) should be included; alternatively, contact information should be given where the code can be obtained on request, or the reasons why the code is not available should be clearly stated.

– We strongly encourage authors to upload any user manuals associated with the code.

– For models where this is practicable, we strongly encourage referees to compile the code, and run test cases supplied by the authors where appropriate.

– For models which have been previously described in the "grey" literature (e.g. as internal institutional documents), we strongly encourage authors to include this grey literature as a supplement, when this is allowed by the original authors.

– All papers must include a model name and version number (or other unique identifier) in the title.

It is our perception that, since Geoscientific Model Development (GMD) was founded, it has become increasingly common to see model descriptions published in other more traditional journals, so we hope that our insights may be of general value to the wider geoscientific community.

1 Introduction

Over the last 10 to 20 yr, the scale and complexity of computer modelling tools used by the geoscientific community has become such that it is no longer practical to describe fully models in papers whose principal aim is the presentation of scientific insights obtained from numerical experiments. Additionally, the normal peer-review process of standard geoscientific journals tends to emphasise the scientific results at the expense of the technicalities of the model description. Thus, around 2005, the peer-reviewed geoscientific literature typically contained little more than the most cursory

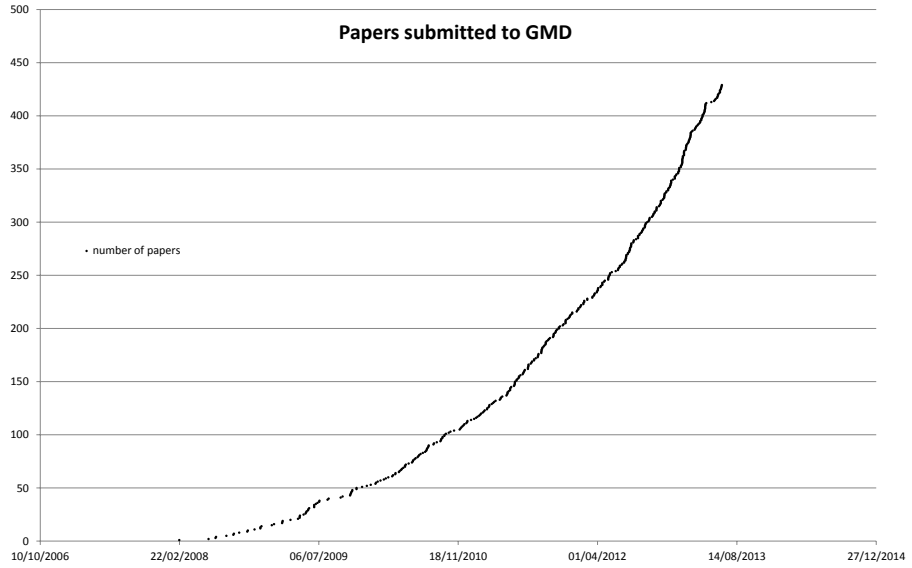

Fig. 1. The total number of submissions received by GMD since the first submission, as of 24 June 2013.

overviews of model development, or its mathematical and numerical formulation. Some models were described in detail in internal documents of research laboratories, but these could be hard to access and be of variable quality. Publication of model descriptions is vital if scientific reproducibility, and hence credibility, is to be maintained. It was in this context that a group of scientists, now the executive editors of GMD, approached the publications committee of the European Geosciences Union (EGU) in 2007 with the idea for a new journal. The committee responded positively and thus GMD was born, with the first paper (Matsumoto et al., 2008) published in August 2008.

Journal submissions have grown steadily since 2008 (see Fig. 1), covering a wide range of sub-fields in the geosciences. Our team of topical editors continues to expand as new specialisms are sought. The Institute for Scientific Information (ISI) listing of the journal was attained two years after start-up, and the ISI impact factor stands at 5.030 for 2012 (up from 3.237 for 2011). The journal is also indexed in Scopus.

Much of the motivation for GMD came from the climate sciences. Climate models had become incredibly complex, but were not always being thoroughly documented. There was the perception that this could have ramifications in the highly politicised world of climate science, given the impact of model simulations on the wider debate. This is evidenced by initiatives such as the Clear Climate Code, which aim to encourage publication of climate codes (Kleiner, 2011). This general trend continues with recent moves by European governments to demand open access publication of government-funded research (for example, in the UK: BMJ editorial, 2012), and by calls for clear publication of all numerical models in the peer-reviewed literature (Ince et al., 2011). This general trend towards openness and accountability has probably contributed to the growing profile of GMD.

At the outset, the optimum processes and requirements for publication of model developments were unclear, and we deliberately adopted an open and flexible editorial policy, in the expectation that the best practice would emerge over time. In the years since GMD was founded, it has become clear that some aspects of the journal work better than others, and that the criteria for publication could be usefully modified. GMD already leads the field of model publication, with its emphasis on version control, a flexible supplement, the structure of special issues (see Appendix B), and its general framework for model descriptions. We observe that it is no longer so difficult to publish models in "standard" geosciences journals, even if these are not always open access (e.g. Gent et al., 2011). In this context, here we aim to share our experience and make suggestions and recommendations for future good practice in publishing model descriptions, with the intention of providing useful information on general applicability throughout geoscientific publishing.

We expect the criteria for good practice in the publication of model development to continue to evolve, and thus name this version of the editorial as "version 1.0". We include in the Supplement a copy of the original GMD "white paper", which is essentially version 0.1 of this present editorial.

In Sect. 2 we discuss the importance of publishing model developments, and the benefits obtained by doing so. In Sect. 3 we outline the revisions to the publishing framework, illustrated by examples of published GMD papers. In Sect. 4 we summarise the progress made and look forward to the future. Furthermore, in the Appendices, we provide the current description of the manuscript types, and the current GMD publication guide, which

includes useful information for GMD editors, referees, and authors. We anticipate updating this information as the need arises: the most recent versions can be obtained from http://www.geoscientific-model-development.net/submission/manuscript_types.html and http://www.geoscientific-model-development.net/publication_guide.pdf.

2 The motivation for the publication of model development

Here we elaborate on the reasons why models and model developments in the geosciences need to be fully described in peer-reviewed publications, and the benefits that are obtained by doing so.

2.1 Reproducibility

One of the foundations of the scientific process is reproducibility of published results. If models are not fully described and published, then there is no way for other scientists to replicate the findings.

To attain the goal of reproducibility, the underlying science and numerical solutions employed in geoscientific models need to be described. Since full description of all the numerical schemes is often impractical for large codes, the model code itself and the manual for the precise model version described need to be made available.

It is important to understand that exact "bitwise" reproducibility is not always readily achievable due to variations caused by different compilers and computer architectures (Monniaux, 2008). Thus the level of descriptive detail required by GMD must be sufficient for "scientific reproducibility". This means that the results may differ at a level expected due to compiler and computer architecture differences, but must not materially affect the scientific conclusions obtained. For example, for a climate model, this would be the expectation that the "weather" of a model was not reproducible, but that the time-averaged "climate" was reproducible to an appropriate level of accuracy given the length of the simulation and the interannual variability.

2.2 Traceability

Complex geoscientific models are almost continually under development and improvement. If model versions are not periodically published, then this process can become progressively more haphazard and the code can become difficult to maintain. In the worst cases, papers concentrating on scientific results have cited model description papers or technical reports which correspond to model versions far removed from the one actually used.

In GMD, online special issues (see Appendix B) are used to allow authors to link together papers documenting updates, bug fixes and different versions or aspects of the development of the same model. This allows the process of model development to be fully documented. See for example the special issue of the FAMOUS model, available at http://www.geosci-model-dev.net/special_issue15.html.

2.3 Transparency and access

In the past, model developments were sometimes published in internal institutional documents, which may be difficult for external users to obtain. By contrast, GMD (as with all EGU journals) is an open access journal: the open access nature of GMD allows all researchers to learn from the advances made by others. A concrete reference describing past model developments enables future researchers to explore and build on the fundamentals of the models more effectively. Thus the establishment of open access, with readily available peer-reviewed model developments, has the potential to improve the level and efficiency of model development worldwide. Model development represents a significant investment, often of public funds. Thus it is important not only that the model development process is properly documented, reviewed and accessible, but also that the model itself continues to be accessible to the wider scientific community for many years to come.

2.4 Peer-review

Internal reports are often not peer-reviewed, and remain part of the "grey literature". In the cases that they are reviewed, this is almost exclusively done internally; as such they do not undergo external scrutiny.

Unlike internal reports, GMD papers undergo a peer-review process, which establishes the criteria for full publication of model developments. Submitted code has not itself been peer-reviewed by GMD, but, as one of our new initiatives, we will require that referees and editors obtain the model code, and encourage them to execute test cases where practical.

An important side-benefit of peer review is that scientists for whom model development is a significant part of their work can now have their achievements and innovations properly recognised.

3 Revised publishing framework: manuscript types

Originally the executive editors envisaged eight GMD manuscript types, to cover the different aspects of model development that are not usually published in the more conventional journals. We have found that, in practice, some types are little used, and there is sometimes confusion amongst authors as to which category is the most appropriate. Therefore, we consider it appropriate to now rationalise and clarify the manuscript types, and the peer-review criteria for each type. The number of manuscript types will now be reduced to five. An analysis of the previous submissions to the journal reveals that the majority of papers

in GMD fall into the "Model Description" category, with the other papers being roughly evenly split between three other types. We discuss the evolution of the manuscript types in the subsections below, and the current fully revised framework is included in Appendix A. The latest version of the manuscript-type description will be continually updated at http://www.geoscientific-model-development.net/submission/manuscript_types.html.

In the case of some of the manuscript types, the new requirements (see summary in Abstract) are more demanding than those currently required by most GMD editors. However, now that the journal is fully established, we believe it is appropriate to revise our editorial policy to encourage and maintain good practice further in the publication of geoscientific models.

3.1 Model Description papers

The main focus of GMD is publishing model descriptions. According to the original framework, this may include the underlying science of the model, details of numerical schemes, examples of model output, user manuals and source code. The original intention was to open up possibilities for ways of publishing models, rather than to give a prescriptive set of demands, which some authors might find unreasonably onerous or even impossible to fulfil. Indeed we find that few, if any, submissions have fulfilled all the possible criteria.

A more common approach to publishing models in GMD has been the publication of new versions of existing models, new modules to be coupled into existing models, or merging or coupling of existing models. Thus full model descriptions and components/frameworks will, from now on, be combined into a single Model Description manuscript type. Papers of this type which have been published in GMD often clearly and thoroughly document the changes compared to previous model versions (e.g. Smith et al., 2008; Sander et al., 2011). Although they tend to stop short of very detailed descriptions of numerical schemes, they may include detailed equations describing the underlying science (e.g. Heus et al., 2010). While this pragmatic approach is fully understandable – it would indeed be a mammoth task to describe fully a state-of-the-art general circulation model – the result is that many of the papers still rely on a network of less rigorously published model descriptions and internal documents. As some authors have already done (e.g. Phipps et al., 2011), we now strongly encourage any non-peer-reviewed literature (such as internal documents), on which the Model Description papers depend to be included in a supplement, in order that this information is readily available to the readers.

Detailed and comprehensive descriptions of the model numerics are generally not practical within a typical GMD Model Description paper, and papers specifically addressing such issues are now included in the Technical, Development and Evaluation manuscript type (see Sect. 3.2).

Model Description papers should generally include examples of model output, and sometimes more in-depth evaluations. Indeed experience shows that papers which present purely theoretical ideas, without the supporting work to show that the models work in practice, have been rejected through the peer-review process. However, papers focussing solely on model evaluation belong in the Technical, Development and Evaluation manuscript type.

The present status quo is, therefore, that authors are making good use of GMD to describe their present progress in model development, but are not generally publishing older historical versions of their models, even if these older versions are still in use by the community. In this context the availability of model code is necessary in order to maintain transparency. However, we find that actual model code is very rarely uploaded. Sometimes this may be due to legal restrictions or licensing agreements, but it also seems that authors are somewhat unwilling to make their code freely available. We have made a number of changes to our framework to address this situation. It is strongly encouraged that Model Description papers include the manuals and code. If the code is not included but is available in the public realm, then the precise means to obtain the code must be included in manuscript. Furthermore, there must exist an archive of the precise version of the model described in the paper, and a link to the final GMD paper (or the PDF file itself) should be included in that archive. Previously, model code was not subject to any form of peer review when submitted to GMD, but we now require that the method of obtaining the code is tested. Furthermore, the ease of compiling the model, and running simple example test cases may be assessed by the editor and/or referees. Referees are also free to comment on the code itself, if they wish.

Nevertheless, we recognise that there may be circumstances when the model code cannot be made publicly available for legal reasons (copyright or licensing restrictions), or the authors do not wish to make the code publicly available. If this is the case, the reasons must be explained clearly in the paper. However, even when the code cannot be made available publicly, it must be made available to referees and editors for the purpose of the review: this is a change from our previous policy. In these cases, which we anticipate will be rare, in order to preserve the anonymity of the referees, the editor should forward the code to the referees, or look at it himself/herself if necessary.

The unique special issue structure (see Appendix B) in GMD enables papers describing aspects of the same model to be linked together. The special issue typically has no closing date, and previously published papers from any EGU journal may be retrospectively added. Indeed it is not uncommon for the special issue to be put together after two or three papers about a model have been published. The papers in a special issue can be a mixture of manuscript types and thus may typically include descriptions of different components, version updates, evaluations, and detailed numerical studies. As they

fall within the scope of standard GMD papers, all special issue papers are edited by regular GMD topical editors, rather than guest editors.

Hitherto, model names and version numbers/tags have not always been included in all GMD Model Description paper titles. Indeed, occasionally the version is not even specified in the manuscript. It is, however, of the utmost importance that this detail is included to enable model evolution to be traced through the literature. This becomes even more important when papers are later combined into a special issue. Consequently, we specify that Model Description papers must include a model name and version number (or other unique identifier) in their title.

3.2 Technical, Development and Evaluation (TDE)

Since the inception of GMD, there have been a large number of submissions in the manuscript type called "Development and Technical". However, on closer inspection we find that these were often descriptions of model components: such component descriptions now fall explicitly into the Model Description category. We have now combined the previous types "Development and Technical" and "Model evaluation" into the single type "Technical, Development and Evaluation".

Under our revised editorial policy, the criteria for "Development and Technical" papers are largely unchanged. They describe technical developments relating to model improvements such as the speed or accuracy of numerical integration schemes (e.g. Hanappe et al., 2011) or new parameterisations, numerical solutions for processes represented in models, and in-depth evaluations of already published models. Also included are papers relating to technical aspects of running models and the reproducibility of results (e.g. assessments of their performance with different compilers, or under different computer architectures). Moving beyond the numerical aspects of model output to validation and verification of models, in the new publishing framework, we include model evaluations in this manuscript type. Model description papers are also expected to contain some model evaluation, but this should not be the main focus of those papers, and papers focussing on evaluation should be submitted within the TDE manuscript type. Authors are strongly encouraged to provide code to perform any test cases described in the paper and to include electronic versions of model output where possible.

3.3 Model Assessment Methods

The manuscript type intended for development of data analysis and visualisation methods has not proved popular, and the benchmarking development manuscript type has frequently been confused with model evaluation. Therefore, here we combine these two types, and make clear that this paper type is about development of methods and software for different kinds of model assessment, rather than the assessments themselves. In practice, papers of this kind have frequently been submitted as Technical and Development papers.

Model Assessment Methods include papers which discuss work on developing new benchmarks for assessing model performance (e.g. Grewe et al., 2012), or novel ways of comparing model results with observational data (e.g. Hemmings and Challenor, 2012). Also included are discussions of novel methods for data analysis or visualisation with relevance to geoscientific modelling (e.g. Kaye et al., 2012), or the application of existing techniques to this field. These papers may be theoretical, in which case an example implementation should be provided as a supplement, or may be based on the description of a full-fledged software tool.

If the paper involves a description of a software tool, then, as for Model Description papers, the name and version number must be supplied in the title, and the same requirements about code availability apply. Examples of input and output to the software should also be supplied where possible.

3.4 Model Experiment Description

This manuscript type remains largely unchanged, and it is for descriptions primarily of model configurations and experimental design rather than model code. Some overview of models may be included, but the main aim is to document in detail the boundary conditions and model set-up for particular experiments. The scientific background of the experiment should be outlined and discussion included of why particular choices were made in the experiment design. The description should be sufficiently complete so that readers may repeat the experiments using their own models. It is therefore required that the boundary conditions are made available. These should be uploaded unless they are too large (currently the limit is 50 MB). In order to maintain transparency, the boundary conditions should be given a version number and uniquely identified with the GMD manuscript. Updates to the protocol may then be published as separate GMD papers and linked to the original paper by means of a special issue (e.g. Schmidt et al., 2011, 2012).

Most of the papers so far submitted in this type have described model intercomparison projects (e.g. Haywood et al., 2010, 2011). Papers such as these should highlight differences in the application of the protocol by the different groups. Configurations and even initial results of individual models within an overall project can also be included in this manuscript type (e.g. Bragg et al., 2012), as well as descriptions of the methodology of experimental procedures such as ensemble generation. As for Model Description papers, these papers provide important reference works for future scientific endeavours.

3.5 Corrigenda

Corrigenda describe corrections to previous GMD papers.

4 Summary

GMD was established with the goal of enabling publication of geoscientific models. The editors felt there was a need for this, but the extent to which it would appeal to the wider geoscientific community was not clear. The editors set guidelines for review criteria, suggested new ways of using a supplement and special issue features, and also encouraged publication of various other aspects of model development, such as model evaluation, analysis methods and experiment description. The journal has proved successful, but some revision of the publication criteria is required in order to pursue the goal of using the peer-review system to make model development publication reproducible, traceable, transparent and accessible.

Very few of the Model Description papers published presently in GMD fulfil all the possible review criteria originally laid down by the editors. In hindsight it is apparent that full completion of all the criteria above is almost impossible within a reasonable length paper. However, the original criteria were essentially a wish list compiled by the editors who, at the time, worked in an environment where any detailed publication of model development through the peer-review system was practically impossible. Thus the editors have, until now, been fairly generous in the demands laid on authors.

It is now time to consolidate and revise our approach in order to ensure that the peer review remains at a high standard. While we expect the field of model development to continue to evolve, we have revised our publishing framework so that we can more strictly enforce those criteria required for good publication of model development while loosening some of the less practical criteria (a summary of the proposed changes is given in the Abstract).

Readers should consult the Appendices for more details of the new publishing framework, and the publication guide, which will be continually updated at http://www.geoscientific-model-development.net/submission/manuscript_types.html and http://www.geoscientific-model-development.net/publication_guide.pdf.

There is little doubt that the societal trend towards greater openness in the results obtained from publicly funded science has contributed to the success of GMD so far. The stage has not yet been reached where all model descriptions, developments and experiments are described in the peer-reviewed literature. We may, however, expect this trend to continue, and hope that soon such publications will become commonplace throughout the peer-reviewed literature.

Appendix A

Framework for GMD manuscript types v1.0

An up-to-date version of this framework is maintained at http://www.geoscientific-model-development.net/submission/manuscript_types.html.

In the following, "must" means that the stated actions are required, and the paper cannot be published without them. In addition, "should" or "strongly encouraged" means that we encourage the action, but papers can still be published if the criteria are not met. Lastly, "may" means that the action may be carried out by the authors or referees, if they so wish.

A1 Model Description papers

Model Description papers are comprehensive descriptions of numerical models which fall within the scope of GMD. The papers should be detailed, complete, rigorous, and accessible to a wide community of geoscientists. In addition to complete models, this type of paper may also describe model components and modules, as well as frameworks and utility tools used to build practical modelling systems, such as coupling frameworks or other software toolboxes with a geoscientific application.

- The main paper must give the model name and version number (or another unique identifier) in the title.
- The publication should consist of three parts: the main paper, a user manual, and the source code, ideally supported by some summary outputs from test case simulations.
- The main paper should describe both the underlying scientific basis and purpose of the model, and overview the numerical solutions employed. The scientific goal is reproducibility: ideally, the description should be sufficiently detailed to allow in principle the reimplementation of the model by others, and so all technical details which could substantially affect the numerical output should be described. Any non-peer-reviewed literature on which the publication rests should be uploaded as a supplement.
- The model web page URL, the hardware and software requirements and the licence information should be given in the text. If papers describe subsequent development on a paper already published in GMD, they will be electronically linked to the previous version(s) in a special issue, and an overview web page will be created.
- The model description should be contextualised appropriately. For example, the inclusion of discussion of the scope of applicability and limitations of the approach adopted is expected.

- Examples of model output should be provided, with comparison to standard benchmarks, observations and/or other model output included as appropriate. In this respect, authors are expected to distinguish between verification (checking that the chosen equations are solved correctly) and validation (assessing whether the model is a good representation of the real system).
- All papers must include a section at the end of the paper entitled "Code availability". In this section, either instructions for obtaining the code (e.g. from a supplement or from a website) should be included, or a contact point should be given where the code can be obtained on request; or the reasons why the code is not available should be clearly stated.
- In cases when the source code is available but not in a supplement, an archive should exist which contains the precise model version described in the paper. After the paper is accepted, this archive should be updated to include a link to the GMD paper. Preferably, a digital object identifier (DOI) should be assigned to the archive, consistent with the Copernicus data policy (http://publications.copernicus.org/services/data_policy.html).
- When copyright or licensing restrictions prevent the public release of model code, or in the cases when authors do not wish to allow access to the code, editors and referees must be given access to the model code for the purpose of the review (whilst preserving the anonymity of the referees).
- The source code and user manual will not be formally reviewed, although during the review process, the ease of model download will be assessed. In addition, compilation and running of test cases may be assessed. Reviewers are free to make general comments on the code if they so wish.

A2 Technical, Development and Evaluation papers

These papers describe technical developments relating to model improvements such as the speed or accuracy of numerical integration schemes as well as new parameterisations for processes represented in modules, and in-depth evaluations of already published models. Also included are papers relating to technical aspects of running models and the reproducibility of results (e.g. assessments of their performance with different compilers, or under different computer architectures). Authors are strongly encouraged to provide code to perform any test cases described in the paper.

A3 Model Assessment Methods papers

Model Assessment Methods include work on developing new benchmarks for assessing model performance, or novel ways of comparing model results with observational data. Also included are discussions of novel methods for data analysis or visualisation with relevance to geoscientific modelling, or the application of existing techniques to this field. These papers may be theoretical, in which case an example implementation should be provided as a supplement. They may also be based on the description of a full-fledged software tool. Descriptions of software tools will be subject to the same criteria as model descriptions (version must be identified in the title, code supplied for the peer-review process, etc).

A4 Model Experiment Description papers

Model Experiment Description papers contain descriptions of standard experiments for a particular type of model, such as a model intercomparison project (MIP). Configurations and overview results of individual models can also be included, as well as descriptions of the methodology of experimental procedures such as ensemble generation. Such papers should include a discussion of why particular choices were made in the experiment design, and sample model output. In the case of papers describing MIPs, they should explain any specific project protocols, should highlight differences in the application of the protocol by the different groups, and should include sufficient descriptions/figures of model results to give an overview of the project. For MIPs in particular, the same version control criteria apply as to Model Description papers (e.g. boundary conditions should be given a version number and uploaded, and links to the GMD paper included on the MIP website).

A5 Corrigenda

Corrigenda correct errors in preceding papers. The manuscript title is as follows: Corrigendum to "TITLE" published in "JOURNAL, VOLUME, PAGES, YEAR". Please note that Corrigenda are only possible for final revised journal papers and not for the corresponding Discussion Paper. Corrigenda should only be used for correcting errors in the papers, not for those occurring in the model development being described. Correction of actual errors in a model, model development or experiment protocol should be published as regular submission within one of the standard manuscript types, and form part of a model special issue.

Appendix B

Publication guide v1.0

This Appendix describes current processes and best practice in publication in GMD. It is liable to change as EGU and the publisher, Copernicus Publications, develop their publication processes. An up-to-date version of this guidance is

maintained at http://www.geoscientific-model-development.net/publication_guide.pdf.

General guidance for editors is available from http://www.geoscientific-model-development.net/review/obligations_for_editors.html, for authors from http://www.geoscientific-model-development.net/submission/manuscript_preparation.html, and for referees from http://www.geoscientific-model-development.net/review/obligations_for_referees.html. Here we give some GMD-specific guidance in addition.

All authors, referees, and editors should make themselves aware of the journal manuscript types: http://www.geoscientific-model-development.net/submission/manuscript_types.html.

B1 Initial submission

On initial submission, editors of EGU open access journals read the manuscript to check that it is within the journal's scope, according to the manuscript types: http://www.geoscientific-model-development.net/submission/manuscript_types.html. In addition, editors check that it is of an appropriate quality to enter the peer-review process. For a GMD paper, a few further checks need to be made at this stage.

The editor should ensure that the appropriate information is included in a supplement, commensurate with the journal requirements, defined in the manuscript types: http://www.geoscientific-model-development.net/submission/manuscript_types.html.

In cases when licensing or copyright restrictions prevent public release of model code, or when the authors do not wish to make the code public, the editor should contact the authors to confirm that they are able to provide access to the model code for the process of peer-review, which the editor will then pass on to the referees. The editor may need to liaise with the authors to make the model code available to the referees without compromising the referees' anonymity.

For those cases when authors do not wish to make the code available once the manuscript is published, the reasons for this must be clearly stated in the manuscript.

Editors may email the authors personally to ascertain the situation, but any issues can usually be effectively resolved by sending the paper for revision with editor review. Assuming these are dealt with adequately, the paper will be accepted for publication in Geoscientific Model Development Discussions (GMDD). Editors should reject papers that fail to comply with these criteria.

In addition, editors should read the similarity report. With GMD papers, it is relatively common for authors to copy, edit and then include text from other publications about the same model. This does not in itself indicate plagiarism, but in this case it is important that the original publication is cited as the correct source of the material.

B2 Referee call

After accepting a paper for publication in the Discussion forum of the journal (GMDD), where it undergoes public peer review, the editor is required to call referees.

The usual number of referees for a GMD paper is two. It is expected that these researchers should be from different institutions, and that they should both be independent of the editor. Editors are encouraged to use internet resources to find appropriate referees outside their usual circle of collaborators. In the case of multi-component models spanning more than one sub-field of geoscience, more referees may be called to review different components of the model. GMD covers the whole field of geoscience, so it is not uncommon for editors to edit papers somewhat out of their main field of expertise. In such cases, it is recommended that there should be three referees.

When a paper is well within the field of interest of the editor, they may choose to review the paper themselves, but should only do so when two other referees are already in place, or when multiple referee calls have failed to find a second referee.

B3 Open-access peer-review period

The call to the referees goes out when the paper is published in GMDD, after which the paper remains in public peer-review for eight weeks. During this time, the referees post their reviews, which appear in the discussion forum (GMDD), and also fill in a checklist indicating the quality of the paper. In addition, other scientists or members of the public may post comments, and the authors or editor may also add comments.

One idiosyncrasy with the system is that the second referee may read the first review and other comments before forming his/her own opinion, which can result in his/her review being largely a reaction to the discussion, rather than an independent view of the paper. This may be seen as either an advantage or disadvantage, but editors should be alert to the case of a purely reactive second review and at this point may call another referee, review the paper themselves or include additional comments in an editorial comment.

The review itself should focus on the clarity and rigour of the model description or development, and the extent to which it has been tested. It is not a requirement of a GMD paper that it contains novel scientific discoveries. If necessary, editors should be prepared to intervene and guide authors towards an improved model description. The open-access platform of the journal provides a useful way to issue that guidance in a constructive fashion. In particular, editorial comments published during the interactive discussion can be used to guide the discussion and indicate the progress through peer review. Editorial comments are particularly helpful at the start of the final response period and also when the final decision on acceptance or rejection for GMD is made.

Editors should make sure that someone (either a referee or the editor) has obtained the model or tool code. They may also attempt to compile the model and run test cases where appropriate. In the case of other supplements, it should be downloaded and inspected with available software – for example, the referee may open files in a NetCDF viewer.

In common with other journals, it is expected that editors make their own comments on the manuscript and guide the authors as to which parts of the reviews they should pay particular attention to.

B4 Closed peer-review period

After the first revision is submitted, the current practice with all EGU journals is that the review process is no longer visible to the public (although this may change in the future). The paper may continue through any number of revisions, with or without calls to the same or new referees. When the paper is finally accepted or rejected for GMD, the editor should post a comment in the discussion forum (GMDD), explaining his/her decision, especially in the case of a manuscript which has received conflicting reviews.

Responsibility for the final decision on the manuscript rests with the assigned topical editor, but any difficulties may be referred to the executive editors.

B5 Special issues

GMD allows several papers to be collected together as a special issue. These can be used in the traditional sense, to bring together a set of related papers over a defined time period. However, GMD special issues can be open-ended, and these allow papers describing incremental development of a model to be collected together indefinitely as the model develops. It is worth noting that, due to their online nature, special issues can be created and added to retrospectively. It is also possible to create special issues in collaboration with other EGU journals. For example, this can be used to provide a home for MIP descriptions, with related model outputs in other EGU journals.

To propose a special issue, the authors should contact the executive editors in the first instance. The name of a contact person for the special issue is required. It it important to understand that papers submitted to GMD special issues are handled the same way as "normal" GMD papers: they are handled by the same topical editors and subject to the same editorial process.

Supplementary material related to this article is available online at: http://www.geosci-model-dev.net/6/1233/2013/gmd-6-1233-2013-supplement.pdf.

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