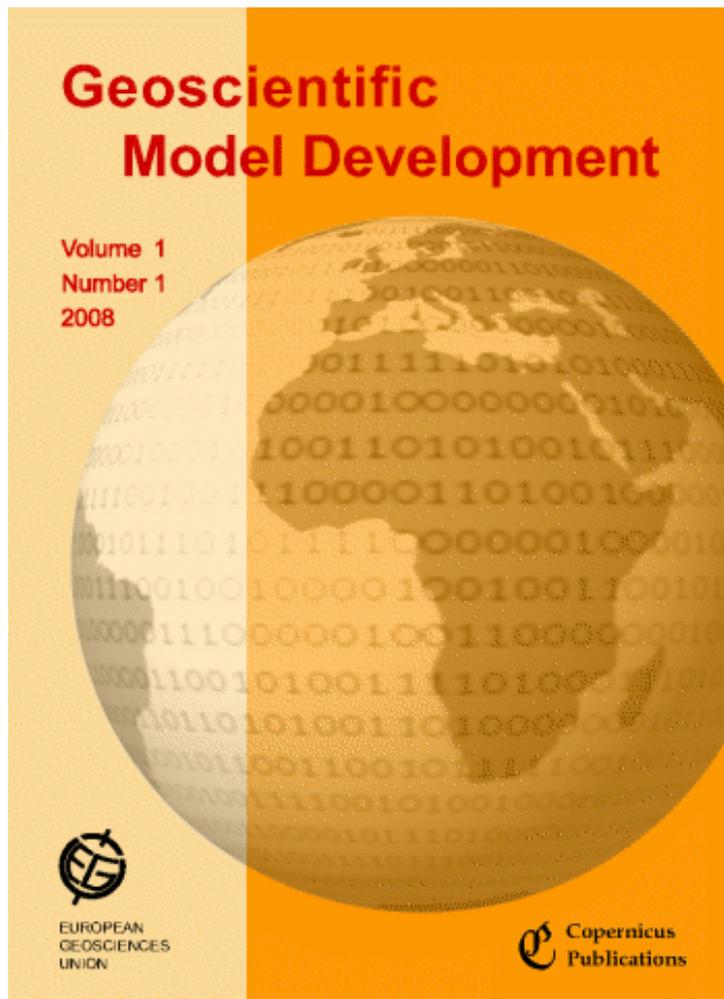


# The new EGU journal

## **Geoscientific Model Development**



Geoscientific Model Development (GMD) is an international scientific journal dedicated to the publication and public discussion of the description, development and benchmarking of numerical models of the Earth System and its components. Manuscript types considered for peer-reviewed publication are: model descriptions, model inter-comparison descriptions, benchmarking papers, and technical papers.

# 1 Introduction

Climate science has risen to significant public prominence in recent years, due to the realisation that anthropogenic climate change threatens far-reaching consequences, both for the planet as a whole, and for society. This has coincided with the development of complex numerical models of the various components of the climate system, enabled by the continuing exponential growth in computing power. Taken together, these last two conditions have made possible the field of Earth System Modelling. In addition to being of intrinsic scientific interest, the outputs of climate and Earth System Models are of interest to policy makers. Therefore, it is of great importance that the whole process of science is undertaken as effectively, rigorously, and as transparently as possible.

Numerical models are the cornerstone of contemporary climate science and Earth System Modelling. Their development is a difficult and time-consuming task; it requires a combination of skills, both scientific, as well as technical. A complex numerical model is rarely ‘complete’; in general, new parameterisations and numerical methods are continually being developed. In addition, models require ongoing maintenance; all complex software can be expected to contain errors, and this is true of Earth System Models and their components as much as anything else.

Current journals in the field of geoscientific modelling (e.g. ‘Ocean Modelling’ or ‘Computers & Geosciences’) focus on scientific results but not on the quality of the model description, or the traceability of incremental model versions. It is clear that our present model for scientific publication does not encourage rigor and transparency in model development. In all the sub-fields involved in Earth System Science, including those areas where the complex interactions between the Earth System components are studied, manuscripts which include comprehensive model descriptions are routinely drastically reduced with many details which may be critical to the results being excluded at the review stage. A common request is that model description be minimised and new scientific ‘novelty’ be maximised. Indeed if there is insufficient novelty then journals are likely to reject the papers as scientifically lightweight (and correctly so, given the journals’ remits).

Yet before scientific discoveries can be made, the models must first be built and tested. In many models, various ingenious techniques are implemented to achieve a ‘working’ model. The results of changing a module, or adding a new component, are often unexpected, and fine-tuning may be required to generate acceptable results. The knowledge gained from these adventures in model development goes largely undocumented. Occasionally the final model version may be published as an internal technical report, yet it is rare to see proper documentation of the techniques used to achieve this, which could really enhance the field of model development. This may lead to a duplication of efforts by others and thus wasted time. Indeed there is little incentive for scientists to spend time making these reports in any way comprehensive. The pressure is always for scientists to produce and publish scientific ‘discoveries’, since this is what drives career progression.

It is with this background in mind that we have created a new journal specifically designed to focus on the description, development and benchmarking of numerical models of the Earth System and its components. In encouraging full publication of Earth System Models we have two main goals. The primary goal is to promote the efficient and effective development of the models, through the clear presentation of the techniques from which all other developers can improve their own models. A secondary goal is to provide increased credibility to the Earth

System Science field by creating a space within which models can be openly presented and critically discussed, and their results reproduced and validated. A welcome side-effect is the formal, peer-reviewed, recognition of the work of Earth System Model developers.

## **2 General description of the journal**

The name of the new journal is ‘Geoscientific Model Development’. It is available on the internet at <http://www.geoscientific-model-development.net>. Here, the abbreviation ‘GMD’ is used from now on.

The main purpose of GMD is to promote model development as a serious and worthwhile activity, by providing a home for papers covering a wide range of aspects of the subject. In particular, we believe the following are currently inadequately provided for in the literature:

- Detailed descriptions of numerical models, covering the processes represented, their mathematical formulation, the numerical methods used, the coding structure, and any other relevant technical information.
- A recognised process for recording the evolution of a model through different versions, with an expectation of being able to distinguish those versions by number or some other label.
- Model benchmarking, including determining the most appropriate benchmarks to use for a given type of model.
- Studies of the dependence of model output and performance on technical considerations.
- A forum for the discussion of best practice affecting all these areas.

## **3 Examples of potential papers**

This section gives some examples of papers which are suitable for publication in GMD. Note that this list is far from exhaustive, and is intended solely to give a flavour of the sort of papers which are considered for publication.

### **3.1 Model description papers**

Model description papers form the backbone of GMD. These describe comprehensively the underlying science behind the models, and also include details often omitted from more traditional papers, such as the numerical schemes employed. The papers should be somewhat more advanced than internal technical reports. For example, the inclusion of discussion of the scope of applicability and limitations of the approach adopted is expected. In order to enable full peer review of the models, evidence of model output should also be provided, with comparison to standard benchmarks, observations and/or other model output included as appropriate. The

publications potentially 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:  
The main paper focuses on the description of the underlying physics and mathematics of the model. In addition, the model description should also include the following items:
  - model name and version number (preferably both in the manuscript title)
  - model home page on the web (URL)
  - system requirements (e.g. PC, workstation, supercomputer)
  - software requirements (e.g. a particular Fortran compiler)
  - license info (e.g. GPL, or code available from authors upon request)
- A User Manual:  
The user manual should contain all information needed for a new model user to install, run, and work with the model. The user manual should be provided by the authors as a separate pdf file. It will be available as an electronic supplement to the main paper. Although the preparation of a user manual is not mandatory, it is strongly recommended.
- The model source code:  
Although not mandatory, it is strongly recommended to include the model source code in the electronic supplement. Although we will not archive large data sets, summaries of model test cases (such as standard benchmarks and statistics) are also welcome.

Model description papers usually also contain an assessment of the model's performance relative to benchmarks, or standard observational datasets. Likely reasons for discrepancies with the data, and improvements/worsening relative to previous versions, should be discussed in some detail.

It is anticipated that subsequent versions of the model, including bug-fixes, will be published in additional papers, and linked to the original model description. For more details, see section 4.2 of this document — Versioning.

For strategies for publication of long established high complexity models, see section 4.3 — Special Issues.

## **3.2 Development papers**

Papers which describe technical developments relating to model improvement are welcome. For example, improvements to the speed or accuracy of numerical integration schemes, or new parameterisations for processes represented in modules (e.g. cloud formation, ocean mixing, biogeochemical processes...). Authors are encouraged to provide code to perform test cases described in the paper. Although some of these topics could potentially find homes in existing journals (e.g. International Journal for Numerical Methods in Fluids), we are not aware of any outlet that covers all of Earth System Science and provides the ability to publish code with test cases.

### **3.3 Benchmarking papers**

Papers are encouraged which discuss work on developing new benchmarks for assessing model performance, or novel ways of comparing model results with observational data.

### **3.4 Technical papers**

GMD also publishes papers related to technical aspects of running Earth System Models, and the reproducibility of results. For example, assessments of their performance with different compilers, or under different computer architectures.

### **3.5 Model inter-comparison project description papers**

In the climate sciences there are now a plethora of MIPs (Model Inter-comparison Projects) such as CMIP, PMIP, C4MIP etc. The aim of these projects is to compare behaviour across a range of models of a certain type by forcing them with common boundary conditions. While the science developed from these projects is readily publishable, reference works which describe in detail the model configurations and experiments are rare. Some information is usually available on the website of the projects but not in a form that is readily accessible to the wider community. These papers would be expected to contain description of the experimental details and the project protocol, including: discussion of why particular choices were made; highlighting of differences in the application of the protocol by the different groups; and including sufficient description/figures of model results to give an overview of the project. Scientific results produced from analysis of the multi-model experiments, as well as detailed results drawn from individual model simulations would be more appropriately published in other journals, for example, *Climate of the Past* for PMIP-type simulations, and *The Cryosphere* for EISMINT-type simulations. The versioning of MIPs can be documented using a similar format as for the model description papers.

## **4 Publication model**

The editorial board of GMD consists of several editors covering the different areas of Earth System Modelling. The editors of GMD are expected to edit about 5 manuscripts per year. Depending on the number of editors and submitted manuscripts, this number may vary.

GMD papers are freely accessible to all via the web ('open access'), and financed through page charges. Page charges are calculated based on the number of pages in the main paper. There is no extra charge for the user manual or model code in the electronic supplement. In the initial phase of GMD, these page charges are waived.

## 4.1 The review process

Like several other EGU journals, GMD papers are published in two stages: First, the manuscript goes to the discussion journal ('Geoscientific Model Development Discussions', GMDD) for public peer review, and after successful completion, a revised paper will be published in GMD (for details of this publication process, see also [http://www.copernicus.org/COPERNICUS/publications/two\\_stage\\_publication\\_concept.html](http://www.copernicus.org/COPERNICUS/publications/two_stage_publication_concept.html)).

In contrast to other journals, the questions asked to the reviewers are slightly different:

- Is the model description solid, and the user manual understandable?
- The production of ground-breaking scientific discoveries from the model are not a review criterion. Instead, the question is whether the model has the potential to perform calculations that will lead to correct and scientifically important results.
- We cannot expect the reviewers to examine the model code in detail or directly verify model output. Bitwise reproducibility of model outputs across a range of platforms is beyond our scope. The goal should be seen as 'scientific reproducibility' rather than 'exact reproducibility': that is, the reviewer should be confident that the model could be constructed to a level which would enable scientifically equivalent results to be generated. Of course, in simpler cases (or with code which is already widely ported) it would be preferable if the code could be directly tested, and the referee will be invited to comment about the code structure and whether the code is well written or not.

## 4.2 Versioning

The electronic publication system of GMD allows model descriptions to be easily updated in a clearly traceable manner. Assuming a standard version of the model has been comprehensively described in GMD in a full model-description paper, the authors will have the possibility to write articles about further model versions. The concept for this is flexible. Small changes such as bug-fixes can be published as a minor paper which cites and is electronically linked to, the original paper. More substantial changes could be treated as a new version of the original 'Major' paper, highlighting the changes. This concept is similar to that of the 'living reviews' journal (<http://www.livingreviews.org/faq.html>), although in our case it is not related to review articles.

Note that the papers about the old model versions are not deleted. Once published, everything is permanently archived and citable in GMD. Different model versions can be grouped together. On the web pages of GMD, it is easy to see which publications refer to the same model, and if appropriate, which refers to the latest version.

There is no intention to enforce a version control system, such as CVS, for the model code. Authors are simply asked to create a zip file of their code and a user manual which will then become the electronic supplement of their paper. Some sample output files can also be archived to aid reproducibility.

### 4.3 Special issues for established models

For high complexity models (such as GCMs), a full model description as a single paper is unlikely to be practicable. Instead, we encourage publication of such models in several papers that are grouped together as a ‘Special Issue’. Such a Special Issue should contain detailed description papers focusing on the individual modules of the model. In addition, the Special Issue should contain an overview paper. The overview paper would be a less detailed version of the model description papers (about 20-30 pages) and succinctly describe the main features of the whole model. The publication of the model code and user manual is still offered and encouraged. Using this system we hope that each complex model develops their own Special Issue with papers describing different aspects of the model. In contrast to Special Issues in other journals, those in GMD will be ‘living’ in that they will continue to grow as a model develops.

This document is available from <http://www.paleo.bris.ac.uk/~ggdjl/GMD/GMD.pdf> and was compiled by:

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