MSc in Data Assimilation and Inverse Modelling in Geoscience (full-time)
For students entering in 2015/6

Awarding Institution:	University of Reading
Teaching Institution:	University of Reading
Relevant QAA subject Benchmarking group(s):	
Faculty:	Science Faculty
Programme length:	12 months
Date of specification:	25/Aug/2015
Programme Director:	
Programme Advisor:	
Board of Studies:	School of MPS PG taught programmes
Accreditation:	

Summary of programme aims

The MSc aims to:
- Provide a foundation of the theory and techniques of data assimilation as applied to the atmosphere, ocean, land surface, the cryo-sphere, hydrology, including groundwater and flooding, traffic modelling and for the oil and gas sector;
- Provide practical experience in the applications of data assimilation;
- Provide an appreciation of the link between theory and application in data assimilation;
- Give an insight into current practice in a variety of areas, bringing in practitioners from industry and government;
- Enhance students' communication and computing skills to a professional level expected by operational and industrial agencies.

Transferable skills

The programme will provide a range of transferable skills in computing and in communication and research skills, through high-level computing at an operation standard, through specific links and experience with industry, and through the diverse range of options available within the programme.

Programme content

The philosophy is that the core of the programme consists of data assimilation-related modules, on methods, mathematical and numerical skills and applications. Optional modules allow students to become familiar with those parts of the Earth system which they would like to know better.

Autumn Term

Introductory module (if required)

Code	Module title	Credits	Level
MTMI0	Elements of numerical analysis	0	7

Compulsory modules

Code	Title	Credits	Level
MAMA14	Stochastic processes	10	7
MTMW12	Introduction to numerical modelling	10	7
MAMB10	Theory and techniques of data assimilation	10	7
MTMG05	Professional Skills (1)		7
MTMG04	Weather and climate discussion	0	7

Optional modules

Code	Title	Credits	Level
MTMG01	Introduction to weather systems	10	7
MTMG02	Atmospheric physics	10	7
MAMNSO	Numerical solution of ordinary differential equations	10	7
MTMW98	Fluid dynamics of the atmosphere and oceans (DAIMG)	10	7

Spring Term

Compulsory modules

Code	Title	Credits	Level
MTMD01	Environmental data exploration	10	7
MTMD02	Operational data assimilation	10	7
MTMD03	Monte-Carlo techniques and particle filters	10	7
MTMG05	Professional skills (2)		7
MTMG04	Weather and climate discussion	0	7

Optional modules

Code	Title	Credits	Level
MTMG38	Remote Sensing	10	7
MAMNSP	Numerical solution of partial differential equations *	10	7
MTMG21	Oceanography	10	7
MTMW14	Numerical modelling of the atmospheres and oceans *	10	7
MTMW20	Global circulation	10	7

* Students may not select MTMW14 if they have chosen either MAMNSO and/or MAMNSP

Summer Term

Compulsory module

Code	Title	Credits	Level
MTMD04	Dissertation	60	7
MTMG05	Professional skills (3)	10	7
MTMG04	Weather and climate discussion	0	7

Optional module

Code	Title	Credits	Level
MAMCMW	Modelling Week	10	7

Notes on module listing

Where a module is taken over more than one term (e.g. MTMG05) the credit weighting is given in the final entry only.

1. Specification for MSc

Autumn and Spring Terms: In addition to the compulsory modules listed above, students must choose 50 credits of level 7 optional modules, consisting of at least 20 credits in each term selected from the list above, or from level 7 modules available elsewhere in the University. Please ensure you check the pre-requisites of each module carefully.

Remainder of the programme:

There is an optional modelling week with applications to data assimilation. Students must complete a dissertation worth 60 credits by mid-August.

total credit value for MSc = 180.

2. Specification for Diploma

Students must complete all compulsory taught modules (60 credits), and then the following two routes are available:
Either:
Students must choose 60 credits of optional modules
Or:

Students must choose 30 credits of optional courses and complete an extended essay worth 30 credits by the end of June. This essay will normally be a literature review.

Total credit value for Diploma = 120.

3. Specification for Certificate

A certificate is awarded on successful completion of 60 module credits including MAMB10.

Total credit value of Certificate = 60.

Part-time or modular arrangements
The programme may be taken over two years on a part-time basis. The minimum requirements are the equivalent of two days a week in the first term with the equivalent of 1 day a week for the five subsequent terms. The dissertation will require the equivalent of 30 days and access to suitable facilities to carry out the work. Students who wish to do the MSc programme part time over two years should contact the programme director to discuss details.

Progression requirements
Not applicable for the MSc programme.

Summary of Teaching and Assessment
The programme consists of two terms of taught courses, with non-assessed seminars in the second term, together with a dissertation that comes from guided research in the summer term. It is expected that many of the guided projects will involve users of data assimilation in industry and government. Teaching is by lectures, computer practicals and guided reading. Assessment is by examination in the vacations following the term in which the course is taught, and all assessed modules contribute to the final mark.

Mark	Interpretation
70% - 100%	Distinction
60% - 69%	Merit
50% - 59%	Good standard (Pass)

Failing categories	
40% - 49%	Work below threshold standard
0% - 39%	Unsatisfactory Work

For Masters Degrees
To pass the MSc students must gain an average mark of 50 or more overall including a mark of 50 or more for the dissertation. In addition the total credit value of all modules marked below 40 must not exceed 30 credits and for all modules marked below 50 must not exceed 55 credits.

Students who gain an average mark of 70 or more overall including a mark of 60 or more for the dissertation and have no mark below 40 will be eligible for a Distinction. Those gaining an average mark of 60 or more overall including a mark of 50 or more for the dissertation and have no mark below 40 will be eligible for a Merit.

Postgraduate Diploma

A diploma is awarded on successful completion of 120 module credits. Students must complete all compulsory modules (70 credits) and then either of the following two routes are possible: ? Students must complete FIVE optional modules in the Spring Term (50 credits) ? Students must choose TWO modules in the Spring Term from those marked optional (20 credits) and complete an extended essay of about 10,000 words on a topic chosen in consultation with a member of staff. The extended essay is worth 30 credits and must be submitted by the end of June.

Distinction:
• A weighted average mark of 70 or more over 120 credits
AND
• no mark below 40.

Merit:

- A weighted average mark of 60 - 69 over 120 credits

AND

- no mark below 40.

Pass:

- A weighted average mark of 50 - 59 over 120 credits

AND

- no significant weakness (ie no mark below 40 in modules agreed at validation to be of special significance to the programme)

AND

- no absolute weakness (ie the total credit value summed for all modules marked below 40 does not exceed 30 credits and for all modules marked below 50 does not exceed 55 credits)*.

Failed

A performance which fails to fulfil the criteria for the above classifications.

Postgraduate Certificate

A certificate is awarded on successful completion of 60 module credits. Students must complete all assessed modules (60 credits) in the Autumn term or a combination of modules from the Autumn and Spring Terms. To pass the Postgraduate Certificate students must gain an average mark of 50 or more. In addition the total credit value of all modules marked below 40 must not exceed 10 credits*.

*Note: the provision to permit a candidate to be passed overall with a profile containing marks below 40 is made subject to the condition that there is evidence that the candidate has applied him or herself to the work of those modules with reasonable diligence and has not been absent from an examination, for example, without reasonable cause.

Admission requirements
Prior knowledge of the applications areas is not necessary. An upper second-class honours degree in maths or a physical/environmental science with a strong mathematical content is required.

Applicants whose first language is not English may be required to demonstrate their evidence of proficiency in English with IELTs or alternative English language qualifications. Applicants will be notified as required.

Admissions Tutor: Professor Peter Jan van Leeuwen

Support for students and their learning
University support for students and their learning falls into two categories.   Learning support is provided by a wide array of services across the University, including: the University Library, the Careers, Placement and Experience Centre (CPEC), In-sessional English Support Programme, the Study Advice and Mathematics Support Centre teams, IT Services and the Student Access to Independent Learning (S@il) computer-based teaching and learning facilities. There are language laboratory facilities both for those students studying on a language degree and for those taking modules offered by the Institution-wide Language Programme.   Student guidance and welfare support is provided by Personal Tutors, School Senior Tutors, the Students' Union, the Medical Practice and advisers in the Student Services Centre. The Student Services Centre is housed in the Carrington Building and offers advice on accommodation, careers, disability, finance, and wellbeing, academic issues (eg problems with module selection) and exam related queries. Students can get key information and guidance from the team of Helpdesk Advisers, or make an appointment with a specialist adviser; Student Services also offer drop-in sessions and runs workshops and seminars on a range of topics. For more information see www.reading.ac.uk/student

Career prospects
The largest group of practitioners of data assimilation are currently in the oil and gas industry, but the use of data assimilation in environmental sciences, including meteorology, oceanography and hydrology, is increasing rapidly. A large range of careers is thus open, including:
- research and forecasting posts in national meteorological and environmental agencies
- research and geophysics posts in the oil and gas sector
- research and technical posts in other environmental science institutes in the UK and internationally (eg MeteoFrance, NOAA, Australian Bureau of Meteorology)
- research and technical posts in space agencies (eg ESA, NASA, JAXA)

Opportunities for study abroad or for placements
There are no formal opportunities to study abroad.

Programme Outcomes

Knowledge and Understanding

A. Knowledge and understanding of:

1. Basic theory of data assimilation
2. Theory and application of operational data assimilation techniques
3. New developments in the field of data assimilation;
4. Specific problems in operational data assimilation in all geosciences.
5. The C++ and FORTRAN 90 programming languages.
6. Exploration and visualization of large data sets.

Teaching/learning methods and strategies

The knowledge is delineated through formal lectures supported by guided reading and problem sheets. Model solutions are provided and feedback given. Feedback on the programming is given initially via non-assessed programming exercises, and later assessed projects.
The industrial expertise is delivered in a series of lectures by outside industrial speaker in the Applications of Data Assimilation Module.

Assessment
Understanding is tested through open note examinations and course work.

Skills and other attributes

B. Intellectual skills - *able to:*

1. Apply knowledge and understanding gained to a variety of familiar and unfamiliar situations
2. Critically analyse numerical results
3. Show independence and initiative in approaches to problem solving
4. Present material clearly to expert and non-expert audiences in written and oral forms
5. Critically review, synthesise and evaluate published research
6. Conduct independent study of a chosen topic and report on the results.

Teaching/learning methods and strategies

1,2 and 3 are developed by a combination of problem sheets, worked examples, coursework assignments, computing project work and dissertation. 4 and 5 are addressed by lectures, practice presentations and the literature seminar in the Communication and Research Skills module, and also by the dissertation. 6 is covered by the dissertation.
Assessment 1, 2 and 3 (in part) are assessed by coursework and examination. 4 and 5 are mainly assessed through the literature seminar and dissertation. 3 and 6 are assessed by the dissertation.

Assessment

C. Practical skills - *able to:*

1. Program a computer in a structured and effective way
2. Analyse numerical methods and respond to the issues of accuracy, stability and convergence
3. Plan, conduct and report on investigations

Teaching/learning methods and strategies

1 is achieved via the Computing Techniques and Projects module. Most mathematics modules enhance skill 2. 3 and 4 are addressed through guidance on the project/ dissertation work.

4. Reference work in an appropriate manner.

D. Transferable skills - *able to:*

Teaching/learning methods and strategies

1. Communicate: the ability to communicate knowledge effectively through written and oral presentations
2. Use the computer to solve numerical problems and to analyse and present results using standard and mathematical software - Computation and It skills
3. Manage personal and professional development: study skills, independent learning, time management
4. Effectively use library resources - library skills.

Skills 1 and 2 are developed throughout most of the programme, but especially in the Computing Techniques and Projects and Communication and Research Skills modules. 3 is encourage throughout the programme. 4 is covered by the Communication and Research Skills module and the dissertation Assessment 1 and 2 are assessed through coursework, examinations, literature seminar and dissertation. 3 is indirectly assessed throughout the programme by its influence on performance. 4 is indirectly assessed in the dissertation

Assessment

Please note - This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content and teaching, learning and assessment methods of each module can be found in the module description and in the programme handbook. The University reserves the right to modify this specification in unforeseen circumstances, or where the process of academic development and feedback from students, quality assurance process or external sources, such as professional bodies, requires a change to be made. In such circumstances, a revised specification will be issued.