MSc Data Assimilation and Inverse Modelling in Geoscience
For students entering Part 1 in 2011/2

Awarding Institution:	University of Reading
Teaching Institution:	University of Reading
Relevant QAA subject Benchmarking group(s):	
Faculty:	Science Faculty
Programme length:	1 years
Date of specification:	27/Oct/2011
Programme Director:	Prof Peter Van Leeuwen
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 and Spring Terms: In addition to the compulsory modules listed below, students must choose 50 credits of level 7 optional modules, consisting of at least 20 credits in each Term selected from the list below, or from level 7 modules available elsewhere in the University.

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.

Autumn Term

Introductory module (if required)

Code	*Module title*	*Credits*	*Level*
MAMI0	Elements of Numerical and Functional Analysis	0	7

Compulsory modules

MAMA14	Stochastic Processes	10	7
MAMA5	Computing Techniques and Projects	10	7
MAMB10	Theory and Techniques of Data Assimilation	10	7
MTMD01	Environmental Data Exploration and Visualisation	10	7

Optional modules (20-30 credits)

MAMA3	Theory of Differential Equations	10	7
MTMG01	Introduction to Weather Systems	10	7
MTMG02	Atmospheric Physics	10	7

MAMA1	Numerical Methods for Initial Value Problems	10	7
MTMW99	Fluid Dynamics of the Atmosphere and Oceans (MNMAO)	10	7

Spring Term
Compulsory modules

MTMD02	Operational Data Assimilation Techniques	10	7
MTMD03	Monte-Carlo Techniques and Particle Filters	10	7
MAMB5	Communication and Research Skills	10	7
M***	Applications of Data Assimilation	0	7

Optional modules (20-30 credits)

MAMB4	Numerical Techniques for Conservation Laws	10	7
MTMG38	Remote Sensing	10	7
MAMB1	Numerical Solution of Boundary Value Problems	10	7
MAMB3	Finite Element Methods	10	7

Summer Term
Compulsory module

MTMD04	Dissertation	60	7

Optional module

MAMC6	Modelling Week	10	7

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 project 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

Assessment and classification
The programme consists of two terms of taught courses, with non-assessed seminars at the beginning of the third 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.

Admission requirements
Prior knowledge of the applications areas is not necessary. A First or Upper Second Class degree in Mathematics, or in a closely related subject joint with mathematics, or in a physical or environmental science with a strong mathematical content is 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 Student Employment, Experience and Careers Centre (SEECC), 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. 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 sciences
- 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:	**Teaching/learning methods and strategies**
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.	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:*	**Teaching/learning methods and strategies**
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.	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:*	**Teaching/learning methods and strategies**
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; 4. Reference work in an appropriate manner.	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. *Assessment* 1 and 2 are tested by computing projects and examinations. 3 and 4 are assessed by the project /dissertation.

D. Transferable skills - *able to:*	**Teaching/learning methods and strategies**
1. Communication: the ability to communicate knowledge effectively through written and oral presentations; 2. Computation and IT: use of the computer to solve numerical problems and to analyse and present results using standard and mathematical software; 3. Self management and professional development: study skills, independent learning, time management; 4. Library skills: effective use of library resources	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.