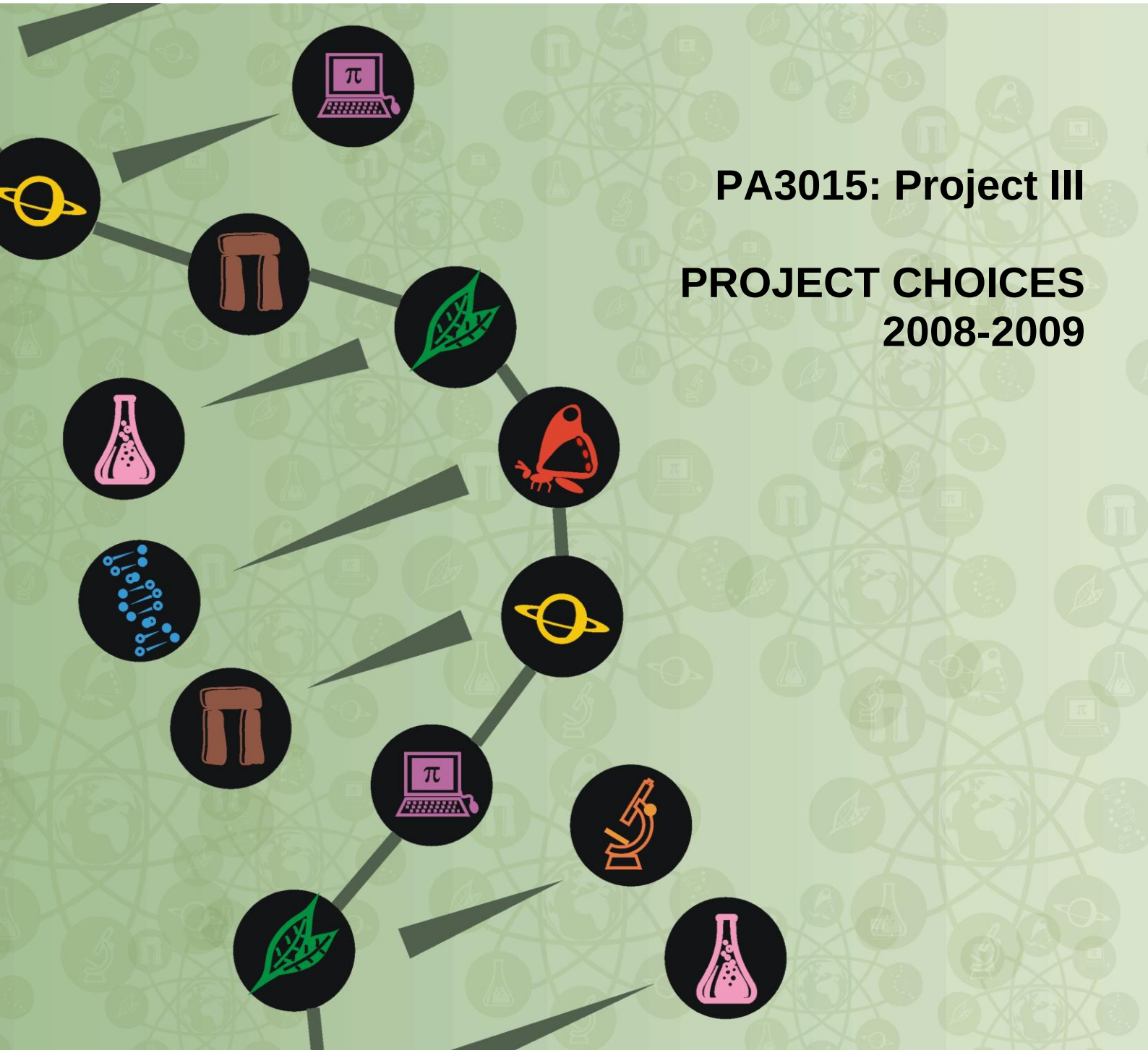
INTERDISCIPLINARY SCIENCE



PA3015: Project III

PROJECT CHOICES 2008-2009

University of Leicester

Contents

Measuring and modelling photosynthesis and its spatial distribution and plant community dependence in a regenerating fenland

Supervisor: Dr J Kaduk

Introduction
This project aims at identifying the patterns of photosynthetic capacity and their dependence on environmental conditions and relationships to nutrient status in different plant communities in a regenerating fenland near Cambridge. For example it is well known pioneer species have a higher photosynthetic capacity than vegetation climax species. However, it is not clear how exactly the photosynthetic capacity changes within more or less flooding tolerant species. The project should comprise measuring light saturated photosynthesis and incident light levels in the field in different locations and plant communities. Leaf nitrogen concentrations should be determined in the lab. The analysis should determine relationships between measured light levels, N concentration, light saturated photosynthesis and species. Finally a spatial extrapolation of photosynthesis based on the species map of the fenland should be conducted using a standard photosynthesis model and weather data from the weather station of the fenland.

Project Aims
- use of the IRGA
- ability to develop small models in matlab or maple
- using basic statistics
- field work

Measuring and modelling soil respiration and its spatial and temporal distribution in a regenerating fenland

Supervisor: Dr J Kaduk

Introduction
This project aims at identifying the patterns of soil respiration (soil CO2 efflux) and its dependence on environmental conditions and relationships to soil carbon content and fine root biomass. It is well known that soil respiration responds to temperature in an exponential fashion. However, less is known about its spatial distribution and its response to soil moisture. The project should comprise measuring soil moisture at a large number of locations as well as soil temperature and moisture. In the lab fine root biomass and soil carbon content should be determined for a representative number of soil cores. Optionally the soil and root nitrogen concentrations can be determined in addition. The analysis should determine relationships between measured soil respiration, soil temperature and moisture, fine root biomass and soil carbon content as well as examine the question whether there are spatial patterns in soil respiration and possible causes for these patterns.

Project Aims
- use of the IRGA
- ability to develop small models in matlab or maple
- using basic statistics
- field work

Measuring and modelling photosynthesis and its distribution in the canopy

Supervisor: Dr J Kaduk

Introduction
This project aims at identifying the patterns of photosynthetic capacity and their dependence on environmental conditions and relationships to nutrient status. For example it is well known that sun leaves have a higher photosynthetic capacity than shade leaves. However, it is not clear how exactly the photosynthetic capacity changes within the canopy for closed and open canopies as well as with orientation to the sun. The project should comprise measuring light saturated photosynthesis and incident light levels in the field in different canopy locations and for different canopy geometries. Leaf nitrogen concentrations should be determined in the lab. The analysis should determine relationships between measured light levels, N concentration, light saturated photosynthesis and leaf position in the canopy.

For safety reasons projects 1, 2 or 3 could be conducted together and they also share the main equipment. The idea would be to obtain the field measurements for the projects in a team of students.

Project Aims
- use of the IRGA
- ability to develop small models in matlab or maple
- using basic statistics
- field work

Interannual variability of the global atmosphere-biosphere CO_2 exchange

Supervisor: Dr J Kaduk

Introduction
The aim of this project is to determine the variations of the global atmospheric CO_2 concentration and relate the observed variations to the variability of temperature and precipitation as well as to determine those geographical regions which are most relevant for the observed variations.

This project builds on 18 years of NDVI and 20 years of global climate data. The task is to analyse these large data sets and to use appropriate simple mathematical operations to determine the relevant characteristics of the global variations in temperature, precipitation, CO_2 and NDVI and relate them to the atmosphere- biosphere CO_2 exchange

Project Aims
- ability to develop small models in matlab or maple
- using basic statistics
- working with large data sets

Complex Systems – Agent based modelling with NetLogo

Supervisor: Prof D Raine

Introduction
NetLogo is a computer programme (and programming language) that is used to model interacting ‘agents’, that is objects that can receive and process information and act on it independently. An early example was a model of shifts in population in ethnically mixed communities. An example from

physics is to magnetic systems (the agents are the spins on a lattice). Another example is traffic flows. The project will investigate the use of NetLogo to model a shared taxi scheme in a city to assess its viability.

Project Aims
To construct an agent-based model of a shared taxi scheme in which passengers hire transport on the basis of shared destinations and a pricing system based on waiting time as well as travel time.

Note: this project is available to BSc students only

Communicating ethics

Supervisor: Dr Chris Willmott

Introduction
Recent years have seen unprecedented developments in biomedicine. "Designer babies", transplant organs from animals, personalised medicine, stem cells and cloning are - to varying degrees - stepping from science fiction to science fact. Whilst the technology has made great strides, the ethical discussion has often failed to keep up.

Project Aims
This project will look at the development of resources for teaching about ethics at secondary and/or undergraduate level. In particular, the project will involve producing and evaluating study guides focussed around pre-existing online Reusable Learning Objects such as news footage streamed on the BBC website or YouTube videos.

Science for Sustainability. Case Studies in environmental problem-solving in the semi-arid tropics - East African Rift Valley.

Supervisor: Dr D Harper

Introduction
Sustainability is a word coined in 1992 by the UN Convention on Sustainability in Rio de Janeiro. It means utilising the earth's resources in the present without compromising their ability to provide for generations in the future. The concept is extremely hard to meet in a modern, industrialised country - one only has to compare the inconsistencies from different Government Departments, or different nations' attitudes to global warming, to see this. In the semi-arid regions of a developing country like Kenya, where human life is almost totally dependent upon the natural resources of the area, the term has a direct meaning. Most people who inhabit the area where the course is based - Lake Bogoria - are aware of the meaning of the term but are unable to put it into practice because the needs of the present - survival - outweigh the needs of the future. The fundamental concept of this course is that the intellect and different experience of a small group of individuals, applied to a problem intensively over 10 days, can produce progress towards solutions that would not otherwise be available. The course fee includes a contribution towards a project fund which will be used for expenditure of small items to implement the solution.

Project Aims
1. To learn the principles of Sustainability, as an increasingly-important issue in everybody's life (by pre-course seminars and reading, early January).
2. To understand and respect the way of life of a different culture, sharing knowledge and experience.
3. To appreciate the sustainability issues of rural people, who may be poorer in monetary goods but richer in spiritual ones.

Sustainability issues

a) freshwater springs, used to provide irrigation water for agriculture and domestic use. Are they wisely apportioned? Could they be better used?
b) fish ponds; as an alternative source of protein. Are they adequately managed? Could there be more?
c) woodlands which provide nectar for bees as well as wood for cooking; Are they sustainably exploited? Is there scope for plantations? If so, of what species?
d) community lands which provide grazing for livestock, including swamps which provide dry season grazing, are they sustainably shared or overgrazed?
e) eroded soils. There has been an increase in erosion in the last 5 years. Is this due to greater overgrazing, climate change altering rainfall intensity, or is it a natural consequence of soils which are young and fragile?
f) eco-tourism camps, which provide additional income. Are they effectively located, maintained and marketed? What other opportunities are there?
g) sales to tourists - profit on sodas; carving; reed products from wetlands, which provide extra income, are they adequately marketed and are there more opportunities?
h) schools and teaching aids. Do the teachers have adequate support to teach sustainability issues, can it be improved?
i) rain water harvesting. Is it effectively used?
j) village centres; social and social communications. Do they work well? Can they be improved?
k) renewable energy sources. To what extent is solar, water, wind power exploited? Can it be improved?

Note: this project involves a 2 week field trip to Kenya in the Easter vacation. If you have any questions please contact Dr Harper at dmh@le.ac.uk

Constructing an Interactive Screen Experiment for Optics

Supervisor: Prof. D J Raine

Introduction

An interactive screen experiments (ISE) is a video record of multiple pathways through an experiment which can then be replayed as a computer experiment. Since the recordings include multiple erroneous pathways, this is useful in providing experimental insight into physics without the difficulty of mastering experimental procedures. The project will involve setting up the protocols (theory, procedures and conditions) for an optics experiment related to observations of the Earth from space. In order to do this it will be necessary to set up and carry out the experiment under a variety of conditions. The ISEs are made in the laboratories at the OU. The project will involve liaison with this laboratory.