

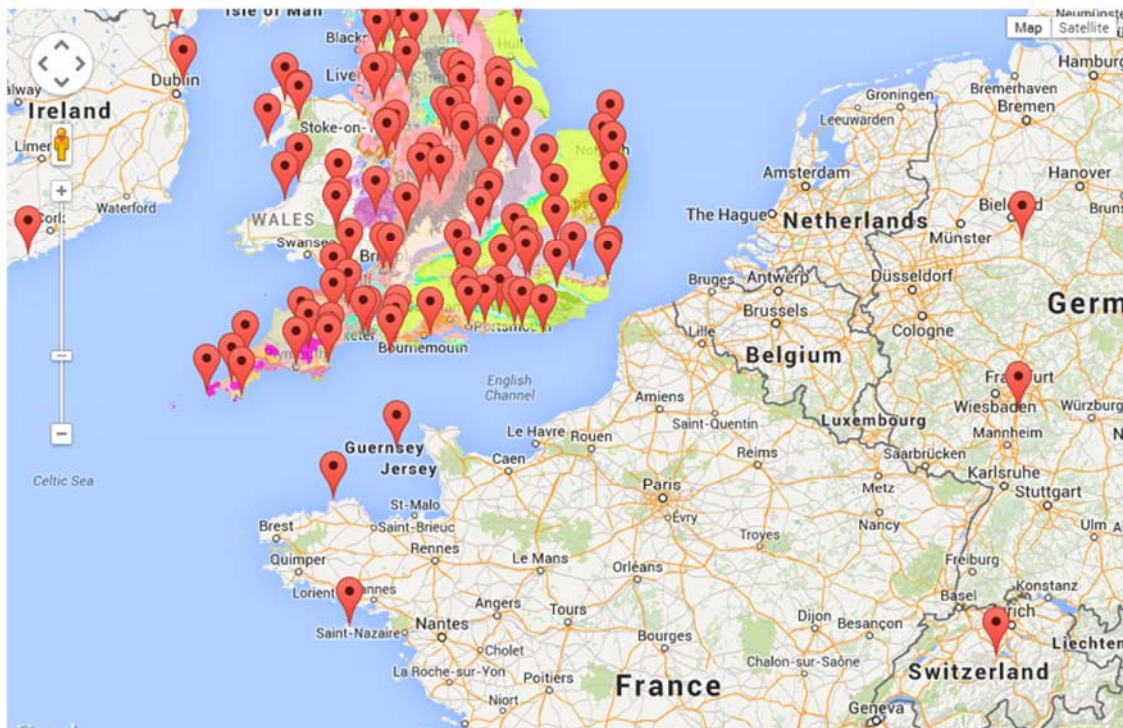
# eSTeEM Project Final Report

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Project title: Geospatial technologies in distance learning and teaching in Science

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Submitted: 10/11/2014



Red pins scattered across the map page of the S209 Geology Photo Blog mark the locations of geological samples or features students and tutors are sharing with each other.

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## Executive Summary

Geospatial technologies (that underpin services such as Google Earth™, ArcGIS™, remote sensing and GPS) can be used to help students grasp difficult or threshold concepts, such as 3D visualisation, and improve their spatial thinking skills, or 'spatial literacy'. These technologies are mostly fairly new to OU teaching, but have the potential to enhance the student experience, particularly for distributed students who can share geolocated data, images and representations online.

Spatial literacy and GIS techniques are skills that are very much in demand from a wide range of employers and need to be enhanced in a modern environmental and geoscience curriculum. In this project, we developed a 'Geology Photo Blog' tool, based around a Google Maps™ interface, to enable OU geology students and tutors to share pictures related to their studies and encourage discussion. Each posted picture was linked to its location on the map, and accompanied by a brief description. Other students and staff could post comments on these images on the blog page, generating discussion. This tool was developed for S276 *Geology*, and finally embedded in the replacement, 60 credit module S209 *Earth science*.

A parallel strand to the project analysed the experience of a 6-week 'Remote observation' topic in the *Practical science* module, S288. This topic required the students to use an open-source GIS software application to pursue practical investigations from very diverse science disciplines. The bulk of the analysis was conducted by collating data from the intense online forums that supported the students during the 6-week topic, across three presentations (2012B, 2013B, 2014B).

Perhaps the primary finding of this project was the value of peer support in distance learning communities, and the various strategies for promoting and encouraging this. In the current (2015) trend towards more fully online modules, peer support is a very valuable asset not just for students, but also for the module teams designing online materials.

## Aims and scope

Geospatial technologies (that underpin services such as Google Earth™, ArcGIS™, remote sensing and GPS) can be used to help students grasp difficult or threshold concepts, such as 3D visualisation, and improve their 'spatial literacy' skills. Spatial literacy is an essential skill for professional geologists and environmental scientists, who routinely work with distributed data associated with particular locations ('geolocated' data) across a range of scales. Practitioners need to develop confidence with manipulating data and imagery at different scales, and mastery of moving between 3-dimensional realities (e.g. landscapes) and 2-dimensional representations (e.g. maps). Many students find learning these skills challenging, but modern geospatial technologies offer opportunities to scaffold that process, as well as enriching the curriculum. These technologies are relatively new to OU teaching, but have the potential to enhance the student experience, particularly for distributed students who can share geolocated data, images and representations online.

- **Primary aim:** to evaluate the use of modern geospatial technologies on OU distance modules in Science
- To gather tutors' and students' views on the value of geospatial technologies and GIS methods to distance teaching and learning
- To explore the impacts of GIS in distance teaching, and identify the strengths and weaknesses of the GIS approach
- To redevelop the pilot Geology Photo Blog, initially for use in S276 *Geology*, and latterly for re-launch as an integral part of S209 *Earth science*
- To evaluate the use of geospatial technologies in S288 *Practical science*

This project built on a number of earlier initiatives at the Open University:

1. A COLMSCT teaching fellowship held by Dr Argles that investigated how GIS-based materials could be delivered to geoscience distance students in a conventional OU module. This resulted in a variety of GIS-based materials being integrated into the module, in a range of formats.
2. The launch of a GIS-based 'mashup' (S276 Geology Blog), enabling students to post images and video clips to an online site built round an interactive map. This pilot project ran in the 2010K presentation of S276 (Nov 2010 – Jul 2011).
3. The development of a new unit on remote sensing within the S288 'Practical Science' module, in which it was decided that students would use open-source GIS software to acquire some basic geospatial skills by testing a variety of scientific hypotheses with real data.
4. The use of a Googlemap/data collection/photo mashup tool for S396 Ecosystems enabling students to geolocate data (temperature measurements) and photographs (tree canopies) for representation on an online map for collaborative data collection across a student cohort.

An eSTEEem PhD research studentship starting in June 2011 '*Using Geographic Information Systems (GIS) in Distance Learning*' was intended to run alongside this eSTEEem project, developing synergies as both projects progressed. There was some success in this approach during the initial stages of the studentship, but thereafter serious health issues resulted in the student requesting a lengthy suspension (from October 2012) and, ultimately, withdrawal from the studentship altogether (September 2013).

## Activities

The project started in April 2011

### Development of Geology Photo Blog

Various bursts of development of the Geology Photo Blog (GPB) occurred throughout the project; these are summarised in Table 1.

**Table 1** Periods of Geology Photo Blog development

Period	Description of development activity
Early 2011	AL testing of S276 pilot blog and suggestions for modifications
Late 2011	Forum discussions with S276 ALs on use of maps and photographs in teaching; further suggestions for GPB
Mar-Apr 2012	Minor modifications preparing for the S276 AL pilot
Aug-Sept 2013	Authoring of specific teaching materials in S209 based on the GPB
Dec 2013-Mar 2014	LTS colleagues (Andy Sutton, Stephanie Housden) updated to latest Google Maps API (Version 3) and liaised with project leaders on further modifications ahead of embedding GPB in S209 <i>Earth science</i>
Sept 2014	Final integration of GPB into S209 website
Oct-Nov 2014	Minor reactive fixes to GPB arising from student or AL comments (mainly glitches related to software conflicts, permissions, or database anomalies)

### Pilot with 2 tutor groups on S276

A pilot of the Geology Photo Blog ran for a subset of S276 students from April to July 2012, with Linda Fowler and Tony Cross as contracted ALs. This was being planned from early 2011, but the impact of academic production workloads, contract processing and a reluctant module team chair delayed the pilot until more than half-way through the 2011K presentation of S276.

Comments from Linda and Tony:

- There was only limited student engagement in the pilot, due to delayed launch of the GPB relative to the module start
- Both ALs felt the GPB would be much more effective if introduced at the module start, especially for icebreaker-type activities
- Tony Cross suggested that the Blog's role would change as the module progressed – from a teaching aid early on to a more reflective discussion forum as the students developed more confidence and gained experience of the module content later on

### Online survey of whole cohort, S276

An online survey to gather views from S276 students on the Geology Photo Blog was set up in July 2012, and ran until the end of September 2012. An Amazon voucher and an iPod Nano were offered in a prize draw of students who either posted on the Blog or completed the survey, as an incentive. The timing of this survey was not ideal; it was designed to capture the views of students on the 2011K presentation just before they

moved on from the module but more responses would have been gained if 1) the pilot had run from the start of the presentation, and 2) the pilot had included the whole cohort from earlier in the presentation

As it was, the Blog was made available to the whole S276 2011K cohort only in July 2011, after the end of module exam, severely limiting the survey's effectiveness. Only 9 students engaged in some way with the GPB between September 2011 and July 2012; 3 students completed the online survey.

#### Analysis of S288 Remote observation topic forums, 2012-2014

A full dataset of statistics on forum usage during the 2012B presentation of the 'Remote observation' topic of S288 was compiled using the forum analytical tools. Unfortunately, similar analyses were not possible for the 2013B or 2014B cohorts, because in the meantime the data analysis parameters were changed, drastically limiting the data that could be compiled and the types of analysis that were possible – yet another frustration associated with this project! The 2012B presentation of S288 ran Remote observation as the first topic for a large and diverse cohort of students, most of whom were tackling an online module for the first time, on a new version of the VLE. Analysis of the geospatial technology component of the module was heavily impacted by other, module-wide factors, and could not be compared directly with the following 2 years (due to both lack of data and changes in the module). Two presentations reflecting on this experience were given, in July 2013 and August 2014 (see below), and the second of these is due to be written up for a special symposium issue of the Journal of Geography in Higher Education.

A summary table of these forum data, along with some graphical illustrations, is available in Appendix A.

#### Feedback from S288 Remote observation topic students, 2012-2014

A limited amount of (anonymised) feedback from S288 students on the Remote observation topic was captured for illustrative purposes within the two conference presentations in July 2013 and August 2014. As can be seen from the forum data, there is an abundance of feedback on the forums, throughout the topic as well as in the specific 'Feedback' threads set up in 2013 and 2014 towards the end of the topic. Given the SRPP restrictions on student data, it is unlikely that any of this feedback will be documented, even in anonymous form, though it would undoubtedly be invaluable for guiding future design of geospatial teaching.

See Appendix B for a sample of comments from the forums.

#### Dissemination – presentations

Below is a list and brief summaries of presentations arising from this project.

##### **HEA-CHES presentation, July 2013**

"Teaching GIS at a distance: a cautionary tale of over-ambition"

This presentation at the Open University summarised the process of presenting the Remote observation topic of SXG288, which introduced students to practical exercises using open-source GIS software (gvSIG).

##### **RGS-IBG conference presentation, August 2014**

"Teaching GIS at a distance: a bluffer's guide"

*Note: This is to be written up for a special symposium issue of the Journal of Geography in Higher Education.*

#### **ABSTRACT**

The growth of online learning and very large class sizes demands constant innovation from educators, and the challenges are particularly acute for practical topics. Many lessons for teaching GIS, for instance, might be learned from distance education, where well-staffed face-to-face laboratory classes are unfeasible. But how do you replace that conventional model with something other than a 'sink or swim' approach?

In 2012 the Open University launched the online 30-point module Practical Science, with topics spanning across all disciplines. One topic, Remote Observation, required distance students to use open-source GIS software for a range of experiments. Online delivery of content included teaching text with activity instructions, software and data downloads, 14 instructional screencasts, and forums monitored by two academic experts for the duration of the topic (6 weeks). Students were also supported by an allocated tutor throughout the module. In the second year, a detailed FAQ document was also available.

Forum data for the 2012 and 2013 cohorts illustrates how tough the topic proved, for both students and staff. Many of the problems (time-limited group work, internet data retrieval, diverse IT issues), were not specific to teaching GIS. However, IT problems are inevitable in a cohort of 200-400 using a variety of hardware and software systems, so expert support was essential. The screencasts were also widely acknowledged as essential scaffolding. Peer support proved vital in fostering a sense of community and bolstering morale – as well as simply providing solutions.

This paper will highlight some of the pitfalls and pleasures of our experience, and explore some wider implications for teaching GIS in a changing educational climate.

#### **Learn About Fair stand, February 2012**

Flyers outlining the project questions and progress were designed, printed and distributed. A poster on the project was also printed and displayed, and we manned the stall on the day.

#### **Learn About Fair posters, February 2013**

Two separate posters were produced and displayed for this event:

1. "Piloting the use of GIS software in a practical science module"  
*This detailed the S288 experience of teaching practical science using open-source GIS software.*
2. "Geospatial technologies in Science distance modules"  
*This poster focused on the project developing the Geology Photo Blog for S276 Geology.*

### **Pitfalls and problems**

The project has been dogged by problems, obstacles, missed opportunities and just bad luck since its outset. Table 2 summarises the main issues that arose during the project that had a negative impact on the research.

**Table 2** Problems encountered during the project

Issue	Description

Argles, T. and Davies, S. (2014) 'Geospatial technologies in distance learning and teaching in Science' eSTeEM Final Report.

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Lack of patronage	The module team chair of S276, the initial ‘host’ module for the GPB, was reluctant to run a pilot with the full cohort, or from the module start – both factors that crippled the study
Workloads	Both academics on the project were overloaded with other work, including successive production modules including the resource-intensive S288 <i>Practical science</i> . This over-commitment impacted heavily on their ability to drive the project forward at critical times
Timing	There were numerous missed opportunities: running the Blog pilot from the start of S276 (2011K); meeting with the OUGS in April 2013; contracting ALs earlier in the 2011K presentation of S276
Personnel	Retirement of AL (Linda Fowler, Nov 2012); suspension and withdrawal of eSTeEM PhD student (Oct 2012-Nov 2013)
Data retrieval	After the 2012B presentation of S288, data retrieval from online forums was drastically restricted, resulting in inadequate data for 2013B and 2014B that could not be compared with the data from 2012B
Google API	This was changed during S209 production, necessitating a rapid modification of the Geology Photo Blog system in time for the first presentation.

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## Findings

### 1. **Teaching GIS at a distance** is hard!

Conventional GIS teaching relies on face-to-face support, dedicated IT laboratories, over-the-shoulder instruction, and consistent hardware. The Remote observation topic broke all these rubrics and then added some extra challenges: comprehensive scope (spanning across Science); short timescale (5 weeks!); over-emphasis on collaboration. Future attempts are advised to:

- Expand the time for teaching
- Tailor materials to more specific disciplines
- Ensure diverse and extensive support (FAQs, user manuals, screencasts, proactive and reactive forums, in-text notes)

### 2. **Peer support** is a valuable asset: don’t underestimate its potential impact.

The Geology Photo Blog works so well partly because it encourages peer-to-peer interactions and discussion, building a peer support community right from the start of a module, based around an activity that most students find very engaging. By contrast, the Remote observation topic fostered peer support as a reaction to the feeling that they, as a community, were ‘under fire’. The outpourings of stress, anxiety, frustration and despair on the forums prompted a powerful support response from other students, which in turn bolstered the advice provided by the two topic specialists. It is hard to quantify just how effective this peer support was, but its impact can be inferred from the discrepancy between the percentage of 2012B students who posted on the forums (46%) compared to the proportion who viewed them (90%).

This supposition was supported by comments on the forums such as this one:



"Although I never posted a question on the forum, I could always rely on there being a similar problem, and hence an answer here!"

(See Appendix B for similar comments.)

3. **Adoption** The success of technology in teaching and learning does not merely follow from the quality of the technology, or the value of the idea behind it. Innovations must be championed and supported not just by the people who design and develop them, but also by those implementing them: module team members and chairs, curriculum managers, tutors/ALs, and ultimately students. The contrast between the success of the Geology Photo Blog in S209 (embedded from the start) and its comparative failure in S276 (a limited pilot only) illustrates this finding clearly.

## Impact

### a) Student experience

- Working study resource in S209 – Geology photo Blog. This has been used as the basis of 'ice-breaker' activities by tutors, and as part of an assignment.
- Interim improvements to 'Remote observation' topic materials (e.g. FAQs) and online forum support (structure/management of forums)
- GIS skills are an important employability skill, transferable across a number of disciplines both within and beyond Science.

"I found this topic thoroughly enjoyable and really has piqued my interest in climate observation and modelling... Things go wrong in the real world, results returned aren't don't match what was expected, and IT is always a battle in any institution or organisation. Problem solving is a big part of the challenge and learning problem solving skills are invaluable."

"The job advert did, however, highlight the growing importance of these skills in the wider world..."

"Very good to get us to work with non-professional SW tools (gvSIG), as a lot of practical science uses such tools nowadays, and they are not always easy to use, not are they always without glitches. A very good and necessary experience!"

- Some components of the 'Remote observation' topic have subsequently been incorporated into other modules (e.g. for Physics/Astronomy)

S209 student comment on online forum:

"The blog is a great idea. Ive never used one before. Its very interesting seeing people's finds!"

### b) Teaching

- 2 presentations on the S288 experience to UK colleagues
- A number of internal OU presentations to department colleagues, module team members (S276 and S209), faculty colleagues, and e-learning groups.
- Comments from tutors and students using the Geology Photo Blog in the 2014J presentation of S209 will feed back into adjustments for the 2015J presentation.
- A couple of technical issues with the Geology Photo Blog were fixed on the fly during the 2014J presentation – including a SQL glitch that affected only those students with apostrophes in their names!
- As a general – rather terse – comment, this would have been completely innovative when it was first proposed (by Sarah, in 2008!). A few years later, the BGS had launched a similar online maps mashup, and a couple of years after that a mobile



app. Meanwhile, the lack of support from the module team at the OU had consigned the Photo Blog to a stuttering pilot study.

## Deliverables

Geology Photo Blog resource for S209 (2014J):

<http://students.open.ac.uk/science/s209/photoblog/v1/map.php>

HEA-CHES presentation, July 2013 “Teaching GIS at a distance: a cautionary tale of over-ambition”

RGS-IBG presentation, August 2014 (and paper for JGHE, in prep) “Teaching GIS at a distance: a bluffer’s guide”

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<b>Figure A3</b>	Graph showing participation in the S288 Remote observation online forums by time of day (2012B)

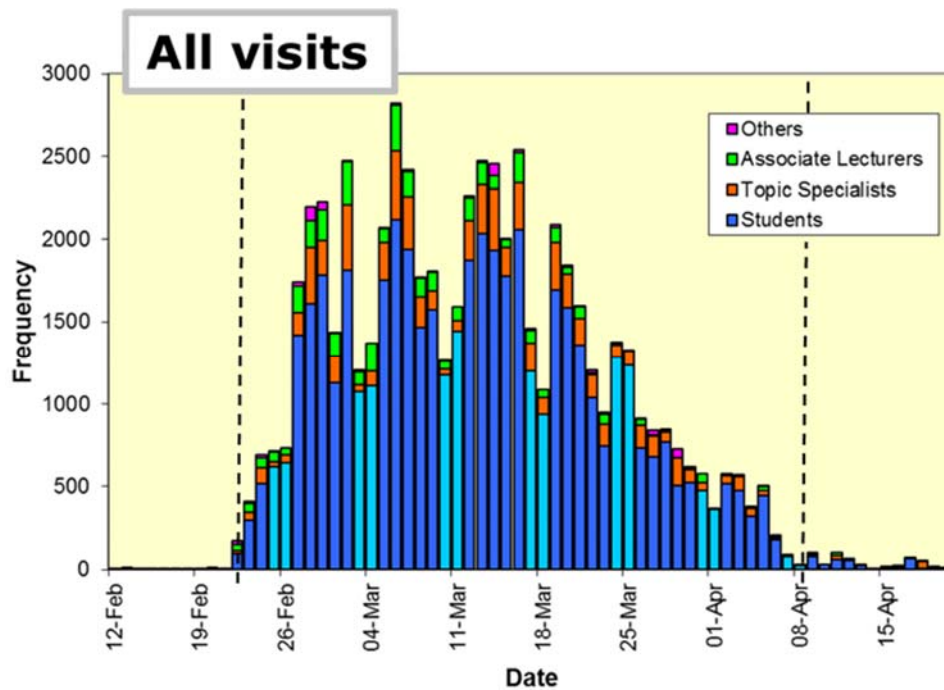
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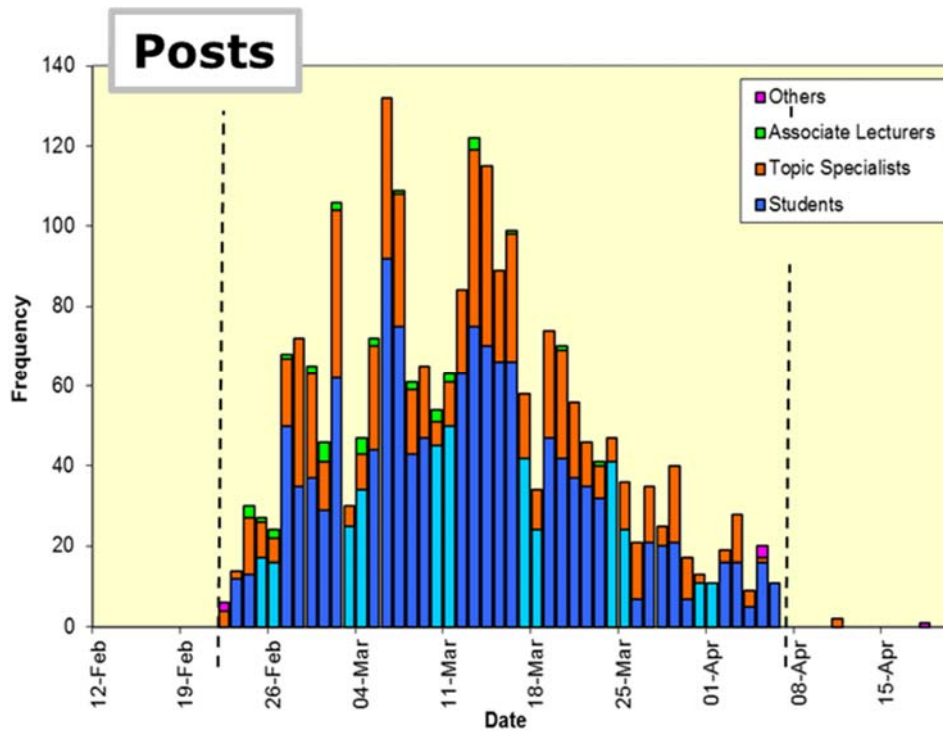
## Appendices

## Appendix A

Summaries and illustrations of data from the S288 Remote observation online forums



(a)



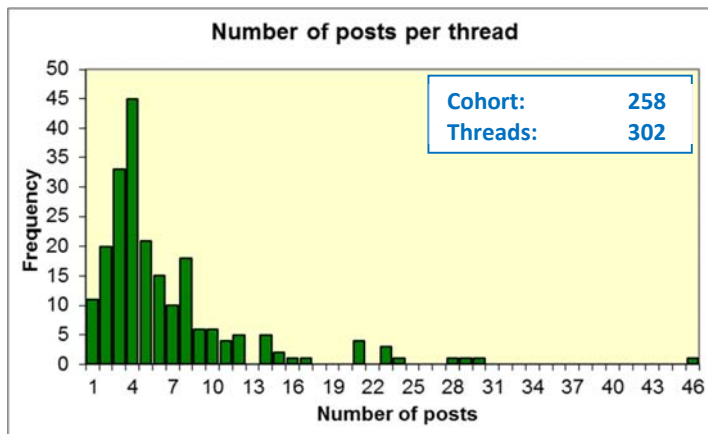
(b)

**Figure A1** Cumulative column graphs summarising participation of different groups in the S288 Remote observation online forums. The dashed lines mark the opening and closing dates of the forums. (a) All visits logged, including all actions from simple views of a page to posts. (b) Actual posts only (both initiating and contributing to discussion threads).

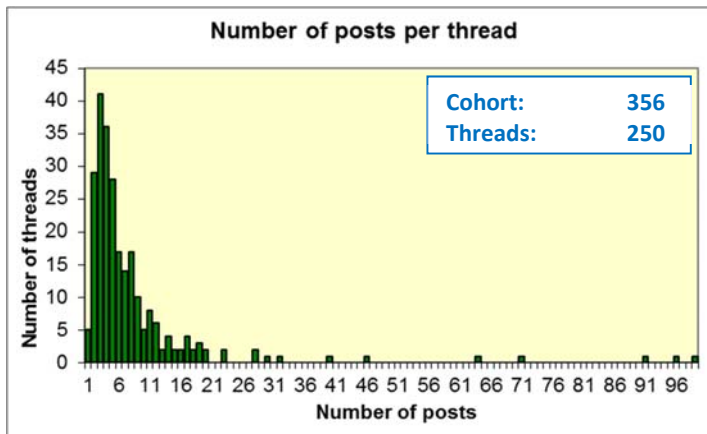
**Table A1** Summary data from the S288 Remote observation topic online forums for the 3 presentation years.

	2012	2013	2014
Cohort	258	356	814
% who viewed	90	<sup>1</sup>	<sup>1</sup>
% who posted	46	46	31
Threads	302	250	353
Longest thread	46	99	119
<b>Posts</b>	<b>2286</b>	<b>2122</b>	<b>2337</b>
<b>Threads ≤3 posts</b>	64 (21%)	75 (30%)	130 (37%)
Threads ≥10 posts	36 (12%)	53 (21%)	54 (15%)
Total views	58,374	<sup>1</sup>	<sup>1</sup>

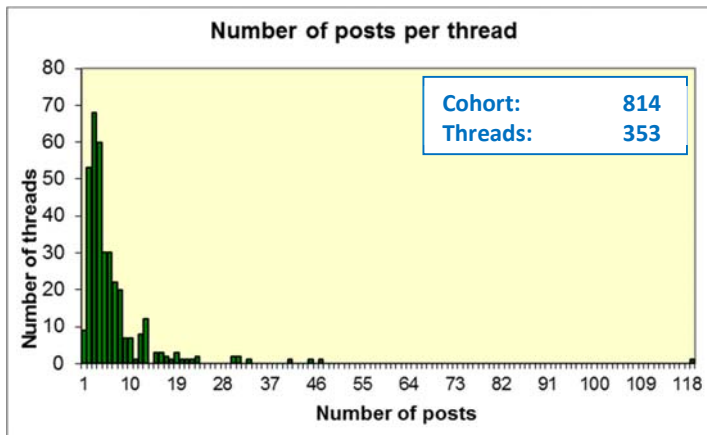
<sup>1</sup> Data unobtainable following changes to the VLE data reporting system in 2012-2013.



(a)

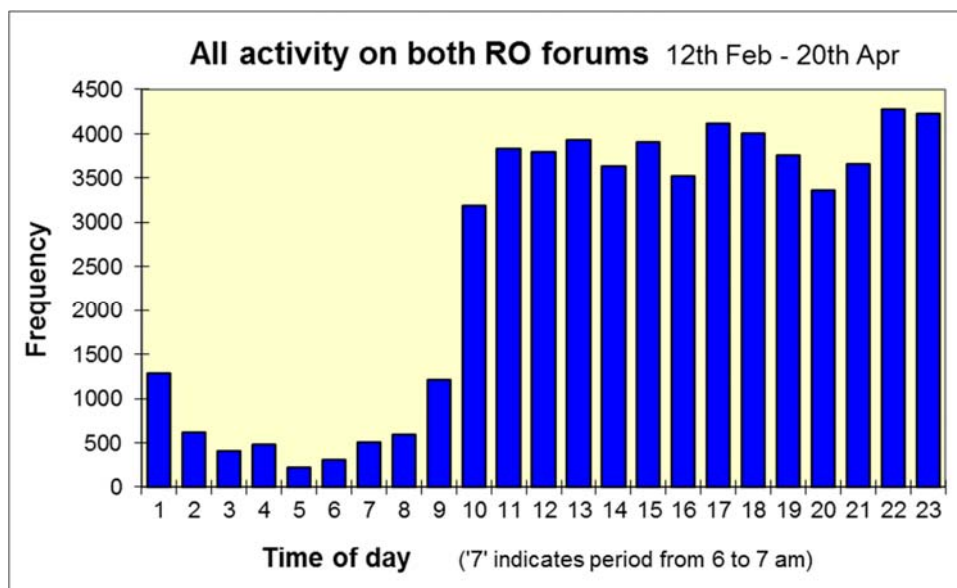


(b)



(c)

**Figure A2** Column graphs showing distribution of the number of posts per discussion thread in the S288 Remote observation online forums. (a) Data for 2012B presentation. (b) Data for 2013B presentation. (c) Data for 2014B presentation.



**Figure A3** Column graph showing the times of day when all groups (students, tutors, topic specialists, other staff) on the 2012B presentation visited the S288 Remote observation online forums. (These data were not available for the 2013 or 2014 presentations.)

## Appendix B

### A selection of student feedback on the S288 Remote observation experience

Most of these comments were posted on the online forum for the Remote observation topic. Comments denoted by Q and A are comments submitted to an end of module survey.

"...it was mostly just following instructions."

"My only real gripe was not having images of what the final product 'should' have looked like."

"The screencasts were however excellent although more images and text in a pdf would have been helpful."

Q) What aspects did you most value about studying this module?

A) "The help and advice posted on the forums by the tutor and other students."

"First, thanks to Tom, Susan<sup>1</sup> and all the people who 'got it' more quickly than I did, for the help via the forum. Yes, it was difficult to find things, but it was great to have such a supportive community."

<sup>1</sup> Topic specialists on the RO forum, 2014B

"A simpler package (if one exists - I can see changing horses would be tricky) might help, or (depending on available skills since it is open source) a stripped down version."

"As far as I can make out, Google Earth is a simplified GIS tool. If so, then using this would make a great introduction to the topic as most people are at least familiar with the way it works, even if they haven't used it directly"

"I would have needed face-to-face-tutorials with computers also present. I realise this is hardly practicable."

"Two topic specialists to 700 students is shocking. I can't imagine how much, collectively, we all paid for the course but that probably equates to the OU raking in a hefty profit. That's not my concern, however. My concern is that every single student gets the help and support they deserve and need to do what is required of them."

"On the positive side, I did actually feel like a proper grown-up scientist when I was getting the hang of it and given more time and less pressure, I think the whole thing would have been much better."

"Firstly, it took me ages to work out what the point of the topic was. I was so involved in trying to follow gvSIG instructions that I was most of the way through Mars before I noticed that there was loads of science going on too."

"I think that the topic would need to be either a module in its own right or cut down to about two investigations because there is far too much to get through in the time available."

"I found gvSIG to be good on the whole, considering it's open source. Yes it has its quirks, but a lot of software does, once you get to know them you can navigate your way around them. It was a steep learning curve, but more than achievable. In the latter investigations I found myself referring very little to the screencasts."

"I started with little experience of image processing software and therefore would have liked an overview of the main features of a GIS (layers, projects, views, projections, histograms, lines, profiles, how converting data points/cells to shape files and then to rasters works, etc) and some typical tasks that earth/planetary/environmental scientists carry out using GIS. (I know this could be inferred from the activity content, but I was so bogged down in following the instructions to the letter that I couldn't rise above them and see the bigger picture.)"