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Preparing for the Research Excellence Framework:  
Perspective from the RAE  
What is a 4\* paper?

Ken Carslaw

“...the habit of analysis has a tendency to wear away the feelings.”

*John Stuart Mill*

- Design of the 2001-2008 Research Assessment Exercise (RAE)
  - Panel definitions of research quality
- Outcomes and analysis of RAE
- What makes a 4\* paper?
  - Fleshing out the definitions
  - Examples from RAE
- How to produce more 4\* papers

# How did the Research Assessment Exercise (RAE) work?

1. External panel graded the quality of research in all UK universities under many discipline categories for 2001-2008
2. SEE was entered in UoA17, Earth Systems and Environmental Sciences
3. Assessed research outputs (65%), research environment (20%) and Esteem (15%)
4. Each member of staff submitted 4 best outputs, with no duplication across School. We submitted 79 staff.
5. RAE leader (KC) and Institute heads judged the quality before submission

Research quality graded as

- 4\* - World leading
  - 3\* - Internationally excellent
  - 2\* - Internationally recognised
  - 1\* - Nationally recognised
4. Final outcome of RAE panel was % activity at each level
  5. Each level attracts different Quality-Related (QR) income to the School per fte

# The meaning of 1\* - 4\*

“Measurement has meaning only if we can transmit the information without ambiguity to others.” *Russell et al., The Science of Science*

4\* - World leading in terms of originality, significance and rigour. *Some* of the following characteristics:

- Agenda setting
- Major influence on a research theme or field
- Great novelty in developing new thinking, new techniques or novel results
- New paradigms or concepts for research
- Major changes in policy or practice with respect to applied research

“Internationally excellent”

- Makes important contributions to the field at an international level
- Contributes important knowledge, ideas and techniques with lasting impact, but no new paradigms or fundamental new concepts
- for applied work, led to significant change to policies or practices

*3\* vs. 4\*: Importance (major importance), significant change to policy (major change to policy) – difficult judgement*

## “Internationally recognised”

- Useful knowledge, but no lasting impact
- Incremental advances, established techniques, conform with existing ideas
- Has influence outside the UK
- Applied work has influenced policy or practice

# Outcome of the RAE

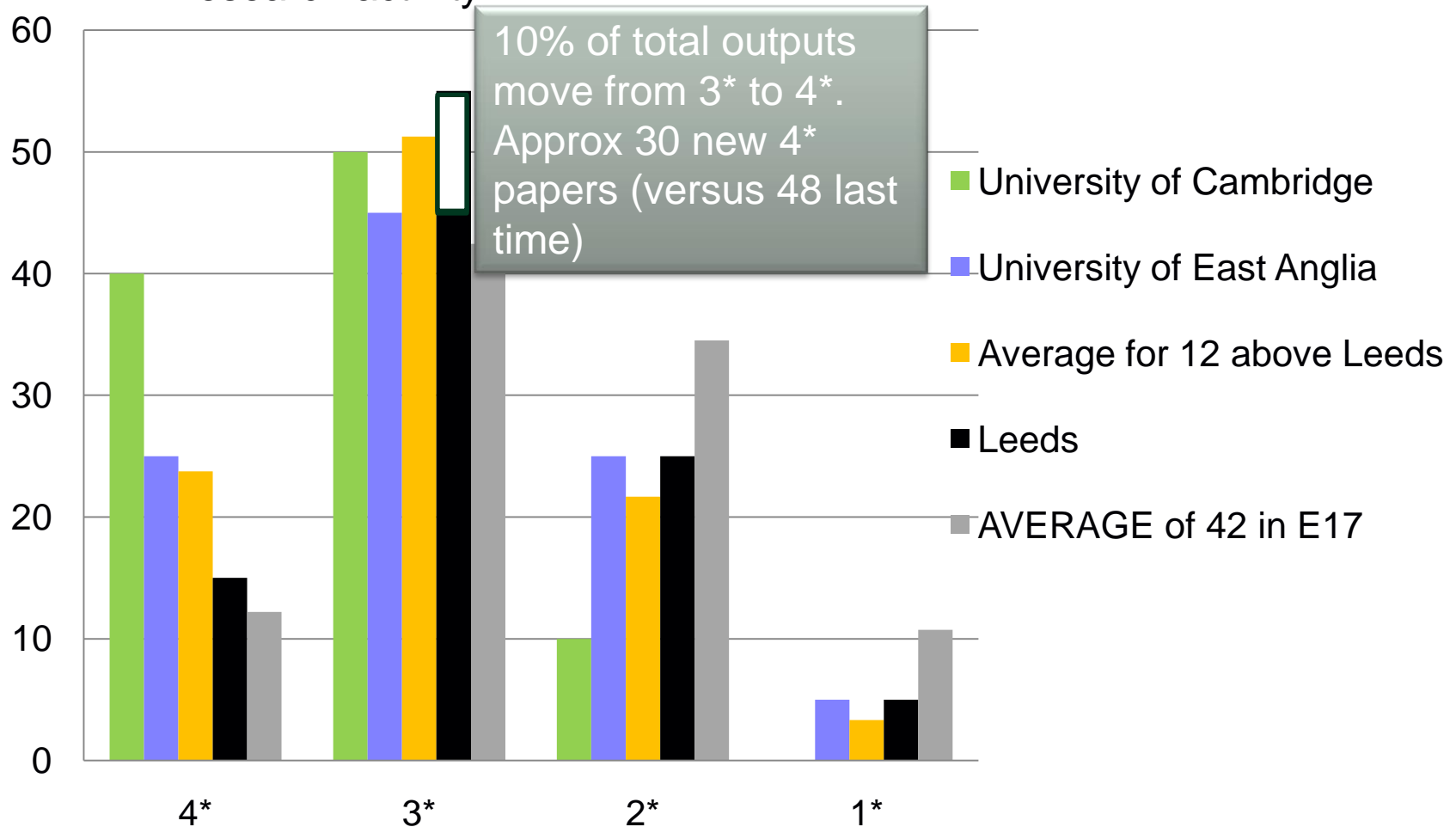
Number of submissions: 42

	Overall quality profile (percentage of research activity at each quality level)						Average grade
	FTE Category A staff submitted	4*	3*	2*	1*	unclassified	
University of Cambridge	44.90	40	50	10	0	0	3.3
University of Oxford	32.08	35	50	15	0	0	3.2
Joint submission: Birkbeck College and University College London	40.50	25	55	20	0	0	3.1
University of Reading	40.70	30	45	20	5	0	3.0
University of Bristol	47.70	25	50	20	5	0	3.0
University of East Anglia	71.67	25	45	25	5	0	2.9
Royal Holloway, University of London	22.30	20	50	30	0	0	2.9
University of Liverpool	25.00	15	60	20	5	0	2.9
University of Manchester	37.10	20	50	25	5	0	2.9
University of Southampton	62.83	20	50	25	5	0	2.9
University of Durham	32.20	15	55	25	5	0	2.8
Lancaster University	55.25	15	55	25	5	0	2.8
<b>University of Leeds</b>	<b>74.30</b>	<b>15</b>	<b>55</b>	<b>25</b>	<b>5</b>	<b>0</b>	<b>2.8</b>
Open University	52.80	15	55	25	5	0	2.8
University of Edinburgh	77.14	15	55	25	5	0	2.8
Cardiff University	37.00	15	55	25	5	0	2.8
University of Birmingham	17.48	15	50	30	5	0	2.8

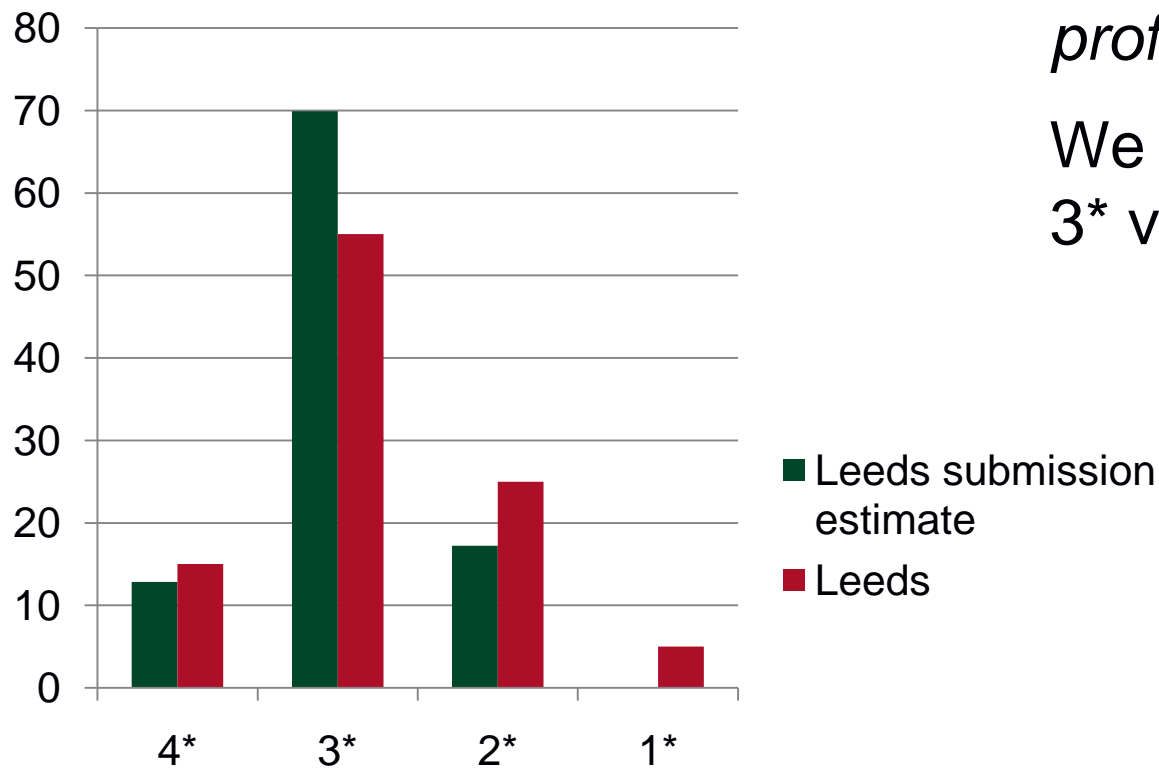
# Where does SEE sit?

## Percent of research activity\* at each level

\* We assume that our publications have same profile as total research activity



# How good a judge are we of our own quality?



Number of 4\* papers estimated to be 41. Judged to be 48 (*assuming publication profile = overall profile*)

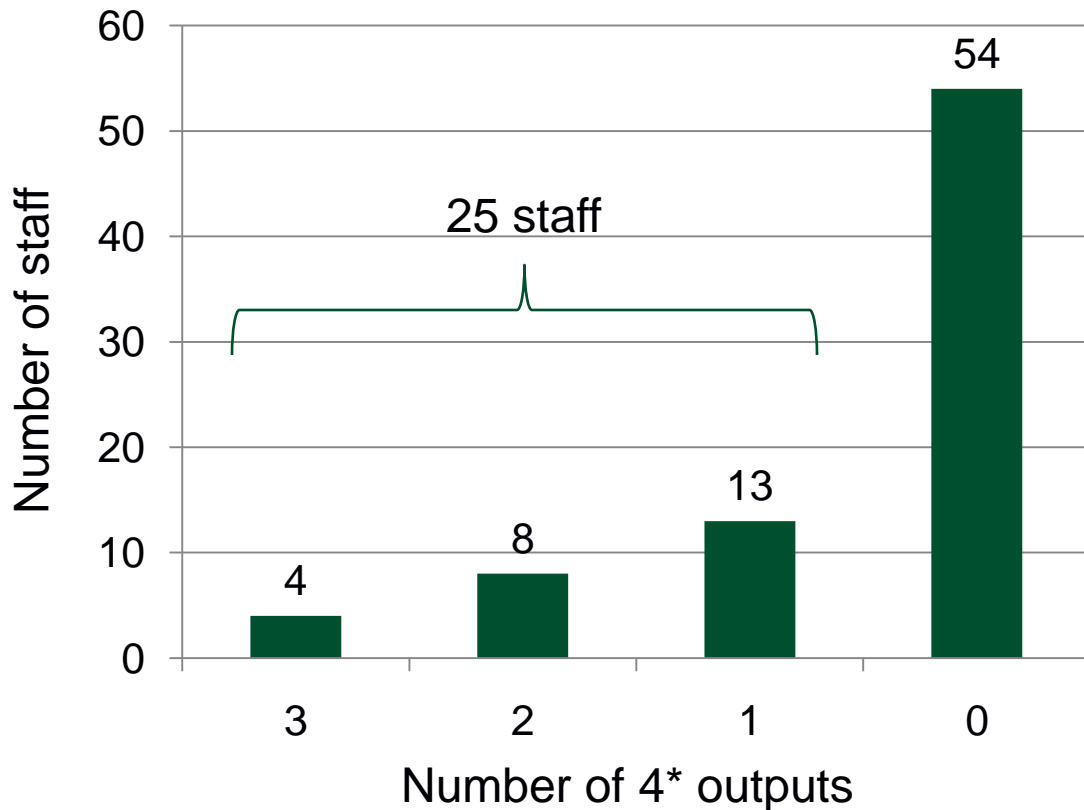
We tended to overestimate 3\* versus 2\*

# How many staff had 4\* outputs in 2001-2008?

For staff with 4\* outputs, they make up about **1 in 25** of their published output - ISI

25 staff had a 4\* output, 54 didn't

Number of staff with 4\* outputs



Average grade was ~uniform across institutes, 4\* papers were not

13 Nature/Science papers

Most 4\* in discipline-leading journals

# 4\* papers and researchers

- Just 1 or 2 high impact papers can launch a research career
- Quality and impact far outweigh volume when it comes to promotions and job applications
- We are all interested in making important discoveries!

# What is a 4\* paper?

## 1. Research with (major) consequences

Other scientists would try to disprove/reproduce, adapt their research, follow up

Policy consequences [often the narrow definition of “impact”]

## 2. Paradigm-changing papers

X view held for ~decade, shown to be different. Consequences obvious.

## 3. Major syntheses that advance our understanding

Major new datasets / model developments, etc coming together [Not reviews]

## 4. Discoveries

## 5. Step changes in model application or measurement (first ever simulation/measurement of ...)

Likely to be followed up and therefore highly cited

## 6. Important “firsts”

Being first helps, but must have importance and consequences

*All of the above tend to attract high citations, but impact can show up in other ways*

# Some 4\* papers from RAE2008

First in situ evaluation of processes linked to ... and quantification of rates and mechanisms of ...using new xx methods. Has opened a new direction of xx research and many studies now apply xx for such studies.

**first, unique methods, consequences**

First recognition that several features of the lavas of mid-ocean ridges could be explained by incorporation of seawater heated to magmatic temperatures within actively-flowing submarine lava.

**first, new paradigm**

Reports a new class of particle in the... Became the central theme of the xx EU campaign in 2002.

**discovery, consequences**

For many years studies showed that models significantly underestimated the observed ... in the Arctic. This paper, based on key advances, showed that we now do have this quantitative agreement.

**step change in modelling, new paradigm**

New idea that links xx to air pollution. Other researchers have since taken on this idea...

**discovery, consequences**

Quantifying one of the most important unknowns in climate change using observations alone for the first time

**new approach, important new knowledge**

# Some 4\* papers from RAE2008

Showed the present fall in Earth's magnetic field strength started in 1860, with no change from 1585-1860.  
Reported by over 20 press reports

**discovery, impact**

Huge addition to xx record from last 40 kyr, including most detailed record of xx to date.

**major data synthesis**

First fully coupled atmosphere-ocean model of ... Helped trigger a major NSF funded project.

**first, step change in modelling, consequences**

Evaluates for the first time the evolutionary history of ... Generated reports on 10 science websites, a press conference and a radio interview...

**first**

A breakthrough in interpreting ... events. The method has high forecasting potential and is now routinely used at several ... observatories

**new paradigm, consequences, application**

# Some 4\* papers from RAE2008

Interdisciplinary and multi-institutional collaboration on economics of ... Among the six most downloaded articles in ...

## **impact**

First paper to document the diurnal cycle of ... Used as the basis for the observing strategy of the ... field programme.

## **first, consequences**

First ever attempt to quantify the main mechanisms of ... delivery to the oceans.

## **first**

Study of unprecedented ... episode in ... First time such a ... event has ever been measured with modern technology.

## **first, discovery**

**First**

**New paradigm**

**Consequences**

**Step-changes**

**Discoveries**

**Major syntheses**

# Maximising the chances of writing 4\* papers

## Planning and doing research:

1. Work on **important/frontier topics** (may be interdisciplinary)  
4\* papers rarely come from 2\* research projects  
Can your research evolve towards more important questions?
2. A **unique tool** (lab, instrument, model)
3. Having **unique data** (e.g., field campaign)
4. Have **good ideas**
5. Being prepared to **deviate from 2\*/3\* research plan**  
4\* papers quite often serendipitous and not from grants

# Maximising the chances of writing 4\* papers

## When writing:

1. Don't bury big ideas in large complex papers – be prepared to write a special paper
2. Do the “Why do I care?” test on the abstract/conclusions

- Do we agree on what a 4\* paper is?
- How do we (as individuals and as a School/Institute) increase the number of 4\* papers?

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- New paradigms or concepts for research [paradigms]
- Major changes in policy or practice with respect to applied research [policy consequences]