

# **My First Thesis**

**First Second Surname**

Submitted in accordance with the requirements for the degree of  
Doctor of Philosophy

The University of Leeds  
School of Earth and Environment

May 2019



The candidate confirms that the work submitted is their own, except where work which has formed part of jointly authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

The work in Chapter 2 of the thesis has appeared in publication as follows:

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Author 1 did...., Author 2 did...., author 3 did.... .

The work in Chapter 3 of the thesis has been accepted for publication pending minor revisions under the following title:

Paper 2 citation.

Author 1 did...., Author 2 did...., author 3 did.... .

The work in Chapter 4 of the thesis is a manuscript about to be submitted under the following title:

Publication 3 title.

Author 1 did...., Author 2 did...., author 3 did.... .

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# Abstract

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# Nomenclature

## List of acronyms

BSS	Blind Signal Separation
CNN	Convolutional Neural Network
DEM	Digital Elevation Model
ESA	European Space Agency
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ICA	Independent component analysis
InSAR	Interferometric synthetic aperture RaDAR
NN	Neural Network
NMF	Non-negative matrix factorisation
PCA	Principal component analysis
PDF	Probability density function
SAR	Synthetic aperture RaDAR
SRTM	Shuttle RaDAR Topography Mission
SVM	Support vector machines

## List of symbols

<b>W</b>	Unmixing matrix
<b>A</b>	Mixing matrix
<b>S</b>	Sources (as row vectors)
<b>X</b>	Mixtures (as row vectors)



# Chapter 1

## Introduction

Aliquam erat volutpat. Nam iaculis euismod urna. Ut neque lacus, condimentum dignissim sem ac, elementum lacinia quam. Vestibulum a dictum justo, non dignissim ipsum. Donec massa nunc, suscipit in tincidunt a, efficitur ac eros. Nulla nec eros elementum, feugiat velit vitae, hendrerit lacus. Curabitur tortor leo, cursus vel ante hendrerit, vulputate fermentum nisl. Praesent fringilla vitae ante at molestie. Nullam lacinia nibh eget rhoncus tristique.

A citation, either (Massonet and Feigl, 1998) or Massonet and Feigl (1998)

$$\text{Binary output} = \begin{cases} 1 & \text{if } \mathbf{w} \cdot \mathbf{x} > \text{threshold} \\ 0 & \text{if } \mathbf{w} \cdot \mathbf{x} \leq \text{threshold} \end{cases} \quad (1.1)$$

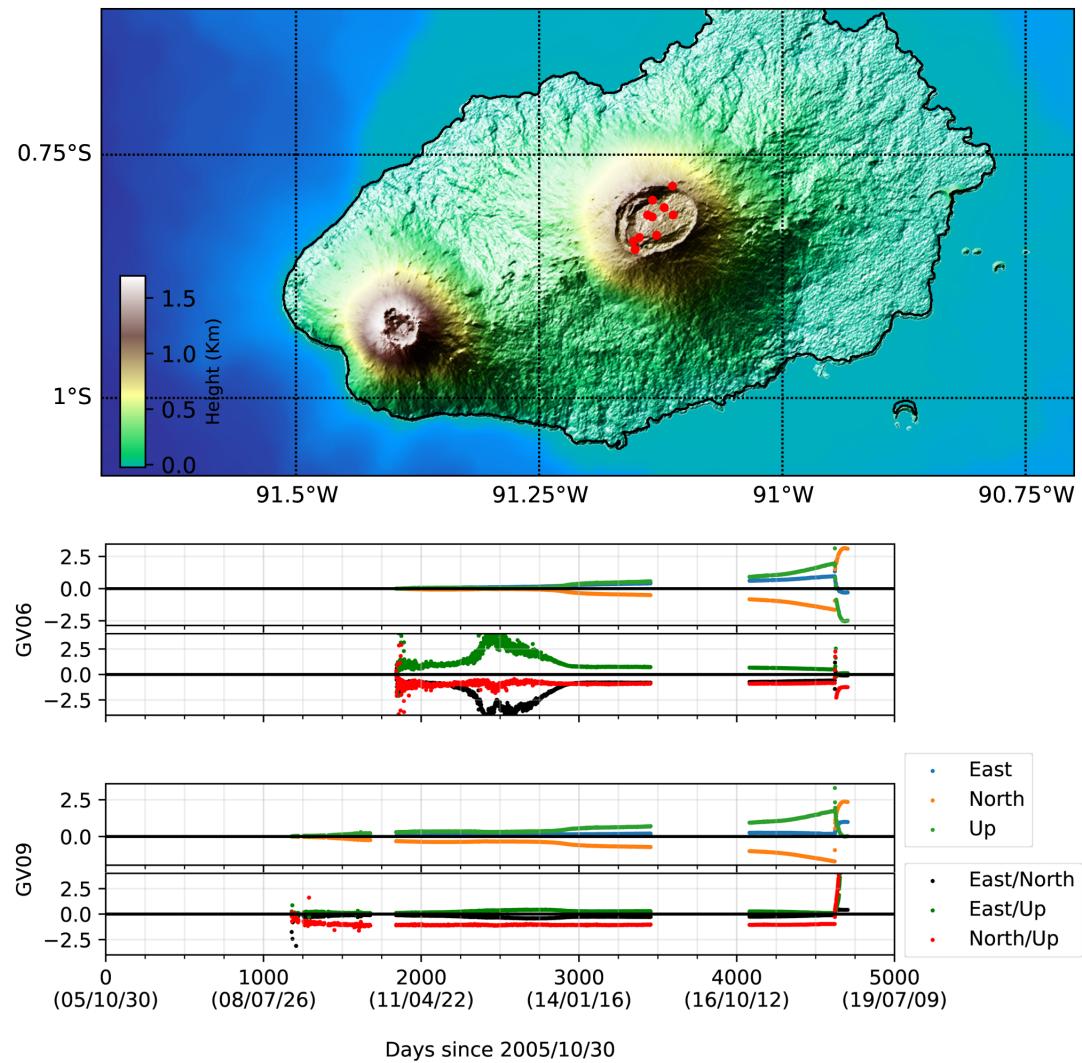
### 1.1 A section

### 1.2 Aims and Objectives

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The objectives of this thesis are:

1. Objective 1
2. Objective 2



**Figure 1.1:** Long caption

### 3. Objective

## 1.3 Thesis outline

The subsequent chapters in this thesis are organised as follows:

- Chapter 2 blah blah.
- Chapter 3 more blah.
- Chapter 4 blah 3.
- Chapter 5 discusses the work contained within the preceding chapters in relation to the goal of Blah.

## References

Massonet, Didier and Kurt L Feigl (1998). “Radar interferometry and its application to changes in the Earth’s surface”. In: 97, pp. 441–500.



## Chapter 2

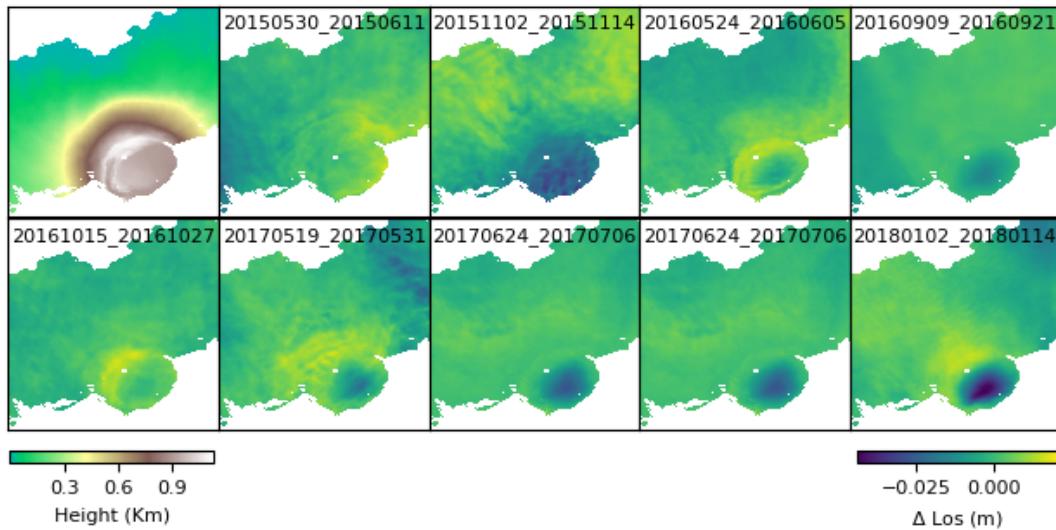
# Publication 1 title

F. surname<sup>1</sup>, A. Supervisor<sup>1</sup>, and B. Supervisor<sup>2,3</sup>

<sup>1</sup> COMET, School of Earth and Environment, University of Leeds, United Kingdom

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<sup>3</sup> Now at Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA



**Figure 2.1:** Long caption

Keypoints:

- Some journals like keypoints.
- Two.
- Three.

## Abstract

Aliquam erat volutpat. Nam iaculis euismod urna. Ut neque lacus, condimentum dignissim sem ac, elementum lacinia quam. Vestibulum a dictum justo, non dignissim ipsum. Donec massa nunc, suscipit in tincidunt a, efficitur ac eros. Nulla nec eros elementum, feugiat velit vitae, hendrerit lacus. Curabitur tortor leo, cursus vel ante hendrerit, vulputate fermentum nisl. Praesent fringilla vitae ante at molestie. Nullam lacinia nibh eget rhoncus tristique.

### 2.1 Introduction

A new citation: (Bernard et al., 1997)

## References

Bernard, P, P Briole, B Meyer, J Gomez, C Tiberi, C Berge, R Cattin, D Hatzfeld, C Lachet, B Lebrun, A Deschamps, F Courboulex, C Larroque, A Rigo, D Massonnet, P Papadimitriou, J Kassaras, D Diagourtas, K Makropoulos, G Veis, E Papazisi, C Mitsakaki, V Karakostas, and E Papadimitriou (1997). “TheMs=6.2, June 15, 1995 Aigion earthquake (Greece): evidence for low angle normal faulting in the Corinth rift”. In: *Journal of Seismology* 1, pp. 131–150. URL: <http://www.springerlink.com/index/n46q460541j72vt3.pdf>.



## Chapter 3

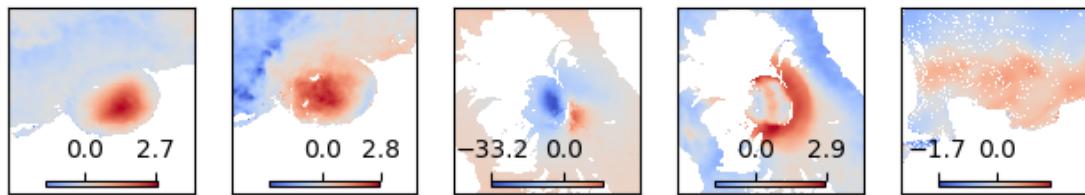
# Publication 2 title

F. surname<sup>1</sup>, A. Supervisor<sup>1</sup>, and B. Supervisor<sup>2,3</sup>

<sup>1</sup> COMET, School of Earth and Environment, University of Leeds, United Kingdom

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**Figure 3.1:** Long caption

Keypoints:

- Some journals like keypoints.
- Two.
- Three.

## Abstract

Aliquam erat volutpat. Nam iaculis euismod urna. Ut neque lacus, condimentum dignissim sem ac, elementum lacinia quam. Vestibulum a dictum justo, non dignissim ipsum. Donec massa nunc, suscipit in tincidunt a, efficitur ac eros. Nulla nec eros elementum, feugiat velit vitae, hendrerit lacus. Curabitur tortor leo, cursus vel ante hendrerit, vulputate fermentum nisl. Praesent fringilla vitae ante at molestie. Nullam lacinia nibh eget rhoncus tristique.

### 3.1 Introduction

A new citation: (Bernard et al., 1997) More citations: (Hyvärinen, 1997)

## References

Bernard, P, P Briole, B Meyer, J Gomez, C Tiberi, C Berge, R Cattin, D Hatzfeld, C Lachet, B Lebrun, A Deschamps, F Courboulex, C Larroque, A Rigo, D Massonnet, P Papadimitriou, J Kassaras, D Diagouras, K Makropoulos, G Veis, E Papazisi, C Mitsakaki, V Karakostas, and E Papadimitriou (1997). “TheMs=6.2, June 15, 1995 Aigion earthquake (Greece): evidence for low angle normal faulting in the Corinth rift”. In: *Journal of Seismology* 1, pp. 131–150. URL: <http://www.springerlink.com/index/n46q460541j72vt3.pdf>.

- Hyvärinen, Aapo (1997). “Independent Component Analysis by Minimization of Mutual Information”. In: *Journal of Chemical Information and Modeling* 53.9, pp. 1689–1699. ISSN: 1098-6596. DOI: 10.1017/CBO9781107415324.004. arXiv: arXiv:1011.1669v3.



## Chapter 4

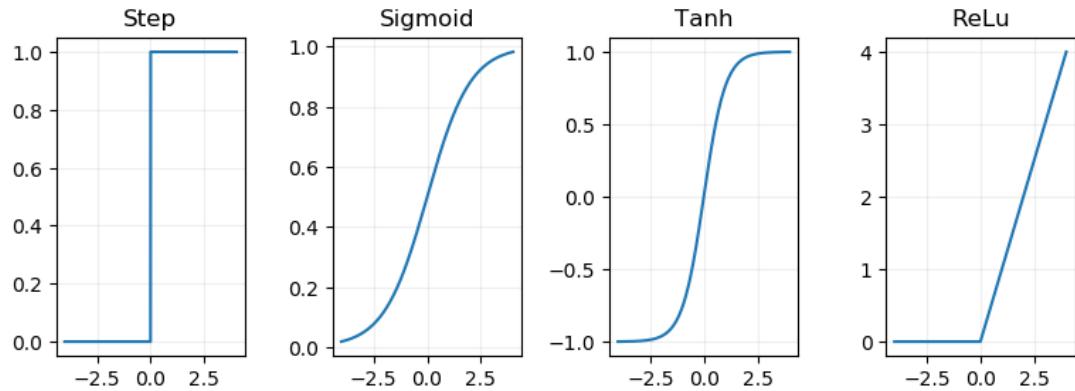
# Publication 3 title

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<sup>3</sup> Now at Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA



**Figure 4.1:** Long caption

Keypoints:

- Some journals like keypoints.
- Two.
- Three.

## Abstract

Aliquam erat volutpat. Nam iaculis euismod urna. Ut neque lacus, condimentum dignissim sem ac, elementum lacinia quam. Vestibulum a dictum justo, non dignissim ipsum. Donec massa nunc, suscipit in tincidunt a, efficitur ac eros. Nulla nec eros elementum, feugiat velit vitae, hendrerit lacus. Curabitur tortor leo, cursus vel ante hendrerit, vulputate fermentum nisl. Praesent fringilla vitae ante at molestie. Nullam lacinia nibh eget rhoncus tristique.

### 4.1 Introduction

A new citation: (Bernard et al., 1997) More citations: (Hyvärinen, 1997) And another: (Mogi, 1958)

## References

Bernard, P, P Briole, B Meyer, J Gomez, C Tiberi, C Berge, R Cattin, D Hatzfeld, C Lachet, B Lebrun, A Deschamps, F Courboulex, C Larroque, A Rigo, D Massonnet, P Papadimitriou, J Kassaras, D Diagouras, K Makropoulos, G Veis, E Papazisi, C

- Mitsakaki, V Karakostas, and E Papadimitriou (1997). “TheMs=6.2, June 15, 1995 Aigion earthquake (Greece): evidence for low angle normal faulting in the Corinth rift”. In: *Journal of Seismology* 1, pp. 131–150. URL: <http://www.springerlink.com/index/n46q460541j72vt3.pdf>.
- Hyvärinen, Aapo (1997). “Independent Component Analysis by Minimization of Mutual Information”. In: *Journal of Chemical Information and Modeling* 53.9, pp. 1689–1699. ISSN: 1098-6596. DOI: 10.1017/CBO9781107415324.004. arXiv: [arXiv:1011.1669v3](https://arxiv.org/abs/1011.1669v3).
- Mogi, Kiyoo (1958). “Relations between the eruptions of various volcanoes and the deformations of the ground surfaces around them”. In: *Bulletin of the Earthquake Research Institute* 36, pp. 99–134. ISSN: 0040-8972. DOI: 10.1016/j.epsl.2004.04.016.



# Chapter 5

## Discussion and Conclusions

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In this thesis, my objective was to develop an algorithm to detect signs of deformation-generating volcanic unrest in a time series of interferograms. In Chapter 1 I divided this objective into four smaller aims, which I revisit in Section 5.1. In Section 5.2 I discuss the opportunities for further work on this topic, and in Section 5.3 I present my concluding remarks.

Refs should still work: A new citation: (Bernard et al., 1997) More citations: (Hyvärinen, 1997) And another: (Mogi, 1958)

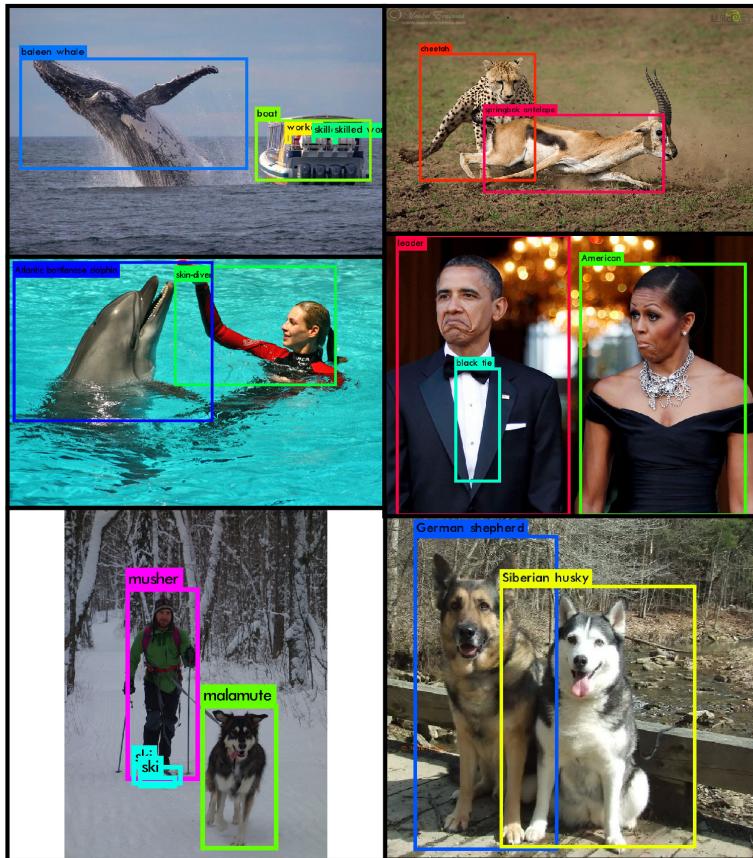
### 5.1 Project aims and key findings

#### 5.1.1 Further Remarks

#### 5.1.2 Key Findings

Some findings

1. some stuff



**Figure 5.1:** Results from YOLO9000, reproduced from Redmon and Farhadi (2017). The figure shows the results of the CNN when applied to ImageNet data, and its ability to both locate and classify multiple objects in a single image.

## 5.2 Future work

## 5.3 Concluding remarks

## References

Bernard, P, P Briole, B Meyer, J Gomez, C Tiberi, C Berge, R Cattin, D Hatzfeld, C Lachet, B Lebrun, A Deschamps, F Courboulex, C Larroque, A Rigo, D Massonnet, P Papadimitriou, J Kassaras, D Diagouras, K Makropoulos, G Veis, E Papazisi, C Mitsakaki, V Karakostas, and E Papadimitriou (1997). “TheMs=6.2, June 15, 1995 Aigion earthquake (Greece): evidence for low angle normal faulting in the Corinth rift”. In: *Journal of Seismology* 1, pp. 131–150. URL: <http://www.springerlink.com/index/n46q460541j72vt3.pdf>.

Hyvärinen, Aapo (1997). “Independent Component Analysis by Minimization of Mutual Information”. In: *Journal of Chemical Information and Modeling* 53.9, pp. 1689–

1699. ISSN: 1098-6596. DOI: 10.1017/CBO9781107415324.004. arXiv: arXiv:1011.1669v3.
- Mogi, Kiyoo (1958). “Relations between the eruptions of various volcanoes and the deformations of the ground surfaces around them”. In: *Bulletin of the Earthquake Research Institute* 36, pp. 99–134. ISSN: 0040-8972. DOI: 10.1016/j.epsl.2004.04.016.
- Redmon, Joseph and Ali Farhadi (2017). “YOLO9000: better, faster, stronger”. In: *Proceedings of the IEEE conference on computer vision and pattern recognition*, pp. 7263–7271.



# **Appendix A: Supporting information for Chapter 2**

## **Contents of this file**

1. Text S1 to S3
2. Figures S1 to S2

**Introduction** From a paper....

