Fortran Specialist Group

Making IT good for society

Presentation to the BCS Bedford Branch, 20 September 2016

Fortran, alive and well at 59!

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Chairman BCS Fortran Specialist Group

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Presentation Outline

My Background

Early Years of FORTRAN

Fortran Pioneers – in Their Own Words

Fortran Standards Summary

Compiler Support for Fortran Standards

BCS Fortran Specialist Group and its Activities

Current Application Areas for Fortran

Further information & Acknowledgements

My Background

1968 – 1984	Industrial research chemist. Started programming in BASIC and Pascal in the late 1970s. Began to use Fortran in the early 1980s.
1985 – 2001	Software developer for Computer Aided Design and Manufacturing systems using Fortran and C.
2003 – 2005	Junior civil servant in the Department for Work and Pensions.
2008 – 2014	Part-time consultant to the Nickel Institute
1993	Joined the British Computer Society
1997 – 2002	Chairman of BCS Birmingham Branch
2002 – to date	Chairman of BCS Fortran Specialist Group
2015 – to date	Treasurer of BCS Wolverhampton Branch

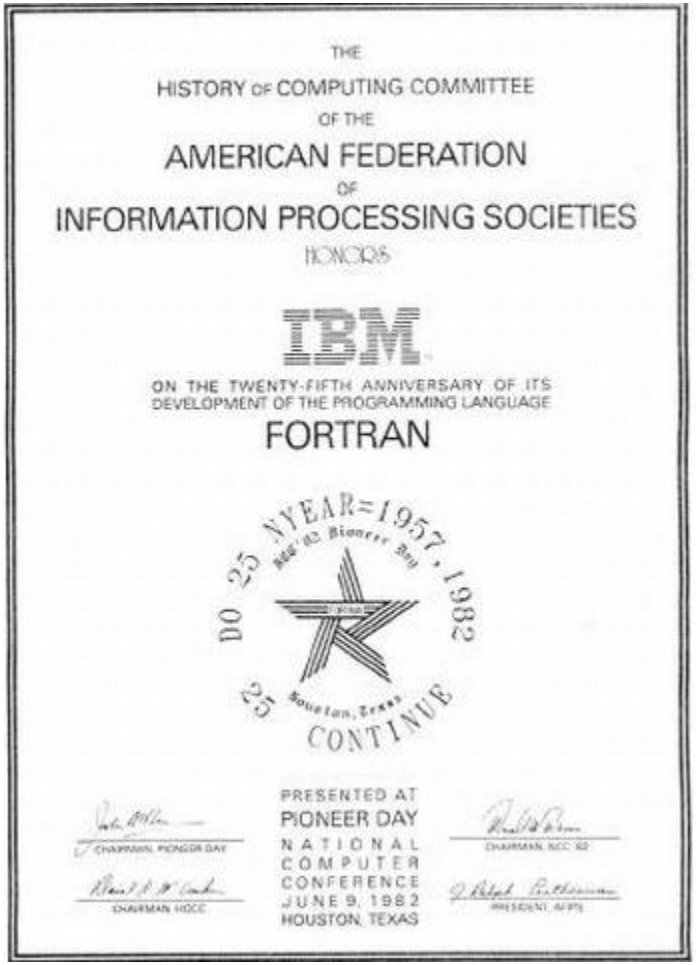
Early years of FORTRAN: 1954-1967

1954	Development work starts in IBM led by John Backus
1957	IBM release a FORTRAN compiler for the IBM 704
1958	IBM release FORTRAN II, with subroutines and blank common
1960	Philco release ALTAC, a FORTRAN II look-alike
1961	IBM have eight different compilers (for the 709, 650, 1620 and 7090) and publish a guide to language variations between them
1961	Univac release FORTRAN I for the SS80, the first compiler called 'FORTRAN' for a non-IBM machine

See www.fortran.bcs.org/2007/jubilee/implementations.php for a list of FORTRAN implementations from 1957 to 1967

An IBM 704 mainframe from the late 1950s (image courtesy of LLNL)

Pioneer Day June 9 1982 Houston, Texas



THE
HISTORY OF COMPUTING COMMITTEE
OF THE
AMERICAN FEDERATION
OF
INFORMATION PROCESSING SOCIETIES
HONORS

IBM

ON THE TWENTY-FIFTH ANNIVERSARY OF ITS
DEVELOPMENT OF THE PROGRAMMING LANGUAGE
FORTRAN

DO 25 NYEAR=1957,1982
25 Houston, Texas
CONTINUE

PRESENTED AT
PIONEER DAY
NATIONAL
COMPUTER
CONFERENCE
JUNE 9, 1982
HOUSTON, TEXAS

CHAIRMAN, PIONEER DAY
CHAIRMAN, HOCC
CHAIRMAN, NCC '82
PRESIDENT, AFIPS

DO 25 NYEAR=1957,1982
25 CONTINUE

The 25th Anniversary
of
FORTRAN
June 9, 1982
Pioneer Day
1982 National Computer Conference
1:45 p.m. The Early Days of FORTRAN
3:30 p.m. The Institutional-ization of FORTRAN

FORTRAN
—"the infantile disorder"—
is hopelessly inadequate for whatever computer application you have in mind today . . . too clumsy, too risky and too expensive.
—Edsger Dijkstra

God is Real
(unless otherwise declared in an explicit type statement or in an implicit declaration).
—B. Graham

I don't know what the language of the year 2000 will look like but I know it will be called FORTRAN
—Tony Hoare

FORTRAN
is a collection of Warts, held together by bits of Syntax.
—Anon.

FORTRAN
is a language to avoid
—unless you want some answers
—Anon.

The one central attribute of FORTRAN is its name
—Martin Greenfield

In the good old days, physicists repeated each other's experiments, just to be sure,
Today they stick to FORTRAN
so they can share each other's programs, bugs included.
—Edsger Dijkstra

Sayings from cards distributed at Pioneer Day.

Annals of the History of Computing, Volume 6, Number 1, January 1984 • 13

Fortran Pioneers, led by John Backus, reunited 25 years on - June 1982

Standing, from left: John Backus, Sheldon Best, Robert Nelson, Irving Ziller.
Seated, from left: Richard Goldberg, Lois Habt, Roy Nutt.

From left: Richard Goldberg, Robert Nelson, Lois Habt, Roy Nutt, Irving Ziller, Shelton Best, Harlan Herrick, John Backus, Peter Sheridan.

The creation of Fortran: in their own words

There are two Fortran films available for download from www.softwarepreservation.org/projects/FORTRAN/video

The first, from 1982, was commissioned by IBM mark the 25th anniversary of the release of the first Fortran compiler. It features John Backus and members of his development team describing how they created the first Fortran compiler between 1954 and 1957.

It is also available for viewing on YouTube.

The second, from 1958, is an IBM demonstration of using Fortran I or II to calculate compound interest. It is available in Quick Time and Windows Media (WMV) format. The video quality is rather poor.

John Backus (1924-2007), *centre*, 47 years on - February 2004 with Alex Stepanov, *left*, and Paul McJones

FORTRAN standards summary (1)

1966

ANSI standard X3.9-66 (FORTRAN 66)

First programming language standard
Developed between 1962 and 1966
Essentially a common subset of vendors' offerings
The US standard is reproduced as an ISO standard in 1972

1978

ANSI standard X3.9-78 (FORTRAN 77)

Introduced CHARACTER data type,
IMPLICIT, PARAMETER, SAVE statements,
IF - THEN - ELSE construct
Also published as ISO standard 1539:1980

1990

Development of Fortran 90

Originally scheduled for completion in 1982
Renamed Fortran 8X, then Fortran 88 and finally completed after rancorous discussions and attempts by some US vendors to derail the entire project

Fortran standards summary (2)

ISO/IEC standard 1539:1991 (Fortran 90)

1991 Major revision - introduced free form source form, whole array operations, memory allocation at runtime, facilities for modular data and procedure definitions, parameterized intrinsic types, user-defined data types, pointers & many minor modernizations and removal of arbitrary restrictions

See "**The Fortran (not the foresight) saga: the light and the dark**" by Brian Meek and "**The Standards Hiatus**" by Miles Ellis and Lawrie Schonfelder, both linked from www.fortran.bcs.org/2007/jubileeprog.php, for more information on the development of Fortran 90

ISO/IEC standard 1539-1:1997 (Fortran 95)

1997 Minor revision – introduced FORALL construct, PURE and ELEMENTAL procedures, initialization for pointers and for structures, some older, duplicated features designated as 'obsolescent'

Fortran standards summary (3)

2000

ISO/IEC 1539-2:2000 - Varying length character strings

Revision of a previous version issued in 1994. Took account of improvements introduced in Fortran 95. Defined interface and semantics for module that provided facilities for manipulation of character strings of arbitrary and dynamically variable length.

2004

ISO/IEC 1539-1:2004 (Fortran 2003)

Major revision - introduced object oriented programming support, standardised interoperability with C, I/O enhancements, including stream access and asynchronous transfers, access to command line arguments & environmental variables, support for IEEE arithmetic & exception handling and for 'international usage'

2010

ISO/IEC standard 1539-1:2010 (Fortran 2008)

Major revision - introduced coarrays as an extension for parallel processing, execution of command shell commands, I/O enhancements including getting unique unit numbers, new edit descriptors, BLOCK construct with declarations

Fortran standards summary (4)

Two Technical Specifications, subsidiary standards, issued

ISO/IEC TS 29113:2012 - Further Interoperability of Fortran with C

2012 Provided for interoperability of interfaces with Fortran dummy arguments that are assumed-shape arrays, have assumed character length, or have the ALLOCATABLE, POINTER or OPTIONAL attributes. New Fortran concepts of assumed type and assumed rank introduced.

ISO/IEC TS18508:2015 - Additional Parallel Features in Fortran

2015 Introduced concept of TEAMS of images, handling of FAILED images and posting of EVENTs by one image to notify another image. New generic intrinsic procedures specified and extensions specified for existing intrinsic procedures.

ISO/IEC standard 1539-1:2018 (Fortran 2015)

2018 Minor revision - incorporating the technical corrigenda to Fortran 2008, the two technical specifications (on further interoperability with C and on additional parallel facilities), editorial improvements and removal of existing deficiencies and irregularities.

Report presented to WG5 meeting in Las Vegas, June 2014 (1)

Alessandro Fanfarillo - Coarrays in GNU Fortran

Report presented to WG5 meeting in Las Vegas, June 2014 (2)

Hardware

- Eurora: Linux Cluster, 16 cores per node, Infiniband QDR QLogic (CINECA).
- PLX: IBM Dataplex, 12 cores per node, Infiniband QDR QLogic (CINECA).
- Yellowstone/Caldera: IBM Dataplex, 16 cores per node, Infiniband Mellanox (NCAR).
- Janus: Dell, 12 cores per node, Infiniband Mellanox (CU-Boulder).
- Hopper: Cray XE6, 24 cores per node, 3-D Torus Cray Gemini (NERSC).
- Edison: Cray XC30, 24 cores per node, Cray Aries (NERSC).

Only Yellowstone and Hopper used for this presentation.

Report presented to WG5 meeting in Las Vegas, June 2014

Software

On Hopper:

- Cray: Cray (CCE) 8.2.1
- GFortran: GCC-4.10 experimental (gcc branch) + Mpich/6.0.1

On Yellowstone:

- Intel: Intel 14.0.2 + IntelMPI 4.0.3
- GFortran: GCC-4.10 experimental (gcc branch) + MPICH IBM opt. Mellanox IB

For Intel CAF, every coarray program runs in CAF Distributed Mode.

Report presented to WG5 meeting in Las Vegas, June 2014

Test Suite Description

- CAF Psnap (Dan Nagle)
  - It is a network noise analyzer. It can be useful for a statistical study of the communication between processes.
- EPCC CAF Micro-benchmark suite (Edinburgh University)
  - It measures a set of basic parallel operations (get, put, strided get, strided put, sync, halo exchange).
- Burgers Solver (Damian Rouson)
  - It has nice scaling properties: it has a 87% weak scaling efficiency on 16384 cores and linear scaling (sometimes super-linear).
- CAF Himeno (Prof. Ryutaro Himeno - Bill Long - Dan Nagle)
  - It is a 3-D Poisson relaxation.
- Distributed Transpose (Bob Rogallo).
  - It is a 3-D Distributed Transpose.
- Dense matrix-vector multiplication (MxV).

Report presented to WG5 meeting in Las Vegas, June 2014

Conclusions - GFortran vs. Intel

- Intel shows better performance than GFortran only during scalar transfers within the same node.
- Intel pays a huge penalty when it uses the network (multi node).
- GFortran shows better performance than Intel on array transfers within the same node.
- GFortran shows better performance than Intel in every configuration which involves the network.

Report presented to WG5 meeting in Las Vegas, June 2014

Conclusions - GFortran vs. Cray

- Cray has better performance than GFortran within the same node.
- Cray has better performance than GFortran during contiguous array transfer on multi node (using the network).
- GFortran has better performance than Cray for strided transfers on multi node. (!!!)
- Cray requires some tuning (env vars and modules).

Report presented to WG5 meeting in Las Vegas, June 2014

Conclusions

- GFortran provides a stable, easy to use and efficient implementation of Coarrays.
- GFortran provides a valid and free alternative to commercial compilers.
- Coarrays in GFortran can be used on any architecture able to compile GCC and a standard MPI implementation.

Compiler support for Fortran 2003 & 2008 Standards and TS 29113

Table first published in April 2007, revised twice a year. Compiled by Ian Chivers and Jane Sleightholme, www.fortranplus.co.uk

Section on Fortran 2008 features added in August 2009

Section on TS 29113 features added in December 2013

Information on 11 compilers is currently available

The latest version is published in the ACM Fortran Forum magazine, Revision 19 – June 2106

The previous version is available from the Fortranplus website at www.fortranplus.co.uk/fortran-information/ , Revision 18 – April 2016

Fortran Compiler Comparisons are available from the Fortran UK website at www.fortran.uk/fortran-compiler-comparisons-2015/

The BCS Fortran Specialist Group is established: 1970

FSG Minutes of 6 January 1970:

The objectives of the group were formally agreed to be:

(a) to form a focus in the United Kingdom for work concerned with establishing and maintaining FORTRAN standards.

(b) to work in association with national and international standardisation bodies.

FSG Minutes of 5 April 1976:

4. Revision of objectives

Following further discussion, the wording of the proposed revised objectives now becomes "To undertake activities associated with any aspects of Fortran".

It is intended to present this for approval at the next Specialist Groups meeting.

Fortran SG Activities 1970-1992

- Fortran SG hold typically four to six meetings per year, mostly discussing working party progress, applications, software tools, programming techniques and, from late 1971, Fortran standards developments
- From late 1970s FSG members become involved in development of Fortran standards and play a significant part in development of Fortran 90
- Presentations are made at conferences and workshops, e.g. Datafair 73, 75 and 77 and a Fortran Forum in London in 1978 with six US members of X3J3 as speakers
- Fortran Forums are held in London (4) and Edinburgh (2), sometimes with visiting US speakers, other meetings are held outside London
- See www.fortran.bcs.org/archive.php for more details of Fortran SG activities from 1970 to 1992

Fortran SG Activities 1993-2007

- In mid-1990s attendances wilt with the advent of the internet. It is decided to hold only annual meetings plus special events
- The Fortran SG is revivified. Events are held in 2002 and 2005 to discuss UK requirements for inclusion in future Fortran standards
- From 2002 successful applications are made to BCS to support between one and three FSG members to attend ISO WG5 meetings to help put the UK case on Fortran standards
- In 2007 a very successful full-day meeting is held with the Computer Conservation Society to mark the 50th anniversary of the release of the first Fortran compiler
- FSG members organized the 2007 ISO WG5 meeting in BCS London offices and held a reception for WG5 delegates
- See www.fortran.bcs.org /2007/jubileevents.php for more details of Fortran activities in 2007

'Fifty Years of Fortran' meeting January 2007 held in BCS London Office

FSG Reception for WG5 delegates and partners on evening of 6 August 2007

held in The Weston Room at King's College Maughan Library

Fortran SG Activities 2010-2015

- In 2010 a successful meeting was held with the Institute of Physics Computational Physics Group to mark the 40th anniversary of the Fortran SG
- From 2011 the FSG AGM has been followed by an afternoon of Fortran-related talks including updates on the progress on Fortran standardisation, organised with the IoP CPG
- FSG members organized the 2015 ISO WG5 meeting in BCS London offices and a dinner for delegates and partners was held at the Salieri Restaurant in the Strand
- See www.fortran.bcs.org/pastevents.php for more details of Fortran SG activities since 1993

WG5 delegates and partners outside BCS London Office on 5 August 2015

before going to dinner at the Salieri Restaurant in the Strand

Some current application areas for Fortran

- Weather forecasting and climate prediction
- Analysis of seismic data for oil and gas exploration
- Nuclear test ban verification (forensic seismology)
- Modelling of nuclear weapons
- Financial analysis
- Vehicle crash simulation
- Computational fluid dynamics (CFD)
- Mathematical modelling of materials and processes
- Computerised aircraft performance monitoring

Supercomputing in the USA, 2010

DreamWorks presents The Power of Supercomputing

- In partnership with the Council on Competitiveness, Dreamworks produced a short animated film on the importance of high performance computing to the U.S. economy. Most of the applications described are written in Fortran.

Supercomputing at the UK Met Office

Met Office supercomputing

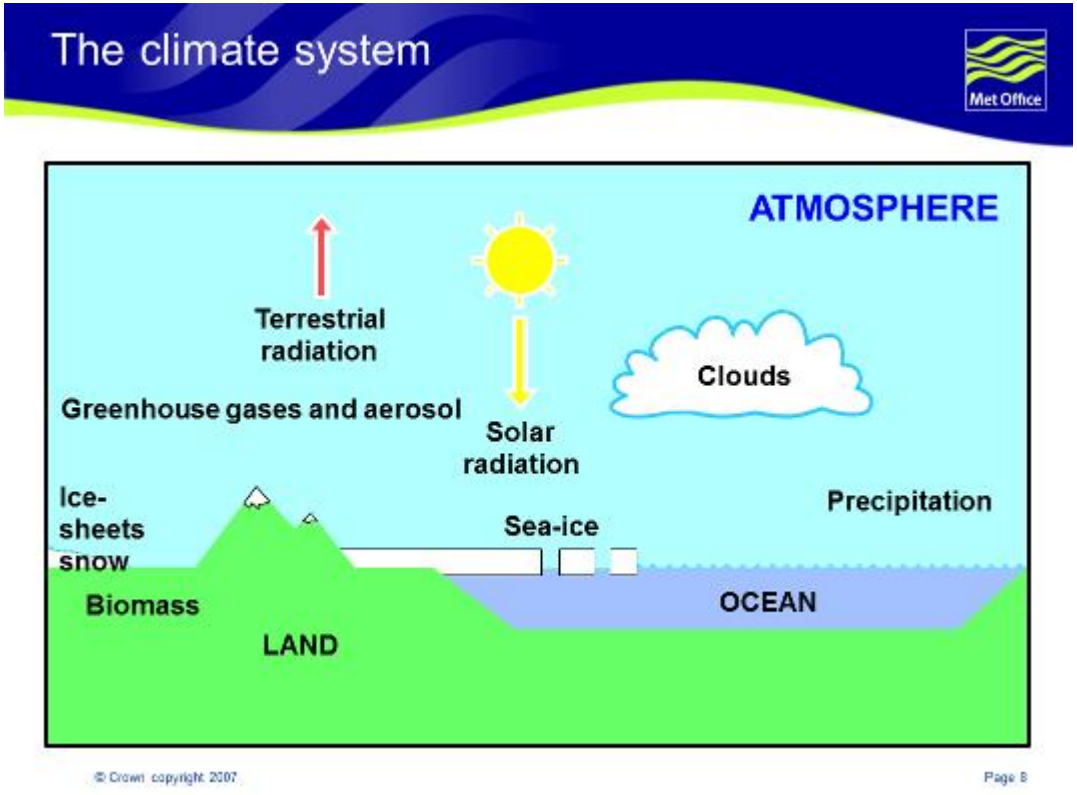
	SX-6	SX-8
CPU/node	8	8
Memory	32GByte	64GByte
Peak/node	64GFlops	128GFlops

3 clusters –

- 15 x SX-6
- 19 x SX-6
- 21 x SX-8

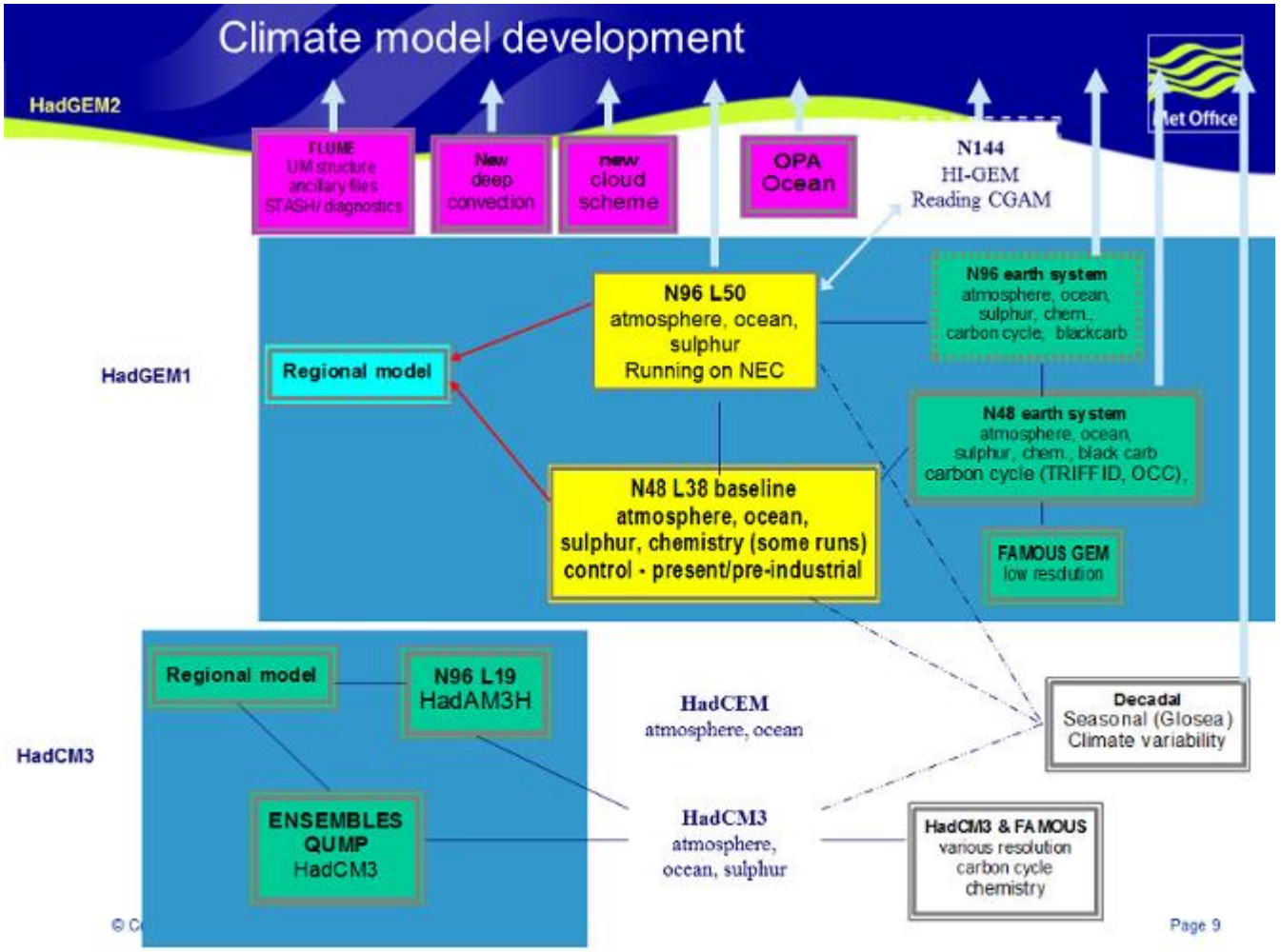
Weather forecast for Friday 16 September 2016 produced by the UK Met Office

The Met Office climate model HadSM3 and climateprediction.net (1)



See "Fifty Years of Fortran" meeting, January 2007, for full presentation by Michael Saunby, Met Office's Hadley Centre for Climate Change

The Met Office climate model HadSM3 and climateprediction.net (2)



The Met Office climate model HadSM3 and climateprediction.net (3)

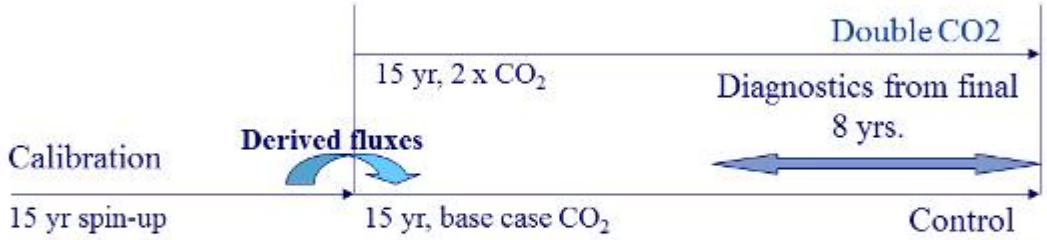
CPDN volunteer computing challenges...

- Model is about 1 million lines of Fortran (40MB src)
- Proprietary, licenced by UK MetOffice
  - distribute executable/binary form only
- Resolution used: 2.75x3.75 degrees (73 lat x 96 long)
- Typically run on a supercomputer (i.e. Cray T3E) or 8-node Linux cluster (minimum)
- Ported to a single-processor, 32-bit Linux box
- Original: Windows only, now also Mac OS X, Linux
- Intel Fortran Win & Linux, IBM XLF for Mac, soon Intel Mac
- Many validation runs made on single-proc/32-bit to compare to supercomputer 64-bit
- Current coupled model takes ~6 months to run on a P4/2GHz PC 24/7!

The Met Office climate model HadSM3 and climateprediction.net (4)

The experiments

- Expt 1: Unified Model with simple, thermodynamic ocean. (HadSM3)
  - Aim: To identify parameter combinations which have little effect on the mean climate but a large effect on climate sensitivity.

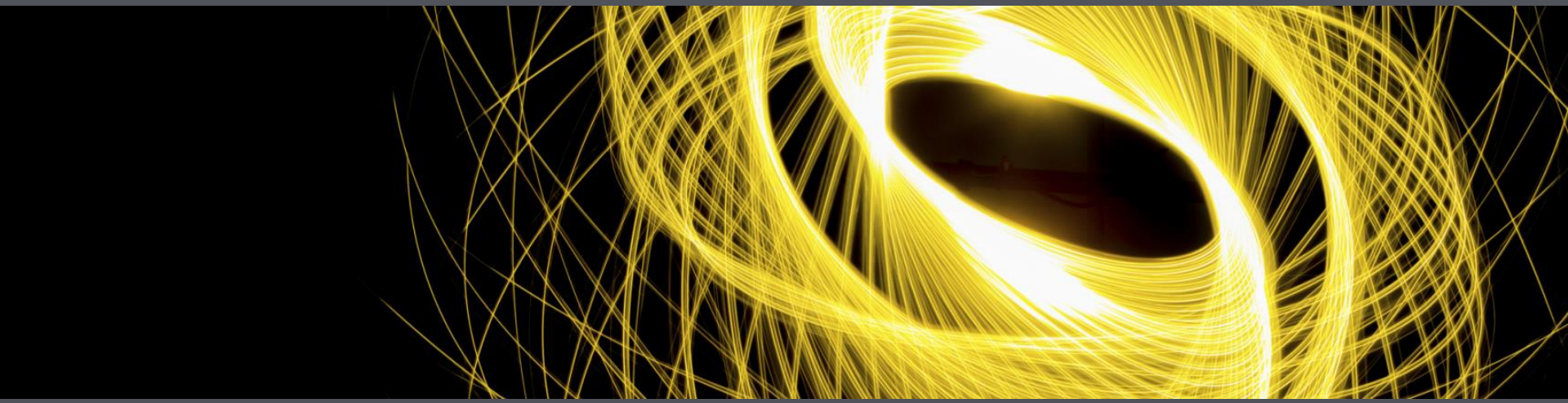


- Expt 2: Fully coupled model. (HadCM3)
  - Distribute pre-packaged simulations of 1950-2050.
  - Downweight or eliminate runs which compare badly with observations.
  - Re-distribute the surviving versions to simulate 2000-2050.
  - Estimate uncertainty from collated results and map the response manifold.

Department of Meteorology

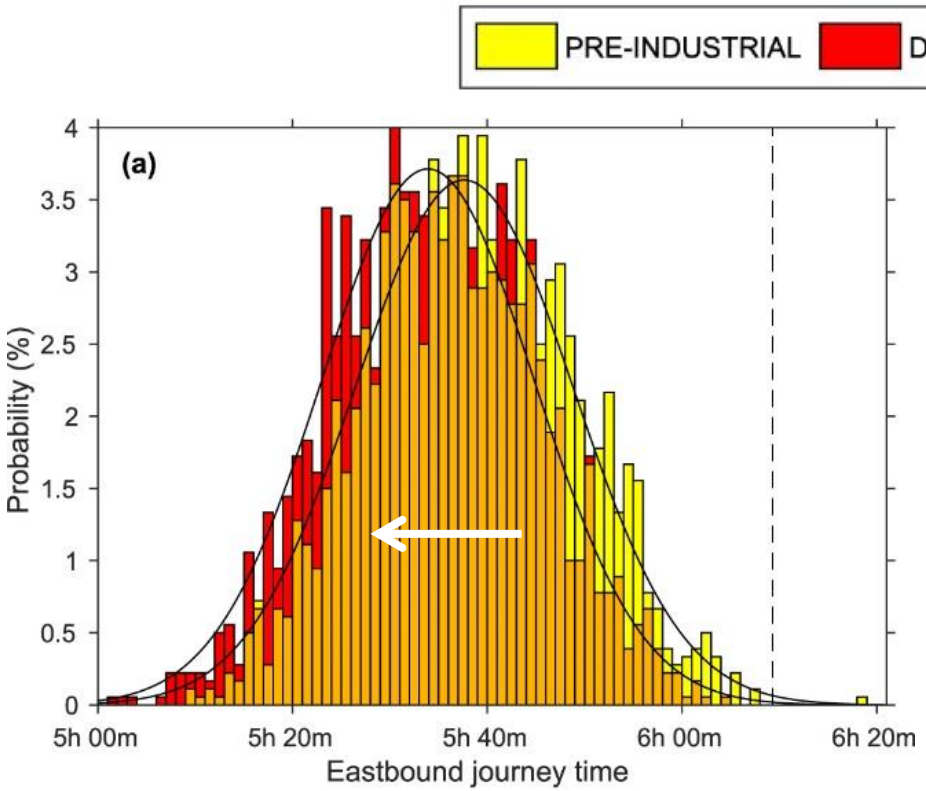
University of Reading

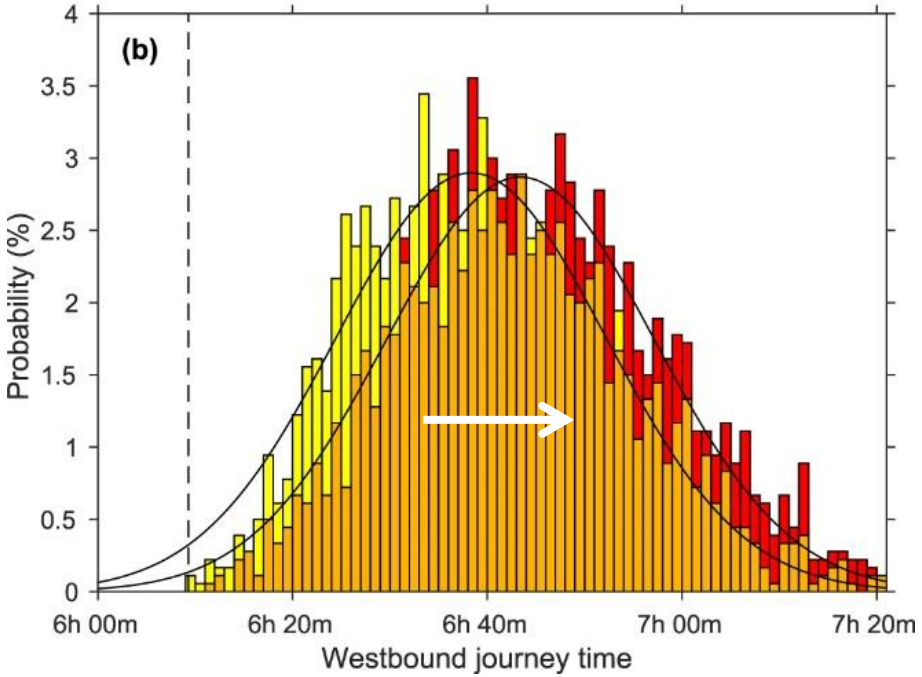
TURBULENCE AHEAD! HOW CLIMATE CHANGE WILL AFFECT AIR TRAVEL



Dr Paul Williams

Flight times in a changing climate

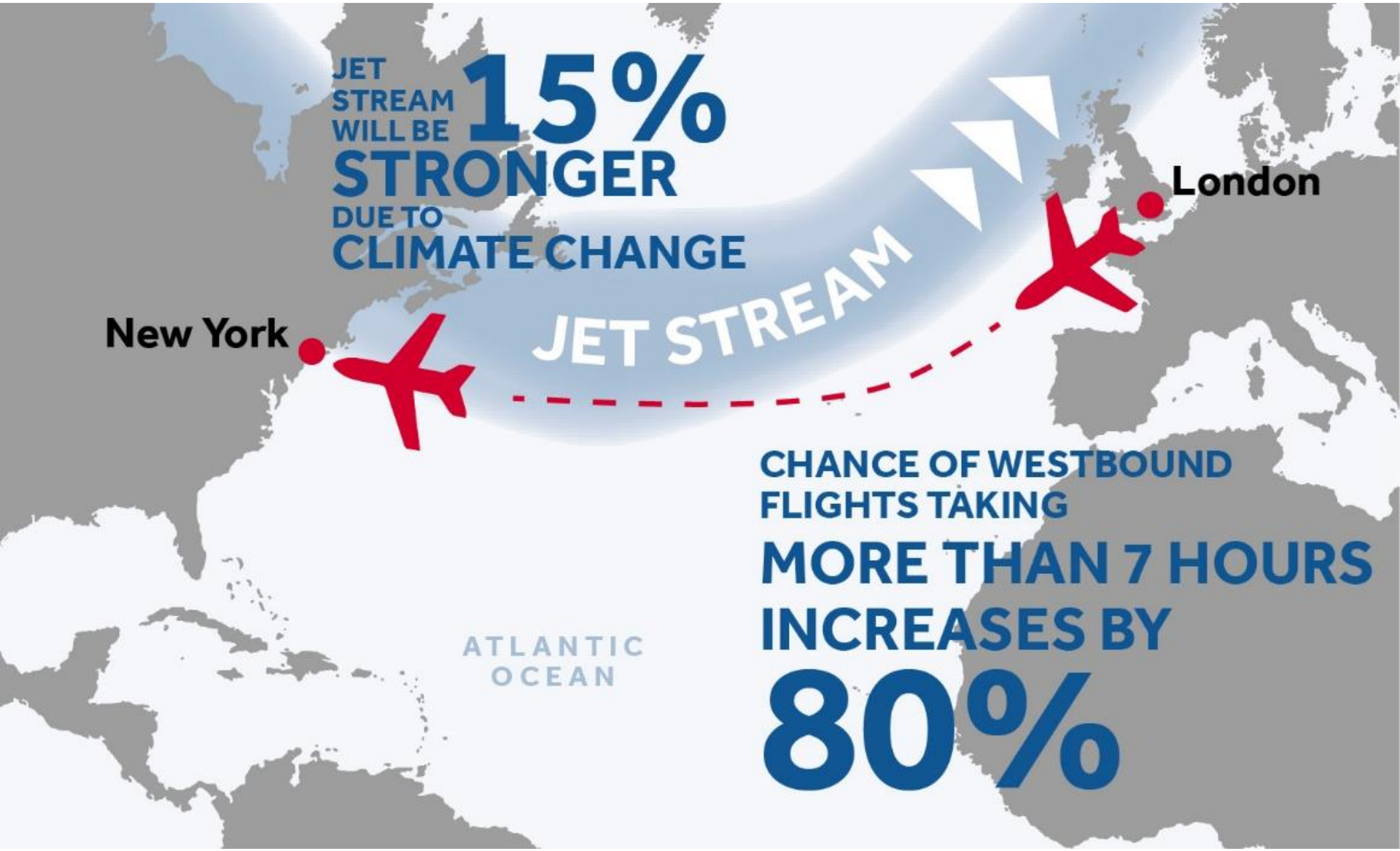




Likelihood of taking under 5 h 20 min more than doubles from 3.5% to 8.1%

Likelihood of taking over 7 h 00 min nearly doubles from 8.6% to 15.3%

Williams (2016)


JET STREAM WILL BE 15% STRONGER DUE TO CLIMATE CHANGE
London
New York
JET STREAM
CHANCE OF WESTBOUND FLIGHTS TAKING MORE THAN 7 HOURS INCREASES BY 80%
ATLANTIC OCEAN

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Page last updated at 12:25 GMT, Monday, 6 October 2008 13:25 UK

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Air turbulence tests 'improved'

A more accurate way of predicting air turbulence for aeroplanes has been developed by researchers.

Dr Williams hopes the technique will be used by the aviation industry

Dr Paul Williams, from the University of Reading, was part of a global team of academics who have developed a new forecasting technique.

Dr Williams said clear-air turbulence can strike suddenly, causing damage to planes and injury to passengers.

BBC Berkshire
Sport, travel, weather, things to do, features and much more

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- University of Reading

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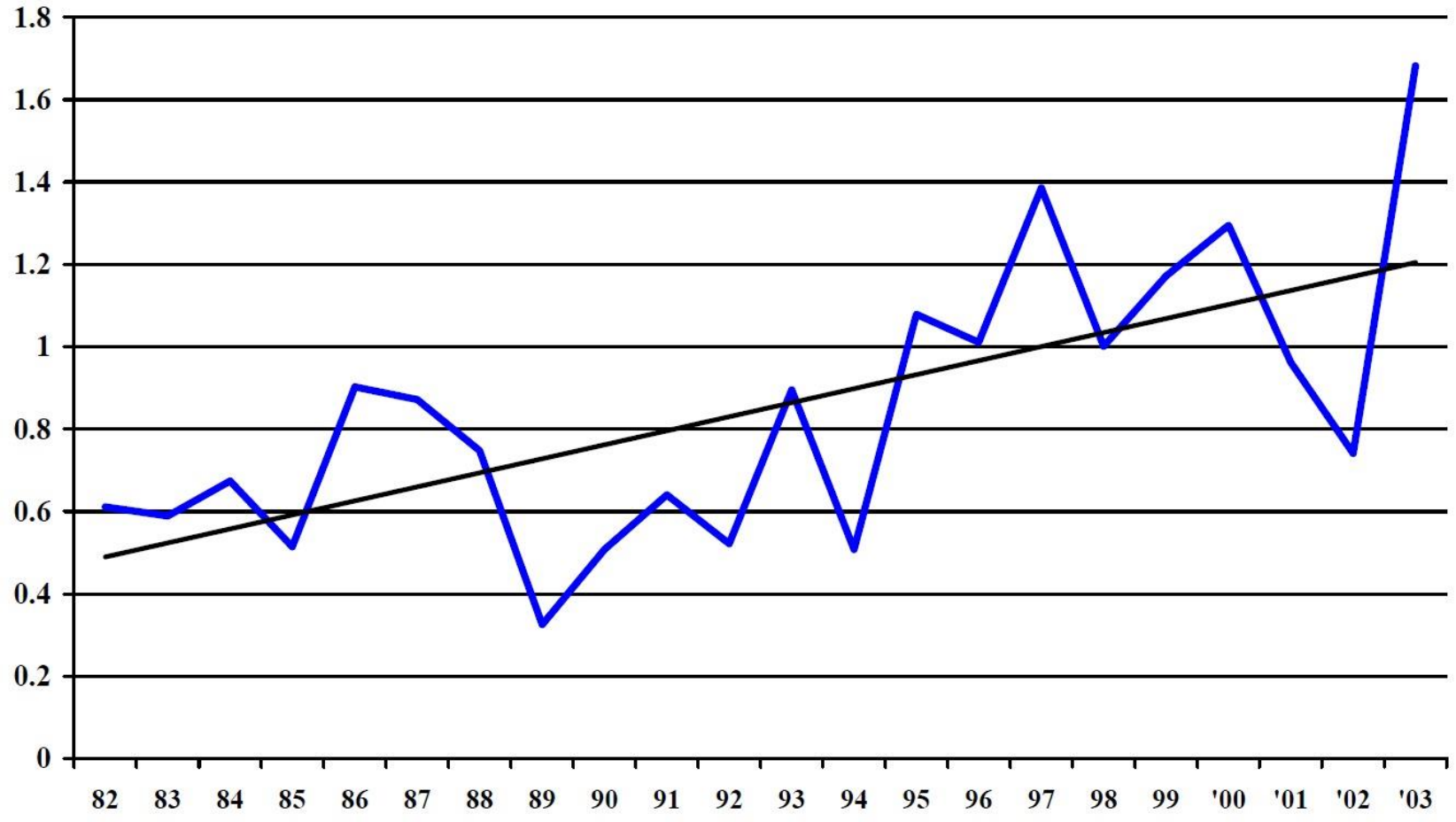
TOP BERKSHIRE STORIES
- Museum to close until next year
- Man robbed and attacked by group

http://news.bbc.co.uk/1/hi/england/berkshire/7654768.stm

Is Clear Air Turbulence increasing?

Number of serious injuries (including fatalities) caused by turbulence, per million flight departures (US carriers)

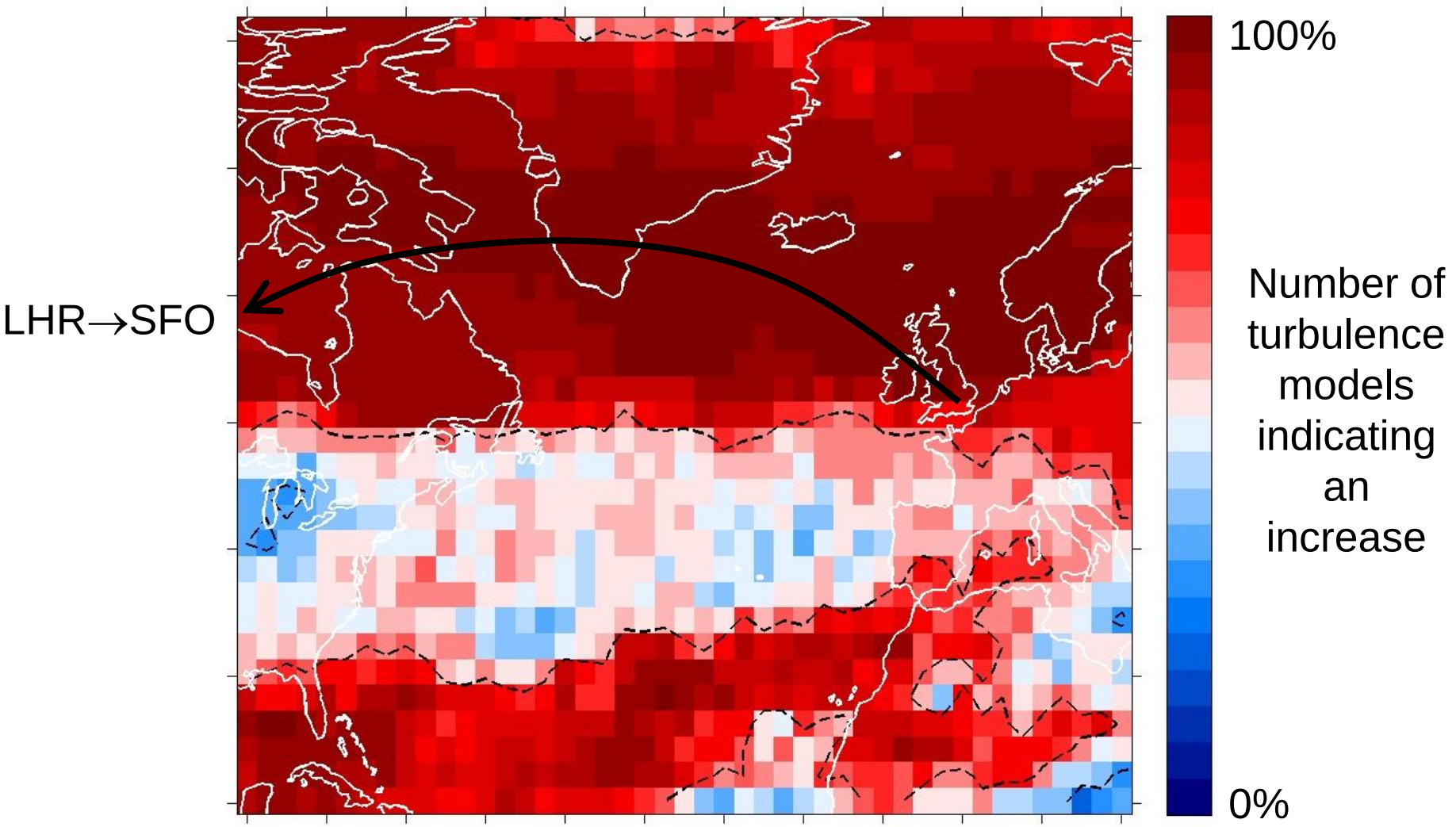


1982

2003

FAA (2006)

Is Clear Air Turbulence increasing?



Williams & Joshi (2013)

Learn more about how Climate Change will affect Air Travel

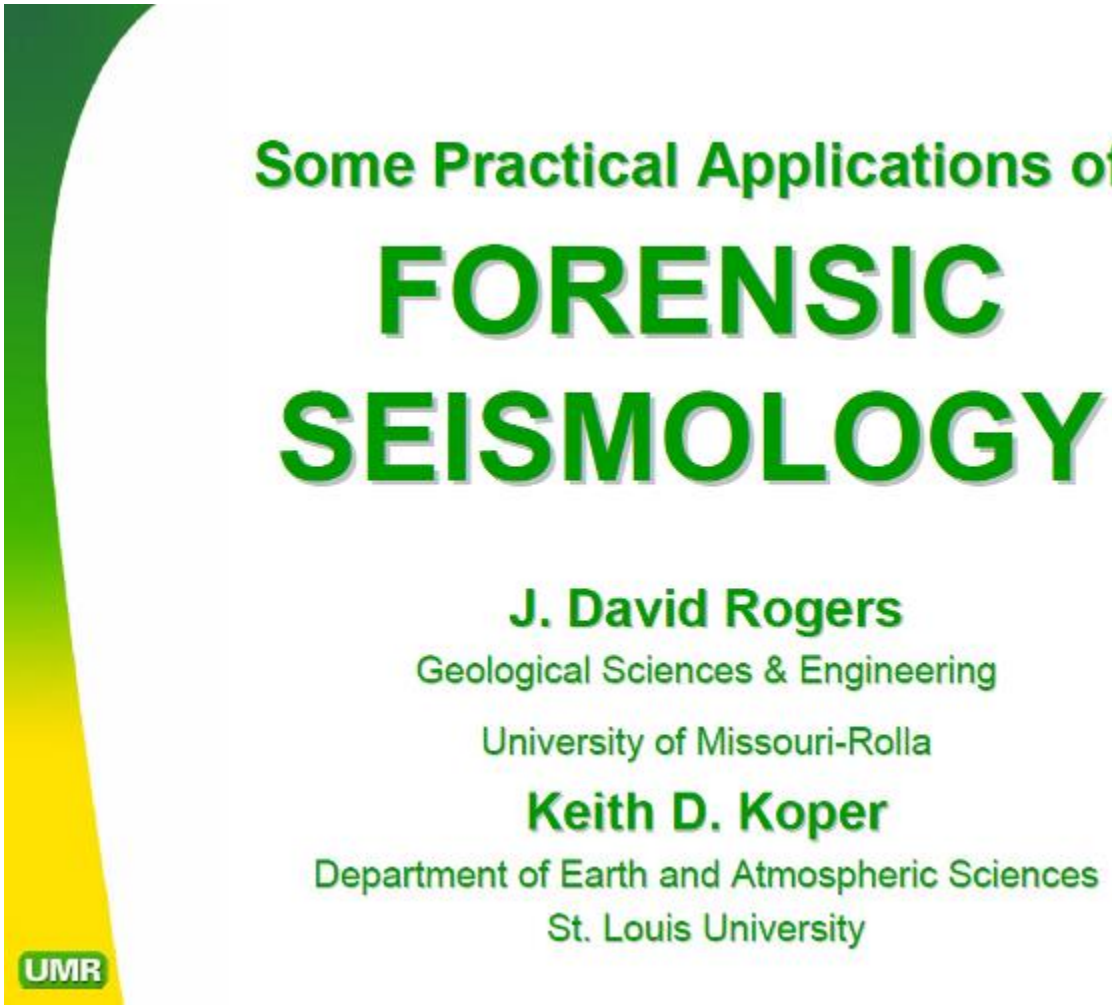
Paul Williams will be speaking at the joint BCS Fortran SG / IoP Computational Physics Group meeting on the afternoon of 29 September at the BCS London Office, see www.fortran.bcs.org/2016/agenda16.php#present for more details.

Twitter: @DrPaulDWilliams

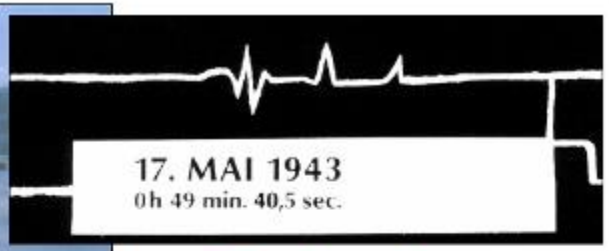
p.d.williams@reading.ac.uk

www.met.reading.ac.uk/~williams

Forensic Seismology for Nuclear Test Ban Verification (1)



Forensic Seismology for Nuclear Test Ban Verification (2)

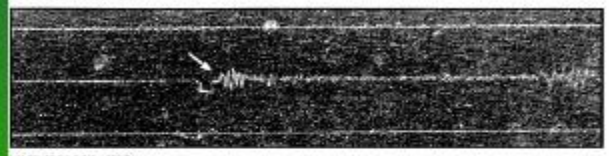


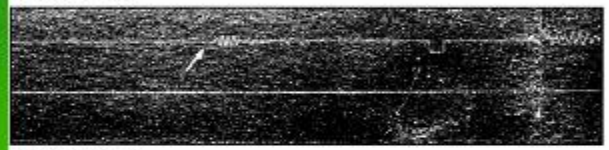
Explosions release energy similar to earthquakes

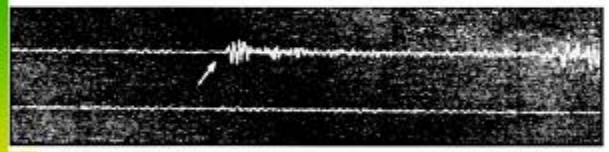
- On the night of May 16-17, 1943 British bombers struck the Mohne, Eder and Sorpe Dams in the German Ruhr Valley, destroying two of them. The inset image shows the blips on the trace of the seismograph at the Institut für Geophysik at Göttingen, 130 km distant.

UMR

Forensic Seismology for Nuclear Test Ban Verification (3)

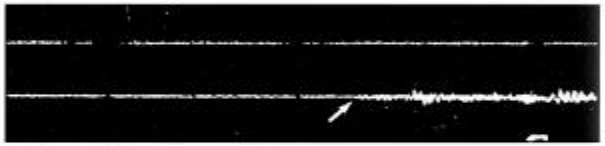


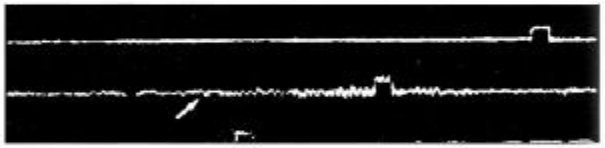




GEOPHYSIKALISCHEN INSTITUT GÖTTINGEN

	Time (DSZ)	Pilot	Period	Maximum Deflection
		Möhne dam		
[1]	00.27:29.8	Gibson	40,8 sec	0,6 mm
[2]	00.38:04.1	Martin	14,9 sec	0,8 mm
[3]	00.43:51.4	Young	2,6 sec	0,2 mm
[4]	00.49:29.5	Maltby	40,5 sec	0,8 mm (Destruction)
		Eder dam		
[5]	01.37:28.1	Shannon	34,0 sec	0,4 mm
[6]	01.50:53.9	Knight	57,0 sec	0,2 mm (Destruction)
		Ennepe dam		
[7]	03.38:	Townsend	Faint mark only	





- The Göttingen seismograph recorded 7 of 11 explosions at the Mohne (130 km), Eder (75 km) Sorpe (139 km) dams. The explosions that were not recorded occurred either in the air above ground or within the earthen embankment of the Sorpe Dam.

UMR

Forensic Seismology for Nuclear Test Ban Verification (4)

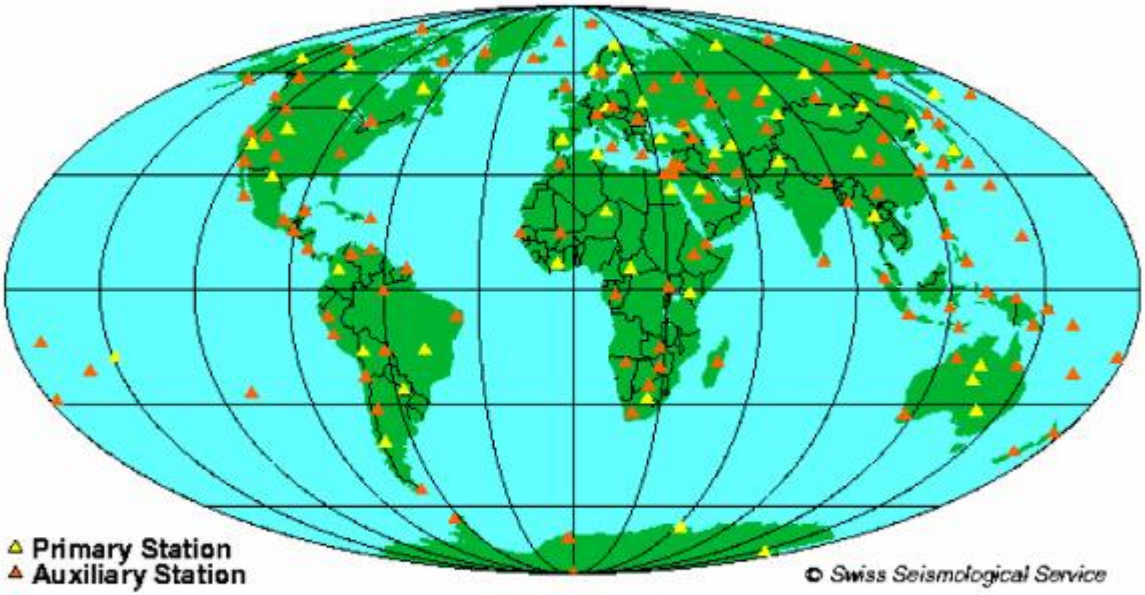
Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)

- Organized in 1996
- Most recent international effort to reduce nuclear weapons proliferation
- By the end of 2004, 41 of 44 countries had signed it; 33 of 44 nations have ratified it
- CTBTO created the International Monitoring System (IMS)
- *"Convinced that the most effective way to achieve an end to nuclear testing is through the conclusion of a universal and internationally and effectively verifiable comprehensive nuclear test-ban treaty, which has long been one of the highest priority objectives of the international community in the field of disarmament and non-proliferation"*

UMR

Forensic Seismology for Nuclear Test Ban Verification (5)

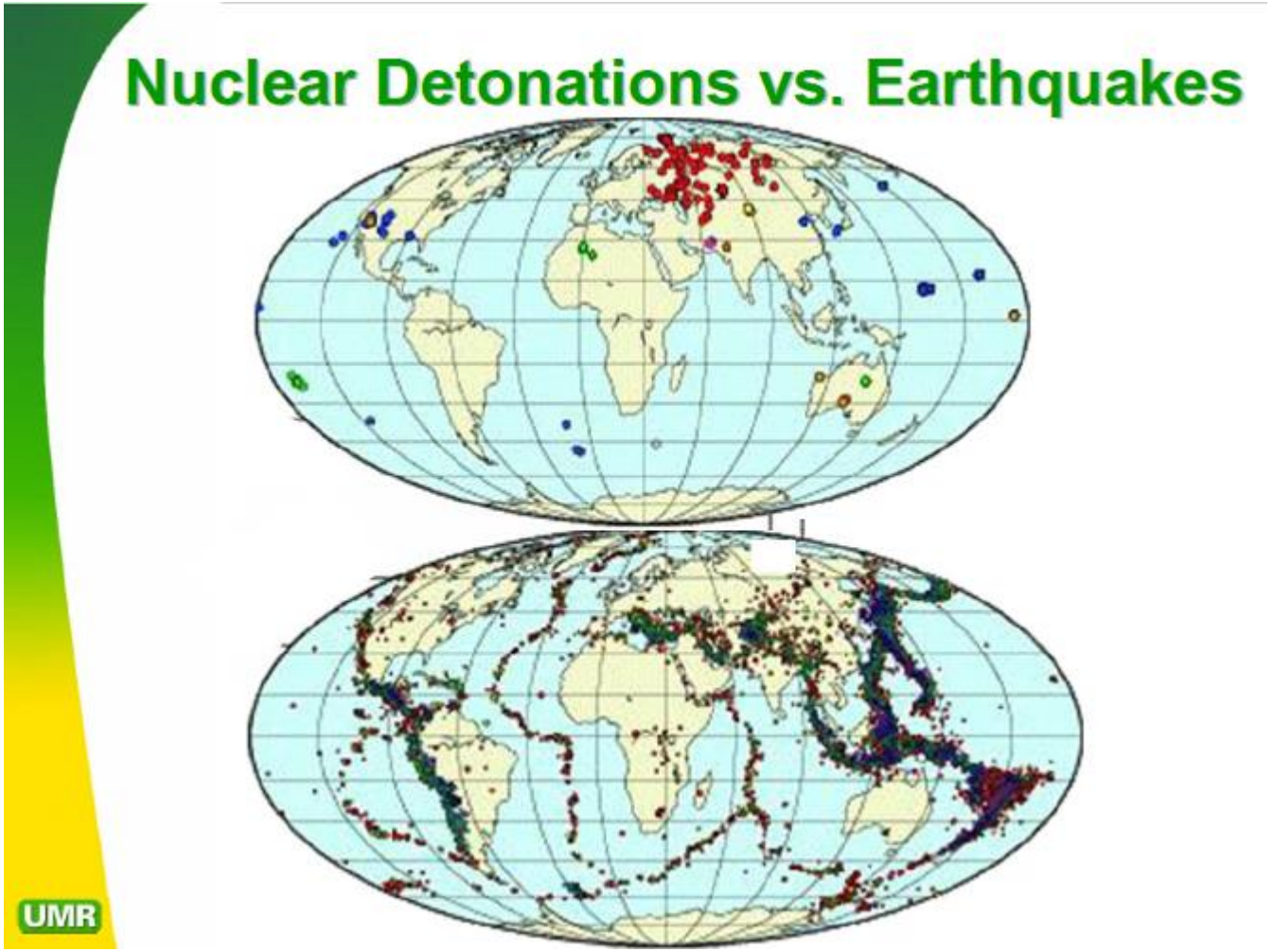
International Monitoring System



The seismic network will consist of 50 primary stations and 120 auxiliary stations.

UMR

Forensic Seismology for Nuclear Test Ban Verification (6)



Forensic Seismology for Nuclear Test Ban Verification (7)

SEISMIC SIGNATURES

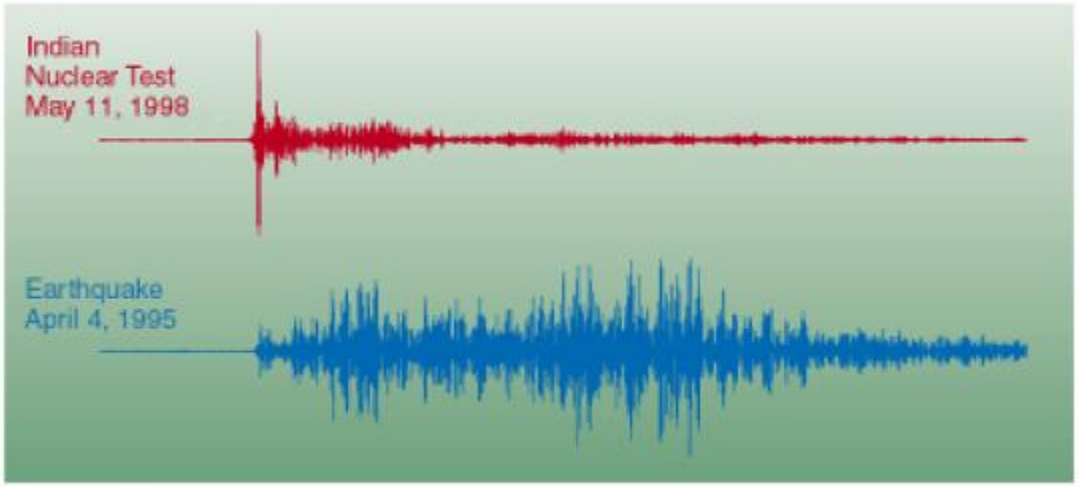


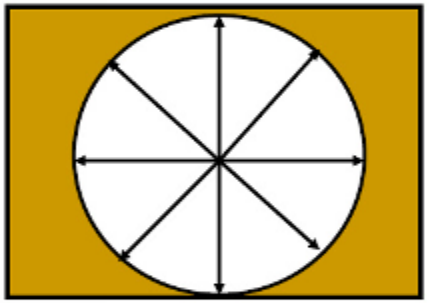
Figure 2. Seismograms of the Indian nuclear test (top) and a representative nearby earthquake (bottom) recorded at the seismic station at Nilore, Pakistan. These seismic signatures for an explosion and earthquake are typical and clearly distinguish one from the other.

UMR

Forensic Seismology for Nuclear Test Ban Verification (8)

SEISMIC WAVE PROPERTIES

UNDERGROUND NUCLEAR BLASTS

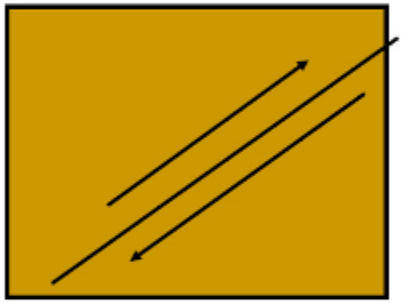


P waves dominate

Compressional waves

Similar to sound waves

NATURAL EARTHQUAKES



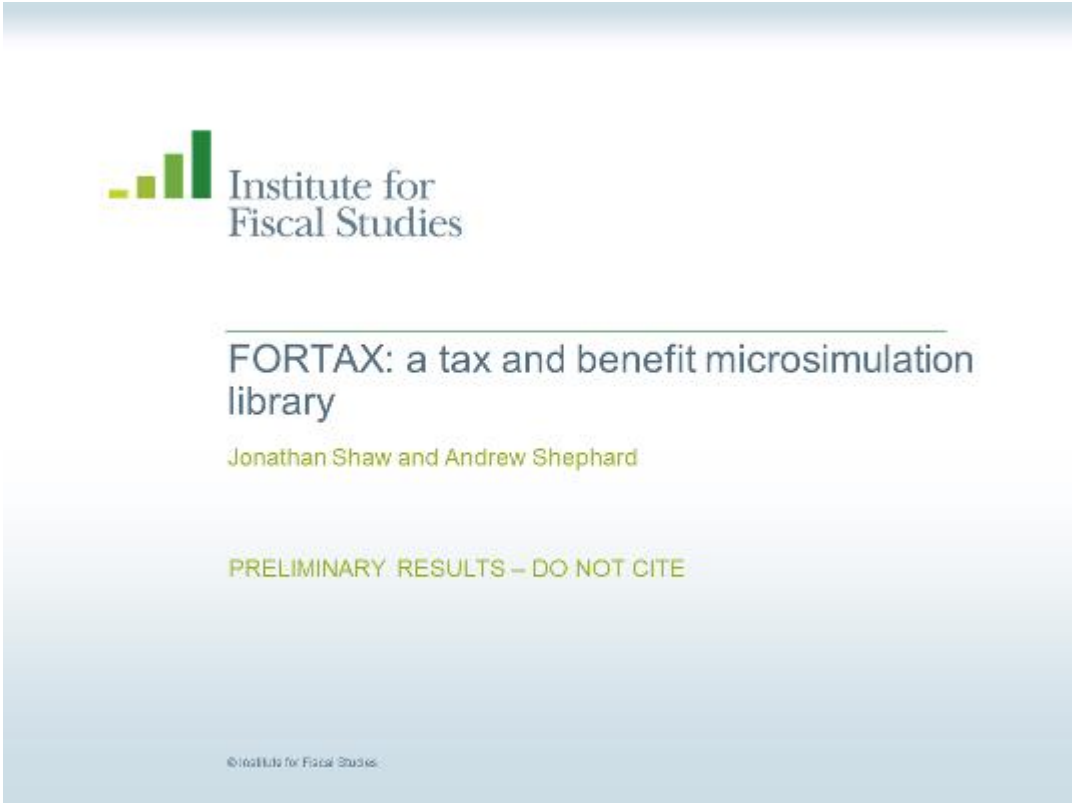
S waves dominate

Transverse waves

Similar to shaking one end of rope

UMR

FORTAX: a tax and benefit micro-simulation library written in Fortran (1)



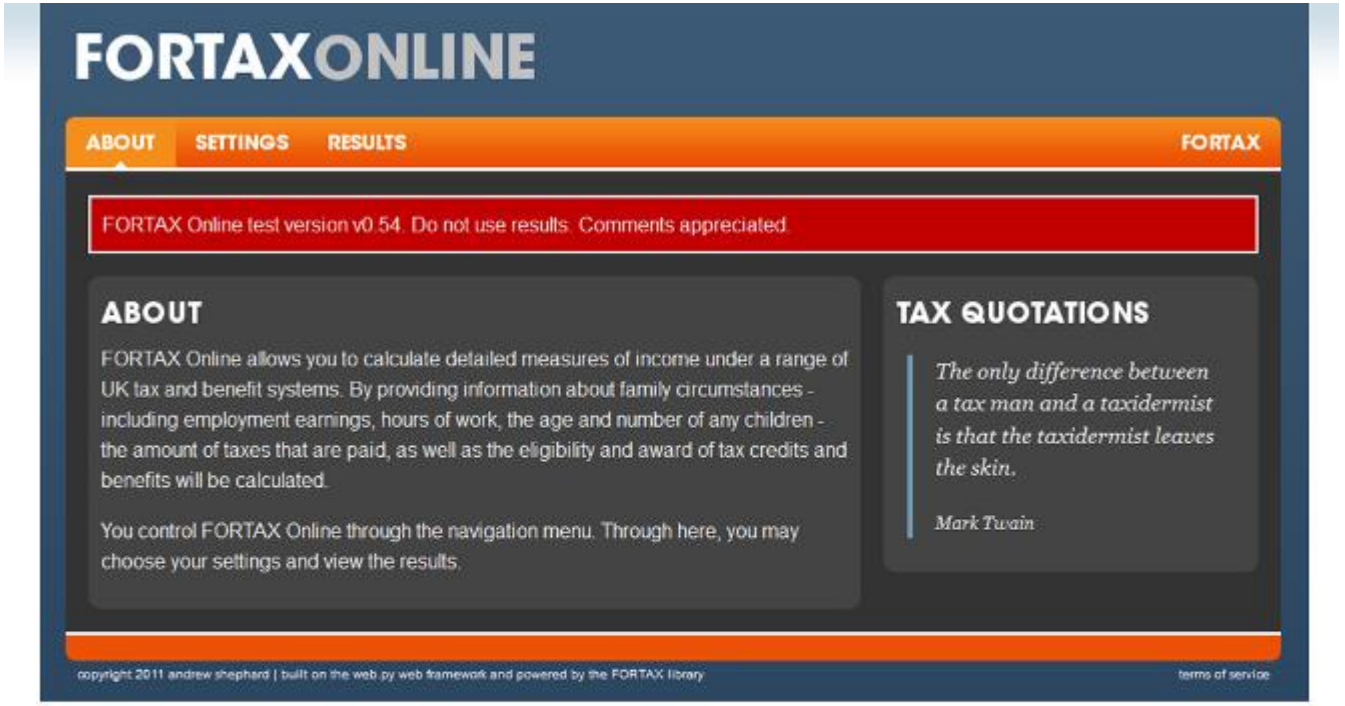
See "Fortran Expo" meeting, June 2012, for full presentation by Jonathan Shaw, The Institute for Fiscal Studies

FORTAX: a tax and benefit micro-simulation library written in Fortran (2)

What FORTAX is

- A UK tax and benefit calculator
  - 1990 onwards
  - Working-age families
- Written in Fortran

FORTAX: a tax and benefit micro-simulation library written in Fortran (3)



PRELIMINARY RESULTS - DO NOT CITE

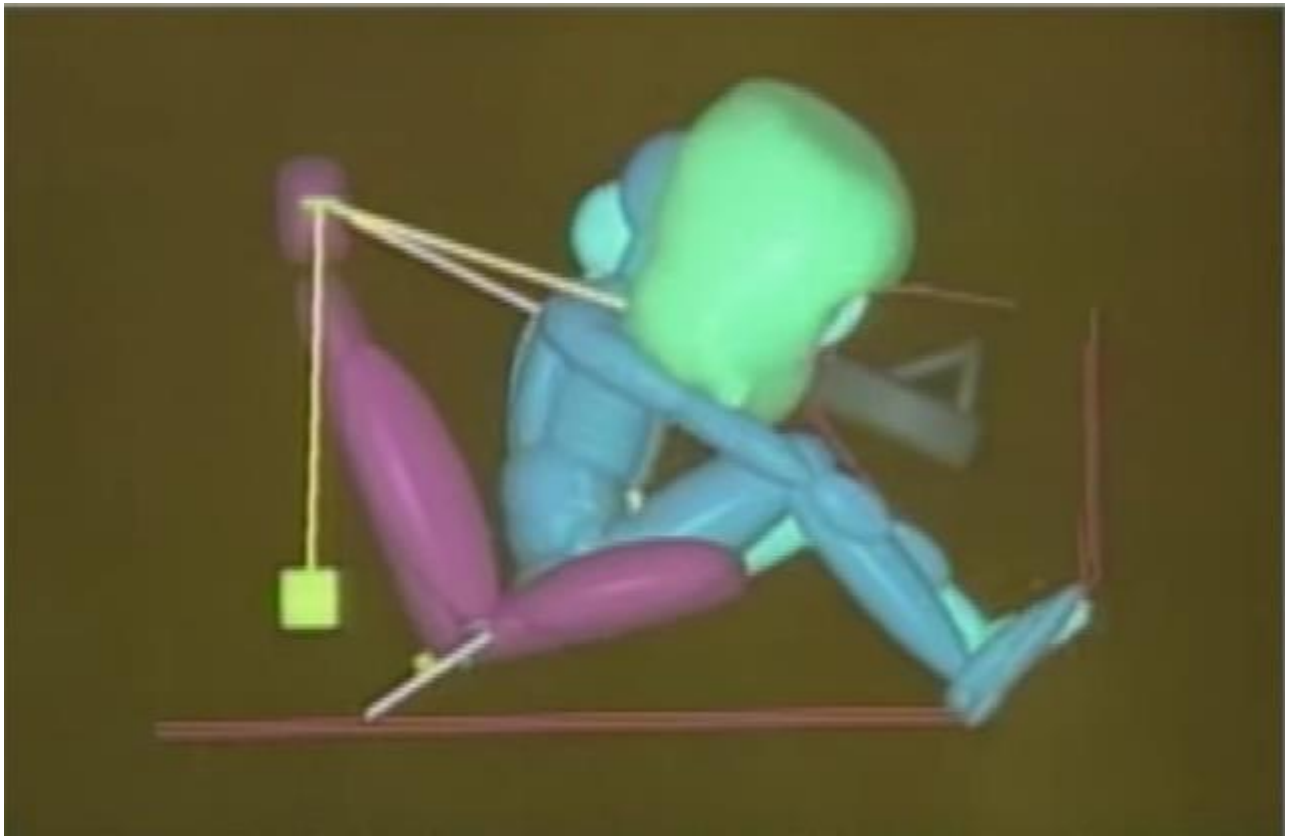
Institute for Fiscal Studies

FORTAX: a tax and benefit micro-simulation library written in Fortran (4)

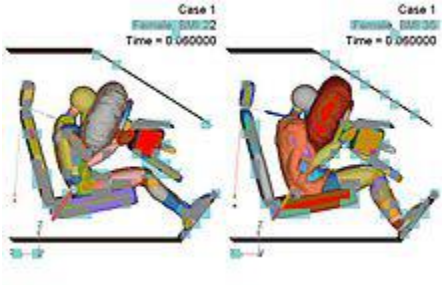
Conclusion

- FORTAX calculates taxes and benefits rapidly
- Essential for dynamic models used to evaluate tax and benefit reforms
- Our application: understanding the effect of UK tax credit reforms
- Preliminary results suggest:
  - Substantial employment effects for lone mothers and mothers in couples
  - Relatively small impact on education choices
  - Employment effects not due to changing education choices
  - Possibly some anticipation effects but little impact on employment during eligibility

Vehicle crash simulation



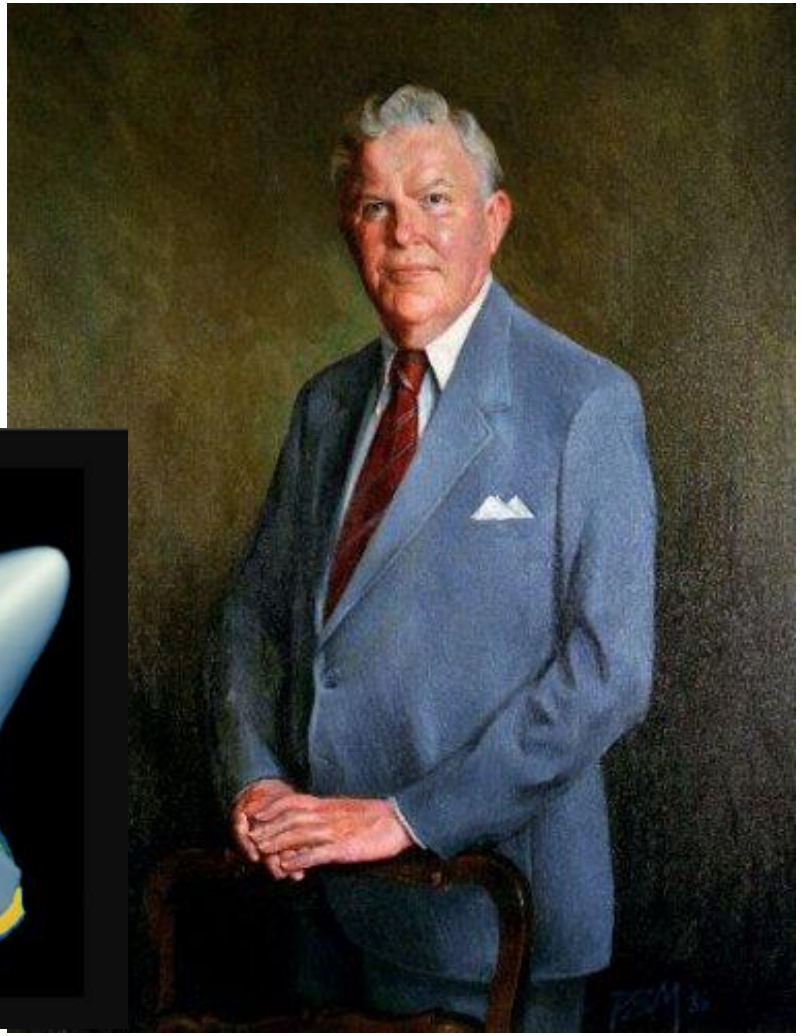
A crash simulation with a slender (left) and obese (right) female passenger

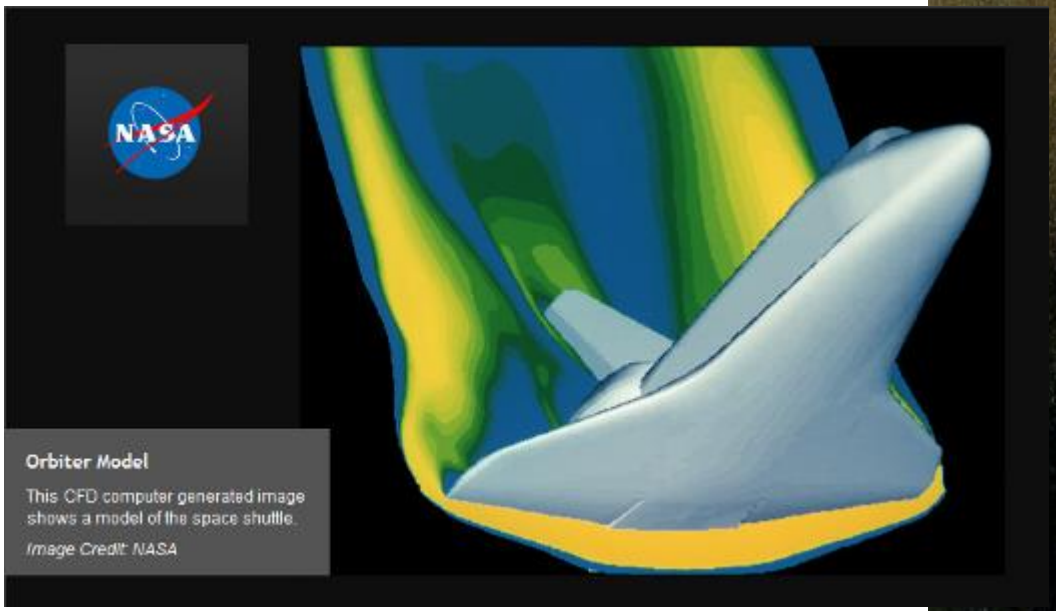


Harvard Lomax, 1922 – 1999

The father of
“The Numerical Windtunnel”

NASA Ames Research Center,
Moffett Field, California,
1944 – 1994

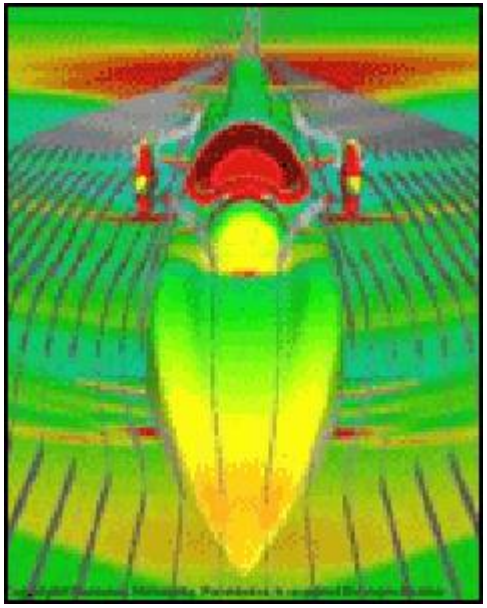




Fortran CFD program used in design of 1000 mph car - September 2010 issue of ITNOW

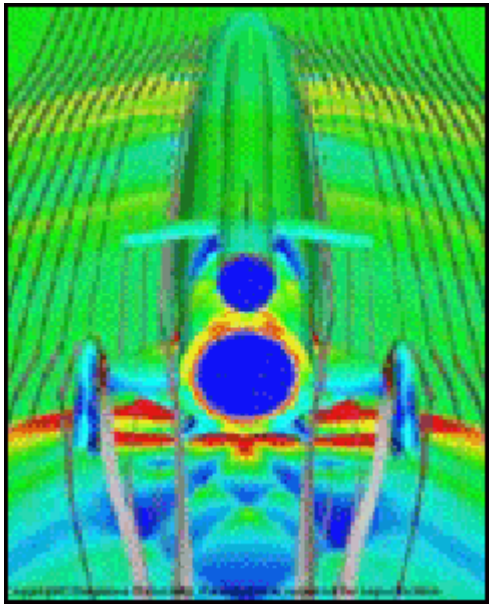
The BLOODHOUND Project

BLOODHOUND SSC, the 1000 mph car, aerodynamic design



Front view

The Super Sonic Car has been aerodynamically designed by Swansea University's School of Engineering experts who have pioneered Computational Fluid Dynamics (CFD) software for this purpose

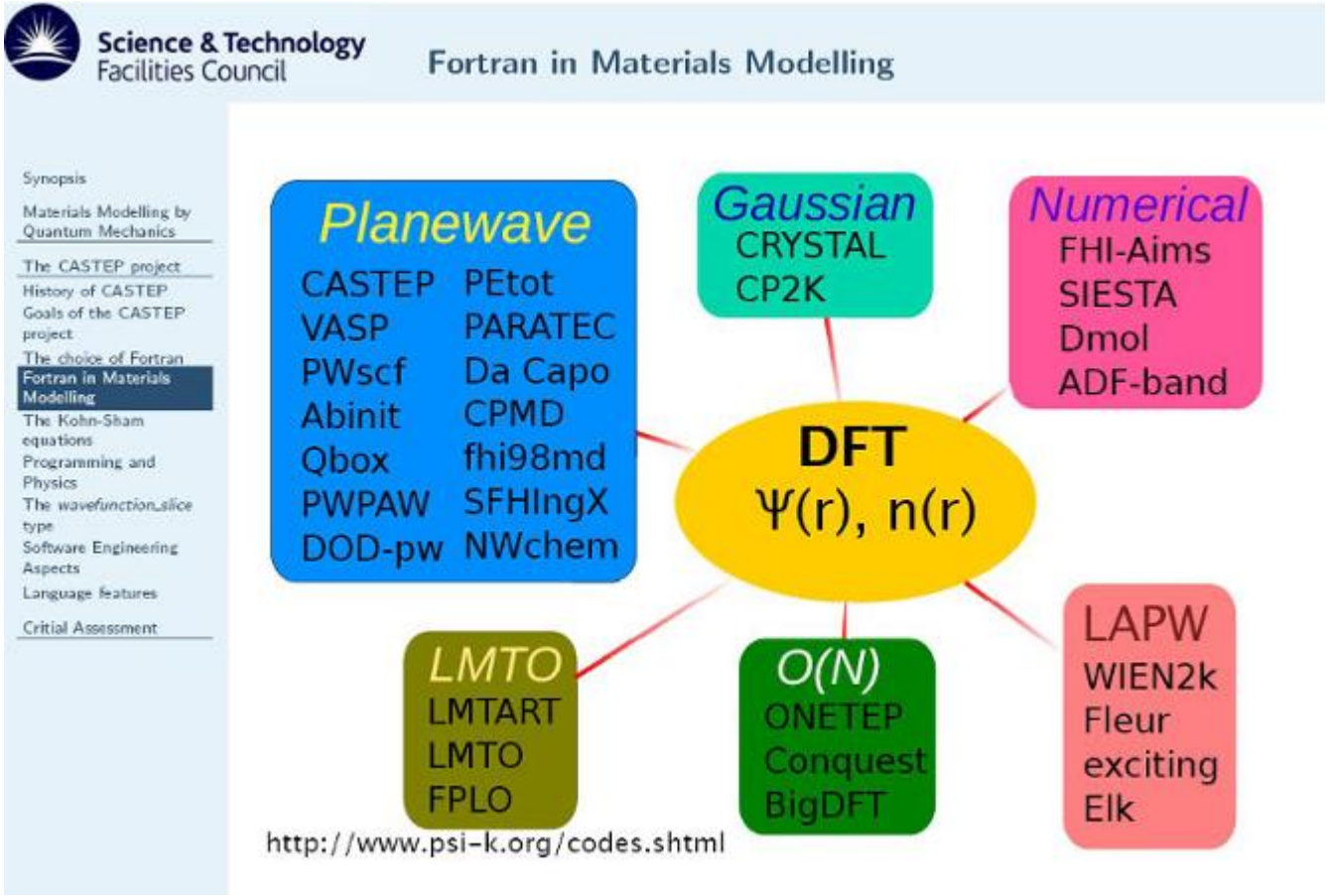


Rear view

BLOODHOUND SSC, the 1000 mph car, testing and record attempt

The BLOODHOUND team plans to go to the Hakskeen Pan in Northern Cape Province, South Africa in 2017 following successful runway testing in the UK.

The CASTEP project: Materials Modelling by Quantum Mechanics

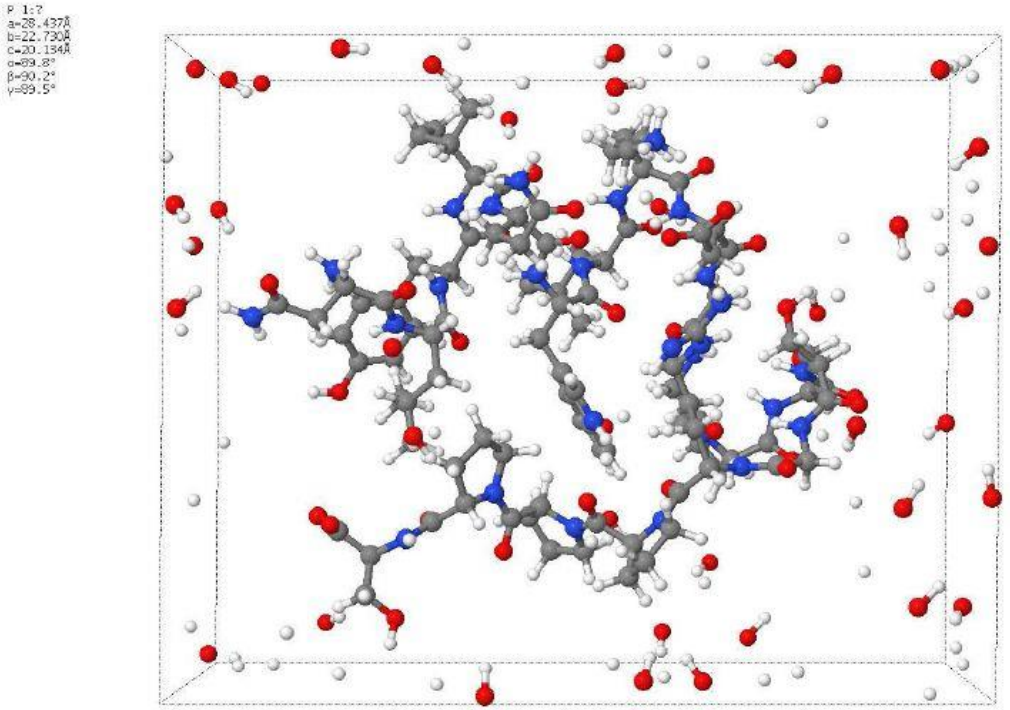


Keith Refson, Rutherford Appleton Laboratory, full presentation can be downloaded from www.fortran.bcs.org/2010/KR_BCS_2010_web.pdf

CASTOR HPC Capability

Science & Technology Facilities Council

HPC Capability: Peptide in water 1280 atoms



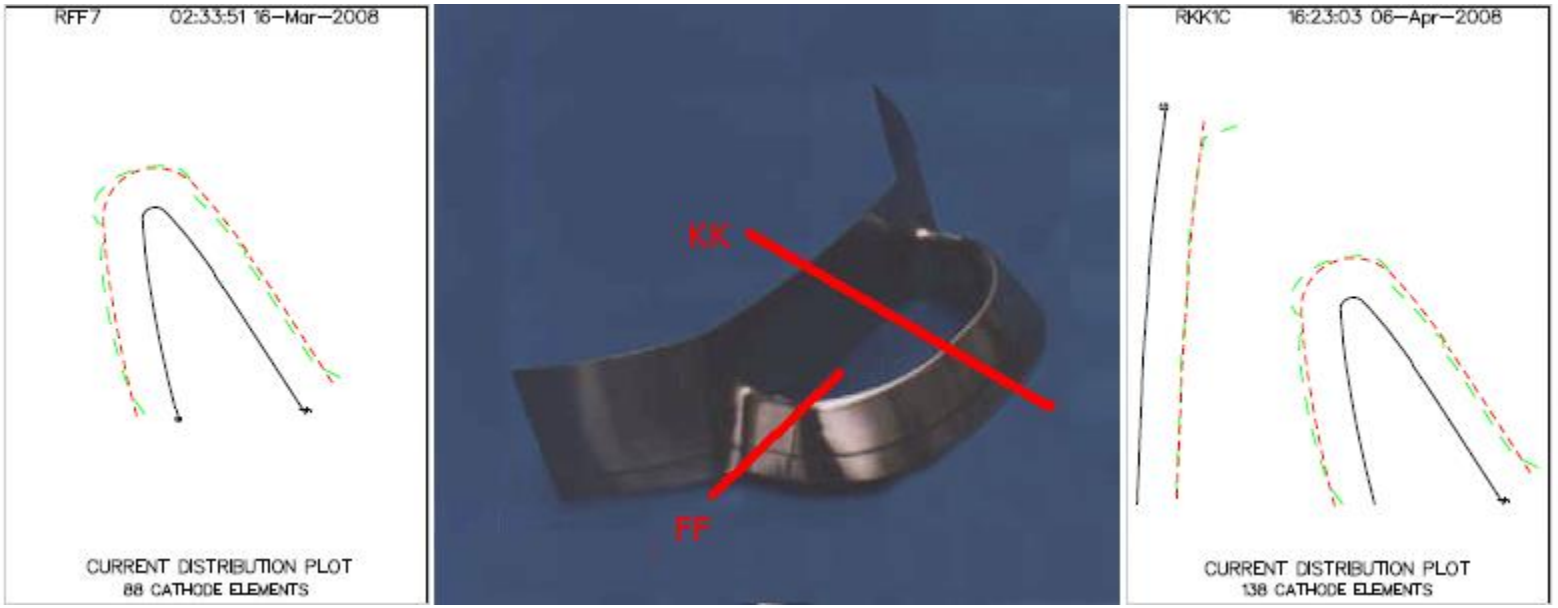
HyperSizer and Virgin Atlantic GlobalFlyer

HyperSizer, 400,00 lines of Fortran and Visual Basic FEA code used to optimise composite materials built into GlobalFlyer which flew non-stop around the world in 67 hours in February – March 2005 piloted by Steve Fossett.

Boundary Element Package for Current Distribution Modelling in Electroforming

Program used in late 1980s and 1990s in the development of the production process for the manufacture of aerospace components in electroformed nickel.

Modelling results for C130J R-R engine oil cooler lip



Nickel erosion shields manufactured by electroforming process

Components for:

Lockheed Martin C130J

Westland Lynx

Augusta Westland AW101, Merlin

Rolls-Royce AE 2100 D3 turboprop engines with Dowty R391 composite scimitar propellers on a RAF Hercules C4 (C-130J-30)

Close-up of oil cooler lip of Rolls-Royce AE 2100 D3 turboprop engine on a RAF Hercules C4 (C-130J-30)

G-LYNX, holder of world helicopter speed record, 400.87 km/h (249.09 mph)

Achieved on August 11 1986 using composite rotor blades protected with nickel and titanium erosion shields.
Record still had not been beaten by 2014.

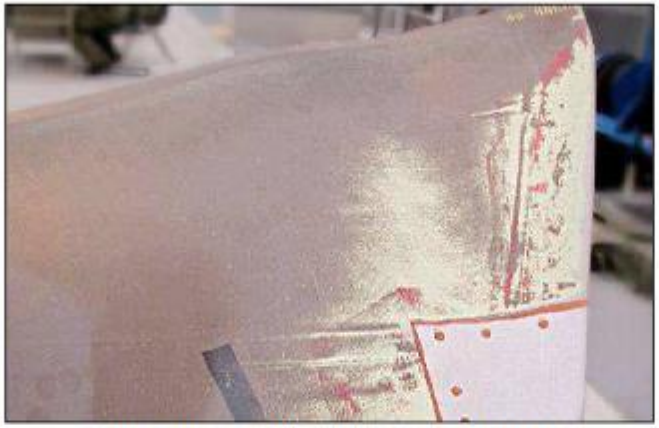
Headline from
FLIGHT INTERNATIONAL
27 December 1986

Fastest blades in the world

Last August a modified Westland Lynx broke the world helicopter speed record by a handsome margin. A speed of just over 216kt was reached, which meant that the advancing tips of its composite blades were near-sonic at Mach 0·97. **Harry Hopkins** reports.

Lynx and AW101 BERP rotor blades, RAF Merlin and BERP IV demonstrator

AW101 Blade Tip



Sand Erosion on Westland Lynx Blade Tip

Tip Strike on AW101 Blade (Crown Copyright)

AW101, Royal Air Force Merlin Mk3

Exploitation is Next Step for BERP IV

BERP IV THE DESIGN, DEVELOPMENT AND TESTING OF AN ADVANCED ROTOR BLADE

Fortran SCAP for iOS by DynamicSource AB (Standard Computerised Airplane Performance)

In short...

Aside from our airline-tailored intranet solution, we have been world first in developing two groundbreaking applications for the iPad (iOS platform).

- Only offline IATA FORTRAN SCAP compliant performance tool
- First terminal chart reader to be used for a Class 2 Type B iPad EFB. Later sold, and further developed by Navtech Aero, Inc.

We have an in-depth knowledge of the airline industry, and advanced system development with high reliability demands. We have supplied systems to airlines since 2009, and we look forward to partner with you and meet the future demands and challenges of the industry together.

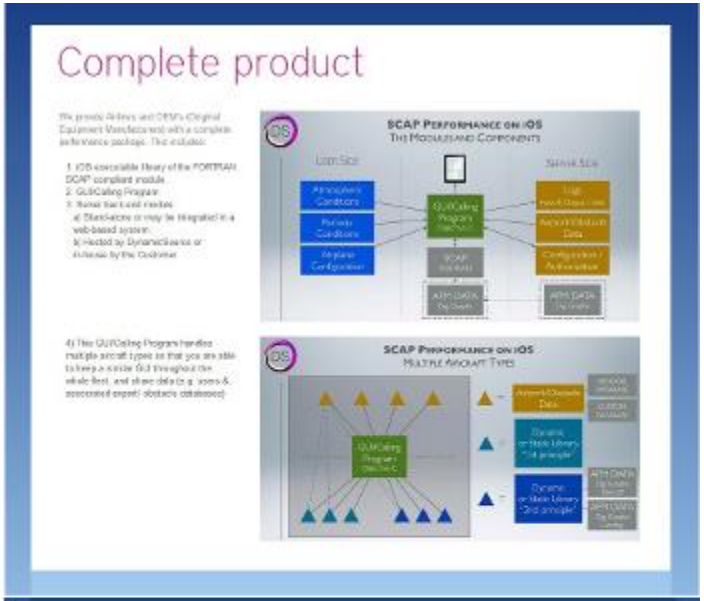
DynamicSource AB

Are you interested in...

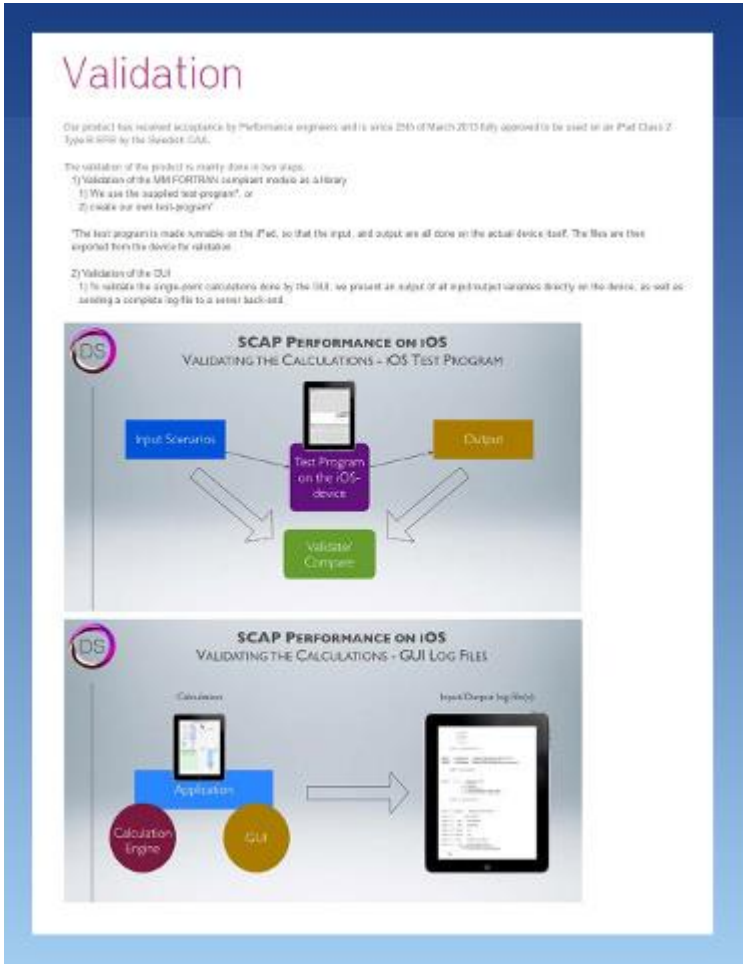
- A Sharepoint alternative?
- Generating statistical reports with On-Time-/Performed flight- statistics with data extracted and combined from your crew- and/or traffic scheduling systems?
- Quickly and easily generate EU ETS reports?
- Move your quality- and safety reporting to a secure and efficient online solution with instant distribution to accountable managers?
- Offer real-time flight status with different filters/interactivity for your airline departments and customers?

Request a demo today!

Fortran SCAP for iOS by DynamicSource AB (2)



Fortran SCAP for iOS by DynamicSource AB (3)



If you want to know more

Modern open source and free Fortran compilers are available from a number of sources as are online tutorials

Links to the above and more are available from the Resources page of the Fortran SG website at www.fortran.bcs.org/resources.php

"*The Seven Ages of Fortran*", a history of Fortran development with examples of modern Fortran concepts by Michael Metcalf , see http://journal.info.unlp.edu.ar/wp-content/uploads/JCST-Apr11-1.pdf

"*Modern Fortran Explained*", Metcalf, Reid & Cohen, OUP, April 2011 see http://ukcatalogue.oup.com/product/9780199601424.do

"*Introduction to programming with Fortran: with coverage of Fortran 90, 95, 2003, 2008 and 77*", Ian Chivers & Jane Sleightholme, Springer-Verlag, 2015, see www.springer.com/gb/book/9783319177007

Acknowledgements

Thanks are due to the many contributors to meetings of the Fortran Specialist Group between 2007 and 2014, including the 'Fifty Years of Fortran' meeting in January 2007 and the joint BCS/IoP meeting in June 2010 marking the 40th anniversary of the Group as many of the slides in this presentation are taken from their presentations.

Thanks to Paul Williams of the University of Reading for the use of slides from his talk to the Alumni Homecoming event in June 2016.

Thanks also to Paul McJones of the Computer History Museum, Mountain View, CA, for providing me with DVD versions of two IBM films and the 2004 photo of John Backus.

I also thank all my colleagues in the Fortran Specialist Group for their assistance and encouragement during my time as Chairman.

Acknowledgements *continued*

Thanks are due to BCS - the Chartered Institute for IT for their continued support of the UK's involvement in the ISO Fortran standardisation process through the Fortran Specialist Group and for hosting the 2007 and 2015 ISO Working Group 5 meetings in the BCS London Office.

Finally I would like to thank the BCS Bedford Branch for this opportunity to share my enthusiasm for Fortran with you.

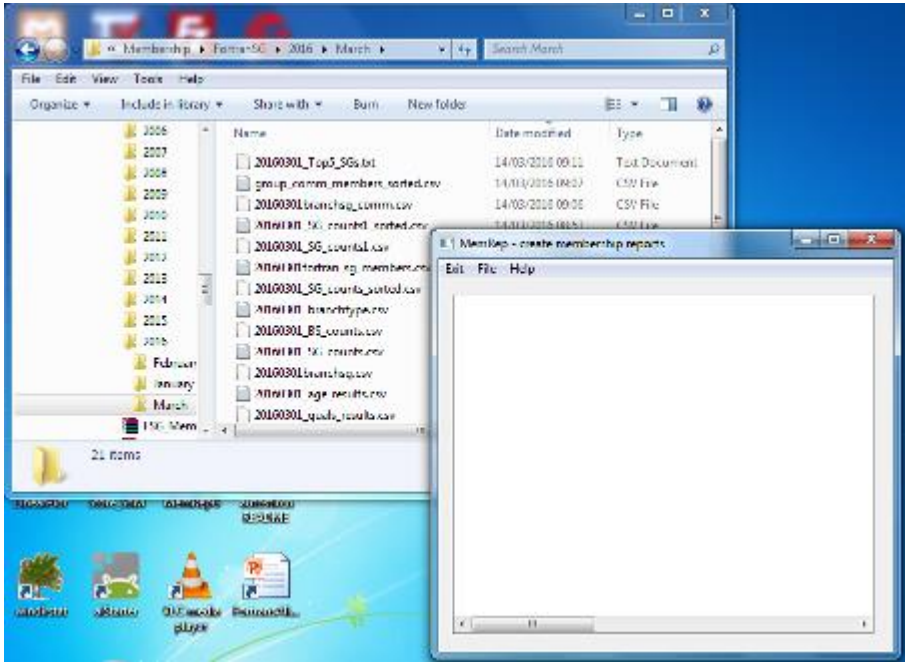
Any Questions

Using the DISLIN library to create a GUI for Fortran programs (1)

Built using the Approximatrix Simply Fortran IDE with the GNU Fortran (GFortran) compiler and the DISLIN and MinGW graphics libraries.

BCS Member Group membership report analysis program

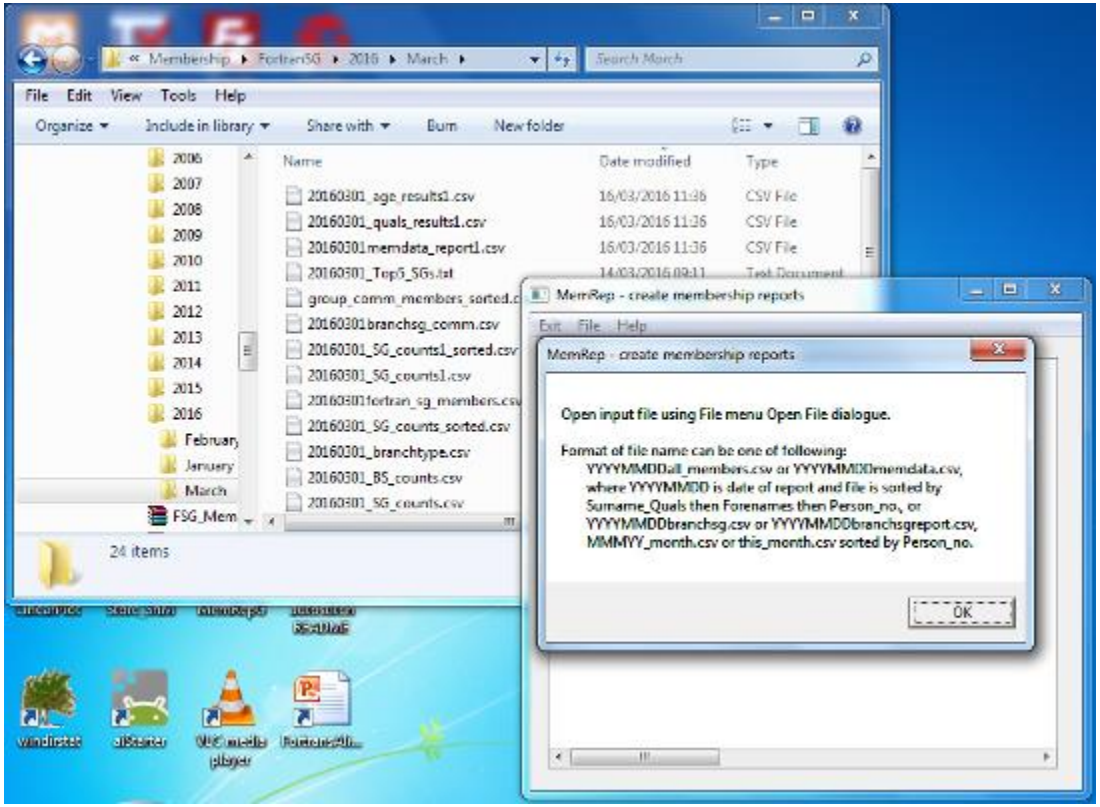
a) Initial program window with three menus, Exit, File and Help



Using the DISLIN library to create a GUI for Fortran programs (1)

BCS Member Group membership report analysis program

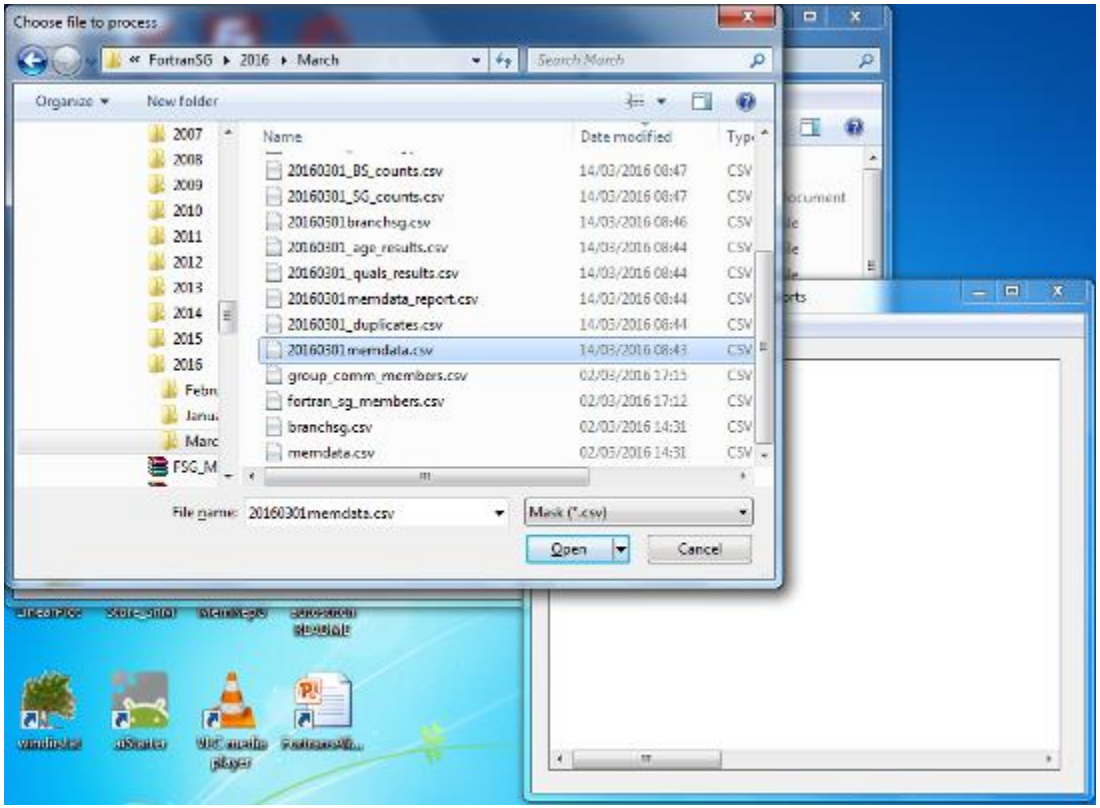
b) Help window



Using the DISLIN library to create a GUI for Fortran programs (1)

BCS Member Group membership report analysis program

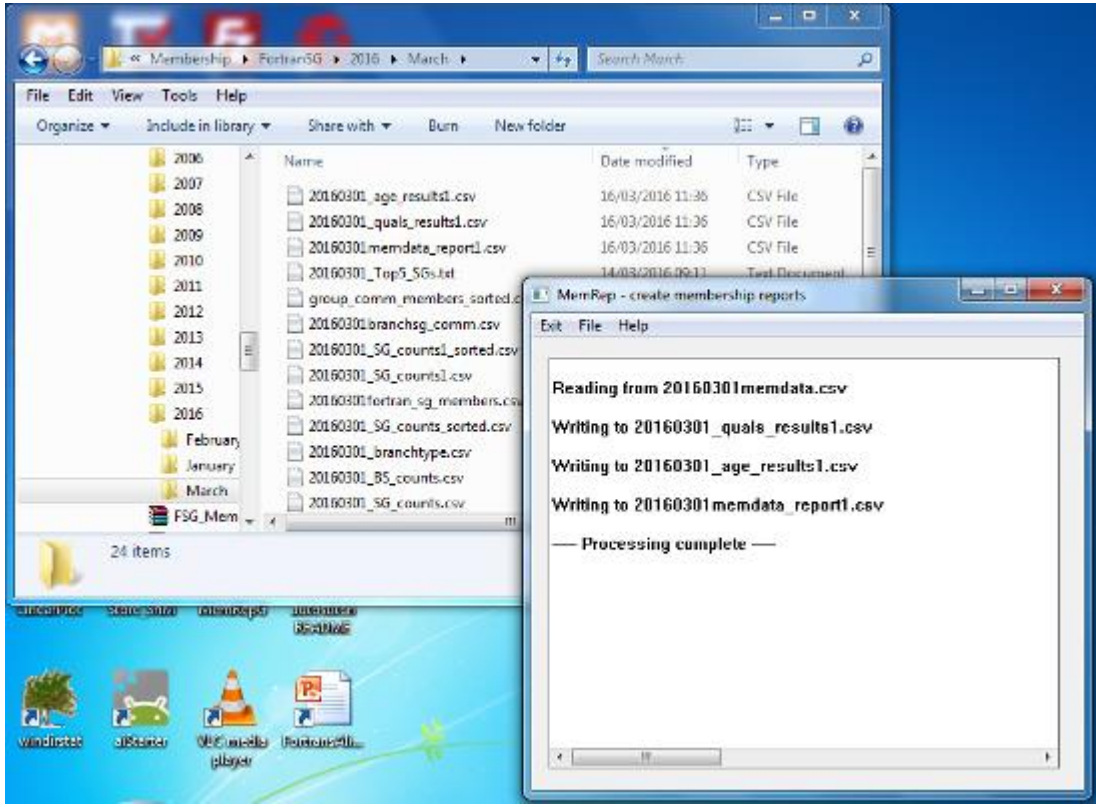
c) File open dialog window for CSV report file



Using the DISLIN library to create a GUI for Fortran programs (1)

BCS Member Group membership report analysis program

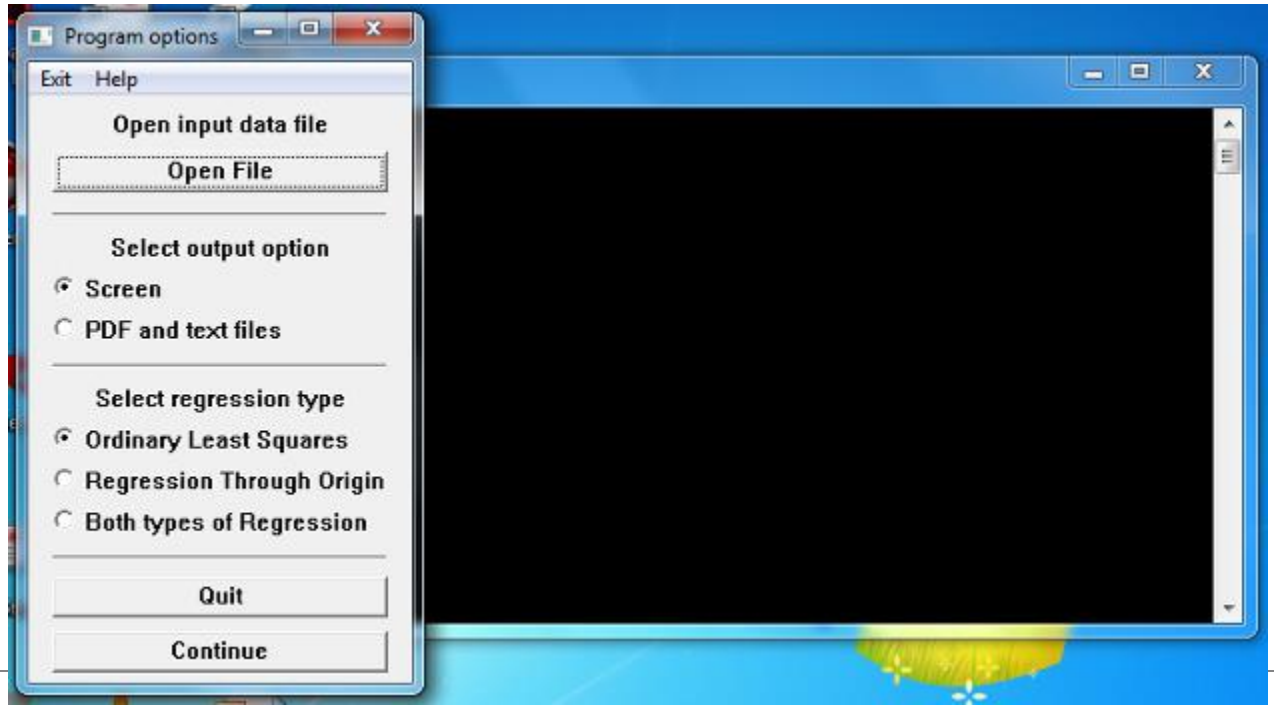
d) Program window displaying files read and written when processing report file



Using the DISLIN library to create a GUI for Fortran programs (2)

Linear regression program with graphical output

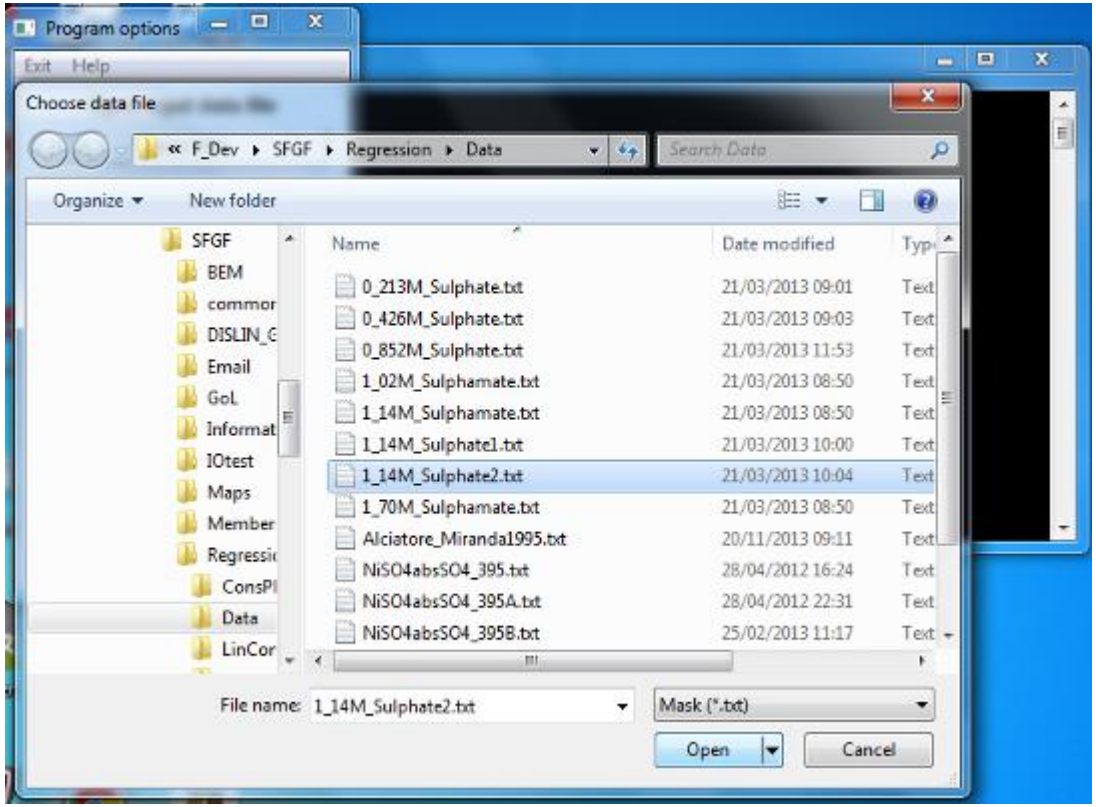
a) Program window with Exit and Help menus, button to open file open dialog window, output option radio buttons (screen or files) and regression type radio buttons (ordinary least squares, regression through the origin or both regressions)



Using the DISLIN library to create a GUI for Fortran programs (2)

Linear regression program with graphical output

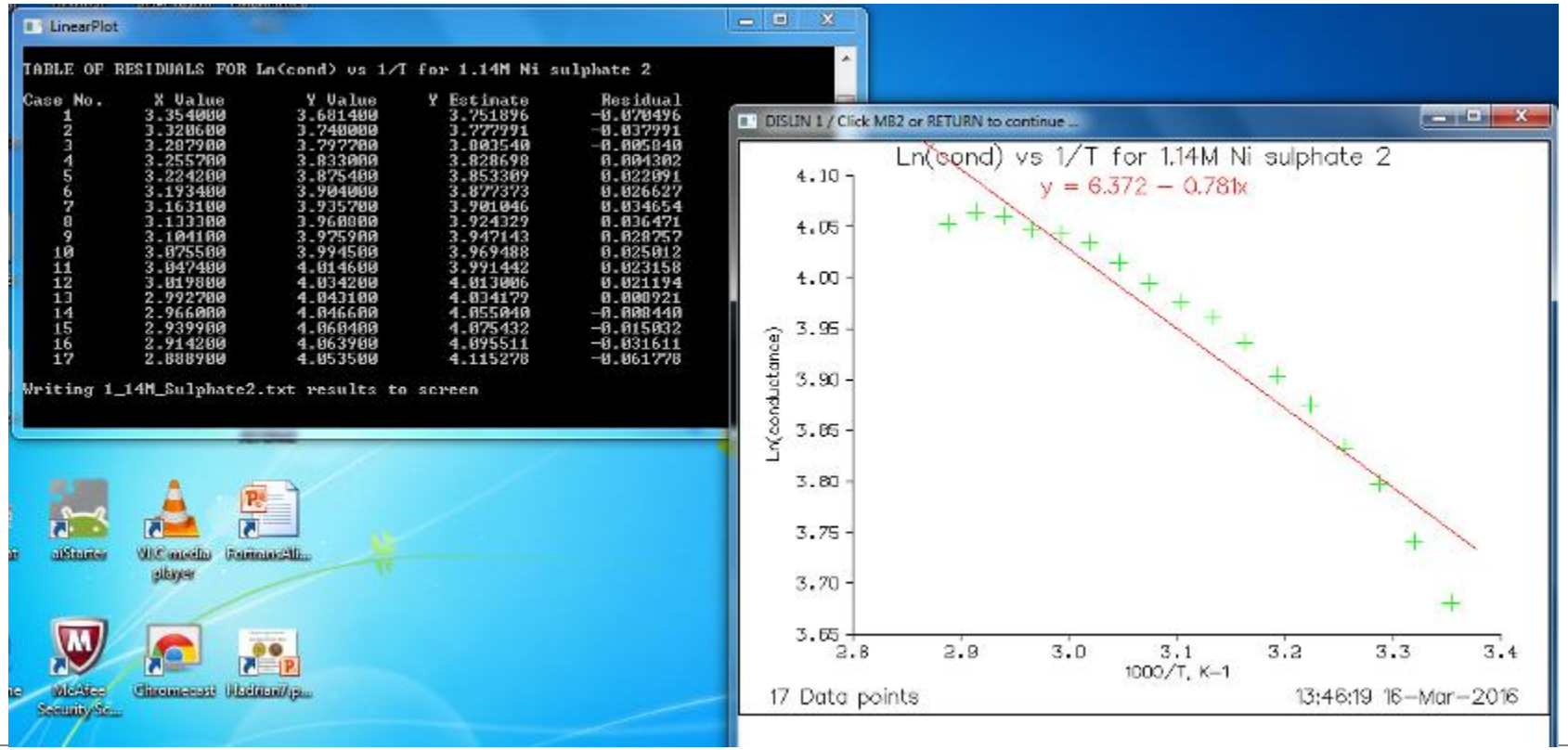
b) File open dialog window for input text file



Using the DISLIN library to create a GUI for Fortran programs (2)

Linear regression program with graphical output

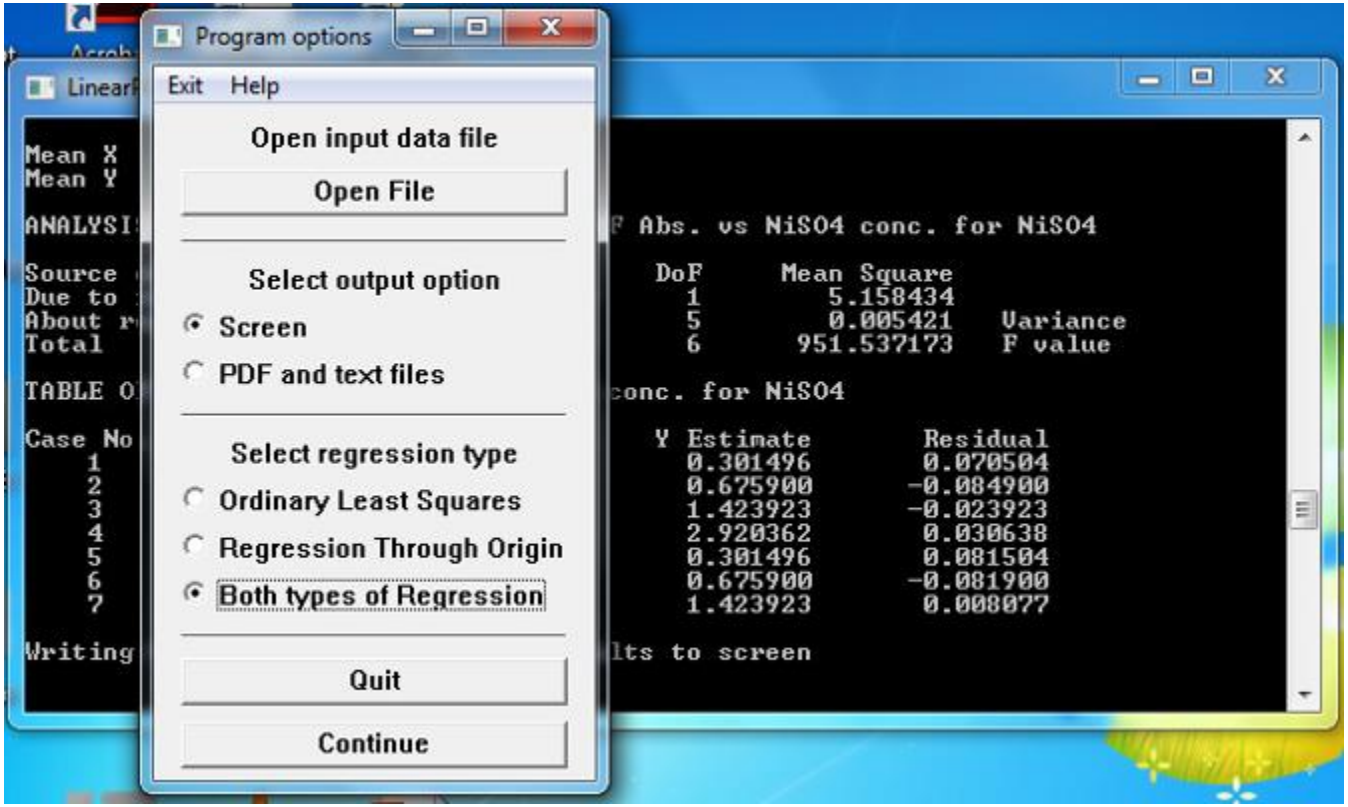
c) Numerical results displayed in command window, ordinary least squares regression line drawn in graphics window



Using the DISLIN library to create a GUI for Fortran programs (2)

Linear regression program with graphical output

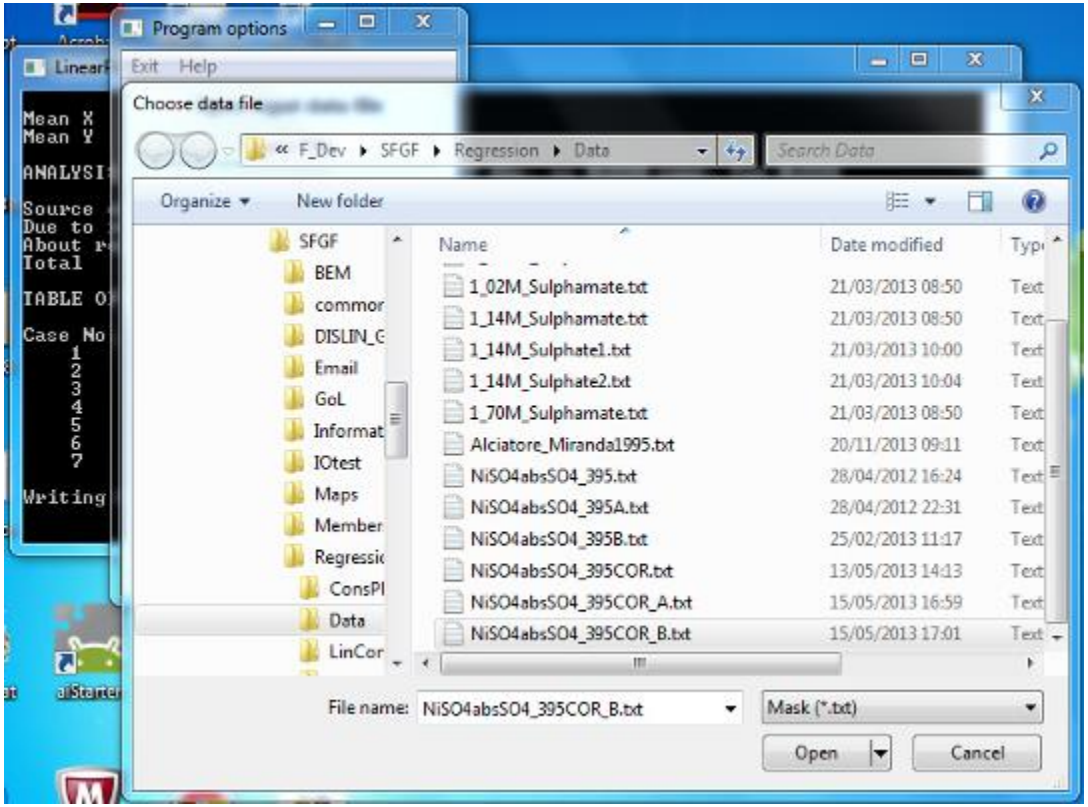
d) Program window showing both regressions option selected



Using the DISLIN library to create a GUI for Fortran programs (2)

Linear regression program with graphical output

e) File open dialog window for another input text file



Using the DISLIN library to create a GUI for Fortran programs (2)

Linear regression program with graphical output

f) Numerical results displayed in command window, both regression lines drawn in graphics window (red for ordinary least squares, blue for regression through the origin)