Writing a paper

using Madagascar

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From the net

Q: What is the difference between a Ph.D. in mathematics and a large pizza? A: A large pizza can feed a family of four...

Top 10 reasons why Professor Sergey called this package Madagascar

- 10. He was in Madagascar, so he said what the heck.
- 9. The only country he did not travel to.
- 8. All the vowels are “a”, which made it easier to spell.
- 7. It is the only country he could spell.
- 6. If you break it down “Mad” “a” “gas” “car”, related to the Oil industry.
- .....

Writing papers, what will we learn?

- Use Madagascar to write papers.
- The template concept.
- The scons role.
- Reproducible.
- The book (file system).

Challenges

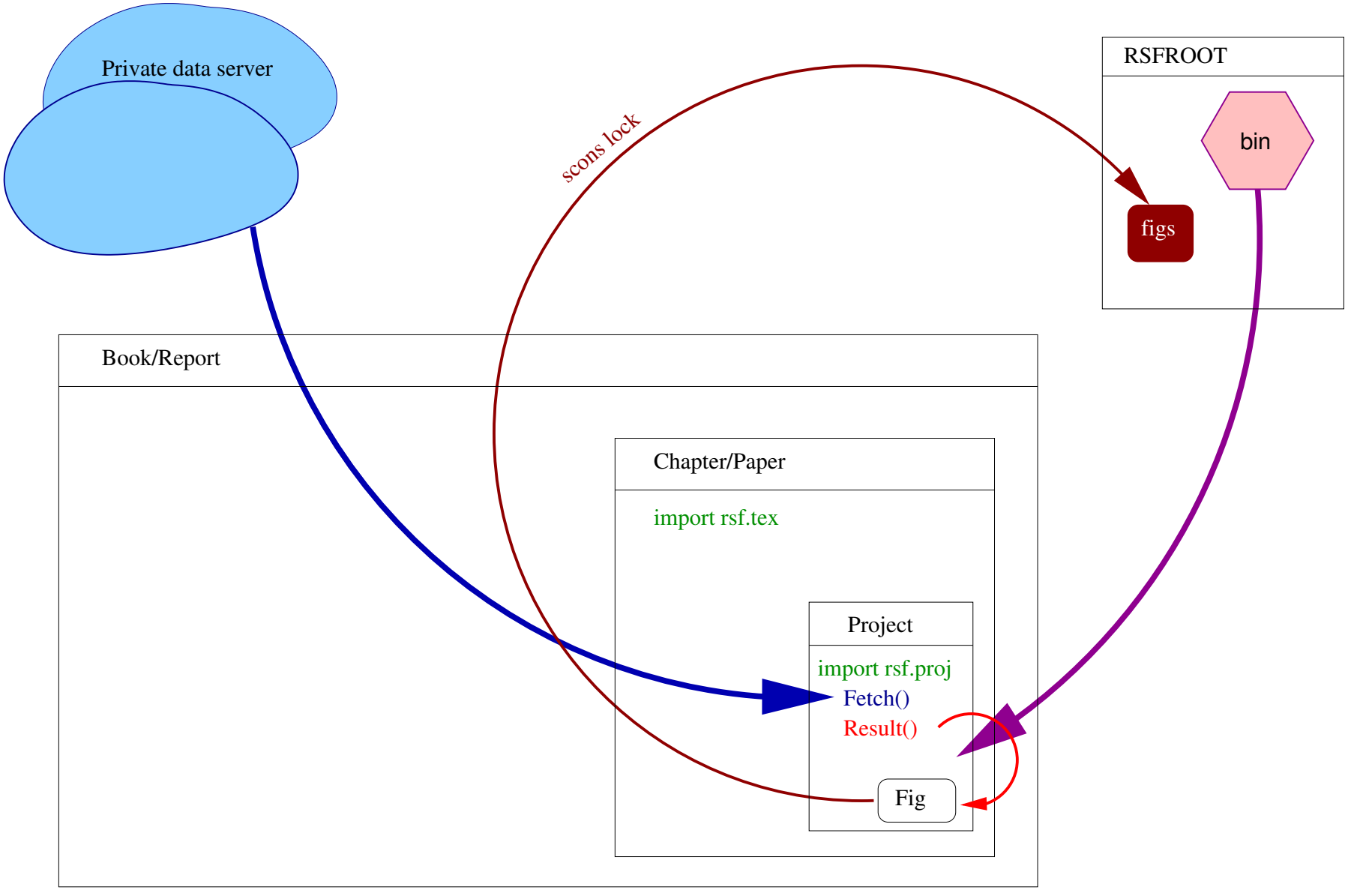
The seemingly complex makeup:

- **LaTeX, python (scons????), and C.**
- **The file system (where is everything?).**
- **incomplete and not-up-to-date documentation.**
- **Any info on the libraries? (C and Python)?**

A general objective

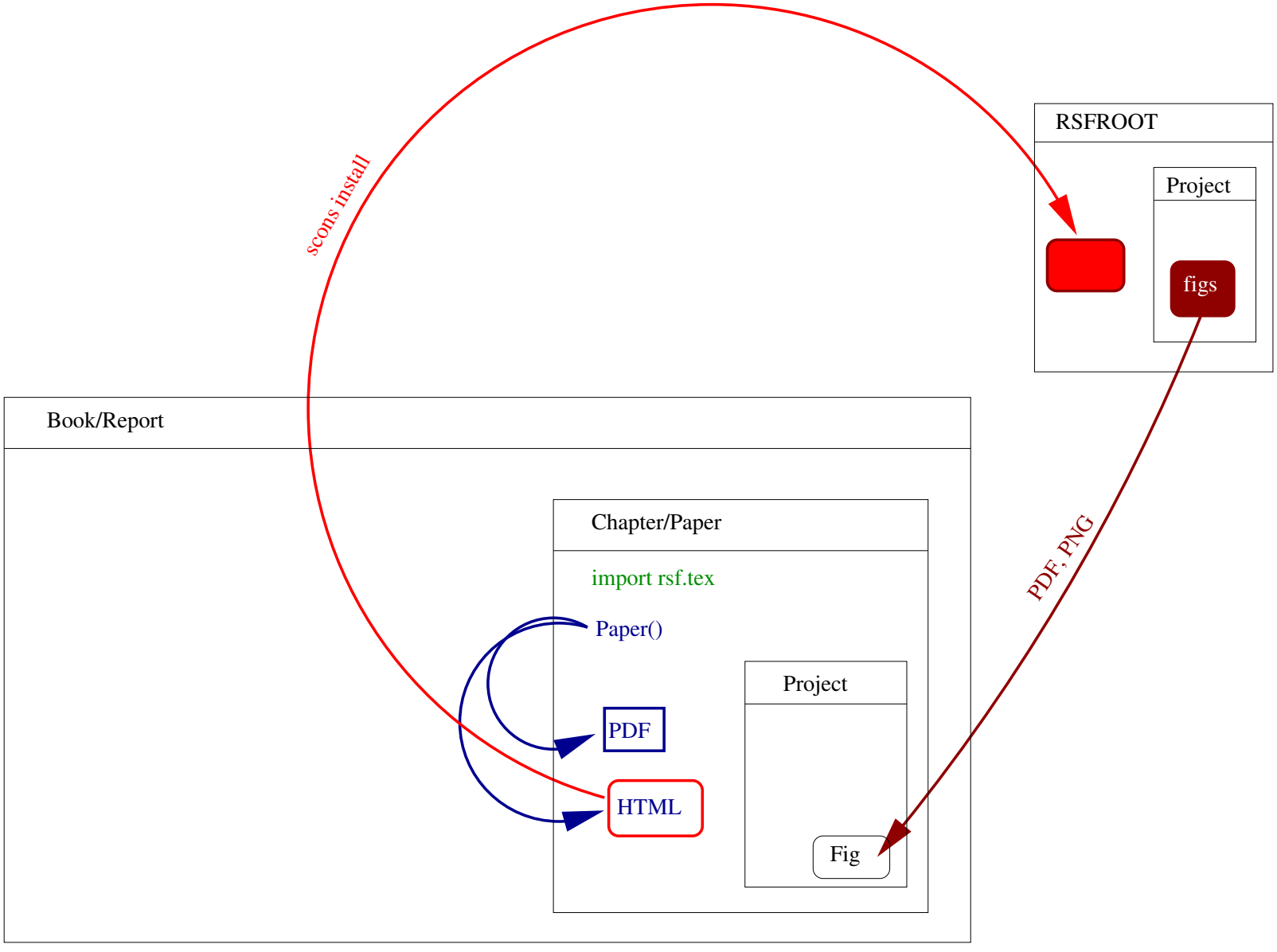
- Getting from Madagascar what you need: even if we have to get dirty.
- Example subject: Traveltime sensitivity kernels

The Big Scheme of Things



Courtesy of Fomel (2006)

The Big Scheme of Things II



Courtesy of Fomel (2006)

LaTeX

- Documentation system
- Extends TeX
  - “Open source”
  - “Reproducible”
- Descriptive language

The essential tool

LeTeX and specifically SEGTeX macros including SEG.bib

- **article class.**
- **Geophysics class.**
- **segabs.cls for SEG abstracts.**

downloading: svn co `https://segtex.svn.sourceforge.net/svnroot/segtex/trunktexmf`

SEGTeX

- LaTeX2e package
- In development 2001–Present
- http://reproducibility.org/wiki/Main_Page
- Multiple purpose
  - *Geophysics* papers
    - Manuscript style
    - Publication style
  - SEG expanded abstracts
  - Other
    - books and reports
    - EAGE publications
    - presentations

Look Inside SEGTeX

- texmf/
  - ls-R (update with texconfig rehash)
  - tex/latex/seg/
    - geophysics.dtx (literate programming)
    - geophysics.cls
    - seg.sty
    - ...
  - bibtex/bst/seg/
    - seg.bst
    - seglike.bst (Joerg Schleicher)
  - bibtex/bib/seg/
    - SEG2005.bib
    - SEG.bib
  - latex2html/
    - perl/geophysics.perl
    - icons/
    - style.css

Where are the live papers?

In the Madagascar file system:

RSFSRC/book

$$\overbrace{\textbf{book}}^{\textit{main}} / \overbrace{\textbf{sep}}^{\textit{group}} / \overbrace{\textbf{banana}}^{\textit{paper}} / \overbrace{\textbf{kernel}}^{\textit{examples}} / \overbrace{\textbf{Fig}}^{\textit{Figures}}$$

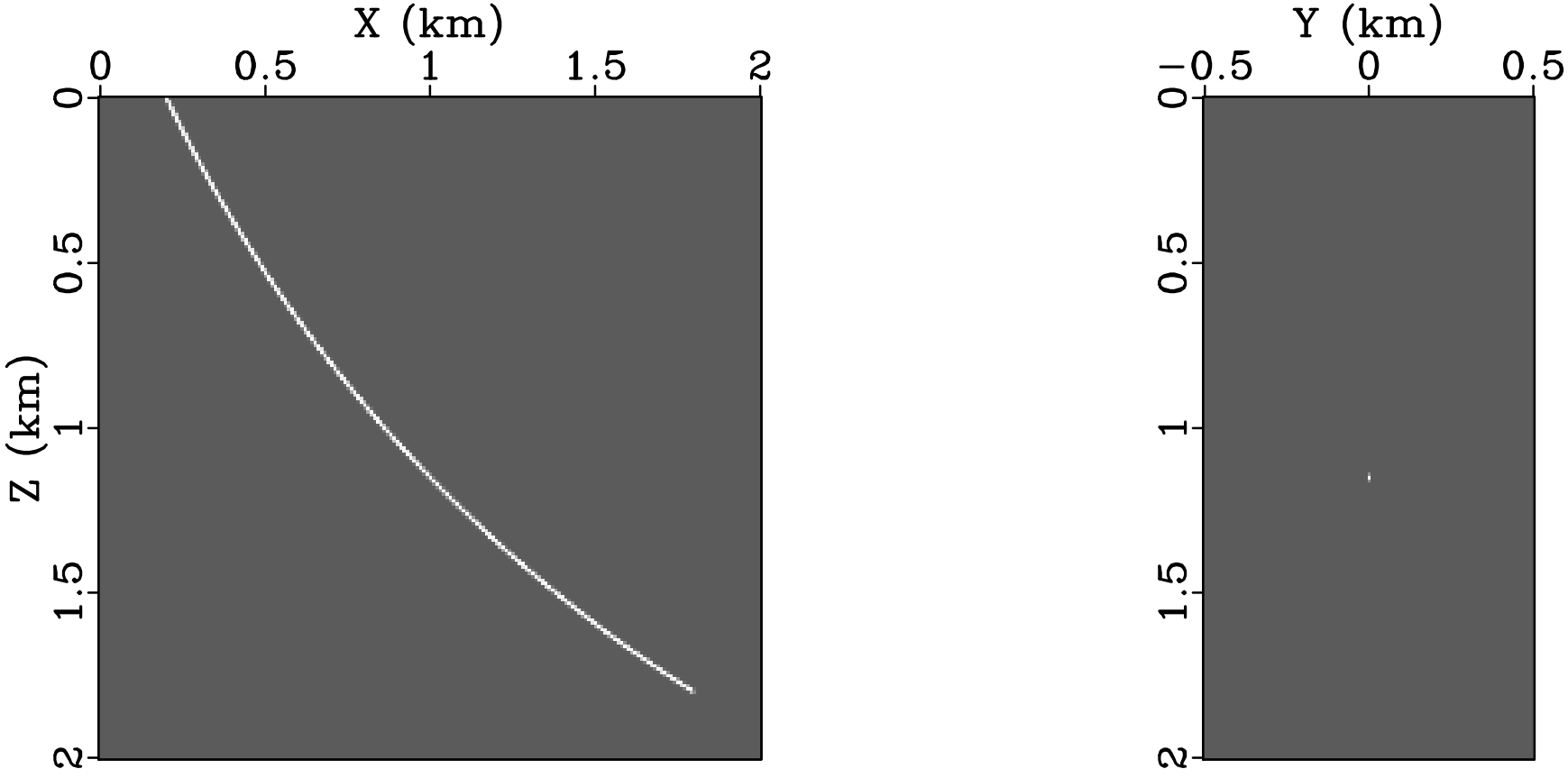
Paper directory

- paper.tex, paper.bib, SConstruct
- Fig directory: static plots
- XFig directory: plots drawn using xfig
- Math directory: examples using mathematica or matlab
- marm directory: example using the Marmousi model

Paper: the example subject

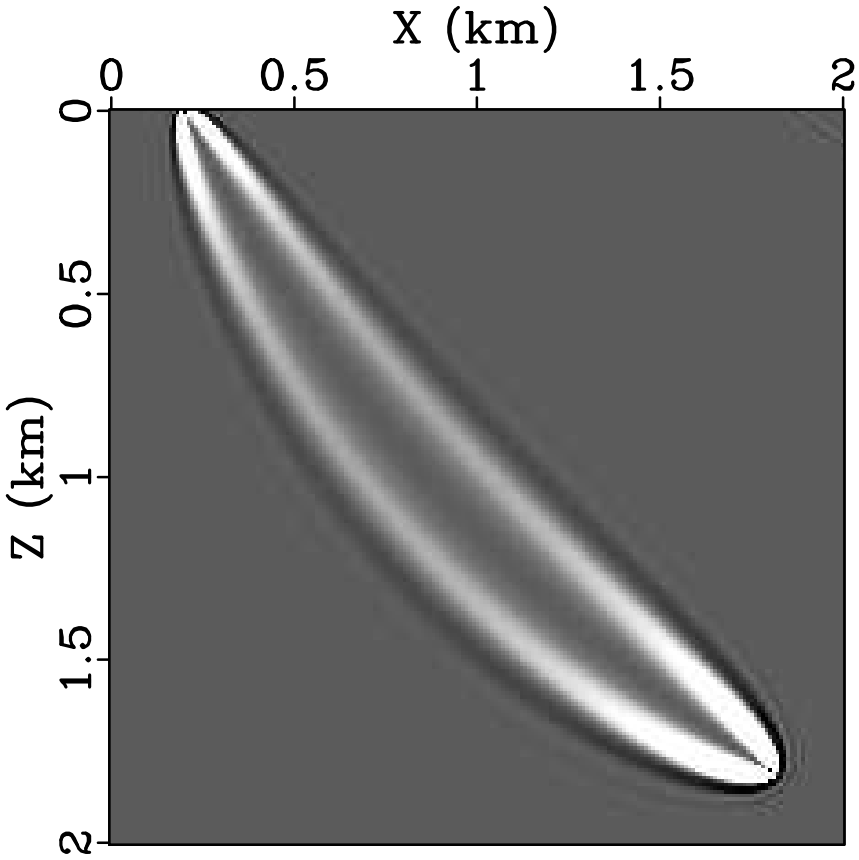
The sensitivity of traveltimes to velocity changes based on (high frequency) rays and (finite frequency) fat rays.

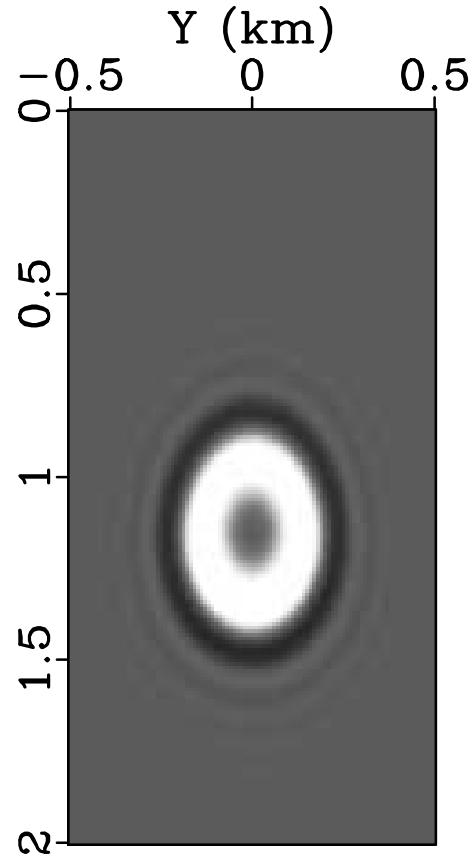
For a ray: the high frequency limit



Courtesy of Rickett (2000)

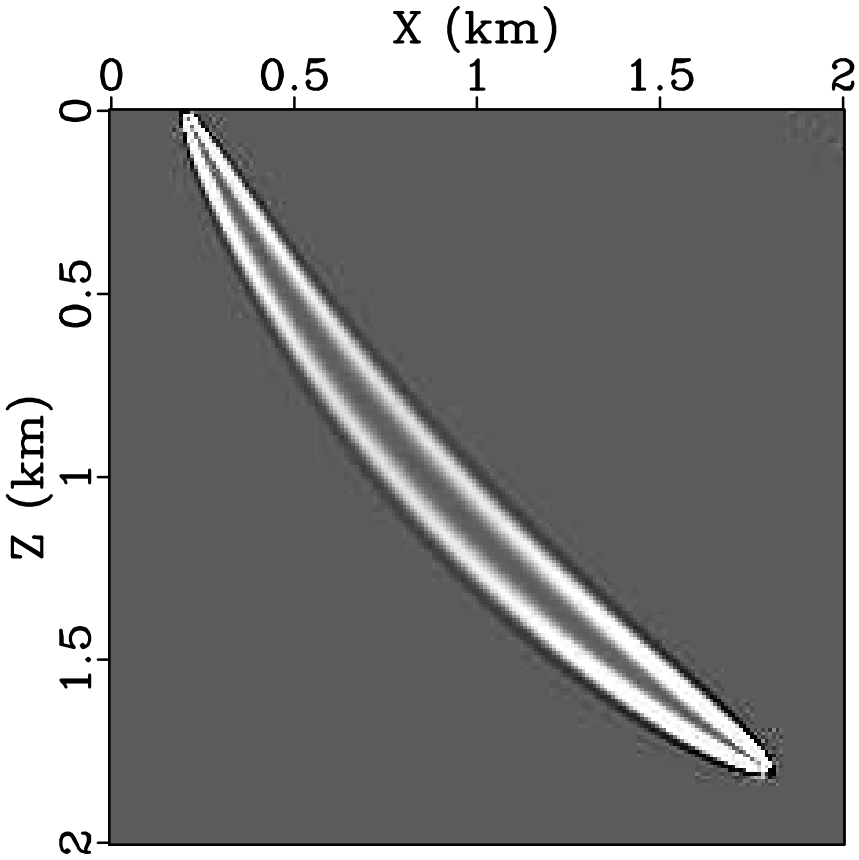
At 30 Hz

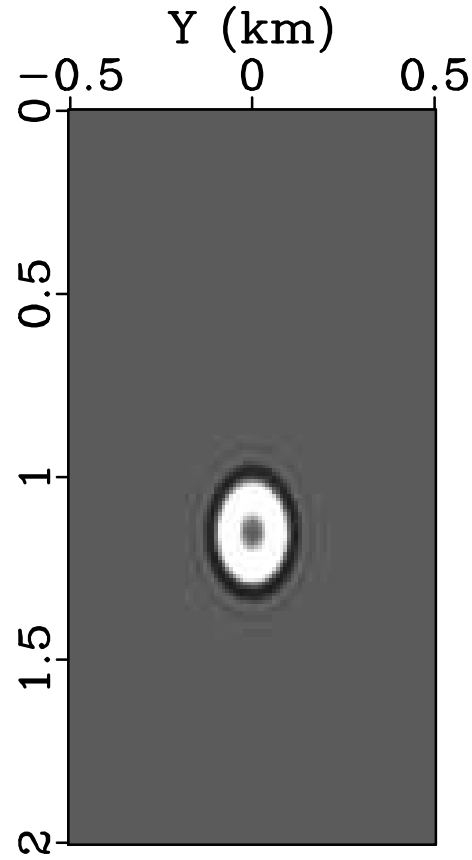




Courtesy of Rickett (2000)

At 120 Hz





Courtesy of Rickett (2000)

Paper: scope

- Finite frequency traveltimes
- Modify paper and develop equations
- A simple example
- Application to the Marmousi example

The paper template: a Madagascar feature

- From the book directory, or one of your own papers
- Read the paper and see if you could form a good introduction from that paper.
- Copy it to your directory compile it (the whole directory)
- Remove unwanted examples and corresponding directories (compile again).
- Write your abstract (a road map).

For the sensitivity kernels

"Traveltime sensitivity kernels: Banana-doughnuts or just plain bananas?"

James Rickett

RSFSRC/book/sep/banana

Perturbation theory

$$\delta \mathbf{T} = \mathbf{A}\ \delta \mathbf{S}$$

δT traveltime perturbations

δS slowness perturbations

A modeling operator

$$\delta T = \int_{\text{ray}} \delta s(\mathbf{x})\ dl$$

Born-based traveltime

$$\delta T = \frac{\int_{t_1}^{t_2} \dot{U}(t)\, \delta U(t)\, dt}{\int_{t_1}^{t_2} \ddot{U}(t)\, U(t)\, dt}$$

courtesy of Marquering et al. (1999)

$$\delta U_{\mathrm{Born}}(\mathbf{x}, \omega) = \frac{\omega^2}{4\pi} \int_V G_0(\mathbf{x}, \omega; \mathbf{x}')\, U_0(\mathbf{x}, \omega; \mathbf{x}') \delta s(\mathbf{x}') dV(\mathbf{x}')$$

Rytov traveltime

$$\delta \mathbf{T} = \sum_{\omega} \frac{F(\omega)}{\omega} \Im \left(\delta \mathbf{\Psi} \right)$$

$$= \sum_{\omega} \frac{F(\omega)}{\omega} \Im \left(\mathbf{R}\ \delta \mathbf{S} \right)$$

$$\delta \psi_{\mathrm{Rytov}}(\mathbf{x}, \omega) = \frac{\delta U_{\mathrm{Born}}(\mathbf{x}, \omega)}{U_0(\mathbf{x}, \omega)}$$

Getting started

- Copy the directory "book/sep/banana" to your desired location
- cp -r book/sep/banana /.
- Change directory name (i.e. doughnut)
- enter the directory
- Compile the paper: "sftour scons lock" and then "scons read"

Compiling options

- **scons paper.read**
- **scons paper.pdf**
- **scons paper.html**
- **scons paper.wiki**

The paper SConstruct

SConstruct

```
from rsf.tex import *

Paper('slidesBeijing',
      lclass='cwpslides',
      use='multicol,color,overpic,listings,amsmath,

End(options='short')
```

Make a change: reproducible?

- Look at the paper
- Access its tex version
- and especially the Figures

paper.tex

```
\def\figdir{./Fig}
\lefthead{Rickett}
\righthead{Traveltime sensitivity kernels}
\footer{SEP--103}
\published{SEP report, 103, 61-68 (2000)}
\title{Traveltime sensitivity kernels: Banana-dough
plain bananas?}

\email{james@sep.stanford.edu}
\author{James Rickett}

\maketitle


%\begin{abstract}
```

paper.tex

The Figures directory

```
\section{Kernels compared}
\inputdir{kernel}

This section contains images of traveltime kernels
numerically for a simple model that may be encounte
```

paper.tex

Calling the Figure

```
\par
Figure~\ref{fig:RayKernel} shows the ray-theoretica
sensitivity kernel: zero except along the geometric
\plot{RayKernel}{width=5in}{Traveltime sensitivity
ray-based tomography in a linear $v(z)$ model.
The kernel is zero everywhere {\em except} along ge
Right panel shows a cross-section at $X=1$~km.}
```

Make a change: reproducible?

- Enter directory “kernel”
- Open SConstruct using your favorite editor

The example SConstruct

kernel/SConstruct

```
from rsf.proj import *

def sensitivity(mode):
    return '''
    sensitivity mode=%d
    nx=201 dx=0.01 ox=0.
    ny=101 dy=0.01 oy=-0.5
    nz=201 dz=0.01 oz=0.
    sx=0.2 sy=0. sz=0.
    rx=1.8 ry=0. rz=1.8
    v0=1.5 vgrad=0.8
    ''' % mode
```

Use Born instead of Rytov

kernel/SConstruct

```
for t in (2,8):
    dt = 0.001*t

    banana = 'banana%d' % t
    pancak = 'pancak%d' % t

    Flow(banana,None,sensitivity(6)+' ny=1 oy=0 dt=
    Flow(pancak,None,sensitivity(6)+' nx=1 ox=1 dt=
```

code name: sfsensitivity

Modifications

- Change 6 to 2 using your favorite editor
- scons view
- scons lock
- cd ..; scons read

Adopting the paper

- Insert new title
- Modify author(s)
- Change introduction to your language, use references and add this paper as a reference “banana.bib”
- Clean the rest, keep one Figure
- start writing your own paper
- remove examples if not needed

Adding synthetic examples

- Directory "RSFSRC/book/data" or any other paper running an example
- Copy the example to your paper directory (i.e. $RSFSRC/-book/swag/eikds/smvel)
- cd smvel; scons view; scons lock
- This forms a start, clean it up and add your code example

Including the new example

- cd ..
- Open paper.tex with you favorite editor
- Above the plot call type: inputdir{smvel}
- Insert the Figure name inside the Plot function
- modify the caption
- reference the Figure in a sentence
- Save and compile; scons read

More info

- http://www.reproducibility.org/wiki/SEGTeX#Documentation
- **$RSFSRC/book/rsf**

Tips and tricks

- Be patient, do not give up
- Use rsf-user@lists.sourceforge.net
- SConstruct controls everything, try, at least, to understand
- Always access other papers with the power of “grep”

Reproducible papers

http://www.reproducibility.org/wiki/Reproducible_Documents
http:
//www.reproducibility.org/RSF/book/sep/banana/paper_html/

- Source: $RSFSRC/book/sep/banana

Documentation

Madagascar Programming Reference Manual

courtesy of SWAG

RSFSRC/book/rsf/manual

Content

- Covers all available data types and subroutines under rsf.h
- Includes a description (beyond what was given by the developer)
- It organizes them in terms of usage and purpose
- we plan to have the manual get built automatically to include updates in the subroutine
- $RSFSRC/book/rsf/manual

Content

- *An example: Finite-Difference modeling*
- *Data types*
- *Preparing for input*
- *Operations with RSF files*
- *Error handling*
- *Linear operators*
- *Data analysis*
- *Filtering*
- *Solvers*
- *Interpolation*
- *Smoothing*
- *Ray tracing*
- *General tools*
- *Geometry*
- *Miscellaneous*
- *System*

Pointers

- Be patient, do not give up
- Use rsf-user@lists.sourceforge.net
- SConstruct controls everything, try, at least, to understand it
- You could always run RSF like SU

Final remarks

- Make things simple
- Get to know Madagascar, it can be your friend, but hopefully not your only friend
- Always compile (makes error search easier)
- Reproducible is good (very good)
- Love thy neighbor $\longrightarrow$ contribute

I thank the supporters of SWAG

http://swag.kaust.edu.sa