madagascar overview

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MADAGASCAR

MADAGASCAR is an open-source **software package** for geophysical data processing and reproducible numerical experiments

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the technology developed using the MADAGASCAR project management system is transferred in the form of recorded processing histories, which become **computational recipes** to be verified, exchanged, and modified by users of the system

open source (standard GPL)

freedom

- to use
- to study and modify
- to redistribute
- to improve

collaboration

peer review

reproducibility

inspirational quote

The purpose of reproducible research is to facilitate someone going a step further by changing something. The first step that someone will want to make is to be sure that your work is reproducible before they change and improve upon it.

Jon F. Claerbout, *Reproducible research*

inspirational quote

Within the world of science, computation is now rightly seen as a third vertex of a triangle complementing experiment and theory. However, as it is now often practiced, one can make a good case that computing is the last refuge of the scientific scoundrel... Where else in science can one get away with publishing observations that are claimed to prove a theory or illustrate the success of a technique without having to give a careful description of the methods used, in sufficient detail that others can attempt to repeat the experiment?

Randall J. LeVeque, *Wave propagation software, computational science, and reproducible research, 2006*

MADAGASCAR **mission**

- a powerful research environment
- a convenient technology transfer tool

for researchers working with digital image and data processing

MADAGASCAR system

software

http://rsf.sourceforge.org

blog

http://www.reproducibility.org/rsflog

- distributed development (academia/industry)
- version control `subversion`
- installation and flows by `scons`

MADAGASCAR development

release: 0.9.5. in October 2007

contributors

- University of Texas (Austin)
- Colorado School of Mines
- University of British Columbia
- ...

MADAGASCAR heritage

software system

- SEPlib (Stanford University)
- SU (Colorado School of Mines)
- DDS (Amoco/BP)

reproducible research

- SEP document system

MADAGASCAR architecture

- documents
- flows
- programs

MADAGASCAR architecture

- documents
- flows
- **programs**
  - C, C++, F90, Python, Matlab ...
  - communicate by pipes
  - provide basic processing modules

MADAGASCAR architecture

- documents
- **flows**
- programs

- Python (SCons)
- combine processing modules
- provide processing history

MADAGASCAR architecture

- **documents**
  - LaTeX and SCons
  - assemble text and numeric results
  - provide reproducible documents
- flows
- programs

MADAGASCAR programs

represent independent processing modules

- combined using pipes
- "sf" prefix
- program count: 411 on 11/14/2007
- documented by examples ("books")

MADAGASCAR file format

borrowed from classic SEPlib

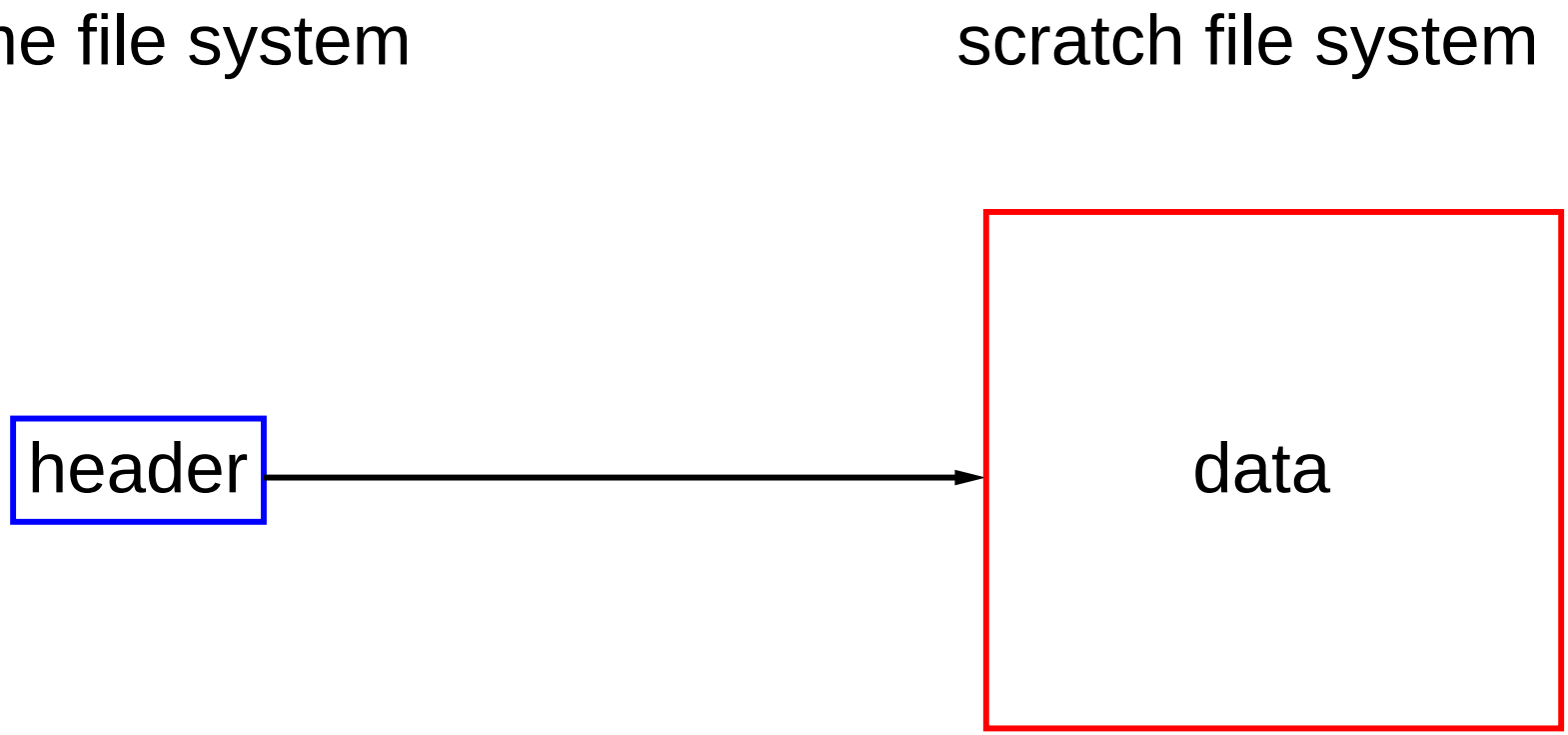
header:

- text file (description of data)
- description of regularly-sampled format
- small, can be archived

binary:

- binary file (actual data)
- N-dimensional hypercube
- large, can be stored on a different file system
- path to binary set with environment variable `DATAPATH`

MADAGASCAR file format



MADAGASCAR demo

this is a reproducible document!

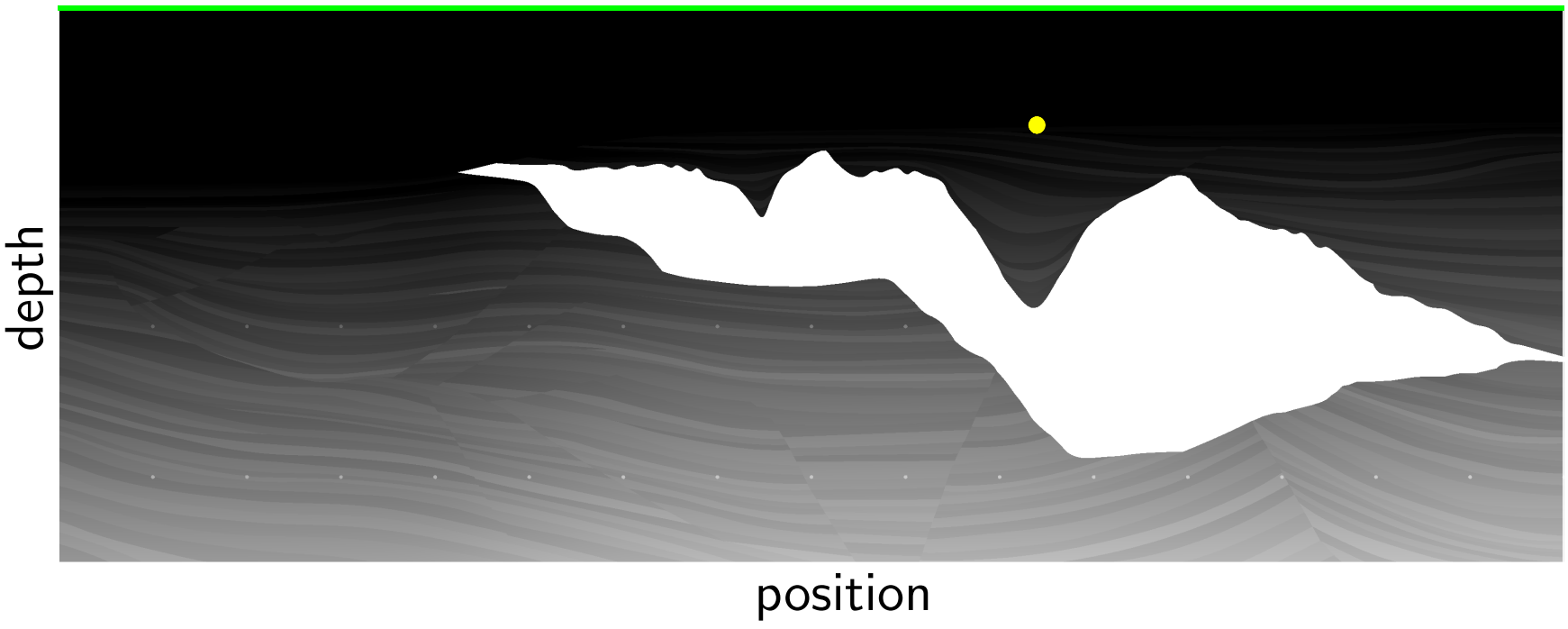
example

- ray tracing
- eikonal solver
- finite-difference modeling

velocity model

flow layer

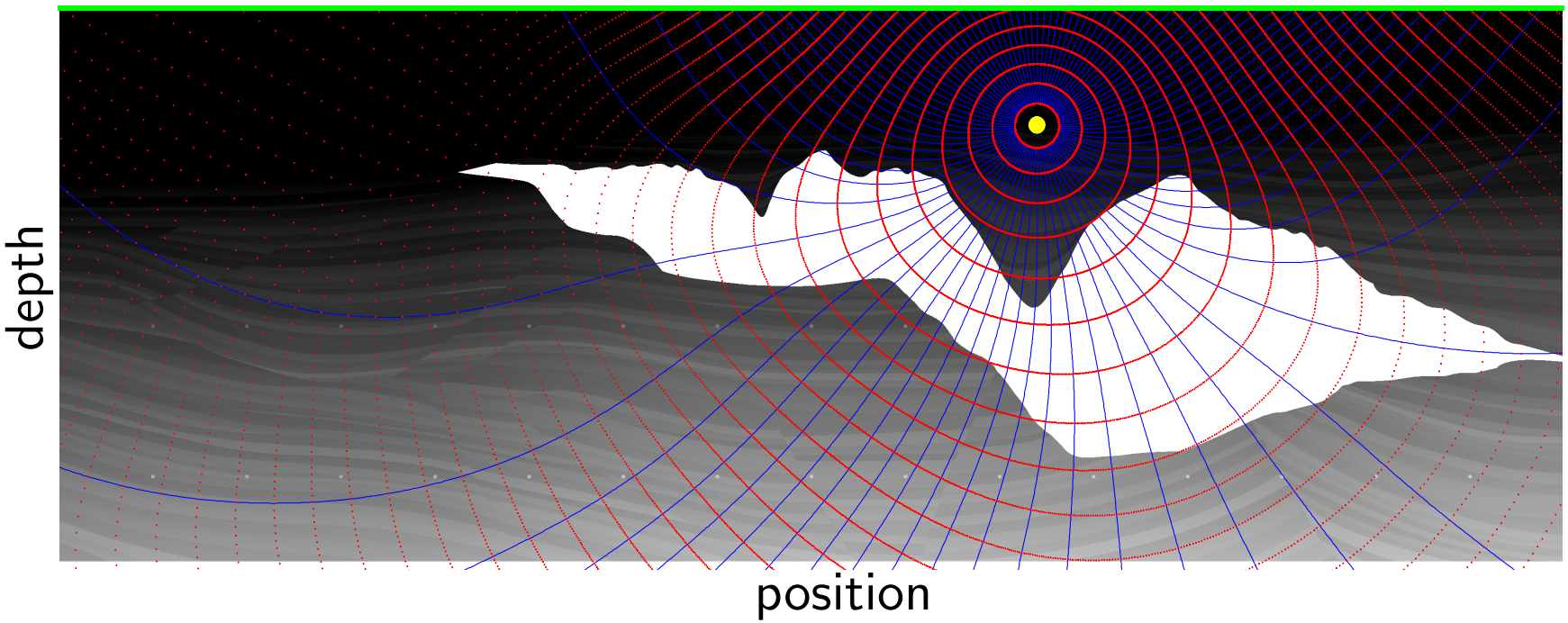
```
sigs.getstrvel('velo',par)
Plot('velo',fdmod.cgrey('allpos=y bias=1.5',par))
Result('velo',['velo','ss','rr'],'Overlay')
```


depth
position

ray tracing

flow layer

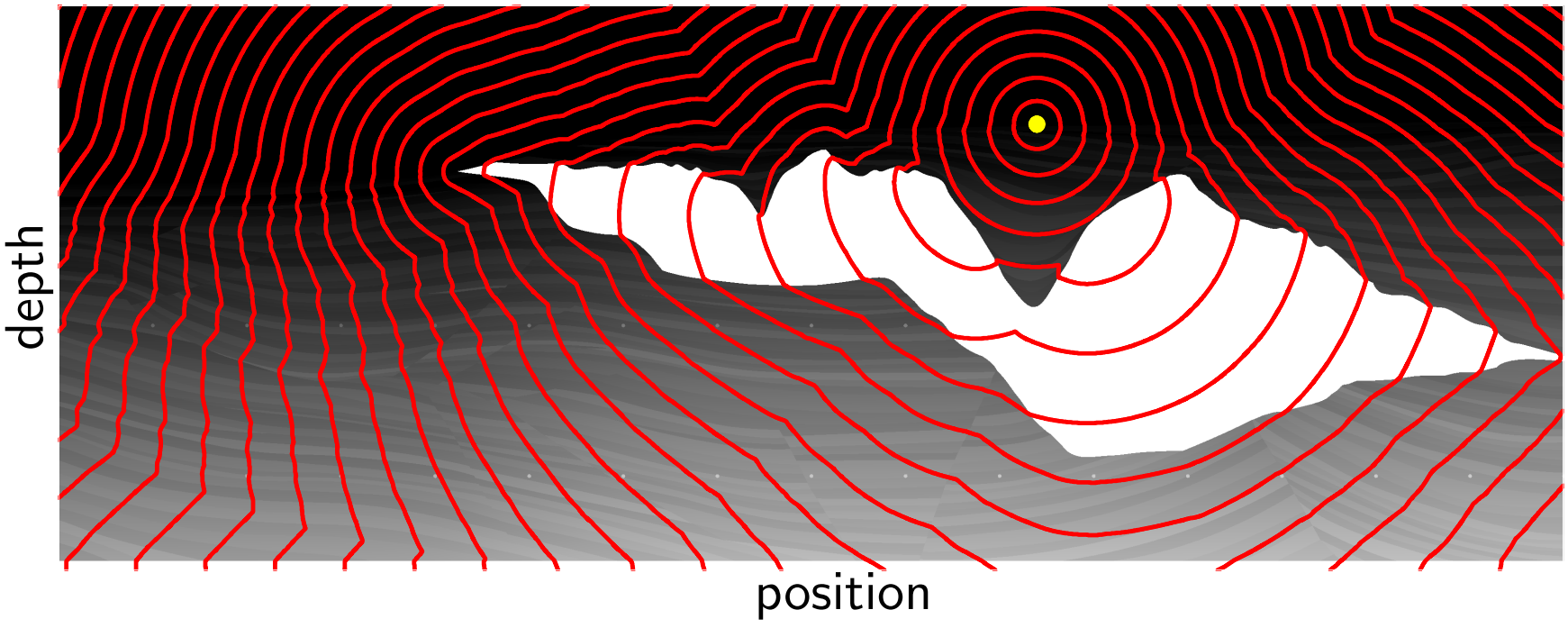
```
Flow('hwt','velo',
     '''
     smooth rect1=150 rect2=150 repeat=5 |
     hwt2d verb=n xsou=%(xsou)g zsou=%(zsou)g
     nt=%(nt)d ot=%(ot)g dt=%(dt)g
     ng=%(ng)d og=%(og)g dg=%(dg)g
     ''' % par)
fdmod.rayplot('hwt',20,10,1,200,'',par)
Result('hwt',['velo','hwt','ss','rr'],'Overlay')
```


depth
position

eikonal solver

flow layer

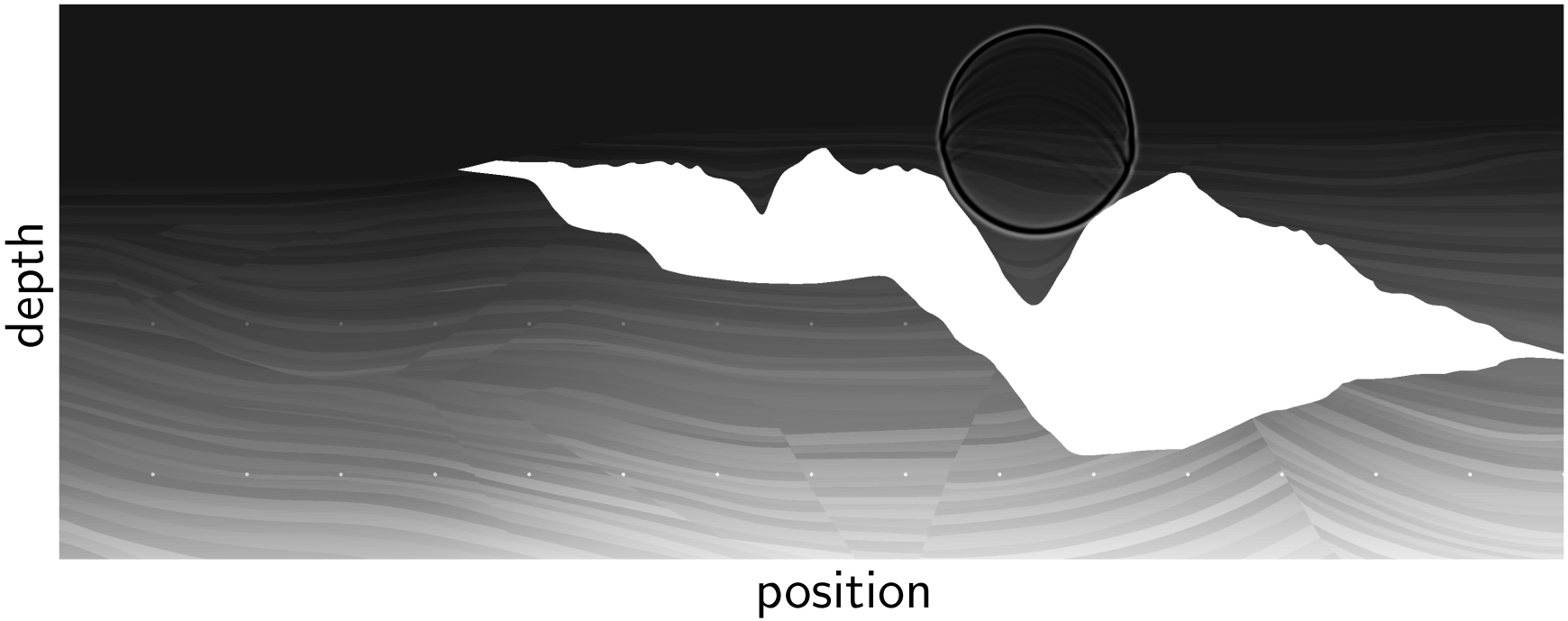
```
Flow('fme','velo','eikonal zshot=%(zsou)g yshot=%(xsou)g' % par)
Plot('fme',fdmod.ccont('dc=0.25',par))
Result('fme',['velo','fme','ss'],'Overlay')
```

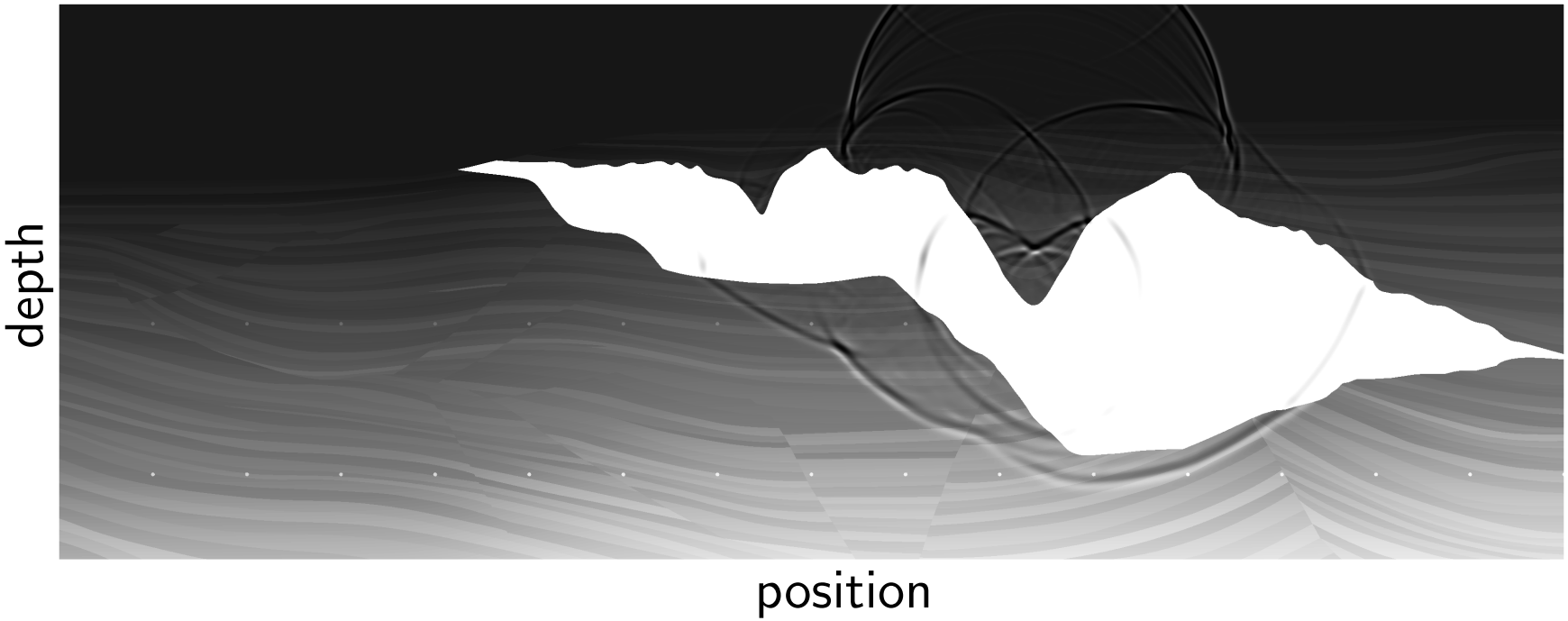

depth
position

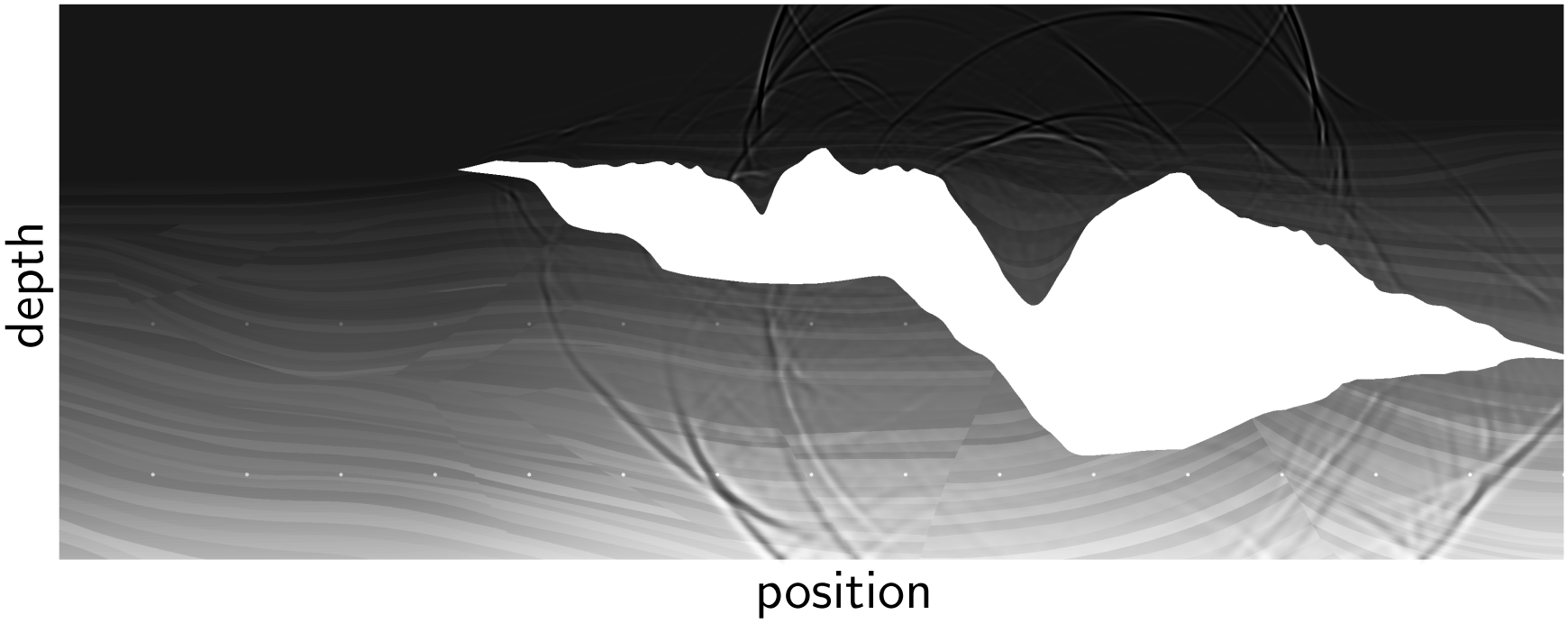
finite-difference modeling

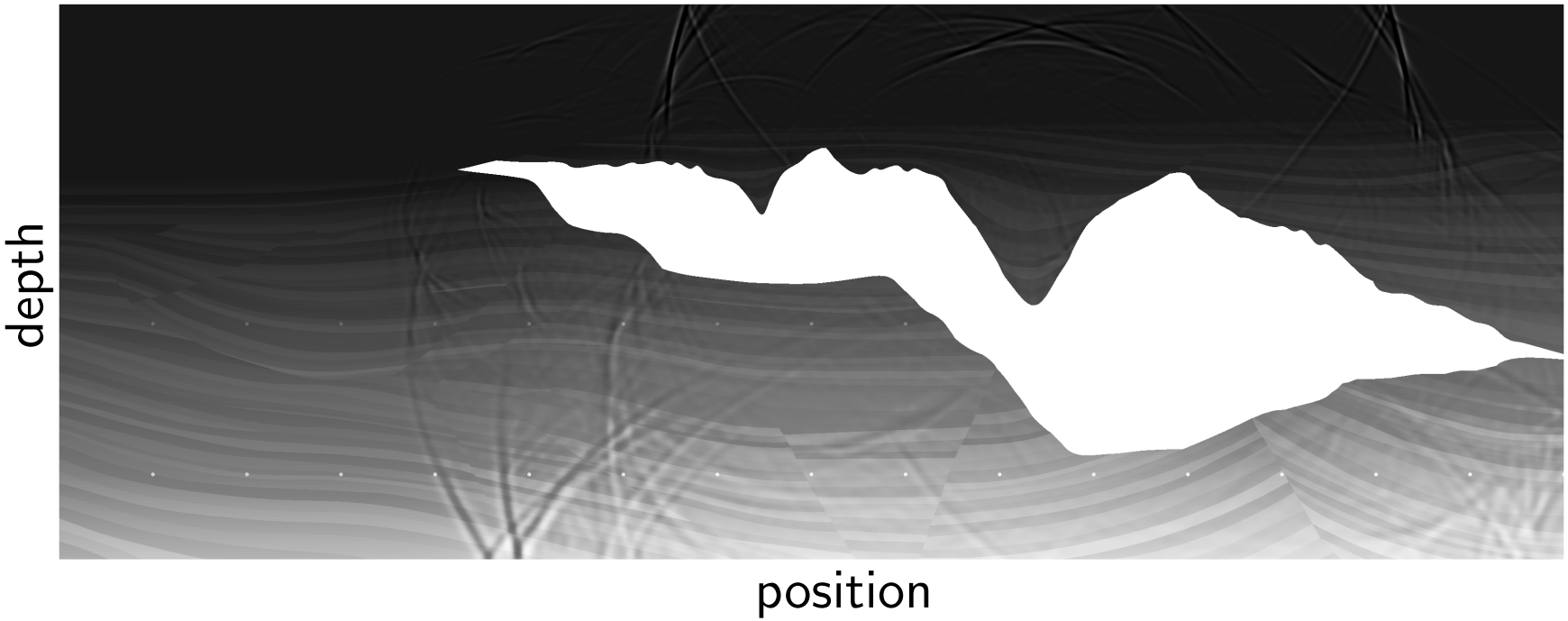
flow layer

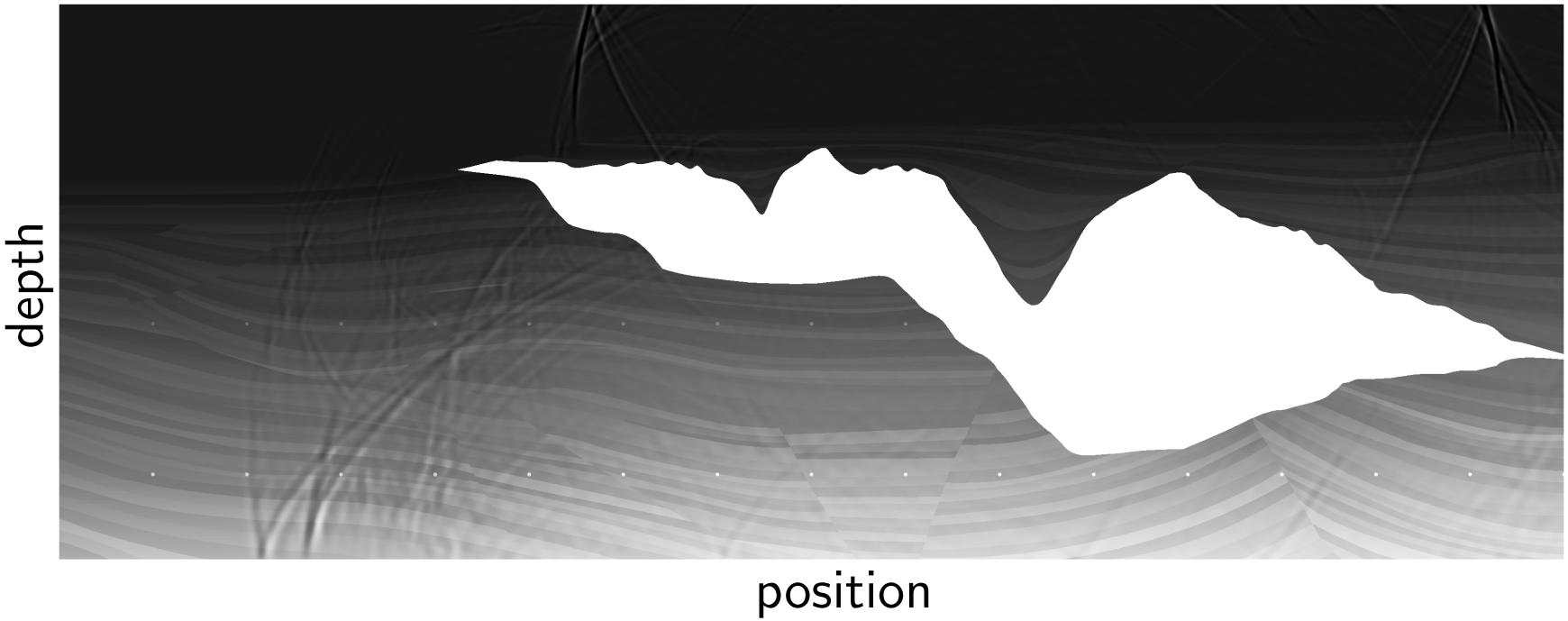
```
fdmod.awefd('dat','wfl','wav','velo','dens','ss','rr','free=n',par)
fdmod.wom('wom','wfl','velo',2.5,par)

Result('wom',fdmod.wgrey('pclip=97',par))
for i in range(0,par['nt']/par['jsnap'],10):
    fdmod.wframe('wom-'+str(i),'wom',i,'pclip=97',par)

Result('dat','transp |' + fdmod.dgrey('pclip=99',par))
```

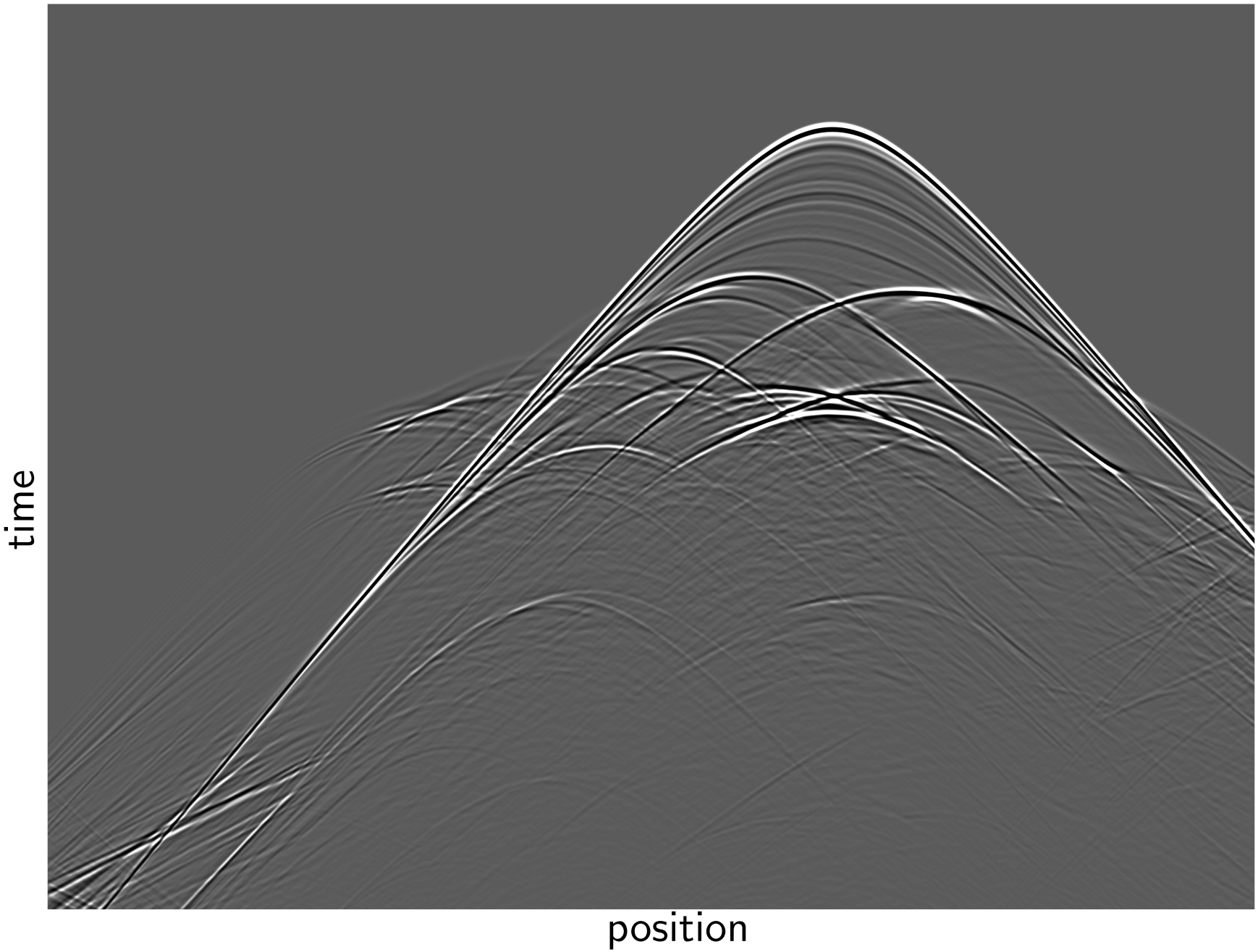

depth
position


depth
position


depth
position


depth
position


depth
position


time
position

MADAGASCAR resources

- introduction to MADAGASCAR
  `http://rsf.sourceforge.net/wiki/index.php/Introduction`
- guide to MADAGASCAR programs
  `http://rsf.sourceforge.net/wiki/index.php/Programs`
- guide to MADAGASCAR file format
  `http://rsf.sourceforge.net/wiki/index.php/Format`
- guide to MADAGASCAR API
  `http://rsf.sourceforge.net/wiki/index.php/API`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