Methodology

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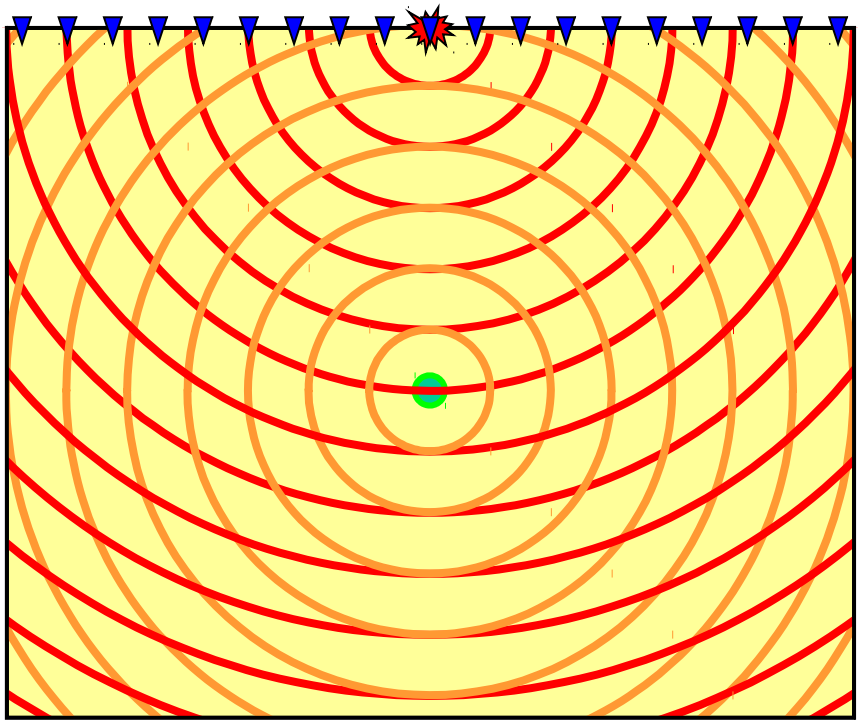
London

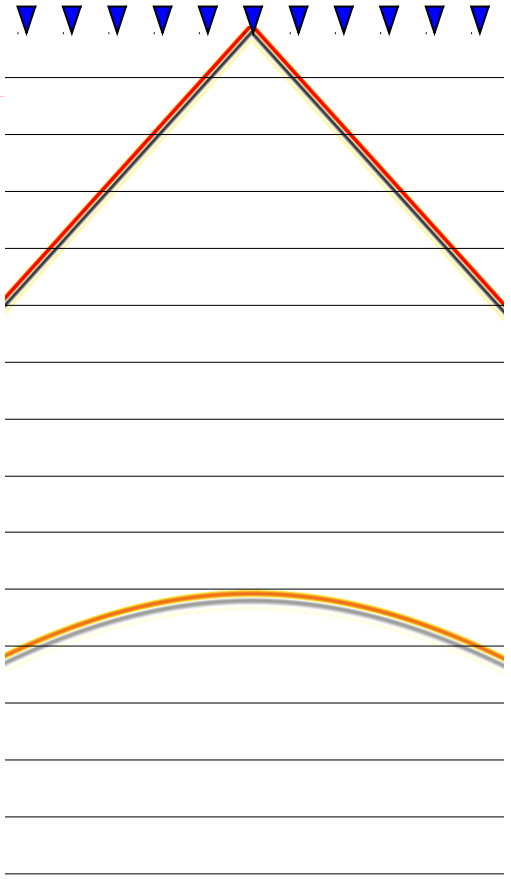
Method

1. Field data, starting model & source
2. Forward model → predicted wavefield
3. Form residual wavefield at receivers
4. Back propagate residuals → residual wavefield
5. Cross-correlate → unscaled model update
6. Step length calculation → scaled model update
7. Update model and iterate

1. Field data

true model



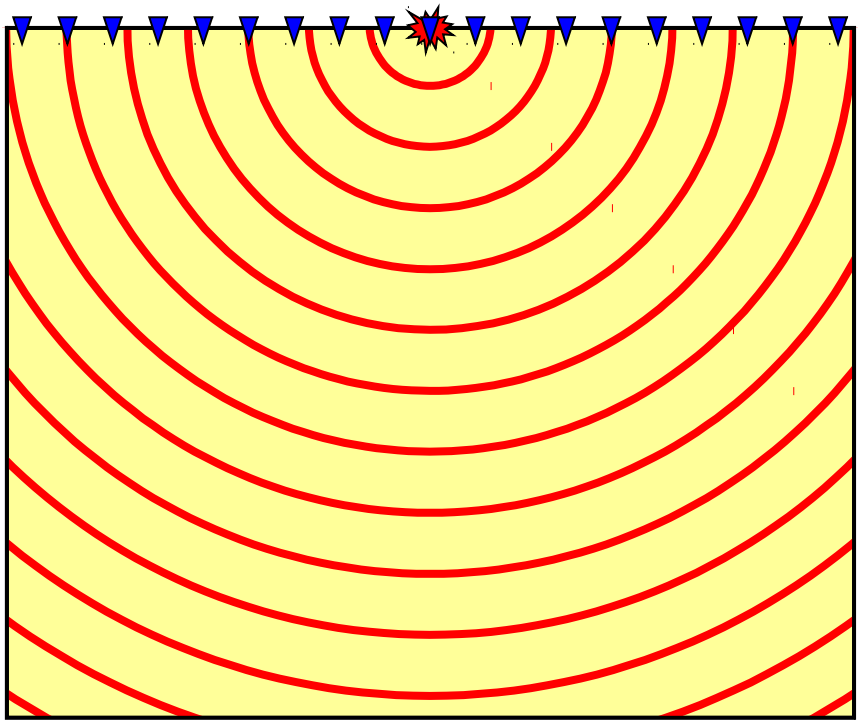


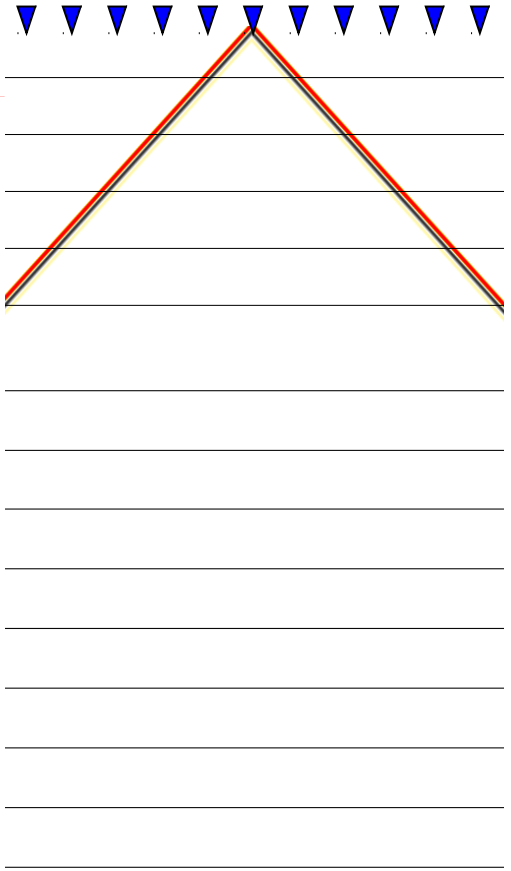
unknown

known

2. Predicted wavefield

starting model





known

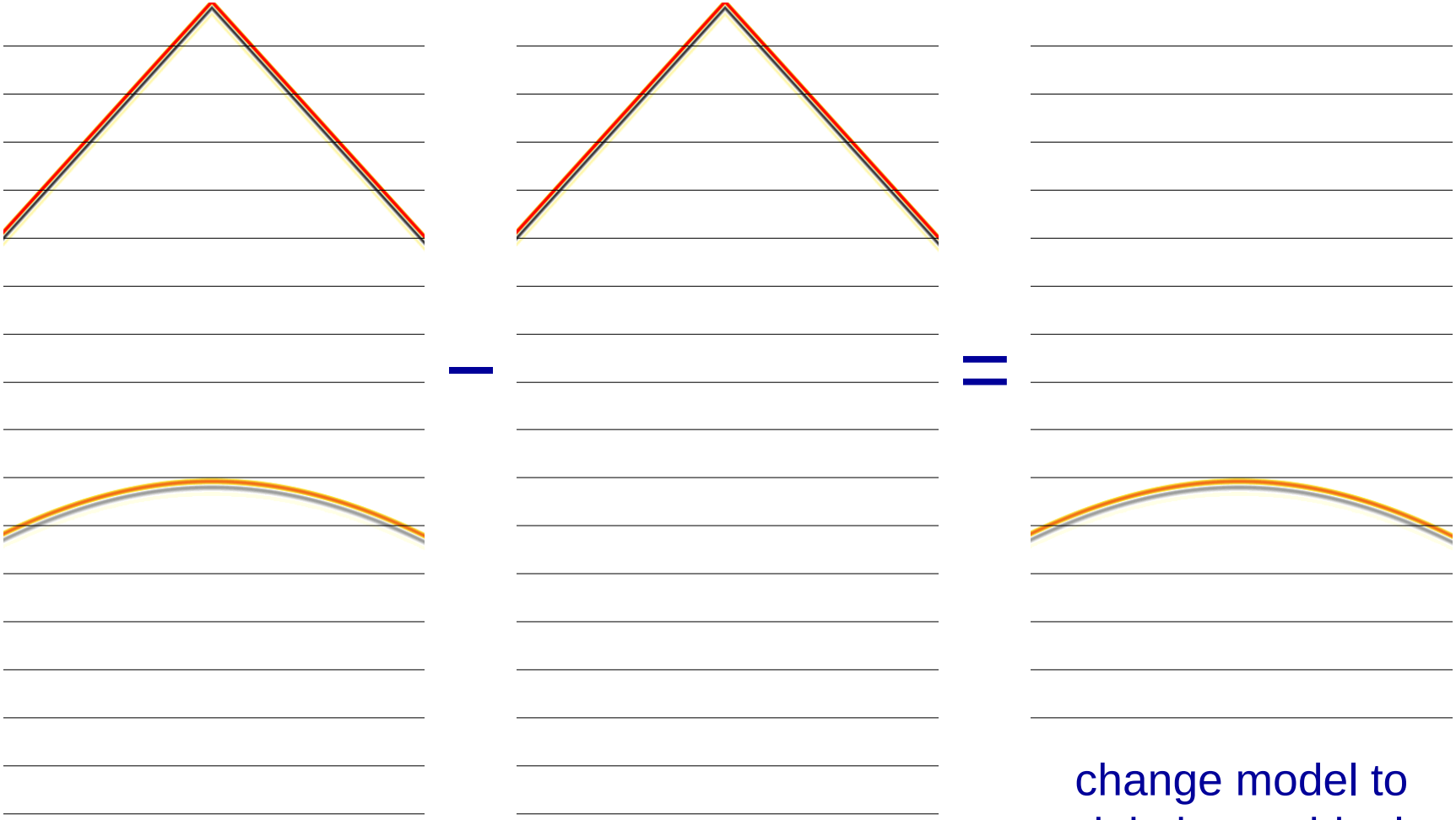
known

3. Residual wavefield at receivers

field data

predicted data

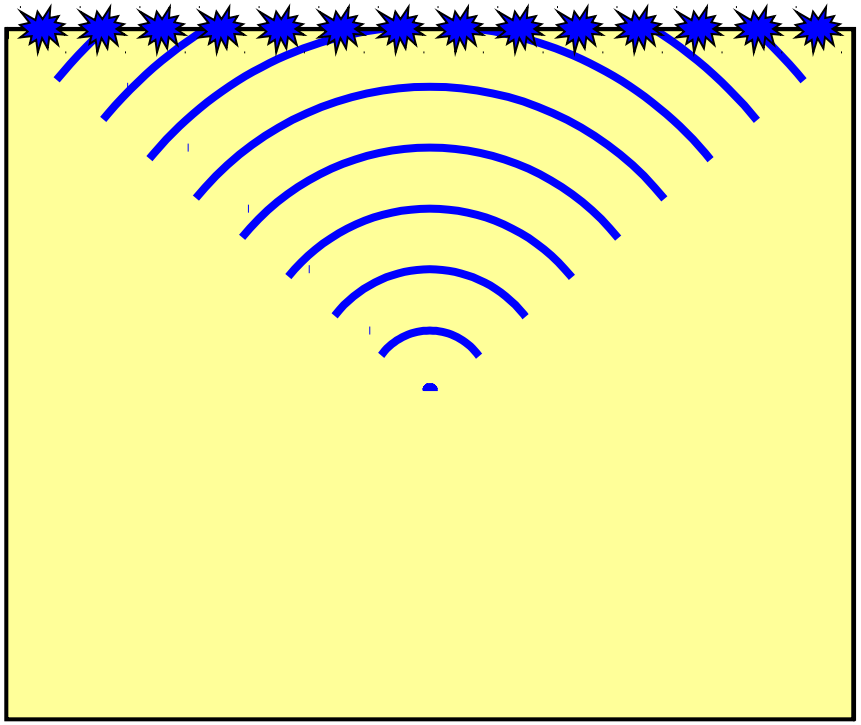
residuals



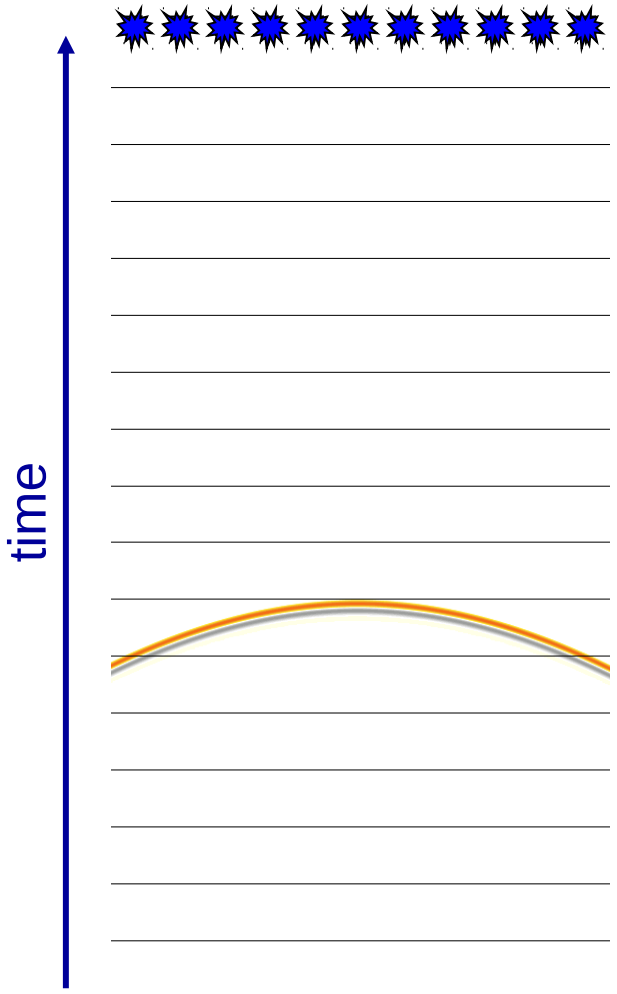
change model to minimise residuals

4. Back propagation

starting model

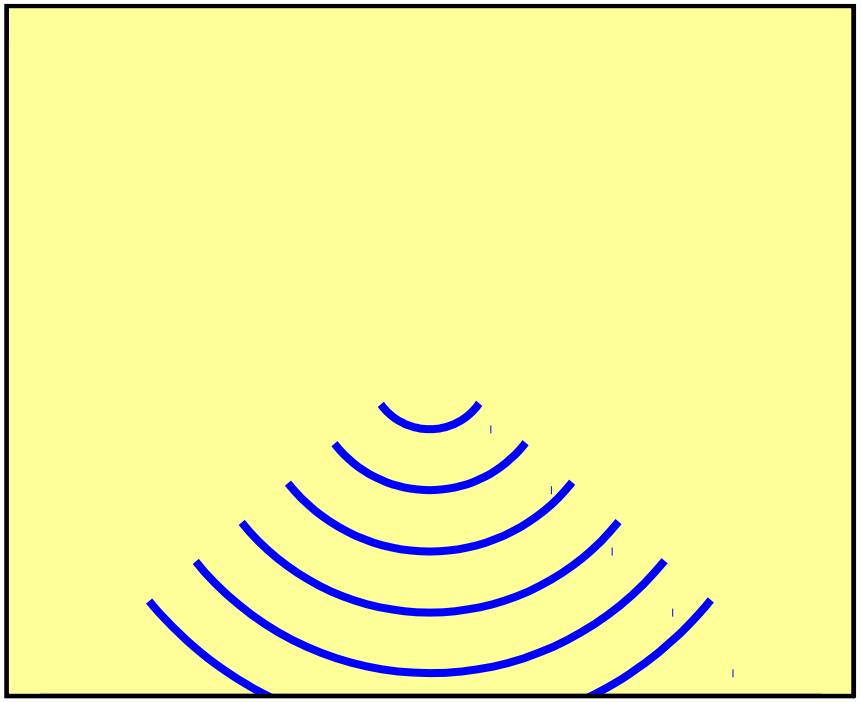


amplitude increasing

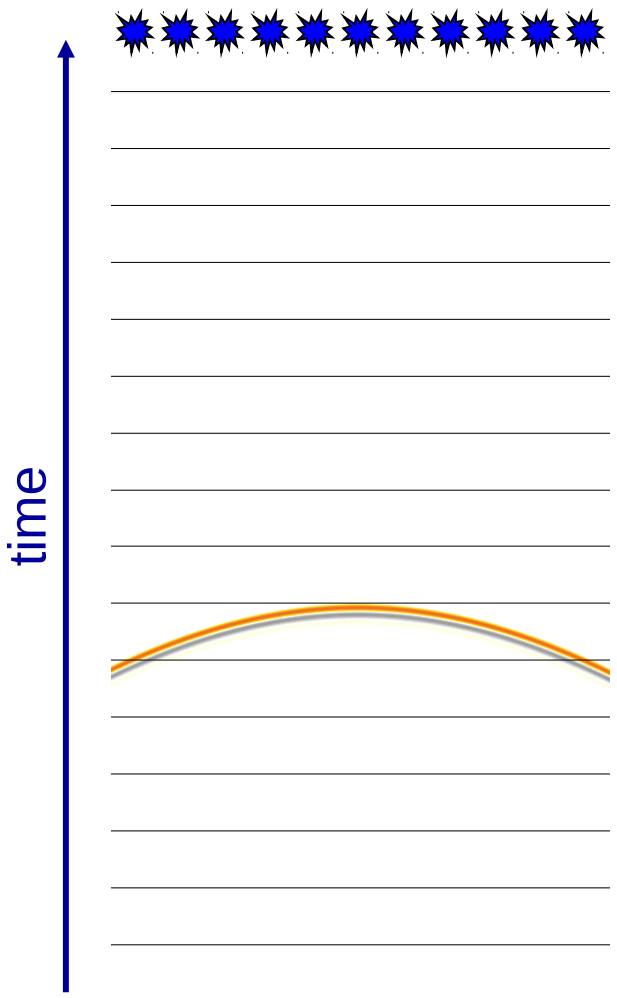


4. Back propagation

starting model

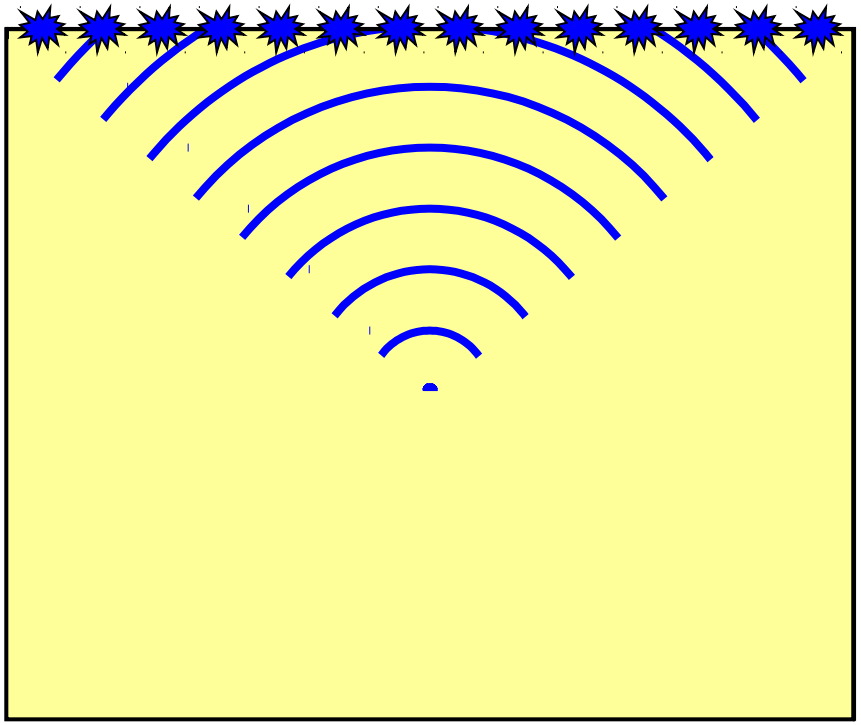


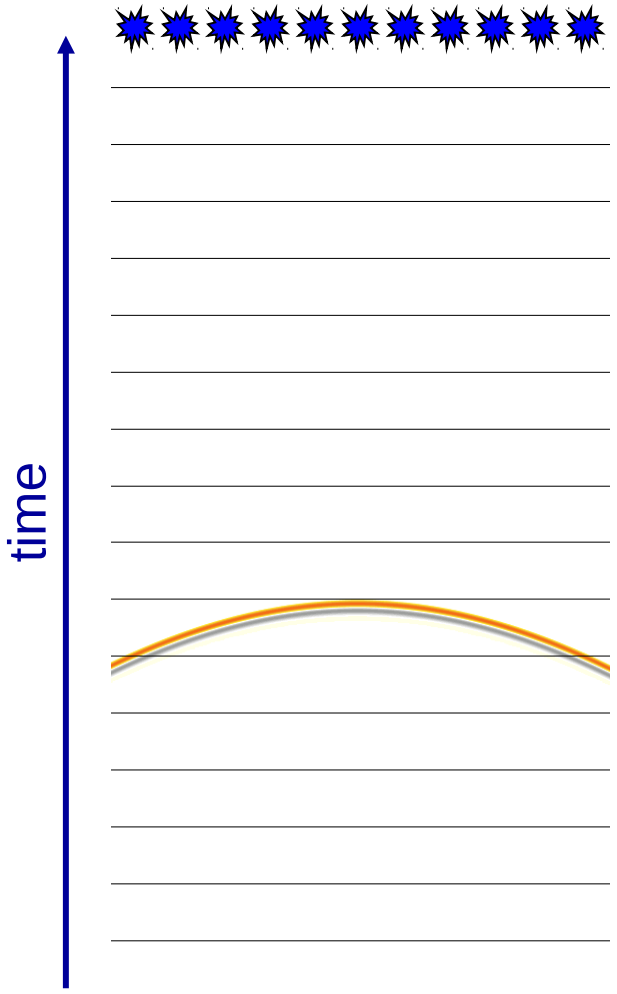
stop at zero time



4. Back propagation

starting model

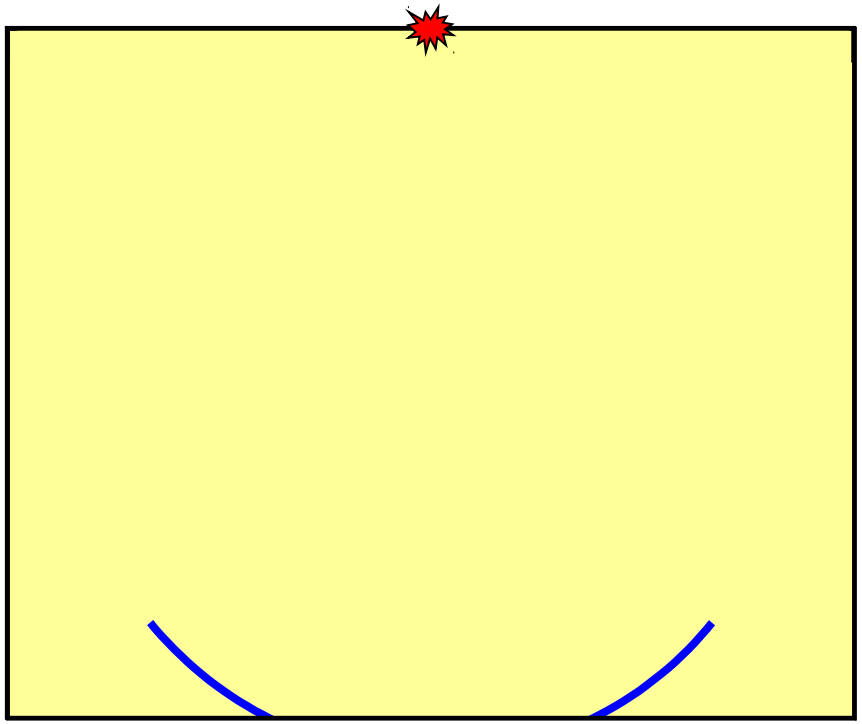




- diffractions from truncations
- incomplete illumination

5. Cross correlation

starting model



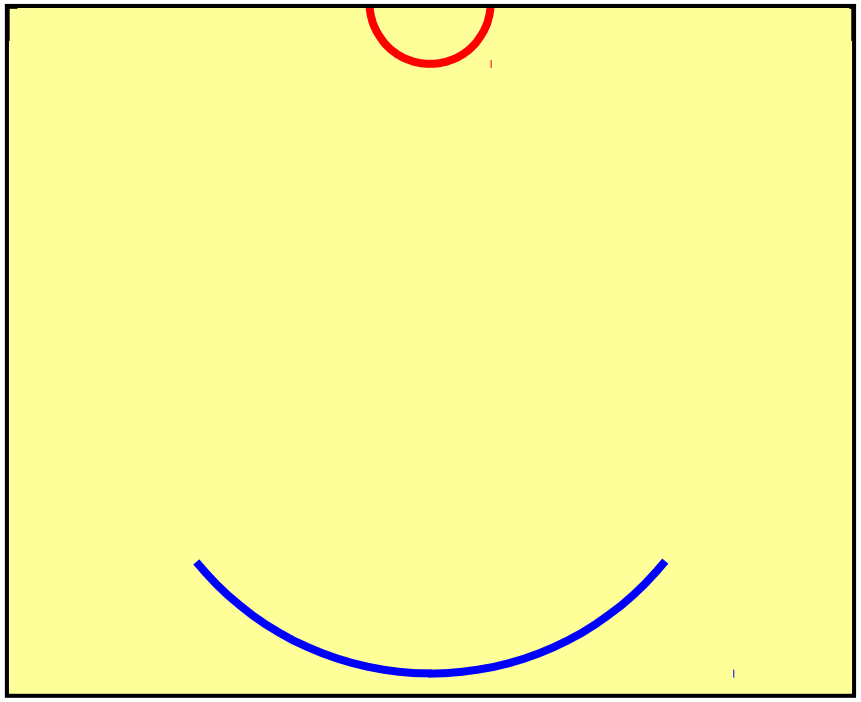
time step #0

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



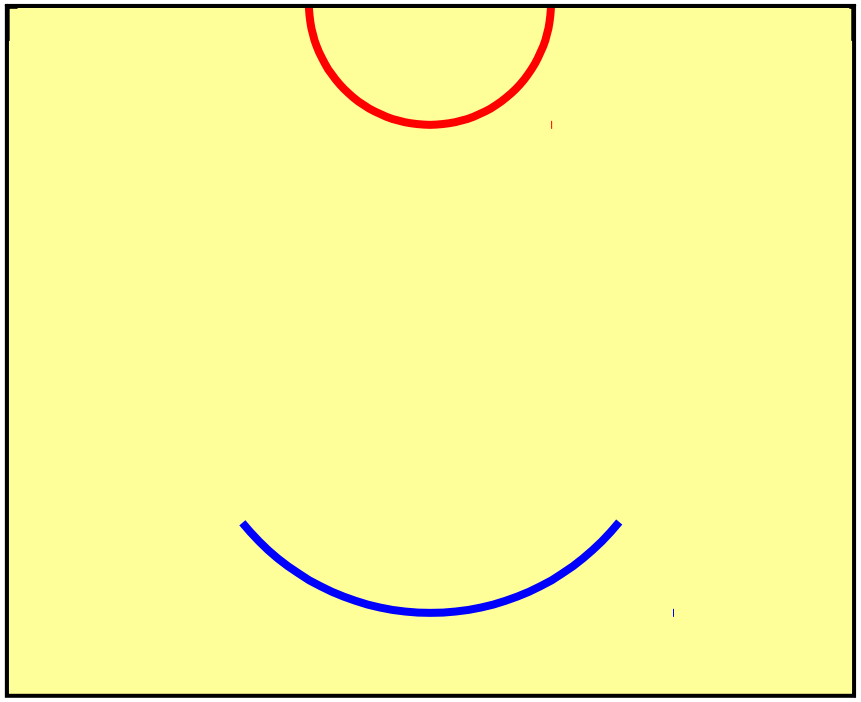
time step #1

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



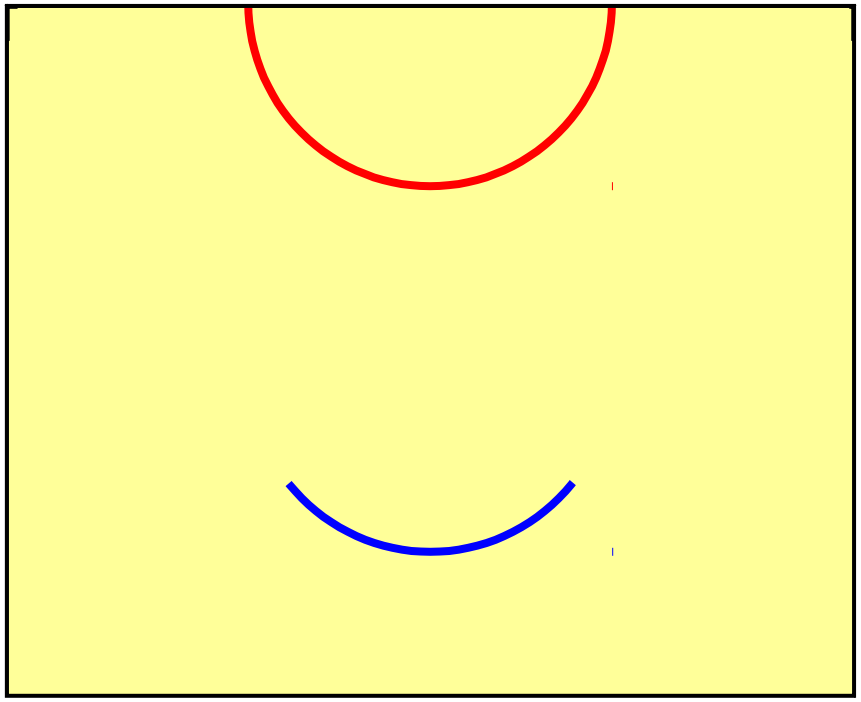
time step #2

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



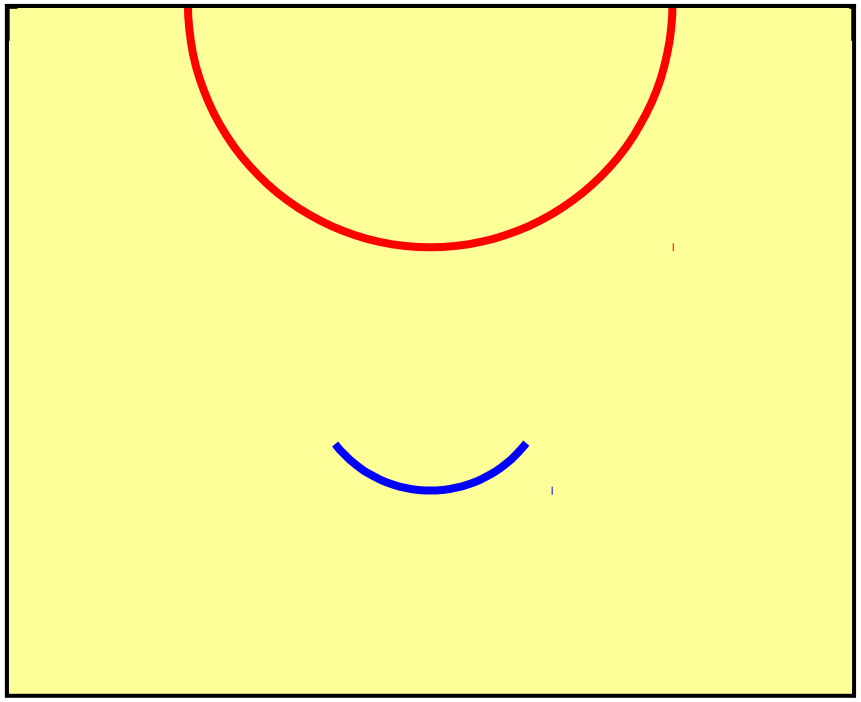
time step #3

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



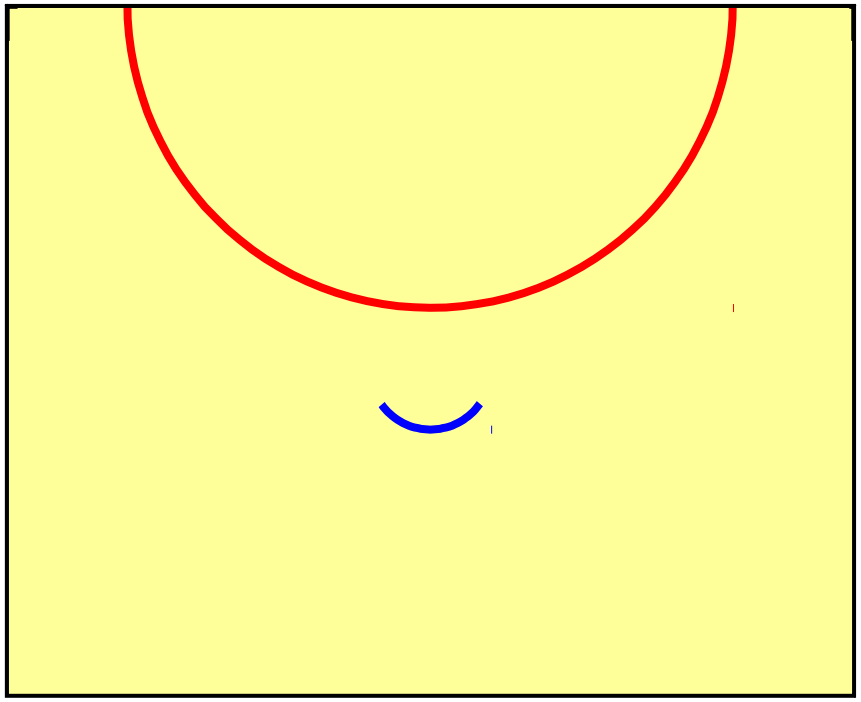
time step #4

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



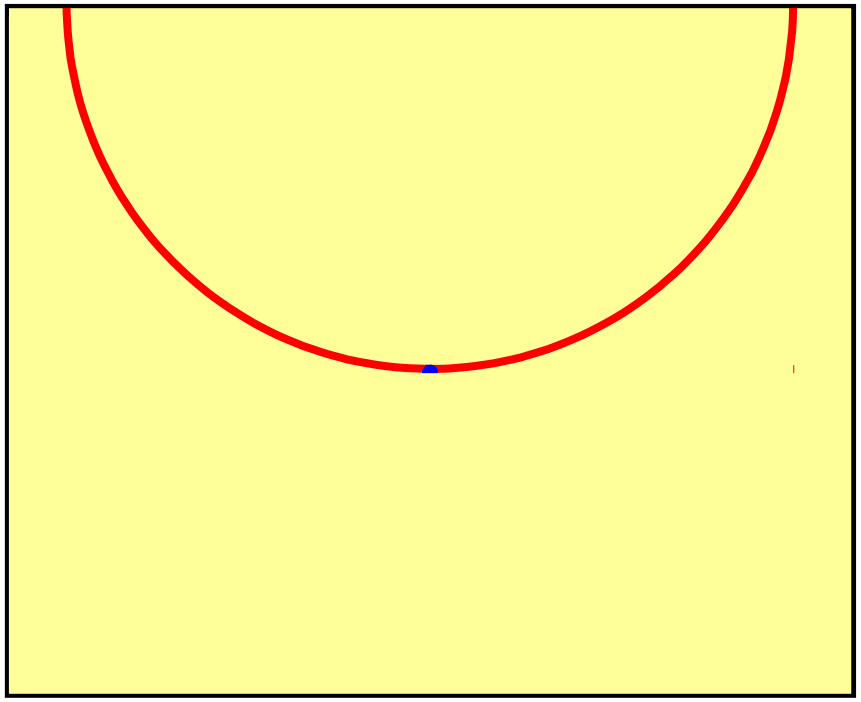
time step #5

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



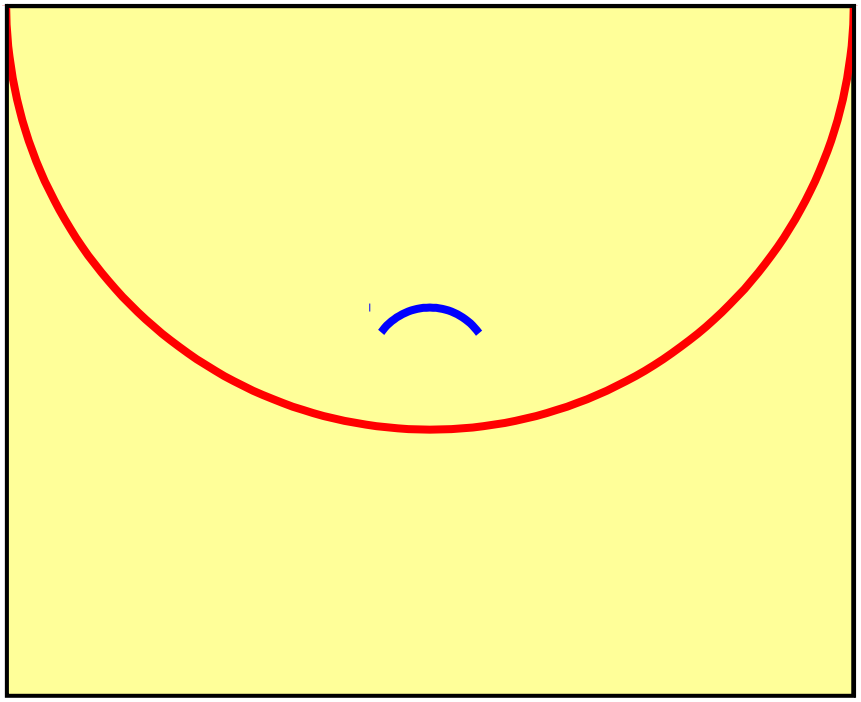
time step #6

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



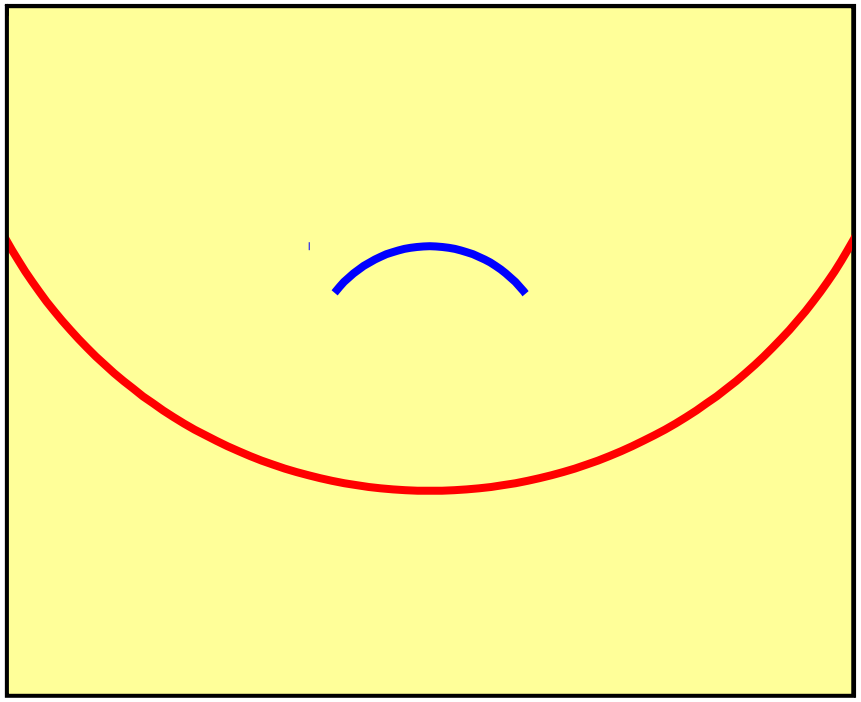
time step #7

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



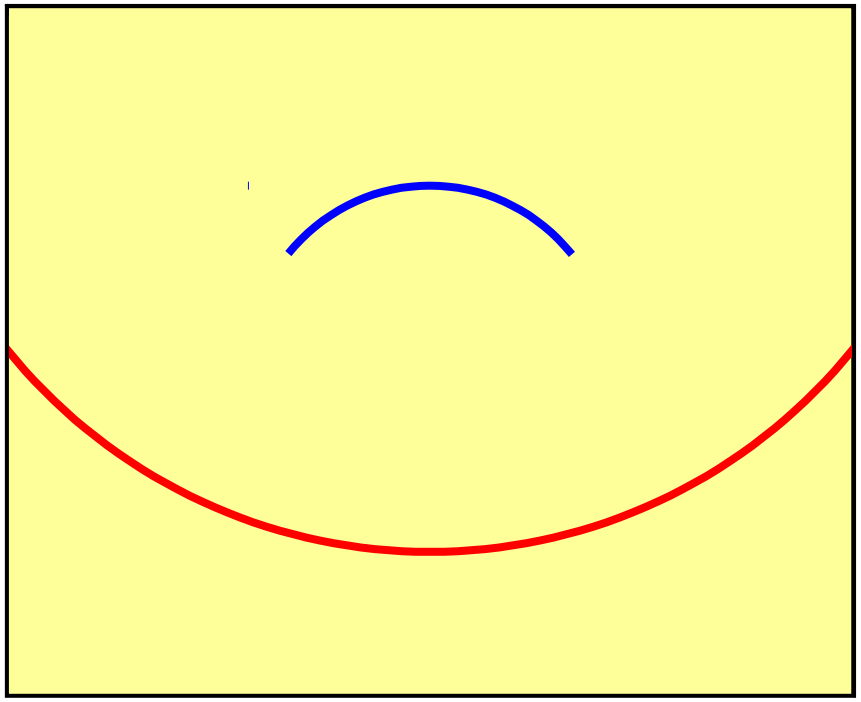
time step #8

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



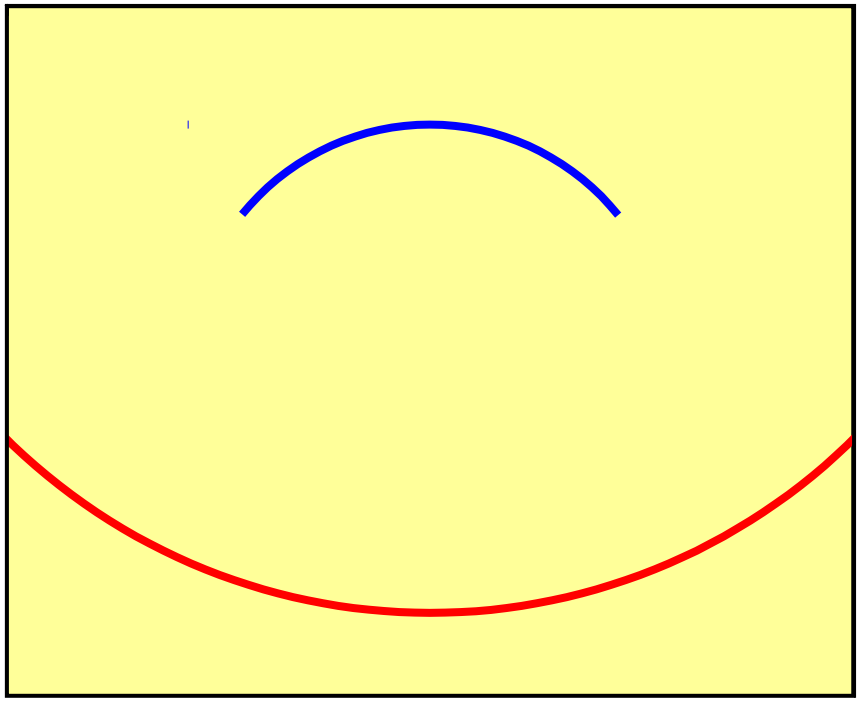
time step #9

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



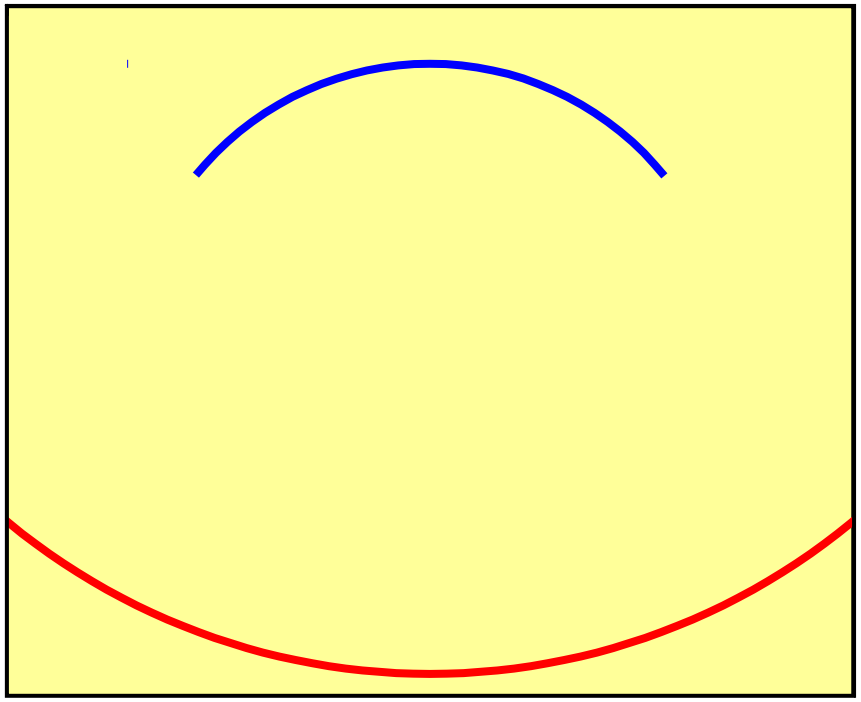
time step #10

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



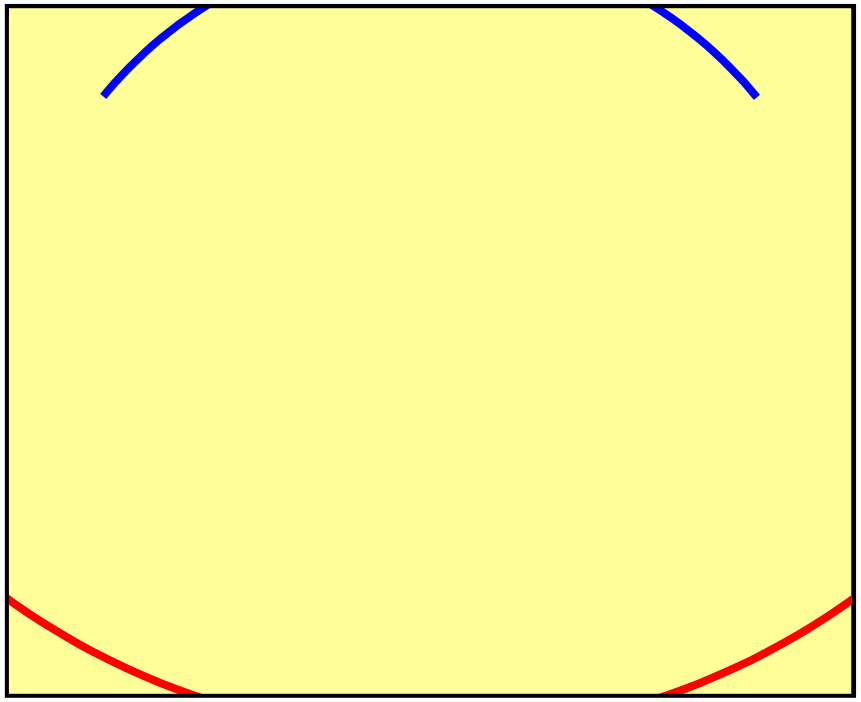
time step #11

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



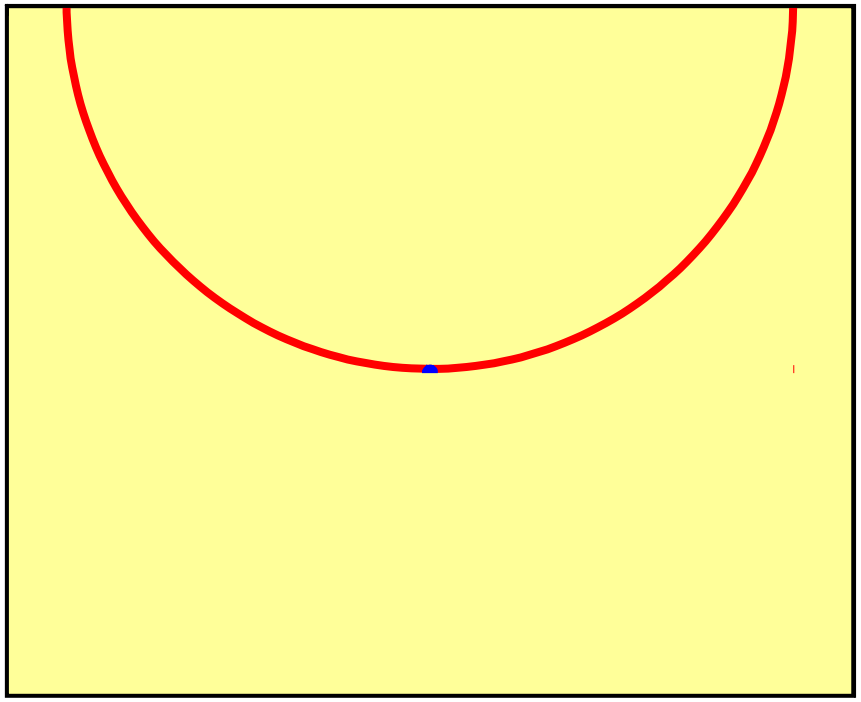
time step #12

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



time step #6

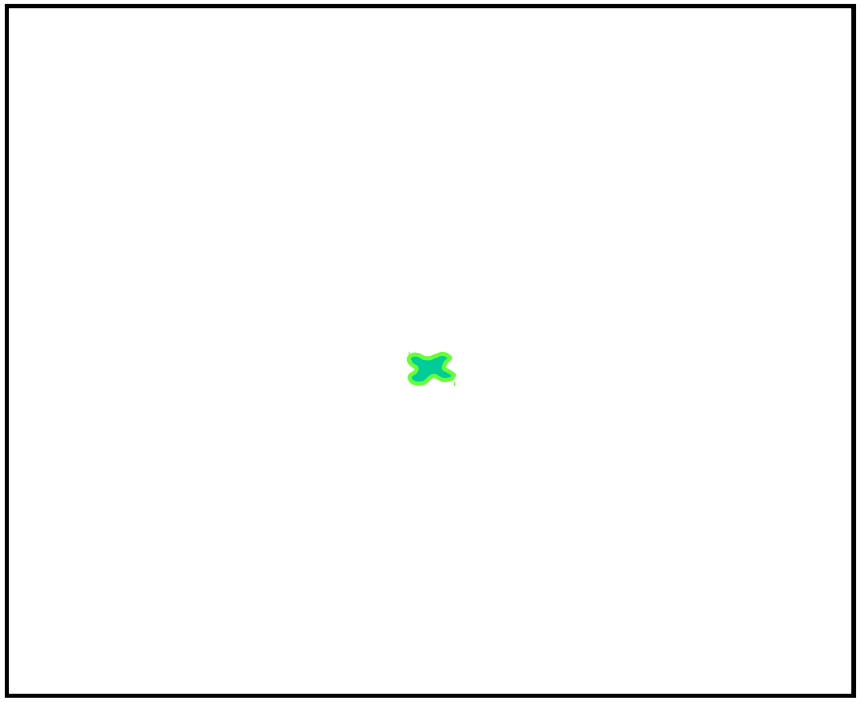
this is the only contribution

- stack all sources
- precondition
- adjust
  - p velocity
  - s velocity
  - p slowness
  - p attenuation
  - . . . .

stacking sources suppress diffractions

5. Cross correlation

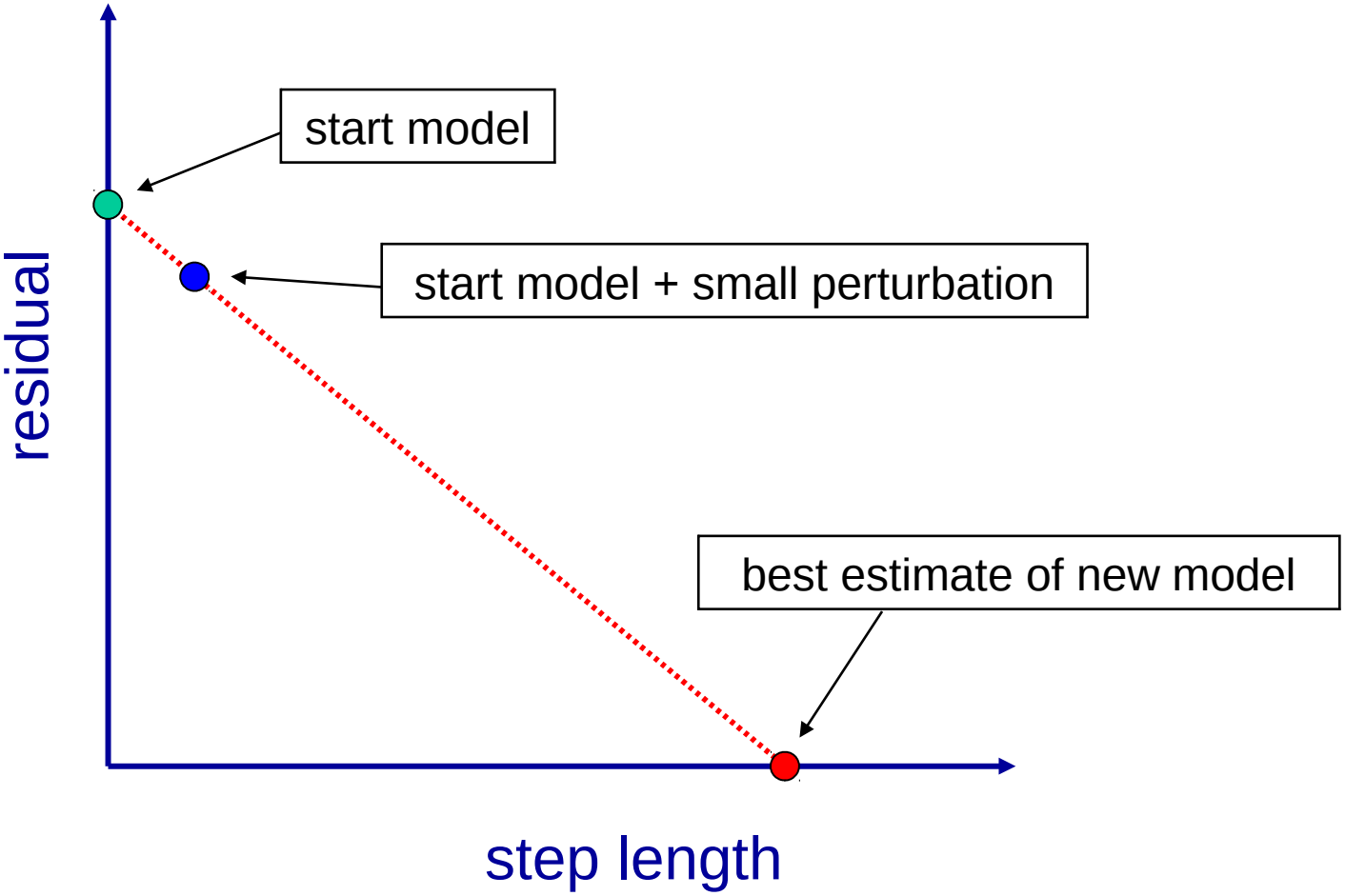
unscaled model update



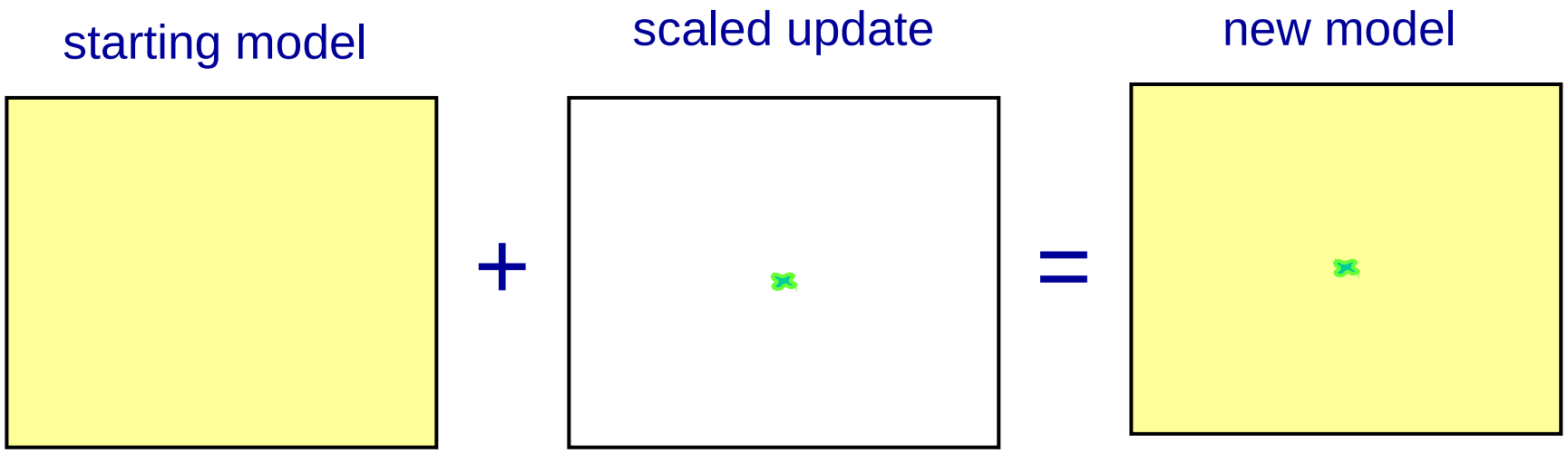
- imperfect image
  - edge effects
  - illumination
  - linearised
  - unscaled

migration update of the reflective velocity model

6. Step length calculation



7. Update and iterate

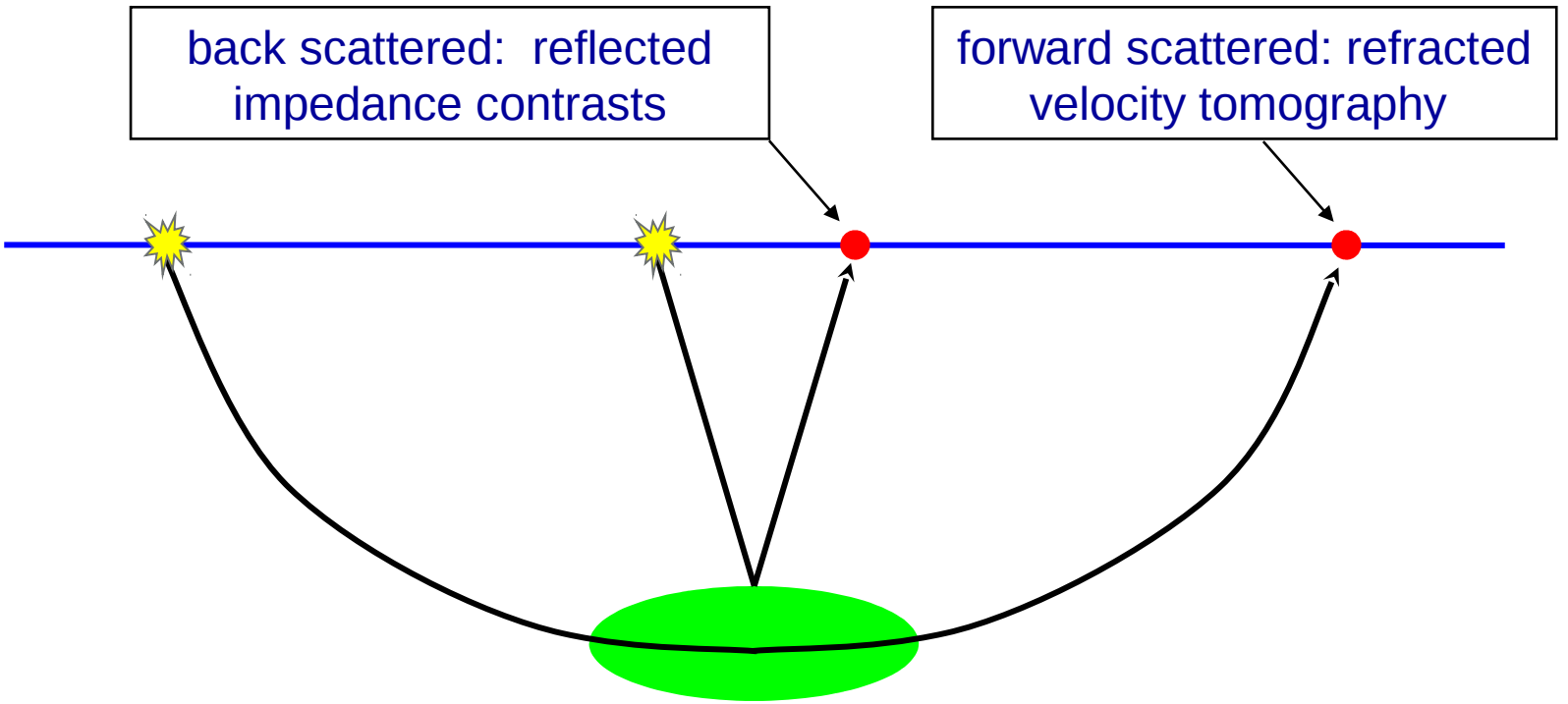


⟹ iterate + optionally change input data and/or parameterisation

Method

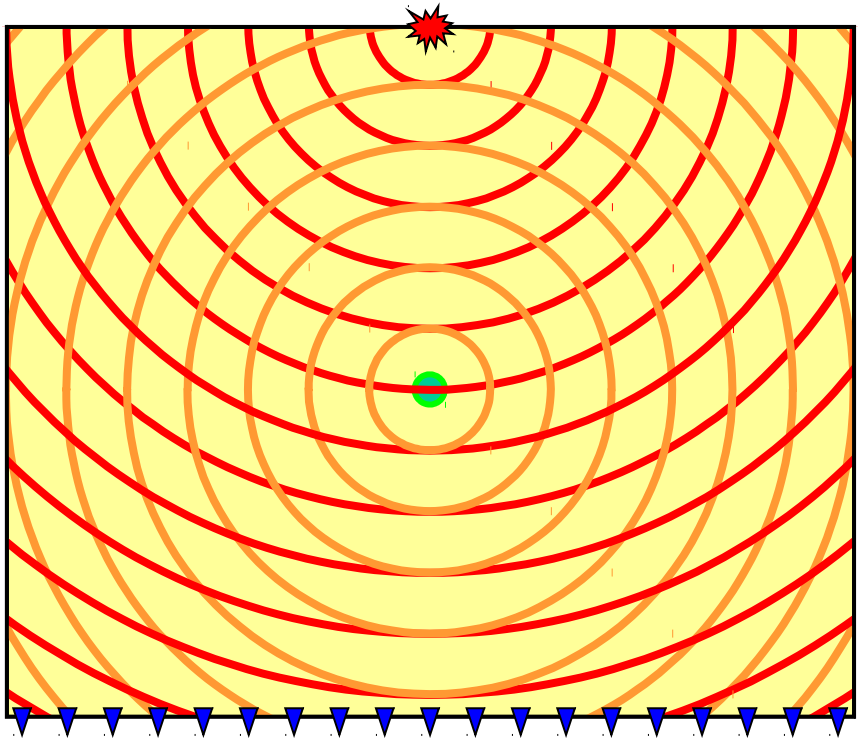
1. Field data, starting model & source
2. Forward model → predicted wavefield
3. Form residual wavefield at receivers
4. Back propagate residuals → residual wavefield
5. Cross-correlate → unscaled model update
6. Step length calculation → scaled model update
7. Update model and iterate

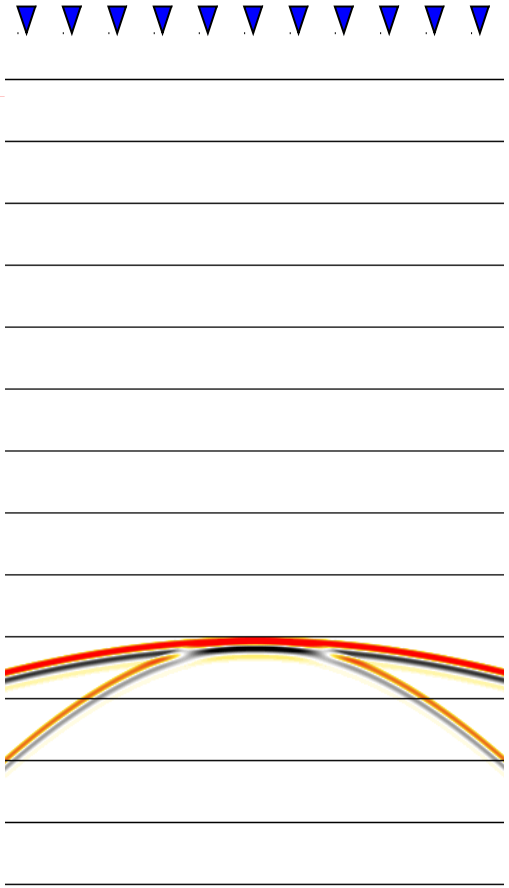
Two types of Imaging



1. Field data – transmission

true model



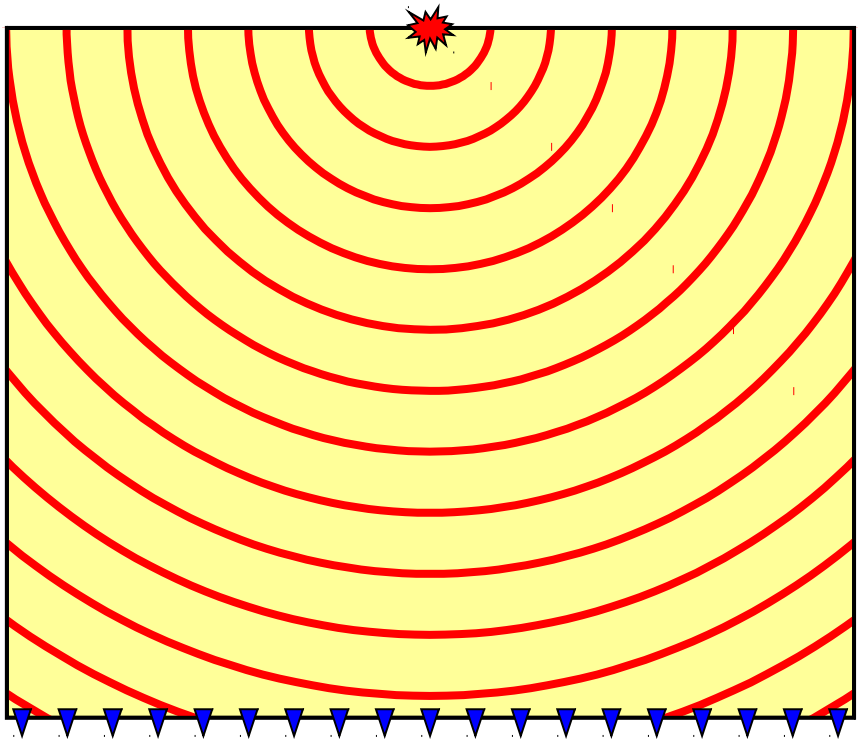


unknown

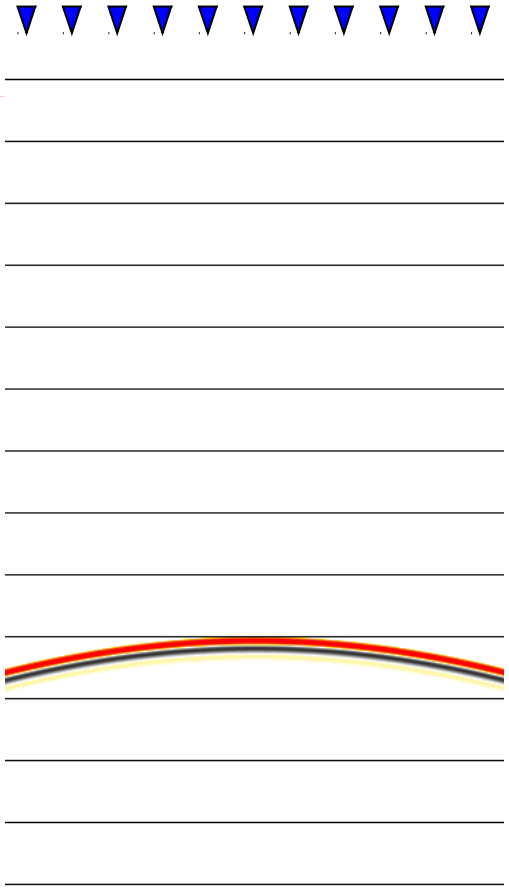
known

2. Predicted wavefield

starting model

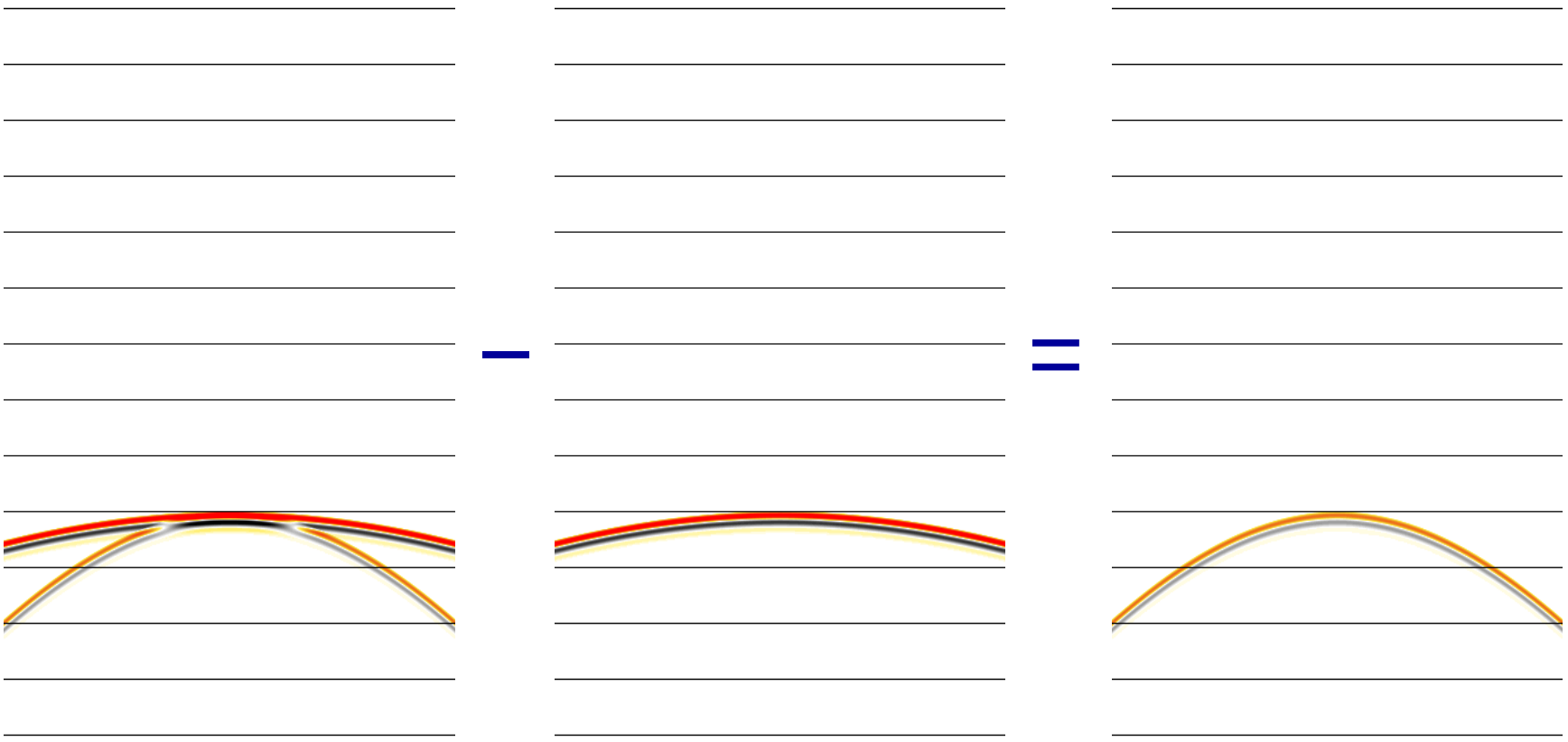


known



known

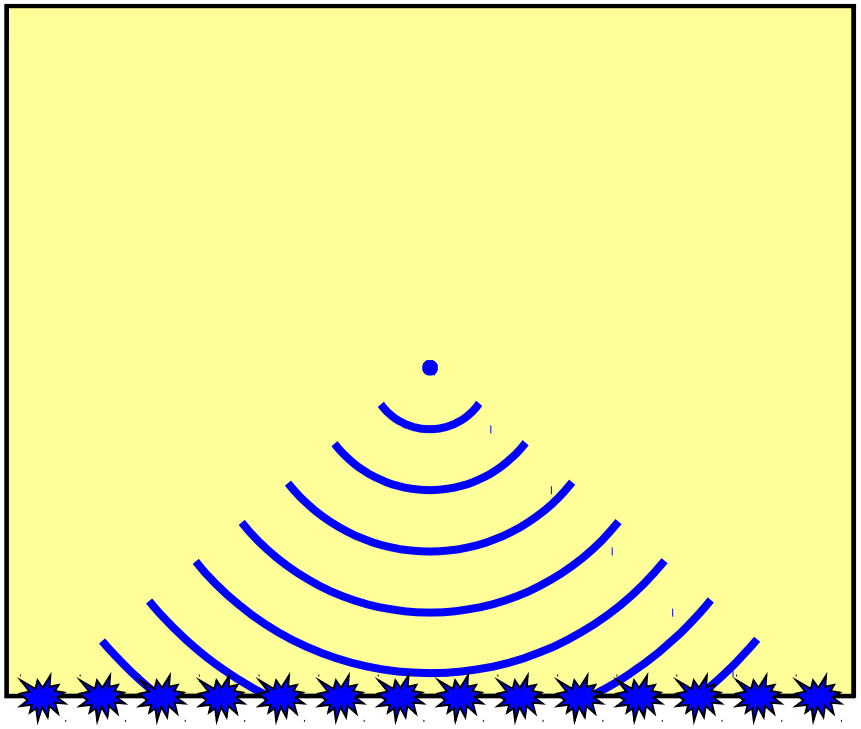
3. Residual wavefield at receivers



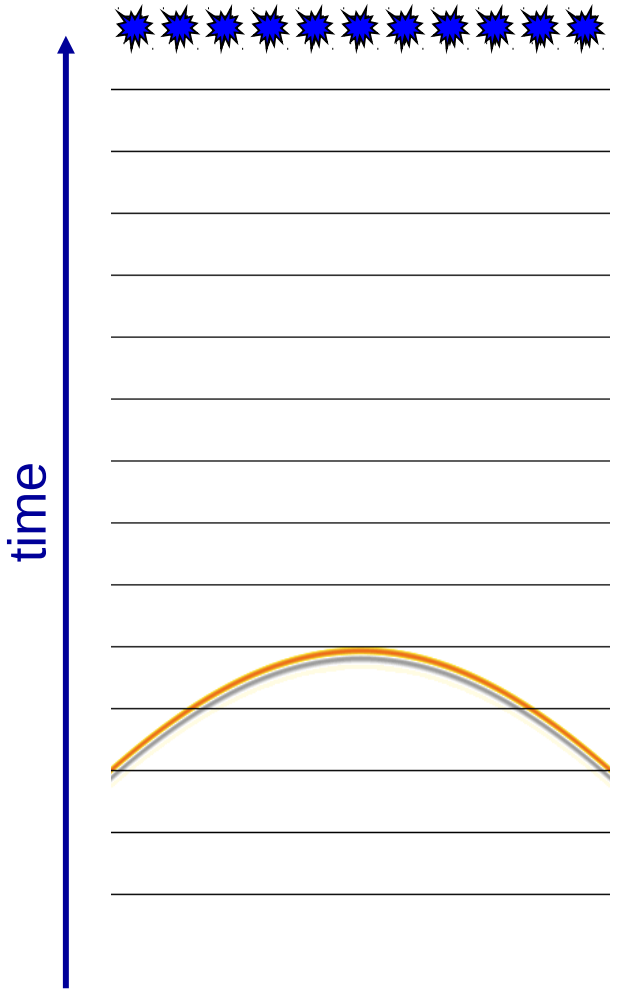
change model to minimise residuals

4. Back propagation

starting model

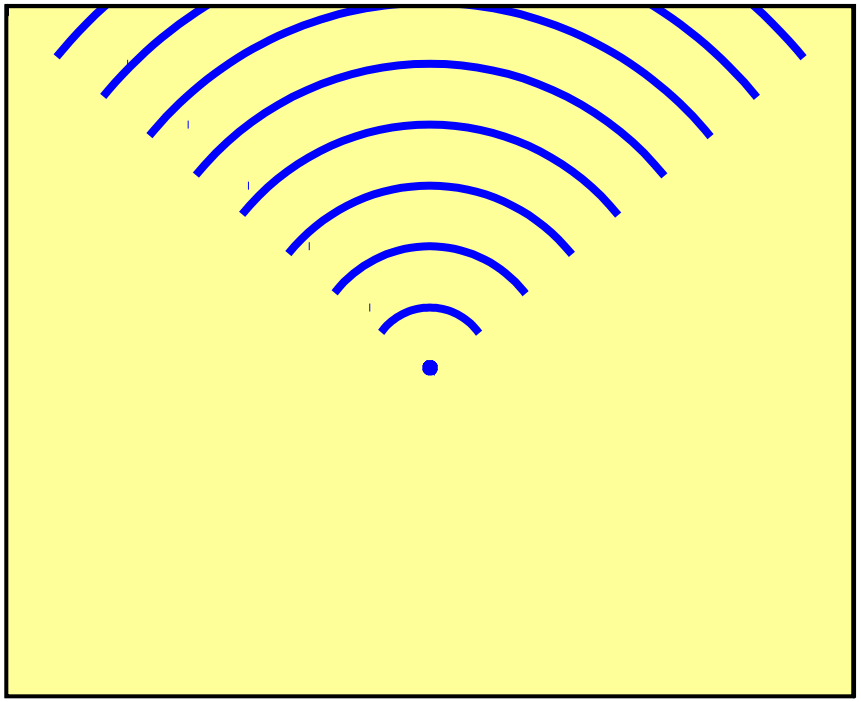


amplitude increasing

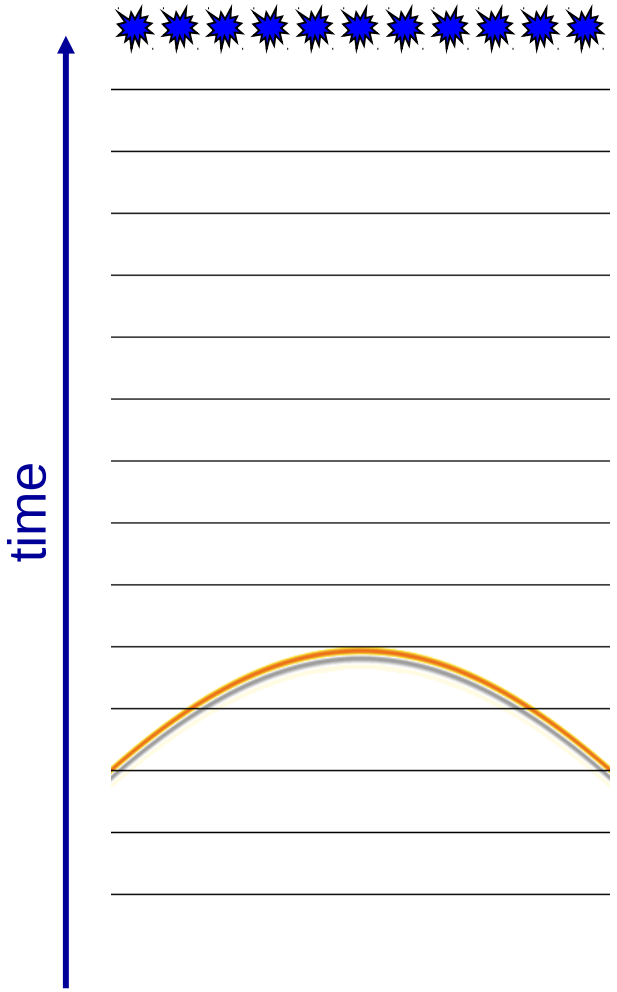


4. Back propagation

starting model

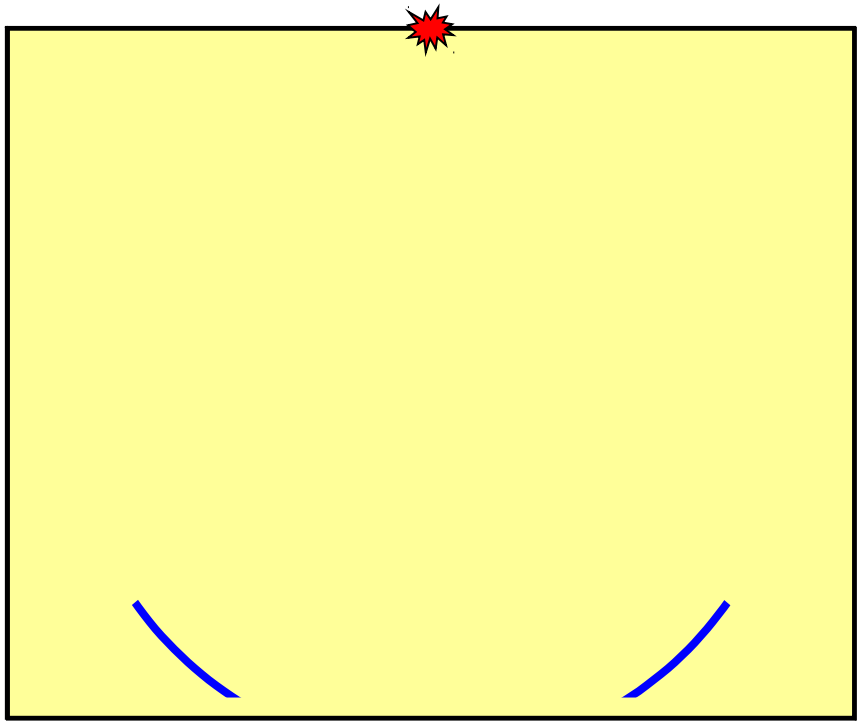


amplitude decreasing



5. Cross correlation

starting model



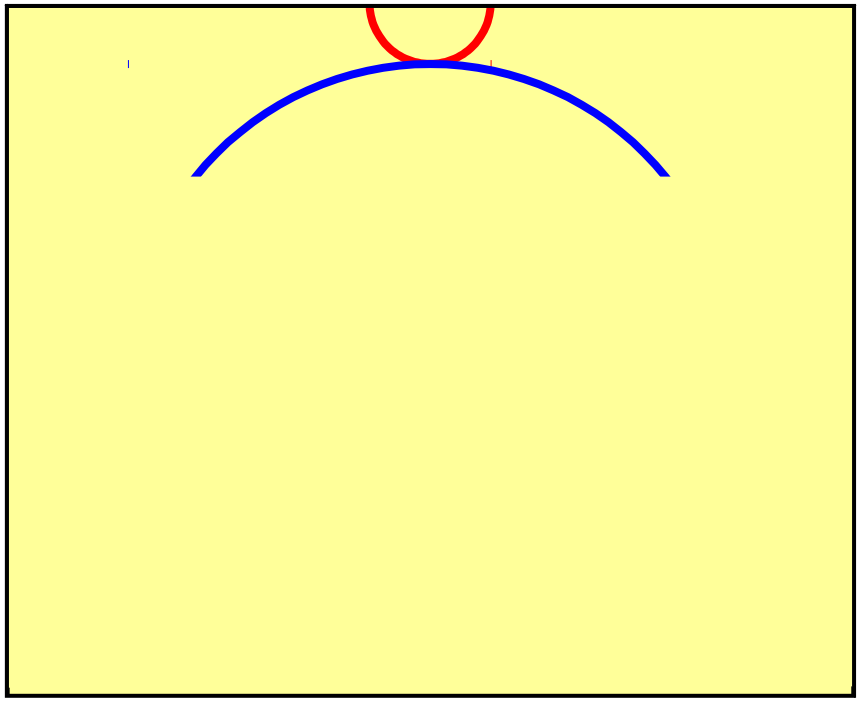
time step #0

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



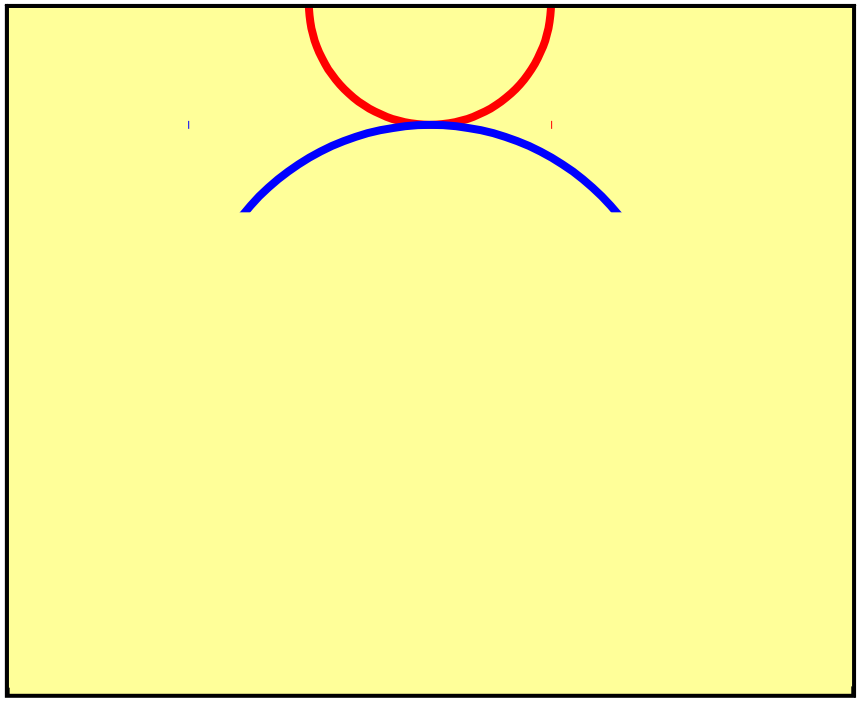
time step #1

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



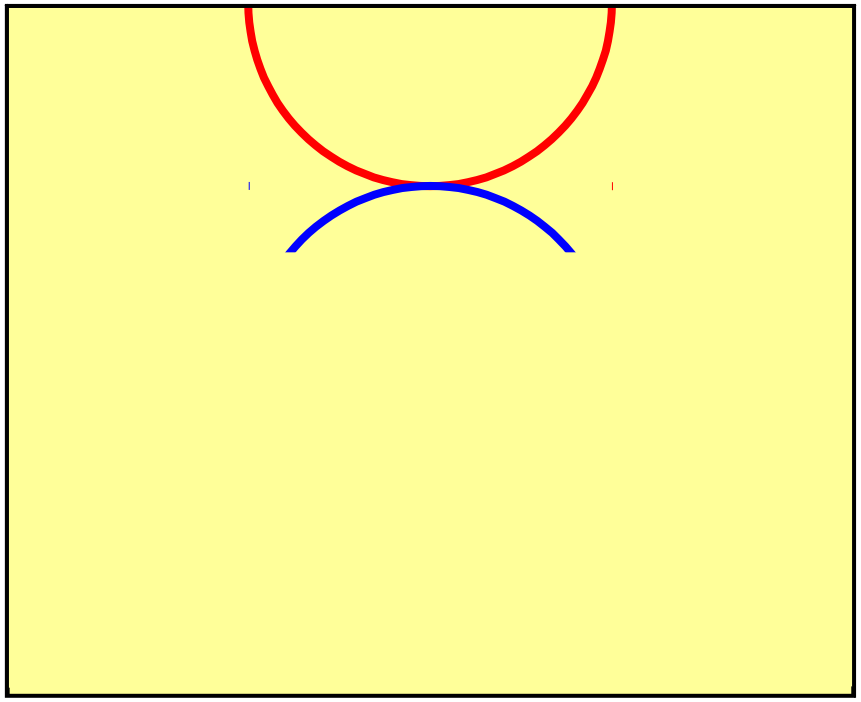
time step #2

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



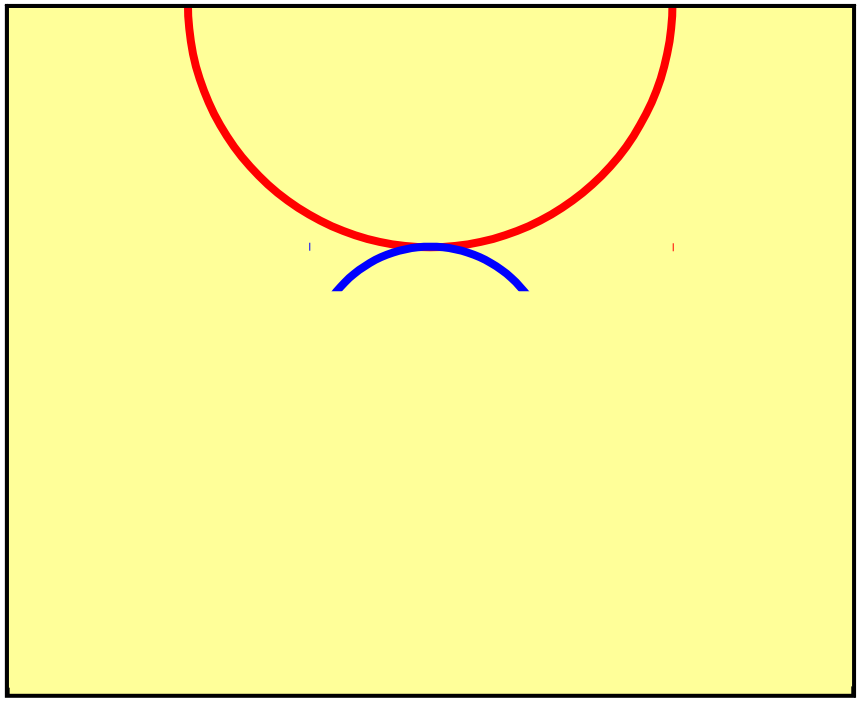
time step #3

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



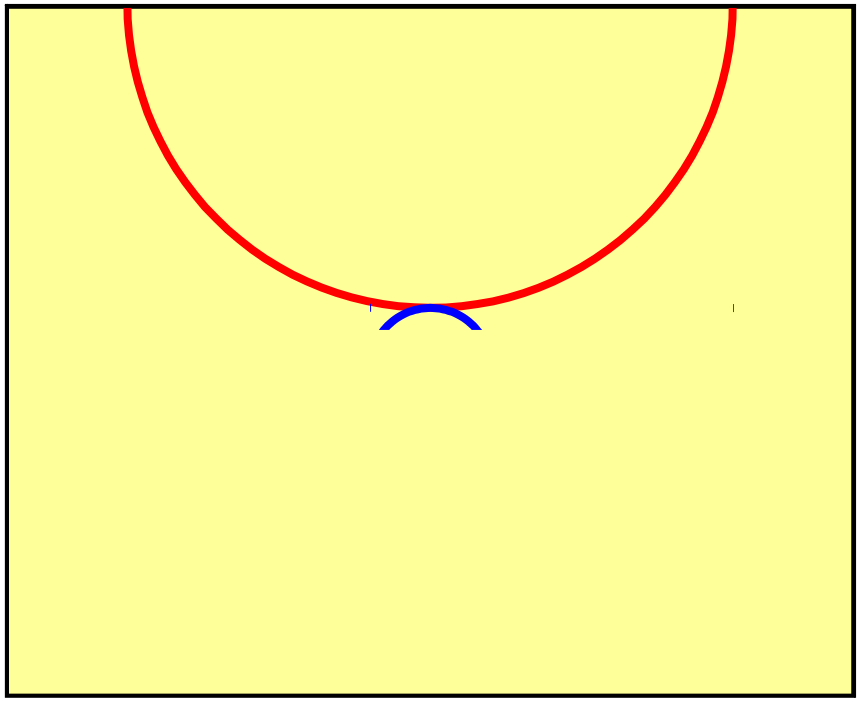
time step #4

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



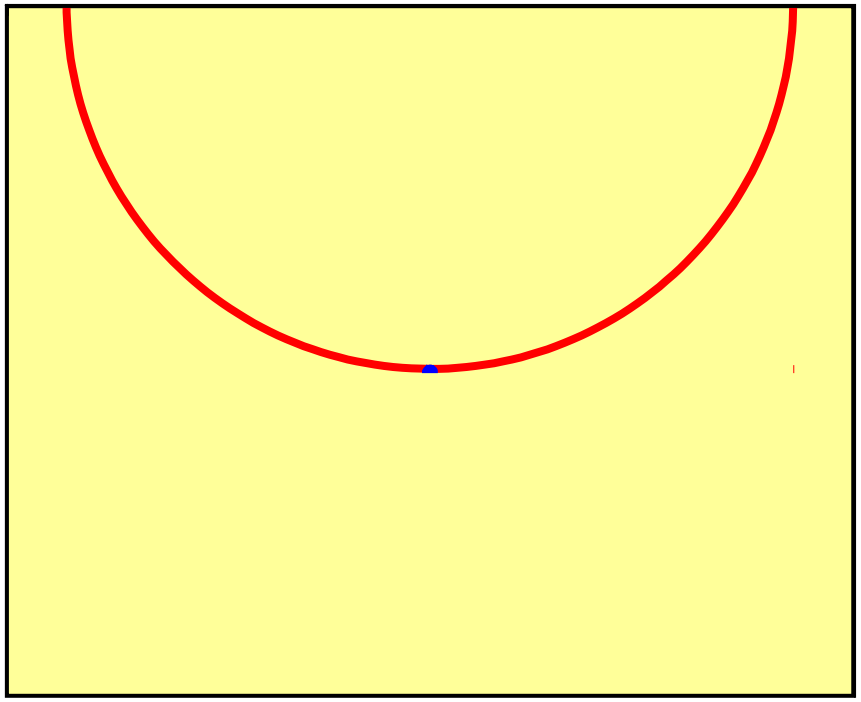
time step #5

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



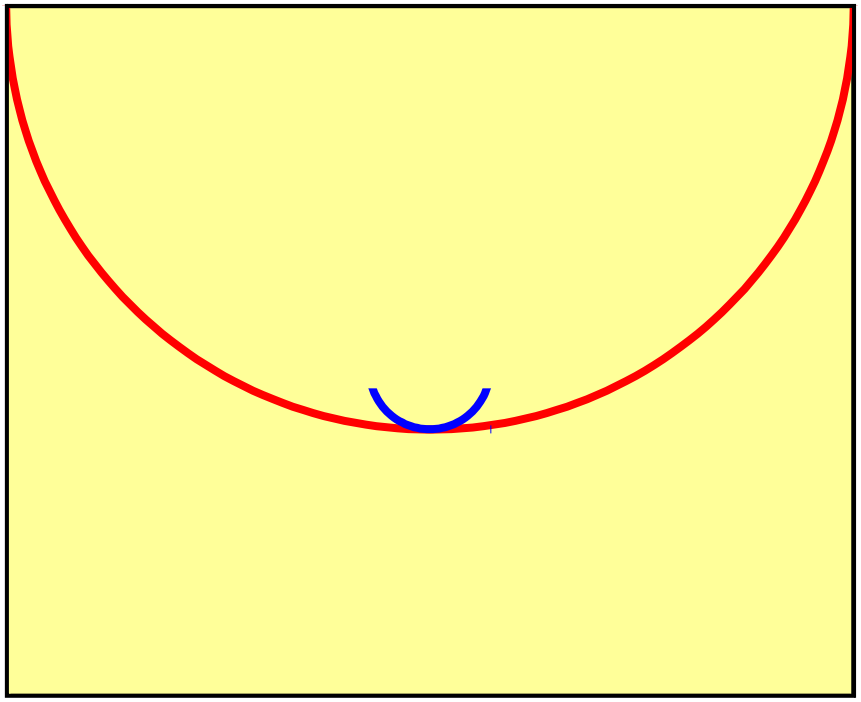
time step #6

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



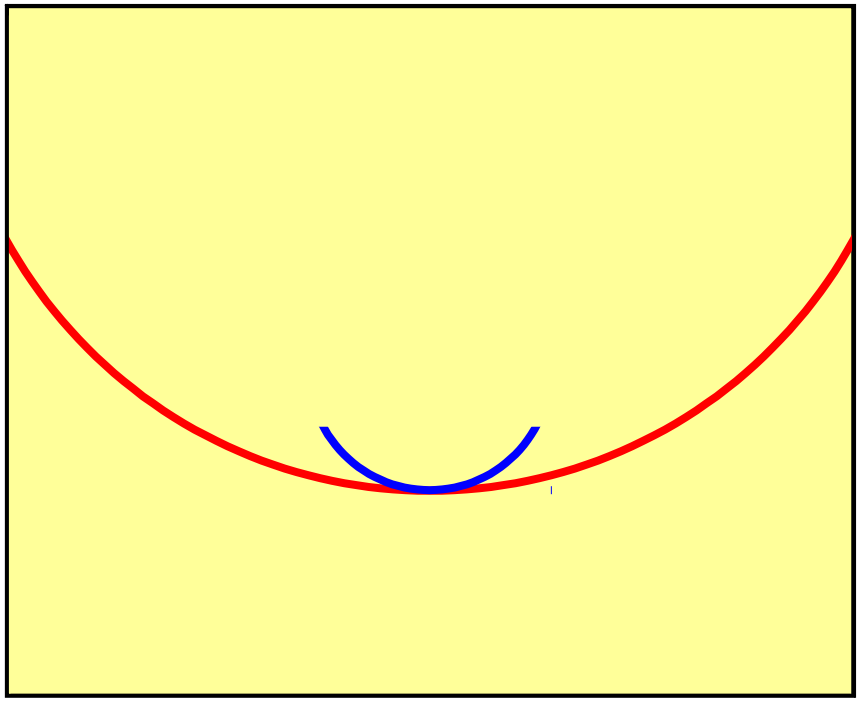
time step #7

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



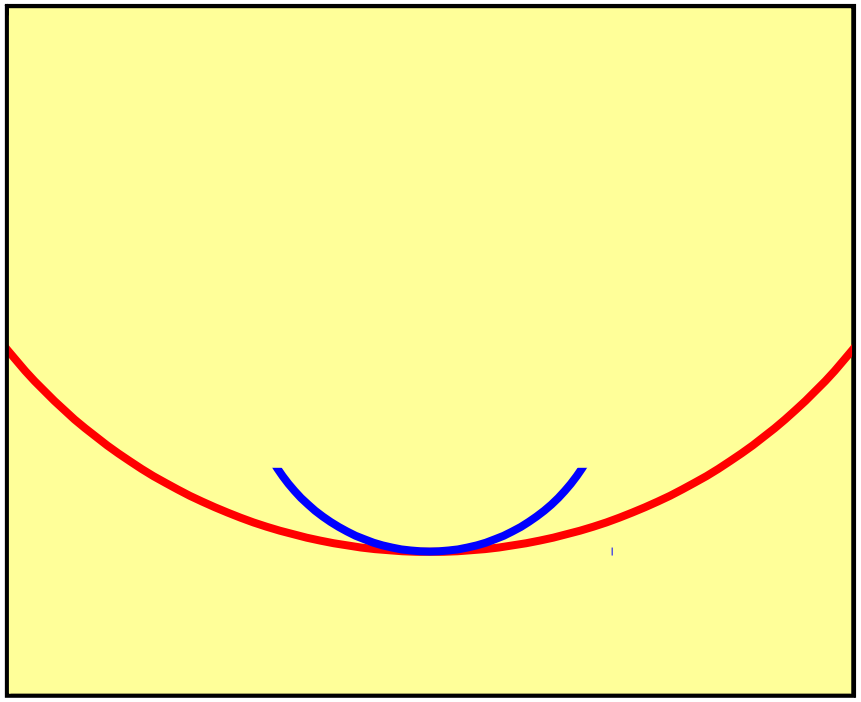
time step #8

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



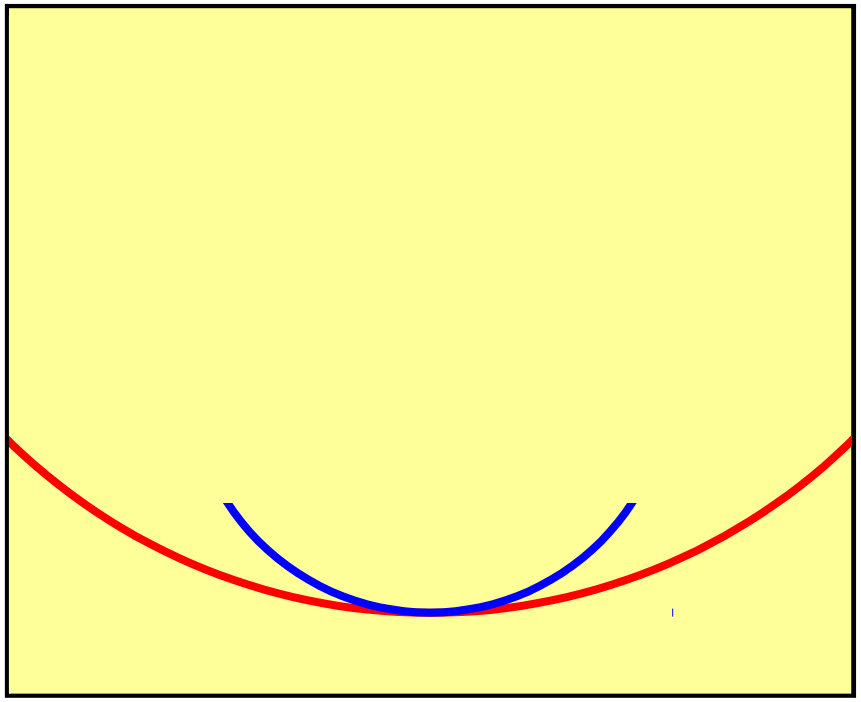
time step #9

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



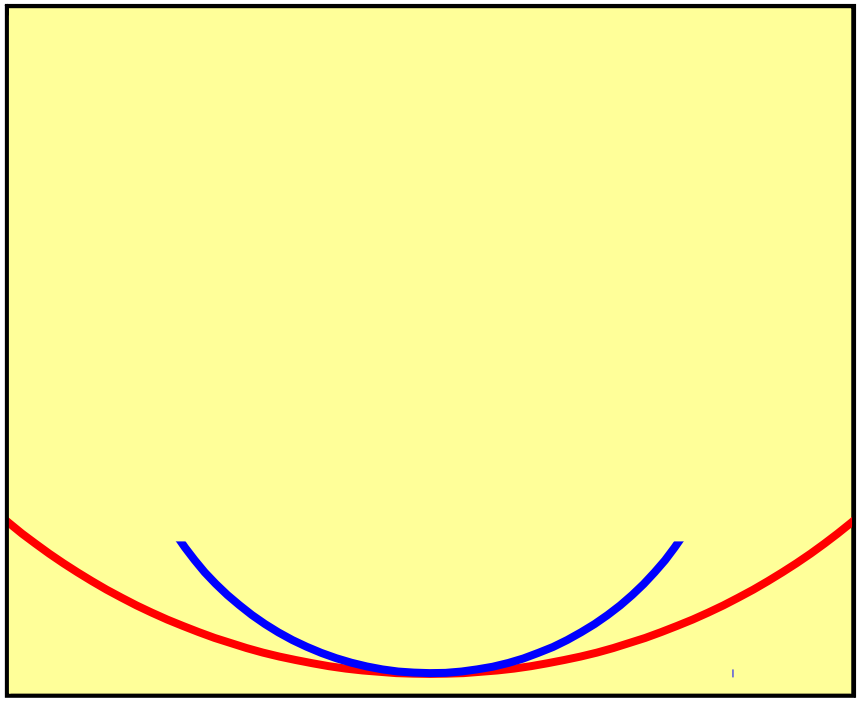
time step #10

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



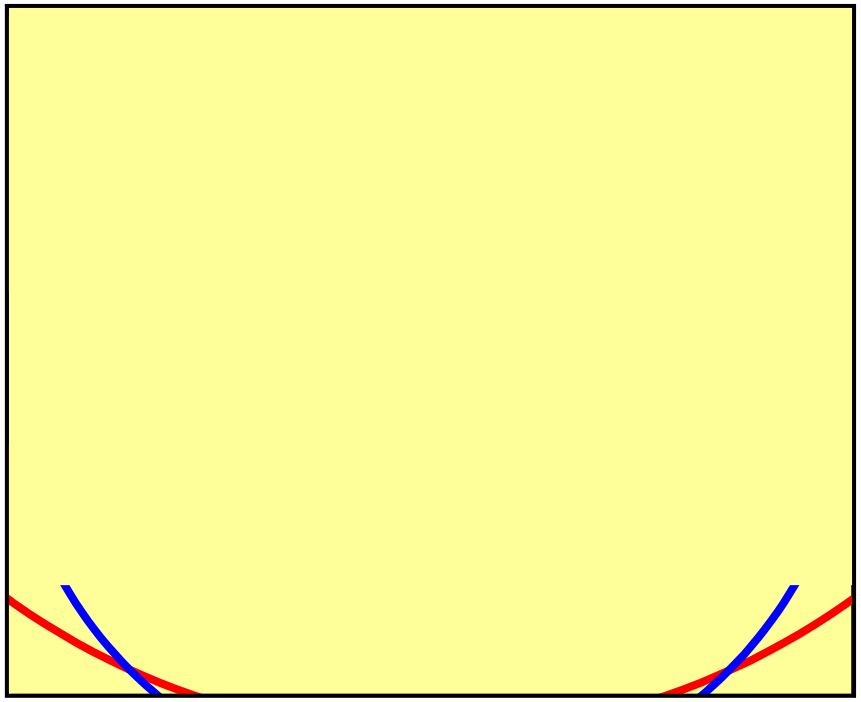
time step #11

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model

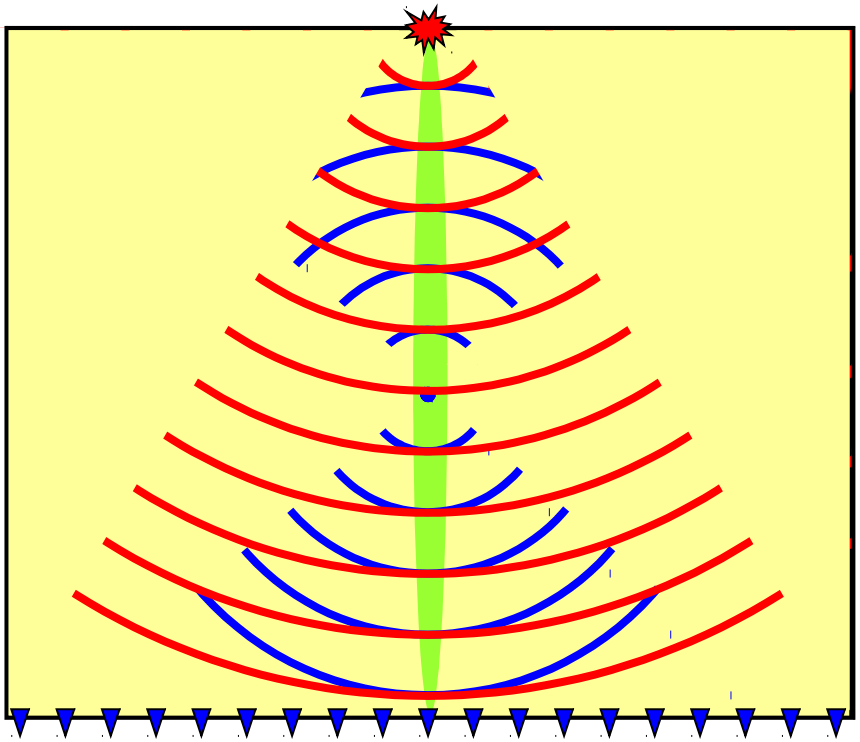


Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

5. Cross correlation

starting model



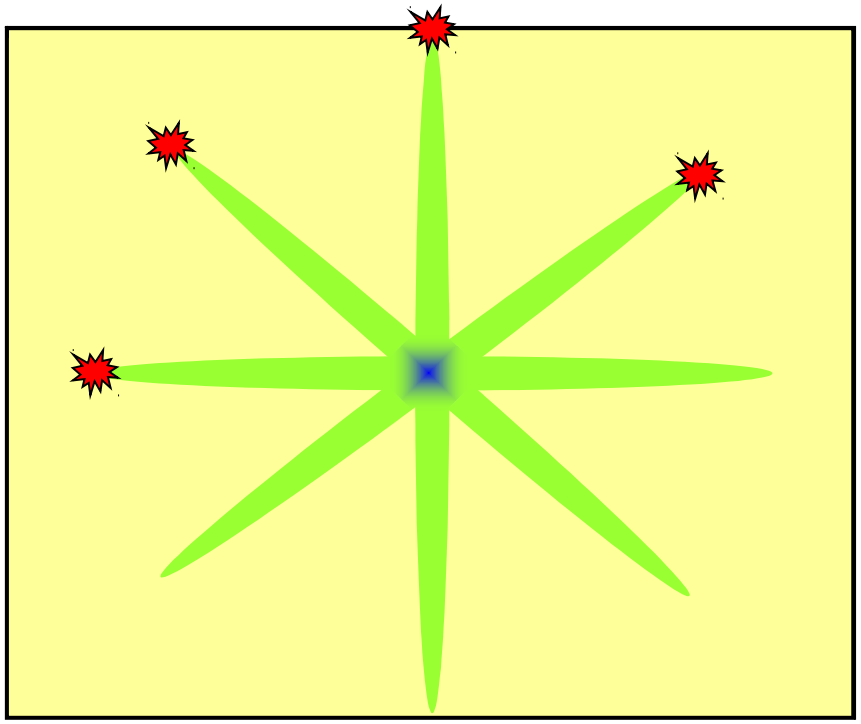
forward-scattered energy
correlates at all time steps

Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

Stack all sources

starting model



forward-scattered energy
correlates at all time steps

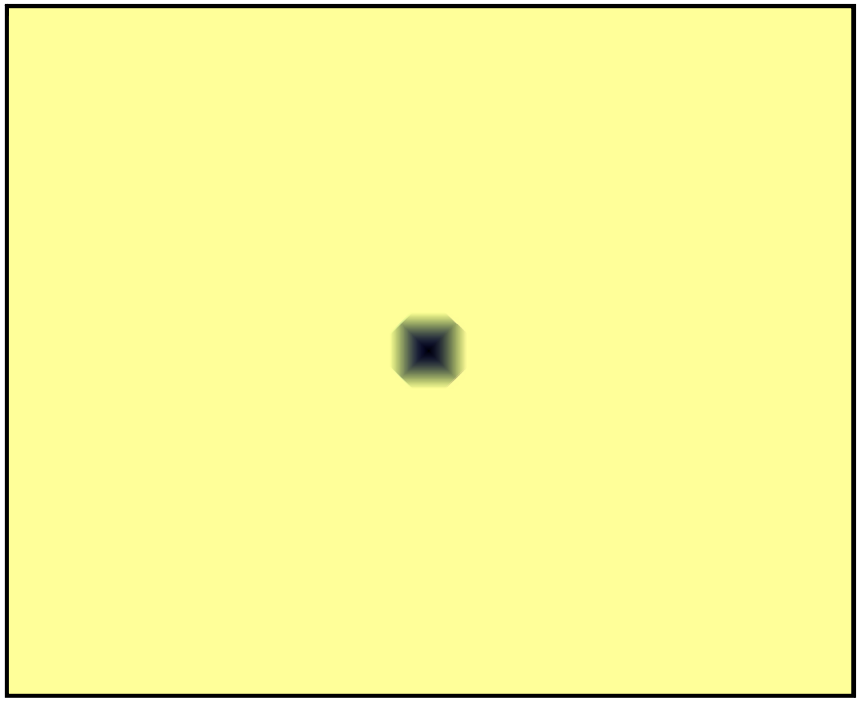
Cross-correlate:

- forward & reverse wavefields
- at each point in space
- take zero lag

tomographic update of
the macro velocity model

Iterate

final model



- back-scattered energy → migrated
- forward-scattered energy → tomography
- migration happens in one iteration
- tomography requires many iterations

migration of fine structure – into velocity not impedance

tomographic update of the macro velocity model