## The Delivery Toolkit

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## Components

WaveletExtractor

- Bayesian well ties and wavelet extraction

- Delivery
  - Bayesian trace-based seismic inversion for layer models, fluids, rock properties
- DeliveryMassager
  - Coercion of inversion outputs through to simulation grids

## WaveletExtractor

| time (ms) | rho   | DT<br>0 2040 60 80100 20140   | DT-interval |                 |   | TVD   | MD     | 4D :     | synthetic                             | se                                      | seismic                                 |     |
|-----------|---|---|-------------|-----------------|---|-------|--------|----------|---------------------------------------|---|---|-----|
|           | 0 0.5 1 1.5 2 2.5   |   | 0E0         | 5E1             | 1 E2                                    |       |        | -2E2 0   | E0 2E2                                | -2E2 0E                                 | 0 2E2 4E2                               | N   |
| 1700      |   |   |             |                 |   | 1480  | - 1500 |          | 5                                     |   |   | 1   |
| 1720      | ····  |   |             |                 |   | 1400  | - 1520 | - <      | Ľ                                     |   |   | ·   |
| 1740      | ·····   |   |             |                 |   | 1520  | - 1540 |          | ₽                                     |   |   | · N |
| 1760      |   | Ž   |             |                 |   | 1540  |        | <i>i</i> | ×                                     |   |   |     |
| 1780      |   |   |             |                 |   | 1560  | - 1580 | <        | <u> </u>                              |   |   |     |
| 1800      |   | <u>}</u>  |             |                 |   | 1580  | - 1600 | - 4      | 5                                     |   | >                                       | ΙT  |
| 1000      | ۲.<br>۲   | Ę.  |             |                 |   | 1600  | - 1620 | - <      | I                                     | $\leq$                                  |   |     |
| 1820      | لمسكح   | <u></u>   |             |                 | <u> </u>                                | 1620  | - 1640 |          |                                       |   |   |     |
| 1840      | The second se |   |             |                 |   | 1640  |        |          | $\triangleright$                      | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | >                                       | 1 V |
| 1860      | ·····**   |   |             | •••••           |   | 1660  | 1-680  |          | 5                                     | ····· C_                                | >                                       | - T |
| 1880      | ····· È····   |   |             |                 |   |       | 1.7.00 |          | 5                                     |   | 5                                       |     |
| 1900      |   | <del>-</del>  |             |                 |   | 17.00 | 17.20  | <        | <b>.</b>                              |   |   | . W |
| 1920      |   |   |             |                 |   | 1720  | - 1740 | -        | >                                     |   | )                                       | . * |
| 1040      | ţ   | *   |             |                 |   | 1740  | - 1760 | -        | 5                                     | Ś                                       | >                                       |     |
| 1940      | Ş   | 3   |             |                 |   | 1760  | - 1780 | [ <      | 5                                     | $\leq$                                  | >                                       | I M |
| 1960      | ····· }   |   |             |                 |   | 1780  | - 1920 | [        | (                                     | <                                       | <                                       | · · |
| 1980      | ····· f ····  | ····· \$  |             | • • • • • • • • |   | 1800  | - 1840 |          | ₽                                     |   | ?<br>\                                  | -   |
| 2000      | ·····ş····  | ·····\$   |             |                 |   | 1840  | 1860   | (        | 4                                     |   |   |     |
| 2020      |   |   |             |                 |   | 1860  |        |          | ₹                                     |   | ,                                       |     |
| 2040      |   | · · · · · · · · · · · · · · · · · · ·   |             |                 |   | 1880  | - 1900 | -        | ₽                                     |   |   |     |
| 2050      | ja<br>B   |   |             |                 |   | 1900  | - 1920 | - `      | 5                                     |   | {                                       |     |
| 2060      | ۲ <u>۲</u>  |   |             |                 | 1                                       | 1920  | - 1940 | i <      | <b>I</b>                              | $\sim$                                  |   |     |
| 2080      | E.  | 1   |             |                 |   | 1940  |        | <        |                                       | \$                                      |   |     |
| 2100      | <b>[</b>  | ····· }   |             |                 | • | 1960  | - 1980 | [        | · · · · · · · · · · · · · · · · · · · | }                                       | • | -   |
| 2120      | ·····   | ·····{  |             |                 |   | 2000  | - 2020 |          |                                       | ]                                       | <u>}</u>                                | -   |
| 2140      | ····· ] ····  |   |             |                 |   | 2020  | 2040   | ¢        | <b>}</b>                              | Q                                       |   |     |
| 21.60     |   |   |             |                 |   |       | 2060   |          | ţ                                     |   |   |     |
| 21.00     | 4   | and the second se |             |                 |   | 2060  | - 2080 | -        | Б                                     | 4                                       |   |     |
| 2180      | 3   | 5   |             |                 |   | 2080  | - 2100 | $\sim$   | 5                                     | $\triangleleft$                         | 5                                       |     |
| 2200      | }   | 1   |             |                 |   | 2100  | 21-20  | <        | (                                     | <                                       | ×                                       |     |
| 2220      |   | ·····}····  |             | •••••           | •••••                                   | 2120  | - 2140 |          | Þ                                     |   | )                                       |     |
| 2240      | ·····   |   |             |                 |   | 2140  | - 2180 | - 7      | <b>}</b>                              | ·····Q                                  |   | -   |
| 2260      | ····· <b>1</b>  |   |             |                 |   | 2180  | 2200   |          | }                                     |   |   |     |
| 2280      |   |   |             |                 |   |       | - 2220 | <        | 4                                     | <                                       |   |     |
| 2200      | March 1   |   |             |                 |   | 2220  | - 2240 |          |                                       |   | >                                       |     |
| 2300      | Whyne   |   |             |                 |   | 2240  | - 2260 |          | $\geq$                                |   | >                                       |     |
| 2320      | Ţ   | 7   |             |                 |   |       | - 2300 | _        | 5                                     |   |   |     |
| 2340      |   |   |             |                 |   | 2280  | - 2320 | _        | f                                     |   |   |     |
| 2360      | *   | <b>-</b>  |             |                 |   | 2320  | - 2340 | <u>-</u> | }                                     |   |   |     |
|           | St.   | -   |             |                 |   | 2340  | - 2360 | -        | P                                     |   |   |     |

Multiwell Multistack Time-to-depth errors Velocity consistency Well positioning errors Wavelet span and uncertainty



### Delivery Bayesian seismic inversion



- Fundamental parameters
  - Layer times
  - Rock properties in each layer
  - Fluid type
- Forward model
  - Reuss/Gassman for fluids
  - Convolution (multi-stack)

- Priors
  - Regional rock trends, layer "picks"
- Likelihoods
  - Synthetic seismic
  - Isopachs
- Posteriors
  - Multimodel MCMC sampling

## DeliveryMassager

• Talk @ 8.55 am, Tues.: "Shared Earth Modelling"

(Large) stochastic output of **Delivery** *Vertical geometry and inter-property coupling* 

#### **ECLIPSE** (cornerpoint) grids *Transverse* correlations+well data





# Things that might interest you

- Bayesian machinery
  - Stabilises inversion
  - Naturally integrates multidisciplinary information
  - Model comparisons: uncertainties within and between models
- Code and modular development
  - Java
  - Parallelisability
  - SU, BHPSU, BHPViewer linkages