



Implementation of GOM trend curves in PROMISE and the new DepSim/PROMISE link

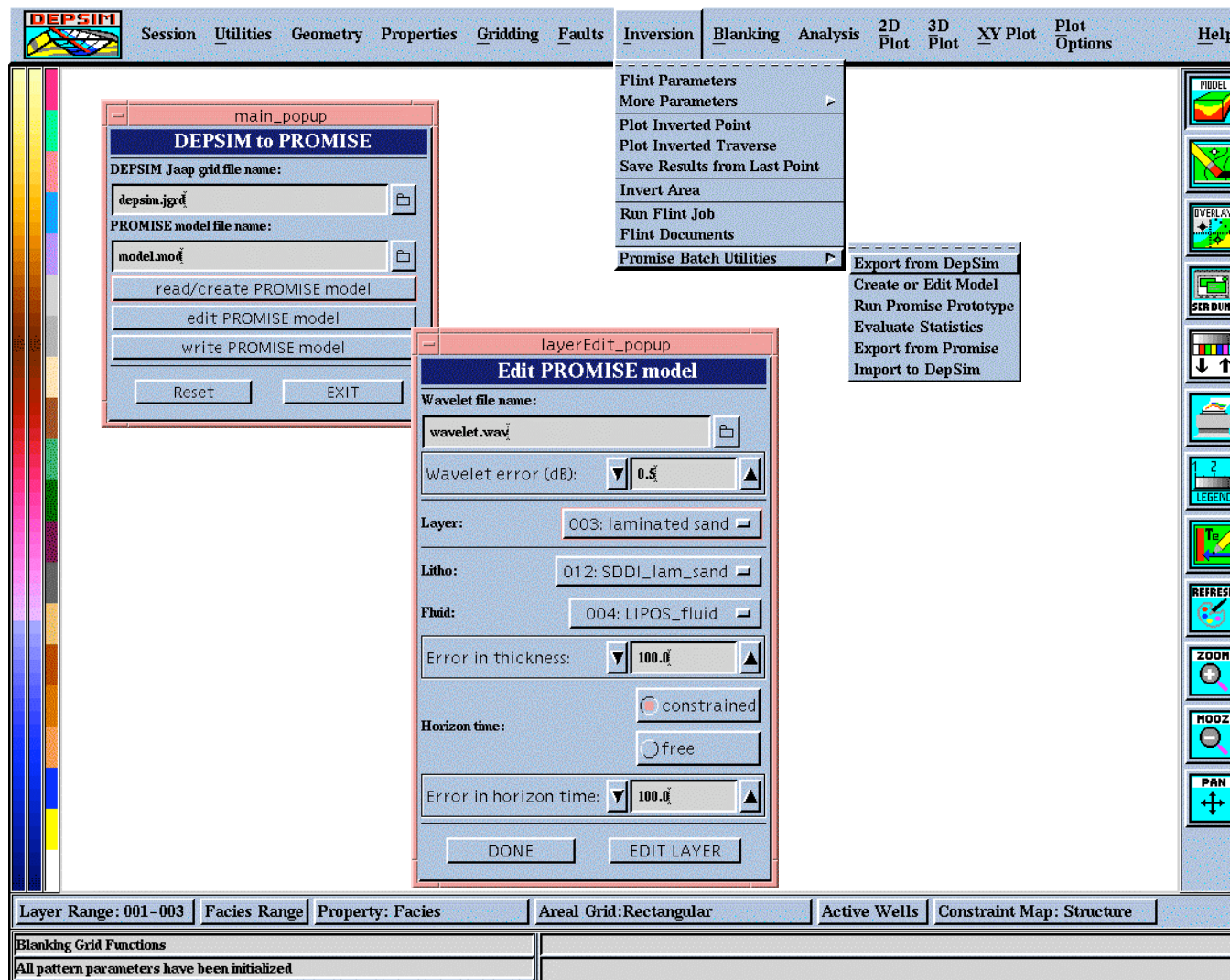
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Philosophy of development



- **DepSim IO engine for PROMISE**
- **SPIRIT II wrapper on prototype PROMISE code**
- **easy specification of seismic noise**
- **compatible and expandable**
 - AVOMOD and AVO inversion
 - neural net (fluid prediction and beyond)
 - GOM petrophysics (trends and LIPOS)

DepSim/PROMISE integration



Fundamentals of PROMISE algorithm



petrophysics
(trend curves)

$P(m|d_{\text{petro}})$ = probability of model given
petrophysical data

seismic

$q_{\langle n \rangle}(n)$ = noise distribution
 $= \exp(-\sum n_k^2 / \langle n_k \rangle^2)$

$s(m)$ = synthetic seismic given model
(forward modeling)

d_{seismic} = seismic data

$\Rightarrow P(d_{\text{seismic}}|m) = q_{\langle n \rangle}(d-s(m))$
= probability of seismic
given the model

$$P(m|d_{\text{seismic}}, d_{\text{petro}}) \sim P(d_{\text{seismic}} | m) P(m| d_{\text{petro}})$$

Specification of lithology and fluid



$$\mathbf{m} = (D, \text{NtG}, \mathbf{f}_k, v_{ps}, v_{ss}, \phi, v_{pm}, v_{sm}, \rho_m)$$

$$P(\mathbf{m} | \mathbf{d}_{\text{petro}}) = \left[\begin{array}{ll} v_{ps} = \mathbf{A}_1^* D + \mathbf{B}_1 & \sigma_{vps} \\ v_{ss} = \mathbf{A}_2^* v_{ps} + \mathbf{B}_2 & \sigma_{vss} \\ \phi = \mathbf{A}_3^* v_{ps} + \mathbf{B}_3 & \sigma_{\phi} \\ v_{pm} = \mathbf{A}_4^* D + \mathbf{B}_4 & \sigma_{vpm} \\ v_{sm} = \mathbf{A}_5^* v_{pm} + \mathbf{B}_5 & \sigma_{vsm} \\ \rho_m = \mathbf{A}_6^* v_{pm}^{B1} & \sigma_{\rho m} \end{array} \right] \left[\begin{array}{ll} D & \sigma_D \\ \text{NtG} & \sigma_{\text{NtG}} \\ \mathbf{f}_k & P(\mathbf{k}) \end{array} \right]$$

$\mathbf{k} = \{\text{oil, gas, brine, residual gas, residual oil, or lowsat gas}\}$

$$\mathbf{s}(\mathbf{m}) = \left[\begin{array}{l} \text{Gassmann substitution for fluid effect} \\ \text{thickness average density, 1/bulk \& 1/shear modulus} \\ \Rightarrow \langle \rho \rangle, \langle v_s \rangle \text{ \& } \langle v_p \rangle \\ \Rightarrow L \text{ \& } M \Rightarrow \text{synthetic seismic of model} \end{array} \right]$$

SDDI laminated sand parameters



litho_popup

Edit lithology

001: Upper_Shale
012: SDDI_lam_sand

Statistical parameters:		Fixed parameters:	
depth_avg	9000.0	vp_mud_zero	6162.0
depth_devia	50.0	vp_mud_slope	0.2828
ntg_avg **** FROM DEPSIM ****	0.5	vp_mud_devia	536.0
ntg_devia	0.2	vs_mud_zero	-3373.0
vp_sand_zero	4988.0	vs_mud_slope	0.801
vp_sand_slope	0.3572	vs_mud_devia	206.0
vp_sand_devia	457.0	density_mud_factor	0.0977
vs_sand_zero	-3996.0	density_mud_exp	0.3467
vs_sand_slope	0.894	density_mud_devia	0.041
vs_sand_devia	226.0		
porosity_zero	0.579		
porosity_slope	-3e-05		
porosity_devia	0.0137		
		density_grain	2.65
		vp_grain	19830.0
		vs_grain	13740.0
		density_ref_fluid	1.0
		vp_ref_fluid	5000.0

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Ok Reset Cancel

LIPOS fluid parameters



fluid_popup

Edit fluid

003: laminated sand
004: LIPOS_fluid

Statistical parameters:	Fixed parameters:
oil_prior ▼ 0.09 ▲	oil_density ▼ 0.7 ▲
gas_prior ▼ 0.03 ▲ **** FROM DEPSIM ****	brine_density ▼ 0.95 ▲
residual_oil_prior ▼ 0.03 ▲	gas_density ▼ 0.3 ▲
residual_gas_prior ▼ 0.01 ▲	oil_vp ▼ 4000.0 ▲
lowsat_gas_prior ▼ 0.02 ▲	brine_vp ▼ 5000.0 ▲
	gas_vp ▼ 3000.0 ▲
	oil_fraction ▼ 0.85 ▲
	gas_fraction ▼ 0.85 ▲
	residual_oil_fraction ▼ 0.15 ▲
	residual_gas_fraction ▼ 0.15 ▲
	lowsat_gas_fraction ▼ 0.05 ▲

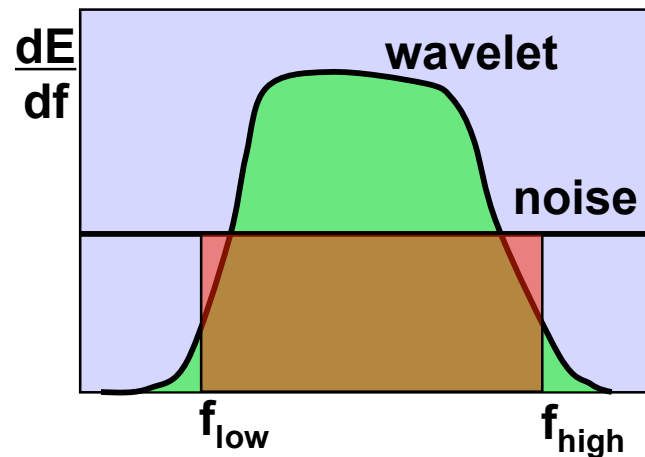
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Specification of white seismic noise

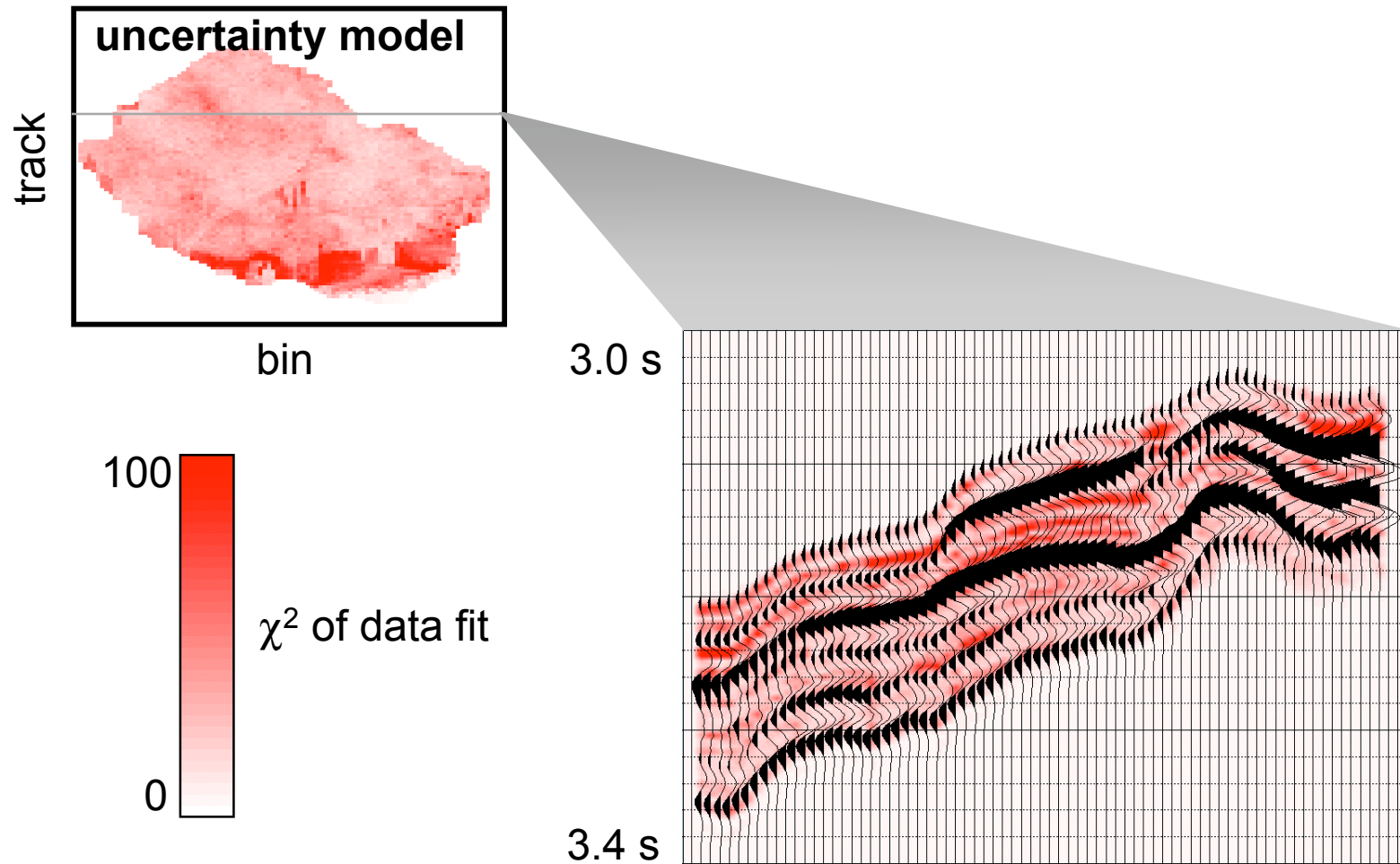


- **seismic wavelet**
- **bandwidth of information content of seismic wavelet**
 - f_{low} and f_{high} (Hz)
- **average reflection coefficient**
- **SNR (dB)**
 - parameter to vary (others set initial scale, use 10 dB)



SNR = green / red

Example of new PROMISE output



Coming attractions



- **AVO inversion in PROMISE (4Q97)**
- **PROMISE with distributed processing and simplified menu drive integrated with DepSim**
- **integrating neural network fluid prediction with PROMISE**
- **strengthening links between PROMISE and SDDI business decision analysis**