



Release Notes

InterWell 2023

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InterWell

Seismic inversion, seismic characterization and time-depth conversion solution

The major **InterWell 2023 release** brings a lot of new functionalities :

- In the database, the **multi-survey** is supported, as well as many improvements in the import/export of the data.
- The **gather conditioning** has been enriched with a new mute picking and new pre-processing (mutes, trim statics...and more) to output better stacks for the seismic inversion workflows.
- Historical modules, such as **wavelet estimation**, **structure** and **QCs** have been either enhanced or revamped to best suit your needs.
- **Machine learning** features, such as **PCA and Clustering**, have been developed to be applied directly on key attributes.
- Advanced workflows, such as **4D** or **azimuthal workflow**, have been completed by new functionalities to better estimate the anomalies.

Feel free to contact us at support@beicip.com if you need any assistance while installing the new version.



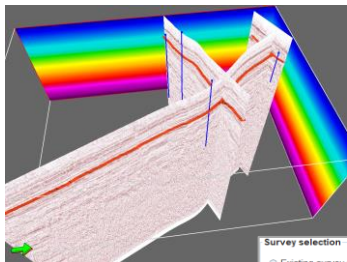
InterWell

Release 2023.1

What's new in the
database ?



Multi-survey in InterWell : a study is now composed of different surveys



Multi-survey in the 3D

Undefined

Survey selection
Existing survey: Create new survey:

Geometry
☒ Automatic geometry calculation (during import of first volume) ☐ Manual geometry calculation

Transformation

	INLINE	XLIN	X	Y
Corner 1				
Corner 2				
Corner 3				

Datum and replacement velocity definition
SRD: m Replacement velocity: m/s

Vertical ranges
The step must be the same for all the wavefield time domains ☒

Min	Max	Step	Domain

Lateral limits

	INLINE	XLIN
Minimum		
Maximum		
Step		

- A name.
- An IL-XL to X-Y transformation.
- IL-XL ranges.
- Time ranges by wavefield domains.

To be defined by the first SEG Y import, historical way to create the survey, only way to create 2D survey

Map mode

Survey selection
Existing survey: Create new survey:

Geometry
☐ Automatic geometry calculation (during import of first volume) ☒ Manual geometry calculation

Transformation

	INLINE	XLIN	X	Y
Corner 1	1	1	259,880	2,619,805
Corner 2	500	1	360,000	2,619,805
Corner 3	500	500	360,000	2,759,400

Datum and replacement velocity definition
SRD: m Replacement velocity: m/s

Vertical ranges
The step must be the same for all the wavefield time domains ☒

Min	Max	Step	Domain

Lateral limits

	INLINE	XLIN
Minimum	1	1
Maximum	500	500
Step	1	1

- A name.
- An IL-XL to X-Y transformation.
- IL-XL ranges.
- Time ranges by wavefield domains.

Enable mapping functionalities of InterWell (gridding, smoothing, kriging...)

Fully defined

Survey selection
Existing survey: Create new survey:

Geometry
☐ Automatic geometry calculation (during import of first volume) ☒ Manual geometry calculation

Transformation

	INLINE	XLIN	X	Y
Corner 1	1	1	259,880	2,619,805
Corner 2	500	1	360,000	2,619,805
Corner 3	500	500	360,000	2,759,400

Datum and replacement velocity definition
SRD: m Replacement velocity: m/s

Vertical ranges
The step must be the same for all the wavefield time domains ☒

Min	Max	Step	Domain
0	2000	4	PP Domain

Lateral limits






	INLINE	XLIN
Minimum	1	1
Maximum	500	500
Step	1	1

- A name.
- An IL-XL to X-Y transformation.
- IL-XL ranges.
- Time ranges by wavefield domains.





Enable all the functionalities in InterWell



Linked to surveys

-  Seismic volumes and arbitrary lines 
-  Horizons/Maps
-  Calibrated and extraction wells
-  Runs (computation in InterWell)

Free of survey

-  Input Wells
-  Pointsets
-  Polygons
-  Tables

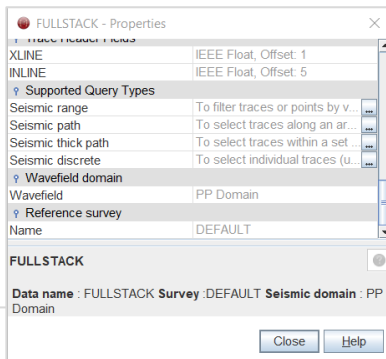
Key benefits :

- A **unique well database** covering different 2D/3D surveys.
- Possibility to **decimate, merge, krig** horizon/map data covering several surveys.
- A unique study gathering a 1ms grid and regular vertical grid for **stochastic inversion workflow**.
- A **unique velocity model** to convert several 2D lines.

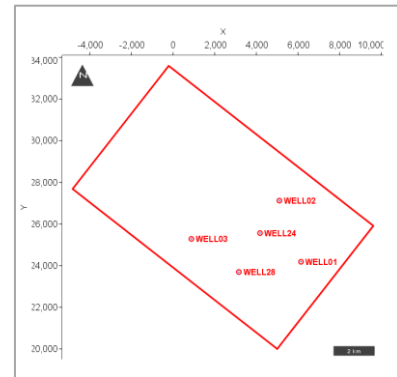
The survey in InterWell



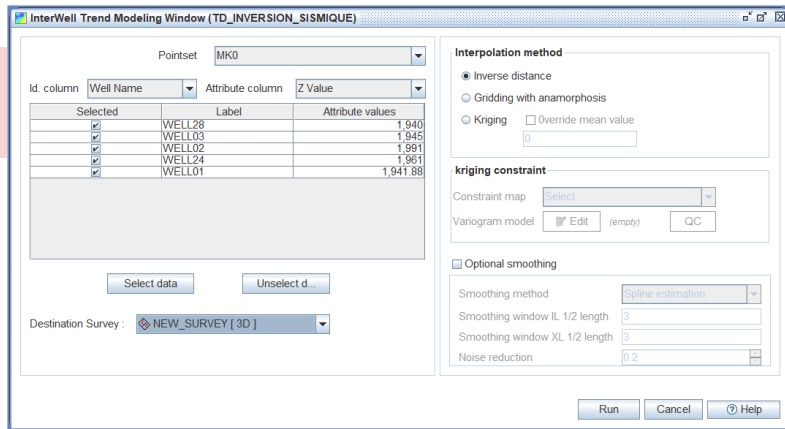
Each object is referenced in a survey, here **DEFAULT**



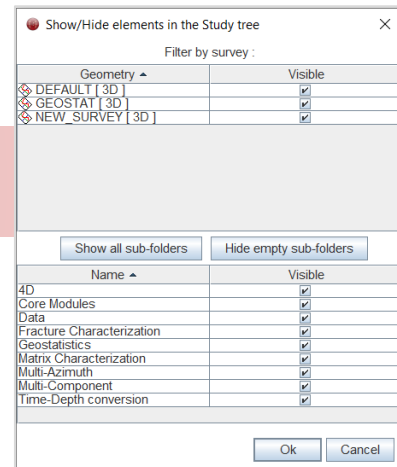
The survey is defined as a polygon, as it can be empty of data



In some modules, the survey must be informed, such as Trend modeling



The survey tree can be filtered by surveys





Migrate a horizon from a survey to another

Migrate horizon or map to other survey

Origin survey DEFAULT [3D]

Horizon / Map H1

Destination survey NEW_SURVEY [3D]

Duplicate management method :

☐ Closest ☒ Average ☐ Inverse distance

Output name

Merge several horizons/maps to create a new one, with priority in case of redundant locations

Merge horizons / maps

Horizon horizon1cut

Priority	Attribute
1	H1
2	part1
3	part2

The highest priority is 1, and decreases while the priority number increases

Output name

A new workflow to combine a map/horizon from different surveys

Operations at wells : Time-depth laws



Shift of the TD law with management of the first layer (for velocity workflow)

TD law value shift

Parameters

Value shift

First values bound

☒ Progressive shift application at first values

Last unchanged m

First changed m

☒ Set new law as preferred

Curve Name

Ok Cancel Help

Avoid common velocity anomalies at the top of your velocity model

Facies time-depth conversion and “most of” upscaling

Convert curve(s)

Law

Method

Parameters

Oversampling step (ms)

Upscaling window length (ms) ?

☒ Ignore null values

Time step selection

Output step (ms)

Survey Set from survey

Output name

Ok Cancel Help

Guess window length

Maximum Frequency (Hz)

☒ Resolution ☐ Detection

Ok Cancel

Handle your feasibility directly in InterWell with the cross-plot functionalities



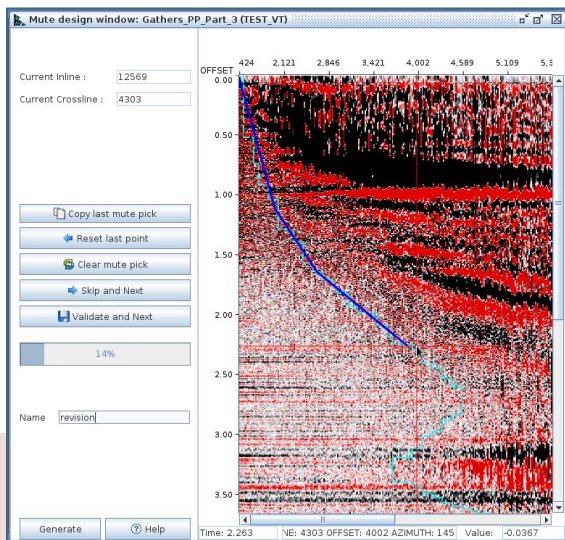
InterWell

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What's new in data
conditioning ?



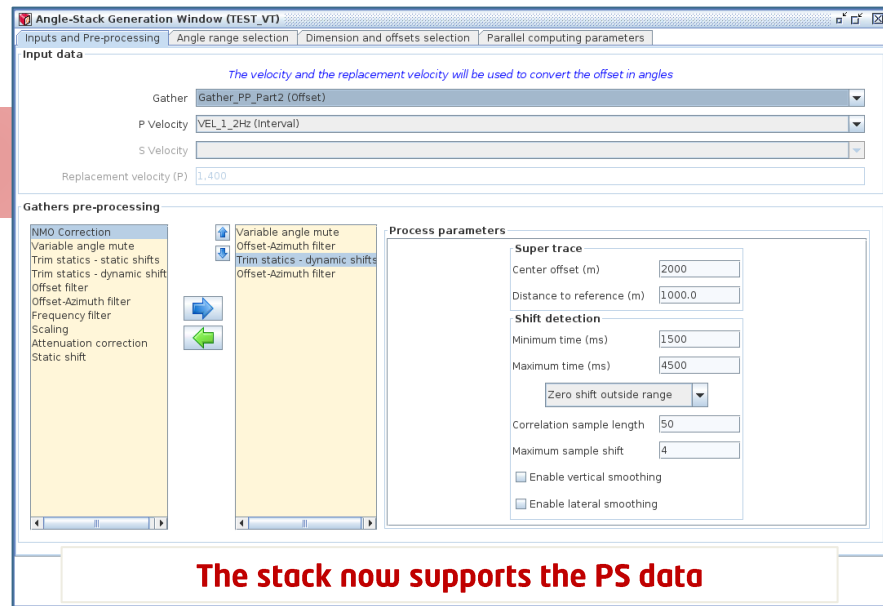
Gather conditioning : mute and new pre-processing



- **Interactive picking** of the mute in a regular grid of the gathers.
- Handy **reset/skip/clear** functionalities to edit current picking.
- Optional **reference mute curve**, for a picking review. If unused, the **previous mute** is plotted for more consistency.
- Save and 3D extrapolation of the mute for be used during gathers conditioning.

New processes for gather conditioning :

- **Offset-Azimuth filter**: Applies a filter (median or medium) to the data based on a distance from the offset and azimuth.
- **Trim statics**: alignment before stack by taking a "super-trace" (partial stack) as a reference.
- **Mutes**: hides the traces for the current and the next processes
 - Variable angle/offset—Define a curve using different points (whether converted to angles).
 - Free after picking.





InterWell

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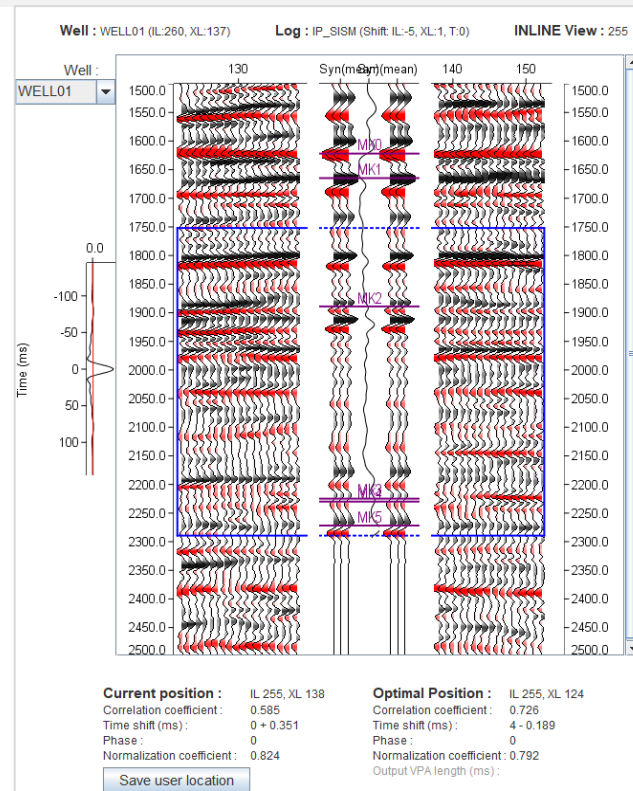
What's new in seismic
inversion workflow ?





Porting of the calibration process in a more modern language, bringing along significant improvements

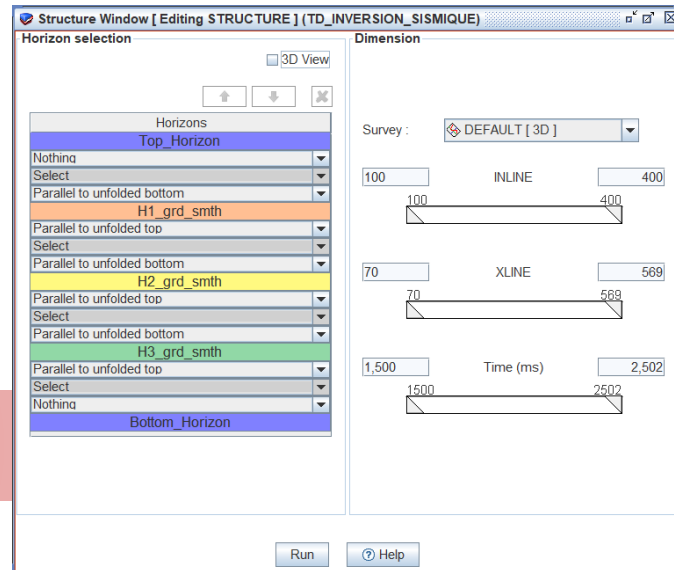
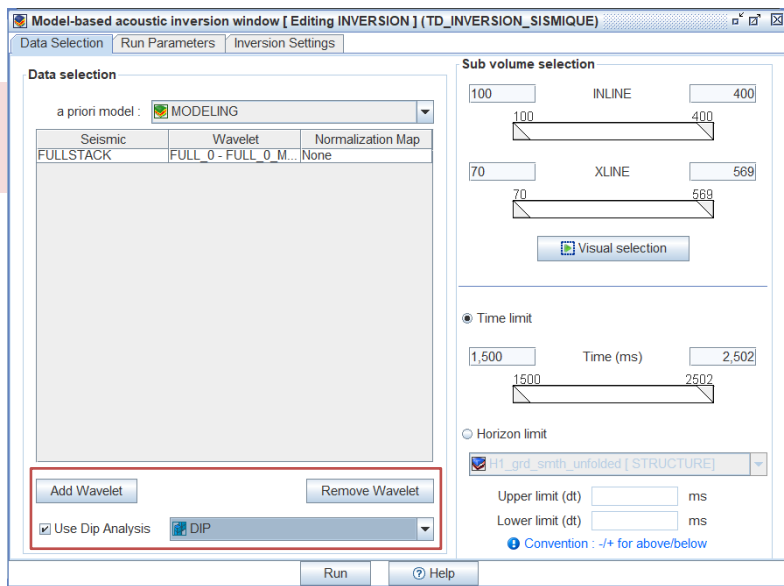
- Deviated wells are more precisely considered.
- Possibility to select shifts not centered in 0ms. Traces rejected only if dead traces or negative correlation.
- Application of the shift with oversampling to be more precise while detecting the phase. Angular mean instead of regular mean for phase estimation.
- The location must be saved once validated by the user, for a more fluent experience.
- Gradual colorbar in seismic window to better visualize areas with high/low energy.



Revamp of the structure module, Dip analysis more accessible



- The structure module has been revamped and simplified. The stratigraphic order and chronographic order is now the same.
- A fully defined survey must be informed. The horizons must be in a survey compatible (same transformation, same limits).

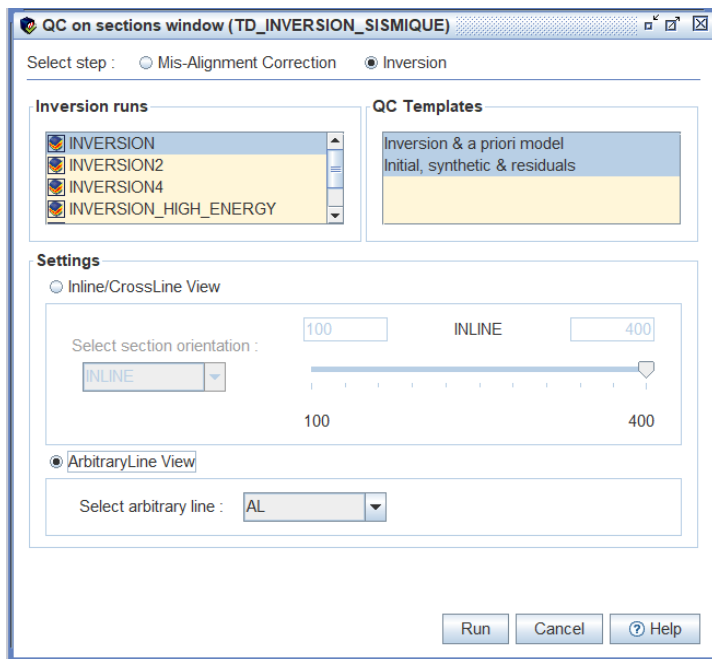


- DipX and DipY created from Dip Analysis directly accessible while selecting the parameters of the inversion.



The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Single run selection, multiple templates

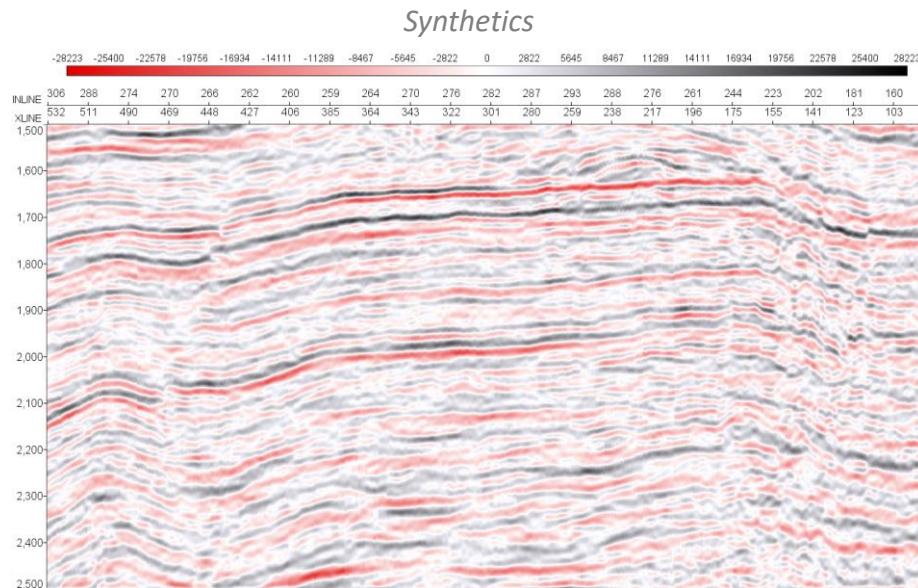
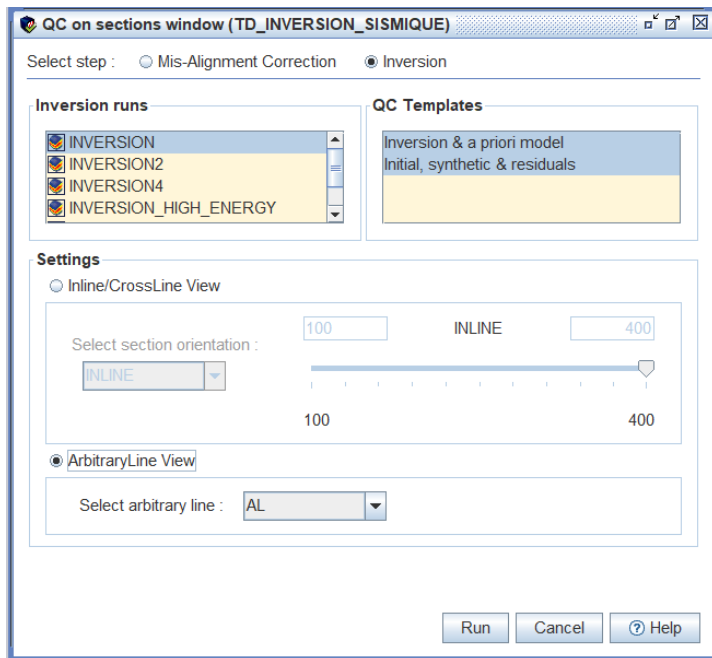


- Create a view (IL,XL, Arbitrary line) according to **templates**.
- For inversions, focus on the **comparison between seismics** (original and synthetics) and **optimization of the elastic model** (initial to optimal).
- For RNMO, **comparison between shifts** and **seismic vertical scale**, comparison between **seismic before** and **after** correction.
- **Automatically** sets the colors and limits according to the data to visualize.
- This QC type only **provides views** without saving any run.



The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Single run selection, multiple templates

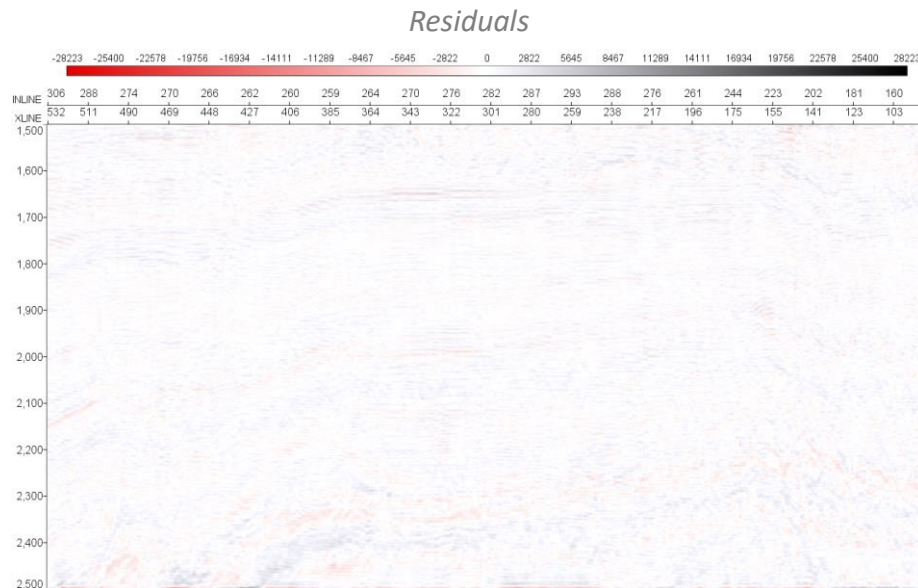
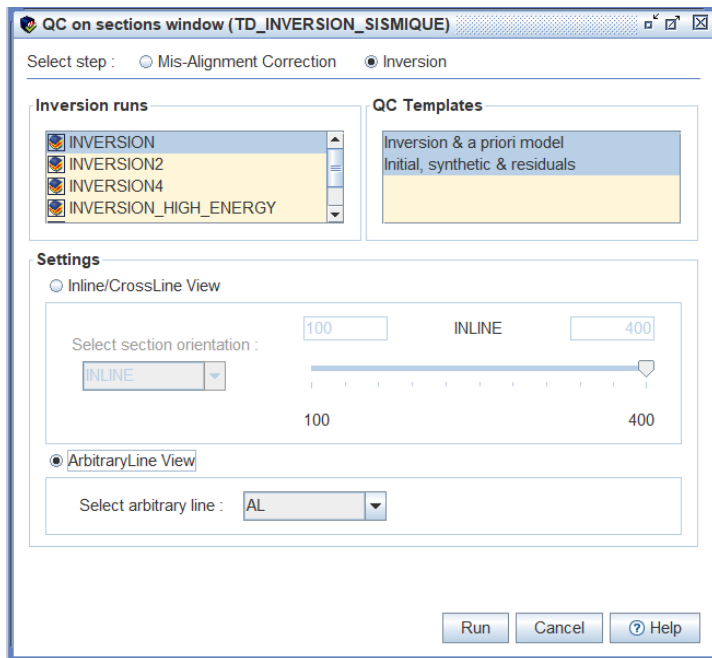


One window by template



The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Single run selection, multiple templates



One window by template



The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Multiple data selection, multiple templates

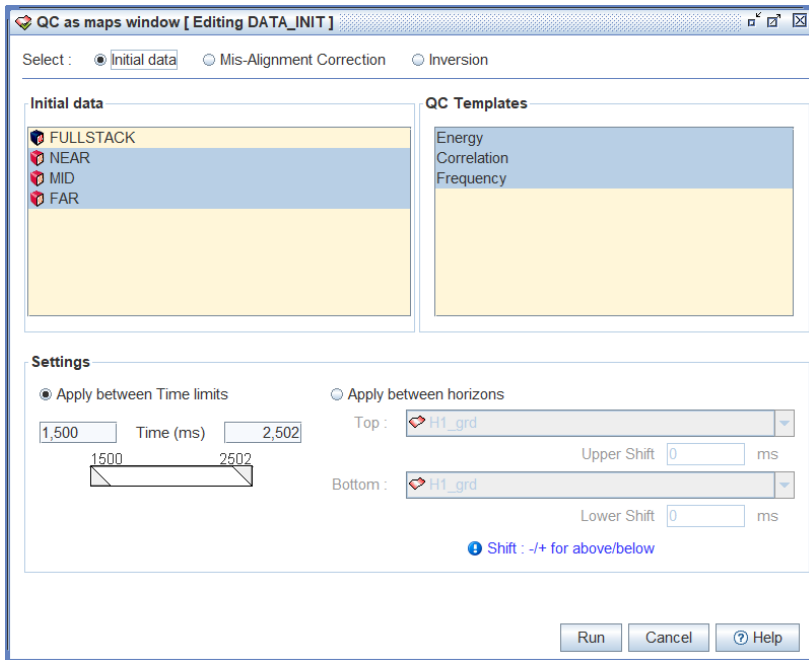
The screenshot shows the 'QC as maps window [Editing DATA_INIT]'. It has three tabs: 'Initial data' (selected), 'Mis-Alignment Correction', and 'Inversion'. The 'Initial data' tab contains a list of data types: FULLSTACK, NEAR, MID, and FAR. The 'QC Templates' tab contains a list of templates: Energy, Correlation, and Frequency. The 'Settings' section has two radio buttons: 'Apply between Time limits' (selected) and 'Apply between horizons'. Under 'Apply between Time limits', there are input fields for 'Time (ms)' with values 1,500 and 2,502, and a visual representation of a time window. Under 'Apply between horizons', there are dropdown menus for 'Top' and 'Bottom' (both set to 'H1_grd') and input fields for 'Upper Shift' and 'Lower Shift' (both set to 0 ms). A blue icon with a question mark and the text 'Shift : +/- for above/below' is also present. At the bottom are 'Run', 'Cancel', and 'Help' buttons.

- **Extract** at constant times or between horizons and creates a views to capture key informations on **data** or **runs**.
- This QC type creates a run which can be **restored**.
- **Automatically** sets the colors and limits according to the data to visualize.
- **Adapted QCs** depending on the run type.

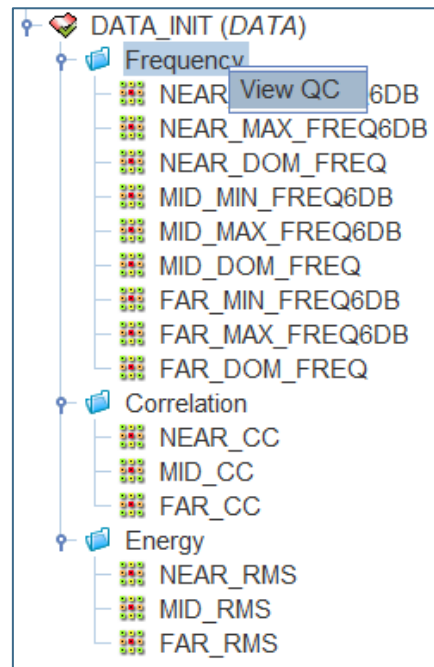


The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Multiple data selection, multiple templates



Maps extracted and stored in the survey tree

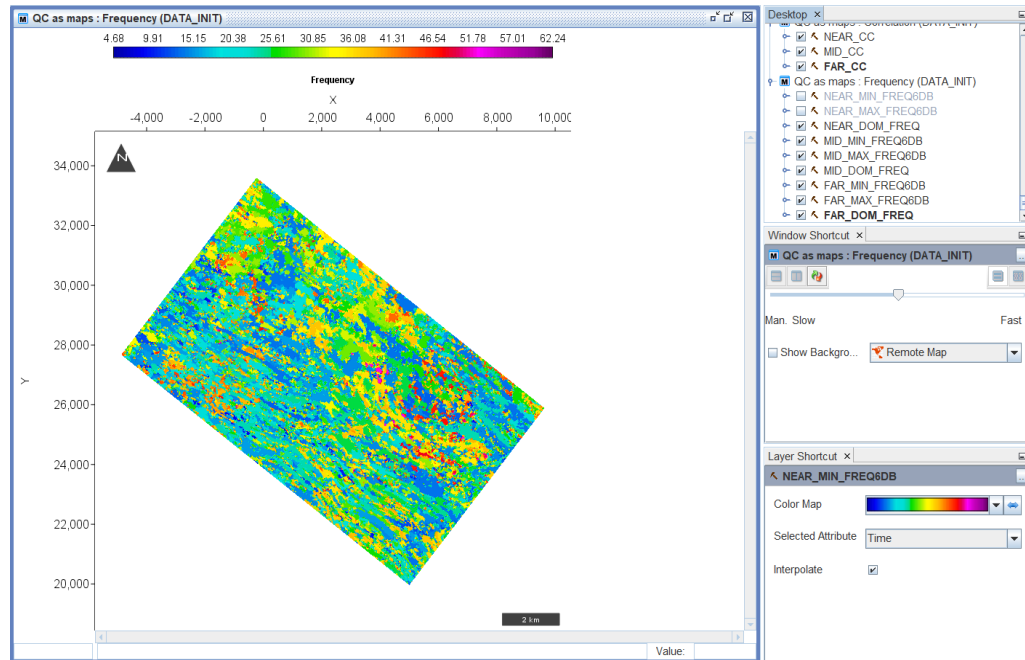
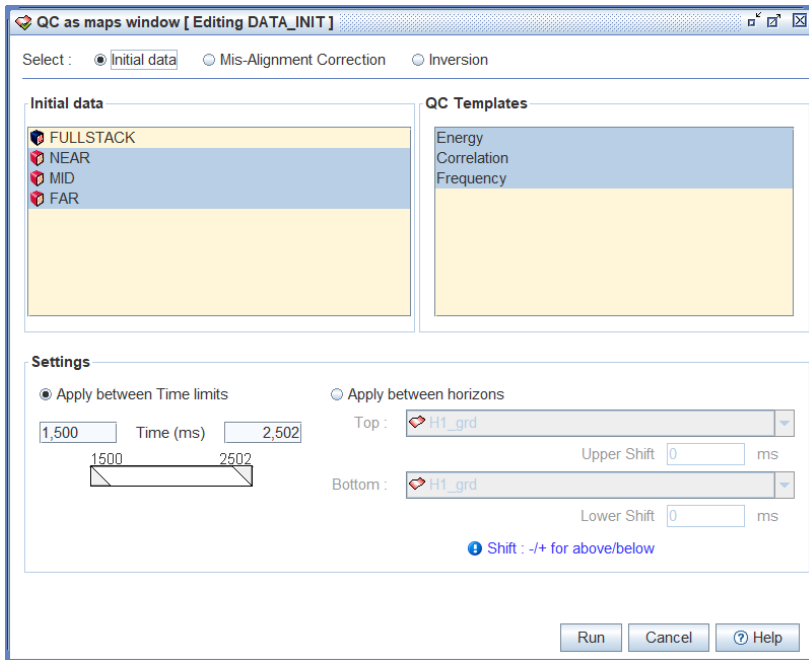




The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Multiple data selection, multiple templates

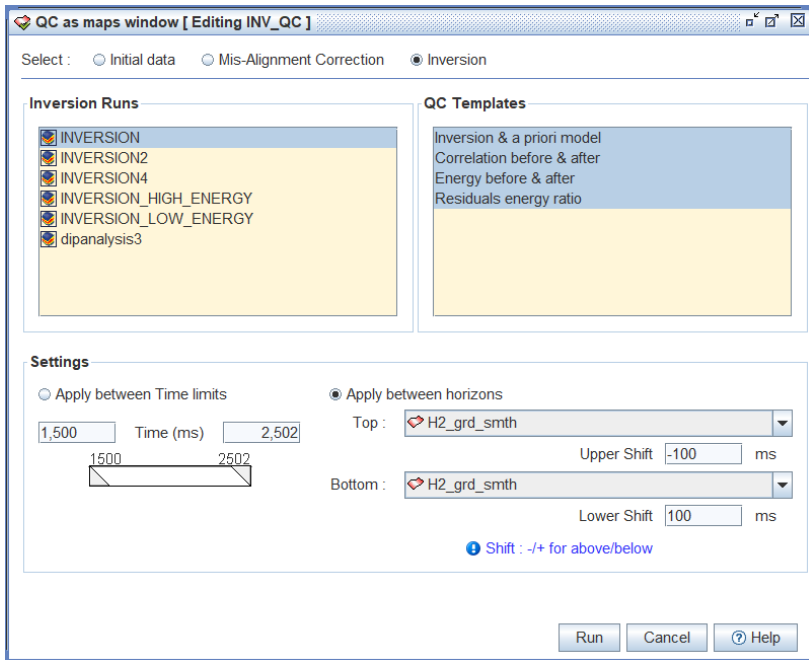
Map view with the same limits to compare the data



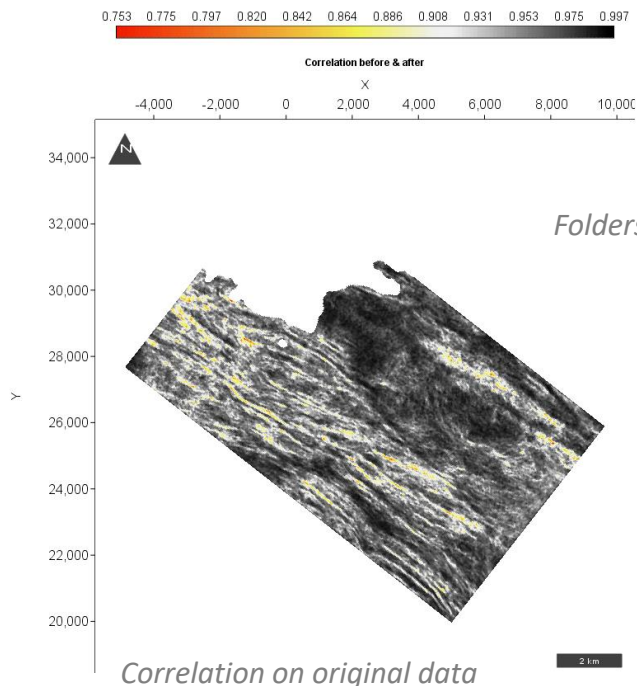


The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

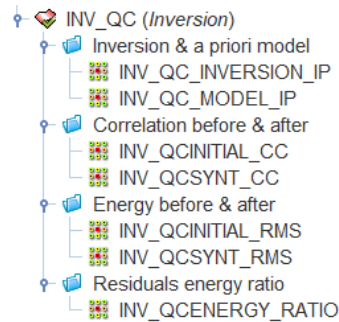
Single run selection, multiple templates



QC your inversion to check the data enhancement



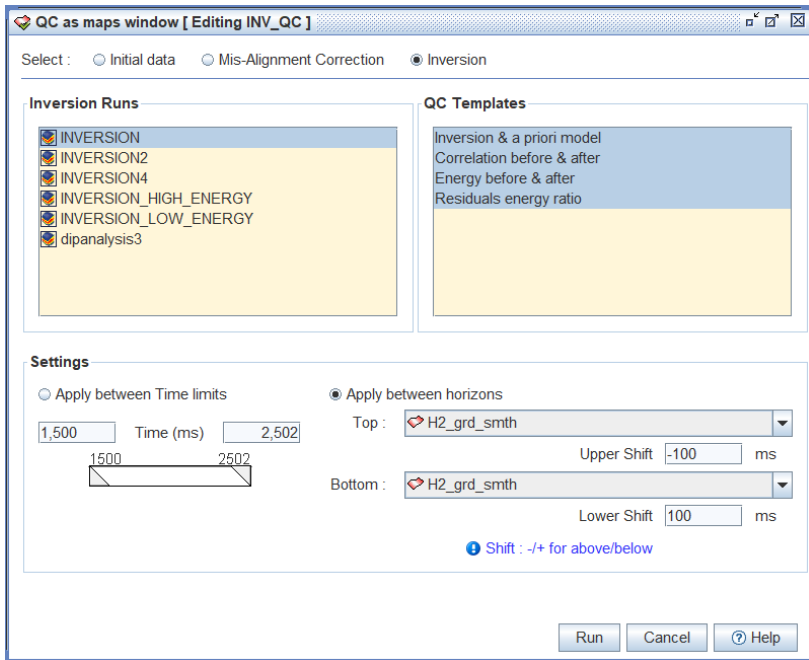
Folders in the data tree, example with an acoustic inversion run



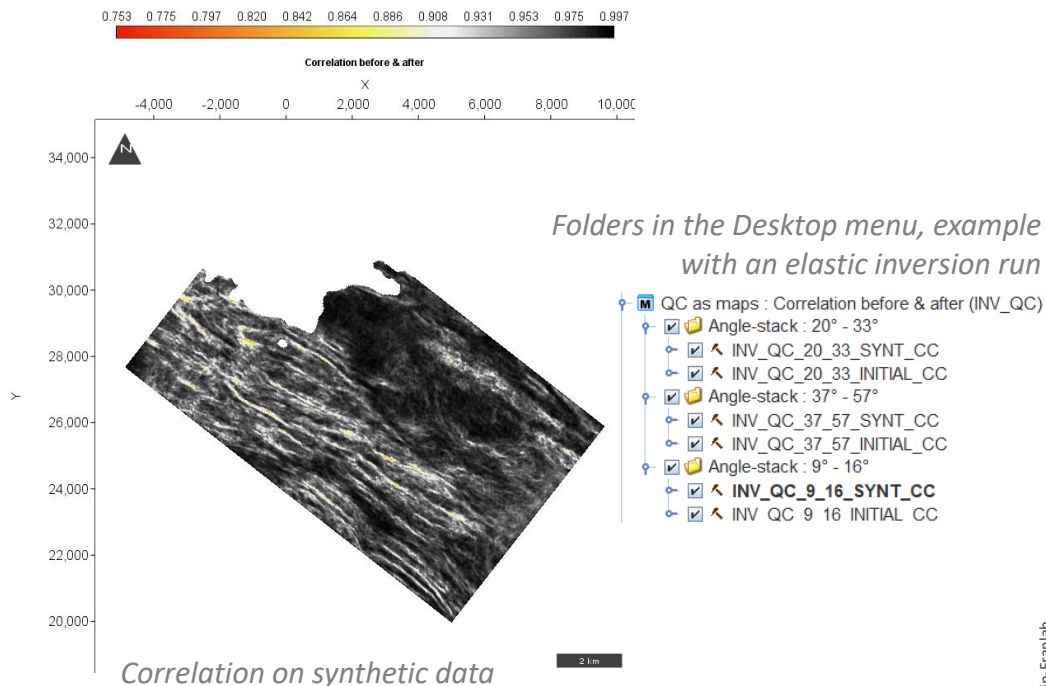


The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Single run selection, multiple templates



QC your inversion to check the data enhancement





The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Multiple run selection, supports calibrated and input wells

QC at wells window [Editing QC_atWells]

Select step : ☐ Modeling ☒ Inversion

Inversion runs

- INVERSION
- INVERSION2
- INVERSION4
- INVERSION_HIGH_ENERGY
- INVERSION_LOW_ENERGY
- dipanalysis3

Well Name Filter:

Logs Filter: ☒ IP ☒ IS ☒ RHO

Comparable cubes if any: ☒ IP ☐ IS ☐ RHO

The available logs must be in time domain, regular, with a sampling rate as defined in the survey definition. The origin must also be on the grid.

Available Logs

Well	Log	Log Type
WELL28	IS_SISM	S-Impedance
WELL28	IP_SISM	P-Impedance
WELL28	RHOB_SISM	S-Impedance
WELL28	PHIE_SISM	S-Impedance
WELL03	IS_SISM	S-Impedance
WELL03	IP_SISM	P-Impedance
WELL03	RHOB_SISM	S-Impedance
WELL02	IS_SISM	S-Impedance
WELL02	IP_SISM	P-Impedance
WELL02	RHOB_SISM	S-Impedance

Selected Logs

Well	Log	Log Type
WELL02_FULL_...	IP_SISM	P-Impedance
WELL28_FULL_...	IP_SISM	P-Impedance
WELL03_FULL_...	IP_SISM	P-Impedance
WELL24_FULL_...	IP_SISM	P-Impedance
WELL01_FULL_...	IP_SISM	P-Impedance

Copy the selection from a reference model

☒ One window by well ☐ One window by type

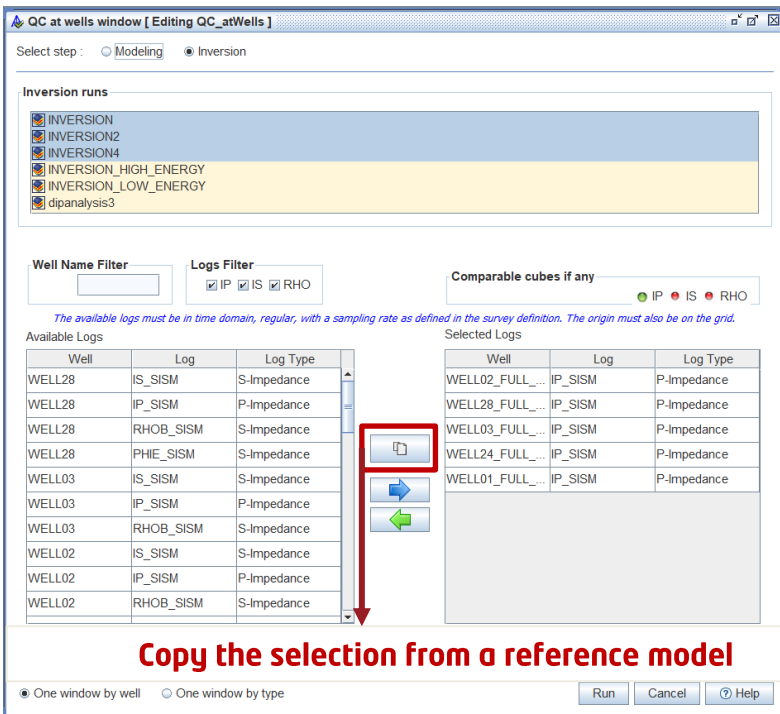
Run Cancel Help

- **Extract** along the well trajectories and creates a view to compare the original logs with the 2D/3D volumes.
- This QC type creates a run which can be **restored**.
- The **modes** (By Well, By Type) can be changed from the study tree regardless the choice in the GUI.
- **Automatically** sets the colors and limits according to the data to visualize.
- Well designed to support **blind wells**.

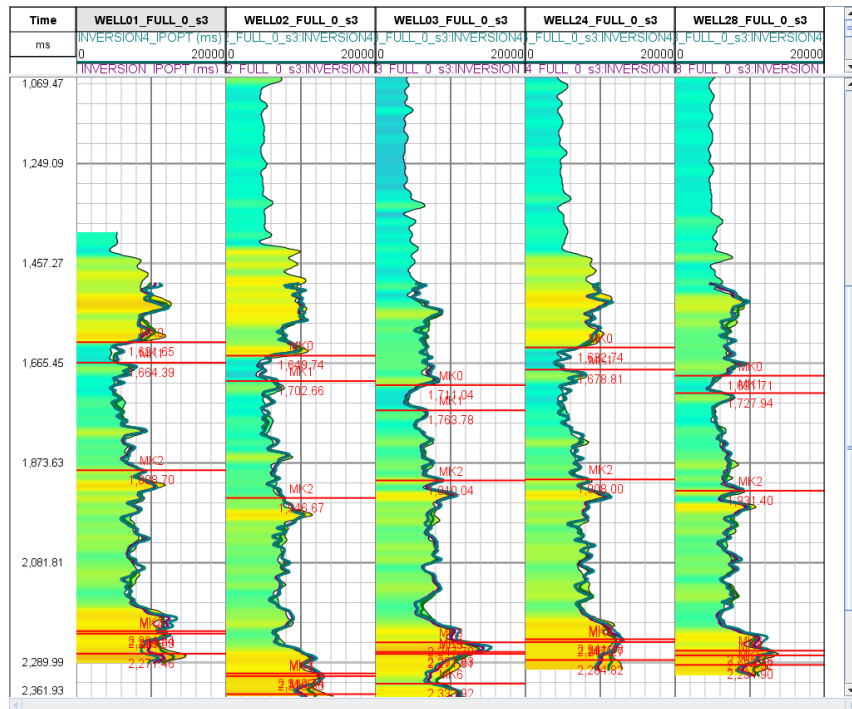


The **QC module** has been simplified to generate view to properly QC the **key step of the inversion process** **Beicip-Franlab consulting standards**.

Multiple run selection, supports calibrated and input wells



Compare the initial logs (color filled) with the runs (colored curves)





InterWell

Release 2023.1

What's new in seismic characterization ?

Matrix characterization	Fracture character
Elastic parameter computation	
Supervised Analysis	
Nested Supervised Analysis	
Cube Cut-Off	
Property laws using facies	
Property laws using probabilities	
Multi-variate Analysis	
Trend modeling	
Geobodies	
Horizon-slice Clustering	
Horizon-slice Supervised Analysis	
3D PCA	
3D Clustering	

New

New

New

New

New classifier : neural network for supervised classification



Discriminant analysis, renamed as supervised analysis, now supports neural network in addition to the discriminant analysis.

The screenshot shows the 'InterWell Supervised Analysis Window (FINAL2020)' with the following settings:

- Settings:**
 - A priori samples: *apriori_lithology*
 - Attribute 1: *IP*
 - ☒ Attribute 2: *IS*
 - ☐ Attribute 3: *IP*
 - Facies: *LITHOLOGY*
- Input attribute volumes:**

IP	IS
INV_ELAS.IPOPT	INV_ELAS.ISOPT
- HyperParameters:**
 - ☒ Discriminant analysis ☐ Neural Network
 - Prior probabilities: *equiprobable*
 - Discrimination Algorithm: ☒ Linear ☐ Quadratic
- Sub volume selection:**
 - Apply between Time limits: ☒
 - Time (ms): 1,500 to 2,502
 - Apply between horizons: ☐
 - Top: *H2_grd*
 - Bottom: *H2_grd*

Buttons at the bottom: Run, Cancel, ? Help

- Supported in the **standard** and the **nested** mode.
- Supported for the **test prediction**.

New classifier : neural network for supervised classification



Standard parameters, to be tested in every case

HyperParameters

Standard Advanced

Hidden layers

Hidden nodes

Tests number



Advanced, to go deeper in the analysis

HyperParameters

Standard Advanced

Learning Rate

Tests proportion (%)

Seed value  

Structure of the neural network

- Hidden layers : the number of hidden layers to be considered in the model.
- Hidden nodes : the number of hidden nodes per hidden layer.

Validation and partitioning parameters

- Test number : the number of tests performed to find the most predictive model.
- Test proportion : the proportion (in %) of the training samples to be randomly left out for cross-validation of the model during training (blind tests).

Initialization and internal parameters

- Learning rate : the learning rate of the model.
- Seed value : the seed value to initialize the weights distribution before starting training the model.

User friendly approaches for seismic characterization : law by facies



After a **supervised analysis**, this functionality allows to assign a law to each facies (constant, linear, quadratic).

Property laws by facies (TUTORIAL)

Input Volume
ACOUSTIC_INV_01.IPOPT

Facies classification runs
DISCRIMINATION

x refers to the input volume property

Edit Clear

Facies	Law
1	0.0
2	0.0
3	$2.6263E-7x^2 + -0.0097x + 91.138$
4	$2.6263E-7x^2 + -0.0097x + 91.138$

Run Cancel

Add law : 3

Law Quadratic

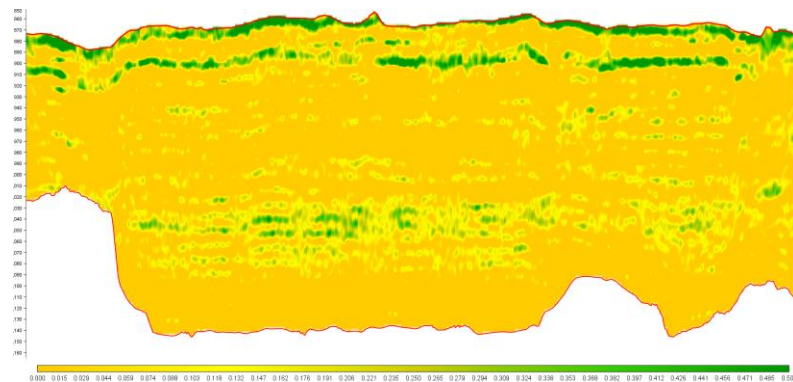
Property = $x0 + x1 * x + x2 * x^2$

x0 91.138

x1 -0.0097

x2 0.0000026263

Apply Cancel



Shale content (V/V)

Suitable for porosity, VSH, TOC estimation...

User friendly approaches for seismic characterization : law by probabilities



After a **supervised analysis**, this functionality allows to assign a law to each facies, defined as a **probability value** (constant, linear, quadratic).

Property laws using probabilities (TUTORIAL)

Input Volume: ACOUSTIC_INV_01.IPOPT

Facies classification runs: DISCRIMINATION

Probability 1: DISCRIMINATION_Proba_Facies_4
Minimum: 0.3 Maximum: 0.5

Probability 2: DISCRIMINATION_Proba_Facies_1
Minimum: 0 Maximum: 1

Use another probability volume: ☐

Outside the ranges, the defined laws are applied. Inside the ranges, the estimation is weighted by the distance to the external probability values.

x refers to the input volume property Edit Clear

Case	Law
P1 >= 0.5	2.6263E-7*x^2 + -0.0097*x + 91.138
P1 <= 0.3	0.0

Facies	In use
1	<input type="checkbox"/>
2	<input type="checkbox"/>
3	<input type="checkbox"/>
4	<input checked="" type="checkbox"/>

Add law : 1

Law: Quadratic

Property = $x_0 + x_1 * x + x_2 * x^2$

x0: 91.138
x1: -0.0097
x2: 0.00000026263

Run Cancel

Apply Cancel

Use 1 or 2 probability cut-offs to define a facies and assign a law. The final value will progressively vary from the first law to the second law according to the probability value(s).

Suitable for porosity, VSH, TOC estimation...



The Principal Component Analysis allows **exploring the redundancy** of the attributes

3D PCA Window (TD_INVERSION_SISMIQUE)

Inputs

INVERSION4.IPOPT

Volumes

FULLSTACK

INVERSION.SYNT

INVERSION4.SYNT

Learning decimation

IL decimation 5 XL decimation 5

Results

☒ Variance proportion ☐ Cumulative variance proportion

Dataset Name PCA2

Run Help

Dimensions

100 400

100 400

70 569

70 569

☐ Apply between Time limits

1,500 2,502

1,500 2,502

☒ Apply between horizons

Top: H1_grd

Upper Shift 0 ms

Bottom: other_horizon_crossingH1_4

Lower Shift 0 ms

Shift: +/- for above/below

Applied in 3D, with no attribute limit.

PCA : check the redundancy between attributes



3D PCA Window [Editing PCA] (TD_INVERSION_SISMIQUE)

Inputs

FULL_DEPTH

Volumes

FULLSTACK

SYNT_INVERSION2

SYNT_INVERSION4

Dimensions

100 400

100 400

70 569

70 569

Apply between Time limits

1,500 2,502

1,500 2,502

Apply between horizons

Top: H1_grd_smth

Upper Shift 0 ms

Bottom: other_horizon_crossingH1_4

Lower Shift 0 ms

Shift: +/- for above/below

Learning decimation

IL decimation 5 XL decimation 5

Results

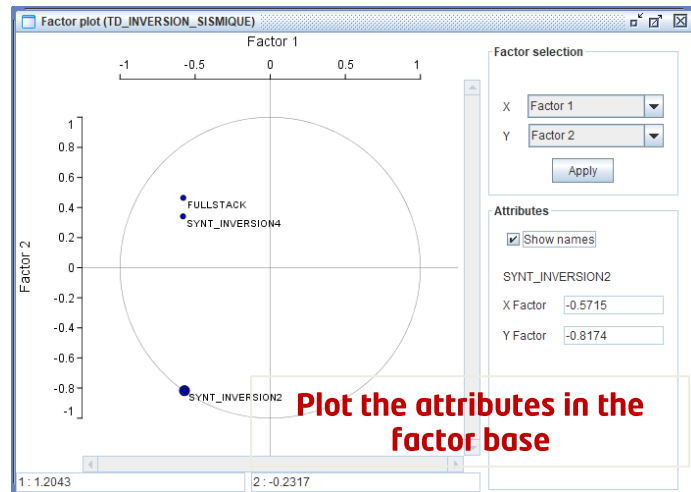
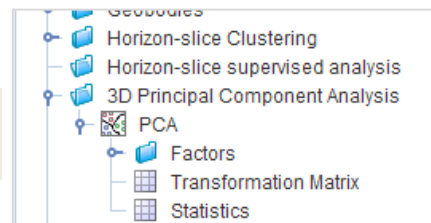
Variance proportion Cumulative variance proportion

F1=97.82% F2=2.08% F3=0.10%

Dataset Name PCA2

Run Help

Get the transformation in the new base



Generate the factors and filter the input volumes

Factor generation

PCA run PCA

Generate single factor 1 Generator several factors

From 1 To 3

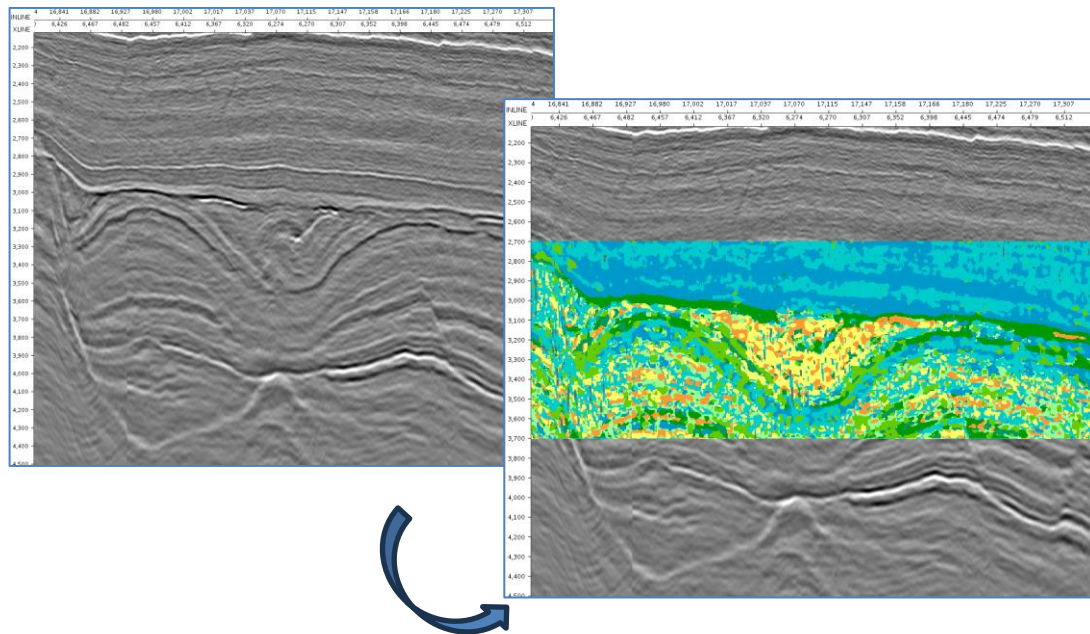
Ok Cancel Help



Find typical patterns, in 3D, based on **key attributes**

The screenshot shows the '3D PCA Window' interface. On the left, under 'Inputs', there's a list of attributes: RMS, FULL_INV_IPOPT, FULL_INV_ISOPT, Energy_5_norm, Sweet_norm, MosPosCurv_norm, QualIDip_norm, and RMS_norm. Below this is a 'Learning decimation' section with 'IL decimation' and 'XL decimation' both set to 1. On the right, the 'Dimensions' section shows three axes: INLINE (16,700 to 17,400), XLINE (6,200 to 6,600), and Time (2,700 to 3,700). There are radio buttons for 'Apply between Time limits' (selected) and 'Apply between horizons'. The 'Top' and 'Bottom' horizons are both set to 'Intra_time_grd'. At the bottom, the 'Dataset Name' is 'PCA_7A.t' and there are 'Run' and 'Help' buttons.

Applied in 3D, with no attribute limit.



Unveil typical response from key attributes



InterWell

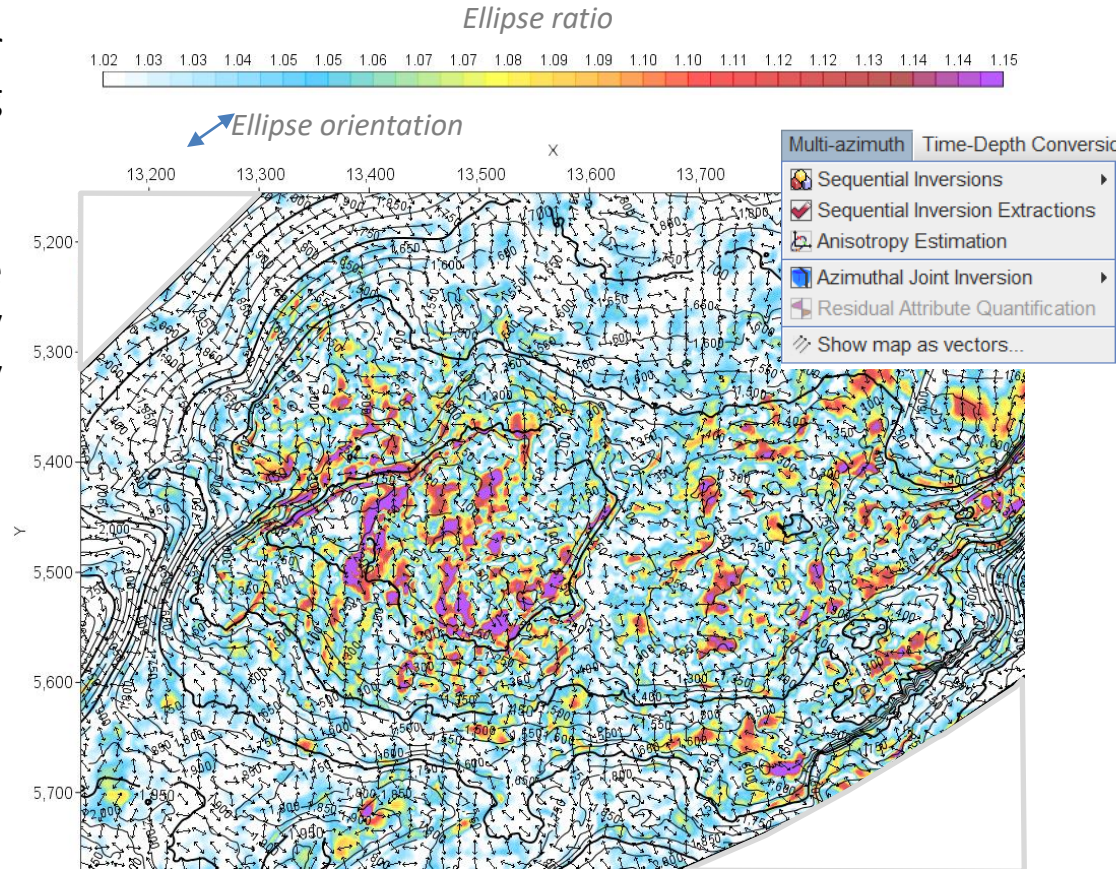
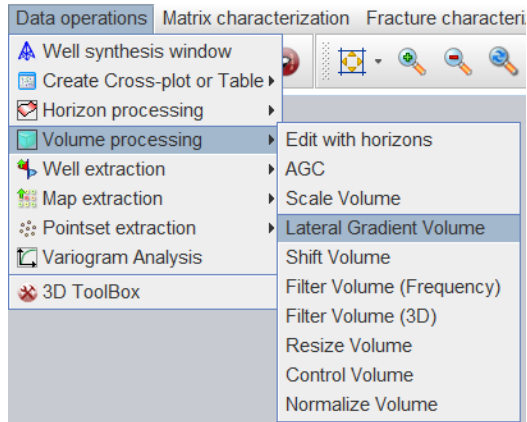
Release 2023.1

What's new in the
advanced workflows ?

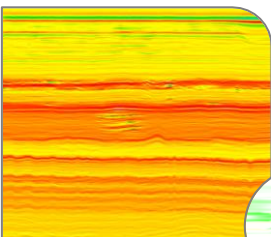




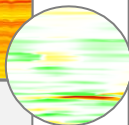
- **More accessible** arrow display, even for volume ellipse fitting mode, by selecting the option in the Top menu.
- **Lateral gradient** attribute to support the anisotropy volume interpretation by deleting any other potential anisotropy source.



4D inversion workflow : enhancement for vintage pre-alignment



4D Inversion :
Registration laws



Initial law

Optimizing shifts between
impedance models

Horizon-based law

New

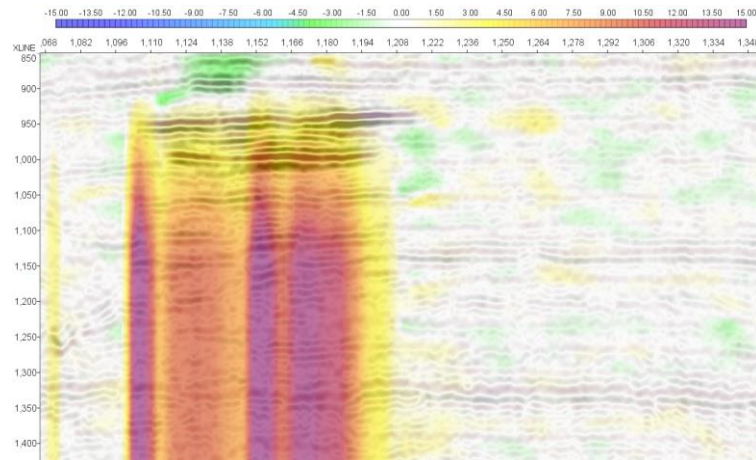
Modeling shifts
according to
horizon pairs

Custom law

New

Free shift import or
mixing methods

Shifts example (ms), combining **RNMO** and **Horizon-based law**, after 3D filtering, loaded as **Custom law**



All connected to
Warping and 4D joint
inversion

Apply any **shift run** to
any **InterWell seismic**



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