DESTRESS

Task 6.3 „Technical performance monitoring for validation and control"

Jan Henninges (GFZ), Bob Paap (TNO), Francesco Grigoli (ETH)

Results

- Parameters for assessment of technical performance defined; Overview of measurement parameters, tools and methods.
- Great potential of innovative new approaches for monitoring, like distributed fiber-optic sensing, and full-waveform methods for microseismic monitoring (ETH, also see Tasks 6.4 and 5.4)

Demonstration sites

- Pohang (KR), Geldinganes (IS): Cyclic hydraulic stimulation
- Soultz-sous-Forêts (FR): Chemical stimulation

## Well monitoring with Distributed Acoustic Sensing (DAS)

DAS response modeling (TNO)
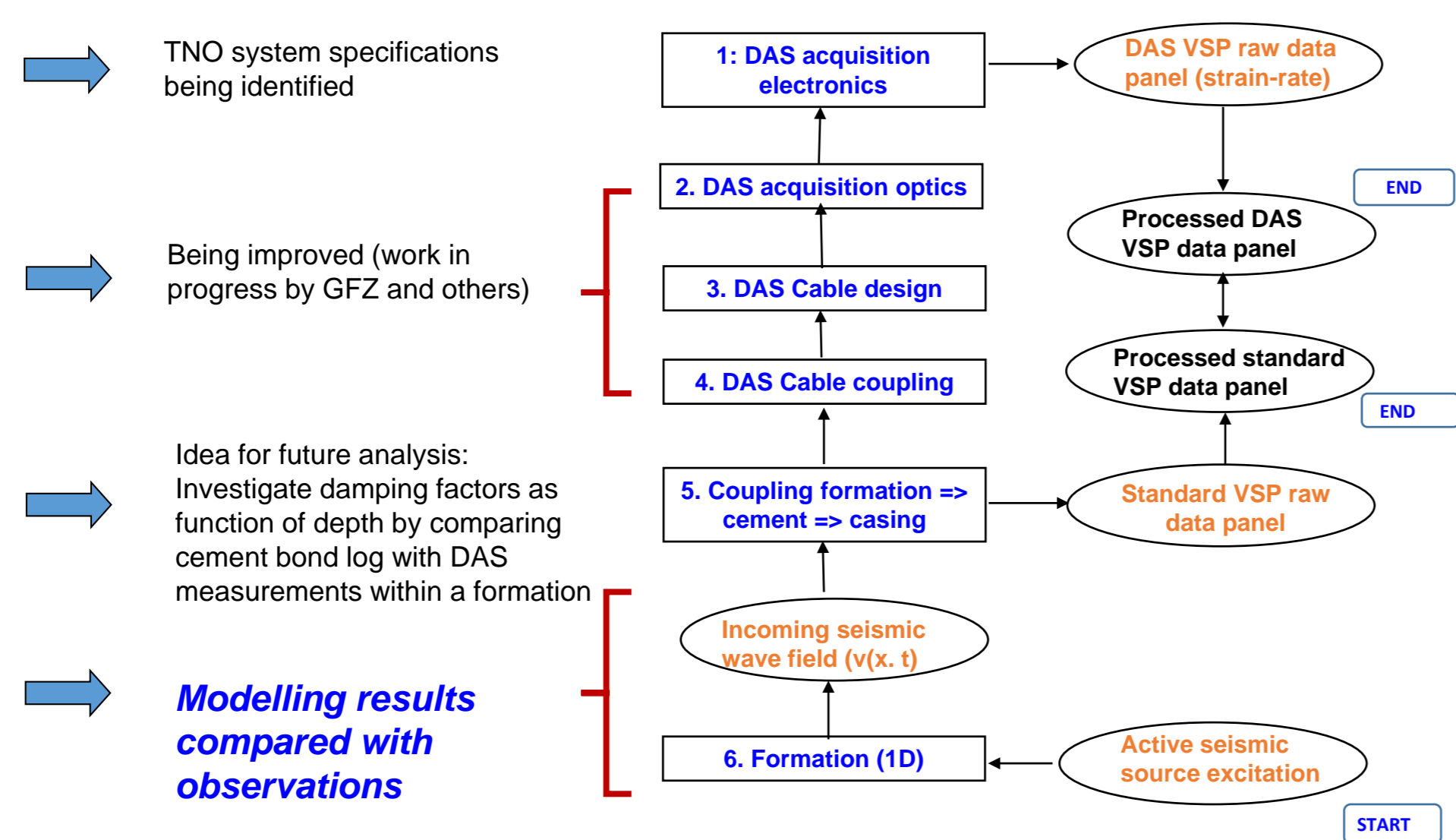
DAS transfer functions, VSP data flow. Simulation: Sensitivity sufficient for microseismic monitoring.

Case studies DAS-VSP feasibility (GFZ)

- High quality VSP products at reduced cost; Specific acquisition characteristics and signal quality.
- Monitoring of borehole integrity using DAS for passive monitoring during well operation.

3D-DAS-VSP image Groß Schönebeck
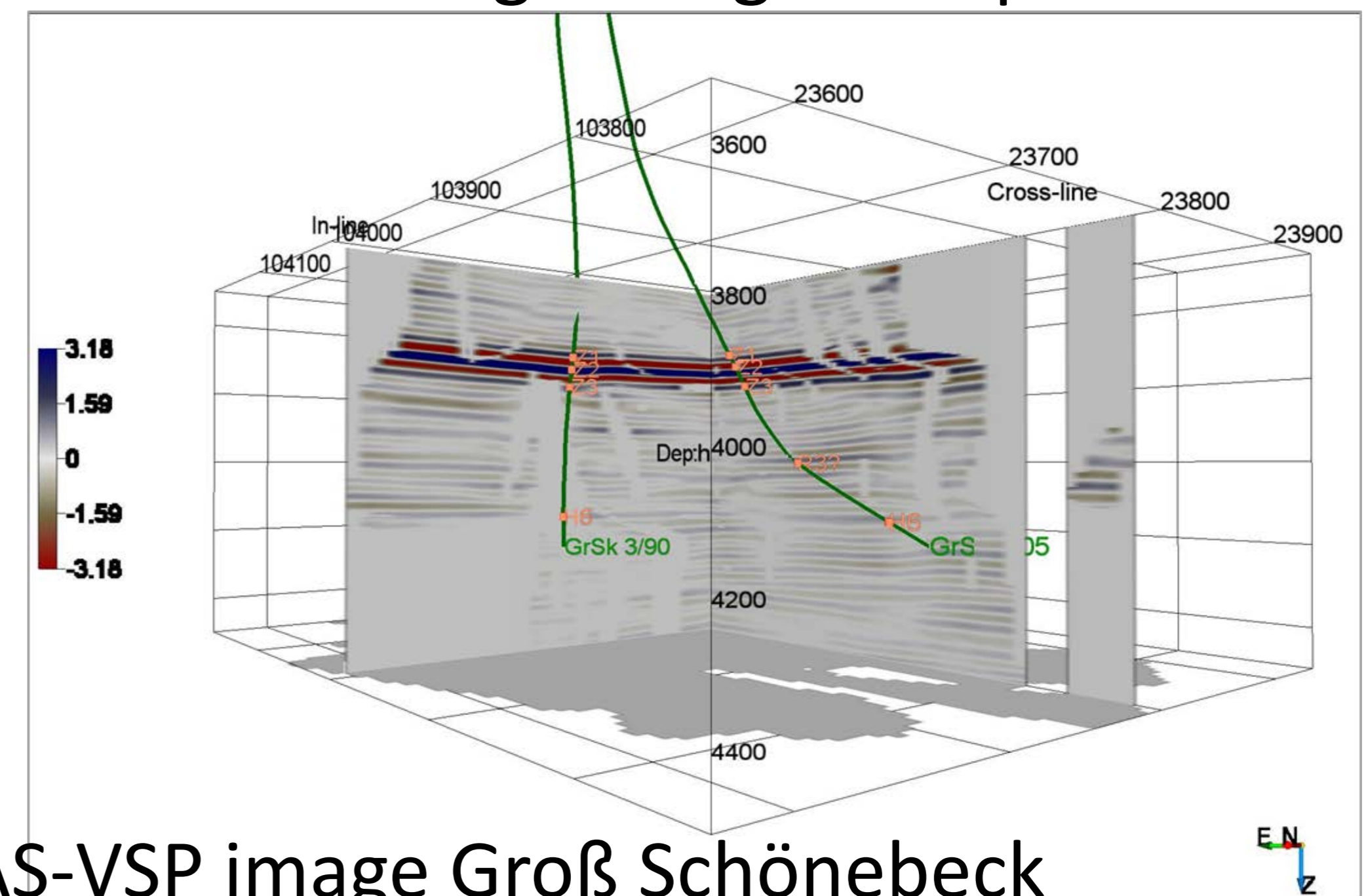
Monitoring design: parameters, tools and methods

Assessment parameter	Input information	Measurand*
Energy output	Flowrate, quality (phase composition), and temperature of produced fluid	1.1, 1.2
Productivity/injectivity of well	a) at surface	1.2, 1.3
Location and size of stimulation intervals	b) downhole	2.2.1, 2.3.1, 2.3.2
Productivity/injectivity of individual reservoir/stimulation intervals		2.1.1, 2.2.1,
Leakage detection (borehole integrity)		2.2.1, 2.3.1, 2.3.2
extent of induced fractures/stimulated rock volume	Location of induced seismic events during stimulation	1.4
Structural integrity of borehole casing and annular cementation, zonal isolation	Borehole integrity measurements	2.2.2, 2.2.3,

Timing of monitoring campaigns:
- Immediately before (base line) and after treatment (assess efficiency, e.g. fold of increase of productivity/injectivity)
- during treatment (control of stimulation process)
- long-term monitoring during operation (sustainability of stimulation effect)
- on demand, e.g. in case of unexpected developments (e.g. changes in productivity/injectivity) or technical problems (e.g. suspected leakages)

Measurand*	Measurement parameters	Sensors, tools and methods
1	**Surface monitoring**	
1.1	Flowrate, quality (phase composition)	Flow meter (at wellhead)
1.2	Fluid temperature	temperature sensor (at wellhead)
1.3	Fluid pressure	pressure sensor (at pump inlet)
1.4	Velocity/acceleration of ground motion	Seismometer array, microseismic monitoring (at surface, in shallow and/or deep boreholes)
2	**Downhole monitoring**	
2.1	*Point sensors*	
2.1.1	Reservoir pressure	Pressure sensor
2.2	*Electric wireline logging*	
2.2.1	Profiles of pressure, temperature, velocity, density of produced/injected fluid over reservoir interval	Production logging tool, e.g. spinner flow meter with gradiomanometer
2.2.2	Morphology/diameter of inner surface of borehole completion	Multi-finger caliper, acoustic borehole scanner
2.2.3	Sonic amplitudes/bond index, acoustic impedance of annular fill	Cement-bond log, acoustic borehole scanner
2.3	*Fiber-optic sensing*	
2.3.1	Repeated well temperature profiles	DTS (Distributed Temperature Sensing)
2.3.2	Repeated profiles of dynamic strain changes or vibration along well	DAS (Distributed Acoustic Sensing)

References
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