

Project No.: 5238-88882467
 Date: 19.12.2023
 From: 5.1.2.e
 To: 5.1.2.e (Nobian)
 Copy to: DEEP.KBB intern

Subsidence Model Zuidwending

1 Introduction

The subsidence predictions for the cavern site in Zuidwending are based on the DEEP.KBB subsidence model Zuidwending. The general model structure and procedure followed therein is described in the Memo "DEEP.KBB Subsidence Model" (rev02 from 11.04.2024). In the following the application of the model for the cavern site in Zuidwending and the respective validations of the model are summarized.

2 Calibration / Validation of Parameters for Convergence Calculations

The fitted creep characteristic based on the history matching process as well as available lab test results from different caverns in the Zuidwending area are depicted in Figure 2-1.

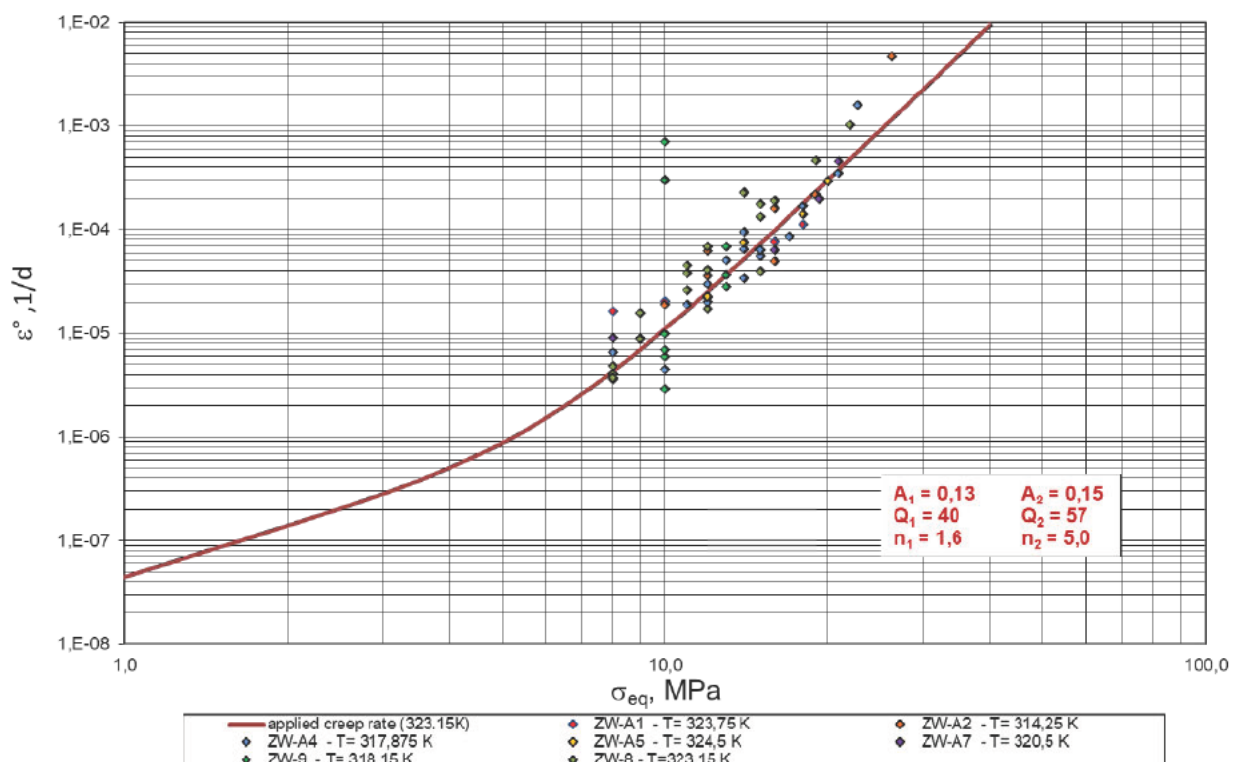


Figure 2-1: Creep characteristic for the Zuidwending cavern field derived from history matching and compared with lab test results [LANGER, 1991], [BRÜCKNER, 2009], [BRÜCKNER, 2012]

In the history matching process, the observable volume of a cavern will be calculated and compared to the results of regularly conducted sonar measurements. The observable open volume describes the volume of a cavern that can be captured by a sonar measurement.

The observable or open cavern volume can be determined using following equation:

$$V_{\text{obs}} = V_{\text{mined}} - V_{\text{conv}} - V_{\text{sump}}$$

Equation 1

with: V_{obs} open cavern volume
 V_{mined} mined cavern volume
 V_{conv} convergence volume
 V_{sump} sump volume

The mined cavern volume V_{mined} can be determined based on the mass of produced salt and the volume of insolubles that accumulate with a certain bulking factor at the cavern sump, resulting in V_{sump} .

Based on the volume development due to the mined cavern volume and the sump volume, the in-situ creep ability of the rock mass can be fitted to the sonar measurements.

However, since a model represents a simplification of the reality, a certain level of inaccuracies is implied in the calculation of the volume development.

The main inaccuracies for the calculated cavern development can be derived from the following sources:

- Produced brine volume
- Salt concentration in brine
- Insoluble content of the salt
- Pressure-dependent generation of convergence volume

Furthermore, the validation values (sonar measurements) imply inaccuracies as well. With regard to the measured cavern volume, generally a measurement error of up to 1 % occurs. If measured through one pipe, the measurement error can generally be expected in the range of 2-4 %. Furthermore, in the case of irregularities in the cavern wall like backpockets, not all parts of the cavern might be detected by sonar measurement. Therefore, the volumetric error of sonar measurements can additionally increase. This has to be taken into account when using the sonar measurements for validation of the volume development. Therefore, the volumes given by sonar measurements are interpreted in case backpockets are identified.

A difficulty in the determination of the in-situ creep behavior exists especially for brine production caverns. Brine production caverns in operation show a permanent increase in volume that mostly is greater than the volume loss by convergence, meaning the resulting creep response is masked behind the volume increase over time.

Nevertheless, by history matching, the volume development of the brine production caverns has been modeled. In Table 2-1 the deviations between modelled and measured cavern volumes are listed. The cavern volumes represent the measured volumes for the latest sonar measurement of the respective cavern. The deviation represents the cumulated deviation of the calculated cavern volumes to all measurements over the total lifetime of the cavern. Moreover, the calculated convergence volumes of the caverns at the point in time of the latest sonar measurement are given.

Table 2-1: Latest sonar measurements, calculated convergence volumes and cumulated deviations over all measurements for the caverns in Zuidwending

Cavern	Cavern Volume, measured (m³)	Deviation calculated-measured Volume, cumulated (m³)	Deviation calculated-measured Volume (-)	Convergence Volume, calculated (m³)	Deviation Convergence Volume (-)
ZW-1	4,283,568	7,273	0.2%	69,088	11%
ZW-2	4,185,895	13,940	0.3%	74,694	19%
ZW-3	4,577,555	14,891	0.3%	88,794	17%
ZW-4	3,551,800	15,256	0.4%	64,049	24%
ZW-5	4,754,615	15,997	0.3%	72,130	22%
ZW-6	4,559,874	45,467	1.0%	84,474	54%
ZW-7	4,517,013	2,877	0.1%	51,058	6%
ZW-8	3,304,553	3,176	0.1%	48,785	7%
ZW-9	2,645,799	11,436	0.4%	14,678	78%
A1	952,367	29,680	3.1%	13,066	227%
A2	566,072	1,410	0.2%	5,426	26%
A3	618,015	11,091	1.8%	10,814	103%
A4	551,067	1,758	0.3%	8,274	21%
A5	877,537	37,324	4.3%	13,113	285%
A6	579,490	96,230	16.6%	4,119	2,336%
A7	930,655	106,736	11.5%	58,484	183%

As can be seen, the cumulated deviation between calculated and measured cavern volumes is relatively low for most of the caverns and within the range of 0.1 – 0.4 %. It is not clear whether the deviations derive from inaccuracies within the production data base, the insoluble content, the convergence calculations or the sonar measurements. However, if it is assumed that the total deviation is only assigned to the calculation of the convergence volume, the average deviation in the convergence volume would be approx. 15 %.

For caverns ZW-6 and ZW-9, higher deviations are noticed. Generally, smaller cavern volumes are calculated than measured. This could be either due to an overvaluing of the convergence volume or due to an undervaluing of the mined cavern volume. Since the deviations mostly exist during the early leaching phase where production data is limited, it is assumed that the inaccuracy results from the production data.

It should generally be noticed that if higher deviations exist for one measurement, the cavern volume will be corrected based on the sonar measurement for following convergence calculations, so that the deviation is negated for the convergence calculations after the respective measurement.

For some of the gas caverns (A1 – A4 and A6 – A7), relatively high deviations exist. This was also noted during the leaching and the debrining phase of the caverns that the chemical volume or the debrining volume of the caverns often show deviations to the sonar measurements. A better indication for the in-situ creep ability of the salt around the gas caverns can be derived from the gas operation of the caverns than during the leaching phase.

With gas storage caverns or brine production caverns at standstill cavern volumes decrease over time. This decline can be directly related to creep of the surrounding rock salt mass. In Table 2-2 the cavern volumes and convergences volumes during the gas operations are listed.

It can be seen that for caverns A2, A4 and A6 the deviation between calculated and measured convergence volumes are relatively low. For the caverns A1, A3 and A7 higher deviations are noticed.

Since cavern A1 shows several backpockets, the accuracy of the sonar measurement can be expected to be too low to derive reliable information about the convergence volume over the short period of time the cavern is in gas operation. Furthermore, the measured convergence volume is based on one measurement in brine and one measurement in gas operation, which might not be directly comparable due to different sonic velocities within the different media.

The sonar measurements for A3 actually indicate a volume increase during the gas operation. Therefore, a direct information about the actual convergence volume is not available.

The chemical and the debrining volume of cavern A7 indicate that the cavern volume at the end of the leaching phase might be slightly lower than measured. In general, it can be stated that the available data are not suited to derive a reliable information about the convergence volume of cavern A7 during gas operations.

If focusing only on the gas caverns that are expected to give a sufficient indication for the actual in-situ creep ability of the salt around caverns A2, A4 and A6, inaccuracies for the convergence calculation can be expected to be in the range of up to 10 %.

Table 2-2: Deviations in convergence volume during gas operation

Cavern	Cavern Volume, measured, previous sonar (m³)	Cavern Volume, measured, latest sonar (m³)	Convergence volume, measured (m³)	Convergence Volume, calculated (m³)	Deviation Convergence Volume (-)
A1	956,555	953,416	3,138	4,188	33%
A2	570,078	565,782	4,296	4,006	7%
A3	580,548	581,712	-1,164	9,475	914%
A4	557,868	550,081	7,787	6,801	13%
A6	580,897	577,029	3,868	3,512	9%
A7	960,398	915,067	45,331	16,125	64%

The applied creep curve for the history matching is depicted in Figure 3-1 in red. As discussed, a sufficient accuracy can be achieved. This is also constituted by a good match between measured and calculated subsidence.

3 Conservative Convergence Calculation for Predictions

The onset and influence of the pressure solution creep was investigated by the Cavern Closure Consortium (CCC) for the salt dome in Zuidwending. Since a history matching in the lower stress region is only possible to a limited extent, for the prognosis of subsidence creep parameters determined by the CCC based on creep tests and microstructural investigations are utilized.

To account for linear and non-linear creep, the NORTON-HOFF power law has been applied with two branches [URAI & SPIERS 2007]:

$$\dot{\epsilon}_{eff} = \frac{b}{TD^3} \cdot \exp\left(-\frac{Q_1}{R \cdot T}\right) \cdot \left(\frac{\sigma_{eq}}{\sigma^*}\right)^{n_1} + A_2 \cdot \exp\left(-\frac{Q_2}{R \cdot T}\right) \cdot \left(\frac{\sigma_{eq}}{\sigma^*}\right)^{n_2}$$

Equation 2

with:

- $\dot{\epsilon}_{eff}$ creep rate (1/d)
- A_2 structural parameter (1/(d * MPaⁿ))
- Q_1 / Q_2 activation energy (kJ/mol)
- n_1 / n_2 stress exponent (-)
- R gas constant (kJ/mol/K)
- T rock mass temperature (K)

σ_{eq} effective von Mises stress (MPa)
 σ^* stress scaling factor = 1 MPa
 b structural parameter ($1/(d * \text{MPa}^n)$)
 D grain size (m)

The differences within the creep ability derived from the history matching process and the creep ability of the expected case (CCC) and the conservative case (CCC) are depicted in Figure 3-1.

The set of parameters provided for the expected case and the conservative case are also listed in

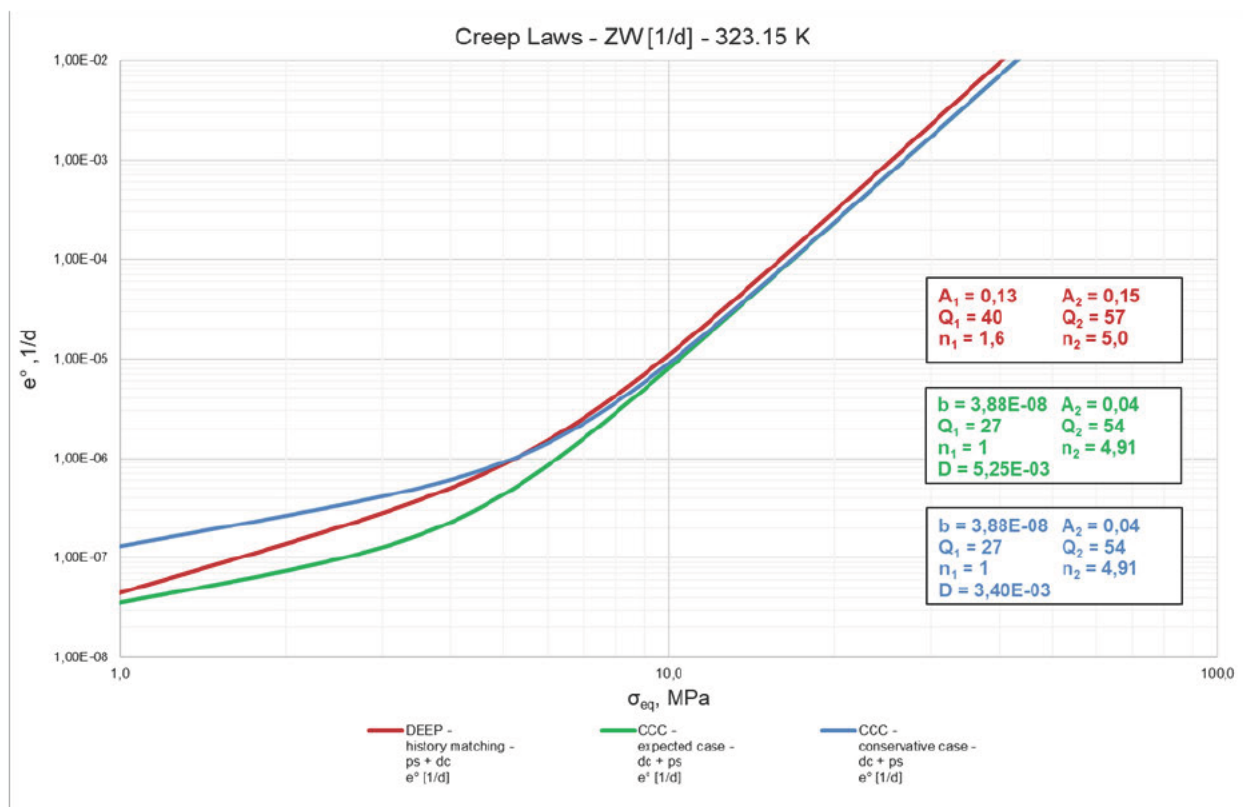


Figure 3-1: Comparison of applied creep abilities for the Zuidwending field at 323.15 K

Table 3-1: Creep parameters for the CCC - expected and CCC - conservative case

Parameter	Unit	CCC – expected case	CCC – conservative case
Q_1	kJ/mol	$3,251.6 \cdot R$	$3,251.6 \cdot R$
n_1	-	1	1
b/V_m	$\log_{10}(\text{MPa}^{-n} \text{ yr}^{-1})$	0.527	0.527
D	m	$5.25 \text{e-}3$	$3.4 \text{e-}3$
Q_2	kJ/mol	$6,445.1 \cdot R$	7066.754
n_2	-	4.91	5.858
A_2	$\log_{10}(\text{MPa}^{-n} \text{ yr}^{-1})$	1.20	$10^{1.311}$
V_m	-	$2.69 \text{e-}5$	$2.69 \text{e-}5$
R	kJ/mol/K	$8.3143 \text{E-}03$	$8.3143 \text{E-}03$

The calculation of the convergence is executed according to [BEREST ET AL, 2008], [VAN SAMBEEK & DIRIENZO 2016]:

$$\frac{\dot{V}}{V} = -\sqrt{3} \cdot \left[\frac{\sqrt{3}}{n_2} \cdot (P_\infty - P_i) \right]^{n_2} \cdot A_2 \cdot e^{\left(\frac{-Q_2}{R \cdot T} \right)} \cdot \left[1 + \frac{(n_2 - n_1)S}{\sqrt{3}(P_\infty - P_i)} \right]^{n_2}$$

Equation 3

with:	S	Transition from pressure solution creep to dislocation creep (MPa)
	A_2	structural parameter dislocation creep (1/(d * MPa ⁿ))
	Q_2	activation energy dislocation creep (kJ/mol)
	n_2	stress exponent dislocation creep (-)
	n_1	stress exponent pressure solution creep (-)

Within the equation, the convergence resulting from dislocation creep is multiplied by a factor which is dependent on the magnitude of the pressure solution creep. The magnitude is defined by the stress exponent n_2 as well as the parameter S, which is the stress level at which the transition between pressure solution dominant and dislocation dominant creep occurs. Equation 6 separates the rock mass surrounding the cavern in two parts, so that in dependence of the difference between P_∞ and P_i a stress distribution is calculated, in which pressure solution creep is dominant when $\sigma_{eq} < S$ and dislocation creep is dominant when $\sigma_{eq} > S$. Therefore, S represents in a creep curve the intersection point between the pressure solution and the dislocation creep. A comparison of the resulting convergence rates for the creep ability derived by history matching and the creep abilities determined by the CCC in dependence of the difference between the geostatic pressure and the internal cavern pressure are depicted in Figure 3-2.

As can be seen, the resulting convergence rates from the CCC parameters are significantly higher than derived from the history matching. Therefore, the applied parameters for the prediction of convergence can be considered as conservative. Within subsidence predictions this might result in quite significantly higher subsidence than it would be usually expected based on the existing field experience within the operational lifetime as well as in the post-operation phase.

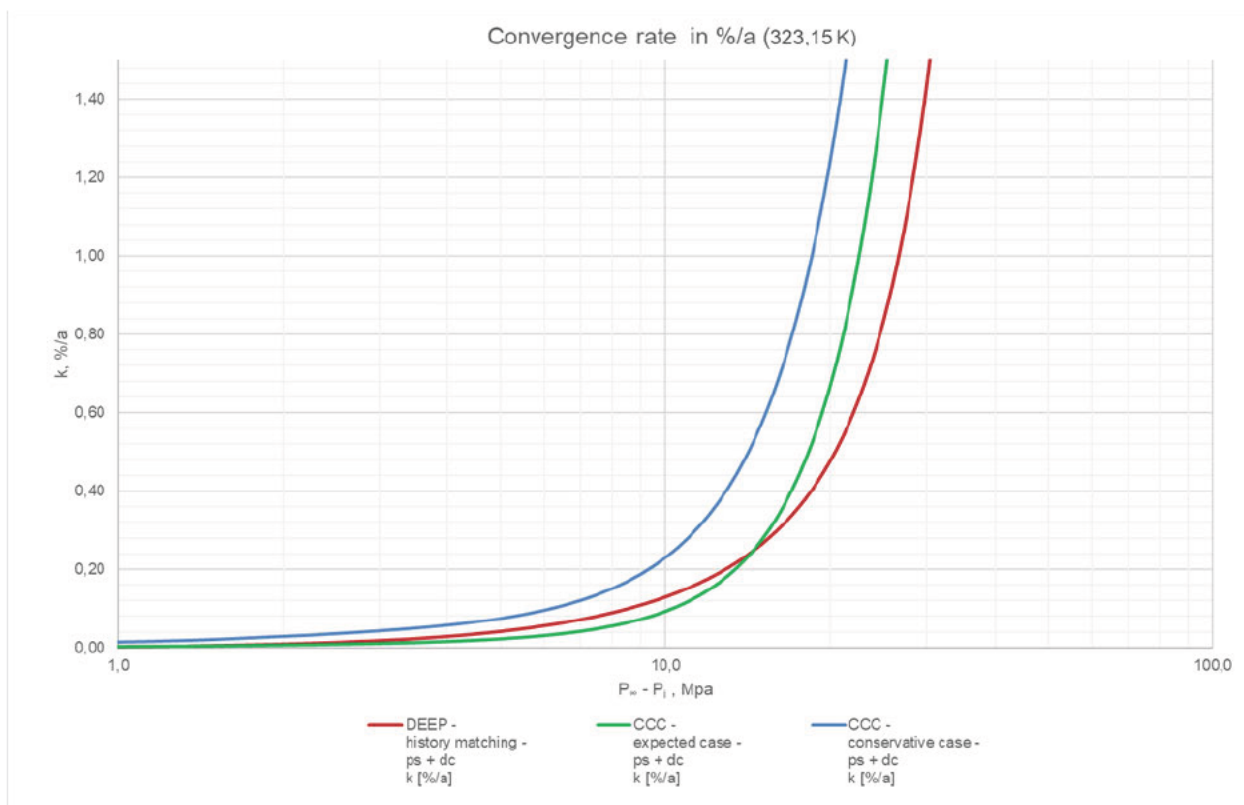


Figure 3-2: Comparison of the applied convergence rates for the Zuidwending field at 323.15 K

4 Calibration/Validation of Parameters for Surface Deformations

The validation of the DEEP.KBB subsidence model Zuidwending is based on the levelling campaign executed in 2020. In total, levelling measurements were executed at 115 benchmarks. At these points, the geodetic height was measured. For the validation process of the model, the measured geodetic height was set against the zero measurement at the benchmark. The difference between these values describes the subsidence at the respective benchmark point toward the zero measurement.

These subsidence values as deduced from the measurements were used for the validation of the subsidence due to cavern operations as calculated by the model.

In general, the subsidence consists of three main components:

- subsidence due to cavern operations
- subsidence due to gas production
- subsidence due to processes in the shallow subsurface

For the estimation of subsidence due to gas production, a subsidence prediction was carried out by Nederlandse Aardolie Maatschappij (NAM) in 2020 [NAM 2020]. The report provides interpreted contour maps of subsidence caused by gas production in the area investigated for 2018, 2030, 2050 and 2080. However, the contour lines were not available digitally and, therefore, had to be re-processed by DEEP.KBB. The generation of the data basis for gas production in 2020 is further described in Chapter 4.1.2.

The influence of subsidence due to natural effects was not considered in the model itself, since the effects differ locally to a high degree depending on the conditions of the benchmark points and the surface area and no detailed information was available in this regard. Therefore, natural effects were neglected at first for the validation of the modelled data, but were qualitatively considered in the interpretation of the measurement data and of the accuracy of the modelled subsidence due to cavern operations.

4.1.1 Correction of Levelling Database

The reference benchmark for the levelling campaign in 2020 is benchmark 012F0011. According to information provided by Nobian, the NAP of the reference benchmark has artificially been kept constant since 2005. This procedure was intended to allow for a differentiation between autonomous subsidence and subsidence due to mining operations. As in fact the reference benchmark has subsided since 2000 and all other benchmarks are measured in relation to the reference benchmark, the measured NAP values for all benchmarks since 2005 need to be corrected by the subsidence at the reference benchmark during this period.

The corrections with regard to NAP were provided by Nobian for the respective levelling campaigns and are displayed in Table 4-1.

Table 4-1: Correction of the results of the levelling campaigns between 2005 and 2020

Year	Correction of NAP (mm)
2005	-11
2011	-7
2016	-11
2020	-15

4.1.2 Generation of Database 2020 for Subsidence due to Gas Production

For the estimation of the surface subsidence due to gas production, subsidence values were used as provided by [NAM 2020] by maps of isokatabases for the years 2018, 2030, 2050 and 2080. Since these maps were not available in a digitally workable form, the maps had to be digitized. Thereby, the following step-by-step procedure was applied:

- Geo-referencing of the existing maps of NAM to the RD New coordinate system (WKID 28992)
- Digitizing of isokatabases from the maps for 2018, 2030, 2050 and 2080
- Rasterizing of isokatabases using Triangulated Irregular Network (TIN)
- Transforming grid values to the benchmarks of the levelling campaign as carried out at Zuidwending in 2020

After execution of this procedure, the subsidence values due to gas production were available at the benchmark coordinates for three different points in time. Since data for 2020 were not explicitly generated, the database for the end of 2020 and later points in time was produced by linear interpolation.

4.1.3 Generation of Database 2020 due to Cavern Operations

The predicted subsidence due to cavern operations at the end of 2020 was calculated using the DEEP.KBB subsidence model.

4.1.4 Superposition of Subsidence due to Cavern Operations and Gas Production (representative Database)

In order to ensure comparability between measurement and modelling data, the subsidence values due to cavern operations as well as due to gas production had to be shifted to the same reference date at the respective benchmark.

The subsidence values, as calculated from levelling data, are relative data, representing the change in geodetic height of a benchmark since the previous respective point in time of measurement. The first measurement represents the zero measurement for a benchmark, meaning that the measured subsidence at this point in time equals zero. The overall amount of subsidence since the zero measurement until the end of 2020 is then compiled for every individual benchmark.

Since the point in time of the zero measurement differs, the modelled subsidence values at a benchmark need to be corrected by the amount of subsidence generated before the zero measurement to create a common point of reference. Especially, considering the subsidence generated by gas production, this potentially results in inaccuracies caused by interpolation.

For the superposition, subsidence values due to gas production and due to cavern operation will be added up and validated by comparing with the measured subsidence values.

5 Validation of Subsidence Model

5.1 Calibration/Validation

In order to validate the subsidence model of the cavern field in Zuidwending, the calculated subsidence values are compared with the measured subsidence values in Enclosure 1.

Three consecutive steps, as described in the following, were executed for the validation of the subsidence model:

Step 1: Validation of the measured values at benchmarks

In the first step, the measurement results itself were evaluated. In relation thereto, it should be stated that, in general, mining operation (gas production and cavern operation) will generate subsidence, while natural effects can cause either subsidence (e.g. due to ground compaction) or lifting (e.g. due to water management).

Since the natural effects are highly dependent on the surface conditions and the surface behaviour as well as on the specific conditions of the respective benchmark, it is not possible to define a value for the natural impact, which would be representative in general for the area investigated.

From a geomechanical point of view with regard to cavern operations, surface lifting cannot be explained. Therefore, the benchmark points, which indicate lifting, are not suited to validate the subsidence model for cavern operations and will be neglected in the validation process.

Measured subsidence values are not corrected by natural effects in this study. This can be seen as a conservative approach, since it is expected that natural effects would cause subsidence. Thus, by considering the observed subsidence as subsidence from gas production and cavern operation will lead to a prediction of higher subsidence due to these operational impacts.

Step 2: Validation of NAM data

The next step consisted of comparing the subsidence induced by gas production to the measured values. As explained before, the NAM data were digitized and shifted in time to the reference measurement of the respective benchmark to enable comparability.

Especially in the north-eastern part of the investigation area, mostly located outside the area, in which subsidence due to cavern operations is expected, subsidence explicitly caused by gas production exceeds the measured values. Therefore, these benchmark points will be neglected in the validation process. This does not generally mean that the data base for gas production is inaccurate, but that a calibration of cavern-induced subsidence at these benchmark points is not possible.

The benchmark points, which are neglected because of the data base for gas production, are displayed in Figure 5-1 (in blue).

Step 3: Calibration of cavern-induced subsidence

For the calibration of the model, 72 representative benchmarks were elected for evaluation.

As a conservative approach, the modelled subsidence has been primarily fitted to represent the development of maximum subsidence due to cavern operations. In the calibration process the angle of draw for the salt dome and the non-salt rock mass were kept equal, at first. This corresponds to the approach by [SROKA ET AL. 1982]. As a first evaluation criterion, the average error in subsidence between the calculated values and the measured values for the levelling campaigns in 2016 and 2020 was chosen.

The best fit could be achieved with an angle of draw of 30° considering a decrease of the angle of draw by 10° in 40 years. However, the best fit in the center of the subsidence bowl could be achieved with an angle of draw of 31°. Based on this angle of draw, the angle of draw for the salt dome β_s and the non-salt rock mass β_n were varied to check if a better fit could be achieved.

The results are shown in Enclosure 2 and summarized in Table 5-1. The best fit was achieved with an angle of draw of 29 ° for the salt dome and of 33 ° for the non-salt rock mass.

Step 4: Validation of cavern-induced subsidence

In the three previous steps, the database for the validation process of the DEEP.KBB subsidence model was compiled by eliminating misleading data. The remaining suitable benchmarks for validation are displayed in Figure 5-1 (in green).

For validation, the overall subsidence values (gas production and cavern operations) are compared with the measured values. The subsidence values due to gas production are considered as invariable, while it was the aim of the calibration/validation process to adjust the subsidence due to cavern operations to achieve the best match between modelling and measurement results.

The evaluation process applied statistical parameters and a visual evaluation of the course of subsidence over time. Considering all 99 benchmark points, the average difference between calculated and measured subsidence at the end of the year 2020 amounts to approx. 8 mm, which can be seen as a relatively low value considering that the 99 points, which were classified as suitable for the validation process, are widely distributed over the investigation area. Furthermore, this value has to be set in perspective to the validation process, since, as explained before, an evaluation of the respective benchmark conditions and natural effects was not carried out beforehand and has to be executed qualitatively for different parts of the investigation area.

Moreover, the absolute difference between measured and modelled subsidence is only partly suited to validate the subsidence model, because the measurement periods at the benchmarks vary.

In order to establish a common validation parameter, the calculated overall subsidence rate (mm/a) as well as the difference/error to the measured subsidence rate at the respective benchmark since the beginning of the measurement was calculated (see Enclosure 1).

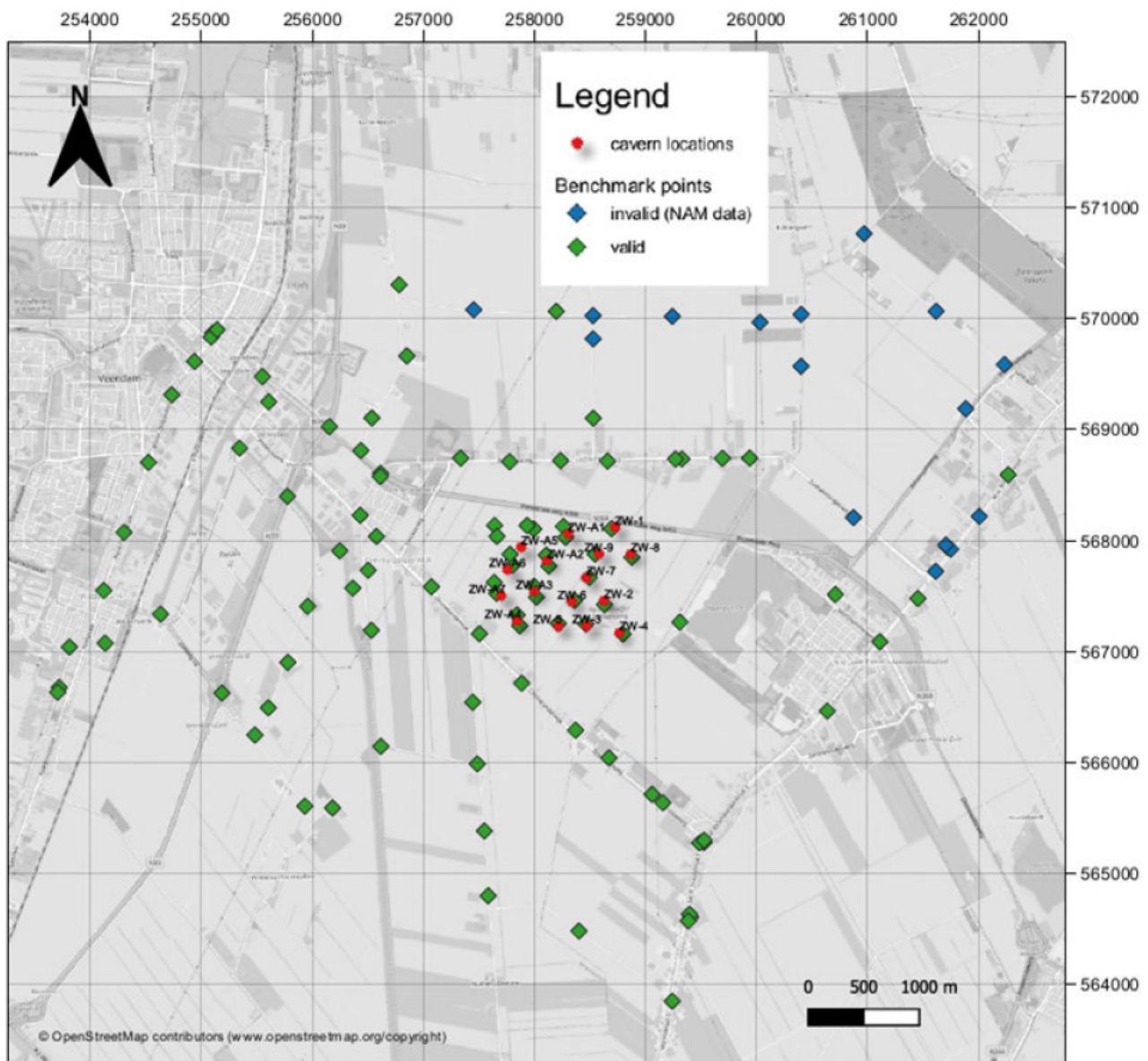


Figure 5-1: Validation of Benchmark Points in Zuidwending

Table 5-1: Calibration of the angle of draw for 72 representative benchmarks

Angle of draw (salt dome) in °	Angle of draw (non-salt rock mass) in °	Average deviation subsidence (measured – calculated) in m	Ranking
30	30	0.0096	2
31	31	0.0098	7
32	32	0.0107	10
33	33	0.0120	11
28	32	0.0098	6
29	33	0.0095	1
30	32	0.0096	3

Angle of draw (salt dome) in °	Angle of draw (non-salt rock mass) in °	Average deviation subsidence (measured – calculated) in m	Ranking
30	35	0.0101	9
29	35	0.0097	4
30	34	0.0099	8
30	33	0.0097	5

The benchmark points were then categorized according to the following principle:

very good	Difference between measurement and prediction up to 0.5 mm/a
good	Difference between measurement and prediction up to 1.0 mm/a
bad	Difference between measurement and prediction greater than 1.0 mm/a

Out of the 99 investigated benchmarks, 71 indicate a very good match, 12 indicate a good match, while 16 indicate a bad match. The local distribution of the benchmarks is displayed in Figure 5-2. As can be seen, very good as well as good modelling results are achieved in all regions of the investigation area.

In Enclosure 3, the course of the modelled subsidence evolution based on the history matching is given for the selected benchmarks. Measured subsidence values are depicted in red dots. Subsidence values due to other mining activities are depicted in orange dots. The light green line depicts the subsidence induced by gas storage caverns and the dark green line subsidence due to brine production caverns. The dark blue line depicts the subsidence due to all caverns since the start of the leaching of the first cavern in the field, while the grey line depicts the subsidence generated since the zero measurement of the respective benchmark. The yellow dots show the superposition of subsidence due to cavern operations and other mining activities. These values can be compared to the red dots and should approximately show an equal development over time.

Visual evaluation showed that the applied subsidence model enables a good prediction of the actual subsidence evolution above the Zuidwending cavern field. The centre of the subsidence bowl is calculated very accurately, as can be seen for example at Benchmarks 012F3210, 012F3500, 012F13600, 012F3700 and 012F6201. However, it has to be noted that the course of modelled subsidence development over the last approx. 15 years is slightly steeper than measured, especially in the centre of the subsidence bowl. From a modelling point of view, this could be due to two reasons: Either the convergence volume during the respective period has been overvalued or the (development of the) angle of draw, which represents the transmission behaviour of convergence volume to surface, is too steep.

Since the calculation of the convergence volume was validated against the sonar measurements and showed a good match, it is not expected that convergence volumes were overvalued over the recent years.

On the other hand, the applied angle of draw amounts to a value of 29° to 33°, depending on the azimuthal direction. Furthermore, a decrease of the angle of draw, as proposed by [ZANDER 2007], of 10° per 40 years, was considered. Based on empirical values for the angle of draw from locations in Northern Europe, the angle of draw generally varies between 25° and 40° for salt domes. Therefore, the considered angle of draw can already be considered as flat (minimum approx. 20°) and a further flattening of the angle of draw could not be justified based on observations.

Furthermore, the peripheral areas in north direction (012F5012 or 012F5102) or in western direction (012F0140, 012F0200, 012F0213 or 012F5607) are modelled sufficiently well, showing that the applied model defines the borders of the subsidence bowl caused by cavern operations to an adequate extent.

Also, in the southern area (e.g. 012F0213 or 012F5623) and the eastern area (e.g. 013A0056 or 013A0254), the calculated subsidence values show a sufficient match with the measured values.

Moreover, benchmarks, where obviously substantial subsidence due to natural effects occurred, can be identified. As an example, Benchmark 012F0122 can be named. The measured subsidence value significantly exceeds the measurements at other benchmarks close-by. This cannot be explained through mining operations. Therefore, this benchmark was not considered as representative for subsidence due to mining/cavern operations.

Conclusively, it can be stated that the applied DEEP.KBB subsidence model describes the actual subsidence bowl due to cavern operations sufficiently well and can, therefore, be used to predict the evolution of the subsidence bowl in the Zuidwending cavern field area.

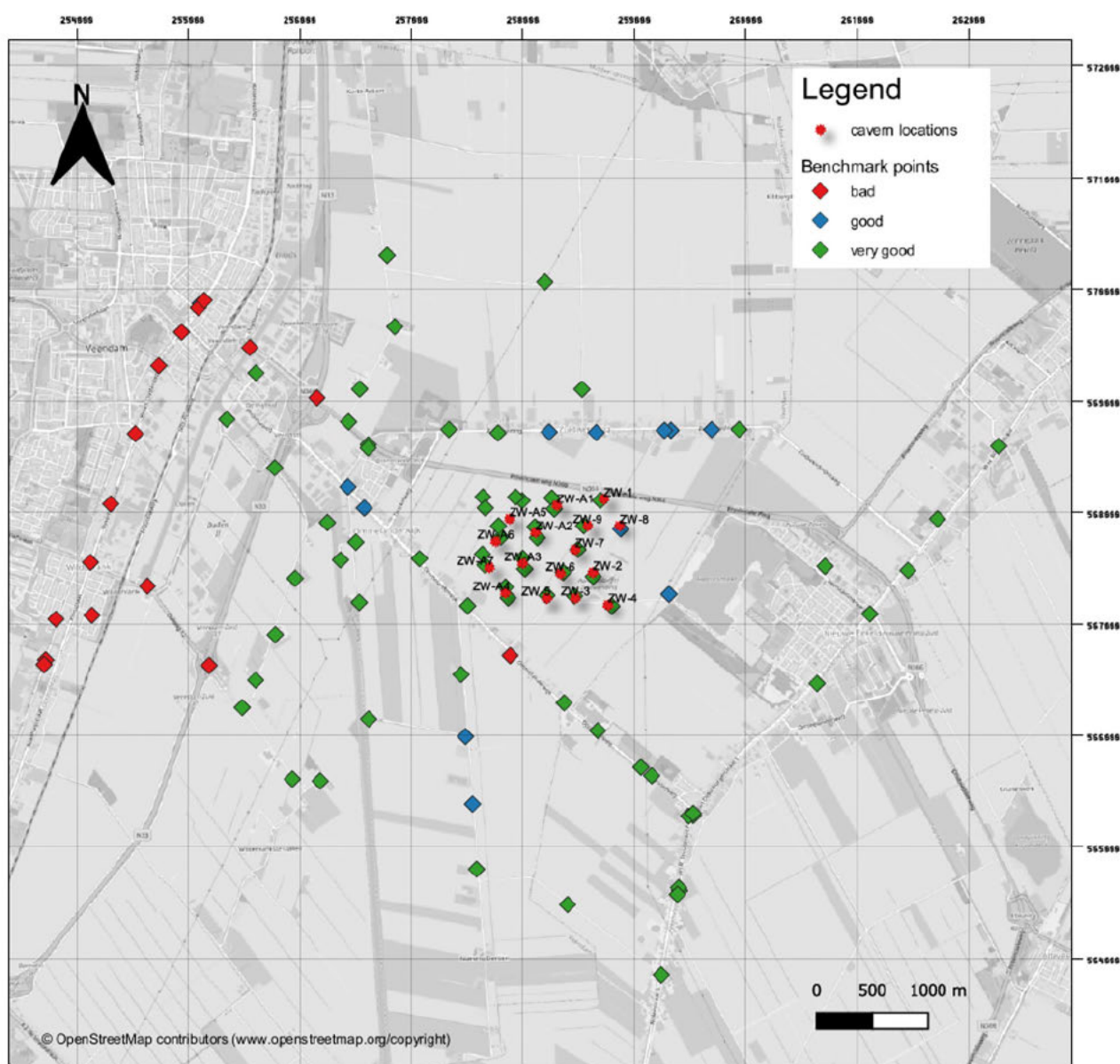


Figure 5-2: Validation of Subsidence Model Zuidwending on Benchmark Points

5.2 Discussion of Uncertainties

In the process of subsidence modelling, different sources contribute as uncertainties and might result in inaccuracies of the model. These might originate from:

- Inaccuracies in the subsidence model
- Inaccuracies of levelling measurements

In general, every model represents a simplification of the reality. Therefore, differences within modelled and measured errors occur. That is why a history matching to validate the modelling approach and to evaluate the model accuracy is of high importance also to provide a sound model basis for future predictions. Within the history matching process, a sufficient fit between modelled and measured values can be achieved. However, this fit implies that model and measurement do not perfectly match.

Furthermore, also levelling measurements involve certain accuracies. Tolerances for levelling measurements are generally dependent on the length of the levelling line. Standard deviations for a single levelling measurement can usually be expected to be in the range of 0 – 5 mm.

To account for these inaccuracies, a conservative approach for the subsidence model has been developed for the prediction of subsidence. This conservative approach mainly consists of two applied measures:

- The investigation of an expected and a conservative creep ability based on an investigation by the CCC.
- The contribution of subsidence due to natural effects and ground water production to subsidence due to cavern operations.

Since the subsidence model is fitted based on the calibrated/validated convergence volumes from part 1 of the subsidence model, the applied conservatism therein can also be directly transferred to part 2 of the subsidence model. The investigation of an expected and a conservative creep ability represents a range for the convergence results. Generally, the convergence based on these creep abilities is higher than within the history matching and the convergence resulting from the conservative creep ability represents an upper limit for resulting convergence based on microstructural investigations. The increase in creep ability ultimately results also in increased subsidence considering a specific point in time before total convergence, while also representing an upper limit for subsidence.

The second conservative assumption included in the model is that subsidence due to natural effects and due to water management are accounted towards subsidence due to cavern operations. In the Netherlands, subsidence due to natural effects is caused mainly by compaction, postglacial isostasy and tectonics [KOOI ET AL 1998]. For example, in the Wadden Sea, the natural subsidence is estimated to be in the range of up to 1 mm/a [FOKKER 2018].

For the Zuidwending/Heiligerlee cavern fields, natural subsidence rates of 0.33 mm/a have been assumed in the past [PÖTTGENS, 1973], while in Heiligerlee additionally subsidence due groundwater production until 1996 for cavern leaching contributed to the overall subsidence.

When applying the rate of 0.33 mm/a to the timespan of 51 years since the first levelling measurement in the Zuidwending area, the influence of natural effects of subsidence would amount to approx. 17 mm. Related to the matched maximum subsidence of 93 mm, this amounts to approx. 18% and would cover inaccuracies due to levelling errors and is also in the range of uncertainties implied by convergence calculations. It has to be stated, that these values for natural subsidence rates have not been validated and shall only be used to show the potential influence on the results of the subsidence model by the neglect of subsidence due to natural effects.

6 Cavern life cycle

The previous validation of the subsidence model required an update of the data base describing cavern operations. In this regard the following data were updated until December 19, 2021:

- daily values of produced mass of salt from each salt production cavern (ZW-1 to ZW-9 and A5)
- daily 06:00 wellhead pressures of the gas storage caverns (ZW-A1 to ZW-A4 and ZW-A6 and ZW-A7)
- sonar survey data

The location of the existing caverns is illustrated in red, of the planned caverns in yellow in Figure 6-1.

The data about produced mass of salt were derived from production data distributed by Nobian. Wellhead pressures for the gas storage caverns were provided by Gasunie. The up-to-dateness of the sonar measurements were checked with Nobian and Gasunie.

The future operational data of the brine production caverns were updated based on the production planning provided by Nobian. The future course of wellhead pressure versus time of the gas caverns was assumed as provided by Gasunie.

During the history matching process a wellhead brine pressure of 20 bars was assumed for the leaching process. For further predictions, it is conservatively assumed that the wellhead brine pressure amounts to 2 bars.

For the post-operation phase, two different scenarios have been considered:

- hard shut-in
- soft shut-in

While the soft shut-in starts directly after the end of production, a waiting time to approach the thermal equilibrium is considered before the caverns will be plugged in the hard shut-in scenario. For the brine production caverns, a waiting time of 30 years is considered. For the gas storage caverns, a waiting time of 10 years is considered. After this waiting period, the technical abandonment will take place within 1 to 2 years. At the end of this technical abandonment period, the cavern is considered to be under halmostatic pressure for one month.

With regard to the gas storage caverns owned by Gasunie, it is assumed that the existing caverns will be repurposed for hydrogen storage and will be in operation until 2100. Furthermore, cavern A5, which is currently filled with brine, is assumed to go into hydrogen operation in the year 2028 and will be in operation until 2080.

The respective points in time for the operational scenario and the final cavern volumes based on the expected creep ability at the end of production for the Nobian caverns are given in Table 6-1.

The respective points in time for the operational scenario for the existing Gasunie caverns are given in Table 6-2.

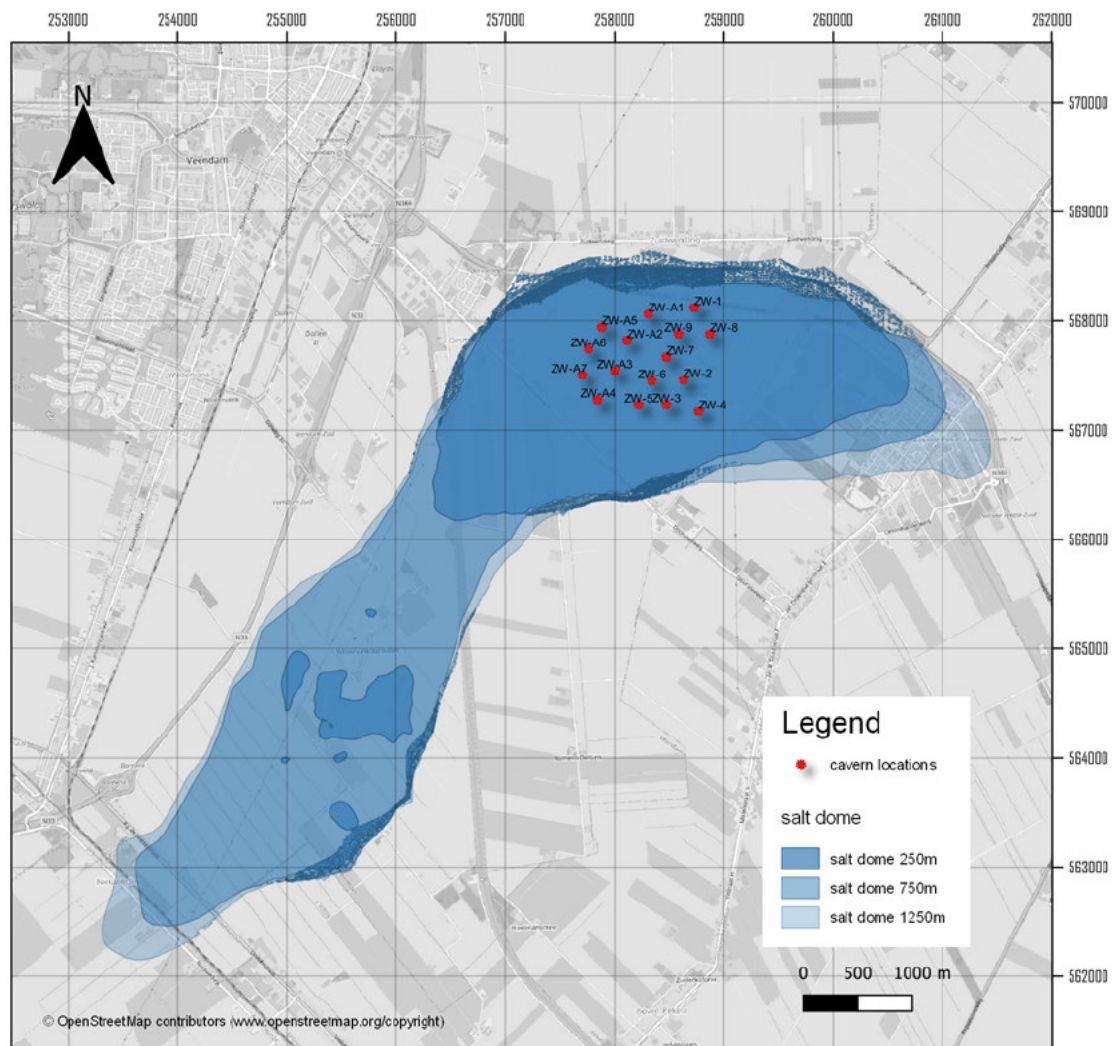


Figure 6-1: Overview field configuration Zuidwending

Table 6-1: Operational scenario for the brine production caverns owned by Nobian

Cavern	End of production (year)	Final cavern volume (m ³)	Time of plugging in hard shut-in scenario (year)
ZW-1	2020	4,595,839	2052
ZW-2	2040	6,532,513	2072
ZW-3	2040	6,360,606	2072
ZW-4	2040	5,324,665	2072
ZW-5	2040	6,728,715	2072
ZW-6	2040	5,594,298	2072
ZW-7	2040	6,409,957	2072
ZW-8	2040	3,340,213	2072
ZW-9	2040	4,761,384	2072

Table 6-2: Operational scenario for the gas storage caverns owned by Gasunie

Cavern	Start of natural gas operation	Start of hydrogen operation	End of storage operation	Time of plugging in hard shut-in scenario (year)
A1	2020	2037	2100	2112
A2	2010	2037	2100	2112
A3	2010	2037	2100	2112
A4	2010	2037	2100	2112
A5	-	2028	2080	2093
A6	2010	2037	2100	2112
A7	2013	2037	2100	2112

List of References

- [BEREST ET AL, 2008] Bérest, P., Brouard, B. & Karimi-Jafari (2008)
'THE EFFECT OF SMALL DEVIATORIC STRESS ON CAVERN BEHAVIOR'.
Galveston: SMRI Fall Meeting.
- [BRÜCKNER, 2009] Brückner, D., (2009)
'Rock Mechanical Investigations on Rock Salt from the Zuidwending Gas Storage Site', Leipzig, Germany: Institut für Gebirgsmechanik GmbH.
- [BRÜCKNER, 2012] Brückner, D., (2012)
'Rock Mechanical Investigations on Rock Salt from the Zuidwending Gas Storage Site – Phase II', Leipzig, Germany: Institut für Gebirgsmechanik GmbH.
- [FOKKER 2018] Fokker, P. A., Van Leijen, F. J., Orlic, B., Van Der Marel, H., & Hanssen, R. F. (2018).
'Subsidence in the Dutch Wadden Sea'. Netherlands Journal of Geosciences, 97(3), 129-181.
- [KOOI ET AL 1998] Kooi, H., Johnston, P., Lambeck, K., Smither, C. & Molendijk, R. (1998)
'Geological causes of recent (~100 yr) vertical land movement in the Netherlands'. Tectonophysics 299: 297–316.
- [LANGER, 1991] Langer, M., (1991)
'Ermittlung und Beurteilung des gebirgsmechanischen Verhaltens des Zechsteinsalzes im Feld Zuidwending', Hannover
- [NAM 2020] Nederlandse Aardolie Maatschappij (2020):
'Statusrapport 2020 en Prognose tot het jaar 2080 - Bodemdaling door Aardgaswinning - NAM-gasvelden in Groningen, Friesland en het noorden van Drenthe'.
- [PÖTTGENS, 1973] Pöttgens, J.J.E. (1973)
'Bodemdaling zoetwinning concessie "Adolf van Nassau". (Vertrouwelijk rapport) Heerlen, 14 februari 1973, Staatstoezicht op de Mijnen
- [SROKA & SCHÖBER 1982] Sroka, A., Schöber, F. (1982):
'Die Berechnung der maximalen Bodenbewegung über kavernenartigen Hohlräumen unter Berücksichtigung der Hohlraumgeometrie', Kali und Steinsalz, 1982.
- [URAI & SPIERS 2007] Urai, J., & Spiers, C. (2007).
'The effect of grain boundary water on deformation mechanisms and rheology' The Mechanical Behavior of Salt - 6th Conference (SaltMech6), Hannover.
- [VAN SAMBEEK & DIRIENZO 2016] Van Sambeek, L., DiRienzo, A. (2016)
'Analytical Solutions for Stress Distributions and Creep Closure Around Open-Holes or Caverns Using Multilinear Segmented Creep Laws', Salzburg: SMRI Fall Meeting
- [ZANDER 2007] Zander-Schiebenhöfer, D. (2007):
'Kriechverhalten von Salzgestein in der Umgebung von Kavernenfeldern', Dissertation, Fakultät für Bauingenieurwesen und Geodäsie, Gottfried Wilhelm Leibniz Universität, Hannover, 2007.

**Subsidence Modell Zuidwending
Evaluation after Measurement 2020**

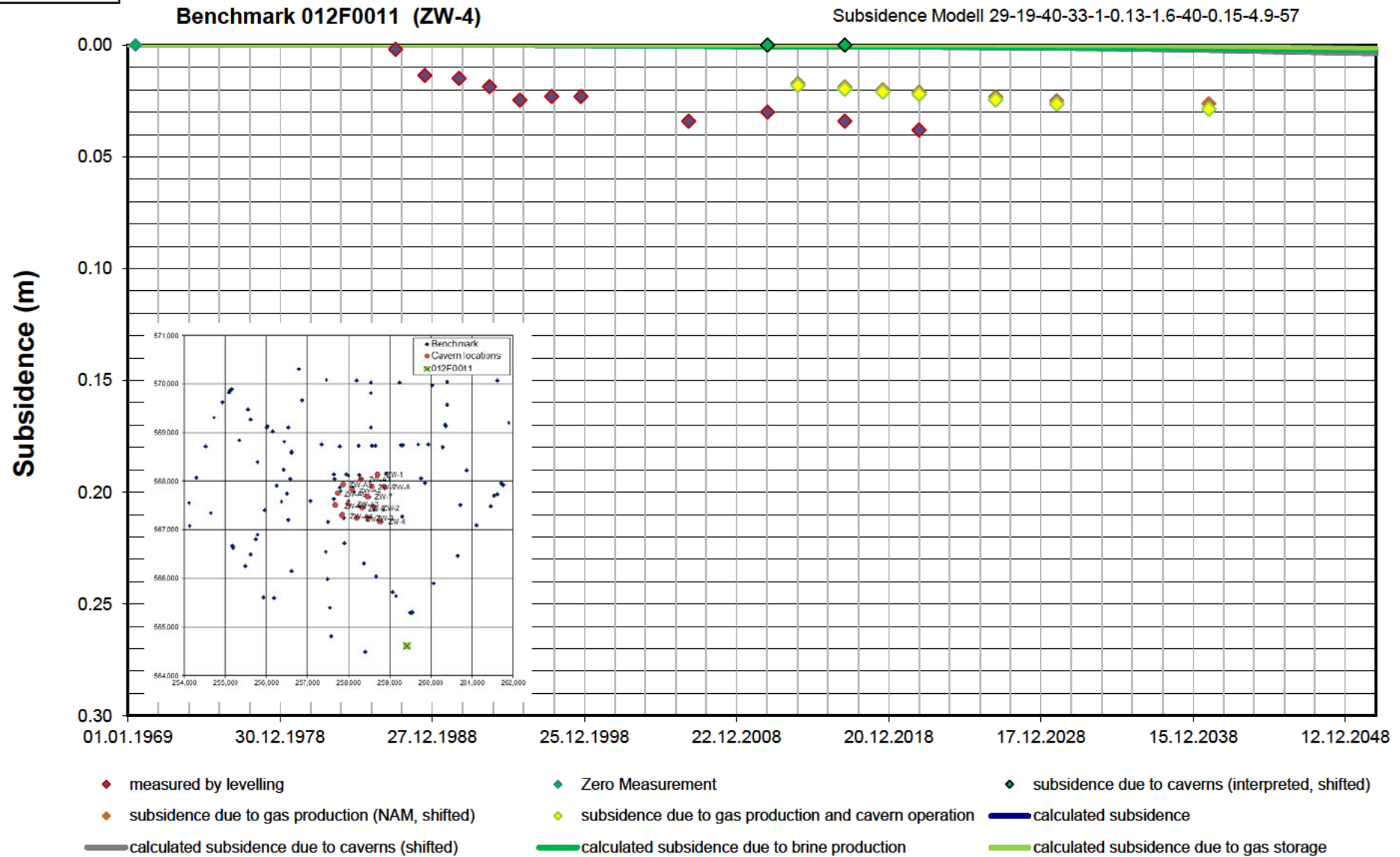
Benchmark	X	Y	modelled subsidence 2020, gas production NAM (m)	modelled subsidence 2020, caverns (m)	modelled subsidence 2020, mining operations (m)	measured subsidence 2020 (m)	measured lifting?	modelled subsidence due to gas production higher than measured subsidence?	Evaluation	Error (mm/a)	Quality
012F0011	258407.7	564608.4	0.0210	0.0010	0.0221	0.0380	no	no	valid	0.31	very good
012F0021	258372.2	566292.0	0.0450	0.0459	0.0909	0.1134	no	no	valid	0.44	very good
012F0030	254524.7	568705.3	0.0089	0.0000	0.0089	0.0320	no	no	valid	2.32	bad
012F0033	256432.0	568229.4	0.0759	0.0154	0.0913	0.1254	no	no	valid	0.66	good
012F0034	256578.5	568038.8	0.0509	0.0204	0.0713	0.0928	no	no	valid	0.59	good
012F0037	257337.4	568743.7	0.0718	0.0295	0.1013	0.1210	no	no	valid	0.38	very good
012F0042	255106.2	569872.4	0.0928	0.0001	0.0929	0.1215	no	no	valid	0.56	good
012F0107	255604.4	566494.6	0.0139	0.0015	0.0154	0.0201	no	no	valid	0.31	very good
012F0108	255959.1	567408.5	0.0172	0.0049	0.0220	0.0225	no	no	valid	0.03	very good
012F0114	256852.2	569664.7	0.0345	0.0029	0.0375	0.0395	no	no	valid	0.09	very good
012F0116	254735.0	569315.3	0.0095	0.0000	0.0095	0.0336	no	no	valid	2.42	bad
012F0120	257585.6	564800.5	0.0125	0.0019	0.0144	0.0222	no	no	valid	0.35	very good
012F0122	257887.4	566715.3	0.0472	0.0628	0.1100	0.1605	no	no	valid	1.09	bad
012F0140	257073.9	567584.5	0.0661	0.0466	0.1127	0.1257	no	no	valid	0.25	very good
012F0143	259329.8	568736.2	0.0334	0.0232	0.0567	0.0374	no	no	valid	0.87	good
012F0149	258198.2	570067.2	0.0553	0.0038	0.0591	0.0611	no	no	valid	0.06	very good
012F0174	254135.3	567077.4	0.0055	0.0000	0.0055	0.0181	no	no	valid	1.27	bad
012F0175	255607.6	569250.9	0.0221	0.0004	0.0225	0.0262	no	no	valid	0.24	very good
012F0194	259530.4	565280.9	0.0174	0.0038	0.0212	0.0178	no	no	valid	0.13	very good
012F0195	259060.9	565714.3	0.0197	0.0122	0.0319	0.0333	no	no	valid	0.05	very good
012F0198	255780.2	566903.8	0.0168	0.0030	0.0198	0.0197	no	no	valid	0.00	very good
012F0200	256614.5	568606.4	0.0316	0.0111	0.0427	0.0499	no	no	valid	0.32	very good
012F0206	258237.8	568721.0	0.0680	0.0472	0.1153	0.1459	no	no	valid	0.60	good
012F0207	259940.9	568744.4	0.0340	0.0132	0.0471	0.0366	no	no	valid	0.48	very good
012F0208	259695.3	568742.8	0.0338	0.0170	0.0509	0.0344	no	no	valid	0.74	good
012F0209	259272.5	568735.1	0.0334	0.0242	0.0576	0.0390	no	no	valid	0.84	good
012F0211	259243.4	563851.3	0.0068	0.0001	0.0068	0.0120	no	no	valid	0.23	very good
012F0212	258672.8	566043.3	0.0406	0.0317	0.0723	0.0969	no	no	valid	0.48	very good
012F0213	259157.7	565639.3	0.0336	0.0132	0.0468	0.0547	no	no	valid	0.15	very good
012F0214	259488.9	565276.5	0.0191	0.0043	0.0234	0.0279	no	no	valid	0.15	very good
012F0215	259530.5	565300.9	0.0184	0.0041	0.0226	0.0274	no	no	valid	0.17	very good
012F0217	255346.2	568833.9	0.0214	0.0004	0.0218	0.0270	no	no	valid	0.34	very good
012F0218	255775.8	568399.7	0.0205	0.0021	0.0226	0.0295	no	no	valid	0.46	very good
012F0221	254940.1	569615.6	0.0106	0.0000	0.0106	0.0312	no	no	valid	2.06	bad
012F0229	254304.6	568075.5	0.0052	0.0000	0.0052	0.0279	no	no	valid	2.28	bad
012F0233	257506.8	567162.0	0.0110	0.0295	0.0404	0.0398	no	no	valid	0.06	very good
012F0234	254122.4	567551.3	0.0041	0.0000	0.0041	0.0214	no	no	valid	1.74	bad
012F0235	254633.7	567338.8	0.0071	0.0001	0.0072	0.0187	no	no	valid	1.16	bad
012F0243	255551.7	569478.7	0.0131	0.0001	0.0132	0.0238	no	no	valid	1.06	bad
012F0244	253812.6	567042.4	0.0041	0.0000	0.0041	0.0188	no	no	valid	1.48	bad
012F0245	258659.8	568716.1	0.0183	0.0194	0.0377	0.0291	no	no	valid	0.86	good
012F0253	255186.7	566627.8	-0.0020	0.0003	-0.0018	0.0056	no	no	valid	1.52	bad
012F0255	256154.2	569027.8	0.0044	0.0009	0.0053	0.0116	no	no	valid	1.29	bad
012F3100	258696.6	568108.3	0.0611	0.0774	0.1386	0.1235	no	no	valid	0.29	very good
012F3210	258633.0	567424.7	0.0555	0.0901	0.1455	0.1436	no	no	valid	0.04	very good
012F3310	258465.6	567248.8	0.0260	0.0578	0.0838	0.0759	no	no	valid	0.35	very good
012F3400	258800.0	567159.1	0.0516	0.0813	0.1329	0.1251	no	no	valid	0.15	very good
012F3500	258217.1	567255.0	0.0561	0.0887	0.1448	0.1510	no	no	valid	0.12	very good
012F3600	258363.4	567462.2	0.0572	0.0924	0.1496	0.1632	no	no	valid	0.26	very good
012F3700	258496.3	567667.8	0.0583	0.0916	0.1499	0.1488	no	no	valid	0.02	very good
012F3800	258879.3	567850.7	0.0373	0.0636	0.1009	0.0817	no	no	valid	0.63	good
012F3900	258547.5	567879.6	0.0397	0.0723	0.1120	0.1019	no	no	valid	0.31	very good
012F5012	257778.5	568712.1	0.0693	0.0416	0.1109	0.1267	no	no	valid	0.31	very good
012F5044	259312.6	567265.8	0.0296	0.0459	0.0755	0.0494	no	no	valid	0.99	good
012F5101	256613.2	568577.9	0.0764	0.0151	0.0915	0.1081	no	no	valid	0.32	very good
012F5102	258532.0	569104.2	0.0703	0.0285	0.0988	0.0920	no	no	valid	0.13	very good
012F5603	258531.0	569819.2	0.0373	0.0053	0.0426	0.0349	no	yes	invalid	-	-
012F5604	257455.0	570080.5	0.0380	0.0021	0.0401	0.0361	no	yes	invalid	-	-
012F5605	256783.3	570306.6	0.0369	0.0006	0.0375	0.0380	no	no	valid	0.02	very good
012F5606	256537.7	569105.5	0.0330	0.0052	0.0382	0.0418	no	no	valid	0.16	very good
012F5607	256503.5	567732.9	0.0283	0.0162	0.0444	0.0468	no	no	valid	0.11	very good
012F5608	256533.1	567192.6	0.0266	0.0169	0.0435	0.0393	no	no	valid	0.19	very good
012F5609	256617.8	566147.3	0.0209	0.0091	0.0300	0.0319	no	no	valid	0.08	very good
012F5610	258402.6	564482.8	0.0110	0.0009	0.0119	0.0160	no	no	valid	0.19	very good
012F5613	256437.8	568812.0	0.0210	0.0050	0.0259	0.0244	no	no	valid	0.10	very good
012F5614	258529.6	570028.5	0.0284	0.0022	0.0306	0.0214	no	yes	invalid	-	-
012F5615	259244.2	570021.3	0.0293	0.0018	0.0311	0.0209	no	yes	invalid	-	-
012F5616	256365.8	567572.6	0.0179	0.0104	0.0283	0.0279	no	no	valid	0.03	very good
012F5619	256247.8	567908.9	0.0184	0.0077	0.0261	0.0295	no	no	valid	0.22	very good
012F5620	256183.0	565592.0	0.0103	0.0015	0.0118	0.0116	no	no	valid	0.01	very good
012F5621	255483.8	566248.9	0.0129	0.0009	0.0138	0.0151	no	no	valid	0.08	very good
012F5622	255934.1	565608.9	0.0104	0.0010	0.0114	0.0120	no	no	valid	0.04	very good
012F5623	257446.1	566545.3	0.0142	0.0244	0.0386	0.0352	no	no	valid	0.23	very good
012F5651	255090.3	569835.8	0.0114	0.0000	0.0114	0.0306	no	no	valid	1.93	bad
012F5652	255143.1	569901.5	0.0116	0.0000	0.0116	0.0306	no	no	valid	1.91	bad
012F5658	253720.6	566676.9	0.0050	0.0000	0.0050	0.0166	no	no	valid	1.16	bad
012F5659	253706.2	566635.2	0.0052	0.0000	0.0052	0.0165	no	no	valid	1.14	bad
012F5662	257486.9	565989.1	0.0069	0.0095	0.0164	0.0226	no	no	valid	0.63	good
012F5663	257550.1	565384.3	0.0060	0.0031	0.0091	0.0145	no	no	valid	0.55	good
012F5664	258399.1	564633.9	0.0049	0.0002	0.0051	0.0074	no	no	valid	0.23	very good
012F5665	258388.2	564574.5	0.0043	0.0002	0.0045	0.0078	no	no	valid	0.33	very good
012F6100	258262.0	568128.8	0.0154	0.0346	0.0500	0.0482	no	no	valid	0.18	very good
012F6101	258282.9	568030.0	0.0155	0.0364	0.0518	0.0508	no	no	valid	0.10	very good
012F6200	258109.4	567869.8	0.0144	0.0382	0.0526	0.0527	no	no	valid	0.01	very good
012F6201	258131.6	567771.4	0.0143	0.0393	0.0536	0.0538	no	no	valid	0.02	very good
012F6300	257999.1	567589.8	0.0134	0.0392	0.0526	0.0506	no	no	valid	0.20	very good
012F6301	258020.2	567491.9	0.0134	0.0393	0.0527	0.0498	no	no	valid	0.29	very good
012F6400	257845.8	567331.2	0.0127	0.0365	0.0492	0.0466	no	no	valid	0.26	very good
012F6401	257869.2	567232.8	0.0121	0.0359	0.0480	0.0455	no	no	valid	0.25	very good
012F6500	257995.9	568104.4	0.0145	0.0339	0.0484	0.0512	no	no	valid	0.29	very good
012F6501	257935.9	568137.2	0.0142	0.0328	0.0470	0.0509	no	no	valid	0.39	very good
012F6600	257805.2	567779.0	0.0133	0.0360	0.0494	0.0508	no	no	valid	0.14	very good
012F6601	257782.5	567878.0	0.0133	0.0348	0.0481	0.0500	no	no	valid	0.19	very good
012F6700	257660.4	567526.8	0.0129	0.0345	0.0475	0.0476	no	no	valid	0.01	very good
012F6701	257638.5	567625.5	0.0130	0.0340	0.0470	0.0486	no	no	valid	0.16	very good
012F6800	257642.7	568138.1	0.0133	0.0289	0.0422	0.0459	no	no	valid	0.37	very good
012F6801	257664.2	568039.4	0.0133	0.0308	0.0441	0.0478	no	no	valid	0.37	very good
013A0046	260640.5	566465.7	0.0375	0.0077	0.0453	0.0708	no	no	valid	0.50	very good
013A0056	261455.9	567479.3	0.0345	0.0026	0.0371	0.0419	no	no	valid	0.14	very good

Subsidence Modell Zuidwending
Calibration of the angle of draw

Benchmark	X	Y	Error (m) - 1 $\beta_x = 30^\circ, \beta_y = 30^\circ$	Error (m) - 2 $\beta_x = 31^\circ, \beta_y = 31^\circ$	Error (m) - 3 $\beta_x = 32^\circ, \beta_y = 32^\circ$	Error (m) - 4 $\beta_x = 33^\circ, \beta_y = 33^\circ$	Error (m) - 5 $\beta_x = 28^\circ, \beta_y = 32^\circ$	Error (m) - 6 $\beta_x = 29^\circ, \beta_y = 33^\circ$	Error (m) - 7 $\beta_x = 30^\circ, \beta_y = 32^\circ$	Error (m) - 8 $\beta_x = 30^\circ, \beta_y = 35^\circ$	Error (m) - 9 $\beta_x = 29^\circ, \beta_y = 35^\circ$	Error (m) - 10 $\beta_x = 30^\circ, \beta_y = 34^\circ$	Error (m) - 11 $\beta_x = 30^\circ, \beta_y = 33^\circ$
012F0011	259407.7	564608.4	0.0143	0.0148	0.0151	0.0154	0.0148	0.0151	0.0149	0.0155	0.0155	0.0154	0.0152
012F0021	258372.2	566292.0	0.0204	0.0188	0.0175	0.0164	0.0238	0.0223	0.0205	0.0214	0.0230	0.0210	0.0207
012F0030	254524.7	568705.3	0.0157	0.0157	0.0158	0.0158	0.0157	0.0158	0.0158	0.0158	0.0158	0.0158	0.0158
012F0033	256432.0	568229.4	0.0343	0.0355	0.0366	0.0378	0.0316	0.0328	0.0341	0.0341	0.0328	0.0341	0.0341
012F0034	256578.5	568038.8	0.0218	0.0228	0.0239	0.0250	0.0191	0.0200	0.0214	0.0209	0.0197	0.0211	0.0212
012F0037	257337.4	568743.7	0.0186	0.0193	0.0202	0.0213	0.0181	0.0184	0.0186	0.0191	0.0189	0.0189	0.0187
012F0042	255106.2	569872.4	0.0230	0.0230	0.0230	0.0230	0.0229	0.0230	0.0230	0.0230	0.0230	0.0230	0.0230
012F0107	256804.4	566494.6	0.0039	0.0041	0.0043	0.0045	0.0033	0.0036	0.0039	0.0039	0.0037	0.0039	0.0039
012F0108	255959.1	567408.5	0.0009	0.0010	0.0011	0.0014	0.0010	0.0008	0.0009	0.0010	0.0009	0.0010	0.0010
012F0116	254735.0	569315.3	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167	0.0167
012F0122	257887.4	566715.3	0.0503	0.0470	0.0439	0.0410	0.0520	0.0488	0.0478	0.0448	0.0469	0.0458	0.0468
012F0140	257073.9	567584.5	0.0162	0.0156	0.0153	0.0154	0.0136	0.0129	0.0142	0.0116	0.0110	0.0124	0.0133
012F0174	254135.3	567077.4	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066	0.0066
012F0175	255607.6	569250.9	0.0027	0.0027	0.0028	0.0028	0.0027	0.0027	0.0027	0.0028	0.0028	0.0028	0.0028
012F0200	256614.5	569606.4	0.0062	0.0069	0.0077	0.0085	0.0050	0.0057	0.0063	0.0066	0.0060	0.0065	0.0064
012F0206	258237.8	568721.0	0.0282	0.0268	0.0257	0.0249	0.0313	0.0299	0.0281	0.0290	0.0306	0.0286	0.0283
012F0212	258672.8	566043.3	0.0209	0.0206	0.0207	0.0210	0.0242	0.0240	0.0223	0.0250	0.0258	0.0240	0.0231
012F0213	259157.7	565639.3	0.0052	0.0062	0.0073	0.0084	0.0074	0.0082	0.0072	0.0101	0.0101	0.0091	0.0082
012F0217	255346.2	568833.9	0.0026	0.0027	0.0027	0.0027	0.0026	0.0027	0.0027	0.0027	0.0027	0.0027	0.0027
012F0218	256775.8	568399.7	0.0051	0.0054	0.0057	0.0059	0.0047	0.0051	0.0053	0.0055	0.0052	0.0054	0.0053
012F0221	254940.1	569615.6	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142	0.0142
012F0229	254304.6	568075.5	0.0155	0.0155	0.0155	0.0155	0.0155	0.0155	0.0155	0.0155	0.0155	0.0155	0.0155
012F0233	257506.8	567162.0	0.0013	0.0003	0.0008	0.0018	0.0009	0.0005	0.0004	0.0018	0.0014	0.0012	0.0006
012F0234	254122.4	567551.3	0.0116	0.0116	0.0116	0.0116	0.0116	0.0116	0.0116	0.0116	0.0116	0.0116	0.0116
012F0235	254633.7	567338.8	0.0060	0.0060	0.0061	0.0061	0.0060	0.0060	0.0060	0.0061	0.0061	0.0061	0.0061
012F0243	255551.7	569478.7	0.0077	0.0078	0.0078	0.0078	0.0077	0.0078	0.0078	0.0078	0.0078	0.0078	0.0078
012F0244	253812.6	567042.4	0.0095	0.0095	0.0095	0.0095	0.0095	0.0095	0.0095	0.0095	0.0095	0.0095	0.0095
012F0245	258659.8	568716.1	0.0074	0.0078	0.0081	0.0082	0.0065	0.0068	0.0073	0.0069	0.0065	0.0071	0.0072
012F0253	255186.7	566627.8	0.0059	0.0060	0.0060	0.0060	0.0059	0.0059	0.0059	0.0060	0.0059	0.0059	0.0059
012F0255	256154.2	569027.8	0.0040	0.0040	0.0041	0.0042	0.0039	0.0040	0.0040	0.0041	0.0041	0.0041	0.0041
012F3100	258996.6	568108.3	0.0096	0.0152	0.0208	0.0285	0.0053	0.0104	0.0128	0.0168	0.0129	0.0155	0.0142
012F3210	258633.0	567424.7	0.0039	0.0047	0.0126	0.0211	0.0091	0.0042	0.0044	0.0068	0.0047	0.0050	0.0047
012F3310	258465.6	567248.8	0.0038	0.0085	0.0135	0.0186	0.0024	0.0047	0.0065	0.0101	0.0070	0.0090	0.0078
012F3400	258800.0	567159.1	0.0043	0.0089	0.0155	0.0222	0.0039	0.0045	0.0060	0.0106	0.0063	0.0092	0.0077
012F3500	258217.1	567255.0	0.0097	0.0027	0.0054	0.0134	0.0149	0.0084	0.0055	0.0032	0.0046	0.0029	0.0035
012F3600	258363.4	567462.2	0.0176	0.0095	0.0044	0.0079	0.0234	0.0164	0.0131	0.0070	0.0124	0.0090	0.0110
012F3700	258496.3	567667.8	0.0041	0.0046	0.0122	0.0209	0.0099	0.0040	0.0062	0.0046	0.0048	0.0048	0.0046
012F3800	258879.3	567850.7	0.0128	0.0176	0.0226	0.0276	0.0097	0.0141	0.0158	0.0199	0.0167	0.0186	0.0172
012F3900	258547.5	567879.6	0.0054	0.0114	0.0176	0.0241	0.0030	0.0064	0.0088	0.0133	0.0092	0.0119	0.0104
012F5012	257778.5	568712.1	0.0142	0.0137	0.0135	0.0137	0.0154	0.0146	0.0139	0.0142	0.0149	0.0140	0.0139
012F5044	259312.6	567265.8	0.0241	0.0269	0.0295	0.0320	0.0234	0.0261	0.0265	0.0296	0.0281	0.0287	0.0276
012F5101	256613.2	568577.9	0.0165	0.0177	0.0189	0.0201	0.0145	0.0156	0.0166	0.0168	0.0158	0.0167	0.0166
012F5102	258532.0	569104.2	0.0084	0.0082	0.0077	0.0069	0.0057	0.0056	0.0071	0.0044	0.0037	0.0054	0.0062
012F5607	256503.5	567732.9	0.0027	0.0034	0.0041	0.0049	0.0009	0.0014	0.0024	0.0020	0.0011	0.0021	0.0022
012F5616	256365.8	567572.6	0.0006	0.0007	0.0011	0.0016	0.0014	0.0008	0.0006	0.0006	0.0009	0.0006	0.0006
012F5619	256247.8	567908.9	0.0031	0.0036	0.0041	0.0047	0.0020	0.0026	0.0031	0.0033	0.0027	0.0032	0.0032
012F5623	257446.1	566545.3	0.0022	0.0025	0.0027	0.0027	0.0030	0.0034	0.0030	0.0040	0.0041	0.0037	0.0034
012F5651	255090.3	569835.8	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136
012F5652	255143.1	569901.5	0.0135	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136	0.0136
012F5658	253720.6	566676.9	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073	0.0073
012F5659	253706.2	566635.2	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072	0.0072
012F5662	257486.9	565989.1	0.0057	0.0060	0.0064	0.0068	0.0053	0.0055	0.0057	0.0059	0.0057	0.0058	0.0058
012F5663	257550.1	565384.3	0.0043	0.0046	0.0050	0.0053	0.0042	0.0045	0.0045	0.0049	0.0048	0.0048	0.0047
012F6100	258262.0	568128.8	0.0016	0.0023	0.0033	0.0053	0.0018	0.0018	0.0020	0.0026	0.0022	0.0024	0.0022
012F6101	258282.9	568030.0	0.0011	0.0019	0.0033	0.0056	0.0023	0.0014	0.0016	0.0023	0.0018	0.0021	0.0019
012F6200	258109.4	567869.8	0.0017	0.0011	0.0031	0.0055	0.0029	0.0007	0.0008	0.0022	0.0011	0.0015	0.0011
012F6201	258131.6	567771.4	0.0015	0.0010	0.0036	0.0062	0.0028	0.0005	0.0005	0.0026	0.0011	0.0018	0.0010
012F6300	257999.1	567589.8	0.0007	0.0022	0.0047	0.0073	0.0013	0.0011	0.0015	0.0040	0.0025	0.0032	0.0023
012F6301	258020.2	567491.9	0.0007	0.0032	0.0058	0.0084	0.0004	0.0018	0.0025	0.0049	0.0035	0.0041	0.0033
012F6400	257845.8	567331.2	0.0005	0.0026	0.0047	0.0068	0.0002	0.0017	0.0021	0.0044	0.0033	0.0037	0.0029
012F6401	257869.2	567232.8	0.0009	0.0029	0.0049	0.0070	0.0003	0.0021	0.0025	0.0047	0.0035	0.0039	0.0032
012F6500	257995.9	568104.4	0.0042	0.0024	0.0015	0.0021	0.0050	0.0034	0.0029	0.0013	0.0023	0.0017	0.0023
012F6501	257935.9	568137.2	0.0039	0.0023	0.0007	0.0008	0.0046	0.0031	0.0027	0.0011	0.0021	0.0016	0.0021
012F6600	257805.2	567779.0	0.0024	0.0004	0.0002	0.0003	0.0030	0.0011	0.0008	0.0014	0.0003	0.0007	0.0001
012F6601	257782.5	567878.0	0.0029	0.0011	0.0007	0.0007	0.0034	0.0017	0.0014	0.0007	0.0003	0.0004	0.0007
012F6700	257660.4	567526.8	0.0019	0.0005	0.0015	0.0033	0.0021	0.0005	0.0004	0.0018	0.0010	0.0011	0.0007
012F6701	257638.5	567625.5	0.0031	0.0015	0.0008	0.0018	0.0033	0.0017	0.0016	0.0009	0.0006	0.0007	0.0009
012F6800	257642.7	568138.1	0.0040	0.0029	0.0019	0.0009	0.0042	0.0031	0.0029	0.0016	0.0022	0.0020	0.0025
012F6801	257664.2	568039.4	0.0042	0.0029	0.0017	0.0005	0.0045	0.0032	0.0030	0.0014	0.0022	0.0020	0.0025
013A0046	260640.5	566465.7	0.0266	0.0275	0.0284	0.0293	0.0251	0.0261	0.0268	0.0272	0.0265	0.0271	0.0269
013A0058	261721.7	567941.5	0.0250	0.0252	0.0254	0.0256	0.0241	0.0245	0.0249	0.0249	0.0245	0.0249	0.0249
013A0065	262269.6	568593.5	0.0161	0.0									

Deviation
0.0151

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

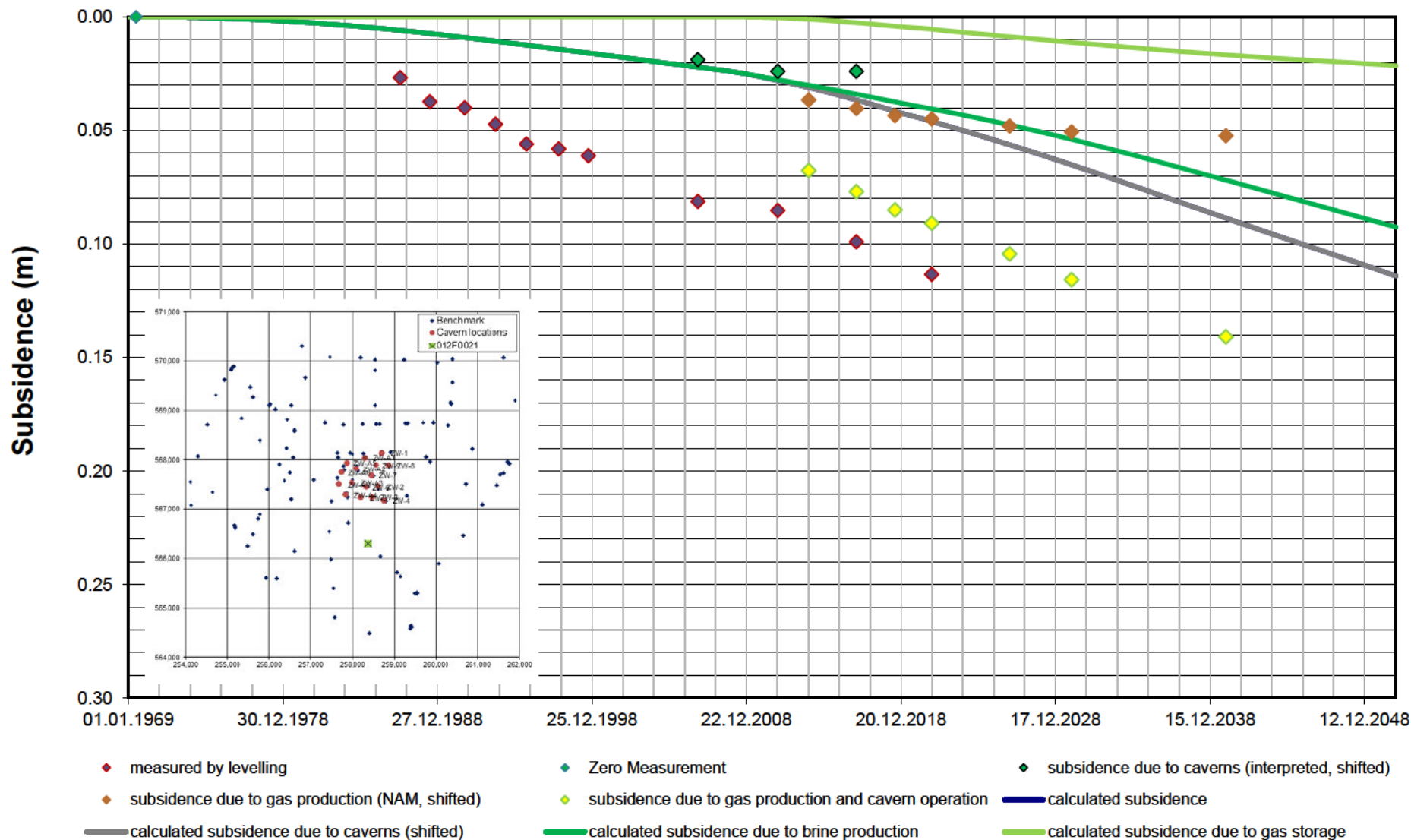


Deviation
0.0223

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0021 (ZW-3)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

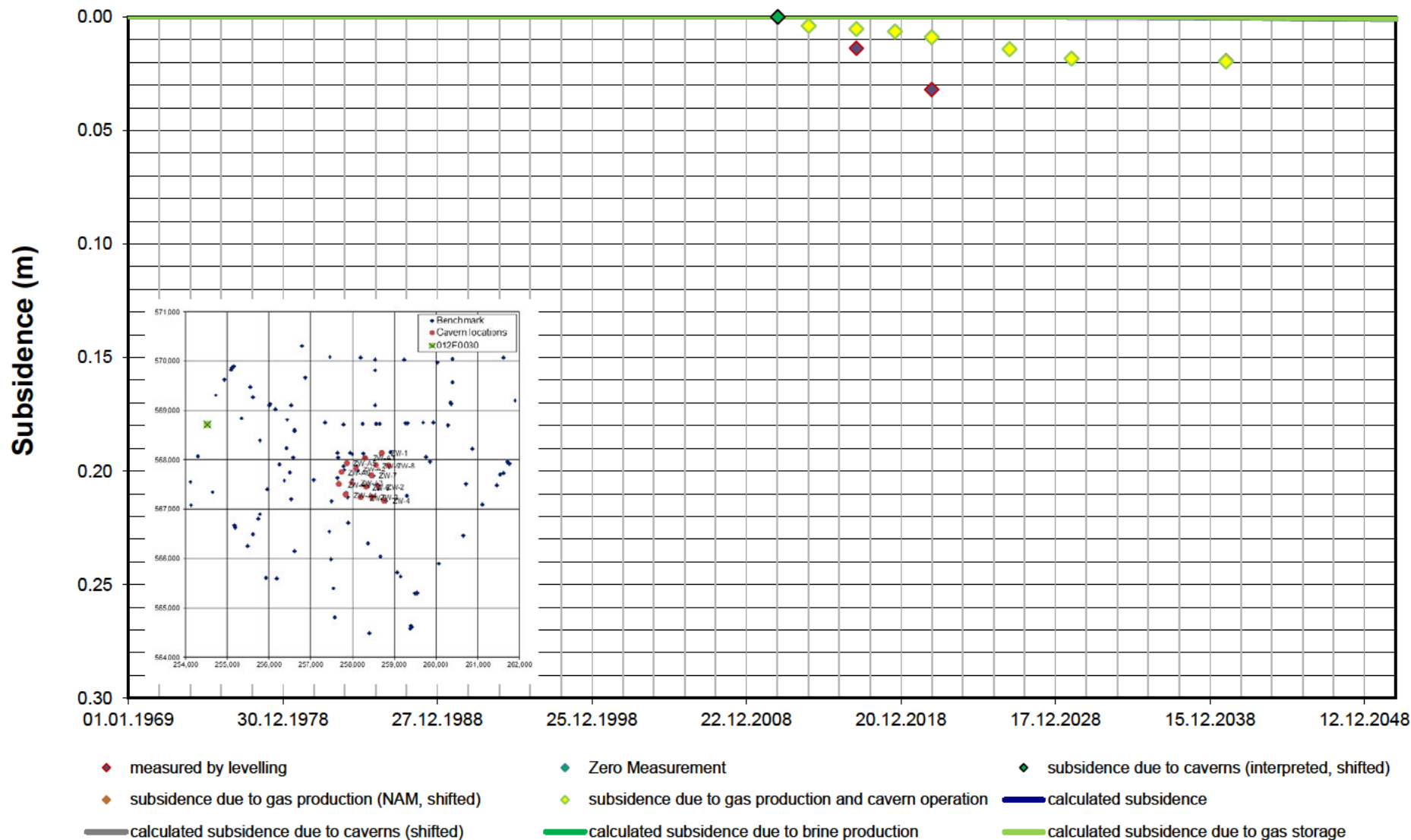


Deviation
0.0158

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0030 (ZW-A6)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

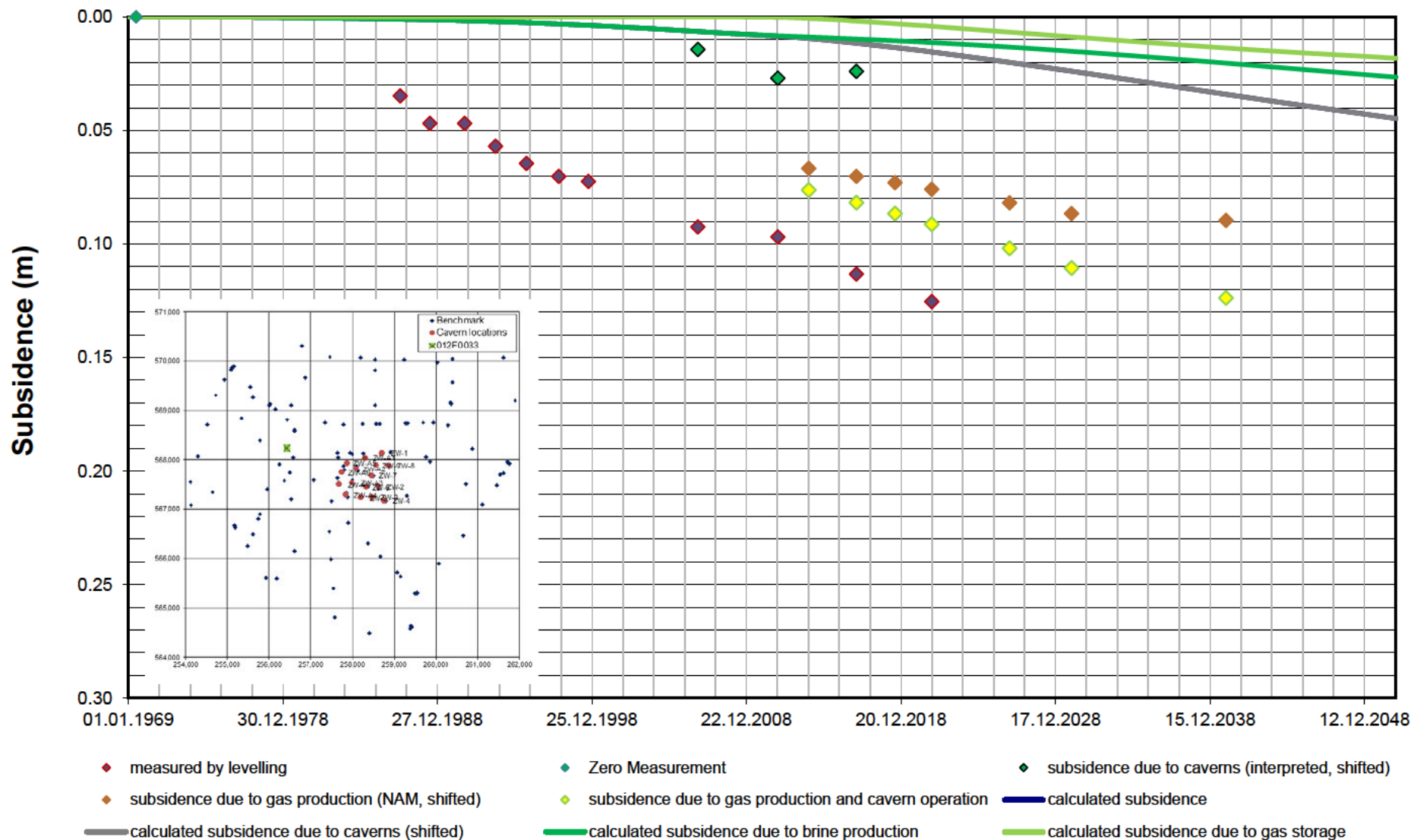


Deviation
0.0328

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0033 (ZW-A6)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

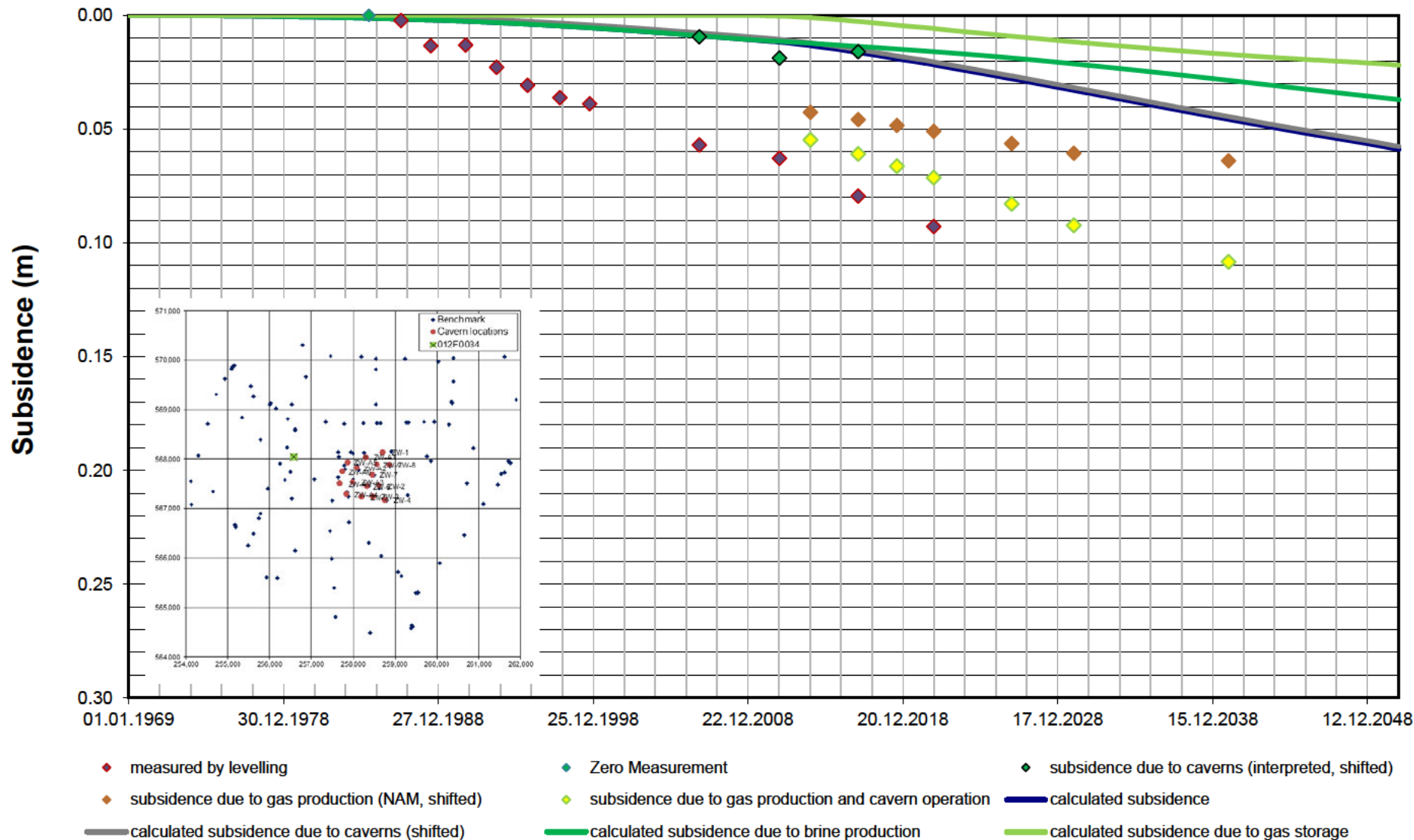


Deviation
0.0200

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0034 (ZW-A6)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

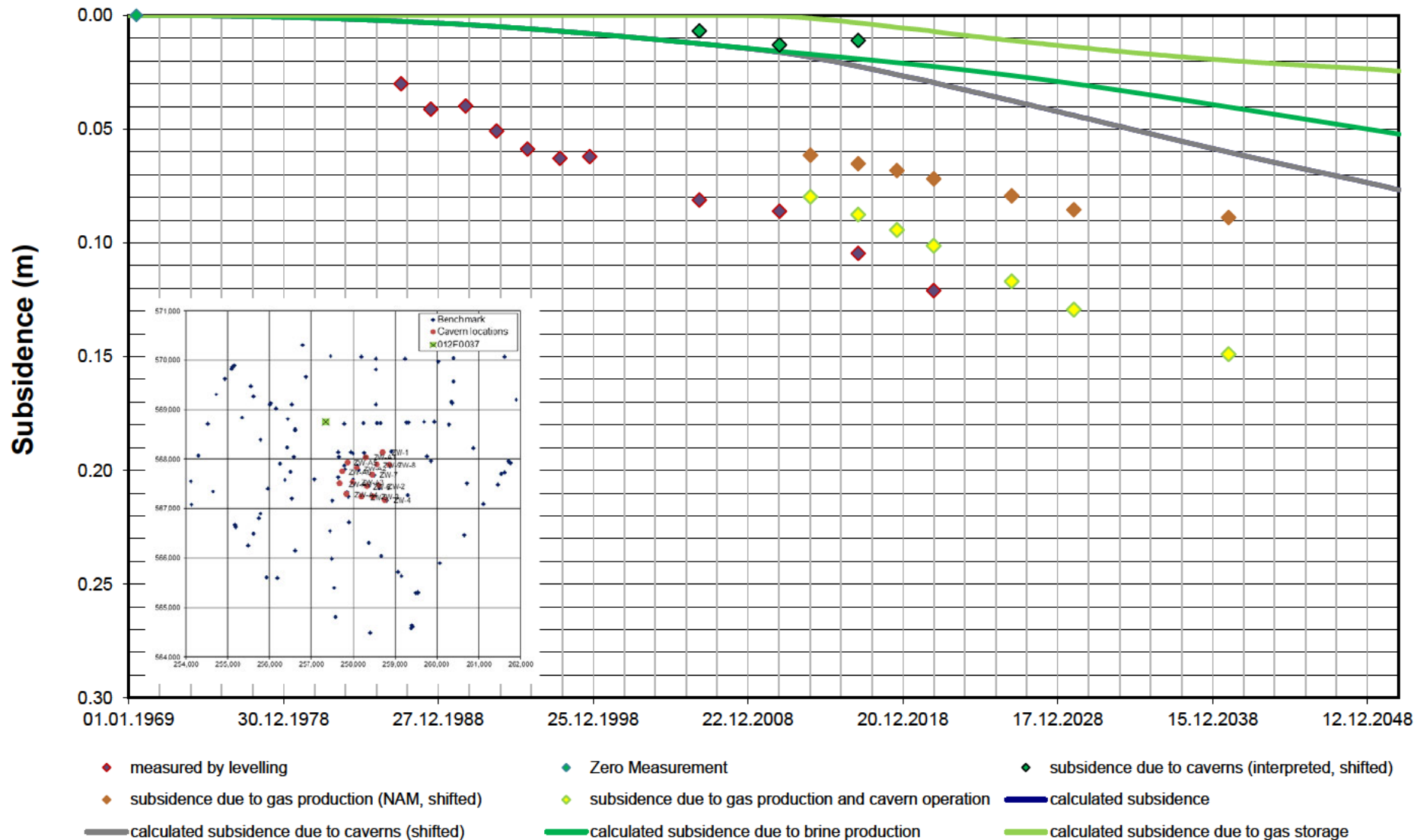


Deviation
0.0184

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

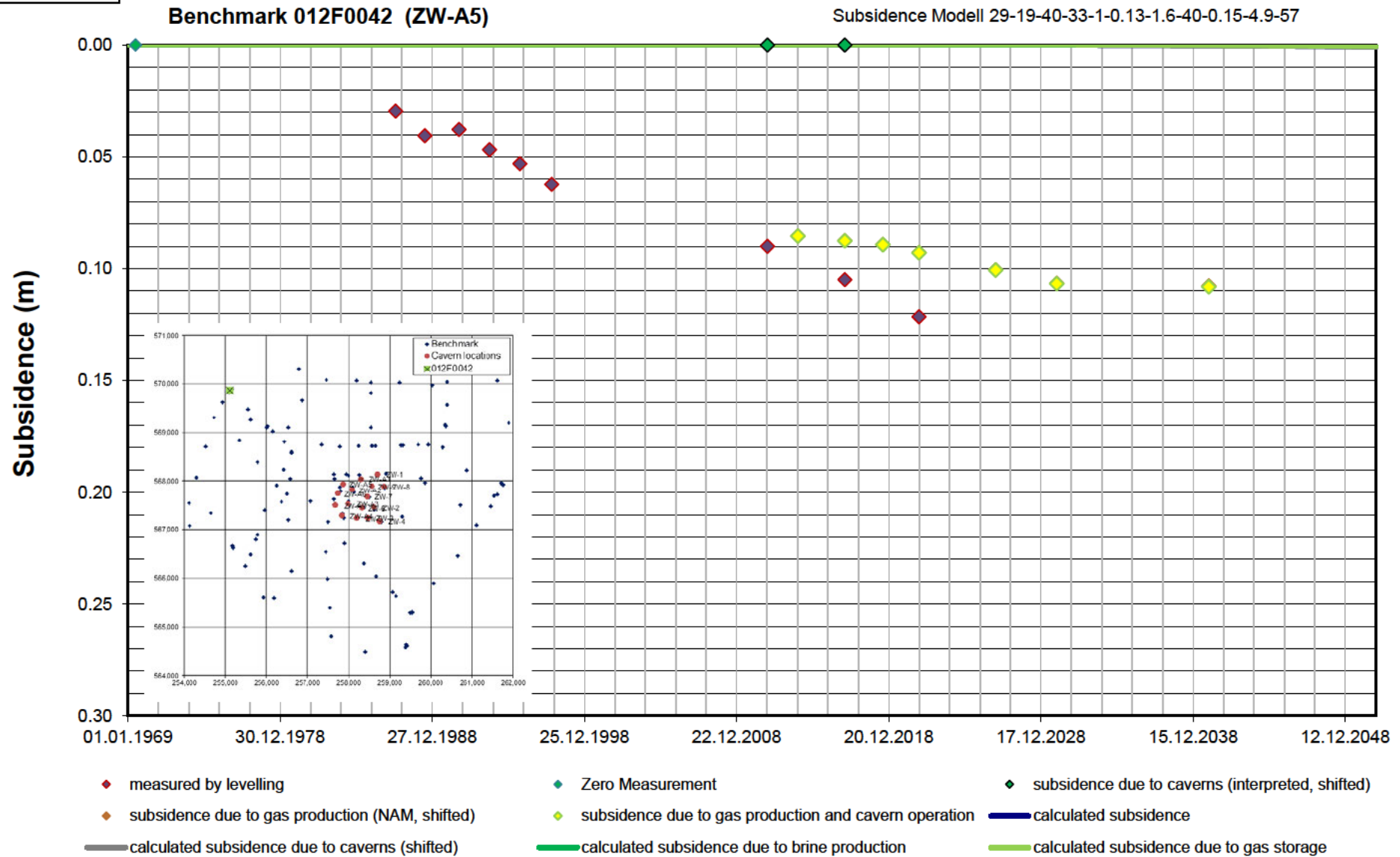
Benchmark 012F0037 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57



Deviation
0.0230

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

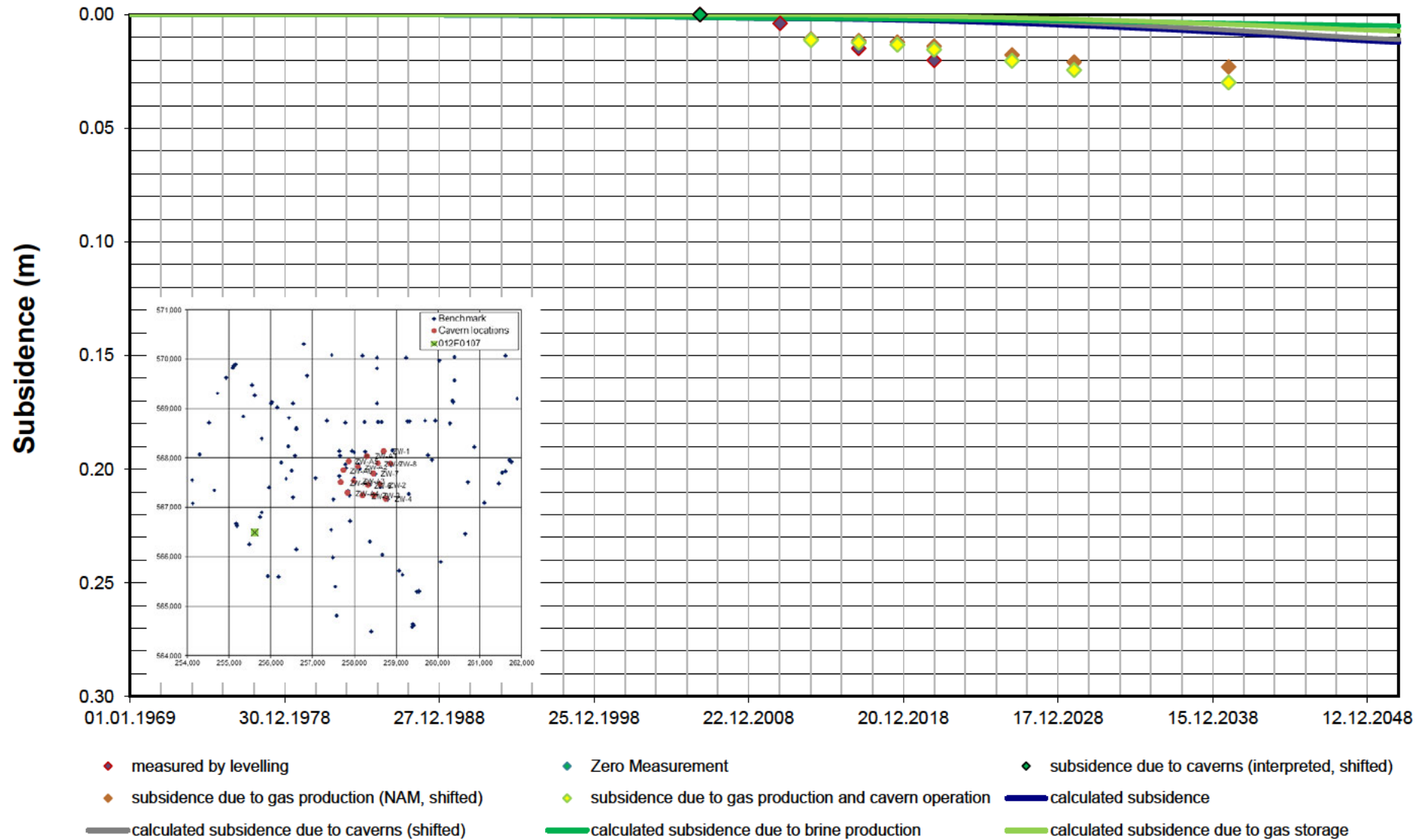


Deviation
0.0036

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0107 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

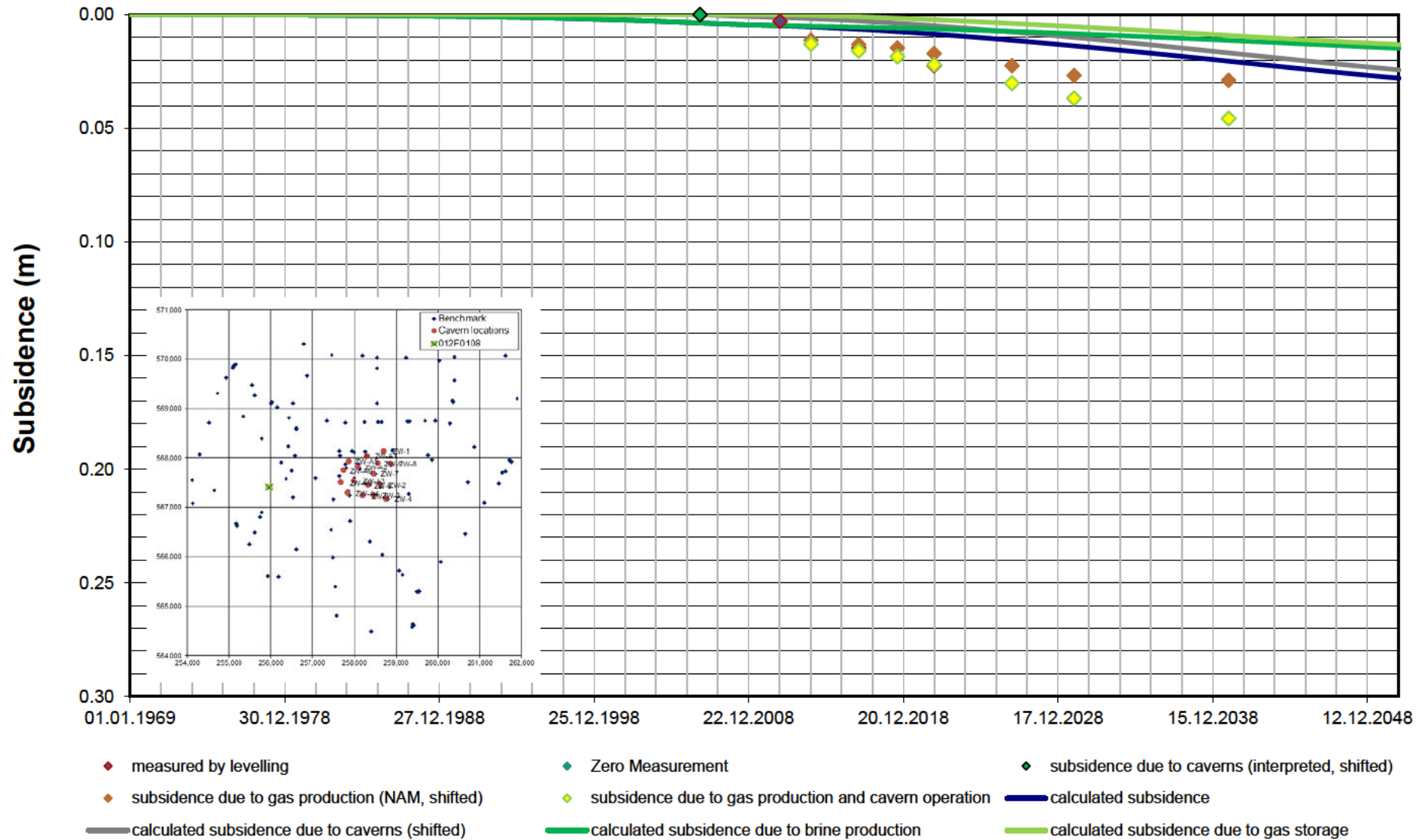


Deviation
0.0008

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0108 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

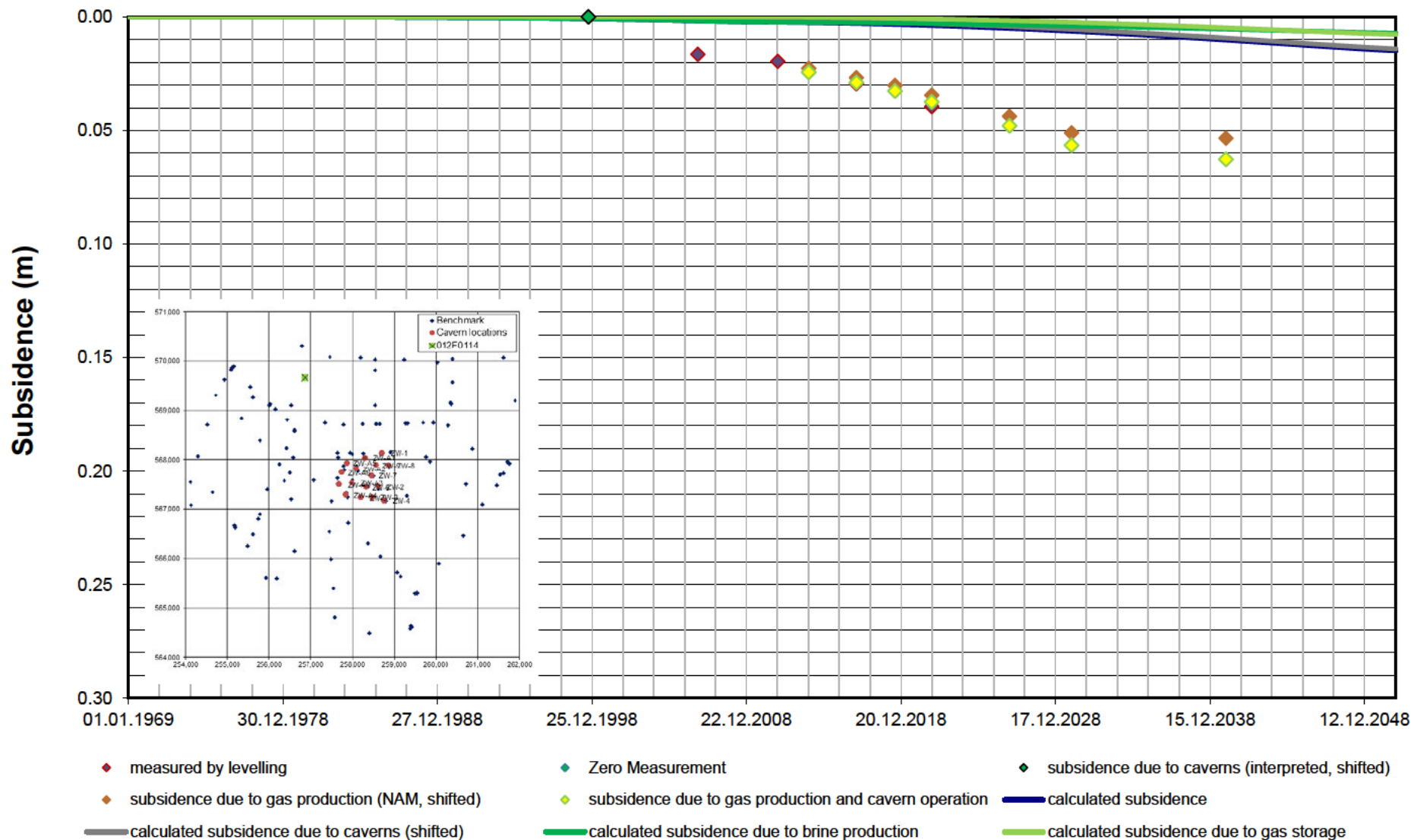


Deviation
0.0013

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0114 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

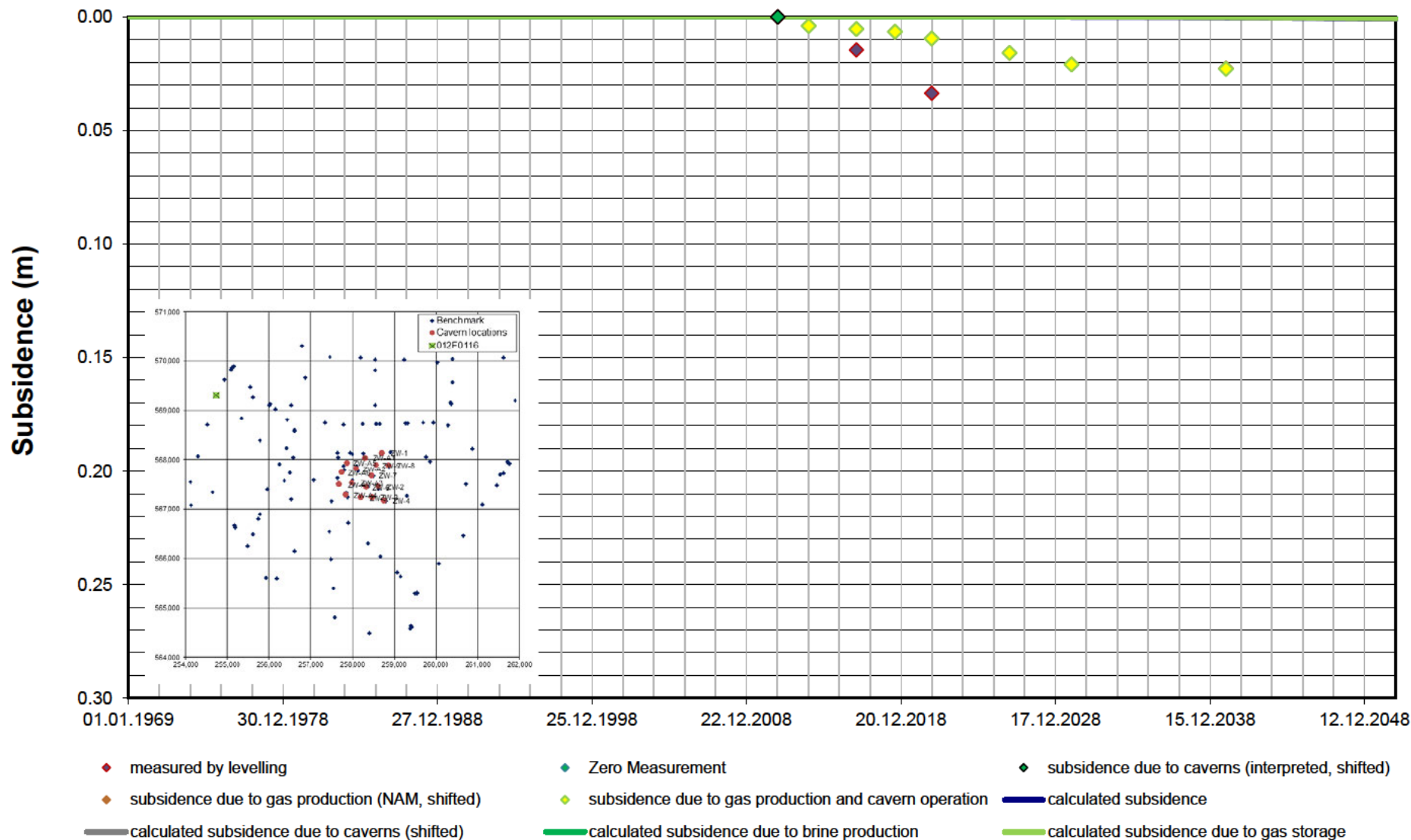


Deviation
0.0167

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0116 (ZW-A6)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

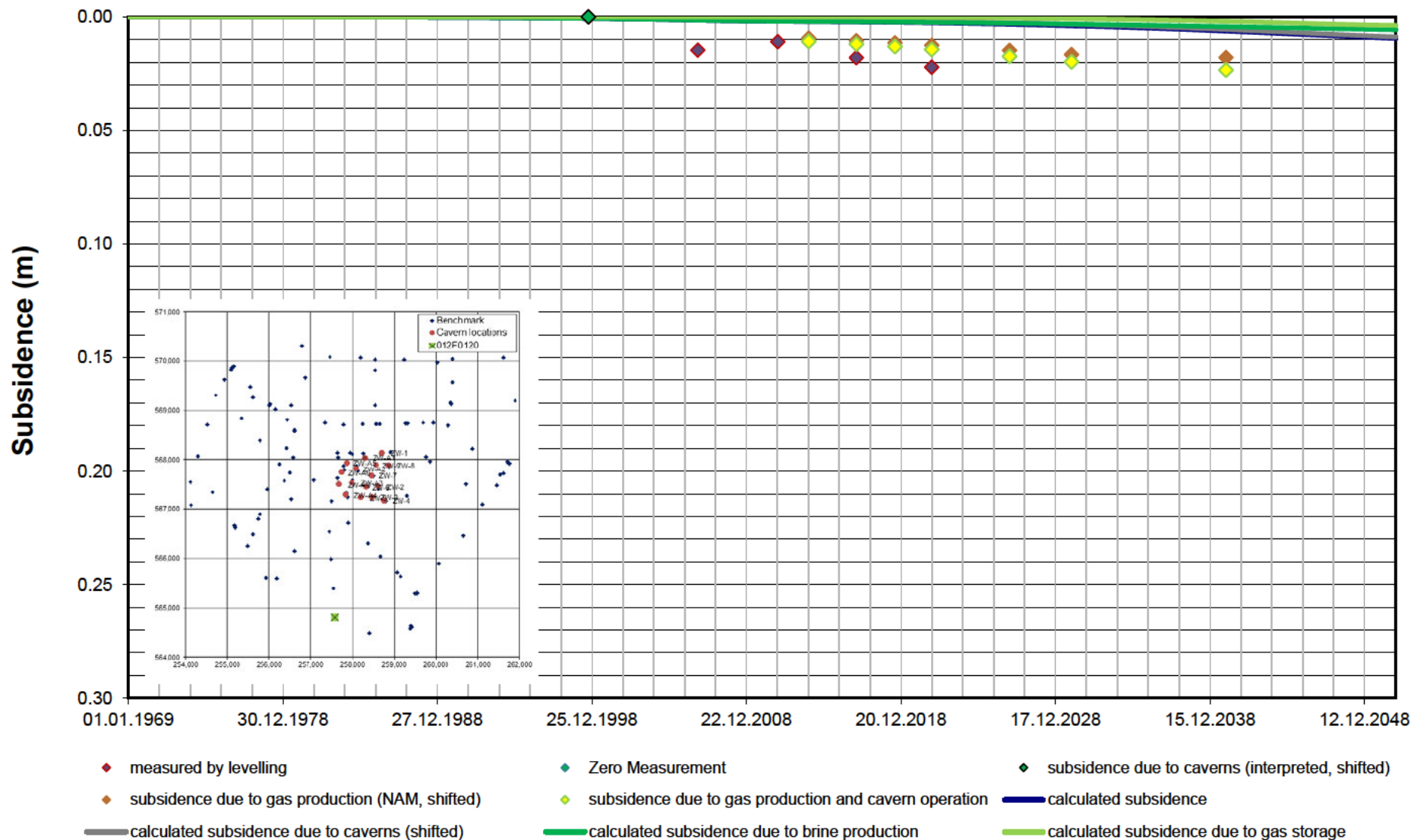


Deviation
0.0069

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0120 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

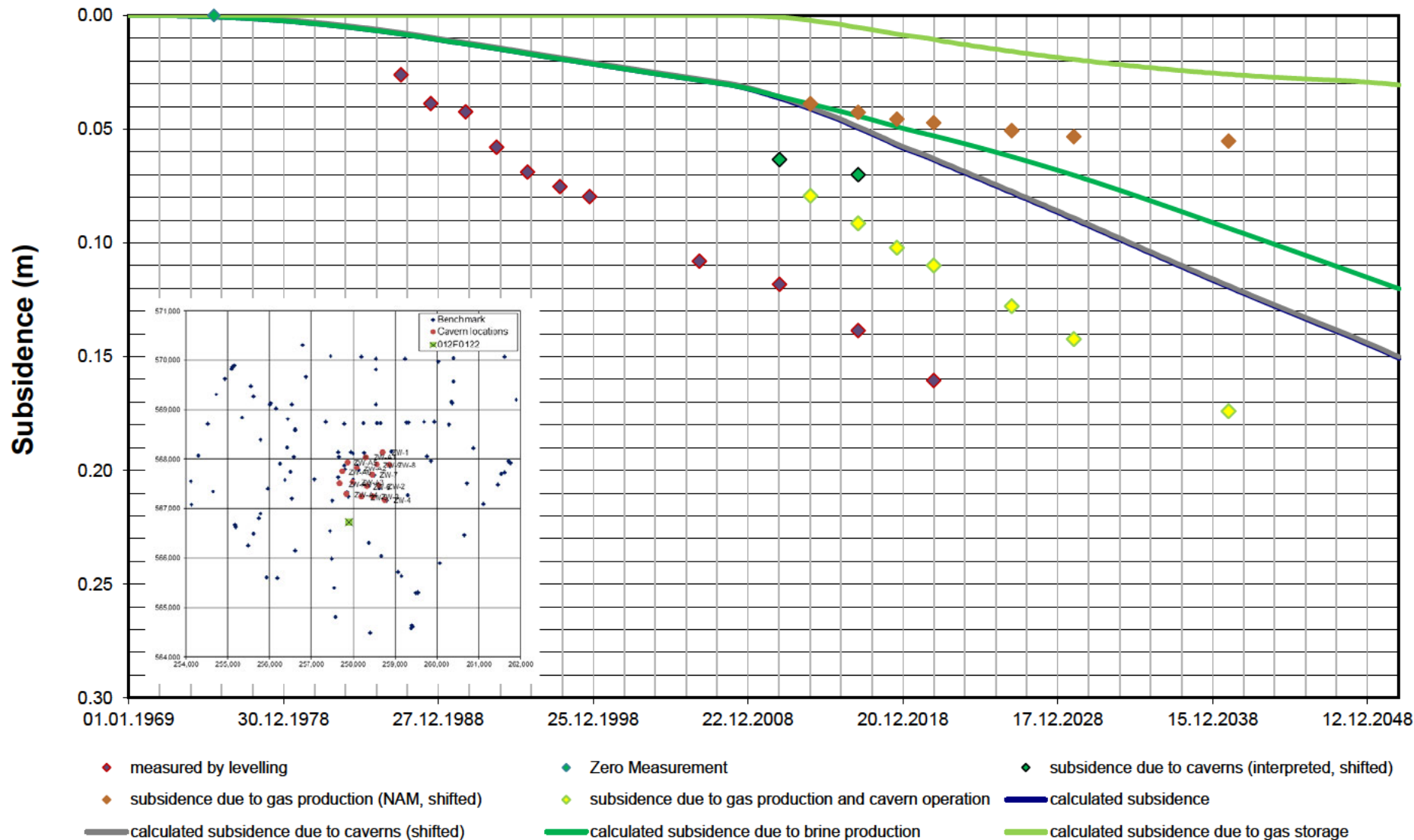


Deviation
0.0488

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0122 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

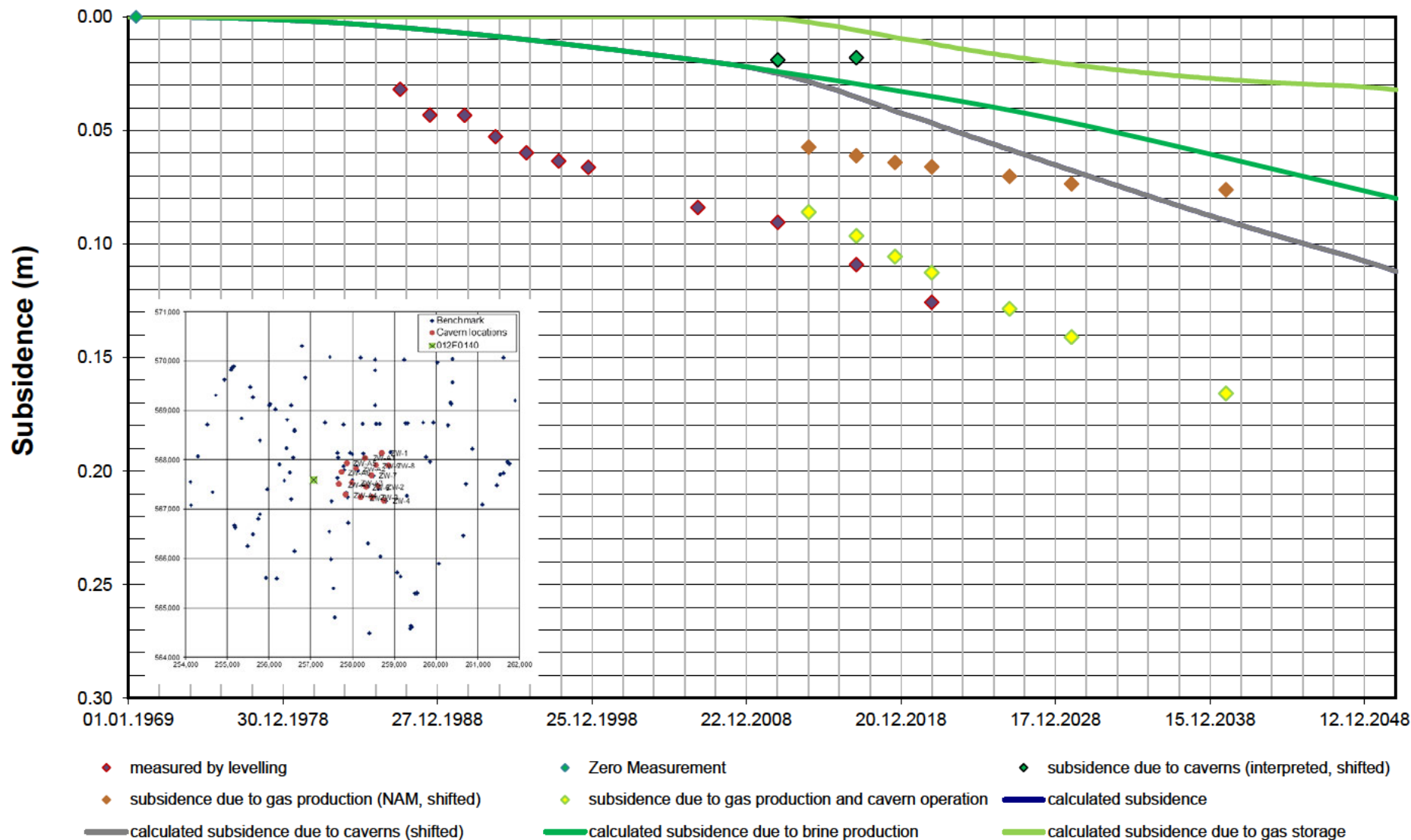


Deviation
0.0129

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0140 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

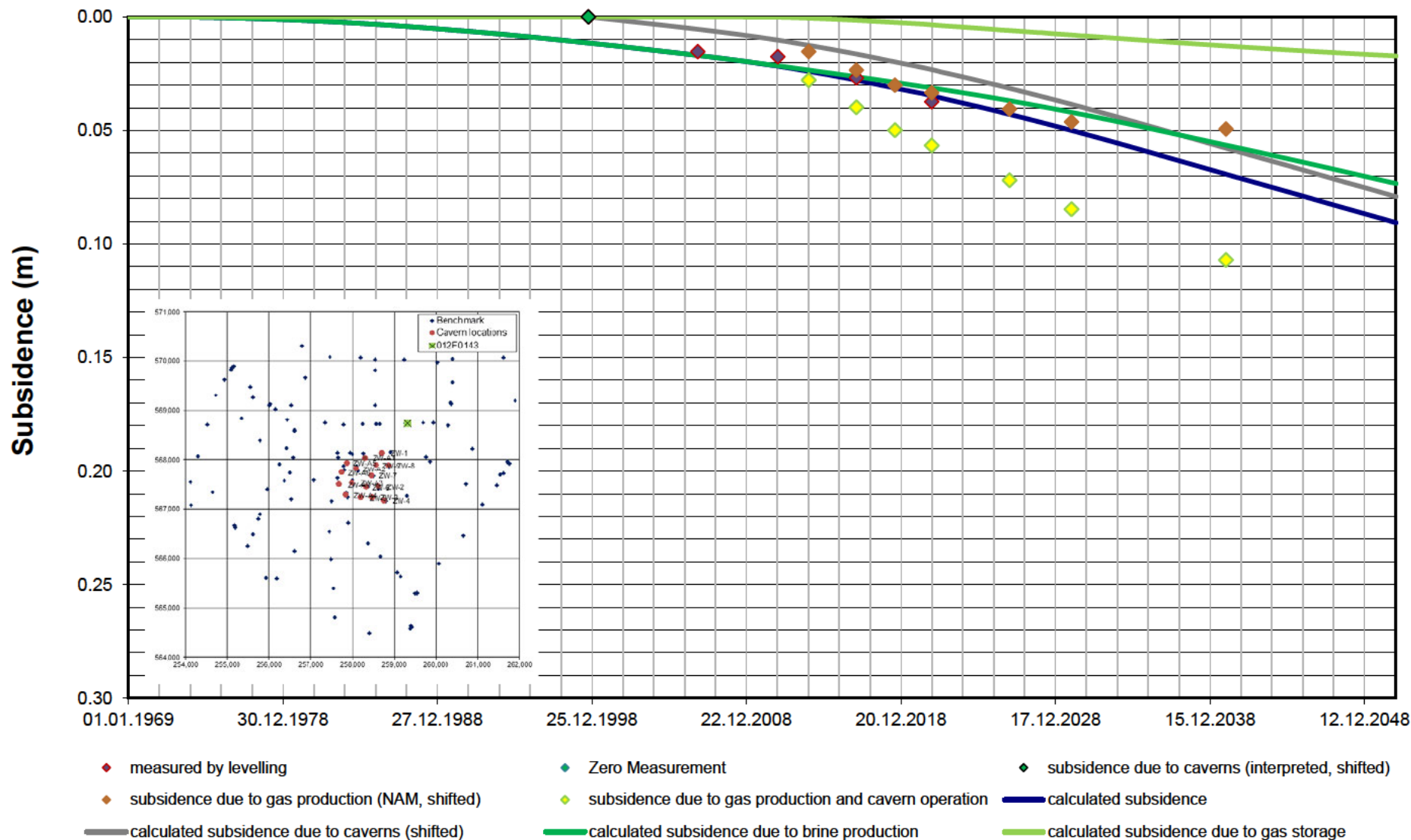


Deviation
0.0161

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0143 (ZW-1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

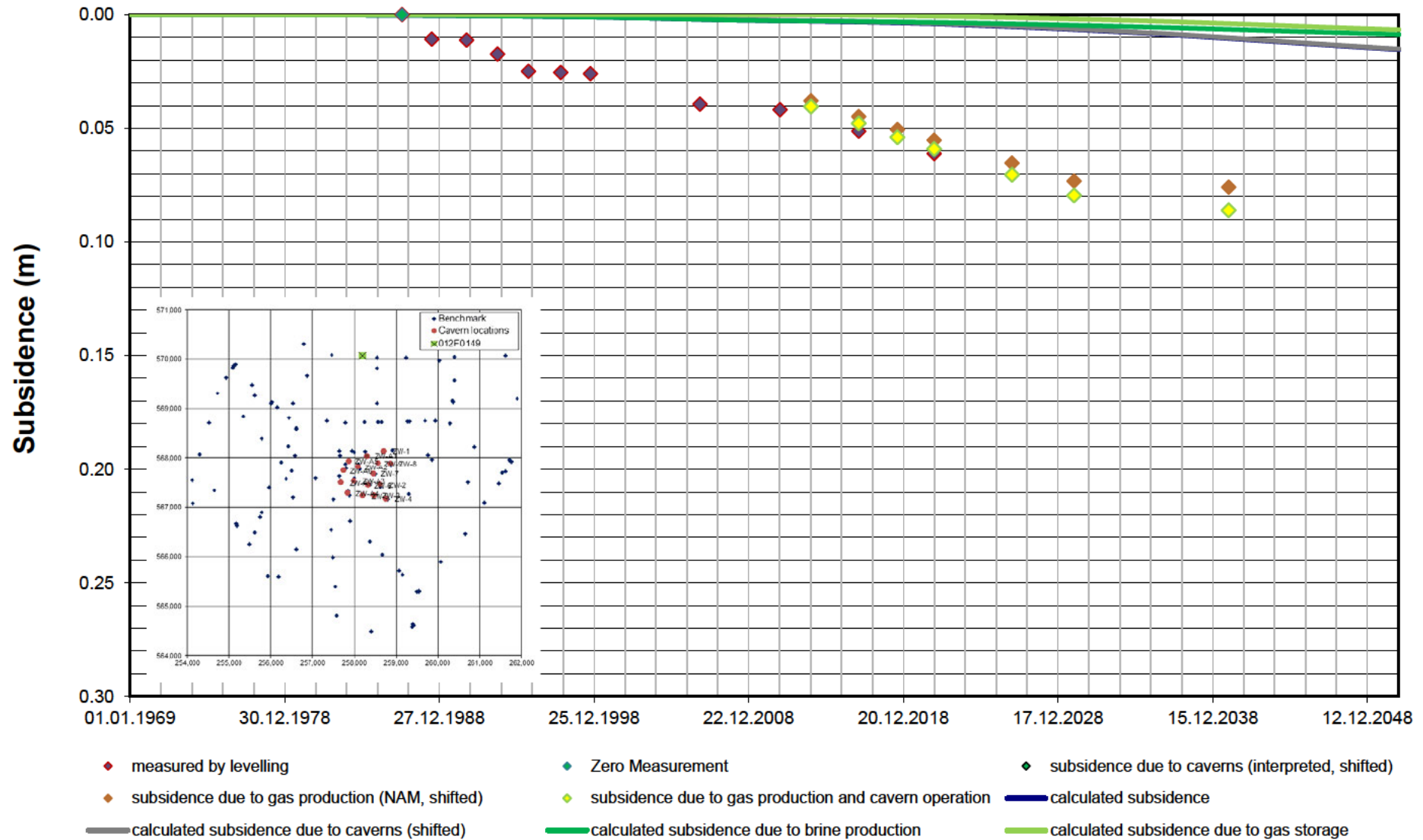


Deviation
0.0027

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0149 (ZW-1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

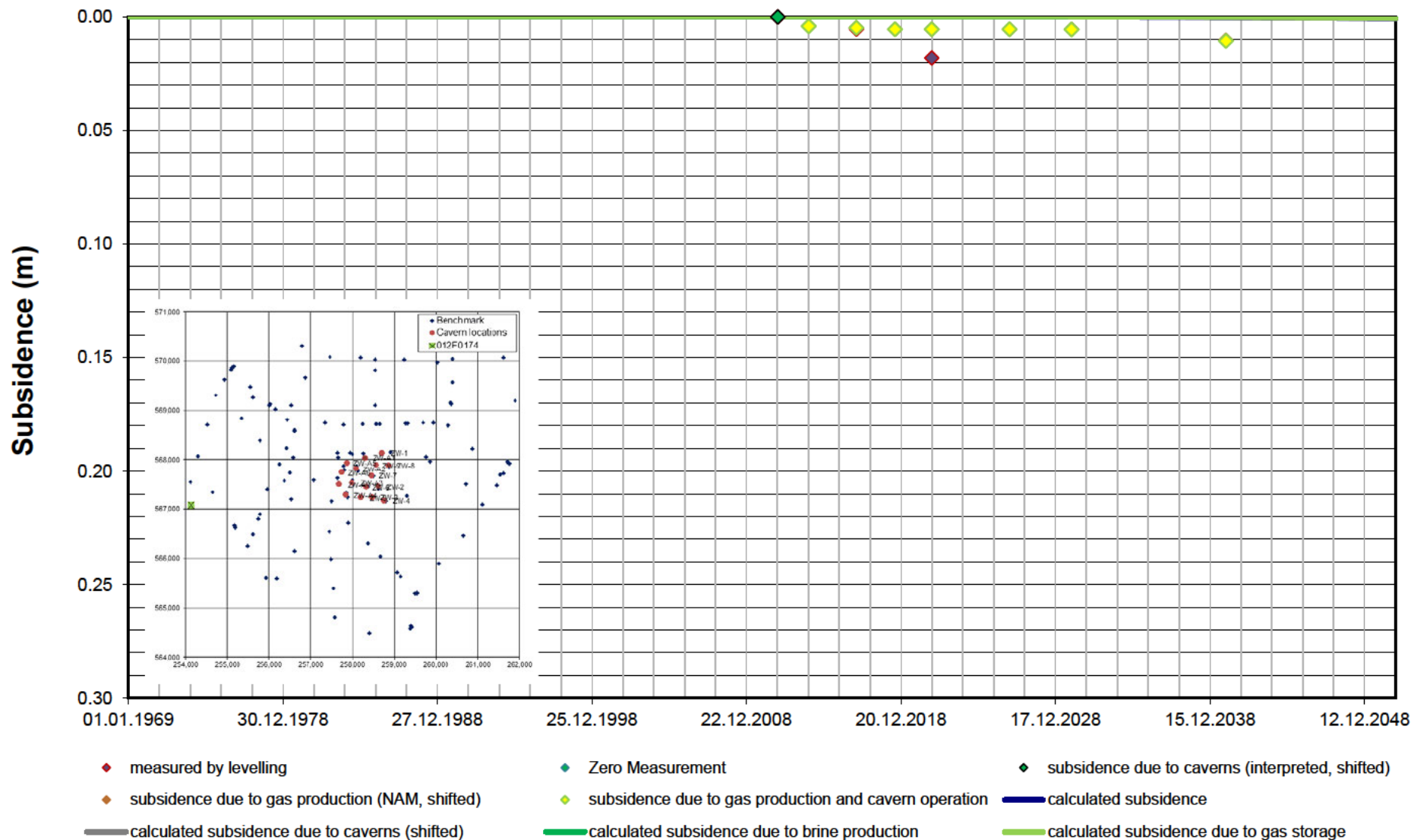


Deviation
0.0066

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0174 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

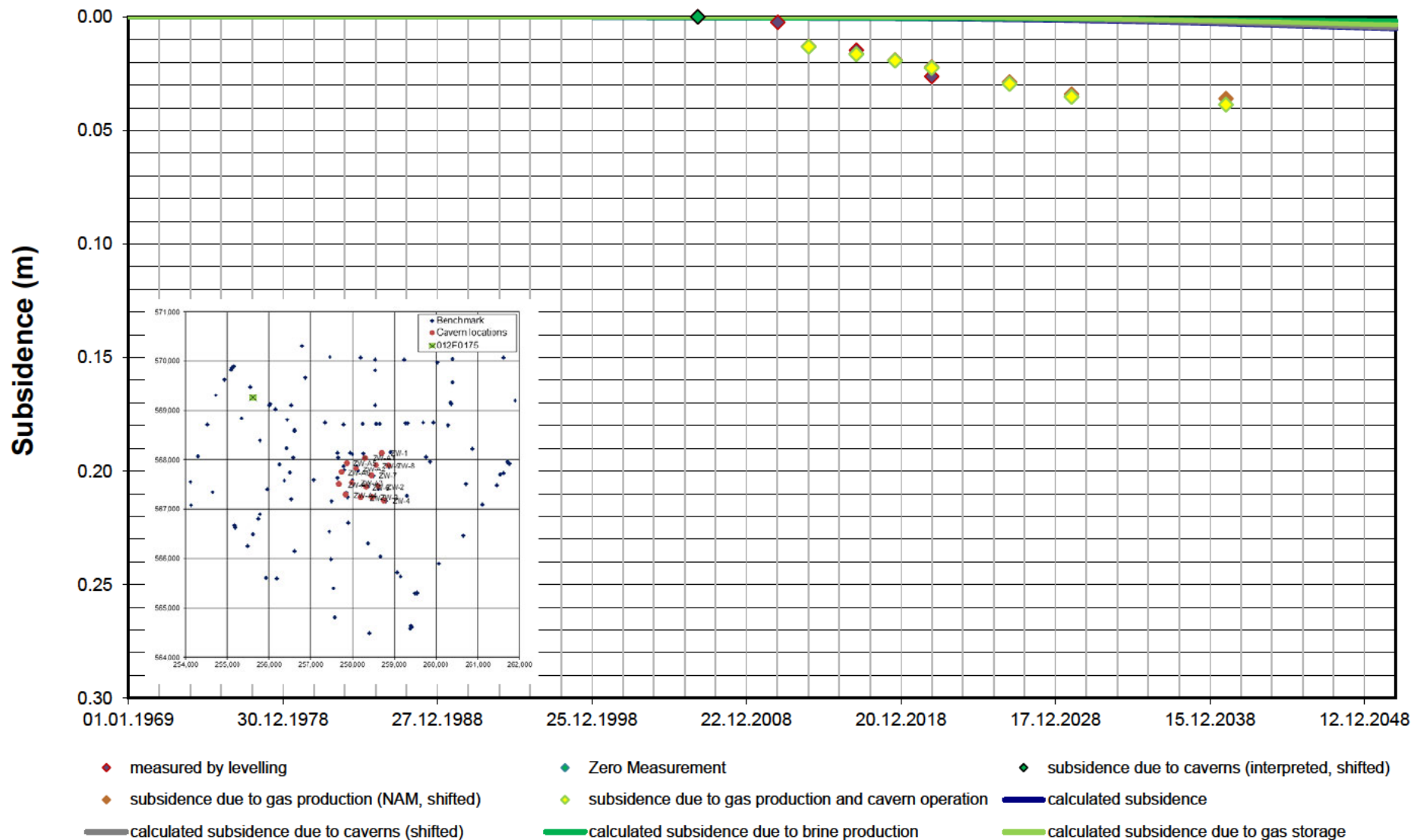


Deviation
0.0027

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0175 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

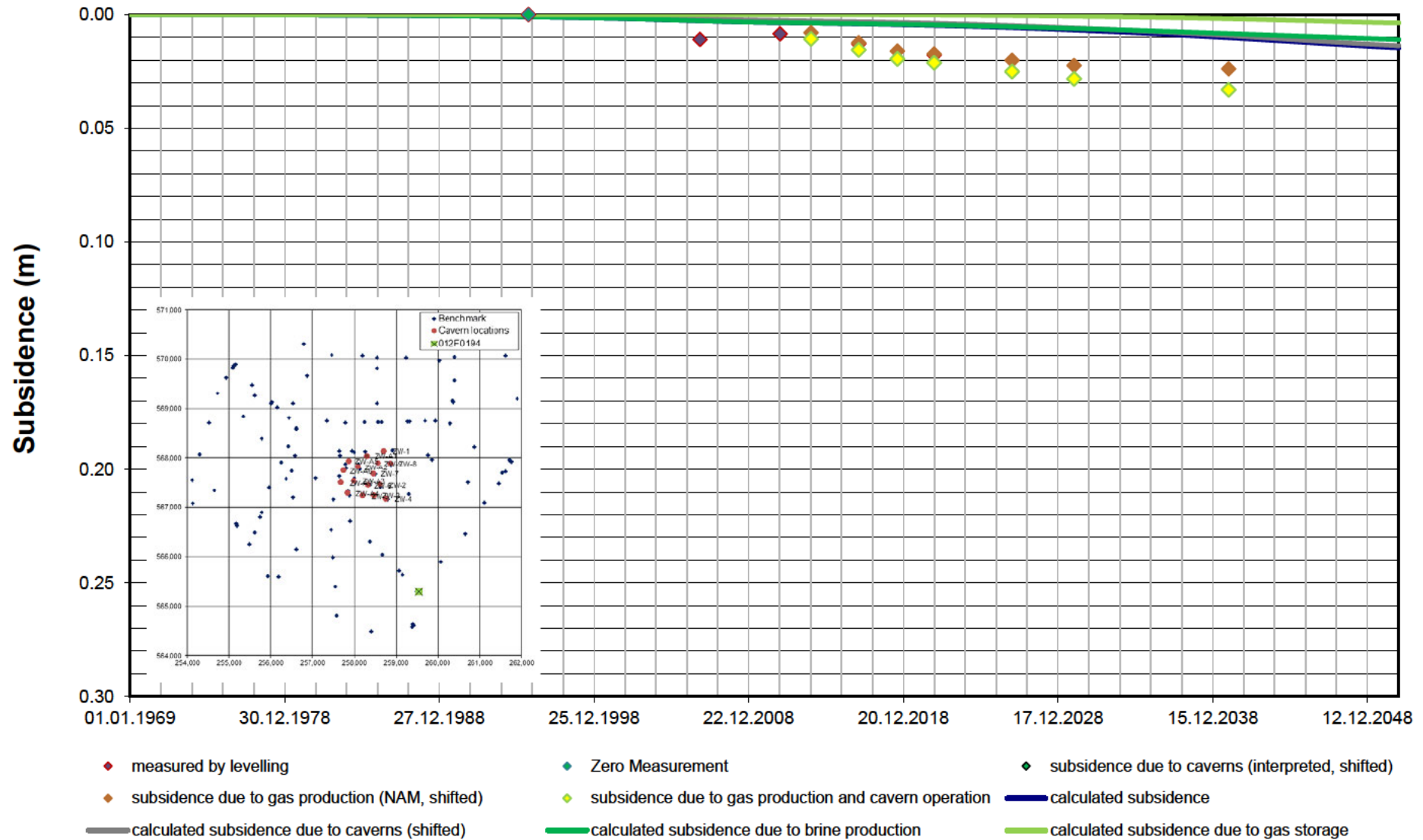


Deviation
0.0031

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0194 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

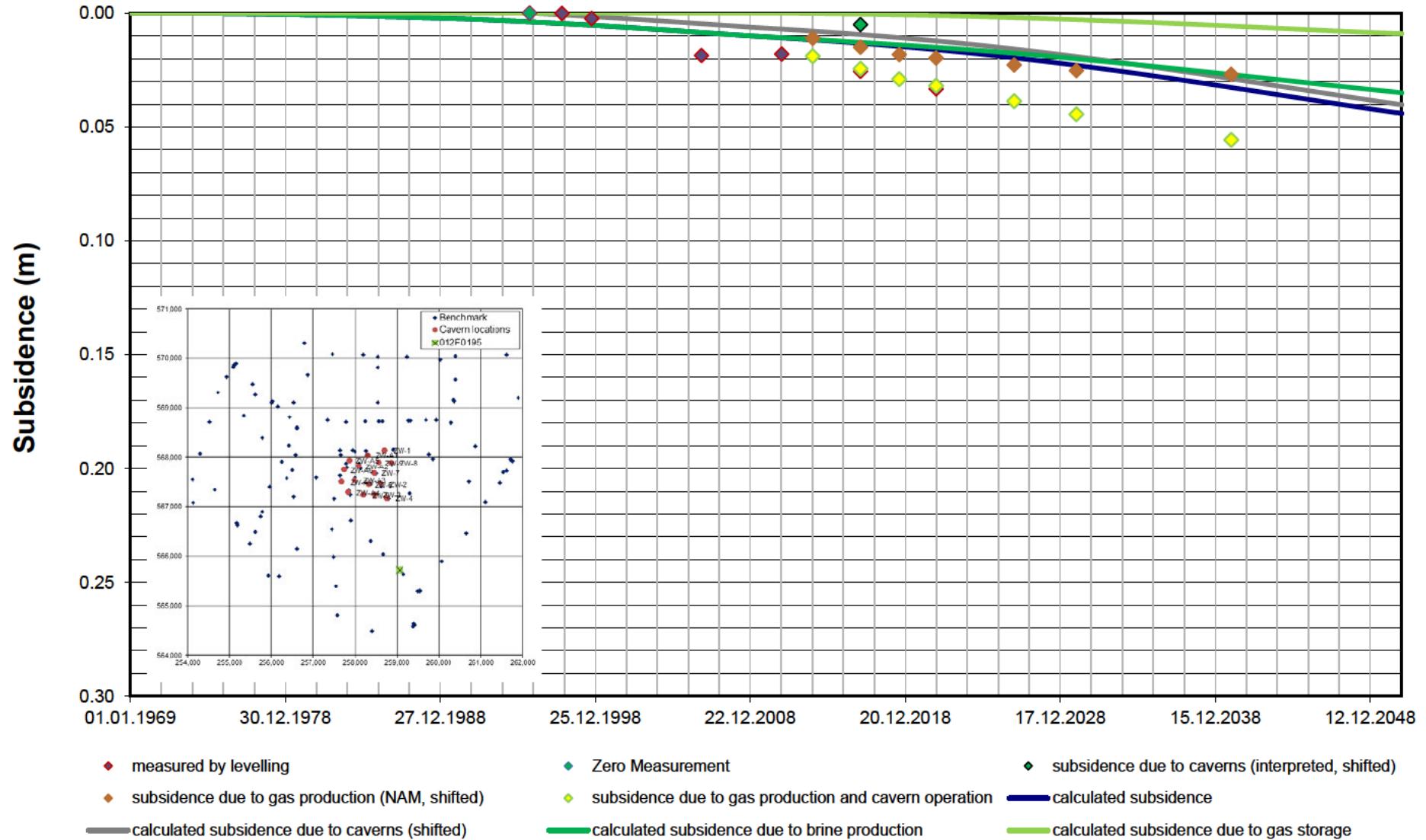


Deviation
0.0013

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0195 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

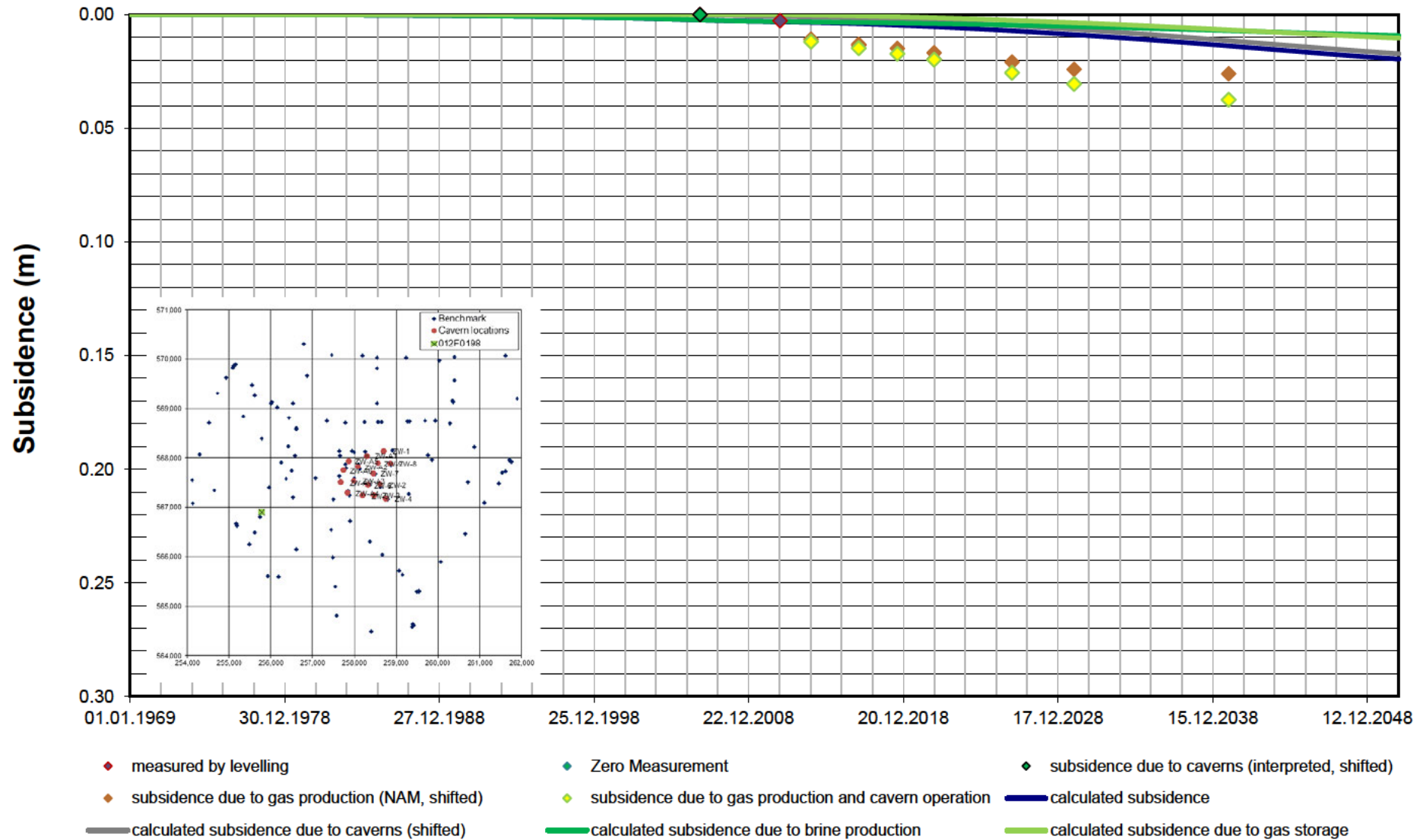


Deviation
0.0007

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0198 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

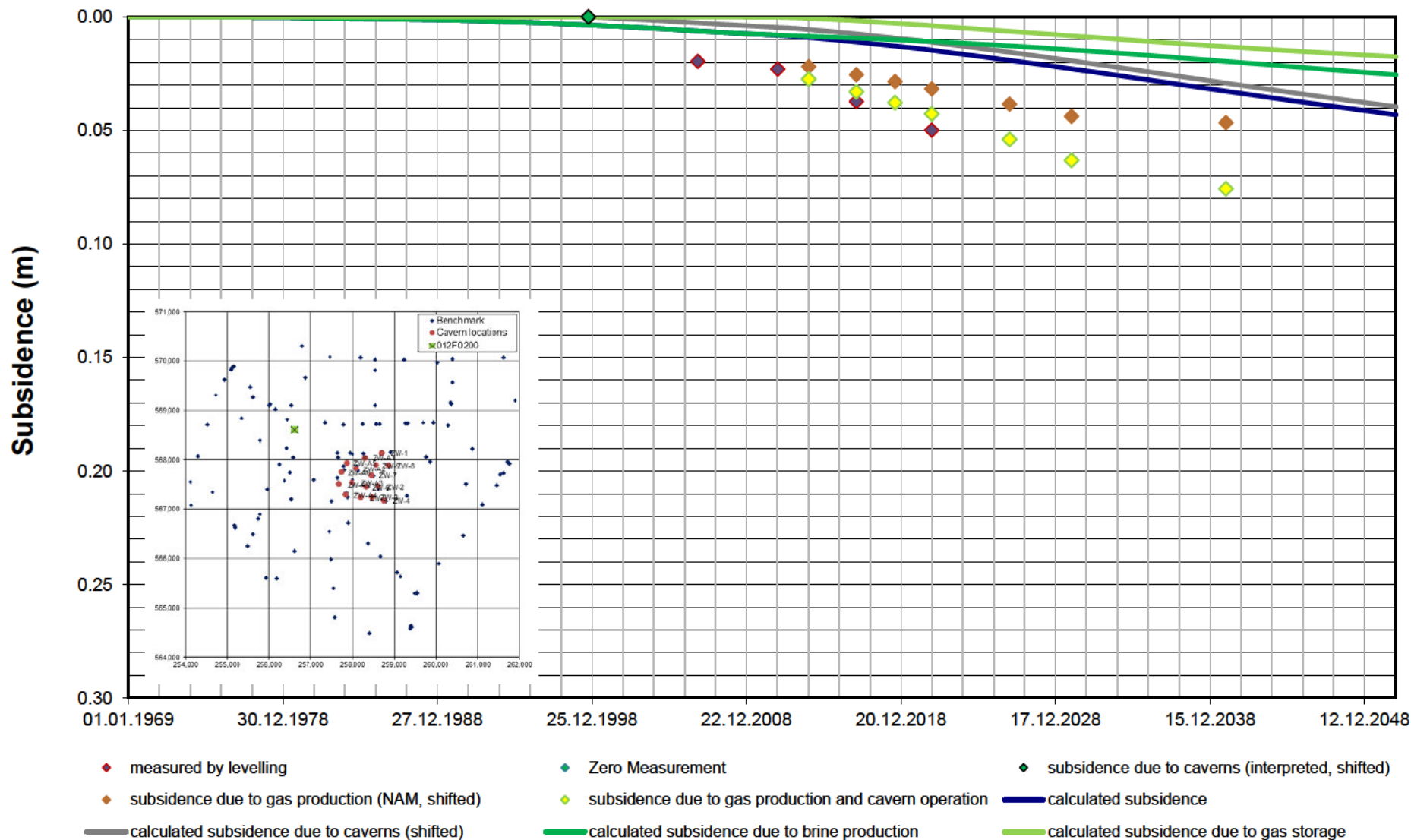


Deviation
0.0057

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0200 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

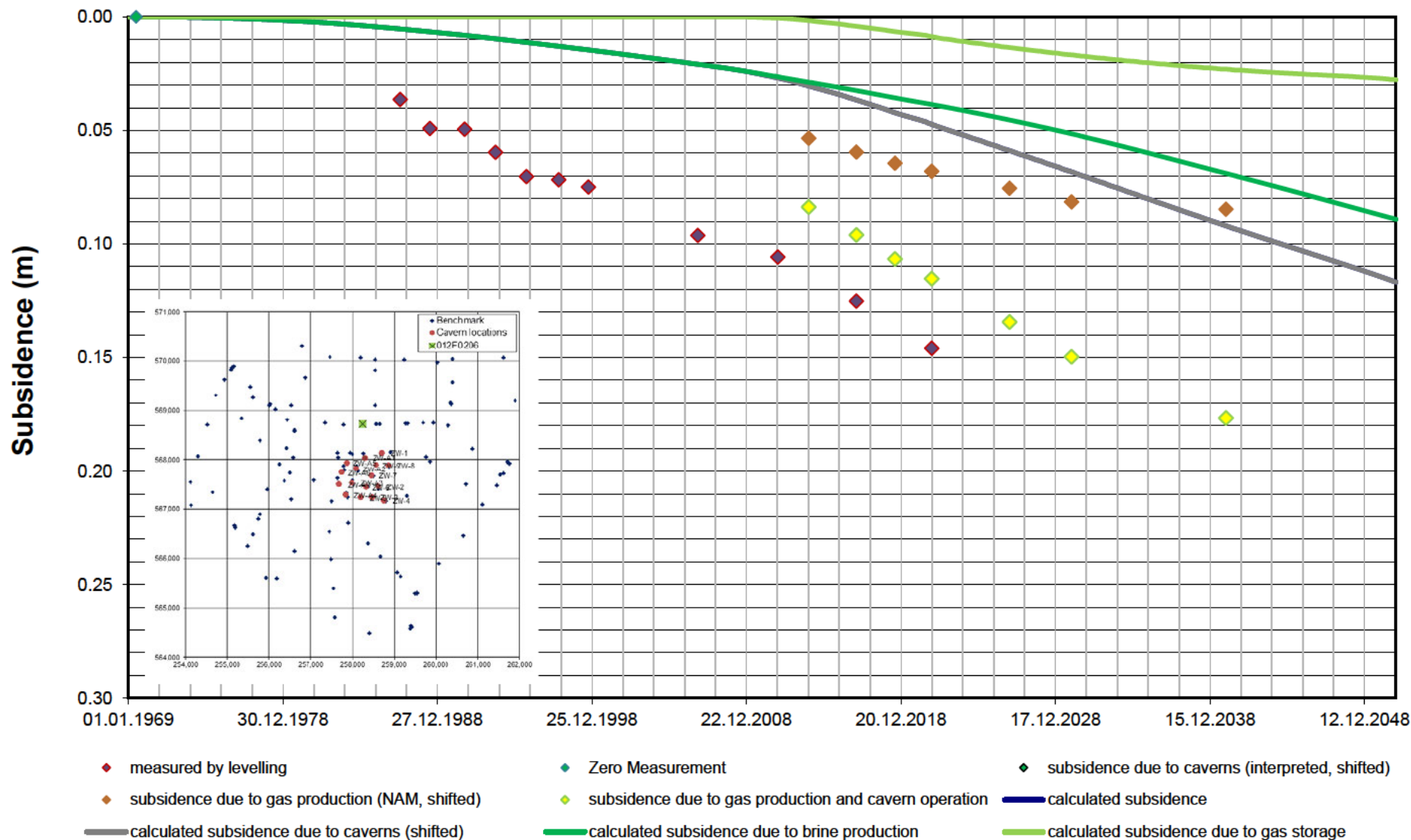


Deviation
0.0299

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0206 (ZW-A1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

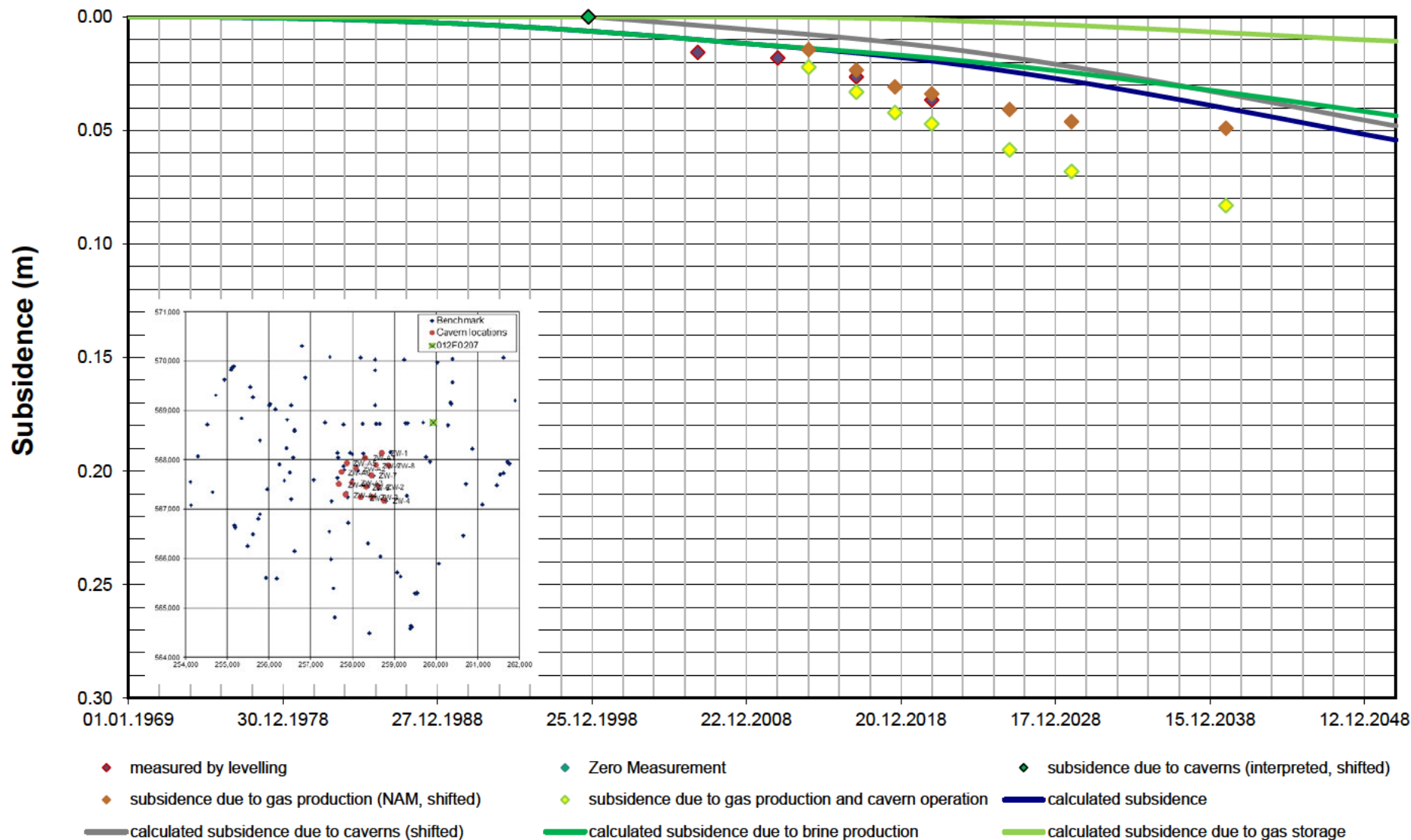


Deviation
0.0086

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0207 (ZW-1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

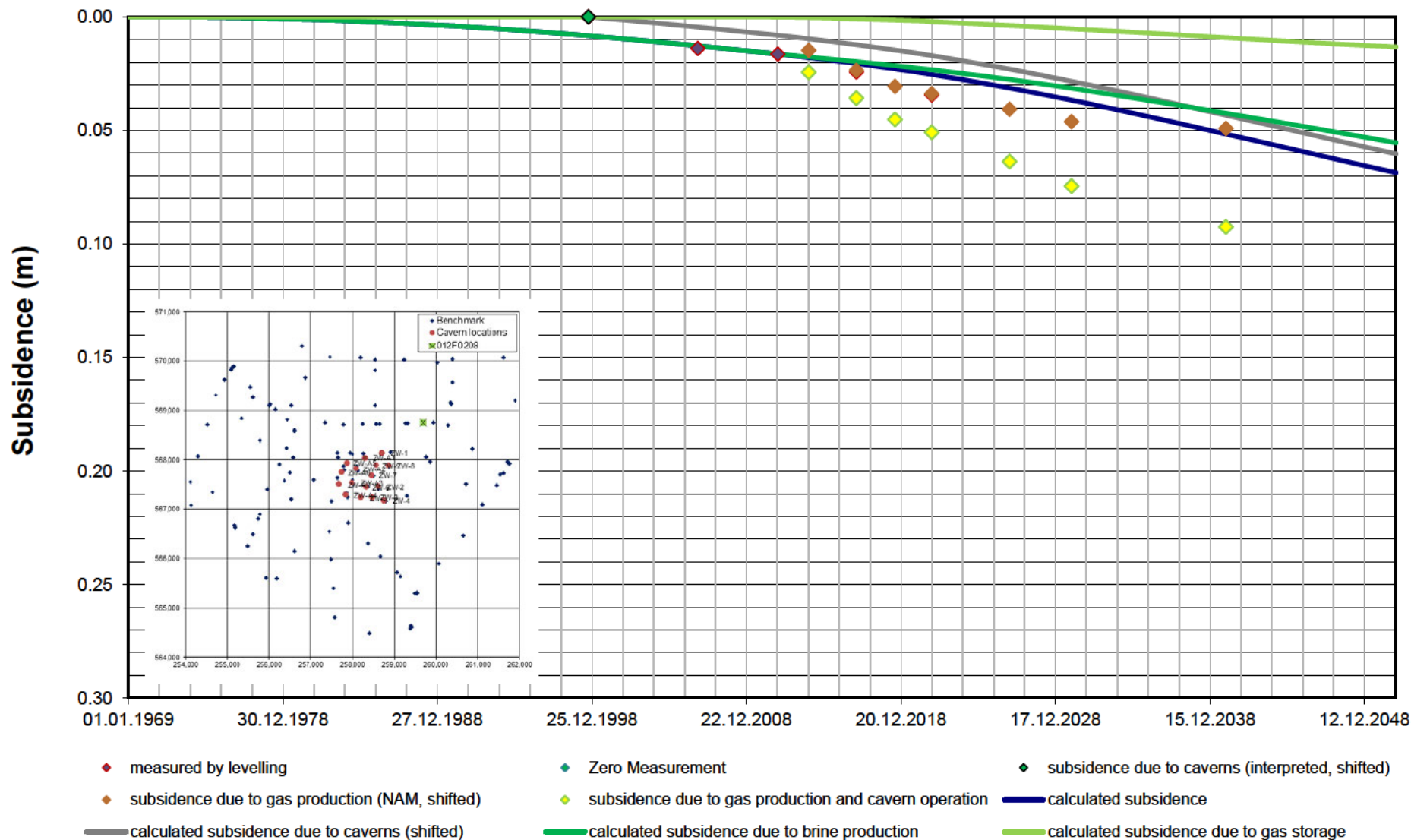


Deviation
0.0140

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0208 (ZW-1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

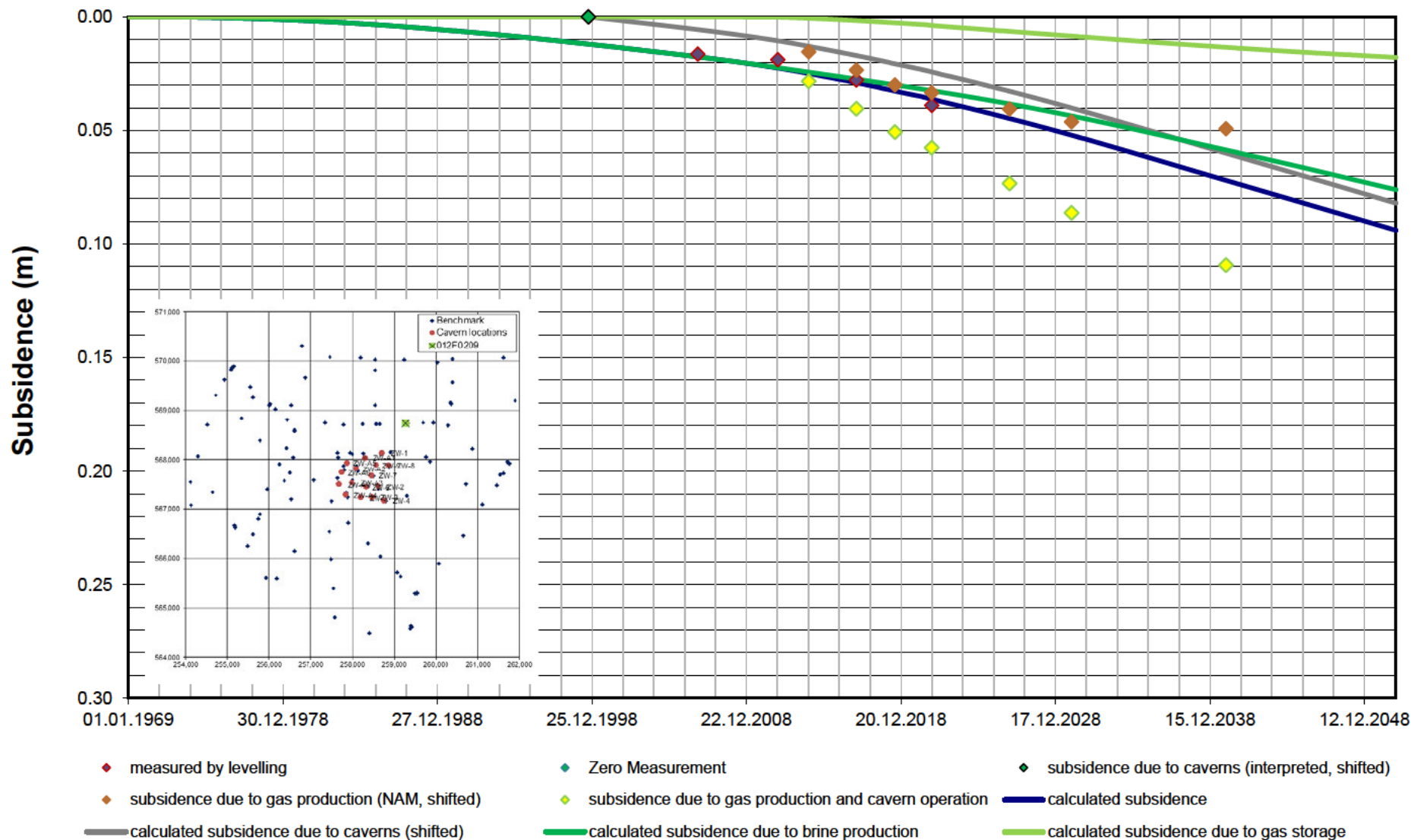


Deviation
0.0157

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0209 (ZW-1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

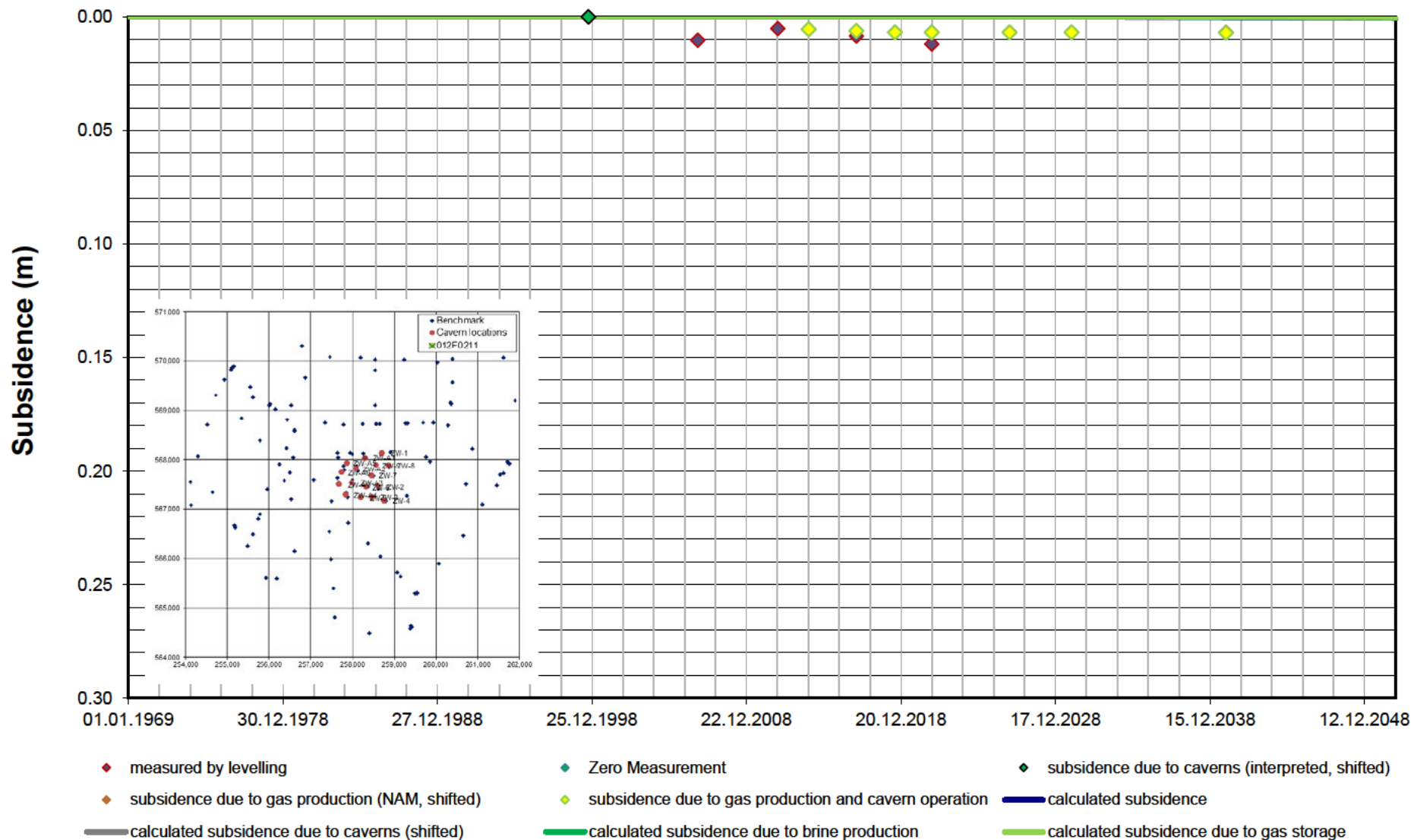


Deviation
0.0037

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0211 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

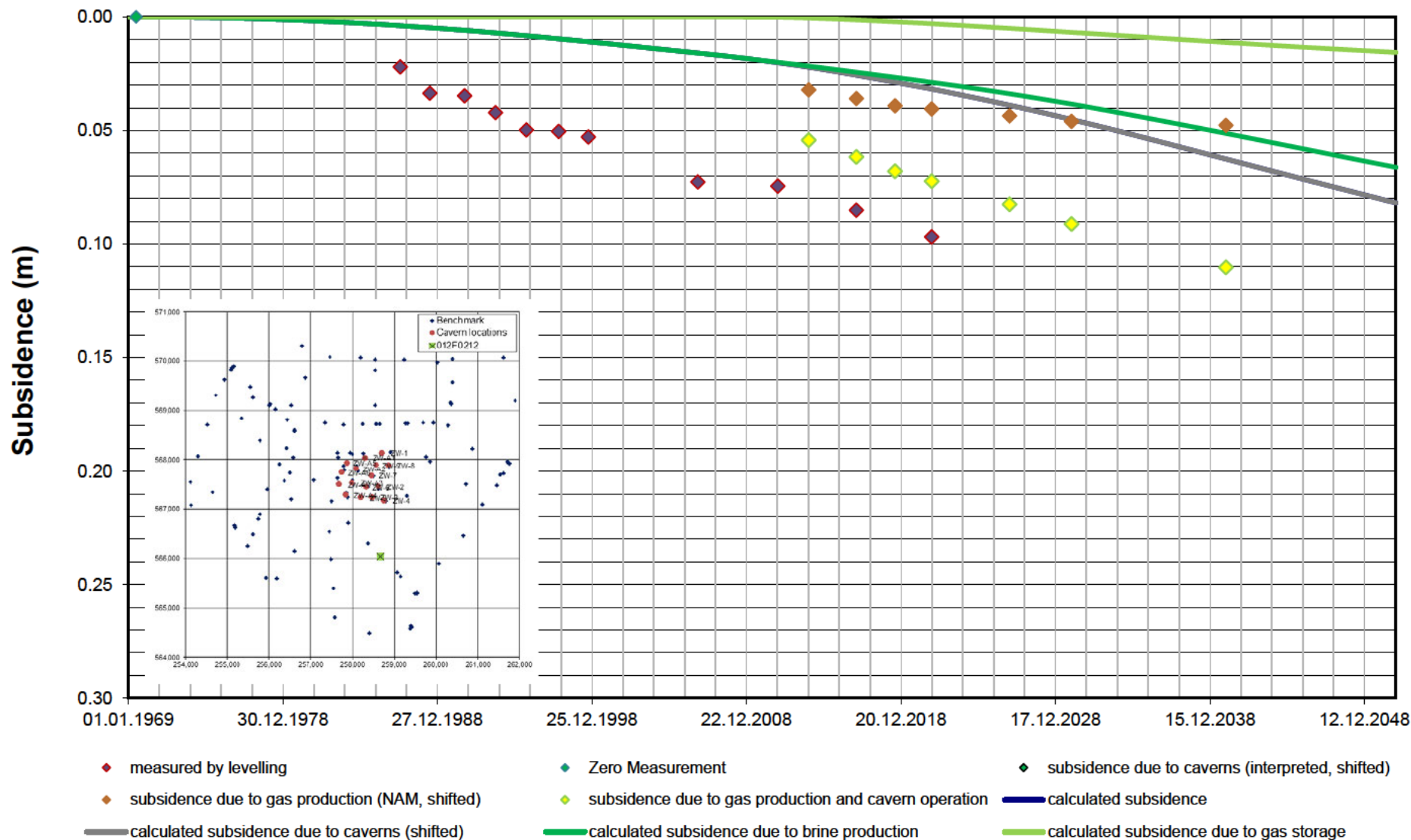


Deviation
0.0240

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0212 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

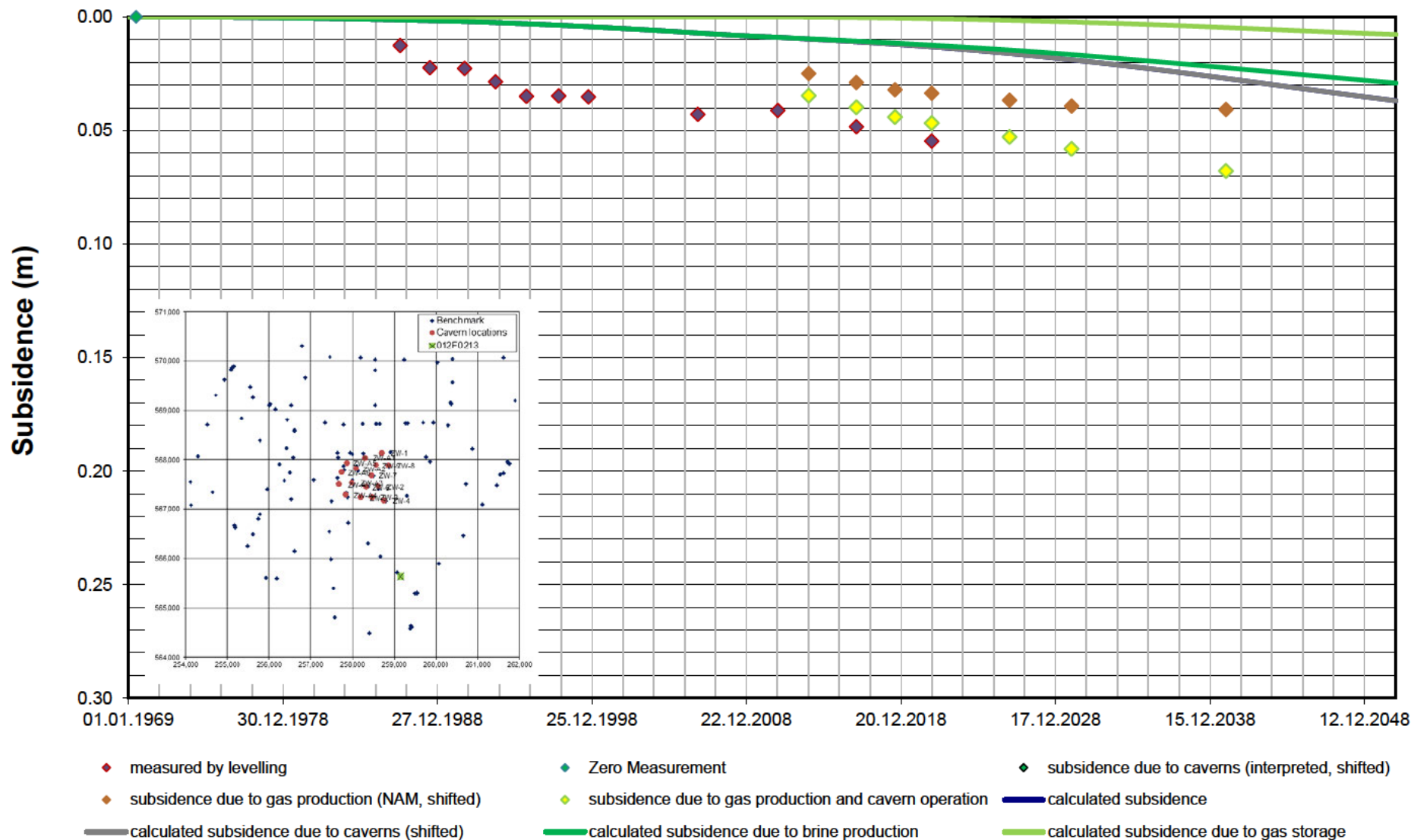


Deviation
0.0082

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0213 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

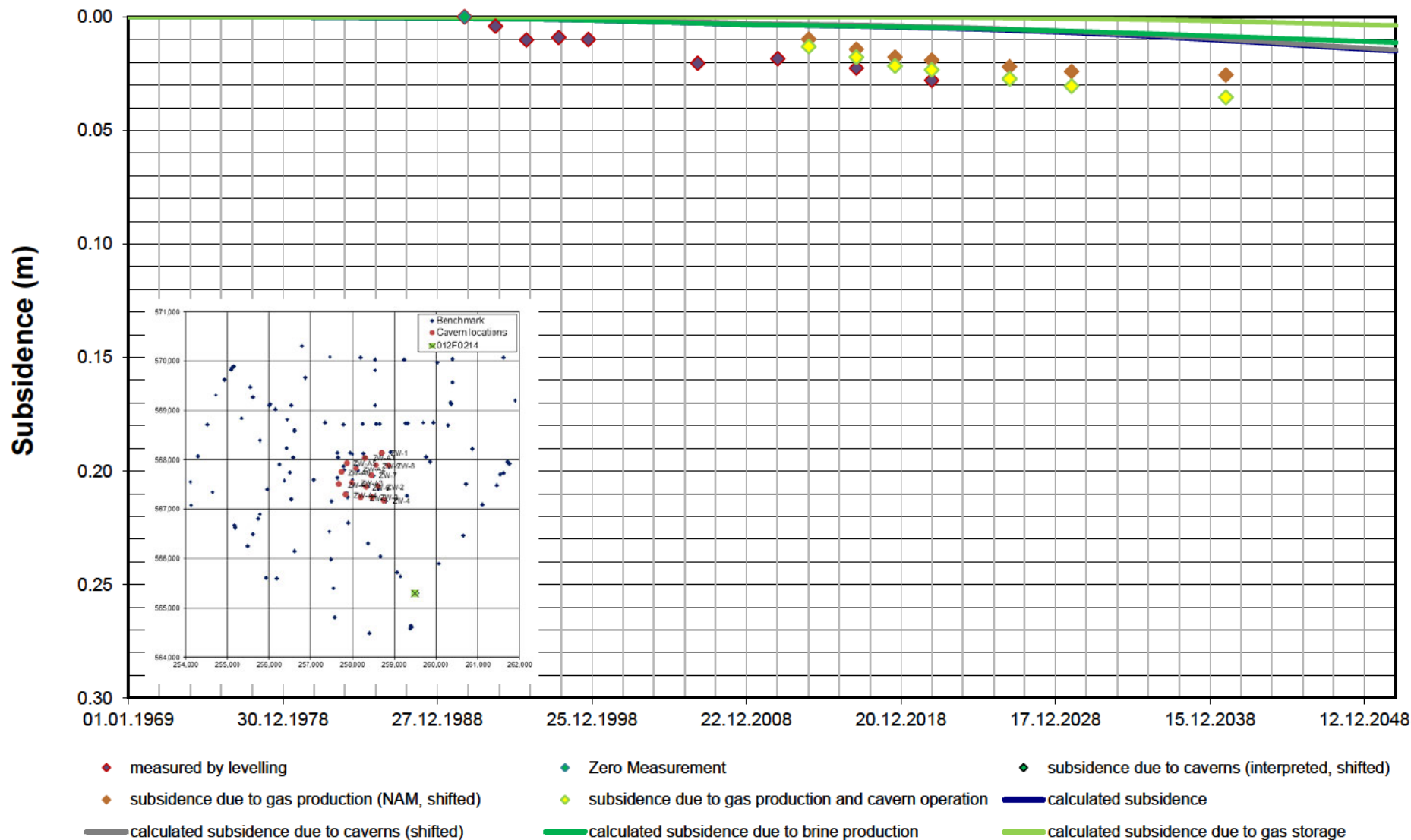


Deviation
0.0047

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0214 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

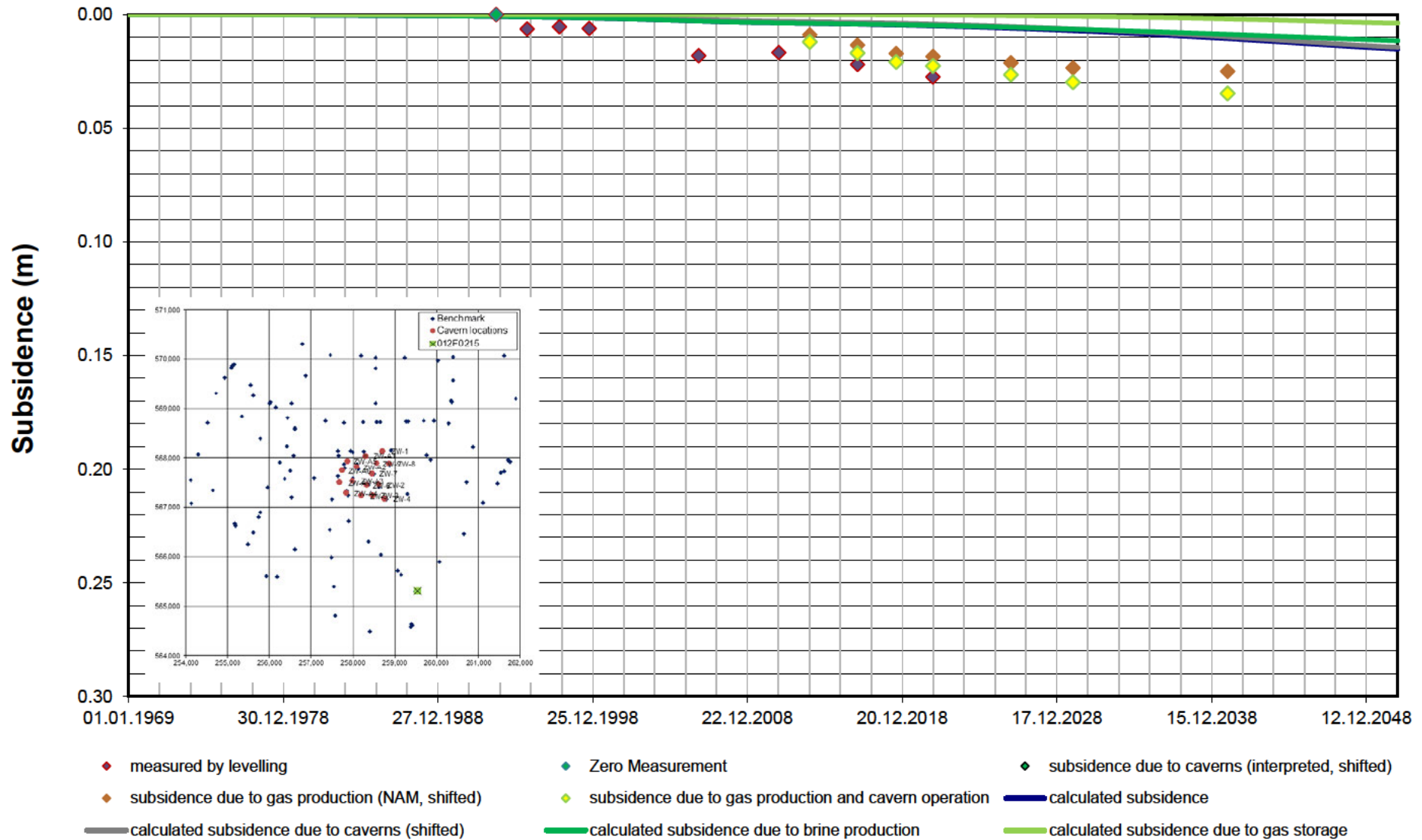


Deviation
0.0049

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0215 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

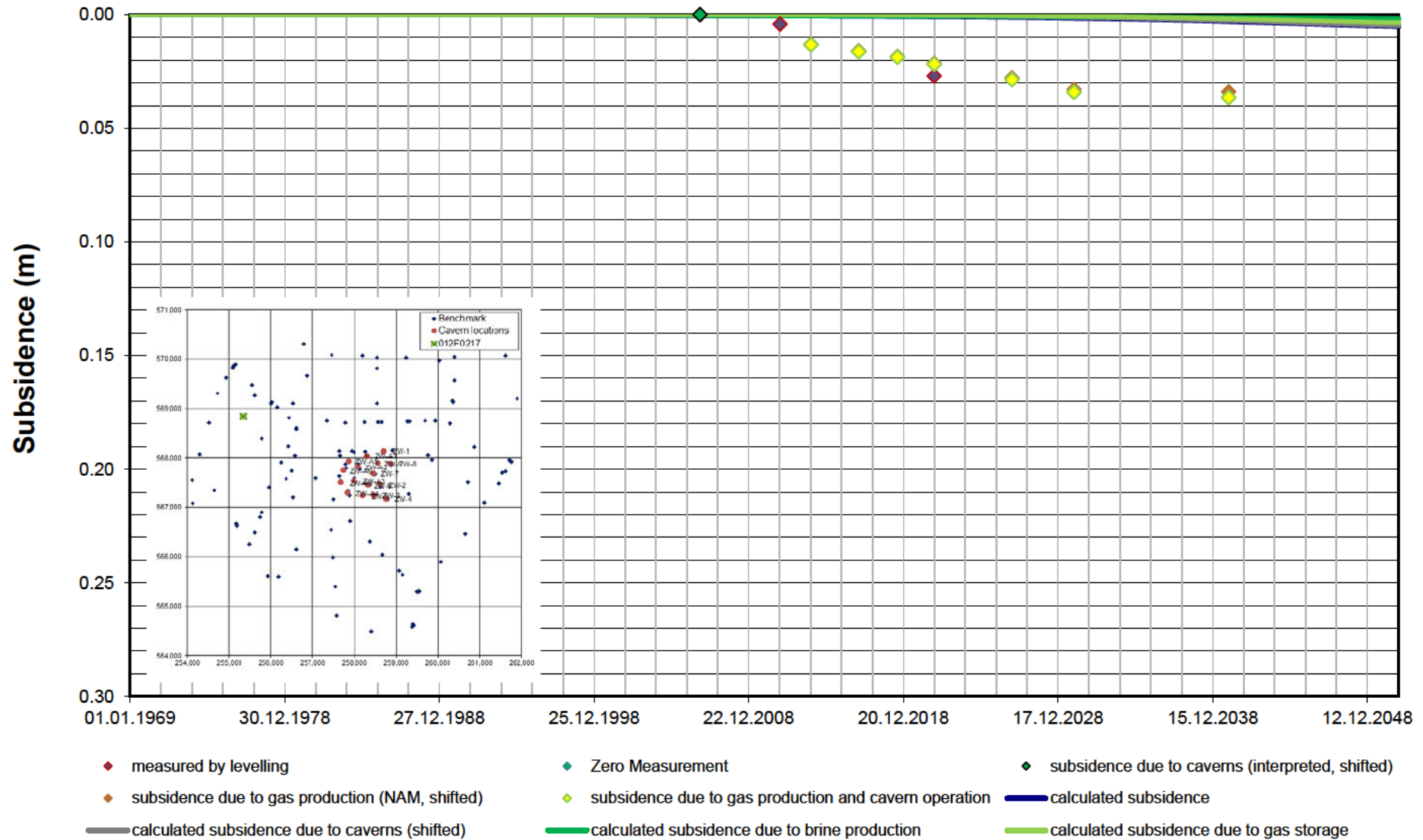


Deviation
0.0027

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0217 (ZW-A6)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

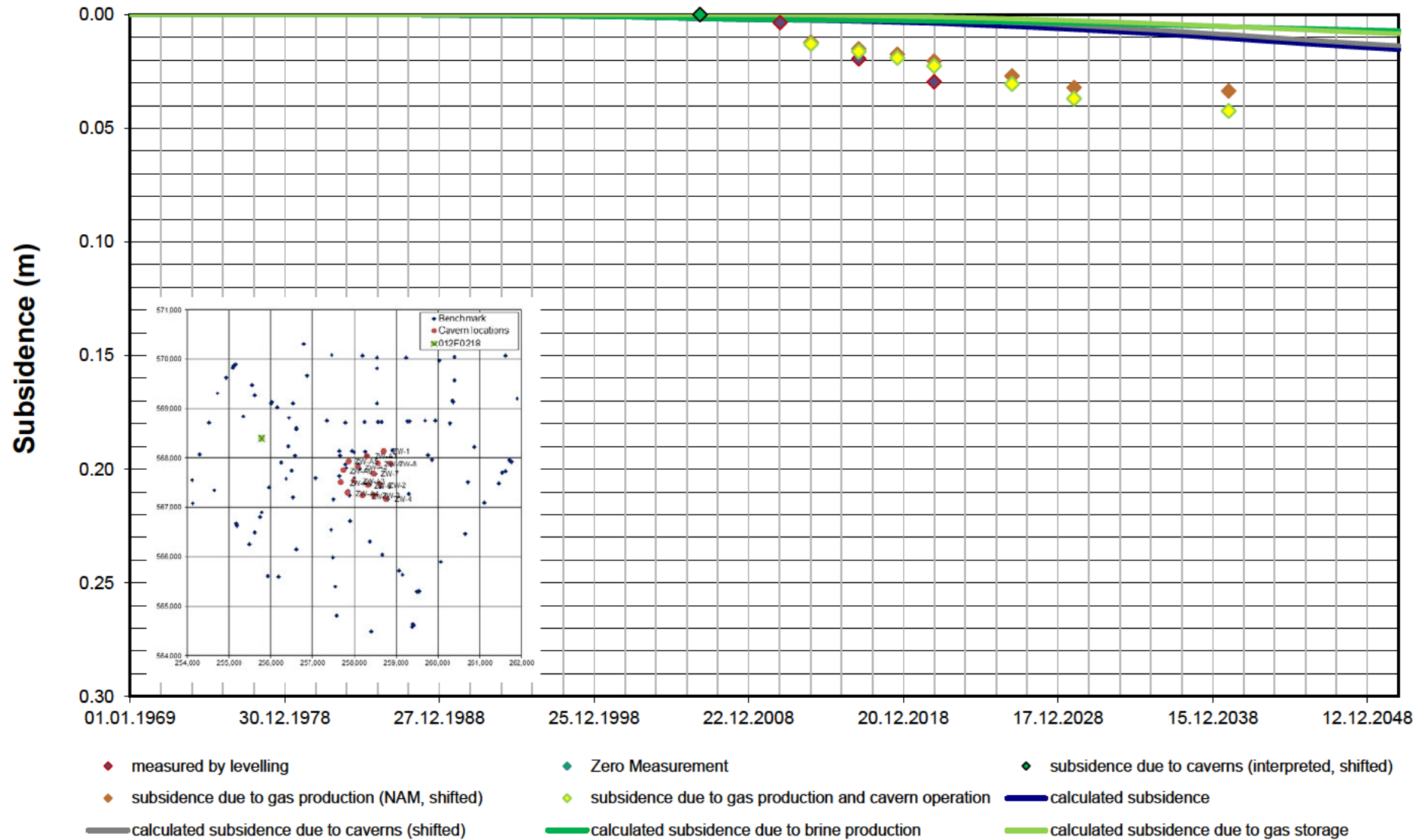


Deviation
0.0051

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0218 (ZW-A6)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

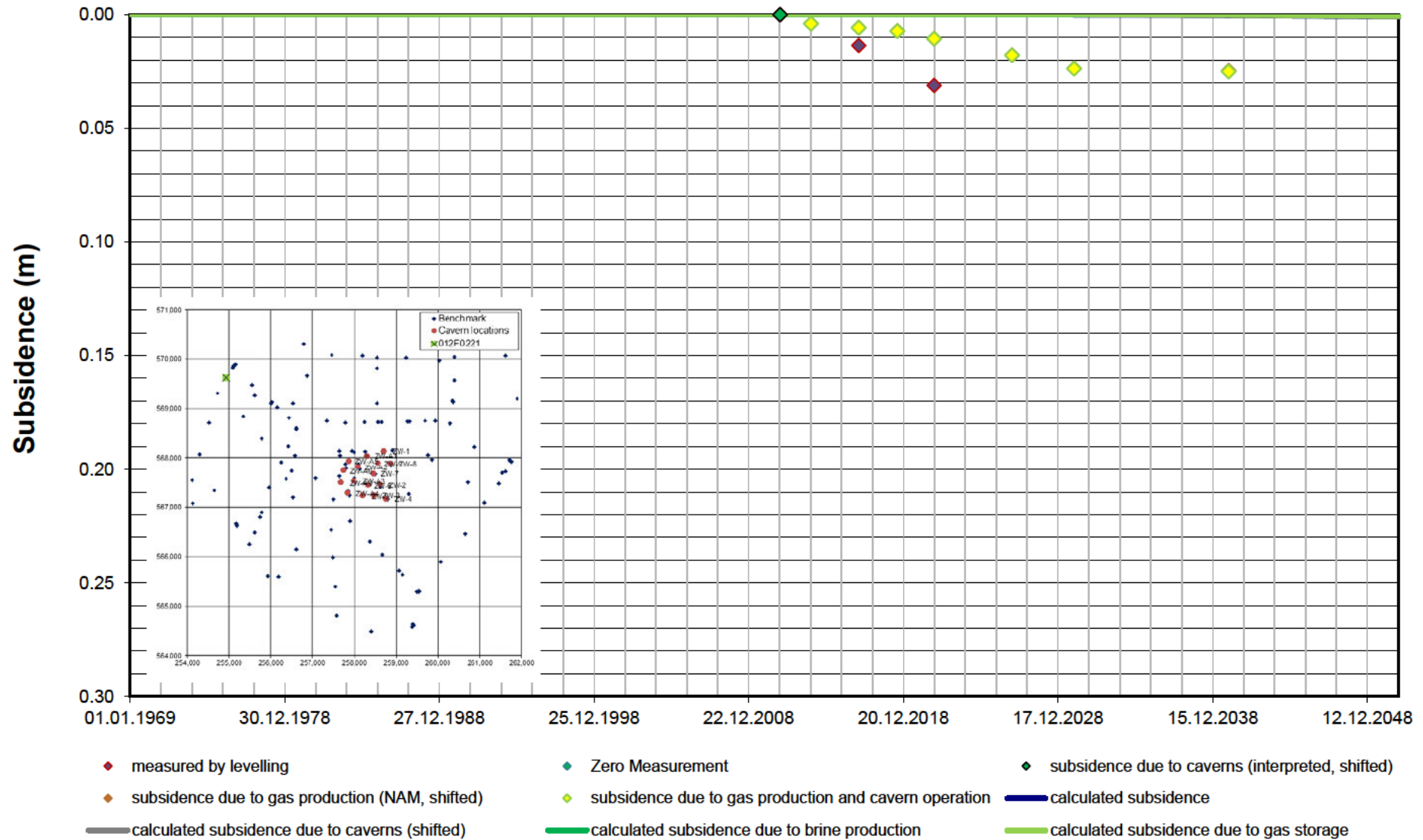


Deviation
0.0142

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0221 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

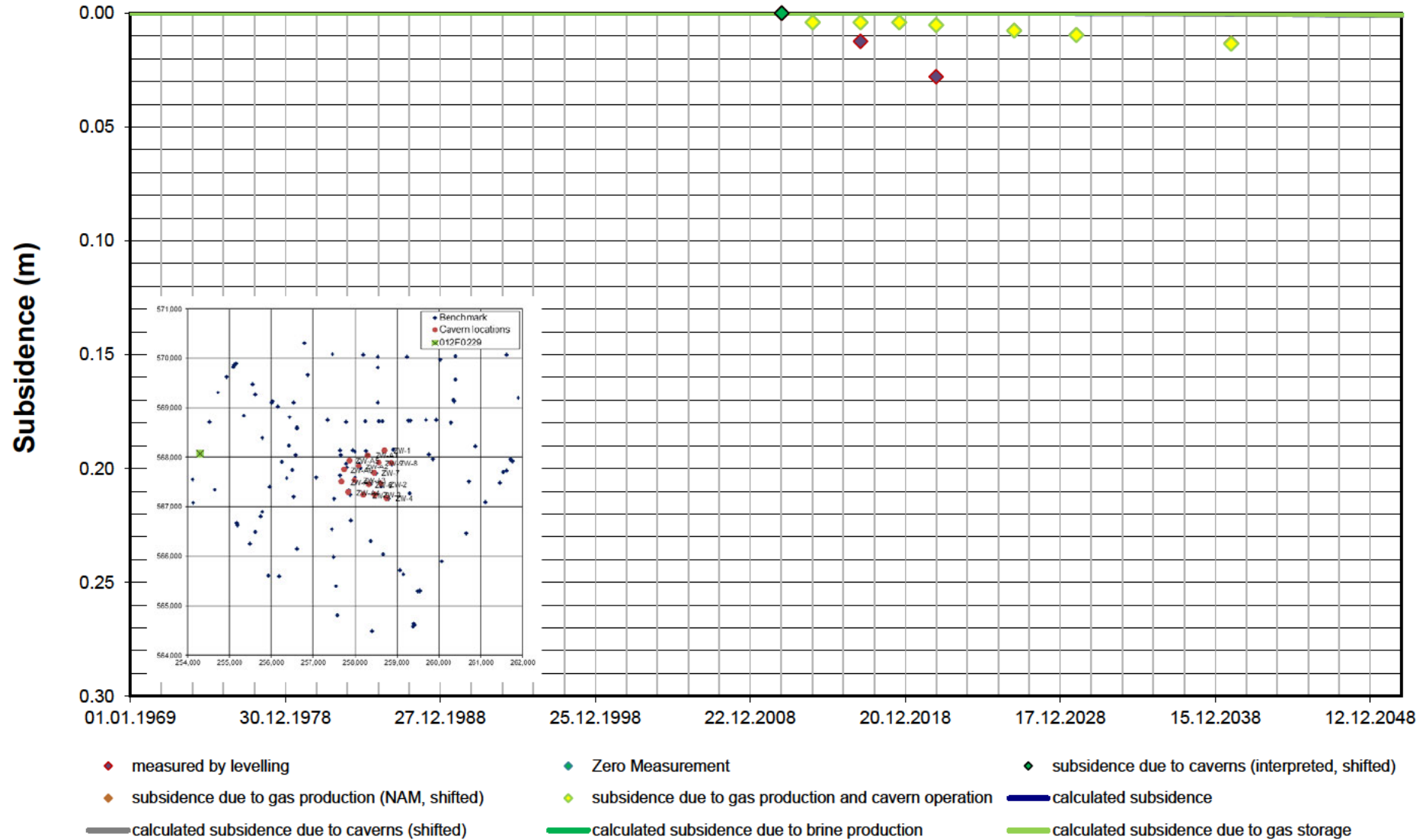


Deviation
0.0155

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0229 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

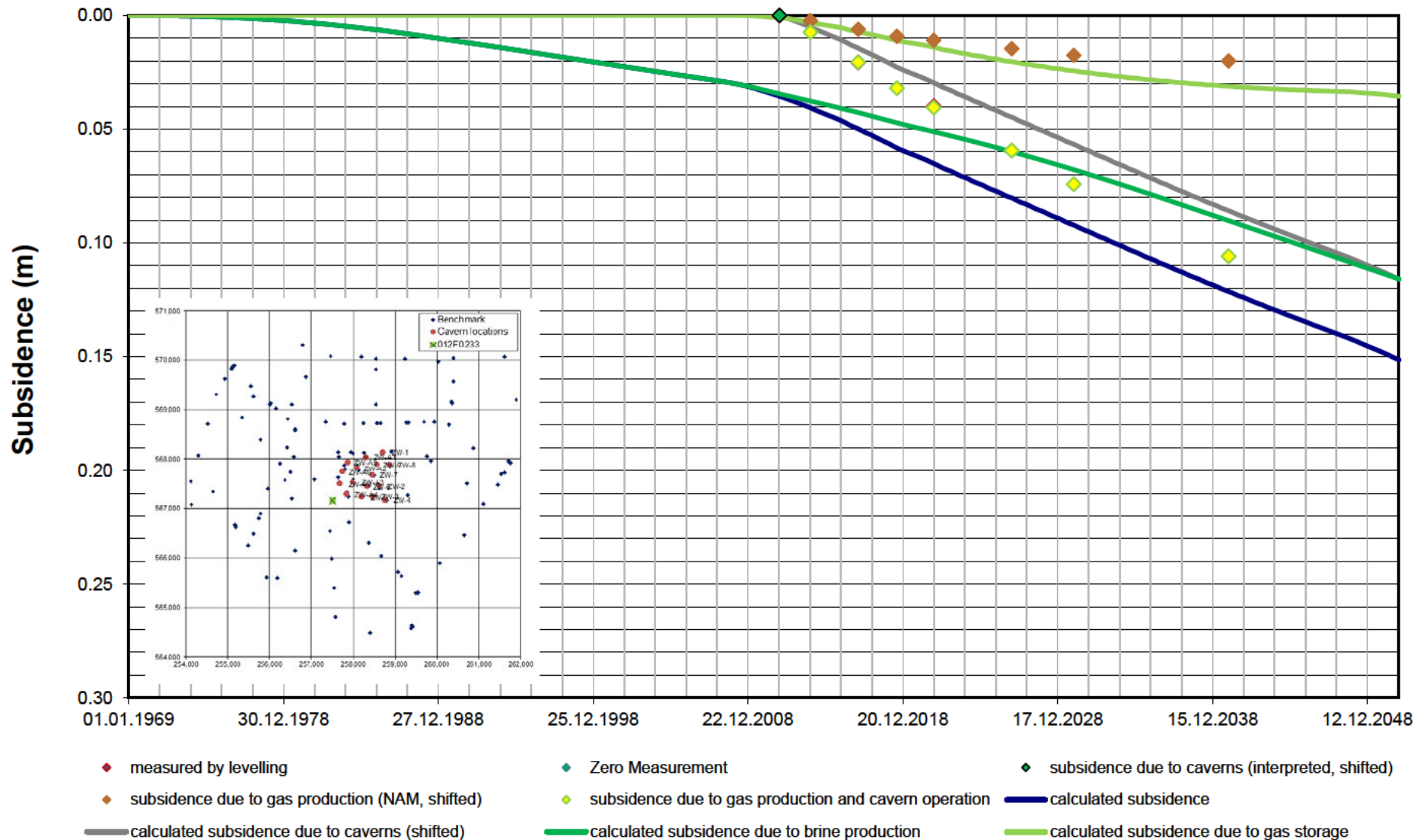


Deviation
0.0005

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0233 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

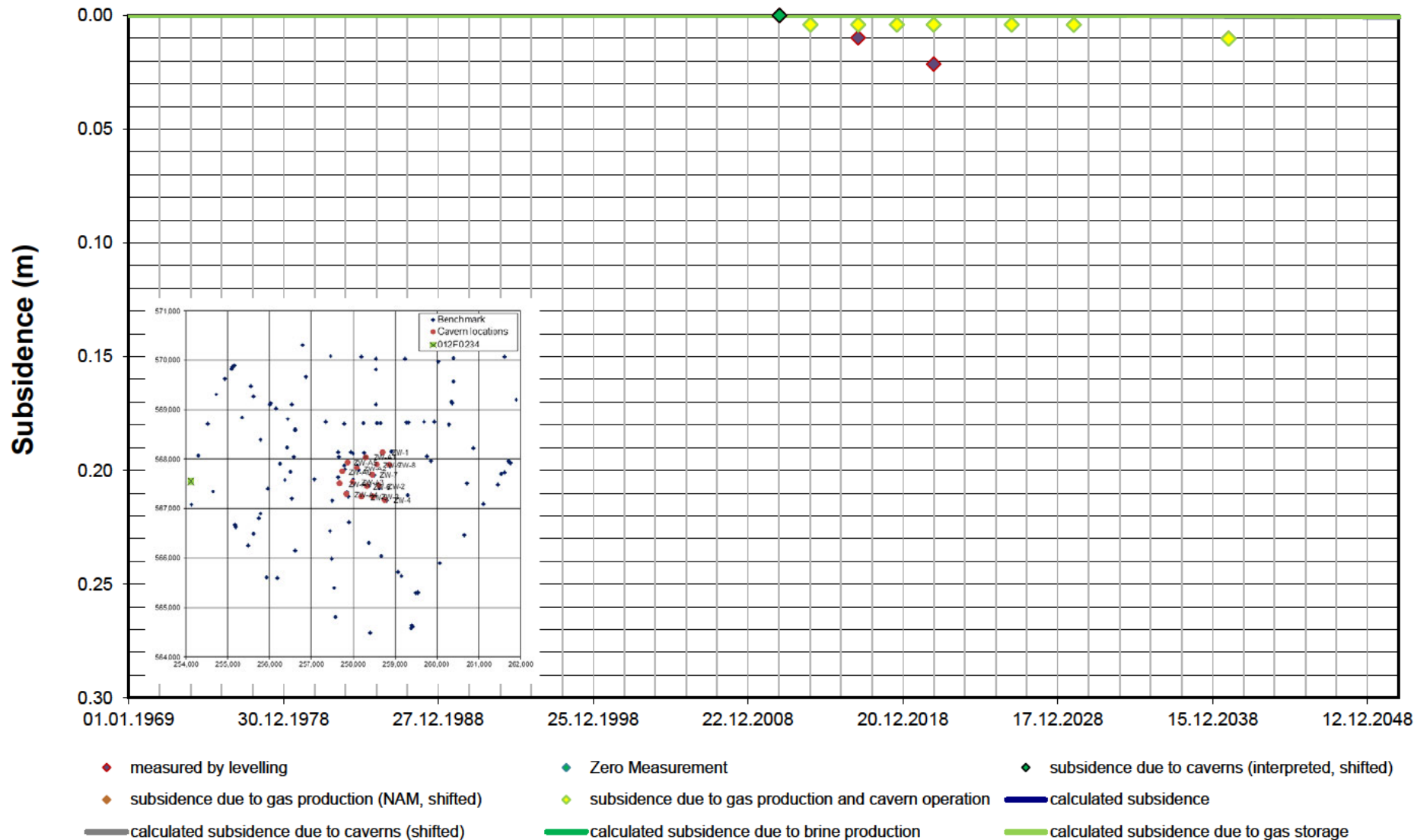


Deviation
0.0116

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0234 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

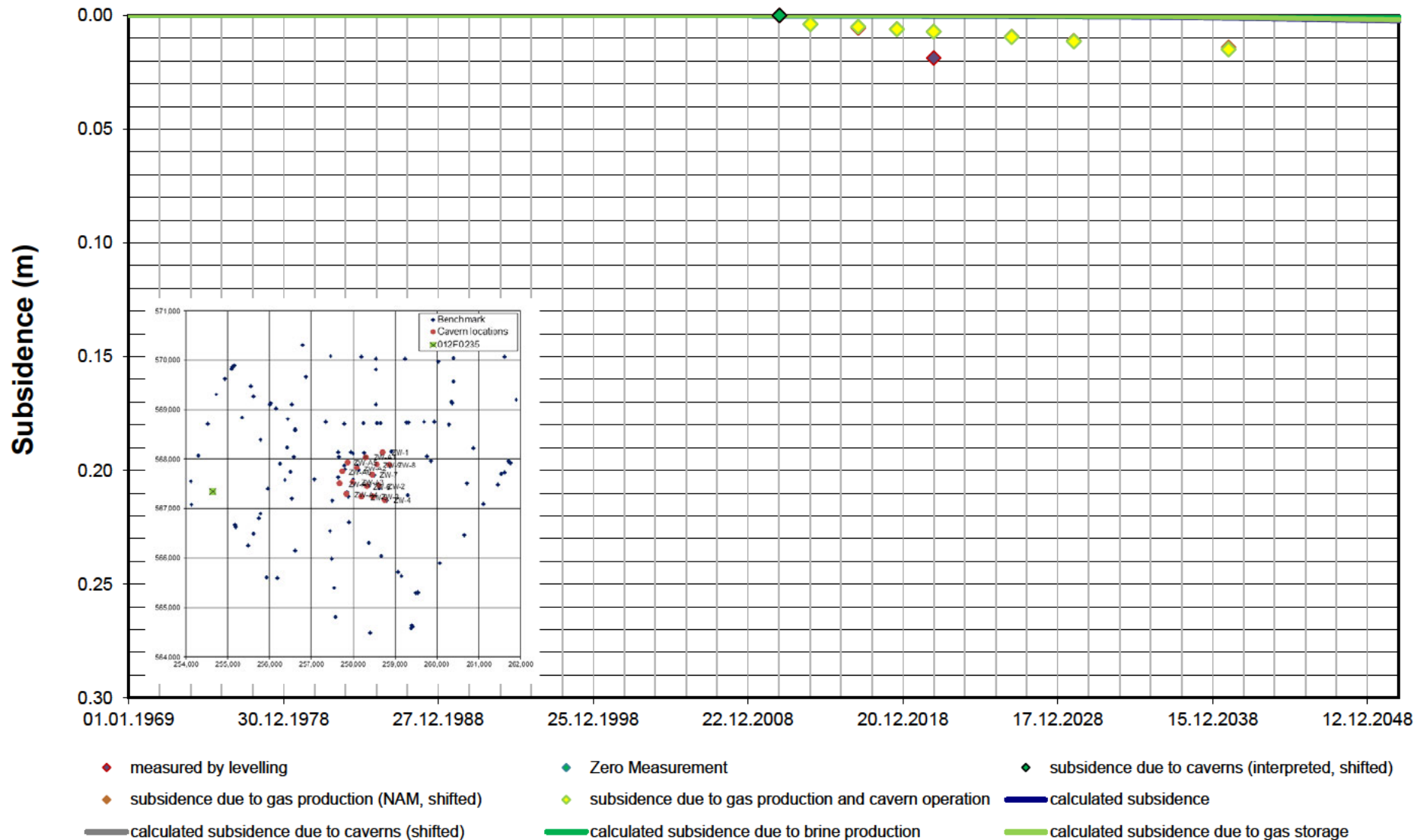


Deviation
0.0060

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0235 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

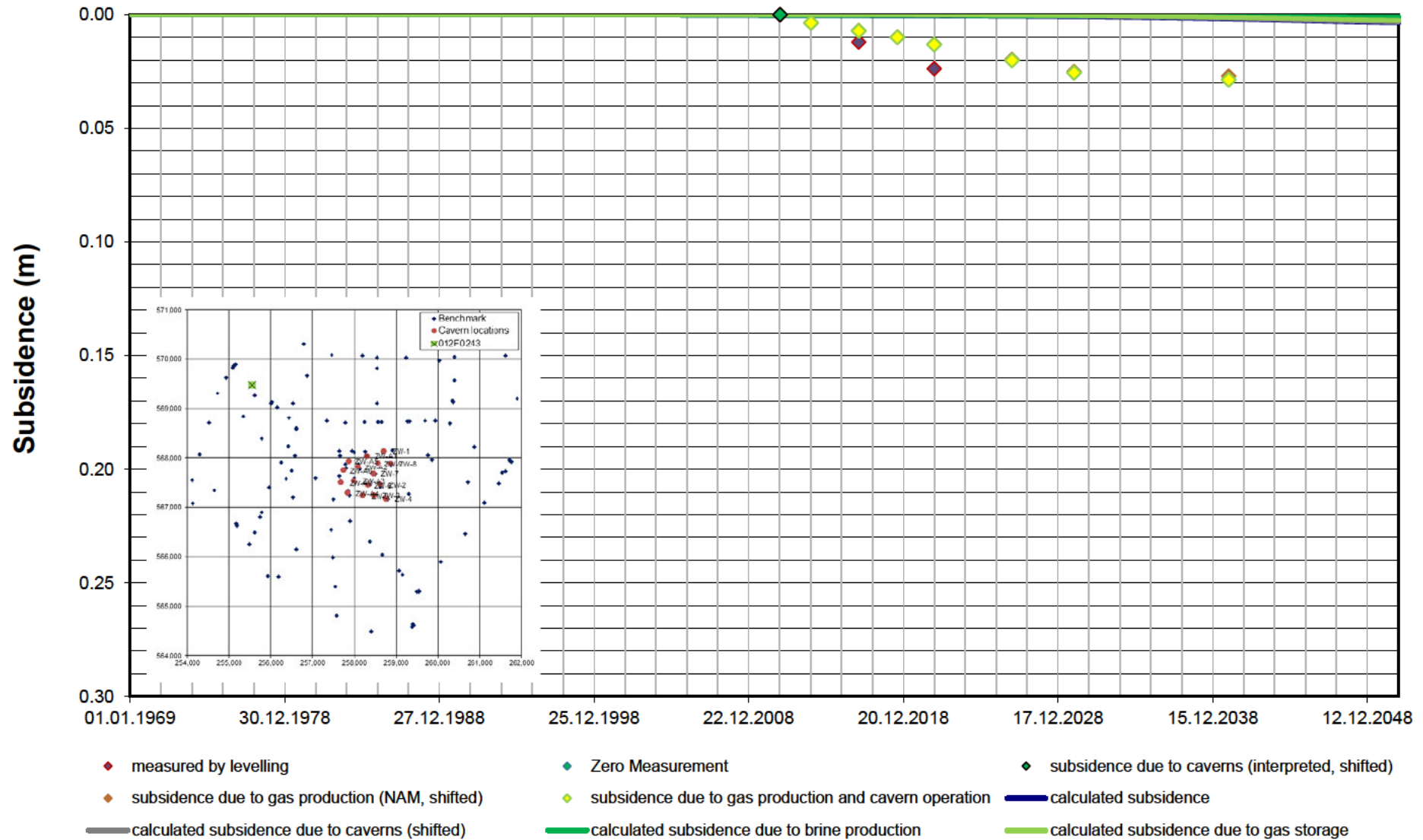


Deviation
0.0078

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0243 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

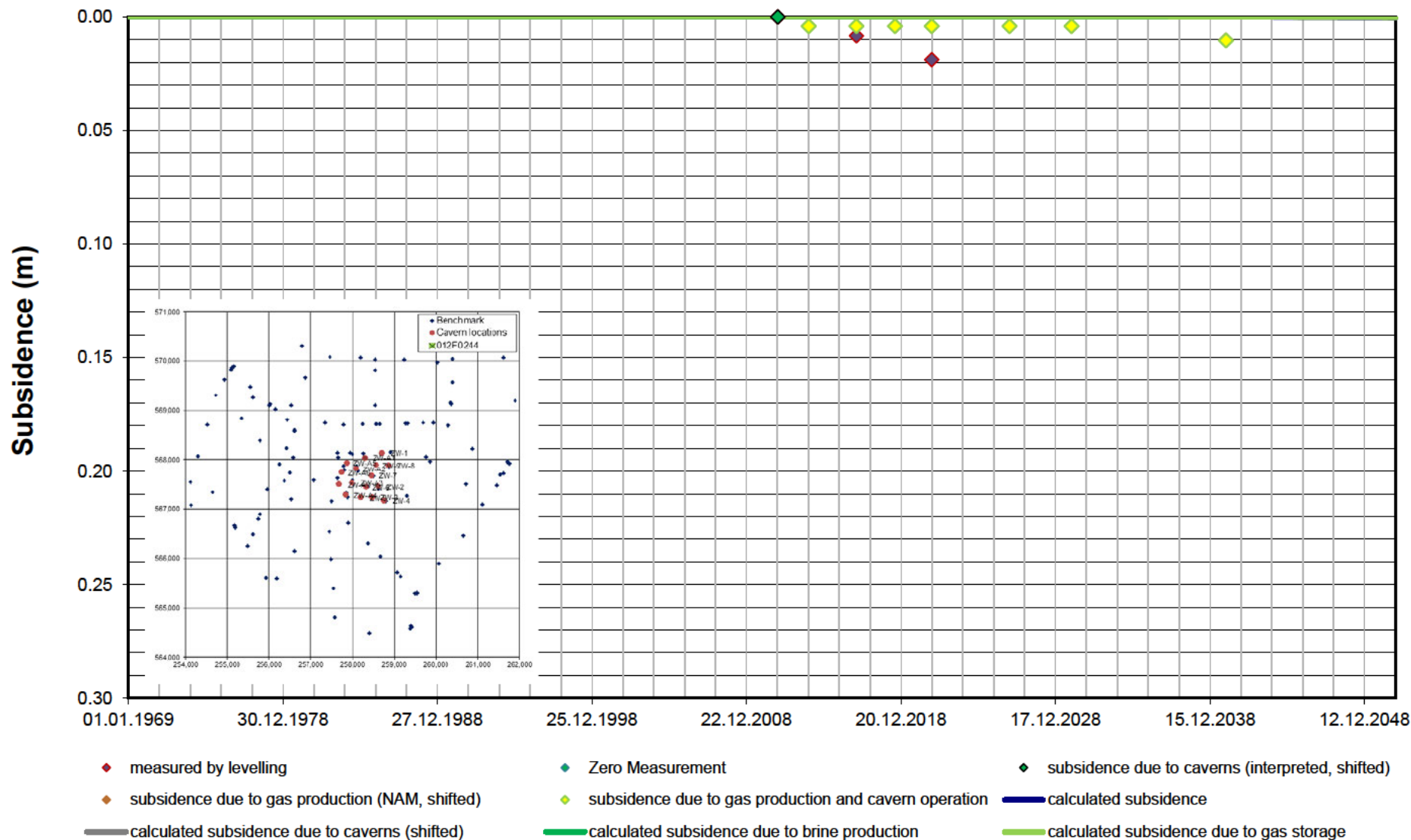


Deviation
0.0095

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0244 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

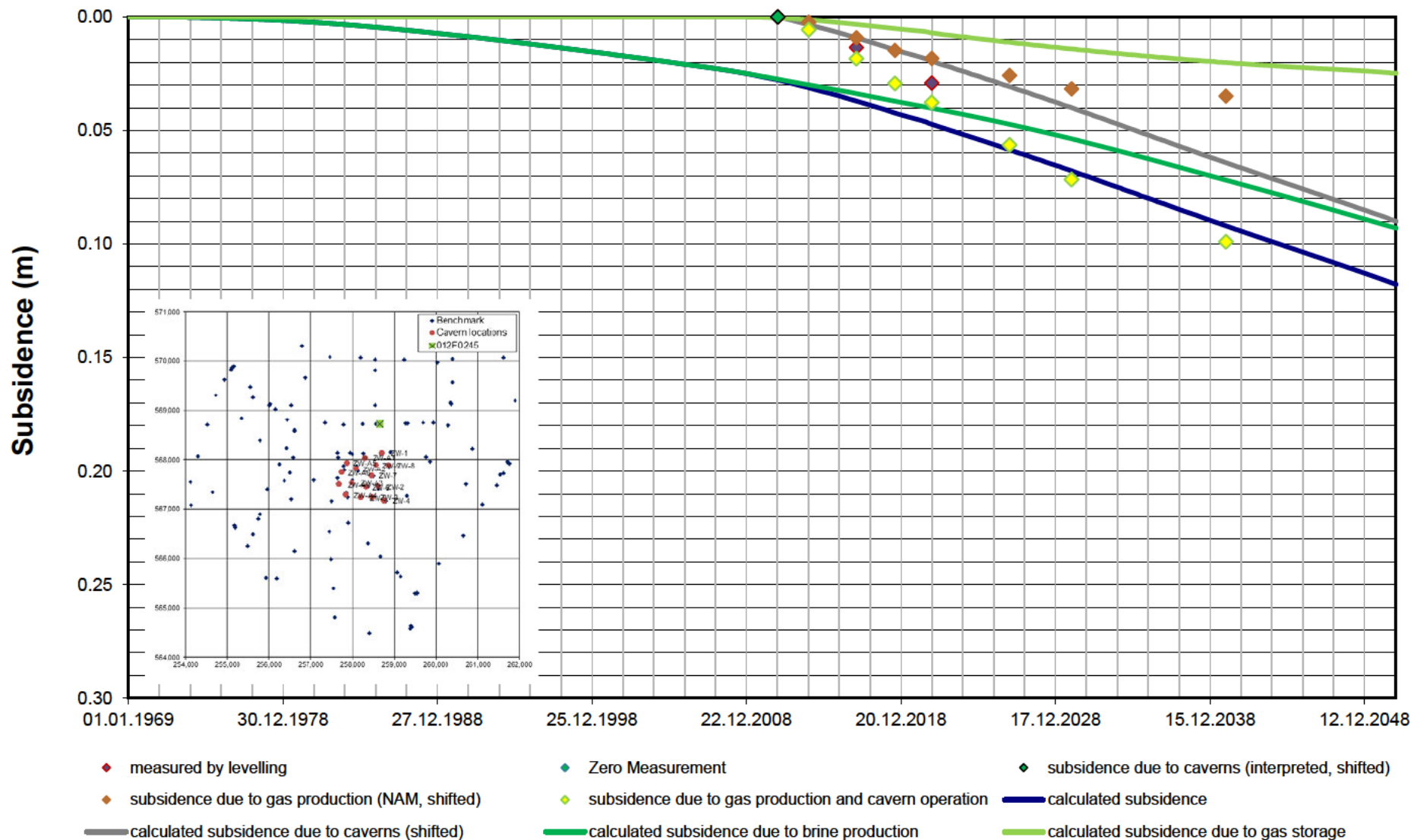


Deviation
0.0068

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0245 (ZW-1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

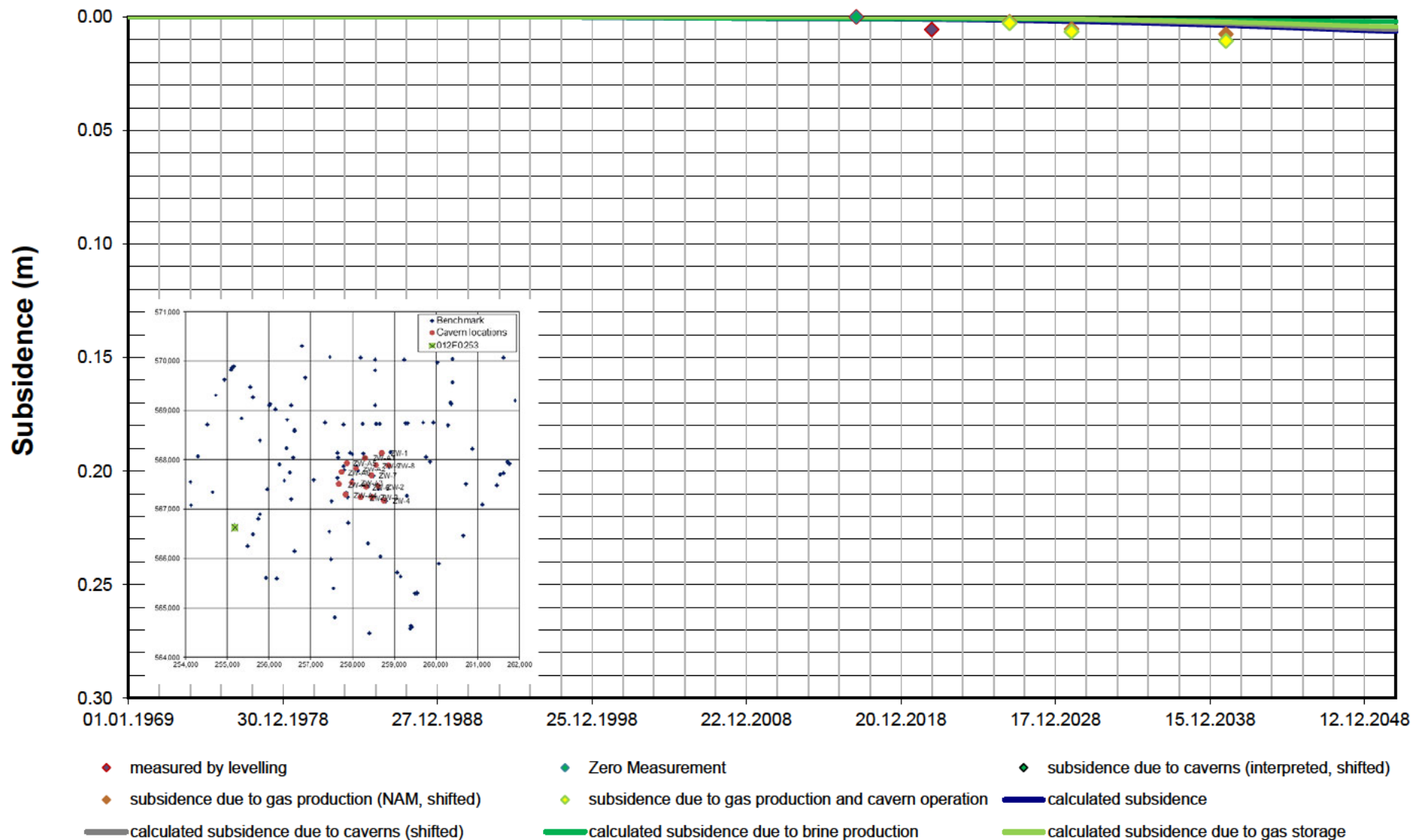


Deviation
0.0059

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0253 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

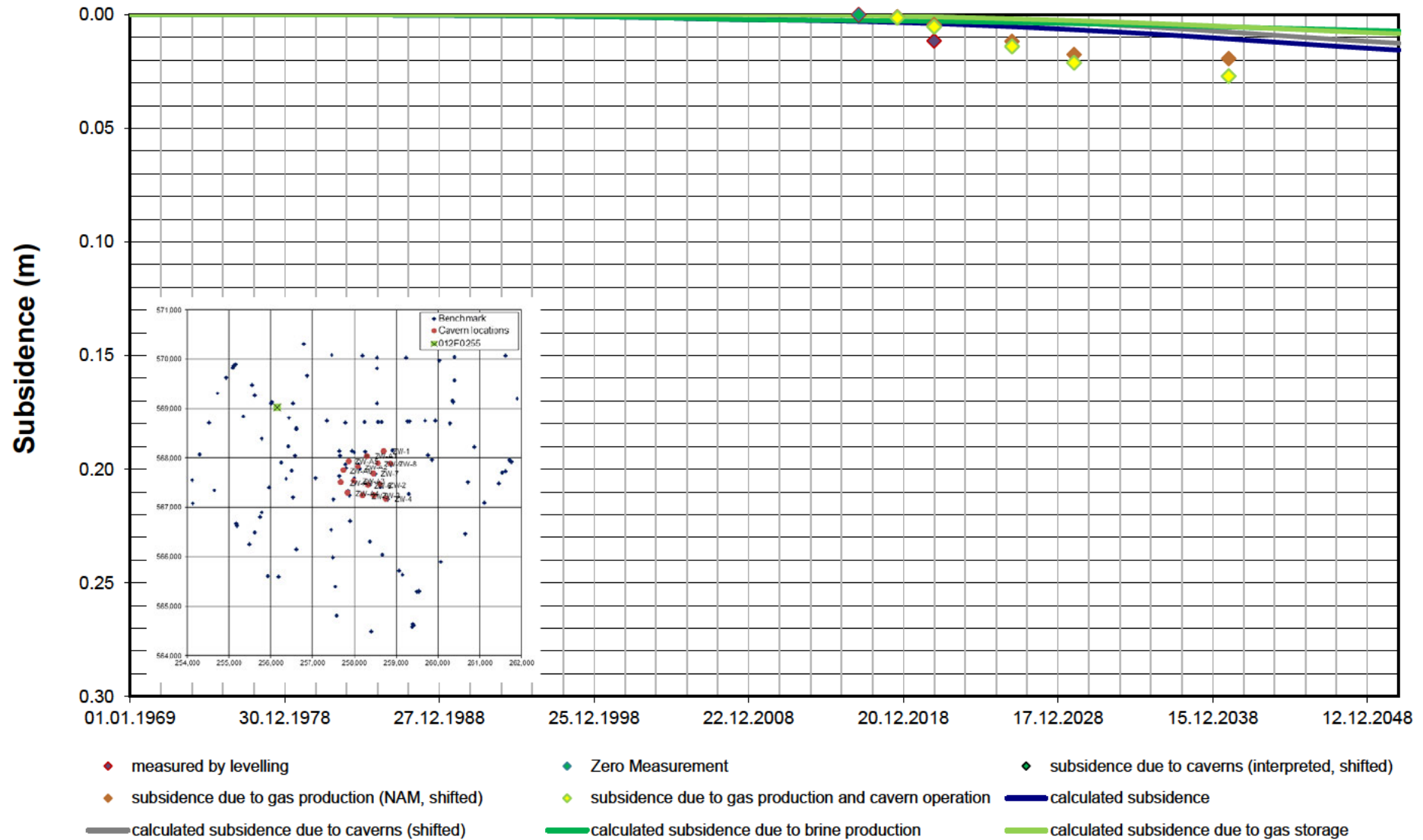


Deviation
0.0040

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F0255 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

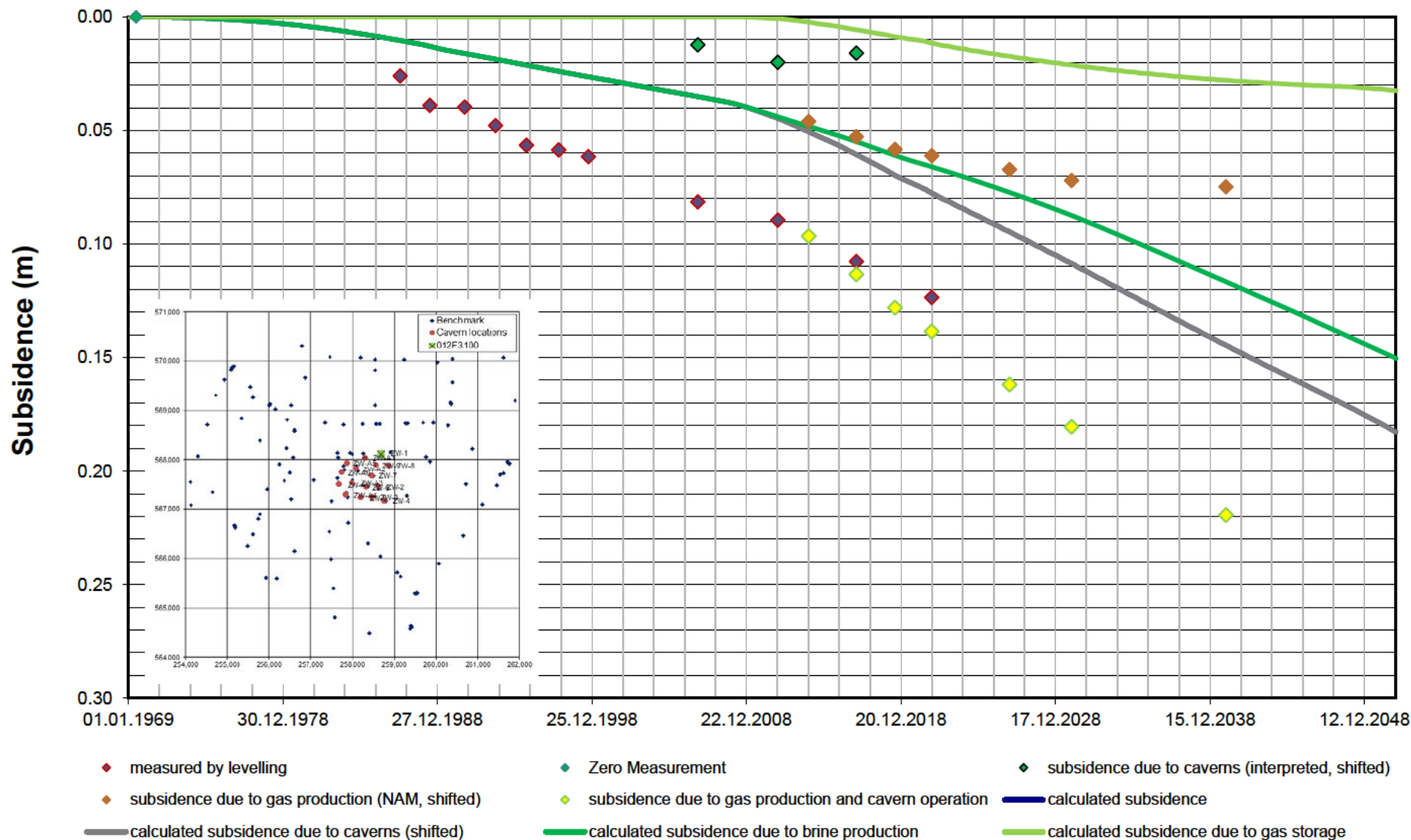


Deviation
0.0104

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3100 (ZW-1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

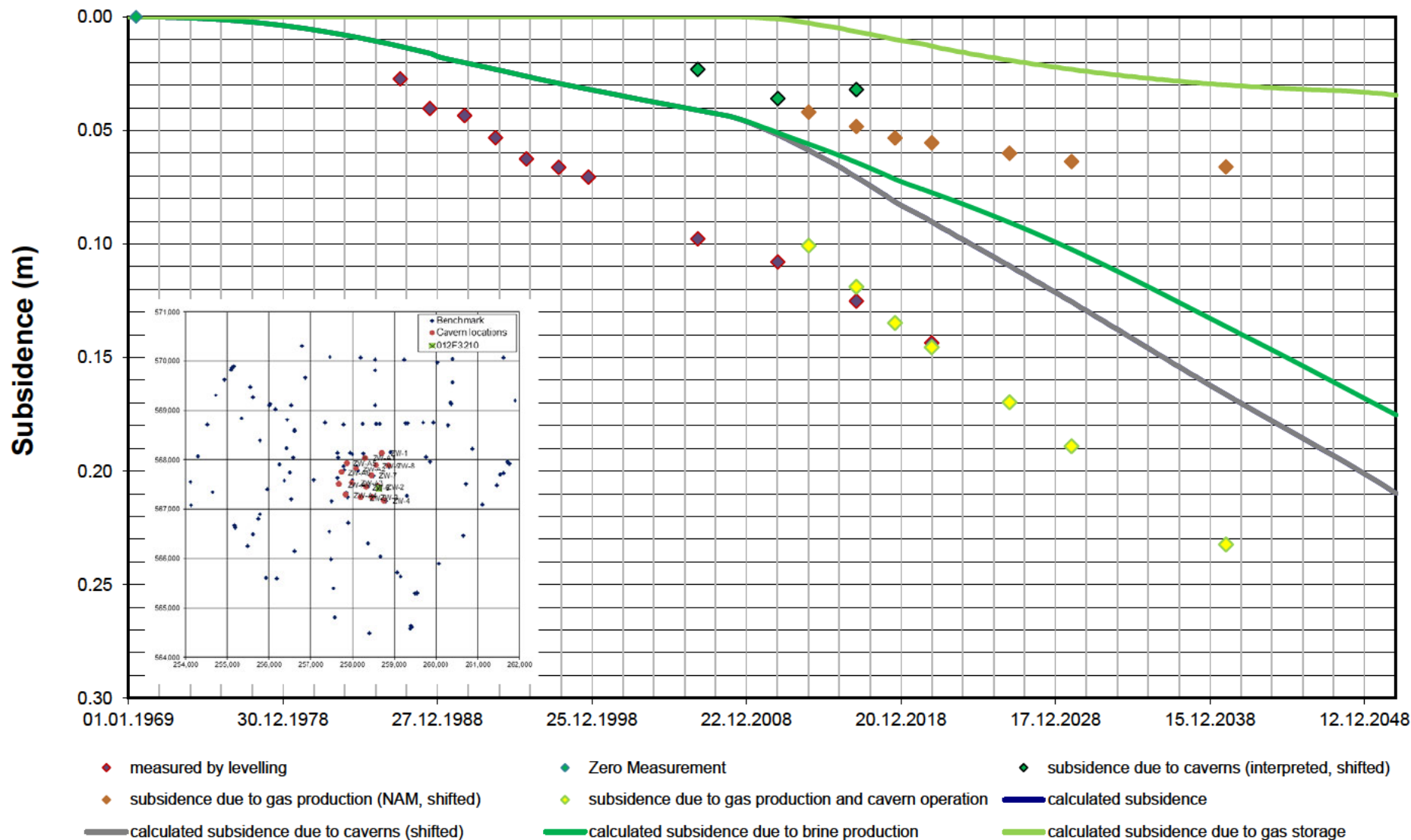


Deviation
0.0042

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3210 (ZW-2)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

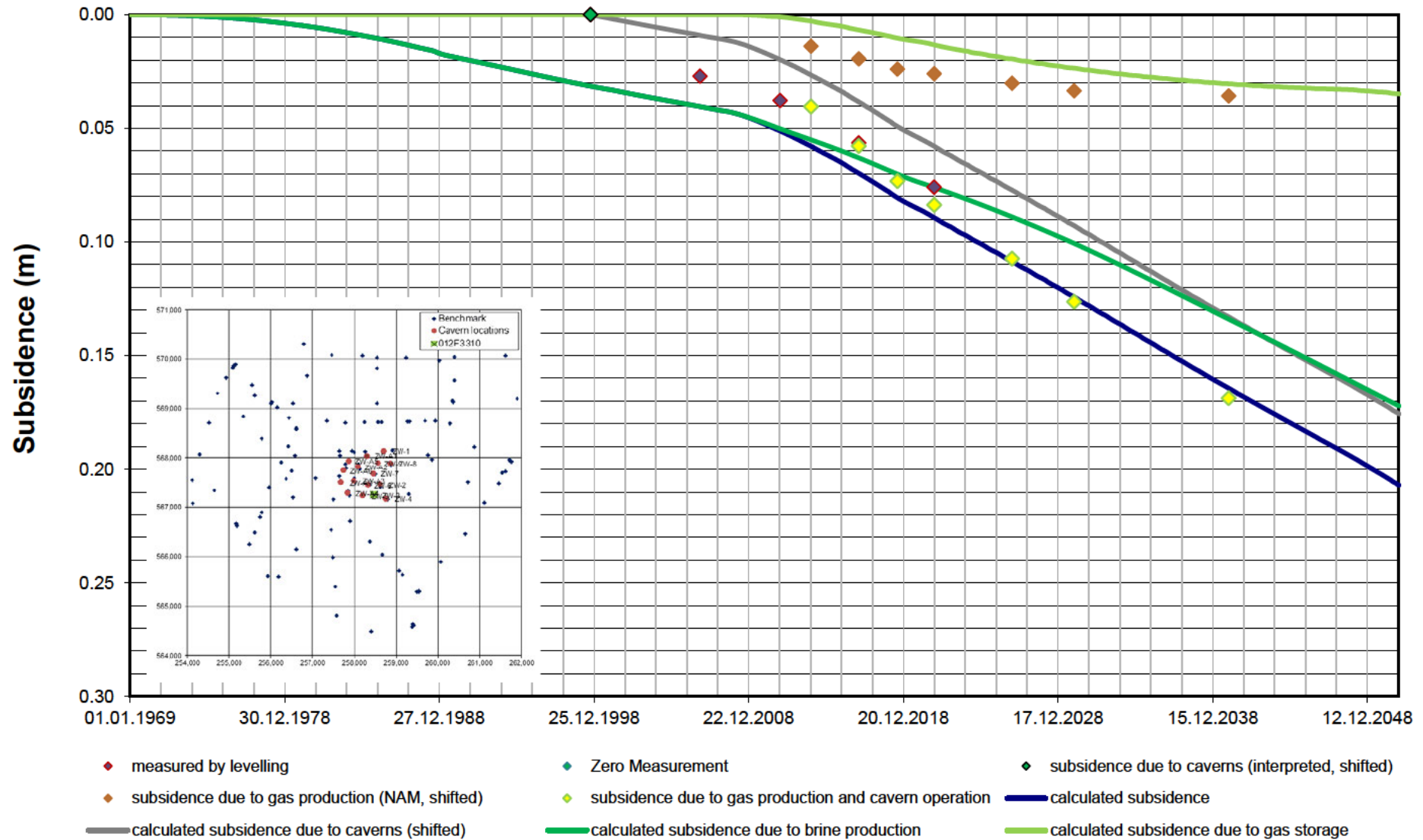


Deviation
0.0047

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3310 (ZW-3)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

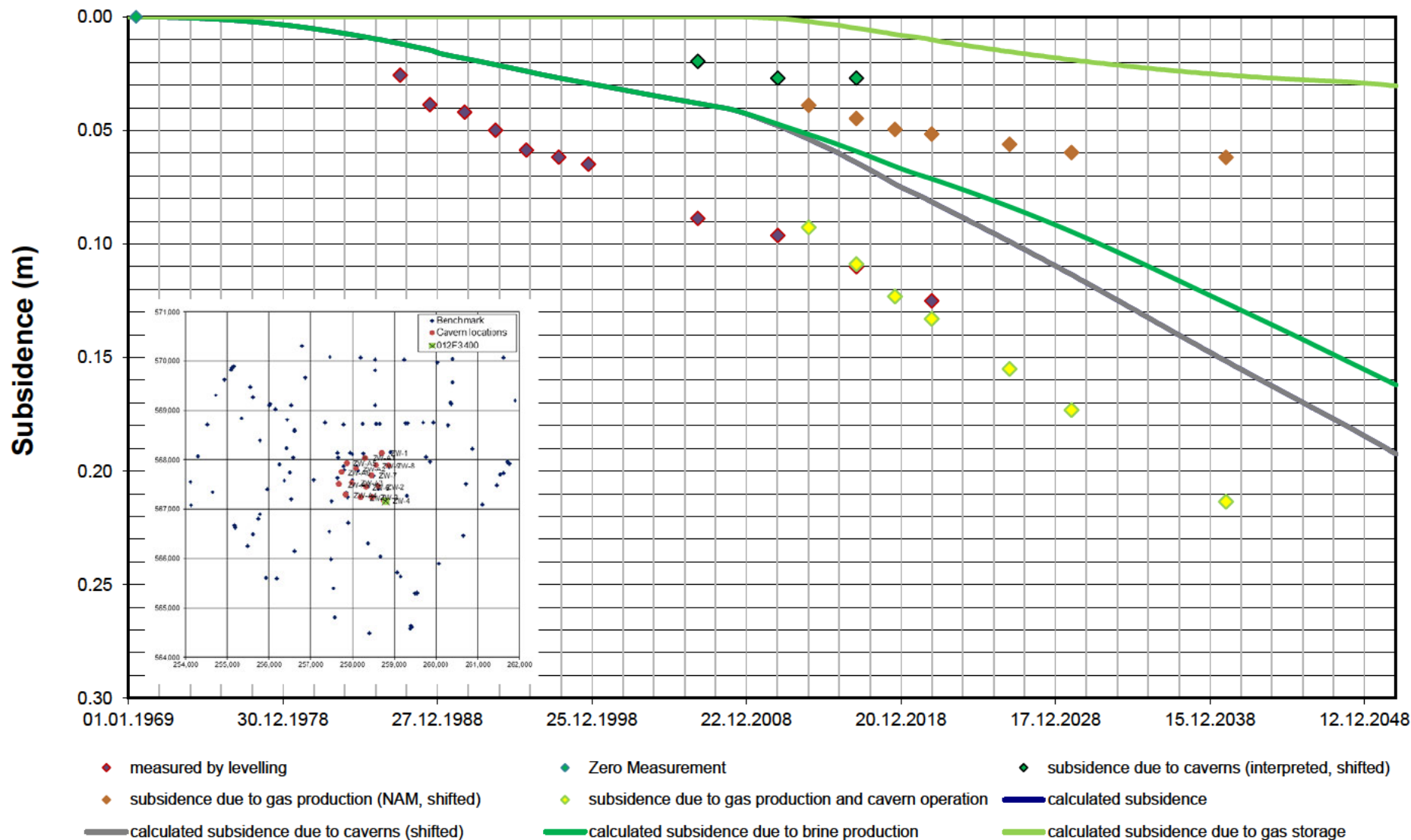


Deviation
0.0045

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3400 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

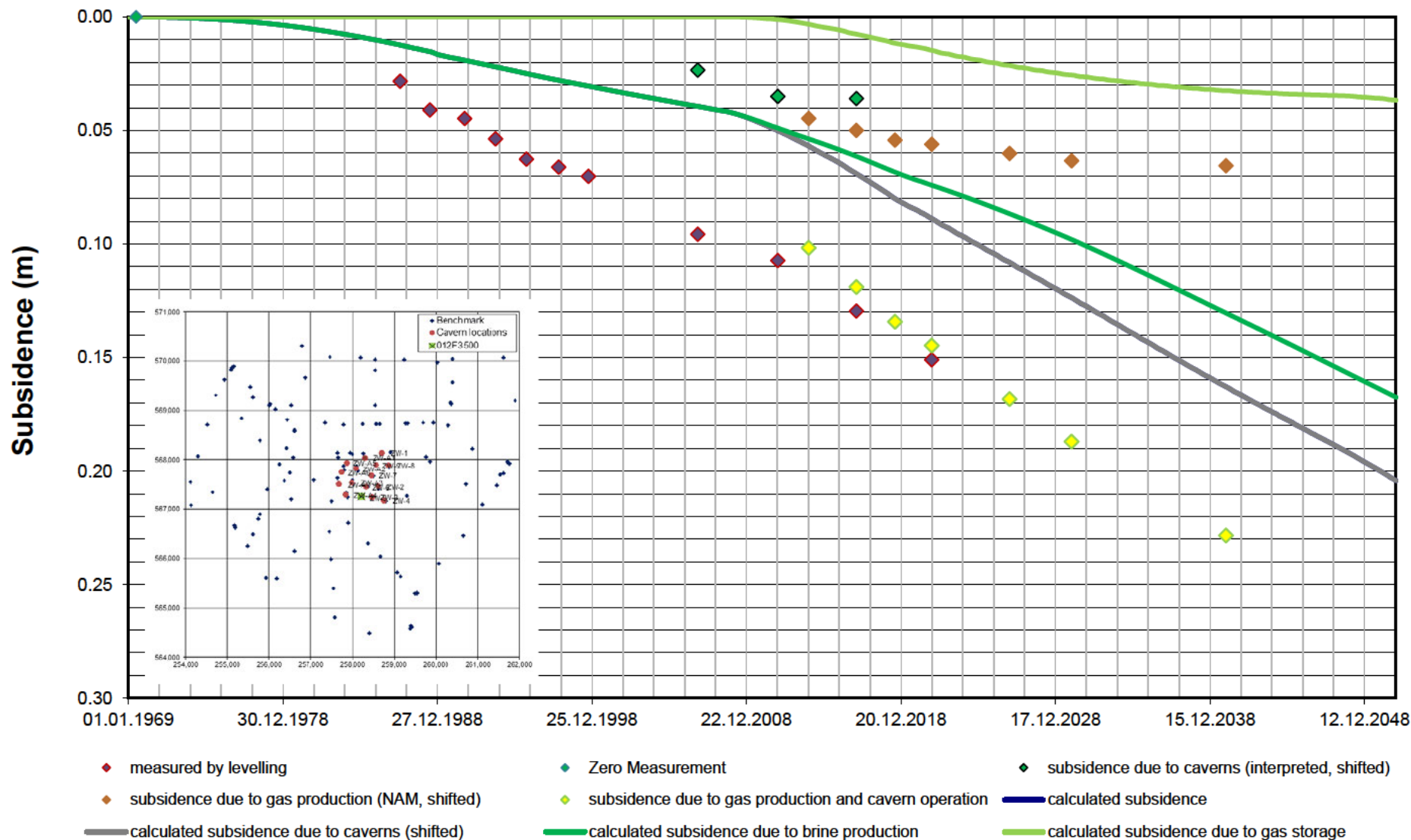


Deviation
0.0084

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3500 (ZW-5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

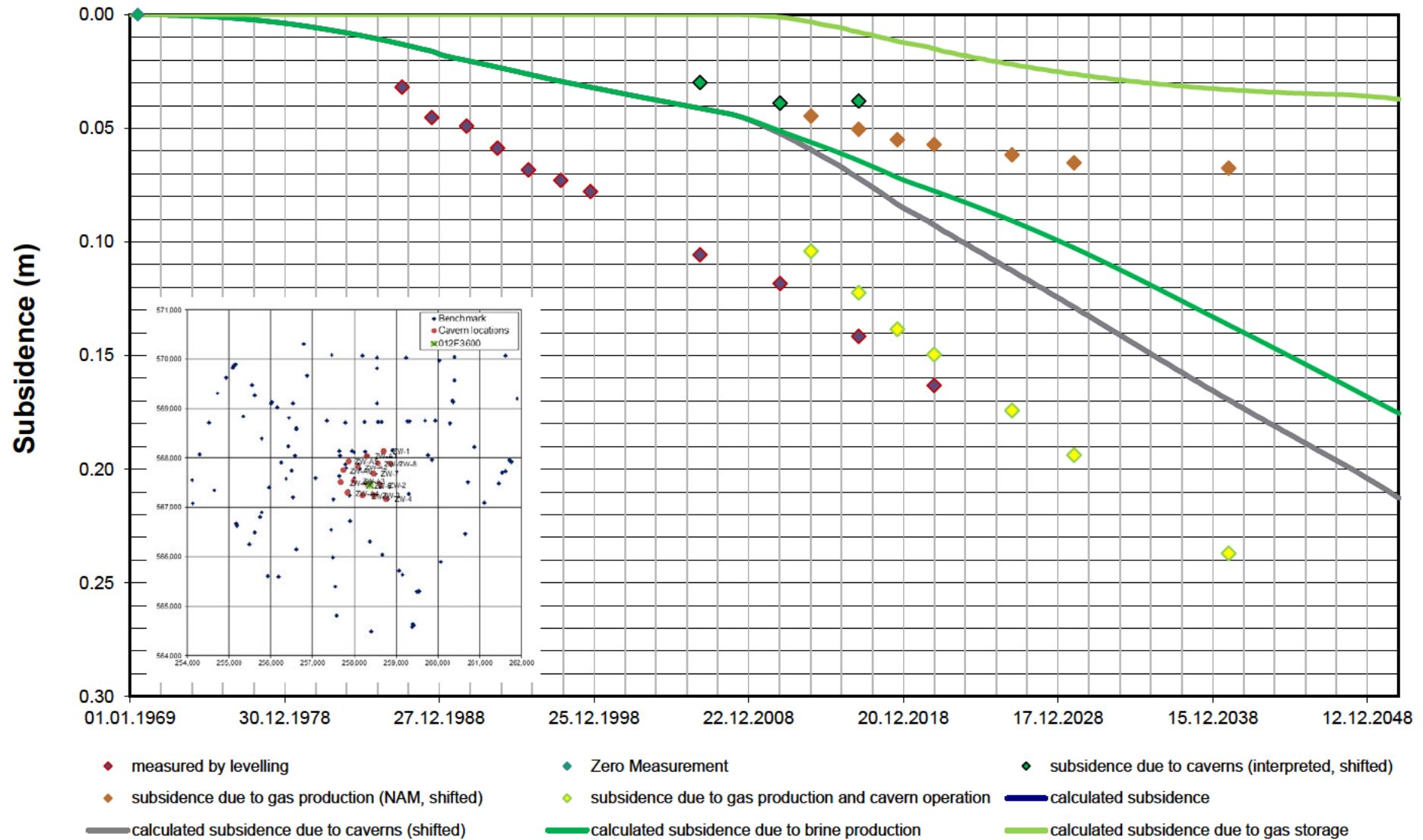


Deviation
0.0164

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3600 (ZW-6)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

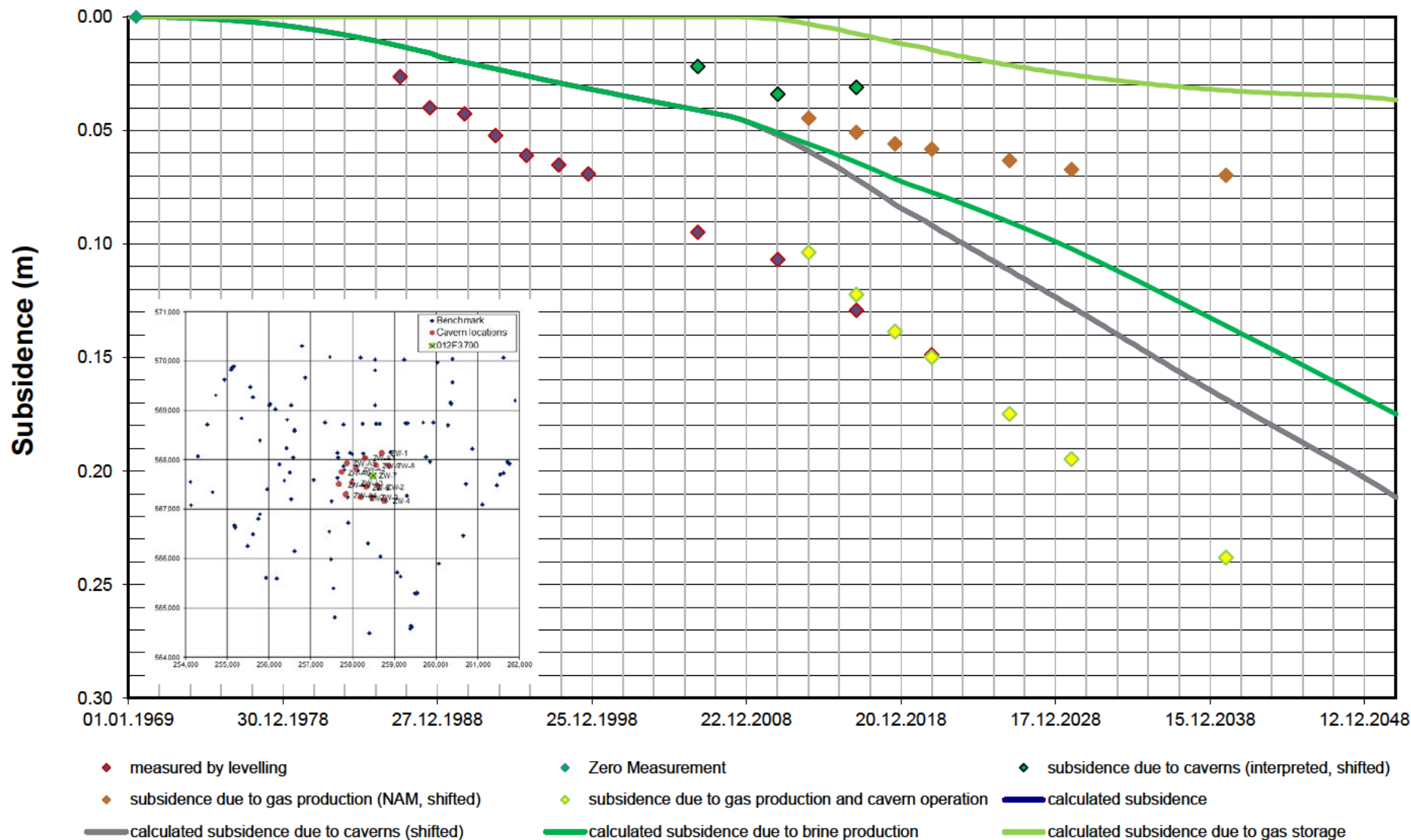


Deviation
0.0040

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3700 (ZW-7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

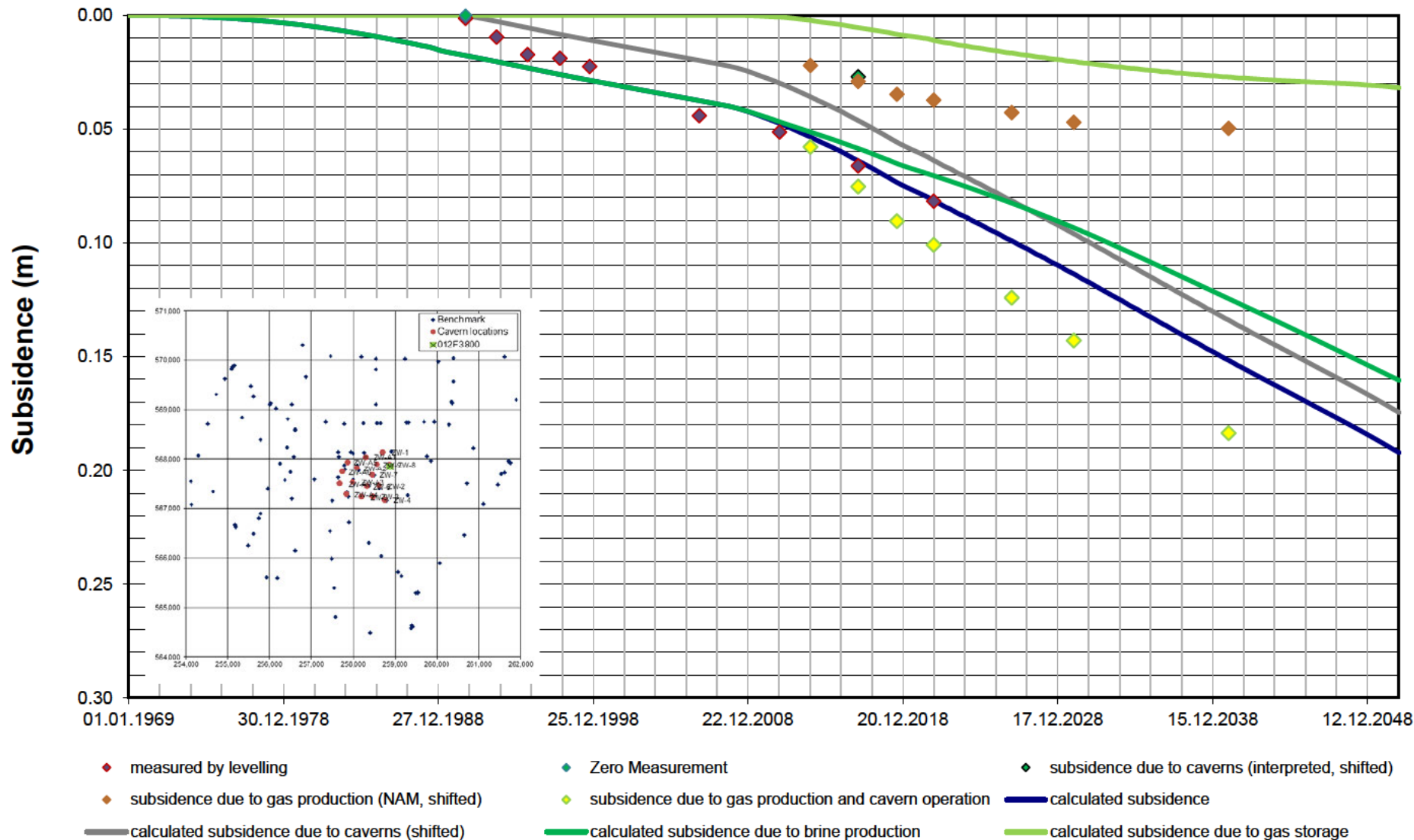


Deviation
0.0141

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3800 (ZW-8)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

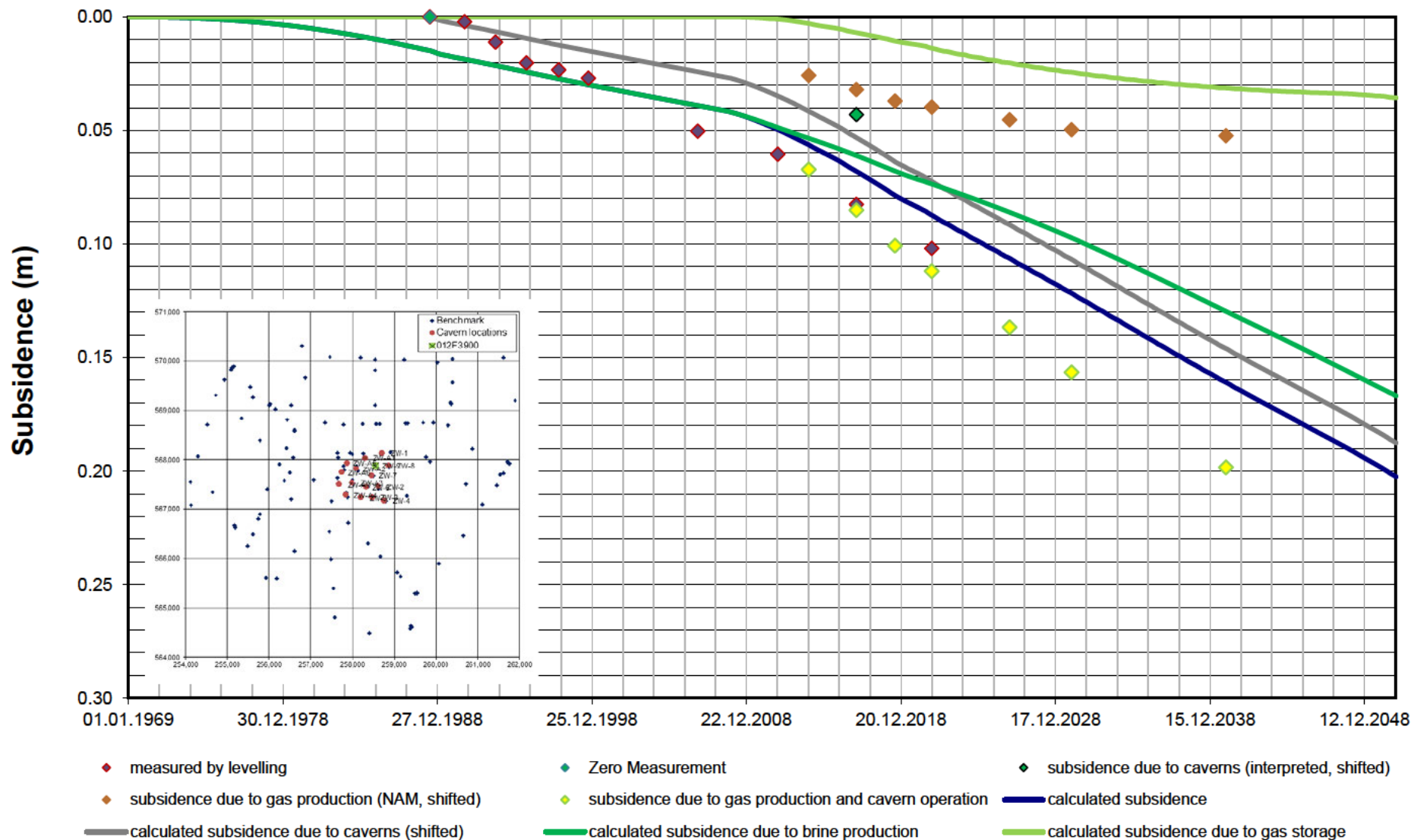


Deviation
0.0064

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F3900 (ZW-9)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

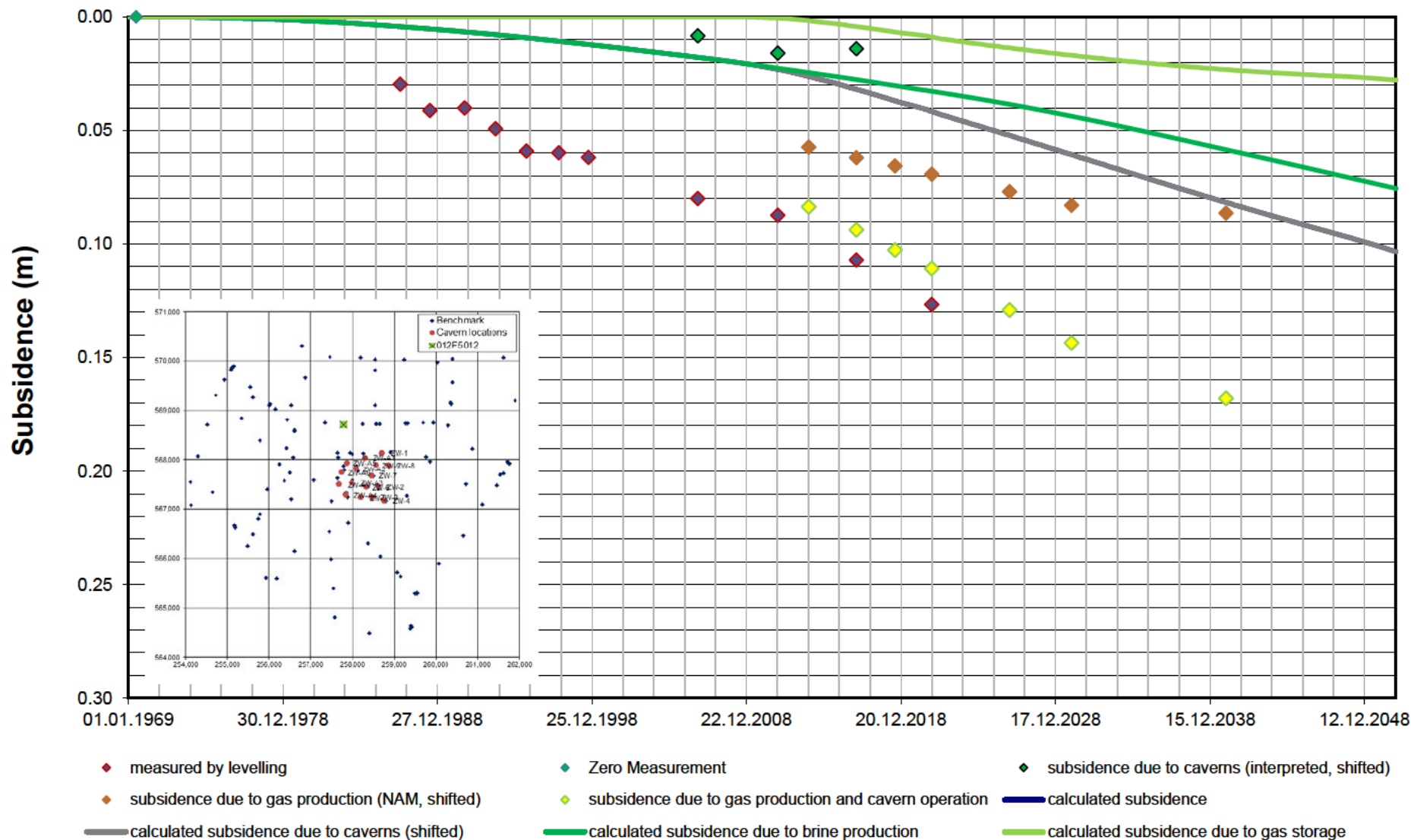


Deviation
0.0146

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5012 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

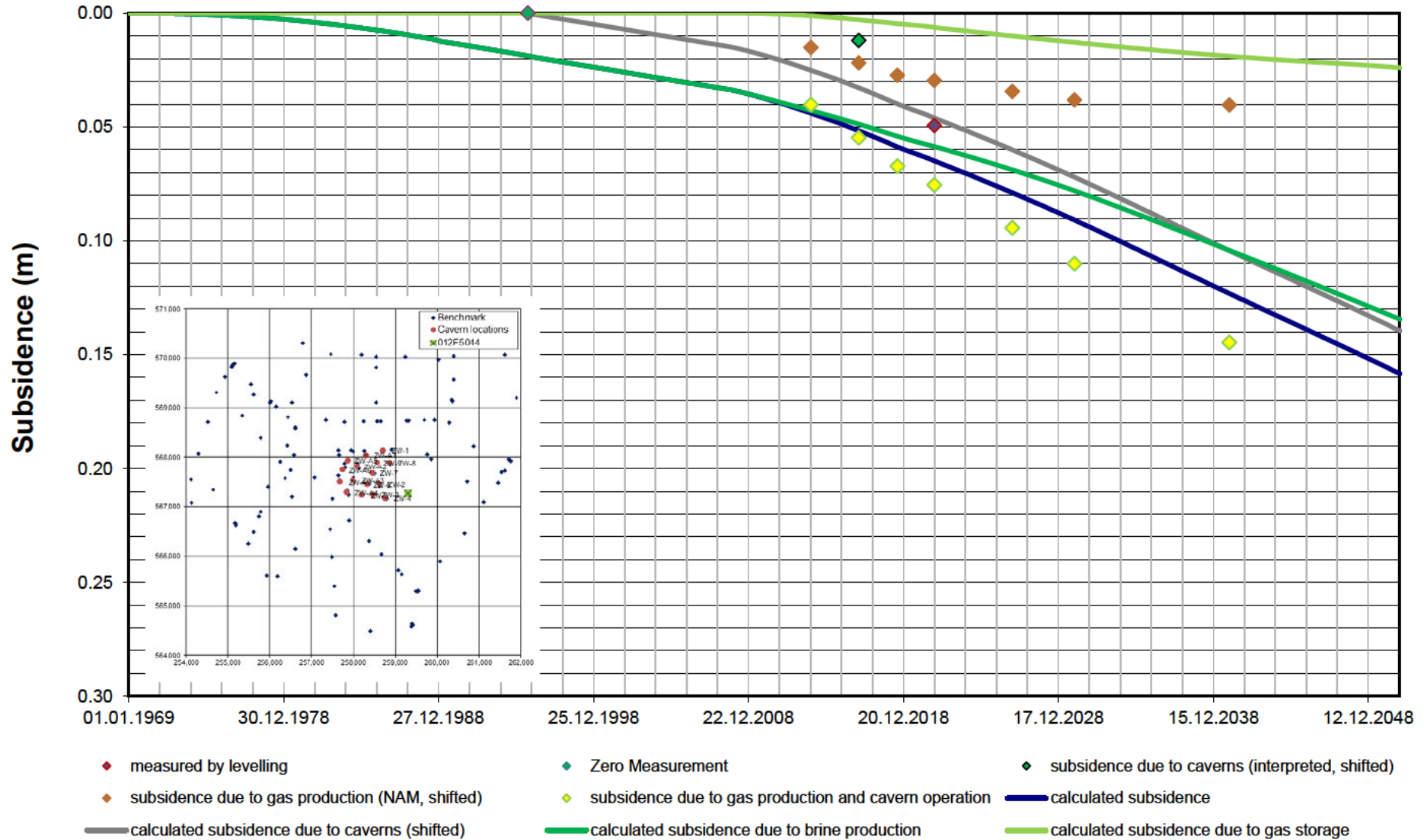


Deviation
0.0261

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5044 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

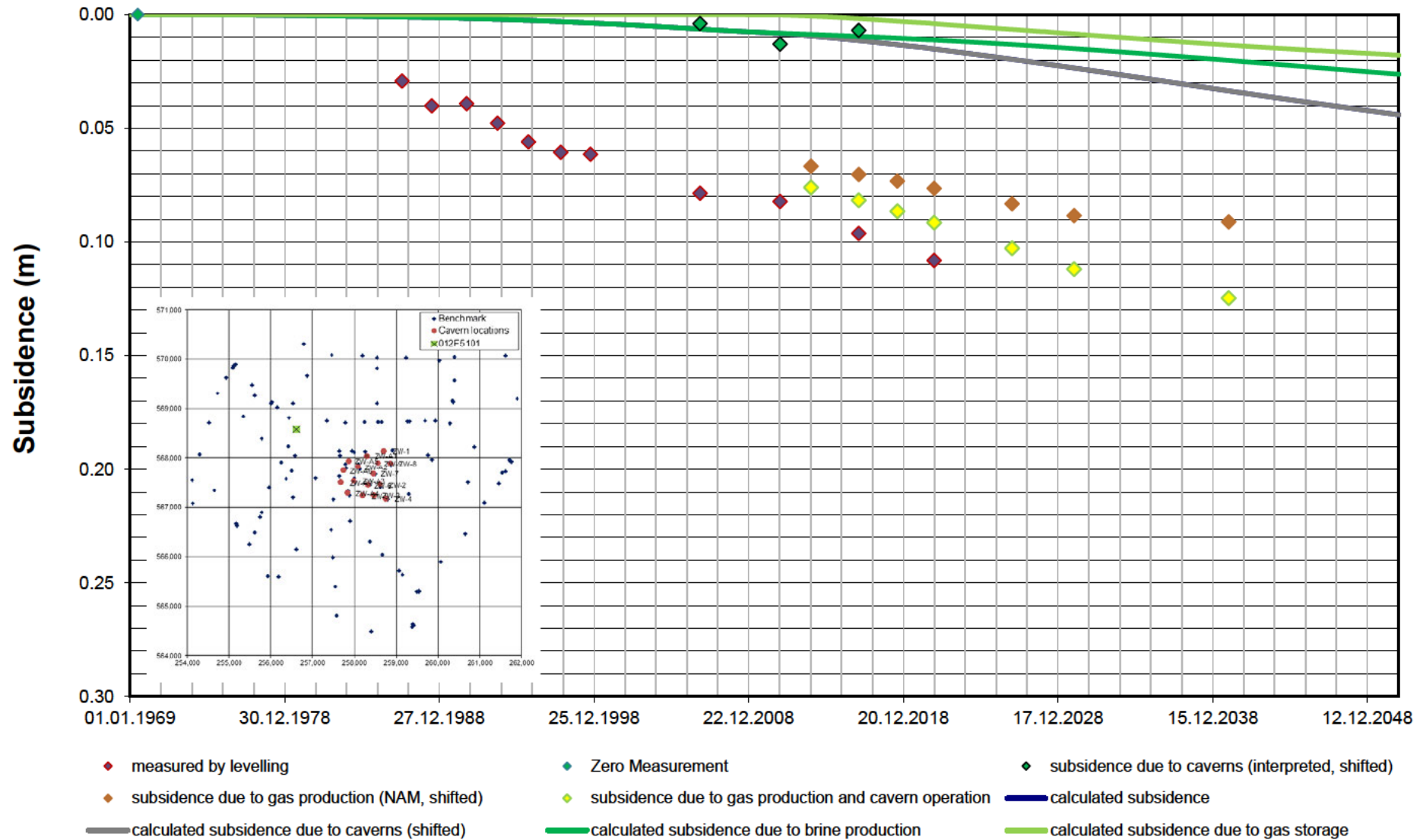


Deviation
0.0156

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5101 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

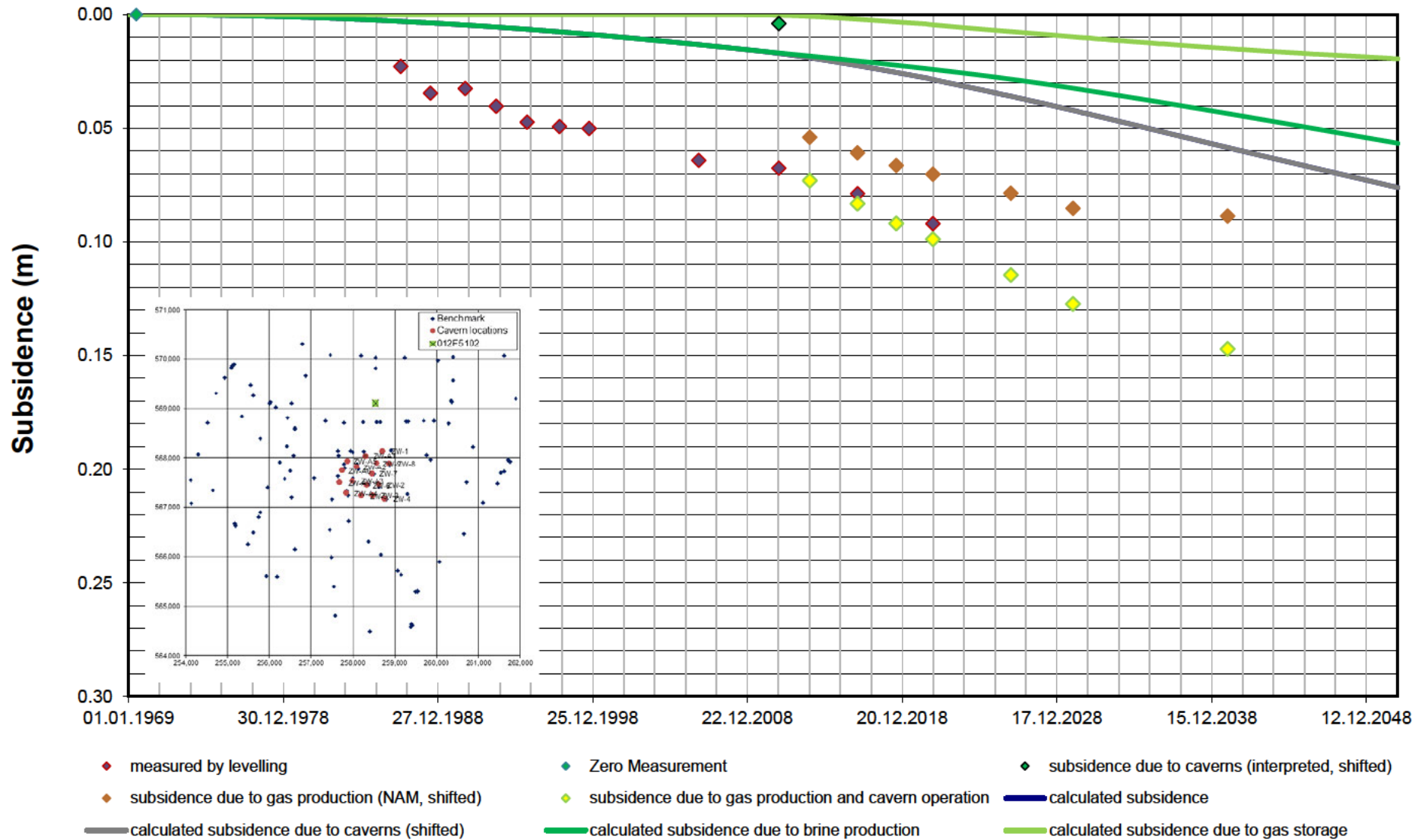


Deviation
0.0056

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5102 (ZW-1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

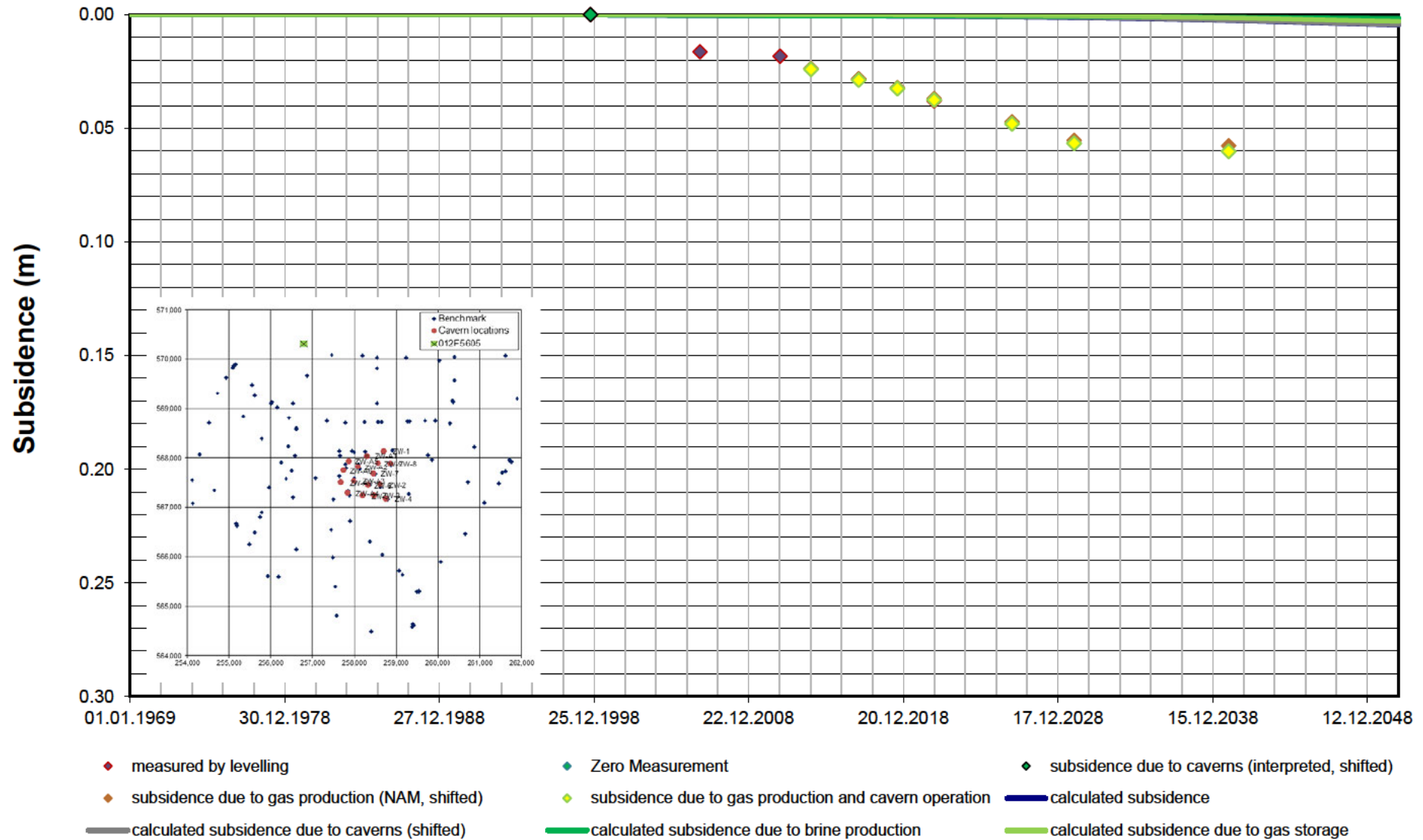


Deviation
0.0004

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5605 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

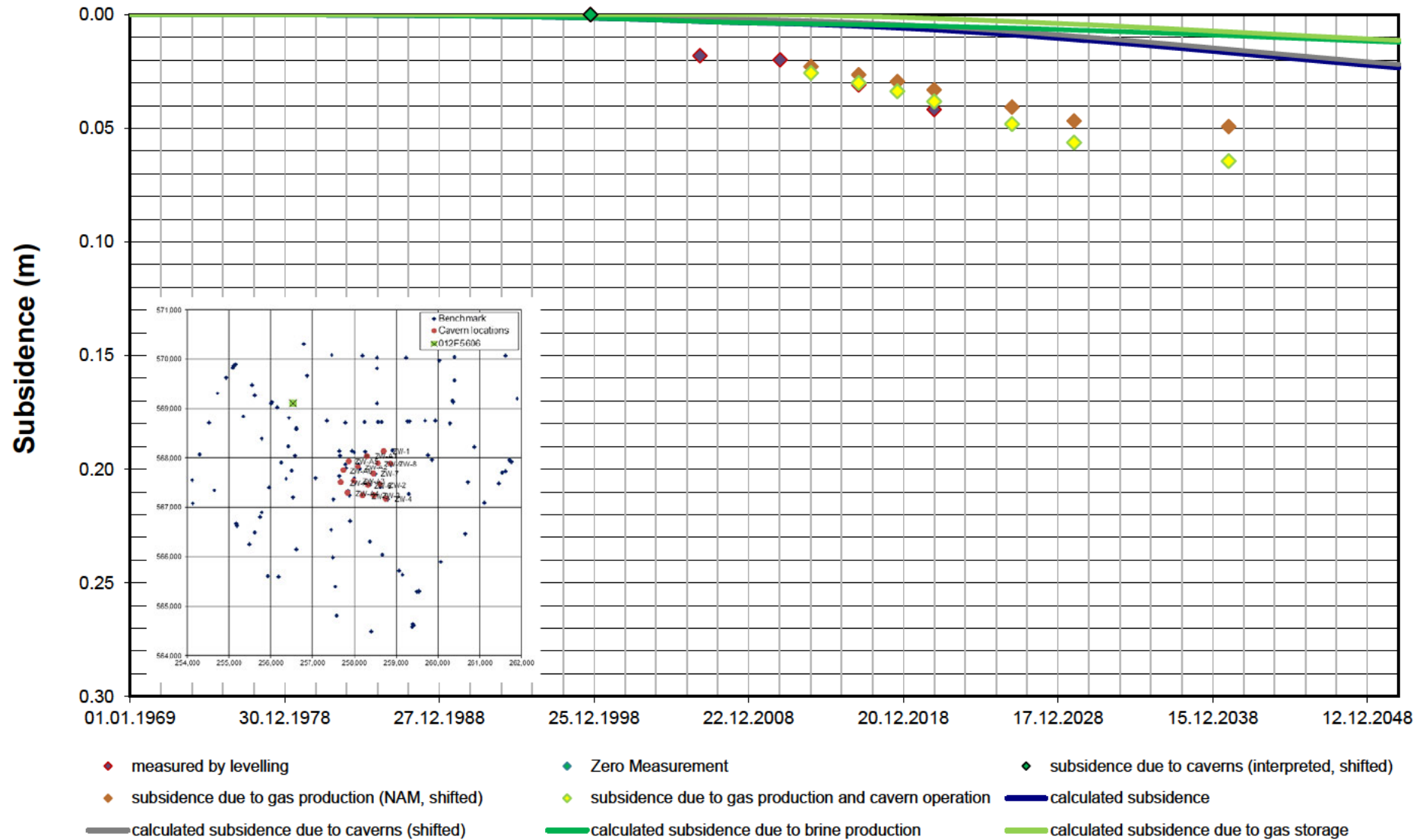


Deviation
0.0022

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5606 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

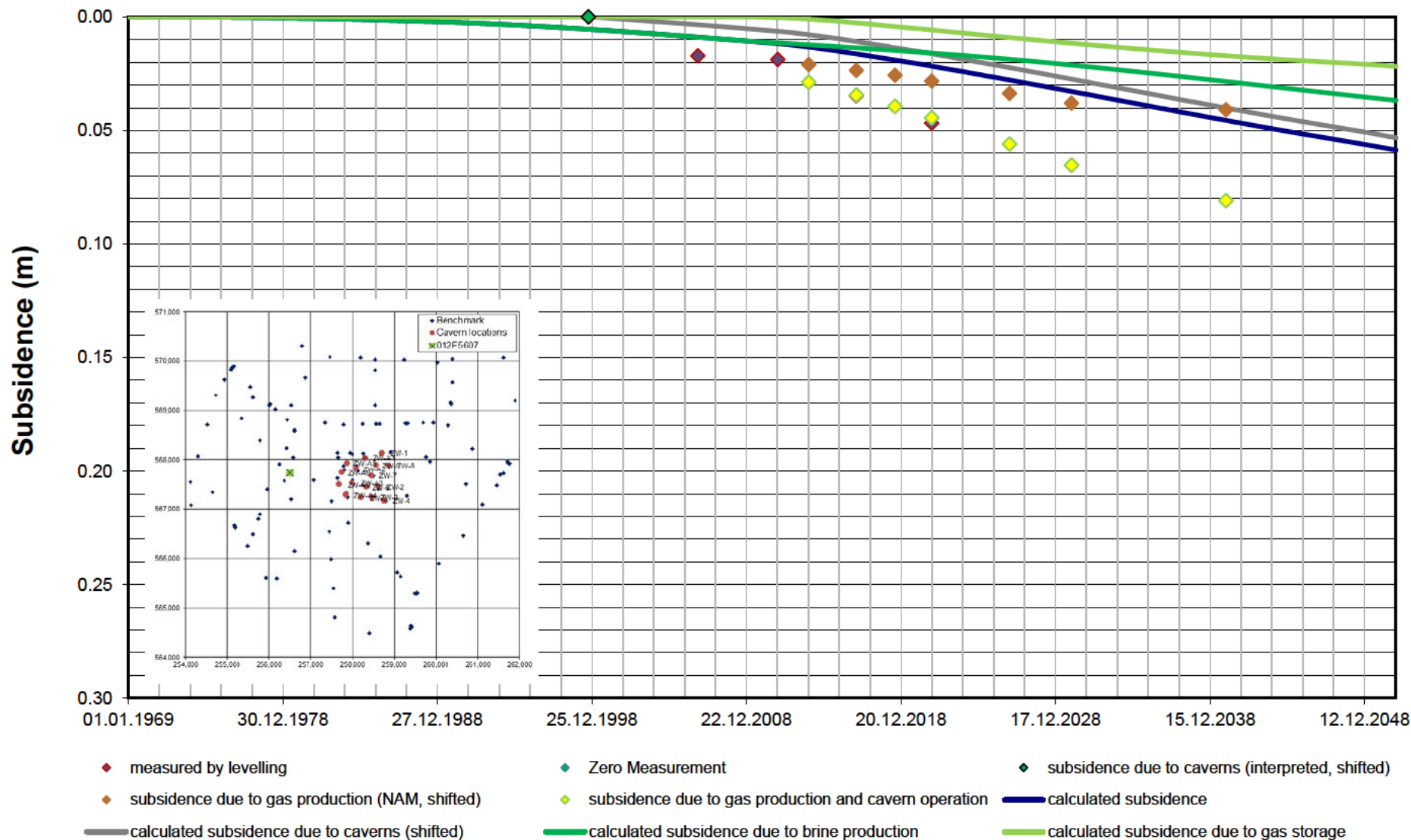


Deviation
0.0014

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5607 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

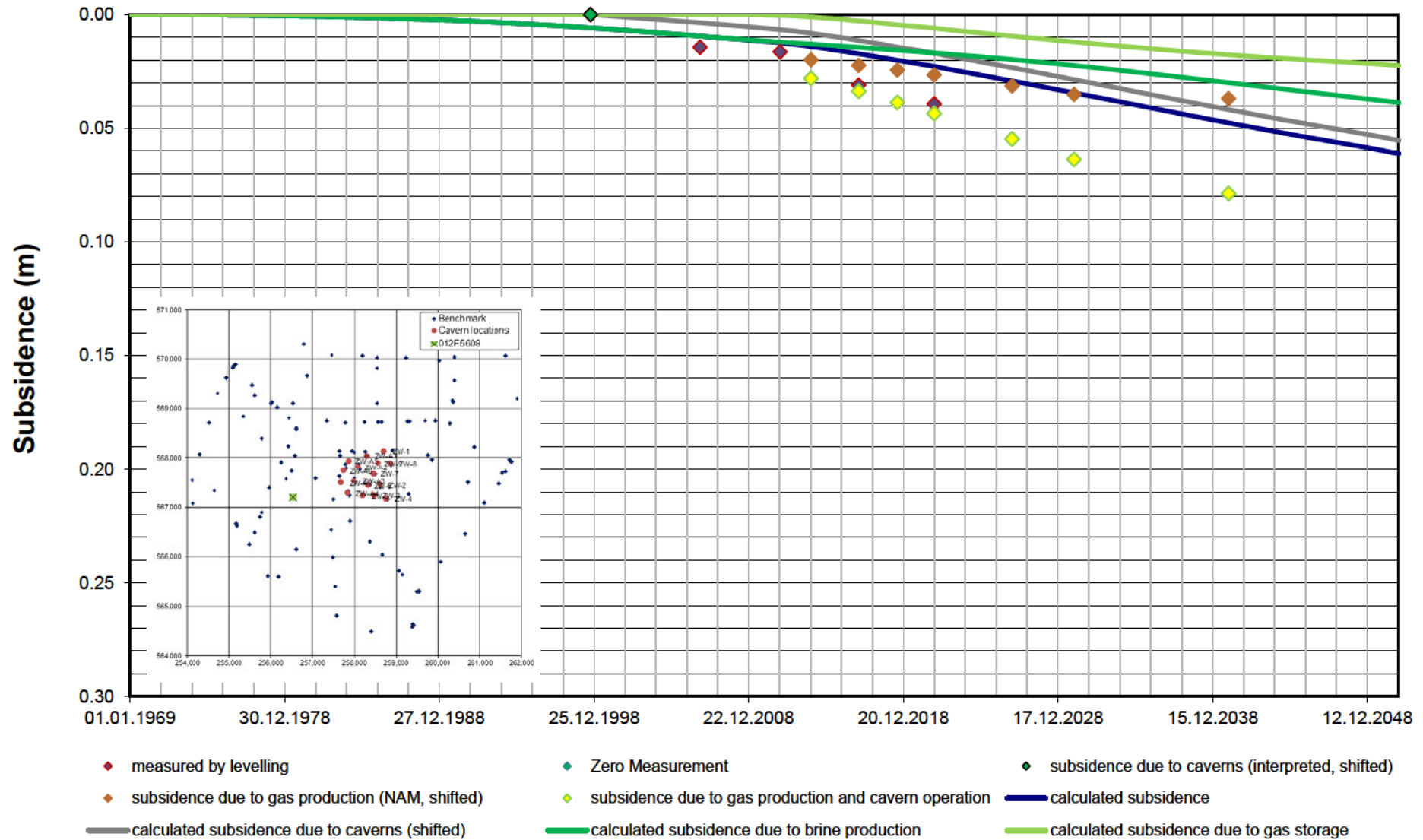


Deviation
0.0035

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5608 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

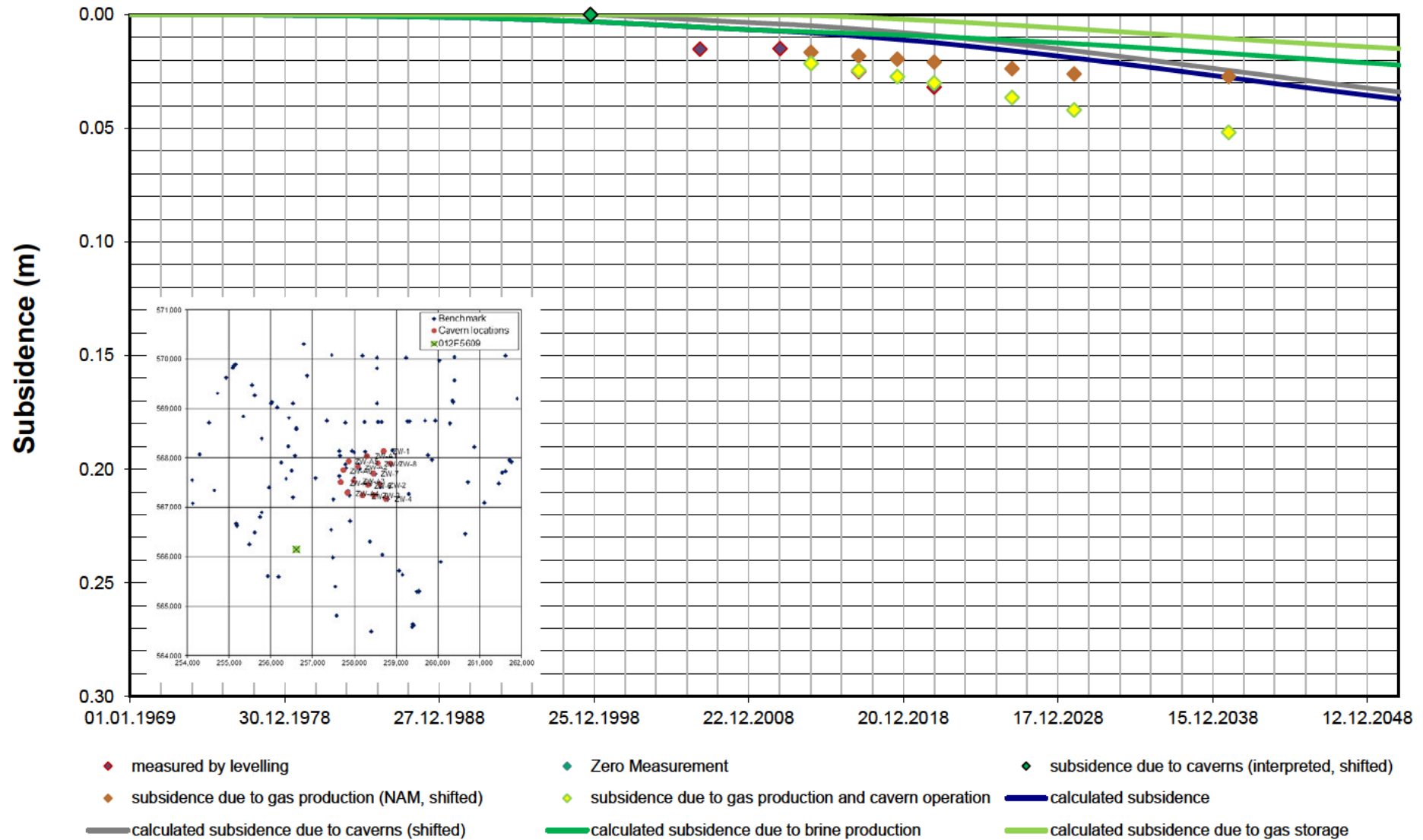


Deviation
0.0012

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5609 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

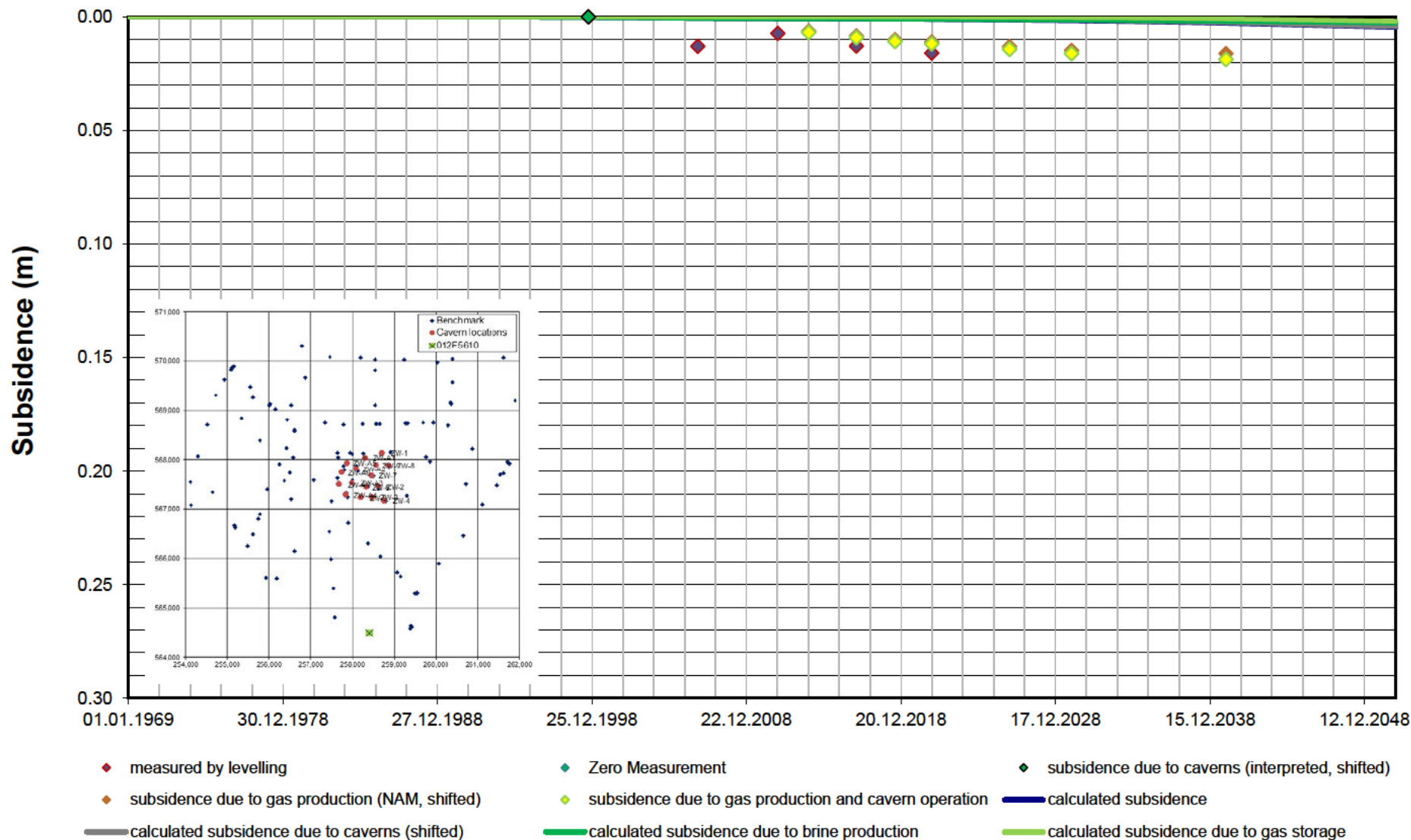


Deviation
0.0039

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5610 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

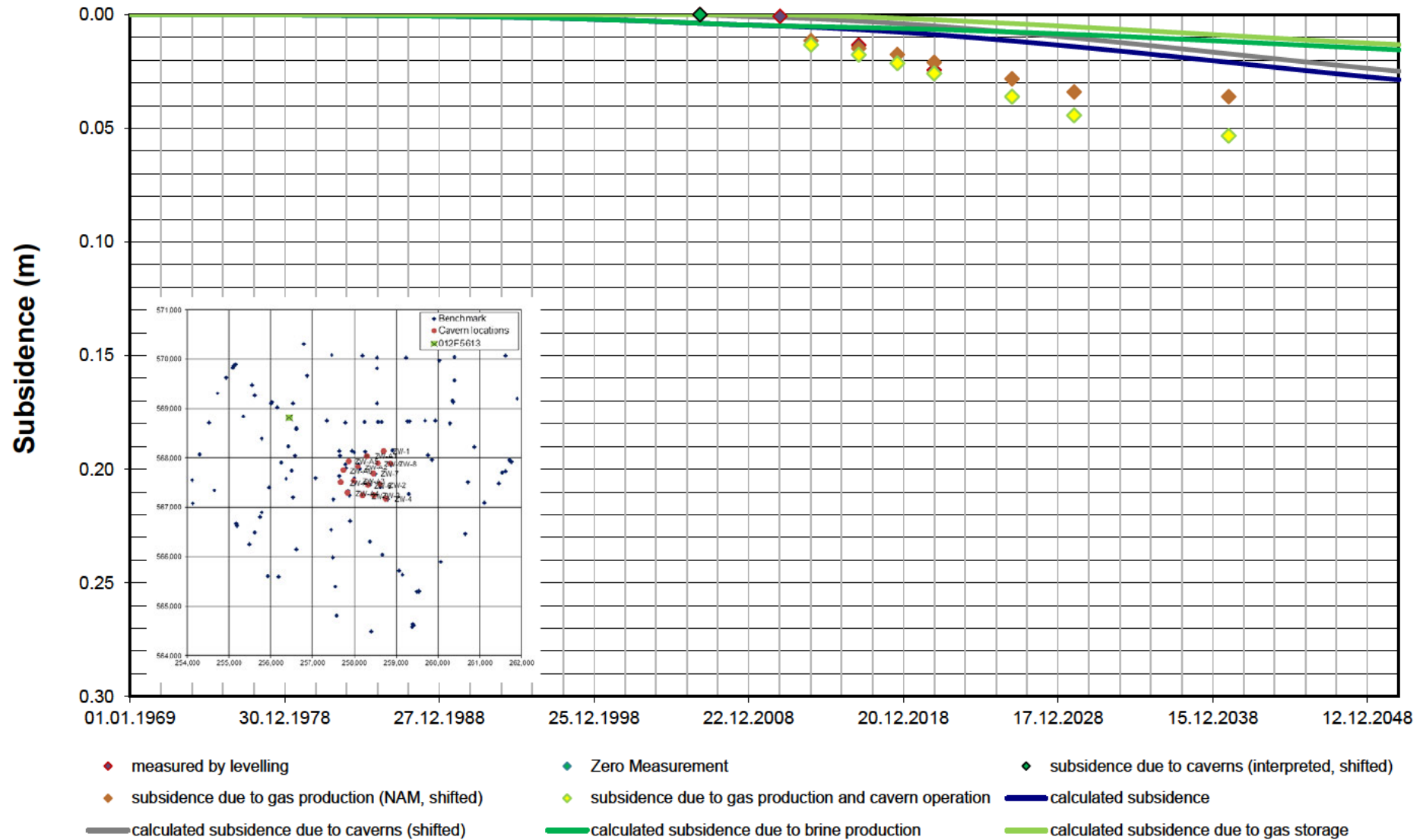


Deviation
0.0029

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5613 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

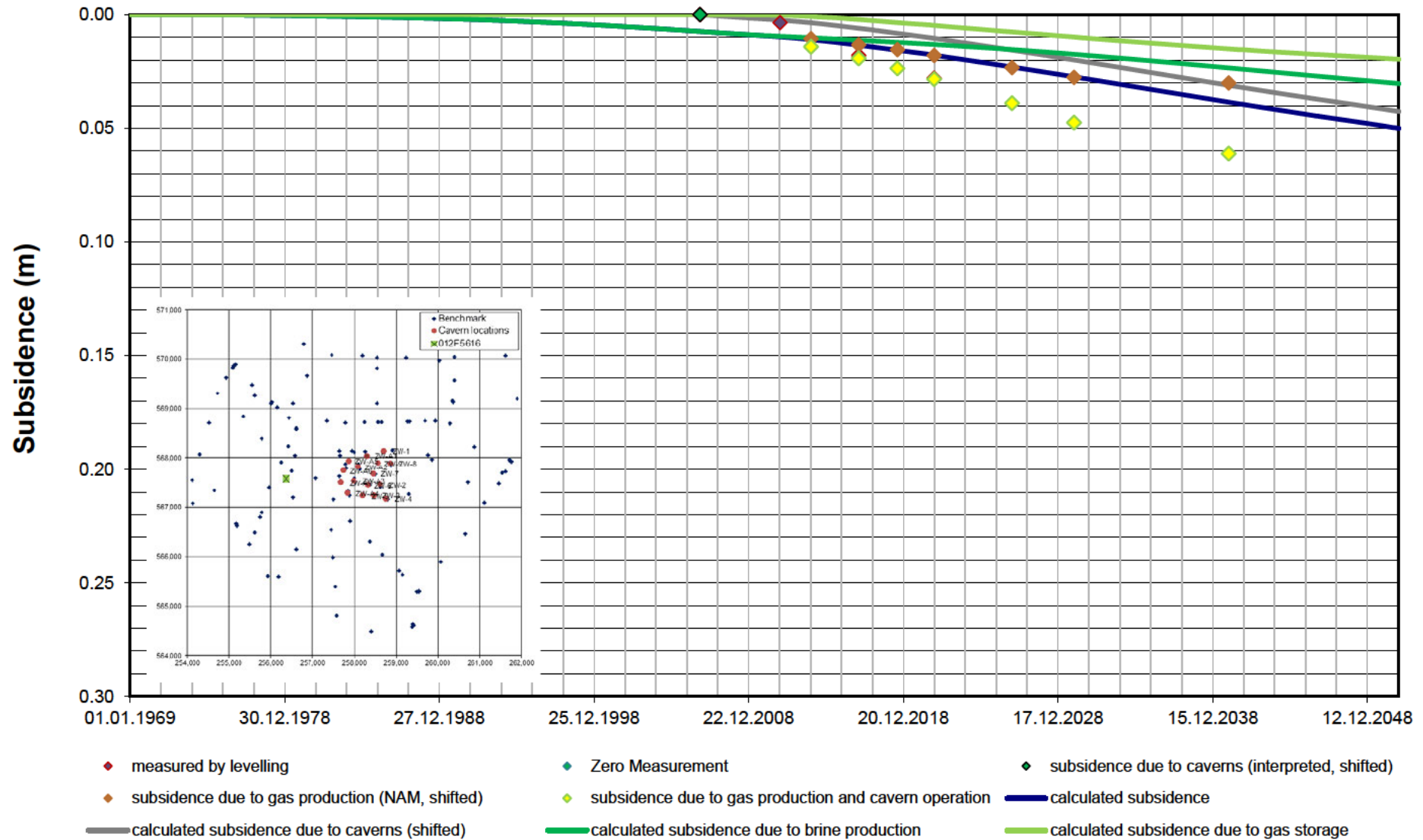


Deviation
0.0008

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5616 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

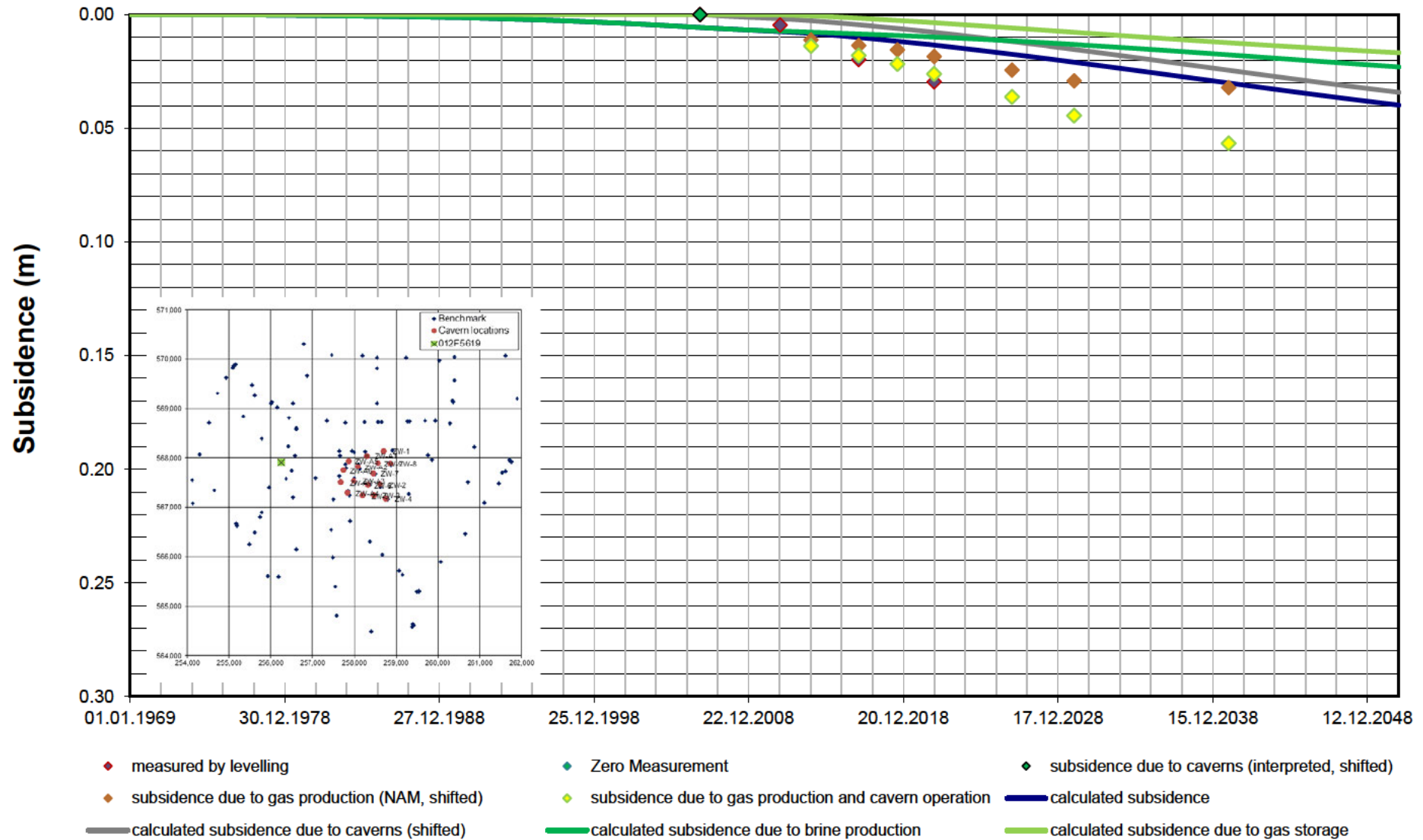


Deviation
0.0026

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5619 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

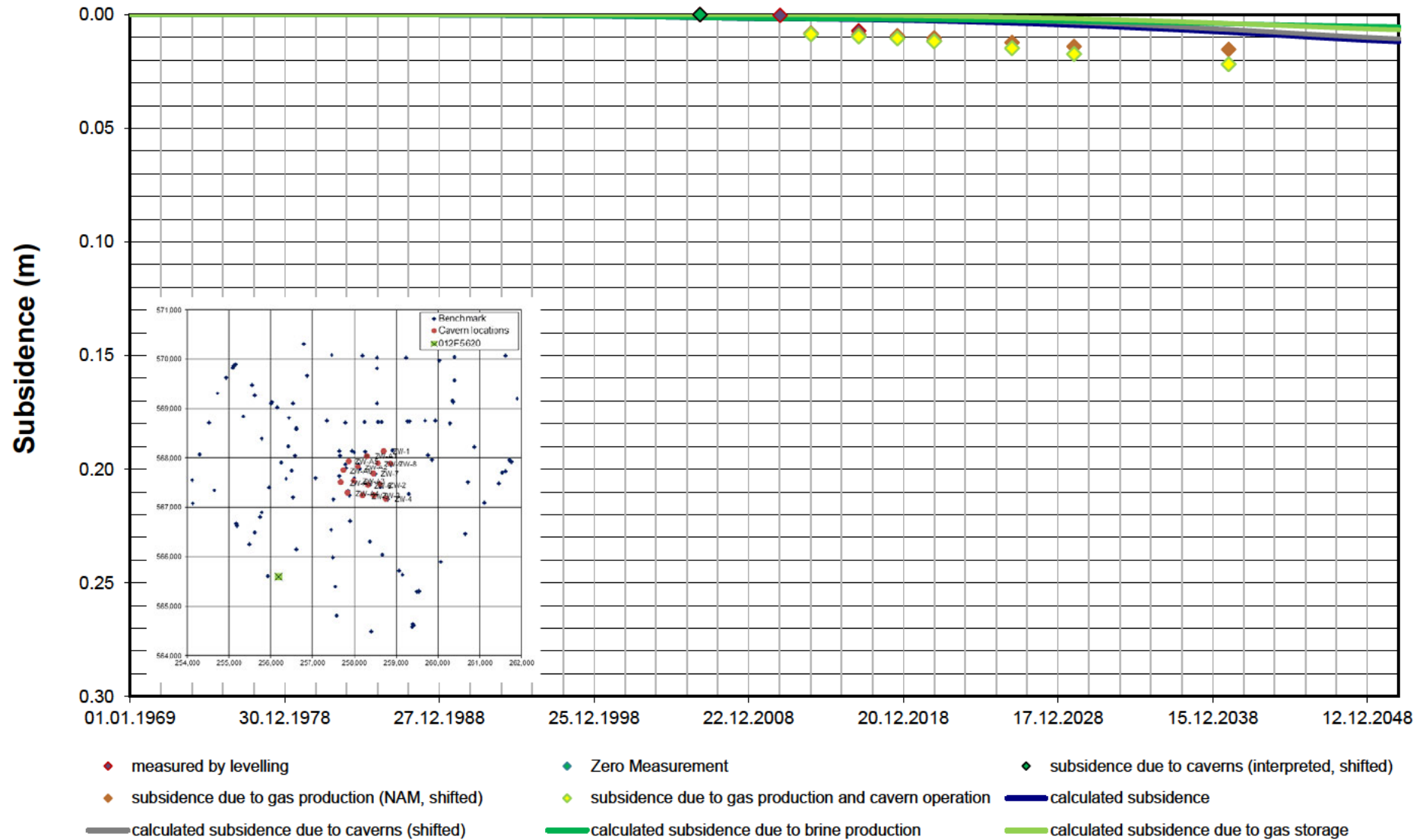


Deviation
0.0013

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5620 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

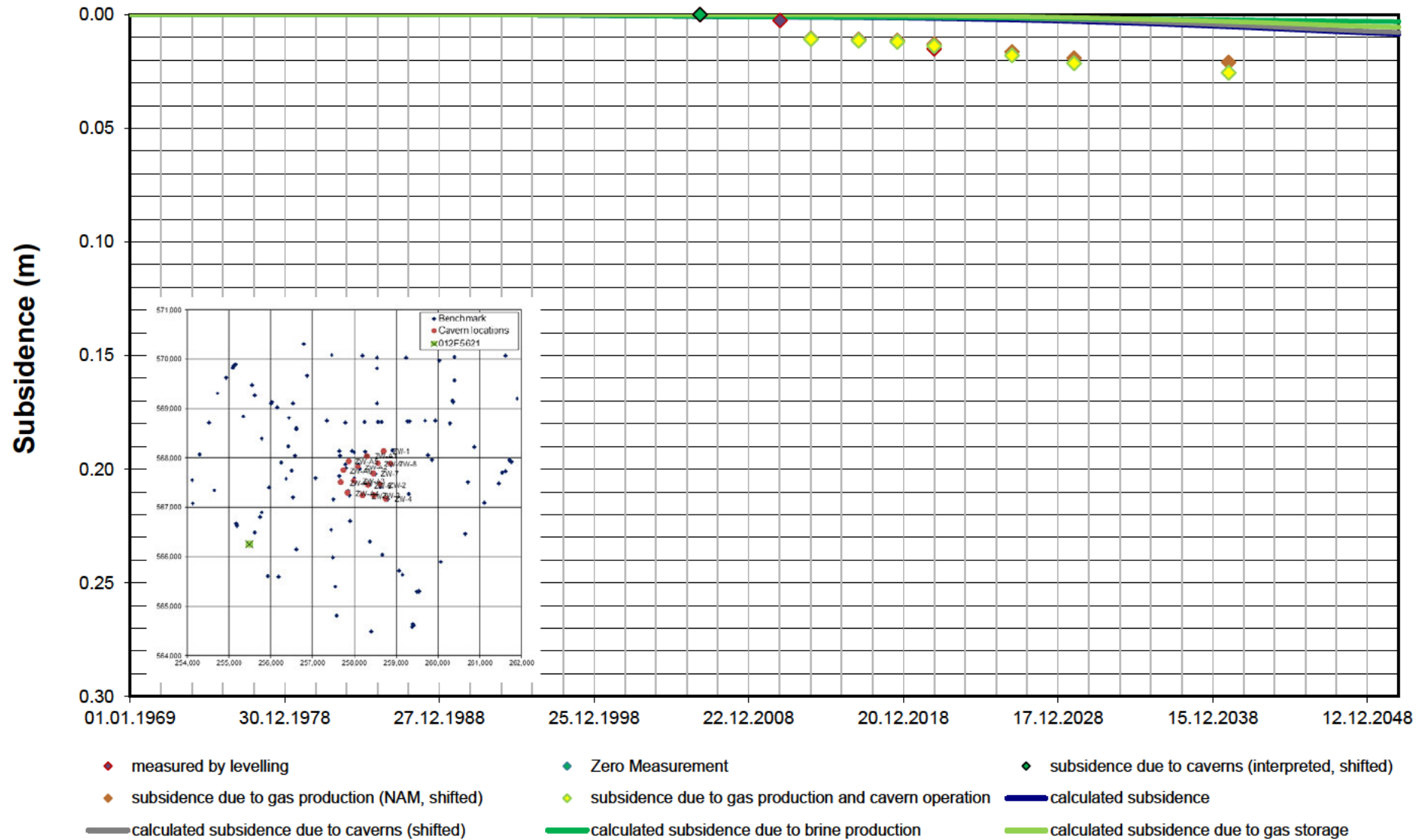


Deviation
0.0008

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5621 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

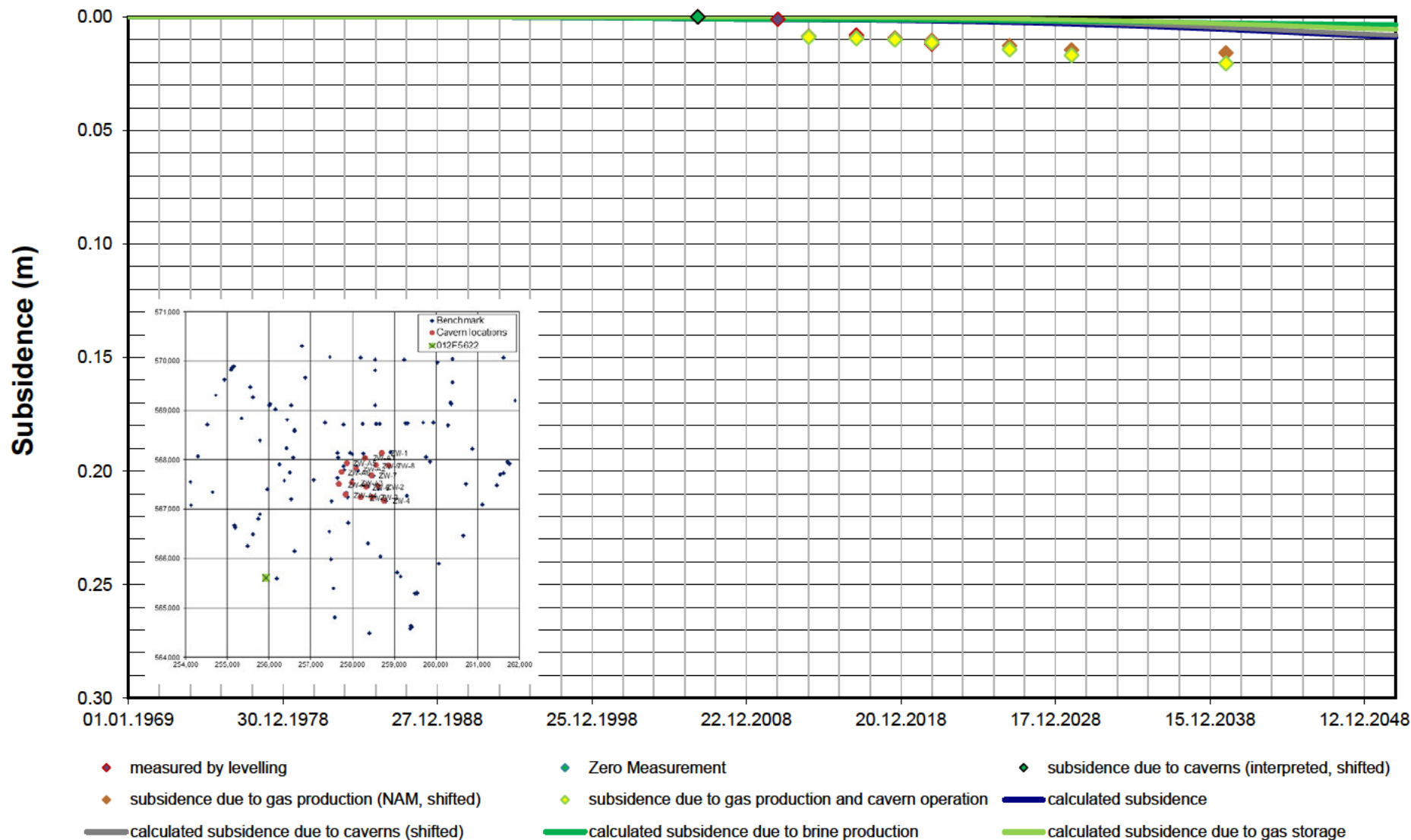


Deviation
0.0011

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5622 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

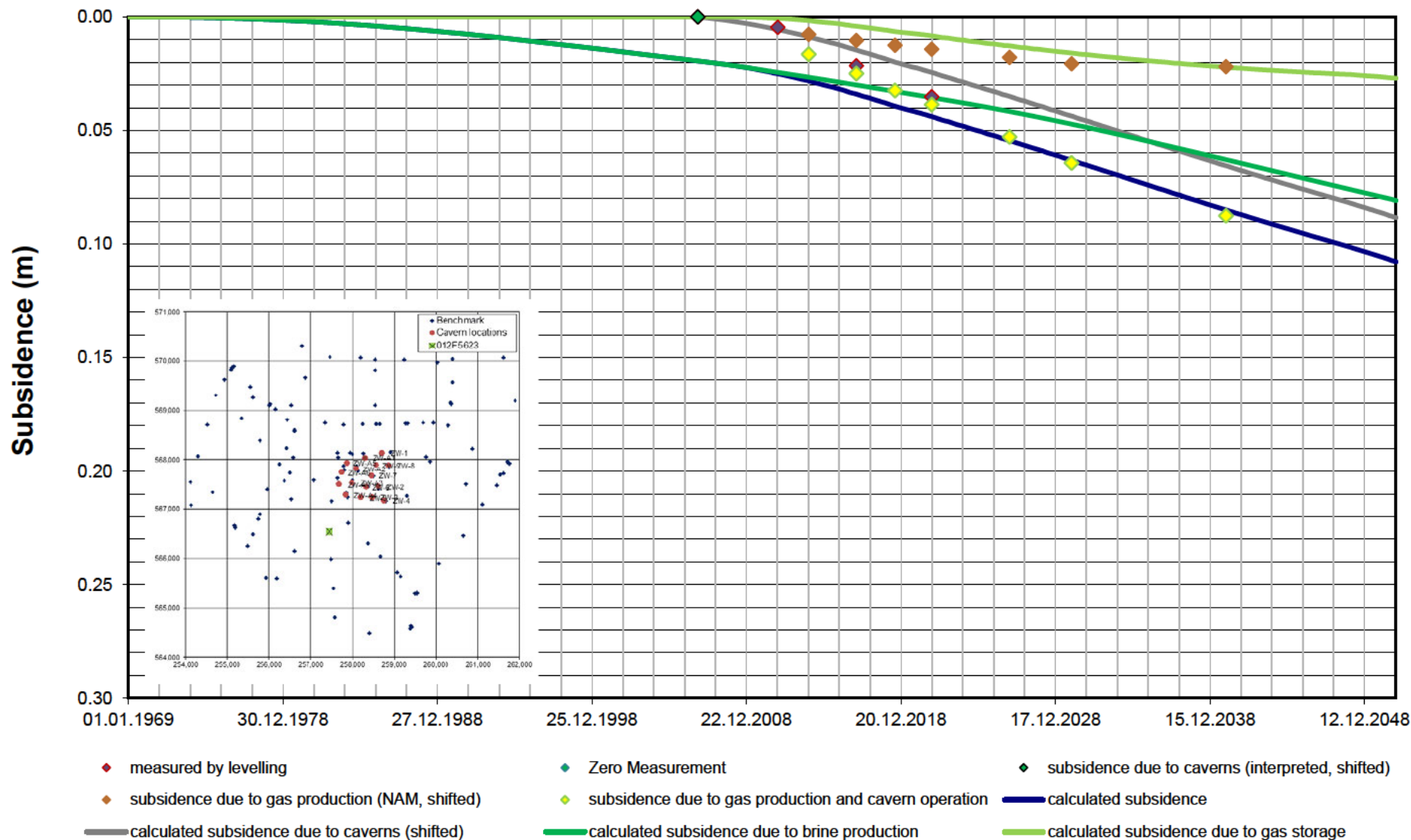


Deviation
0.0034

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5623 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

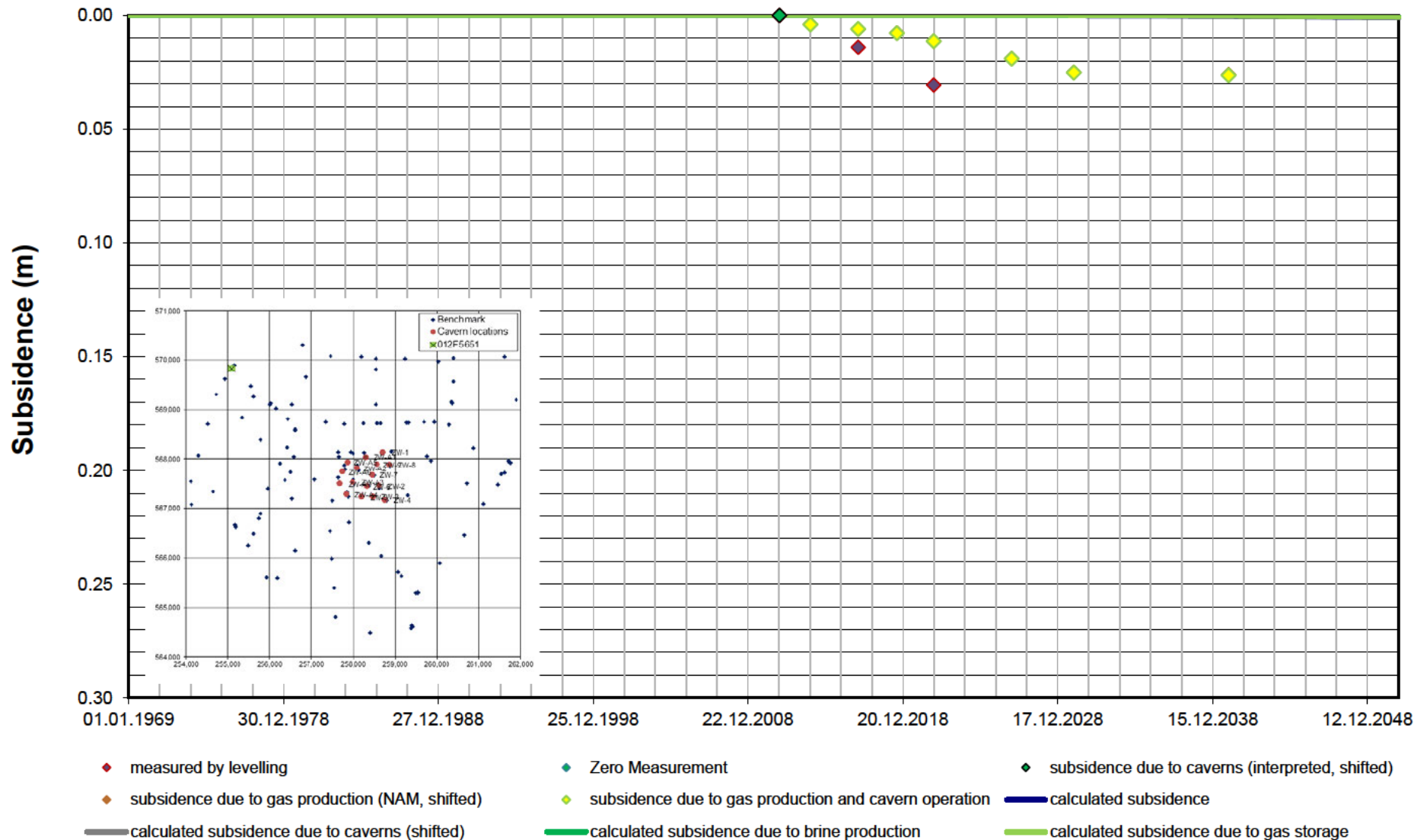


Deviation
0.0136

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5651 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

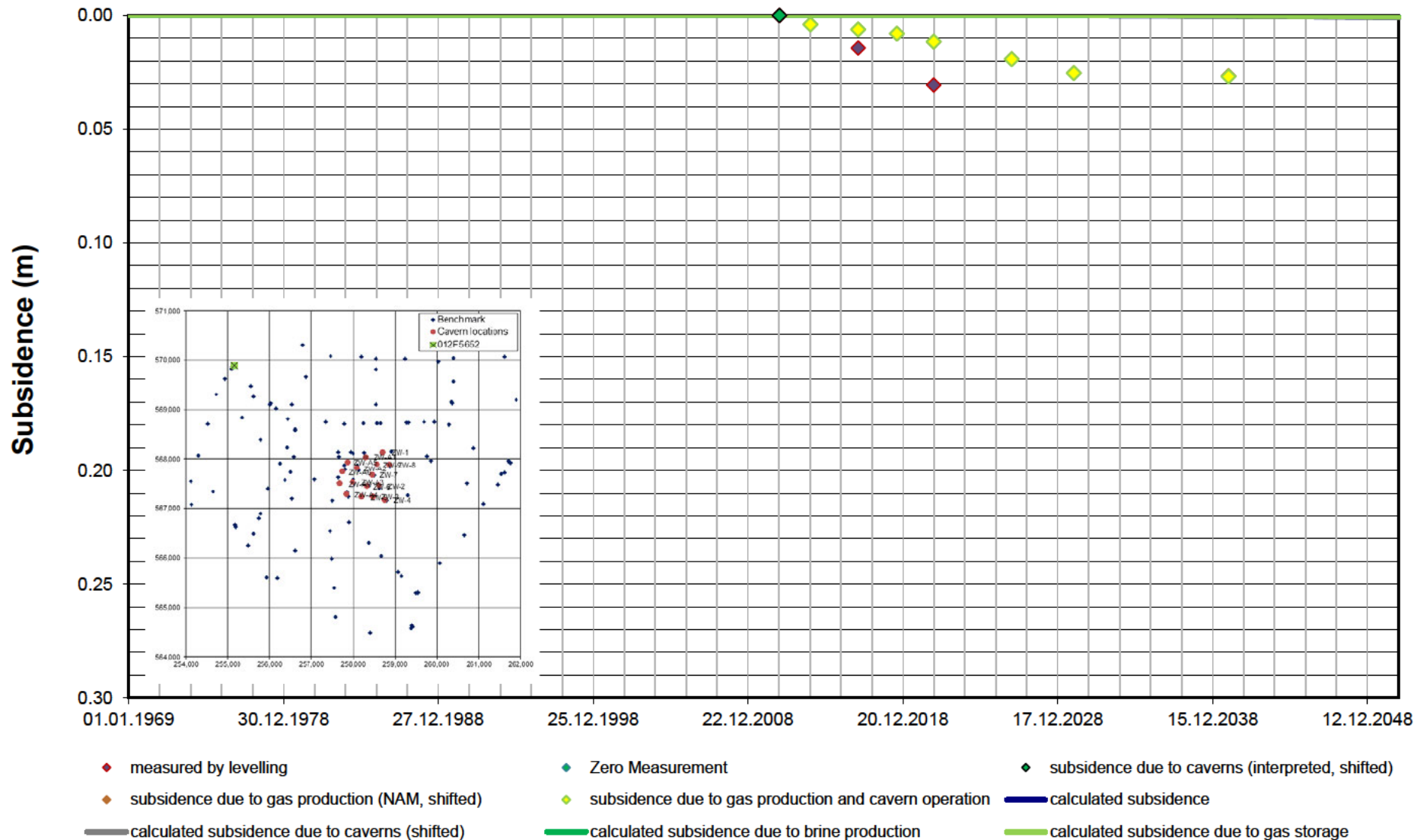


Deviation
0.0136

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5652 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

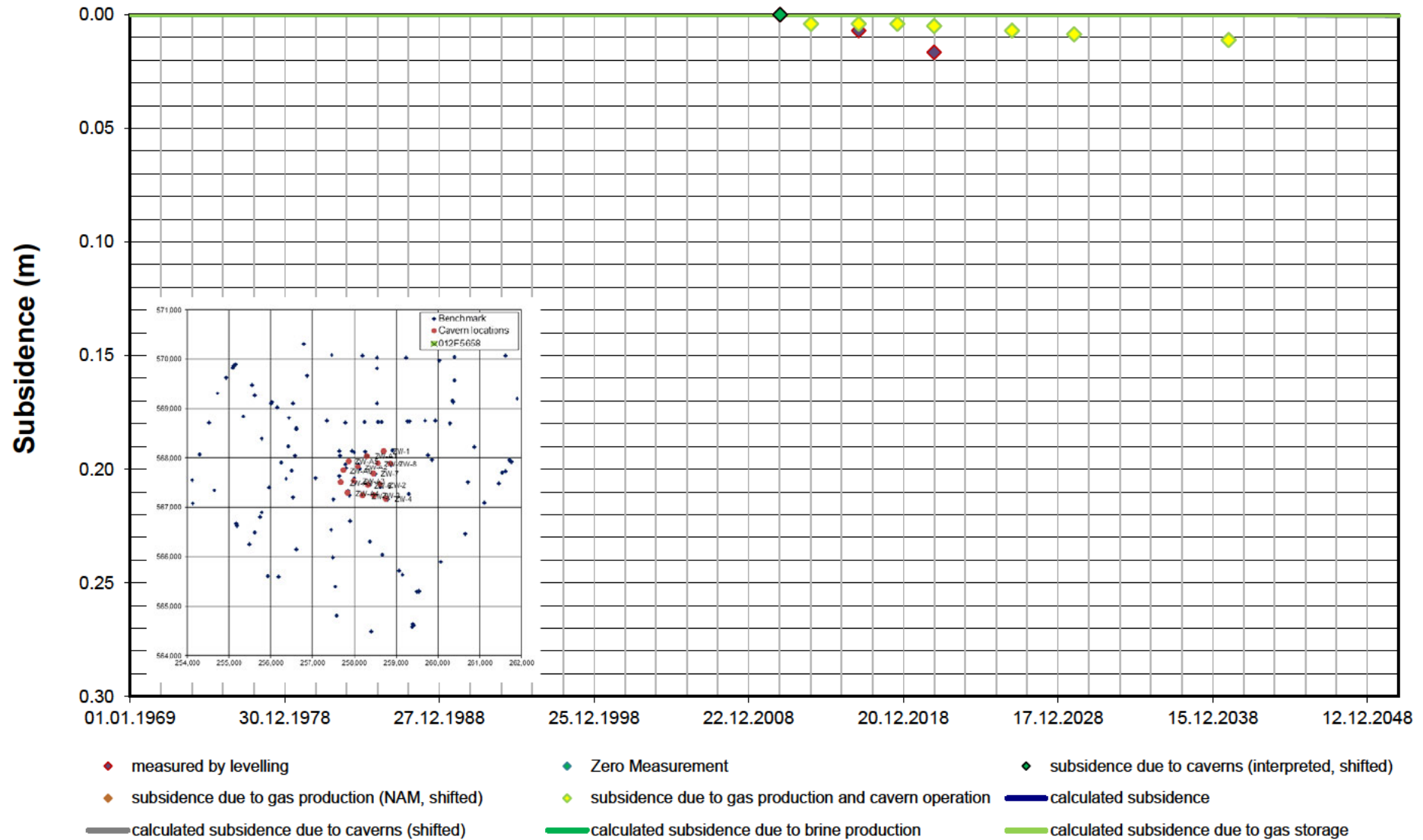


Deviation
0.0073

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5658 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

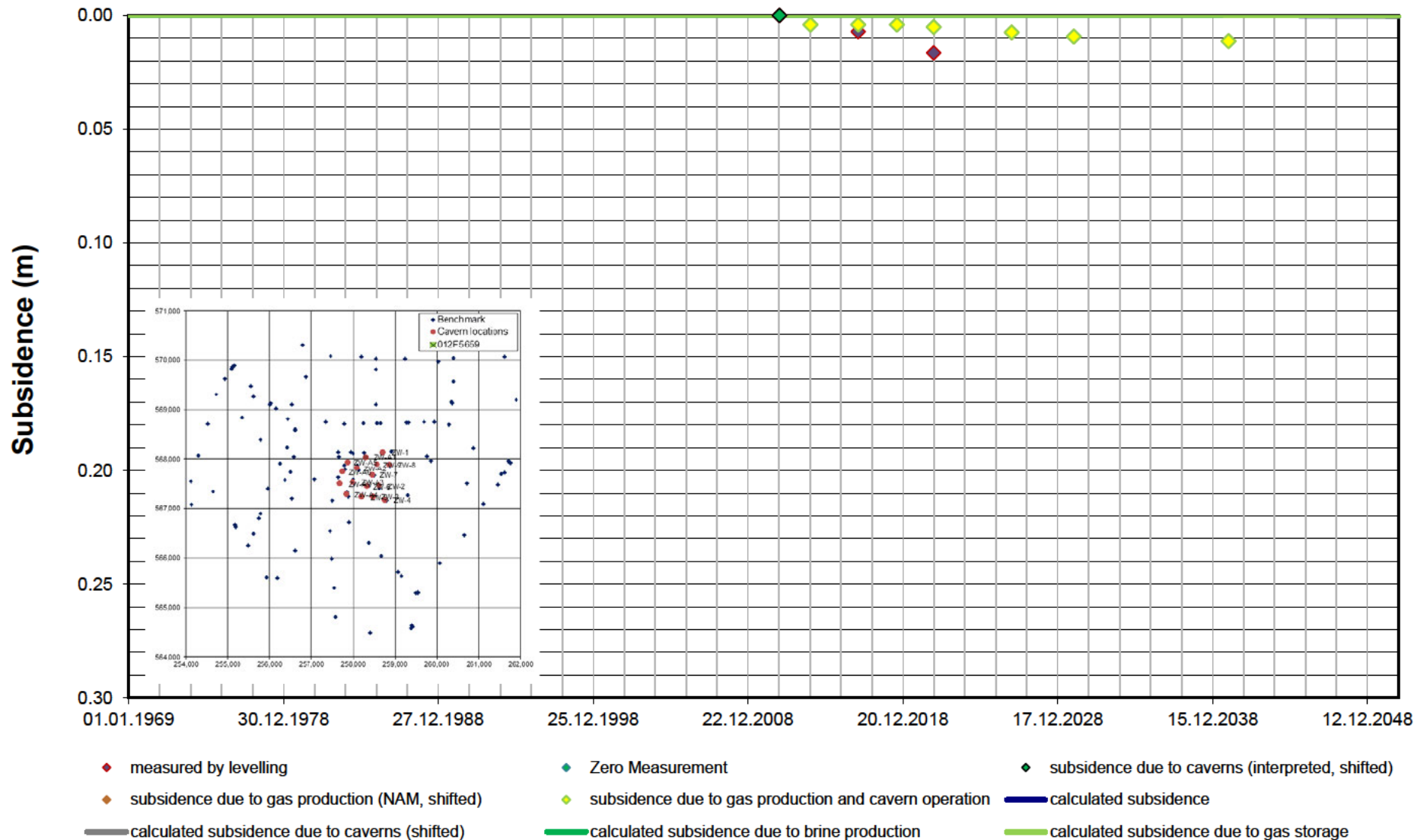


Deviation
0.0072

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5659 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

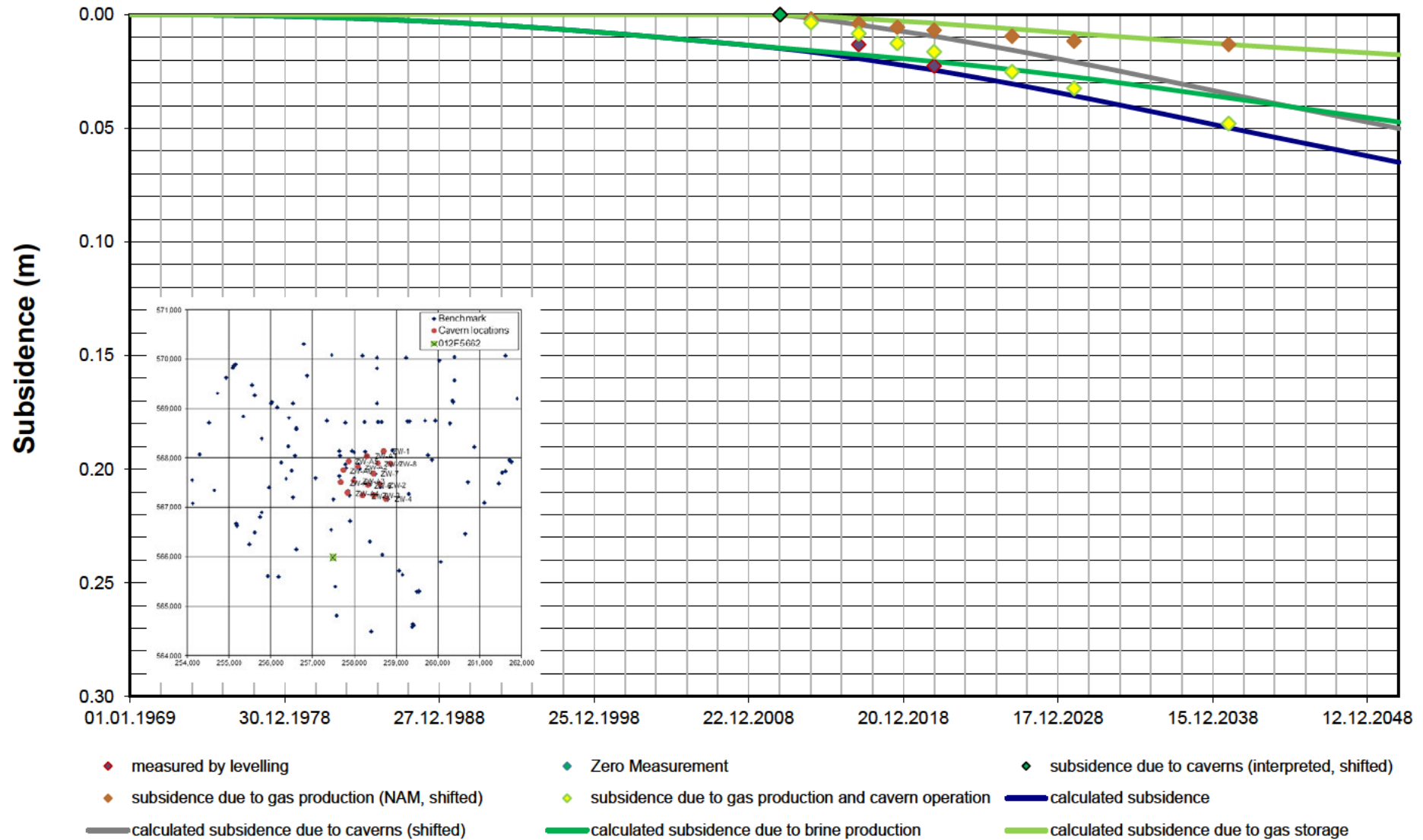


Deviation
0.0055

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5662 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

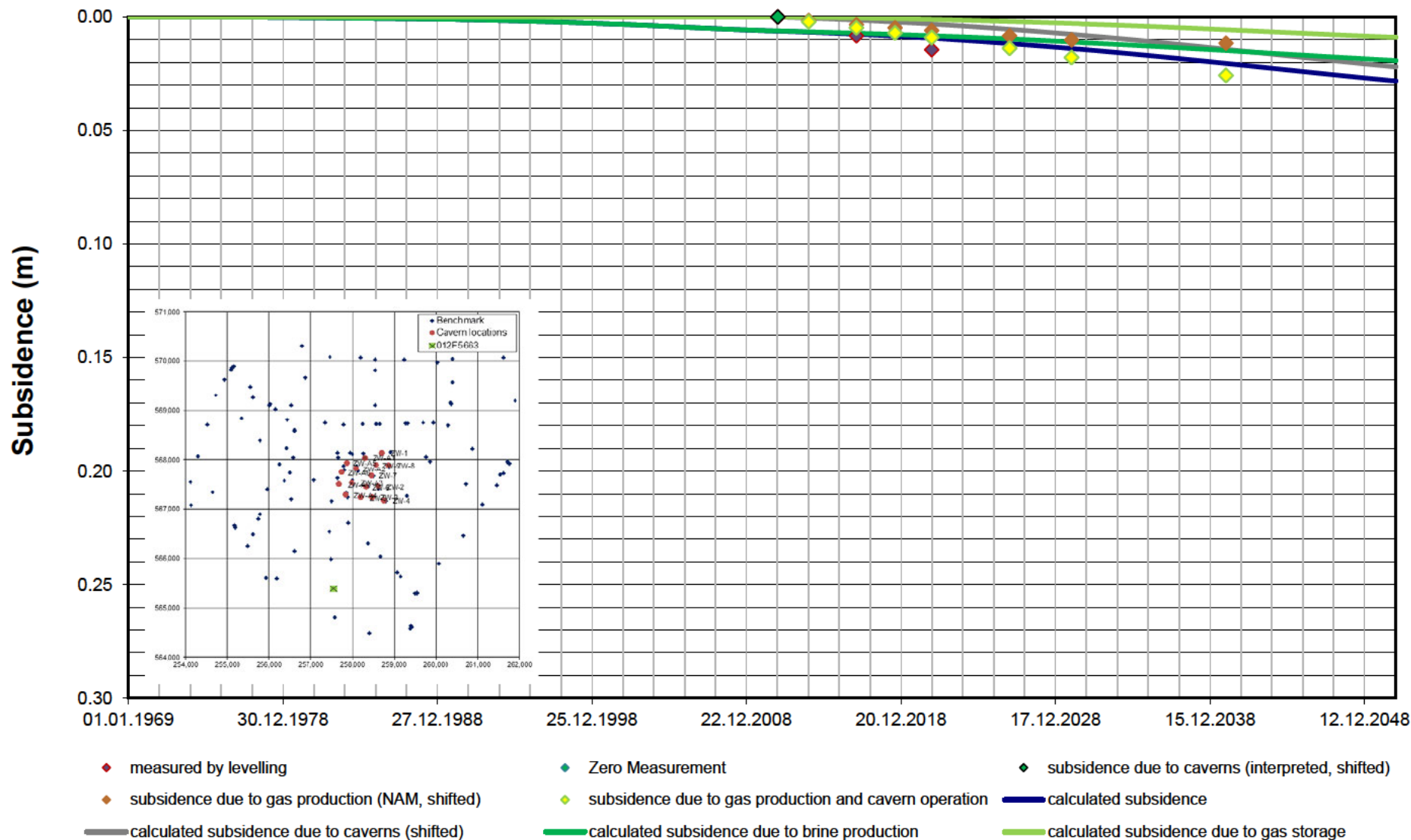


Deviation
0.0045

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5663 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

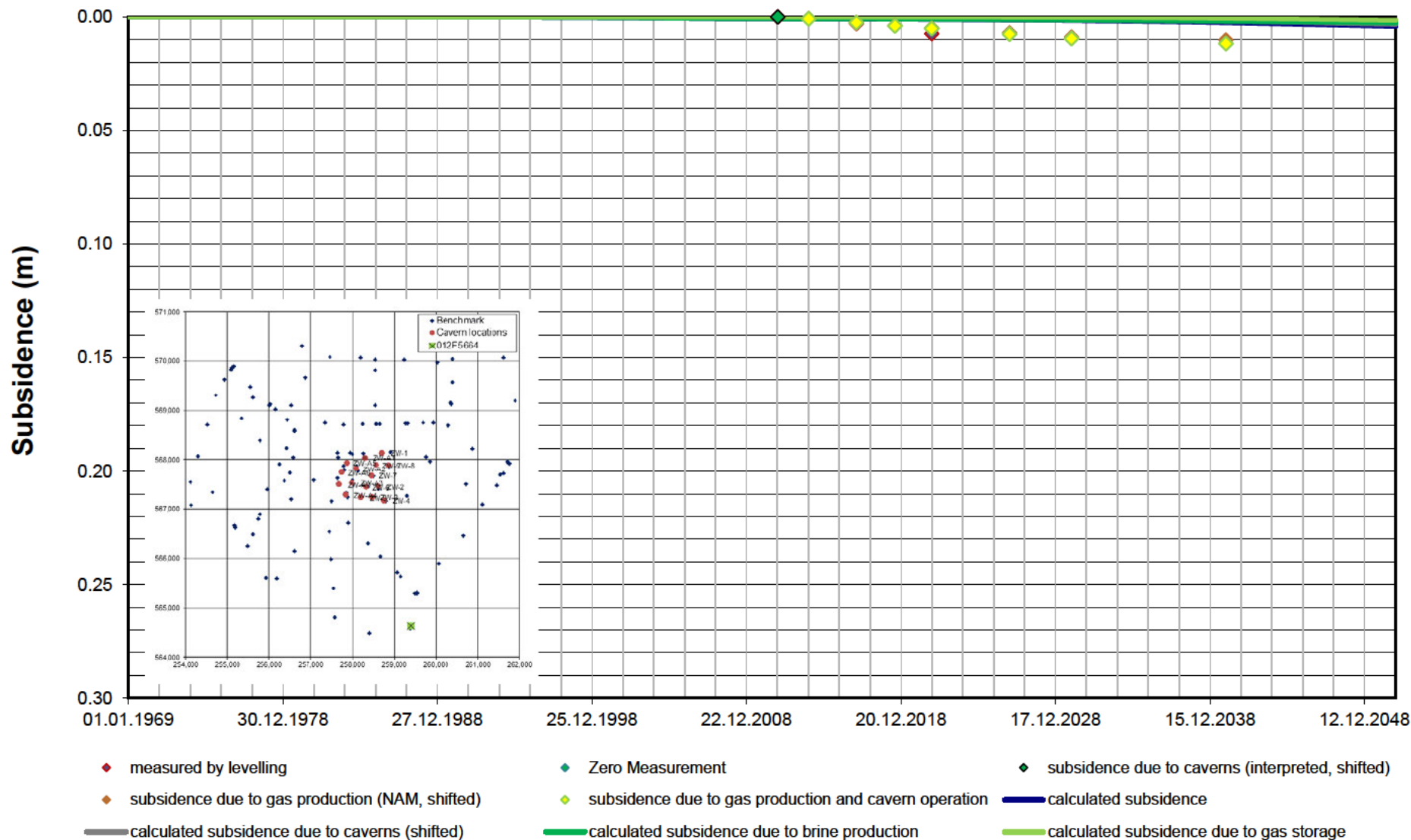


Deviation
0.0014

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5664 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

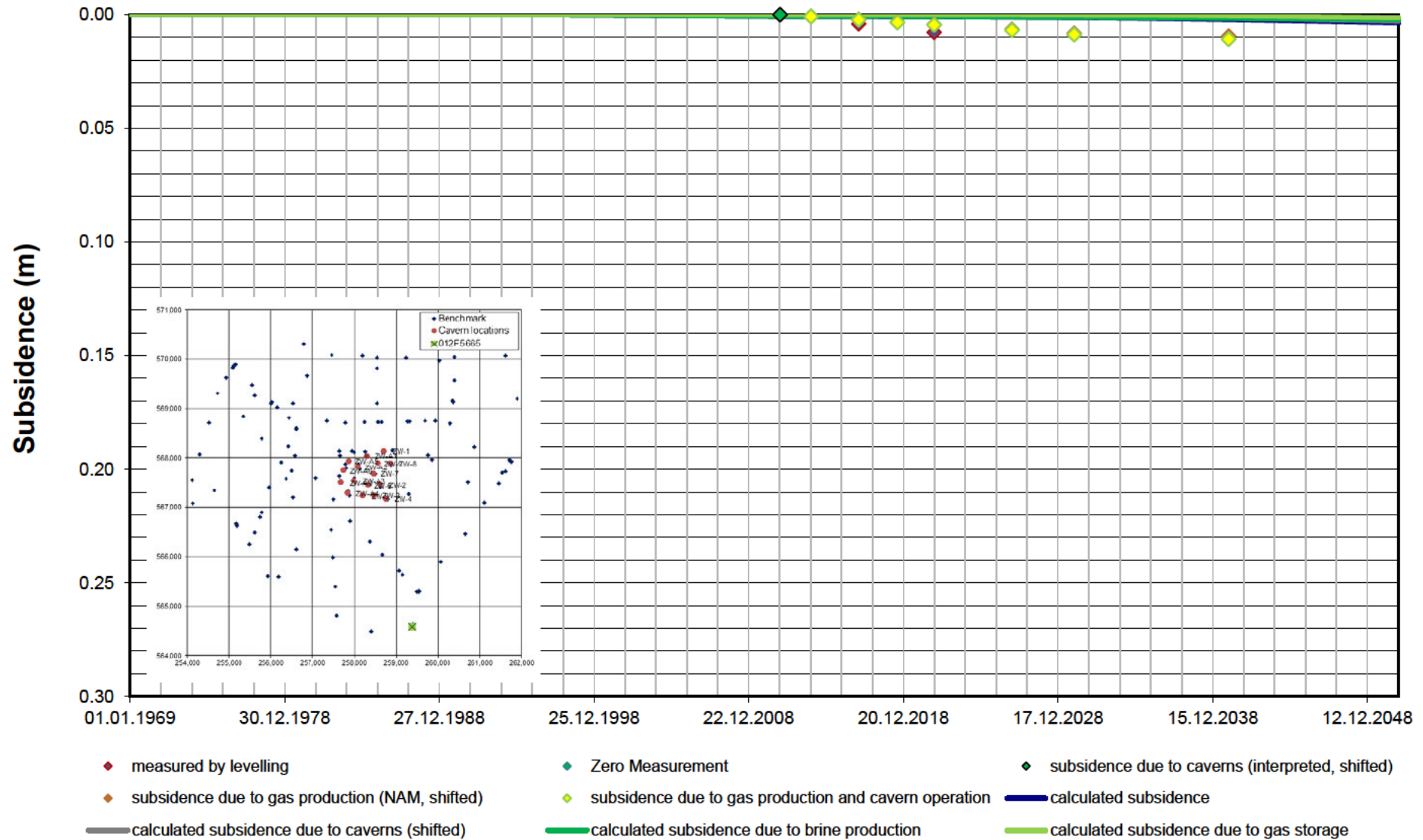


Deviation
0.0026

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F5665 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

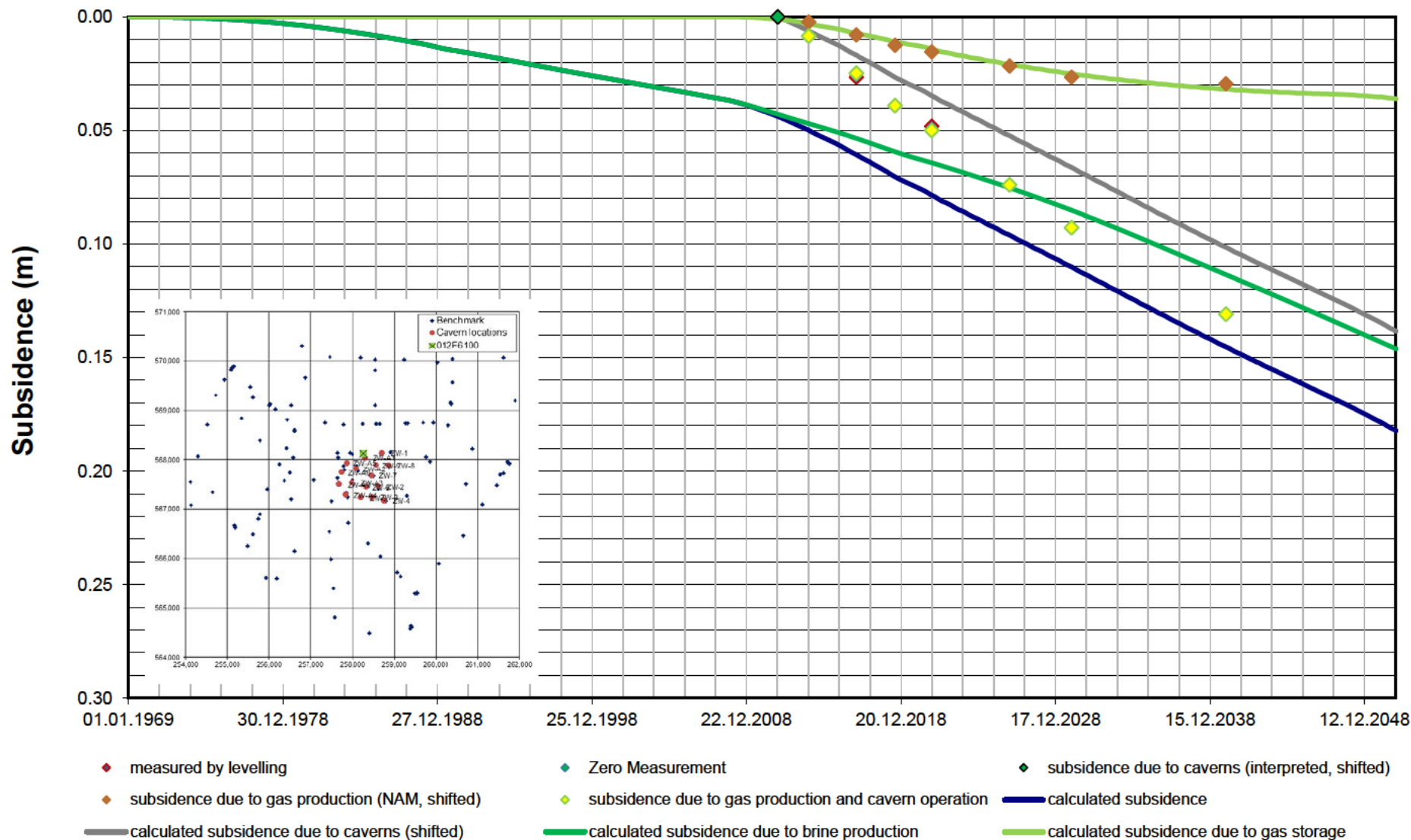


Deviation
0.0018

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6100 (ZW-A1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

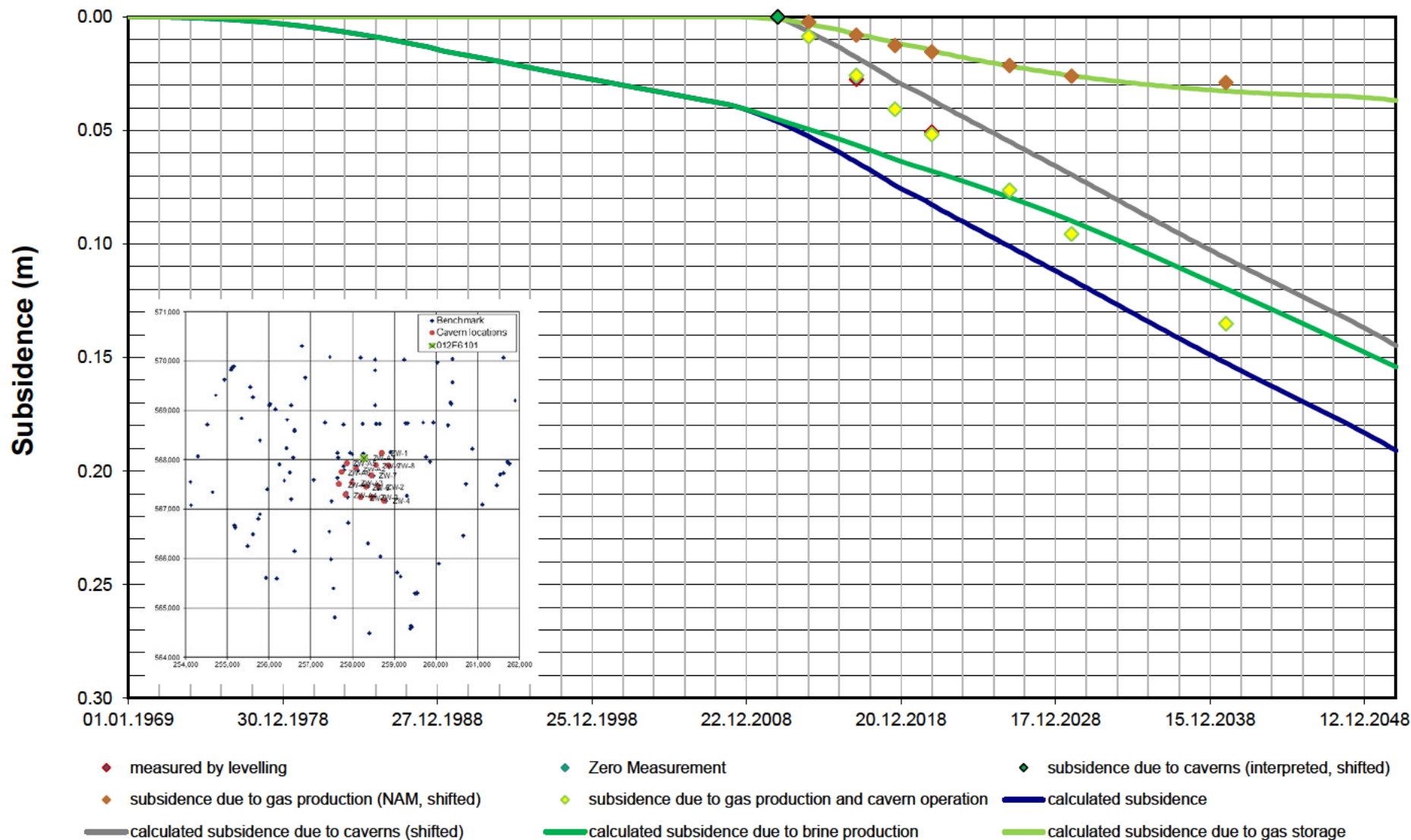


Deviation
0.0014

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6101 (ZW-A1)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

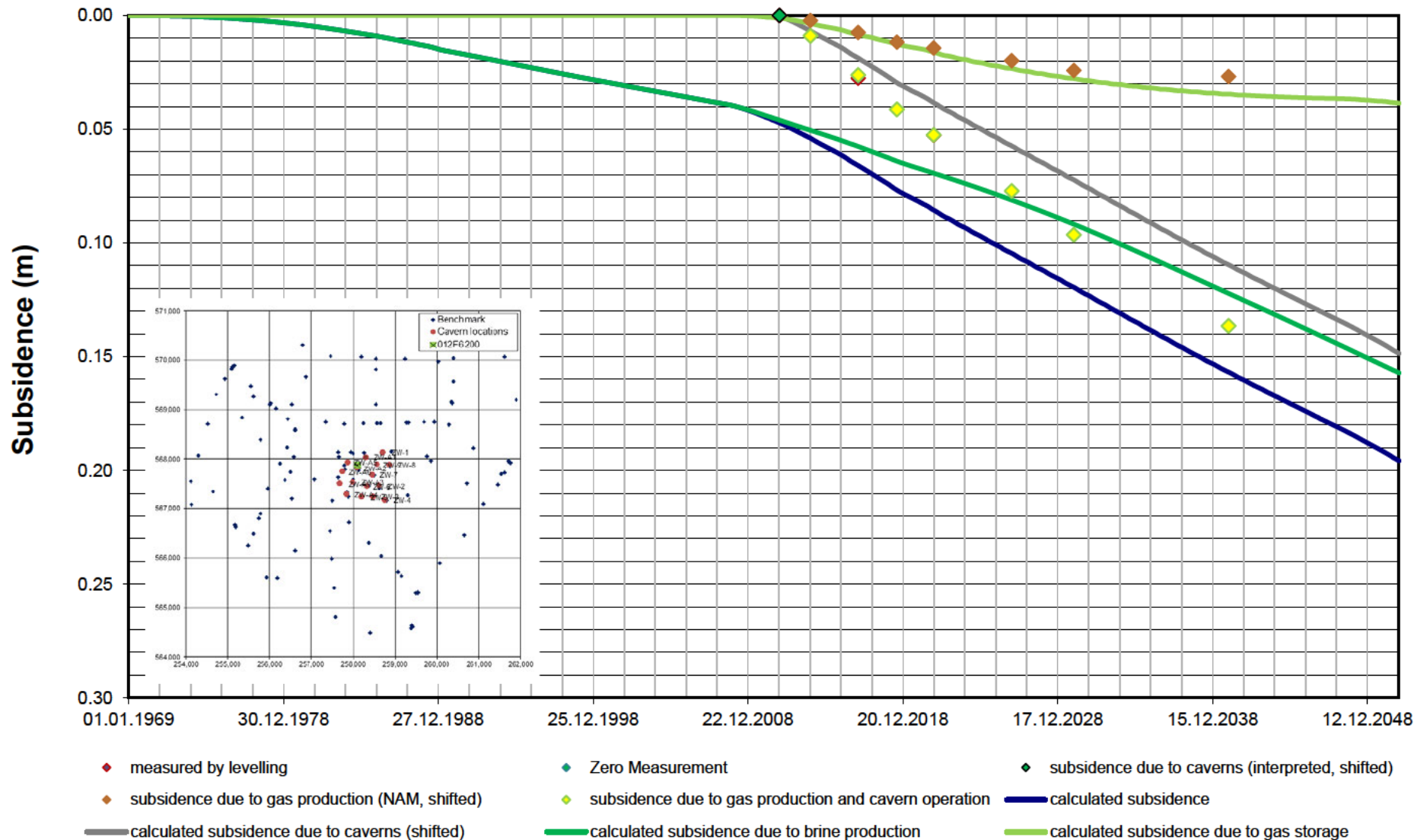


Deviation
0.0007

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6200 (ZW-A2)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

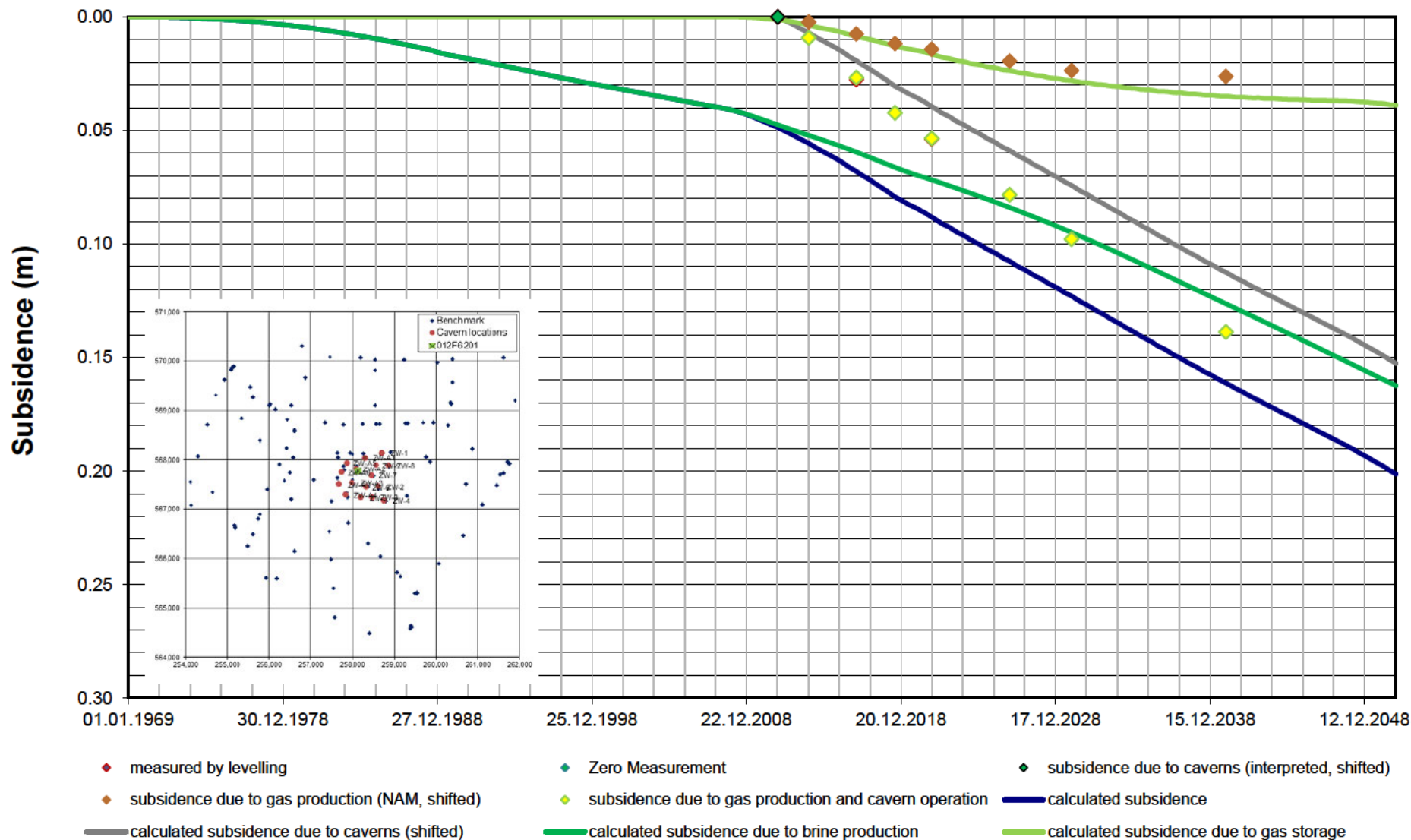


Deviation
0.0005

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6201 (ZW-A2)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

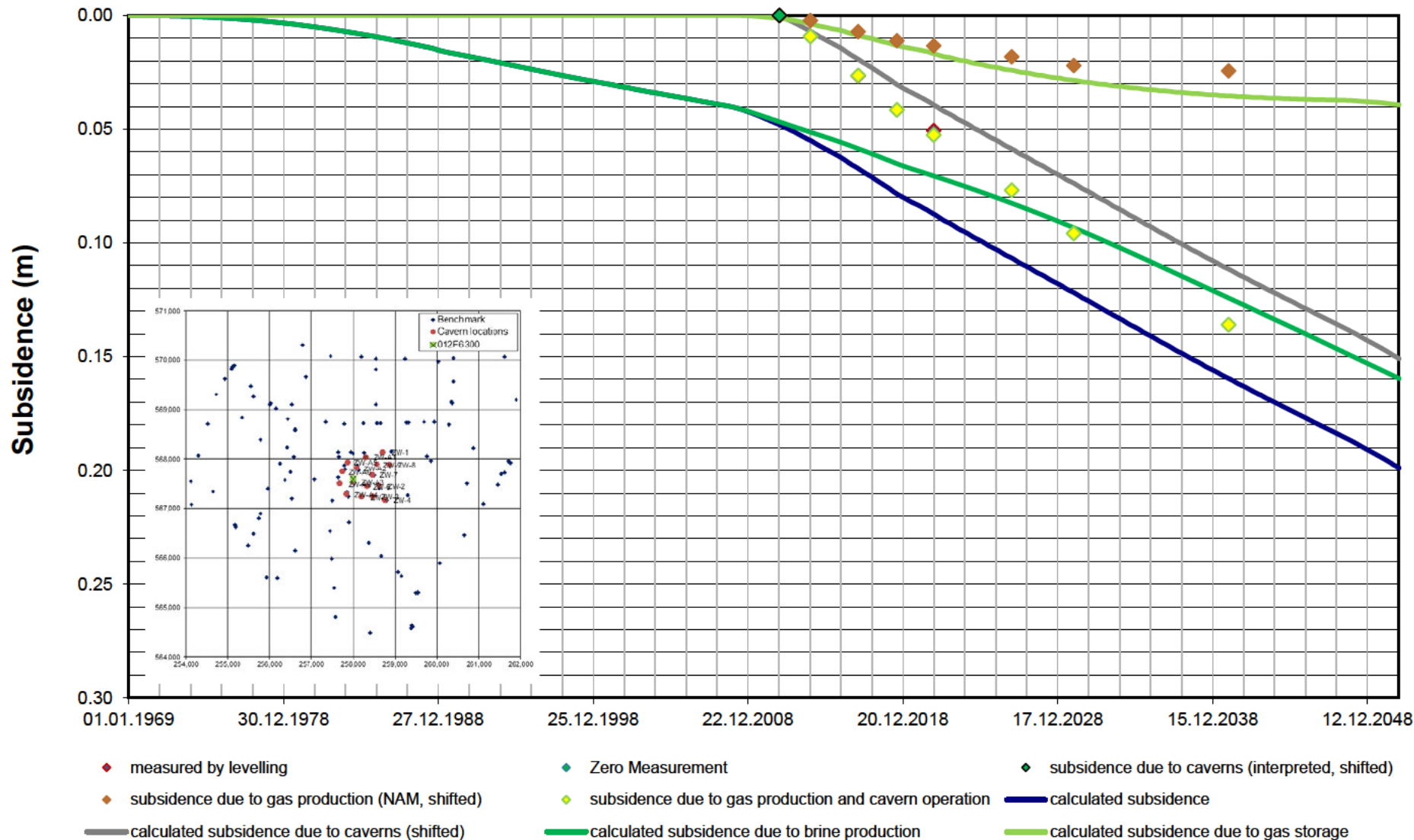


Deviation
0.0011

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6300 (ZW-A3)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

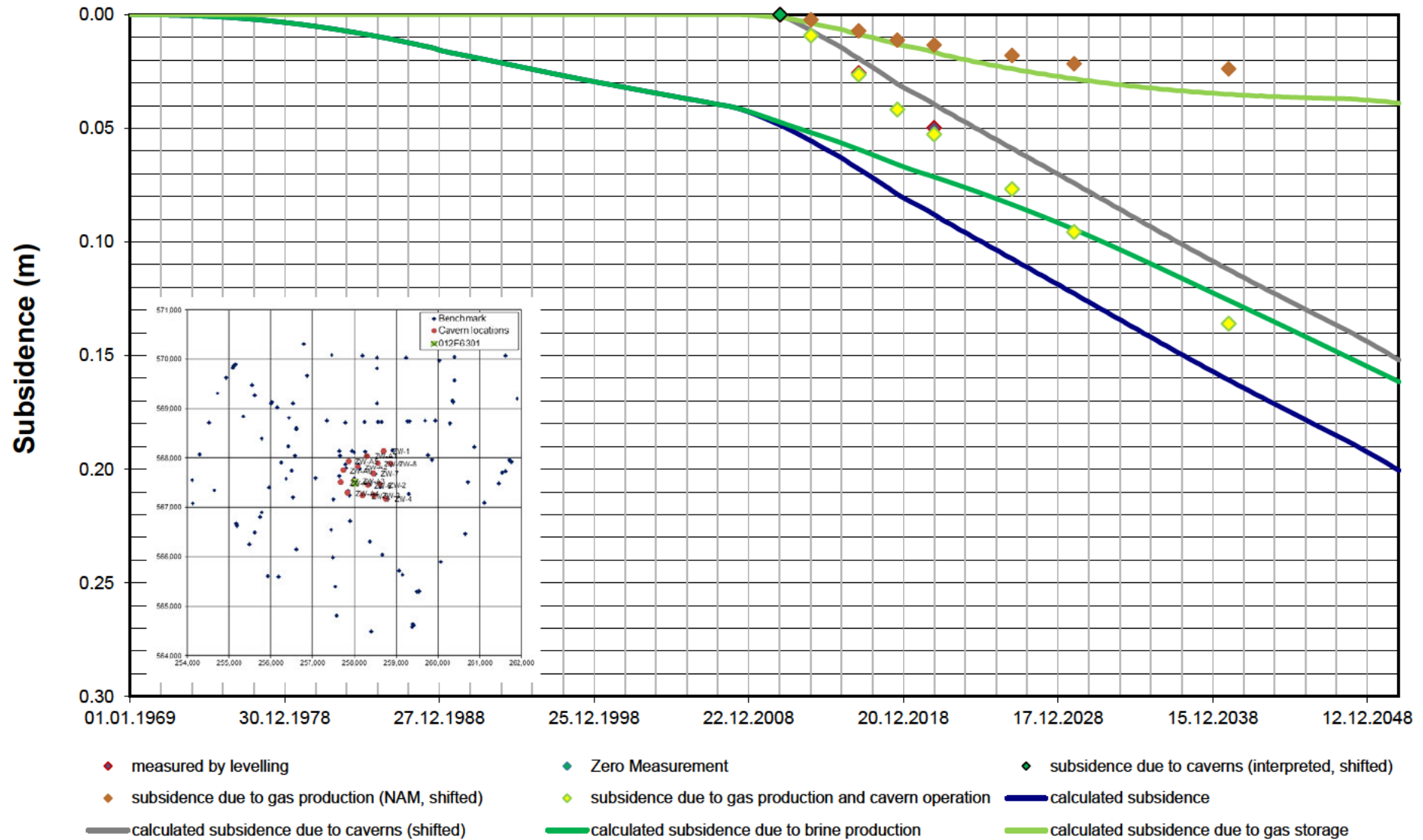


Deviation
0.0018

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6301 (ZW-A3)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

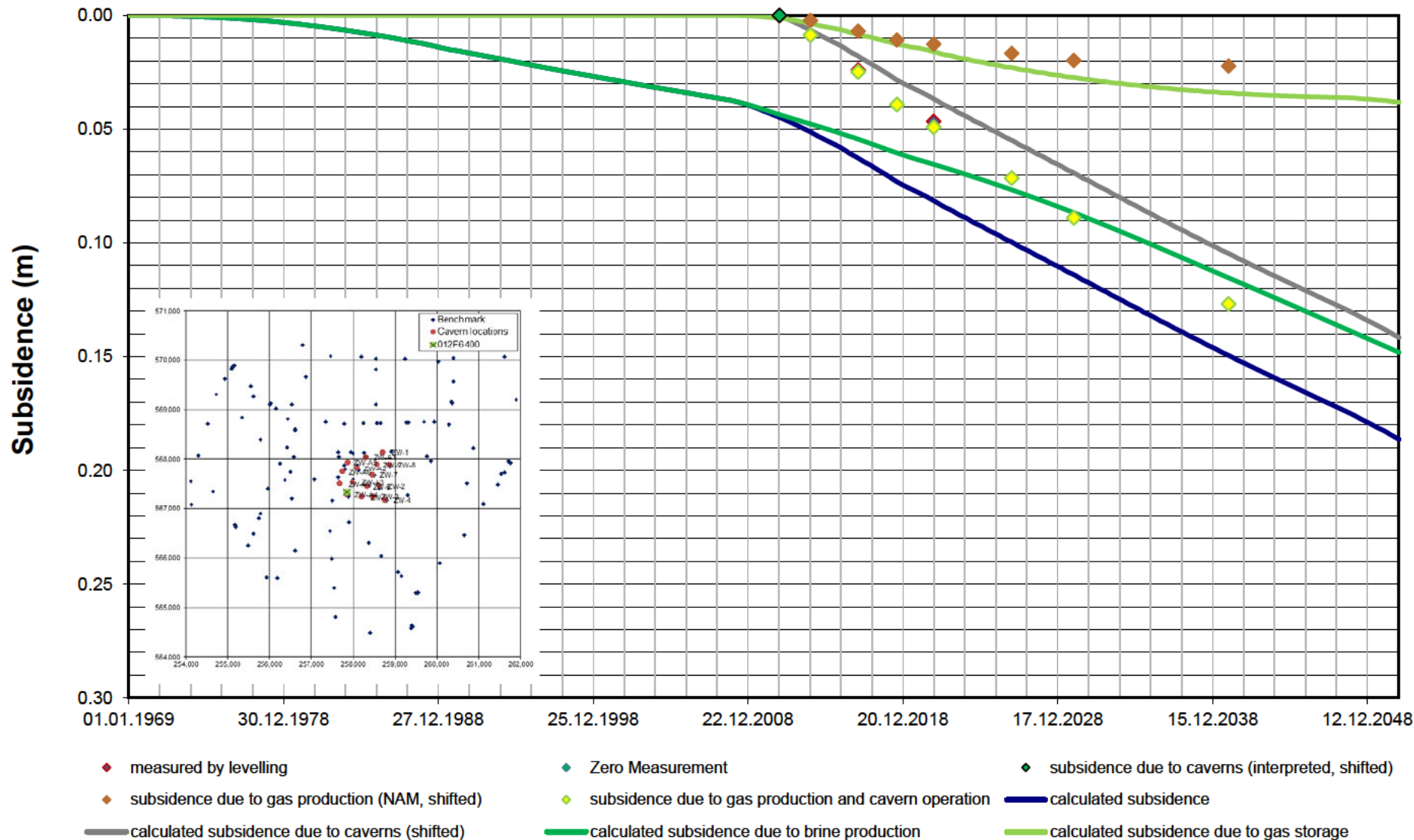


Deviation
0.0017

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6400 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

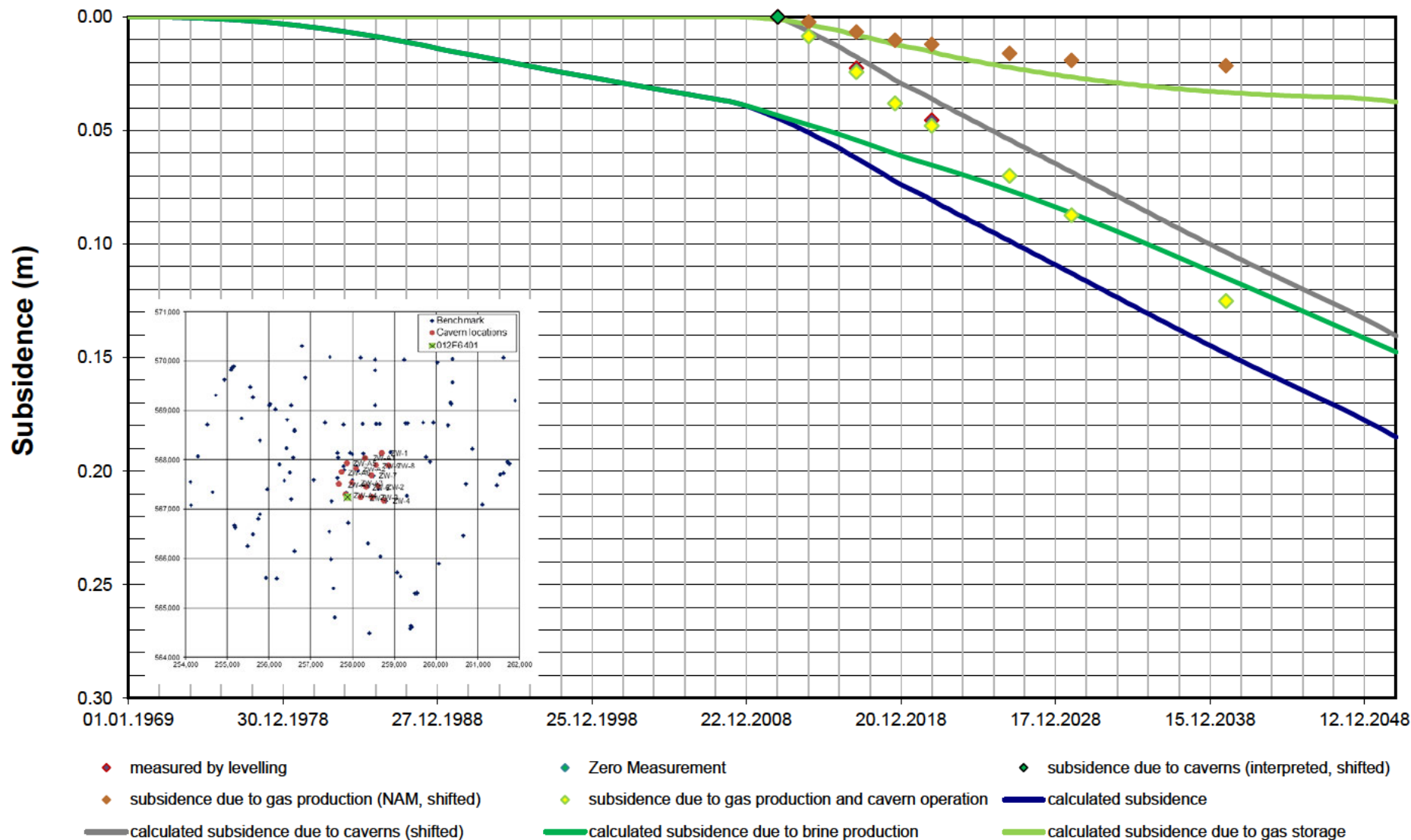


Deviation
0.0021

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6401 (ZW-A4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

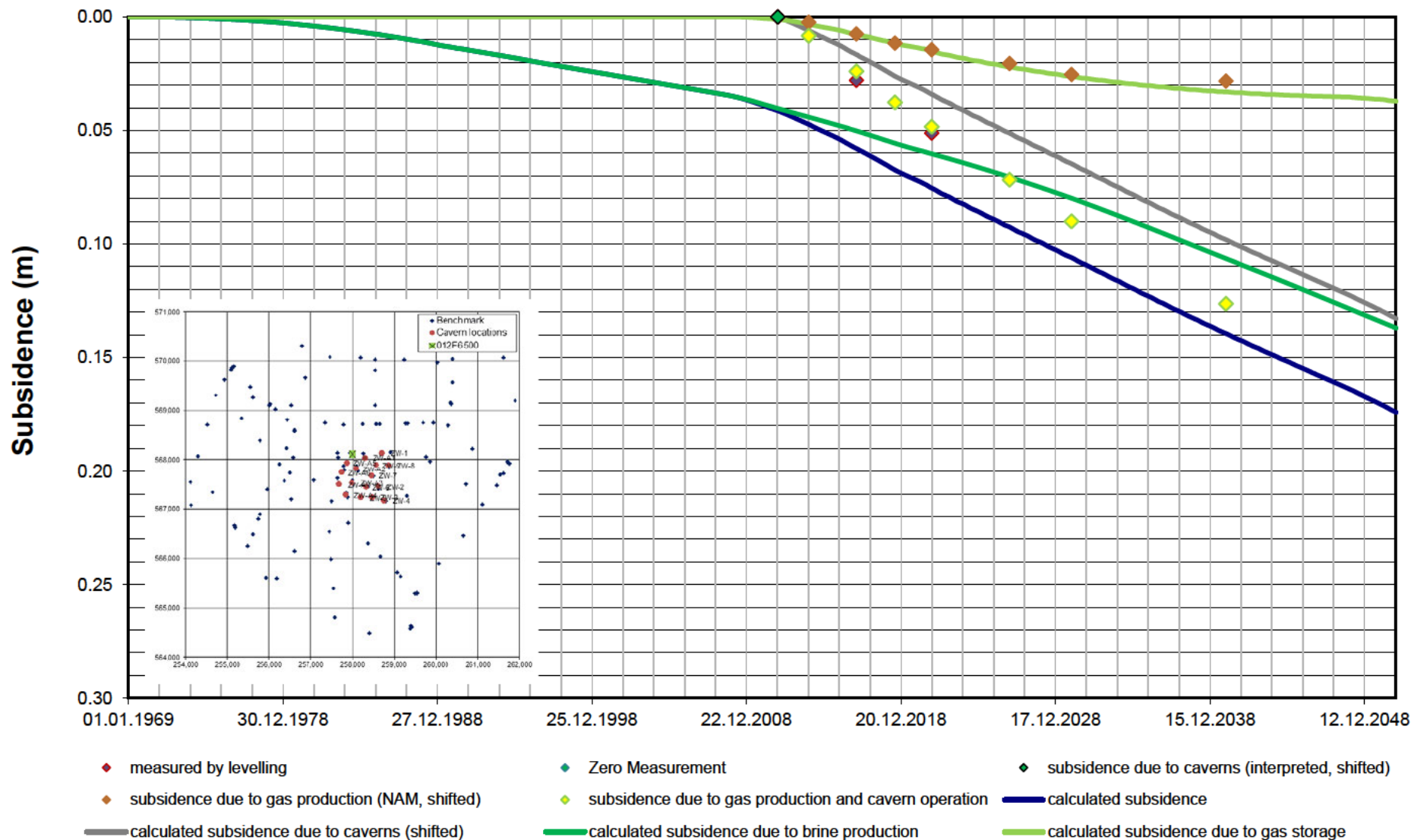


Deviation
0.0034

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6500 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

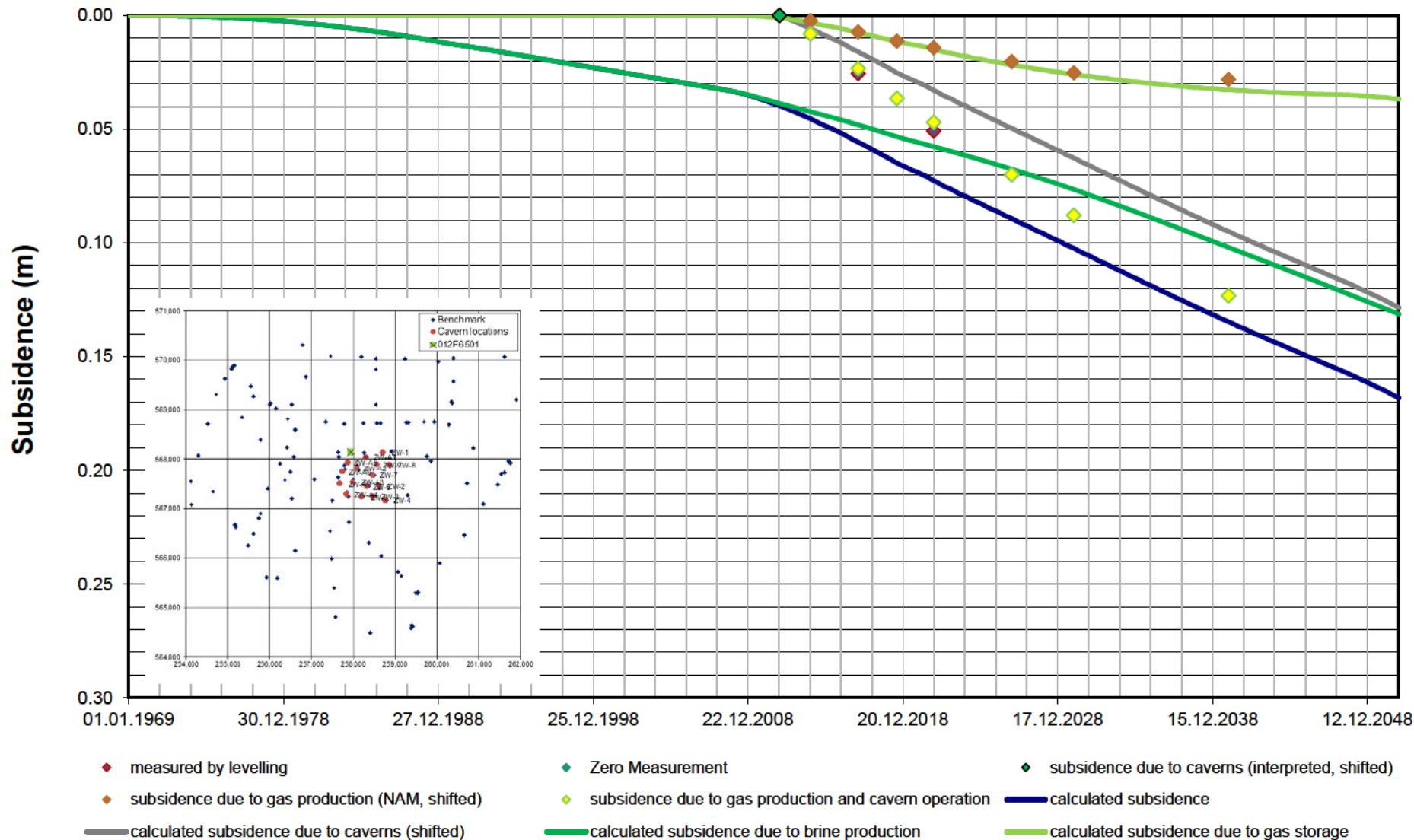


Deviation
0.0031

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6501 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

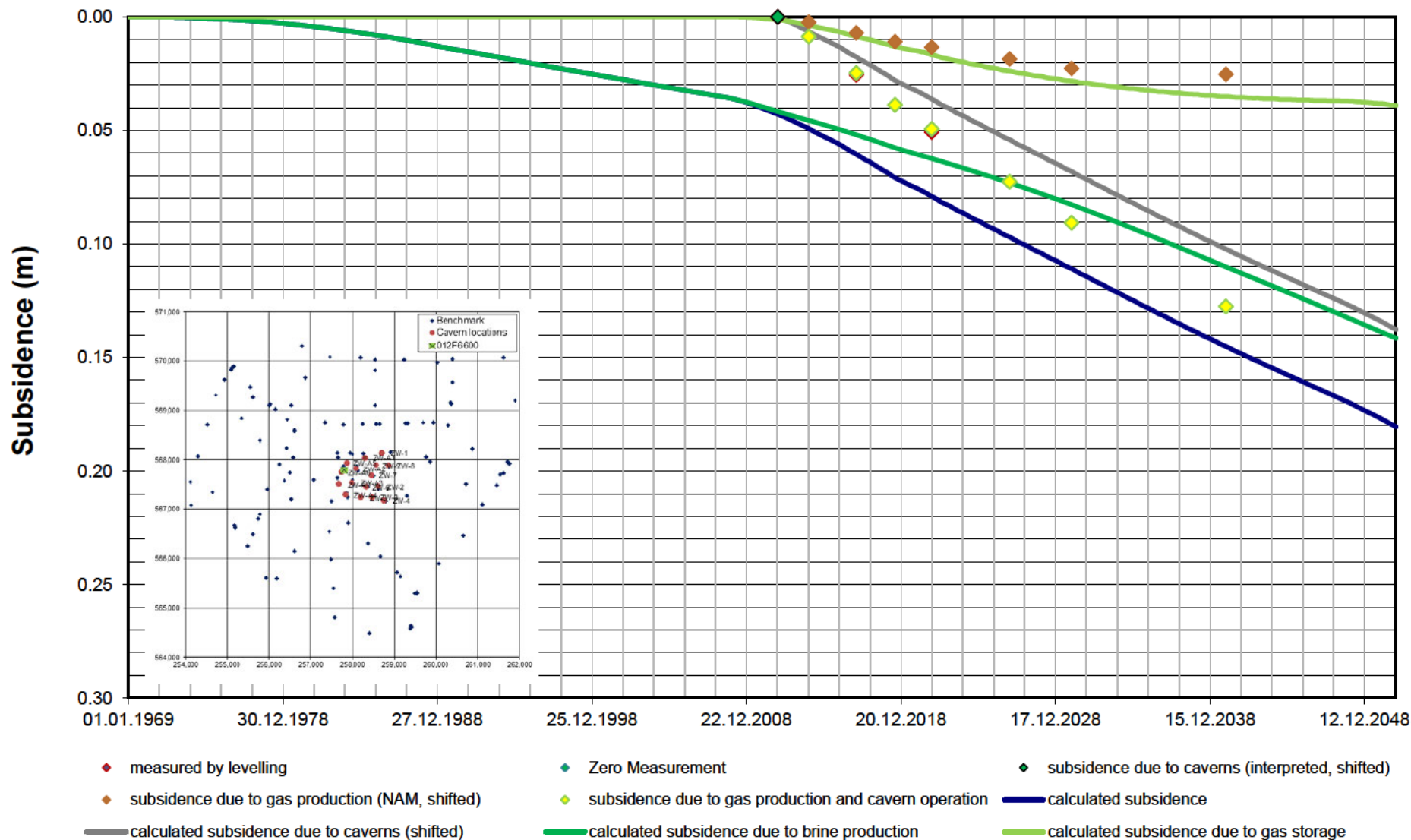


Deviation
0.0011

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6600 (ZW-A6)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

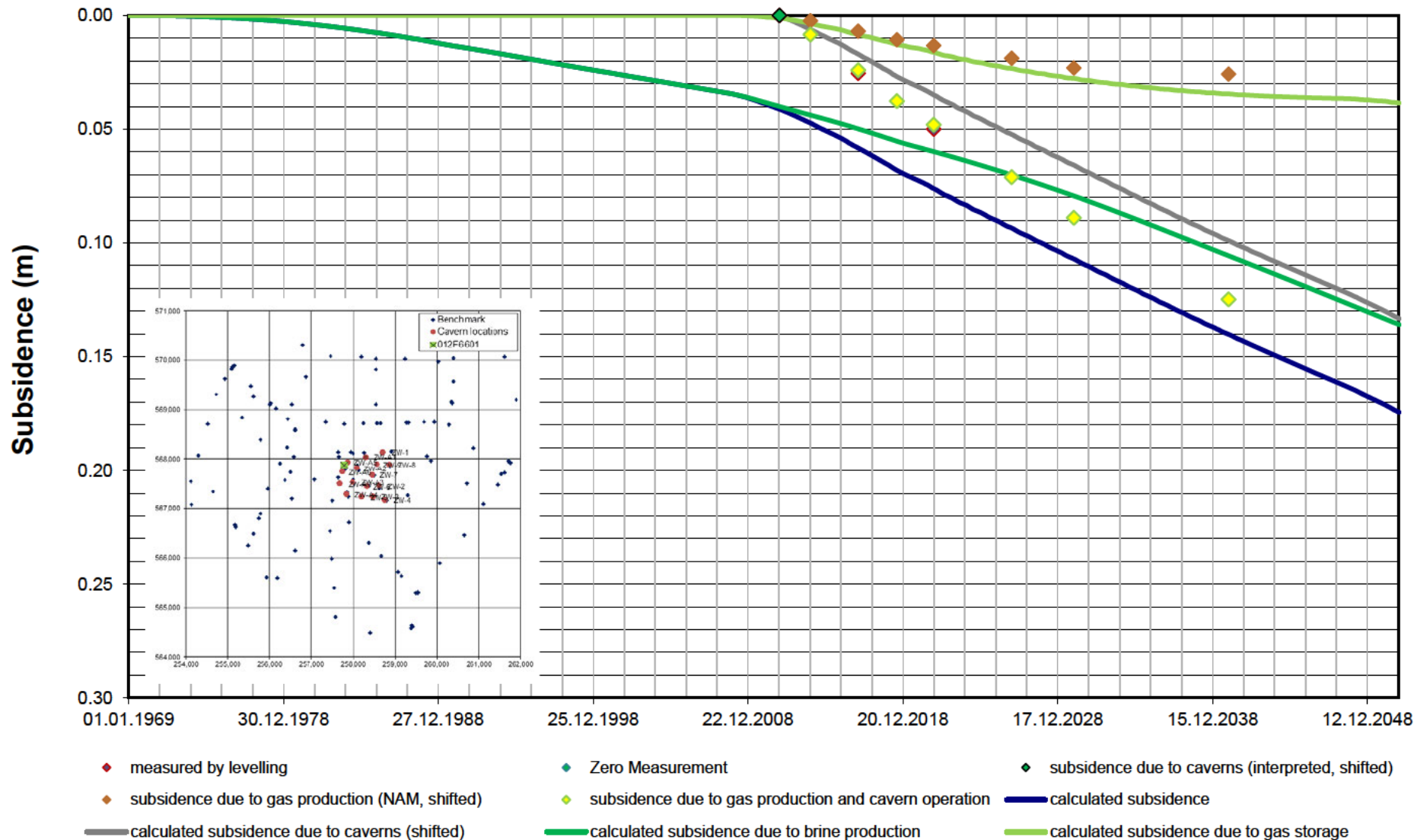


Deviation
0.0017

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6601 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

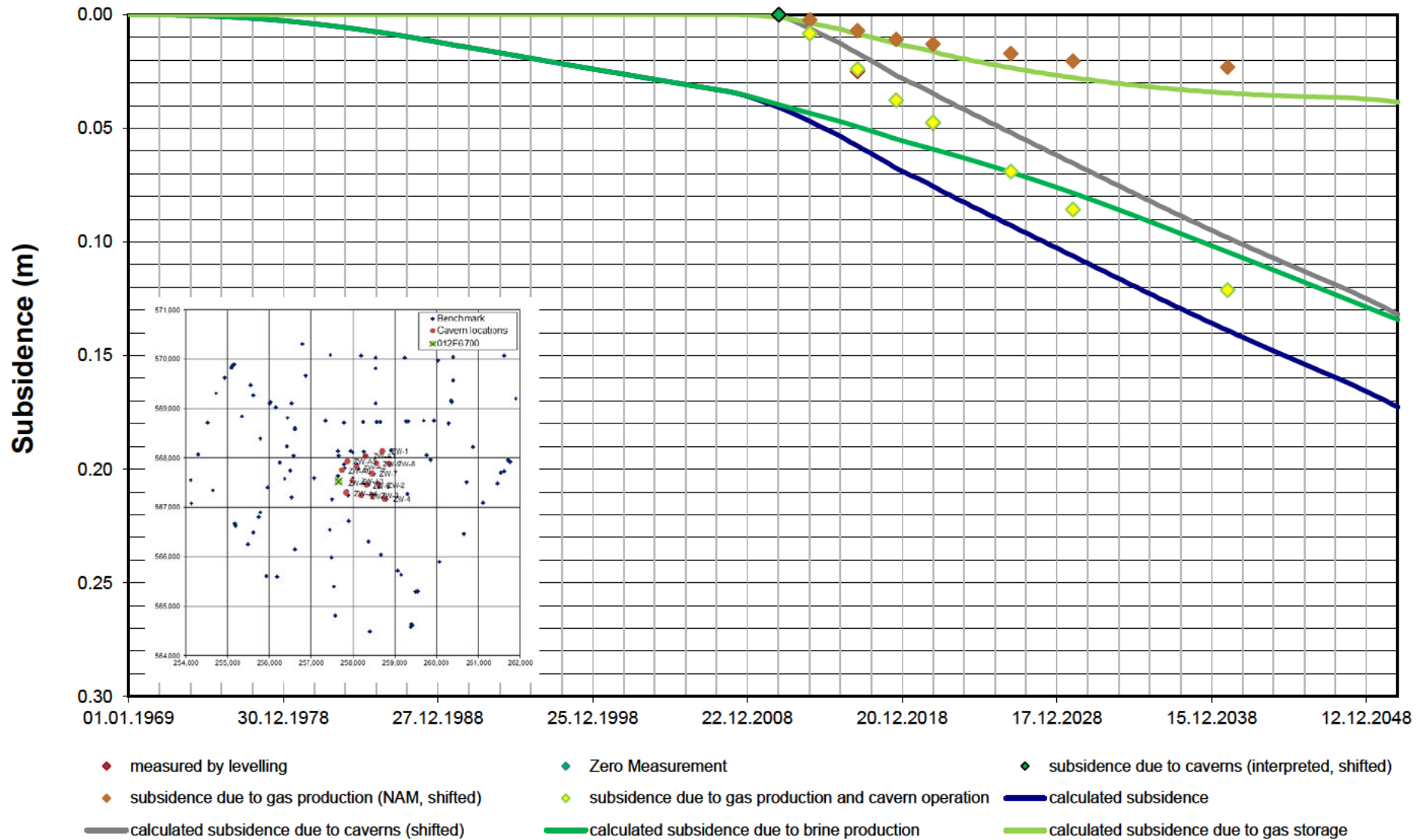


Deviation
0.0005

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6700 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

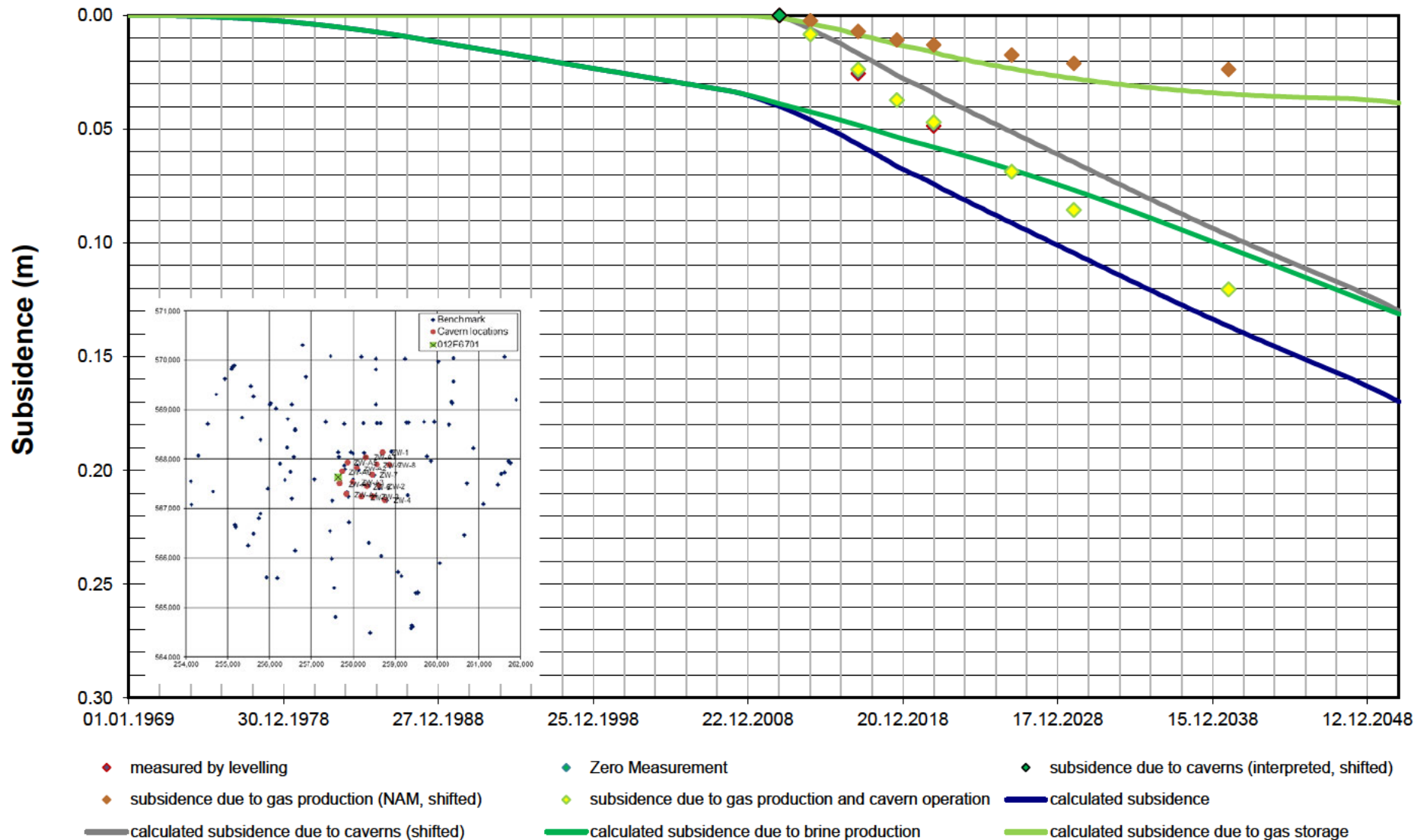


Deviation
0.0017

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6701 (ZW-A7)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

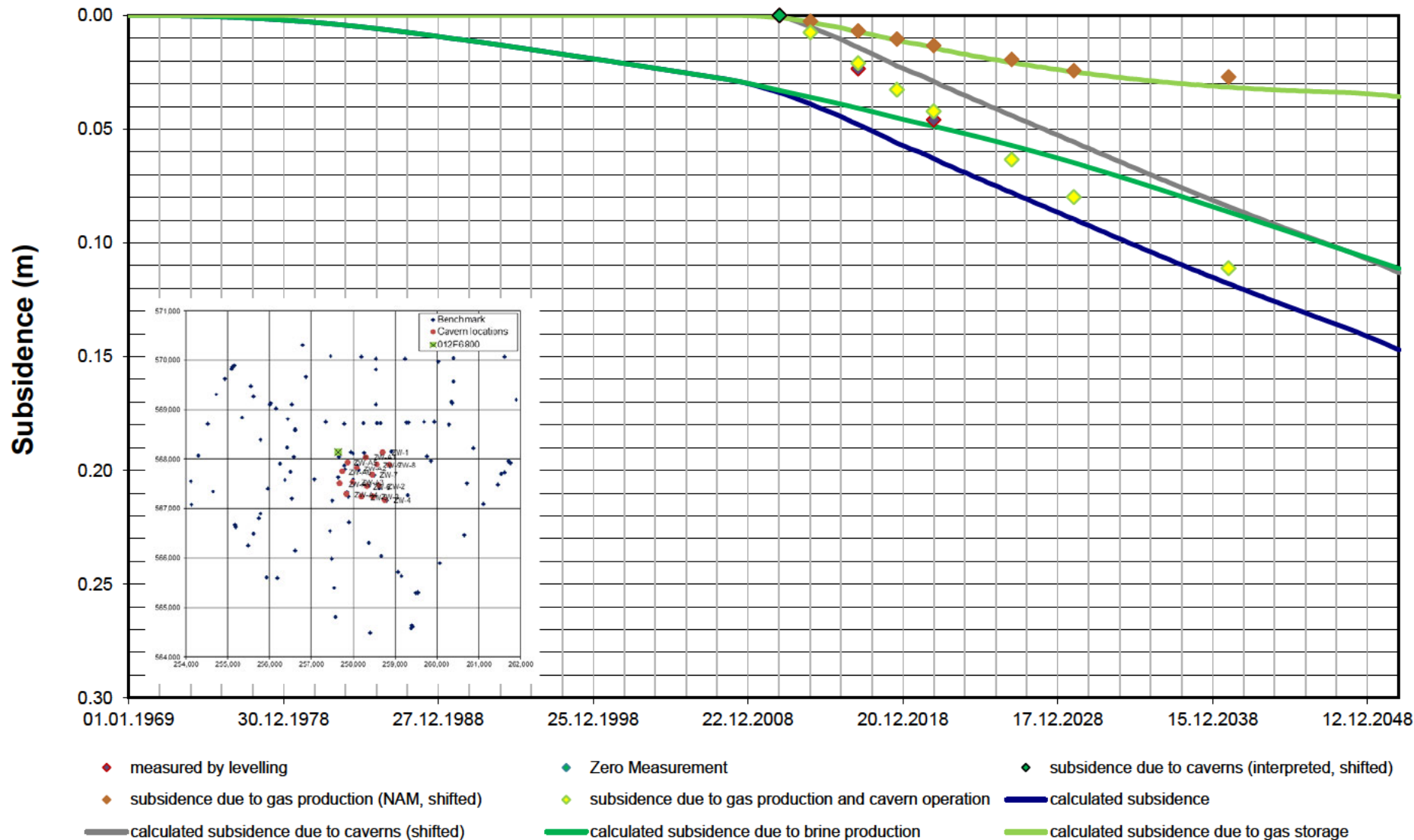


Deviation
0.0031

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6800 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

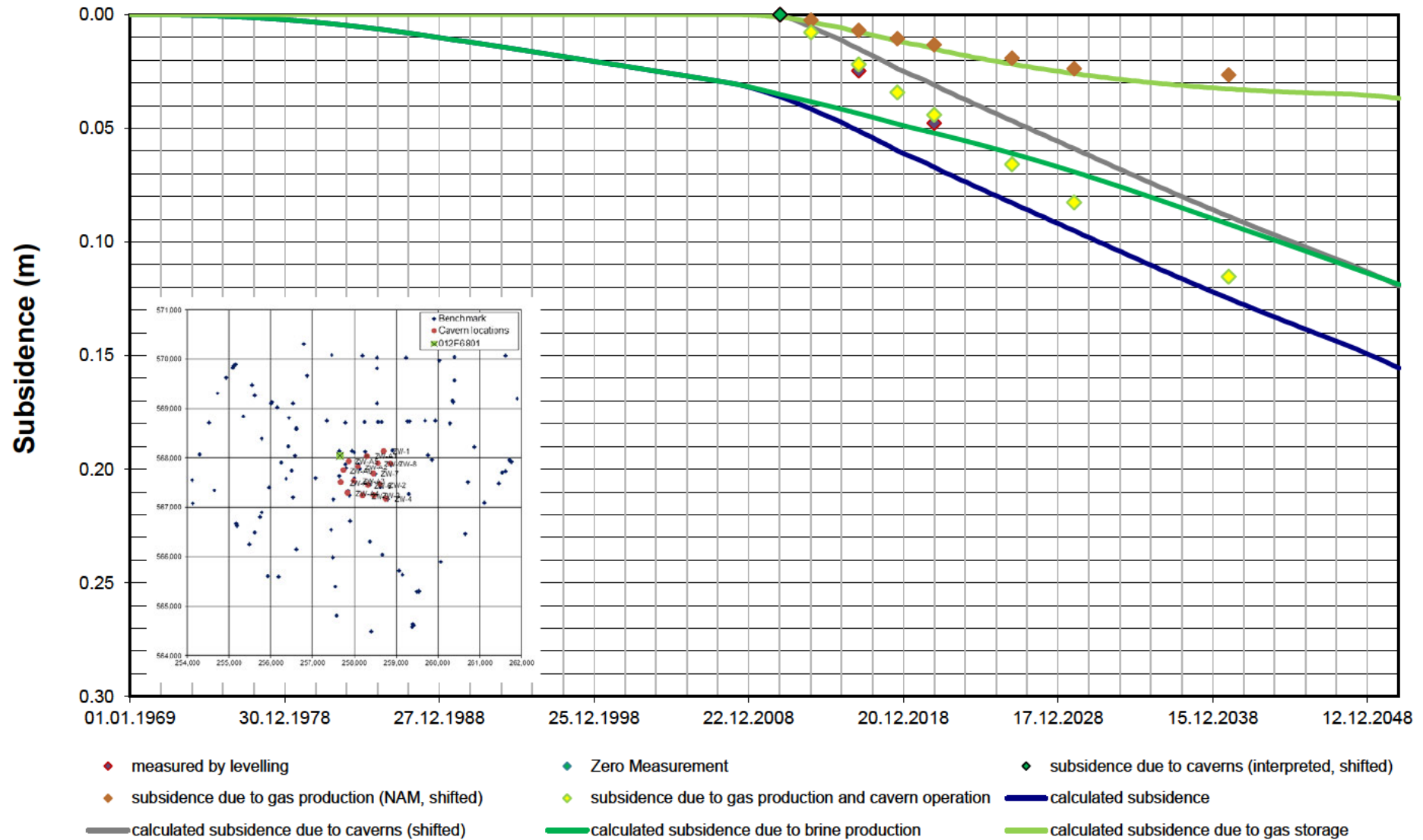


Deviation
0.0032

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 012F6801 (ZW-A5)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

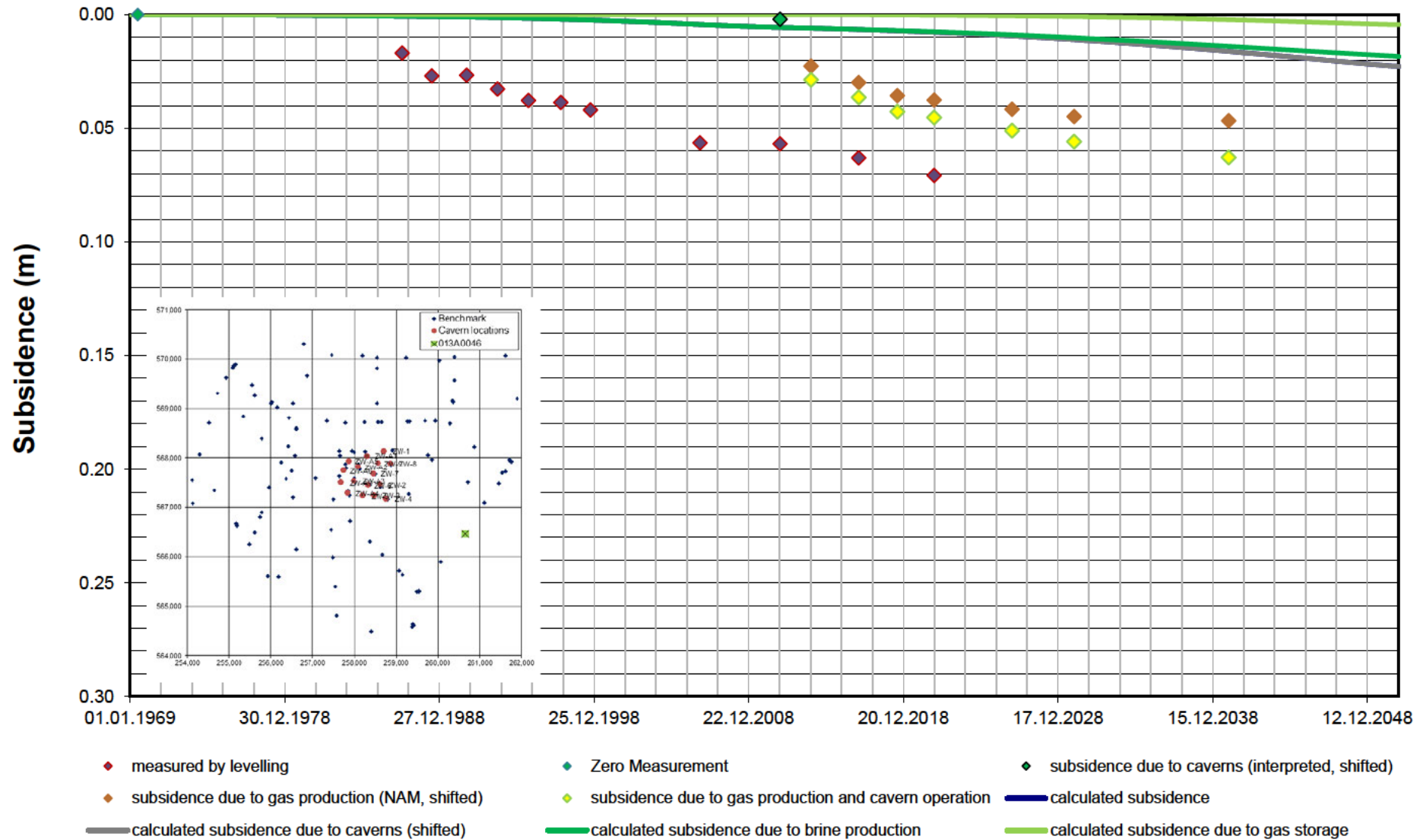


Deviation
0.0261

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 013A0046 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

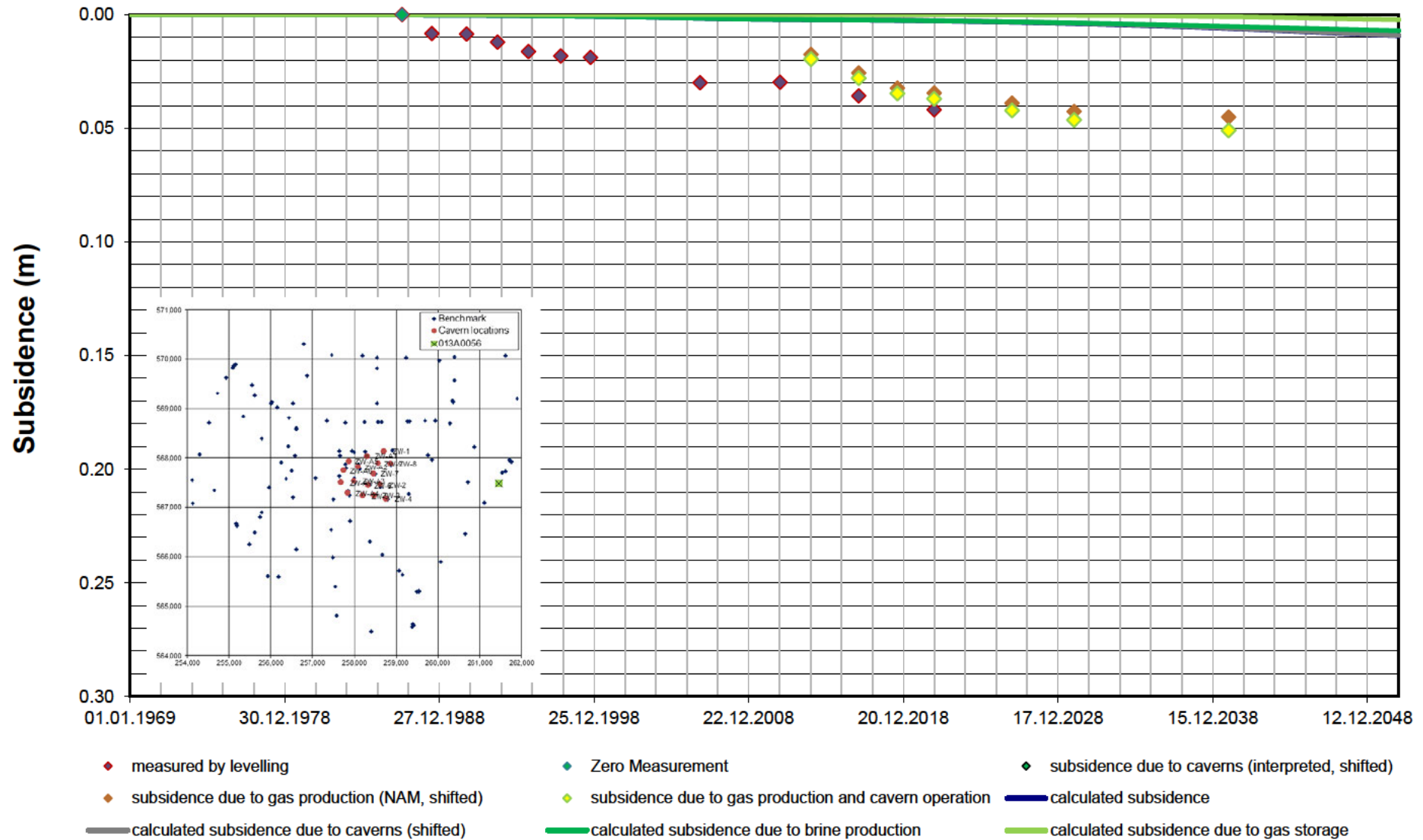


Deviation
0.0063

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 013A0056 (ZW-8)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

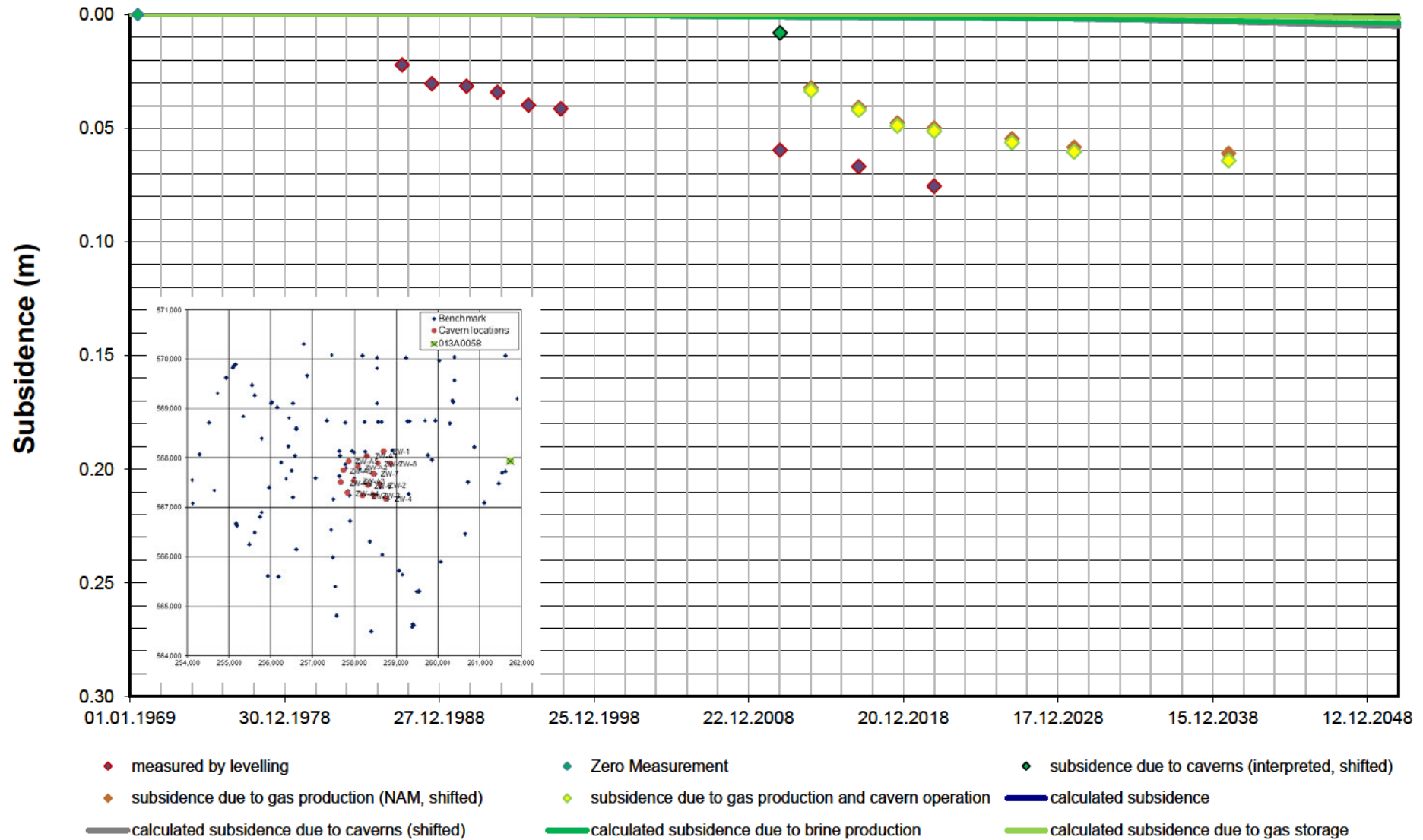


Deviation
0.0245

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

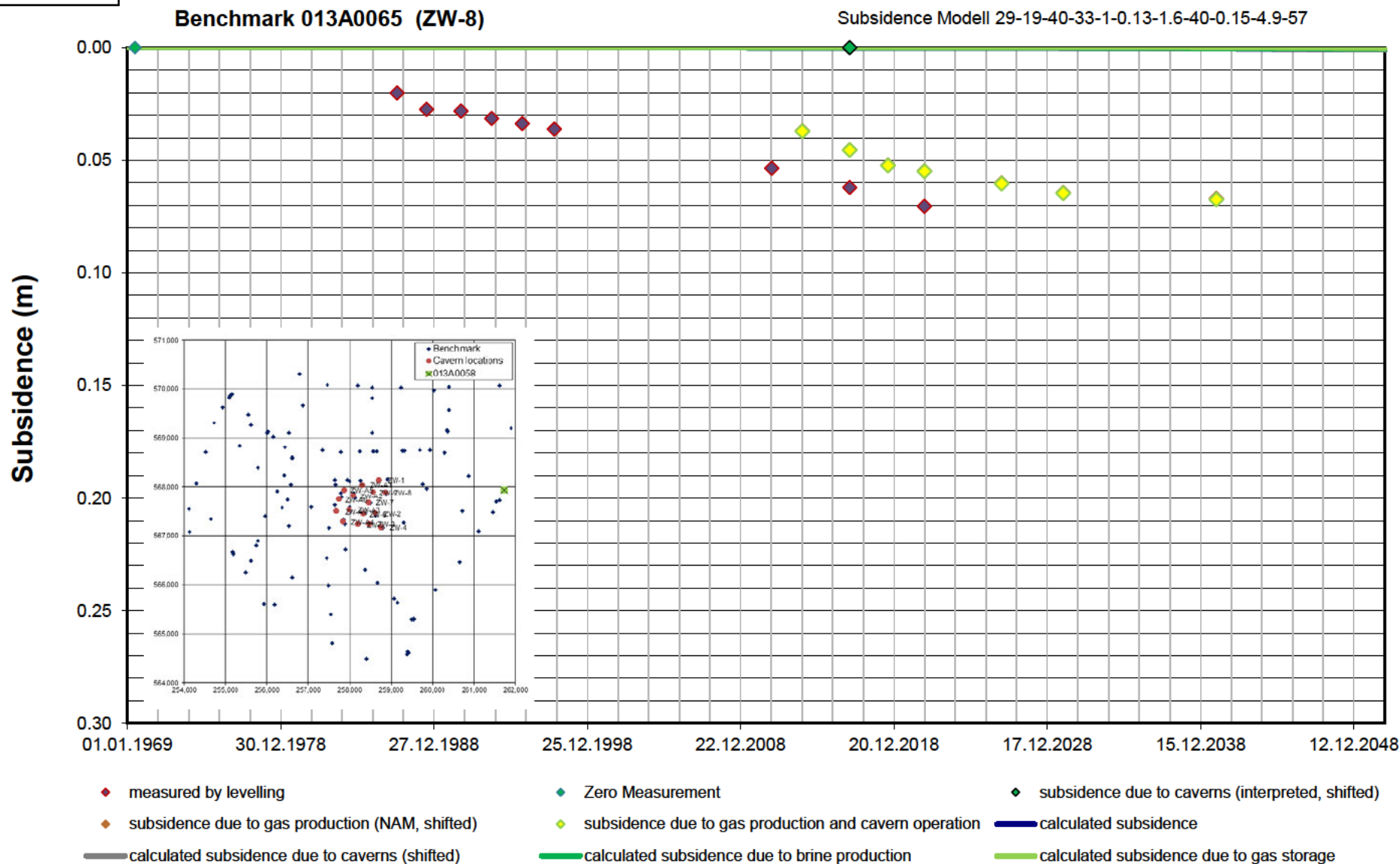
Benchmark 013A0058 (ZW-8)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57



Deviation
0.0160

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

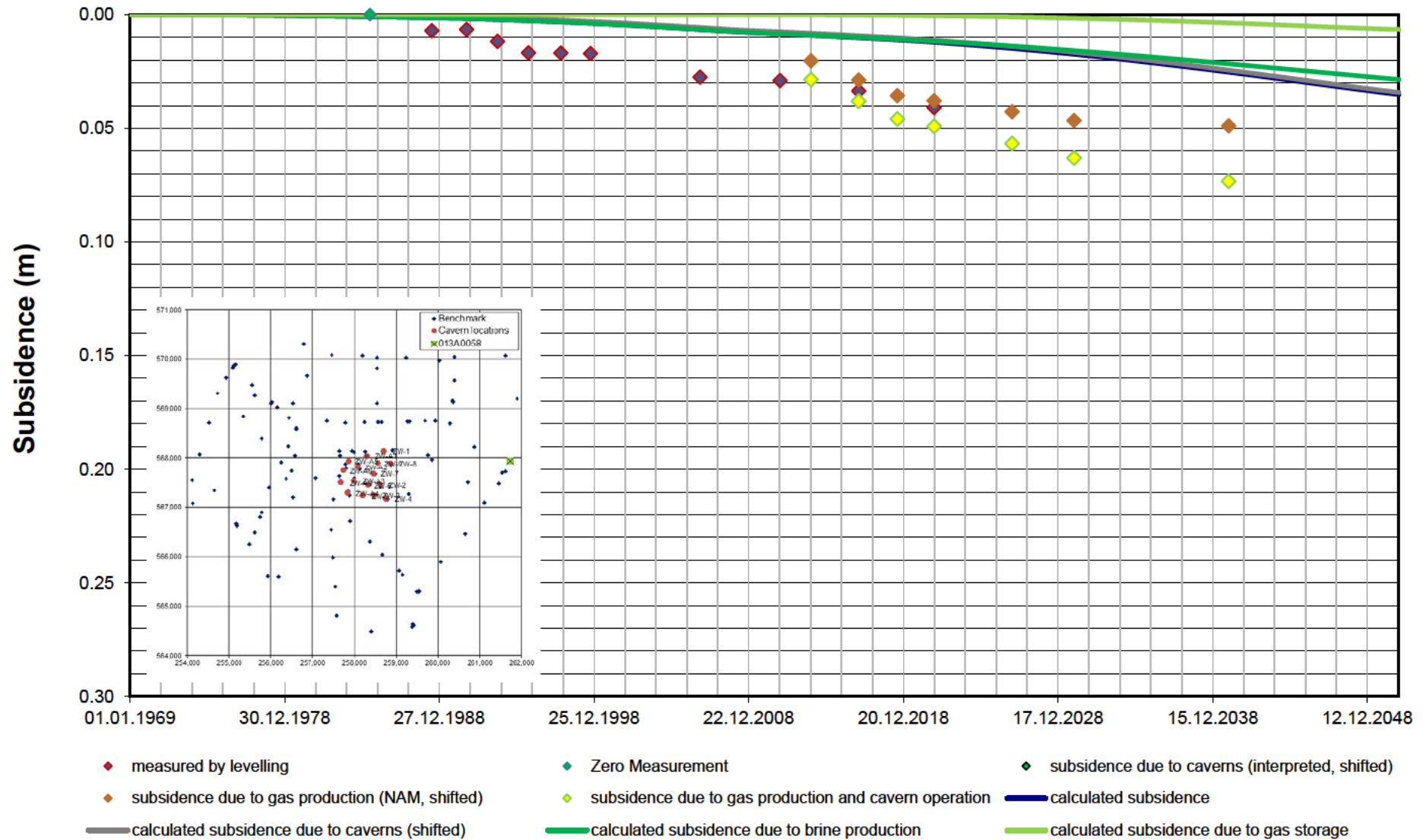


Deviation
0.0064

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 013A0159 (ZW-8)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57



Deviation
0.0023

Gasunie/Nobian (Zuidwending) - Subsidence Bowl (Gauss)

Benchmark 013A0254 (ZW-4)

Subsidence Modell 29-19-40-33-1-0.13-1.6-40-0.15-4.9-57

