

# Background Information on the update 03 / 2021

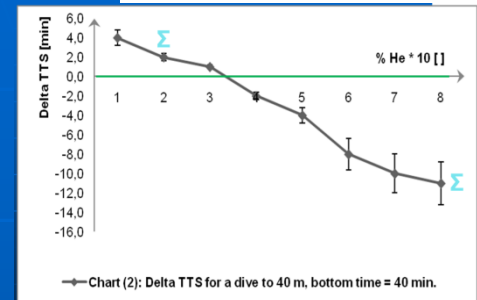
SUB  
MARINE  
CONSULTING

DOI: 10.13140/RG.2.2.22574.02888

Decompression-Calculations for  
Trimix Dives with PC-Software;  
Gradient Factors: do they repair  
defective algorithms or do they  
repair defective implementations?

# Decompression-Calculations for Trimix Dives with PC-Software; Gradient Factors: do they repair defective algorithms or do they repair defective implementations?

SUB  
MARINE  
CONSULTING



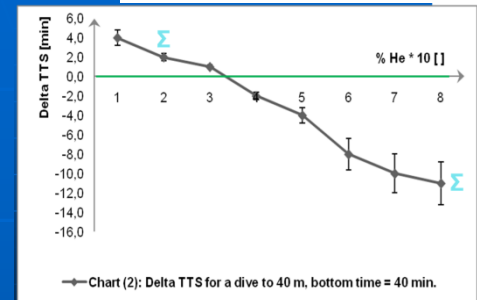
The overall # of profiles as a data base for this communication [1], resp. [1a]:

- 4 software products (2 different versions of DIVE, COTS 3, COTS 4)
- one of the COTS products being GAP, Version 3
- 6 bottom-depths: 30, 40, 50, 60, 70, 80 m
- 5 bottom-times: 20, 30, 40, 50, 60 min
- 16 Helium fractions per mix: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80 %

i.e.:  $6 * 5 * 16 = 480$  box profiles per software product  
that is:  $480 * 4 = 1.920$  profiles overall in the data base

# Decompression-Calculations for Trimix Dives with PC-Software; Gradient Factors: do they repair defective algorithms or do they repair defective implementations?

SUB  
MARINE  
CONSULTING

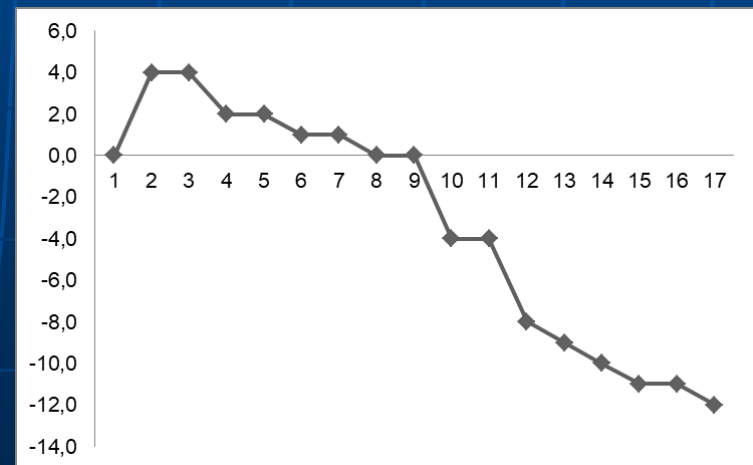
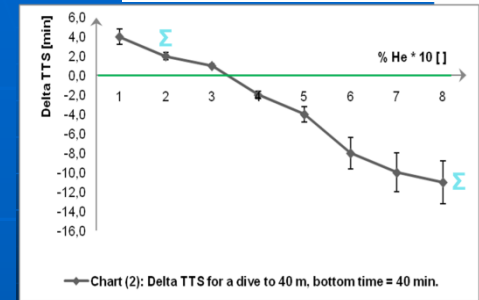
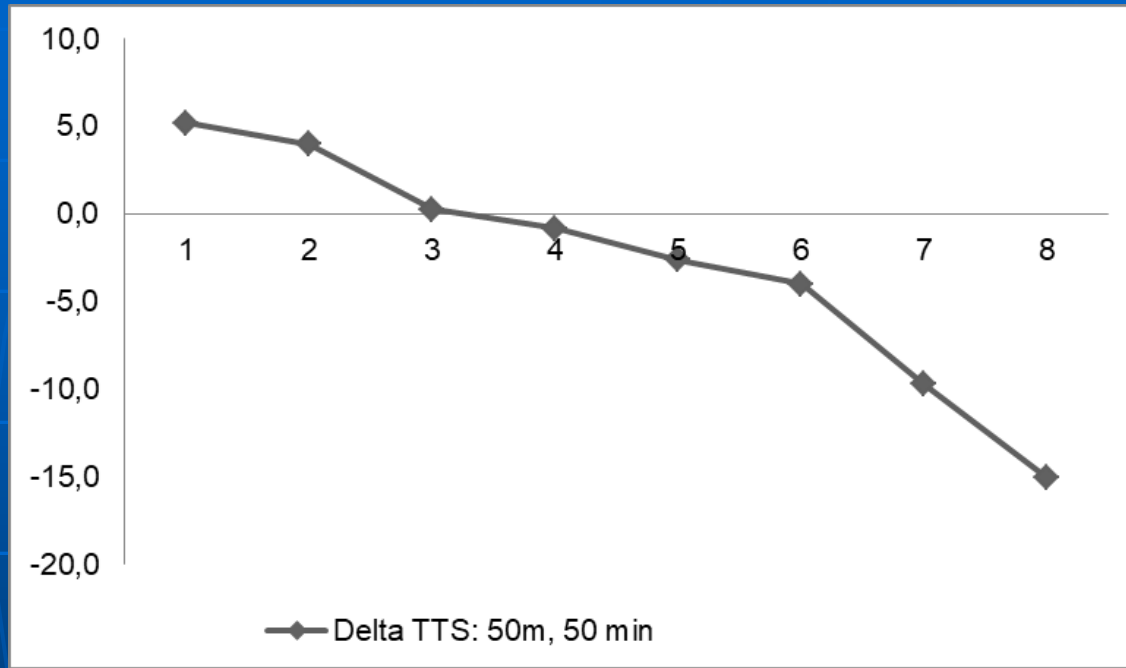


There is a wealth of data in this report, Ref. [1]  
and the topical conference paper: „update per 03 / 2021“ [1a]  
and as well a huge data base, not fully exploited:  
30 graphs like Chart (2), pls. cf. next slide  
underlining the basic messages:

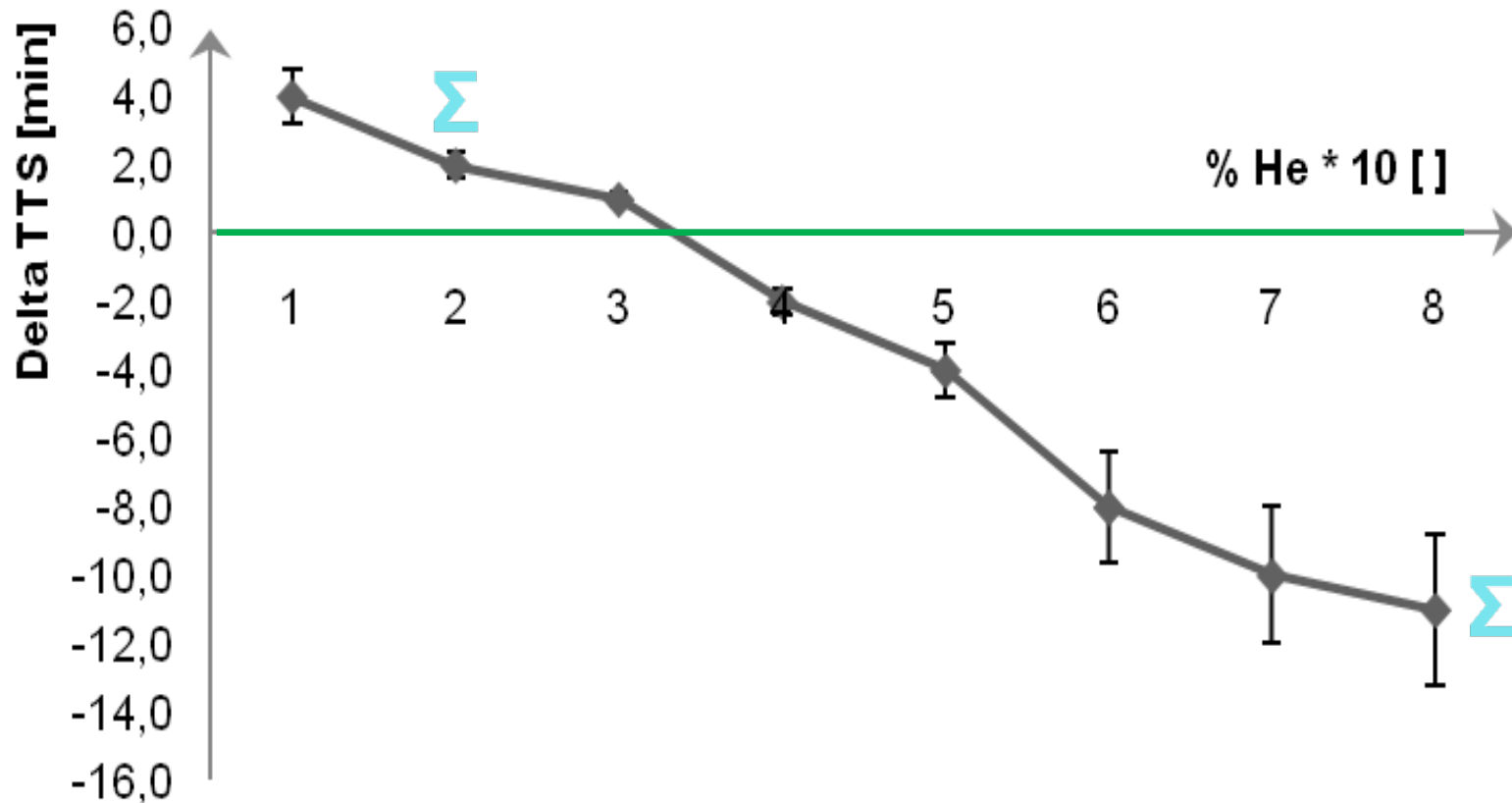
- $\Delta TTS > 0$ , decreases slowly @  $f_{He} \rightarrow 30 - 40 \%$
- $\Delta TTS$  vanishes @  $f_{He}$  around 30 to 40 % for nearly all evaluated profiles
- $\Delta TTS < 0$ , increases with increasing decompression obligation  
AND Helium fraction  $f_{He}$

# Decompression-Calculations for Trimix Dives with PC-Software; Gradient Factors: do they repair defective algorithms or do they repair defective implementations?

SUB  
MARINE  
CONSULTING



# Decompression-Calculations for Trimix Dives with PC-Software; Gradient Factors: do they repair defective algorithms or do they repair defective implementations?



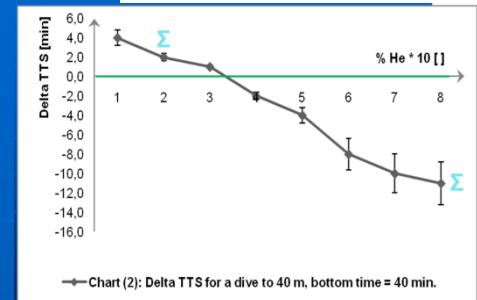
—◆— Chart (2): Delta TTS for a dive to 40 m, bottom time = 40 min.

- base line: numerical solution

$$\Sigma \bullet : \Sigma (t_{D,1} + t_{D,2} + t_{D,3}) / 3$$

# Decompression-Calculations for Trimix Dives with PC-Software; Gradient Factors: do they repair defective algorithms or do they repair defective implementations?

SUB  
MARINE  
CONSULTING



There is as well a wealth of data in the published Chart (2) in [1], [1a]:

for one box profile (= 1 combination of one bottom-depth with one bottom-time) it condenses 16 \* 4 datasets

1 data set = **green line, the bottom line of method A)**  
→ defined as: TTS = 0 for the numerical method

3 data sets = black line  
the black line with the  $\Sigma$  consists of the arithmetic mean of the calculated TTS, according to:  $\Sigma = TTS_i / 3$  with  $i = 1 - 3$

Let's have a closer look at Chart (2), pls. cf. next slide:

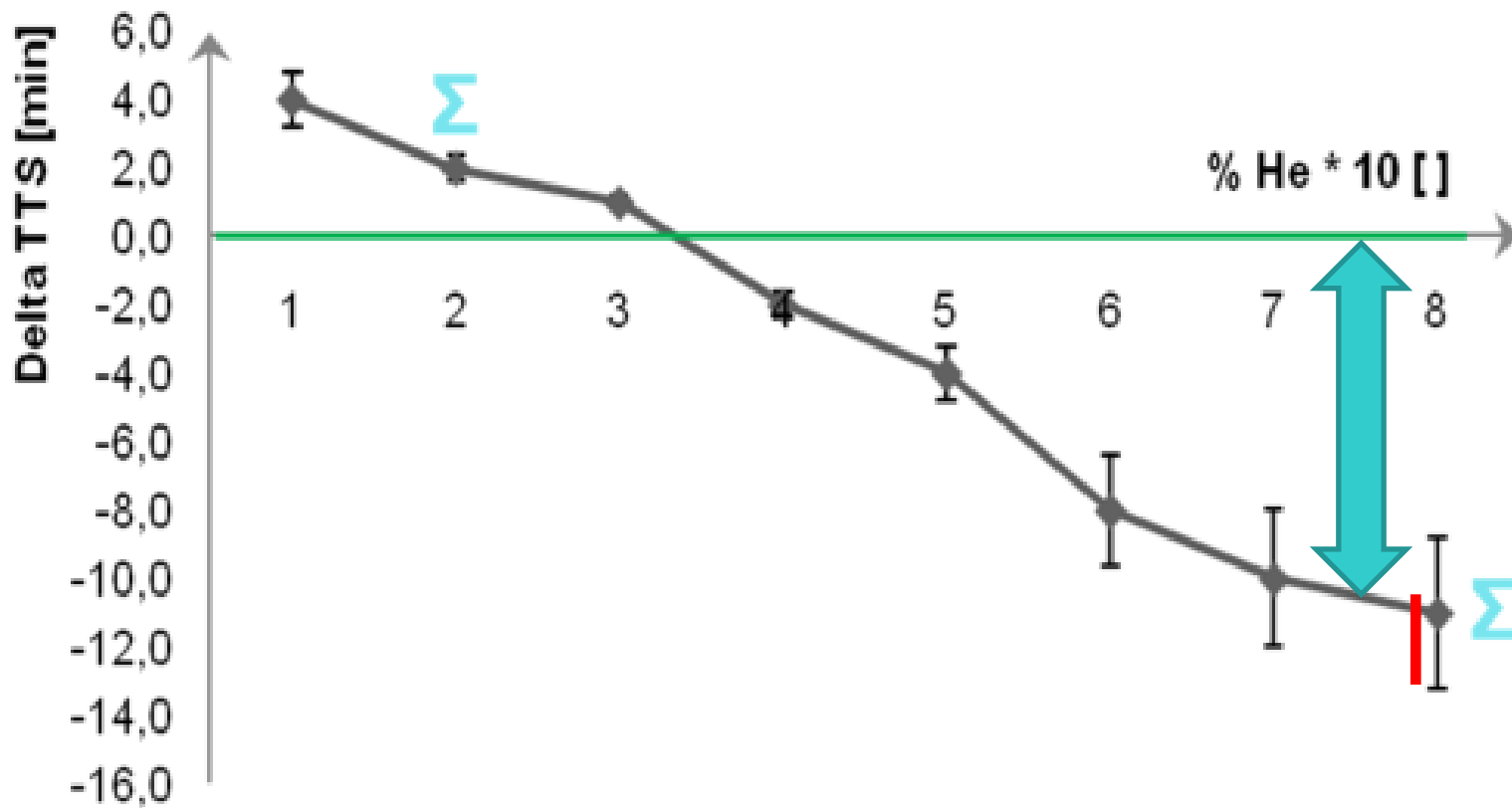


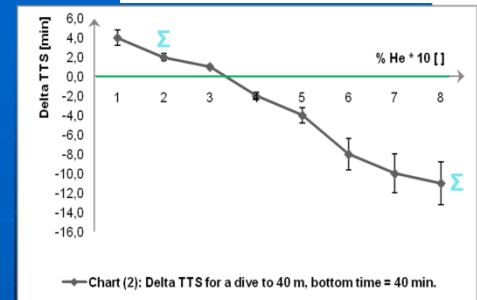
Chart (2): Delta TTS for a dive to 40 m, bottom time = 40 min.

IG

- Instead of 16 data sets, there is only each 2nd. set depicted;
- double arrow: Delta TTS, increasing with increasing Helium fraction
- error margins: **only through the GAP** software,
- since:  $\Delta TTS = 0$  between one COTS product & DIVE with method B)

Decompression-Calculations for Trimix Dives  
with PC-Software;  
Gradient Factors:  
do they repair defective algorithms or  
do they  
repair defective implementations?

SUB  
MARINE  
CONSULTING



The 4 desktop deco software products under comparison:

- DIVE Version 2\_900 with method B), obsolete since 2013 due to not running under Windows 7 or higher
- DIVE Versions 3, now 3\_09 with methods A) and B) , pls. cf. ref. [2], [3]
- COTS (commercially off-the-shelf) #3
- COTS (commercially off-the-shelf) #4:

About GAP-Diveplanner



GAP-Diveplanner

Version 3.0.425.6

© 2003-2010

GAP-Software



But there are software products which come pretty close to our numerical solution: for eg. the OSTC Planner 2.70.5 from 2014, now obsolete:

OC Gas Liste:

\* erstes Gas#3 = Hx20/80

...

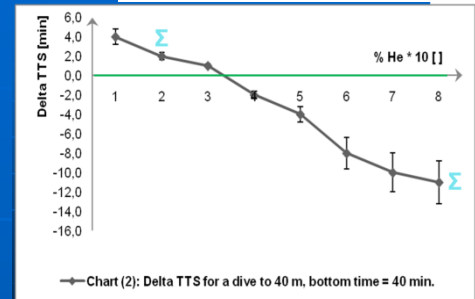
==== OC Runtime ====

61:16 80.0m Deko: **ppO2=1.80 CNS=255%**

80 m	60 ' 60.0 ' Gas#3
39 m	2 ' 66.1 ' 1
36 m	5 ' 71.4 ' 1
33 m	6 ' 77.8 ' 1
30 m	9 ' 87.1 ' 1
27 m	10 ' 97.4 ' 1
24 m	16 ' 113.7 ' 1
21 m	20 ' 134.0 ' 1
18 m	29 ' 163.3 ' 1
15 m	44 ' 207.6 ' 1
12 m	66 ' 273.9 ' 1
9 m	111 ' 385.2 ' 1
6 m	229 ' 614.4 ' 1
3 m	255 ' 869.7 ' 1
3 m	16 ' 885.7 ' 1
0 m	---- 886.7 ' 1

TTS = 827 ' 1

**CNS = 255%**



### *OSTC Planner* v2.70.5 - OSTC firmware 2.70 (release)

Der Zweck des *OSTC Planner* ist es:

- mit den Dekompressions-Parametern (Model, Gradienten Faktoren, Gaswechselliefen etc.) deines *OSTC*-Computer herumzuspielen und diese zu verstehen
- simulierte Tauchgänge zu drucken und mit anderen Konfigurationen zu vergleichen (Gas Mix, Deko Tanks, SetPoints, Stopps, etc.)
- den *OSTC* mit anderen Deko Softwares zu vergleichen und überprüfen.
- die *OSTC* Computer Konfiguration zu sichern, bearbeiten und wiederherstellen.

Lizenziert für: NICHT REGISTRIERT, TESTVERSION

© 2011-2014, JeanDo, all rights reserved. <https://ostc-planner.net>

And there are software products which pretty much match our numerical solution: for eg. Subsurface 4.9.10 available @: <https://subsurface-divelog.org>

**Subsurface (4.9.10.0) Plan** erstellt am 21.03.21

Runtime: 789min

	Tiefe	Dauer	Runtime	Gas
↘	80m	2min	2min	(20/80)
→	80m	60min	62min	
↗	39m	5min	67min	
-	39m	2min	69min	
-	36m	5min	74min	
-	33m	7min	81min	
-	30m	8min	89min	
-	27m	10min	99min	
-	24m	15min	114min	
-	21m	20min	134min	
-	18m	27min	161min	
-	15m	40min	201min	
-	12m	60min	261min	
-	9m	97min	358min	
-	6m	190min	548min	
-	3m	241min	789min	

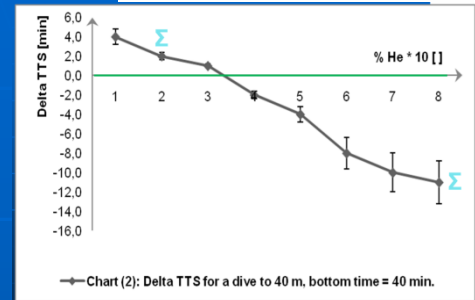
CNS: 896%

OTU: 182

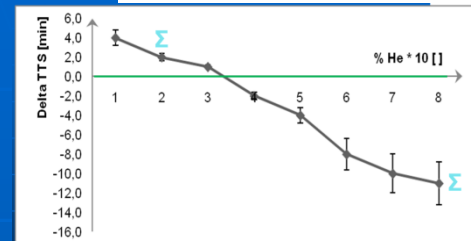
TTS: 729

Dekomodell: Bühlmann ZHL-16C mit GF niedrig = 100% und GF hoch = 100%

Luftdruck: 1.013mbar (0m)



There is nearly a perfect 1:1 mapping on the stop times per every stage +/- 1 → 2 min (except the 12 min at the stage @ 6m: we are trying to clarify with the developpers, why & how!)



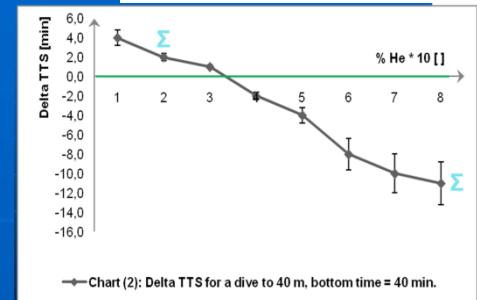
TTS for a dive to 40 m, bottom time = 40 min.

```
Deko Prognose numerisch:
Schrittweite (default = 0.01)?0.001
42m Stopp APPROXIMATION :      0.00 Steps N=          1.0 Komp.#:  16
39m Stopp APPROXIMATION :      2.53 Steps N=        2534.0 Komp.#:   7
36m Stopp APPROXIMATION :      4.73 Steps N=        4734.0 Komp.#:   7
33m Stopp APPROXIMATION :      6.49 Steps N=        6489.0 Komp.#:   8
30m Stopp APPROXIMATION :      8.39 Steps N=        8393.0 Komp.#:   8
27m Stopp APPROXIMATION :      9.94 Steps N=        9942.0 Komp.#:   9
24m Stopp APPROXIMATION :     14.92 Steps N=       14925.0 Komp.#:   9
21m Stopp APPROXIMATION :     20.19 Steps N=       20186.0 Komp.#:  10
18m Stopp APPROXIMATION :     27.47 Steps N=       27466.0 Komp.#:  11
15m Stopp APPROXIMATION :     40.85 Steps N=       40846.0 Komp.#:  12
12m Stopp APPROXIMATION :     61.47 Steps N=       61468.0 Komp.#:  13
 9m Stopp APPROXIMATION :    100.36 Steps N=      100359.0 Komp.#:  14
 6m Stopp APPROXIMATION :    202.83 Steps N=      202830.0 Komp.#:  16
 3m Stopp APPROXIMATION :    240.61 Steps N=      240607.0 Komp.#:  16
TTS                = 749.67
TTS gerundet      = 762.
CPU TIME used:    0.156250
```



# Decompression-Calculations for Trimix Dives with PC-Software; Gradient Factors: do they repair defective algorithms or do they repair defective implementations?

SUB  
MARINE  
CONSULTING



References:

[1] Salm, Albi (2012) Decompression-Calculations for Trimix Dives with PC-Software; Gradient Factors: do they repair defective algorithms or do they repair defective implementations?

DOI: 10.13140/RG.2.2.35405.87527

[1a] update per 03 / 2021

(PDF) Update per 03 / 2021 on: Decompression-Calculations for Trimix Dives with PC- Software; Gradient Factors: do they repair defective algorithms or do they repair defective implementations? (researchgate.net)

[2] Salm, Albi (2021) Synopsis and Fact Sheet

(PDF) Synopsis & Fact Sheet: PoC for DIVE (Proof of Concept for a free-/shareware decompression suite) (researchgate.net)

[3] www.SMC-de.com (1991): DIVE, a desktop decompression suite for Win7, german version:

https://www.divetable.info/DIVE\_V3/index.htm