Interactieve tijdreeksmodelontwikkeling

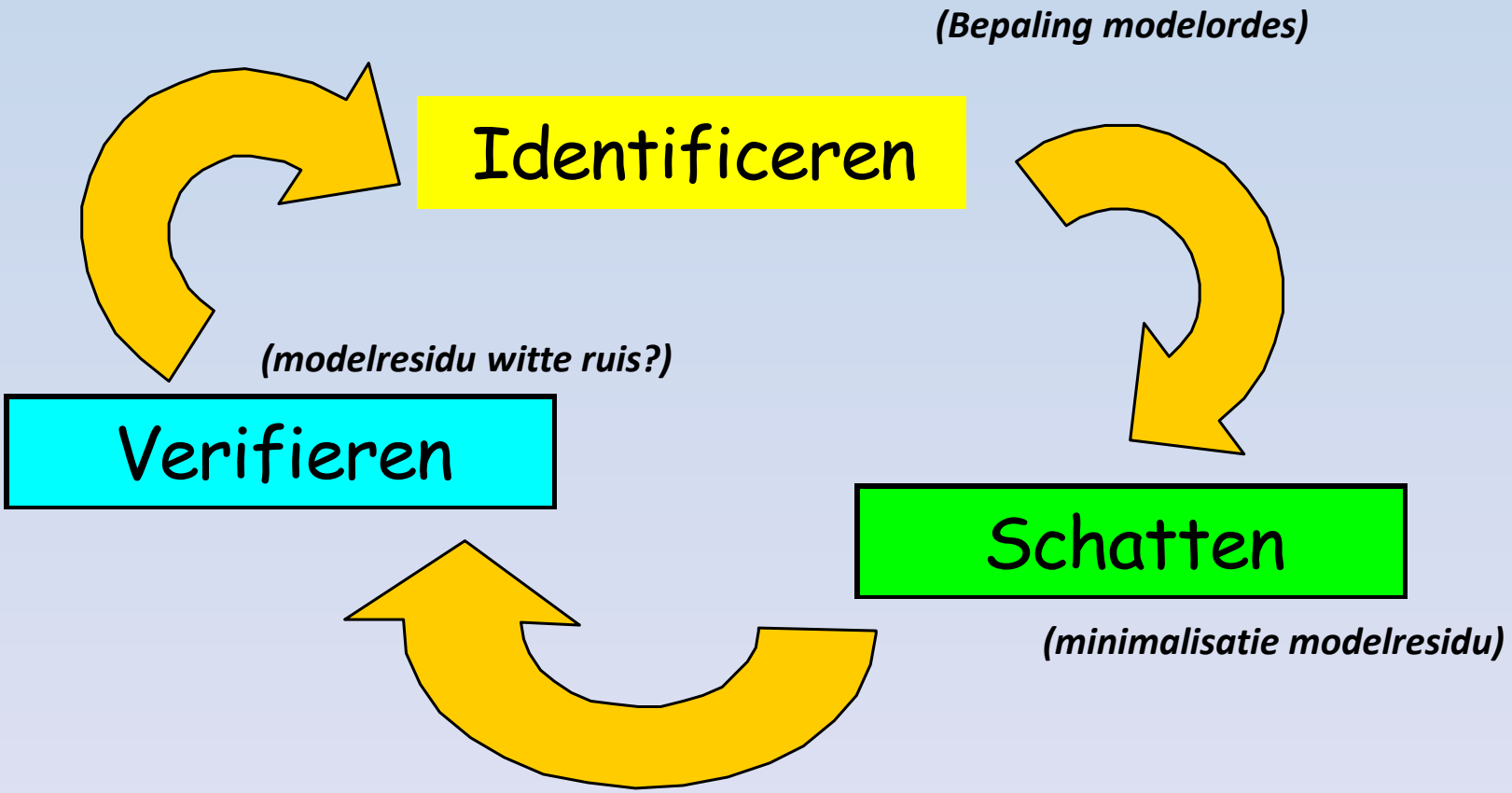
Cyclus modelidentificatie – parameterschatting – modelverificatie

Eit van der Meulen

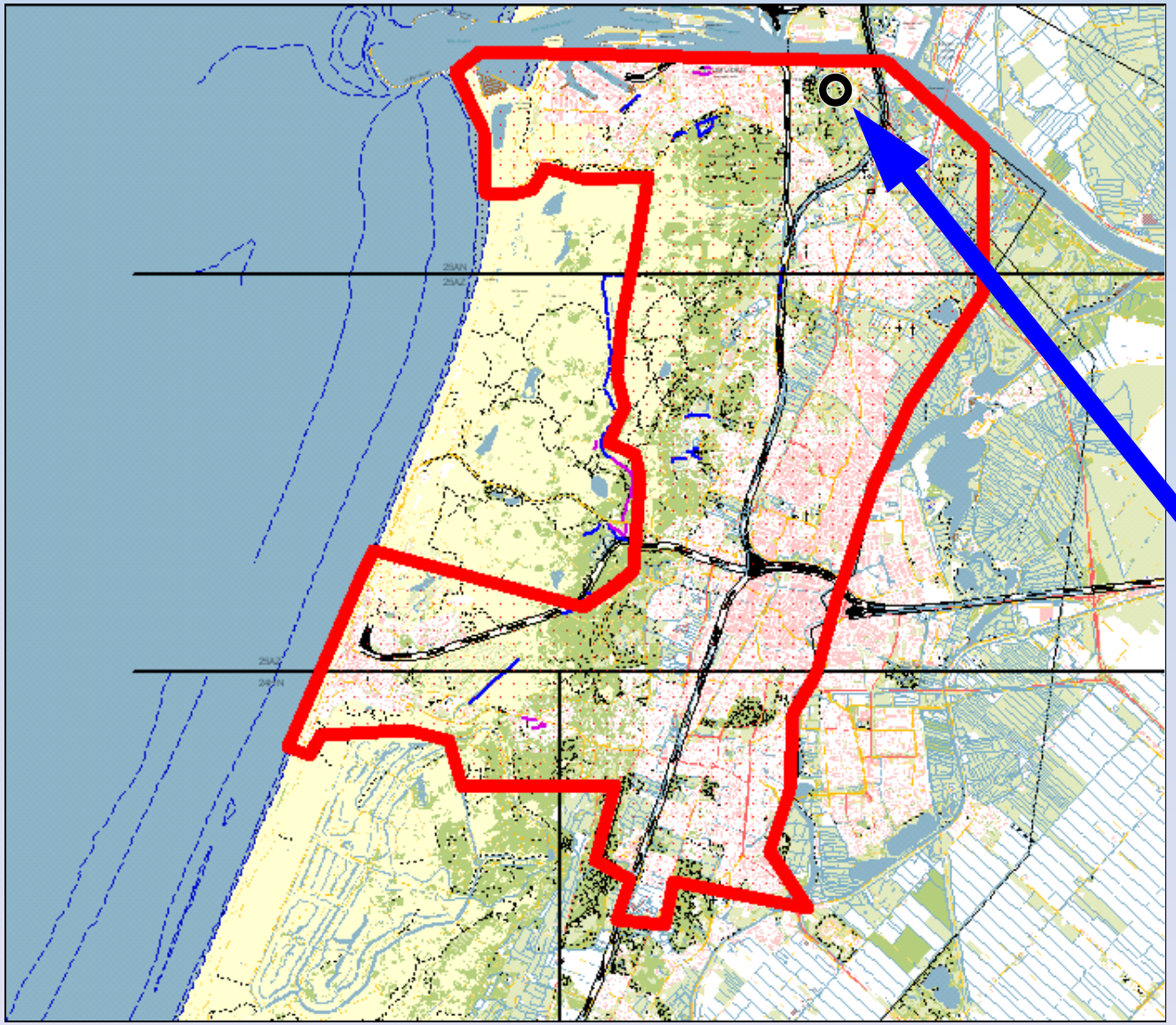
AMO

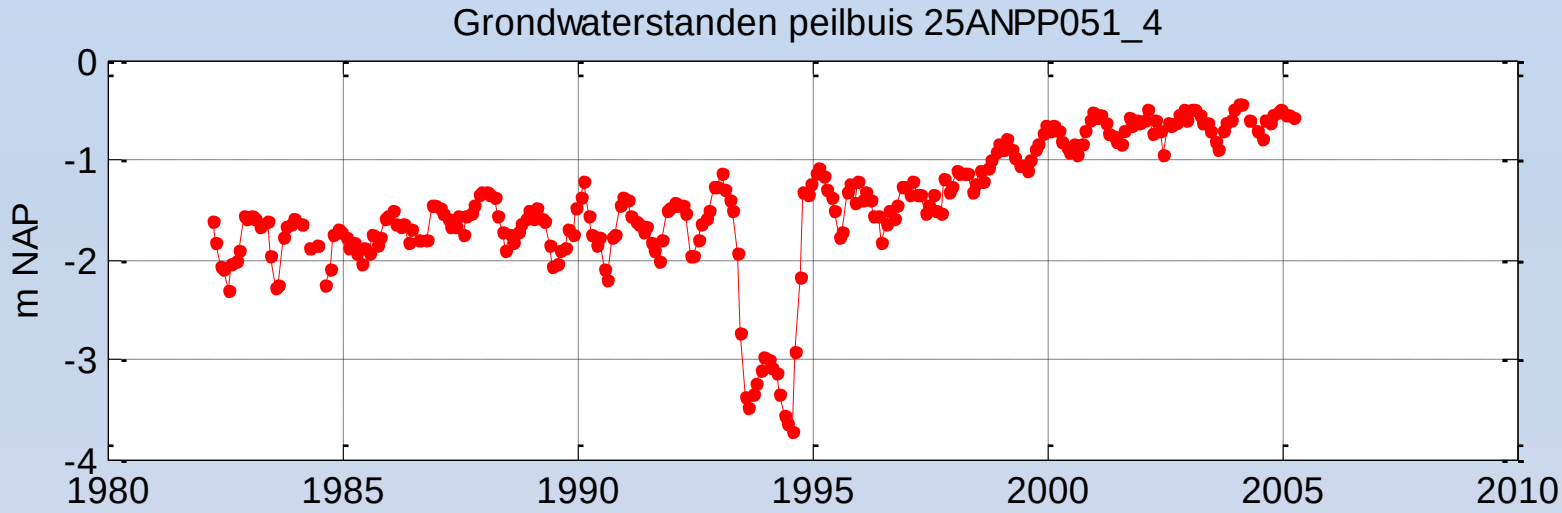
http://www.amo-nl.com

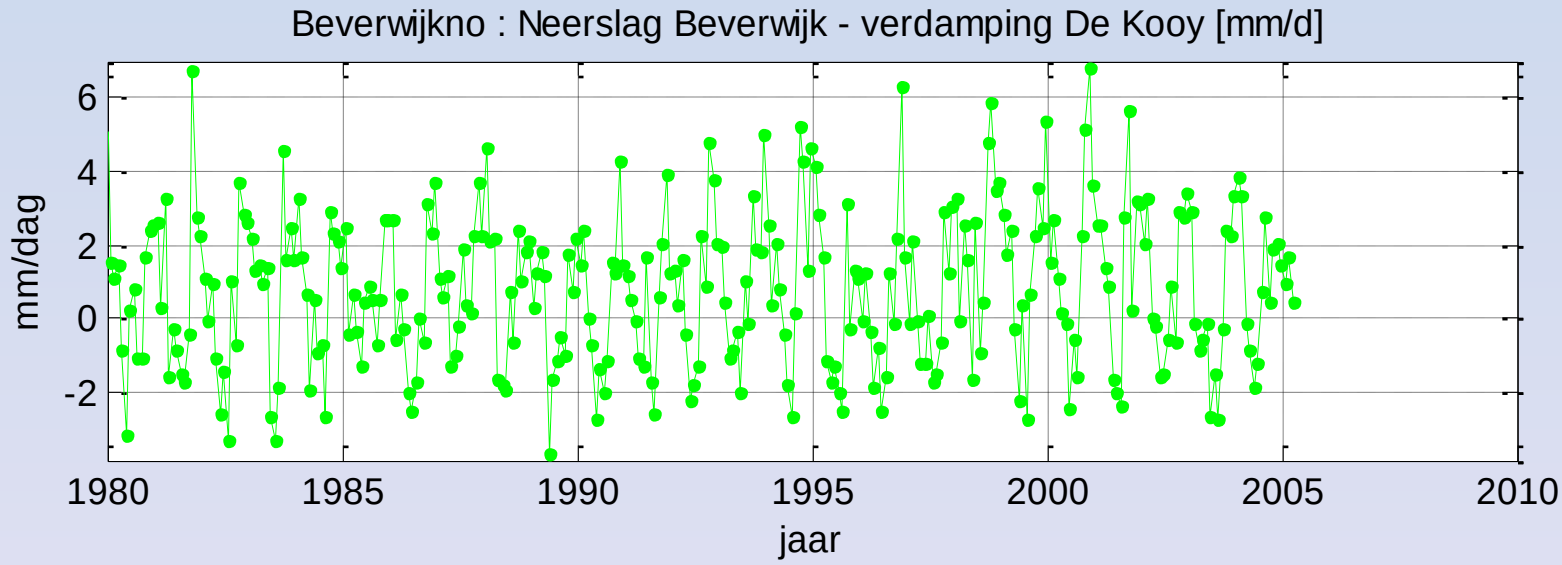
Cyclus modelidentificatie – parameterschatting – modelverificatie

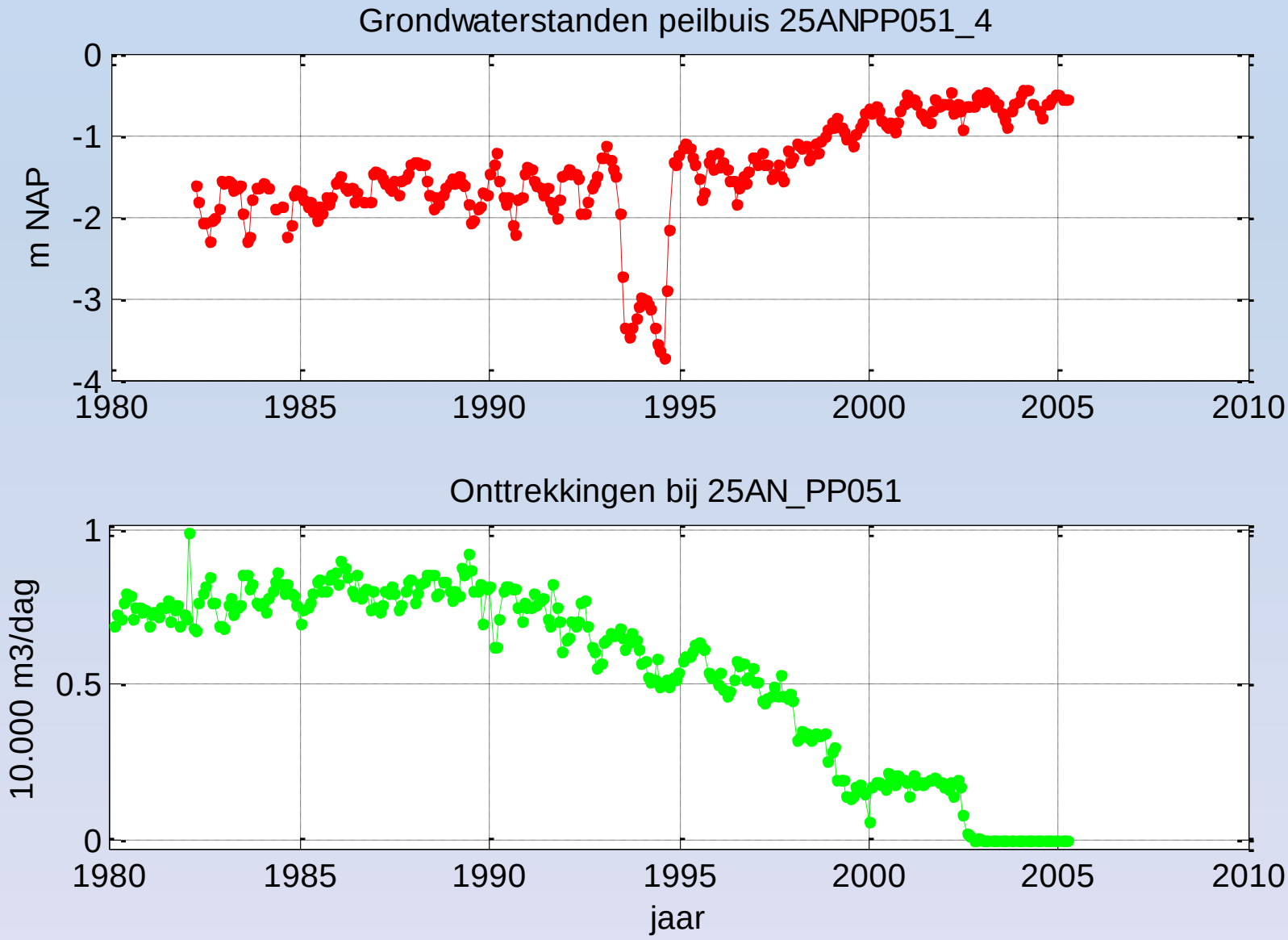


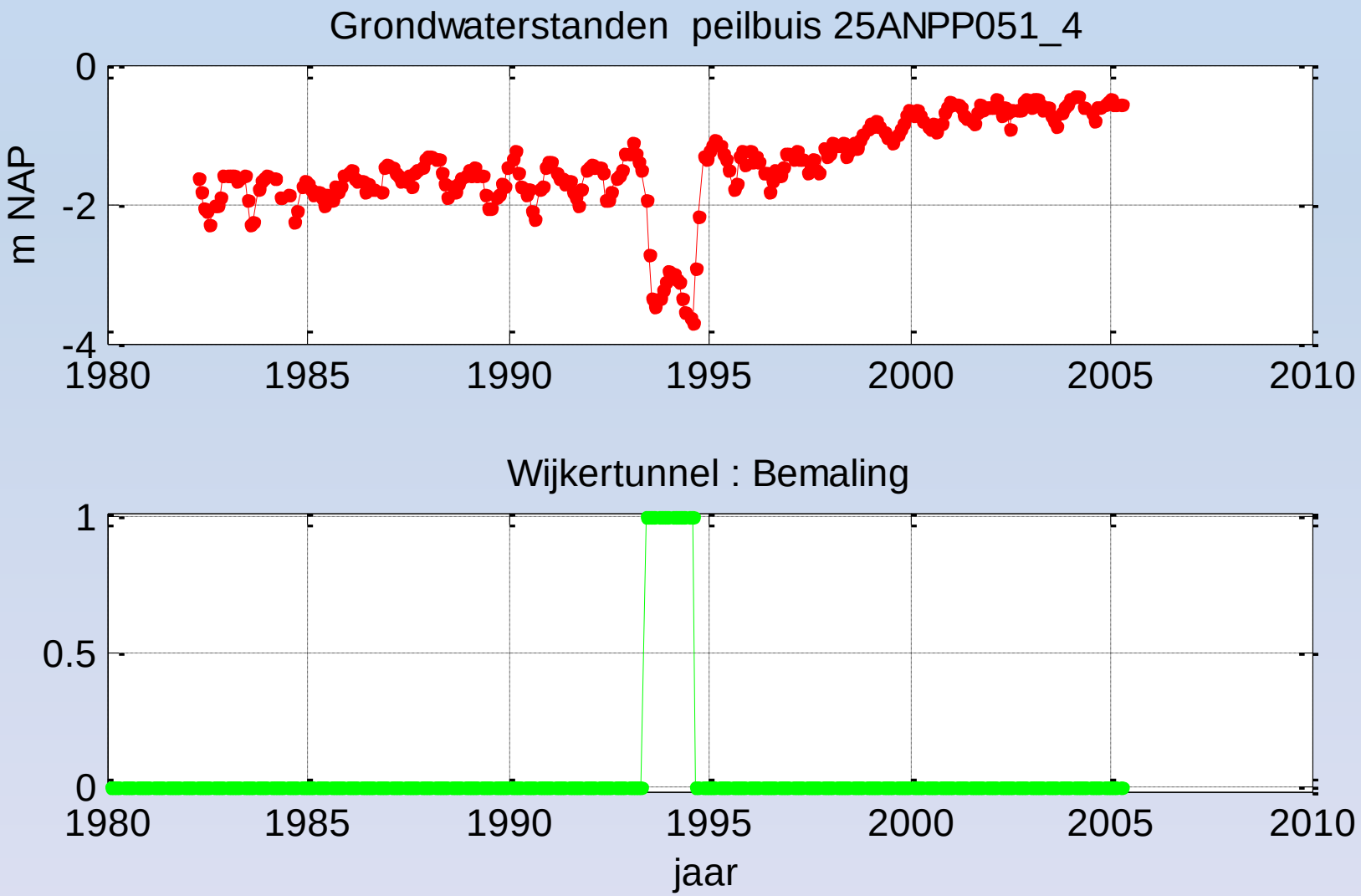
Evaluatie hydrologische effecten stopzetten winning




Grondwaterstanden peilbuis 25ANPP051_4
m NAP
0
-1
-2
-3
-4
1980
1985
1990
1995
2000
2005
2010


Beverwijkno : Neerslag Beverwijk - verdamping De Kooy [mm/d]
mm/dag
6
4
2
0
-2
1980
1985
1990
1995
2000
2005
2010
jaar

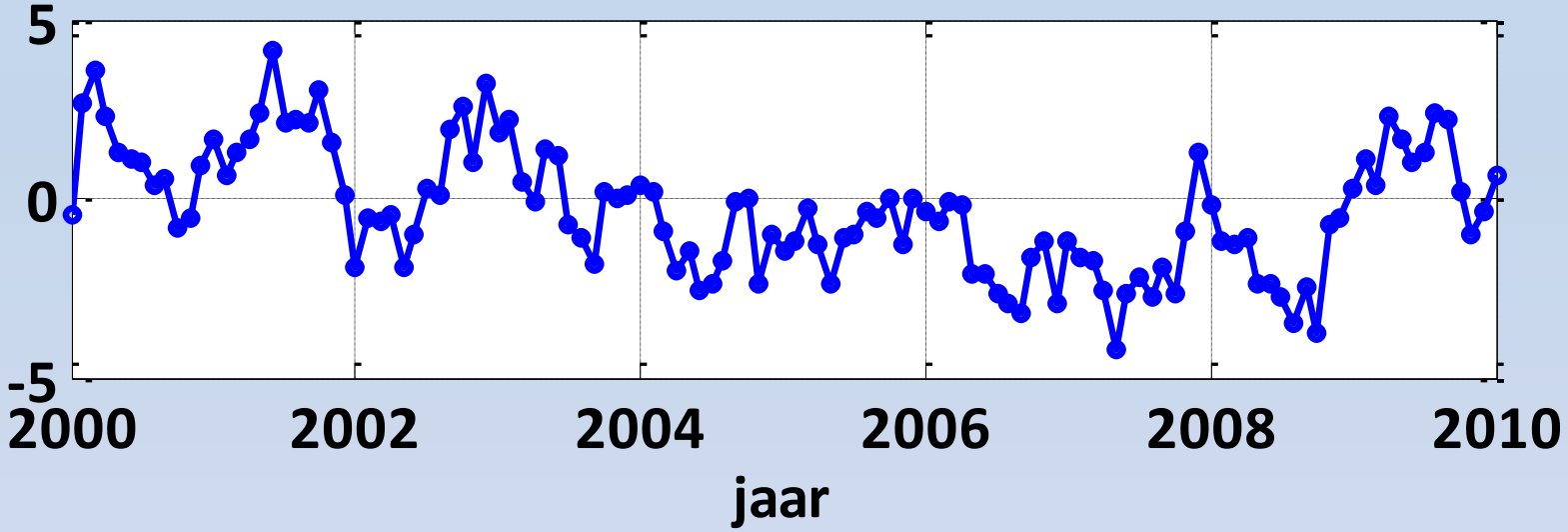

Grondwaterstanden peilbuis 25ANPP051_4
m NAP
0
-1
-2
-3
-4
1980
1985
1990
1995
2000
2005
2010
Onttrekkingen bij 25AN_PP051
10.000 m3/dag
1
0.5
0
jaar


Grondwaterstanden peilbuis 25ANPP051_4
m NAP
0
-2
-4
1980
1985
1990
1995
2000
2005
2010
Wijkertunnel : Bemaling
1
0.5
0
jaar

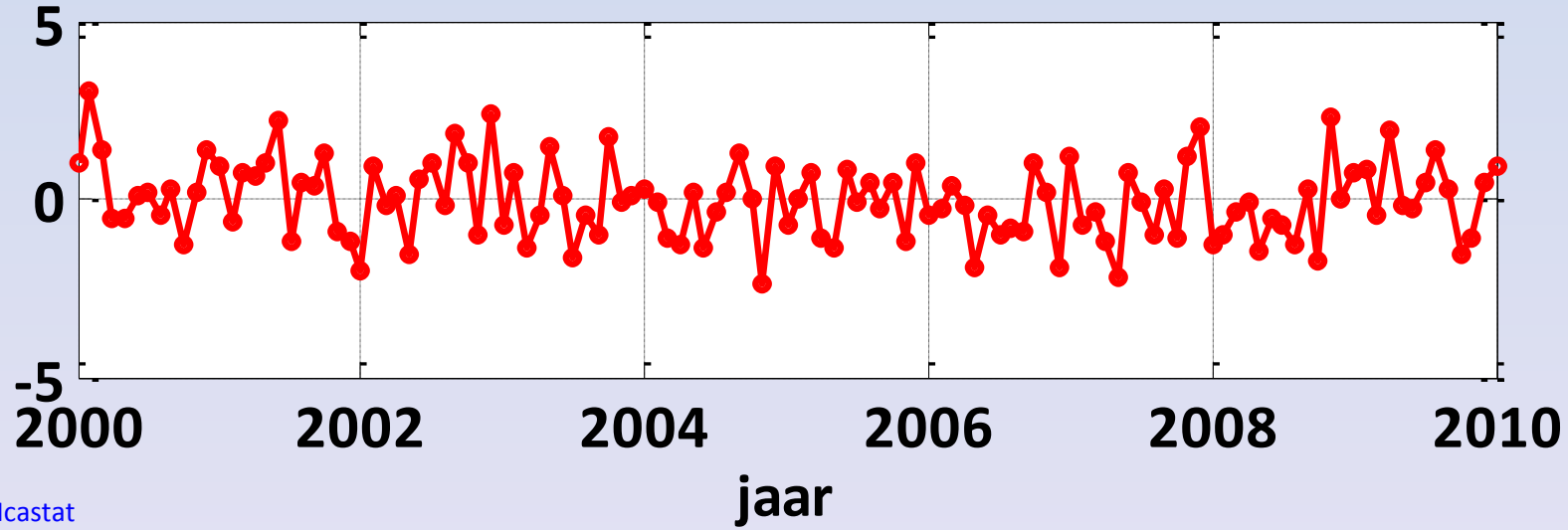
Klasse van modellen

- Discreet dynamisch stochastisch
- Tijdsonafhankelijke modelparameters
- Equidistante reeks, tijdsinterval afhankelijk van processnelheid
- Autocorrelatie verdisconteren

Tijdreeks met autocorrelatie $Y_t = 0.8Y_{t-1}+a_t$



Tijdreeks zonder autocorrelatie $Y_t = a_t$



Formulering Box-Jenkins

Transfer-ruismodel

grondwaterstand

transferfuncties

constante

ruis

$$Y_t = H_{1,t}(X_{no}) + H_{2,t}(X_{ont}) + c + N_t$$

transferfunctie

$$H_t = \delta_1 H_{t-1} \; .. + \omega_0 X_t + \omega_1 X_{t-1} + .. \; \omega_s X_{t-s}$$

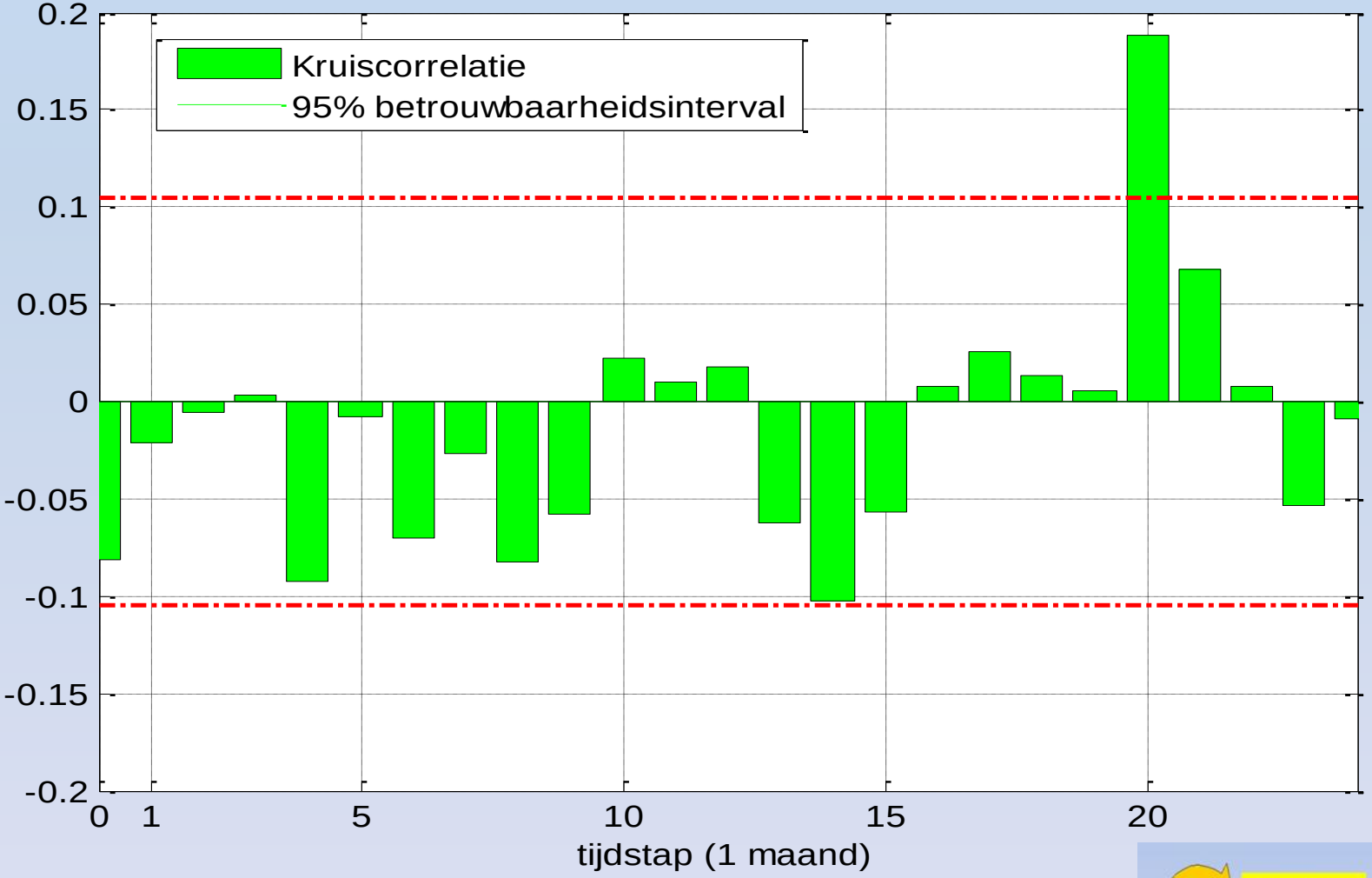
ruismodel

$$N_t = \phi_1 N_{t-1} \; ..+ \theta_1 a_{t-1} + \theta_2 a_{t-2} \; ..+ a_t$$

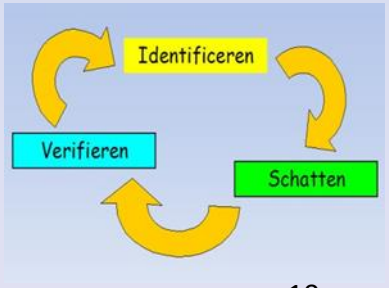
Modelresiduën a_t vormen 'witte ruis':

- gemiddeld nul
- zelfde normale kansverdeling
- geen autocorrelatie

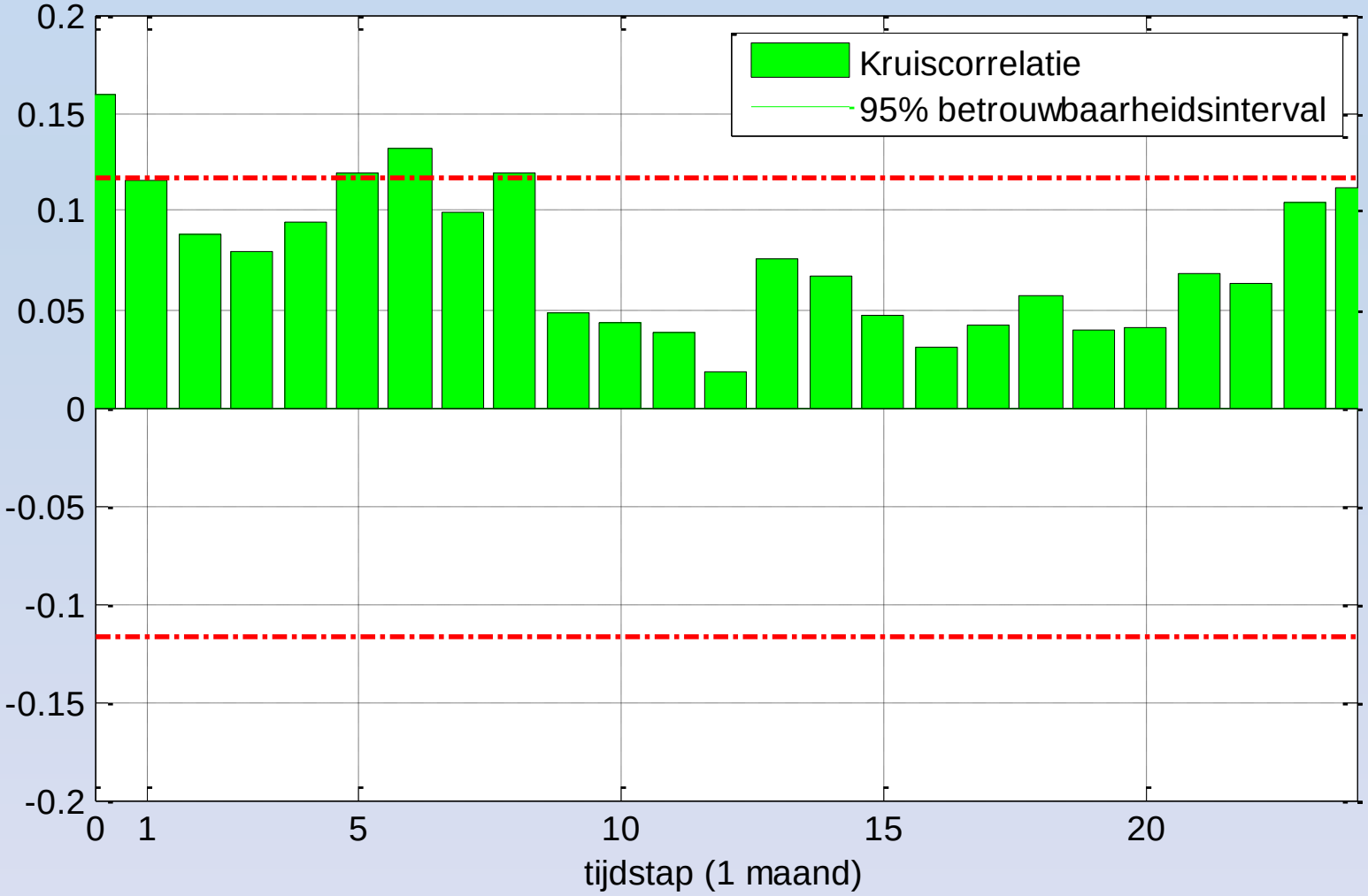
Kruiscorrelatie (grondwaterstanden 25ANPP051_4 , onttrekkingen 25ANPP051) na prewhitening



$$H_t = \omega_0 X_t + \omega_1 X_{t-1} + .. \omega_{19} X_{t-19}$$

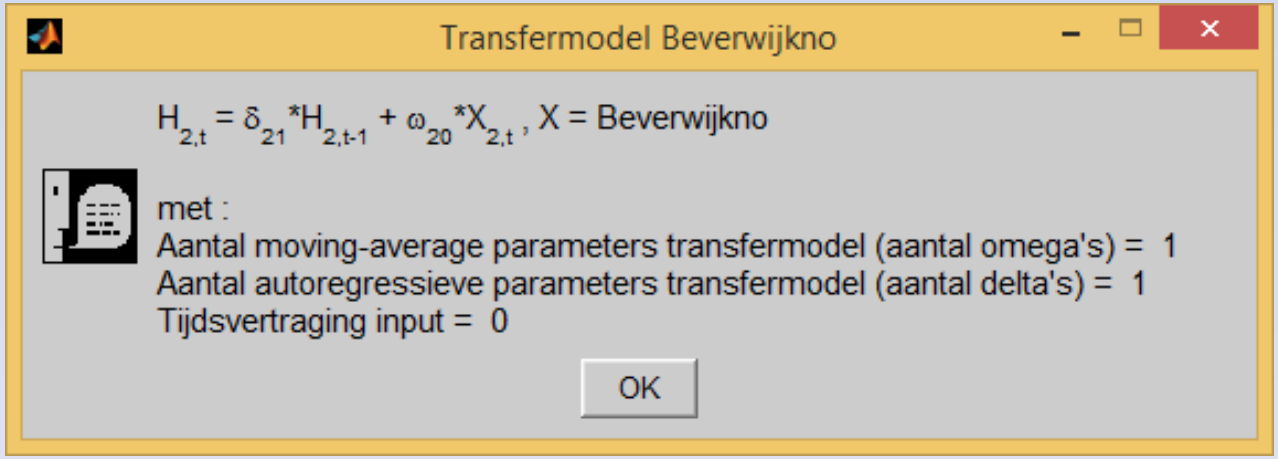


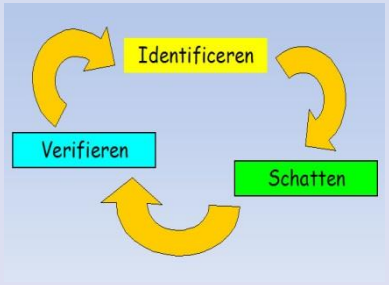
Kruiscorrelatie (grondwaterstanden 25ANPP051_4 , neerslagoverschot Beverwijkno) na prewhitening



$$H_t = \delta_1 H_{t-1} + \omega_0 X_t$$

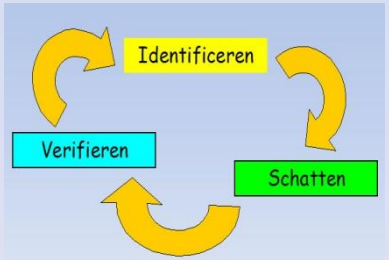
Modelidentificatie zonder ruismodel



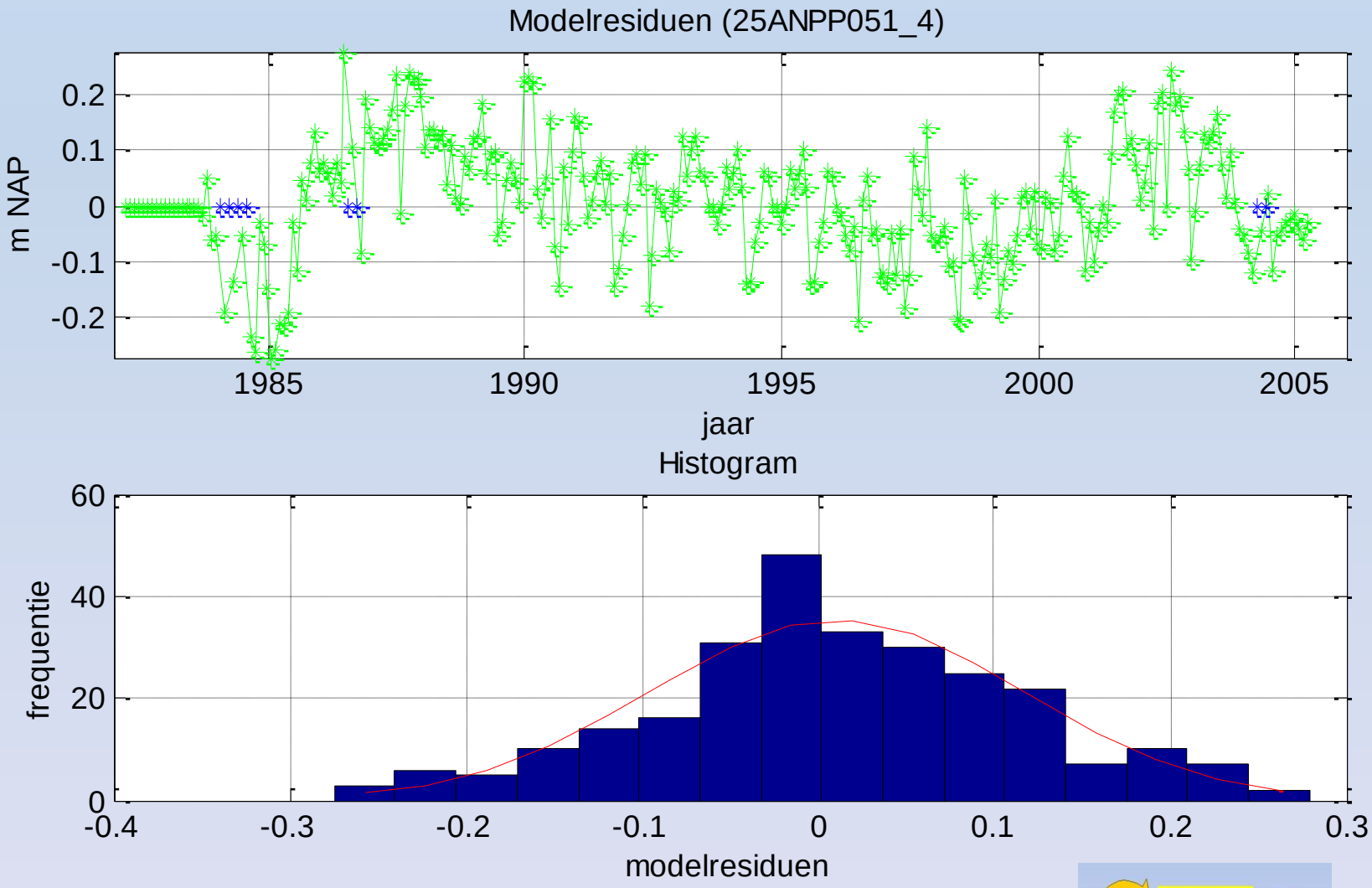


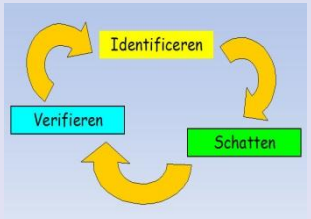
Resultaten toetsen eerste model

Toets modelresiduen	toetst	uitkomst	detail
Lilliefors-toets	normaal verdeeld (99%)	Ja	p = 0.50
Jacque-Bera-toets	normaal verdeeld (99%)	Ja	p = 0.19
Portmanteau-toets	geen autocorrelatie (95%)	Nee	573.62>25.00 (15)
Runs-toets	geen autocorrelatie (95%)	Nee	p = 0.00
Engle-toets	geen heteroscedasticiteit residuen (95%)	Nee	p = 0.00
Breusch-Pagan-toets	geen heteroscedasticiteit residuen-fit (95%)	Nee	p = 0.02

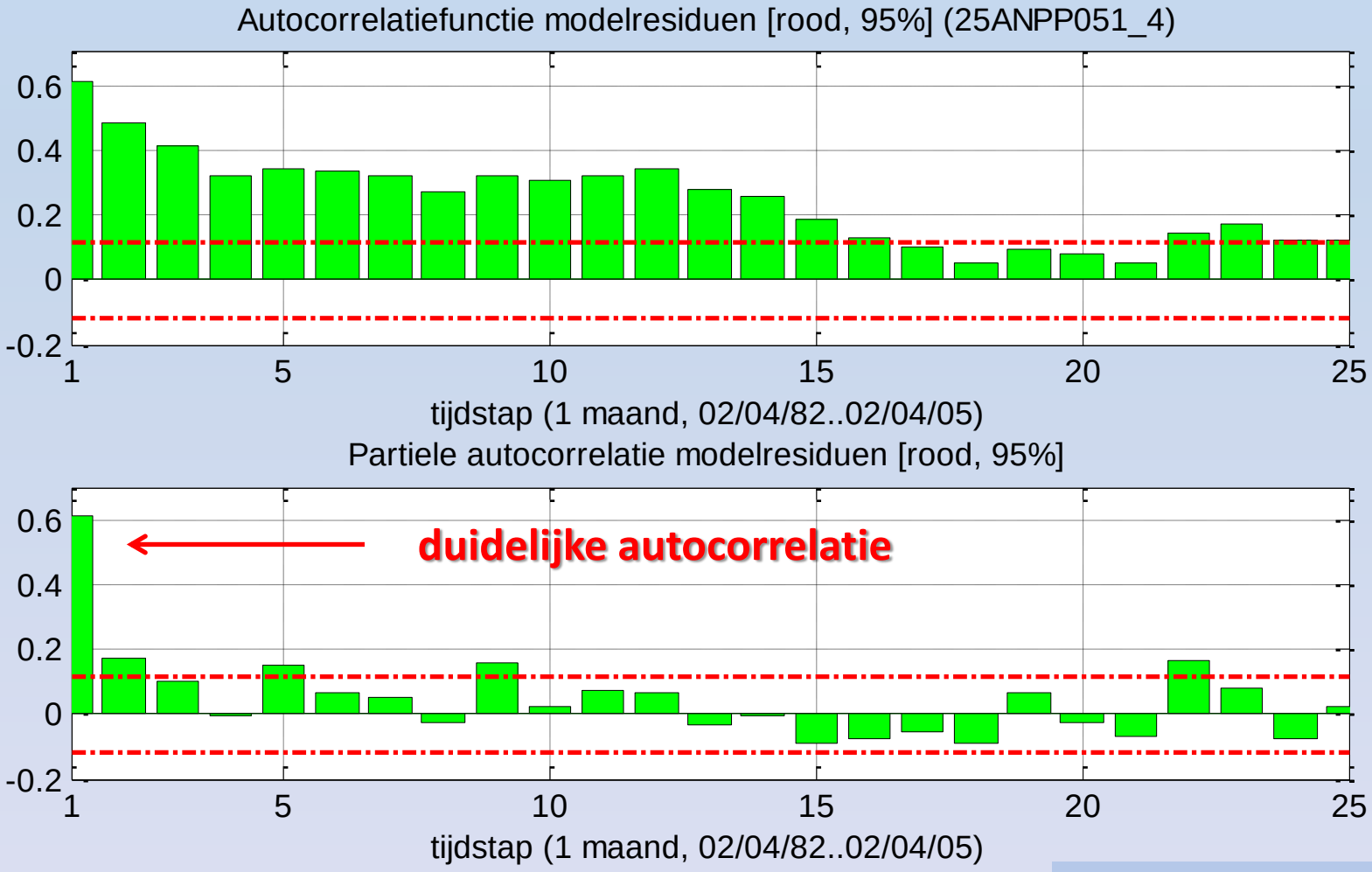


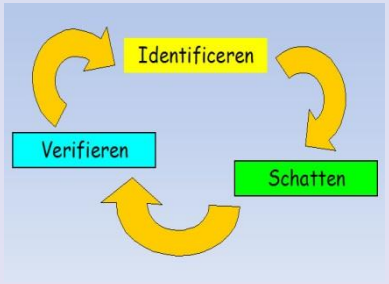
Modelverificatie eerste model



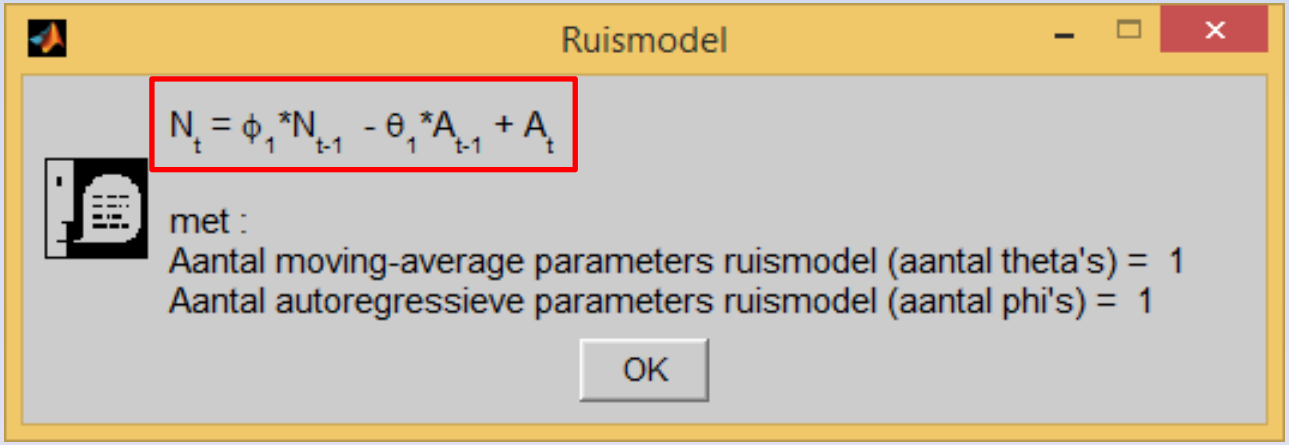


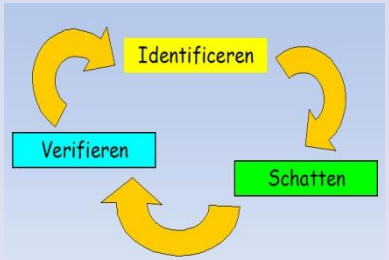
Autocorrelatie modelresiduen





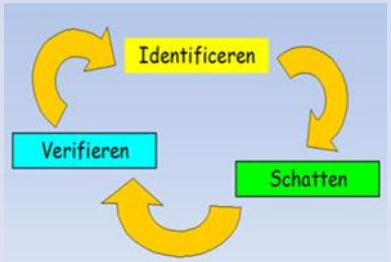
Modelidentificatie, met ruismodel

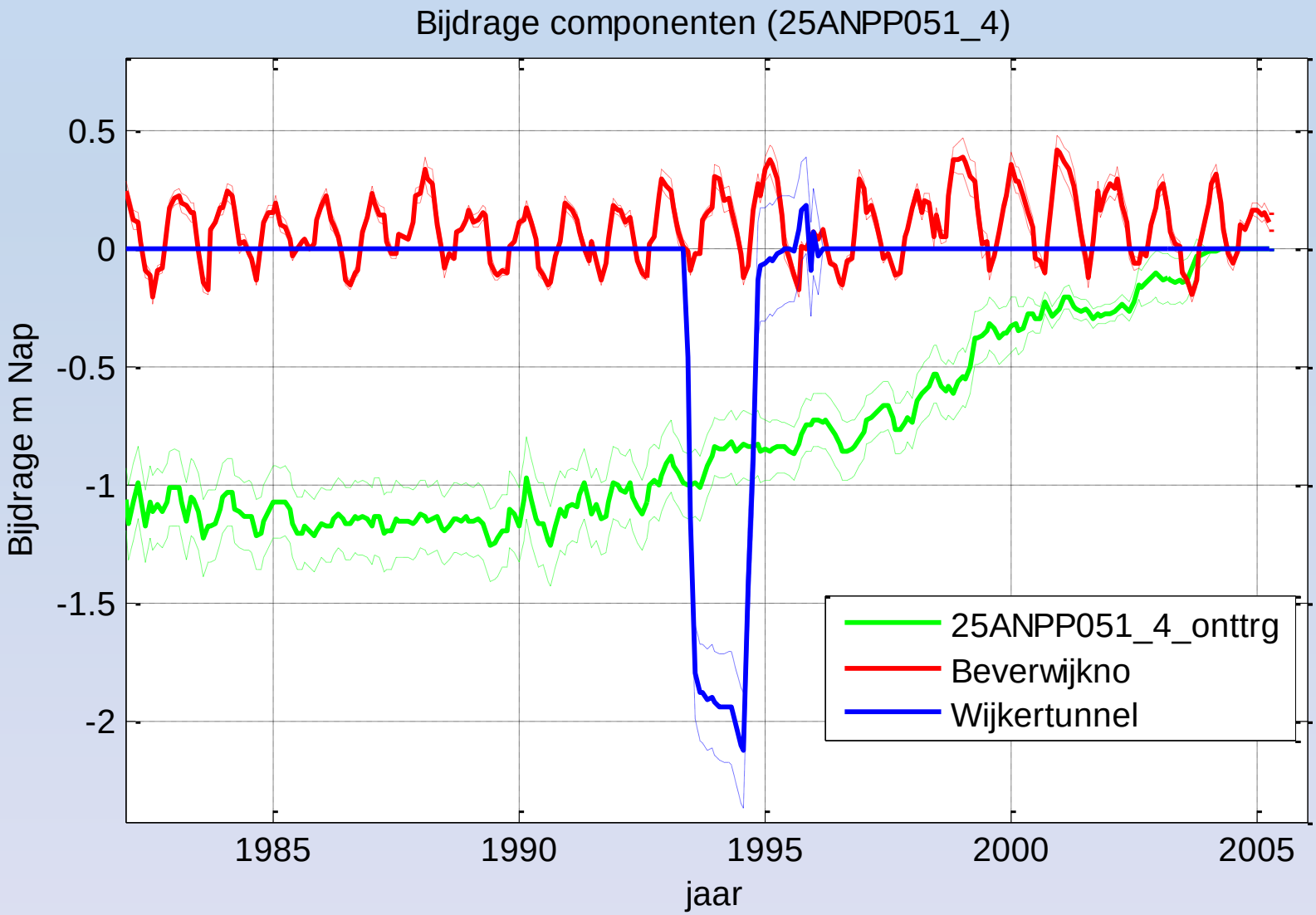


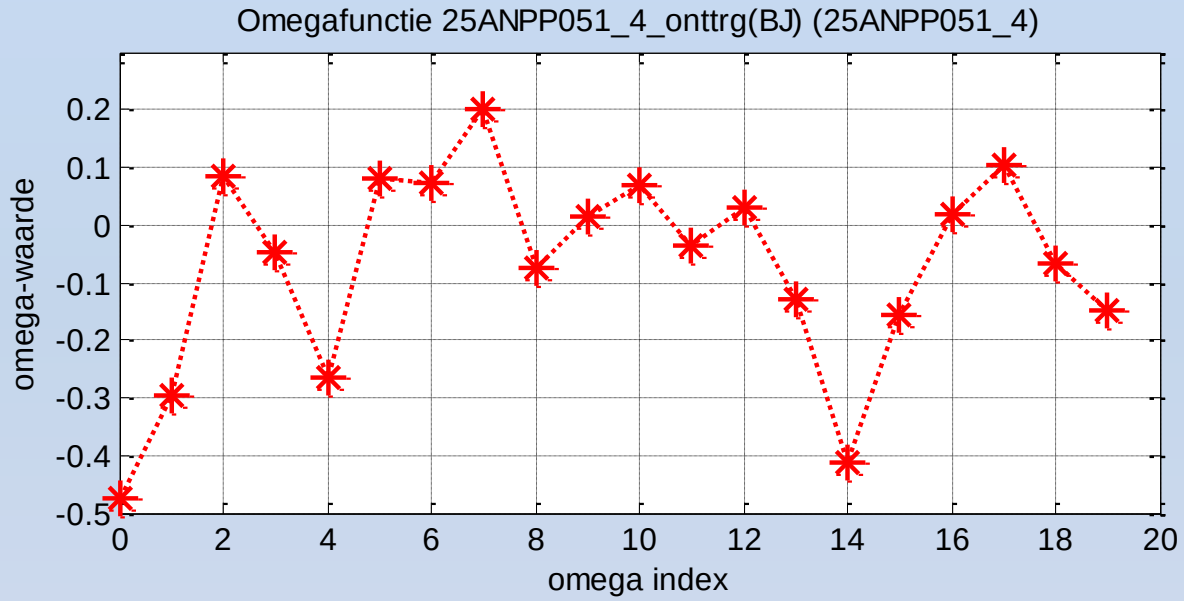


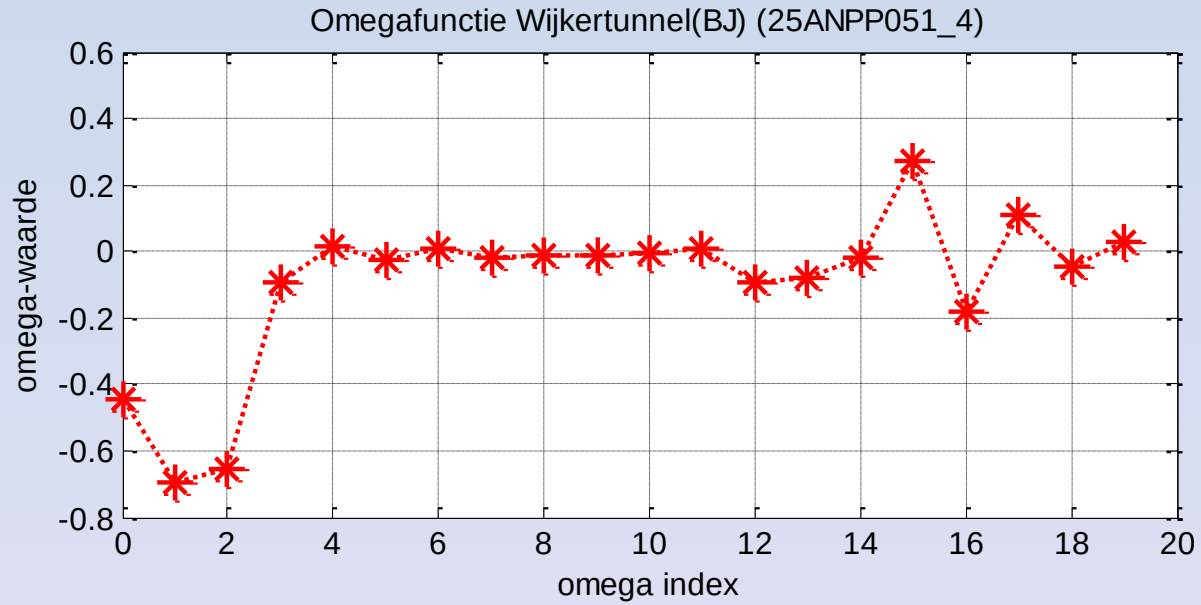
Resultaten met ruismodel

Toets modelresiduen	toetst	uitkomst	detail
Lilliefors-toets	normaal verdeeld (99%)	Ja	p = 0.35
Jacque-Bera-toets	normaal verdeeld (99%)	Ja	p = 0.50
Portmanteau-toets	geen autocorrelatie (95%)	Ja	20.42<22.36 (13)
Runs-toets	geen autocorrelatie (95%)	Ja	p = 0.40
Engle-toets	geen heteroscedasticiteit residuen (95%)	Ja	p = 0.46
Breusch-Pagan-toets	geen heteroscedasticiteit residuen-fit (95%)	Ja	p = 0.05

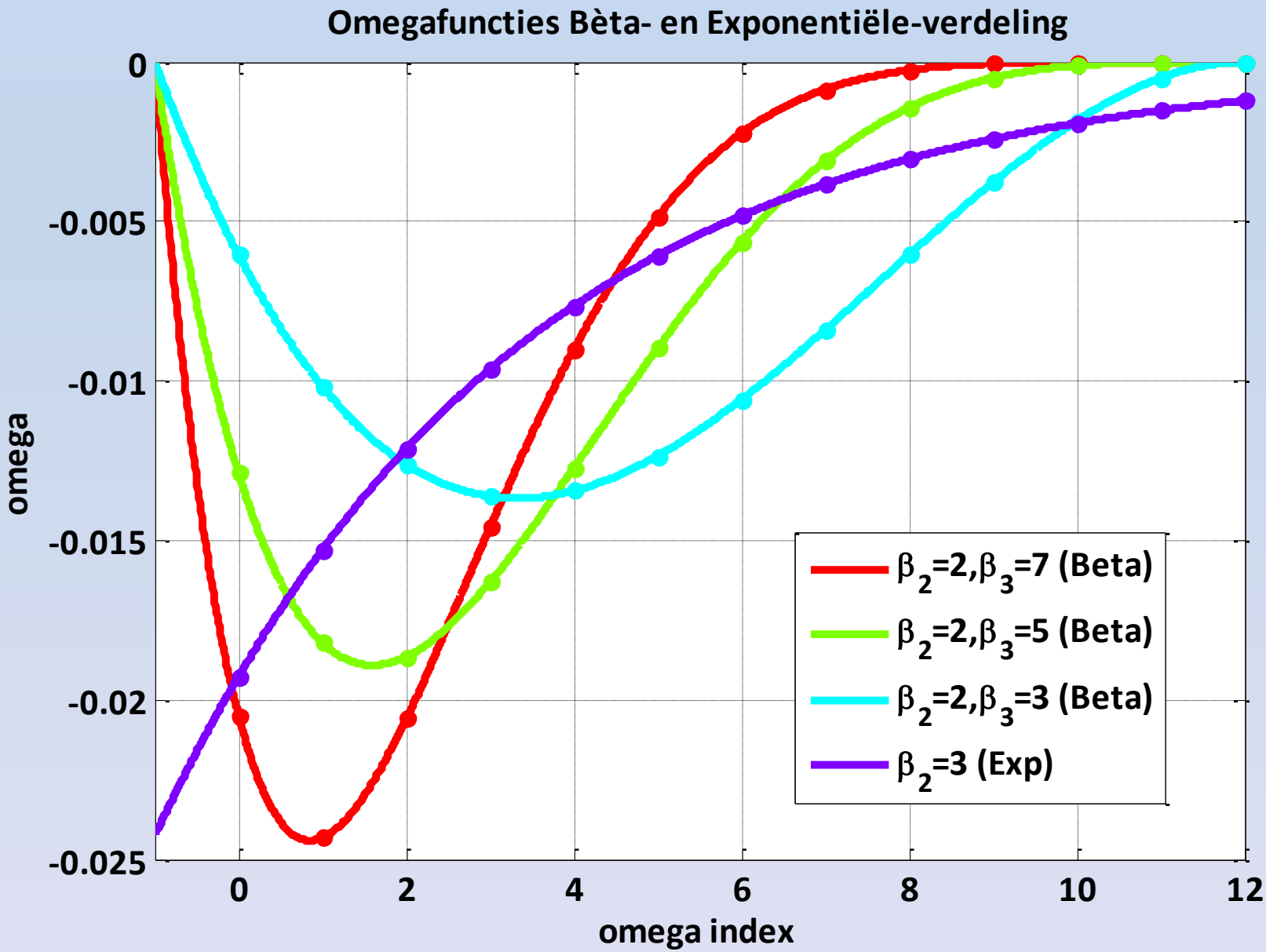



Bijdrage componenten (25ANPP051_4)
Bijdrage m Nap
0.5
0
-0.5
-1
-1.5
-2
1985
1990
1995
2000
2005
jaar
25ANPP051_4_onttrg
Beverwijkno
Wijkertunnel

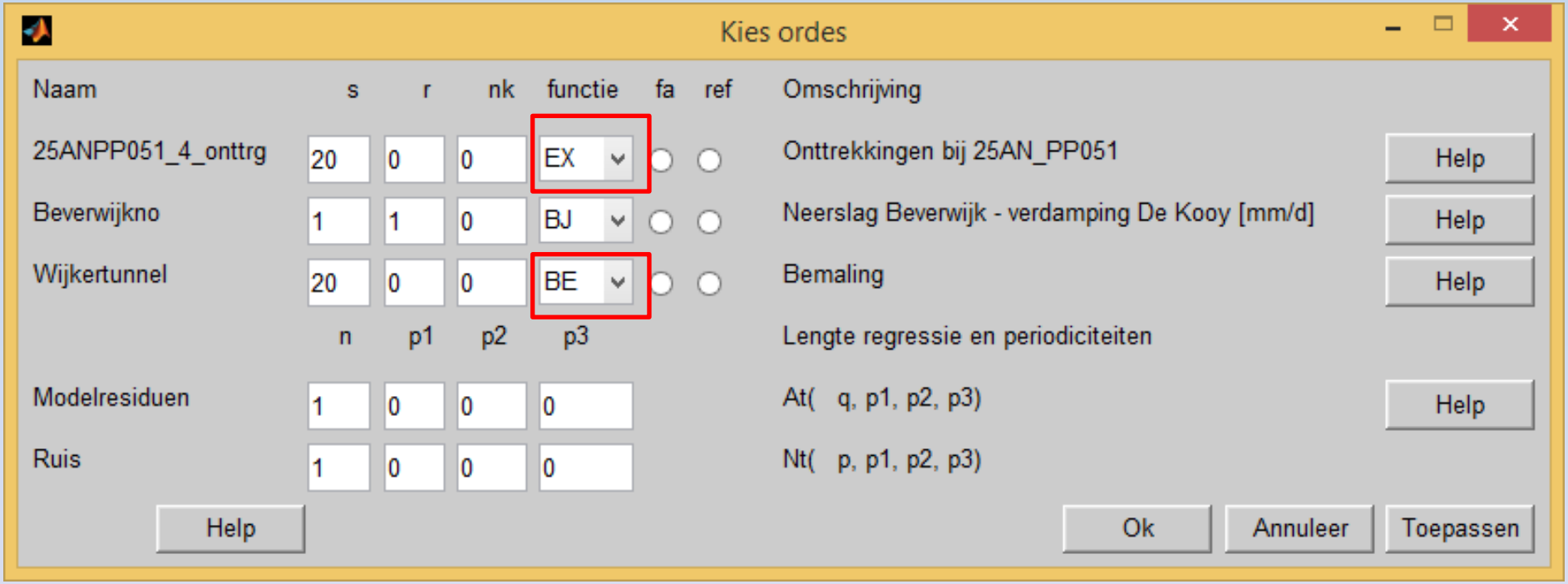


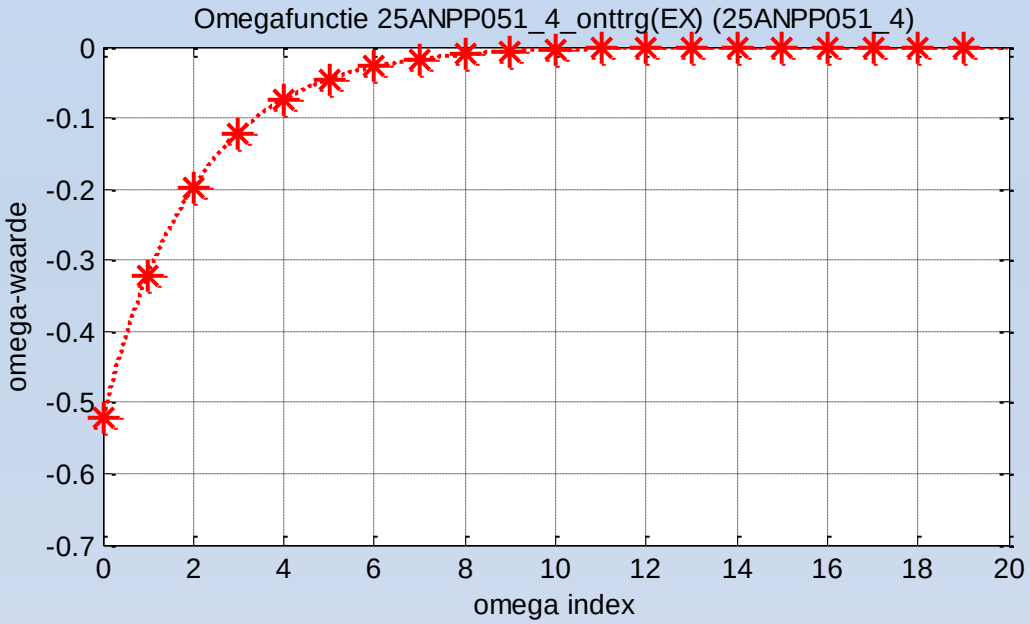


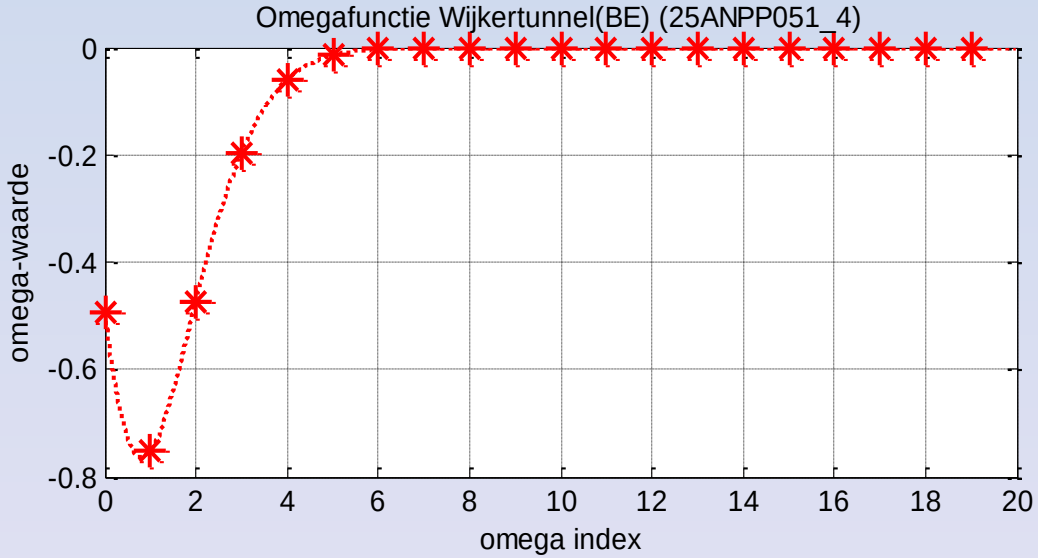
$$H_t = \omega_0 X_t + \omega_1 X_{t-1} + .. \omega_{19} X_{t-19}$$

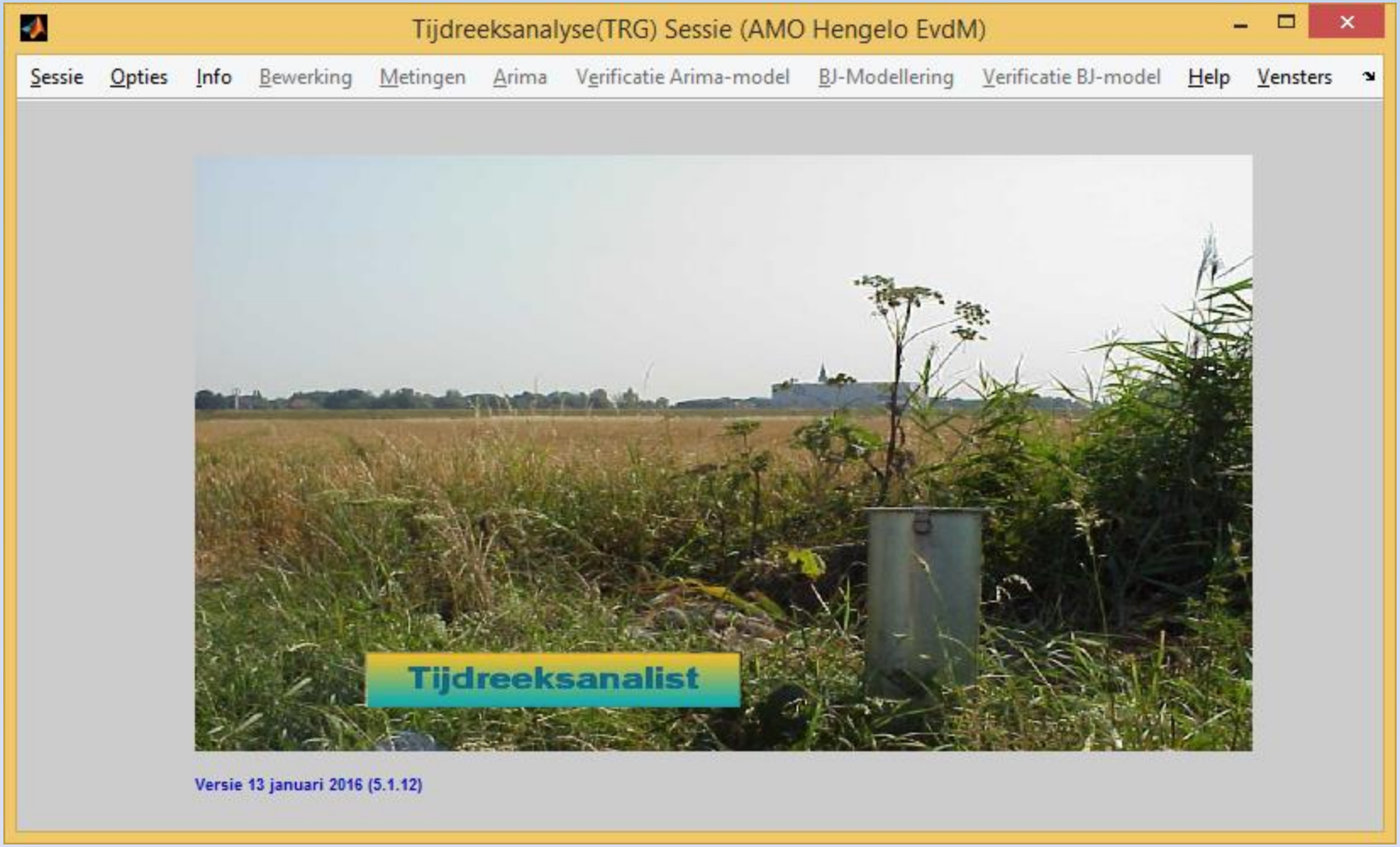

Omegafuncties Bèta- en Exponentiële-verdeling
omega
omega index
0
-0.005
-0.01
-0.015
-0.02
-0.025
0
2
4
6
8
10
12
β2=2,β3=7 (Beta)
β2=2,β3=5 (Beta)
β2=2,β3=3 (Beta)
β2=3 (Exp)

Modelidentificatie met ruismodel en voorgedefinieerde transferfuncties

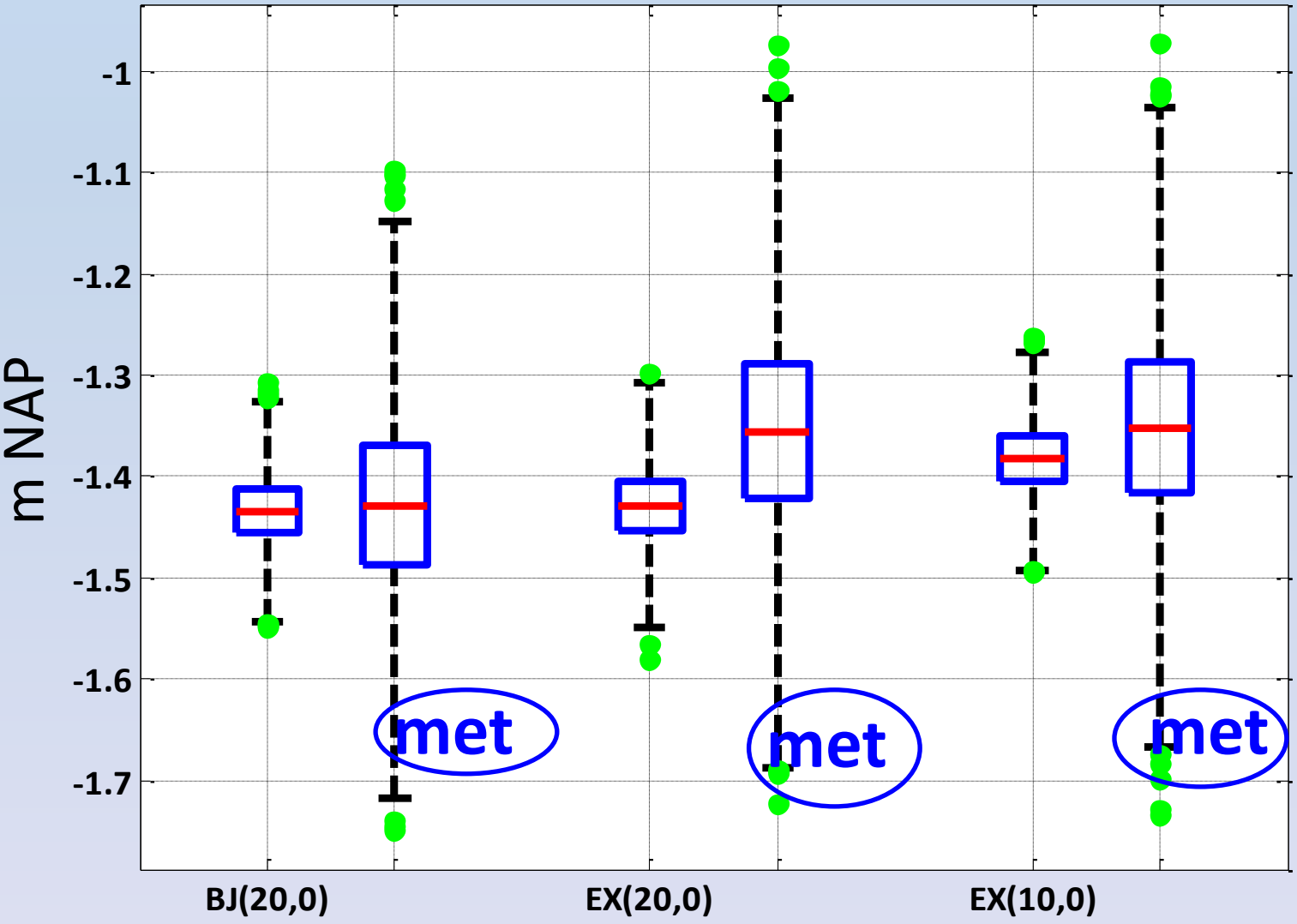



Omegafunctie 25ANPP051_4_onttrg(EX) (25ANPP051_4)
omega-waarde
omega index
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
0
2
4
6
8
10
12
14
16
18
20


Omegafunctie Wijkertunnel(BE) (25ANPP051_4)
omega-waarde
omega index
0
-0.2
-0.4
-0.6
-0.8
0
2
4
6
8
10
12
14
16
18
20


Tijdreeksanalyse(TRG) Sessie (AMO Hengelo EvdM)
Sessie
Opties
Info
Bewerking
Metingen
Arima
Verificatie Arima-model
BJ-Modellering
Verificatie BJ-model
Help
Vensters
Tijdreeksanalist
Versie 13 januari 2016 (5.1.12)

Evenwichtsrelatie Onttrekkingen



drie modellen zonder en met ruismodel

Conclusies

- Modelverificatie is onontbeerlijk
- Autocorrelatie modelresiduen geeft onderschatting standaardfout
- Als ruismodel niet voldoet zijn afgeleide betrouwbaarheden onbruikbaar
- Interactieve tijdreeksontwikkeling levert:
  - garantie voldoen modelvoorwaarden
  - inzicht robuustheid model