New portal provides data foundation for water management and climate adaptation in Denmark

Eva Bøgh

Agency for Data Supply and Efficiency (SDFE)

Ministry of Climate, Energy and Utilities, Denmark

Styrelsen for Dataforsyning og Effektivisering

Who we are, and how we collaborate

Agency for Data Supply and Efficiency

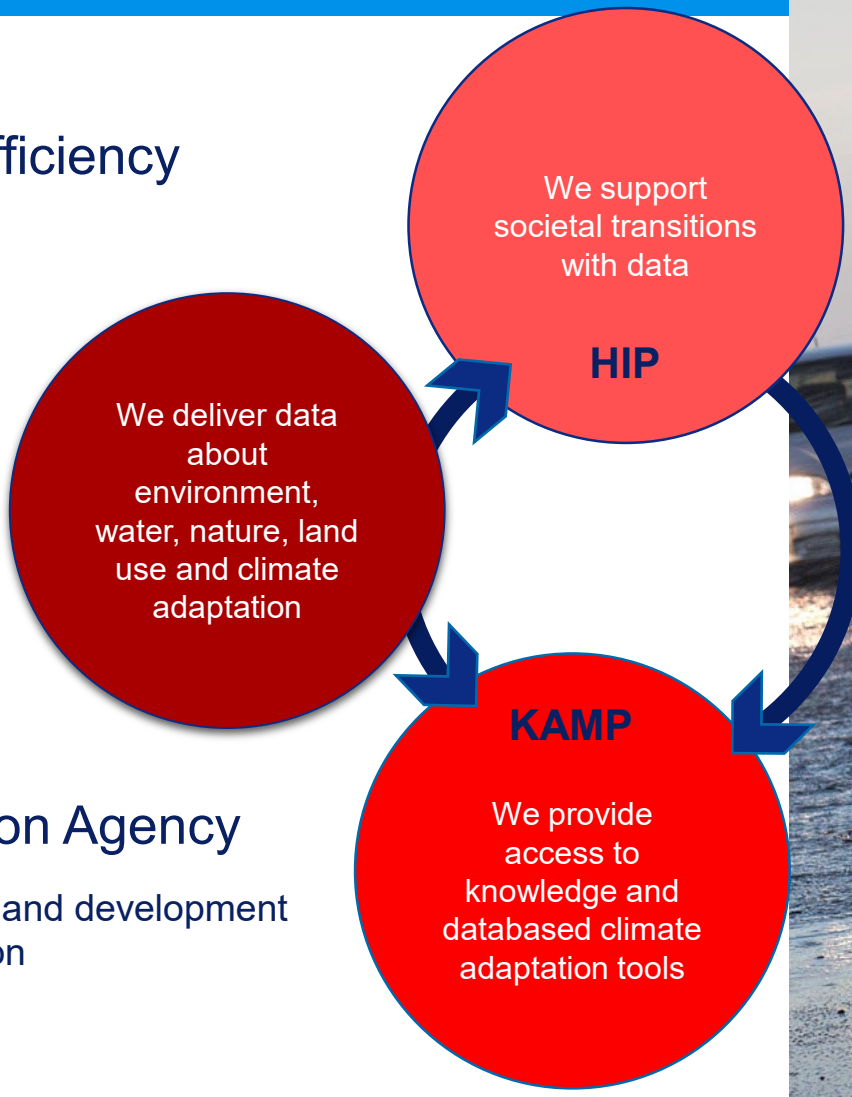
- Basic data - GeoDanmark
- Maps of terrain, remote sensing etc
- Datainfrastructure
- Datadistribution

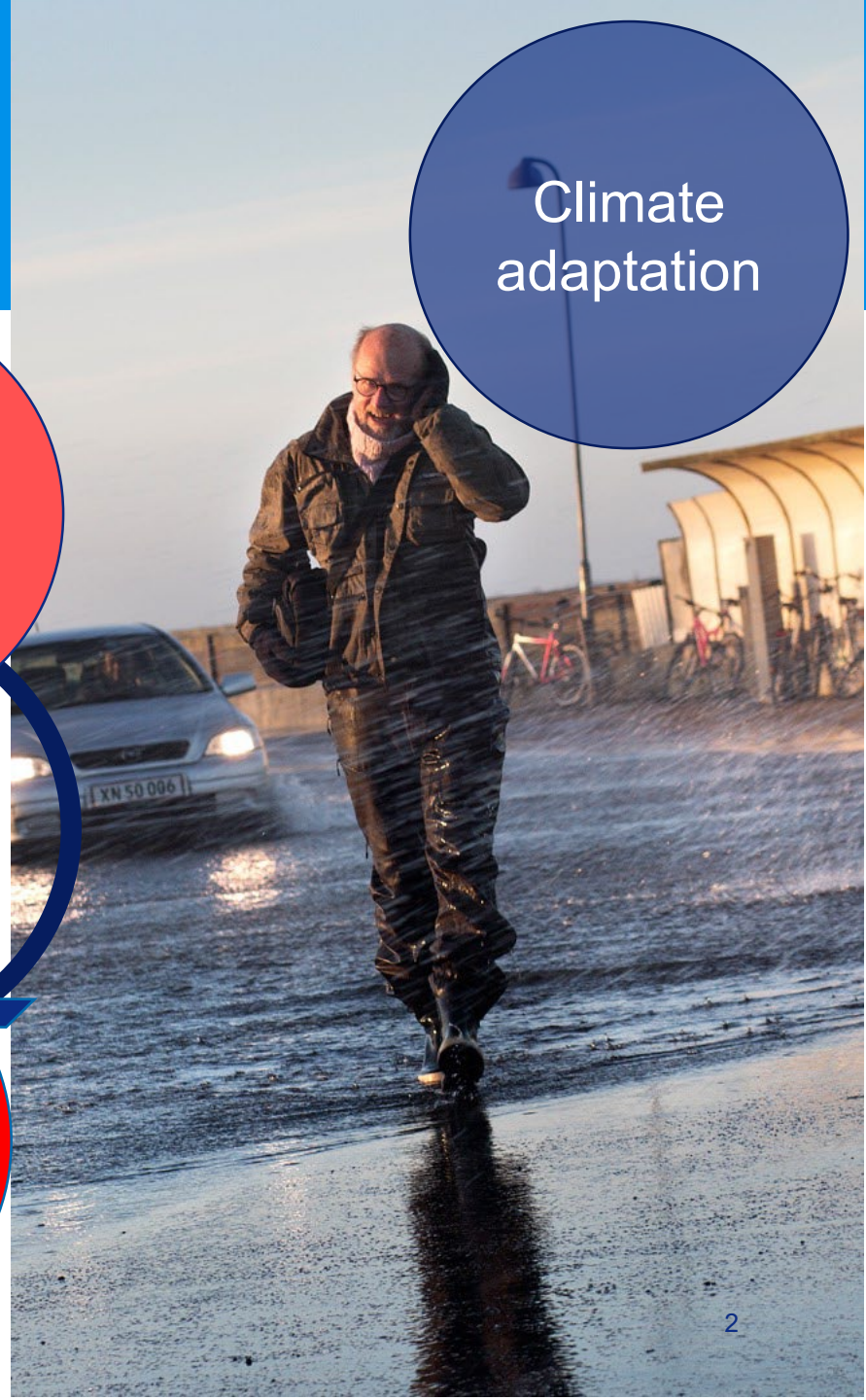
Danish Environmental Portal

- Environment
- Nature
- Water
- Land use
- Climate adaptation

Danish Environmental Protection Agency

- Communication about data, research and development
- Climate change and climate adaptation
- Climate adaptation tools

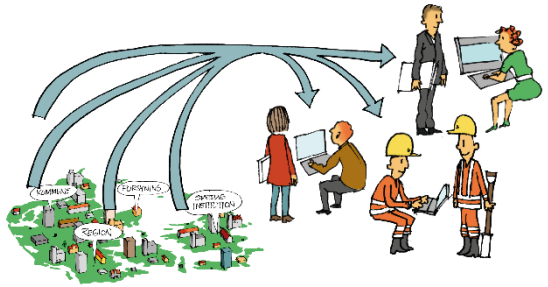




The climate changes

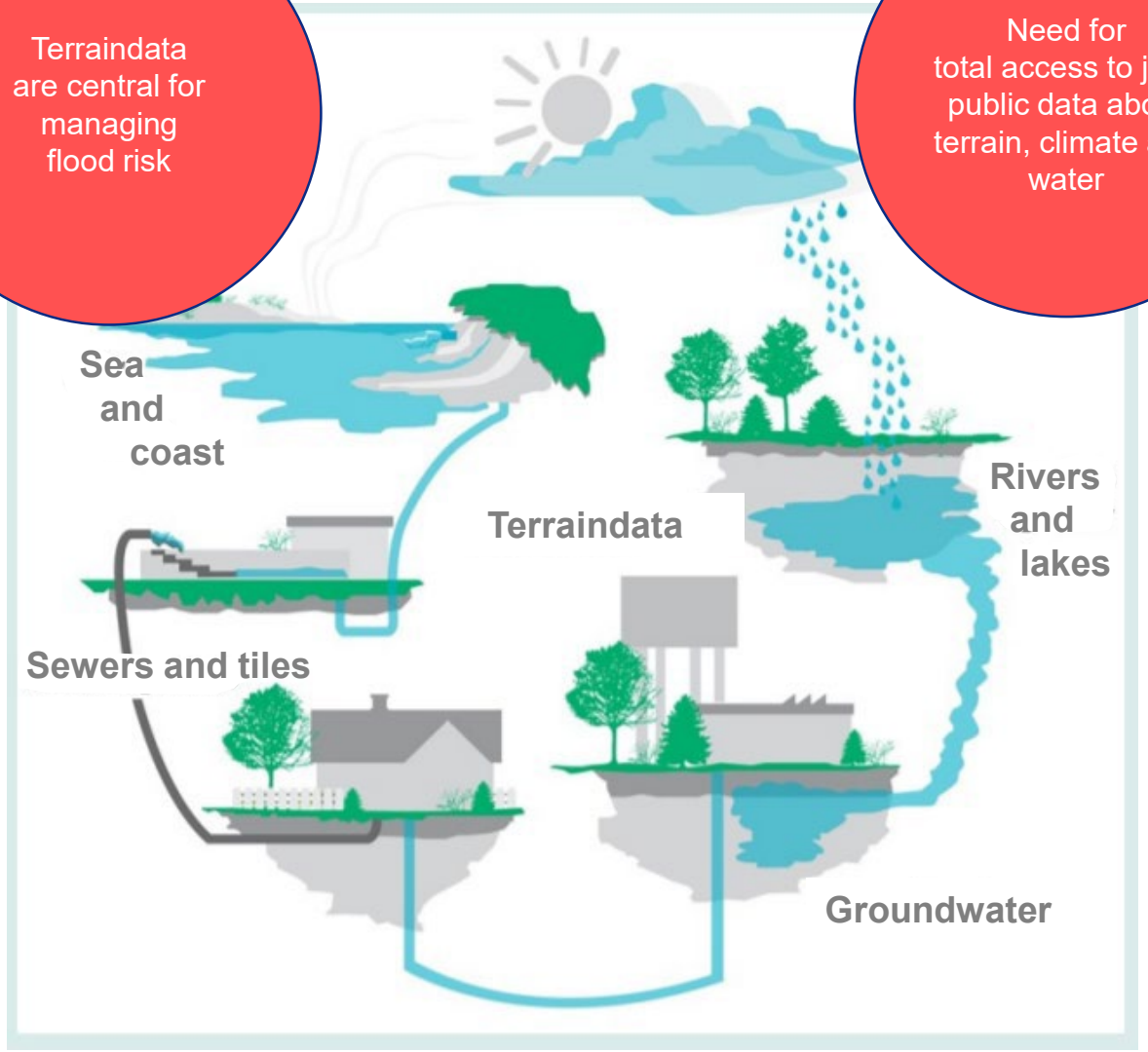
Need for societal transition

- Data and digitalisation → total access to joint public data about terrain, climate and water – Many dataowners
- Better use and sharing of data
- Streamline and support collaboration
- Solid basis for decisionmaking for climate protection and sustainable development



Terraindata are central for managing flood risk

Need for total access to joint public data about terrain, climate and water



Digital strategy of Danmark

Government in collatboration with the Danish Regions and the Local Government, Denmark

20 years of digital strategies

2001 DIGITALT SAMARBEJDE

- Digital signatur
- Borgere kan sende e-mail til det offentlige
- Myndigheder kommunikerer digitalt

2004 EFFEKTIVE BETALINGER OG INTERN DIGITALISERING

- NemKonto og eFakturering
- Virk og Sundhed.dk
- Sikker e-mail mellem myndigheder

2007 FÆLLES INFRASTRUKTUR

- NemID, NemLog-in, eIndkomst
- Digital Post, NemSMS, Borger.dk
- Myndigheder skal benytte fælles it-infrastruktur

2011 DIGITAL KOMMUNIKATION

- Digital Post til borgere og virksomheder
- Borgere og virksomheder betjener sig selv på nettet
- Udbredelse af digital velfærd
- **Basic data programme**

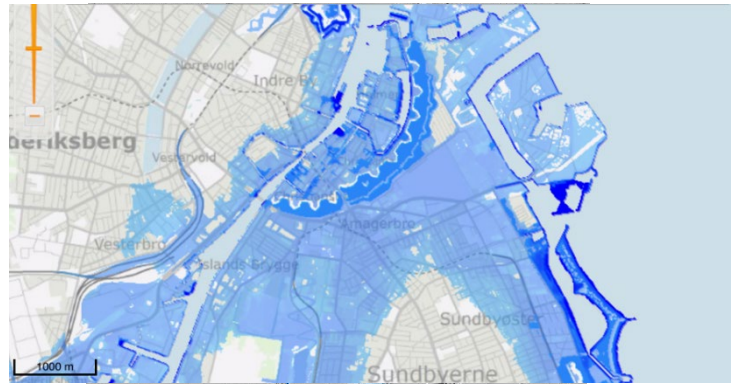
2016 BEDRE BRUG OG DELING AF DATA

- Deling af offentlige data
- Sammenhængende brugerrejser på tværs af løsninger
- Højere informations sikkerhed
- Nye generationer af Digital Post, Nem ID og NemLog-in

Basic data for climate adaptation 2011 - 2015

Open access to basic data to support efficient management and climate adaptation planning

- hydrological adjusted elevation model (0,4 m)
- updated watercourse maps
- visualization, download and webservices



Webservices for climate adaptation tools

Focus on extreme rain and storm surges

Digital strategy of Danmark

Government in collatboration with the Danish Regions and the Local Government, Denmark

20 years of public digital strategies

2001 DIGITALT SAMARBEJDE

- Digital signatur
- Borgere kan sende e-mail til det offentlige
- Myndigheder kommunikerer digitalt

2004 EFFEKTIVE BETALINGER OG INTERN DIGITALISERING

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2011 DIGITAL KOMMUNIKATION

- Digital Post til borgere og virksomheder
- Borgere og virksomheder betjener sig selv på nettet
- Udbredelse af digital velfærd
- Grunddata-programmet

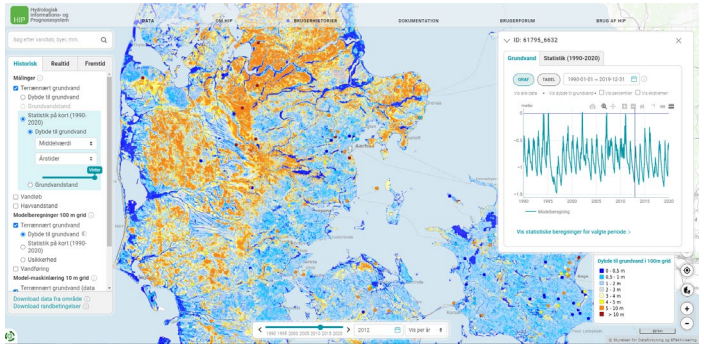
2016 BEDRE BRUG OG DELING AF DATA

- **Sharing of public data**
- Sammenhængende brugerrejser på tværs af løsninger
- Højere informations-sikkerhed
- Nye generationer af Digital Post, Nem ID og NemLog-in

Better use and sharing of data 2016 - 2020

Total access to joint public hydrological data

- measurements (municipalities, regions, state)
- modelsimulations – historical and future
- visualization, download and webservices

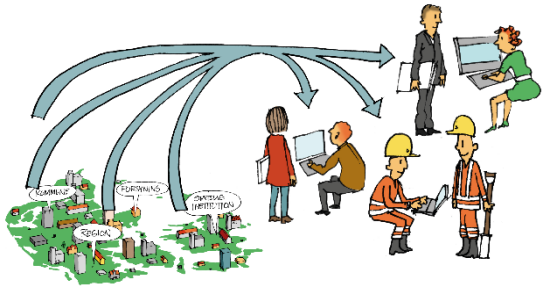


Hydrological Information- og prediction system (HIP) at hipdata.dk

Focus on shallow ground-water and rivers

Hipdata.dk

Digital strategy 2016-2020



Hydrologisk Informations- og Prognosesystem

DATA | OM HIP | BRUGERHISTORIER | DOKUMENTATION | BRUGERFORUM | BRUG AF HIP

Søg efter vandløb, byer, mm.

Historisk | Realtid | Fremtid

Målinger

- Terrænnært grundvand
  - Dybde til grundvand
  - Grundvandstand
  - Statistik på kort (1990-2020)
- Vandløb
  - Vandstand
  - Vandføring
  - Tværprofildata
  - Vandløbsmidte
- Havvandstand

Modelberegninger 100 m grid

- Terrænnært grundvand
- Vandføring

Model-maskinlæring 10 m grid

- Terrænnært grundvand (data fra 1990-2020)

Download data fra område
Download randbetingelser

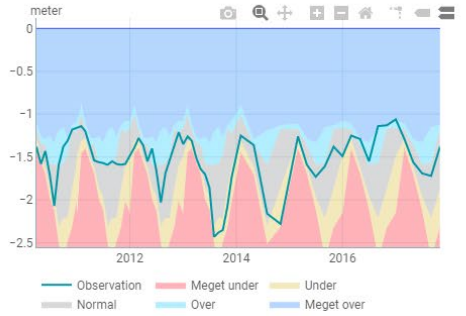
Measured depth to groundwater

DGU nummer: 197.552

Grundvand | Statistik (1990-2020)

GRAF | TABEL | 2010-03-30 ~ 2017-11-01

Vis alle data | Vis dybde til grundvand | Vis percentiler | Borerapport



Vis statistiske beregninger for valgte periode

Minimumsværdi: -2.43 | Maximumsværdi: -1.06

Standardafvigelse: 0.314 | Gennemsnit: -1.531

BEREGN

Dybde til grundvand
- 0 - 0,5 m
- 0,5 - 1 m
- 1 - 2 m
- 2 - 3 m
- 3 - 4 m
- 4 - 5 m
- 5 - 10 m
- > 10 m
- Manglende værdi

Time slider (day, month, season or year)

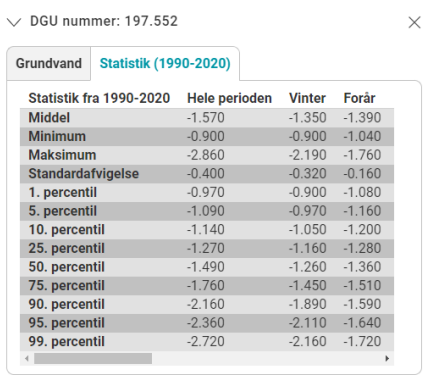
1990 1995 2000 2005 2010 2015 2020 | 2020 | Vis per år

Vis per dag
Vis per måned
Vis per årstid
Vis per år

20 km

© Styrelsen for Dataforsyning og Effektivisering

- Statistics 1990–2020 (n > 5)



DGU nummer: 197.552

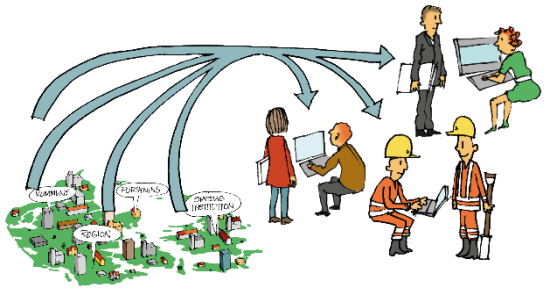
Grundvand | Statistik (1990-2020)

Statistik fra 1990-2020	Hele perioden	Vinter	Forår
Middel	-1.570	-1.350	-1.390
Minimum	-0.900	-0.900	-1.040
Maksimum	-2.860	-2.190	-1.760
Standardafvigelse	-0.400	-0.320	-0.160
1. percentil	-0.970	-0.900	-1.080
5. percentil	-1.090	-0.970	-1.160
10. percentil	-1.140	-1.050	-1.200
25. percentil	-1.270	-1.160	-1.280
50. percentil	-1.490	-1.260	-1.360
75. percentil	-1.760	-1.450	-1.510
90. percentil	-2.160	-1.890	-1.590
95. percentil	-2.360	-2.110	-1.640
99. percentil	-2.720	-2.160	-1.720

- > 32.000 shallow groundwater measurements retrieved from the 5 Danish regions (> 10.000 wells)

Hipdata.dk

Measured depth to groundwater



Shallow well with no data on selected date.
Select point to see graph with data

Dybde til grundvand
- 0 - 0,5 m
- 0,5 - 1 m
- 1 - 2 m
- 2 - 3 m
- 3 - 4 m
- 4 - 5 m
- 5 - 10 m
- > 10 m
- Manglende værdi

Hydro

1990 1995 2000 2005 2010 2015 2020

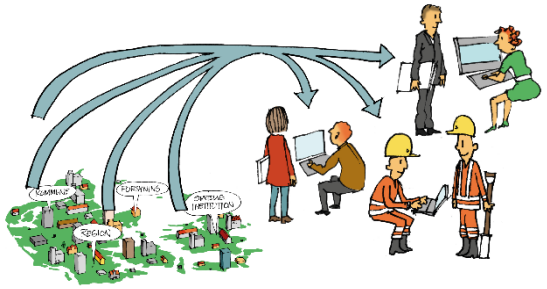
2006

Vis per år

1000 m

Hipdata.dk

Statistical analyses of measured depth to groundwater



Hydrologisk Informations- og Prognosesystem

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Søg efter vandløb, byer, mm.

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- Terrænnært grundvand
  - Dybde til grundvand
  - Grundvandstand
  - Statistik på kort (1990-2020)
    - Dybde til grundvand
      - Middelværdi
      - Hele perioden
    - Grundvandstand
- Vandløb
- Havvandstand

Modelberegninger 100 m grid

- Terrænnært grundvand
- Vandføring

Model-maskinlæring 10 m grid

- Terrænnært grundvand (data fra 1990-2020)

Download data fra område
Download randbetingelser

Statistical analyses 1990-2020 (n > 5)

Dybde til grundvand
0 - 0,5 m
0,5 - 1 m
1 - 2 m
2 - 3 m
3 - 4 m
4 - 5 m
5 - 10 m
> 10 m
Manglende værdi

Hydro

1990 1995 2000 2005 2010 2015 2020 | 2006 | Vis per år

20 km

© Styrelsen for Dataforsyning og Effektivisering

- Statistics 1990–2020 (n > 5)

DGU nummer: 197.552

Grundvand | Statistik (1990-2020)

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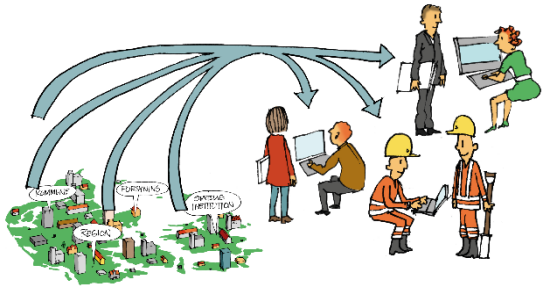
Hipdata.dk

Daily model simulations of the depth to groundwater in 100 m grid



- Daily model simulations in 100 m grid
- Statistics 1990–2020 (n = 30 yrs)
- Downscaled to 10 m grid

Produced by GEUS (DK-model HIP)

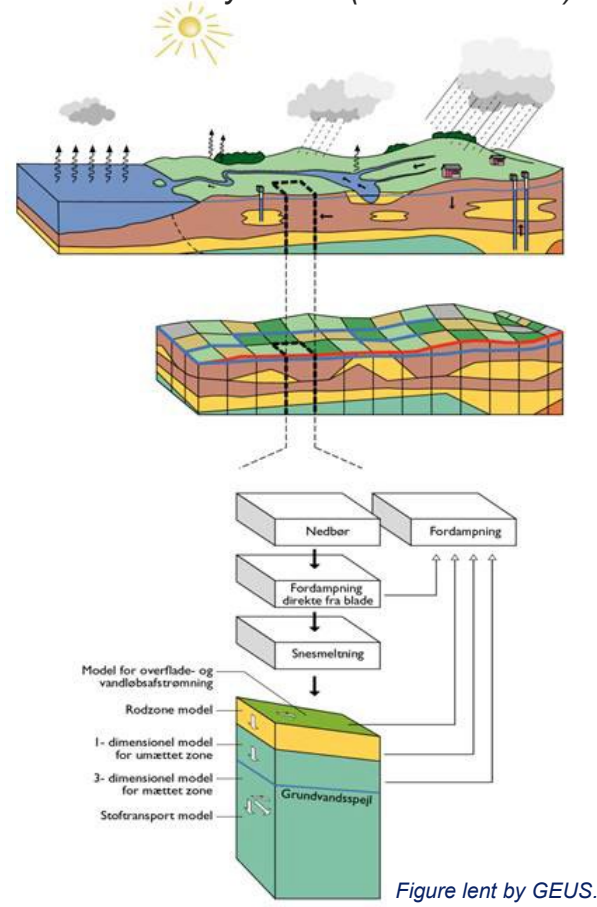
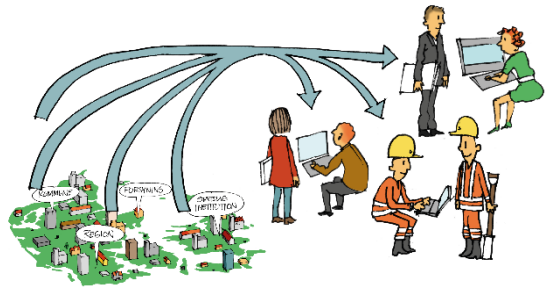
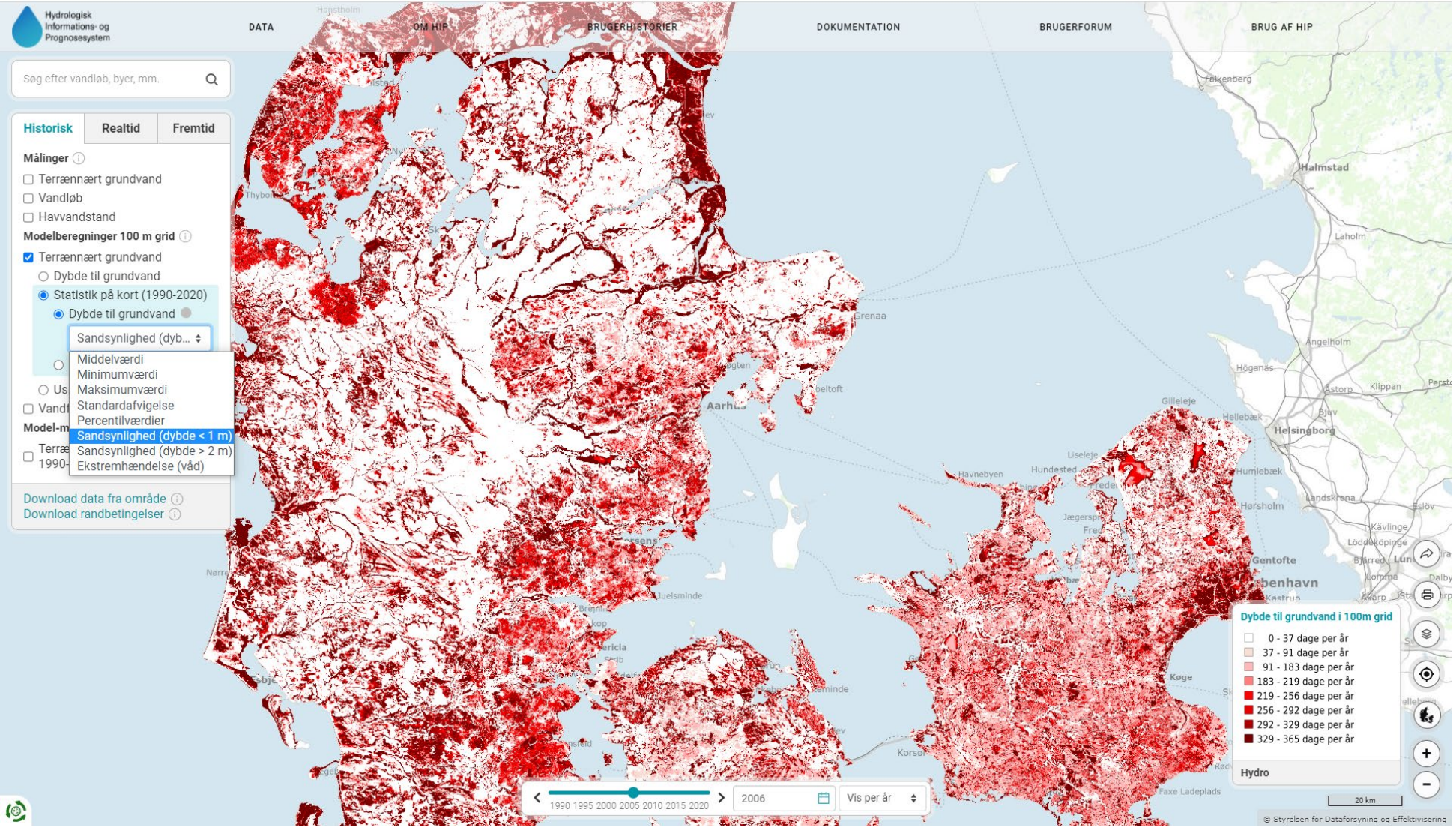


Figure lent by GEUS.

Hipdata.dk

Modelled probability that the depth to groundwater is less than 1 meter





- Daily model simulations in 100 m grid
- Statistics 1990–2020 (n = 30 yrs)
- Downscaled to 10 m grid

Produced by GEUS (DK-model HIP)

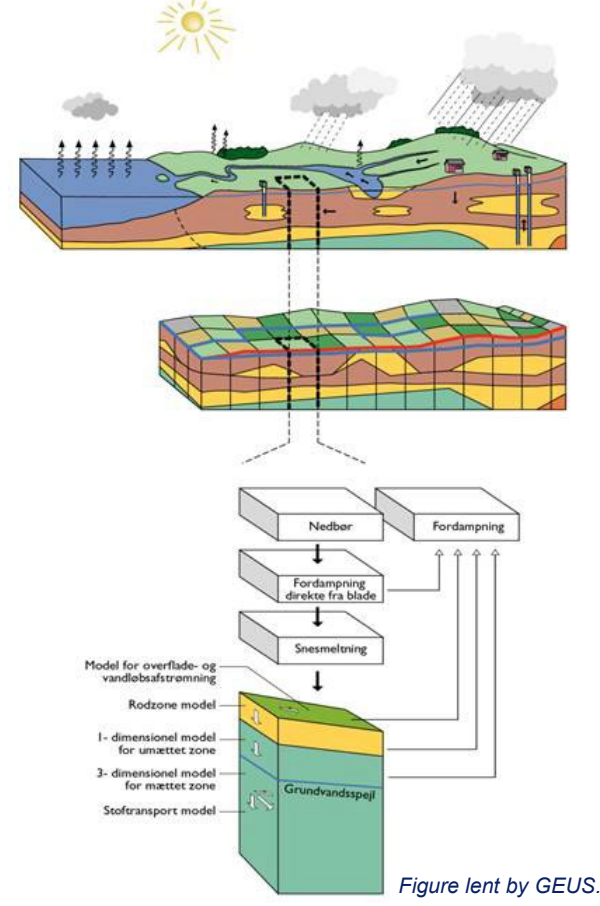
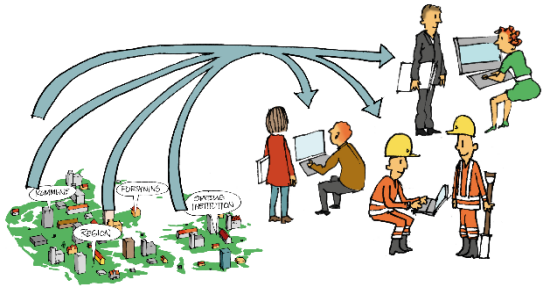


Figure lent by GEUS.

Hipdata.dk

Most likely depth to groundwater in 10 m grid – using machine learning



- Daily model simulations in 100 m grid
- Statistics 1990–2020 (n = 30 yrs)
- Downscaled to 10 m grid

Produced by GEUS (DK-model HIP)

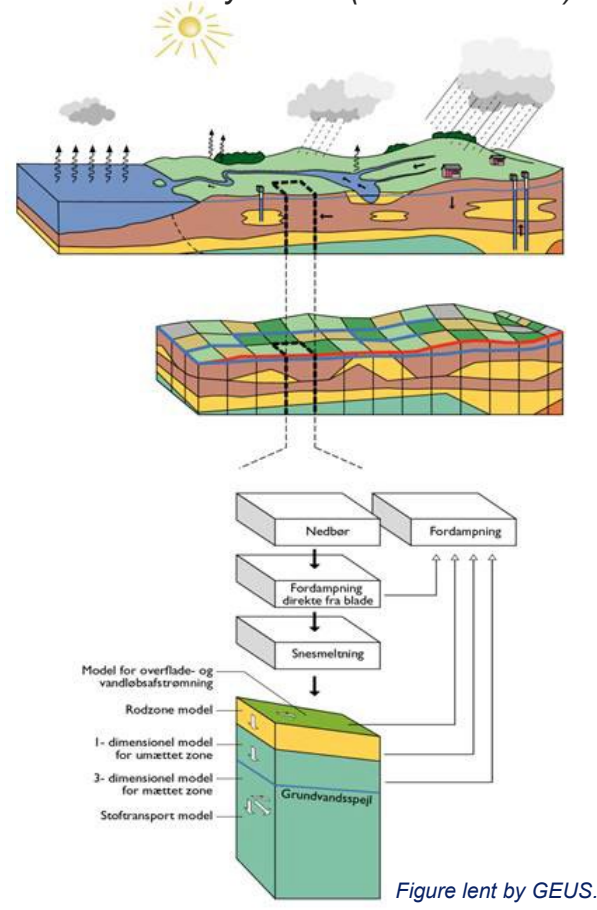
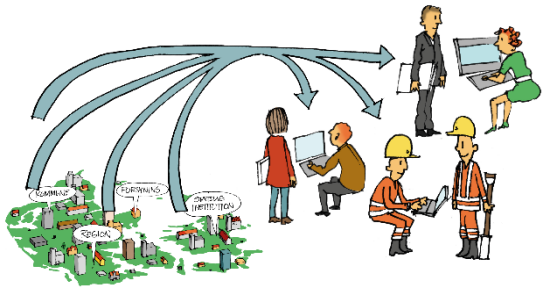


Figure lent by GEUS.

Hipdata.dk

Combine detailed map of most likely groundwater depth with time series



Dybde til grundvand
Grundvandstand
Statistik på kort (1990-2020)
Vandløb
Havvandstand
Modelberegninger 100 m grid
Terrænnært grundvand
Vandføring
Model-maskinlæring 10 m grid
Terrænnært grundvand (data fra 1990-2020)
Sommer
Vinter
Mest sandsynlige
Download data fra område
Download randbetingelser

Measured

DGU nummer: 75.1284
Grundvand | Statistik (1990-2020)
GRAF | TABEL | 2014-02-20 ~ 2018-05-18
Vis alle data • Vis dybde til grundvand • Vis percentiler | Borerapport
meter
0 | -0.2 | -0.4 | -0.6 | -0.8 | -1
2015 | 2016 | 2017 | 2018
Observation | Meget under | Under
Normal | Over | Meget ov
Vis statistiske beregninger for valgte periode >

Modelled (1990-2020)

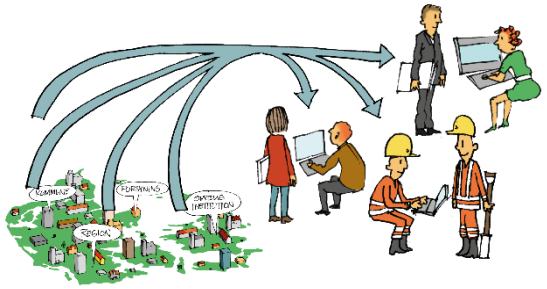
ID: 62447_5095
Grundvand | Statistik (1990-2020)
GRAF | TABEL | 1990-01-01 ~ 2019-12-31
Vis alle data • Vis dybde til grundvand • Vis percentiler | Vis ekstremer
meter
-0.2 | -0.4 | -0.6 | -0.8
2014 | 2015 | 2016 | 2017 | 2018
Modelberegning | Meget under | Under
Normal | Over | Meget over
Vis statistiske beregninger for valgte periode >

Dybde til grundvand i 10m grid
Dybde til grundvand
0 - 0,5 m
0,5 - 1 m
1 - 2 m
2 - 3 m
3 - 4 m
4 - 5 m
5 - 10 m
> 10 m
Manglende værdi
Hydro

1990 1995 2000 2005 2010 2015 2020
2006
Vis per år
1000 m
© Styrelsen for Dataforsyning og Effektivisering

Hipdata.dk

Measured hydrometry and cross section data of streams



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Søg efter vandløb, byer, mm.

Historisk | Realtid | Fremtid

Målinger

- [ ] Terrænnært grundvand
- [x] Vandløb
  - [ ] Vandstand
  - [x] Vandføring
  - [x] Tværprofildata
  - [x] Vandløbsmidte
- [ ] Havvandstand

Modelberegninger 100 m grid

- [ ] Terrænnært grundvand
- [ ] Vandføring

Model-maskinlæring 10 m grid

- [ ] Terrænnært grundvand (data fra 1990-2020)

Download data fra område
Download randbetingelser

Tarm Møllebæk

Vandføring

GRAF | TABEL | 2012-12-06 ~ 2021-11-15

Vis Alle data | Beregnede kvalitetssikrede data | Download data

m³/s

Beregnede kvalitetssikrede data

Dataejer: Miljøstyrelsen

Lokalitet: Kyvling Bro

Vis statistiske beregninger for valgte periode >

- Rørtilløb
- Rørprofil
- Regulativprofil sammensat
- Regulativprofil simpel
- Brønd
- Andre Observationer
- Åbent Tilløb
- Broprofil
- Opmålt profil

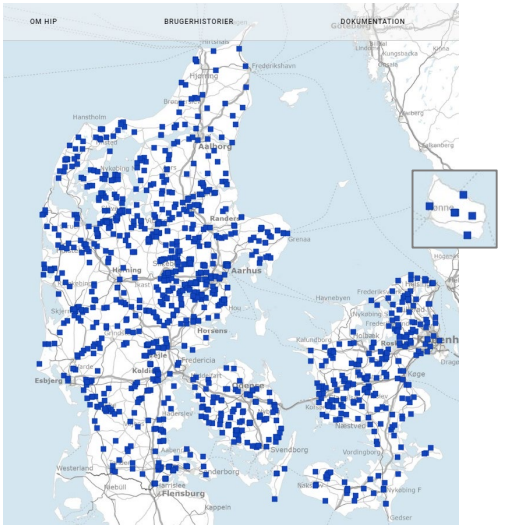
Hydro

1990 1995 2000 2005 2010 2015 2020 | 2013-12-06 | Vis per dag

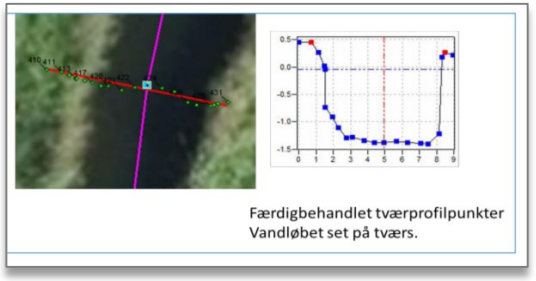
1000 m

© Styrelsen for Dataforsyning og Effektivisering

Hydrometry data – streams

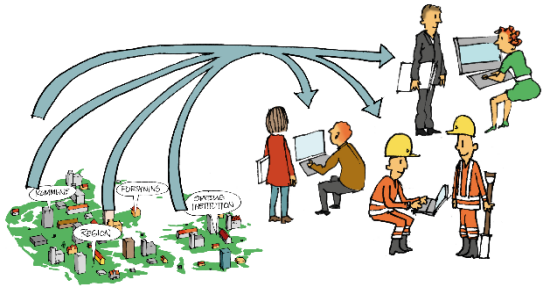


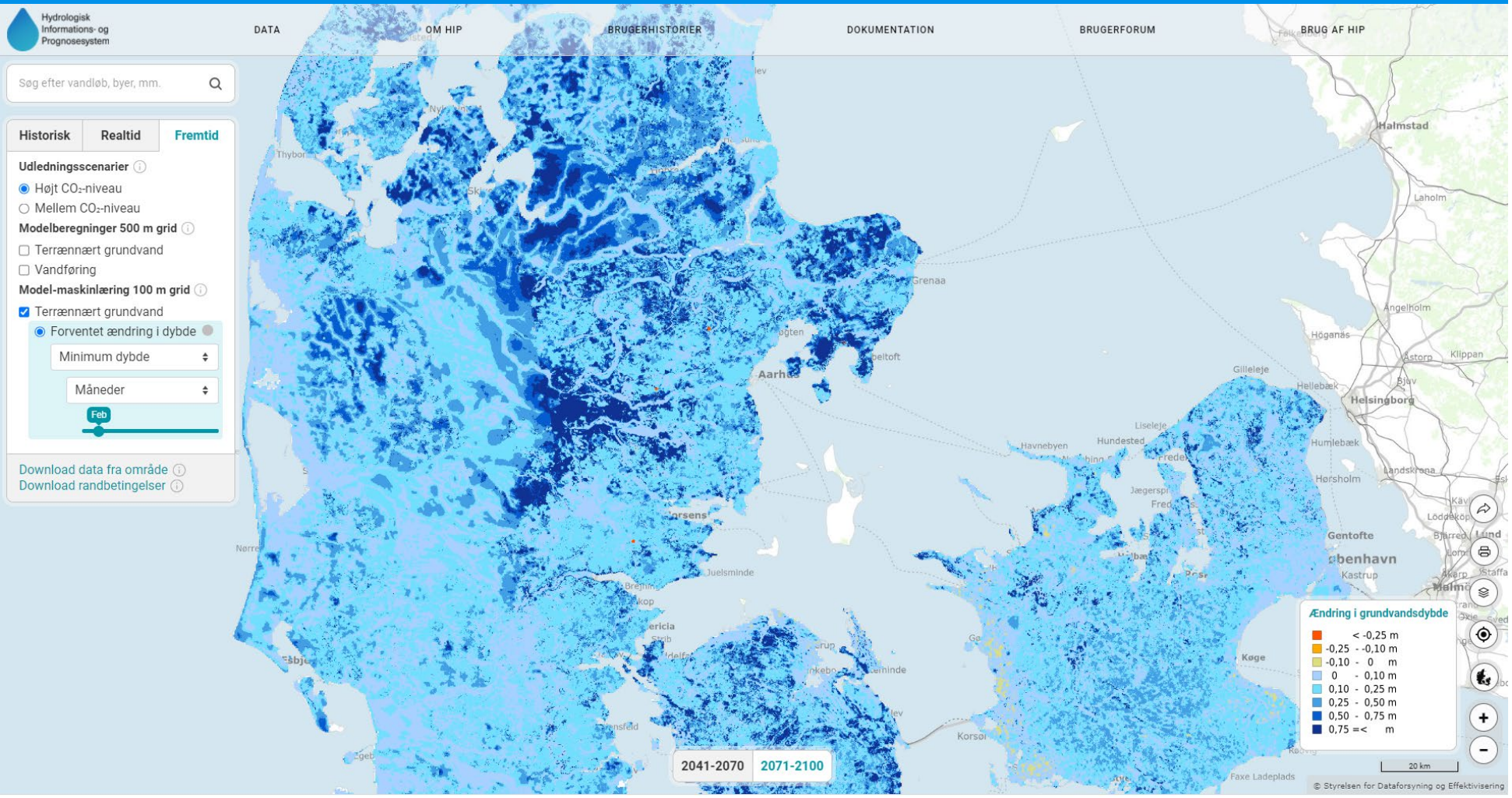
Cross section data of streams



Hipdata.dk

Climate change increases groundwaterlevel in more than 90% of the country

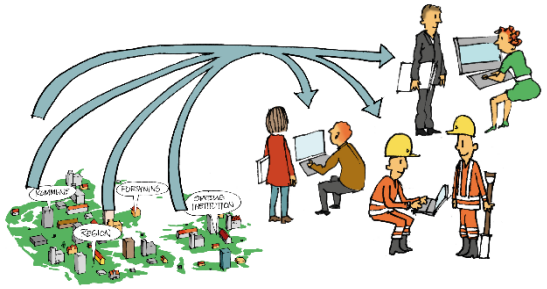


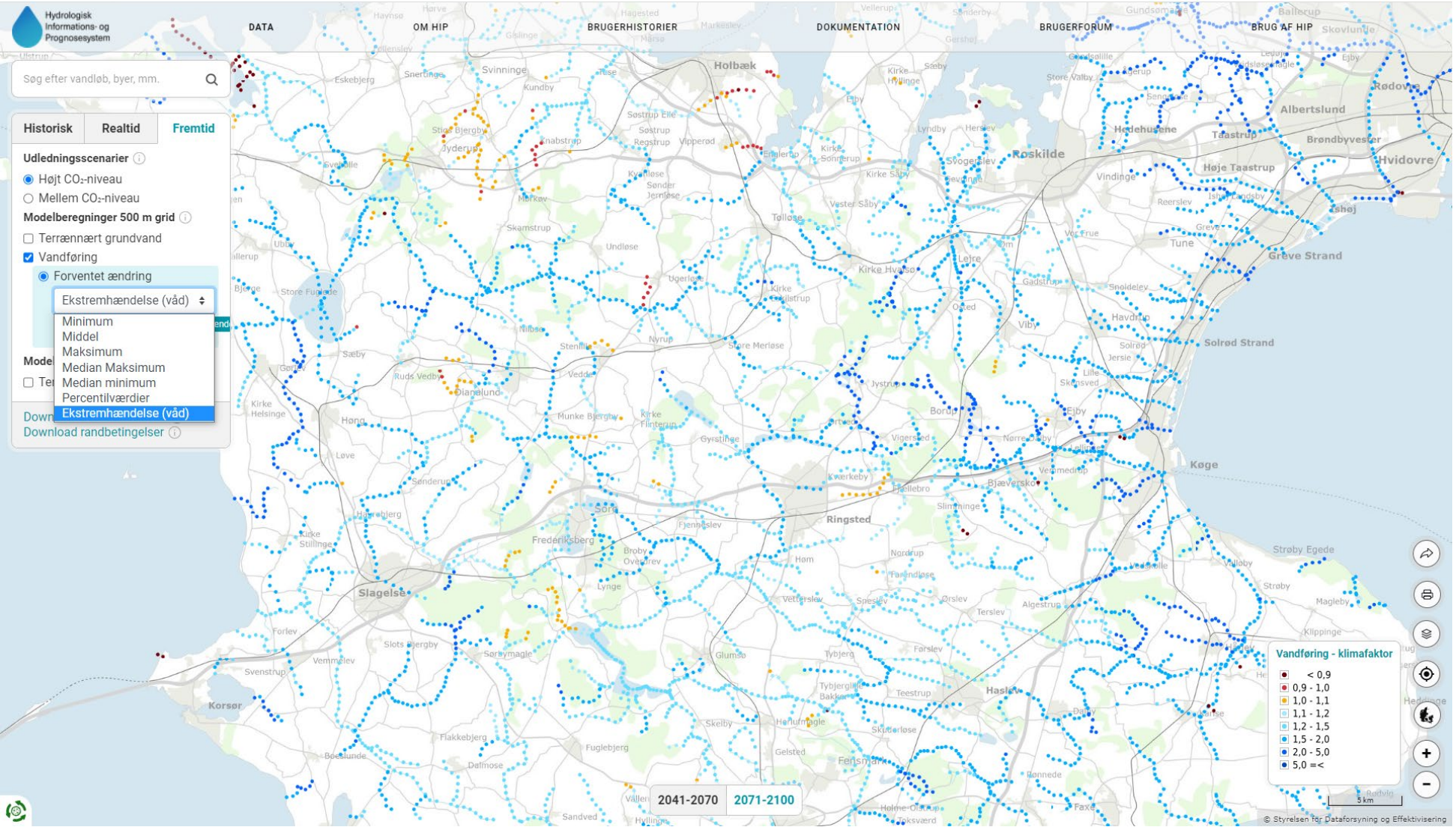


- **The upper groundwaterlevel increases**
  in more than 90% of the country
- **Tile drainage increases**
  – it is seen in the streams

Hipdata.dk

Climate change impact on stream discharge

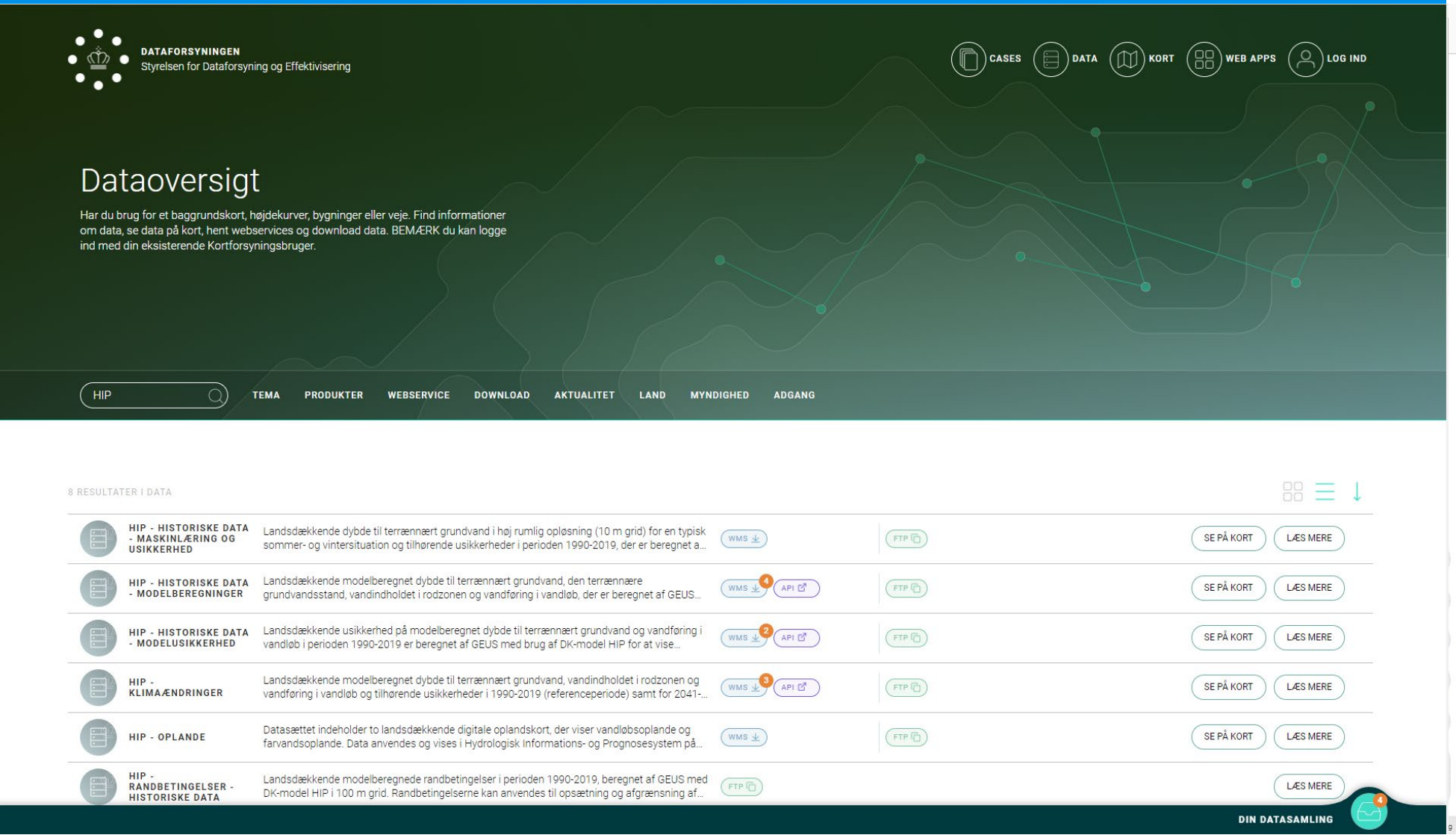


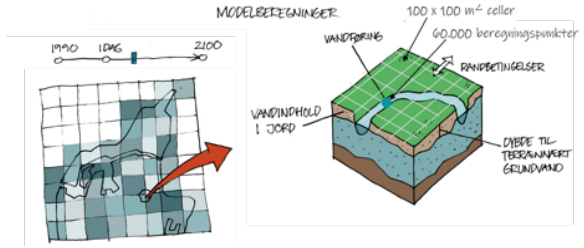


- **The upper groundwaterlevel increases**
  in more than 90% of the country
- **Tile drainage increases**
  – it is seen in the streams
- **A 100-year discharge increases by**
  a factor 2-5 in large parts of the country
- **More dry periods in future summers**

Hipdata.dk

Download selected data from HIP or get webservice from dataforsyningen.dk





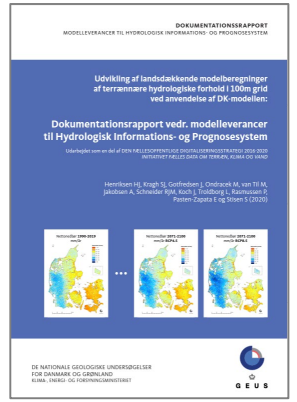
Download also other model simulations from DK-model HIP, eg.

- Soil moisture
- Groundwater potential
- Groundwater recharge
- Horizontal groundwater flow
- Vertical groundwater exchange

for historical time and climate impact sceanarios (21 set of climate impact timeseries modelsimulations) and statistics

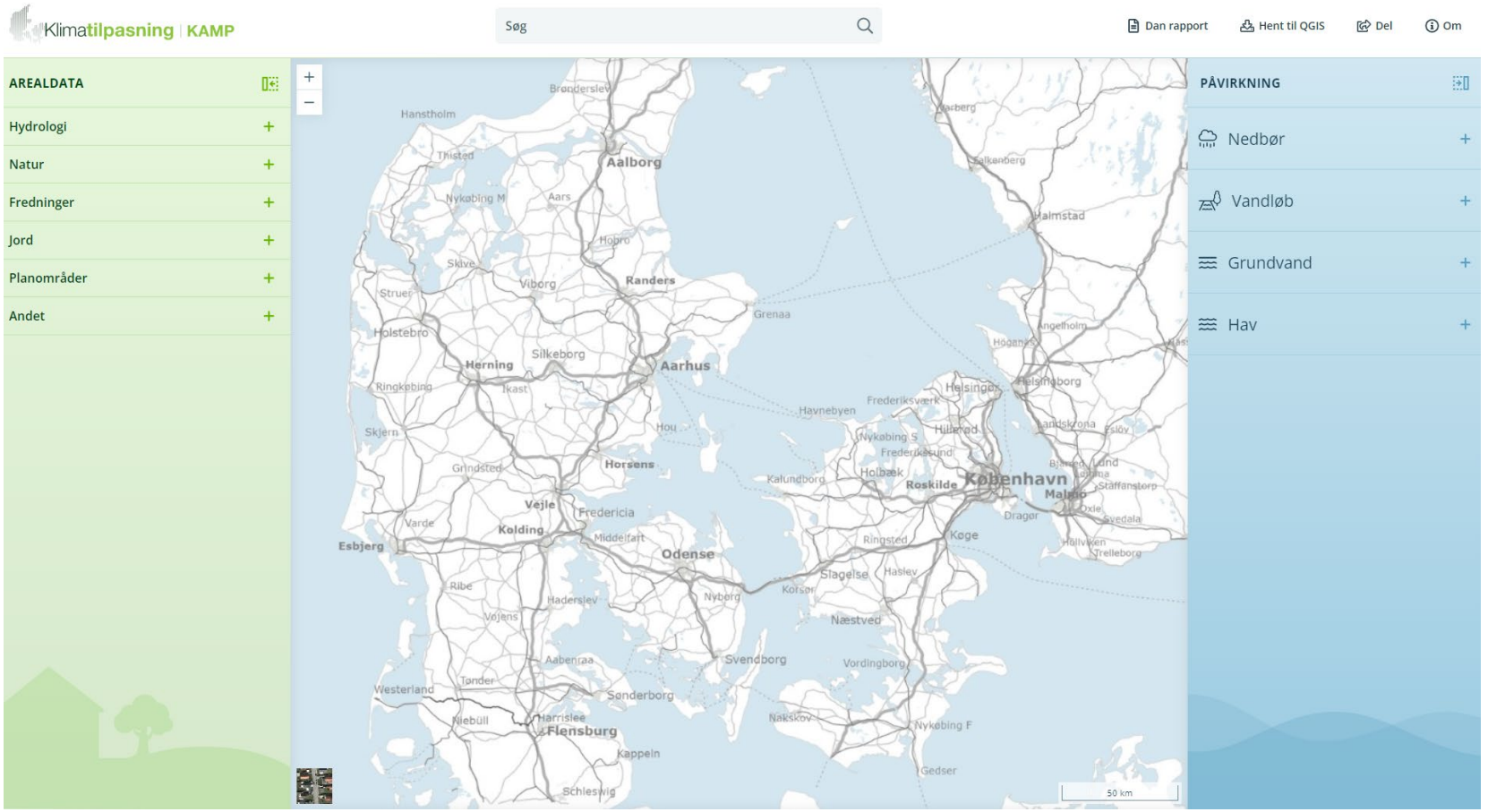
Use as boundary conditions to develop more detailed local models and solutions

GEUS documentation report at hipdata.dk



KAMP screeningtool for climate adaptation

Ministry of Environment



Impact layers

Nedbør
- Bluespot (lavninger) SDFE

Vandløb
- Vandløbsoversvømmelse National Risikokortlægning, KDI

Grundvand
- Terrænnært grundvand i dag SDFE
- Ændring i terrænnært grundvand i fremtiden SDFE
- Antal dage med højtstående grundvand i dag SDFE
- Ændring i antal dage med højtstående grundvand i fremtiden SDFE

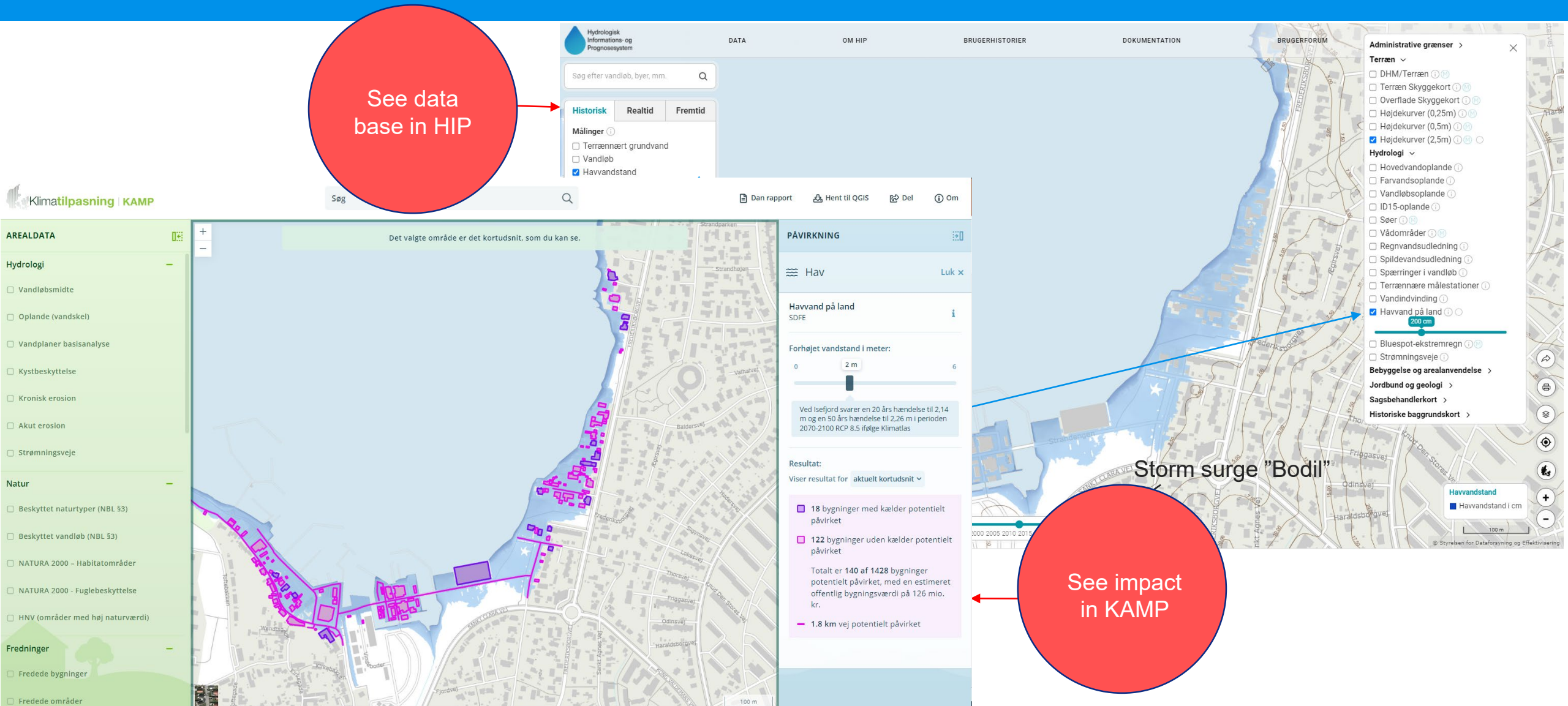
Hav
- Havvand på land SDFE

HIP model-simulations

Data is for screening. See model uncertainty and download boundary conditions in HIP for further development and detailed planning

Example 1 – Use of HIP og KAMP

Data base and impact of high seawaterlevel



Example 2 – Use of HIP og KAMP

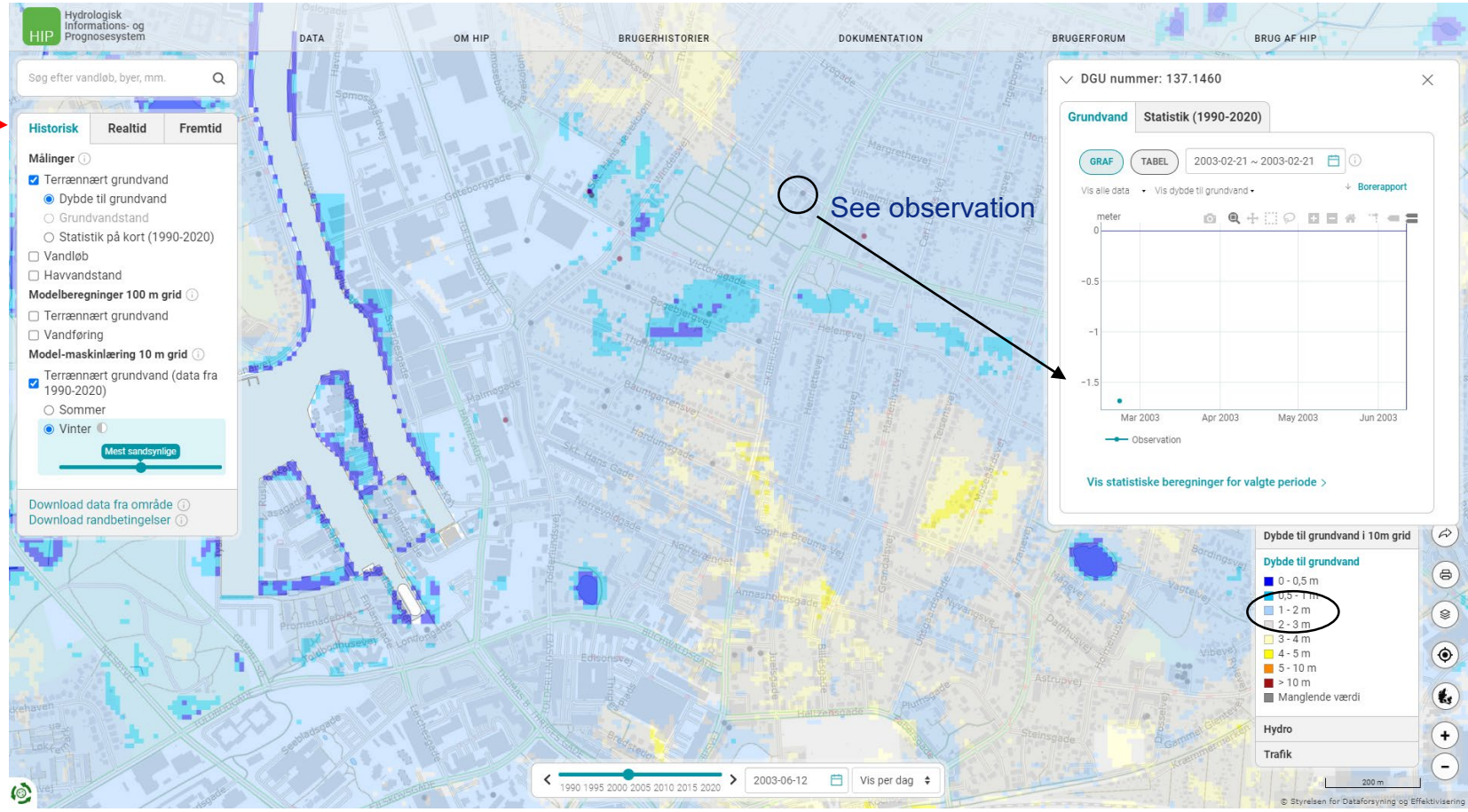
Data base and impact of high groundwaterlevel

See data base in HIP

Most likely depth to groundwater – winter (10 m grid)

Compare with measurements in wells

Look up modeluncertainty



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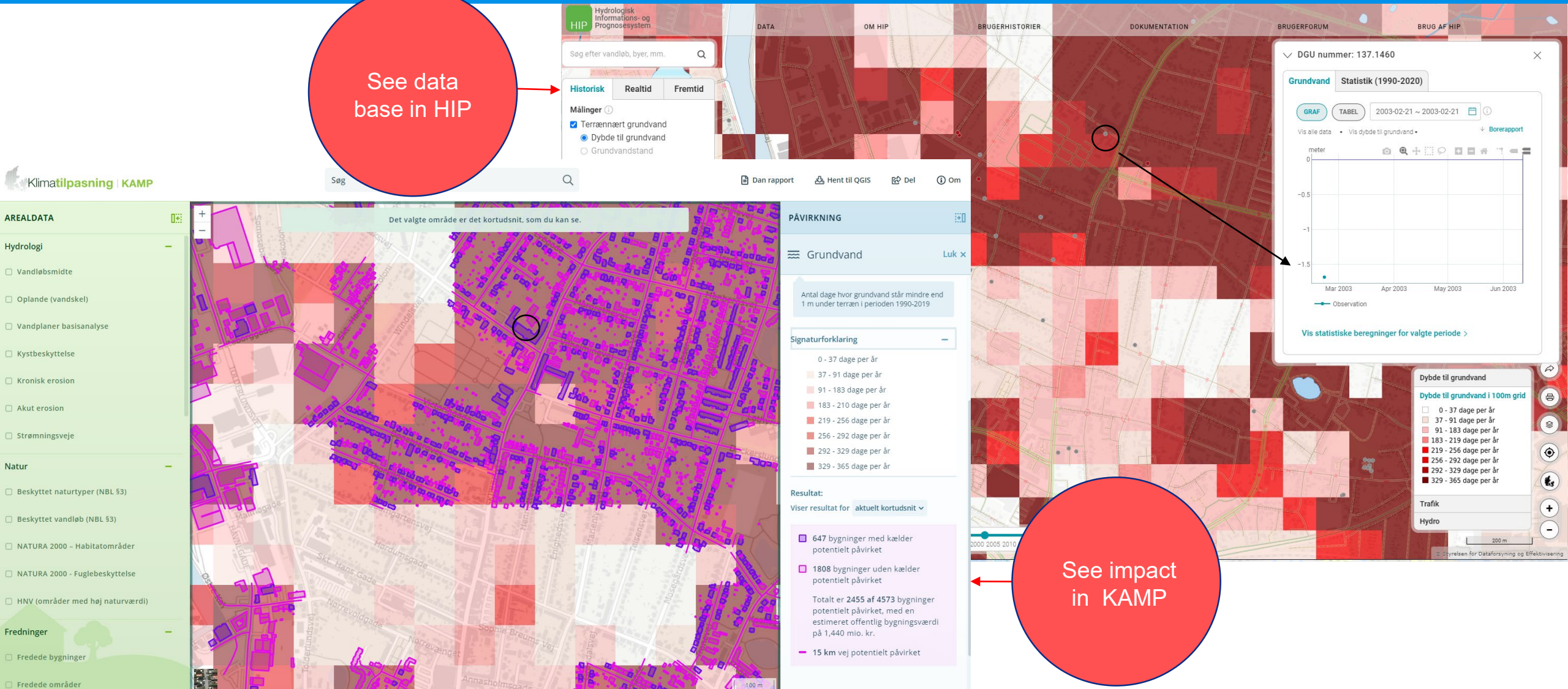
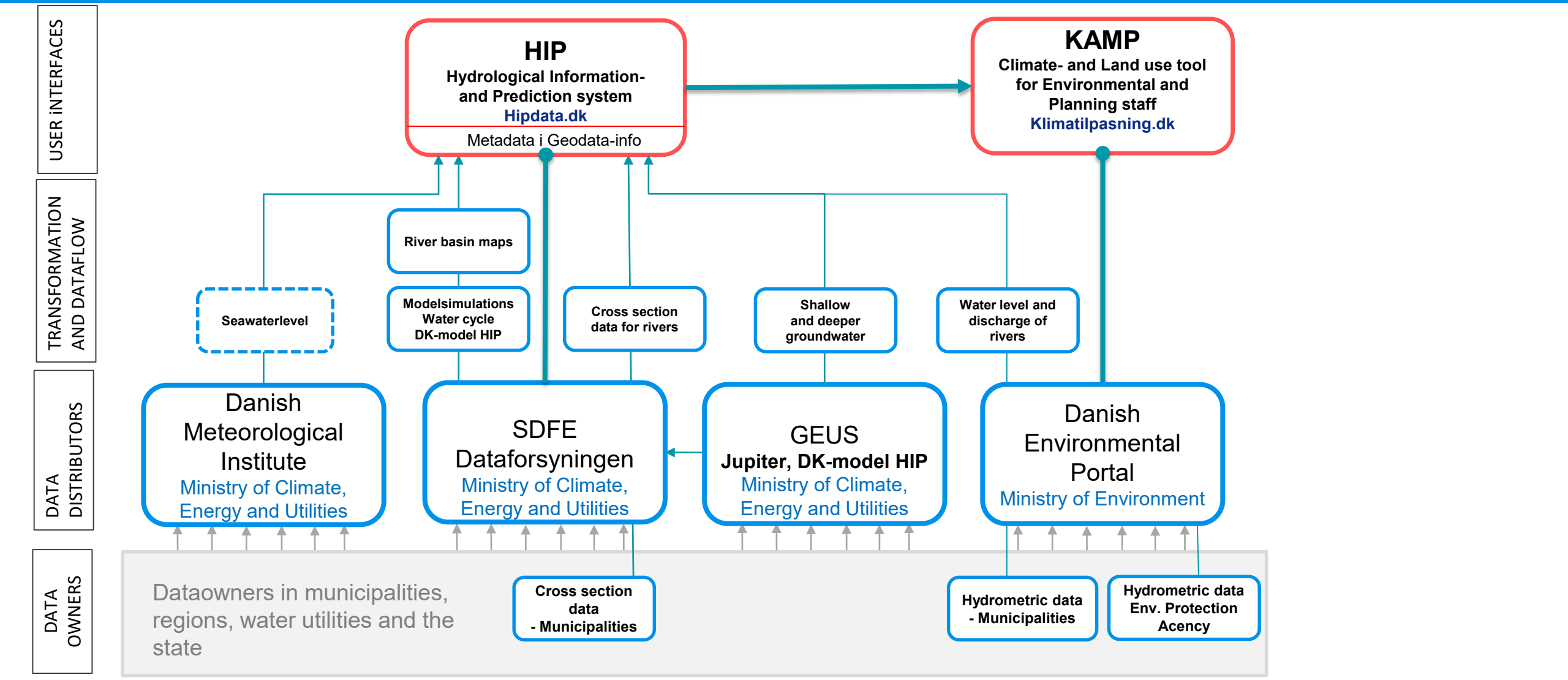
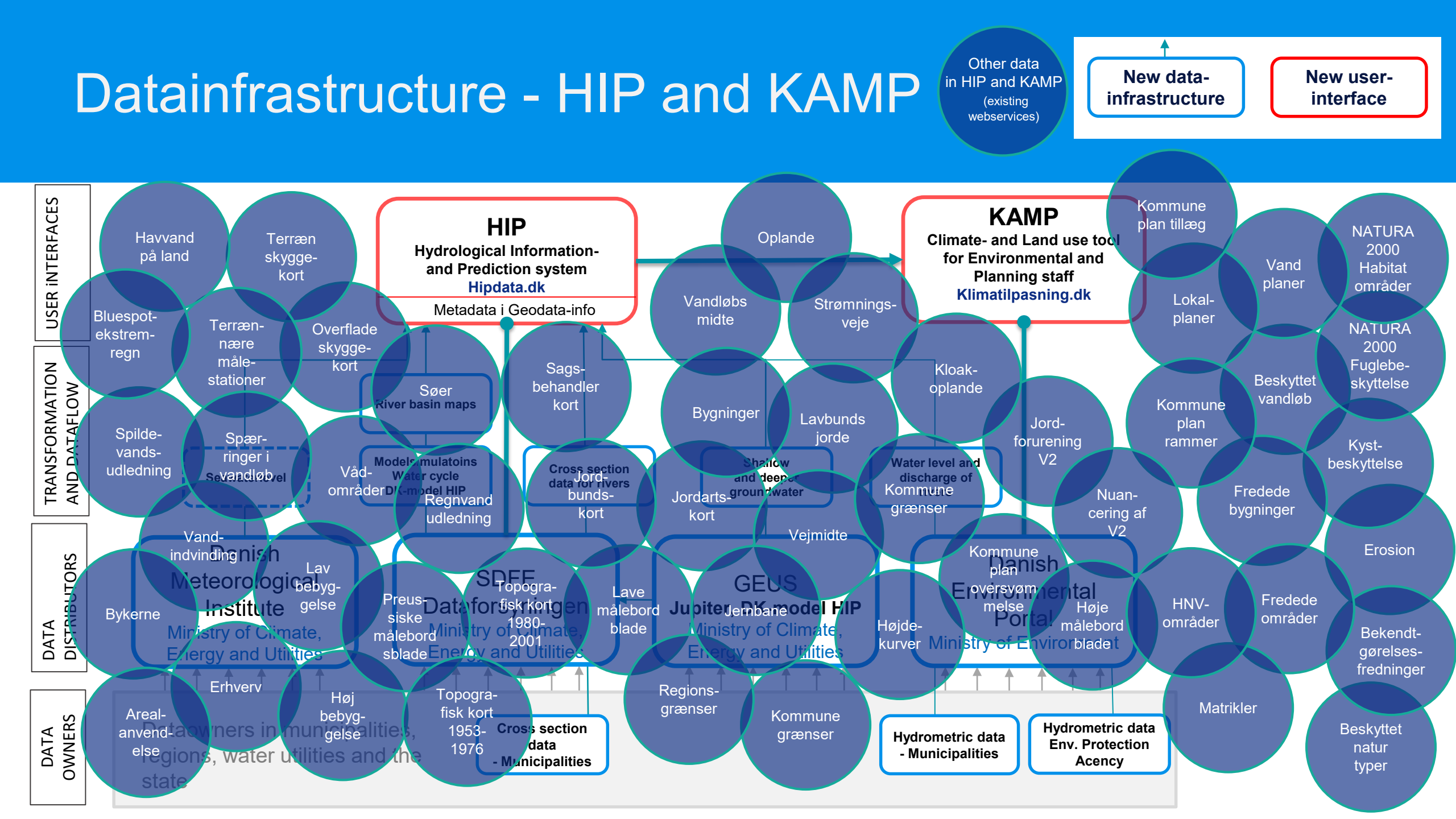
Data base and impact of high groundwaterlevel



Datainfrastructure - HIP and KAMP



Datainfrastructure - HIP and KAMP



Summary

Robust datafundament, coherent datainfrastructures and climate adaptation tools qua the Danish digital strategy

Model simulations of shallow groundwater and river discharge are for screening and can be used for further development of local solutions

The development was userdriven. User satisfaction is very high.

Thank you for the attention