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# Monitoring pitfalls: Aquatic environment

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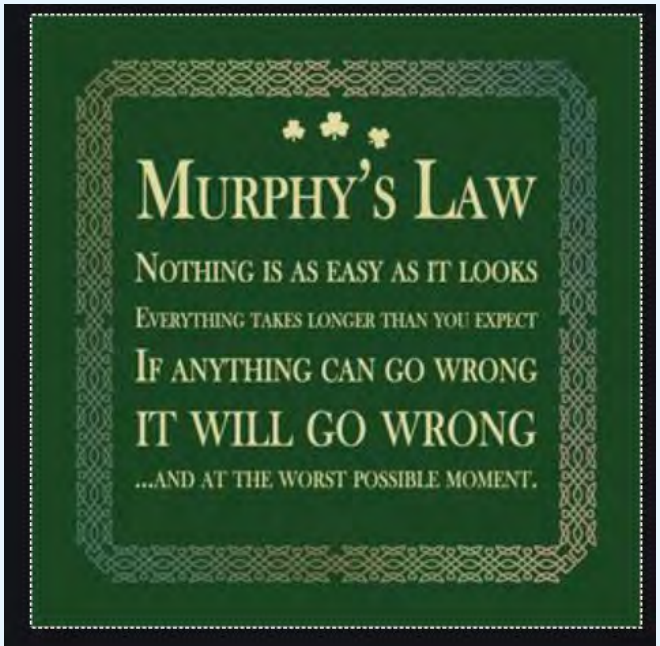
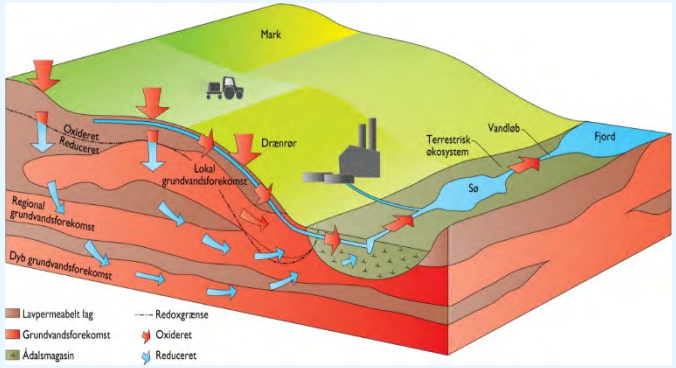
# Monitoring Pittfals

- Precipitation
- Nutrient concentrations in surface waters (NP)
- Discharge
- Lessons learned



# NOVANA, - the Danish Monitoring Program of the Aquatic Environment

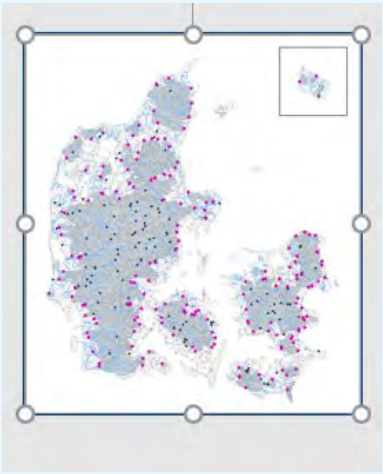


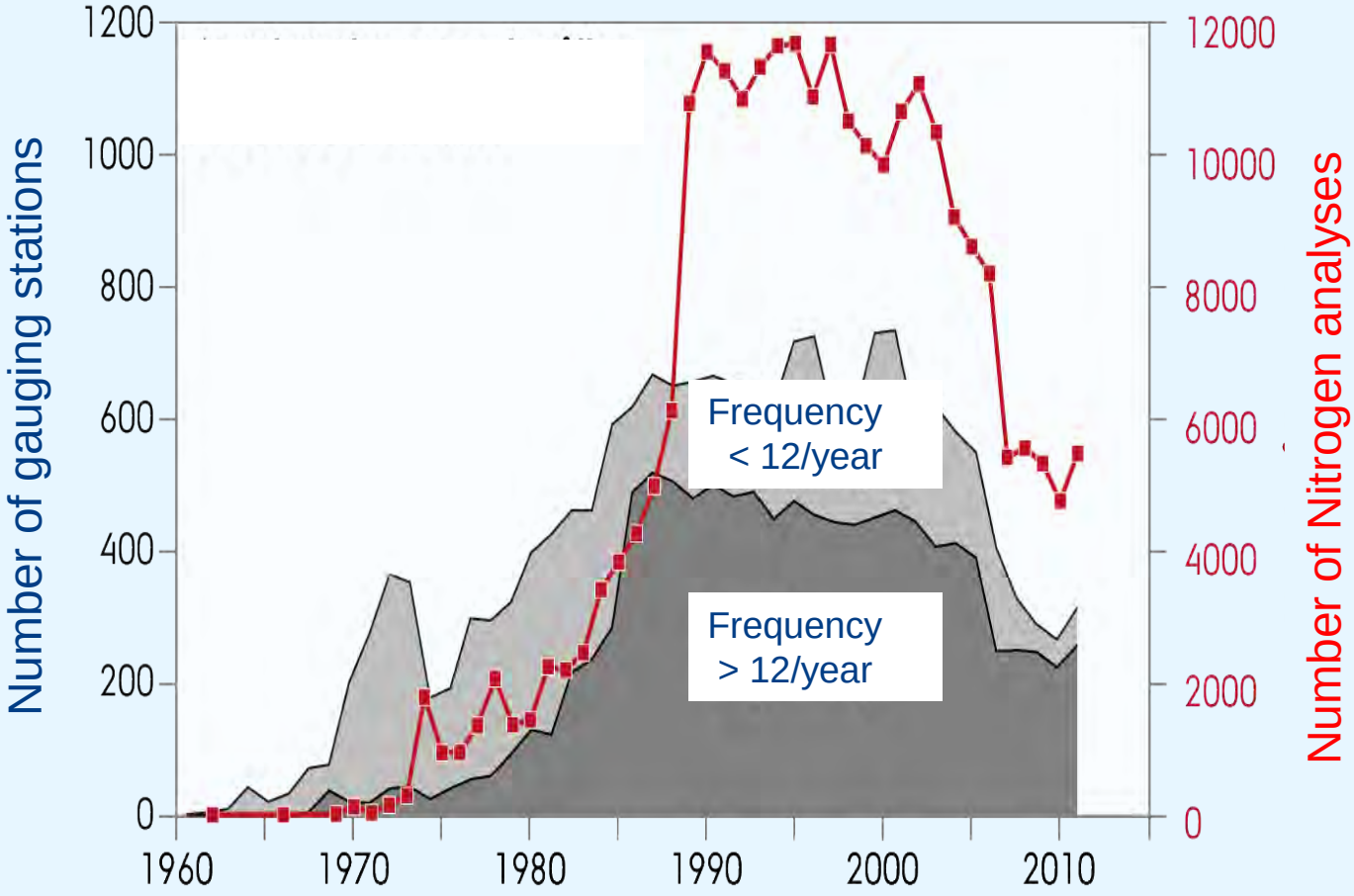

- **Monitoring purpose** NOVANA: (started in 1989…)
  - nationally (annual **state of environment** and progress (**trends**) and internationally (HELCOM, WFD, Nitrate Directive)
  - **Evaluate** nationally **implemented Action Plans**
  - **Etc…**

- **Therefore, reliable monitoring data in time and space are crucial.**

- Aim of this presentation to give examples of pitfalls in Danish riverine water and nutrient monitoring

# Trends in number of gauging stations and water samples
taken in Danish streams





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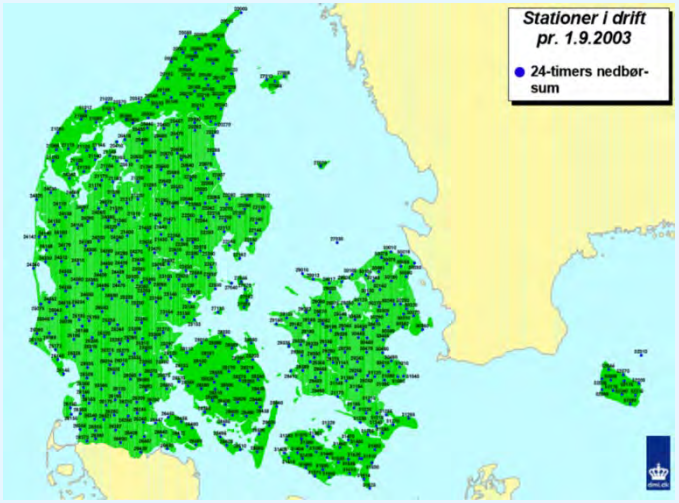
# Precipitation

## Number of Gauging stations GRID values (10*10 km)




| YEAR | Number of stations |
|---|---|
| **1961-2006** | **400-700** |
| 2007 | 430 |
| 2008 | 250 |
| **2009-2010** | **150** |
| 2011 | 220 |
| 2012 | 250 |
| 2013 | 260 |
| 2014 | 260 |
| 2015 | 260 |
| 2016 | 260 |
| 2017 | 270 |
| 2018 | 285 |
| **2019** | **285** |

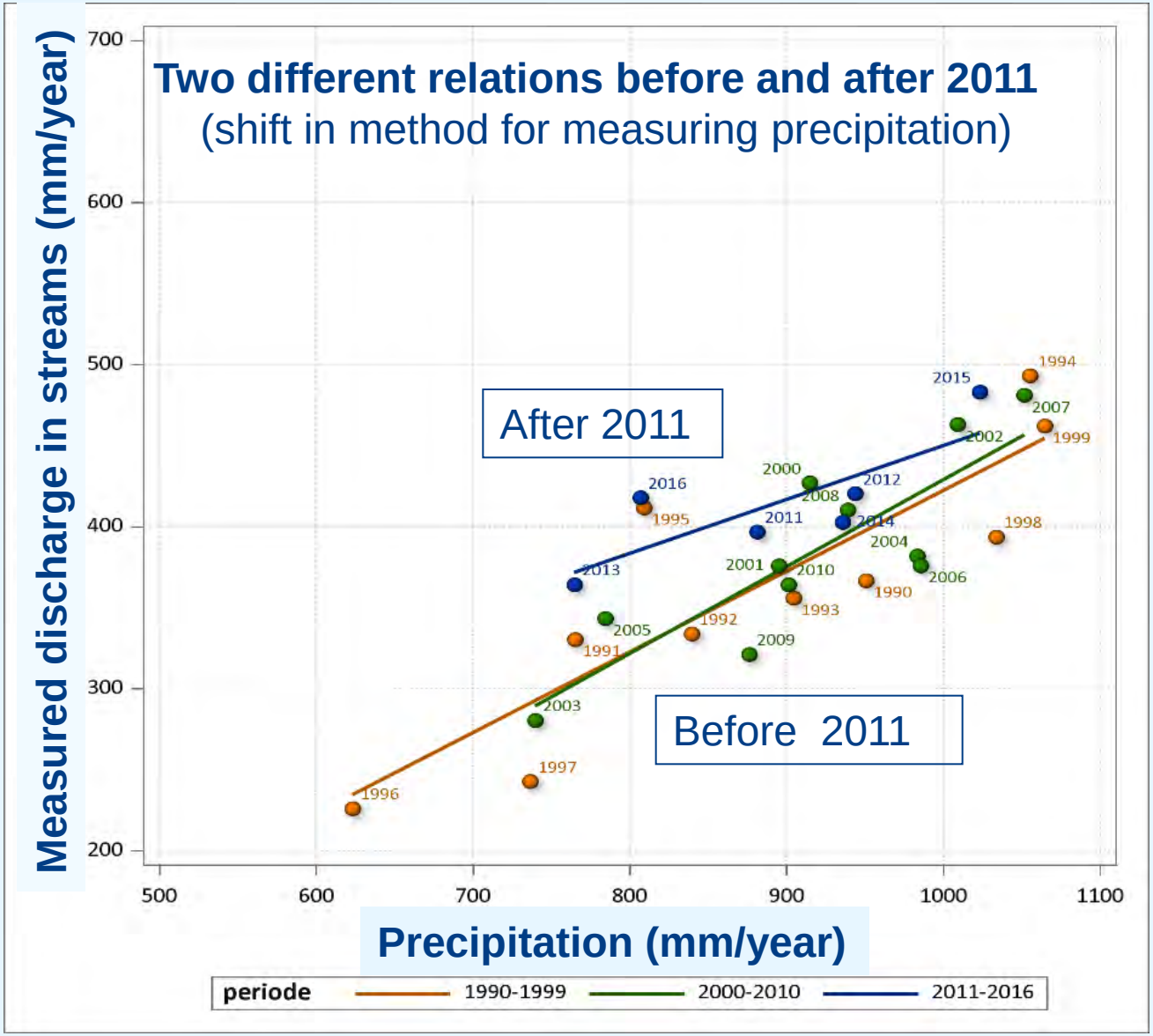
**january 2011:**

**Change in monitoring equipment;**

Danish area: 43,000 km2

0.7 station/100 km2

# Precipitation



# Precipitation

Grid values for Denmark 1990-2019 (10*10 km)

Number of measuring stations has been reduced

Change in measuring equipment & methods (2011). No overlap in time series where both methods used

**Consequences:**

Changing relation between precipitation & measured discharge in streams = non consistent time series for precipitation

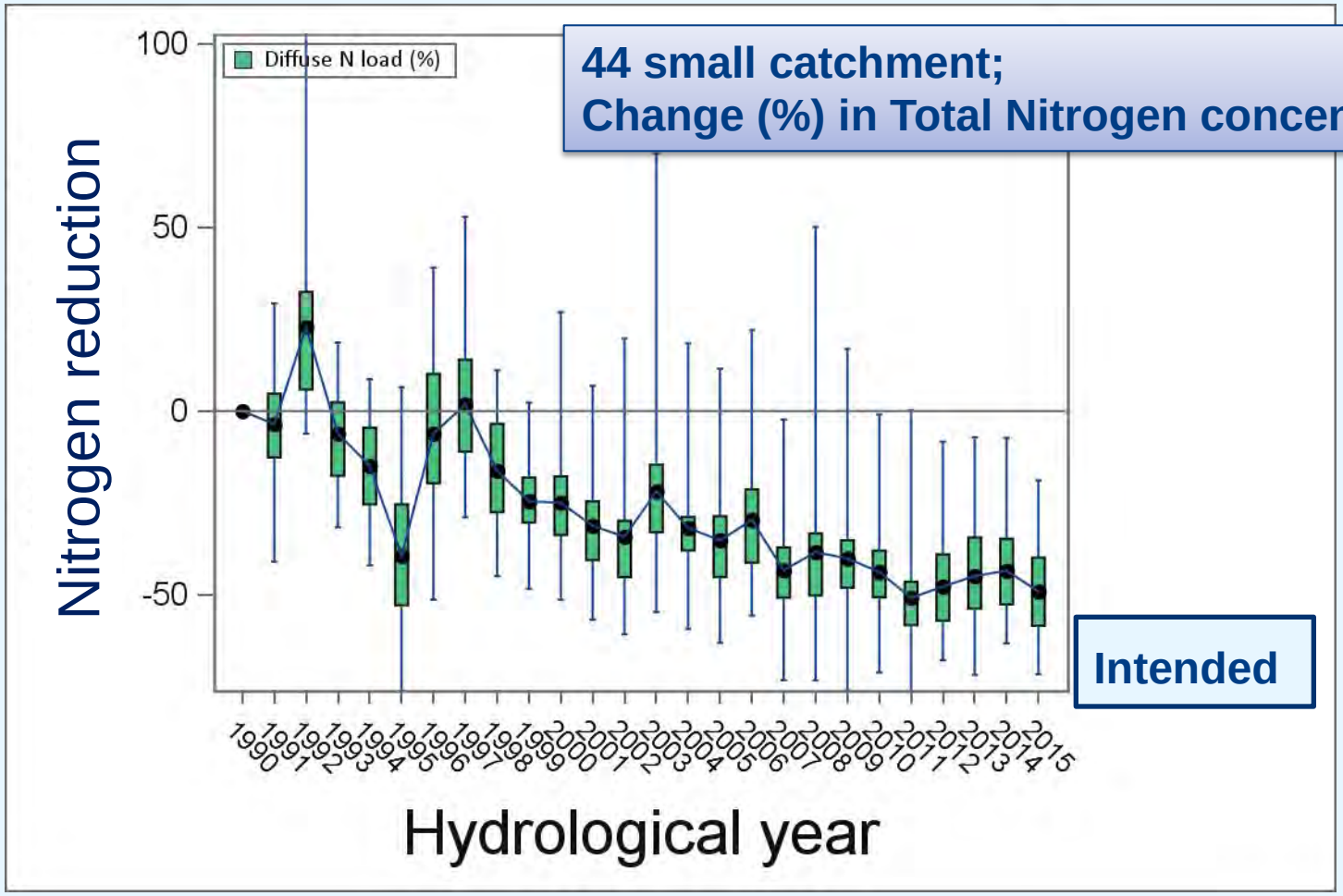
Problematic interpretation of development in precipitation and hydrological model output.

Leading to less reliable modelling of - in example - the national Nitrogen model (DK-N model) - Ungauged areas

Ongoing considerations of correcting time records of precipitation to get trustworthy time series

- **Damage control vs. due diligence??**

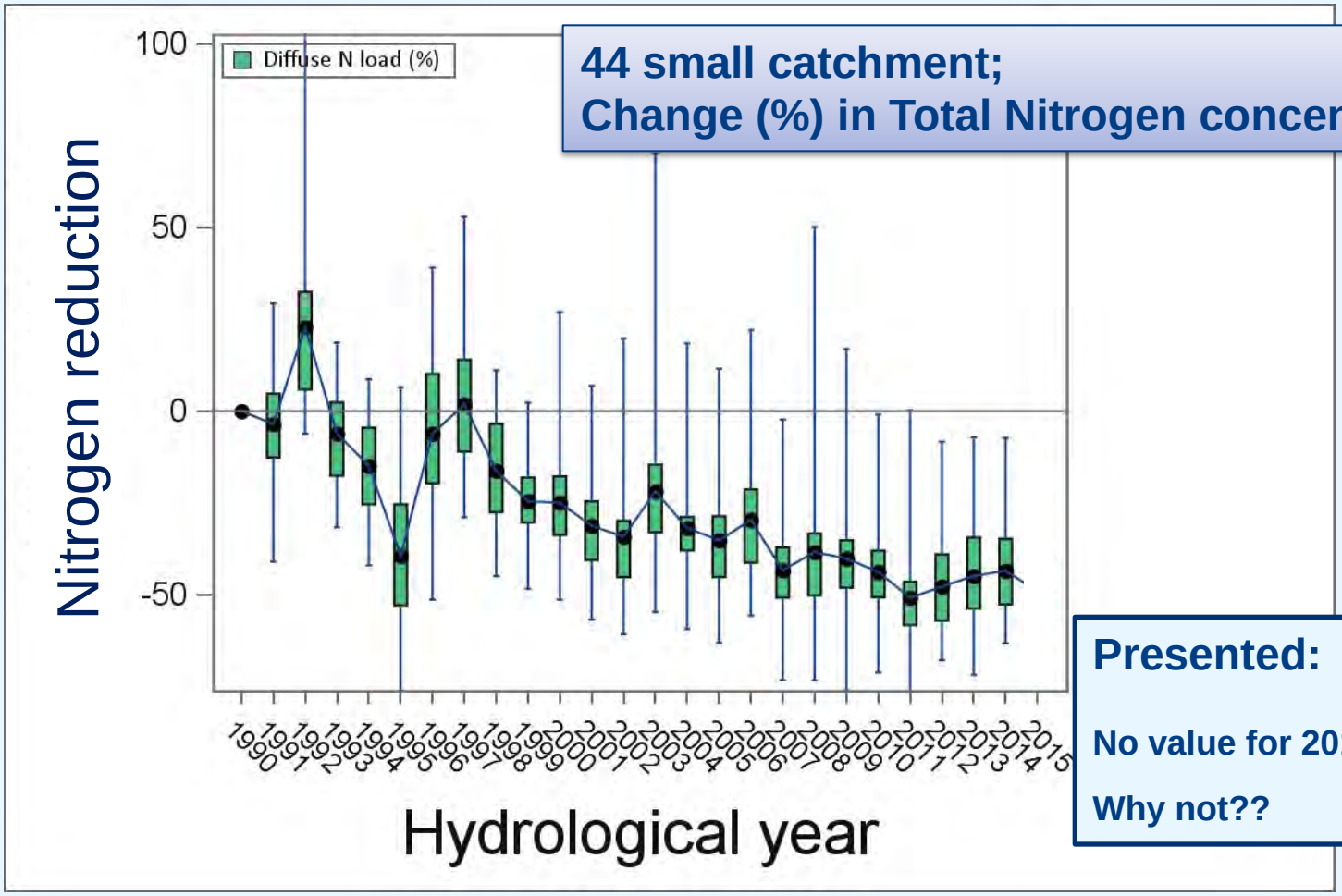
# Analyses of Total N in Danish surface waters
## ..... LUWQ 2017 conference in Den Haag




**44 small catchment;**
**Change (%) in Total Nitrogen concentration**

**Intended**

# Analyses of Total N in Danish surface waters
## ..... LUWQ 2017 conference in Den Haag




**44 small catchment;**
**Change (%) in Total Nitrogen concentration**

**Presented:**

**No value for 2015/16 –**

**Why not??**

# Analyses of Total N and P in Danish surface waters

- Shift in **analytic methods** for total N and total P with insufficient test of validity of new (cheaper) methods
  - **Old:** Hot acid oxidation digestion (autoclave method).
  - **New:** UV destruction

- Recommendation from National Reference laboratory (2012): Stick to the old autoclave method. **Recommendation not followed** ….

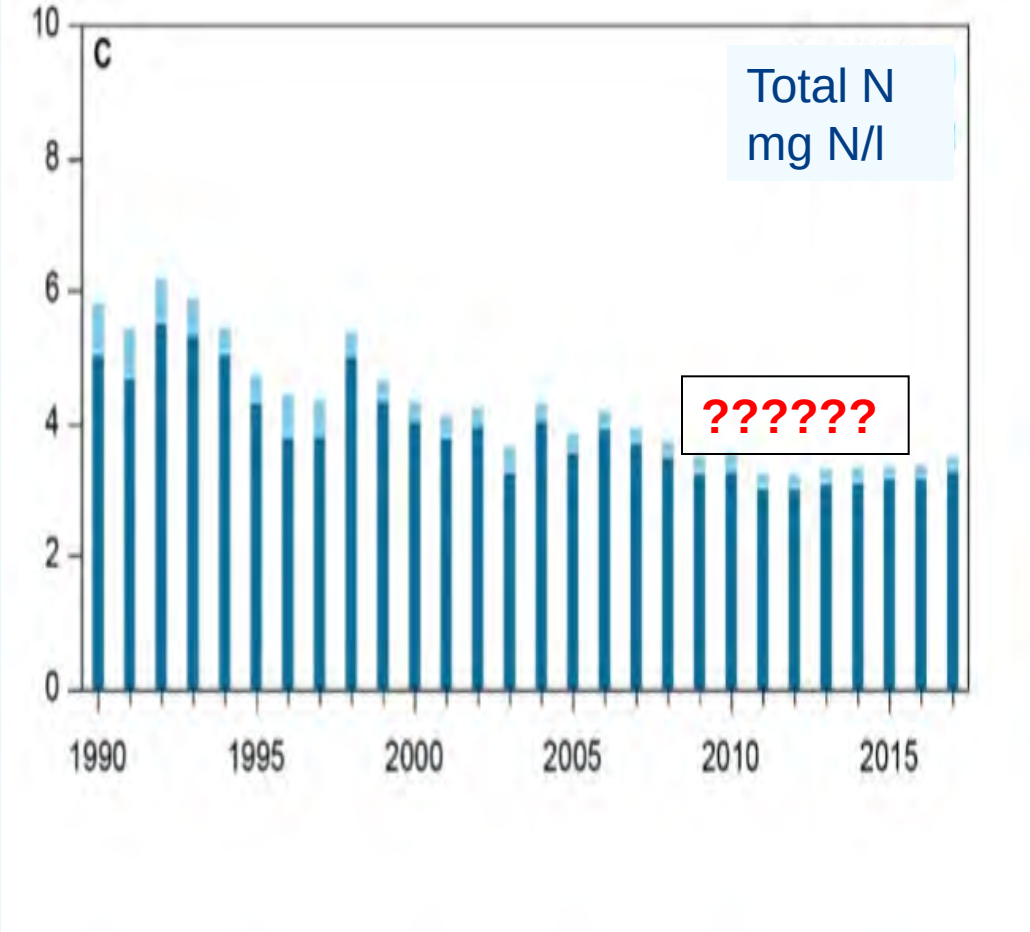
| Relative error: UV method to Autoclave (2016-17) | | | | |
|---|---|---|---|---|
| | n | Total N | n | Total P |
| Streams | 383 | 6.9 % | 293 | 14.0 % |
| Lakes | 64 | 16.3 % | 87 | 14.8 % |
| Marine | ? | ? | ? | ? |

Bias corrected Total N: (2016-17):

# Analyses of Total N in Danish surface waters

## 2007-14?? Something wrong here??

Measured Total N 77 near-coastal gauging stations…..



# Monitoring Pittfals:
## Total N – Nitrate-N = 'Residual N' (mg N/l)

| Year | Total N | Nox-N | Residual N |
|---|---|---|---|
| | | mg N/l | |
| 2007 | 4,81 | 3,94 | 0,88 |
| 2008 | 4,67 | 3,78 | 0,90 |
| 2009 | 4,55 | 3,75 | 0,80 |
| 2010 | 4,86 | 4,01 | 0,85 |
| 2011 | 4,04 | 3,36 | 0,68 |
| 2012 | 3,90 | 3,27 | 0,62 |
| 2013 | 4,11 | 3,53 | 0,58 |
| 2014 | 4,09 | 3,47 | 0,62 |
| 2015 | 4,03 | 3,38 | 0,65 |
| 2016 | 4,11 | 3,20 | 0,91 |
| 2017 | 5,63 | 4,60 | 1,03 |

# Monitoring Pittfals:
# Discharge measurements in streams

## Small streams

**Propeller (old method: Flügel)**

**Magnetic induction (new method: OTT MF PRO)**

## Larger streams

**Doppler instrument (new method)**
**Propeller (old method)**

# Monitoring Pittfals:
## Discharge measurements in streams

**New methods introduced within last decade**

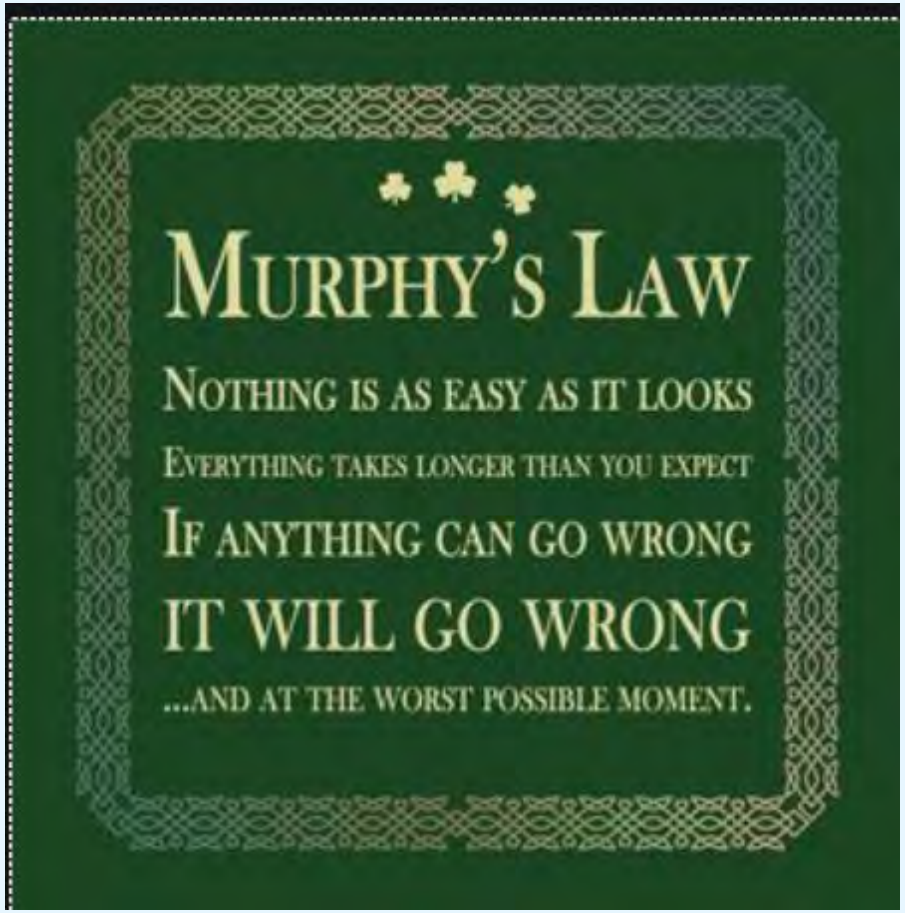
**No proper evaluation before shift in methods**

**No overlap in period using several different methods simoultaneously**

**Can we relay on consistencey in our time records of discharge?**

**Don’t quite know --- ungoing evaluation….**

# Lessons Learned:




## Murphy's law is valid !!

If problems in consistency of discharge (Q) measurements and chemical analyses (C)??

**What about Nutrient loading estimates** ??

Load = Q x C

Dosing of Mitigations measures ??

Evaluation of measures and national Action Plannes to reduce nutrient loading..??

# Lessons Learned:

Be carefull out there !!!

**Murphy's law is valid !!**

**<u>Due dilligence</u> in proper time**

**Or…..**

**Hard work of <u>damage</u> <u>control</u> !!**