



NVE

# COMPARISON OF TRADITIONAL AND NEW MEASUREMENT TECHNIQUES

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"All the News That's Fit to Print"

# The New York Times

**Late Edition**  
 Today, clouds and some sunshine, breezy, milder, high 63. Tonight, mostly cloudy, low 56. Tomorrow, cloudy, afternoon showers, high 69. Weather map appears on Page D8.

VOL. CLXVI ... No. 57,400 + © 2016 The New York Times Company

NEW YORK, SATURDAY, OCTOBER 29, 2016

\$2.50

## Climate change!!! Runoff from Norway up 2%

**With 11 Days to Go, Trump Says Revelation 'Changes Everything'**

By AMY CHOZICK and PATRICK HEALY

Everything was looking up for Hillary Clinton. She was riding high in the polls, even seeing an improvement on trustworthiness. She was sitting on \$153 million in cash. At 12:37 p.m. Friday, her aides announced that she planned to campaign in Arizona, a state that a Democratic presidential candidate has carried only once since 1948.

Twenty minutes later, October delivered its latest big surprise. The F.B.I. director's disclosure to Congress that agents would be reviewing a new trove of emails that appeared pertinent to its investigation into Mrs. Clinton's private email server — an investiga-

tion that had been declared closed — set off a frantic and alarmed scramble inside Mrs. Clinton's campaign and among her Democratic allies, while Republicans raced to seize the advantage.

In the kind of potential turnabout rarely if ever seen at this late stage of a presidential race, Donald J. Trump exulted in his good fortune. "I think it's the biggest story since Watergate," he said in a brief interview, adding, "I think this changes everything."

He promised to batter Mrs. Clinton as a criminal in the race's final week and a half. And Republican

Continued on Page A12

**Decision Pulls F.B.I.'s Leader Back Down Into Political Fray**

This article is by Eric Lichtblau, Michael S. Schmidt and Matt Apuzzo.

WASHINGTON — James B. Comey, the F.B.I. director, faced a dilemma on Thursday when deputies briefed him about the discovery of a new trove of emails that might be connected to the dormant inquiry into Hillary Clinton's private email server.

Mr. Comey could immediately inform Congress about the emails, which were found in an investigation into former Representative Anthony D. Weiner. That unusual step, months after Mr. Comey had cleared Mrs. Clinton of any criminal wrongdoing in the email case,

would risk accusations that he was unfairly harming her presidential campaign less than two weeks before the election.

Or he could delay any announcement and examine the new emails more closely, risking criticism that he had suppressed important new information if it came out after the election, despite his pledges of "transparency" in the investigation.

Mr. Comey, a Republican appointed by President Obama three years ago, decided that he could live with criticism of his judgment, aides said. So on Friday morning, the F.B.I.'s congressional

Continued on Page A13

less than two weeks before the election, left Mrs. Clinton's team furious and scrambling for explanations while bolstering the spirits of Donald J. Trump after a wave of controversies and Republican defections had led many to write him off.

"We are calling on the F.B.I. to release all the information that it has," Mrs. Clinton said adamantly in an evening news conference that took issue with Mr. Comey for making the disclosure so close to

STEPHEN CHERRY/THE NEW YORK TIMES

Donald J. Trump at a rally in Manchester, N.H., on Friday.

NB! This one IS fake!



## WHY?

- We use discharge measurements to build rating curves
  - We use rating curves to generate time series for discharge
  - We use time series for discharge to detect climate changes
- ... And a lot of other things



# HOW?

- Direct comparisons
  - Regatta
  - Parallel measurements
  - Regular fieldwork or campaigns
- Indirect comparisons
  - Dual calculation
  - Historical data (Batch processing)
  - Fresh data (Manual processing)
  - Historical data
  - Compare to rated discharge

# Regatta

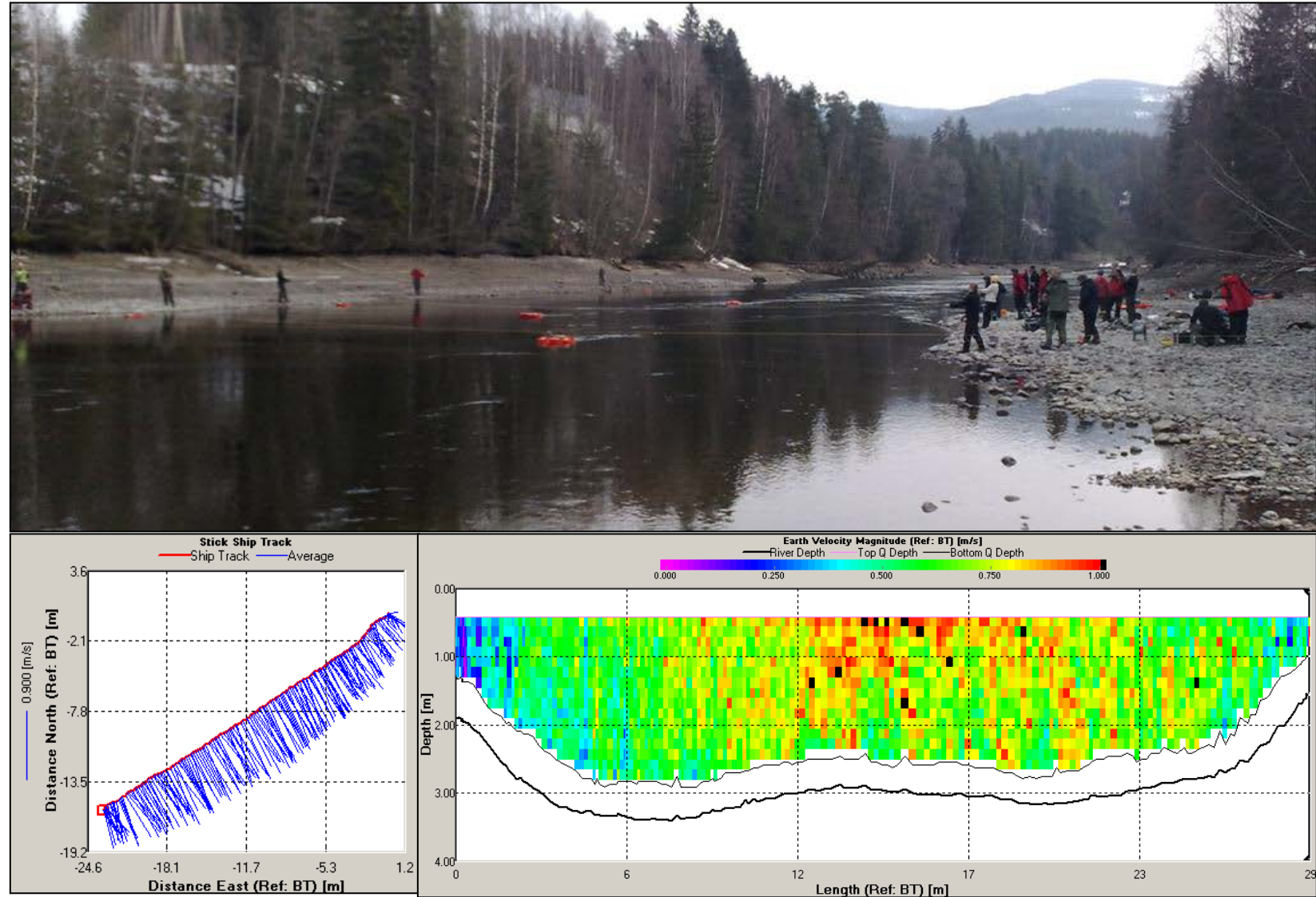


Collect all instruments and check if they agree with each other



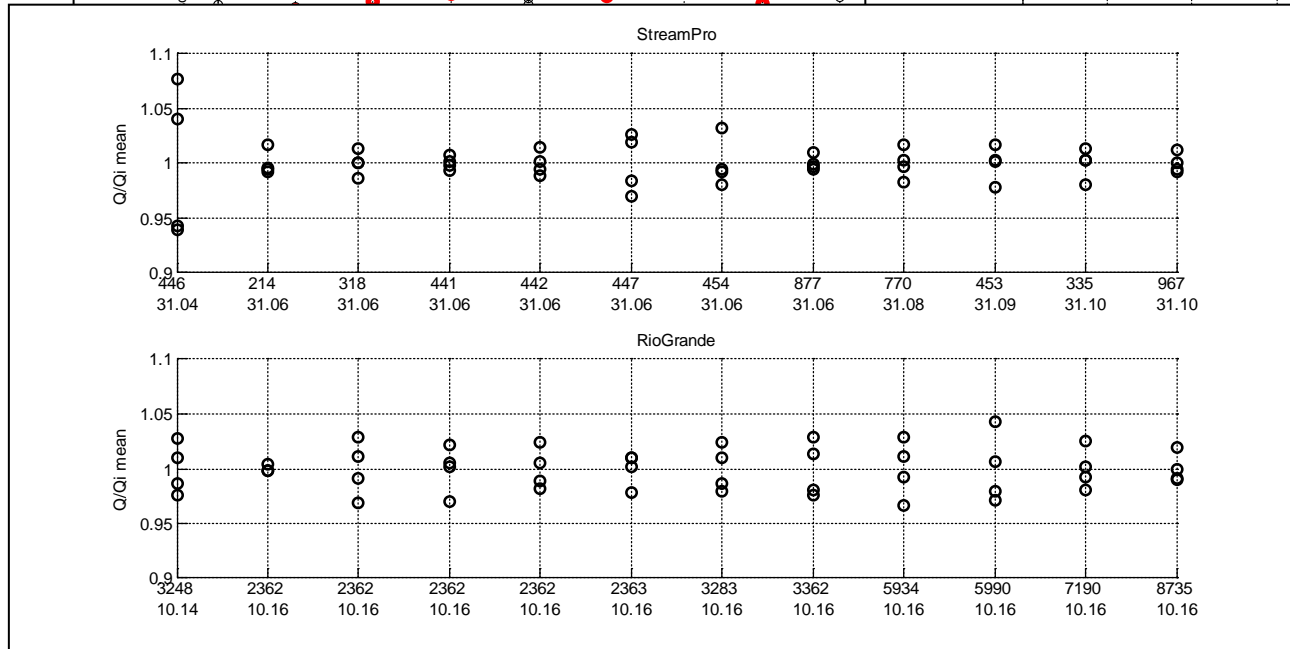
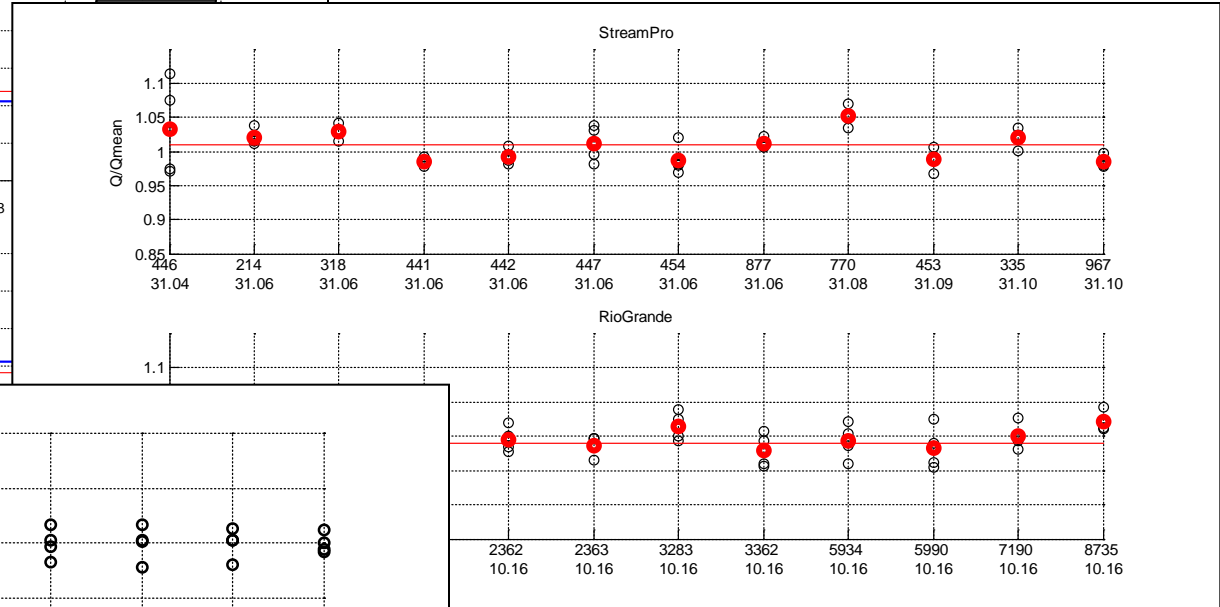
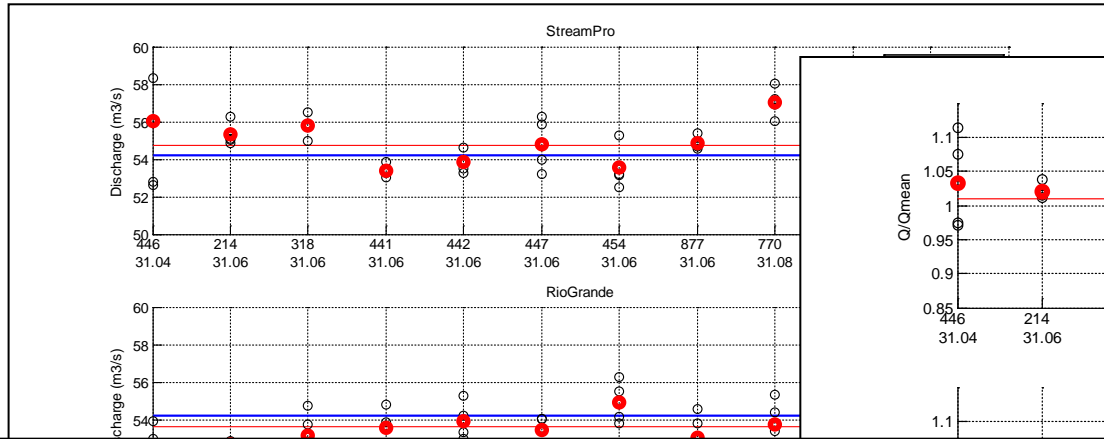
## Collect data

- All NVE's ADCPs
- 9 RG & 12 SP
- Same setup for all instruments
- Only good locations
- Compare instruments, not sites
- “True discharge” = mean of all





# Review data



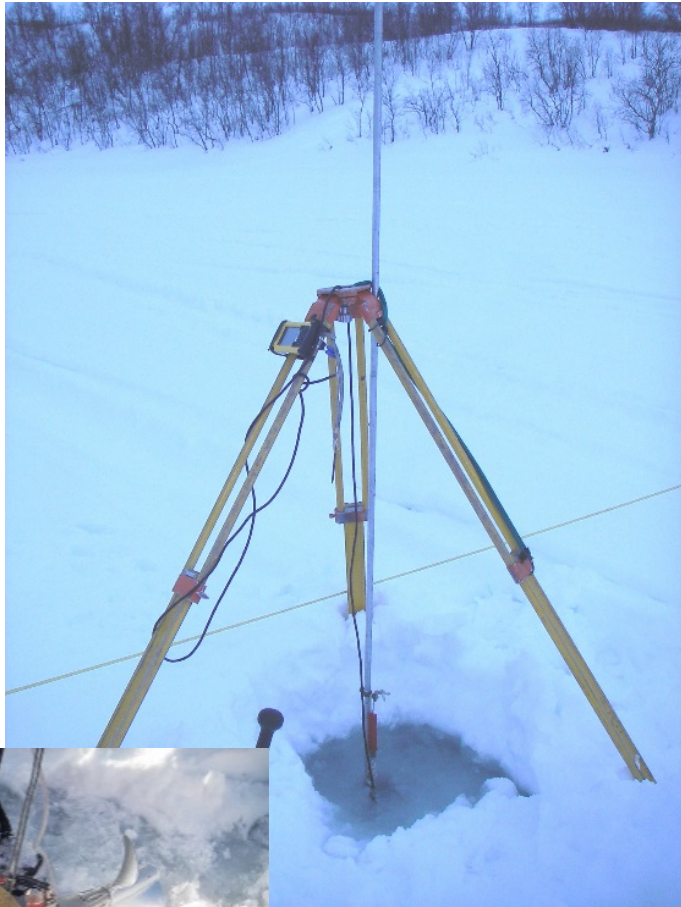


## Conclude

- All Dopplers but one were OK
  - SP and RG agree with each other
  - SP and RG agree with themselves
- One SP was off
  - It had a faulty temperature sensor
  - OK when corrected speed of sound in post-processing
  - Off to repair in France
  - Would not have detected problem without regatta
  - External temperature measurement after this



# Parallel measurements



Use more than one instrument at each site when doing field work



# Parallel measurements

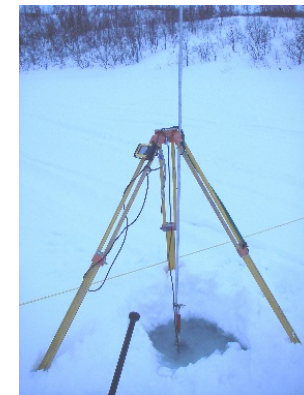
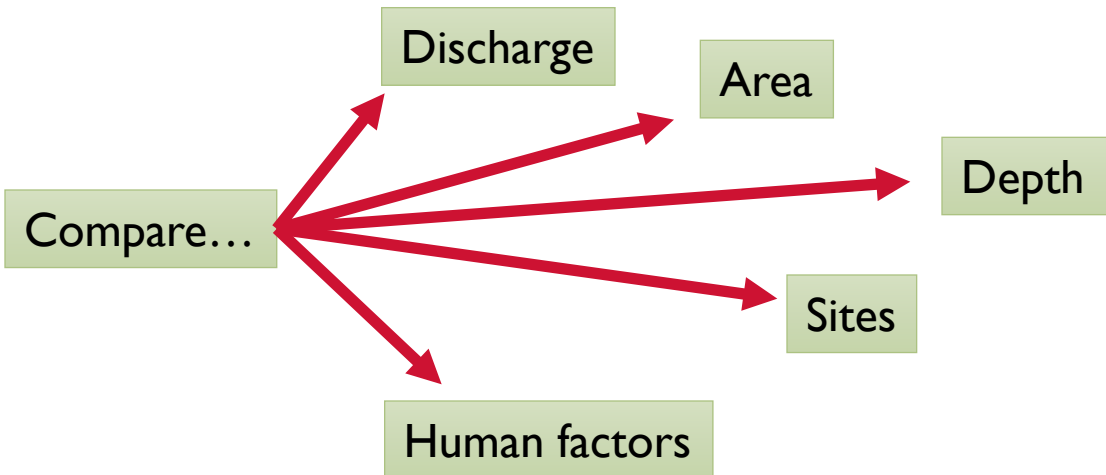
**Options, conditions, alternatives...**

Stable discharge?

Not stable discharge?

Same location(s)?

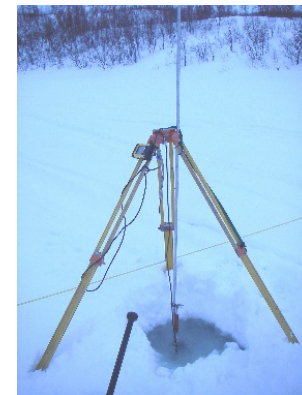
Same time?





## NVE case: Measurements under ice

- Comparing instruments for measuring under ice
  - Campaign winters 2006-2008 and 2011
  - Reference is current meter, 2-points per vertical
- Same cross-section, same verticals, so-to-say same time
- Compared depths and mean velocities for all verticals
- Compared areas and discharges for each measurement





## NVE case: Measurements under ice

### What could possibly go wrong?

This sounds very evident, but it will go wrong unless it is stressed.  
...and it will cause a lot of extra work when reviewing data

From previous slide:

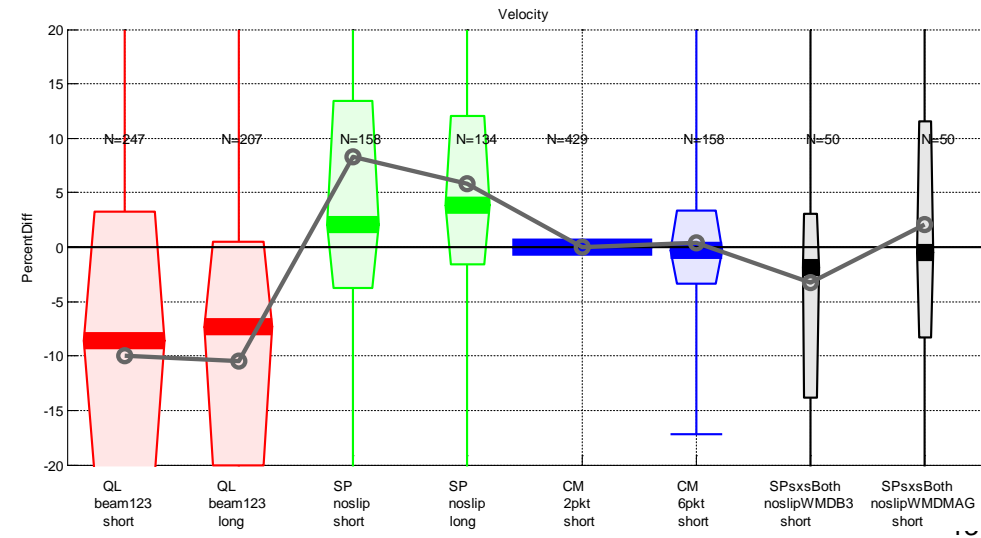
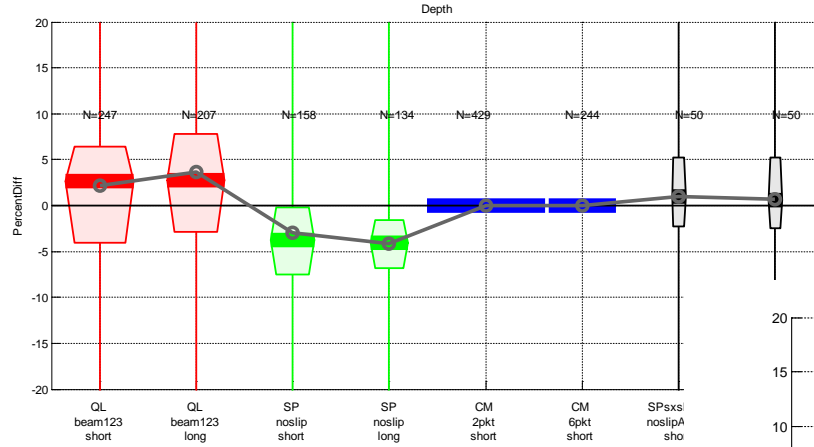
*“Same cross-section, same verticals, so-to-say same time”*

All instruments actually measured in the same holes in the ice, a few minutes apart

- File/site/folder name conventions must be consistent
- Time & date must be correct on all laptops, PDAs and controllers
- Operators must agree that Edge of water is at 7 meters and that the holes in the ice are at 9, 11, 13, ... etc, ... meters



# Review data



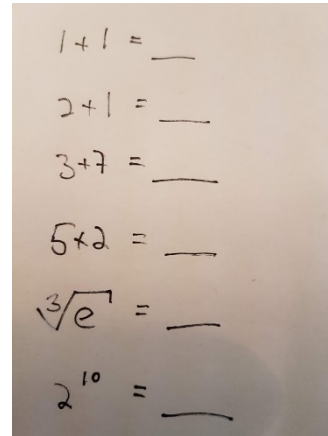


## NVE case: Measurements under ice

- Depth
  - QLiner measures greater depths than the reference
  - StreamPro (pda) measures smaller depths than the reference
  - Current meter... equal!
  
- Velocity
  - QLiner measures smaller velocities than the reference
  - StreamPro (pda) measures greater velocities than the reference
  - Current meter (6 points per vertical) is very close to the reference
  
- Discharge
  - Current meter 6 and 2 points closest
  - **2 points is sufficient**
  - **StreamPro closest to current meter**
  - StreamPro recommended for consistency
  - Qliner potentially more correct than both others but cannot tell
  - On sites with reverse currents



## Dual calculation



?

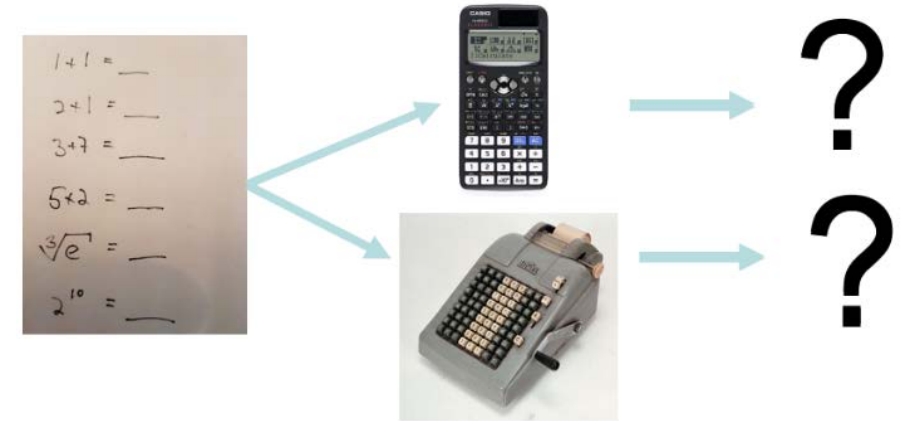
?

Calculate same data using different algorithms/methods



## Dual calculation

- 2 NVE-cases
  - Recalculate all old currentmeter-measurements using old and new algorithms
  - Calculate ADCP-measurements using default extrapolation and extrapolation from Extrap/Qrev

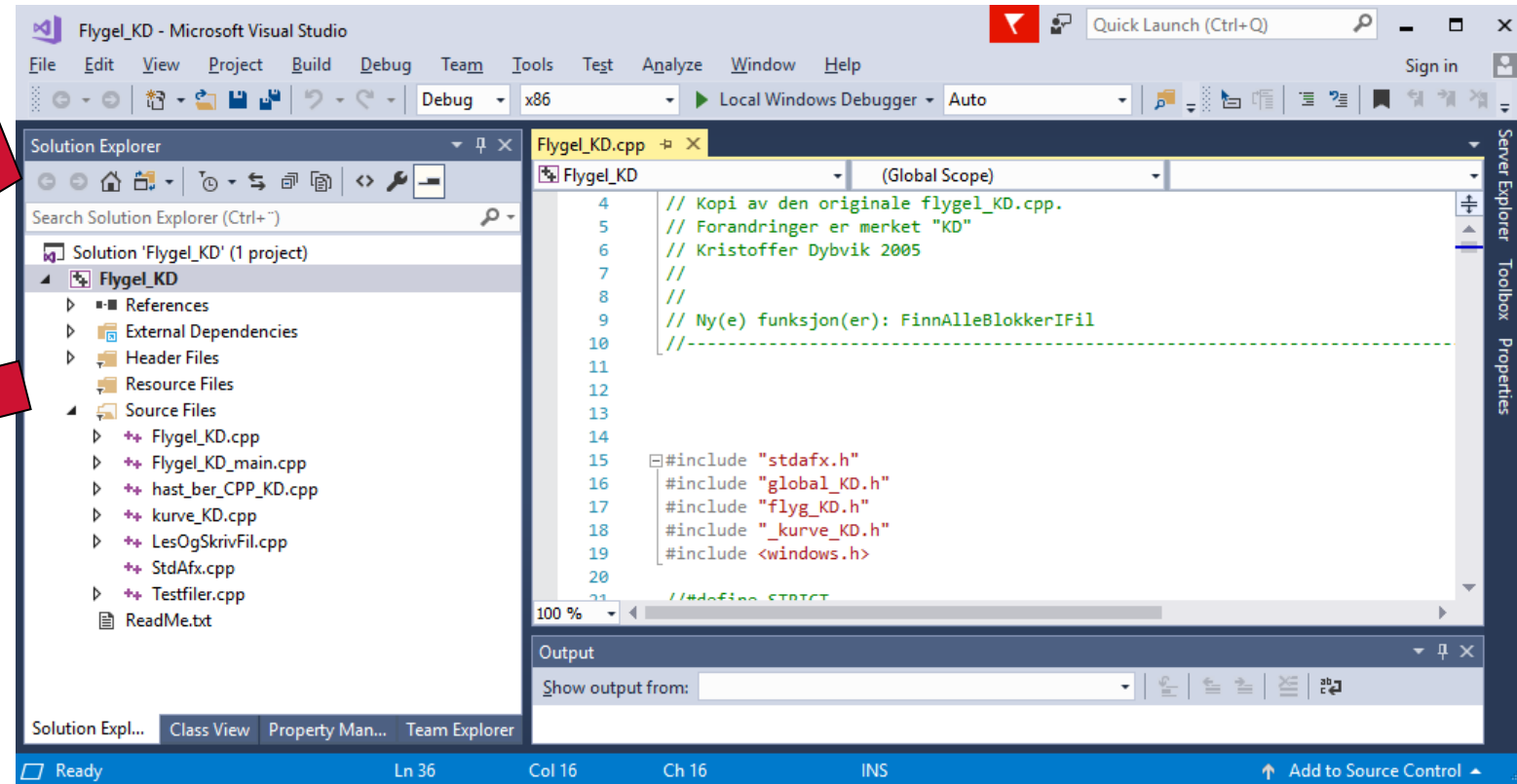
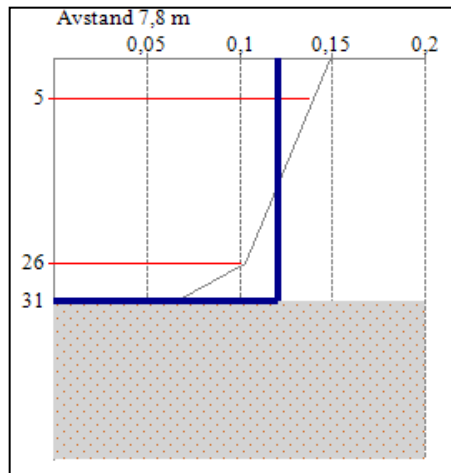
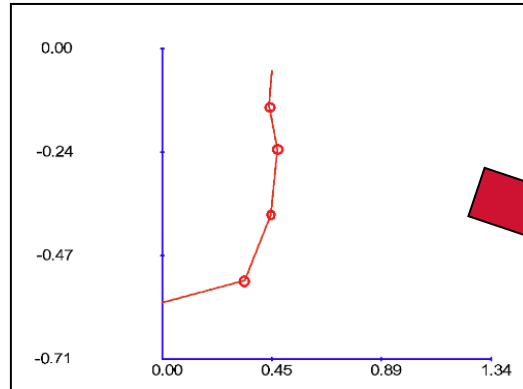


Calculate same data using different algorithms/methods





# Case I: Old vs. new current meter software



Re-process old Current meter data using new algorithms

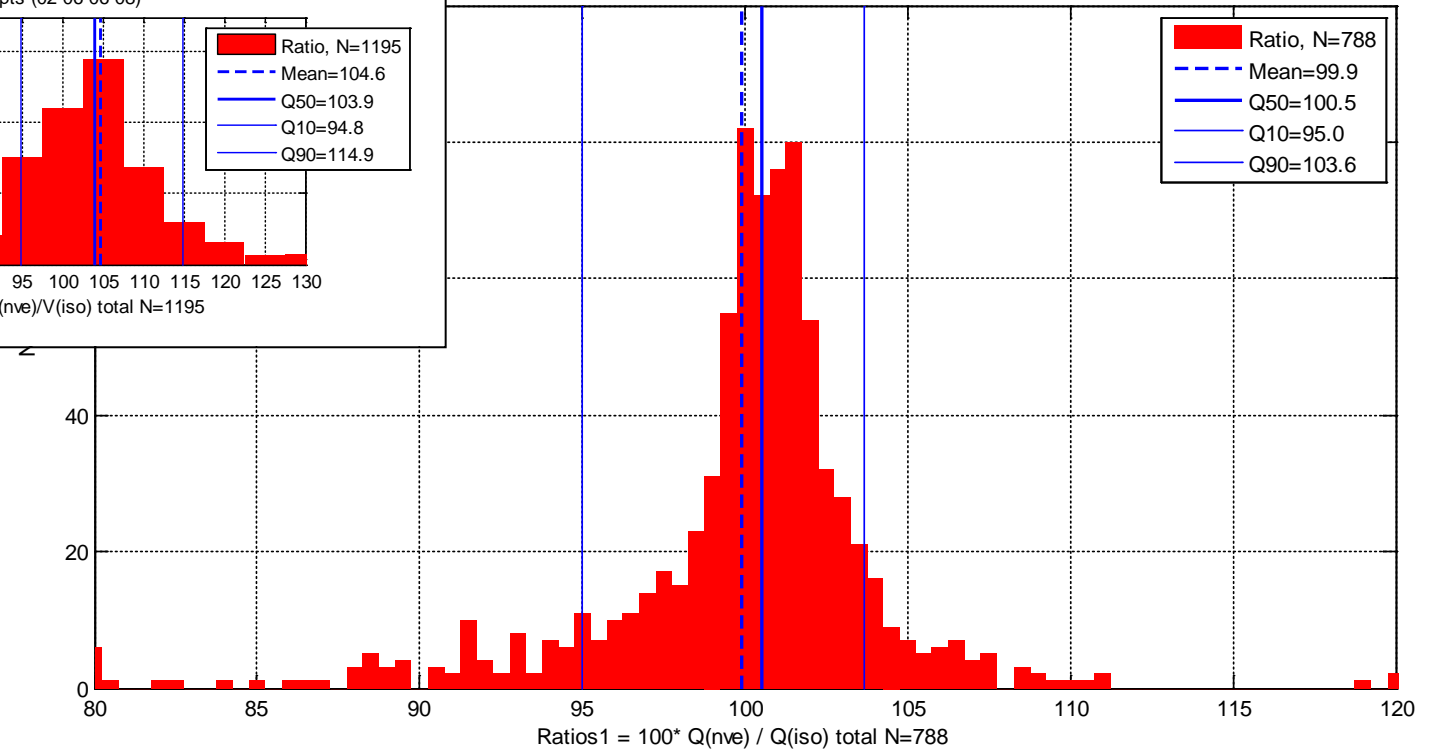
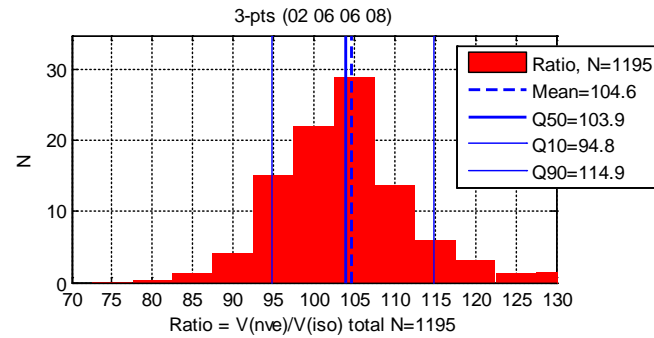
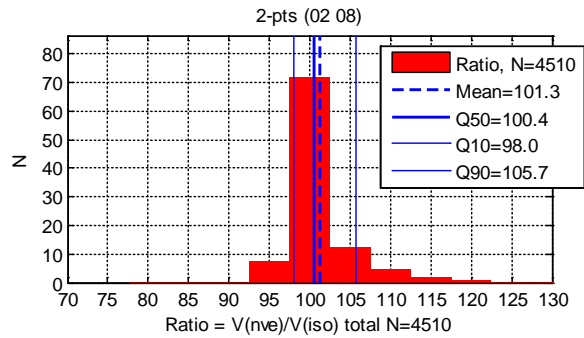
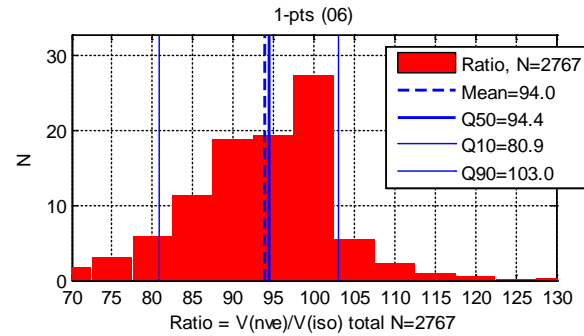
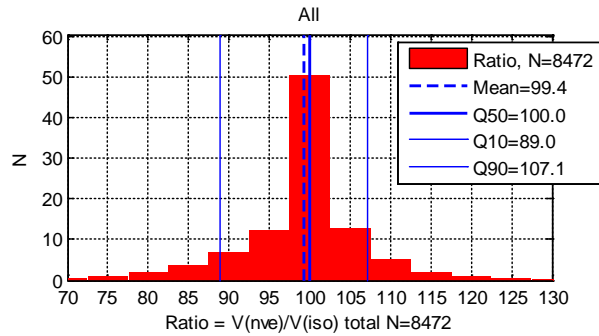


# Collect data

- New Current meter software from 2006
  - Using ISO 748 reduced points & mid section
- Old Current meter software
  - Computer-mimic of hand-drawing & millimetre-scale paper
- Batch processed all old measurements using old and new algorithms
  - Wrote a small program “around” the original code
  - Re-calculated using ISO 748 and compared to original calculations



# Review data



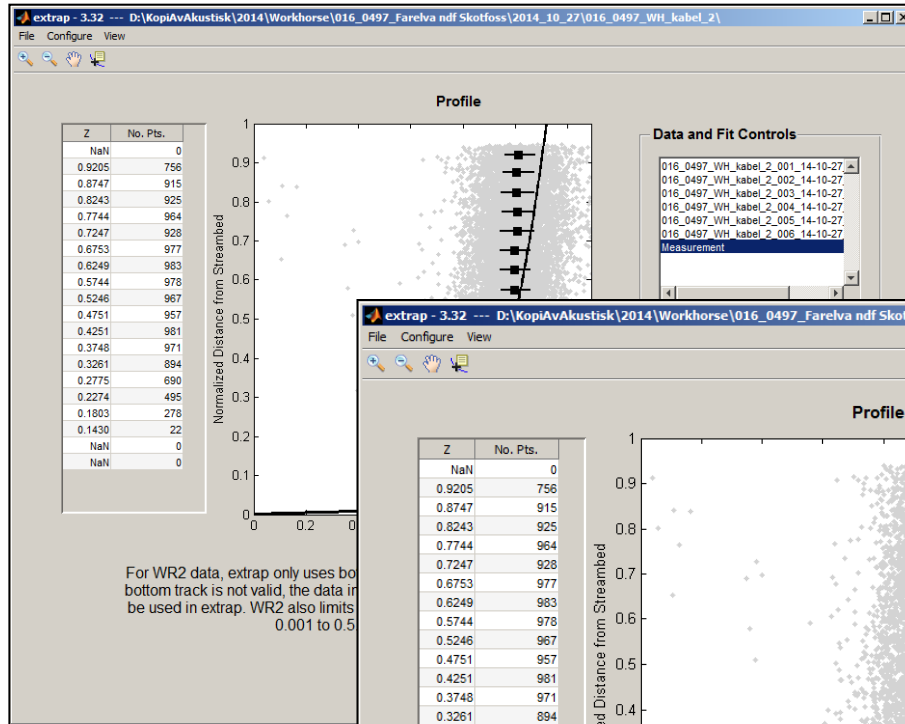


# Conclude

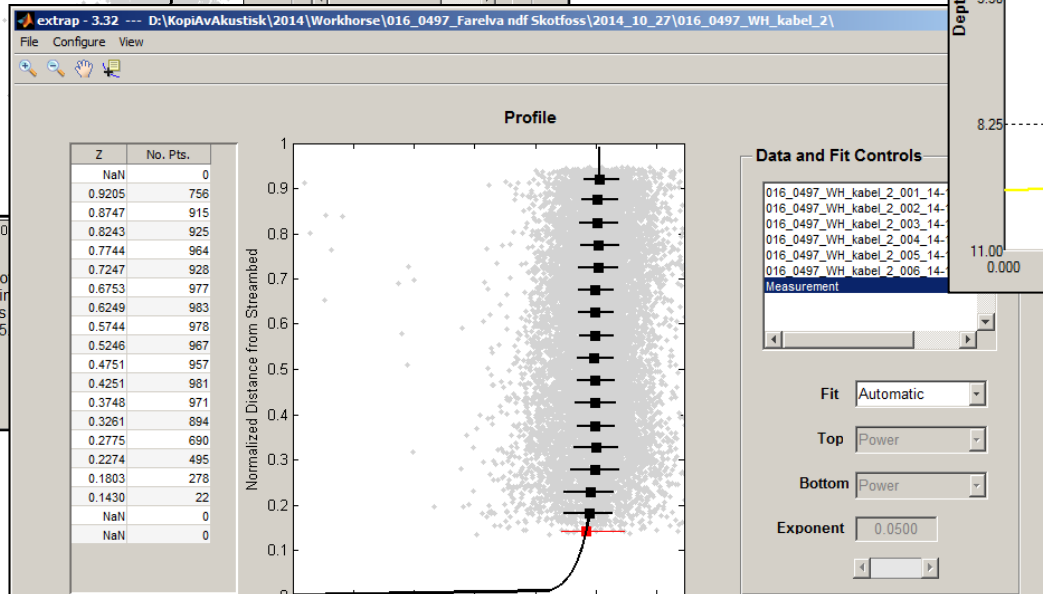
- Discharge,  $Q(\text{nve})/Q(\text{iso})$ 
  - Mean and median showing less than 1% difference
  - 1 points verticals problematic
  - New method approved



# Case 2: ADCP-data with and without Extrap



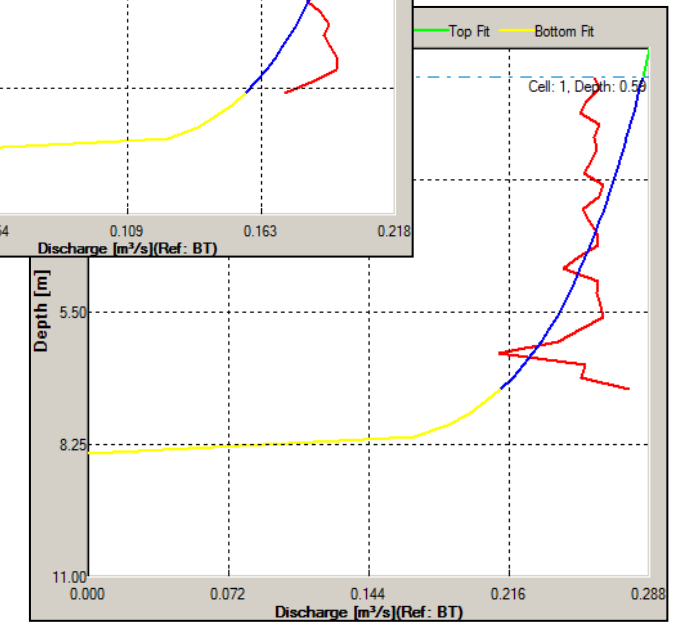
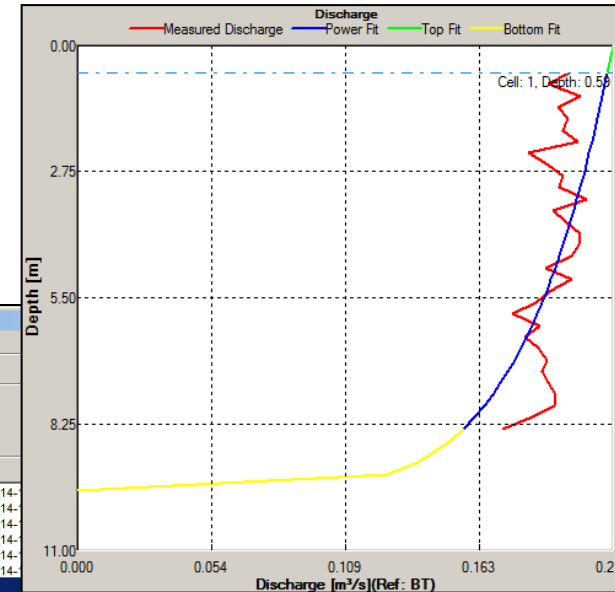
For WR2 data, extrap only uses bottom track if bottom track is not valid, the data in that ensemble will not be used in extrap. WR2 also limits the exponent range to 0.001 to 0.5



For WR2 data, extrap only uses bottom track reference. If bottom track is not valid, the data in that ensemble will not be used in extrap. WR2 also limits the exponent range to 0.001 to 0.5.

Average Discharge Sensitivity Analysis

Top	Bottom	Exponent	% Difference
Power	Power	0.1667	Reference
Power	Power	0.0500	3.26
Constant	No Slip	0.1667	1.02
Constant	No Slip	0.0500	3.40
3-Point	No Slip	0.1667	1.07
3-Point	No Slip	0.0500	3.45





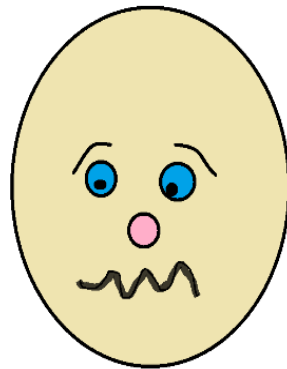
## Case 2: ADCP-data with and without Extrap

Hey... It tells me to use constant/no-slip

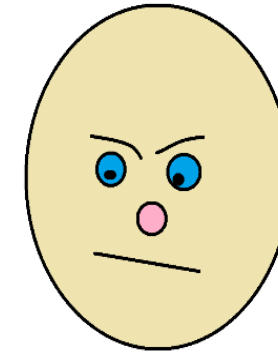
And the last time too?

Q goes down. Again!!!

I want to find out what's going on!



Or... Did it go down the last time too? Did it actually go up?





## Collect data

<p><b>What kind of extrapolation on what kind of rivers?</b>  <i>Always const/no-slip?</i></p>	<p><b>Q1</b></p>
<p><b>What is the extent of the problem?</b></p> <ul style="list-style-type: none"> <li>- Present and past, how many discharge measurements have           <ul style="list-style-type: none"> <li>- Pwr / pwr / 0,1667</li> <li>- Pwr / pwr / (not 0,1667)</li> <li>- Const / no-slip</li> <li>- Other (3pt/no-slip, pwr/co</li> </ul> </li> </ul>	<p><b>Q2</b></p>
<p><b>How is discharge affected?</b></p> <ul style="list-style-type: none"> <li>- Up, down, random/noise, systematically/bias</li> <li>- <i>The real problem is in the small rivers...?</i></li> <li>- <i>In the large ones the problem is neglectable...?</i></li> </ul>	<p><b>Q3</b></p>
<p><b>Flow disturbance?</b></p>	<p><b>Q4</b></p>

Many questions, a lot of data to gather and to harvest



## Collect data

<b>What kind of extrapolation on what kind of rivers?</b> <i>Always const/no-slip?</i>	<b>Q1</b>
<b>What is the extent of the problem?</b> <ul style="list-style-type: none"><li>- Present and past, how many discharge measurements have<ul style="list-style-type: none"><li>- Pwr / pwr / 0.1667</li><li>- Pwr / pwr / (not 0,1667)</li><li>- Const / no-slip</li><li>- Other (3pt/no-slip, pwr/const, ...)</li></ul></li></ul>	<b>Q2</b>

- Wrote Matlab-code to collect data from all ADCP data files
- Matched data-files to database entries using Excel





## Collect data

How is discharge affected?

- **Up, down, random/noise, systematically/bias**
- *The real problem is in the small rivers...?*
- *In the large ones the problem is neglectable...?*

**Q3**

- Too much data to require the hydrologists to enter into the standard ADCP report
- Wrote Excel-macro to automatically extract data
  - ...to the ADCP-report we make anyway
  - ...to a «shaddow-database» with a lot of extra data



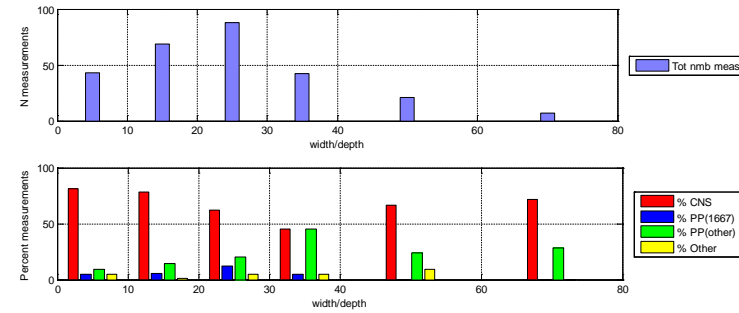
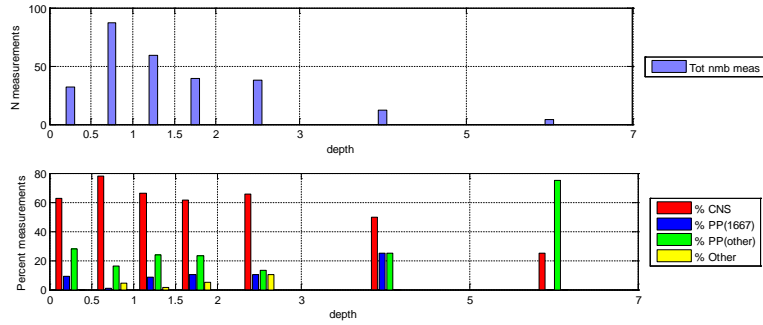
## Collect data

Flow disturbance?	<b>Q4</b>
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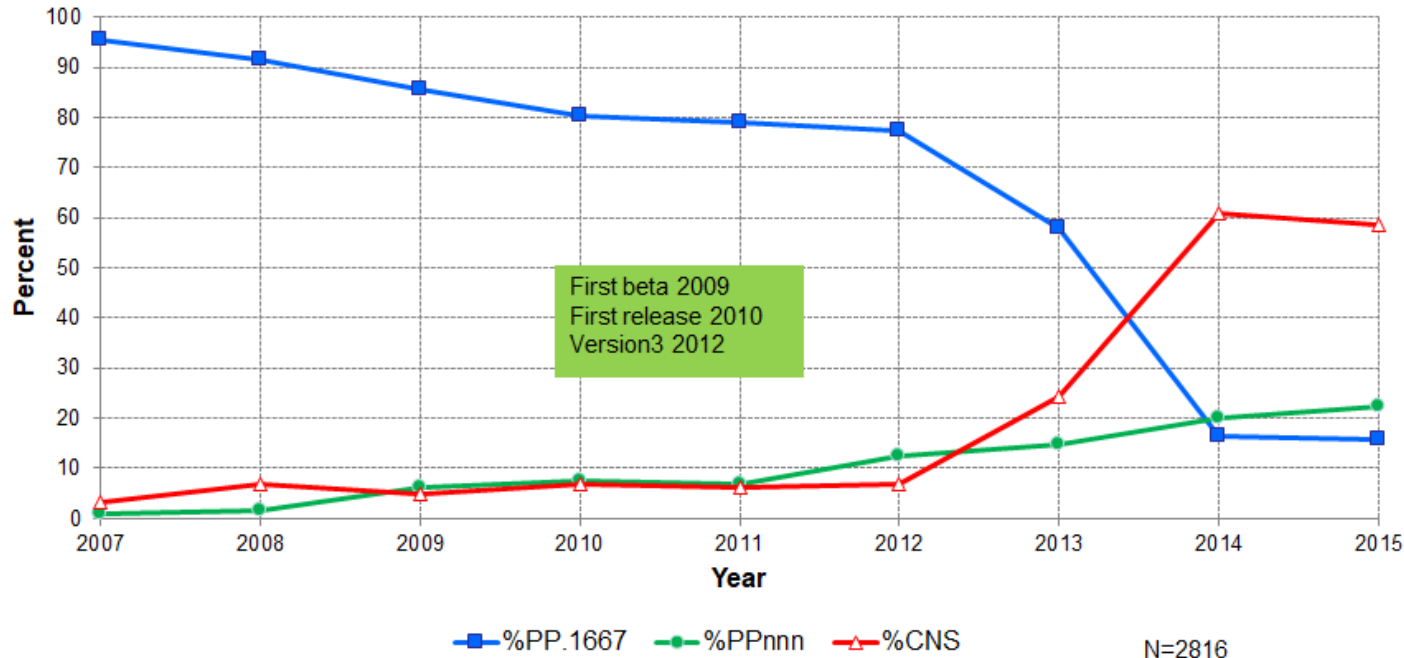
- Field or tow-tank work



# Review data

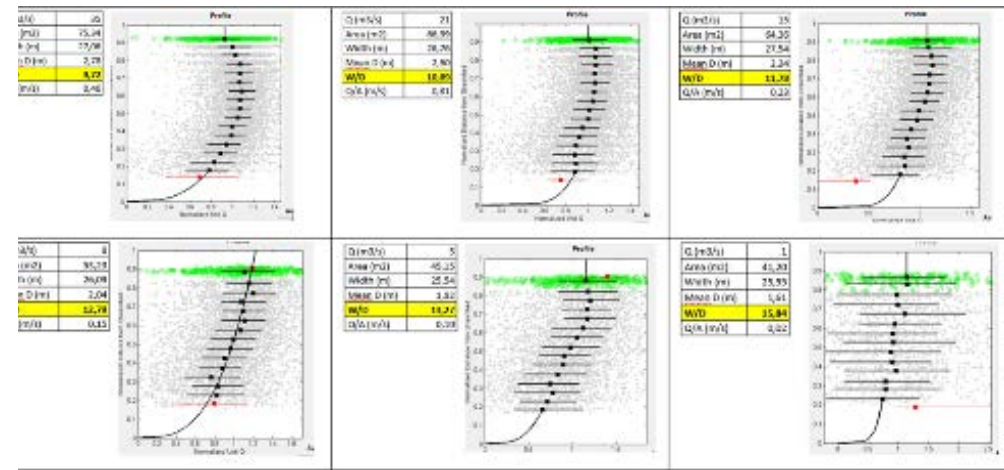


## Extrapolation methods



First beta 2009  
First release 2010  
Version3 2012

N=2816





## Conclude

- For approximately 500 discharge measurements, it seems like Extrap *has* changed data
  - For all data, discharge decreases by 2%
  - For c/ns discharge decreases by 2.6%
  - 60% of recent measurements are c/ns
  - For pwr/pwr/not. I 667 discharge decreases by approximately 0.8%
  - 20% of recent measurements are pwr/pwr/not. I 667
- **We use extrap/Qrev and document changes**



# How do we handle changes?

- ...new methods produce different data?
- For each agency to decide
- NVE policy:
  - Produce as correct data as we can
  - Document changes
- Other views on this?
  - Correct is more important!
  - Consistent is more important!



## ...Summing it all up

- Instruments and methods evolve
  - Need to document consistency in results
  - Many ways to achieve this
  - Direct...
  - Indirect...
  - Field, database, programming,...
  - The sky is the limit (and the budgets)
- Reliable = Consistent ...or accurate?