CBP Trend Analysis
TMAW
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Overview of

Where we've been,
Where we are,
and
Thoughts on moving forward.

MDE

MARYLAND DEPARTMENT
OF THE ENVIRONMENT

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Governor

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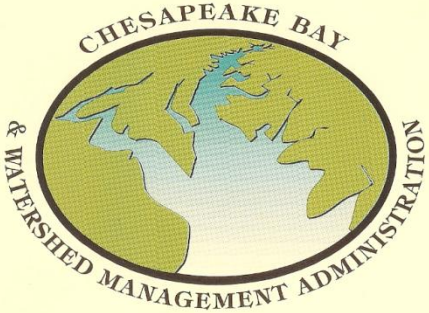
Secretary

GUIDANCE FOR THE ANALYSIS OF WATER QUALITY TRENDS IN CHESAPEAKE BAY

Prepared by
The Maryland Department of the Environment
for the Data Analysis Workgroup
of the Chesapeake Bay Program
Monitoring Subcommittee



Cast of Players

- Authors:
- Richard Eskin
- Ray Alden
- Richard Batiuk
- Steve Bieber
- Susan Brunenmeister
- Carlton Haywood
- Rick Hoffman
- Robert Magnien
- Marcia Olson

Trends (~1990):

- Seasonal Kendall test
- Observed and Flow adjusted
- Flow adjustment based on best of NASQUAN models.
- Software used SAS IML

Status (~1990):

- Trim 5% from each tail of benchmark distribution
- Use linear scoring between 5^{th} and 95^{th} percentiles to get score on 0-100 scale
- Status was median of scored data.

Moving Forward: 1990-2000

- Looked at lags of flow
- Least Squares Nonlinear trends assessment
- Status based on Log-Logistic scoring
- Ported software to Base SAS

Moving Backward:

- Flow adjustment became unfashionable
- Status report fell into disfavor

Here we are:

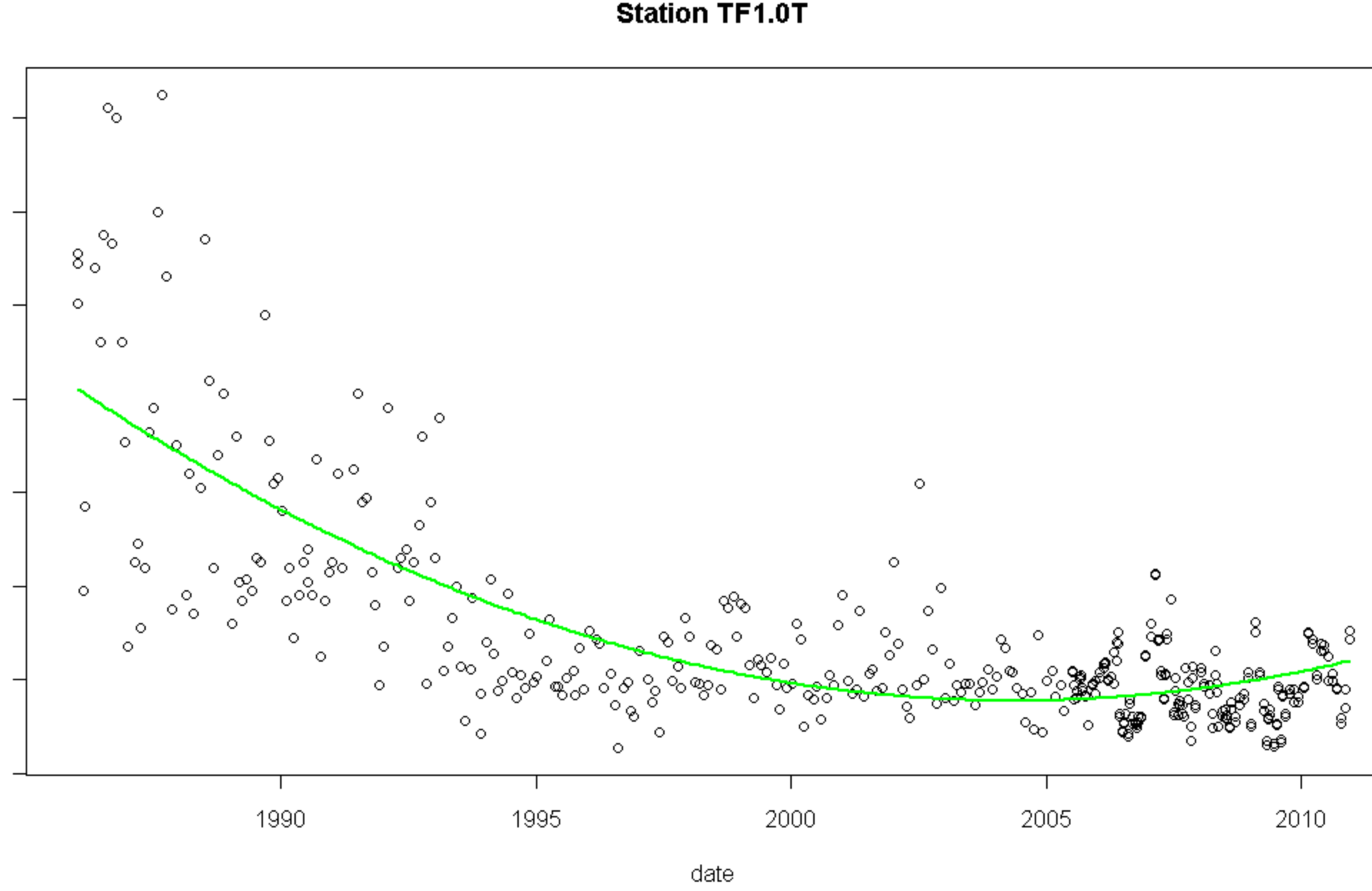
- Trends by SK
- NL trends by least squares
- Status based on percent compliance
  - report card
  - CFD approach

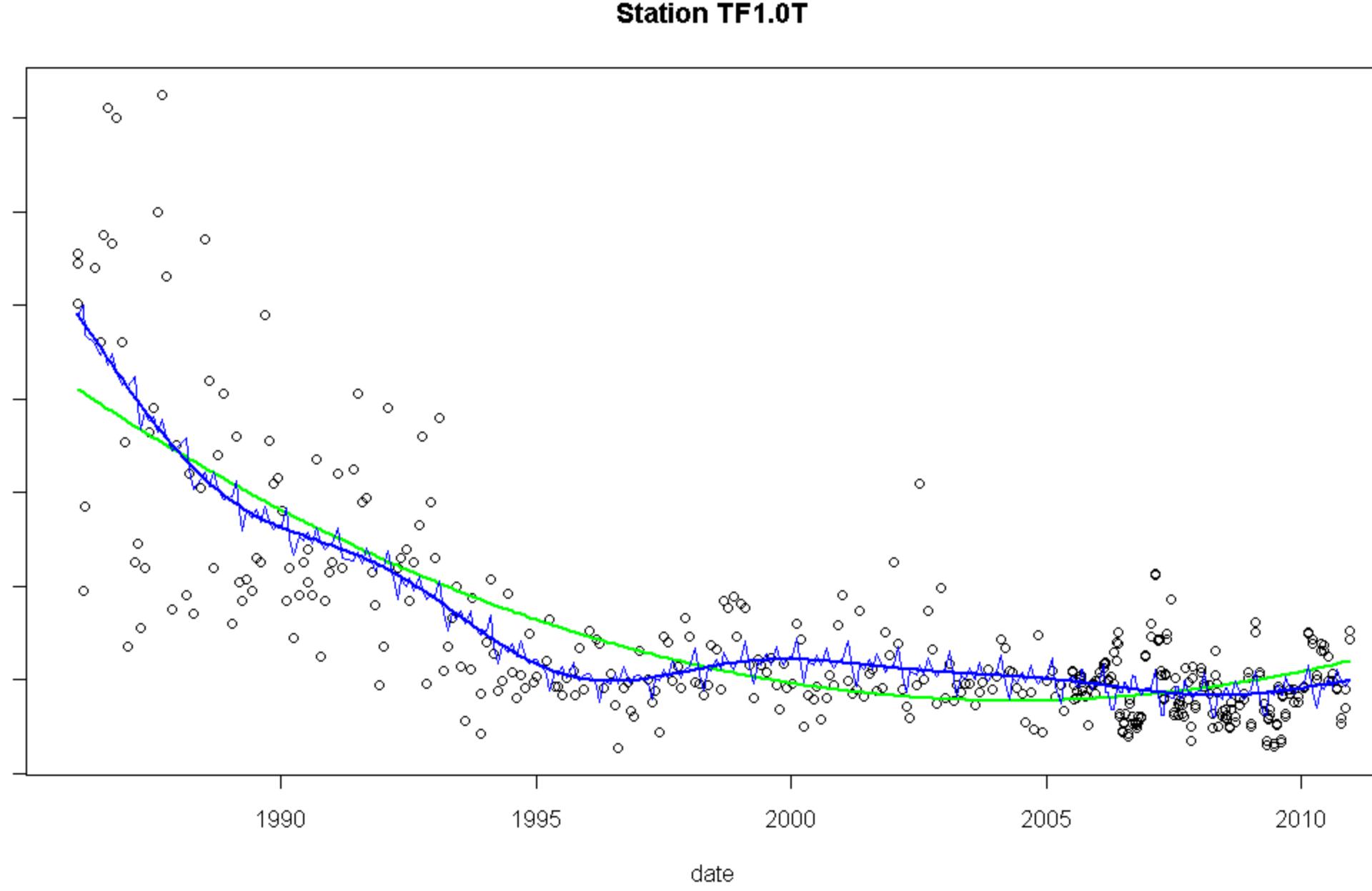
Misleading results

- **Station = TF1.0T Parameter = tn**

- **parameter estimate p_val**
- **----------**
- **mean 1.8719**
- **linear -0.0616 0.000000**
- **quadratic 0.0099 0.000000**
- **----------**

- **These results suggest a nonlinear U-shape**
- **trend is present in these data. The critical point**
- **is 13MAY04**


Station TF1.0T
1990
1995
2000
2005
2010
date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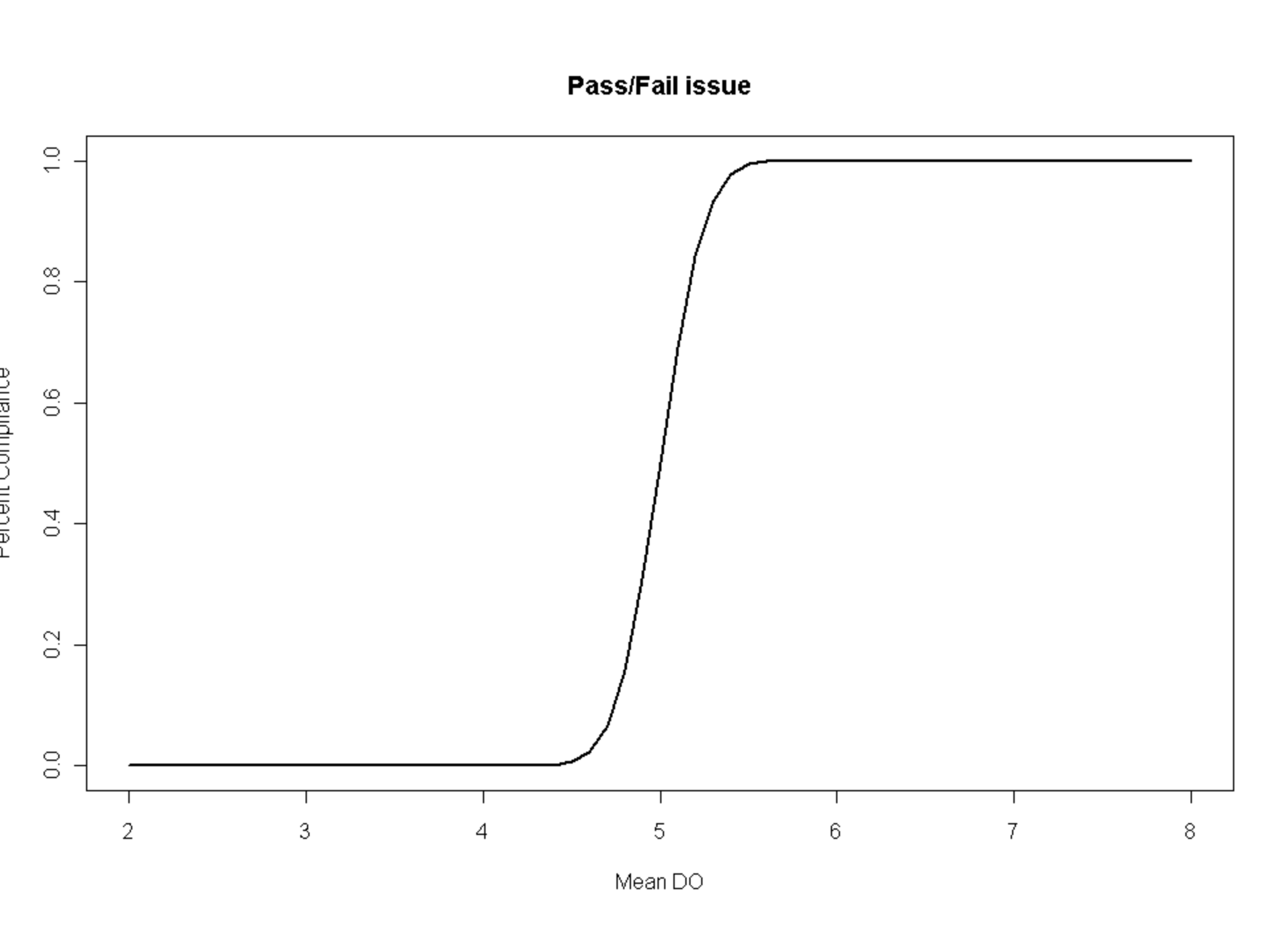
Pass/Fail issue
Percent Compliance
0.0
0.2
0.4
0.6
0.8
1.0
2
3
4
5
6
7
8
Mean DO

In 2008 started effort to move forward

- Formulate a data analysis framework
- Identify water quality data issues
- Develop a strategy to implement methods that address the issues within our framework.

Framework

- Routine Analysis – every year/everywhere
  - Status and trends
  - Automated
  - Robust
- Exploratory Analysis – basin level, linkages
  - Mgt Action -> system response
  - Bottom up v. Top down
  - Hysteresis

Water Quality data issues:

- non-normality (often log-normal)
- serial correlation (continuous monitoring)
- spatial correlation (DataFlow)
- censoring (will hopefully go away)
- unbalanced sampling designs
- unequal sampling intervals
- seasonality
- climate effects (flow, salinity, temperature,NAO)
- step trends (WTP upgrade, method change)
- outliers (misrecorded data, extreme events)

Thoughts

- Keep SK test as simple trend test
- Cut down on trends variations
- Update trends analysis to use gams for nonlinear trends.
- Re-introduce adjusting for flow and other variables (gams here too).
- Implement an absolute status indicator and a relative status indicator

Thoughts continued

- Identify linkage issues to address and give this a higher priority than routine status and trends.
- Feedback loop from linkage analyses to routine analyses.