Recent advances in reporting and interpreting water quality trends

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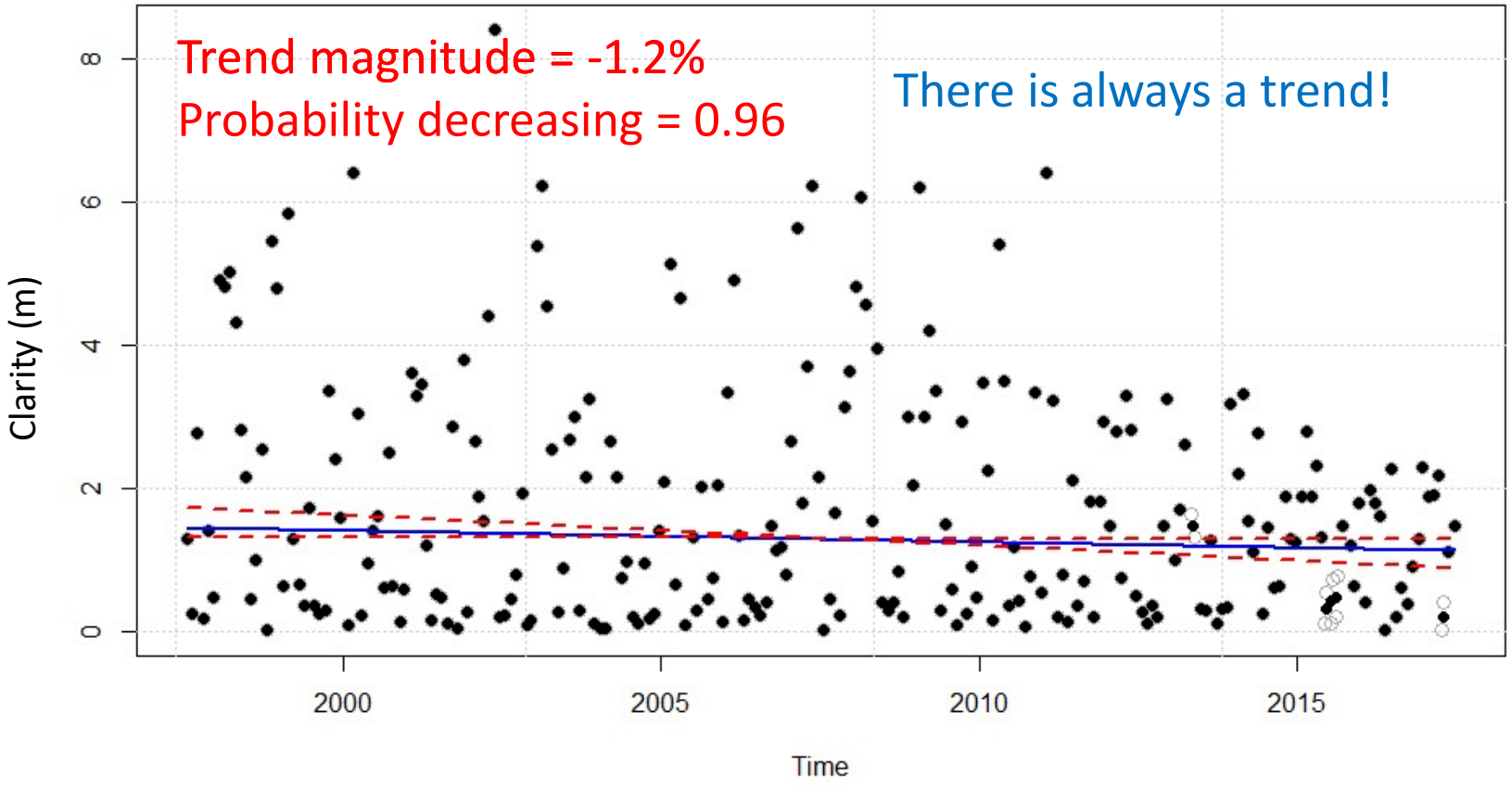
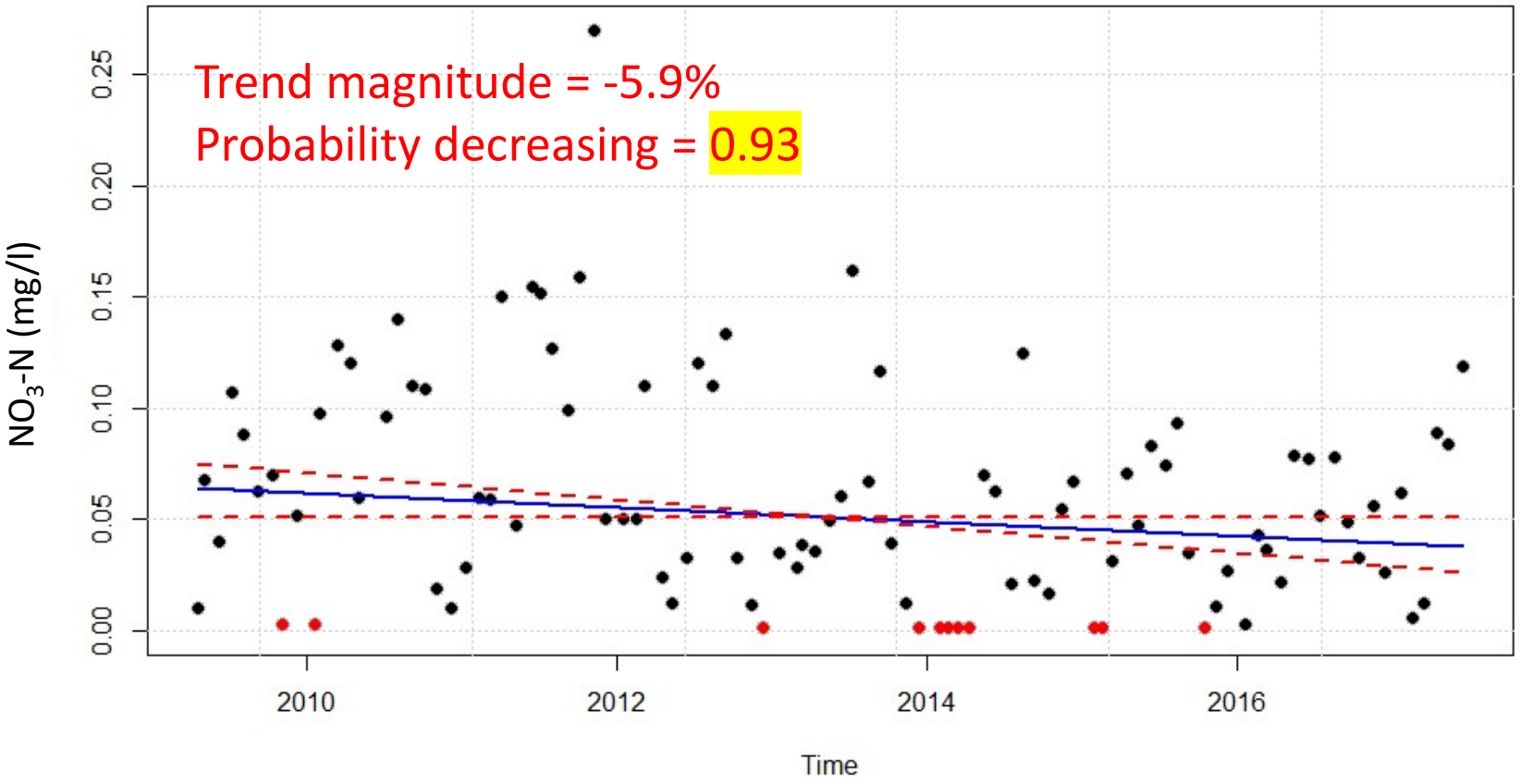
Contents

- Overview of trend analysis
- Explanation of PIT statistic
- Examples of patterns in aggregate trends
- Some cautions about interpreting trends

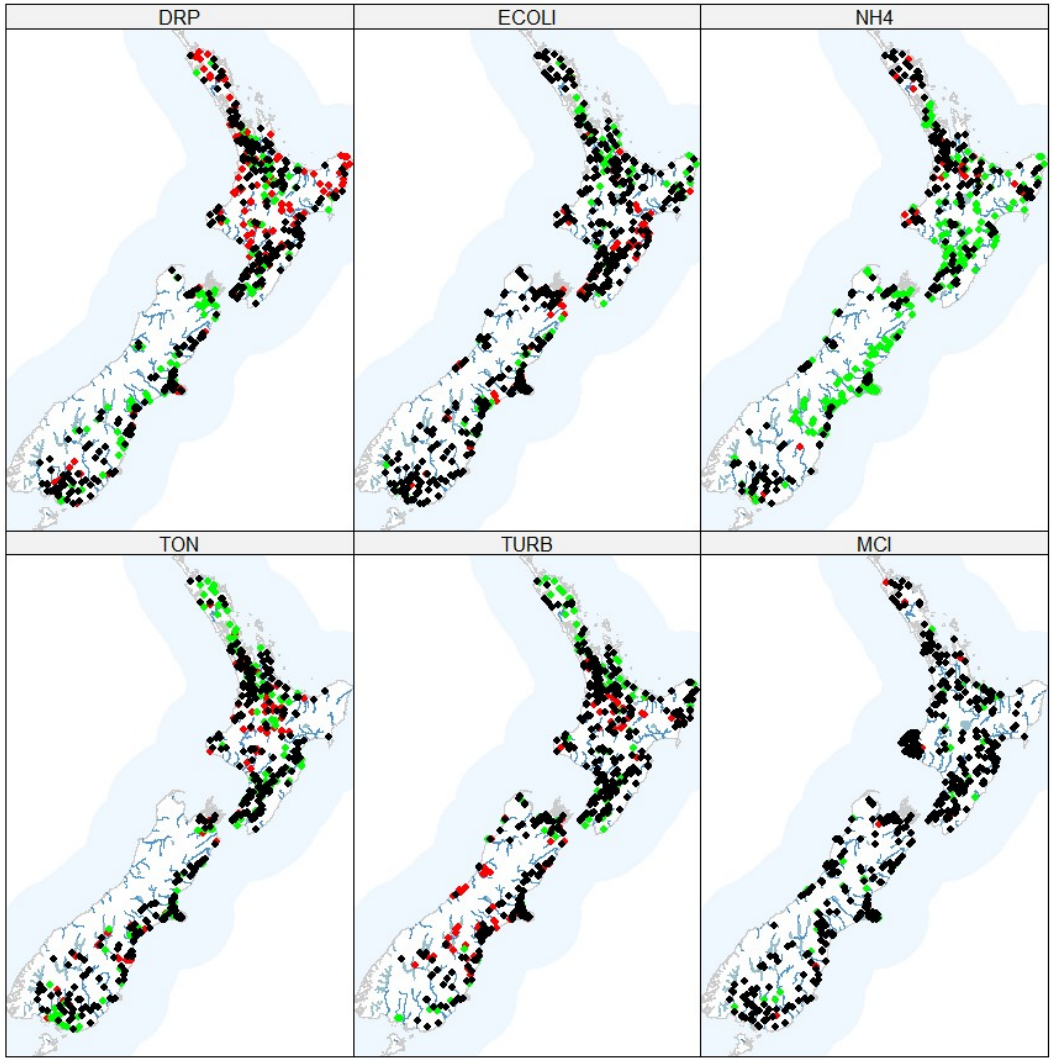
Clarity; Rangitikei at Mangaweka (20 years)



Nitrate; Tokomaru at Horseshoe bend (10 years)



Traditional trend categories (10 years ending 2017)



Traditional table 10 year trends (95% confidence)

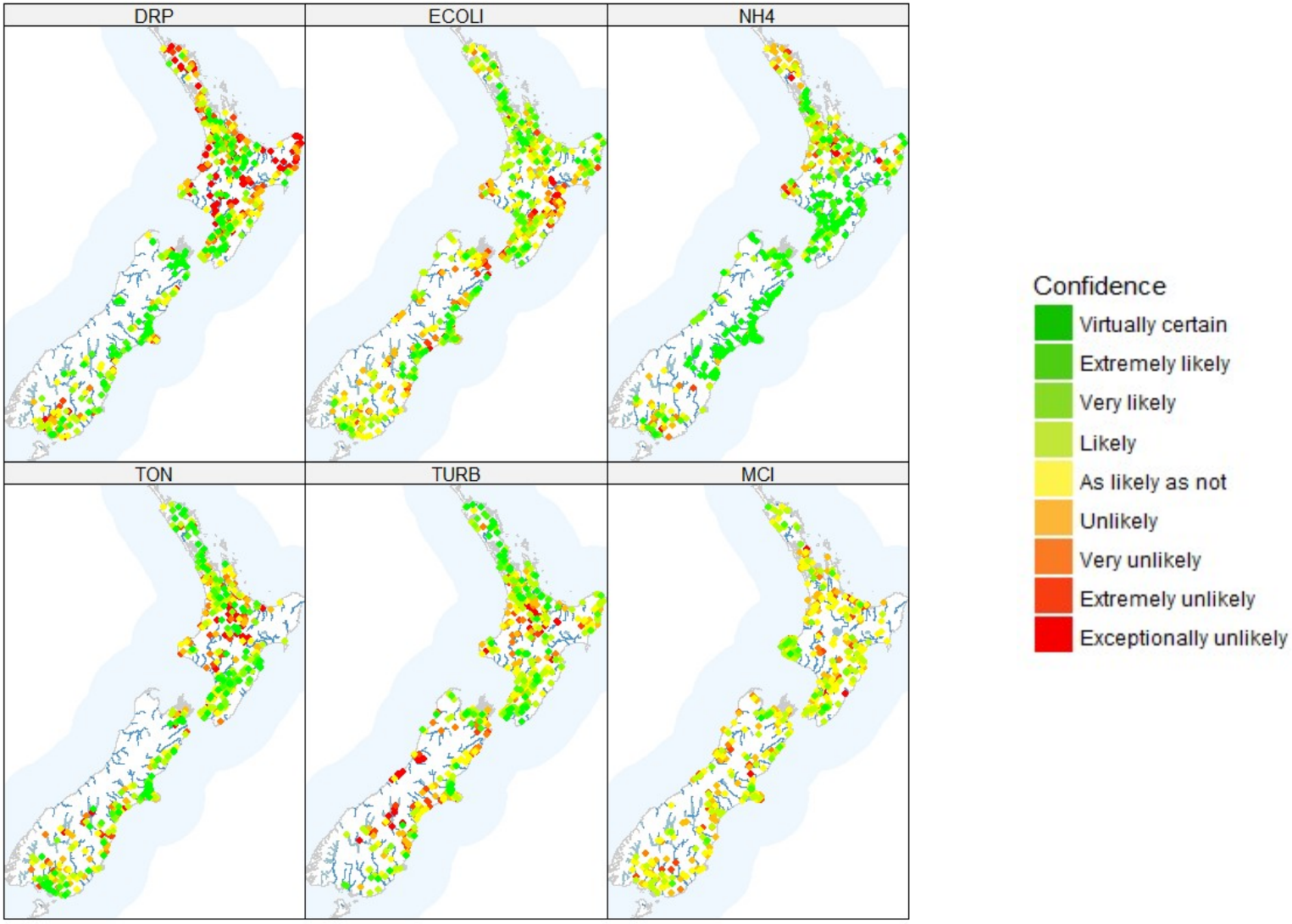
≠ “stable”

Variable	Increase (%)	Decrease (%)	Insufficient Data (%)
DRP	23	27	51
ECOLI	13	14	73
NH4	8	44	48
TON	13	25	61
TURB	15	16	68
MCI	4	11	85

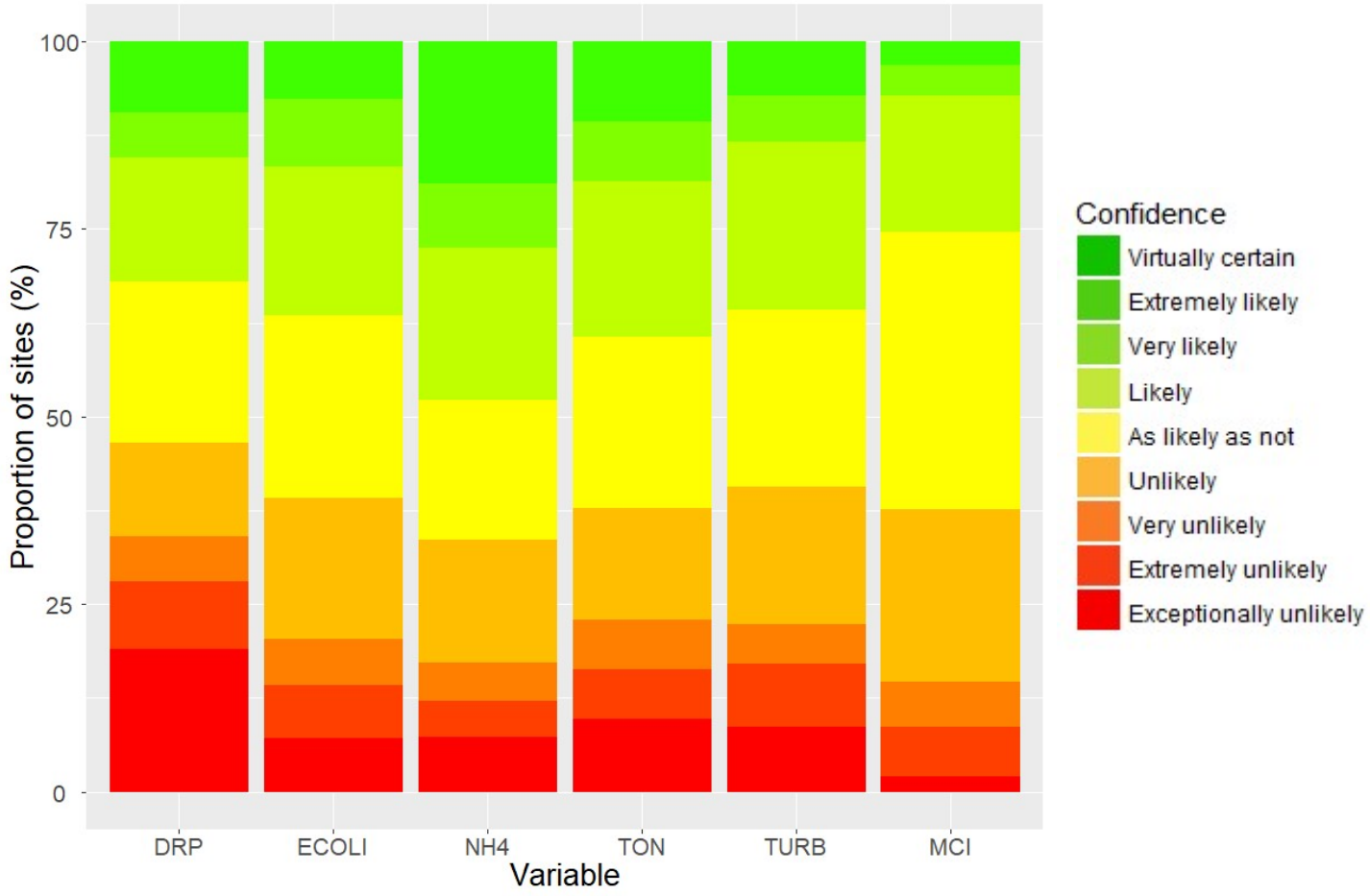
Categorical levels of confidence (trend improving)

Categorical level of confidence	Probability (%)	Colour
Virtually certain	99–100	
Extremely likely	95–99	
Very likely	90–95	
Likely	67–90	
About as likely as not	33–67	
Unlikely	10–33	
Very unlikely	5–10	
Extremely unlikely	1–5	
Exceptionally unlikely	0–1	

Likelihood water quality improved (10 years ending 2017)



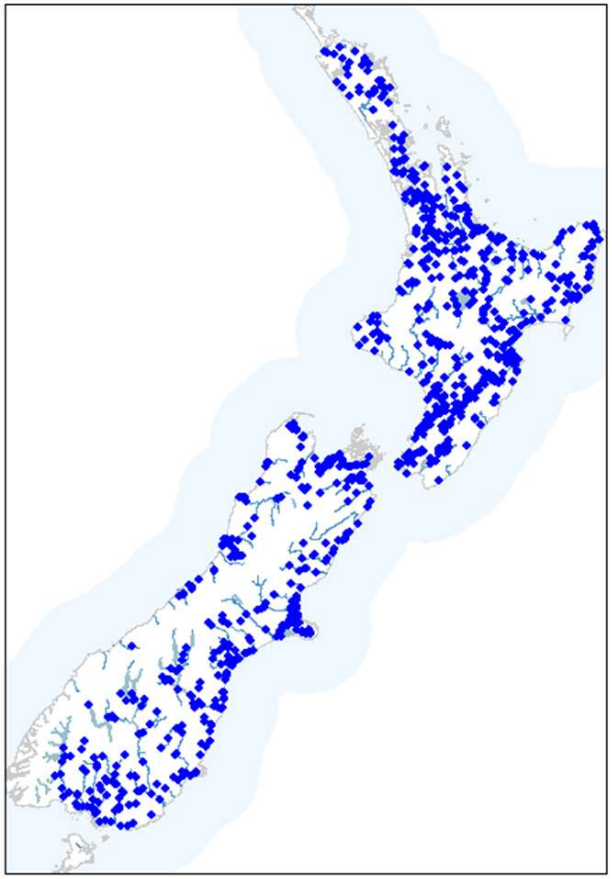
Confidence trend was improving (10 years ending 2017)



Proportion of improving trends (PIT statistic)

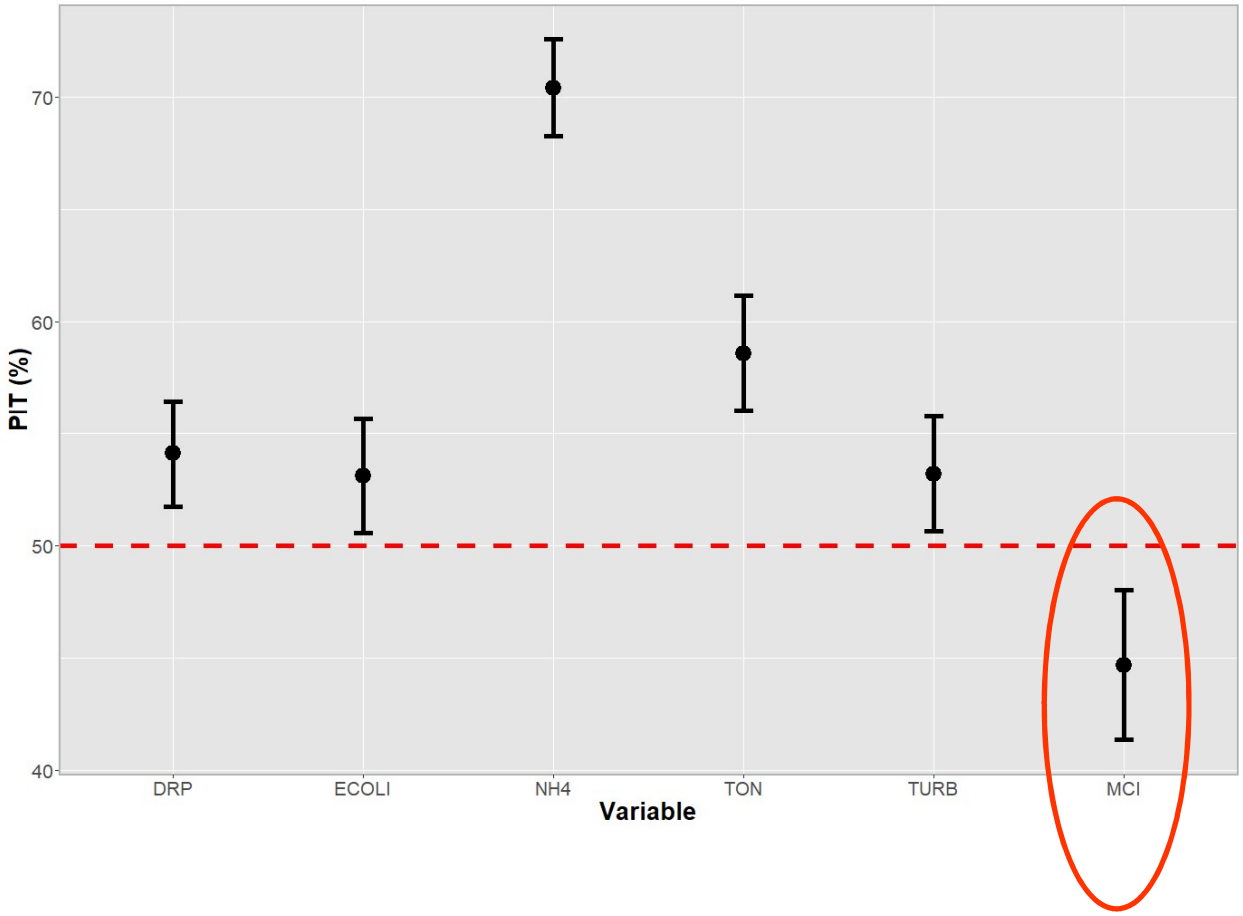
- I_s Bernoulli distributed variable
- $I_s = 1$ when $p_s \geq 0.5$ (improving trend)
- $PIT = \frac{1}{S}\sum_{s=1}^{s=S} I_s$
- $Var(PIT) = \frac{1}{S^2}\sum_{s=1}^{s=S} p_s(1-p_s)$
- $CI_{95} = PIT \pm 1.96 \times \sqrt{Var(PIT)}$

Sampled sites in domain
$s \in \{1, \ldots, S\}$

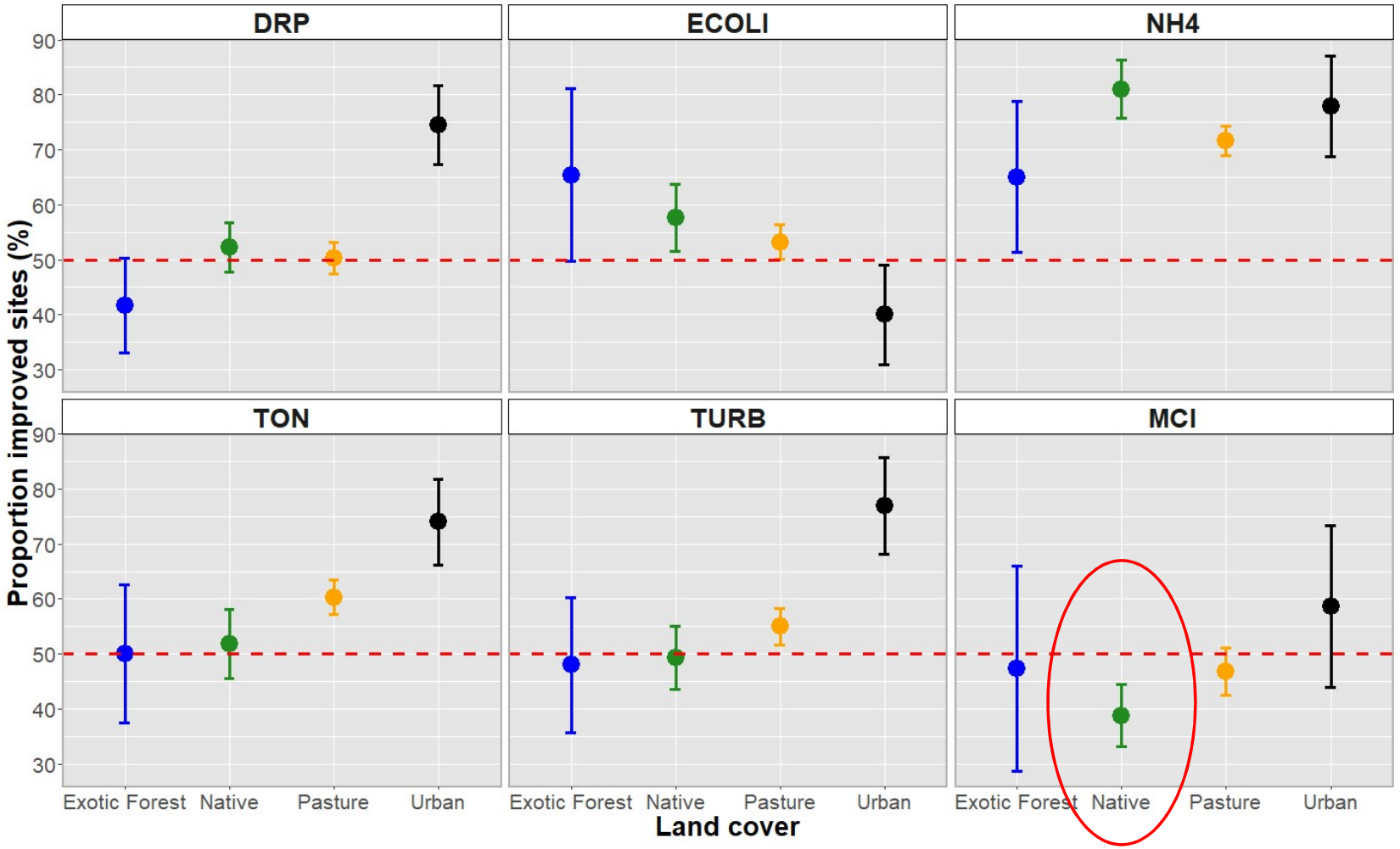


PIT statistics (10 years ending 2017)
Domain = national

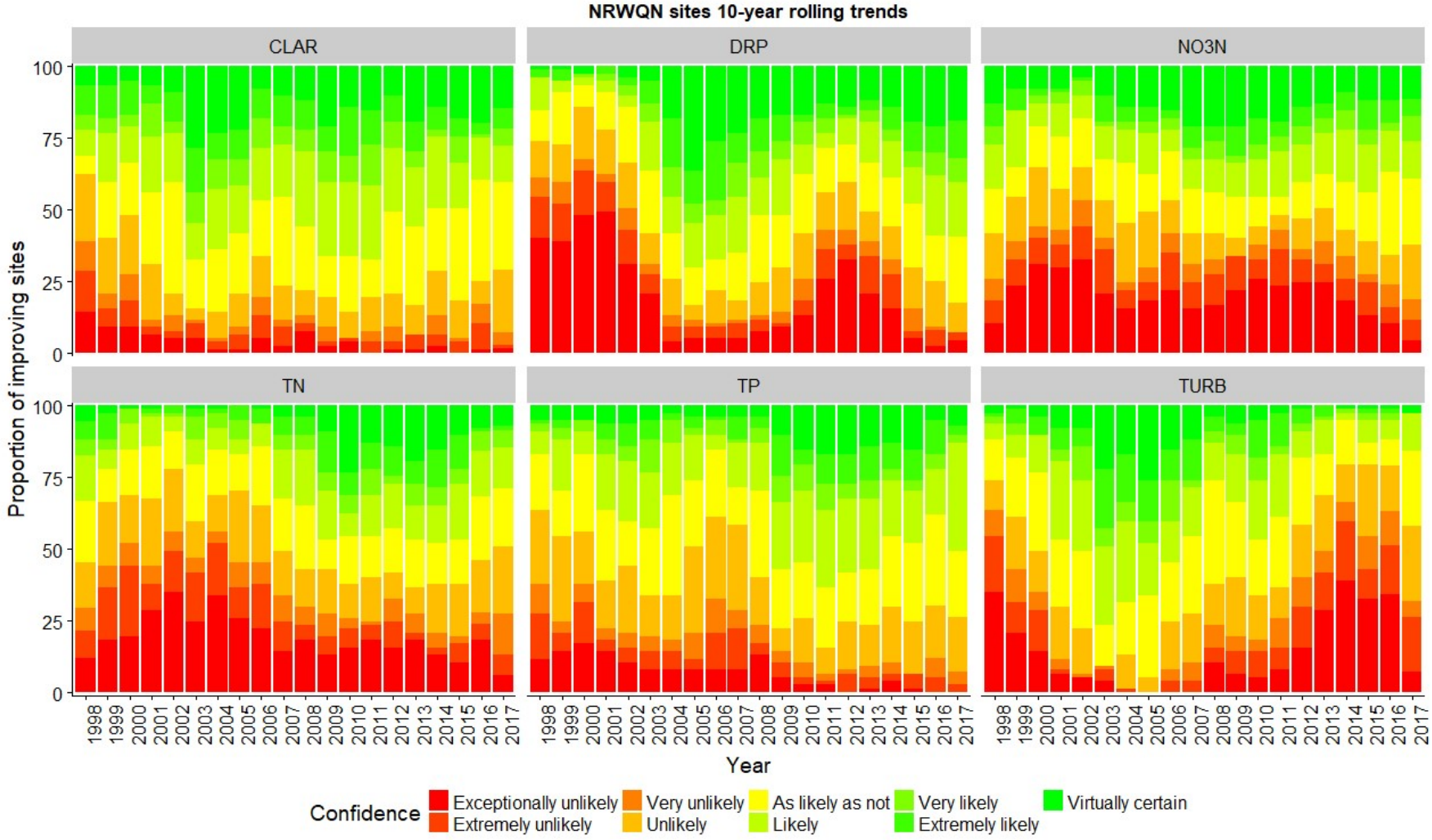
Variable	PIT (%)	Uncertainty
DRP	54.1	1.2
ECOLI	53.1	1.3
NH4	70.4	1.1
TON	58.9	1.3
TURB	53.2	1.3
MCI	41.4	1.5



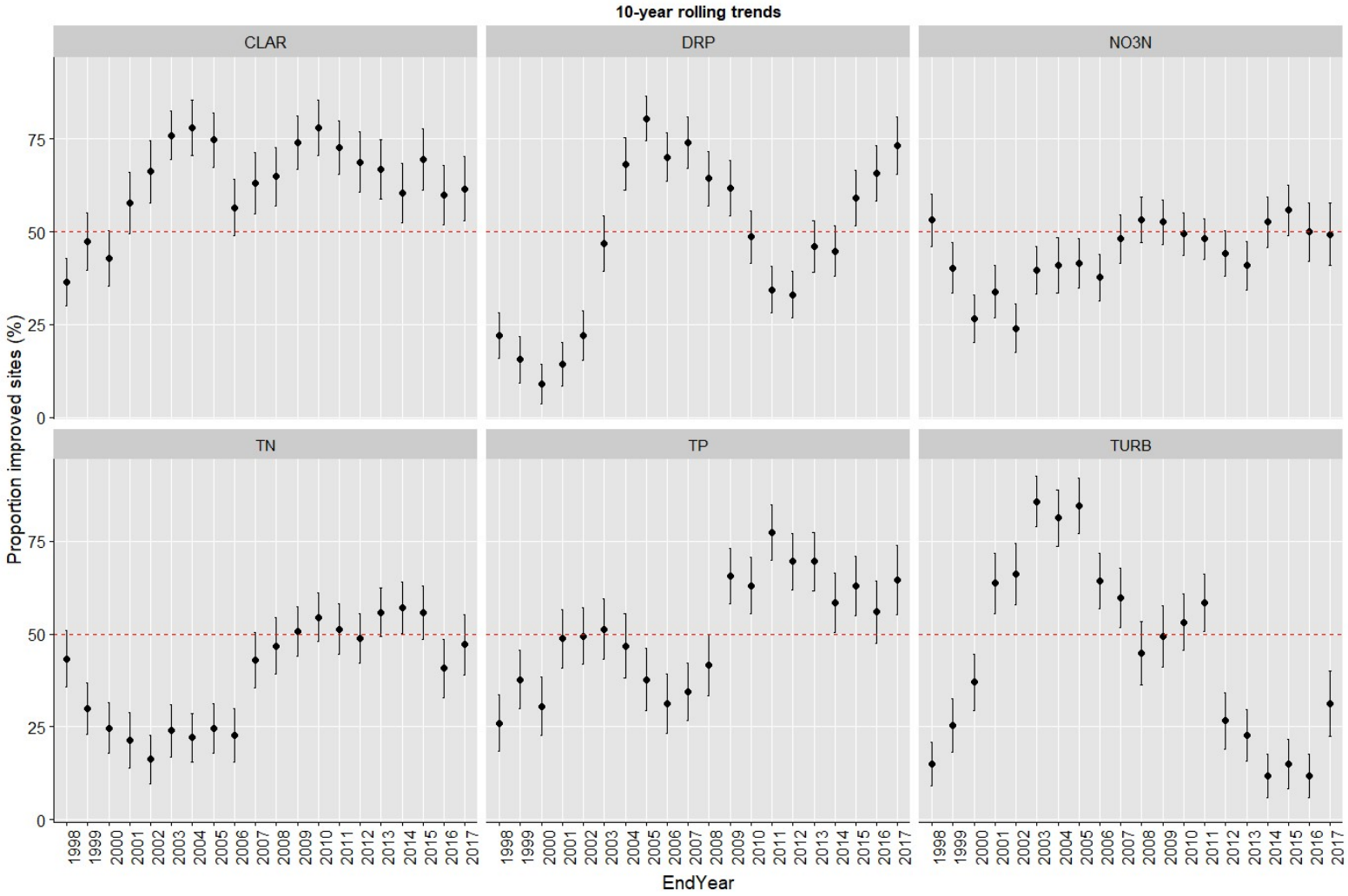
PIT statistics (10 years ending 2017)
Domain = land cover classes



NRWQN sites – 10 year rolling trends ending 1998 - 2017



NRWQN sites – 10 year rolling trends ending 1998 - 2017



Conclusions

- New statistical methods are evolving
- Trends don’t tell us anything about causes
- Aggregate trend statistics elucidate patterns of water quality change
- There is always a water quality trend
  - Need to understand underlying natural rates of change
  - Need to link water quality changes to land use and management

Thank you

For code visit: http://landwaterpeople.co.nz

NRWQN sites – 10 year rolling trends ending 1998 - 2017