The Signpost Series 9th October 2020

Findings from 11 years of high temporal resolution monitoring in the ACP

Per-Erik Mellander

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Policy, Agriculture & environment

- **Food production**
- **Climate change**

- **Science**
- **Environmental policy**

- **Nitrates Directive**
- **Good Agricultural Practice**
- **Agricultural Catchments Programme**
- **Water Framework Directive**
- **Food Harvest 2020 & Food Wise 2025**
- **Climate**

Agricultural Catchments Programme (ACP)

- 2008 – on going
- Collaboration with >300 farmers in 6 catchments
- Scientists, advisors, technologists and technicians

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A whole catchment approach

Source → Mobili-sation → Transfer → Delivery → Impact

- *Conceptual framework*

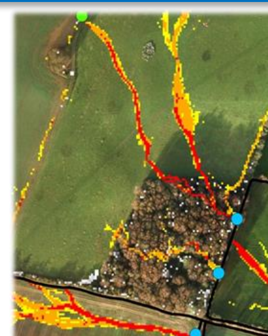
- *Same Experimental design across all catchments*

Source & Mobilisation | **Transfer** | **Delivery** | **Impact**

Farm management

Soil sampling

Weather



Surface pathways

Below ground pathways

Water quantity & quality

Ecological survey

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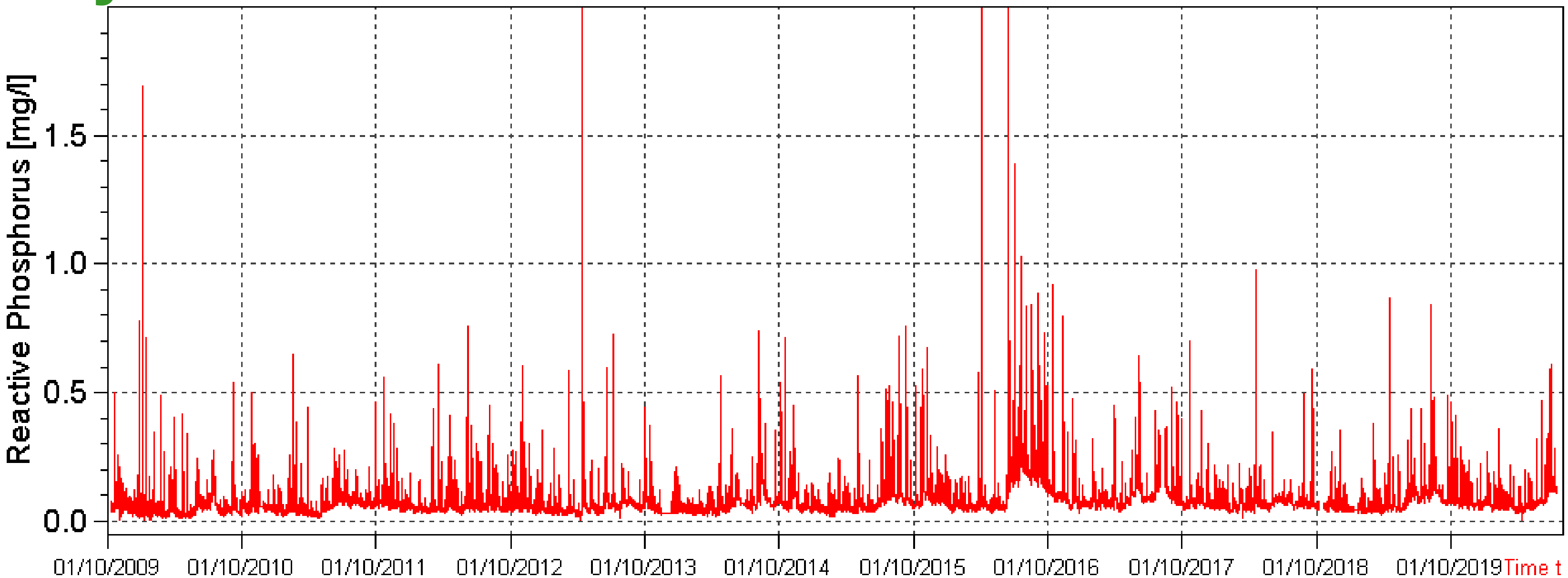
Why so much data?



1. Captures all
2. Insights to WQ during lowflow and high flow
3. Detected subtle changes in WQ
4. Insights to influence off large-scale weather systems on WQ
5. Analytical methods to identify and quantify pathways of nutrients
6. Validate/build models
7. Test other sampling schemes
8. Interpret low frequency sampling
9. Extrapolate to larger areas
10. Educational platforms

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Diverse landscape

- Irish agricultural landscape has many soil types, landscape features, a complex geology and different land use
- Nutrient transfer pathways, transfer times and transformation processes varies highly within and between catchments

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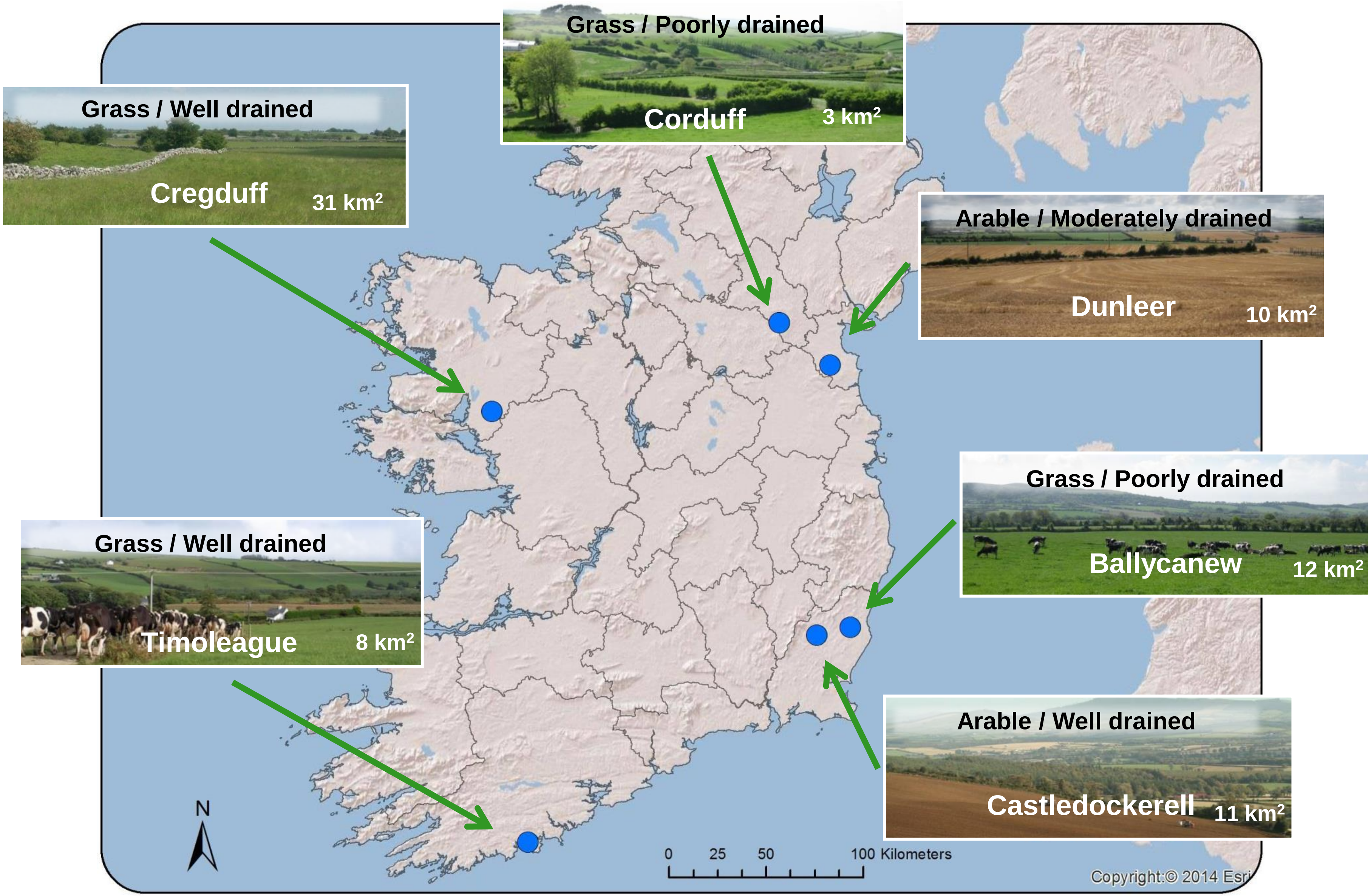
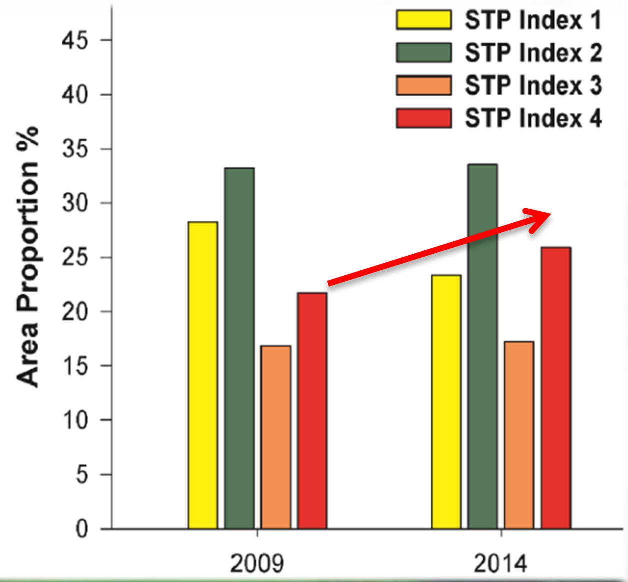
ACP catchments



[McDonald et al., AEE 2019]

I Agronomical controls

- Arable land on poorly to freely drained soils
- Complex pathways
- High P in all pathways
- Increase in index 4 soils
- **“Source risky”**

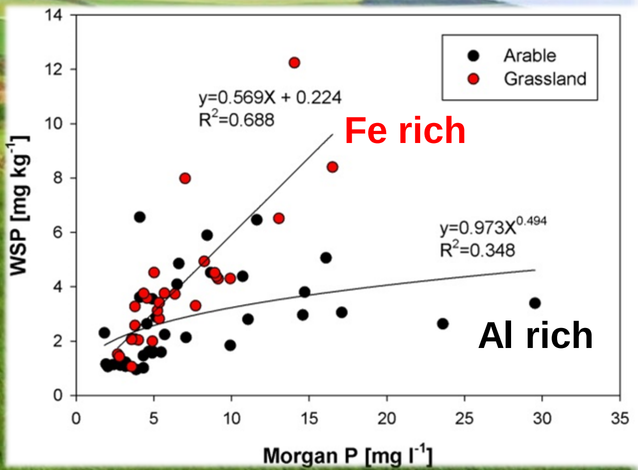


- Good farm-scale nutrient management is needed to improve the spatial distribution of nutrients
- There is room for improvement

[Mellander et al., STOTEN 2016]

II Chemical controls

- Grassland on freely drained and Fe rich soils
- Fe rich soils favoured P into soluble form
- 50% RP loss via GW; 3 times higher P loss than the Al rich catchment
- **“Mobilisation risky”**

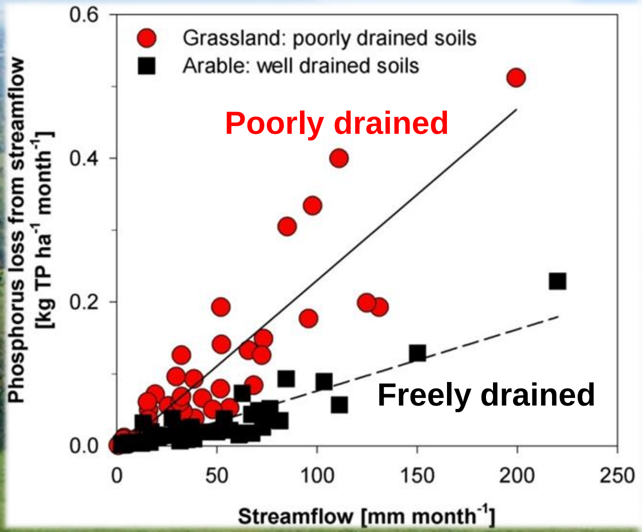


- Leaching of P can be important at catchment scale
- There may be hotspots for leaching of P

[Mellander et al., Hyd Proc 2015]

III Physical controls

- Grassland on poorly drained soils
- Hydrological flashy
- Three times higher P loss than neighbouring arable catchment despite similar soil P source
- **“Transfer risky”**



- Hydrology overrides source pressure

There are no “one size fits all” solutions

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Temporal variability – freely drained soils

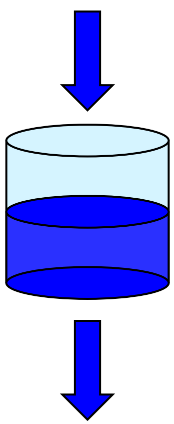
Summer rain event

- SMD = 31 mm
- Rainfall = 25 mm
- Stream flow = 2 mm
- P loss = 1.6 g TRP/ha

Winter rain event

- SMD = 0 mm
- Rainfall = 29 mm
- Stream flow = 20 mm
- P loss = 6.5 g TRP/ha

25 mm



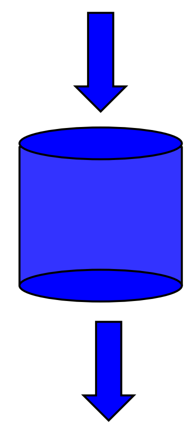
31 mm

2 mm

1.6 g TRP/ha

Four times higher P loss in the winter event!

29 mm



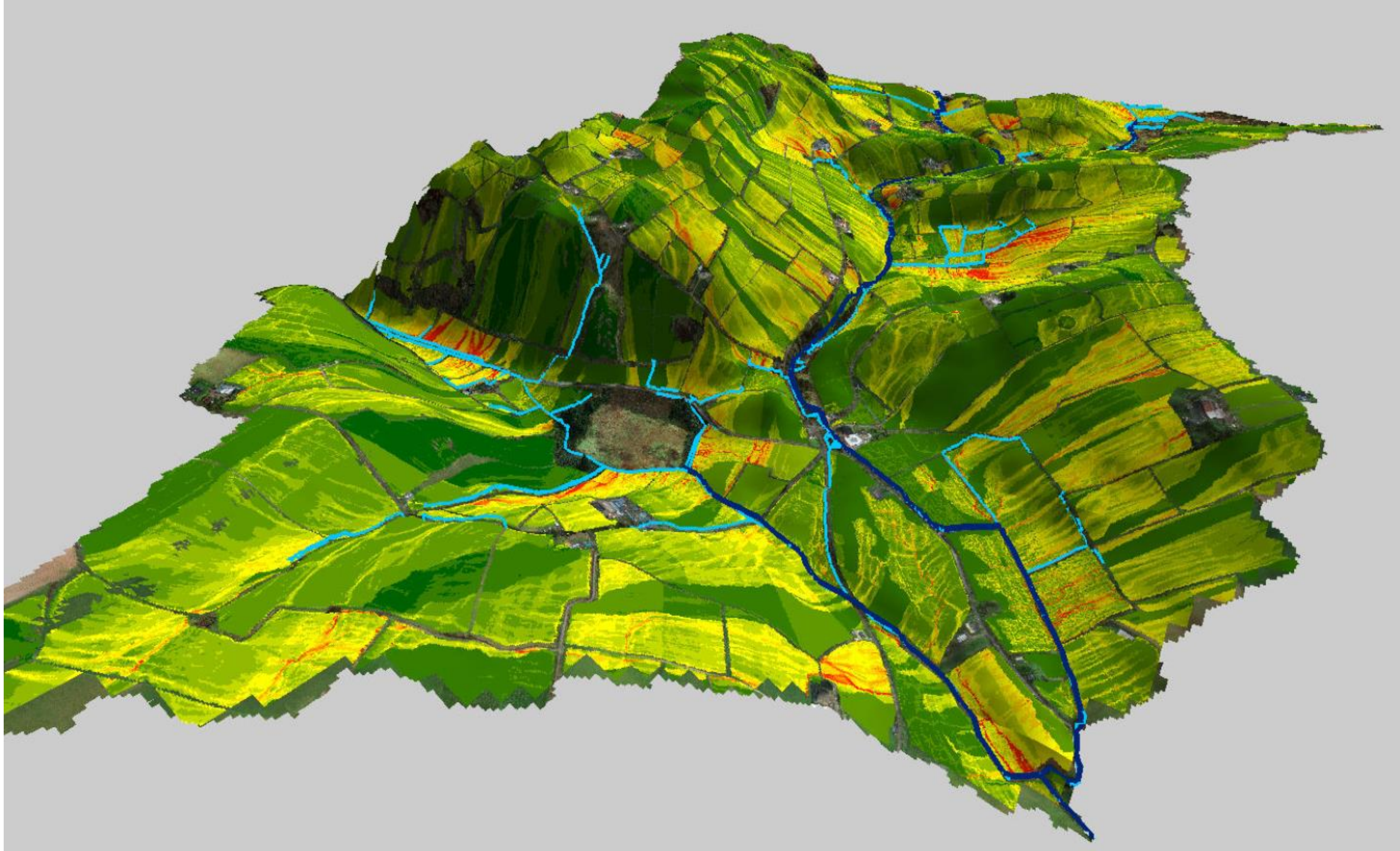
0 mm

20 mm

6.5 g TRP/ha

(Thomas et al., STOTEN 2016)

Critical Source Areas



- Soil P concentration
- Erosion risk
- Mobilisation potential
- Hydrological Sensitive Areas

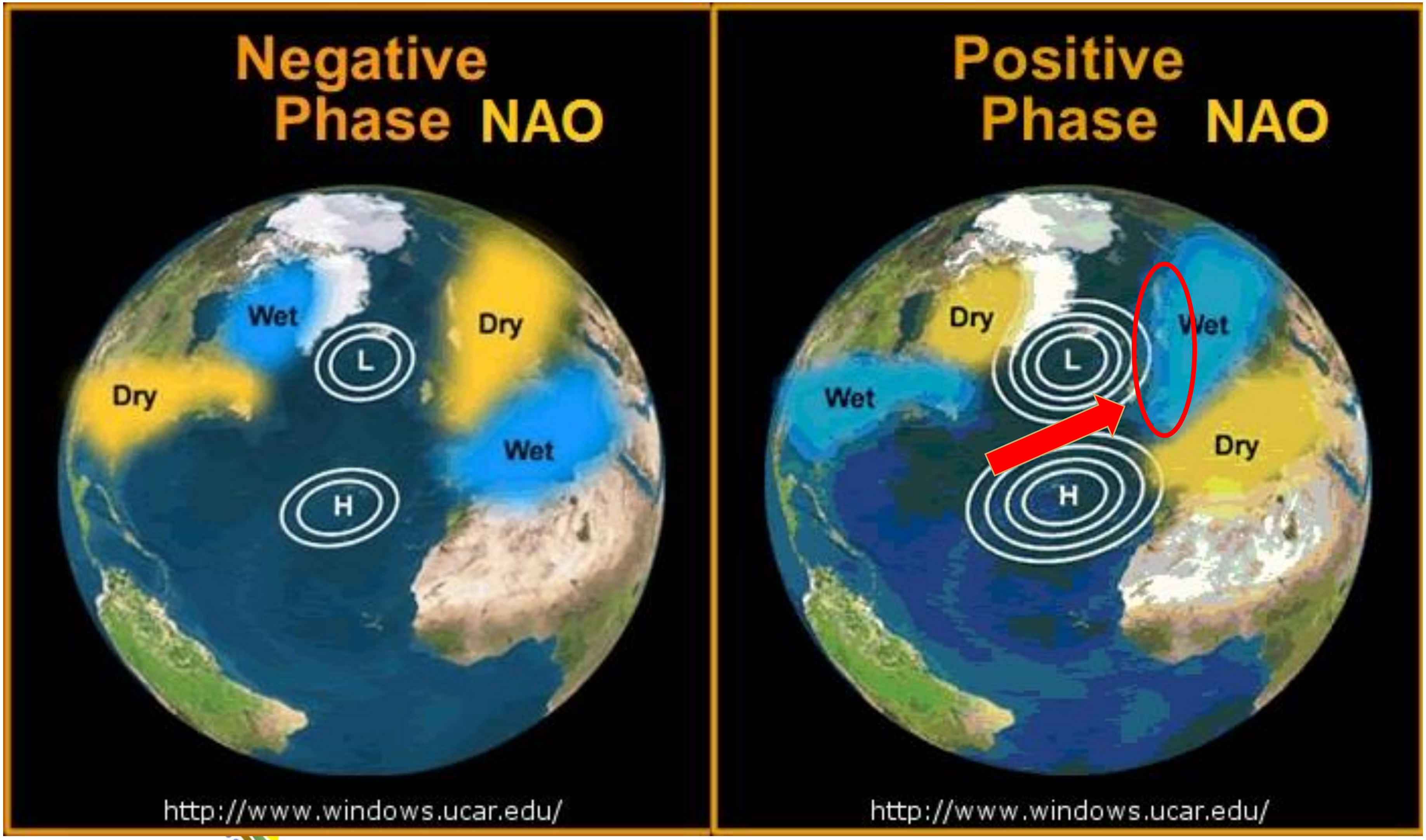
Weather

Ireland listed as one of 'worst-hit' countries impacted by Europe-wide drought

Claire Mc Cormack | Aug 15, 2018, 9:35am

1 Share

North Atlantic Oscillation



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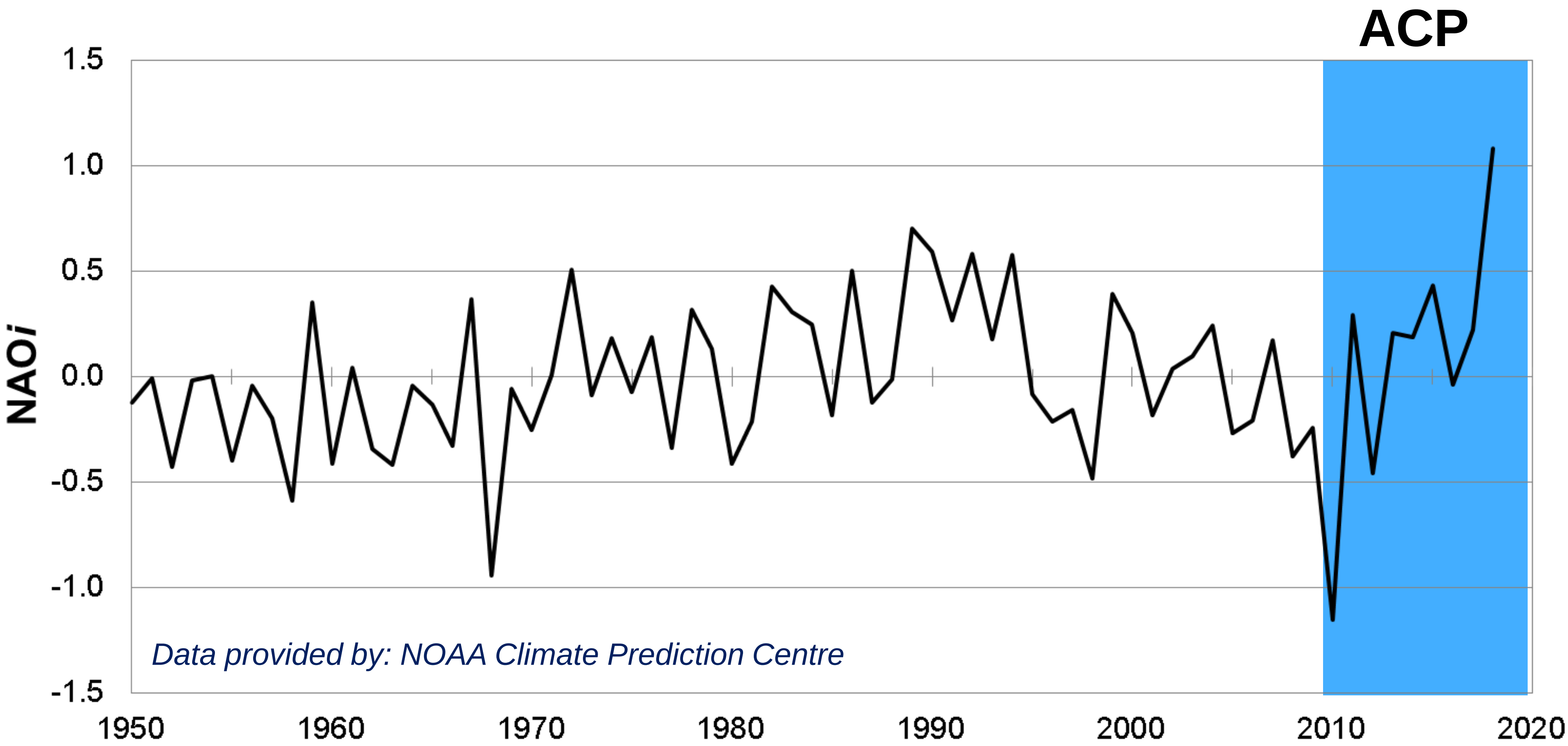
North Atlantic Oscillation *index*

[Mellander et al., Sci Rep 2018]



- N and P concentrations were correlated to changes in NAOi
- Different response for different catchment typologies
- Weather changes may override local management!

Weather extremes

Source: Noel Powell, internet

Weather events that may drastically offset “normal” conditions

May also alter the type of riskiness and require additional mitigation strategy

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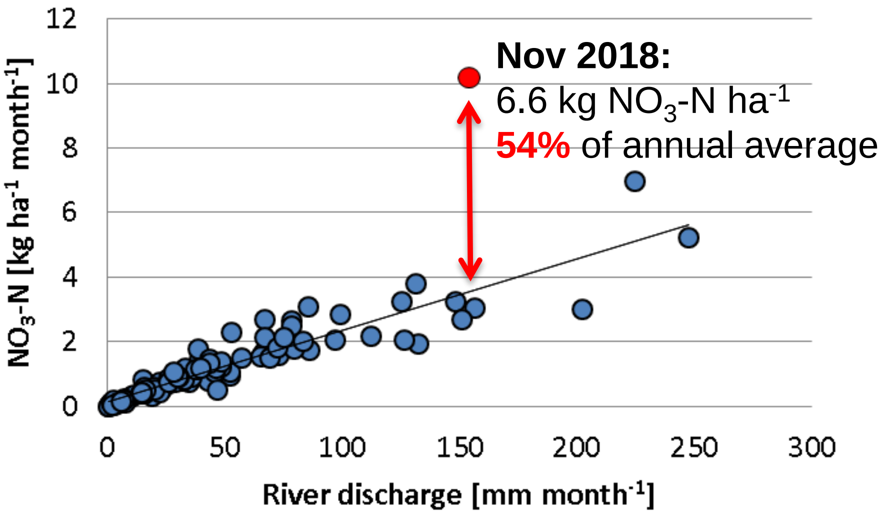
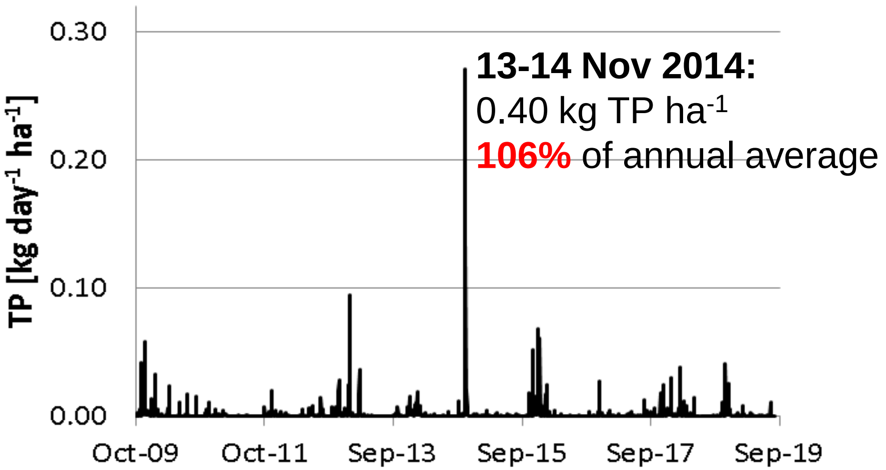
[Mellander et al., in prep]

Weather extremes

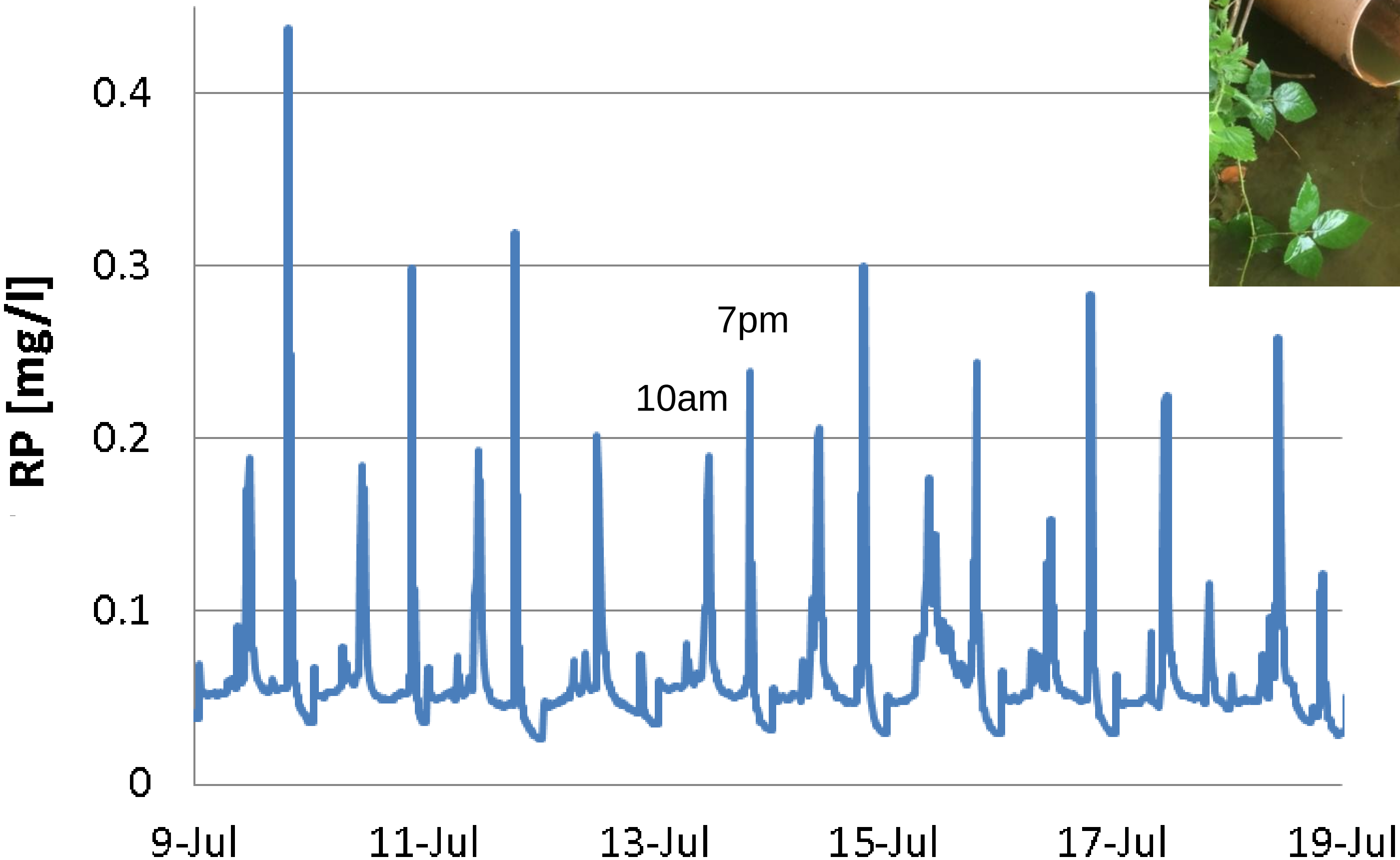




- **Influence of long-term weather shifts and short-term weather extremes both need consideration and require different mitigation strategies**

Summer drought

Up to
2.0 mg/l



- Increased impact of point sources
- Even a small source may significantly elevate P conc. during an ecological sensitive period
- Improved management

Future: ACP (2020 – 2024)

- Increased budget (65%)
- Extended data collection and research
- Farm-scale monitoring of N and P in soil solution and groundwater on derogation and non-derogation farms
- Towers for monitoring of GHG emission
- Test “above-baseline” mitigation measures
- Model scenarios of intensification (farming and weather) - upscale to regional and national scale

Summary

- Efficient & targeted measures are needed
- Continuous monitoring has provided an understanding of when, where and how nutrients are lost to water
- There are no “one size fits all” solutions due to different catchment typologies
- Different dominating pressures: i) source; ii) mobilisation and iii) transport
- Overriding climate pressure, long-term changes & short-term extremes

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