

RECENT RESEARCH FOCUS

- Importance of climatic variability and extremes for agriculture
- Contribution of novel cropping and management systems for reducing net greenhouse gas emissions
- Potential of precision farming technologies for managing water and nitrogen
- Achieving low nitrogen loading with sustained agricultural production
- Perennial cropping systems for biorefining and reducing environmental footprints

Exemplified in research activities and outputs

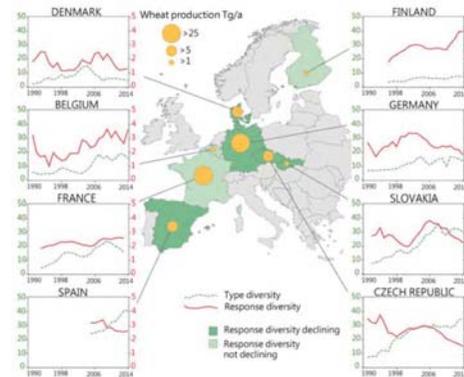
SECTION CLIMATE AND WATER

Section Manager: Professor Jørgen E. Olesen
Presenter: Senior Researcher Uffe Jørgensen



Declining resilience of European wheat

- Climate change increases variability in temperature and rainfall
- Adaptation to such changes requires increasing resilience
- Resilience may be achieved with greater varietal response diversity
- Analysis of >100.000 observations of yield from European variety trials
- Results show declining diversity and lower resilience
- Need for greater focus on diversity and resilience through breeding and variety choice



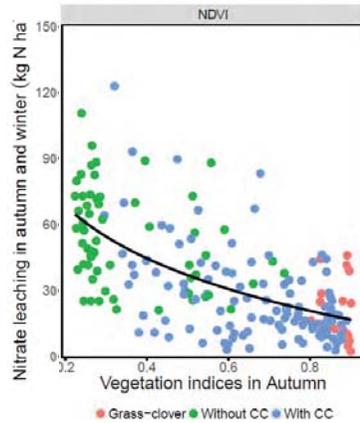
Kahiluoto et al. (2019) PNAS 116, 123-128

SCIENTIFIC FOCUS

- How agriculture can reduce GHG emissions,
- Adapt to changing climatic conditions,
- Improve water use,
- Reduce water pollution, and
- Enhance sustainability of agricultural production
- While enhancing production efficiency of food, feed and bioenergy



Spectral reflectance for estimating nitrate leaching

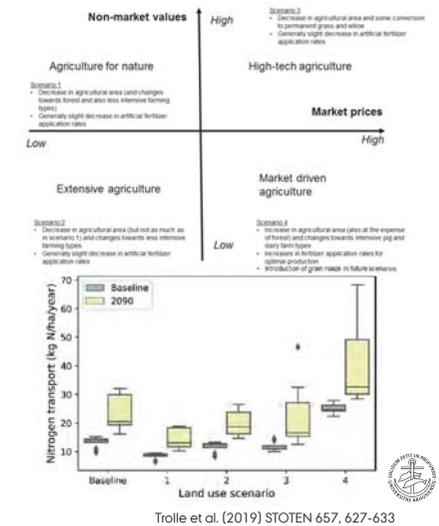


Zhao et al. (submitted) Agric. Ecosyst. Env.



Climate change enhances nutrient loading to the aquatic environment

- Nutrient loading constitutes one of the main challenges for agriculture in Denmark
- N loading can be reduced through change in land use and management
- N loading is also affected by climate change
- Scenario analyses for Odense River basin in Denmark demonstrate the interaction between land use change and climate change
- Mitigation of N loading through land use and management change can (partially) mitigate enhanced N loadings from climate change

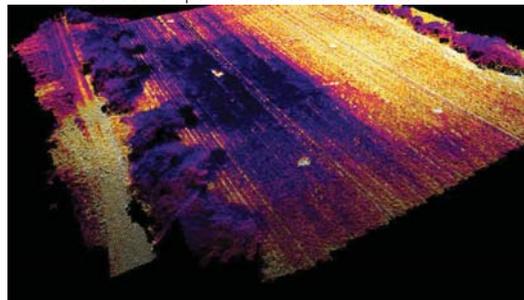


Trolle et al. (2019) STOTEN 657, 627-633

Precision irrigation technology How to assess need?



Thermal image of potato field in 2018
Surface temperature varies from 25 to 50°C



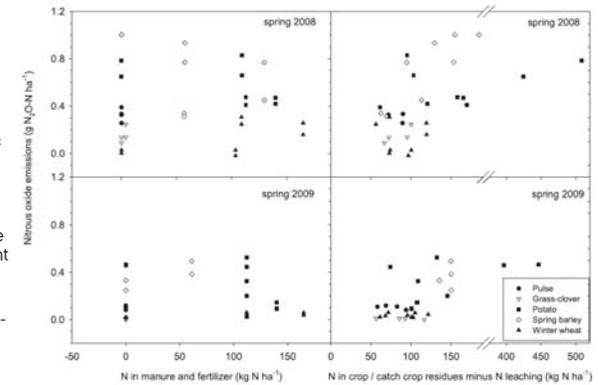
- Satellite and drone images may give the required spatial and temporal resolution for site-specific application
- However, water and N deficits both lead to reduced leaf area in crops
- Thus vegetation indices (e.g. NDVI) alone may not do the job
- Therefore we supplement multi-spectral cameras with thermal images showing the surface temperature to detect drought

Mathias N. Andersen: several projects



Crop residues as drivers of N₂O emissions

- Measurements of N₂O over two years in the long-term arable crop rotation experiment at AU Foulum (rotations, +/- manure, +/- cover crops)
- N₂O emissions were mainly driven by input of N in crop residues
- ResidueGas (led by AU):
 - Propose a new and improved methodology to estimate N₂O emissions from crop residues for the most important cropping systems in Europe, for use in national emissions inventories
 - Assess the relative importance of crop residue management for total N₂O emissions and the soil C and N balance of agricultural systems across cropping and residue management systems for various soils and climates for identification of mitigation strategies.



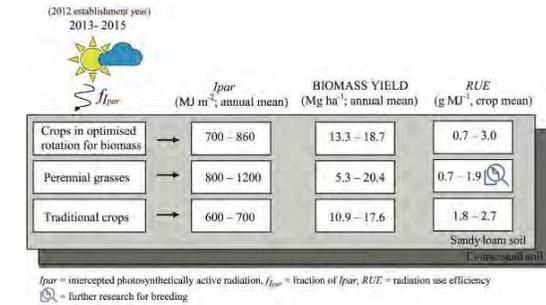
Pugsgaard et al. (2017) Agric. For. Met. 116, 123-128

ACTIVE IN GLOBAL RESEARCH NETWORKS

- Global Research Alliance on Agricultural Greenhouse Gases (GRA)
- FACCE-JPI (ERA-GAS, MACSUR)
- The Agricultural Model Intercomparison and Improvement Project (AgMIP)
- Analyses and Experimentation on Ecosystems (AnaEE)
- Task Force on Emission Inventories and Projections (TFEIP)
- Borlaug Global Rust Initiative (BGRI)
- EuroBlight
- Ongoing collaborations with China (SDC, CAS, CAU)
- Ongoing collaborations with Africa through BSU (Ghana, Tanzania)

Enhancing light interception and biomass yield through optimised cropping systems

- Biomass yields of novel cropping systems for biorefining were optimised
- The largest biomass yields were obtained with beet, festulium and tall fescue
- Perennial crops had a high radiation interception but low radiation use efficiency
- Protein-rich perennial grasses may be bred to improve their radiation use and quality for biorefining
- Shift to novel systems optimised for high radiation use should be considered.



Improving nitrogen balances through novel cropping systems for feedstock to biorefining

- Biomass nitrogen (N) of novel cropping systems for biorefinery feedstock was examined
- The largest biomass N was achieved by fertilised and unfertilised (N-fixing) perennial systems
- Optimised rotation with annual crops also held high potential for biomass N supply
- The novel systems had lower nitrate leaching compared to the conventional systems
- Soil N balance of the systems was overall negative, except for grass-legume systems.

