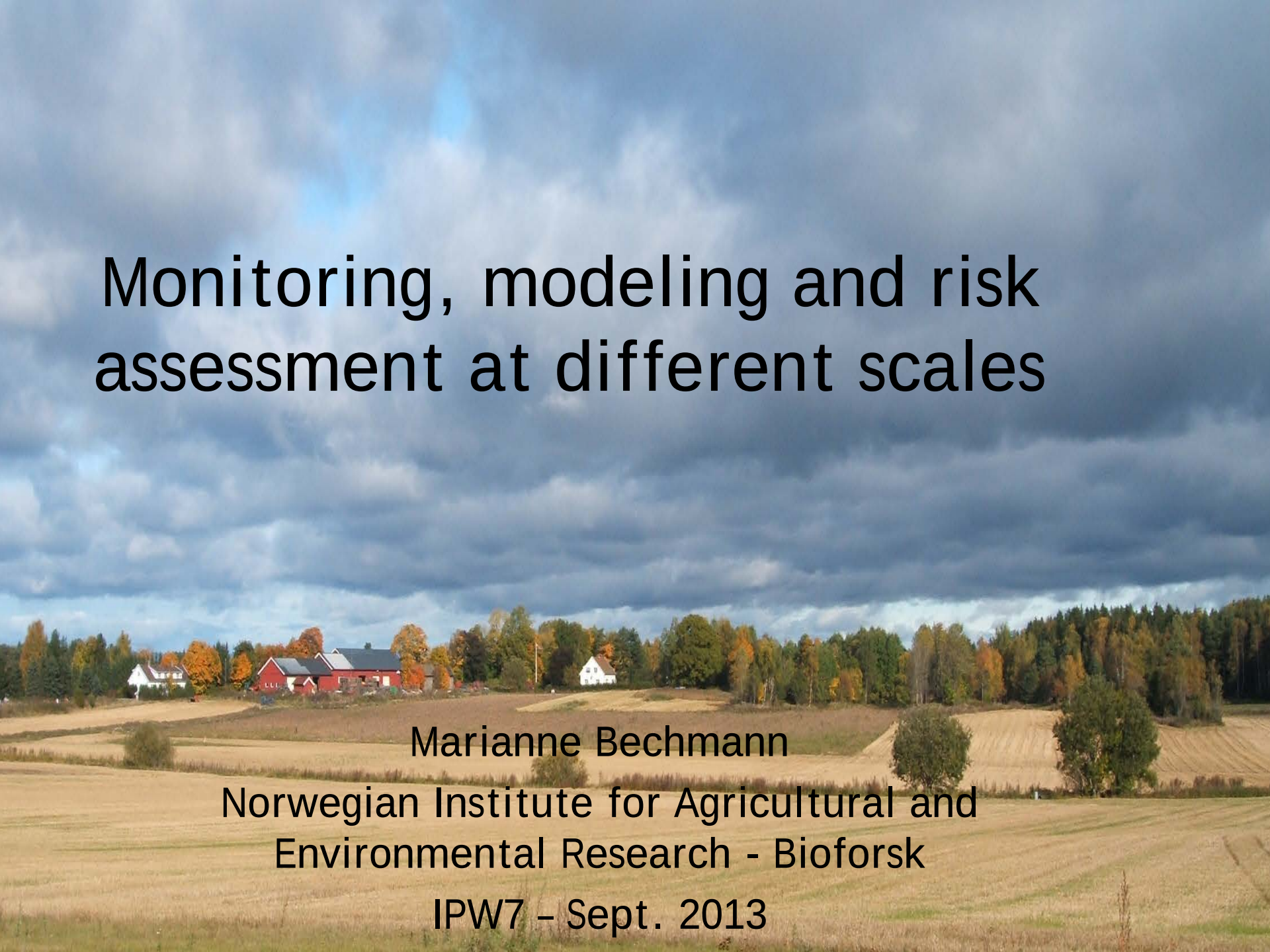
Monitoring, modeling and risk assessment at different scales



Marianne Bechmann

Norwegian Institute for Agricultural and Environmental Research - Bioforsk

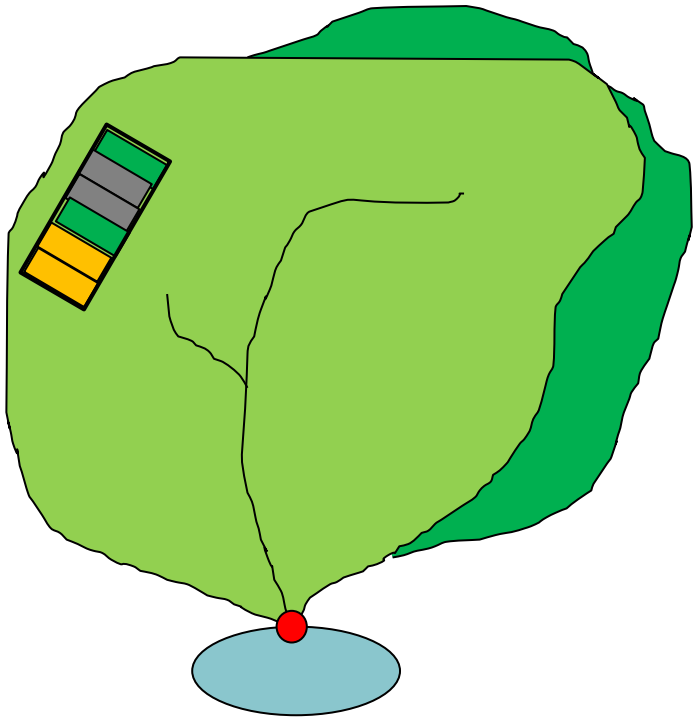
IPW7 – Sept. 2013

Challenge:

To evaluate/document effect of mitigation methods at the catchment scale

Tools:

- Monitoring
- Modeling



Eutrophication in Norway
Example: Lake Western Vansjø

Eutrophication due to increased phosphorus concentration

Agricultural practice in the catchment

Mainly arable farming

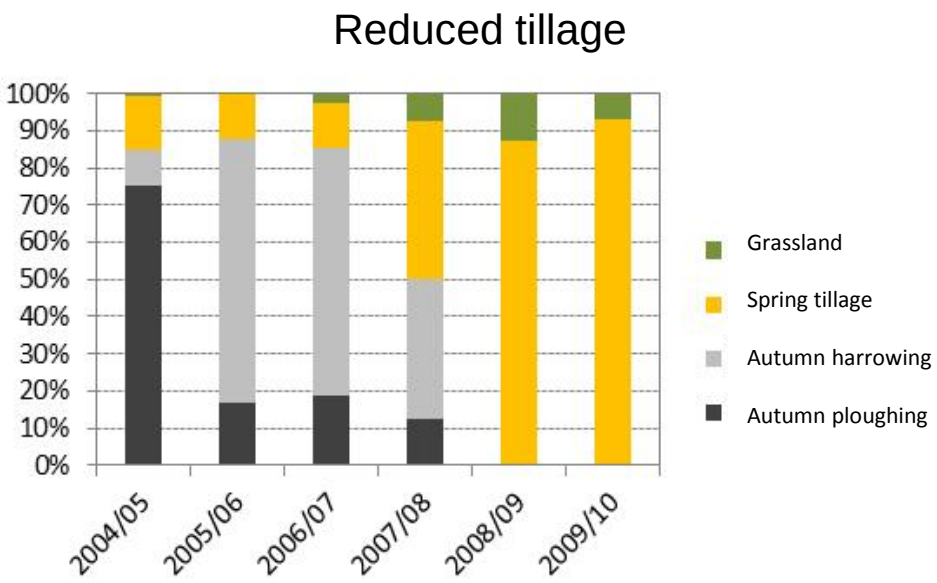
- Winter and spring cereals
- Potato and vegetables

A few livestock farms

Local catchment area: 70 km^2

Recreation area for 60 000 inhabitants

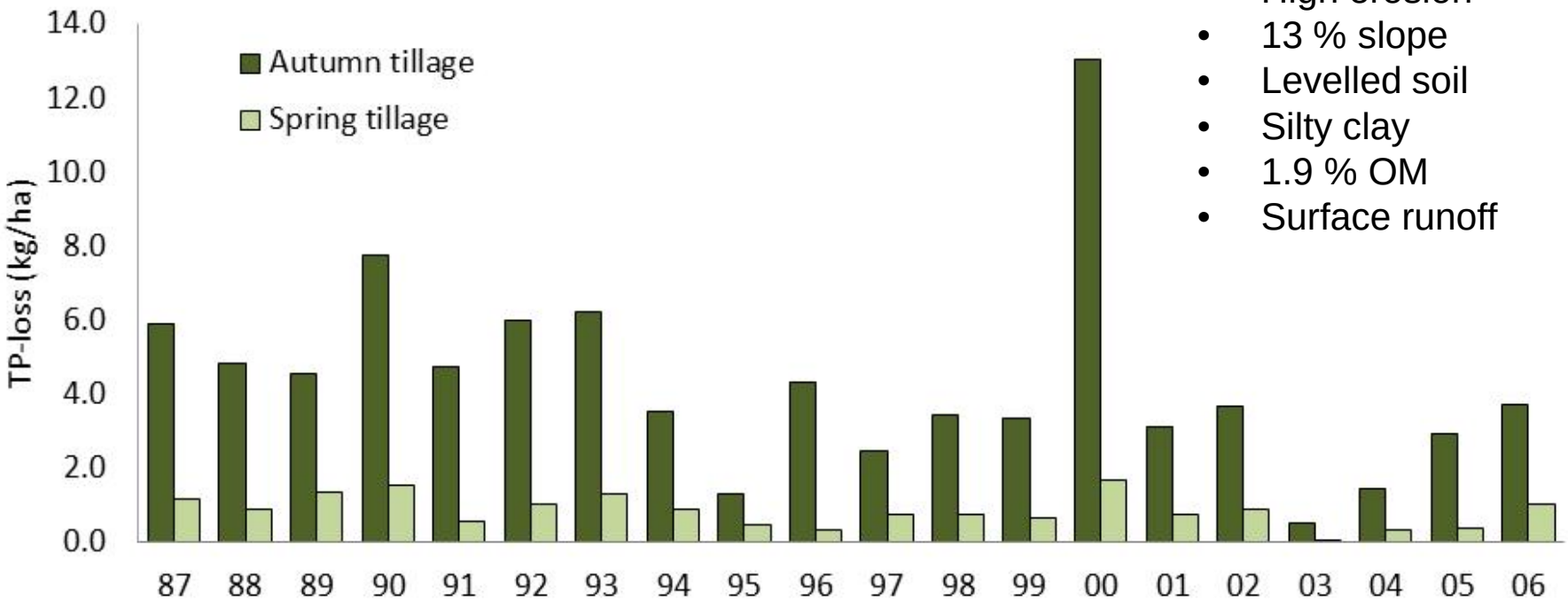
Comprehensive mitigation methods implemented in the catchment of western Vansjø



Reduced P application	kg P/ha				
	2004	2007	2008	2009	2010
Mean for area with contract	**22**	**11**	**6**	**4**	**5**

What do we know about effect of mitigation methods?

Soil tillage and P loss at the plot scale



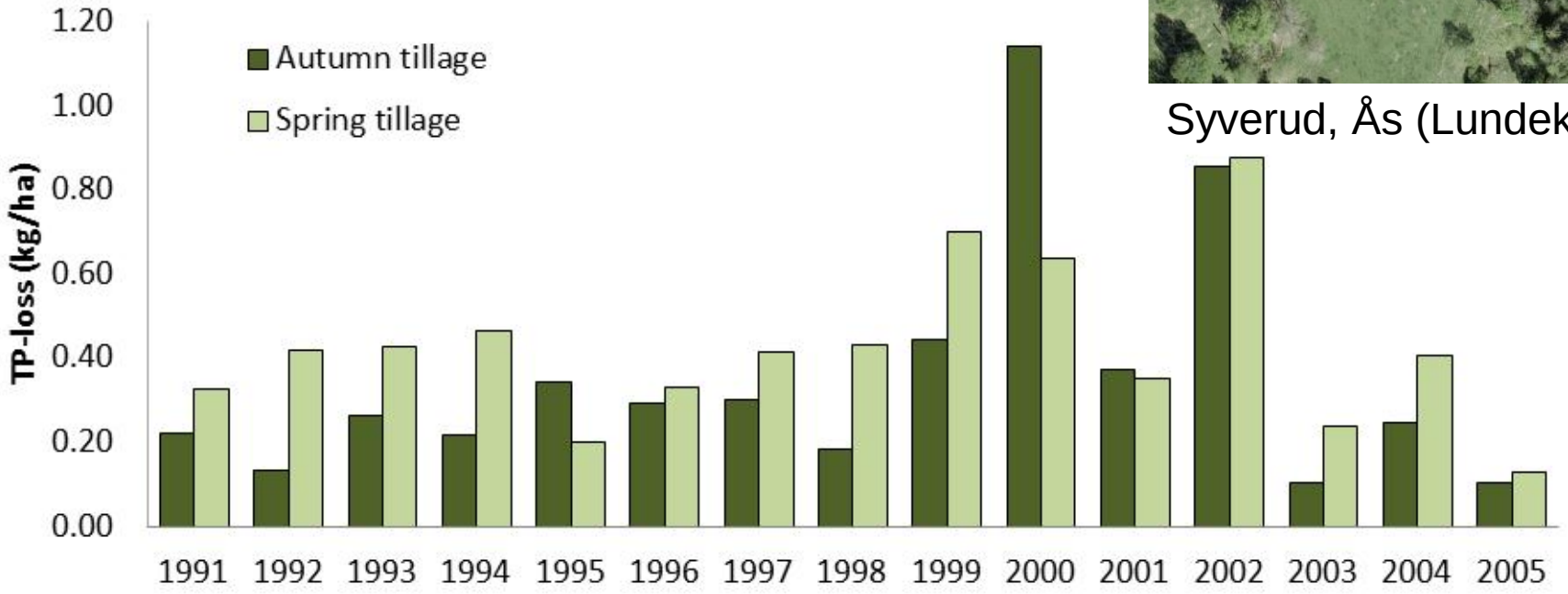
- High erosion
- 13 % slope
- Levelled soil
- Silty clay
- 1.9 % OM
- Surface runoff

Bechmann et al. (2011)

Soil tillage and P loss at the plot scale

- Low erosion
- 13 % slope
- 5,5 % OM
- Surface runoff

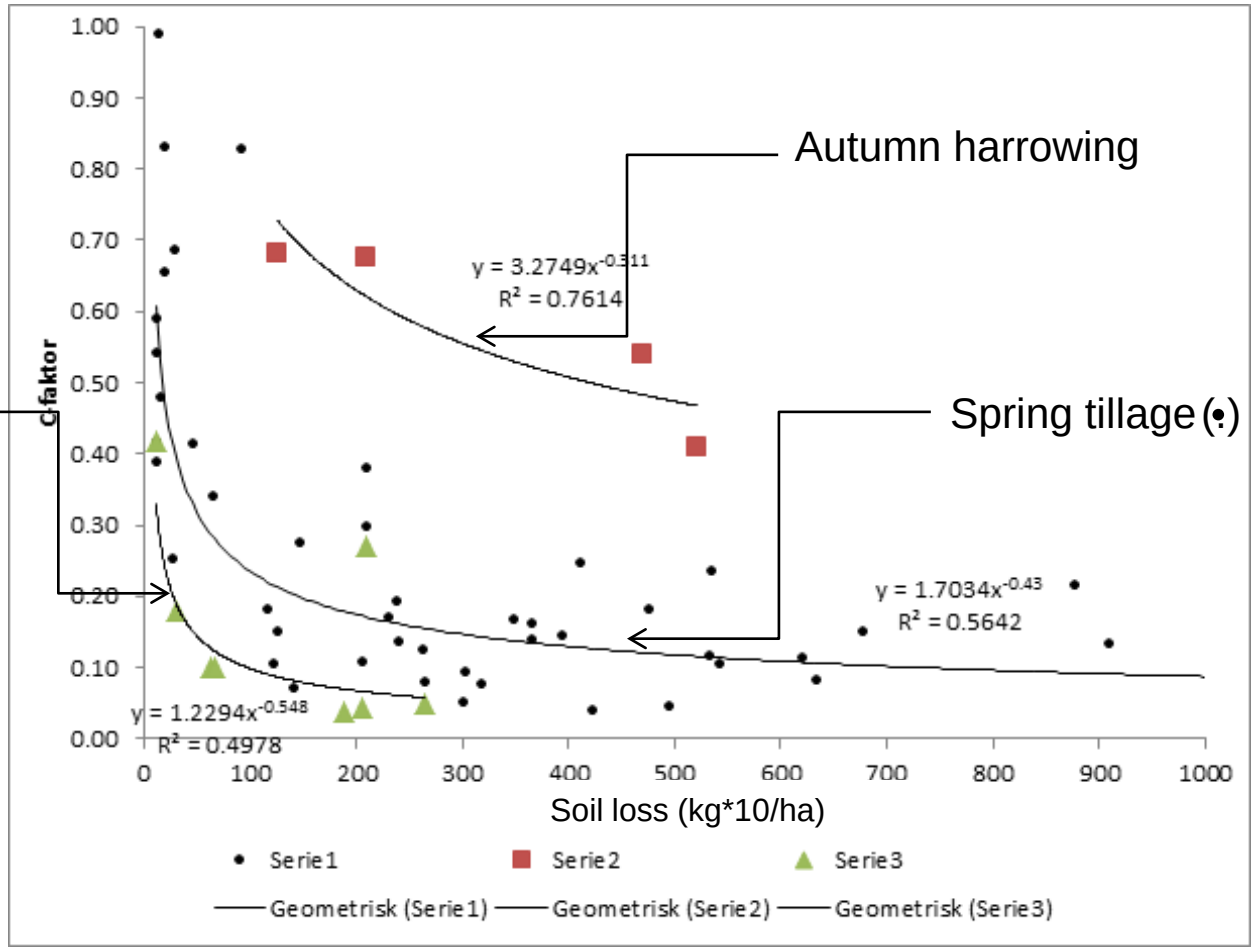
Syverud, Ås (Lundekvam)



Bechmann et al. (2011)

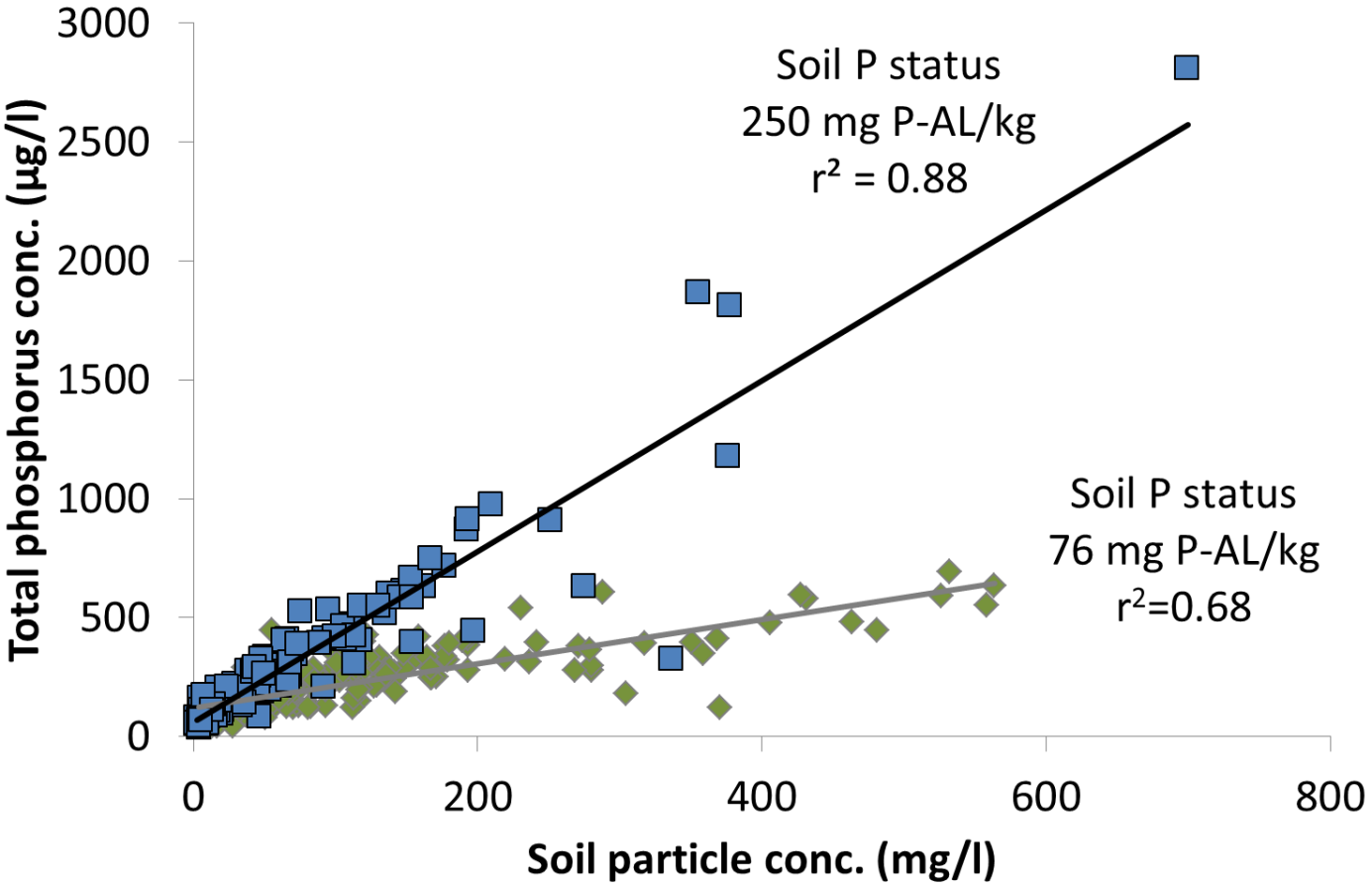
Effect of soil tillage on erosion

compared to autumn ploughing

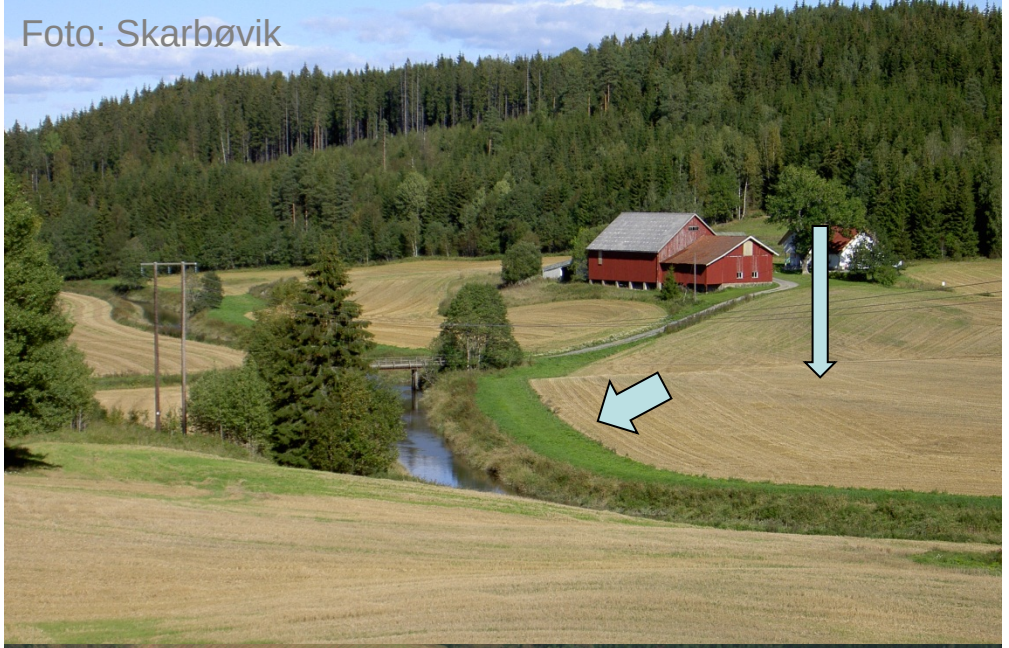


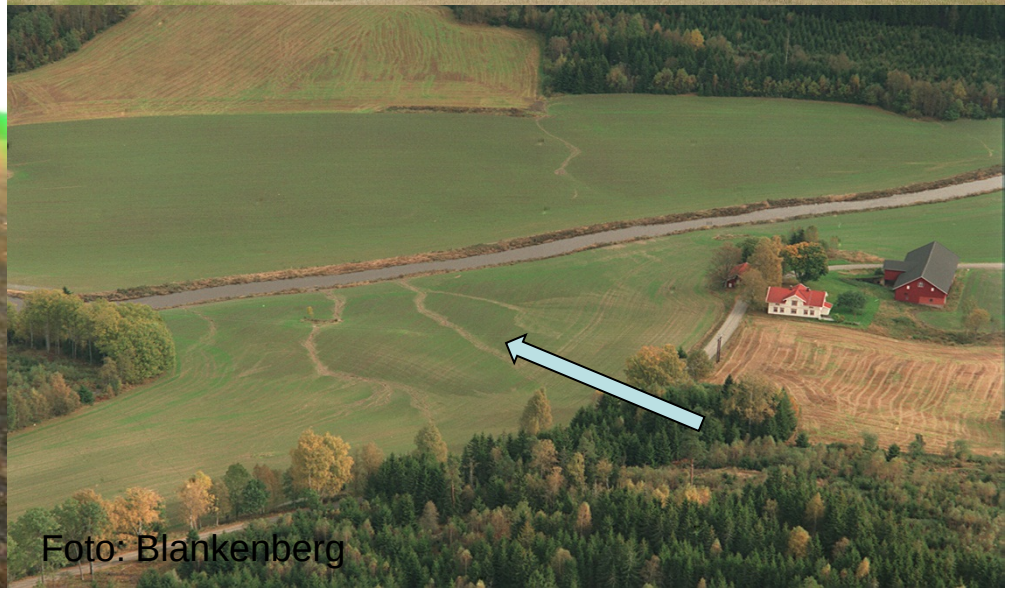
Ulén et al. (2010)
Kværnø, unpubl.

P application -> Soil P status from small catchments



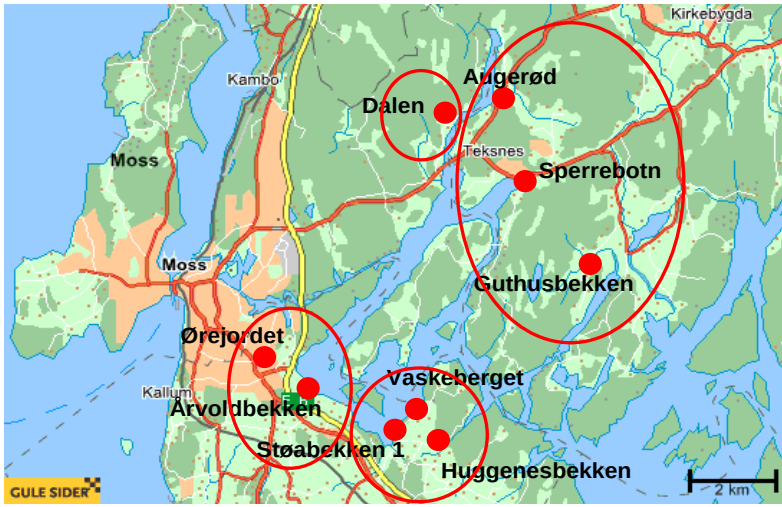
Effect of grassed buffer zones





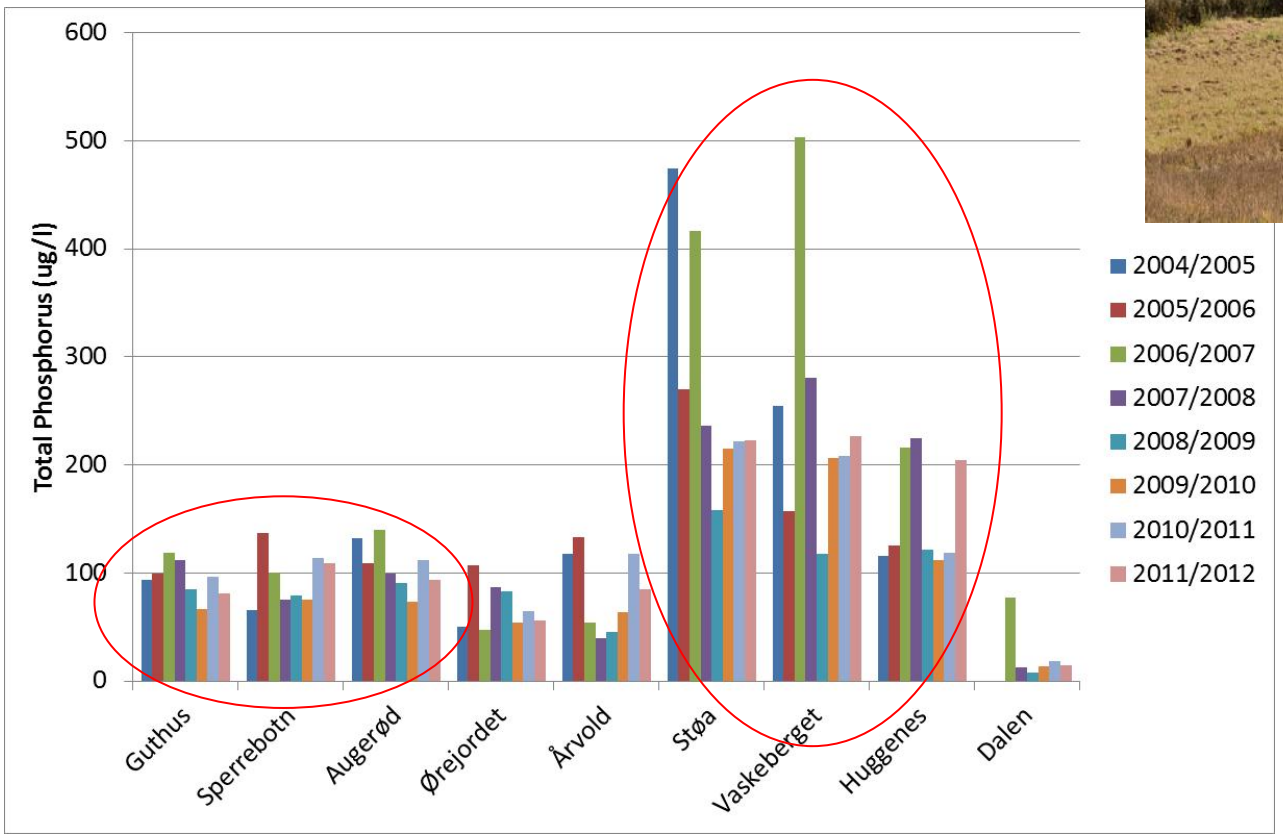
Effect of mitigation methods at the catchment scale

Monitoring

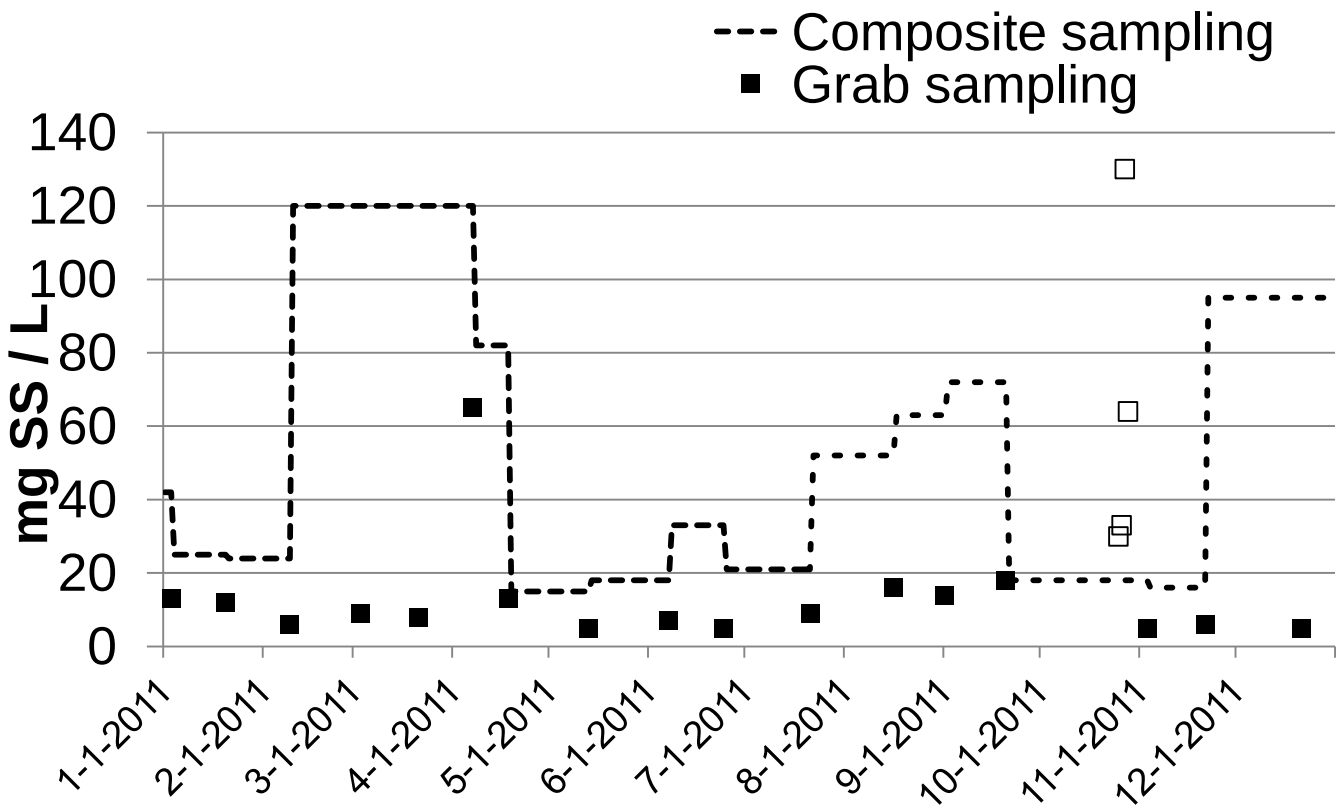


western Vansjø

Western Vansjø

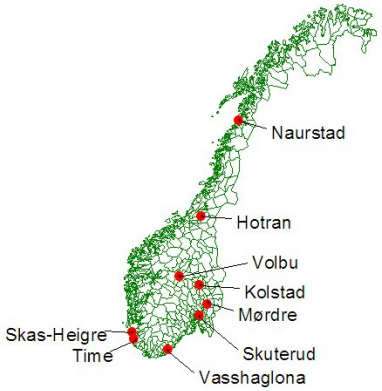


Monitoring methods



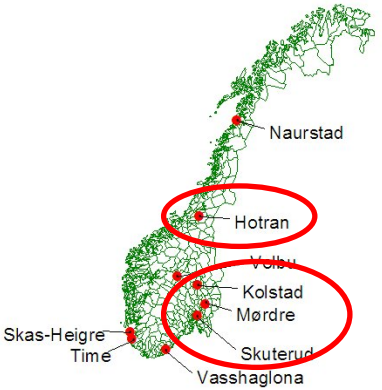
Skarbøvik, 2013

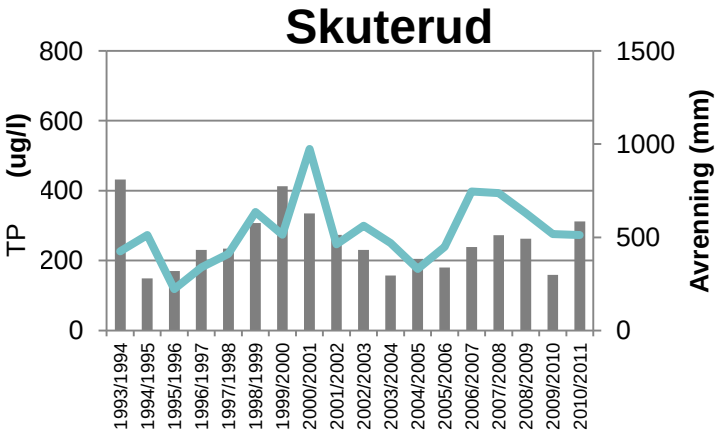
Composite flow proportional sampling

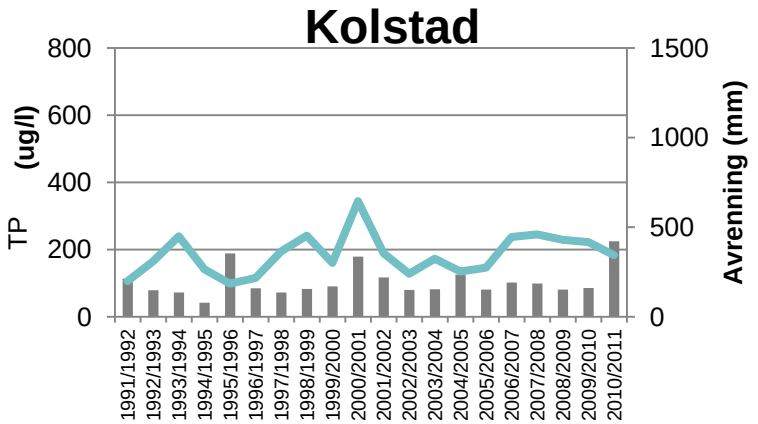


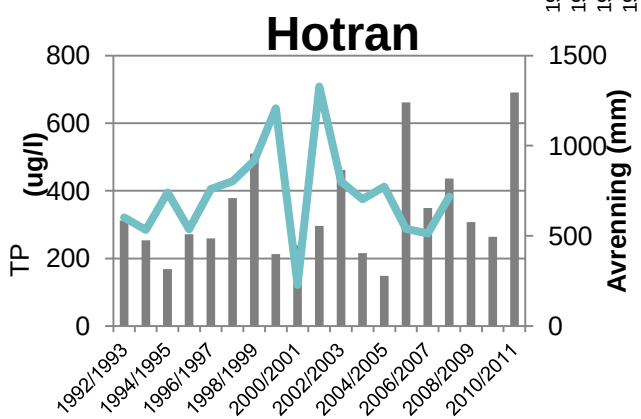
The Norwegian Environmental Agricultural Monitoring programme

Trends in phosphorus concentrations









No significant trends

P tap

Avrenning

Time trends

- Contrary changes in agricultural management – increased livestock density
- Changes in weather
- Retention in the catchment
- Monitoring started too late
- Spatial variation in effect og mitigation methods

Monitoring

National monitoring

Western Vansjø

Two examples with no effects of mitigation methods

Complex systems -> modeling

- If too many factors influence P loss – modeling may be used to sort out the relationship
- Keeping everything else constant – only effect of mitigation methods
- Estimate the effect of changes in weather

Farkas (2013)

The INCA-P model – application for the Skuterud catchment

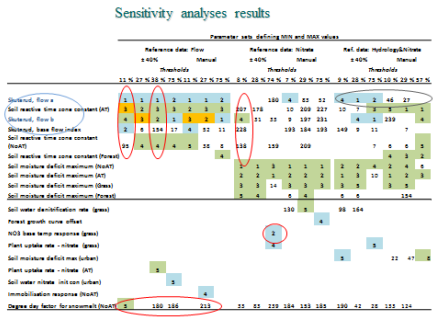
1. Parameterisation
   - Available data from the Skuterud catchment and stream
   - Literature review
   - Expert assumptions (qualitative information)

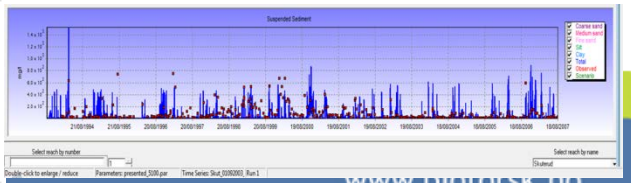
2. Calibration procedure
   - Stepwise calibration approach (flow; SS&TP)

flow → flow&SS&TP

3. Validation procedure

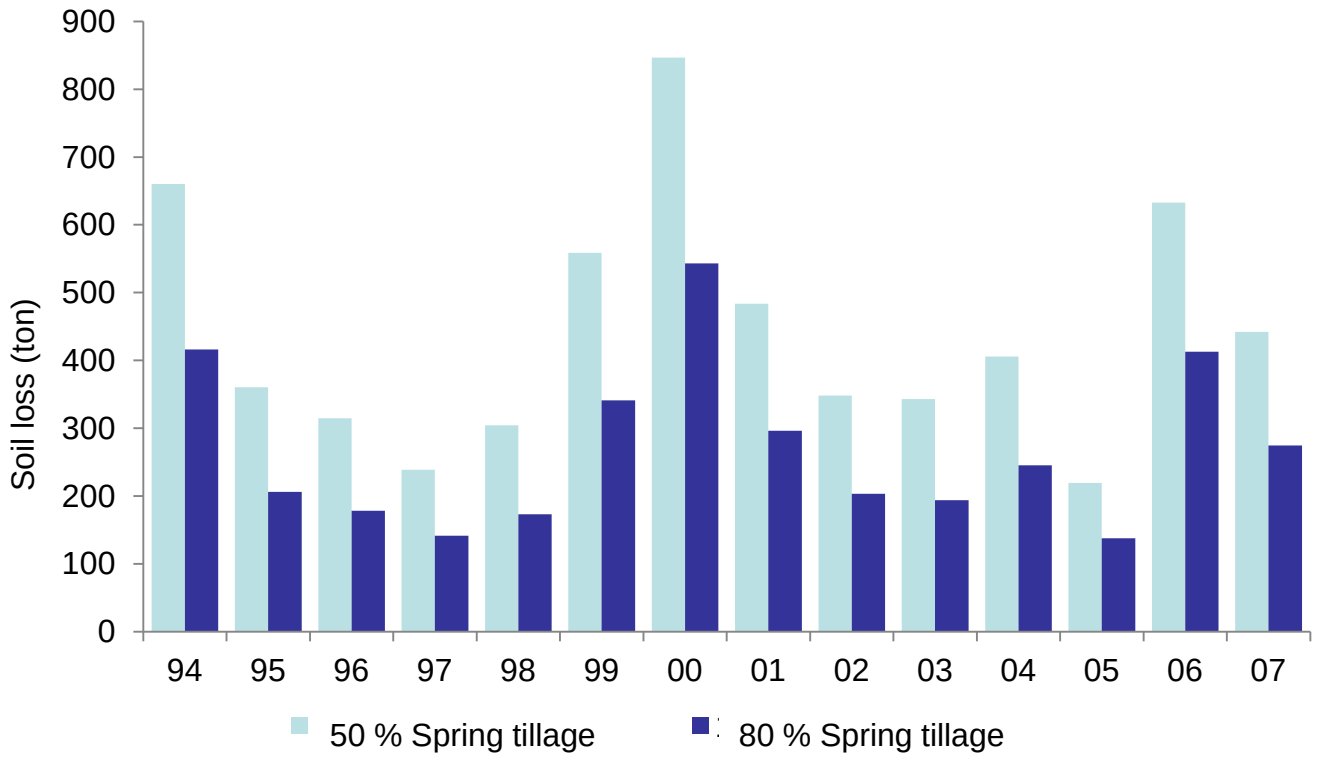
4. Scenario analyses





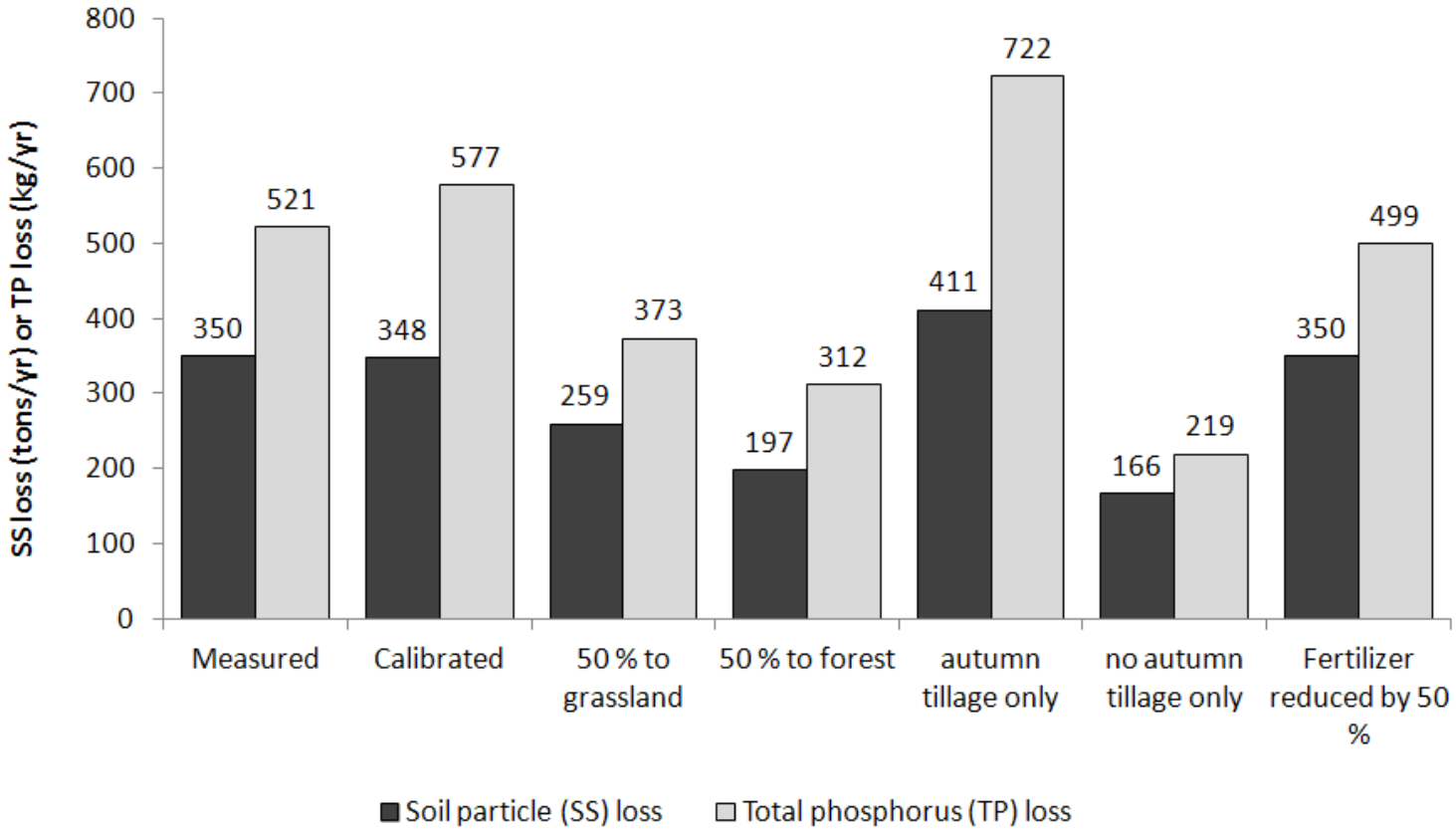
Farkas (2013)

Modeling effect of two scenarioes for tillage



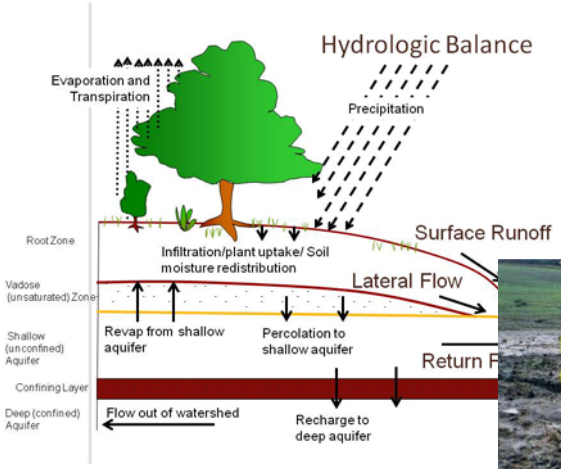
INCA (Kværnø et al., 2012)

INCA-P



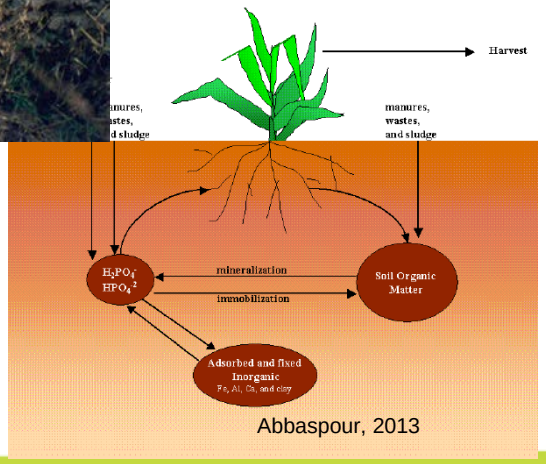
Farkas (2013)

Soil and Water Assessment Tool (*SWAT) (Neitsch, Arnold et al. 2009)*



- Process based
- Dynamic

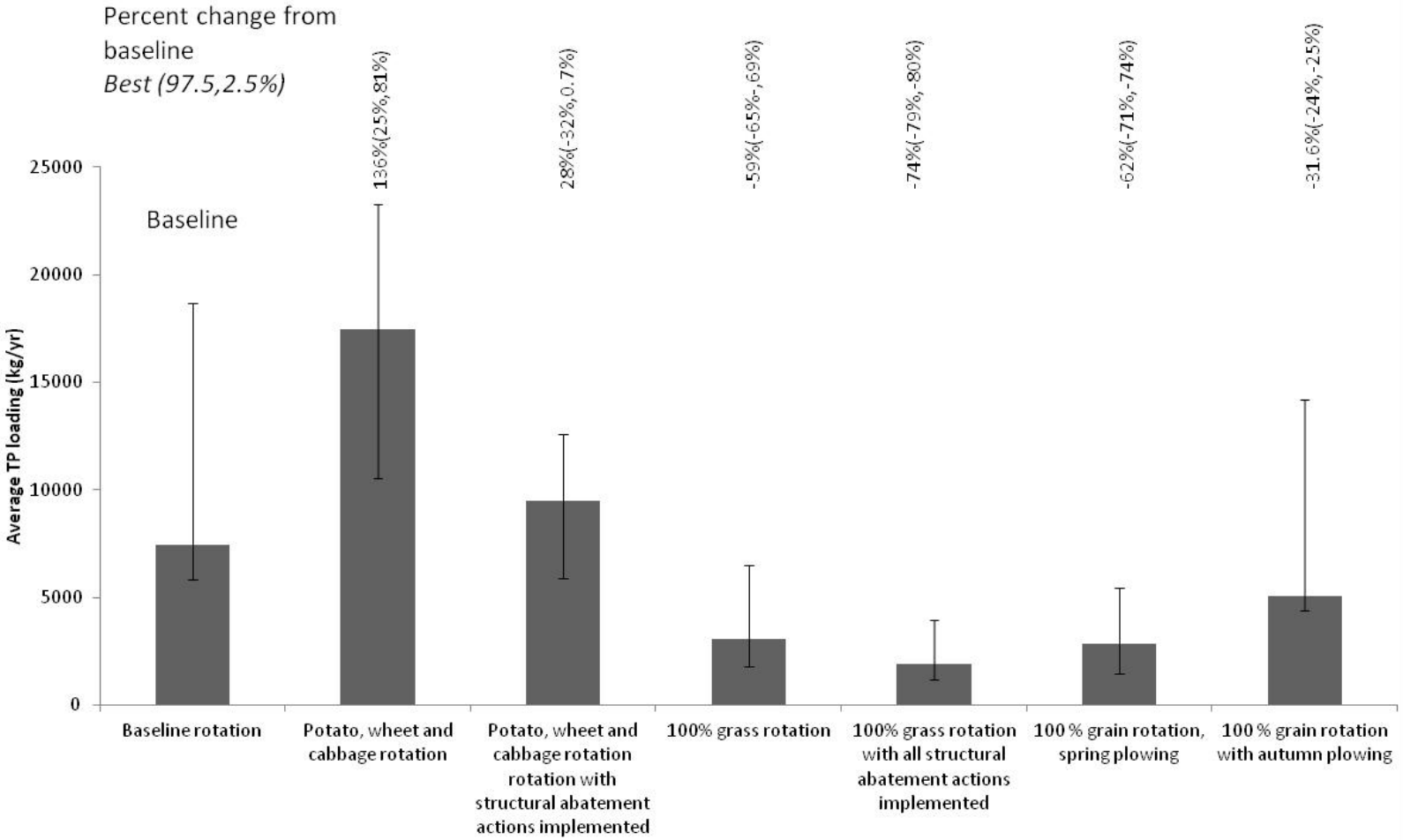
- Simulates changes in water quality based on farmer management practices
- Distributed in space
- Runs on a daily time scale



Abbaspour, 2013

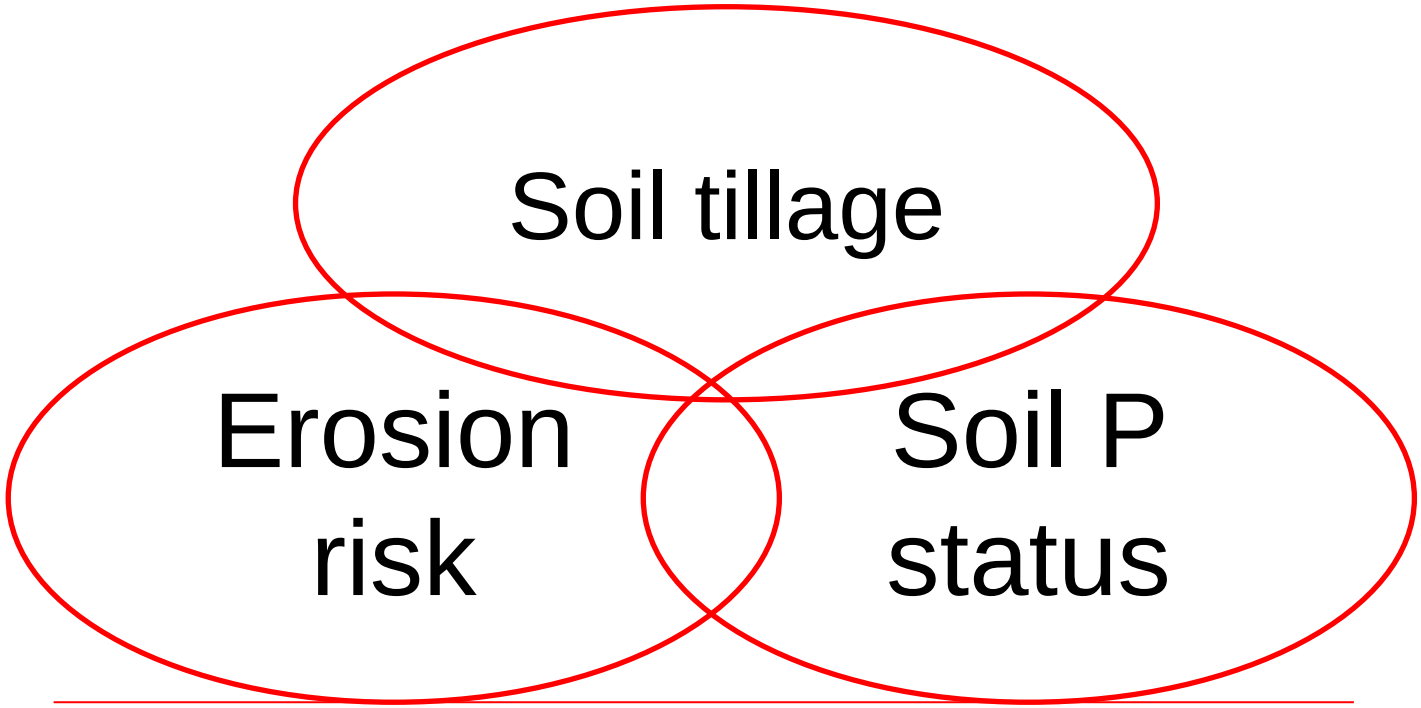
Engebretsen (2013)

SWAT in the western Vansjø catchment: Changes in crop rotations



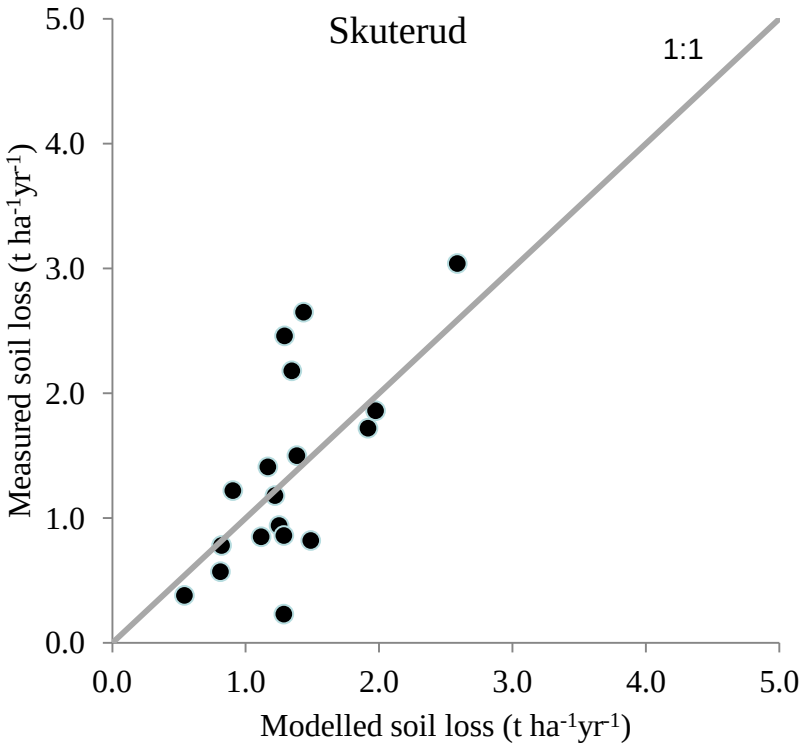
Engebretsen (2013)

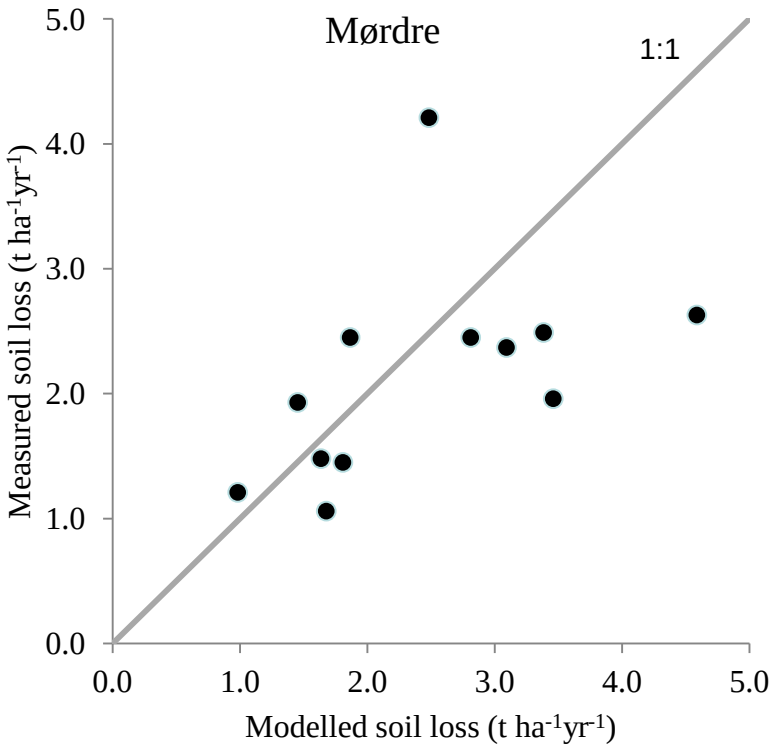
The Agricat model



Borch et al., (2010)

Agricat test on soil loss





Effect of mitigation strategies in Agricat

Soil tillage change:

Scenario 1-3: No autumn till

Scenario 4-6: No autumn till and grass on very high risk areas

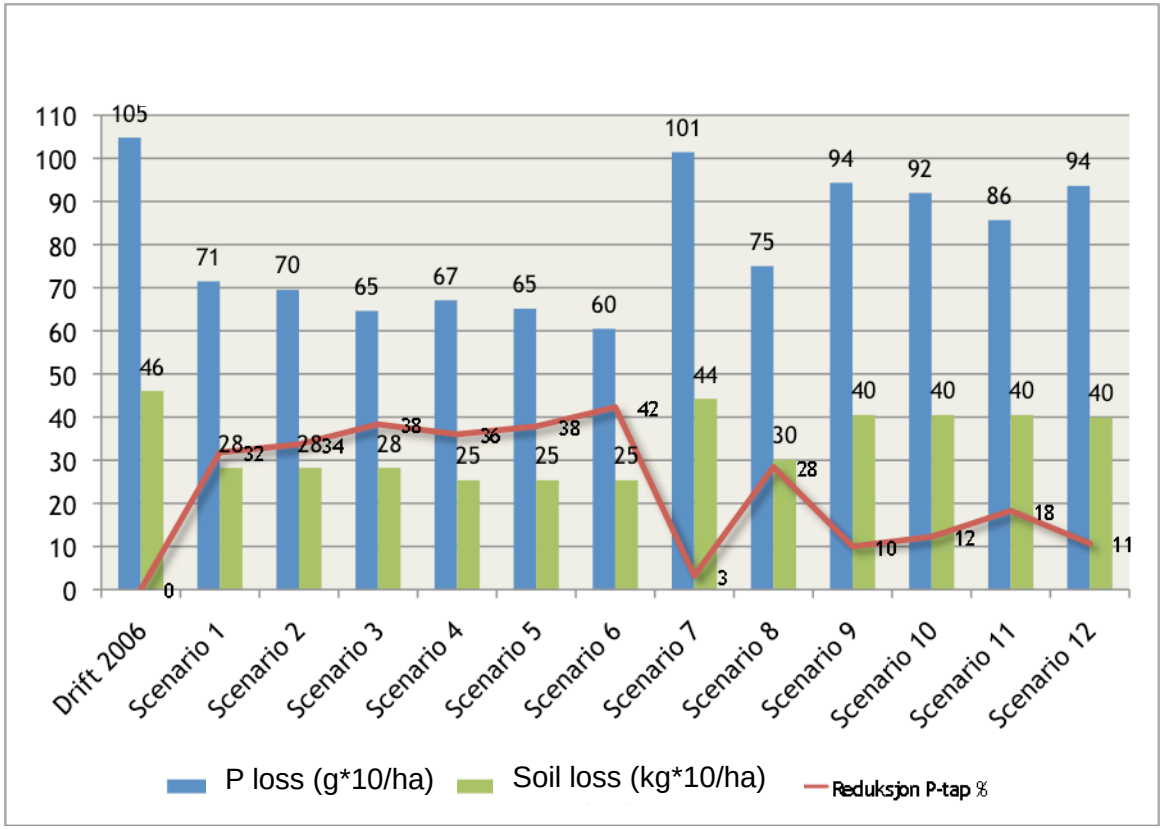
Scenario 7: Autumn harrowed area changed to no autumn till

Scenario 8: No autumn till on high erosion risk areas, flood risk and along streams

Scenario 9-11: 20 % of the area autumn ploughed

Combined with change in soil P status:

No change, reduction to 7 or 10



Borch et al., (2010)

Different prosesses – does models account for these processes?

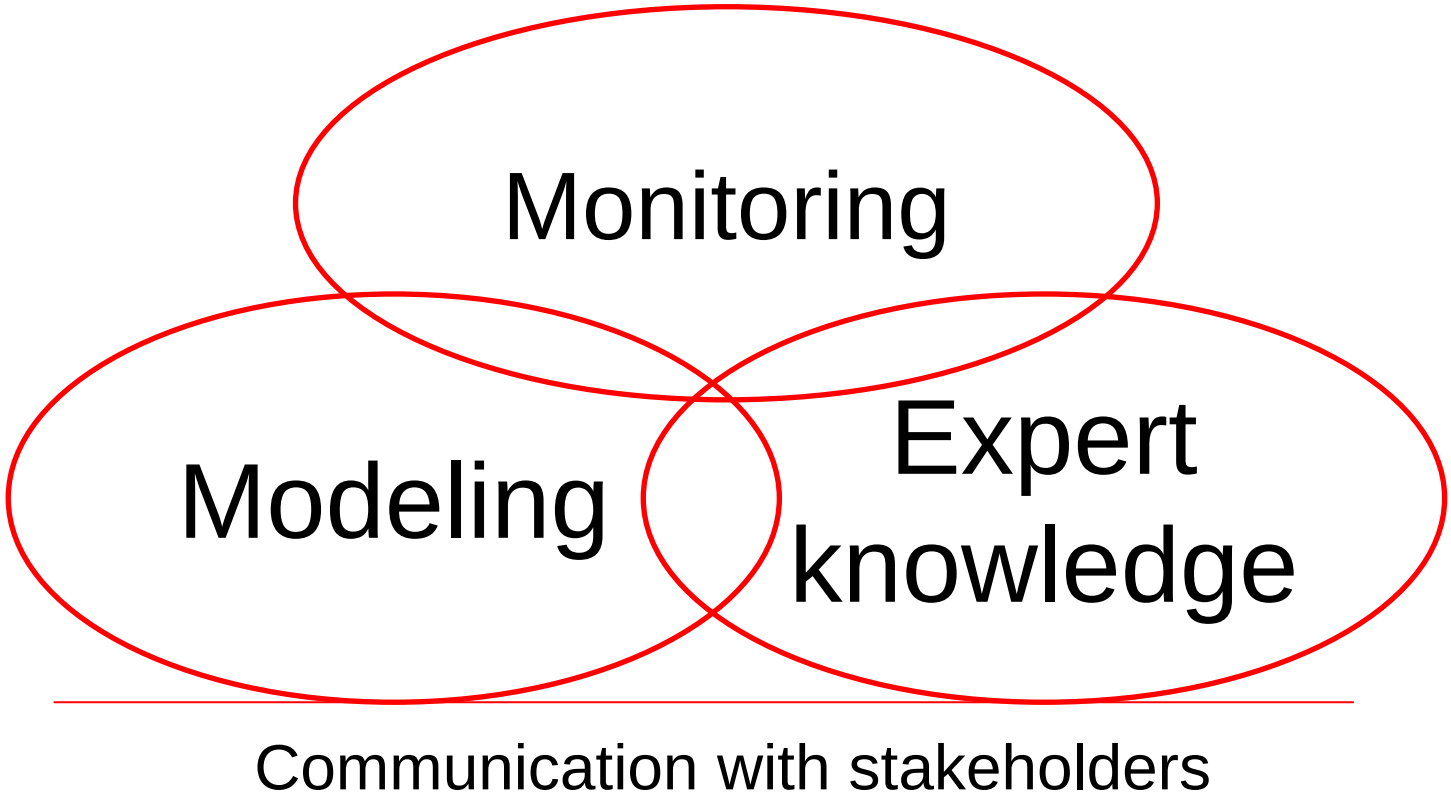
Model uncertainty and costs

"All models are wrong, but some are useful" – George Box

- All models have inherent uncertainties related to:
  - uncertainties in input data
  - uncertainties in parameter values
  - uncertainties in process simplifications
  - processes not accounted for by the model
  - processes in the catchment that are unknown to the modeler.

Engebretsen (2013)

Stakeholder tools consist of




Thank you for
your attention