

Biophysical parameters and Soil Sealing data in the E-HYPE European Hydrological model



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CIS Water in geoland2

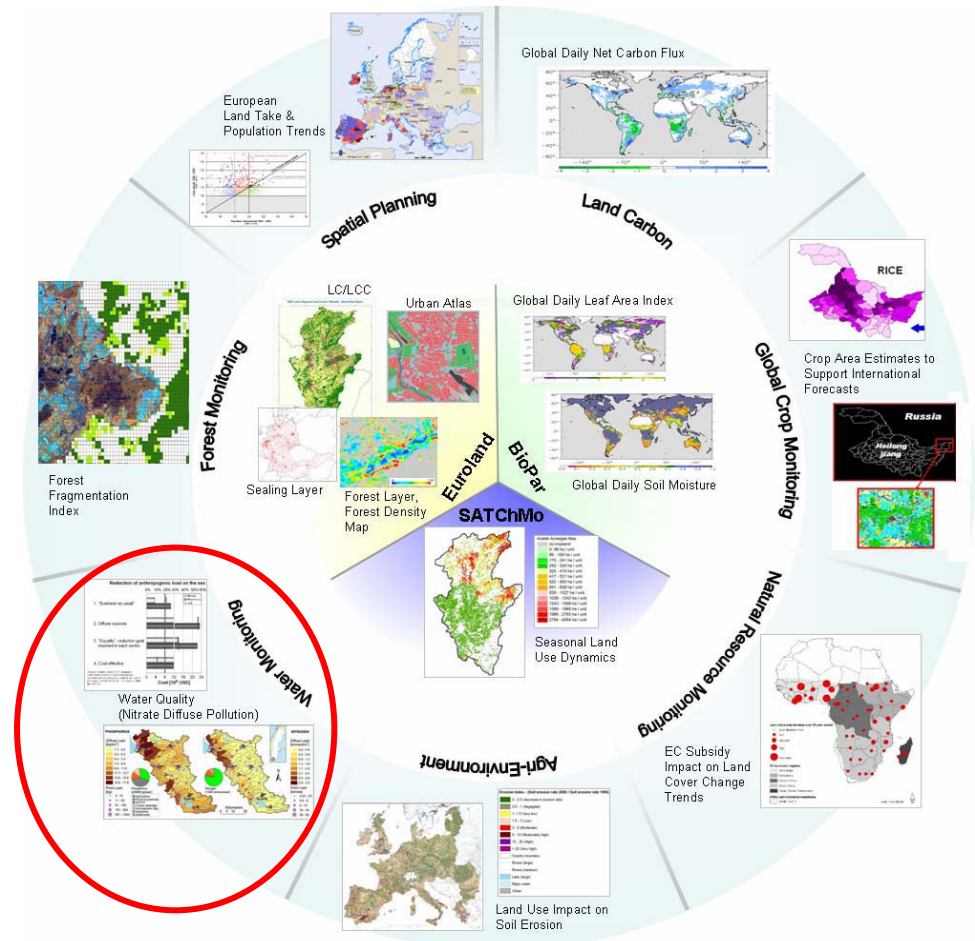
CIS Water connect products from Euroland and Biopar in water and nutrient models.

Hypothesis:

Satellite data will improve the quality of model results.

CIS Water pan-European tools:

- **E-HYPE** (dynamic water & nutrient model)
- CAPRI (agric. nutrient surplus)
- MONERIS (nutrient source apportionment for rivers)



E-HYPE applications in geoland2 CIS Water

Hydrological predictions (WA-01)

Long-term water resources (WA-02)

Nutrient loads to enclosed seas & source apportionment (WA-03)

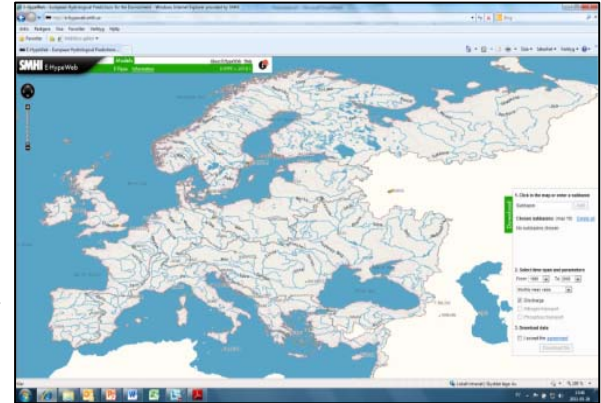
End user scenario tool (WA-06)

All these applications are based on the combination of:

- **GMES satellite products**
- **hydrological model**
- **readily available global/regional databases**
- **operational technical infrastructure**
- **web visualisation and downloading functions.**

Access: <http://www.smhi.se/e-hype>

HYPE on the Web (today)



Continental Europe (E-HYPE)

www.smhi.se/e-hype

Water discharge (m³/s): Daily and Monthly
Resolution: ~200 km²

Baltic Sea basin (Balt-HYPE)

www.smhi.se/balt-hype

Water, phosphorus and nitrogen load: Daily and Monthly
Resolution: river outlet to the Baltic Sea

Sweden (S-HYPE)

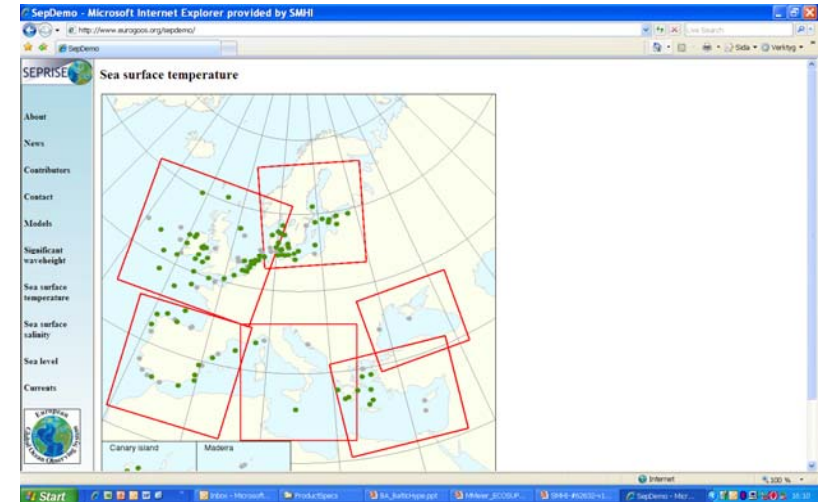
www.smhi.se/tema/vattenforvaltning

Water, phosphorus and nitrogen load: Daily and Monthly
Resolution: ~28 km² / ~10 km²




European HYPE Users so far...

- Water management and ecological status, WFD (SE Government)
- Oceanographic forecasting, EuroGoos (EU FP7: MyOcean, OPERR)
- Eutrophication combatement in the Baltic Sea, HELCOM (BONUS: Ecosupport)
- Adaptation to climate change in the Baltic Sea region, MSFD, Governmental cooperation (EU Interreg / SE Government: Baltadapt)
- Water allocation – (EU FP7: Sirius)
- Climate services (EU FP7: SUDPLAN, ECLISE, Impact2C)






Tested satellite products from CMS



| BIOPAR products | |
|--------------------------|---|
| FCOVER | Fraction of surface covered by green vegetation |
| FBROWN | Fraction of surface covered by brown vegetation |
| LAI | Leaf Area Index |
| FWATER | Fraction of water on the surface |
| FSNOW | Fraction of snow on the surface |
| SWI | Soil Water Index |
| EUROLAND products | |
| SOIL SEALING | Degree of Imperviousness |
| CORINE++ | Landuse cover with the resolution of 10x10 m |

FBROWN and FCOVER (BioPar)

Fraction of Brown and Green vegetation (FBROWN and FCOVER)

= fraction of area covered by Non Photosynthetic Vegetation (NPV) and the green part of the vegetation canopy.

Analysis

Usefulness for E-HYPE

Input data of:

1. the length of the growing season?
2. classification of forest types?

Test Areas

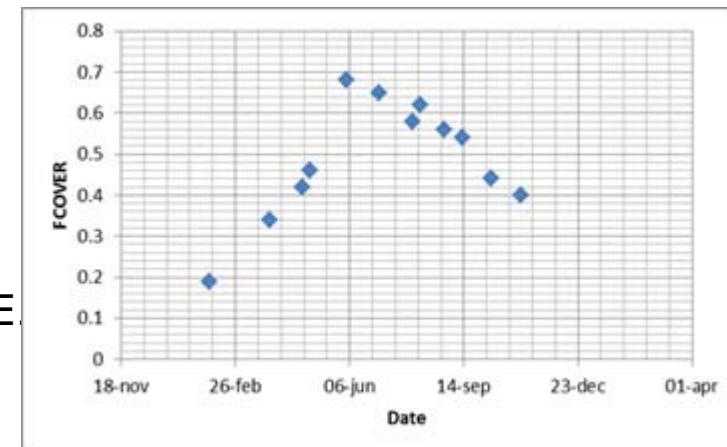
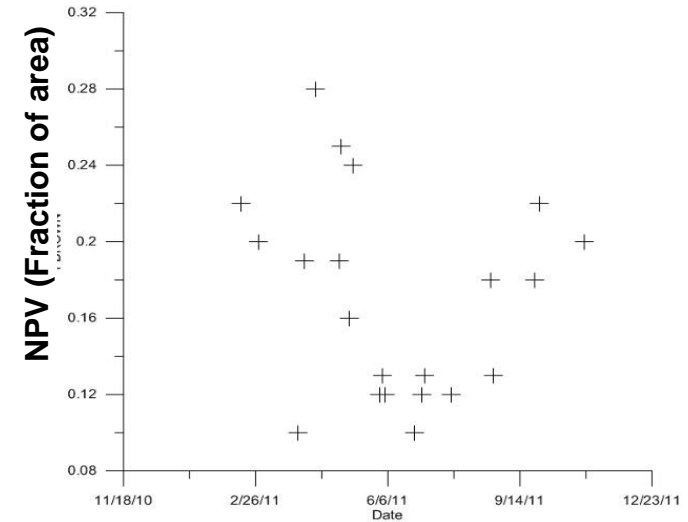
Motala Ström: 15 500 km², South Eastern Sweden.

Results

1. Temporal pattern of NPV could be distinguished
2. FBROWN combined with FCOVER could be used to identify forest type

Conclusion

- The FBROWN have a potential to contribute to E-HYPE
- Temporal resolution must be improved.
- Too few and too scattered data were available for full analysis.



LAI (BioPar)

The Leaf Area Index (LAI)

= half the developed area of photosynthetically active elements of the vegetation per unit horizontal ground area

Analysis

Usefulness for E-HYPE

Input data of:

-Spatial variability of vegetation growth over time

Test Areas

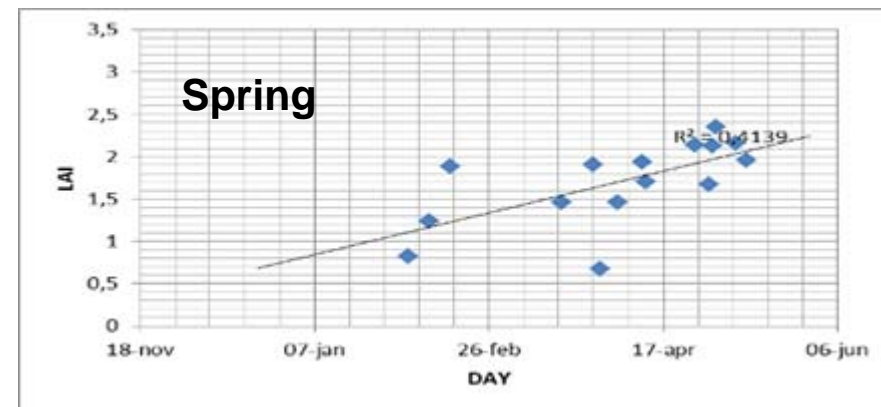
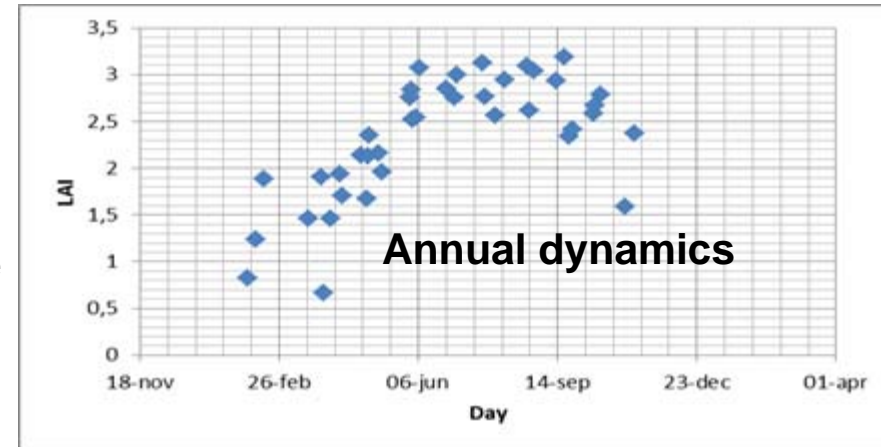
1. Motala Ström: 15 500 km², South Eastern Sweden.
2. Sventoji River: 472 km², Lithuania

Results

Four seasons could roughly be distinguished.

Conclusion

- LAI is useful to determine vegetation dynamics over large areas.
- Higher temporal resolution and longer time series would make the results more robust.



FWATER (BioPar)

Fraction of Water (FWATER)

= fraction of the pixel that is covered by water.

Analysis

Usefulness for E-HYPE:

1. input data of lake surface
2. validation of modelled dynamics in lake water level and wetland surface.

Test Areas

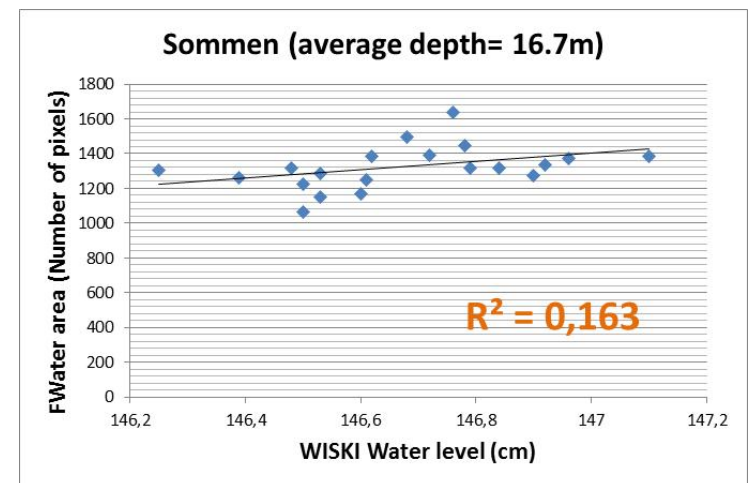
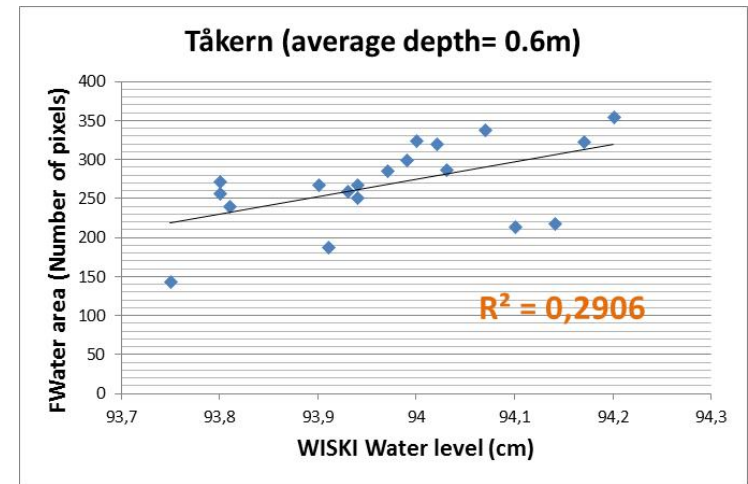
Motala Ström: 15 500 km², South Eastern Sweden.

Results

1. Lake surface correspond well to other lake databases, but does not contribute new info.
2. The fluctuation of lake area correlates only to water level measurement for very shallow lakes.
3. Wetlands as defined by CORINE could not be defined using FWATER.

Conclusion

- FWATER may be used for validation of dynamic modelling of lake surface of shallow lakes and large wetlands, and dam regulations. This will be further evaluated.
- Clouds disturb many images, which reduces the usefulness.



FSNOW (BioPar)

The Fraction of Snow (FSnow)
= visible snow on soil or vegetation canopy

Analysis

Usefulness for E-HYPE results is validation of:

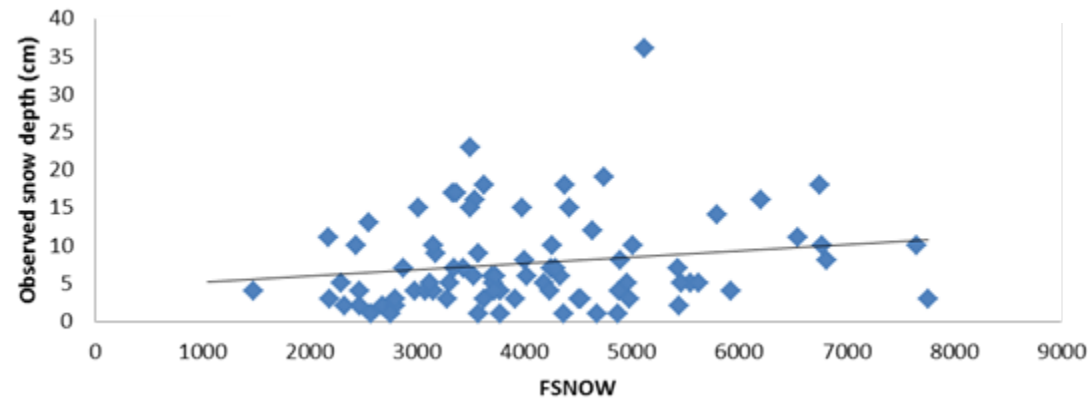
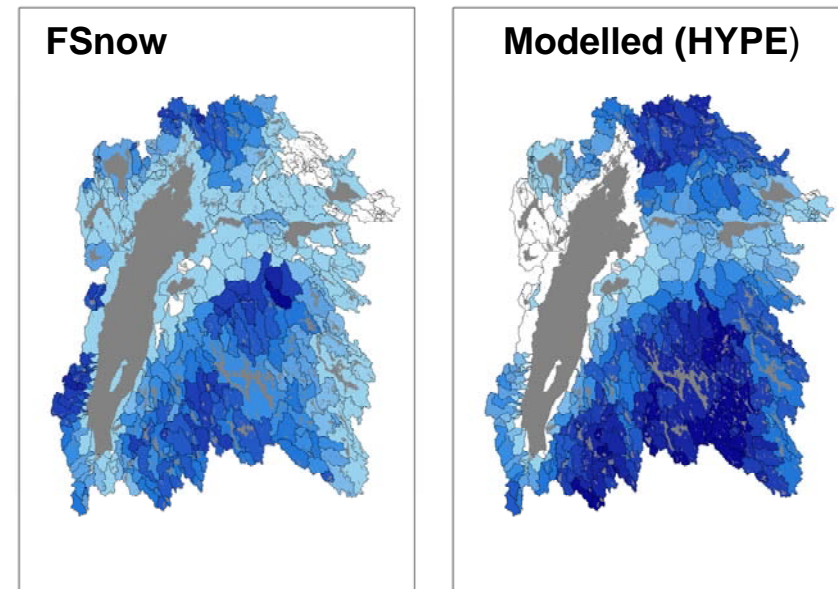
1. modelled snow depths
2. observed snow depths

Test Areas

Motala Ström: 15500 km², South Eastern Sweden.

Results

1. Modelled snow depths patterns show similarities (spatial average)
2. Observed snow depths show poor correlation $R^2=0.03$ (points)



Conclusions

- The FSNOW product has a potential to be used for E-HYPE updating and evaluation.
- The quality of the product should be compared to the snow product of the FP7 project CryoLand.

SWI (BioPar)

The Soil Water Index (SWI)
= daily soil moisture in the root zone based on
time series of surface soil moisture (SSM).

Analysis

Usefulness for validation of E-HYPE results:

- Ground water level (m)
- Soil Moisture, i e. total amount of ground water
in catchment (mm)

Test Area

Baltic Sea basin (June 2007)

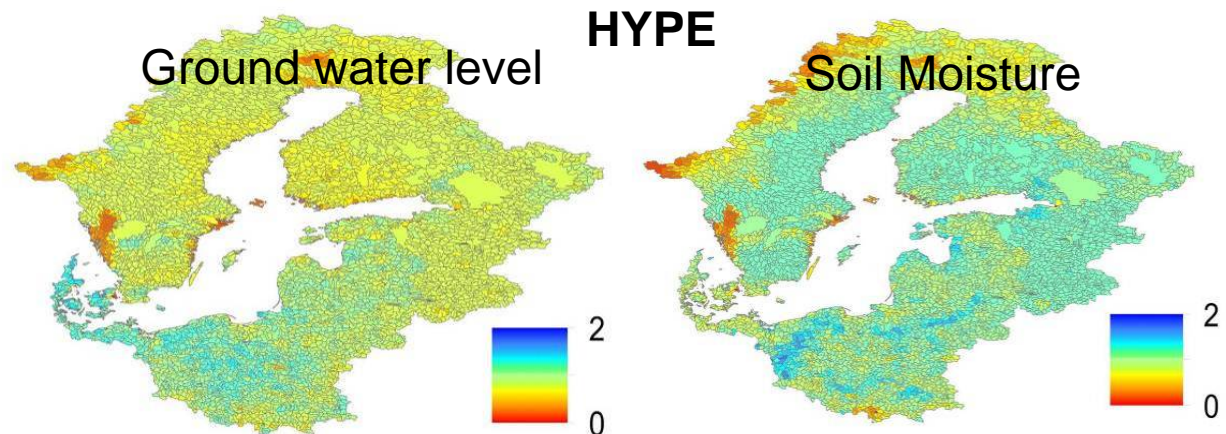
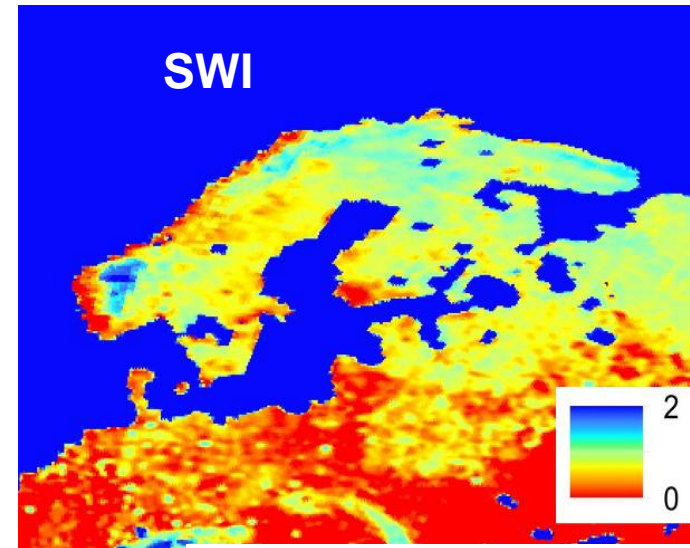
Results

SWI does not contribute
further information than
the surface soil moisture
product.

Conclusion

The SWI product could be used for updating E-HYPE model state variables, if a correlation
between SWI and HYPE parameters can be found.

First, infiltration time and depth must be established for various soil types.



Tested satellite products from CMS

BIOPAR products

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EUROLAND products

| | |
|--------------|--|
| SOIL SEALING | Degree of Imperviousness |
| CORINE++ | Landuse cover with the resolution of 10x10 m |

SOIL SEALING (Euroland)

Degree of imperviousness (Euroland SoilSealing)

= highly resolved (20x20m) imperviousness for built-up areas and changes between 2006 and 2009.

Analysis

Usefulness for input data to E-HYPE:

Replacement of CORINE's artificial surfaces

Test Areas

Motala Ström: 15 500 km², South Eastern Sweden.

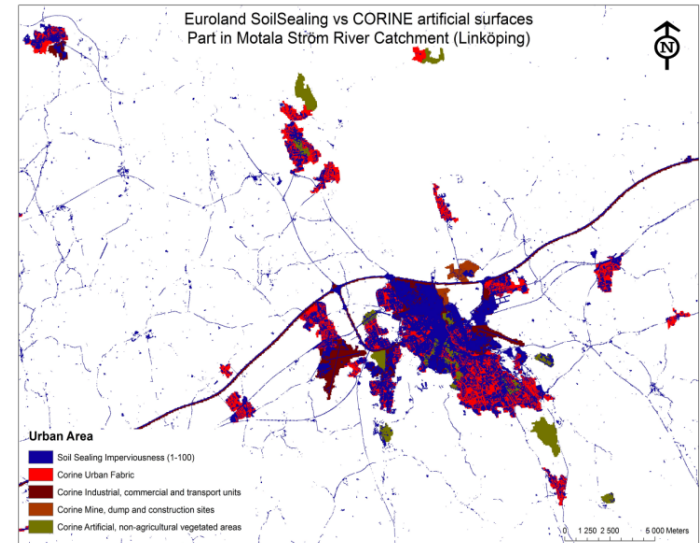
Results

1. Soil Sealing vs Corine: Less sealed area in cities, and slightly more sealed area in the countryside.

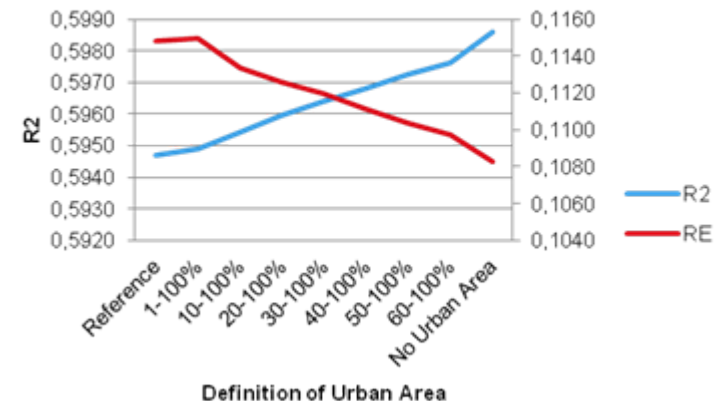
2. Impact on E-HYPE results: improvement for simulations of discharge could be seen in partly sealed areas

Conclusion

The Euroland Soil Sealing has already been included in E-HYPE2.0



Nash- Sutcliff R2 and Volume error (RE) for Discharge simulations



CORINE++ (Euroland)

CORINE ++

= highly resolved (10x10m) landcover database with 34 classes

Analysis

Usefulness for input data to E-HYPE:

Replacement of CORINE (100x100 m)

Test Areas

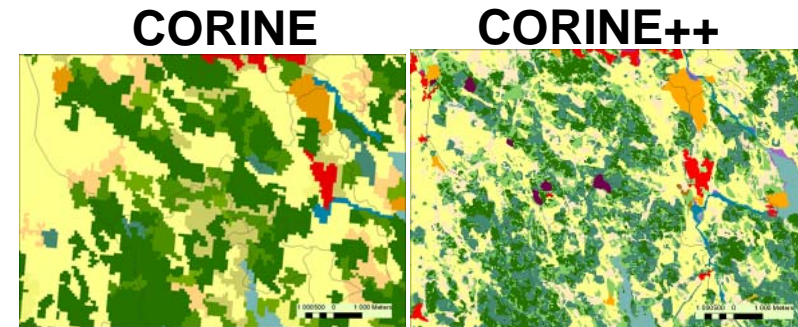
Motala Ström: 15 500 km², South Eastern Sweden.

Results

An improvement for simulations of discharge could be seen in explained variance of daily time-series.









Conclusion

The product would have been very useful if it had been available for entire Europe (now only available for the test catchment)



| | CORINE | CORINE ++ |
|----------------------------------|--------|-----------|
| Average explained variance (NSE) | 0.59 | 0.61 |
| Average volume error | 0.11 | 0.11 |

Conclusions

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Up-coming HYPE services

2011 the version of E-HYPE2.0 is released

2011 an open source community for the HYPE code is launched

<http://hype.sourceforge.net/>

2012 the model will provide forecasts and climate change impacts

2012 nutrient load will be provided for the whole domain

Thank you for the attention!



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