Markus Huttunen, Inese Huttunen, Marie Korppoo, Vanamo Seppänen and Bertel Vehviläinen

Finnish Environment Institute SYKE
P.O. Box 140, FI-00251 Helsinki Finland
Email: markus.huttunen@environment.fi

SYKE GisBloom EU LIFE+ FICCA

The European Agricultural Fund for Rural Development: Europe investing in rural areas

National level nutrient loading estimation tool in Finland
WSFS-Vemala

Introduction

- WSFS-Vemala tool has been developed for estimation of nutrient loading into rivers and lakes in Finland and into the Baltic Sea.
- Simulation of total phosphorus, total nitrogen, suspended solids and total organic carbon is included.
- Provides for each about 58 000 lakes in Finland an estimate of nutrient concentration in the lake, incoming and outgoing nutrient load and division of incoming load by source, which are agriculture, forests and forestry, scattered dwelling and point sources.
- For implementation of the WFD it provides an estimate of the present state of the lake by nutrient concentrations, it provides understanding reasons for the state of the lake by dividing the loading by the sources and it also provides scenarios for the future state and loading of the lake with different load reduction options.

Nutrient leaching and transport simulation

- Hydrological simulation is based on WSFS system, which simulates the hydrological cycle by one day time step.
- For phosphorus leaching and erosion simulation the field level Icecream model is applied. In the Icecream model farming practices, fertilization, crop growth, phosphorus cycle in the soil and finally leaching and erosion are simulated on daily time step (Fig. 1)
- Slope profile, crop and soil type data for each 1 100 000 fields in Finland are described.
- For nitrogen simulation in fields a similar process based model is applied on sub-basin level and field scale nitrogen simulation with Icecream model is under development.
- For loading from forests and forestry are used estimated values. Process based simulation is under development.
- Point loads, atmospheric deposition and load from scattered dwelling are included in the model.
- Transport, sedimentation, erosion and denitrification are modelled for rivers. In lakes sedimentation, resuspension, release from sediments and denitrification are modeled (Fig 2)

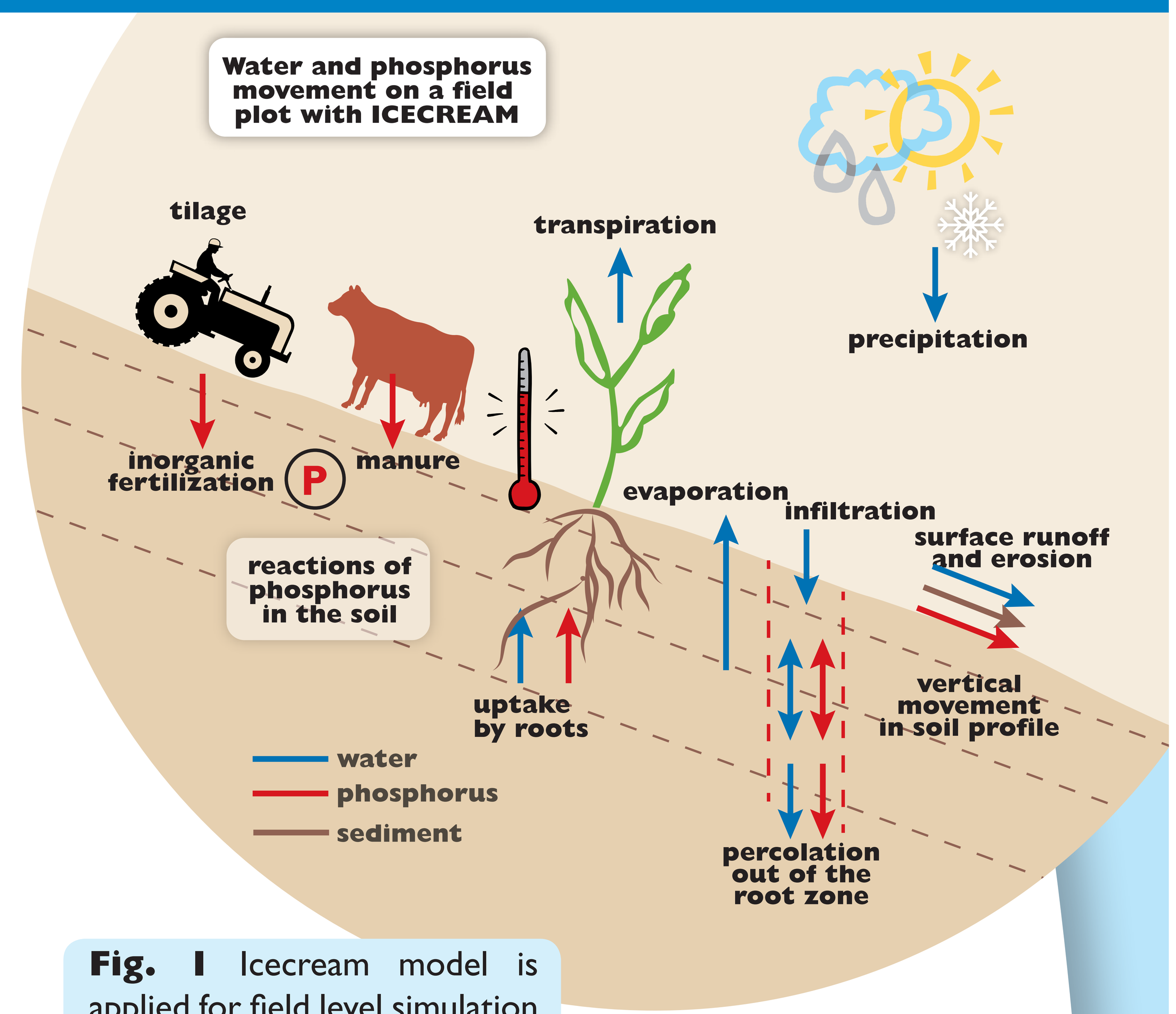

Fig. 1 Icecream model is applied for field level simulation of phosphorus and erosion.

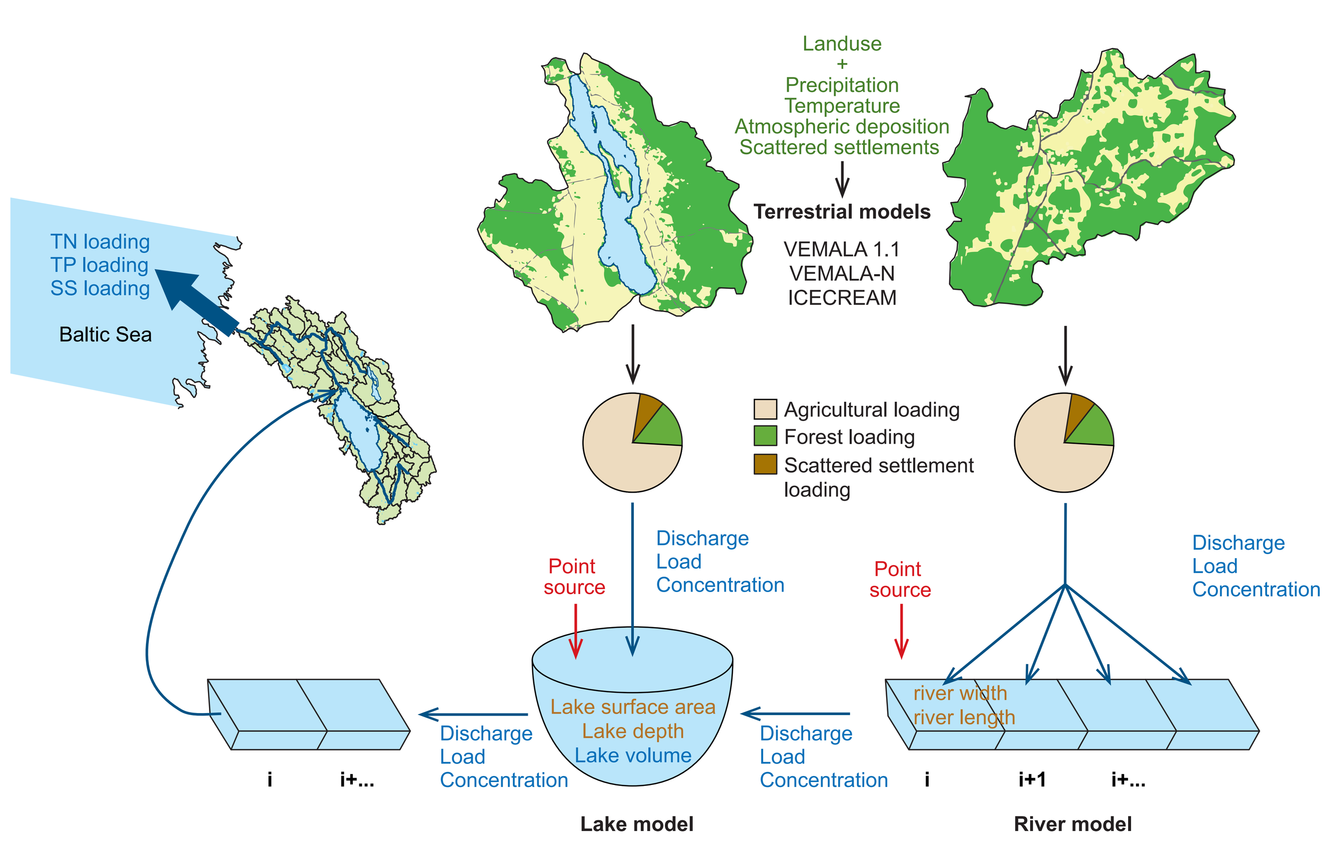

Fig. 2 Structure of the WSFS-Vemala model.

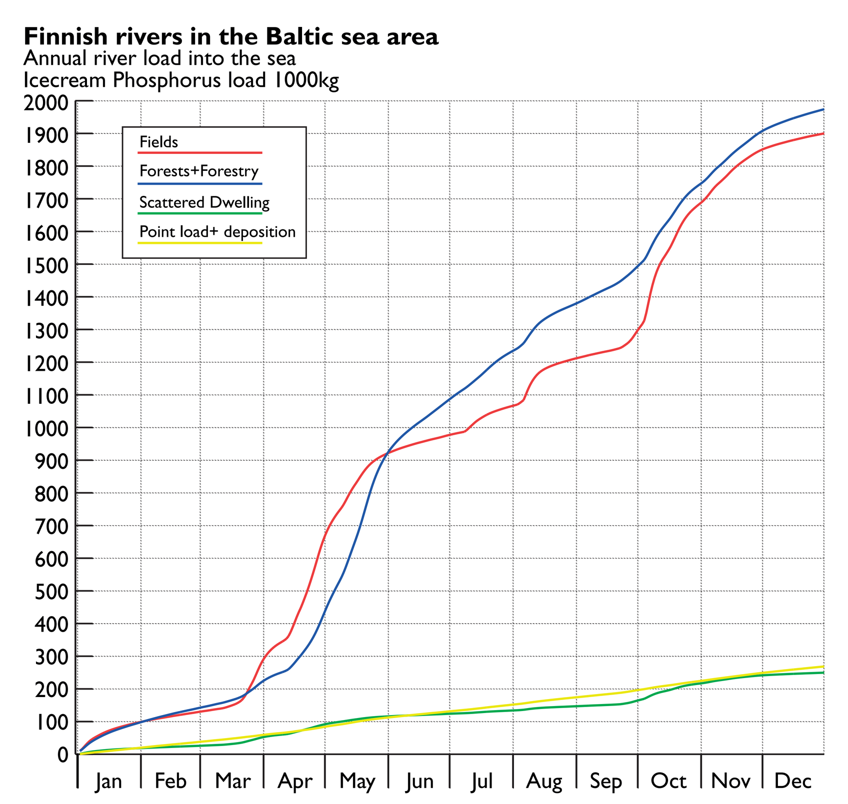

Fig. 3 Loading to the Baltic Sea divided by sources.

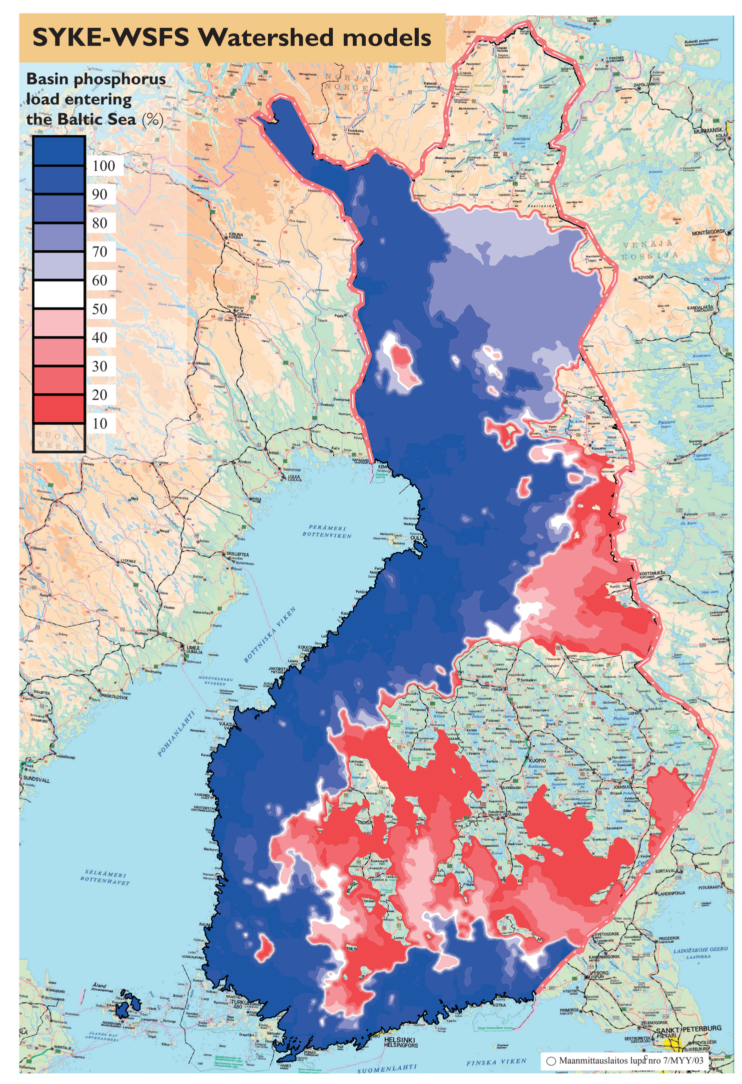

Fig. 4 Phosphorus retention in rivers and lakes. Actions to reduce loading to the Baltic Sea should be placed on blue areas.

Scenarios

- The WSFS-Vemala tool is applied for load reduction and country wide climate change scenarios.
- The tool can also be applied for basin specific scenarios, where even farming practices and fertilization of each field can be adjusted separately by the characteristics of the field.
- For the effects of climate change on agriculture the DREMFIA sector model scenarios from MTT Agrifood Research Finland are applied.
- Scenario results include field level results (Table 1), for lakes division of incoming loading (Table 2) and finally loading to the Baltic Sea (Fig 3)
- Retention simulation supports planning the placement of load reduction actions (Fig 4)

GisBloom - Tools for evaluation and management of eutrophication

- Life+ EU project (Life09 ENV/FI/000569)
- The demonstration and validation of scenario tools on six river basins
- Definition and analysis of local scenarios in workshops with local stakeholders
- Presentation of the scenarios for the public via Vesinetti.fi (will be opened in 2013)
- Country wide scenarios give an overall picture about the possible pathways for water quality
- Real time simulation and forecasting of water quality at www.environment.fi/waterforecast

Field id	Name	Slope, %	Area,ha	Phosphorus leaching kg/ha/a
7620256645	Pihantaus	4.47	16.93	1.7
7620330205	Rikkasuo 1	5.34	6.59	1.61
7620520262	Nivonniska	3.47	4.02	1.59
7620254827	Inganmäki	3.75	3.8	1.54
7620239164	Koskenniska	0.69	2.71	1.4
7620262305	Väliaho	3.03	4.02	1.22
1400111639	Paskosuo	2.29	3.47	1.02
1400072031	Vinkuanlahti	2.35	6.08	0.9
7620248965	Nurmela	1.84	5.55	0.9
7620520464	Rauhanranta	0.26	1.75	0.85
7620300596	Lauranlampi	2.2	6.89	0.84
7620405781	Särkilahti 1	2	15.16	0.81
7620231888	Pihapelto	2.3	5.99	0.81
7620184196	Riemuraivio	1.34	7.86	0.67
7620519858	Perkiö	0.18	16.08	0.66
7620204206	Rikkapuro	0.82	6.92	0.58
7620060827	Niskalahti	2.06	3.48	0.56
7620028794	Keskipelto	0.95	16.26	0.53
7620109630	Rikkasuo	0.87	20.07	0.51
7620029303	Lohilahti 2	0.95	6.61	0.42
7620028895	Koivupelto	0.34	23.28	0.41
7620530669	Kouluntaus	1.66	16.38	0.16

Table 1. An example of the field level results.

Table 2. Loading to each lake divided by source. Upstream retention simulated by the model.

Lake id	Name	Phosphorus Concentration ug/l	Incoming load P kg/a	Fields P kg/a	Forest P kg/a	Scattered dwelling P kg/a	point sources P kg/a	Load out P kg/a
04 582 001	Vinkuanlahti	42.84	15172.83	6235.78	7238.96	660.38	1037.68	15114.44
04 582 002	Sulkavanlahti	134	139.04	115.47	15.3	7.41	0.86	137.43
04 582 003	Vehkalampi	115.09	4.3	3.71	0.29	0.17	0.13	2.72
04 582 004	Kivilampi	104.29	27.66	21.22	4.33	1.84	0.28	26.52
04 582 005	Rajalahti	60.23	17.05	8.85	5.07	1.8	1.33	13.86
04 582 006	Pentanlahti	41.61	14876.35	6082.15	7256.38	647.03	890.75	14745.66
04 582 007	Iso Lapinjärvi	26.53	78.07	44.13	20.1	7.33	6.51	27.39
04 582 008	Pieni Lappi	53.99	20.55	12.55	5.05	1.88	1.08	13.85
04 582 009	Itä-Kaija	55.95	11.88	4.96	4.92	1.66	0.34	11.67
04 582 010	Kuikkalampi	88.12	22.12	15.5	4.6	1.8	0.22	21.39
04 582 011	Rikkalampi	98.48	490.68	359.91	90.38	36.52	3.87	479.97
04 582 012	Pyöree	72.95	1.67	1.23	0.22	0.1	0.12	0.91

Acknowledgements

Work funded by EU Life, Academy of Finland Ficca program and The European Agricultural Fund. Supported by projects Gisbloom, Marisplan and Velho.

Layout: Erika Várkonyi / SYKE, 3/2013