VACCIA-project: aims and key results

Martin Forsius
Finnish Environment Institute (SYKE)
Ecosystem Change Unit

www.environment.fi/syke/vaccia

SYKE

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

UNIVERSITY OF HELSINKI

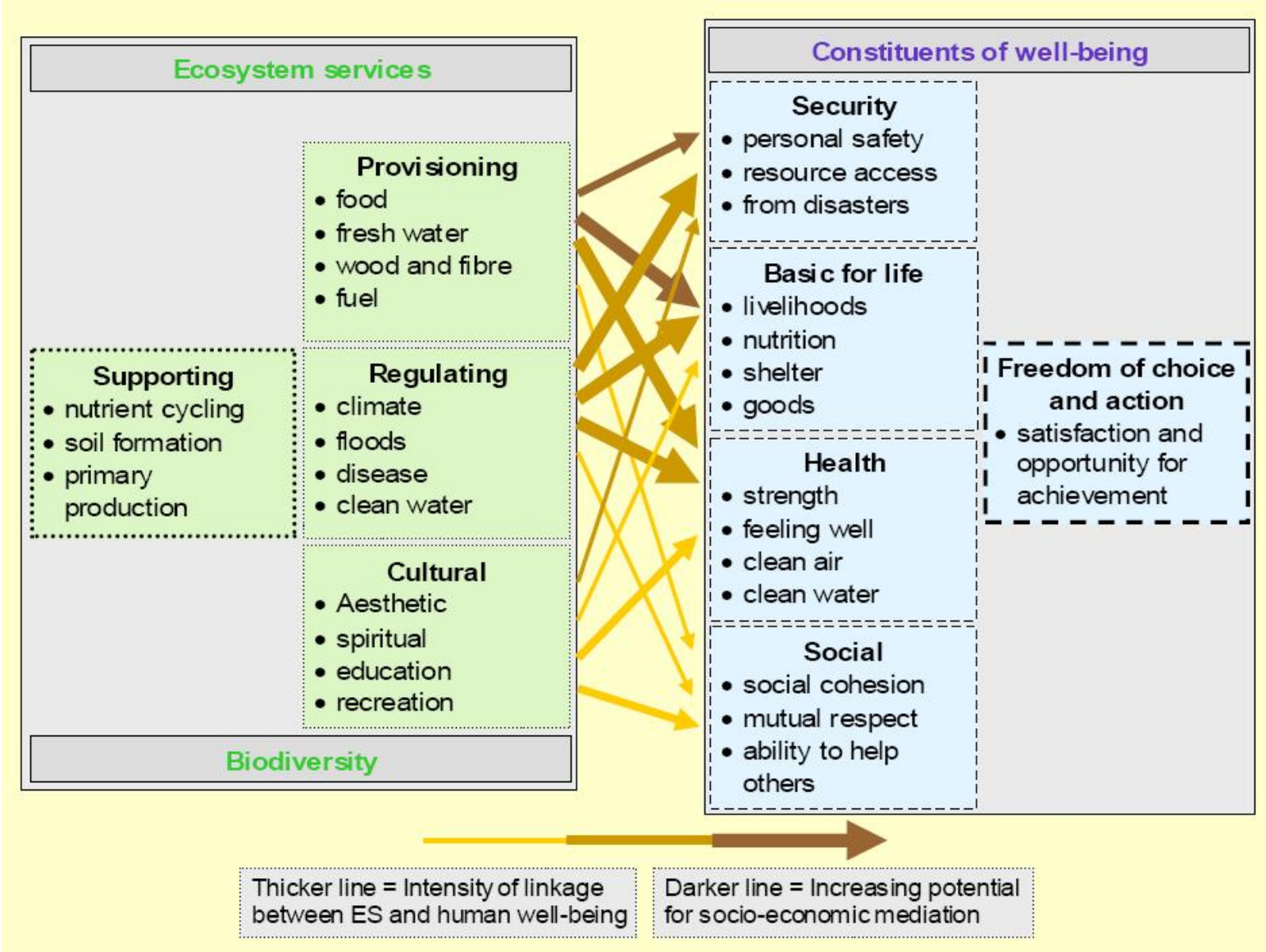
UNIVERSITY OF JYVÄSKYLÄ

OULUN YLIOPISTO
UNIVERSITY of OULU

Main general aims of project

- Develop methods and tools for making climate change impacts and adaptation assessments on key ecosystem services
- Derive critical thresholds for environmental change
- Provide inventories of realistic climate change adaptation measures together with end-users
- Contribute to the development of existing/planned national and international policies and networks in the fields of climate change impacts and adaptation

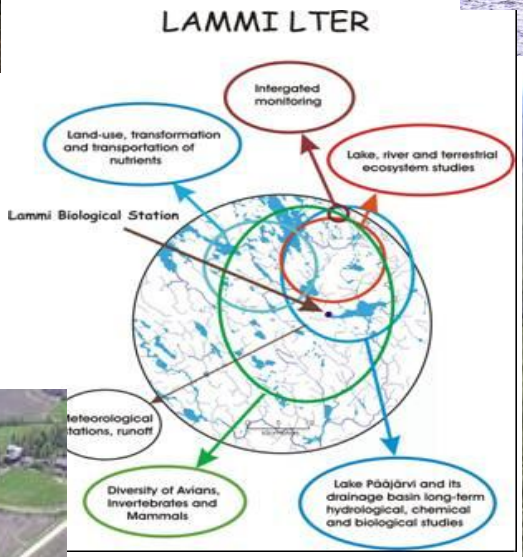
Ecosystem services and human well-being



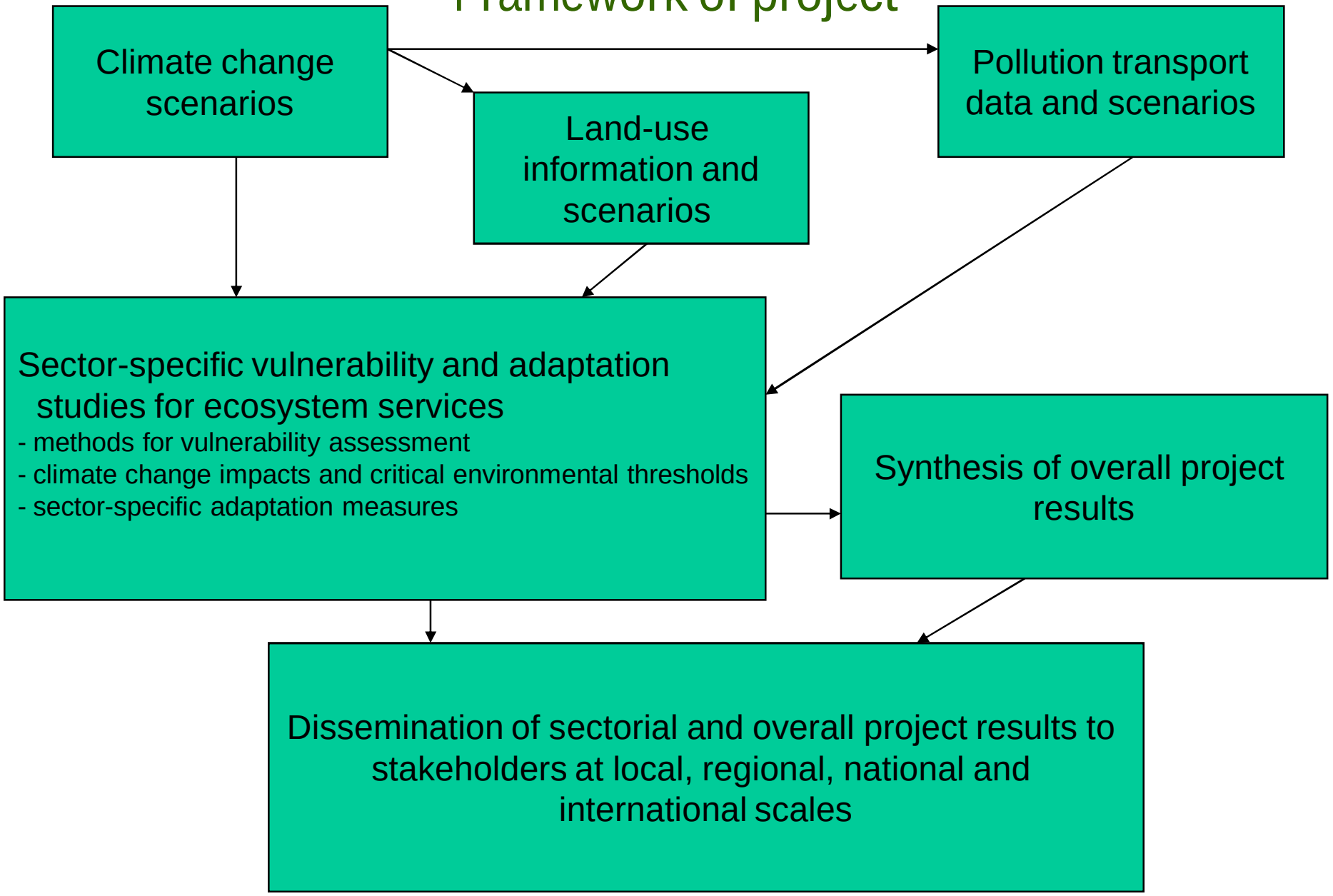
VACCIA-project

- Based directly on Finnish network of Long-Term Ecosystem Research (LTER) sites, called FinLTSER
- The FinLTSER-sites have top-class infrastructure, long-term data, and are well integrated in the local economy
- Partners: SYKE (coordination), Finnish Meteorological Institute, Universities of Helsinki, Jyväskylä and Oulu
- Total budget 3,2 milj. € (50% EU LIFE+)
- Duration: 1.1.2009 - 31.12.2011
- Co-operation: many institutes, companies, municipalities, associations

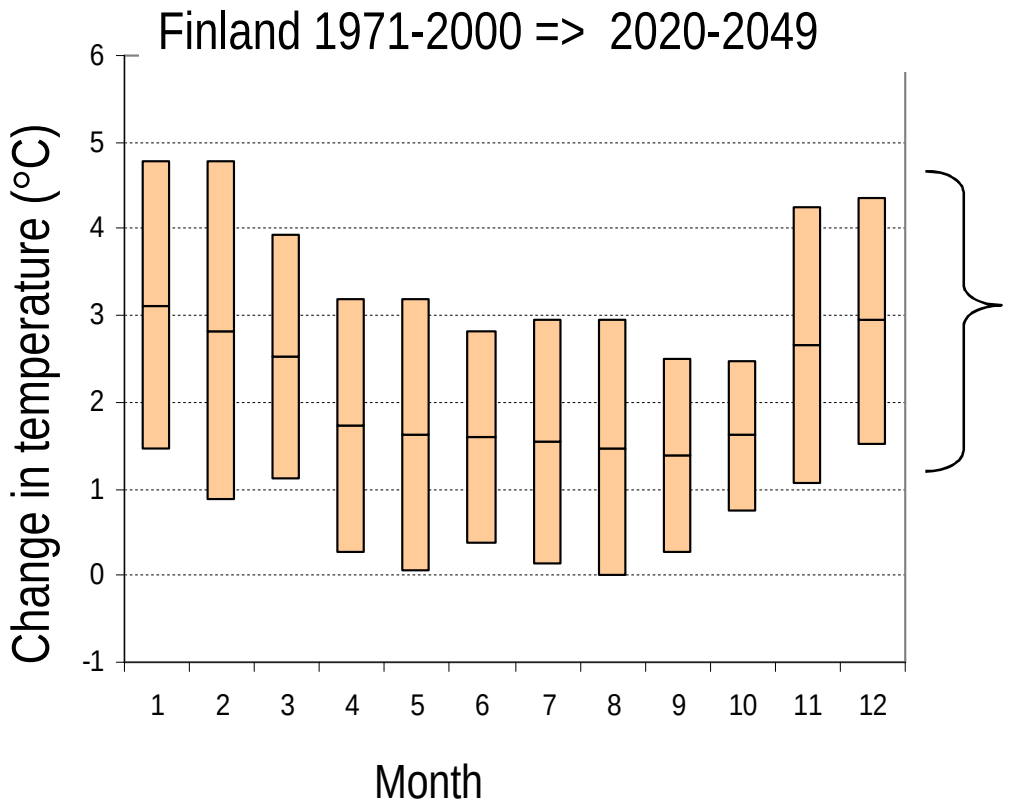
Lammi LTER


LAMMI LTER
Intergated monitoring
Land-use, transformation and transportation of nutrients
Lake, river and terrestrial ecosystem studies
Lammi Biological Station
Meteorological stations, runoff
Diversity of Avians, Invertebrates and Mammals
Lake Pääjärvi and its drainage basin long-term hydrological, chemical and biological studies

Framework of project

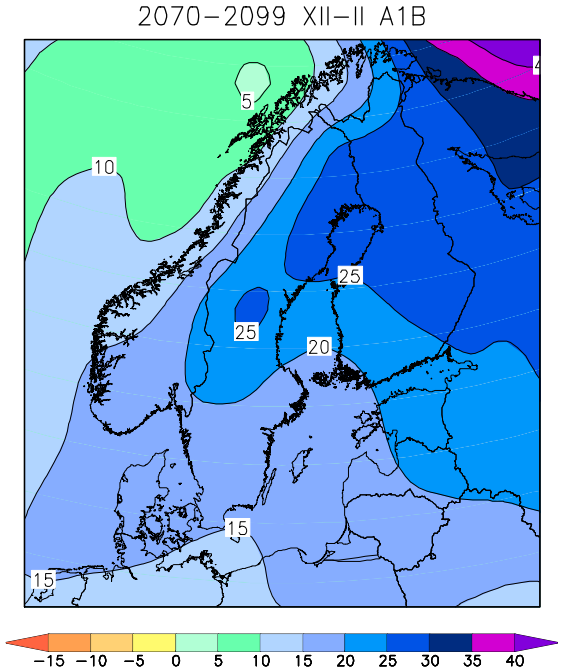


Temperature and precipitation in Finland are predicted to increase particularly during winter



Best estimate and 90% confidence interval (A1B scenario)

Precipitation change %

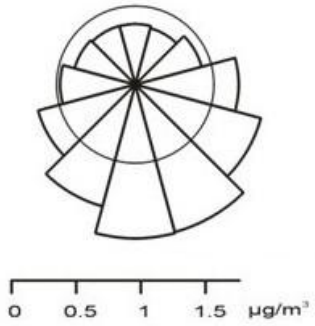


ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

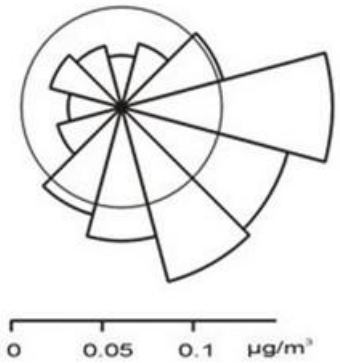
Increase of Arctic shipping increases air pollution in north Finland

2009

NO_x 0.7 µg/m³

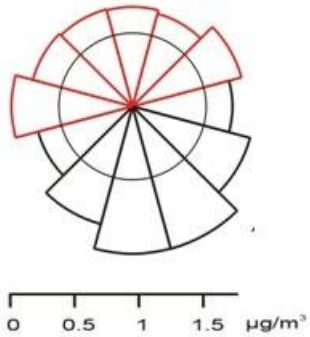


Black Carbon 0.06 µg/m³

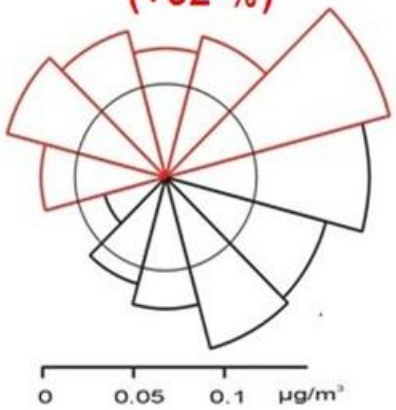


2030

NO_x 0.9 µg/m³
(+17 %)

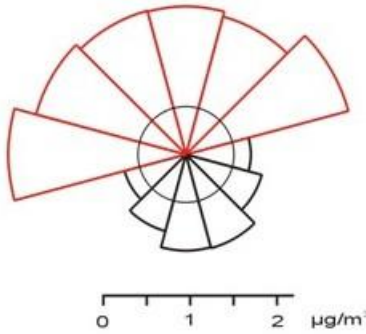


Black Carbon 0.08 µg/m³
(+32 %)

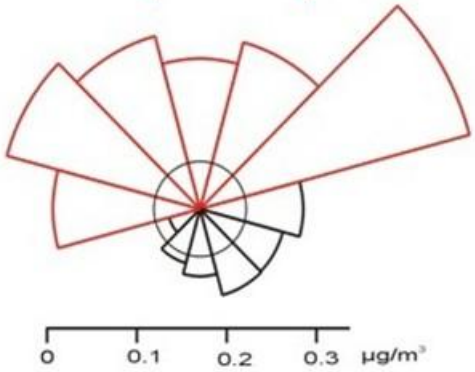


2050

NO_x 1.3 µg/m³
(+71 %)

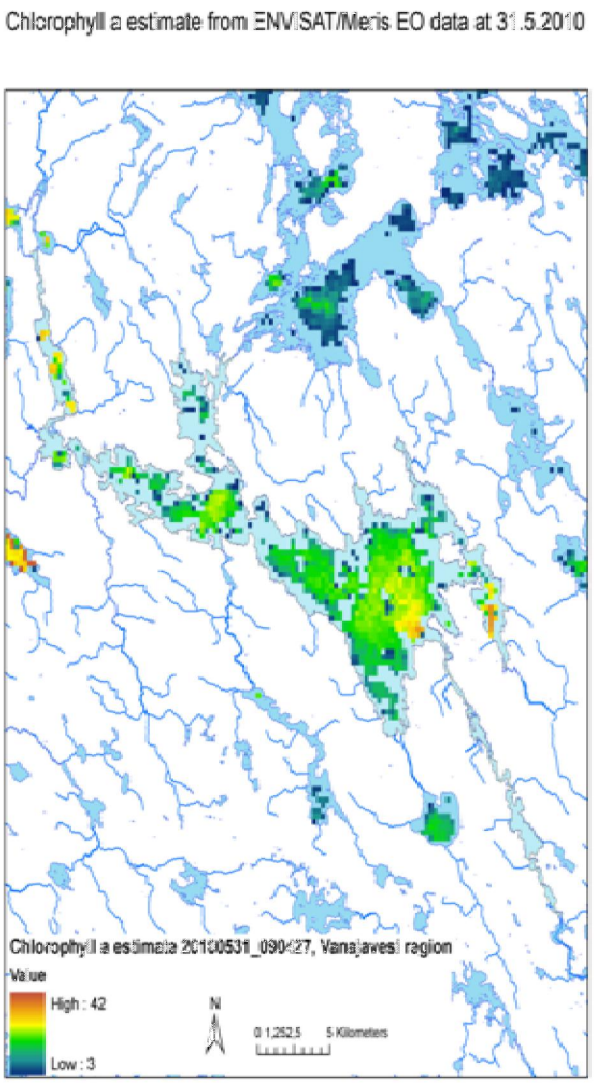


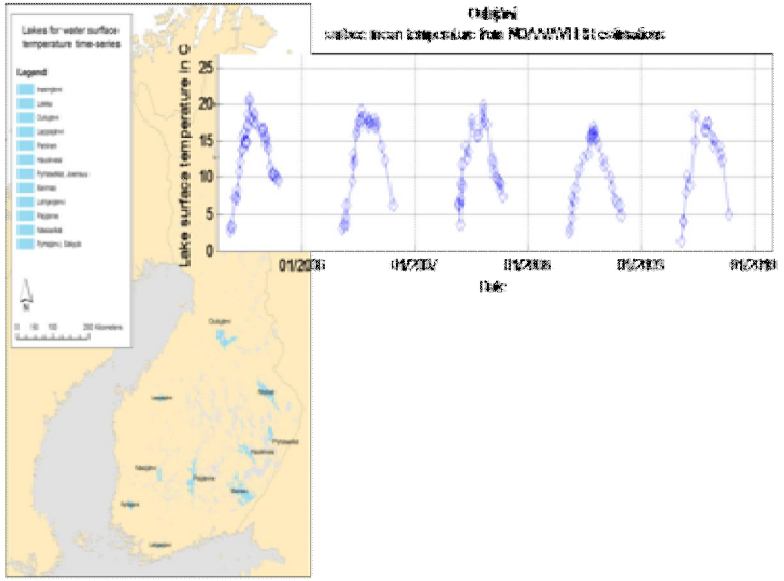
Black Carbon 0.13 µg/m³
(+108 %)



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Development of remote sensing tools

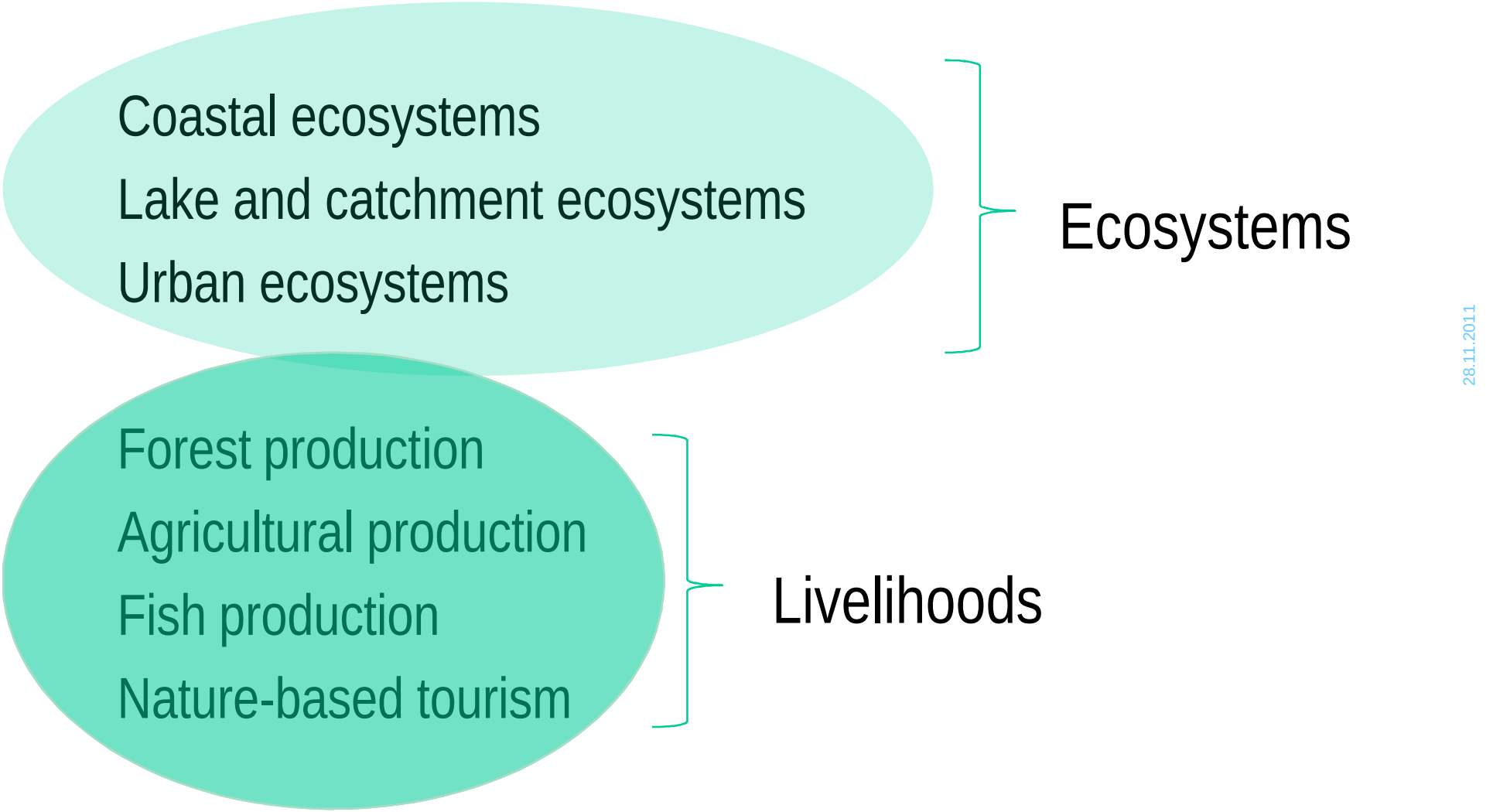




28.11.2011

SYKE

Sectors in VACCIA-project



Key results

Coastal ecosystems

Lake and catchment ecosystems

Urban ecosystems

Gulf of Finland, Tvärminne

- Long-term measurements (1939-2007) of water turbidity show a decrease in visibility depth from about 7 m → 3.5 m. This indicates increasing eutrophication
- Climate change is likely to increase the loadings of nutrients and suspended matter even further
- Climate warming has resulted in an earlier spring migration and later autumn migration of water birds. On average autumn migration occurs 0.37 days/year later (11 days in 30 years)
- GIS-portal constructed (http://maps.tvarminne.helsinki.fi/)

UNIVERSITY OF HELSINKI

VACCIA

VACCIA-PAIKKATIETOPORTAALI AVATTIIN 29.9.2010 18.00

VACCIA Vulnerability Assessment of Ecosystem Services for Climate Change Impacts and Adaptation – VACCIA

GIS-portaali

Visualisointi

Coastal ecosystems

Lake and catchment ecosystems

Urban ecosystems

Bothnian Bay

- The 2010 Red List of Finnish Species reports shores to be the prime habitat for an important proportion (12.9 %) of endangered species
- Climate change and overgrowth of meadows threaten several critically endangered (CR) species in the Bothnian Bay area

- *Ex situ* action plan for the conservation of threatened native plants taxa in Finland produced: 18 % of the total nationally threatened taxa are part of *ex situ* conservation measures; target = 75 %

OULUN YLIOPISTO
UNIVERSITY of OULU

Coastal ecosystems

Lake and catchment ecosystems

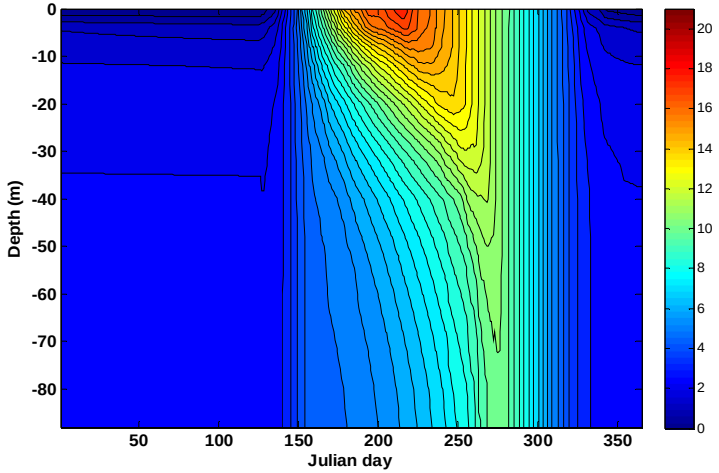
Urban ecosystems

- The watersheds and surface water ecosystems of the boreal zone are sensitive to changes in climate.
- Changes are predicted regarding nutrient cycling, leaching of nutrients to the waters and lake physical properties
- Thermal stratification in lakes during summer will be longer
- Temperature in upper water layer will be 2-3 °C higher
- Duration of ice-covered period will decrease or be totally lost
- Lake Pyhäjärvi: Increase in annual loading of suspended matter 740 → 920 kg d^{-1} (A1B scenario)

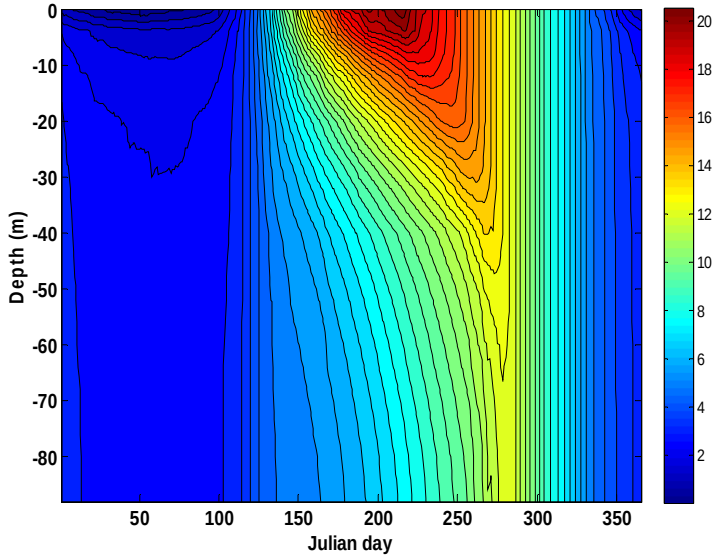
UNIVERSITY OF HELSINKI UNIVERSITY OF JYVÄSKYLÄ SYKE

Daily mean temperature changes in Lake Päijänne

Reference situation and climate change prediction (MyLake model)



1971-2000



2070-2099
Scenario A1B

UNIVERSITY OF JYVÄSKYLÄ

Coastal ecosystems

Lake and catchment ecosystems

Urban ecosystems

- Consolidating urban structure decreases the amount of the urban green providing local ecosystem services and weakens their quality
- Quantity and quality of groundwater are affected by the urban structure
- Analyses of soil samples indicated lower production of many ecosystem services of soils in the dense urban areas
- Dense urban structure can be an effective means of decreasing the local carbon footprint, but other environmental challenges need to be considered at the same time

  → Adaptation to the climate change demands a comprehensive vision

Livelihoods: key results

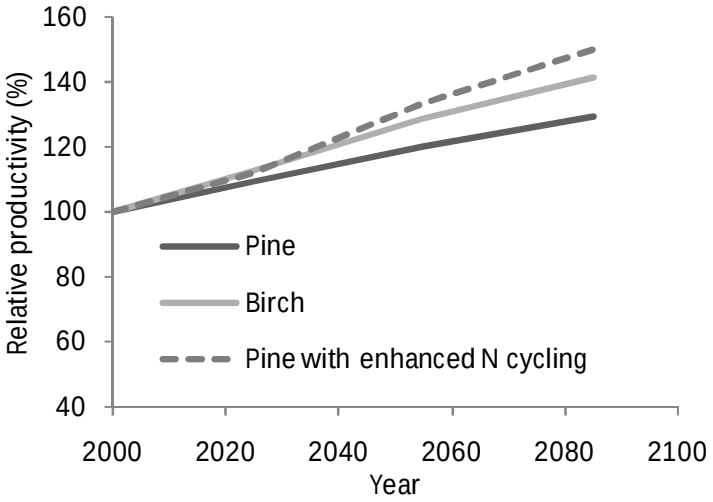
Forest production

Agricultural production

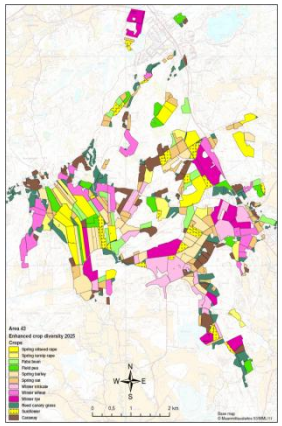
Fish production

Nature-based tourism

- Results (medium change scenario)
  - Photosynthesis production of forests in south Finland will increase by ca 30%
  - Growth may increase up to 50% due to increasing soil decomposition and increase in availability of N
  - Extreme events will reduce the development of forest resources
- Recommendations for forestry
  - The rotation period maximizing yield may decrease to < 50 years for pine in southern Finland.
  - Growth of deciduous trees may increase even more
  - More emphasis has to be put on combating ground vegetation



UNIVERSITY OF HELSINKI

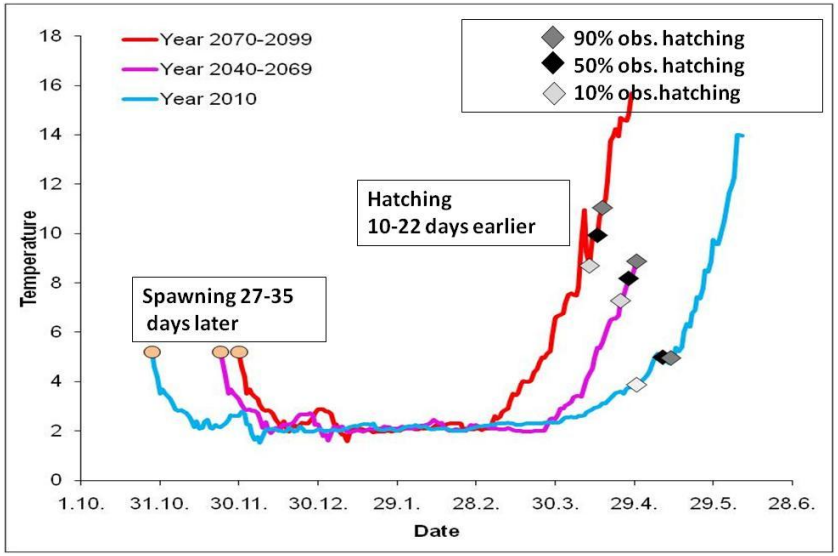


Forest production
Agricultural production
Fish production
Nature-based tourism

- Increases in the warmth and length of the growing season will improve the yield potential and enable the introduction of a wider selection of crops
- Sowing will on average start one week earlier in 2011-2040, two weeks earlier by 2041-2070 and three weeks by 2071-2100
- Warming climate favours the spreading and overwintering of pests, pathogens and weeds
- Climate change will bring new challenges for water protection efforts in the farming environment (suspended sediment load + 15 %; N load + 5% at Lepsämänjoki LTER-site)

UNIVERSITY OF HELSINKI

SYKE



Vendace

Forest production
Agricultural production
Fish production
Nature-based tourism

- The predicted changes in lake temperatures, lake ice and eutrophication influence both fish behavior and fisheries
- For some fish species the growing season will increase even by one month
- Pikeperch and perch are predicted to benefit from the changing conditions; trout populations suffer
- For vendace and whitefish both positive and negative effects are predicted
- The economic value of the available fish resource will likely decrease

Forest production
Agricultural production
Fish production
Nature-based tourism

- Changes in precipitation and substantial decreases in snow and ice cover can dramatically change the operational preconditions of nature-based tourism in northern Finland
- The increase of risks is related to the overall increasing unpredictability of local weather conditions → These risks will increase in the context of the assessed climate change scenarios
- Challenge for local adaptation is caused by the close connection of tourism to other societal practices, processes and economics

Adaptation options 1
(examples)

Coastal ecosystems
Lake and catchment ecosystems
Urban ecosystems

- Selection of management and grazing practices
- Biomanipulation
- Countermeasures to increased runoff: buffer zones, fertilizer amounts, and use of crop land
- Artificial recharge of storm waters via use of more permeable surfaces in urban areas
- Design of new types of infrastructures in the urban environment

28.11.2011

Adaptation options 2
(examples)

Forest production
Agricultural production
Fish production
Nature-based tourism

- Maintaining of the migration possibilities of forest species in the management of forest landscapes
- Species selection, optimal stand densities, and timing of intermediate cuttings
- Breeding of cultivars that can make use of the prolonged growing season
- Adaptation of commercial fishing to changes in fish stocks
- Development of year-round tourism services

Contributions to policy development

- VACCIA-results currently used in updating process of the national climate change adaptation strategy
- Results also useful for the national implementation of recent EU-strategies
- Evaluation of the *ex situ* conservation goals (national obligation of the Convention on Biological Diversity)
- Development of SAON network (Sustained Arctic Observation Network, Arctic Council)
- Support of local and regional scale development: e.g. vulnerability assessment of nature-based tourism
- VACCIA dissemination: > 60 reports/publications, 14 seminars

Concluding remarks

- LTER-sites provide good platform for detailed studies on climate change impact and adaptation assessment
- Climate change will have both positive and negative effects on key ecosystem services in Finnish conditions
  → results sector and scenario specific
- Adaptation measures mainly done at local/regional scale
  → need for high-resolution data (VACCIA-concept)
- VACCIA has contributed to policy development, results efficiently disseminated
- Global-scale assessment using VACCIA-concepts planned in international LTER-network (ILTER)


Thank you
www.environment.fi/syke/vaccia
www.environment.fi/syke/lter