



10th International Drainage  
Workshop of ICID 06.-11. July 2008

# **Flood risk management and land use planning in changing climate conditions**

**Mikko Huokuna**

**Finnish Environment Institute, SYKE**

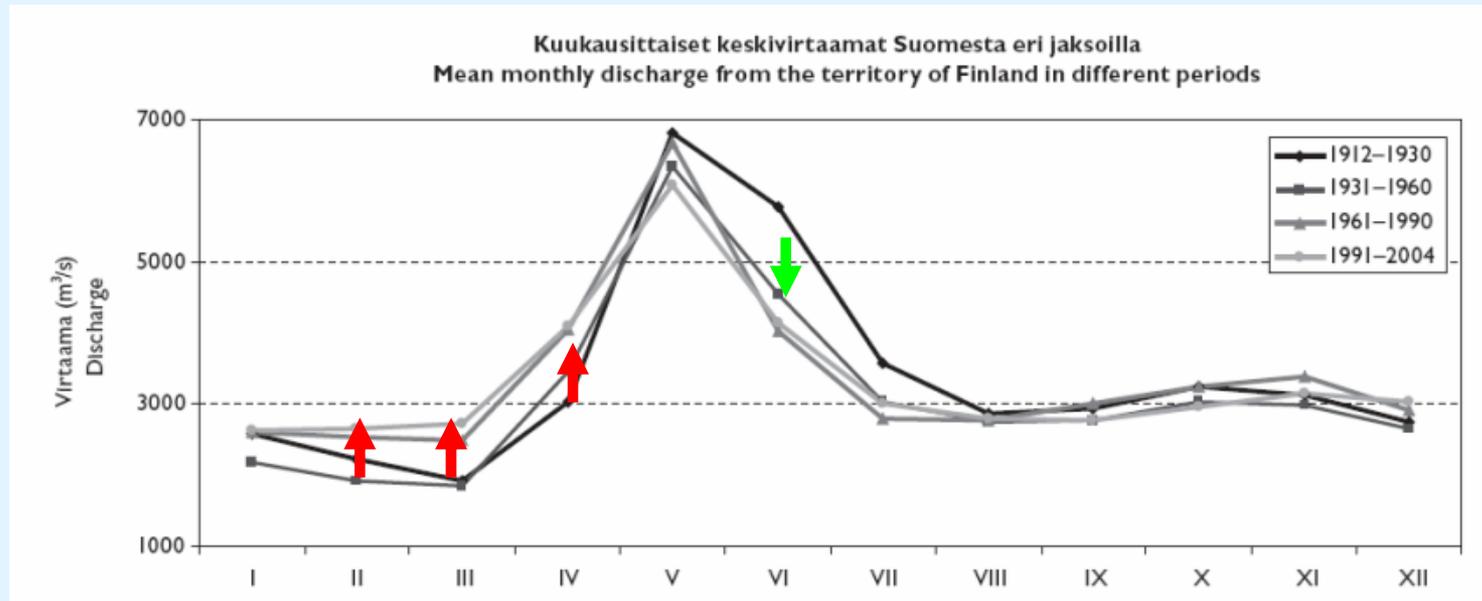
# Background hydrological information

- Finland's mean precipitation is about 700 mm/year
  - The half of this amount is evaporated and the rest flows to the seas.
- Currently, snow melt induced floods are causing the most serious flood damage in Finland
- Average annual flood damage has normally been less than five million euros

## Observed changes in climate in Finland

- In Finland the mean temperature rose by around 0.7°C during the 20<sup>th</sup> century
- No statistically significant precipitation or total annual mean outflow changes have been observed
- Significant seasonal changes have been observed
  - milder and shorter winters, causing increase in winter and early spring discharges

# Observed changes in climate in Finland



# Climate change predictions; the effects on precipitation

- Based on average of 19 global climate change models (A1B-scenario) precipitation is expected to increase in Finland by 2070-2099, relative to period 1971-2000 (RATU 2008)
  - winter season 10-40 %
  - summer 0-20 %
- In some regions 6 hour maximum precipitation may increase 30-40 %

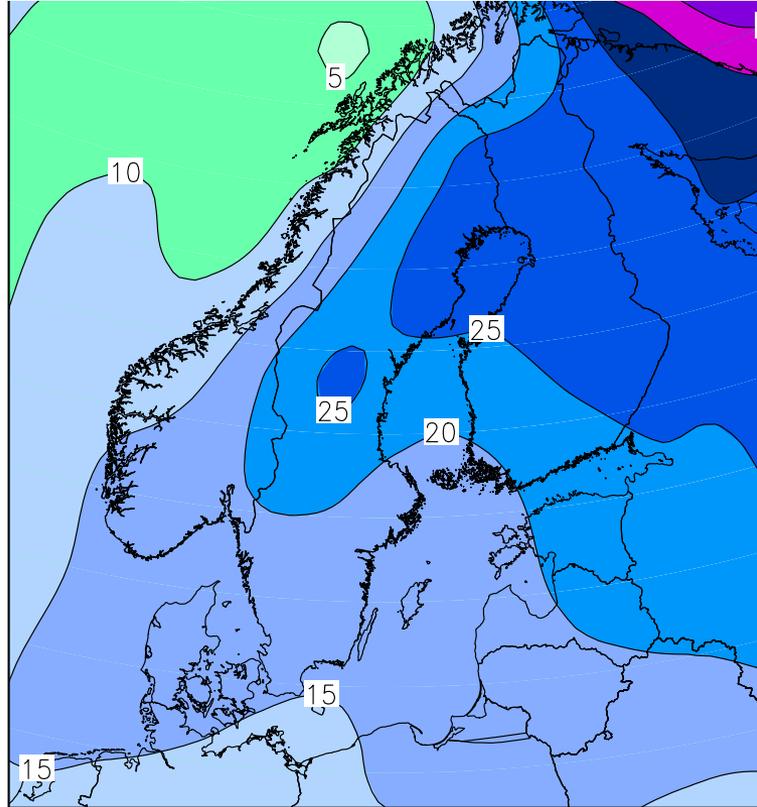
# Climate change predictions; the effects on floods

- Predicted changes in discharge vary largely
- Some examples:
  - large (27 000 km<sup>2</sup>) regulated river basin Kokemäenjoki with 11 % lakes in southern Finland is expected to have 0-15 % higher floods
  - small non regulated Uskelanjoki river located in southern Finland (600 km<sup>2</sup>, 0,6 % lakes), peak discharge of floods is predicted to reduce by 10 to 30 % (TOLERATE 2008)

# Precipitation increase in Finland

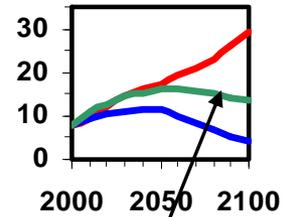


1971-2000 => 2070-2099, Dec-Feb



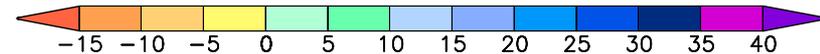
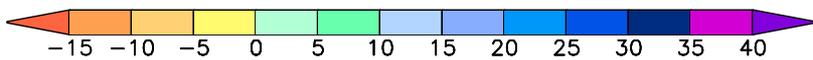
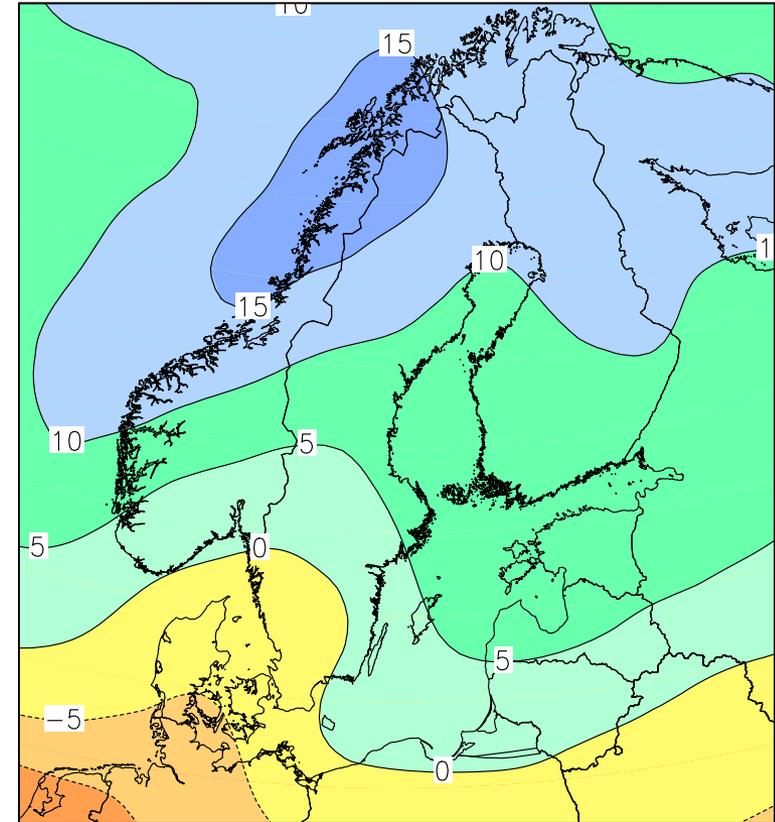
Unit: %

Päästöt



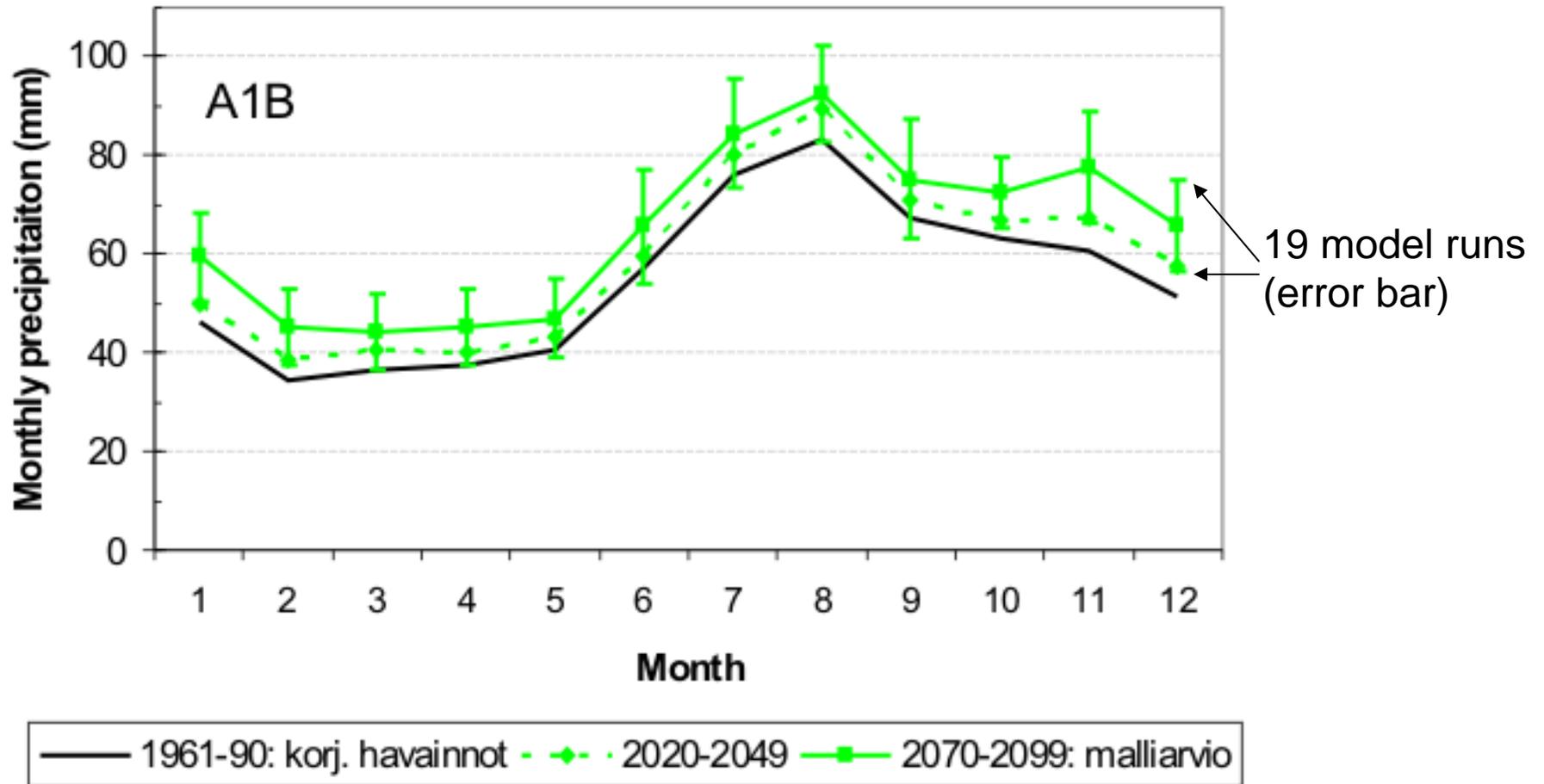
A1B

1971-2000 => 2070-2099, Jun-Aug



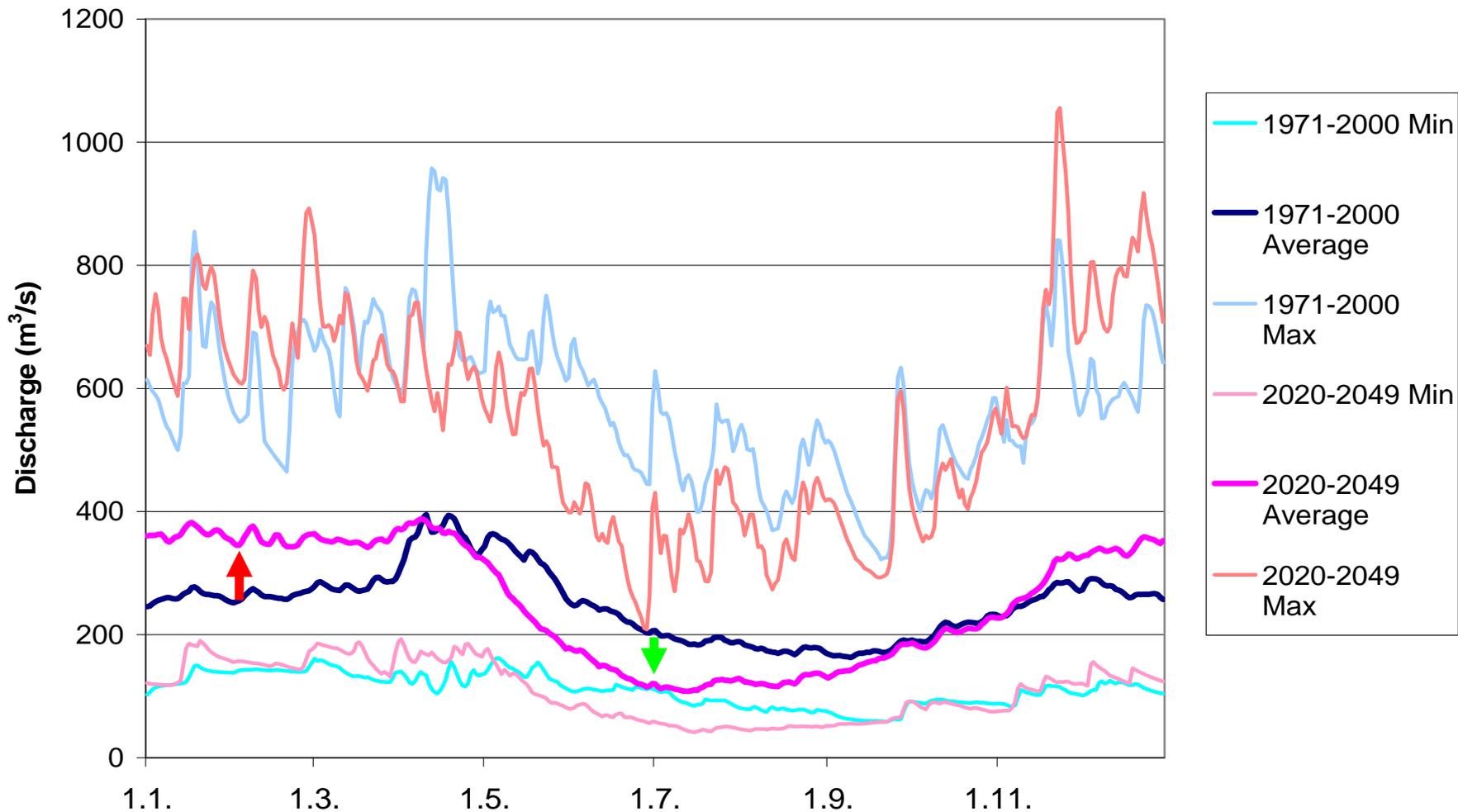
Annual: precipitation 660 mm

# Seasonal variation

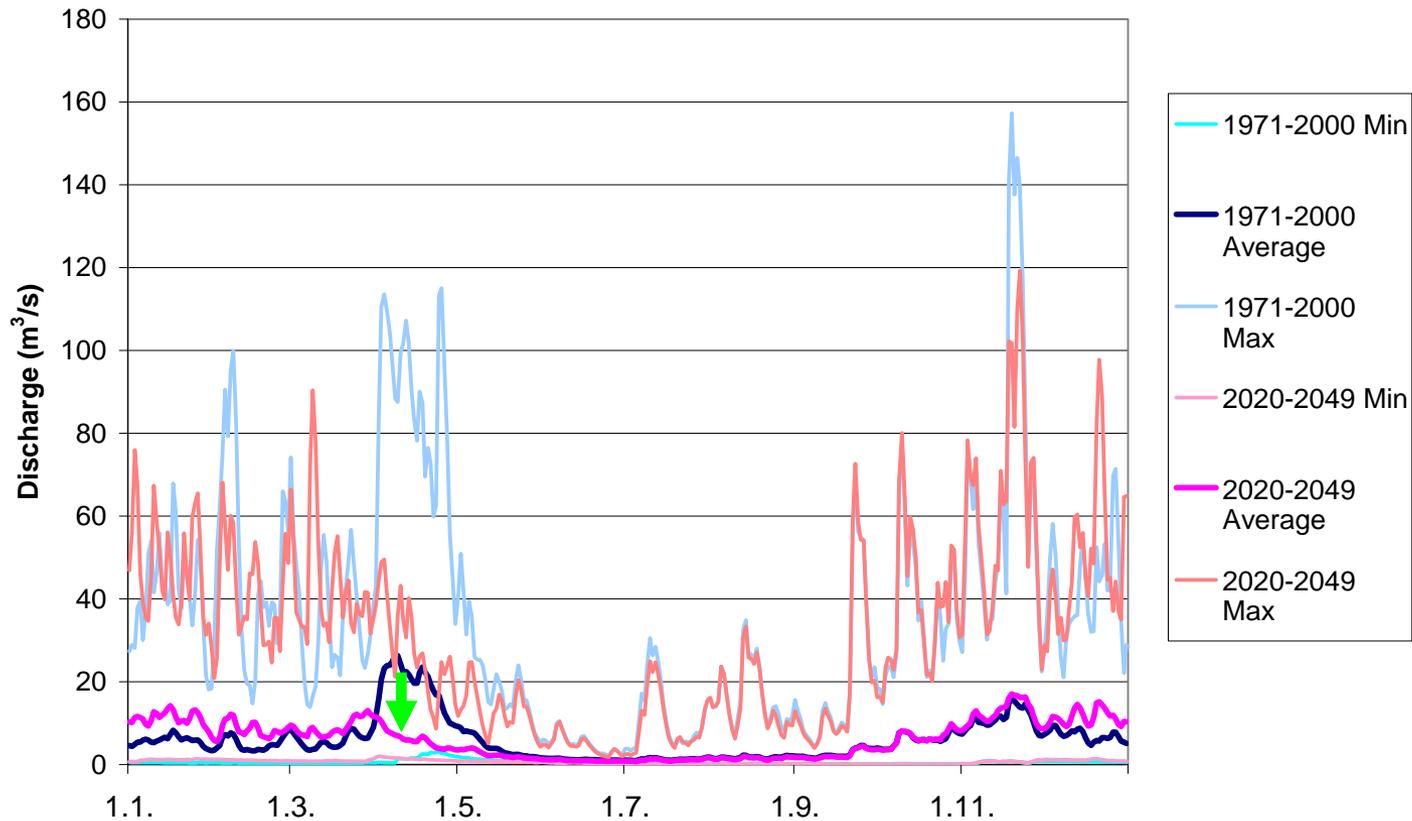




# Large river basin Kokemäenjoki (mean A1B-scenario)- Climate change simulation (southern Finland)



# Small river basin Uskelanjoki (mean A1B-scenario)- Climate change simulation (southern Finland)



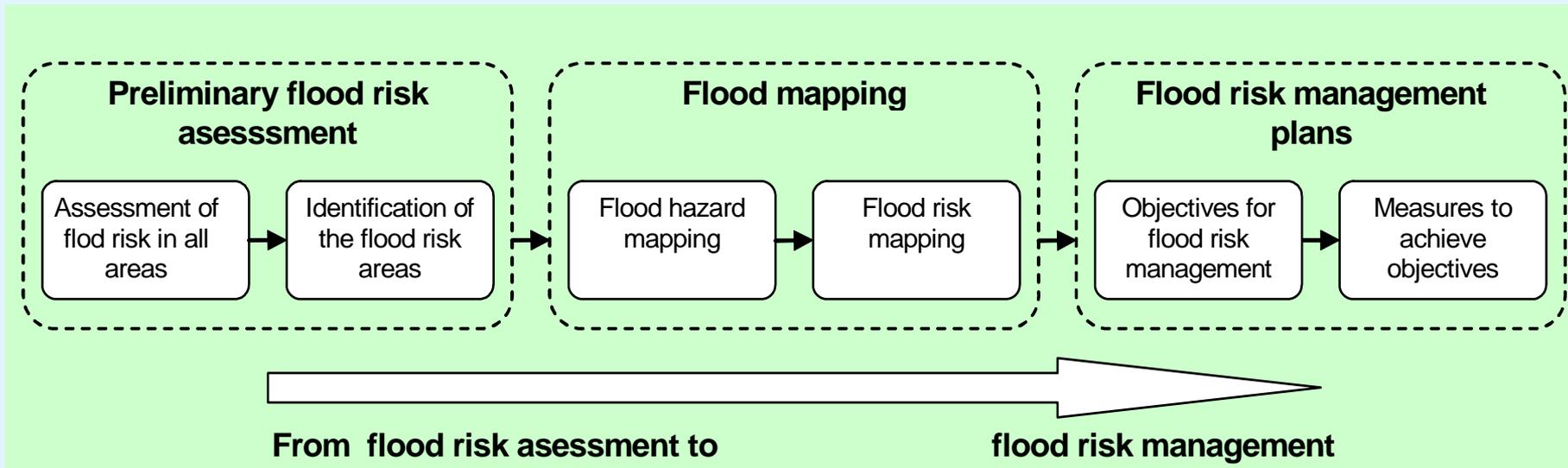
# Directive 2007/60/EC on the assessment and management of flood risks

- The aim of the directive is to "reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity" in the area of European Commission
- Entry into force – 26.11.2007
- The EU floods directive considers all types of floods
  - However, floods from sewerage systems can be excluded

# Floods directive; the content

- The following steps should be followed to achieve the requirements of the directive:
  - **preliminary flood risk assessment** by 2011
    - identify the catchment areas and coastal areas at risk of flooding
  - **flood hazard maps and flood risk maps** by 2013
    - should be prepared for the identified flood risk areas
  - **flood risk management plans** by 2015
    - for the catchments or other management areas which contain identified flood risk areas.

# Floods directive; the content



# Floods directive; “new” concepts

- Integrated river basin approach
- Upstream-downstream solidarity
- Coordination across borders
- Coordination with Water Framework Directive
- Public participation
- 6 year review cycles
- Sustainable land use practices
- **Pillar for climate change adaptation**

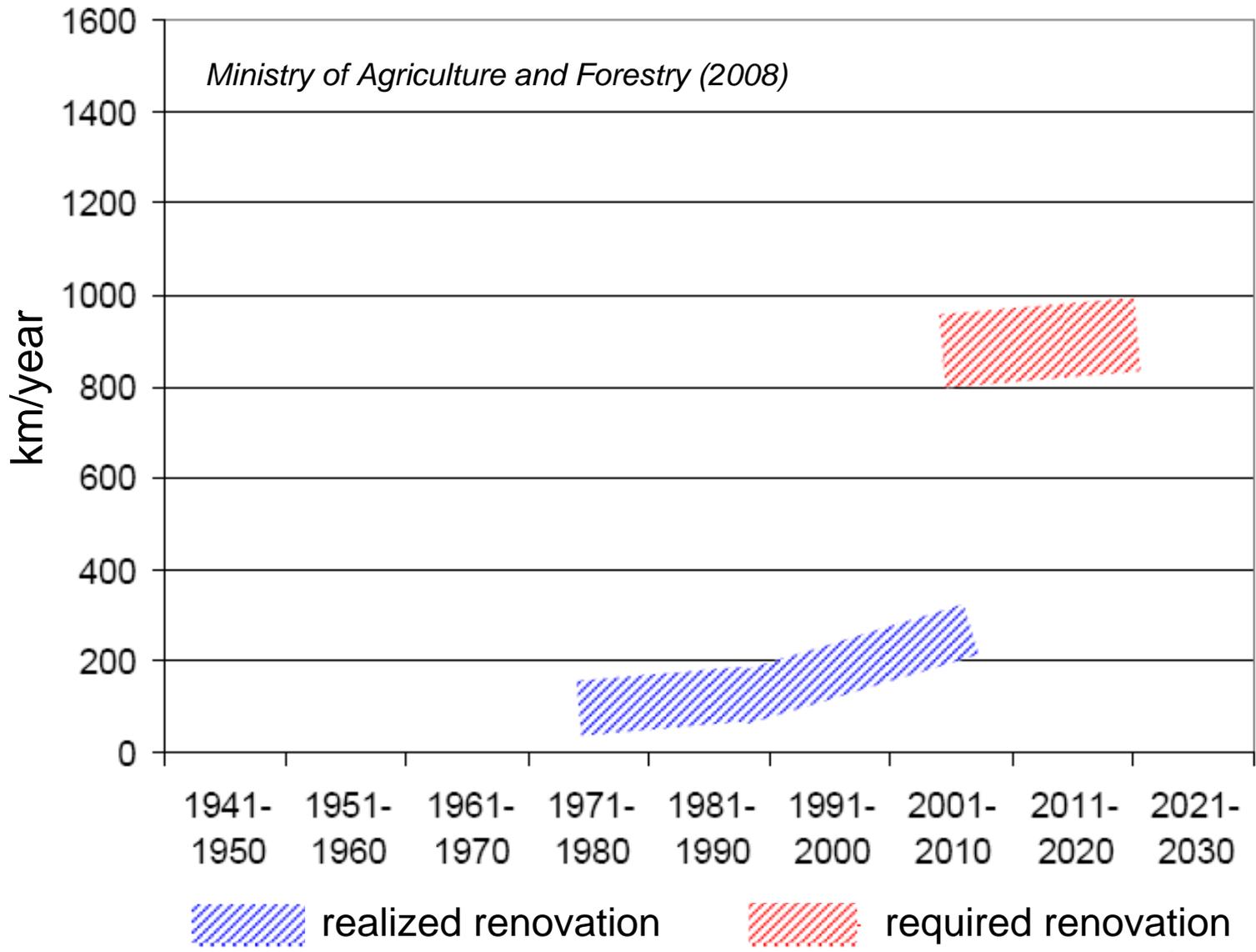
# Flood risk management for river, lake and sea floods

- The adaptive capacity of the Finnish environment and society to a changing climate was assessed in FINADAPT-project (2007).
- The main recommendations related to flood management were:
  - estimation and if necessary revision of recommended building elevation levels, design precipitations and flood return periods, flood maps etc.
  - revision of discharge and water level regulation permits
  - designated water retention areas in a catchment should be considered
  - watercourses should be considered as entities
  - dam safety should be considered in changing climate conditions

# Flood risk management for urban sewerage floods

- The Ministry of Agriculture and Forestry (2008) contracted out a survey about the state of the water supply service network in Finland
  - 12 % of the sewer network was considered to be in bad or very bad condition
  - annual demand of renovation for 900 km of sewer line in 2010-2020
  - Sewer network consisted of both storm water and waste water system.
- The upcoming massive renovation work offers an opportunity to upgrade the urban drainage network to respond the challenges of climate change and increasing urbanization

# The volume of required and realized sewer renovation



# Flood risk management for urban sewerage floods

- Urban drainage system can be considered to consist of two components.
  - The minor system is designed to control runoff generated from more frequent rainfalls
    - underground sewer pipes and overground ditches and gutters
  - The major system routes the overland flow during more severe and rare rainfall events, when the minor system is not able to drain the catchment.
- The level of protection should be balanced between the costs of building and flood damage.

# Flood risk management for urban sewerage floods

- Sewers can not be technically economically used as only method in urban drainage for future increased storm rains
- Sustainable methods have to be used to increase the storage volume and proportion of pervious area in the cathment
- Regardless of the used drainage system, a proper maintenance program should be created and followed
- Instructions should be considered to inform citizens about the hazards and to give guidelines how to minimize the damages and act under the flood

# Land use planning

- Land use planning has effects on all aspects of water management – floods, water quality and droughts
- Land use planning should be used for climate change adaptation and also for climate change prevention
- Land use planning is the most important measure to prevent the increase of damage potential in flood prone areas

# Land use planning and flood maps

- Flood hazard maps will be important tools to prevent building to flood risk areas.
- There have been flood maps available only for a couple of years in Finland
- Now there are flood hazard maps ready for about 60 locations and more locations are mapped every year.
- The challenge is to get this flood map information to be used by land use planners

# Land use planning

- The protection and extension of retention areas and flood plains should be taken in to account in the regional land use plans
  - Regional land use planning should also be made at catchment scale
- The extension of retention areas is often difficult because the flood problems are often in the downstream and the possible retention areas in upstream part of the catchment area

# Conclusions

- The predicted effects of climate change on hydrology request several changes in flood risk management and land use planning
- The actions to fulfill the requirements of the Floods Directive will be the foundation for the national flood risk management in Finland
- The directive has several aspects which consider the effects of climate change
- Sustainable drainage solutions are preferable in urban runoff control, since conveying storm water downstream the catchment just exacerbates the situation elsewhere
- The needs of sustainable drainage solutions should be noted in municipal planning when densifying the infrastructure or renovating the existing drainage system