Climate change and inland navigation

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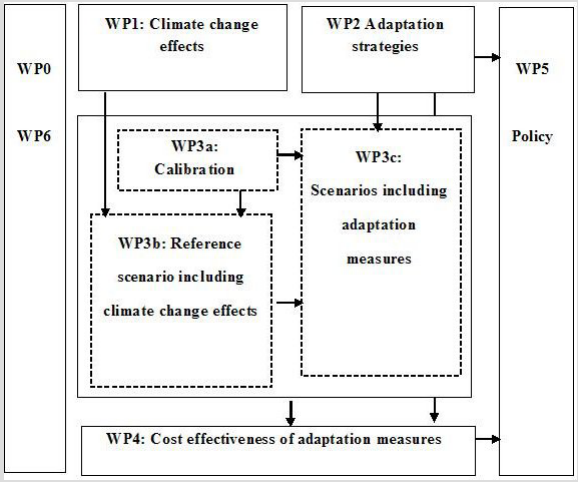
Contents

ECCONET

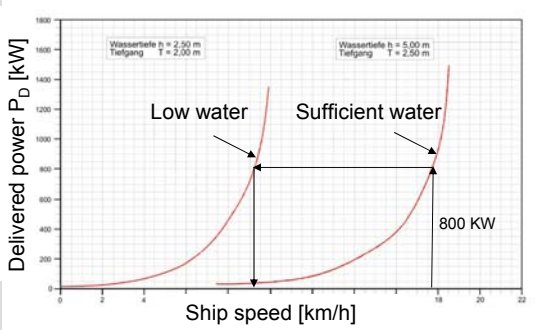
Effects of climate change on the inland waterway networks

- Coordination and support action
- Funded within FP7 by the European Commission
- Duration: 2010 – 2012
- Website: www.ecconet.eu



Climate change impacts on navigation (1)

- Reduced water levels:
  - Reduced capacity utilisation of vessels
  - Longer sailing times
  - Increased fuel consumption
  - Increased transportation costs per ton
  - Associated with longer periods



Source: DST, Kliwas 2009. Modified figure.

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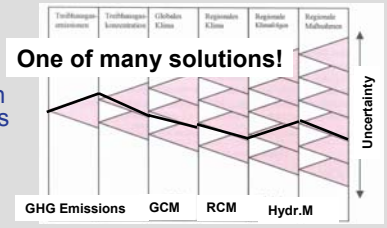
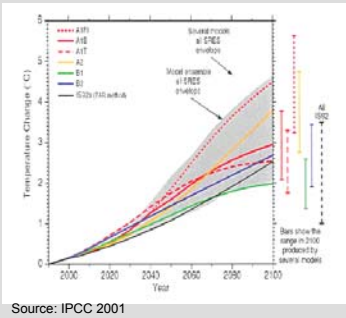
Climate change impacts on navigation (2)

- High water levels:
  - Suspension of navigation
  - Usually limited only to a few days
- Ice
  - Suspension of navigation
  - Once it occurs it might take several days or weeks, depending on region
- Wind, storms:
  - Increased requirements on maneuverability and course stability
  - Main cause for accidents due to environmental reasons

Uncertainty

- Model: simplification of reality
- Usage of multiple climate models => bandwidth of possible projections rather than single results
- Ensembles and KLIWAS
- Single model chain: Glowa Danube and Glowa Elbe => uncertainty difficult to assess objectively
- Reproduction of future from past events not necessarily correct
- Climate change signals weaker till 2050 than 2100 due to continuously increasing temperatures till 2100

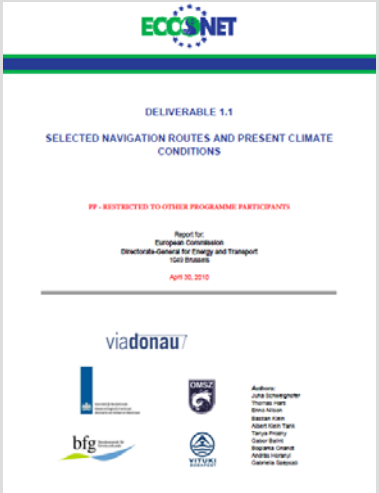




Source: IPCC 2001

Deliverable 1.1

- General assessment of CC on IWT
  - Relevant projects
  - Hydrometeorology
  - Hydrology
  - Europe, Rhine, Danube, Alpine region, Elbe, Seine-Nord Canal
- Present climate and navigation conditions
  - Rhine
  - Danube


DELIVERABLE 1.1

SELECTED NAVIGATION ROUTES AND PRESENT CLIMATE CONDITIONS

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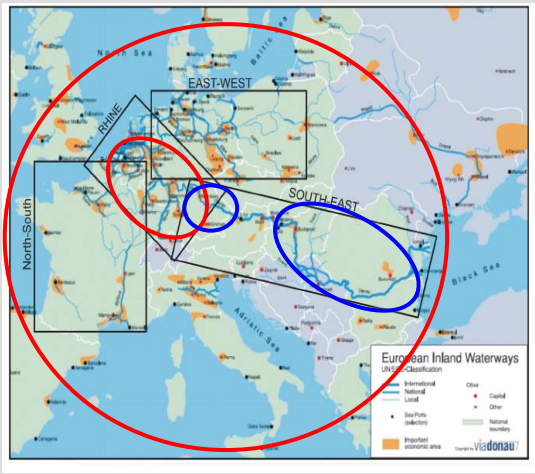
Projects considered (1)

- Europe:
  - Ensembles
  - Peseta
- Rhine:
  - KLIWAS
  - Rheinblick 2050
  - Activities of CHR,
  - ICPR and IHP (UNESCO)
- Danube:
  - Glowa Danube
  - Clavier



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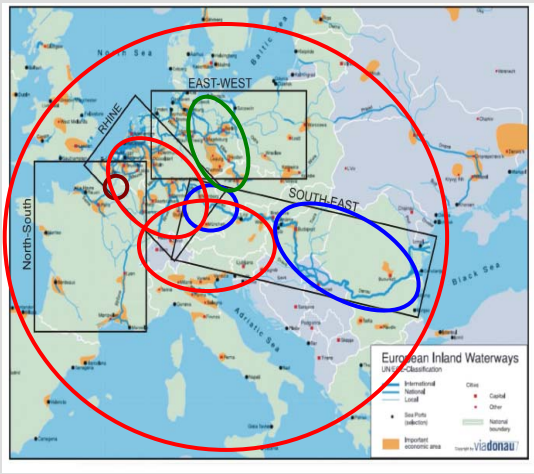
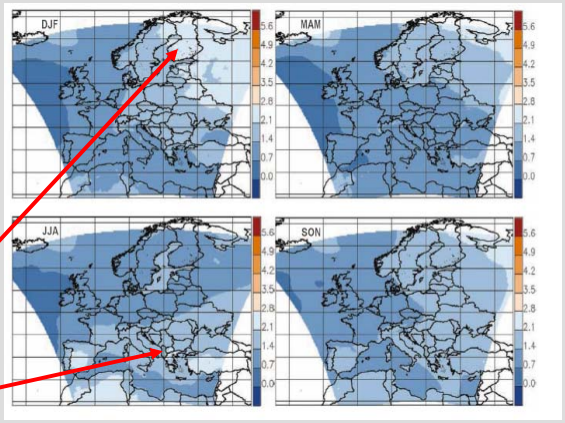
Projects considered (2)

- Alpine region:
  - Glowa Danube
  - ClimChalp
  - Adaptalp
- Elbe:
  - Glowa Elbe
- Seine-Nord Canal:
  - Investigations of VNF
- Common Implementation Strategy for the Water Framework Directive – Guidance Document 2009.



Europe (1)

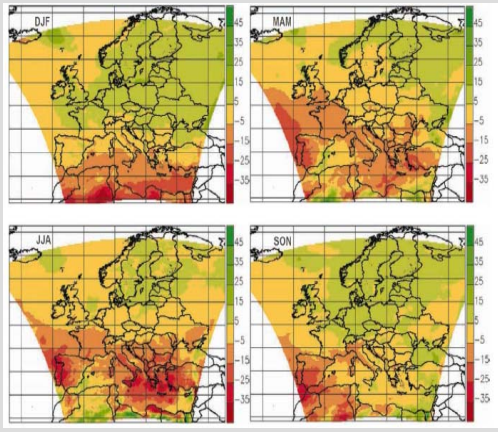
- Temperature
  - Temperature increase for all areas and seasons (2021 -2050)
  - Strength of T increase dependent on region
  - N-Europe: greatest warming in winter, spring and autumn, less in summer (JJA)
  - S-Europe: greatest warming in summer



Source: Ensembles

Europe (2)

- Precipitation (2021 – 2050)
  - Annual precipitation:
    - N-Europe: increase
    - S-Europe: decrease
    - Rhine-Main-Danube: almost no change
  - Seasonal precipitation:
    - North:
      All seasons: increasing trend greatest in winter
    - South:
      All seasons: decreasing trend greatest in summer



Source: Ensembles

Europe (3)

- Hydrology (end 21st century)
- Finland, Russia, South Spain:
  - 100-year return levels of river discharge (floods): decrease
- Rest of Europe:
  - almost no changes or increase of floods

  ⇒ Consideration of floods will gain importance

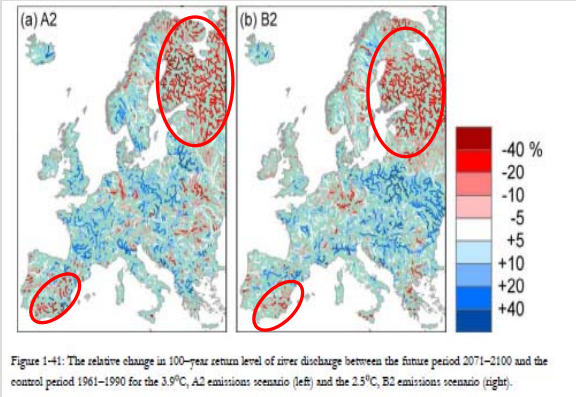
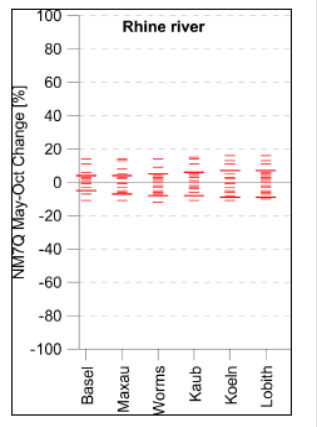


Figure 1-41: The relative change in 100-year return level of river discharge between the future period 2071–2100 and the control period 1961–1990 for the 3.9°C, A2 emissions scenario (left) and the 2.5°C, B2 emissions scenario (right).

Source: Peseta

Rhine region

- Low water NM7Q
  - Summer:
    - almost no change till 2050 by KLIWAS for all relevant gauges
    - Significant decrease by 42% by KNMI06 W+ at Lobith
  - Winter: moderate increase in discharge
- Mean discharges: no clear tendency
- 100-year return levels of discharge:
  - No changes till 2100
- No suspension of navigation due to ice on the Rhine since 1970!



Source: Kliwas

Danube region (1)

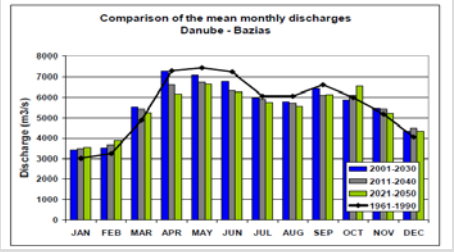
- Upper Danube (GLOWA DANUBE)
  - Annual discharge: decreasing
  - Maximum discharge: shift from summer to spring
  - Minimum discharge: shift from autumn and winter to summer
  - Low water NMQ7:
    - Till 2060 contradiction in results
    - Till 2100 reduction of discharge
  - 100-year return levels (floods):
    - Decrease
    - Contradictory trends
    - No change (A2) or moderate increase (B2) by Peseta

Danube region (2)

- Upper Danube (GLOWA DANUBE)
  - Glaciers - melting ice:
    - Currently most significant in August 10 % share, starting from ca. 2031 negligible
    - Limitation to JJAS
- For a comprehensive evaluation of proper bandwidth of solutions related to hydrology complementary research necessary

Danube region (3)

- Central Danube (CLAVIER):
  - More balanced discharge distribution over the year
  - Spring and summer: decrease in monthly mean discharge
  - Winter: increase in monthly discharge
  - Autumn: no change
  - Low water (till 2050):
    - Duration and frequency decreasing
    - Less extreme
  - 100-year return levels (Peseta, floods):
    - Central Danube: No change (A2) or moderate increase (B2)
    - Lower Danube: No change (A2) or significant increase (B2)
  - Ice occurrence decreasing



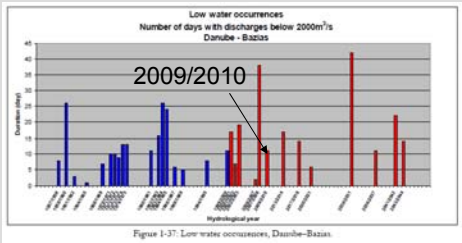


Figure 1-37: Low water occurrences, Danube–Bazias.

Summary

- Uncertainties are still high
- Increase of temperature is a common result
- Floods are not projected to decrease for European waterways (except Finnland, Russia and South Spain)
- Relatively comprehensive results available for the Rhine requiring minor complementary investigations
- Danube: limited results available allowing for no objective uncertainty analysis
- Danube: results locally limited
- Further investigations in ECCONET:
  - www.ecconet.eu
  - Entire Rhine
  - Danube from Straubing – Vilshofen till Austria
  - Danube from Austria till Iron Gates

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http://www.ecconet.eu/news/ECCONET_newsletter1.pdf