TACTIC
- Tools for Assessment of Climatic change ImpacT on Groundwater and Adaptation Strategies

Anker Lajer Højberg, Ida Bjørnholt Karlsson, Klaus Hinsby, Jacob Kidmose, Hélène Bessiere, Majdi Mansour, and David Pulido-Velázquez
TACTIC consortium

• Partners:
  – 20 partners
  – 17 countries

• Budget:
  – Total: 1,799,979€
  – Partners: 1,265,385€
  – EU: 534,594€ from EU

• Coordinator:
  – GEUS, Denmark
Climate change challenges

“…observed climate changes are already having widespread impact on ecosystems, economic sectors and human health and well-being in Europe.” - European Environmental Agency

“More extreme weather conditions are anticipated…and the impact is expected to increase in the future.” - JRC

- Impacts of climate change experienced today
- Impacts expected to increase in future
- The cost is immense

➢ Improved knowledge and tools to assess climate change impact are needed to support EU policy

“Cost of climate change in Europe could reach 4 % of GDP if no policy measures are adopted” – Horizon, the EU research and innovation Magazine

“The Greatest Threat To Global Security: Climate Change Is Not Merely An Environmental Problem” – UN Security Council
TACTIC contribution

• Numerous CC studies already

➢ But most ignores the groundwater system
  – Impact on groundwater
  – A freshwater buffering system
  – Can enhance or dampening impacts from extreme weather events and vital for assessment of the CC impacts

TACTIC Vision

Improve **use and access** to data and knowledge acquired by the GSOs of the subsurface system in CC impact assessments and adaptation
TACTIC impacts

**Advance**
Advance scientifically sound climate change impact assessments
- Local/national assessments
- Support EU policy on member state actions

*Experiences vary among GSOs*

**Harmonise**
Harmonise assessments and results – prerequisite for EU policy-making
- Common approaches
- Cross-comparison

*Multiple tools and approaches available*

**Access**
Make data and results available for future assessments and applications
- Assessments by GSOs
- Third parties “on-top” services
- New research and innovation

*Data, results and knowledge currently difficult to access*
TACTIC objective and approach

TACTIC will develop an *infra-structure among European Geological Survey Organisations* for collaboration to advance and harmonise climate change assessments within the GSOs.

**TACTIC Toolbox and guidelines**
- TACTIC Toolbox
  - Identify usable tools
- Guideline
  - Selecting approach and Harmonising

**Pilots**
- Demonstrate in pilots (41 pilots)
- Different challenges
- Facilitating knowledge sharing

**Interaction with GIP**
- Collect and harmonise data
- Provide easy access to data and results in GIP

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731166
TACTIC Toolbox

- 53 tools collected
- Selected tools presented at webinars
- Shared among GeoERA partners and external universities/institutions
- A work in progress

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731166
TACTIC guidelines

- When to use what, data availability
- How to use/analyse
- What to use for harmonisation
- How to store in GIP

Building on
- Existing guidelines
- TACTIC experiences

Guideline topics

- Assessing surface water – groundwater interaction and change
- Definition of recharge
- Climate change scenarios
- Downscale-bias correct climate data
- Natural background chloride concentrations
- ...
- ...

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731166
TACTIC pilots

• TACTIC partners active in 41 pilots across Europe
  • 7 < 100 km²
  • 23: 100-1000 km²
  • 11 > 10,000 km²

• Assessments
  • Reproduce historical conditions
  • Assess impact of future climate
  • Evaluate adaptation strategies

• Results reported for each pilot
Climate change scenarios

- Developing common climate change scenarios
  - Reference period
  - Future conditions
    - +1 (+3) degree temp increase from present conditions
  - Metrics and indicators
    - Change in recharge, change in groundwater levels, etc.

- Climate change scenarios from ISIMIP (Inter-Sectoral Impact Model Intercomparison Project)
  - Monthly delta-change values from ensemble of global models
  - Selection of 2\textsuperscript{nd} highest and 2\textsuperscript{nd} lowest precipitation for each pilot

Model ensemble
- 15 models (3 RCP x 15 GCM)
- GCM biascorrected

New Tool
- Calculate local delta change factors
- Calculated for all pilots
- Can be used outside TACTICs
Climate change assessments

• Assessing impacts on groundwater
  – Propagation by
    • Complex physically based, integrated and fully distributed hydrological models
    • Lumped and conceptual models
    • Statistical models

• Harmonising assessments
  – Multiple tools applied in 13 pilots
  – Common tools in most pilots

Multiple tools
• Partners apply several tools in pilot
• Statistical + Lumped + ?

Statistical tool
• Same statistical tool applied in most pilots

Similarity test/vulnerability
• Collaboration with Gothenburg university
• Tests in selected pilots
• All Pilots?
European recharge map and satellite data

Combining pilot assessments and satellite data for recharge estimate at EU-scale

Utilising satellite data
- EU-recharge map
- Subsidence by overexploitation of aquifers
- Estimation of land use
- Calculating lake areas – monitor water budget

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 731166
Salt/sea water intrusion

- Index based approach for harmonised assessment of status and vulnerability towards climate change
- Further development for islands
- Identification of natural background concentrations
More info @

https://geoera.eu/projects/tactic9/
https://www.researchgate.net