WP2.2 – Sustainable operational management of coastal groundwater resources using data-model integration

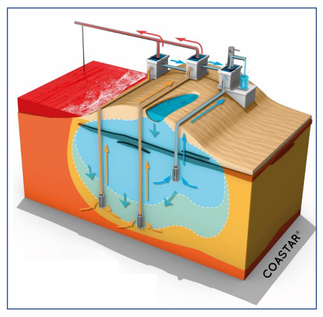
Thijs Hendrikx (t.l.hendrikx@uu.nl), Gualbert H.P. Oude Essink, Marios Karaoulis, Marc F.P. Bierkens

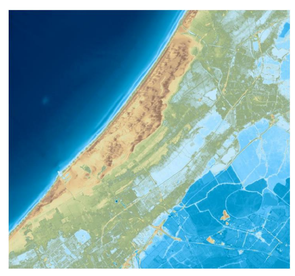
Research objective

Main aim: contribute to sustainable operational management of coastal groundwater resources

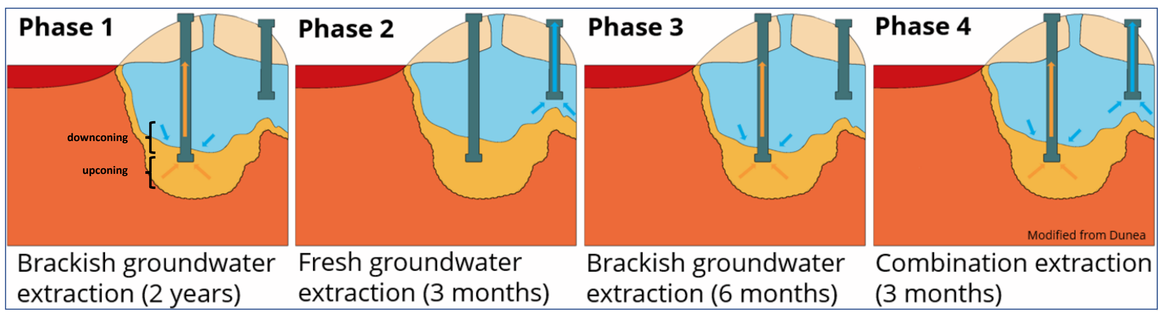
Research questions 1 and 2:
- Local scale (1 km^2)
- Detailed monitoring and simulation of groundwater salinity in response to multi-level extractions

Research questions 3 and 4:
- Regional scale (entire dune reserves Dunea)
- Salinity 'early warning' toolbox (optimization operational management, future scenarios)





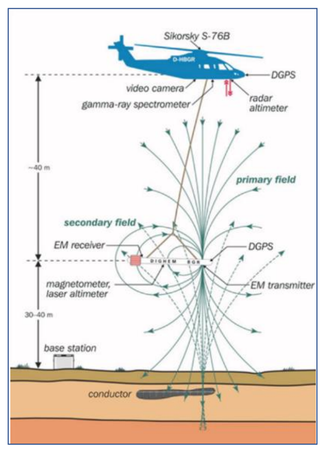
Case study: FRESHMAN pilot
- Brackish groundwater extraction pilot
- Four management phases (over 3 years)
- Including high-resolution innovative monitoring (ERT, AH-DTS)



Results

An updated initial 3D-chloride field: based on 3D-interpolation flightlines (Airborne EM) corrected by local chloride measurements

Improved understanding sensitivity model boundaries and parameters: aquitard heterogeneity, general head boundary conditions, groundwater recharge



Improved model performance before parameter optimization:
- Figure A, right: comparison simulated and observed hydraulic heads and chloride concentrations after ± 1 year
- Figure B, right: cross-section 3D-VD-FT model showing chloride concentrations after ± 1 year
- Figure C, below: comparison observed and simulated chloride concentration profiles over time for an extraction well

Figure A

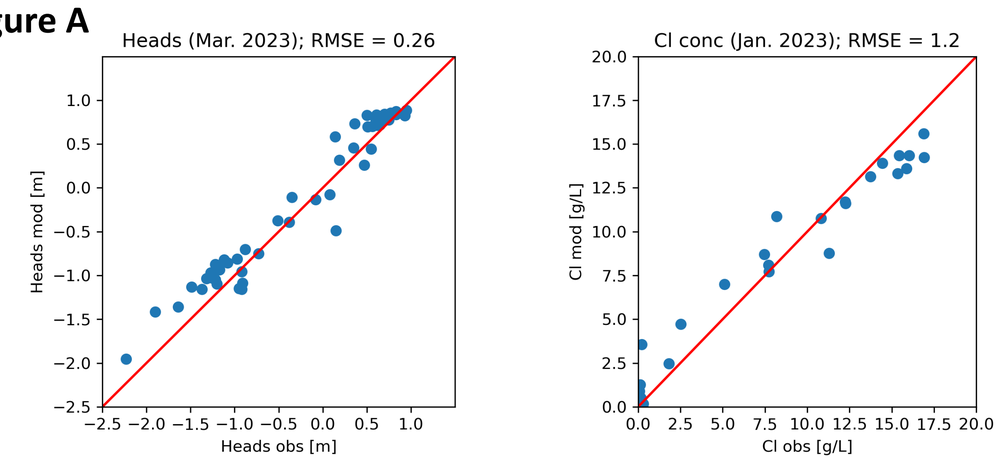


Figure B

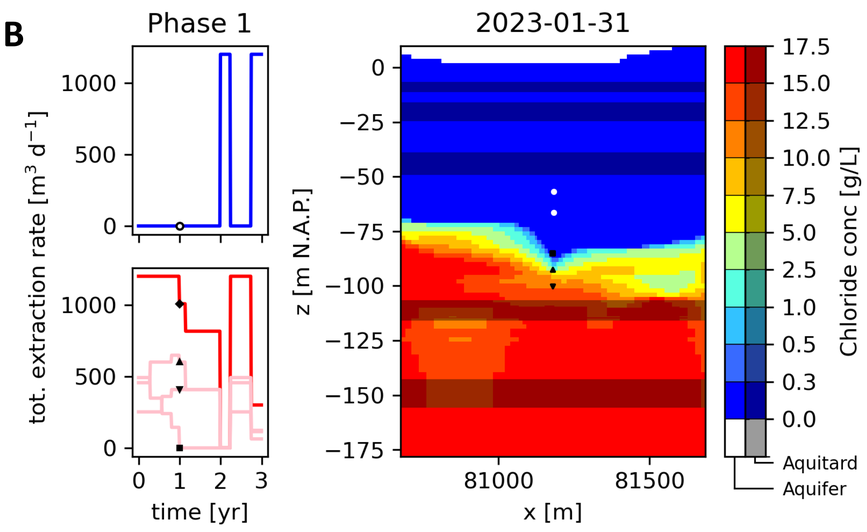
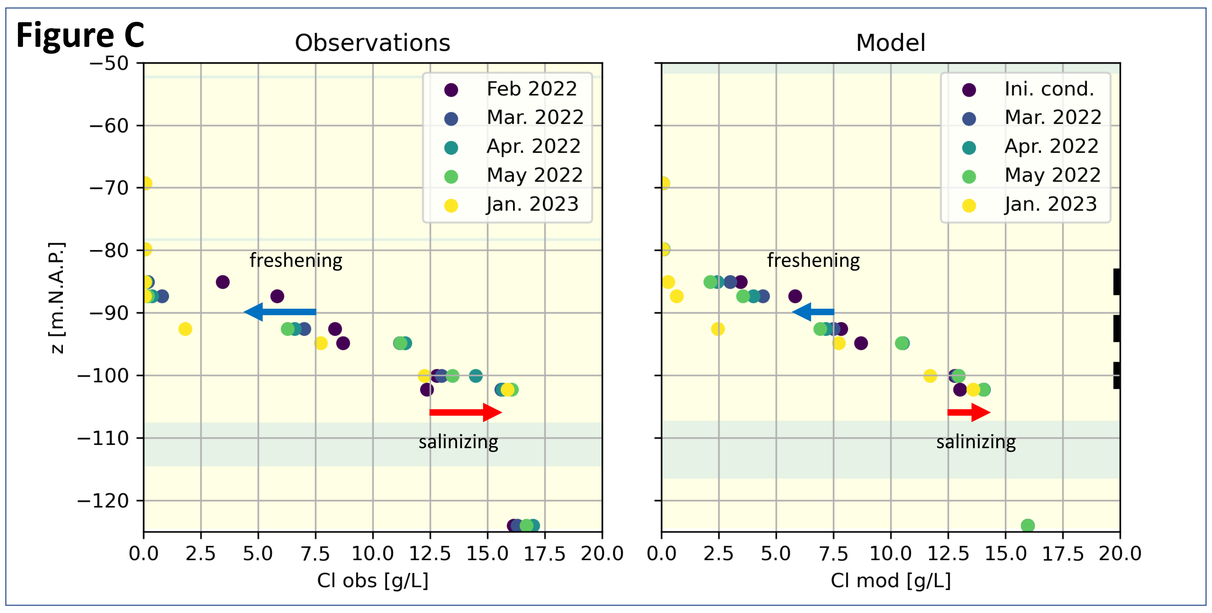


Figure C



Ongoing work in progress

Execute model parameter optimization: hydraulic conductivity aquifer and aquitard, porosity, dispersivity

Execute Monte-Carlo simulation: generate multiple sets of parameters, simulate model for each set to make projections pilot with an uncertainty range

Future plans (6 months)

To further improve predictive capacity 3D groundwater and salt transport model
- Data assimilation methods
- Innovative geophysical monitoring methods such as Electrical Resistivity Tomography (ERT) and Active Heating-Distributed Temperature Sensing (AH-DTS)

Take-home message

- The model already captures upconing and downconing of brackish groundwater before optimization
- The research leads to a better understanding of fresh-saline groundwater dynamics during multi-level groundwater extractions