Transport and Mixing in the Arkona Sea

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• The QuantAS project cluster (funding requested)
• Along-slope bottom plume (geostrophic balance)
• Downslope bottom plume (pressure-friction balance)
• Idealised simulations for Arkona Sea
• Comparison to recent observations
Arkona Sea from space
Conflict of interests
Offshore Constructions

Additional *user* conflict due to additional mixing by Offshore Wind Farms?

Graphics by Jan Donath (IOW)
Baltic cross section: salt

Source: IOW monitoring data
Baltic Sea cross section: O$_2$
Consequence of extra mixing

- Diluted bottom water sandwiches less deep into the basins of the Baltic Sea.
- The oxygen of the intermediate and deep waters will be renewed less.
So what ... ?

- Cod eggs float in the area of the 13 ppt isopycnal and need an oxygen concentration of > 2 ml/l.
- In case of reduced ventilation, the oxygen concentration may sink below this level.
Floating cod eggs

Graphics from Rolf Schneider, IOW
QuantAS-Consortium

For the purpose of estimating the effect of offshore wind farms on the mixing in the Arkona Sea, the QuantAS (Quantification of Water Transformation Processes in the Arkona Sea) has been built, with members from Denmark, Sweden, Poland and Germany.
Quantification of Water Mass Transformations in the Arkona Sea: Impact of Offshore Wind Farms (QuantAS-Off)

Regional scale
- In-situ Observations
- Numerical Simulations
  - Quantification of natural water mass transformation rates

Local Scale
- Laboratory experiments
- Numerical Simulations
  - Quantification of additional mixing due to wind farms

Synthesis:
- additional mixing by extensive wind parks
- environmental consequences

Recommendations for Wind Park Layouts
Ecological Impact
Along-slope flow

Downslope grid
Along-slope flow

Bed salinity after 1 day (min: 8 psu, max: 25 psu)

(Look at animation)
Down-slope flow

As initial condition, the left part will be filled with salty water
Down-slope flow

Part of high-resolution grid with HHC violations marked in green
Down-slope flow: salt profiles

Horizontal & vertical salt profiles after 1 month of inflow
Arkona Sea

Graphics by Volker Mohrholz, IOW
Arkona Sea

Model bathymetry

Longitude

- QuantAS station

IOW
Computer simulation (MOM)
Arkona Sea

Surface salinity (8-25 PSU)

Bottom salinity (8-25 PSU)

Simulation with GETM
Arkona Sea

Observations from moored ship (MzB Helmsand)

Salinity north of Kriegers Flak

Current velocity north of Kriegers Flak

Data by Jürgen Sellschopp, Volker Fiekas, FWG Kiel
Arkona Sea

Idealised simulations (with GETM)

Salinity north of Kriegers Flak

Current velocity north of Kriegers Flak