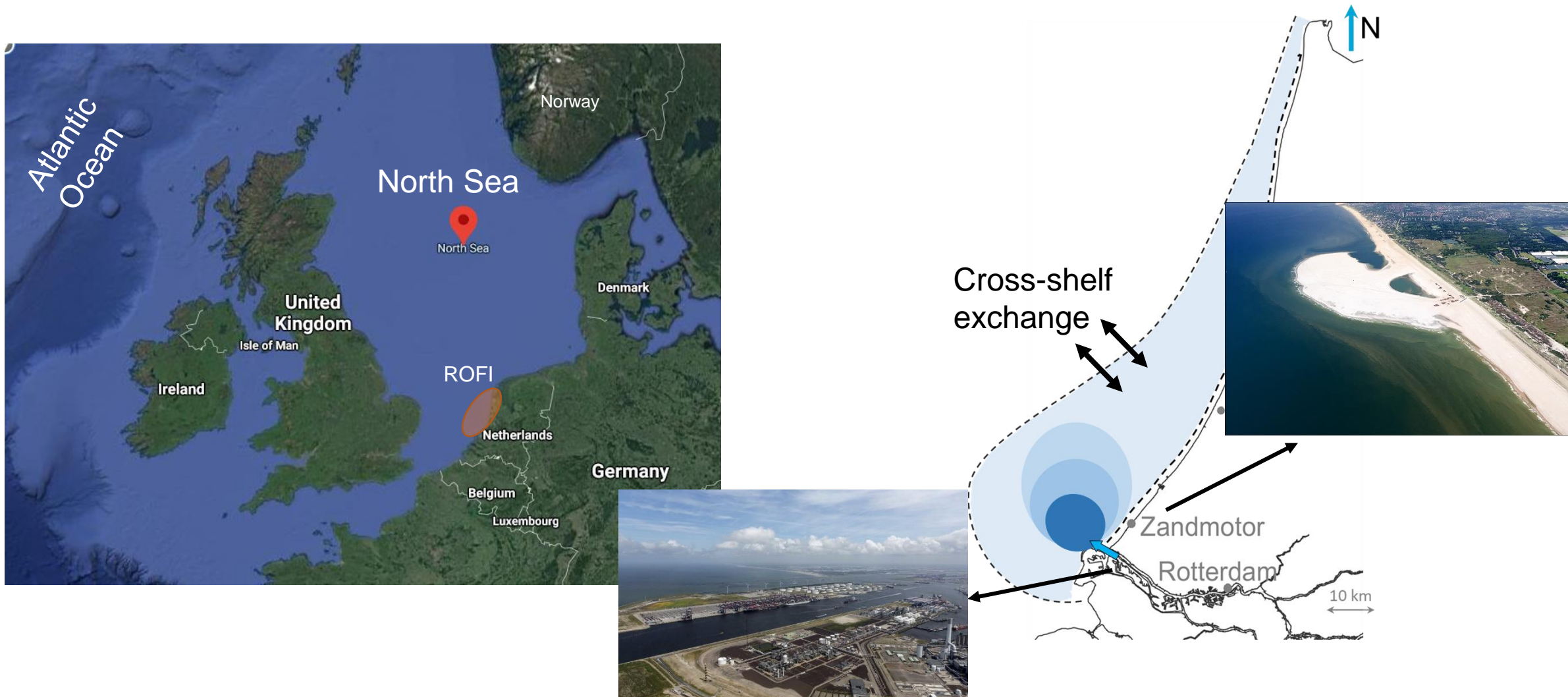


# Spring-neap variability in the wind-driven response of the Rhine ROFI

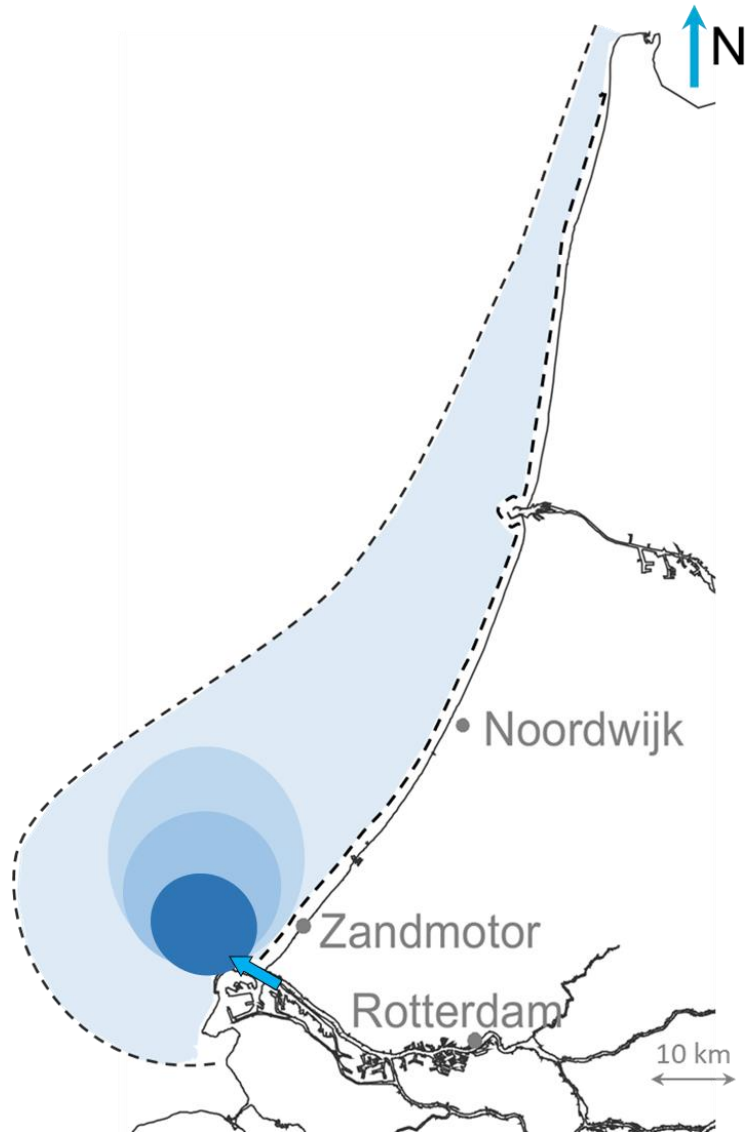
*EGU 2022*

**L.M. Keyzer**, J.D. Pietrzak, C.A. Katsman, M. Snellen, Y. Afrasteh,  
H. Guarneri, F. Zijl, M. Verlaan, R. Klees, D.C. Slobbe

# The Rhine ROFI

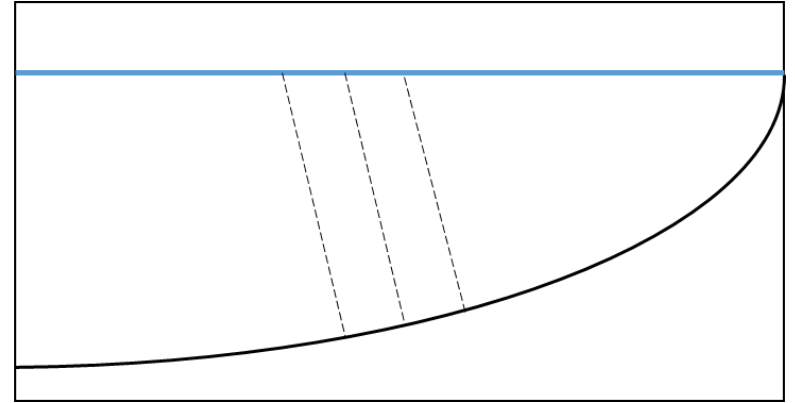


# Spring-neap variability



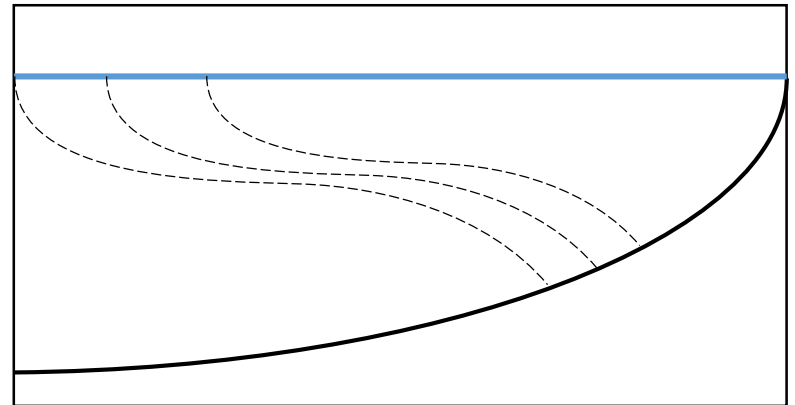
## Spring tide

- Well-mixed



## Neap tide

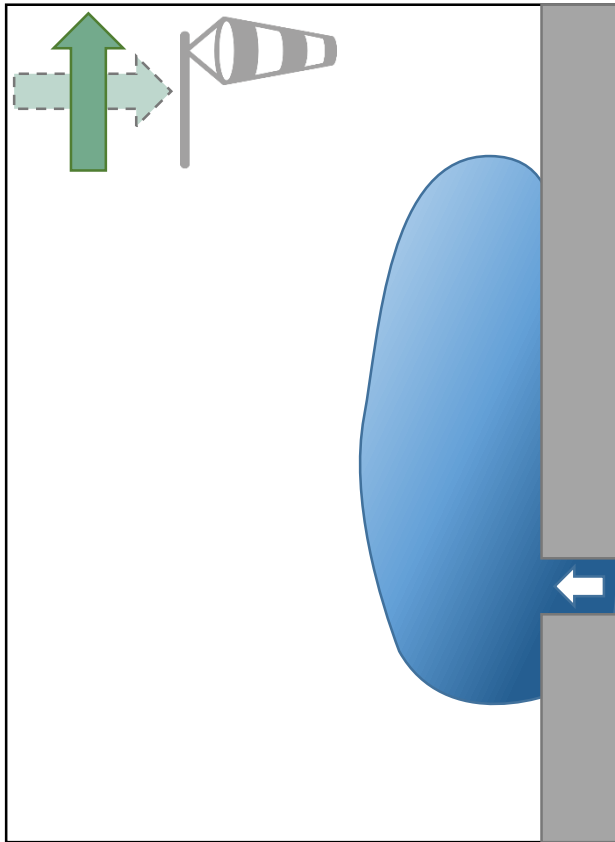
- Stratified



# Up- and downwelling

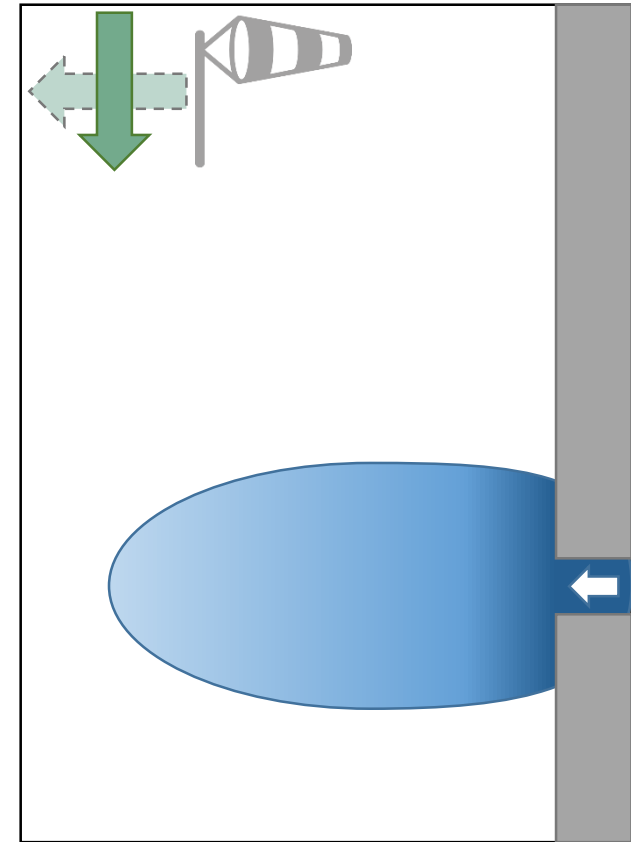
## Downwelling-favourable winds

- Onshore-directed Ekman transport
- Thickening of freshwater layer



## Upwelling-favourable winds

- Offshore-directed Ekman transport
- Thinning of freshwater layer

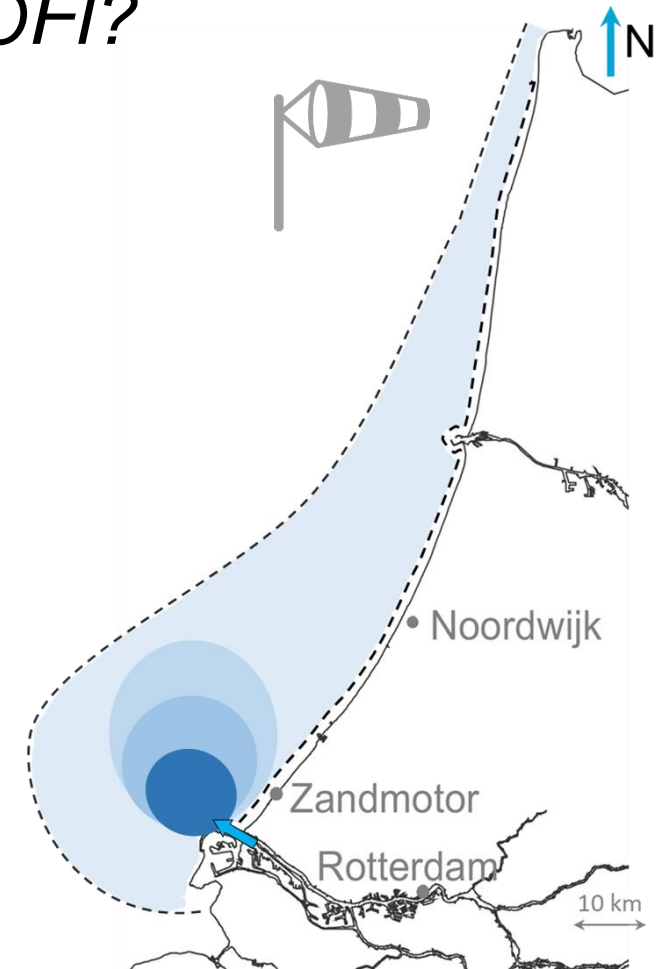


# Goal

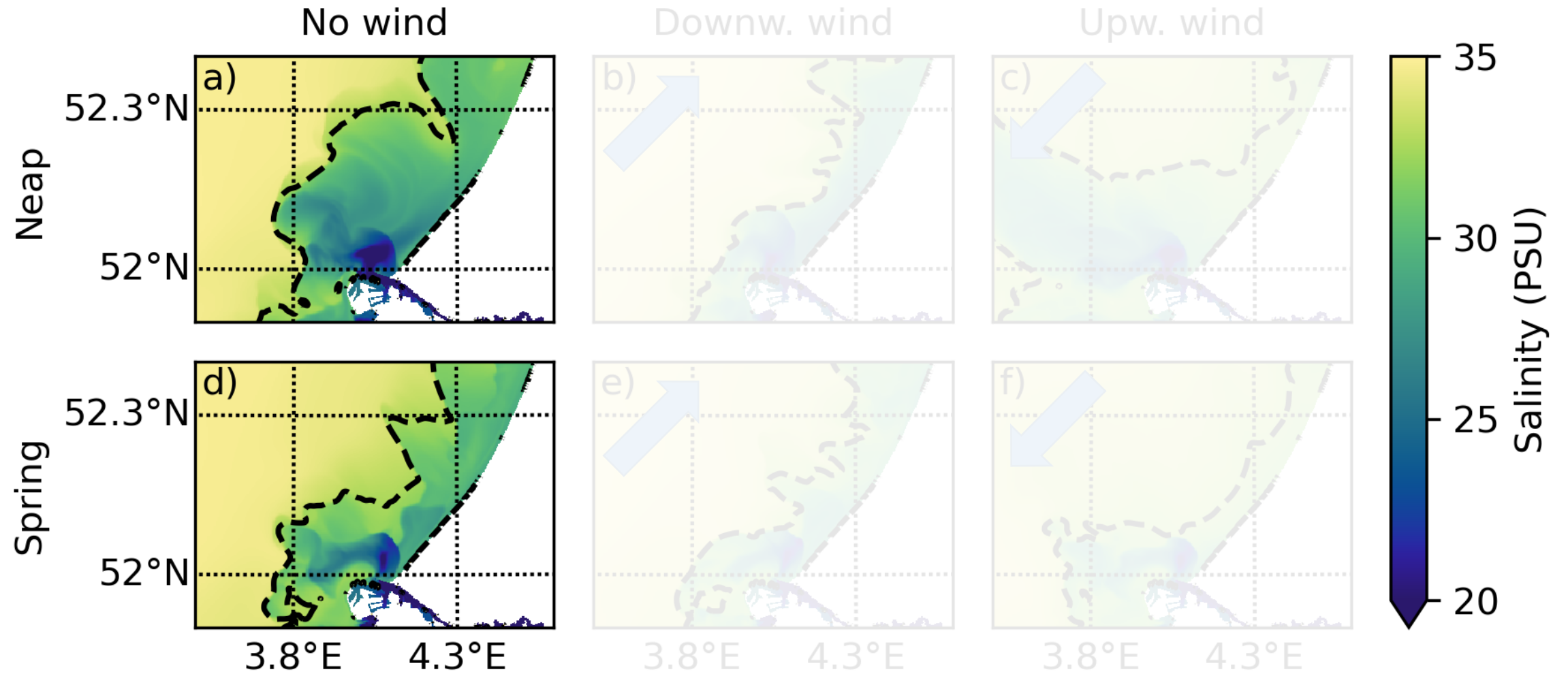
*What is the impact of the spring-neap variability on the wind-driven response of the Rhine ROFI?*

## Simulations of spring-neap cycle:

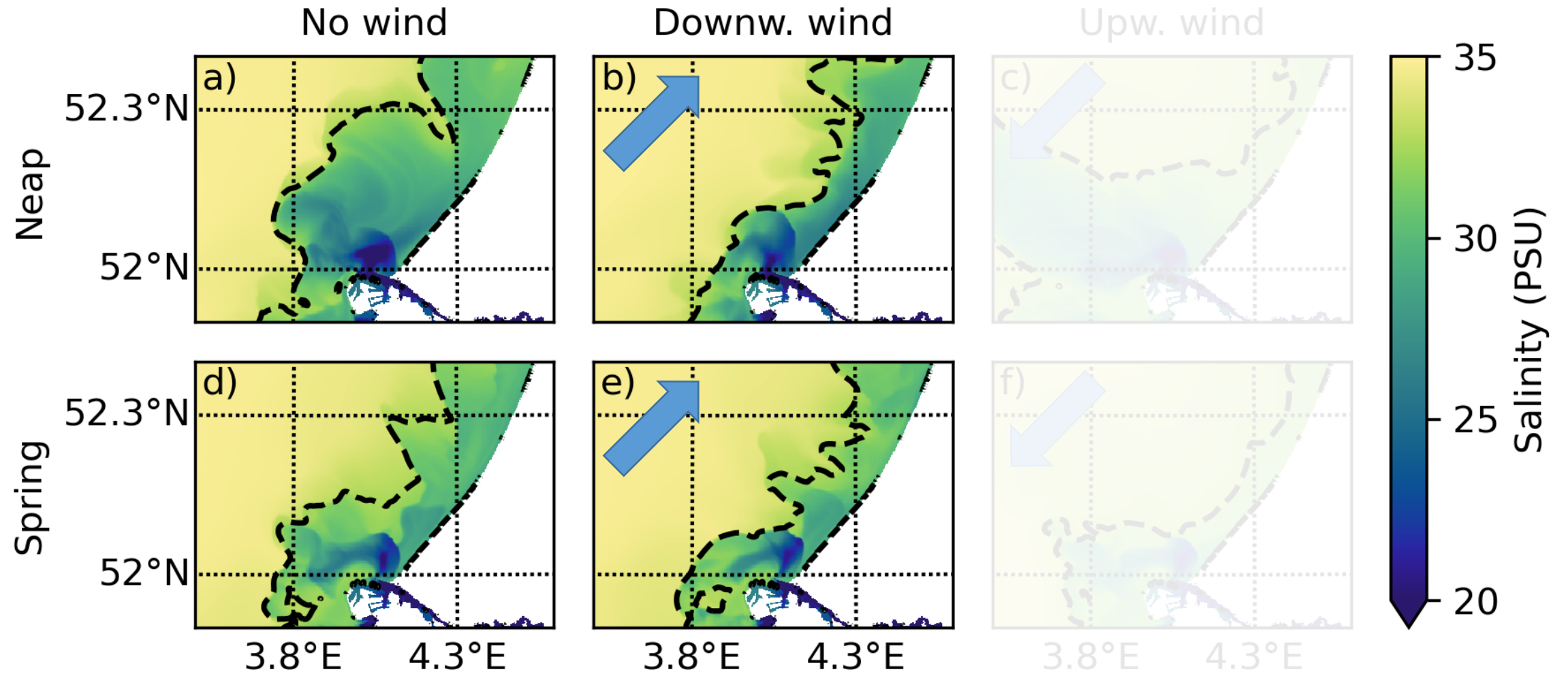
1. No wind
2. Downwelling-favourable wind (5 m/s)
3. Upwelling-favourable wind (5 m/s)



# Results

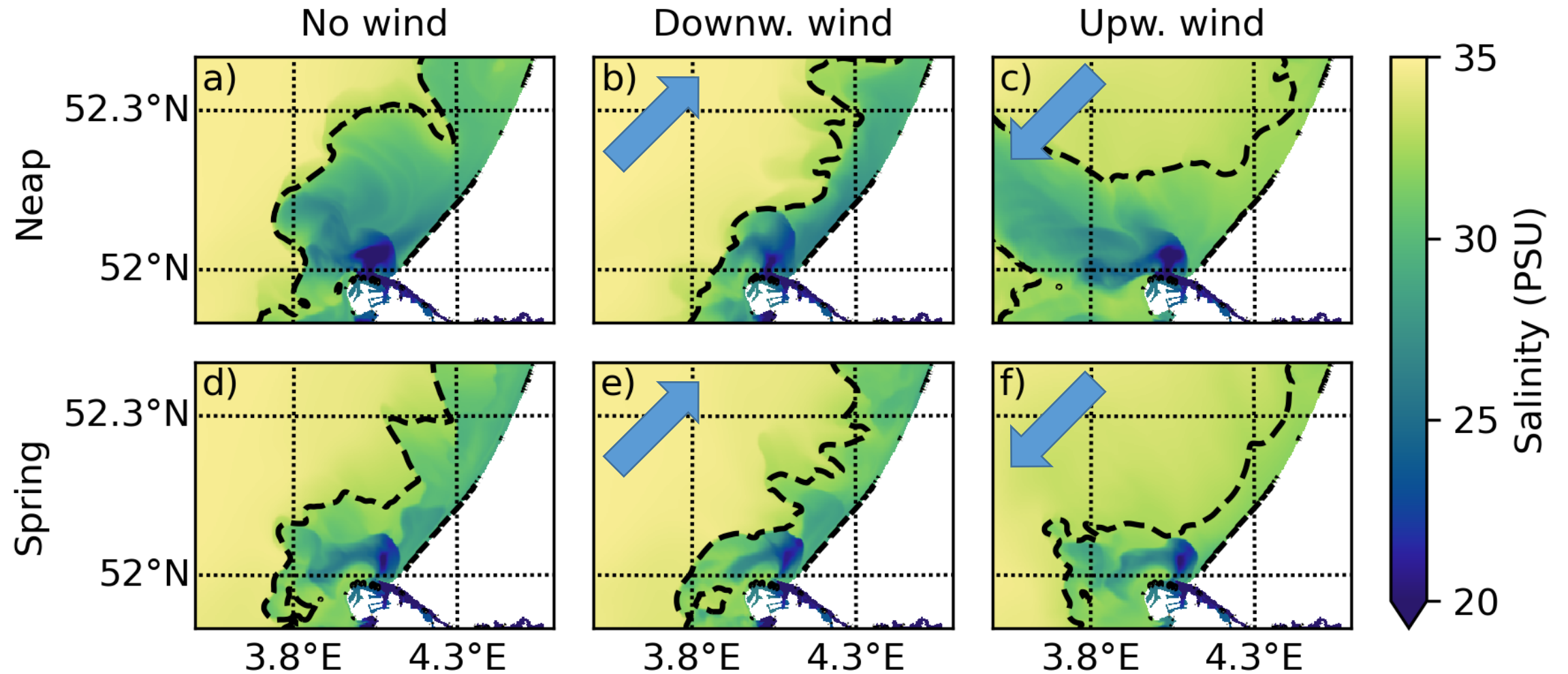


# Results



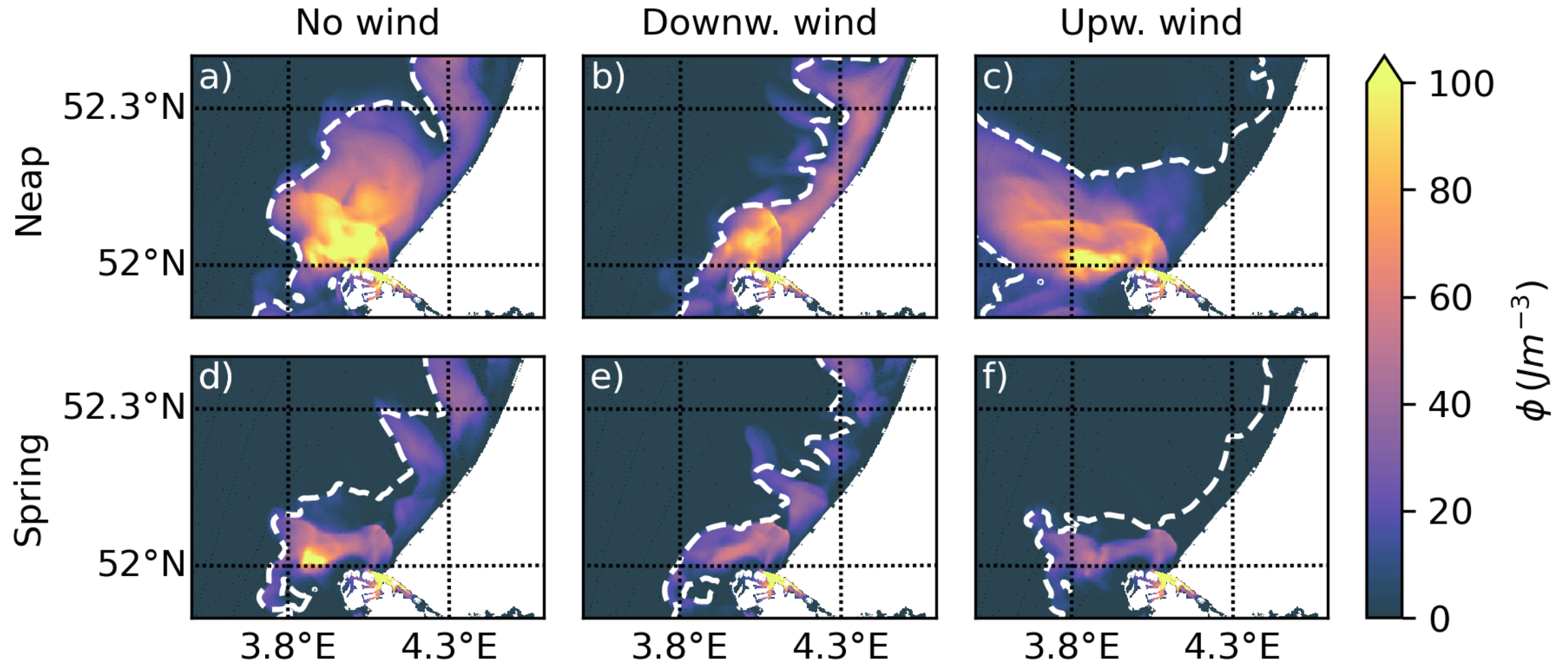


# Results

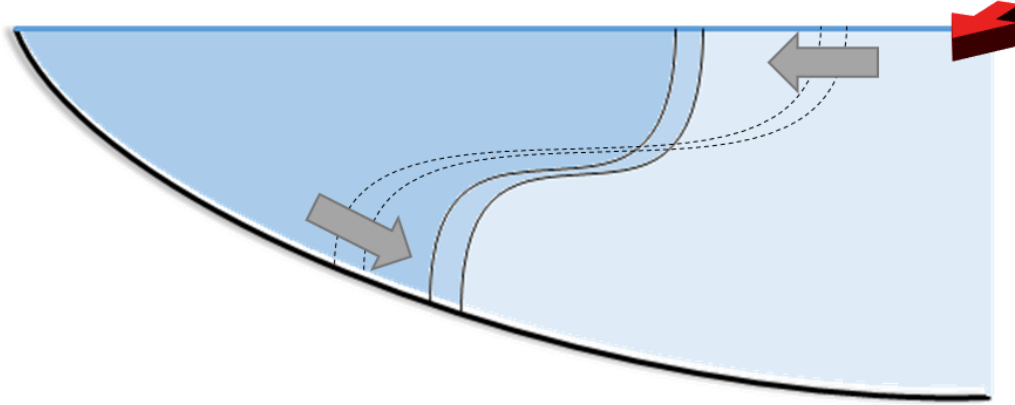




# Results



# Downwelling wind

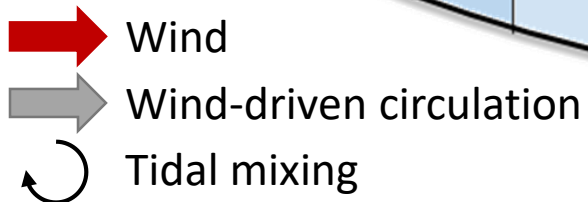
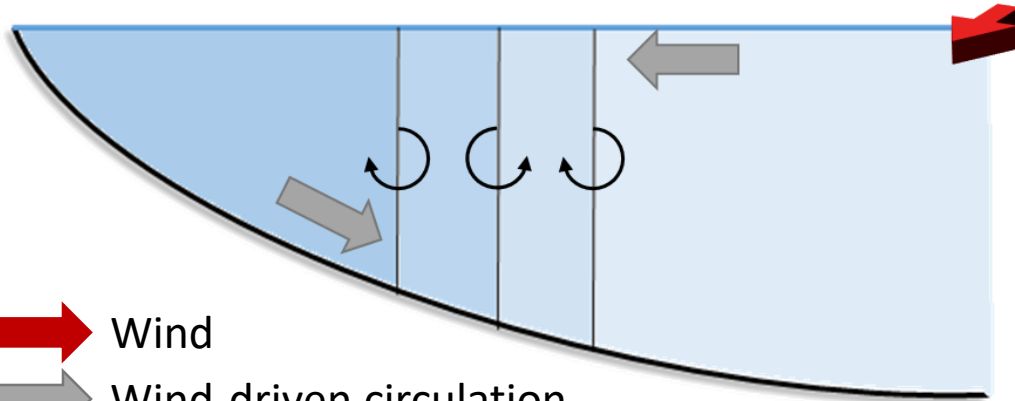


## Neap tide

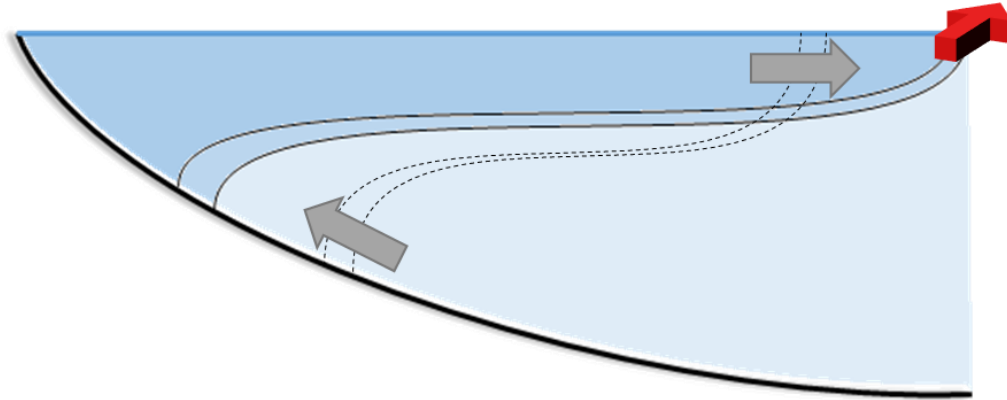
- Narrower
- Thicker

## Spring tide

- Tilting isopycnals  
→ unstable stratification



# Upwelling wind

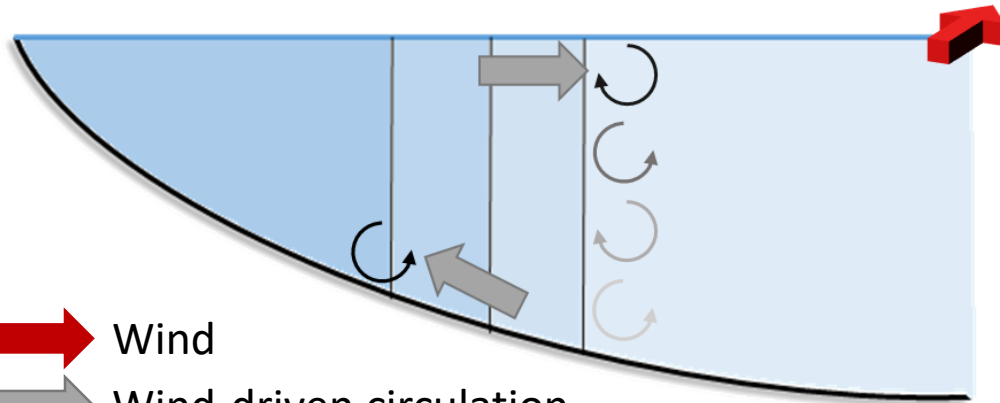


## Neap tide

- Wider
- Thinner

## Spring tide

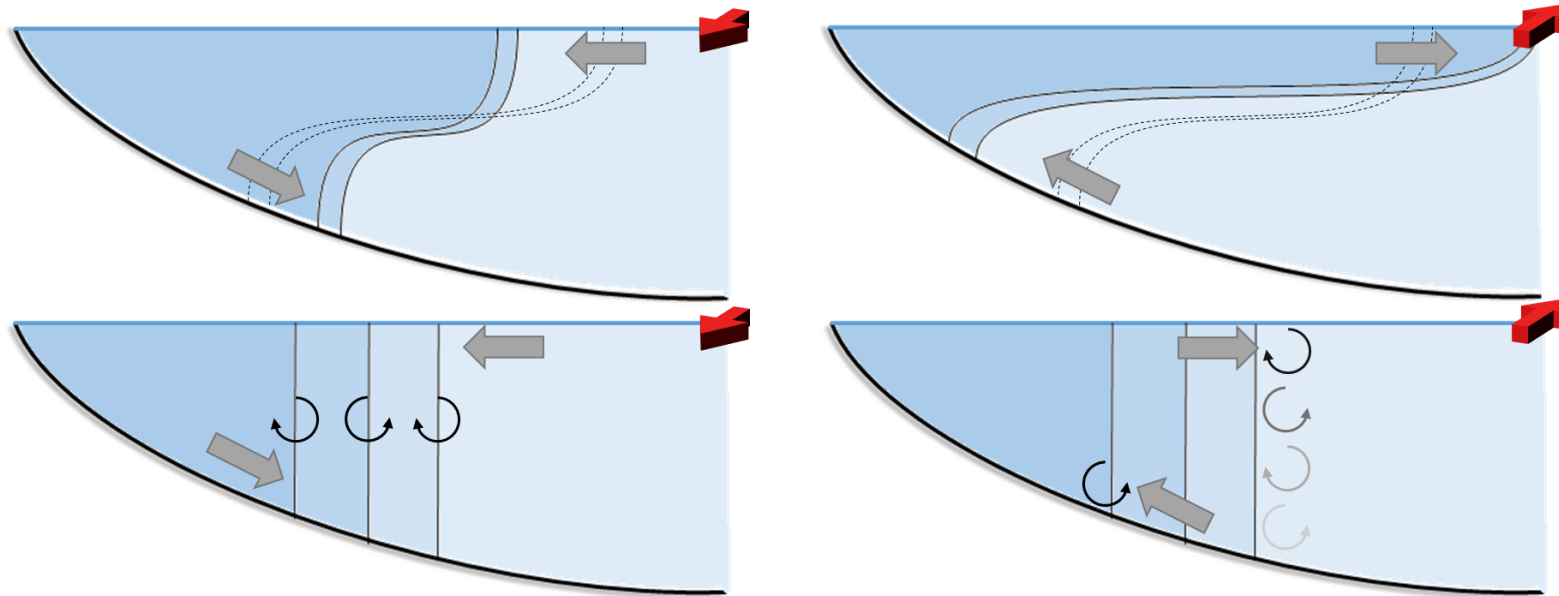
- Shorter mixing time scales  
→ limited offshore spreading



- ➡ Wind
- ➡ Wind-driven circulation
- ↻ Tidal mixing

# Conclusions

**Spreading and mixing of freshwater in the Rhine ROFI strongly depends on the phasing of tides and winds.**



- Strong variations in tidal mixing during a spring-neap cycle alter the wind-driven response of the Rhine River plume.
- On neap tide, the wind-driven response is in accordance with Ekman dynamics.
- On spring tide, the wind-driven response is affected by increased tidal mixing.