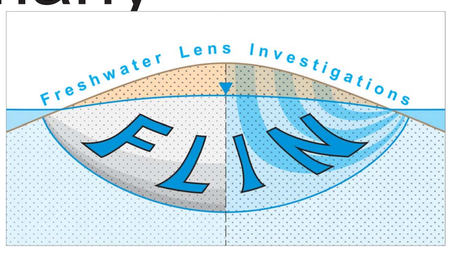
Impact of tourism on groundwater extraction on the island of Langeoog, Germany

Georg Houben

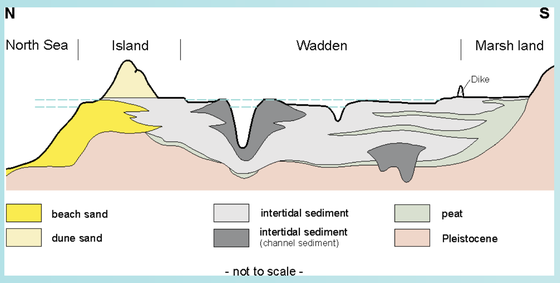
Federal Institute for Geosciences and Natural Resources(BGR), Hannover, Germany georg.houben@bgr.de



Water supply on the East Frisian Islands

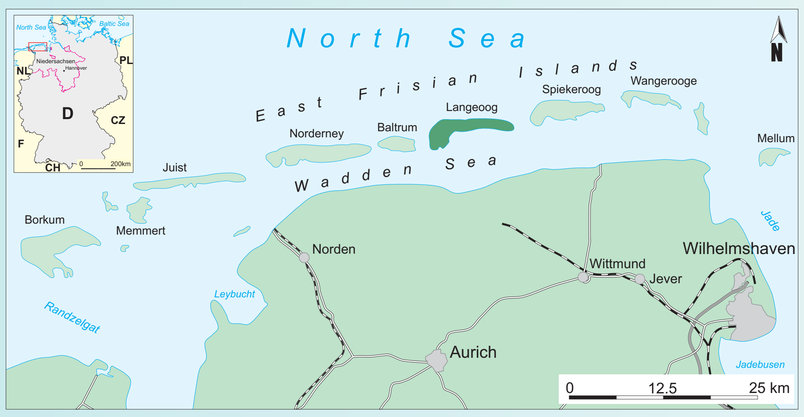
The East Frisian Islands are a chain of barrier islands in the Wadden Sea area of the North Sea. Extensive intertidal mudflats separate them from the coast.

Rainwater infiltrating into the dunes forms freshwater lenses in dynamic equilibrium with surrounding saline water. Water supply on most islands depends on these lenses.



Cross-section of the East Frisian coast (modified after Streif 1990)

The economic base of the islands is tourism. The high seasonality of this business and the elevated water demand of tourists stress the limited water resources. Climate change might exacerbate this situation.

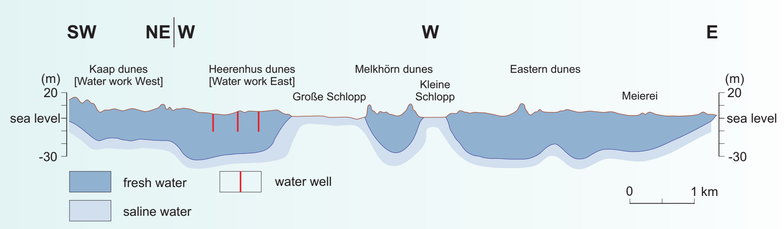


Groundwater extraction	[m³/a]
Borkum	800,000
Juist	300,000
Norderney	940,000
Langeoog	334,000
Spiekeroog	140,000

The islands Baltrum and Wangerooge are supplied from the mainland via pipeline

Example Langeog

The island of Langeoog has three freshwater lenses. The separation was caused by storm flood inundations in historical times, especially during the 17th century.



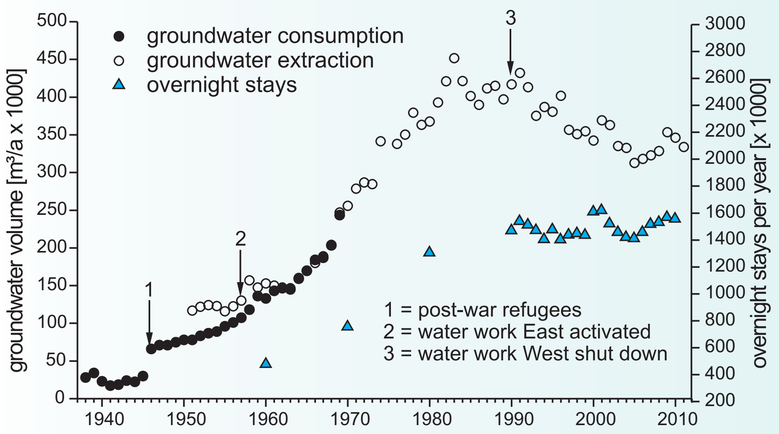
Cross-section of the freshwater lenses of Langeoog (modified after Streif 1990).

Water supply solely depends on groundwater pumped from the western freshwater lens. To prevent upconing of underlying saline water, extraction is distributed over 20 shallow wells (10 to 18 m depth) which pump intermittently at low rates of around 10 m³/h.

Water demand

Historical development

Consumption steadily rose until the 1980s, parallel to increasing tourism. With the implementation of water-saving household appliances in the 1990s, consumption significantly decreased.

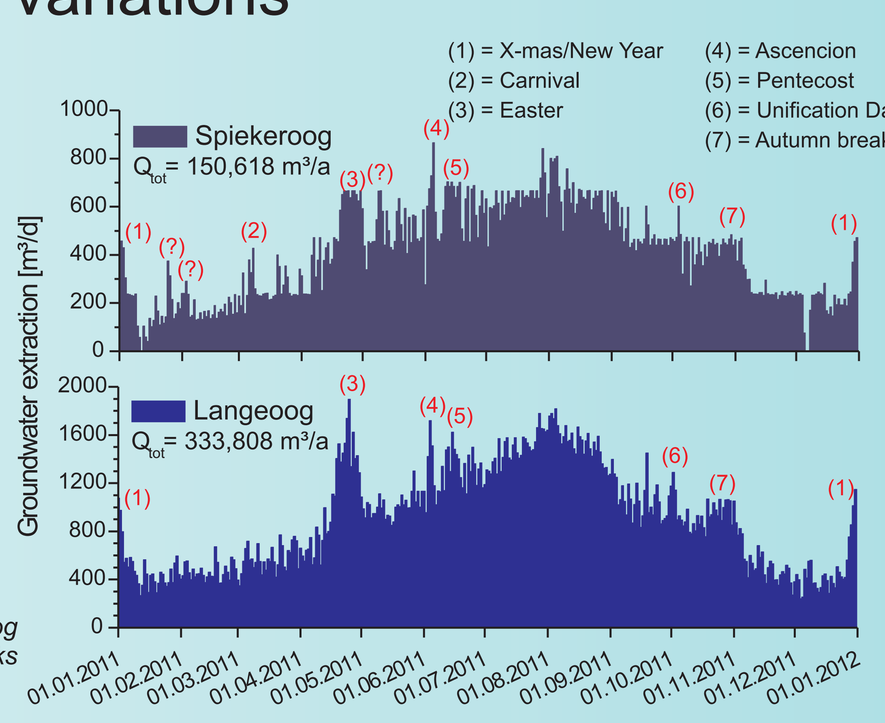


The 2011 extraction of 334,000 m³/a is about a quarter less than the peak extraction of 452,000 m³/a recorded 1983, although the number of overnight stays has remained more or less stable at least since 1990!

Seasonal variations

Water demand varies strongly according to seasons, vacation periods, public holidays and individual weekends. The lowest water demand on Langeoog during the off-season of 2011 was 238 m³/d while the maximum during the Easter holidays reached 1,894 m³/d, a factor of eight between maximum and minimum!

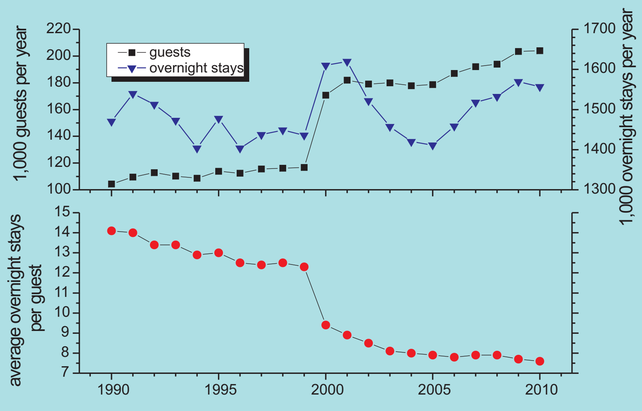
At 125 liter per day and person, the 2,000 permanent residents consume about 92,000 m³/a. Subtracting this from 2011´s consumption, the remaining 242,000 m³/a, equivalent to about 72 % of all extraction, must be attributed to tourism.



Groundwater extraction on the islands of Spiekeroog and Langeoog in the year 2011 showing strong seasonal demand variation. Peaks are even more pronounced on the smaller island of Spiekeroog. After data by OOWV.

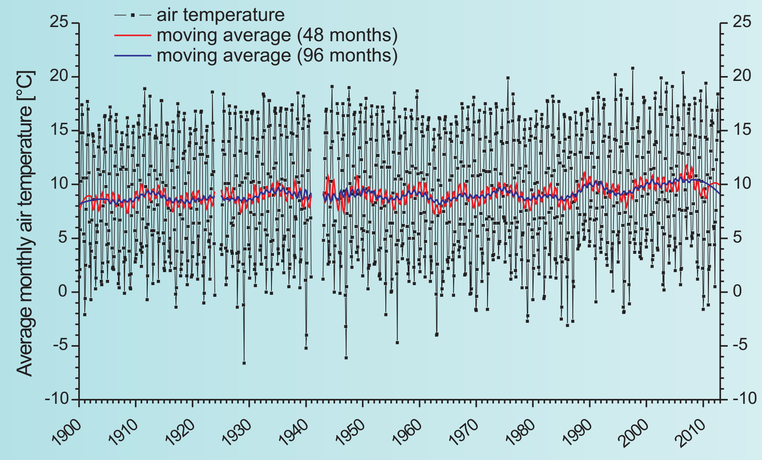
Tourism

Langeoog 2011:
(a) 2,000 permanent residents
(b) 150 seasonal workers
(c) 1,540,000 overnight stays
(d) 124,000 day visitors



Guest numbers rise but the number of overnight stays remains constant = shorter vacations
= more frequent cleaning of rooms and washing of towels and linen

Climate change



Air temperature records from the island of Norderney indicate an increase of the average annual temperature of about 2.0° C over the last 115 years. Especially summers in the last 20 years have become warmer and cold winters have become less frequent. Will this cause an increase in water demand?

Conclusions

- Water supply on East Frisian Islands mainly depends on freshwater lenses
- Tourisms accounts for more than 70% of all water consumption
- Strong demand variations over the course of the year due to tourist seasons
- Water consumption has decreased due to implementation of water saving installations although number of overnight stays has become constant
- Tendency towards more frequent but shorter vacations might increase demand again (more frequent washing and cleaning)
- Future effects of climate change (rising temperatures in summer) might be a game-changer.

The results presented on this poster were elaborated in the framework of the BGR project FLIN (Freshwater Lens Investigations)

References:
Streif, H. 1990. Das ostfriesische Küstengebiet: Nordsee, Inseln, Watten und Marschen. Sammlung geologischer Führer 57, 376 p., Berlin.

Acknowledgement:
We thank the Oldenburgisch-Ostfriesischer Wasservernband (OOWV) for data on water consumption