

Introduction

In the COSYNA framework an implementation of a pile HPA Elbe1 in mouth of the Elbe estuary between the fairway and the wadden sea (photo and schematic sketch of the pile HPA Elbe1 see Figure 1 on the right) was proposed and have been realized in the years **2012** and **2013**. The idea of the pile was to implement an observation station to measure morphodynamic exchange processes between the North Sea and the Elbe estuary and also between the deep fairway and the flat wadden sea area.

The data could also be used to complement existing monitoring systems and programs. The collected data contain the following basic COSYNA parameter of the so called category I :

- **Hydro- and morphological parameter:**
Currents, water pressure, water temperature, conductivity (and derived salinity), pH value, dissolved oxygen content, fluorescence, turbidity (incl. water samples)
- **Meteorological parameter:**
Wind velocity, wind direction, barometrical pressure, air temperature, humidity, global solar radiation, precipitation rate

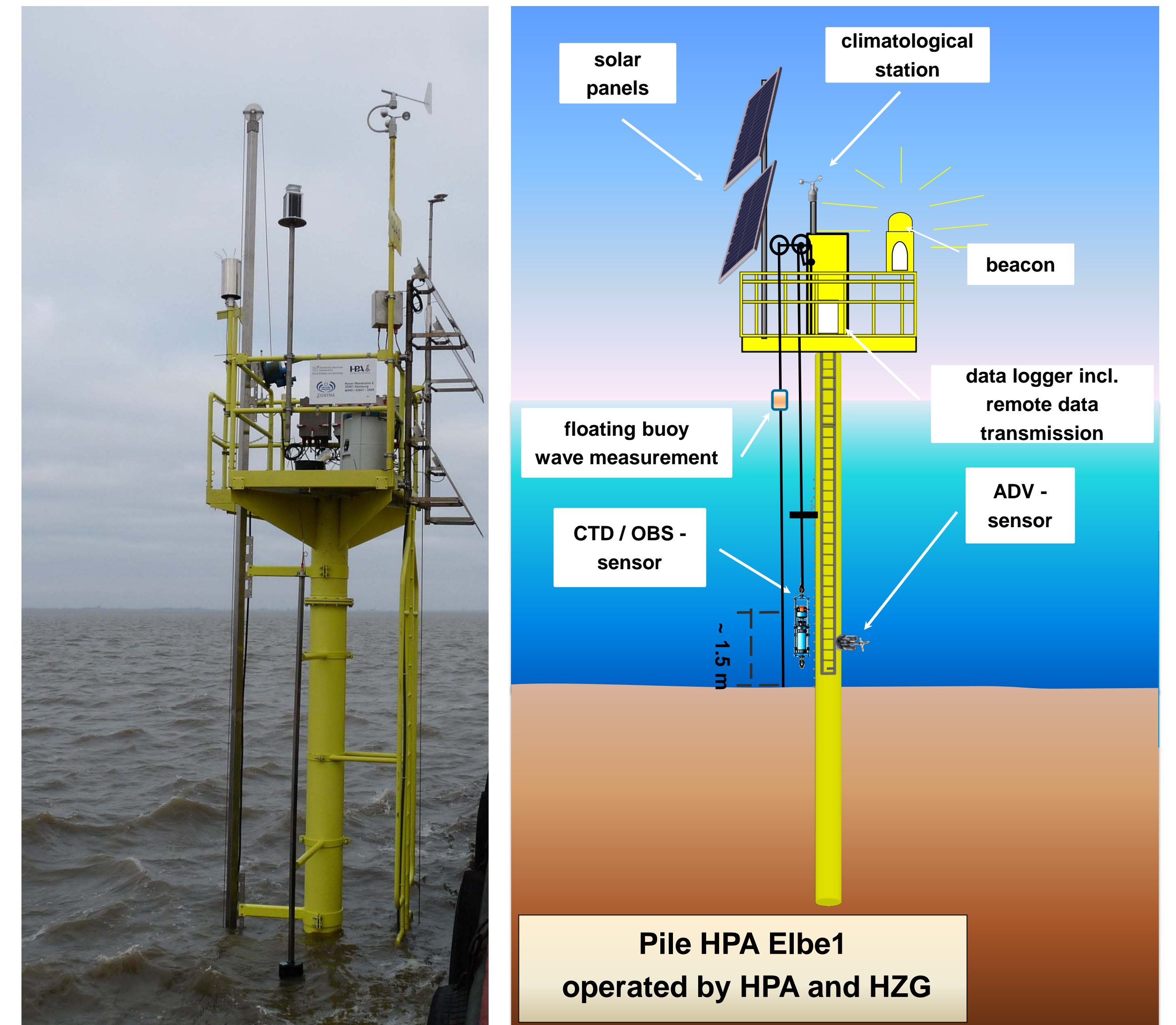


Figure 1: Photo and schematic sketch of the pile HPA Elbe1 (operated by HPA and HZG)

Location and Operation Time



The location of the pile HPA Elbe1 is shown on the left in Figure 2. The pile was placed near a former monitoring station (LZ2, operates until 2006) of the federal water and shipping administration in Cuxhaven (WSA Cuxhaven). As there was no external power supply at the off-shore location of the pile, measurements and analysis of nutrients could not be done at that location. Therefore a ferry box was installed at an on-shore location in Cuxhaven.

Due to the construction of the pile it was not possible to have an installation during the winter. Therefore the pile was uninstalled during winter time and was only in operation in the summer time of the years **2012** and **2013** during the following time periods:

- **2012:** March, 15th until November, 20th 2012
- **2013:** March, 19th until October, 30th 2013

Figure 2: Location of the pile HPA Elbe1 (operated by HPA and HZG) in the Elbe mouth

Results

Data delivery of the HPA Elbe1 pile was robust. Most of the data were categorized as data with the COSYNA quality status 2 (see also Figure 3 on the left). Due to a failure within the CTD/OBS- and the ADV-sensor, there were some gaps in the measurements. Therefore no morphological data have been taken from September, 18th 2012, 06:20 h to September, 25th 2012, 11:30 h and no hydrodynamic measurements have been taken between September, 28th 2013, 07:20 h and October, 09th 2013, 03:38 h.

The data of **turbidity (NTU)** and **salinity (PSU)** correlate on one hand with the **wind speed (m/s)** and therefore with the wave impact on the flat wadden sea areas and on the other hand with the **fresh water discharge Q (m³/s)** of the Elbe (measured in Neu Darchau). Therefore the data gives a spectrum of the exchange processes within the Elbe mouth.

Figure 4 on the right shows the main **current directions** in 5 degree intervals at the pile. The prevailing ebb and flood currents are shown in red colour and mean flow velocities are marked with a dot. The pile is located at an ebb current dominated position with mean ebb currents of ~ 0.76 m/s and mean flood currents of ~ 0.59 m/s.

The variability of the energy density spectrum of **wave measurements** on a 2 Hz basis at the pile is shown in Figure 5 on the right. The mean significant wave height H_{m0} were calculated with ~ 0.3 m and the mean wave period T_{m01} to ~ 2.0 s. In stormy periods with wind velocities up to 15 m/s (e.g. end of March 2013 and 2014) the significant wave height H_{m0} rose to ~ 0.8 m and the mean wave period T_{m01} to ~ 3.0 s.

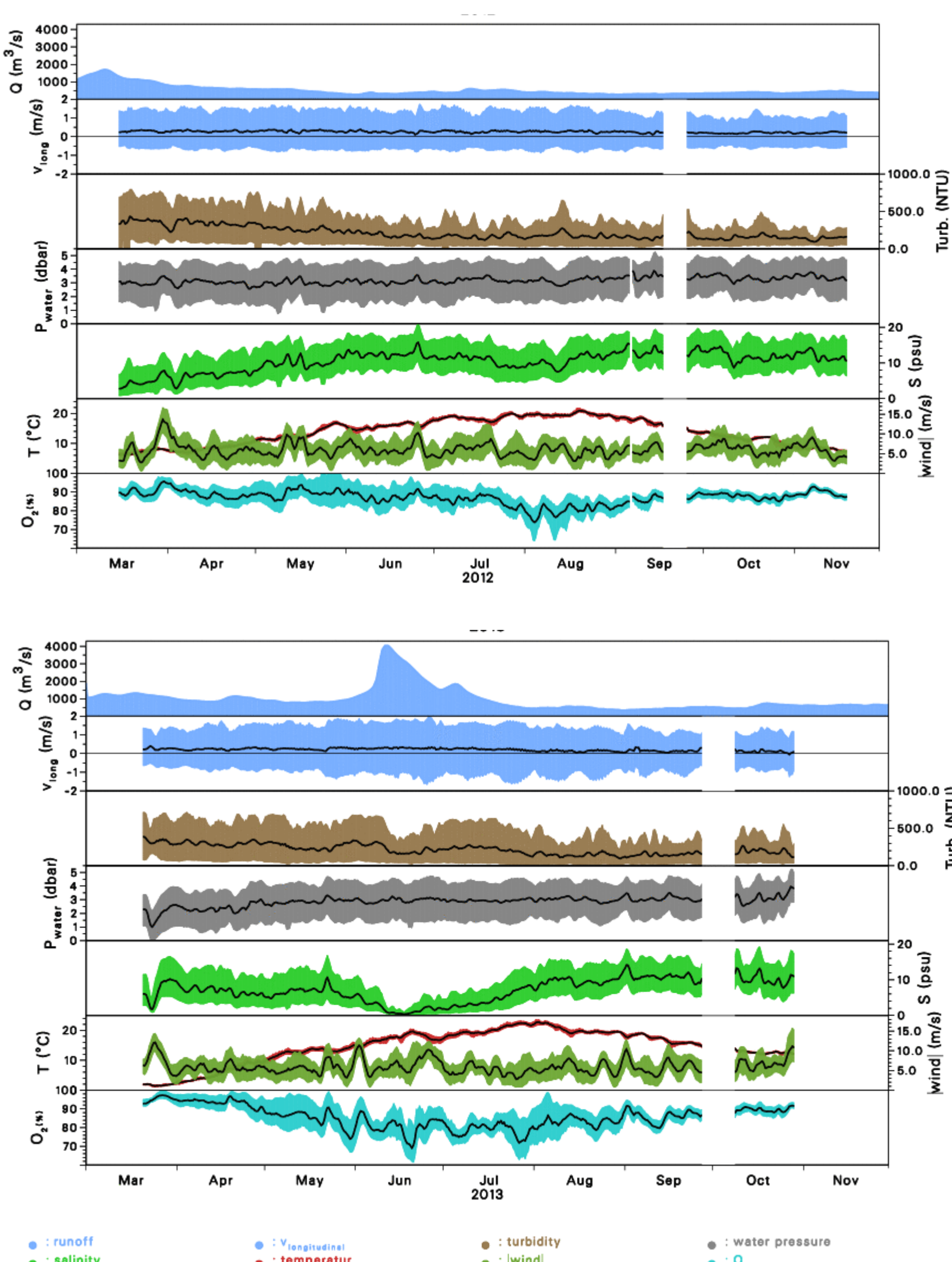


Figure 3: Time series of tidal means and extremes at the pile HPA Elbe1 (operated by HPA and HZG)

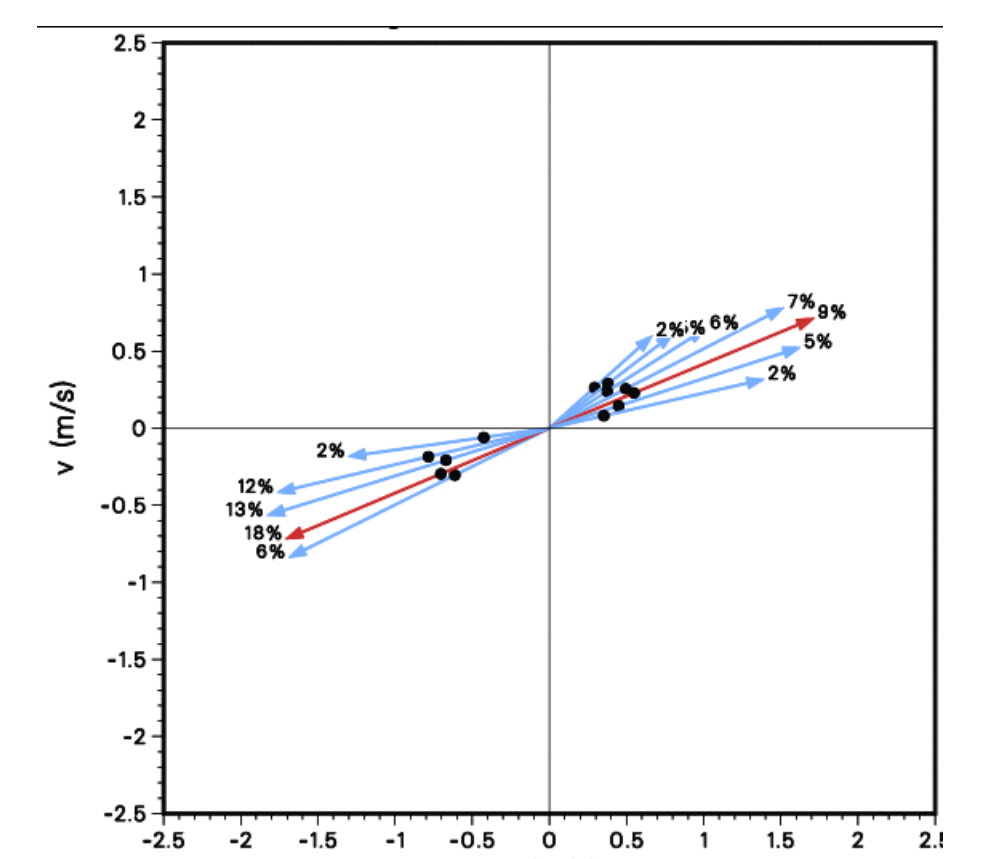


Figure 4: Main current directions in 5 degree intervals (prevailing ebb and flood currents in red and mean flow velocities are marked with a dot)

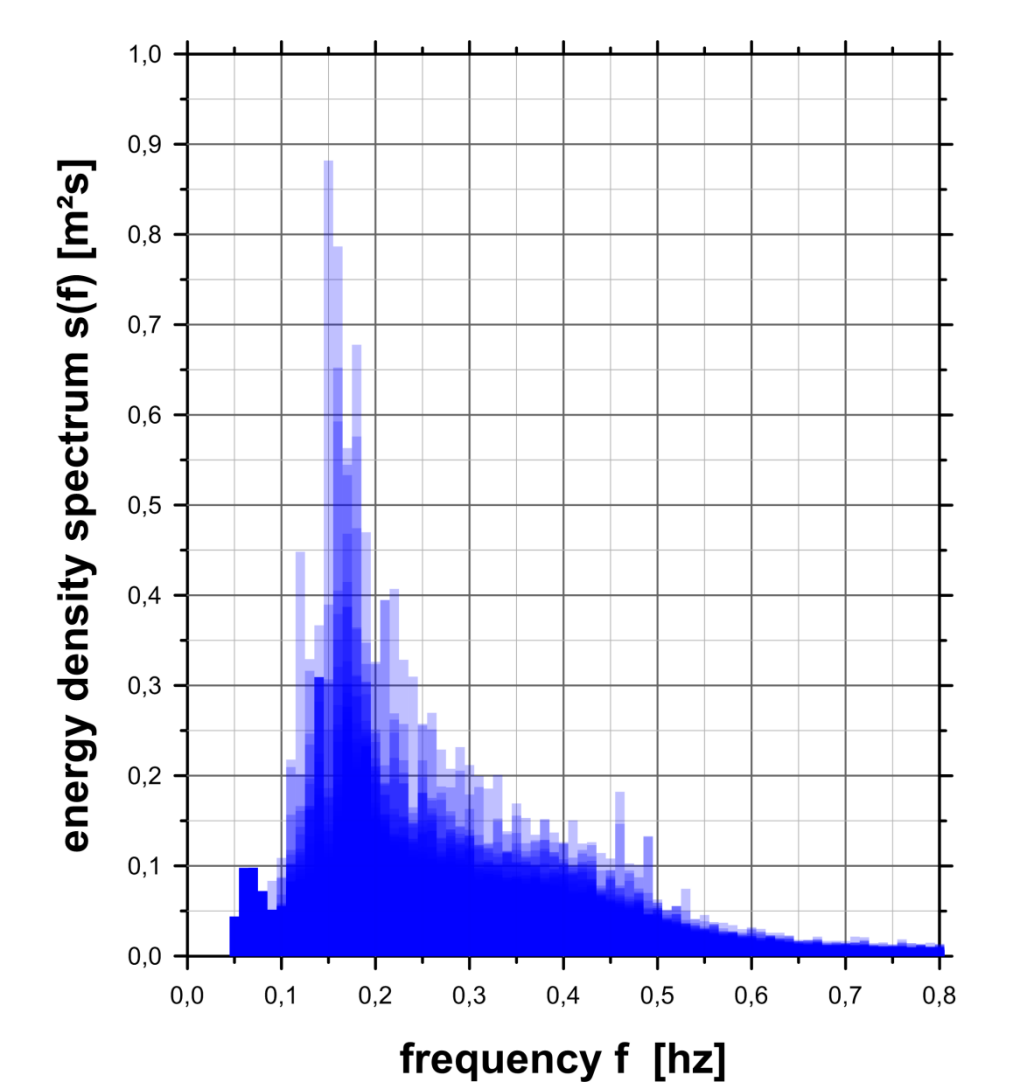


Figure 5: Variability of the energy density wave spectrum (measurements on 2Hz basis)