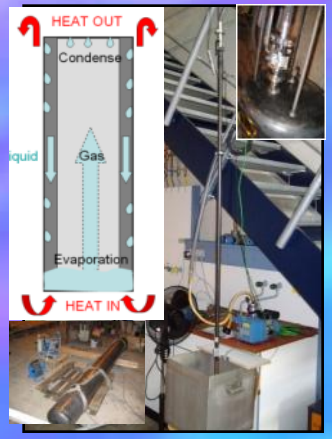
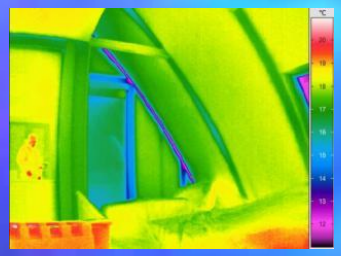


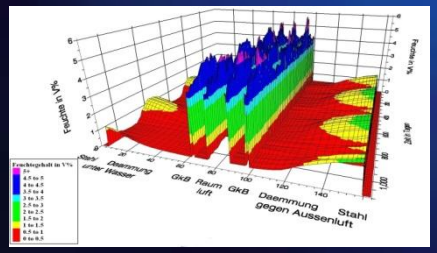


Floating architecture and structures –

an answer to the global change

BTU Cottbus-Senftenberg
Facullty VI, Dep.: Building Physics

Brandenburgische Technische Universität Cottbus - Senftenberg



1 Global changes

2 Floating houses

2.1 History and current situation

2.2 Global – national - regional examples

3 What is to do? : to become a floating smart city?

3.1 Activities

3.2 Case studies

4 Conclusion + outlook

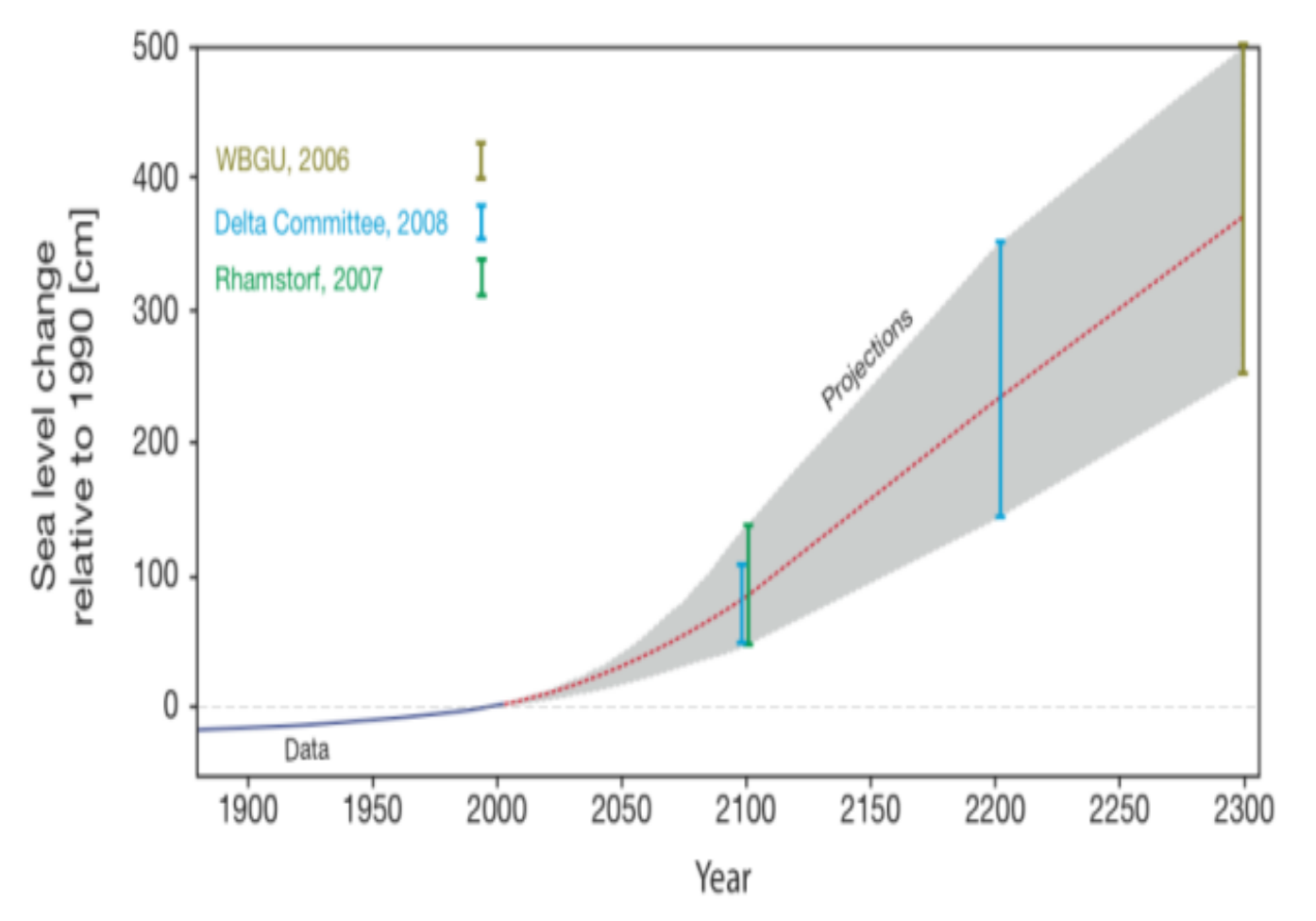
1 Global change

- Objectivly related processes
  - population of the world increases
  - sea level rises
  - limited resources: water, (energy) and volume of the planet earth

- Subjectivly related processes
  - quality of life : representation (Seoul, Hamburg….)
  - quality of life : for all people with regard to drinking water
    energy
    construction ground

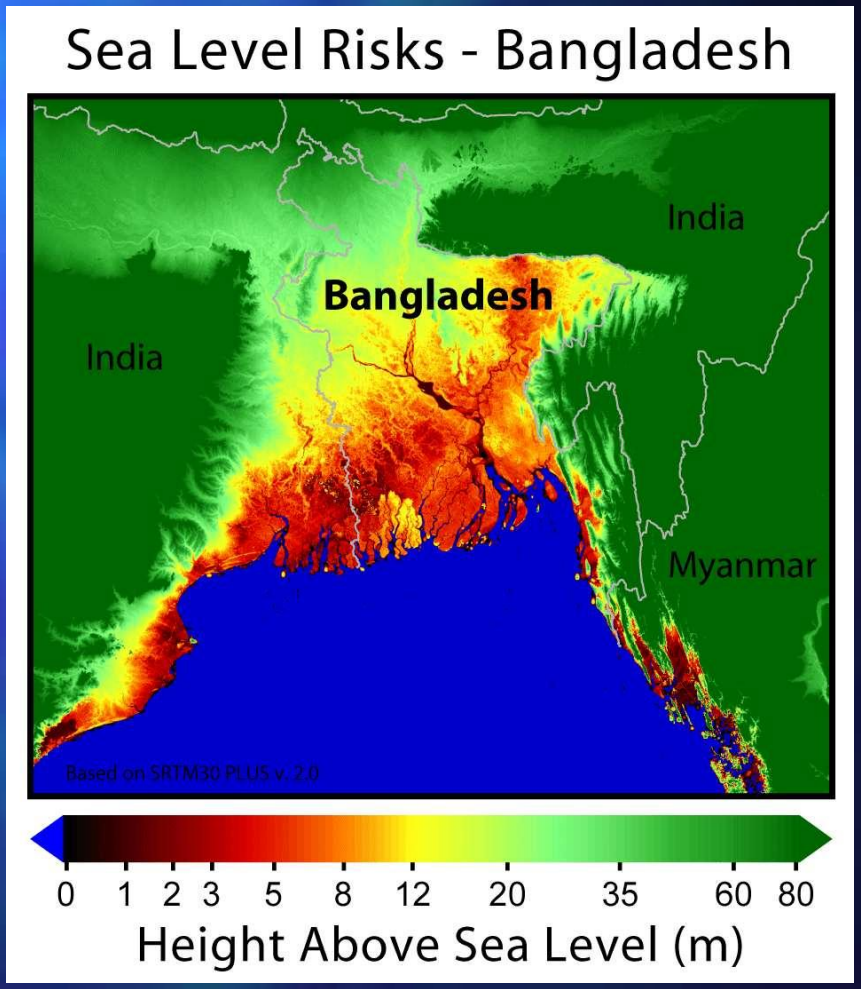
Rising sea level

indeed:
-sea level rises,
-(independent on sources and the reasons)
-many economic centres located near coastlines or near river,
-low distance above the sea water level



Prognoses of IPCC

Intergovernmental panel on climate change

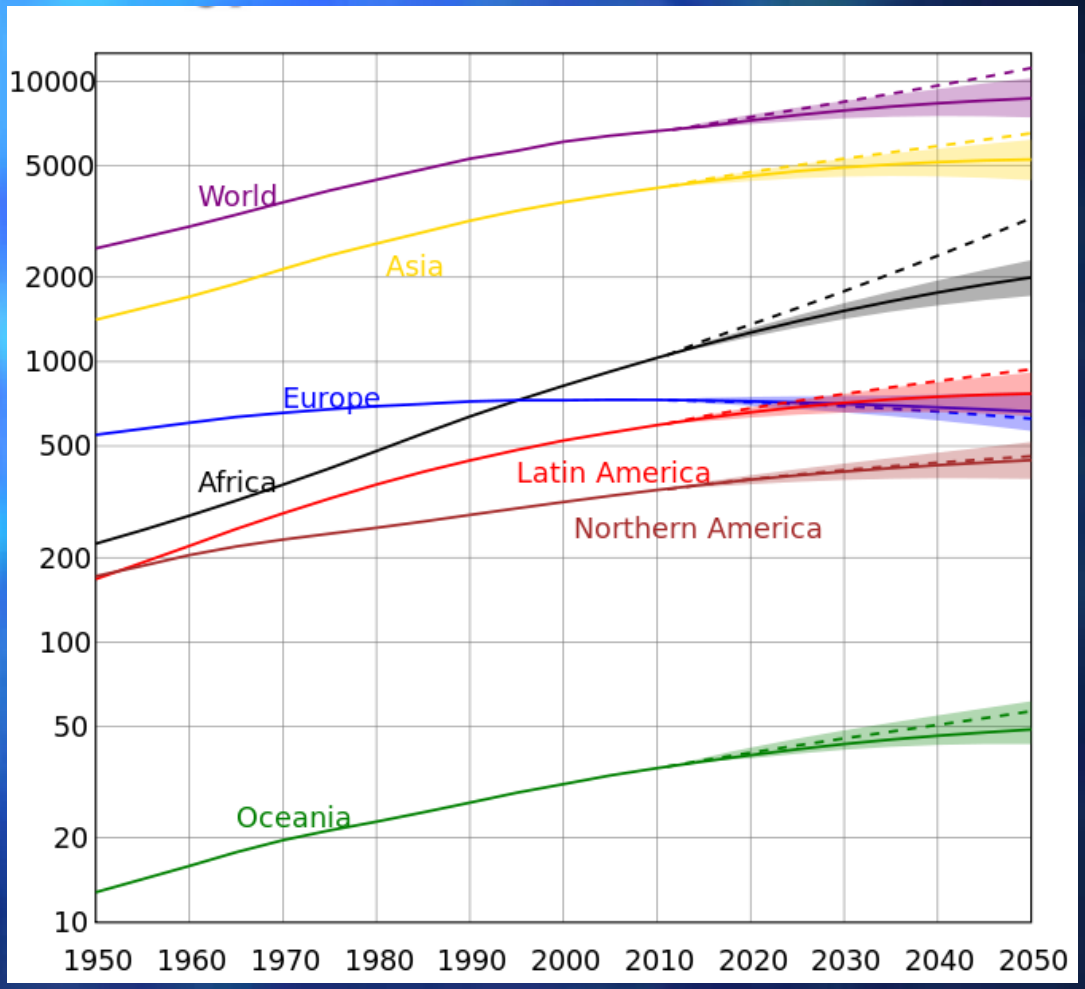


world population growth rates

The expansion rate percentage decreases,

but the absolute expansion rate increases in the future

up to 10 billion around the world



time in years

Intermediate results :

1. we find a lot of backgrounds for the need to deal with the topic „floating structures“.

Subjectively related backgrounds:
- mainstream, a good feeling, history

objectively related backgrounds:
- Precaution for existence

2 Situation with regards to the floating houses

Historical situation

- in the past: in most cases organic materials were available
  - in Asia: there are a lot of different materials
  - in North America: in Canadian forest floating accommodation of former lumberjacks
  - later old ???? were varied and used as living

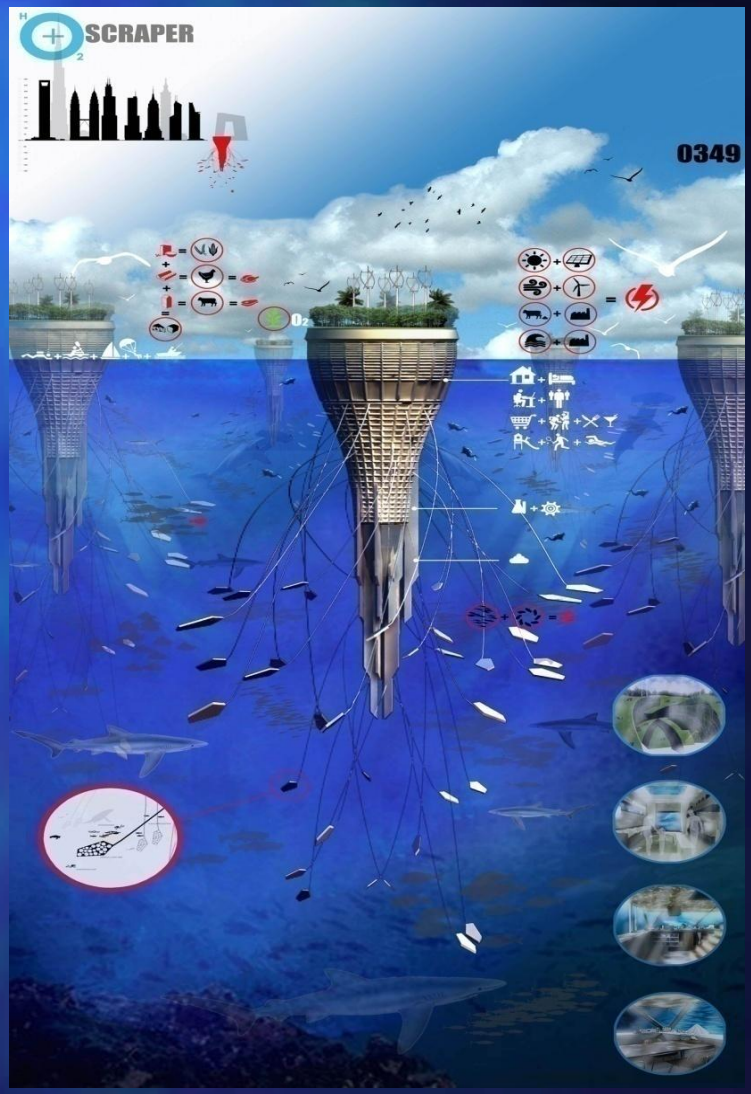
Planning of floating settlements all over the world

- hO2 +Scraper:

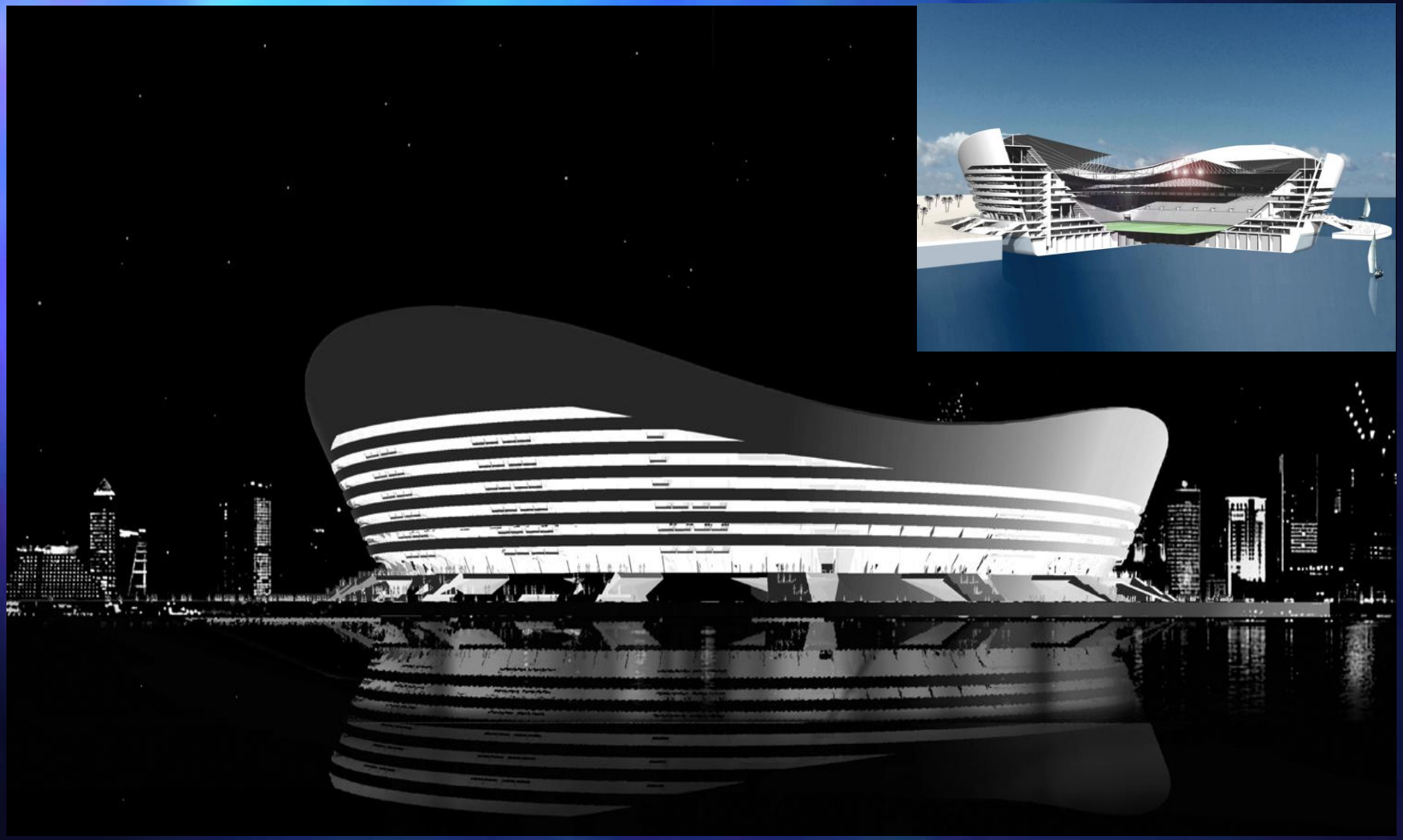
  - self-sufficient underwater skysraper
  - producing renewable energy to grow its own food.

- No man`s land:

  - a vision for the solution of the political and ecological crisis in Middle East



Floating Off-Shore Stadium FIFA World Cup 2022



Situation in Central Europe

Austria:

- On the lake „Weißensee“ a floating house made of wood was installed.

- Basement is also made of wood.

- Energy-saving: by turning the house according to the sun position

Memory of a former village: floating church

-At this location there was a village with its church,

-Today weddings and other events are held at this location (booked for a long time in advance),

-Power is supplied by ships

Research station on a gravel lake near river Rhine

- Transferability of the passiv-house measures to the floating homes,

- development of a mini heatpump,

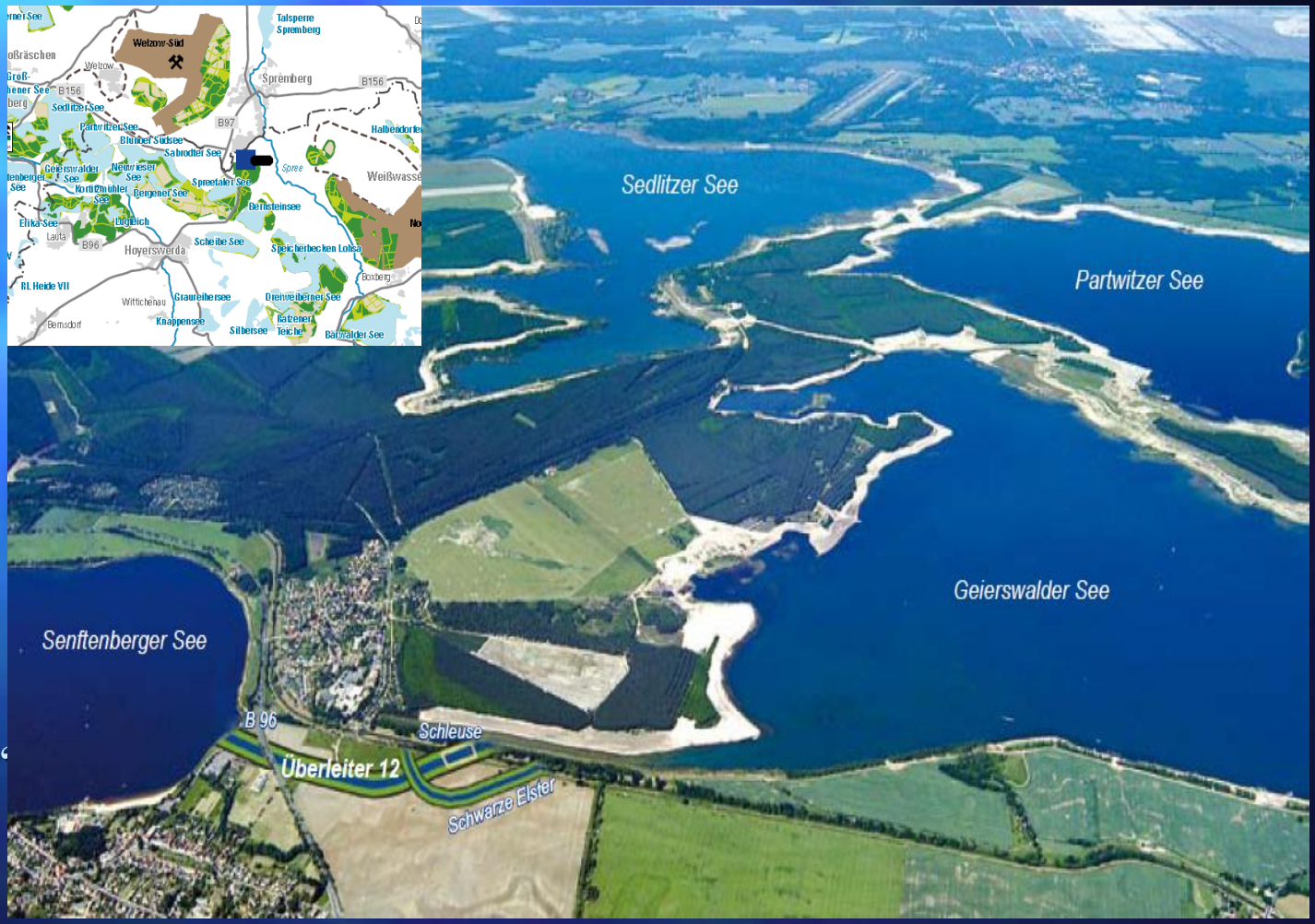
- optimized PV-plant for water areas,

- controlled venti - lation with heat recovery.

Testfield for floating architecture

- map of former opencast lignite mines, partly filled with water (interconnected by so called crossings)

-an important pre-condition for a solid result of the reevaluation of the former open-cast mines is a prior good „earth“ modulation.



e.g. Floating architecture in former brownfields

In most cases: nice pictures or
postcards of floating houses,

But : …..

Intermediate results:

- 1. We find a lot subjectively and objectively related backgrounds for the need to study the topic „floating structures.
- 2. Worldwide and regional potentials of floating architecture are available.

3 What is to do now ?

3.1 Activities

- Measurements of boundary conditions
  (outdoor climate components, attacks by chemistry, waves)
- Measurements of room climate
- Self-sufficiency
- Pontoons
- Passive air condition
- Material: investigation and development
- Optimization of heat exchangers
- Mobility
- Social and technical aspects of safty

3.2 Examples of activities

3.2.1 Optimization of heat exchangers

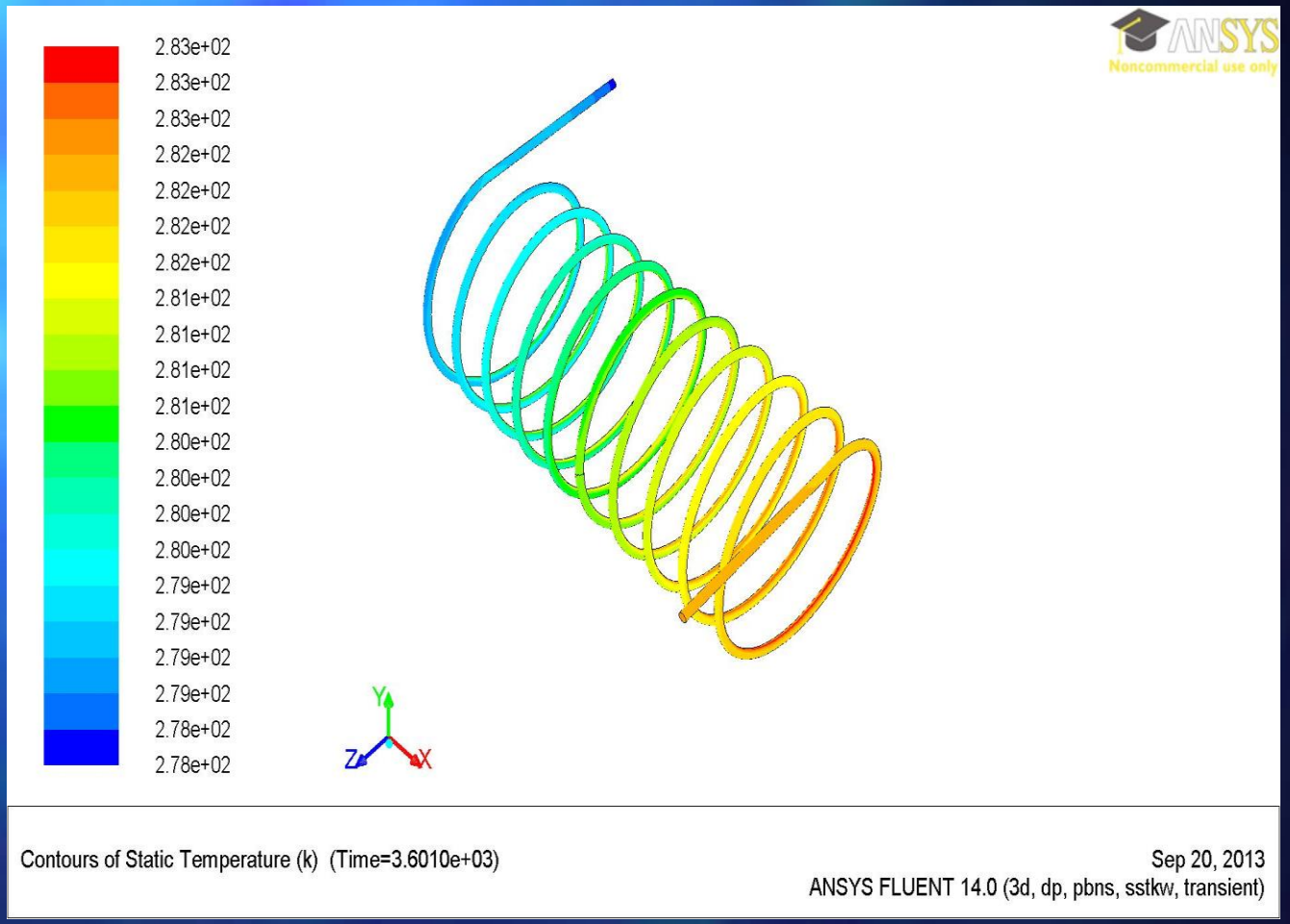
Heating+cooling support by heat-exchangers

-The assembley of heat exchanger between the segments of a pontoon of the typ „Ar-che“

Spiral heat exchanger: temperature distribution

Numerical simulation, quasi-stationary state

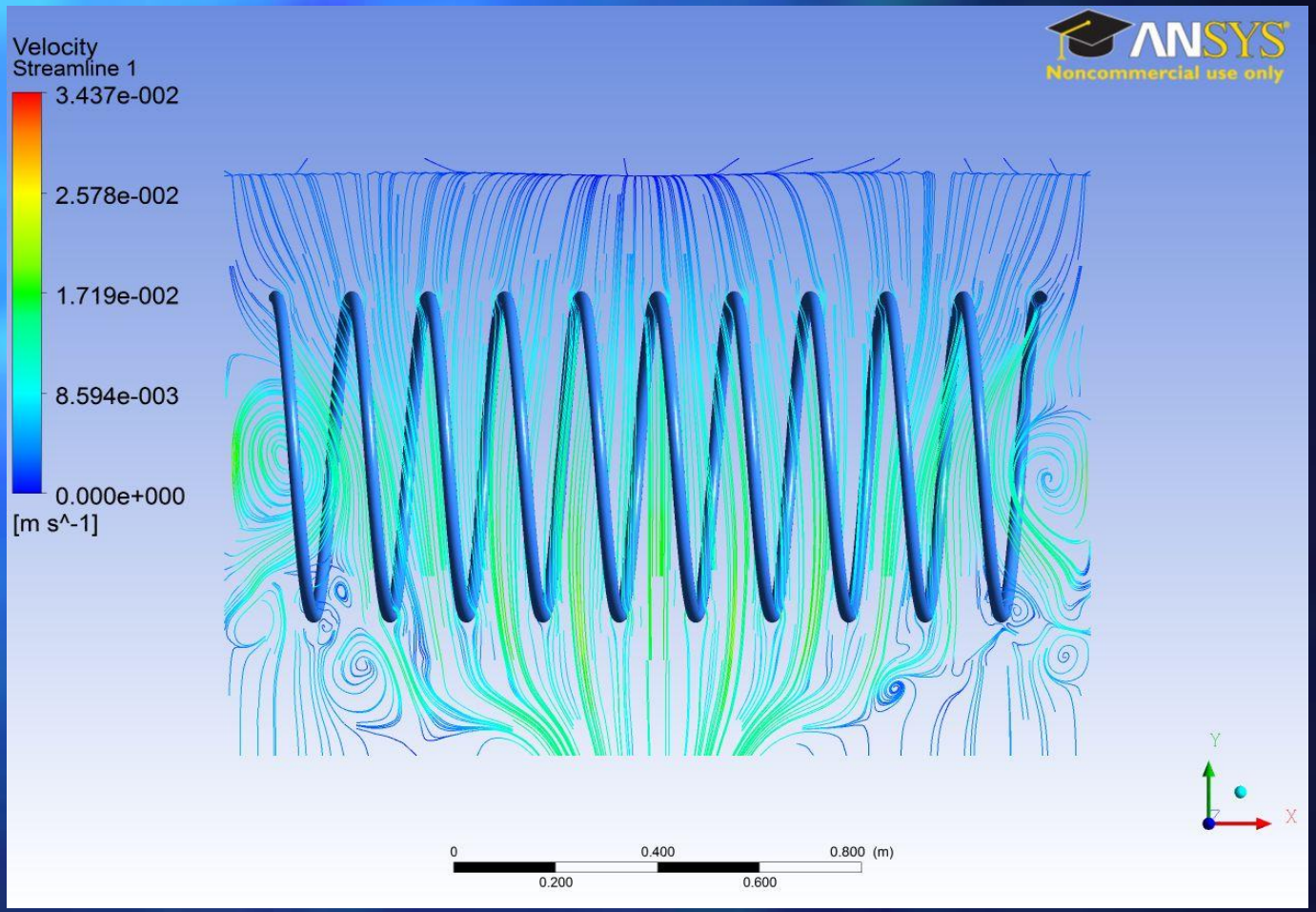
- Mass flow of the sole: 0,09kg/s
- leading temperature of the sole: 5°C
- Temperature of the surrounding water: 15°C (constant)
- Length of the spiral: 1,5m
- Cross-section: diameter: 0,65m
- Pipe length: 22m
- PE-pipe: $\lambda = 0{,}33$ W/m²K



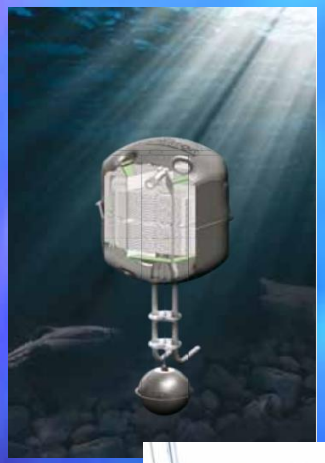
Spiral heat exchanger: velocity distribution by buoyancy

Numerical simulation. quasi-stationary state

- Temperature of the sole: 5°C (constant)
- Initial temperature of the surrounding water: 15°C



Compact heat exchanger

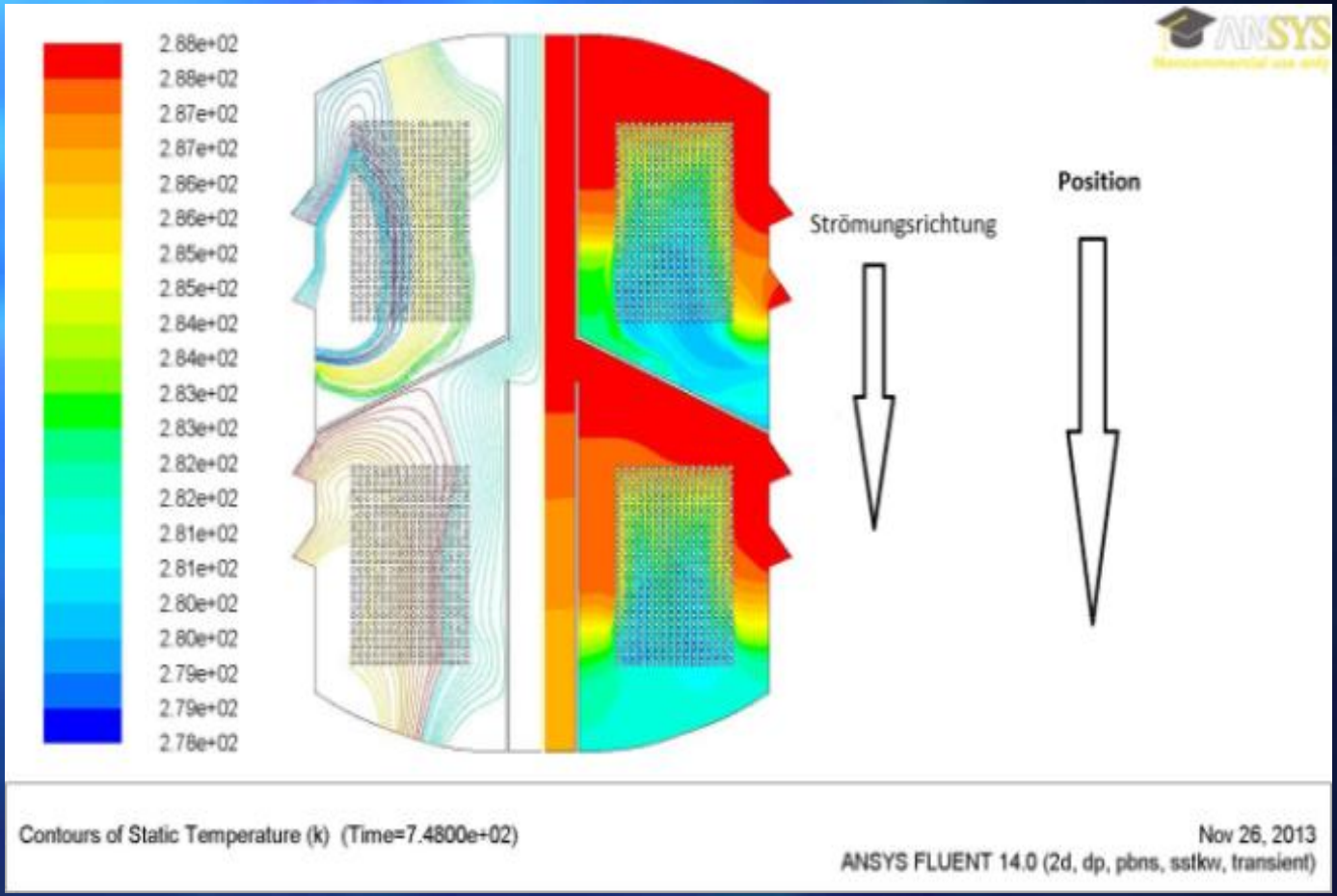


Compact heat exchanger: temperature distribution

operation
in wintertime

- temperature of surrounding water: 15°C

- temperature of sole: 5°C constant



Compact heat exchanger: temperature distribution

operation
in summertime

advantageous positioning:

Total mass flow:
$|\dot{m}| = 4{,}3$ kg/s

- temperature of surrounding water: 15°C
- temperature of sole: 25°C constant

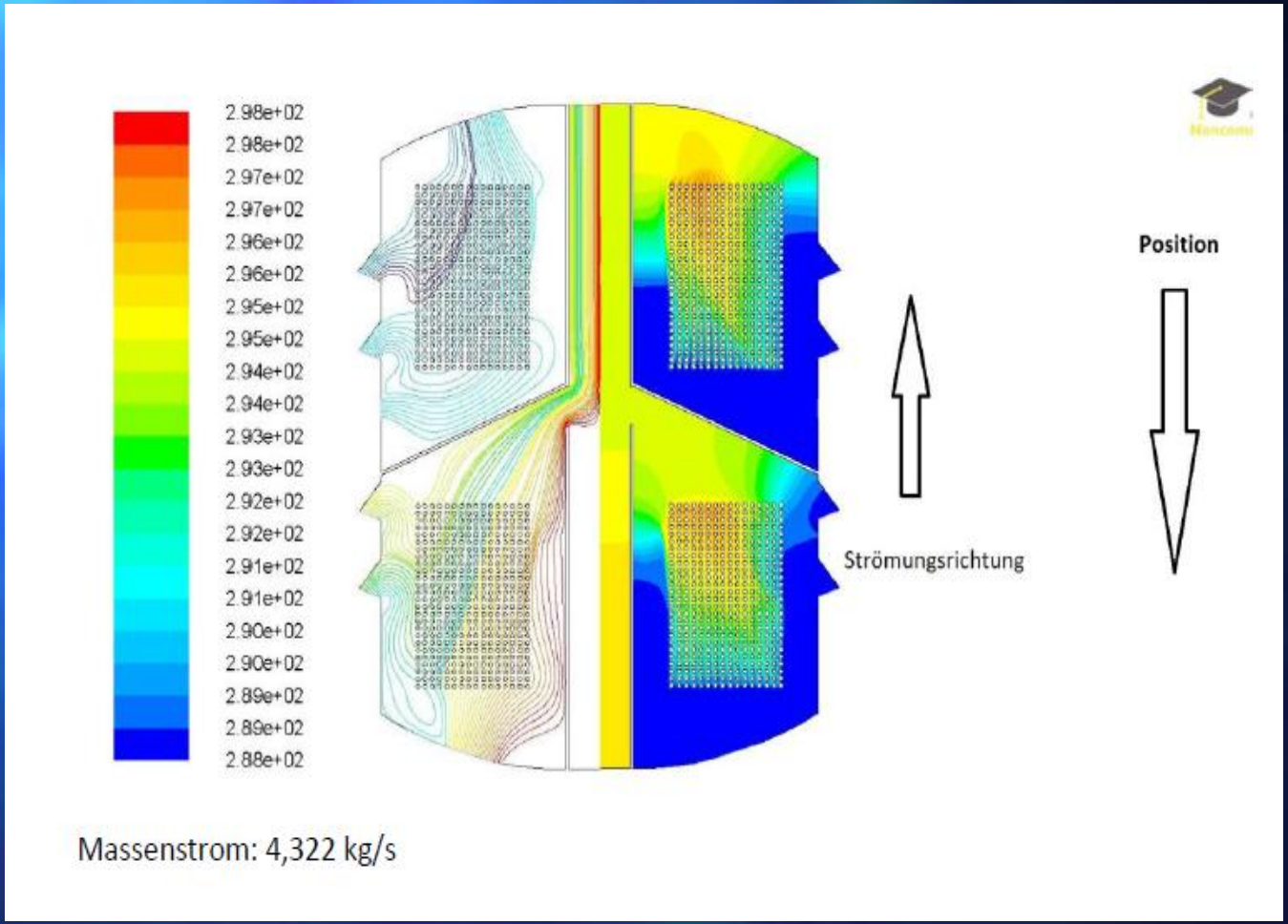
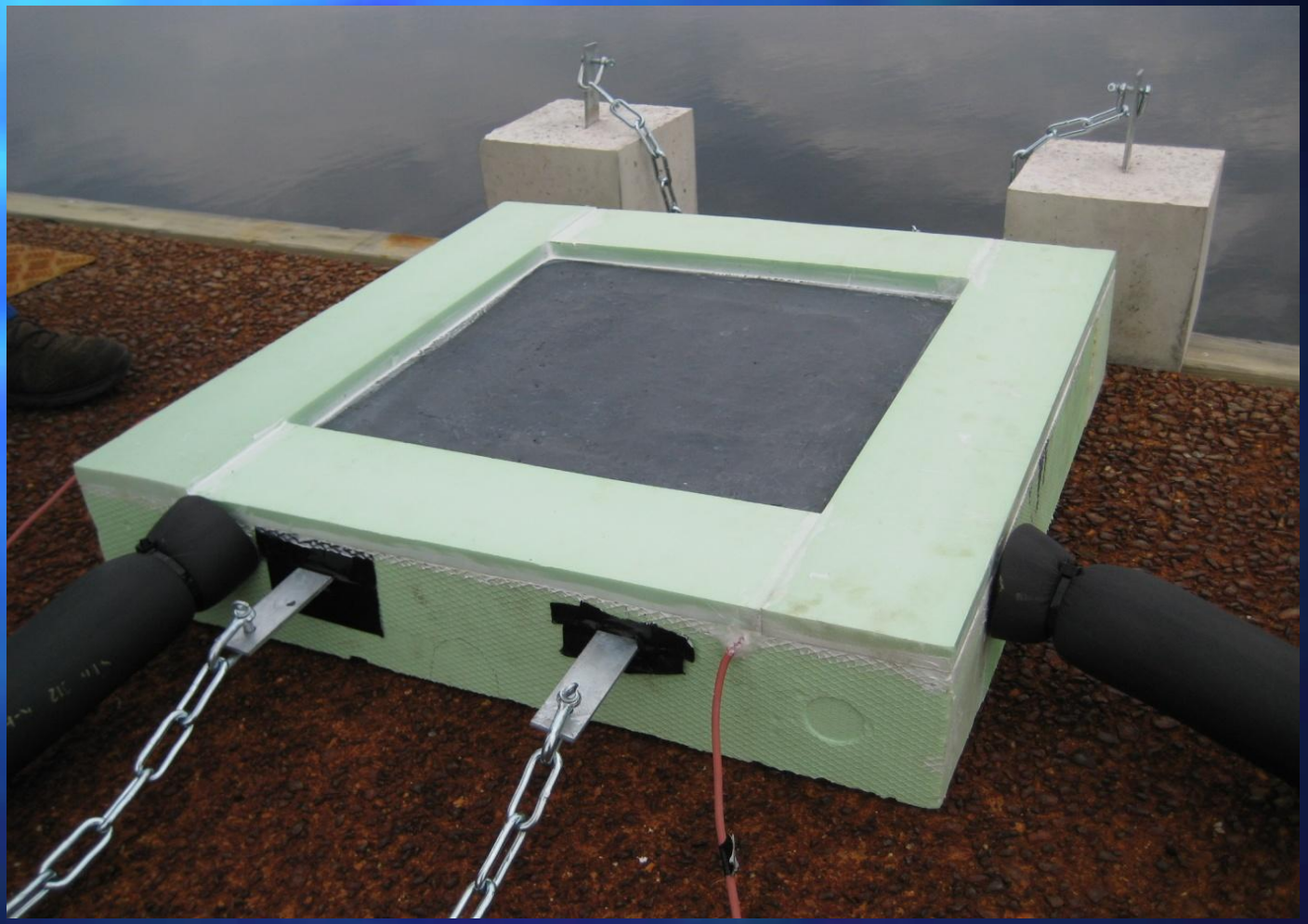


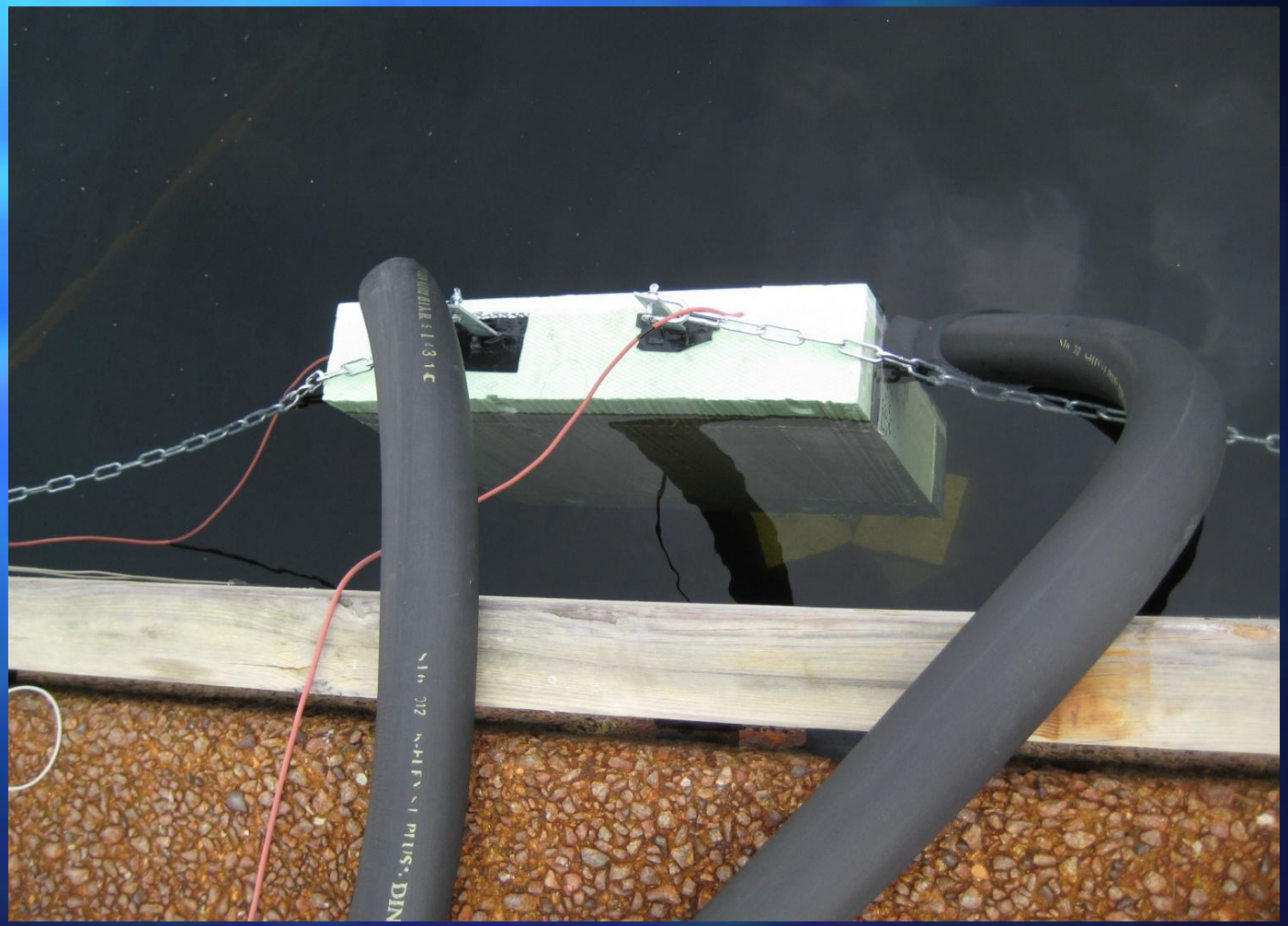
Plate-shaped heat exchanger with concrete

- Thermal Insulation is necessary to guarantee one - dimen-sional heat-transfer

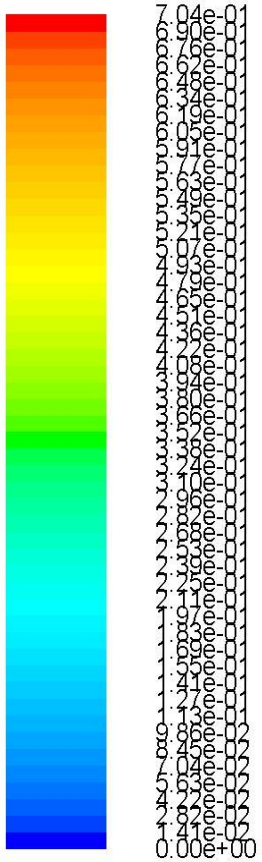


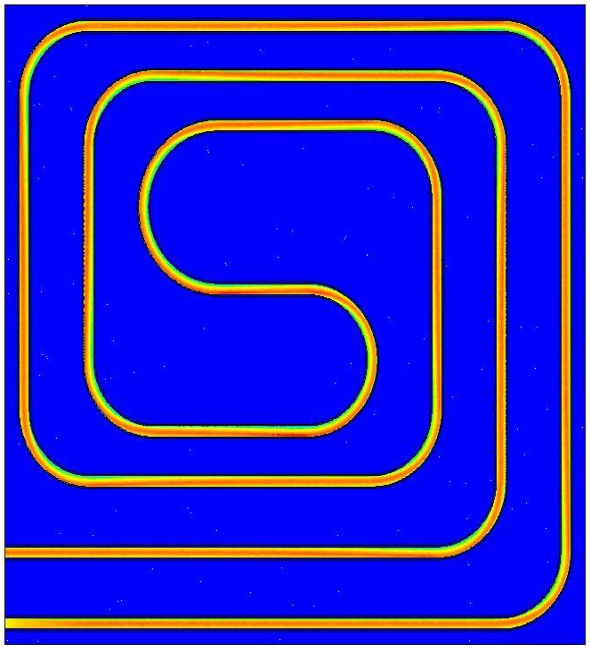
Measurements performing

- Safety chains for a case of disaster



Numerical simulation: Flow velocity in the pipe





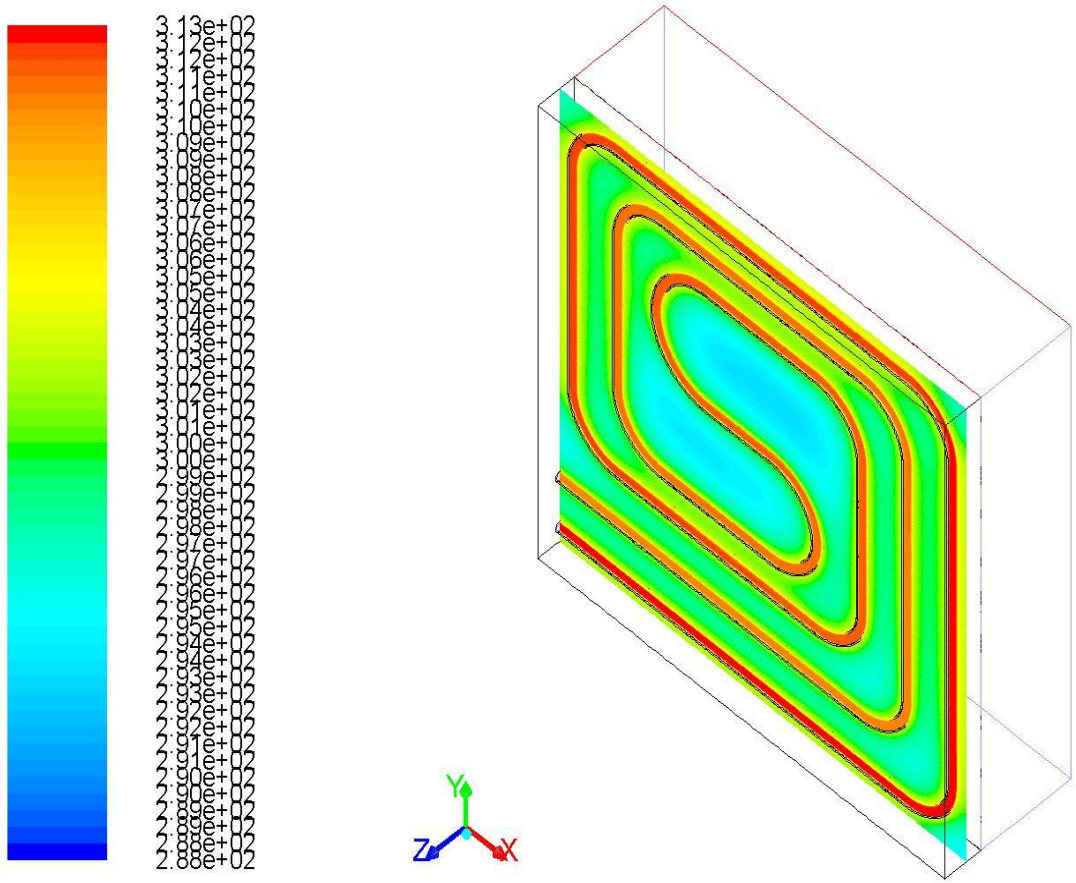
ANSYS
Noncommercial use only

average flow velocity=0.5m/s

Contours of Velocity Magnitude (m/s)

Jun 11, 2014
ANSYS FLUENT 13.0 (3d, dp, pbns, rngke)

Quasi stationary temperature distribution



temperatures at the
inlet = 313.0 K
outlet= 310.6 K(calculated)

Contours of Static Temperature (k)

Jun 11, 2014
ANSYS FLUENT 13.0 (3d, dp, pbns, rngke)

3.2.2 Materials: investigation and development

- It will be necessary to use industrial prefabricated products as tubes in plastic, steel or concrete to reduce the costs of the pontoons
- Industrial Halbzeuge als Alternativen für kosten-günstige, dauerhaft scha-densfreie Schwimmkörper einschl. der Beschichtun-gen und Klebverbindungen

Corrosion of materials

- investigation of concrete samples in situ subjected to different mediums: water, air and fluctuating zone between water and air.

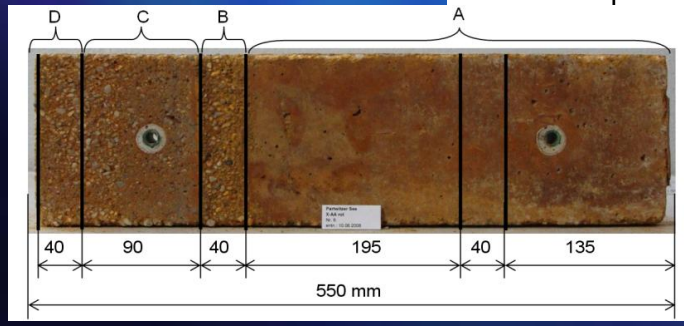
PUR coated steel plates and concrete samples

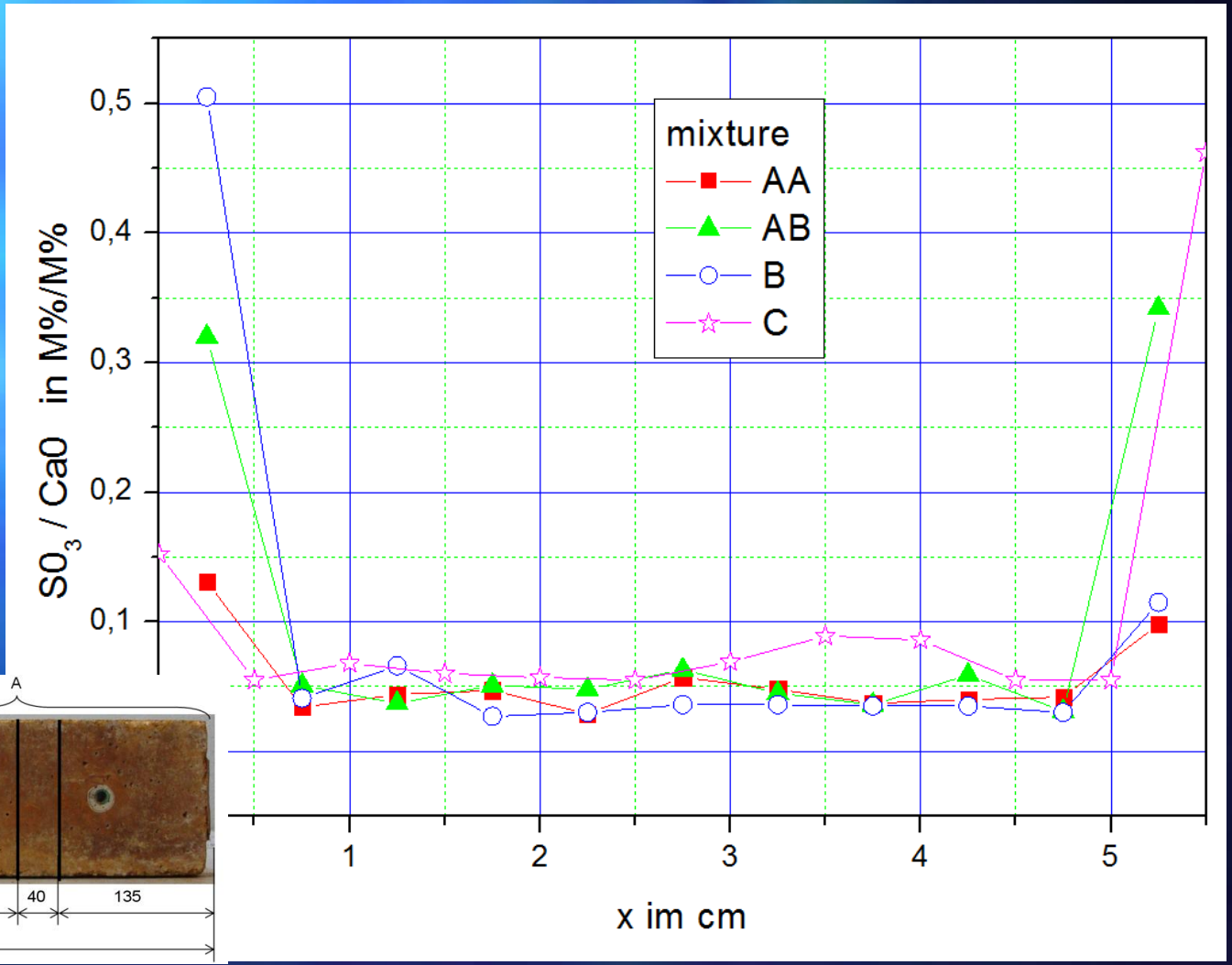
samples exposed to an attack of the water in the lake of a former open-cast lignite mine for two years.

Distribution of chemically bound sulfur in the water

-results after exposure of one year in the water of the lake Partwitz

-the sketch of the figure gives the names and dimensions of the areas of a concrete sample





3.2.3 Determination of boundary conditions

- wind-speed/ direction
- outdoor rel. humidity
- outdoor air temperature
- short wave radiation: $a(\Lambda,\vartheta_{solar})$
- longwave emission: $\varepsilon(\Lambda,\vartheta_{surface})$
- driving rain
- water waves parameters (frequency, amplitude, length)
- water chemistry (various ions, pH-value)

Outdoor climate components

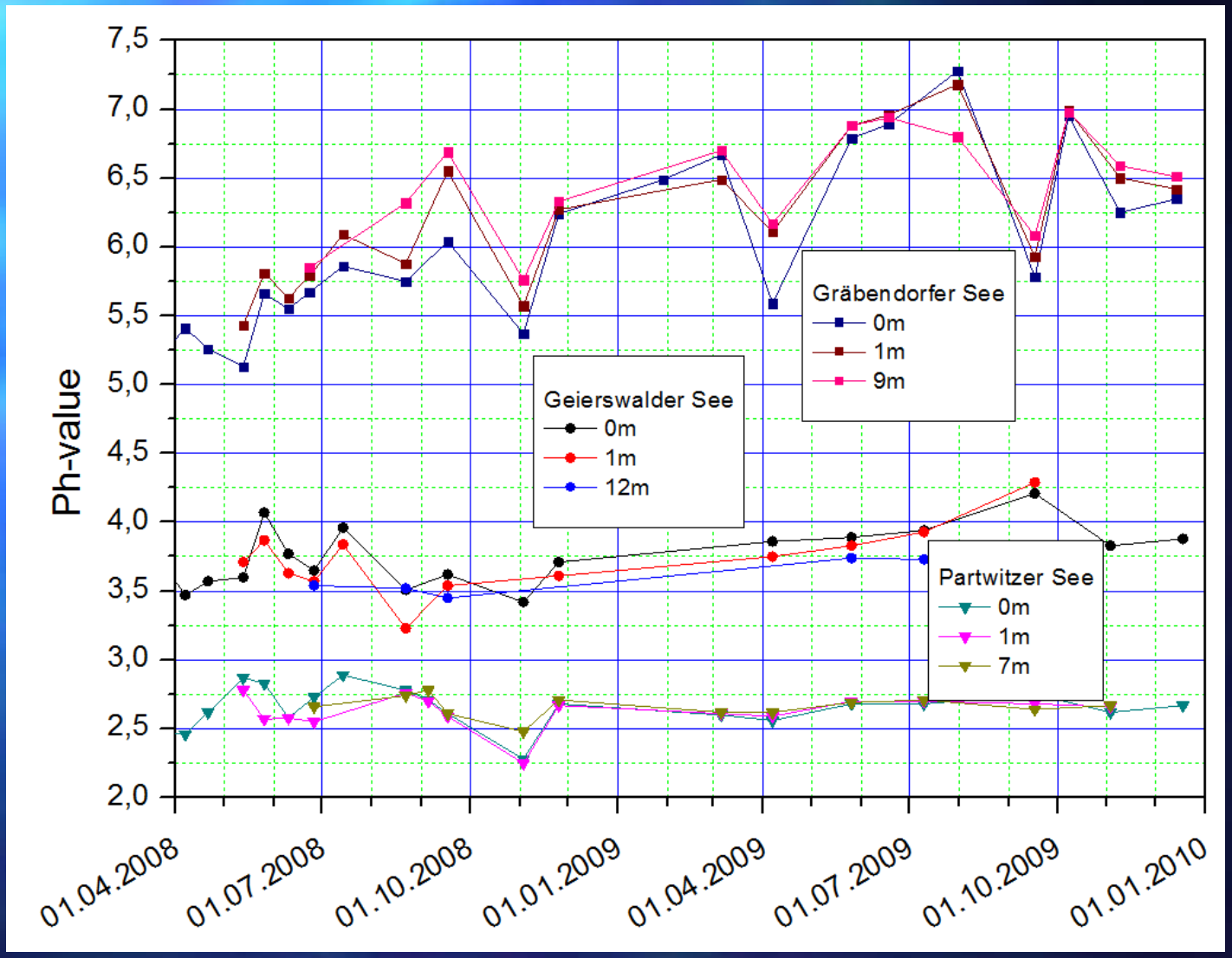
Wintertime:

floating houses in German district Lusatia, near the border to Poland

Floating bridges must grant safety in the cold season without chemical substances.

Water attack by the chemistry

Course of the ph-value of three different lakes of the Lusatian lake Land (former opencast lignit mines)

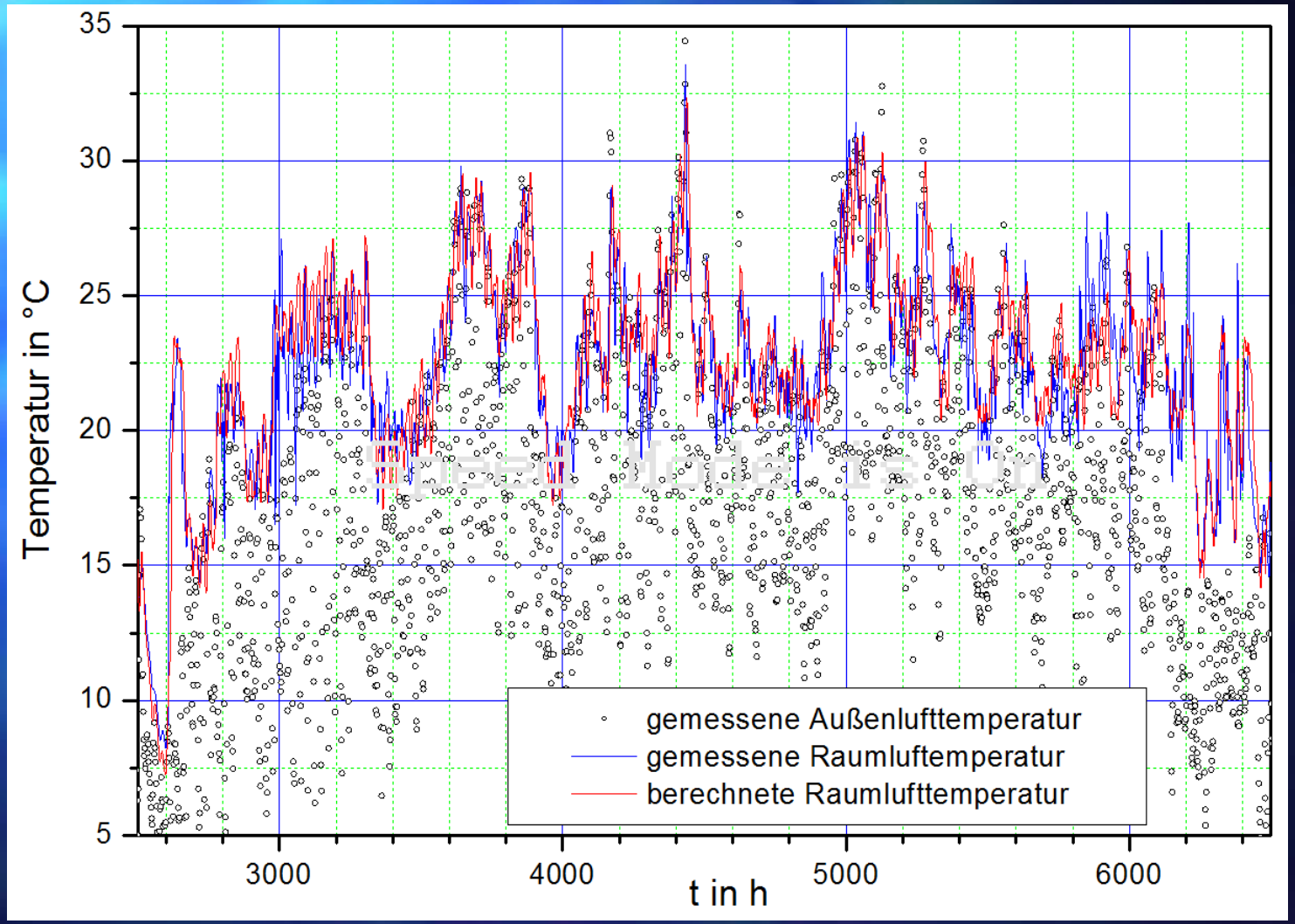


Water: attacks by the waves

waves at the lake Partwitz in summer time

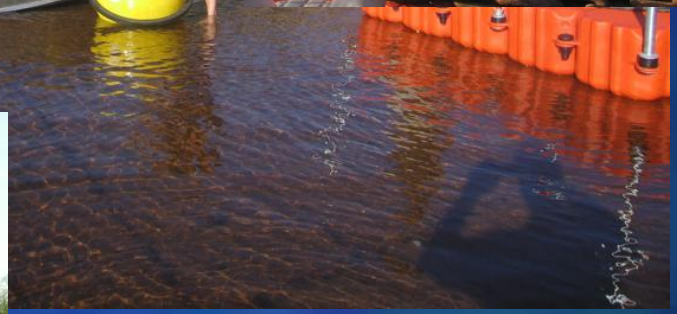
Course of temperature in a diving school

Comparison:
-measured temperature,
-calculated temperature by a self-developed software



Measurement and recording of waves

-measuring of the wind/water waves by means of GPS technology,

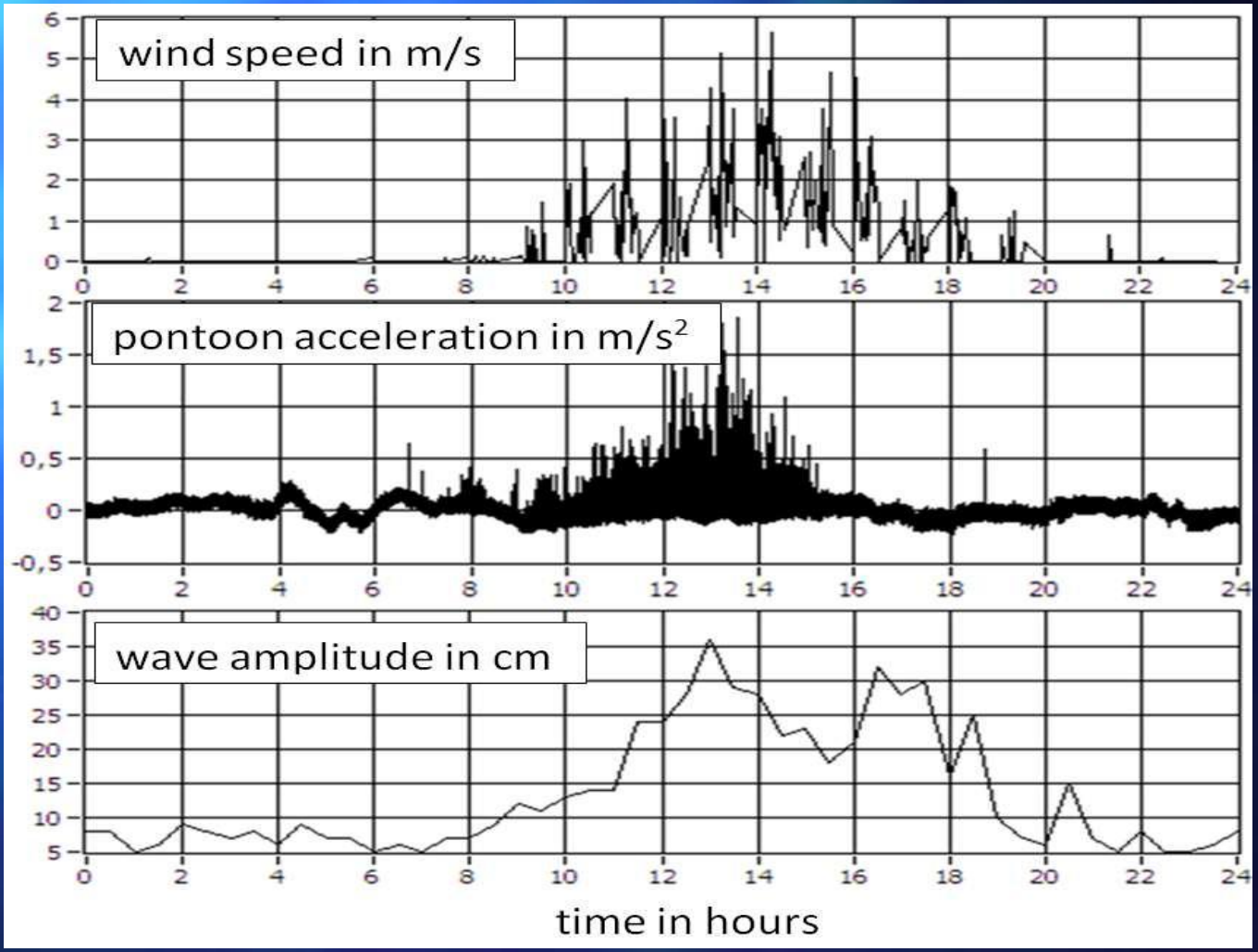


for the installing of the measuring buoy a long and heavy anchor chain was necessary

Wind measuring device is located about 200m from measuring buoy

Measuring results

Measuring protocol:
- 2009/ 09/23
- measurements for prognosis of waves



Intermediate results:

- 1. We find a lot of subjectively and objectively related backgrounds for the need to deal with the topic „floating structures“.
- 2. Worldwide and regional potentials of floating architecture are available
- 3. The new building site „water surface“ must be considered in order to avoid damages. The techniques require an individual adaptation to the conditions of floating structures in order to achieve optimal results.

4 Conclusion + outlook

- „Floating architecture“ includes a wide range of subjects and is *an object of comprehensive complexity.*
- the topic could be increasingly important in *solving urban problems with regard to floods*
- the surrounding „water“ offers:
  - chances and innovative opportunities
  - but also it has hidden dangers

<u>in the future we need cost-effective solutions above all</u>
and self-sufficient structures *to become a floating smart city*

Result:

- Floating smart cities → Precaution for existence

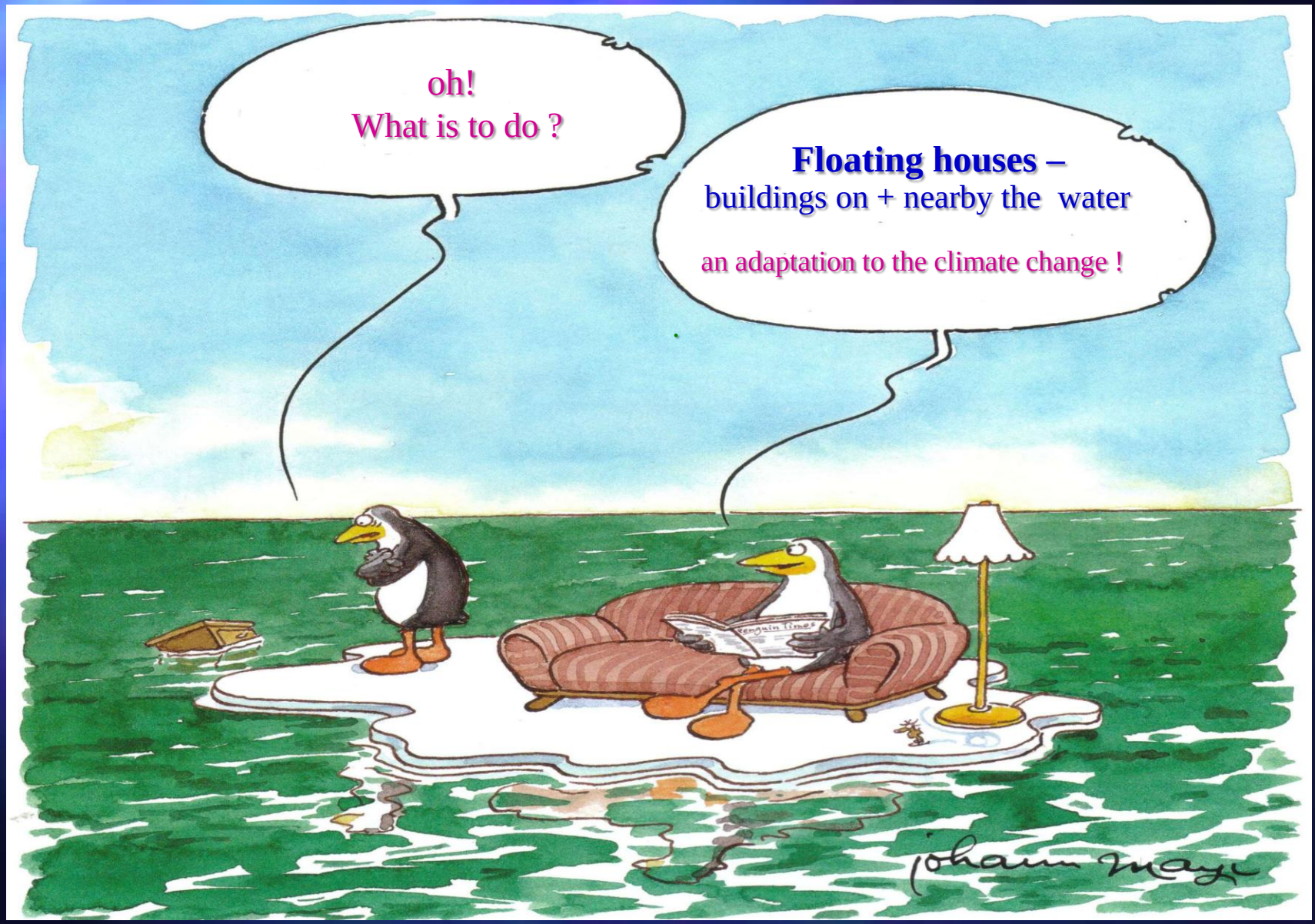
rrr

- **do not build against the water, but with its assistance**

- make safe the national economy

→ a proposal :

Floating houses – a solution for near future !


oh!
What is to do ?
Floating houses –
buildings on + nearby the water
an adaptation to the climate change !
Penguin Times
Johann Mayr

„Autartec“ - project

„Wachs – tumskern“:

growing core of ≈15 partners of the region,

result of the project : floating **demon – strator**

Testfield at the resulting lake “Großräschen Süd”

Potential of pontoons

- Up to now:

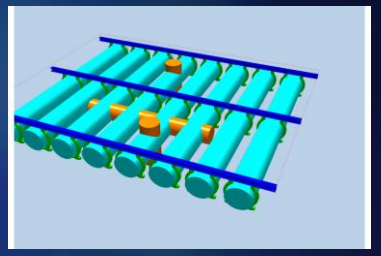
  the task of pontoon in most cases is to guarentee the buoyancy

- In the future

  there will be additional tasks:

  - lounges for humans or animals,
  - living and bedrooms or equipment rooms
  - replacement of bridges
  - capacity for the storage of products, water, energy
  - breeding of fish or plants (e.g. algae)

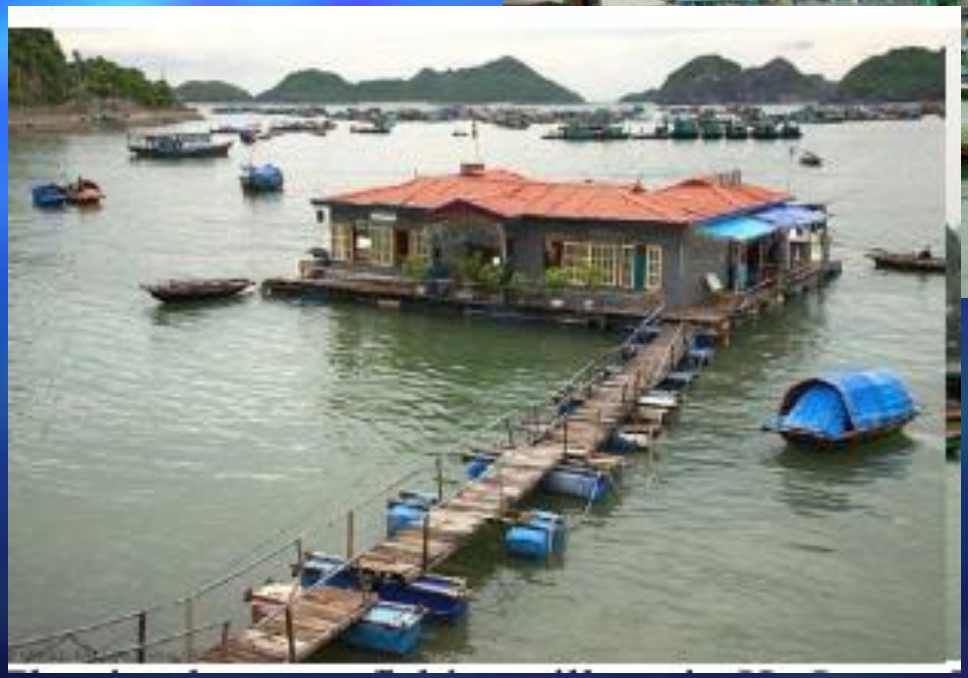
Expanding the range of pontoons: use of the space volume



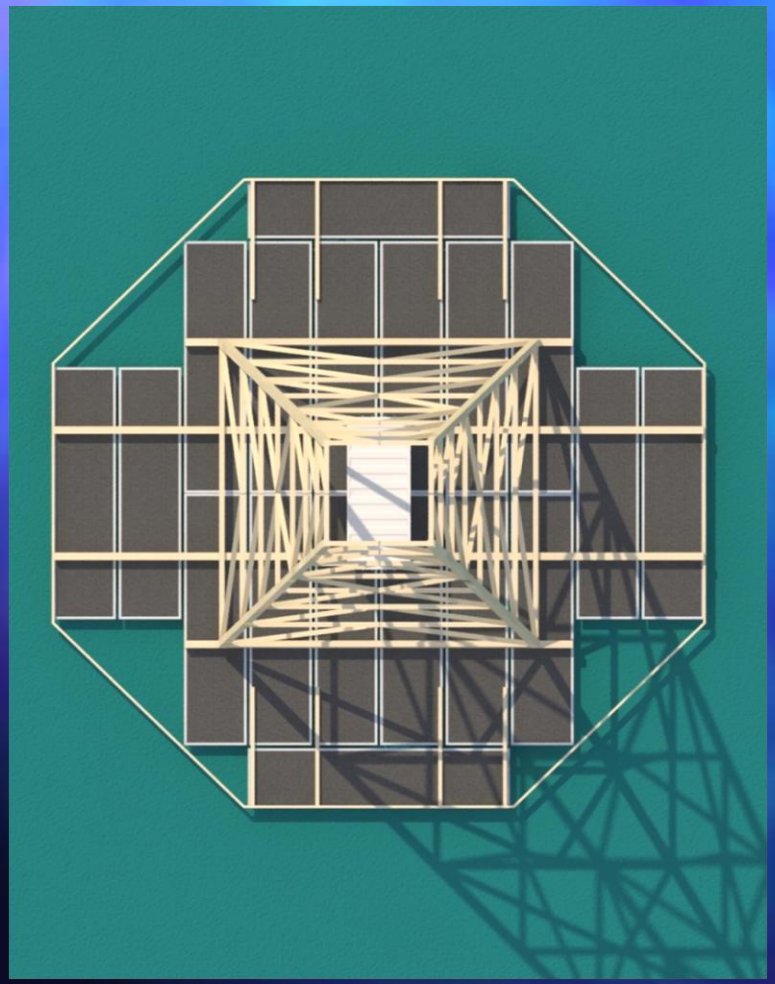
Test trials for connection technology

Study model of floating housing units in Viet nam

- a doctorate is startet
  in 2015 supported by
  by DAAD



Institute IfSB – Activities: e.g. applications for research funding



Floating settlement structures in past and future

End