HELMHOLTZ-ZENTRUM GEESTHACHT

People with Ideas

in2science #4

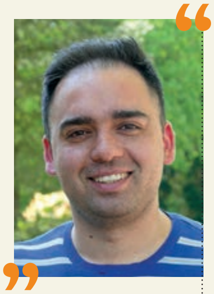
The Magazine

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

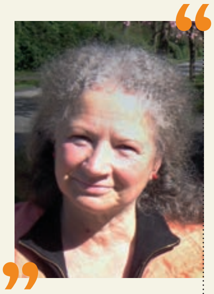
Trusting in *Science*

According to a 2016 study conducted by "Wissenschaft im Dialog", the public's trust in science has decreased compared to previous years. We surveyed employees at the HZG:

"What can we do to increase public trust in science again?"



Ilay Mehdizada,
Technology Transfer Support
Two factors are important for me: on the one hand, science should use comprehensible language when communicating with the public or the media. On the other hand, it should provide sufficient data to support the conclusions. The results as well as explaining the scientific approach play a major role.



Dr. Gisela Bengtson,
Works Council Chair
Considering the overwhelming flood of (mis) information from the Internet, it is very important that science attempts to stem this tide with actual facts. This means that in the future we need a less "closed-off scientific environment", and instead need more "open access" as well as generally comprehensible publications once in a while.

Dr. Marcus Reckermann,
International "Baltic Earth" Secretariat
We must make science more transparent and explain how it works in an honest and comprehensible manner. We must confidently point out what we know, but also admit if we have no simple and definite answer.

At the Centre

Lara Grünig,
Doctoral Candidate (Polymer Research)
I'm generally convinced that scientists in all disciplines should work more closely together and for each other rather than viewing others as competition. In addition, a comprehensible communication style helps in gaining lost trust – by this I mean, not only in speaking, but also in scientific practice, where basic principles should already be learned in secondary school. This, in turn, is not the job of science, but of government policy.

Ina Teutsch,
Doctoral Candidate (Coastal Research)
Apparently people trust the least in science when the topics deal with lots of unknown risks – a calculation error when genetically modifying food, for example, directly affects us and our descendants. This shows us how unbelievably important it is to inform people and to tell them why research is necessary at all, to illustrate the expected advantages, and to present vital results – whether it's within local debates or in the papers or through supermarket flyers.

Eshwara Nidadavolu,
Doctoral Candidate (Materials Research)
I believe that we as scientists should ensure the reproducibility of our scientific results through careful investigation and by optimising influencing parameters that lead to these results. This also means validating outcomes through regular scientific discussion within our professional circle. Constructive criticism from the public also contributes to better results.

Letter from the Editors

Dear Readers,

Research with a vision: real and digital viewpoints – this is the slogan for the HZG's 2017 Annual Meeting. In order to study new materials for lightweight engineering or medical technology, to understand coastal regions and to better comprehend climate change, we sometimes look to the past, but most of the time we must look into the future.

"Real and digital" not only applies to research but also to our society. With technical possibilities come growing quantities of data. It isn't only scientists who collect data from experiments, models and studies – more technology is available to all of us than ever before. We store music in the cloud, are constantly taking photos and our email inboxes are always growing.

This issue of In2Science is therefore dedicated to the processing of data. Both materials and coastal researchers work with enormous quantities of data. Here you can read all about how this information is useful to our society and how to deal with such data.

You can experience how models and simulations work in research by taking a glimpse at our infographics, read an interview with Thomas Ludwig, the head of the German Climate Computing Centre, or decode research data with materials researcher Martin Müller and coastal researcher Volker Matthias.

This time we also accompanied magnesium scientists around their laboratories. Their labs are where they produce bone screws by "sintering" metal. You can discover more in our photo feature on the pages to come.

Our portrait features introduce Corinna Schrum, Director at the Institute of Coastal Research, and Martin Reimann, doctoral candidate in materials research. We've uncovered more exciting topics in the fields of coastal research, where scientists have measured current velocities with a drone for the first time, as well as in biomaterials research, where scientists produce a material as solid as steel but as pliable as a feather.

We hope you enjoy the magazine!

Your Editorial Team / In2science@hzg.de

Photo Feature

4 **Powder Metallurgy**
How magnesium and titanium are converted into implants.

From Small Metal Granules Comes Medical Technology

Materials researchers produce small screws based on a magnesium-titanium alloy using powder metallurgical methods. The staff in the Department of Materials Design and Characterisation at the Institute of Materials Research develop these implant prototypes and determine the alloys' material properties. They need to be particularly clever when it comes to magnesium. The procedure itself is called metal injection moulding (MIM).

Johannes Schaper (left) and Martin Wolff (right) study this method in the MIM Laboratory.

The Process

Powder Injection Moulding

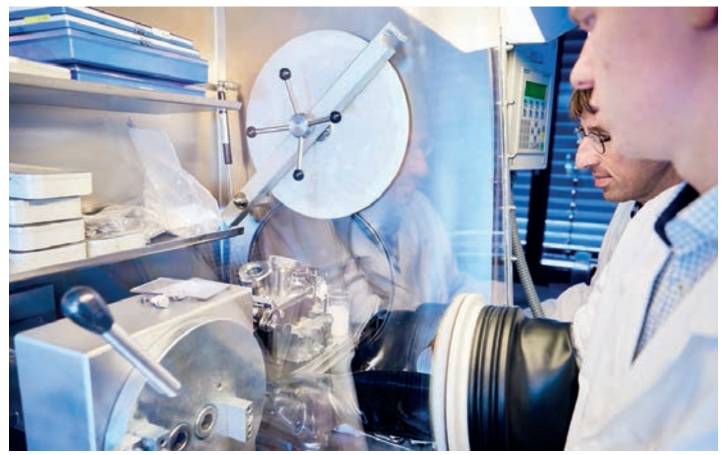
The fine metal powder is first mixed with a polymer binder. This mixture is then shaped in an injection moulding machine. The binder is subsequently removed again and the piece is heated in an oven at a high temperature so that the shape is retained and it solidifies. This method is called sintering.

Hermetically Sealed

Metal powders and binders are mixed into a homogenous mass within the glove box. This metallic powder-plastic mixture is called feedstock. It is mixed in a kneading vessel or planetary mixer (image below).

Argon in the Glove Box

The feedstock is processed in an argon atmosphere so that the titanium or magnesium powder doesn't react with oxygen. Argon is used because, as a noble gas, it doesn't undergo any reactions.



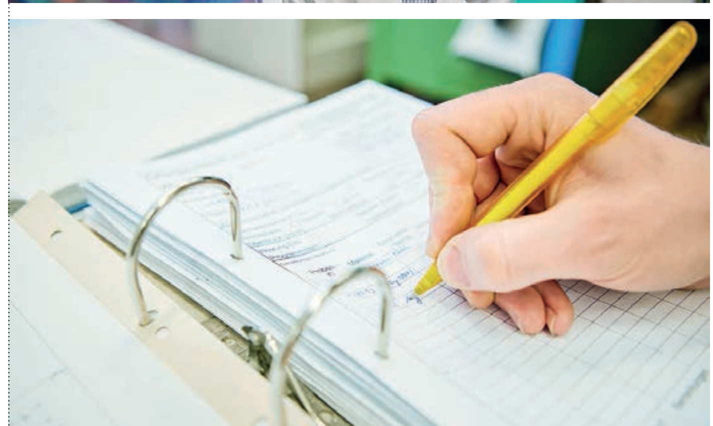
Inside the Argon Atmosphere

Magnesium powder injecting process for biomedical use

M. Wolff, et al Metals, Vol.6 No.118 (2016), DOI:10.3390/met6050118

This publication outlined that magnesium alloy implants could be produced through powder metallurgy using metal injection moulding (MIM) for the first time. The method ensures a homogeneous microstructure, which is of utmost importance for a predictable degradation process.

Up Close



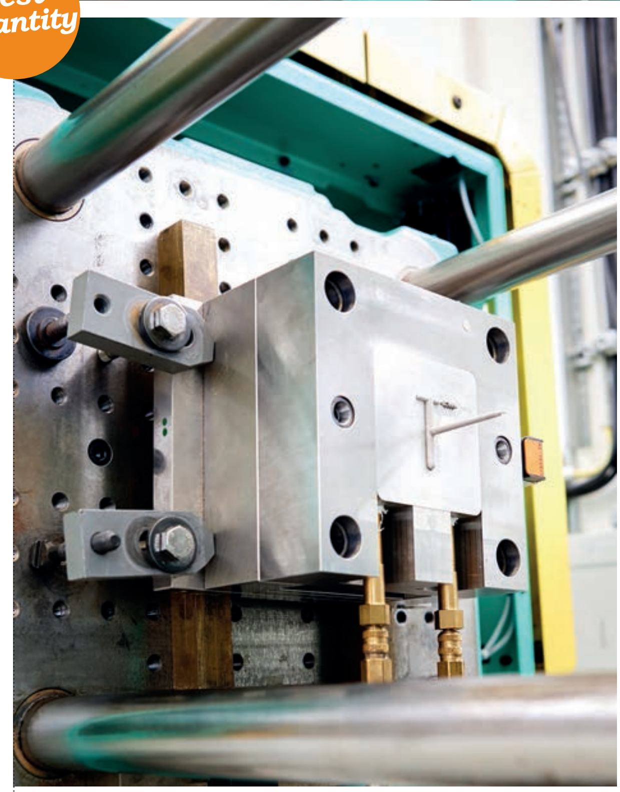
The grey colour indicates:
a magnesium powder was processed.
The material is suitable for implants,
as it possesses properties similar to bone.
Magnesium alloys are both stable and flexible.

Test Quantity

Injection Moulding

The metal-plastic mixture is poured into a sealed implement. Here the mixture solidifies. A shaped form, called a "green body", is created.

The binder in the green body is removed by rinsing (image below). What is created is a pure metal component.



In the Furnace

Sintering the Screws

The debound shaped form still displays a highly porous structure. This form is called the “brown body“. It is compressed by sintering at high temperature to a component possessing its final geometrical and mechanical properties.

At a Glance

The ingredients for powder injection moulding: metallic powder and different plastic binders (image above). Centre: the grey feedstock. Image below (from left to right): green body, brown body and the sintered magnesium screw.

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The Coast Whisperer

What drives oceanographer Prof Corinna Schrum?

Prof. Corinna Schrum

heads the Department for Systems Analysis and Modelling at the Institute of Coastal Research

Science has many aims. In Faust, Goethe put it in the purest and simplest of words: one wants to understand "what holds the world together in its innermost folds".

This idea also applies also to Prof Corinna Schrum. The oceanographer has been the institute director for the Division of Systems Analysis and Modelling at the Institute of Coastal Research in Geesthacht since October 2015. The 55-year-old has travelled an unusual career path.

The native Hamburger found her way to oceanography rather by chance. "You know how young people are: they don't know what they want," she says. What she brings to her field of study is, however, not a wistful longing for the sea, or for the sound of the waves or the salty taste of the air. "It wasn't ever my aim to save the whales," she says. „What fascinated me from the beginning was theory." The decisive push comes from an informational brochure from the Hamburg Student Advisory. The publication points out that oceanography requires a great deal of physics and mathematics. "That interested me at the time." Schrum focused on the natural sciences even in secondary school. And so the „Girl of Mathematics" heads to university to understand the sea through numbers and equations.

Schrum soon completes her studies under difficult circumstances. She becomes a mother in her sixth semester. Her second child arrives while she is still undertaking her studies, and her third while she is writing her dissertation. The topic of her work at the time is thermal stratification in the German Bight. As in other seas, the region has a "summer stratification"with a warm surface layer as well as a cold deep water layer, between which relatively little exchange occurs. A different scenario, however, also takes place occasionally in the coastal regions of the German Bight: "The tidal mixing in some areas is so strong there that the water column is also mixed in summer. This leads to more biological activity," explains Schrum. Soon after completing her doctoral dissertation, she discovers the main topic of her scientific career: physical and biological coupling in her numerical models. One of her studies, for example, examines how sea warming affects the growth and abundance of cod in the North Sea. Her science and models can be used to draw conclusions about the future: "What happens in a bight if I build a damn? If the climate changes? If I put a wind farm in the sea?"

Moving from Bergen to Geesthacht in 2015 is not an easy decision for her. "I actually didn't want to leave," she confesses. Not only because her family still lives in Norway – her husband with the two youngest of the five children. She also likes Norway as a country: the nature and the government system – but mainly because hierarchy plays a much smaller role, particularly in the relationships between professors and scientific staff. "You trust younger people more there and you give them greater responsibility than here in Germany."

So why did she come back to Germany? "I've always said that if I ever move, that it will only be to Geesthacht's Institute of Coastal Research." It's the topic of coasts that ignites Schrum's passion – the supreme discipline of her field. "Because all elements come together there: the sea, the land, the atmosphere." Coastal modelling has made enormous strides in recent years. Movements in the air and water have been reasonably well researched by now.

The major scientific challenge for the near future lies in better understanding the interactions between these compartments. Another area of focus Schrum sees for her division is that she would like to more heavily examine the direct influence of humans on the coasts. Also of interest are the conflicts that can arise from time to time when competing for use – for example, when tourists or fisheries are bothered by new offshore wind farms. All these aims can only be tackled, however, in conjunction with other scientists. "As an individual scientist, I can work on a process my entire life, on a single term. I can, however, never understand the coastal system as one individual scientist." Collaboration of many is required for such understanding. The big team full of specialists.

"A team like that can only be found in Geesthacht. That excited me."

Schrum gave up a comfortable position in Norway. Not for career reasons. Not because of money. But because she recognised the limits of a single individual. "That's how it is now in science. We all know a lot – but of most things we know are little or nothing." Corinna Schrum wants to understand the coasts. And perhaps she's now found the place where she can do this better than anywhere else in the world.

Author: Jochen Metzger

Predicting – not producing – climate change

Interview with Prof Thomas Ludwig – German Climate Computing Centre

Thomas Ludwig is the lord of FLOPS and bytes: The computer scientist heads the Deutsches Klimarechenzentrum (DKRZ) in Hamburg, which is Germany's central body for researchers who seek to understand how our climate changes in the long term. His supercomputers can compute and store enormous amounts of data – and also deliver detailed simulation results to scientists at the HZG.

“Meanwhile, we have been able to calculate several components in parallel. Experts at the HZG study air currents so they can come to conclusions about the future development of wind and waves.”

Mr Ludwig, Germany is one of the leading nations in climate research. Does science owe this status in part to your Climate Computing Centre, the DKRZ?

In certain way, yes – even if we only provide the infrastructure for this success. In this branch of research, many questions simply cannot be addressed without the immense computing capacity of high performance centres like ours.

Why is that?

Because researchers must take into account highly complex global developments in, for example, extremely diverse regions such as the Arctic and the Sahara. And they must do so over periods of at least thirty years – only then can we talk about climate in a scientifically meaningful way. Many scientists, however, also choose to look at considerably longer periods, even back to the last ice ages. If the calculation results match other data – for example, those from ice cores – this is a clear indication of their robustness.

When the Computing Centre managed to calculate two developments at the same time in one climate model twenty-five years ago—the oceans and the atmosphere—this was considered a decisive step toward the DKRZ’s success. How many factors can models at your centre integrate today?

Considerably more than the two components back then. Depending on the project, the researchers now take into consideration, for example, the growth of algae in a marine region or an area’s agricultural use. Experts at the Helmholtz-Zentrum Geesthacht examine air currents so that they can draw conclusions

> **We rank thirty-four out of the five hundred highest performance computers globally.**

ABOUT
Thomas Ludwig

Thomas Ludwig earned his doctorate and his “Habilitation” at the Technical University of Munich, where he researched high performance computing between 1988 and 2001. In 2001 he headed to the University of Heidelberg, where he held a professorship in the Parallel and Distributed Systems Group at the Institute of Computer Science. He has been the managing director of the German Climate Computing Centre GmbH (DKRZ) and professor of Scientific Computing at the University of Hamburg since 2009. His field of research encompasses large data storage, energy efficiency, performance analysis concepts as well as parallel systems.

about future development of wind and waves. Today we can also take into consideration climate change dynamics much better than before. There is hardly a value in our work that remains constant over the years. In some cases, developments are mutually reinforcing: if a forested region, for example, shrinks as a result of a region's temperature increase, it possesses fewer trees to produce oxygen or absorb CO_2. This leads to an even more pronounced change in climate. By now, we can simulate these cycles in our models.

This requires an incredible amount of computing capacity – how has this capacity developed at the DKRZ since its founding thirty years ago.

Worldwide computing capacity has increased by a factor of one thousand every twelve-and-a-half years, and the DKRZ is consistent with this trend. Since its founding in 1987, the capacity has increased altogether by approximately fifteen million. The third floor of our centre is home to approximately 100,000 processor cores – today these machines can handle more than three quadrillion computations per second! We rank thirty-four out of the five hundred highest performance computers globally. These components are housed in seventy-nine cabinets, each as large as a phone booth and weighing one ton.

Installing the equipment in our building was half the challenge for our structural engineers. What's more is that our data archive is one of the largest in the world. It stores as much data as you'd find in 135,000 laptop computers. The data is accessible online to scientists all over the world. In hindsight, you can see how rapidly the computing capacity at our centre has developed: even our first supercomputer ranked as one of the largest in the world. It, however, only had one processor at the time and had the capacity of one of today‘s smartphones.

Do you expect similar development in the future too?

At least for the coming decades. Even our next computer, which will go into operation in 2020, is expected to increase our computing power tenfold. It is again financed by the Helmholtz Association, and this time by the Max Planck Society and the city of Hamburg as well.

You place great emphasis on the energy efficiency of your computers. As you're constantly increasing your computing capacity, however, you face an unavoidable dilemma: more capacity requires more energy, right?

Surprisingly, no. Our present computer consumes even less power than its predecessor – though its capacity is twenty times greater. This is attributed to a special cooling system that enables us to dispense with fans in the computer nodes. Water pipes cool the processors instead. The water heats up to fifty degrees and is then directed to the roof of our building. Here it cools down and flows back into the circuitry again. What is special in this system is its high heat tolerance. It even works with warm water at forty degrees, which is why we don't need to cool the liquid as much as with other computer models. This works for us even in summer without cooling units, though of course the comparably mild weather here in Hamburg also plays a role. We save altogether 300,000 Euros or more per year in energy costs.

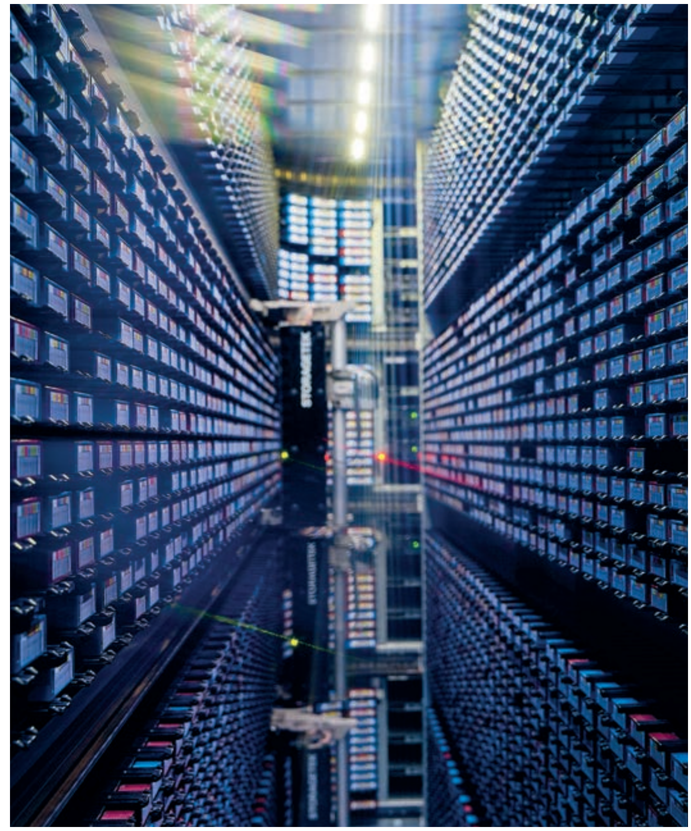
Our present computer consumes even less power than its predecessor – though its capacity is twenty times greater.

In addition, we only use green energy – we do, after all, want to predict climate change, not produce it. If, however, we can achieve a similarly good energy balance with the next computer remains to be seen. Computer technology changes so quickly that I can't say what model we'll start operating in 2020.

As a computer scientist, how were you drawn to climate research?

Scientific computing always fascinated me, those complex models developed to aid science. While they are purely mathematical constructs, they aren't scientific gimmicks; these simulations mostly contribute to branches of science that are of basic importance to all human beings. In medicine, for example, where I began my career, we used models to calculate the course of illnesses such as cancer.

In climate research, too, computer programs are particularly relevant. On the one hand, they forecast developments that affect many people, such as the land becoming uninhabitable or soils no longer yielding crops due to climate change. But on the other hand, scientists in this discipline are heavily under attack. This is why IT must provide particularly reliable data. It's why I feel challenged! This is, for example, why what are known as "ensemble computations" are standard: the same process is computed twenty times, again and again, with slightly altered initial conditions to ensure that biased values aren't used. We only consider our outcome as valid when our models provide clear results in those calculations. This is why I can say with full conviction that climate research works with extremely reliable data. I have still yet to see any other science that puts such effort into quality assurance.



Are you able to see the climate research trends in your research applications?

Absolutely, especially the extent to which the topics have now diversified. The range of the several hundred projects here is enormous. On the one hand, scientists look at vast periods of time or huge regions while, on the other, they look at representations of fragile structures such as clouds, the movements of which we only reproduce over a period of a few minutes. We are not only more flexible temporally, but also spatially. Earlier, our computing capacities were only sufficient for grids of five hundred kilometres edge length. We could only take into consideration three measurement points for all of Germany at the time. Research has progressed much further here.

Scientists from the Helmholtz-Zentrum Geesthacht, for example, are closely observing individual regions in Europe and Germany and are precisely reproducing those surface areas with a resolution of up to ten kilometres. This is important because climate change can have a very different effect within a country – on the coast, for example, with more storms and flooding while inland the soils are drying up.

You are regularly confronted with some very distressing research results as director of the German Climate Computing Centre. Does that frustrate you sometimes?

Of course I'm not immune to the results; they're often too alarming. But I seek a professional distance. Sometimes the disaster scenarios can be even impressively beautiful: I recently viewed a tornado simulation that could have come from a Hollywood blockbuster. And then I think to myself that we need to work here with precision and quality standards – and collect evidence of what will happen if we do nothing.

The interview with Prof. Dr. Thomas Ludwig was conducted by science journalist Jenny Niederstadt at the DKRZ.

From School Laboratory Participant to Doctoral Candidate

Martin Reiman –
The mechanical engineer who returned to his hometown of Geesthacht

Martin Reimann –

works on new joining processes

It's a warm and sunny day when Martin Reimann takes time out for a chat. He is surrounded by stacks of paper in his office, which the mechanical engineer shares with a colleague. He quickly suggests we get some fresh air. He carries a table from the experimentation hall, then two chairs, and we eventually find ourselves sitting in the shade behind the building. Then he begins to talk.

The native Geesthachter first came into contact with the HZG in the school laboratory "Quantensprung". At the time, he was attending Otto Hahn Gymnasium in Geesthacht. "When I was in my tenth year of school, we made a day trip to what was known as the GKSS at the time, where we connected a fuel cell model to a wind turbine," says the 29-year-old. He has always had great interest in scientific and technical subjects. "After finishing school, it was immediately clear that I wanted to study mechanical engineering," he adds.

And that's just what he did. He completed both his master's and bachelor's degrees at the Technical University of Darmstadt. In the meantime, he engaged in student projects and took on internships, which led him to Lufthansa Technik AG in Hamburg and even to London. There, he researched areas such as engine repair and maintenance. "We investigated changes and properties associated with certain repair procedures. Does a component get lighter after repairs? More efficient? Better? Or does the repair have negative effects? This is how we can decide if it pays to do a repair or if it's better if the component is completely replaced," explains Reimann.

The mechanical engineer liked his internships so he wrote his master's thesis at Lufthansa Technik. Here he tested „friction point welding" in a new application. Different metal sheets are joined together in this technology so that they don't melt, but remain in a fixed state. A special tool is used that creates frictional heat when rotating on the plates to be joined.

His doctoral work is undertaken within the framework of a technology transfer project – this also involves a collaboration with Lufthansa Technik. At the HZG, he works at the Institute of Materials Research in the Department of Solid State Joining Processes.

"That all seems like it was planned. It was actually a coincidence that I worked for Lufthansa again and again–and that I returned here to Geesthacht. It was just luck," Reimann says with a smile.

The doctoral candidate studies different possible applications in relation to borehole sealing. Reimann explains, "I carry out feasibility studies for this. I inspect pieces that have a hole and examine precisely whether and how they can be sealed using friction spot welding." His doctoral work, overseen by his advisor and HZG Institute Director Prof Norbert Huber, is affiliated with the TU Hamburg. It lasts three years and will be completed in December 2017.

Are there any initial results? "Absolutely. The procedure can definitely be used for sealing boreholes. Conceivable applications include not only repairs, but also tank production for space shuttles or dishes on satellites." Everything is going according to plan at the moment.

"The beauty of my studies is that I get to work on concrete goals. It's nice to know that my results can be utilised," Reimann says.

Even though his research brings him a lot of joy, he often heads to a natural environment when he gets off work: on the island of Fehmarn, he lets the wind caress his face and goes kite surfing with his office mate. "We even pack our bags before work and drive directly from the HZG to the Baltic Sea. With some luck, we'll have two sunny hours we can enjoy on the water," he says. Even in winter he can't resist the kites. "I went snow kiting in Norway this year – it's like on water, except you're pulled by the kite through the snow-covered landscape."

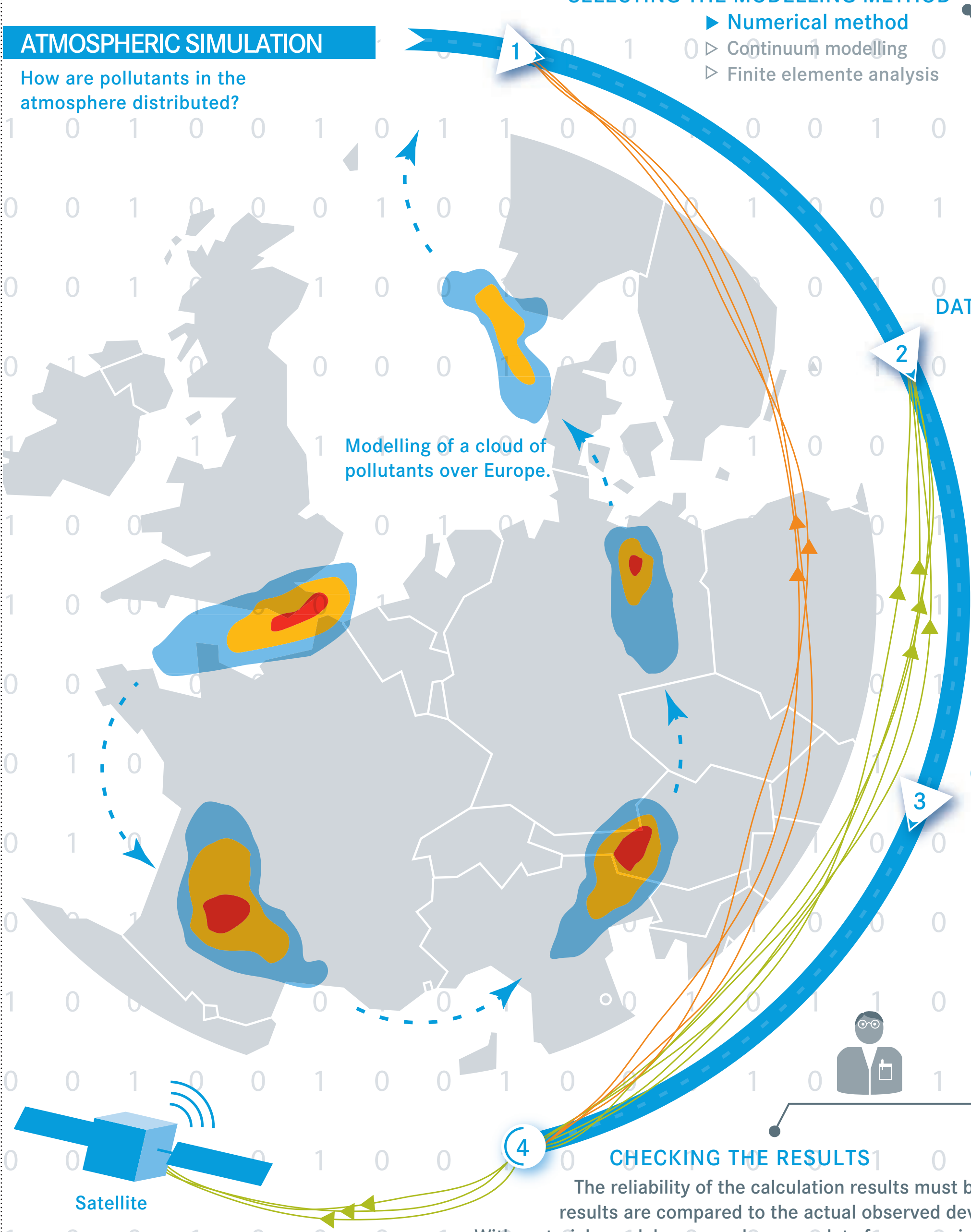
Author: Gesa Seidel, HZG / Illustrations: RoseFlohr Kommunikation

Infographic

Solving Mysteries Using Models

ATMOSPHERIC SIMULATION

How are pollutants in the atmosphere distributed?



SELECTING THE MODELLING METHOD

- ▸ Numerical method
- ▷ Continuum modelling
- ▷ Finite elemente analysis

$$f(x) = \sum c_i \cdot \nu_i(x), C_i \in \mathbb{R}.$$

DATA

The quality of the underlying mathematical model and the data utilised dictates the forecast's reliability. It is impossible to integrate all conceivable influencing factors into an atmospheric model, a continuum or ...

DKRZ DEUTSCHES KLIMARECHENZENTRUM

CALCULATION

Selecting relevant input data is the prerequisite for effective and meaningful calculation. The complex simulations are carried out on supercomputers. The German Climate

CHECKING THE RESULTS

The reliability of the calculation results must be analysed. The atmospheric-chemical calculation results are compared to the actual observed developments, such as from satellite measurements. With materials models, researchers use data from experiments and compare them with the calculated data. Verified results are transferred for future calculations to databases, which then become more and more ...

NUMERICAL METHOD

Physical and chemical processes can be described by a set of differential equations. The relevant variables, for example, of the Earth's surface cannot, however, be analytically calculated. Instead, the space is divided into individual cells that form a grid system. Only the mean value of a property within a grid cell is considered and this is regarded as representative for the entire cell.

CO

The modelling works with many unknowns, which must be calculated if they are to be incorporated into the model. Continuum models describe an

How do ship exhaust gases spread in coastal regions? How quickly can a magnesium implant degrade within the body? Using models and simulations, scientists get closer and closer to the answers. In the beginning, lies the research question – then what happens? How do these models work?

Scientists at the HZG must process data and check the results.

SELECTING THE MODELLING METHOD
▷ Numerical method
▷ Continuum modelling
▶ Finite element analysis

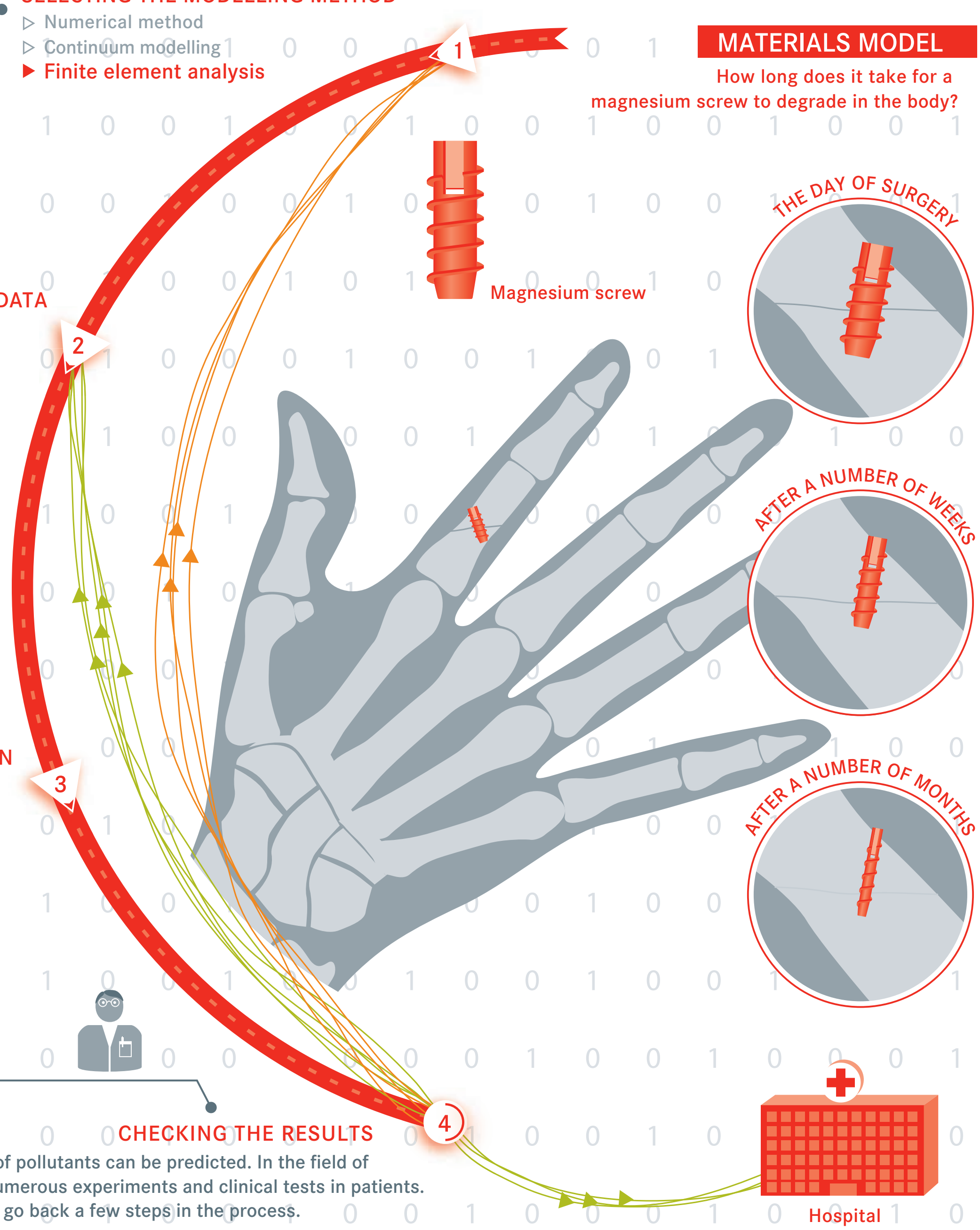
DATA

numerical simulation. What is important is to identify the parameters crucial to the result of a physical/chemical process.

Computer-Cluster

CALCULATION

Computing Centre (DKRZ) and in-house computer clusters are made available to the HZG scientists for these simulations.



CHECKING THE RESULTS

detailed. This, for example, is how the spread of pollutants can be predicted. In the field of biomaterials, a new material is utilised after numerous experiments and clinical tests in patients. The scientists must discard invalid results and go back a few steps in the process.

ONTINUUM MODELLING

area with one or more equation systems, which are solved jointly as a function of space and time. The advantage here is that changes in the entire system, even with a miniscule change, can be predicted.

FINITE ELEMENT ANALYSIS (FEA)

FEA can calculate virtual components on the computer and, for example, simulate deformation and tension under pressure influence. This is a mathematical method to solve differential equations. The first FEA computer programs appeared on the market in the seventies.

At the Centre

Hydrogen Research at the HZG

Scientists at the Helmholtz-Zentrum Geesthacht research metals that store hydrogen. In order to do so, they develop tank prototypes and optimise materials for mobile and stationary use. The tanks house various mixtures of light metals, such as sodium, aluminium or magnesium. What are known as metal hydrides are formed under certain conditions if gaseous hydrogen is added.

But how much hydrogen does the metal bind?

This is what the scientists measure, for example, with surface and porosity measurement equipment. The metal hydride powder is located in the glass container. The sample is immersed in a container of liquid nitrogen to cool it to 77 Kelvin (-196 degrees Celsius). A certain amount of gaseous nitrogen is simultaneously added to the small sample glass container. The gas molecules attach to the metal hydride surface. The researchers now compare the pressure before and after they attach. This allows them to calculate nitrogen adsorption and therefore the surface size of the metal hydride. The larger this surface, the faster the hydrogen can accumulate and be stored.

A video of the filmmaker Tim Peters gives an insight behind the scenes of hydrogen research. Please note that the film is only available in German. In addition, a picture gallery shows further details. More: **www.hzg.de/h2**.

Experiments with Magnesium Alloy Improve Database

A project supported by the German Research Foundation (DFG) at the HZG has shown in its initial results that data on magnesium-neodymium-zinc alloys is in need of improvement. This type of alloy can be utilised in the future for lightweight automotive and aircraft engineering or in medical technology.

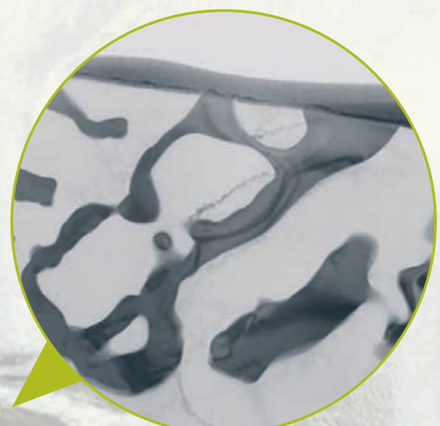
The two-year project began in November 2015 and is carried out by the Magnesium Innovation Centre (MagIC) in the Department of Magnesium Processing. The three HZG scientists, Dr Domonkos Tolnai, Dr Serge Gavras and Dr Tungky Sosro Subroto, work in collaboration with students on the project.

What's it all about?

Due to its low density, magnesium is extremely popular in lightweight engineering and is also studied in medical technology for absorbable implants. It has now been tested for the first time as a special high-alloy mixture: magnesium-neodymium-zinc (Mg-Nd-Zn alloy). Magnesium possesses very good specific properties, but it is difficult to shape due to its hexagonal lattice structure at ambient temperature, which presents a problem for producing components using deformation. The scientists therefore sought a link to a rare earth metal (neodymium). Because this element is rare, as its name suggests, the researchers added the element zinc to reduce the amount of neodymium. The microstructure changes when adding zinc to the magnesium-rare earth alloy. This also affects the mechanical properties.

What is the goal?

The researchers' goal is to develop an economical magnesium alloy system that can be altered to fit the application requirements. The mechanical properties can then be adjusted by modifying the alloy composition. Ultimately, it will be possible to use more magnesium alloys commercially – and at a lower cost.



What exactly is studied?

The magnesium researchers want to become familiar with the various phases the alloy undergoes during solidification and what microstructural properties they possess. This is, for example, very important for producing application products. The researchers wish to understand the impact the ratio of neodymium and zinc has on the alloy's mechanical properties.

How is this research carried out?

The project used a combination of synchrotron diffraction and synchrotron tomography. These results were validated by tests with two different electron microscopes: the scanning electron microscope for imaging as well as the transmission electron microscope for quantitative analysis of the microstructure. In addition, tension and compression tests were carried out. This is how the scientists tested how the alloy and its properties change under thermomechanical loads – that is, for example, under increasing temperature, tension or stress. Most experiments could be carried out at the HZG, but the synchrotron tests were completed at the Deutsche Elektronensynchrotron DESY in Hamburg and at the Paul Scherrer Institute (PSI) in Switzerland.

What do the results show?

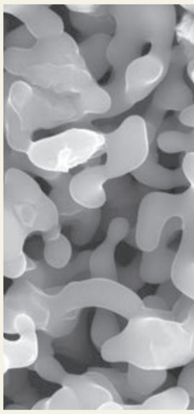
One of the most surprising results was that the theoretical data the researchers are familiar with so far does not agree with the values from the experiments. The current valid phase diagram, which describes the phases in equilibrium, must now be corrected. The data the scientists have obtained will permit more precise modelling in materials research in the future.

The researchers have gathered a great deal of knowledge on the magnesium-neodymium-zinc alloy: they know how the phases in the microstructure look during casting and after thermal treatments and how they change during solidification and under thermomechanical loads as well as what happens during these processes. Even if the project will soon come to an end and some gaps could already be filled, the research is far from over.

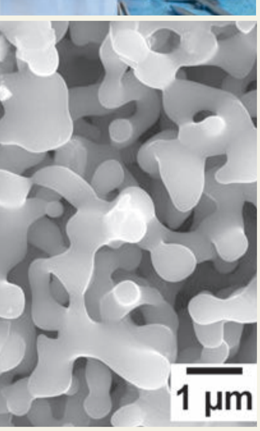
Firm as steel, pliable as a feather

Novel composite material could provide better bone implants

The scientists Jürgen Markmann (left) and Ilya Okulov (right) in the lab.



Scanning electron microscope image of a porous titanium-niobium alloy produced by liquid metal alloy corrosion. The magnesium has already been etched out. What remains is a network structure of interconnected ligand ends and a porous area that will later be filled with polymer.



A laboratory at the HZG's Institute for Materials Research. Jürgen Markmann points to a tiny material sample squeezed into a massive press. “That's our test equipment,” the physicist explains. “A sensor measures how much force is used to compress a material. And a laser precisely detects how heavily it deforms.” The measurement instrument revealed a remarkable property in one sample: the composite material – a titanium “sponge” with pores filled with plastic – is simultaneously both firm and pliable. This could be interesting for medicine as a basis for improved bone implants.

The origin of the project arose from a process in its early stages for producing porous metal, known as liquid metal alloy corrosion. “We first produce a metal alloy of titanium and copper,” says Markmann, who is deputy head of the Department of Hybrid Materials Systems. “We then lower this titanium-copper block into an 800-hundred-degree molten mass of magnesium.” This is when something astonishing happens: because the copper is attracted to the magnesium like magic, it pulls away from the block and disappears into the molten mass. The titanium then rearranges itself in the block to form a sponge-like structure with pores measuring in the nano and micrometre range. The molten magnesium spreads into these pores and then solidifies when cooled.

“This magnesium can then be washed out with nitric acid,” explains Markmann's colleague, Ilya Okulov. The result is a small metal sponge that can be effortlessly squeezed but breaks apart relatively easily when uncompressing . To prevent the latter from occurring, the HZG researchers have a trick: they impregnate the sponge with a liquid polymer – in other words, a plastic.

“We therefore need to press all the gas from the pores, otherwise it will get in the way of the filler,” says Okulov. “In addition, the polymer mustn't be too viscous or it can't penetrate into the pores.” The Russian postdoc experimented with different processing temperatures and different types of plastic. He finally managed to push a liquid polymer into the titanium sponge within a few minutes – what are known as capillary forces suck it into the pores. The polymer hardens in the metal and a new composite material is ready.

The special thing about the material is that “it yields to mechanical loads a hundred times greater than pure titanium without breaking,“ says Markmann. “Like a feather, it returns to its original state.” The titanium sponge filled with polymer is simultaneously as firm as steel – a unique material combination. The two physicists together with their department director, Prof Jörg Weißmüller, presented the material in the online magazine Nature Scientific Reports.

But what can be done with the new composite material? Ilya Okulov searched for possible applications and encountered a medical problem: with fractures today, splints or prostheses made of titanium are often used to relieve and stabilize bones. Because titanium is considerably stiffer than bone, it absorbs most of the load when subjected to stress. The adjacent bone, on the other hand, is hardly affected – which, similar to an unstressed muscle, hinders its regeneration.

„A material possessing the same mechanical properties as bone would be the implant material of choice,“ explains Markmann. “The implant would then stabilise the bone but nevertheless pass on enough load so that it can regenerate.” The new composite material from Geesthacht shows precisely these material properties that are similar to bone.

Before they can use it in application, however, the physicists still need to clear up some questions. How do living organisms react to the material? The danger here is that if any copper were to remain in the material, it would poison the organism. In order to test this matter, the researchers collaborate with the HZG's Division of Metallic Biomaterials. Here, experts routinely test new materials for biocompatibility by having cell cultures thrive on them. „The results thus far look very good for our composite material,” says Okulov, pleased. “The material seems biocompatible and the copper has obviously been completely removed.”

Now the experts are about to improve the titanium-plastic composite further. Rather than using pure titanium, they're experimenting with a titanium-zircon alloy; this makes the material even stronger. They also want to create a metal sponge with larger pores. “This should make it even easier for cells to settle on the material,” explains Okulov. “And that should accelerate the healing process once again.”

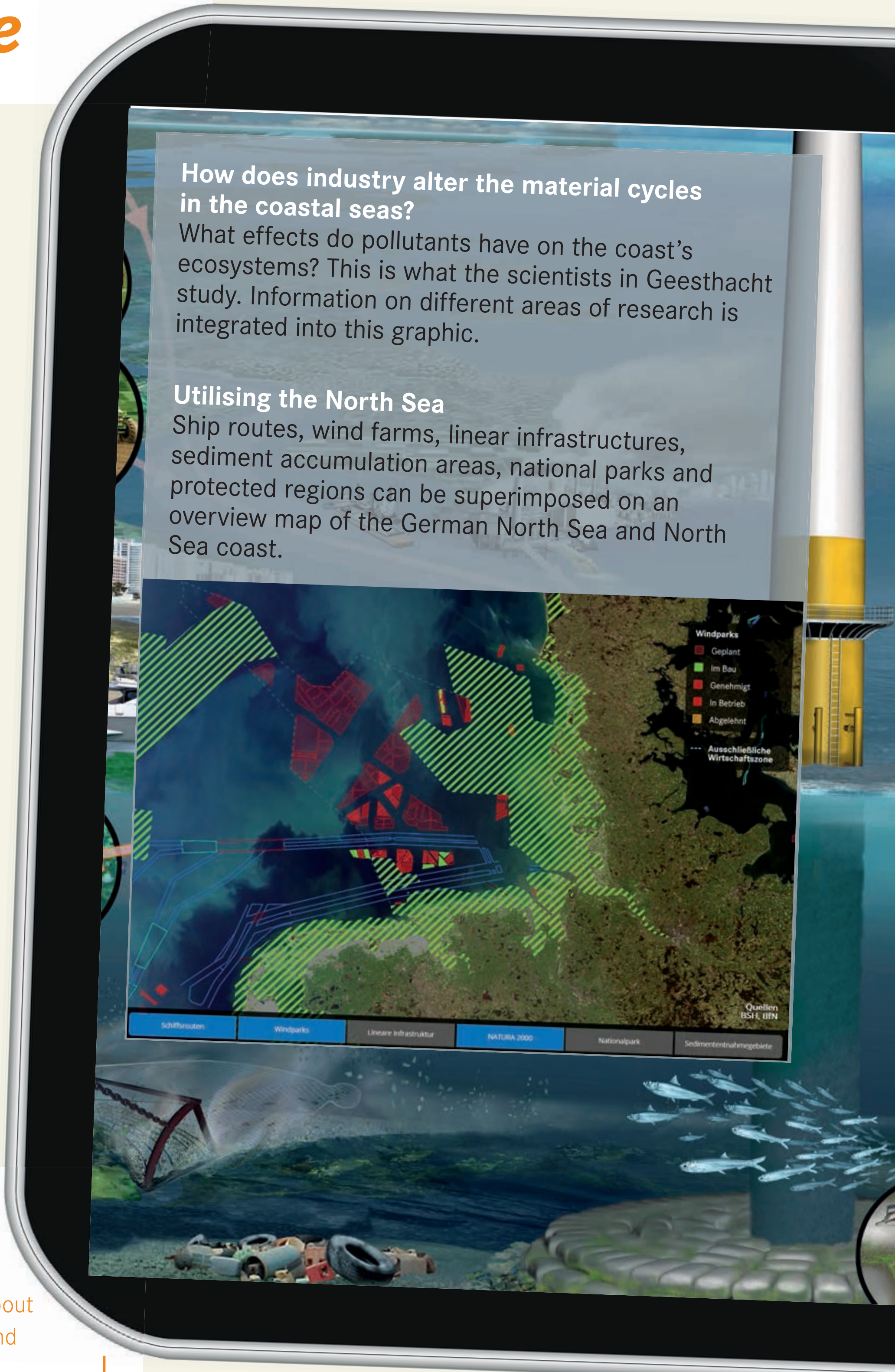
Author: Science journalist Frank Grotelüschen

Interactive Coastal Research for Everyone

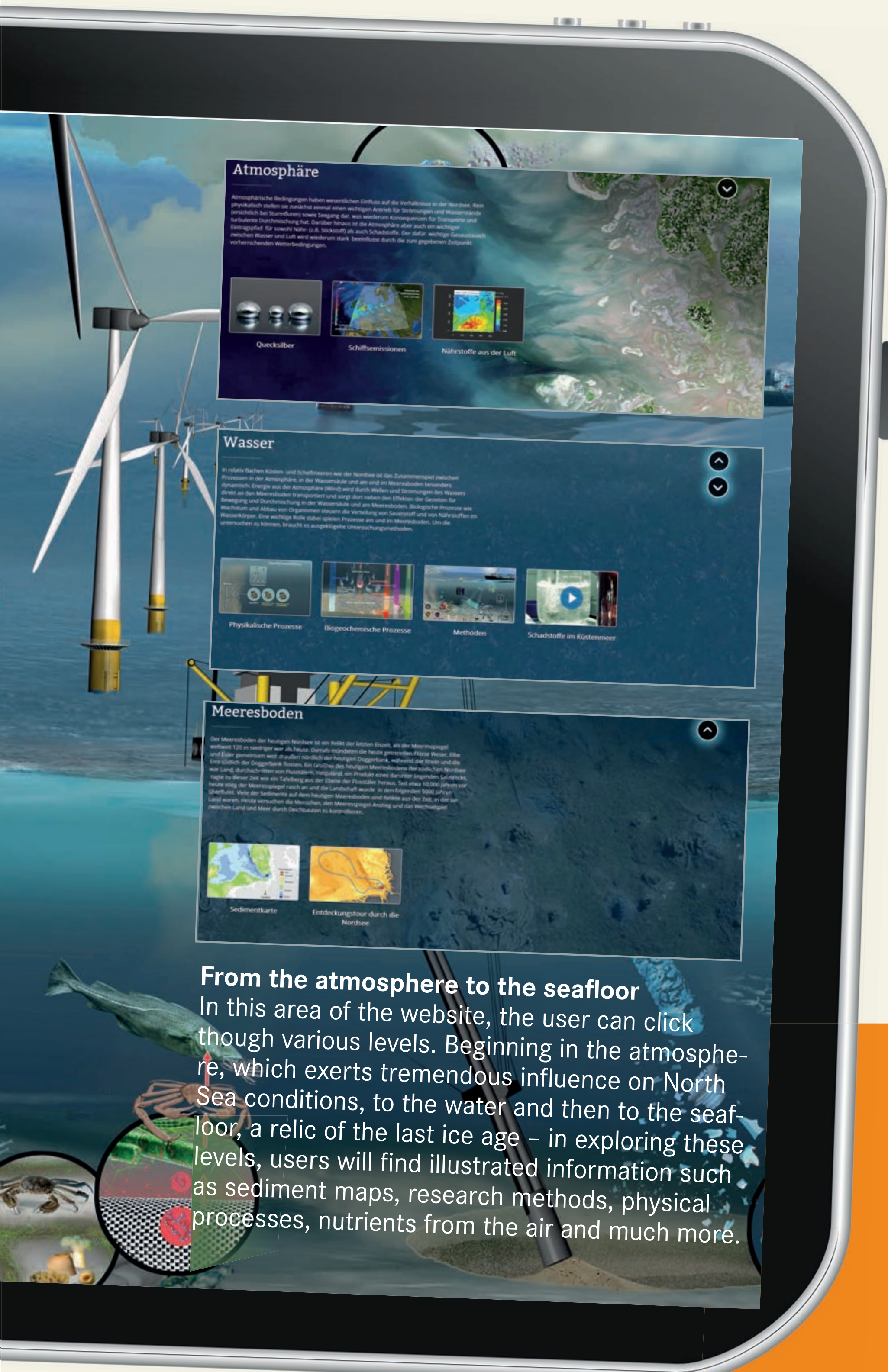
www.coastmapapp.hzg.de

Take a tour of discovery through the North Sea; take a look at how the sea is used on an industrial level; get to the bottom of materials cycling – all that and much more is possible with our interactive web application „coastMap“, developed by the Biogeochemistry of the Coastal Seas Division.

All information and scientific results are integrated into this project.



Listen: In the resonator podcast of the Helmholtz Association Kay Emeis talks about the biogeochemistry of the coastal sea and the coastMap App:
www.resonator-podcast.de/2017/res106
Please note that the podcast is only available in German.



From the atmosphere to the seafloor
In this area of the website, the user can click though various levels. Beginning in the atmosphere, which exerts tremendous influence on North Sea conditions, to the water and then to the seafloor, a relic of the last ice age – in exploring these levels, users will find illustrated information such as sediment maps, research methods, physical processes, nutrients from the air and much more.

"The North Sea is one of the most researched marine regions in the world," explains Prof Kay-Christian Emeis, institute director and an initiator of the "coastMap" app. This research is displayed on the website through various content. The interactive website only went online in April 2017 after a year-and-a-half of planning, numerous brainstorming meetings, discussions and a number of corrections.

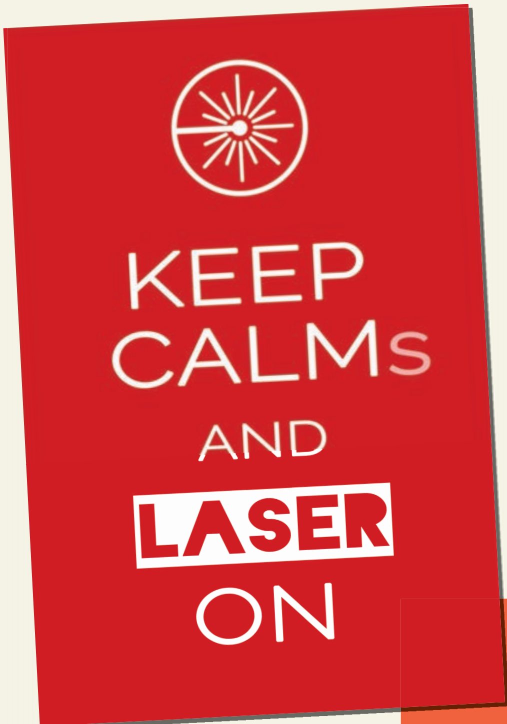
The topics are aligned with the five focal areas of the Institute of Biogeochemistry in Coastal Seas: marine bioanalytical chemistry, environmental chemistry, chemistry transport modelling, aquatic nutrient cycles and modelling for coastal systems assessment. The content is processed and displayed in a way where users can navigate through the topics that really interest them. This is where the texts, graphics and videos come in. "It is important to us that the content is comprehensible to anyone interested in the science of our research," says Marcus Lange, one of the web application's chief editors and a staff member who works on coastMap. He adds, "Scientific papers are not only too difficult for the layperson to understand, but they are often expensive to access and only available in English."

How do I use coastMap?

There are three ways to begin from the homepage:

1. from the atmosphere to the seafloor
2. our North Sea and
3. a journey of discovery.

Depending on what the user clicks, further content will appear in the form of texts, graphics, photos or videos. Have fun diving in!



Josephin Enz in discussion with her colleague Stefan Riekehr at the laser welding portal facility. The scientists observe a welding seam.

About: Josephin Enz has been junior group leader since October 2015 in the Department of Joining and Assessment (WMF) at the Institute of Materials Research. She had earlier studied mechanical engineering with a focus on materials engineering, also completed her special welding engineer degree and subsequently earned her doctorate at the TU Hamburg on "Laser Beam Welding of High Strength Aluminium-Zinc Alloys." The native Berliner had always possessed an urge to do research, and always wanted to know from a young age: "Why is it like that?" It's therefore particularly important to observe a problem from different angles for this mechanical engineer. In her case, this includes manual dexterity, theoretical foundations and creativity: lateral thinking is in demand.

They don't mill the metals; they don't pour them; they don't glue them – they weld them. They are the scientists in the CALMS group ("Characterization of Laser Additive Manufactured Structures") at the HZG's Institute of Materials Research. In contrast to subtractive methods, structures here are literally welded using lasers.

The layered application of structures offers entirely new possibilities that weren't feasible using conventional methods. Component design can now by carried out using the "form follows function" principle. This makes the structures lighter and more energy-efficient. There is, however, a great deal of basic research still to be done in order to obtain optimal component properties and to develop a concrete application.

The Joining and Assessment Department (WMF) had already been divided into two groups back in 2015: CALMS and RSE ("Residual Stress Engineering"). CALMS deals with additive production using laser radiation. Two different methods, therefore, are used and developed: a converted glove box with integrated robotic arm, a powder conveyor unit, connection to a laser as well as a laser welding facility, which uses wire instead of powder for material application. The unique thing is that none of the equipment can be bought off the shelf. "We've just taken the basic framework and converted it for our purposes," says Dr Josephin Enz, group leader. "We're still far from finished though. Both facilities are constantly in the process of optimisation." The scientists are now working on checking the most varying metallic materials for suitability in the additive production process and on characterising the resulting components.

Enz as well as two doctoral candidates, a master's student, a technician and two scientific members of staff comprise the CALMS group. These members don't restrict their research only within the group though. "Our work is inter-departmental and we also cooperate with other centres," says Enz. This includes the working group "Tailored Materials and Processes for Generative Manufacturing", which is comprised of members not only from the HZG, but also from Leuphana University in Lüneburg, the Helmut Schmidt University as well as partners from the industrial sector.

Newsflash

Ground-breaking Ceremony for the Photon Science Building

These scientists and politicians dug down into the sand with some delight. The festive ground-breaking ceremony for the new photon science building took place on March 23, 2017. The new structure is to serve as a research facility for scientists from the Helmholtz-Zentrum Geesthacht (HZG), Kiel University (CAU) and the Deutsches Elektronen-Synchrotron DESY. Prof Wolfgang Kaysser, managing director of the Helmholtz-Zentrum Geesthacht says: “In this shared structure, we‘re establishing a new qualitative use of PETRA III. This applies to the partners HZG, CAU and DESY as well as for external research groups from all over the world. This building is a big leap forward in the notion of long-term cooperation with external users at our “German Engineering Materials Science Centre”.

Photo, from left to right: DESY Director Prof Helmut Dosch, HZG Managing Director Prof Wolfgang Kaysser, Hamburg Research State Councillor Dr Eva Gümbel, Science Minister for Schleswig-Holstein Kristin Alheit, University of Kiel President Prof Lutz Kipp, DESY’s Administrative Director Christian Harringa and the DESY Nanolabs Director Prof Andreas Stierle.

Anchors Aweigh!

Taking water samples, looking over the shoulders of scientists and listening to exciting talks – that’s what happens every summer at the „Open Ship“ tour on the LUDWIG PRANDTL. This year, the tour heads through the Baltic Sea, from Sassnitz on the island of Rügen to Barth, then on to Timmendorf. The „Open Ship“ is filled with activities during the day while talks and discussions take place in the evenings.

It has been a tradition since 2009 that the LUDWIG PRANDTL not only helps scientists in their research, but also passes on knowledge to anyone interested. The journey lasts one week and always tours different locations on the German North and Baltic Sea coasts. The ship, named after German physicist LUDWIG PRANDTL, was especially engineered for use in coastal regions. With its small draught, it can navigate shallow waters to carry out research.

For those who can’t be there in person, the HZG‘s Coastal Research Blog lets you keep up with the activity. You can find photos, news and stories for all past tours on the site.

www.kuestenforschung.com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Research with a vision

Scientists discuss digital methods and virtual laboratories at the Helmholtz-Zentrum Geesthacht's 2017 Annual Meeting. These topics include X-ray imaging, undertaken by HZG materials researchers at DESY's PETRA III X-ray source, which quickly gobbles up several terabytes of storage space. The data archive that climate researchers rely on stores as much as 135,000 laptop computers. Coastal researcher Dr Volker Matthias and materials researcher Dr Martin Müller explain here how coastal and materials scientists at the Helmholtz-Zentrum Geesthacht work with huge quantities of data and what they learn from this data.

Volker Matthias heads the *Department of Chemistry Transport Modelling* at the Institute of Coastal Research

Mr. Matthias, you're interested in how ship exhaust gases spread in coastal regions. Why is that?

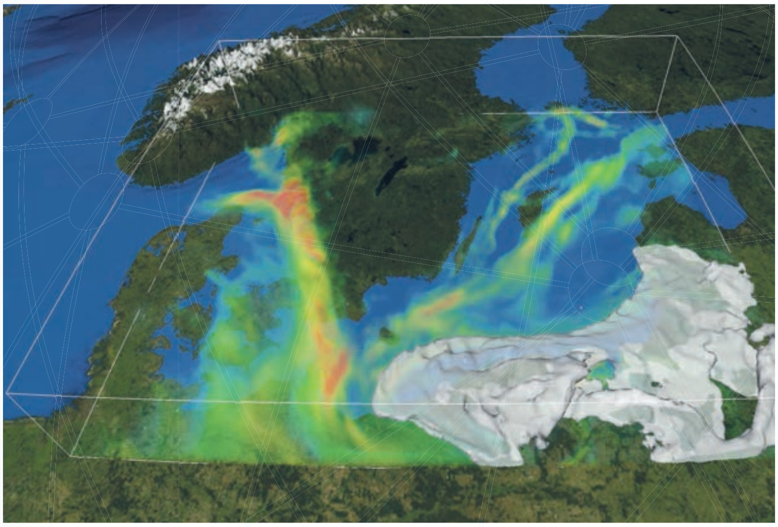
Approximately one thousand ships sail the North Sea alone every day. They discharge pollutants such as soot, sulphur dioxide and nitrogen oxides. Only ships using fuel low in sulphur have been allowed to travel the North and Baltic Seas for some time now. This has considerably reduced their sulphur dioxide emissions. Seagoing vessels, however, still contribute a substantial amount of nitrogen oxides to emissions. These nitrogen oxides add, for example, to the formation of ozone and fine particulate matter – particularly in harbour cities: a third of nitrogen oxide pollution in Hamburg is estimated to come from ships.

Our research aims to determine in detail how much shipping contributes to harmful emissions and how effective counter-measures could be – for example, by using catalytic converters.

How do computer simulations – chemistry transport models – help you in this work?

Our simulations are similar to those from computer models used for weather forecasting. In addition, we take into account pollutant emissions, material transport and chemical reactions. Our simulations are based on grids. We divide the atmosphere into several hundred thousand grid cells, and the computer calculates a set of chemical reaction equations for each of these cells. The cells then exchange information with each other – and that's how we simulate the material transport.

Our simulation initially works with a rough grid for all of Europe, with 64 x 64-kilometre-sized grid cells. We then calculate the North and Baltic Seas area more precisely, with grid cells measuring 16 × 16 kilometres. In the end, we simulate the North Sea coast at our highest currently available resolution, which is 4 x 4 kilometres.



Atmospheric Simulation

Computers at the German Climate Computing Center in Hamburg.

We feed our models with meteorological data and the closest estimates for emissions obtained from traffic, industry, households and agriculture. Pollutant emissions from ships can be determined very precisely by taking into account the movements of every single vessel. We then let two simulations run: one with all pollutant sources and the other without including shipping emissions. The proportion from shipping can be derived with great precision from the difference.

What kind of computers are you working with?

On the one hand, we're working with the in-house computer cluster. It includes about 2500 processors, and we can use two to three hundred of those simultaneously. In addition, we can also fall back on the computer belonging to the German Climate Computing Centre (DKRZ). We require not only a great deal of storage space for our calculations, but the data must also be able to be stored quickly. A single simulation produces a data set of about one terabyte; the time required for the calculations ranges from several days to an entire week.

What have the results produced so far?

One thing we could show was how different emission sources interact. Ship exhaust gas can react with ammonia emissions from agriculture and form fine particulate matter. We have also looked into the future with our simulations and calculated different scenarios. One example is that starting in 2021 all newly constructed ships on the North and Baltic Seas will only be allowed to emit a quarter of the nitrogen oxide quantities they emit today. How does that impact 2030? 2040? Our simulations predict that nitrogen oxide pollution by 2040 will decrease by up to eighty percent, whereby we also assume that ships will use considerably less fuel. We don't see as much improvement in 2030, as there will still be plenty of old ships traveling the seas to which this stricter limit doesn't apply. If we want to see improvement more quickly, we need to consider outfitting older ships with catalytic converters.

And what plans do you have for the future?

We, for example, would like to improve our model resolution, from 4 x 4 kilometres to 1 x 1 kilometre. We could then improve imaging of regions like the Hamburg Harbour. We simply need more computing power to do that. We also plan to use typical big data methods. To capture emissions from street traffic more precisely, we could use traffic information or data from Toll Collect. We could also take advantage of satellite data to determine which agricultural pollutants are emitted during different seasons.

Thank you for your time.

Prof Martin Müller heads the “German Engineering Materials Science Centre” (GEMS) at the Institute of Materials Research

Helmholtz Incubator Information & Data Science

The Helmholtz presidents introduced the “Helmholtz Incubator Information and Data Science” initiative to improve handling of large quantities of data (“big data”) in science. The incubator comprises thirty-six IT and data science experts from all Helmholtz centres and is supported by experts from the researching industry.

Automatic sample changer at a GEMS HZG beamline.

Mr Müller, GEMS holds a special position at the Helmholtz-Zentrum Geesthacht. What makes it special?

Our laboratories are not in Geesthacht. We instead operate several measurement instruments at two large facilities – PETRA III at DESY in Hamburg as well as at FRM II in Garching bei München. The storage ring PETRA III produces extremely bright X-ray light, while the research reactor FRM II produces neutrons. Both are highly efficient tools in examining the inside of materials.

How do you contribute to the HZG materials researchers' work?

Together with the institute division led by Prof Norbert Huber, we have looked into what precisely happens during laser welding. Using bundled x-rays, we can observe how the laser beam welds the material and how the welding seam solidifies afterwards. Another example is that we have integrated a machine for friction stir welding at one of the measurement stations – a method developed substantially at the HZG. The PETRA III X-ray beam allows us to track how the process takes place with the utmost precision. Lately, we've also been working with Prof Regine Willumeit-Römer's team to examine novel metal biomaterials: How does a magnesium bone screw degrade, especially under conditions present in the human body?

How much data has resulted from these experiments?

Just a single image can take up several gigabytes. If we, however, want to track a process, we need to take thousands of images in quick succession. That will quickly take up several terabytes – and with future detector generations, this will probably even be petabytes. The computer, data storage and data transmission requirements will grow accordingly. This also applies to evaluating the data—for example, in displaying 3D images. To master these challenges, we work closely with the DESY and FRM II computing centres.

How quickly can the measurement data be displayed and how rapidly are they available to those conducting the experiments?

Our goal is to evaluate the data in real-time and/or to evaluate it with a time delay of merely a few minutes. Fast algorithms, for example, help us here in data reduction. The advantage of this rapid evaluation is that the researchers can already see how the experiment is running during the measurements themselves. They can therefore recognize in time when a test is heading in the wrong direction. They can optimize their measurement strategy so that they can achieve their goal more quickly and with fewer experiments. This is already possible in some instances at GEMS. We want to develop this considerably in the future.

What role can big data methods play here – for example, in automatic recognition of imaging data patterns?

Methods such as "machine learning" have a lot of potential. The vision is for algorithms to recognise particular patterns in the measurement data and then to be able to automatically inform us in what direction the experiment is headed. Image face recognition from internet firms like Google have already proven the technology does work. For us, it's now about transferring this to the scientific realm. The Helmholtz Association is helping us in this regard with "the Helmholtz Incubator Information and Data Science" initiative. Scientists from completely different fields of specialisation who are facing similar problems come together: How can we extract the right measurement strategy from large data quantities as quickly as possible?

Thank you for your time.

Both interviews were conducted by science journalist Frank Grotelüschen.

Flow Computations with a Twist

Coastal research with a drone (from left to right): Michael Streßer (doctoral candidate), Dr Jochen Horstmann (department head) and Ruben Carrasco Alvarez (engineer).

When conventional methods are no longer enough, then you need to think of something new – that‘s how it goes in research too. Scientists from the Institute of Coastal Research are now using drones to measure river flow velocities and to study smaller waves.

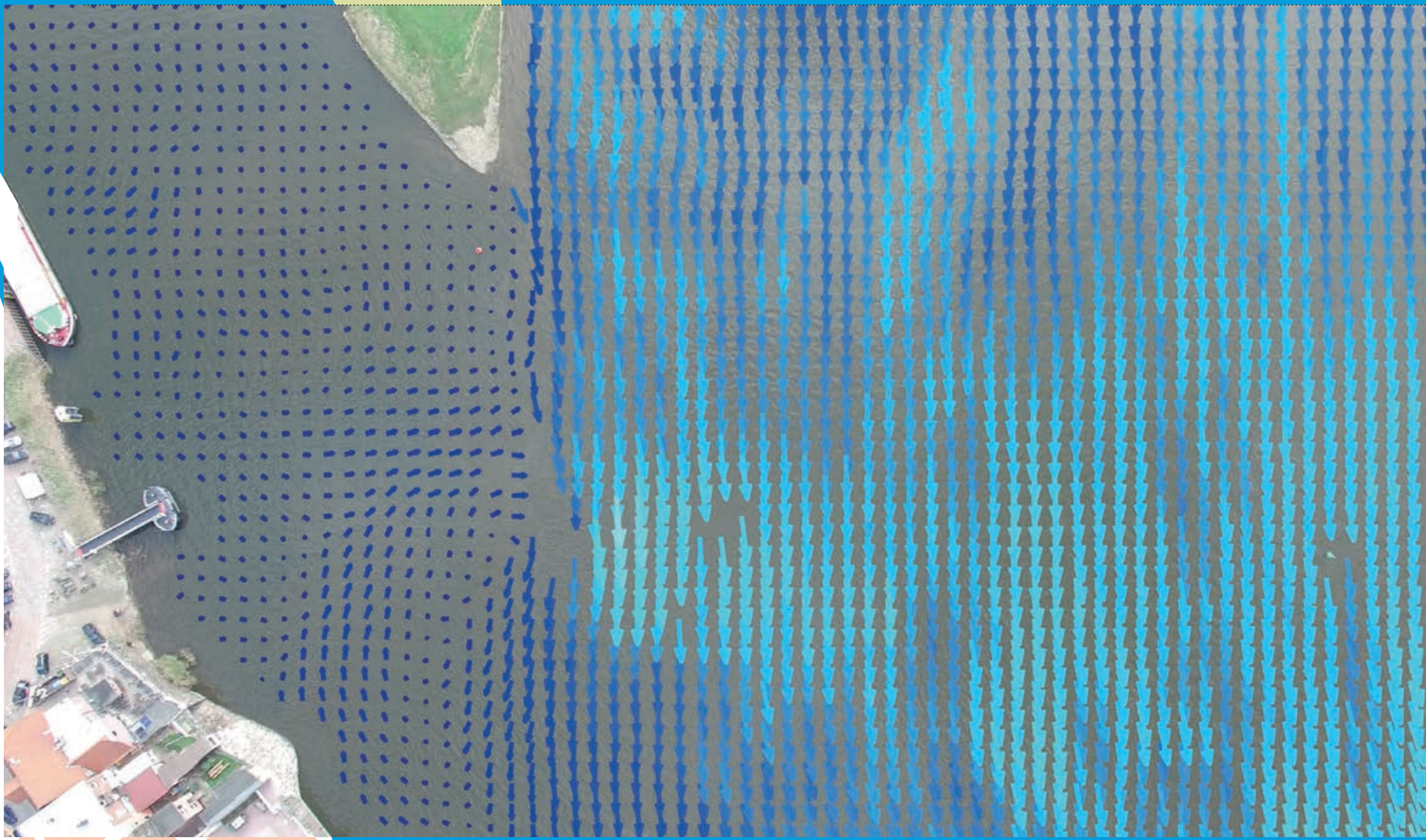
The sky is slightly cloudy, the Elbe flows leisurely by the city of Lauenburg and a few ducks waddle about. Members of the Institute of Coastal Research’s Radar Hydrography Department aren’t looking at the water though – they’re looking into the sky. A drone is flying above them with a camera. It’s controlled by Michael Streßer, doctoral student at the Institute of Coastal Research in the Radar Hydrography Department (KOR). His colleagues, Dr Jochen Horstmann and Ruben Carrasco Alvarez, are observing the situation. The three scientists wish to determine how high the flow velocity is at this location of the Elbe. Specifically, they want to find out if their new method using drones functions as well as they had imagined.

Linear wave theory – what’s that?

Linear wave theory states that waves move at different rates depending on their length. The researchers theoretically know exactly how fast a wave moves as soon as they have determined its length – provided there would be no current. A current, however, almost always exists; it doesn‘t matter whether it‘s a creek, river or the sea – the water is always in motion. This is why the researchers must initially measure how fast the wave is actually moving, then they can deduct the theoretical value. The resulting difference is the actual flow velocity. It’s similar to an escalator, explains Michael Streßer: “If we know how quickly a person ascends normal stairs and then measure how long the person needs on an escalator – from the bottom to the top – we can subtract this value from the person’s velocity and therefore can determine the speed at which the escalator is moving.”

What do drones have to do with it?

The HZG scientists have been using radar measurements for current calculations in the past. These measurements, however, are laborious and result in coarser resolution. This is still a good approach for measurements in the open sea. For small waves under a metre long – for example, at times in the Elbe – finer and higher resolution images are beneficial. Now, drones take video recordings of the wave movements that can later be studied. They capture the average flow of the upper ten centimetres over the entire area. The scientists are also much more flexible with the drone and can move from site to site more quickly. They can record larger areas more rapidly and more effectively using this method rather than with conventional measurements. In addition, the drone is altogether more cost-efficient than typical instruments used for current measurements. The scientists can come up with a current profile of the Elbe within five minutes using a drone.



Lauenburg

Jochen Horstmann and his colleagues have only utilised the drone a few times. At the moment, they're still testing how strong the results are, what impact other parameters, such as light conditions, have on the recordings and therefore on the results. For comparison, they also record profiles using a current metre, known as an Acoustic Doppler Current Profiler (ADCP). In this case, the relative water velocity is measured against the ship, from which the absolute velocity of the water can be determined. The HZG's research vessel Zwergseeschwalbe crosses the Elbe, zig-zagging through the area, something that takes a great deal of time. While it remains above the river at a particular position, the drone measures the same area within only a few minutes.

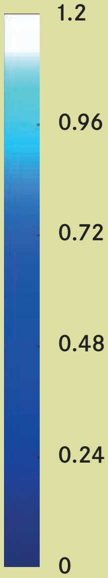
What happens with the video recordings?

The drone's video recordings will be evaluated on the computer back at the research centre. Using imaging methods, a type of grid is placed over the recordings. This way, the researchers obtain five-by-five metre areas, which they can analyse in more detail. The scientists then use a program they developed themselves, with which the current velocities can ultimately be calculated. The researchers need about an hour to analyse one minute of video material. They must view the material, make calculations and then think about whether the results are plausible. A number of weeks and several tests flights later, Dr Jochen Horstmann reports: "The drone results are a pretty close match to the those from the research vessel. This means that our method works." They nevertheless need to optimise their analysis methods to minimise errors.

In the service of science

What Jochen Horstmann and his colleagues are testing on the Elbe on a small scale can also conceivably be utilised for larger measurement projects. How do the waves mutually affect each other? What are the prevailing current velocities in small eddies? These questions and many more are what the scientists at the Institute of Coastal Research are now trying to answer.

Lower Saxony



flow velocity (m/s)

Surface current in Lauenburg the Elbe

This image clearly shows the direction in which the Elbe flows. The colours of the arrows show the flow velocity. The water flows down faster in the centre of the river than in the tributary.

Dr Jochen Horstmann heads the Radar Hydrography Department at the Institute of Coastal Research. He and his team started using drones for research in 2016.

Possible applications:

Why are current calculations useful?

Knowledge of currents, waves and eddies in the water enable scientists to identify vulnerable areas and efficiently plan and implement coastal protection measures. The flow rate can also help determine how much water, for example, flows down the Elbe during a certain time interval.

This data can be of importance in other research: when, for example, scientists study coastal regions where a river flows into the sea, determining the volume of water flowing there can be crucial. Currents greatly influence the shifting of sand and silt deposits. They are responsible for the transport of nutrients as well as pollutants. Fast and efficient current measurements from the air can therefore also assist in fighting oil spills or similar accidents. Precise knowledge of the local current conditions is also necessary, for example, to ensure safe ship navigation.

Using drones for current velocity measurements would also allow researchers to come to more accurate conclusions about where bathers can safely swim and which areas produce strong currents that could pose a threat to humans.

Author: Gesa Seidel, HZG

Colleagues with exciting stories or outstanding collaborations they'd like to share are encouraged to get in touch with the editors. Suggestions, praise and criticism are always welcome. Please contact us at in2science@hzg.de.

We look forward to hearing what you think about this issue of in2*science*

Imprint

In2science Team Magazine published by the Helmholtz-Zentrum Geesthacht
E-Mail: In2science@hzg.de

Publisher: Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research GmbH
Max-Planck-Str. 1, 21502 Geesthacht, Phone +49 4152 87 1648, Fax +49 4152 87 1640

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Illustrations: p20 RoseFlohr Kommunikation, pp.22-23: Jörg Stiehler, p30 RoseFlohr Kommunikation, pp.40-41 RoseFlohr Kommunikation

Senior Editor & Editor-in-Chief: Gesa Seidel, Heidrun Hillen, Dr. Torsten Fischer (ViSdP)

Contributing Editors: Frank Grotelüschen, Jochen Metzger, Jenny Niederstadt

Design: RoseFlohr Kommunikation; HZG/Bianca Seth

Printing: Helmholtz-Zentrum Geesthacht in-house printing. Paper/ Envirotop (produced from 100% recycled paper, Blue Angel certified [RAL-UZ 14]

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schützt die RESSOURCEN

Trusting in Science

According to a 2016 study conducted by "Wissenschaft im Dialog", the public's trust in science has decreased compared to previous years. We surveyed employees at the HZG:

"What can we do to increase public trust in science again?"

"Qaiser Ali Khan,
Master's Student (Materials Research)
Scientific communication is vital for explaining our research to a broad public. This is why we should use simple words, incorporate a story and use the media."

"Irmela Burkhardt,
Doctoral Candidate (Materials Science)
We as scientists should increase the amount of research results we pass on to the public and present them in a comprehensible and visual way. And in regard to research institutions: if the public doesn't come to you, then you must become active and turn to the public. This also means advertising science itself as well as the research centres in a way."

March for Science

In these times, it is important that scientists show that facts aren't fiction and that "alternative facts" don't exist. That is why people all over the world took to the streets on April 22nd, 2017.

They demonstrated for scientific freedom, for providing science to society, for evidence-based decisions in political policy making, for diversity and equal rights in science and for much more. Employees from the HZG as well as many other Helmholtz centres took part in Hamburg and Berlin.

www.marchforscience.de/en/


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