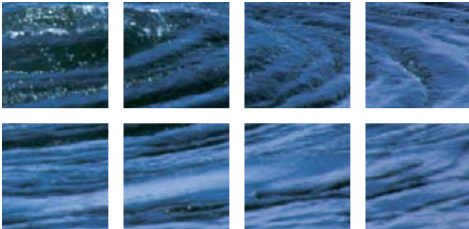


Impacts of Climate Change on Waterways and Navigation in Germany



The KLIWAS Objectives



Navigation is one of the most environment-friendly means of transport, and important for industry and trade relying on inland and coastal waterways. It is therefore crucial to assess if and how waterways and their services are affected by climate change. Consequently, the Federal Ministry of Transport,

Building and Urban Development (BMVBS) launched the research programme KLIWAS to analyse the current situation and future projections of water bodies. The KLIWAS scientists develop ways to adapt that are ecologically and economically state-of-the-art.

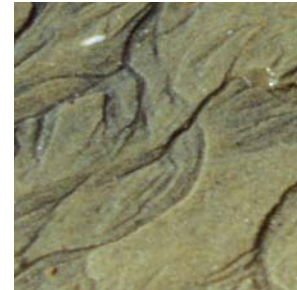
*KLIWAS contributes to maintain waterways
now and for the future.*



An aerial photograph of a tidal flat, showing a complex network of dark, winding channels and ridges in the sand. The patterns are intricate and resemble a topographical map or a series of interconnected veins. The colors range from dark brown to light tan, with some areas appearing wet and reflective. The overall texture is highly detailed and organic.

We are experts from 17 research disciplines collaborating closely to achieve ambitious aims.

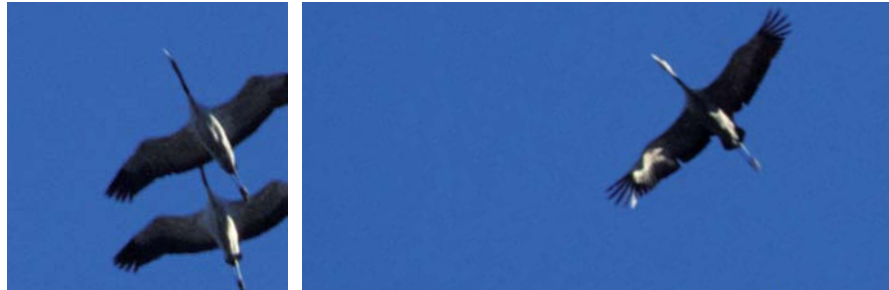
The KLIWAS Framework



Scientists from 17 research disciplines work – and network – in 30 projects, each with its own focus, but linked with all others. The KLIWAS research programme was launched in March 2009 and will finish its work by the end of 2013. During this period, up to 100 scientists will contribute to the ultimate objective of maintain-

ing environmentally beneficial waterways. They are supervised by a steering group and advised by an international scientific committee as well as by the water and navigation authorities concerned. Last but not least stakeholders from all sectors are invited to become active in the KLIWAS programme.

With diversified Approaches to a holistic Analysis



Before we can face environmental changes, we need to understand the complete system, and we need certainty in our knowledge about the essential change parameters. Then we can find appropriate solutions. KLIWAS therefore applies a so-called model chain. That means we start at future greenhouse gas emission scenarios,

assess projections of their impacts on global and regional climate for the next 100 years. Consequently, we investigate the impacts of these changes on the waterways, considering hydrologic, chemical and biological impacts. Finally, we evaluate how effective potential adaptation measures are.

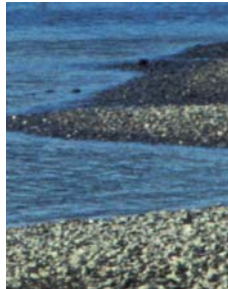
*KLIWAS stands for unique expertise
and reliable state-of-the-art research
– with excellent results.*



*Physical processes change waterways
– we understand them both.*



Hydrology



In order to maintain navigation safe KLIWAS focuses on all crucial climate change parameters of inland and coastal waterways and canals. For instance, we investigate changes on currents, sea states and wave heights as well as concentrations of salt and suspended loads for coastal regions. In parallel, we study changes of stream flow, water

levels and sediment transport on German inland waterways. We particularly work out whether low water or floods will occur more frequently – circumstances that definitely influence navigation. Eventually we propose ways to adapt, in full respect of the economical impacts of both the changes and the measures.

Quality of Water Bodies and Ecology

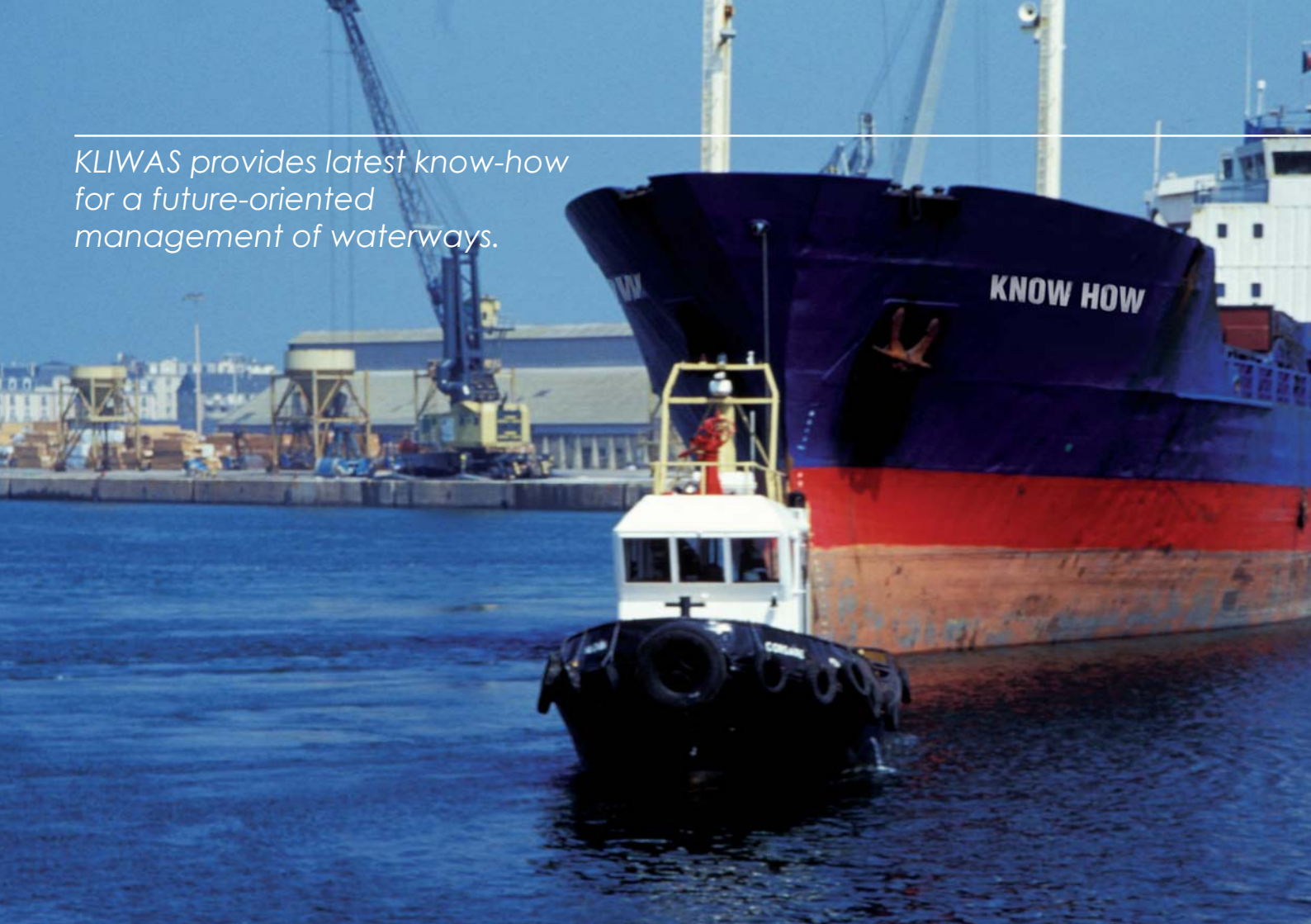


Climate change may also affect the quality of water bodies. Thus, we estimate physical changes in water quality and ecology. On our coasts, we estimate changes in pollutant levels, in the growth of neophytes and pathogenic microbes. As to inland waterways, we research potential blooms of toxic algae and analyse changes in oxygen and nutrient concentrations. Especially in estuaries, we study and invest in floodplain vegetation in order to protect the respective river banks. Our results will help to differentiate between the vast variety of climatic and human origins of changes in water quality. The outcome is clarity.



KLIWAS differentiates between changes in water bodies caused by climate and humans.

*KLIWAS provides latest know-how
for a future-oriented
management of waterways.*





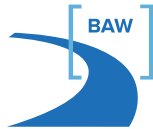
Adaptation



The central aim of the KLIWAS activities is to apply our sound expertise on climate change directly to waterways. We want to boost them as future-oriented means of transport in terms of ecology and economy. We therefore look closely at potentially modified transport logistics, ship types and at adapted maintenance options for waterways.

We also work out methods to prevent algal blooms and other changes harming tourists or people working or living at rivers and coasts. Before recommending any options, we test them by model experiments or on site. On the basis of our scientific know-how we can anticipate and mitigate conflicts between waterway maintenance and quality of water bodies.

Joined Institutes



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We look forward to getting in touch with you.

