Virtual Alpine Observatory: Unique Climate Research Network

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How will the climate evolve? What effects will that have on particular regions? Changes can be monitored especially rapidly and distinctly at high altitudes. In the atmosphere above high mountain regions climate researchers can accordingly find good indicators for global climate change trends. Alpine high-altitude research stations in Italy, France, Switzerland, Austria and Germany have now joined in an international network, the "Virtual Alpine Observatory" (VAO).The newly expanded research association specializes in intensive data exchange with a focus on the atmosphere, the Alpine environment and Alpine water resources. The German Aerospace Center (DLR) is responsible for overall scientific coordination and is the coordinator for two of the nine subprojects. The Bavarian Research Alliance handles the VAO project administration.

"Linking the information technology of the separate stations allows rapid and convenient data exchange meeting international standards. Research will become more efficient and it will be possible to jointly make use of the data", explains VAO project coordinator Prof. Michael Bittner of DLR's German Remote Sensing Data Center. "By cooperating across national borders and disciplines we can address science issues at levels of complexity which would not be possible without this infrastructure", Bittner continues.

Accessing a data resource

Currently available and future VAO measurement data are to be combined at an Alpine Data Analysis Centre (Alpen-DAZ) – a facility so far unique in this form. It will be set up by DLR's German Remote Sensing Data Center in cooperation with Leibniz Computer Centre (LRZ). Researchers will then be able to access the data of other VAO partners, which makes possible an invaluable exchange of knowledge and avoids duplicate measurements.

In cooperation with LRZ, the project team under DLR scientist Dr. Julian Meyer-Arnek will first develop concepts for connecting the participating Alpine observatories with VAO. The quite remote location of some of the research stations poses a challenge for establishing the data links. An IT solution for efficient data management is also called for. Using a modern interface it will reflect all steps in the science value adding chain from the management of measuring data to the publication of research results. The VAO user interface is accessible via a Web site, functions as a central database, and permits explicit queries. Alpen-DAZ will also make it possible to operate computationally intensive computer models in real time for "on demand" research applications.

The data centre of the Virtual Alpine Observatory will also be linked to DLR's World Data Center for Remote Sensing of the Atmosphere (WDC-RSAT). Climate researchers will thus have global satellite data additionally available, giving them a comprehensive synergistic data resource.

Preciser forecasts

The goal of the VAO subproject "LUDWIG" is to contribute to improving climate, atmosphere and weather models and the associated forecasts with the help of gravity wave investigations in the Alpine region. This "cross-border investigation of the dynamics of atmospheric waves in mountainous regions" is being led by DLR's German Remote Sensing Data Center in cooperation with international research institutions.

Gravity waves are air movements with horizontal wavelengths of a few to several thousand kilometres and periods of a few minutes to several hours. They are one of the great unknowns in climate models. Frequently arising near mountain ranges, they are one of the atmosphere’s small-scale processes.

In climate and weather models they are accordingly only taken into account in simplified form. But their influence on atmospheric dynamics is global. They transport huge amounts of momentum and energy, even over large distances. For example, gravity waves can influence, somewhat like a train track switch, the direction of the jet stream and other large-scale air currents. Discrepancies between model calculations and measurements are thus often attributed to the influence of gravity waves. Precise knowledge of the characteristics of gravity waves should lead to more accurate climate and weather models in the future.

Toward this end, the team of experts under DLR scientist Dr. Sabine Wüst is increasing the density of an Alpine network of identical measuring instruments that are part of the international Network for the Detection of Mesospheric Change (NDMC). The GRIPS infrared spectrometer (GRound-based Infrared P-branch Spectrometer) is being employed. Originally developed at Wuppertal University, this instrument was optimized in recent years at DLR and will use the airglow of the atmosphere at an altitude of 90 kilometres to monitor gravity waves. GRIPS measurements will be made at eleven locations worldwide: from the Zugspitze mountain in Germany to Abastumani in Georgia to the Neumeyer research station in the Antarctic. The scientists will use the data to precisely determine flow parameters for model calculations, for example amplitudes, period durations and potential energy. The information obtained will be integrated in existing climate and weather models, for example to increase the accuracy of forecasts of major storms.

About the research association

The VAO research association currently involves cooperation between the Schneefernerhaus Environmental Research Station (UFS), Leibniz Computer Centre of the Bavarian Academy of Sciences (LRZ), the International Foundation High Alpine Research Stations Jungfraujoch and Gornergrat (Switzerland), the Sonnblick High Altitude Observatory (Austria), the European Academy (EURAC) Bozen (Italy) and the Observatory Haute Provence (France). An associated institution is the Norwegian research station ALOMAR, and negotiations are under way with analogous stations in Alpine-like mountain regions. VAO project management was delegated to the Bavarian Research Alliance. The Bavarian Ministry of Environment and Consumer Protection supports the 16 participating Bavarian partners with three million euro over three years.

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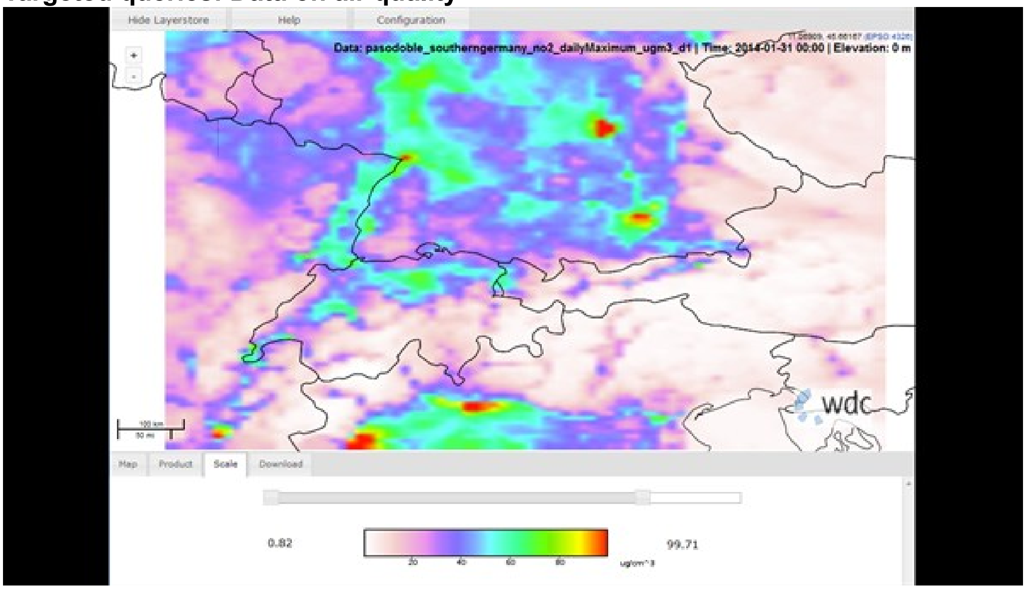
At the Zugspitze mountain: Schneefernerhaus Environmental Research Station

At the Zugspitze mountain: Schneefernerhaus Environmental Research Station (UFS).

Credit: UFS/Markus Neumann.

Targeted queries: Data on air quality



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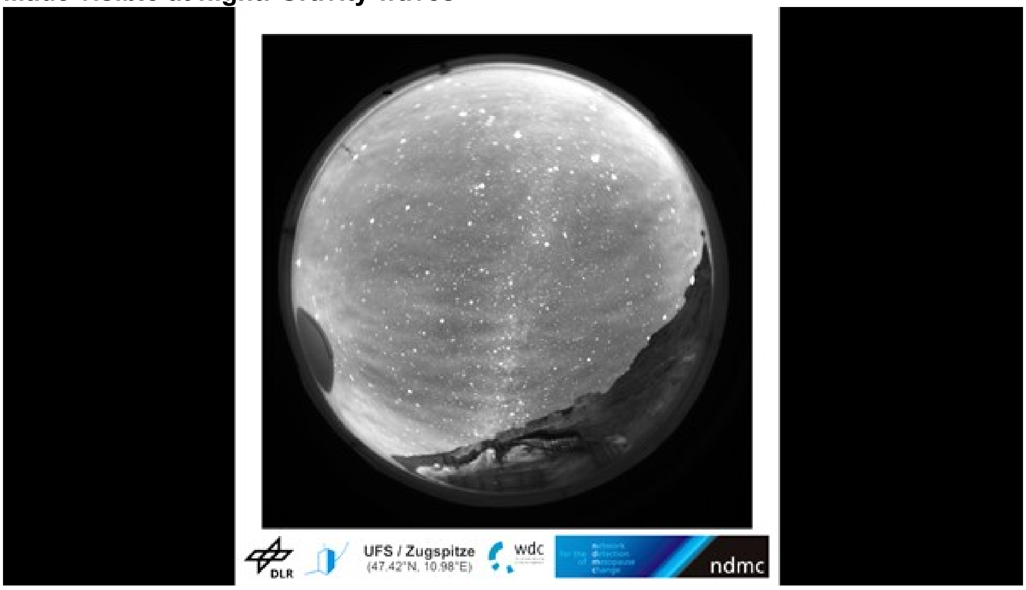
Credit: DLR.

Cloud bands above the Zugspitze mountain

Gravity waves often arise near mountain ranges. The air movements with horizontal wavelengths can stretch across several thousand kilometres. Under certain circumstances these air movements are apparent in cloud bands - in typical waveform.

Credit: DLR (CC-BY 3.0).

Made visible at night: Gravity waves



At the research station Schneefernerhaus the scientists are able to observe gravitiy waves in the airglow at night. In this picture the wave signatures are clearly visible in the horizontal line. The picture was taken on 8 October 2013 with the All-Sky Airglow Imager BAIER.

Credit: DLR.

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