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# Balloon flights – improving climate models with BHEA

*24 February 2012*

The first sounding balloons are in the air, and by 30 April 2012, 90 of these atmospheric probes will have been launched in sequence to gather data. Starting at Oberpfaffenhofen, their purpose is to record wind velocities and temperatures, especially at elevations between 12 and 30 kilometres. This measurement campaign is being carried out by the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR), in cooperation with the Environmental Research Station Schneefernerhaus and funded by the Bavarian State Ministry of the Environment and Public Health. The project team is investigating the 'Impact of High Mountain Ranges on Energy Transport in the Atmosphere' (**B**edeutung von **H**ochgebirgszügen für den **E**nergietransport in der **A**tmosphäre; BHEA).

**'Eyesight tests' for satellites**

Until now, only large-scale processes immediately affecting the climate, such as jet streams, have been taken into account in atmospheric modelling. But in the future, small-scale atmospheric processes will also be increasingly considered, since they can have a significant effect on the powerful wind circulation systems present in the troposphere, stratosphere and mesosphere. "Jet streams are like moving freight trains; it takes a considerable force to stop them, but their direction can be changed by simply setting the switch," explains BHEA project leader Sabine Wüst of DFD.

Satellites make it possible to monitor the atmosphere, but the quality of the measurements is limited: "It is as if the satellite enables us to look through wonderfully large eyeglass lenses, but with a slightly out-of-focus result. Detailed ground measurements supply the correction factor for sharpening the images," explains Michael Bittner, Head of the Earth Observation Center at DLR's German Remote Sensing Data Center (Deutsches Fernerkundungsdatenzentrum; DFD).

High-precision data obtained using radiosondes attached to the balloons make it possible to measure very fine structures in the atmosphere. By comparing these measurements with those taken by the Earth observation satellite TIMED (Thermosphere Ionosphere Mesosphere Energetics and Dynamics), the global data set can be refined.

**Precisely determining the direction of jet stream flow**

In the atmosphere, 'oscillating air parcels', also referred to as gravity waves, can function as switches for large air flow systems. 'Setting the switch' is initiated when air parcels encounter obstacles such as mountain ranges and are diverted upward – the rising air expands and cools. As soon as the temperature of the air parcel falls below that of the surrounding atmosphere and it becomes denser than its surroundings, it begins to descend – contracting and warming as it does so. Once the packet is again warmer than the surrounding air, it rises again; the process repeats and the air packet oscillates.

Gravity waves expand horizontally and vertically until they encounter a major wind circulation system, which causes the gravity waves to collapse, thereby accelerating or slowing down the jet stream. The circulation system can also be redirected as a consequence. This is the effect that will be more precisely incorporated in the climate models.

The measurement data will be stored at the DLR World Data Center for Remote Sensing of the Atmosphere on behalf of the World Meteorological Organization (WMO) and with a mandate from the International Council for Science (ICSU). The BHEA project will run until February 2014 and the measurement data will be made available to the research community.

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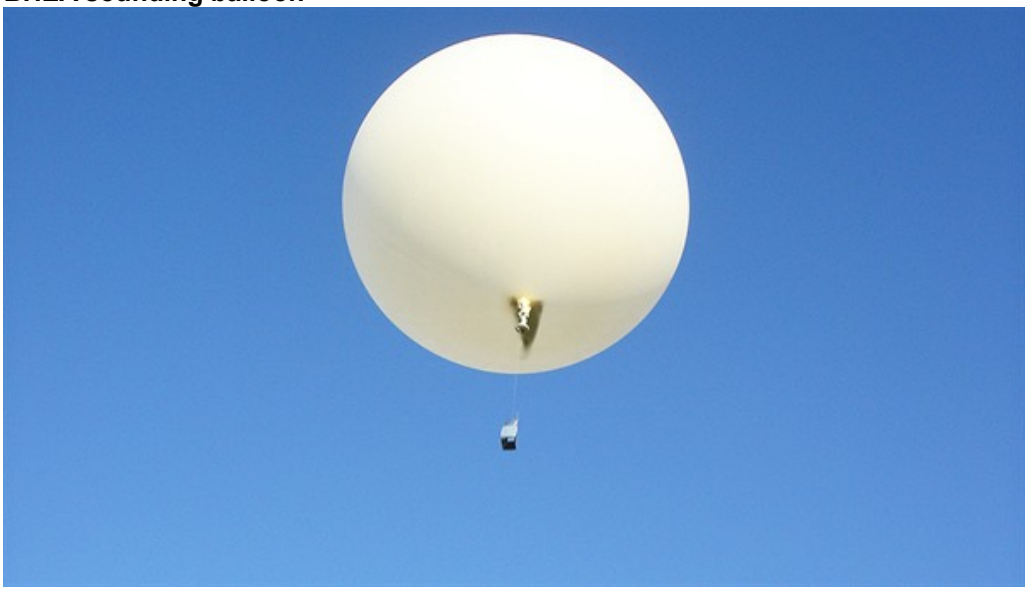
## BHEA sounding balloon



The sounding balloon is made of special rubber material and is about 1.50 metres in diameter. The balloon is filled with helium and can reach an altitude of 30 kilometres.

Credit: DLR (CC-BY 3.0).

**Ground check**

Ground check – is the radiosonde operational?

Credit: DLR (CC-BY 3.0).

**Ground check**

Ground check – can the data be received from the radiosonde?

Credit: DLR (CC-BY 3.0).

**Attaching the sonde**

The balloon has been filled with helium. Now, researchers from DLR's German Remote Sensing Data Center (Deutsches Fernerkundungsdatenzentrum; DFD) attach the radiosonde.

Credit: DLR (CC-BY 3.0).

**The BHEA measurement campaign can begin**

The balloon is ready for launch. The receiving system is visible at the left of the image.

Credit: DLR (CC-BY 3.0).

**The sounding balloon about to begin its journey**

The BHEA measurement campaign is being conducted from the forecourt of one of the hangars at DLR Oberpfaffenhofen.

Credit: DLR (CC-BY 3.0).

**... and away it flies!**

The sounding balloon rises quickly – at a speed of about five metres per second.

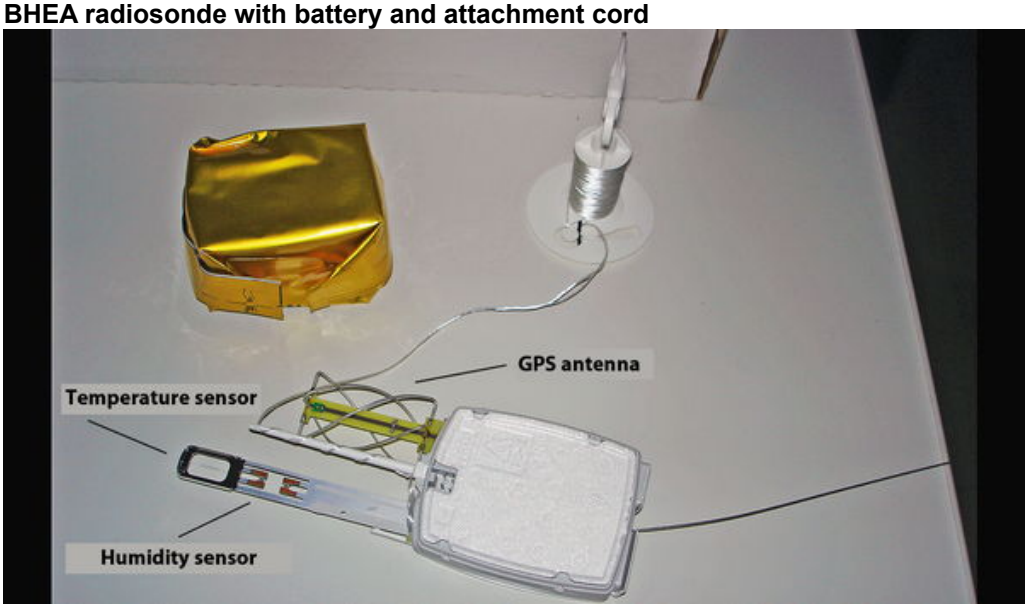
Credit: DLR (CC-BY 3.0).

**Final view of the sounding balloon**

The researchers from DLR's German Remote Sensing Data Center (Deutsches Fernerkundungsdatenzentrum; DFD) will immediately receive a continuous stream of data and initial analysis can begin.

Credit: DLR (CC-BY 3.0).

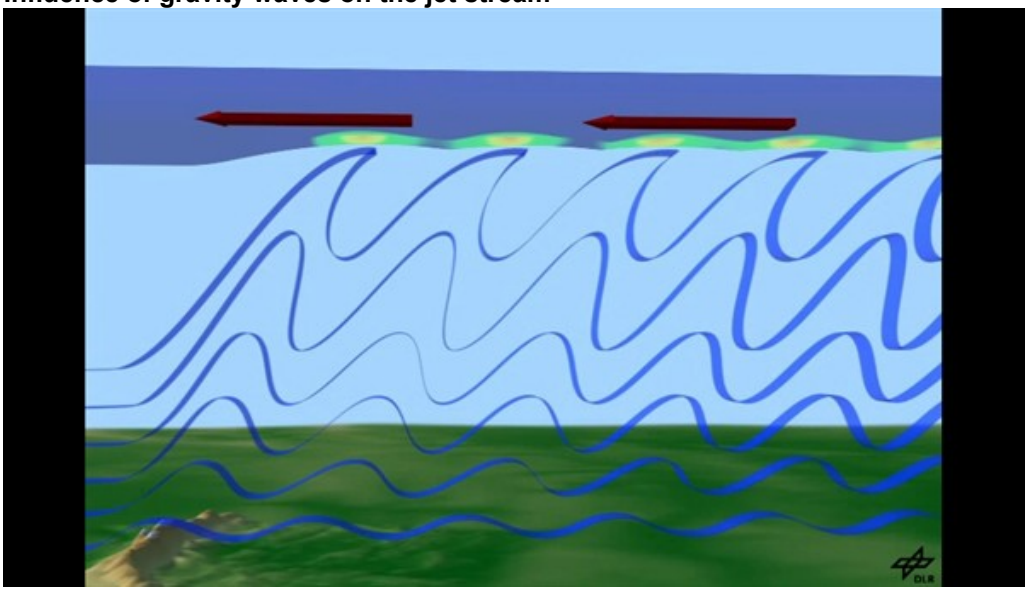
**BHEA radiosonde with battery and attachment cord**




The radiosonde is equipped with a GPS antenna and sensors to measure air temperature and humidity. The navigation data provides not only information about the position of the sonde, but also about the prevailing wind speed. The battery (next to the radiosonde and still in its packaging) is inserted into the sonde. The radiosonde is attached to a sounding balloon and sent on its measurement journey.

Credit: DLR (CC-BY 3.0).

**Influence of gravity waves on the jet stream**



Gravity waves are air parcels in the atmosphere that oscillate up and down. These waves expand horizontally and vertically until they encounter a major wind circulation system, which causes the gravity waves to collapse, thereby accelerating or slowing down the jet stream. The circulation system can also be redirected as a consequence. This is the effect that will be more precisely incorporated in the climate models.

Credit: DLR (CC-BY 3.0).

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