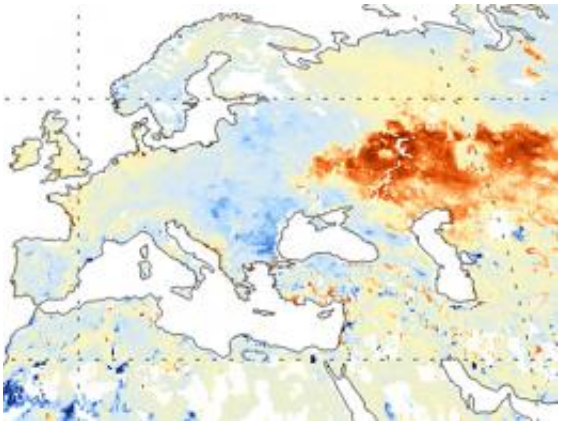
Soil moisture climate data record observed from space

June 19 2012, By Florian Aigner and Wolfgang Wagner



Dry areas and moist areas - a map created from satellite data

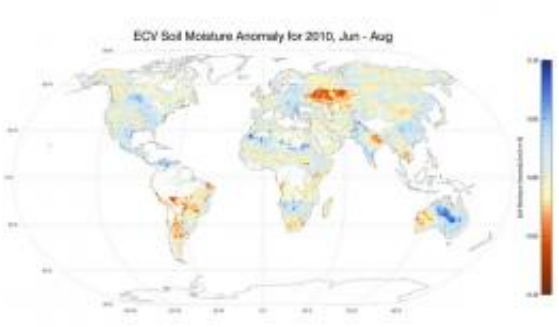
Soil moisture influences our climate. For the first time, long-term data for the whole world is now presented by ESA, the Vienna University of Technology and the Free University of Amsterdam.

The future of the world's climate is determined by various parameters, such as the density of clouds or the mass of the Antarctic ice sheet. One of these crucial climate parameters is soil moisture, which is hard to measure on a global scale. Now, the European Space Agency (ESA), in cooperation with the Vienna University of Technology (Institute of Photogrammetry and Remote Sensing) and the Free University of Amsterdam, is presenting a data set, containing global soil moisture data from 1978 to 2010. This was possible by extensive mathematical

analysis of satellite data.

Warmer Climate Changes Soil Moisture

Even though soil moisture makes up only about 0.001 % of the total water found on earth, it plays a crucial rule in the climate system. “The link between climate and soil moisture is still not well understood, because so far reliable long-term data has not been available”, says professor Wolfgang Wagner (Vienna University of Technology). One of the predicted consequences of global warming is that warming will lead to higher evaporation rates and hence soil drying in some regions. But drier soils themselves will heat up the air near the land surface. This positive feedback mechanism may thus act to increase the number of extreme heat waves similar to those experienced in Western Europe in 2003 and Russia in 2010. On the other hand, hot air can hold more water and lead to increased precipitation in some regions. “The effects of climate change vary from region to region”, says Wolfgang Werner, “this makes it all the more important to have reliable long-term data for the whole globe.”



Soil moisture anomaly, from June to august 2010.

Microwaves from Space

Soil moisture can be measured with satellites using microwave radiation. Unlike visible light, microwaves can penetrate clouds. Satellites can either measure the earths natural microwave radiation to calculate the local soil moisture (passive measurement) or the satellite sends out microwave pulses and measures how strongly the pulse is reflected by the surface (active measurement). Over the years, various satellites with different measurement methods have been used. “It is a great challenge to extract reliable soil moisture data from these very different datasets, spanning several decades”, says Wolfgang Wagner.

To address the current lack of long-term soil moisture data the European Space Agency (ESA) has been supporting the development of a global soil moisture data record derived by merging measurements acquired by a series of European and American satellites. ESA is now happy to announce that the release of the first soil moisture data record spanning the period 1978 to 2010. The soil moisture data record was generated by merging two soil moisture data sets, one derived from active microwave observations and the other from passive microwave observations. The active data set was generated by the Vienna University of Vienna (TU Wien) based on observations from the C-band scatterometers on board of ERS-1, ERS-2 and METOP-A; the passive data set was generated by the VU University Amsterdam in collaboration with NASA based on passive microwave observations.

Technological Challenges

The harmonization of these datasets aimed to take advantage of both microwave techniques, but still the challenges were significant. Amongst other issues, the potential influences of mission specifications, sensor degradation, drifts in calibration, and algorithmic changes had to be accounted for as accurately as possible. Also, it had to be guaranteed that

the soil moisture data retrieved from the different active and passive microwave instruments are physically consistent. As this is the first release of such a product, not all caveats and limitations of the data are yet fully understood. It will therefore require the active cooperation of the remote sensing and climate modeling communities to jointly validate the satellite and model data, and advance the science in both fields along the way.

Provided by Vienna University of Technology