Geophysical Research Abstracts
Vol. 12, EGU2010-10348, 2010
EGU General Assembly 2010

Improving spatial resolution of water vapor observed from infrared satellite platform by means of a spectral approach.

Montopoli Mario (1), Frank Marzano (2), and Mauro Pierdicca (2)

(1) Cetemps University of L'Aquila and DIEI, L'Aquila, Italy (mario.montopoli@univaq.it), (2) DIE, Sapienza University of Rome, Italy

The role of water vapor is central in the physics of atmospheric processes since it has many important effects on the weather and climate. On the other hand, the presence of water vapor poses some limitations in the use of space born measurements of earth surface. For example, high spatial resolution (i.e. of the order of meters) active microwave imaging systems, such as Synthetic Aperture Radars (SAR), often used to analyze tectonic motions or to improve the accuracy of digital terrain model, can be drastically affected by water vapor variability which induces an unwanted component on the received signal of the interferometric SAR system.

In this context, it appears crucial to be able to retrieve the Integrated Precipitable Water Vapour (IPWV) field at high spatial resolution for example for reducing its effects on the SAR backscattered signal. Nowadays, the estimation of IPWV maps from satellites can suffer of poor spatial resolution. This is quite evident when using satellite microwave radiometers which can have a resolution of the order of 50x50 km2 when embarked aboard a Low-Earth-Orbit (LEO) platform such as Special Sensor Microwave Imager (SSM/I) aboard DMSP platform, the Advanced Microwave Scanning Radiometer Enhanced (AMSR-E) aboard Aqua and Terra platforms, and the Advanced Microwave Sounding Unit A (AMSU-A) aboard NOAA and ENVISAT platforms. On the other hand, the use of infrared satellite radiometers such as the Medium Resolution Imaging Spectrometer Instrument (MERIS) aboard on ENVISAT and the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard Aqua platform, reaches resolutions of the order of 1x1 km2. However, infrared measurements are not always available since they are subjected to the sun illumination conditions.

This work proposes a statistical spectral approach to increase the spatial resolution (downscaling) of radiometers IPWV retrievals. The concept behind this approach is that the large-scale field can be considered as a boundary condition to small-scale field and, if the field spatial auto-correlation or spectral density is known, then the small-scale field can be reconstructed at least on the average. This approach has been already used for the rainfall field at ground in order to enhance the spatial resolution of weather forecast rainrate at "reliable" scales, which are of the order of tens kilometres, to hydrological scale which are of the order of kilometers or even less.

To set up the spectral downscaling algorithm here proposed a large set of measurements of IPWV from MERIS, MODIS, SAR and ground station GPS have been firstly used to characterize the IPWV in the spatial domain in terms of variograms. Secondly, the spectral downscaling has been tested applying it to a upscaled MERIS reference map and then downscaled to restore the original spatial resolution of the reference MERIS map before considered. Results reveal the ability of the spectral downscaling to reproduce quite well the second order characteristic of water vapor field at the small spatial scales as opposed to its lack ability in minimizing the estimation error between the reconstructed field at the desired resolution and the reference one at the same resolution.