

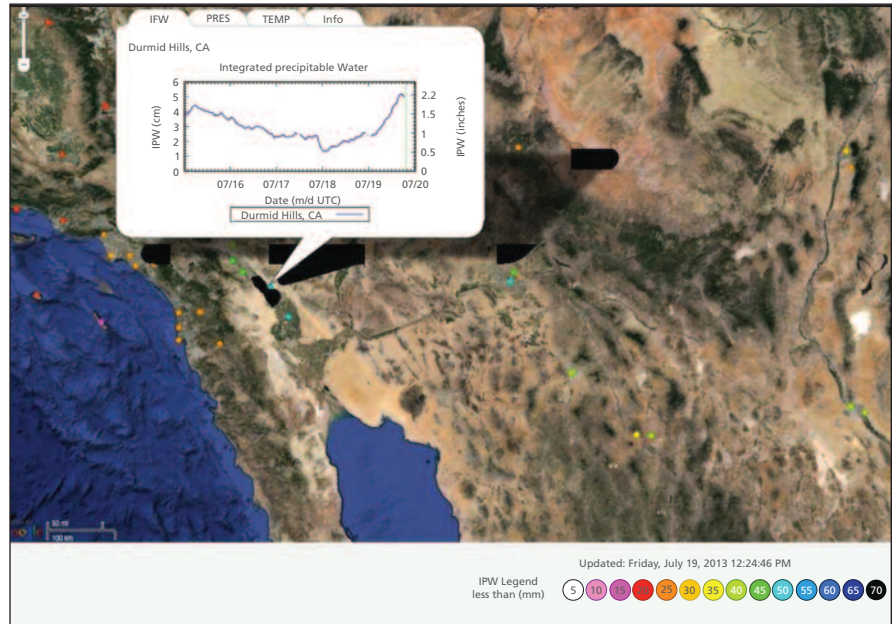
GPS Estimates of Integrated Precipitable Water Aid Weather Forecasters

This technique improves weather-forecasting operations.

NASA's Jet Propulsion Laboratory, Pasadena, California

Global Positioning System (GPS) meteorology provides enhanced density, low-latency (30-min resolution), integrated precipitable water (IPW) estimates to NOAA NWS (National Oceanic and Atmospheric Administration National Weather Service) Weather Forecast Offices (WFOs) to provide improved model and satellite data verification capability and more accurate forecasts of extreme weather such as flooding. An early activity of this project was to increase the number of stations contributing to the NOAA Earth System Research Laboratory (ESRL) GPS meteorology observing network in Southern California by about 27 stations. Following this, the Los Angeles/Oxnard and San Diego WFOs began using the enhanced GPS-based IPW measurements provided by ESRL in the 2012 and 2013 monsoon seasons. Forecasters found GPS IPW to be an effective tool in evaluating model performance, and in monitoring monsoon development between weather model runs for improved flood forecasting.

GPS stations are multi-purpose, and routine processing for position solutions also yields estimates of tropospheric zenith delays, which can be converted into mm-accuracy PWV (precipitable water vapor) using in situ pressure and temperature measurements, the basis for GPS meteorology. NOAA ESRL has im-



A screenshot from <http://gpsmet.noaa.gov> of ground GPS-based Integrated Water Vapor Information utilized by NOAA NWS San Diego Weather Forecasting Office during the 2013 monsoon season. The upward IWW trend supported satellite data and contributed to the issuance of a flood watch.

plemented this concept with a nationwide distribution of more than 300 “GPS-Met” stations providing IPW estimates at sub-hourly resolution currently used in operational weather models in the U.S.

This work was done by Angelyn W. Moore of Caltech; Seth I. Gutman and Kirk Holub of

NOAA Earth System Research Laboratory; Yehuda Bock of UC San Diego's Scripps Institution of Oceanography; and David Danielson, Jayme Lauer, and Ivory Small of NOAA National Weather Service. Further information is contained in a TSP (see page 1). NPO-48881

Integrating a Microwave Radiometer into Radar Hardware for Simultaneous Data Collection Between the Instruments

Electronics are shared between the instruments.

Goddard Space Flight Center, Greenbelt, Maryland

The conventional method for integrating a radiometer into radar hardware is to share the RF front end between the instruments, and to have separate IF receivers that take data at separate times. Alternatively, the radar and radiometer could share the antenna through the use of a diplexer, but have completely independent receivers. This novel method shares the radar's RF electronics and digital receiver with the radiometer, while allow-

ing for simultaneous operation of the radar and radiometer.

Radars and radiometers, while often having near-identical RF receivers, generally have substantially different IF and baseband receivers. Operation of the two instruments simultaneously is difficult, since airborne radars will pulse at a rate of hundreds of microseconds. Radiometer integration time is typically 10s or 100s of milliseconds. The bandwidth of radar may be 1 to 25 MHz, while a ra-

diometer will have an RF bandwidth of up to a GHz. As such, the conventional method of integrating radar and radiometer hardware is to share the high-frequency RF receiver, but to have separate IF subsystems and digitizers. To avoid corruption of the radiometer data, the radar is turned off during the radiometer dwell time.

This method utilizes a modern radar digital receiver to allow simultaneous operation of a radiometer and radar

with a shared RF front end and digital receiver. The radiometer signal is coupled out after the first down-conversion stage. From there, the radar transmit frequencies are heavily filtered, and the bands outside the transmit filter are amplified and passed to a detector diode. This diode produces a DC output proportional to the input power. For a conventional radiometer, this level would be digitized. By taking this DC output and mixing it with a system oscillator at 10 MHz, the signal can instead be digitized by a second channel on the radar digital receiver (which typically do not accept DC inputs), and can be down-converted to a DC level again digitally. This unintuitive step allows the digital receiver to

sample both the radiometer and radar data at a rapid, synchronized data rate (greater than 1 MHz bandwidth).

Once both signals are sampled by the same digital receiver, high-speed quality control can be performed on the radiometer data to allow it to take data simultaneously with the radar. The radiometer data can be blanked during radar transmit, or when the radar return is of a power level high enough to corrupt the radiometer data. Additionally, the receiver protection switches in the RF front end can double as radiometer calibration sources, the short (four-microsecond level) switching periods integrated over many seconds to estimate the radiometer offset.

The major benefit of this innovation is that there is minimal impact on the radar performance due to the integration of the radiometer, and the radiometer performance is similarly minimally affected by the radar. As the radar and radiometer are able to operate simultaneously, there is no extended period of integration time loss for the radiometer (maximizing sensitivity), and the radar is able to maintain its full number of pulses (increasing sensitivity and decreasing measurement uncertainty).

This work was done by Matthew McLinden and Jeffrey Piepmeier of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16490-1

Rapid Detection of Herpes Viruses for Clinical Applications

Lyndon B. Johnson Space Center, Houston, Texas

There are eight herpes viruses that infect humans, causing a wide range of diseases resulting in considerable morbidity and associated costs. Varicella zoster virus (VZV) is a human herpes virus that causes chickenpox in children and shingles in adults. Approximately 1,000,000 new cases of shingles occur each year; post-herpetic neuralgia (PHN) follows shingles in 100,000 to 200,000 people annually. PHN is characterized by debilitating, nearly unbearable pain for weeks, months, and even years. The onset of shingles is characterized by pain, followed by the zoster rash, leading

to blisters and severe pain. The problem is that in the early stages, shingles can be difficult to diagnose; chickenpox in adults can be equally difficult to diagnose. As a result, both diseases can be misdiagnosed (false positive/negative).

A molecular assay has been adapted for use in diagnosing VZV diseases. The polymerase chain reaction (PCR) assay is a non-invasive, rapid, sensitive, and highly specific method for VZV DNA detection. It provides unequivocal results and can effectively end misdiagnoses. This is an approximately two-hour assay that allows unequivocal diagnosis and

rapid antiviral drug intervention. It has been demonstrated that rapid intervention can prevent full development of the disease, resulting in reduced likelihood of PHN. The technology was extended to shingles patients and demonstrated that VZV is shed in saliva and blood of all shingles patients. The amount of VZV in saliva parallels the medical outcome.

This work was done by Duane Pierson of Johnson Space Center, and Satish Mehta of Enterprise Advisory Services, Inc. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-25009-1

High-Speed Data Recorder for Space, Geodesy, and Other High-Speed Recording Applications

Goddard Space Flight Center, Greenbelt, Maryland

A high-speed data recorder and replay equipment has been developed for reliable high-data-rate recording to disk media. It solves problems with slow or faulty disks, multiple disk insertions, high-altitude operation, reliable performance using COTS hardware, and long-term maintenance and upgrade path challenges.

The current generation data recorders used within the VLBI community are aging, special-purpose machines that are both slow (do not meet today's re-

quirements) and are very expensive to maintain and operate. Furthermore, they are not easily upgraded to take advantage of commercial technology development, and are not scalable to multiple 10s of Gbit/s data rates required by new applications.

The innovation provides a software-defined, high-speed data recorder that is scalable with technology advances in the commercial space. It maximally utilizes current technologies without being locked to a particular hardware plat-

form. The innovation also provides a cost-effective way of streaming large amounts of data from sensors to disk, enabling many applications to store raw sensor data and perform post and signal processing offline.

This recording system will be applicable to many applications needing real-world, high-speed data collection, including electronic warfare, software-defined radar, signal history storage of multispectral sensors, development of autonomous vehicles, and more.