# Using the SPoRT POES/GOES Hybrid in OCONUS Forecasting

Matt Smith[1], Kevin Fuell[1], Michael Lawson[2], James Nelson[2]

[1]University of Alabama in Huntsville
[2]NWS WFO, Anchorage, AK

The Short-term Prediction Research and Transition (SPoRT) center is located at NASA's Marshall Space Flight Center in Huntsville, Alabama. It has been around for about 10 years – beginning with unique NASA data flowing to the co-located National Weather Service (NWS) Weather Forecasting Office (WFO) in 2003. The first data used at the WFO were Lightning Mapping Array (LMA) data. The LMA is a North Alabama-based, NASA-operated network of 11 sensors used in the detection of total cloud lightning. The range of the LMA is roughly a 200 mile radius centered near Huntsville. SPoRT also provided the LMA data to a few nearby WFOs, Nashville, TN, Birmingham, AL, and Jackson, MS. Shortly thereafter, SPoRT began providing several channels of Moderate Resolution Imaging Sensor (MODIS) data – flown on two NASA satellites: Terra and Aqua. These data were retrieved from the Space Science and Engineering Center (SSEC) at the University of Wisconsin. In 2003, SPoRT provided various data products to nine WFO partners located in the NWS's Southern Region. SPoRT began with a paradigm centered on forecasting problems. I.e., (1) determine forecast problem, (2) offer product(s) to help improve the forecast problem - within the forecaster's Decision Support System (DSS), (3) train the forecasters, (4) assess the product (by surveying forecasters), and finally, (5) improve the product(s) as needed.

Beginning with the advice of SPoRT's Science Advisory Committee (around 2009) SPoRT began expanding to other NWS regions. As of 2014, SPoRT partners with more than 25 WFOs in all six regions, and provides data to five National Centers. Over the past several years, SPoRT's funding profile has changed to include some funding from NOAA.

In 2009, after SPoRT had been partnering with WFOs, providing MODIS data for over six years, it became apparent that many forecasters simply did not make good use of these high resolution data. It seemed the infrequency was a major distraction. Many forecasters were simply not used to working with polar-orbiting data sources. In 2010, as SPoRT became a partner in the GOES-R Proving Ground efforts, SPoRT decided to use the MODIS data as a proxy for the upcoming Advanced Baseline Imager (ABI) on GOES-R. The intent was to "sneak" the higher resolution MODIS data into the "consistent, high-frequency" GOES data that they were used to using. We started with 15-minute frequency GOES data over the CONUS, with its 4km IR and 1km VIS resolutions. When a MODIS swath arrived, we determined into which 15-minute 'slot' it belonged. Therefore, the time discrepancy between GOES and MODIS was never more than 7.5 minutes. The five products generated were: Visible; 11 µm IR (LW); 3.9 µm IR (SW); 6.7 µm IR (Water Vapor); and Fog (difference of 11 µm & 3.9 µm). We originally called it the *GOES/MODIS Hybrid*. It was a success with many forecasters. The product provided the context of a consistent animate-able sequence of images – as well as the occasional higher resolution information of the polar-orbiting instruments. One of the best features of the products was that there was no longer a need to hunt for MODIS data – wondering when it would arrive. When a forecaster views an animation of GOES data over their forecast domain – there may be, for example, 20 GOES images, with 3-4 of them containing MODIS and/or VIIRS data. Viewing the animation, the cloud and ground features appear "normal" (as they've been viewed for many years by NWS forecasters). Then, when one of the higher-resolution frames appears – the ground features and clouds become "clear". It's been said that it's like suddenly "putting on your glasses". Certainly, this product makes one yearn for the GOES-R ABI era. Technically, both MODIS and VIIRS have higher resolutions than the current GOES Imager and future GOES-R's ABI. This table compares the four instruments.

| Instrument | Visible Resolution (km) | Infrared Resolution |
|---|---|---|
| GOES-13/15 Imager | 1 | 4 |
| GOES-R/S ABI | 0.5 | 1 and 2 |
| MODIS | 0.25 | 0.5 and 1 |
| VIIRS | 0.375 | 0.75 |

In 2012, as SPoRT was a JPSS Proving Ground partner, we added high resolution data from the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument, onboard the Suomi National Polar-orbiting Partnership (S-NPP) platform. This provided wider swath coverage, as well as simply more GOES images containing higher resolution data. With the increasing popularity of Red-Green-Blue (RGB) imagery, SPoRT decided to include this additional information into some of the Hybrid products. The MODIS Air Mass RGB product was "inserted" into the GOES Water Vapor imagery. There is no VIIRS version of the Air Mass RGB since it has no water vapor channel. And the Nighttime Microphysics RGB product was "inserted" in the GOES Fog imagery.

During 2011 SPoRT began partnerships with the three WFOs in the Alaska Region. The Geographic Information Network of Alaska (GINA) at the University of Alaska Fairbanks (UAF) provided a great deal of support to the Alaska Region WFOs. SPoRT began working with GINA to access MODIS and VIIRS data from their direct broadcast receiving stations. In 2013 GINA offered the use of virtual machines (VM) on which to generate Alaska versions of SPoRT products. These VMs removed the need for large raw data transfers to/from Huntsville. In 2013 SPoRT began referring to the products as *Geo/Polar Hybrids*.

The Geo/Polar Hybrid products are very popular with forecasters – though they are clearly qualitative. Let me outline the basic pros and cons about the products.

| PROs | CONs |
|---|---|
| Higher resolution polar-orbiting instrument data | Viewing angles differ (parallax) |
| Context of 15-min. imagery retained (small time discontinuity) | Instrument calibrations differ |
| Context of large field-of-view retained | Geolocations sometimes differ |
| Convenient viewing of polar-orbiting instrument data | Redundant geostationary instrument data |
| | Still some time discontinuity |

At issue in this presentation is the use of the Geo/Polar Hybrid products at OCONUS latitudes – i.e., Alaska in this case. With the hybrids over the CONUS, the higher resolution of MODIS and VIIRS provides a useful situational awareness tool…while over Alaska the reduced resolution of GOES data provides an even greater contrast with MODIS and VIIRS. The resolutions shown in the table above are only “at nadir”, i.e., the platform’s station longitude at the equator. At latitudes above about 60 degrees, the effective resolution degrades dramatically, approaching uselessness above 70 degrees – and with increasing longitudinal distance from the satellite. Using GOES-West satellite data for forecasting in Anchorage, AK is comparable to using GOES-*West* data to forecast for Bogota, Colombia. The problem in Fairbanks is worse still. For these reasons the Geo/Polar Hybrid is more useful in Alaska than over the CONUS. Fortunately, another “PRO” for the Alaska version of the Hybrid is that there are many more overpasses since successive polar-orbital passes are closer together at high latitudes.

All of SPoRT’s efforts in the Geo/Polar Hybrid area have been developed within the NWS’s DSS called AWIPS. Over the past several years, the NWS has been developing the next generation DSS - AWIPS II. SPoRT has been at the forefront of non-NOAA software development for AWIPS II. Full implementation of AWIPS II at all 122 WFOs will signal the retirement of this product since it will be able to natively overlay MODIS and VIIRS data over GOES data without a special “product”. However, the full deployment may be over a year away. In the meantime, SPoRT will pursue additional polar-orbiting instruments to augment the Geo/Polar Hybrid. There are 4 AVHRR instruments flying aboard POES (NOAA-xx) satellites (and MetOp-A), as well as Chinese and Russian instruments that are being considered if data accessibility and latency are agreeable. For short-term forecasting purposes, a latency of over 50-60 minutes seriously reduces the usability to a forecaster.