P2.4 Applications of Lightning Data at the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin-Madison

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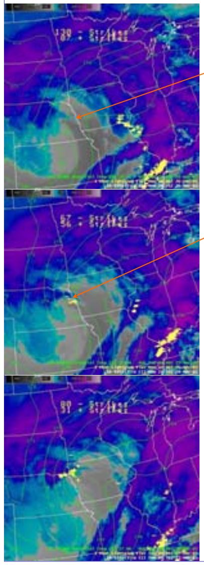
Introduction

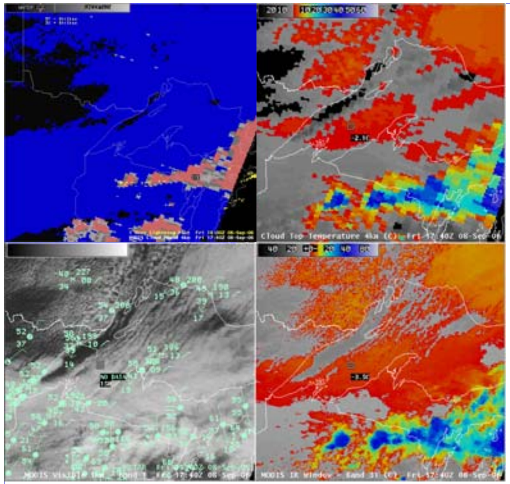
National Lightning Detection Network (NLDN) data have been delivered to the University of Wisconsin-Madison pursuant to an agreement with Vaisala, Inc. that began in late Spring 2006. These data are ingested into AWIPS workstations running on a Dell cluster, and are available for use in tandem with other AWIPS datasets (satellite, radar, model fields, etc).

Lightning data are used in case studies that are posted on the CIMSS Satellite Blog (**http://cimss.ssec.wisc.edu/goes/blog**). Lightning data complement satellite, radar, and surface data to provide an integrated view of the structure of significant atmospheric phenomena. For example, lightning plots associated with newsworthy events (such as the lightning-caused Oil Refinery Fire in Gloucester County, New Jersey, on 11 July 2007, not shown here) are overlain on color-enhanced infrared satellite imagery to relate storm structures and lightning to the fire site. In other examples, lightning data relate electrically active portions of strong convection to satellite features (such as "enhanced-V" or "warm wake" cloud-top signatures), or relate MODIS cloud phase classification to regions of lightning generation.

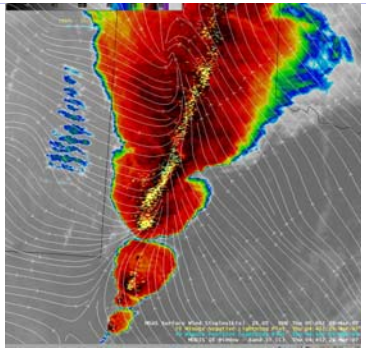
Some entries in the CIMSS Satellite Blog are cursory looks at interesting weather events. Other more in-depth entries serve as repositories for potential training cases to be used in the National Weather Service VISIT and SHyMet distance learning programs. Several of the blog entries have migrated into NWS teletraining modules. For example, the TROWAL in the Upper Midwest, October 2007 entry has been incorporated into the TROWAL identification teletraining. That particular teletraining also incorporates lightning data, which data are used to indicate the strength of a shortwave approaching a region of low-level warm air in the atmosphere.



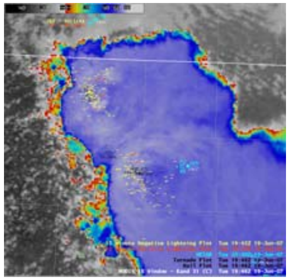
In this example from 2002, a small filament of cooler clouds tops, likely reflecting upper-level forcing, moves towards a region in which a TROWAL had been identified. Notice the increase in lightning activity as the line of cold cloud tops moves into the region of low-level warmth that characterizes the TROWAL. Lightning activity continues for several hours as the shortwave rotates up into southern Minnesota where the heaviest snows fell.



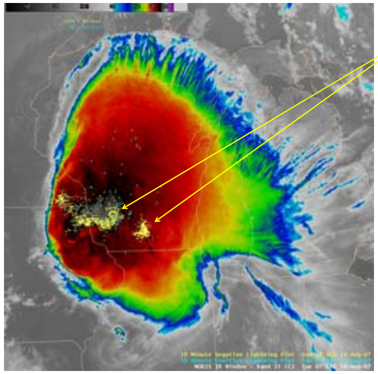
In this example of Lake-Effect showers from early September 2006, Lightning data (upper left) are overlain on top of MODIS cloud phase. These data, together with the brightness temperature and cloud top temperature (right column) underline the importance of ice crystals (graupel) for lightning generation. The data also underscore the intensity of the convection that developed downwind of the Lake. The visible image (bottom left) shows the lake effect clouds moving off of Lake Superior during the early-season cold intrusion.



In this example, lightning data are overlain on top of a color-enhanced MODIS image (Channel 31). The spatial correlation between the lightning, the coldest cloud tops and the MSAS surface winds is obvious. It is likely that the convergent line and coldest tops correlate well with the strongest updraft that will suspend the graupel needed for charge separation. This would be a useful example in a training on convective hazards, for example

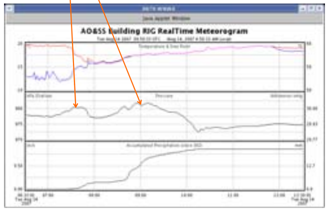


The example at left shows a severe thunderstorm complex over Kansas. Two enhanced-v structures are evident, and they are associated with plentiful positive (yellow) and negative (red) lightning strokes. Only the southernmost of these enhanced-v structures was associated with a tornado at the surface, even though the northern system had higher radar reflectivities (not shown); both convective systems produced hail with diameters up to 1.75". This case could be included in the VISIT Teletraining on the Enhanced-V structure, with the lightning data used to help describe the convective system more completely.



The example at left shows lightning associated with two convective cores within a southward-propagating Derecho over the upper Midwest in August, 2007. (The CIMSS Goes Blog includes an animation of lightning overlain on the satellite image so that the evolution of the cloud top and the propagation of the lightning can be compared). The core of the region of western lightning moved through western Wisconsin and was associated with wind damage reports, as shown below.

Furthermore, as the two lightning systems passed over Madison, Wisconsin, pressure perturbations associated with mesoscale processes in the convective cores were recorded as noted below.



Conclusion

Lightning data have been used to diagnose the intensity of convection in systems that are discussed at the CIMSS satellite blog. These lightning data are tapped to be included in training done for the National Weather Service through VISIT. Training includes modules that directly discuss lightning, and also modules that include lightning as one of the variables used to give a complete description of an ongoing event. All the modules discuss ways that lightning can be used to improve forecast accuracy and to improve understanding of atmospheric events.

Incorporation of these cases into VISIT teletraining modules will complement the rich lightning training material already extant that have been developed by VISIT colleagues at CIRA at Colorado State. These include modules that discuss the climatology and dynamics of lightning over the continental United States. Here are the links to those training modules.

http://rammb.cira.colostate.edu/visit/ltg_conus.html
http://rammb.cira.colostate.edu/visit/ltgmet1.html
http://rammb.cira.colostate.edu/visit/ltgmet2.html

Screenshots of the title pages for these lessons are below

For more information on the VISIT program:
http://rammb.cira.colostate.edu/visit/visithome.asp
The CIMSS GOES blog is at
http://cimss.ssec.wisc.edu/goes/blog