Satellite-based Nowcasting and Aviation Weather Applications for Convection, Turbulence, and Volcanic Ash

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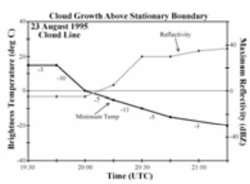
Project Description

A recent research emphasis has been placed on 0-6 hour satellite-based short-term forecasting to improve nowcasting for aviation hazards such as convection, turbulence, and volcanic ash. The Advanced Satellite Aviation-weather Products (ASAP) initiative was formed four years ago through NASA resources to provide satellite-derived meteorological applications/products and expertise to the United States Federal Aviation Administration (FAA) weather research community. The University of Wisconsin-Madison SSEC/CIMSS Satelllite-based Nowcasting and Aviation APplications (SNAAP) team in conjunction with the University of Alabama in Huntsville has been tasked to provide research, education, and transition to operations for satellite-based aviation hazard detection methodologies. This presentation will provide an overview of current satellite-based aviation application research and evolution to operations including recent efforts to port GOES imager applications to MSG SEVIRI and the future GOES-R Advanced Baseline Imager.

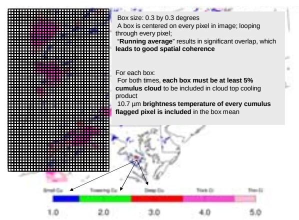
Convection

Cooling Rate / Convective Initiation

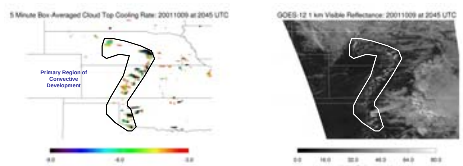


Rapid IR window cooling, coupled with T_B drop below 0° C can provide 30-45 mins lead time in nowcasting convective initiation (Roberts and Rutledge, *Wea. Forecasting* (2003))

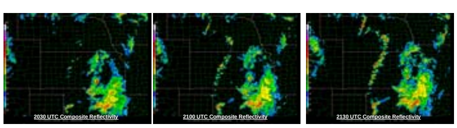
Cloud Top Cooling Rate Methodology



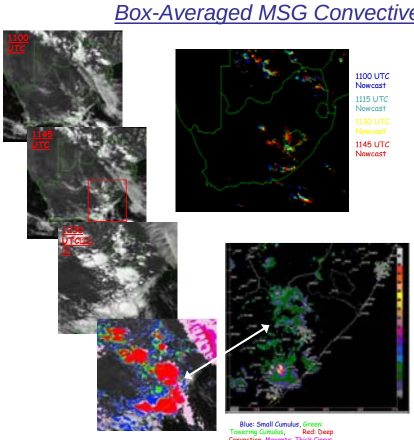
Box-Averaged GOES Imager Convective Cooling Rate Example



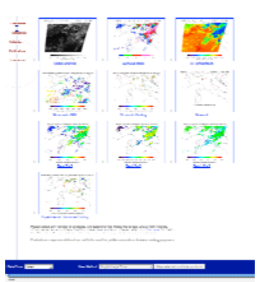
The use of 5 minute GOES-12 imagery provides a clearer depiction of individual rapidly growing clouds, without smoothing induced by cumulus movement



Box-Averaged MSG Convective Initiation Example

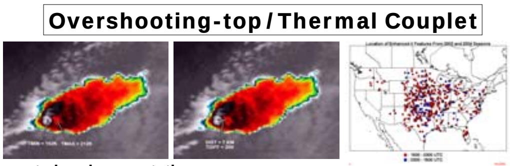


SEVIRI Quicklook Evaluation



* See König and Bedka CI poster and Mecikalski et al poster/oral presentations

Overshooting-top / Thermal Couplet



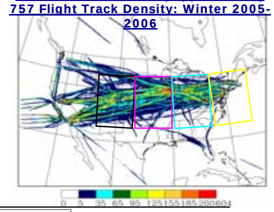
* See Brunner et al oral presentation

Turbulence

Aviation Eddy Dissipation Rate (EDR) Objective Reports

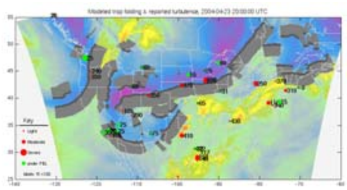
This EDR database, collected by United Airlines (UAL) Boeing 757 aircraft, represents an objective measure of the vertical accelerations induced by turbulent atmospheric phenomena. The objective nature and continuous reporting of turbulent + null EDR observations are essential to this effort, and provide a distinct advantage of the subjective and spatially disparate pilot reports (PIREPS) of turbulence.

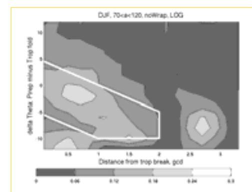
United Airlines EDR-Equipped Boeing 757 Flight Track Density: Winter 2005-2006



* See Bedka et al. CIT poster

Tropopause Folding

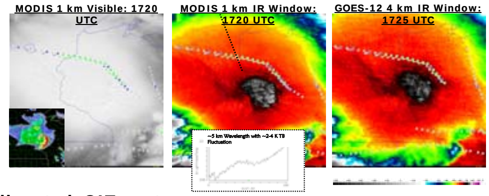




* See Wimmers and Feltz CAT poster

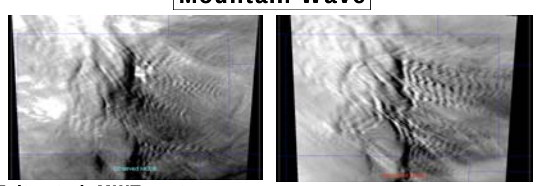
After applying the selection criteria, we measure a frequency of Light or greater ("LOG") turbulence of around 20%

Convectively Induced



* See Bedka et al. CIT poster

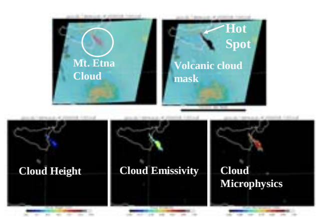
Mountain Wave



* See Feltz et al. MWT poster

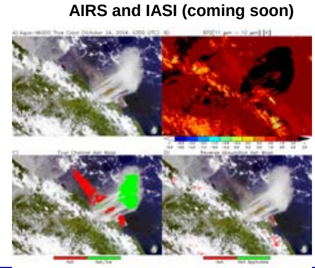
Volcanic Ash

- Automated volcanic aerosol detection
- Volcanic cloud height
- Volcanic cloud optical depth
- Volcanic cloud microphysical parameter (directly related to particle size for a given particle habit distribution)
- Volcanic ash path (mass/area) → coming soon
- SO_2 amount → coming soon



Platforms

- GOES (imager)
- SEVIRI
- MTSAT
- AVHRR
- MODIS
- AIRS and IASI (coming soon)



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