The ASAP Initiative: The Beginning

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4th OWPDT Science Meeting
15-16 July 2003
OUTLINE

1. ASAP Overview

2. ASAP Components:
   - Convection & Cloud Properties (J. Mecikalski Tuesday)
   - Winds (J. Mecikalski Tuesday)
   - Turbulence (D. Johnson Wednesday)
   - Volcanic Ash (D. Johnson Wednesday)

3. Logistics and Data Transfer
Convection Initiation Research at UW

1. Perform analysis on ~6 cases to assess the quality of existing techniques
   - Started with April 5-6, 2003 and May 4, 2003 due to presence of satellite derived wind data
   - Will analyze Sept. 8-9, 1999 and June 2, 2000 (NCAR cases) as soon as wind data becomes available

2. Developed collaboration with U. Nair (U. Alabama-Huntsville) for improved cloud mask/pattern recognition expertise

3. Use UW-CIMSS Visible/IR satellite winds to incorporate cloud motion into temporal differencing calculations
   - Eliminates cloud advection signal inherent to per pixel temporal differencing
   - Perform calculation only where cumulus mask detects cumulus clouds to save processing time

4. Enhanced CI web page (http://biscayne.ssec.wisc.edu/~johnm/CI_home/) to include radar composite/satellite wind data
   - New cumulus mask (UAH) will be likely online within August

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Examples of Cl Interest Fields: 1815 UTC

A. Cumulus Cloud Mask
B. 6.7-10.7 μm Difference
C. 3.9-10.7 μm Difference
D. 45 min 10.7 μm Difference
E. 13.3-10.7 μm Difference
Example of 10.7 μm Temporal Differencing Techniques

\[ u = U \cos(\theta) = 7.07 \text{ ms}^{-1} \quad \Delta \text{pixel}_x = (u \Delta t) / \Delta x \approx 2 \text{ pixels} \]

\[ v = V \sin(\theta) = 7.07 \text{ ms}^{-1} \quad \Delta \text{pixel}_y = (u \Delta t) / \Delta y \approx 2 \text{ pixels} \]
Case Study Segment 1:
May 4, 2003, 2030-2115 UTC

• Cumulus line evolving into tornadic supercells

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Cumulus Cloud Mask with Satellite Wind Vectors

- **Green (Red):** Mature (Immature) cumulus
- **Black (Blue):** Winds below (above) 500 mb
- Only 25% of wind vectors are shown
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10.7 µm Temporal Differencing
White areas = no winds nearby

Offset Vector Differencing
Satellite data valid at: 2115 UTC 4 May 2003
Temporal differencing of 10.7 µm band

Per Pixel Differencing
- Offset Vector technique performs better in isolating individual cell trends and eliminating advection signal

45 min Difference

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Cumulus Cloud Top Cooling

Satellite data valid at: 2115 UTC 4 May 2003
Temporal differencing of 10.7 μm band

- Temporal trends using offset vector technique
- Trends calculated only where convective cloud mask detects cumulus
- Noise (e.g. cirrus, altocumulus) reduction should occur upon implementation of improved cumulus mask
Cumulus Cloud Top Cooling
(“Vigorous Growth” > - 8 K/15 mins)

Satellite data valid at: 2115 UTC  4 May  2003
Temporal differencing of 10.7 μm band

Temperature Differences (K):
-80.0  -64.2  -48.4  -32.6  -16.8  -1.0

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Example of 45 min “Vigorous Growth” (< -24 K) Trend

- Radar animation ending at 2115 UTC

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Application of Existing Techniques to CI problem

Questions addressed:

Is a cloud feature a cumulus?

IF YES:

1. Is the cloud top below freezing?
2. Has the cloud top $T_b$ transition from above to below freezing temperatures in the last 30 mins?
3. Does the cumulus meet band differencing technique criteria (based on non-objective comparison of band differencing values with radar imagery (values before cumulus begin to precipitate)?
4. Have the cloud tops been consistently cooling over the last 45 mins?

FUTURE WORK

5. Temporal trends of band differencing techniques?
6. Incorporation of Sounder DPI?
7. Incorporation of selected numerical model (RUC) fields (moisture convergence, stability, etc…)

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Case Study Segment 2:
May 4, 2003, 1730-1815 UTC

• Pre-CI conditions in E. KS
Preliminary CI Assessment (Combining Cumulus Mask, Band Differencing and Temporal Trends)

Satellite data valid at: 1815 UTC  4 May  2003

1815 UTC

1845 UTC

Red, Orange: Probable Locations for CI
Purple: Cirrus Clouds
Cloud Property Information

Various cloud property data sets are available at CIMSS (several supported by NOAA) for use in ASAP in a variety of ways. Plans are to explore their use in the NCAR PDTs, once there use can be determined.

Three main sources for cloud property information:

- **MODIS**
  - available at CIMSS through Direct Broadcast
  - CIMSS Experimental products

- **GOES**
  - available at CIMSS’s servers (SSEC/NOAA)

- **AVHRR**
  - available at CIMSS’s servers
  - Experimental Products (NOAA)
Cloud Property Information

**MODIS Products** (Vis & IR data; 1 km resolution):

1. **MOD6** (Cloud phase, particle effective radius, optical thickness, cloud top temperature, cloud effective emissivity, cloud fraction)

2. **MOD35** (Cloud Mask- 0/1)

3. **MODIS Multilevel Clouds** (experimental and new)

Data/Products are available in HDF format via ftp at CIMSS
Cloud Property Information

**GOES Products** (Vis & IR data; 4 & 10 km resolutions, hemispheric coverage, SFOV):

1. **GOES-9, -10, -12 Sounder Products** (CAPE, LI, PW, effective cloud amount, cloud top pressure, cloud top temperature)

2. **GOES Imager** (cloud top pressure, new)

3. **Other Experimental Efforts** (e.g., Fog, O₃, Fires, etc.)

Data/Products are available in AREA and ASCII file format via ftp at CIMSS

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Cloud Property Information

**AVHRR Products** (multispectral; 1 km resolution):

1. **NOAA AVHRR Products** (cloud mask, cloud phase, cloud top pressure, cloud top height, particle effective radius, optical thickness)

All are new from CLAVR-x program—to be operational in August 2003, processing at NOAA and possibly CIMSS in future. AREA format for now. Hybrid type scheme that incorporates sounding information.
Cloud Property Information

Key Points:

CIMSS has been working closely with NESDIS, and on its own, for many years and has developed a host of satellite-based data/Information that can be made available to the PDTs.

Issues of data quality, area coverage and formats need to be discussed and determined as part of ASAP.
Validation of GOES derived Cloud Top Heights with DOE ARM Radar/LIDAR product

GOES $3 \times 3$ FOV and processed MPL/MMCR cloud top comparisons. Regression line—solid black line while the dashed line is a 1:1 reference. J. Hawkinson, UW MS 2003
Logistics & Data Transfer

1. Collection of data in one place (e.g., anonymous ftp server, dedicated computer facilities).

2. Identification of all useful NOAA/CIMSS satellite products.

3. AREA format versus Terascan. ASCII and HDF formats.

4. Issues of validation (PTOST, ATOST, ongoing and past validation research).