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SUMMARY OF SIGNIFICANT SATELLITE SIGNATURES INVOLVING THUNDERSTORMS

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Severe weather warnings over the continental U.S. have traditionally been mainly based on radar data and spotter information. Very little input to field office forecasts has resulted from satellite imagery, because of the relatively late receipt of the data and lack of looping capability. But with the addition of SWIS (Satellite Weather Information System) to weather offices across the United States, real-time "nowcasting" of convective activity is now possible using satellite imagery.

Satellite data contains a wealth of information! A detailed look by the trained forecaster can yield a three-dimensional picture from a "birds-eye" view of the mesoscale environment. Characteristics of individual cells can be identified, determining strength, stage of development, dissipation, and much more. In addition, features of the convective scale environment can be identified, defining areas for possible later thunderstorm formation, dissipation, or intensification. Satellite imagery can "fill in the gaps" left behind by conventional surface, upper air, and even radar data. It is an extremely powerful tool if used by trained field forecasters.

The goal of this paper is to provide field personnel a short, complete list of the most significant characteristics of convection visible in satellite imagery. The list, plus a brief description of each feature, will alert forecasters of what to look for in a satellite picture, and what each signature means. This short technical attachment is the nucleus of a much larger, more comprehensive slide training program developed at the Louisville WSFO. Information included has been compiled from numerous reference articles and case studies. For brevity, examples have not been included, though they are available.

Significant Signature List

	Feature	Importance of Feature
1.	Hardness (well defined or sharp upwind anvil edge with tight IR temperature gradient).	More Severe (Hedges, 1980).
2.	Overshooting top (defines location of strong high speed updraft within cell) (updraft penetrating cirrus canopy).	More severe. Better heavy rainfall potential (Scofield, 1984).

3.	Enhanced-V signature (severe weather forms 5-25 km south or southeast of the coldest top at about 1/2 hour later) (McCann, 1981).	Severe weather producing storm.
4.	Doughnut (variation of the enhanced-V) (rapidly growing cell in weak upper wind flow). NOTE: New cells are usually more severe than old ones (severity potential decreases with age).	More severe.
5.	Collapsing top (possible updraft collapse) (Fujita, 1978).	More severe. Possible tornadic development.
6.	Pimpled and pitted cirrus canopy (textured anvil top, presence of numerous strong updrafts within the thunderstorm complex).	More severe. Possible heavy rain (Scofield, 1984).
7.	Cirrus canopies on top of each other.	More severe.
8.	Striations in the cirrus canopy (ripples or waves in the cirrus top).	Storms beginning to weaken.
9.	Tops becoming fuzzy or less defined.	Dissipating stage of storm.
10.	Flanking line (towering cumulus building into the middle of a parent storm) (called a "tail" on a cell).	More severe. Indication of possible supercell formation.
	NOTE: Tail in middle of cell.	Usually more severe than a tail on the left side.
11.	Cumulus feeder lines (line of cumulus feeding into storm representing low level inflow) (flanking line more severe, possibly a supercell).	More severe.
12.	Broken line of storms	More severe than a solid line, because of a smaller chance that the low level moisture will become cut off.
13.	Southern end of a solid line of storms.	Most severe region of the line because it is the strongest area of low level inflow. Best area for tornadic generation.

14. Southern cell usually more severe than cells north of it.	Reason is that the southern cell may cut off the fuel source of the northern one.
15. Tail on left side of a cell.	Strong development but not necessarily a signature of a supercell (usually caused by frontal zone convergence) (not as strong as middle of the cell tail).
16. Bubble squall line or thunderstorm cluster.	Curved forward edge of anvil and tight IR temperature gradient on forward edge indicate strong winds with storm passage (Hedges, 1980).
17. A rapid cloud top warming area in a thunderstorm cluster.	Possibly downburst development (Fujita, 1978; Ellrod, 1985).
18. Low level boundaries.	Extremely important in defining areas of possible new thunderstorm development.
19. Intersections	All intersections: between cells, cells and lines, and between lines, are favored areas of strong convective development, possible severe weather, and <u>heavy rain</u>. Intersections with convective cloud lines ahead of a boundary may enhance convection also.
20. Intersections between two boundaries.	Favored area of severe weather (Purdom, 1979).
21. Arc clouds.	Outflow boundary or gust front from a thunderstorm. Watch for intersection areas of the gust front and other boundaries or cells (favored area for severe weather).

22.	Low level moisture axes and pockets (seen in the low level cumulus field).	Deeper layer of moist, unstable airmass.
23.	Low level wind flow and convergent zones (also seen in cumulus field).	Defines position of old meso-boundaries and frontal systems.
24.	Upper level short waves, cirrus streaks, jet stream cirrus, etc.	All aid in defining synoptic scale features such as upper level wind flow, diffluent zones, short wave positions, etc. (Miller and McGinley, 1978).

References

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