Overview of CW/HIW observational data sources characteristics

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Contents

Introduction

Every weather has its impact!

1. Inconvenience of carrying an umbrella,
2. Higher power bills,
3. The dispersion of atmospheric pollutants,

   ...

n. The destruction caused by a tornado.

To someone affected, any of these may seem “significant” at that moment.

Some impacts are clearly more significant than others.

Four general categories of impacts:

1. Low-impact – minor inconvenience, small and local economic losses, etc.
2. Moderate-impact – minor damage, some social disruption, etc.
3. **High-impact – damage, risks to health, broad economic impact, etc.**
4. **Extreme-impact – dramatic losses, deaths, injuries, major social disruption, etc.**

Challenging / High Impact Weather

Since every weather has its impact…

… each weather element can be treated as an impact source. It's just a matter of scale.

1. ”regular” elements – temperature, precipitation, windspeed…

2. ”specific elements” – visibility limitations, thunderstorms, tornadoes, …

Observational data for each element can easily be obtained from a variety of sources.

Observational Data Sources

1. Data from SYNOP stations, climatological stations, rain gauges, telemetry stations
   - temperature, precipitation, visibility range/limitations, windspeed, occurrence of fog/haze
2. Lightning Detection Networks*
   - thunderstorms, lightnings
3. Radar data, Doppler radar data
   - precipitation intensity and type, windspeed, lightning
4. Satellite data
   - occurrence of fog/haze, detection of convective storms (direct measurement of moisture and instability**), also *via* convective indices and CAPE

* PERUN, SAFIR/FLITS, LINET,

**infrared (IR) 10.8 µm and water vapor (WV) 6.2 µm channels

Intercomparison of diagnostic methods for thunderstorm activity.

- Lightning Detection Networks
  - Lightning detectors indicate electrical activity
  - Triangulation can estimate the exact* location of occurrence
- Radar data, Doppler radar data
  - weather radar indicates precipitation

Both phenomena are associated with thunderstorms and can help indicate storm strength

Generally: weather radar will show a **developing storm before a lightning detector does.**

But: weather radar also suffers from a masking effect by attenuation, where precipitation close to the radar can hide precipitation farther away.

Lightning detectors do not suffer from a masking effect and provide confirmation when a shower cloud has evolved into a thunderstorm.

Lightning may be also located outside the precipitation recorded by radar.

Large airliners are more likely to use weather radar than lightning detectors, since weather radar can detect smaller storms that also cause turbulence. Modern avionics for additional safety include lightning detection as well. For smaller aircraft, especially in general aviation (where the aircraft nose is not big enough to install a radome) lightning detectors can find and display IC and CG strikes.

*almost

Intercomparison of diagnostic methods for thunderstorm activity.

Digital radar systems now offer thunderstorm tracking surveillance. This provides users with the ability to acquire detailed information of each storm cloud being tracked.

Thunderstorms are first identified by matching precipitation raw data received from the radar pulse to some sort of template preprogrammed into the system.

In order for a thunderstorm to be identified, it has to meet strict definitions of intensity and shape that distinguish it from any non-convective cloud.

Usually, it must show signs of organization in the horizontal and continuity in the vertical: a core or a more intense center to be identified and tracked by digital radar trackers.

Intercomparison of diagnostic methods for thunderstorm activity.

- Satellite data detection of convective storms
  - direct measurement of moisture and instability,
    - Intensity = IR + ((IR-NWP)-(WV-IR)) *)

    with IR, NWP, WV being temperature obtained from different channels (**NWP – GFS – seems to be needed**!!!)
  - convective indices – good forecasting tools IF ONLY forecasters understand why values are approaching critical levels
    - Showalter Index – extreme instabilities for SI less than -6
    - Total Totals Index – severe storms with TTI greater than 50
    - K Index – high convective potential for K greater than 40
    - SWEAT Index – severe phenomena possible for SWEAT greater than 300
    - Lifted Index – extreme instabilities for LI less than -6
    - CAPE – extreme values of 2500 and more

*) da Silva et al., 2016. A method for convective storm detection using satellite data. Atmósfera 29 (4), 343-358

Conclusions

1. Basically, one might want to consider using observational data sources simultaneosly.

2. The usefulness of data strongly depends on the particular case. In the stormy season, all methods can be equally useful, as well as their combination.

3. For individual cases of thunderstorms, LDN seems to be the best to determine their intensity and location.

4. Supplementing LDN results with radar data would give a full picture of the situation.