FROM: NWCG Fire Weather Subcommittee
TO: NWCG Fire Environment Committee
DATE: October 30, 2023
SUBJECT: Recommendation to Cease Using "Lightning Activity Level" in Wildland Fire Forecasts

Overview

The Lightning Activity Level (LAL) is a tool that was originally developed to characterize lightning risk for use as an input into the National Fire Danger Rating System (NFDRS). The LAL has a range of values from 1 through 6: a value of 1 represents no lightning, values from 2 through 5 represent an increasing coverage of wet thunderstorms and corresponding increases in the frequency of lightning strikes, while 6 represents rare dry lightning events with a lightning frequency similar to a LAL of 3 (Figure 1). As the NFDRS is a numerical model, it required quantitative values as inputs and the LAL was designed to fit this need.

Brief History of the LAL

The LAL was developed from a 3-year study of thunderstorms in the area around Missoula, MT during the late 1960s. Thunderstorms were observed, lightning data were collected, and correlations were made between differing thunderstorm characteristics (i.e. radar echo coverage, cloud characteristics, rainfall extent) and the lightning strike frequency. The relation between lightning strike frequency and thunderstorm coverage was documented and is given here in Figure 1.

The NFDRS used the number of expected lightning strikes, as approximated by the LAL, along with a local lightning scaling factor to calculate lightning occurrence risk. The local lightning scaling factor accounted for different thunderstorm coverage-lightning strike relationships and susceptibility of local fuels to lightning ignition across varying geographic areas. The authors of the NFDRS envisioned that each National Forest unit would empirically derive their own local lightning scaling factor although in practice this never occurred. As originally formulated, the NFDRS would then incorporate both the LAL and the local lightning scaling factor to compute lightning risk and then the overall fire danger for a given area.

LAL Today and Forecasts for LAL

Today's formulation (and the formulation of the past ~20 years) of the NFDRS does not include a lightning risk factor and therefore it does not rely on the LAL to compute a fire danger rating. The LAL remains an input but it is not included in any of the calculations.

The National Weather Service (NWS) was originally tasked, and continues to be tasked, with producing LAL forecasts for the NFDRS even though the LAL is not used in the system. The forecast LAL is derived from thunderstorm coverage forecast, as shown in Table 1. The forecast process for LAL does not incorporate any direct information on lightning strike frequency.

In any type of NWS fire weather forecast (zone, spot, or incident), the forecast includes a "sky/weather" section and this section is meant to provide clear text on sky cover and thunderstorm coverage probabilities. As the latter directly dictates the LAL (see Table 1), listing both within a forecast is unnecessary and repetitious.

Recommendations

The Fire Weather Subcommittee recommends eliminating the LAL from all fire weather forecasts and fire weather training/reference materials. In the next NWCG Incident Response Pocket Guide update (proposed January 2025) the FWSC recommends that all references to the LAL be eliminated, and we specifically recommend the removal of the LAL table on page 51 (January 2022 edition). Note: we are

also recommending removal of the Haines Index (HI) table from page 51. The replacement for the LAL will be the thunderstorm coverage clear text included in the sky/weather section of the fire weather forecast. Graphical forecasts of LAL can be replaced by similar graphical forecasts for thunderstorm coverage which are already being produced. It is anticipated that eliminating the LAL from fire weather forecasts would increase clarity and transparency within the forecast process.

Justification for these recommendations, in descending order of importance, are:

1. The LAL is a direct duplication of the forecast for thunderstorm coverage.
2. The LAL thunderstorm coverage-lightning strike relationships (as seen in Figure 1) were developed specifically for the area surrounding Missoula, MT and have not been validated for other regions.
3. It is easy to misinterpret an undefined numeric value such as the LAL on a forecast.
4. Training on the LAL would not be required for firefighters and LAL-related materials would be eliminated.

It should be noted that recent research indicates that new numerical weather prediction tools have the ability to produce skillful lightning flash density forecasts but operational use of these tools is not currently widespread. Going forward it may prove fruitful to pursue these types of lightning forecasts. This type of product, however, would represent a fundamental shift away from the original intent of the LAL.

Lightning Activity Level (LAL)

Level	LAL Indicators
LAL 1	• No thunderstorms
LAL 2	• Isolated thunderstorms. • Light rain occasionally reaches the ground. • Lightning very infrequent. • 1-5 strikes in 5 minutes.
LAL 3	• Widely scattered thunderstorms. • Light to moderate rain will reach the ground. • Lightning is infrequent. • 6-10 strikes in 5 minutes.
LAL 4	• Scattered thunderstorms. • Moderate rain is commonly produced. • Lightning is frequent. • 11-15 strikes in 5 minutes.
LAL 5	• Numerous thunderstorms. • Rainfall is moderate to heavy. • Lightning is frequent and intense. • More than 15 strikes in 5 minutes.
LAL 6	• Widely scattered dry thunderstorms. • No rain reaches the ground. • Lightning is infrequent. • May constitute the issuance of a Red Flag Warning.

What the LAL chart conveys and if/where similar information can be found on the fire weather forecast:

- First bullet gives thunderstorm coverage in clear text. This can be found in the Sky/weather section the forecast.
- Second bullet lists rain amount. This can also be inferred from the Sky/weather section of the forecast.
- Third bullet lists lightning frequency/intensity. Frequency of lightning cannot be accurately forecast but can be inferred from overall thunderstorm coverage as found in the Sky/weather section of the forecast.
- Fourth bullet lists how many strikes are seen in 5 minutes for the given thunderstorm coverage. This reflects the observational origins of a location-specific LAL and may not be valid everywhere.
- Dry lightning may be part of the reasoning for a Red Flag Warning and will be explicitly stated (if expected) in the Sky/weather section of the forecast.

Figure 1. The Lightning Activity Level (LAL) as given in the Incident Response Pocket Guide, January 2022 version, on the left and where to find similar information within the fire weather forecast on the right.

Table 1: NWS thunderstorm coverage forecast and associated LAL values

Areal Coverage/Qualifying Term and Probability	**Associated LAL Value**
Isolated or Slight Chance (15-24%)	2
Scattered or Chance (25-54%)	3
Numerous or Likely (55-74%)	4
Widespread or Categorical (75-100%)	5
Dry Thunderstorms (special wildcard)	6