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Development of a lightning activity nowcasting tool

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Electrical phenomena inside thunderstorm clouds are a significant threat to numerous activities. Summertime convective activity is usually associated to local thermal instability, which is hard to predict using numerical weather prediction models. Despite their relatively small areal extend, these thunderstorms can be violent, resulting to infrastructure damage and loss of life. In the frame of TALOS project the National Observatory of Athens has developed a lightning activity nowcasting tool. This tool uses as sole inputs: (i) real time infrared Meteosat Second Generation (MSG) imagery and (ii) real time flashes provided by the VLF lightning detection system ZEUS, which is operated by the National Observatory of Athens.

The MSG SEVIRI 10.8 and 6.2μm channels data are utilized to produce 3 Interest Fields (IFs). These fields are the TB10.8 brightness temperature (indicative of the cloud top glaciation), the TB6.2-TB10.8 difference (indicative of the cloud depth) and the TB10.8 15 minute trend, which will be referenced as "TB10.8trend" (indicative of the cloud growth rate). The latter is defined as the difference between two successive 15 minutes images of the TB10.8. When a predefined threshold value is surpassed, the delimited area is considered to be favorable for lightning activity. A statistical procedure is employed to identify the optimum threshold values for the three IFs, based on the performance of each one. The assessment of their efficiency showed that these three IFs can be used independently as predictors of lightning activity. However, in an effort to improve the tool's efficiency a combined estimation is performed.

When all three IFs agree that lightning activity is expected over an area, then a Warning Level 3 (WL3) is issued. When 2 or 1 IFs indicate upcoming activity then a WL2 or WL1 is issued. The assessment of the efficiency of the combined IF tool showed that the combined estimation is more skillful than the individual IFs estimations. In a final attempt to improve the estimation, the real time flashes data are utilized. The absence of lightning inside a convective cloud can be considered as a negative factor regarding the possibility of upcoming activity. To quantify that notion, when no flashes are recorded over an area during the previous 15 minutes, the Warning Level is reduced by one level.

Overall, the developed tool can predict the lightning activity for the following hour with a probability of detection just over 80%, while the false alarms are just over 40%.