Improvement of hail diagnostic by development of a logistic hail model

**Method**

**Logistic Hail Model (LHM):**

\[ P_{\text{Hail}} = \frac{1}{1 + e^{-(\beta_0 + \beta_1 \cdot \text{SLI} + \beta_2 \cdot \text{T}_{\text{night}} + \beta_3 \cdot \text{T}_{\text{day}} + \beta_4 \cdot \text{OWT})}} \]

considering:
- Surface-based Lifted Index at 12 UTC (SLI)
- Minimum near-surface temperature in the morning (T\(_{\text{night}}\))
- Near-surface temperature at 12 UTC (T\(_{\text{day}}\))
- Hail-related and hail-unrelated weather types (OWT)

**Validation of LHM:**
- Good agreement with insured losses and hail signals derived from radar data (Puskeiler, 2013).

**Potential Hail Index (PHI):** [unit of PHI is the count of days with hail]

**What is the average of PHI in Germany?**
- North-south gradient in the hail probability
- Largest number of potential hail days occurring in the South.

**What is climatology of PHI in Europe?**
- Results of a reduced logistic hail model confirm several hail relevant regions known from literature.
- PHI shows high annual variability and with a periodicity around 35 – 40 years.

**Conclusions**
- Improvement of hail diagnostic by development of a logistic hail model and development of a new index: Potential Hail Index (PHI).
- Climatology of PHI shows a markedly north-to-south gradient with the highest hail potential occurring in Southern Germany.
- Increasing hail potential in the future, but only in the northwest and south of Germany statistically significant.
- A modified version of the logistic hail model identifies well-known hail regions in Europe.