SRNWP–EPS II project

Mario Papa[1]

SUPERVISORS:

Francesca Marcucci[2], Lucio Torrisi[2],Chiara Marsigli[3]

1: Eumetnet/Geo–k
2: COMET–Italian Air Force Operational Center for Meteorology
3: Arpae Emilia-Romagna

Aeronautica Militare

Fog forecasting tool *(fortran code)*

- Input:

  standard GRIB1/GRIB2 fcst from different models (defined by configuration namelist)

- Output:

  horizontal visibility [m] at surface computed with different algorithms

  \+ precipitation reduction (optional)

- Methods

  - Boudala et al., 2012 (minimum set of input parameters ... only surface fields T,Td,Ps,UV)
  - LWC (surface fields + T,Q,P,UV fields at lowest model level + qi,qc,qr,qs,qg)
  - Zhou, 2011 (surface fields + T,Q,P,UV vertical information at least in the first 500 m)
  - UPS approach (surface fields + T,Q,P,UV vertical information at least in the first 1200 m + 0-24 hours fcst of TD2m and T2m)
  - combined methods + correction for visibility reduction by precipitation

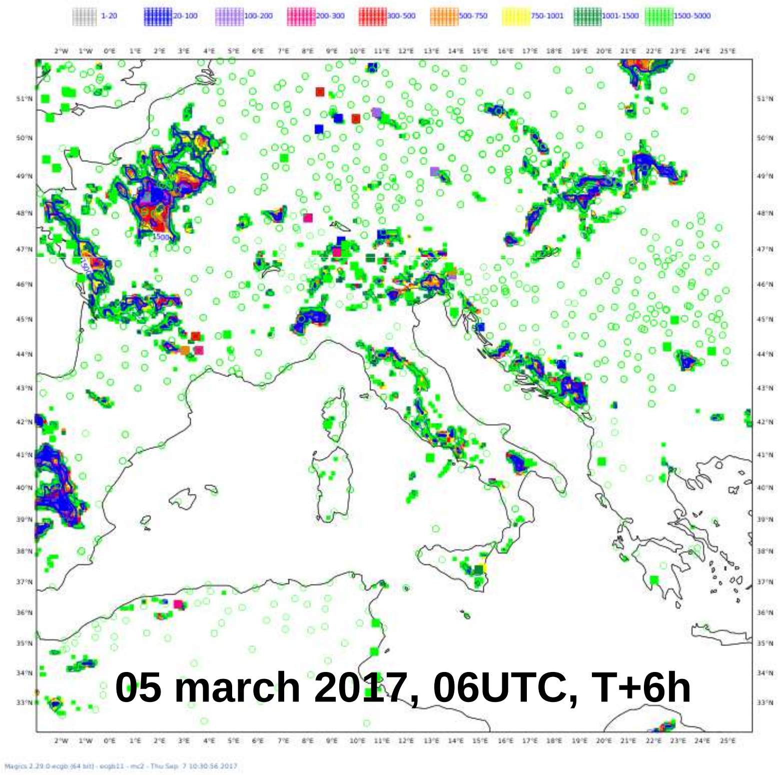
\# input parameters

Boudala et al., 2012

$$x_{vis} = -\frac{\log(0.02)}{\beta}$$

$$\beta = \exp(-5.605 + 0.0114\, RH\, \varphi)$$ extinction coefficient

$$\varphi = \ln\left[\left|\frac{1}{\ln\left(min\left(T_d/T\right), 0.9998\right)}\right|\right]$$



✓ *The extinction coefficient becomes very sensitive to changes in RH when the RH exceeds 95%; an accurate prediction of is very crucial for such parameterization.*

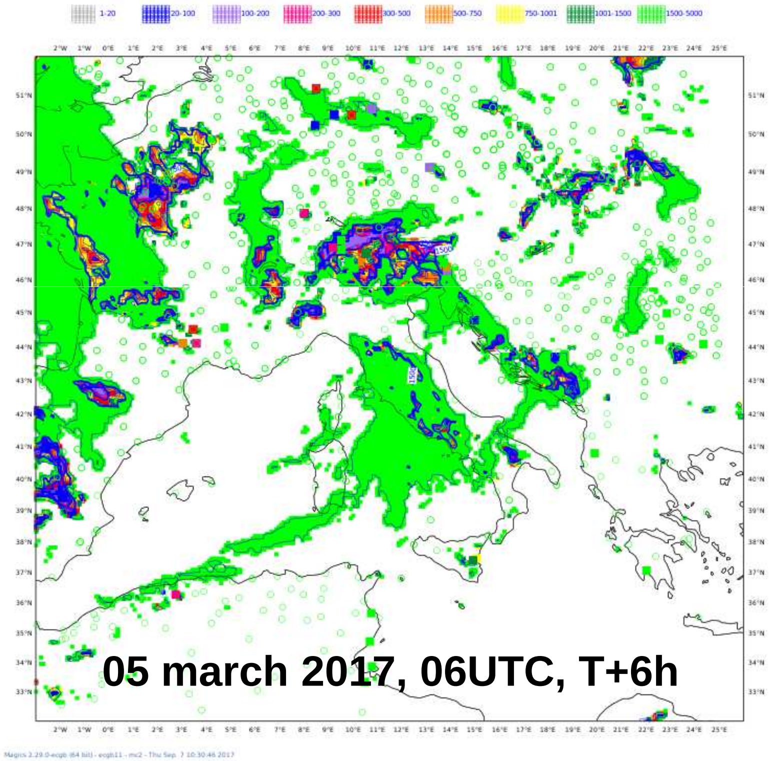
✓ *The code provides fog forecasts only in the case with RH>=95% and with total precipitation smaller than 0.5 mm/h . A check of these conditions is performed in the code, when field is not given, the code controls only the condition on RH, but in this case some errors arise , i.e. an overestimation of visibility in the case with high values of total precipitation.*

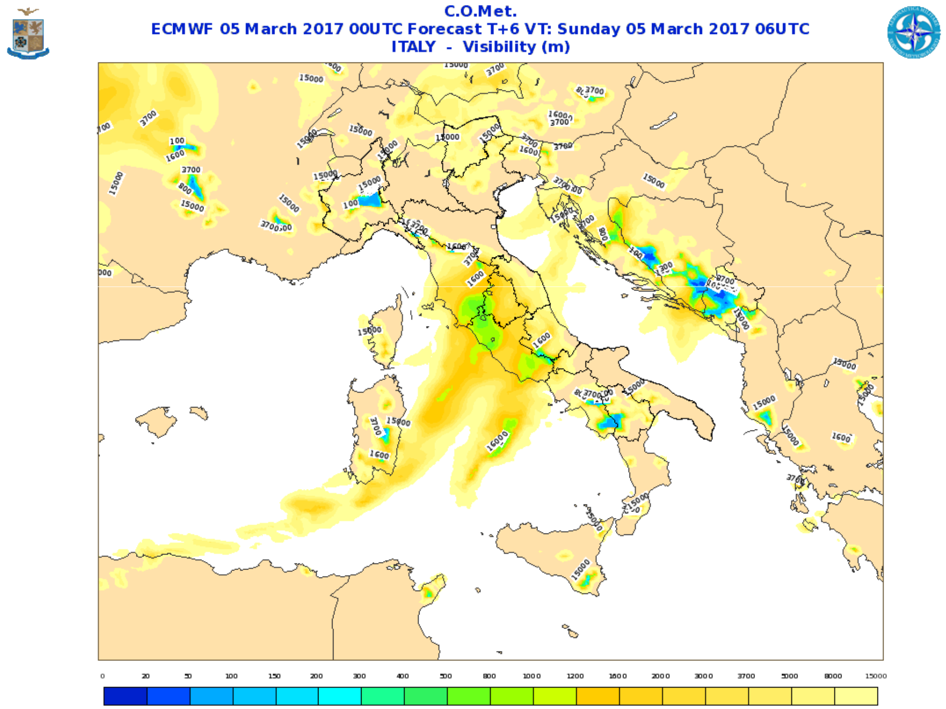
Aeronautica Militare

Correction for visibility reduction by precipitation

Boudala and precipitation correction

ECMWF



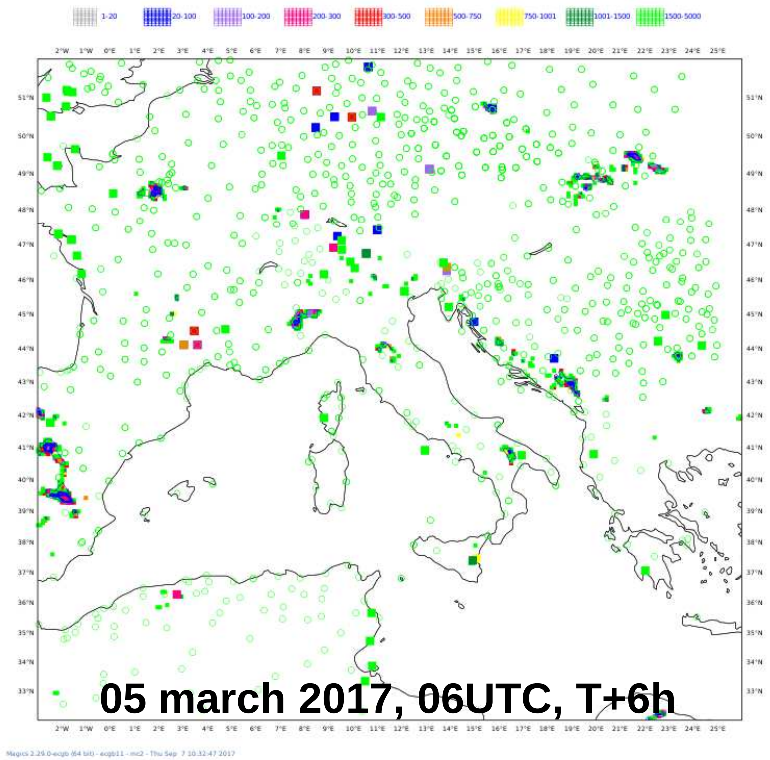


LWC algorithm

$$LWC = q_c\,\rho\,1000$$

$$\rho = p\left\{R_d\left[1+\left(\frac{R_v}{R_d}-1\right)q-q^l-q^f\right]T\right\}^{-1}$$

graupel specific content is an optional field



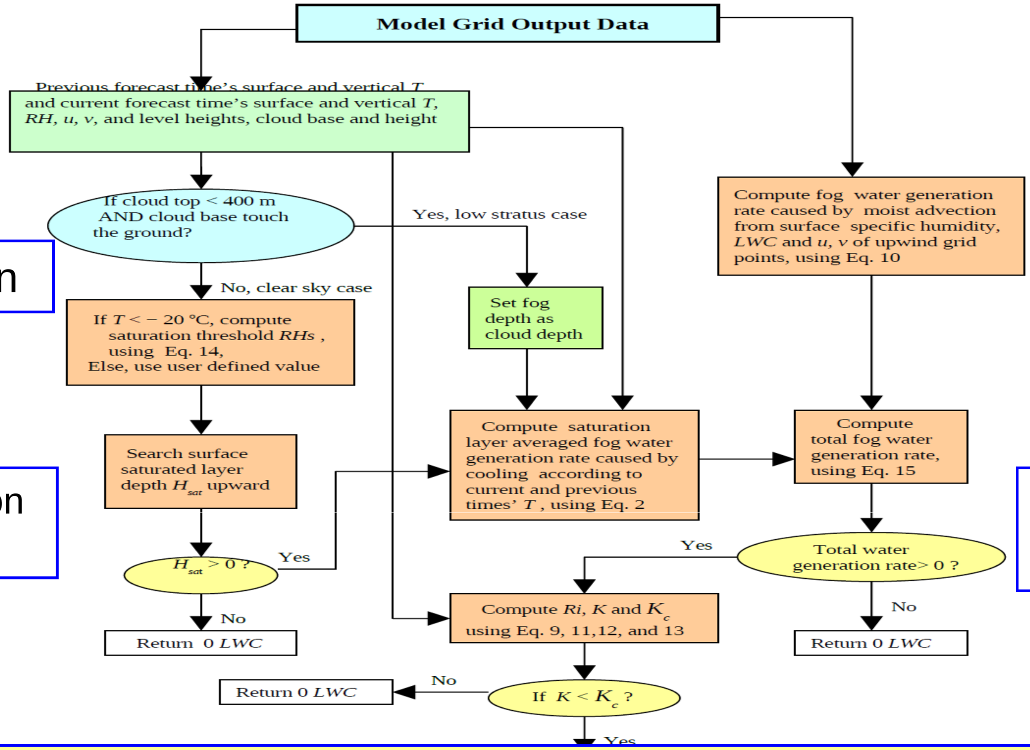
05 march 2017, 06UTC, T+6h

q^l: specific water content of a category of liquid water (qr + qc)
q^f: specific water content of a category of frozen water (qi + qs + qg)

$$xvis = \frac{1.13}{(LWC\ N_c)^{0.51}}$$

Zhou, 2011

recommended for radiation and advection fog



cloud cover information

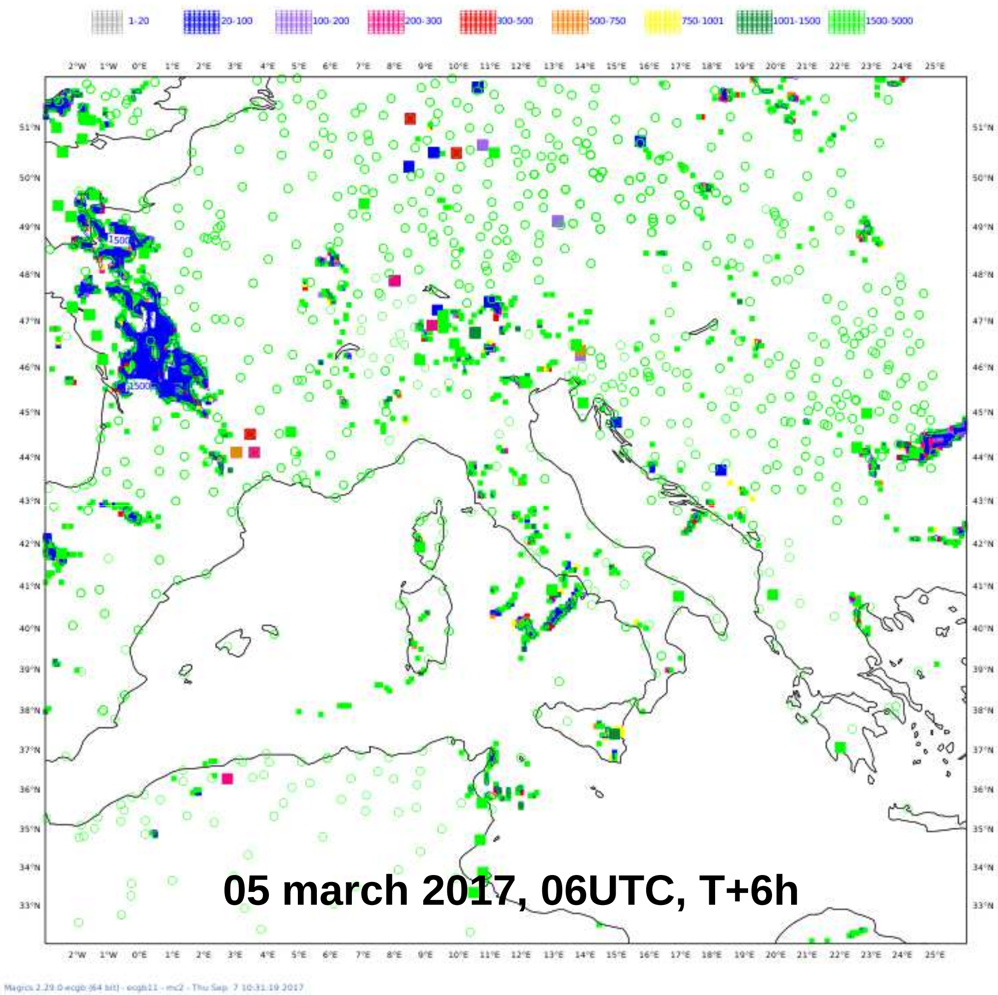
trigger condition
RH>=95 %

turbulent exchange coefficient

$$LWC(z,k) = \left\{\frac{[Adv + \beta(p,T)C_0]H_{sat}}{\alpha}\right\}^{1/2}\left[\left(1-\frac{z}{H_{sat}}\right)^{1/2}\right] - \frac{2}{1+e^{z/\delta}}$$

$$xvis = \frac{1.13}{(LWC\ \ N_c)^{0.51}}$$

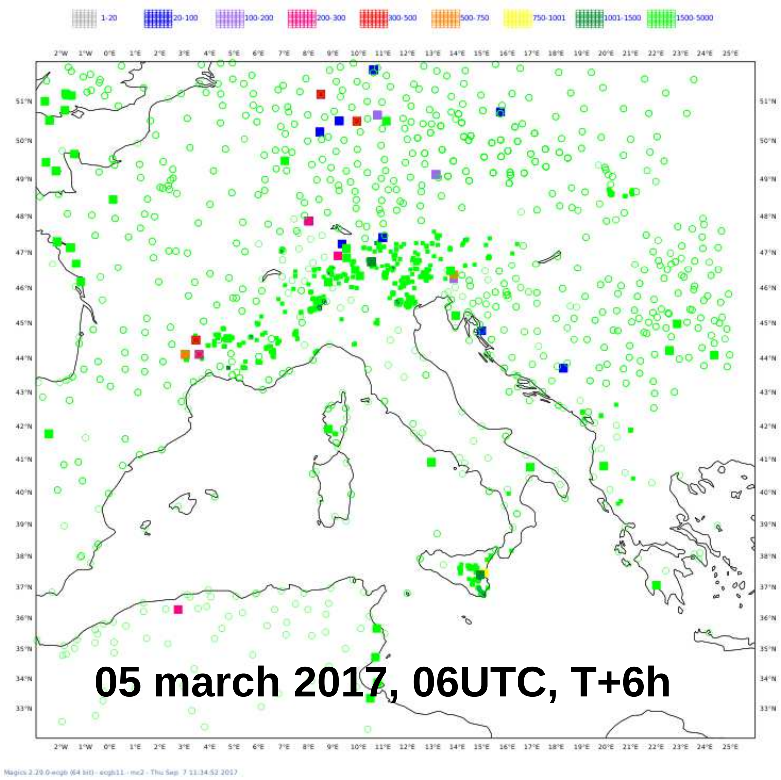
Zhou, 2011


1-20
20-100
100-200
200-300
300-500
500-750
750-1001
1001-1500
1500-5000
2°W 1°W 0°E 1°E 2°E 3°E 4°E 5°E 6°E 7°E 8°E 9°E 10°E 11°E 12°E 13°E 14°E 15°E 16°E 17°E 18°E 19°E 20°E 21°E 22°E 23°E 24°E 25°E
51°N 50°N 49°N 48°N 47°N 46°N 45°N 44°N 43°N 42°N 41°N 40°N 39°N 38°N 37°N 36°N 35°N 34°N 33°N
05 march 2017, 06UTC, T+6h

UPS method

empirical method based on Baker at al. (2002) for radiation fog forecasting

The predictor is the **crossover temperature Tx**
(def. the minimum dew point temperature during the warmest daytime hours)



05 march 2017, 06UTC, T+6h

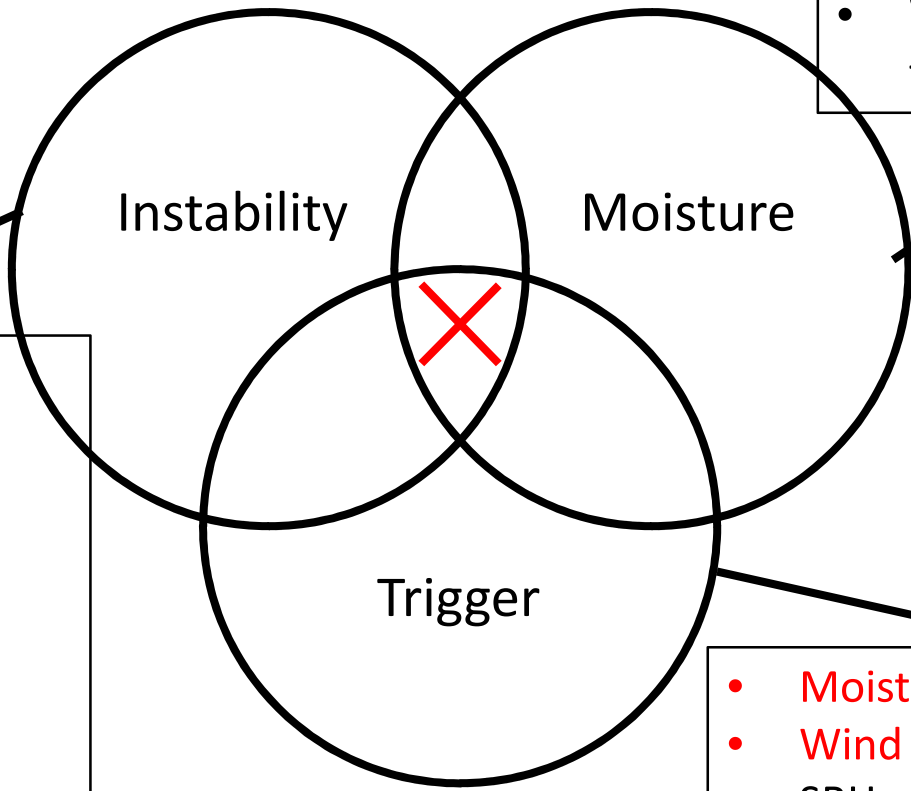
- $T_{sfc} = T_x$ → MIST
- $T_{sfc} <= (T_x – 3°F)$ FOG if MRi > 0.008

$$MRi = \frac{T_b - T_{sfc}}{u^2}$$

MRi turbulent mixing
(T_b average temperature in the lowest 1200 m)

Introduction: Thundestorm ingredients

- RH index
- RH 2m
- Wet bulb temperature@850 hPa

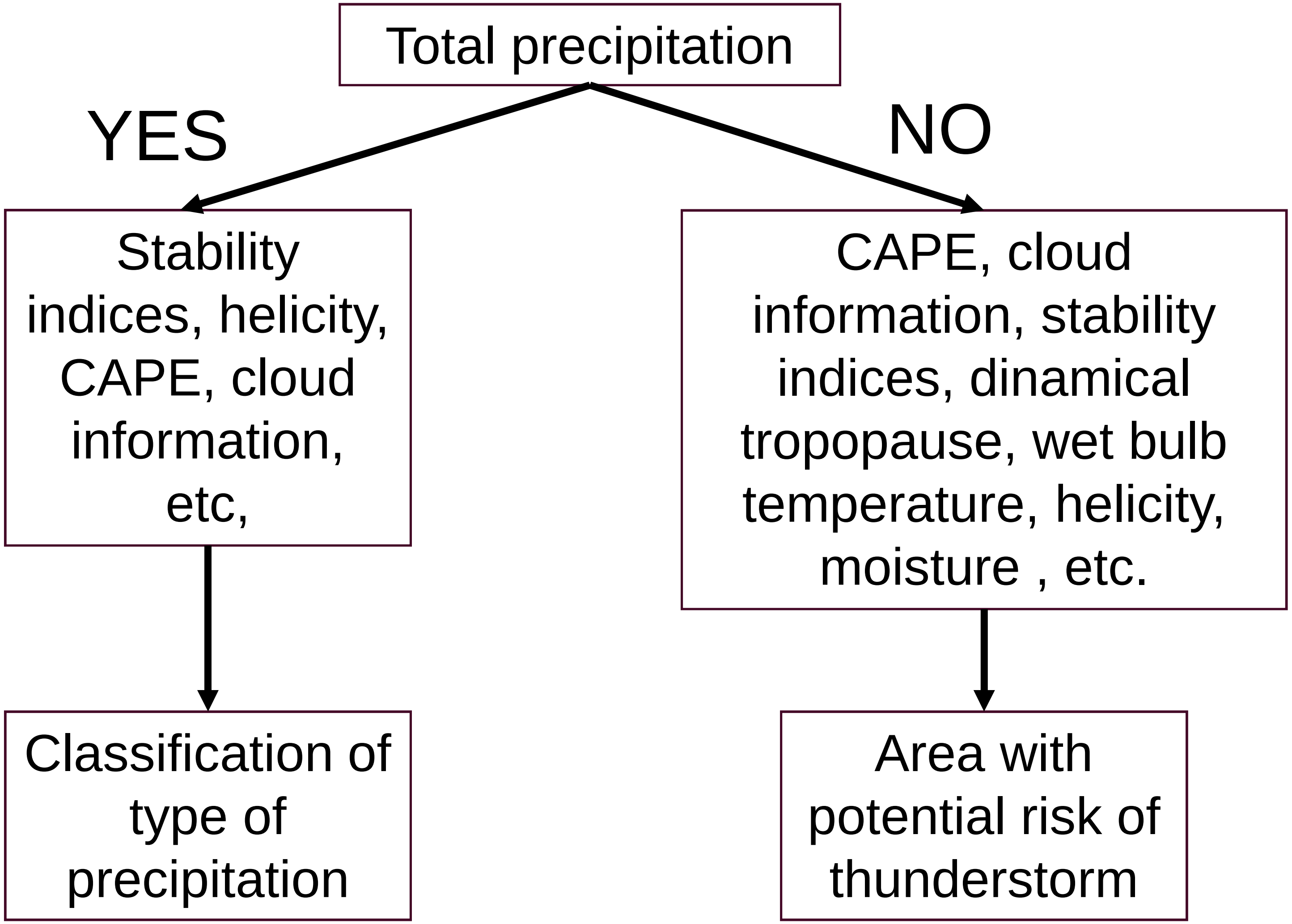


- CAPE
- CIN
- Total Totals Index
- K Index
- Jefferson Index
- Showalter Index
- KO Index
- Lifted Index
- Dynamical tropopause

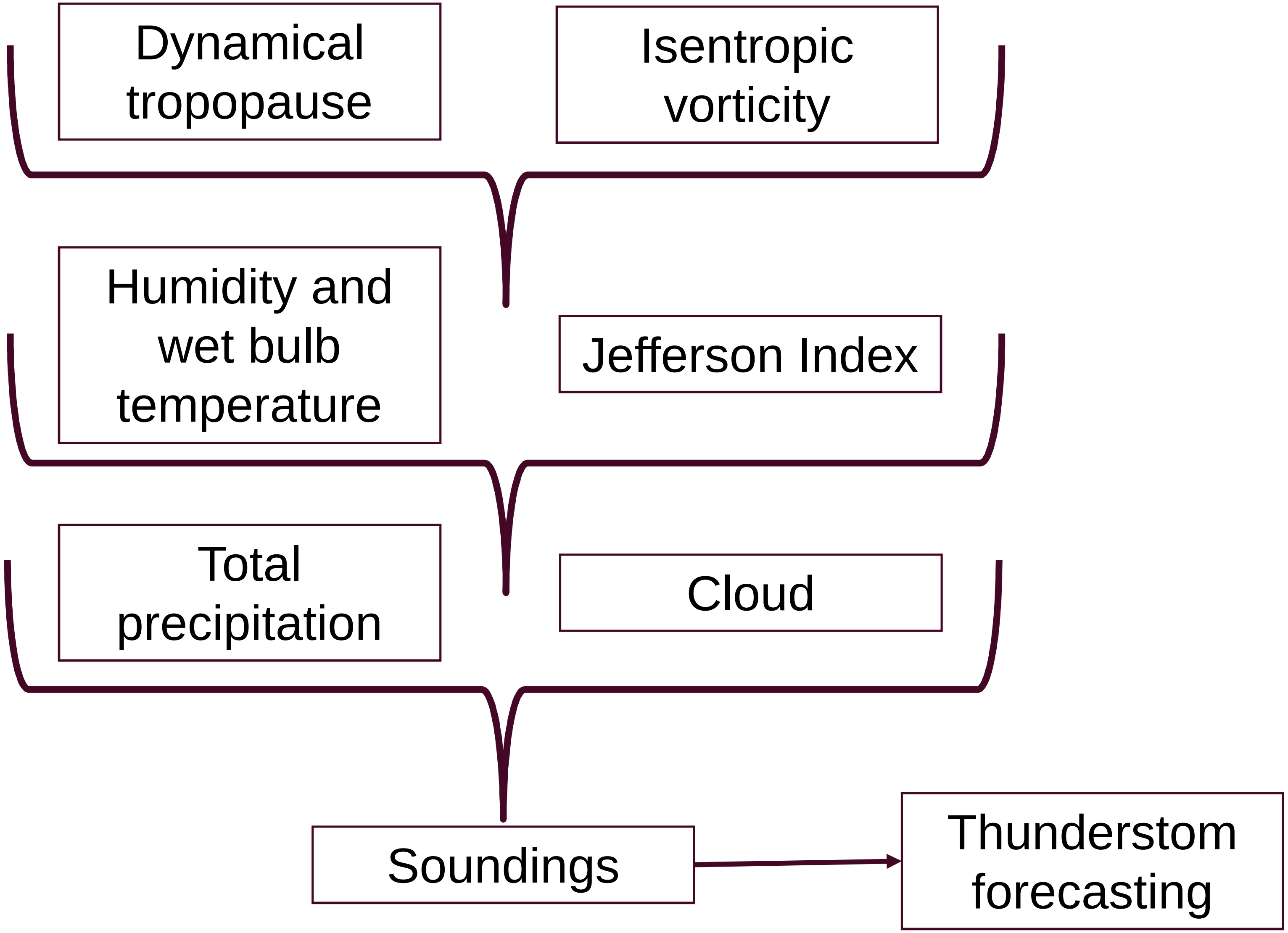
- Moisture flux convergence
- Wind shear (0-3 km, 0-6 km)
- SRH
- Orography

Integrated graupel for lightning information

TS Forecast tree



Forecaster tree



INPUT (grib 1 and/or grib 2):

- **CAPE and CIN** (computed if not present)

- **Vertical pressure level fields:**
  - Vertical level heights: $H(k)$
  - Temperature: $T(z)$
  - Relative humidity: $RH(z)$
  - Wind speeds: $U(z)$, $V(z)$, *W(z)*
  - Convective cloud base/top (computed if not present)
  - Specific content: q, q_c, q_r, q_s, q_i (the code checks the presence of q_g)

- **Surface fields:**
  - Surface height: H_{surf}
  - 2 m temperature: T_{2m}
  - 2 m relative humidity: RH_{2m} *(or* Td_{2m} *or* q_{2m}*)*
  - 10 m wind speeds: U_{10m}, V_{10m}
  - Surface pressure: P_{surf} *(or mean sea level pressure)*