

New philosophy in warning severe thunderstorms at ZAMG



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- Motivation
- Ingredients-based approach for forecasting severe convection
- Different types of thunderstorms
- Conclusion

before 2018:

- * Automatic thunderstorm warning system (Nowcasting)
- * pre-warnings (1-2 days ahead): for MCSs and line convection only

Problem: other convective cells with high impact not warned (e.g. slow moving cells with high rain amounts, flash floods, single cells with high impact ,..) not covered by pre-warnings ☹️

➡️ costumers not satisfied

➡️ new philosophy and guidance necessary

Ingredients-based approach

WGCEF, Dublin, 27th of September 2019

04.10.2019

Folie 4

Frequency	Widespread >30% of area			
	Regional 10-30% of area			
	Local 3-10% of area			
		TS	Strong TS	Very strong TS
		Impact		



Distinction between strong and very strong thunderstorms

	Strong TS	Very strong TS
hail	$\geq 2\text{cm}$	$\geq 5\text{cm}$
wind gusts	$\geq 90\text{ km/h}$	$\geq 120\text{ km/h}$
rain rate	$\geq \sqrt{20 \cdot t[\text{min}]}$ $\geq 25\text{mm}/30\text{min}$	$\geq \sqrt{45 \cdot t[\text{min}]}$ $\geq 40\text{mm}/30\text{min}$

Ingredients-based approach



WGCEF, Dublin, 27th of September 2019

04.10.2019

Folie 6

Lifting, CAPE and vertical wind shear causing intensity of TS

Negative/neutral/positive forcing

Vertical wind shear	strong			
	moderate			
	weak			
		weak	moderate	strong

CAPE

Ingredients-based approach

WGCEF, Dublin, 27th of September 2019

04.10.2019

Folie 7

CAPE (J/kg)	weak	moderate	strong
	10-200	200-1000	> 1000

Vertical wind shear (m/s)	weak	moderate	strong
0-6 km	< 10	10-20	> 20
0-3 km	< 7	7-15	> 15
0-1 km	< 5	5-10	> 10

Vertical motion	sinking	neutral	rising
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Different types of thunderstorms



WGCEF, Dublin, 27th of September 2019



Impact: heavy rain

- CAPE at small vertical temperature gradients ($< 7\text{K/km}$)
- Small/moderate vertical wind shear

Impact: storm and hail

- CAPE at high vertical temperature gradients ($> 8\text{K/km}$)
- strong vertical wind shear




Distinction between storm and hail

- linear forcing perpendicular to flow (e.g. sharp troughs, line convection)
- vertical wind shear concentrated in lower levels
- Very dry boundary layer and high cloud base (dew point difference $> 15\text{K}$; cloud base $> 2000\text{m}$)

 strong wind gusts more likely than hail



Ingredients-based approach:

- Decision tree  harmonization of mode of operation between forecasters
- Thunderstorm warnings easy to interpret for public and clients
- Impact-based thinking: colour code as function of frequency and intensity of thunderstorms
- Useful thunderstorm warning information for public and clients



Thank you very much for your attention! Questions???



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