



TAF verification - improvements of the thunderstorm forecasts at Croatian airports

Jadran Jurković, Vinko Šoljan,

Zoran Pasarić, Igor Kos



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■ Introduction

- ECSS : “The scope of the conference covers all aspects of severe convective storms. Researchers, operational forecasters, and risk and emergency managers...”



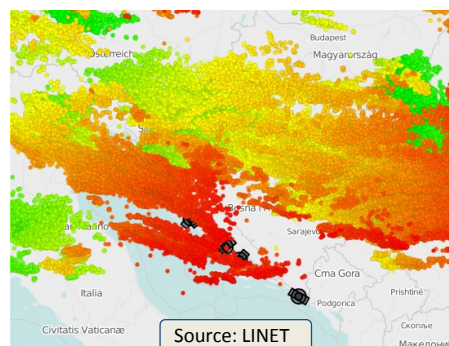
- Goal: verify convection forecast in end-user products during the last ten years

■ TAF & thunderstorms

Thunderstorms (TS) can have significant impacts on air traffic: en-route and at the airport

Terminal aerodrome forecast (TAF)

- standard ICAO product
- validity 24h
- forecaster generated





Convection in TAF

Terminal aerodrome forecast (TAF) - every 6h (+AMD)

```
TAF LDZA 071125Z 0712/0812 25007KT CAVOK TX31/0713Z TN15/0803Z
    TEMPO 0712/0715 32015G25KT      TSRA FEW040CB SCT045
    TEMPO 0713/0718 03012KT
    TEMPO 0715/0721 32020G35KT 3000 +TSRA SCT040CB BKN045
PROB30 TEMPO 0716/0718 32020G45KT 1000 TSGR BKN025CB BKN035
PROB40 TEMPO 0800/0807      1000 BCFG BKN003
    BECMG 0807/0809 05008KT
PROB30 TEMPO 0809/0812      TSRA FEW040CB SCT045=
```

Measurements (METAR) - every 30min

```
METAR LDZA 071500Z 32020G31KT 270V350 6000 SHRA VCTS BKN026 FEW030CB 20/16
Q1011=
METAR LDZA 071530Z 03012KT 360V140 6000 TSRA FEW026 FEW030CB 18/16 Q1009 RERA=
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Verification

- all forecasted hours
- all airports
- ~35000 FCST hours/year
- contingency tables for TS
- from 2009 summer

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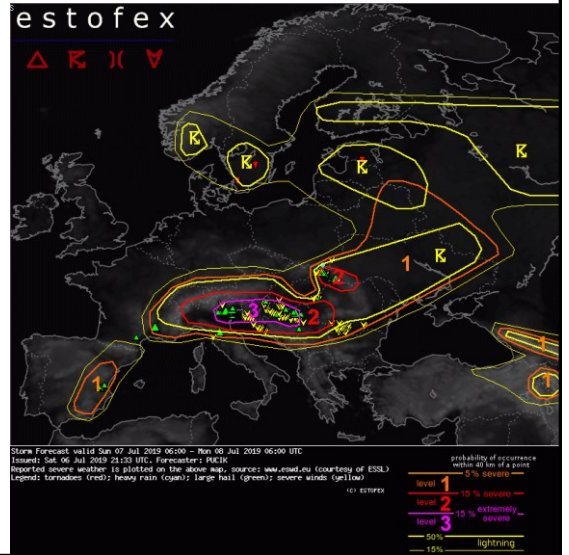
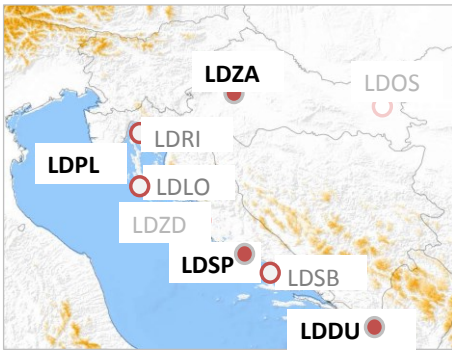
CROATIA
CONTROL



TAF vs ESTOFEX

TAF

- defined for area radius 8km



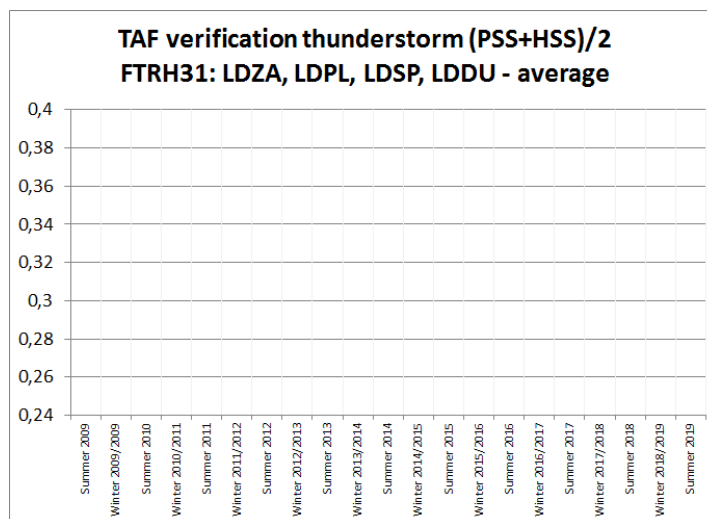
Verification results 10 years

Dubrovnik
2009

PW_TS	OBS	
FC	yes	no
yes	93	1332
no	145	15830

2018

PW_TS	OBS	
FC	yes	no
yes	285	1729
no	168	15377



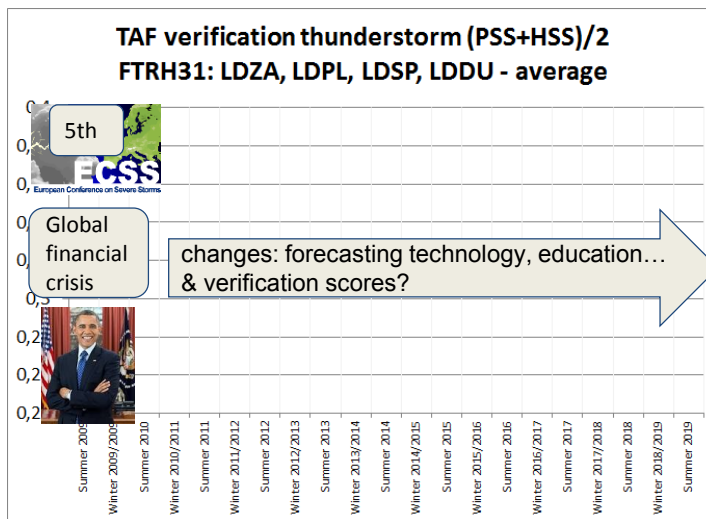
Verification results **10 years**

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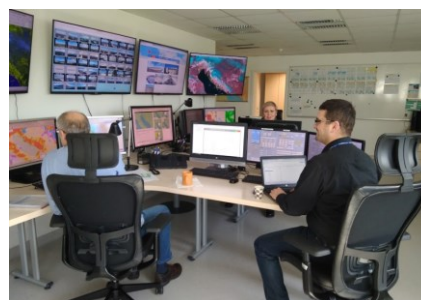
2018

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FC	yes	no
yes	285	1729
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Technology

- observations (e.g. lightning detection, webcams)
- new personnel
- optimized organization of forecasting tasks
- Visual Weather
- new models+MOS
- forecasting tools
- new products for ATM



Education

- 10 years of seminars
- V. Šoljan (our convection expert) since 2014:
 - introduced ingredients-based approach
 - education and workshops for convection
 - convection forecasting manual
 - case studies, verification
- 20 (of 22) forecaster attended **ESSL Testbed**
- Other education related to convection
 - theory, climatology, experts from NMS
 - motivated forecasters



Prilogeći za prognozu i/ili druge vrste konvekcije	
1. Osnovne informacije	1
2. Osnovne informacije	2
3. Osnovne informacije	3
4. Osnovne informacije	4
5. Osnovne informacije	5
6. Osnovne informacije	6
7. Osnovne informacije	7
8. Osnovne informacije	8
9. Osnovne informacije	9
10. Osnovne informacije	10
11. Osnovne informacije	11
12. Osnovne informacije	12
13. Osnovne informacije	13
14. Osnovne informacije	14
15. Osnovne informacije	15
16. Osnovne informacije	16
17. Osnovne informacije	17
18. Osnovne informacije	18
19. Osnovne informacije	19
20. Osnovne informacije	20
21. Osnovne informacije	21
22. Osnovne informacije	22

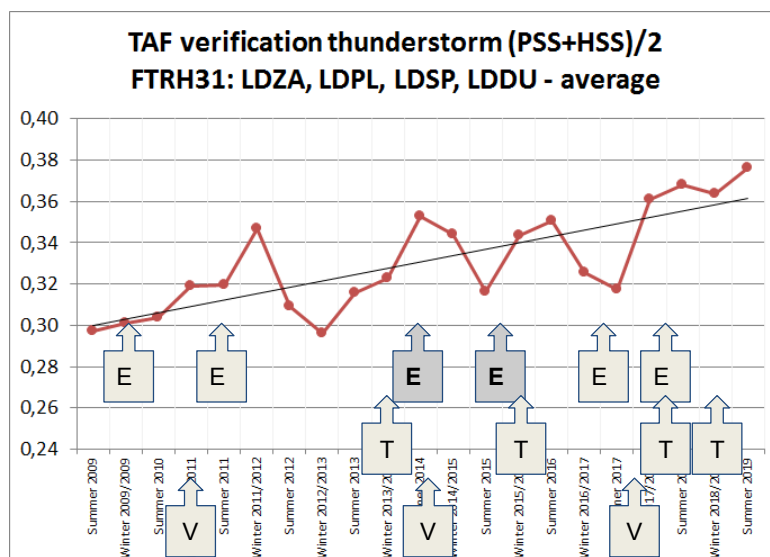


■ Verification method

- Methodology similar to Met Alliance - Mahringer (2008)
 - Scores $KPI = (HSS + PSS) / 2$
- Seasonal verification reports
 - introduced in 2017, results from 2009
 - possible corrective actions
 - mail to forecasters, new education, proposals to improvements in forecasting or observing systems
- Special verification results - diagnostic purpose
 - leading time, hour in day, seasons, forecasters, etc.



■ Verification results (10 years)



Education

Technology

Verification



Conclusions

- Verification of product for the end user
- Verification scores show clear positive trends
 - forecasting system, education, verification
- Implementing scientific advances in operational environment is not easy
- After proved progress, users, managers and forecasters can be

