On-demand mapping
Rapid Mapping
Risk and Recovery Mapping
Early warning and monitoring
Floods
Fires
Droughts
Exposure Mapping
Population
Built-up areas

A skill analysis of the European Flood Awareness System

Casado-Rodríguez, Jesús[a]; Carton De Wiart, Corentin[b]; Grimaldi, Stefania[a]; Salamon, Peter[a]

[a]*European Commission – Joint Research Centre, Ispra, Italy*
[b]*European Centre for Medium-Range Weather Forecasts, Reading, UK*

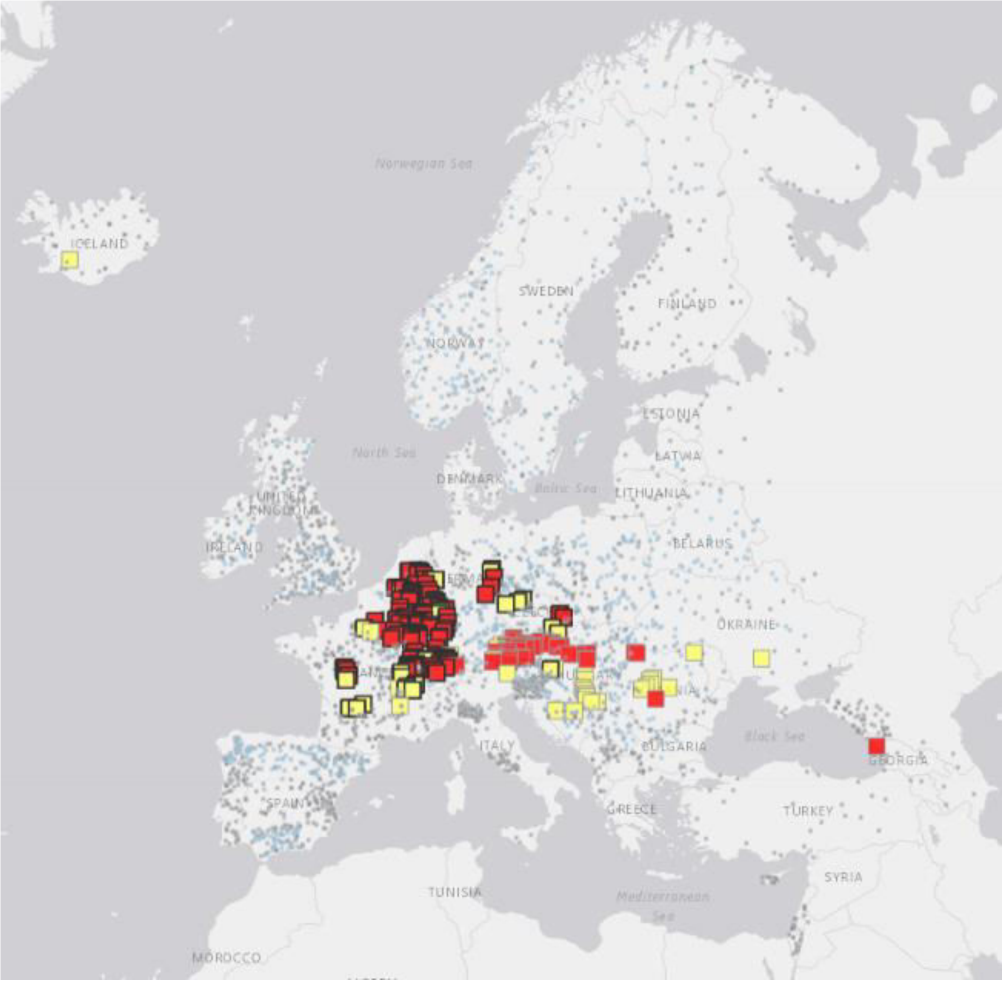
hepex

Copernicus
Europe's eyes on Earth
European Commission

Emergency Management

The European Flood Awareness System is a hydrological forecast and monitoring system whose aim is to support preparatory measures before major flood events.

- **LISFLOOD-OS** hydrological model github.com/ec-jrc/lisflood-code
- 4 meteorological forecasts:
  - Deterministic: ECMWF-HRES DWD-ICON
  - Probabilistic: ECMWF-ENS COSMO-LEPS
- Spatial characteristics:
  - Greater European domain
  - 5 km resolution
- Temporal characteristics:
  - Forecasts every 12 h
  - 10 days lead time
  - 6 h temporal resolution
- Access:
  - Web portal
  - Formal/informal flood notifications to EFAS partners



EFAS forecast July 15th 2021 (efas.eu/en)

Objective

To assess if EFAS skill in predicting flood events can be optimized by varying the notification criteria.

1. Can the catchment area threshold be reduced?
2. How should the total probability be computed?
3. What’s the optimal probability threshold?
4. Is persistence a valuable criteria?

area	lead time	approach	probability	persistence
>= 2000 km^2	> 48 h	1 deterministic + 1 probabilistic	$P(Q \geq Q_5) \geq 0.30$	3 consecutive

Emergency Management

Geographical extent

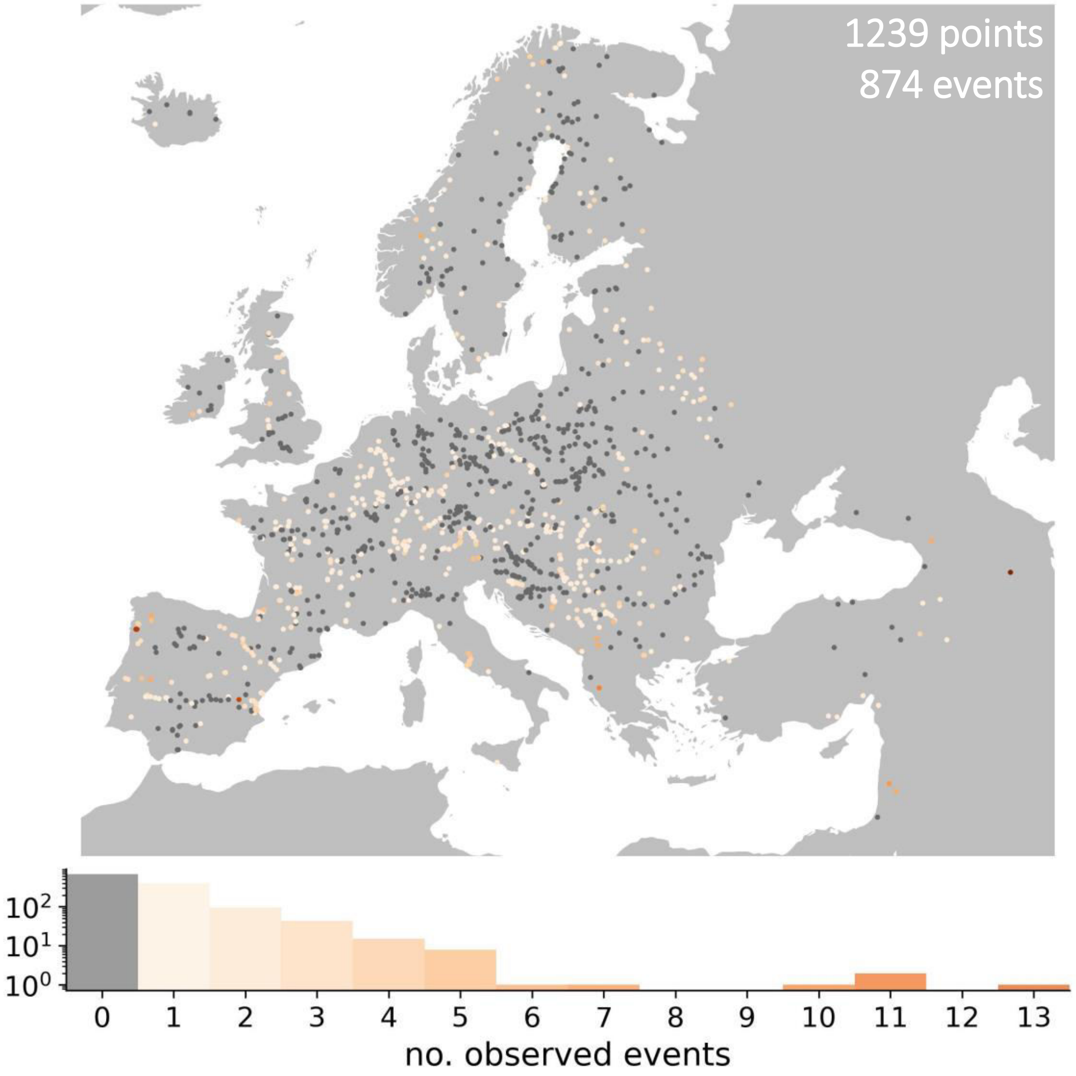
Fixed reporting points with a contributing area larger than 500 km² and a KGE larger or equal than 0.5.

Temporal extent

From October 2020 to June 2023

Discharge data

- «Observed»: EFAS v4.0 reanalaysis.
- Predicted: EFAS v4.0 reforecast.
- Discharge asociated with the 5-year return period.



Experiment 1: individual meteorological models

Compare the individual NWP models against the current approach and set a baseline.

area	lead time	NWP	probability	persistence
≥ 2000 km²	• lt ≤ 48 h • 48 h < lt ≤ 132 h • 132 h < lt ≤ 168 h • 168 h < lt	• COSMO-LEPS • DWD-ICON • ECMWF-ENS • ECMWF-HRES	$P \in [0.05, 0.95]$	• 1/1 • 2/2 • … • 3/3

Experiment 2: combinations of models

Find the best combination of NWP models and whether it adds value over the baseline.

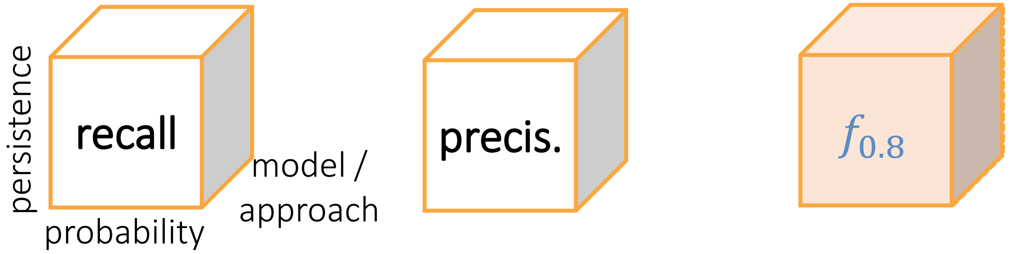
area	lead time	approach	probability	persistence
		• 1P + 1D • Model mean • Member weighted • Brier weighted		

Imbalanced classification		Forecast	
		Notified	Non-notified
Observed	Flood	hits	misses
	Non-flood	false alarms	?

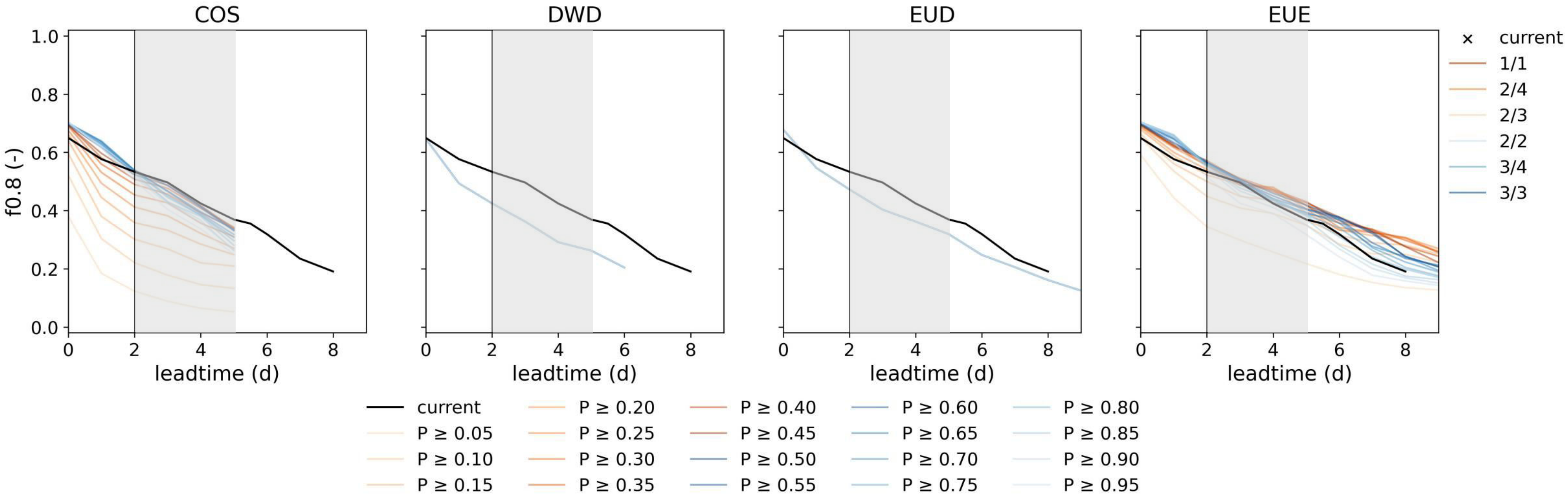
$$recall = \frac{hits}{observed} = \frac{hits}{hits + misses}$$

$$precision = \frac{hits}{predicted} = \frac{hits}{hits + false\ alarms}$$

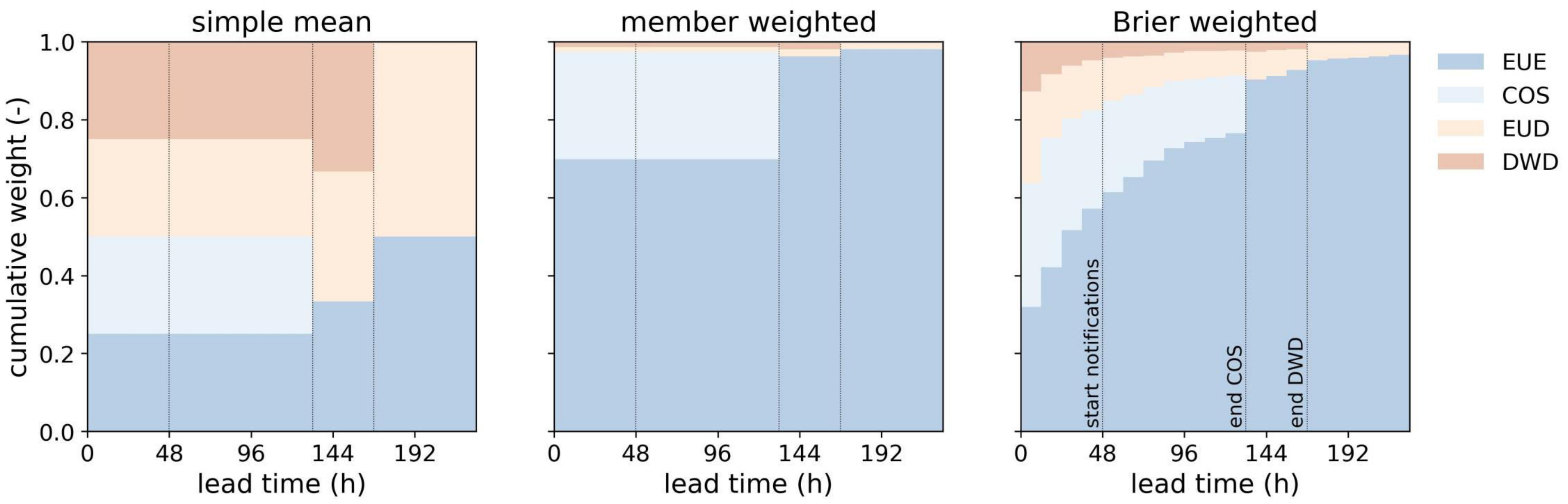
$$f_\beta = (1 + \beta^2)\frac{precision \cdot recall}{\beta^2 \cdot precision + recall}$$

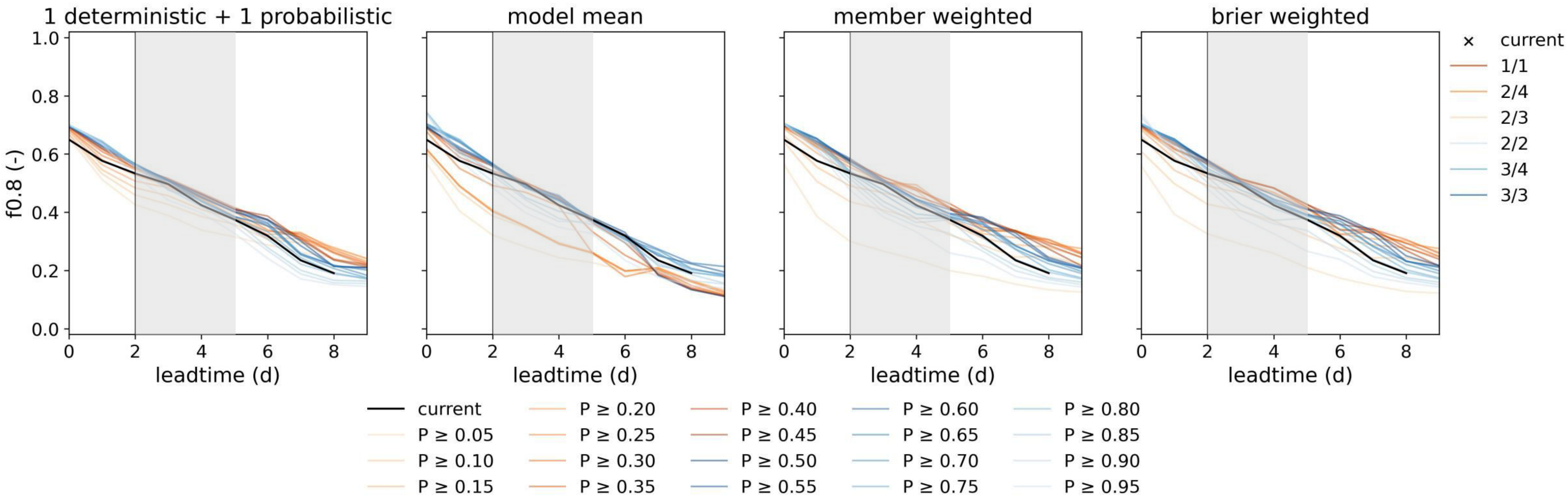


The objective is to find the criteria that maximize $f_{0.8}$

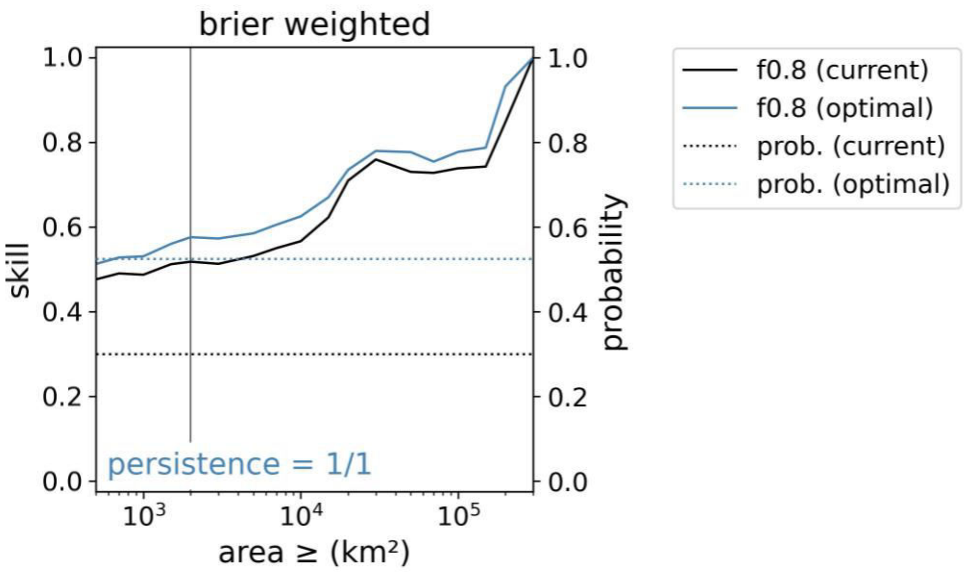


- Probabilistic models outperform the current notification criteria. EUE will be the baseline.
- There is a range of equally good performing probability thresholds.
- The persistence criterion is only useful for the deterministic models.


simple mean
member weighted
Brier weighted
cumulative weight (-)
1.0
0.8
0.6
0.4
0.2
0.0
0
48
96
144
192
lead time (h)
start notifications
end COS
end DWD
EUE
COS
EUD
DWD



- Member weighted and Brier weighted are the two most promising approaches:
  - Similar skill.
  - Similar optimal criteria: no persistence and a probability threshold around 50%.



- Skill improves with catchment area.
- The improvement in f-score at 2000 km^2 is kept throughout all lead times.

1. Can the catchment area threshold be reduced?
   - The area limit could be reduced to 1,000 km^2.

2. How should the total probability be computed?
   - Probabilistic NWP outperform the current criteria.
   - The Brier weighted and member weighted approaches show the highest skill.

3. What's the optimal probability threshold?
   - The optimal value is 50%.

4. Is persistence a valuable criteria?
   - The optimal criteria does not require persistence.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