SEASONAL PREDICTIONS OF WATER FOR EUROPE

Wouter Greuell
Hester Biemans, Wietse Franssen and Ronald Hutjes
Wageningen University and Research Centre

Aims

- Where, when and for what lead times is there **skill** in forecasts of runoff, discharge and soil moisture?
- Is possible skill due to the forecasts of **meteorological variables** or to the **initial conditions**?
- **Which** meteo variables and which initial conditions?
- What is the **difference in skill between** hydrological **models**?
- Can we gain skill with an **ensemble** of hydrological models?

TOOLS AND DATA

- Forcing from hindcasts of System4 seasonal 15 (ECMWF)
  - Period 1981-2010
  - Start each month (so 12 x 30 runs)
  - 15 members (so 12x30x15 runs)
  - Duration of runs: 7 months

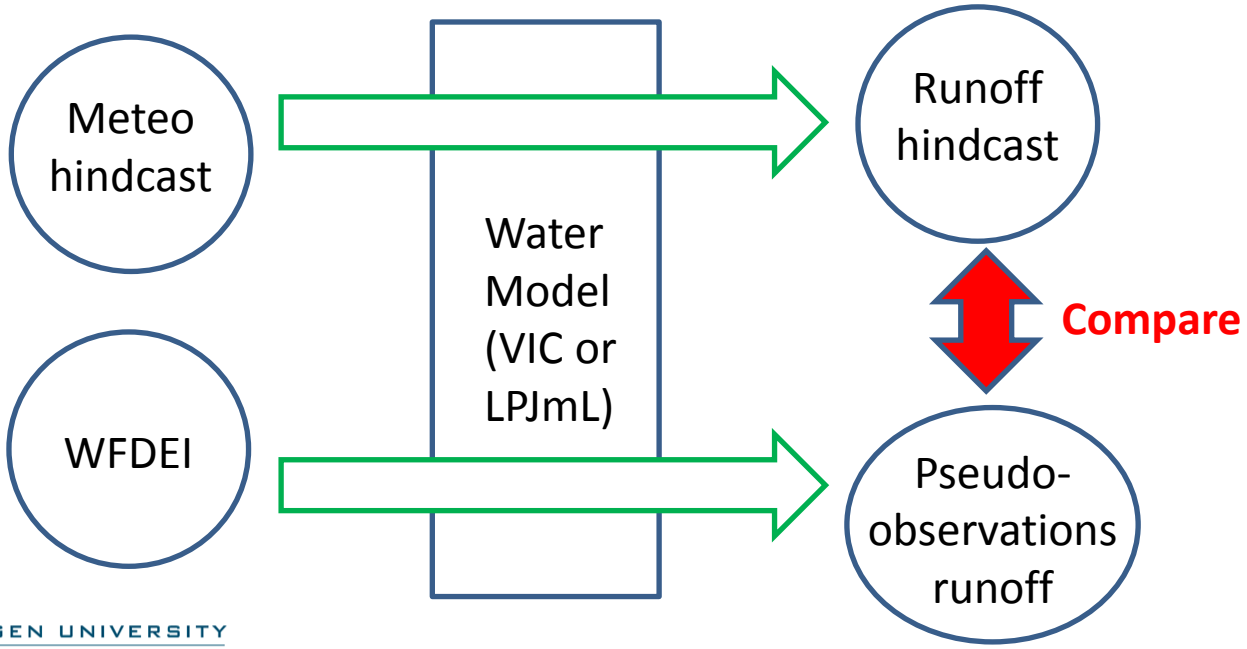
- Bias correction of forcing with WFDEI
- Hindcasts with two hydrological models: VIC and LPJmL
- Resolution: 0.5 degrees

- Also: simulations with WFDEI forcing
- To create initial conditions for hindcasts

- Calculate daily values, convert to monthly means
- Predictability quantified with ROC area and Ranked Probability Score

RESULTS SHOWN HERE

- **VIC** simulation: 12 members, forcing not corrected for bias
- **LPJmL** simulation: 15 members, bias-corrected forcing
- Verification with **pseudo-observations**, i.e. the output from the WFDEI-simulation

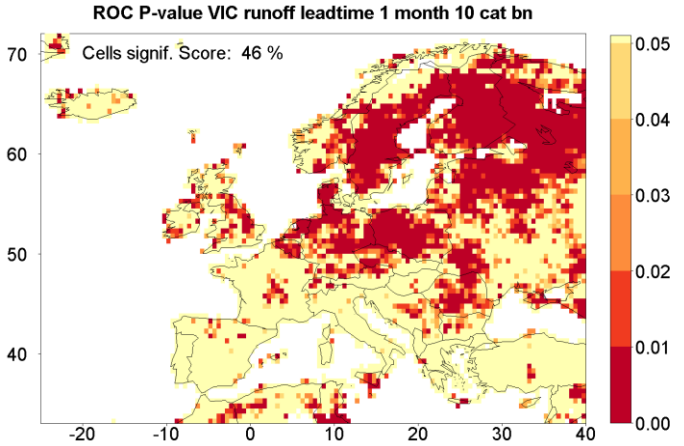


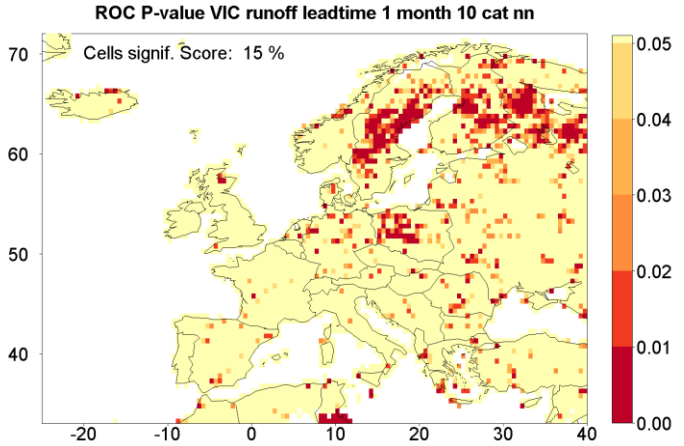
EXAMPLE MAPS PREDICTIBILITY

Hindcasts of runoff made on October 1 for month 2 = November

- Roc area converted into p-values, e.g. p = 0.05 means skill is significant at 95% confidence
- Fraction of cells with significant score (Fs)

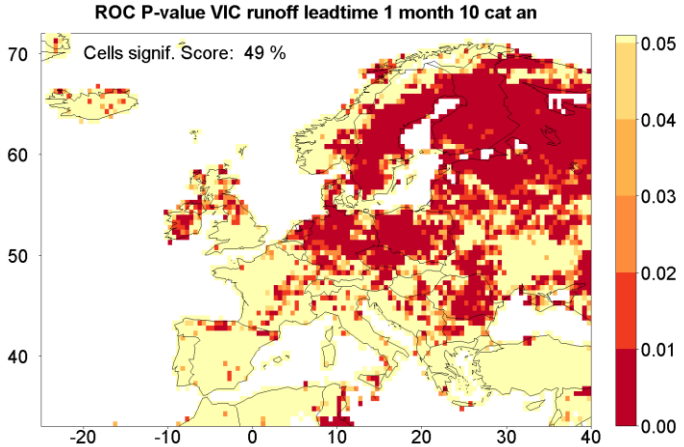
ROC p-value Lower Tercile (Fs = 46%)

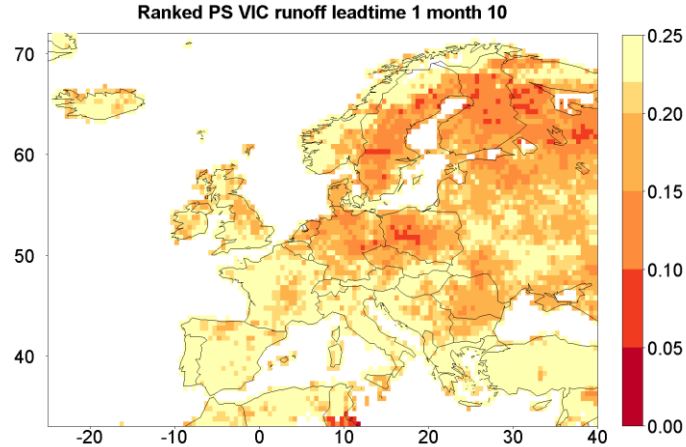




ROC p-value Middle Tercile (Fs = 15%)

ROC p-value Upper Tercile (Fs = 49%)





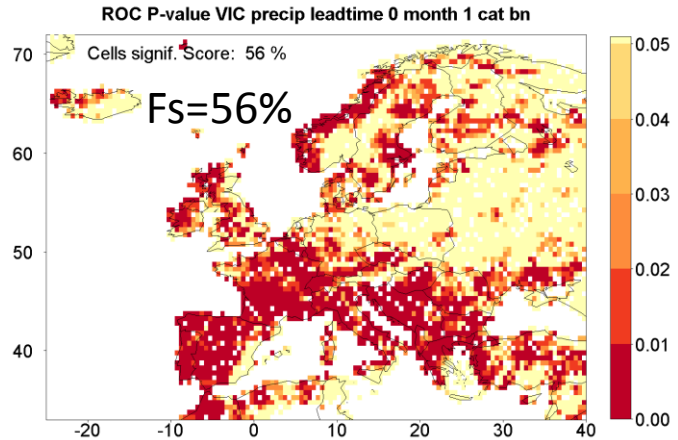
Ranked Prob. Score

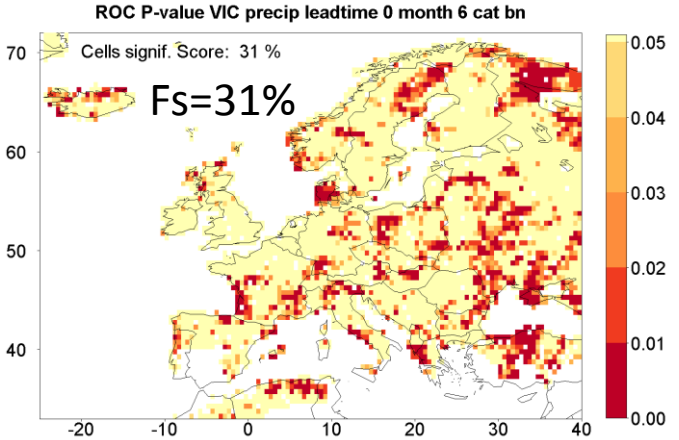
PRECIPITATION – lower tercile

Start January 1

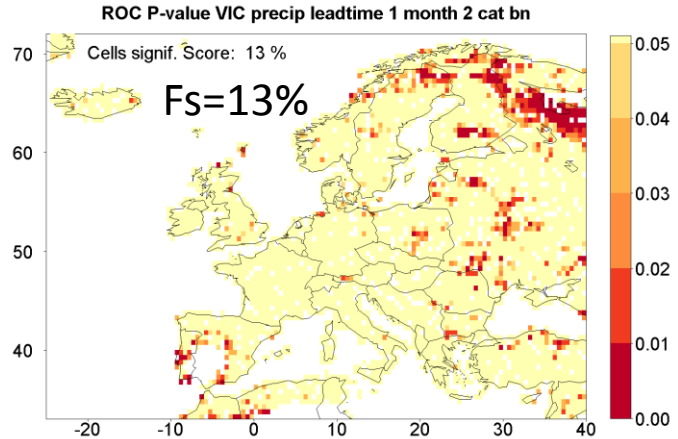
Start June 1

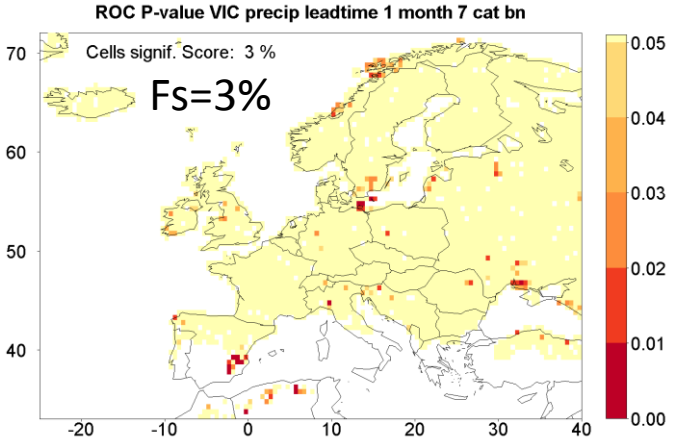
first month





second month





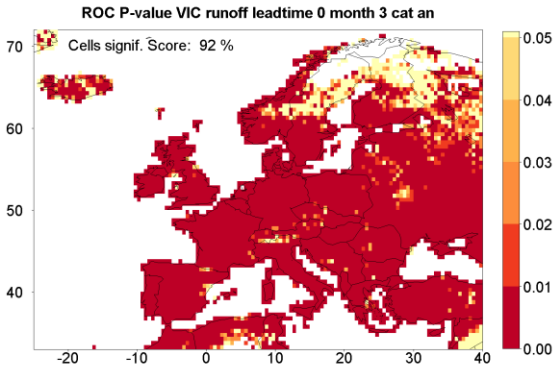
- Skill limited to first month
- More skill in Winter; less in Summer

WAGENINGEN UNIVERSITY
WAGENINGEN UR

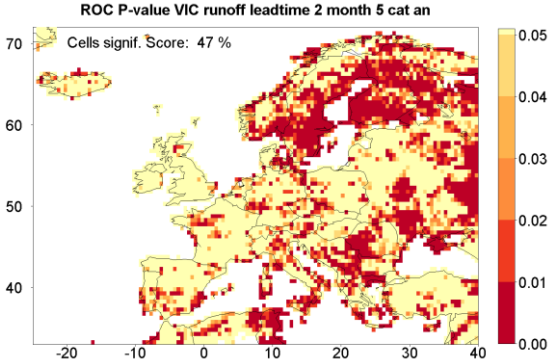
EUPORIAS

RUNOFF – VIC– start March 1 – upper tercile

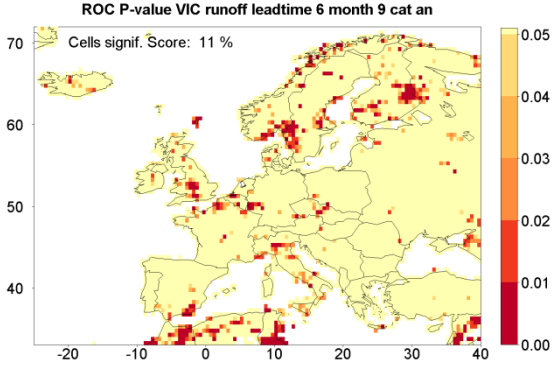
first month (Fs=92%)

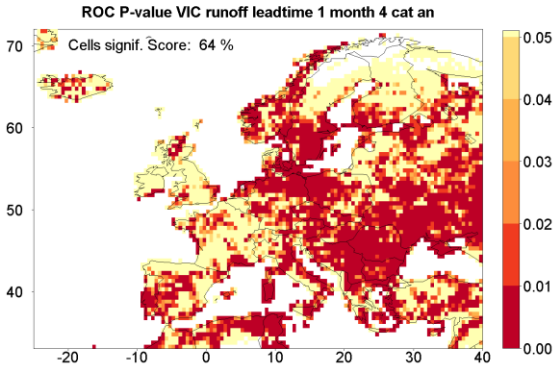


third month (Fs=47%)

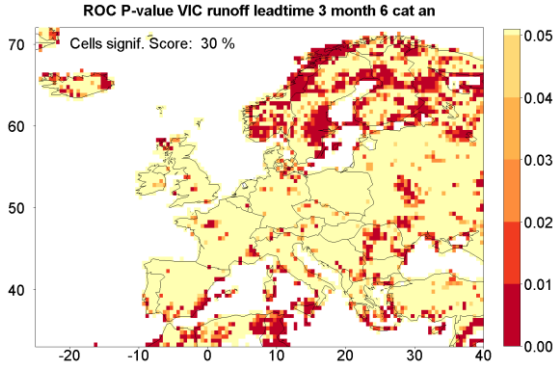


seventh month (Fs=11%)





second month (Fs=64%)



fourth month (Fs=30%)

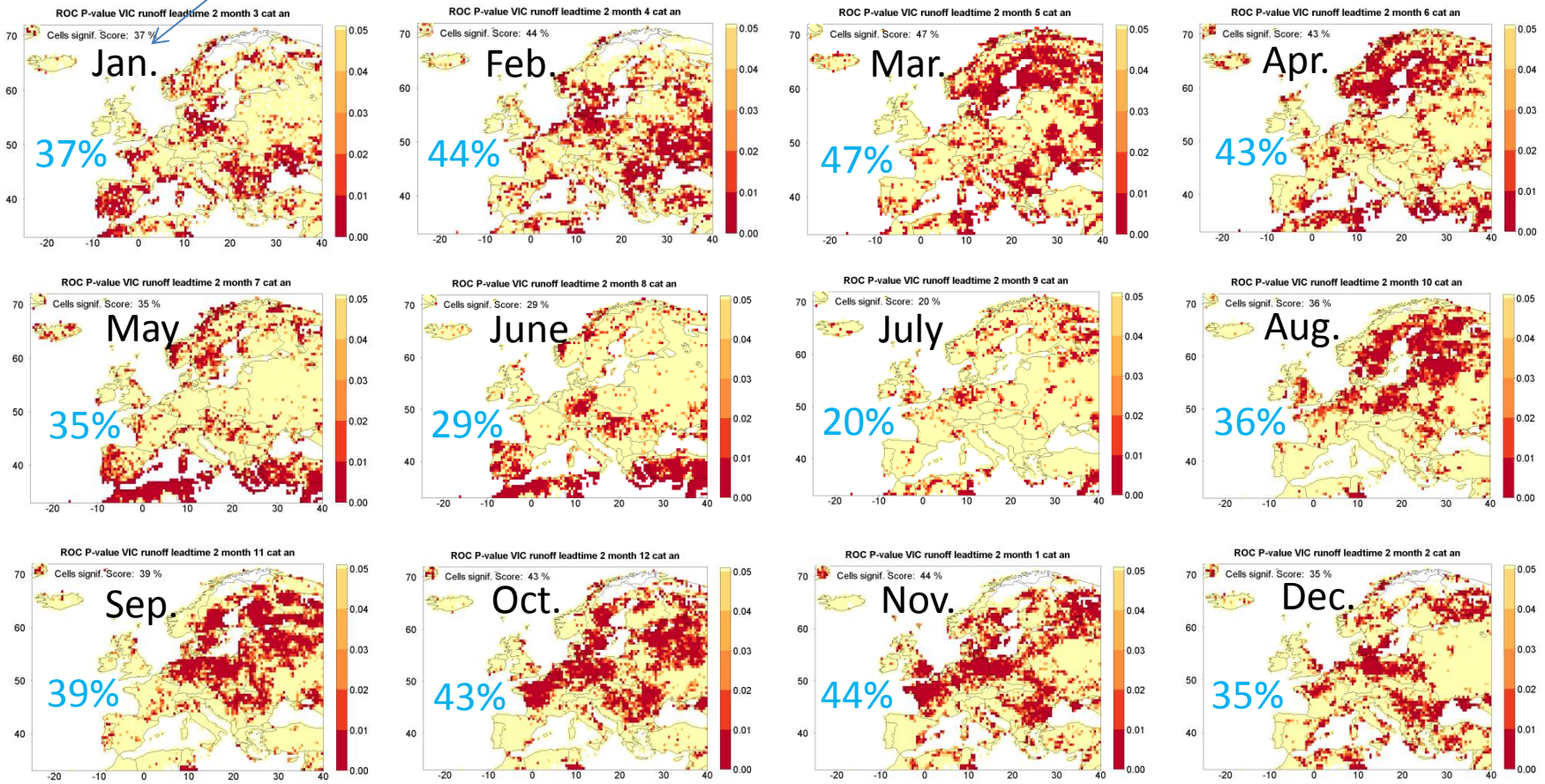
- There is considerable skill beyond the first month
- It is large in the first month
- Some skill seems to be left in the last month

WAGENINGEN UNIVERSITY
WAGENINGEN UR

EUPORIAS

RUNOFF – VIC – ANNUAL CYCLE – month 3 – UT

Start month



Enhanced skill: southern Mediterranean, April – June, soil moisture?
Baltic Sea, August – November, soil moisture?
Fennoscandia, March – May, snow?
Bulgaria and Romania, October - February

WAGENINGEN UNIVERSITY
WAGENINGEN UR

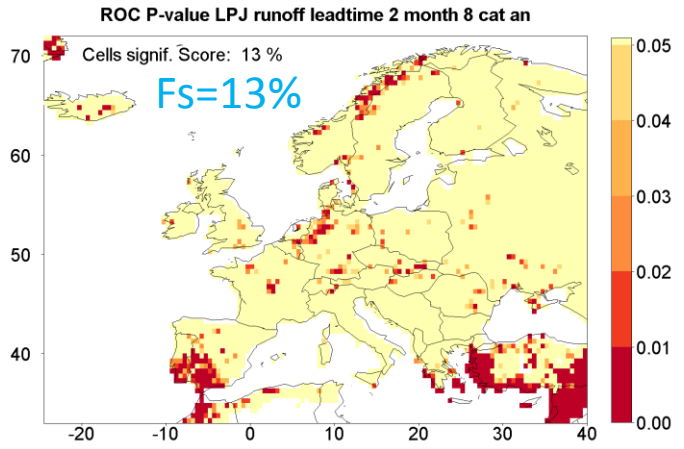
EUPORIAS

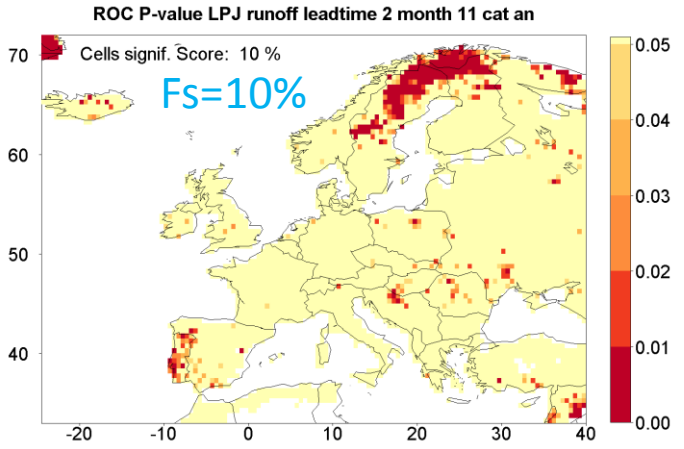
RUNOFF – LPJmL vs. VIC – third month - UT

Start June 1

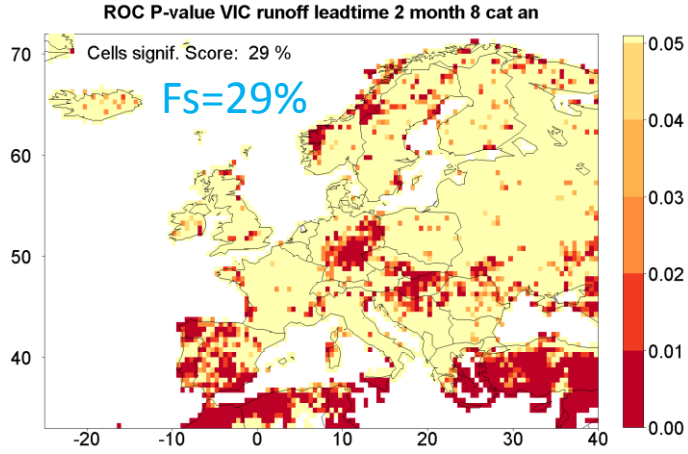
Start Sept 1

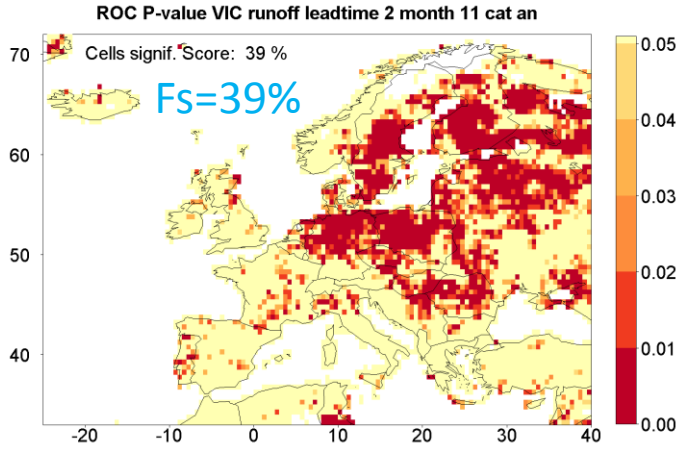
LPJmL





VIC



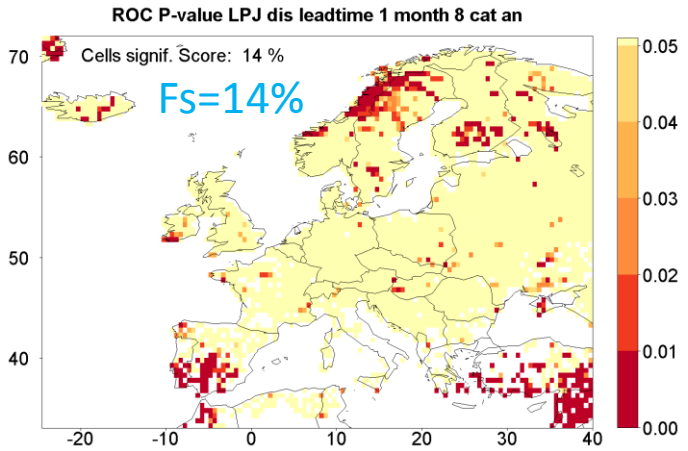


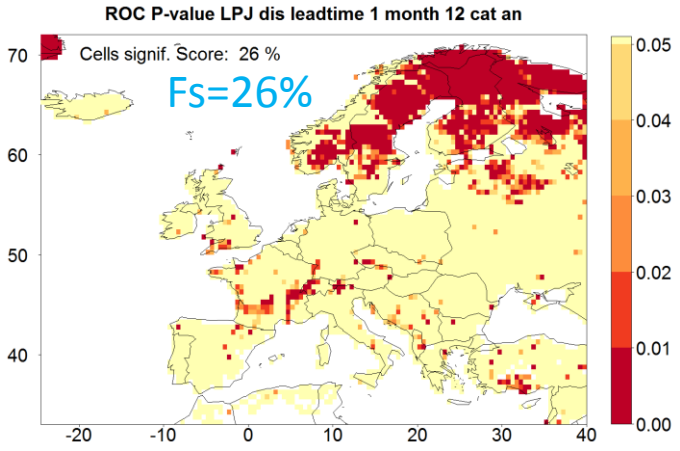
VIC much more skill than LPJmL

DISCHARGE – LPJmL – second month - UT

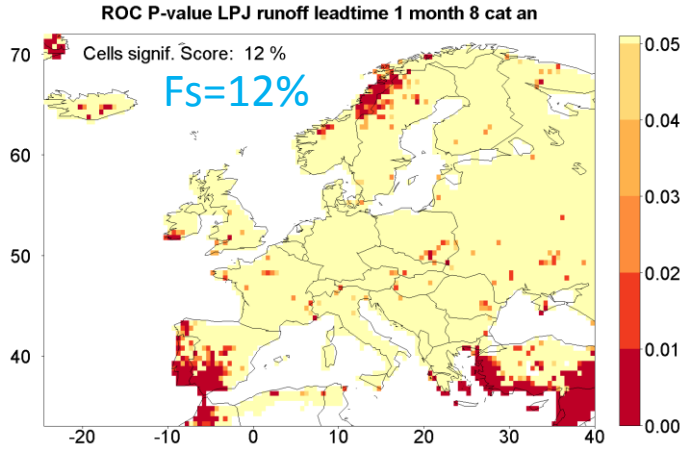
Start July 1 | **Start November 1**

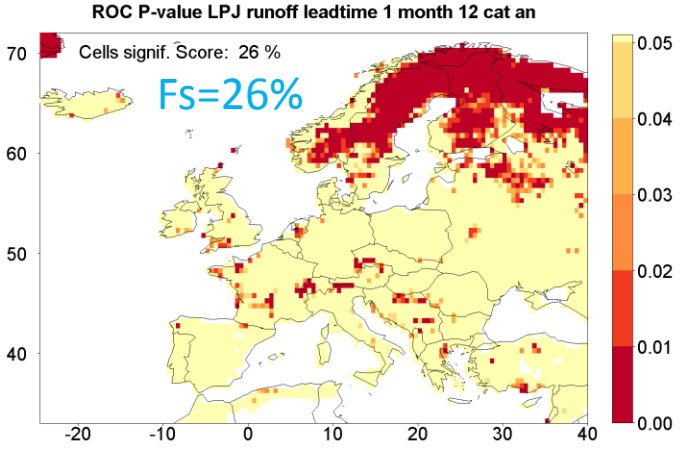
discharge





runoff



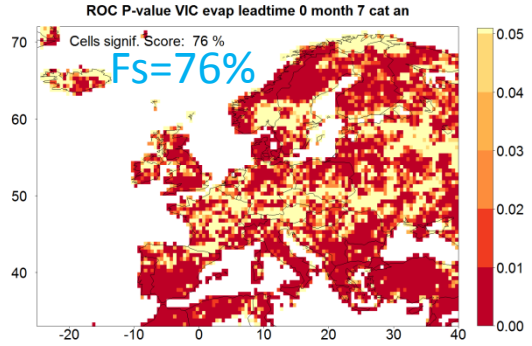


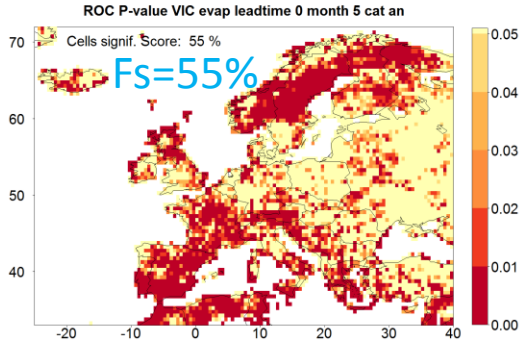
- Skill pattern of runoff and discharge are similar
- Some pockets of skill in runoff are carried downstream along rivers

EVAPOTRANSPIRATION – VIC – upper tercile

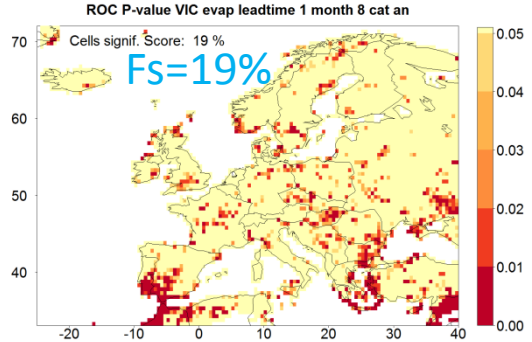
Start July 1 | **Start May 1**

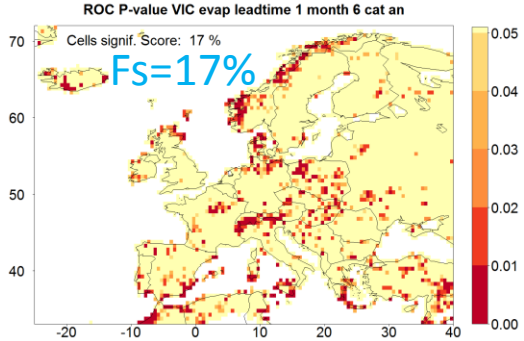
first month



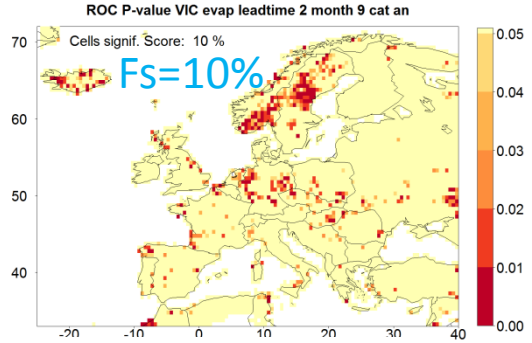


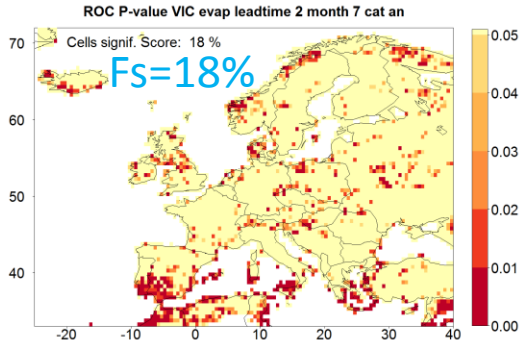
second month





third month





- Some skill beyond first month only for starts from February to August
- Enhanced skill in southern Mediterranean for starts from April to July (like for runoff)

WAGENINGEN UNIVERSITY
WAGENINGEN UR

EUPORIAS

SOIL MOISTURE – VIC – upper tercile

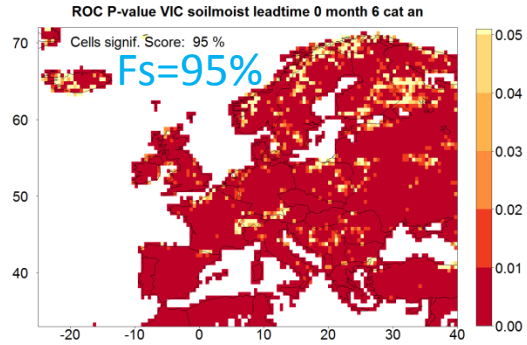
Start June 1

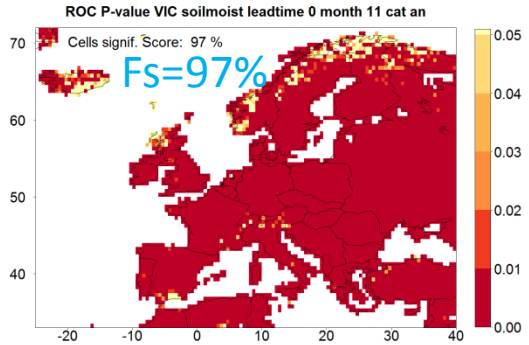
Start November 1

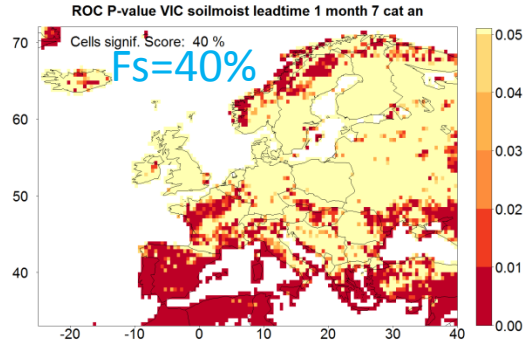
first month

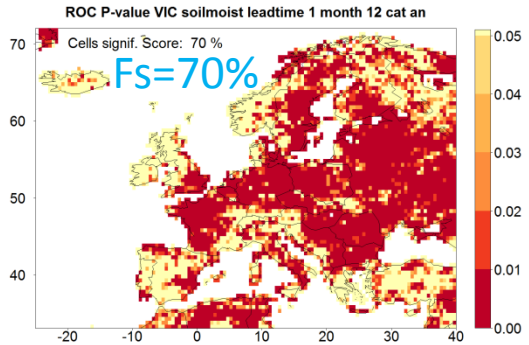
second month

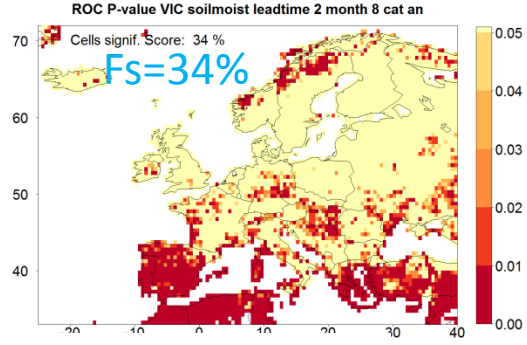
third month

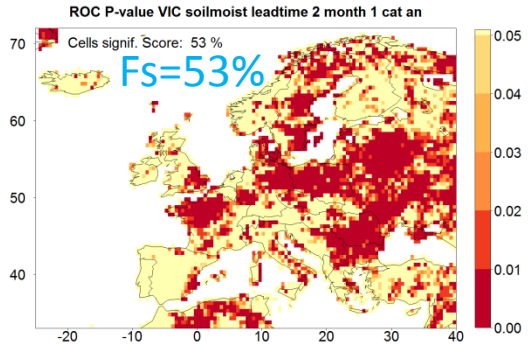












- Fractions of cells with significant skill are similar to runoff
- More skill for starts from Oct. to Jan.; less for starts from Febr. to July
- Like for runoff there is enhanced skill in southern Mediterranean for starts from April to July

WAGENINGEN UNIVERSITY
WAGENINGEN UR

EUPORIAS

SOME CONCLUSIONS

- There is hardly skill in the hindcasts of the precipitation beyond the first month
- There is considerable skill in the runoff and soil moisture hindcasts
- There is some similarity in the timing and location of the skill for these two variables
- Since this skill is not due to precipitation, it is most probably due to the initial conditions
- VIC has more skill than LPJmL

OUTLOOK

- Make hindcasts with climatological forcing so that predictability can only be caused by initial conditions
- Same but replace snow initial conditions by its climatology
- Same but replace soil moisture initial conditions by its climatology
- Make ensemble of hydrological models hindcasts (including E-HYPE)
- and analyse skill
- Determine skill by comparison with discharge observations