



Verification at RWC Belgium

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What do we forecast?

- probability of solar flares
- K-index
- 10.7 cm flux
- proton events

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:Issued: 2013 Sep 30 1259 UTC
:Product: documentation at http://www.sidc.be/products/meu
#-----#
# DAILY BULLETIN ON SOLAR AND GEOMAGNETIC ACTIVITY from the SIDC #
# (RWC Belgium) #
#-----#
SIDC URSIGRAM 30930
SIDC SOLAR BULLETIN 30 Sep 2013, 1209UT
SIDC FORECAST (valid from 1230UT, 30 Sep 2013 until 02 Oct 2013)
SOLAR FLARES : Quiet conditions (<50% probability of C-class flares)
GEOMAGNETISM : Quiet (A<20 and K<4)
SOLAR PROTONS : Proton event in progress (>10 MeV)
PREDICTIONS FOR 30 Sep 2013 10CM FLUX: 103 / AP: 007
PREDICTIONS FOR 01 Oct 2013 10CM FLUX: 097 / AP: 007
PREDICTIONS FOR 02 Oct 2013 10CM FLUX: 097 / AP: 007
COMMENT: A yet unnumbered, flux emerging region in the South-Eastern solar
quadrant
might develop flaring potential in the coming days. A large filament in
the solar north-western hemisphere erupted Sunday evening around 21:45UT.
The event was associated with a long duration C1.2 flare peaking at 23:39.
The GOES proton flux level has crossed the event threshold (> 10 pfu for
10 MeV). LASCO observed a full-halo CME. In STEREO-B Cor2, the plane-of the
sky speed is of the order of 600km/s. In the coming 3 days, we expect
quiet geomagnetic conditions. The halo-CME of midnight Sept 29/30 is
expected to arrive midnight October 2/3.
TODAY'S ESTIMATED ISN : 037, BASED ON 17 STATIONS.

SOLAR INDICES FOR 29 Sep 2013
WOLF NUMBER CATANIA : ///
10CM SOLAR FLUX : 103
AK CHAMBON LA FORET : 007
AK WINGST : 003
ESTIMATED AP : 003
ESTIMATED ISN : 032, BASED ON 26 STATIONS.
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Verification analysis: what?

Quantitative evaluation:

- Bias: over/underestimation?
- Accuracy: how large are our errors?
- Hit rate: how well do we predict events?
- Sharpness: ability to predict extreme events?
- Skill: how accurate with respect to reference?
- ...

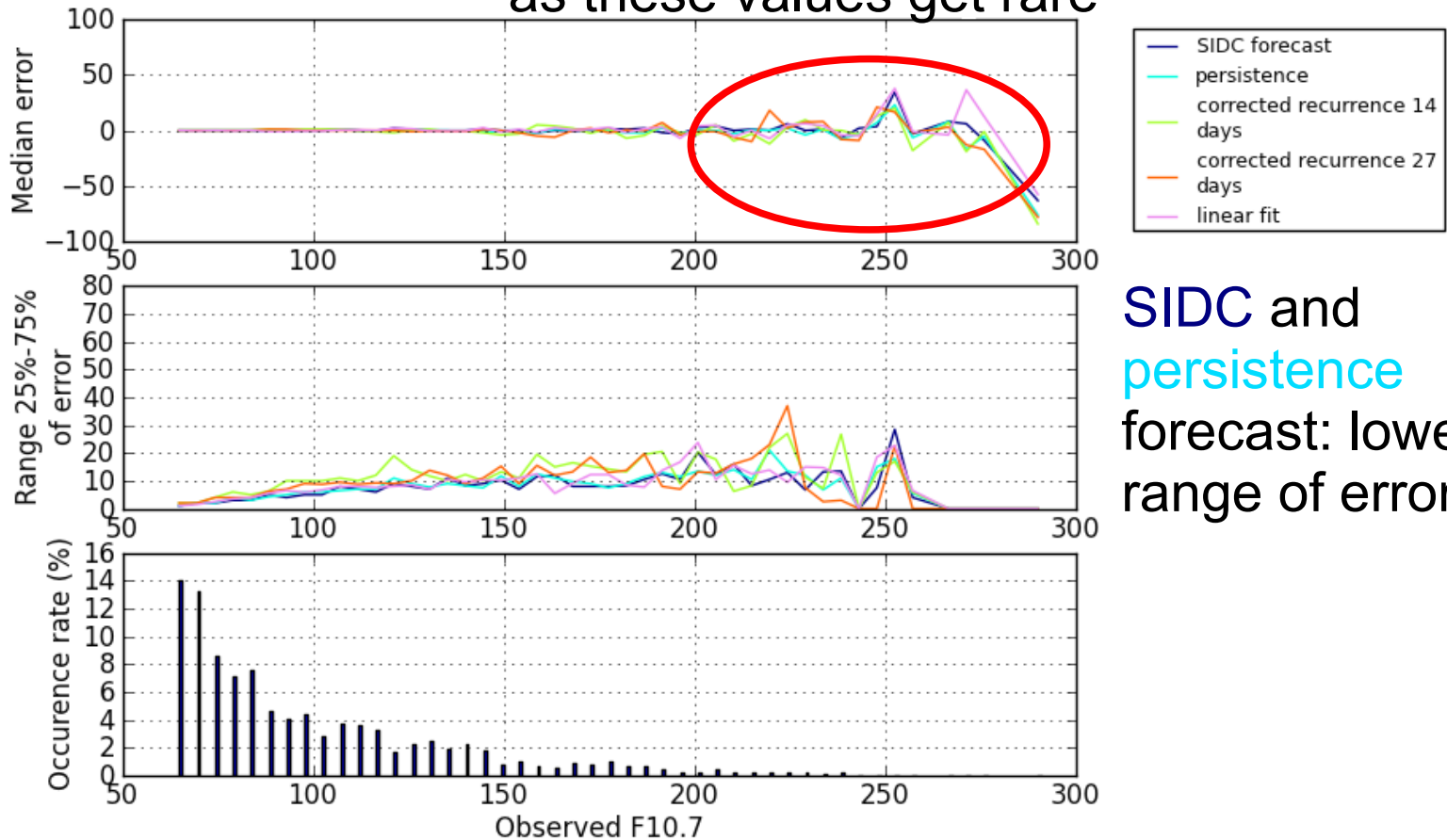
Benefits:

- strong and weak points
- compare
- monitor

Solar flux – error analysis

day 1

errors get larger if $F_{10.7} \geq 200$ sfu,
as these values get rare

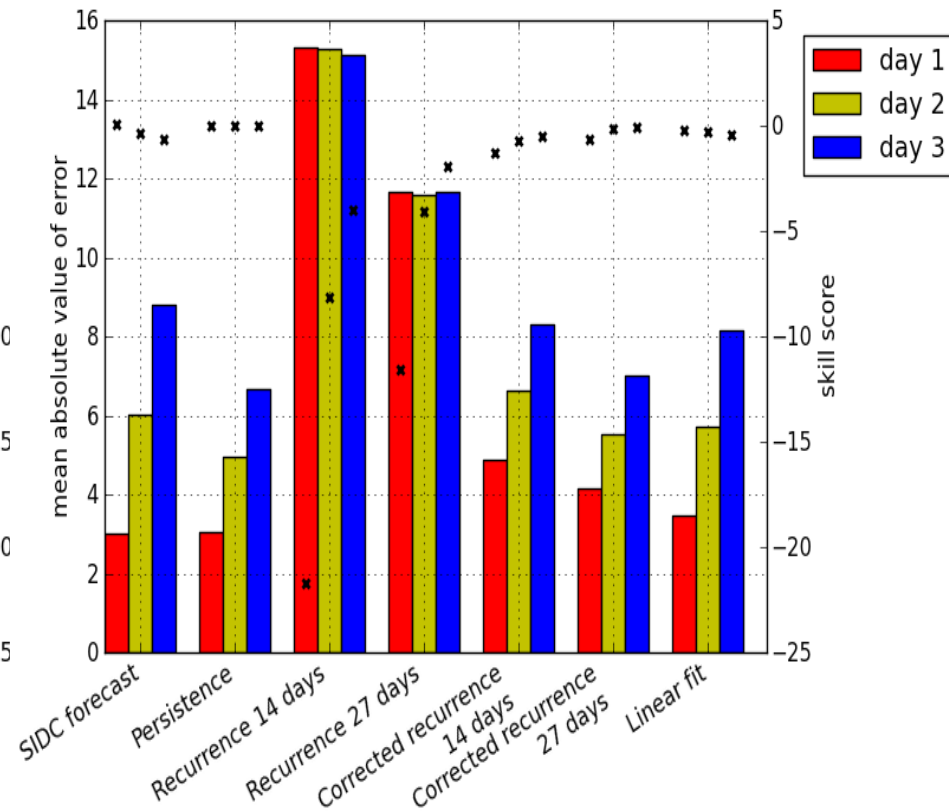
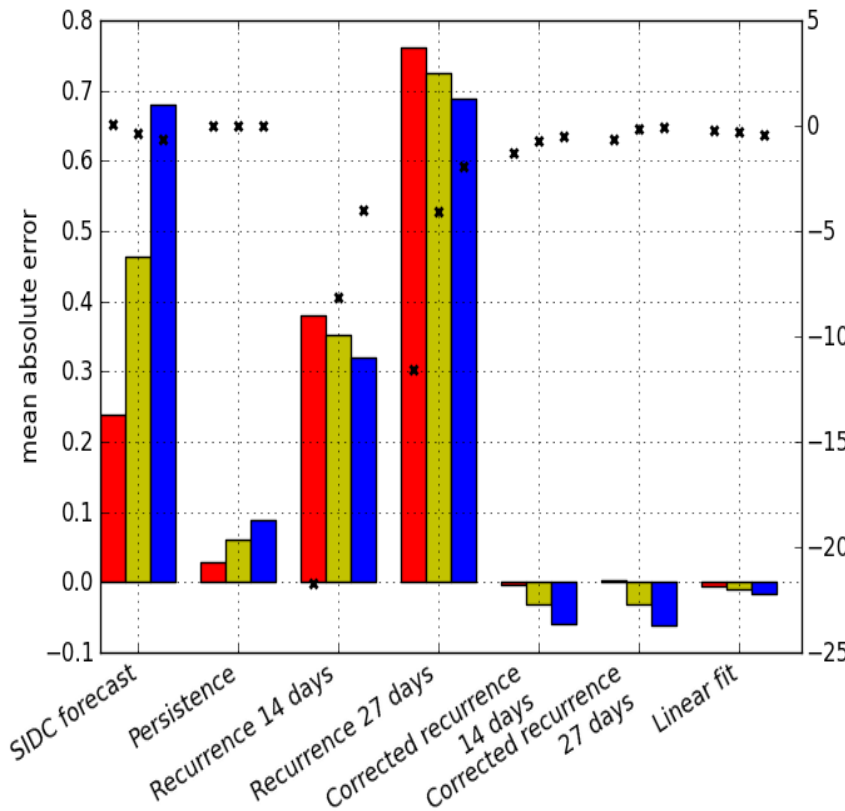


SIDC and
persistence
forecast: lowest
range of errors

Solar flux – error analysis

'bias of the errors'

'size of the errors'



skill score (x): $1 - \frac{mse}{mse_{ref}}$

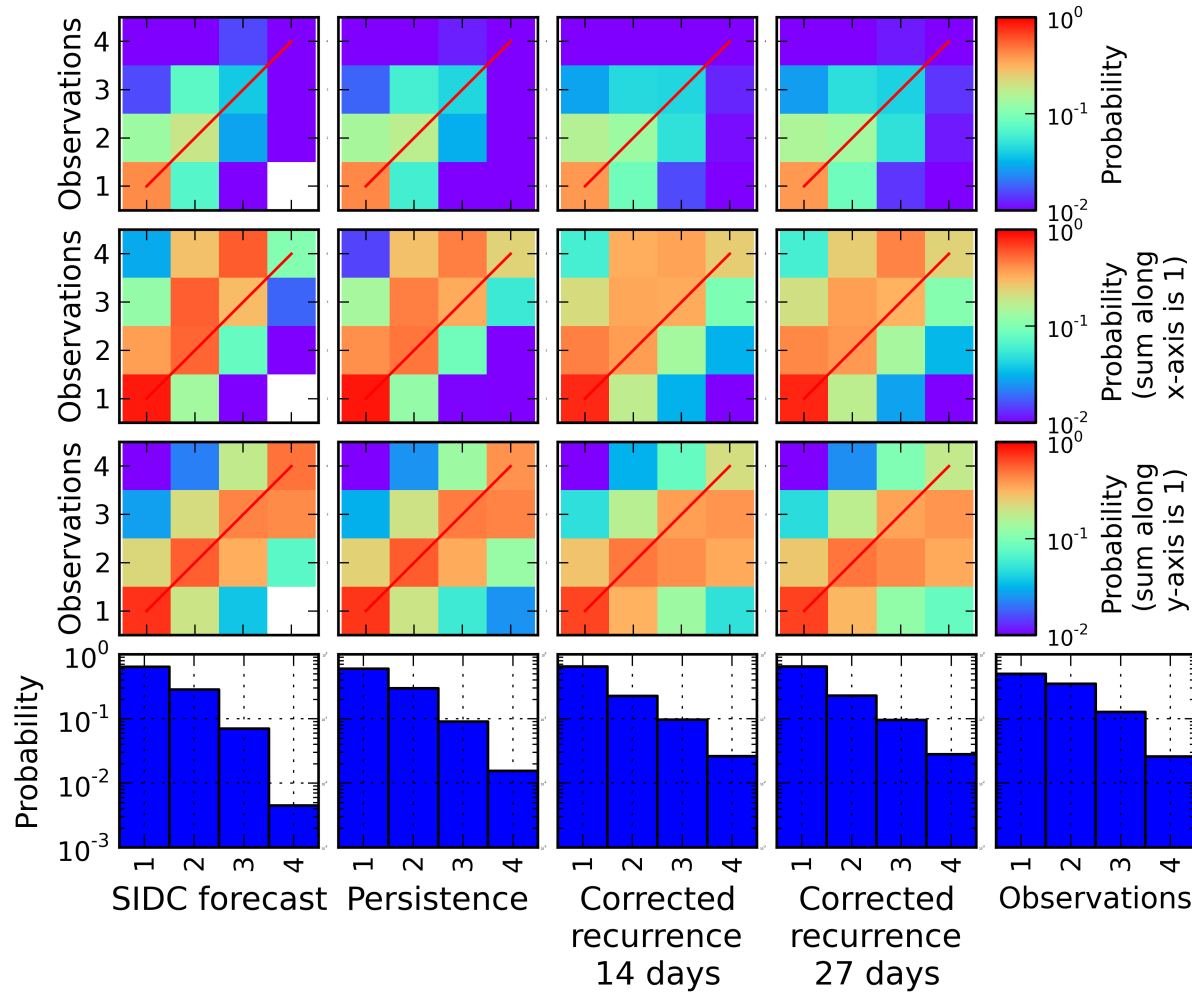
1: optimal, 0: as good as reference model

Forecast of solar flares

- flare classes: B, C, M, X measured in X-ray by GOES

level	flare class	wording in bulletin
<50% probability of C-class flares	B or lower	quiet conditions
C-class flares expected, probability $\geq 50\%$	C	eruptive conditions
M-class flares expected, probability $\geq 50\%$	M	active conditions
X-class flares expected, probability $\geq 50\%$	X	major flares

Color grids forecast vs observations

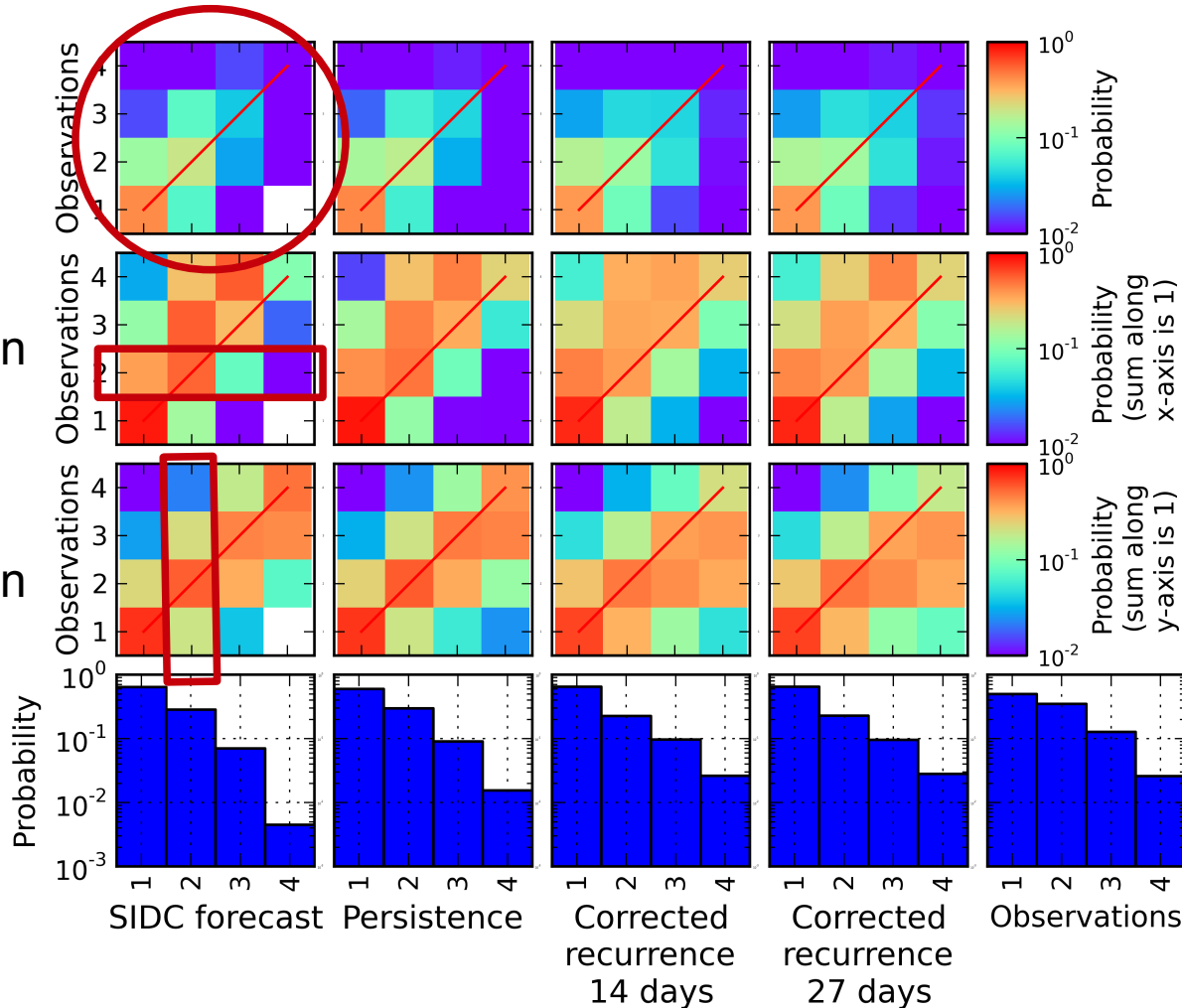


Color grids forecast vs observations

sum across
grid= 1

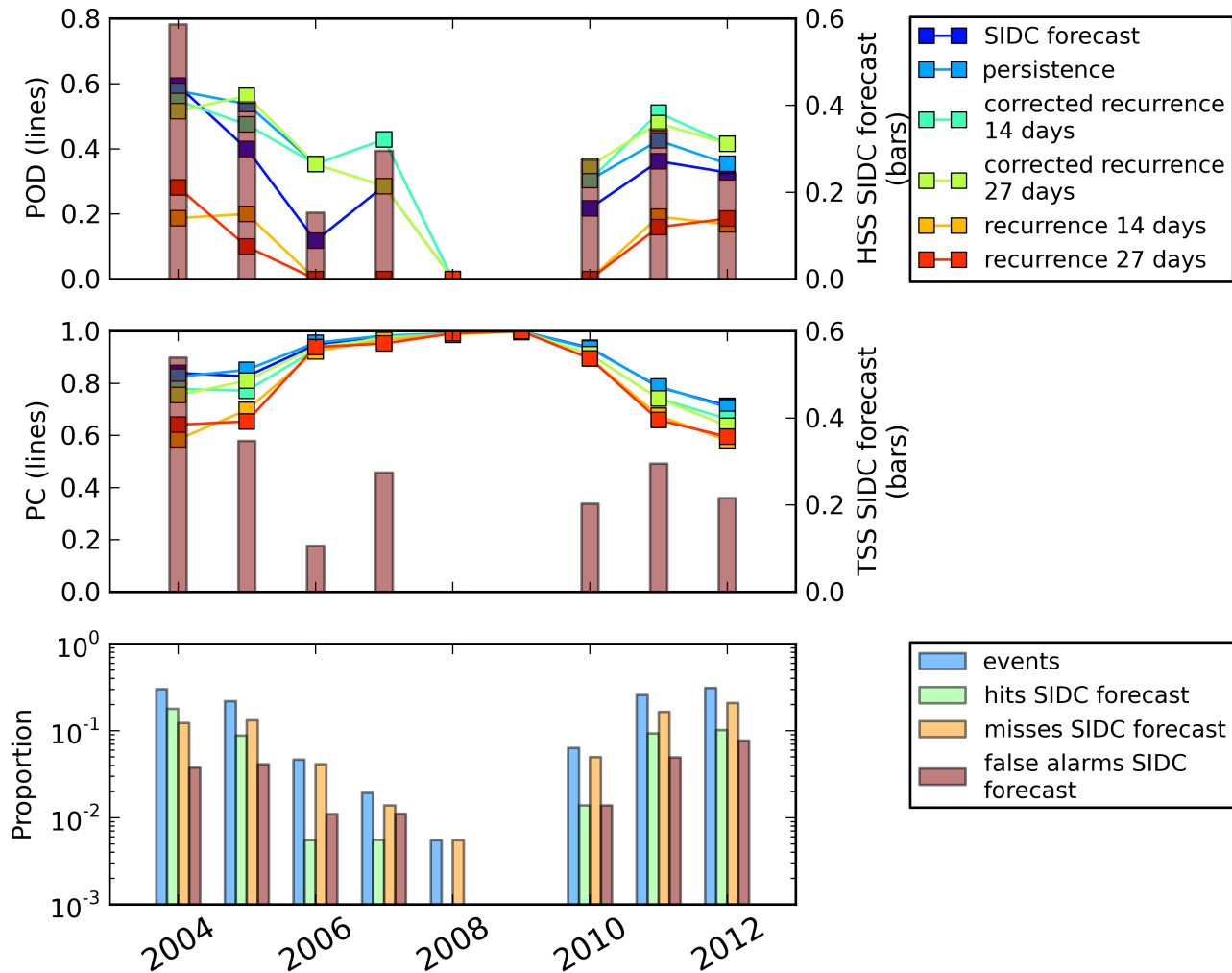
conditional on
observation

conditional on
forecast



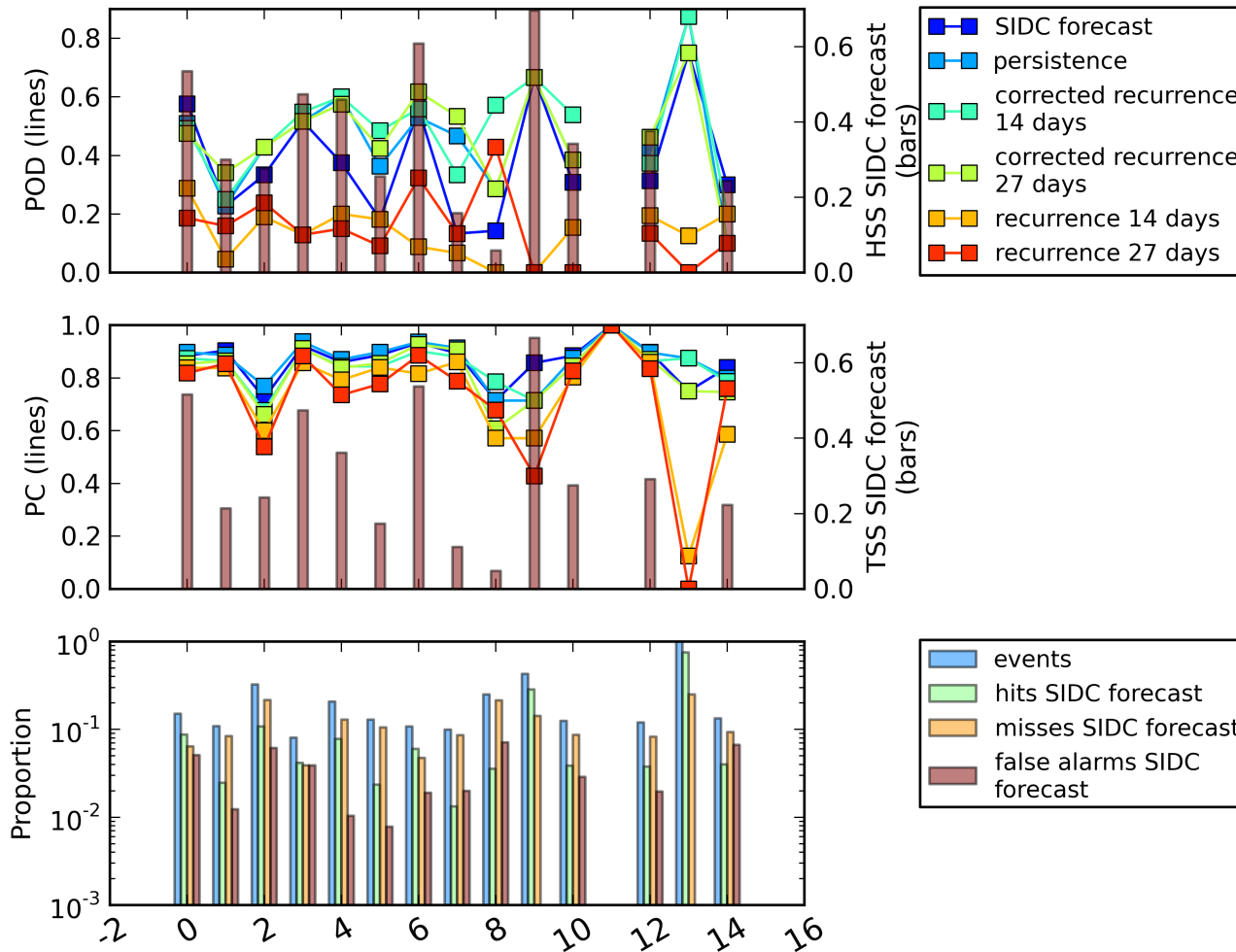
Forecast of solar flares

M/X flares



Effect of the forecaster

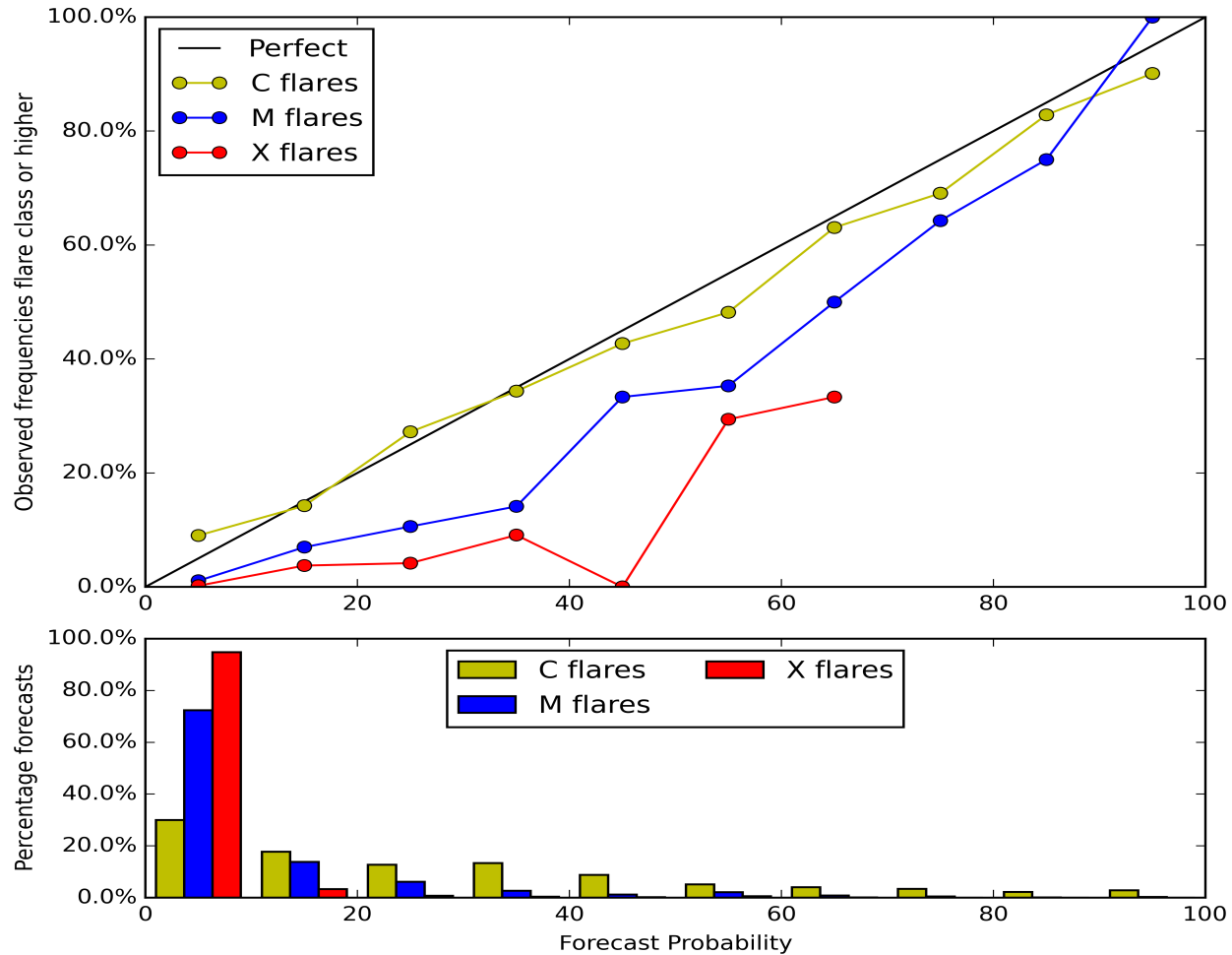
M/X flares



forecaster (on x-axis)	#days on duty
0	391
1	406
2	65
3	385
4	193
5	256
6	316
7	151
8	28
9	7
10	208
11	39
12	559
13	8
14	75

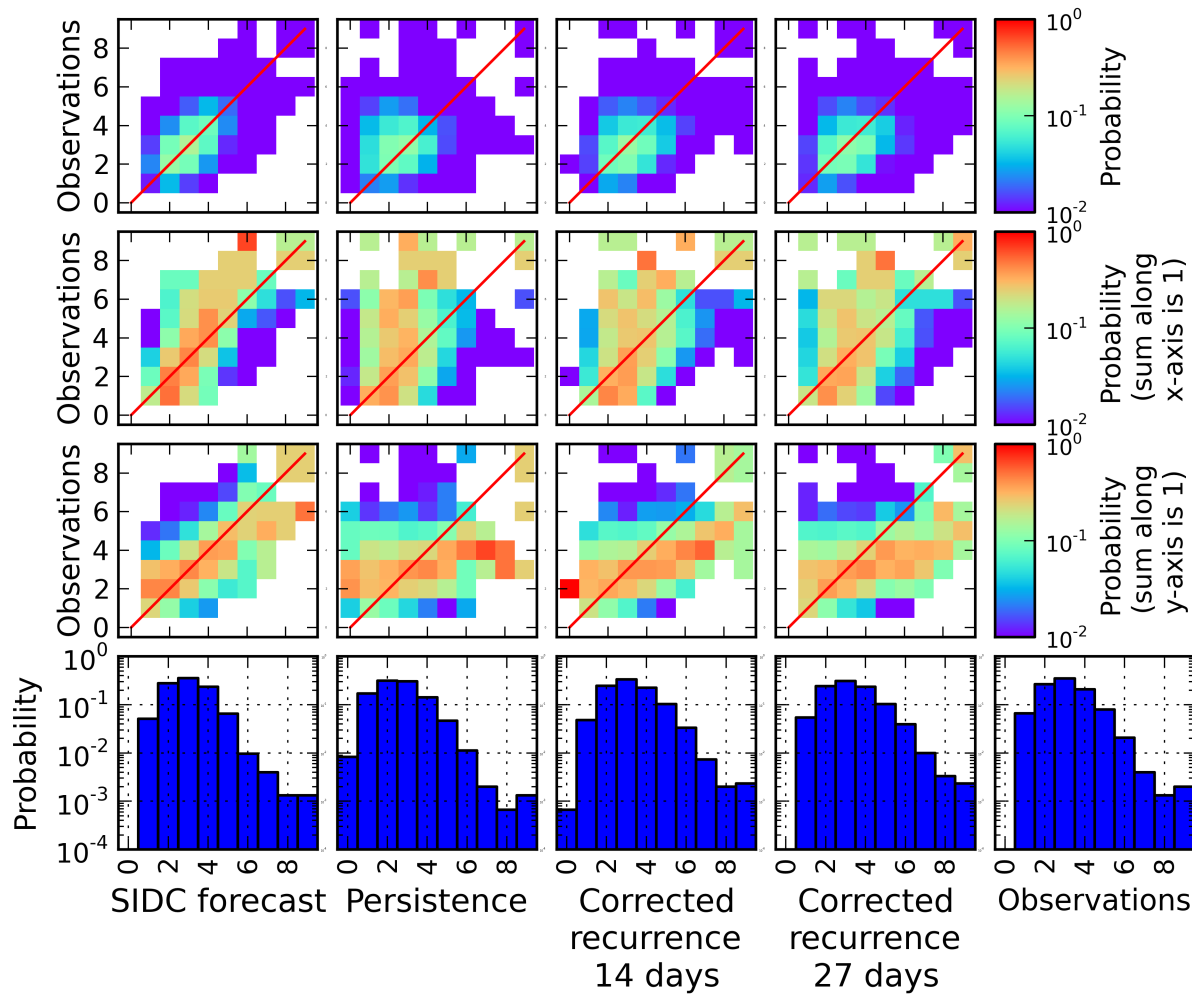
Reliability diagram

Probabilities per active region



Geomagnetic K-index

full scale (0-9)



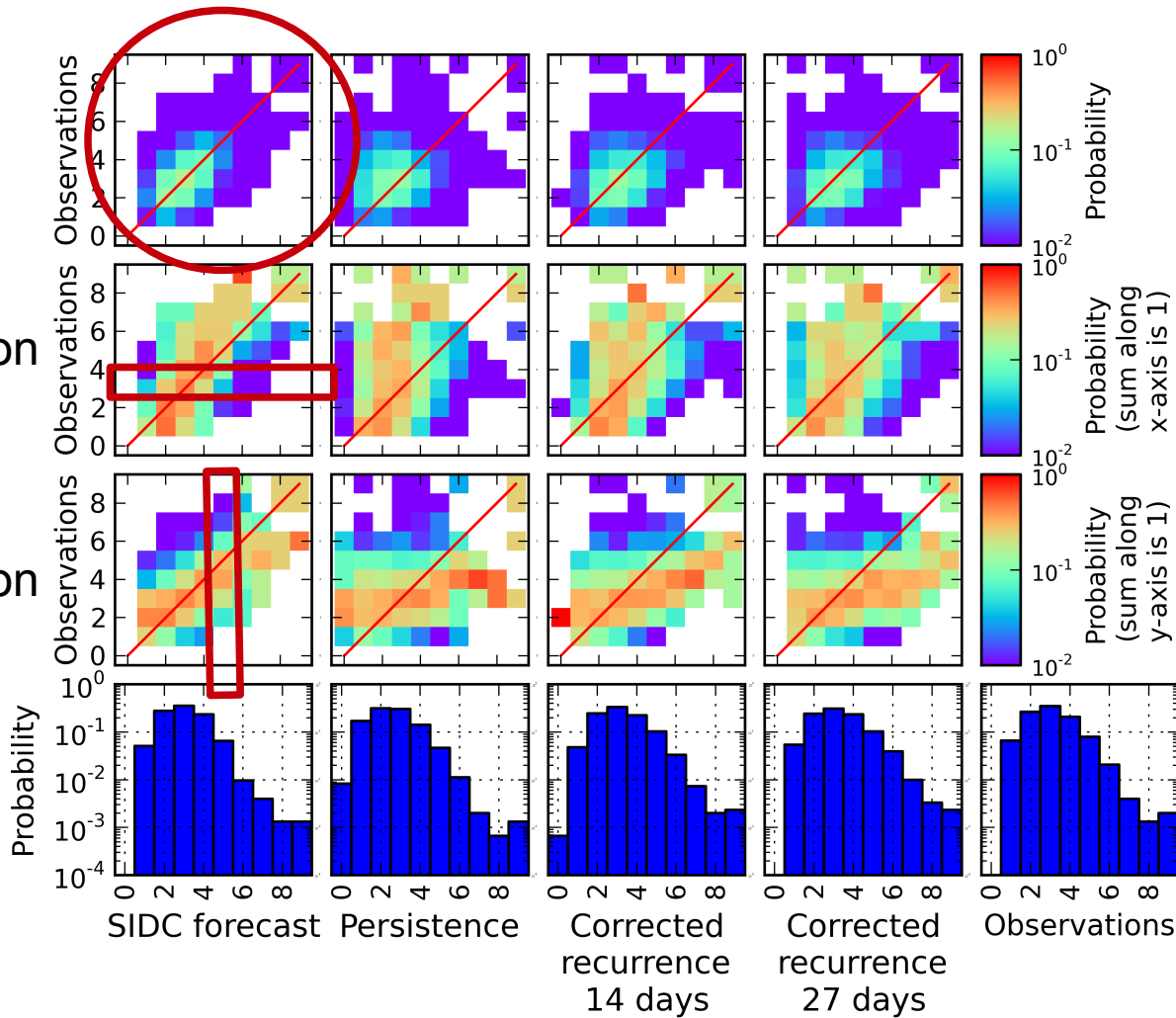
Geomagnetic K-index

full scale (0-9)

sum across
grid= 1

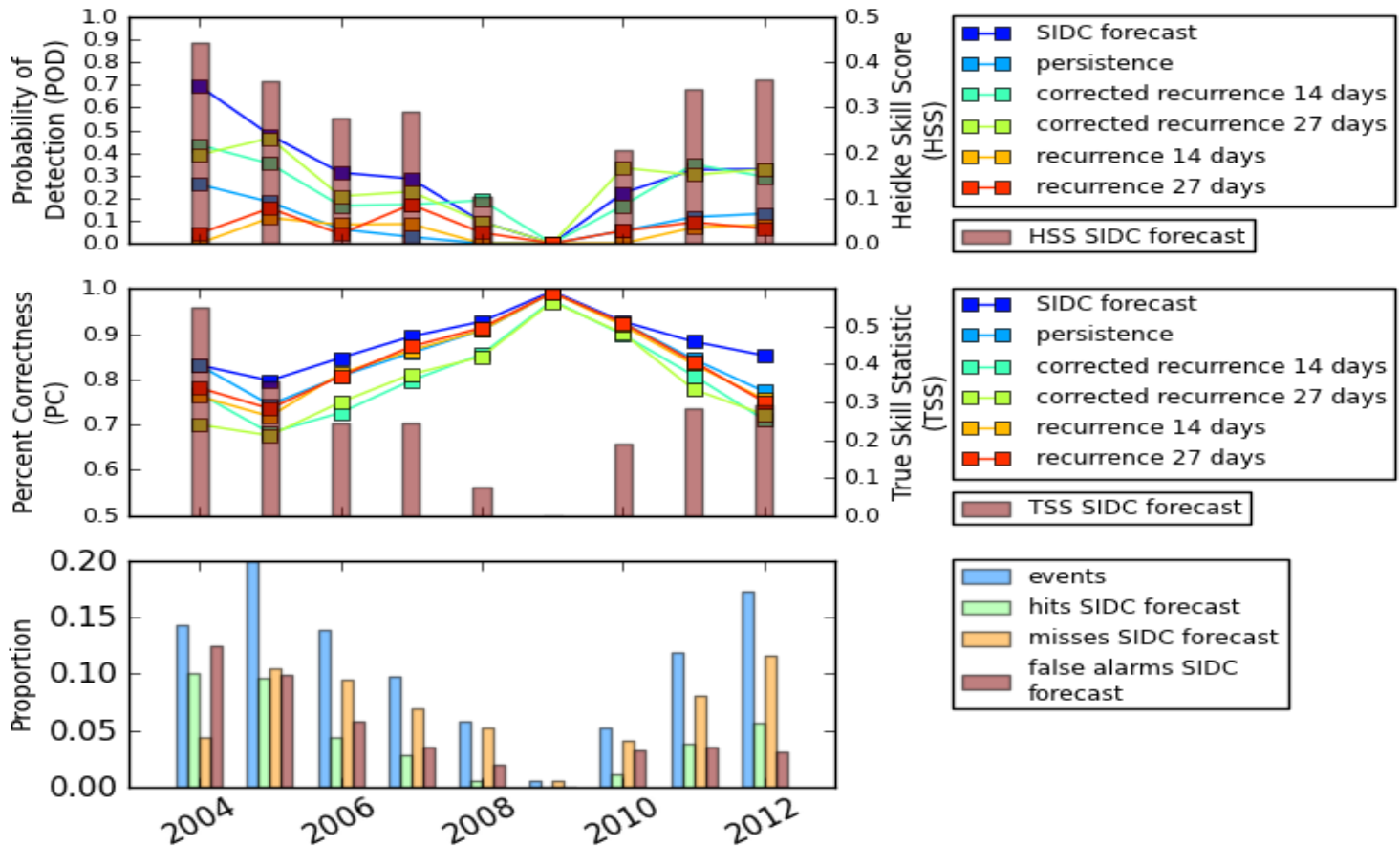
conditional on
observation

conditional on
forecast



Forecast of a geomagnetic storm ($K \geq 5$)

- SIDC forecast overall best
- rare events: hard to predict (high PC, but low POD)



Next steps

- implement insights from this analysis: e.g. (conditional) error bars
- continuously reevaluate SW forecasting
- better understand situations with correct versus erroneous forecast
- focus on forecast probabilities
- comparison to forecast of other RWCs
- comparison to more sophisticated numerical models
- extend analysis on influence of the forecaster
- ...

Website: <http://sidc.be/forecastverification>

Devos et al (2014): <http://dx.doi.org/10.1051/swsc/2014025>

Thank you for the attention!



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