Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

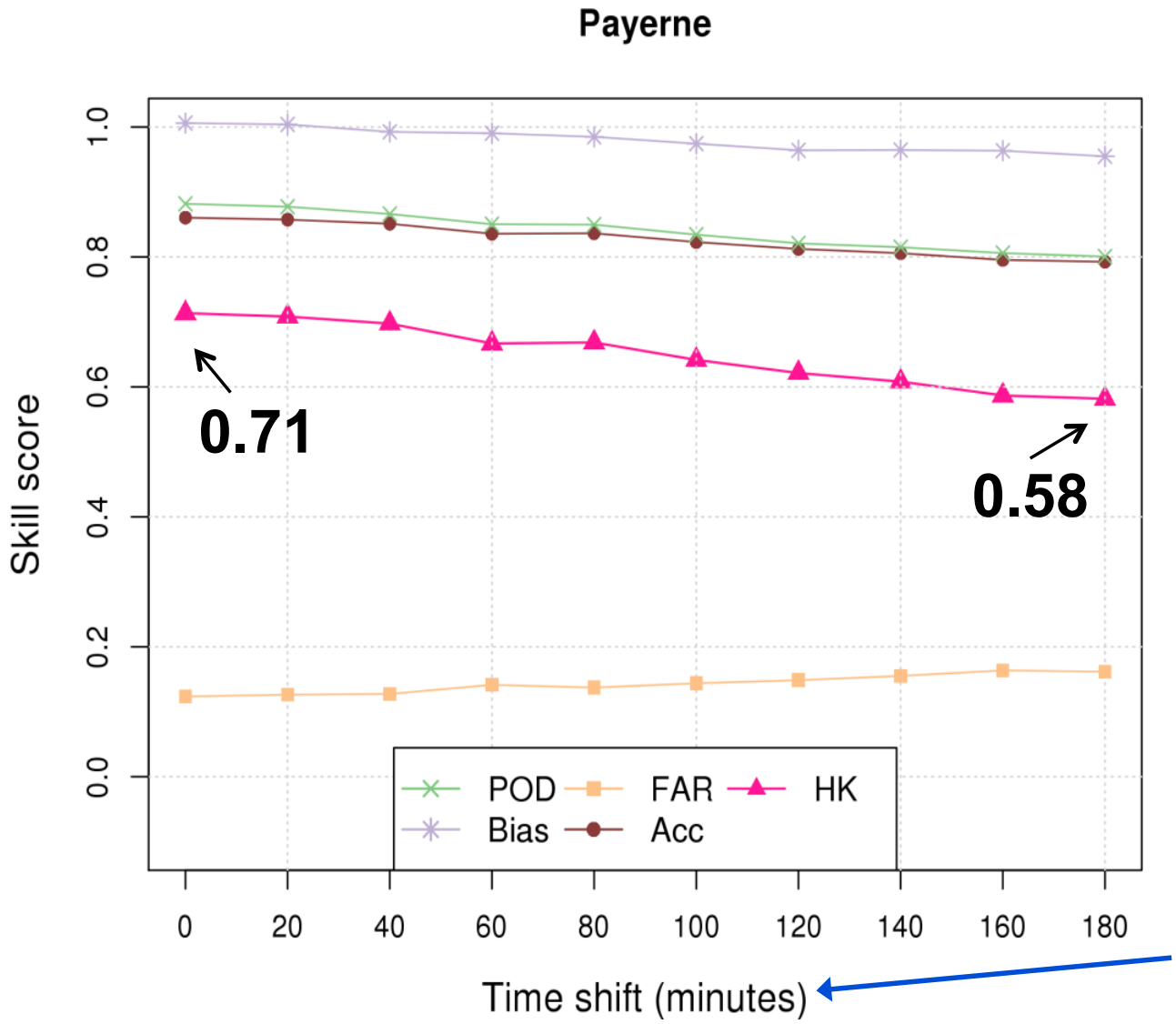
Towards characterizing the uncertainty of in-situ cloud observations:

a case study for the ESA CCI Cloud project validating satellite-based cloud amount in mountain and polar regions

Jędrzej S. Bojanowski
Reto Stöckli

cloud cci

Motivation



ESA CCI Clouds

MODIS-derived cloud amount evaluation

Cloud: 7-8 okta
Cloudless: 0-1 okta

Maximum time difference between satellite overpass and SYNOP observation

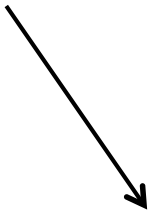
Objective & hypotheses

To systematically analyse the impact of the time difference between satellite overpasses and in-situ observations on evaluation results of satellite-derived data

Increase in time difference (shift):

\+ increases a number of samples (up to no. of overpasses)

– makes satellite and in-situ data less comparable



- Cloud amount temporal variability
- Error temporal variability
- …
- Accuracy of satellite-derived data

Methods

		in-situ: cloud	in-situ: no-cloud
model	cloud	a	b
model	no-cloud	c	d

For a given location:

DATA

- Satellite-derived cloud amount (binary) with exact overpass times
- 10-minute resolution APCADA cloud amount classified to binary
- Times of 3h or 6h SYNOP

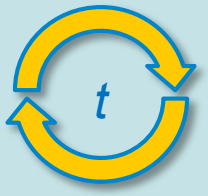
Real HK

- Validate satellite-derived cloud amount against APCADA (max. time shift of 5 minutes) Hanssen-Kuipers Discriminant: $\mathrm{HK} = \frac{ad-bc}{(a+c)(b+d)}$

Number of samples (n)

Shift time series by t minutes (e.g. 10 minutes)

- number of samples (to build contingency matrix) for which time difference between overpass and SYNOP is below t minutes
- calculate HK of satellite-derived cloud amount against APCADA shifted by t minutes;
  - 500 times taking randomly n samples from all satellite overpasses

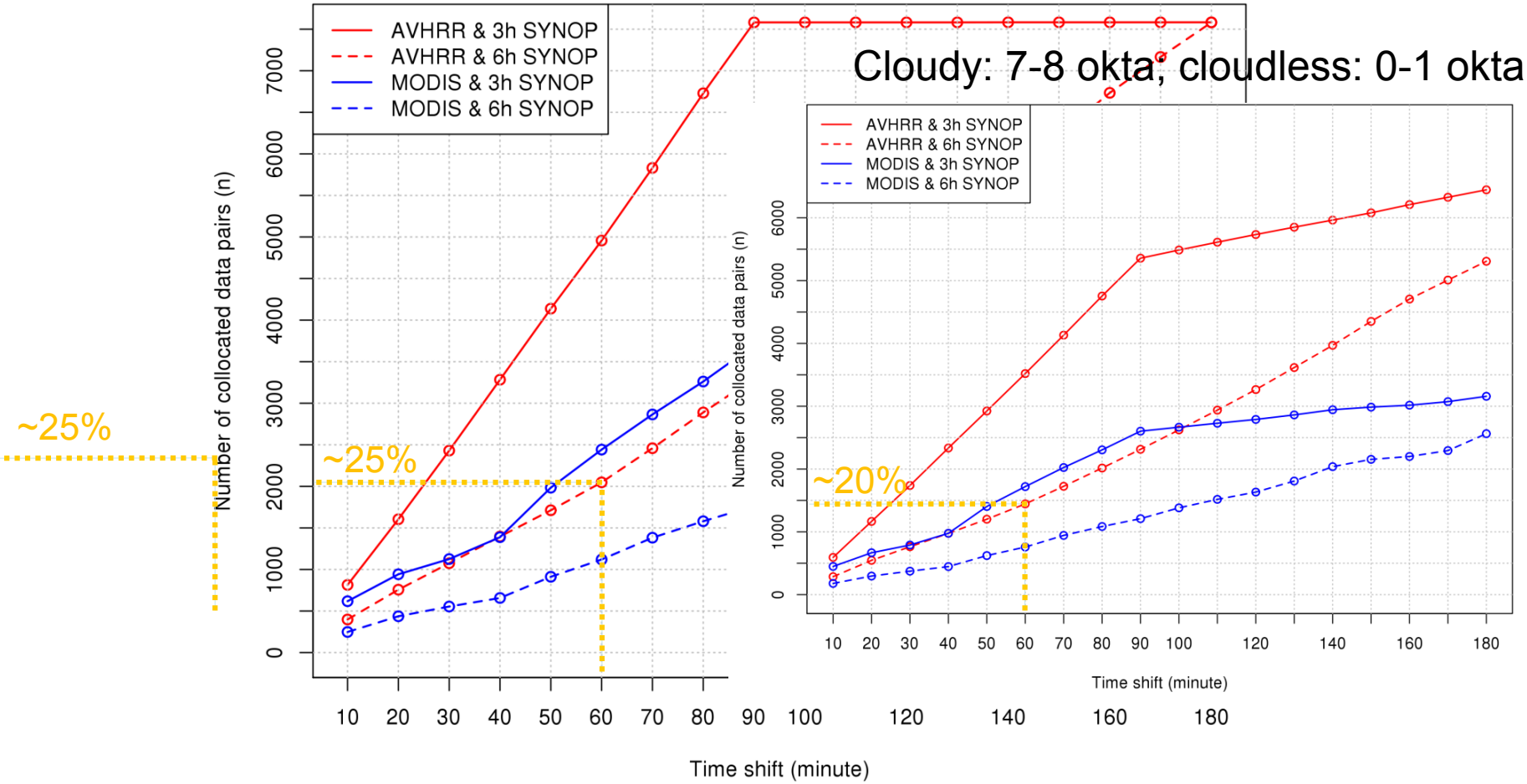


t = 10, 20, …, 90/180

Time shift vs number of samples

3 years of data, SYNOP every 3 or 6 hours

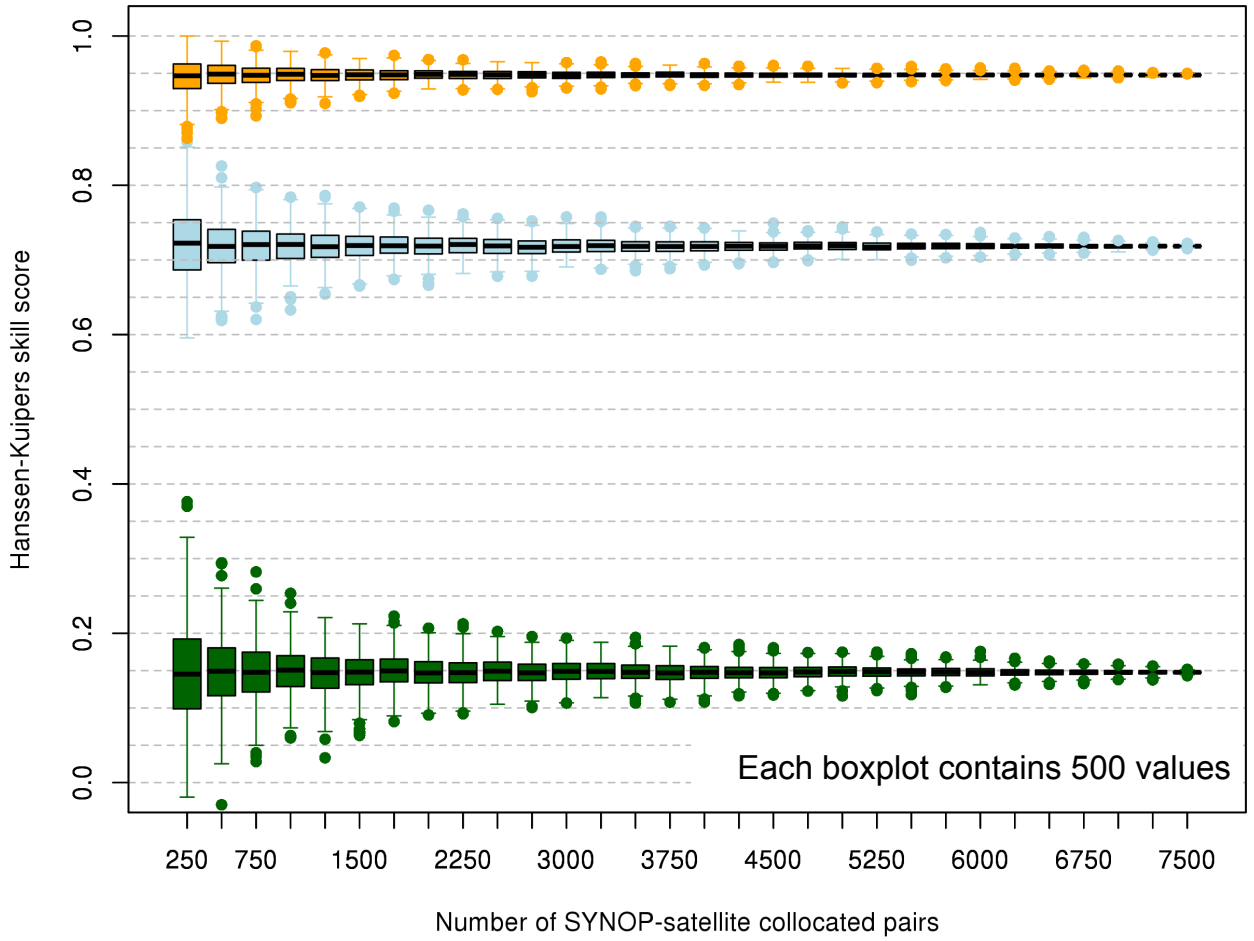
NOAA 15-18: 8 overpasses per day
AQUA&TERRA: 4 overpasses per day



Numbers of samples vs skill score

3 years of data, SYNOP every 3 hours
NOAA 15-18: 8 overpasses per day

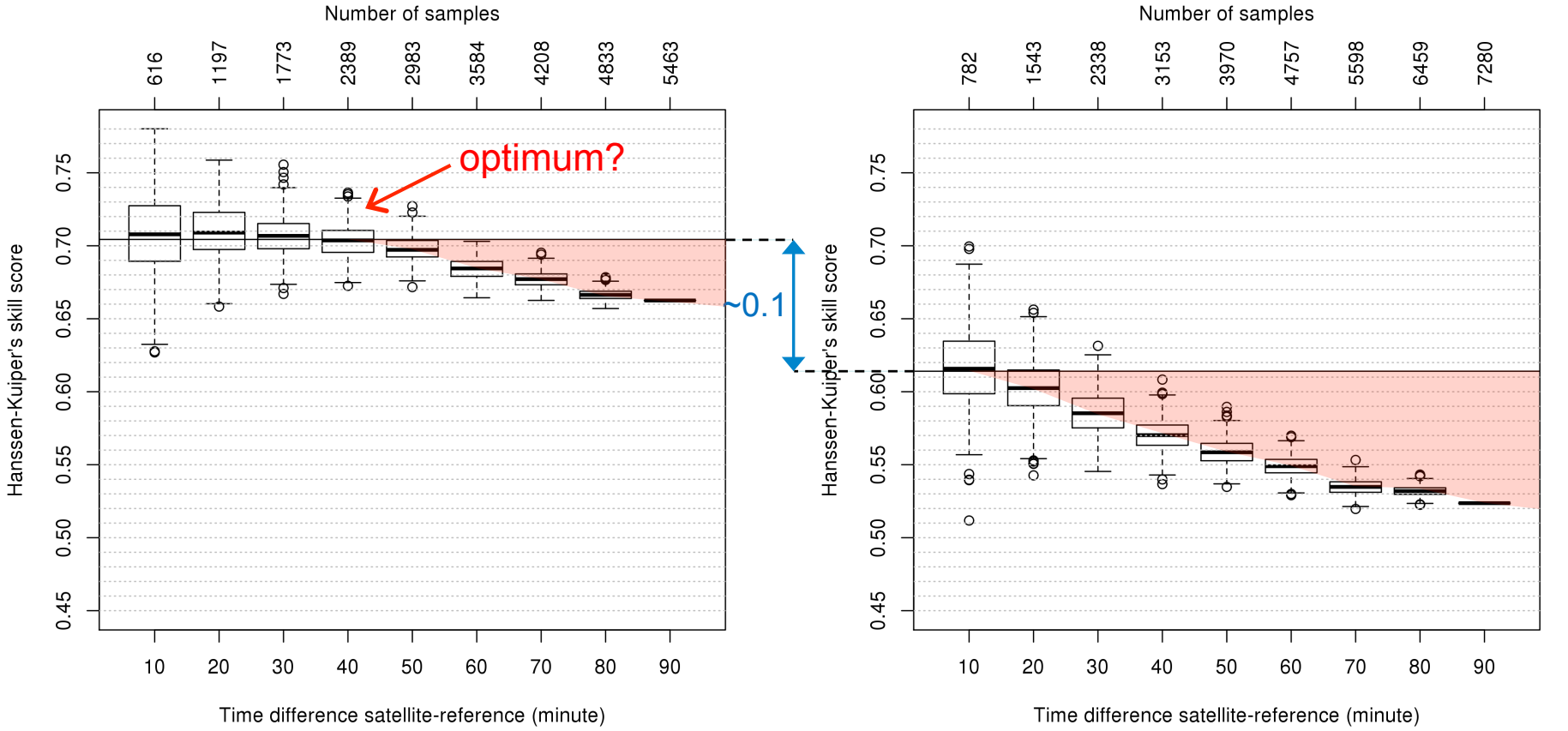
→ maximum number of samples: **7589**



Time shift vs skill score AVHRR

3 years of data, SYNOP every 3 hours
NOAA 15-18: 8 overpasses per day

→ maximum number of samples: **7589**



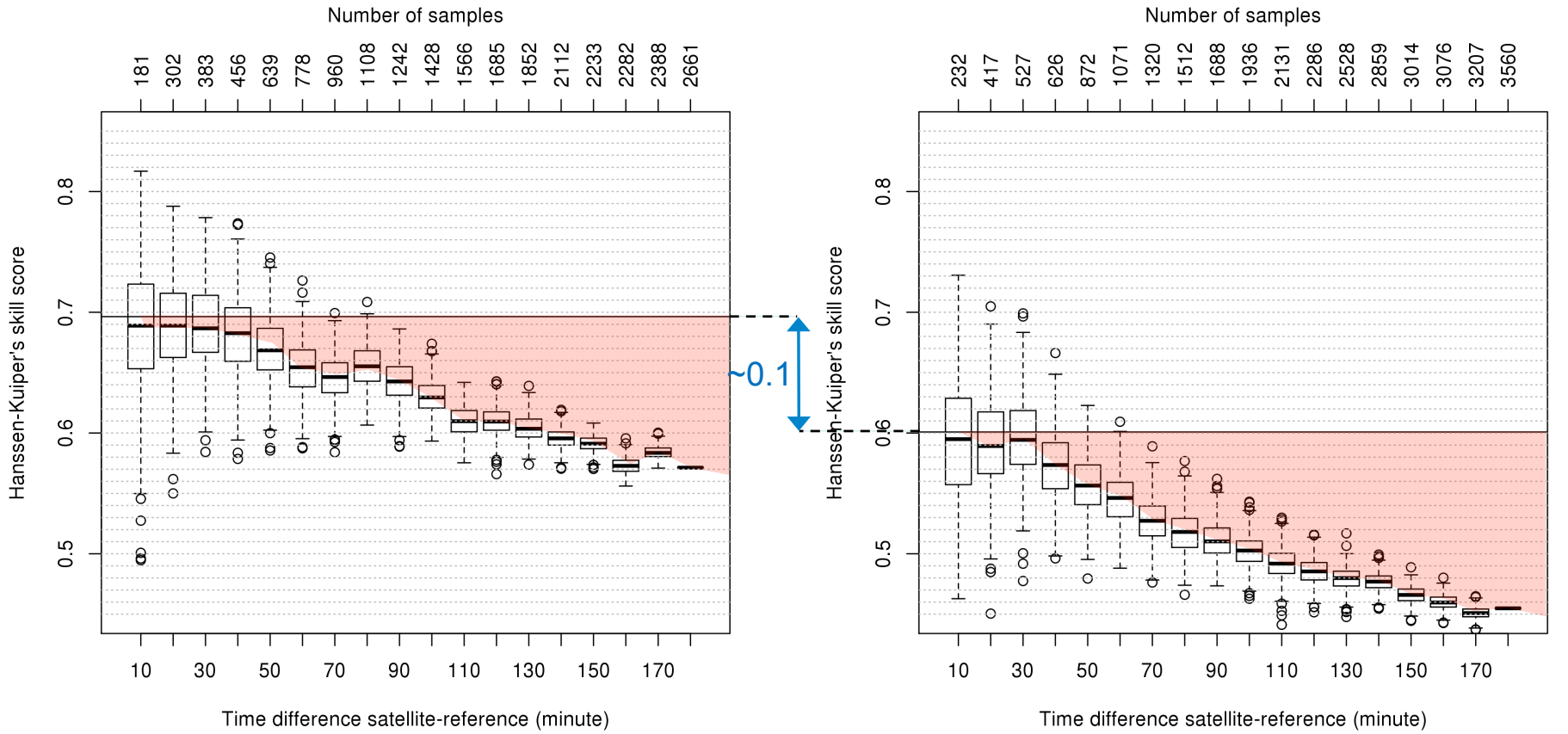
Cloudy 7-8 okta / Cloudless 0-1 okta

Cloudy 5-8 okta / Cloudless 0-3 okta

Time shift vs skill score MODIS

3 years of data, SYNOP every 6 hours
MODIS A/T: 4 overpasses per day

→ maximum number of samples: **3700**



Cloudy 7-8 okta / Cloudless 0-1 okta

Cloudy 5-8 okta / Cloudless 0-3 okta

Conclusions

- Low number of samples introduces uncertainty in skill scores
- Larger time shift allows for a high number of samples, but introduces bias in skill score
- *Compromise between time shift and number of samples is needed*

- Time shift is crucial for high-accuracy data validation
- *Certain accuracies will not be found for a given time shift*

- Impact of time shift on validation results depends on: cloud variability (climatology), error variability, cloud amount classification (okta→binary), number of samples (observations available), ...
- *It makes a systematic analysis of validation uncertantity very complex*
- Still, this uncertainity should be empirically assessed while validating satellite data with low temporal resolution data (i.e. SYNOP)

QUESTIONS? COMMENTS? RECOMMENDATIONS?