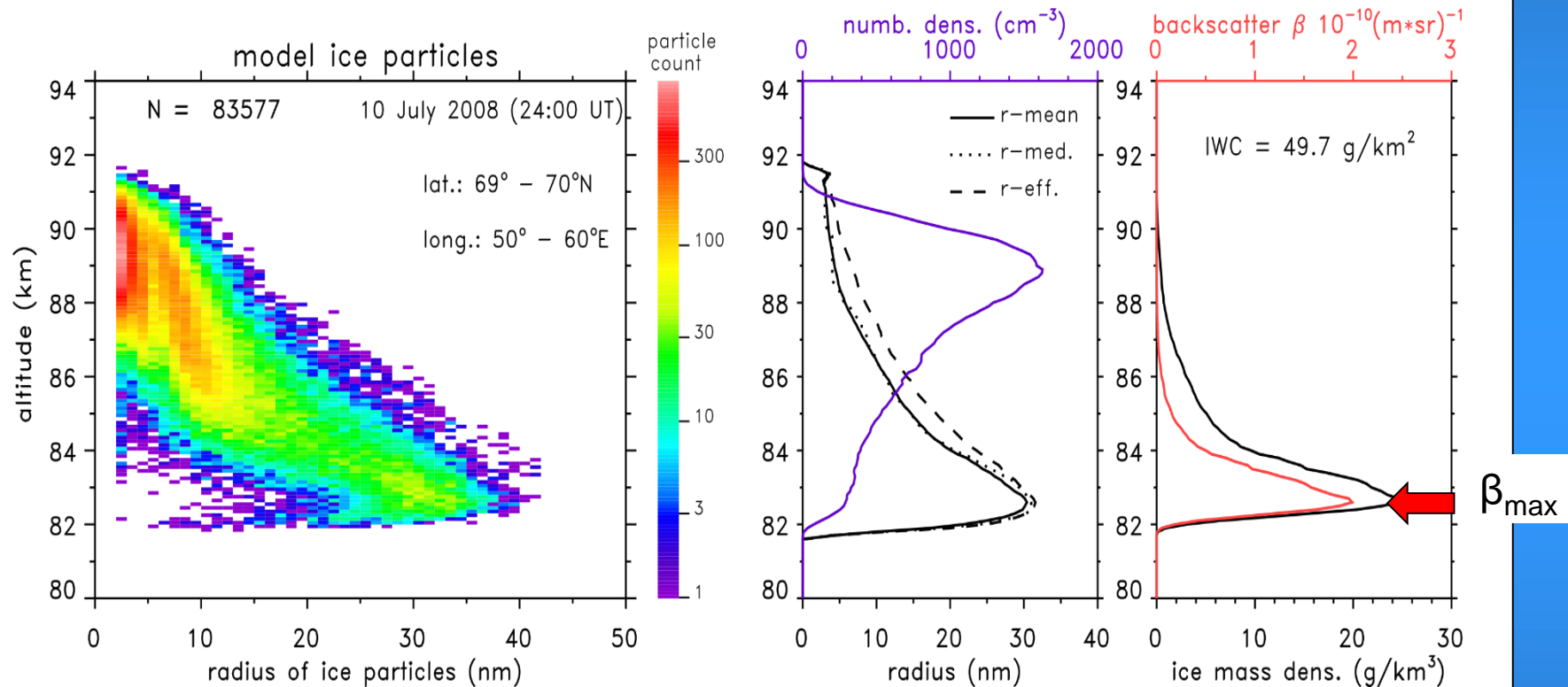


On the long term evolution of noctilucent clouds

Franz-Josef Lübken, Uwe Berger, and Gerd Baumgarten

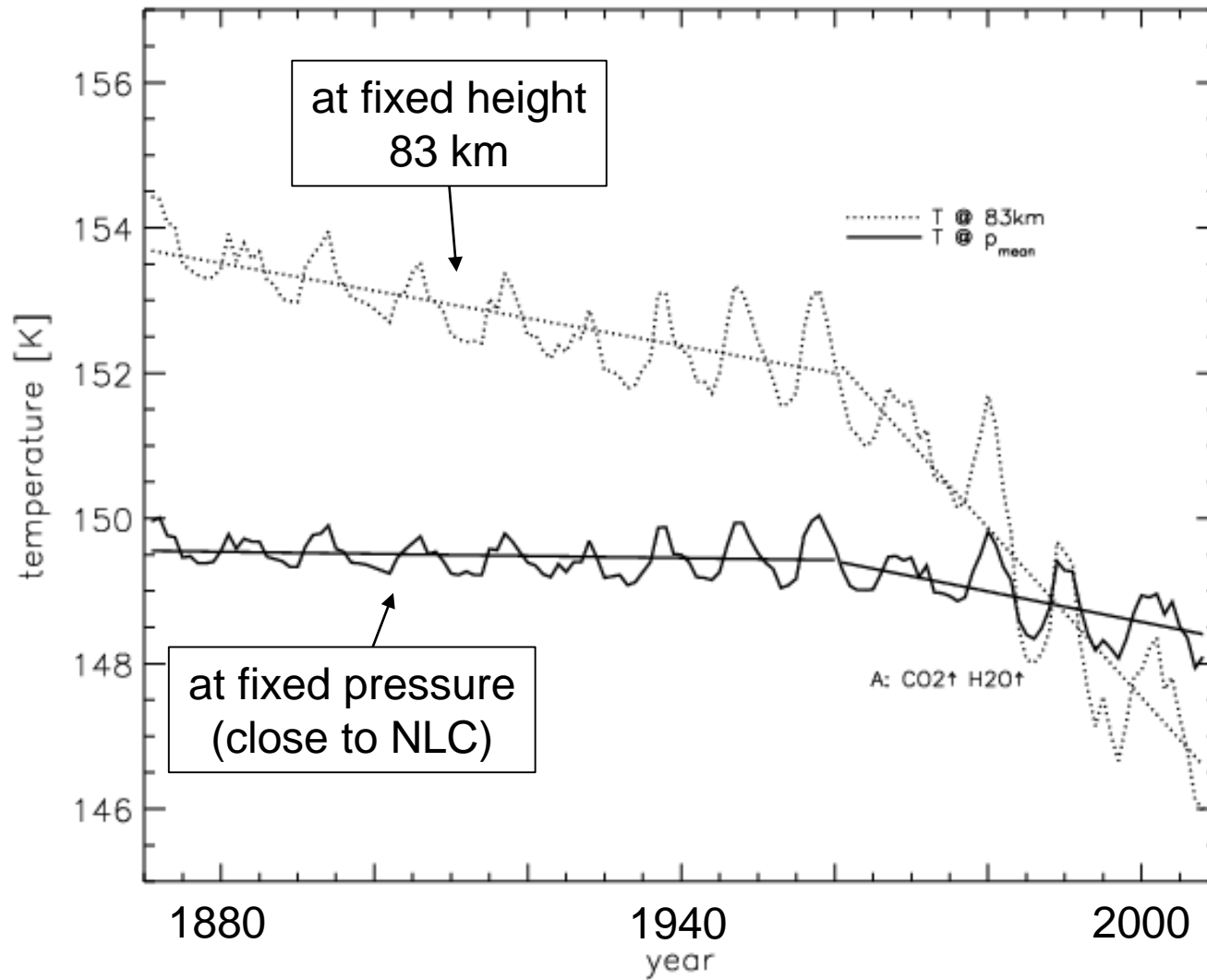


Snapshot of ice cloud at one location



Lübken et al., Geophys. Res. Lett., 2018

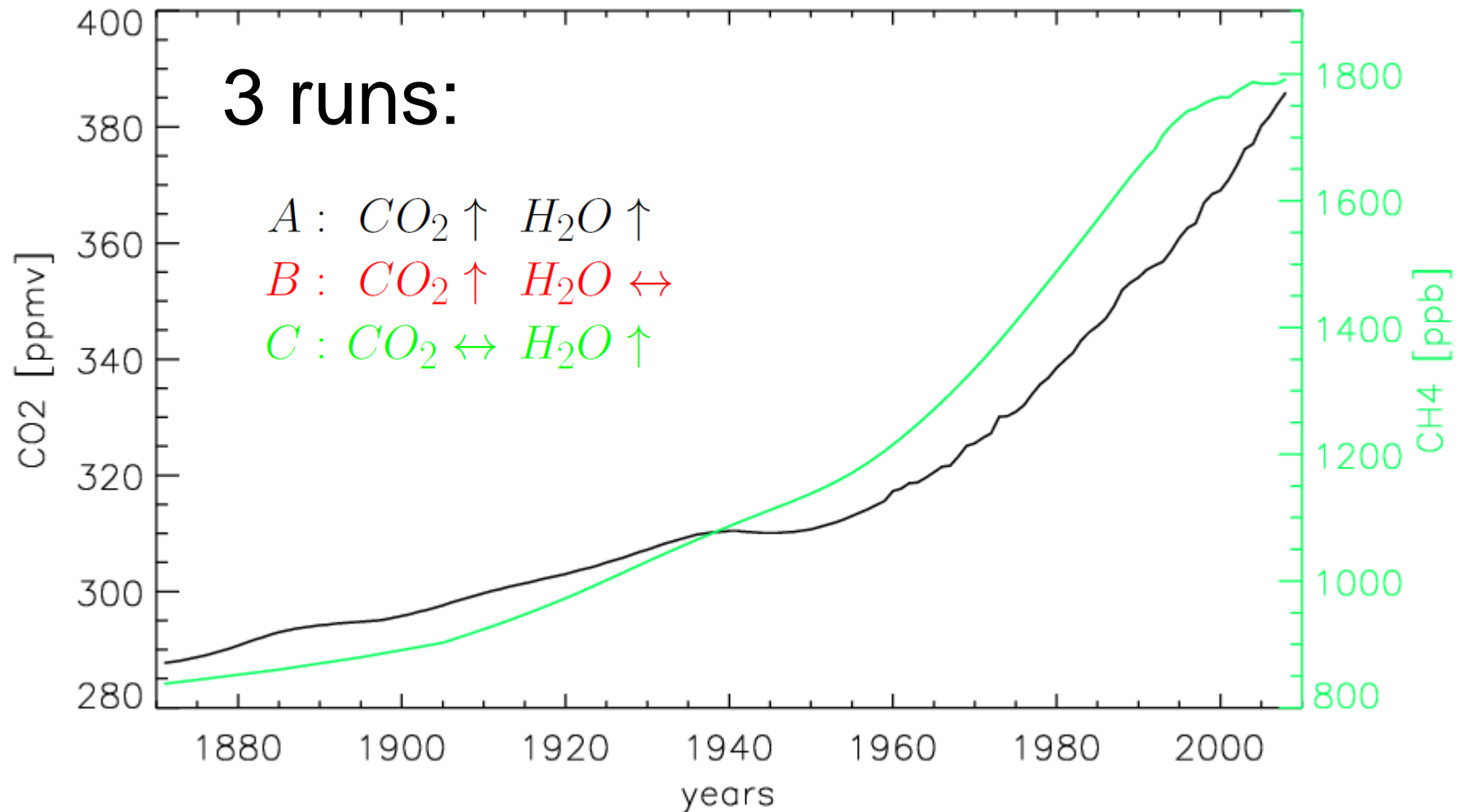
temperature close to NLC: @p and @z



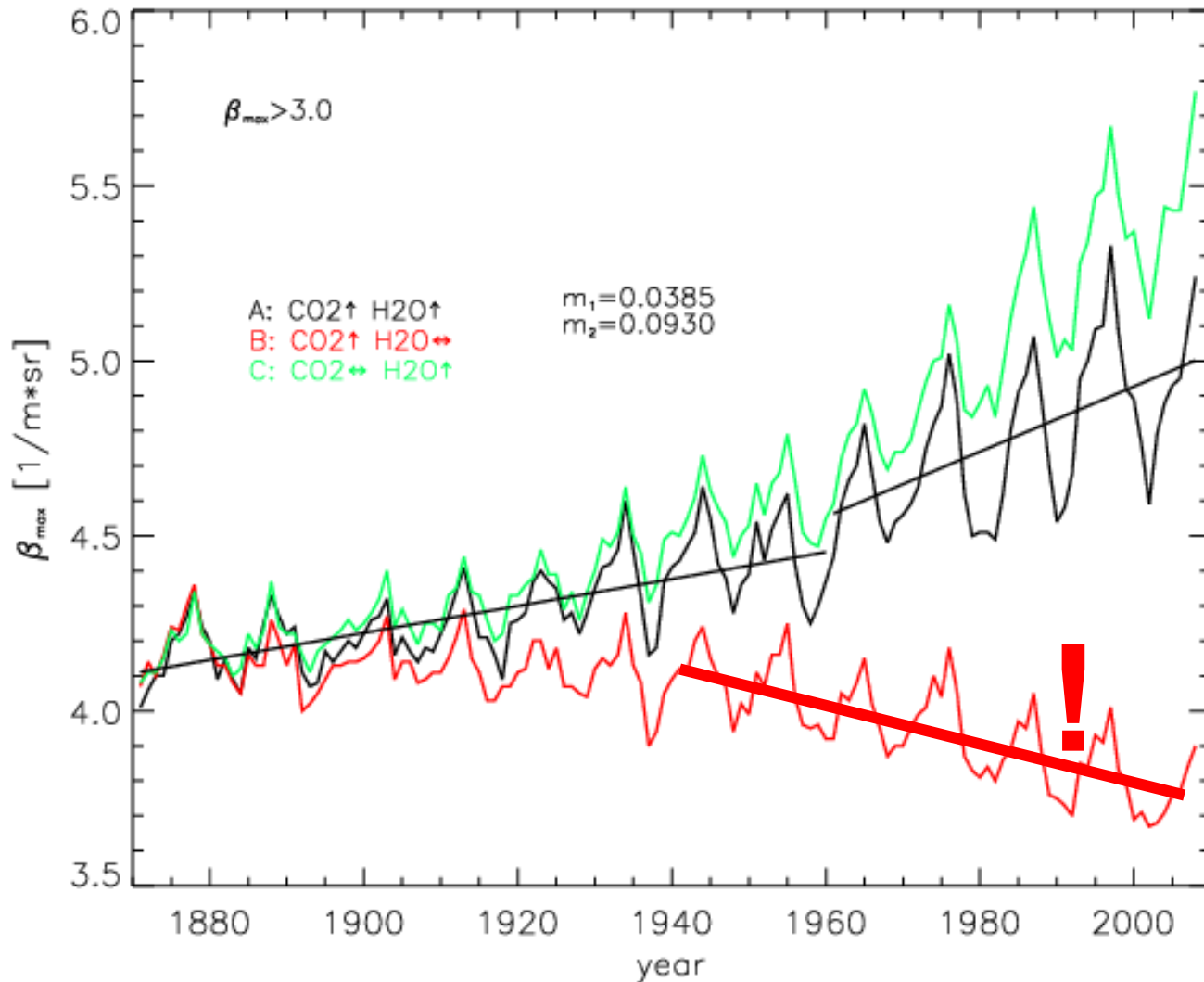
Lübken et al., Geophys. Res. Lett., 2018

New: 1871-2008

Lübken et al., Geophys. Res. Lett., 2018

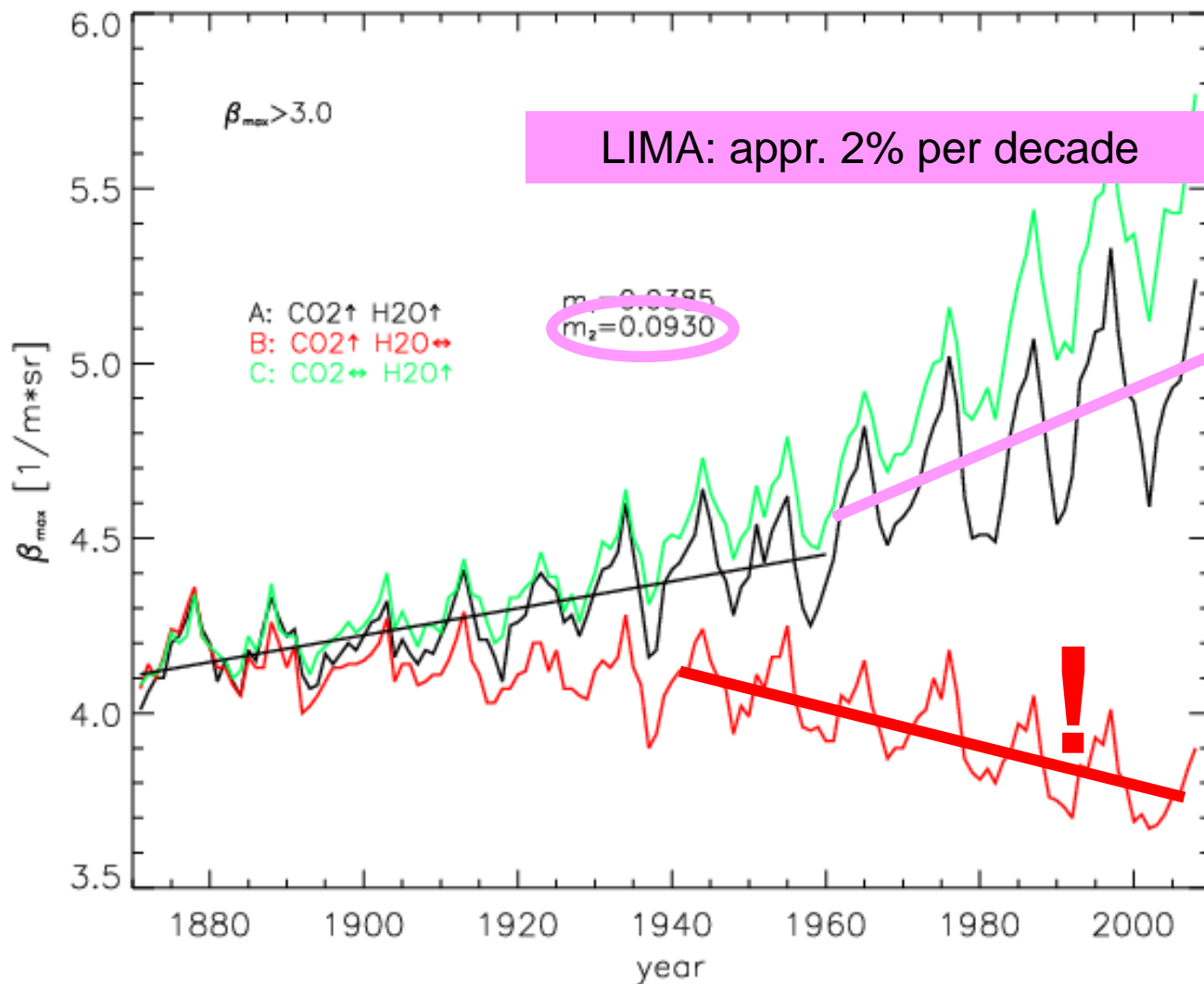


brightness of NLC (beta-max)



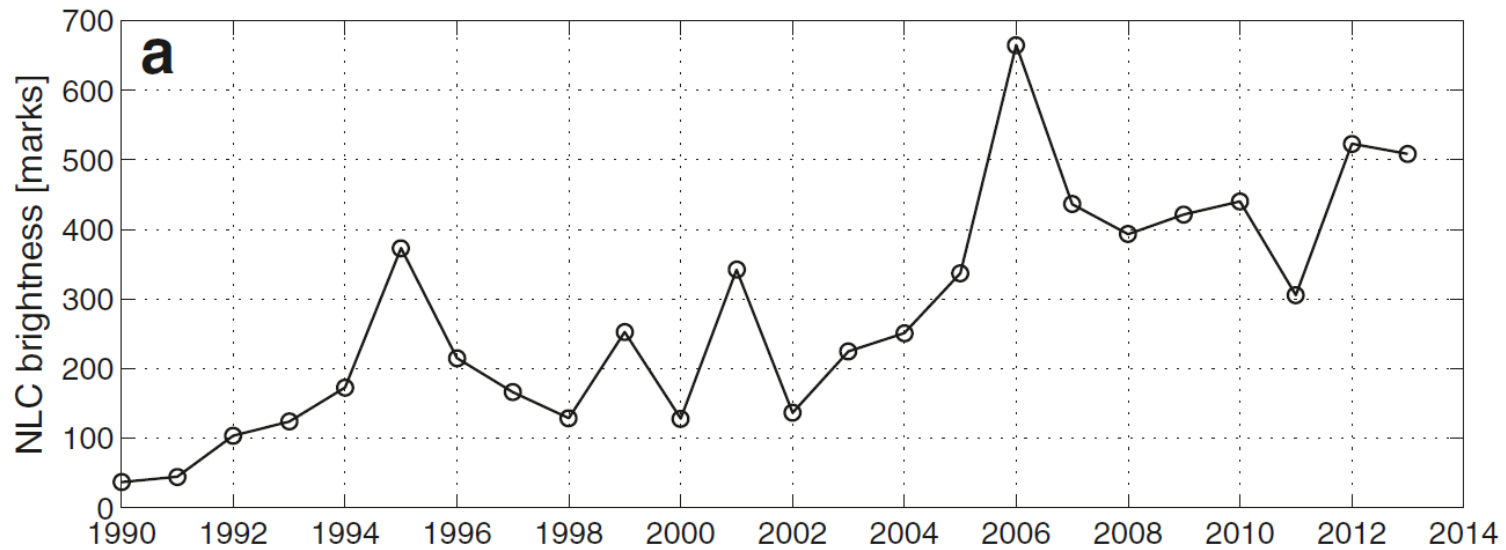
Lübken et al., Geophys. Res. Lett., 2018

brightness of NLC (beta-max)

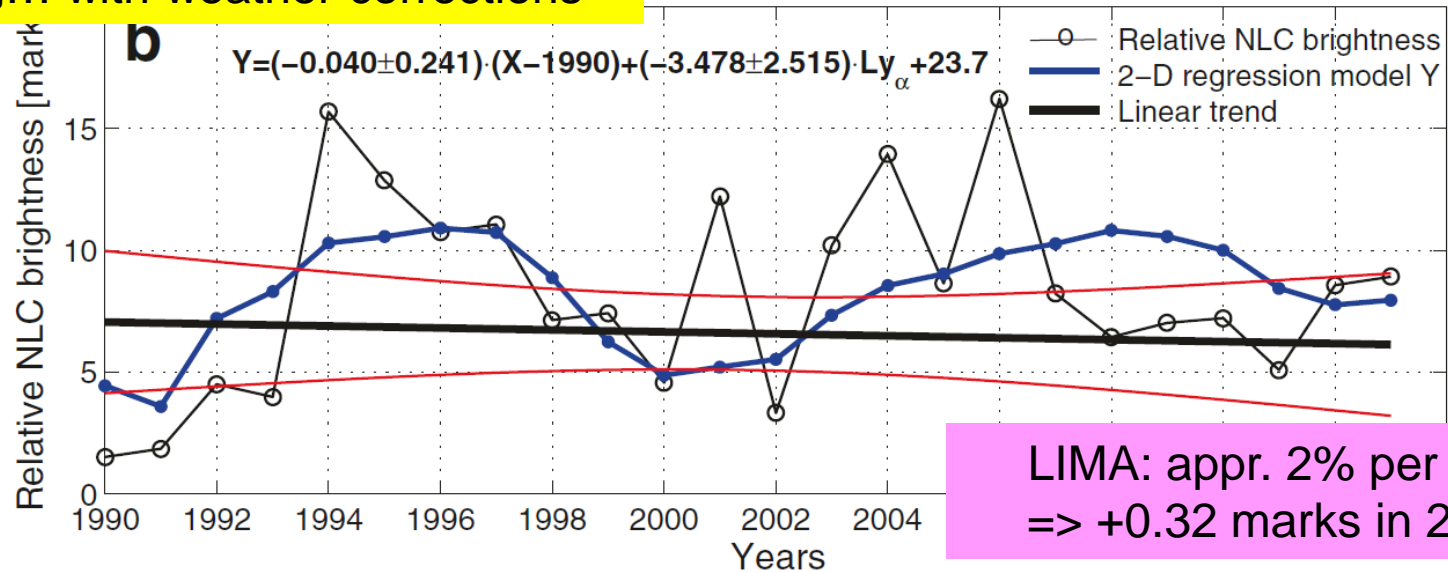


Lübken et al., Geophys. Res. Lett., 2018

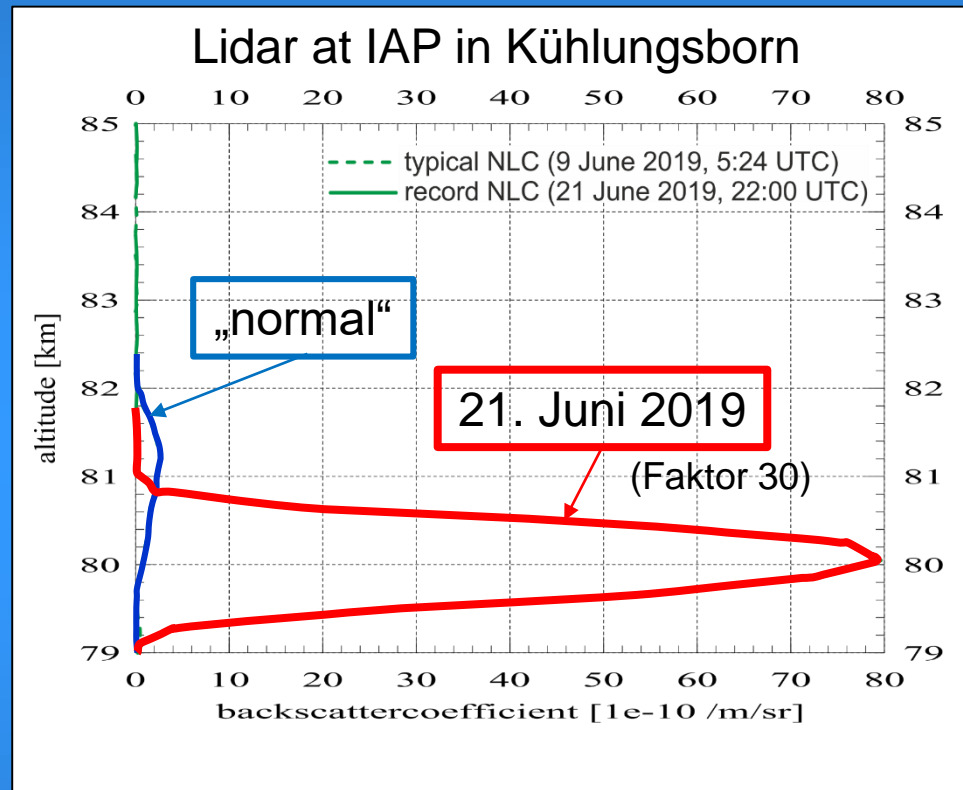
NLC observed from the ground (Pertsev et al., EPS, 2014)



„... with weather corrections“

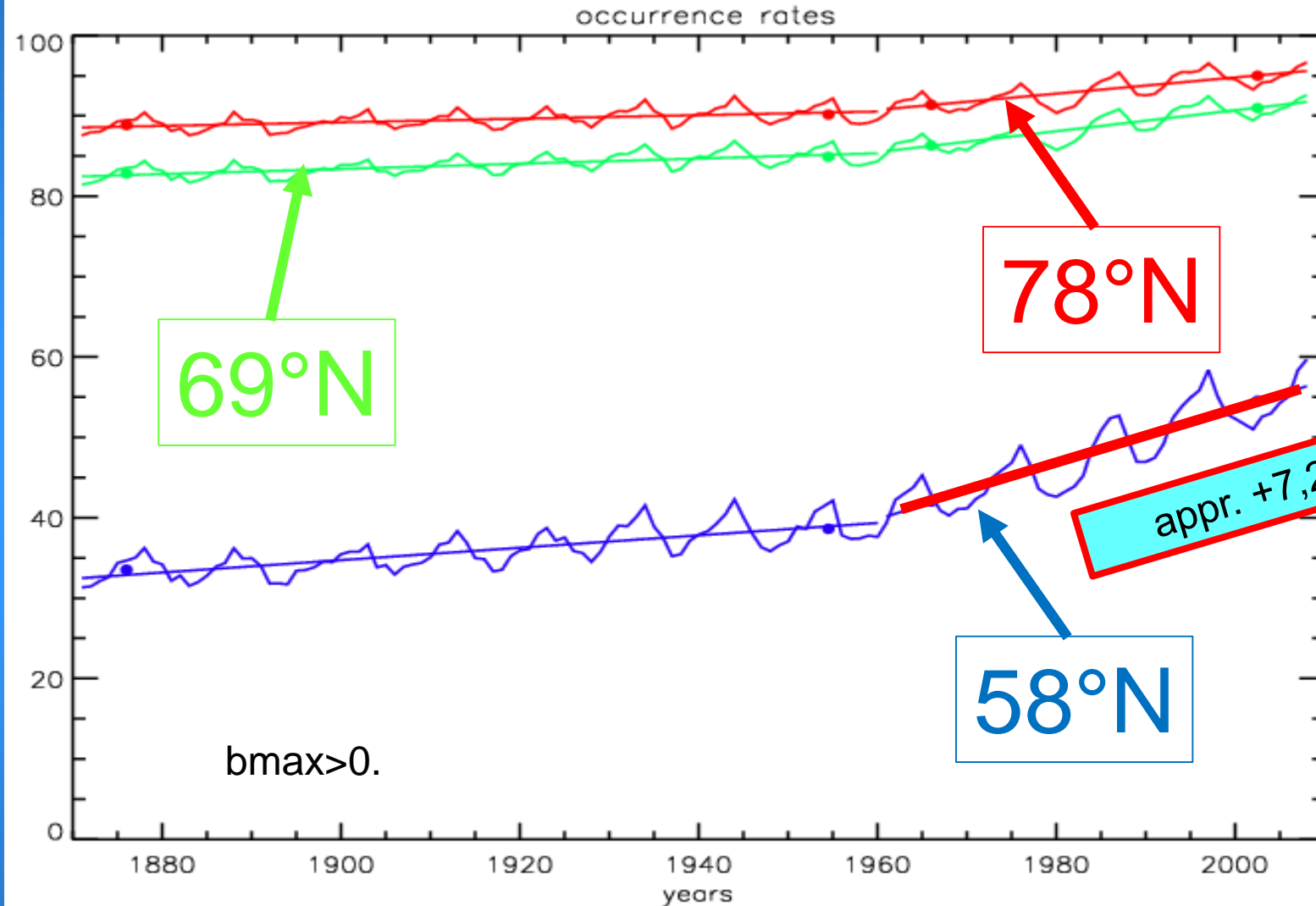


LIMA: appr. 2% per decade
=> +0.32 marks in 24 years



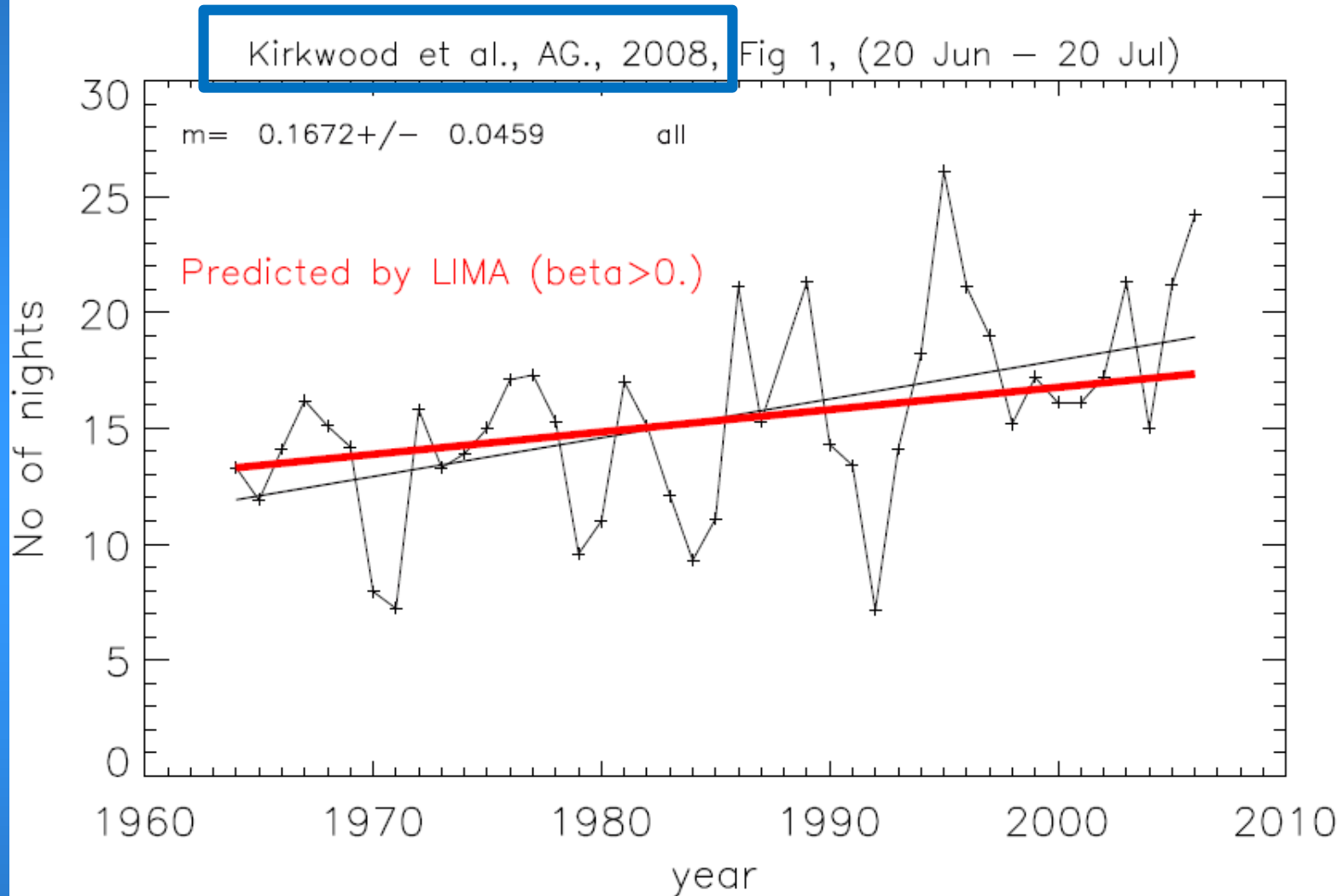
courtesy of IAP

occurrence rate of NLC



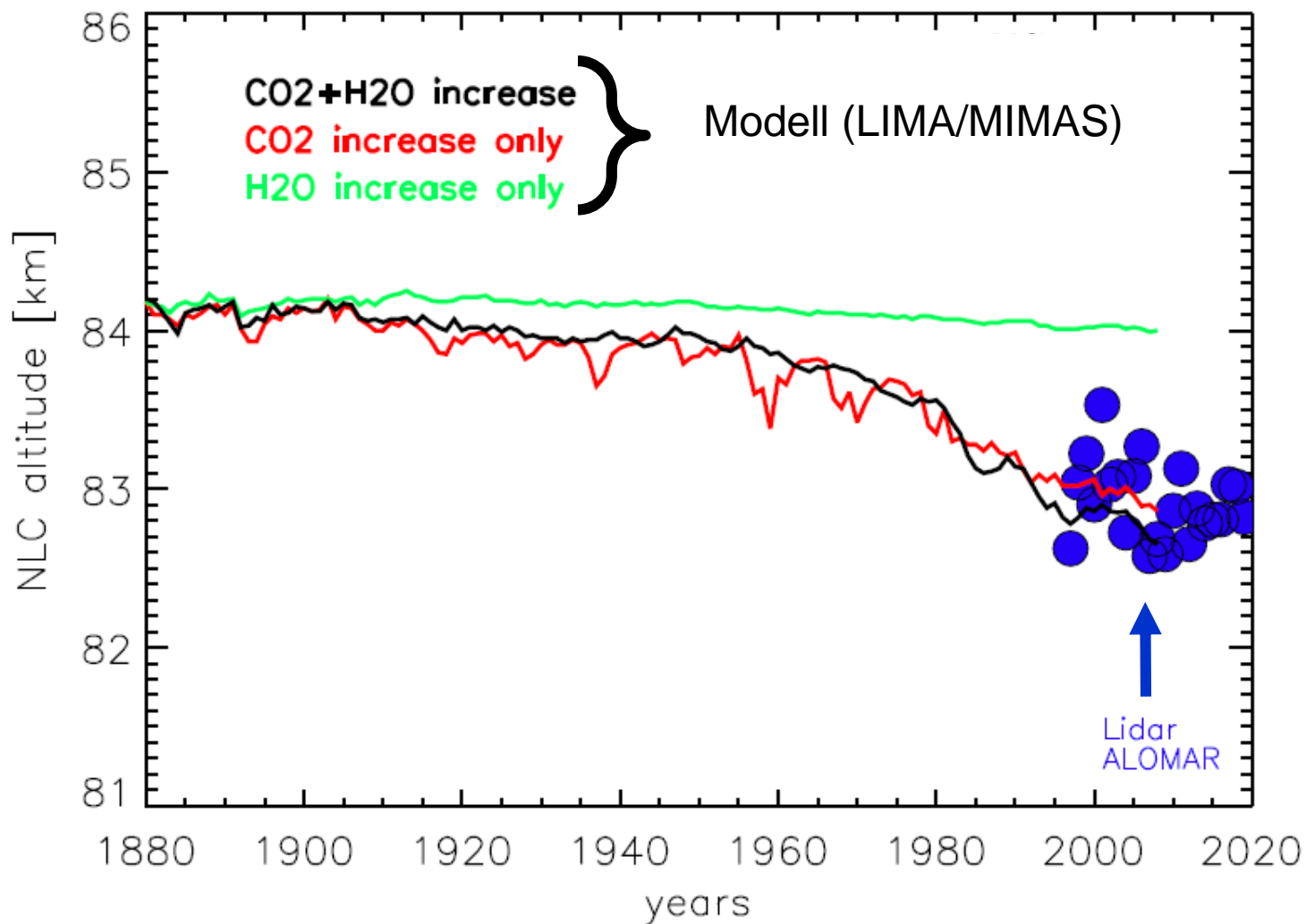
Consistent
with PMSE
occurrence

~/fj/icetrends/plot_ice_time.pro, run on Fri Nov 30 16:57:39 2018

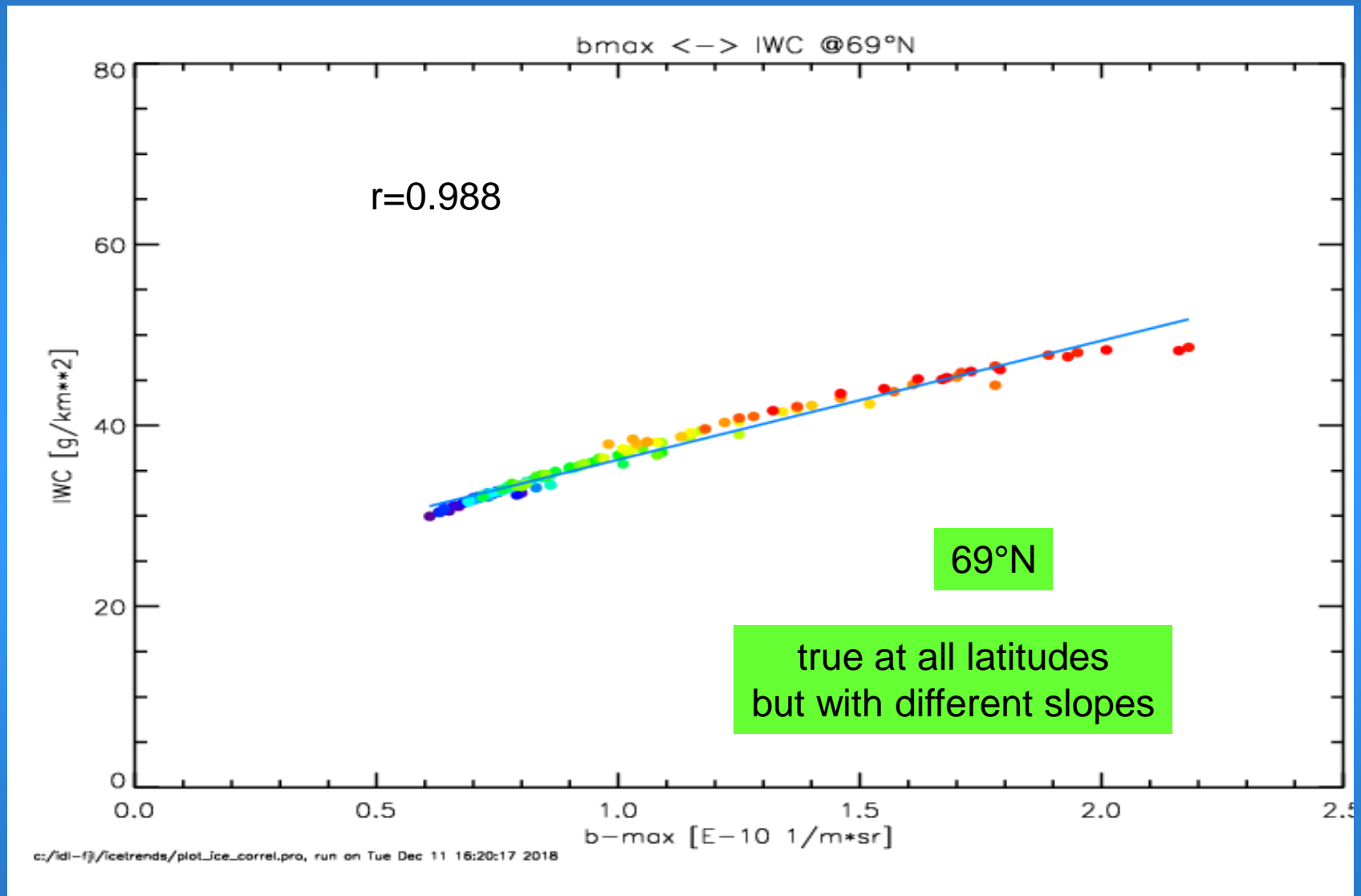


/idl-fjl/LIMA/icetrends/Kirkwood.pro, run on Thu Oct 03 23:19:25 2019

The altitude of NLC @ 69°N



Brightness of cloud is a good measure of the total amount of ice water in a column



Conclusions

- It must be cold enough to allow ice particles to grow ($<150\text{K}$).
- Further cooling changes altitude of NLC (shrinking), but has little impact on brightness etc.
- Increase of H_2O increases total ice mass and brightness
- Increase of H_2O enhances chance to see a NLC
- Conclusion: NLC are indicator of climate change
more precisely: increase of $\text{CH}_4 \gg \text{H}_2\text{O}$
- NLC were presumably present before 1880s, but very seldom
- LIMA/MIMAS results agree nicely with observations

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Long term trends of mesospheric ice layers: A model study

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