

Aspekter på prognosernas kvalitet och osäkerhet

Åke Johansson

SMHI

Aspekter på prognosernas

~~kvalitet och osäkerhet~~

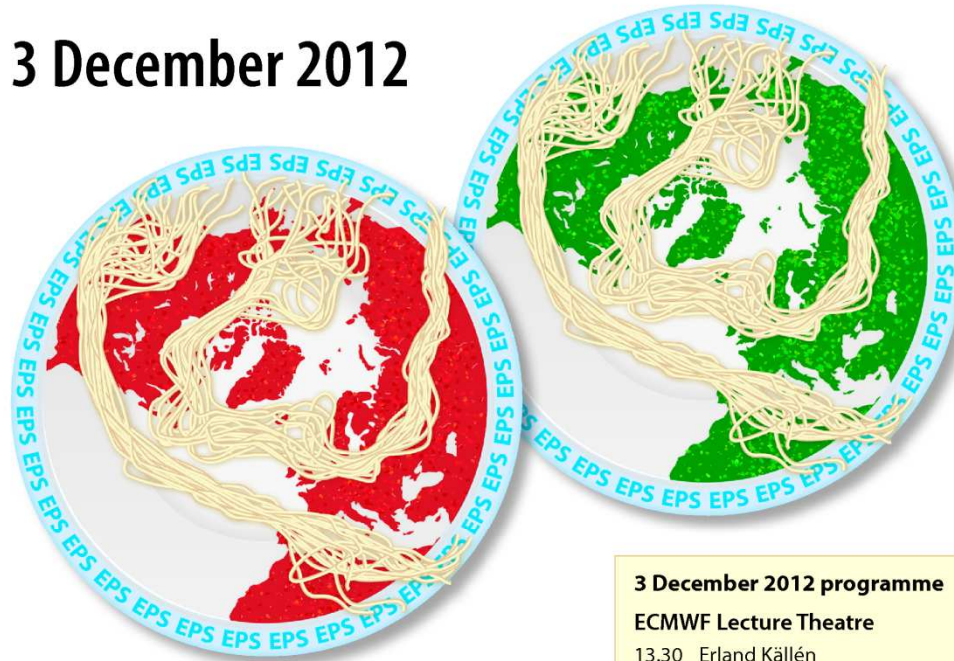
skill and spread

Åke Johansson

SMHI

Twenty years of Ensemble Prediction at ECMWF

3 December 2012



Twenty years ago, on 24 November 1992, the first ensemble forecasts were produced at ECMWF.

At that time, ensemble forecasts were issued three times a week, on Friday, Saturday and Sunday, with 33 members at a T63L19 resolution for up to 10 days. Today, the ensemble system runs twice a day with 51 members at resolution T639L62 to day 10, and T319L62 from day 10 to 15. It uses a coupled ocean-atmosphere model when it is extended to 32 days twice weekly. Worldwide, it is recognised as providing the best global, medium-range and monthly probabilistic forecasts. 'Spaghetti' maps are now firmly on the table of most forecasters! You are invited to join us to celebrate 20 years of ensemble prediction with an afternoon of talks from people who contributed to its design and implementation in its early days.

3 December 2012 programme

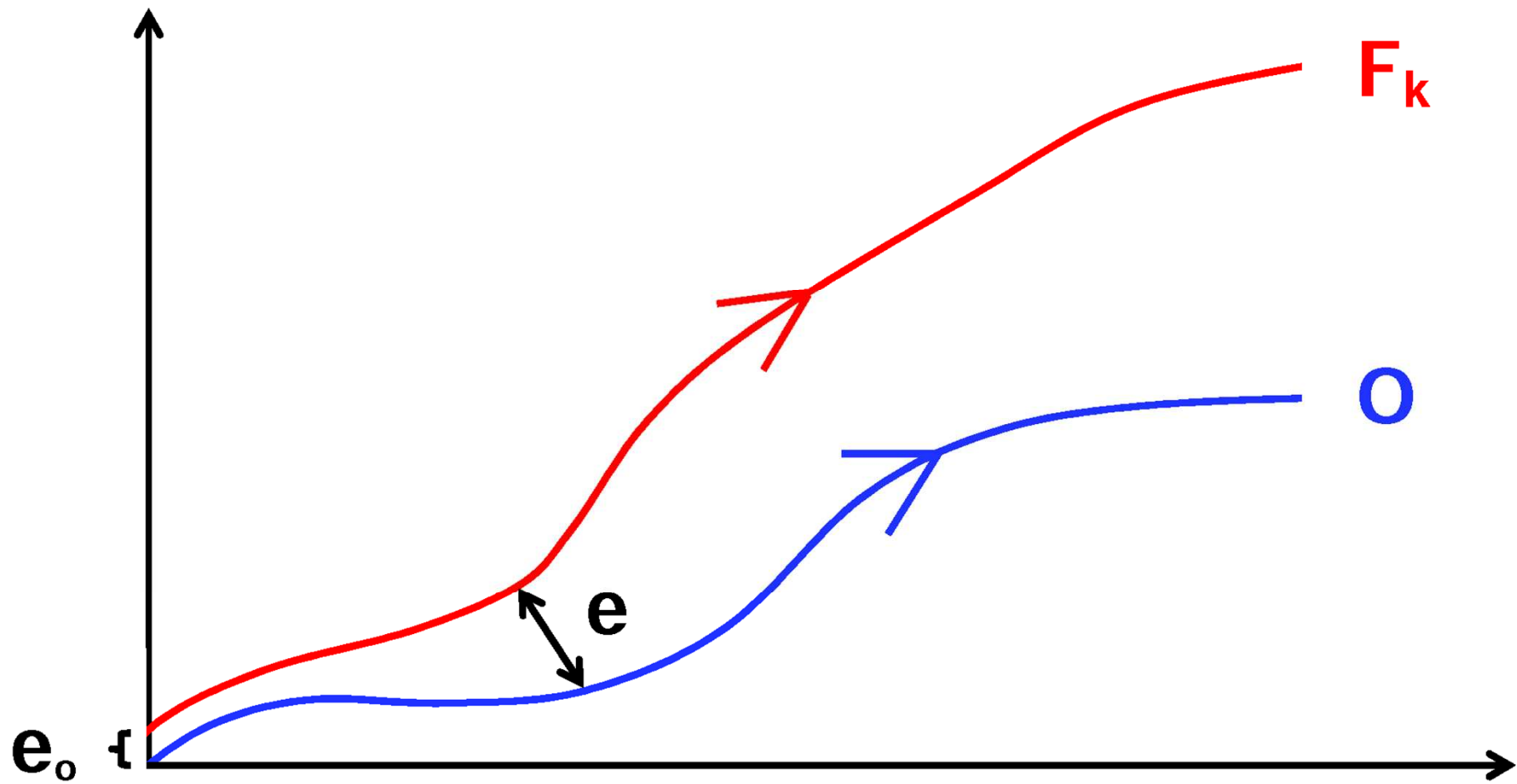
ECMWF Lecture Theatre

- 13.30 Erland Källén
Welcome
- 13.45 Stefano Tibaldi
Why ensembles?
- 14.15 Joe Tribbia
SVs: are they still valuable?
- 14.45 Tim Palmer
Is the butterfly effect real?
- 15.15 Coffee break
- 15.45 Robert Mureau
Do users really want ensemble forecasts?
- 16.15 Jan Barkmeijer
A bright future for linear models?
- 16.45 Franco Molteni
Ensemble methods and long-range prediction
- 17.15 Roberto Buizza
What's next?

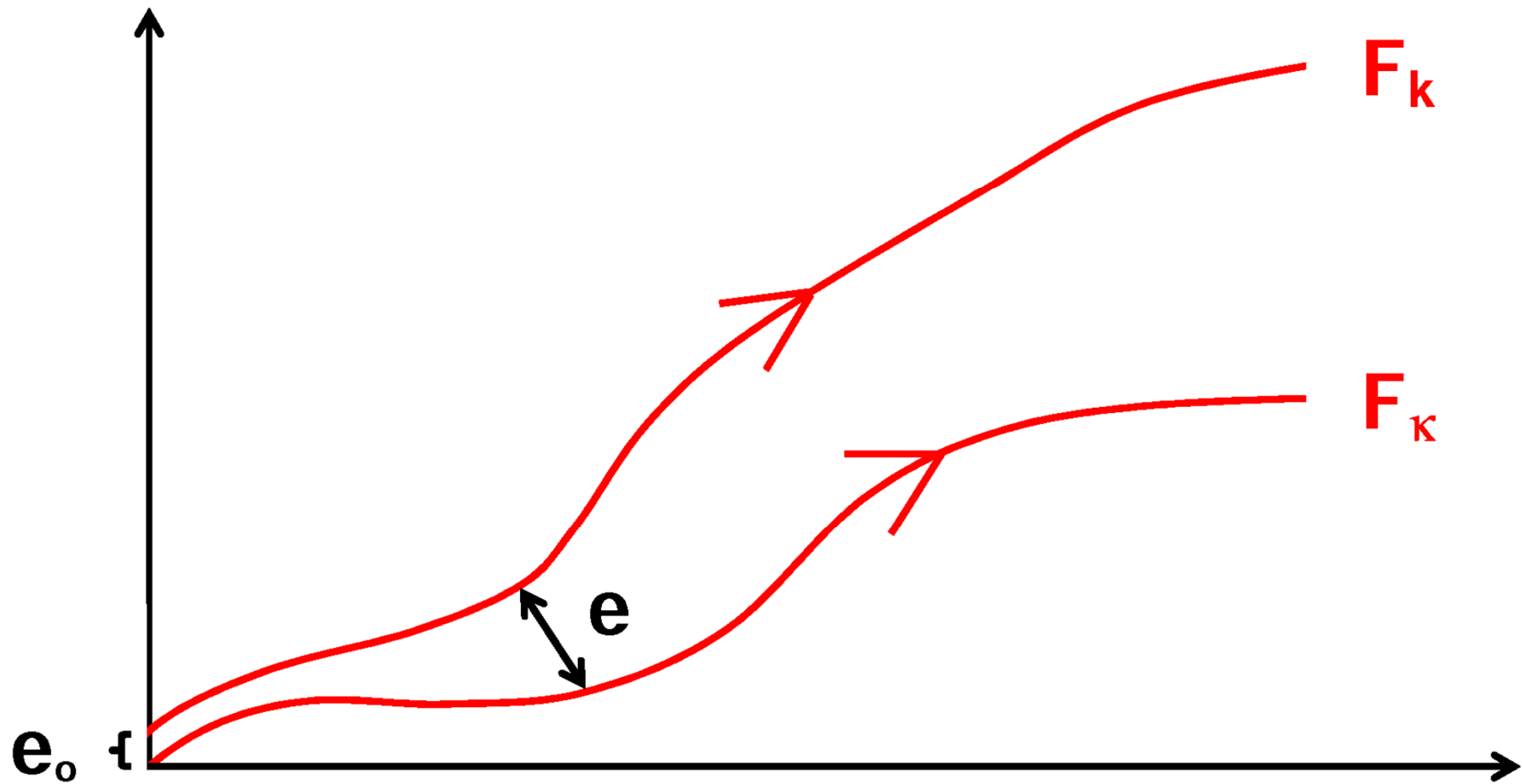
GLAMEPS
fortfarande
Pre-Operationell
år 2013

Skill and Spread

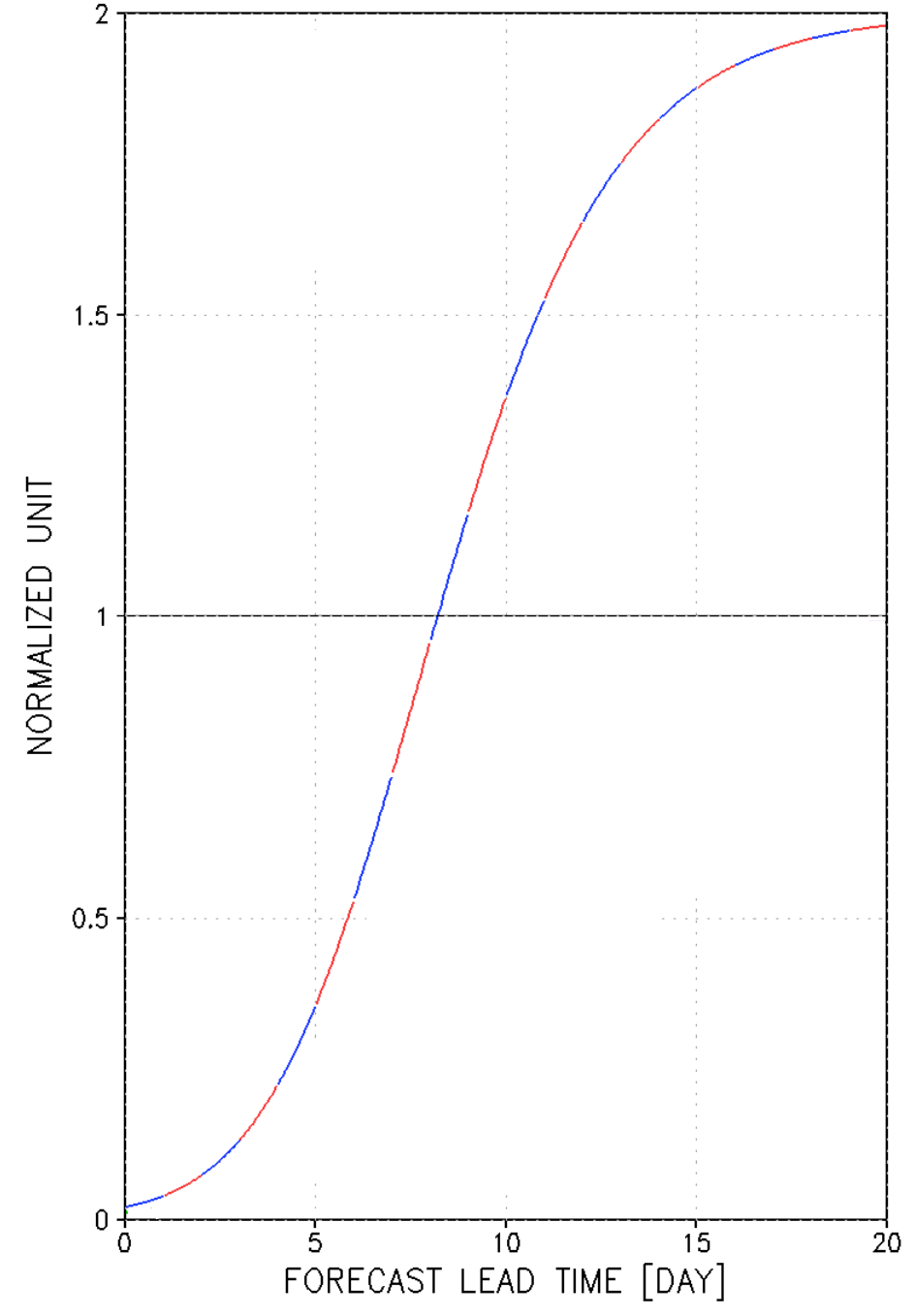
SKILL



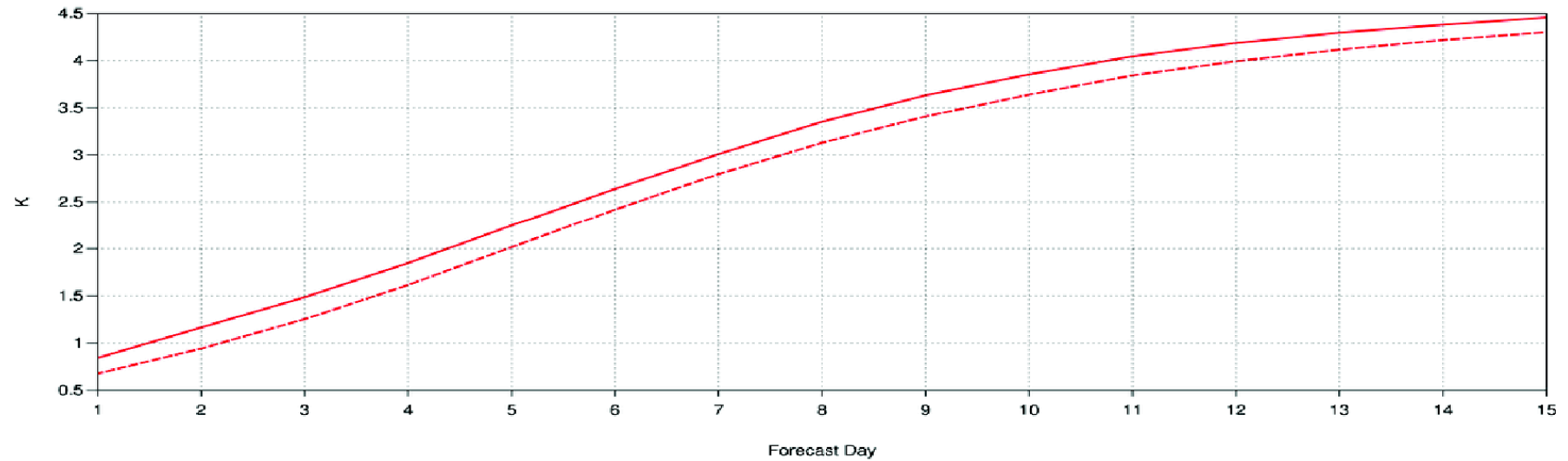
SPREAD



SPREAD and SKILL Ideal Situation



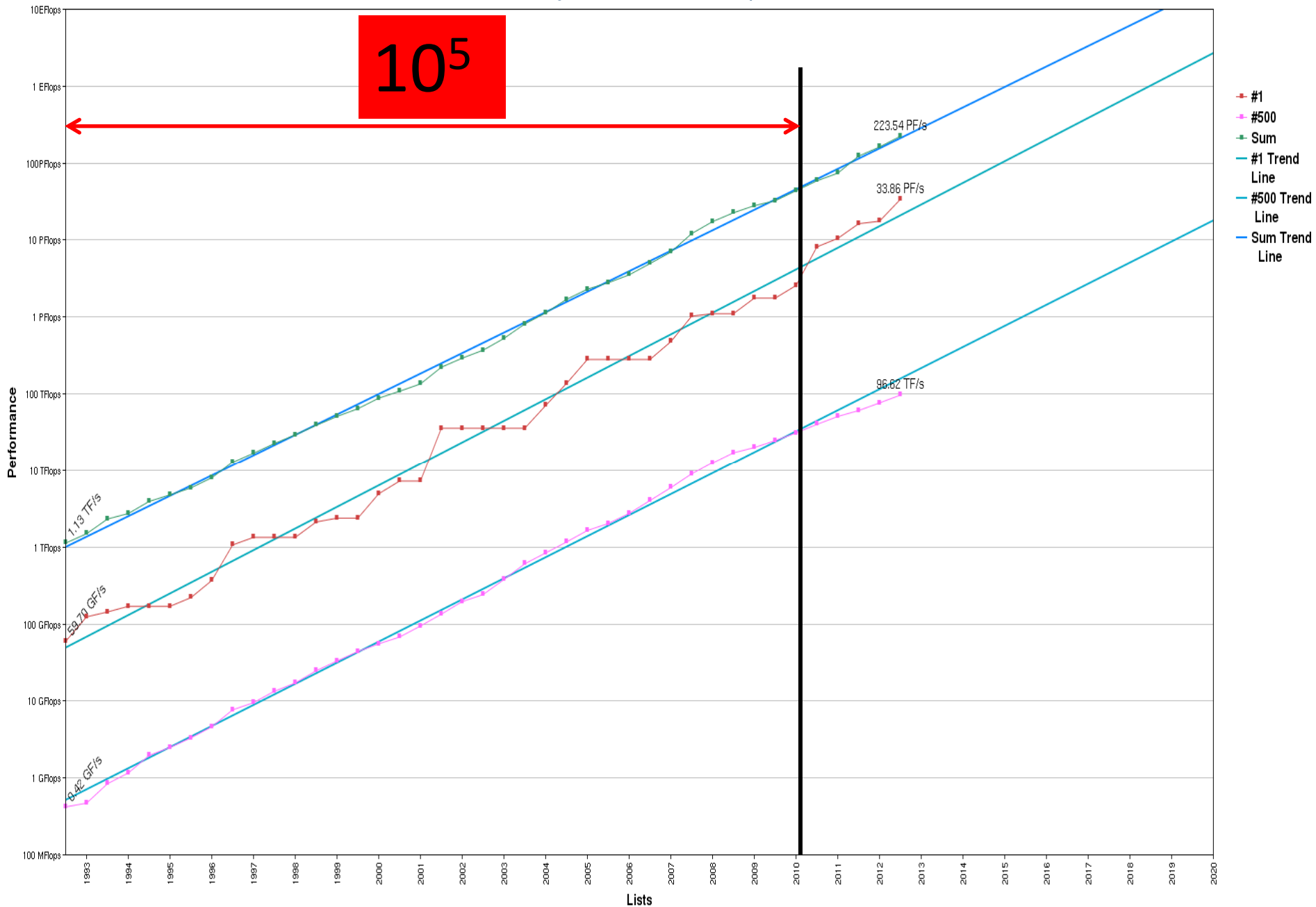
T850 ECMWF



2011-2012

Moore's Law

Projected Performance Development

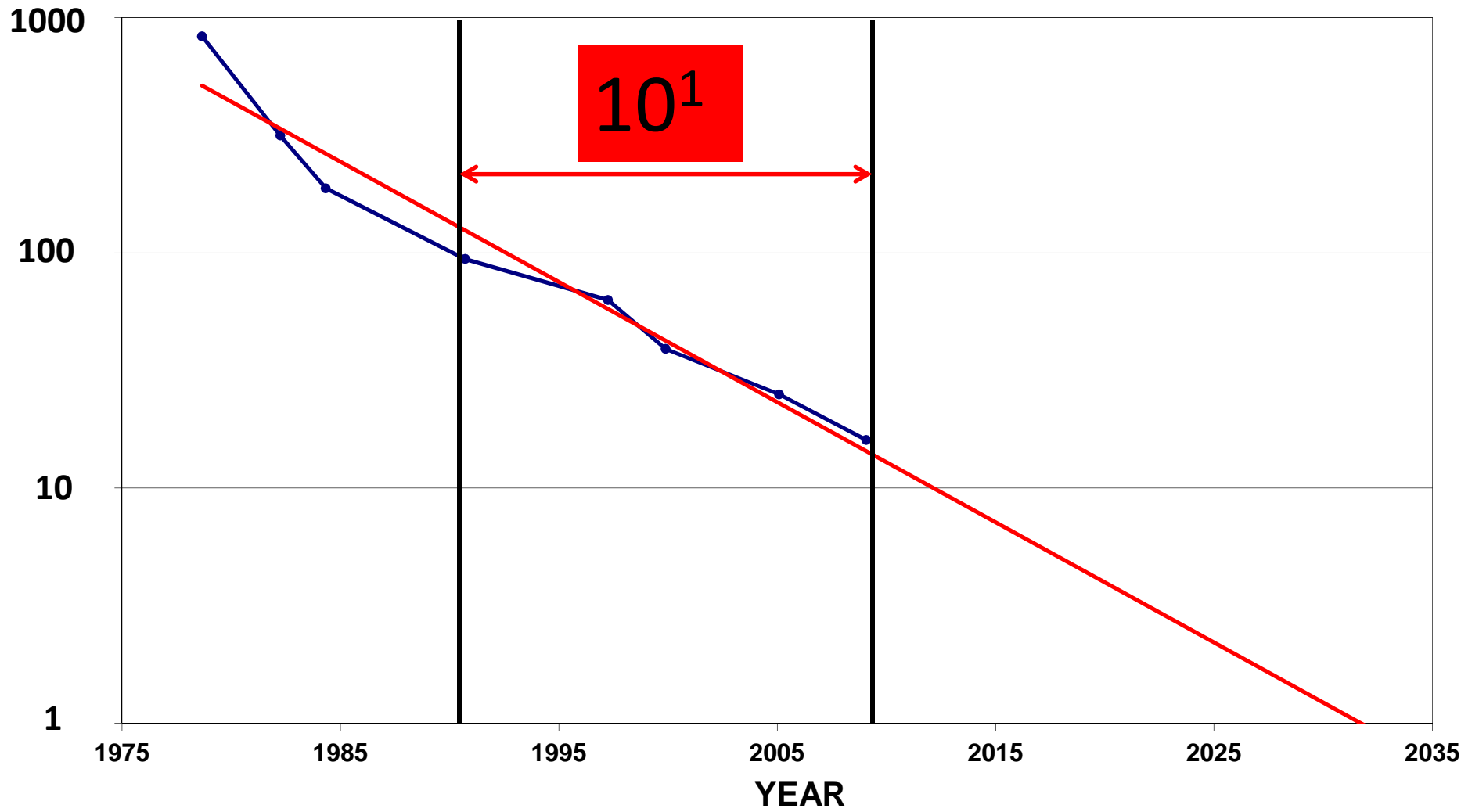


1992

2010

[km]

EVOLUTION OF THE HORIZONTAL GRID SIZE OF ECMWF HREF MODEL



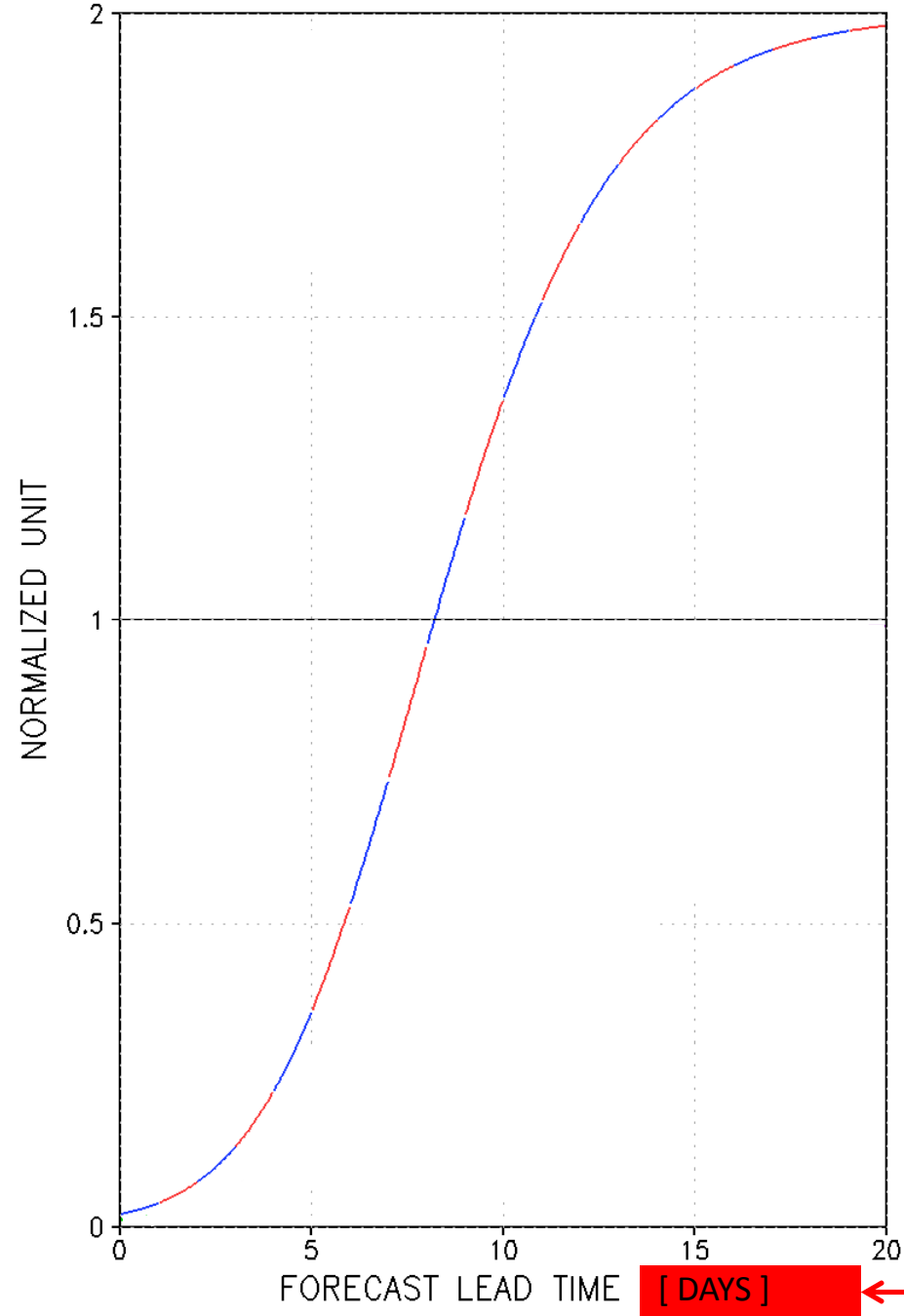
dx * dy * dz * dt * dp

10 * 10 * 10 * 10 * 10

10^5

dx * dy * dz * dt * dp * nmb

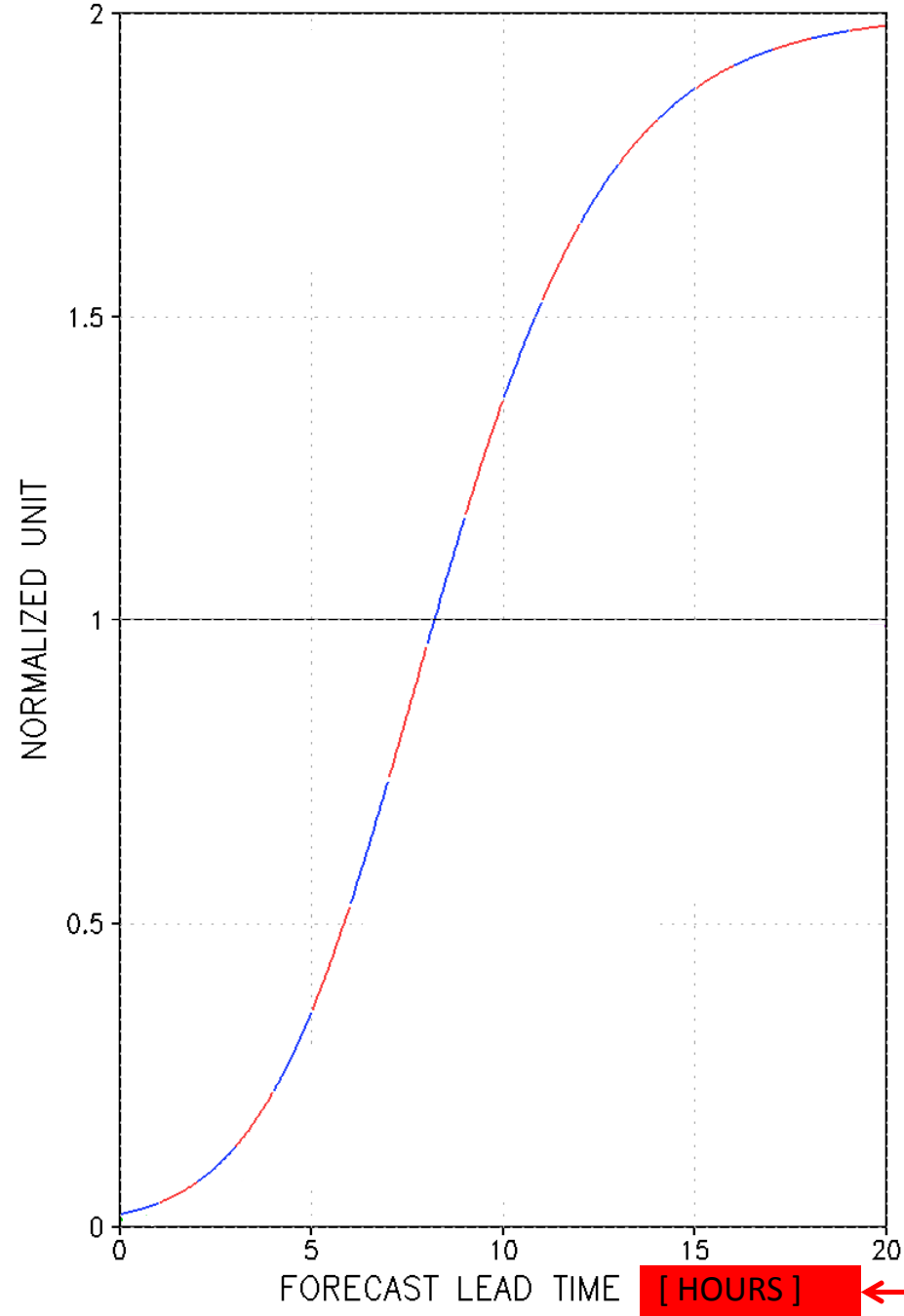
SPREAD and SKILL
Ideal Situation



LARGE SCALES

[DAYS]

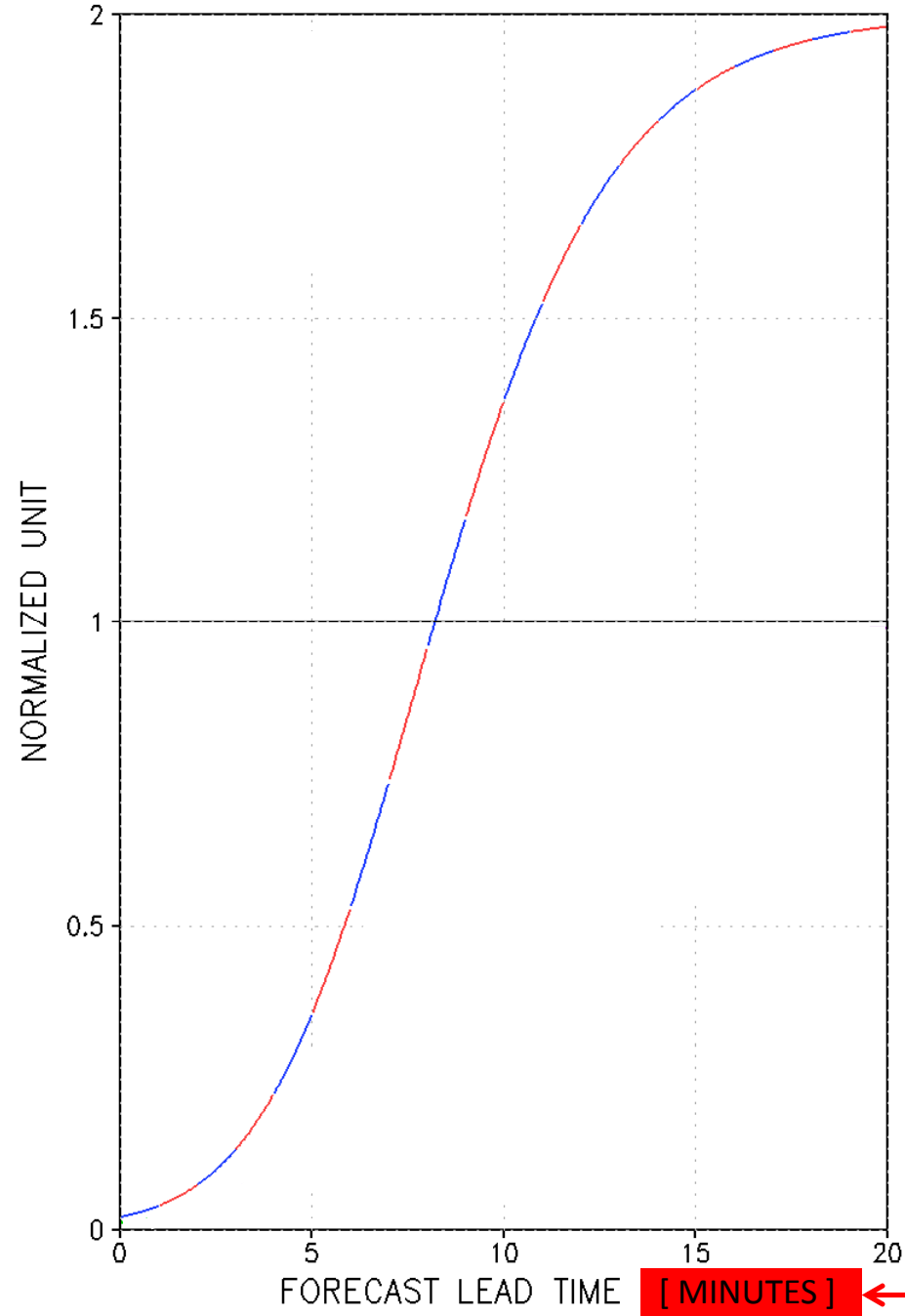
SPREAD and SKILL
Ideal Situation



MEDIUM SCALES

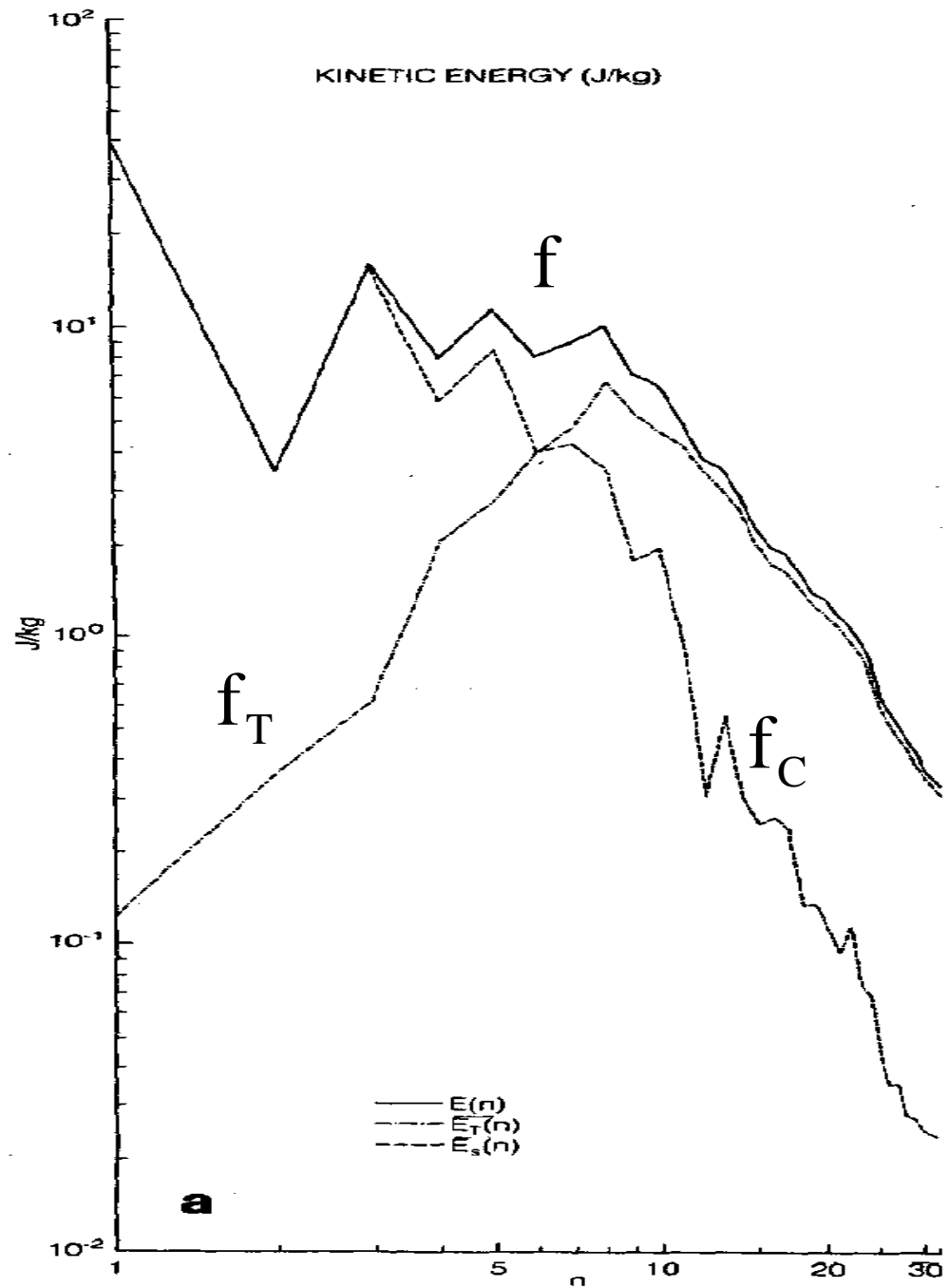
[HOURS]

SPREAD and SKILL
Ideal Situation

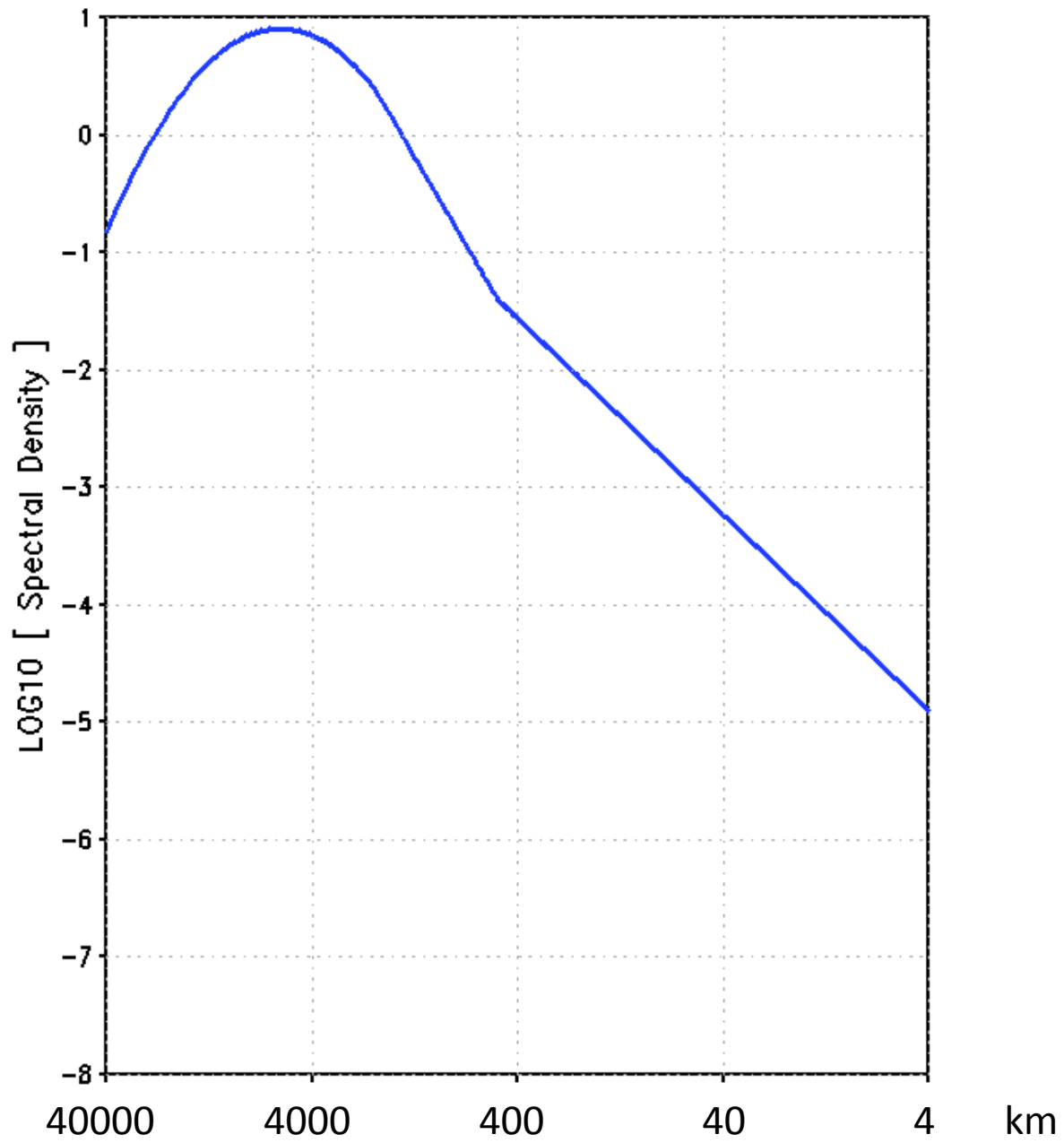


SMALL SCALES

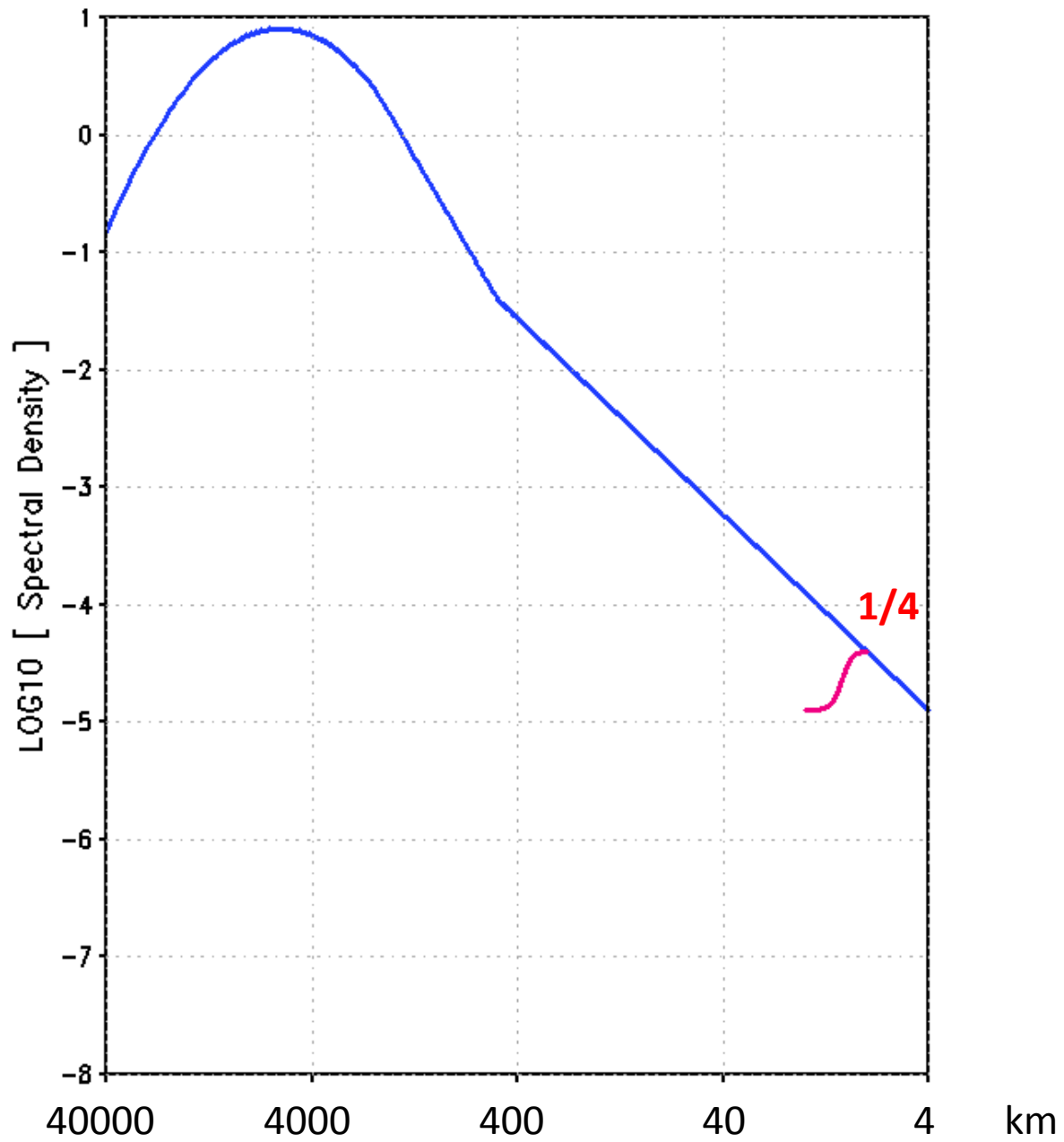
$$f = f_C + f_T$$



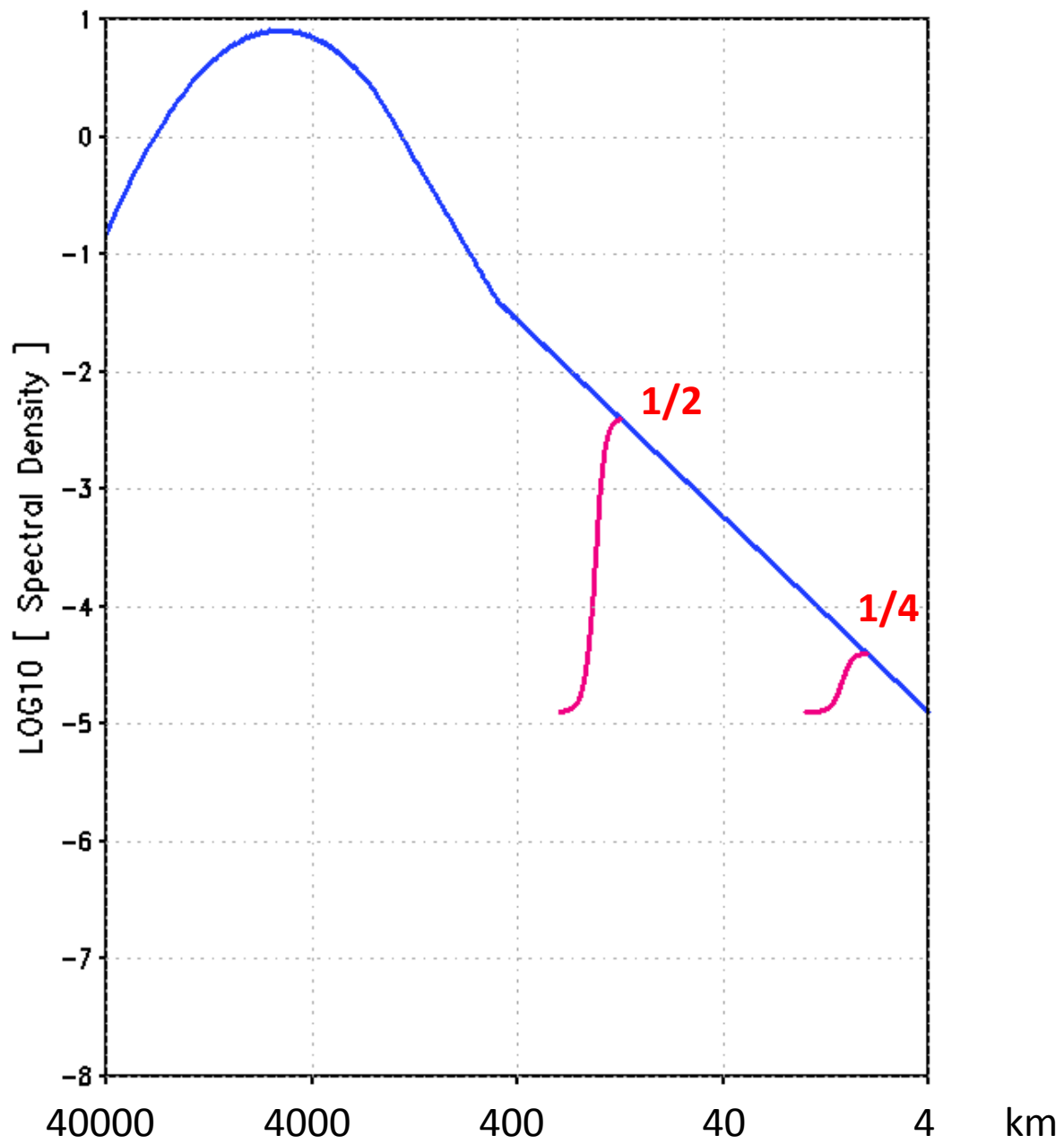
K^{-3} AND $K^{-5/3}$ SPECTRA



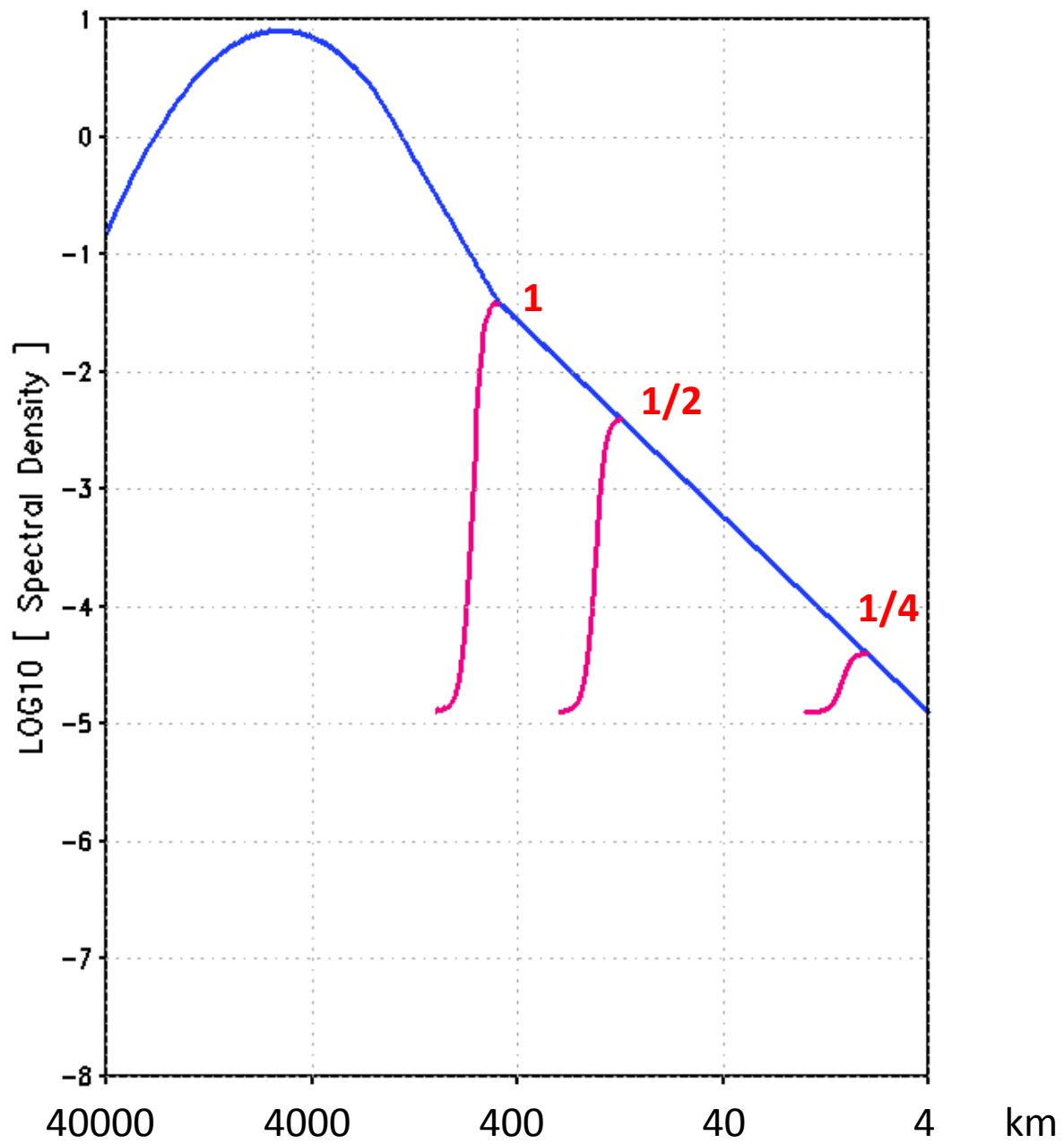
K^{-3} AND $K^{-5/3}$ SPECTRA



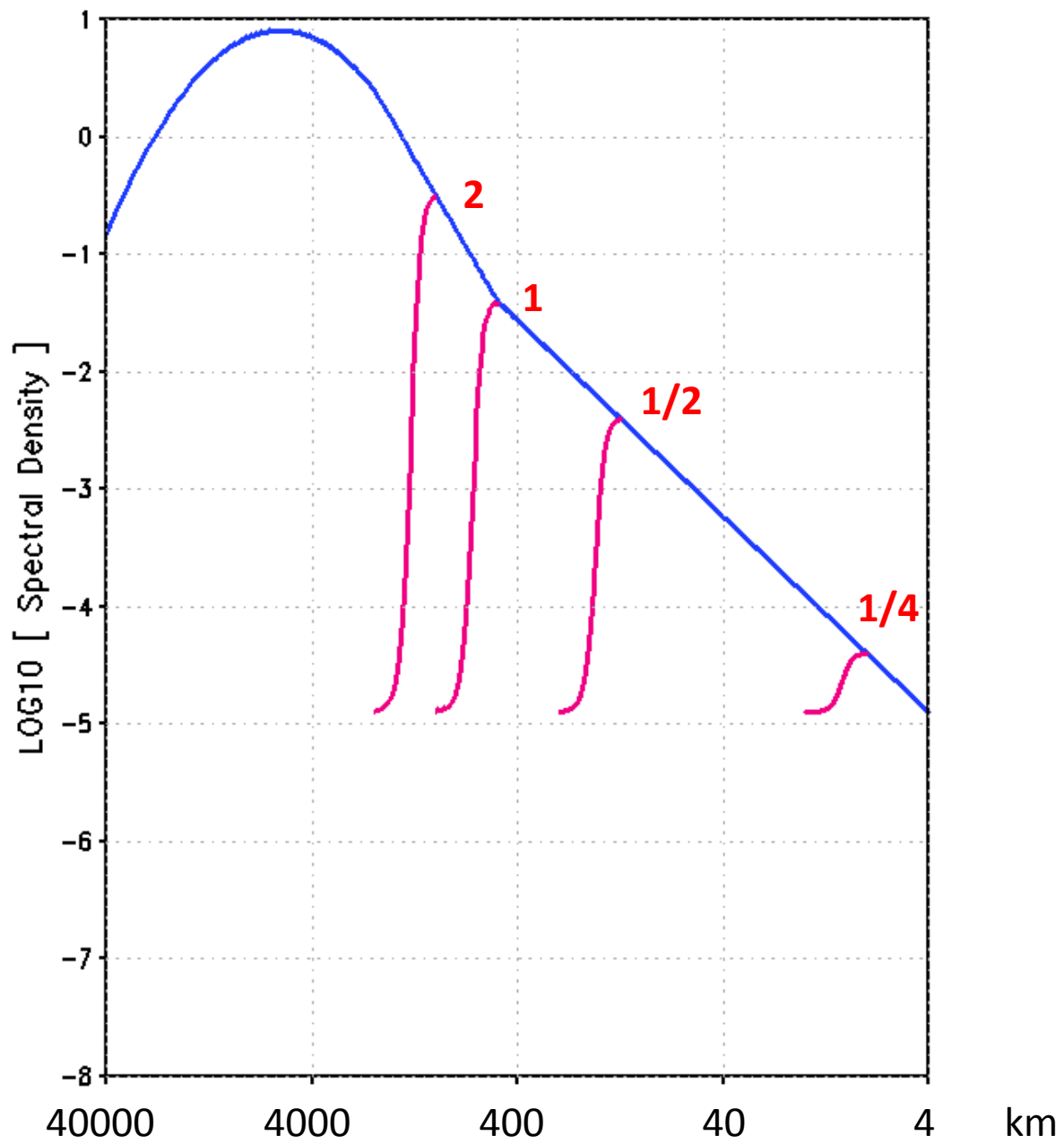
K^{-3} AND $K^{-5/3}$ SPECTRA



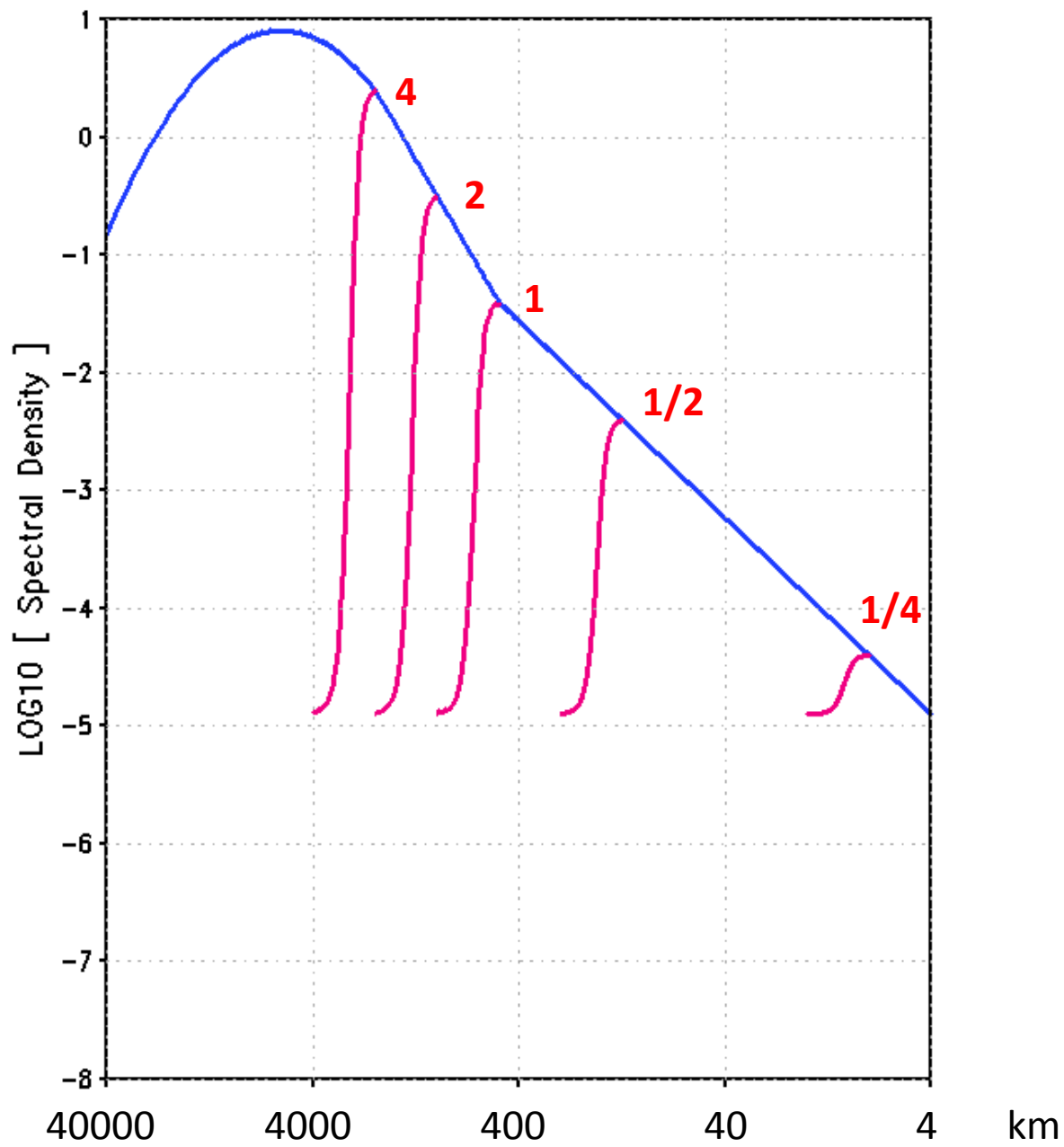
K^{-3} AND $K^{-5/3}$ SPECTRA



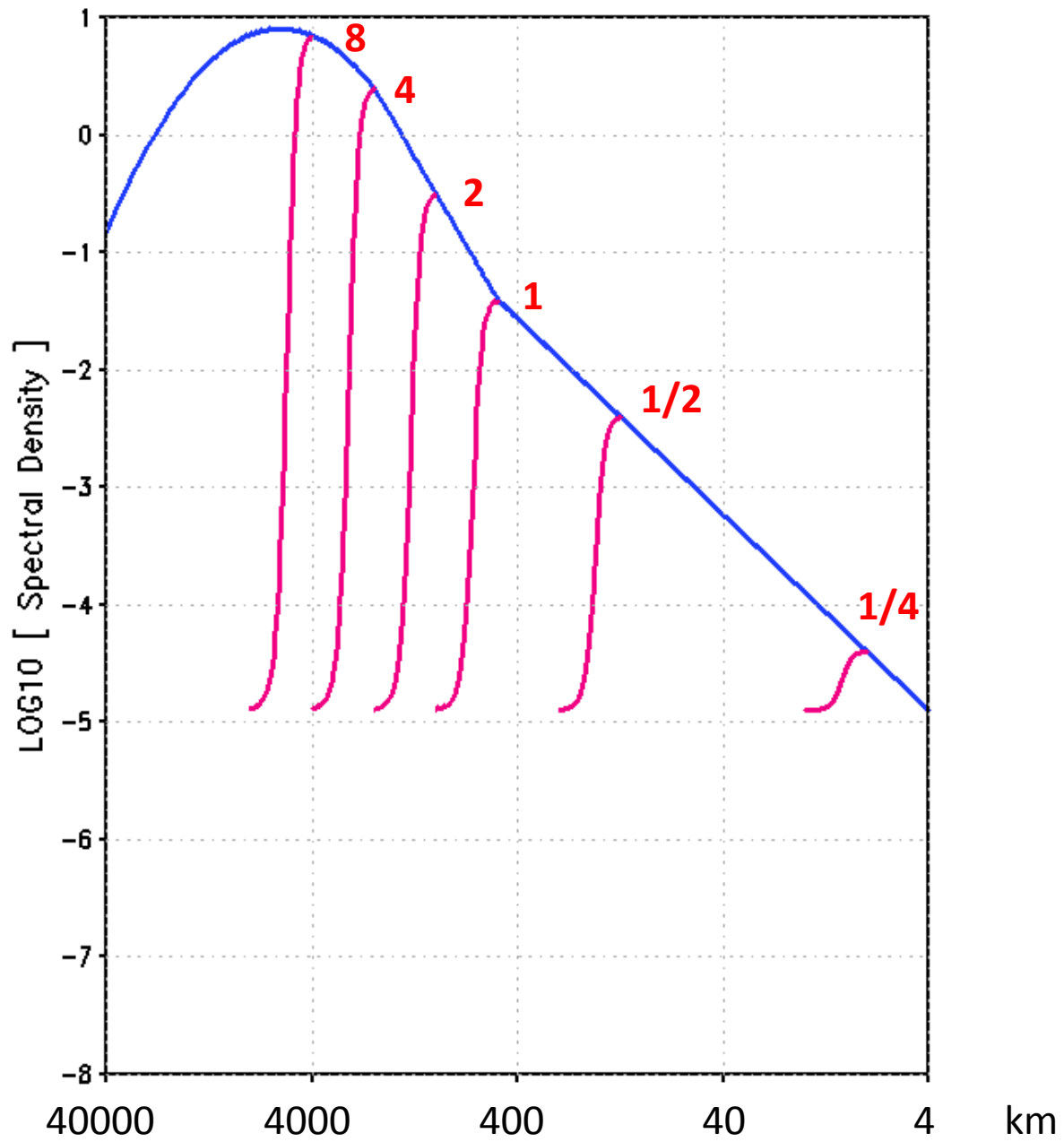
K^{-3} AND $K^{-5/3}$ SPECTRA

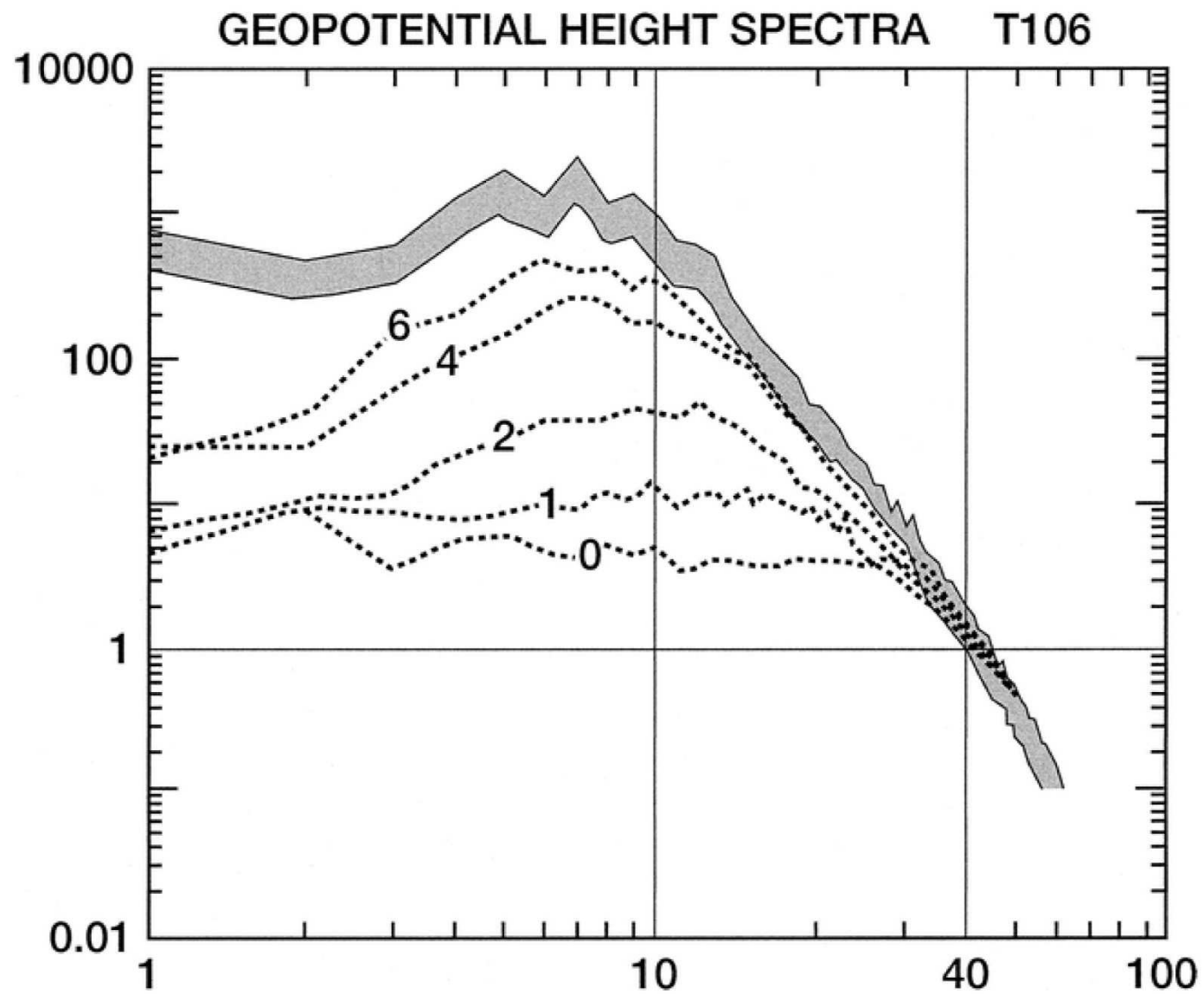


K^{-3} AND $K^{-5/3}$ SPECTRA



K^{-3} AND $K^{-5/3}$ SPECTRA





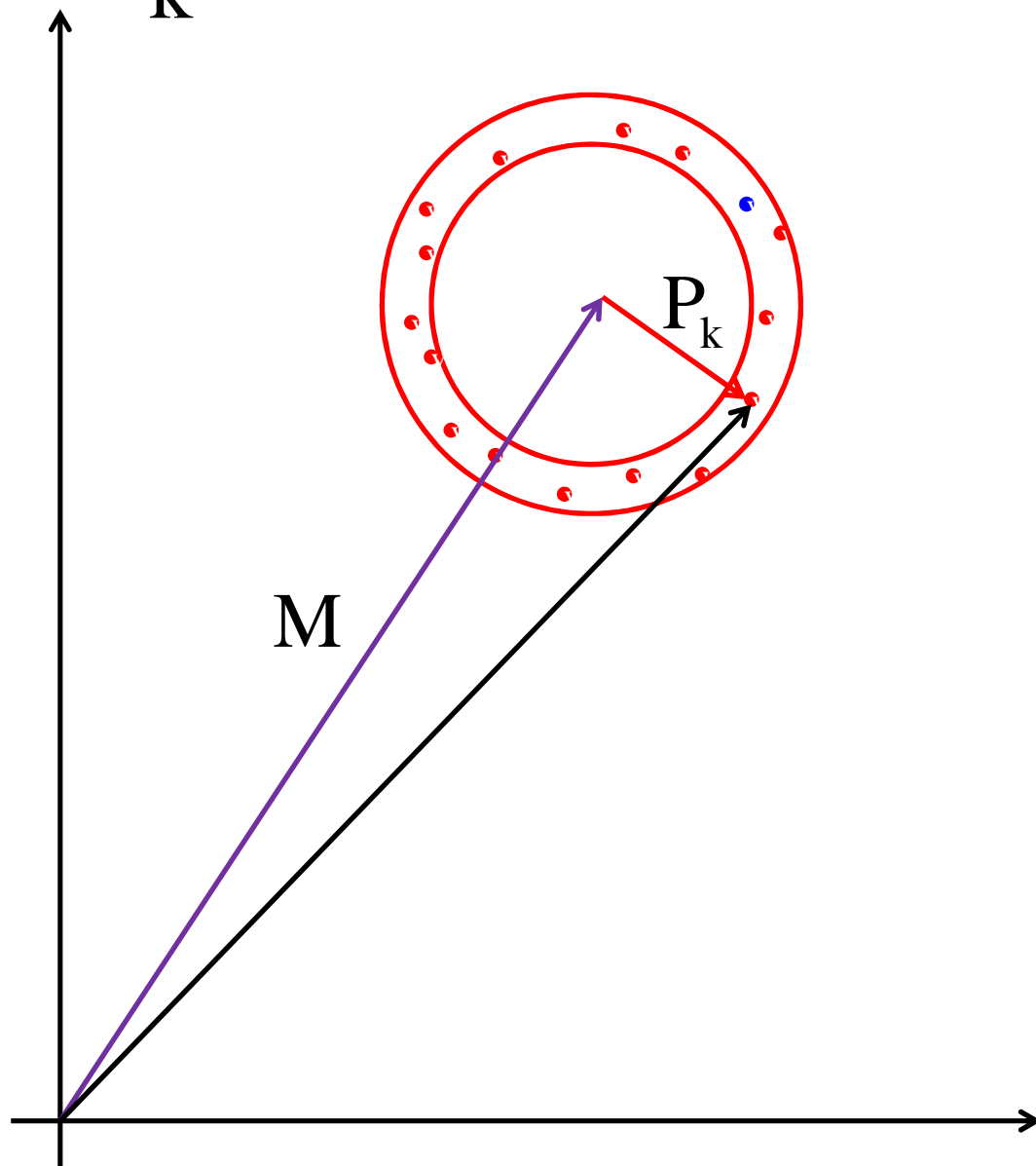
$$f_T(x, y, t_o, t_f, k) = \sum_{m=1}^M \sum_{n=1}^N \hat{f}_{mnk}(t_o, t_f) e^{i(mx+ny)}$$

$$\hat{f}_k = A e^{i\Phi}$$

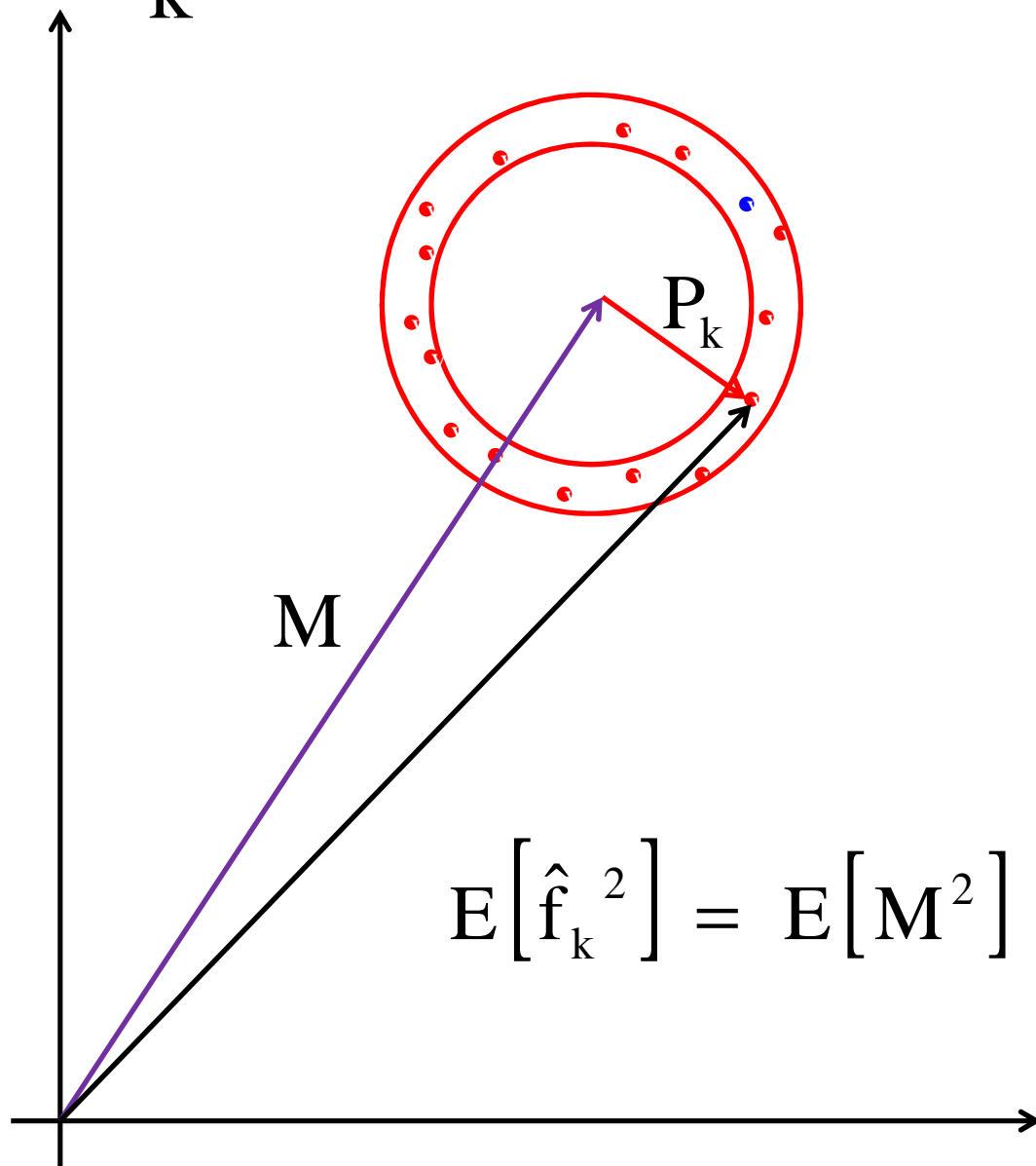
$$\hat{f}_k = A e^{i\Phi}$$

$$\hat{f}_k = M e^{i\Phi} + P_k e^{i\phi_k}$$

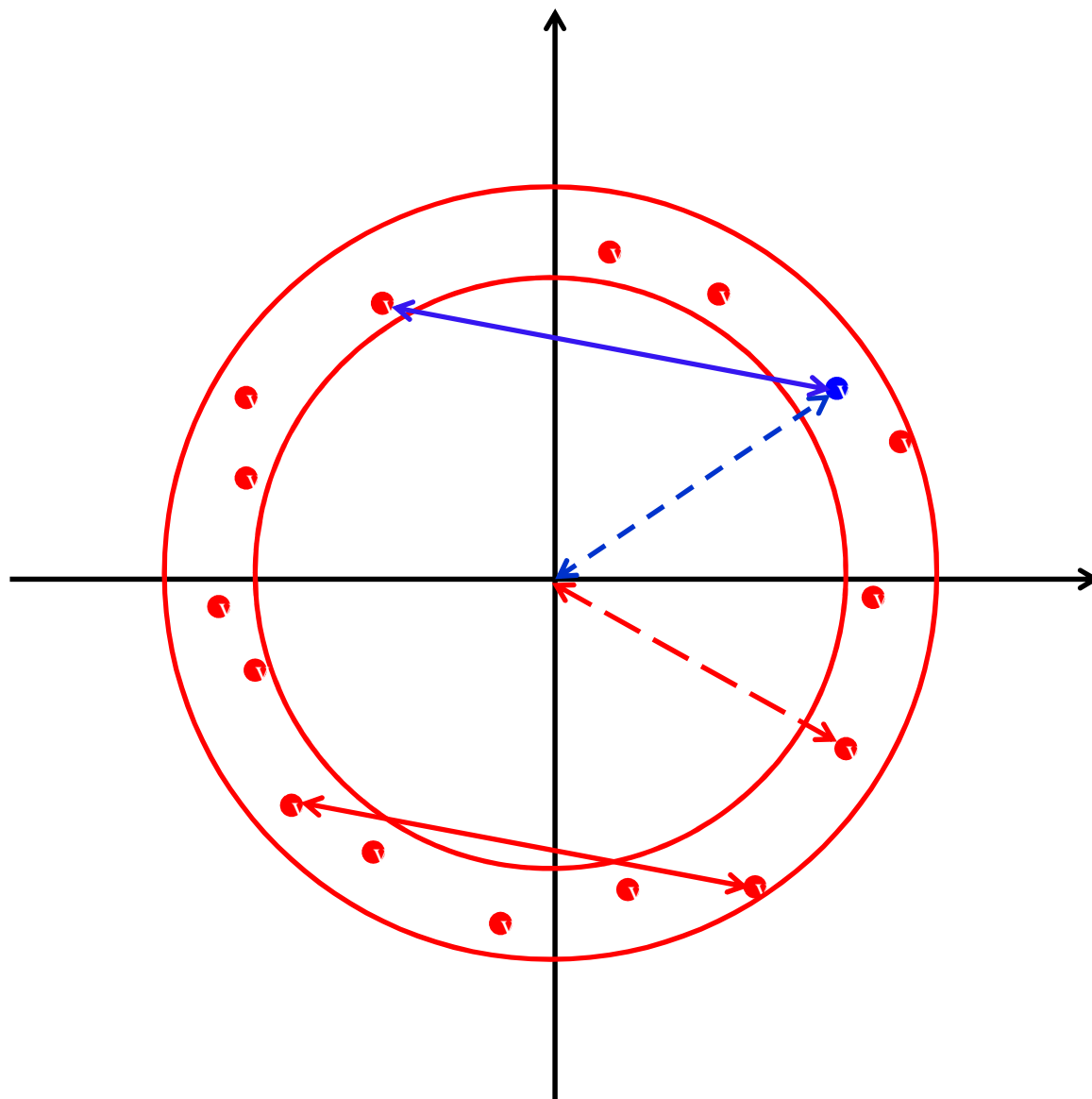
$$\hat{f}_k = M e^{i\Phi} + P_k e^{i\phi_k}$$



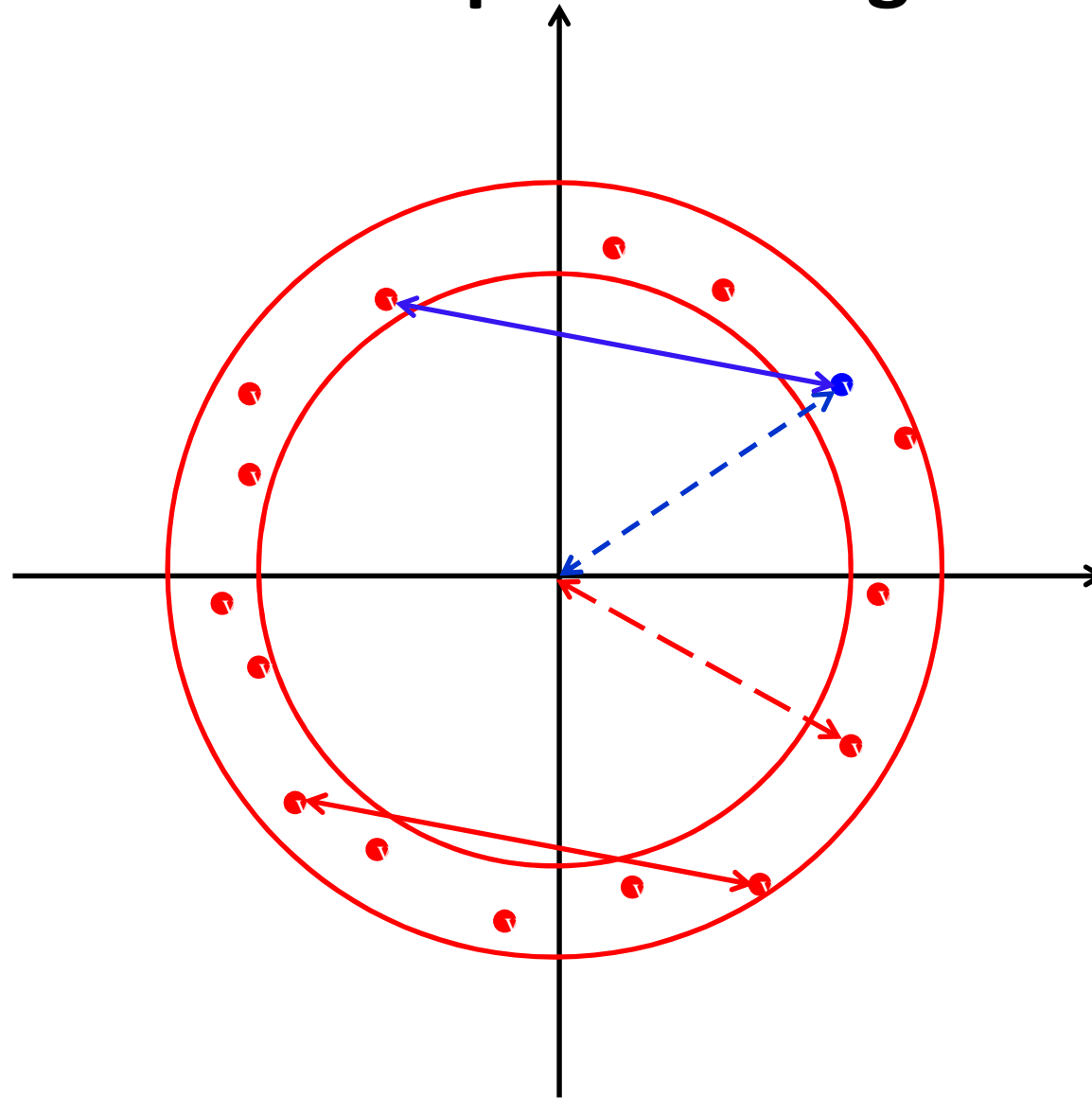
$$\hat{f}_k = M e^{i\Phi} + P_k e^{i\phi_k}$$

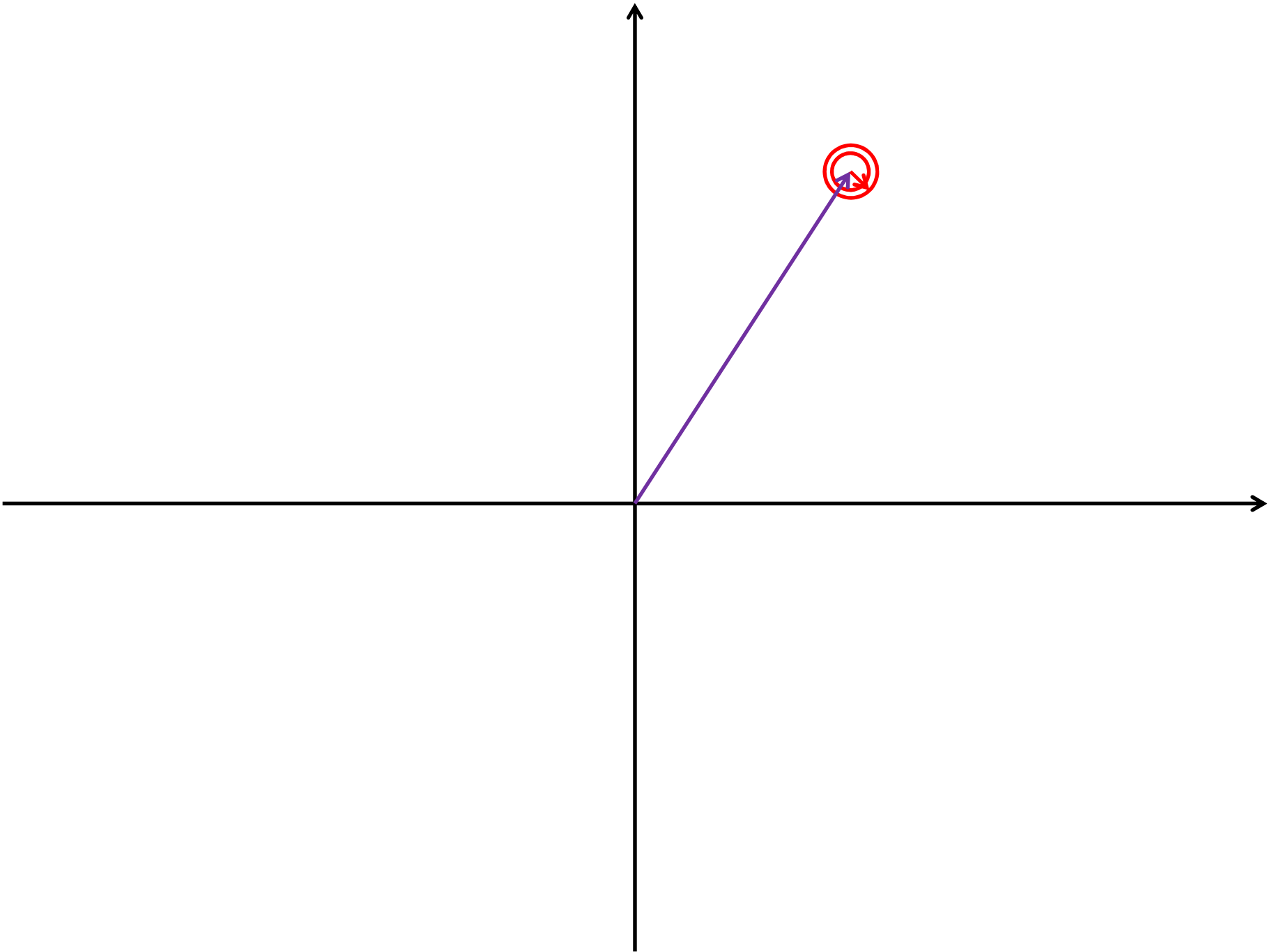


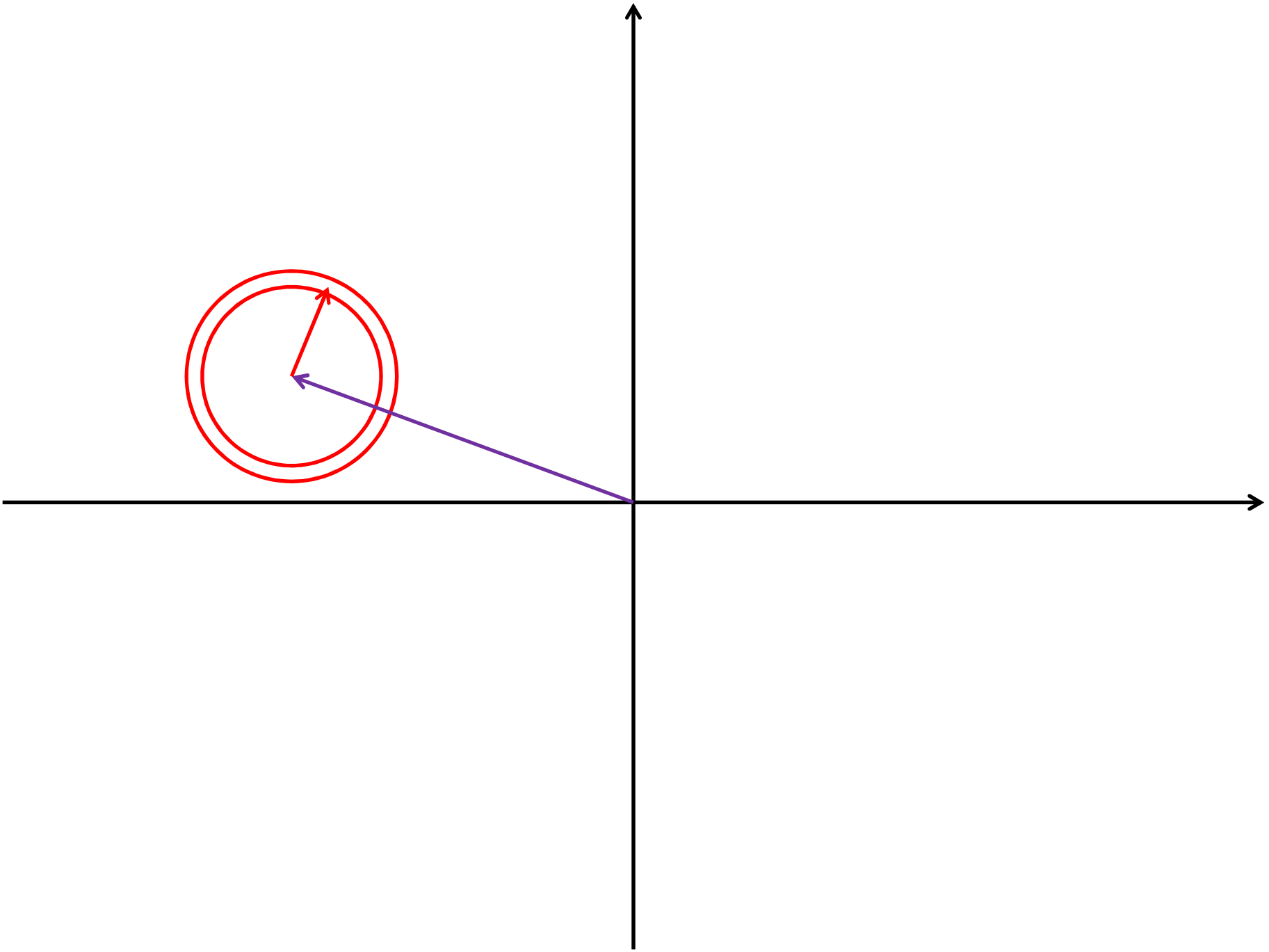
$$E[\hat{f}_k^2] = E[M^2] + E[P_k^2]$$

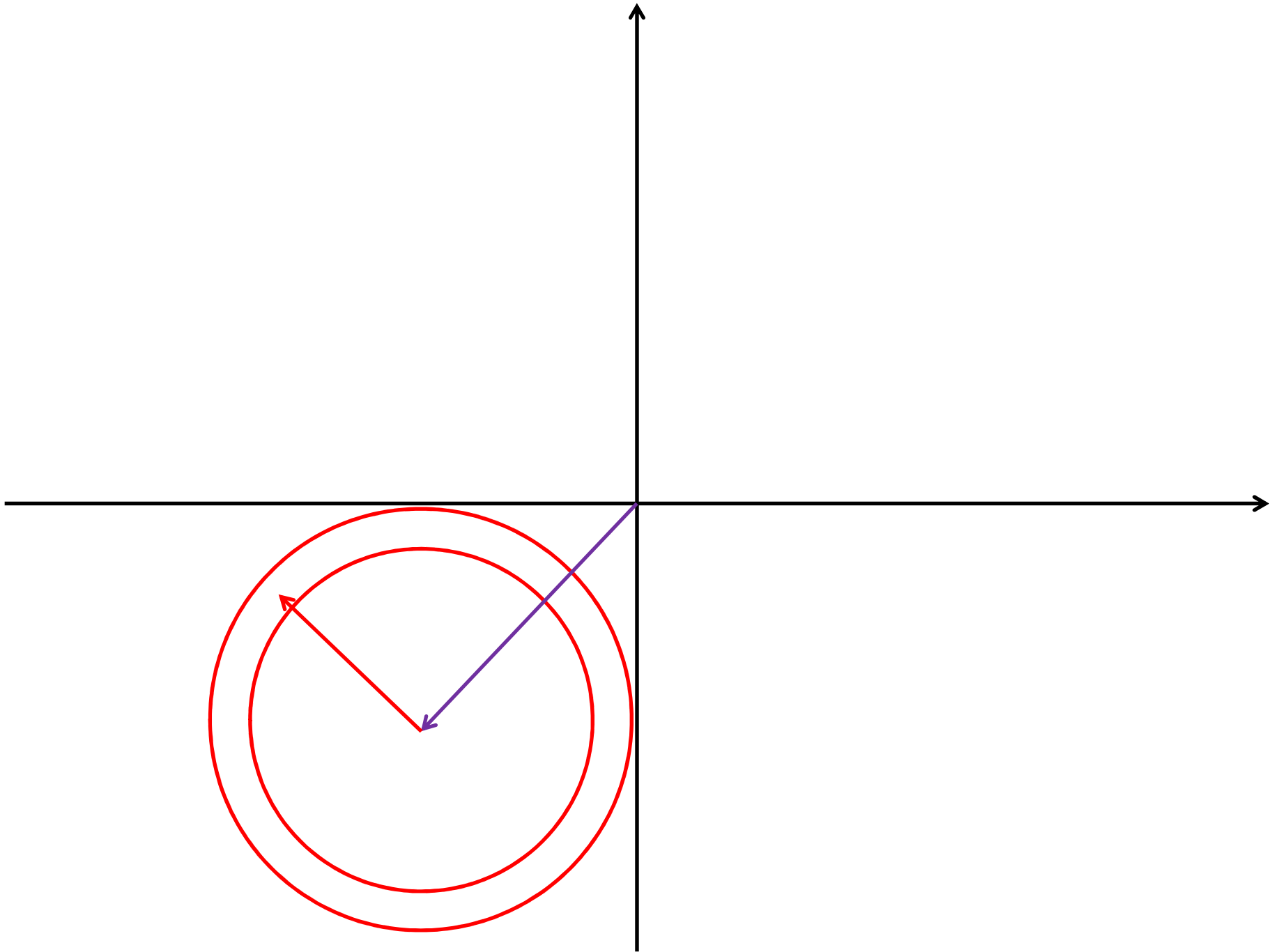


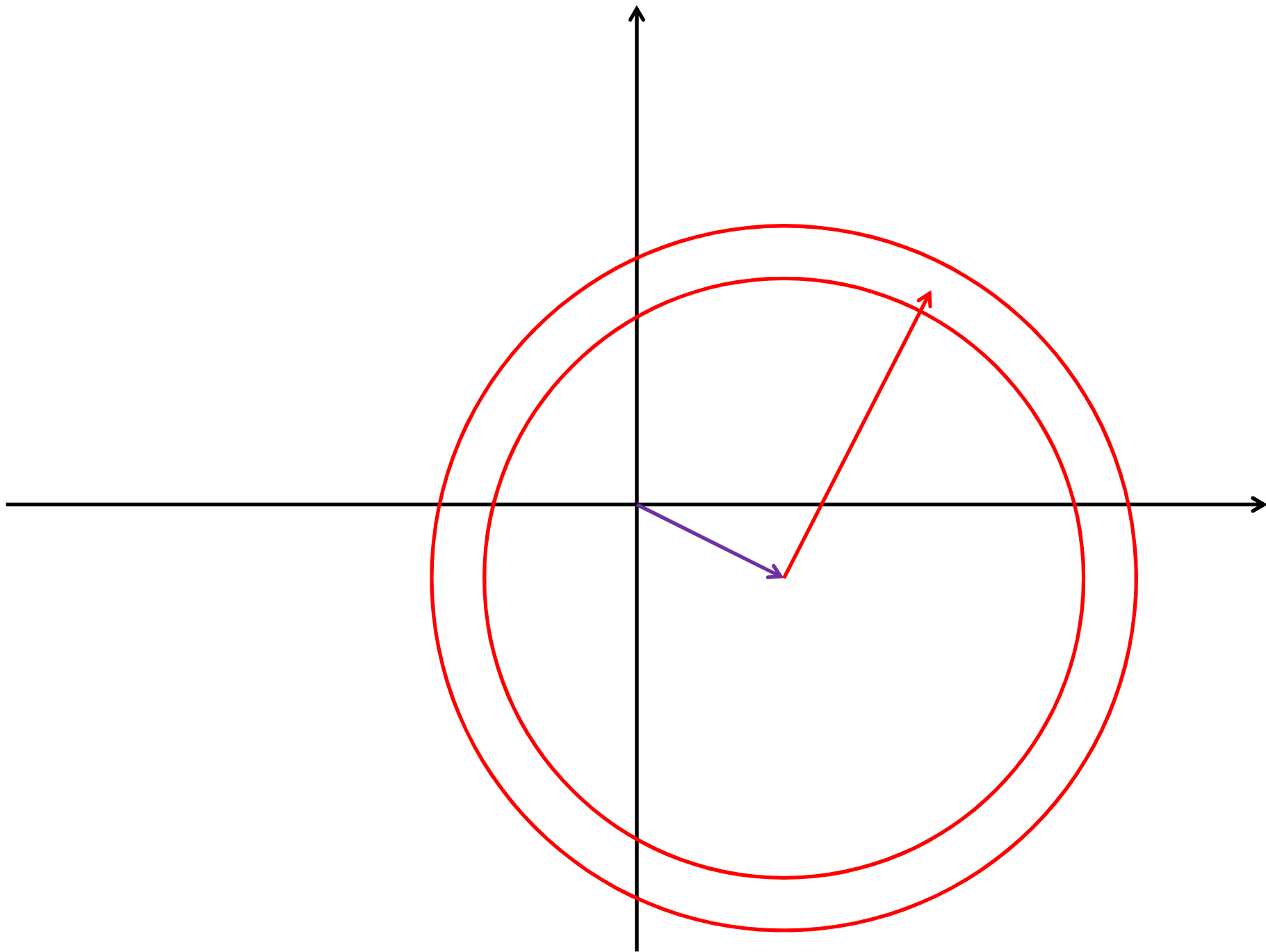
Unoccupied Average

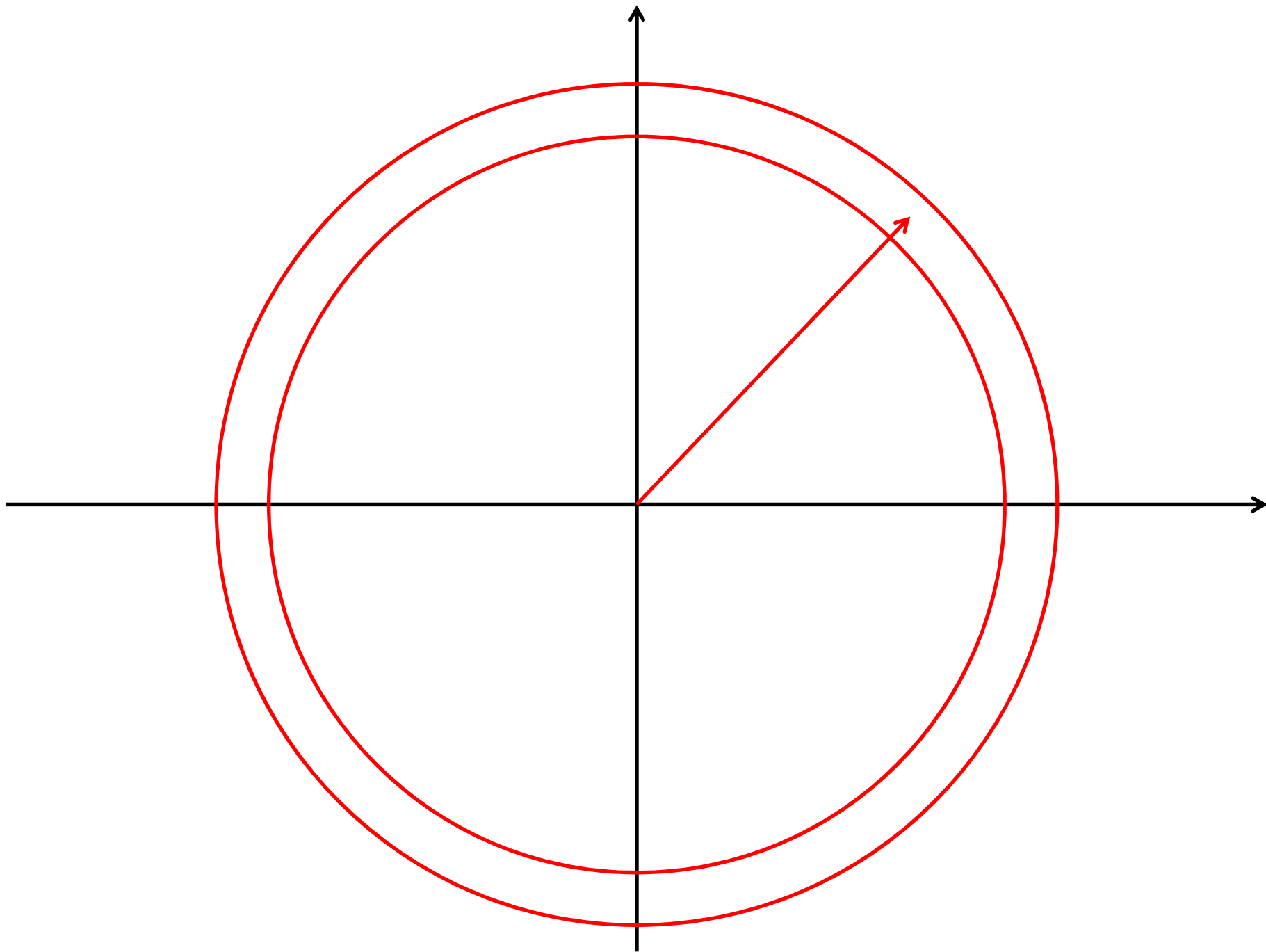












Ensemble Mean

- **Minimerar prognosfelet = Bästa prognosen**

Ensemble Mean

- **Minimerar prognosfelet = Bästa prognosen**
- **Representerar det som är prediktabelt**

Ensemble Mean

- **Minimerar prognosfelet = Bästa prognosen**
- **Representerar det som är prediktabelt**
- **Ej som observerade fält – Unoccupied average**

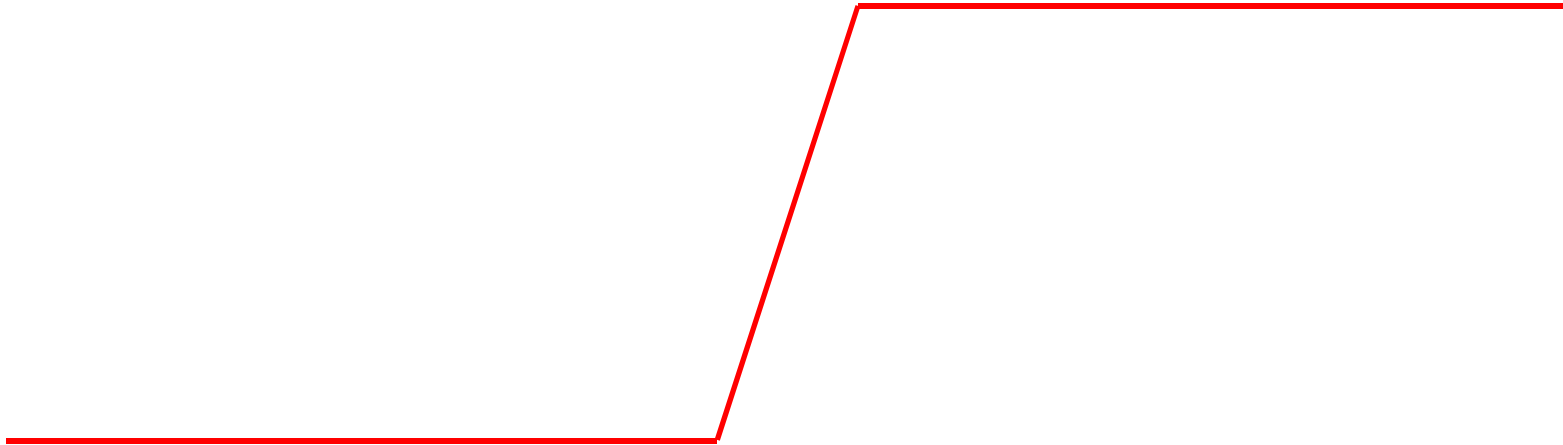
Ensemble Mean

- **Minimerar prognosfelet = Bästa prognosen**
- **Representerar det som är prediktabelt**
- **Ej som observerade fält – Unoccupied average**
- **Går asymptiskt mot Klimatologin =
Minskar med prognoslängden**

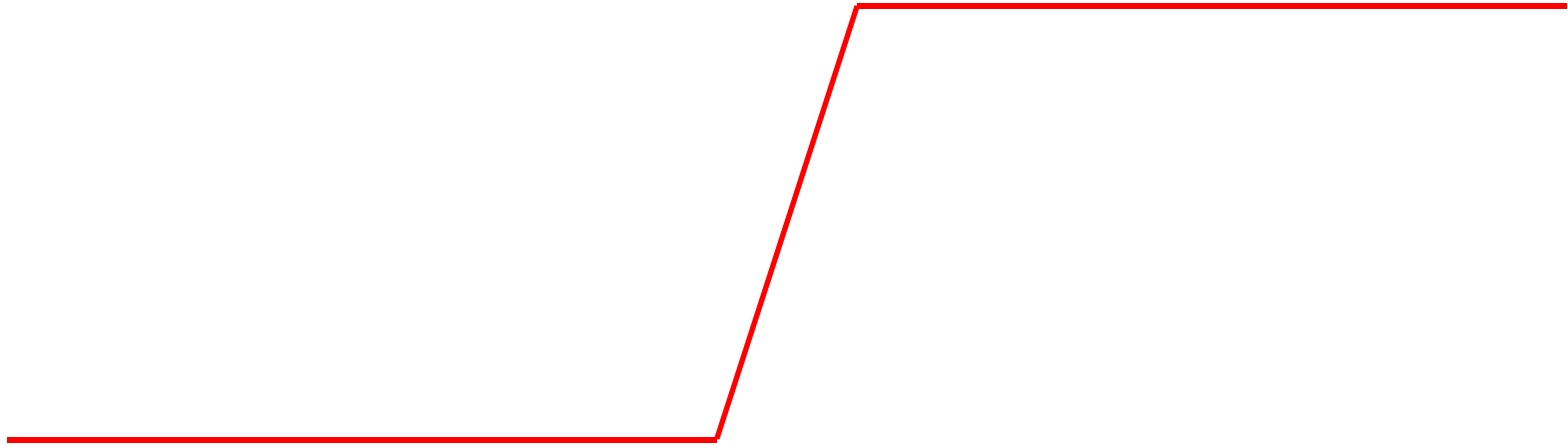
Ensemble Member 1



Ensemble Member 2



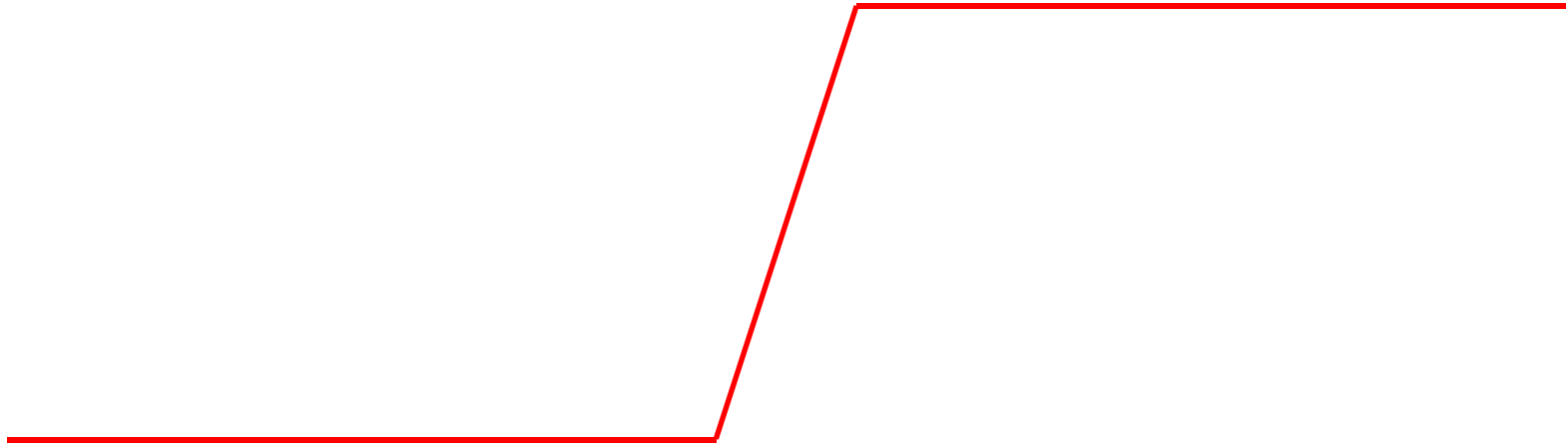
Ensemble Member 3



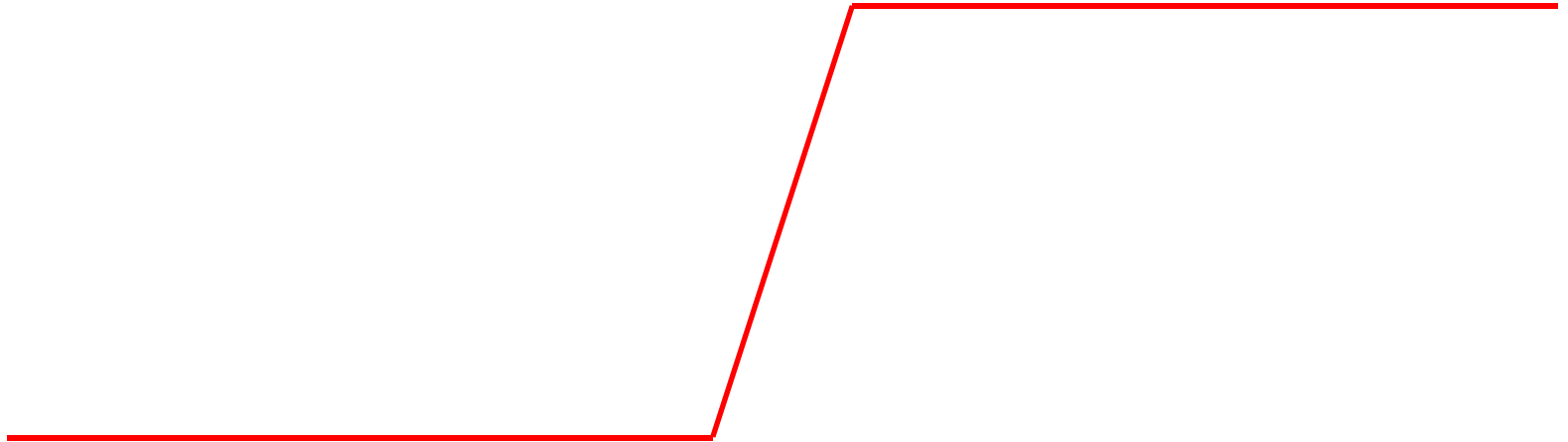
Ensemble Member 4



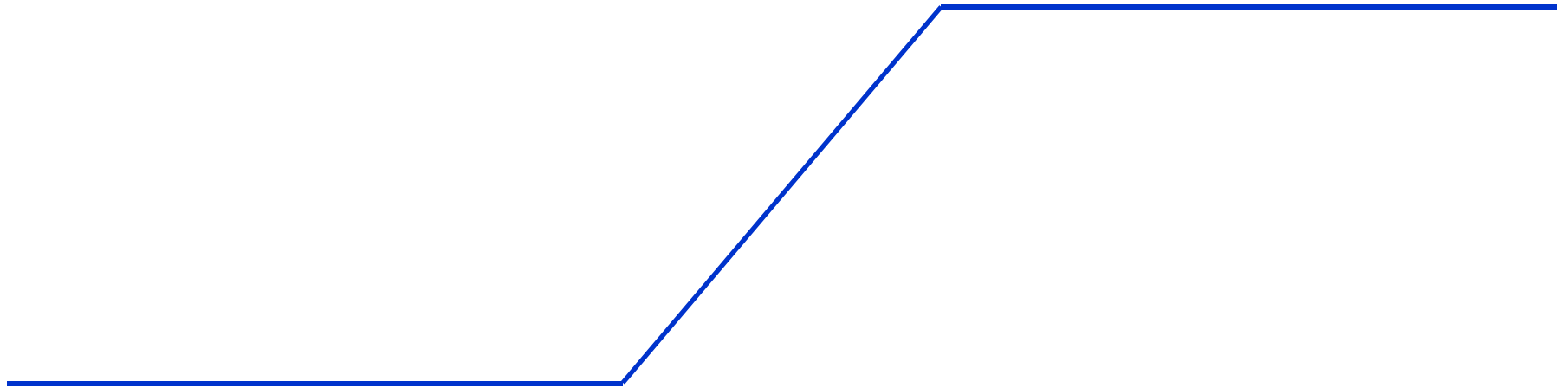
Ensemble Member 5



Ensemble Member 6



Ensemble Mean



Spread

- **Mått på osäkerhet**

Spread

- **Mått på osäkerhet**
- **Prognos och Observation statistiskt lika**

Spread

- **Mått på osäkerhet**
- **Prognos och Observation statistiskt lika**
- **Ökar med prognoslängden**

Spread

- **Mått på osäkerhet**
- **Prognos och Observation statistiskt lika**
- **Ökar med prognoslängden**
- **Går asymptotiskt mot Klimatologiska Variabiliteten**