

How do we estimate the Aerosol Indirect Effect in CAM ?

**Cécile Hannay, CAM Science Liaison
Atmospheric Modeling and Predictability (AMP)**

Outline

- **Aerosol Indirect Effect: Whatsdat ?**
- **How do we estimate the Aerosol Indirect Effect ?**
- **Putting an error bar on our estimation.**

Disclaimer: I will not say a single word about CESM2

Nada. Non, rien du tout. Gar nichts.

How to explain “Aerosol Effect” to your Mom or Dad?

Aerosol Direct Effect => Not for today talk !

Aerosols scatter and absorb solar and infrared radiation

Aerosol Indirect Effect

Cloud droplets form on aerosols (Cloud Condensation Nuclei=CCN).

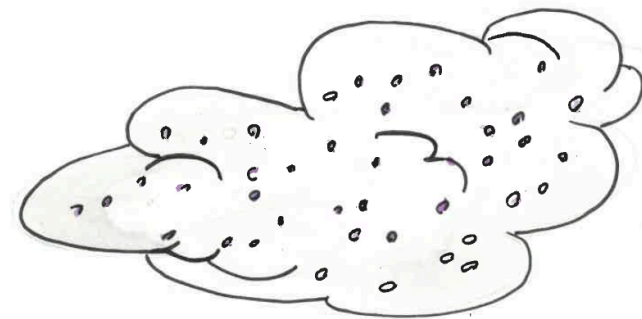
More aerosols => more smaller cloud droplets

Pristine air (few CCN)



Few big droplets

Polluted air (many CCN)



Many small droplets

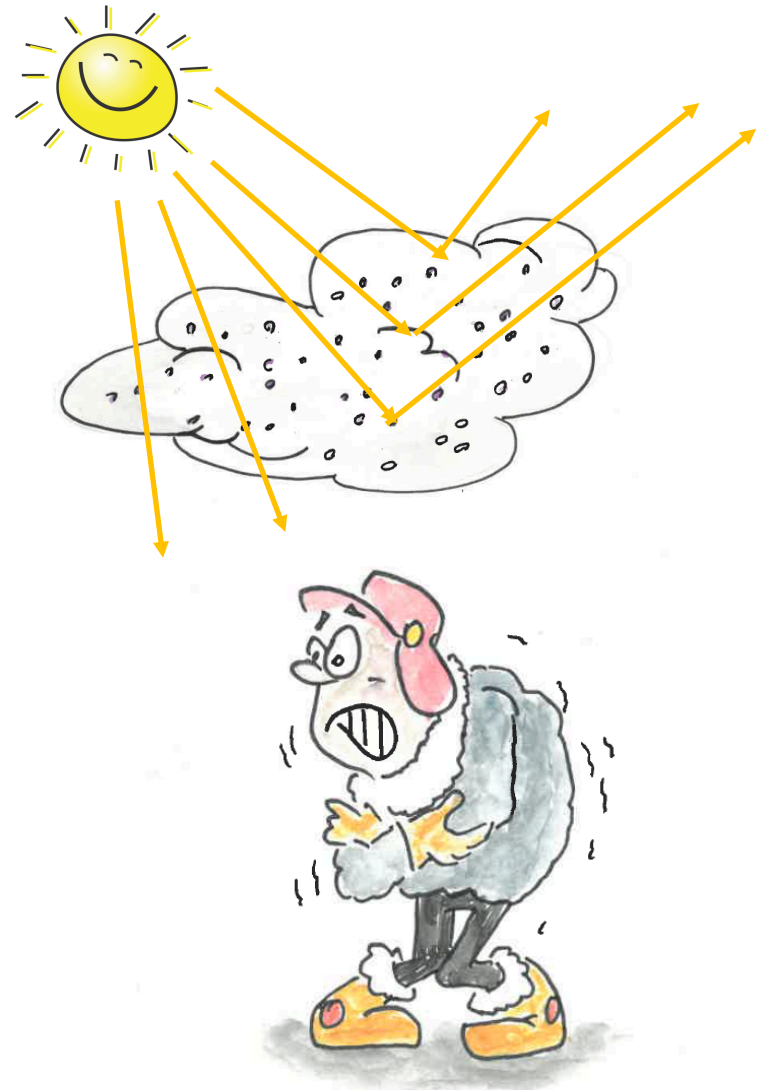
=> 2 indirect effects on climate

First Aerosol Indirect Effect: Cloud albedo effect

Pristine air (few CCN)



Polluted air (many CCN)



Second Aerosol Indirect Effect: Cloud lifetime effect

Pristine air (few CCN)



Polluted air (many CCN)

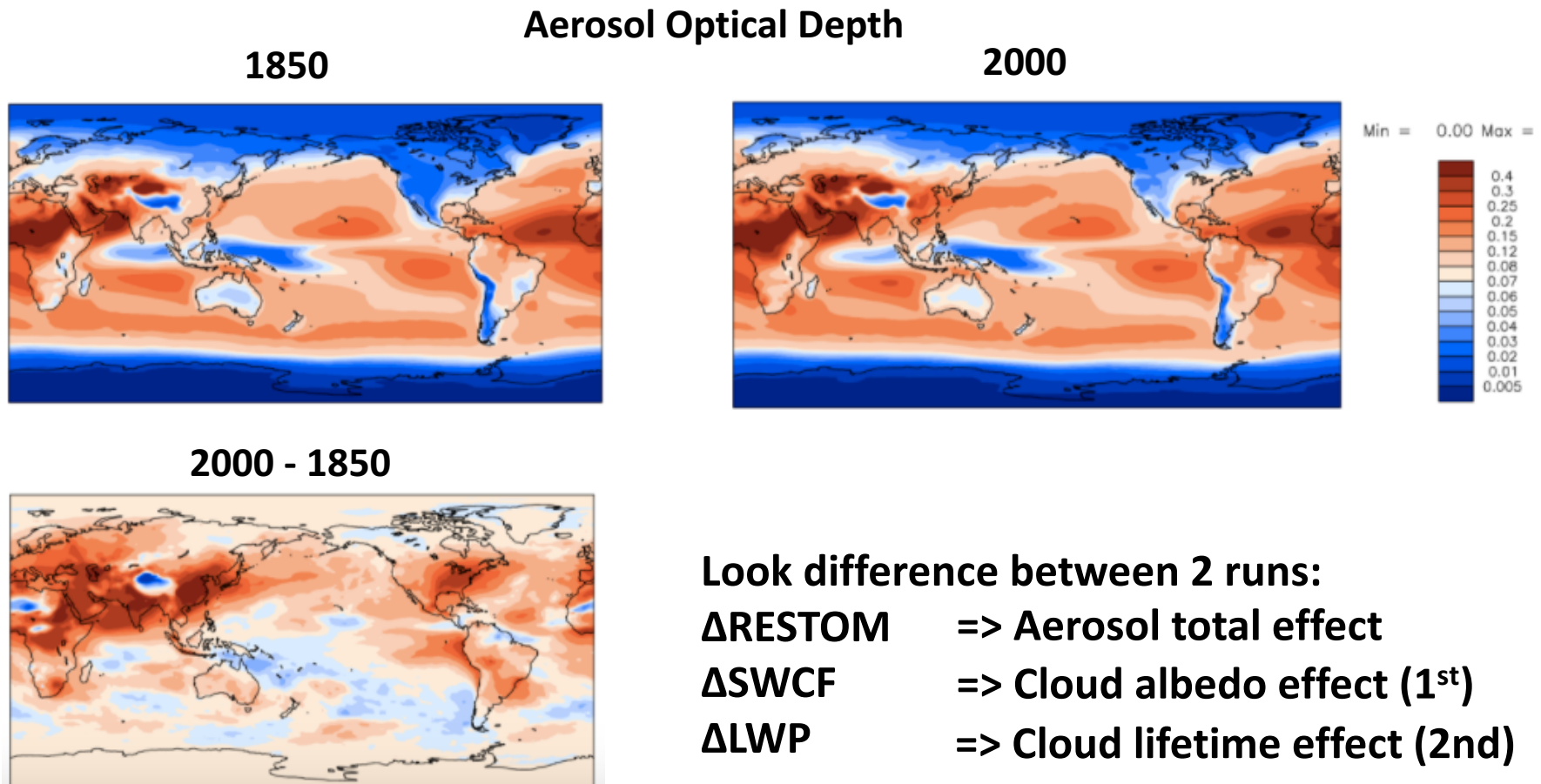


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How do we estimate the indirect effect in CAM ?

Two **5-year simulations** with prescribed climatological SSTs for year 2000 (F2000) with **present day aerosol (2000)** and with **pre-industrial aerosol (1850)**.



Example: Suite of simulations to assess indirect effect

Recently, we looked at a table with 18 x 2 simulations (2000 and 1850 aerosols)
 Δ RESTOM varies between $-1.6\text{W}/\text{m}^2$ and $-1.2\text{ W}/\text{m}^2$.

Configuration	Δ RESTOM	Δ SWCF	Δ LWCF	Δ LWP
001	-1.6	-1.8	0.28	4.6
002	-1.3	-1.7	0.35	4.1
003	-1.2	-1.6	0.41	4.2
004	-1.7	-1.9	0.35	5.3
005	-1.6	-1.7	0.27	4.7
006	-1.4	-1.6	0.27	4.1
007	-1.3	-1.6	0.26	4.0
008	-1.4	-1.5	0.28	3.9
009	-1.4	-1.6	0.31	3.9
010	-1.4	-1.5	0.27	3.6
011	-1.6	-1.7	0.27	4.6
012	-1.2	-1.4	0.24	3.9
013	-1.4	-1.6	0.35	4.0
014	-1.4	-1.7	0.27	4.1
016	-1.3	-1.6	0.35	4.0
017	-1.5	-1.8	0.38	4.4
018	-1.6	-1.5	0.18	4.1

We tried to determine which configuration has the most desirable indirect effect. However, results seemed somewhat “all over the place”.

For full description of experiments:

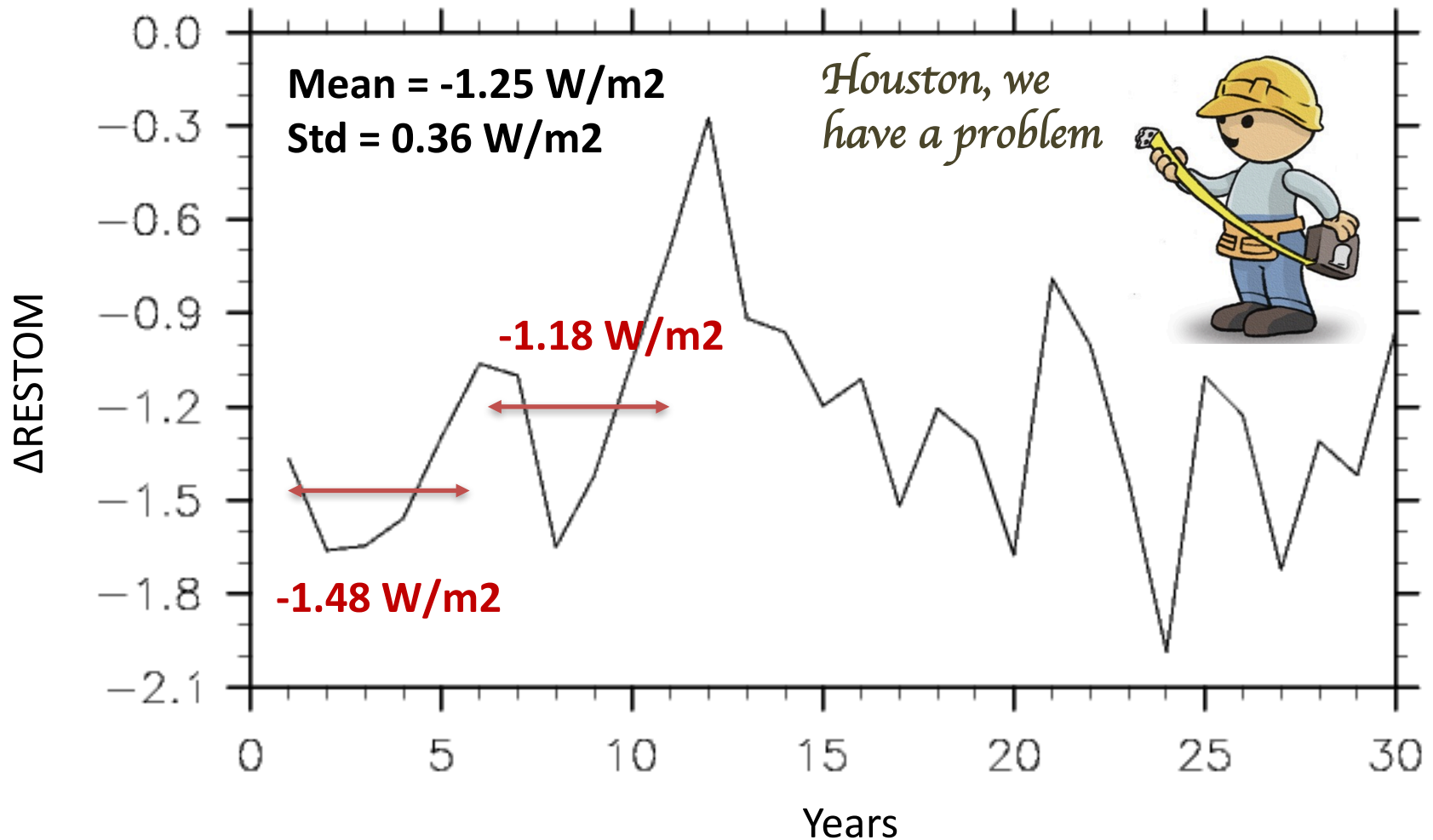
http://www.cesm.ucar.edu/working_groups/Atmosphere/development/cam6_dev/index_autoconversion_190.html

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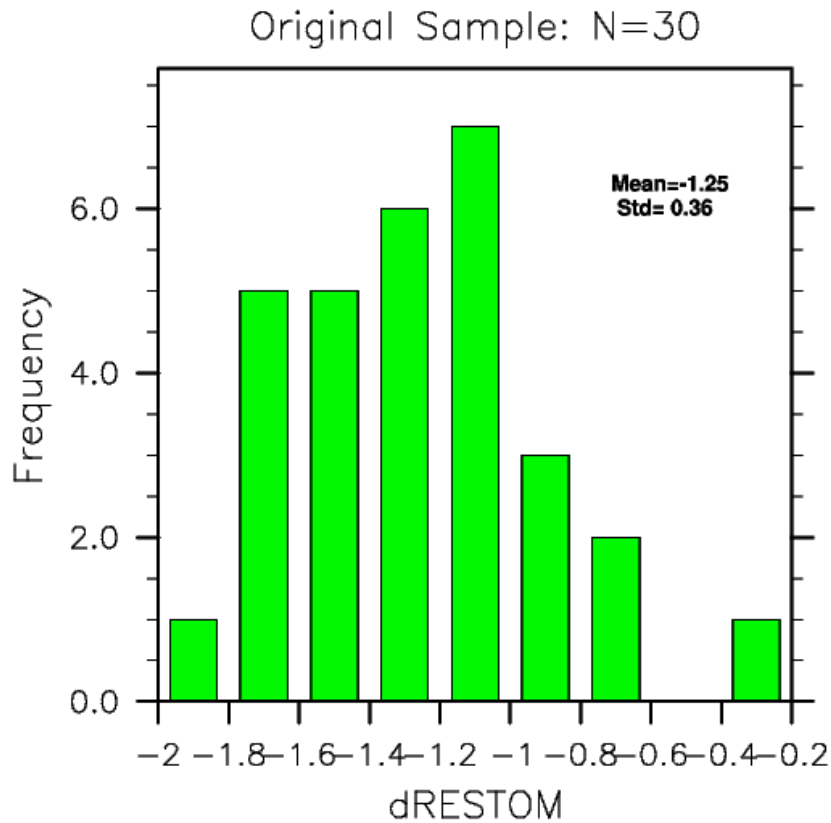
Timeseries of RESTOM

We extend the run from 5 years to 30 years

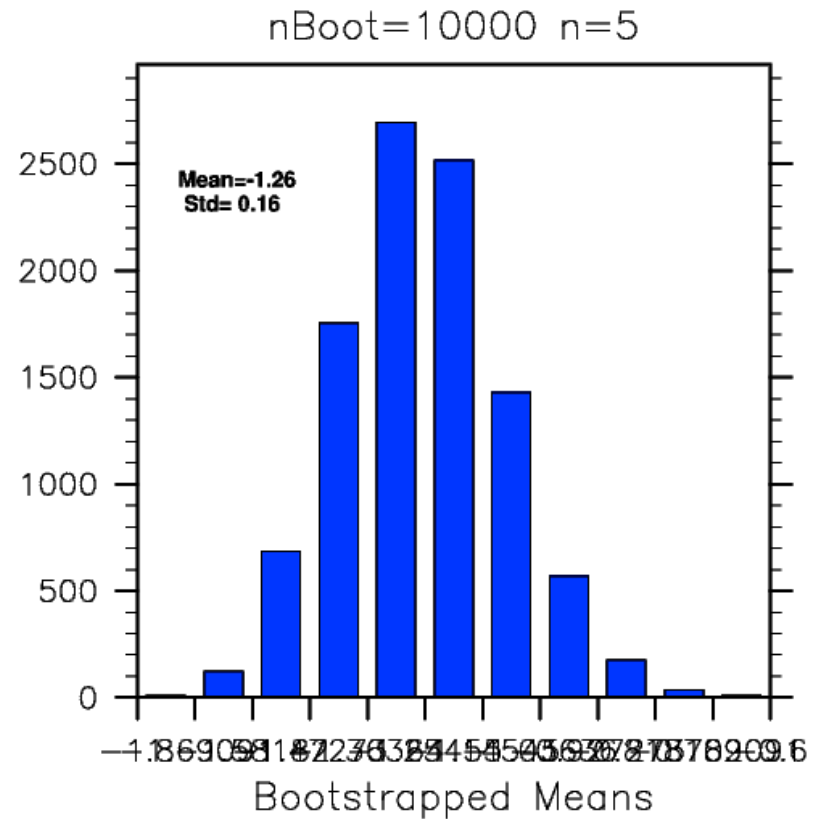


Bootstrap analysis

Use 10000 bootstrap samples (random sampling with replacement).



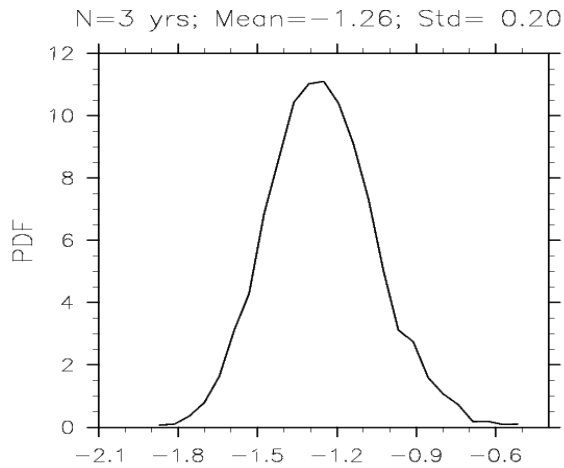
Original sample: 30 years



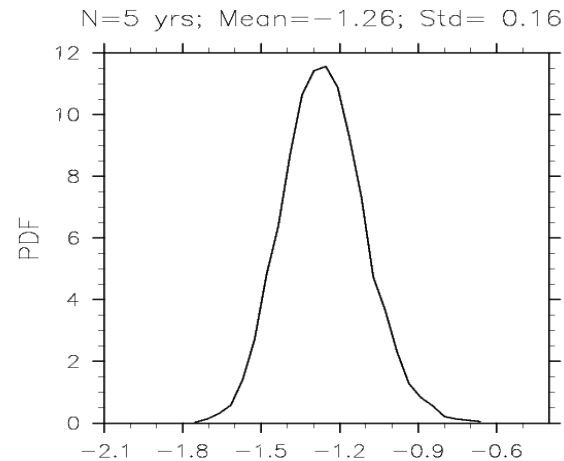
Create 5-year subsamples from original sample.

Pdf of RESTOM for 3, 5, 10, 20-year samples

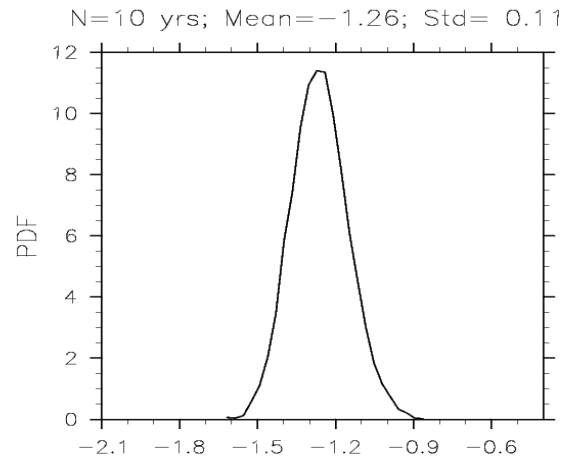
3 years



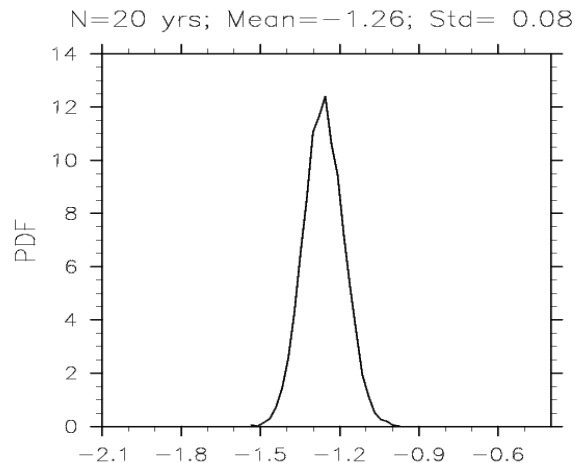
5 years



10 years



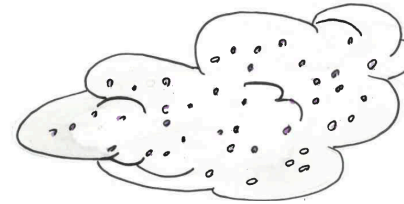
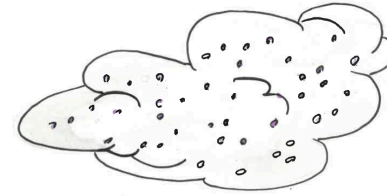
20 years



Putting an error bar

yrs	Mean	Std
3	-1.26	0.20
5	-1.26	0.16
10	-1.26	0.11
20	-1.26	0.08
30	-1.26	0.06

The making of a research report



Thanks to Vincent