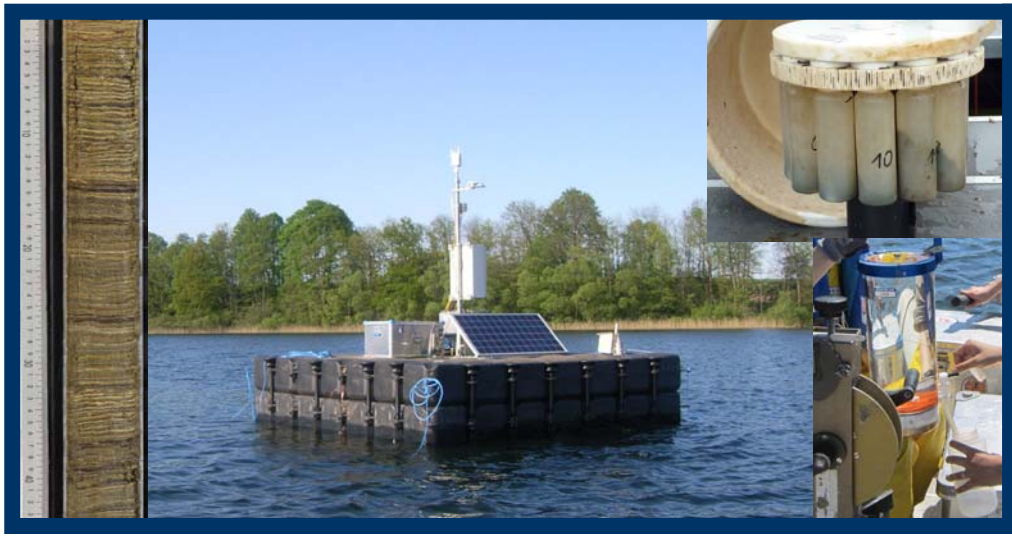
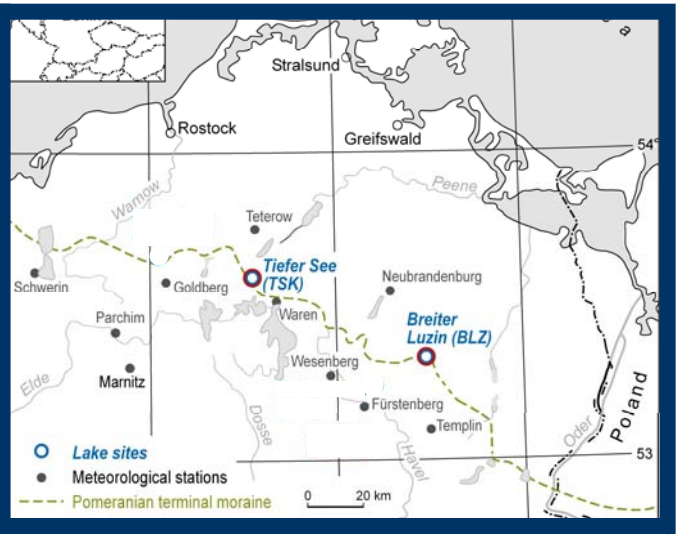
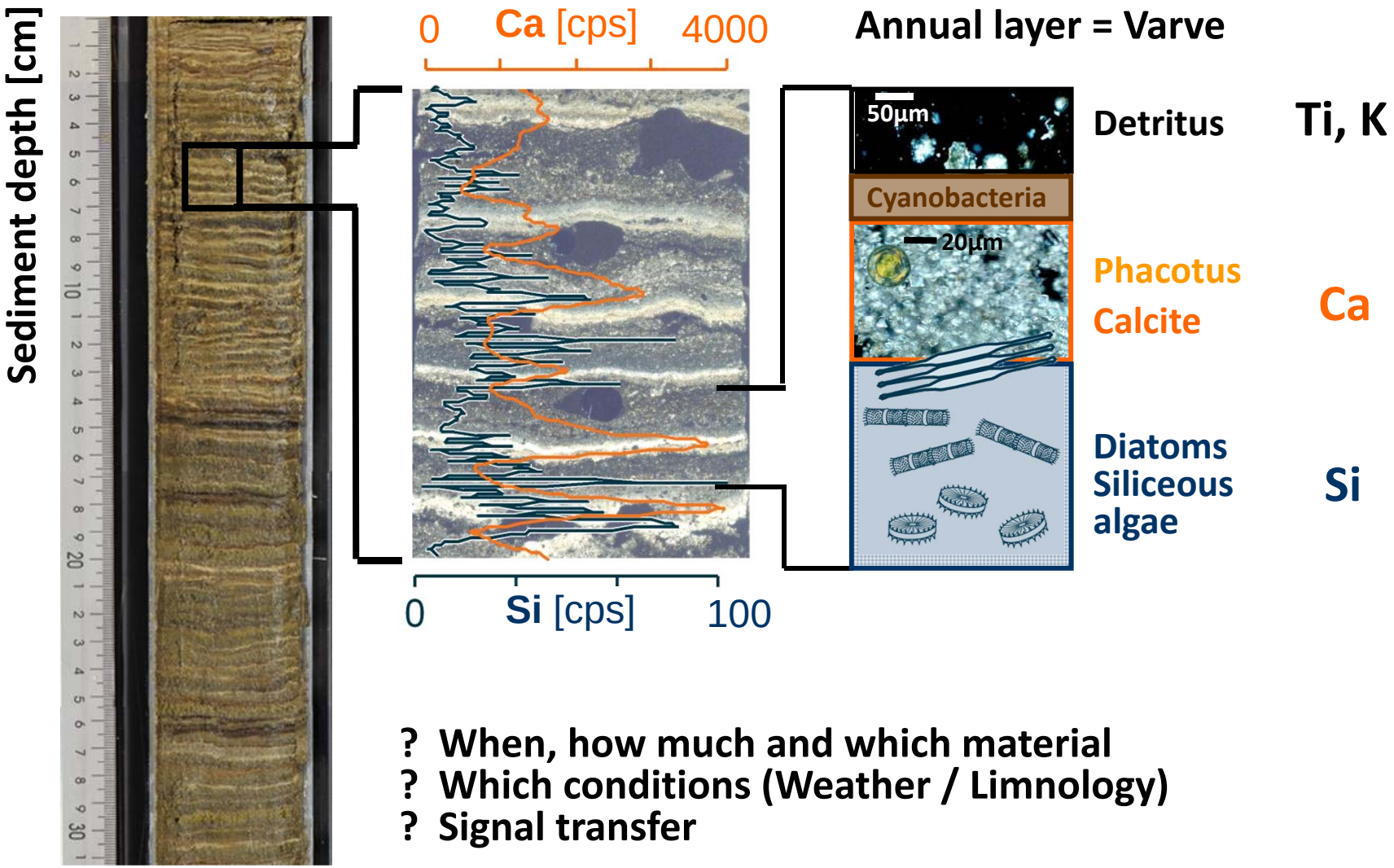
Linking diatom deposition with the spring temperature gradient Lake Tiefer See (NE Germany)

U. Kienel,
B. Brademann, N. Dräger, P. Dulski, F. Ott, B. Plessen, A. Brauer



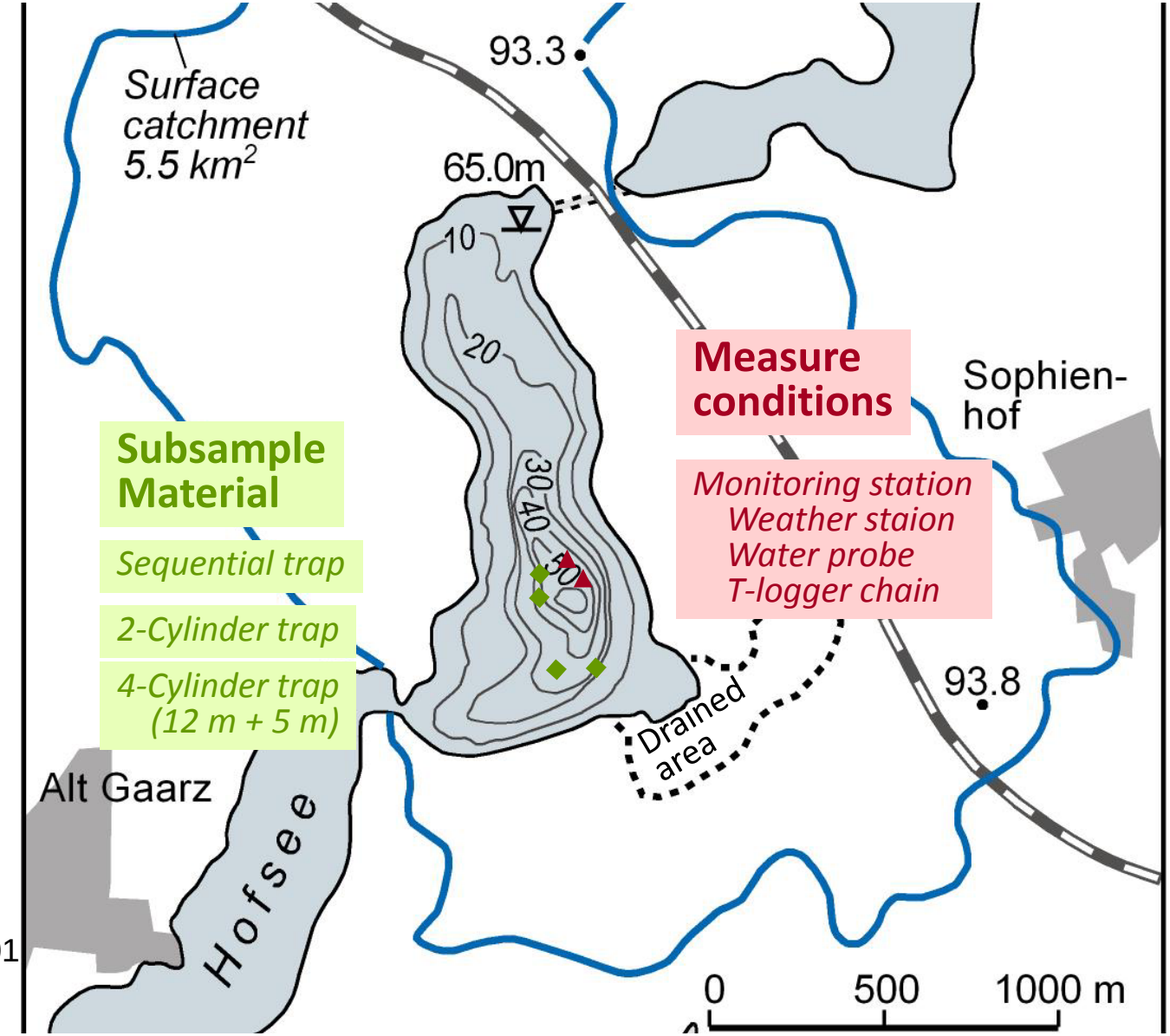


Formation of varves and seasonal layers

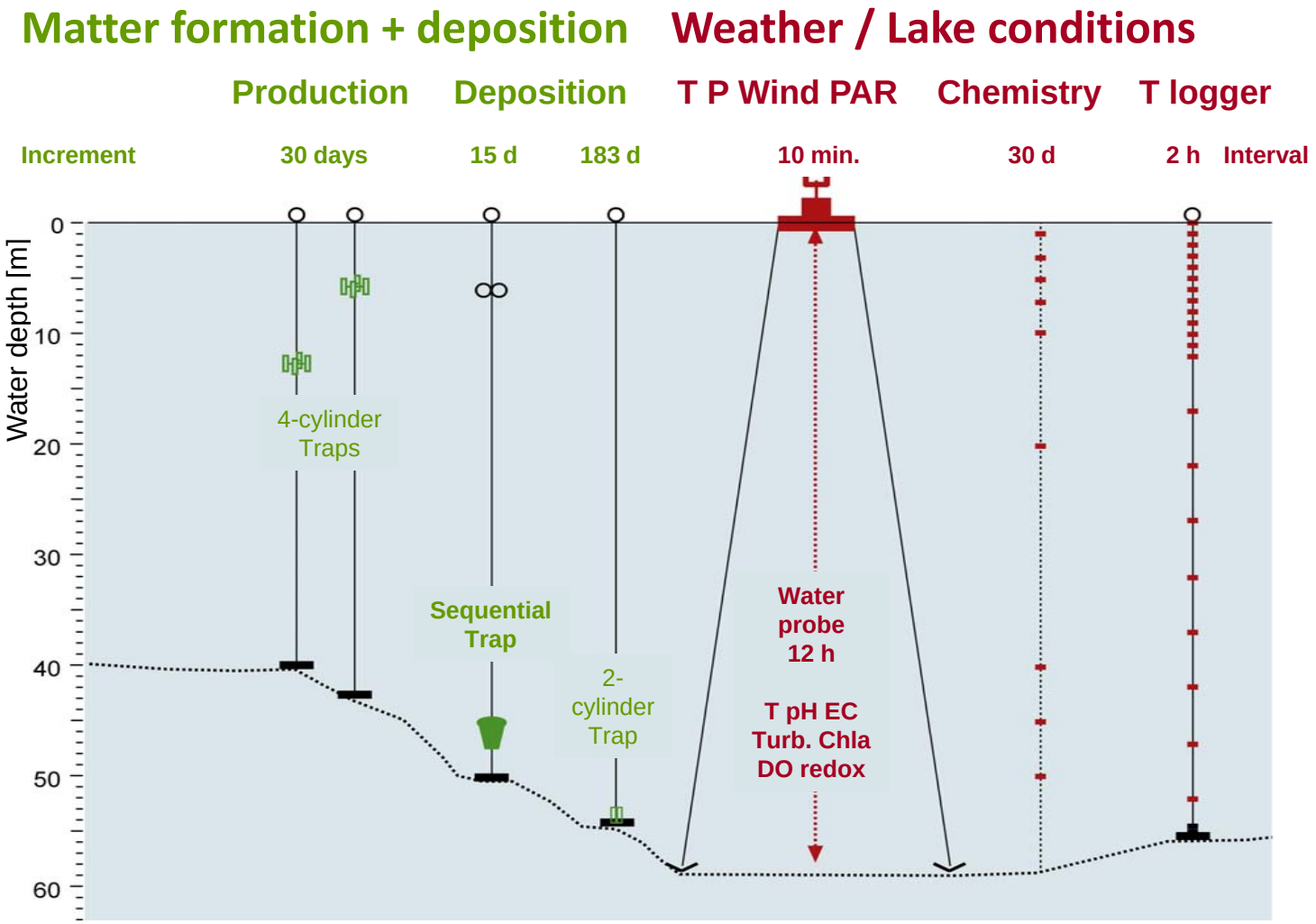


? When, how much and which material
? Which conditions (Weather / Limnology)
? Signal transfer

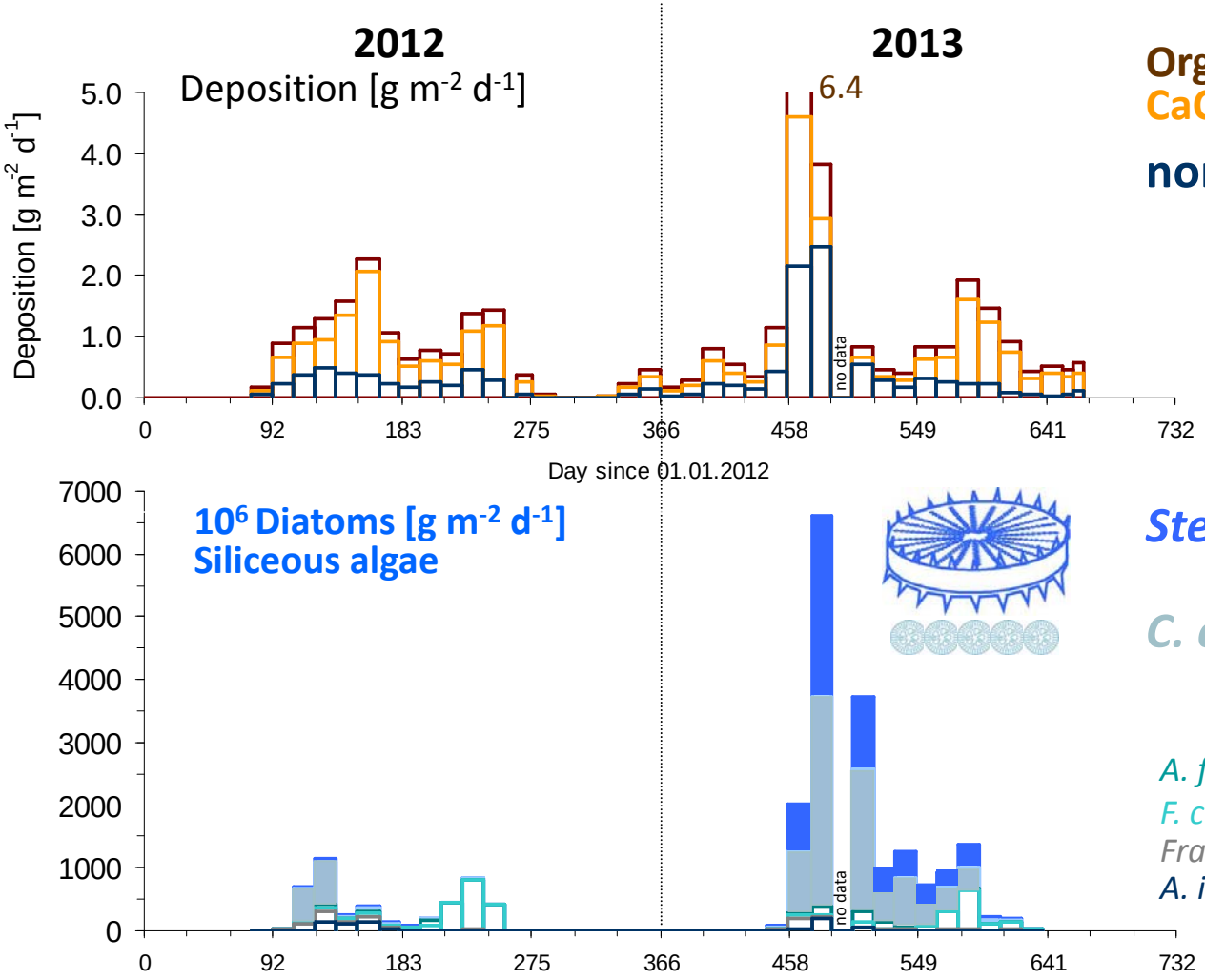
Lake Tiefer See Monitoring – Instrumentation



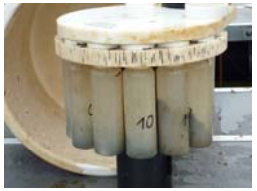
Lake Tiefer See Monitoring – Instrumentation



Trapped hypolimnion deposition



Organic matter
$CaCO_3$
non-$CaCO_3$ IM

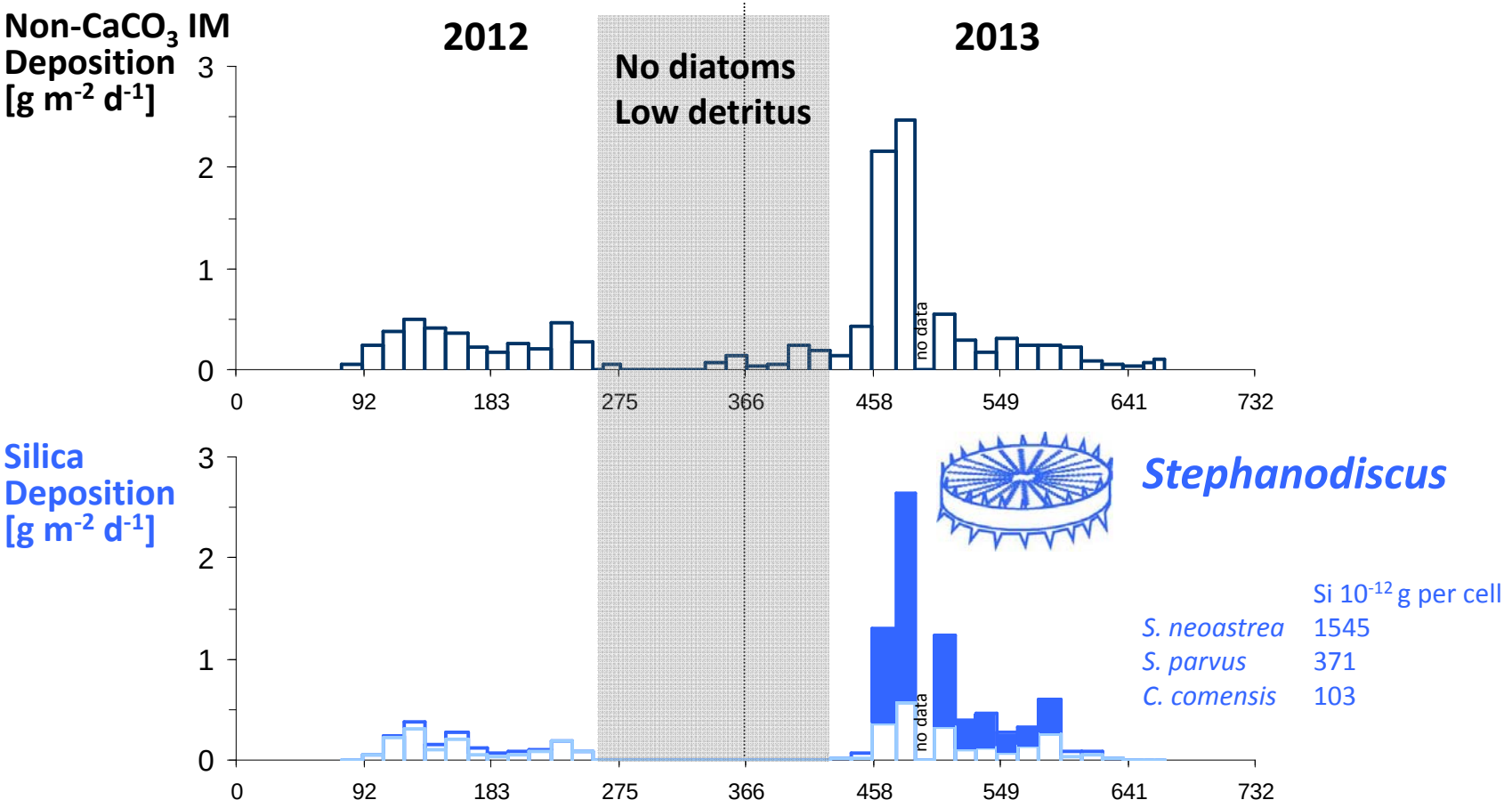


Stephanodiscus

C. comensis

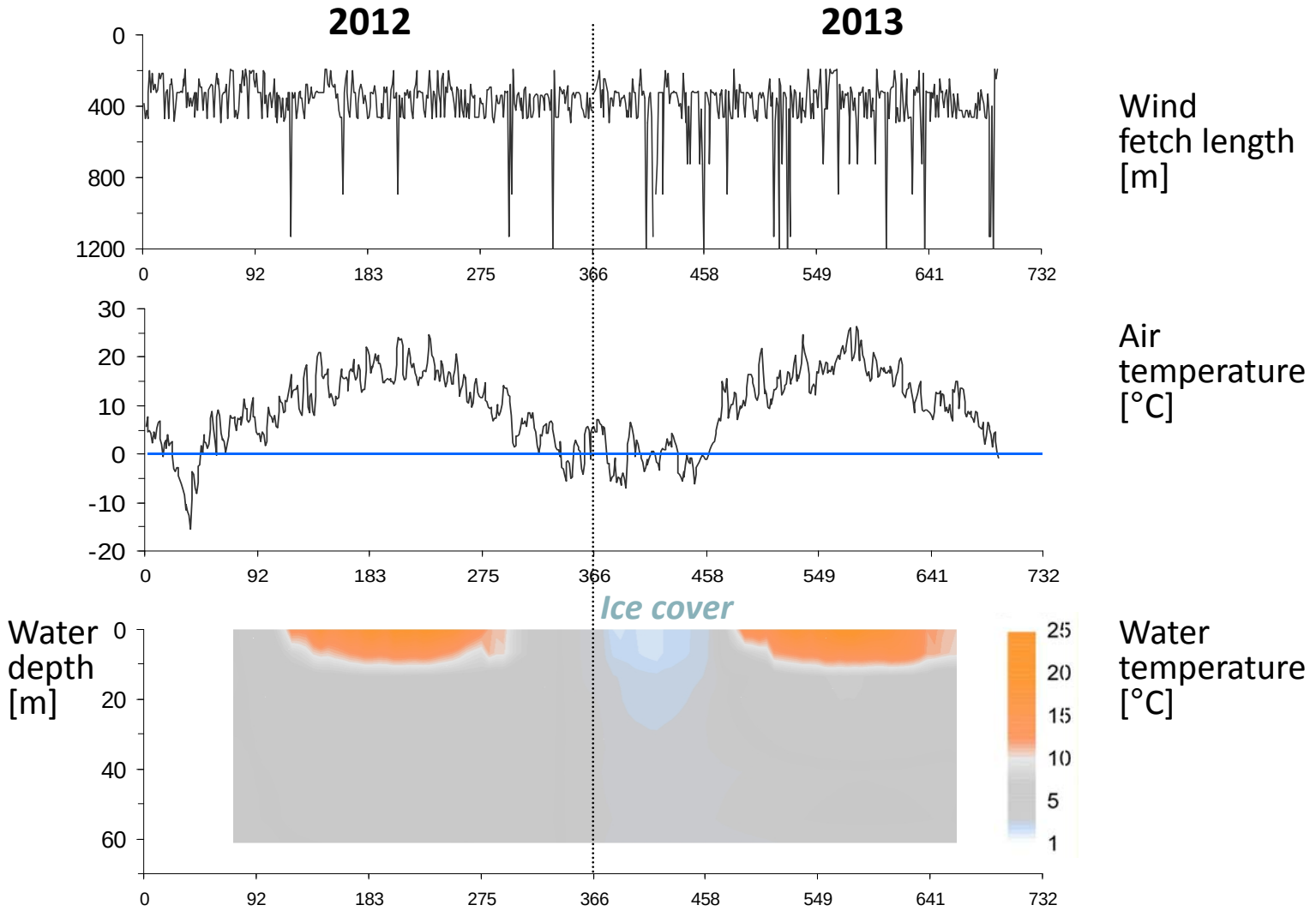
A. formosa
F. crotonensis
Fragilaria
A. islandica

IM deposition transferred to Diatom Si



$\log_{10}$[silica content] = 1.03 $\log_{10}$[biovolume] - 2.45
(Conley et al. 1989)

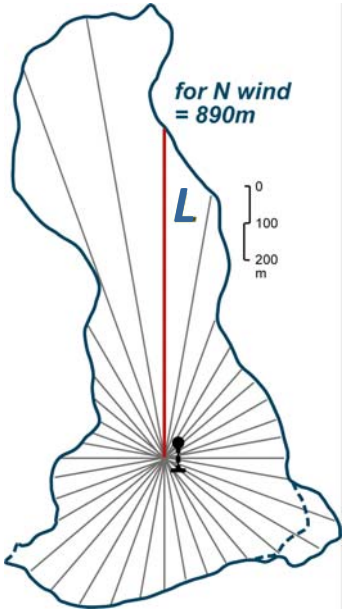
Weather and Lake conditions –> Lake mixing



Lake mixing depth related to T_{water} and wind

Wedderburn number W = 1

depth to which water column is mixed by wind (Walsby & Schanz 2002)



Buoyancy **Wind action**

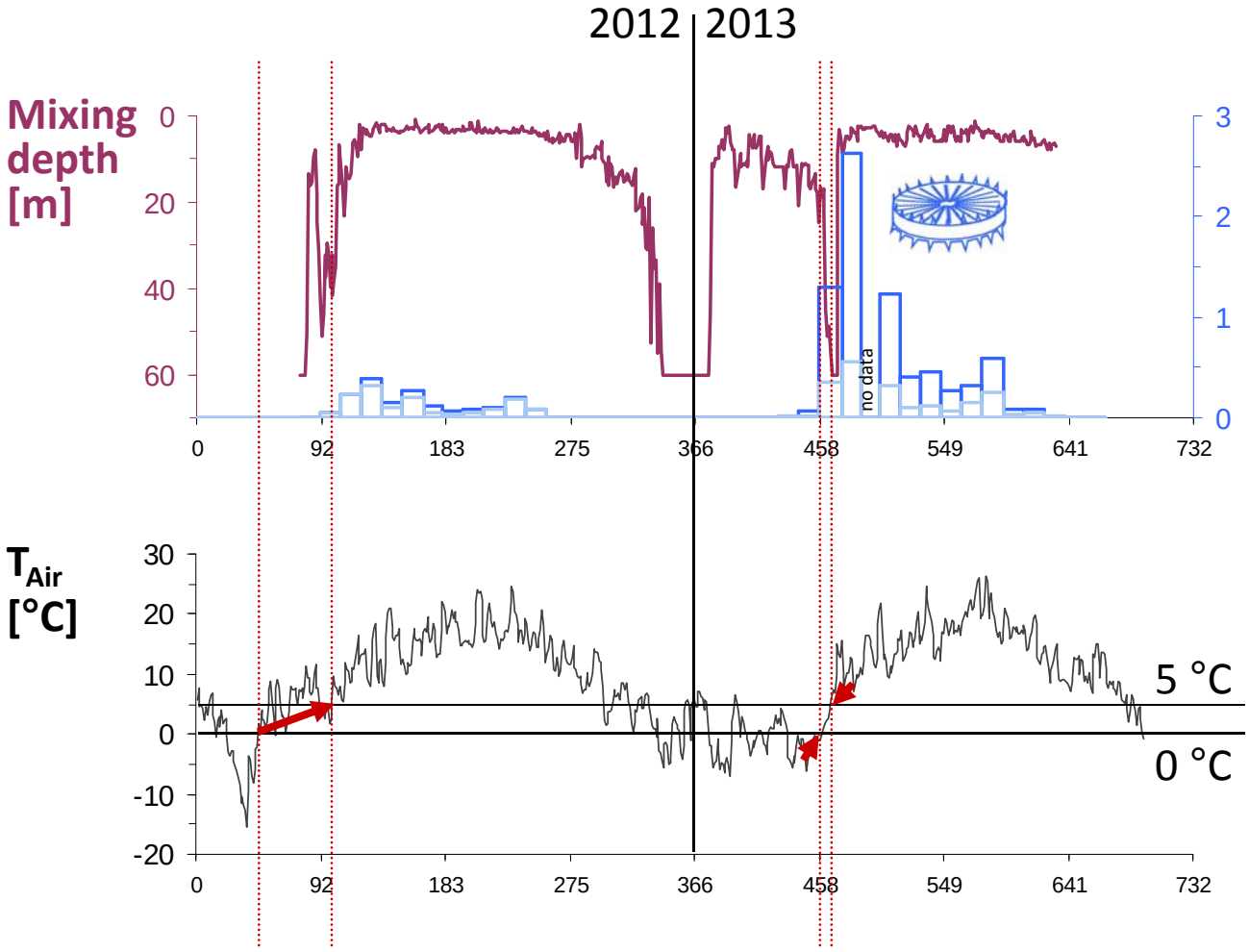
$$W = (\Delta\rho\ g\ h^2) / (\rho_w\ U^{*2}\ L)$$

$\Delta\rho$	water density difference surface and depth *h*
g	gravitational acceleration
ρ_w	water density
L	wind fetch length
*U**	wind-induced shear velocity (Spigel & Imberger 1987)

$$U^{*2} = (\rho_a/\rho_w)\ C_d\ U_w^2$$

ρ_a / ρ_w	density ratio air / water (0.0012)
C_d	drag coefficient (0.0013)
U_w	wind speed

Diatoms and Spring mixing - transfer function



Diatom Si
deposition
[g m^{-2} d^{-1}]

↓

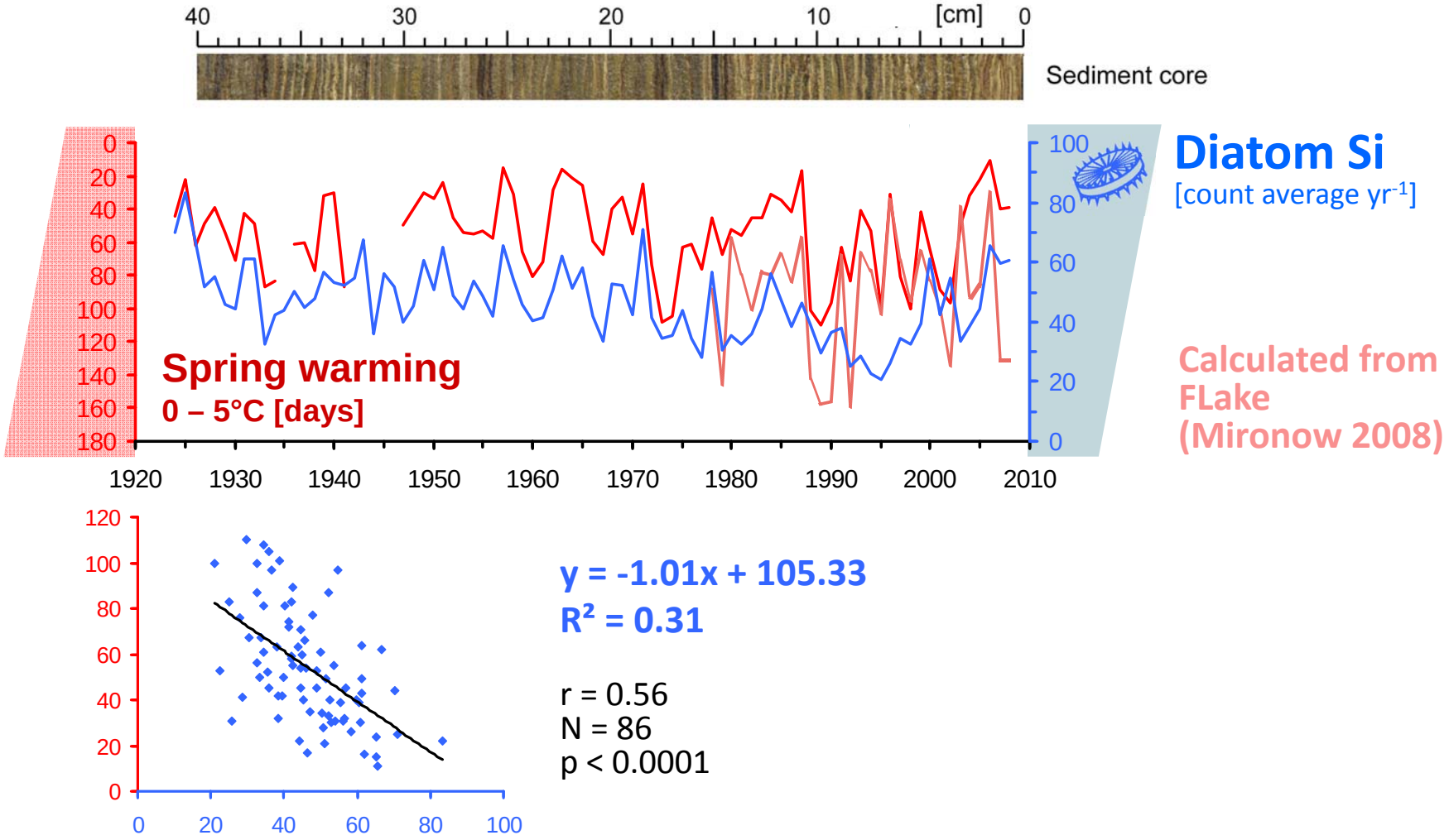
Sediment
Si mean yr^{-1}

T Duration
0 - > 5°C
[days]

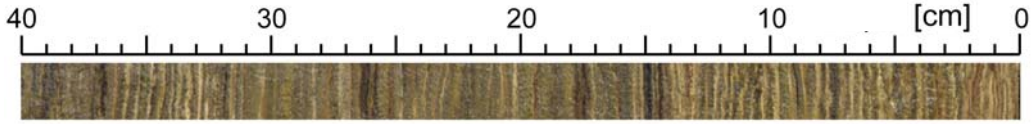
↓

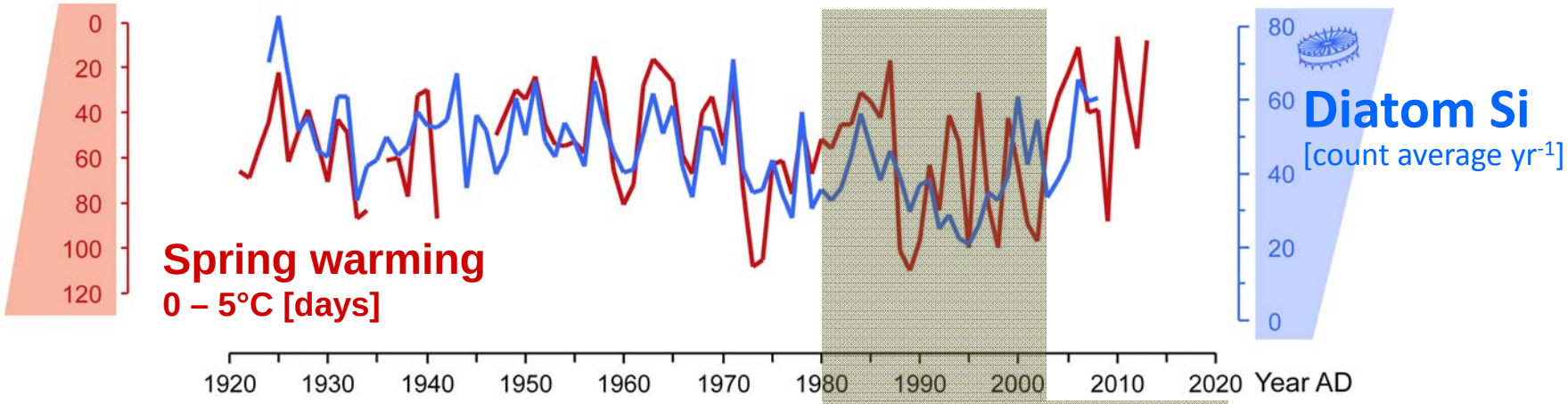
Schwerin TDur
since 1890

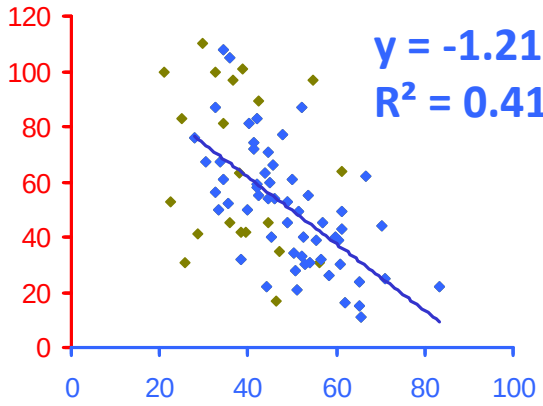
Transfer : Diatom Si = 1/Tduration 0 - ≥ 5°C

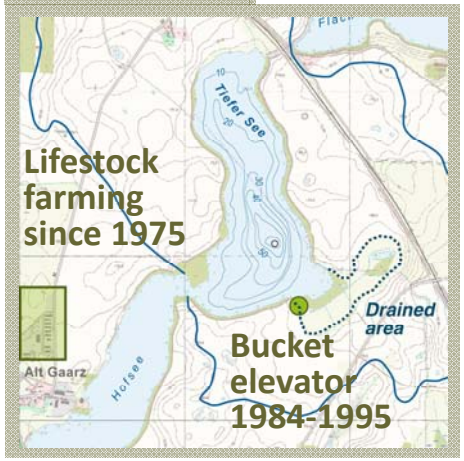


Transfer : Diatom Si = 1/Spring warming

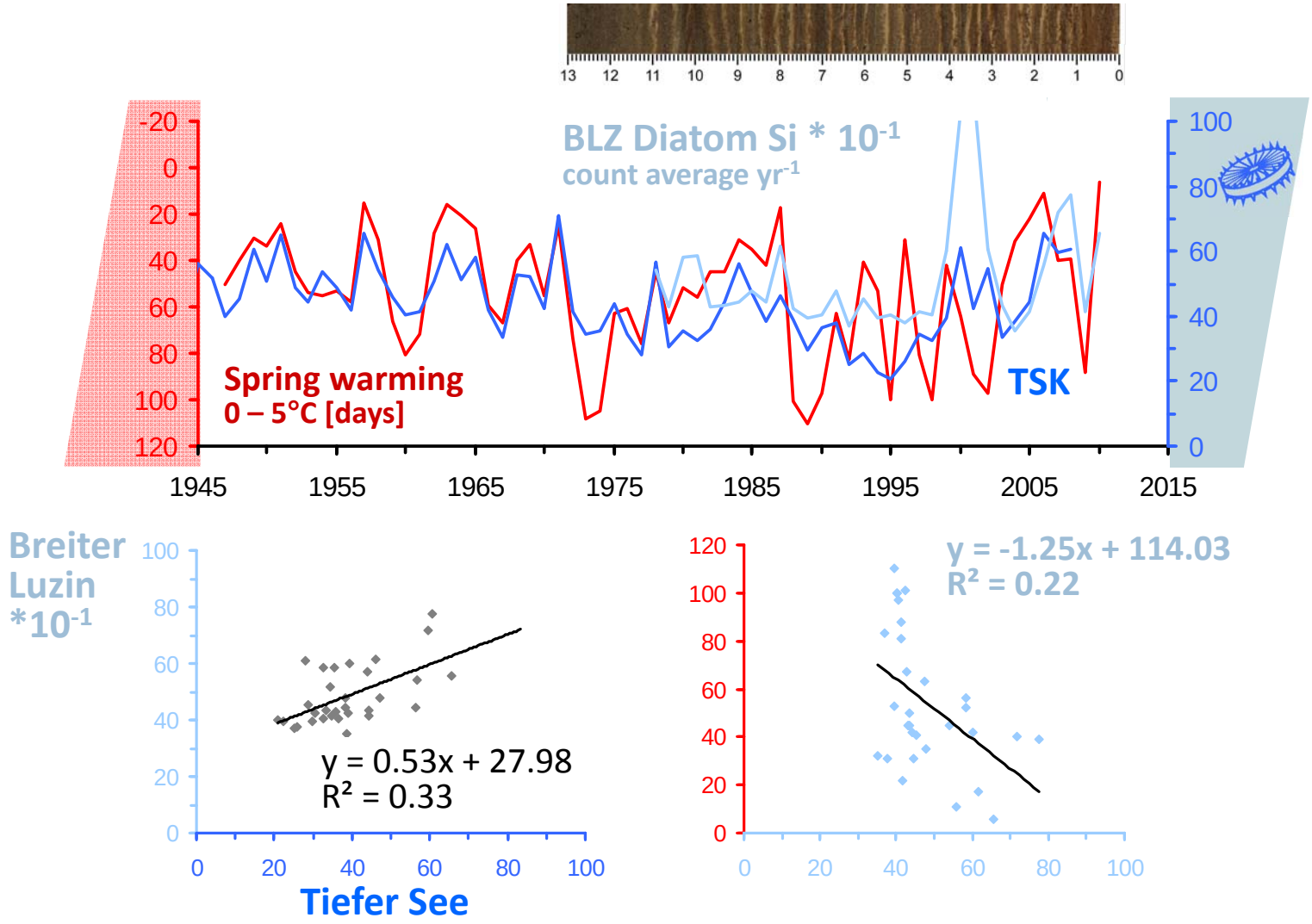








Testing the stability of the Diatom – T relation



First-step conclusions

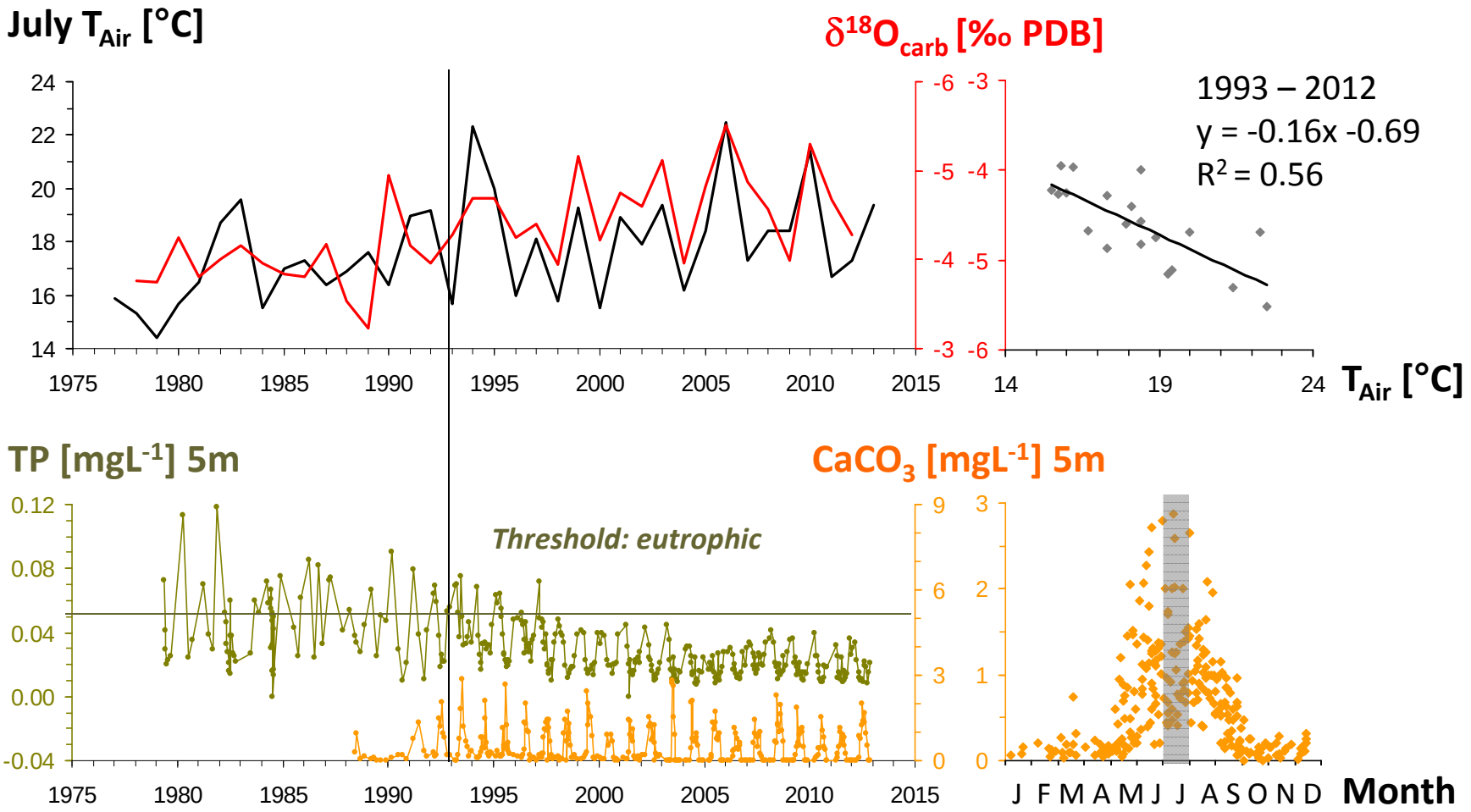
TDuration 0 to ≥ 5°C ~ 1/Diatom Si deposition

Process:	**Mixing depth -> Nutrients Light availablity**
Systematic?:	Breiter Luzin
Chance:	**Nutrient threshold**
Problem:	**Detrital Si**

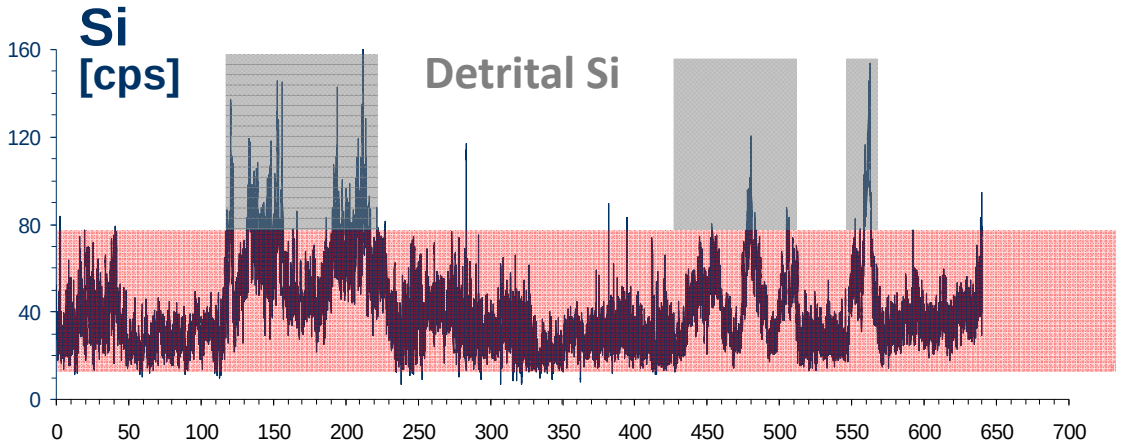
Questions

Are the relations systematic?
Anthropogenic thresholds for climate signal transfer?
Stationarity of proxies?
What are the system response times?

Outlook: Carbonate $\delta^{18}O$ preserves July temperature?



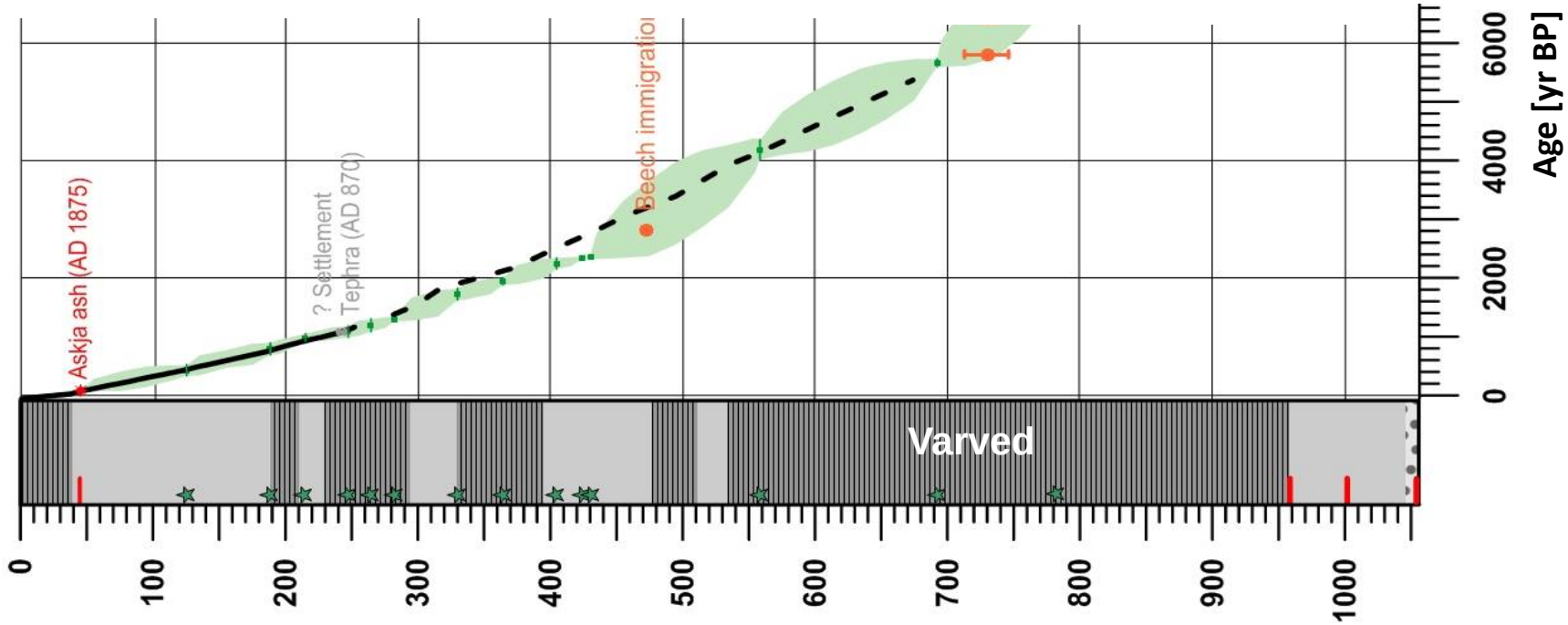
Potential for T - transfer in TSK long core



Spring warming
0 –> 5°C [days]

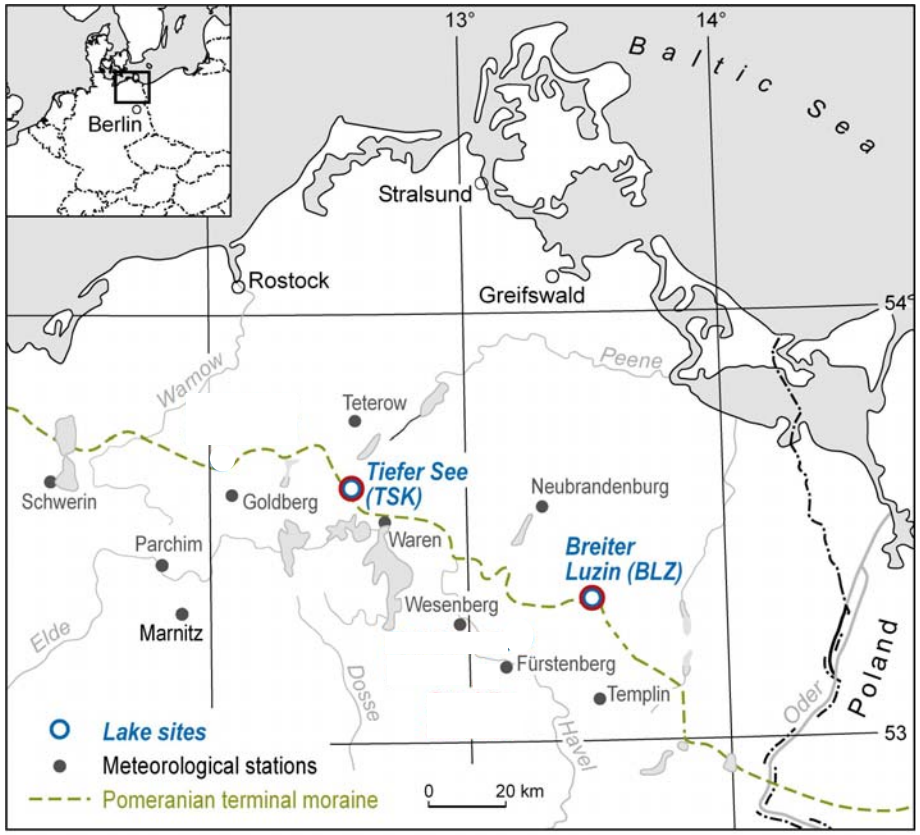
20 days

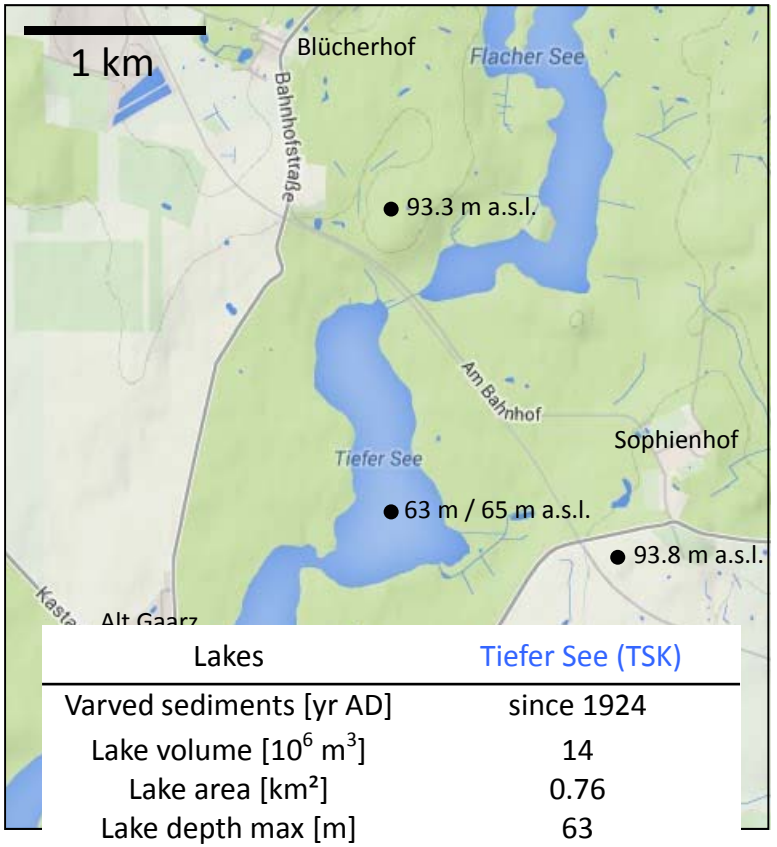
100 days



Tiefer See – Long core composite depth [cm]

Site map: Lakes and their varved sediments





Lakes	Tiefer See (TSK)
Varved sediments [yr AD]	since 1924
Lake volume [10^6 m^3]	14
Lake area [km^2]	0.76
Lake depth max [m]	63
El. Conduct. [µS cm^{-1}]	520 / 560
TP [µg L^{-1}]	47 (0)
TN [mg L^{-1}]	1.3
Trophic state / reference	Mesotr. / Oligotr.