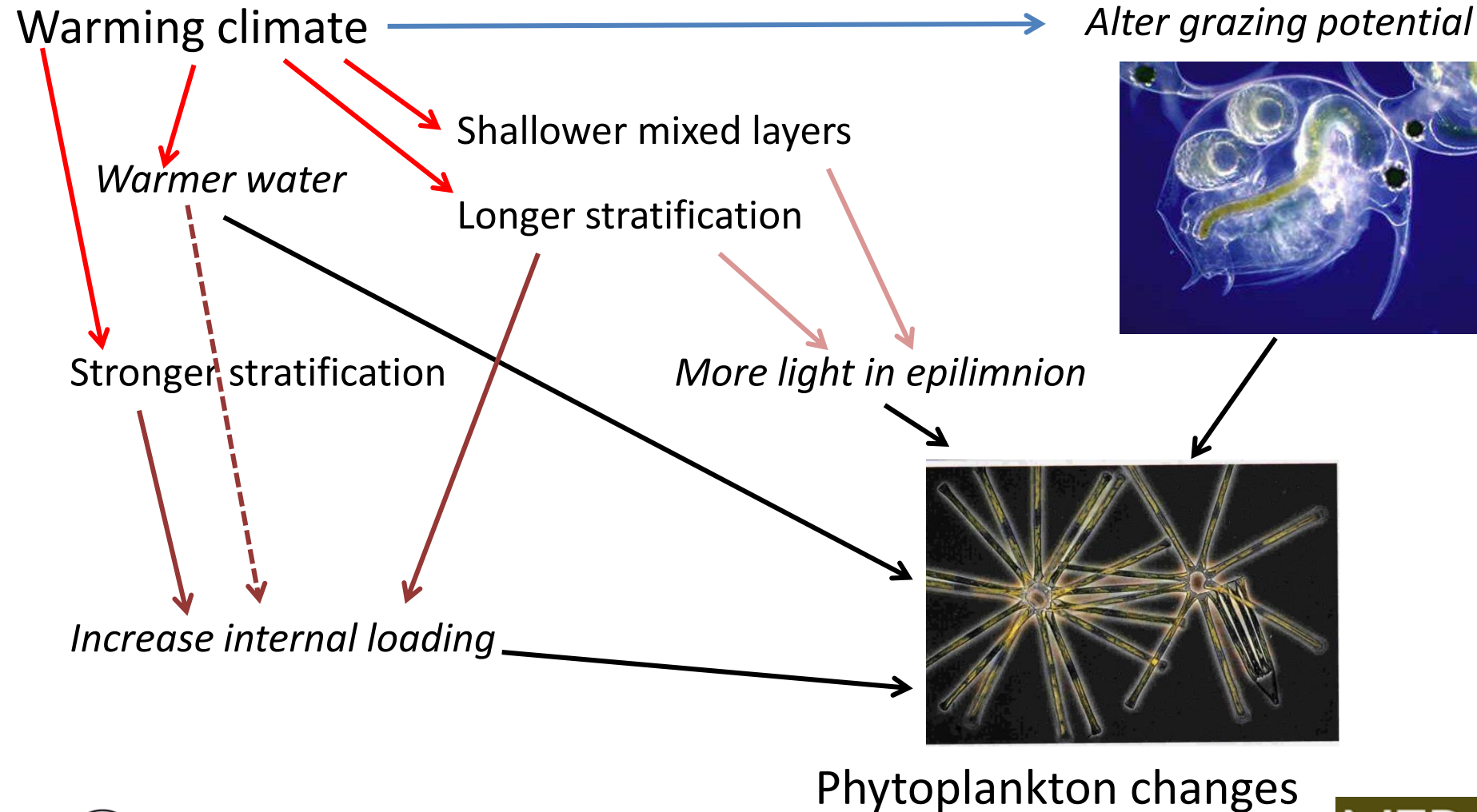


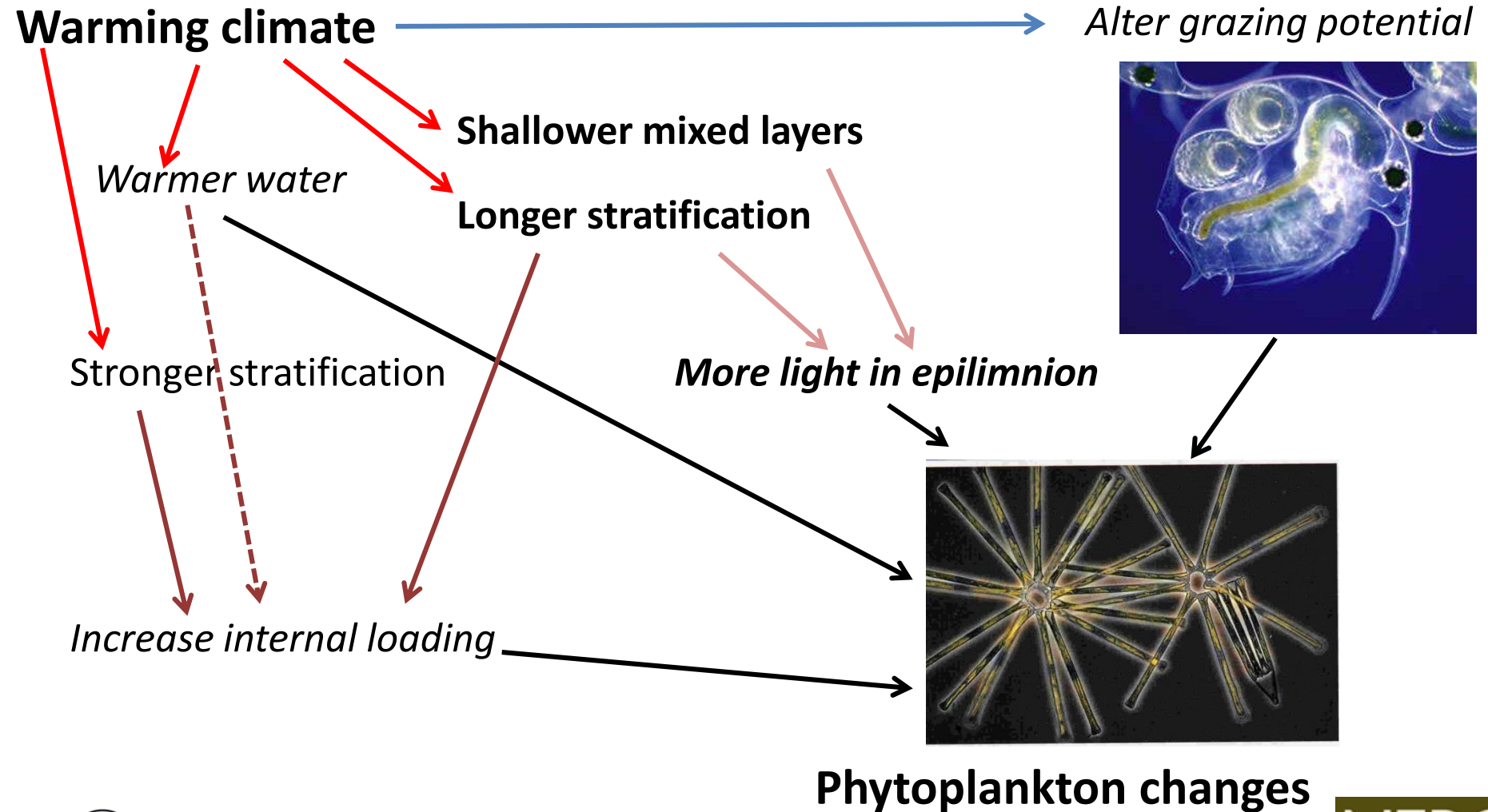
AUTUMNAL PHENOLOGY: LIMNOLOGICAL CHANGES AT THE FORGOTTEN TIME OF YEAR

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Climate and lakes



Climate and lakes



The two lakes of Windermere

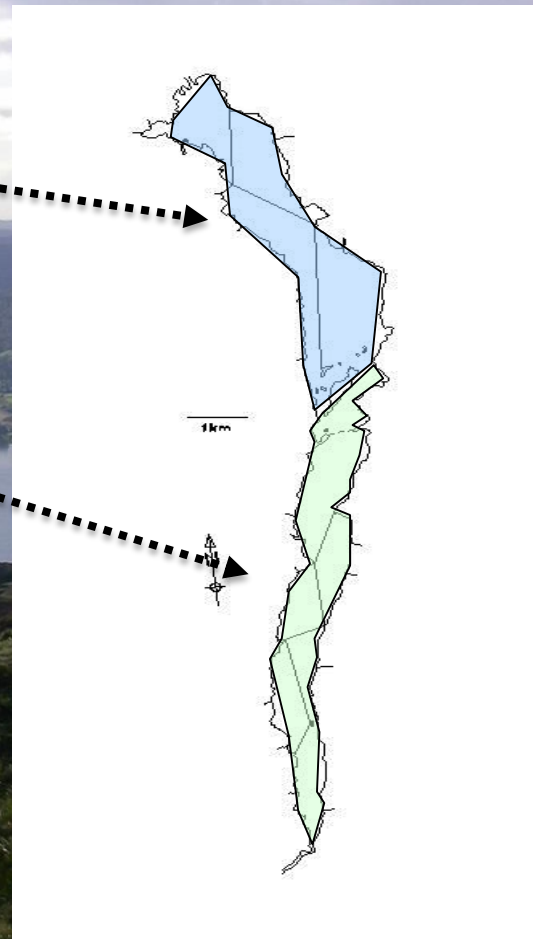


WNB: Area 8.046 km²; Max depth 64 m

WSB: Area 6.718 km²; Max depth 42 m

Windermere North Basin

Windermere South Basin

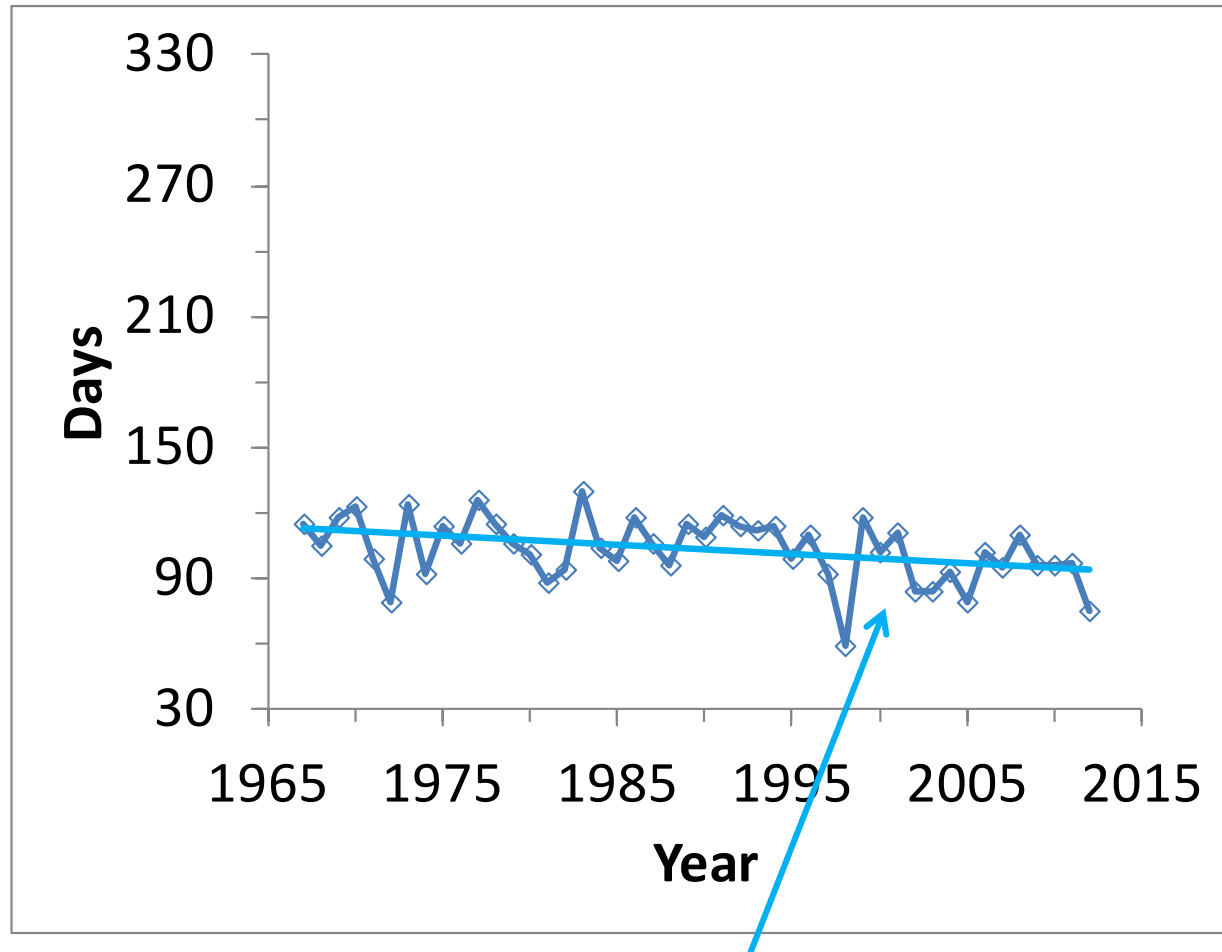


WNB deeper, less fetch,
less eutrophic

Approx 50 years
long-term
monitoring data

Start, end and duration of stratification

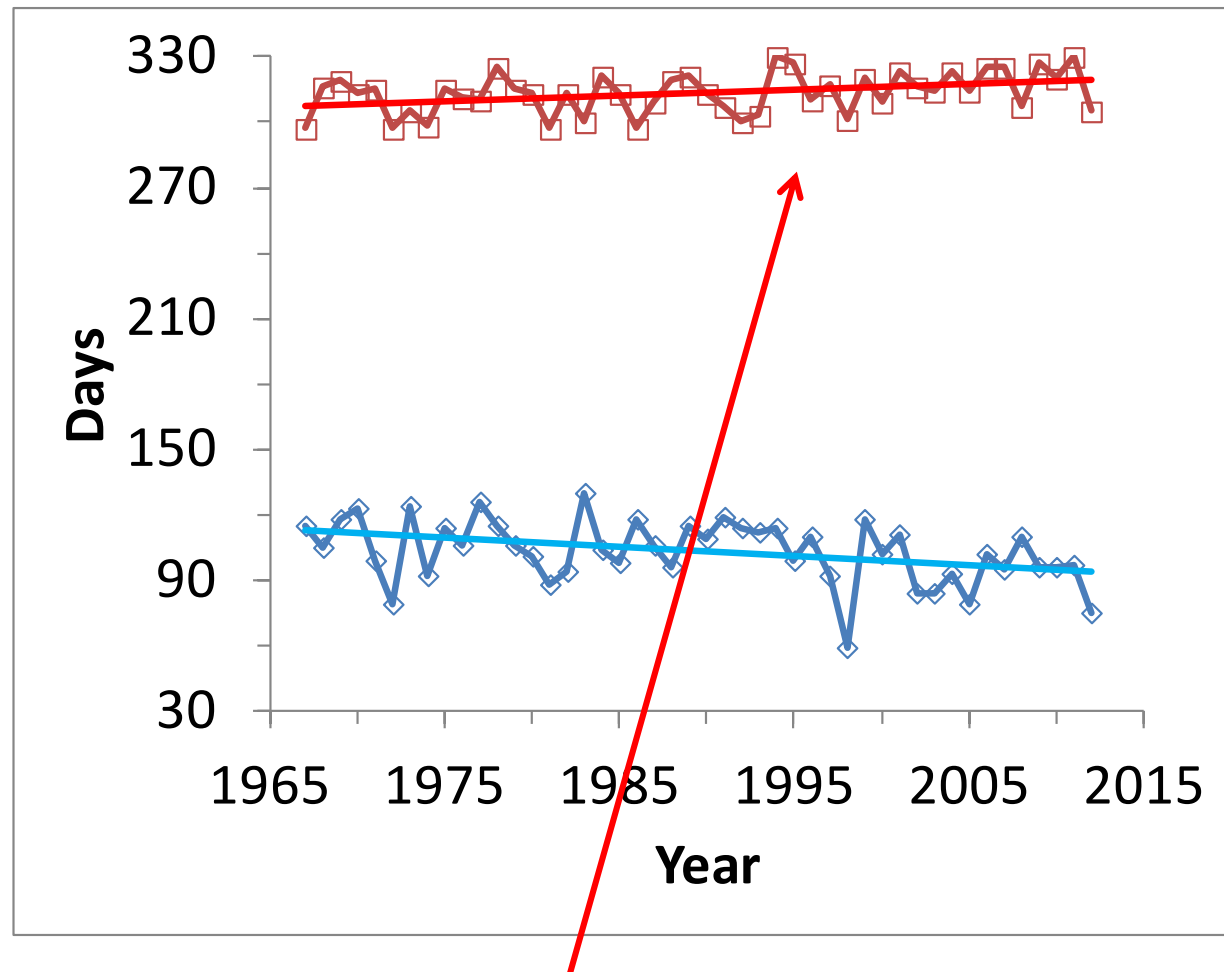
WSB



Start: slope = -0.4 days/yr, $P < 0.01$

Start, end and duration of stratification

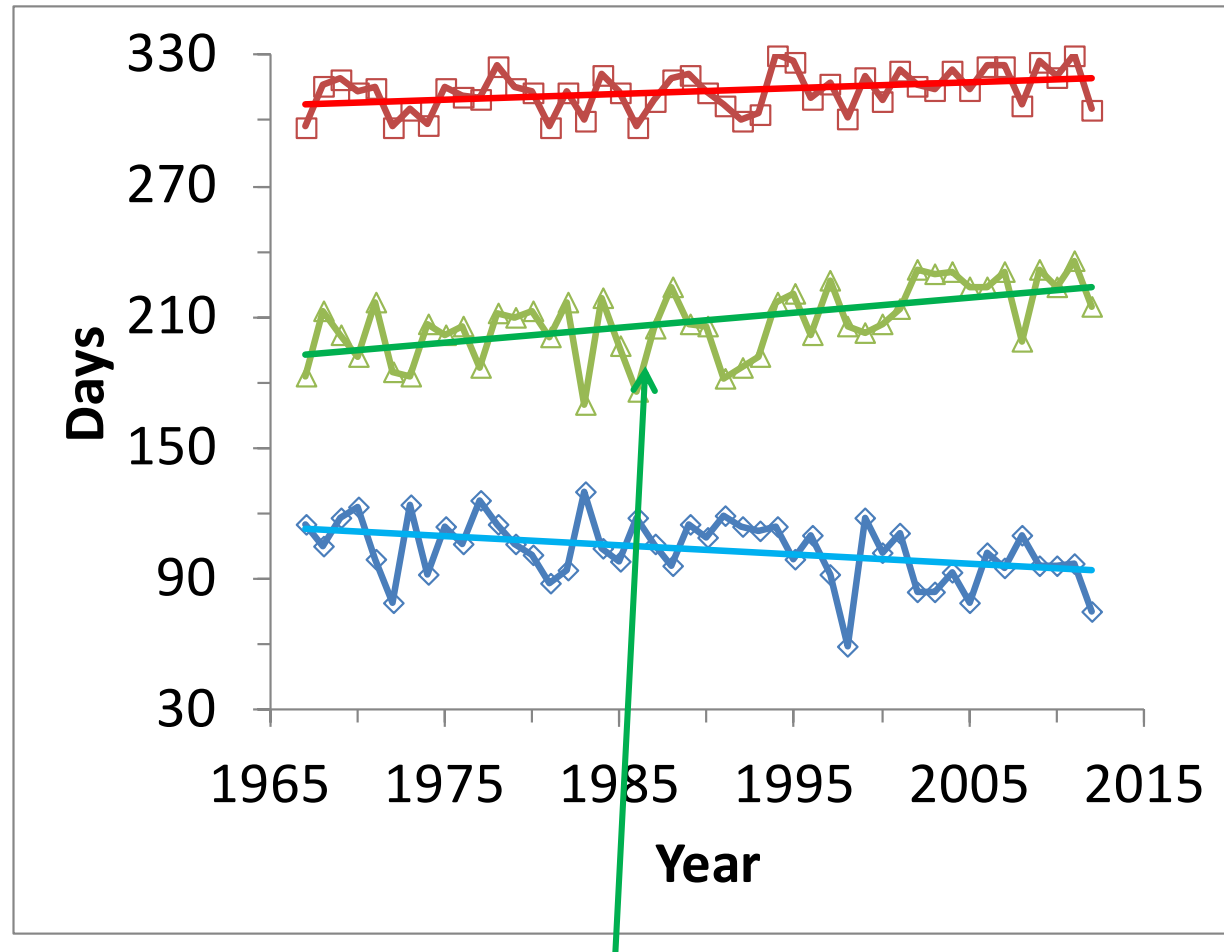
WSB



End: slope = 0.3 days/year, $P < 0.05$

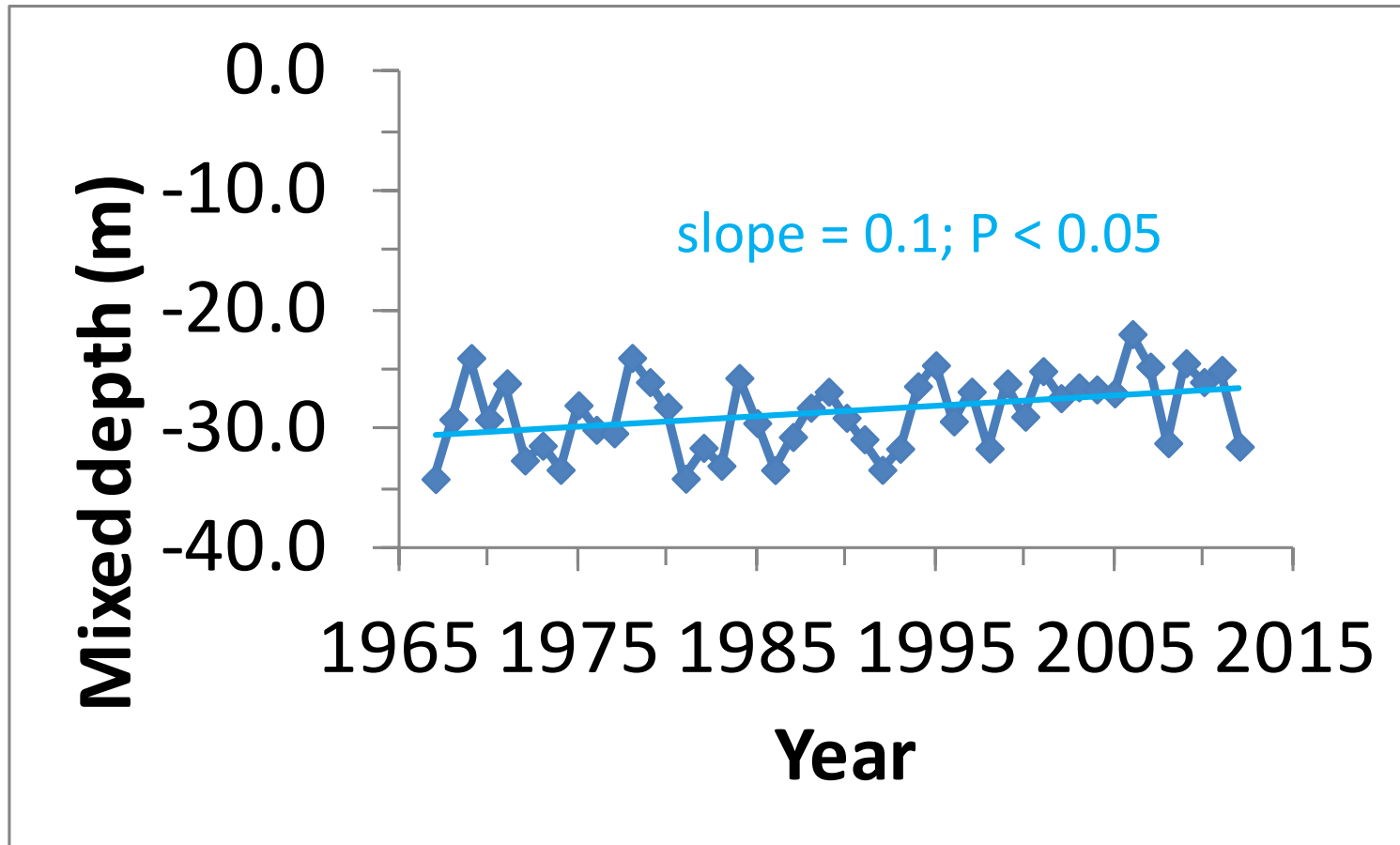
Start, end and duration of stratification

WSB



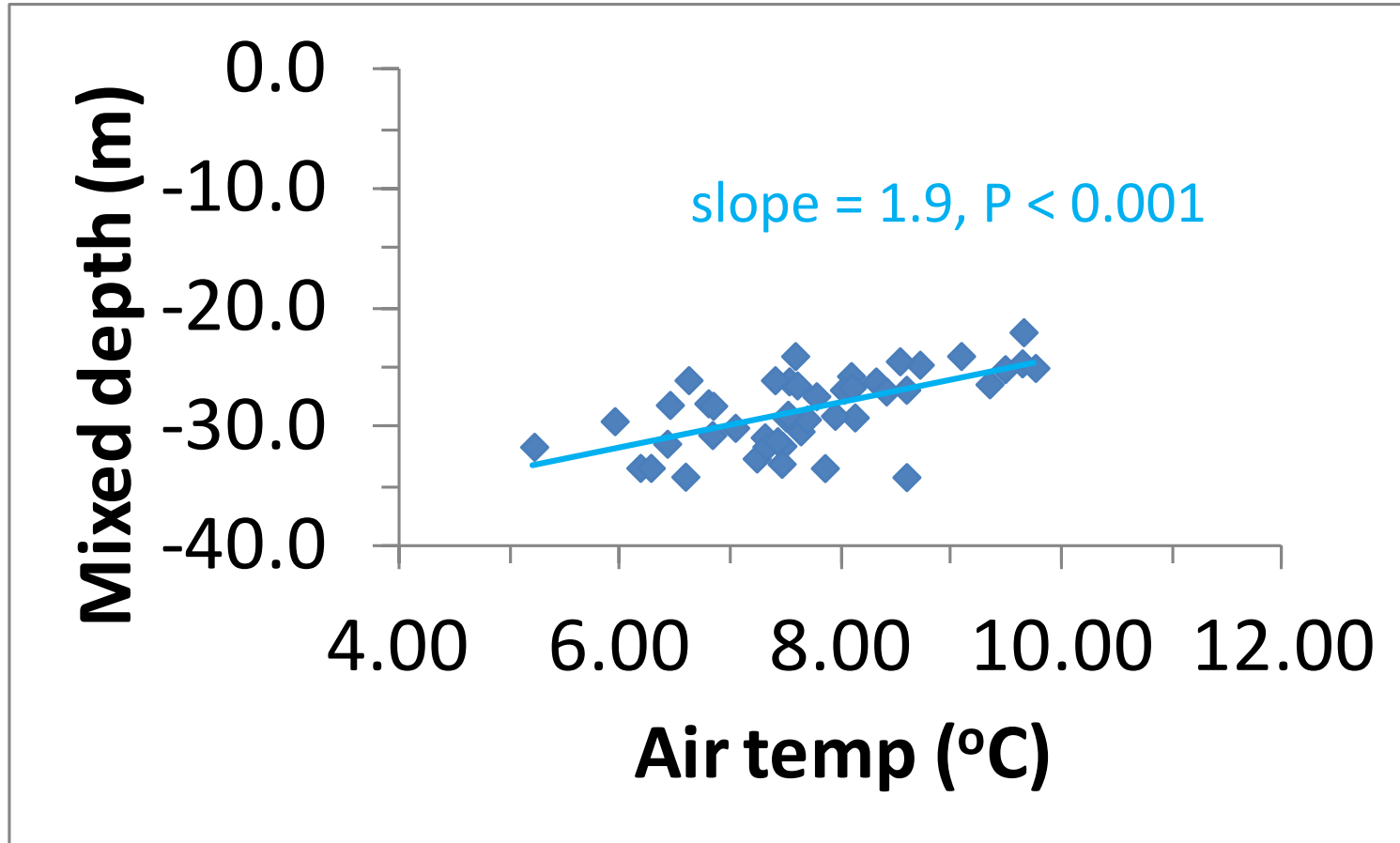
Duration: slope = 0.7 days/yr, $P < 0.001$

Change over time of Oct & Nov md

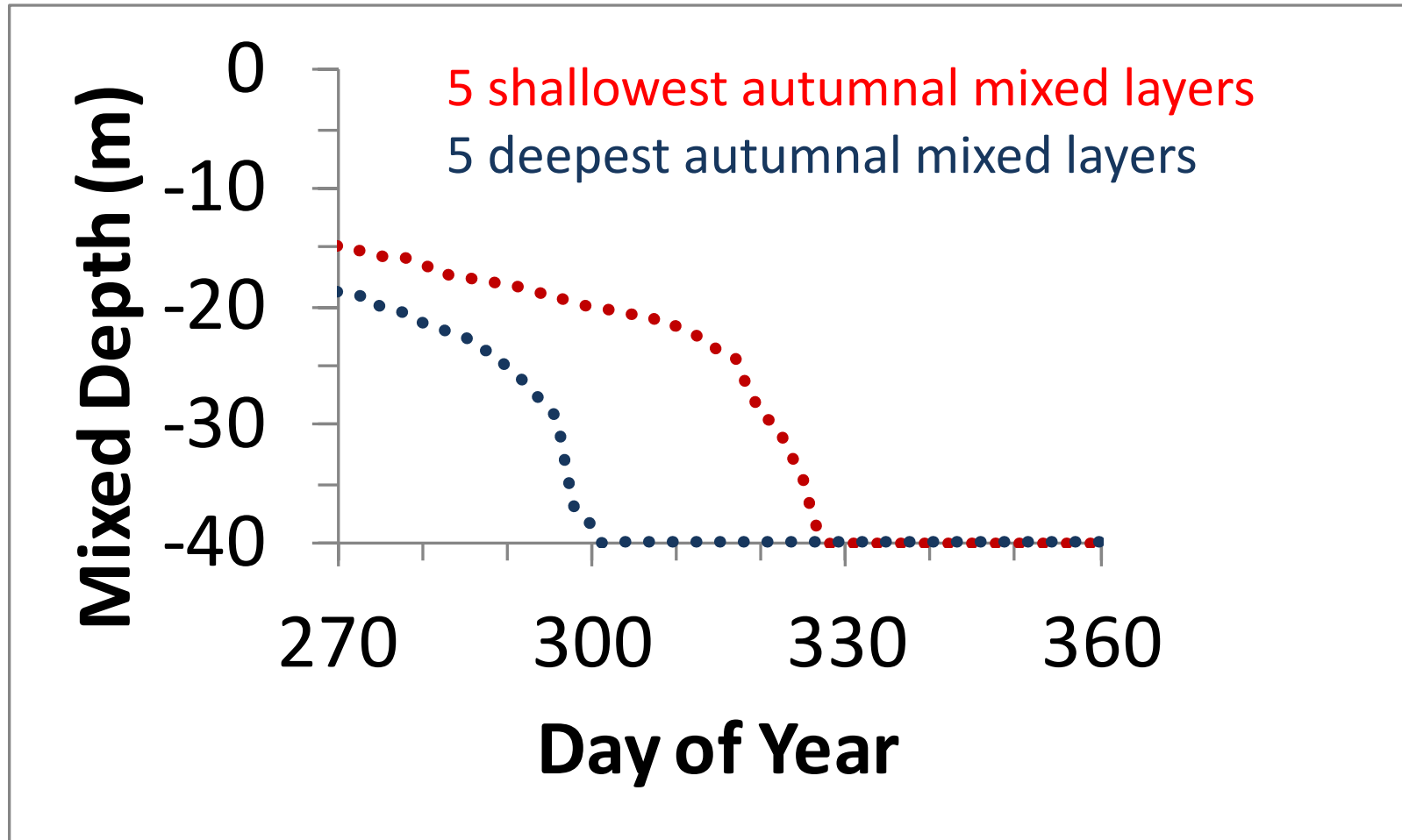


WSB

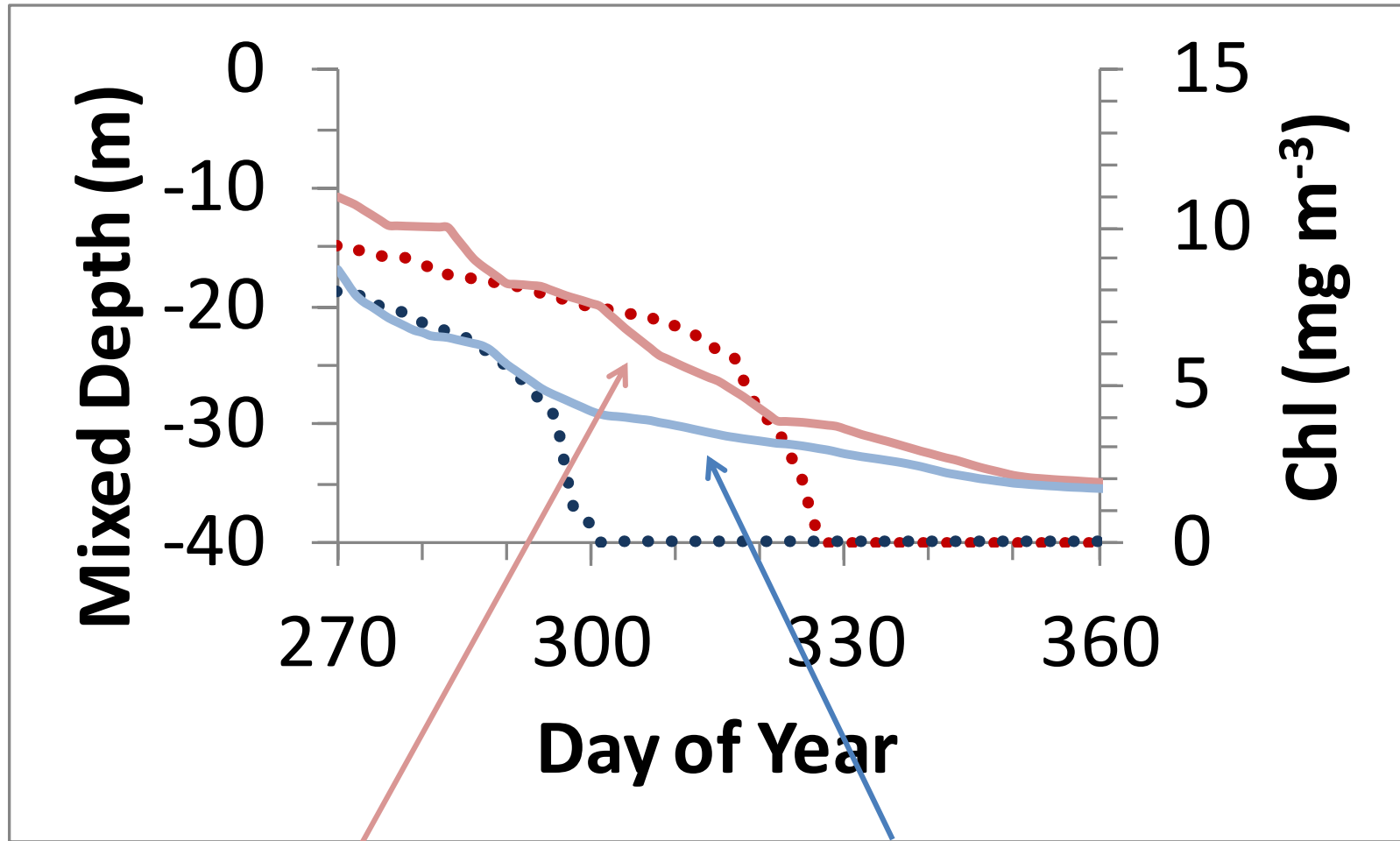
Oct & Nov air temperature



'Deep' and 'shallow' years



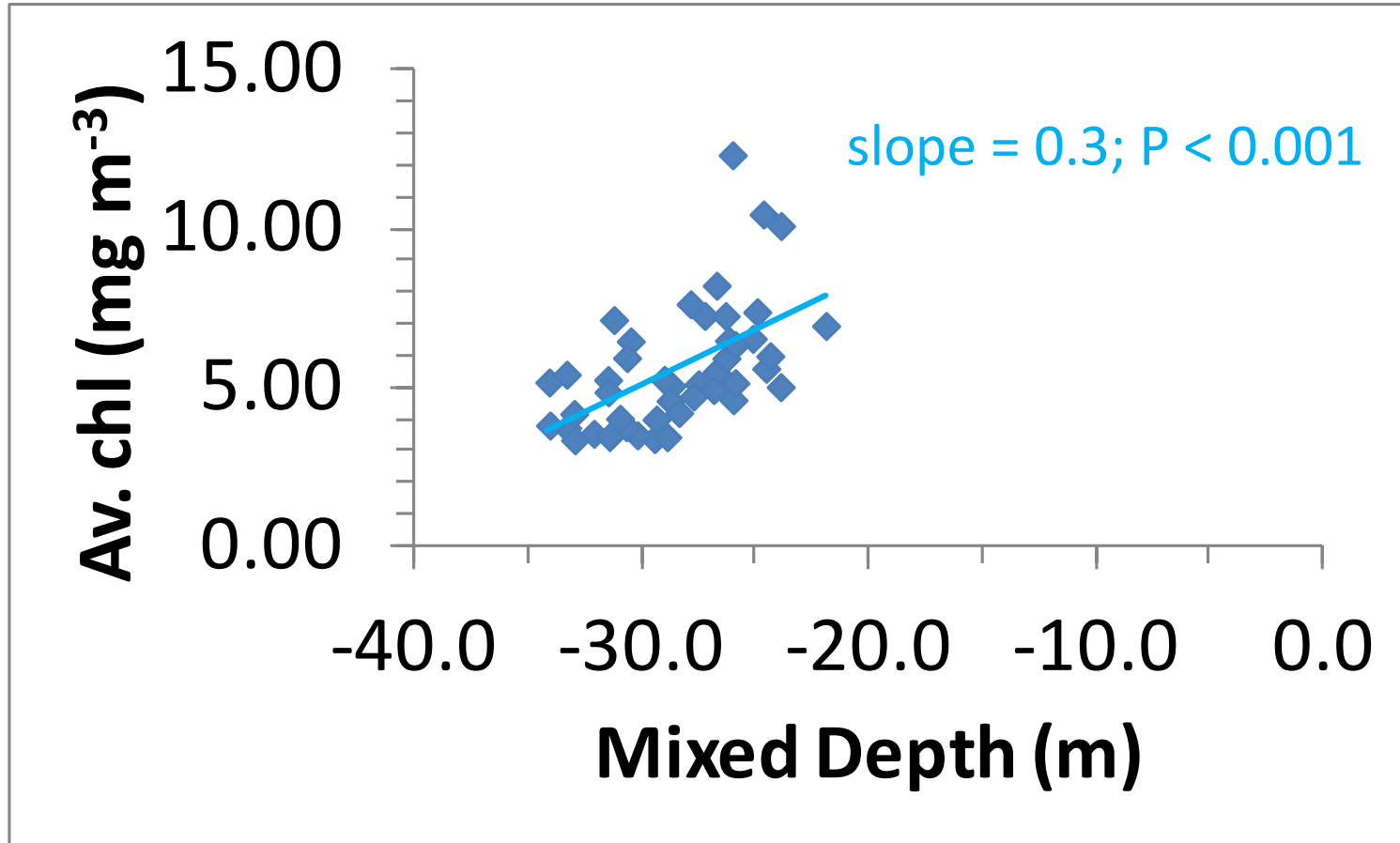
'Deep' and 'shallow' years



Chl in 'shallow' years; Chl in 'deep' years

WSB

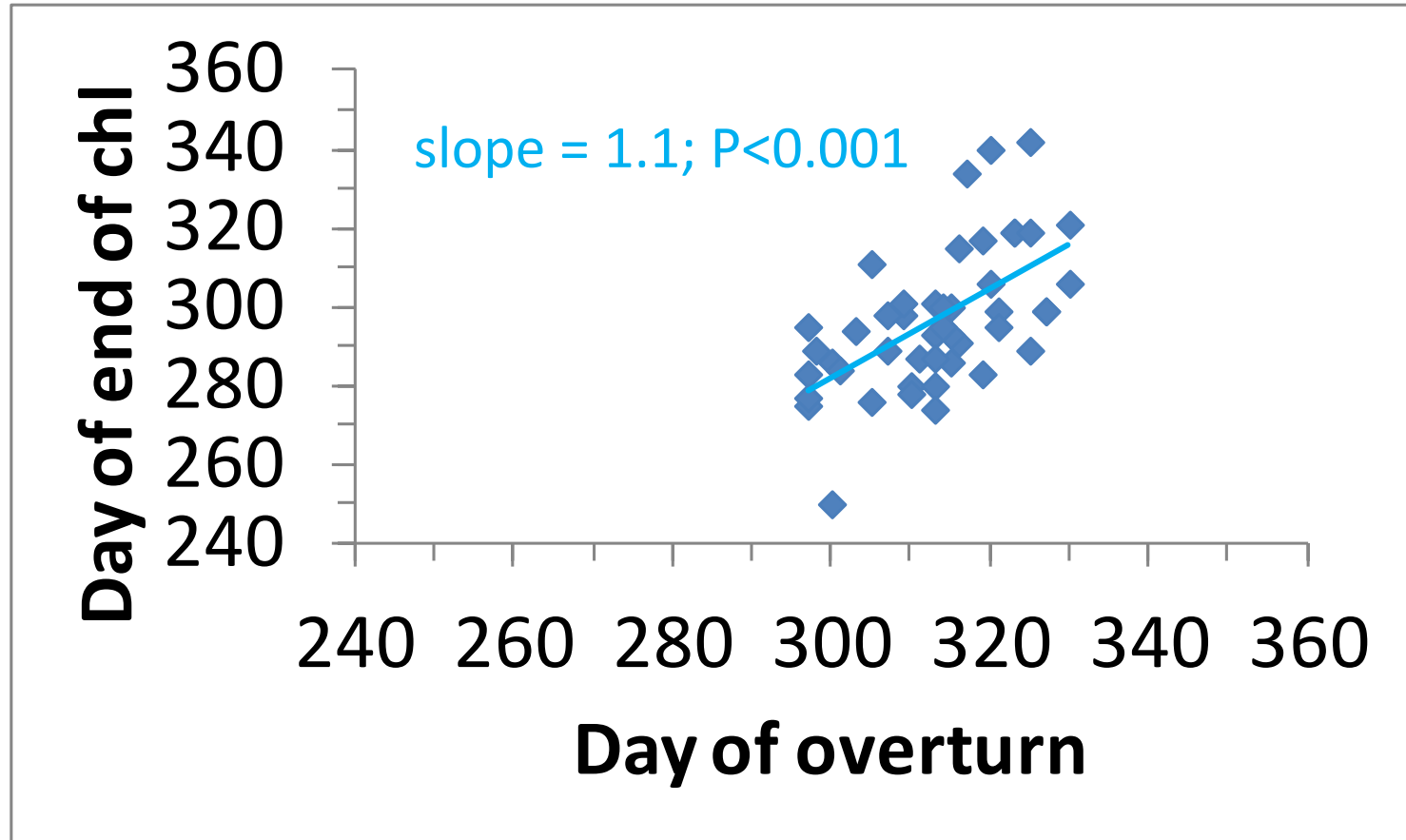
Oct & Nov mixed depths and chl



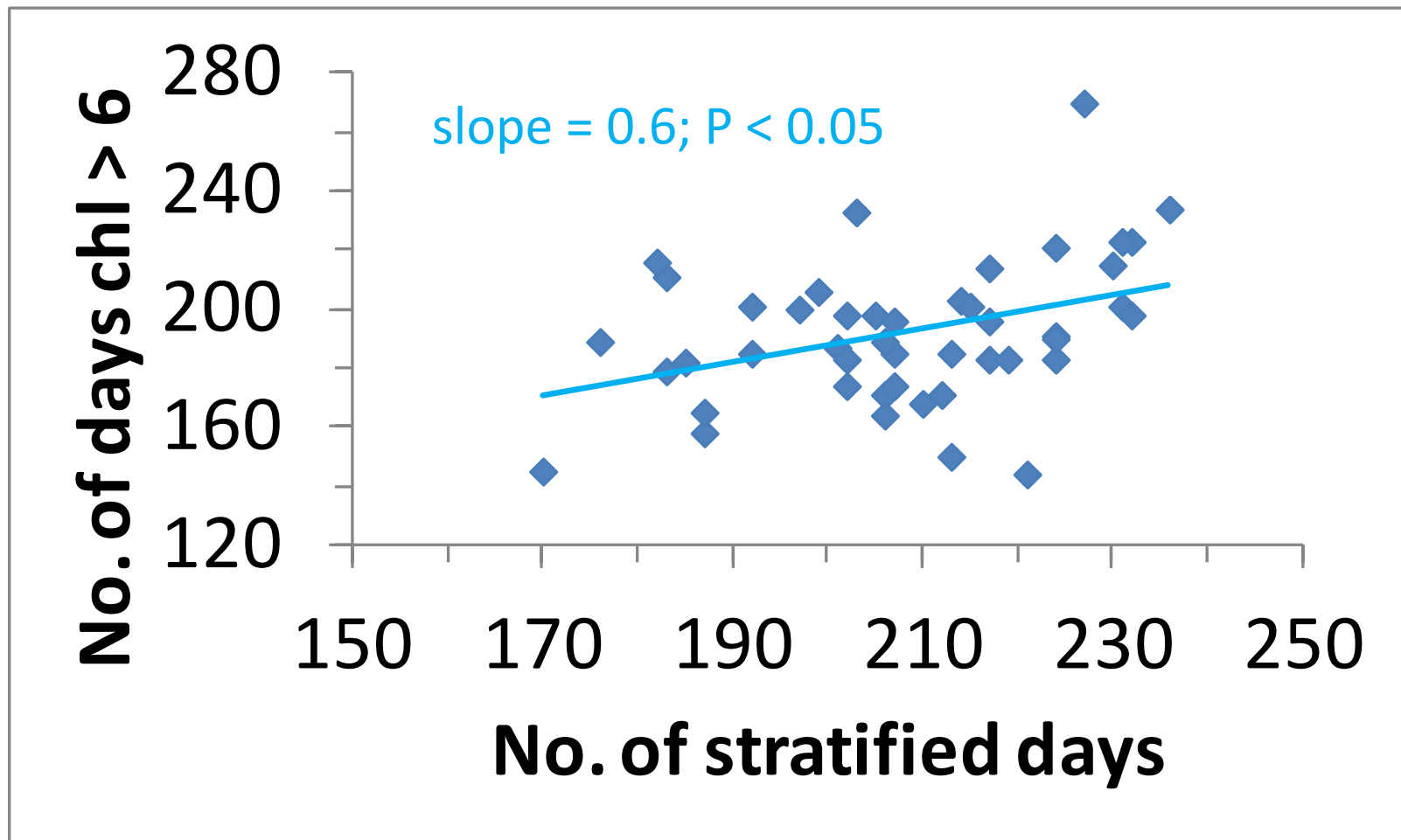
WSB

Autumnal phytoplankton phenology

WSB

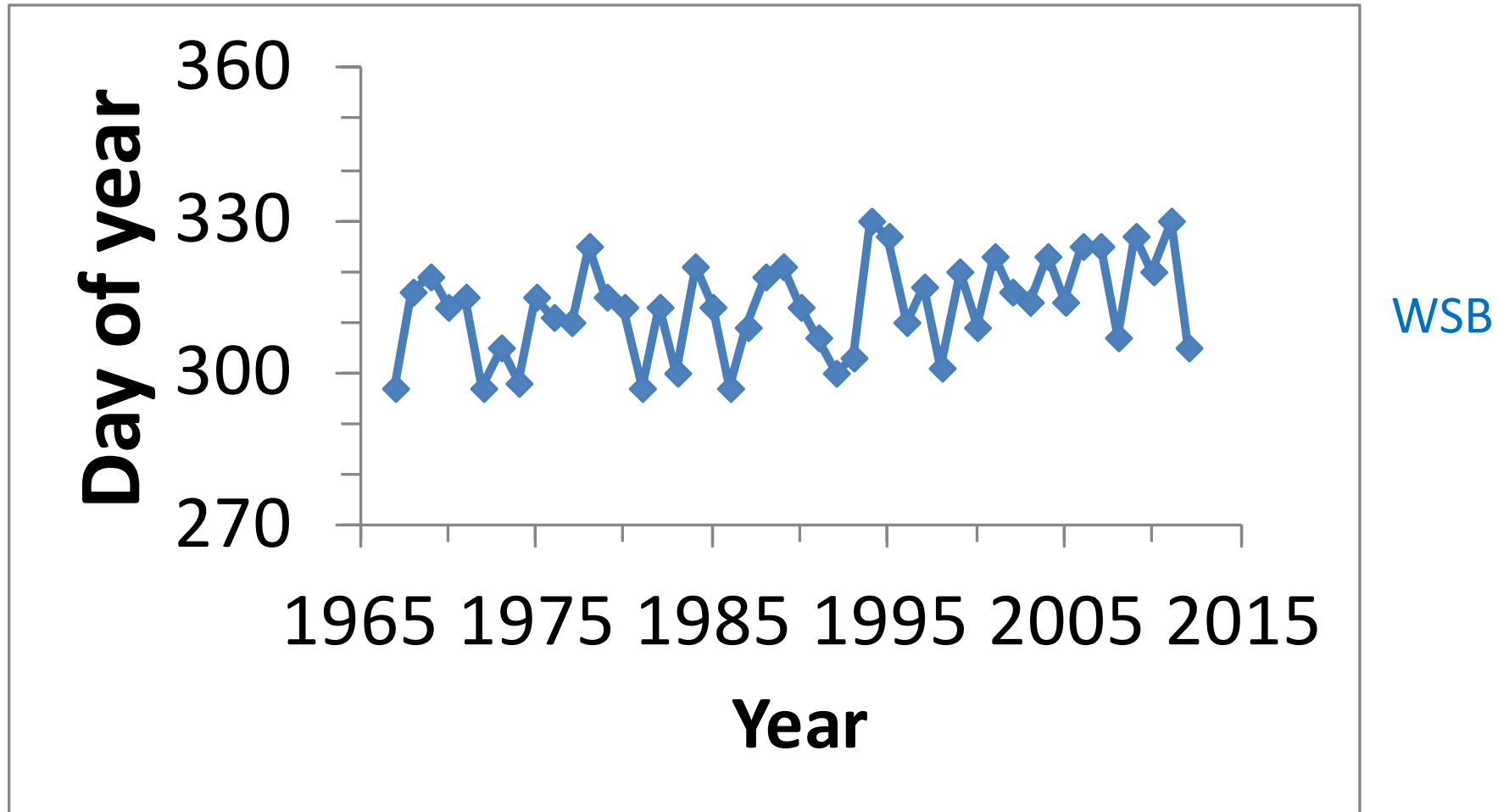


Influence of more stratified days

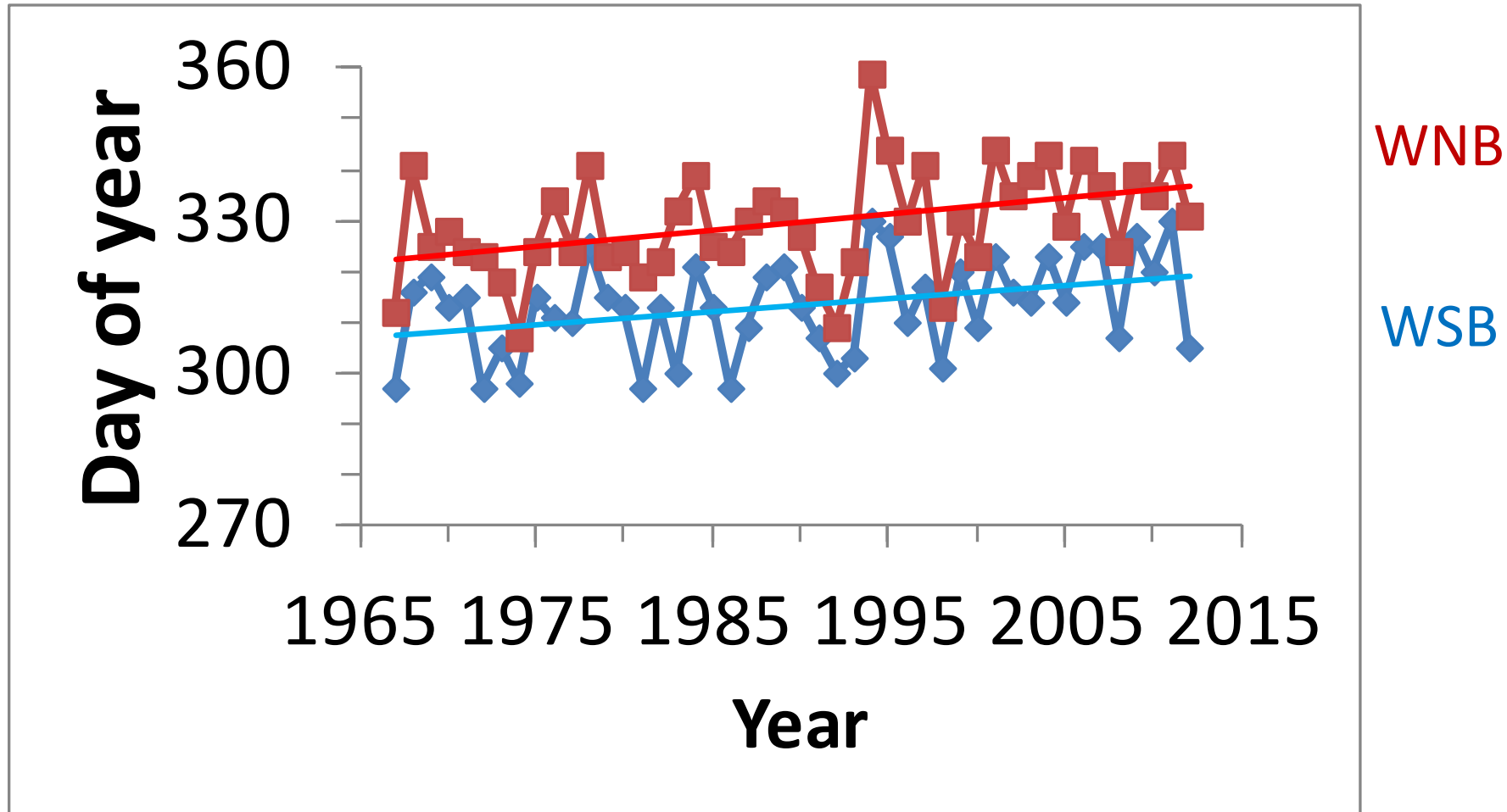


WSB

WSB & WNB overturn

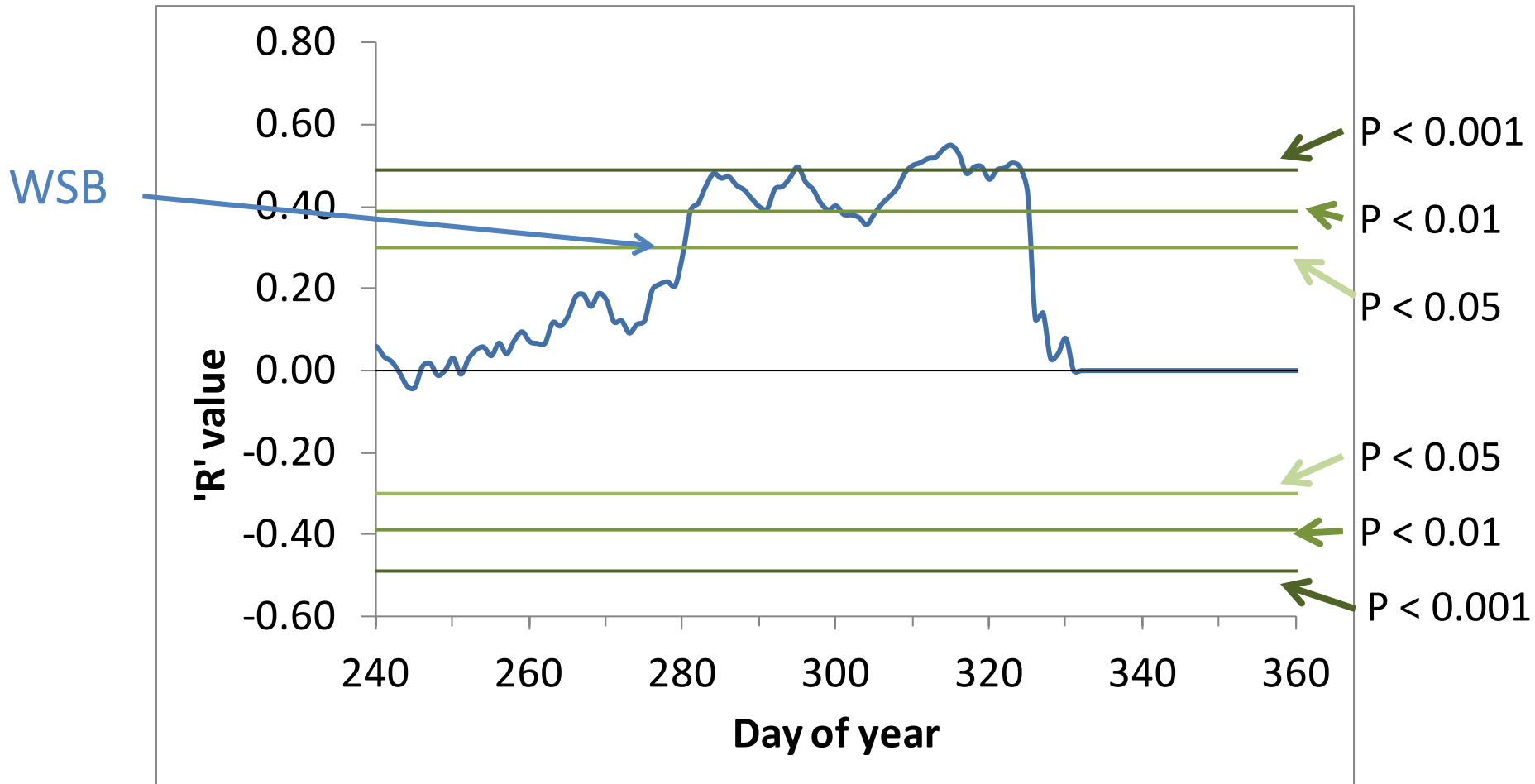


WSB & WNB overturn

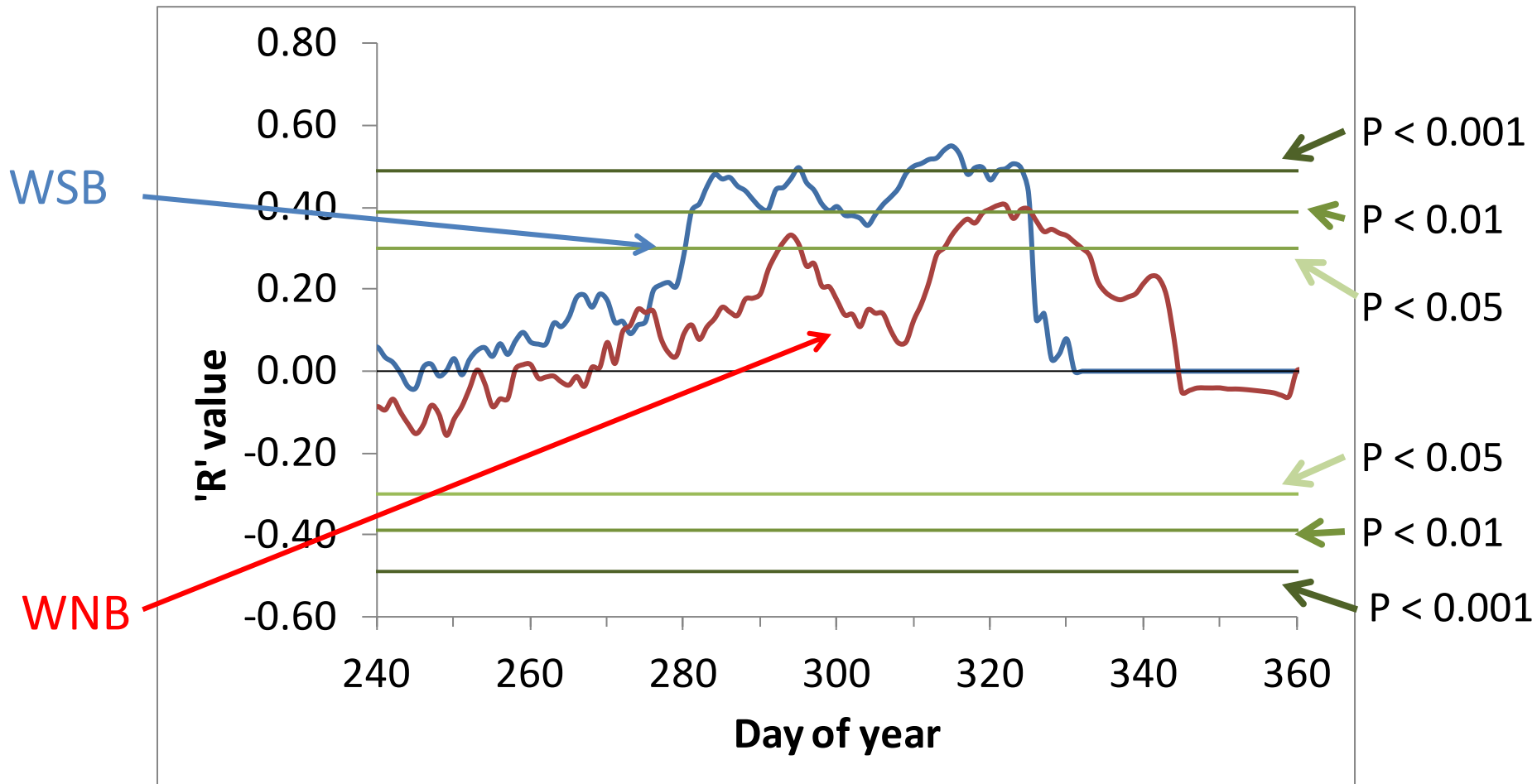


Windermere South Basin (WSB)
Windermere North Basin (WNB)

Daily relationship between mixed depth and chl

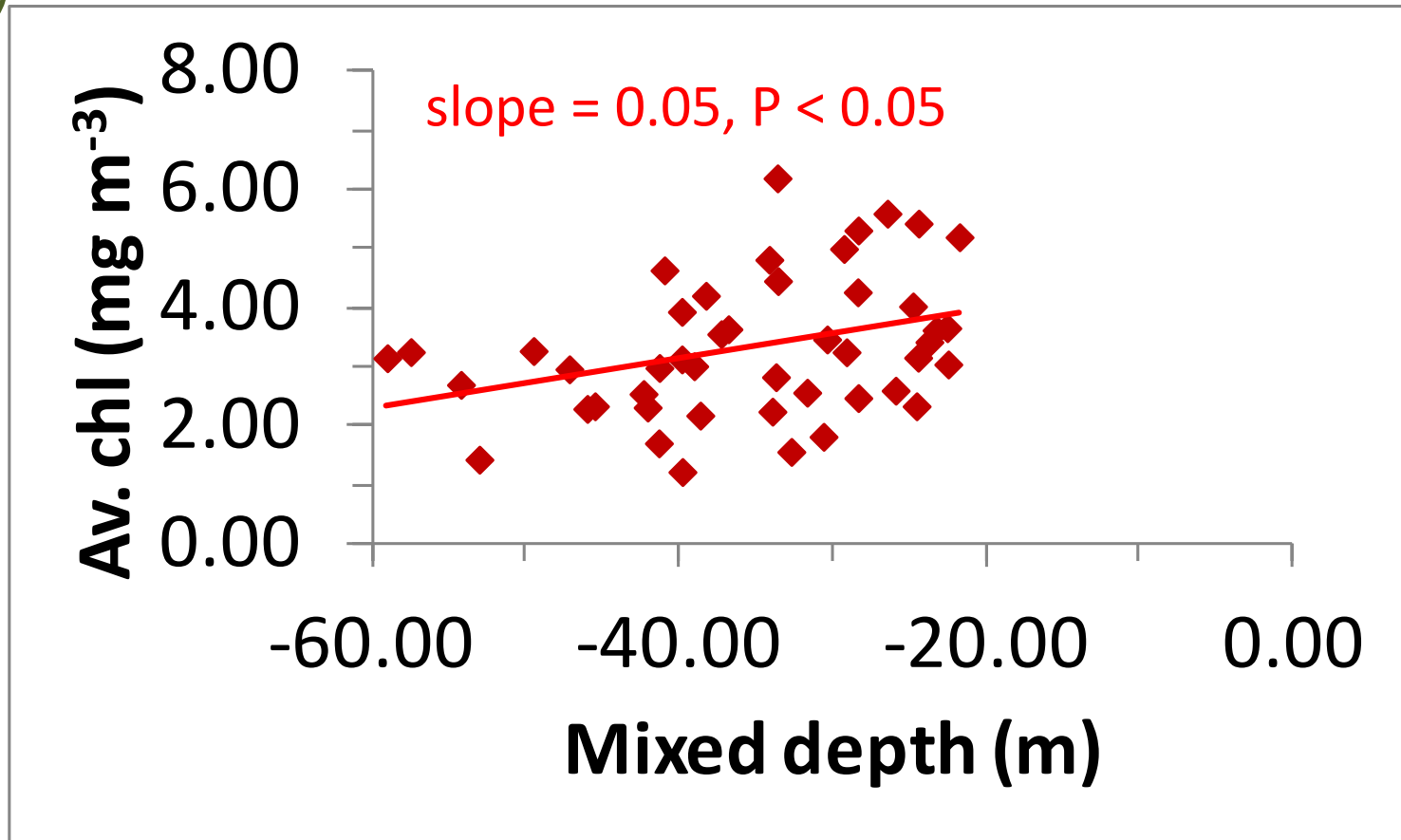


Daily relationship between mixed depth and chl



Mixed depths and phytoplankton

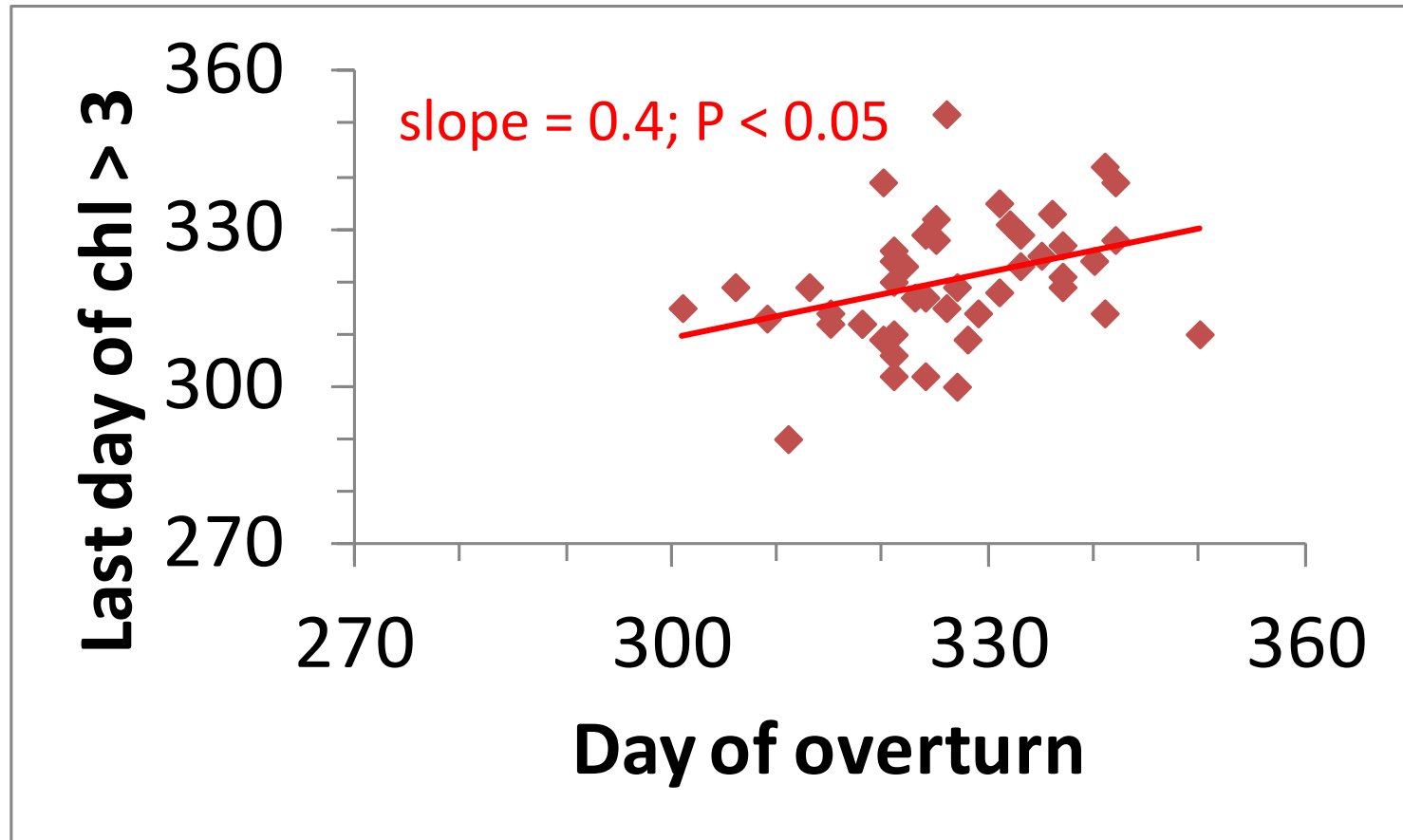
WNB



Mid-November to Mid-December

Autumnal phytoplankton phenology

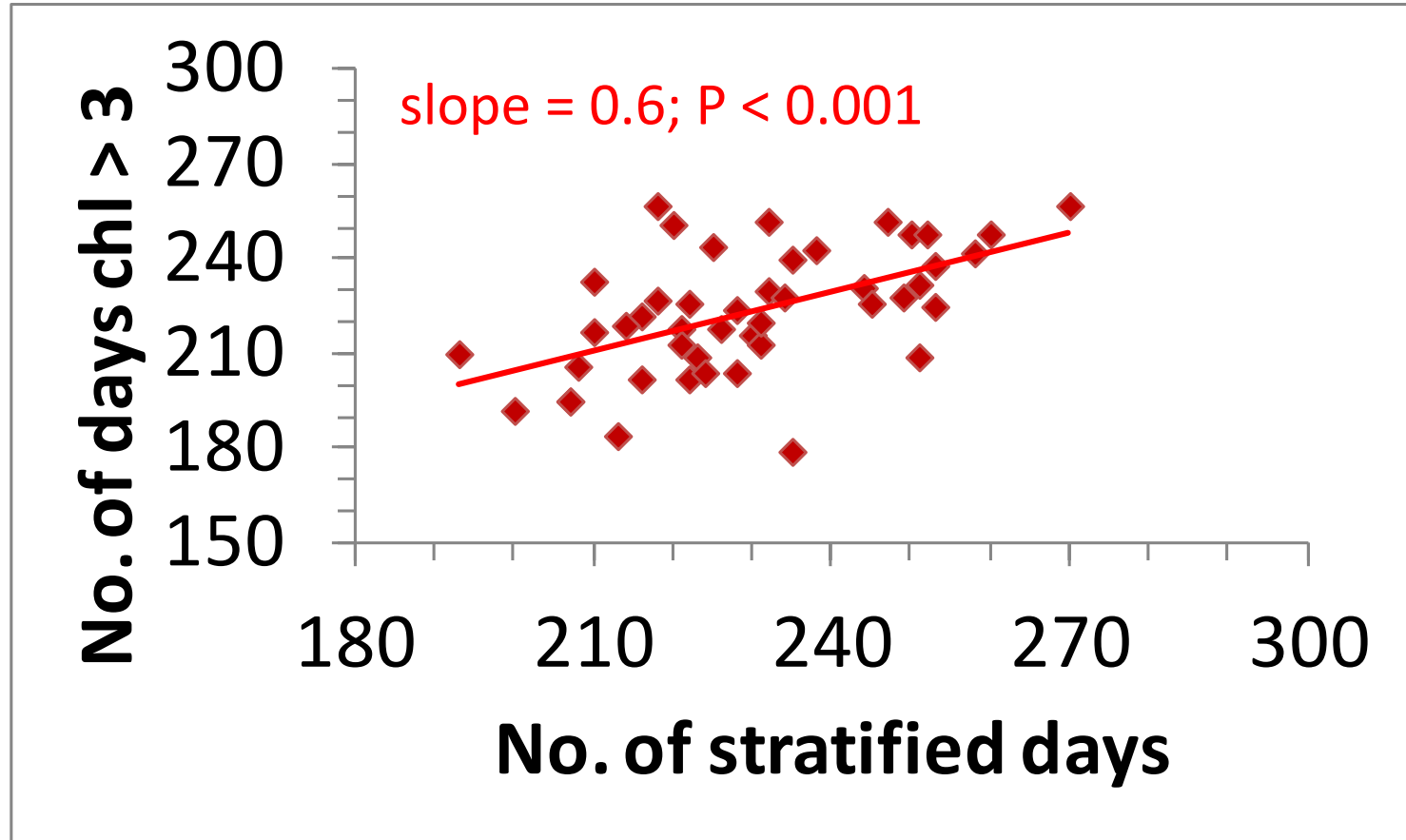
WNB



Last day chl > 3 mg m⁻³

Influence of more stratified days

WNB



Summary

- Approximately 50 years of data for two lake basins
- Stratification is getting longer, 'autumnal' mixed depths are shallowing (related to air temperature increases)
- Shallower autumnal mixed layers coincide with increased autumnal phytoplankton biomass
- Later overturn coincides with later decline of phytoplankton biomass
- More stratified days coincides with more days with high phytoplankton biomass
- More pronounced effects in WSB than WNB (WNB overturns later, when light availability is reduced)