

Winter Vertical Migration across the Arctic: Seeking the Pan-Arctic View

Finlo Cottier, Laura Hobbs, Kim Last
Scottish Association for Marine Science

Jørgen Berge
University of Tromsø
University Centre in Svalbard

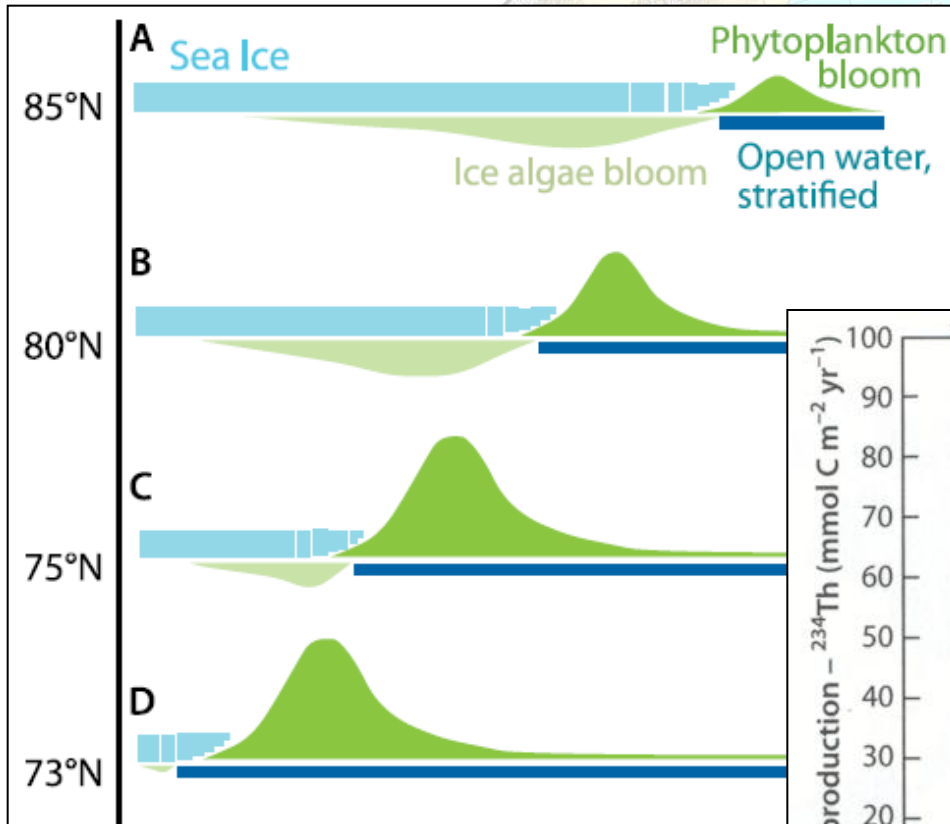
finlo.cottier@sams.ac.uk



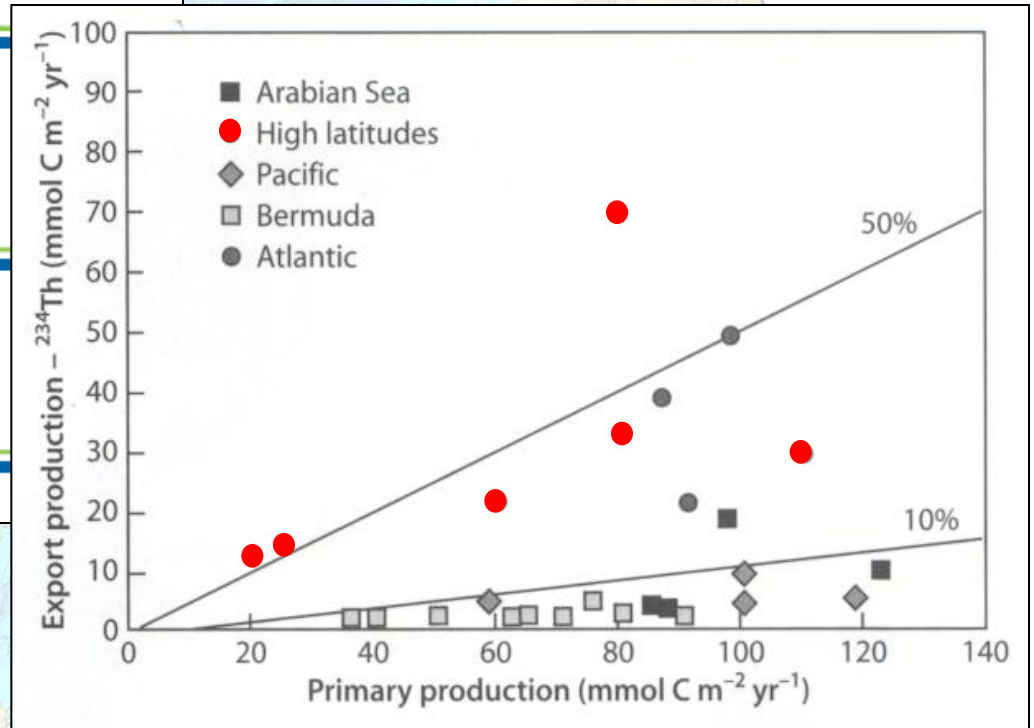
SCOTTISH
ASSOCIATION
for MARINE
SCIENCE



Motivation



Wassmann & Reigstad 2011

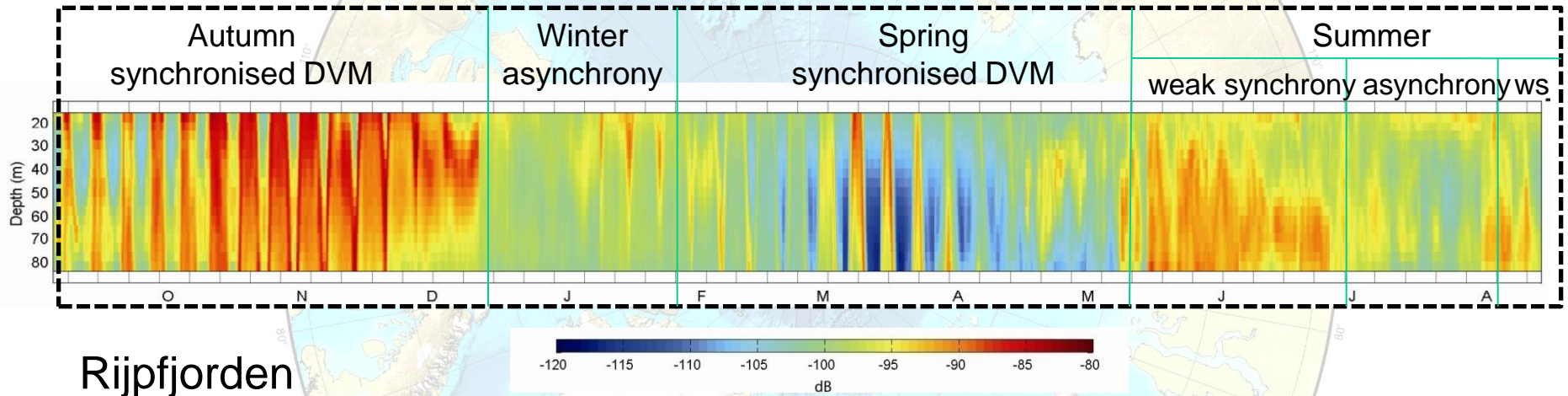


Buessler 1998

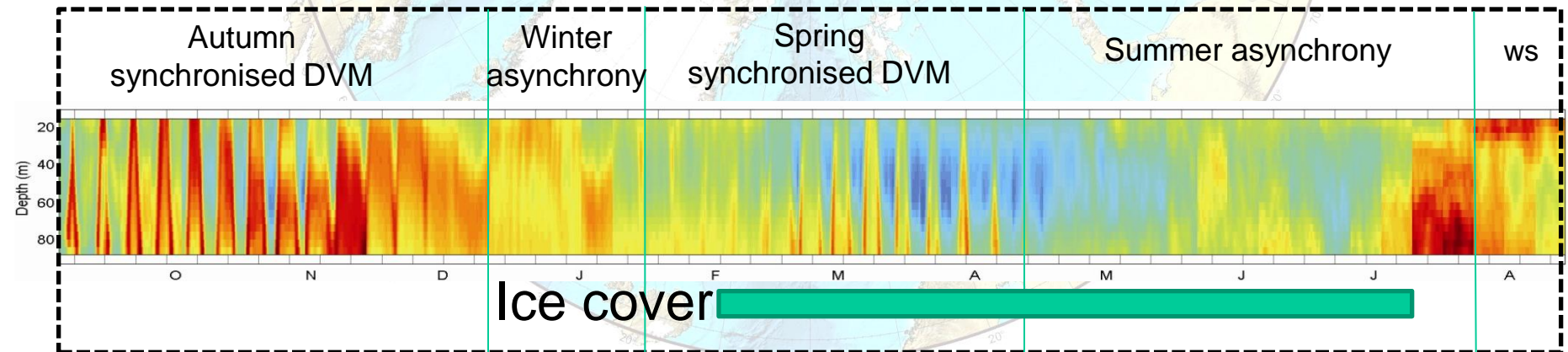
A Brief History ...

Wallace et al 2010

Kongsfjorden



Rijpfjorden



A Brief History ...



- Arctic DVM studies have mainly focused in a few locations
- We only get a local view
- We have developed some understanding of seasonality
- We don't have a robust understanding of general behaviours
- We have a good set of analytical tools
- A Pan-Arctic view will improve ability to model C-flux

A Pan-Arctic view

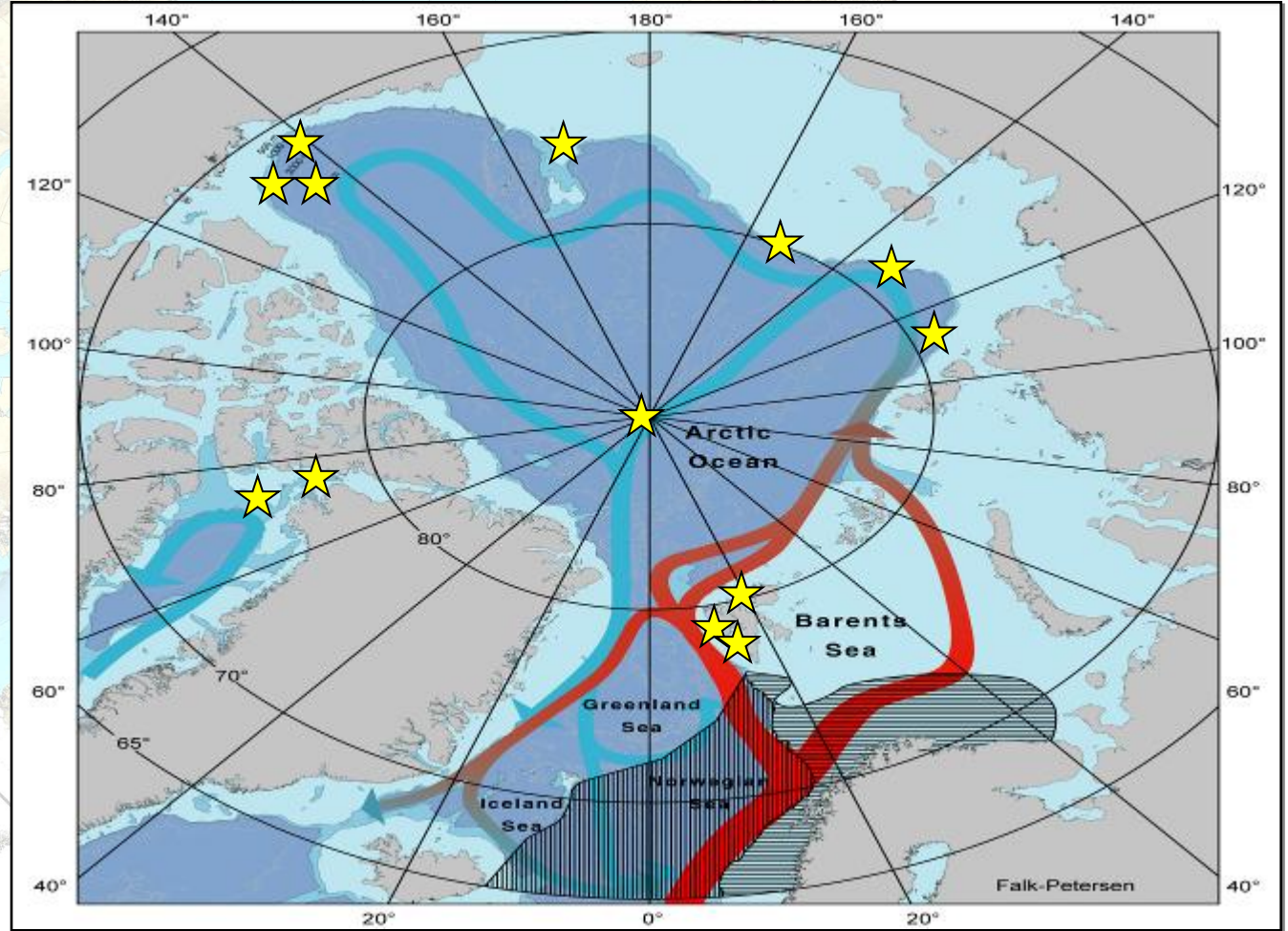


ArcticNet

ᐅᐸᐃᑦᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦ ᑲᑲᑲᑦᑲᑦᑲᑦᑲᑦᑲᑦ



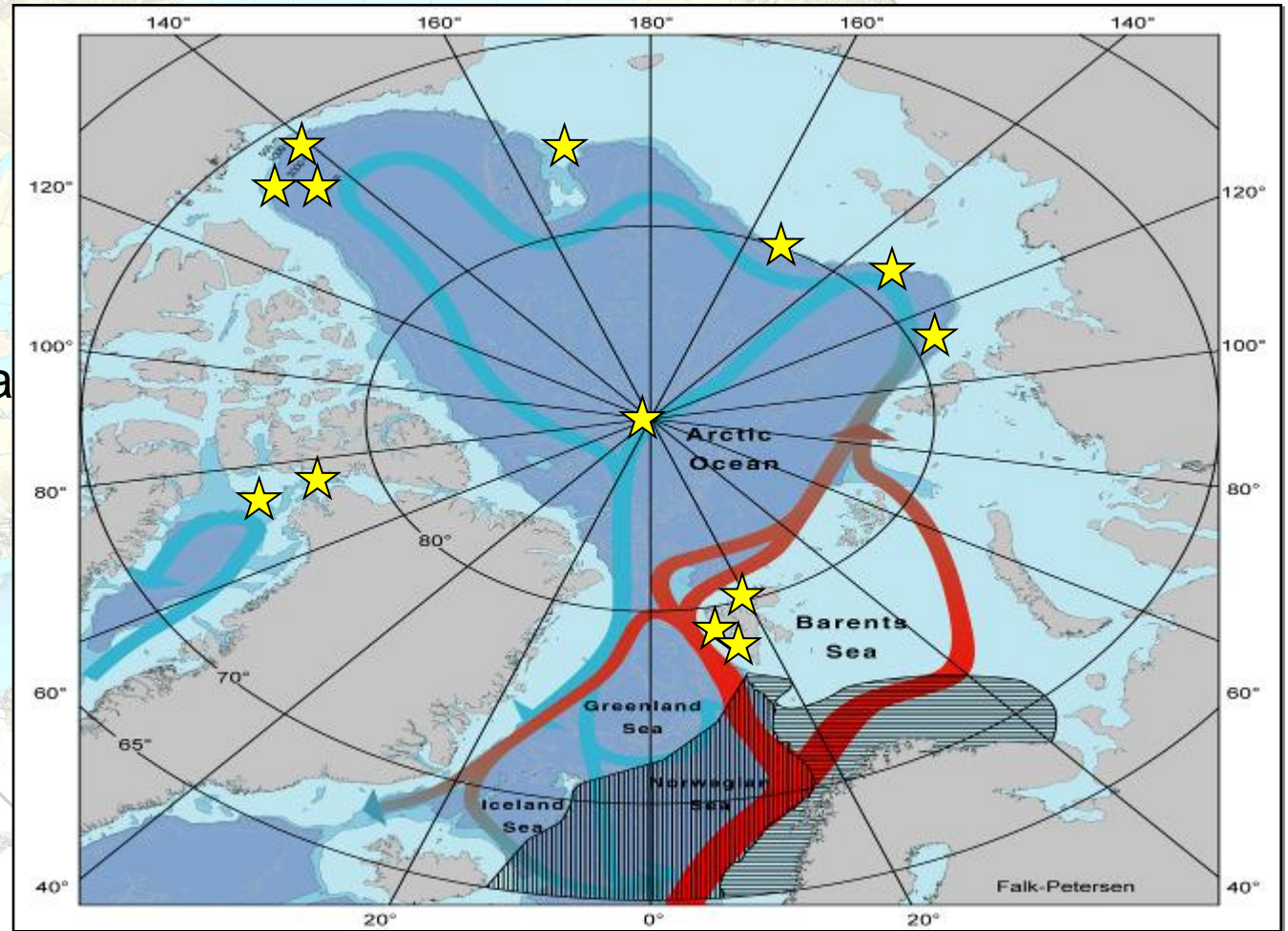
Fisheries and Oceans
Canada



The “PanArchive”

Data Statistics:

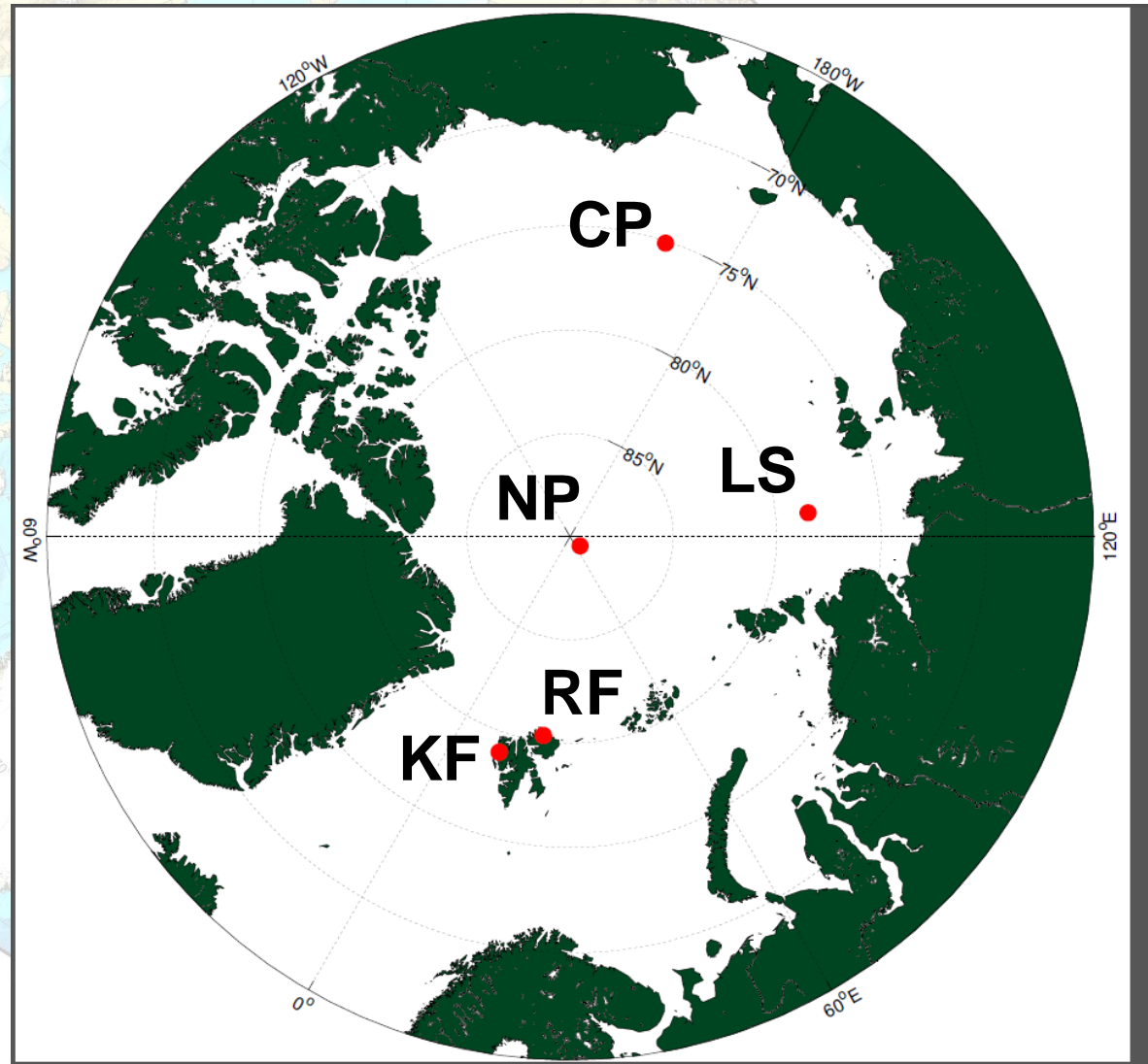
- 300 kHz ADCP
- 50 – 300 m
- 60+ data series
- 50+ years of data
- 12 locations
 - Fjords
 - Shelves
 - Shelf slope
 - Basin
- 15 Latitude
- Any more??



PanArchive Subset

Data:

- 300 kHz
- 50 – 120 m
- 2006/07
- ~12 m deployment
- Variety of locations



Data Subset

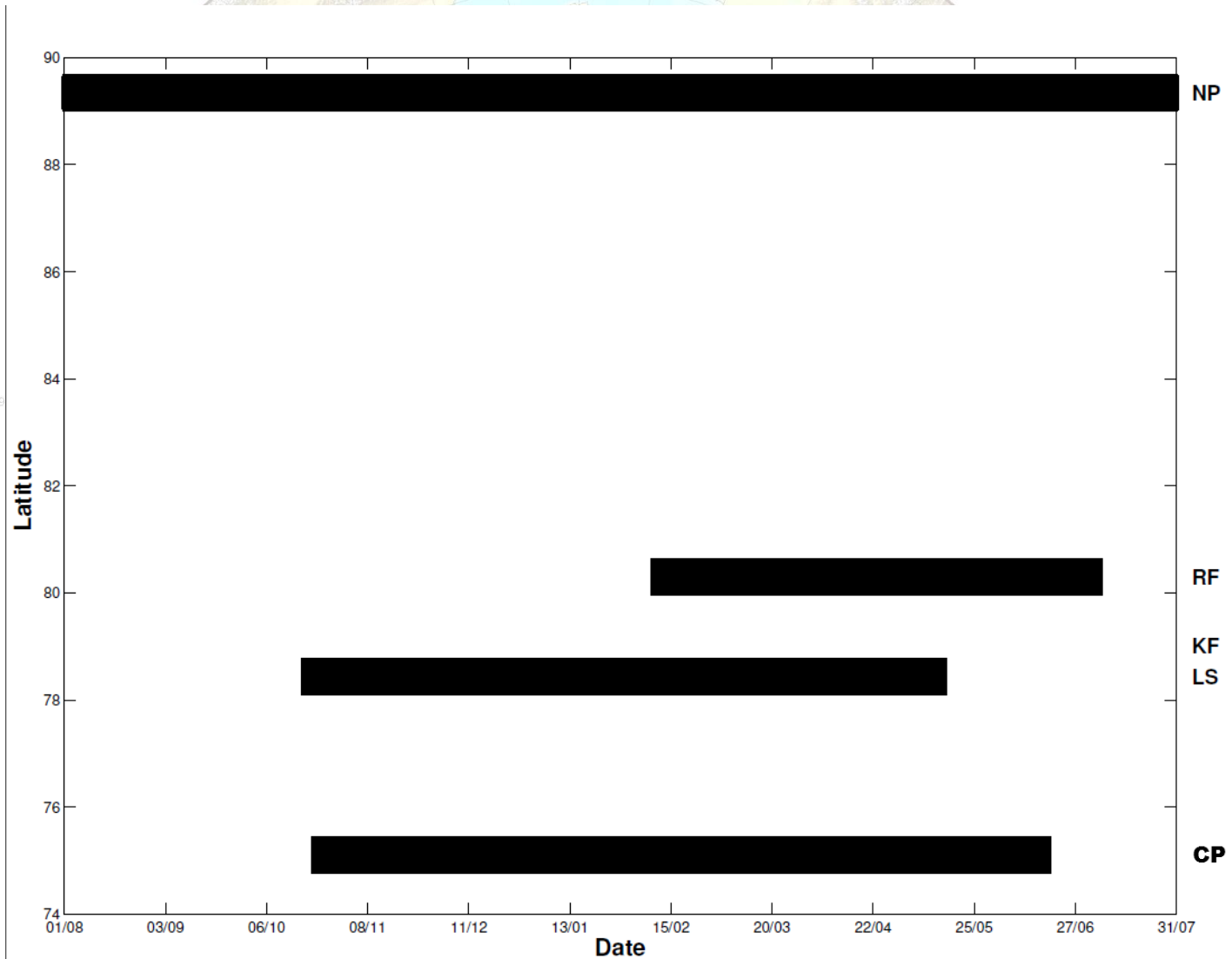
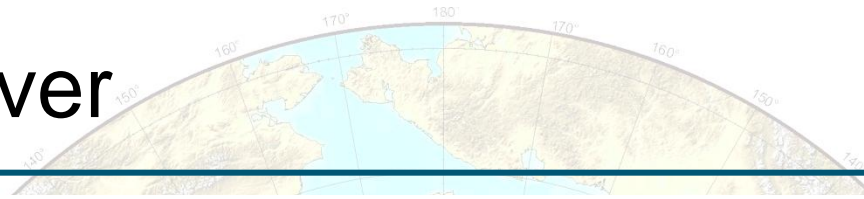
Increasing Latitude



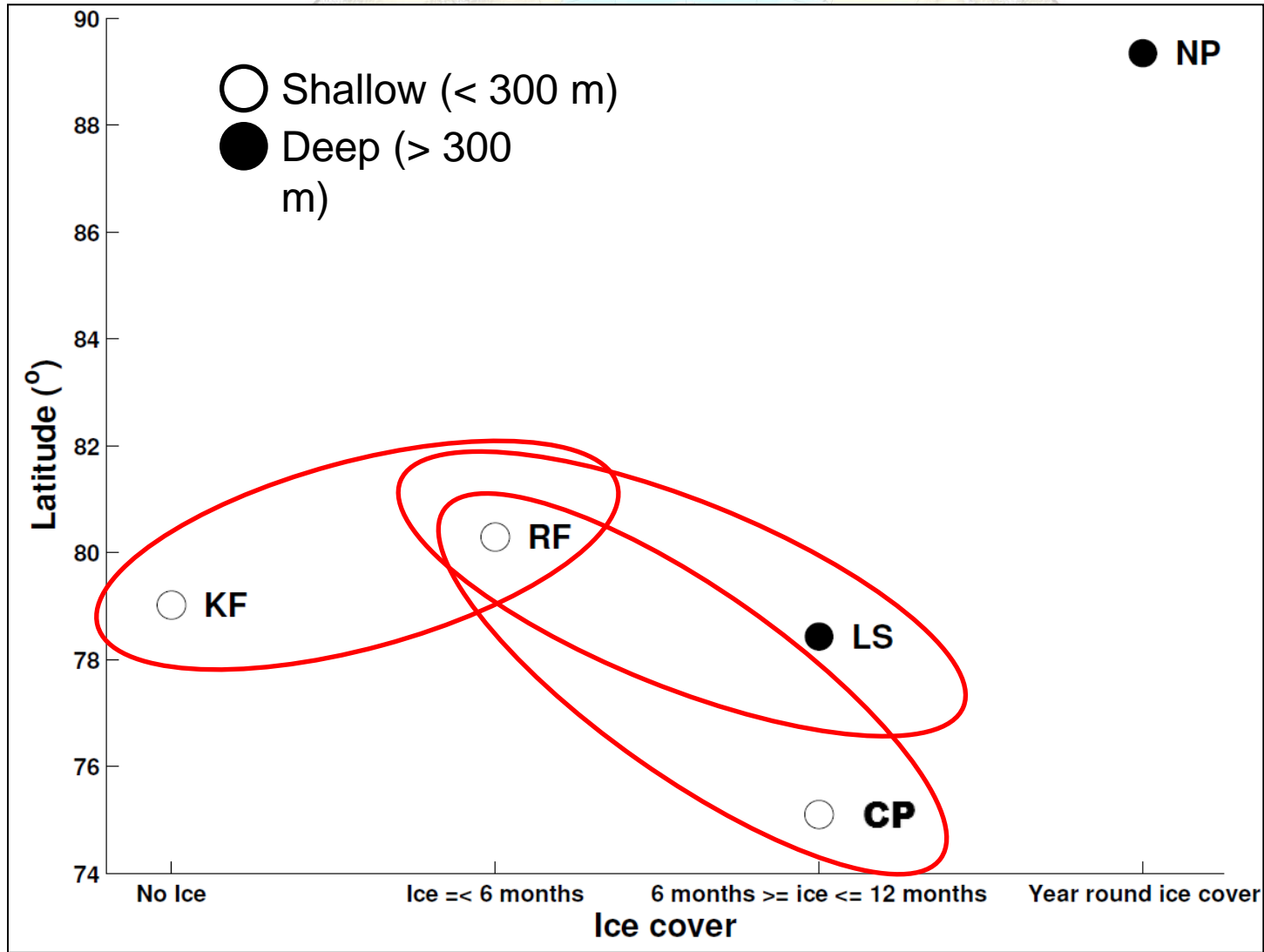
| | Chuckchi Plateau | Laptev Sea | Kongsfjorden | Rijpfjorden | North Pole |
|-----------|------------------|-------------|--------------|-------------|------------|
| Latitude | 75° | 78° | 79° | 80° | 89° |
| Depth | 200 m | 2000 m | 200 m | 200 m | 4000 m |
| Ice cover | Seasonal | Seasonal | Nil | Seasonal | All year |
| Location | Shelf | Shelf Slope | Fjord | Fjord | Basin |

- Using contrasting sites to *test* environmental parameters:
Latitude: Chuckchi Plateau and Rijpfjorden
Ice cover: Kongsfjorden and Rijpfjorden
Location: Laptev Sea and Rijpfjorden

Sea Ice Cover

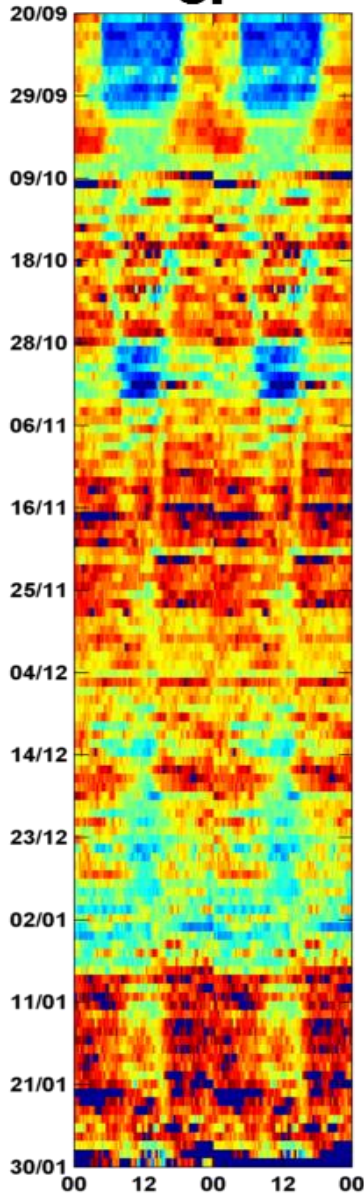


Parameter Space

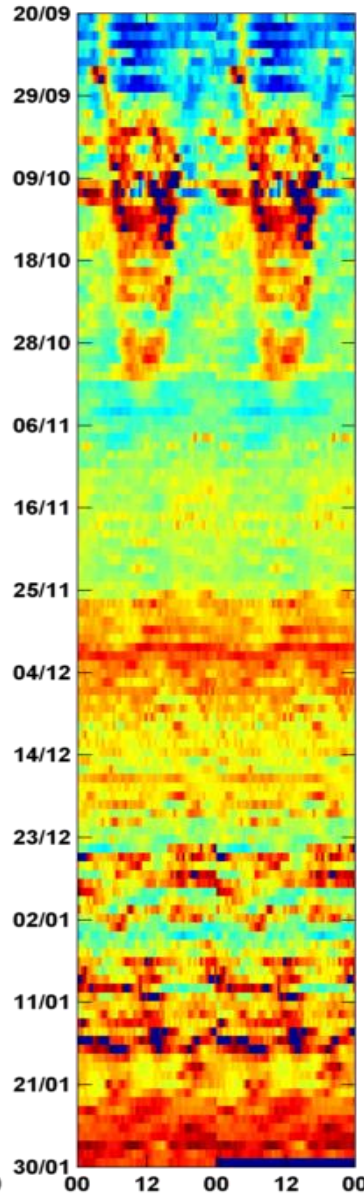


DVM in Actograms (~30m)

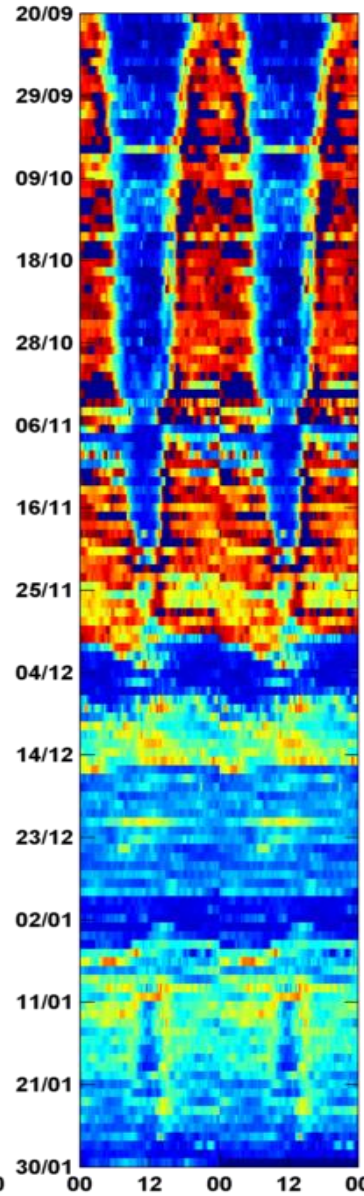
CP



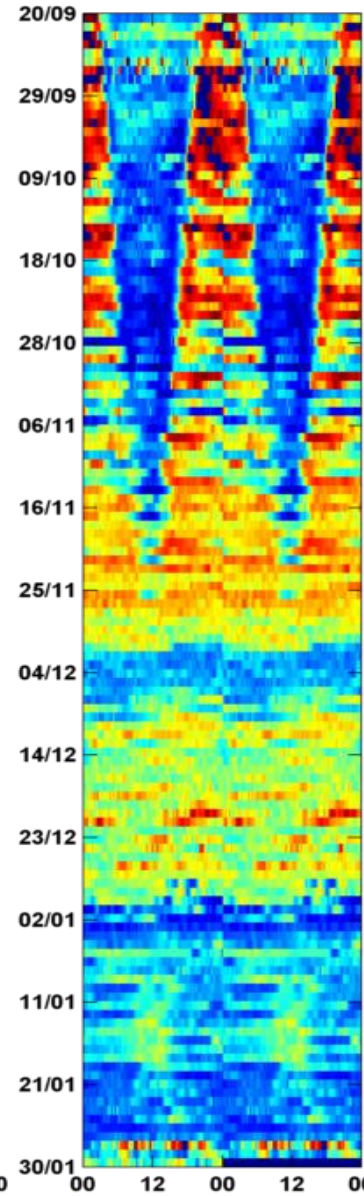
LS



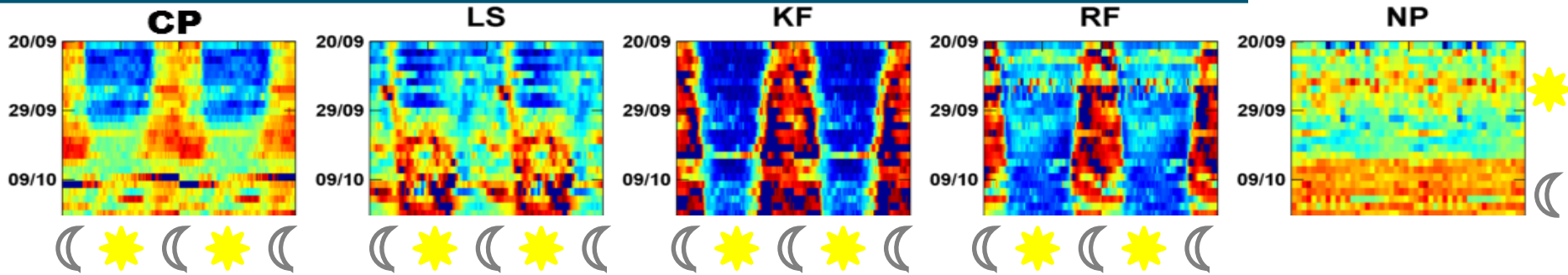
KF



RF

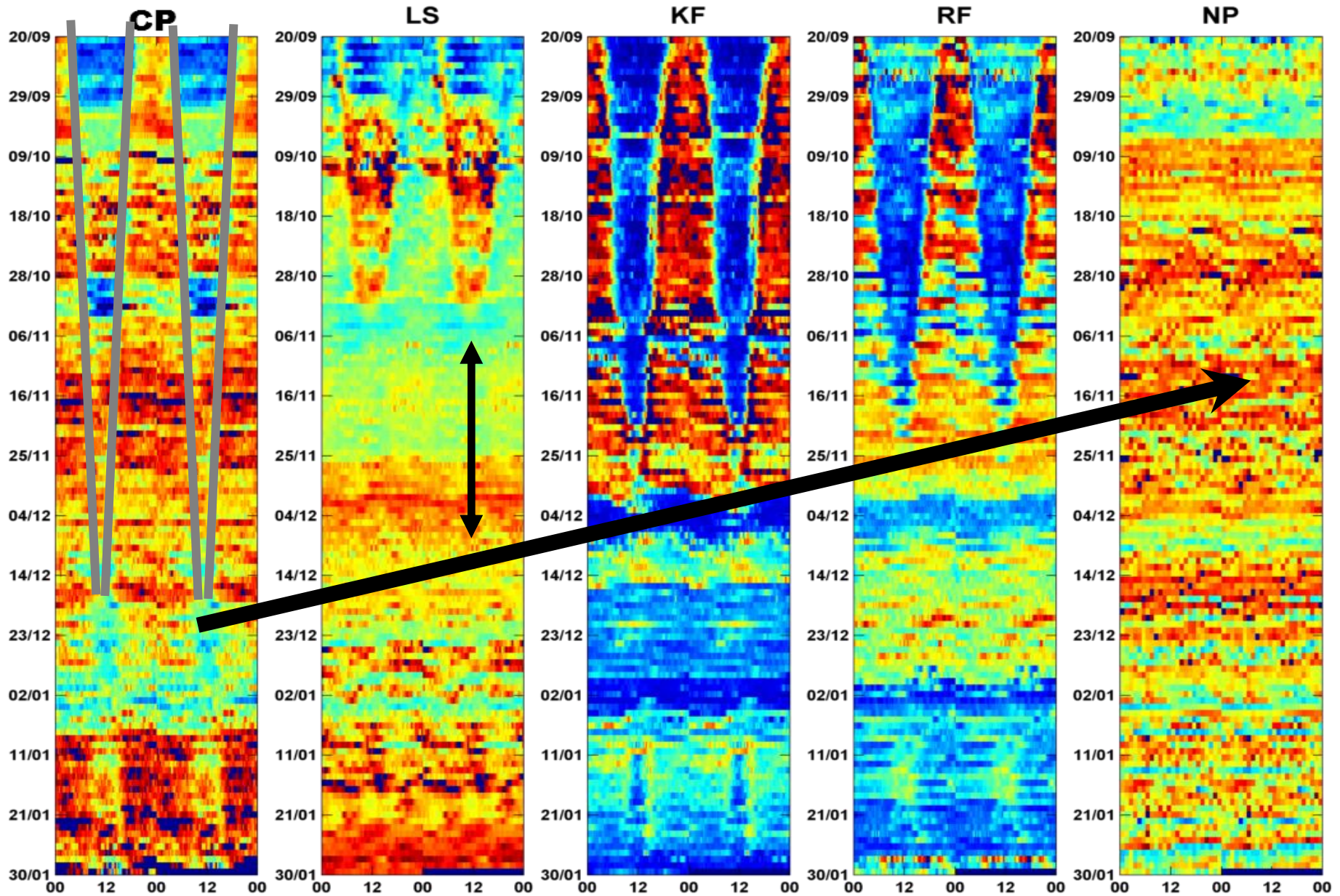


DVM at Equinox

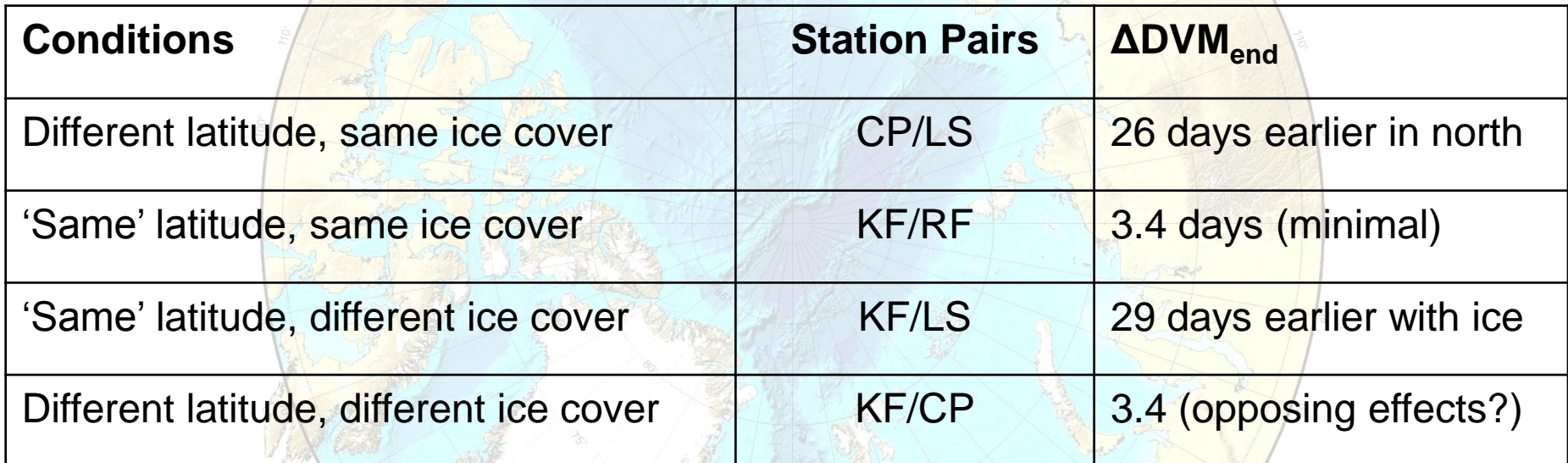


- DVM is most developed during Autumn equinox
- DVM measured pan-Arctic, except ...
- DVM not detected at North Pole (no day-night cycle)
- Response in the vertical position of zooplankton at NP

Winter DVM

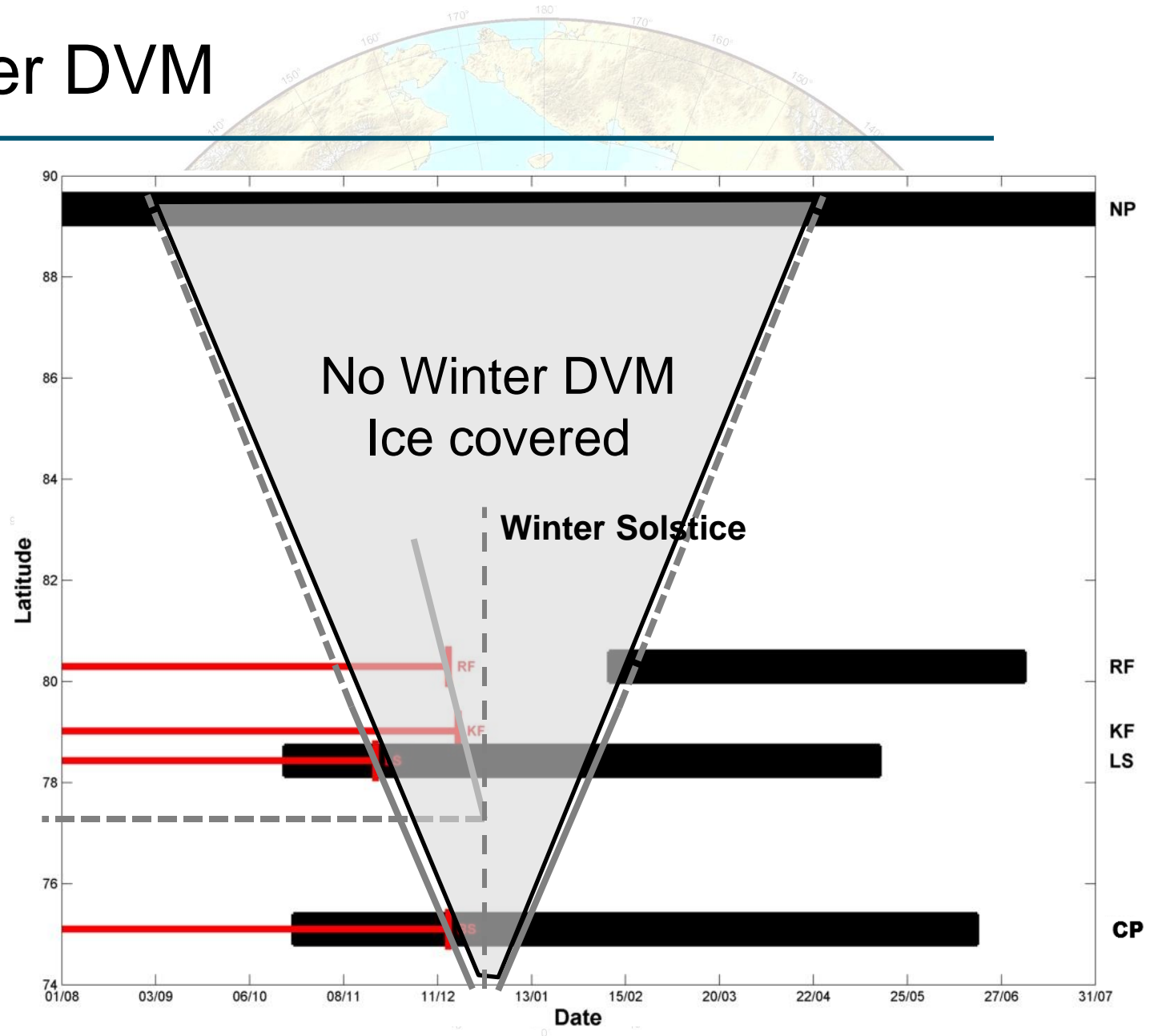


Winter DVM

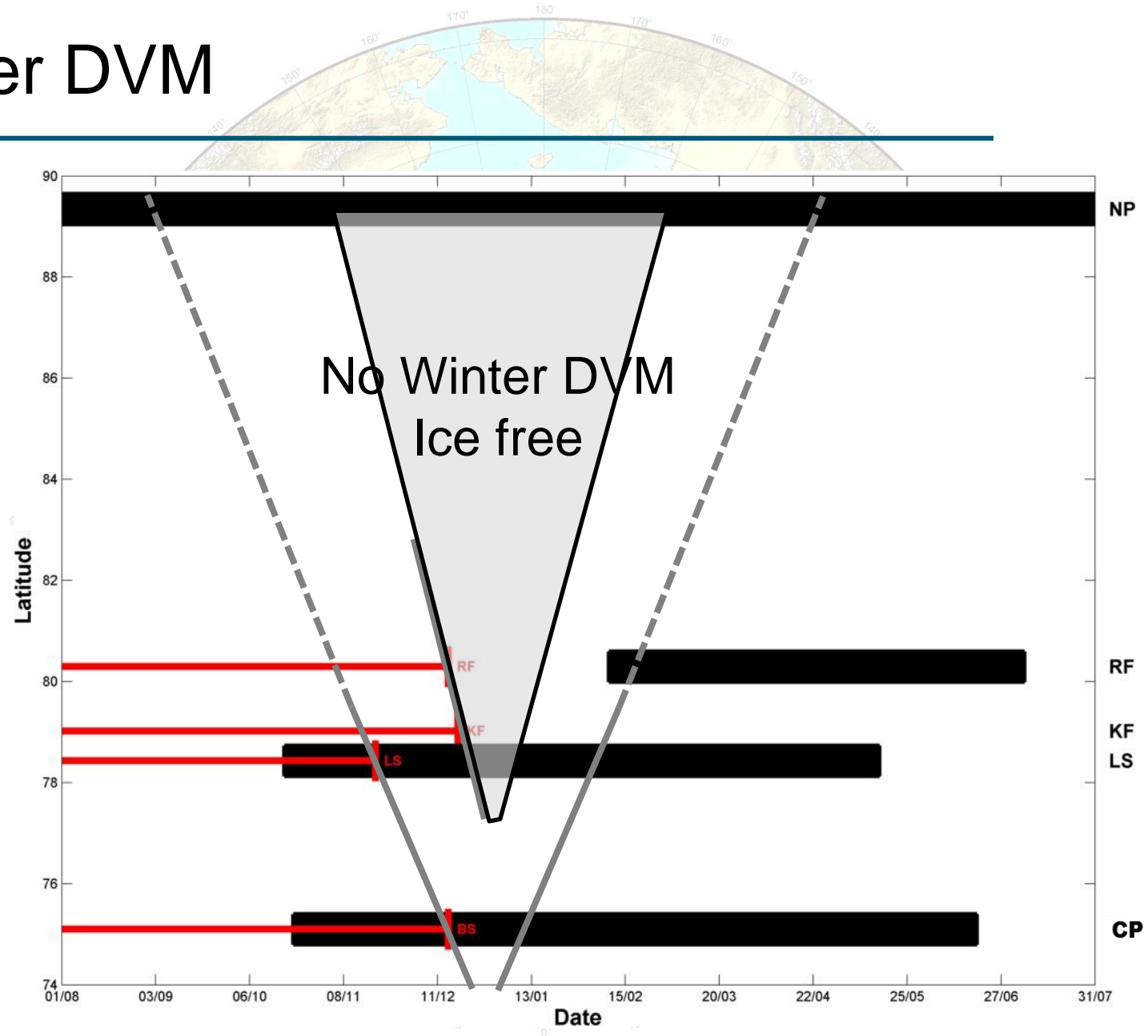


| Conditions | Station Pairs | $\Delta\text{DVM}_{\text{end}}$ |
|---|---------------|---------------------------------|
| Different latitude, same ice cover | CP/LS | 26 days earlier in north |
| 'Same' latitude, same ice cover | KF/RF | 3.4 days (minimal) |
| 'Same' latitude, different ice cover | KF/LS | 29 days earlier with ice |
| Different latitude, different ice cover | KF/CP | 3.4 (opposing effects?) |

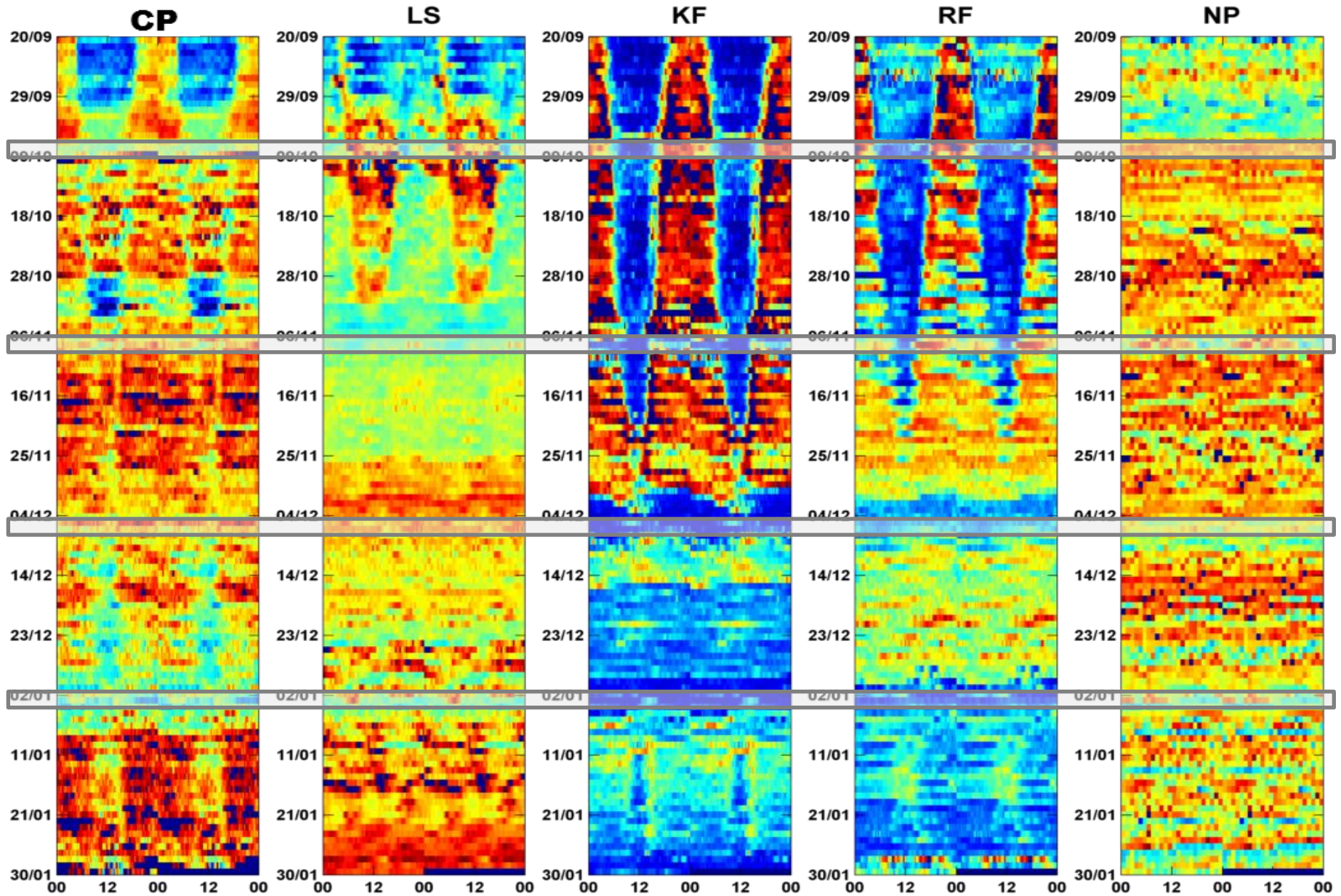
Winter DVM



Winter DVM



Full Moon?



Winter DVM - Conclusions



- DVM illustrated for 30 m depth
- Winter DVM is active across the Arctic ...
- ... except close to the North Pole
- Properties/timings are latitude and ice dependent
- Sea ice can reduce the period during which DVM is active
- Sea ice cover has similar effect to 3° of latitude
- The entire Arctic zooplankton population responds to the full moon
- Further analysis from PanArchive will determine robustness of these conclusions

QUESTIONS?