



Extreme Snow Events In the Mediterranean Region and correlations with Large-Scale Atmospheric Circulation

MSc Oceanography Research project

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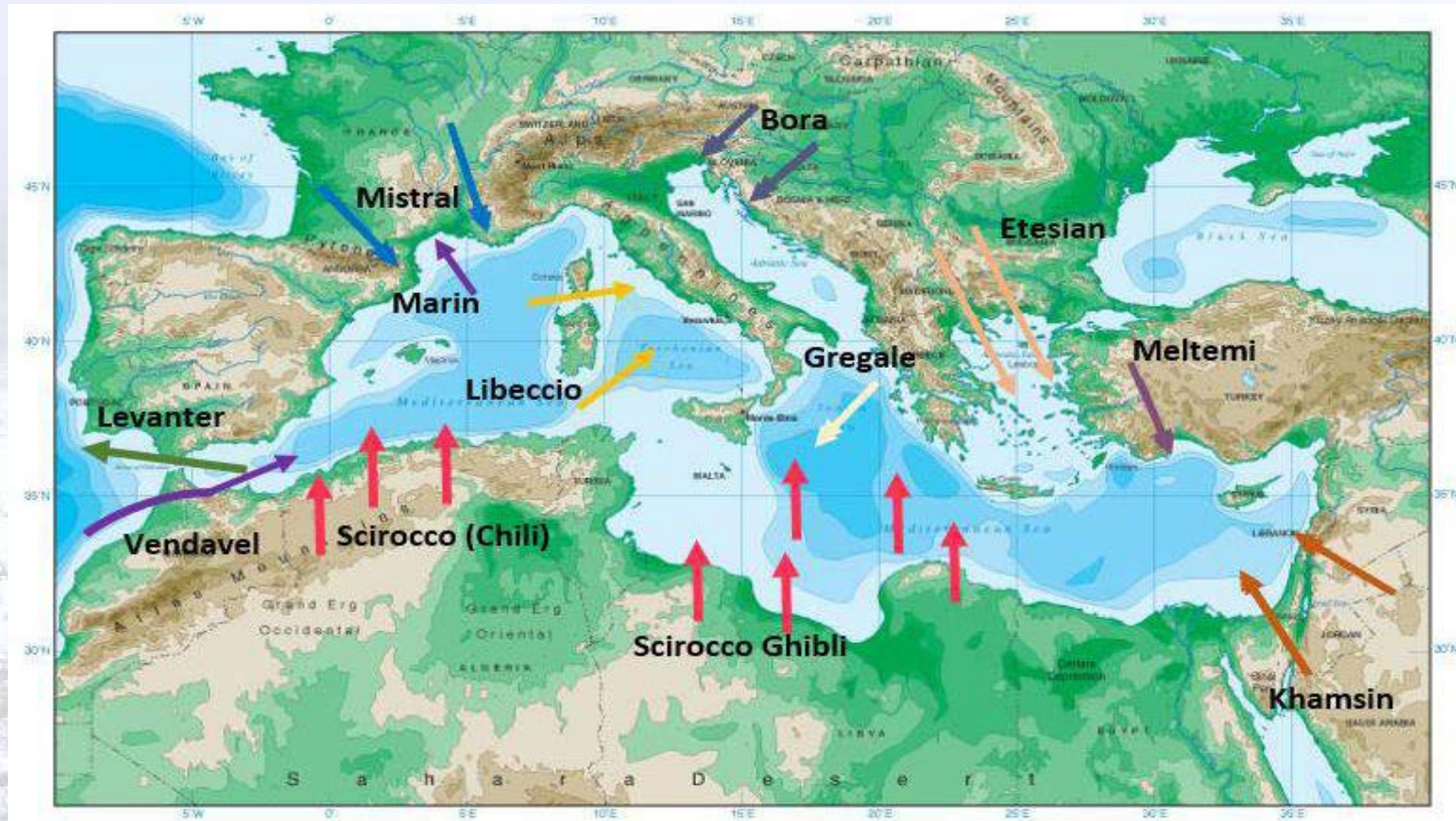
Conclusions and Outlook

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References

Mediterranean Region

- A transitional semi-enclosed basin
- Sharp morphology drives contrasting weather



Introduction

- Warm/dry summers, mild/wet winters, transient autumn and spring
- A “Hot Spot” vulnerable to climate changes in the 21st century
- Projections for pronounced droughts
- Infrequent cold events



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Introduction

YET...



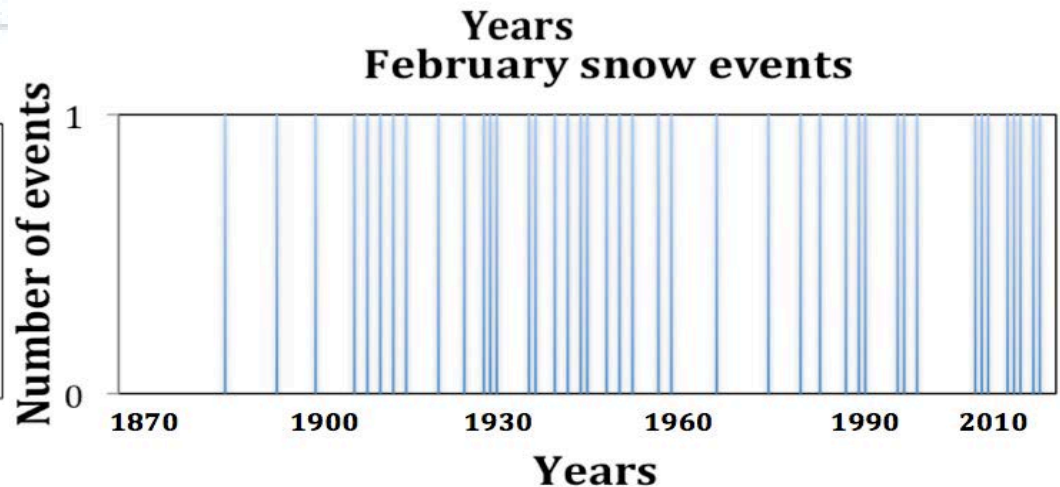
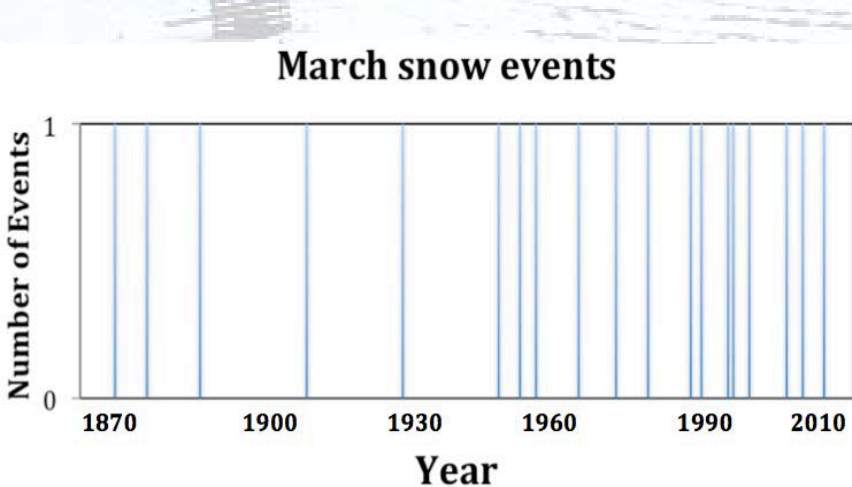
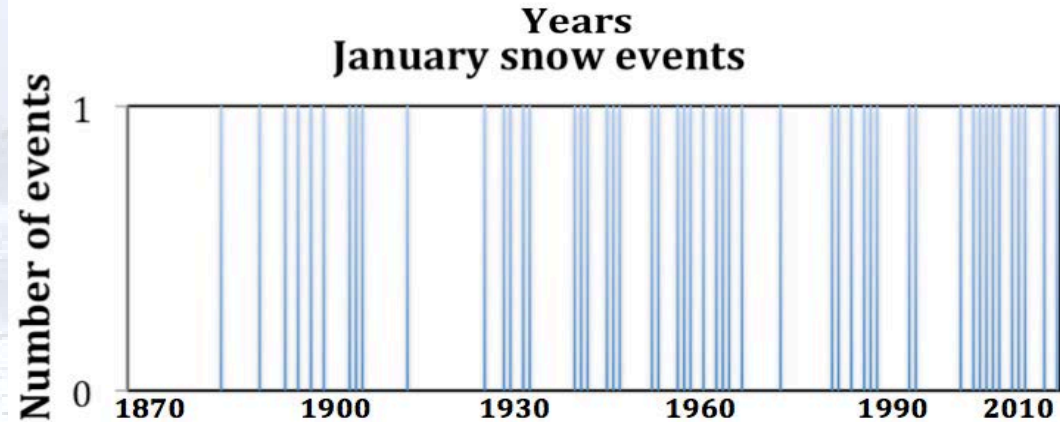
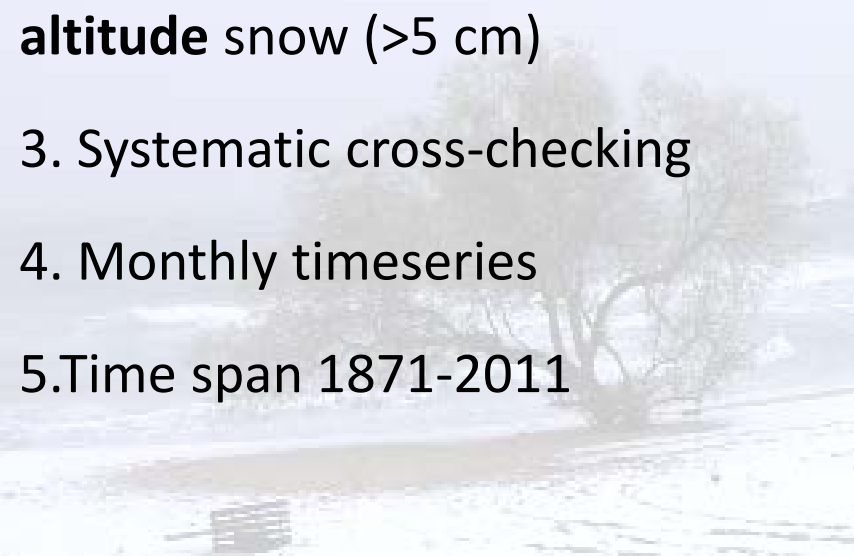
Introduction

- Cities can paralyze without electricity
- Transportation/communication impeded, Isolated areas
- Damages in forests, infrastructures from snow and melting
- Economic losses ~\$15bn
- Fatalities



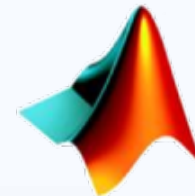
Database construction and Processing

1. Literature and online sources
2. Heavy (>10 cm) and rare **low-altitude** snow (>5 cm)
3. Systematic cross-checking
4. Monthly timeseries
5. Time span 1871-2011



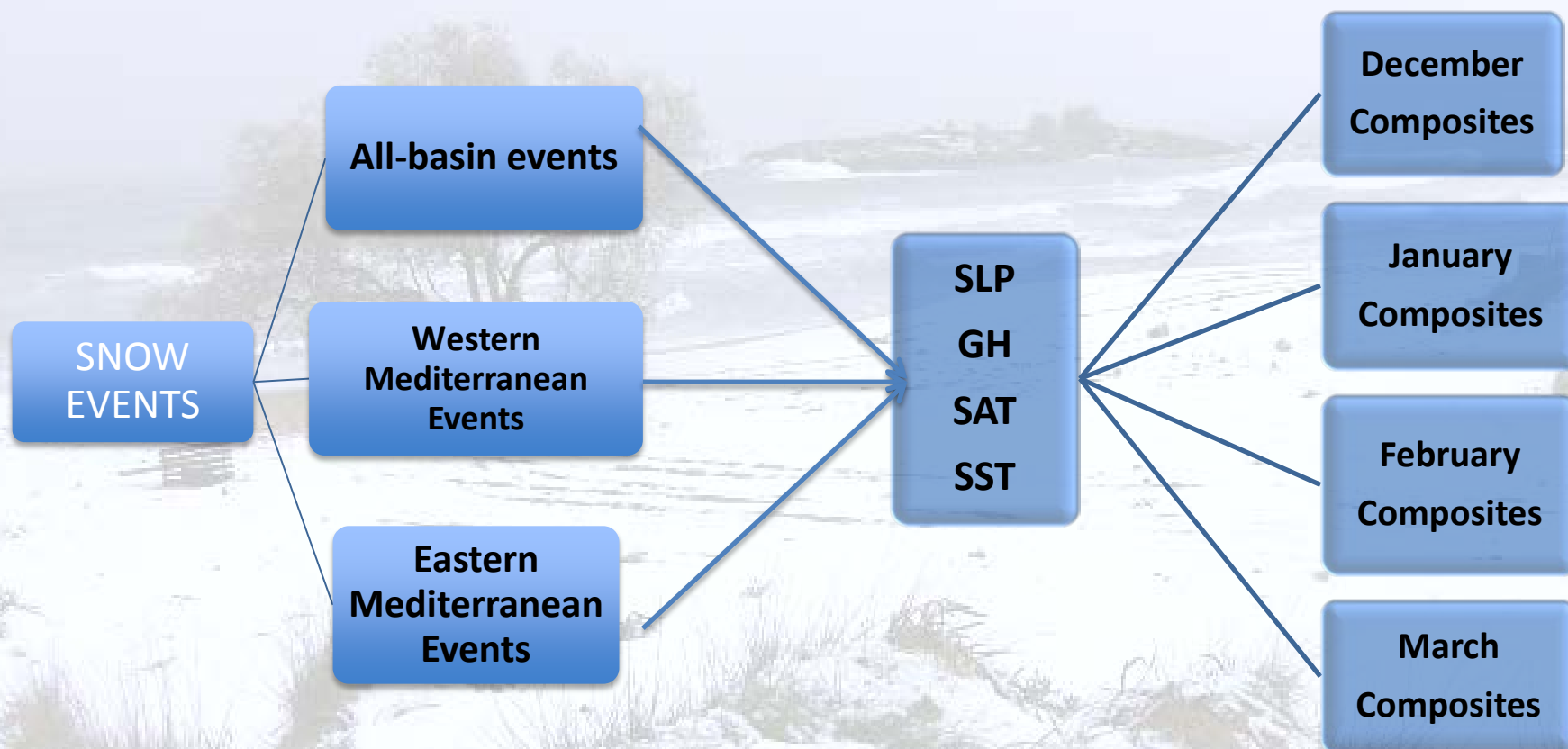
Database construction and Processing





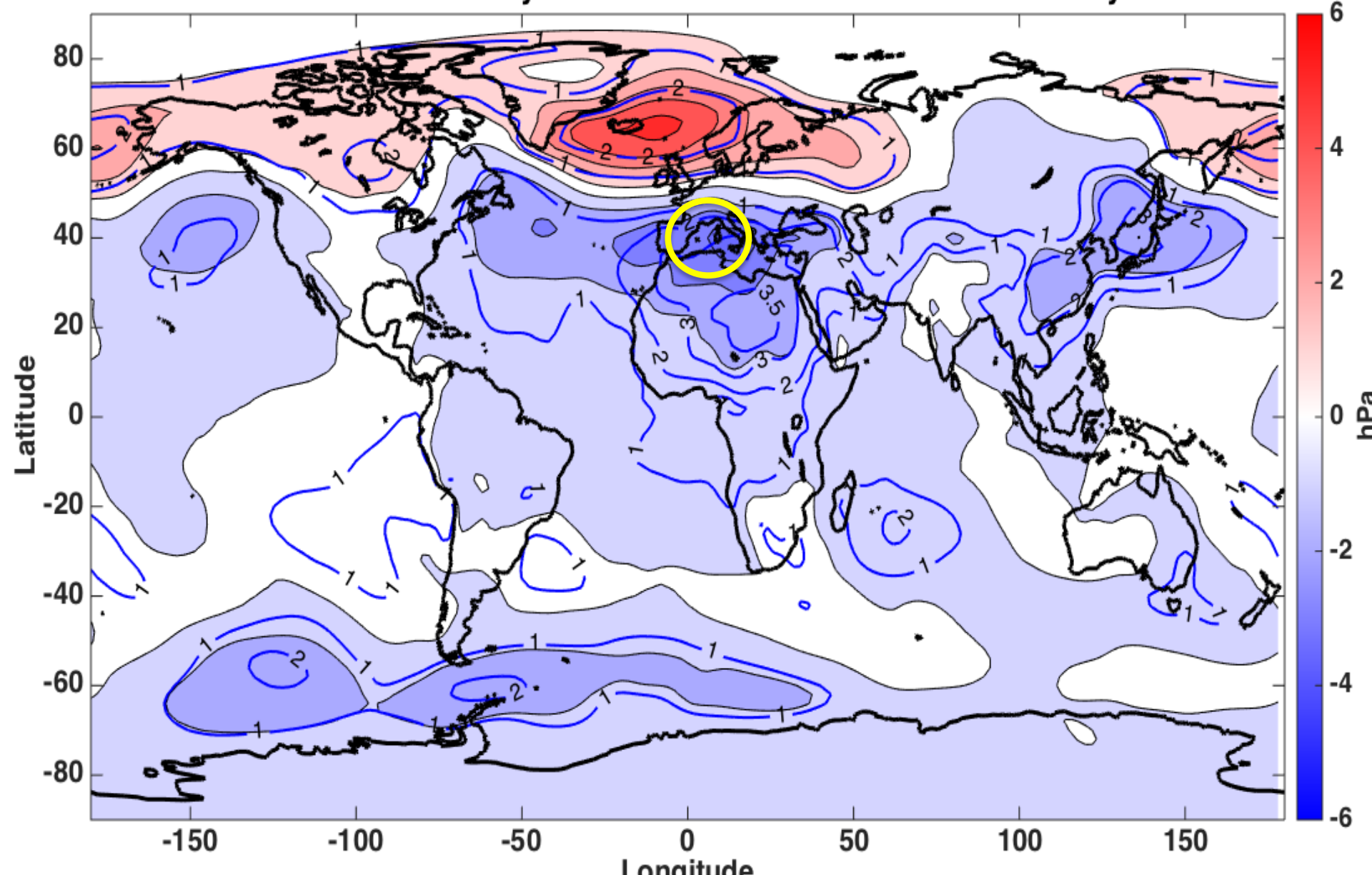
Observational datasets

- *20th Century Reanalysis Project: Monthly (DJFM) **Sea Level Pressure**, **Geopotential Height**, **Surface Air Temperature** anomalies (1870-2011)*
- *Reynolds Data set for monthly SST anomalies (1981-2015)*



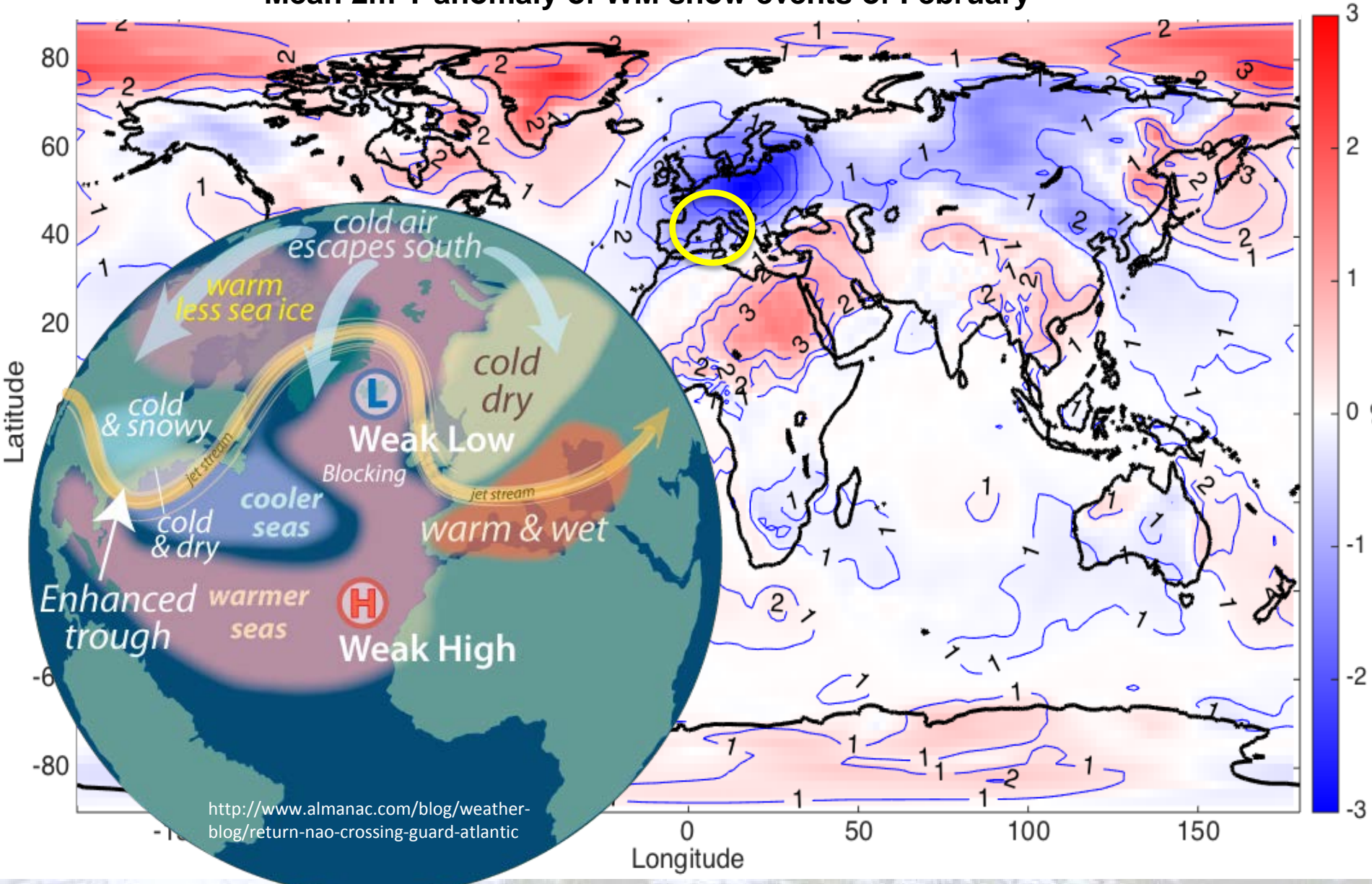
*Global and Mediterranean composites =
average of monthly extreme conditions for each month*

Mean SLP anomaly of WM extreme snow events of February

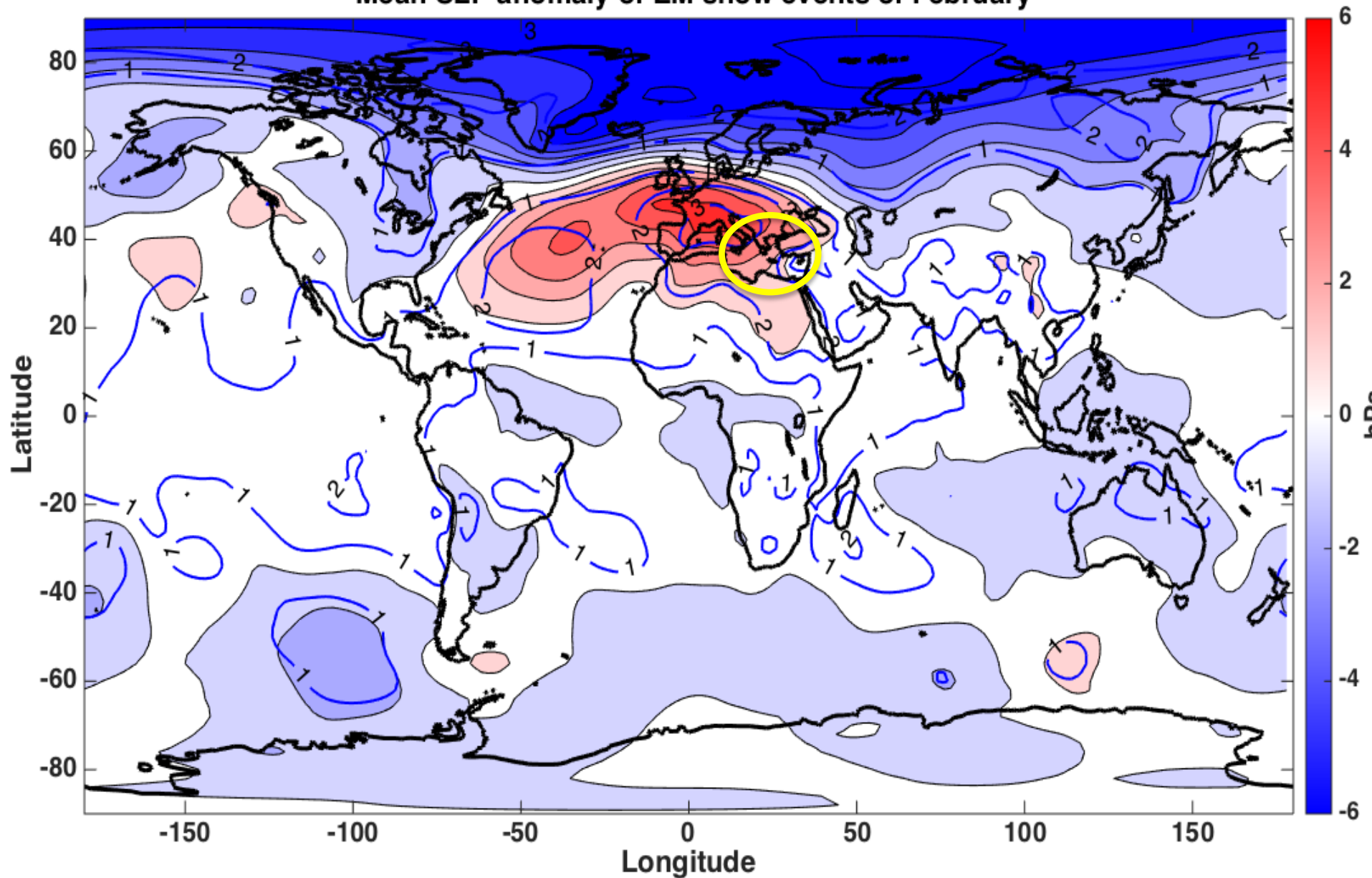


Snow in the Mediterranean

Mean 2m-T anomaly of WM snow events of February

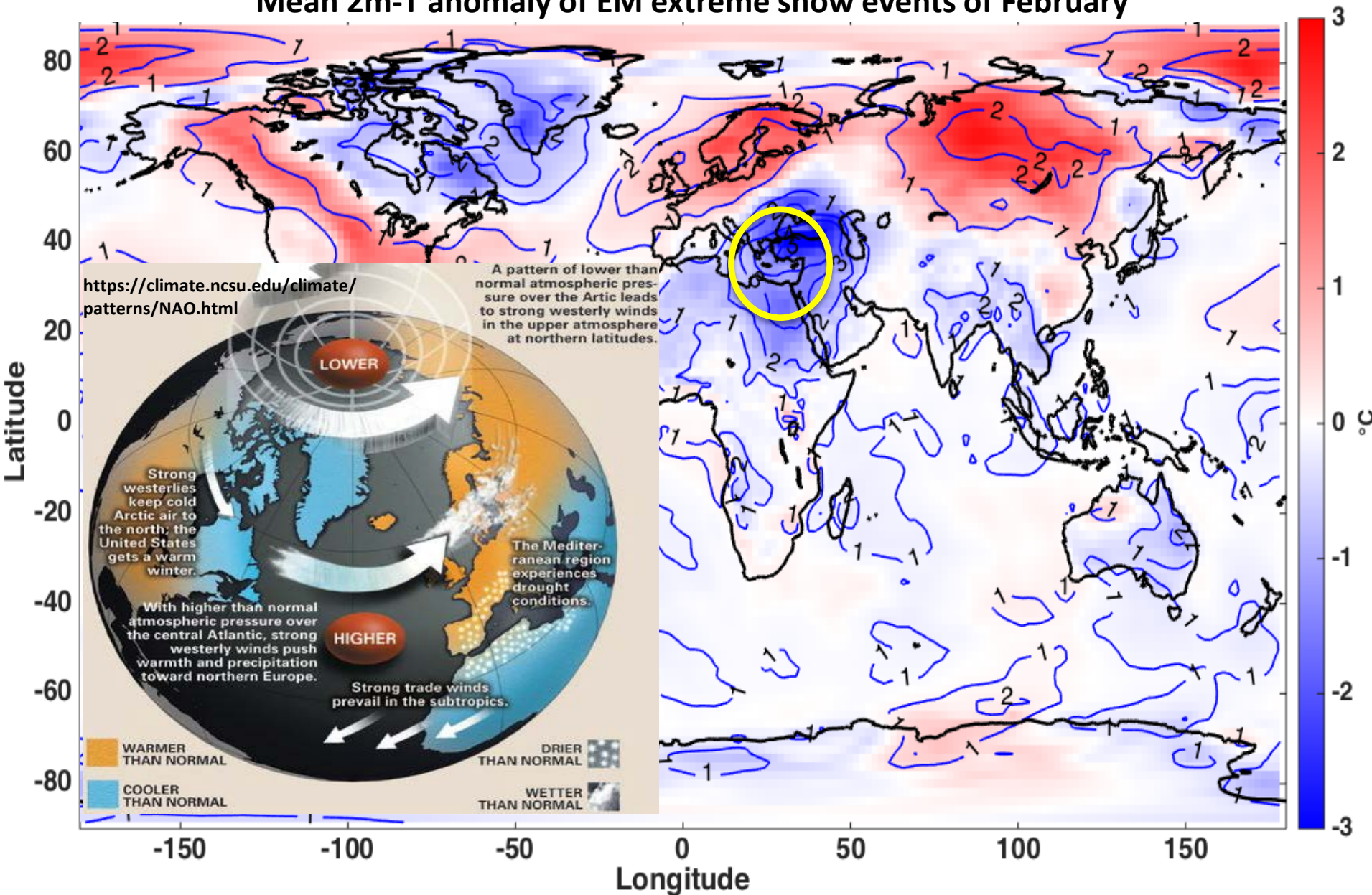


Mean SLP anomaly of EM snow events of February

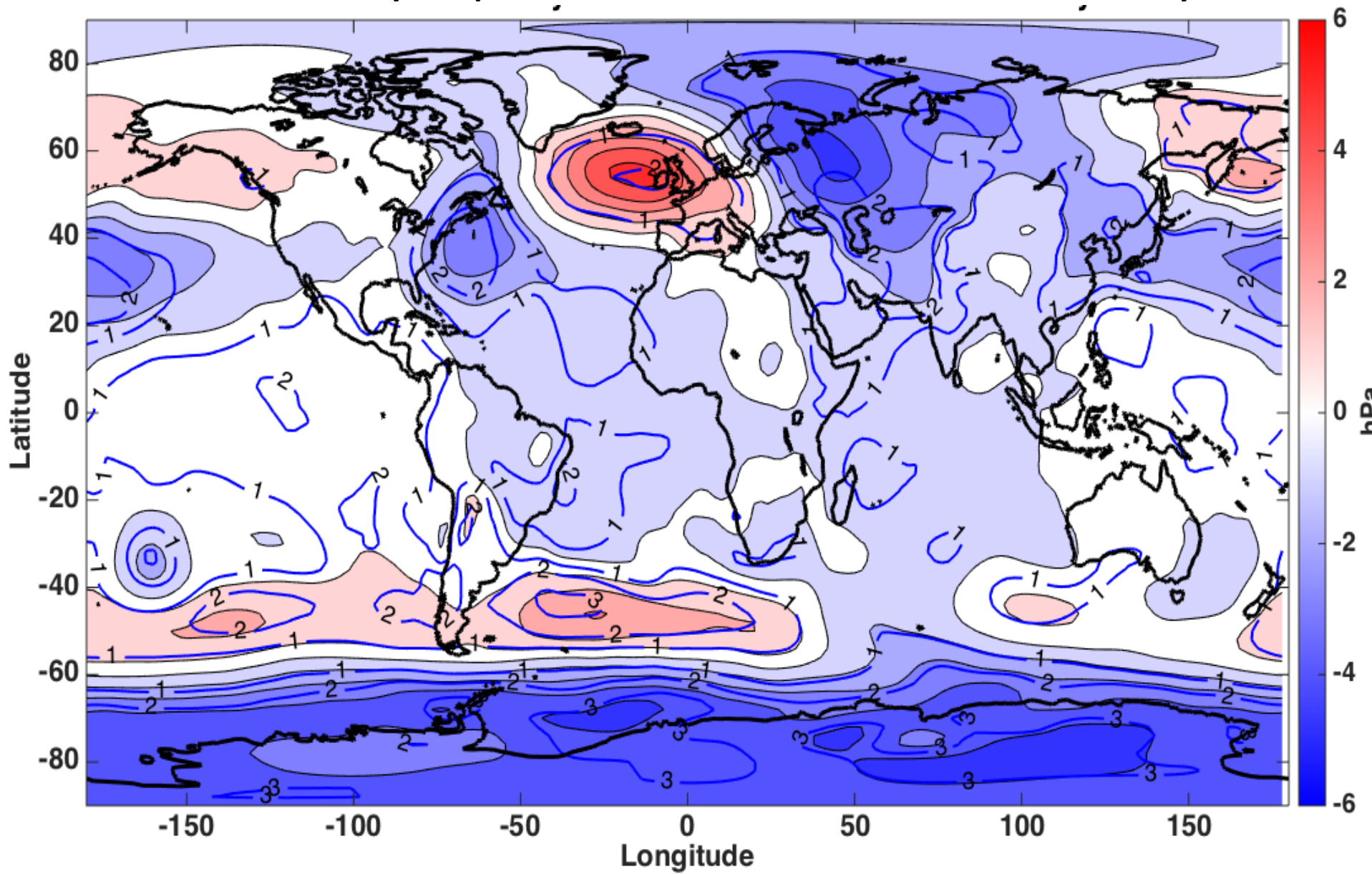


Snow in the Mediterranean

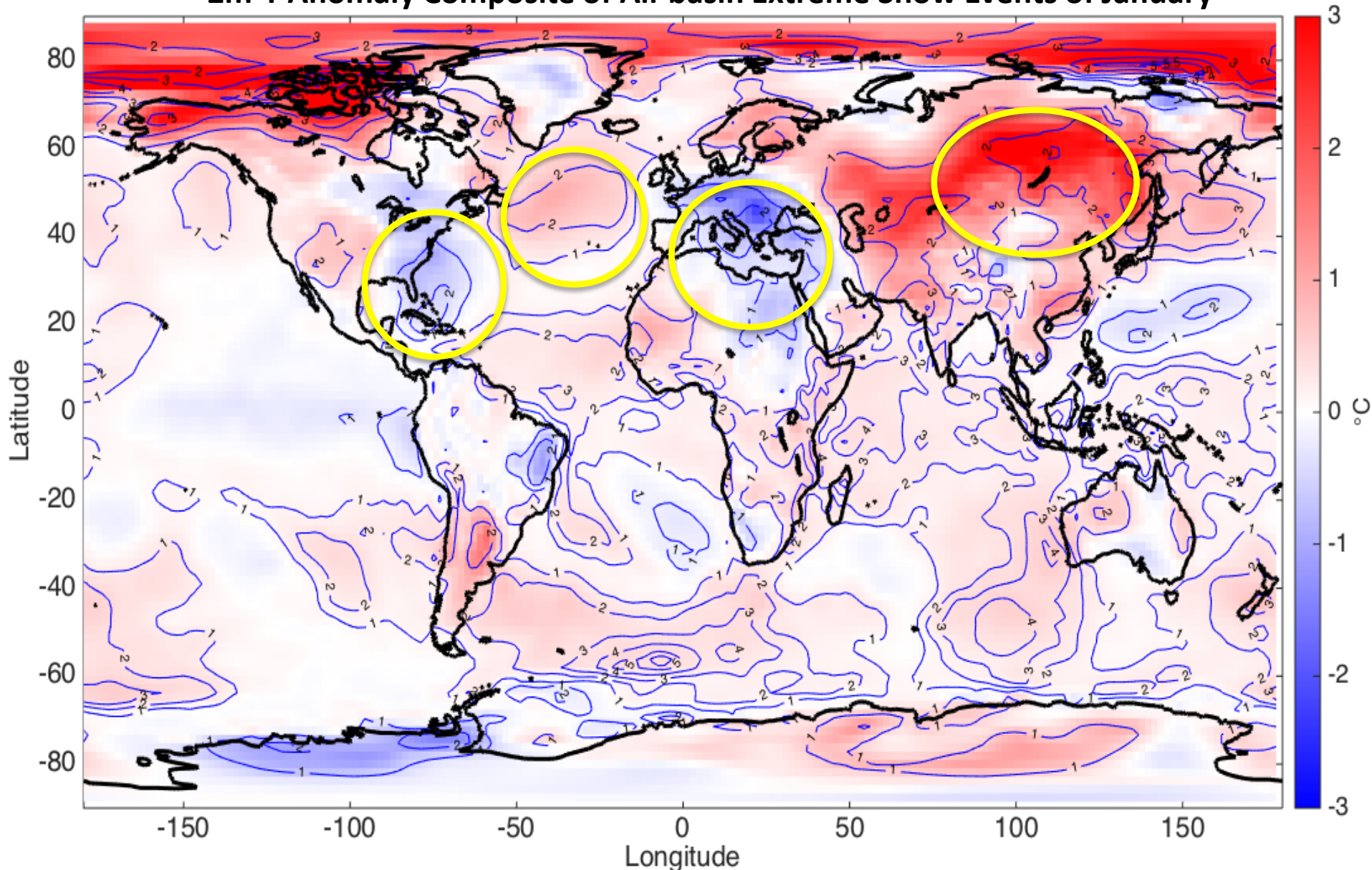
Mean 2m-T anomaly of EM extreme snow events of February

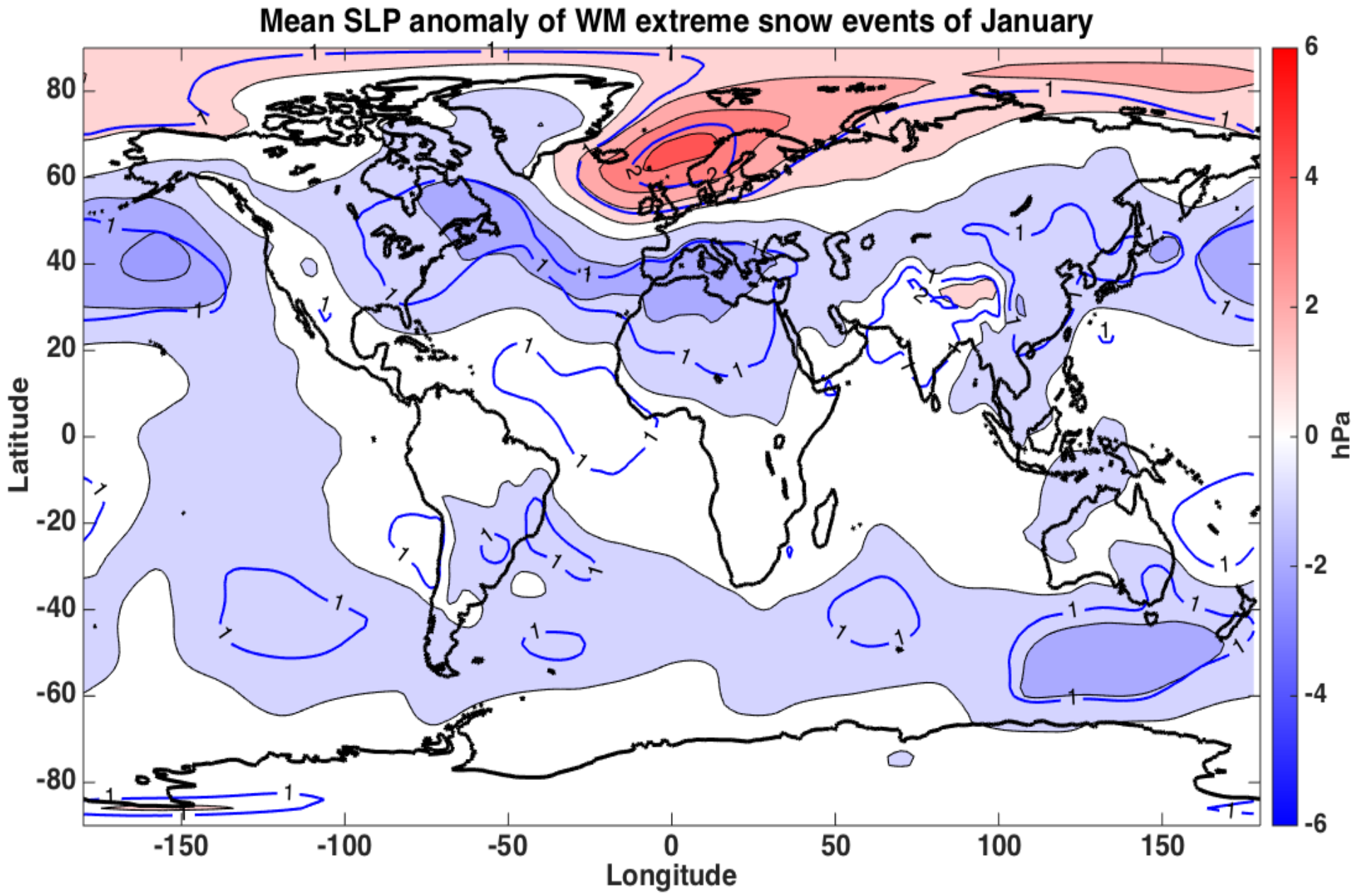


SLP anomaly composite of all-basin extreme snow events of January



2m-T Anomaly Composite of All-basin Extreme Snow Events of January





- ***Statistical Significance points*** to the tendency of NAO- to coincide with most of the WM snow events and AO+/NAO+ with most of the EM events, in February
- Classification of our events supported
- Large variability of atmospheric modes may favor snowfalls during the other months with events (December, January, March)



LIMITATIONS

- ✓ Some snow events not reported/registered
- ✓ Some events might coincide with not significantly cold temperatures
- ✓ Temporal limitation of SST



FUTURE

- ✓ Retrieve more snow events
- ✓ Examine the atmospheric conditions in daily scale
- ✓ Searching for other large-scale connections
- ✓ Impact on the Mediterranean Sea

References

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- **Giorgi, F., & Lionello, P. (2008). *Climate change projections for the Mediterranean region. Global and Planetary Change*, 63(2-3), 90–104.**
- **Tükeş, M., & Erlat, E. (2008). *Influence of the arctic oscillation on the variability of winter mean temperatures in Turkey. Theoretical and Applied Climatology*, 92(1-2), 75–85. doi:10.1007/s00704-007-0310-8**
- **Xoplaki, E. (2002). *Climate variability over the Mediterranean. PhD thesis***



***THANK YOU FOR
YOUR ATTENTION***

Statistical Significance

Monte Carlo

How likely is to observe the same atmospheric anomalies by just picking randomly the same number of years as the observed number of snowfalls in each month?

Repeat the experiment
1000 times

Significance =
Extreme composites/SD of
random composites

