# Large–scale dynamical impacts on regional Arctic climate change

D01

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## 1 Summary

Investigate the role of large-scale processes in Arctic Amplification

- Role of the large–scale circulation on regional patterns of Arctic Amplification,
- Relative importance of large–scale circulation changes and local feedback processes
- Role of troposphere/stratosphere coupling
- Interaction of Arctic Amplification and stratospheric ozone loss

## Hypothesis

**Regional Arctic climate change and Arctic Amplification is modulated by large scale tropospheric and stratospheric circulation patterns**

## 2 Research rationale

### State of the Art

- Arctic troposphere – strato-sphere interactions due to vertical coupling of the annular modes
- Large-scale circulation impact via tropospheric meridional transport of heat and water vapour
- Northern Annular Mode (NAM) variability affects the meridional transport of ozone in the stratosphere
- Persisting ozone anomalies that affect NAM via radiation and temperature
- Arctic temperatures affected by NAM
- Affects ozone chemistry and in particular anthropogenic ozone loss

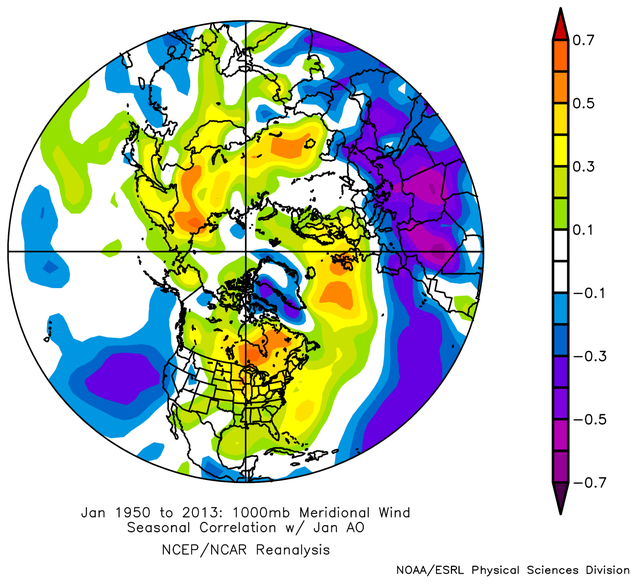



*Fig. 1: Linear correlation between meridional surface winds and Arctic Oscillation. Data source: NCEP Reanalysis.*

### Aims

Quantify the relative importance of local feedback processes, large scale dynamics, and stratosphere–troposphere coupling for regional climate changes in the Arctic

- diagnose circulation parameter variability
- evaluate large–scale circulation and in situ processes
- analyse long–term climate records
- assess changes in meridional heat flux, vertical momentum flux and chemical ozone loss

## 3 Research plan

### Work packages

**WP1: Large scale dynamics and surface parameters**
- Reanalysis and CMIP5 data
- Lagged correlation analysis at timescales days – months
- Surface parameters vs. planetary waves

**WP2: Horizontal transport and large–scale dynamics**
- Mean and regional heat fluxes
- Extend by CMIP5 RCP8.5 for larger signal/noise ratio

**WP3: Hot spots of Arctic Amplification and large–scale dynamics**
- ICON GCM simulations with enhanced local feedback
- Disentangle local feedback and large-scale variability impacts

**WP4: Vertical coupling processes and the role of stratospheric ozone**
- MUAM ensemble driven by reanalysis/CMIP5
- Wave analysis and determination of role for vertical coupling
- Ozone variability and trend impacts

**WP5: Synopsis**
- Relative strength of large-scale and of local feedback processes

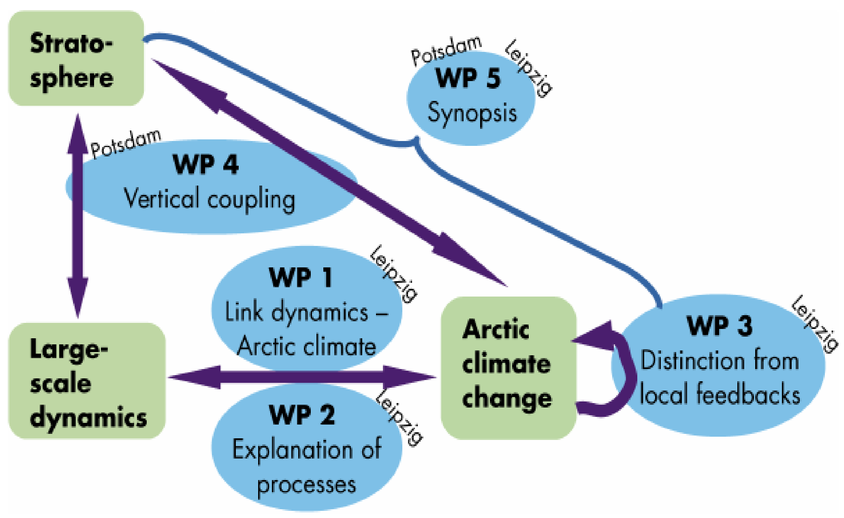
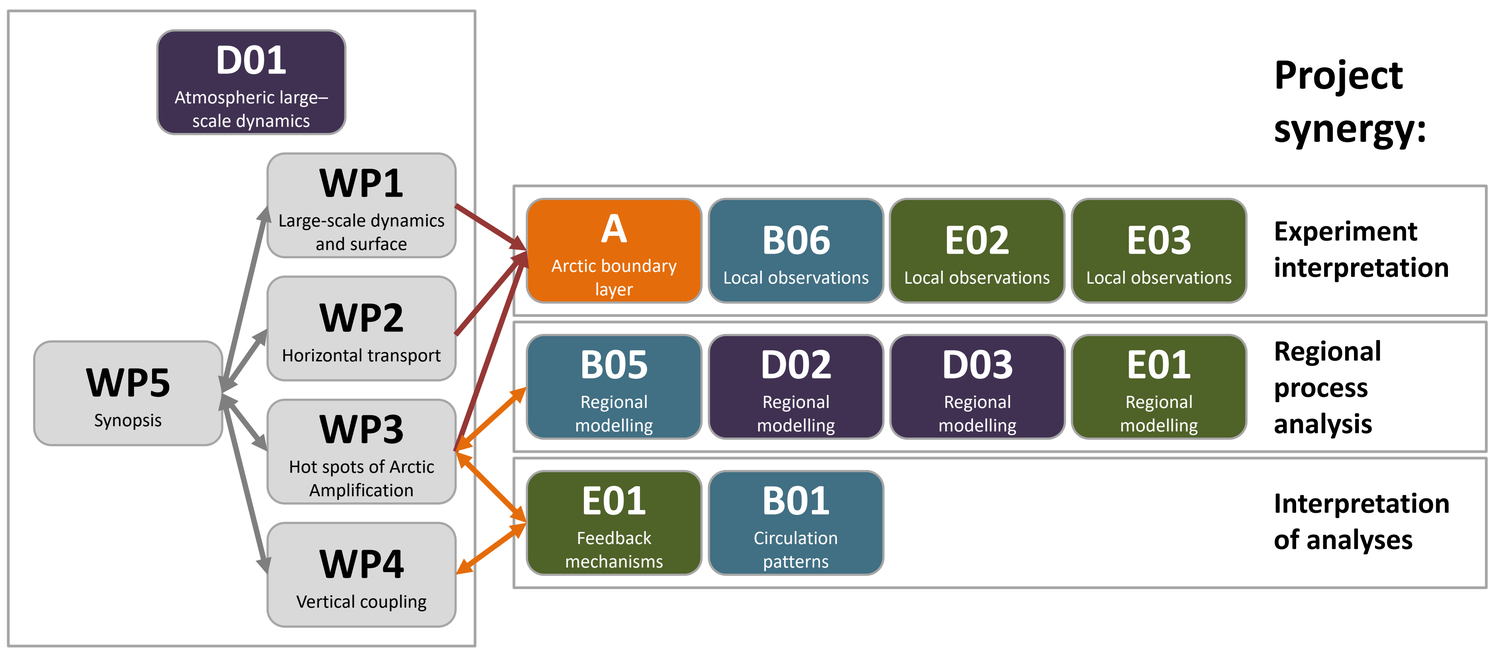



*Fig. 2: Overview of work packages*

## 4 Role within $(AC)^3$ & perspectives




### Collaboration within $(AC)^3$

coupling of large and local scales:

- Define regions most sensitive to local feedback processes in cooperation with Cluster A
- Assist interpreting observations in collaboration with B06, E02 and E03.
- Provide large–scale analyses as boundary values for regional modelling in B05, D02, D03 and E04.
- Analyse in situ processes with D02 and D03 and use their results in WP3.
- Physical feedback mechanisms analysis in E01
- NAM and NAO analyses with B01 and E01

### Perspectives

long-term model runs and analysis:

- AOGCM ensemble runs with fast interactive stratospheric ozone
- Very long time slice runs to assess spectrum of internal variability

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