Evaluation and understanding of atmospheric conditions over the Totten region (Wilkes Land, Antarctica) from a 5 km resolution COSMO-CLM² simulation

COSMO-CLM Online General
Assembly 2020

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Content

- Why studying Totten?

- CCLM² setup and model domain

- Evaluation of surface climatology for 1987

- Outlook for the future

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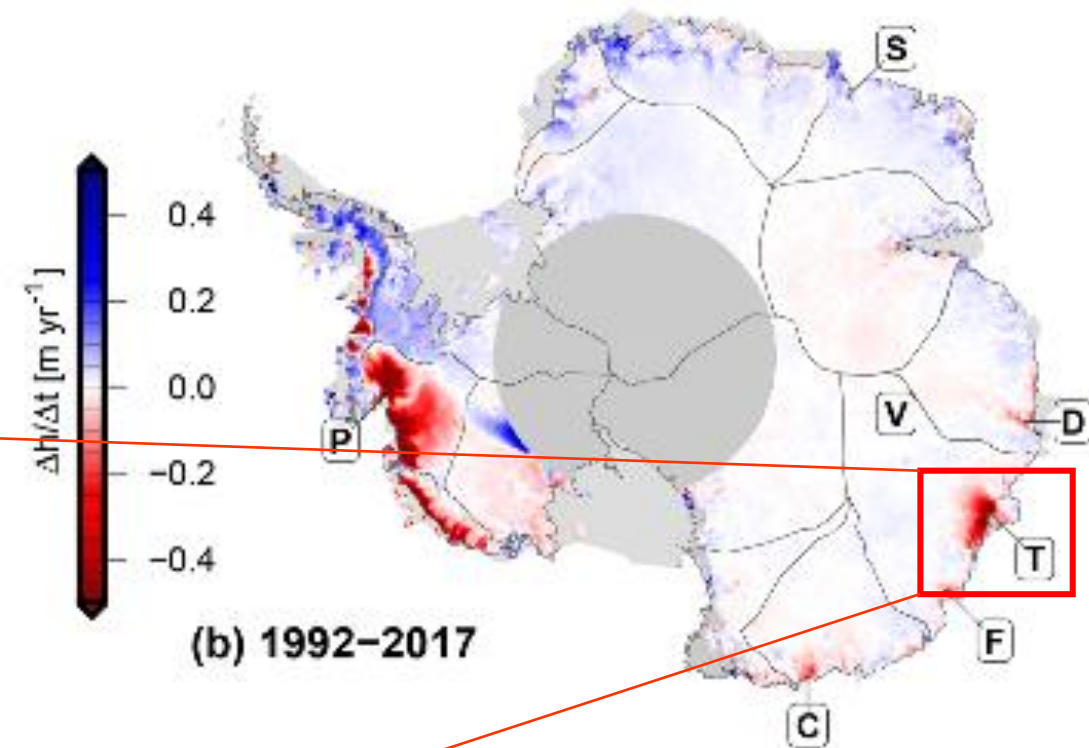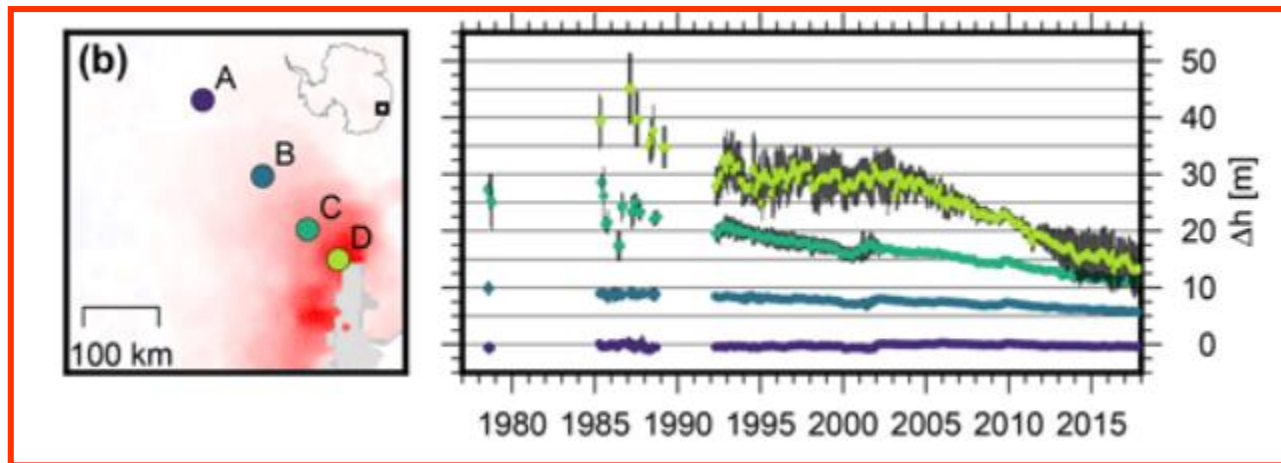# The Antarctic Ice Sheet has been losing mass...

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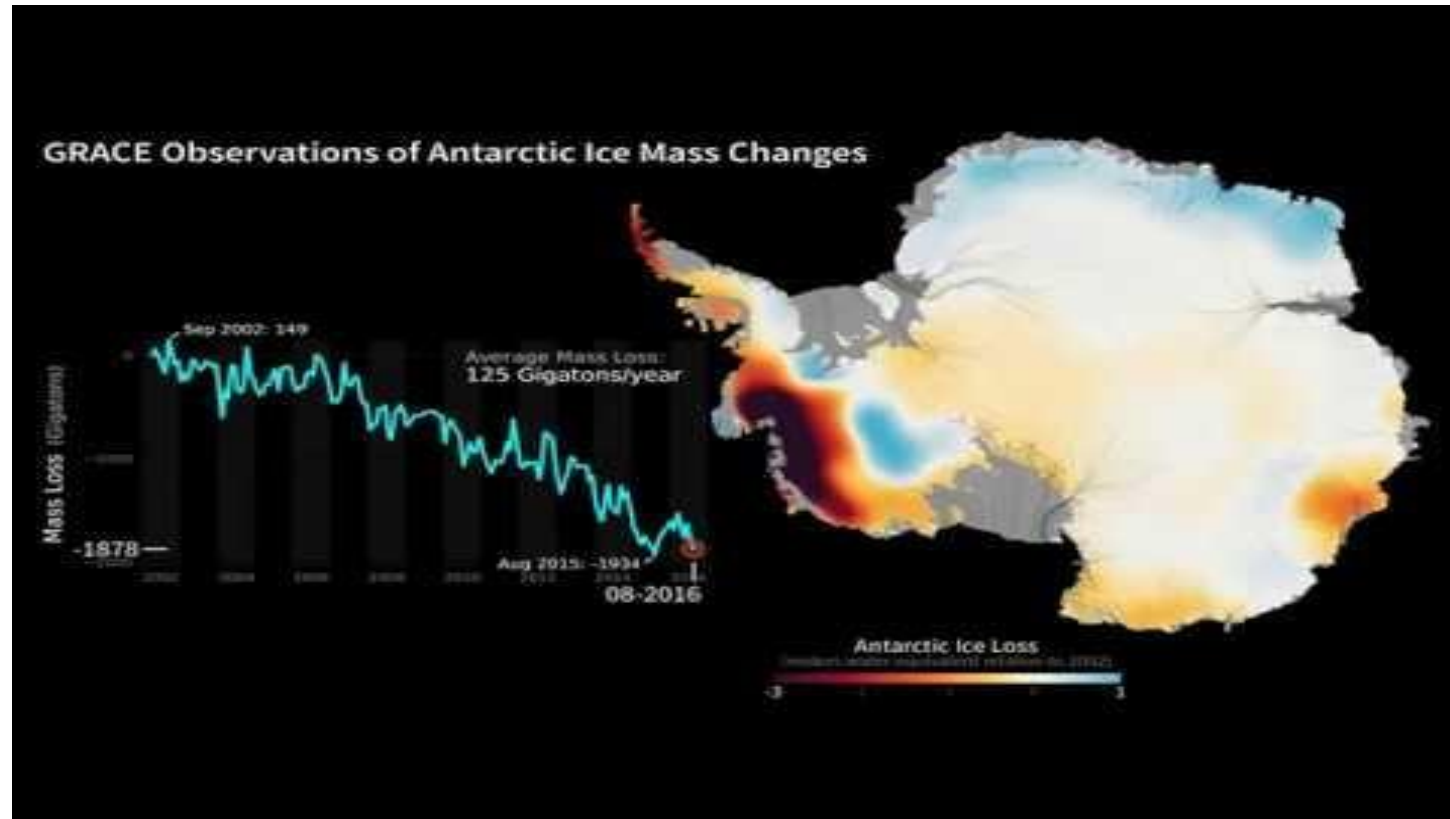
Totten glacier is losing mass…

Mass loss ~ 7 Gt/y for 1989-2015 (Li et al., 2015,2016)

GL retreat of **~ 1-3 km** in 17 yrs (Li et al., 2015,2016)

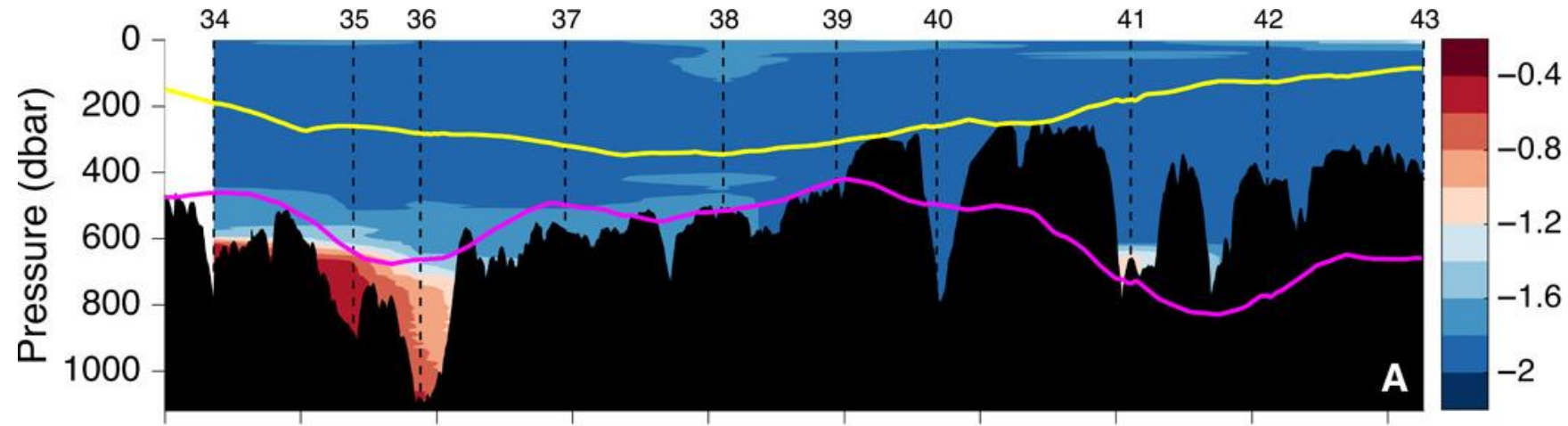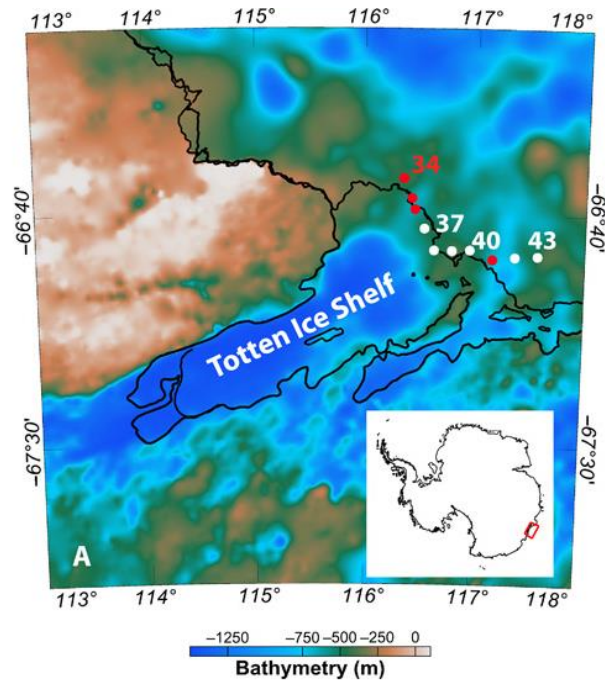**Thinning** near GL of **~ 31 m** between 1987-2017 (~ 1m/yr)

Schroder et al. 2019

Totten glacier is losing mass…

Mass loss and retreat related to **high basal melt rates**

High basal melt due to **intrusions of mCDW** under ice shelf cavities

Rintoul et al. 2016

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Why studying the Totten Glacier?

- Potential SLR of ~ 3.5 meters!

- Highly dynamic and losing mass

- Importance of **atmosphere-ocean-ice shelf interactions**

- A lot known already about ocean-ice interaction

- Little known about atmosphere-ice interaction

NASA

Department Earth- and Environmental Sciences
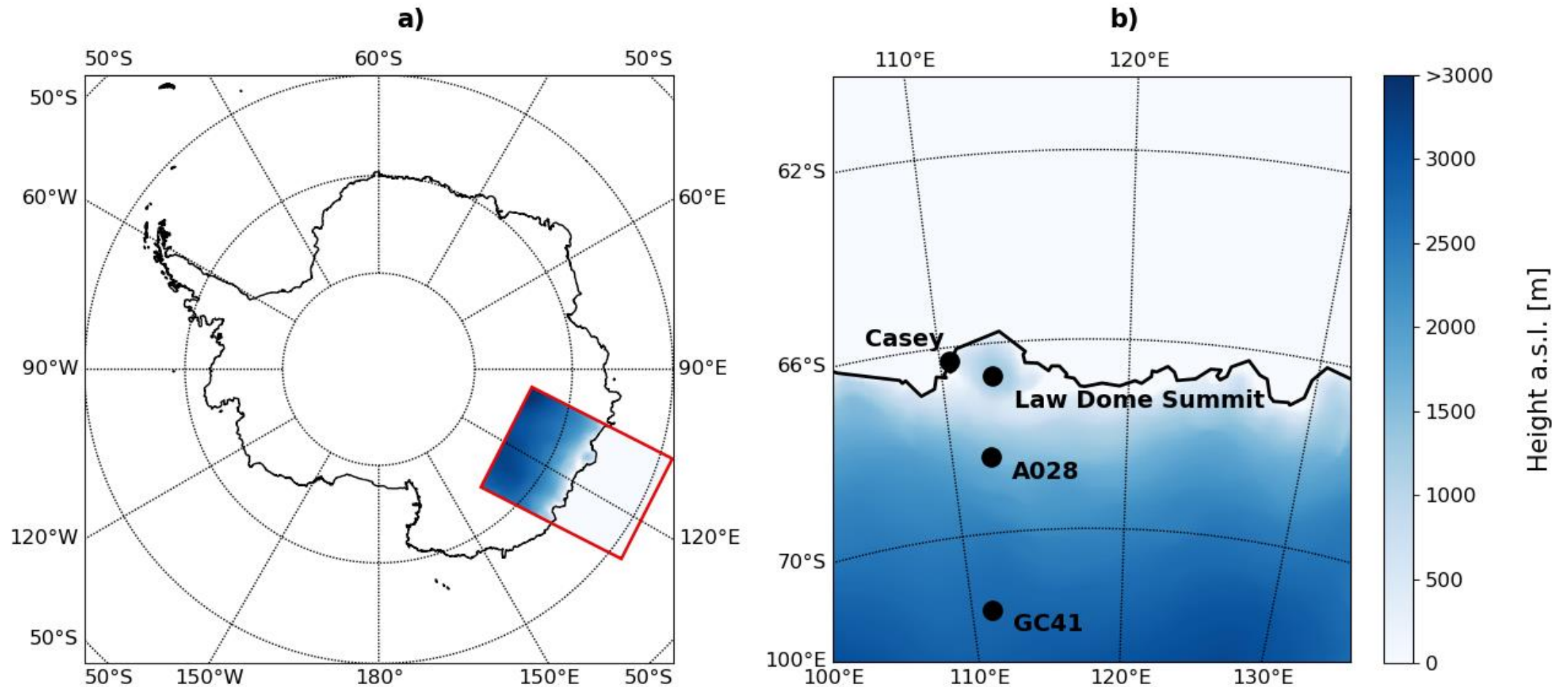
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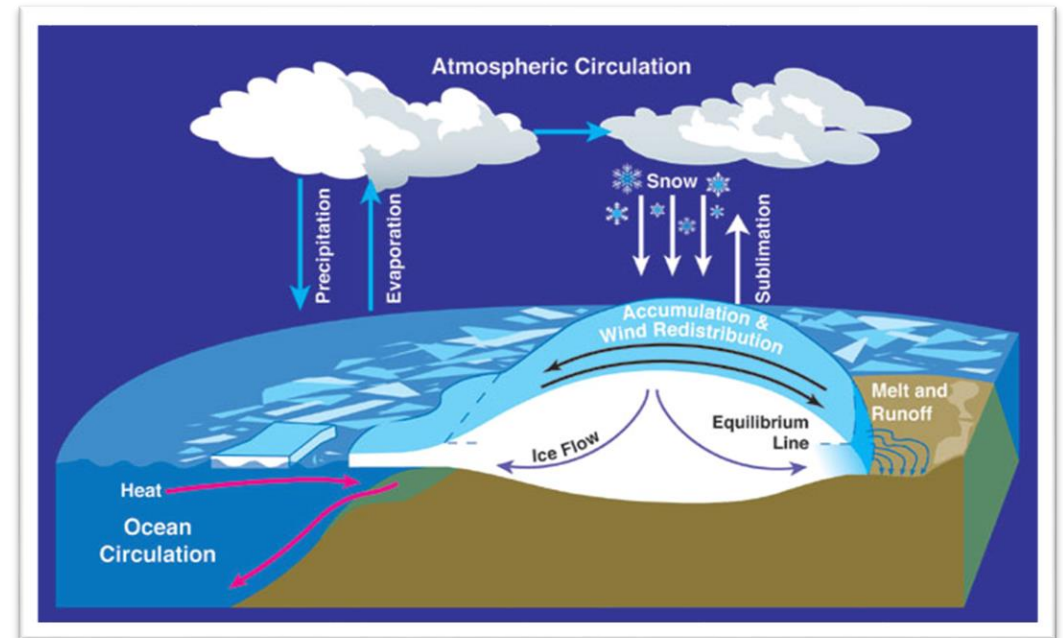
Modelling the AIS using COSMO−CLM^2

- Regional Climate Models (e.g. RACMO, MAR,…)
  - Higher resolution -- > more **small-scale processes** resolved
  - Adaptation of physics to represent Antarctic climate

- COSMO-CLM adapted by coupling to Community Land Model (COSMO−CLM^2) by Souverijns et al. (2019) to get state-of-the-art representation of AIS climate

  - Snowpack of several layers with hydrology, snow compaction and heat fluxes
  - Improvement of perennial snow representation (Van Kampenhout 2017)
  - Adaptations to boundary layer and cloud microphysics parameterization

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# Model configuration over Totten + methods

- Nested in AW run driven by ERA-INT

- 60 vertical levels

- Domain of 250-350 pixels at 5 km resolution

- 2 moment microphysics scheme for precipitation

- Daily and monthly model output compared with **AWS data** for **1987**

    Temperature and wind speed/direction

- Comparison with **ERA5 reanalysis**

    also precipitation/MSLP
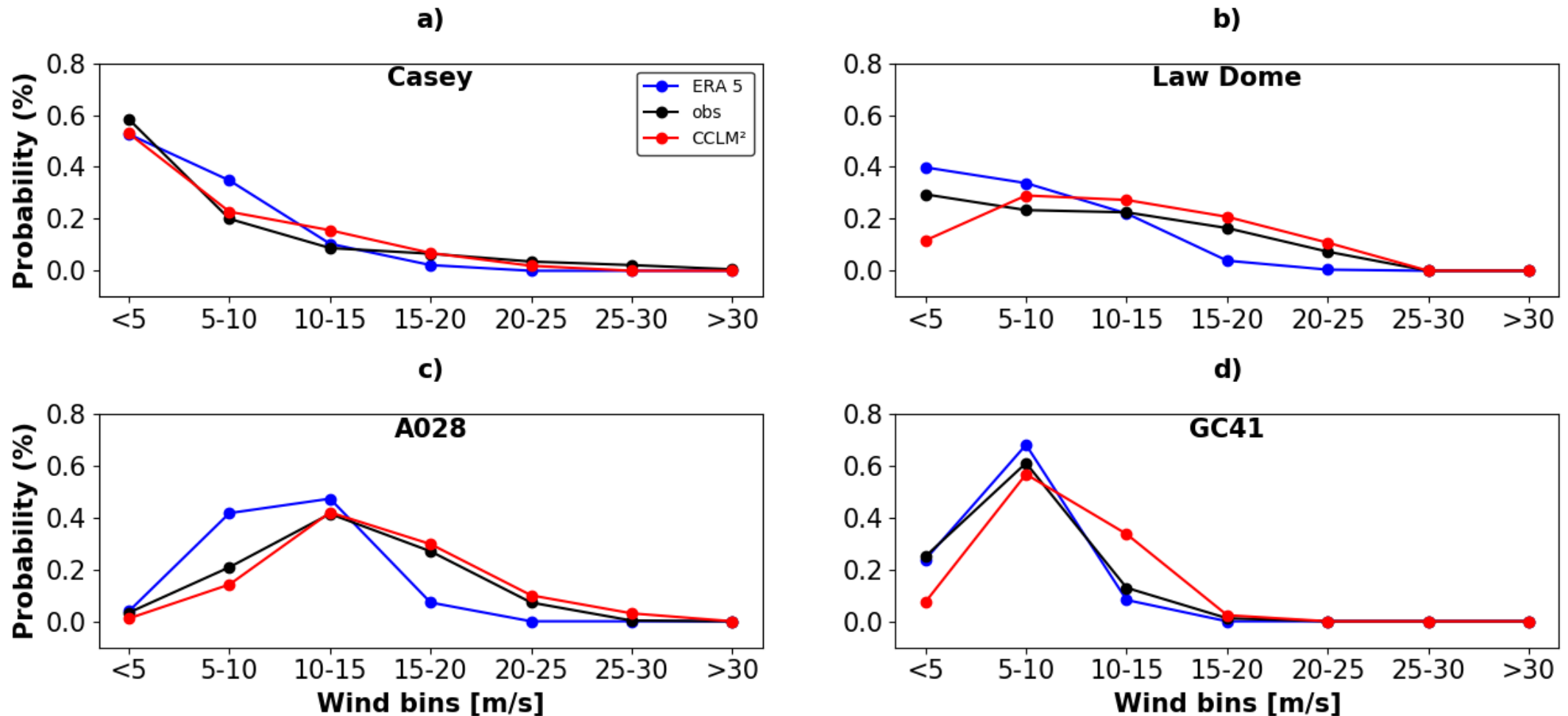
- Study of important **processes** in this region

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Model domain and AWS used for evaluation

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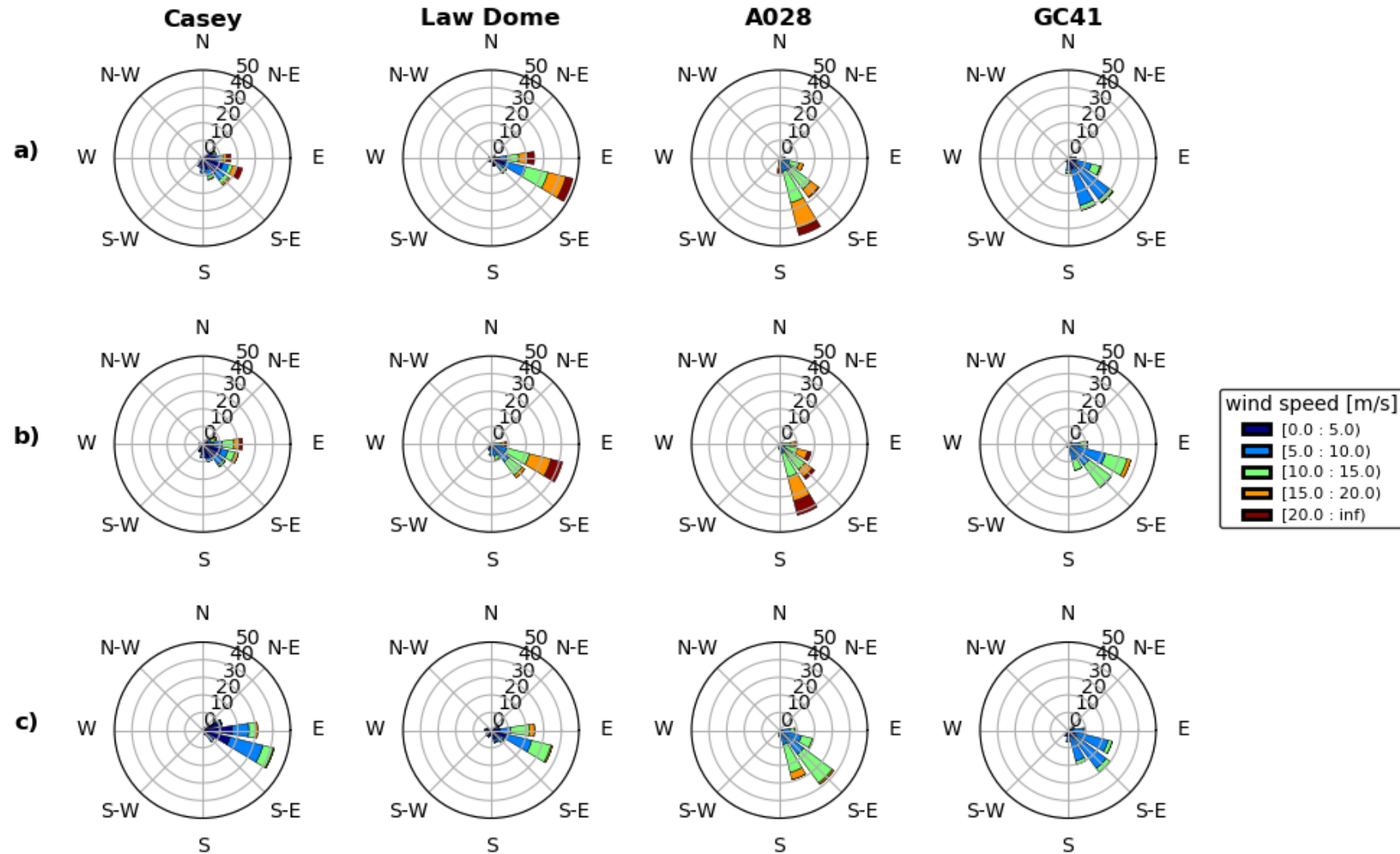# Evaluation of surface climatology

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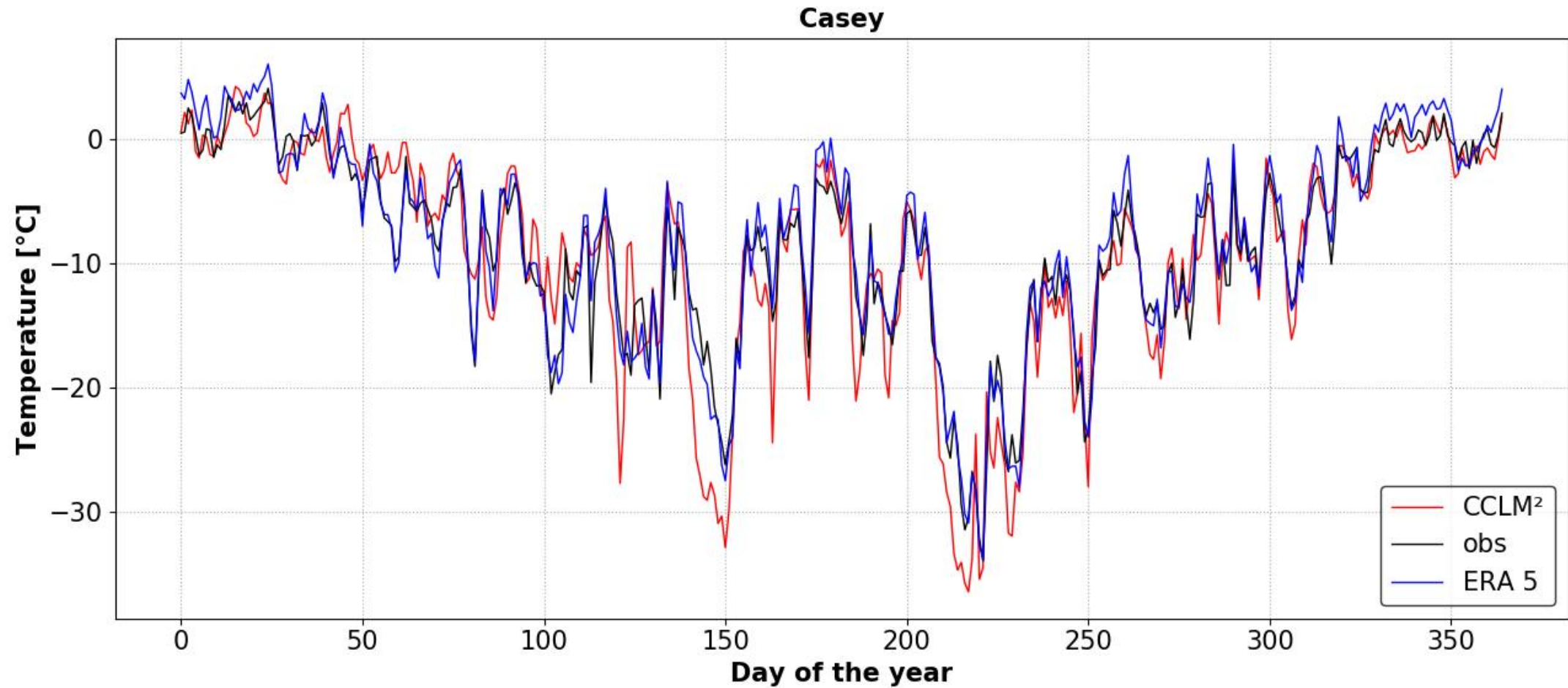
Evaluation of surface climatology
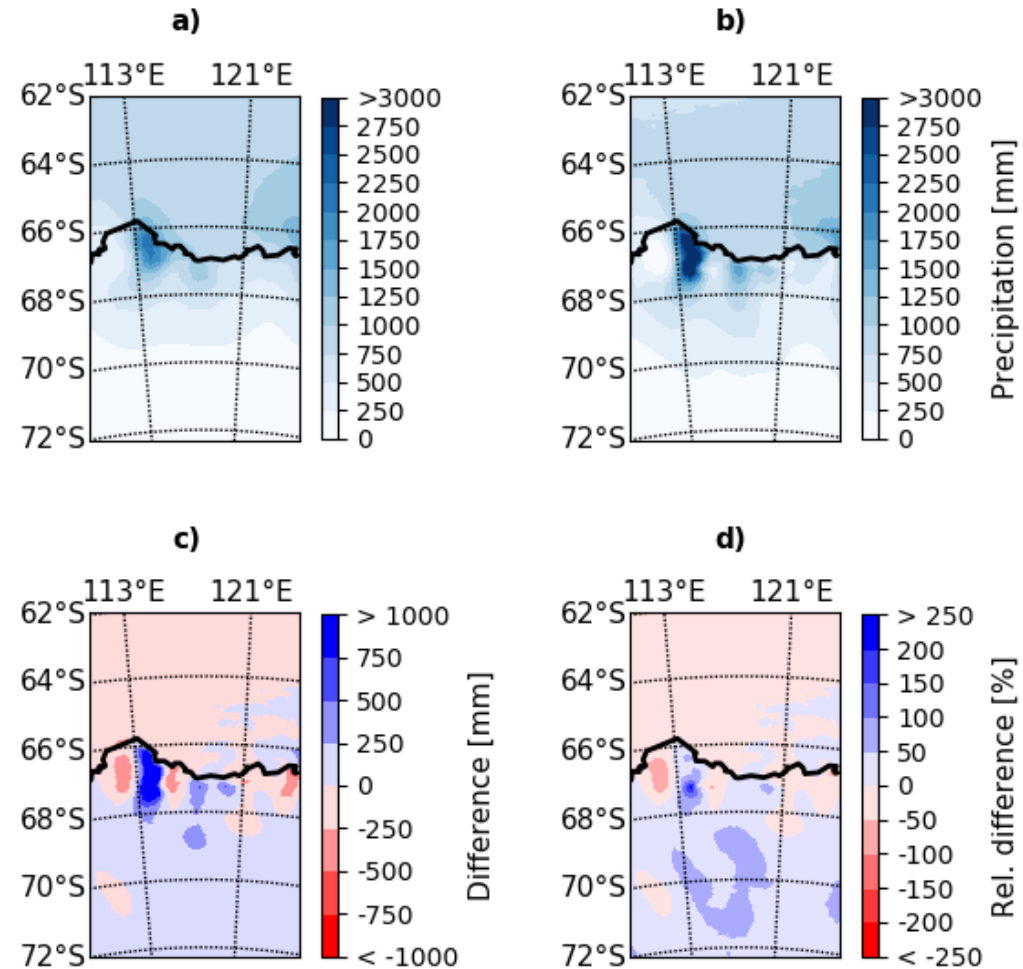

Daily wind distributions

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Evaluation of surface climatology
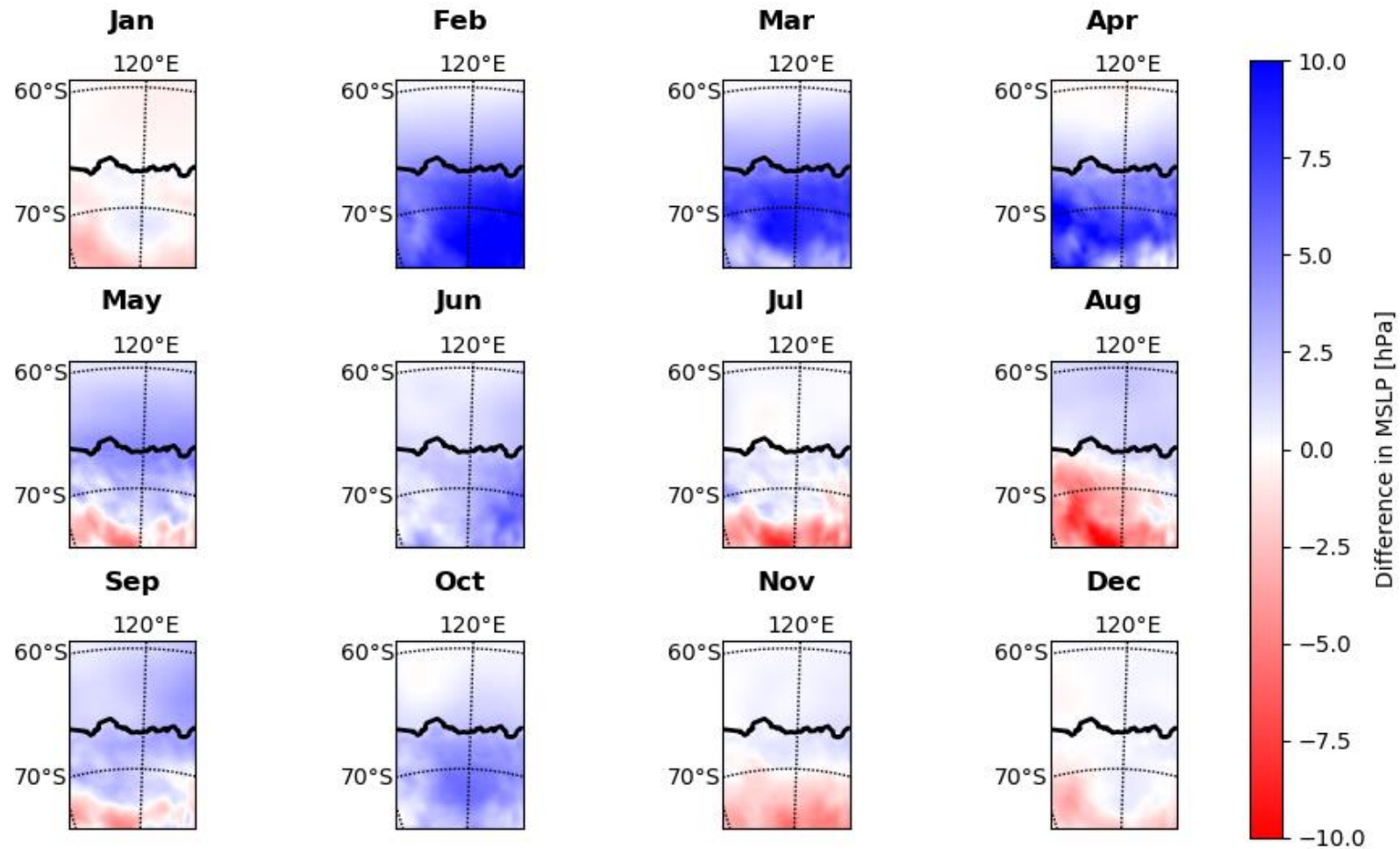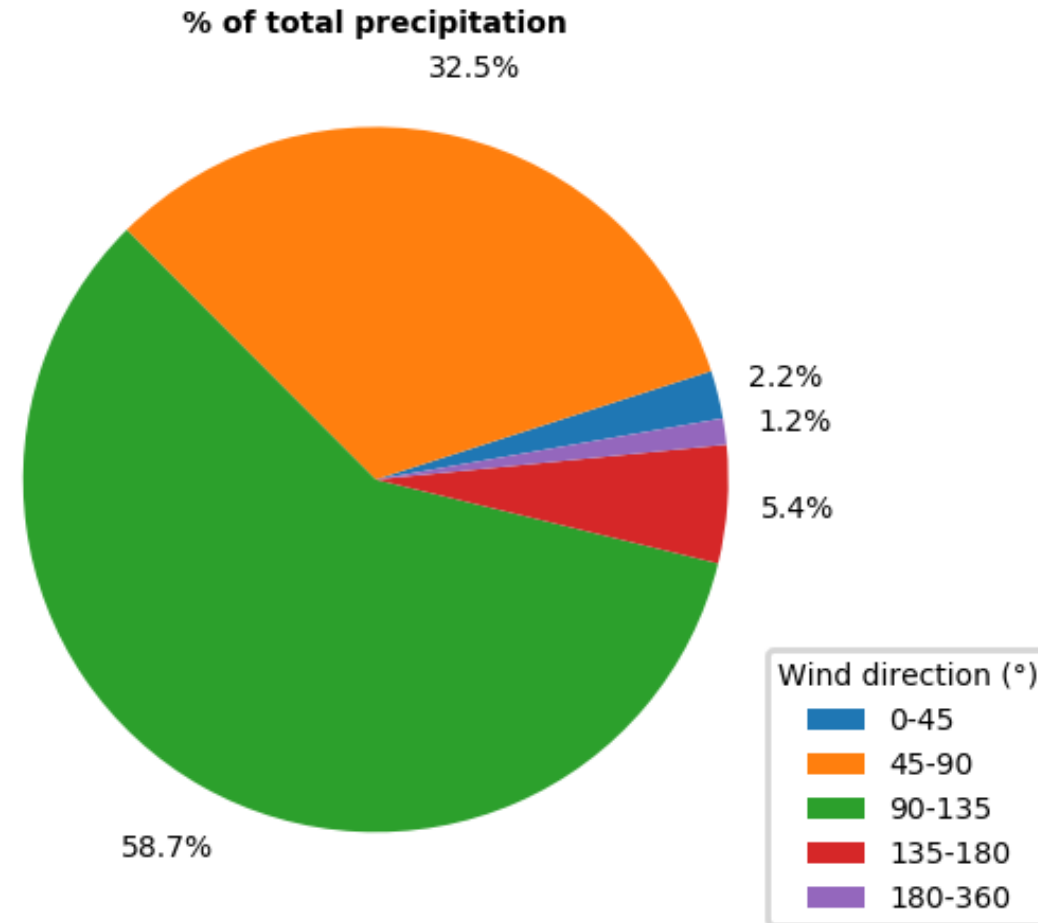
Comparison with ERA5 reanalysis

Left: ERA 5   Right: CCLM

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Comparison with ERA5 reanalysis

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Precipitation regime over Totten region

% of total precipitation

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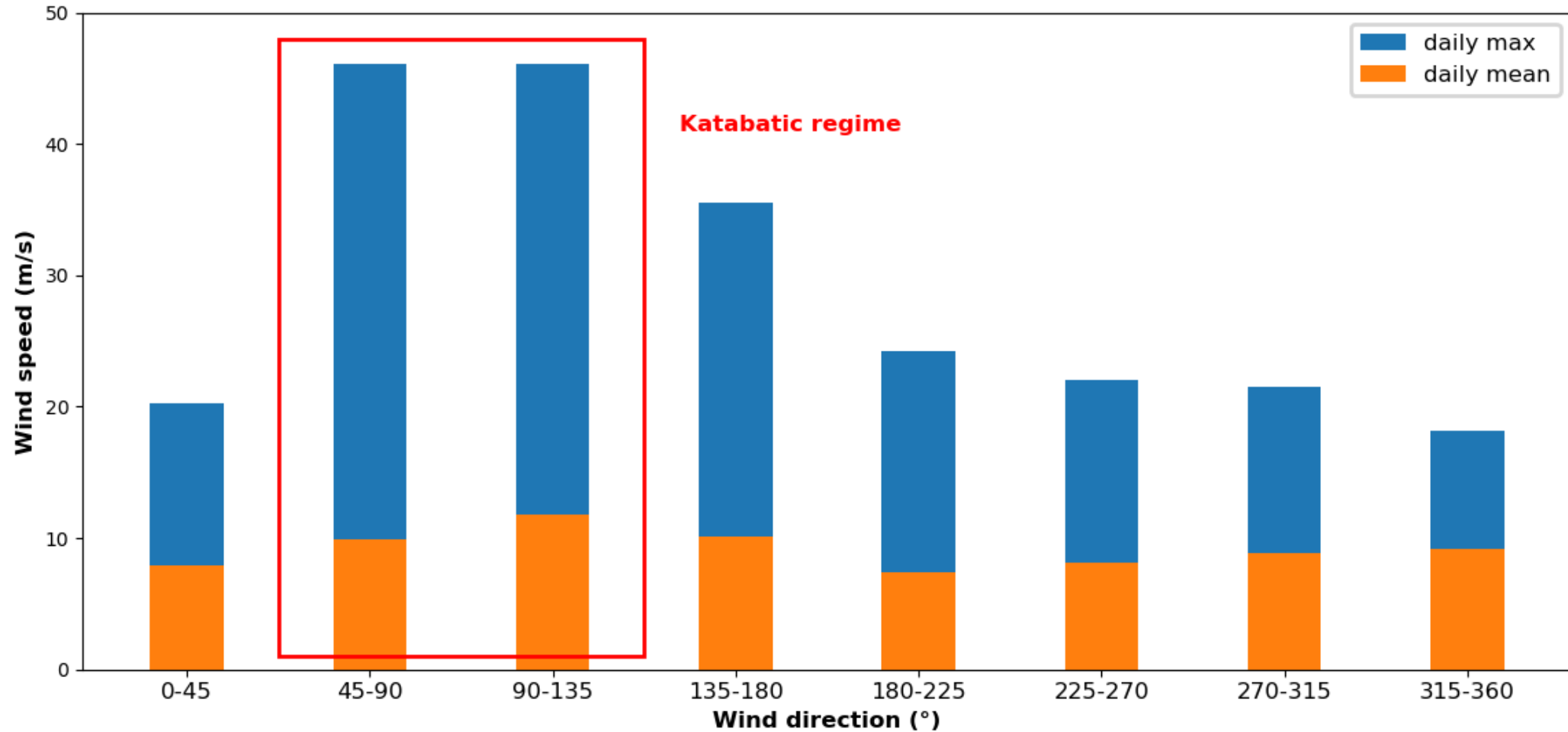
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MSLP regime over Totten region
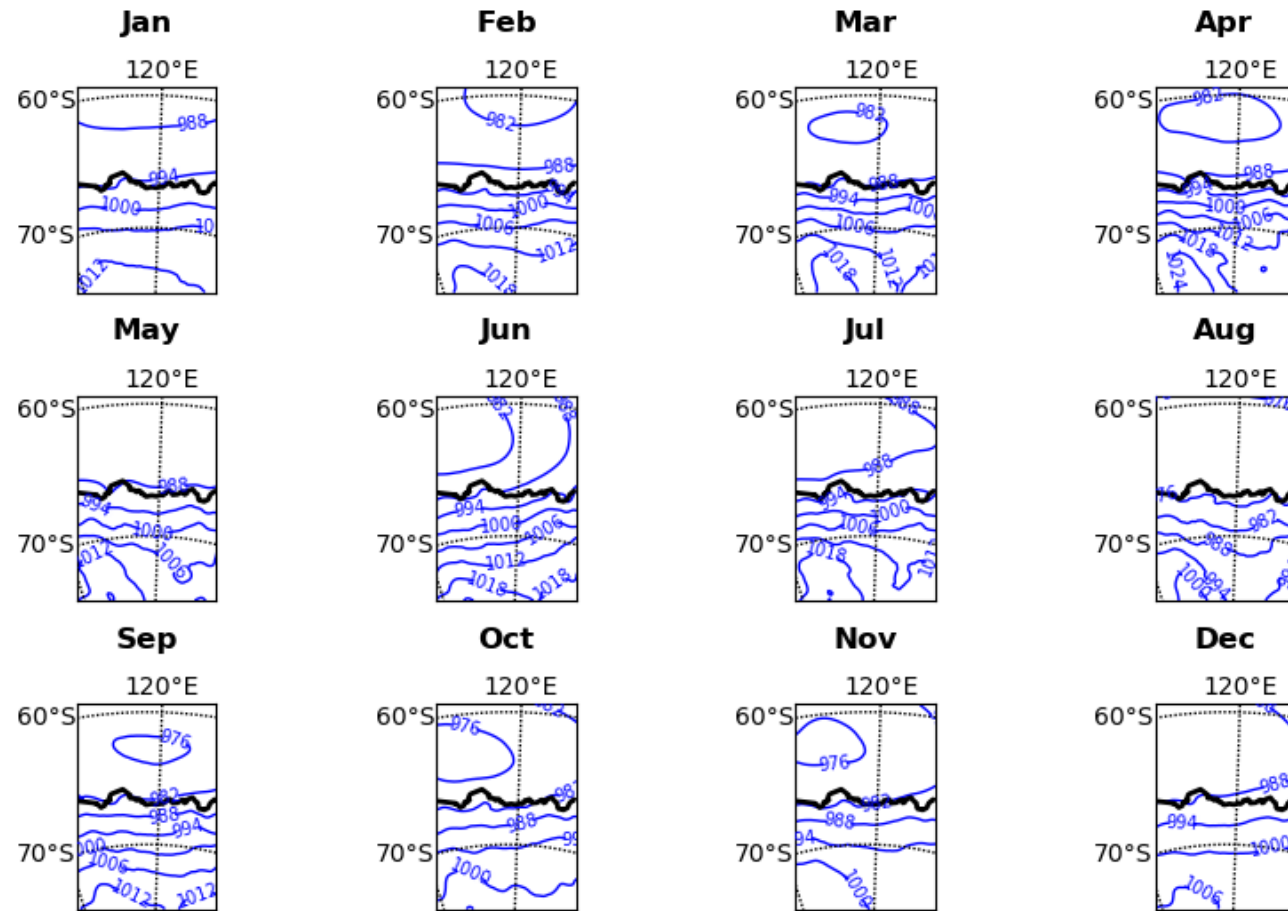
Wind regime over Totten region
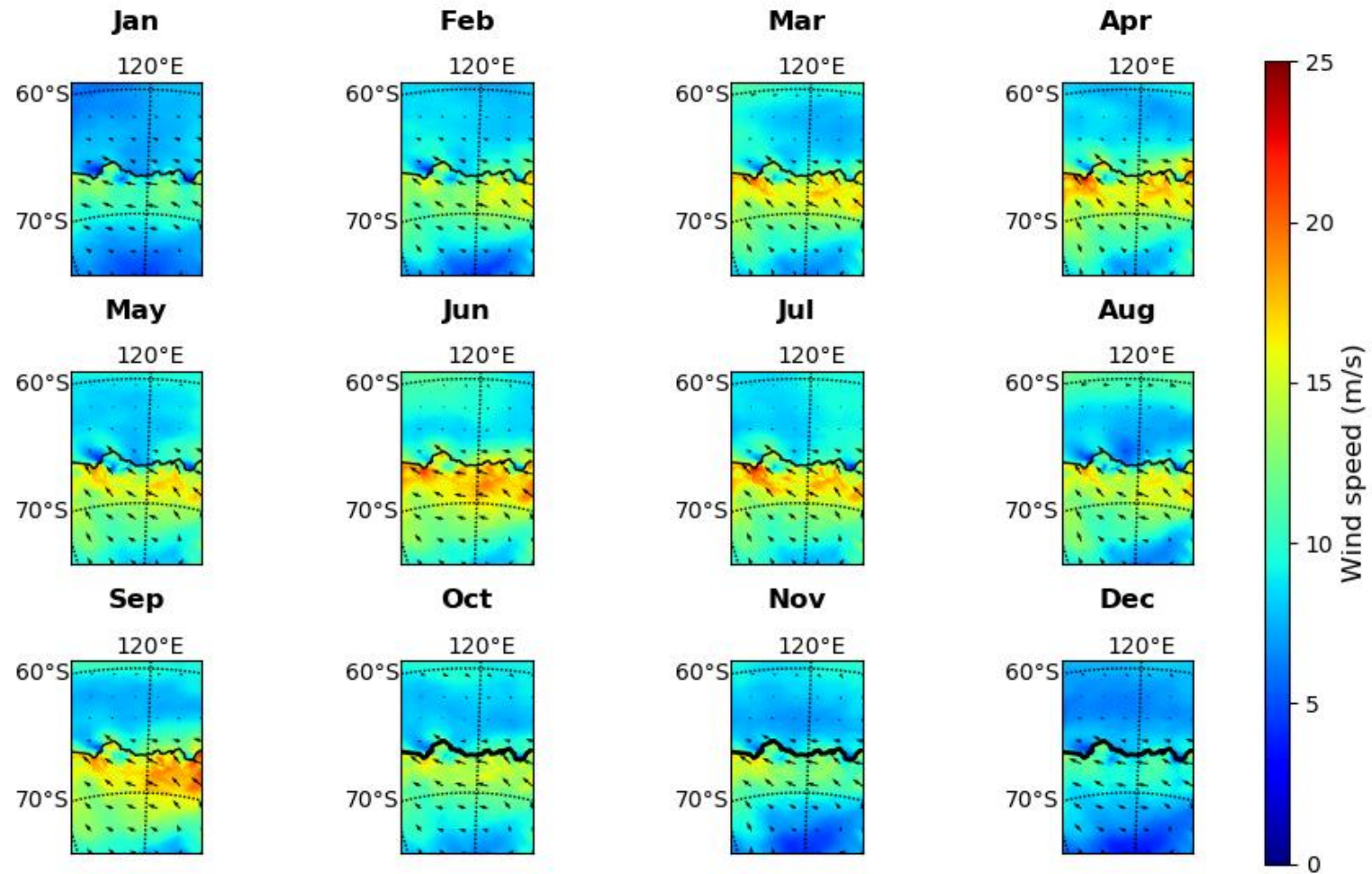
Wind regime over Totten region

Conclusions

Overall **good performance of CCLM²** for temperature and wind speed/direction

Precipitation patterns are well represented, except **orographic overestimation near Law Dome** ice rise

Precipitation regime is dominantly **ESE,** driven by synoptic patterns of low pressure over the ocean

Katabatic wind regime with strong **E-S winds** during the winter period

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Outlook for the future

Performing a 10-30y run in this configuration

Coupling CCLM2 to NEMO and BISICLES via OASIS

Investigation of decadal climate variability and predictability in this region

PARAMOUR

Decadal Predictability and vAriability of polar climate: the Role of AtMosphere- Ocean-cryosphere mUltiscale inteRactions

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