Differences and similarities of the 2018 and 2003 drought for the Rhine basin studied in terms of evaporative sources

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- Short overview of main findings -

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Why

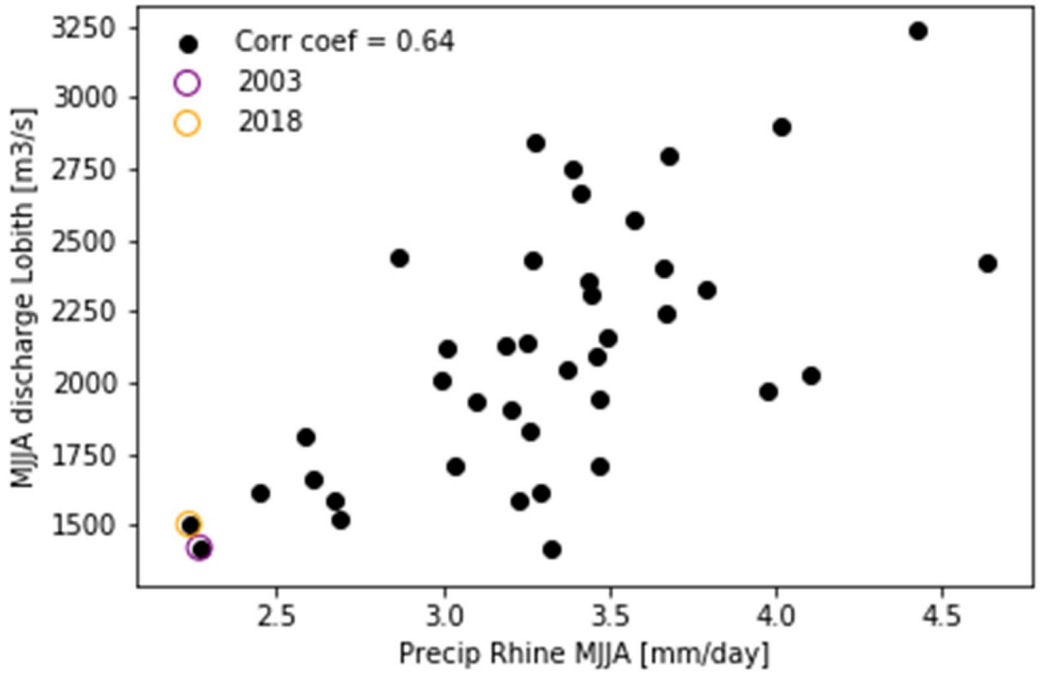
- By determining evaporative sources of a basin you both capture dynamics and thermodynamics, large-scale circulation and land-atmosphere interactions

→What are the evaporative sources of the Rhine during the drought of 2003 and 2018?

- 2003 & 2018 driest summers in precip over Rhine in 40-year timeseries

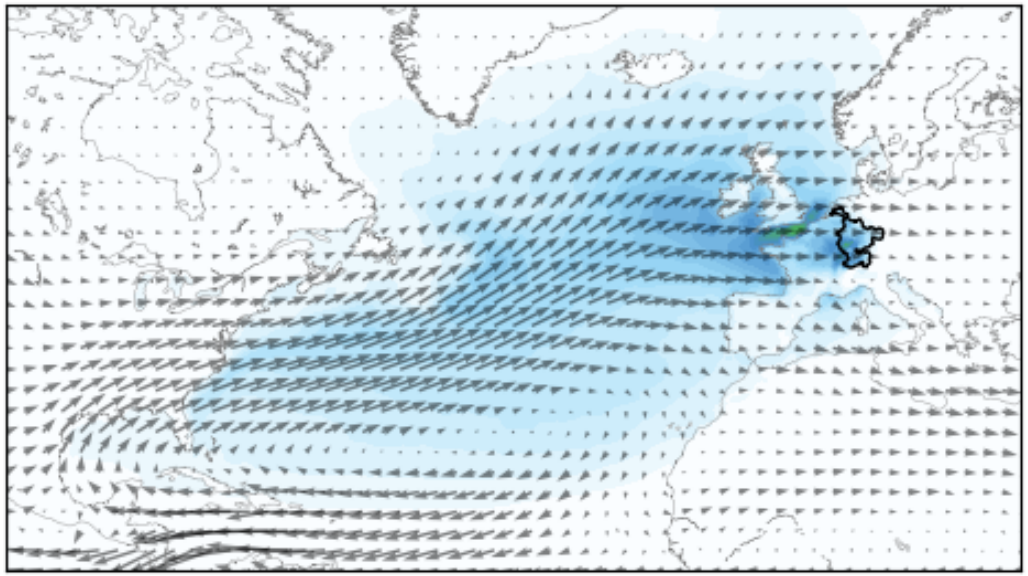
Methodology

- ERA5 reanalysis data (1979-2019)
- WAM-2layers tracking method (Van der Ent, 2014; Benedict, 2020)
- Focus on summer months: May-June-July-Aug

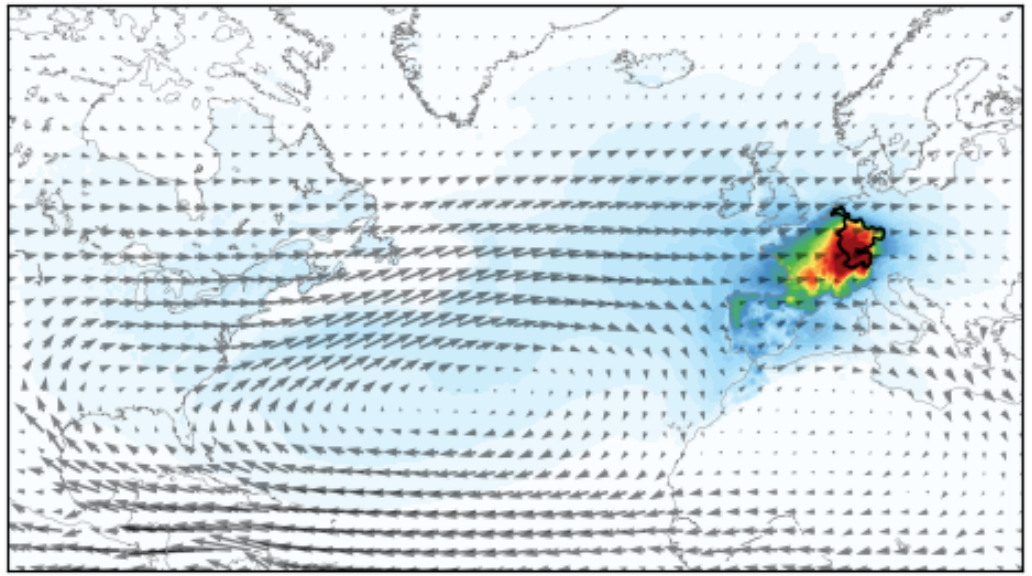


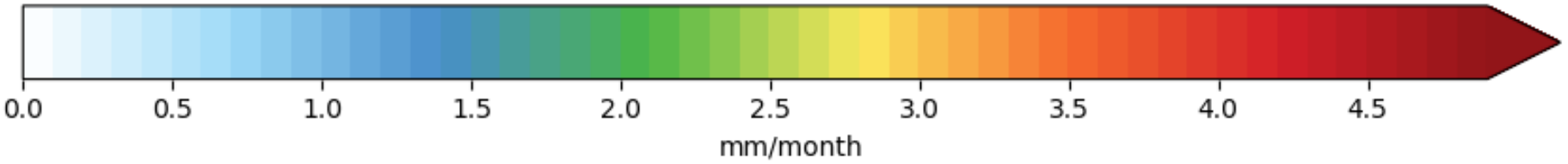
To get some feeling:
Evaporative sources Rhine in summer and winter

Evaporation resulting in precipitation Rhine winter



Evaporation resulting in precipitation Rhine summer





Arrows are moisture fluxes

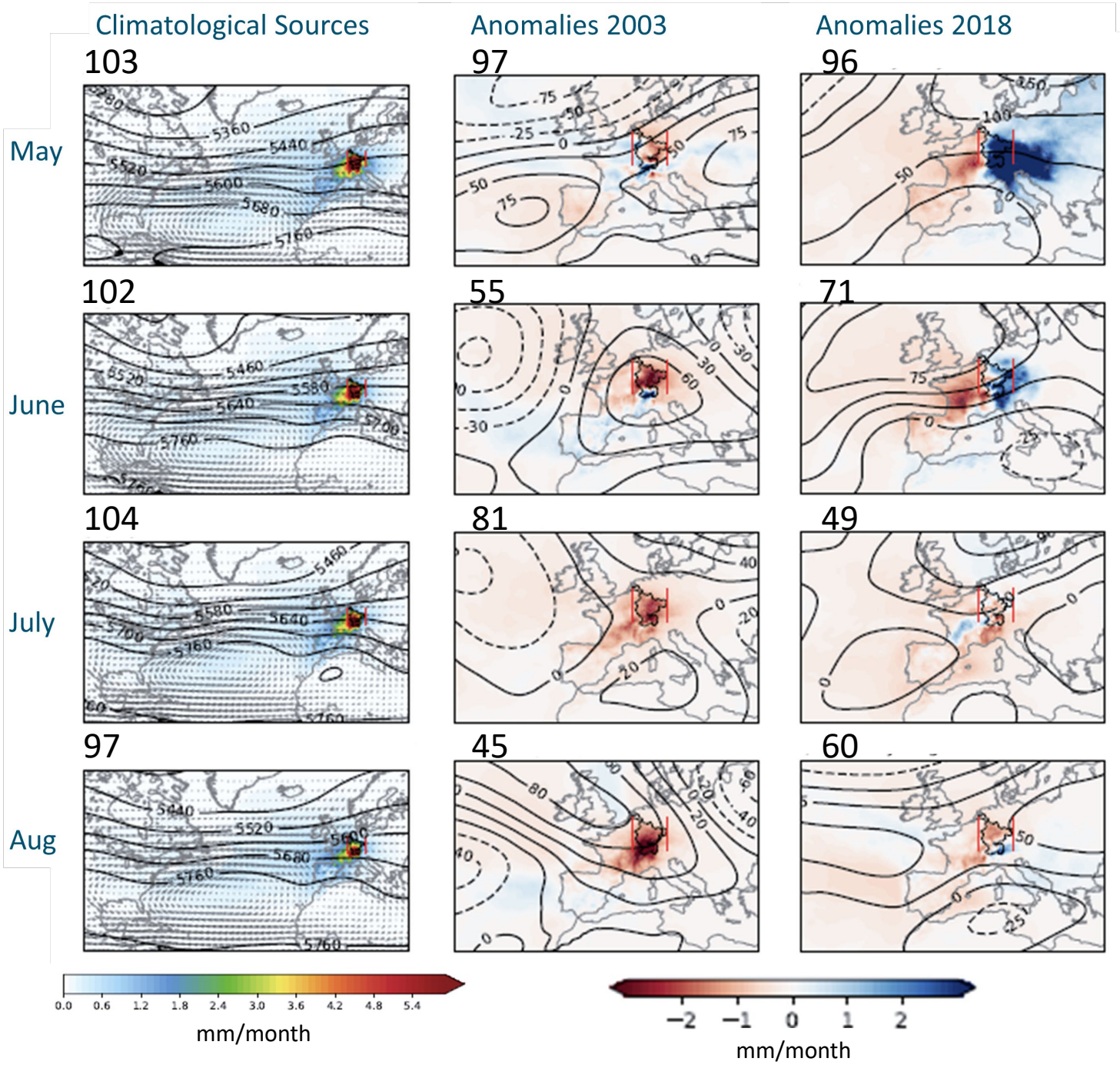
Absolute moisture source anomalies Rhine

- During droughts:

  Less source from ocean
- May-June 2018:

  Positive anomalies from

  Eastern Europe

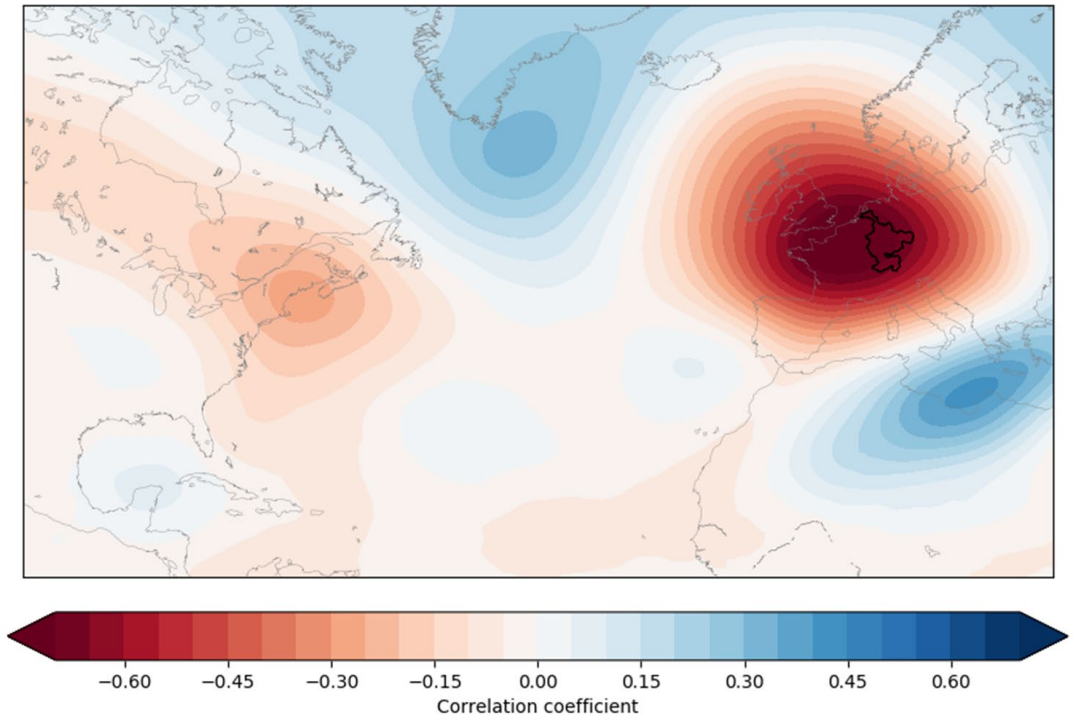


Title: precip in mm/month over Rhine
Colours = moisture source (anomaly)
Contours = 500 hPa geopotential height (anomaly)

Inter-annual variability of precipitation over Rhine

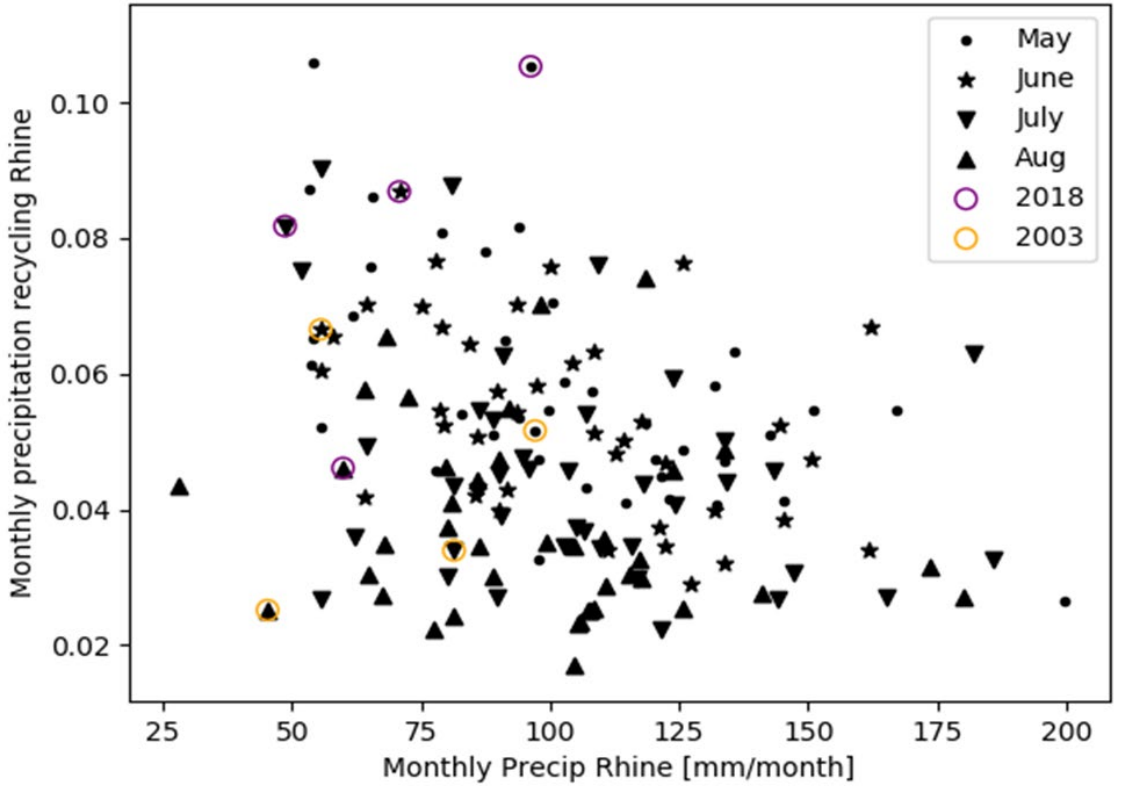
→ Related to large-scale circulation

Correlation of 500 hPa geopotential with precipitation timeseries Rhine for MJJA 1979-2018



- Blocking pattern over Rhine basin most favourable for dry conditions

→ Related to moisture recycling within the basin



- Higher recycling with lower precip
- Except with dry soils (August 2003)

Conclusions:
Differences and similarities in evaporative sources Rhine basin during summer droughts 2003 & 2018

- Moisture sources can help to understand the large-scale and land-atmosphere processes during droughts

- Decrease in evaporative source from oceanic areas during drought
- Drought events of 2018 and 2003 are mostly related to anomalies in large-scale circulation (wind, results not shown here)
- Regional recycling is generally higher during droughts (2018), except when soils dry out (August 2003)

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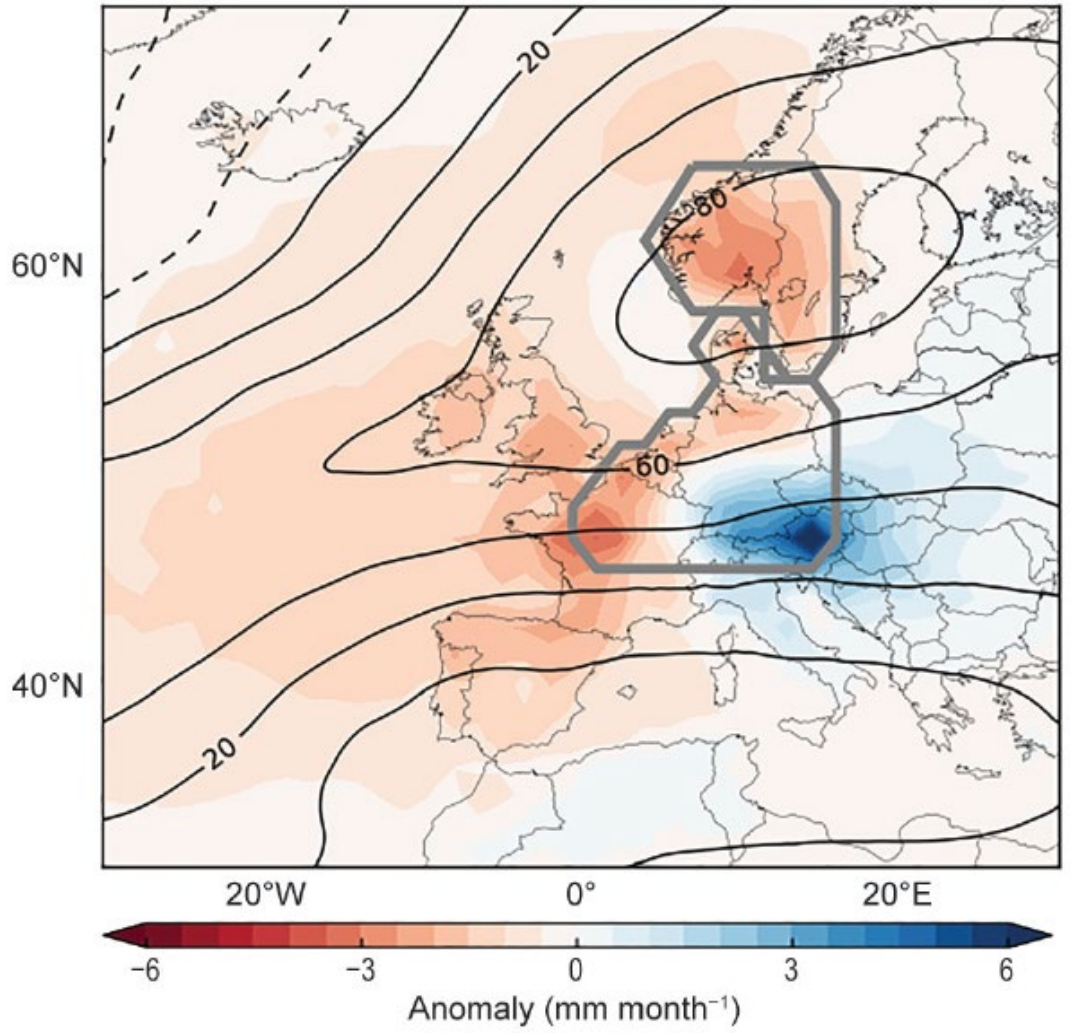

Absolute moisture (evaporative) source anomalies for western Europe region (indicated with gray lines) in 2018, compared to climatology (1979-2018)

Contribution to:

BAMS State of the Climate 2018

https://www.ametsoc.net/sotc2018/Socin2018_lowres.pdf