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• Editorial Notes •

Preface to the Special Issue on Antarctic Meteorology and Climate: Past, Present and Future

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The Antarctic, including the continent of Antarctica and the Southern Ocean, is a critically important part of the Earth system. Research in Antarctic meteorology and climate has always been a challenging endeavor. Studying and predicting weather patterns in the Antarctic are important for understanding their role in local-to-global processes and facilitating field studies and logistical operations in the Antarctic (e.g., Walsh et al., 2018). Studies of climate change in the Antarctic are comparatively neglected compared to those of the Arctic. However, significant climate changes have occurred in the Antarctic in the past several decades, i.e., a strong warming over the Antarctic Peninsula even with a recent minor cooling, a deepening of the Amundsen Sea low, a rapid warming of the upper ocean north of the circumpolar current, an increase of Antarctic sea ice since the late 1970s followed by a recent rapid decrease, and an accelerated ice loss from the Antarctic ice shelf/sheet since the late 1970s (e.g., Turner et al., 2005; Raphael et al., 2016; Sallée, 2018; Parkinson, 2019; Rignot et al., 2019). Investigating recent climate change in the Antarctic and the underlying mechanisms are important for predicting future climate change and providing information to policymakers.

The recent effort of the Year of Polar Prediction (YOPP) in the Antarctic has further stimulated a focused research activity on Antarctic meteorology and climate through the YOPP Special Observing Period (SOP) from mid-November 2018 to mid-February 2019 (Bromwich et al., 2020[a]). This has enhanced the routine observations and modeling efforts in the Antarctic. More comprehensive and precise observations, increased computing power and improving understanding of Antarctic meteorology and climate, suggest that we expect that coupling of the atmosphere, land, ocean and sea ice in weather and climate prediction will be achieved with sufficient skill as to become operational in coming years.

This special issue showcases recent research progress and augments existing knowledge in Antarctic meteorology and climate. It has solicited a total of 10 articles, covering a broad scope of research topics.

Lazzara et al. (pp. 423–430) provide a summary of challenges and outcomes of five themes discussed at the 13th and 14th workshops on Antarctic meteorology and climate, including "meteorological observations, atmospheric numerical mod-

[a] Bromwich, D. H., and Coauthors, 2020: The year of polar prediction in the southern hemisphere (YOPP-SH). *Bull. Amer. Meteor. Soc.*, submitted.

eling, meteorological and climate research, weather forecasting and operational services, and YOPP-Southern Hemisphere".

Sato et al. (pp. 431−440) assessed numerical experiments with and without assimilation of radiosonde data measured from the Japanese icebreaker and station. They found that additional radiosonde observations would improve the prediction of the strength of deep cyclones near the coast of Antarctica and associated strong winds and moisture transport. Using the PolarWRF model, Sun et al. (pp. 441−454) also showed that the assimilation of sounding data measured by unmanned aerial vehicles (or UAVs) and radiosondes from the German icebreaker has positive impacts on the simulation of near-surface fields, and the impact can be seen a few hundred kilometers from the observation site. By analyzing radiosonde data obtained from the YOPP-SOP, Gorodetskava et al. (pp. 455−476) identified that atmospheric river events strongly influence tropospheric humidity and low-level jets over the locations of Neumayer and Syowa. During the YOPP-SOP, more than 2000 radiosondes were launched—much more than routine observations. The YOPP-SOP data are providing more insights on communicating atmospheric prediction uncertainty and improving prediction capabilities at daily-to-sub-seasonal time scales. Importantly, a winter YOPP-SOP is being organized to aid understanding of atmospheric predictability in the Antarctic during the cold season as sea ice expands rapidly.

Bozkurt et al. (pp. 477−493) analyzed recent near-surface temperature trends over the Antarctic Peninsula using a combination of observations, reanalyses, and model simulations. All data show that there is a windward warming over the Peninsula except during summer. Autumn has the largest warming trend, which might be due to the recent strengthening of the Amundsen Sea low. By analyzing precipitation from the Chinese station and atmospheric reanalysis, Ding et al. (pp. 494−504) identified a change in the trend of the phase of summer precipitation (rainfall vs snowfall), which occurred around the early 2000s. They linked such change to the variability of the Amundsen Sea low.

Xia et al. (pp. 505−514) identified that ozone-induced cloud radiative forcing is one of the contributors to the observed increase of Antarctic sea ice. By conducting numerical experiments with the Community Atmosphere Model, they found that Antarctic ozone recovery results in a warming in the lower stratosphere and a decrease of downward longwave radiation in autumn. This leads to a surface cooling and an increase of Antarctic sea ice. Wu et al. (pp. 515−531) quantified the role of atmospheric variability across two hours to eight days in determining the state of the Southern Ocean. They found that high-frequency atmospheric variability contributes significantly to the variability of ocean and sea-ice circulation. Ding et al. (pp. 532−544) examined the relationship between surface air temperature and polynya area in the Terra Nova Bay. They pointed out that, at lower temperatures, the polynya area is more closely related to air temperature than wind speed. Marquetto et al. (pp. 545−554) compared two different sampling methods (solid-state cutting vs continuous melting system), and showed a clear seasonal variation of the concentration of refractory black carbon in a snow and firn core obtained from West Antarctica: high (low) during winter and spring (summer and autumn).

The published papers in this special issue constitute an important contribution to YOPP by providing valuable insights into the challenging research on Antarctic meteorology and climate.

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