SCAR 2020

Antarctic Science - Global Connections

SCAR OPEN SCIENCE CONFERENCE 2020

SESSION 4

POLAR METEOROLOGY: SHORT TERM CLIMATE VARIABILITY

David Bromwich
Steve Colwell, Adriana Gulisano

ABSTRACTS SUBMITTED TO THE (CANCELLED) SCAR 2020 OSC IN HOBART

1507

Identification of a possible channel in the trajectory of air masses between Subtropical South America and Antarctica in 2016 and 2017

Francisco Aquino[1], Ronaldo Bernardo[1], Venisse Schossler[1], Pedro Reis[1], Jefferson Simões[1], José Griebler Junior[1]
[1]UFRGS - Centro Polar e Climático, Porto Alegre, Brazil

This study explores interactions between the Antarctic and South American (SA) air masses and a snow pit located in Criosfera 1 (C1 - 84°S 79° 29' 39"O), between 2016 and 2017. This interaction was responsible for precipitation events in southern Brazil (SB). The period studied stands between the three global warmest years, as well as being the third and fourth in SA, respectively. The rain was collected in the city of Porto Alegre with a Palmex RS1 sampler; snow samples were collected a 2.5 meters depth snow pit in December 2017 (C1). The oxygen isotope ratios were determined by Cavity Ring-Down Spectroscopy (Picarro system). were analyzed the geopotential height fields, wind vectors, temperature and precipitable water at 925, 850, 500 and 200 hPa (monthly and seasonal), using ERA5 Reanalysis data. The polar fronts associated with low and high level atmospheric circulation strengthened convection and the development of severe storms in the SB. Three sources of moisture are associated with this mechanism: Amazonian Forest, South Atlantic Ocean and Antarctica/Weddell. A contrast of temperature was observed with the circulation of air masses, channeled between La Plata Basin/SB/SA and the Antarctic Peninsula/Weddell, increasing the storms in the SB and the trench in C1 (by the isotopic signal). The δ18O values found in precipitation show high variability, from -2.93 ‰ to -9.80 ‰ and show the different sources of air masses and seasonal signal (summer/winter)in Porto Alegre; and seasonal signal of -30.93 ‰ (summer); and up to -45.80 ‰ (winter) on site C1.

998

Observing System Experiments in the Antarctic with the Antarctic Mesoscale Prediction System (AMPS)

David Bromwich[1], Jordan Powers[2], Kevin Manning[2], Xun Zou[1]
[1]Ohio State University/Byrd Polar & Climate Research Center, Columbus, United States, [2]National Center for Atmospheric Research, Boulder, United States

The Year of Polar Prediction in the Southern Hemisphere (YOPP-SH) had a Special Observing Period (SOP) that ran from mid-November 2018 to mid-February 2019. The goal of YOPP-SH is to advance environmental prediction capabilities for the Antarctic and Southern Ocean region. Around 2200 additional radiosondes and an enhanced drifting buoy network in the Southern Ocean were deployed for this austral summer SOP. Here, the impact of the additional radiosondes on the forecast skill of the Antarctic Mesoscale Prediction System (AMPS) is examined with Observing System Experiments. Forecasts are run with and without the additional radiosonde profiles in the model initialization; satellite radiances were not assimilated for this initial evaluation. This study launched 72h experimental forecasts from ensemble mean analyses that initialized at 0000 and 1200 UTC each day for 52 days (December 28, 2018 – February 17, 2019). Results show that the additional radiosondes yield the greatest forecast improvement for deep cyclones near the Antarctic coast, specifically over Amundsen-Bellingshausen Seas and King Haakon VII Sea. Averaged for January 2019, surface pressure and upper level geopotential height are the variables that had the most improvement, followed by the 10m wind speed and 2m temperature over Antarctica. In the next project phase, a refined data assimilation approach will be adopted for the experimental run and satellite radiances will be assimilated. The experimental run will also be extended to span the entire SOP, and more case studies will delve into the causes of the wide range of forecast behavior exhibited.

700

The influence of the oceanic mesoscale on the lower atmosphere

Mylene Cabrera[1], Luciano Pezzi[1], Ueslei Sutil[1], Jonas Carvalho[1], Marcelo Santini[1], Celina Rodrigues[1]
[1]*National Institute for Space Research, São José dos Campos, Brazil*

The influence of the oceanic mesoscale on the lower atmosphere in the high latitudes regions, the Drake Passage, the Bellingshausen Sea and the western region of the Weddel Sea, was analyzed in this work through the regional numerical simulations using the Coupled Ocean Atmosphere Wave Sediment Transport (COAWST) Modeling System. The COAWST system components used were: the atmospheric model Weather Research and Forecasting (WRF), the ocean model Regional Ocean Modeling System (ROMS) and the Sea Ice Model. The simulation period was one month, November 2019, simultaneous to in situ measurements made by the AnTarctic Modeling Observation System (ATMOS) project. The field experiment was developed during Phase II of the Antarctic Operation XXXVIII (OP38). The in situ data, reanalysis data, and satellite images were used to verify the model's ability. In addition, the Locally Weighted Smoothing (LOESS) filter implemented within COAWST was used, to remove high frequency from sea surface temperature (SST) before it is passed to the atmospheric model. Thus, in this work, first we will present COAWST as a useful tool for studies of ocean-atmosphere-sea ice interaction in high latitude regions. Also, demonstrate how positive SST perturbations can lead to positive perturbations on the lower atmosphere momentum, sensible and latent heat fluxes perturbations. These positive perturbations influenced the development and stability of the marine atmospheric boundary layer (MABL), causing a more unstable and deeper MABL than the observed over the negative SST perturbations.

331

Ocean wave climate on Bransfield Strait

Jonas T. Carvalho[1], Luciano P. Pezzi[1], Ronald Buss Souza[1], Marcelo Santini[1], Joey Voermans[2], Claudia Parise[3], Eliana Rosa[1], Ueslei Sutil[1], Manuel Victor[1], Giullian Reis[1], Celina Rodrigues[1], Bruna Pavani[5], Regiane Moura[1], Fabiane Furlan[4], Joel Rubert[1], Gabriel Munchow[4], Mylene Cabrera[1]

[1]Inpe, Cachoeira Paulista, Brazil, [2]University of Melboune, Melbourne, Australia, [3]Universidade Federal do Maranhão, São Luis, Brazil, [4]Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil, [5]Instituto Tecnologico da Aeronautica, São José dos Campos, Brazil

The Bransfield Strait, located between the South Shetland Islands and the north of the Antarctic Peninsula, is on the edge of the seasonal sea ice cover, and is a region of access to scientific research bases, being important the knowledge of the wave climate in this area to study the interaction of this physical phenomenon with sea ice and icebergs, as well as for navigation safety. To characterize preliminary the wave climate in the region, a global simulation with WW3 (25 km of spatial resolution) was carried out from 1998 to 2019, with two points selected for analysis of the main waves parameters, the significant wave height (Hs), peak period (Tp) and peak direction (Dp). One of these points refers to the buoy location (P1 – 58.16ºW, 62.19ºS) close to Almirantado Bay (King George Island). The other point is located in a central region of the Strait (P2 - 57.88ºW, 62.53ºS). In P1, the most intense wave systems (99th percentile) were from E-SE during summer and autumn, with some cases from S-SW during summer and E-NE during winter and spring. In P2, the most intense wave systems were from W-SW, with larger number of cases in June and September. A higher resolution simulation over the Strait region was done during the buoy record period, showing correlation of 0.81 and RMSE of 0.54. The WW3 model simulations followed the oscillations presented by the buoy, understimating Hs values, probably due to the choice of the atmospheric forcing.

39

Autonomous Observations of the Atmospheric Boundary Layer Over Ice Sheets and Sea Ice

John Cassano[1]
[1]*University Of Colorado, Boulder, United States*

Unmanned aerial systems (UAS) and automatic weather stations (AWS) have been used to study the atmospheric boundary layer in the polar regions. AWS observations from a 30 m tower on the Ross Ice Shelf, Antarctica have been made since 2011. Six field campaigns, using small UAS, have been conducted throughout the annual cycle and over ice sheet, sea ice and bare ground locations in the Antarctic from 2012 to 2017. The AWS and UAS data capture a wide range of boundary layer conditions including strongly stable, very shallow boundary layers, shallow wind-mixed boundary layers, and deep convective boundary layers. Analysis of this data offers insights into the processes that control the thermodynamic state of the lower atmosphere and how the atmosphere interacts with the underlying ice surface. Examples illustrating the range of boundary layer states will be presented. This presentation will conclude with a discussion of a new 30 m AWS that will be installed in West Antarctica as well as present initial results from UAS flights conducted over the central Arctic in late-winter as part of the MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) expedition.

1450

Recent trends in the variability of Southern Hemisphere polar jet and its position based on CMIP6 models

Sheeba Chenoli[1,2], Muhammad Yunus Bin Ahmad Mazuki[2], Azizan Abu Samah[1,2]
[1]Department of Geography, , University Malaya, Malaysia, [2]National Antarctic Research Centre, University of Malaya, , Malaysia

Poleward shift and strengthening of southern hemispheric jet streams are significant feature in southern hemisphere climate under future scenario of increased greenhouse gas concentrations. In this study, we utilised recently available models (27) from the World Climate Research Programme's phase 6 of the Coupled Model Intercomparison Project (CMIP6) to assess the diversity in the historical changes in the speed and meridional location of the polar front jet (PFJ). We used the ERA5 reanalysis dataset to evaluate the historical simulations of the polar jet stream by the CMIP6 models for the period 1979-2014. Based on the climatology of the PFJ from ERA-5, we selected the area of study as 40-70°S and from 400 hPa to 100 hPa to reduce altitude related bias. In order to assess the changes of the jet streams in terms of strength and the shift in the location, we performed a three dimensional analysis on CMIP6 model output.
Based on ERA5 data, PFJ shows significant annual strengthening at 1.374 ms-1decade-1 and poleward shift of 0.168 °/decade. Trend in the seasonal averages of wind speeds varies from 4.439 to 6.508 ms-1decade. Seasonal averages show a poleward shift from 0.976 to 1.512 °/decade.
The historical simulations of the CMIP6 models show a wide range of trends in meridional location and jet strength. 96% of the models show annual strengthening of PFJ while 89% of the models show annual shift towards the pole. Most significant strengthening is observed during the month of September, October and November

402

Record warming at the South Pole during the past three decades

Kyle Clem[1], Ryan Fogt[2], John Turner[3], Benjamin Lintner[4], Gareth Marshall[3], James Miller[4], Anthony Broccoli[4], James Renwick[1]

[1]Victoria University Of Wellington, Wellington, New Zealand, [2]Ohio University, Athens, USA, [3]British Antarctic Survey, Cambridge, UK, [4]Rutgers University, New Brunswick, USA

Over the last three decades the South Pole has experienced a record-high statistically significant warming of 0.61 ± 0.34°C per decade, more than three times larger than the global average. Using an ensemble of climate model experiments, we find this recent warming lies within the upper bounds of the simulated range of natural variability. The warming resulted from a strong cyclonic anomaly in the Weddell Sea caused by increasing sea surface temperatures in the western tropical Pacific, which, coupled with a positive polarity of the Southern Annular Mode, advected warm, moist air from the South Atlantic into the Antarctic interior. These results underscore the intimate linkage of interior Antarctic climate to tropical variability. Further, this study shows that atmospheric internal variability can induce extreme regional climate change over the Antarctic interior, which has masked an anthropogenic warming signal there during the 21st century.

106

Development of an Antarctic Regional Climate Centre (RCC) network

Steven Colwell[1], Scott Carpentier[2]
[1]British Antarctic Survey, Cambridge, United Kingdom, [2]Australian Bureau of Meteorology, , Australia

World Meteorological Organisation (WMO) RCCs are centres of excellence that operationally generate regional climate products including climate monitoring and prediction in support of regional and national climate activities and thereby strengthen the capacity of WMO Members in a given region to deliver better climate services to national users. While all WMO RCCs are required to fulfil certain mandatory functions, the RCC concept includes flexibility to accommodate specific regional needs, capabilities and limitations. The concept also provides options to implement a single multi-functional entity or a distributed-function RCC-Network collaboratively implemented by a number of interested hosts.

The Arctic RCC network https://arctic-rcc.org/ is currently in a demonstration phase and an Antarctic RCC is being proposed based on the lessons learned from setting up the Arctic RCC network. A scoping workshop was held in Bologna in October 2019 and the outcomes of this workshop and the next stages for the development of the Antarctic RCC network will be presented.

1662

Difference in the annual snow accumulation rate between the Antarctic Peninsula and West Antarctica in the period 1981–2007

José Mauro Dalla Rosa[1], Jefferson Simões[1], Francisco Aquino[1], Pedro Reis[1], Mariuz Potocki[2], Isaías Thoen[1]
[1]Centro Polar e Climático/Universidade Federal do Rio Grande do Sul , Porto Alegre, Brazil, [2]Climate Change Institute/University of Maine, Orono, USA

We have investigated the variability of the net snow accumulation rate from 1981 to 2007 using two shallow ice cores, one from the Antarctic Peninsula (PA) [Detroit Plateau - 64°05’07”S, 59°38’42” W; 1,937 m a.s.l.] and other from the West Antarctica [Mount Johns - 79°55’S, 94°23’W; 2,100 m a.s.l.]. On the Detroit Plateau, only ~40 km from the west coast of the PA, the annual net snow accumulation rate was 2.44 m in water equivalent (w.eq.) showing a trend of +0.036 m a-1 in the period. On Mount Johns, a site within the West Antarctic ice sheet and about 600 km from the coast, the annual net snow accumulation rate was 0.23 m in w.eq. and without a statistically significant trend. The Amundsen Sea Low (ASL) is the main driver of the variability of snow precipitation between the PA and the West Antarctic ice sheet. The positive trend of the Southern Annular Mode (SAM) in recent decades and strengthened ASL, increased cyclonic activity and snowfall in the PA region. However, the spread of the El Niño-Southern Oscillation (ENSO) signal in the Southern Ocean, and the greater distance from the coast, contributed to the snow precipitation remaining stable in the Mount Johns during the period.

1364

Climate from the McMurdo Dry Valleys, Antarctica, 1986 – 2017: surface air temperature trends and examining seasonality

Maciej Obryk[2], Peter Doran[1], Andrew Fountain[3], Maddie Myers[1], Chris McKay[4]
[1]Louisiana State University, Baton Rouge, United States, [2]USGS, Vancouver, USA, [3]Portland State University, Portland, USA, [4]NASA Ames Research Center, Moffett Field, USA

The weather of the McMurdo Dry Valleys, Antarctica, has been continuously monitored since 1985 with currently 14 operational meteorological stations distributed throughout the valleys. At present, data from the Lake Hoare station represent the longest continuous (a short gap in 2012) record in the dry valleys and arguably on the Continent. A comprehensive examination of trends in the dry valley record was published in 2002. We present here an update of the record, adding on another 18 years and extending the climatic record to a period of 30 years in total. The mean annual air temperature and solar radiation in the McMurdo Dry Valleys varied between -14.7°C and -29.6°C and between 72.1 W m-2 and 122.4 W m-2, respectively. Air temperatures decreased from 1986 to 2006 at 0.7°C per decade at Lake Hoare, a trend that was previously reported only until 2001. No apparent trend was detected after 2006.
Based on the shift in atmospheric stability and associated up-valley warming from the coast and concurrent wind direction change, we propose to redefine summer season in the McMurdo Dry Valleys between November and February. The newly-defined seasons are based on physical observations and also align better with ecosystem ephemerality (productivity) in the region. Based on the physical process of up-valley warming (i.e., atmospheric stability) driven by the solar radiation, our redefined seasonality is universal and applicable to other ice-free regions in Antarctica.

1451

Sensitivity of the Ze-S relationship parameters to ice particle microphysics using radar and in-situ observations at the coast of Adélie Land, East Antarctica.

Claudio Durán-Alarcón[1], Brice Boudevillain[1], Alexis Berne[2], Christophe Genthon[3], Irina V. Gorodetskaya[4]
[1]CNRS, IRD, Grenoble INP Institute of Engineering, Université Grenoble Alpes , Grenoble, France, [2]Environmental Remote Sensing Laboratory, École polytechnique fédérale de Lausanne, Lausanne, Switzerland, [3]e, Sorbonne Université, École normale supérieure, PSL Research University, École polytechnique, CNRS, LMD/IPSL, Paris, France, [4]Centre for Environmental and Marine Studies, Department of Physics, University of Aveiro, Aveiro, Portugal

Solid precipitation is the main input in the surface mass balance of the Antarctic ice sheets. Its quantification is complex due to the lack of data, difficult access on the field and the unsuitability of traditional gauges under harsh weather conditions. Ground-based remote sensing has proven useful for studying Antarctic precipitation, especially using precipitation radars (e.i. Gorodetskaya et al., 2015, Genthon et al., 2018). A power law between the radar reflectivity factor (Ze) and the solid precipitation rate (S) has been used to quantify snowfall. Currently, there are only two Ze-S relationships in Antarctica, parameterized using in-situ observations at the Dumont d'Urville station (DDU) on the coast of Adélie Land (Grazioli et al., 2017) and at the Princess Elisabeth station (PE) in the escarpment region of Dronning Maud Land (Souverijns et al., 2017) and averaged over a range of local snowfalls with different properties. The relationship parameters are highly dependent on the hydrometeor characteristics, which is particularly important when studying solid precipitation, due to the high variability of ice particle microphysical properties (e.g. shape, size, density). We use a unique dataset of two vertically-pointing micro-rain-radar observations with different vertical resolutions (15 and 100 m), in-situ snowfall rate measurements and a multi-angle snowflake camera to derive particle microphysics at DDU, provided by the APRES3-project. The analysis of the temporal variability of the Ze-S relationship parameters will be presented as well as the dependency on ice particle characteristics. This investigation is valuable to improve the interpretation radar-based measurements of snowfall in Antarctica.

1287

The CO2 fluxes exchange between ocean and atmosphere at Austral Ocean

Celina Candida Ferreira Rodrigues[1], Luciano Pezzi[1], Marcelo Santini[1], Nathaniel Brunsell[2], Mylene Cabrera[1]
[1]National Institute for Space Research (INPE), São José dos Campos, Brazil, [2]University of Kansas, Lawrence, United States

The studies that increase knowledge of the ocean-atmosphere processes are important for weather forecast improvements and for the studies of global carbon fluxes budget. The Austral Ocean plays a major role in the global weather and climate, besides this area represents a significant global carbon sink area. The objective of this work is to investigate the behavior of turbulent CO2 fluxes at high latitude under different atmospheric and oceanic conditions, during the trajectories of research vessels to the Austral Ocean. Meteorological data were collected by sensors installed in a micrometeorological tower (collected at high and low frequencies) at the front bow of a research polar ship called “Almirante Maximiano’’. The sampling period was from November 07th to 21th, 2018 during the Antarctic Operation 37. The CO2 flux in the ocean and atmosphere interface was calculated by the Eddy Covariance (EC) method. The wind data measurements over the oceans need corrections prior to the estimation of fluxes, due to ship movement. Statistical analyzes show a negative correlation between salinity and sea surface temperature with CO2 fluxes. So, the warm and salty waters in part of Drake Passage behaved more as CO2 Source. The cold and less salty waters of the Bransfield Strait behaved more as CO2 sink. However, the atmosphere stability conditions impact de CO2 fluxes as well, for the more stable (unstable) atmosphere the fluxes are directed to the ocean (atmosphere). Although the atmosphere stability conditions impacts on CO2 fluxes, the sea surface temperature effects are more significant.

706

A large information network for all scientific communities.

Felipe Arturo Figueroa Quintero[1]
[1]*Fuerza Aérea Colombiana CETIA (Pasante) - Fundación Universitaria Los Libertadores, Bogota, Colombia*

A few decades ago the result of the research of different scientific communities announced the news of climate change and global warming, it is definitely taken by nations as a simple speculation and the image projected by the scientific community that predicted abnormal climates and in constant change is only aligned as a remote possibility, today this news is a reality; Temperatures in Antarctica that exceed 18.3 ºC have already been reported, we have lost 20% of ice on one of the islands in just 9 days, which leads to sea level rising much more, we also see how wildlife The wild in the region has been affected by climate change, and for many people it is usual to see snow every year in the Sahara, and these facts become normal or "natural" facts.

For these reasons, the scientific community must have more support from governments and start making global alliances that allow them to explore and share their knowledge with all regions, so that research can be applied together.

Currently, agreements with Argentina are being developed in Colombia and in a joint exercise monitoring stations have already been installed that allow access to different atmospheric measurements in real time, however these measurements should not only be shared between the countries of the agreement, but that they should be free consultation data, aiming in this way to create an international monitoring network with which we can take the necessary measures in the race against global warming and climate change.

1423

Representation of Antarctic atmospheric boundary layer properties in the NASA GEOS model framework

Manisha Ganeshan[1,2], Yuekui Yang[2]
[1]USRA, Greenbelt, United States, [2]NASA Goddard Space Flight Center, Greenbelt, United States

Representation of Antarctic atmospheric boundary layer properties in the NASA Goddard Earth Observing System (GEOS) model framework

Recent high-resolution dropsonde observations from the 2010 Concordiasi field campaign in austral spring season show that surface-based inversions (SBIs) over Antarctica are frequently eroded, with well-mixed boundary layers occurring 33% and 18% of the time in West and East Antarctica, respectively. In this study, using the dropsonde observations, we evaluate the performance of the Modern-Era Retrospective analysis for Research and Applications, version 2 (MERRA-2) in representing the Antarctic boundary layer thermodynamic structure. Results show that MERRA-2 has a good overall representation of the Antarctic surface stability and correctly predicts 82% of the SBIs. However, an underprediction of less stable boundary layer occurrence, especially over the elevated East Antarctic plateau, is favored during conditions of increased lower tropospheric stability associated with model dynamics, indicating difficulty in parameterizing turbulence in very stable boundary layers. In addition, a lower tropospheric cool bias (first model level and above) is observed in the MERRA-2 reanalysis, especially over West Antarctica, which amplifies in the boundary layer during mixed conditions. The near-surface cold bias is most pronounced when the model fails to predict mixed layers over West Antarctica and is expected to negatively impact the representation of surface energy budget and melt processes. Results suggest that advances in modeling and data assimilation as well as improvements in parameterizing turbulence in very stable boundary layers may rectify the biases.

1403

Precipitation and atmospheric rivers from sub-Antarctic Chile to Antarctic Peninsula: transition between rain and snowfall

Irina Gorodetskaya[1], Penny Rowe[2,3], Heike Kalesse[4], Patric Seifert[5], Sang-Jong Park[6], Yonghan Choi[6], Raul Cordero[3], Claudio Durán-Alarcón[7]

[1]CESAM - Centre for Environmental and Marine Studies, University of Aveiro, Aveiro, Portugal, [2]NorthWest Research Associates, Redmond, USA, [3]University of Santiago, Santiago, Chile, [4]Institute for Meteorology, University of Leipzig, Leipzig, Germany, [5]Leibniz Institute for Tropospheric Research, , Germany, [6]Korea Polar Research Institute, Seoul, South Korea, [7]Université Grenoble Alpes, Grenoble, France

Atmospheric rivers (ARs) impact Antarctic surface mass balance through transport of anomalous heat and moisture from subtropical regions. ARs reaching the Antarctic coast have a prominent impact on moisture and wind profiles, representing an extreme state of the troposphere (Gorodetskaya et al., 2020). Antarctic ARs have been linked to intense snowfall events (Gorodetskaya et al., 2014), a temperature record at the Antarctic Peninsula (Bozkurt et al., 2018) and major surface melt events in West Antarctica (Wille et al 2019). On the Antarctic Peninsula, the surface mass balance can be especially sensitive to AR events during summer, when surface temperatures vary around zero and frequent transitions occur between snow and rainfall. We use radiosonde, cloud and precipitation measurements, along with reanalysis products, to investigate the spatial and vertical structure of the ARs and impact on precipitation at the Antarctic Peninsula. The data from two Year of Polar Prediction endorsed projects are used - the Characterization of the Antarctic Atmosphere and Low Clouds (CAALC) project at King George Island and the Dynamics, Aerosol, Cloud, And Precipitation Observations in the Pristine Environment of the Southern OCEAN (DACAPO-PESO) project in Punta Arenas. We present case studies characterizing the temporal evolution of ARs, focusing on thermodynamic and dynamic conditions, and cloud microphysical properties, accompanying the transition between snowfall and rain. We also show the added value of increased frequency in radiosonde observations in improving the forecast of weather conditions during ARs, particularly precipitation, which have important consequences for air, ship and station operations in Antarctica.

330

A new blowing snow scheme to represent snow transport at the surface of the Antarctic Ice Sheet

Alexandra Gossart[1,3], Charles Amory[2], Sam Vanden Broucke[3], Leo van Kampenhout[4], Sotiris Sotiriadis[3], Bill Sacks[5], Nicole P.M. van Lipzig[3], Jan T.M. Lenaerts[6]
[1]Victoria University Of Wellington, Wellington, New Zealand, [2]Universite de Liege, Liege, Belgium, [3]Univeristy of Leuven, Leuven, Belgium, [4]Utrecht University, Utrecht, The Netherlands, [5]National Centers for atmospheric Research, Boulder, USA, [6]Univeristy of Colorado Boulder, Boulder, USA

Current simulations of the Antarctic ice sheet surface mass balance are still uncertain since both precipitation and blowing snow processes are poorly constrained and likely lead to inconsistencies betweeen modelled and measured snow accumulation values. Here, we apply the PIEKTUK-B blowing snow transport routine, developed for the Canadian prairies by Déry and Yau (2001), over coastal areas in East Antarctica. This routine was tested with two sets of simulations: an offline simulation in order to evaluate PIEKTUK-B as implemented in the land part of CESM (CLM4.5), and simulations with the coupled COSMO-CLM2 model in which the horizontal transport of snow is taken into account as well as changes to the snow surface properties.

Results indicate that (i) both off and online simulations display similar blowing snow occurrence at three coastal locations , and (ii) the routine is able to reproduce the observed temporal variability in snowdrift fluxes in Adelie Lan. The prescribed relation linking wind speed and aeolian snow transport is similar to that of the observations, and in general the modelled transport discrepancies are a result of the misrepresentaton of wind speeds by the COSMO-CLM2 model, although a tendency to overestimate the observed transport rates at highest wind speeds is depicted.

166

Wintertime wind-induced surface temperature anomalies in the Antarctic: A climatology based on MODIS and regional climate model data

Guenther Heinemann[1], Sascha Willmes[1], Lukas Glaw[1]
[1]*University Trier, Trier, Germany*

It is well-known that katabatic winds can be detected as warm signatures in the surface temperature over the slopes of the Antarctic ice sheets. For appropriate synoptic forcing and/or topographic channeling, katabatic surges occur, which result in warm signatures also over adjacent ice shelves. Moderate Resolution Imaging Spectroradiometer (MODIS) ice surface temperature (IST) data are used to detect warm signatures over the Antarctic for the winter periods 2002–2017. In addition, high-resolution (5 km) regional climate model data is used for the years of 2002 to 2016. We present a climatology of wind-induced IST anomalies for the Ross Ice Shelf and the eastern Weddell Sea. The IST anomaly distributions show maxima around 10–15K for the slopes, but values of more than 25K are also found. Katabatic surges represent a strong climatological signal with a mean warm anomaly of more than 5 K on more than 120 days per winter for the Byrd Glacier and the Nimrod Glacier on the Ross Ice Shelf. The mean anomaly for the Brunt Ice Shelf is weaker, and exceeds 5K on about 70 days per winter. Model simulations of the 2m-temperature, IST and 10m-wind are compared to the MODIS IST and automatic weather stations. Overall, show a very good agreement of the model data with observations is found. The model data show that the near-surface stability is a better measure for the response to the wind than the IST itself.

167

High-resolution regional climate model simulations using CCLM for the Weddell Sea region of the Antarctic: Verification and near-surface climate

Guenther Heinemann[1], Rolf Zentek[1]
[1]*University Trier, Trier, Germany*

The non-hydrostatic regional climate model CCLM was used for a long-term hindcast run (2002-2016) for the Weddell Sea region with resolutions of 15 and 5 km. CCLM was nested in ERA-Interim data and used in forecast mode. Two different turbulence parametrizations are used for the stable boundary layer. The performance of the model was evaluated in terms of temperature and wind using data from Antarctic stations, AWS over land and sea ice, operational forecast model and reanalyses data, and lidar wind profiles. For the latter comparisons, CCLM was used with 1km resolution. Overall, CCLM shows a good representation of temperature and wind for the Weddell Sea region. An extended period of 2002-2019 was used to investigate the near-surface climate in the Weddell Sea region, including the surface energy balance (particularly of coastal polynyas), katabatic winds, barrier winds at the Antarctic Peninsula (AP) and foehn winds at the AP.

235

Large-scale feature of surface-based inversion layer over the traverse route from Syowa to the Antarctic interior in cold season

Naohiko Hirasawa[1], Kyohei Yamada[1], Katsumi Saga[2]
[1]National Institute of Polar Research, Tokyo, Japan, [2]TYPE-S CO., LTD. , Gunma, Japan

Suface-based temperature inversion layer on the Antarctic ice sheet is a typical feature. Phillpot and Zillman [1970] estimated the distribution of the inversion intensity on the ice sheet as an average field from June to August based on the limited observation data. Since then, there have been few new collective observations that can update their figure, so their result is still cited as observation that represent the characteristics of the inversion layer in winter. This situation will continue for some time, but continuing to collect observational data that can be compared to their result is necessary to update the knowledge. On the other hand, the accuracy of numerical models has improved remarkably, Antarctic Meso-scale Prediction System (AMPS) using the Weather Research and Forecasting Model (WRF) has been carried out, and it has also been used for meteorological mechanism analysis and climate analysis. For such numerical models, validation regarding the reproducibility of the inversion layer on the Antarctic ice sheet is one of the points of interest.
In spring season, we carried out radiosonde observation during a traverse from Relay Point to Syowa Station in 2018 and from MD78 to Syowa in 2019. In this presentation, we describe the characteristics of the cross-sectional structure of the inversion layer along the traverse route, and discuss the new facts with some comparable results derived from a numerical model.

241

Early indications of anomalous behavior in the 2019 spring ozone hole over Antarctica

Oksana Ivaniga[1], Gennadi Milinevsky[1,2,3], Oleksandr Evtushevsky[1], Andrew Klekociuk[4,5], Yuke Wang[2], Asen Grytsai[1], Valerii Shulga[2,6]

[1]Taras Shevchenko National University Of Kyiv, Kyiv, 01601, Ukraine, [2]International Center of Future Science, College of Physics, Jilin University, Changchun, 130012, China, [3]National Antarctic Scientific Center, Ministry of Education and Science of Ukraine, Kyiv, 01601, Ukraine, [4]Antarctica and the Global System, Australian Antarctic Division, Kingston, 7050, Australia, [5]School of Earth Sciences, University of Melbourne, Melbourne, 3053, Australia, [6]Institute of Radio Astronomy, National Academy of Sciences of Ukraine, Kharkiv, 61002, Ukraine

The quasi-stationary planetary wave (QSW) activity in the Antarctic winter stratosphere provides insights into the likely behavior of the ozone hole in the following spring months. Observation of anomalously large amplitude of the winter stratospheric temperature QSW serves as an indicator that strong disturbances to the polar vortex are likely to occur. These disturbances may lead to large reductions in both the area of the Antarctic ozone hole area and the overall amount of stratospheric ozone that is depleted. In the sudden stratospheric warming preconditions in 2019, the maximum QSW amplitude over Antarctica in August was approximately 12 K, which was only 2 K less than conditions prior to the unprecedented historical major Antarctic sudden stratospheric warming in 2002. Under these conditions, the Antarctic sudden stratospheric warming in 2019 had the potential to become an unusual event, which has been confirmed by the satellite ozone observations in September-October. The additional factors disturbing the Antarctic stratosphere in 2019 was anomalously warm sea surface temperatures in the central tropical Pacific Ocean and western Indian Ocean, and the descending easterly phase of the Quasi-Biennial Oscillation (QBO). The combination of these factors – the large amplitude of the QSW, the warm tropical sea surface temperatures and transitioning phase of the QBO – created the potential to cause the early disruption of the ozone hole and reduce the overall level of ozone depletion in 2019. This event probably brought important regional anomalies in weather conditions in the Southern Hemisphere.

1093

Where are all the Foehn impacted coastal regions of Antarctica?

Marwan Katurji[1], Rajasweta Datta[1], Peyman Zawar-Reza[1], Hanna Meyer[2], Maite Lezama Valdes[2]
[1]School of Earth and Environment, University of Canterbury, Chirstchurch, New Zealand, [2]Institute of Landscape Ecology, University of Munster, Munster, Germany

Intense warming events that are driven by intra-seasonal mesoscale weather variability cause seasonal streams to flood in the Dry Valleys and ice shelf melt in the Antarctic Peninsula. The Antarctic coastline topography acts to ground warm Foehn induced air masses impacting the near surface air temperatures. Due to Antarctica's complex topographic coastline and difficulty to numerically resolve or observe mesoscale weather circulation patterns at the continental scale, we hypothesize that Foehn induced warming is impacting most of the Antarctic rugged coastline and is gone undetected so far.
We have developed and validated an Antarctic wide near-surface AIR temperature dataset (AntAIR) at a daily and 1km resolution, which was based on statistical learning from satellite and in-situ observations suitable for mesoscale climatological analyses. AntAIR was used successfully to detect some of the Dry Valley Foehn cases that were independently verified with regional climate model outputs. Results show valley-wide warming patterns associated with Foehn that are distinct from patterns associated with surface radiative cooling in winter or solar warming in summer. We are also developing sub-kilometre land surface temperature datasets that take advantage of MODIS's daily resolutions and LandSat's high spatial resolutions, which will become useful for localized warming impacts on the terrestrial landscape. With the scarcity of Antarctic weather stations and the costs involved in developing numerical simulations at mesoscale resolutions, we propose that both AntAIR and newly developed automatic Foehn detection algorithms can be used to discover new areas impacted by extreme warming.

679

Current state of snow cover in the area of Ukrainian Antarctic research base "Academician Vernadsky"

Serhii Klok[1], Anatolii Kornus[2], Olena Danylchenko[2]
[1]Ukrainian Hydrometeorological Institute, Sumy, Ukraine, [2]Sumy State Pedagogical University named after A.S. Makarenko, Sumy, Ukraine

The paper analyzes the results of comprehensive observations of the snow cover in the area of the Ukrainian Antarctic research base "Academician Vernadsky" for 1986-2019.
It has been established that the formation of a snow mass of 2-3 m high in the region occurs under relatively warm conditions (average January temperature of 0.7 °C, the sum of the temperatures of the winter months is -23.7 °C) and during long (6-7 months) winter. Because of it, snow falls wet, its temperature is close to 0 °C, the dynamic factor increases its density to 0.5 g/cm3 and higher.
The analysis showed a shift of the snow cover existence period in the study area to a later date, while its duration remains stable. The seasonal component (annual cycle) with a period of 366.04 days (which explains the shift) describes 58% of the total variability, and the long-period (period of 11 years) - 17.6%.
The increase in snow depth by the monthly section turned out to be a very informative and promising characteristic.
The delving of snow cover revealed the following features: during the snow accumulation season, the 6-7 permanent layers are usually formed during the season, although in some unstable winters their number may be greater. These layers are formed during specific time intervals, close in different years, under the influence of certain synoptic formations; the snowmelt period is characterized by 3-4 stable periods; an avalanche-hazardous layer of insignificant vertical thickness is formed during the period of maximum snow growth (July-August).

951

Recent weakening of southern stratospheric polar vortex and its impact on the surface climate over Antarctica

Hataek Kwon[1], Hyesun Choi[2], Baek-Min Kim[3], Sang-Woo Kim[1], Seong-Joong Kim[2]
[1]Seoul National University, Seoul, South Korea, [2]Korea Polar Research Institute, Incheon, South Korea, [3]Pukyong National University, Busan, South Korea

Variability of southern stratospheric polar vortex (SSPV) and its downward coupling with the troposphere are known to play a crucial role in driving climate variability over the Antarctica. In this study, the SSPV weakening events and their impact on the surface over the Antarctica are examined using in situ observation and reanalysis data. Combining rules in the several previous studies, we devised a new detection method for the weak SSPV event. Based on the new criteria, the occurrence frequency of weak SSPV events has exhibited a systematic increasing trend since the 2000s. However, the weakened anomalies of individual SSPV event were not particularly different between the earlier (1979-1999) and later periods (2000-2017). The recent increase in the occurrence of weak SSPV events is largely controlled by tropospheric mechanisms, the poleward heat flux carried by southern hemisphere planetary waves and related vertical wave propagation. We show that the SSPV weakening event induces statistically significant cooling over the Antarctic Peninsula (AP) region and warming over the rest of Antarctica. Typically, large negative values smaller than -0.6 ºC and positive values larger than + 0.8 ºC of surface air temperature anomalies are observed over the east coast of the tip of AP and the King Edward VII Land, respectively. The influence of weak SSPV on surface lasts for several months with higher height anomalies off west Antarctica, providing favorable conditions for the atmosphere to transport cold air from the interior of Antarctica to the AP via the Weddell Sea.

436

Shallow convection and precipitation over the Southern Ocean: A case study during the CAPRICORN field campaign

Francisco Lang[1], Yi Huang[2,3], Steven Siems[1,3], Michael Manton[1], Son Truong[1,3]
[1]School of Earth, Atmosphere and Environment, Monash University, Melbourne, Australia, [2]School of Earth Sciences, The University of Melbourne, Melbourne, Australia, [3]Australian Research Council Centre of Excellence for Climate Extremes, Melbourne, Australia

Persistent biases in the energy budget over the Southern Ocean (SO) within climate simulations and reanalysis products have been linked to the poor representation of clouds over the region, particularly in regions of shallow, post-frontal convection. In response to these challenges, the CAPRICORN (Clouds, Aerosols, Precipitation, Radiation, and atmospherIc Composition Over the southeRn oceaN) field campaign was carried out to characterize the cloud, aerosol, precipitation and boundary layer properties over the SO. The Australian R/V Investigator undertook a 35-day cruise from March to April in 2016 making observations from Hobart (43°S) to the polar front (53°S). One case is examined in this study with a focus on shallow convective clouds that were commonly observed during the cruise. Shipborne measurements, Himawari-8 products are integrated to investigate the dynamical and microphysical characteristics of the targeted marine boundary layer cloud fields. This case (26-28 March) focusses on a sustained period of open mesoscale cellular convection in a post-frontal environment. The observed cloud field resided primarily below 2.5 km and in the sub-freezing temperature range (0 to -8°C), where mixed-phase cloud tops were suggested by both the shipborne and Himawari-8 observations. Relatively heavy precipitation was observed to be generated from these clouds. High-resolution simulations with a convection-permitting configuration of the Weather Research and Forecasting (WRF) model are performed with relatively good representation of some surface meteorology. However, simulations have difficulties in producing both the low-level cloud field, mixed-phase cloud tops, boundary-layer decoupling and surface precipitation.

1123

West Antarctic Surface Melt: Energy Budget, Meteorological Drivers and Large-Scale Climate Forcing

Ryan Scott[1], Dan Lubin[2], David Bromwich[3], Julien Nicolas[4], Joel Norris[2]
[1]NASA Langley Research Center and SSAI, Hampton, United States, [2]UCSD Scripps Institution of Oceanography, La Jolla, United States, [3]Byrd Polar and Climate Research Center, Columbus, United States, [4]ECMWF, Shinfield Park, United Kingdom

Surface melt over West Antarctica is increasingly recognized as a contributor to ice mass loss, through hydrofracturing of ice shelves that buttress ice sheets. The US Department of Energy Atmospheric Radiation Measurement (ARM) Program West Antarctic Radiation Experiment (AWARE) provided insight into lower atmosphere perturbations and the influence of cloud microphysics on the surface energy balance. Here we generalize AWARE objectives to identify meteorological drivers of surface melt throughout West Antarctica. We diagnose these drivers of surface melt by comparing satellite-observed melt patterns to anomalies of near-surface air temperature, winds, and satellite-derived cloud cover, radiative fluxes and sea ice concentrations spanning the austral summers 1979-2017. Summertime melt-inducing warming is favored by Amundsen Sea (AS) blocking activity and a negative phase of the Southern Annular Mode, both of which correlate with ENSO conditions in the tropical Pacific Ocean. Extensive melt events in the Ross-Amundsen sector of the West Antarctic Ice Sheet (WAIS) are linked to intense and persistent AS blocking anticyclones that force intrusions of marine are over the ice sheet. Surface melting is driven primarily by enhanced downwelling longwave radiation and turbulent mixing of sensible heat to the surface by föhn winds. Since the late 1990s, concurrent with ocean-driven WAIS mass loss, summer surface melt has increased from the AS Embayment to the eastern Ross Ice Shelf. Increasing anticyclonic advection of marine air over the WAIS, and enhanced air-sea fluxes associated with declining sea ice concentration in the coastal Ross-Amundsen Seas, together provide a possible mechanism for this trend.

708

Atmospheric Warming-Induced Surface Melt in West Antarctica: Recent Field Observations and Climate Change Context

Dan Lubin[1], Madison Ghiz[1], Ryan Scott[2]
[1]Scripps Institution Of Oceanography, La Jolla, United States, [2]NASA Langley Research Center and SSAI, Hampton, United States

Recent remote sensing and climate modeling studies show that summer surface melt over West Antarctica is more frequent and widespread than previously realized, and that surface meltwater can substantially weaken ice shelves and ice cliffs through hydrofracturing. When evaluating the role of atmospheric warming in West Antarctic Ice Sheet (WAIS) loss, the key considerations are not necessarily the total resulting meltwater volume and geographic extent as over Greenland, because most WAIS melt events last only a few days. Instead, one should focus on surface melt specifically over vulnerable ice shelves and ice cliffs that can weaken their structure even if short-lived. Surface melt generally results from changing radiative and turbulent flux components of the surface energy balance when surface and lower atmosphere temperatures are near the freezing point. In Antarctica the meteorological drivers of these changes vary, and we review three based on observations. During the joint US NSF-DOE Atmospheric Radiation Measurement (ARM) Program West Antarctic Radiation Experiment (AWARE), radiation and turbulent flux instrumentation at WAIS Divide diagnosed the role of cloud longwave surface heating during the extensive January 2016 melt event. In a recent field program at Siple Dome during December 2019-January 2020, similar instruments provided new data on the role of optically thin clouds that induce an all-wave surface radiative flux enhancement similar to what has been discovered over Greenland. Analysis of automatic weather station (AWS) data near the Transantarctic Mountains enables us to quantify the role of foehn winds in localized surface melt events.

1540

An Examination of the ERA5 Reanalysis Dataset over the Ross Ice Shelf using Observations from a large scale SNOW WEB deploymnet

Adrian Mcdonald[1]
[1]*University Of Canterbury, Christchurch, New Zealand*

This study compares meteorological output from the ERA5 reanalysis product with a large scale deployment of the SNOW WEB observational network over the Ross Ice Shelf. Deployments of 14 SNOWWEB stations in the 2017/2018 Antarctic field season through to the present day and a second deployment since the 2018/2019 of a further 12 SNOWWEB stations are used to compare with ERA5 winds, temperatures and pressures. We also use our observational network to identify potential gaps in the existing observational network. The earlier deployment occurred along a 240 km transect along the South Pole Traverse route and the second was from Siple Dome to a region on the Ross Ice Shelf close to the Kamb icestream. We also use a Self-Organizing Map analysis to compare the ERA5 model output with data from our observational network under a varying range of synoptic conditions. We also examine the quality of the reanalyses to represent the relationships between these synoptic conditions and snowfall events using ancillary datasets. This analysis allows a quantification of the impact of synoptic states and their representation on snowfall. We also focus on whether extreme events observed by the SNOWWEB stations related to periods of significant snow accumulation are represented correctly in the ERA5 reanalysis.

1454

CO2 flows in the Bransfield Strait during the austral summer 2018

Wilson Carhuapoma[1], Rodrigo Kerr[2], Michelle Graco[1], Luis Vasquez[1], Jesús Ledesma[1], Hairo León[3], Edwin Loarte[3], Katy Damacia Medina Marcos[3]

[1]Marine Institute of Peru (IMARPE), Lima, Peru, [2]National Institute of Science and Technology of the (INTC of Cryosphere) - Rio Grande Federal University (FURG), Brazil, [3]National Institute for Research on Glaciers and Mountain Ecosystems (INAIGEM), Huaraz, Peru

An estimated that 30% of the CO2 present in the atmosphere has been absorbed by the oceans, however, this sink characteristic has been affected due to the increase of this gas in the atmosphere. To understand these processes the Bransfield Strait and the surroundings of Elephant Island have been chosen, which is affected by the Bellinghausen Sea (TBW), the Weddell Sea (TWW) and the Scottish Sea.
Data on sea surface temperature, salinity, dissolved oxygen, chlorophyll-a, wind speed and partial CO2 pressure (pCO2) have been used and then treated by a GIS to space them along the Strait. The results indicate that there are two well-defined bodies of water, TBW characterized by a temperature between 1 to 2 °C and salinities 33.8 to 34.2; TWW with -0.7 to 1 °C and with salinities 34.2 to 34.5. The dissolved oxygen shows a heterogeneous surface distribution and chlorophyll-a values less than 1 µg/L, the wind speed reaches values of 6 m/s in the Strait and values of 10 m/s in faraway areas. The difference between the ocean atmospheric pCO2 and ocean pCO2 were positive, this indicates that ocean CO2 is being transferred into the atmosphere (~ 5 at 20 mmol.m-2.day-1). A relationship was also found between CO2 absorption and sea ice coverage, with the greatest absorption occurring when sea ice is scarcer or seasonal, while it decreases when ice coverage increases.

829

Antarctic Regional Warming Events in Winter Observed by the University of Wisconsin-Madison Automatic Weather Station Network: An Analysis of Extreme Temperature Increases on the Ross Ice Shelf

David Mikolajczyk[2], Matthew Lazzara[3], Jonathan Martin[2], Linda Keller[1], John Cassano[4]
[1]Antarctic Meteorological Research Center, Space Science and Engineering Center, University of Wisconsin-Madison, Madison, United States, [2]Department of Atmospheric and Oceanic Sciences, University of Wisconsin-Madison, Madison, United States, [3]Department of Physical Sciences, School of Arts and Sciences, Madison Area Technical College, Madison, United States, [4]Cooperative Institute for Research in Environmental Sciences and Department of Atmospheric and Oceanic Sciences, University of Colorado, Coulder, United States

Previous studies of Antarctic climate have highlighted relatively uniform, cold conditions throughout the austral winter. Other studies, however, have shown warming deviations occurring on monthly timescales during the winter. One cause for these increases in temperature may be brief but rapid increases in surface temperature. Observations from the University of Wisconsin-Madison (UW) Automatic Weather Station (AWS) network have shown dramatic and rapid increases in temperature in austral winter. An investigation of these events was conducted for all UW AWS in the years 2002 through 2018. These warming events in winter (WEW) are defined as increases in temperature observed at a UW AWS of 30 degrees C or greater in 5 or fewer days, with a decrease in temperature during that period of no more than 10 degrees C. A regional warming event in winter (RWEW) was subsequently defined as an event that included one or more WEW occurring in the same predefined region at about the same time. The Ross Ice Shelf (RIS) observed the most WEW and RWEW in this study. An analysis of 500 hectopascal (hPa) geopotential height anomalies during RWEW revealed that RWEW in the RIS had the largest variability in said height anomalies. Smaller-scale processes are hypothesized to lead to RWEW in this region, including turbulent mixing. Presented will be typical large-scale atmospheric flow regimes preceding RWEW on the RIS. A case study analysis will be presented of an RWEW that occurred on the RIS between 12 and 15 July 2007.

257

On the 16-year periodicity in the Antarctic Peninsula temperature variability

Gennadi Milinevsky[1,2,3], Oleksandr Evtushevsky[1], Asen Crytsai[1], Volodymyr Kravchenko[1]
[1]Taras Shevchenko National University Of Kyiv, National Antarctic Scientific Center, Kyiv, Ukraine, [2]International Center of Future Science, College of Physics, Jilin University, Changchun, China, [3]National Antarctic Scientific Center, Ministry of Education and Science of Ukraine, Kyiv, Ukraine

Surface temperature in the Antarctic Peninsula (AP) region increased rapidly since the middle of the last century and shows no warming since the 2010s. In addition, long-term climate changes across AP vary both seasonally and spatially. The distinctive role of the decadal periodicity in the change in winter temperature (June–August) in the northern and southern AP is analyzed. The Scientific Committee on Antarctic Research Reference Antarctic Data for Environmental Research (SCAR READER) was used. The time series 1952–2017 for the two AP weather stations Esperanza (northern AP) and Vernadsky (southern AP) were compared. If the Esperanza data show a stable 16-year periodicity, then the Vernadsky data show irregular decadal variability. This is clearly seen from the wavelet transforms, which also display opposite phases in the recent temperature change with warming at Esperanza and weak cooling at Vernadsky. The spatial heterogeneity in temperature variations along AP is usually attributed to the competing impacts of the El Niño–Southern Oscillation and Southern Annular Mode. We have revealed that the periodic temperature oscillation at Esperanza is associated with the latter mode combined with the zonal wave 3 pattern. In the related surface pressure anomalies, wave 3 ridge located east of southern South America is the cause of the regional anticyclonic anomaly. The corresponding westerly wind anomaly covers Esperanza in the northern AP but does not reach Vernadsky in the southern AP. This leads to a differentiated contribution of decadal variability to temperature changes along AP.

52

Sudden Stratospheric Warming over Antarctica in 2019 and the hemispheric implications

Jing Ming[1]
[1]*Beacon Science & Consulting, Melbourne, Australia*

In late August to early September of 2019, the temperature in the mid- and low stratosphere over Antarctica rose by over 70 degrees Celsius. This event is later confirmed as a Sudden Stratospheric Warming over Antarctica (SSWA) for the second time only after the event in 2002. Along with the SSWA, the ozone depletion does not prevail as usual in the springtime. The zonal mean temperature (60-90S) and wind (60S) show that the event could be resulting from the planetary waves' propagation into the stratosphere and weakening the polar vortex. Whereas, another possible explanation is that the warming over Antarctica is simply mirroring the cooling over the Arctic in 2019, configured by the satellite anomalies in the low stratosphere. The SSWA event causes some hemisphere-scale disturbances. For example, the sea-ice extent and area in Antarctica reach their minimum level throughout the last 40 years; and unusual drought and bushfires spread in the east part of Australia.

103

Seasonal variability of net sea–air CO_2 fluxes
in the northern Antarctic Peninsula

Thiago Monteiro[1,2,3], Rodrigo Kerr[1,2,3], Eunice Machado[1,4]
[1]Programa de Pós-Graduação em Oceanologia, Instituto de Oceanografia, Universidade Federal do Rio Grande (FURG), Rio Grande, Brazil, [2]Laboratório de Estudos dos Oceanos e Clima, Instituto de Oceanografia, Universidade Federal do Rio Grande (FURG), Rio Grande, Brazil, [3]Brazilian Ocean Acidification Network (BrOA), Rio Grande, Brazil, [4]Laboratório de Hidroquímica, Instituto de Oceanografia, Universidade Federal do Rio Grande (FURG), Rio Grande, Brazil

Several studies have been conducted in the Antarctica to investigate the net sea–air CO_2 fluxes (FCO_2). However, the Antarctic coastal regions are still poorly sampled and the majority of the studies are restricted to the austral summer. Here, we constructed a temporal series (2002-2017) of hydrographical and biogeochemical data in Gerlache Strait, a hotspot for climate change that is ecologically important in the northern Antarctic Peninsula. Thus, we show for the first time a detailed annual overview of the FCO_2 and primary drivers in the Gerlache Strait. In autumn and winter, episodic upwelling increases the remineralized carbon in the surface, leading the region to act as a moderate or strong CO_2 source to the atmosphere of up to 50 mmol/m^2/day. During summer and late spring, photosynthesis decreases the CO_2 partial pressure, enhancing ocean CO_2 uptake higher than –50 mmol/m^2/day. Therefore, the autumn/winter CO_2 outgassing is nearly balanced by an only 4–month period of intense ocean CO_2 ingassing during summer/spring. Hence, the estimated annual FCO_2 from 2002 to 2017 was 1 ± 17 mmol/m^2/day. The main drivers of changes in the surface CO_2 system were total dissolved inorganic carbon and total alkalinity, revealing the dominant influence of both physical and biological processes. These findings demonstrate the importance of Antarctica coastal zones as carbon sinks and emphasize the need to better understand the sensitivity of the local/regional Southern Ocean carbon cycle to the impacts of climate change.

1066

Antarctic convection west of Maud Rise.

Kent Moore[1]
[1]University Of Toronto, Toronto, Canada

Maud Rise, a seamount in the Weddell Sea, is a location where a polynya occasionally forms. The most dramatic of these events was the ~300,000km2 polynya that occurred over the 3-year period from 1974-1976. Another smaller polynya developed in 1994. In 2016, a polynya developed near Maud Rise in late July and persisted for approximately 3 weeks. In September 2017, the polynya returned and remained open through November. The presence of a polynya can lead to vigorous air-sea interaction resulting in a densification of the surface waters and a convective overturning of the water column that was indirectly observed after the 1976 polynya and directly observed during the 2017 event. There is still much that is unknown regarding how these polynyas form as well as the characterization of the atmospheric forcing that occurs within them and the oceanic response. Here we use a new high resolution atmospheric reanalysis to compare and contrast the meteorological conditions associated with the polynyas from the 1970s with those from the more recent openings. Included will be a characterization of the spatial and temporal variability in the air-sea interaction that occurred within these polynyas.

1404

An overview on the Southern Hemisphere storm tracks from the Brazilian earth system model' RCP8.5 Scenario

Claudia Parise[1], Kevin Hodges[2], Ronald Souza[3], Luciano Pezzi[4]
[1]Federal University Of Maranhao - UFMA, Sao Luis, Brazil, [2]University of Reading, Reading, England, [3]National Institute for Space Research - INPE, Cachoeira Paulista, Brazil, [4]National Institute for Space Research - INPE, Sao Jose dos Campos, Brazil

The Brazilian Earth System Model (BESM) consists of a coupled climate model developed by the National Institute for Space Research (INPE) that has allowed Brazil to join a selected group that provides contributions of climate change statistics to the IPCC's reports. Here we show the first results of the analysis of the Southern Hemisphere (SH) storm tracks under the BESM's RCP8.5 scenario (2006-2104) in the lower troposphere (850 hPa). This is compared with the ERA5 reanalysis dataset (1979-2019). The storm tracks are obtained from an automated feature-tracking technique applied on the relative vorticity field, focusing on the seasonality (summer and winter) of systems that last longer than 2 days and move more than 1000 km. We have found that the zonally symmetric behavior of the SH storm tracks, climatologically observed during the summer, is remained in the RCP8.5 scenario, though there is a shift northwards of its location, leading to an increase (decrease) of the track density from 45°S to 55°S (from 60°S to the Antarctic coast), both in 50%. The asymmetric spiral pattern during the winter is also observed for the storm tracks in the future climate, however the maximum density of mobile storms found near to the Antarctic coast (from 180° to 120°E) is reduced (in 50%), meanwhile it is increased (by 25%) at the south of South America, South Africa and Australia in comparison to the reanalysis. The response of storm tracks to the RCP8.5 scenario is also being done for the other seasons and atmospheric levels.

141

First results from Antarctic Modelling and Observational System (ATMOS) Project

Luciano Pezzi[1], Ronald Souza[1], Marcelo Santini[1], Joey Voermans[3], Jonas Carvalho[1], Claudia Parise[2], Eliana Rosa[1], Ueslei Sutil[1], Manuel Victor[1], Giullian Reis[1], Celina Rodrigues[1], Bruna Pavani[4],Regiane Moura,Fabiane Furlan[1], Joel Rubert[1], Gabriel Munchow[5], Mylene Cabrera[1], Rita Alves[5]

[1]National Institute for Space Research (INPE), São José Dos Campos, Brazil, [2]Federal University of Maranhão (UFMA), São Luiz, Brazil, [3]University of Melbourne, Mebourne, Australia, [4]University of São Paulo (USP), São Paulo, Brazil, [5]Federal University of Rio Grande do Sul (UFRGS), Porto Alegre, Brazil

Antarctic Modelling and Observational System (ATMOS) is a scientific project conceived to improve our understanding of sea ice-ocean-atmosphere-waves interactions and turbulent fluxes exchanges, at micro and meso-scales in the Atlantic sector of the Southern Ocean. The expectation is to build an innovative system able to do in situ measurements of atmospheric and oceanic variables. Another goal is develop a regional coupled model of seaice-ocean-atmosphere-waves to understand the physical mechanisms that occur at these interfaces that will fine-tune with observations. Here we present some of first ATMOS year results. On our way to Antarctica we crossed a warm eddy detached from Brazil Current. The vertical profile measurements of the atmosphere and of the ocean, showed that the atmosphere superimposed on warm water becomes unstable, by causing stronger winds over it. Opposite behavior is seen over colder waters outside of eddy core. Together, preliminary results obtained through the wave buoy installed in vicinity of King George Island are presented and compared with numerical simulations carried out for that region. The wave buoy showed two groups of predominant wave systems. The first one from E-SE with peak period (Tp) below 10 s and significant wave height (Hs) around 1.0 m, and the second one from S-SO with higher Tp (above 10 s) and with Hs reaching 3.0 m. The WW3 model simulations followed the oscillations presented by the buoy, underestimating Hs values, probably due to the choice of the atmospheric forcing.

1106

Challenging Antarctic WRF with Satellite-based Cloud and Precipitation Observations via COSP2: Early Results

David Reusch[1]
[1]New Mexico Institute Of Mining & Technology, Seattle, United States

Polar clouds and precipitation are fundamental, but poorly understood, meteorological variables with wide relevance to understanding Antarctic climate, including mass balance, the surface energy budget and surface melting.

Satellites carrying active sensors (e.g., CloudSat) provide the only platform with spatial coverage suited to observing precipitation and clouds regularly across the ice sheet. But because of their spatial resolution and temporal sampling, satellite observations are not enough on their own to fully understand these variables.

Regional atmospheric models like Polar WRF offer high-resolution, continuous time series of precipitation, clouds and other related variables but have known skill shortfalls (as do all models, ultimately). By combining remote-sensing observations with modeling, the models can be improved through skill testing/diagnosis. In turn, the verified model supports development of better precipitation datasets and new insights into Antarctic weather and climate variability.

We bridge models and observations using the instrument simulator COSP2 to translate from the modeled atmosphere to products that can be compared directly with satellite-based observational datasets thereby supporting “level playing field” skill testing.

We established our methodology using WRF datasets from the Antarctic Mesoscale Prediction System (AMPS) archive. Because AMPS files are missing some COSP2 input variables, some assumptions and approximations had to be made during this pilot work. Preliminary results from testing the COSP2 CloudSat simulator against CloudSat observations are encouraging but indicate more development is needed before our ideal scenario is viable: production of an improved, long-term precipitation record from new WRF runs.

963

Trends in Atmospheric Humidity and Temperature above Dome C, Antarctica Evaluated from Observations and Reanalyses

Philippe RICAUD[1], Paolo Grigioni[2], Romain Roehrig[1], Pierre Durand[3], Dana Veron[4]
[1]CNRM, Toulouse, France, [2]ENEA, Roma, Italy, [3]Laboratoire d'Aerologie, Toulouse, France, [4]University of Delaware, Newark, USA

The time evolution of humidity and temperature above Dome C (Antarctica) has been investigated by considering observations performed at Dome C from radiosondes since 2005 and from the microwave radiometer HAMSTRAD since 2012. These data have been coupled with reanalyses selected since the end of the 20th century (from 1980 to 2017/2018) from ERA-Interim, MERRA2 and JRA-55, and the southern annular mode (SAM) index over the same period. The observations at Dome C reveal a significant moistening (0.08 ± 0.06 g m-3 dec-1) associated with a significant warming (1.08 ± 0.55 K dec-1) in summer, and a significant drying (-0.04 and -0.05 ± 0.03 g m-3 dec-1) associated with a significant cooling (-2.4 ± 1.2 and -5.1 ± 2.0 K dec-1) in autumn and winter, respectively whilst, in spring, no significant trends are evaluated. Considering the reanalyses, our study showed that 1) the summer moistening/warming and the autumn and winter drying/cooling observed in the beginning of the 21st century agreed with the reanalyses and 2) periods of moistening/warming alternated with periods of drying/cooling whatever the season considered. The decadal trends in Integrated Water Vapour (IWV) and 2-m temperature were obviously anticorrelated to the decadal trends in SAM index for all the seasons but spring. Our study suggests that the decadal trends observed at Dome C since the beginning of the 21st century in humidity and temperature are well within the variability of the atmosphere analysed since the end of the 20th century.

1242

Observing and modeling snowfall at Dumont d'Urville station, Antarctica, during YOPP special observing campaign : a 3D approach

Marie-Laure Roussel[1], Christophe Genthon[1], Chantal Claud[1], Florentin Lemonnier[1], Claudio Duran Alarcon[2], Etienne Vignon[3], Eric Bazile[4]

[1]Laboratoire de Météorologie Dynamique, IPSL, Paris, France, [2]Institut des Geosciences de l'Environnement, CNRS, Grenoble, France, [3]Ecole Polytechnique Federale de Lausanne, Lausanne , Suisse, [4]Meteo-France, CNRM, Toulouse, France

Antarctica is the largest reservoir of continental fresh water on Earth: sensitivity to climate change may induce mass balance change and result in significant impact on global sea-level. The surface mass balance of the cap is mainly fueled by precipitation, which is expected to increase by the end of the 21st century according to climate projections. However, there is still limited knowledge and understanding of the processes involved because observations are limited as a results of remoteness and extreme weather conditions.

The OMM project dedicated to improving meteorological research and prediction at the poles (YOPP: Year of Polar Prediction) had a Southen Hemisphere special observing period between November 2018 and February 2019, during which unique observations were made, in particular at the Dumont d'Urville station YOPP supersite in East Antarctica. Models were also run in this framework. In addition to the conventional approach – the surface accumulation of precipitation– the vertical dimension of snowfall is studied, allowing to account for microphysics and dynamics throughout the atmospheric column.

Snowfall occurrences and fluxes from various weather forecast and atmospheric circulation models are evaluated. The use of diagnostics to detect snowing events and of 3 scores exhibits model overestimation both in terms of frequency and intensity. A fair representation of subtle processes such as re-evaporation in the lowest levels even in global models is encouraging but progress is still needed to correctly account for the observations.

358

Atmospheric and turbulent fluxes measurements at King Georg Island

Marcelo Santini[1], Luciano Pezzi[1]
[1]Earth Observation General Coordination, National Institute for Space Research - OBT/INPE, São José dos Campos, Brasil

The Atmospheric Modeling Observation System (ATMOS) Project is an innovative project that aims improve the knowledge of sea ice-atmosphere-ocean processes. As part of ATMOS activities is to perform measurements of turbulent fluxes and atmospheric parameters. A micrometeorological tower installed in the coastal region of King George Island made these measurements. Here we present the results from 9 to 23 November 2019 when the research vessel used to deploy these sensors was present in this area in the Bransfield Strait. Air temperature varied from - 3.6 to 6.5 ^{o} C, soil temperature from -0.3 to 7.6 ^{o} C, wind speeds of up to 35 m s^{-1}, with predominant northwest direction, short wave radiation reached values up to 1150 W m^{-2}. The momentum fluxes reached values up to 3.6 Kg $m^{-2}s^{-1}$, sensible and latent heat fluxes, in most of the period, presented positive values reaching up to 250 W m^{-2}. During the sampled period, the region behaved predominantly as a CO_2 source with an average positive flux of 0.21 µmol $m^{-2}s^{-1}$. During the campaign we had problems with the load controller, used to manage the solar and battery energy distribution, restricting our sampling this time only during the day. Even with this failure we consider to have a good quality data to study the interaction processes between coastal zone and atmosphere.

1310

Positive trend in regional sea level anomalies and Southern Annular Mode: the southern Brazil analysis

Venisse Schossler[1], Jefferson Cardia Simões[1], Francisco Eliseu Aquino[1], Pedro Amaral Reis[1]
[1]Centro Polar e Climático/Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Pressure gradients and winds play an important role in the regional sea level of the Southern Hemisphere (SH), currently associated with the positive trend of the Southern Annular Mode (SAM) positive trend. Furthermore, projections point to the vulnerability and effects of sea level rise of low-lying coastal countries in the SH. This work investigates regional sea level anomalies (SLA) in the southern Brazil continental shelf (SBcs - 30°–35° S and 49°–52° W) using altimeter data (1993–2019) post-processed by the X-TRACK (CTOH/LEGOS), indicated for coastal areas. We observe negative SLA from 1993 to 2009 and positive from 2010 to 2019, with upward trend throughout the period. We analyse the pressure and wind fields at sea level (ERA 5) and sea surface temperature and height anomalies (SSTA / SSHA - NOAA) in South Atlantic (SAt) in these two periods: 1993–2009 and 2010–2019. In relation to the first period, the second shows the enhance in Hadley and Walker cells and trade winds, in addition to greater SSTA and SSHA in ASt. The ASt subtropical gyre and the zonal winds in 45°S contribute to the intensification of western boundary current. A greater pressure gradient between the SAt surface and the southeast of South America is noteworthy. Regionally, the positive SAM brings an increase in sea level to the SBcs, caused by greater wind stress and variability in heat flows. Thus, we expect an intensification of the current scenario, since the trend of global temperature anomalies and SAM remain positive.

1401

An intercomparison of Antarctic NWP during the Year of Polar Prediction

Benjamin Schroeter[1]
[1]*Institute For Marine And Antarctic Studies, Hobart, Australia*

The Special Observing Periods (SOPs) of the Year of Polar Prediction present an opportunity to assess the skill of Numerical Weather Prediction models operating over the Antarctic, many of which assimilated additional data made available during these periods through enhanced observational frequency. Hence, the outputs of these models are some of the most observationally-informed to date for the Antarctic, allowing clearer examination of model performance as a result of parameterisation, rather than lack of observations. This intercomparison evaluates several NWP models operating in the Antarctic during a SOP to assess model performance and identify key areas of systematically stronger/weaker performance to inform model development.

1323

Analysis of high-resolution precipitation and wind events in the Ross Island Region, Antarctic through remote sensing observations

Mark Seefeldt[1], David Kingsmill[1], John Cassano[1]
[1]*University Of Colorado - Boulder, Boulder, United States*

Studies of high-resolution wind features, and to a much lesser degree precipitation, in the Ross Island region, Antarctica have been investigated through surface automatic weather station observations and numerical modeling. This presentation will investigate the precipitation and high-resolution wind features in the region through remote sensing observations. The observations for this study were collected during the Atmospheric Radiation Measurement (ARM) West Antarctic Radiation Experiment (AWARE) sponsored by the U.S. Department of Energy and National Science Foundation. AWARE occurred from 23 November 2015 to 5 January 2017 and made use of the second ARM mobile facility (i.e., AMF2). The primary AMF2 observing platform employed in this study is the X-band Scanning ARM Cloud Radar (XSACR), which was deployed on the southern tip of Ross Island near McMurdo Station. The focus of the study will be on three precipitation events, each associated with predominantly southerly flow in the lowest 3 km and containing at least 60 hours of widespread radar echoes from XSACR. The remote sensing observations will also be compared to output from the Antarctic Mesoscale Prediction System (AMPS). The comparisons to AMPS will be used to provide a larger understanding of the atmospheric dynamics and circulation and to assess the performance of AMPS in capturing the observed high-resolution features.

1261

The austral summer atmospheric vertical structure characteristics of Zhongshan Station in 2018-2019

Hui Shen[1]
[1]*National Marine Environmental Forecasting Center, Beijing, China*

Using the sounding data and the automatic weather station（AWS）data of the Zhongshan Station Meteorological Station during the 35th Chinese National Antarctic Expedition (CHINARE) in austral summer 2018-2019(Year of Prediction Plan Special Observing Period (YOPP SOP) in the Southern Hemisphere), the atmospheric vertical structure and surface climatic conditions of the Zhongshan Station in the austral summer of 2018-2019 were analyzed. Comparing with the climatic mean, the wind speed , relative humidity and temperature appeared a higher bias, but lower air pressure were observed at Zhongshan Station in summer austral 2018-2019. the average height of lapse-rat e tropopause (LRT) near Zhongshan Station is 8 550 m, and the average height of cold-point tropopause (CPT) is 9 300 m. The corresponding temperatures are –52.8 °C and –55.3 °C, respectively. The corresponding average wind speeds at the top of the troposphere are 18.9 m/s and 16.9 m/s. Compared with the sounding observation data, the NCEP/NCAR and ERA Interim reanalysis data have less error in temperature and a larger error in wind speed. The average performance of the two reanalysis data in the Zhongshan Station area is not much different. Under different weather conditions, the vertical distribution of tropopause height and wind speed is quite different at Zhongshan Station in the austral summer of 2018-2019.

317

First efforts of the Antarctic Modeling and Observational System (ATMOS) in coupling the ocean-atmosphere system of the Antarctica through numerical modeling

Ueslei Adriano Sutil[1], Luciano Ponzi Pezzi[1], Jonas Takeo Carvalho[1], Marcelo Freitas Santini[1], Eliana Bertol Rosa[1], Claudia Klose Parise[2], Joel Rubert[1], Joey Voermans, Bruna Pavani[4], Gabriel Bonow Munchow[5], Mylene Cabrera[1]

[1]National Institute For Space Research, São José Dos Campos, Brazil, [2]Federal University of Maranhão, São Luís, Brazil, [3]University of Melbourne, Melbourne, Australia, [4]Aeronautics Institute of Technology, São José dos Campos, Brazil, [5]Federal University of Rio Grande do Sul, Porto Alegre, Brazil

Since there are very few in situ measurements systems around Antarctica applied to studies of air-sea fluxes, the Brazilian National Institute for Space Research (INPE) conceived the Antarctic Modeling and Observational System (ATMOS), a project aimed at optimizing our understanding about sea ice-ocean-atmosphere-waves interaction in the Southern Ocean. Using a regional coupled numerical modeling system, we will investigate the air-ocean-wave-sea ice interaction in the Atlantic Sector of the Southern Ocean in order to join efforts to understand the exchanges of heat that occur at the ocean-atmosphere interface under the influence of the presence or absence of sea ice. We will perform two simulations: one coupling the sea ice model to an atmospheric and a hydrodynamic model and another one without the sea ice coupling, using dataset from November, 2019 to February, 2020 and then compare the model output with an deployed buoy and a weather station located at -50.17 ºW, -62.19 ºS. At this location, the buoy is protected from the influence of the Antarctic Circumpolar Current and the data consist of a wind generated waves and ocean swell. Our work is still in progress, since the full dataset is currently being analysed. The influence of the sea ice on the heat fluxes in the Atlantic Sector of the Southern Ocean will be discussed and we expect that our efforts will provide unpublished data to propose physical mechanisms that can explain the role of the ocean and the atmosphere in restoring the equilibrium state of sea ice.

236

First results of the Low Cost Atmosphere Measurement Device (LCAMD), developed under Antarctic Modeling and Observational System (ATMOS)

Ueslei Adriano Sutil[1], Luciano Ponzi Pezzi[1]
[1]National Institute For Space Research, São José Dos Campos, Brazil

Antarctic Modeling and Observational System (ATMOS) is a scientific project conceived by the Brazilian National Institute for Space Research (INPE) to improve our understanding on sea ice-ocean-atmosphere-waves interactions of the Southern Ocean. One of ATMOS umbrella projects is to build a system of arduino-based low cost devices to gather data to be assimilated on a regional coupled modeling system. We developed the first Low Cost Atmosphere Measurement Device (LCAMD) prototype in a Pelican Case equipped with a ESP32-DevKitC development board with a DHT22 and BME280 sensors to measure Air Temperature (Tair), Pressure (Patm) and Relative Humidity (RH). In order to prospect LCAMD ability to collect data on extreme weather and climate, we placed our first prototype on Comandante Ferraz Antarctic Station, at the King George Island, at 7 meters high. LCAMD collected data from 14 to 18 February 2020 and we compared the data with a near weather station located at the Chilean Base Frei Montalva President. It was possible to observe the passage of low pressure system through the region, when, at the first 24 hours, the pressure drops from 987 to 981 hPa. Although at the night both compared data showed similar results, during the day we observed a bias in Tair and RH, possible related to LCAMD protection used against radiation and snow/rain. In the future, we plan to facilitate exchange of air inside the device still protecting against severe weather, then develop more devices to deploy in several sites to collect data during the austral summer.

1301

Climate Variability in the West Antarctica and its Predictability Potential on different time scales

Vladyslav Tymofeev[1], Vazira Martazinova[1], Oksana Mazepa[2]
[1]Ukrainian Hydrometeorological Institute, Kiev, Ukraine, [2]Taras Shevchenko National University, Kiev, Ukraine

Assessment of the climate change in the West Antarctic sector (WAS) and its predictability potential mainly for the Antarctic Peninsula (AP) region is the main purpose of the research. El-Nino-Southern Oscillation (ENSO), and in particular El Niño, was found to be responsible for the recent regional climate variability and individual climate extremes. An increase in the near-surface air temperature (SAT) has been peaked at the western coast of AP to the end of 20th century, during the warm ENSO phase. It is shown how the large-scale atmospheric circulation in the West Antarctic sector varies depending on the ENSO phase; the ENSO signal is traced to the lower stratosphere.
The recent warming period is characterized by intensified westerlies and prevailing cyclogenesis within the WAS. Climate after the beginning of the 21st century is characterized by the cessation of surface warming in the AP region, along with changes in the atmospheric circulation, the most important is the increased residence time of its patterns.
A high synchronous and asynchronous correlations are found between SAT anomalies in the AP and set of the oceanic indexes; with the best correlation reached through the East Pacific and South Atlantic index. Statistical forecast schemes for the seasonal SAT for the Antarctic Peninsula stations are obtained. Atmosphere and ocean teleconnections as well as transitions between scales, from large-scale (hemispheric) to regional are showed. Climate projections for the 21st century are developed being based on established links of indexes and teleconnections, growing ENSO influence and geophysical parameters

327

Connecting the upper ocean to the atmosphere through ocean waves: a wave buoy mooring at King George Island

Joey Voermans[1], Luciano Pezzi[2], Marcelo Santini[2], Bruna Pavani[3], Eliana Rosa[2], Fabiane Furlan[2], Regiane Moura[2], Ueslei Sutil[2], Jonas Carvalho[2], Alexander Babanin[1]

[1]University Of Melbourne, Melbourne, Australia, [2]INPE, São José dos Campos, Brazil, [3]Universidade de São Paulo, São Paulo, Brazil

Ocean waves are critical in the coupled atmosphere-ocean system through the enhancement of fluxes of heat, energy and momentum across the air-sea interface and mixing of the upper ocean. Despite the continuous exposure of the Antarctic sea ice cover to energetic storm and wave events from the Southern Ocean there are very limited observation systems present around the Antarctic continent to define the interfacial fluxes and the role of ocean waves therein. To study the role of ocean waves in the air-sea coupled system we deployed a wave buoy mooring at 80-meter water depth near King George Island (62°S 58°W) during the Antarctic Summer from November 2019 till February 2020 in the absence of sea ice. The mooring facilitates observations of the atmosphere, the upper ocean and waves. While sheltered from the Southern Ocean by King George Island, waves in excess of 3 m were recorded and consist of a combination of wind generated waves and ocean swell. As the full data set is currently being analysed, this work is still in progress. The influence of waves on the fluxes of heat and momentum will be discussed and is expected to signify the importance of waves in the air-sea coupled system. More observations of waves around the Antarctic continent are required to further improve our understanding and parameterization of air-sea-wave interactions.

422

The Influence of Non-static Sea Ice on the Numerical Weather Prediction

Zhaohui Wang[1], Phil Reid[2], Alex Fraser[3], Siobhan O'Farrell[4], Richard Coleman[1]
[1]University Of Tasmania, Hobart, Australia, [2]Australian Bureau of Meteorology (BoM), Hobart, Australia, [3]Australian Antarctic Program Partnership (AAPP), Hobart, Australia, [4]The Commonwealth Scientific and Industrial Research Organisation (CSIRO), Melbourne, Australia

Antarctic sea ice is an important component of the weather and climate system, modulating radiative and moisture fluxes across the ocean/atmosphere interface and the momentum transfer from the lower atmosphere to the ocean within the higher southern latitudes of the Southern Ocean. These quantities can vary quite rapidly in regions and times of the year where sea ice advances or retreats quickly over large areas (e.g., May – advance, and December - retreat). It is suggested that these quantities are not well represented in Numerical Weather Prediction (NWP) forecasting models when using static sea ice, particularly during times of rapid advance and retreat. In this research, the polar-optimised Weather Research and Forecasting model (Polar WRF) is implemented to investigate how the static sea ice in NWP model impacts the short-term (to +10 days) weather forecast in the whole southern hemisphere, especially the Antarctic region, compared to daily-updated sea ice. In this presentation we quantify the improvement to Antarctic (and lower-latitude) NWP when using more realistic (daily-updating) sea ice fields, and attribute the improvement to various components on the simulated atmosphere (e.g., radiation balance, humidity, cloud, heat flux, etc.). Our results, based on 2018, indicate that inclusion of more realistic sea ice fields into regional NWP should be a priority for national NWP programmes.

1620

The Southern Hemisphere sudden stratospheric warming of September 2019

Xiaocen Shen[1], Lin Wang[1], Yuyun Liu[1], Scott Osprey[2]
[1]Institute Of Atmospheric Physics Chinese Academy Of Sciences, Beijing, China, [2]University of Oxford, Oxford, United Kindom

A sudden stratospheric warming (SSW) is observed in the Southern Hemisphere during September 2019, causing the most substantial stratospheric polar warming since 1979. Although the polar night jet did not reverse to easterlies at 10hPa, the polar-cap temperature rose by 70K within approximately three weeks, exceeding that of the 2002 major SSW. The exceptional warming suppresses the formation of polar stratospheric clouds, facilitating the smallest Antarctic ozone hole on record. Diagnostics suggest that this SSW is caused by the enhanced upward propagation of zonal wavenumber 1 Rossby waves from the troposphere, which is the strongest and most persistent on record. The abnormal zonal wavenumber 1 planetary wave behavior is further attributed to a tropospheric wave train emanating from the subtropical Pacific surrounding Norfolk Island and its downstream development. Plausible links between this SSW, tropospheric circulation anomalies and the subsequent bushfires in eastern Australia warrants future investigation.

1077

Antarctic Atmospheric River Climatology and Impacts

Jonathan Wille[1], Vincent Favier[1], Irina Gorodetskaya[2], Cécile Agosta[3], Christoph Kittel[4], Jai Beeman[1], Nicolas Jourdain[1], Jan Lenaerts[5], Francis Codron[6]
[1]IGE - Institut des Géosciences de l'Environnement, Grenoble, France, [2]CESAM - Centre for Environmental and Marine Studies, Aveiro, Portugal, [3]LSCE - Laboratoire des Sciences du Climat et l'Environnement, Gif-sur-Yvette, France, [4]University of Liège, Liège, Belgium, [5]University of Colorado, Boulder , U.S.A., [6]Université Pierre and Marie Curie, Paris, France

Atmospheric rivers, broadly defined as narrow yet long bands of strong horizontal vapor transport, provide a sub-tropical connection to the Antarctic continent and are observed to significantly impact the affected region's surface mass balance over short, extreme events. When an atmospheric river makes landfall on the Antarctic continent, their signature is clearly observed in increased downward longwave radiation, cloud liquid water content, surface temperature, snowfall, surface melt, and moisture transport.
Using an atmospheric river detection algorithm designed for Antarctica and regional climate simulations from MAR, we created a climatology of atmospheric river occurrence and their associated impacts on surface melt and snowfall. Despite their rarity of occurrence over Antarctica (maximum frequency of ~1.5% over a given point), they have produced significant impacts on melting and snowfall processes. From 1979-2017, atmospheric rivers landfalls and their associated radiative flux anomalies and foehn winds accounted for around the majority of total summer surface melt on the Ross Ice Shelf and winter surface melt on the ice shelves along the Antarctic Peninsula. On the other side of the continent in East Antarctica, atmospheric rivers have a greater influence on annual snowfall variability. There atmospheric rivers are responsible for 20-40% of annual snowfall while controlling the inter-annual variability of snowfall across most of the region. Many of the moisture or marine air responsible for high precipitation and melting events described in past studies were identified as atmospheric rivers so there are advantages in using the atmospheric river framework to connect these and future events.

216

Warm-moist air intrusion into the polar regions enhancing cloud longwave radiation and contributing to the warming

Takashi Yamanouchi[1], Naohiko Hirasawa[2]
[1]National Institute of Polar Research, Tachikawa-shi, Japan, [2]National Institute of Polar Research and SOKENDAI (The Graduate University of Advanced Studies), Tachikawa-shi, Japan

The warm-moist air intrusion from low latitude greatly contributed to the warming in the Arctic (Yamanouchi, 2019). Clouds activated by intrusion together with water vapor and high air temperature increased downward longwave radiation (LD), and contributed greatly to the extreme warming in winter 2015/16 Arctic. This was a part of the mechanism explained by Yoshimori et al. (2017) using climate model. On the other hand, similar increase of LD was found in the occasion of warm and moist air intrusion into the Antarctic. One example of 130 W/m2 increase in LD was found at Dome Fuji Station in 1997, when abrupt temperature rise (+40°C) was caused by the strong ridge due to the blocking formation (Hirasawa et al., 2000), and LD also increased at Syowa Station. Intrusion of warm moist air was just comparable with the Arctic case. Also these intrusions with large amount of water vapor contributed to the accumulation and were called "Atmospheric river".

Looking at the similar abrupt LD increase in these 20 years (BSRN), most intrusions were not so steep and warming events seemed not so large in the Antarctic compared to the Arctic. Blocking which makes the intrusion deep is rather frequent in the Arctic, and makes the stronger intrusions much common in the Arctic. Also the topography – high ice sheet surface of the Antarctic continent – suppresses warm-moist air mass to penetrate deep into the continent. These might cause the warming suppression in the Antarctic compared to the warming amplification in the Arctic.

T

V

W

Y

Z

INTERNATIONAL SCIENCE COUNCIL

SCAR

SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

ISBN: 978-0-948277-59-7

www.scar2020.org