

WORLD METEOROLOGICAL ORGANIZATION

WWRP POLAR PREDICTION PROJECT (WWRP-PPP) YEAR OF POLAR PREDICTION IN THE SOUTHERN HEMISPHERE PLANNING MEETING #04 (YOPP-SH#04)

27–28 JUNE 2019

DOWNTOWN MARRIOTT HOTEL
170 LOCKWOOD BLVD.,
CHARLESTON, SC, UNITED STATES



Group Photo by NAVWAR

(back row, from left) Daniela Liggett, Eric Bazile, Steve Colwell, Deniz Bozkurt, David Bromwich, Jordan Powers, Kevin Manning, David Reusch, Jun Inoue, Kazutoshi Sato
(center row, from left) Lee Welhouse, Sophie Orendorf, Kirstin Werner, David Mikolajczyk, Sang-Jong Park, François Massonnet, Lin Zhang, Qizhen Sun, Paola Uribe
(first row, from left) Wonseok Seo, Matthew Lazzara (kneeling), Vito Vitale (kneeling),

1. Executive Summary

The fourth meeting of the Year of Polar Prediction Task Team active in the Southern Hemisphere (YOPP-SH) took place from 27 to 28 June 2019 in Charleston, South Carolina, USA. As in previous years, it was preceded by the annual Workshop on Antarctic Meteorology and Climate ([WAMC](#)), this year organized by [NAVWAR](#), the Naval Information Warfare Systems Command.

The meeting aimed at bringing together all parties involved in Antarctic meteorology and the advancement of this discipline through scientific research and improving operational support during the Year of Polar Prediction. In particular, the efforts in extra observations made during the YOPP-SH Special Observing Period (SOP) from 16 November 2018 to 15 February 2019 were reported during this meeting. In total, about 2,000 extra radiosondes have been launched during the SOP at 24 stations and research vessels by 13 nations involved. The high-resolution radiosonde data was collected by the British Antarctic Survey that hosts the publicly available ftp server <ftp://ftp.bas.ac.uk/src/YOPP-SH/radiosondes>. An overview on the additional radio soundings was also made available by NCAR http://www2.mmm.ucar.edu/rt/amps/information/YOPP_SH_SOP_raob_accounting.html.

Updates on various modelling, verification, and Observing System Experiments (OSE) efforts for YOPP-SH were presented at the meeting. Several nations have contributed during the YOPP-SH SOP1 with real-time numerical weather prediction output. Météo France now provides high-resolution weather forecasts for Antarctica during the YOPP-SH SOP1 available from the ftp server [ftp.umd-cnrm.fr](ftp://ftp.umd-cnrm.fr) (user: yopp/password: Arpege). Results from the SIPN South effort were presented, and an update from the YOPPSiteMIP group has been given at the meeting. These activities will be continued during the YOPP Consolidation Phase which is the final phase of YOPP lasting until the end of 2022.

In order to estimate the impact of YOPP, the Societal and Economic Research and Applications group of YOPP (PPP-SERA) is active in stakeholder engagement, collecting requirements of Antarctic operators using weather and sea ice forecasts for their decision-making. A Weather and Society workshop will therefore be organized in 2020 aligned with the SCAR meetings in Hobart, Tasmania. It was suggested to hold a Special Service Period during austral summer 2020/2021 where research investment could be assessed in regard of their benefits for safety in operations.

The Italian CAPIRE-YOPP schools project contributed significantly to the educational and outreach efforts of YOPP-SH. Almost four hundred school students have monitored for more than six months the activities carried out at the Italian-French Antarctic station Concordia and to some extent have worked with the data from there.

During the meeting, it was agreed to hold a second Southern Hemisphere Special Observing Period (YOPP-SH SOP2) during Antarctic winter. In order to cover the sea-ice growth in early winter, the current intent is to schedule it between mid-April to mid-July 2021. The ocean community will need to become involved with this.

The following is primarily based on notes by François Massonnet

2. Background and Introduction

David Bromwich introduced the context and goals of the meeting. YOPP-SH aims at coordinating Southern Ocean contributions to the Year of Polar Prediction but relies largely on initiatives from national programs. The first Special Observing Period (SOP) in Antarctica (16 November 2018-15 February 2019) is now over. There are two big items to be discussed during the two-day workshop.

1. The first big question is whether we will (need to) have a second Special Observing Period (SOP) in the Southern Ocean, in winter. If we decide to do it, we commit to...
 - a. ... do it, whatever happens;
 - b. ... find the funds to support it;
 - c. ... go beyond the SOP itself and come up with scientific contributions.

To place this first question in context, we have to note that there is a growing interest in Antarctic prediction year-round, including winter. Barbara Casati has shown that there is room for improving skill in winter. She also noted that the overall skill in summer during the first YOPP-SH SOP was not significantly different from preceding summers. This raises the question if we are making good use of the extra data that were collected. We also need to demonstrate that the first SOP brought measurable impacts, which is not so obvious so far from the overview statistics but may be very impactful for important events and their forecast lead time.

2. Another challenge is to go beyond the collection of extra data and make use of them in dedicated scientific studies to demonstrate the impact on predictions. That is, we need to ensure the legacy of the SOP activities beyond simple inclusion in the operational systems.

Something to keep in mind is that the national programs have their own timelines and agendas. A significant obstacle to a second SOP is the convince national agencies to provide the funding that will accommodate the extra observations. Currently, a significant share of the available funding is taken for logistics, so a message to bring up to national levels would be to invest in numerical weather prediction improvement to enhance logistic efficiency and safety and to facilitate successful execution of scientific field programs.

3. Presentations

David Bromwich. [*Year of Polar Prediction in the Southern Hemisphere – Update*](#)

- The first SOP was held in the period 16 Nov 2018-15 Feb 2019 and consisted of:
 - ~2000 extra radiosonde launches (twice the baseline), very well spread across Antarctica. The extra data went successfully into the Global Telecommunications System (GTS) and were assimilated into the forecast models.
 - Ship observations
 - Drifting buoy deployments
 - Ocean Observatories Buoy – high-frequency atmosphere and ocean data, including fluxes, so useful for evaluation of, e.g., reanalyses.
 - A coordinated sea ice prediction exercise (SIPN South) that highlighted the Ross Sea as a challenging region to forecast.

- New real-time numerical weather prediction (NWP) output from Chile and Météo-France, (to add to existing NWP systems: AMPS, ECMWF, China, and India). Special output from Météo -France and AMPS at model time steps at Supersites.
- Observing System Experiments (OSEs): one from AMPS and others from Japan and France.
- Educational and outreach activities at high school and university levels.
- Consolidation phase. Now that YOPP-SH exits the SOP “active” phase, it is critical to capitalize on outcomes and ensure legacy:
 - An overview paper on YOPP-SH for BAMS
 - A winter 2021 SOP?
 - The continuation of data-denial experiments for a winter SOP (need funding).
 - Support SCAR/COMNAP conference in Hobart, August 2020.

Kirstin Werner. [Update from the YOPP International Coordination Office](#)

- YOPP is particularly active on the web and social media, with several webinars and the YOPP YouTube channel (<https://www.youtube.com/channel/UCwPqw3Ed-FOEAMpzWkFHGEA>) and on Instagram (www.instagram.com/polarprediction)
- There is a YOPP data portal at <https://yopp.met.no>. This includes the Canadian Arctic prediction system CAPS.
- The PPP Steering group has welcomed three new members: Taneil Uttal, Machiel Lammers and Irina Sandu
- A new version of the YOPP Implementation Plan will be published soon.
- The Consolidation phase consists of six objectives: Research, Use by services in an operational context, Coordination, Outreach, Legacy, and Determining success
- Final YOPP meeting will likely be in Montreal, mid-2022.
- Blog: Polar Prediction Matters (<https://blogs.helmholtz.de/polarpredictionmatters/>) to capture the perspective of users.

Paola Uribe. [Chilean contributions to YOPP-SH SOP.](#)

- Launch of radiosondes from King Georges Island (tip of Antarctic Peninsula). Once a day, 2017-2019 summers.
- Polar WRF forecasts run every 12 hours for 120 hours. Nested domains: 1 of 50 km resolution including 1 nest of 10 km and 3 nests of 2 km.
- The interest of Chile to participate in a second SOP is so-so and depends on manpower available (uncertain at the moment).

Qizhen Sun. [Observations at Chinese stations during YOPP-SH.](#)

- Radiosonde launches at Dome A (twice daily for ten days in January 2019) and Zhongshan (in Prydz Bay, daily mid-December-February 10). Time-height plots for temperature, wind, relative humidity available.
- AWS deployed at 1 new site in 2019.
- Plans: UAV activities, Dome A Station, more AWS deployments especially inland of Zhongshan, fixed wing aircraft flights.
- Involvement for a second SOP: why not?

Eric Bazile. [Extra radiosonde data at Dumont d’Urville.](#)

- Frequency of launches tripled during SOP.
- SOP data usage in ARPEGE: The 06 and 18 UTC data go from 0 to ~50,000 data points during the SOP. The 00 and 12 UTC data are enhanced by ~30-50%.

- The addition of 00 and 06 UTC launches revealed that the ARPEGE model has a diurnal cycle in the temperature profile bias.
- Involvement for a second SOP: Not against it, but would perhaps need a support letter from WMO. Also take into account the fact that the budget is decreasing. The problem is that the planned SOP is longer than the first one (five months instead of three months: **Update** Will be 3 months in duration) and it's winter (more constraints to have men out). The WMO letter could be drafted together with the WMO letter for the SOP during MOSAiC in winter/spring 2020.

Kirstin Werner. [*AWI contributions to YOPP-SH.*](#)

- A little bit less than four launches a day from German Neumayer station and RV Polarstern during the SOP.
- Resolving the six-hour variability helps to capture diurnal variability (Holger Schmithüsen).
- Snow buoys released in the Weddell Sea (Stefanie Arndt).
- Active Surface Velocity Profilers (SVPs) deployed. One did a full turn around Antarctica, and still alive after 1242 days.
- Proposed Winter SOP: Cruise from mid January-mid March 2021 already scheduled that will deploy 6 snow buoys and 6 ice mass balance buoys in the Weddell Sea.

Jun Inoue. [*Japanese Contributions to YOPP-SH.*](#)

- Additional radiosondes during the SOP from Syowa, Dome F, and Shirase reached the GTS.
- AWS observations from 3 sites similarly went to the GTS.
- OSEs show the largest reductions in forecast errors are over Terre Adélie region and the Lazarev Sea (Sato et al. 2020).
- ECMWF (using extra radiosonde data from Dome Fuji) vs. JMA (not using them) forecasts show that the passage of a low-pressure system is less accurately predicted in JMA, that is, when radiosonde data from Dome F are not assimilated.

- Participation in proposed winter SOP: contingent on national support.

Vito Vitale. [*Italian contributions to YOPP-SH.*](#)

- Many projects/programs ongoing in all aspects (ocean-sea ice-atmosphere).
- Radiosonde launches from Terra Nova and Concordia from one up to four per day.
- 2006-now data from Concordia station (Antarctic continent) available.
- Precipitation data
- MORSea: Marine observatory. Long-time measurements (1996-2014) of temperature & salinity along vertical, studies of the ACC from XBTs.
- Snels et al., 2019: Monitoring of polar stratospheric clouds.

- Six YOPP projects funded via a 2018 call for proposals.
- Involvement in the proposed winter SOP: possible, but one has to be aware that operating Concordia base (inland) in winter is costly.

Sang-Jong Park. [*Korean contributions to YOPP-SH.*](#)

- King Sejong Station and Jang Bogo Station: One radiosonde launch a day on average at each site during SOP.
- Estimates of tropopause height and boundary-layer height in December 2018: ~9 km and 700 m, respectively.
- Very interested in SOP2, but the budget for the next 3 years will be determined by Dec. 2019.

Steve Colwell. [*BAS contributions to YOPP-SH.*](#)

- Extra radiosonde launches: 2/week at Rothera, 1/day at Halley.
- ORCHESTRA project: understand Southern Ocean heat and carbon uptake (<https://www.bas.ac.uk/project/orchestra/>)
- Flux measurements from an airplane (BAS Twin Otter) going up and down along transects.
- BAS hosts high-resolution radio sonde data (<ftp://ftp.bas.ac.uk/src/YOPP-SH/radiosondes>). Don't forget acknowledgment. Suitable for OSEs.

Matthew Lazzara. [*A few US contributions to YOPP-SH.*](#)

- Runs extensive U.S. AWS network.
- GTS distribution of AWS observations involves many steps: getting funding from NSF, convert to GRIB format, attach WMO headers, send the data to NOAA, then NOAA to GTS.
- U.S. has a well-organized network (Antarctic IDD) through which data flows involving U. Wisconsin, NOAA, Colorado University, NCAR, NIWC among others.
- Stabilizing the Antarctic Meteorological Data Research Center is a short-term goal
- WAIS Divide data: first observations in West Antarctica in decades.
- Second SOP: target on what makes winter special: cold and highly stable boundary layer. Motivations are many: medical evacuations, extending the field season, winter flight operations, improve predictability at a challenging time of year.

Wonseok Seo. [*Characteristics of the vertical structure of temperature, wind, and humidity.*](#)

- Autosonde measurements at Terra Nova Bay.
- Reduction of northwesterlies during YOPP-SH.
- ABL height correlated to sensible heat flux variability.

Daniela Liggett. [*PPP-SERA.*](#)

- Societal and Economic Research and Applications (SERA) task team of the PPP.
- Contributed to the Polar Prediction Matters blog.
- Making sure the impact of YOPP is realized .
- Will be PPP regional Weather and Society workshops (including the Antarctic but also Alaska, Canada, Russia, European Arctic).

Scott Carpentier. [*Special Service Projects \(SSPs\).*](#)

- Quantification of investment of research measured by Benefit-Cost Ratio.
 - Example: 2000:1 ratio for heat warning service in Philadelphia (2000\$ saved for 1\$ investment)
- WMO has a “Strategy for Service Delivery” implementation plan (http://www.wmo.int/pages/prog/amp/pwsp/documents/WMO-SSD-1129_en.pdf).

Four-step roadmap: (1) partnerships, (2) projects designed at the national levels, (3) SSP undertaken, (4) evaluate outcomes.

- Not everything is quantifiable, but some relevant metrics can be drawn.
 - Example: efficiency function= missed flying days = season length * ratio of days where weather precludes flying * the effectiveness of forecasts in avoiding weather delays. This corresponds to the amount of money wasted. But re-evaluation after SSP could indicate how many such days, and so money was not wasted by making certain choices.

Jun Inoue. *[Potential Research Activity toward the Special Service Projects.](#)*

- Polar services include routing. Navigation for the ice-strengthened Mirai in the Arctic should be carried out only where sea ice thickness is less than 70 cm and concentration less than 10%; air temperature should be $> -15^{\circ}\text{C}$.
- Vessel Navigation Unit Support (VENUS) system: <https://ads.nipr.ac.jp/venus.mirai>
- Flights are delayed when passing over polar regions if environmental conditions are not anticipated.
- Sato and Inoue (2019): flight routing. <http://okhotsk-mombetsu.jp/okhsympo/src/11820/2019OSPOR-Sato.pdf>
- Uncertainty for flight forecasts over the Southern Ocean is greater than shown by the above Arctic study.

Paola Uribe. *Chilean weather and climate services.*

- Climate Services
 - Annual reports on the State of the Climate in Chile (incl. Antarctic Peninsula that is part of Chile). See Villaroel et al. (2018) for the 2017 report.
 - 2018 temperatures were above average in all seasons, especially in winter.
 - Teleconnections from Southern Chile to Santiago.
 - <https://climatologia.meteochile.gob.cl/>
- Weather Services
 - Monthly Antarctic Meteorology Bulletin
 - Ozone layer and UV radiation monitoring
 - Public forecasts are available.
 - Weather forecasts for aviation purposes.
- Training

Jordan Powers & Kevin Manning. *[YOPP-SH SOP Data Impact Study.](#)*

- Looks at the impact of adding extra radiosonde data in the forecasting of specific weather events during SOP and exploring the skill of different data assimilation approaches.
- Current RAOB data: http://www2.mmm.ucar.edu/rt/amps/status/prepbuf_r_aob_accounting.html
- WDK38HS “ghost” ship sends radiosonde data; no one knows who that is. (*Update*: it was the Norwegian research vessel Kronprins Haakon).
- Adding data has an impact on temperature aloft and surface pressure, as seen from the “background – analysis” difference fields.
- Plan to extend the analysis with satellite radiance data.

Eric Bazile. *[ARPEGE-SH prediction system over the Southern Ocean for YOPP-SH.](#)*

- An ARPEGE T1198 configuration (“ARPEGE-SH”) configuration was developed centered over Dome C, with resolution ~ 7.5 km.

- Nested configurations at ~1.3 km at Dumont d'Urville and Alexander Tall Tower.
- Both configurations are/will be coupled to 1D GELATO sea ice model.
- ARPEGE-SH improves over ARPEGE versus radiosonde data. ARPEGE-SH generally uses way more observations.
- Output available, in particular at YOPP supersites. <ftp://ftp.umr-cnrm.fr> / user: yopp / password: Arpege
- Diurnal cycle at Dome C underestimated versus observations.
- Coupling ARPEGE-SH to a sea ice model (GELATO) reduces the bias in T2m and reduces the RMS. Coupling with sea ice model also improves the diurnal cycle (too small amplitude for points over sea if no sea ice model coupled).
- For proposed winter SOP: ARPEGE-SH-GELATO output can probably be provided in near-real time.

François Massonnet. [SIPN South](#).

- Need for sea ice forecasts
- Sea ice thickness estimates are desirable
- Enhanced zonal winds in October -- enhanced southwesterly winds in the Ross Sea (Holland et al. Nat. Commns. 2017)
 - Delay sea ice formation in March/April
 - Storage of heat in the ocean that re-emerges in the autumn
- Climate models all over the place with differing estimates
- Sister project to SIPN2 (Arctic sea ice prediction).
- Started in 2017.
- **Supposed to end in 2019, but going to continue**
- Rapid melt in November and December 2018
- 1 Dec 2018 - 28 Feb 2019 -- call for forecast
 - ~200 contributing forecasts
- Start with high positive bias
- Statistical model -- low possible bias
- Difference between Antarctic and Arctic models lead to no [reduction or false] prediction
 - Far off from prediction
 - Problems with different initial conditions
 - Areas of overestimation and underestimation -- integrated
 - Ice edge error
- Dynamical models struggle
- 5-6 contributions for potential winter SOP

Taneil Uttal. [YOPPsiteMIP](#).

- Merged Observatory Data File: NetCDF file collecting all data at one site.
- Models currently producing time-step output at SuperSites: ECMWF-IFS (Global), ECCO-GPDS (Global), AROME (Regional), ARPEGE-SH (Global). [And AMPS as well now].
- Interested at looking at tendency terms using high-frequency output (7.5 min or 15 min) and compare with 1-min observations.

Vito Vitale. [CAPIRE-YOPP](#). *Italian Educational Project*

- “Capire” = Understand. Goal is to understand Antarctic weather forecasts via an extensive educational activity that involves hundreds of students, ages 10-16.
- Paintings, poems, etc.
- <https://volarebeyondyopp.blogspot.com/>

4. Discussions

1. New winter SOP. Everyone agrees it is scientifically interesting and well justified. What is more challenging is to get people and nations engaged.
 - a. A letter from WMO needed.
 - b. We commit to find funding for extra data collection
 - c. The first SOP was essentially about collecting more atmosphere and surface data and demonstrating the impact on prediction. We need to engage ocean people for the winter SOP, e.g. by communicating to SOOS and SORP that a second SOP will be undertaken (François).
 - d. Formal decision was made to hold the winter SOP.**
 - e. Period chosen: mid-April to mid-July 2021 to catch the sea ice increase.
2. White paper on SSP to be written for EC-PHORS.
3. Suggestion to extend YOPP-SH, as there will be only 1.5 years left after the second SOP. Idea has to be submitted to the PPP SG meeting. There will be an Antarctic Regional Climate Center Workshop in October 2019 (Bologna).
4. BAMS submission. Full submission by 15 December 2019.

5. References

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6. Acronyms

ABL	Atmospheric Boundary Layer
ACC	Antarctic Circumpolar Current
AMPS	Antarctic Mesoscale Prediction System
AWS	Automatic Weather Stations
BAMS	Bulletin of the American Meteorological Society

BAS	British Antarctic Survey
CAPS	Canadian Arctic Prediction System
COMNAP	Council of Managers of National Antarctic Programs
GTS	Global Telecommunications System
EC-PHORS	EC Panel of Experts on Polar and High Mountain Observations, Research and Services
ECMWF	European Centre for Medium-range Weather Forecasts
JMA	Japan Meteorological Agency
MIZ	Marginal Ice Zone
NIWC	National Information Warfare Center
NOAA	National Ocean and Atmosphere Administration
NSF	National Science Foundation
MOSAiC	Multidisciplinary drifting Observatory for the Study of Arctic Climate
OSE	Observing System Experiment
PPP	Polar Prediction Project
RAOB	RADiosonde OBServations
SCAR	Scientific Committee on Antarctic Research
SIPN South	Sea Ice Prediction Network South
SOOS	Southern Ocean Observing System
SORP	Southern Ocean Regional Panel
SVP	Surface Velocity Profilers
VENUS	Vessel Navigation Unit support System
WMO	World Meteorological Organization
WRF	Weather Research and Forecasting (Model)
YOPP(-SH)	Year of Polar Prediction (in the Southern Hemisphere)

ANNEX 1: AGENDA

Thursday 27 June		
13:00-13:10	<i>Welcome and Introduction</i>	Art Cayette & David Bromwich
13:10-13:25	An Overview of the Year of Polar Prediction in the Southern Hemisphere (YOPP-SH)	David Bromwich
13:25-13:35	Update from the YOPP International Coordination Office	Kirstin Werner
Session I – SOP Observations		Chair: David Bromwich
13:35-13:45	Chilean Observations/Contributions to the YOPP-SH Special Observing Period	Paola Uribe
13:45-13:55	Radiosonde observations at Chinese Antarctic stations during YOPP-SH	Qizhen Sun
13:55-14:05	Additional Sounding Observations at Dumont-D'Urville	Eric Bazile
14:05-14:15	German Contributions to YOPP-SH SOP	Kirstin Werner
14:15-14:25	Japanese Activities in Observation during the YOPP Period	Jun Inoue
14:25-14:35	YOPP-SH: The Italian contribution during the Special Observing Period	Vito Vitale
14:35-14:45	YOPP-SH Activities of the Korean Antarctic Stations during First SOP	Sang-Jong Park
14:45-14:55	UK contribution to YOPP-SH & YOPP-SH SOP Radiosonde Ascents Collected at BAS ftp Site	Steve Colwell
14:55-15:05	A U.S. Contribution to the Year of Polar Prediction	Matthew Lazzara
15:05-15:20	Characteristics of Atmospheric Boundary Layer at the Jang Bogo Station, Terra Nova Bay, East Antarctica during YOPP-SH	Wonseok Seo
15:20-16:00	Discussion (Observations YOPP-SH SOP)	
16:00-16:30	Coffee break	
Session II – From Research into Operations and Services		Chair: Kirstin Werner
16:30-16:45	The PPP Societal and Economic Research and Applications (PPP-SERA) task team: Recent developments and future plans	Daniela Liggett
16:45-17:00	Chilean Weather Service at the Antarctic Peninsula	Paola Uribe
17:00-17:15	PPP-YOPP Special Services Projects	Scott Carpentier (remote)
17:15-17:30	Potential research activities toward the SSPs	Jun Inoue
17:30-18:00	Discussion (User Engagement and SSPs)	
19:00	<i>Dinner in Town</i>	

Friday 28 June		
Session III – Special Efforts in NWP and Data Denial Experiments		Chair: David Bromwich
08:30-08:50	Developments in the YOPP-SH OSU-NCAR Data Impact Study and SOP Data Acquisition	Jordan Powers and Kevin Manning
08:50-09:05	Preliminary results of the numerical experiment done with the global model ARPEGE-SH for YOPP-SH	Eric Bazile
09:05-09:20	SIPN South: two years of coordinated seasonal sea ice predictions in the Southern Ocean	François Massonnet
09:20-09:40	Verification & YOPP SiteMIP in Southern Hemisphere	Taneil Uttal (remote)
09:40-09:55	Leveraging YOPP observations and modeling to enhance long-term characterization of the Eastern Antarctic Plateau	Dana Veron (cancelled)
09:55-10:05	CAPIRE-YOPP: an educational activity to bring students closer to meteorology in Antarctica	Vito Vitale
10:05-10:30	<i>Coffee break</i>	
10:30-11:30	Discussion (NWP & Winter YOPP-SH SOP)	
General Discussion & Wrap Up		Chair: David Bromwich
11:30-12:15	General Discussion	
12:15-12:30	Wrap up and Closure	

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