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de aveiro

Enhanced moisture transport towards Antarctica and low level jets: radiosonde measurements at the coastal stations and Southern Ocean



ETH zürich



Center for Western Weather
and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

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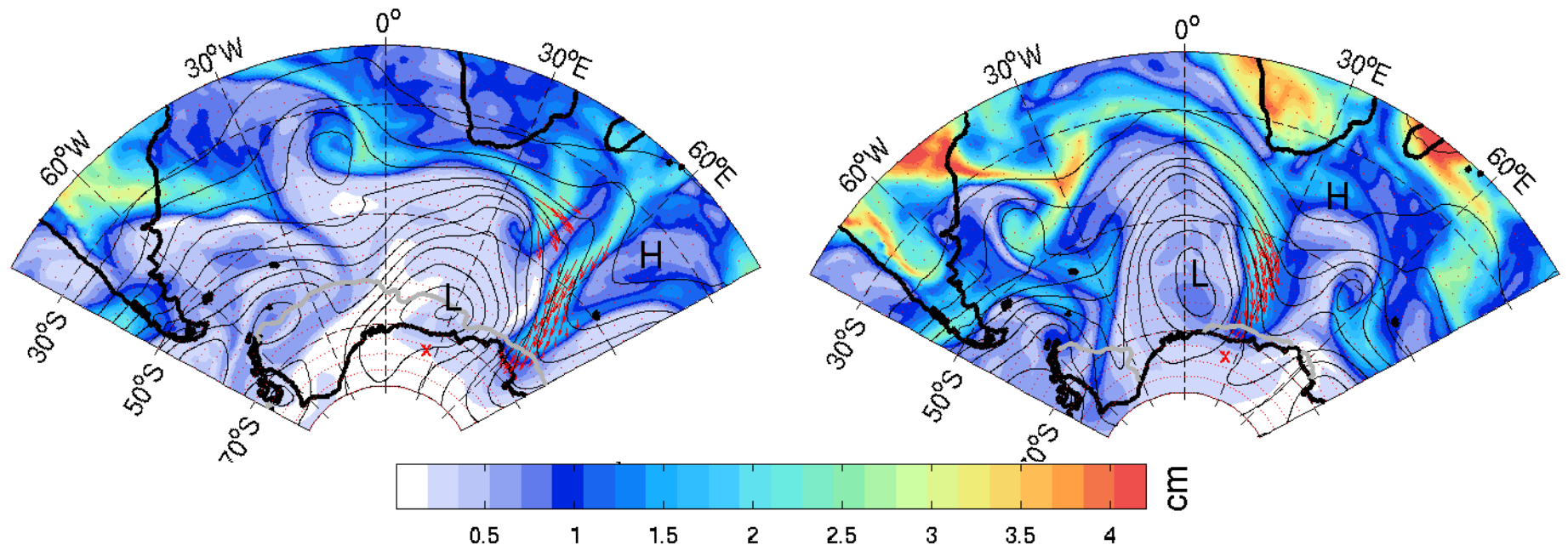
²ETH Zurich, Switzerland

³Brown University, USA

⁴Scripps Institution of Oceanography, UC San Diego, USA

Enhanced moisture transport (atmospheric rivers) affecting Antarctica:

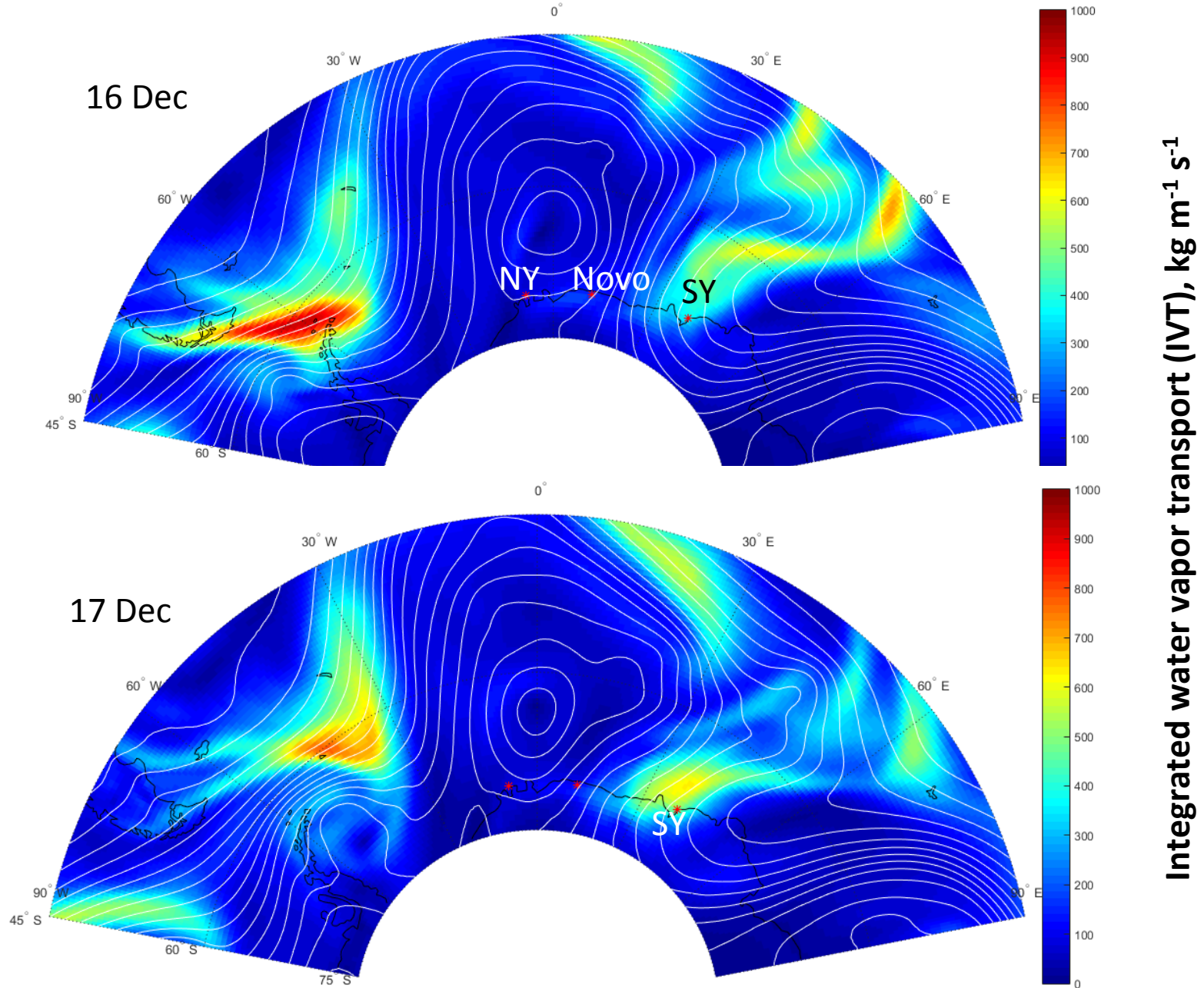
- what is the role of the cyclonic low level jet?
- what is the height and magnitude of moisture advection?
- does reanalysis capture these events?



Radiosonde measurements at several East Antarctic coastal stations

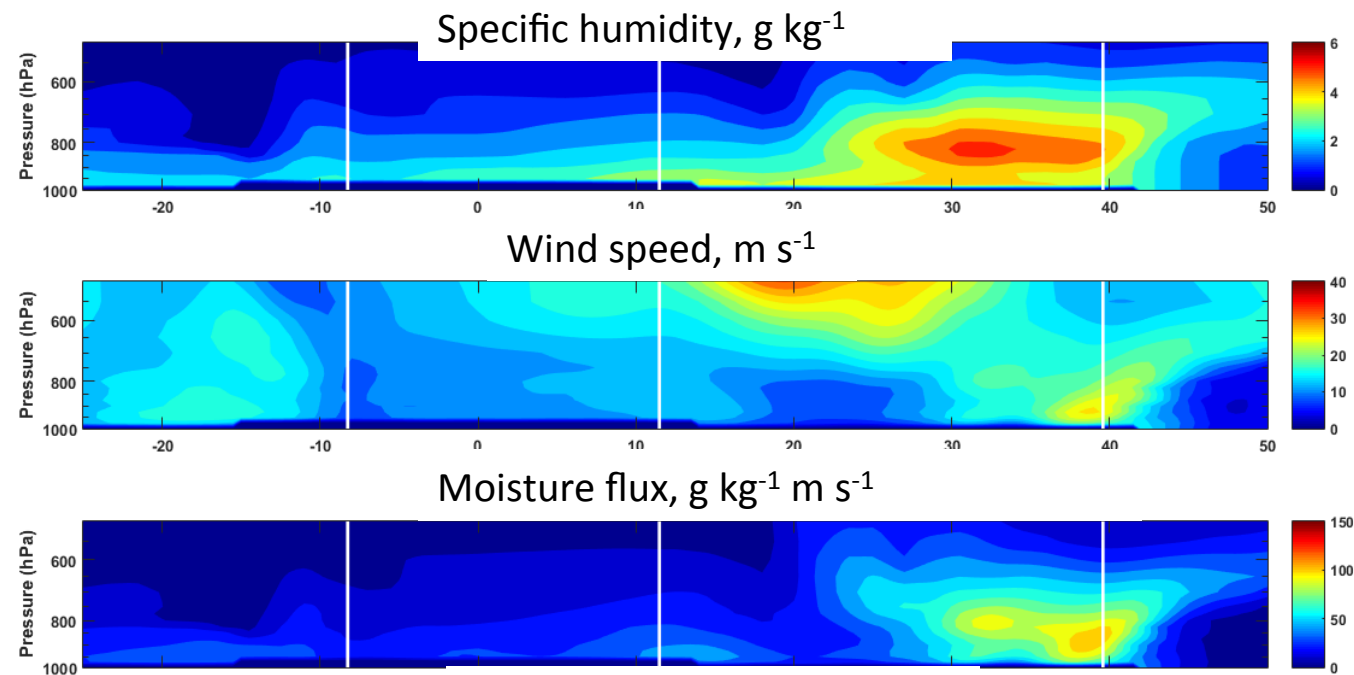


Atmospheric river event 16-17 December 2011 (ERA-Interim)

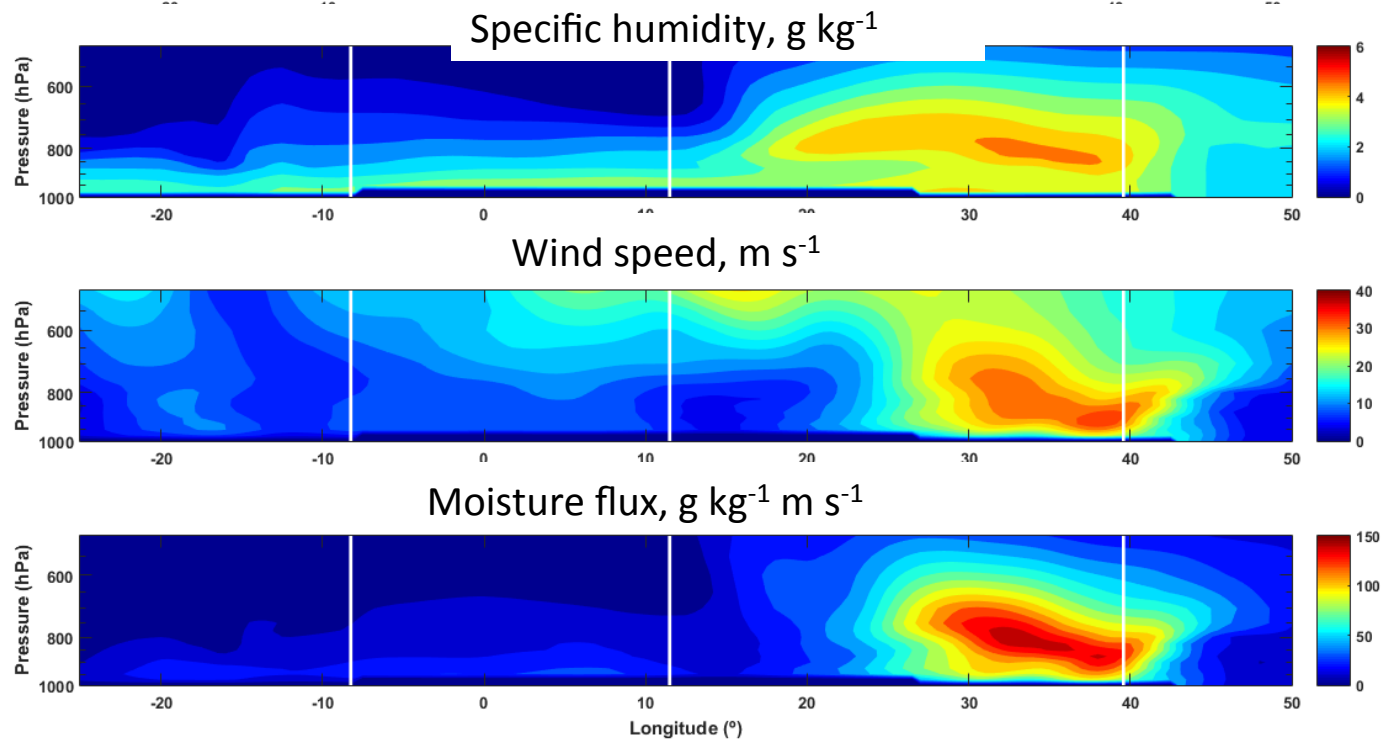


Vertical profiles at 69°S latitude, from 25°W to 50°E longitude (ERA-Interim)

16 Dec 2011



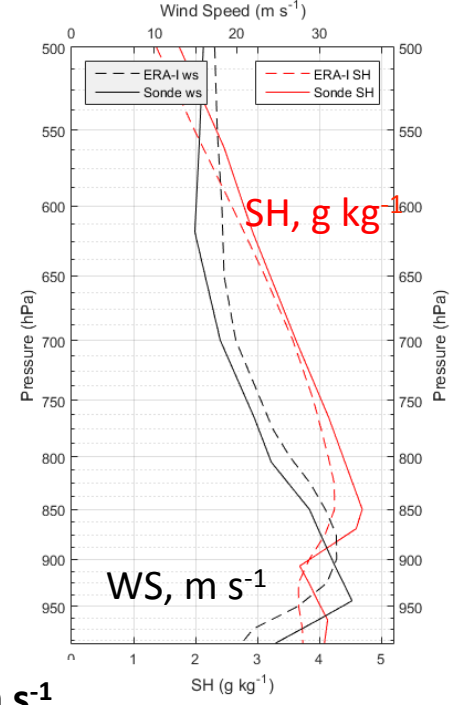
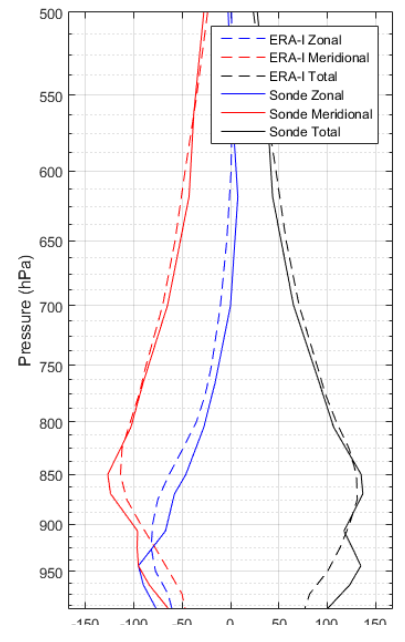
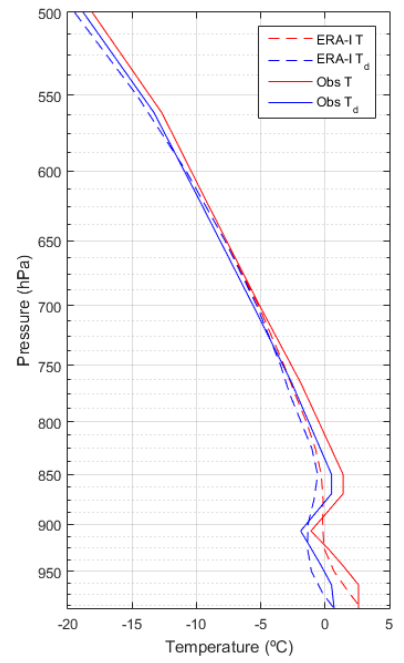
17 Dec 2011



Vertical profiles of
 air and dew temperature,
 specific humidity,
 wind speed from
 radiosonde measurements
 at **SYOWA** + calculated
 moisture flux

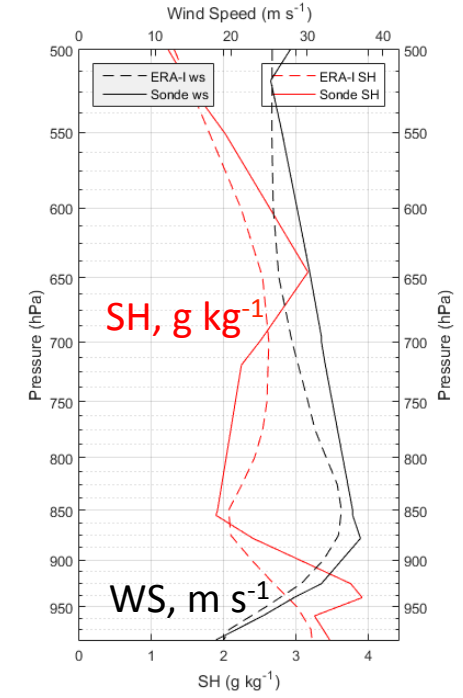
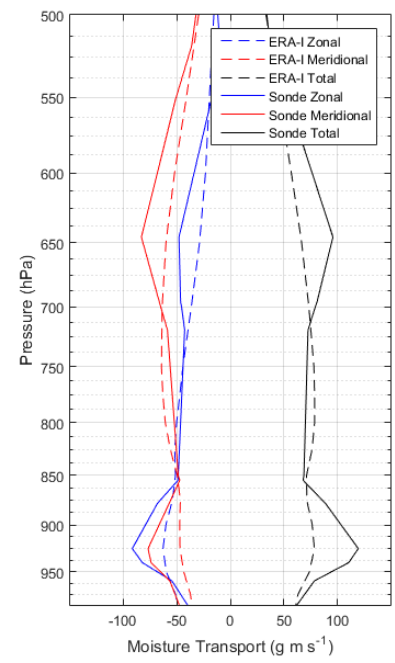
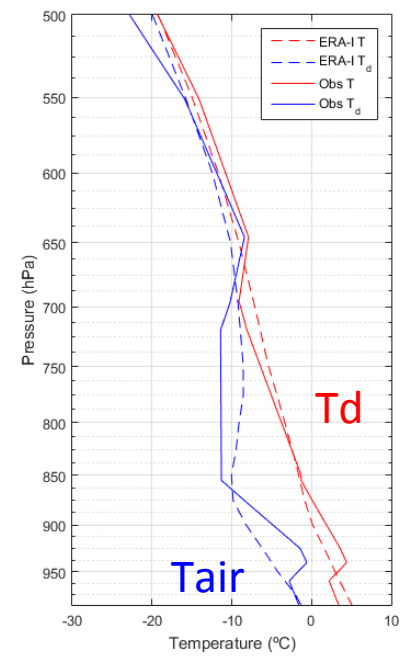
17 Dec 2011, **00Z**

Syowa: ERA-I lat -69 ° lon 39.5 °; Obs lat -69 ° lon 39.58 ° at 0Z20111217



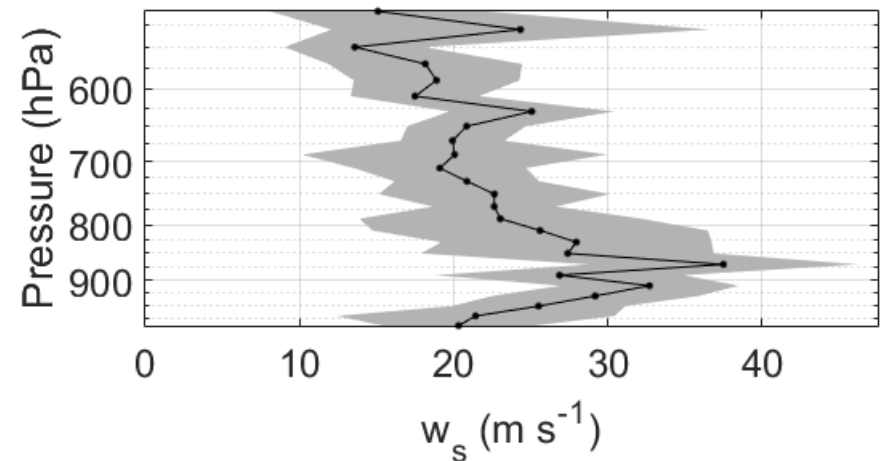
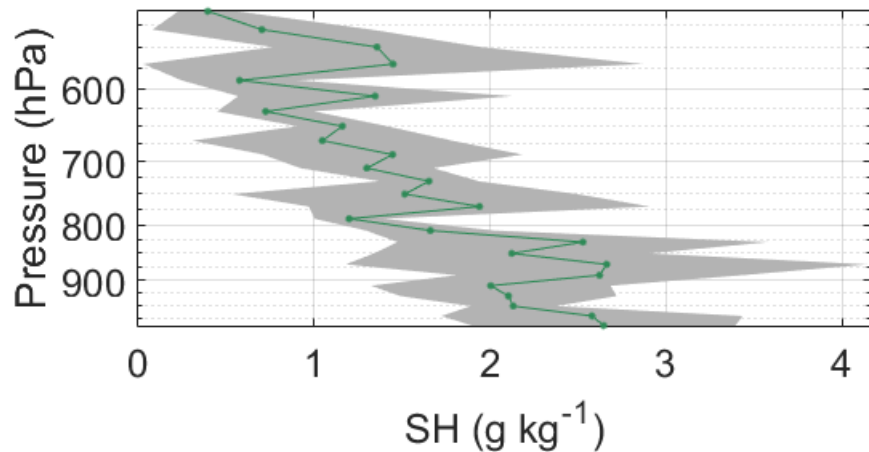
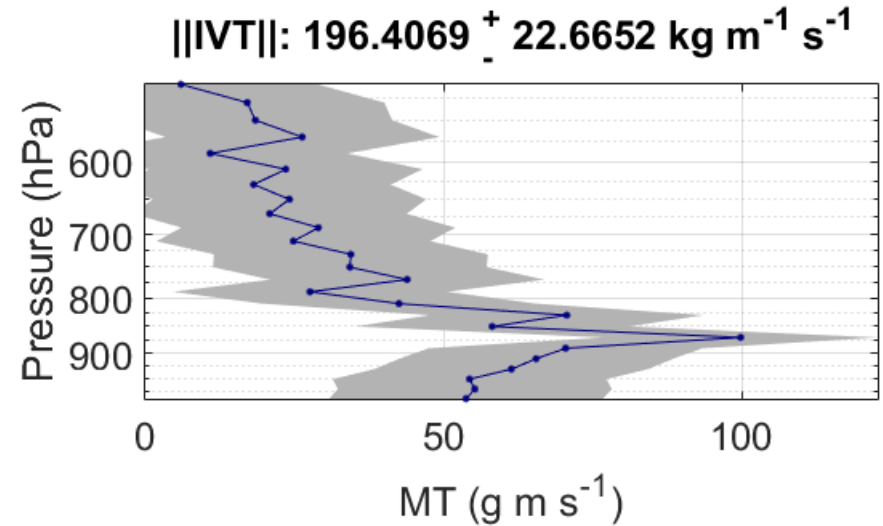
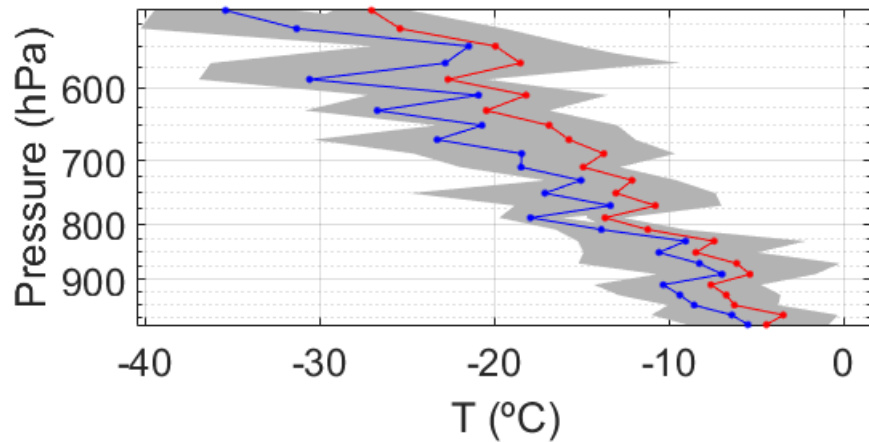
Moisture flux, $g\ kg^{-1}\ m\ s^{-1}$

Syowa: ERA-I lat -69 ° lon 39.5 °; Obs lat -69 ° lon 39.58 ° at 12Z20111217

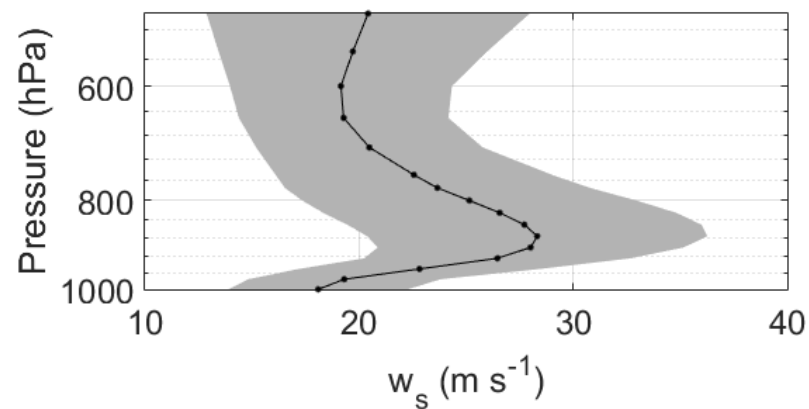
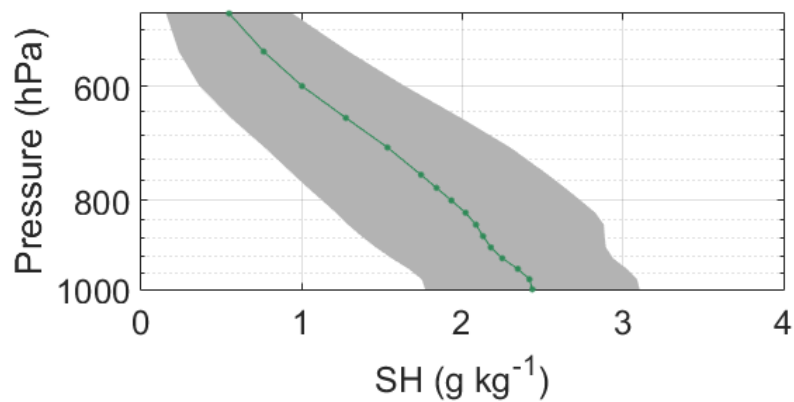
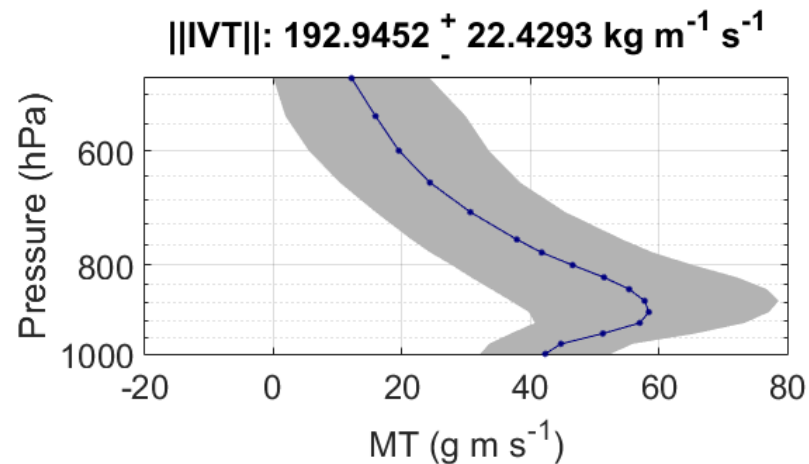
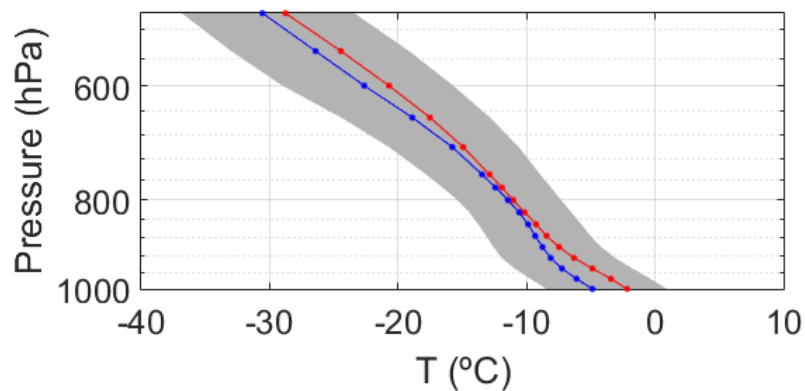


17 Dec 2011, **12Z**

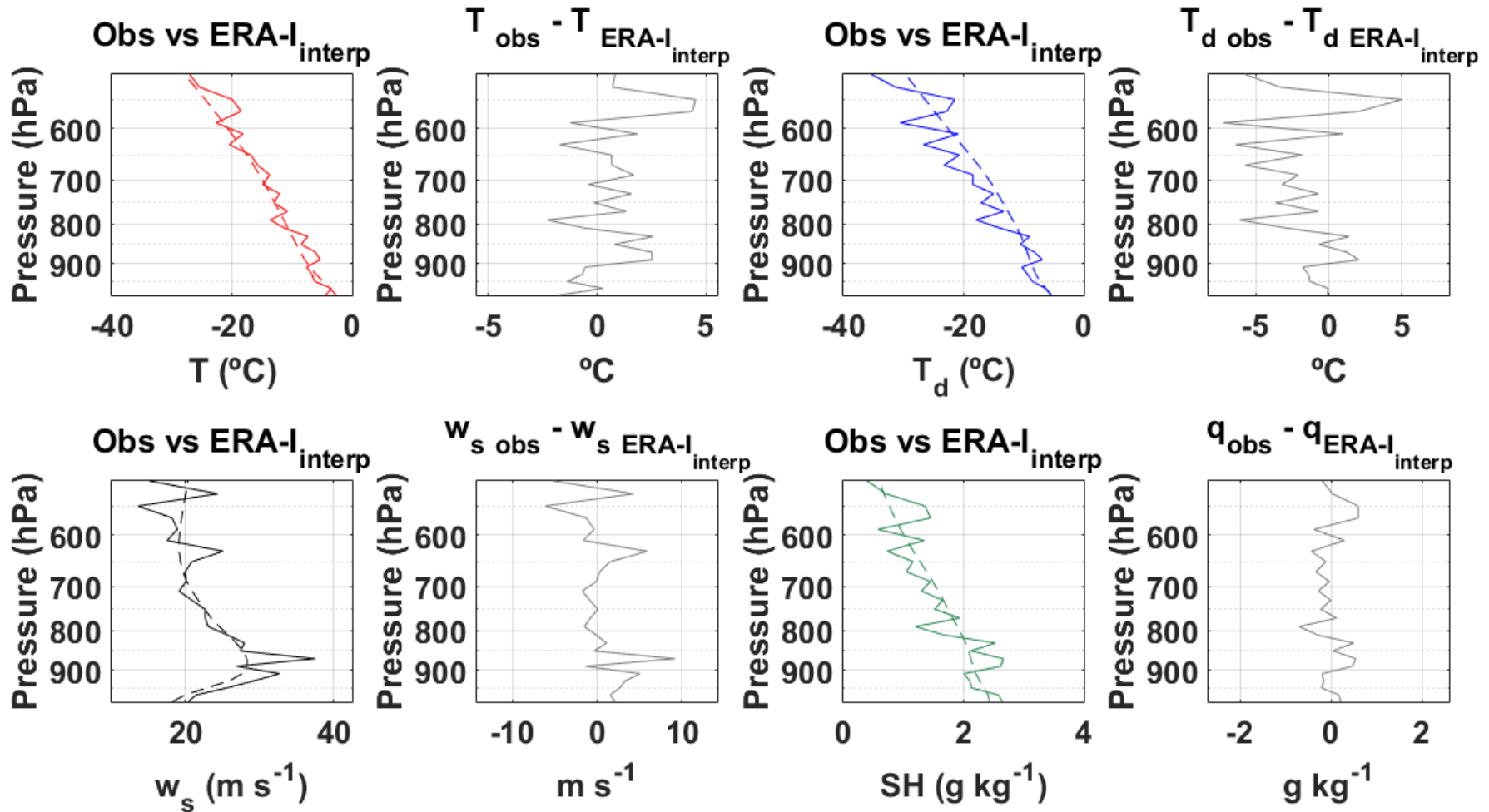
Average profiles and standard deviations (gray shading) for all enhanced MT events identified during 2009-2012 at DML stations (radiosonde measurements)



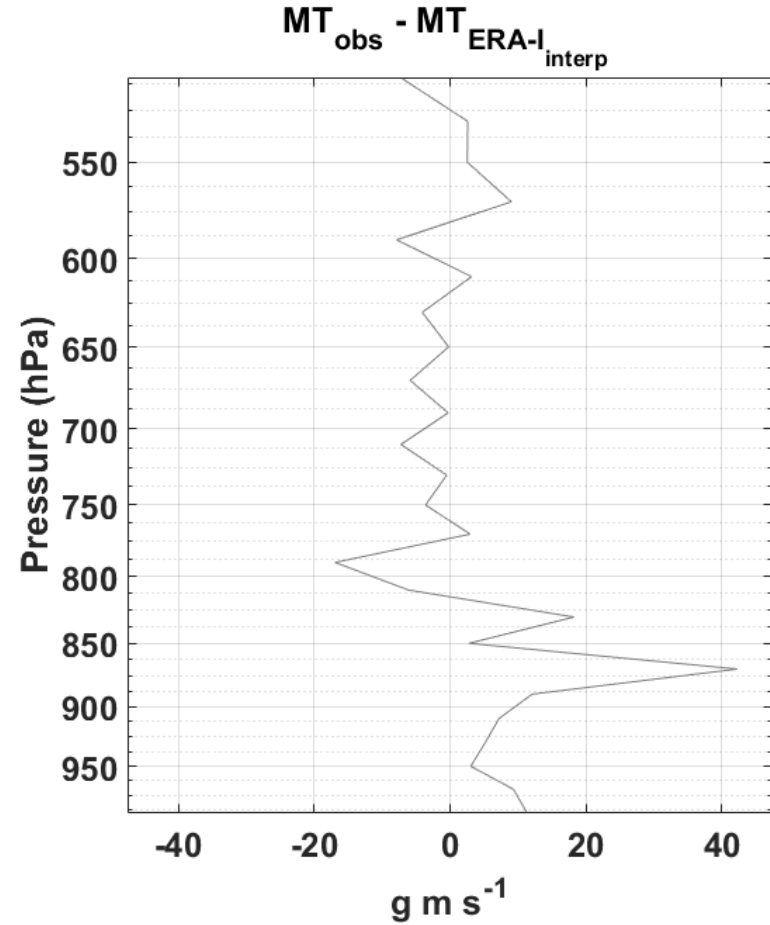
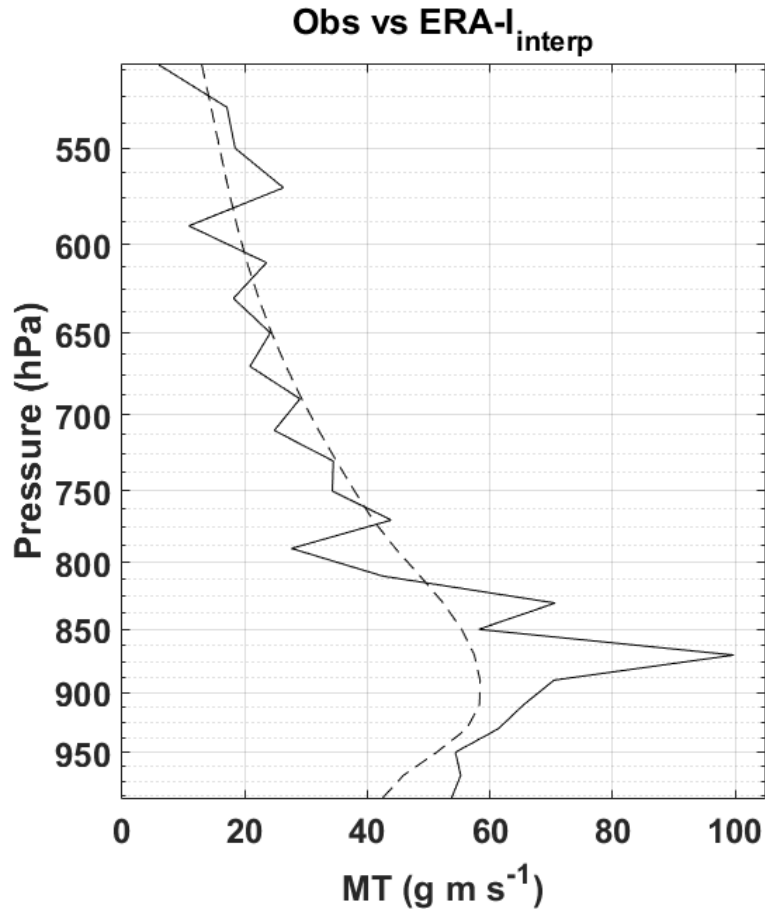
Average profiles and standard deviations (gray shading) for all enhanced MT events identified during 2009-2012 at DML station grid points (ERA-Interim)



Differences between Observations (solid) and ERA-Interim (dash) average profiles for all enhanced MT events identified at DML coastal stations



Differences between Observations (solid) and ERA-Interim (dash) average profiles
of the moisture flux profile
for all enhanced MT events identified at DML coastal stations





Expedition route:



Antarctic Circumnavigation Expedition
December 2016-March 2017 on board
icebreaker-type research vessel
"Akademik Tryoshnikov"

measurements for ACE project 18 (PI
Katie Leonard, EPFL/U Boulder)

+ other 21 other projects onboard!!



Expedition route:

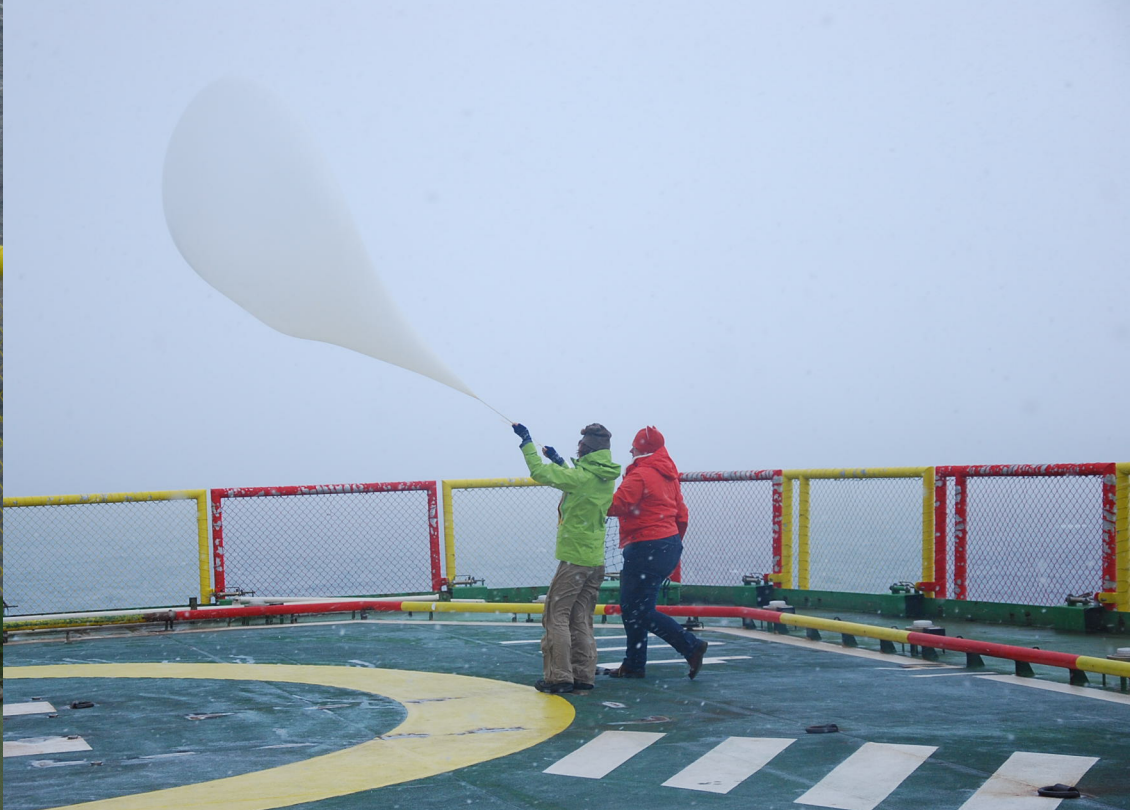


Antarctic Circumnavigation Expedition
December 2016-March 2017 on board
icebreaker-type research vessel
"Akademik Tryoshnikov"

Will show two AR events:

- 1) Indian Sector of the Southern Ocean (3-4 Jan 2017)
- 2) DDU/Mertz (9-10 Feb 2017)

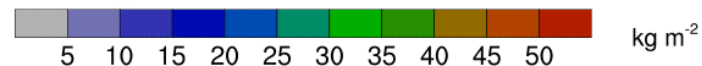
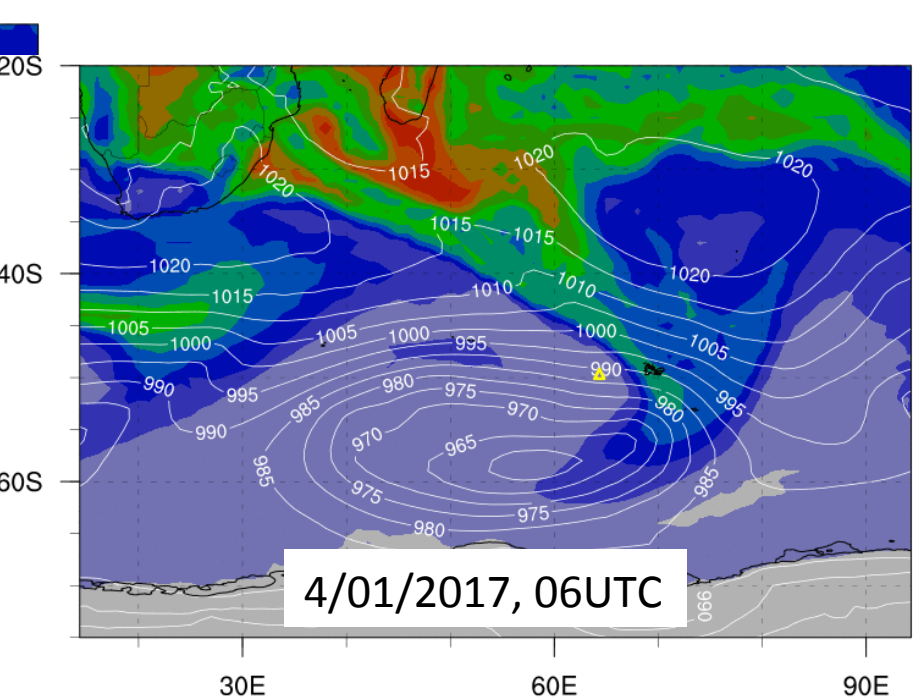
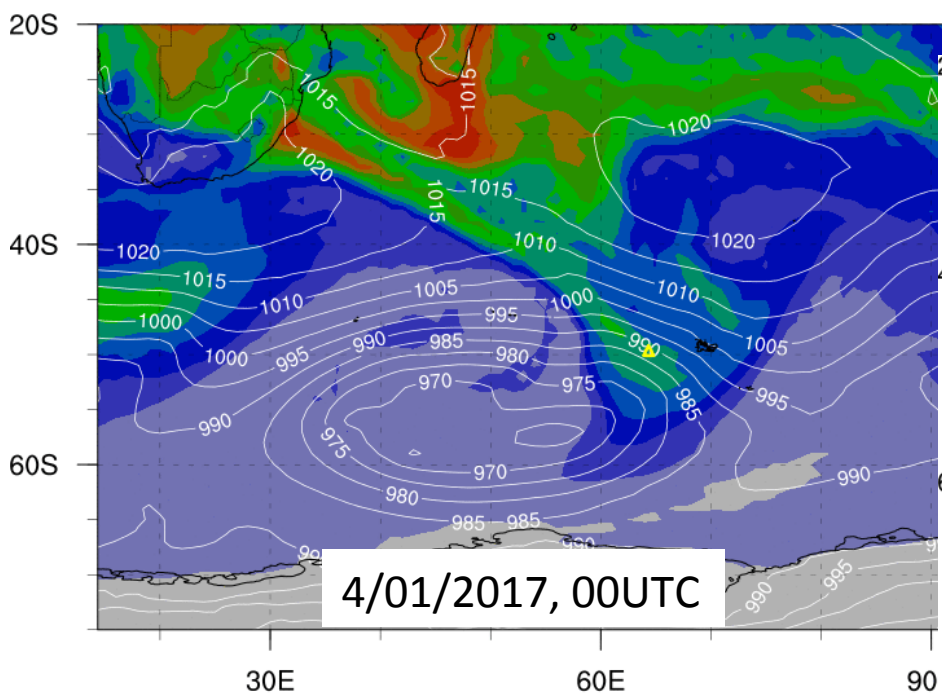
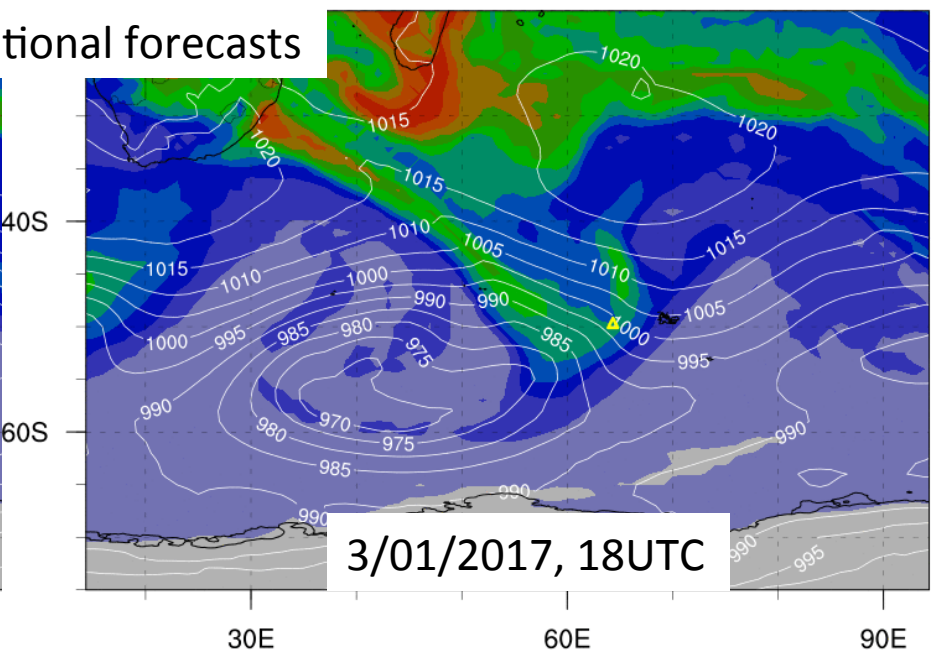
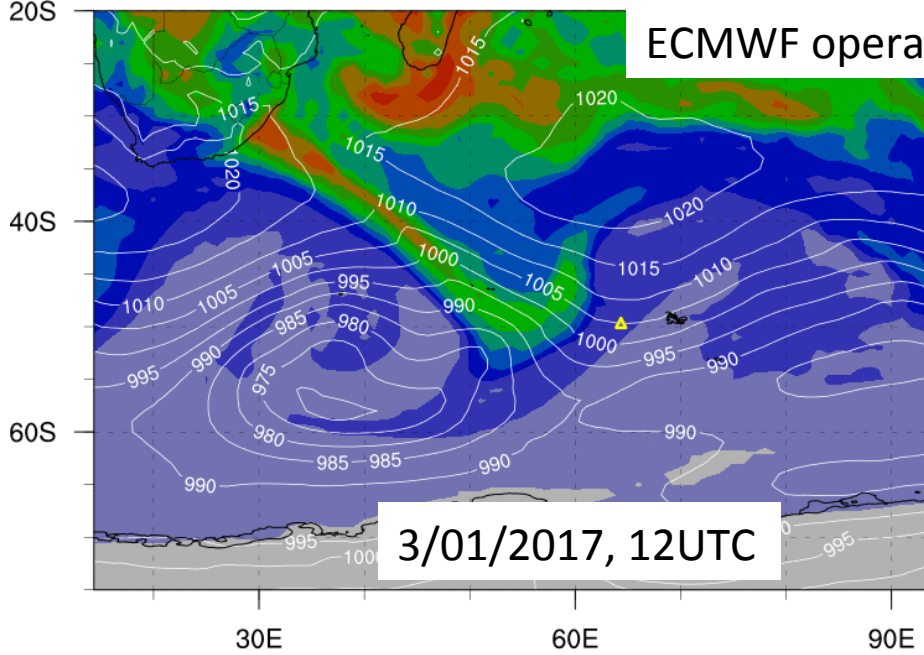




Using a combination of products from ECMWF operational forecast and AMPS => decision to do frequent launches during an interesting event (atmospheric river)



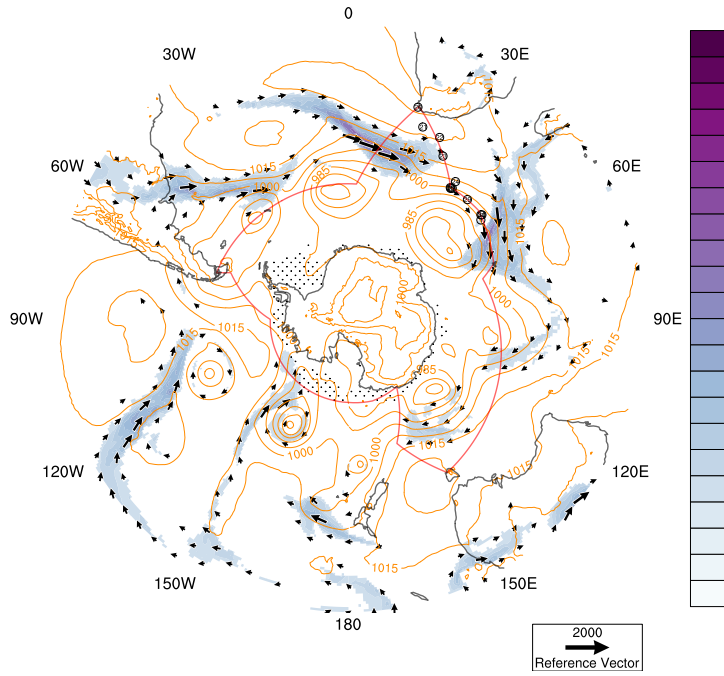
ECMWF operational forecasts



2017010400

IVT ($\text{kg m}^{-1} \text{s}^{-1}$)

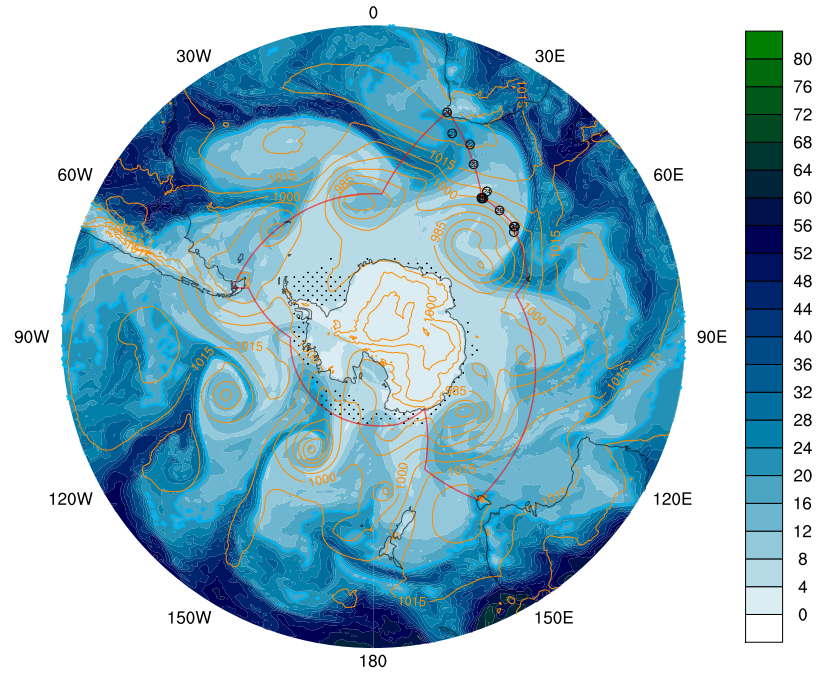
+60hrs



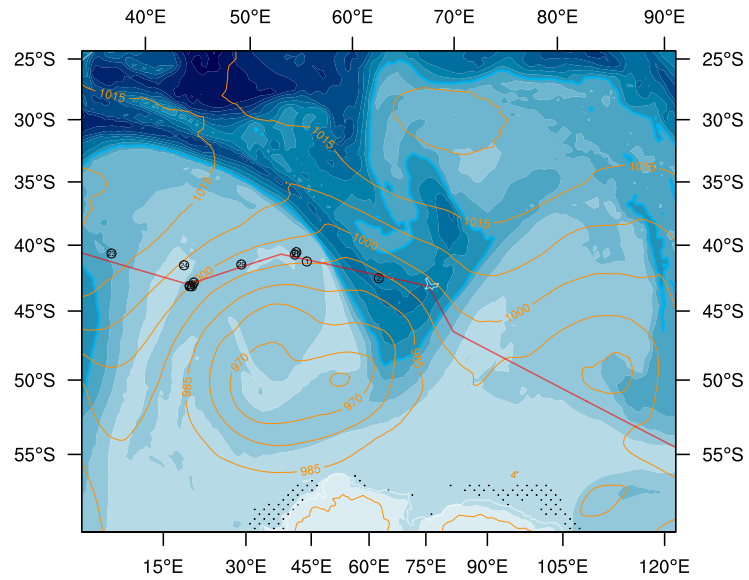
2017010400

IWV (kg m^{-2})

+60hrs



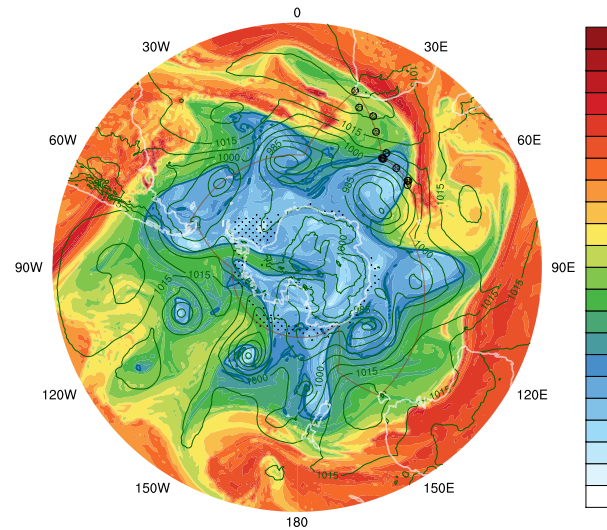
2017010400 +60hrs



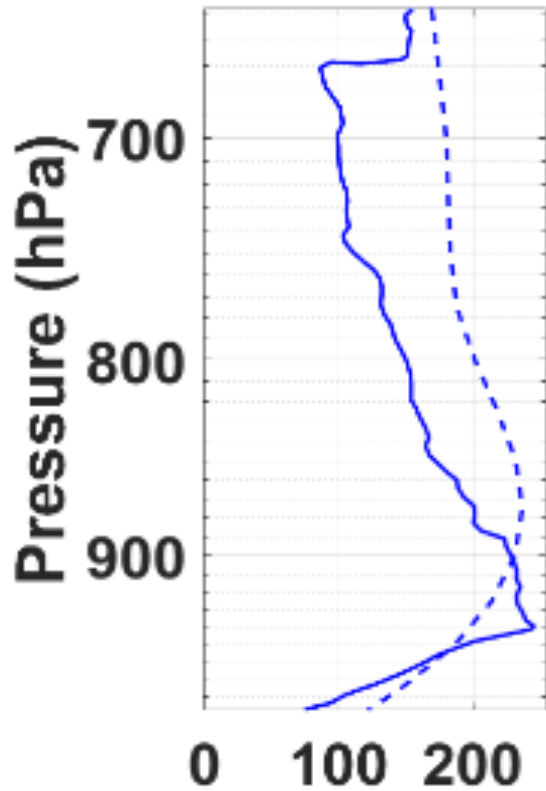
2017010400

Pot.temp. (K) at 2PVI

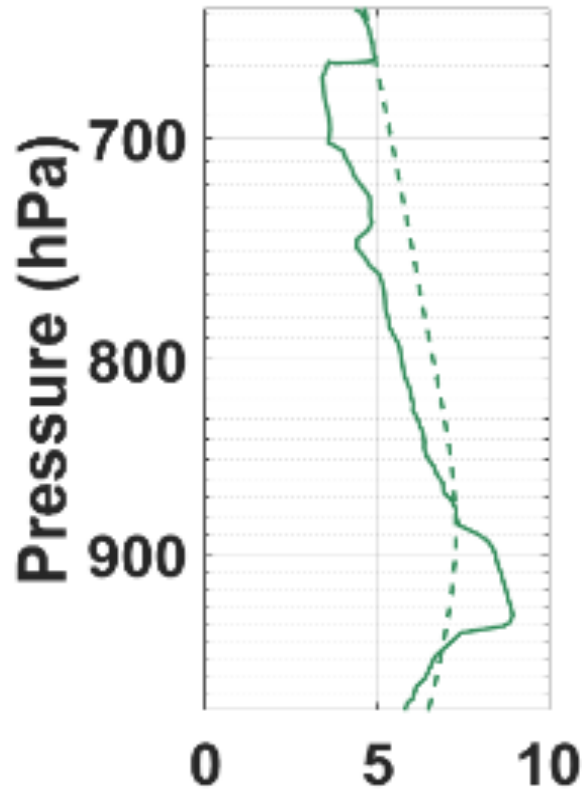
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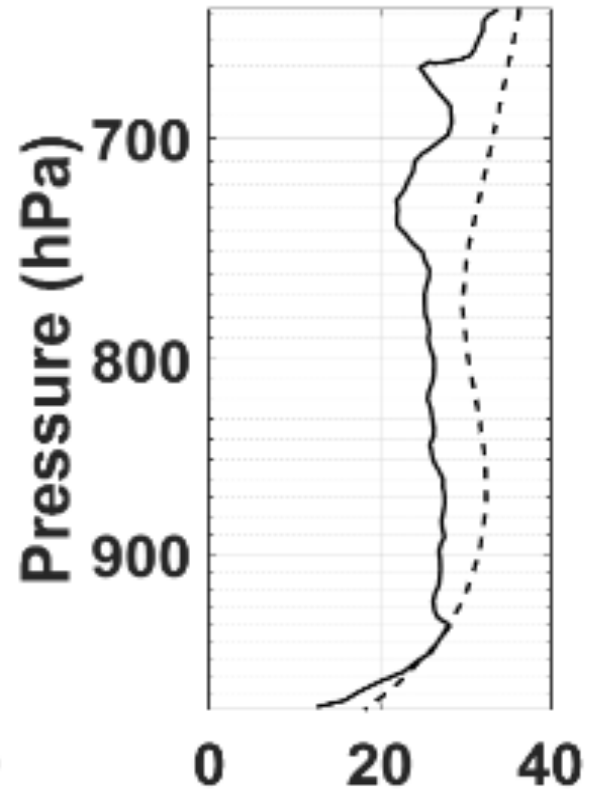
Radiosonde measurements (solid line)
compared to the nearest ERA-Interim grid point (dash)
during an AR event in the Southern Ocean (50°S; 66°E), 3 Jan 2017, 00UTC



MF (g kg⁻¹ m s⁻¹)



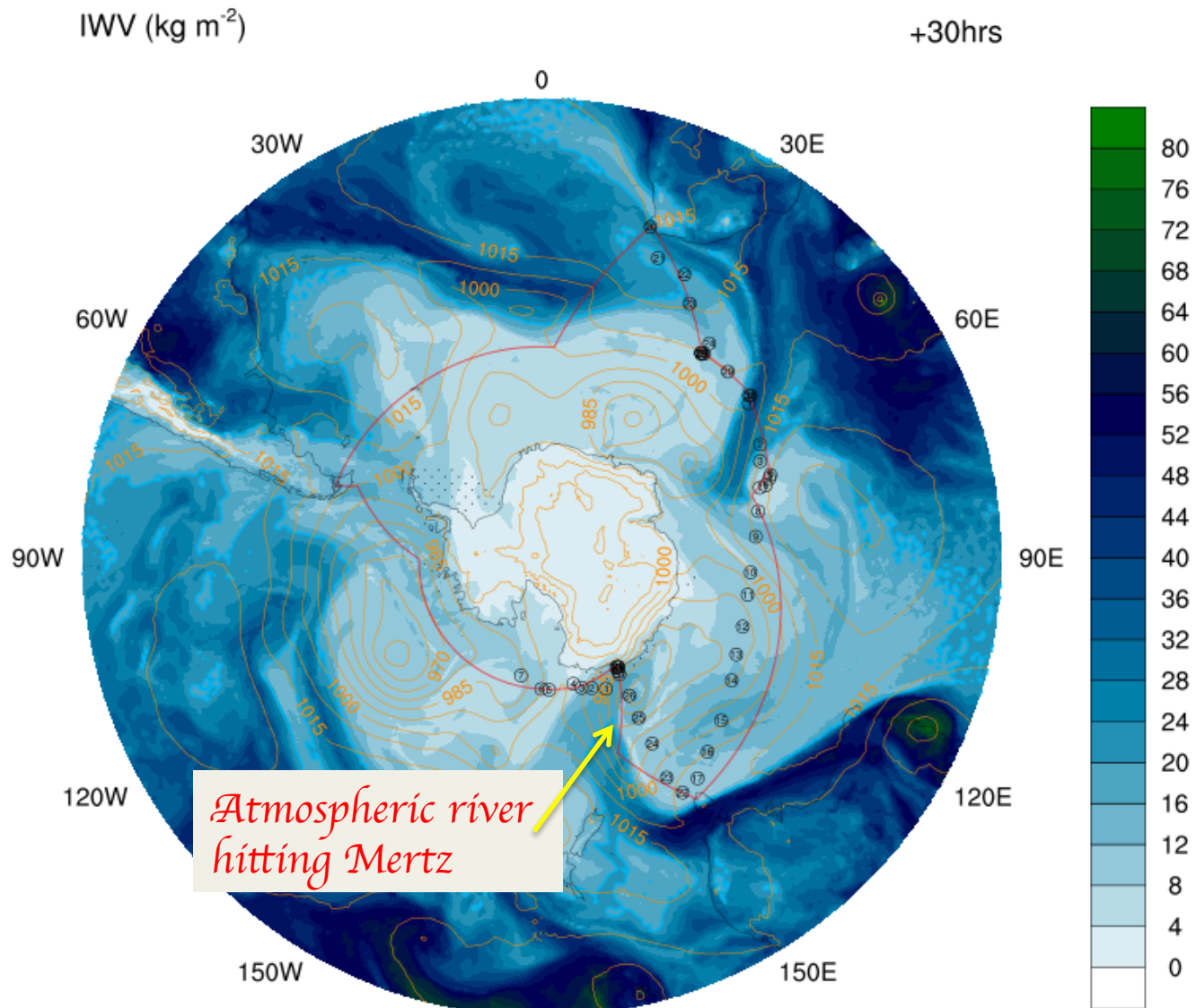
q (g kg⁻¹)



WS (m s⁻¹)

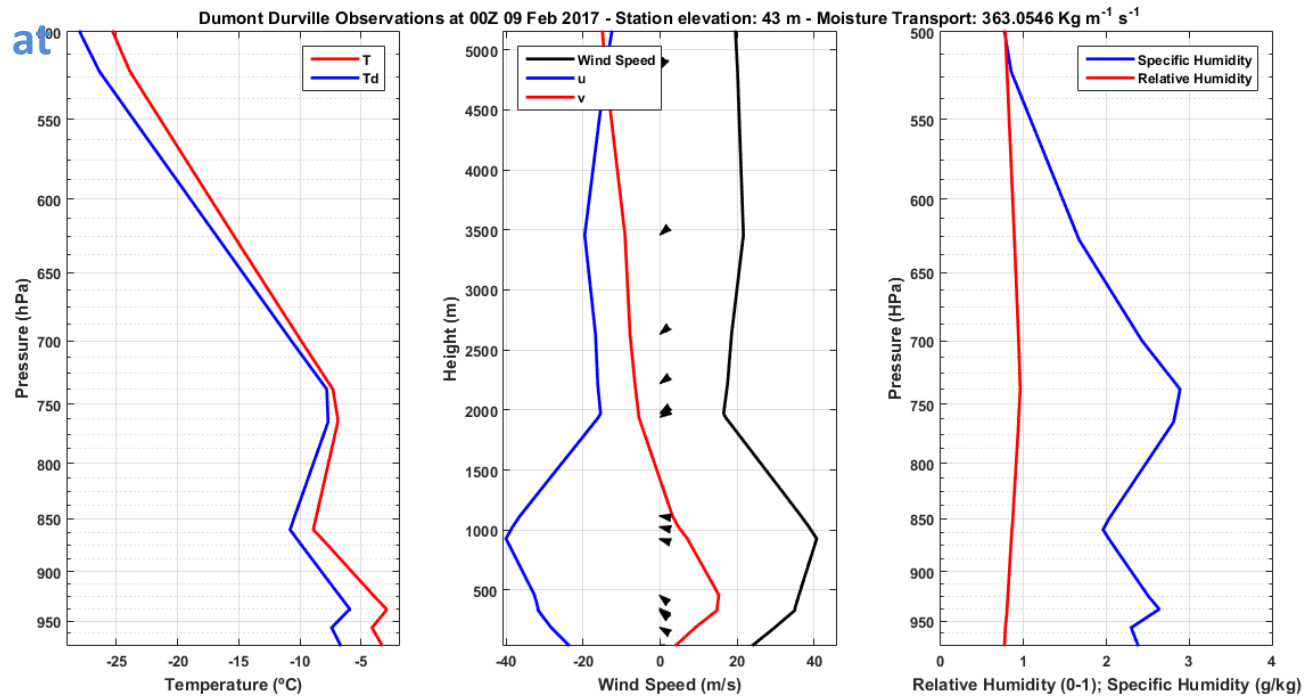
Atmospheric river @MERTZ glacier

2017020906

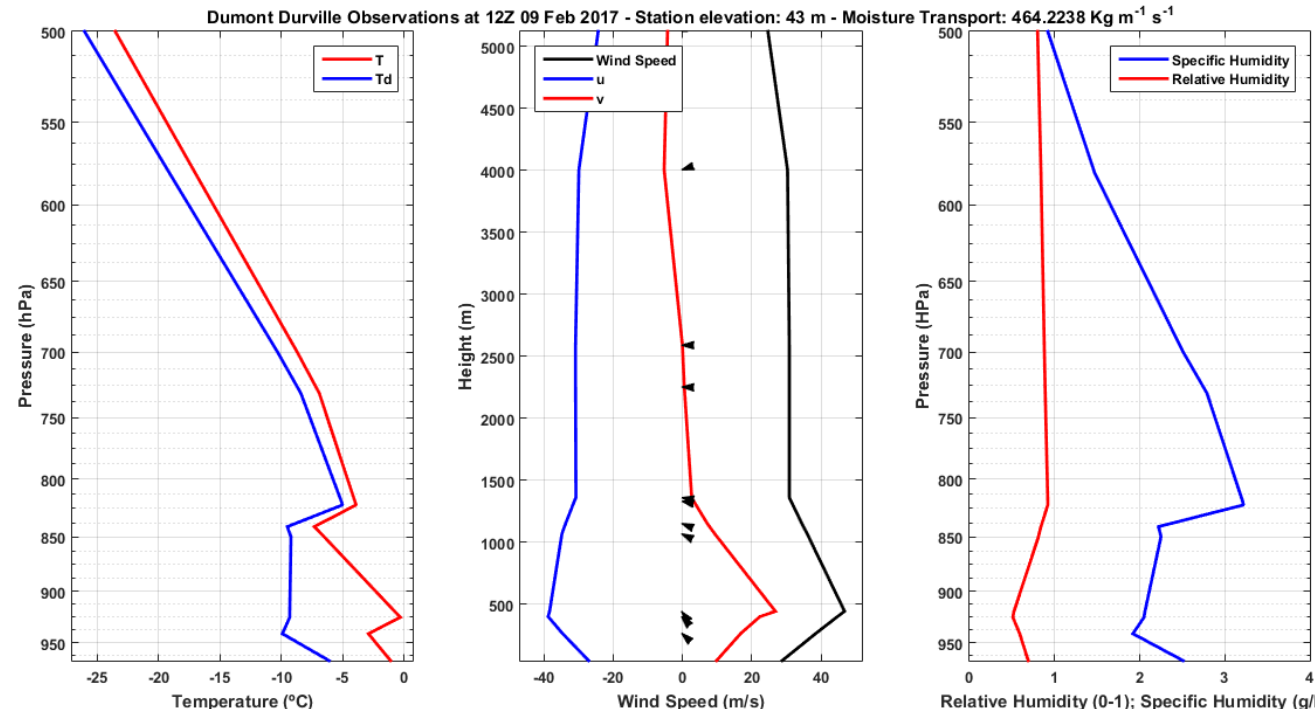


Radiosonde measurements at DDU during AR event

9 Feb 2017, 00 UTC
(regular)

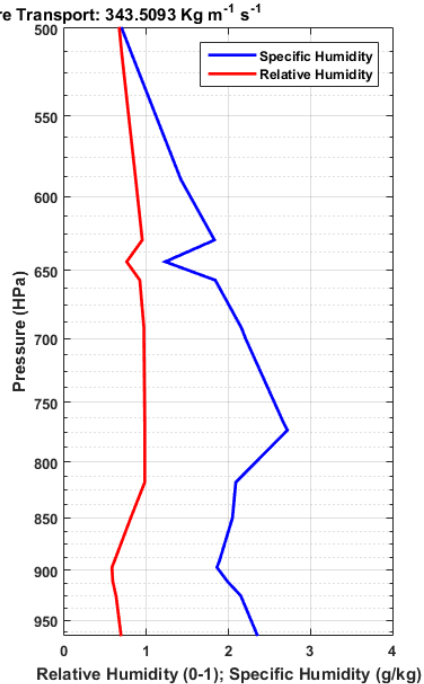
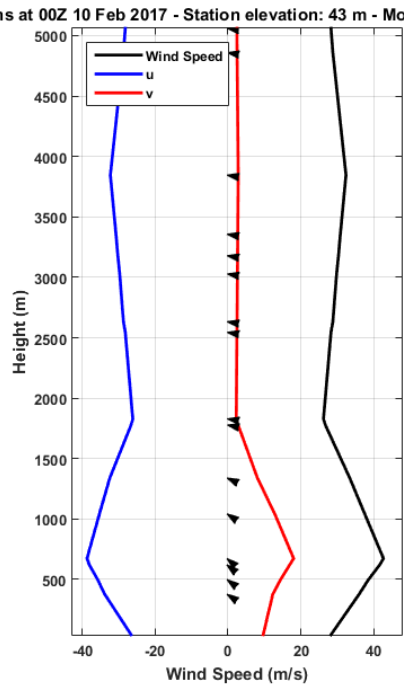
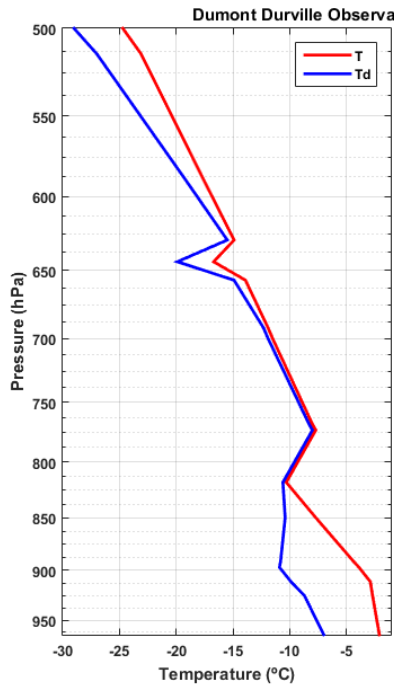


9 Feb 2017, 12 UTC
(additional!)

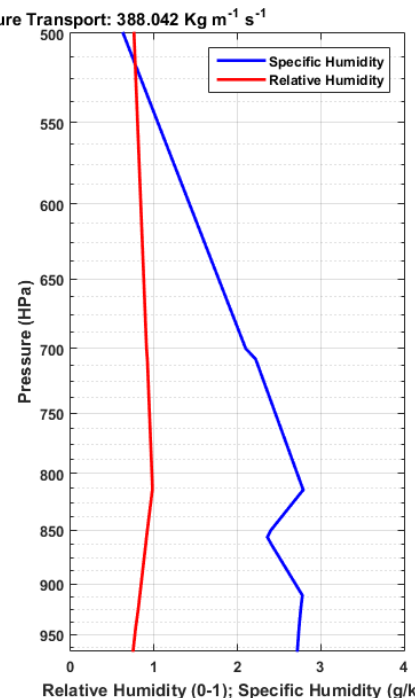
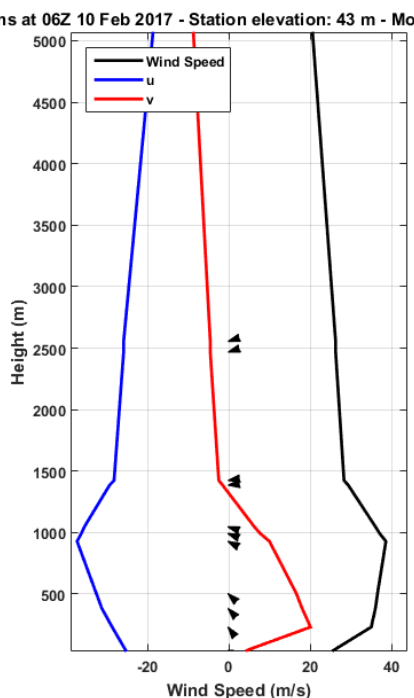
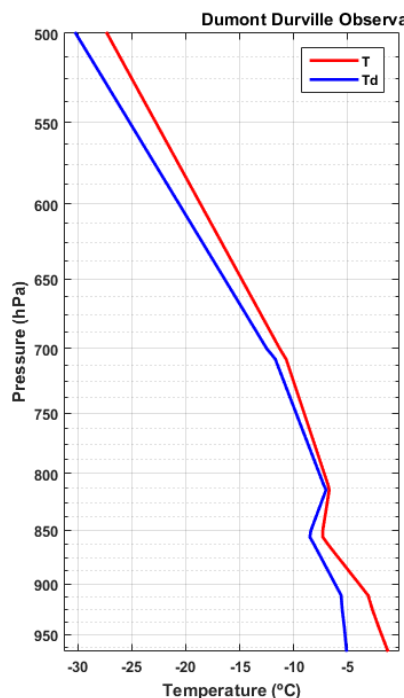


Radiosonde measurements at DDU during AR event

10 Feb 2017, 00 UTC
(regular)

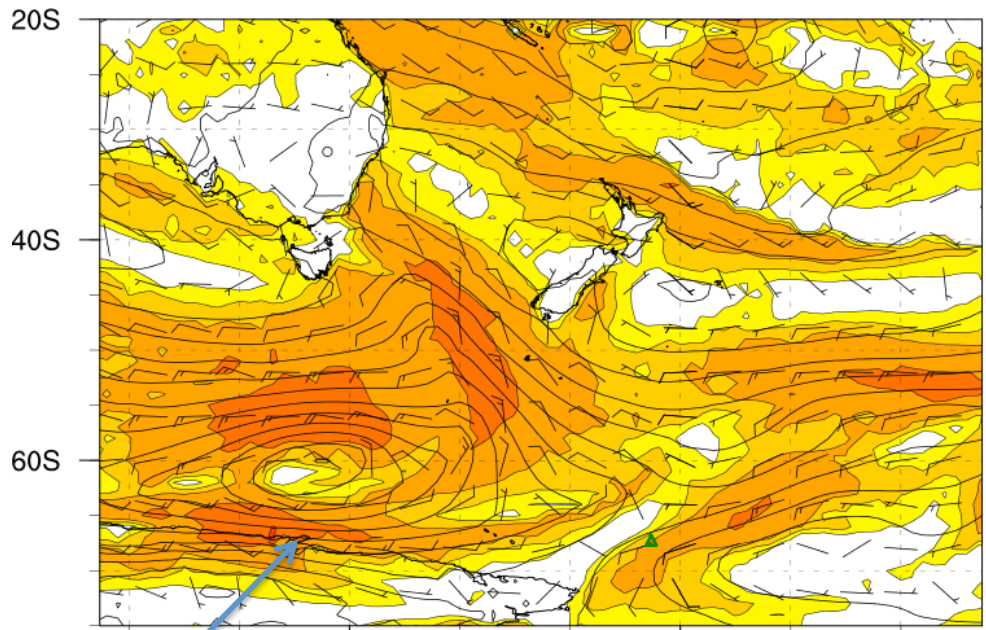


10 Feb 2017, 06 UTC
(additional!)

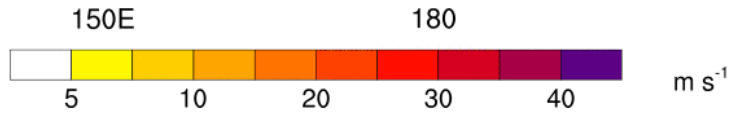


ECMWF forecast for
9 February 2017 06 UTC

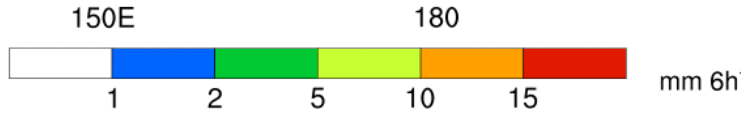
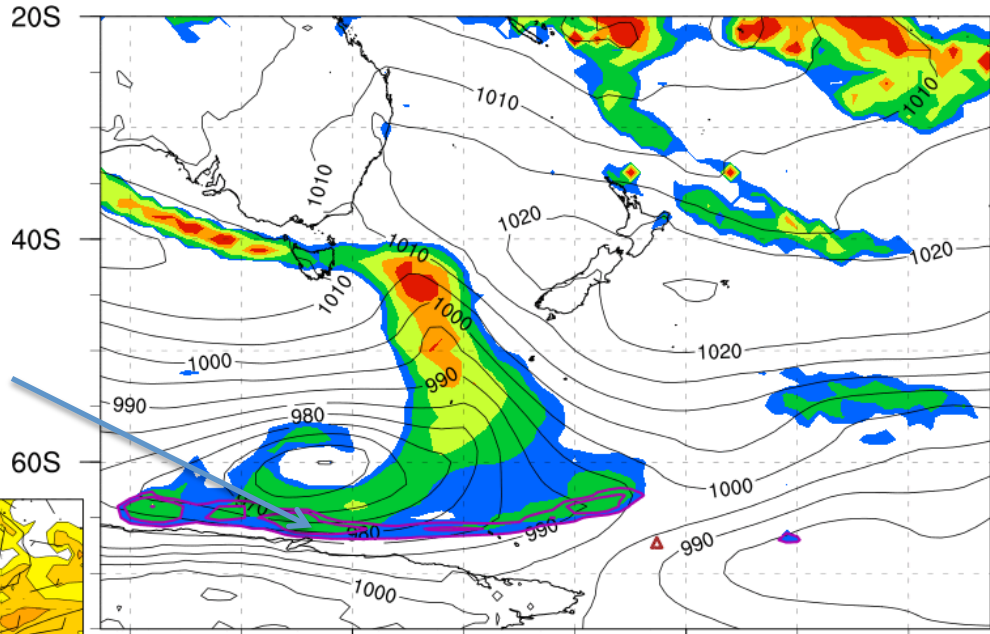
Near-surface wind



Mertz



Rain-snow



Conclusions

- Radiosonde measurements provide important information about the evolution of the vertical profiles of T, q, WS
- During enhanced MT events, distinct low level jet and increased q observed between 850-900 hPa at the coastal DML stations – mostly underestimated by ERA-Interim
- Moisture flux calculated from radiosonde profiles shows peak flow at the LLJ height
- Precipitation forecast during an AR can change a lot over one day - from majority of precipitation over the ocean to majority over land (DDU case). How does it depend on the ability of the model to represent strong moisture fluxes during ARs?
- More measurements especially during the AR evolution over the Southern Ocean can improve our understanding of the phenomenon and precipitation/weather forecast
- Restrictions on radiosonde launches (including autosondes) during high wind speeds can introduce bias in available profiles and possibly bias in reanalysis and models where these data are assimilated
- YOPP can provide a great opportunity - sites with possibility to launch during high winds? from islands? from ships?



Thank you!

*Questions and feedback
are very welcome!*

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