

May 2009 Atmospheric River Event in the Dronning Maud Land

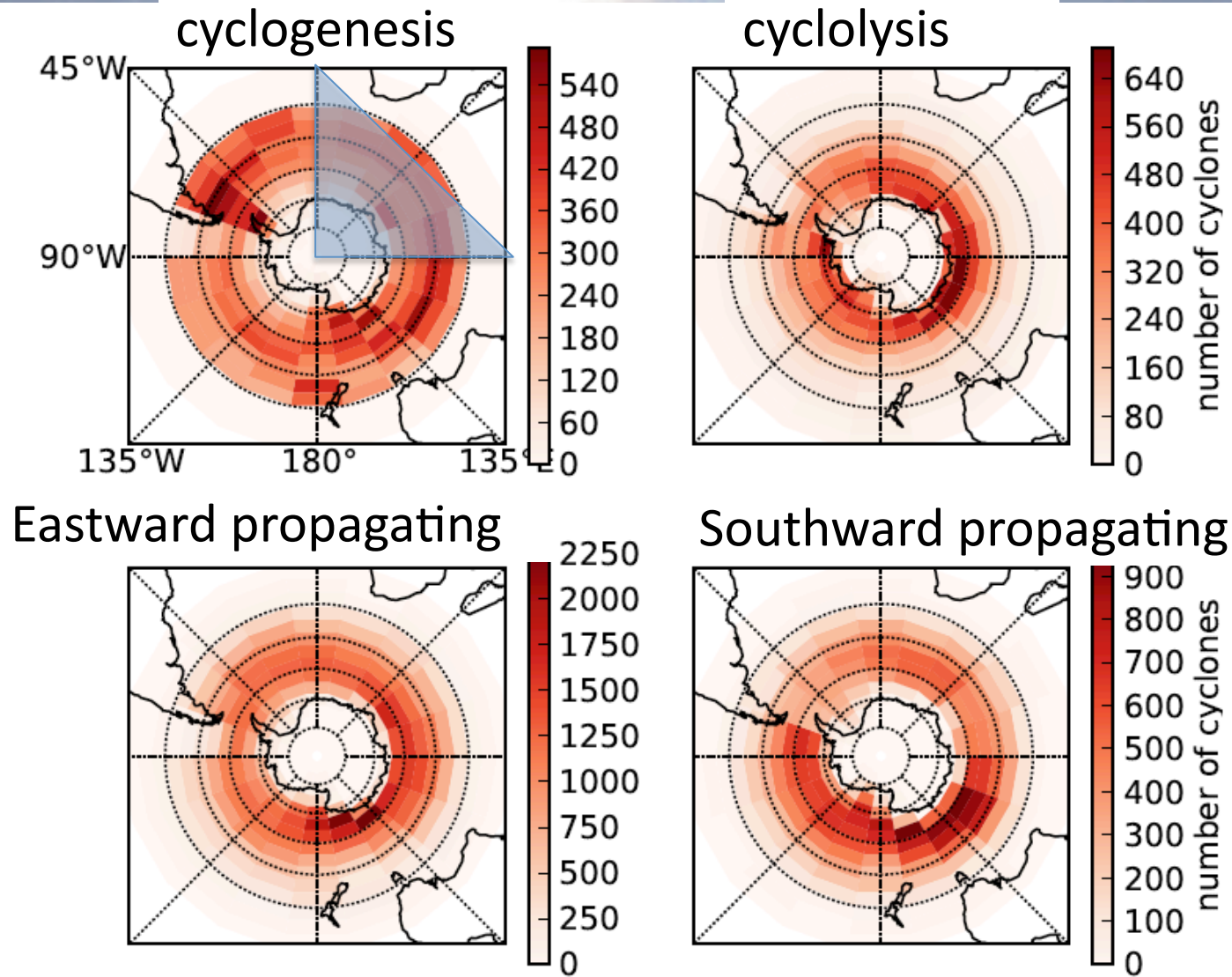
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Gorodetskaya²

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*²K.U. Leuven, Department of Earth and Environmental Sciences,
Belgium*

Cyclone budget analysis



Uotila et al., 2013, GRL in press

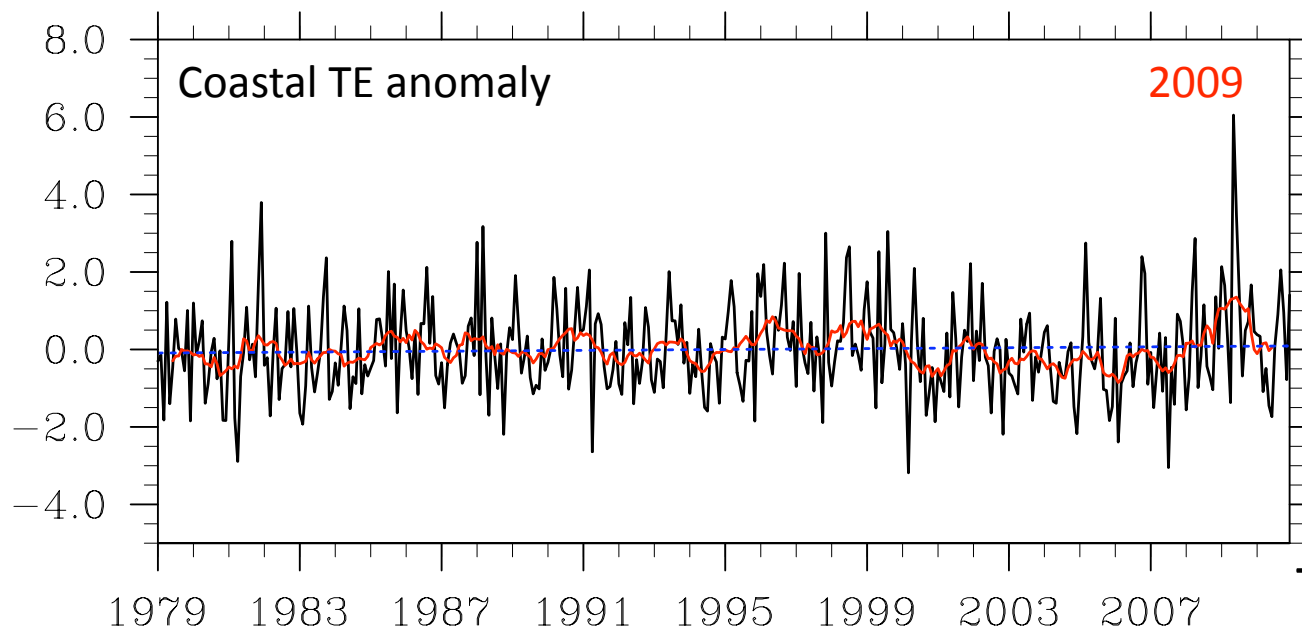
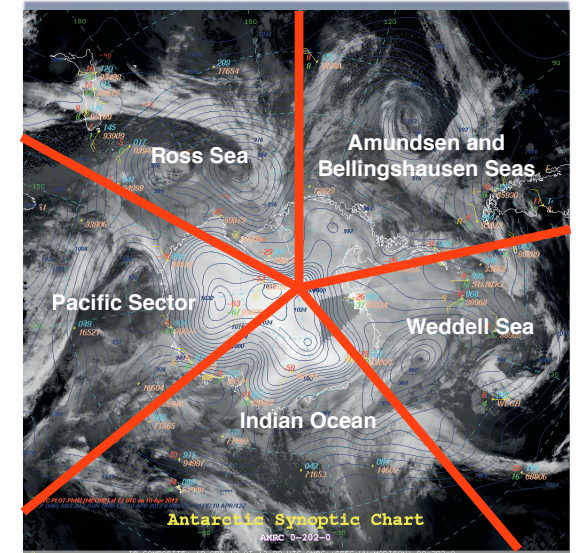
Meridional moisture flux

INDIAN OCEAN SECTOR

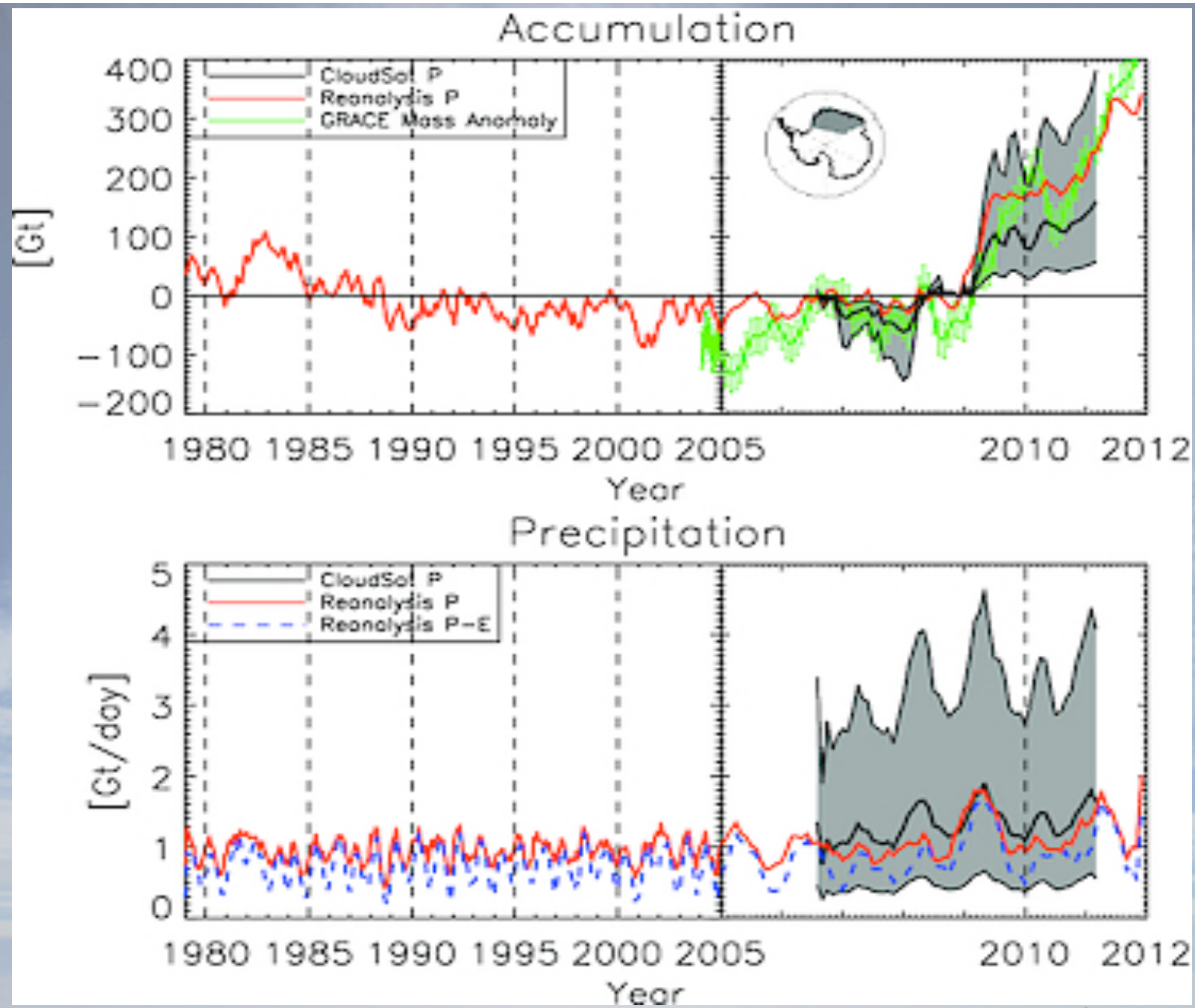
Lowest total moisture flux

No trend for 1979-2011

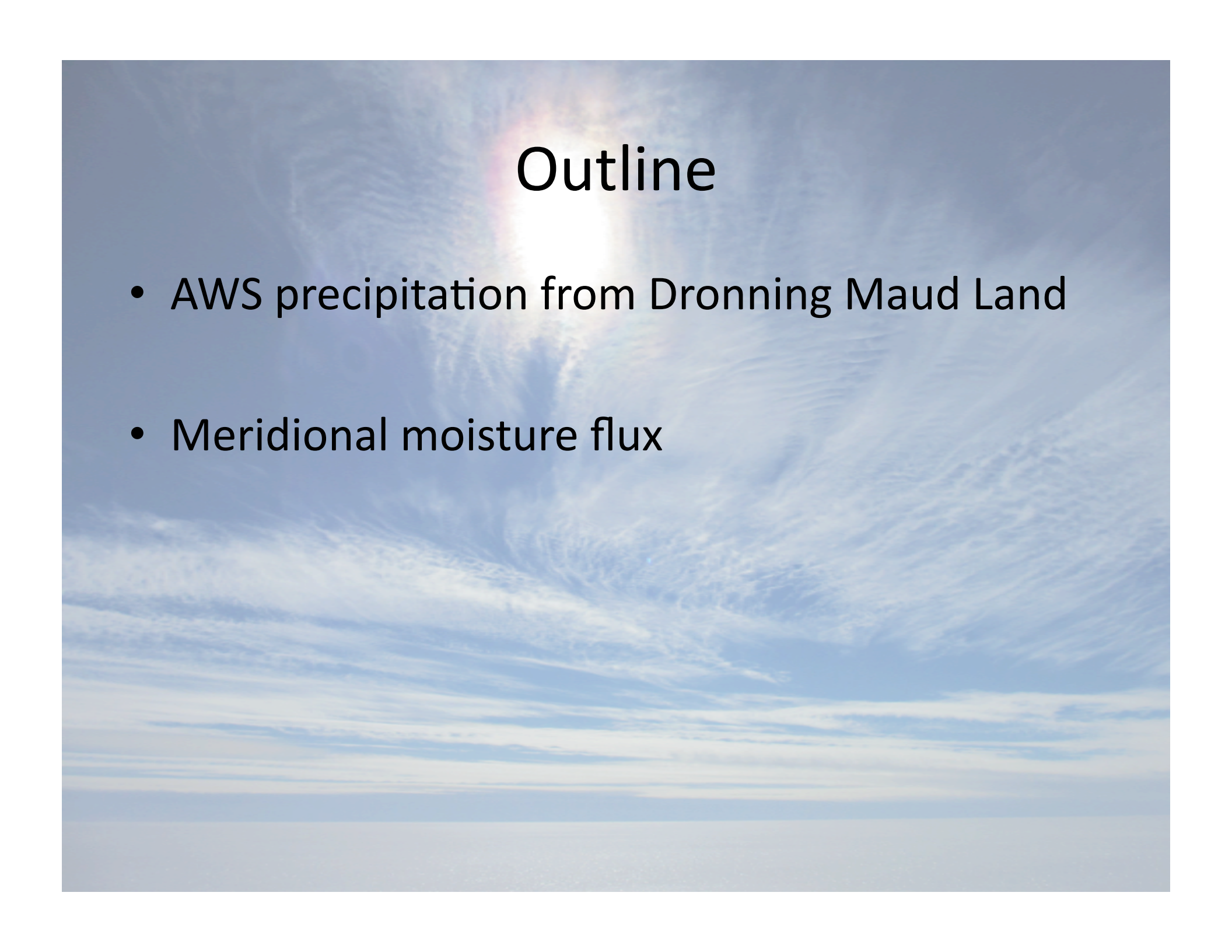
Coastal zone: anomaly in 2009



Tsukernik and Lynch,
JCLimate, in press



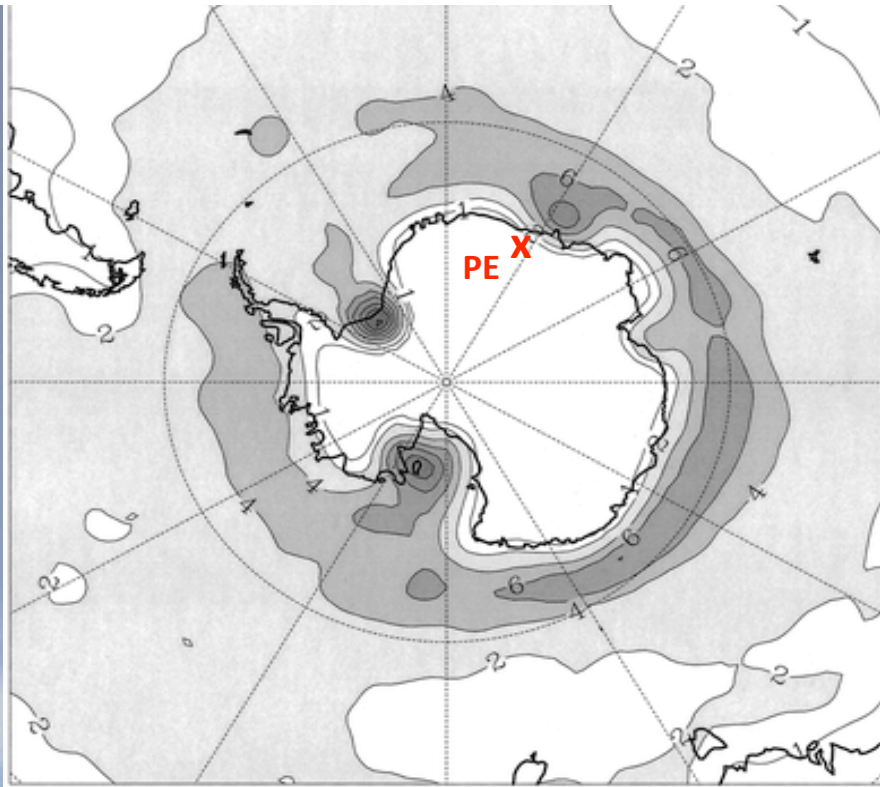
Boening et al. GRL 2012



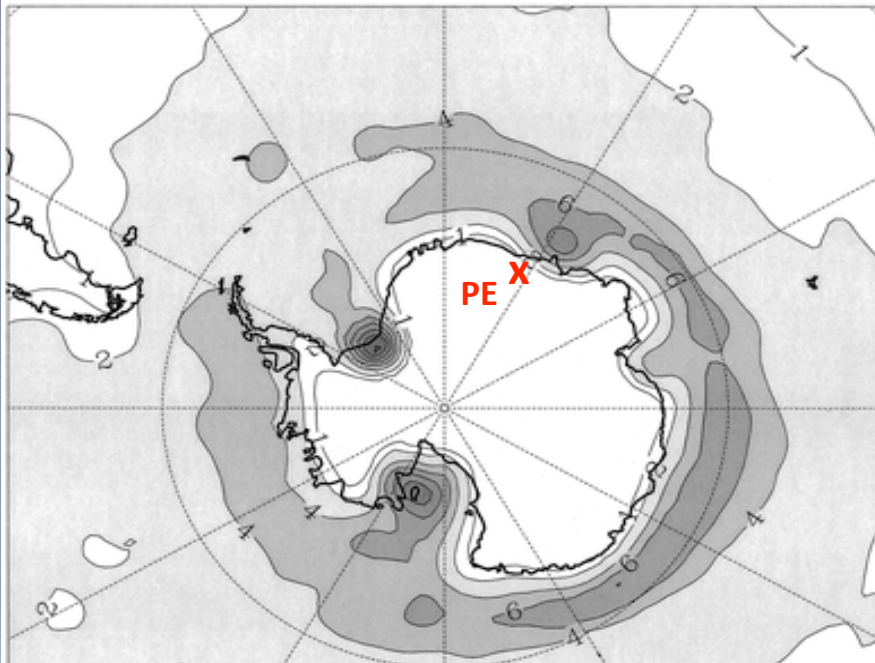
Outline

- AWS precipitation from Dronning Maud Land
- Meridional moisture flux

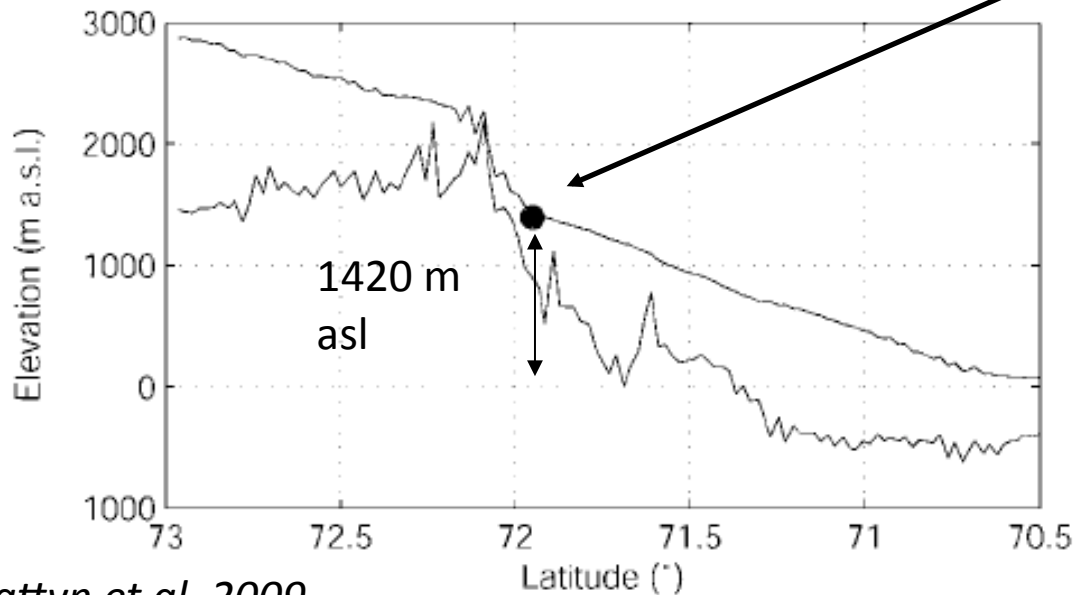
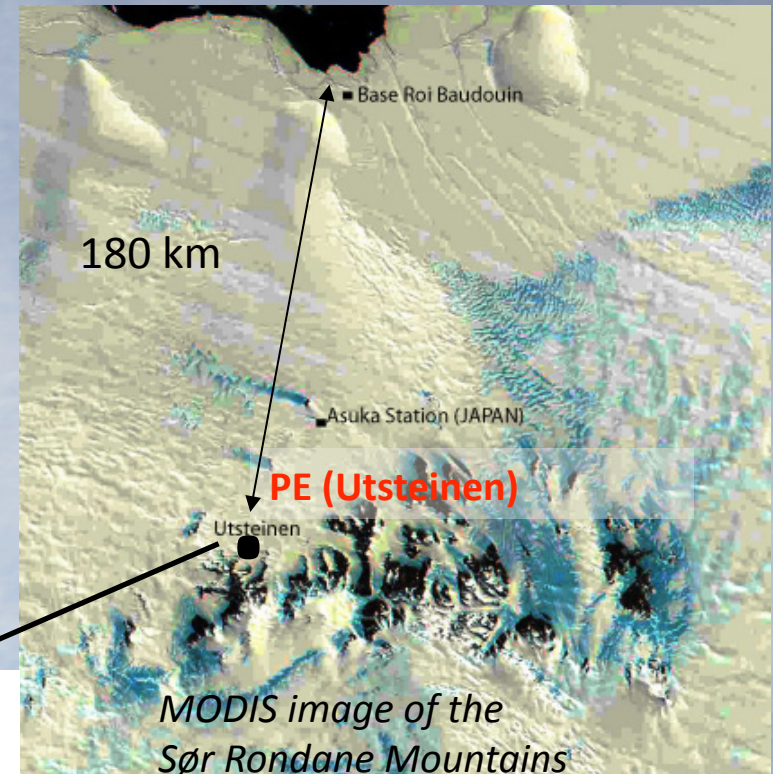
Density of cyclones in winter



Density of cyclones in winter



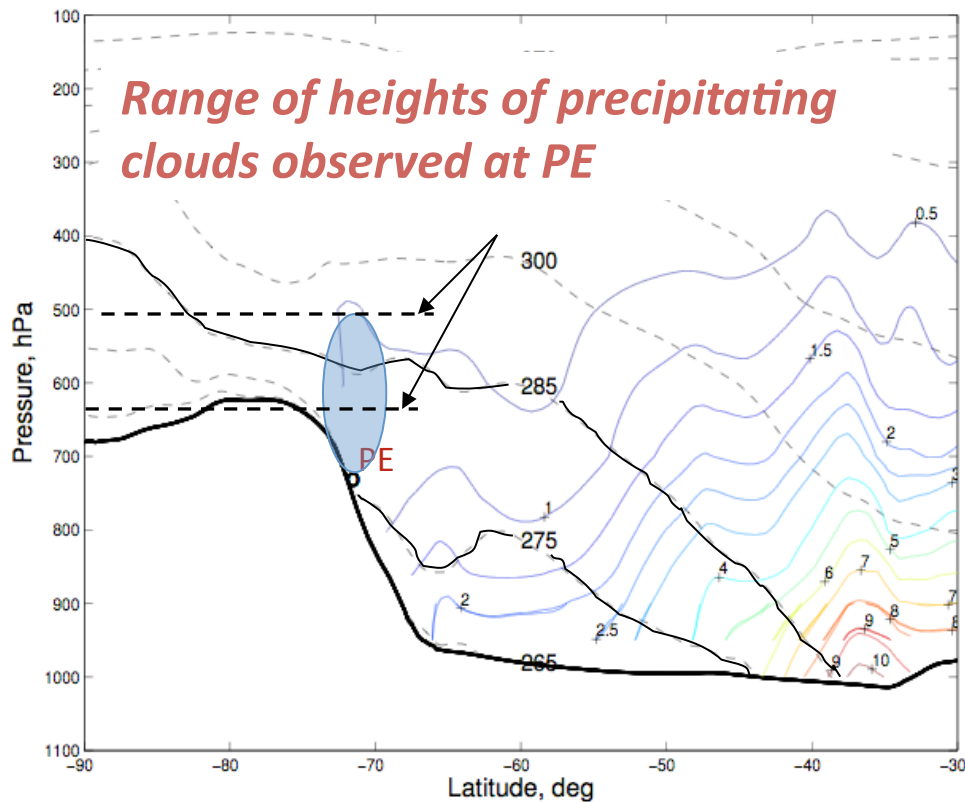
Princess Elisabeth (PE) station



Pattyn et al. 2009

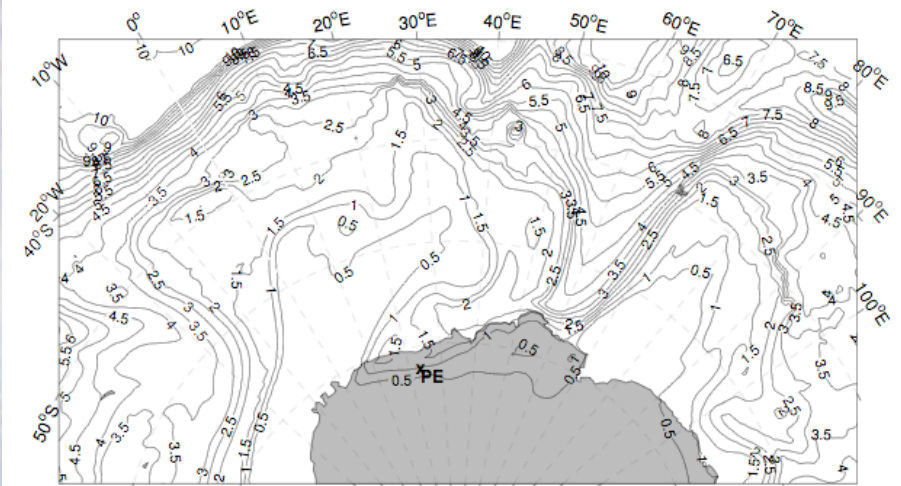
**PE located at the
ascent to the East
Antarctic plateau
(orographic precip!)**

Isentropic analysis for high accumulation event May 19, 2009

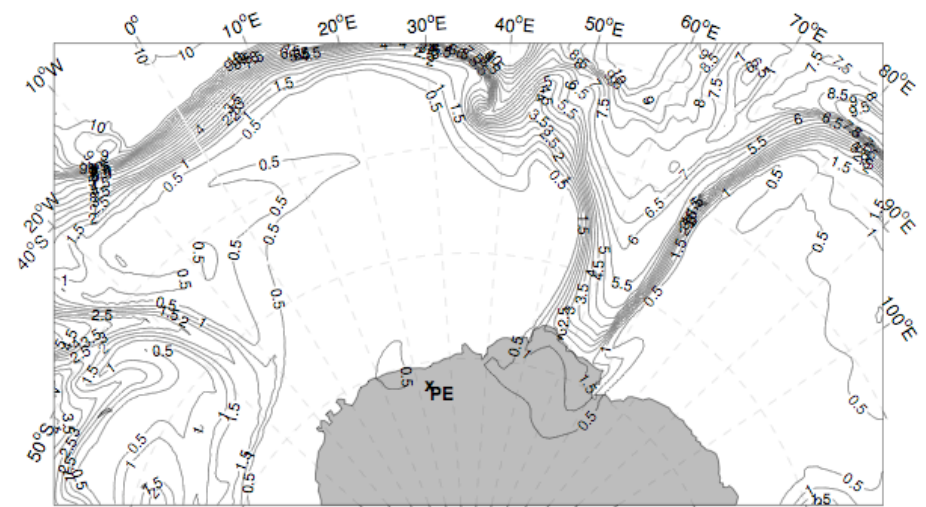


*Mean meridional cross-section
(20-60°E) of isentropic surfaces
with specific humidity color contours*

ERA-Interim



ERA Interim. Analysis. 0.25x0.25deg. Specific humidity on 275 K isentrope 2009-05-19.0UTC



ERA Interim. Analysis. 0.25x0.25deg. Specific humidity on 285 K isentrope 2009-05-19.0UTC

*Specific humidity on 275K
and 285K isentropic surfaces*

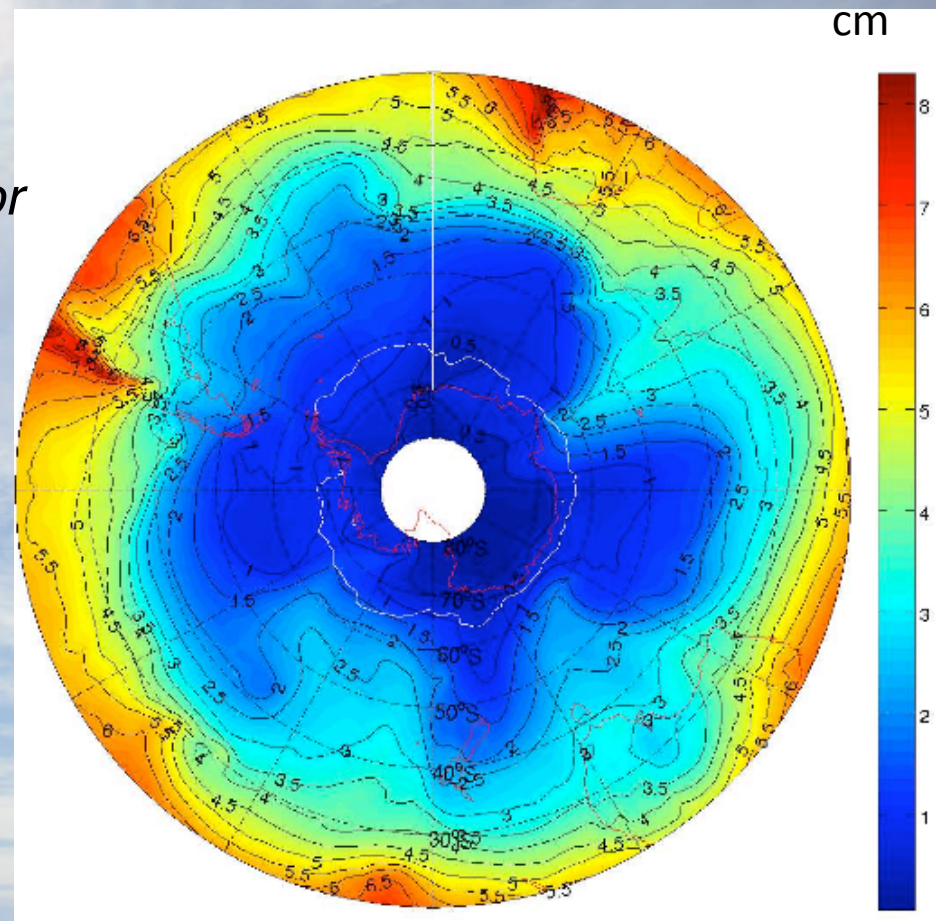
Gorodetskaya et al., 2012

Two factors taken into account for a modified definition of atmospheric rivers for Antarctica:

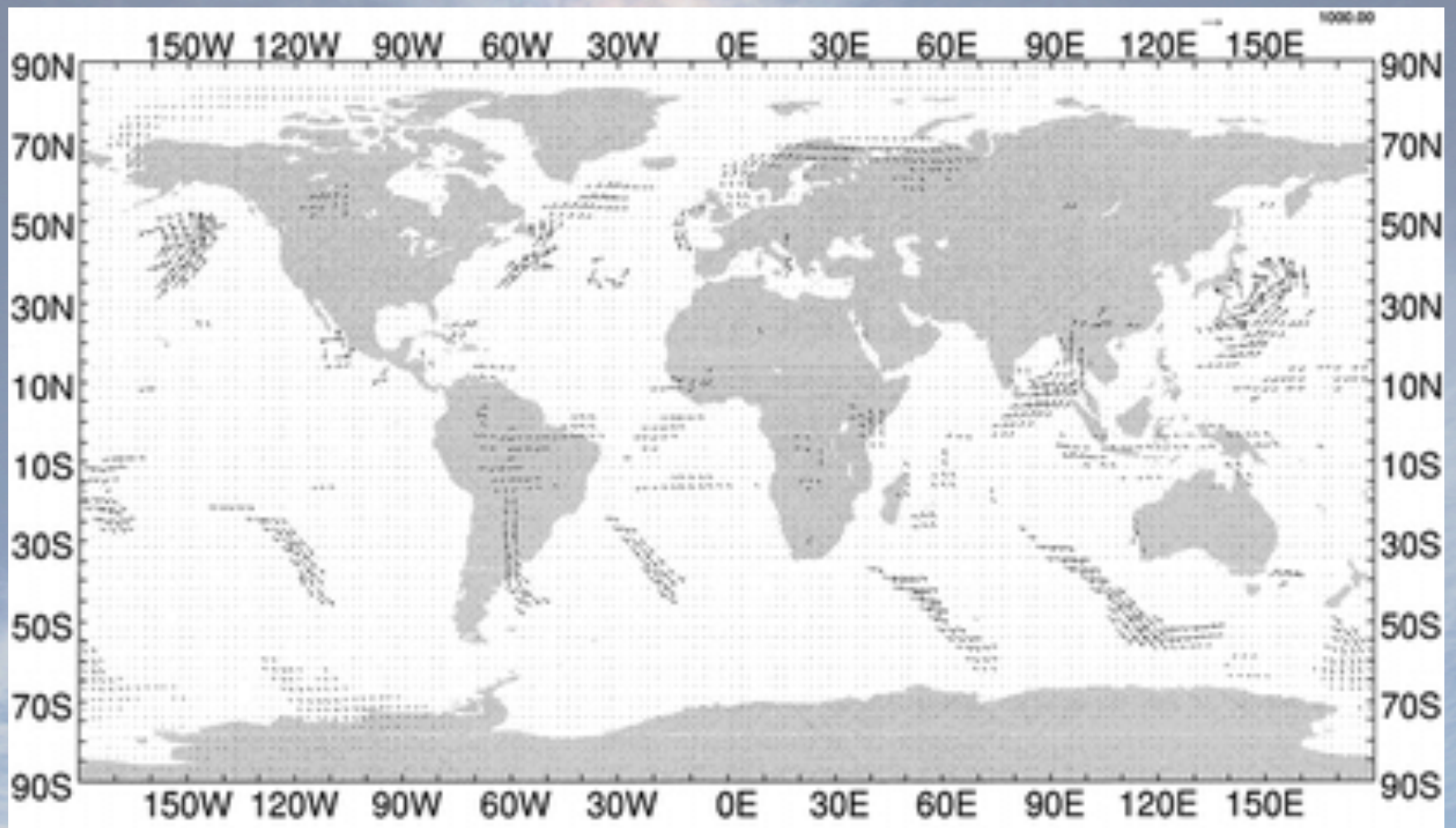
- 1) The moisture-holding capacity decreases strongly due to the decrease in the tropospheric temperatures
- 2) Atmospheric river reaches the Antarctic coast

Map of integrated *saturated* water vapor
(colors and contours)
for 19 May 2009:

$$IWV_{sat} = \int_{900}^{300hPa} q_{sat}(T) dp$$



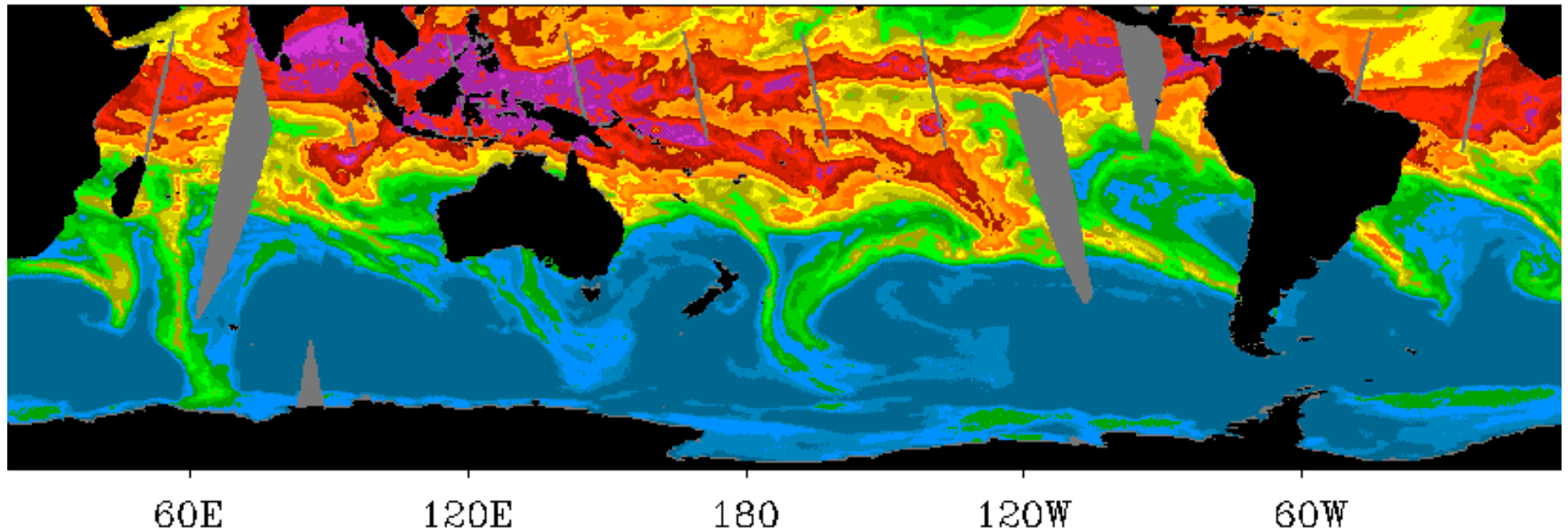
**Grey line shows 50% sea ice concentration boundary on 19/5/2009*



Moisture flux by atmospheric rivers on a sample day 12 October 1991 from Zhu and Newell (1998)

Water vapor in the Southern Hemisphere as seen from SSM/I on 19 May 2009

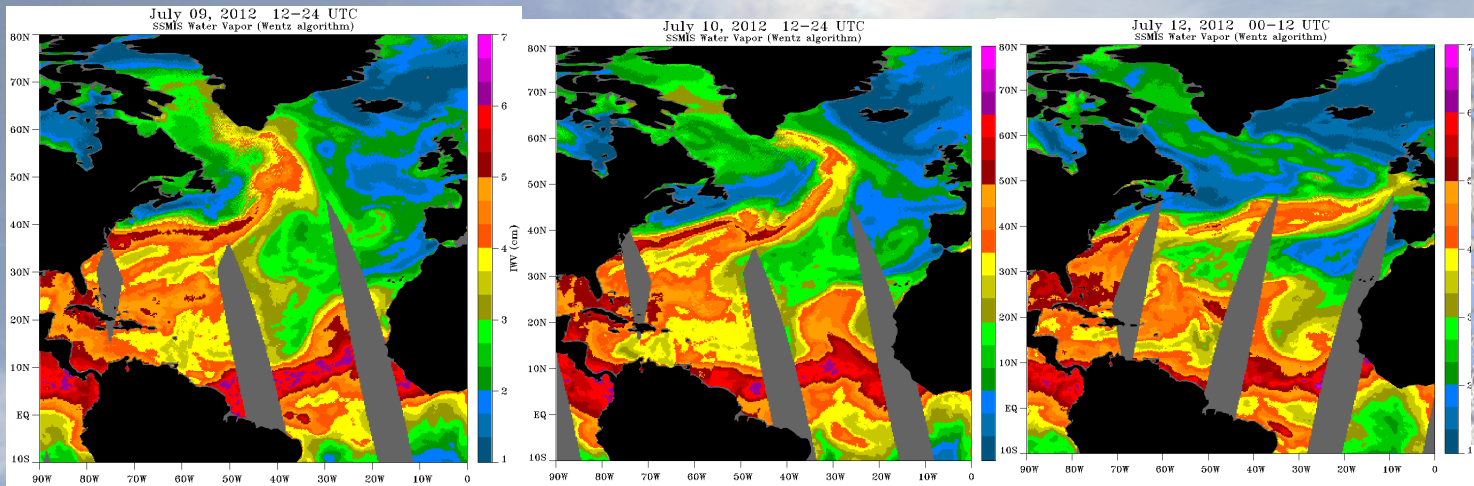
May 19, 2009 00–12 UTC
SSMIS Water Vapor (Wentz algorithm)



Courtesy of Gary Wick, NOAA

Atmospheric Rivers

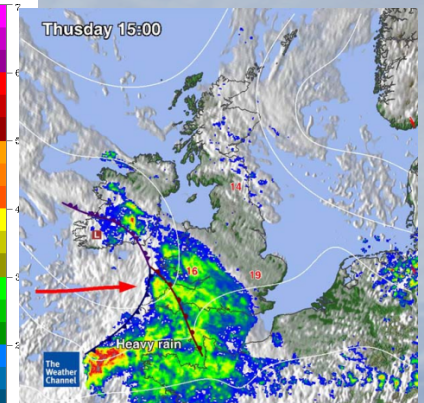
(see Tsukernik et al tomorrow for the Antarctic case)



9 July

10 July

12 July

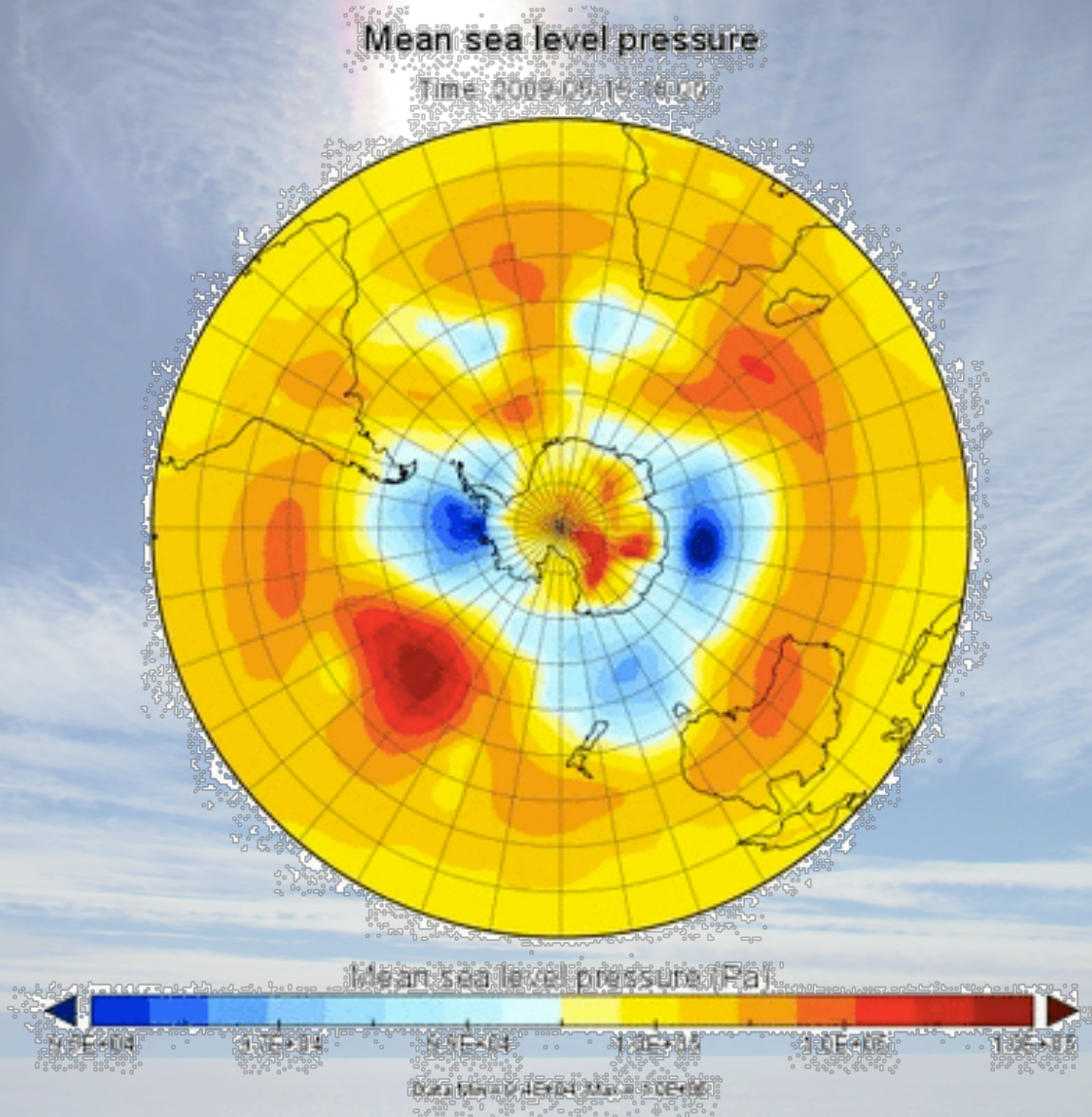


Heavy
rain
12 July
1500Z

Atmospheric river!

- Reached Prince Elisabeth AWS site
 - 180 km inland, 1420m asl
- Deposited ~80 mm w.e.
- Followed by several significant AR events in June and July
 - 40% of annual accumulation
- What kind of synoptic conditions promoted the formation of this event?

ERA1 family of cyclones



AM4DC - American Medical Device Company

PS 45-km WRF

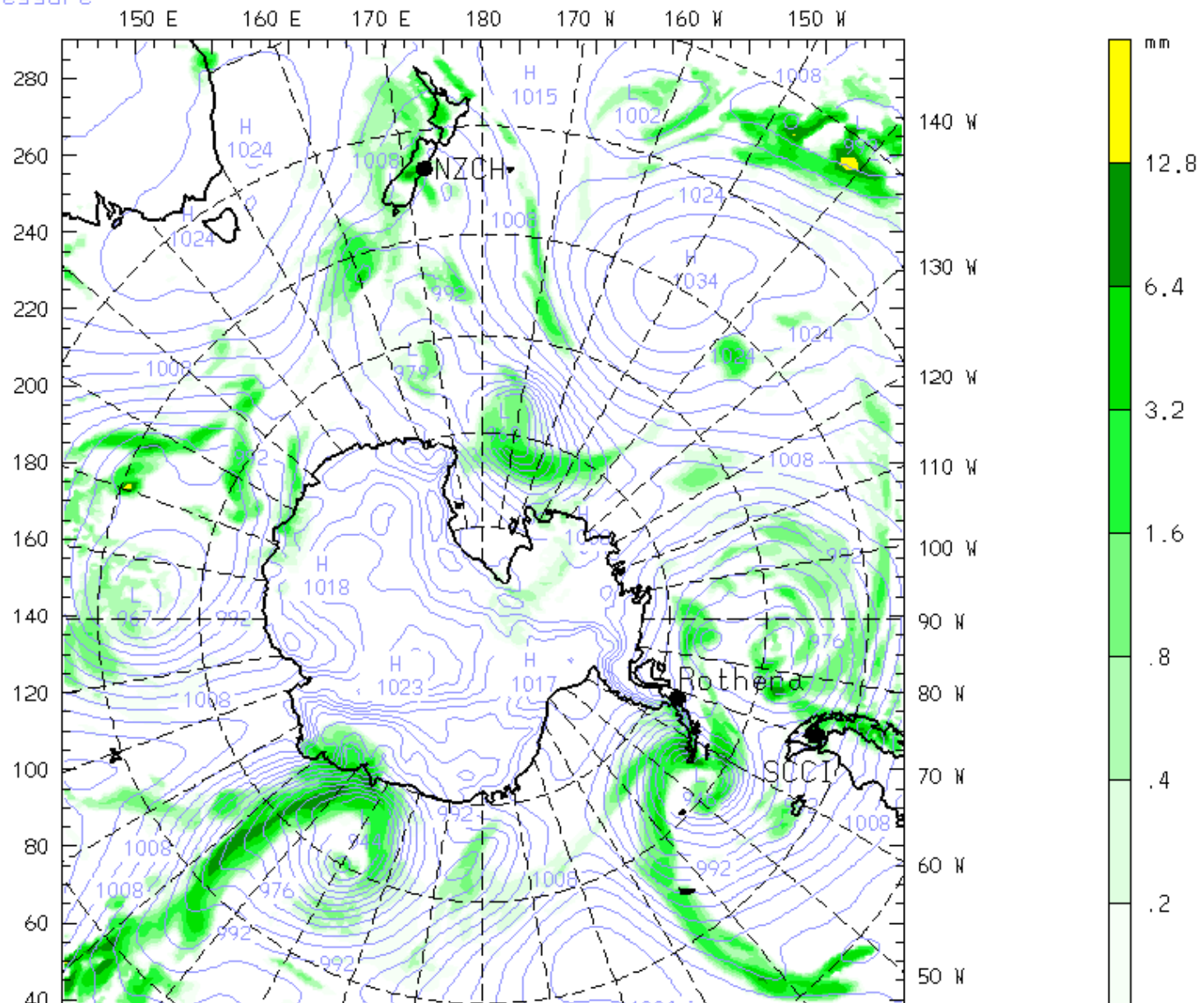
st. 6 h

total precip. in past 3 h

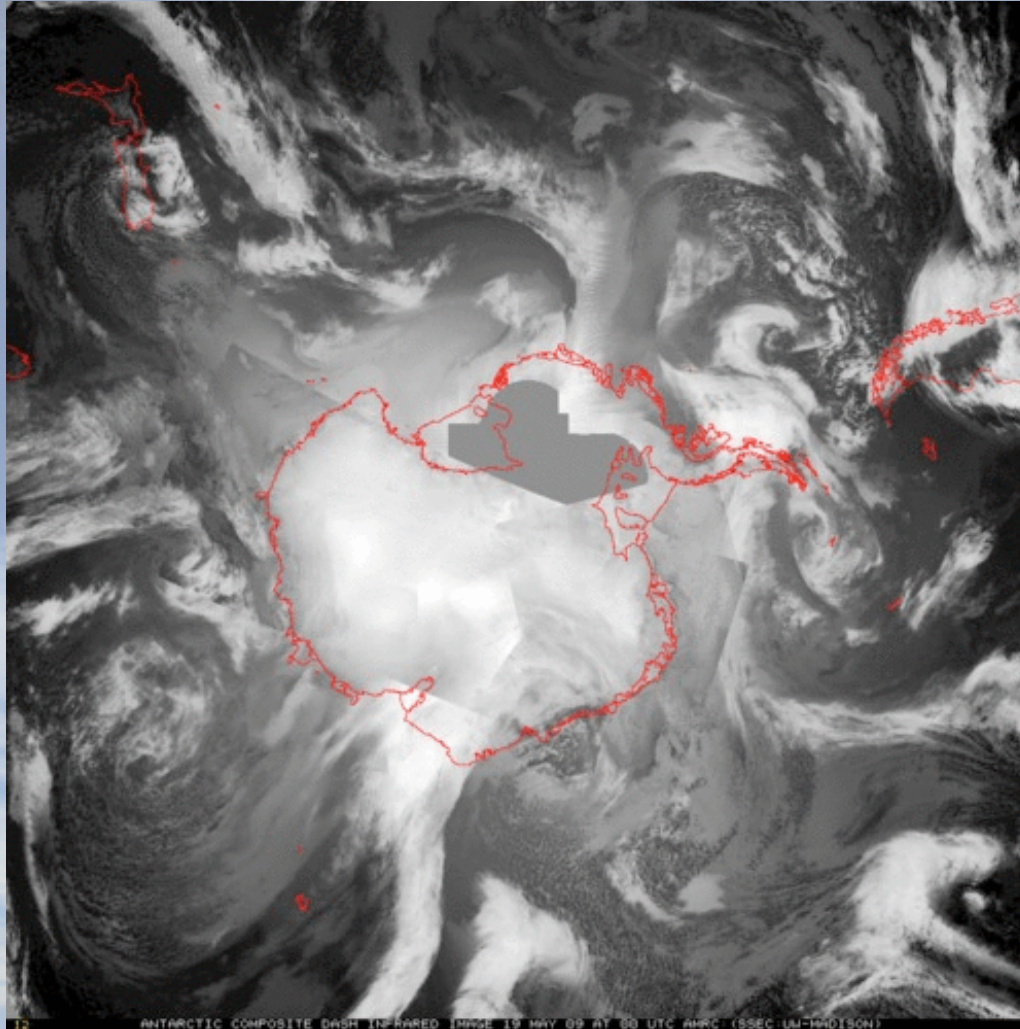
sea-level pressure

Init: 00 UTC Mon 18 May 09

Valid: 06 UTC Mon 18 May 09

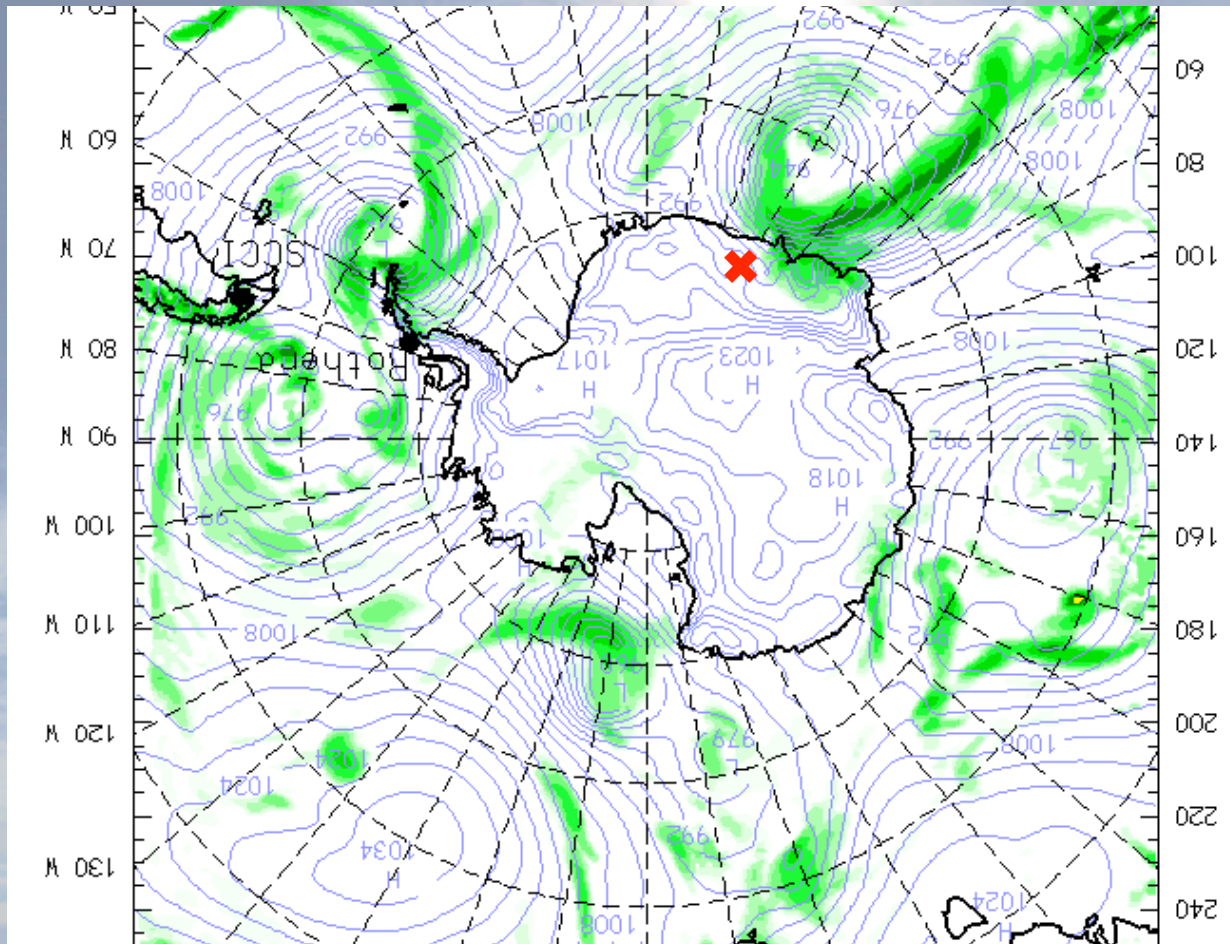


Infrared Composite

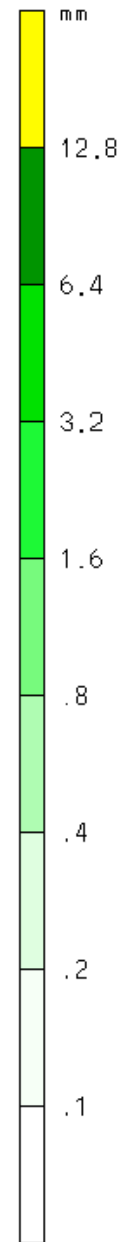
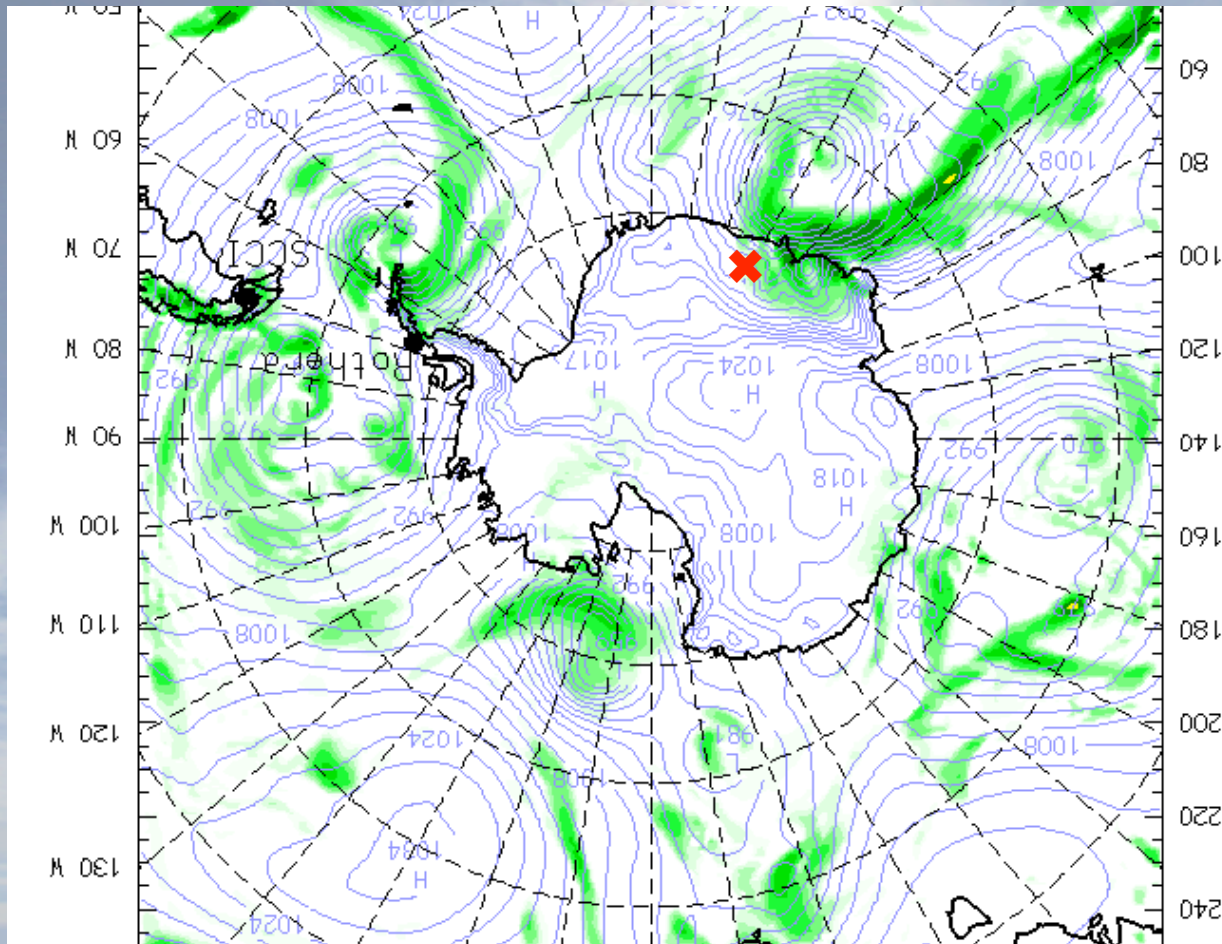


(Courtesy of Matthew Lazzara, AMRC, University of Wisconsin)

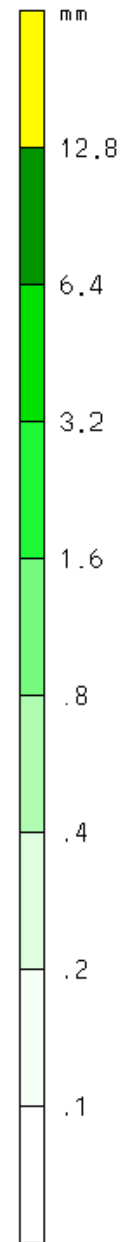
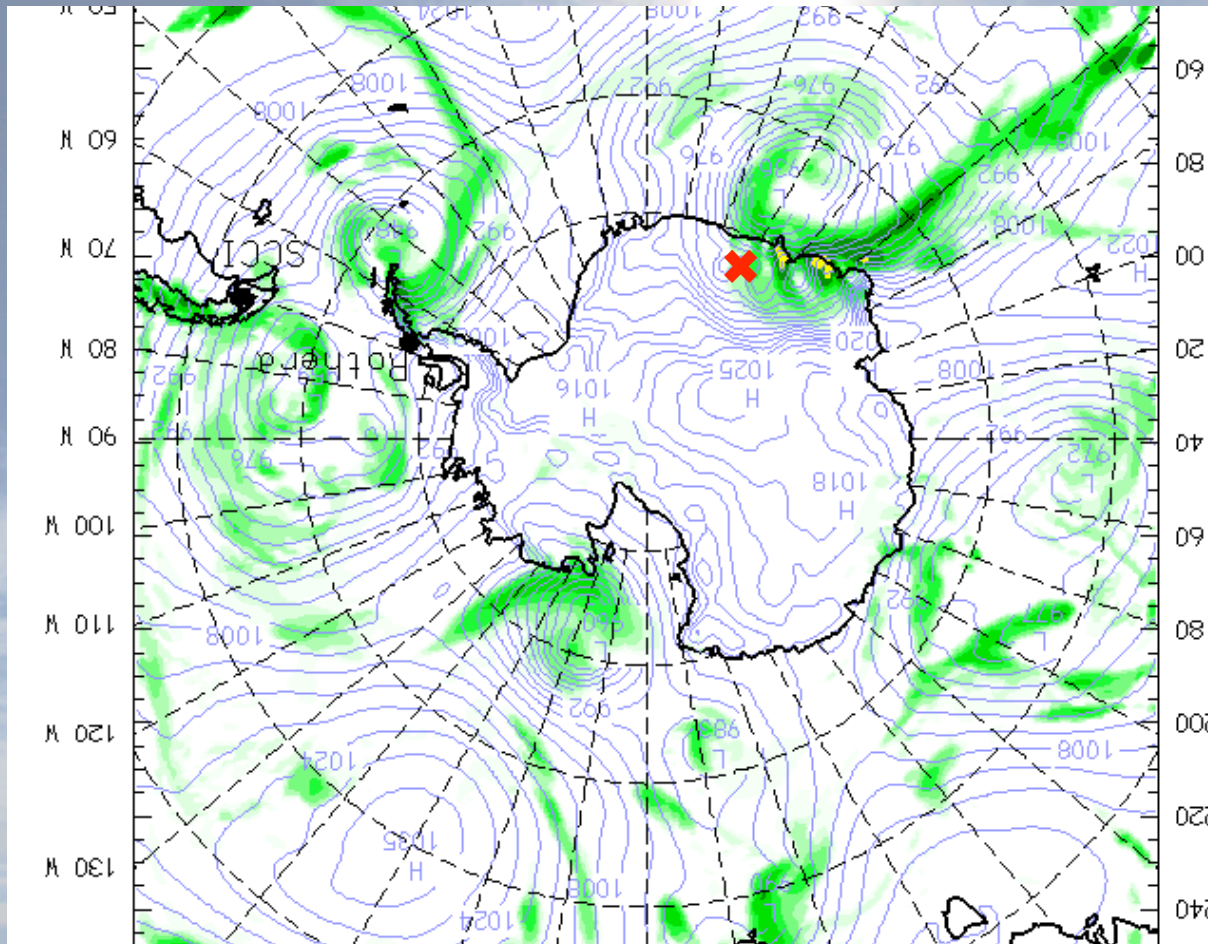
WRF precipitation forecast



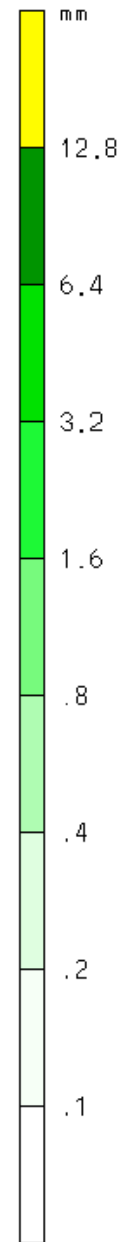
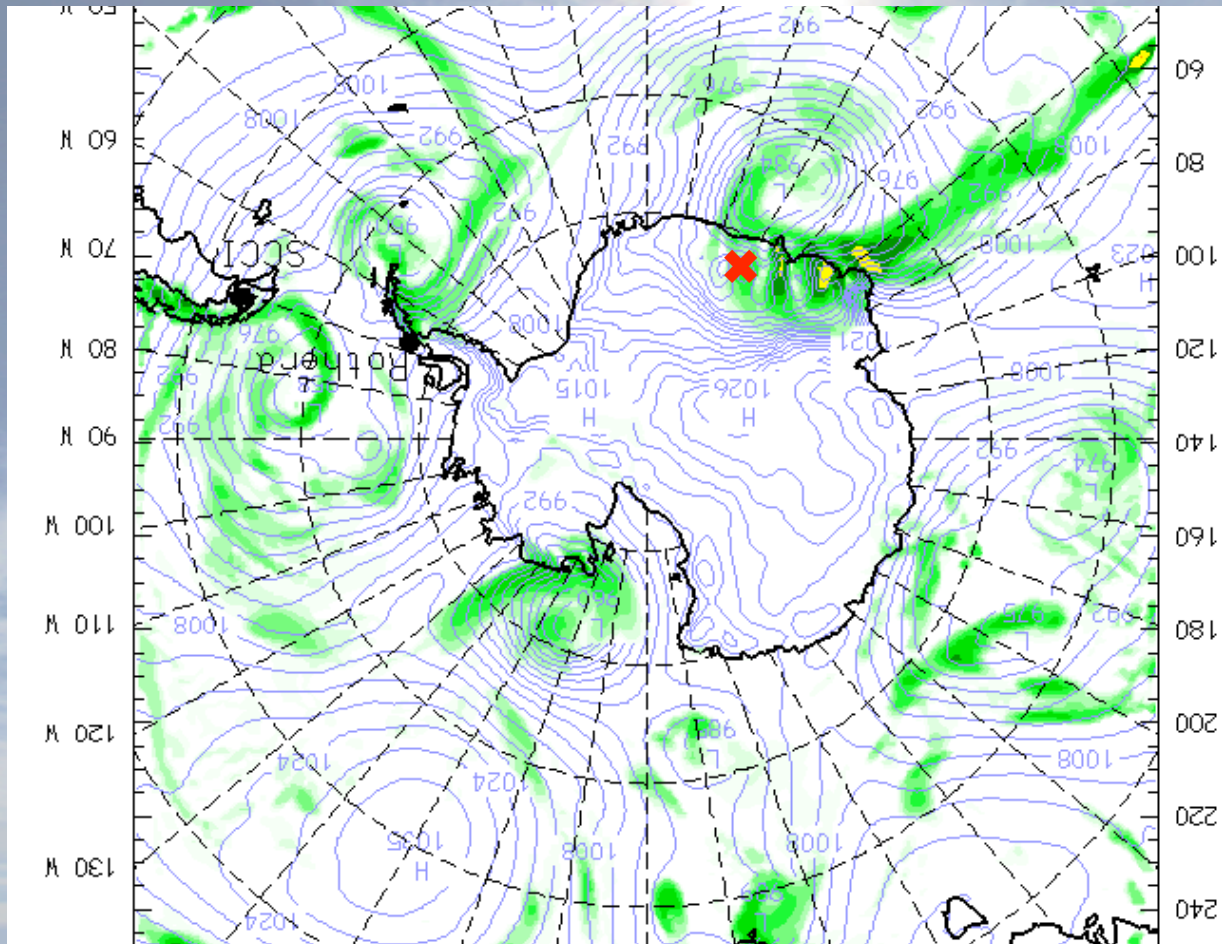
WRF precipitation forecast



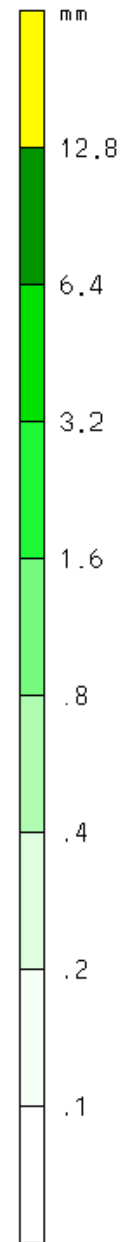
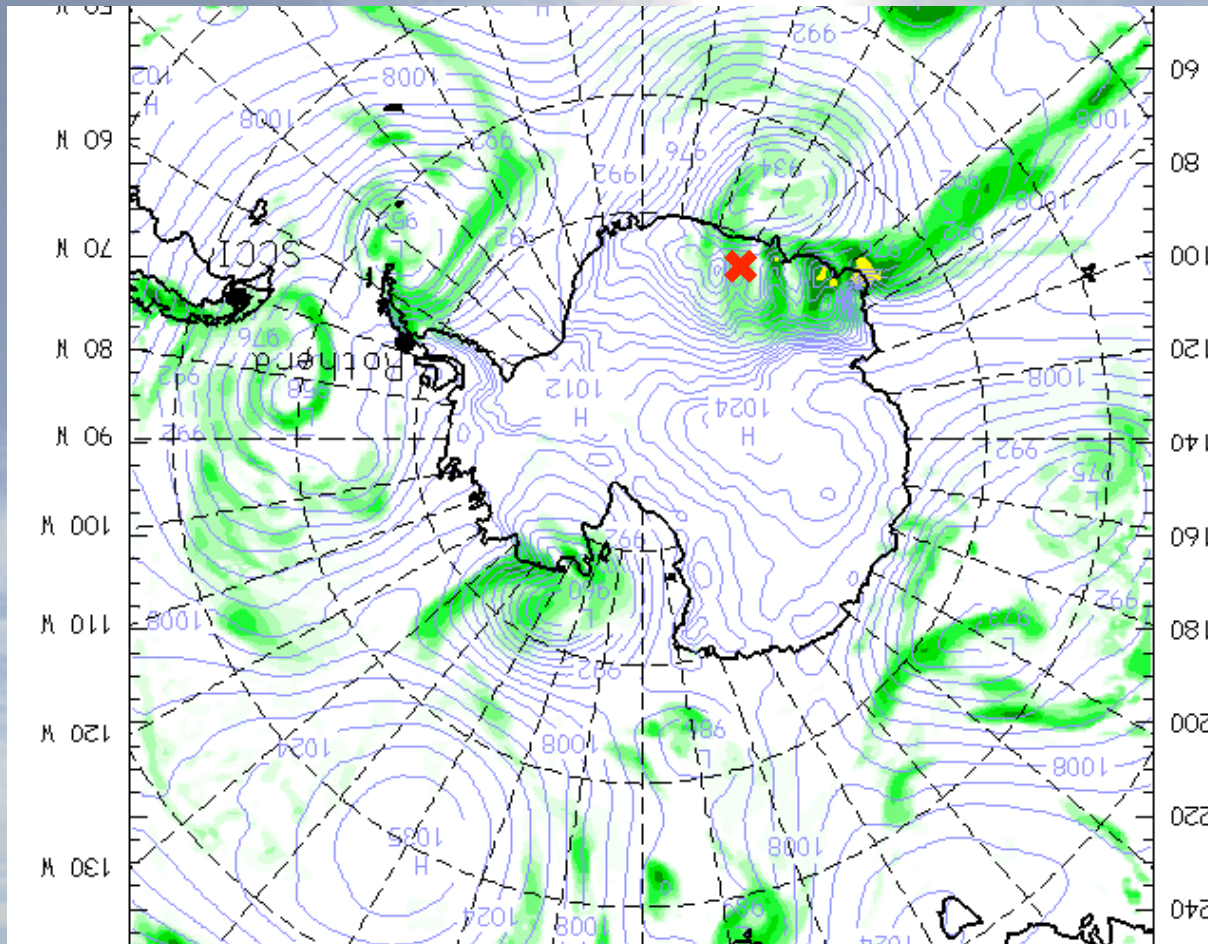
WRF precipitation forecast



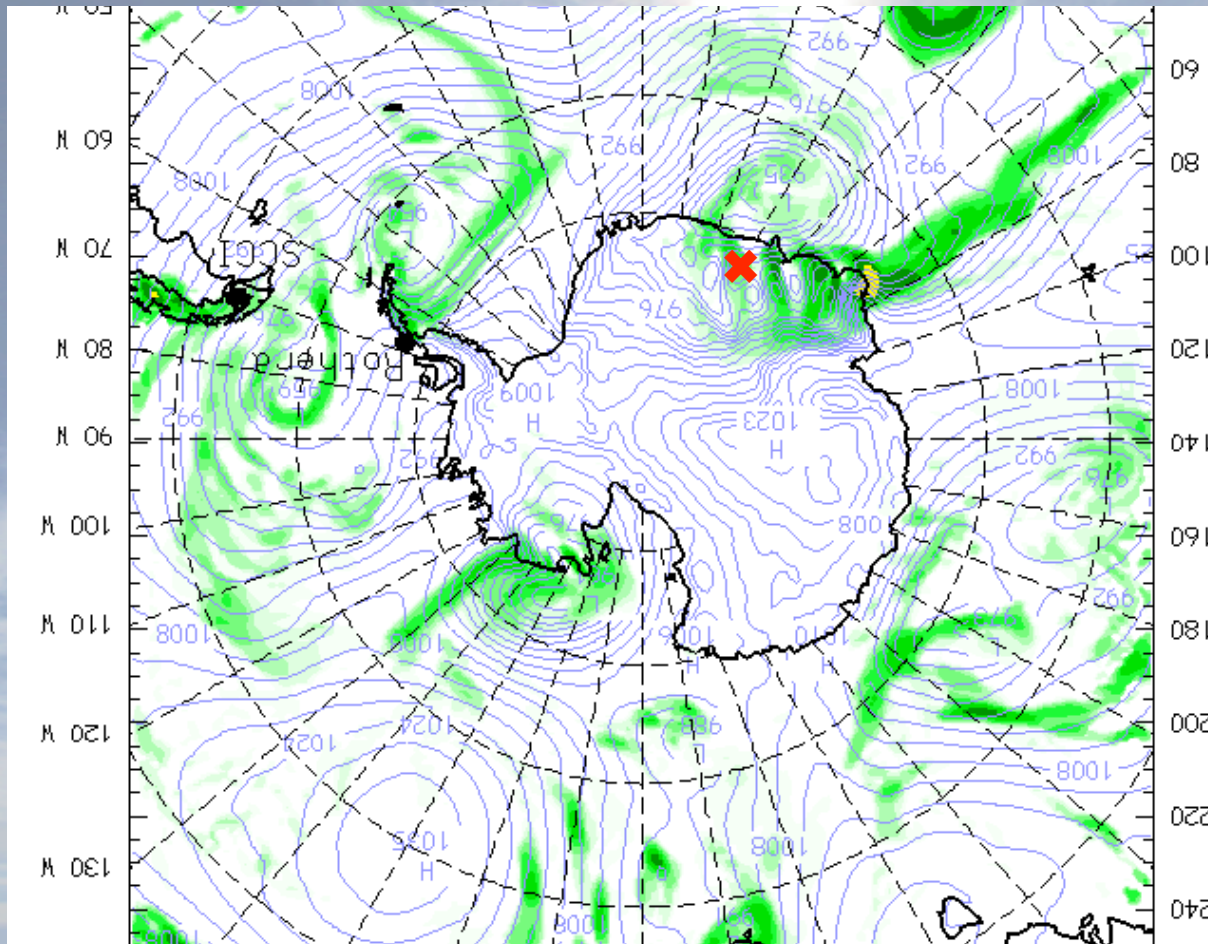
WRF precipitation forecast



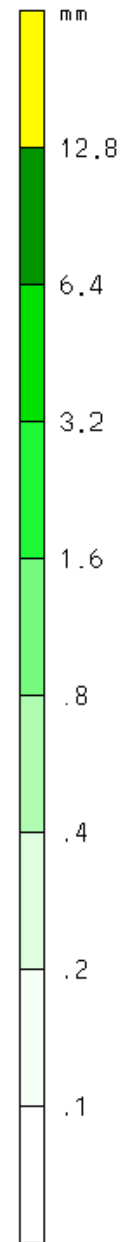
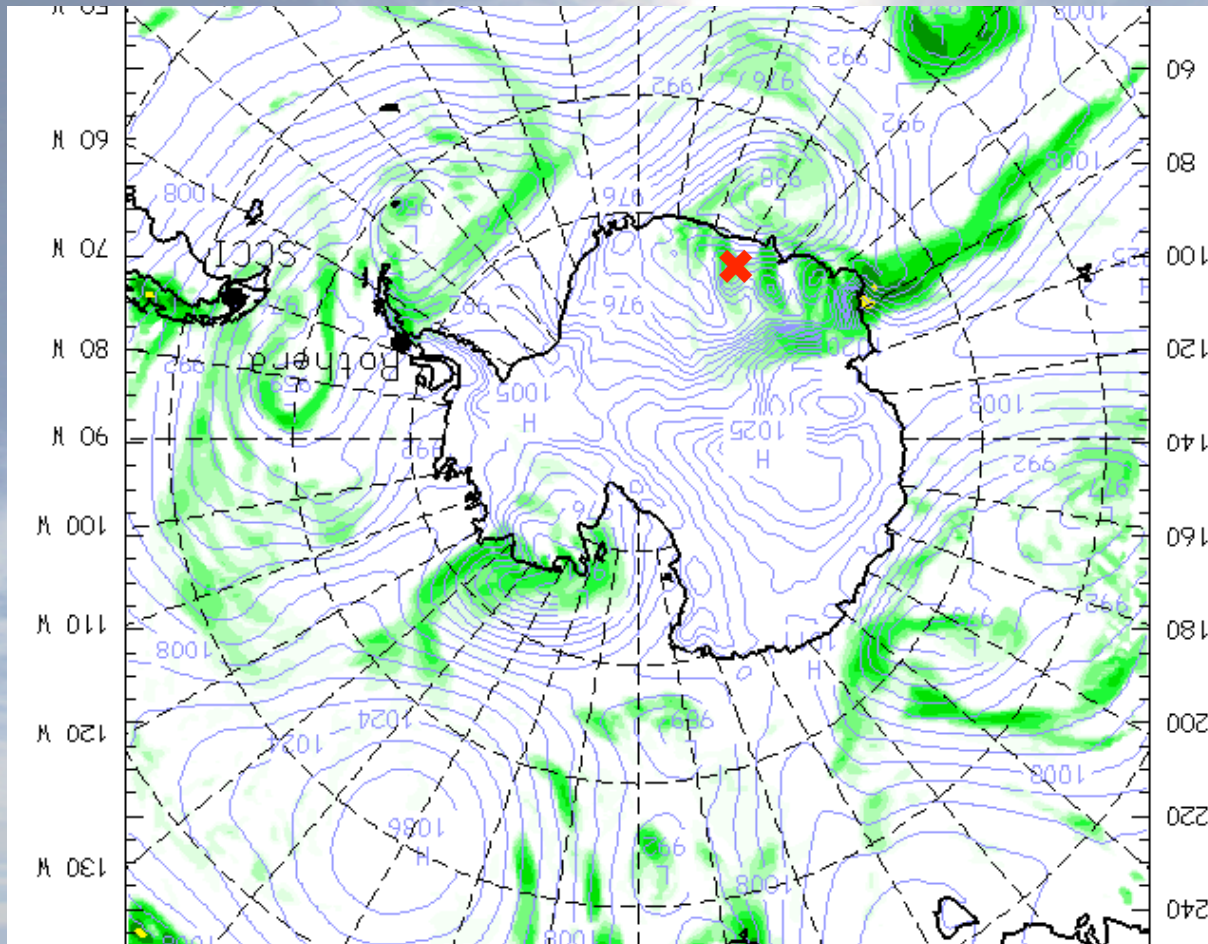
WRF precipitation forecast



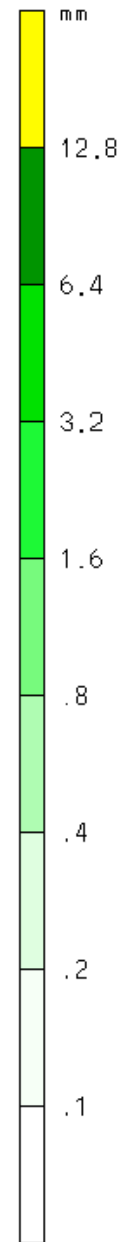
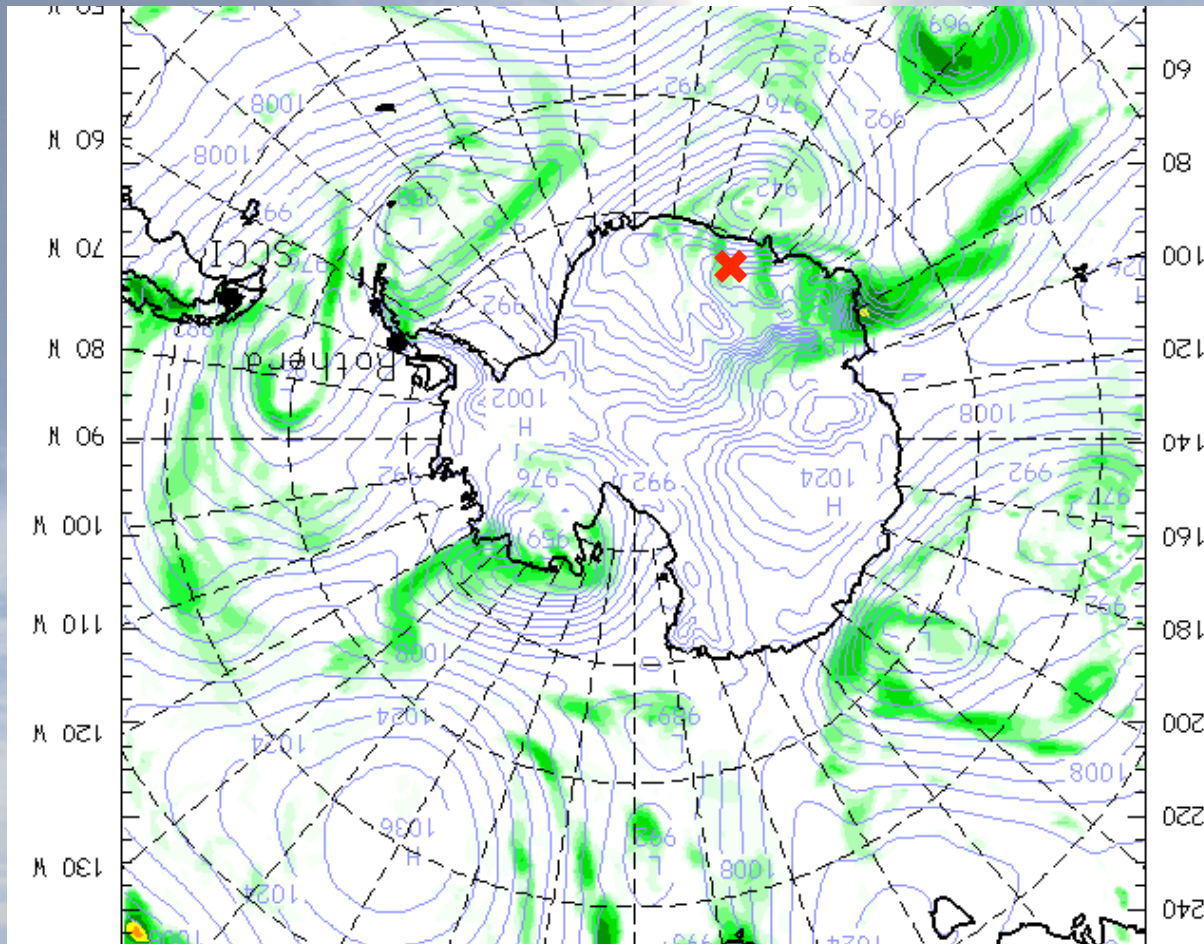
WRF precipitation forecast



WRF precipitation forecast



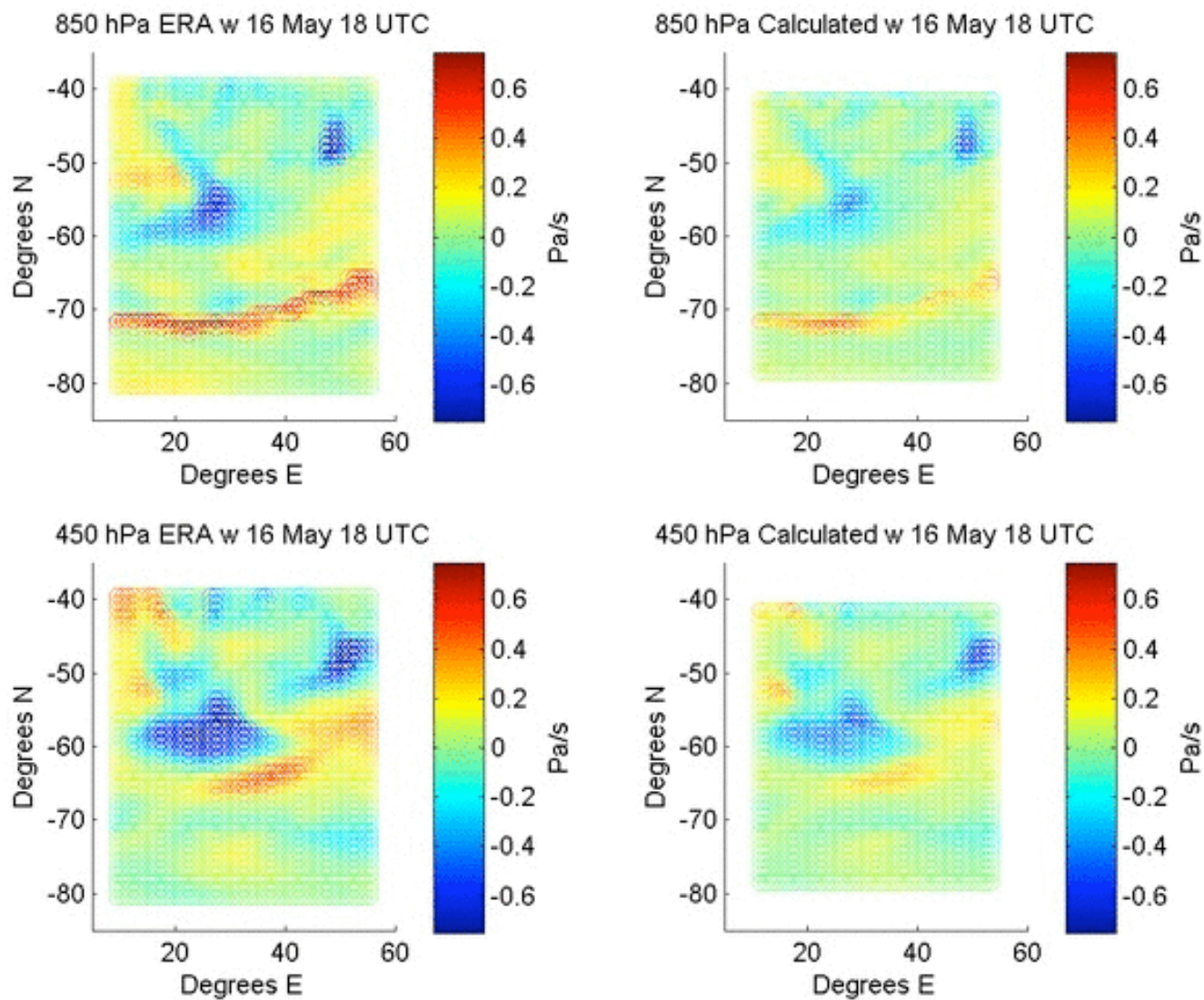
WRF precipitation forecast



Quasi-geostrophic analysis

- Lynch et al. 2003
 - Diabatic heating
 - Thermal gradient
 - Pressure gradient
 - = Estimate q-g vertical motion and examine components
- Bracegirdle and Gray (2008)
 - Type A (low level thermal gradients)
 - Type B (upper level forcing)
 - Type C (latent heat release)

Reanalysis v. Calculated ω



Courtesy of Maya Wei

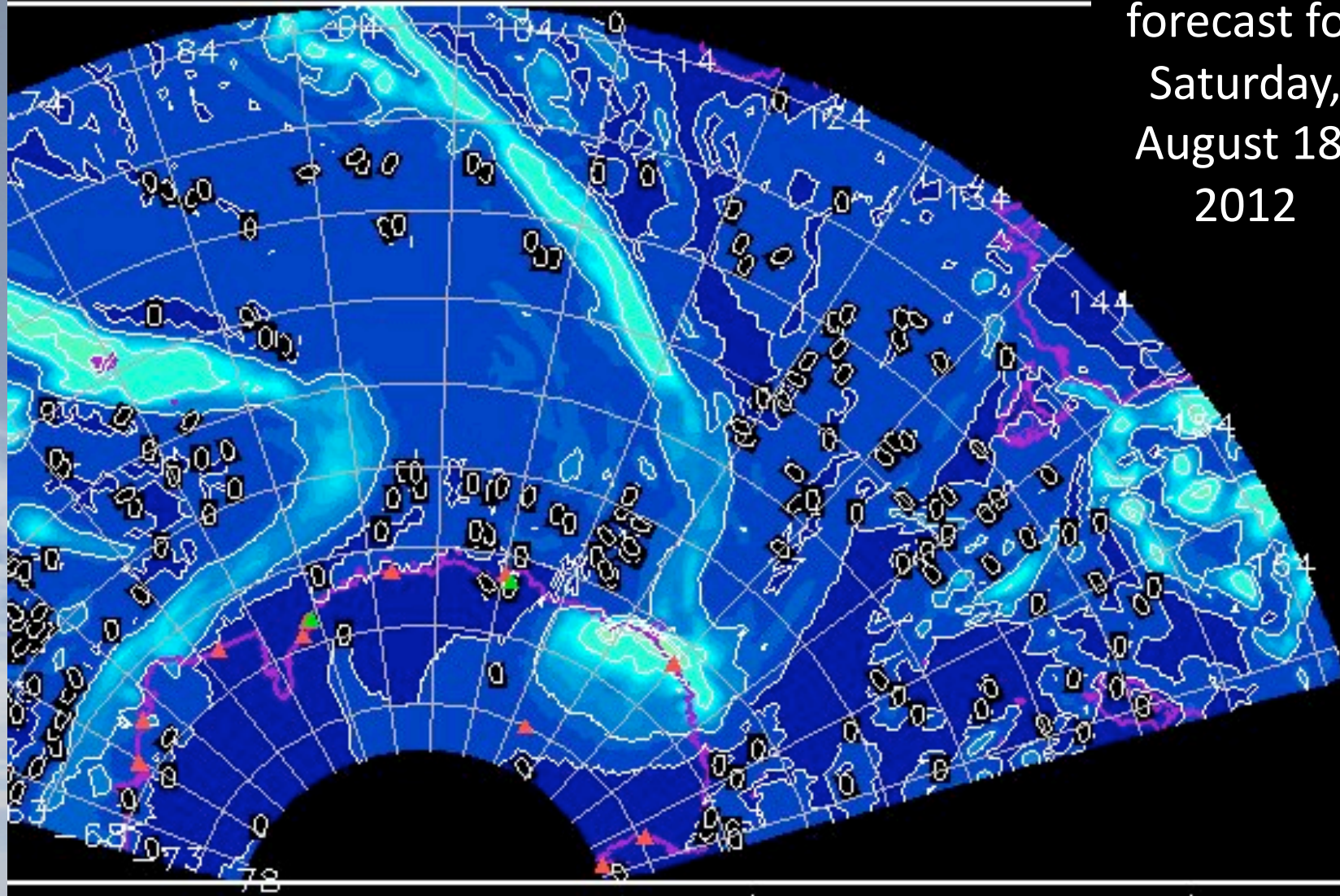
Preliminary conclusions

- Dramatic synoptic event
- Strictly meridional moisture transport
- Atmospheric river signature
 - Although IWV values are smaller than in midlatitudes and even Greenland

Atmospheric River in East Antarctica

Precipitation (mm/hr).

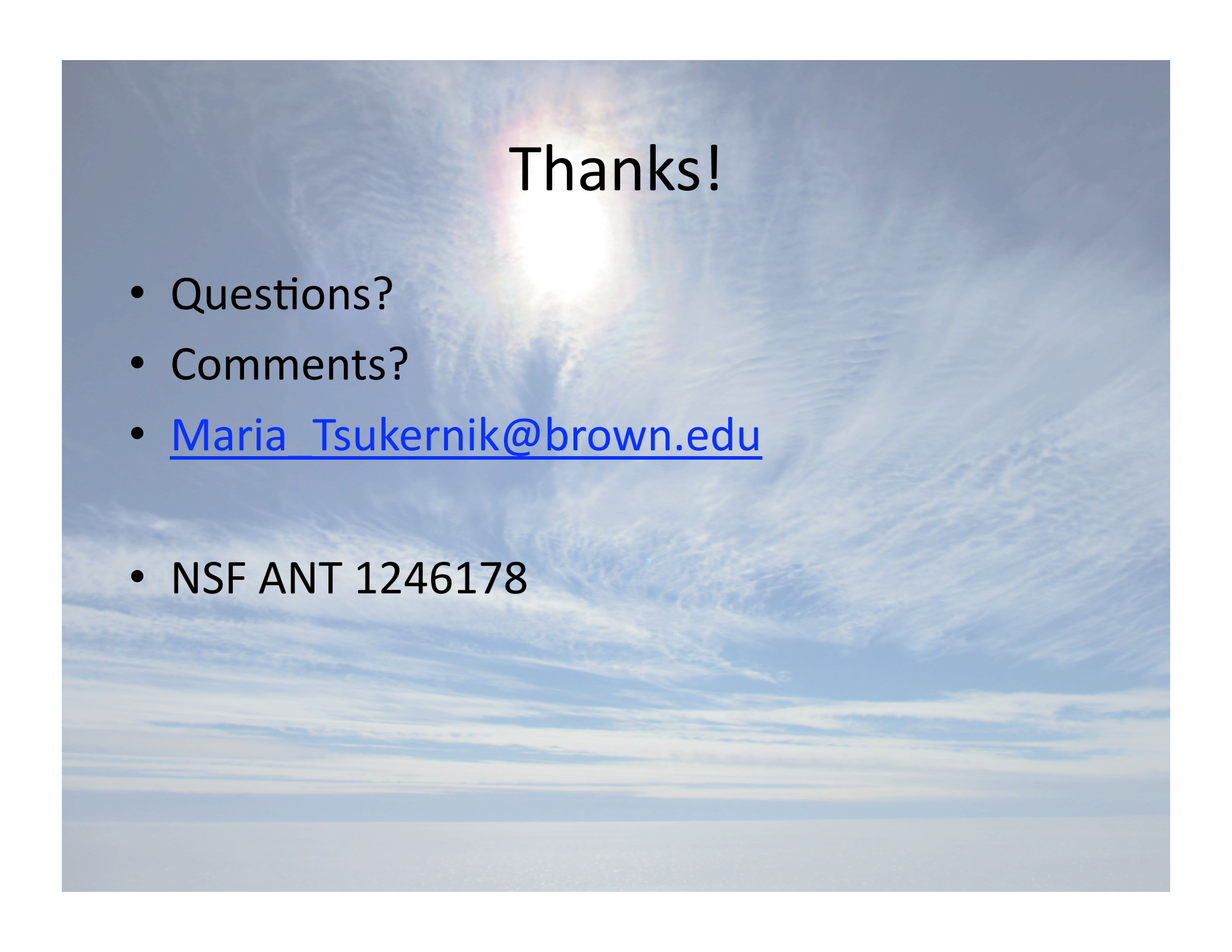
BOM
forecast for
Saturday,
August 18,
2012



gnosis Sat 0000UTC 18 AUG 2012 (base: 12Z13AUG2012).

Future directions

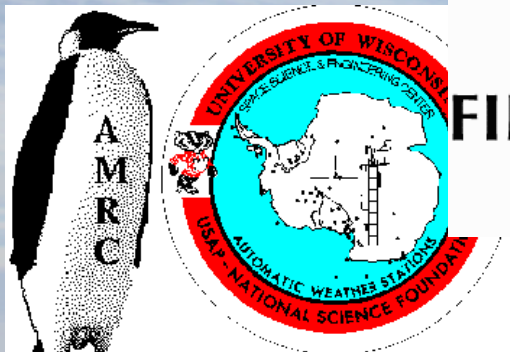
- Analysis of May 2009 case
 - Midlatitude/subtropical connection?
 - WRF sensitivity studies
 - WRF q-g analysis
- Defining other atmospheric river events reaching Antarctic coast
- Automated algorithm?



Thanks!

- Questions?
- Comments?
- Maria_Tsukernik@brown.edu
- NSF ANT 1246178

Thanks!



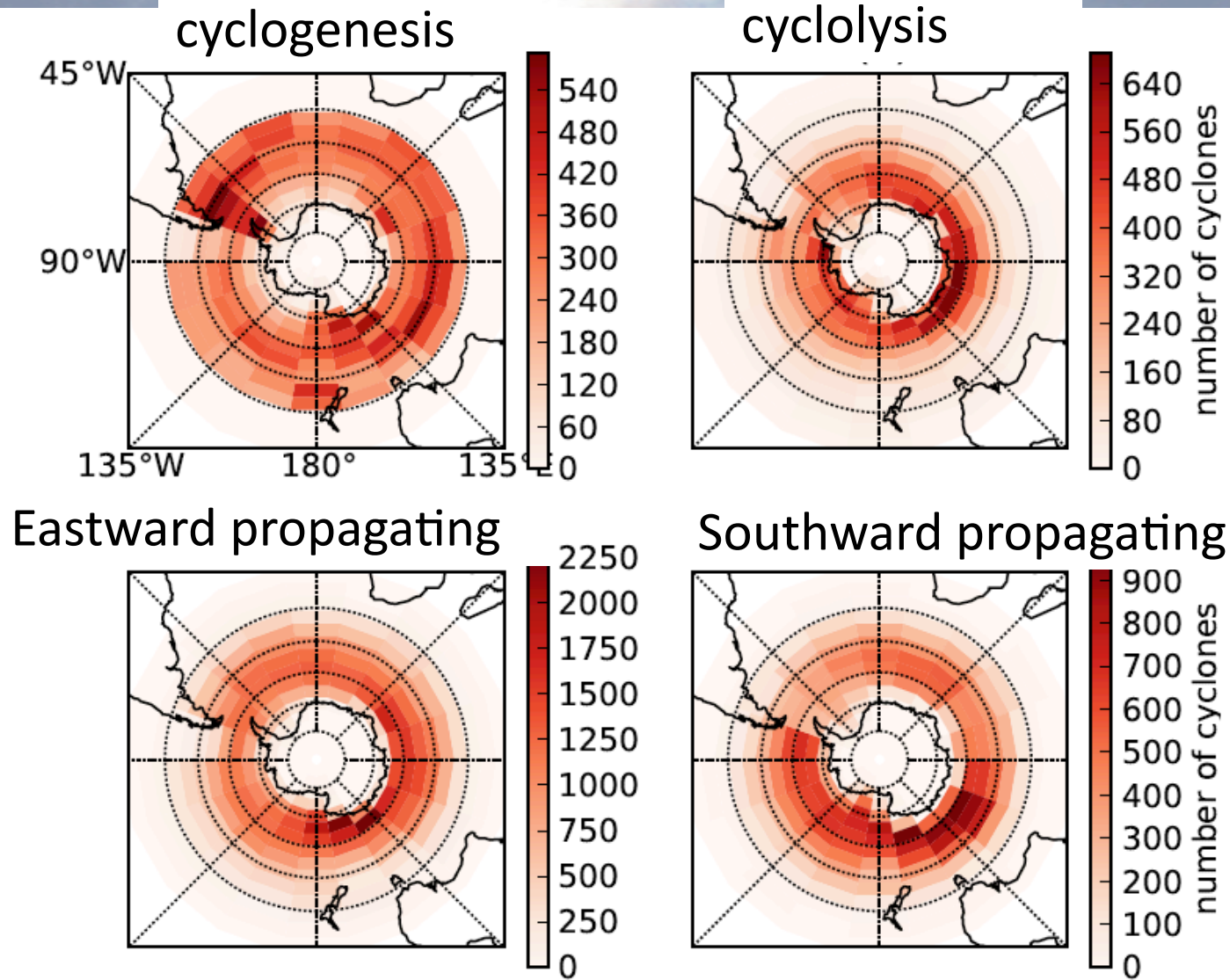
FINNISH METEOROLOGICAL
INSTITUTE



Cyclone budgets and large-scale indices

- 1. the importance of ZW3 mode and its association with the meridional movement of cyclones,
- 2. that positive SAM values are related to decreased eastward and increased southward movement of cyclones, resulting in higher cyclone densities along the Antarctic coast and
- 3. that the impact of ENSO in the Amundsen–Ross Seas is comparable to that of SAM.

Cyclone budget analysis



Uotila et al., 2013, GRL in press

