



# ANGWIN

## ANtarctic Gravity Wave Instrument Network



### Action Group Proposal

#### Names of the lead proponents

Takuji Nakamura (National Institute of Polar Research(NIPR), Japan)

Mike Taylor (Utah State University, USA)

Damian Murphy (Australian Antarctic Division(AAD), Australia)

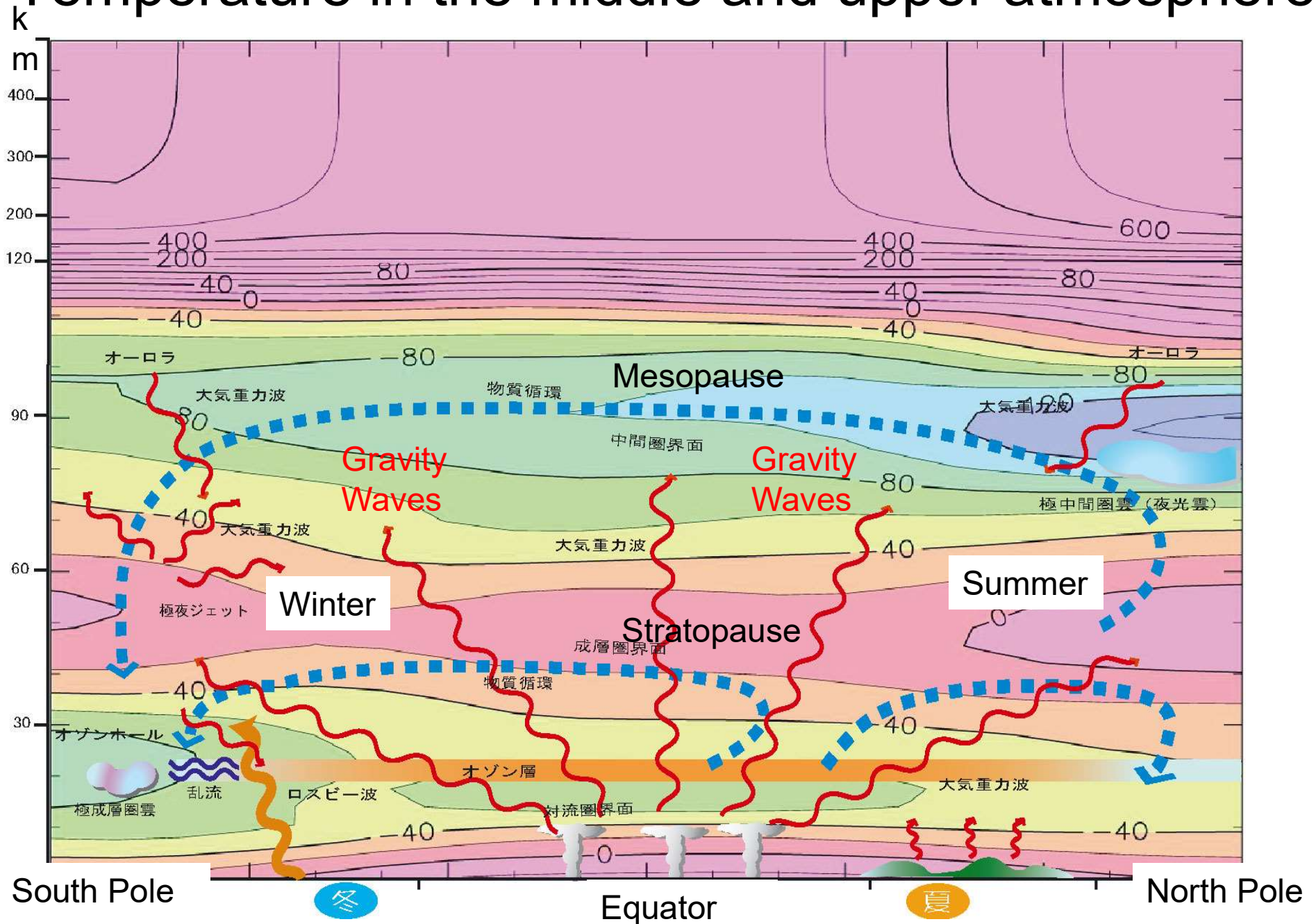
Tracy Moffat-Griffin (British Antarctic Survey(BAS), UK)

José Valentin Bageston (National Institute for Space Research – INPE, Brasil)

Geonhwa Jee, (Korea Polar Research Institute(KOPRI), S. Korea)



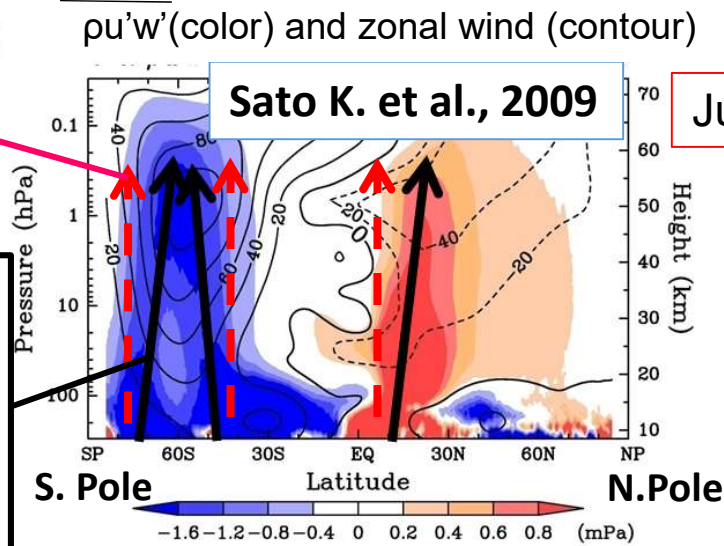
# Temperature in the middle and upper atmosphere



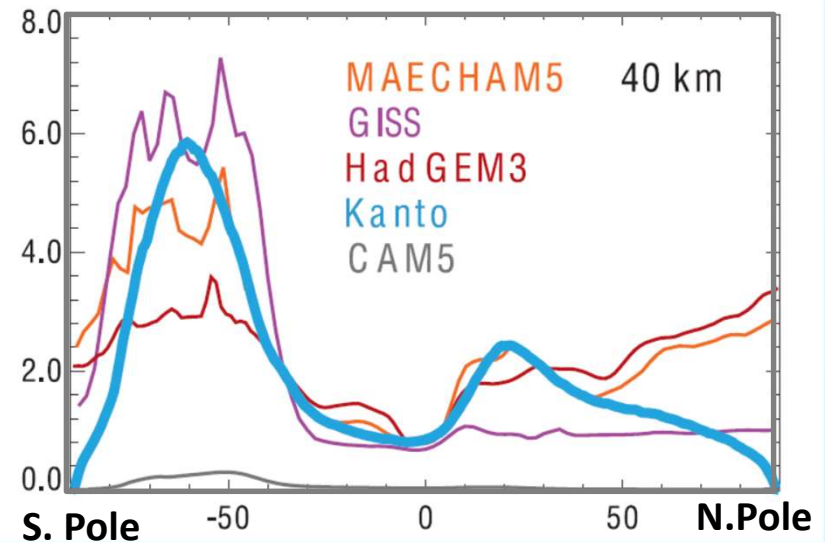
# Target of ANGWIN: Gravity waves in the southern high latitude

Assumption in the climate models

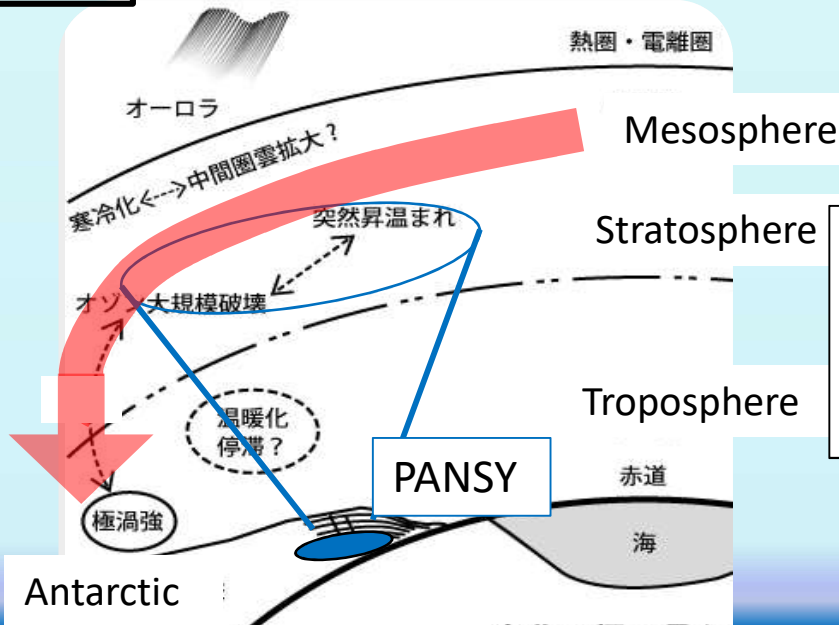
Indication of high resolution model (KANTO)



Absolute Momentum Flux by GW



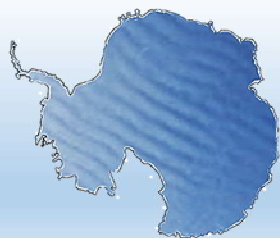
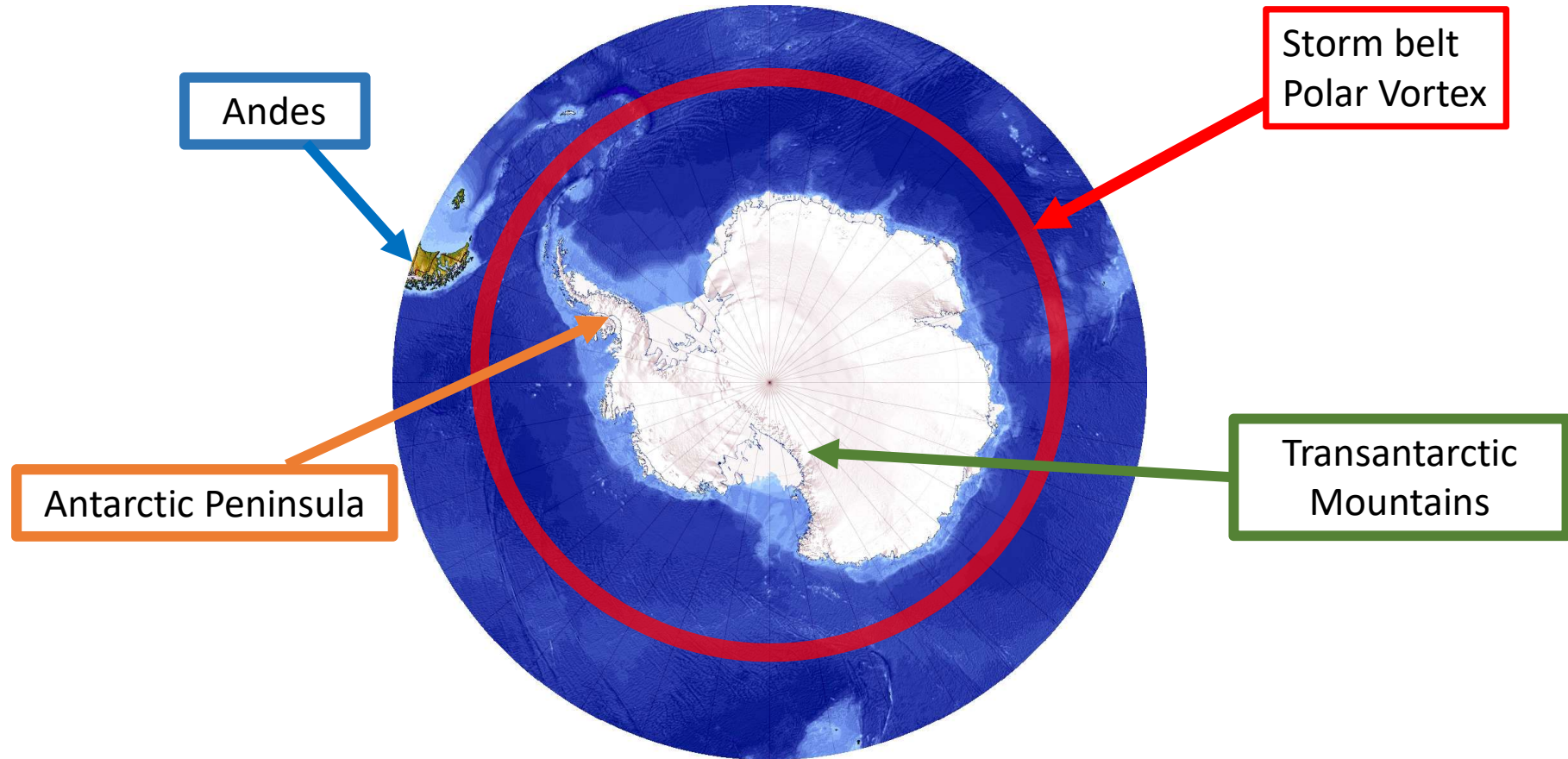
Geller et al. (J Climate, 2013)



Correct understanding of Antarctic gravity waves (GW) and appropriate parameterization of GW is one of the important factors to improve climate models.



# Sources of gravity waves

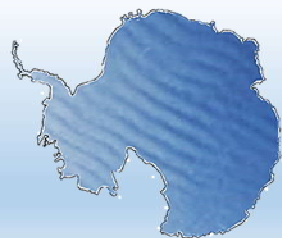
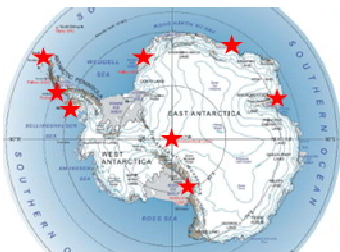


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# Why important over Antarctica?

- Knowledge of the gravity wave sources and how they vary are not well understood in this region due to lack of observations.
- These observations can help refine gravity wave representations in models
- Most global atmosphere models struggle to predict realistic temperatures (the “cold pole” problem) and the timing of the polar vortex breakdown (winds too strong).
- This has been shown to be linked to how gravity waves are represented in these models.



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# What is ANGWIN?

ANGWIN is a “scientist driven” concept that is designed to develop a network of ***Antarctic gravity wave observatories***.

Operated by different nations working together in a spirit of close scientific collaboration.

Collaboration between **U.S.A., Japan, U.K., Australia, Brazil, and Korea**

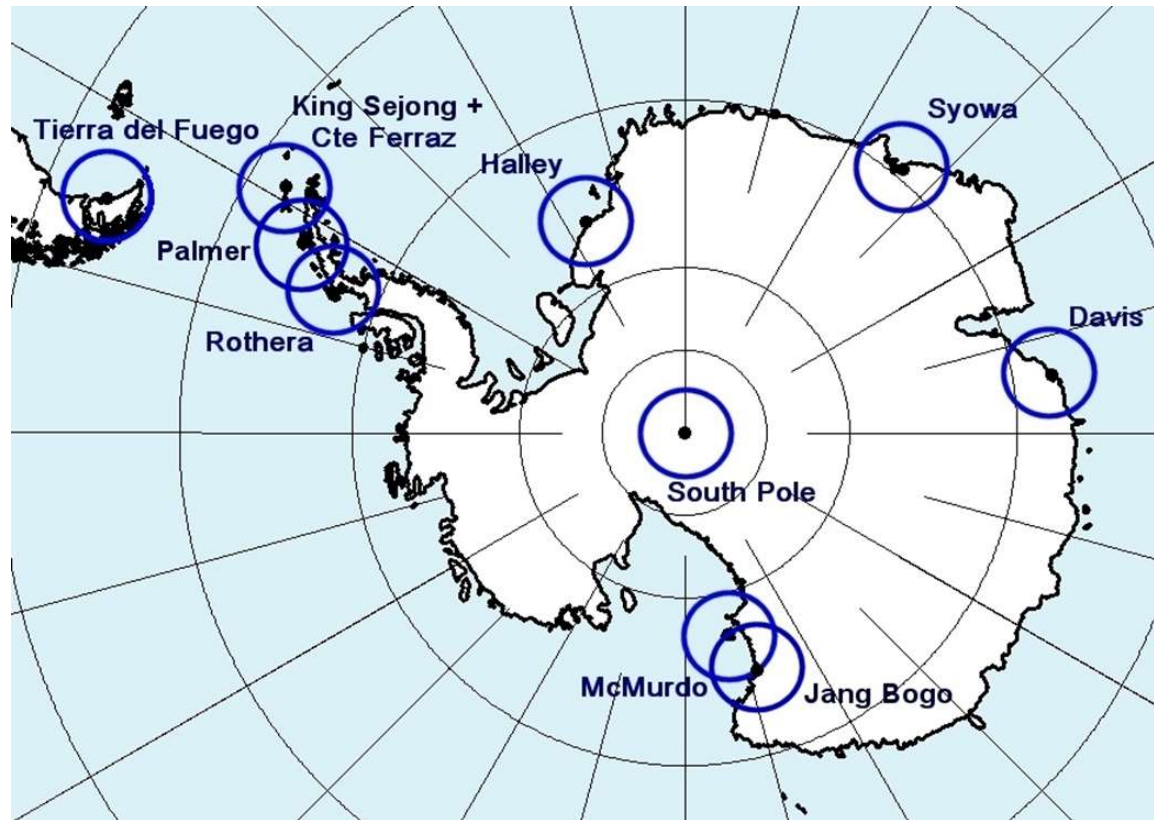


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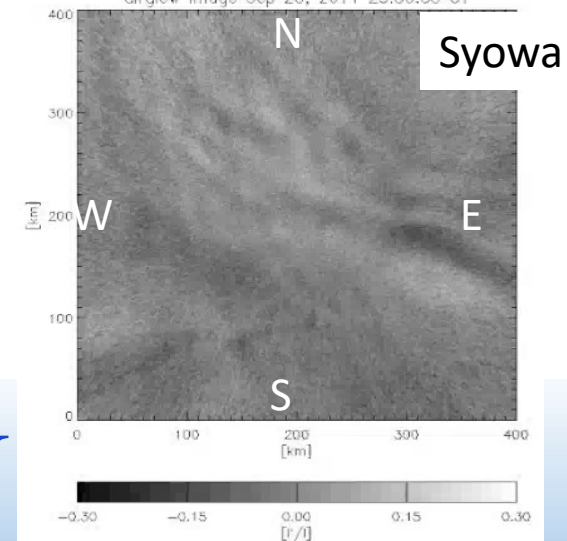
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# What is ANGWIN?

Initially started with a focus on mesospheric airglow observations, now expanded to include all gravity wave instrumentation.



at 23:00 – 00:06 UT on Sep 20, 2011  
airglow image Sep 20, 2011 23:00:00 UT



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# The primary objectives of the network are to:

- Quantify the longitudinal variation in gravity wave activity from the lower atmosphere into the mesosphere and lower thermosphere above Antarctica, and determine causes.
- Characterize the propagation and dynamical influence of mountain waves on stratosphere and MLT dynamics.
- Relate gravity waves observed in the stratosphere, mesosphere and thermosphere to sources such as storms in the Drake's Passage and Southern Ocean, auroral activity or the polar vortex.
- Study the interaction of gravity waves with global scale waves and their contribution to the polar vortex dynamical and thermal structure.
- Compare observed polar gravity wave characteristics to parameterized gravity waves in climate model.



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# What have we done so far...

## Workshops:

- Four held since 2012 (Japan, USA, UK, Brasil)
- each attended by 35-50 scientists
- over 12 different nations represented
- about 1/3 attendees early career scientists

## Website and social media:

- [www.bas.ac.uk/project/angwin/](http://www.bas.ac.uk/project/angwin/), @ANGWIN\_2
- The instrument database started - intend to list as many gravity wave instruments that are in the Antarctic as possible.
- Twitter used to advertise workshops, ANGWIN related presentations and papers.
- Web of the latest workshop <http://www.inpe.br/angwin/>



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# 1st International ANGWIN Workshop, NIPR, Tokyo, Japan, March, 2013



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# 2nd International ANGWIN Workshop

## Logan, Utah, USA, October, 2014



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# 3rd International ANGWIN Workshop, Cambridge, UK, April, 2016



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# 4th International ANGWIN Workshop, São José dos Campos, SP, Brasil, April 2018.



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# What have we done so far...

## Papers and presentations:

- JGR (joint atmosphere and space) **special issue:**
  - currently 8 papers published, with 3 more under review
  - topics ranging from ionospheric observations of gravity waves to those observed in the stratosphere above Antarctica.
- Encouraging attendees at the ANGWIN workshops to use ANGWIN as a keyword in related papers.
- Numerous ANGWIN related presentations at conferences such as IUGG, IAGA, COSPAR, SCAR OSC

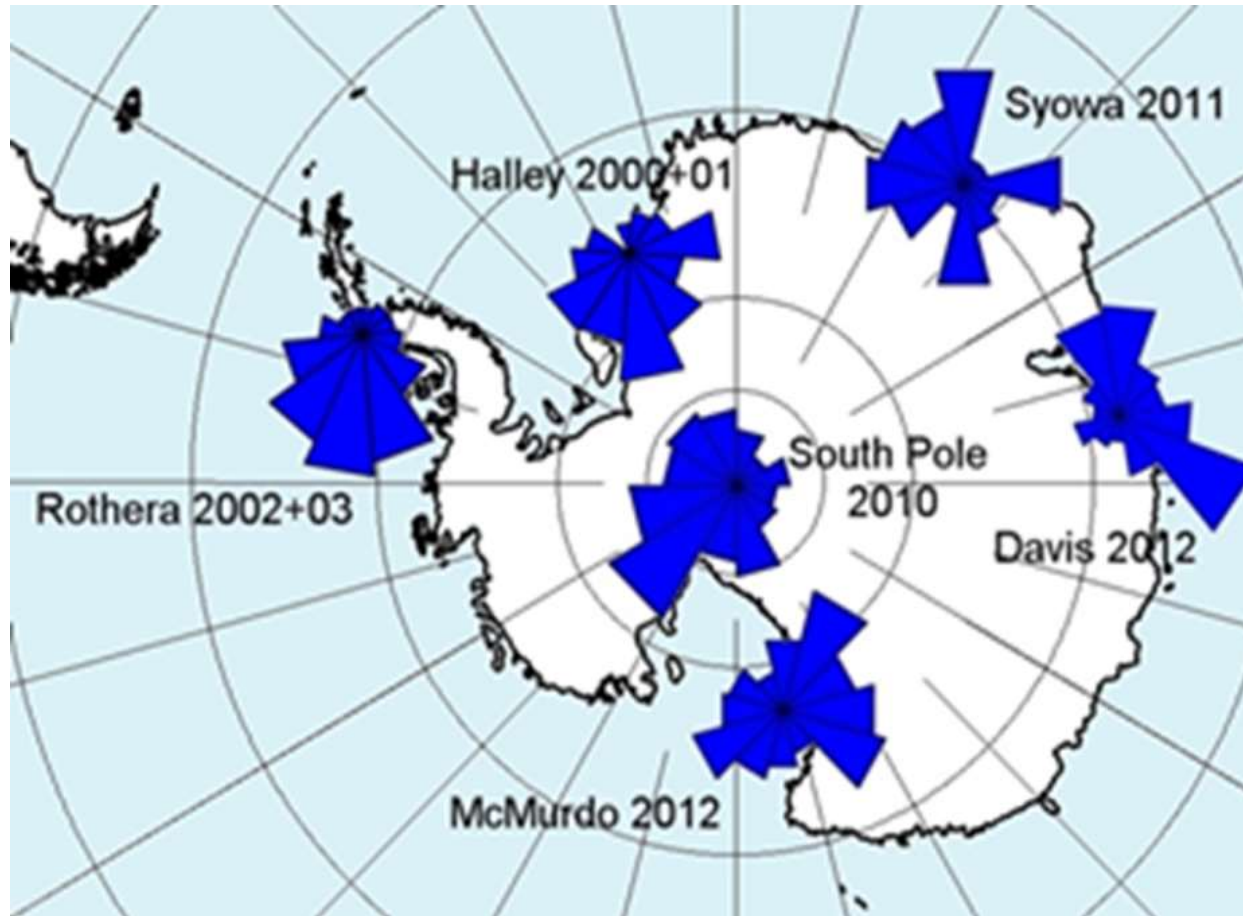


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# What we have done so far (First step)

Comparison of GW statistics (directionality) of different years



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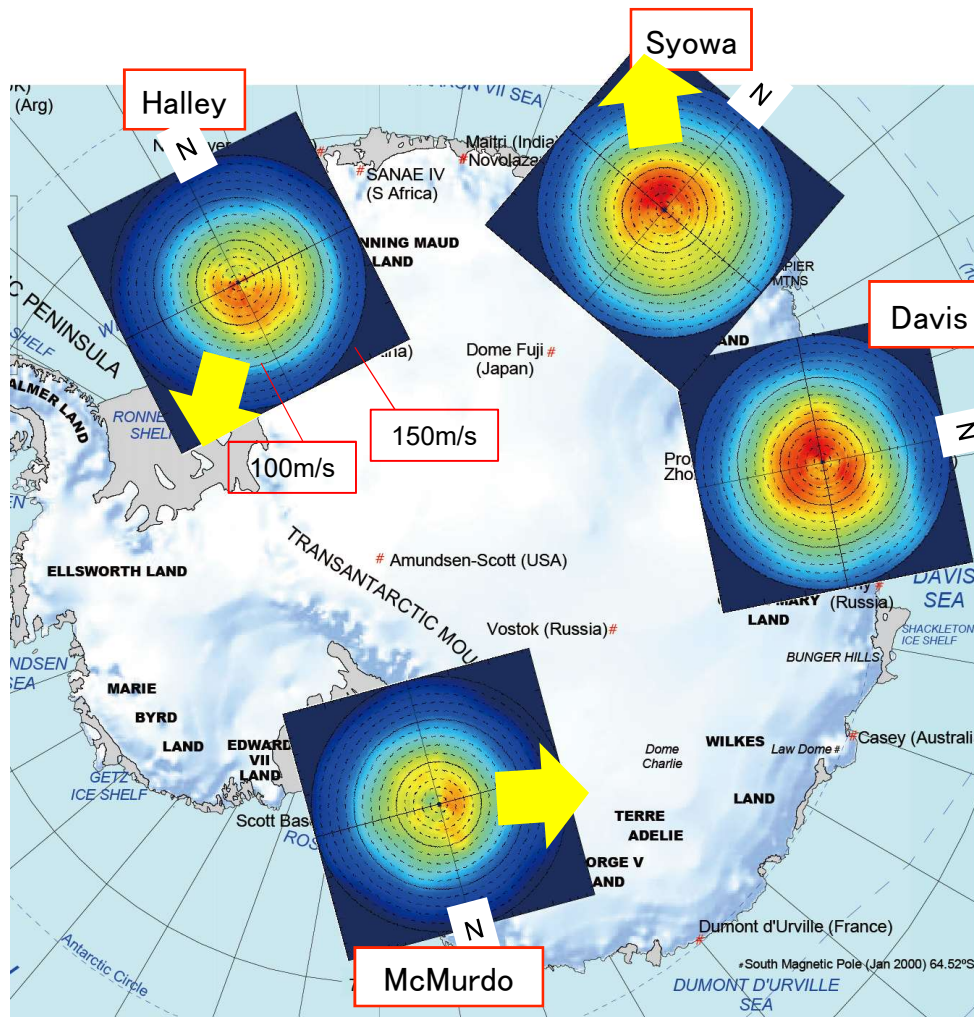


# 1<sup>st</sup> Comparison of propagation direction by phase velocity spectrum (the same analysis technique has been applied for the first time)

(Spectra averaged for Apr 6 - May 21, 2013)

[Matsuda et al., 2017, ANGWIN special issue, JGR]

Propagation direction and speed of gravity waves ( $\lambda$ :10-100km,  $\tau$ :8-60min)



Station	lat	lon	directionality
Syowa	69S	40E	SW-NW-NE
Davis	69S	78E	<u>All</u>
McMurdo	78S	156E	SW-W-N
Halley	76S	27W	SE-SW-NW

Davis

propagating to all directions

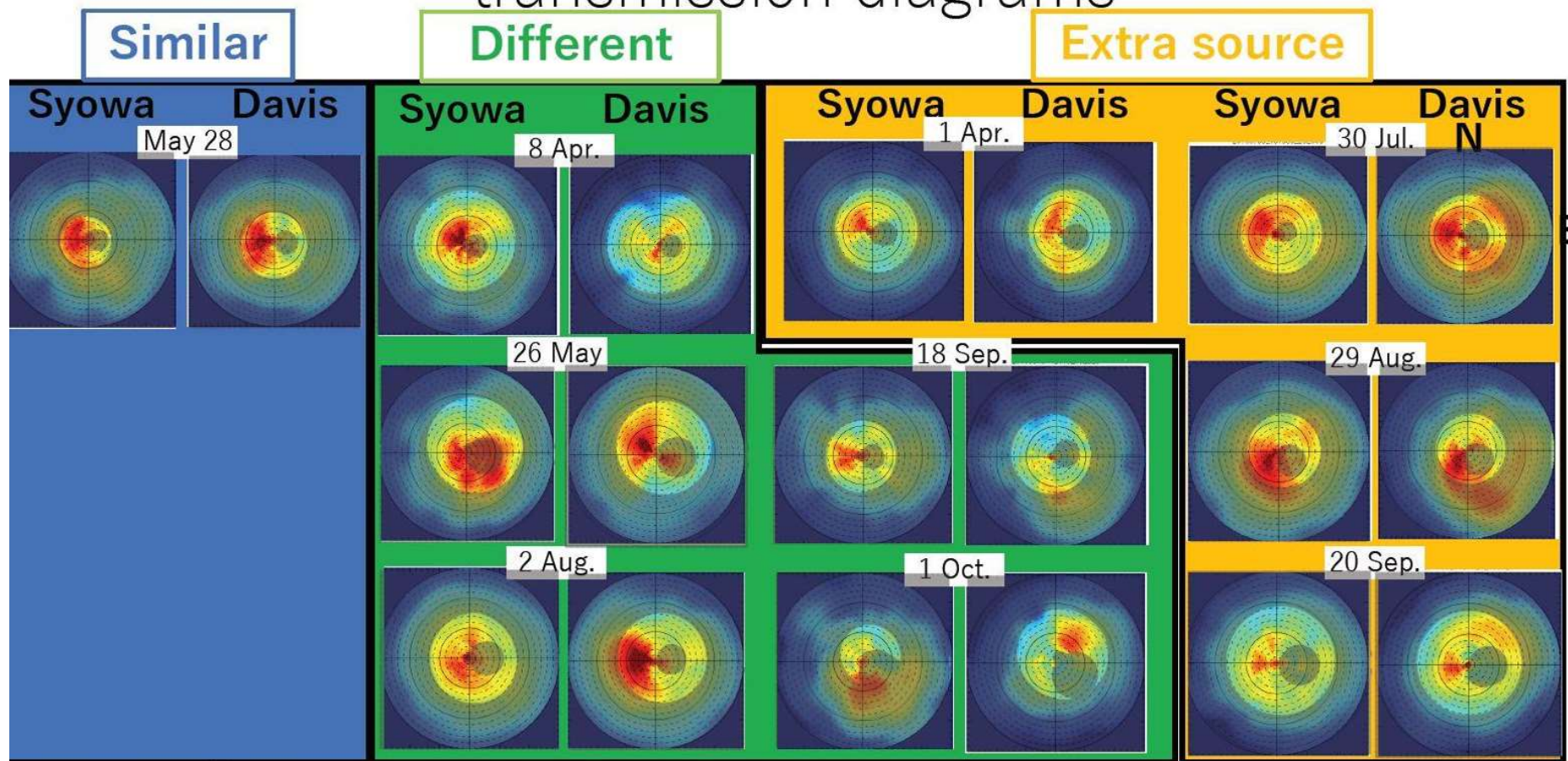
Other three stations (Syowa, Halley, McMurdo):  
generally Westward



# Detailed comparison between the two sites (Syowa, Davis)

2016 winter data

Comparison between the spectra and transmission diagrams



# What have we done so far...

## Exchange students between ANGWIN institutes

NIPR, Japan to **USU, USA for three months** (2015)

NIPR, Japan to **USU, USA for one month** (2017)

Chungnam National Univ., S. Korea to **NIPR, Japan for two months** (2017/8)

NIPR, Japan to **AAD, Australia for 4 months** (2018)

USU, USA to **NIPR, Japan, for three month** (2018)



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