Moisture transport to Syowa Station and Dome Fuji Station, Antarctica

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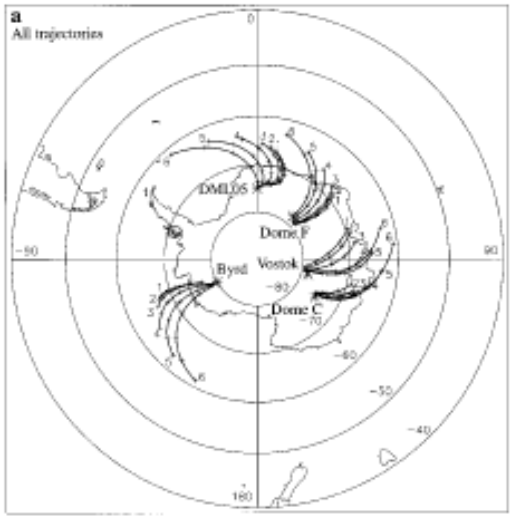
2nd Antarctic Meteorological Observation, Modeling, and Forecasting (AMOMF) Workshop

Rome, Italy on 26-28 June 2007

Motivation

Analysis of Ice core data for "Reproduction of Paleoclimate"



Reijimer et al. (2002)

- **is requiring information about transport of water vapor that accumulates the ice sheet.**

Early studies

Reijimer et al. 2002:

Using Snowfall data from ERA-15 which they compared to amounts of RH from AWS (near DML and Dome C).

Schlosser et al. 2005:

Mean air transport routes by cluster analysis and a relationship δ18-T and its dependence on trajectory class from sampling snow data at Neumayer station.

Hensen et al. 2006:

Snowfall events were determined by SHR from AWS.
Mean air transport routes were calculated to average routes and covariance ellipses.

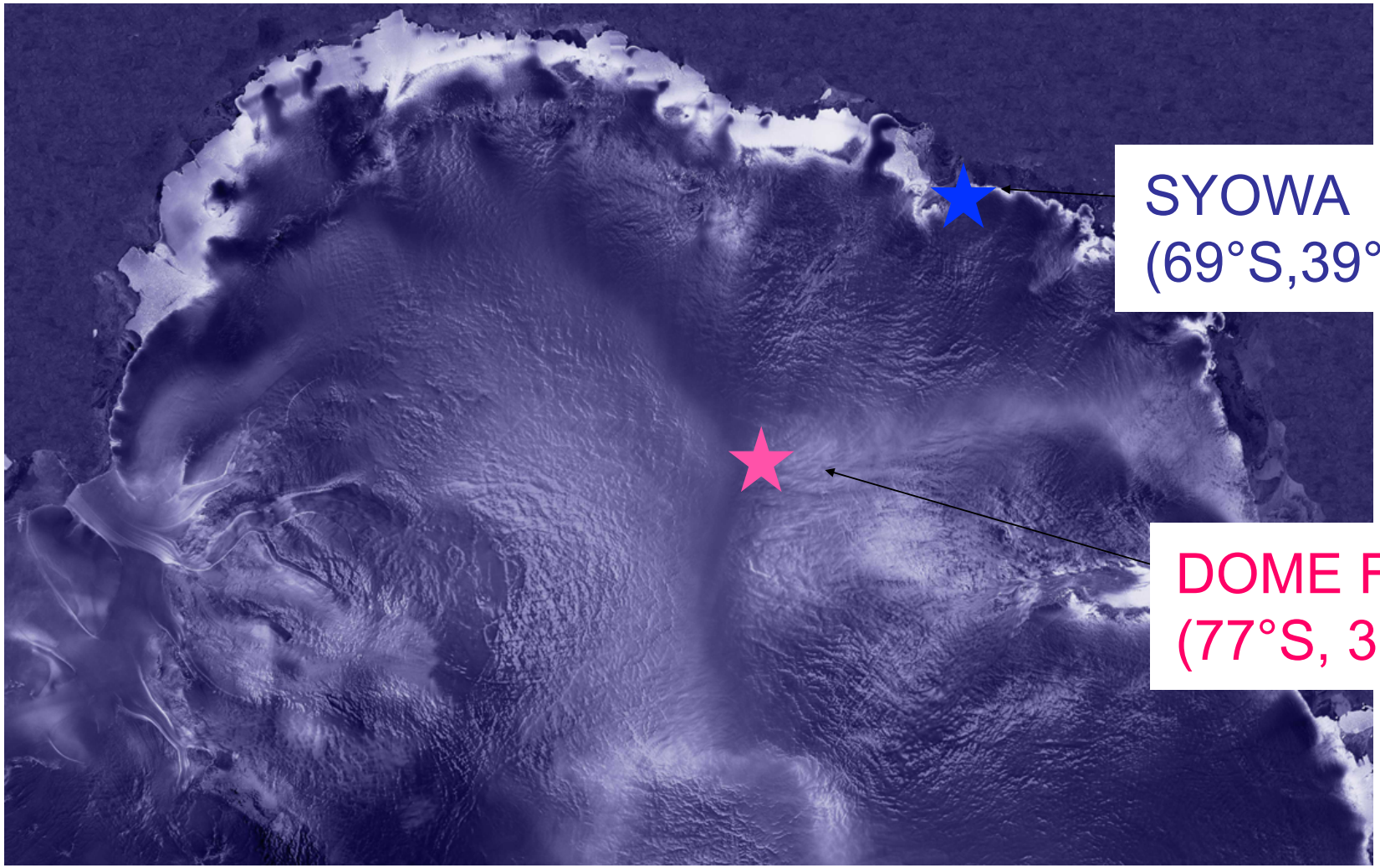
Mean trajectory path has a possibility that individual characteristics might be ignored.

In this study,

Climatology of transport routes of air parcels and moisture to the stations in Antarctica.

Moisture transport by using ground-based meteorological data.

Japanese sites over Antarctica in this study



Goal

We will discus about:

- Characteristics and seasonal variation of air transport routes comparing clear and snow weather condition.
- Differences of moisture and air transport between the coastal region and the continental interior.

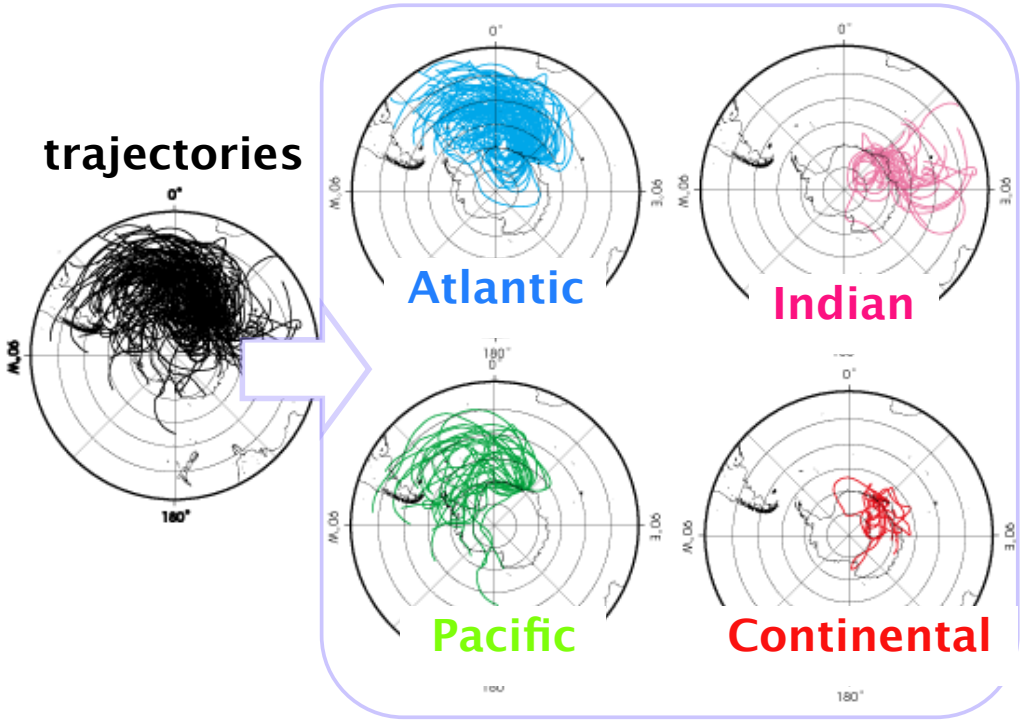
Data and Methods -3D-trajectory-

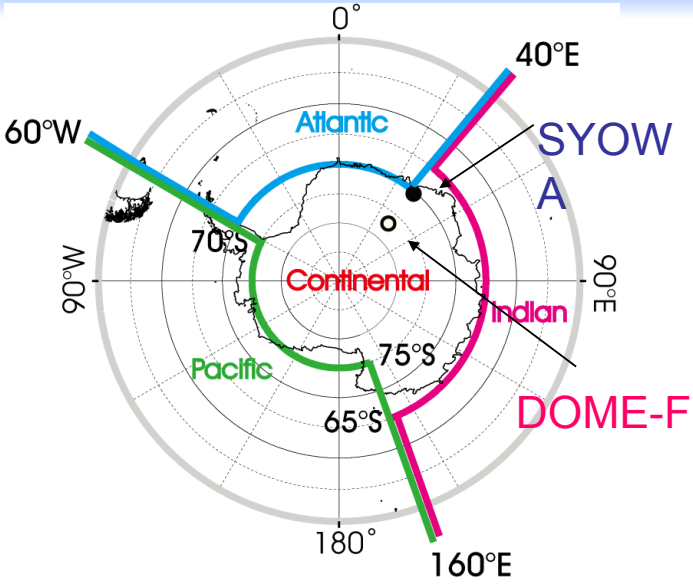
- We calculated air transport to each station using these data and Model;

Meteorological data:
ERA-40 reanalysis 2.5°×2.5°grid, 6-hourly.
u, v, ω, temperature, geopotential height,
specific and relative humidity.
Term: Jan. 1990 - Dec. 1999

Model:
NIPR Trajectory Model(Tomikawa and Sato, 2005)
using 4th-order Runge-Kutta integration scheme and cubic spline time interpolation.
Time step: 60 min
Start points: 500hPa, 850hPa at Syowa Station(SYOWA)
500hPa at Dome Fuji Station(DOME-F)

Origins of air parcels

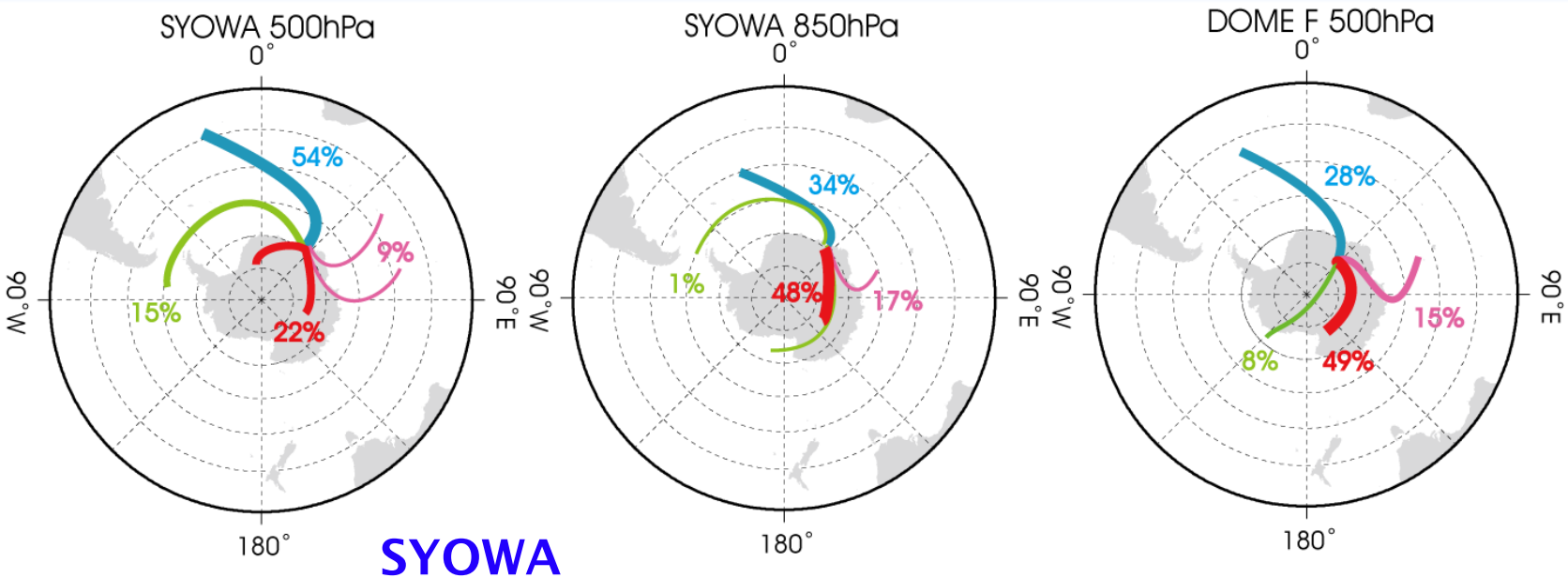


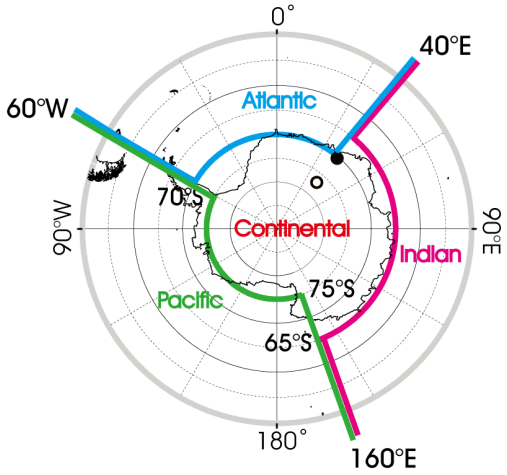


Atlantic	60°W-40°E,0°-70°S
Indian	40°E-160°E,0°-65°S
Pacific	160°E-60°W,0°-75°S

The point of an air parcel at 5 day before is defined as the origin.
The Southern Hemisphere is divided into 3 oceans and the continent.

Climatology of air transport to SYOWA and DOME-F





SYOWA

- ▪500hPa
- 69% of air parcels came from west of SYOWA.
- (Atlantic 54%, Pacific 15%)
- ▪850hPa
- 65% of air parcels came from east.
- (Continental 48%, Indian 17%).

DOME-F

- About 50% of air parcels stayed within the continent,
  whereas another 50% of air parcels liable to come from each ocean.

Data and Methods
-Assorting of moisture transport using observed data-

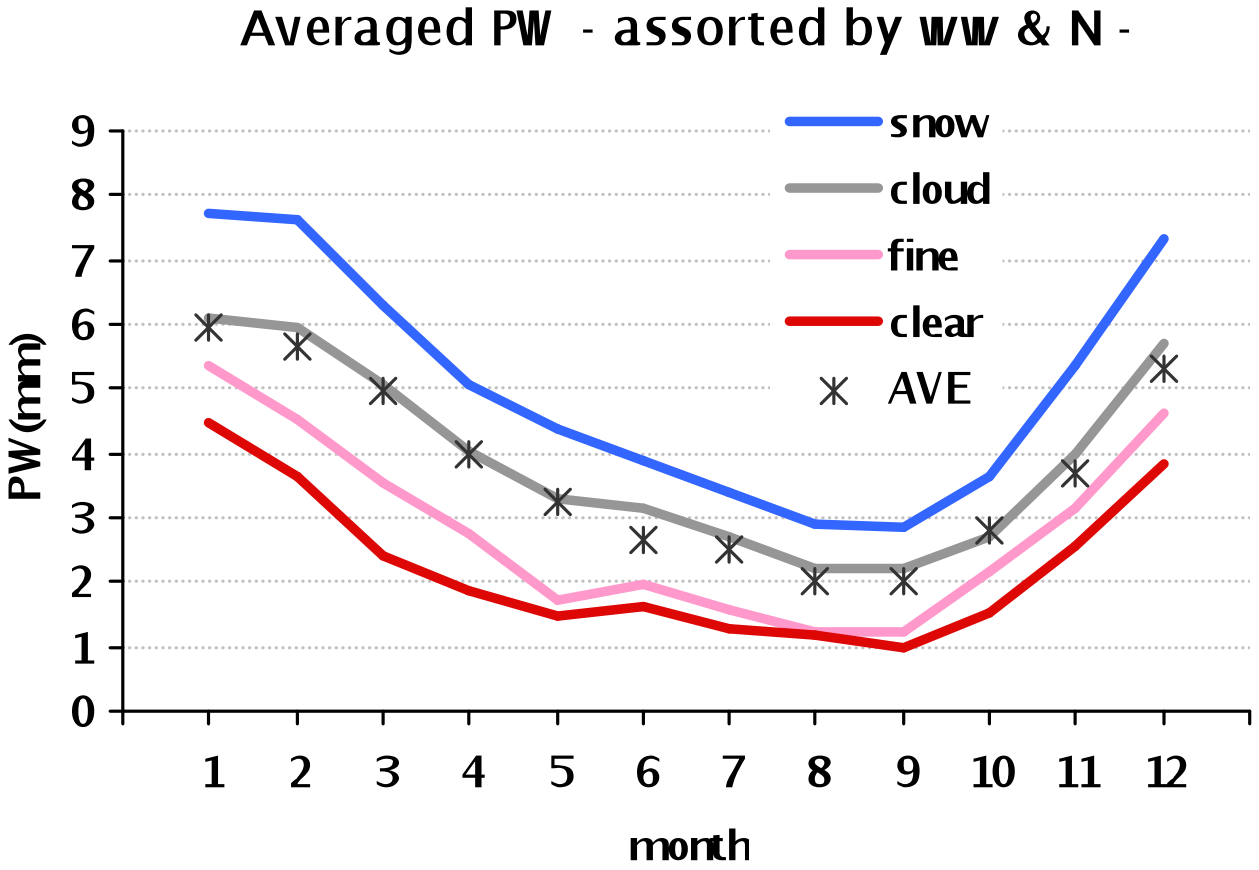
- To assort trajectories, we used these data:

- Present weather (ww), Cloud amount (N) from ground-based meteorological data.
  ex.) ww >70 means precipitation phenomina
- ⇒ weather condition
- Rawin-sonde (RH, P, T) every 00UTC, 12UTC
- ⇒ Precipitable water

SYOWA :
Ground-based meteorological data (1990~1999, 3-hourly)
Rawin-sonde (1990~1999, twice-daily)

DOME-F :
Ground-based meteorological data
(1995Feb~1998Jan, 3~6-hourly)

PW calculated by rawin sonde



SNOW
N>=8.5
ww>=70

CLOUDY
N>=8.5
ww<70

FINE
1<=N<8.5
ww<70

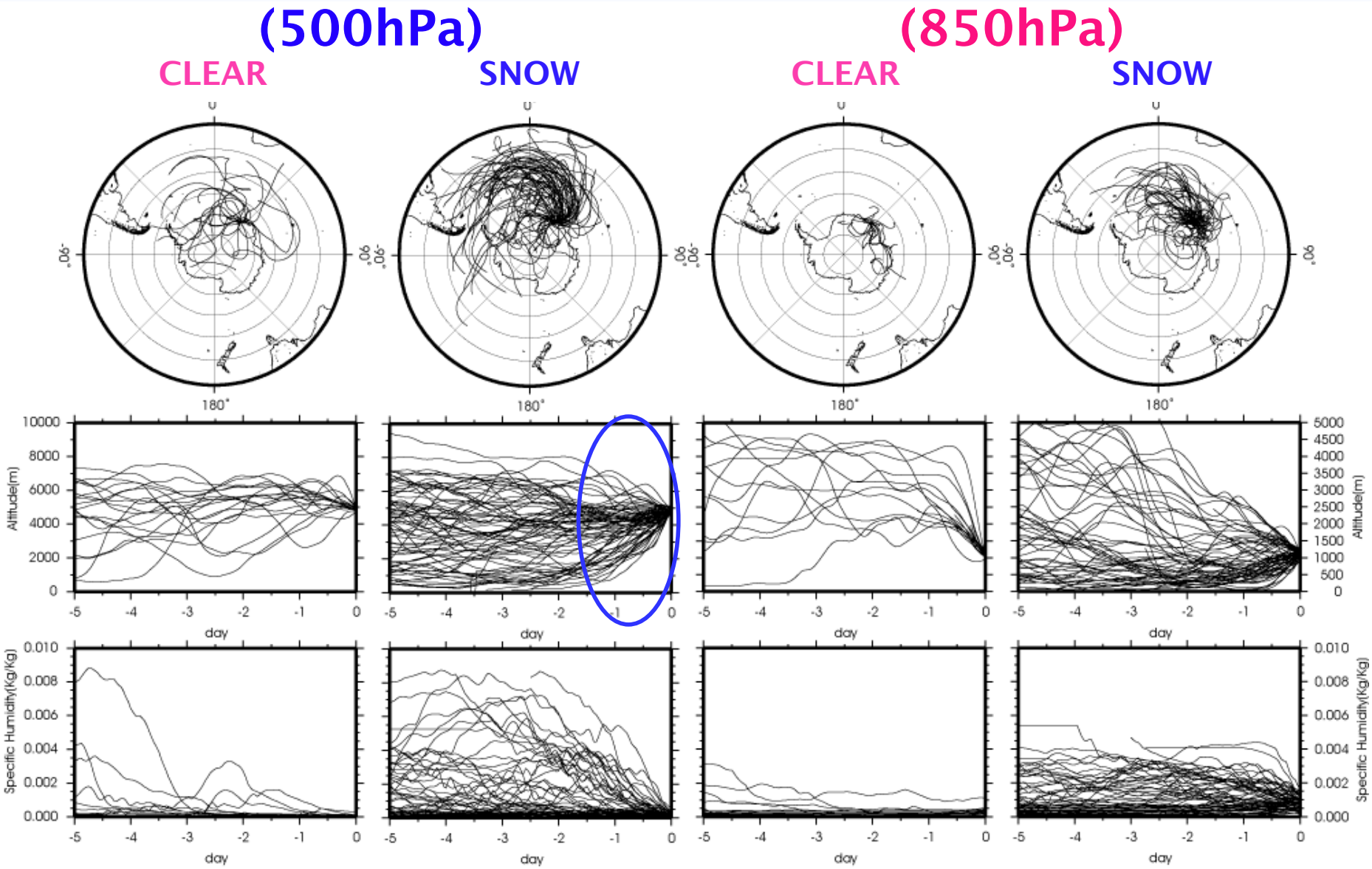
CLEAR
N=0

At "SNOW" condition, the atmosphere has much moisture.

At "CLEAR" condition, the atmosphere has less moisture.

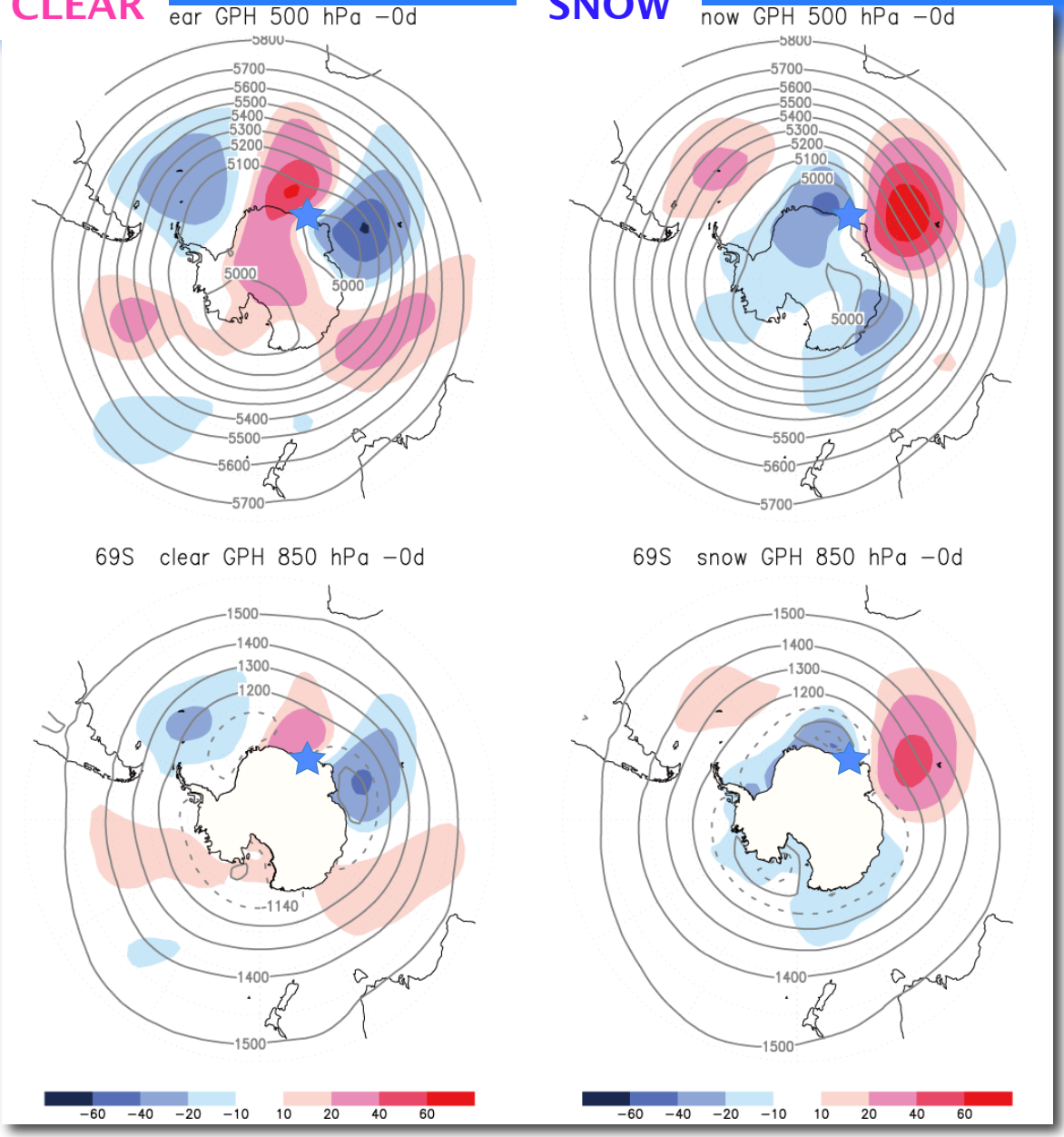
Trajectories in CLEAR and SNOW at SYOWA

SNOW N>=8.5, ww>=70 CLEAR N=0



Geopotential Height distributions and Anomalies

CLEAR



SNOW

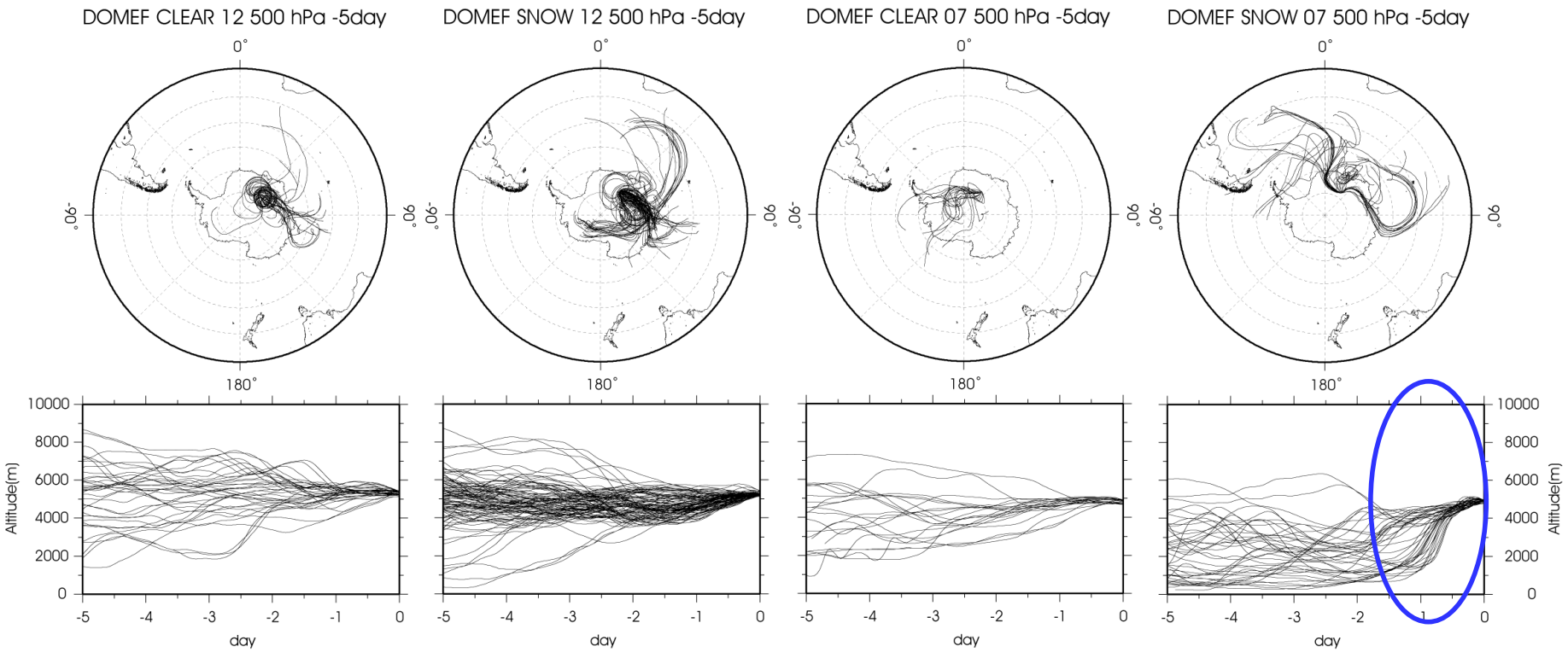
- The characteristics of geopotential height distributions and anomalies at 850 hPa are similar to those at 500 hPa.
- In SNOW, Cyclones were west of SYOWA.
- In CLEAR, Cyclones were east in converse.

Mainly, cyclones which came from west of SYOWA would be associated to transport moisture to SYOWA.

Trajectories in CLEAR and SNOW at DOME-F

SNOW N>=8.5, ww>=70 CLEAR N=0

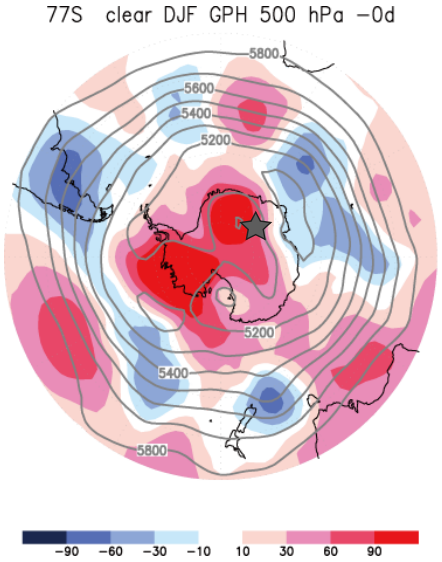
SUMMER **WINTER**

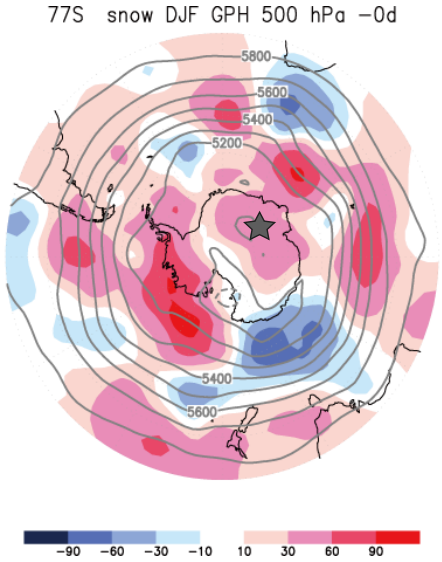


- **SNOW in winter :**
  Many trajectories moved over the sea and upward just before arrival.
- **CLEAR and SNOW in summer :**
  Several air parcels came from the ocean, however they had few vertical motions.
  Especially, residence times of trajectories over the continental in SNOW are long.

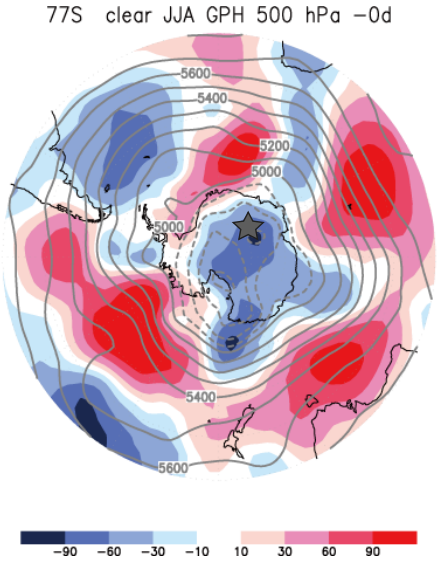
Geopotential Height distributions and Anomalies

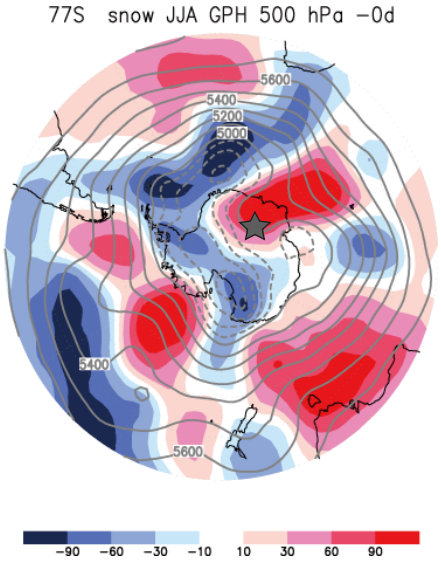
SUMMER





WINTER





WINTER

In SNOW, a developed ridge appeared over DOME-F like a blocking,

whereas geopotential height over the ice sheet lowered in CLEAR.

SUMMER

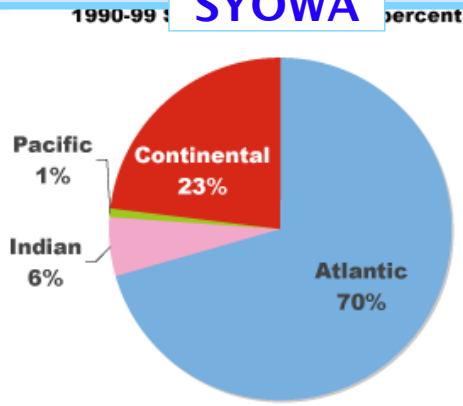
However geopotential height in CLEAR was higher than in SNOW (about 100hPa), there is few difference in their characteristics.

Ratios of origins of trajectories at the point of 5 days before

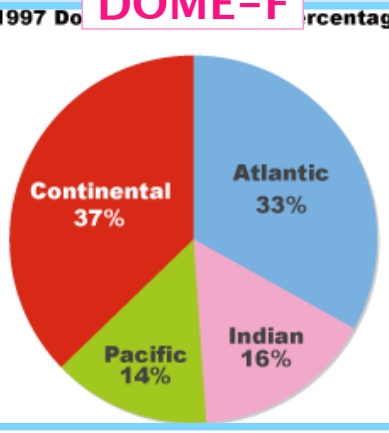
SNOW

SYOWA

SEA：LAND
＝8：2



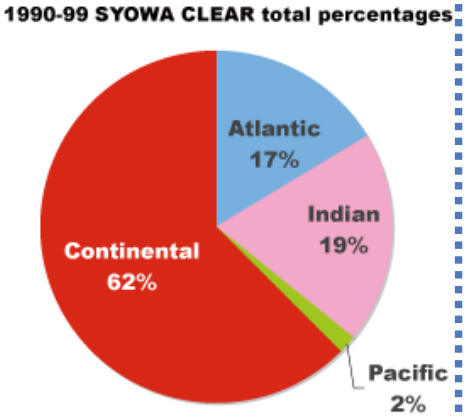
DOME-F

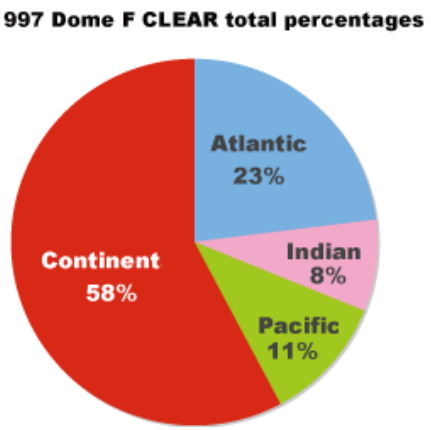


SEA：LAND
＝6：4

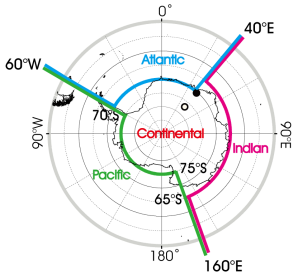
CLEAR

SEA：LAND
＝4：6





SEA：LAND
＝4：6



The ratio of continental is as twice as Reijimer et al. (2002).
Their result showed the origin dominated at DOME-F was Indian.
However, in this study, the ratio of Indian is not superior.

Conclusions

These are conclusions gained from our results about moisture transport to stations over Antarctica using observed meteorological data.

SYOWA

- SNOW : Air parcels came from over Atlantic Ocean with upward advections, whereas mean trajectories came from the Continental interior at 850hPa.
- CLEAR : Air parcels reached along the topography.
- Mainly, cyclones which came from west side of SYOWA would be associated to transport moisture to SYOWA.

DOME-F

SNOW in winter : Many trajectories moved over the sea and upward just before arrival.

CLEAR and SNOW in summer : Several air parcels came from the ocean, however they had few vertical motions.