ARCTIC PRECIPITATING SYSTEMS

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OBJECTIVE

For the Arctic, to give a general sense of:

- Water cycle and its cold phase
- Storm tracks
- Light and heavy precipitation
- Relevant features of high latitudes
- Some important issues

The bias will be towards the Canadian Arctic or sub-Arctic
FUTURE PRECIPITATION

Precip. % Change

-75 - -30
-30 - -20
-20 - -10
-10 - 0
0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 75
75 - 100
100 +
JANUARY PRECIPITATION

Yang et al.
STORM TRACKS

Whittaker and Horn (1984)
CLOUD FRACTION

Iqaluit

Percentage of time [%]

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

0-2 tenths
3-7 tenths
8-10 tenths
SOLID PRECIPITATION

[Bar chart showing hours of frozen precipitation by month, with labels for different types of solid precipitation: Snow, Showers, Ice Crystals, Snow]
LIQUID PRECIPITATION

[Bar chart showing liquid precipitation by month.]

- **Rain**
- **Showers**
- **Drizzle**

Hours of liquid precipitation
PRECIPITATION AMOUNTS

- 1998-1999 research year
- Average of the 1964-1999 research years
STORM TRACKS PRODUCING HEAVY SNOW OVER IQALUIT
Severe Snowstorm, 20:33 EST on 24 October 2004

Heavy snow and strong winds at Iqaluit

Iqaluit

Cold front

Low

Hudson Bay

Baffin Island

Davis Strait

500 km
IQALUIT

Scale Bars = 1 mm
LIGHT PRECIPITATION

• Light snowfall (< 2.5 mm/h) commonly occurs at Fort Simpson:

  90% of the time during precipitation

• Associated cloud tops vary greatly in height:

  approximately 50% are > 5 km
REFLECTIVITY PROFILES
(a light snow event over Ft. Simpson)

Evidence of sublimation of ice crystals as they fall to the surface
VIRGA
November 2005, Iqaluit

Sublimating ice crystals below cloud are common in the Arctic
CLOUD LAYERING DURING PRECIPITATION

3 observing periods (Hudak et al., 2004)

Ft. Simpson, North West Territories
SNOWFALL RATE AND PARTICLE TYPES

for T=0°C and RH=60%
CLOUDSAT OVER BAFFIN ISLAND
November 7, 2006

MODIS
CTT (°C)

P Pangnirtung
CLOUDSAT INFORMATION

Height (km)

dBZ
PENNY ICE CAP

- The birth place of the Last Ice Age is shrinking
PRECIPI TATION EFFICIENCY

Initial sub-cloud RH wrt ice

- RH = 90% w.r.t. ice
- RH = 85%
- RH = 83%
- RH < 80%

Time after initiation of cloud model (h)
HIGH LATITUDE
‘DISTINCT’ FEATURES

Some ‘distinct’ features of the Arctic include:

• Persistent coldness
• Strong atmospheric stability
• High Coriolis parameter
• Vast flat regions interspersed with topography
• (often) Limited local moisture sources
• (often) ‘Clean’ air
• ...
ISSUES RELATED TO PRECIPITATING SYSTEMS

A few issues include …

Within the current climate system:

• What precisely is the role of these systems within the cycling of water in the Arctic?

• What is the means through which precipitation is produced within these systems and what bottlenecks are there?

• To what extent do surface features (open water, topography, snowcover …) influence the production of their precipitation?

• How do precipitating systems affect the evolution of, for example, ice caps, glaciers and sea ice?

And, how will these systems ‘interact’ with a changing climate?
CONCLUDING REMARKS

A few key comments include:

- Precipitating systems are part of the overall climate system
- Precipitating systems that influence the Arctic follow a number of different tracks and typically pass over a varying surface
- The Arctic has several ‘distinct’ features that may directly or indirectly affect precipitation production
- Over the long cold season, these systems produce light as well as heavy precipitation
- The detailed nature of the actual snow particles is important

And:

- We have a great opportunity to collectively address these and many other important issues associated with the Arctic hydrological cycle
Thank you for your attention