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Weather Patterns for Significant Snowfall Events in Prince William Sound, Alaska Kristy C. Carter¹, James A. Nelson², Tsing-Chang Chen¹ Department of Geological and Atmospheric Sciences, Iowa State University, Ames, IA¹ NOAA/NWS Weather Forecast Office, Anchorage, AK²



Introduction

- •Alaska statewide annual precipitation 1,050,000,000,000 gallons per day
- •Average annual snowfall in Prince William Sound: •Valdez, AK: 322"
 - •Thompson Pass, AK: 552"
 - •Cordova, AK: 108"
- Significant variation among cities/snowfall
 - •Findings help improve snowfall forecasts

Data and Methodology

•2 Studies

•Study 1: Patterns leading to large snowfall events (>12 inches) in Cordova, Valdez and Thompson Pass, AK

- Data from Valdez, Thompson Pass, and Cordova, AK •2001-2012
- 16 cases
- Case selection based on snowfall accumulation variation among sites
- Analyzed using NARR data
- Variables studied: Air temperature, wind speed, wind direction, geopotential height, stability, precipitable water, mean sea level pressure
- WRF used for further investigation of event evolution data examined in BUFKIT and AWIPS
- •Study 2: Climatology of snowfall events 1918-Present for Valdez, AK
 - •Data from Valdez Weather Service Office
 - •1918-2012
 - •Used only large snowfall events (>12in)
 - •Examined frequency of events for long term patterns
 - •Correlations studied between PDO and patterns
 - •Top 20 events (1979-2012) further studied using NARR •Same variables as study 1



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Results – Study 1

YYYY/MM/DD	Cordova	ТР	Valdez	Site High
2009/12/16	9.5	24	21.4	All
2009/12/17	12	12	8.8	All
2012/01/06	18	24	19.3	All
2008/02/03	16	4	0	Cordova
2008/04/11	22	3	2.1	Cordova
2012/01/26	12	1	0	Cordova
2007/11/08	0	18	0.5	TP
2007/11/00	10	24	2.7	тр
2010/03/09	10	24	2.1	
2010/04/15	0	28	0.1	ТР
2010/10/29	0.5	19	0	ТР
2011/10/25	0	24	0	ТР
2006/12/30	1	6	16.2	Valdez
2011/04/07	5	1	27.3	Valdez
2011/12/17	0	5	20	Valdez
2012/01/05	6	6	19.2	Valdez
2012/02/26	20	7	20.9	Valdez

Table 1 – Cases selected for inclusion with snowfall amounts listed under each city in inches



Figure 1 (above) – 2012/01/06 09UTC MSLP with surface winds and precipitation; circle shows location of cities

Figure 2 (below) – 2012/01/06 09UTC Cordova (right circle) – Thompson Pass (left circle) cross section with wind, relative humidity, and omega





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Figure 3 – 2008/04/22 03UTC Cordova (right circle) – Thompson Pass (left circle) cross section with wind, relative humidity, and omega

Study 1 WRF output revealed:

•SE surface flow needed for snow in Cordova

•Shallow moisture and weaker flow allows for greater snowfall in Cordova

•SW flow good indicator of no snow in TP

•Stronger flow, deeper moisture, greater snowfall in TP

•S-SW low level flow preferred direction for significant snow in Valdez



Results – Study 2

Figure 4 – Valdez large snowfall events by snowfal accumulation per year (in inches). Color key represents number of events per year in which snowfall totals came from

Figure 5 – Valdez large snowfall events by frequency of month

Top 20 Valdez events placed in categories based on location of the surface low pressure and 500mb height

Category 1 (30%): Ex – 1996/02/05

Surface Low in Gulf

500mb Trough in West

Category 2 (25%): Ex – 2009/12/15

500mb Low in Northern Alaska

Category 3 (45%): Ex 1987/12/23

Surface Low in Eastern Aleutian Islands

500mb Ridge in Gulf of Alaska

Conclusions

•Study 1

•No clear explanation for variation in snowfall from NARR data analysis

•Orography, low level wind direction, moisture content, and temperature conditions dictate precipitation patterns •Study 2:

•Greatest frequency of events occur between December and February

•Over 80% of Valdez snowfall comes from small snowfall events

•On average, Valdez receives about five large snowfall events a year

•Years with fewer events coincide with warmer SST in the Pacific Ocean

•Large snowfall events can be classified into three distinct categories based on location of the surface low and upper level pattern

•Snowfall distribution in southern AK is complex

•Forecasters can identify large snowfall events based on sea surface temperature anomalies in the Pacific

•Severity can be anticipated on a seasonal timescale

