Area Forecast Discussion: Vladivostok and Sapporo
Date: Tuesday 02 February 2019
Forecasters: Chelsea Snide and Brennan Stutsrim

Big Picture Perspective

Slight ridging is stagnant over the Sea of Japan prior to the forecast period. Cold polar air is being entrained over the region by predominantly northwesterly flow. Significant instability, as indicated by high lapse rates, is caused by cold polar air flowing over the warm SST in the Sea of Japan creating deep convection. This instability grows into a polar low creating troughing over the region with forced ascent through Q-Vector convergence. The trough that builds into the area is followed by low 500-hPa height anomalies (2 to 3 sigma) keeping temperatures below climatology for the first two forecast ranges. The period ends with anonymously high heights at 500-hPa building in due to latent heat release and weak Q-Vector divergence forcing decent and adiabatic warming bringing temperatures closer to climatology. The main source for precipitation over Japan in the later periods will be 'ocean effect' do to uniform westerly winds blowing polar air over warm SST but earlier in the forecast there is widespread precipitation due to the polar low. Eastern Russia stays dry as cold dry continental air dominates the region with minimal orographic influence for Vladivostok.

Extended Range: Day 7-10

The period will be dominated by a giant trough covering the eastern half of Asia, bringing near climatological heights and anomalously low surface temperatures. The trough widens during the period due to the cyclone at the downstream inflection point propagating eastward towards a Q-vector convergence maximum and a lack of forcing for height change on the upstream side. Shortwave troughs within the larger scale trough will be responsible for frozen precipitation over Vladivostok and mixed precip over of Japan later in the period as they overlap with a small thermal ridge, creating steeper lapse rates and weak Q-vector convergence.

Medium Range: Day 4-6

Cold Siberian air rushes into the region at the start of the period sending temperatures well below climatology as shown in the 850-hPa temperature anomalies (2 to 3 sigma). Strong low level temperature advection and vorticity advection are attributed to deepening this trough and allowing for cold air to pool over Sapporo. Weak Q-vector convergence is forcing for upward vertical motion causing pressure to lower at the

surface and therefore building the trough. Frozen precipitation during this period can be attributed to ‘ocean effect’ off the Sea of Japan. Predominantly westerly and northwesterly flow throughout the column (low directional shear) persists throughout the period bringing polar air over warm SSTs. There is about a 20 degree celsius difference between 850-hPa temperatures and the SSTs setting up conditions for ocean effect precipitation.

Short Range: Day 0-3

An upper tropospheric anticyclonic circulation in central Russia and cyclonic circulation in far eastern Russia causing a northerly flow into China throughout the profile will increase the pressure gradient and produce a strong zonal jet throughout the period. Increasing vorticity advection with height on the eastern edge of the cyclone will intensify and propagate the cyclone eastward, just North of Japan, towards the end of the period. As the meridional trough associated with the cyclone digs towards Japan, the pressure trough moves ahead of the thermal trough and the confluent flow over eastern China increases, producing significant frontogenesis over Vladivostock and leading to a cold front. The beginning of the period will bring some light precipitation associated with weak Q-vector forcing and steep lapse rates ahead of the cold front. The cold frontal passage will bring heavier precipitation in the southern half of Japan, where there are higher values of precipitable water and frontogenesis, while lighter precip forms as a result of the Q-vector forcing over Sapporo.

Probabilistic Forecast

Vladivostok, Russia:

Day 0-3:

Max Temp: -7ºC (10th), -9ºC (50th), -10ºC (90th)
Min Temp: -17ºC (10th), -18ºC (50th), -19ºC (90th)
Precip: 0 mm (10th), 1 mm (50th), 2 mm (90th)

Day 4-6:

Max Temp: -4ºC (10th), -5ºC (50th), -7ºC (90th)
Min Temp: -12ºC (10th), -14ºC (50th), -15ºC (90th)
Precip: 0 mm (10th), 1 mm (50th), 2 mm (90th)

Day 7-10:

Max Temp: -1ºC (10th), -2ºC (50th), -3ºC (90th)
Min Temp: -10ºC (10th), -11ºC (50th), -13ºC (90th)

Precip: 0 mm (10th), 1 mm (50th), 2 mm (90th)

Sapporo, Japan:

Day 0-3:

Max Temp: -3ºC (10th), -7ºC (50th), -10ºC (90th)
Min Temp: -10ºC (10th), -11ºC (50th), -12ºC (90th)
Precip: 3 mm (10th), 5 mm (50th), 10 mm (90th)

Day 4-6:

Max Temp: -3ºC (10th), -4ºC (50th), -5ºC (90th)
Min Temp: -5ºC (10th), -8ºC (50th), -10ºC (90th)
Precip: 0 mm (10th), 1 mm (50th), 2 mm (90th)

Day 7-10:

Max Temp: -1ºC (10th), -2ºC (50th), -3ºC (90th)
Min Temp: -4ºC (10th), -5ºC (50th), -8ºC (90th)
Precip: 5 mm (10th), 7 mm (50th), 8 mm (90th)

Links

Temperature Anomalies: Japan
https://www.jma.go.jp/en/longfcst/000_1_01.html

SST
https://www.seatemperature.org

Japan Snow Depth
https://www.jma.go.jp/en/amedas/203.html?elementCode=4

Trajectory 08 Feb 2019
https://ready.arl.noaa.gov/hypubout/trajplot_121659.pdf Japan
https://ready.arl.noaa.gov/hypubout/trajplot_122475.pdf Russia

5-day 500 height anomaly (days 3-7)
https://www.tropicaltidbits.com/analysis/models/?model=gfs-ens&region=ea&pkg=z500aMean&runtime=2019020506&fh=168

5-day 500 height anomaly (days 6-10)

https://www.tropicaltidbits.com/analysis/models/?model=gfs-ens&region=ea&pkg=z500aMean&runtime=2019020506&fh=240

http://www.atmos.albany.edu/student/tburg/analysis/loop.php?model=gfs&prod=300wind;500hght_std;850temp;500relvort;700qvect;850temp_std;lapse;1kmrefl;&curid=0&proj=pac&archive=1&run=2019020512

Brennans loop:
http://www.atmos.albany.edu/student/tburg/analysis/loop.php?model=gfs&prod=300wind;500relvort;700fgen;850temp;700qvect;lapse;pwat;1kmrefl;&curid=0&proj=pac&archive=1&run=2019020512