EAS372 Mid-term Exam 26 Feb., 2015

Professor: J.D. Wilson Time available: 80 mins Value: 15%

Open book exam. Please answer in the booklet provided.

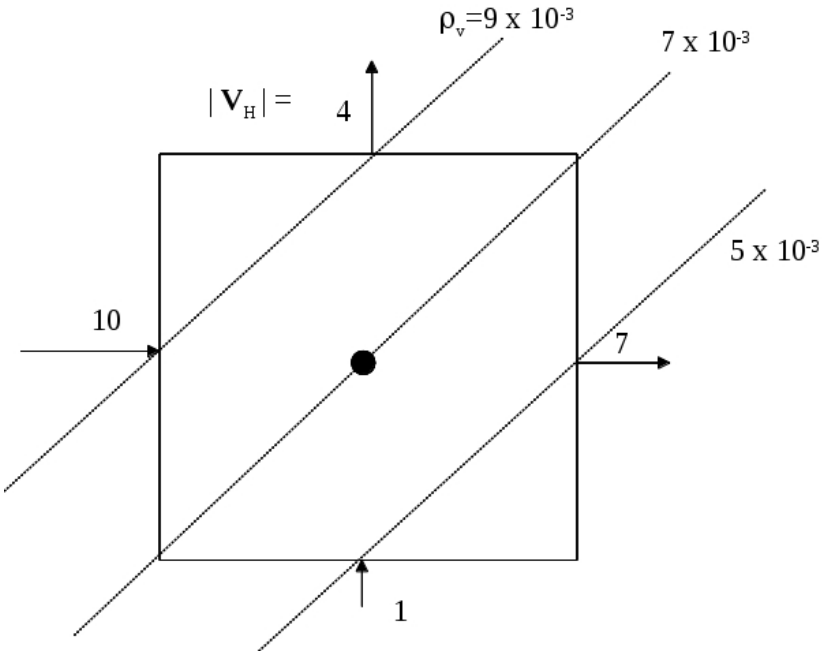
A. Calculations (2 x 3 → 6%)

A1. Suppose that a sounding in the tropics indicated that at the 700 hPa level $T = 8^{\circ}$C, $T_d = 6^{\circ}$C and $\omega = -4\,\mathrm{Pa\,s^{-1}}$. Compute the resolved vertical flux density of water vapour

$$E\,[\mathrm{kg\,m^{-2}\,s^{-1}}] = W\,\rho_v \equiv -\frac{\omega\,q}{g}\,,$$

where $q\,[\mathrm{kg\,kg^{-1}}]$ is the specific humidity and $W\,[\mathrm{m\,s^{-1}}]$ is the vertical velocity. (A link to a saturation vapour pressure table is given on the EAS 372 course home page.)

A2. The diagram below shows a square cell (a 2D "control volume") with sidelength 10 km. Arrows with affixed numbers give the direction and magnitude $[\mathrm{m\,s^{-1}}]$ of the "horizontal" wind vector $\mathbf{V}_H$ at each interface, and the diagonals are contours of absolute humidity ρ_v $[\mathrm{kg\,m^{-3}}]$. Calculate the Laplacian of the humidity $\nabla^2\rho_v$ and the (2D) velocity divergence $\nabla\cdot\mathbf{V}_H$ at the centre of the cell. If the absolute uncertainty in the wind velocity measurements is stated as $\epsilon = 0.1\,\mathrm{m\,s^{-1}}$, then what is the *fractional* uncertainty in your result for the divergence?



B. "Live" web weather data (8 x 1/2 → 4%)

1. Figure 1 is the 24h NAM prog, valid at 12Z today. Comparing with this morning's RDPS 0h prog for 12Z, what was the *error* in NAM's forecast for the 1000-500 hPa thickness in the southeastern corner of Alberta?

2. What thickness contour on this morning's RDPS 0h prog valid 12Z is closest to The Pas (Manitoba; YQD)?

3. What was the coldest cloud top temperature on the MSC/CMC GOES east ir image as of 1215Z this morning? (State a value or range.)

4. From the CYYC (Calgary Int'l Airport) METAR at 12Z today, what codes and remarks (RMK) are given in relation to cloud, and what do they mean?

5. From the ~~temperature and dewpoint at 850 hPa given by the~~ YQD (The Pas, Manitoba) sounding for 12Z today, what is the 1000-500 hPa thickness?

6. From the UQAM meteogram for Winnipeg that is based on the GDPS run from 00Z today, determine the lowest and highest 2 m temperatures forecast to occur over the duration of the forecast.

7. Consult the NAM model run that was initialized at 06Z today (`http://www.cnrfc.noaa.gov/weather_models.php`). Referring to the offshore storm just east of Newfoundland this morning, what does NAM indicate for the "bullseye" (maximum) 6 hour cumulative precipitation over the interval 06Z-12Z? Is this likely to be snow or rain?

8. In Vizaweb, bring up the RDPS model run that was initialized at 06Z today: choose "Domain1 EAST_COAST". What does this prog give for the *maximum* accumulation [mm] of precipitation during 06-12Z associated with the storm east of Newfoundland?

C. Interpretation of Weather Charts (→ 5%)

A colour figure (attached, at back) conveys some elements of the GDPS 72h forecast, valid at 12Z today, for conditions over Western Canada. Compare and contrast that 72 h forecast with actual conditions, as assessed on the basis of the RDPS 0h prog for this morning (12Z today, if available; and if not, 06Z; please state your choice). Explain any particularly significant features you observe, on either a forecast panel or on the RDPS 0h prog you have chosen to represent observed conditions.

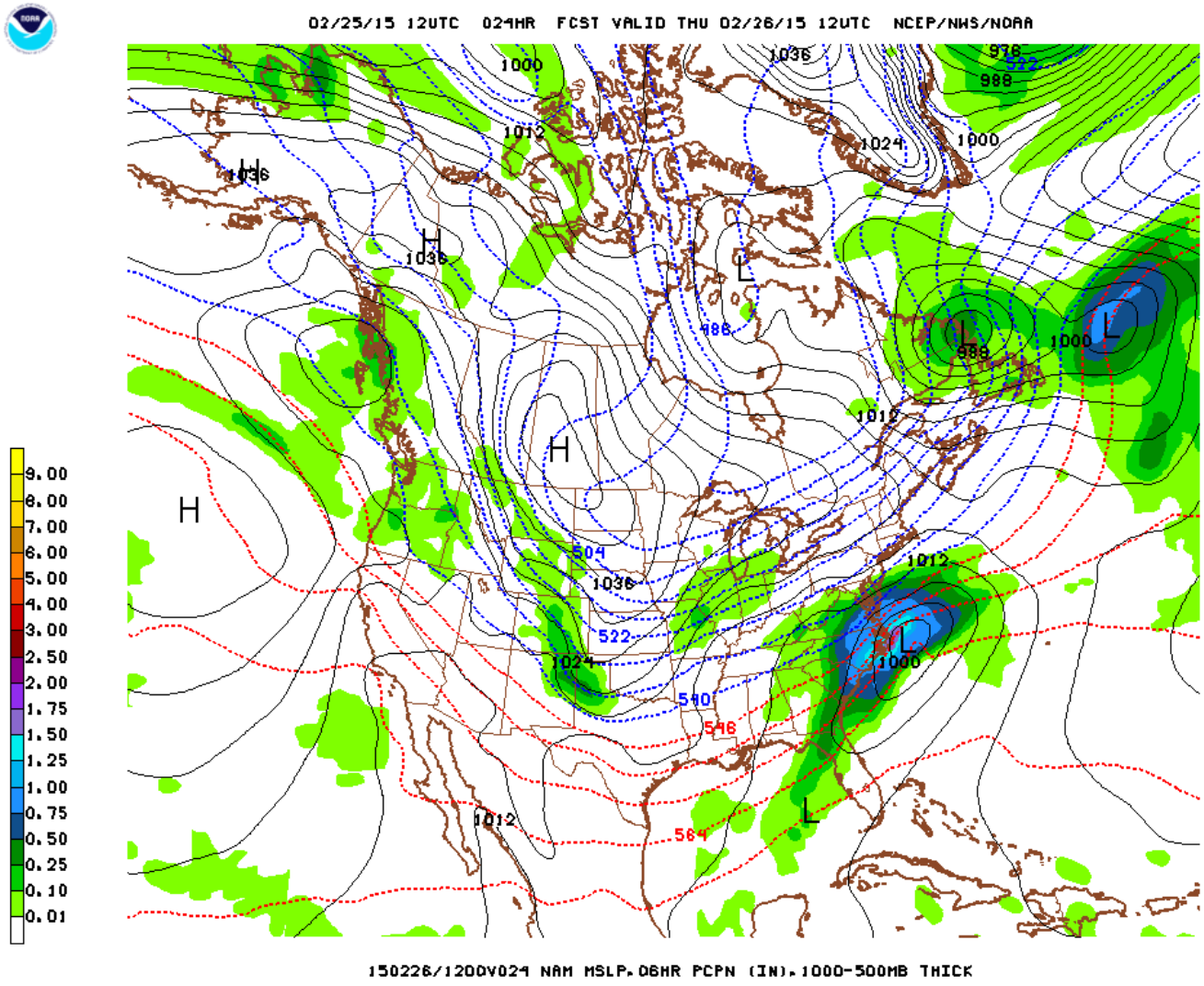
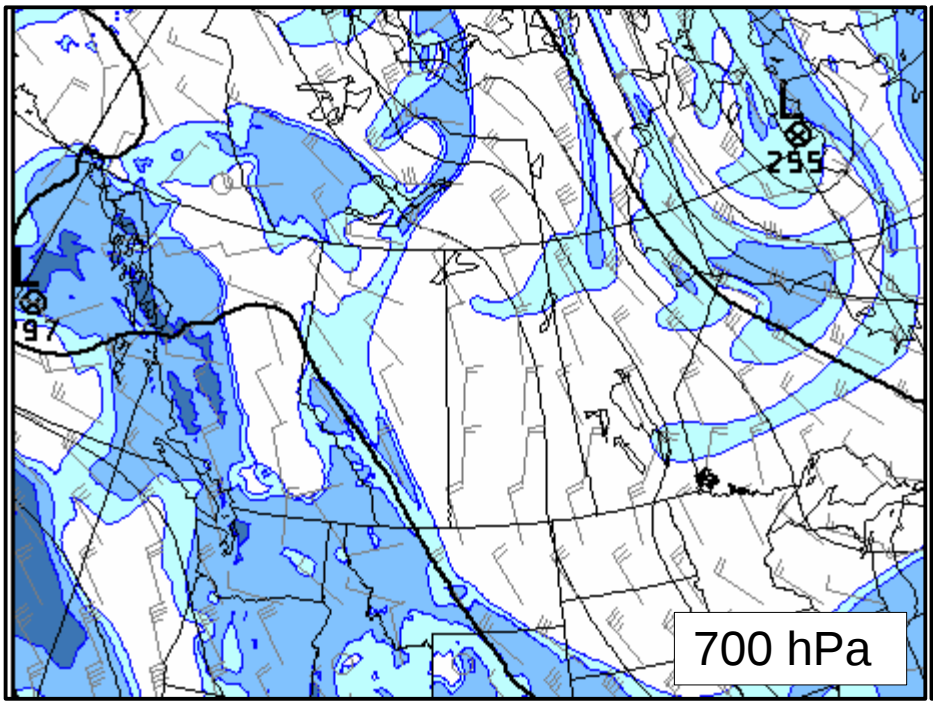
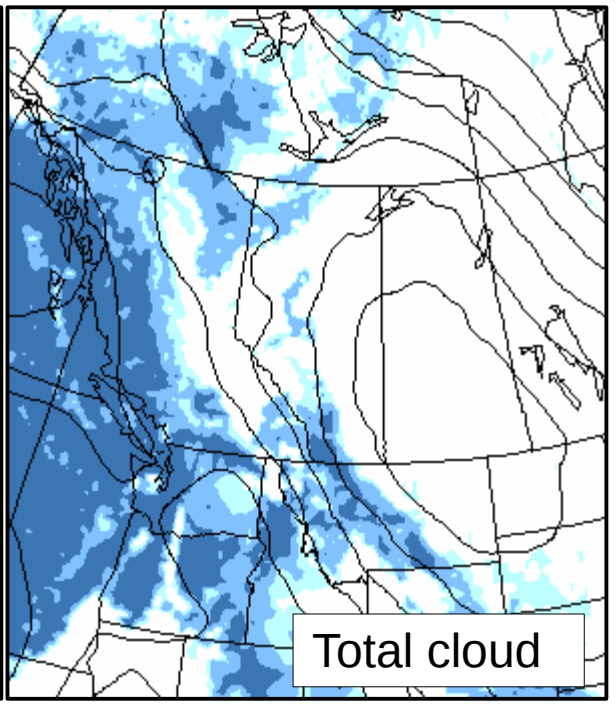
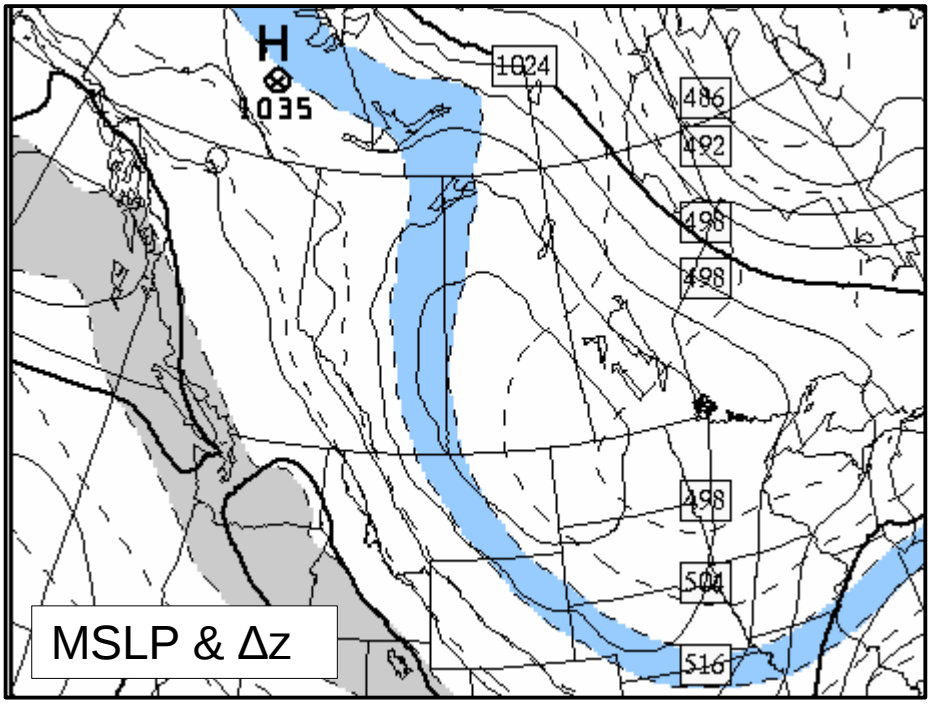
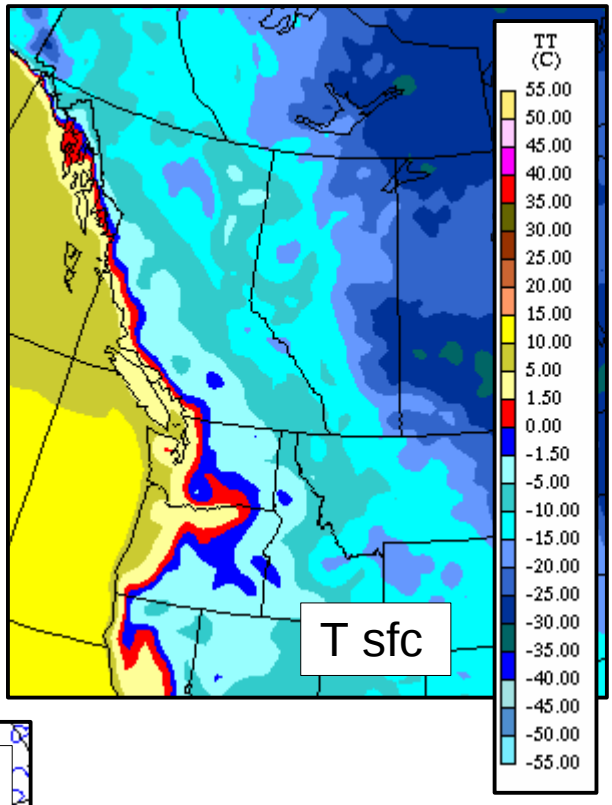


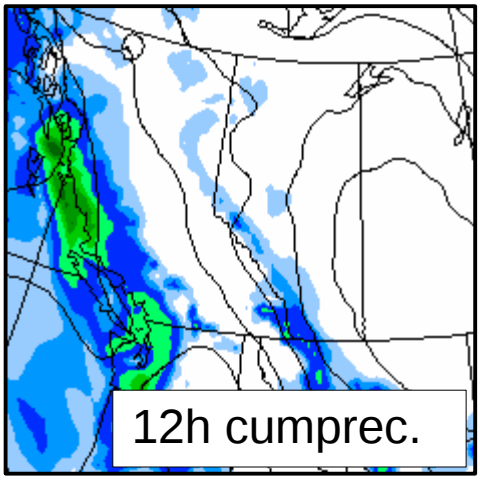
Figure 1: NAM 24h forecast, valid 12Z Thursday 26 Feb. 2015.

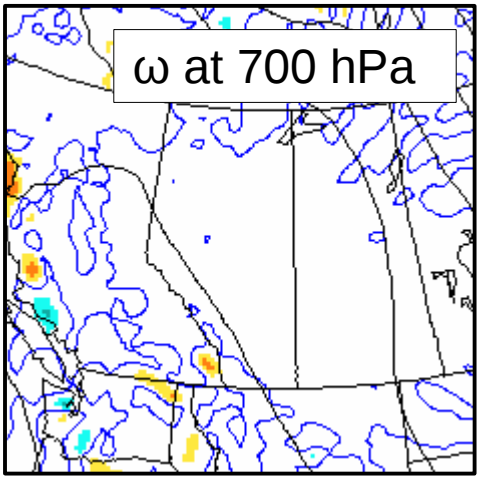












GDPS 72h prog valid 12Z Thurs 26 Feb. 2015 (cropped)