AMPS Update – July 2018

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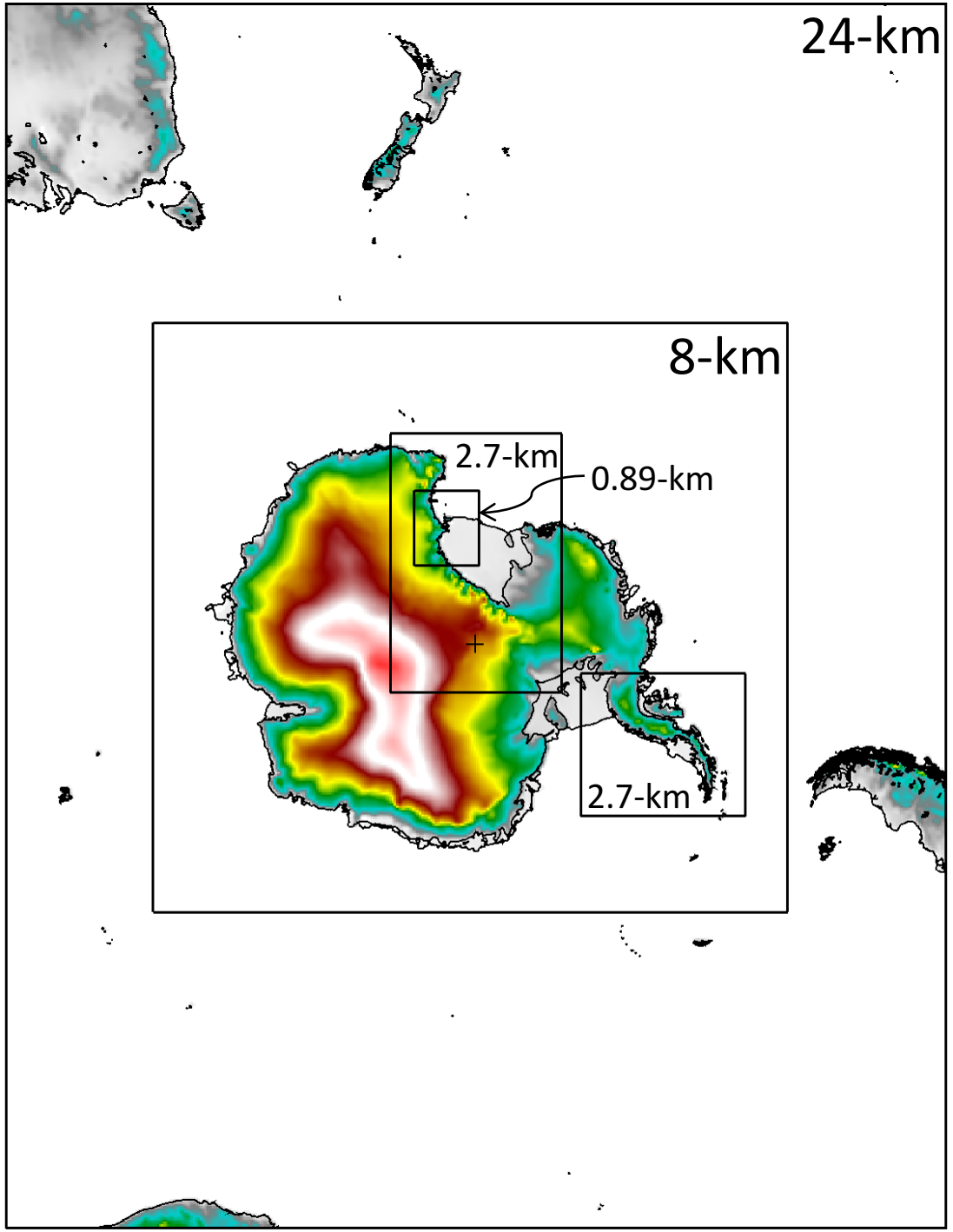
The Antarctic Mesoscale Prediction System (AMPS)

- Real-time, experimental NWP system serving the needs of forecasters for the U.S. Antarctic Program (USAP)
- Funded by NSF Office of Polar Programs
- Based on NCAR's Weather Research and Forecasting (WRF) model
  - Using adaptations from OSU/BPCRC Polar WRF effort
  - Testing NCAR's Model for Prediction Across Scales (MPAS)
- Twice-daily forecasts since September 2000
- Real-time NWP graphics, text, and GRIB openly available through AMPS web page
  - http://www2.mmm.ucar.edu/rt/amps

• Primary AMPS Grid Configuration

- AMPS runs WRF with five two-way interactive nests
  - 24- and 8-km grids over all of Antarctica and environs
    - 3-hourly output to forecast hour 120
  - 2.67- and 0.89-km grids over areas of particular interest to USAP
    - Hourly output to forecast hour 39
- Additional model jobs for extra nests
- Two forecasts per day
  - 00Z and 12Z forecast cycles
- Grids initialized from NCEP GFS, with additional WRF Data Assimilation step
  - Hybrid Ensemble/3D-Variational Data Assimilation
  - 24-km lateral boundary conditions from GFS
- Ensemble on 24- and 8-km grids
  - Small ensemble: O(15 members)



New Stuff

First year on new computer “Cheyenne”

- Cheyenne
  - NCAR-Wyoming Supercomputing Center’s (NWSC) primary supercomputer
  - Managed by NCAR’s Computational and Information Systems Lab (CISL)

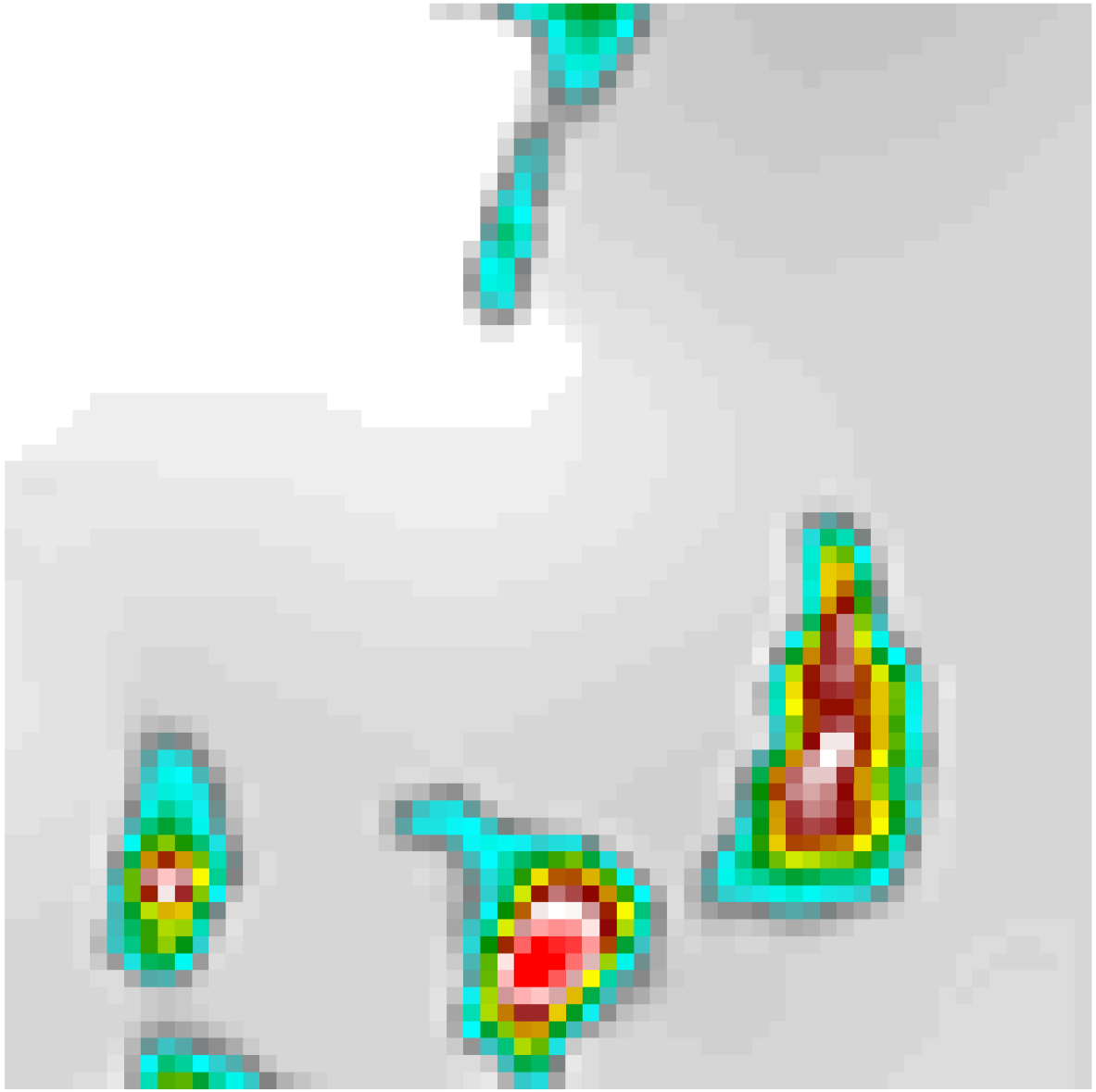
> *An SGI ICE XA Cluster, the Cheyenne supercomputer features 145,152 latest-generation Intel Xeon processor cores in 4032 dual socket nodes and 313 TB of total memory.*

First year on new computer “Cheyenne”

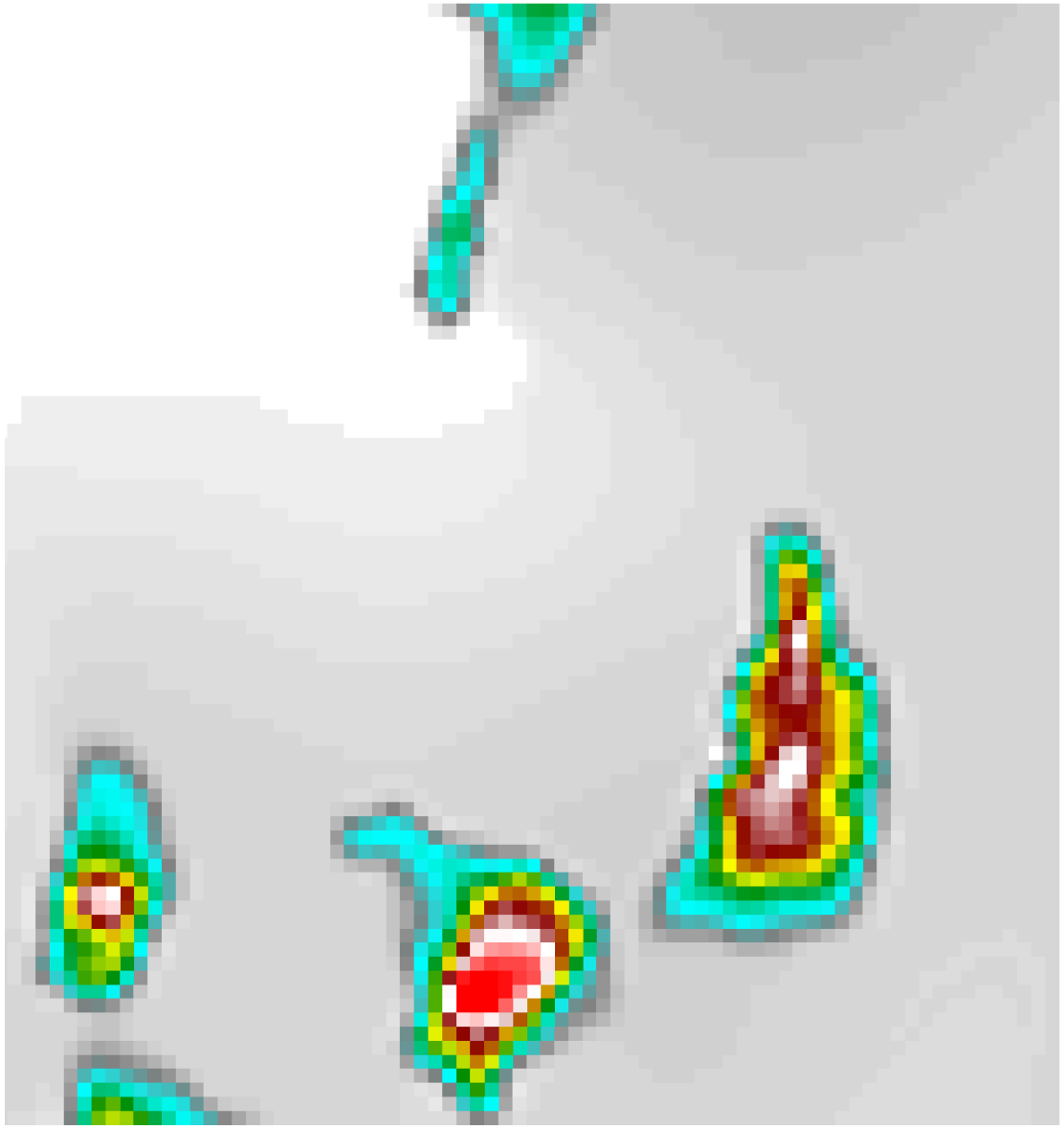
- Cheyenne
  - NCAR-Wyoming Supercomputing Center’s (NWSC) primary supercomputer
  - Managed by NCAR’s Computational and Information Systems Lab (CISL)
- Challenges in the first year
  - More frequent AMPS failures and outages
    - Near-constant oversight required
  - Instances of scheduled and unscheduled machine outages of several days or more
- Cloud fallback
  - Presents its own challenges
- Local fallback
  - AMPS will have priority on “Laramie” a small cousin of Cheyenne, also at NWSC
- Outlook
  - Better, but challenges remain

Higher Resolution

- New computer platform allows us to increase resolution of all grids
  - Beginning in September 2017
  - Grid-length (Δx) reduced by 20%
    - 30-km → 24-km
    - 10-km → 8-km
    - 3.3-km → 2.67-km
    - 1.1-km → 0.89-km
  - ~2.5 times the computational cost



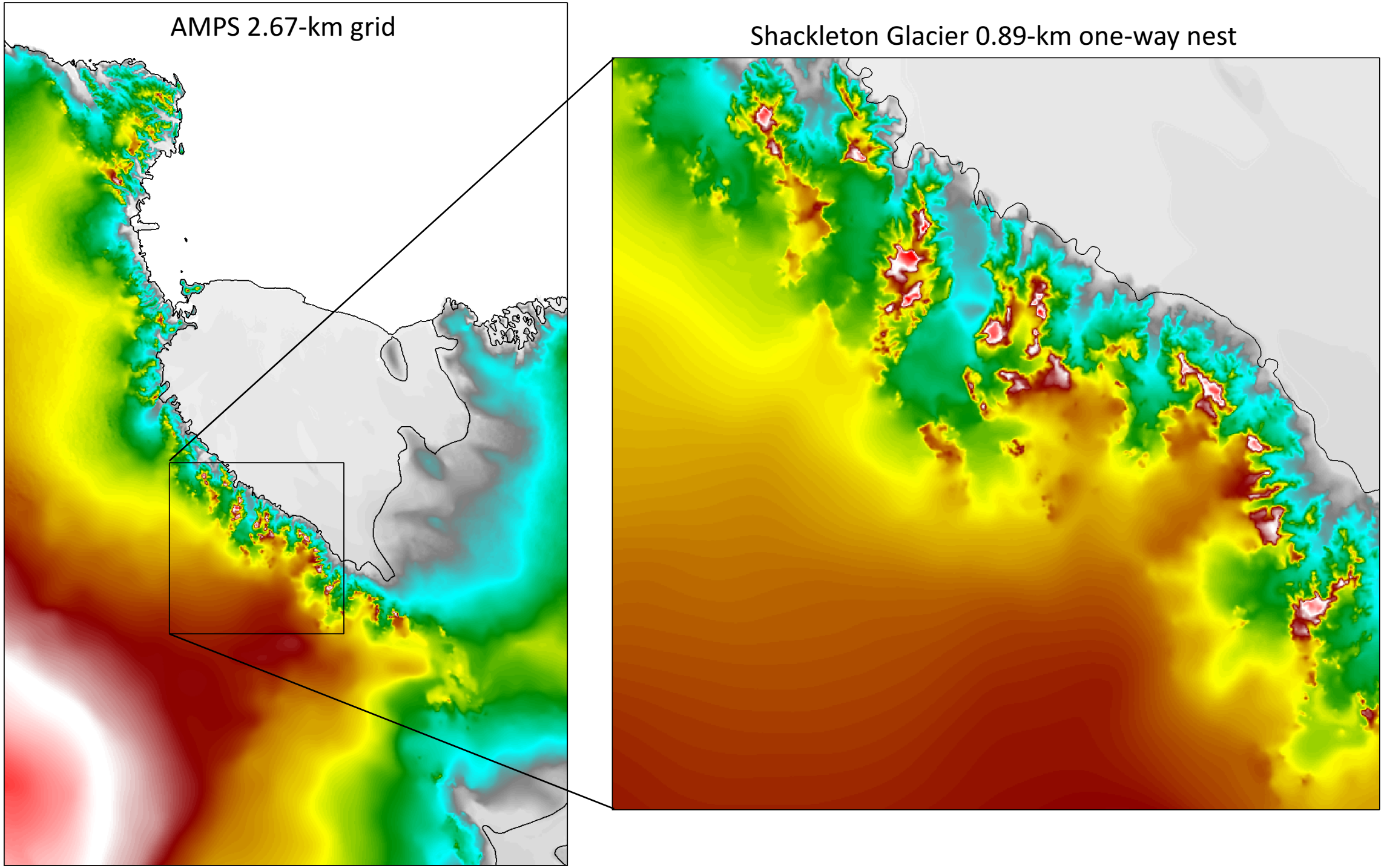
Δx 1.1-km

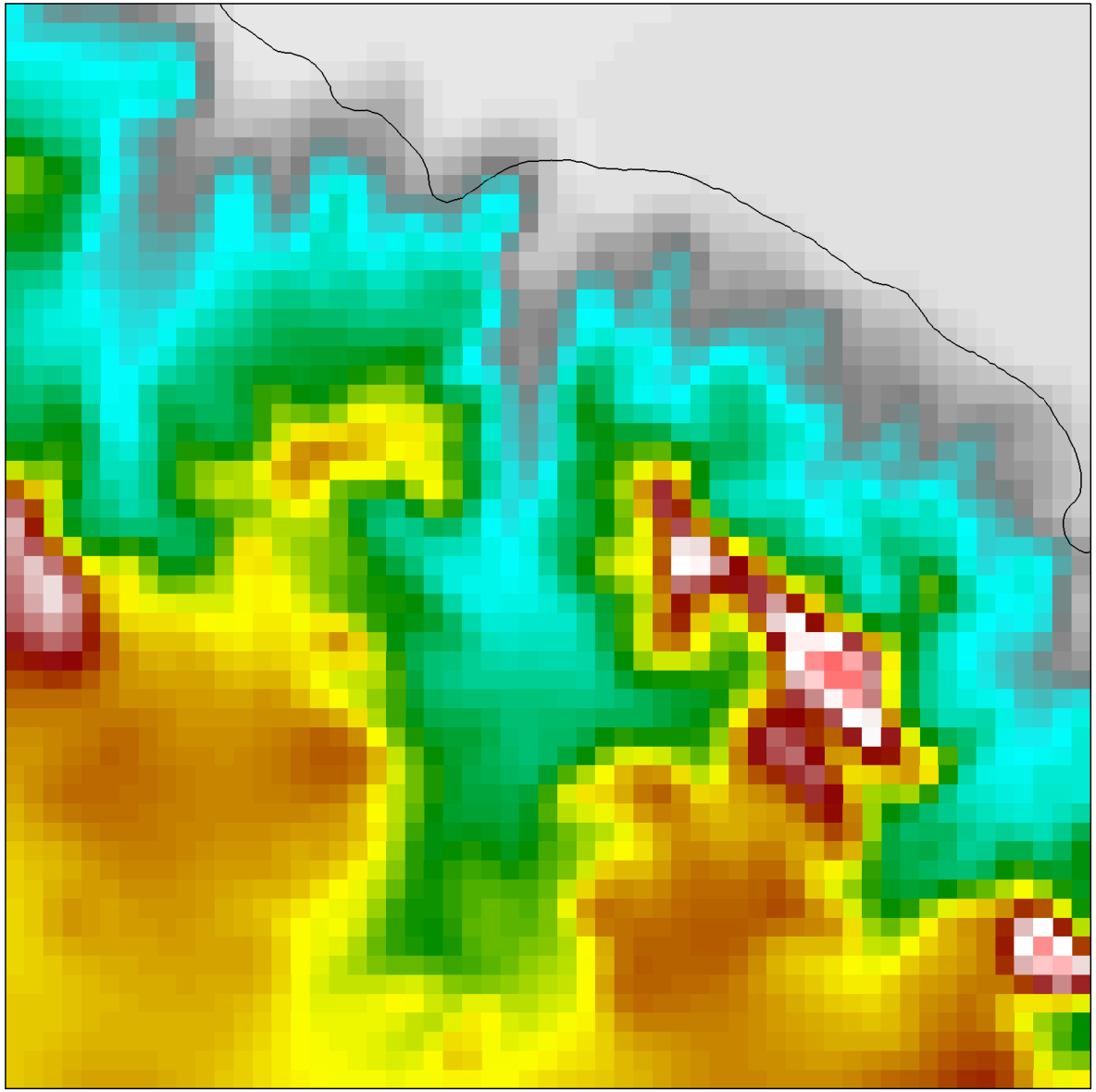


Δx 0.89-km

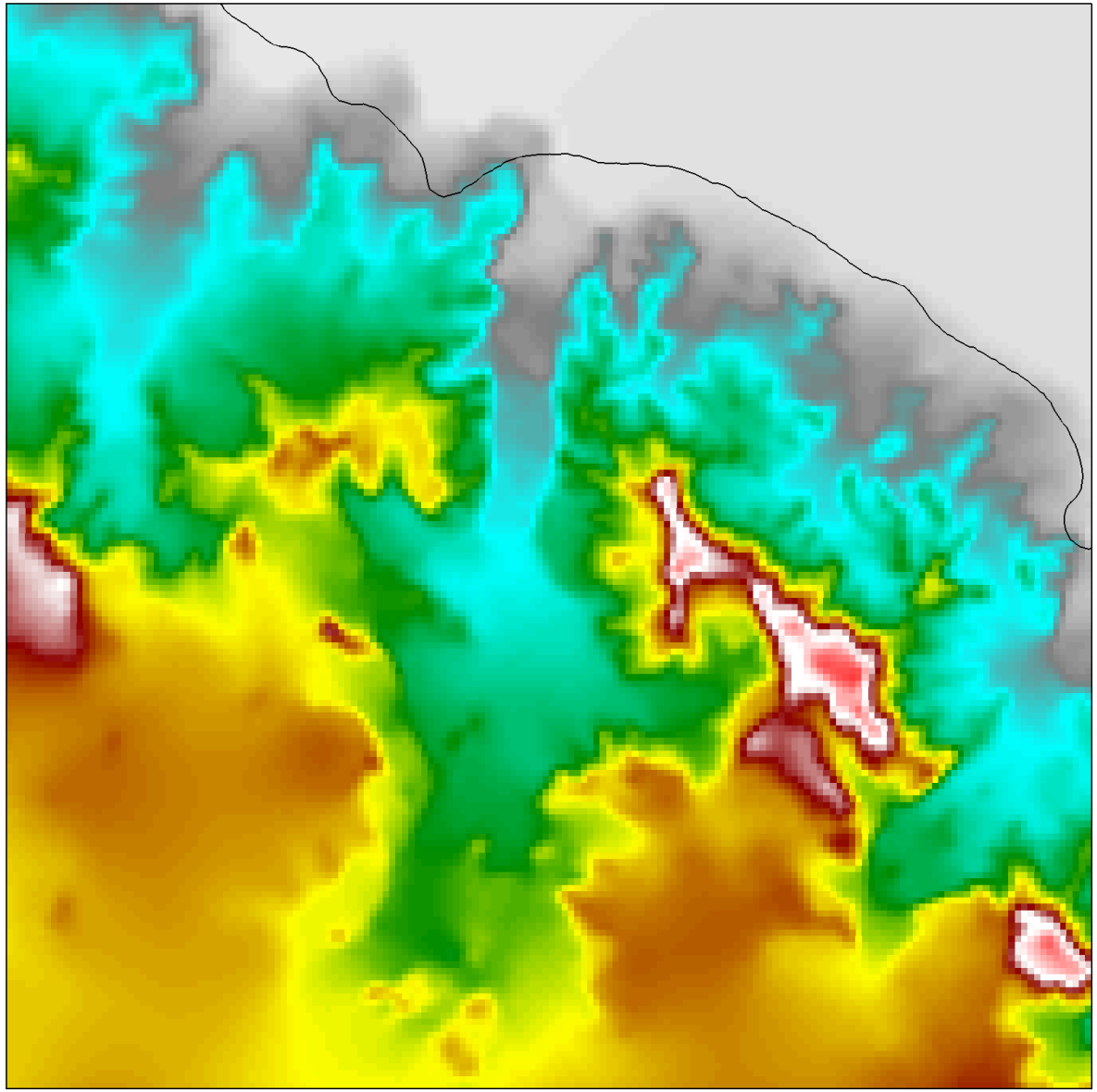
Shackleton Glacier one-way nest

- Requested by USAP forecasters
- Run from ~20 Nov 2017 to 10 Feb 2018 in support of flight activities in the area
- Grid spacing 0.89-km


AMPS 2.67-km grid
Shackleton Glacier 0.89-km one-way nest



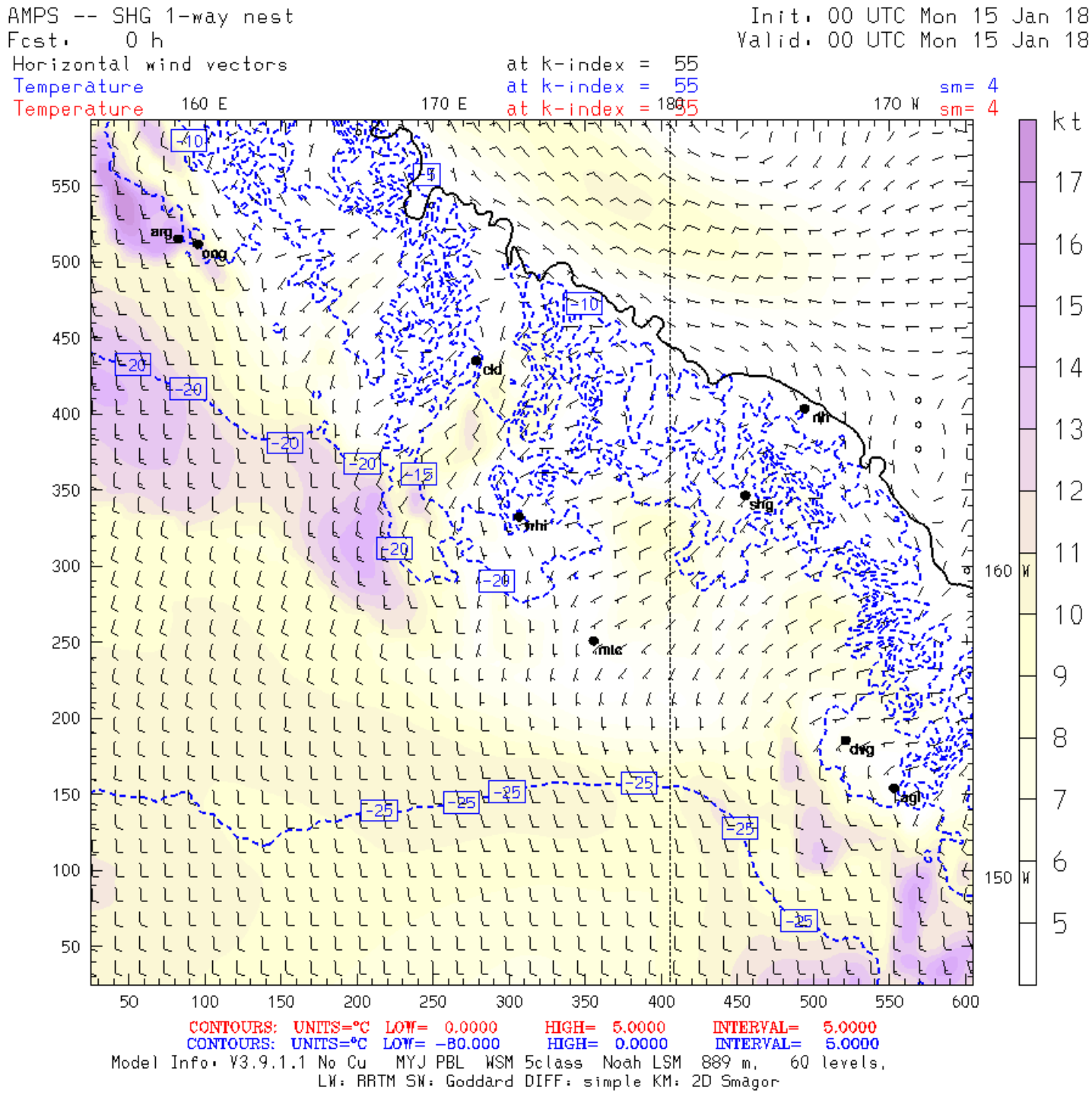
2.67-km grid terrain



0.89-km nest terrain

Wind
~1000 ft AGL

SHG 888m grid



Weather depiction along flight route (RouteWX)

- Similar to a vertical cross section, but the horizontal coordinate takes into account the time-shift due to flight time between waypoints
- On-demand product
  - User fills out and submits a web form
  - Chart shows up in an AMPS web directory in ~10 minutes

Route Name: A338 LC-130 South | A338 LC-130 South | Save Route? ☐ | Delete Route? ☐

From which forecast? 2018070612

(Optional) Reference Line (kft): 28

(Optional) Reference Line (kft): 24

(Optional) Plot Top Level (kft): 30

Wind coordinate system: Grid ○ True ◉

	Site ID (Optional)	Latitude Dec. Deg. South Neg.	Longitude Dec. Deg. West Neg.	Time YYYYMMDDHH[[:]mm] (or +h[:mm])	
	NZCH	-43.4897	172.5269	2018050620	Delete Site? ☐
	LASSE	-50.00	171.200	+1	Delete Site? ☐
	FRITH	-60.00	170.200	+1	Delete Site? ☐
	SNIPT	-70.00	168.200	+1	Delete Site? ☐
	BOENZ	-75.000	166.300	+1	Delete Site? ☐
	NZWD	-77.870	167.028	+1	Delete Site? ☐
	NZFX	-77.9561	166.76833	+1	Delete Site? ☐

Add Another Waypoint

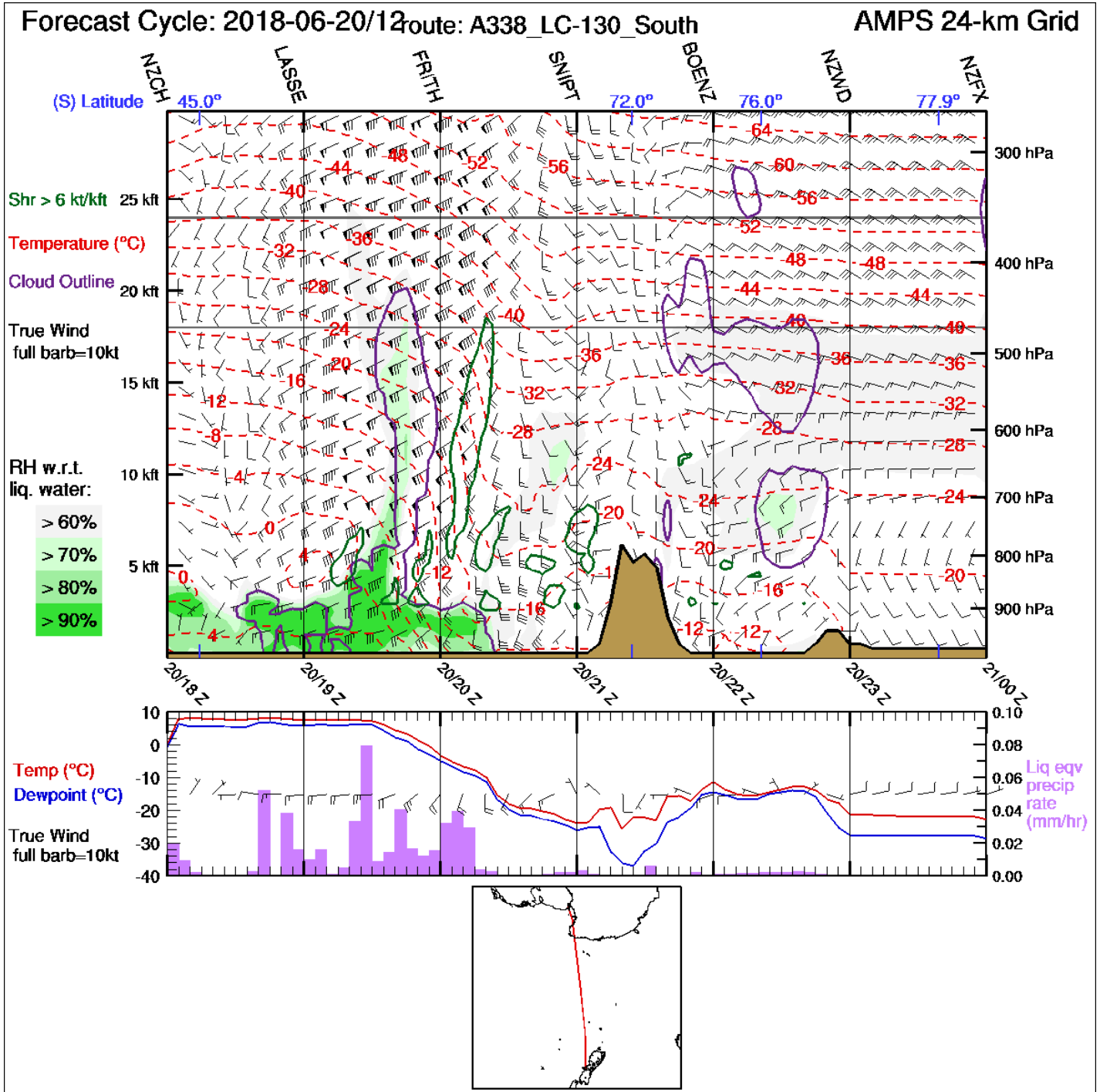
Submit Query

Horizontal axis represents time as well as distance

Temperature, cloud, wind, humidity, vertical shear, terrain along flight rouge

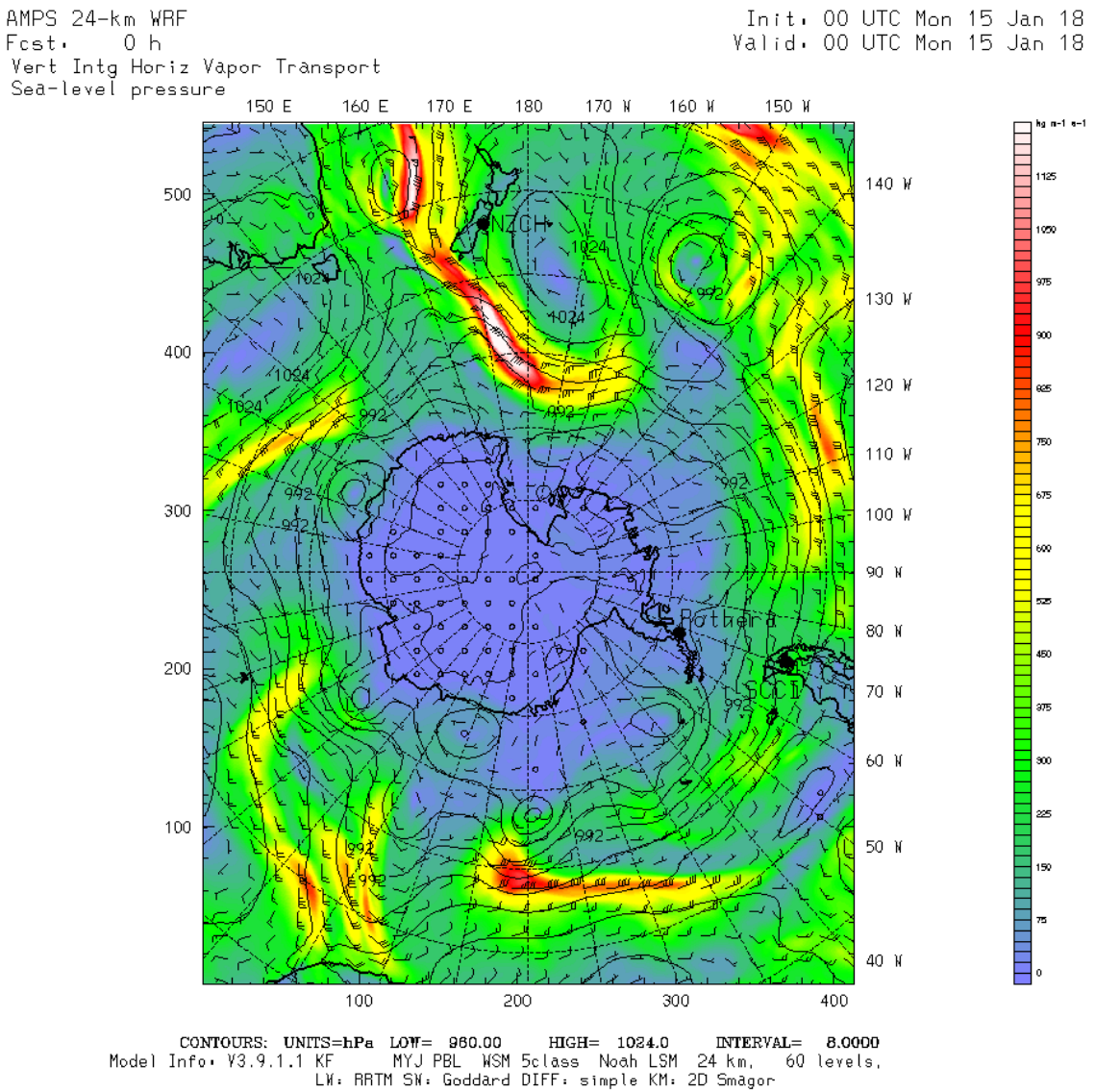
Surface parameters

Map shows flight path



Integrated water vapor transport (IVT)

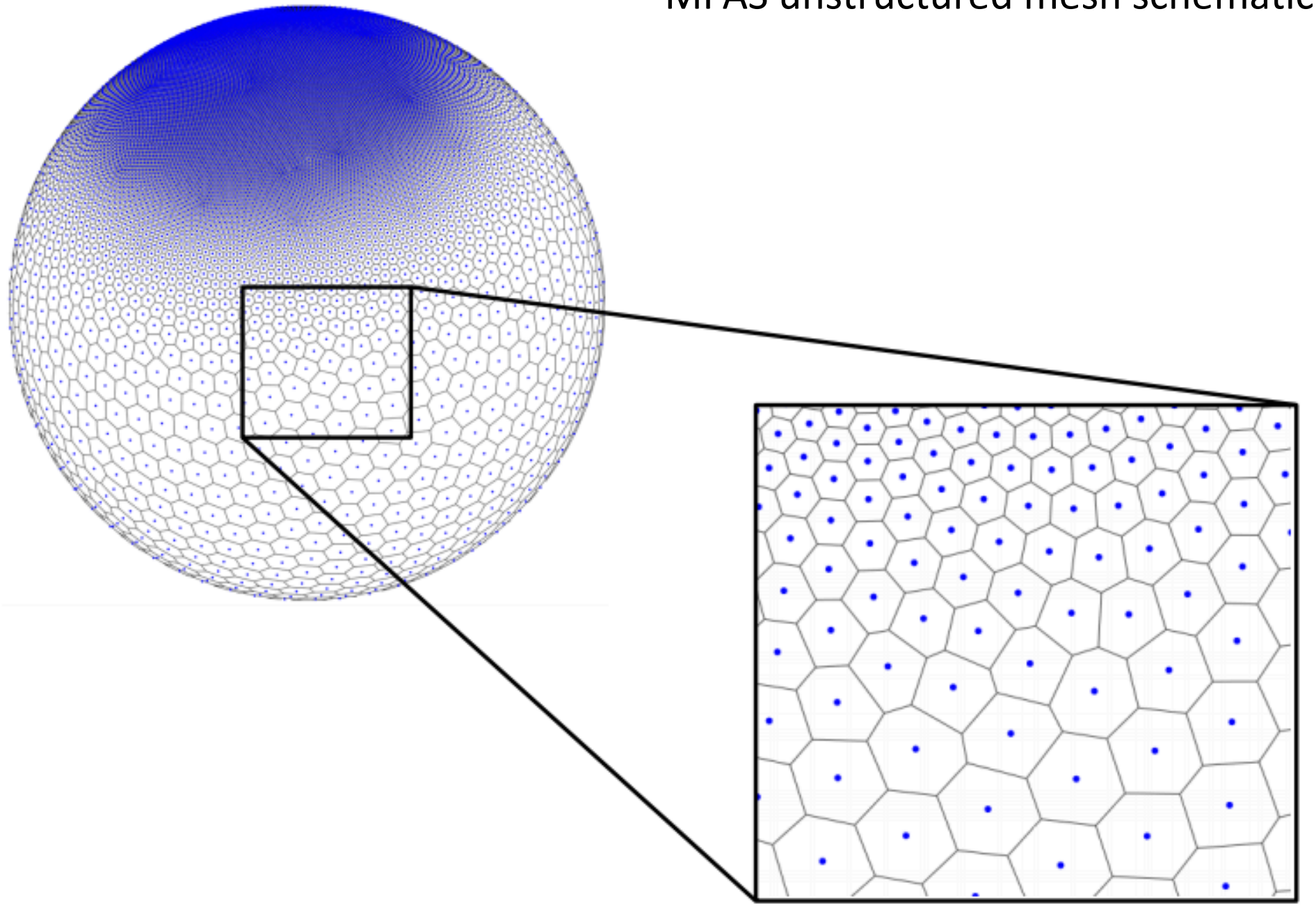
- Offered in response to growing interest in how “atmospheric rivers” affect Antarctica



MPAS Developments

- Model for Prediction Across Scales
  - Key feature
    - Unstructured mesh of mostly hexagons allows for smooth transitions between regions of lower resolution and regions of higher resolution

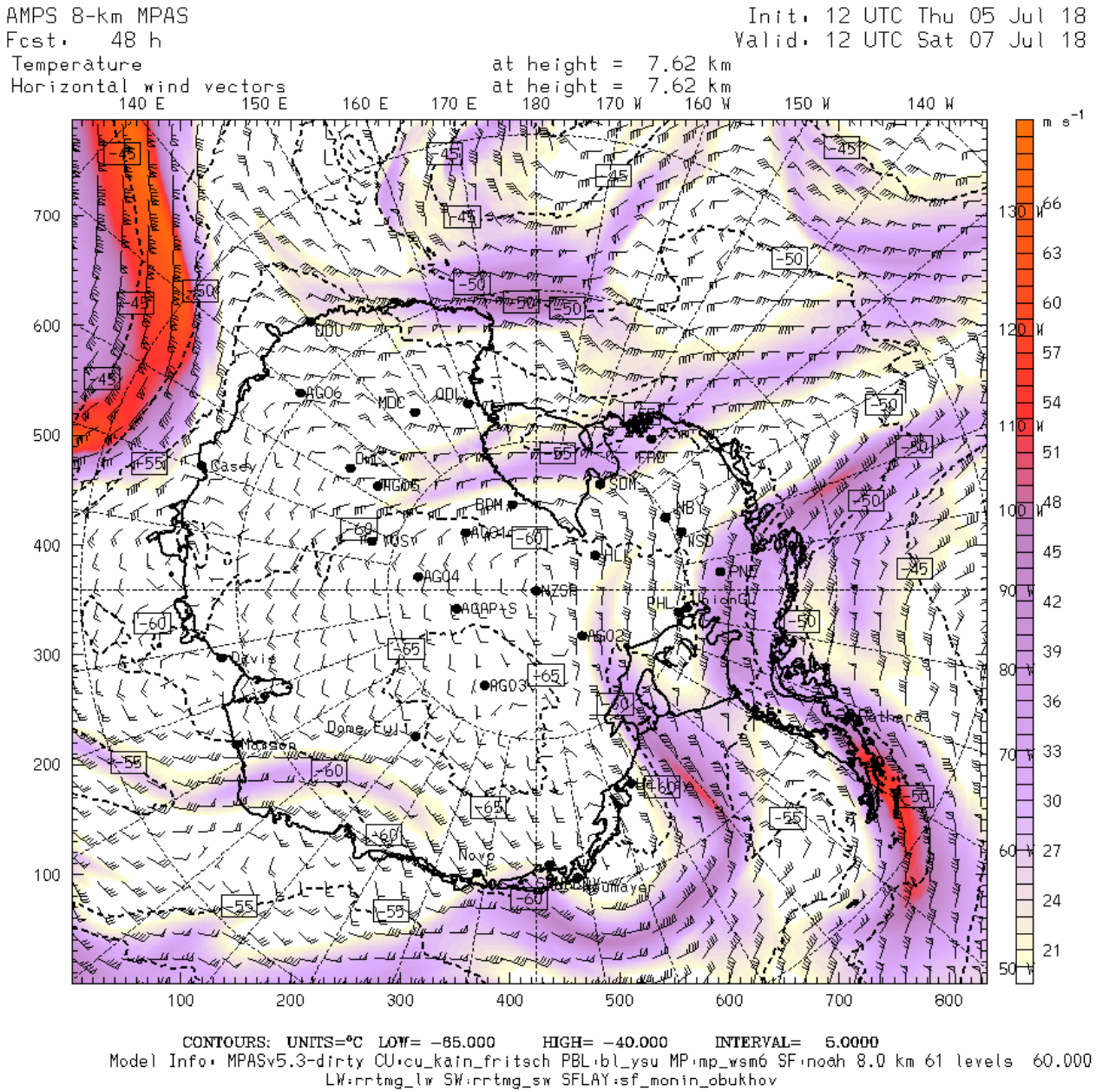
MPAS unstructured mesh schematic



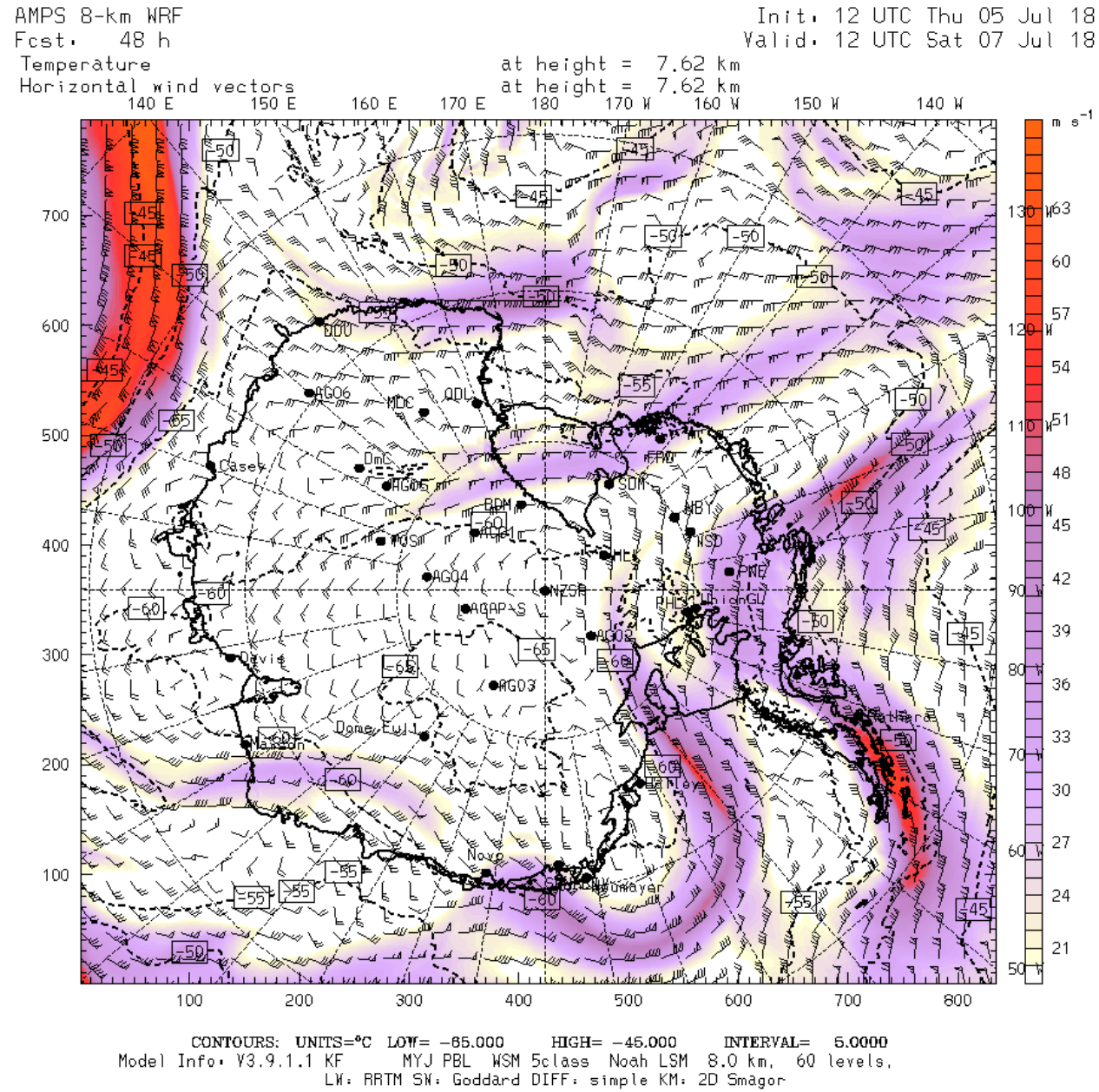
MPAS Developments

- Model for Prediction Across Scales
  - Key feature
    - Unstructured mesh of mostly hexagons allows for smooth transitions between regions of lower resolution and regions of higher resolution
- MPAS version used in AMPS updated to 5.3
- WRF graphics package (RIP) adapted to work with MPAS
  - Thanks to NCAR's Michael Duda and visitor Priscilla Mooney
  - AMPS plots from MPAS now have the familiar AMPS look-and-feel

MPAS


AMPS 8-km MPAS
Init: 12 UTC Thu 05 Jul 18
Fcst: 48 h
Valid: 12 UTC Sat 07 Jul 18
Temperature at height = 7.62 km
Horizontal wind vectors at height = 7.62 km
140 E 150 E 160 E 170 E 180 170 W 160 W 150 W 140 W
m s-1
CONTOURS: UNITS=°C LOW= -65.000 HIGH= -40.000 INTERVAL= 5.0000
Model Info: MPASv5.3-dirty CU:cu_kain_fritsch PBL:bl_ysu MP:mp_wsm6 SF:noah 8.0 km 61 levels 60.000
LW:rrtmg_lw SW:rrtmg_sw SFLAY:sf_monin_obukhov

WRF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140 E 150 E 160 E 170 E 180 170 W 160 W 150 W 140 W
m s-1
CONTOURS: UNITS=°C LOW= -65.000 HIGH= -45.000 INTERVAL= 5.0000
Model Info: V3.9.1.1 KF MYJ PBL WSM 5class Noah LSM 8.0 km, 60 levels,
LW: RRTM SW: Goddard DIFF: simple KM: 2D Smagor

Grid/Window pull-down menu

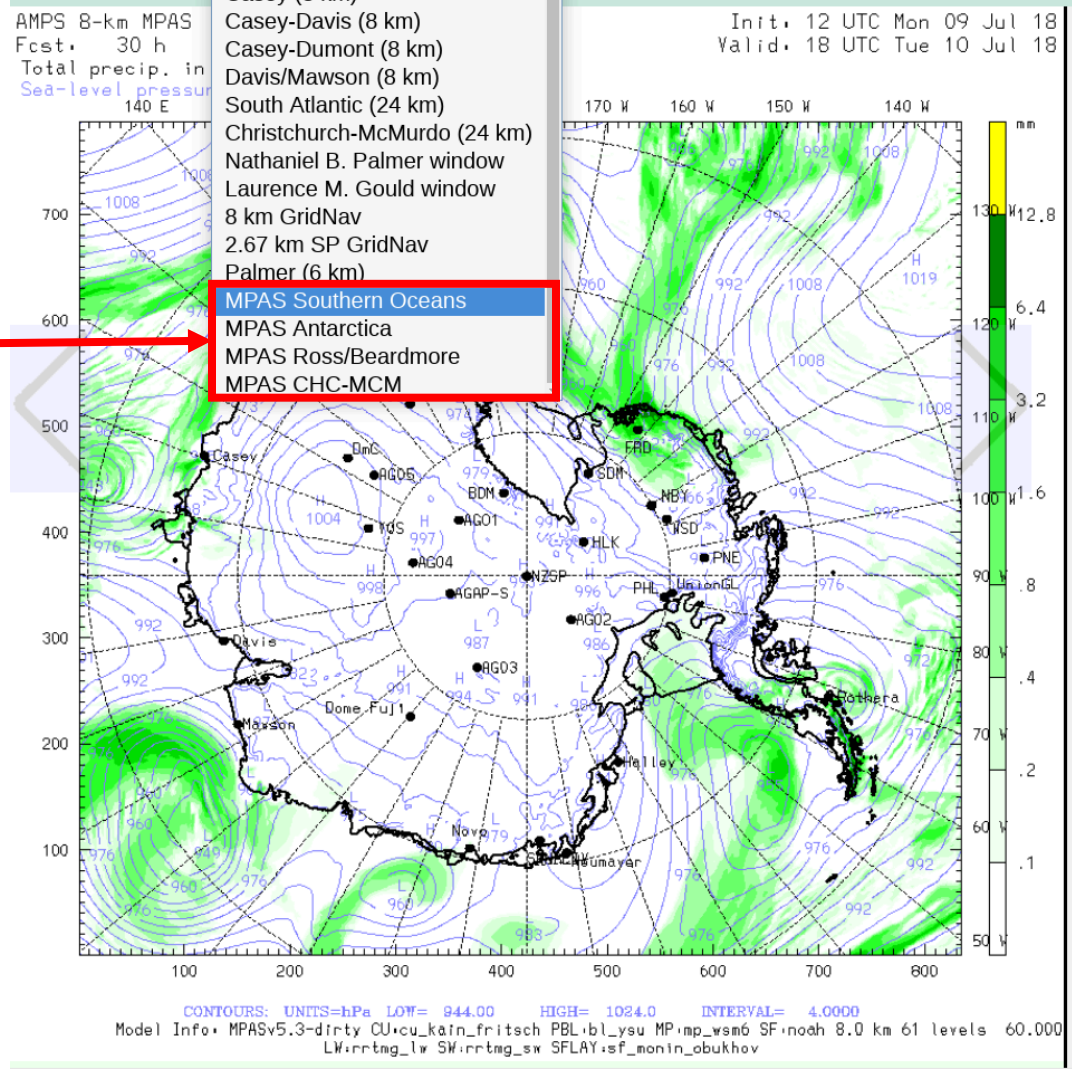
MPAS chart selections

The Antarctic Mesoscale Prediction System (AMPS)

AMPS Info | Products Directory | GRIB | Status | AMPS-Related Links

Forecast Hr	Grid / Window	Initial Time	Product
00 h	MPAS Southern Oceans	2018070912	SFC · Sfc RH · Sfc RH (H20) · SLP/Precip · Cloud base · Sea ice
Animations	Helo (0.89 km)	Go Left	Upper air · Soundings · Tables (none)
4-Panel	Ross Is. (0.89 km)	Go Right	Cross sections · PseudoSat · Sfc wind · Meteograms (none)

Grid / Window options:
Helo (0.89 km)
Ross Is. (0.89 km)
Marie Byrd Land (8 km)
McMurdo-SP-Rothera (8 km)
Queen Maud Land (8 km)
Casey (8 km)
Casey-Davis (8 km)
Casey-Dumont (8 km)
Davis/Mawson (8 km)
South Atlantic (24 km)
Christchurch-McMurdo (24 km)
Nathaniel B. Palmer window
Laurence M. Gould window
8 km GridNav
2.67 km SP GridNav
Palmer (6 km)
MPAS Southern Oceans
MPAS Antarctica
MPAS Ross/Beardmore
MPAS CHC-MCM



Instructions

- Select a forecast hour— "Forecast Hr"
- Select a model grid or plotting window— "Grid / Window"
- Select a forecast initial time— "Initial Time"
- Select a plot view
  Scaled plot— "Scaled" (Scaled to fit your browser window)
  Full-size plot— "Full" (Requires scrolling to view in its entirety)
  New window for the plot— "New"
- Select a product to view— "Product"
- Select "Go Left" or "Go Right" to view the product in either the panel in lower half of page (if "full" or "scaled" selected)

Upcoming

- AMPS support for forecasting for Thwaites Glacier campaign
  - One-way nest (perhaps expanding our routine WAIS Divide one-way nest)
  - Customized AMPS graphics and products
- AMPS support for YOPP
  - Standard AMPS forecast archive
  - AMPS model output for YOPP supersites
- Other needs and opportunities
  - Prioritizing USAP forecasting needs and support for NSF projects
  - Ideas and suggestions always welcome

Thank you

- Questions?

Extras