GOES-16 DATAFLOW AND APPLICATIONS IN THE NATIONAL WEATHER SERVICE

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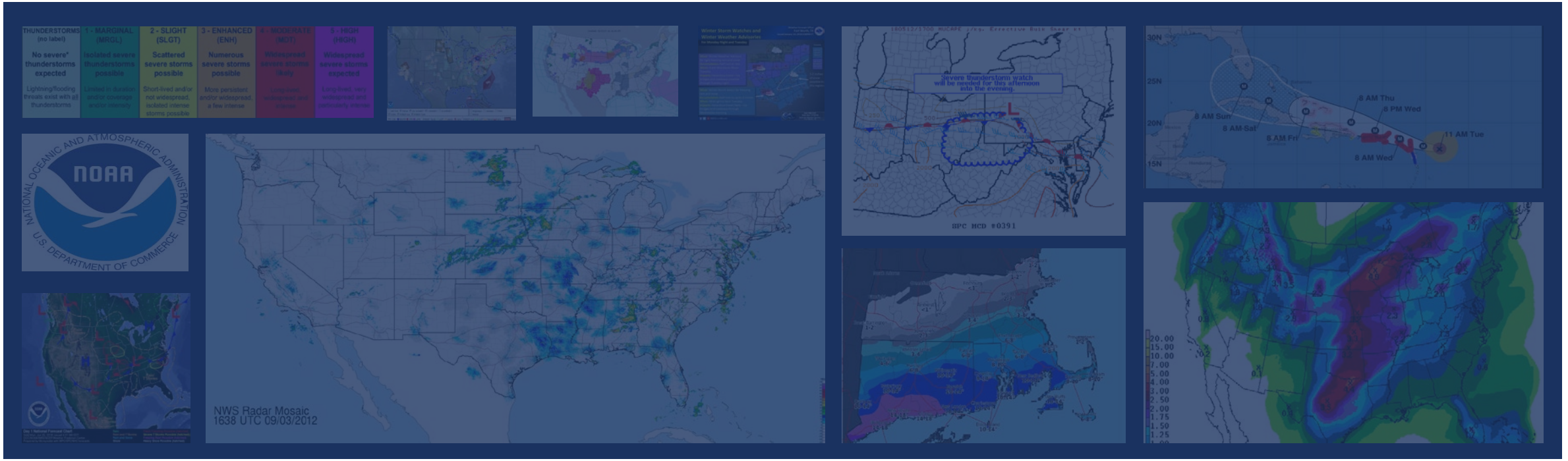
CIRA/CSU AND AVIATION WEATHER CENTER
UNIDATA WORKSHOP – JUNE 25 – 28, 2018



DATAFLOW

GETTING THE FIREHOSE OF GOES-16 INTO NATIONAL WEATHER SERVICE SYSTEMS

Primary data feed for GOES-16/17

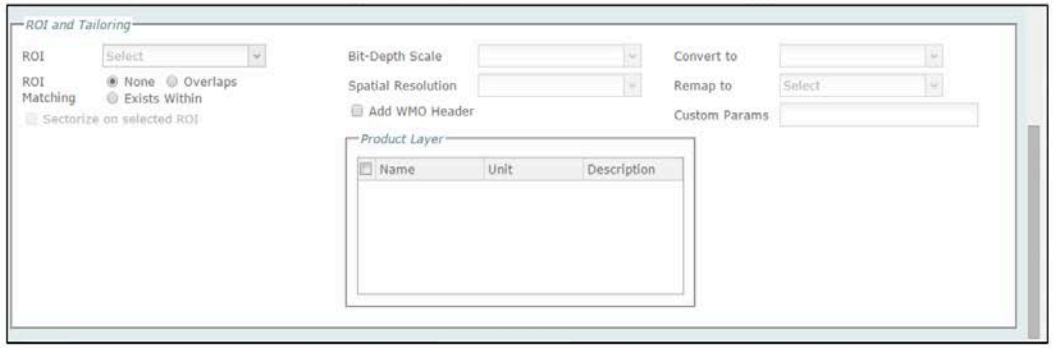
- **Storm Prediction Center**
- **National Hurricane Center**
- **CIMSS** – Jerrold Robaidek
  robo@ssec.wisc.edu
  CIRA – Deb Molenar
  debra.molenar@colostate.edu
  SPoRT – Kevin McGrath
  kevin.m.mcgrath@nasa.gov
- **Pacific Region**
- **Alaska Region**
- **Guam (HCAST only)**

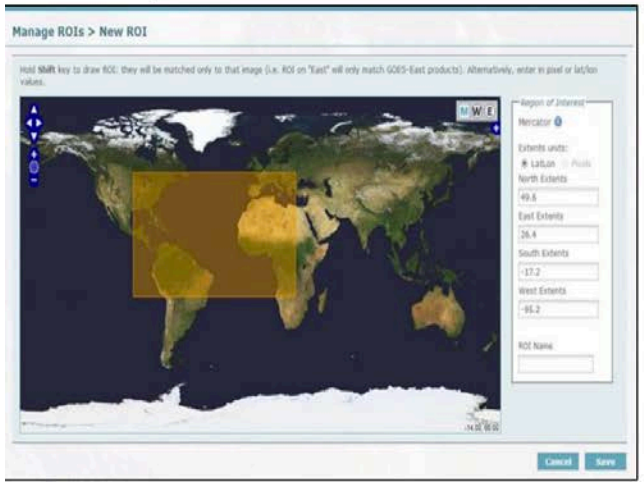
GOES-R REBROADCAST ANTENNAS (GRB)

- Back up for ABI imagery and GLM
  - FTP-S utilizing curl for pulls
  - Dataflow sanity check for primary GOES-16 sources
- Primary for derived (GOES-16 L2) products into N-AWIPS; secondary for WFOs
- Primary for legacy polar and international (eventually)
- PDA was offered to non-NWS users (i.e. universities), but resource usage concerns have had them cutting back on non-essential users
- Contact info: PDA_DHS@noaa.gov

PDA User Portal

Region of Interest (ROI) and Tailoring Per-Subscription





```
for file in $latest; do
   if [ $ptrn == LV* ]; then
     yyyy=`expr substr $file 25 4`
     jdate=`expr substr $file 29 3`
     hhnn=`expr substr $file 32 4`
   elif [ $ptrn == "DMWC" ]; then
     yyyy=`expr substr $file 27 4`
     jdate=`expr substr $file 31 3`
     hhnn=`expr substr $file 34 4`
   else
     yyyy=`expr substr $file 24 4`
     jdate=`expr substr $file 28 3`
     hhnn=`expr substr $file 31 4`
   fi
   yyyymmdd=`date -d "$yyyy-01-01 +$jdate days -1 day" "+%Y%m%d"`
   fname="${yyyymmdd}_${hhnn}.${ptrn}"
#   echo $outdir $fname
   # Get two latest files
   NOW=`date -u +%s`
   THEN=`date -u --date="${yyyymmdd} ${hhnn}" +%s`
   DIFF="$((NOW-THEN))"
   if [[ "$DIFF" -le "600" ]]; then
   # Check to see if we already have this file
   if [ ! -e $file ]; then
     # Get the latest file
     curl -O -vk --no-epsv --ftp-ssl-control ftp://140.90.190.143/${ftpdir}/${file} -u
     # Log file for PDA validation
#     echo -e $file >> /scratch/PDA/${yyyymmdd}_nsof.log
     # Rename file
#     mv $file $fname
   fi
   fi
done
```

Satellite Broadcast Network

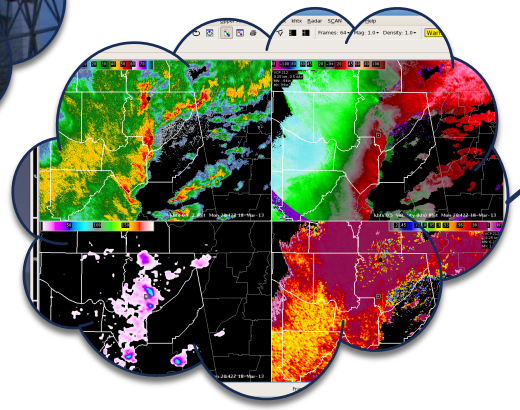
- ABI was just updated to fixed grid on June 19th!
  - Saves a lot of space!
- Primary for WFOs
- For National Centers:
  - Primary for ABI L2 products in AWIPS
  - "Cushion" data… or backup in case GRB and PDA are unavailable…
  - Secondary source of AHI, VIIRS, NUCAPS, etc.

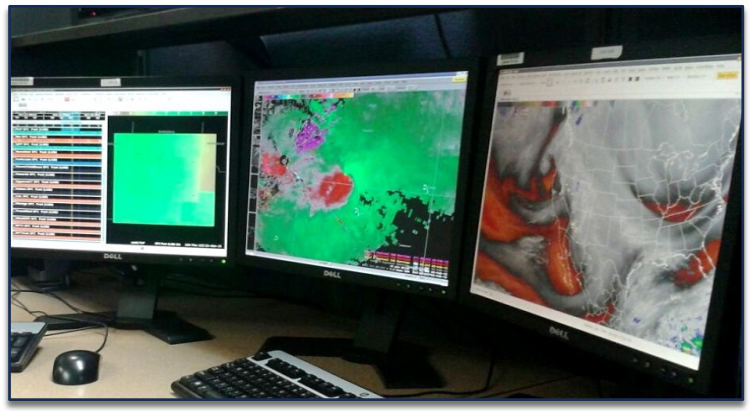
SO MUCH DATA… SO MANY ENDPOINTS…

GRB

PDA

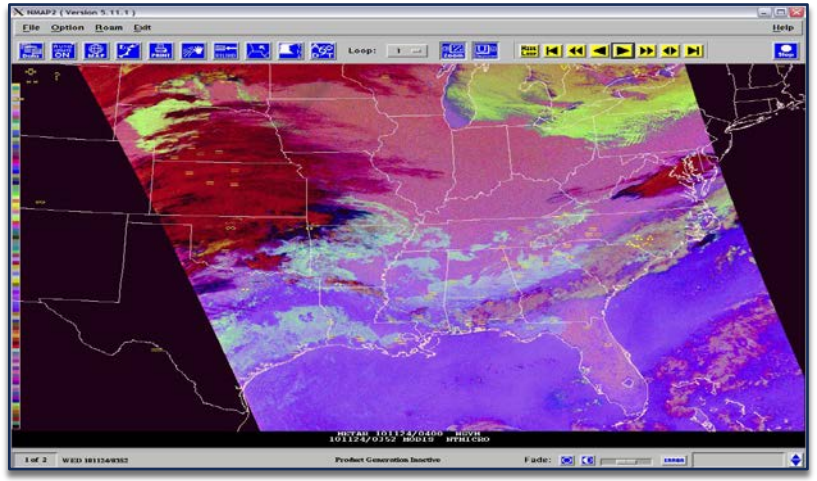
SBN





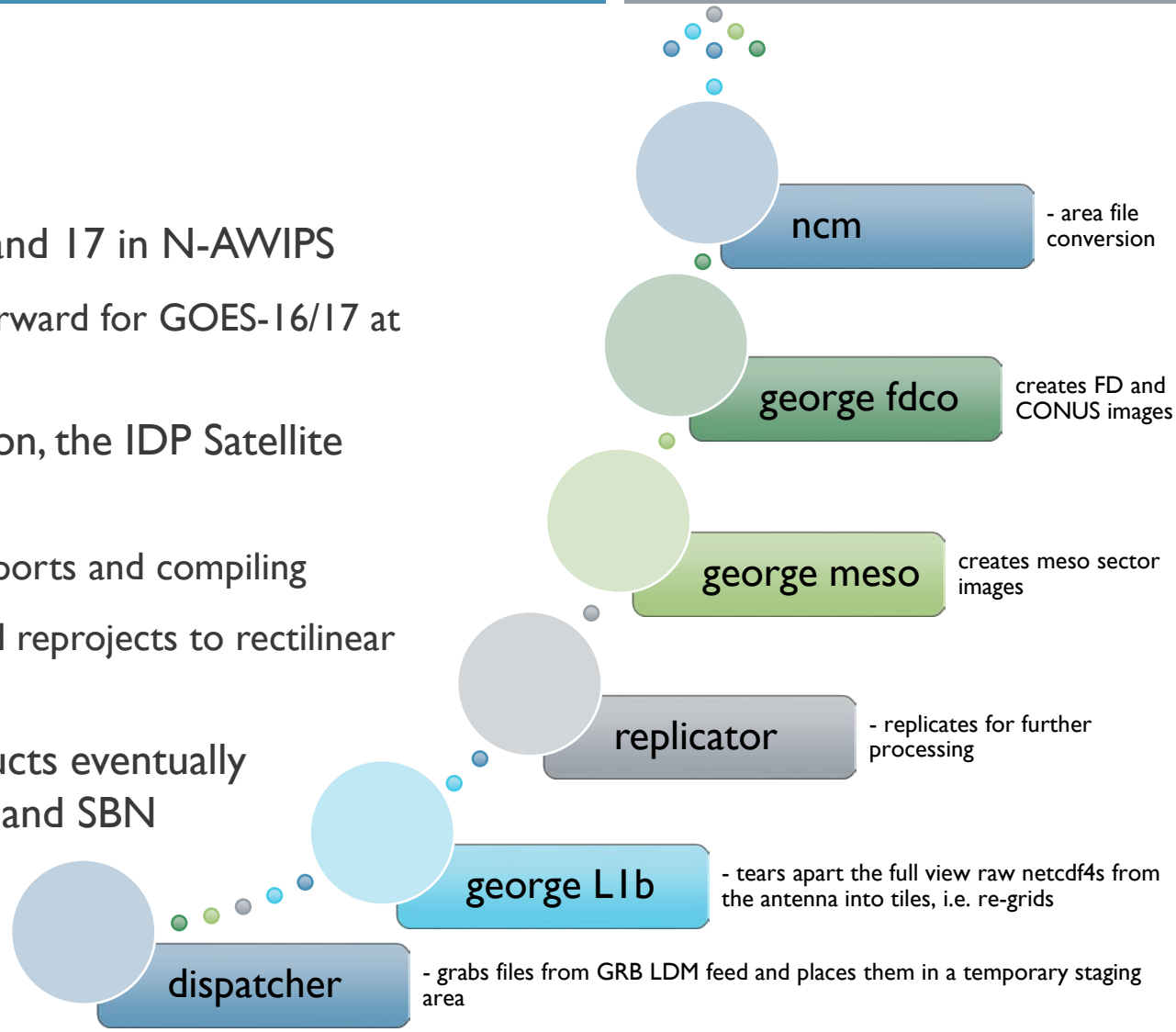
AWIPS-2
- D2D
- NCP

N-AWIPS



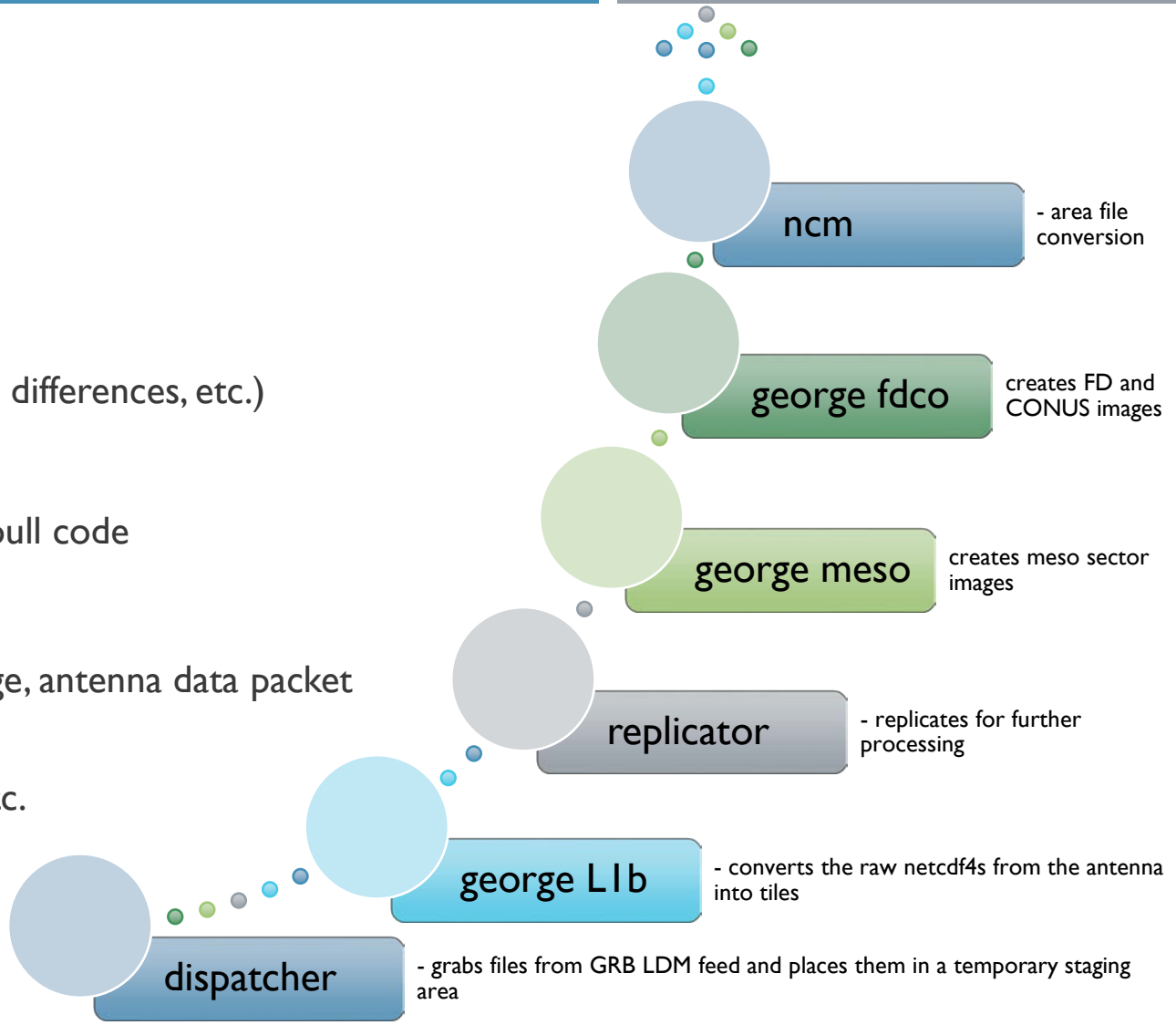
ISatSS

- Came from a requirement for GOES-16 and 17 in N-AWIPS
  - McIDAS wasn't certain about their path forward for GOES-16/17 at the time
- NWS created an open source, free solution, the IDP Satellite SubSystem
  - All Python3 (using anaconda for library imports and compiling
  - Translates netcdf4 to tiles for AWIPS-2 and reprojects to rectilinear areas for N-AWIPS
- Became also an evaluation zone for products eventually transitioned to the Ground Segment/IDP and SBN



ISatSS

- Other applications…
  - PIGG – points to grids for GLM
  - MOJo – multiple object joiner (RGBs, band differences, etc.)
  - App for derived motion winds
  - PDA interface – to improve kludgy FTP-S pull code
- Other utilities…
  - System monitoring – system health, data age, antenna data packet drops, etc.
  - System monitoring integration – Nagios, etc.

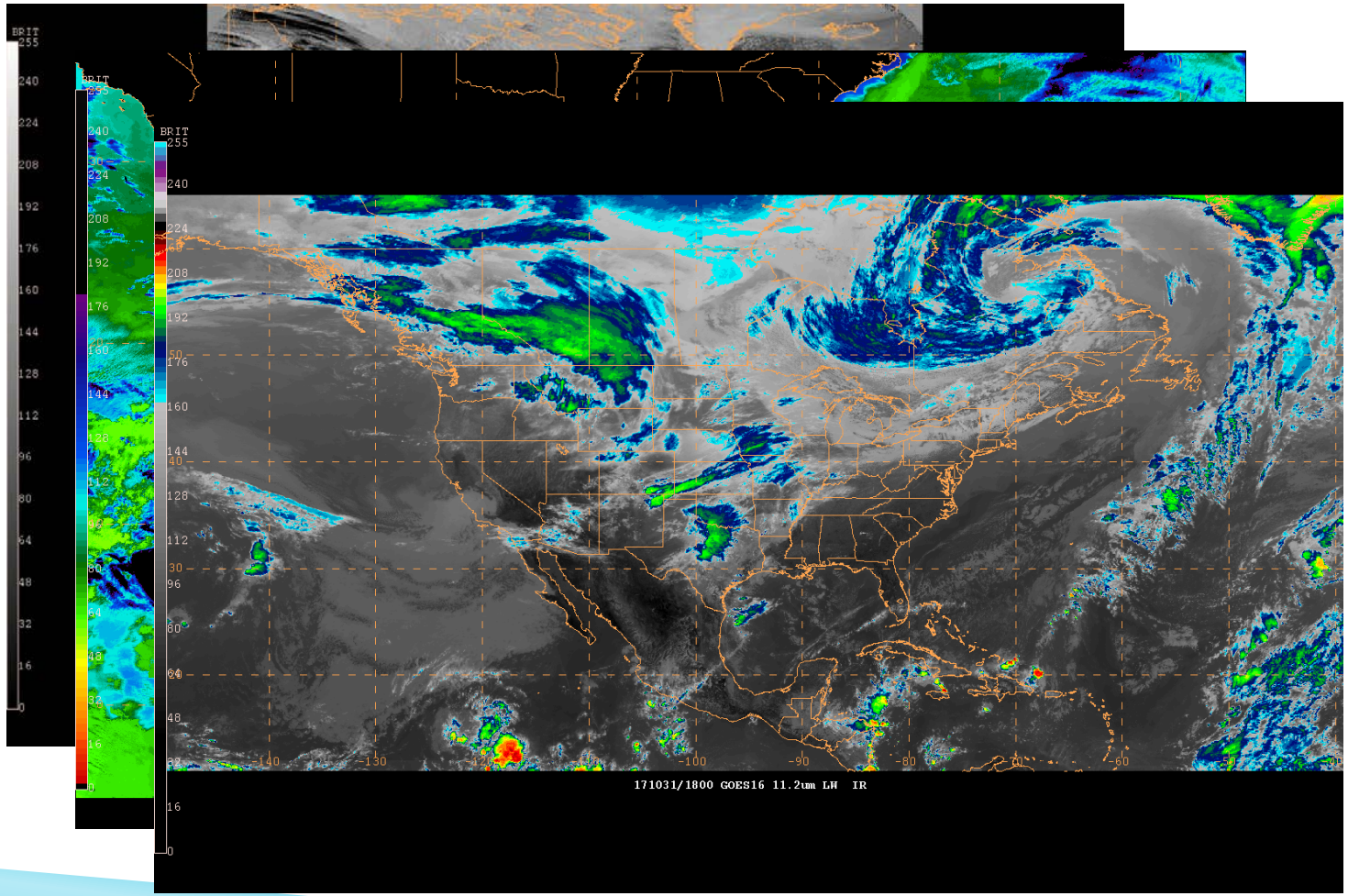


Terminal — ssh aterborg@goesr.eee — 125×53

```
import os
os.environ['PATH']='%s'%os.environ['PATH']
os.environ['MCPATH']='/scratch/sat:%s/data:/awids/local/mcidas/mcidas2017.1/help'%os.environ['MCIDAS']
mc = mcidasx.mcenv()

b07Out=mc.imglist('G16/B07F FORM=ALL')
yyyyjjj1 = b07Out.stdout[426:433]
#hhmmss1 = b07Out.stdout[434:440]
hhmm = b07Out.stdout[301:306]
hhmm1 = hhmm.replace(":","")

b13Out=mc.imglist('G16/B13F FORM=ALL')
yyyyjjj2 = b13Out.stdout[426:433]
#hhmmss2 = b13Out.stdout[434:440]
hhmm2 = b13Out.stdout[301:306]
hhmm3 = hhmm2.replace(":","")

b02Out=mc.imglist('G16/B02F FORM=ALL')
yyyyjjj3 = b02Out.stdout[426:433]
#hhmmss3 = b02Out.stdout[434:440]
hhmm4 = b02Out.stdout[301:306]
hhmm5 = hhmm4.replace(":","")


timdif = int(hhmm1) - int(hhmm3)
timdif2 = int(hhmm3) - int(hhmm5)
print hhmm1, hhmm3, timdif
print hhmm3, hhmm5, timdif2

if timdif < 1:
# First check the time between the two IR bands to make sure they are the same. If the write time difference is more
# than 1 minute, quit. If less, print okay message and continue processing.
    print("IR file times okay. Begin fog diff...")
    b07diffb13=mc.imgoper('G16/B13F G16/B07F SFOG16F.1 COEF=1 -1 UNIT=TEMP SIZE=4500 4500 SCALE=-8 6 1 255 DEV=CCC')
    print b07diffb13.stdout
# Next, check the time diff between the IR images and the visible image. If okay, start the vis normalization
    if timdif2 < 1:
        print("Vis file times okay. Begin vis copy and normalization...")
        b02copy=mc.imgcopy('G16/B02F SFOG16F.2 SIZE=4500 4500 MAG=-4 DEV=CCC')
        b02norm=mc.imgconv('SFOG16F.2 SFOG16F.3 CONV=NOR SAMPL=5 SIZE=ALL DEV=CCC')
        print b02norm.stdout
# Then stitch the two together. Also, change the band to 2 for more accurate imgtyp.tbl configuration
        print("Norm complete. Begin vis and fog difference stitch...")
        visfog=mc.imgfilt('SFOG16F.3 SFOG16F.1 G16FVF.1 FILTER=MERGE 20 255 SIZE=ALL DEV=CCC')
        print visfog.stdout
        print("Stitch complete. Change band to 2 for imgtyp.tbl...")
        vfcha=mc.imgcha('G16FVF.1 BAN=2 DEV=CCC')
# Then copy the AREA file /scratch/sat/ to the operational directory
    else:
        print("Vis file times don't match. Quit.")
else:
    print("IR file times don't match. Quit.")
                                                                55,1          Bot
```

McIDAS local processing

- Formats
  - Legacy McIDAS macros
  - New Python McIDAS code
- Applications
  - Local band differences
  - RGB creation with 2018.1
  - Display of GLM with 2018.1
  - Hemispheric/global mosaics



McIDAS local processing

- Formats
  - Legacy McIDAS macros
  - New Python McIDAS code
- Applications
  - Local band differences
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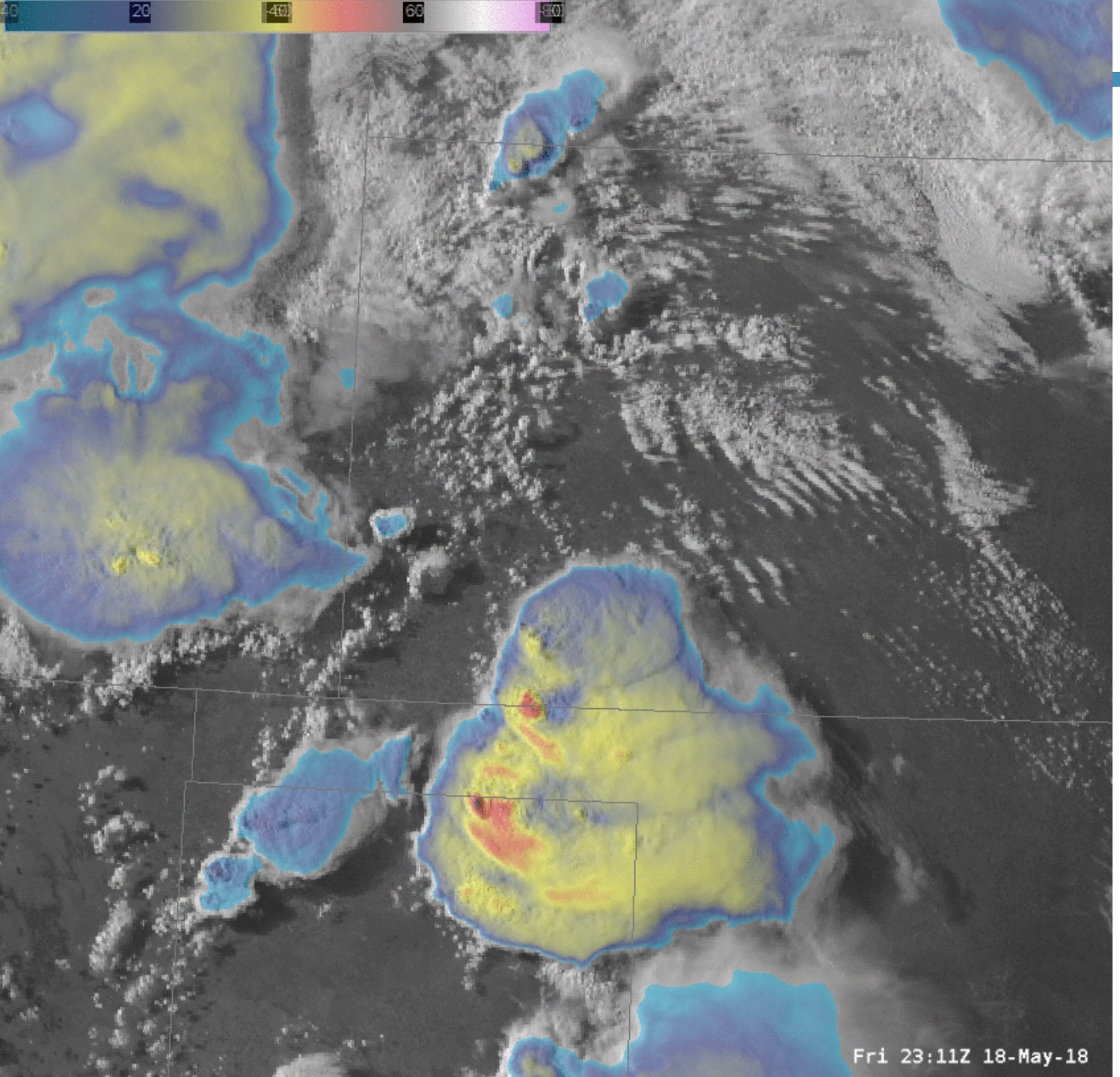
  - Display of GLM with 2018.1
  - Display of L2 derived products
  - Hemispheric/global mosaics

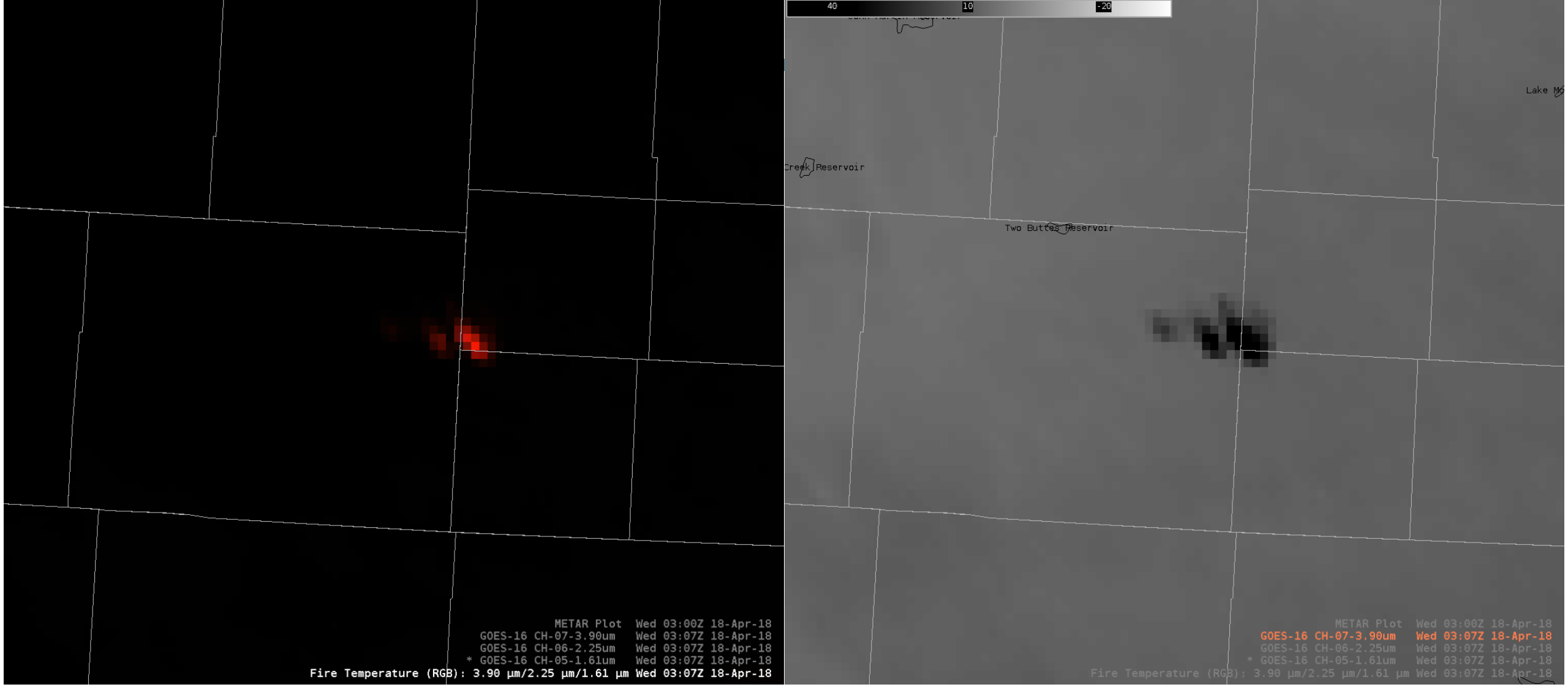
APPLICATIONS

USING GOES-16 IN NATIONAL WEATHER SERVICE OPERATIONS



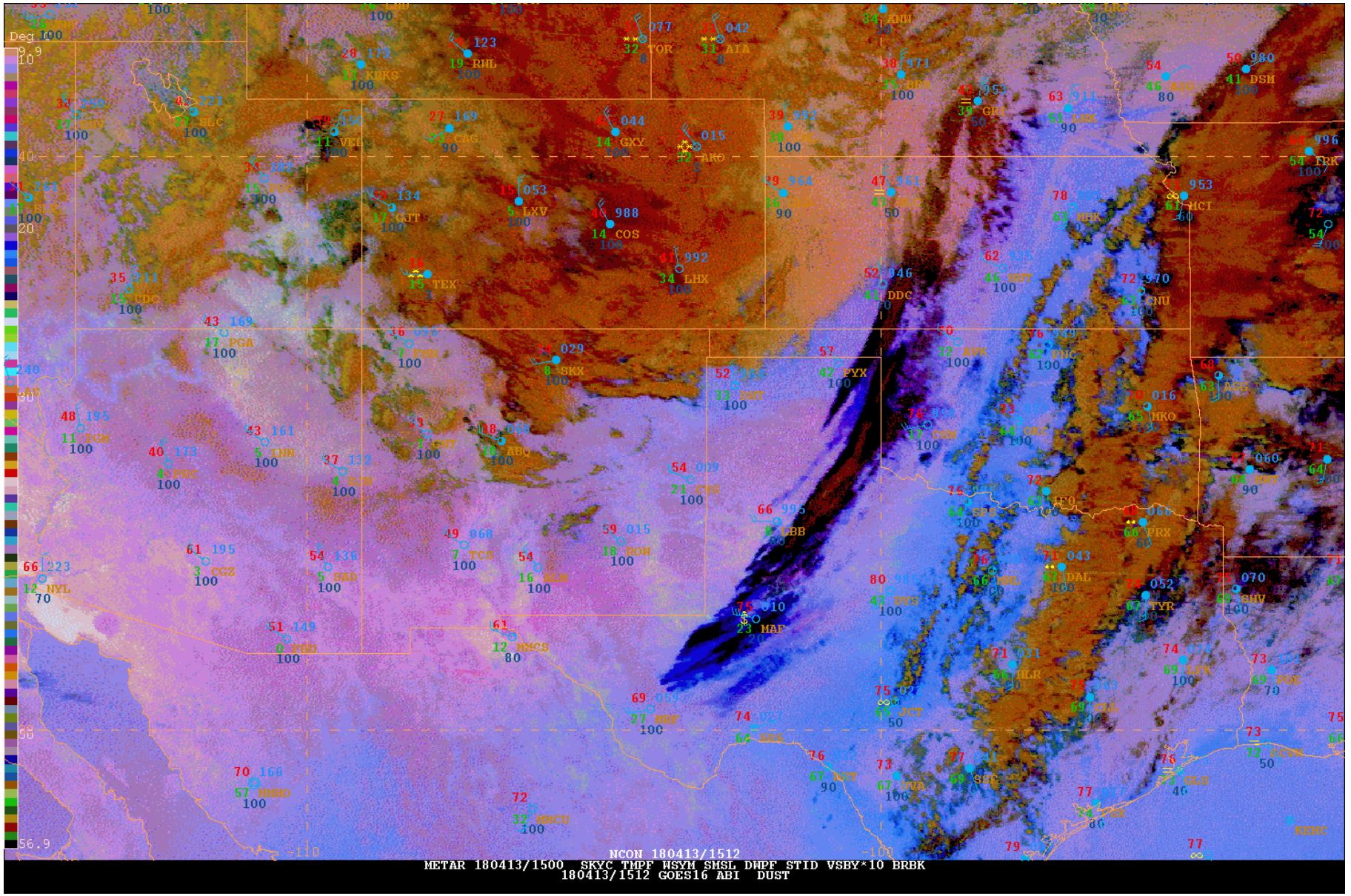
VIS/IR "SANDWICH" AND 1-MINUTE IMAGERY FOR CONVECTIVE SITUATIONAL AWARENESS

- Many WFOs take advantage of the 'sandwich' combination in AWIPS-2, utilizing both the 0.64 and 10.35 channels to examine convective complexes
- 1-minute refresh provides insight on rapid convective development and life cycle



WILDFIRES AND SMOKE

- Additional spectral resolution provides additional derived fire products; spatial and temporal resolution provide additional detail on fires
- Utilized by many WFOs and fire incident commands for fire locations, temperature, forecasting; used also by aviation interests at CWSUs/AWC

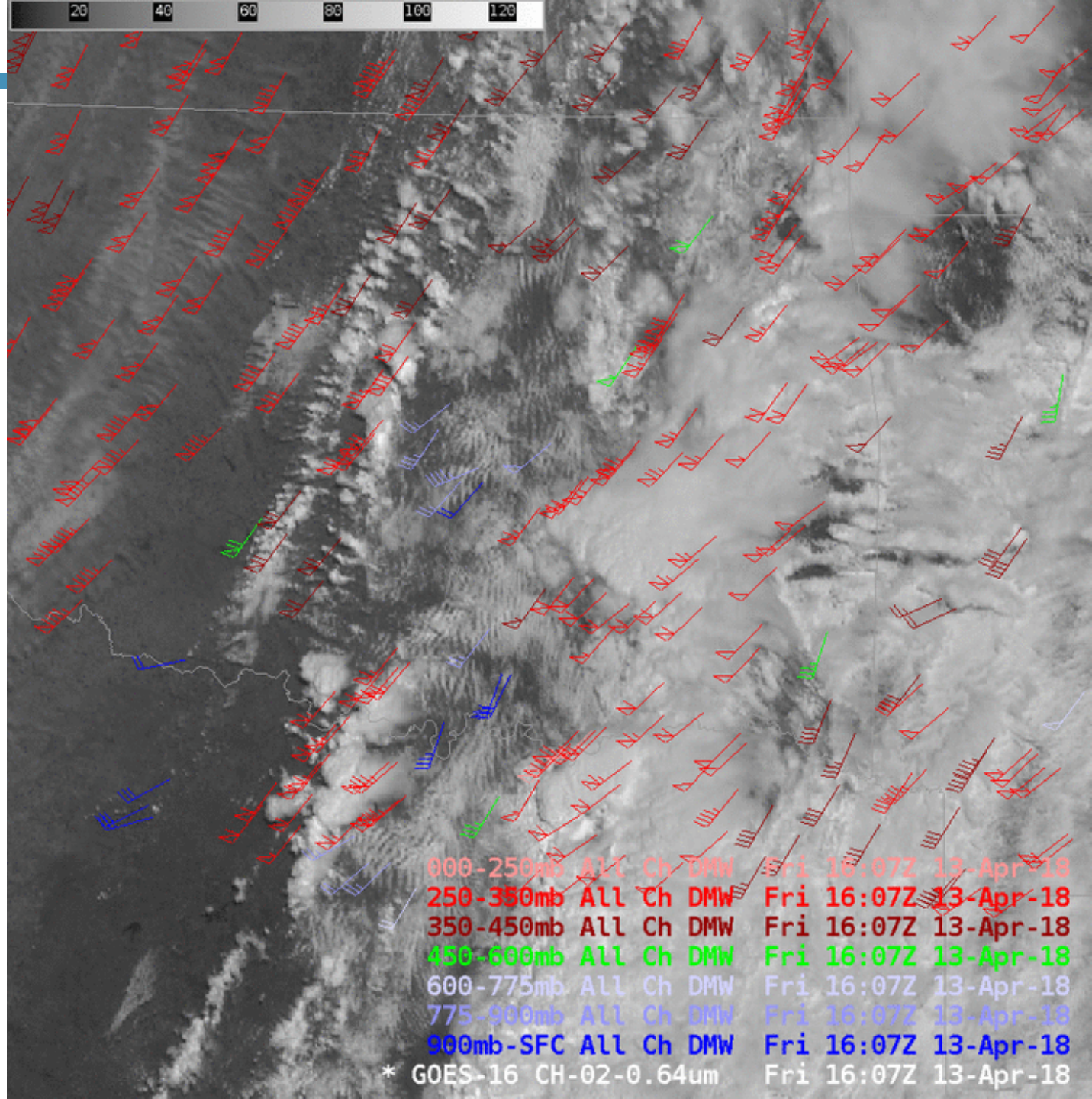


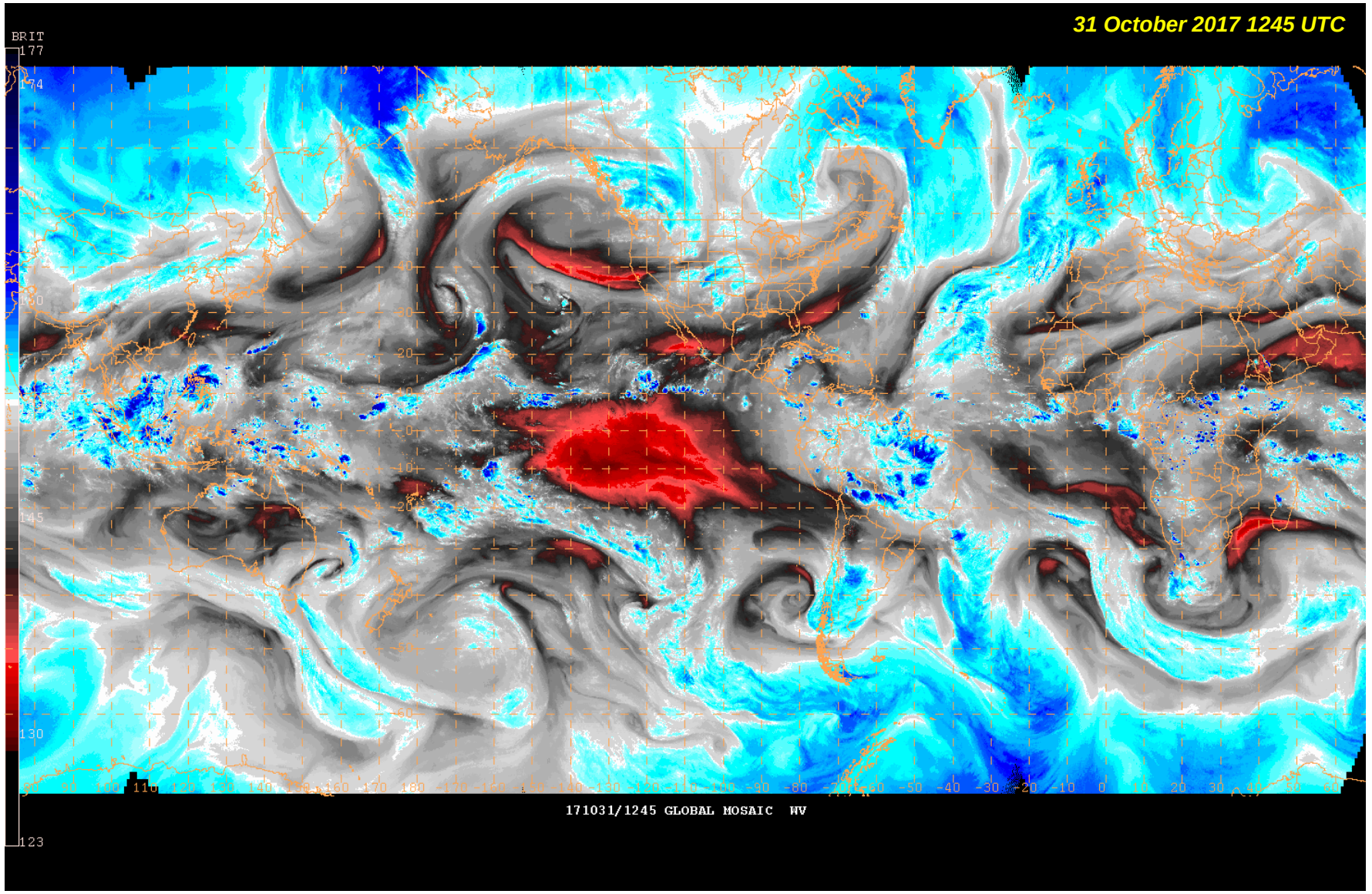
RGB IMAGERY AND DUST

- Utilized by Aviation Weather Center for blowing dust SIGMETs
- Utilized by Western Region offices for dust storm watches and warnings
- Utilized by Center Weather Service Units for local terminal operation advisories

DERIVED MOTION WINDS AND CONVECTIVE ACTIVITY

- Derived motion winds have a much higher temporal resolution than observed winds, also provide many vertical levels because of additional spectral resolution of GOES-16/17
- In this case used for convective analysis and forecasting for WFOs
- Also used by National Hurricane Center for hurricane and tropical system forecasting



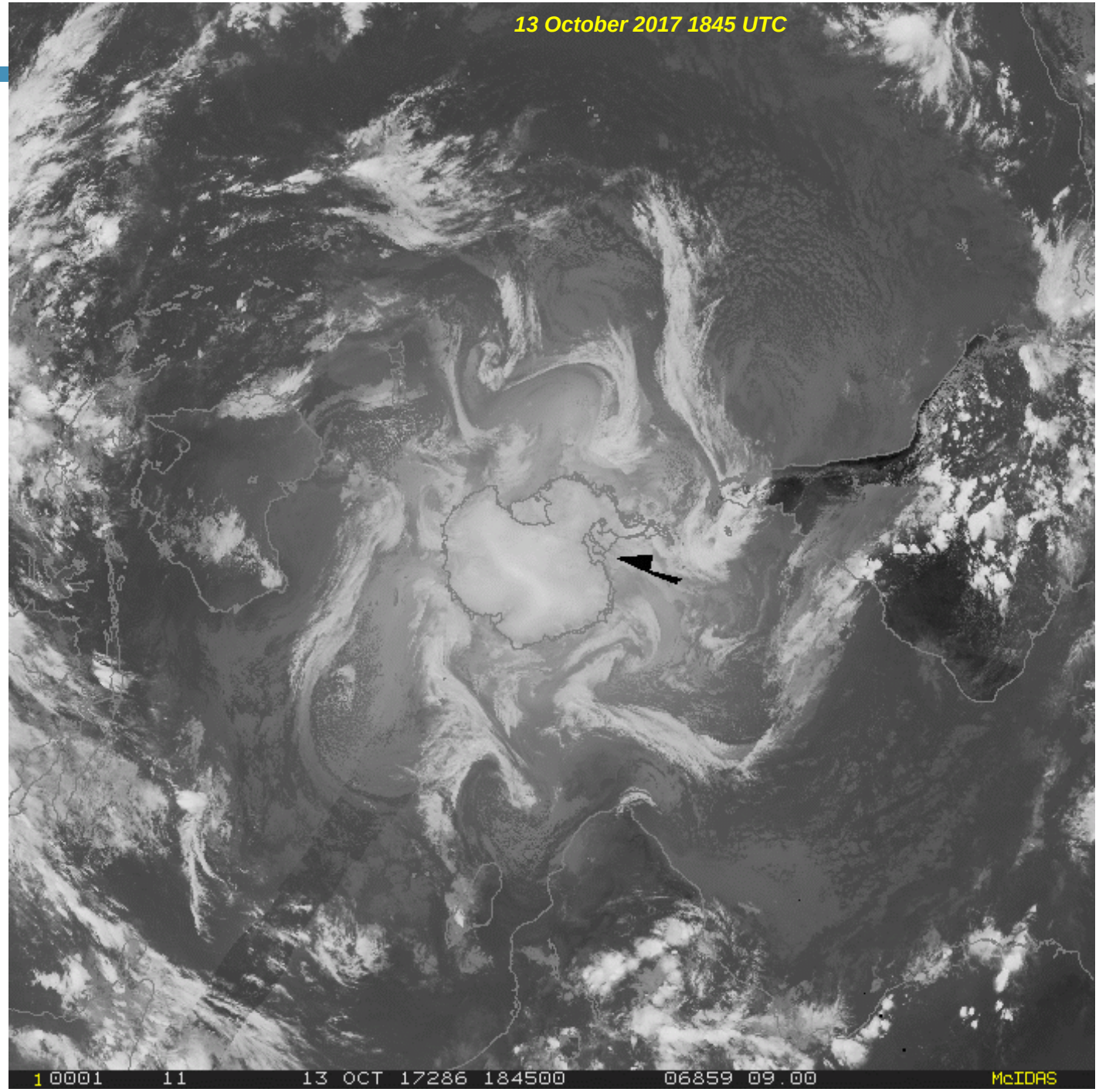


GLOBAL MOSAIC IMAGERY WITH GOES-16

- Improved spatial resolution
- Improved temporal resolution
- Improved spectral resolution

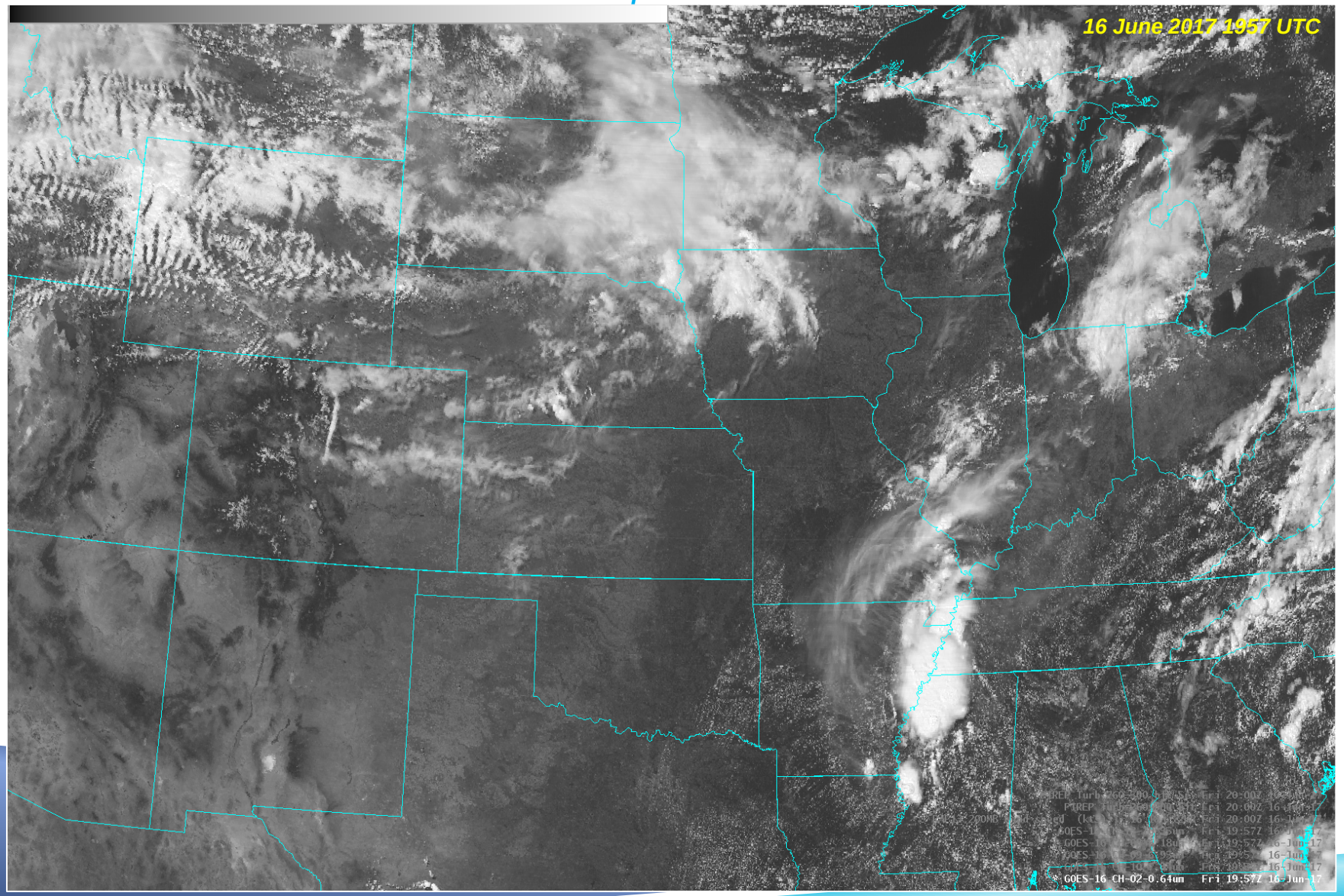
POLAR STEREOGRAPHICS

- Weather Prediction Center and Ocean Prediction Center utilize higher spatial and temporal resolution mosaics for high seas and other forecasts
- National Hurricane Center utilizes imagery for tropical forecasting and web graphics
- Aviation Weather Center takes advantage of this imagery for global forecasting responsibilities and also web graphics for international partners



IN-FLIGHT TURBULENCE

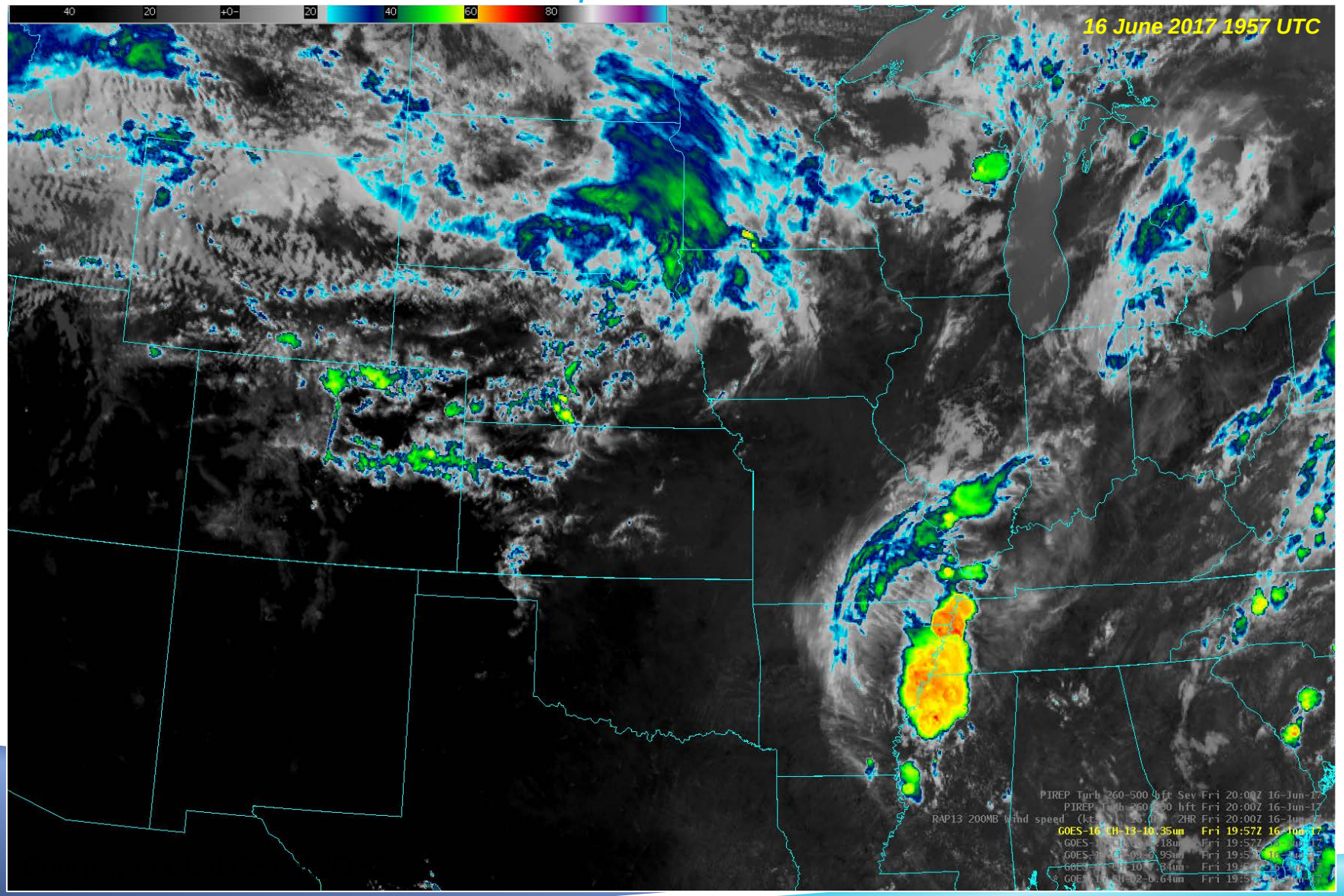
GOES-16 0.64 µm – RED VISIBLE



Courtesy of Chad Gravelle

IN-FLIGHT TURBULENCE

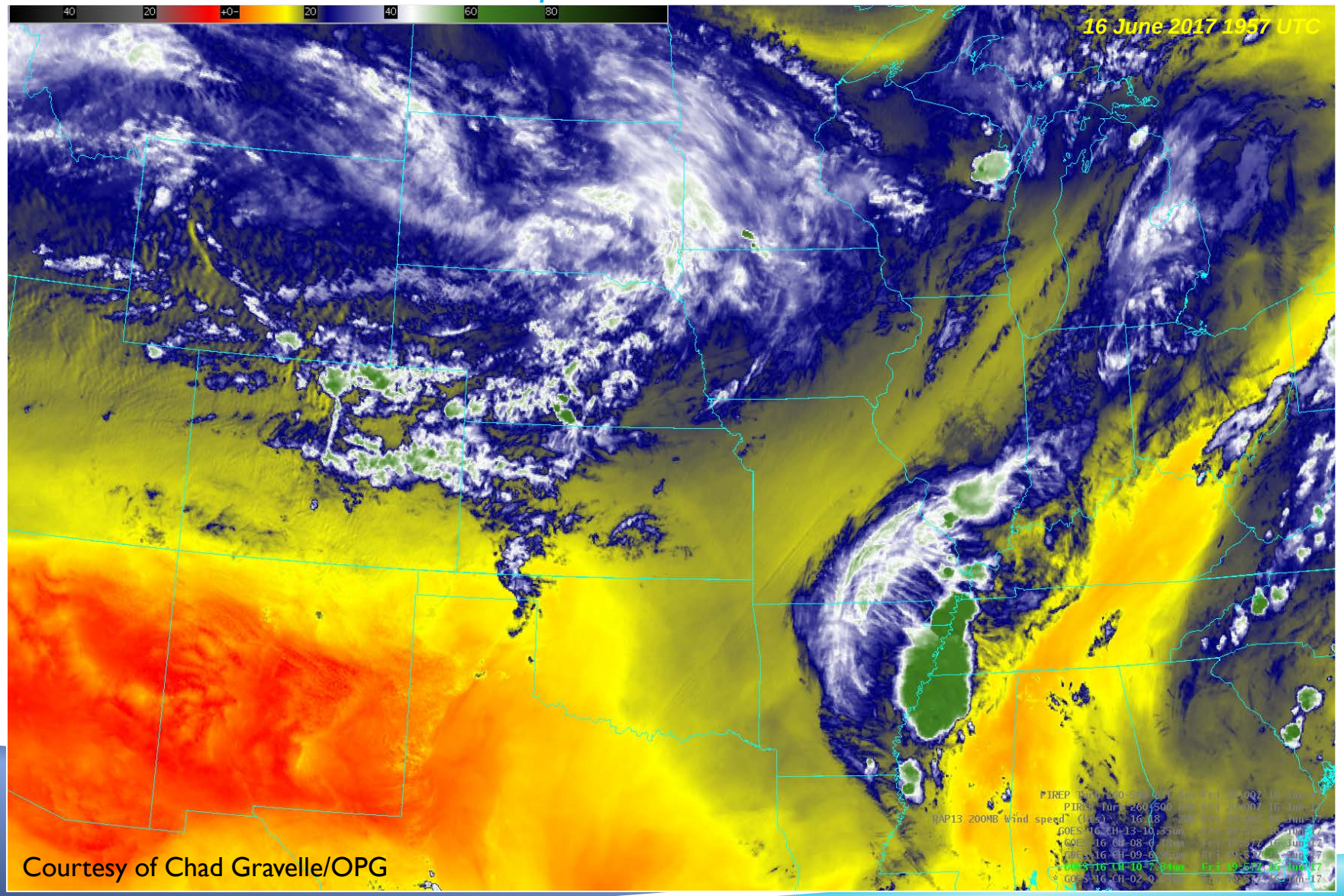
GOES-16 10.3 µm – CLEAN IR LONGWAVE



Courtesy of Chad Gravelle

IN-FLIGHT TURBULENCE

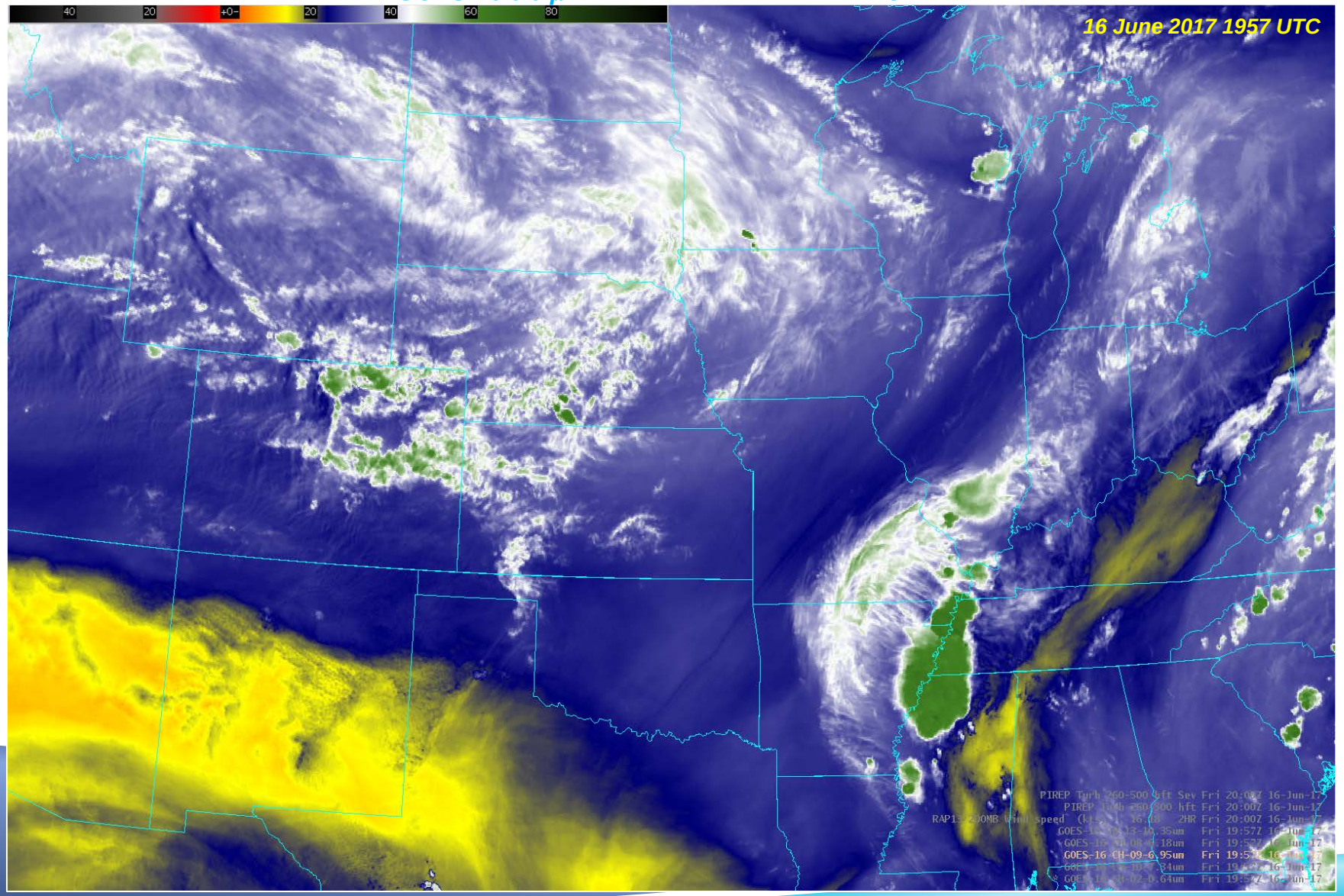
GOES-16 7.3 µm – LOW-LEVEL WATER VAPOR



Courtesy of Chad Gravelle

IN-FLIGHT TURBULENCE

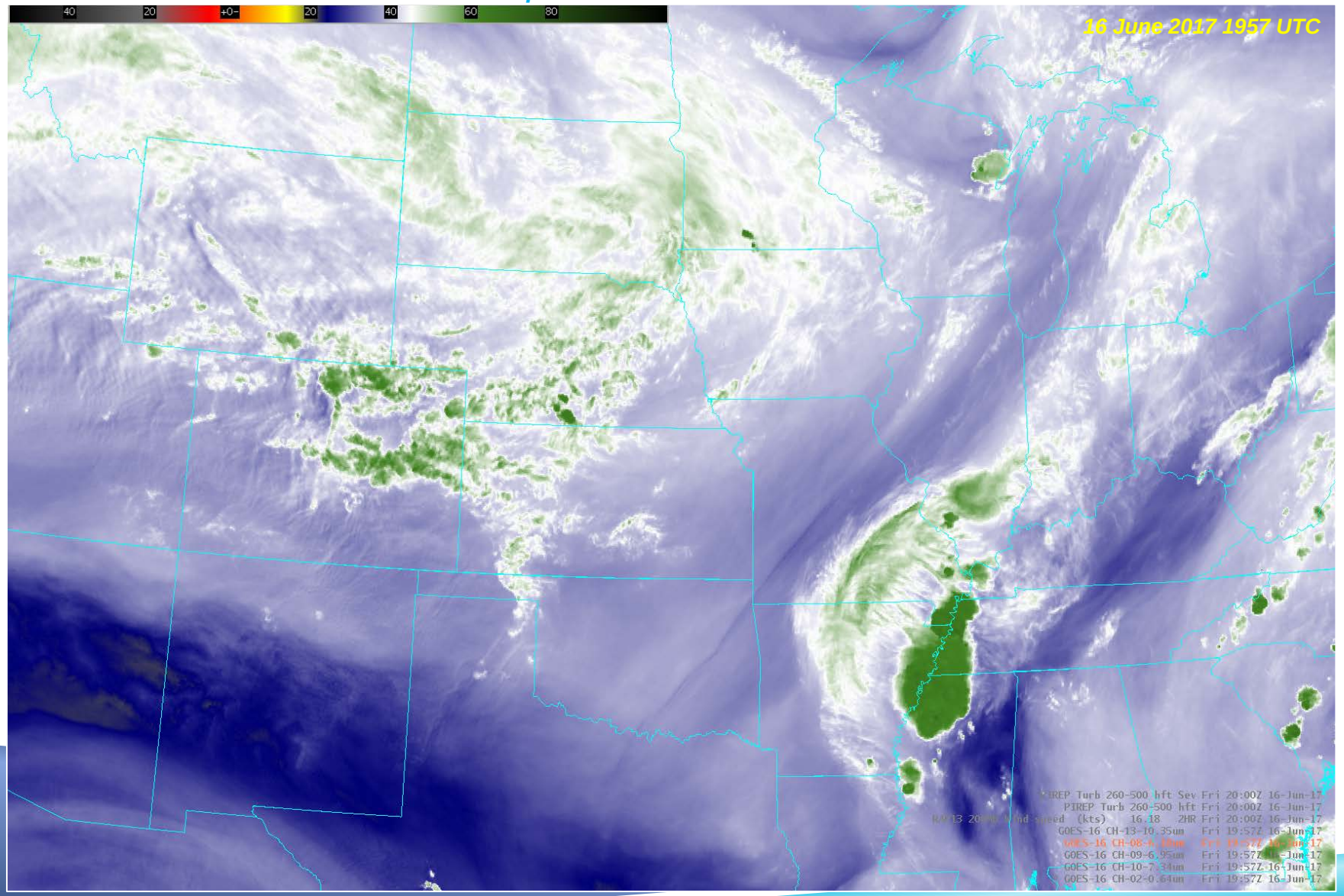
GOES-16 6.9 µm – MIDLEVEL WATER VAPOR



Courtesy of Chad Gravelle

IN-FLIGHT TURBULENCE

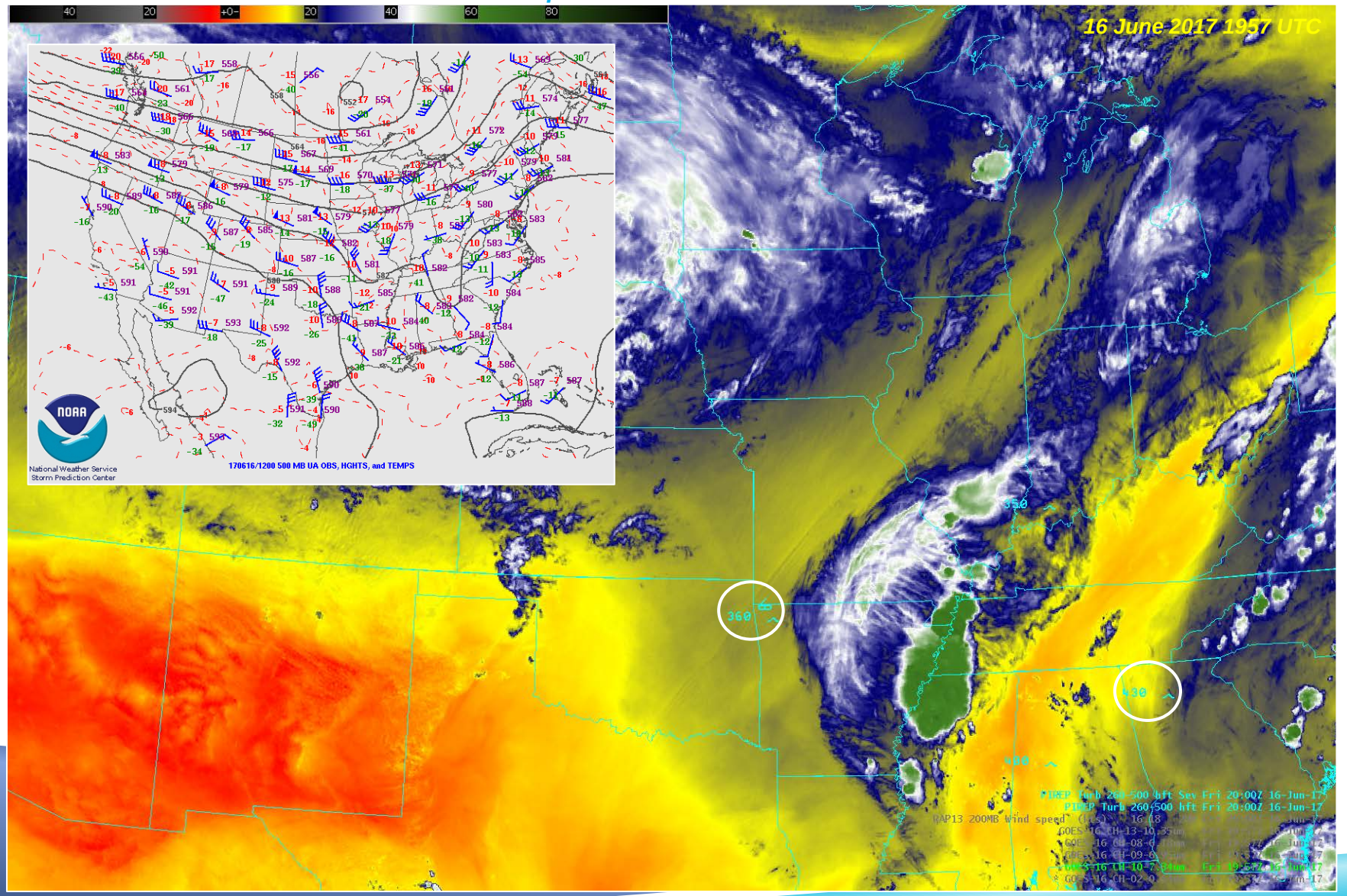
GOES-16 6.2 µm – UPPER-LEVEL WATER VAPOR



Courtesy of Chad Gravelle

IN-FLIGHT TURBULENCE

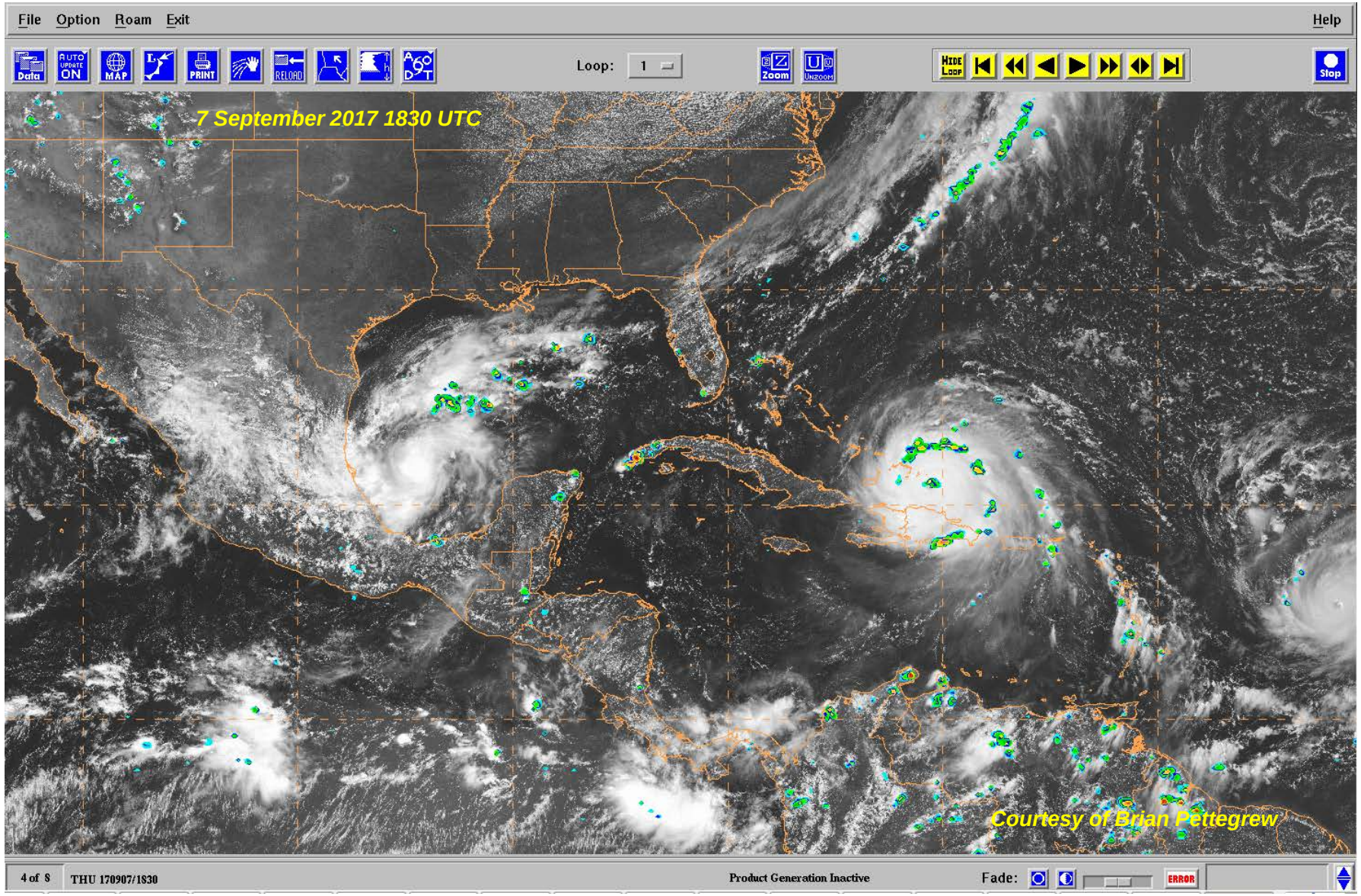
GOES-16 7.34 µm – LOW-LEVEL WATER VAPOR



Courtesy of Chad Gravelle

GEOSTATIONARY LIGHTNING MAPPER

- Exploring point vs gridded displays of GLM
- Exploring the advantages of satellite-based lightning detection over the tropics and other data sparse areas
- Exploring other possible GLM utilities



GOES-17 STATUS UPDATE

- ABI heating pipe system currently running in a degraded state
  - Affects the NIR and IR channels only; visible channels are unaffected
  - Impacts the NIR and IR and certain parts of the day when the sun is pointing at the satellite
- Troubleshooting
  - Engineering teams have been troubleshooting during the months of May and June, nearly complete
  - A statement will be issued to NWS within the next couple of weeks with the operational status and options
  - NWS then to determine how to proceed with PLTs, etc.
- In a nutshell
  - It is possible that GOES-17 will be able to be made operational in some sort of degraded state this fall/winter
  - Other contingencies will also be explored (satellite shuffle, etc.)

THANKS! QUESTIONS!

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