MAXIMIZING “Experience Index”

OF GIRO DATA SERVICES, WEB PORTAL, AND API

Ivan Galkin and LGDC team

UMass Lowell Space Science Laboratory
Lowell Digisonde International, LLC

LDI LOWELL DIGISONDE INTERNATIONAL

SSL UML SPACE SCIENCE LAB

22 SEPTEMBER PRE-FORUM SCIENCE DAY

IGF 2025

23-26 SEPTEMBER XVI INTERNATIONAL GIRO FORUM

Big question

- How do we get to your data?
  - Easy… or not.

Experience Index

- (*def*.) A *merit* system to identify the impact of design on user experiences
  - "great", "good", "not-so-good", "poor" experience
  - The merit system identifies key drivers for a great experience

The goal:
Build great GIRO services that keep people coming back.

How do we do that?

What do we all want?

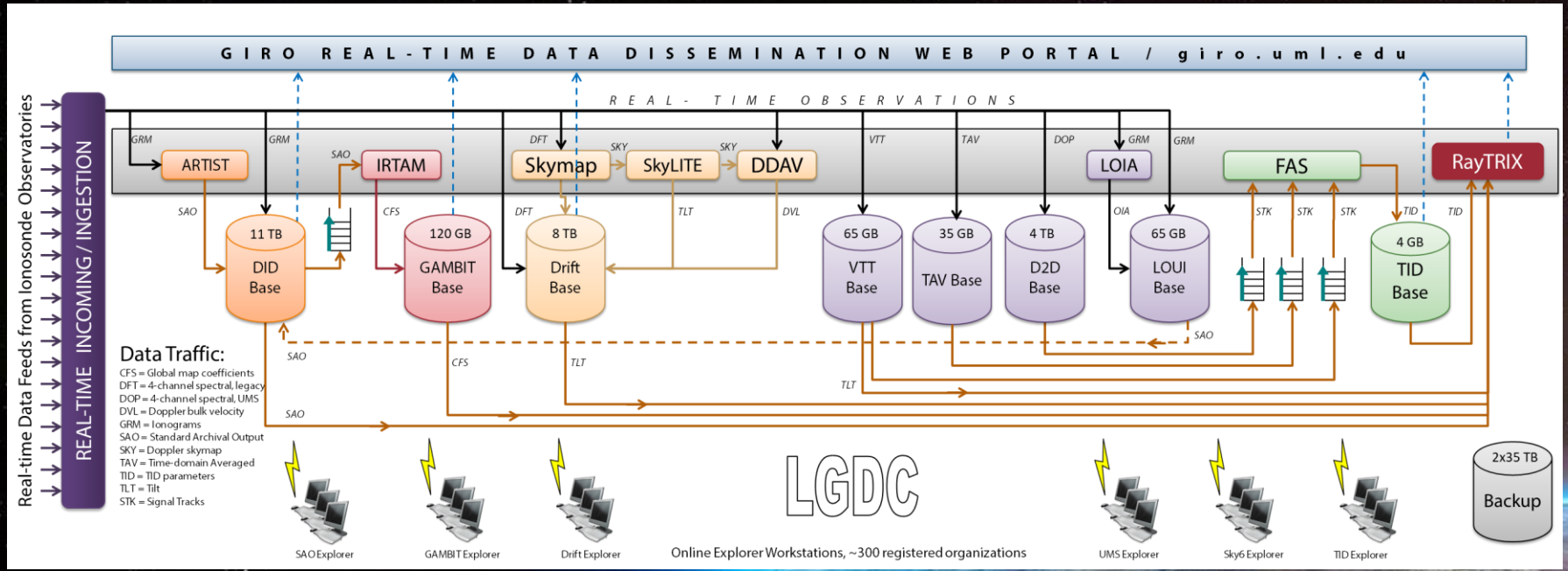
GIRO Users:

- Model ionosphere
- Study processes
- Locate relevant data
- Access data **quickly**
- Get good quality data
- Avoid format problems
- Avoid fighting computers
- Publish **quickly**
- Enjoy life

GIRO Crew:

- Enjoy life
- Make GIRO a powerful tool
- Cut development costs
- Cut maintenance costs
- Cut troubleshooting costs
- Cut documentation costs
- Cut computer HW costs
- Cut networking costs

Lowell GIRO Data Center: LGDC



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What do you want from LGDC?

YES PLEASE

- Search and locate relevant data
- Access data quickly
- Trust data quality

OH NO!

- Missing data
  - Incomplete data
  - Wondering if data are incomplete
- A long wait
- Unknown format
- Data errors
  - Autoscaling

What do we want from LGDC?

YES PLEASE

- Everything works without our supervision:
  - Ingestion
  - databasing
  - frontend servlets
  - real-time processors
  - backups

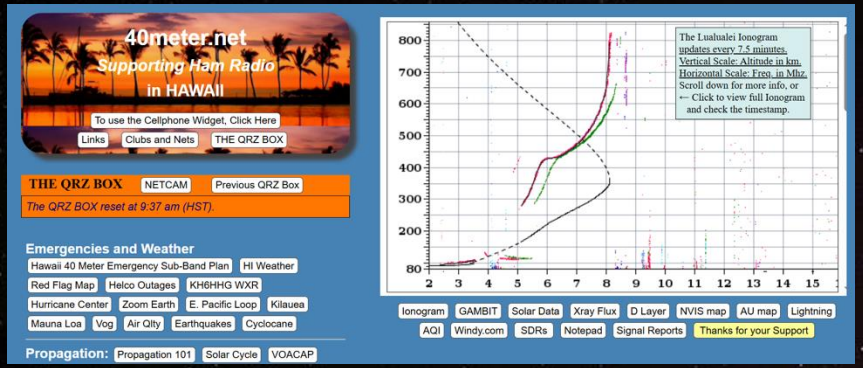
OH NO!

- Cyber-attacks
- Vulnerability prevention duties (upgrades)
- Online software crashes
- Computer failures

GIRO Web Portal, giro.uml.edu

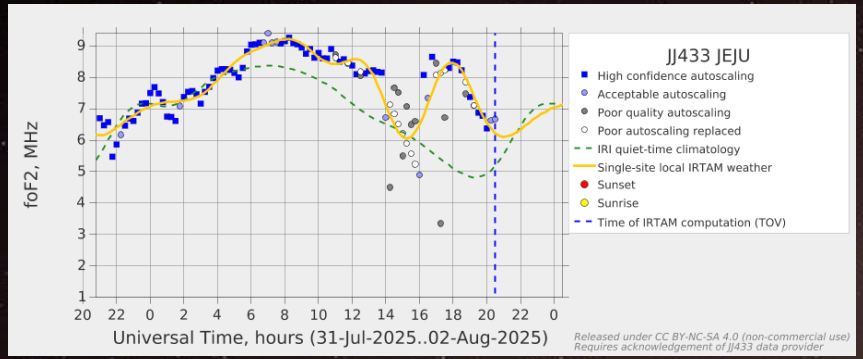
Success Story: *Latest* displays

Latest Local Ionogram



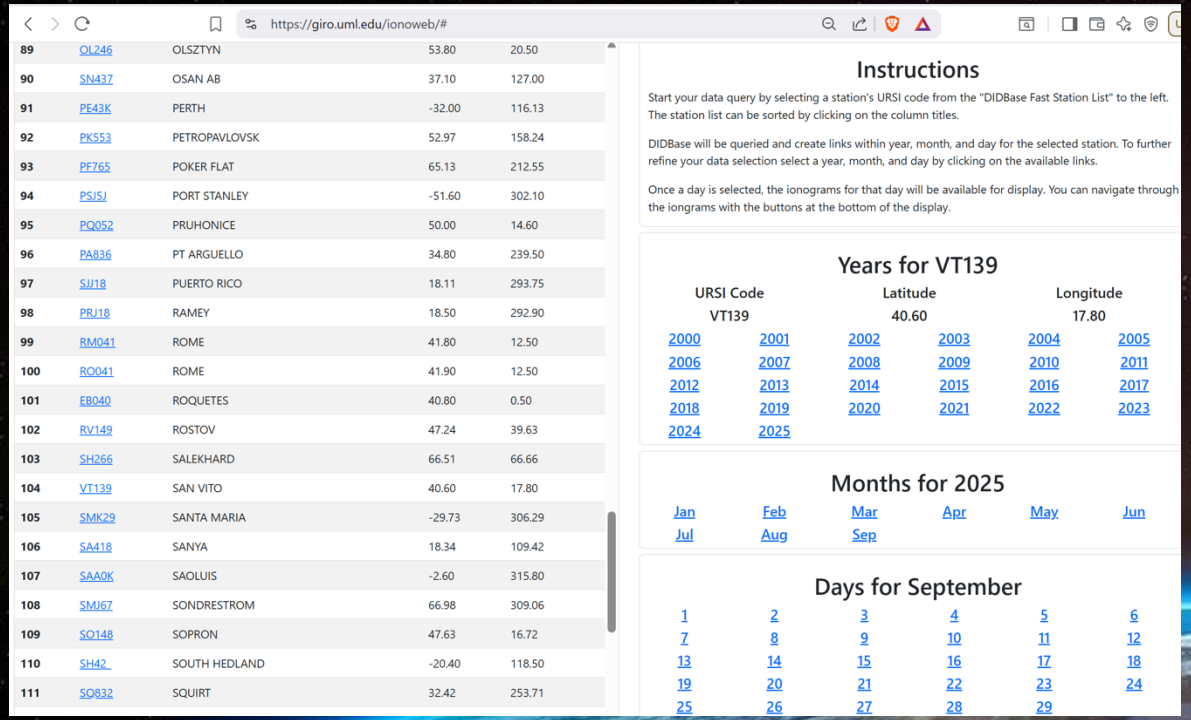
https://lgdc.uml.edu/ionoweb/latest?&ursiCode=LL721

Latest GAMBIT Local Weather



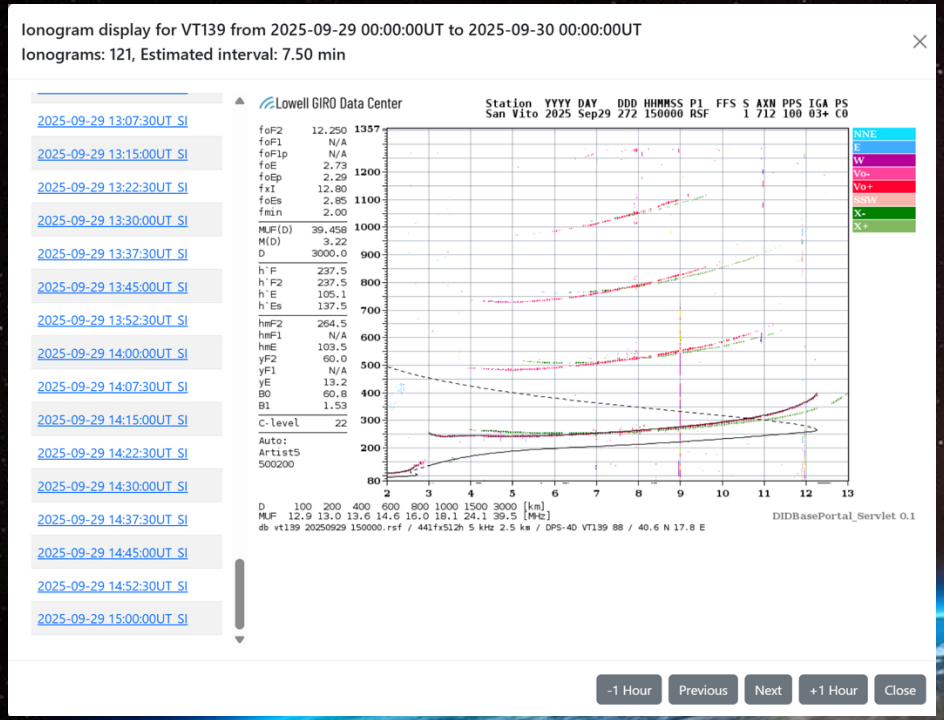
https://lgdc.uml.edu/rix/gambit-local-nowcast?charName=foF2&site=LL721

Success story: ionogram browser



The main source of DoS and DDoS

Success story: ionogram browser



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Ionogram viewer overuse

- Requests to plot an ionogram image coming in at unreasonable pace (<1 Hz)

```
joint@lgdc /var/log/nginx $ tail -f access.log | grep 109.252.119.212
109.252.119.212 - - [04/Aug/2025:21:06:07 -0400] "GET /ionoweb/ionoimage?ursiCode=CL424&mid=50630298&time=1996-07-28T06:44:58.000 HTTP/1.1" 200 50089 "-" "python-requests/2.25.1"
109.252.119.212 - - [04/Aug/2025:21:06:08 -0400] "GET /ionoweb/ionoimage?ursiCode=CL424&mid=50630299&time=1996-07-28T06:49:58.000 HTTP/1.1" 200 49729 "-" "python-requests/2.25.1"
109.252.119.212 - - [04/Aug/2025:21:06:10 -0400] "GET /ionoweb/ionoimage?ursiCode=CL424&mid=50630300&time=1996-07-28T06:54:58.000 HTTP/1.1" 200 49951 "-" "python-requests/2.25.1"
109.252.119.212 - - [04/Aug/2025:21:06:11 -0400] "GET /ionoweb/ionoimage?ursiCode=CL424&mid=50630301&time=1996-07-28T06:59:58.000 HTTP/1.1" 200 51072 "-" "python-requests/2.25.1"
109.252.119.212 - - [04/Aug/2025:21:06:12 -0400] "GET /ionoweb/ionoimage?ursiCode=CL424&mid=50630302&time=1996-07-28T07:04:58.000 HTTP/1.1" 200 49873 "-" "python-requests/2.25.1"
109.252.119.212 - - [04/Aug/2025:21:06:13 -0400] "GET /ionoweb/ionoimage?ursiCode=CL424&mid=50630303&time=1996-07-28T07:09:58.000 HTTP/1.1" 200 51621 "-" "python-requests/2.25.1"
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109.252.119.212 - - [04/Aug/2025:21:06:31 -0400] "GET /ionoweb/ionoimage?ursiCode=CL424&mid=50630318&time=1996-07-28T08:19:58.000 HTTP/1.1" 200 50774 "-" "python-requests/2.25.1"
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109.252.119.212 - - [04/Aug/2025:21:06:37 -0400] "GET /ionoweb/ionoimage?ursiCode=CL424&mid=50630322&time=1996-07-28T08:39:58.000 HTTP/1.1" 200 51343 "-" "python-requests/2.25.1"
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```

- These are robots of course, but built by clever humans
- There are 45,000,000+ ionograms, what are they thinking about?
  - It will take 2+ years per user to get images
  - There will be millions more ionograms in 2 years

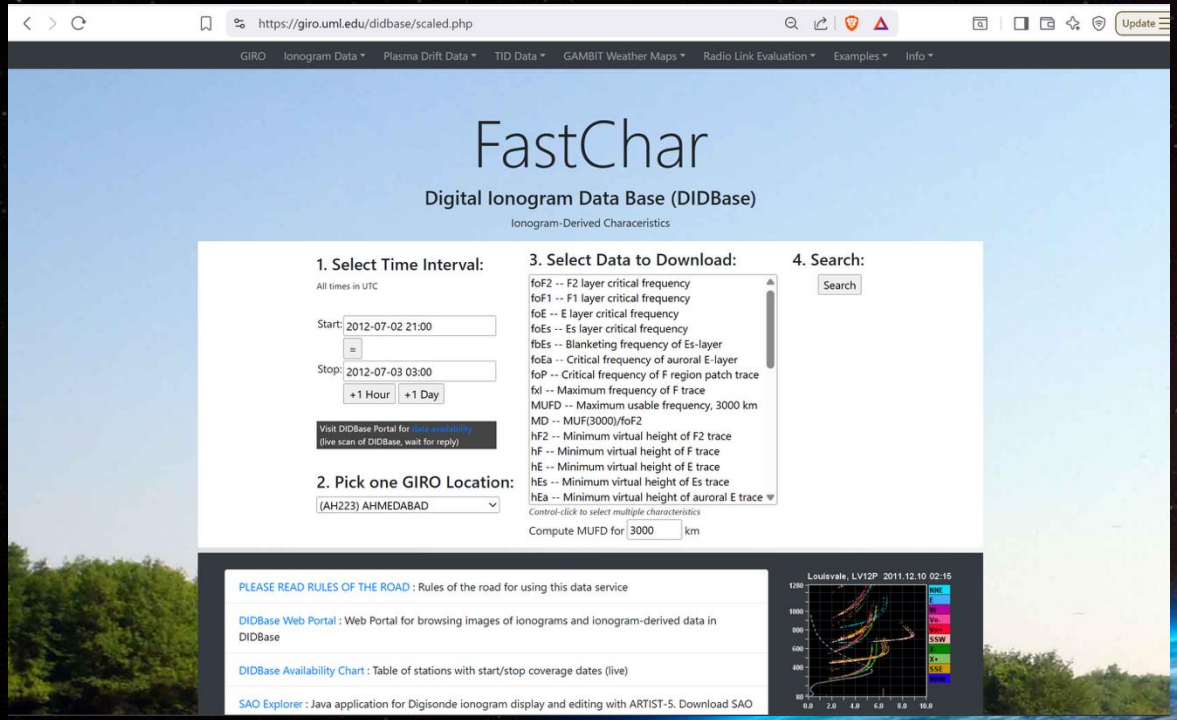
Data Avalanche at LGDC

- DIDBase (since 2001):
  - 45.0 million raw ionograms
  - 61.5 million SAO scalings
  - 1.3 billion FastChar values
- Hats off to Firebird DBMS

If process 200 ionograms/day, then ~800 work-years are needed to look at these ionograms

By that time, new millions of ionograms will be available to process

Success story: FastCar




```
# Global Ionospheric Radio Observatory
# GIRO Tabulated Ionospheric Characteristics, Version 1.0 Revision B
# Generated by DIDBGetValues on 2025-09-29T19:19:25.384Z
#
# Location: GEO 40.6N 17.8E, URSI-Code VT139 SAN VITO
# Instrument: Ionosonde, Model: DPS-4D
#
# Query for measurement intervals of time:
# 2025-09-29T00:00:00.000Z - 2025-09-30T00:01:00.000Z
#
# Data Selection:
# CS is Autoscaling Confidence Score (from 0 to 100, 999 if manual scaling, -1 if unknown)
# foF2 [MHz] - F2 layer critical frequency
# hmF2 [km] - Peak height F2-layer
#
# All GIRO measurements are released under CC-BY-NC-SA 4.0 license
# Please follow the Lowell GIRO Data Center RULES OF THE ROAD
# https://ulcar.uml.edu/DIDBase/RulesOfTheRoadForDIDBase.htm
# Requires acknowledgement of VT139 data provider
#
#Time                      CS   foF2 QD   hmF2 QD
2025-09-29T00:00:00.000Z  90  5.575 //  407.6 //
2025-09-29T00:07:30.000Z  95  5.525 //  393.5 //
2025-09-29T00:15:00.000Z  95  5.525 //  387.8 //
2025-09-29T00:22:30.000Z  95  5.500 //  382.7 //
2025-09-29T00:30:00.000Z  90  5.500 //  387.5 //
2025-09-29T00:37:30.000Z 100  5.425 //  388.4 //
2025-09-29T00:45:00.000Z  75  5.425 //  398.8 //
2025-09-29T00:52:30.000Z  95  5.375 //  395.5 //
2025-09-29T01:00:00.000Z  95  5.375 //  397.6 //
2025-09-29T01:07:30.000Z 100  5.350 //  391.3 //
2025-09-29T01:15:00.000Z  95  5.325 //  391.8 //
2025-09-29T01:22:30.000Z  90  5.325 //  396.7 //
2025-09-29T01:30:00.000Z 100  5.325 //  395.9 //
2025-09-29T01:37:30.000Z 100  5.250 //  386.8 //
2025-09-29T01:45:00.000Z  95  5.325 //  395.9 //
2025-09-29T01:52:30.000Z  90  5.300 //  389.7 //
2025-09-29T02:00:00.000Z  90  5.450 //  401.9 //
2025-09-29T02:07:30.000Z  95  5.400 //  379.8 //
2025-09-29T02:15:00.000Z  95  5.525 //  386.0 //
2025-09-29T02:22:30.000Z  95  5.575 //  384.9 //
2025-09-29T02:30:00.000Z  95  5.625 //  389.5 //
2025-09-29T02:37:30.000Z  90  5.650 //  379.0 //
2025-09-29T02:45:00.000Z  95  5.675 //  373.6 //
2025-09-29T02:52:30.000Z  95  5.700 //  367.0 //
2025-09-29T03:00:00.000Z  95  5.700 //  365.6 //
2025-09-29T03:07:30.000Z  75  5.675 //  353.5 //
2025-09-29T03:15:00.000Z  95  5.675 //  345.4 //
2025-09-29T03:22:30.000Z  90  5.650 //  336.3 //
2025-09-29T03:30:00.000Z  95  5.625 //  332.5 //
```

Experience index of LGDC Services

- How do we access data *better*?
  - Faster
  - More conveniently
- How do we have entire data?
  - LGDC to store *all* ionogram data ever collected by human civilization

Quick-access tools

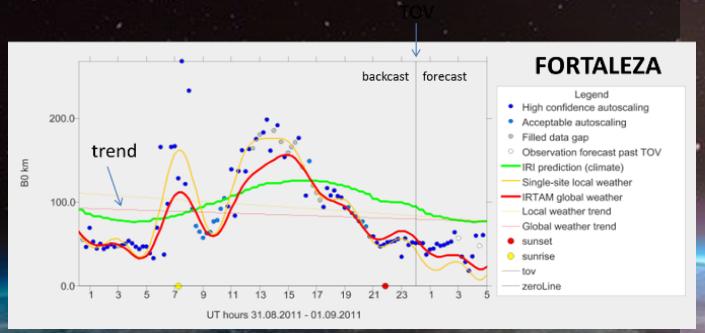
- SAO Explorer is not a quick access tool
- Quick access:
  - FastChar table in DIDBase
  - GAMBIT
  - Servlets/API
    - Various latest displays
- MUF Computations using ionograms and raytracers

MUF Computations

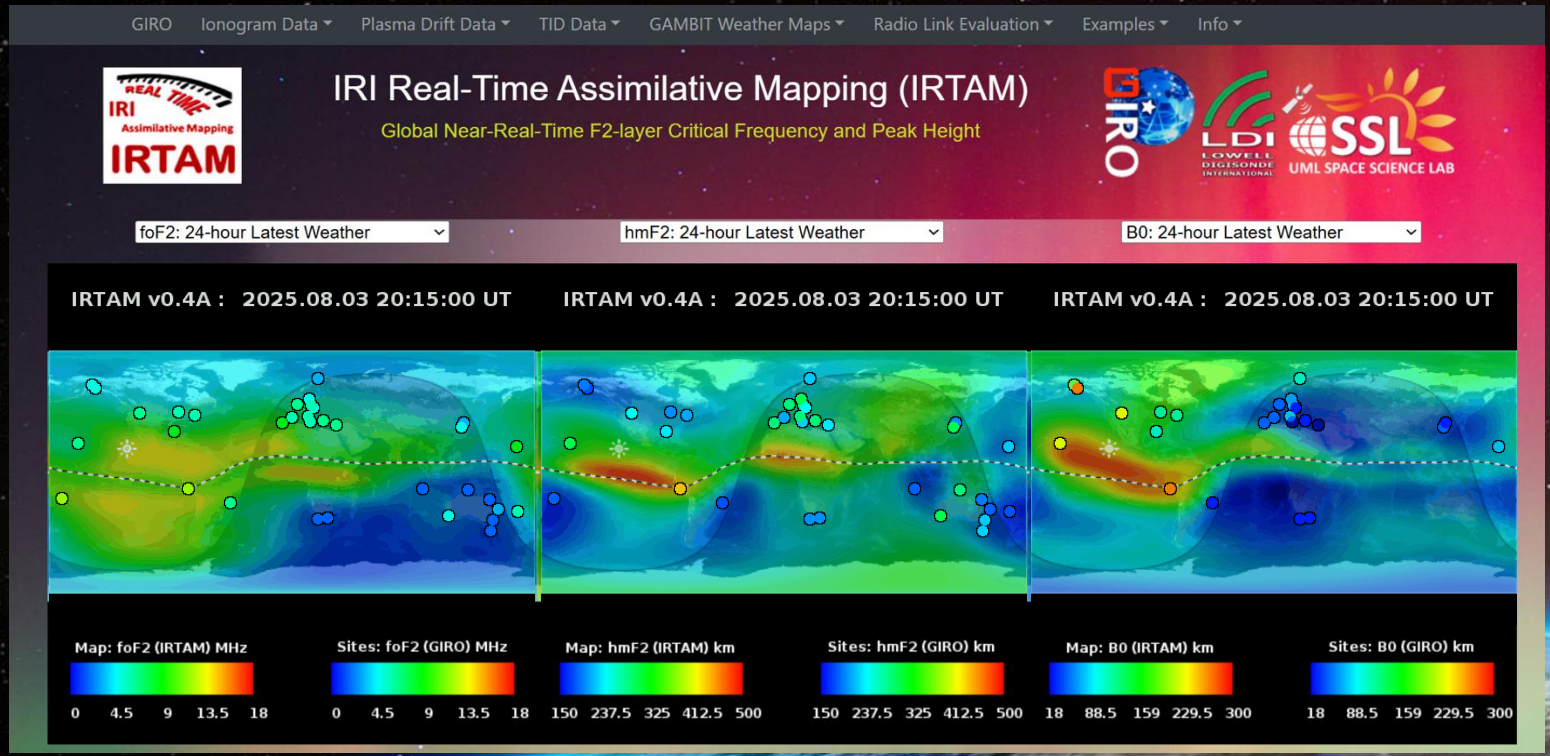
- Digisonde *.MUF files
- LGDC resources
  - MUF servlets (Digisonde sites, any D)
    - */fastchar/getmuf* servlet
    - *https://giro.uml.edu/rix/MUF/* landing page
  - GAMBIT MUF3000 (global map, IRTAM weather)
    - */rix/gambit-muf-message*
  - RayTRIX CQP (any radio link, 2-hop supported)
    - *https://giro.uml.edu/rix/oi-synth/*

Use GAMBIT instead of DIDBase

- Separate database from DIDBase
- Holds foF2, hmF2, B0, and B1 observations
  - 24-hour timelines per station
- Also, IRTAM(ss) coefficients
- Data access servlets available
  - global (needs authorization)
  - local for each site (..)



Not very popular: animated maps



https://giro.uml.edu/IRTAM

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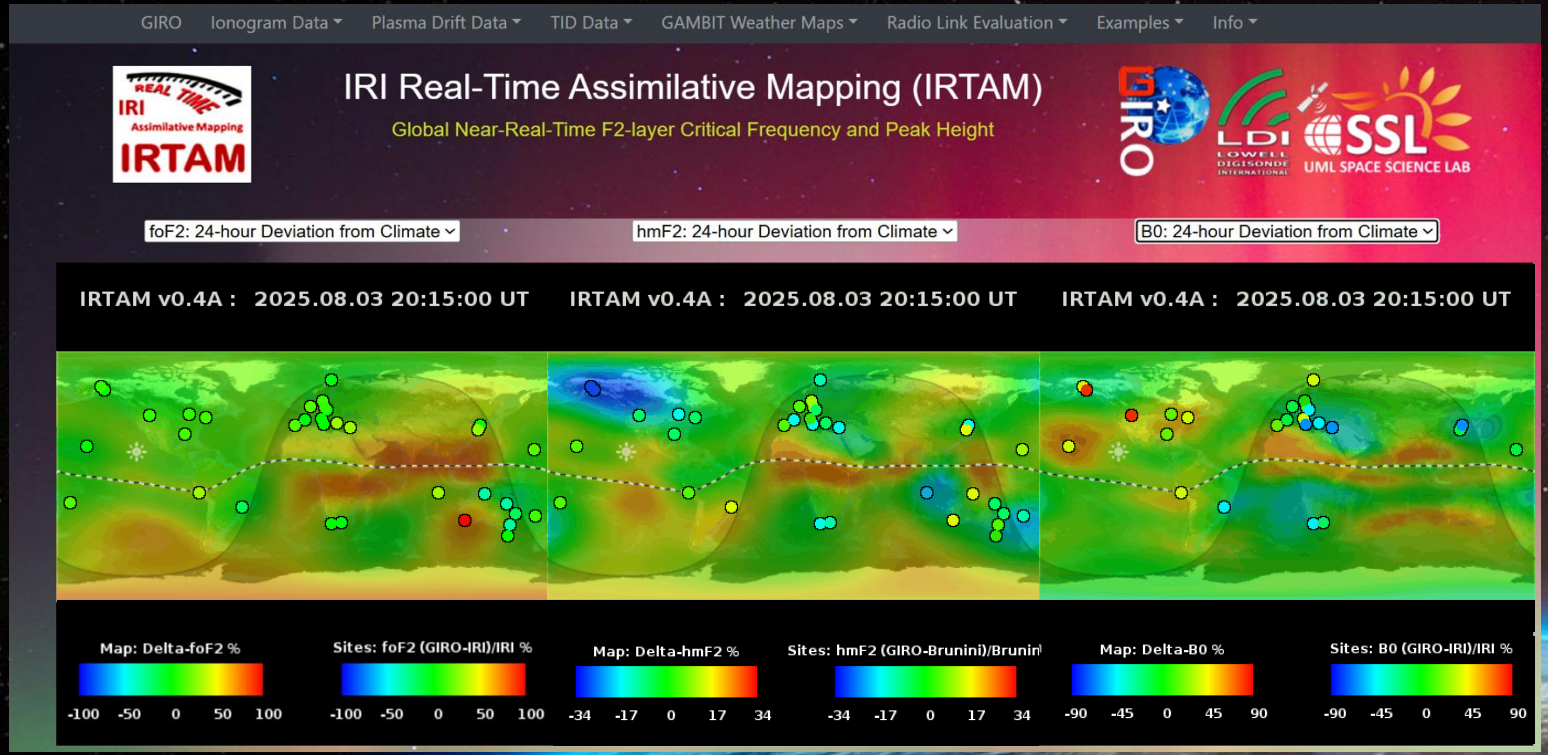
“Weather-minus-climate” maps



Use MUF(3000) instead of B0?


Dalu
감사합니다
Gracias
Danke
Ευχαριστίες
THANK YOU
obrigado
Köszönöm
Grazie
Спасибо
Dank
Tack
谢谢
Merci
ありがとう
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