### **GAMBIT Explorer User Guide**

by Artem Vesnin Editor Dr. Ivan Galkin

Space Science Laboratory University Massachusetts Lowell





#### Welcome to GambitX startup interface

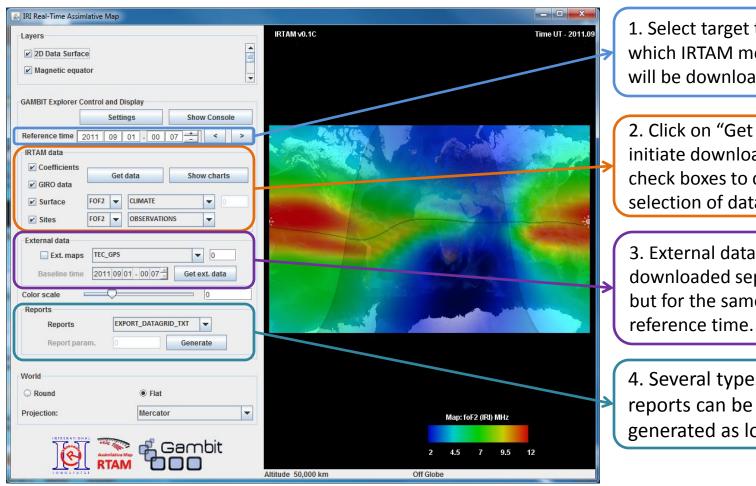
IRI Real-Time Assimlative Map	
Layers	IRTAM v0.1C Time UT - 2011.
✓ Magnetic equator	
GAMBIT Explorer Control and Display	
Settings Show Console	
Reference time 2011 09 01 - 00 07 - < >	
IRTAM data	
✓ Coefficients  Get data  Show charts	
✓ GIRO data	
✓ Surface F0F2 ✓ CLIMATE ✓	
✓ Sites FOF2 ✓ OBSERVATIONS ✓	
External data	
□ Ext. maps TEC_GPS   □ 0	
Baseline time 2011 09 01 - 00 07 = Get ext. data	
Color scale 0	
Reports	
Reports EXPORT_DATAGRID_TXT	
Report param. 0 Generate	
World	
○ Round ● Flat	
Projection: Mercator ▼	
	Map: foF2 (IRI) MHz
Gambit	
RTAM TOO	2 4.5 7 9.5 12
104075455	Altitude 50,000 km Off Globe

GAMBIT is a single frame application with all controls available on the main panel





#### Requesting data for display and reports



1. Select target time for which IRTAM model data will be downloaded.

2. Click on "Get Data" to initiate download. Use check boxes to control selection of data display.

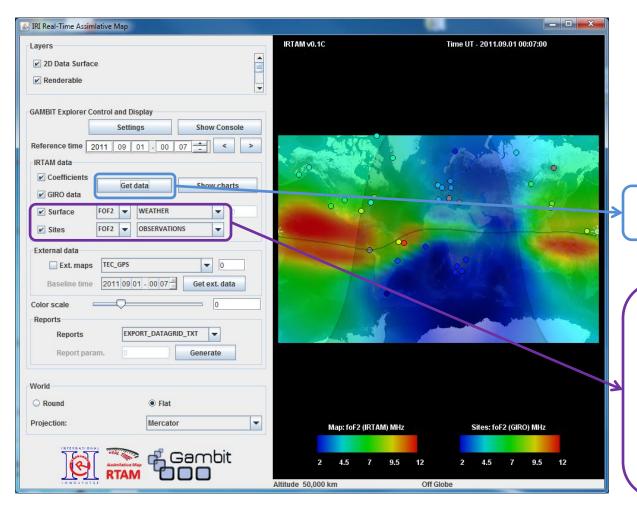
3. External data are downloaded separately, but for the same

4. Several types of data reports can be generated as local files





#### Data controls: Select IRTAM data for display



Make sure data are requested and downloaded.

Select an ionospheric characteristic from the list (foF2, hmF2 etc) and map type (CLIMATE for IRI, WEATHER for IRTAM, DELTA for differential maps showing difference between IRTAM and IRI).





# Data controls: Select external data for display [GPS TEC of Madrigal database]

Layers  2D Data Surface  Renderable	IRTAM v0.1C	Time UT - 2011.09.01 00:07:00
Settings Show Console  Reference time 2011 09 01 - 00 07 - < >  IRTAM data  Coefficients GIRO data Surface FOF2 WEATHER Sites FOF2 OBSERVATIONS  External data  External data  Color scale Reports Reports Reports Report param.  Generate		
World  Round  Projection:  Mercator	Map: GPS TE 0 4.5 9	
RTAM Gambit	Altitude 50,000 km Off Glo	be

Download external data from other sources for comparison studies and validation. Note that these external data resources are not assimilated by IRTAM.





#### Select background information

IRI Real-Time Assimlative Map	
Layers  ✓ 2D Data Surface  GPS TEC map (delta)	IRTAM v0.1C Time UT - 2011.09.01 00:07:00
GAMBIT Explorer Control and Display  Settings Show Console  Reference time 2011 09 01 00 07	
World  ○ Round  ● Flat  Projection:  Mercator  ▼	Map: foF2 (IRTAM) MHz Sites: foF2 (GIRO) MHz
RTAM Gambit	2 4.5 7 9.5 12 2 4.5 7 9.5 12  Altitude 50,000 km Off Globe

Specify which layers you want to be displayed to optimize visualization.
The number of available layers is dynamic and different for different selection of data.





#### Optimization of Color Mapping

DD Data Surface  GPS TEC map (delta)  MBIT Explorer Control and Display  Settings Show Console  ference time 2011 09 01 - 00 07 - < >  TAM data  C Coefficients Get data Show charts  GIRO data  Surface FOF2 WEATHER	
Data Surface  GPS TEC map (delta)  MBIT Explorer Control and Display  Settings Show Console  ference time 2011 09 01 - 00 07 -	
MBIT Explorer Control and Display  Settings Show Console  ference time 2011 09 01 - 00 07 - < >  TAM data  Coefficients Get data Show charts  GIRO data  Surface FOF2 WEATHER	
Settings Show Console  ference time 2011 09 01 - 00 07 -	
ference time 2011 09 01 - 00 07 - >  TAM data  Coefficients Get data Show charts  GIRO data  Surface FOF2 WEATHER	
TAM data  C Coefficients Get data Show charts GIRO data  Surface FOF2 WEATHER	
✓ Coefficients ✓ GIRO data ✓ Surface  FOF2 ✓ WEATHER ✓	
Get data  Show charts  Girlo data  Surface  FOF2   WEATHER   O	
Sites FOF2  OBSERVATIONS	
cternal data	
Ext. maps DELTA_TEC_GPS	
Baseline time 2011 08 31 - 00 07 ± Get ext. data	
lor scale 0.0	
eports	
Reports LONG_SLICE ▼	
Enter Longitude 0 Generate	
orld	
Round    Flat	
ojection: Mercator 🔻	Map: foF2 (IRTAM) MHz Sites: foF2 (GIRO) MHz
INTERNATIONAL	
Gambit Gambit	2 4.5 7 9.5 12 2 4.5 7 9.5 12
RTAM CO	Altitude 50,000 km Off Globe

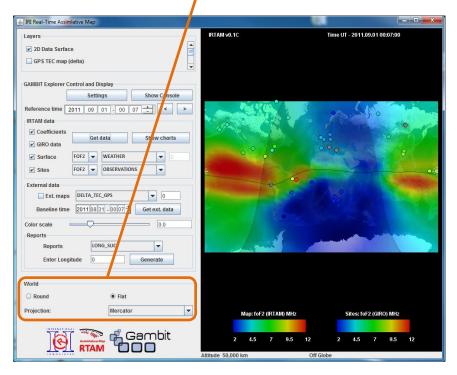
Manually changing of color scale is useful when automatically defined color codes are saturated and do not represent some fine details.

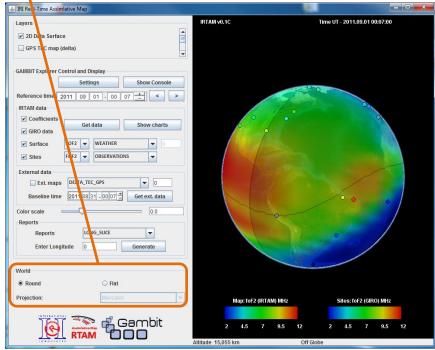




#### **World Display Options**

Select the globe appearance (Flat and Round) and projection (Mercator, Lat-Lon and etc.).









#### Zoom in for greater detail

Layers	IRTAM vo.1C		
✓ 2D Data Surface			
2D Data Surface		ALL STATES	12.
GAMBIT Explorer Control and Display			h 13
Settings Show Console			1
Reference time 2015 03 18 - 00 07 - < >			
IRTAM data			
Coefficients  Get data  Show charts			
✓ GIRO data		•	
✓ Surface HMF2 ▼ DELTA ▼ 0			
✓ Sites			
External data			
■ Ext. maps TEC_GPS ■ 0			
Baseline time 2011 09 01 - 00 07 Get ext. data	•		
Color scale -0.3			
Reports			
Reports EXPORT_DATAGRID_TXT ▼			
Report param. Generate			100
World			
○ Round ● Flat			
			A
Projection: Mercator			
INTESNATIONAL MAN			
Gambit		Map: hmF2 (IRTAM-Brunini) km	sites: hmF

Use mouse drag and mouse wheel to navigate and zoom in the world display

Keyboard command are also available (arrows and page up and down)

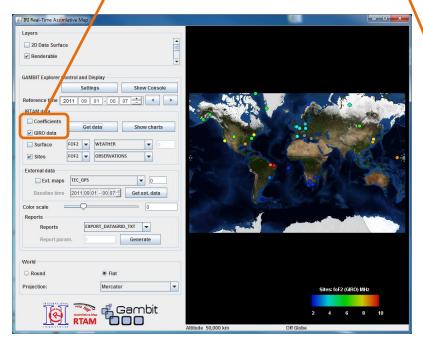


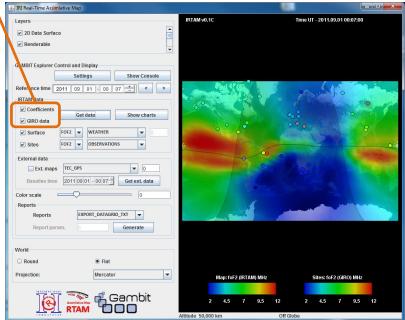


#### **Optimize Data Access**

#### Partial data downloads for faster access

For faster download: uncheck data products that you do not need for analysis. Note the different selection results.





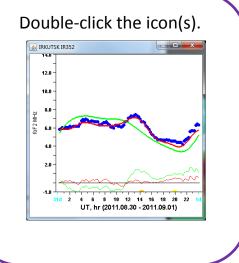




## Data controls: IRTAM data. Explore source data used for assimilative maps

RI Real-Time As <mark>siml</mark> ative M ayers			IRTAM v0.1C		Time UT - 201	1.09.01 00:07:00	
Report's icons		<u> </u>					
2D Data Surface		-					
AMBIT Explorer Control a	nd Display			J			
S	ettings	Show Console	1	1	10	YN	
eference time 2011	9 01 - 00 07	- < >	A CONTRACTOR OF THE PARTY OF TH	1Co	3	A Property of	J
RTAM data					111	in the	
<b>☑</b> Coefficients	Get data	Show charts	in the street		1		No.
✓ GIRO data	oot duta	one we charte	1		61		
Surface FOF2	WEATHER	V 0		All			1/2
✓ Sites FOF2	OBSERVATIONS		€ 1°C	EIC			-
External data				179	1/2		
Ext. maps TEC_0	iPS	▼ 0	/	10	10		
Baseline time 2011	09 01 - 00 07	Get ext. data		100			
olor scale	<del>-</del>	0		•			
Reports				1		-	
Reports	EXPORT_DATAGRID_	TXT ▼	1				
Report param.	0	Generate					
orld							
Round	Flat						
rojection:	Mercator	-	Map: foF2 (IRT	AM) MHz	Sitos	foF2 (GIRO) MHz	
			Wap. 10F2 (IK1	ANN) WITZ	sites:	or 2 (diko) MH2	
INTERNATIONAL	🔊 🕰 G8	embit	2 45 7	05 12	2 45	7 05	-12
Assimi	lative Map		2 4.5 7	9.5 12	2 4.5	7 9.5	12

Inspect differences
between GIRO
observations and IRI
prediction at individual
locations. Observe
assimilation results
restored from the global
map at each GIRO site.







### Data controls: IRTAM data. Geographical functions

IRI Real-Time Assimlative Map	IRTAM v0.1C	Time UT - 2011.09.01 00:07:00
Layers	TTAIN CO. TO	11110 01 - 2011103.01 00.01.00
✓ 2D Data Surface     ☐ Renderable     ✓		
GAMBIT Explorer Control and Display		
Settings Show Console		
Reference time 2011 09 01 - 00 07 - < >		
Coefficients Get data Show charts		
✓ Surface FOF2 ▼ GK ▼ 39		
Ext. maps   TEC_GPS   0    Baseline time   2011 09 01 - 00 07   Get ext. data		
Color scale 0		
Reports		
Reports EXPORT_DATAGRID_TXT ▼  Report param.		
World		
○ Round ● Flat		
Projection: Mercator	Map: GK	
Gambit	-0.6 -0.3 0 0.3 0.	6
RTAM	Altitude 50,000 km	Off Globe

Inspect spatial expansion functions ("geographic" functions Gk by Jones and Gallet) that optimize representation of the ionospheric characteristics in both geographic and geomagnetic field frames.

Enter the geofunction index k (from 0 to 75) in the text field to visualize Gk.







ayers	IRTAM ∨0.1C	Time UT - 2011.09.01 00:07:00
2D Data Surface		
Renderable	•	
AMBIT Explorer Control and Display		
Settings Show Conso	le	
Reference time 2011 09 01 - 00 07 -	> (WC	
IRTAM data		
Coefficients  Get data  Show charts		
GIRO data		
Surface FOF2 ▼ WEATHER ▼ 0	Sec. 30.00	
☐ Sites FOF2 ▼ OBSERVATIONS ▼		
External data		
Ext. maps		1988 ASS 100 M
Baseline time 2011 08 31 - 00 07 + Get ext. data		
Color scale -0.5		Sept 1
Reports		Carried March 1997
Reports EXPORT_DATAGRID_TXT ▼		
Report param. 0 Generate		
	GF	PS TEC delta ( - 2011.08.31 00:07:00 ), TECU
Vorid		
Round • Flat		-10 -5 0 5 10
Projection: Mercator		
INTEGRATIONAL		
Gambit		
RTAM TO D	Altitude 50,000 km	Off Globe

Plotting differential TEC maps is possible for comparisons with differential IRTAM "DELTA" displays.

The differential TEC maps are computed using TEC values taken at user-defined baseline time (presumably a quiet day). TEC values at baseline time are subtracted from TEC data at target time.

Note that target time is specified in the main window above.





#### Data controls: Reports.

IRI Real-Time Assimlative Map		
Layers  ✓ 2D Data Surface  Renderable	IRTAM v0.1C	Time UT - 2011.09.01 00:07:00
Settings Show Console  Reference time 2011 09 01 - 00 07 - < >  IRTAM data  Coefficients  GIRO data  Surface  Sites  FOF2 WEATHER  Sites  FOF2 OBSERVATIONS  External data  Ext. maps  Baseline time 2011 08 31 - 00 07 - Get ext. data  Color scale  Reports		
Reports LONG_SLICE   Enter Longitude 0 Gene Calculates longitudi in the text box below	nal slice; longitude should be specified . See file output/LonSlice	
World  Round  Projection:  Mercator  Mercator	Map: foF2 (IRTAM) MHz	12
1040224325	Altitude 50,000 km	Off Globe

Reports are useful to export data in different formats. Every report has a tool-tip descriptive information that pops up when the mouse pointer is placed on top of the report title in the menu. Report generation may requires a user parameter specified it in the text field.

Click *Generate* button to generate the report.





#### Other Settings

IRI Real-Time Assimlative Map	
Layers	IRTAM v0.1C Time UT - 2011.09.01 00:07:00
✓ 2D Data Surface	
GPS TEC map (delta)	
GAMBIT Explorer Control and Display	
Settings Show Console	Part of Co.
Reference time 2011 09 01 - 00 07 -	
✓ Coefficients	
Get data Show charts	③ Time interval
✓ Surface FOF2 ✓ WEATHER ✓	The interval
✓ Sites FOF2 ▼ OBSERVATIONS ▼	□ foF2 min 2.0 □ foF2 max 12.0 □
External data	☐ hmF2 min 200.0 ☐ hmF2 max 500.0
Ext. maps DELTA_TEC_GPS   ▼ 0	☐ TEC min 0.0 ☐ TEC max 60.0
Baseline time 2011 08 31 - 00 07 ± Get ext. data	✓ Delta foF2 min -3.0 ✓ Delta foF2 max 3.0
Color scale 0.0	✓ Delta hmF2 min -100.0 ✓ Delta foF2 max 100.0
Reports  Reports  LONG_SLICE  ▼	✓ Delta TEC min -20.0 ✓ Delta TEC max 20.0
Enter Longitude 0 Generate	☐ Buffer size(days)
Eliter Longitude   5	Ok Cancel
World	
○ Round	
Projection: Mercator	Map: foF2 (IRTAM) MHz Sites: foF2 (GIRO) MHz
INTERNATIONAL	
Gambit Gambit	2 4.5 7 9.5 12 2 4.5 7 9.5 12
INDICATE REPORT OF THE PROPERTY OF THE PROPERT	Altitude 50,000 km Off Globe

Push **Settings** button to access different display and usability settings.
Pop-up information explains what this setting affects. If checkbox is unchecked this means that the value for this setting is calculated automatically.