



# TECHNICAL MEMORANDUM

## GAMBIT Data Access Protocol Data Model and Format of *IRTAM Coefficients* Message

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**Project:** Realistic Ionosphere

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**From:** Ivan Galikin (GIRO)

### SCOPE

This document describes data model and format of the *IRTAM Coefficients* message produced by GAMBIT Explorer MasterApp software and *Realistic Ionosphere* web portal.

The IRTAM Coefficients message contains coefficients of a single IRTAM computation for a particular ionospheric characteristic and *time of validity* (TOV). Currently two flavors of IRTAM computation are supported:

- Standard: 1064 coefficients of the IRTAM-2016 trending analyzer (NECTAR v0.2 and up)
- Legacy: 988 coefficients of the IRTAM-2012 IRI-compatible analyzer (NECTAR v0.1)

### TWO EXPANSION FORMALISMS IN IRTAM

#### Legacy Expansion

The legacy 988-coefficient computation results produced by NECTAR 0.1 are stored in the GAMBIT database for comparisons with later releases of NECTAR. Both legacy and standard Jones-Gallet bases, in their general representation, combine two expansions, (1) over the *diurnal* basis  $D_i$ , and (2) over the *geographic* basis  $G_k$  [ITU-R, 2009], <http://www.itu.int/rec/R-REC-P.1239/en>. The resulting dual expansion defines a global Day In The Life (DITL) of a characteristic  $P$  as a function of time  $t$  and geographic location  $(\lambda_G, \phi_G)$ :

$$P(t, \lambda_G, \phi_G) = \sum_{i=0}^{N_i} \sum_{k=1}^{N_k} c_{ik} D_i(t) G_k(\lambda_G, \phi_G) \quad (1)$$



The legacy diurnal expansion over  $D_i$  basis describes only one DITL as function of time-of-day angle  $T$  that changes from  $-180^\circ$  to  $+180^\circ$  over the course of a day from 0 to 24UT, using the Fourier harmonics of 6<sup>th</sup> order and a constant term  $a_0$ :

$$P(t, \lambda_G, \phi_G) = a_0(\lambda_G, \phi_G) + \sum_{i=1}^6 \{a_i(\lambda_G, \phi_G) \cos iT + b_i(\lambda_G, \phi_G) \sin iT\} \quad [\text{legacy}] \quad (2)$$

$$T[^\circ] = 15 \cdot t_{DITL} - 180, \quad t_{DITL} = HH + \frac{mm}{60} + \frac{ss}{3600} [h] \quad (3)$$

This DITL description is the same for any day:  $T$  smoothly wraps to the next or previous day over the midnight (UT=0), and the same description (2) repeats to any time  $t$  from  $-\infty$  to  $+\infty$ .

The 13 coefficients in Eq. (2) are in turn functions of the geographic and geomagnetic coordinates:

$$\begin{aligned} a_n &= a_n(\lambda_G, \phi_G; \lambda_M, \phi_M), \quad n = 0, 1, 2, \dots, 6 \\ b_n &= b_n(\lambda_G, \phi_G; \lambda_M, \phi_M), \quad n = 1, 2, \dots, 6 \end{aligned} \quad (4)$$

$$\begin{cases} a_n \\ b_n \end{cases} = \sum_{k=1}^8 \sum_{j=0}^{J(k)} \left( c_{njk} [\sin \chi(\lambda_M, \phi_M, \phi_G)]^j [\cos \lambda_G]^k \begin{cases} \cos k\phi_G \\ \sin k\phi_G \end{cases} \right)$$

where  $\chi$  is the modified dip latitude (modip) that depends on the true magnetic dip angle  $I(\lambda_M, \phi_M)$ :

$$\chi(\lambda_M, \phi_M, \phi_G) = \tan^{-1} \frac{I(\lambda_M, \phi_M)}{\sqrt{\cos \phi_G}} \quad (5)$$

Total number of legacy coefficients is  $13 \times 76 = 988$ .



The spatial expansion is identical for both legacy and standard IRTAM formalisms



The legacy coefficient sets cannot be accessed via Realistic Ionosphere portal at LGDC; the *IRTAM Coefficients* messages holding 988 coefficients are available only within GAMBIT Explorer MasterApp environment (as a coefficient export function)

## Standard Expansion

The standard 1064-coefficient expansions in IRTAM-2016 introduce additional term  $b_0 t$  in the diurnal expansion to describe the linear trend of the characteristic P over the 24-hour interval prior to TOV:

$$P(t, \lambda_G, \phi_G) = a_0(\lambda_G, \phi_G) + b_0(\lambda_G, \phi_G)t + \sum_{i=1}^6 \{a_i(\lambda_G, \phi_G) \cos iT + b_i(\lambda_G, \phi_G) \sin iT\} \quad [\text{standard}] \quad (6)$$

which results in additional 76 coefficients in the IRTAM-2016 set ( $14 \times 76 = 1064$ ). This diurnal representation of P does not smoothly wrap to the next or previous day because of the new  $b_0 t$  term.



The IRTAM-2016 formalism is better suited for descriptions of the ionospheric weather variability as it does not enforce repeatability of a single DITL along the time axis.

## DATA MODEL OF IRTAM COEFFICIENTS MESSAGE

Figure 1 describes the data model of IRTAM Coefficients in both legacy and standard versions:

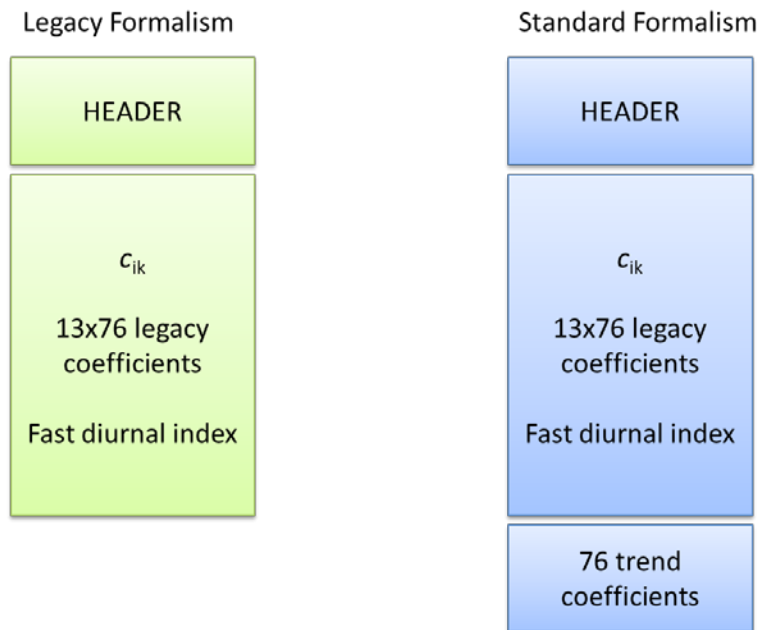


Figure 1: Data model of Legacy and Standard IRTAM Coefficients message.

## DATA FORMAT OF IRTAM COEFFICIENTS MESSAGE

### General Description

The IRTAM Coefficients message is a plain text document.

### Header

All header lines in the message are preceded by a hashtag symbol # as the first character of the line.

The header section begins with the **#START\_HEADER** line and ends with **#END\_HEADER** line in order for an easier identification of the data section beginning using standard Fortran language means.

All items of the header are supplied with descriptive text. The header includes:

- Identifier of the message content
- Version of the software that produced the message
- Timestamp of message generation in ISO format
- Name of the characteristic
- Time of Validity
- Description of the assimilation algorithm
  - Name and version of the assimilation engine
  - Size of the Earth Grid used in assimilation
  - Type of the expansion basis and basis dimension
- List of ionosondes that provided data for the assimilation



## Legacy Coefficients

13x76 = 988 coefficients of the original Jones-Gallet expansion (**excluding** the trend term coefficient set of  $b_0$ ) are stored first. The two-dimensional array of cij coefficients is output with the fast index of the diurnal expansion (1-13) and slow index of the spatial expansion (1-76). Each line of text contains **4 coefficients** in the format **4F16.8**.

## Standard Coefficients

For IRTAM Coefficients message holding standard expansion of IRTAM-2016, the additional section in the message holds remaining 76 coefficients of the linear trend term  $b_0$  in the expansion in the same format 4F16.8 per line.



The standard expansion message contains the following description of the basis in the header:

```
# Expansion Basis: JonesGallet_LinTrend  
# Basis Lengths: 14(temporal) x 76(spatial)
```

The legacy expansion message contains

```
# Expansion Basis: JonesGallet  
# Basis Lengths: 13(temporal) x 76(spatial)
```

## REFERENCES

ITU-R, International Telecommunications Union (2009), ITU-R reference ionospheric characteristics, *Recommendation P.1239-2 (10/2009)*. Retrieved from <http://www.itu.int/rec/R-REC-P.1239/en> on January 25, 2017.



## APPENDIX A. Example of Standard IRTAM Coefficients Message

```
# START_HEADER
# GLOBAL IONOSPHERE RADIO OBSERVATORY (G.I.R.O.)
# giro.uml.edu
#
# IRI-based Real-Time Assimilative Model (IRTAM)
#
# IRTAM Coefficients of Temporal-Spatial Expansion
# Generated by GambitCoefficients V0.1a on 2017-01-25T18:27:31.588Z
# Ionospheric Characteristic: B1 []
# Time of Validity 2016-12-01T10:00:00.000Z
# Assimilative Engine: NECTAR v0.2A
# Earth Grid: 46 lats x 45 lons
# Expansion Basis: JonesGallet_LinTrend
# Basis Lengths: 14(temporal) x 76(spatial)
# Assimilated stations:
# END_HEADER
  1.00889541      0.02573597      0.03623349      -0.04908125
 -0.04824644      0.01171696      0.00861741      -0.01444465
  0.02066342      0.00913024      0.05954658      0.01969484
  0.01145611     -0.01782978      0.36500581      0.45777865
 -0.04915480      0.20113193      0.01003894      0.10399627
 -0.12637600      0.05096561     -0.02714309      0.07599890
 -0.03636936      0.12274754      1.63976680     -0.22955162
 -0.39738528     -0.68450362     -0.10117575     -0.21813210
 -0.42623684     -0.11570896      0.14280397     -0.00930170
 -0.08487274      0.58121628     -0.14238221     12.36794832
 -1.42960535     -2.99737198     -1.09544677     -3.56641852
 -2.20915402     -1.22777486      1.92895897     -0.73379502
  0.79026849      0.62244634      1.72327690     -1.54081006
 -21.14149355      0.10439302     -1.77801961      6.48362197
  4.00084762      2.40372123      2.75538315      0.19447202
 -0.95419346     -0.25245969     -0.99383880     -5.07913661
  1.22817480     -83.99267350      4.30347095     19.07745059
  8.70456266     18.51583230     13.55108665      7.36246241
 -10.58187448      3.83806125     -3.06737369     -6.42412592
 -11.16801201      9.21938196     79.63177821      1.99797696
  3.42030979     -17.68528360    -14.72871984     -9.04237924
 -6.87800809      0.33407638      2.49433784      1.54957829
  3.57295856     14.56838386     -3.77348924     218.60038537
 -9.25116034     -52.28526666    -21.64442340    -39.83421855
 -29.77834144    -19.58673658     22.28834408     -8.08647420
  3.93686620     18.07967029     28.13466536    -21.05710913
 -108.09667818    -3.82733891      1.04527967     19.24499806
  19.02732705     12.02029717      7.37770138     -0.60110275
 -2.84358117     -2.32984638     -4.08876724    -16.63568337
  4.29874464     -234.34882400      9.75876267     58.43359334
  22.09819585     38.27694136     27.75055734     22.21408515
 -19.79297671      7.48350964     -1.35645293    -20.15113747
 -30.05992334     19.93190345     47.07716331      1.96023162
 -2.32414121     -7.30417268     -8.13268800     -5.17430513
 -2.82926024      0.20329129      1.14456534      1.03775280
  1.53425278      6.54178891     -1.62241349     87.48076855
 -3.72961845     -22.68181857     -8.00868306    -13.57655207
```



-9.31765191	-8.86751512	6.28340270	-2.55061353
-0.27667698	7.80340431	11.40787005	-6.67574872
0.24342135	-0.21376594	-0.32608348	0.09684327
-0.03073636	0.15045912	-0.01494644	-0.00160677
-0.00099335	-0.08669202	-0.04709285	-0.06439934
0.00639591	-0.02223018	0.28625986	0.22603204
-0.10072188	0.08684644	-0.10644725	0.06667431
-0.04670608	-0.01591574	0.04480991	0.08216876
0.03974986	0.01602682	-0.58273406	0.42370363
0.48463247	0.08703428	0.21675272	0.04450090
0.12285368	-0.02735159	0.13507725	-0.00455304
-0.15218471	-0.10823775	0.12591723	0.75787000
0.17952616	0.29985698	-0.29960441	0.09507595
0.05103444	0.07274593	-0.04972015	0.06805441
-0.02088775	0.06967488	-0.03546818	0.12707310
1.94427225	-0.14054753	-2.10424591	-1.39130487
-1.42305520	-0.99239031	-0.31548631	0.11156218
0.07102501	0.24913759	-0.48058908	0.43615738
-0.20600575	-2.90587034	1.16488135	0.34571409
0.26355952	-0.36511610	0.51181801	0.22007423
0.20335360	0.05555205	-0.38429132	0.51338536
-0.29265245	-0.05906377	-7.51522820	-8.02759066
-10.56446940	-0.73339403	-5.77454776	-1.17019010
-3.59359147	0.50688471	-2.91478324	-1.11110000
1.88468235	1.26468792	-1.69244147	0.31227147
1.03985016	-2.00713149	3.19724471	-2.46252330
-0.10553289	-0.98335882	-1.42531044	-1.31781856
0.98686924	1.21074377	0.82303993	-2.35788255
-6.48679580	2.94748536	17.98906724	12.54443860
16.94082991	8.02678998	1.54353664	-2.08286554
0.13027804	-0.86391406	4.67698417	-1.99289130
1.57104006	26.15511687	-16.07904236	-4.60315031
0.75278305	-4.81315709	-3.48673290	-2.06476705
1.14674352	-2.47947309	2.99058326	-4.15759749
1.82956289	0.24037162	65.45742353	59.38666049
77.00211362	7.23415135	39.53080338	7.79428370
25.15224188	-3.38846851	18.59899195	9.55550262
-10.91876466	-8.04053553	11.56123049	5.23560220
-16.66439442	0.33674531	-19.37546935	14.25820105
-0.06727215	3.32572016	11.13255163	9.59966828
-6.45164730	-11.12971835	-4.57188499	14.95208119
36.53076399	2.70072956	-62.18157978	-42.59448262
-60.56099575	-26.99284456	-1.69521433	6.56200038
0.88262759	1.65985746	-14.42966827	4.42097812
-3.26346722	-88.06706189	60.27192525	14.24557065
-5.77538988	29.59681288	12.39753358	6.15544443
-7.55394495	10.64907474	-12.19311405	9.53245733
-8.13298399	-0.91794370	-202.04860156	-160.26810556
-209.41762783	-28.90189781	-114.85730600	-17.05370367
-68.39135249	4.25120201	-45.82026461	-29.83660733
26.56786610	21.80088190	-26.98222169	-62.63070373
63.38211702	27.77717287	49.04067457	-30.80243223
-0.28719691	-2.58121134	-32.06945272	-25.02700221
14.70530120	30.48584008	8.77997120	-42.06344703
-69.36978023	-18.93612535	84.17200773	56.94829858



79.83324634	35.07417856	-2.92619357	-6.19954468
-3.87972253	-0.52343103	18.69237141	-3.73131530
1.69931018	117.42194831	-80.60086194	-19.74366772
11.71707843	-52.04076661	-16.83885318	-6.76997390
11.09621971	-15.75567432	18.19020825	-8.71735617
14.00758827	0.52926990	266.34811686	176.65445148
232.28297299	44.02035728	141.67415483	15.43833620
75.81429083	2.53568352	47.20096177	37.97809199
-26.76980378	-24.58915975	24.65755038	125.55946921
-84.28324433	-59.02642853	-50.44023846	23.90639808
0.28226298	-0.55614691	38.04592963	25.79250176
-13.67393550	-33.67431858	-5.65186572	49.20557859
39.61134487	14.63005611	-37.14762384	-25.61847255
-34.20057302	-15.17276084	3.86728976	1.58785292
2.98523700	-0.42312127	-8.50014759	0.73652626
0.26787790	-52.15503109	35.03286801	9.92485106
-7.13786577	28.39610490	7.54650244	2.40184150
-4.80794481	7.71815559	-8.71694239	2.69587850
-7.65714584	0.25918842	-121.58195870	-67.97678815
-89.43680505	-21.94289693	-60.73151136	-4.90926177
-28.89372504	-4.00660525	-17.10932013	-16.62978326
9.32511468	9.55471468	-7.61441935	-70.21268548
36.41159677	33.39793354	17.74278977	-4.46124526
0.16143912	0.68752787	-15.67335006	-9.01687752
4.43550379	13.07629267	0.51603390	-19.89718601
-0.16357114	-0.08639279	-0.11330936	0.09583736
-0.01374772	0.03231938	-0.01939243	0.00539959
0.02177296	0.02882769	-0.04551827	0.02712698
-0.02157167	-1.13637889	0.02550023	-0.17173556
0.08365753	0.09846838	-0.02115436	0.00068939
0.02040843	-0.04674110	-0.01414124	-0.08714520
-0.04506711	-0.00772695	-1.42766717	-0.44174791
-0.21942646	0.09769030	-0.45589921	-0.07873290
-0.27927352	0.01306456	-0.01680207	0.12457064
-0.08742823	0.04905494	-0.07452341	-1.04724776
-0.68036588	-0.38888533	0.35177076	-0.27462149
0.10460483	-0.11650337	0.03883604	-0.08820698
-0.00622141	-0.18701175	-0.08567239	-0.02365188
-3.58711555	-1.36522951	-1.54845008	-0.16414345
-2.10666556	-0.61262949	-0.45182449	0.42079503
-0.40725276	0.12631470	-0.05326261	-0.14187854
-0.16172549	-2.50908771	-0.86266037	0.95470208
0.65545968	-1.16269089	0.10264181	0.00702933
0.56180117	0.14527501	-0.31214727	0.19094929
-0.10356870	0.17428280	11.15630486	5.44327403
4.08719536	-0.04644576	4.40737049	0.80901351
1.74552649	-0.38663995	1.01535188	-0.12890226
-0.18629917	-0.60266822	1.08749581	7.50312166
4.15558257	-0.49856435	-2.20638786	3.01894054
1.02622814	0.11766586	-0.70088558	1.49203455
-0.32606072	0.56102939	-0.04114111	0.02980075
36.79673516	11.60786511	10.08929345	1.83120030
14.52393399	4.82816311	3.85472013	-2.64753703
2.32849137	-1.56852018	1.37956429	0.92388962
1.47549004	30.82225785	9.04756092	-0.69023298



-4.43839484	5.12495560	-0.34303270	0.77600739
-3.60342457	-1.14273663	2.61435257	0.93167366
0.51929576	-1.37597581	-30.37935367	-12.37087501
-11.73435300	-0.92821232	-13.67227570	-1.71282920
-3.60354591	0.74767726	-2.83672243	-0.76702186
1.32508406	2.32107986	-2.37826629	-13.18362732
-13.41166943	3.56536061	4.50658272	-9.83153318
-4.64598183	0.04245495	2.09020190	-3.73186027
1.80609035	-0.66854113	1.31778975	0.25069298
-84.46204980	-21.95074749	-25.96117850	-6.77069678
-33.41318132	-10.27423401	-8.51574750	5.41922013
-4.14635126	2.37653426	-3.13367030	-1.47016108
-2.25085752	-59.59317324	-24.70303895	-5.74052365
8.96103580	-10.51215707	0.08064087	-2.29151324
7.78248941	2.53021991	-5.57690198	-2.95188338
-0.08251832	4.27293799	24.88286823	8.21380492
8.05554374	1.40699177	10.70727472	0.84739671
2.31109616	-0.36710474	1.91178131	1.03627209
-1.18579274	-2.16991560	1.21088231	6.36624701
11.28275265	-2.73077649	-1.64883550	8.63975246
4.32678414	-0.13244777	-1.22573028	2.27217637
-1.71809158	0.38090426	-1.64016390	-0.41343376
55.50158083	13.16870336	20.10888436	5.96697535
23.02187227	6.49798815	5.64832383	-3.61050980
2.34256009	-0.77573866	1.95967537	0.37045711
0.93638321	33.33933034	18.60473074	7.15099888
-4.64462350	7.99343010	0.81890703	1.59455102
-4.86390568	-1.62503757	3.46647374	2.13786655
-0.63308455	-3.39715443	0.18258907	0.23918732
0.06358408	-0.08869619	0.02370649	-0.05937900
0.06100577	-0.02907112	-0.01670113	0.00929700
0.07780327	0.02651695	0.02794448	0.14519017
0.08039542	0.19717394	-0.01947645	0.00629945
-0.12963922	-0.04721688	0.04195440	0.03697294
0.09533938	-0.00931142	0.08472697	-0.02589809
0.55469675	0.08568772	0.01630409	-0.19741630
0.15581846	0.07834395	-0.06969302	-0.07532942
-0.02362548	0.00657608	0.05741205	-0.06432089
0.06328774	0.20033179	-0.08190532	-0.17187033
0.12583182	-0.11145791	0.04658029	-0.02536418
0.01850929	0.06134686	0.08739290	-0.06296398
0.02595043	-0.02338463	0.29557283	-1.33914272
-0.45555298	0.39943182	-0.03778448	0.33339715
-0.11413733	0.21941147	-0.35554329	-0.14493474
-0.05506556	0.02989263	-0.19295926	-1.54983534
0.59716808	-0.40786628	0.33529533	-0.18255672
0.29627288	0.18600379	-0.18653762	-0.23548179
-0.11162425	-0.03821682	-0.46966926	0.11450212
2.59443256	0.22284028	0.12826565	0.37249939
-0.36928247	-0.39202395	0.27149578	-0.12446422
0.24095358	0.11833255	-0.04973825	0.28990698
-0.01825524	0.94679862	-0.31020136	0.42484764
-0.25800425	0.10787563	-0.06982876	-0.11313250
-0.05559941	0.03019586	-0.19010786	0.19709316
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-0.09522498	0.02799275	0.63425045	5.82550817
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-0.39501283	-0.17906051	0.34405210	0.40918960
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0.01370941	-0.00304635	-0.01249885	0.00510982
-0.00659320	-0.04124064	-0.02556267	-0.00105424
0.01367555	0.34835221	0.18933425	0.00009786
-0.10393514	0.04408399	-0.03152293	0.01920596
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-0.03473749	-0.00577572	0.27428397	-0.02110868
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-0.11429562	-0.04269514	0.04656943	-0.03619414
-0.00464443	-0.04771276	0.01756290	-0.23516140
0.17592555	0.07651514	-0.09219990	-0.01533874
0.08736439	0.03518022	-0.08940694	-0.04311615
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0.00251252	-0.04429192	0.00625211	-0.03273919
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-0.01807253	-0.02509185	0.00466589	0.02344287
-0.00635105	-0.01513923	-0.00607571	-0.00682288
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0.00382372	-0.05172139	0.06293831	0.01685815
0.02813510	-0.02845090	0.01969235	-0.03387770
-0.00356384	0.00584102	0.00720409	-0.22783882
-0.00577451	0.09531386	0.02963897	-0.06540348
0.01155778	-0.01317967	0.01020648	0.01862359
0.01904189	0.00090882	-0.01890662	-0.00152653
0.00974174	0.02532000	0.06613410	-0.03671163
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0.02344625	-0.00267799	0.01732809	-0.00134676
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-0.00147800	-0.01284126	-0.00465055	0.00949446
-0.01202950	0.10795918	0.00648689	-0.04224437
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0.00318307	0.07655008	-0.00158436	-0.02617304
0.00019221	-0.00017935	0.00078015	-0.00024244
-0.00220412	-0.00039521	-0.01498166	-0.00053950
0.02159813	-0.00796932	0.09858653	0.00146580
-0.07055296	0.06052359	-0.26356171	0.02953494
0.08250526	-0.10649534	0.29592224	-0.06983638
-0.03012093	0.05576882	-0.11621012	0.04047553
0.00010236	-0.00000802	-0.00081560	-0.00041976



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0.03256428	0.01564007	-0.02481155	-0.02337647
-0.07094987	-0.04028868	0.01807759	0.01917401
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0.00170076	-0.00033866	0.00287970	-0.00120966
-0.00009156	0.00010765	-0.00000543	0.00005471
0.00004988	0.00011881	0.00011345	0.00004108
0.00004143	-0.00012480	-0.00009900	-0.00009533



## APPENDIX B. Example of Legacy IRTAM Coefficients Message

```

# START_HEADER
# GLOBAL IONOSPHERE RADIO OBSERVATORY (G.I.R.O.)
# giro.uml.edu
#
# IRI-based Real-Time Assimilative Model (IRTAM)
#
# IRTAM Coefficients of Temporal-Spatial Expansion
# Generated by GAMBIT v0.9.02beta on 2017-01-25T16:53:27.037Z
# Ionospheric Characteristic: foF2 [MHz]
# Time of Validity 2011-09-01T03:15:00.000Z
# Assimilative Engine: NECTAR v0.1B
# Earth Grid: 46 lats x 45 lons
# Expansion Basis: JonesGallet
# Basis Lengths: 13(temporal) x 76(spatial)
# Assimilated stations:
# GA762 PA836 SMJ67 MHJ45 THJ77 WP937 AS00Q KJ609 BC840 EB040
# GR13L DB049 MU12K SAA0K PQ052 TR169 EG931 JR055 CAJ2M KS759
# YA462 LV12P FZA0M IR352 HE13N NO369 PSJ5J JJ433 IC437 NDA81
# JI91J AT138 FF051
# END_HEADER
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0.00595701      -0.01321151      0.93242695      -0.00010495
0.55476909      -0.57871450      0.36435345      -0.42631627
0.06427411      0.02512042      -0.00958821      0.11099591
0.03016237      -0.00941442      0.02068382      -0.02290721
12.88952389      0.00024988      -0.07751573      4.69637665
2.26607754      -1.96059509      0.11655677      0.11592568
-0.00064608      -0.21722307      0.14952975      -0.19961348
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-2.94689660      11.64384276      -5.77956487      6.38134431
-0.71494942      -1.11103616      -0.27151705      -2.04267009
-0.36078441      0.00772286      -0.30792143      0.34467849
-73.92803285      -0.00263705      0.89202493      -26.28991699
-17.72770179      7.00955258      -2.47058591      0.75242731
-1.27570923      2.22311039      -1.37998804      2.08498131
1.12624564      0.06721415      94.13730535      -0.00659080
-3.12261158      -49.58524811      30.06641772      -21.88261580
2.86573633      7.12177730      0.47931366      11.69252656
0.61612864      1.10861241      1.39085789      -1.69884343
133.13599442      0.00696829      -10.32651225      56.93623480
43.43038354      -8.76690436      7.88328907      -1.31803953
4.02208139      -5.58110826      3.64053714      -4.82076924
-2.07768221      0.91425317      -204.71138832      0.01479702
36.53270825      72.51449073      -67.11250466      34.70677373
-4.49603064      -15.77497782      2.01342126      -25.73022498
1.38286506      -5.09797395      -3.26005139      2.19070521
-114.37009357      -0.00635503      19.14741355      -53.02248061
-43.84888947      2.94741131      -9.44026299      0.02736585
-4.56710314      5.55113310      -3.66056781      4.20762296
1.09093649      -1.62815460      189.07511405      -0.01276857
-58.92619820      -37.93850584      66.86560828      -28.63249710

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