⇧ HF radio propagation:
Scientific and Technical Concepts You Should Know

This page is part of the project "Understanding HF Propagation."
by Doron Tal, 4X4XM

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HF (High Frequency) radio propagation, used for long-distance communication, involves several key concepts and terminology. Knowing this terminology can help you understand long-distance communication via skywaves.

Find below a glossary of basic terms and an extended index of terms, all related to HF radio propagation:

A glossary of basic terms

Waves and radio propagation

1. Frequency (f) is the number of cycles of a radio wave that occur in one second, measured in hertz (Hz).
2. Wavelength (λ) is the distance between two consecutive points in a wave, usually measured in meters (m).
   The relationship between wavelength and frequency is inverse, with higher frequencies corresponding to shorter wavelengths and vice versa.
3. Groundwave propagation is the use of radio waves that travel along the earth's surface, providing communication over relatively short distances, typically up to a few hundred kilometers.
4. Skywave propagation is the phenomenon in which HF radio waves are bounced back to earth's surface, via the

ionosphere, allowing long-distance communication beyond the line of sight.

5. The ionosphere is the region of the earth's upper atmosphere (approximately 50 to 800 kilometers above the ground) where ionization occurs due to solar radiation. This region plays a crucial role in HF radio propagation by bouncing radio waves back to Earth. The ionosphere is continuously changing due to natural storms, as explained below:

   A storm represents a disturbed state of the natural environment, characterized by significant disruptions to normal conditions. In this project, we specifically refer to:

   i. Solar storms occur on the sun.
   ii. Space weather storms occur in the space between the sun and Earth.
   iii. Geomagnetic storms (also known as magnetic storms) are temporary disturbances of the Earth's magnetosphere caused by a solar wind shock wave.
   iv. Ionospheric storms involve varying densities of energized free electrons in the ionosphere due to geomagnetic storms.

   Understanding the dynamics of solar and space weather storms reveals the intricate relationship between our sun and Earth. Solar storms, originating on the sun, unleash powerful energy that travels through space, affecting not only the celestial environment but also our planet's magnetic field. When these solar winds encounter Earth's atmosphere, they can trigger geomagnetic storms, which are temporary disturbances that disrupt communication systems and power grids. Additionally, the presence of energized free electrons in the ionosphere gives rise to ionospheric storms, further complicating our technological landscape.

6. Skip distance is the minimum distance from the transmitter for receiving skywaves, while blind, or dead zone, refers to the region with poor or nonexistent reception.
7. MUF (Maximum Usable Frequency) is the highest frequency at which skywave propagation is reliably

achievable between two points on earth during a specific time and under specific ionospheric conditions.

8. LUF (Lowest Usable Frequency) is the lowest frequency at which skywave propagation can be used effectively.
9. Fading (QSB) is the variation in signal strength and quality experienced during radio transmission due to changes in ionospheric conditions, interference, or other factors.
10. The F-region is the upper region of the ionosphere that consists of two sub-regions, F1 and F2, and is the primary region for HF propagation. The F2 is particularly important for long-distance communication.
11. The E-region is the middle region located below the F-region. It is responsible for sporadic E propagation, which can enable HF communication at higher frequencies.
12. The D-region is the lowest region of the ionosphere, located at an altitude of approximately 48 to 90 kilometers. The D-region absorbs HF radio waves during daylight hours, affecting propagation.
13. The ionosphere bounces a radio wave at vertical incidence below the critical frequency (fc), regardless of transmitter power.
14. The Optimum Working Frequency (OWF) is the frequency that provides the best propagation conditions for a given HF communication path.
15. The Solar Flux Index (SFI) is a measure of the sun's radio emissions at a specific wavelength (usually 10.7 cm). It is used as an indicator of solar activity, which affects ionospheric conditions and HF propagation.
16. The A-index is a daily measure of geomagnetic activity on a scale from 0 to 400, with lower values indicating quieter

geomagnetic conditions. Geomagnetic activity can disrupt HF propagation.

17. The K-index represents short-term (3-hour) geomagnetic activity at a specific geomagnetic station. It quantifies disturbances in Earth's horizontal magnetic field by comparing geomagnetic fluctuations, measured by a magnetometer, to a quiet day. The K-scale is logarithmic, a scale from 0 to 9.

Extended index of terms

A list of terms that are explained on this website:

A

1. A-Index
2. Absorption of skywaves
3. ACE - Advanced composition explorer
4. ALE — Automatic link establishment
5. Amateur radio
6. Amateur radio bands
7. Amateur radio propagation today
8. Angle elevation/transmission
9. Applications for analyzing and forecasting HF propagation
10. Applications used for forecasts and predictions (references)
11. Aurora
12. At what Kp index can I see aurora?

B

13. Band activity
14. Band conditions
15. Band conditions banners

16. Band Openings
17. Beacons
18. Beyond line of site (BLOS)
19. Blackouts; R_{1-5} scale
20. Blind zone
21. BLOS (Beyond line of site)
22. Bt - total strength of the Interplanetary Magnetic field (IMF)
23. Bz - orientation of the IMF

C

24. Carrington event
25. ChatGPT learns about forecasting tools for radio amateurs
26. Chirping
27. Clouds of plasma in the ionosphere
28. CME - coronal Mass ejection
29. Compare DR2W propagation tool with VOACAP
30. Compare forecasting tools for HF radio propagation
31. Compare forecasting tools for radio amateurs
32. Communication conditions
33. Complex HF propagation Modes
34. Conductive ground
35. Coronal Mass ejection (CME)
36. Current ham band conditions
37. Current ham band propagation
38. Current ham radio conditions
39. Current HF band conditions maps for radio operators
40. Current HF band conditions online map
41. Current HF bands conditions—charts for radio hams
42. Current HF propagation
43. Current HF propagation conditions

44. Current HF radio propagation
45. Current propagation
46. Current propagation conditions
47. Current shortwave propagation conditions
48. Current solar activity
49. Current solar events
50. Critical frequency
51. Critical frequencies concept
52. Critical frequency map

D

53. D-region
54. Dead zone
55. Digisonde directogram
56. Direct wave propagation (LOS - Line Of Site)
57. DRAP
58. DX clusters DX Spots
59. DX propagation map
60. DX propagation online map
61. DX propagation prediction
62. DXlook
63. DXMAPS
64. DXWatch
65. DXZone

E

66. E-region
67. Earth's magnetic field
68. Earth's Magnetosphere
69. Earth Magnetosphere vs Earth's magnetic field
70. Earth observing system (EOS)
71. Earth's magnetic field

72. Effects of solar activity on amateur radio
73. Electron densities
74. Electron flux (Ef)
75. Electromagnetic Radiation
76. Electromagnetic Spectrum
77. Electromagnetic Wave
78. Electromagnetic Spectrum
79. Electromagnetic Radiation
80. Electromagnetic Wave
81. Elevation Angle
82. EME Deg - earth-Moon-Earth Degradation
83. EsEU - Sporadic e europe
84. EsNA - Sporadic e North America
85. EUV sunlight

F

86. FAQ: HF propagation
87. FAQ: Current HF propagation conditions
88. F10.7
89. F-region
90. Flare
91. f_oF_2 - critical frequency
92. foF2 map
93. Forecast HF propagation conditions
94. Forecast HF radio propagation - applications
95. Forecast propagation
96. Forecast propagation for radio amateurs
97. Forecast vs prediction of HF band conditions
98. Forecasting HF propagation for radio amateurs
99. Forecasting MUF for a 3000 km path
100. Forecasting tools for radio amateurs
101. Free Electron Density

G

102. G1-G5 - scale of Geomagnetic storms
103. Gamma rays
104. Gama rays bursts (GRB)
105. GRB - Gama-rays bursts
106. "GeoMag" (index) - earth`s agnetic field activity GMF activity
107. Geomagnetic
108. Geomagnetic activity | What is Geomagnetic activity
109. Geomagnetic conditions
110. Geomagnetic data
111. Geomagnetic field activity
112. Geomagnetic indices K, A
113. Geomagnetic storms and HF communications
114. Geomagnetic storms; G_{1-5} scale
115. Global conditions
116. Global HF propagation
117. Global radio propagation conditions
118. Greyline
119. Greyline radio propagation explained
120. Greyline vs "Solar Terminator"
121. Ground wave
122. Ground wave propagation
123. Ground waves

H

124. HAARP Project for Radio Hams
125. Hale cycle
126. Ham Activity
127. Ham band conditions
128. Ham bands' activity
129. Ham conditions

130. Ham propagation
131. Ham propagation map
132. Ham radio communications
133. Ham radio HF propagation (real-time)
134. Ham radio propagation conditions
135. Ham radio propagation tutorial
136. Ham Radio Range Guide: How Far Can You Talk?
137. Ham solar
138. Helium lines
139. HF bands allocated for radio amateurs
140. HF bands allocated for radio amateurs and their characteristics
141. HF band conditions
142. HF band conditions maps
143. HF bands Info affected by solar conditions
144. HF bands Monitoring
145. HF conditions
146. HF propagation
147. HF propagation app
148. HF propagation blackout
149. HF propagation calculator
150. HF propagation chart
151. HF propagation conditions
152. HF propagation conditions at a glance
153. HF propagation experts
154. HF propagation explained
155. HF propagation explanation
156. HF propagation fadeouts
157. HF propagation for beginners and advanced radio hams
158. HF propagation for radio amateurs
159. HF propagation for radio hams
160. HF propagation forecast for radio amateurs

161. HF propagation forecast tools
162. HF Propagation Forecasting
163. HF propagation: fundamentals
164. HF propagation live map
165. HF propagation map
166. HF propagation models
167. HF propagation modes
168. HF propagation online map
169. HF propagation overview
170. HF propagation now (real-time)
171. HF propagation predictions
172. HF propagation prediction online
173. HF propagation prediction software
174. HF propagation preface
175. HF propagation reporter
176. HF propagation Status
177. HF propagation — The basics
178. HF Propagation Today
179. HF Propagation Tools
180. HF radio propagation indices and scales
181. HF radio propagation prediction
182. HF radio propagation tutorial for radio amateurs
183. HF propagation widget
184. HF radio conditions
185. HF radio propagation
186. HF signals propagation
187. HF skywave window: LUF—MUF
188. HF radio propagation forecast
189. HF radio propagation today
190. HF radio wave propagation
191. HF radio waves (basics)
192. HF radio wave propagation factors

193. HF radio propagation prediction
194. HF real time propagation
195. HF Skywave propagation for radio amateurs
196. HF wave propagation
197. HFTA - High frequency Terrain Assessment
198. Helium lines
199. High frequency
200. Highest Possible Frequency (HPF)
201. How skywave propagation works
202. HPF—Highest Possible Frequency

I

203. IMF - Interplanetary Magnetic field
204. Impacts of space weather
205. Incident angle
206. Interplanetary Magnetic field (IMF)
207. Introduction to HF propagation
208. Ionisation
209. Ionization
210. Ionogram
211. Ionosonde
212. Ionosphere
213. Ionosphere and HF radio propagation
214. Ionosphere propagation of radio waves
215. Ionosphere regions
216. Ionosphere, radio waves
217. Ionosphere probing
218. Ionosphere regions
219. Ionospheric absorption—D-region
220. Ionospheric bubbles
221. Ionospheric clouds

222. Ionospheric conditions
223. Ionospheric data
224. Ionospheric disturbances
225. Ionospheric irregularities
226. Ionospheric propagation
227. Ionospheric refraction
228. Ionospheric regions
229. Ionospheric skywave propagation
230. Ionospheric storms
231. IRI ionospheric model
232. ITU model

K

233. K-Index
234. Key concepts of HF propagation
235. Key Factors Affecting HF Propagation
236. Kp index
237. KiwiSDR map of remote public SDR receivers accessible via the Internet

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L

238. Lagrange points
239. Learning about space weather
240. Line-Of-Sight propagation (LOS)
241. Live HF propagation map
242. Long-distance communication
243. Live solar events and past solar activity
244. LOS
245. LOS - Line of sight propagation
246. LUF - Lowest Usable frequency
247. LUF Chart - The Lowest Usable frequency map

M

248. Magnetic field
249. Magnetosphere (MS)
250. Maximum usable frequency (MUF)
251. Maximum usable frequency map
252. Minimum usable frequency map
253. Modes of HF radio propagation
254. Modes of radio propagation
255. Monitor band activity of radio amateurs ↗
256. Monitor HF propagation
257. Monitor propagation conditions
258. MS — Meteor Scatter Activity
259. MUF — Maximum Usable frequency
260. MUF Indicators
261. MUF How what, why?
262. MUF factor
263. MUF map
264. MUF propagation map by KC2G for a 3,000 km hop
265. MUF propagation online map

N

266. Near real-time regional maps
267. NET ionospheric model
268. NOAA National Oceanic and Atmospheric Administration
269. Noise level
270. NVIS
271. NVIS map
272. NVIS propagation
273. NVIS propagation concept
274. NVIS tutorial

O

275. Observations - Terrestrial & Solar

276. On-Line HF propagation prediction
277. Online propagation tools
278. Online real-time propagation charts
279. Optimal Sending frequency
280. OWF - Optimum Working frequency

P

281. Past solar activity
282. PCA—polar cap absorption
283. Plasma
284. Plasma clouds
285. Polar cap absorption (PCA)
286. Practical applications
287. Predict conditions
288. Predict HF radio propagation
289. Predict MUF
290. Predict propagation
291. Predict skywave propagation now
292. Predict sunspot numbers
293. Prediction of sky-wave propagation conditions
294. Predicting propagation
295. Prediction vs forecast of HF band conditions
296. Propagation conditions
297. Propagation conditions monitoring
298. Propagation DX
299. Propagation factors and conditions
300. Propagation forecast
301. Propagation indicators — A review of skywave propagation indicators
302. Propagation indices single: propagation index
303. Propagation modes
304. Propagation of high frequency radio waves

305. Propagation of HF radio waves - Global conditions and Regional conditions
306. Propagation of shortwave radio
307. Proton flux
308. Propagation | modes of HF radio propagation
309. Propagation forecast
310. propagation of high frequency radio waves | the rebirth of hf
311. Propagation of radio waves explained
312. Propagation prediction
313. Propagation prediction programs and forecasts
314. Propagation report
315. Proton flux (Pf)
316. PSKR - PSK reporter

Q

317. Quick guide to HF propagation using solar indices

R

318. Radio Amateur
319. Radio amateurs HF bands charactaristics
320. Radio blackouts / fadeouts; R_{1-5} scale
321. Radio frequency
322. Radio propagation
323. Radio propagation beacon
324. Radio propagation conditions today
325. Radio propagation forecast
326. Radio propagation free software
327. Radio propagation online tools
328. Radio propagation properties
329. Radio propagation software
330. Radio propagation tool

331. Radio propagation tutorial
332. Radio wave propagation in the ionosphere
333. Radio spectrum
334. Radio waves
335. Radio waves propagation
336. Radio wave propagation model
337. Radio-wave HF propagation models
338. Radio-wave propagation modes
339. Ray tracing (Optics)
340. RBN - Reverse beacon Network
341. Real-time activity of radio amateurs
342. Real-time band conditions
343. Real-time DX data
344. Real-time DX propagation conditions
345. Real-time HF band conditions
346. Real-Time hf propagation charts
347. Real-time HF propagation prediction
348. Ham radio HF propagation real-time
349. Real-time HF propagation reports
350. Real-time ham band activity using the internet
351. Real-time MUF 3000 km propagation map
352. Real-Time MUF and solar indices
353. Real-time MUF map
354. Real-time propagation and band conditions
355. Real-time radio propagation reports
356. Real-time reports of HF propagation
357. Real-time reports of radio propagation
358. Real-time reports of space weather
359. Real-time space weather reports
360. Real-time watching of worldwide hams' activity
361. Real-time watching of worldwide ham activity
362. Recent geophysical & solar observations

363. Recent MUF distribution
364. Recent observations - Geo (Terrestrial) & Solar
365. Recent sunspot number
366. Regional conditions
367. Regional HF conditions
368. Regional MUF and solar indices
369. Regional vs Global HF propgation conditions
370. Regional vs Global propgation conditions
371. Regions of ionization
372. Region vs. Layer: Earth's Atmosphere and Ionosphere
373. Remote sensing of the ionosphere
374. Reports of space weather
375. RSG scales of Space Weather

S

376. Satellites for space weather observations
377. SDO - Solar Dynamic Obervatory (NASA)
378. SDR - Software Defined radio
379. SDR spectrum
380. Seasonal variations in HF radio propagation
381. Seasons affect HF radio propagation
382. SEP
383. SFI - Solar flux Index
384. Shortwave propagation
385. Shortwave propagation conditions
386. Shortwave propagation forecast
387. Shortwave radio propagation
388. SID - Sudden ionospheric disturbances
389. Significant frequencies relevant to skywaves
390. Skip distance
391. Skip zone
392. Skywave

393. Skywave concept
394. Skywave HF radio propagation
395. Skywave propagation
396. Skywave propagation concept
397. Skywave propagation conditions
398. Skywave propagation for radio amateurs
399. Skaywave propagation indicators for radio amateurs
400. Skaywave propagation indicators for radio hams
401. Skywave propagation forecast
402. Skywave propagation tutorial
403. Software for HF propagation prediction
404. Solar activity
405. Solar Activity & Ham radio propagation
406. Solar activity affects HF propagation
407. Solar activity affects skywaves
408. Solar activity for radio amateurs
409. Solar conditions affect HF radio propagation
410. Solar conditions and ham radio propagation
411. Solar conditions and HF radio propagation
412. Solar cycle
413. Solar Cycle Ham Radio
414. Solar data
415. Solar electromagnetic spectrum
416. Solar events
417. Solar energetic Particle (SEP)
418. Solar events
419. Solar flares
420. Solar flux index (SFI)
421. Solar flux today
422. Solar Ham
423. Solar indices
424. Solar observations

425. Solar maximum
426. Solar minimum
427. Solar Particle event (SPE)
428. Solar phenomena
429. Solar propagation
430. Solar radiation
431. Solar radiation storms (flares); S_{1-5} scale
432. Solar radio flux
433. Solar spectra
434. Solar storms
435. Solar Storms Ham Radio
436. Solar synoptic map
437. Solar terminator (i.e. Greyline)
438. Solar wind; The impact of the solar wind on HF radio transmission.
439. Solar wind reports
440. Solar X-Ray (Phenomenon)
441. Solar X-ray Imaging system (SXI)
442. Solar X-Ray flux levels
443. Space wave
444. Space Weather
445. Space weather data and plots
446. Space weather definitions and explanations
447. Space weather events
448. Space weather forecasts
449. Space weather ground-based observatories
450. Space weather observations
451. Space weather observations from satellites
452. Space weather prediction
453. Space weather prediction center (NOAA)
454. Space Weather predictions for radio amateurs
455. Space weather reports

456. Space weather scales
457. SPE
458. Spread F
459. Sudden ionospheric disturbances
460. Sunspots
461. SuperDARN
462. SWPC = Space Weather prediction center (NOAA)
463. Sporadic e
464. Stratosphere
465. Sudden ionospheric disturbances (SID)
466. Sunlight
467. Sunspots
468. Sunspot cycle
469. Sunspot number (SSN)
470. Sunspots recent days
471. Sunspots today
472. Surface wave propagation
473. Space Weather prediction center (NOAA)

T

474. T Index map
475. TEC - Total electron content
476. Terminator line
477. Terrestrial geomagnetic indices
478. Terrestrial observations
479. The Holy Cluster
480. The Rebirth of Shortwave radio communication
481. The recent HF propagation conditions
482. The recent propagation conditions
483. The recent skywave propagation conditions
484. The Super Dual Auroral Radar Network (SuperDARN)
485. Thermosphere

486. TID (Traveling ionospheric disturbances)
487. Tools for analyzing and forecasting HF propagation
488. Total electron content — TEC
489. Transmission Angle
490. Traveling ionospheric disturbances (TID)
491. Troposphere
492. Twilight zone

U

493. Ultraviolet
494. Understanding Ham bands conditions banner
495. Understanding Ham radio propagation
496. Understanding HF propagation
497. Understanding HF propagation review
498. Understanding HF propagation Numbers
499. Understanding HF radio propagation
500. Understanding LUF and MUF
501. Understanding NVIS
502. Understanding Skywave propagation
503. Understanding the basics of HF band conditions
504. Usable Frequency Range from LUF to MUF
505. Usable HF frequencies
506. Using HF beacon tracking programs

V

507. Variations in HF radio propagation
508. Very High frequency (VHF)
509. Very Low frequency (VLF)
510. VHF propagation map
511. View HF bands conditions at a glance
512. Visualizing HF propagation
513. VOACAP

W

514. Wave propagation
515. What are radio waves?
516. What is ham radio communications
517. What is radio?
518. What is radio propagation?
519. What is space weather?
520. What is the current LUF?
521. What is the current minimum useable frequency?
522. What is the current Maximum Frequency?
523. What is the current MUF?
524. Wide-band WebSDR
525. Window of useful frequencies from LUF to MUF
526. World-wide Space Weather agencies & services
527. Worldwide LUF map
528. WSPR - Weak Signal propagation reporter * WSPR Live * WSPR Rocks * WSPRnet

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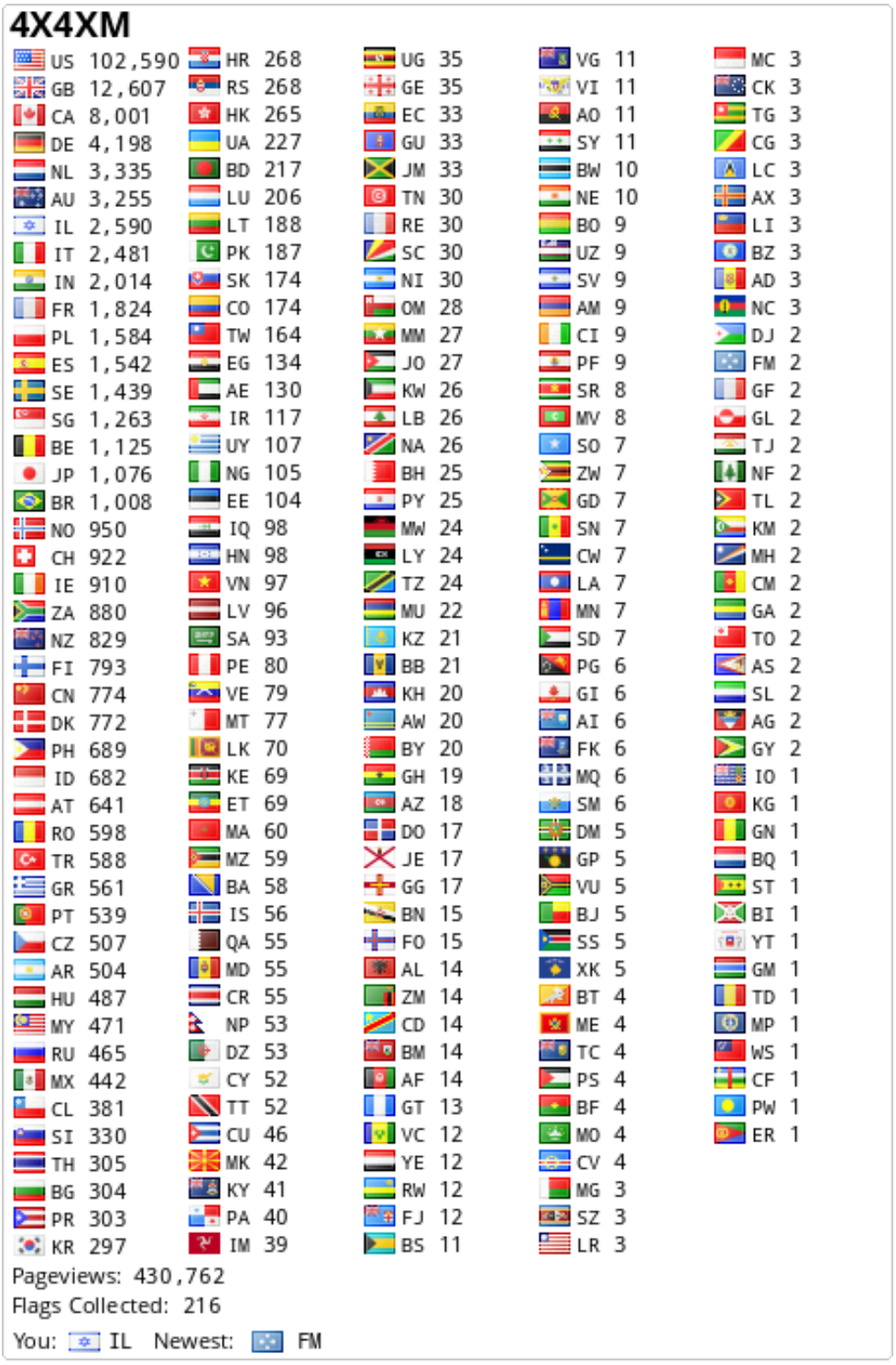
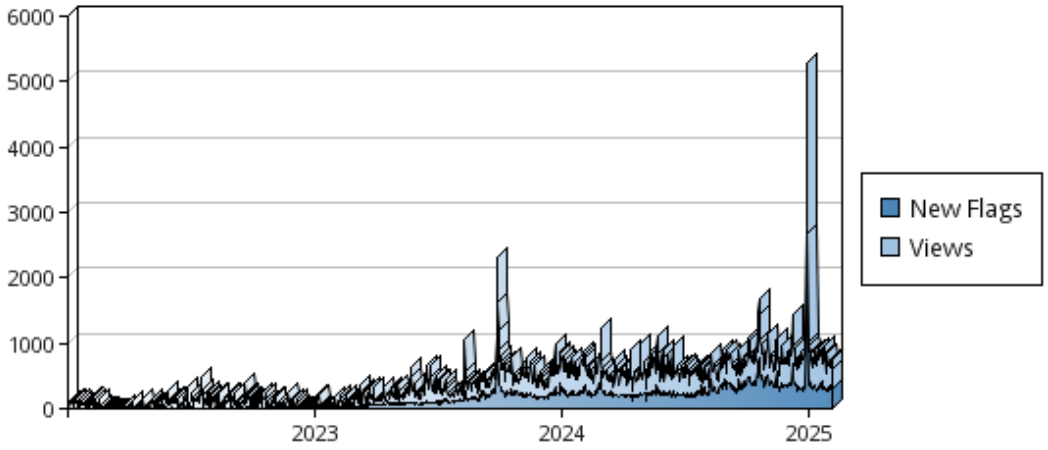
X

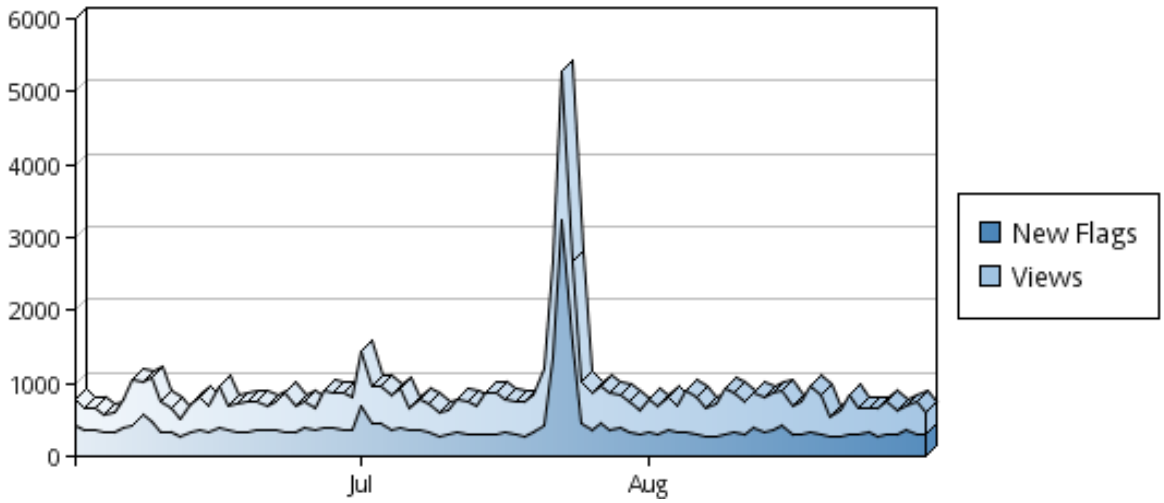
529. X-Ray flares
530. X-Ray flux levels (scale)



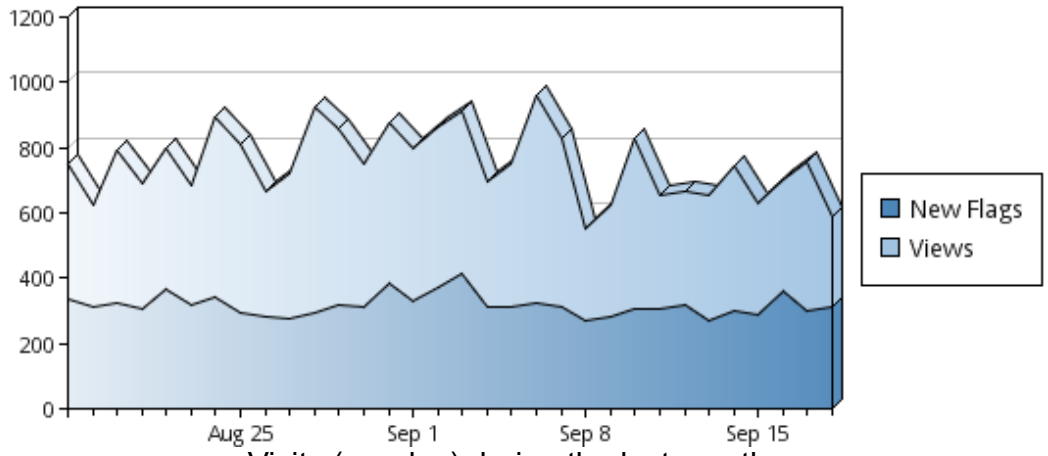
The number of visits (graphs displayed below) peaked during HF propagation disruptions.



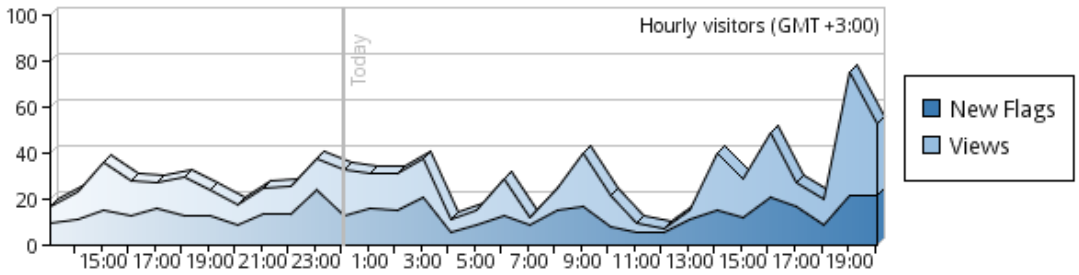
Visits (per day) since 2022



Visits (per day) during the last 3 months



Visits (per day) during the last month



Hourly visits today
