

# Supporting Information

for

## Synthesis, effect of substituents on the regiochemistry and equilibrium studies of tetrazolo[1,5-*a*]pyrimidine/2-azidopyrimidines

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## Additional material

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## 1. Experimental data for the synthesized compounds

**5-Phenyltetrazolo[1,5-*a*]pyrimidine (3a)** and **2-azido-4-phenylpyrimidine (4a)**: C<sub>10</sub>H<sub>7</sub>N<sub>5</sub> (Mw. 197.07). Yield 82%; m.p. 129-131°C. <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **3a**: δ = 9.82 (d, <sup>3</sup>*J* 7, 1H, H7), 8.40-8.36 (m, 2H, H-Ar), 8.24 (d, <sup>3</sup>*J* 7, 1H, H6), 7.73-7.59 (m, 3H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 165.0 (C5), 155.2 (C3a), 135.6 (C7), 132.8, 129.7, 128.7, 127.5 (C-Ar), 110.9 (C6). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **4a**: δ = 8.79 (d, <sup>3</sup>*J* 5, 1H, H6), 7.89 (d, <sup>3</sup>*J* 5, 1H, H5). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 165.5 (C4), 160.8 (C2), 135.5 (C6), 132.1, 130.0, 129.5, 127.5 (C-Ar), 113.5 (C5). LCMS MS: = 198.2 [M+H]<sup>+</sup>.

**5-(4-Fluorophenyl)tetrazolo[1,5-*a*]pyrimidine (3b)** and **2-azido-4-(4-fluorophenyl)pyrimidine (4b)**: C<sub>10</sub>H<sub>6</sub>FN<sub>5</sub> (Mw. 215.06). Yield 83%; m.p. 122-124°C. <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **3b**: δ = 9.80 (d, <sup>3</sup>*J* 7, 1H, H7), 8.46-8.42 (m, 2H, H-Ar), 8.21 (d, <sup>3</sup>*J* 7, 1H, H6), 7.46 (t, 2H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 163.8 (C5), 155.1 (C3a), 135.7 (C7), 132.0 (<sup>3</sup>*J* 3), 131.4 (<sup>2</sup>*J* 9.2), 116.8 (<sup>1</sup>*J* 21.9) (C-Ar), 110.8 (C6). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) compound **4b**: δ = 8.76 (d, <sup>3</sup>*J* 5, 1H, H6), 8.25 (d, 2H, H-Ar), 7.86 (d, <sup>3</sup>*J* 5, 1H, H5), 7.36 (d, 2H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 166.9 (C4), 163.6 (C2), 160.9 (C6), 166.4 (<sup>3</sup>*J* 2), 130.1 (<sup>2</sup>*J* 9) (C-Ar), 113.3 (C5). LCMS MS: = 216.1 [M+H]<sup>+</sup>. Anal. Cald. for C<sub>10</sub>H<sub>6</sub>FN<sub>5</sub> (M+H): 216.0685; found: 216.0664.

**5-(4-Chlorophenyl)tetrazolo[1,5-*a*]pyrimidine (3c)** and **2-azido-4-(4-chlorophenyl)pyrimidine (4c)**: C<sub>10</sub>H<sub>6</sub>ClN<sub>5</sub> (Mw. 231.03). Yield 91%; m. p. 138-140 °C. <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **3c**: δ = 9.69 (d, <sup>3</sup>*J* 7, 1H, H7), 8.30 (d, <sup>3</sup>*J* 8, 2H, H-Ar), 8.11 (d, <sup>3</sup>*J* 7, 1H, H6), 7.63 (d, <sup>3</sup>*J* 8, 2H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 163.9 (C5), 155.0 (C3a), 135.6 (C7), 134.2, 130.4, 129.7, 129.2 (C-Ar), 110.8 (C6). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **4c**: δ = 8.72 (d, <sup>3</sup>*J* 5, 1H, H7), 7.78 (d, <sup>3</sup>*J* 5, 1H, H6), 7.72 (d, <sup>3</sup>*J* 8, 2H, H-Ar), 7.54 (d, <sup>3</sup>*J* 8, 2H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 164.3 (C4), 163.9 (C2), 160.9 (C6), 137.9, 137.0, 129.7, 129.5 (C-Ar), 114.4 (C5). MS (EI, 70 eV): *m/z* % = 231 ((M<sup>+</sup>, 92), 203 (100), 176.7 (28), 82.6 (27). Anal. Cald. for C<sub>10</sub>H<sub>6</sub>ClN<sub>5</sub> (M+H): 232.0390; found: 232.0384.

**5-(4-Bromophenyl)tetrazolo[1,5-*a*]pyrimidine (3d)** and **2-azido-4-(4-bromophenyl)pyrimidine (4d)**: C<sub>10</sub>H<sub>6</sub>BrN<sub>5</sub> (Mw. 274.98). Yield 95%; 147-149°C. <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **3d**: δ = 9.79 (d, <sup>3</sup>*J* 7, 1H, H7), 8.31 (d, <sup>3</sup>*J* 9, 2H, H-Ar), 8.19 (d, <sup>3</sup>*J* 7, 1H, H6), 7.84 (d, <sup>3</sup>*J* 9, 2H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 163.6 (C5), 154.7 (C3a), 135.2 (C7), 132.2, 130.1, 129.0, 126.5 (C-Ar), 110.8 (C6). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **4d**: δ = 8.79 (d, <sup>3</sup>*J* 5, 1H, H6), 8.12 (d, <sup>3</sup>*J* 9, 2H, H-Ar), 7.87 (d, <sup>3</sup>*J* 5, 1H, H5), 7.77 (d, <sup>3</sup>*J* 8.6, 2H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 163.0 (C4), 161.5 (C2), 160.5 (C6), 134.2, 132.2, 130.2, 125.5 (C-Ar), 113.5 (C5). LCMS MS: = 276.1 [M+H]<sup>+</sup>. Anal. Cald. for C<sub>10</sub>H<sub>6</sub>BrN<sub>5</sub> (M+H): 275.9885; found: 275.9870.

**5-(4-Iodophenyl)tetrazolo[1,5-*a*]pyrimidine (3e)** and **2-azido-4-(4-iodophenyl)pyrimidine (4e)**: C<sub>10</sub>H<sub>6</sub>IN<sub>5</sub> (Mw. 322.97). Yield 86%; 167-199°C. <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **3e**: δ = 9.78 (d, <sup>3</sup>*J* 7, 1H, H7), 8.18 (d, <sup>3</sup>*J* 7, 1H, H6), 8.12 (d, <sup>3</sup>*J* 8, 2H, H-Ar), 8.00 (d, <sup>3</sup>*J* 8, 2H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 164.2 (C5), 155.1 (C3a), 135.7 (C7), 138.6, 135.8, 130.4, 129.4, 101.1, (C-Ar), 110.7 (C6). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **4e**: δ = 8.77 (d, <sup>3</sup>*J* 5, 1H, H6), 7.90 (d, <sup>3</sup>*J* 8, 2H, H-Ar), 7.85 (d, <sup>3</sup>*J* 5, 1H, H5), 7.69 (d, <sup>3</sup>*J* 8, 2H, H-Ar). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 164.7 (C4), 162.2 (C2), 161.0 (C6), 138.4, 135.0, 129.4, 99.8 (C-Ar), 113.4 (C5). LCMS MS: = 324 [M+H]<sup>+</sup>.

**5-(4-Methylphenyl)tetrazolo[1,5-*a*]pyrimidine (3f)** and **2-azido-4-(4-methylphenyl)pyrimidine (4f)**: C<sub>11</sub>H<sub>9</sub>N<sub>5</sub> (Mw. 211.09). Yield 89%; 119-121°C. <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **3f**: δ = 9.72 (d, <sup>3</sup>*J* 7, 1H, H7), 8.22 (d, *J* 8, 2H, Ar), 8.13 (d, <sup>3</sup>*J* 7, 1H, H6), 7.37 (d, <sup>3</sup>*J* 8, 2H, Ar), 2.38 (s, 3H, CH<sub>3</sub>). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 164.8 (C5), 155.2 (C3a),

143.3 (C7), 135.3, 132.7, 130.3, 128.6 (C-Ar), 110.6 (C6), 21.5 (CH<sub>3</sub>). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **4f**: 2.48 (s, 3H, CH<sub>3</sub>). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 165.4 (C4), 160.6 (C2), 142.3 (C6), 130.1, 129.7, 129.3, 127.7 (C-Ar), 113.1 (C5), 31.0 (CH<sub>3</sub>). LCMS MS: = 212.1 [M+H]<sup>+</sup>. Anal. Calcd. for C<sub>11</sub>H<sub>9</sub>N<sub>5</sub>: C, 62.55; H, 4.29; N, 33.16; found: C, 62.64; H, 4.24; N, 32.86.

5-(4-Methoxyphenyl)tetrazolo[1,5-*a*]pyrimidine (**3g**) and 2-azido-4-(4-methoxyphenyl)pyrimidine (**4g**): C<sub>11</sub>H<sub>9</sub>N<sub>5</sub>O (Mw. 227.08). Yield 93%; 161-163°C. <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **3g**: δ = 9.69 (d, <sup>3</sup>J 7, 1H, H7), 8.34 (d, <sup>3</sup>J 9, 2H, Ar), 8.14 (d, <sup>3</sup>J 7, 1H, H6), 7.14 (d, <sup>3</sup>J 9, 2H, Ar), 3.86 (s, 3H, OCH<sub>3</sub>). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 163.4 (C5), 155.3 (C3a), 135.1 (C7), 130.7, 129.3, 127.8, 115.2 (C-Ar), 110.4 (C6), 56.0 (OCH<sub>3</sub>). <sup>1</sup>H NMR (400 MHz, DMSO-*d*<sub>6</sub>) for compound **4g**: δ = 8.67 (d, <sup>3</sup>J 5.6, 1H, H6), 8.26 (d, <sup>3</sup>J 8.8, 2H, Ar), 7.79 (d, <sup>3</sup>J 5.3, 1H, H5), 7.05 (d, <sup>3</sup>J 8.8, 2H, Ar), 3.82 (s, 3H, OCH<sub>3</sub>). <sup>13</sup>C NMR (100 MHz, DMSO-*d*<sub>6</sub>): δ = 167.4 (C4), 160.3 (C2), 155.3 (C6), 134.3, 115.0 (C-Ar), 112.7 (C5), 55.9 (OCH<sub>3</sub>). LCMS MS: = 228.1 [M+H]<sup>+</sup>.

7-(Trifluoromethyl)tetrazolo[1,5-*a*]pyrimidine (**5h**) C<sub>5</sub>H<sub>2</sub>F<sub>3</sub>N<sub>5</sub> (Mw. 189.10). Yield 70% (IL) and 40% (toluene). m.p. 120-122°C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ = 8.85 (d, <sup>3</sup>J 5, 1H, H6), 7.38 (d, <sup>3</sup>J 5, 1H, H5). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>): δ = 163.2 (C5), 161.5 (C3a), 157.7 (q, <sup>2</sup>J 36, C7), 119.8 (q, <sup>1</sup>J 275, CF<sub>3</sub>), 112.3 (q, <sup>3</sup>J 2, C6). LCMS MS: = 189 [M+H]<sup>+</sup>.

7-(Trichloromethyl)tetrazolo[1,5-*a*]pyrimidine (**5i**): C<sub>5</sub>H<sub>2</sub>Cl<sub>3</sub>N<sub>5</sub> (Mw. 238.46). Yield 68% (IL) and 77% (toluene). Oil. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ = 8.80 (d, <sup>3</sup>J 5, 1H, H6), 7.67 (d, <sup>3</sup>J 5, 1H, H5). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>): δ = 168.0 (C5), 162.3 (C3a), 161.5 (C7), 111.3 (C6), 94.8 (CCl<sub>3</sub>). LCMS MS: 238 [M+H]<sup>+</sup>.

5-Phenyl-7-(trichloromethyl)tetrazolo[1,5-*a*]pyrimidine (**6h**): C<sub>11</sub>H<sub>6</sub>Cl<sub>3</sub>N<sub>5</sub> (Mw. 314.56). Yield 82%; 125-126°C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ = 7.50 (s, 1H, H6), 2.61 (s, 3H, CH<sub>3</sub>). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>): δ = 172.9 (C5), 167.4 (C3a), 161.9 (C7), 110.7 (C6), 94.9 (CCl<sub>3</sub>), 24.4 (CH<sub>3</sub>). MS (EI, 70 eV): 313 (27), 250 (100), 187 (29), 77 (37). Anal. Calcd.: C, 42.00; H, 1.92; N, 22.26; found: C, 42.66; H, 1.85; N, 21.12.

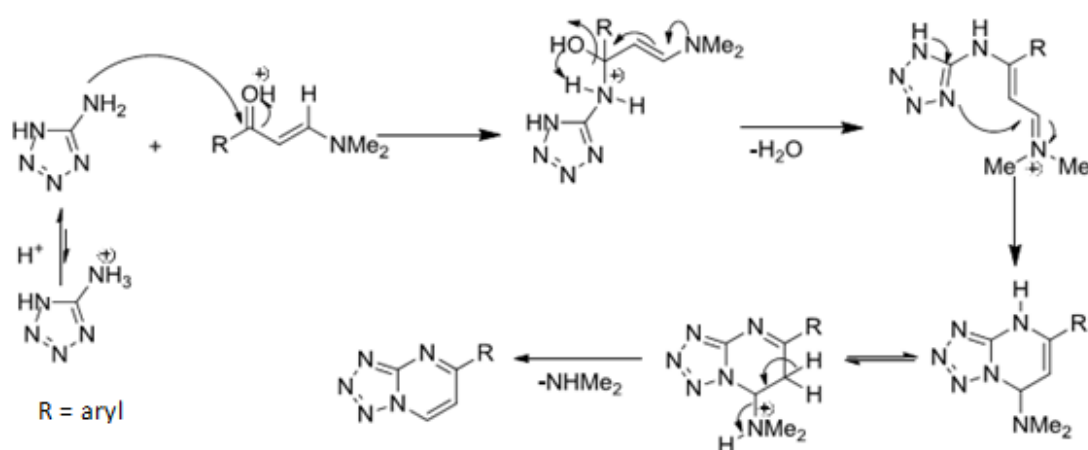
5-methyl-7-(trichloromethyl)tetrazolo[1,5-*a*]pyrimidine (**6i**): C<sub>6</sub>H<sub>4</sub>Cl<sub>3</sub>N<sub>5</sub> (Mw. 252.49). Yield 74%; 83°C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ = 8.14-8.19 (m, 2H, H-Ar), 8.06 (s, 1H, H6), 7.50-7.60 (m, 3H, H-Ar). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>): δ = 168.9 (C5), 168.6 (C3a), 162.4 (C7), 135.1, 132.3, 129.1, 127.6 (C-Ar), 106.9 (C6), 95.2 (CCl<sub>3</sub>). MS (EI, 70 eV): 251.9 (58), 215.9 (100). Anal. Calcd.: C, 28.54; H, 1.60; N, 27.74; found: C, 28.72; H, 1.87; N, 27.71.

4-Phenyl-2-(4-phenyl-1H-1,2,3-triazol-1-yl)-6-(trifluoromethyl)pyrimidine (**8a**): C<sub>19</sub>H<sub>12</sub>F<sub>3</sub>N<sub>5</sub> (Mw. 367.33). Yield 91%; 179-181°C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ = 8.88 (s, 1H, H5'), 8.30 (m, 2H, H-Ar), 8.07 (s, 1H, H5), 8.00 (d, 2H, <sup>3</sup>J 7, H-Ar), 7.59-7.67 (m, 3H, H-Ar), 7.49 (t, 2H, H-Ar), 7.40 (t, 1H, H-Ar), 7.29 (dd, 2H, <sup>3</sup>J 8, <sup>3</sup>J 9, H-Ar). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>): δ = 168.4 (C4), 158.3 (q, <sup>2</sup>J 37, C6), 154.9 (C2), 148.3 (C4'), 165.9 (d, <sup>1</sup>J 255, CAr), 130.4 (d, <sup>3</sup>J 3), 130.3 (d, <sup>2</sup>J 9), 129.6, 128.9, 128.8, 126.1, 120.1 (q, <sup>1</sup>J 275.6, CF<sub>3</sub>), 118.5 (C5'), 111.0 (C5). LCMS MS: = 368.2 [M+H]<sup>+</sup>. Anal. Calcd.: C, 62.13; H, 3.29; N, 19; found: C, 61.76; H, 3.42; N, 18.63.

4-(4-Bromophenyl)-2-(4-phenyl-1H-1,2,3-triazol-1-yl)-6-(trifluoromethyl)pyrimidine (**8b**): Yield 93%; 177-179°C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ = 8.84 (s, 1H, H5'), 8.06 (d, <sup>3</sup>J 3, 1H, H-Ar), 7.99 (d, 2H, <sup>3</sup>J 7, H-Ar), 7.85 (s, 1H, H5), 7.74 (d, <sup>3</sup>J 4, 1H, H-Ar), 7.49 (t, <sup>3</sup>J 7, 2H, H-Ar), 7.40 (t, <sup>3</sup>J 7, 1H, H-Ar), 7.28 (d, <sup>3</sup>J 4, 1H, H-Ar). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>): δ = 168.5 (C4), 158.4 (q, <sup>2</sup>J 37, C6), 154.9 (C2), 148.4 (C4'), 133.0 (CAr), 132.7, 129.5, 129.3, 128.9, 128.8, 128.3, 126.1, 120.1 (q, <sup>1</sup>J 276, CF<sub>3</sub>), 118.6 (C5'), 111.2 (q, <sup>3</sup>J 2, 5, C5). HRMS (ESI-TOF) *m/z*: [M + H]<sup>+</sup> Calcd., for C<sub>19</sub>H<sub>12</sub>BrF<sub>3</sub>N<sub>5</sub> 446.0228, found: 446.0231.

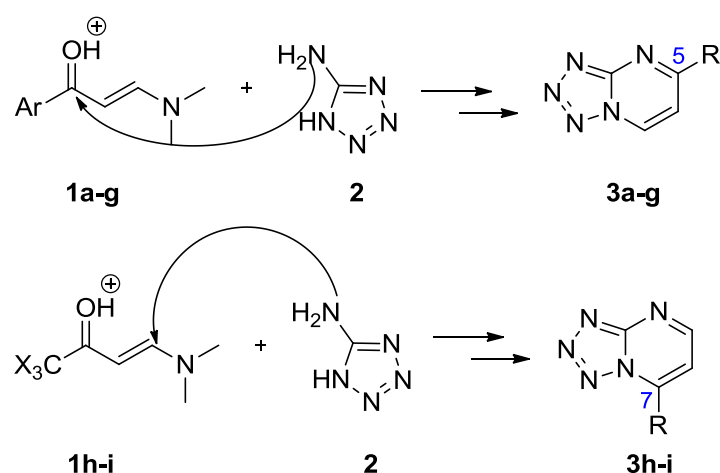
**4-(4-Methoxyphenyl)-2-(4-phenyl-1H-1,2,3-triazol-1-yl)-6-(trifluoromethyl)pyrimidine (8c):** Yield 93%; 132-134°C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>): δ = 8.81 (s, 1H, H5'), 8.21 (d, <sup>3</sup>J 9, 2H, H-Ar), 7.95 (d, <sup>3</sup>J 7, 2H, H-Ar), 7.91 (s, 1H, H5), 7.48-7.35 (m, 3H, H-Ar), 7.01 (d, <sup>3</sup>J 9, 2H, H-Ar), 3.87 (s, 3H, OCH<sub>3</sub>). <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>): δ = 168.8 (C4), 163.9 (C2), 157.7 (q, <sup>2</sup>J 36, C6), 154.8 (C4'), 129.8, 129.7, 128.8, 128.6, 126.6, 126.1 (C-Ar), 120.3 (q, <sup>1</sup>J 275, CF<sub>3</sub>), 114.8 (C5'), 110.3 (q, <sup>3</sup>J 2, C5), 55.5 (OCH<sub>3</sub>). HRMS (ESI-TOF) *m/z*: [M + H]<sup>+</sup> Calcd., for C<sub>20</sub>H<sub>14</sub>F<sub>3</sub>N<sub>5</sub>O 398.1229, found: 398.1233.

## 2. Tetrazolo[1,5-*a*]pyrimidines synthesis

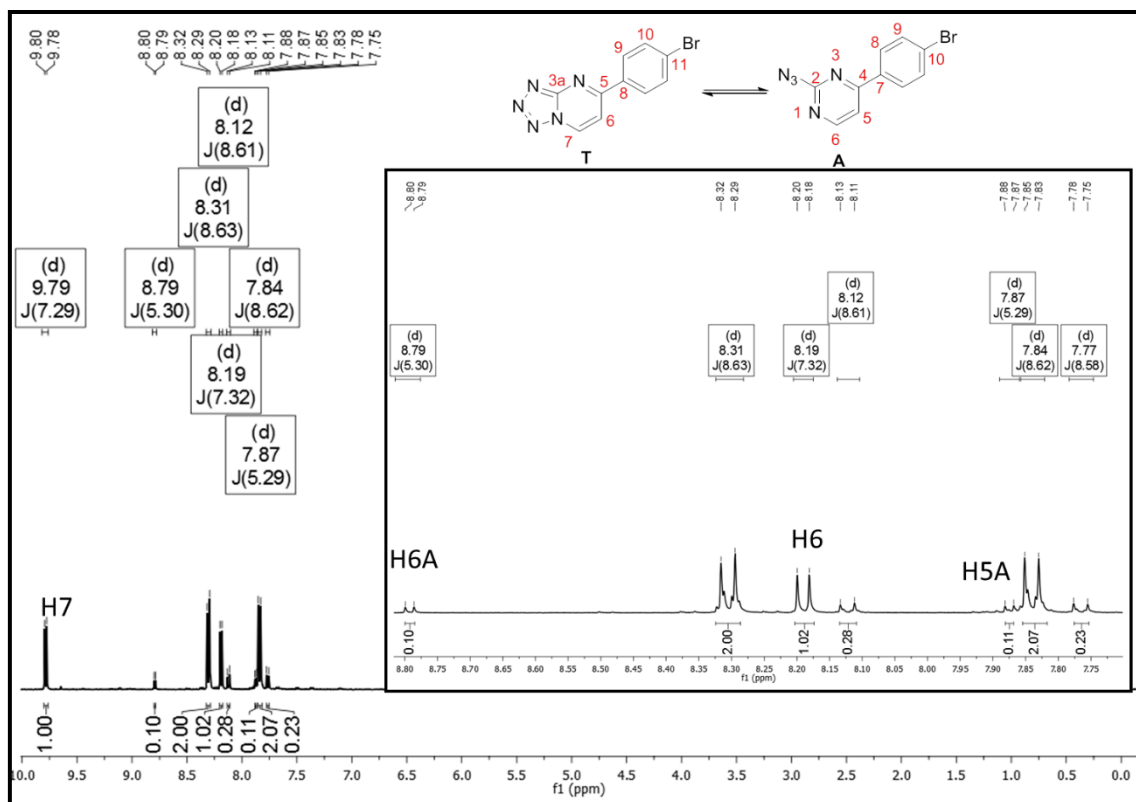


**Figure S1:** Scheme that illustrate the mechanism of tetrazolo[1,5-*a*]pyrimidines formation from β-enaminone and 5-aminotetrazole.

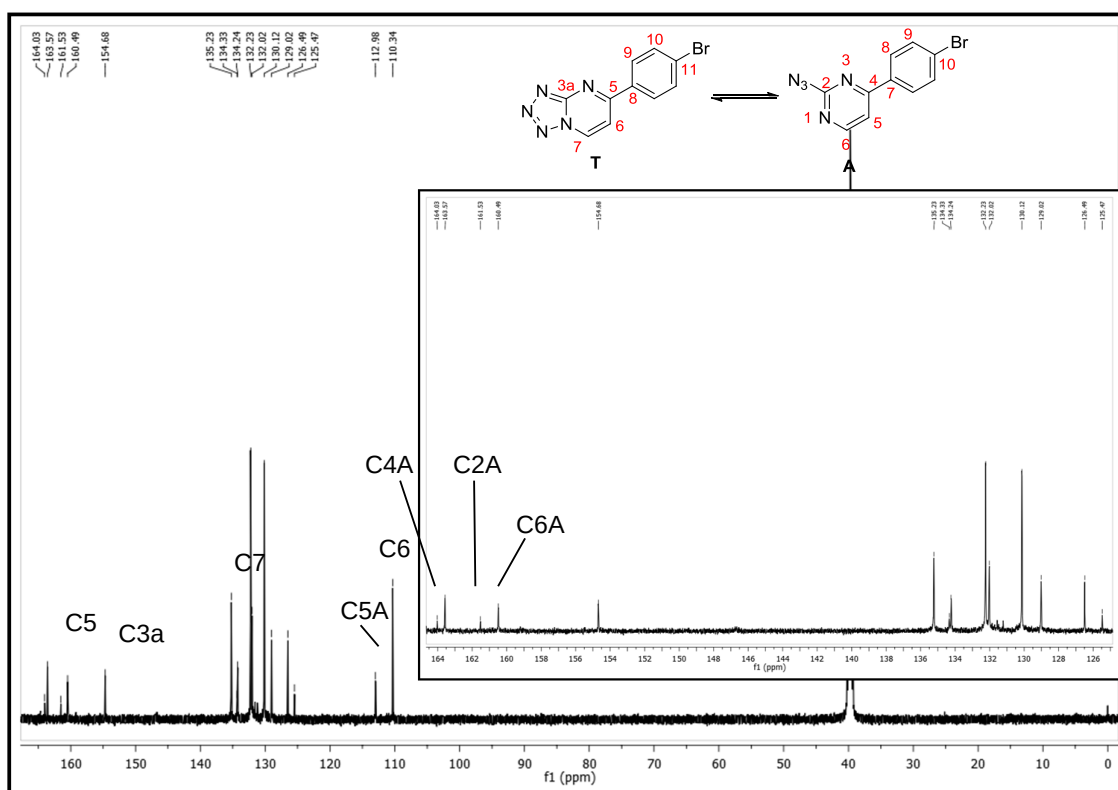
## 3. Regiochemistry of the reactions according with β-enaminones substituent



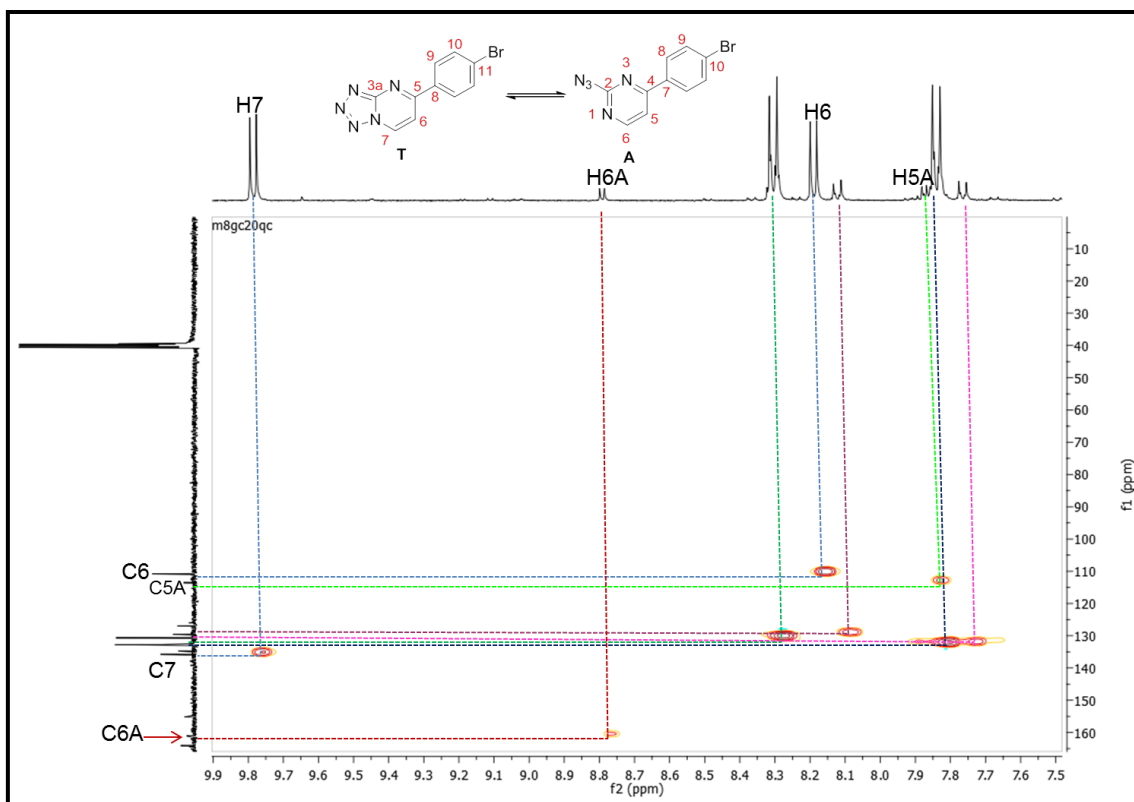
**Figure S2:** The scheme illustrate the first nucleophilic attack which lead to different tetrazolo[1,5-*a*]pyrimidines, according with β-enaminone substituent.



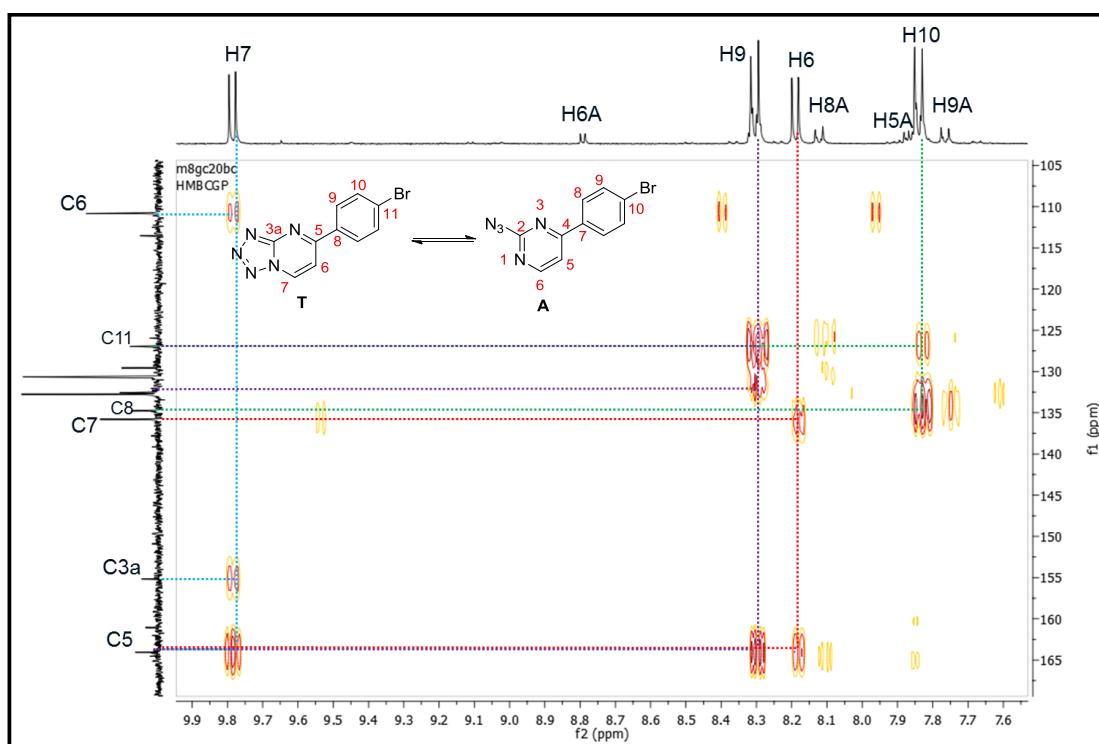
**Figure S3:** <sup>1</sup>H NMR of compound 3d⇌4d in DMSO-*d*<sub>6</sub> at 25 °C.



**Figure S4:** <sup>13</sup>C NMR of compound 3d⇌4d in DMSO-*d*<sub>6</sub> at 25 °C.

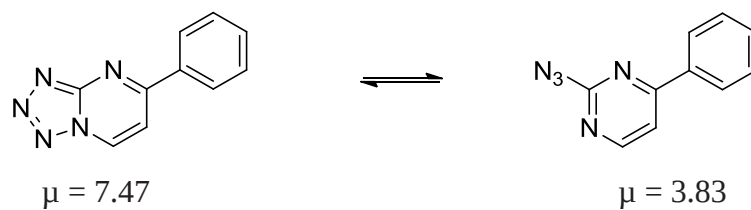


**Figure S5:**  $^1\text{H}$ - $^{13}\text{C}$  HMQC NMR of compound  $3\text{d} \rightleftharpoons 4\text{d}$  in  $\text{DMSO-}d_6$  at  $25\text{ }^\circ\text{C}$ .

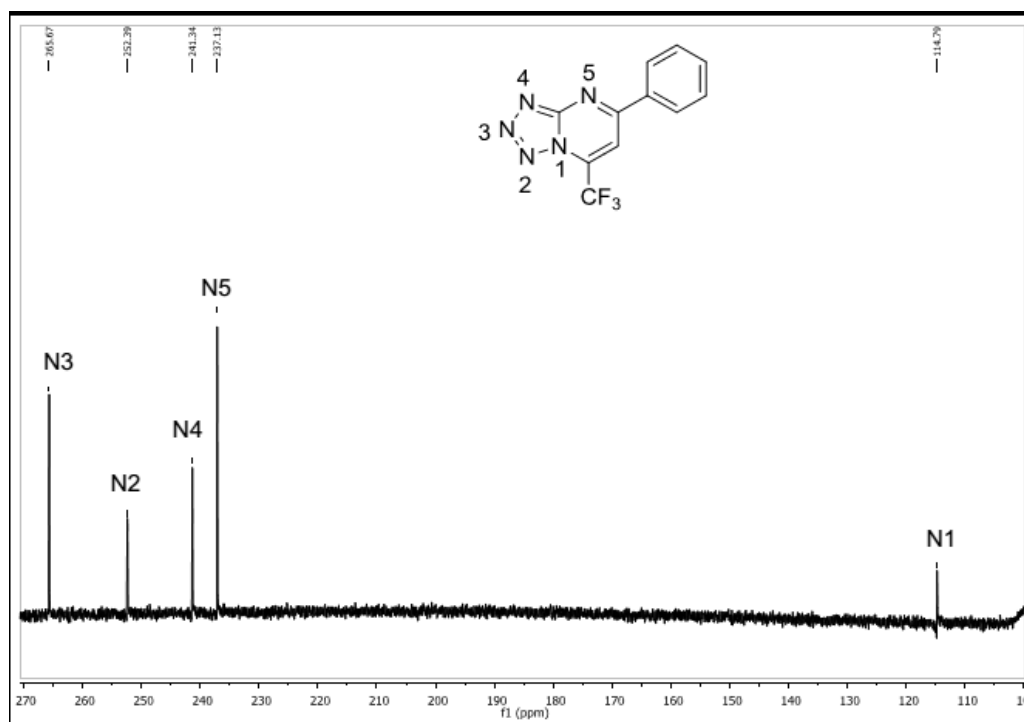


**Figure S6:**  $^1\text{H}$ - $^{13}\text{C}$  HMBC NMR of compound  $3\text{d} \rightleftharpoons 4\text{d}$  in  $\text{DMSO-}d_6$  at  $25\text{ }^\circ\text{C}$ .

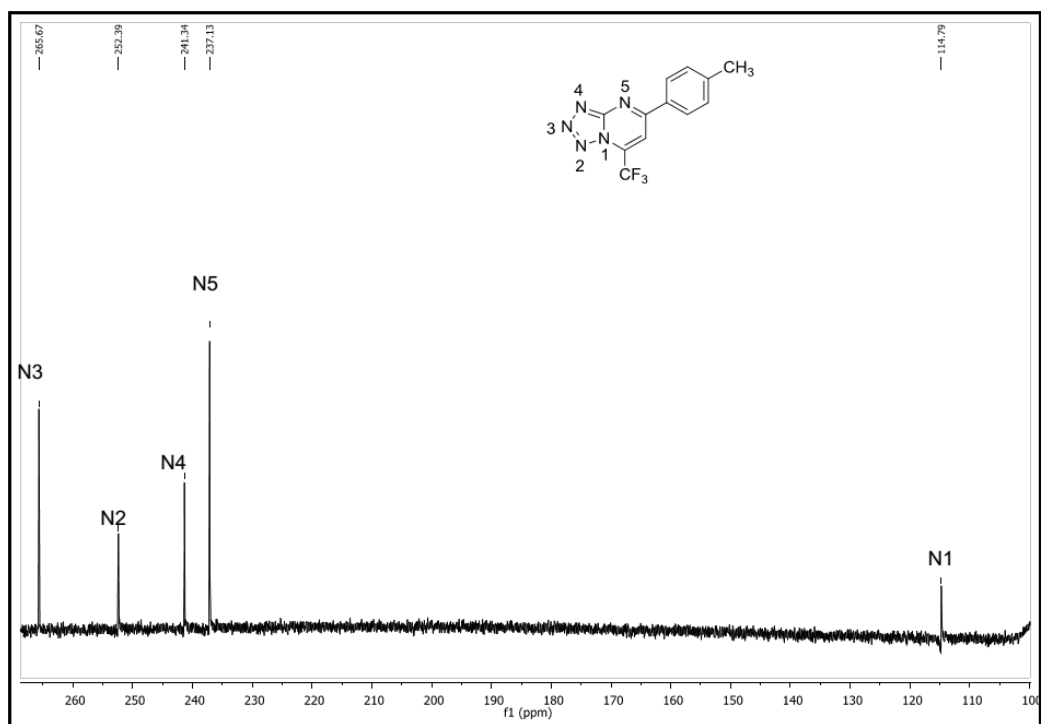
#### 4. The equilibrium of tetrazolo[1,5-*a*]pyrimidines in solution



**Figure S7:** Dipole moment for **3a** and **4a**.



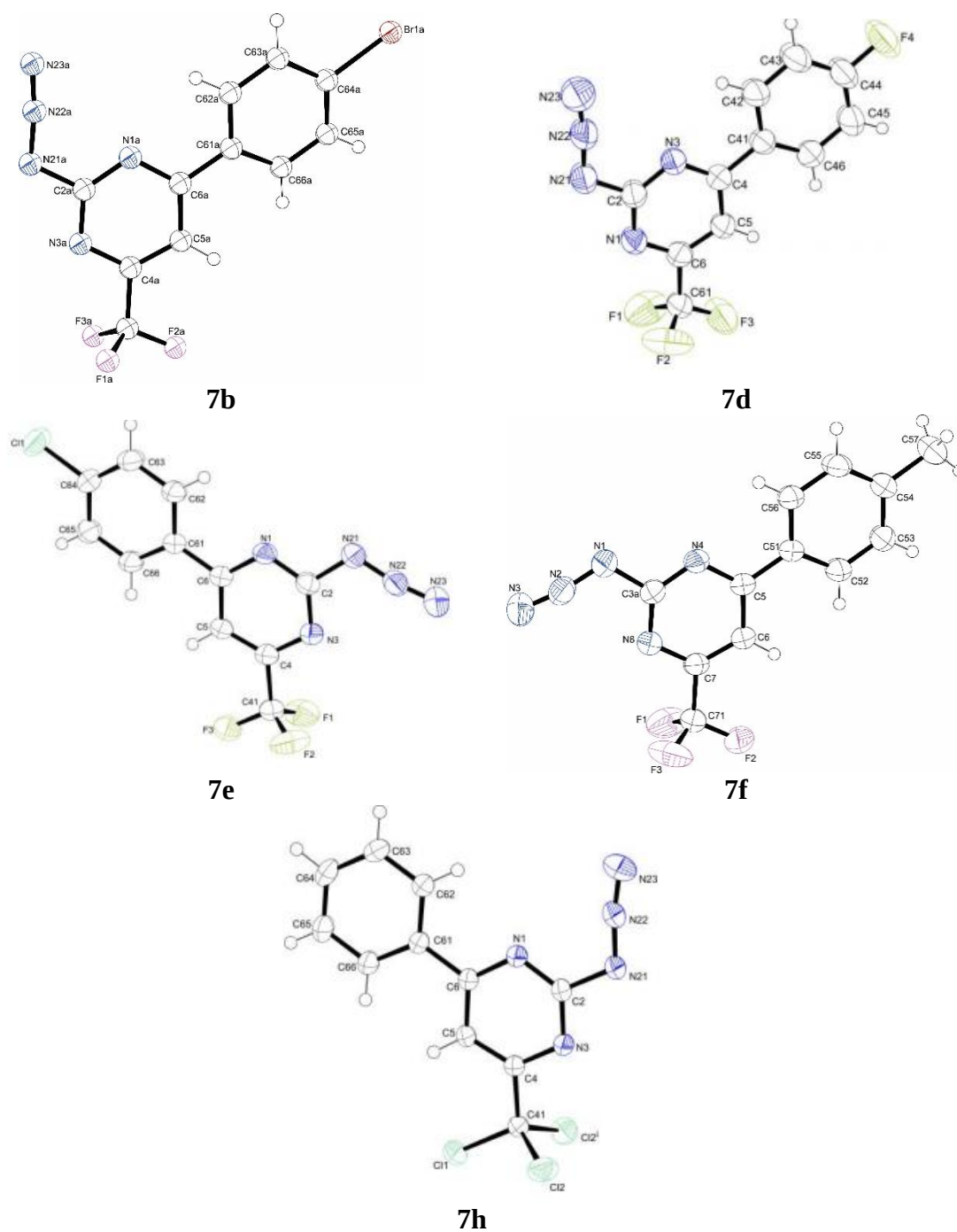
**Figure S8:**  $^{15}\text{N}$  NMR spectra for compound 5-phenyl-7-trifluoromethyltetrazolo[1,5-*a*]pyrimidine (**6a**) in  $\text{CDCl}_3$ .



**Figure S9:** <sup>15</sup>N NMR spectra for compound 5-(4-methylphenyl)-7-(trifluoromethyl)tetrazolo[1,5-a]pyrimidine (**6g**) in CDCl<sub>3</sub>.



## 5. ORTEP and crystallographic data



**Figure S10:** ORTEP<sup>®</sup> [1] of **7b**, **7d**, **7e,f**, **7h** with thermal ellipsoids drawn at 50% probability level.

**Table S1:** Crystallographic Data for compounds **7a**, **7b**, **7d** and **7e**

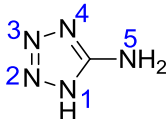
| Compound                                       | <b>7a</b>                                                    | <b>7b</b>                                                      | <b>7d</b>                                                    | <b>7e</b>                                                      |
|------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------------------|
| CCDC                                           | 1055527                                                      | 1055528                                                        | 1561853                                                      | 1055526                                                        |
| Empirical formula                              | C <sub>11</sub> H <sub>6</sub> F <sub>3</sub> N <sub>5</sub> | C <sub>11</sub> H <sub>5</sub> BrF <sub>3</sub> N <sub>5</sub> | C <sub>11</sub> H <sub>5</sub> F <sub>4</sub> N <sub>5</sub> | C <sub>11</sub> H <sub>5</sub> ClF <sub>3</sub> N <sub>5</sub> |
| Molecular weight                               | 265.21                                                       | 344.11                                                         | 283.20                                                       | 299.65                                                         |
| Temperature (K)                                | 293 (2)                                                      | 293 (2)                                                        | 293 (2)                                                      | 293 (2)                                                        |
| Crystal system                                 | Monoclinic                                                   | Triclinic                                                      | Triclinic                                                    | Monoclinic                                                     |
| Space group                                    | C2/c                                                         | P-1                                                            | P-1                                                          | C2/c                                                           |
| Cell parameters                                |                                                              |                                                                |                                                              |                                                                |
| a (Å)                                          | 9.6721(3)                                                    | 8.1168(4)                                                      | 7.7390(4)                                                    | 21.9971(7)                                                     |
| b (Å)                                          | 18.4409(7)                                                   | 11.9327(7)                                                     | 11.7442(6)                                                   | 4.9657(2)                                                      |
| c (Å)                                          | 13.2081(4)                                                   | 15.2077(9)                                                     | 14.0976(7)                                                   | 22.1893(8)                                                     |
| α (°)                                          | 90                                                           | 67.481(3)                                                      | 73.475(3)                                                    | 90                                                             |
| β (°)                                          | 103.411(2)                                                   | 87.182(3)                                                      | 83.479(3)                                                    | 99.812(2)                                                      |
| γ (°)                                          | 90                                                           | 71.989(3)                                                      | 76.629(3)                                                    | 90                                                             |
| V (Å <sup>3</sup> )                            | 2291.59 (13)                                                 | 1289.94                                                        | 1193.52                                                      | 2388.30                                                        |
| Z                                              | 8                                                            | 4                                                              | 4                                                            | 8                                                              |
| Calcd. density (g.cm <sup>-3</sup> )           | 1.537                                                        | 1.772                                                          | 1.576                                                        | 1.667                                                          |
| Abs. Coef. (mm <sup>-1</sup> )                 | 0.134                                                        | 3.219                                                          | 0.145                                                        | 0.355                                                          |
| F (000)                                        | 1072                                                         | 672                                                            | 568                                                          | 1200                                                           |
| Crystal size (mm)                              | 0.44 x 0.35 x<br>0.25                                        | 0.68 x 0.13 x<br>0.12                                          | 0.65 x 0.63 x<br>0.39                                        | 0.58 x 0.39 x<br>0.32                                          |
| θ data collection (deg)                        | 2.21 to 28.37                                                | 1.45 to 27.85                                                  | 1.85 to 27.28                                                | 1.86 to 27.17                                                  |
| h,k,l range                                    | -12≤h≤12,<br>-19≤k≤24,<br>-17≤l≤17                           | -10≤h≤10,<br>-15≤k≤15,<br>-19≤l≤19                             | -9≤h≤9,<br>-15≤k≤15,<br>-18≤l≤18                             | -28≤h≤28,<br>-6≤k≤6,<br>-28≤l≤28                               |
| Reflections collected/unique                   | 33551 / 2868<br>[R(int) = 0.0263]                            | 39166 / 5980<br>[R(int) = 0.0368]                              | 28216 / 5315<br>[R(int) = 0.0239]                            | 16975 / 2659<br>[R(int) = 0.0214]                              |
| Data/restraints/parameters                     | 2868 / 0 / 172                                               | 5980 / 0 / 361                                                 | 5315 / 0 / 361                                               | 2659 / 0 / 181                                                 |
| Absorption correction                          | Gaussian                                                     | Gaussian                                                       | Gaussian                                                     | Gaussian                                                       |
| Refinement method                              | Full-matrix least-squares on F <sup>2</sup>                  | Full-matrix least-squares on F <sup>2</sup>                    | Full-matrix least-squares on F <sup>2</sup>                  | Full-matrix least-squares on F <sup>2</sup>                    |
| Final R indices                                | R1 = 0.0500,<br>wR2 = 0.1362                                 | R1 = 0.0534,<br>wR2 = 0.1475                                   | R1 = 0.0588,<br>wR2 = 0.1754                                 | R1 = 0.0373,<br>wR2 = 0.0948                                   |
| R all data                                     | R1 = 0.0657,<br>wR2 = 0.1484                                 | R1 = 0.0997,<br>wR2 = 0.1708                                   | R1 = 0.0786,<br>wR2 = 0.2035                                 | R1 = 0.0451,<br>wR2 = 0.1005                                   |
| Goodness of fit on F <sup>2</sup>              | 1.066                                                        | 1.072                                                          | 0.790                                                        | 1.051                                                          |
| Largest diff. peak and hole(eÅ <sup>-3</sup> ) | 0.467 and -0.334                                             | 0.977 and -0.811                                               | 0.671 and -0.399                                             | 0.292 and -0.262                                               |

**Table S2:** Crystallographic Data for compounds **7f**, **7h** and **8i**

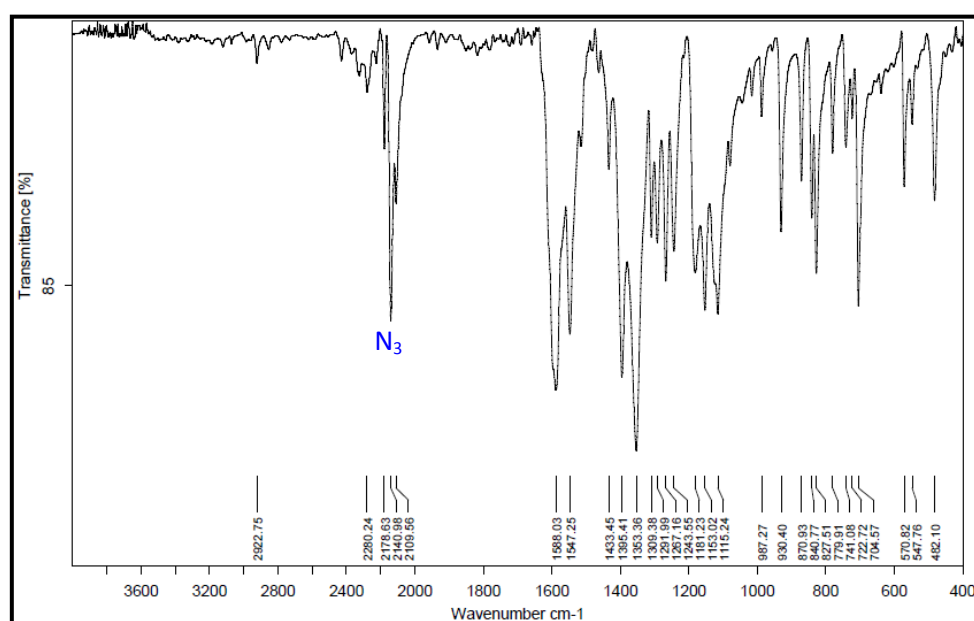
| Compound                                       | <b>7f</b>                                                                  | <b>7h</b>                                                                  | <b>8i</b>                                                                  |
|------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| CCDC                                           | 1055530                                                                    | 1055529                                                                    | 1042114                                                                    |
| Empirical formula                              | C <sub>12</sub> H <sub>8</sub> F <sub>3</sub> N <sub>5</sub>               | C <sub>11</sub> H <sub>6</sub> Cl <sub>3</sub> N <sub>5</sub>              | C <sub>6</sub> H <sub>4</sub> Cl <sub>3</sub> N <sub>5</sub>               |
| Molecular weight                               | 279.23                                                                     | 314.56                                                                     | 252.49                                                                     |
| Temperature (K)                                | 293                                                                        | 100                                                                        | 100                                                                        |
| Crystal system                                 | Monoclinic                                                                 | Orthorhombic                                                               | Monoclinic                                                                 |
| Space group                                    | C2/c                                                                       | Pnma                                                                       | P2 <sub>1</sub> /c                                                         |
| Cell parameters                                |                                                                            |                                                                            |                                                                            |
| a (Å)                                          | 21.9497(14)                                                                | 18.9696(8)                                                                 | 8.2837(3)                                                                  |
| b (Å)                                          | 4.9922(4)                                                                  | 6.7126(3)                                                                  | 8.9787(3)                                                                  |
| c (Å)                                          | 22.4848(16)                                                                | 10.0801(4)                                                                 | 13.4877(4)                                                                 |
| $\alpha$ (°)                                   | 90 deg.                                                                    | 90.                                                                        | 90                                                                         |
| $\beta$ (°)                                    | 100.799(4)                                                                 | 90                                                                         | 105.6690(10)                                                               |
| $\gamma$ (°)                                   | 90                                                                         | 90                                                                         | 90                                                                         |
| V (Å <sup>3</sup> )                            | 2420.2                                                                     | 1283.55                                                                    | 965.89                                                                     |
| Z                                              | 8                                                                          | 4                                                                          | 4                                                                          |
| Calcd. density (g.cm <sup>-3</sup> )           | 1.533                                                                      | 1.628                                                                      | 1.736                                                                      |
| Abs. Coef. (mm <sup>-1</sup> )                 | 0.131                                                                      | 0.705                                                                      | 0.913                                                                      |
| F (000)                                        | 1136                                                                       | 632                                                                        | 504                                                                        |
| Crystal size (mm)                              | 0.83 x 0.40 x 0.32                                                         | 0.72 x 0.49 x 0.24                                                         | 0.62 x 0.49 x 0.46                                                         |
| $\theta$ data collection (deg)                 | 1.84 to 28.35                                                              | 2.15 to 27.21                                                              | 2.55 to 27.10                                                              |
| h,k,l range                                    | -28 $\leq$ h $\leq$ 28,<br>-4 $\leq$ k $\leq$ 6,<br>-30 $\leq$ l $\leq$ 29 | -24 $\leq$ h $\leq$ 24,<br>-8 $\leq$ k $\leq$ 8,<br>-12 $\leq$ l $\leq$ 12 | -6 $\leq$ h $\leq$ 10,<br>-11 $\leq$ k $\leq$ 9,<br>-16 $\leq$ l $\leq$ 14 |
| Reflections collected/unique                   | 18808 / 3016<br>[R(int) = 0.0313]                                          | 18393 / 1551 [R(int)<br>= 0.0188]                                          | 13530 / 2028 [R(int)<br>= 0.0189]                                          |
| Data/restraints/parameters                     | 3016 / 0 / 181                                                             | 1551 / 0 / 112                                                             | 2028 / 0 / 127                                                             |
| Absorption correction                          | Gaussian                                                                   | Gaussian                                                                   | Gaussian                                                                   |
| Refinement method                              | Full-matrix least-squares on F <sup>2</sup>                                | Full-matrix least-squares on F <sup>2</sup>                                | Full-matrix least-squares on F <sup>2</sup>                                |
| Final R indices                                | R1 = 0.0506,<br>wR2 = 0.1416                                               | R1 = 0.0277,<br>wR2 = 0.0771                                               | R1 = 0.0420,<br>wR2 = 0.1086                                               |
| R all data                                     | R1 = 0.0702,<br>wR2 = 0.1558                                               | R1 = 0.0300,<br>wR2 = 0.0793                                               | R1 = 0.0499,<br>wR2 = 0.1160                                               |
| Goodness of fit on F <sup>2</sup>              | 1.052                                                                      | 1.080                                                                      | 1.065                                                                      |
| Largest diff. peak and hole(eÅ <sup>-3</sup> ) | 0.454 and -0.253                                                           | 0.348 and -0.223                                                           | 0.509 and -0.462                                                           |

## 6. HOMO coefficients

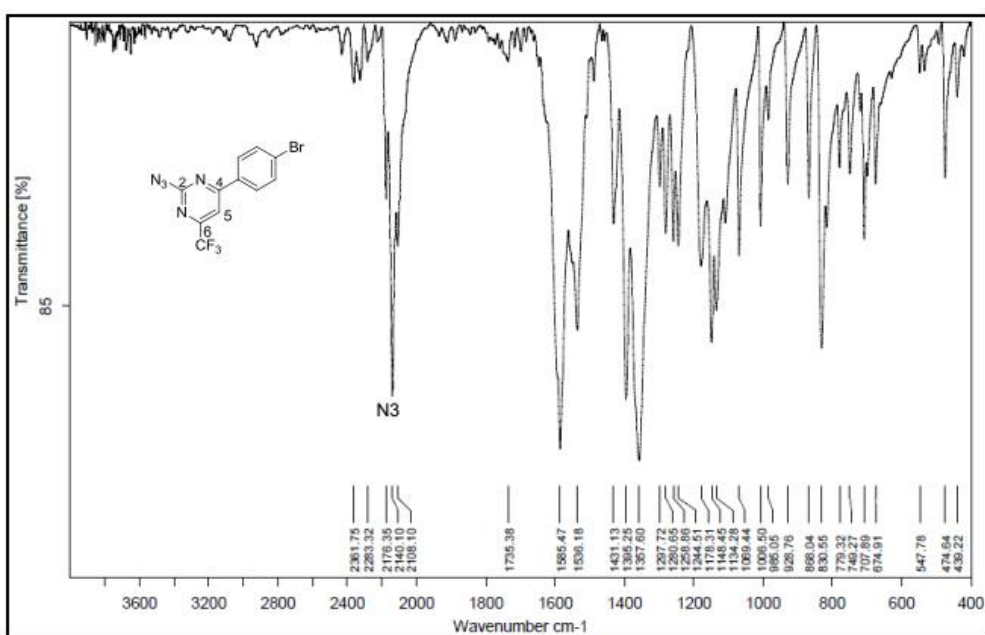
**Table S3:** HOMO coefficients for the aminotetrazole nucleophile.

|  | 1     | 2     | 3     | 4     | 5     |
|-----------------------------------------------------------------------------------|-------|-------|-------|-------|-------|
|                                                                                   | 0.077 | 0.193 | 0.094 | 0.182 | 0.232 |

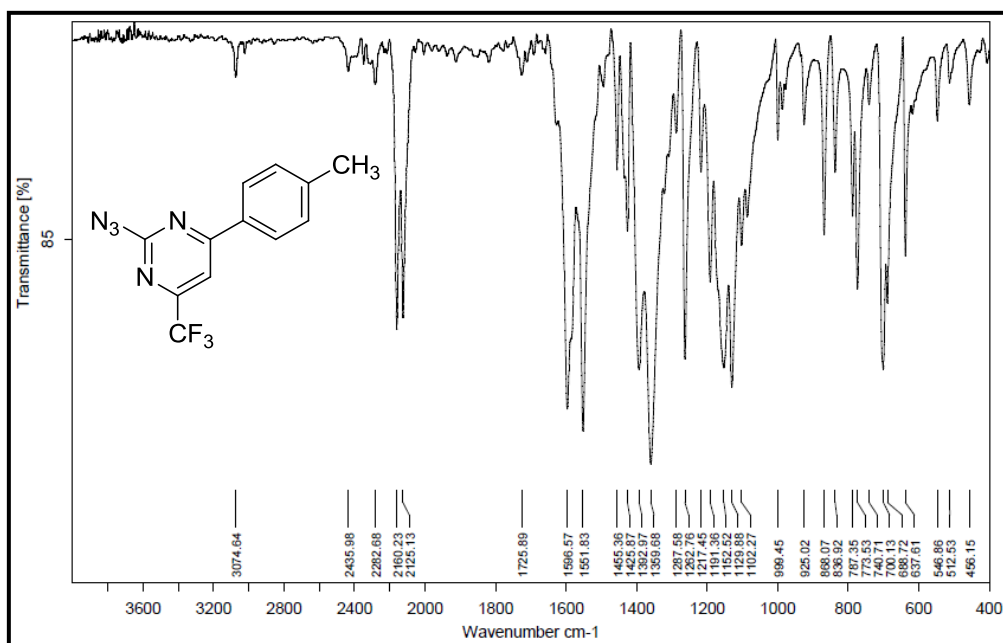
## 7. FTIR spectrum of compounds **7a,b** and **7f**



**Figure S11:** FTIR spectra of compound **7a** using KBr pellet.

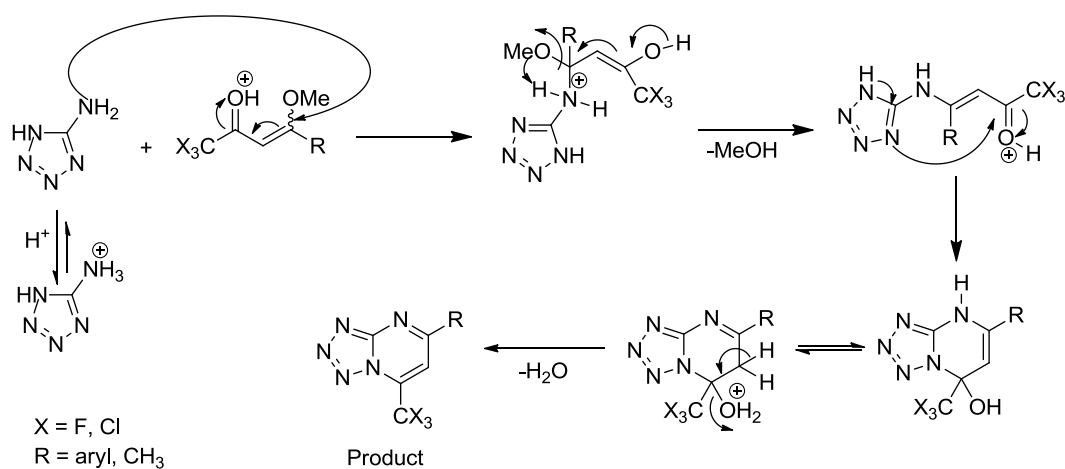


**Figure S12:** FTIR spectra of compound **7b** using KBr pellet.



**Figure S13:** FTIR spectra of compound **7f** using KBr pellet.

## 8. Mechanism of trifluoromethylated tetrazolo[1,5-*a*]pyrimidines (**6a–i**) formation.



**Figure S14:** Scheme that demonstrate the mechanism of trifluoromethylated tetrazolo[1,5-*a*]pyrimidines (**6a–i**) formation.

9. NMR spectrum of compound **3b-f**, **5i**, **6h-i** and **8a-c**

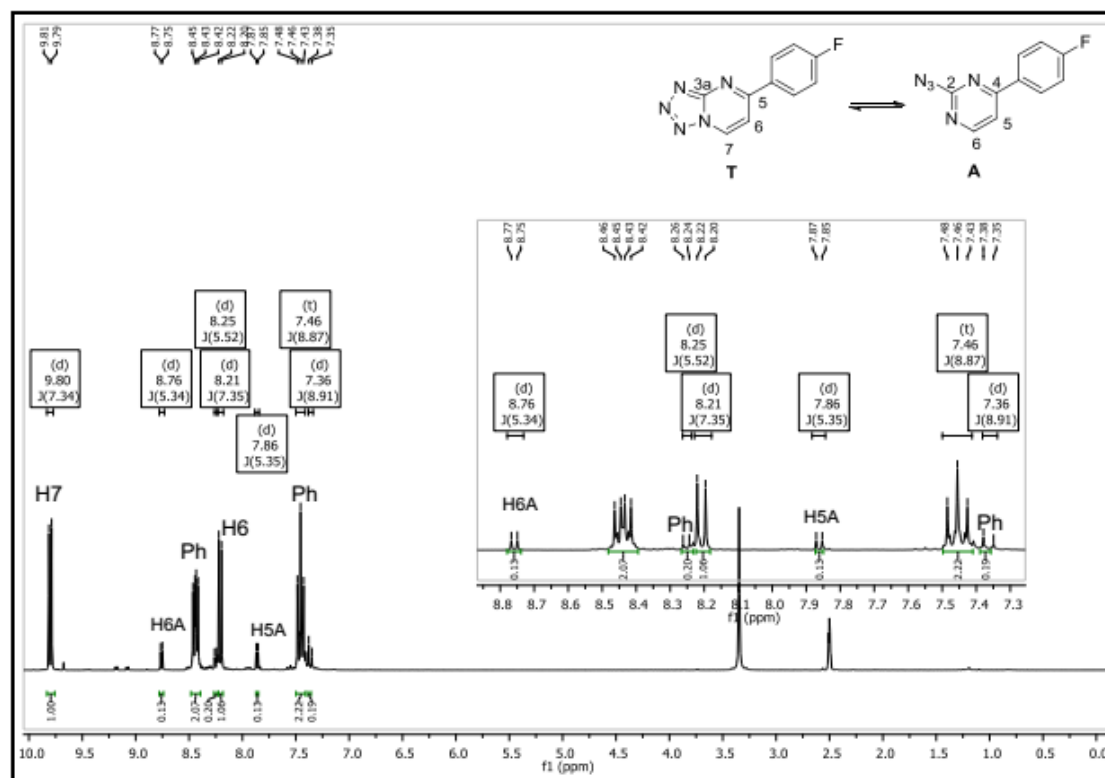


Figure S15:  $^1\text{H}$  NMR of compound **3b** in  $\text{DMSO}-d_6$ .

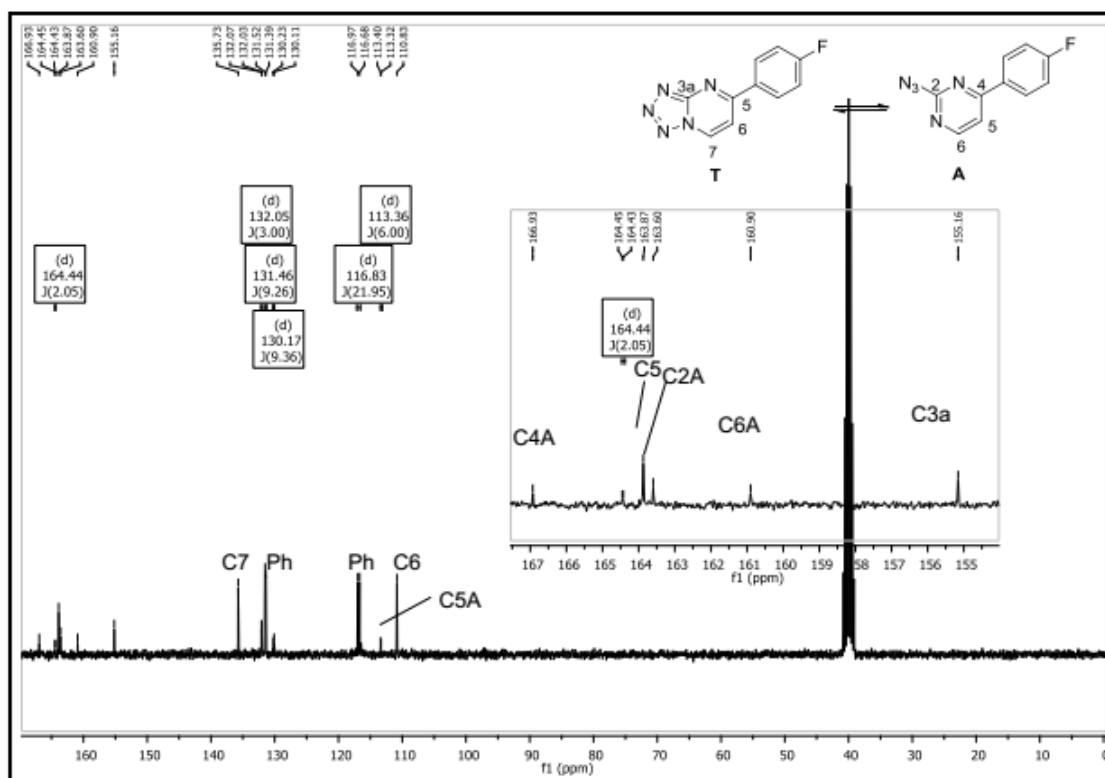
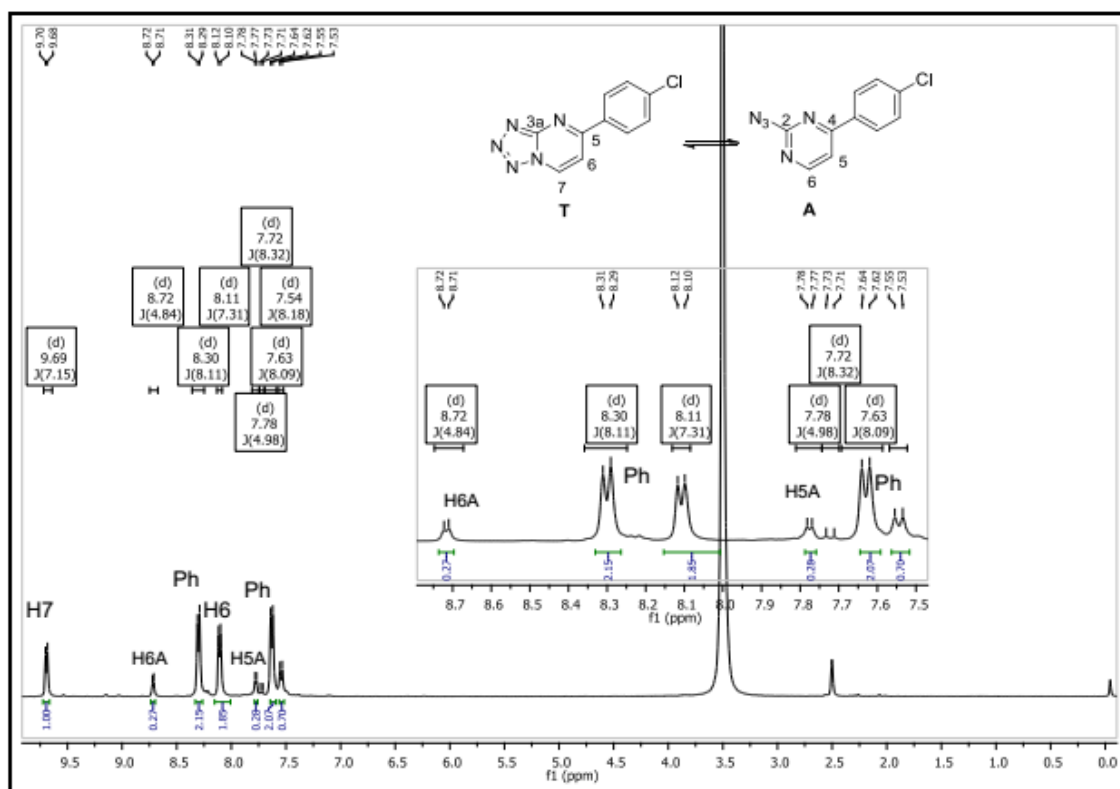
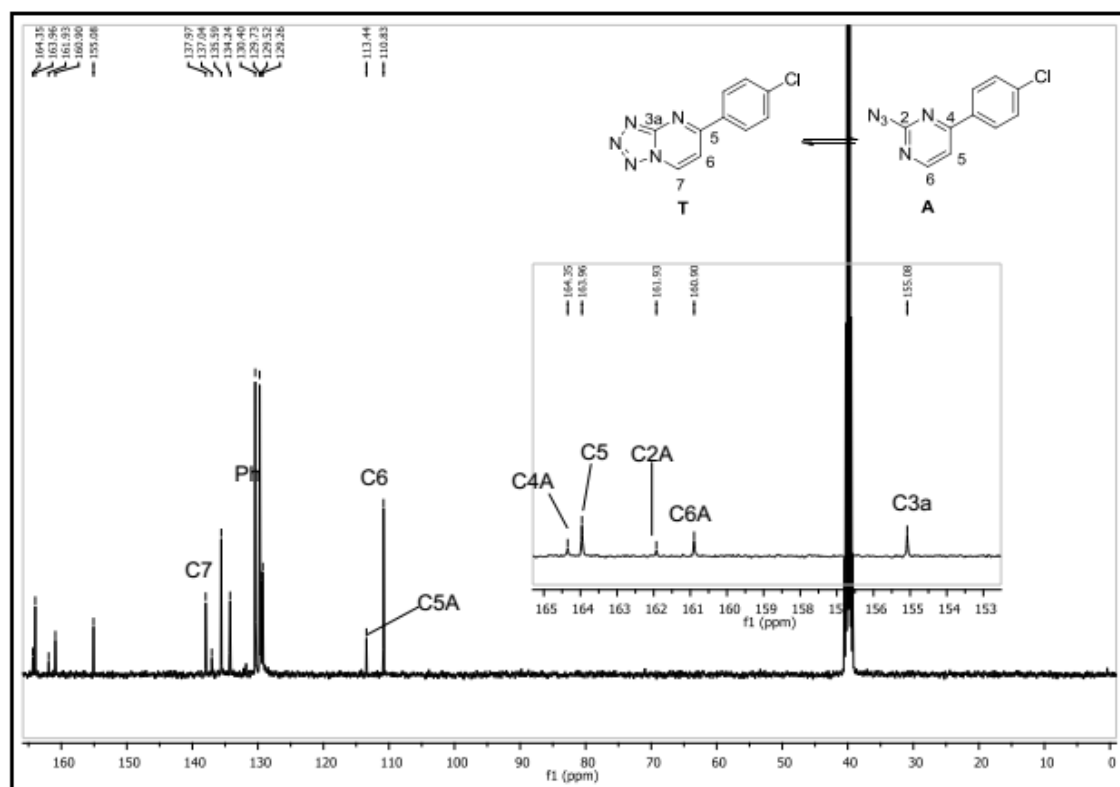


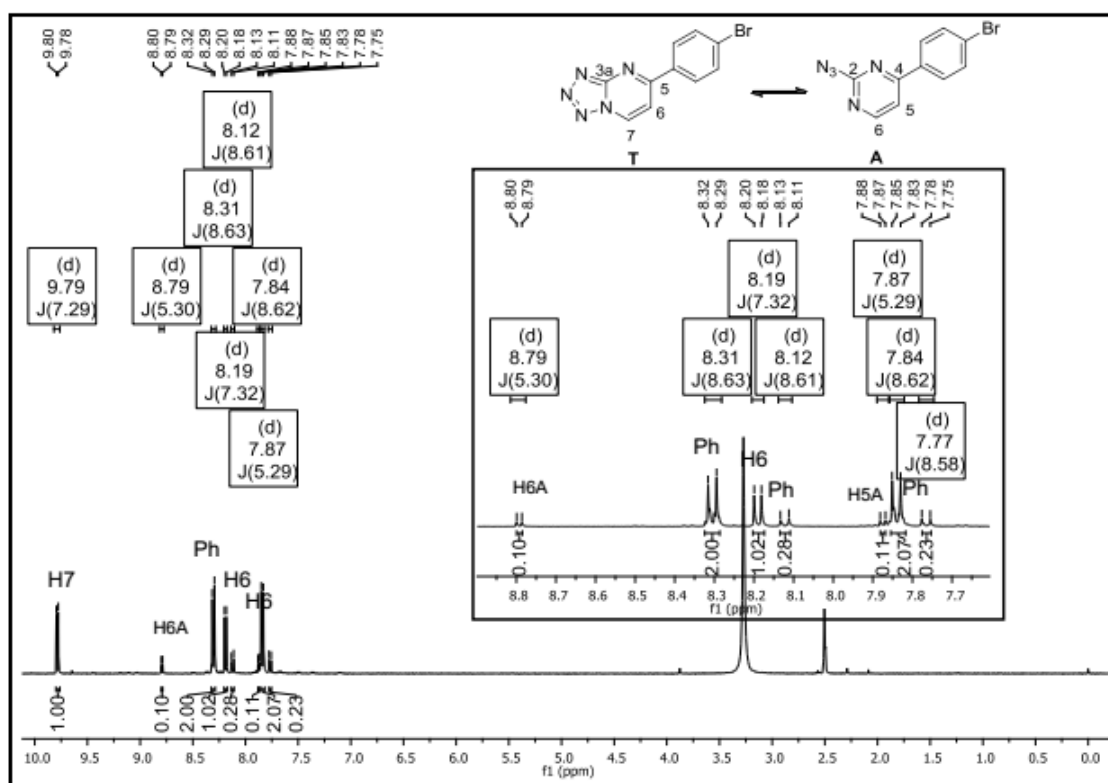
Figure S16:  $^{13}\text{C}$  NMR of compound **3b** in  $\text{DMSO}-d_6$ .



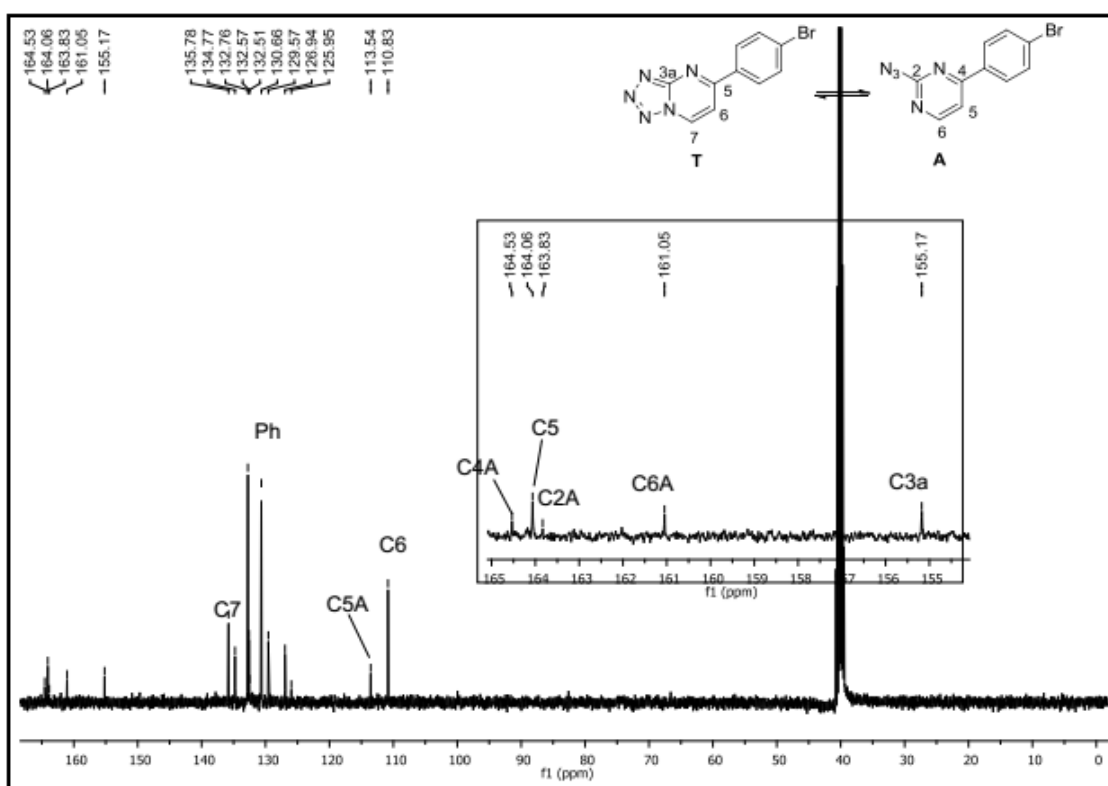
**Figure S17:**  $^1\text{H}$  NMR of compound 3c in  $\text{DMSO}-d_6$ .



**Figure S18:**  $^{13}\text{C}$  NMR of compound 3c in  $\text{DMSO}-d_6$ .

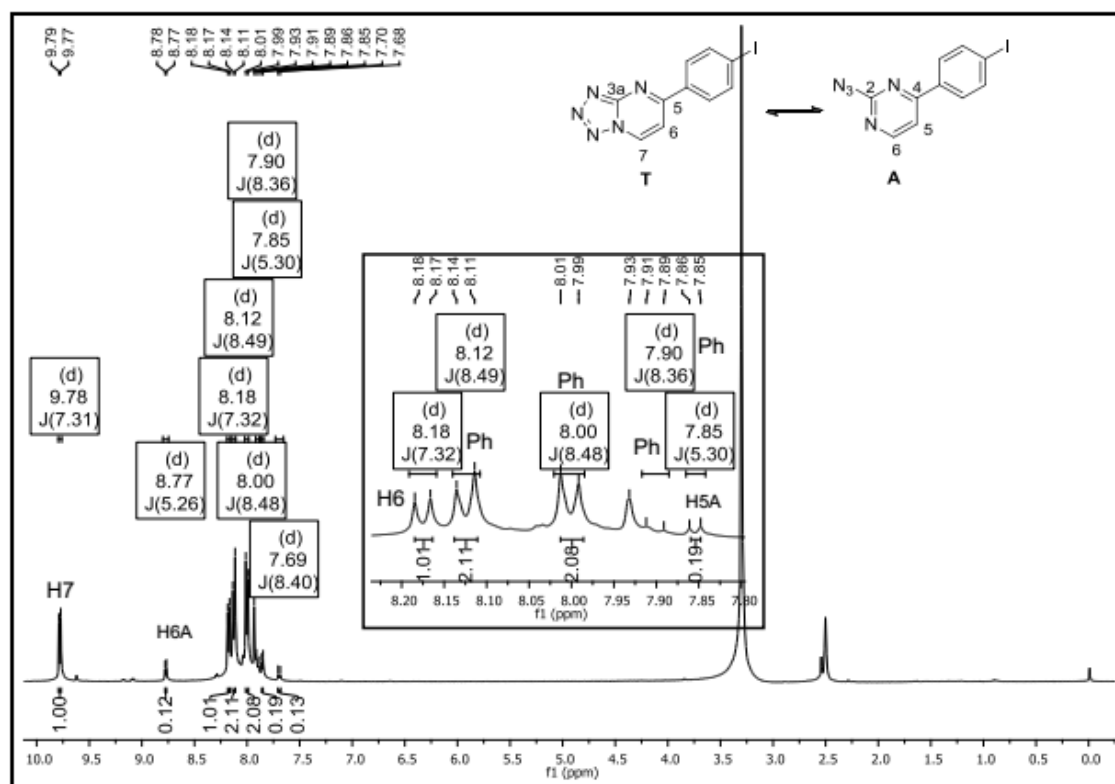


**Figure S19:**  $^1\text{H}$  NMR of compound **3d** in  $\text{DMSO}-d_6$ .

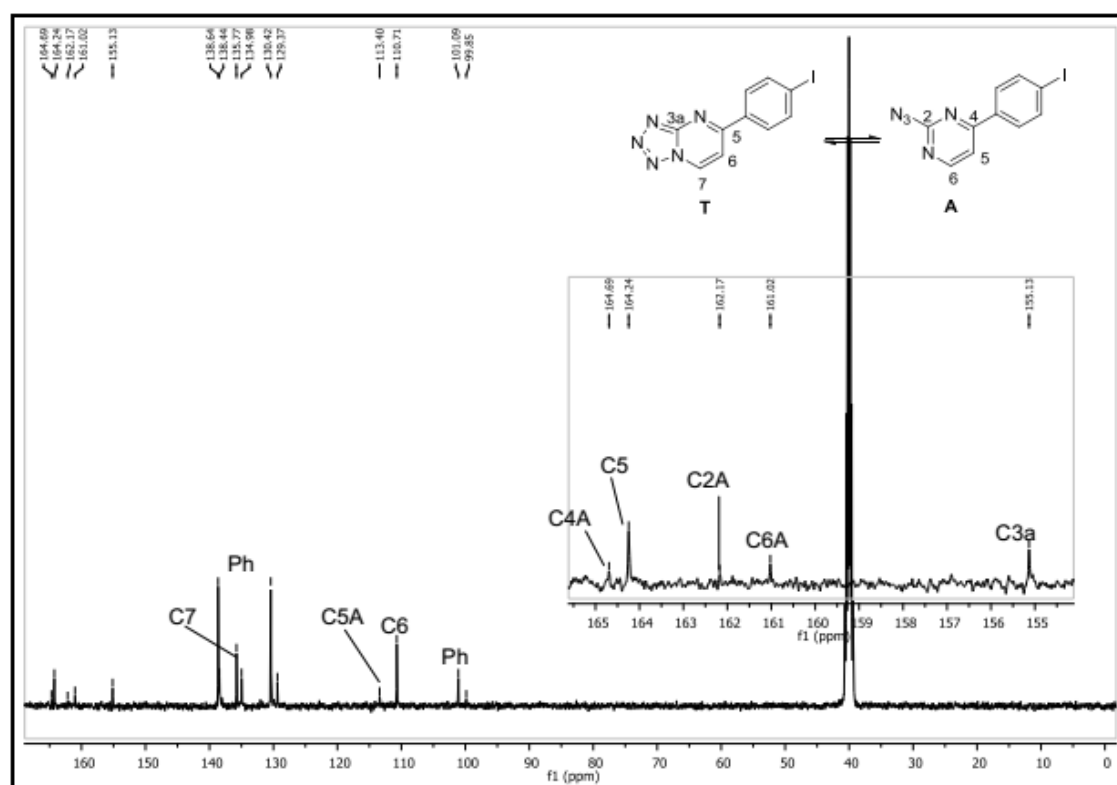


**Figure S20:**  $^{13}\text{C}$  NMR of compound **3d** in  $\text{DMSO}-d_6$ .

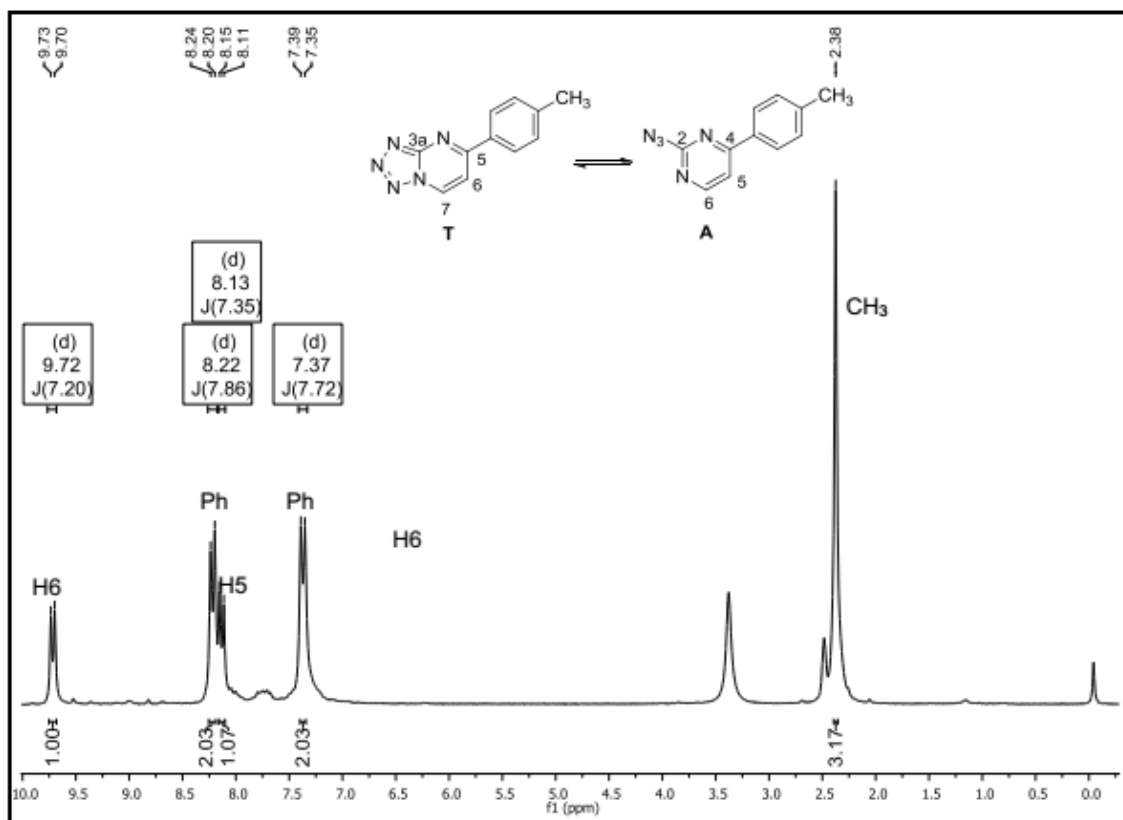




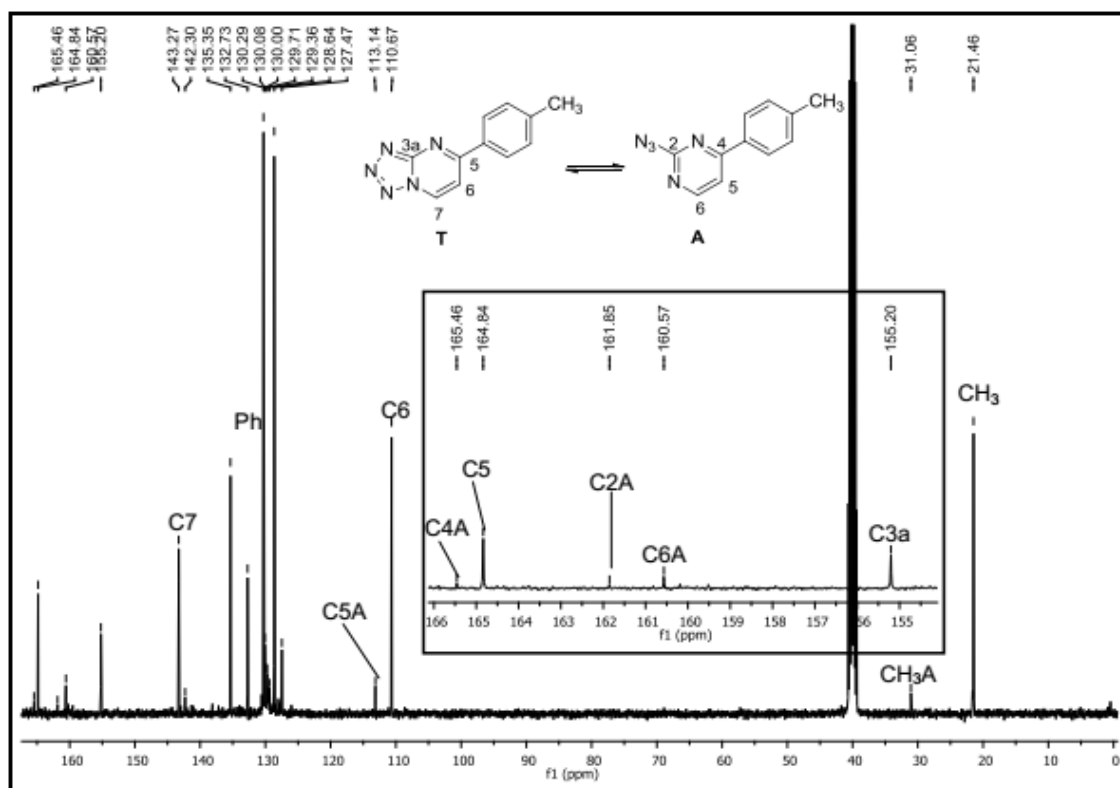
**Figure S21:**  $^1\text{H}$  NMR of compound **3e** in  $\text{DMSO}-d_6$ .



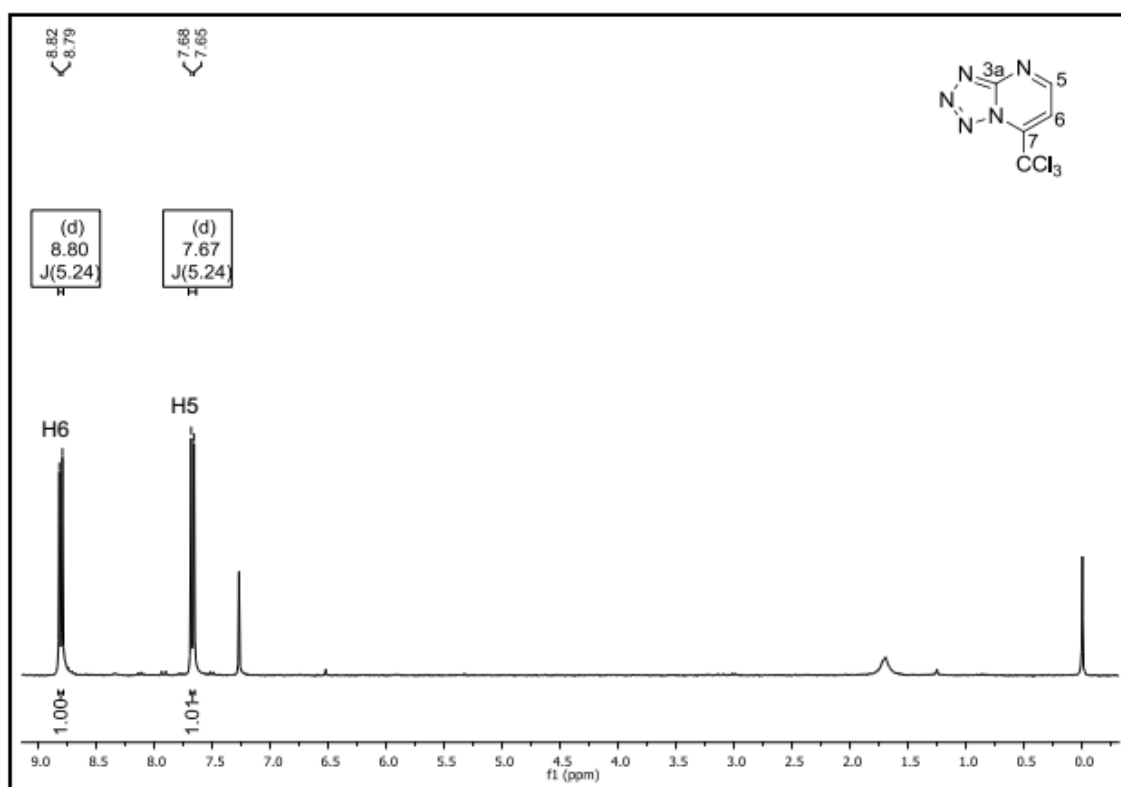
**Figure S22:**  $^{13}\text{C}$  NMR of compound **3e** in  $\text{DMSO}-d_6$ .



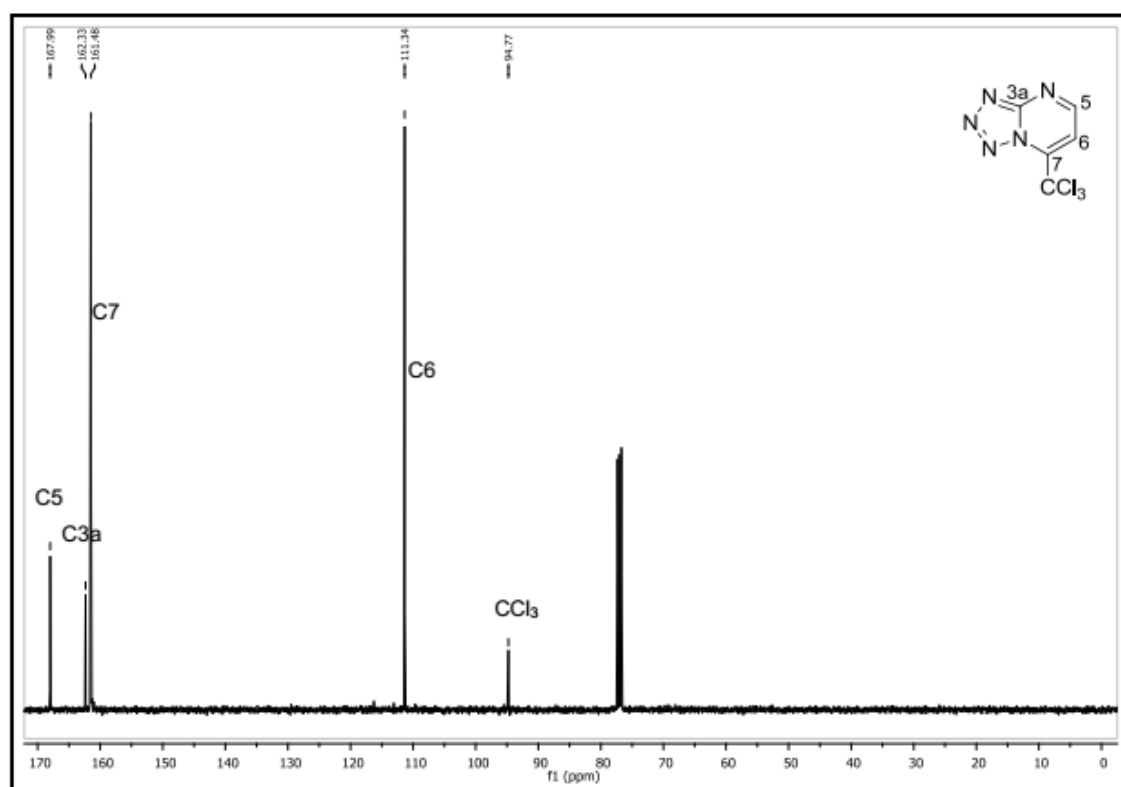
**Figure S23:**  $^1\text{H}$  NMR of compound **3f** in  $\text{DMSO}-d_6$ .



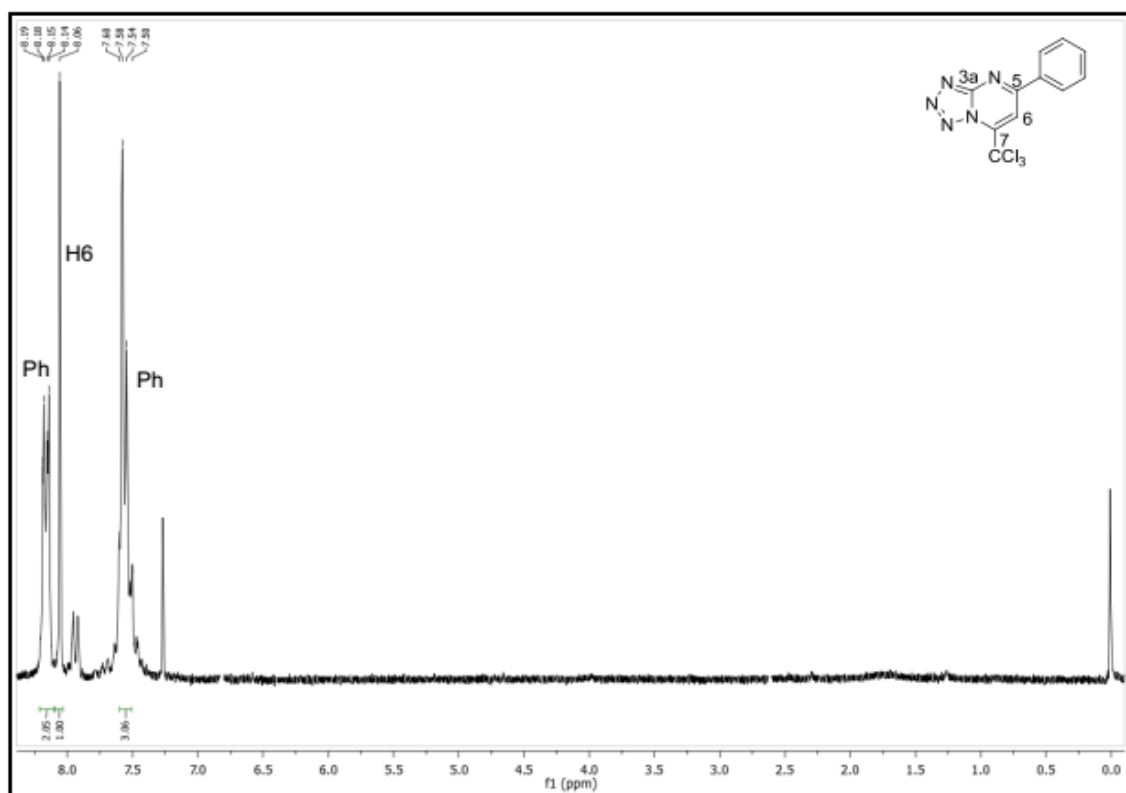
**Figure S24:**  $^{13}\text{C}$  NMR of compound **3f** in  $\text{DMSO}-d_6$ .



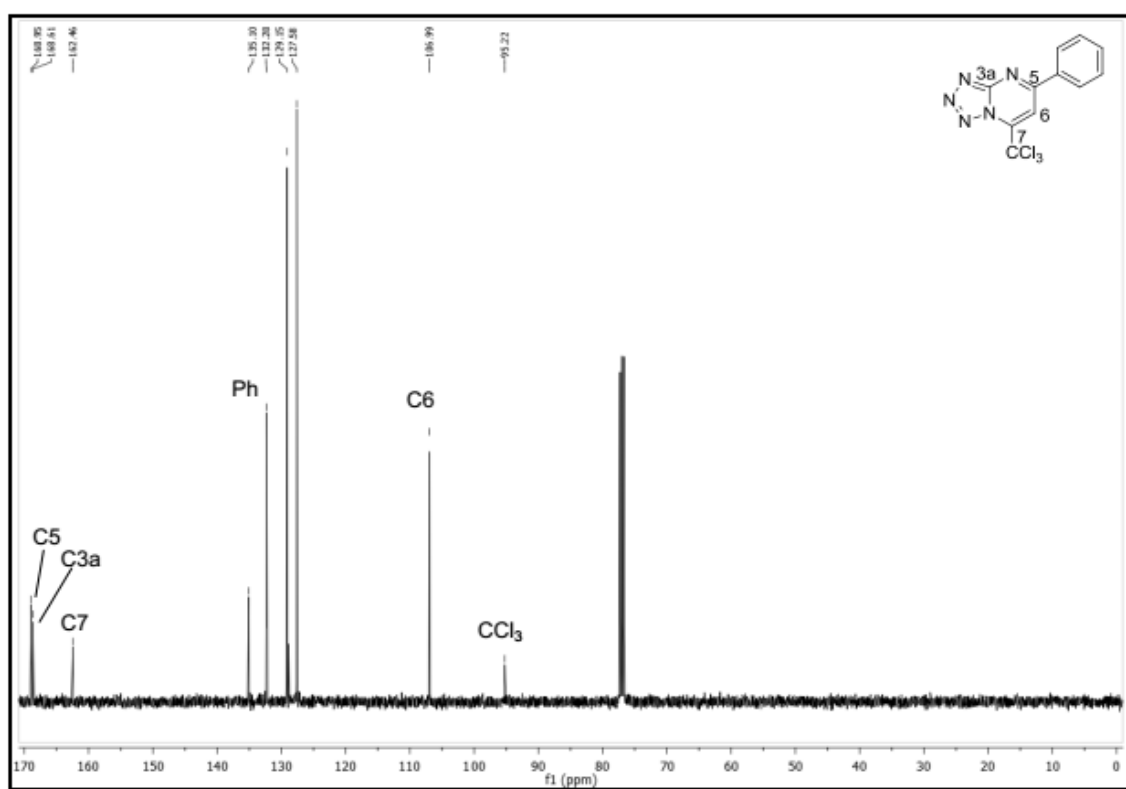
**Figure S25:** <sup>1</sup>H NMR of compound **5i** in CDCl<sub>3</sub>.



**Figure S26:** <sup>13</sup>C NMR of compound **5i** in CDCl<sub>3</sub>.



**Figure S27:**  $^1\text{H}$  NMR of compound **6h** in  $\text{CDCl}_3$ .



**Figure S28:**  $^{13}\text{C}$  NMR of compound **6h** in  $\text{CDCl}_3$ .

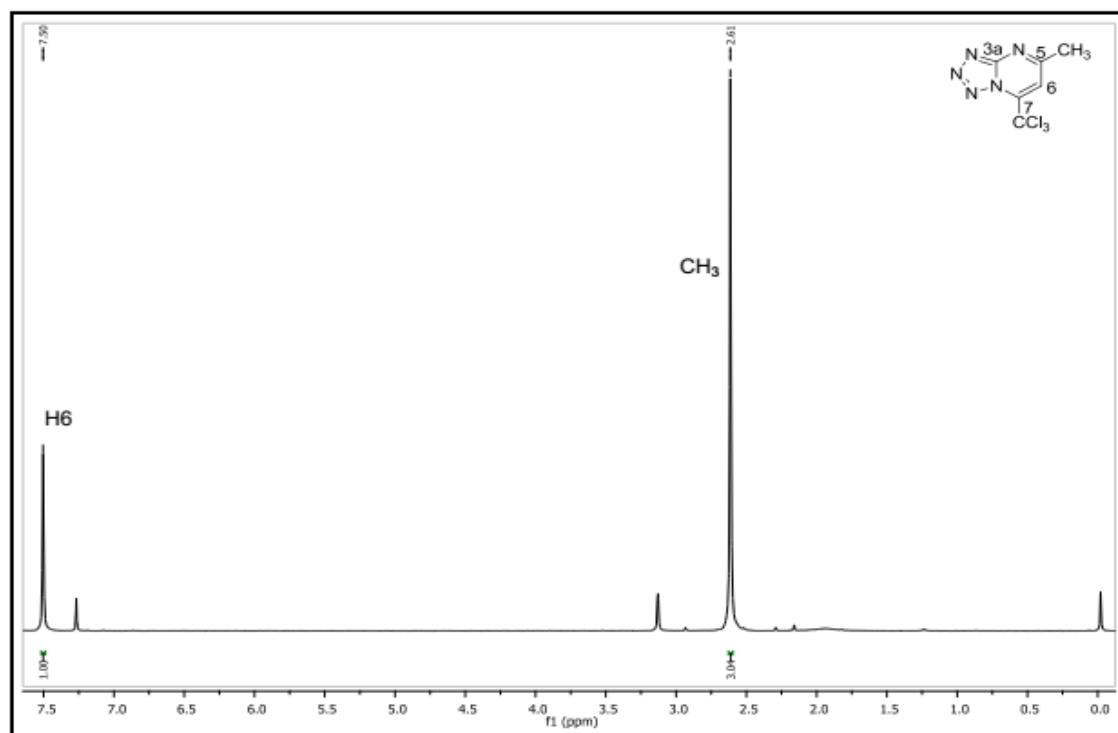


Figure S29:  $^1\text{H}$  NMR of compound **6i** in  $\text{CDCl}_3$ .

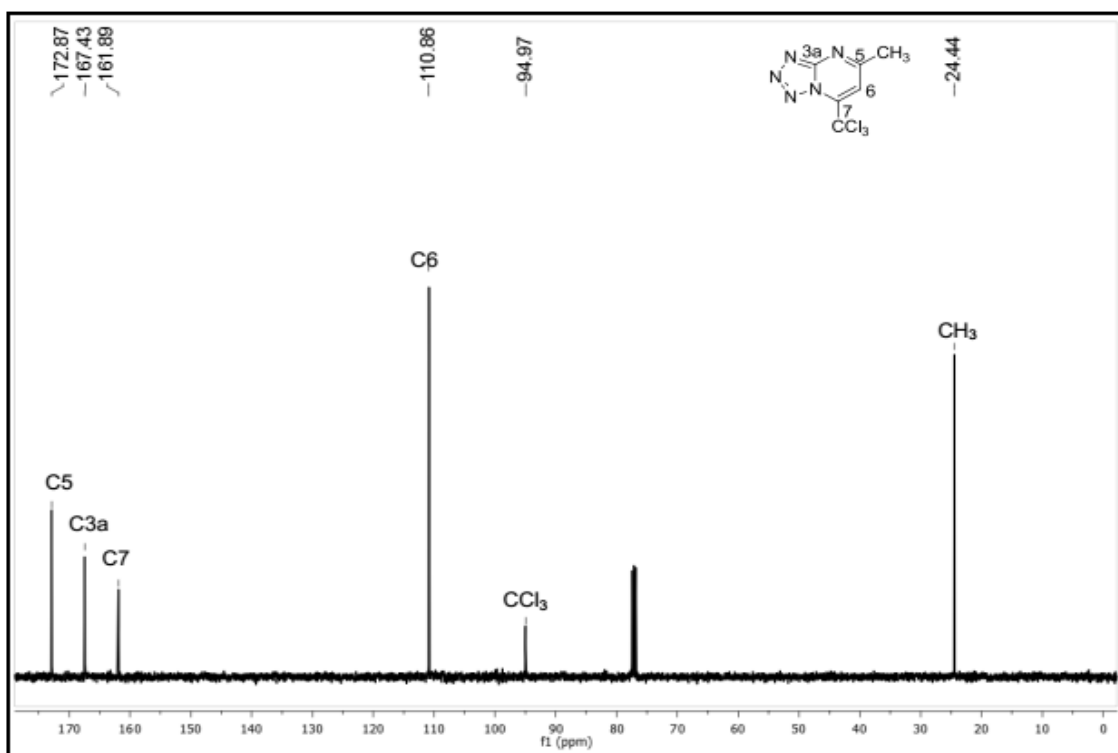
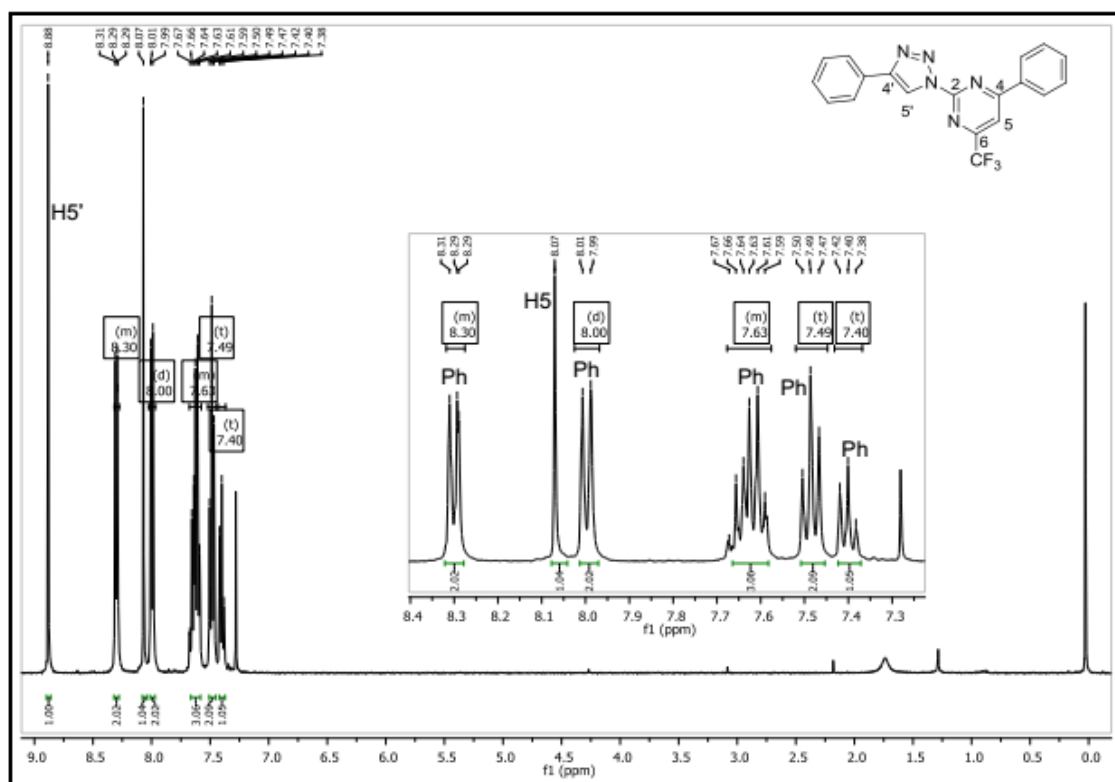
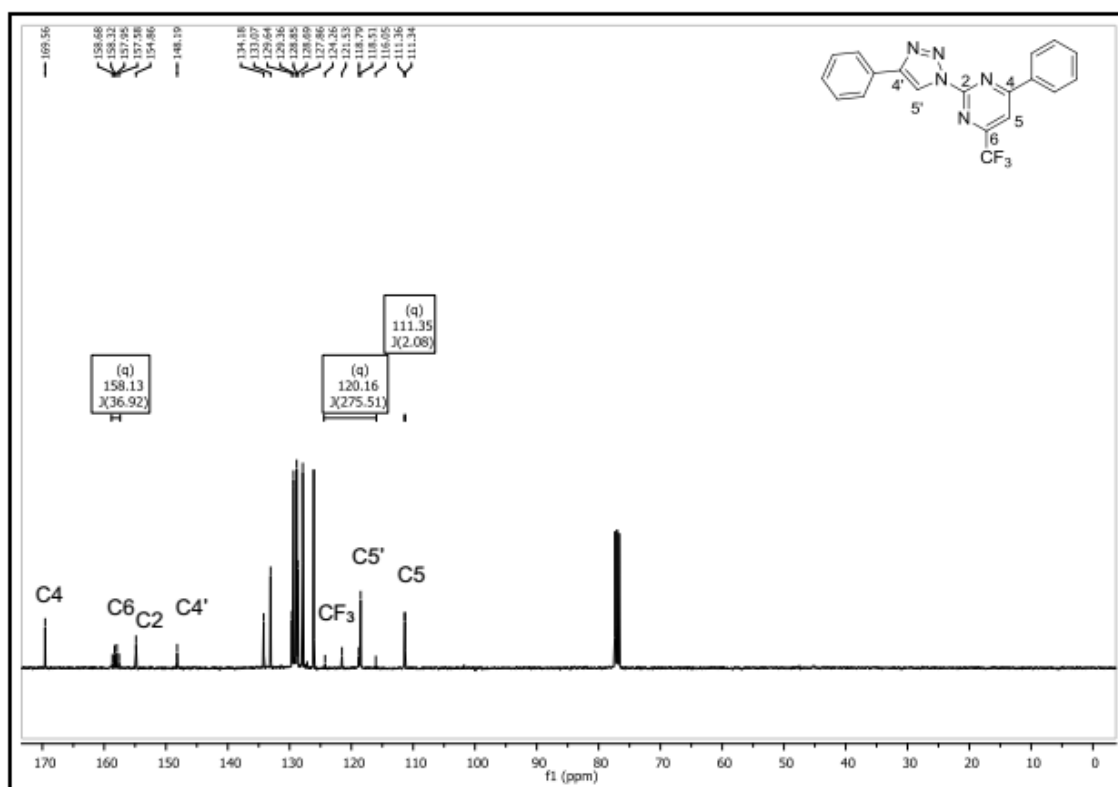


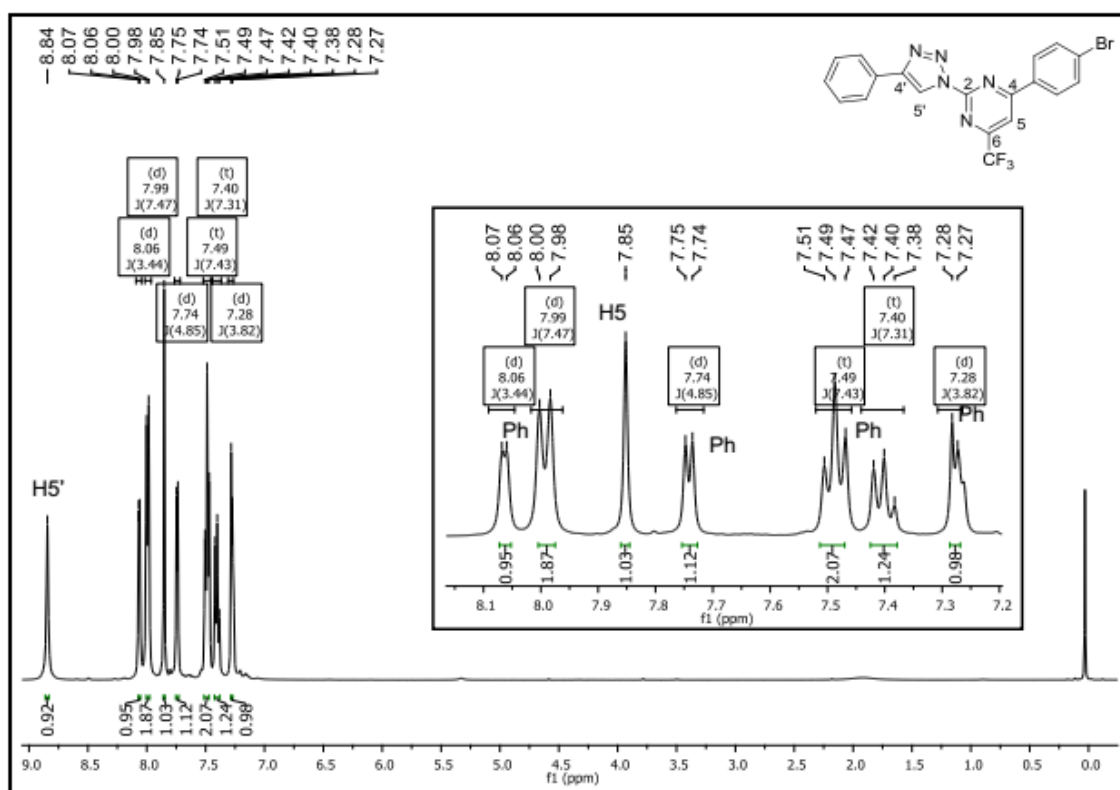
Figure S30:  $^{13}\text{C}$  NMR of compound **6i** in  $\text{CDCl}_3$ .



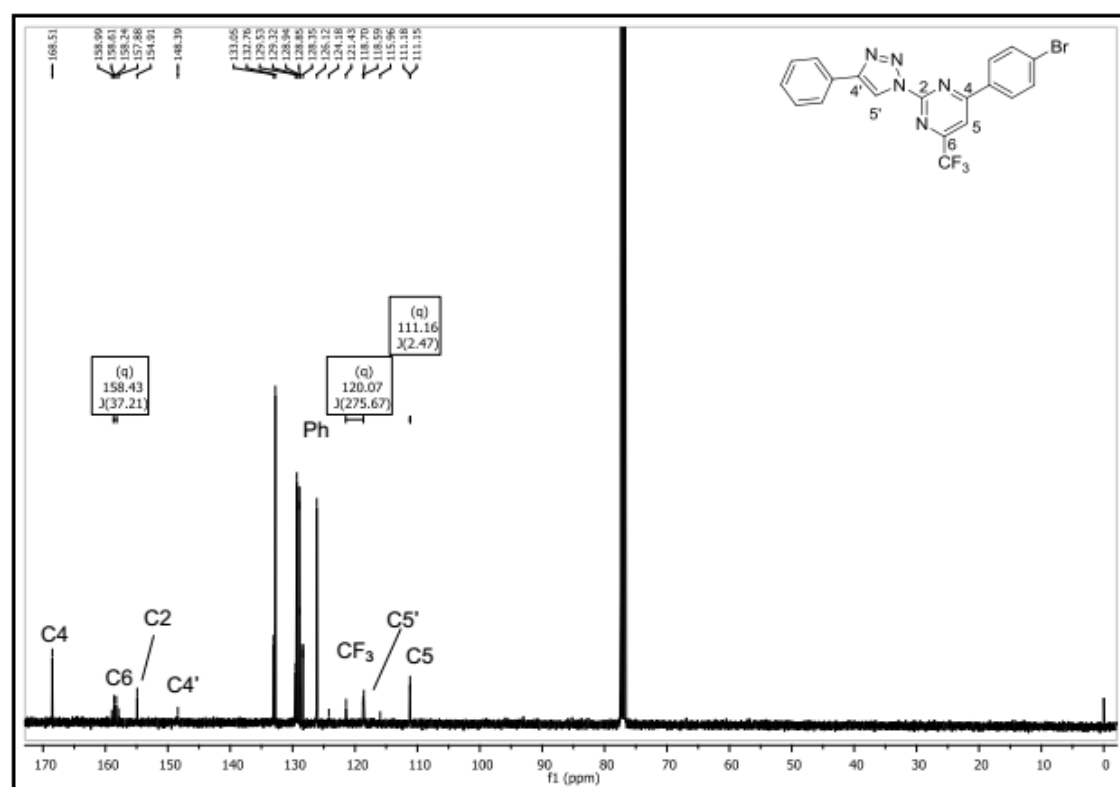
**Figure S31:**  $^1\text{H}$  NMR of compound **8a** in  $\text{CDCl}_3$ .



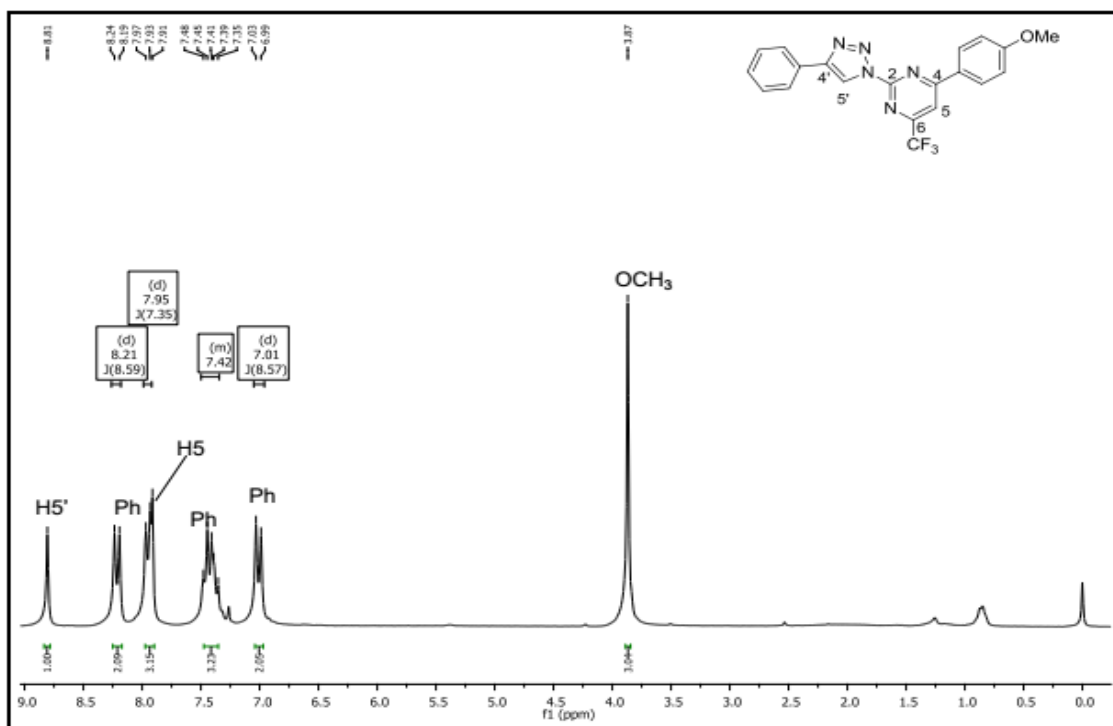
**Figure S32:**  $^{13}\text{C}$  NMR of compound **8a** in  $\text{CDCl}_3$ .



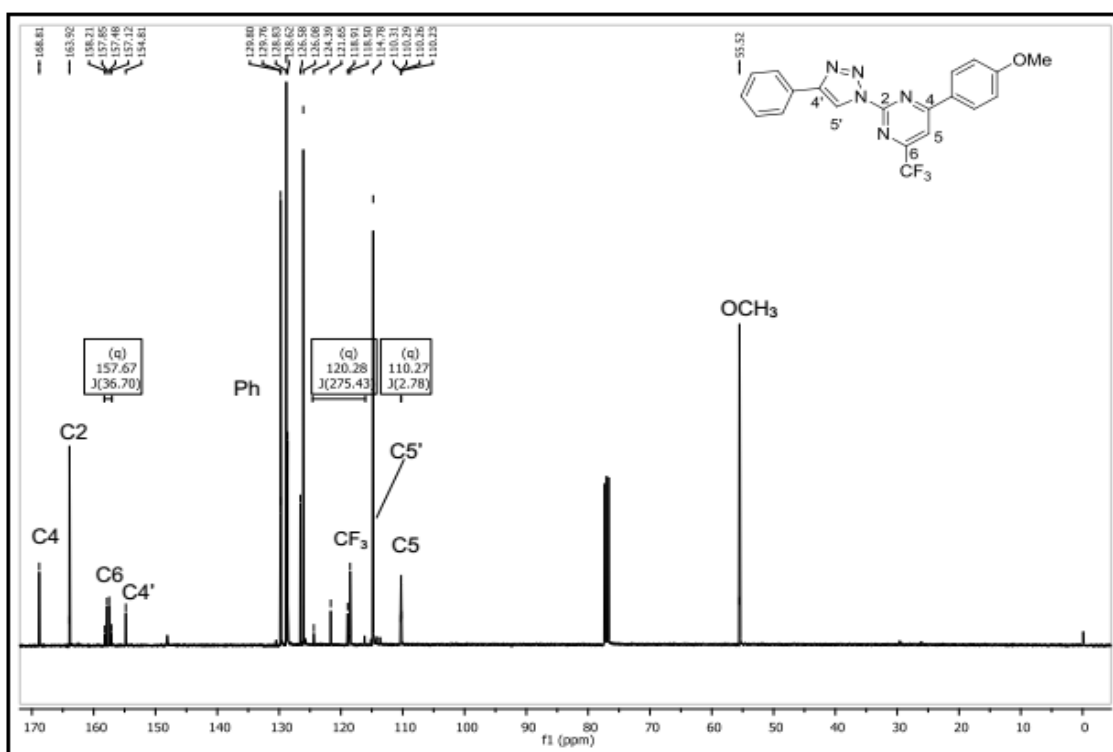
**Figure S33:** <sup>1</sup>H NMR of compound **8b** in CDCl<sub>3</sub>.



**Figure S34:** <sup>13</sup>C NMR of compound **8b** in CDCl<sub>3</sub>.



**Figure S35:** <sup>1</sup>H NMR of compound **8c** in CDCl<sub>3</sub>.



**Figure S36:** <sup>13</sup>C NMR of compound **8c** in CDCl<sub>3</sub>.

- [1] L. J. Farrugia, "ORTEP -3 for Windows - a version of ORTEP -III with a Graphical User Interface (GUI)," *J. Appl. Crystallogr.*, vol. 30, no. 5, pp. 565–565, Oct. 1997.