X-shortcut

February 14, 2020

[1]:
```
from IPython.display import clear_output
```

[3]:
```
import runpy
```

0.1 Preprocess:

[ ]:
```
runpy.run_path('0_database-generation.py')
runpy.run_path('1_preprocess_data.py')
runpy.run_path('2_compute_delta_T.ipynb.py')
clear_output()
```

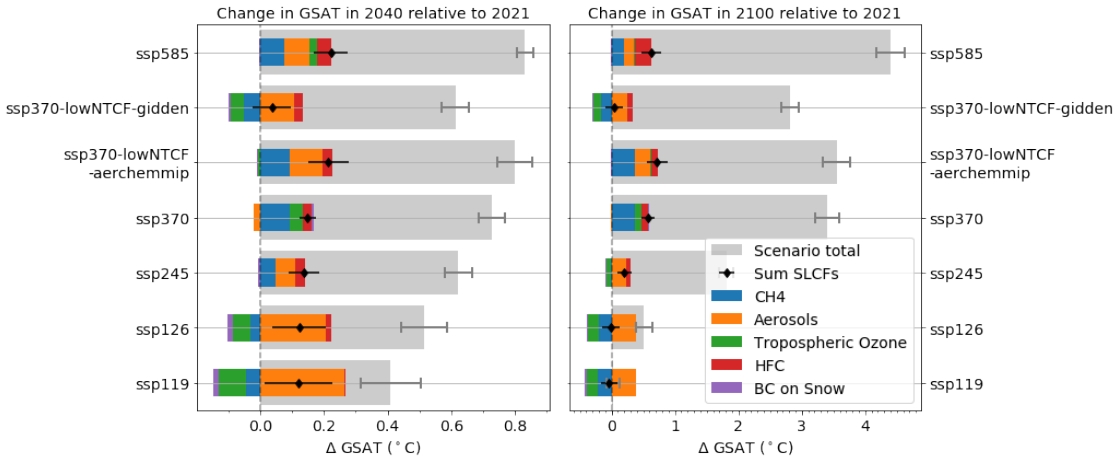
0.2 Create table on delta T dependence on ECS:

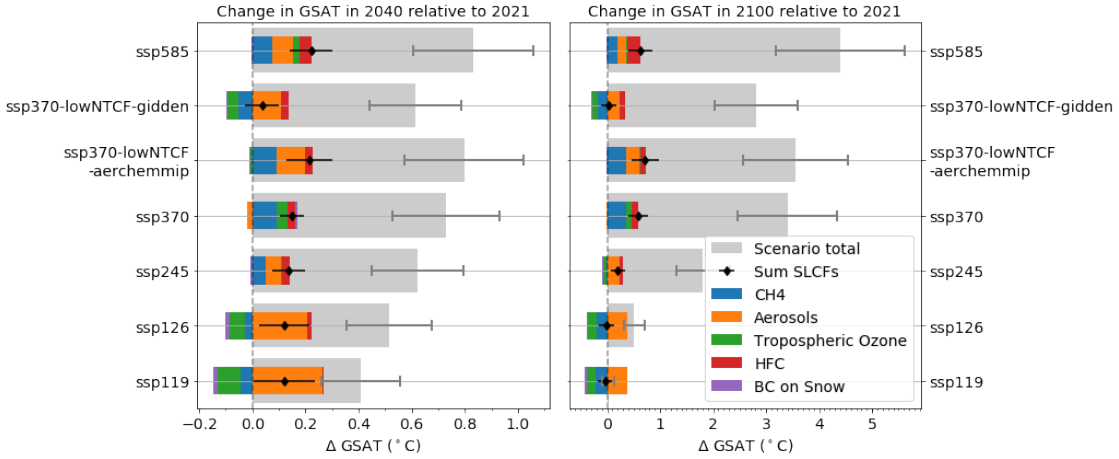
[ ]:
```
runpy.run_path('2-1_compute_delta_T_sensitivity.py')
```

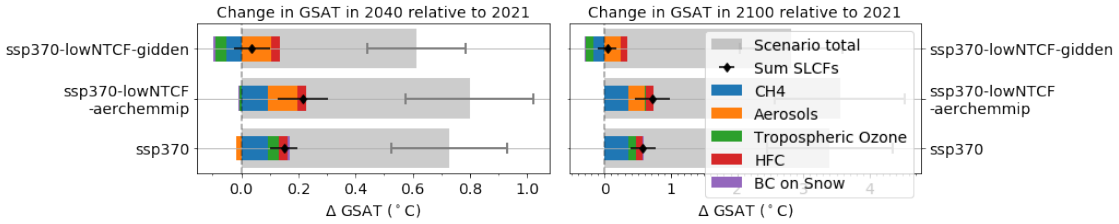
0.3 Create plots etc:

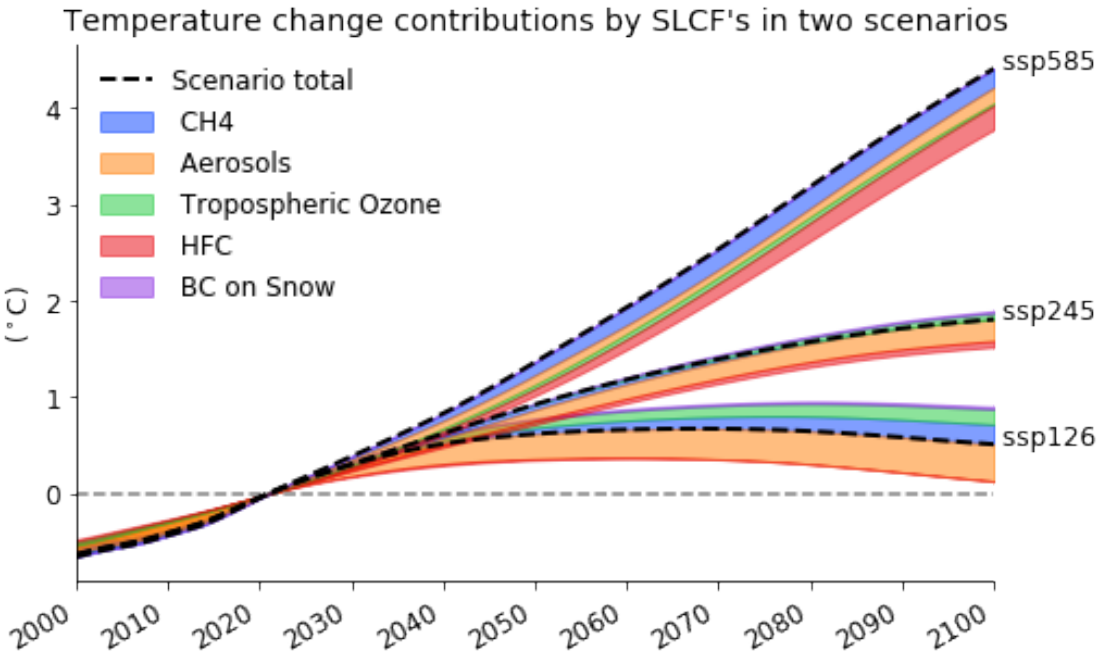
[4]:
```
runpy.run_path('3_delta_T_plot.py')
```

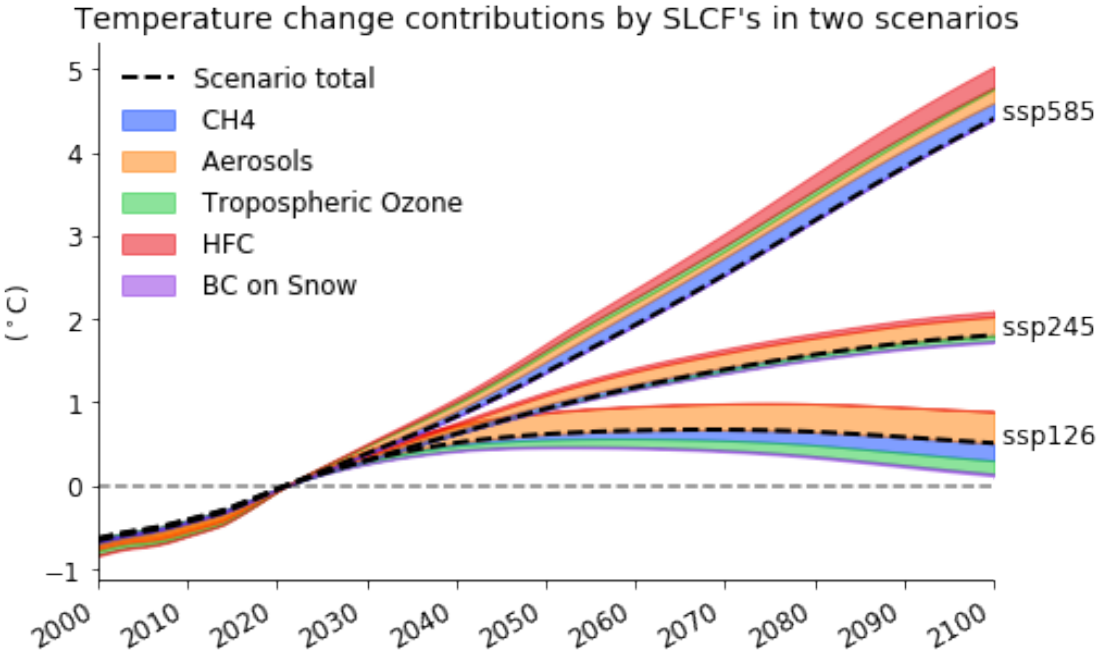
[5]:
```
runpy.run_path('3-2_delta_T_plot_bar_stacked.py')
runpy.run_path('3-2_delta_T_plot_contribution_total.py')
```

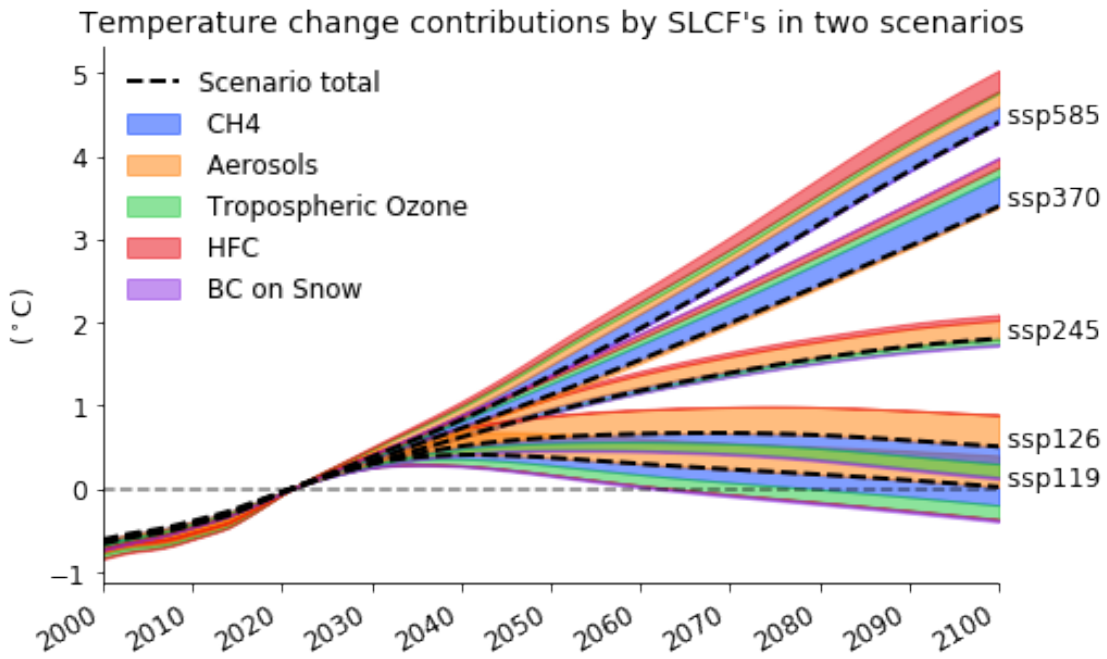

Change in GSAT in 2040 relative to 2021
Change in GSAT in 2100 relative to 2021
ssp585
ssp370-lowNTCF-gidden
ssp370-lowNTCF
-aerchemmip
ssp370
ssp245
ssp126
ssp119
Scenario total
Sum SLCFs
CH4
Aerosols
Tropospheric Ozone
HFC
BC on Snow
Δ GSAT (°C)


Change in GSAT in 2040 relative to 2021
Change in GSAT in 2100 relative to 2021
ssp585
ssp370-lowNTCF-gidden
ssp370-lowNTCF
-aerchemmip
ssp370
ssp245
ssp126
ssp119
Scenario total
Sum SLCFs
CH4
Aerosols
Tropospheric Ozone
HFC
BC on Snow
Δ GSAT (°C)


Change in GSAT in 2040 relative to 2021
Change in GSAT in 2100 relative to 2021
ssp370-lowNTCF-gidden
ssp370-lowNTCF
-aerchemmip
ssp370
Scenario total
Sum SLCFs
CH4
Aerosols
Tropospheric Ozone
HFC
BC on Snow
Δ GSAT (°C)


Temperature change contributions by SLCF's in two scenarios
Scenario total
CH4
Aerosols
Tropospheric Ozone
HFC
BC on Snow
ssp585
ssp245
ssp126
(°C)
4
3
2
1
0
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100


Temperature change contributions by SLCF's in two scenarios
Scenario total
CH4
Aerosols
Tropospheric Ozone
HFC
BC on Snow
ssp585
ssp245
ssp126
(°C)
5
4
3
2
1
0
−1
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100



[5]:

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  'callable': <function callable(obj, /)>,
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  'compile': <function compile(source, filename, mode, flags=0,
```

```
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  All Rights Reserved.

  Copyright (c) 2000 BeOpen.com.
  All Rights Reserved.

  Copyright (c) 1995-2001 Corporation for National Research Initiatives.
  All Rights Reserved.
```

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  All Rights Reserved.,
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thousands
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information.,
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  'help': Type help() for interactive help, or help(object) for help about
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```

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 Dimensions:
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datetime64[ns] 1850-01-01 … 2100-01-01
     model                                                         object …
   * scenario                                                      (scenario)
object 'historical' … 'ssp585'
```

```
     region                                                          object …
     unit                                                            object …
   * climatemodel
(climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
     unit_context                                                    object …
   * variable                                                        (variable)
object 'Effective Radiative Forcing|Anthropogenic|CH4' … 'Effective Radiative
Forcing|Anthropogenic|Other|BC on Snow'
 Data variables:
     Effective Radiative Forcing                                     (scenario,
climatemodel, time) float64 …
     Effective Radiative Forcing|Anthropogenic                       (scenario,
climatemodel, time) float64 …
     Effective Radiative Forcing|Anthropogenic|Other|BC on Snow      (scenario,
climatemodel, time) float64 …
     Effective Radiative Forcing|Anthropogenic|F-Gases|HFC           (scenario,
climatemodel, time) float64 …
     Effective Radiative Forcing|Anthropogenic|Tropospheric Ozone    (scenario,
climatemodel, time) float64 …
     Effective Radiative Forcing|Anthropogenic|Aerosols              (scenario,
climatemodel, time) float64 …
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climatemodel, time) float64 …
     year                                                            (time) int64
…
     month                                                           (time) int64
…
     day                                                             (time) int64
…
     delta_t                                                         (time)
float64 …
     Delta T|Anthropogenic|CH4                                       (scenario,
climatemodel, time) float64 …
     Delta T|Anthropogenic|Aerosols                                  (scenario,
climatemodel, time) float64 …
     Delta T|Anthropogenic|Tropospheric Ozone                        (scenario,
climatemodel, time) float64 …
     Delta T|Anthropogenic|F-Gases|HFC                               (scenario,
climatemodel, time) float64 …
     Delta T|Anthropogenic|Other|BC on Snow                          (scenario,
climatemodel, time) float64 …
     Delta T|Anthropogenic                                           (scenario,
climatemodel, time) float64 …
     Delta T|                                                        (scenario,
climatemodel, time) float64 …
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scenario, climatemodel, time) float64 0.05507 … 0.143
```

```
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scenario, climatemodel, time) float64 0.007051 … 0.1044,
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  'Effective Radiative Forcing|Anthropogenic|Other|BC on Snow':
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          [9.551465e-05, 5.818354e-04, …, 1.235325e-01, 1.210762e-01]],

         …,

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          …,
          [0.000000e+00, 6.089714e-05, …, 2.180994e-01, 2.189952e-01],
          [9.551465e-05, 5.818355e-04, …, 2.077428e-01, 2.085087e-01]],

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          …,
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          [9.551465e-05, 5.818354e-04, …, 7.248429e-01, 7.203346e-01]]])
  Coordinates:
    * time          (time) datetime64[ns] 1850-01-01 1851-01-01 … 2100-01-01
      model         object …
    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
```

```
      unit_context  object …,
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(scenario: 8, climatemodel: 5, time: 251)>
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          …,
          [      nan,       nan, …,       nan,       nan],
          [-0.123547, -0.134514, …,       nan,       nan]],

         [[-0.035112, -0.034923, …, -0.082849, -0.080173],
          [-0.056313, -0.056009, …, -0.13288 , -0.128587],
          …,
          [ 0.      ,  0.001579, …, -0.534518, -0.532353],
          [-0.098828, -0.10178 , …, -0.461632, -0.454743]],

         …,

         [[-0.035112, -0.034923, …, -0.234524, -0.232593],
          [-0.056313, -0.056009, …, -0.376148, -0.37305 ],
          …,
          [ 0.      ,  0.001579, …, -0.710743, -0.708808],
          [-0.098828, -0.10178 , …, -0.933394, -0.946314]],

         [[-0.035112, -0.034923, …, -0.2357  , -0.227787],
          [-0.056313, -0.056009, …, -0.378039, -0.365344],
          …,
          [ 0.      ,  0.001579, …, -0.772121, -0.767465],
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    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …,
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Ozone' (scenario: 8, climatemodel: 5, time: 251)>
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          …,
          [     nan,      nan, …,      nan,      nan],
          [0.023718, 0.025997, …,      nan,      nan]],

         [[0.022203, 0.021303, …, 0.096837, 0.09583 ],
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          …,
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          [0.      , 0.      , …, 0.069548, 0.068591],
          [0.015646, 0.016422, …, 0.140637, 0.137795]],

         …,

         [[0.022203, 0.021303, …, 0.183005, 0.182702],
          [0.022203, 0.021303, …, 0.183005, 0.182702],
          …,
          [0.      , 0.      , …, 0.149386, 0.149087],
          [0.015646, 0.016422, …, 0.32287 , 0.314997]],

         [[0.022203, 0.021303, …, 0.355322, 0.350594],
          [0.022203, 0.021303, …, 0.355322, 0.350594],
          …,
          [0.      , 0.      , …, 0.313831, 0.309444],
          [0.015646, 0.016422, …, 0.502925, 0.501615]]])
  Coordinates:
    * time          (time) datetime64[ns] 1850-01-01 1851-01-01 … 2100-01-01
      model         object …
    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …,
  <xarray.DataArray 'Effective Radiative Forcing|Anthropogenic|F-Gases|HFC'
(scenario: 8, climatemodel: 5, time: 251)>
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          …,
          [         nan,          nan, …,          nan,          nan],
          [0.000000e+00, 2.912843e-10, …,          nan,          nan]],

         [[2.505055e-08, 2.534181e-08, …, 2.151563e-02, 2.144492e-02],
          [2.505055e-08, 2.534181e-08, …, 2.151563e-02, 2.144492e-02],
          …,
          [0.000000e+00, 0.000000e+00, …, 2.128000e-02, 2.121103e-02],
          [2.912843e-10, 5.825702e-10, …, 2.158859e-02, 2.151814e-02]],

         …,

         [[2.505055e-08, 2.534181e-08, …, 1.775795e-01, 1.787541e-01],
          [2.505055e-08, 2.534181e-08, …, 1.775795e-01, 1.787541e-01],
          …,
          [0.000000e+00, 0.000000e+00, …, 1.762799e-01, 1.774550e-01],
          [2.912843e-10, 5.825701e-10, …, 1.799828e-01, 1.811671e-01]],

         [[2.505055e-08, 2.534181e-08, …, 4.295196e-01, 4.312340e-01],
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         [2.912843e-10, 5.825702e-10, …, 4.340816e-01, 4.356393e-01]]])
  Coordinates:
    * time          (time) datetime64[ns] 1850-01-01 1851-01-01 … 2100-01-01
      model         object …
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      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …,
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(scenario: 8, climatemodel: 5, time: 251)>
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          [          nan,           nan, …,           nan,           nan],
          …,
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          [ 2.286523e-02,  2.456125e-02, …,           nan,           nan]],

         [[          nan,           nan, …,           nan,           nan],
          [          nan,           nan, …,           nan,           nan],
          …,
          [ 0.000000e+00, -1.337689e-04, …,  1.164128e-02,  1.157329e-02],
          [ 2.022516e-02,  2.089970e-02, …,  3.800706e-02,  3.718390e-02]],

         …,

         [[          nan,           nan, …,           nan,           nan],
          [          nan,           nan, …,           nan,           nan],
          …,
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          [ 2.022516e-02,  2.089970e-02, …,  1.109722e-01,  1.132050e-01]],

         [[          nan,           nan, …,           nan,           nan],
          [          nan,           nan, …,           nan,           nan],
          …,
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          [ 2.022516e-02,  2.089970e-02, …,  1.417682e-01,  1.430395e-01]]])
  Coordinates:
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      model         object …
    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …],
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climatemodel: 5, time: 251)>
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          …,
          [         nan,          nan, …,          nan,          nan],
          [0.000000e+00, 1.222866e-05, …,          nan,          nan]],

         [[7.050745e-03, 1.260732e-02, …, 2.072280e-01, 2.054552e-01],
          [7.050745e-03, 1.260732e-02, …, 2.072280e-01, 2.054552e-01],
          …,
          [0.000000e+00, 7.796610e-06, …, 1.421386e-01, 1.405527e-01],
          [1.222866e-05, 8.410359e-05, …, 1.409339e-01, 1.392414e-01]],


         …,

         [[7.050745e-03, 1.260732e-02, …, 2.592373e-01, 2.598386e-01],
          [7.050745e-03, 1.260732e-02, …, 2.592373e-01, 2.598386e-01],
          …,
          [0.000000e+00, 7.796610e-06, …, 1.864379e-01, 1.869245e-01],
          [1.222866e-05, 8.410359e-05, …, 1.837622e-01, 1.841472e-01]],

         [[7.050745e-03, 1.260732e-02, …, 6.352168e-01, 6.331651e-01],
          [7.050745e-03, 1.260732e-02, …, 6.352168e-01, 6.331651e-01],
          …,
          [0.000000e+00, 7.796610e-06, …, 5.089401e-01, 5.071831e-01],
          [1.222866e-05, 8.410359e-05, …, 5.420217e-01, 5.399040e-01]]])
  Coordinates:
    * time          (time) datetime64[ns] 1850-01-01 1851-01-01 … 2100-01-01
      model         object …
    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …
  Attributes:
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  <xarray.DataArray 'Delta T|Anthropogenic|Aerosols' (scenario: 8, climatemodel:
5, time: 251)>
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          [-7.209655e-03, -1.283759e-02, …, -1.051915e+00, -1.052912e+00],
          …,
          [          nan,           nan, …,           nan,           nan],
          [-1.581760e-02, -2.965434e-02, …,           nan,           nan]],

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```

```
         …,
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         [-1.265282e-02, -2.297585e-02, …, -4.220177e-01, -4.195698e-01]],

        …,

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         [-7.209655e-03, -1.283759e-02, …, -3.972700e-01, -3.953288e-01],
         …,
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         [-1.265282e-02, -2.297585e-02, …, -7.217990e-01, -7.247892e-01]],

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         …,
         [ 0.000000e+00,  2.021723e-04, …, -6.388084e-01, -6.354164e-01],
         [-1.265282e-02, -2.297585e-02, …, -8.066395e-01, -8.080605e-01]]])
  Coordinates:
    * time          (time) datetime64[ns] 1850-01-01 1851-01-01 … 2100-01-01
      model         object …
    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …
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          …,
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          [0.003037, 0.005715, …,      nan,      nan]],

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          …,
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          [0.002003, 0.003677, …, 0.140752, 0.139785]],

         …,

         [[0.002843, 0.004962, …, 0.156727, 0.156589],
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          …,
          [0.      , 0.      , …, 0.128805, 0.128654],
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```
         [0.002003, 0.003677, …, 0.261947, 0.260846]],

        [[0.002843, 0.004962, …, 0.285505, 0.283007],
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         …,
         [0.      , 0.      , …, 0.250789, 0.248477],
         [0.002003, 0.003677, …, 0.400332, 0.397706]]])
  Coordinates:
    * time          (time) datetime64[ns] 1850-01-01 1851-01-01 … 2100-01-01
      model         object …
    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …
  Attributes:
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climatemodel: 5, time: 251)>
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          …,
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          [0.000000e+00, 3.729288e-11, …,          nan,          nan]],

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          …,
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          [3.729288e-11, 1.038981e-10, …, 1.636323e-02, 1.633906e-02]],

         …,

         [[3.207201e-09, 5.765340e-09, …, 1.141347e-01, 1.150383e-01],
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          …,
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          …,
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          [3.729288e-11, 1.038981e-10, …, 2.746107e-01, 2.764612e-01]]])
  Coordinates:
    * time          (time) datetime64[ns] 1850-01-01 1851-01-01 … 2100-01-01
      model         object …
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```
    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …
  Attributes:
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          [          nan,           nan, …,           nan,           nan],
          …,
          [          nan,           nan, …,           nan,           nan],
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         [[          nan,           nan, …,           nan,           nan],
          [          nan,           nan, …,           nan,           nan],
          …,
          [ 0.000000e+00, -1.712631e-05, …,  1.316450e-02,  1.311078e-02],
          [ 2.589410e-03,  4.711039e-03, …,  3.794793e-02,  3.770517e-02]],

         …,

         [[          nan,           nan, …,           nan,           nan],
          [          nan,           nan, …,           nan,           nan],
          …,
          [ 0.000000e+00, -1.712631e-05, …,  2.510785e-02,  2.494763e-02],
          [ 2.589410e-03,  4.711039e-03, …,  8.408960e-02,  8.468376e-02]],

         [[          nan,           nan, …,           nan,           nan],
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  Coordinates:
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    * scenario      (scenario) object 'historical' 'ssp119' … 'ssp585'
      region        object …
      unit          object …
    * climatemodel  (climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
      unit_context  object …
  Attributes:
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 'dt_all': 'Delta T|Anthropogenic|All',
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 'SMALL_SIZE': 12,
 'MEDIUM_SIZE': 12,
 'BIGGER_SIZE': 14,
 's_y2': '2000',
 'e_y': '2100',
 'e_y2': '2100',
 'scenarios_ss': ['ssp245', 'ssp119', 'ssp585', 'ssp126', 'ssp370'],
 'ref_var_erf': 'Effective Radiative Forcing|Anthropogenic',
 'ref_var_dt': 'Delta T|Anthropogenic',
 '_ds': <xarray.Dataset>
 Dimensions:
(climatemodel: 5, scenario: 5, time: 101, variable: 5)
 Coordinates:
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datetime64[ns] 2000-01-01 … 2100-01-01
     model                                                   <U1 ''
   * scenario                                                (scenario)
object 'ssp245' … 'ssp370'
     region                                                  <U5 'World'
     unit                                                    <U5 'W/m^2'
   * climatemodel
(climatemodel) object 'Cicero-SCM' … 'OSCARv3.0'
     unit_context                                            <U12
'not_required'
   * variable                                                (variable)
object 'Effective Radiative Forcing|Anthropogenic|CH4' … 'Effective Radiative
Forcing|Anthropogenic|Other|BC on Snow'
 Data variables:
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climatemodel, time) float64 -1.122 … 4.564
     Effective Radiative Forcing|Anthropogenic               (scenario,
climatemodel, time) float64 -1.061 … 4.616
     Effective Radiative Forcing|Anthropogenic|Other|BC on Snow    (scenario,
climatemodel, time) float64 nan … 0.03244
     Effective Radiative Forcing|Anthropogenic|F-Gases|HFC   (scenario,
climatemodel, time) float64 -0.038 … 0.1615
     Effective Radiative Forcing|Anthropogenic|Tropospheric Ozone  (scenario,
climatemodel, time) float64 -0.03249 … 0.06036
     Effective Radiative Forcing|Anthropogenic|Aerosols      (scenario,
climatemodel, time) float64 -0.2689 … -0.1668
     Effective Radiative Forcing|Anthropogenic|CH4           (scenario,
climatemodel, time) float64 -0.06237 … 0.4663
     year                                                    (time) int64
-21 … 79
     month                                                   (time) int64
0 … 0
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    day                                                          (time) int64
0 … 0
    delta_t                                                      (time)
float64 0.0 … 0.0
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climatemodel, time) float64 -0.04581 … 0.3453
    Delta T|Anthropogenic|Aerosols                               (scenario,
climatemodel, time) float64 -0.1216 … -0.2074
    Delta T|Anthropogenic|Tropospheric Ozone                     (scenario,
climatemodel, time) float64 -0.02918 … 0.1079
    Delta T|Anthropogenic|F-Gases|HFC                            (scenario,
climatemodel, time) float64 -0.01855 … 0.1095
    Delta T|Anthropogenic|Other|BC on Snow                       (scenario,
climatemodel, time) float64 nan … 0.03082
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climatemodel, time) float64 -0.6335 … 3.159
    Delta T|                                                     (scenario,
climatemodel, time) float64 -0.6746 … 3.129
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scenario, climatemodel, time) float64 -0.06237 … 0.03244
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scenario, climatemodel, time) float64 -0.04581 … 0.03082,
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  'Effective Radiative Forcing|Anthropogenic|Other|BC on Snow':
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   0.8862745098039215)},
 'cdic2': {'Delta T|Anthropogenic|CH4': (0.00784313725490196,
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   1.0),
  'Delta T|Anthropogenic|Aerosols': (1.0, 0.48627450980392156, 0.0),
  'Delta T|Anthropogenic|Tropospheric Ozone': (0.10196078431372549,
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   0.2196078431372549),
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   0.16862745098039217,
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2002-01-01                           0.592861
2003-01-01                           0.571464
2004-01-01                           0.553648
…                                       …
2096-01-01                          -3.936752
2097-01-01                          -3.992038
2098-01-01                          -4.046849
2099-01-01                          -4.101254
2100-01-01                          -4.155242

            Delta T|Anthropogenic|Other|BC on Snow
time
2000-01-01                               0.649712
2001-01-01                               0.625867
2002-01-01                               0.602167
2003-01-01                               0.580912
2004-01-01                               0.563284
…                                           …
2096-01-01                              -4.185577
2097-01-01                              -4.243275
2098-01-01                              -4.300397
2099-01-01                              -4.356991
2100-01-01                              -4.413006

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        0.00916962,  0.00922913,  0.0092944 ,  0.00933461,  0.00932705,
        0.00936428,  0.00940651,  0.00943527,  0.00948523,  0.00952066,
        0.0095506 ,  0.00956552,  0.00959692,  0.00962955,  0.00966555,
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        0.01003749,  0.01011623,  0.01019771,  0.01028404,  0.0103746 ,
        0.01046725,  0.01056081,  0.01065465,  0.01074777,  0.01083834,
        0.01092984,  0.01102327,  0.01111696,  0.01120952,  0.01130586,
        0.01135093])
Coordinates:
  * time          (time) datetime64[ns] 2000-01-01 2001-01-01 … 2100-01-01
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    region        <U5 'World'
    unit          <U5 'W/m^2'
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Coordinates:
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    model         <U1 ''
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  array([3.39963924])
  Coordinates:
    * time          (time) datetime64[ns] 2100-01-01
      model         <U1 ''
      scenario      <U6 'ssp370'
      region        <U5 'World'
      unit          <U5 'W/m^2'
      unit_context  <U12 'not_required')}}
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[ ]:
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↪do echo "file is $line"; jupyter-nbconvert --to pdf $line; done
```

```
file is ./3_delta_T_plot.ipynb
[NbConvertApp] Converting notebook ./3_delta_T_plot.ipynb to pdf
[NbConvertApp] Support files will be in 3_delta_T_plot_files/
[NbConvertApp] Making directory ./3_delta_T_plot_files
[NbConvertApp] Making directory ./3_delta_T_plot_files
[NbConvertApp] Making directory ./3_delta_T_plot_files
[NbConvertApp] Making directory ./3_delta_T_plot_files
```

```
[NbConvertApp] Making directory ./3_delta_T_plot_files
[NbConvertApp] Making directory ./3_delta_T_plot_files
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to pdf
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citations
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file is ./2_compute_delta_T.ipynb
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