



Supplement of

**Data assimilation for the Model for Prediction Across Scales –
Atmosphere with the Joint Effort for Data assimilation Integration (JEDI-
MPAS 1.0.0): EnVar implementation and evaluation**

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```
1 cost function:
2   cost type: 3D-Var
3   window begin: '2018-04-14T21:00:00Z'
4   window length: PT6H
5   jb evaluation: false
6   geometry:
7     nml_file: "./namelist.atmosphere_30km"
8     streams_file: "./streams.atmosphere_30km"
9     deallocate non-da fields: true
10    interpolation type: unstructured
11  analysis variables: &incvars
12  - temperature
13  - spechum
14  - uReconstructZonal
15  - uReconstructMeridional
16  - surface_pressure
17  - qc
18  - qi
19  - qr
20  - qs
21  - qg
22  variable change: Identity
23  background:
24    state variables: [temperature, spechum, uReconstructZonal,
... uReconstructMeridional, surface_pressure,
25                      qc, qi, qr, qs, qg, cldfrac,
26                      theta, rho, u, qv, pressure, landmask, xice, snowc,
... skintemp, ivgtyp, isltyp,
27                      snowh, vegfra, t2m, q2, u10, v10, lai, smois, tslb,
... pressure_p]
28    filename: "./bg.2018-04-15_00.00.00.nc"
29    date: '2018-04-15T00:00:00Z'
30  background error:
31  covariance model: ensemble
32  date: '2018-04-15T00:00:00Z'
33  localization:
34    localization method: BUMP
35    timeslots:
36    - '2018-04-15T00:00:00Z'
37    localization variables: *incvars
38  bump:
39    datadir:
... /glade/p/mmm/parc/liuz/pandac_common/
... 60km_bumploc_1200km_6km_384p_20210927code
40    prefix: bumploc_1200km_6km
41    strategy: common #specific_univariate
42    load_nicas_local: 1
43  members:
44  - filename: ./ensemble_input/01/EnsForCov.2018-04-15_00.00.00.nc
45    date: '2018-04-15T00:00:00Z'
```

```
46 state variables: *incvars
47 - filename: ./ensemble_input/02/EnsForCov.2018-04-15_00.00.00.nc
48 date: '2018-04-15T00:00:00Z'
49 state variables: *incvars
50 - filename: ./ensemble_input/03/EnsForCov.2018-04-15_00.00.00.nc
51 date: '2018-04-15T00:00:00Z'
52 state variables: *incvars
53 - filename: ./ensemble_input/04/EnsForCov.2018-04-15_00.00.00.nc
54 date: '2018-04-15T00:00:00Z'
55 state variables: *incvars
56 - filename: ./ensemble_input/05/EnsForCov.2018-04-15_00.00.00.nc
57 date: '2018-04-15T00:00:00Z'
58 state variables: *incvars
59 - filename: ./ensemble_input/06/EnsForCov.2018-04-15_00.00.00.nc
60 date: '2018-04-15T00:00:00Z'
61 state variables: *incvars
62 - filename: ./ensemble_input/07/EnsForCov.2018-04-15_00.00.00.nc
63 date: '2018-04-15T00:00:00Z'
64 state variables: *incvars
65 - filename: ./ensemble_input/08/EnsForCov.2018-04-15_00.00.00.nc
66 date: '2018-04-15T00:00:00Z'
67 state variables: *incvars
68 - filename: ./ensemble_input/09/EnsForCov.2018-04-15_00.00.00.nc
69 date: '2018-04-15T00:00:00Z'
70 state variables: *incvars
71 - filename: ./ensemble_input/10/EnsForCov.2018-04-15_00.00.00.nc
72 date: '2018-04-15T00:00:00Z'
73 state variables: *incvars
74 - filename: ./ensemble_input/11/EnsForCov.2018-04-15_00.00.00.nc
75 date: '2018-04-15T00:00:00Z'
76 state variables: *incvars
77 - filename: ./ensemble_input/12/EnsForCov.2018-04-15_00.00.00.nc
78 date: '2018-04-15T00:00:00Z'
79 state variables: *incvars
80 - filename: ./ensemble_input/13/EnsForCov.2018-04-15_00.00.00.nc
81 date: '2018-04-15T00:00:00Z'
82 state variables: *incvars
83 - filename: ./ensemble_input/14/EnsForCov.2018-04-15_00.00.00.nc
84 date: '2018-04-15T00:00:00Z'
85 state variables: *incvars
86 - filename: ./ensemble_input/15/EnsForCov.2018-04-15_00.00.00.nc
87 date: '2018-04-15T00:00:00Z'
88 state variables: *incvars
89 - filename: ./ensemble_input/16/EnsForCov.2018-04-15_00.00.00.nc
90 date: '2018-04-15T00:00:00Z'
91 state variables: *incvars
92 - filename: ./ensemble_input/17/EnsForCov.2018-04-15_00.00.00.nc
93 date: '2018-04-15T00:00:00Z'
94 state variables: *incvars
95 - filename: ./ensemble_input/18/EnsForCov.2018-04-15_00.00.00.nc
```

```

96     date: '2018-04-15T00:00:00Z'
97     state variables: *incvars
98     - filename: ./ensemble_input/19/EnsForCov.2018-04-15_00.00.00.nc
99     date: '2018-04-15T00:00:00Z'
100    state variables: *incvars
101    - filename: ./ensemble_input/20/EnsForCov.2018-04-15_00.00.00.nc
102    date: '2018-04-15T00:00:00Z'
103    state variables: *incvars
104    variables: *incvars
105    observations:
106    - obs space:
107        name: Radiosonde
108        obsdatain:
109            obsfile: Data/sondes_obs_2018041500.h5
110        obsdataout:
111            obsfile: Data/obsout_omboma_sondes.h5
112        simulated variables: [air_temperature, virtual_temperature,
... eastward_wind, northward_wind, specific_humidity]
113        obs operator:
114            name: VertInterp
115        obs error:
116            covariance model: diagonal
117        obs filters:
118        - filter: PreQC
119            maxvalue: 3
120            apply at iterations: 0,1,2
121        - filter: Background Check
122            threshold: 3
123            apply at iterations: 0,1,2
124        get values:
125            interpolation type: unstructured
126    - obs space:
127        name: Aircraft
128        obsdatain:
129            obsfile: Data/aircraft_obs_2018041500.h5
130        obsdataout:
131            obsfile: Data/obsout_omboma_aircraft.h5
132        simulated variables: [air_temperature, eastward_wind, northward_wind,
... specific_humidity]
133        obs operator:
134            name: VertInterp
135        obs error:
136            covariance model: diagonal
137        obs filters:
138        - filter: PreQC
139            maxvalue: 3
140            apply at iterations: 0,1,2
141        - filter: Background Check
142            threshold: 3
143            apply at iterations: 0,1,2

```

```
144     get values:
145         interpolation type: unstructured
146 - obs space:
147     name: Satwind
148     obsdatain:
149         obsfile: Data/satwind_obs_2018041500.h5
150     obsdataout:
151         obsfile: Data/obsout_omboma_satwind.h5
152     simulated variables: [eastward_wind, northward_wind]
153 obs operator:
154     name: VertInterp
155 obs error:
156     covariance model: diagonal
157 obs filters:
158 - filter: PreQC
159     maxvalue: 3
160     apply at iterations: 0,1,2
161 - filter: Background Check
162     threshold: 3
163     apply at iterations: 0,1,2
164 get values:
165     interpolation type: unstructured
166 - obs space:
167     name: GnssroRef
168     obsdatain:
169         obsfile: Data/gnssro_obs_2018041500.h5
170     obsdataout:
171         obsfile: Data/obsout_omboma_gnssroref.h5
172     simulated variables: [refractivity]
173 obs operator:
174     name: GnssroRef
175     obs options:
176         use_compress: 0
177 obs error:
178     covariance model: diagonal
179 obs filters:
180 - filter: Domain Check
181     where:
182     - variable:
183         name: altitude@MetaData
184         minvalue: 0
185         maxvalue: 30000
186     - variable:
187         name: earth_radius_of_curvature@MetaData
188         minvalue: 6250000
189         maxvalue: 6450000
190     - variable:
191         name: geoid_height_above_reference_ellipsoid@MetaData
192         minvalue: -200
193         maxvalue: 200
```

```
194 - filter: Background Check
195   threshold: 3.0
196   apply at iterations: 0,1,2
197 - filter: R0bserror
198   variable: refractivity
199   errmodel: NBAM
200 get values:
201   interpolation type: unstructured
202 - obs space:
203   name: SfcPCorrected
204   obsdatain:
205     obsfile: Data/sfc_obs_2018041500.h5
206   obsdataout:
207     obsfile: Data/obsout_omboma_sfc.h5
208   simulated variables: [surface_pressure]
209 obs operator:
210   name: SfcPCorrected
211   da_psfc_scheme: UKMO # or WRFDA
212 linear obs operator:
213   name: Identity
214 obs error:
215   covariance model: diagonal
216 obs filters:
217 - filter: PreQC
218   maxvalue: 3
219   apply at iterations: 0,1,2
220 - filter: Difference Check
221   reference: station_elevation@MetaData
222   value: surface_altitude@GeoVals
223   threshold: 200
224 - filter: Background Check
225   threshold: 3
226   apply at iterations: 0,1,2
227 get values:
228   interpolation type: unstructured
229 - obs space: &amsuaobsspace
230   name: AMSUA-N0AA19
231   obsdatain:
232     obsfile: Data/amsua_n19_obs_2018041500.h5
233   obsdataout:
234     obsfile: Data/obsout_omboma_amsua_n19.h5
235   simulated variables: [brightness_temperature]
236   channels: 5-7,9
237 obs error:
238   covariance model: diagonal
239 obs filters:
240 - filter: PreQC
241   maxvalue: 0
242   apply at iterations: 0,1,2
243 - filter: Background Check
```

```
244     threshold: 3
245     apply at iterations: 0,1,2
246 obs operator: &crtmdry
247     name: CRTM
248     Absorbers: [H20,03]
249     SurfaceWindGeoVars: uv
250     linear obs operator:
251         Absorbers: [H20]
252     obs options: &crtmopts
253         Sensor_ID: amsua_n19
254         EndianType: little_endian
255         CoefficientPath: /glade/p/mmm/parc/liuz/pandac_common/crtm_coeffs/
256 get values:
257     interpolation type: unstructured
258 - obs space:
259     <<: *amsuaobsspace
260     name: AMSUA-NOAA15
261     obsdatain:
262         obsfile: Data/amsua_n15_obs_2018041500.h5
263     obsdataout:
264         obsfile: Data/obsout_omboma_amsua_n15.h5
265     simulated variables: [brightness_temperature]
266     channels: 5-9
267 obs error:
268     covariance model: diagonal
269 obs filters:
270 - filter: PreQC
271     maxvalue: 0
272     apply at iterations: 0,1,2
273 - filter: Background Check
274     threshold: 3
275     apply at iterations: 0,1,2
276 obs operator:
277     <<: *crtmdry
278     obs options:
279         <<: *crtmopts
280         Sensor_ID: amsua_n15
281 get values:
282     interpolation type: unstructured
283 - obs space:
284     <<: *amsuaobsspace
285     name: AMSUA-NOAA18
286     obsdatain:
287         obsfile: Data/amsua_n18_obs_2018041500.h5
288     obsdataout:
289         obsfile: Data/obsout_omboma_amsua_n18.h5
290     simulated variables: [brightness_temperature]
291     channels: 5-9
292 obs error:
293     covariance model: diagonal
```

```
294 obs filters:
295 - filter: PreQC
296   maxvalue: 0
297   apply at iterations: 0,1,2
298 - filter: Background Check
299   threshold: 3
300   apply at iterations: 0,1,2
301 obs operator:
302   <<: *crtmdry
303   obs options:
304     <<: *crtmopts
305     Sensor_ID: amsua_n18
306 - obs space:
307   <<: *amsuaobsspace
308   name: AMSUA-METOPA
309   obsdatain:
310     obsfile: Data/amsua_metop-a_obs_2018041500.h5
311   obsdataout:
312     obsfile: Data/obsout_omboma_amsua_metop-a.h5
313   simulated variables: [brightness_temperature]
314   channels: 5,6,9
315 obs error:
316   covariance model: diagonal
317 obs filters:
318 - filter: PreQC
319   maxvalue: 0
320   apply at iterations: 0,1,2
321 - filter: Background Check
322   threshold: 3
323   apply at iterations: 0,1,2
324 obs operator:
325   <<: *crtmdry
326   obs options:
327     <<: *crtmopts
328     Sensor_ID: amsua_metop-a
329 get values:
330   interpolation type: unstructured
331 - obs space:
332   <<: *amsuaobsspace
333   name: AMSUA-METOPB
334   obsdatain:
335     obsfile: Data/amsua_metop-b_obs_2018041500.h5
336   obsdataout:
337     obsfile: Data/obsout_omboma_amsua_metop-b.h5
338   simulated variables: [brightness_temperature]
339   channels: 8,9
340 obs error:
341   covariance model: diagonal
342 obs filters:
343 - filter: PreQC
```



```
344     maxvalue: 0
345     apply at iterations: 0,1,2
346 - filter: Background Check
347     threshold: 3
348     apply at iterations: 0,1,2
349 obs operator:
350     <<: *crtmdry
351     obs options:
352         <<: *crtmopts
353         Sensor_ID: amsua_metop-b
354 get values:
355     interpolation type: unstructured
356 - obs space:
357     <<: *amsuaobsspace
358     name: AMSUA-AQUA
359     obsdatain:
360         obsfile: Data/amsua_aqua_obs_2018041500.h5
361     obsdataout:
362         obsfile: Data/obsout_omboma_amsua_aqua.h5
363     simulated variables: [brightness_temperature]
364     channels: 8,9
365 obs error:
366     covariance model: diagonal
367 obs filters:
368 - filter: PreQC
369     maxvalue: 0
370     apply at iterations: 0,1,2
371 - filter: Background Check
372     threshold: 3
373     apply at iterations: 0,1,2
374 obs operator:
375     <<: *crtmdry
376     obs options:
377         <<: *crtmopts
378         Sensor_ID: amsua_aqua
379 get values:
380     interpolation type: unstructured
381 ##### cloudy amsua
382 - obs space:
383     name: cldAMSUA-NOAA19
384     obsdatain:
385         obsfile: Data/amsua_n19_obs_2018041500.h5
386     obsdataout:
387         obsfile: Data/obsout_omboma_amsua_n19_cld.h5
388     simulated variables: [brightness_temperature]
389     channels: 1-4,15
390 obs error:
391     covariance model: diagonal
392 obs filters:
393 - filter: Background Check
```

```

394     threshold: 3
395     apply at iterations: 0,1,2
396 - filter: BlackList
397     filter variables:
398     - name: brightness_temperature
399       channels: 1-4,15
400     action:
401       name: assign error
402       error function:
403         name: ObsErrorModelRamp@ObsFunction
404         channels: 1-4,15
405         options:
406           channels: 1-4,15
407           xvar:
408             name: CLWRetSymmetricMW@ObsFunction
409             options:
410               clwret_ch238: 1
411               clwret_ch314: 2
412               clwret_types: [ObsValue, HofX]
413               bias_application: ObsValue
414             x0: [ 0.030, 0.030, 0.030, 0.030, 0.030 ]
415             x1: [ 0.760, 0.760, 0.320, 0.430, 0.240 ]
416             err0: [ 5.510, 3.650, 2.530, 0.510, 6.330 ]
417             err1: [30.310, 41.17, 13.29, 2.30, 19.24]
418     apply at iterations: 0,1,2
419 - filter: Domain Check
420     filter variables:
421     - name: brightness_temperature
422       channels: 1-4,15
423     where:
424     - variable:
425       name: water_area_fraction@GeoVals
426       minvalue: 1.0
427     apply at iterations: 0,1,2
428 obs operator: &crtmcloud
429     name: CRTM
430     Absorbers: [H2O,03,C02]
431     SurfaceWindGeoVars: uv
432     Clouds: [Water, Ice, Rain, Snow, Graupel]
433     linear obs operator:
434       Absorbers: [H2O,03,C02]
435       Clouds: [Water, Ice, Rain, Snow, Graupel]
436     obs options:
437       <<: *crtmopts
438       Sensor_ID: amsua_n19
439     get values:
440       interpolation type: unstructured
441 - obs space:
442     name: cldAMSUA-NOAA18
443     obsdatain:

```

```
444     obsfile: Data/amsua_n18_obs_2018041500.h5
445     obsdataout:
446     obsfile: Data/obsout_omboma_amsua_n18_cld.h5
447     simulated variables: [brightness_temperature]
448     channels: 1-4,15
449     obs error:
450     covariance model: diagonal
451     obs filters:
452     - filter: Background Check
453       threshold: 3
454       apply at iterations: 0,1,2
455     - filter: BlackList
456       filter variables:
457       - name: brightness_temperature
458         channels: 1-4,15
459       action:
460         name: assign error
461         error function:
462         name: ObsErrorModelRamp@ObsFunction
463         channels: 1-4,15
464         options:
465         channels: 1-4,15
466         xvar:
467         name: CLWRetSymmetricMW@ObsFunction
468         options:
469         clwret_ch238: 1
470         clwret_ch314: 2
471         clwret_types: [ObsValue, HofX]
472         bias_application: ObsValue
473         x0:      [ 0.030, 0.030, 0.030, 0.030, 0.030 ]
474         x1:      [ 0.730, 0.670, 0.300, 0.420, 0.230 ]
475         err0:    [ 5.580, 3.680, 2.550, 0.560, 6.420 ]
476         err1:    [32.270, 43.09, 13.31, 2.880, 19.25]
477       apply at iterations: 0,1,2
478     - filter: Domain Check
479       filter variables:
480       - name: brightness_temperature
481         channels: 1-4,15
482     where:
483     - variable:
484       name: water_area_fraction@GeoVals
485       minvalue: 1.0
486       apply at iterations: 0,1,2
487     obs operator: &crtmcloud
488     name: CRTM
489     Absorbers: [H2O,03,C02]
490     SurfaceWindGeoVars: uv
491     Clouds: [Water, Ice, Rain, Snow, Graupel]
492     linear obs operator:
493     Absorbers: [H2O,03,C02]
```

```

494     Clouds: [Water, Ice, Rain, Snow, Graupel]
495     obs options:
496         <<: *crtmopts
497         Sensor_ID: amsua_n18
498     get values:
499         interpolation type: unstructured
500 - obs space:
501     name: cldAMSUA-NOAA15
502     obsdatain:
503         obsfile: Data/amsua_n15_obs_2018041500.h5
504     obsdataout:
505         obsfile: Data/obsout_omboma_amsua_n15_cld.h5
506     simulated variables: [brightness_temperature]
507     channels: 1-4,15
508     obs error:
509         covariance model: diagonal
510     obs filters:
511     - filter: Background Check
512         threshold: 3
513         apply at iterations: 0,1,2
514     - filter: BlackList
515         filter variables:
516     - name: brightness_temperature
517         channels: 1-4,15
518     action:
519         name: assign error
520         error function:
521             name: ObsErrorModelRamp@ObsFunction
522             channels: 1-4,15
523             options:
524                 channels: 1-4,15
525                 xvar:
526                     name: CLWRetSymmetricMW@ObsFunction
527                     options:
528                         clwret_ch238: 1
529                         clwret_ch314: 2
530                         clwret_types: [ObsValue, HofX]
531                         bias_application: ObsValue
532                 x0: [ 0.030, 0.030, 0.030, 0.030, 0.030 ]
533                 x1: [ 0.740, 0.740, 0.310, 0.720, 0.220 ]
534                 err0: [ 5.560, 3.690, 2.580, 0.520, 6.400 ]
535                 err1: [42.860, 51.61, 12.800, 4.300, 18.83]
536         apply at iterations: 0,1,2
537     - filter: Domain Check
538         filter variables:
539     - name: brightness_temperature
540         channels: 1-4,15
541     where:
542     - variable:
543         name: water_area_fraction@GeoVals

```

```

544     minvalue: 1.0
545     apply at iterations: 0,1,2
546 obs operator: &crtmcloud
547     name: CRTM
548     Absorbers: [H2O,03,C02]
549     SurfaceWindGeoVars: uv
550     Clouds: [Water, Ice, Rain, Snow, Graupel]
551     linear obs operator:
552         Absorbers: [H2O,03,C02]
553         Clouds: [Water, Ice, Rain, Snow, Graupel]
554     obs options:
555         <<: *crtmopts
556         Sensor_ID: amsua_n15
557 get values:
558     interpolation type: unstructured
559 - obs space:
560     name: cldAMSUA-METOP-A
561     obsdatain:
562         obsfile: Data/amsua_metop-a_obs_2018041500.h5
563     obsdataout:
564         obsfile: Data/obsout_omboma_amsua_metop-a_cld.h5
565     simulated variables: [brightness_temperature]
566     channels: 1-4,15
567 obs error:
568     covariance model: diagonal
569 obs filters:
570 - filter: Background Check
571     threshold: 3
572     apply at iterations: 0,1,2
573 - filter: BlackList
574     filter variables:
575 - name: brightness_temperature
576     channels: 1-4,15
577 action:
578     name: assign error
579     error function:
580         name: ObsErrorModelRamp@ObsFunction
581         channels: 1-4,15
582         options:
583             channels: 1-4,15
584             xvar:
585                 name: CLWRetSymmetricMW@ObsFunction
586                 options:
587                     clwret_ch238: 1
588                     clwret_ch314: 2
589                     clwret_types: [ObsValue, HofX]
590                     bias_application: ObsValue
591     x0: [ 0.030, 0.030, 0.030, 0.030, 0.030 ]
592     x1: [ 0.710, 0.610, 0.300, 0.360, 0.230 ]
593     err0: [ 5.510, 3.640, 2.680, 0.510, 6.290 ]

```

```
594         err1: [27.410, 34.88, 13.05, 2.370, 19.35]
595     apply at iterations: 0,1,2
596 - filter: Domain Check
597     filter variables:
598     - name: brightness_temperature
599       channels: 1-4,15
600     where:
601     - variable:
602       name: water_area_fraction@GeoVaLs
603       minvalue: 1.0
604     apply at iterations: 0,1,2
605 obs operator: &crtmcloud
606     name: CRTM
607     Absorbers: [H2O,03,C02]
608     SurfaceWindGeoVars: uv
609     Clouds: [Water, Ice, Rain, Snow, Graupel]
610     linear obs operator:
611     Absorbers: [H2O,03,C02]
612     Clouds: [Water, Ice, Rain, Snow, Graupel]
613     obs options:
614     <<: *crtmopts
615     Sensor_ID: amsua_metop-a
616 get values:
617     interpolation type: unstructured
618 - obs space:
619     name: cldAMSUA-METOP-B
620     obsdatain:
621     obsfile: Data/amsua_metop-b_obs_2018041500.h5
622     obsdataout:
623     obsfile: Data/obsout_omboma_amsua_metop-b_cld.h5
624     simulated variables: [brightness_temperature]
625     channels: 1-4
626     obs error:
627     covariance model: diagonal
628     obs filters:
629     - filter: Background Check
630       threshold: 3
631       apply at iterations: 0,1,2
632     - filter: BlackList
633       filter variables:
634       - name: brightness_temperature
635         channels: 1-4
636     action:
637     name: assign error
638     error function:
639     name: ObsErrorModelRamp@ObsFunction
640     channels: 1-4
641     options:
642     channels: 1-4
643     xvar:
```

```

644         name: CLWRetSymmetricMW@ObsFunction
645         options:
646             clwret_ch238: 1
647             clwret_ch314: 2
648             clwret_types: [ObsValue, HofX]
649             bias_application: ObsValue
650         x0:      [ 0.030, 0.030, 0.030, 0.030]
651         x1:      [ 0.830, 0.740, 0.320, 0.320]
652         err0:    [ 5.610, 3.740, 2.550, 0.510]
653         err1:    [31.820, 44.29, 14.69, 2.340]
654     apply at iterations: 0,1,2
655 - filter: Domain Check
656     filter variables:
657     - name: brightness_temperature
658       channels: 1-4
659     where:
660     - variable:
661       name: water_area_fraction@GeoVaLs
662       minvalue: 1.0
663     apply at iterations: 0,1,2
664 obs operator: &crtmcloud
665     name: CRTM
666     Absorbers: [H2O,03,C02]
667     SurfaceWindGeoVars: uv
668     Clouds: [Water, Ice, Rain, Snow, Graupel]
669     linear obs operator:
670       Absorbers: [H2O,03,C02]
671       Clouds: [Water, Ice, Rain, Snow, Graupel]
672     obs options:
673       <<: *crtmopts
674       Sensor_ID: amsua_metop-b
675 get values:
676     interpolation type: unstructured
677 - obs space:
678     name: MHS-NOAA19
679     obsdatain:
680       obsfile: Data/mhs_n19_obs_2018041500.h5
681     obsdataout:
682       obsfile: Data/obsout_omboma_mhs_n19.h5
683     simulated variables: [brightness_temperature]
684     channels: 3-5
685 obs error:
686     covariance model: diagonal
687 obs filters:
688 - filter: PreQC
689     maxvalue: 0
690     apply at iterations: 0,1,2
691 - filter: Background Check
692     threshold: 3
693     apply at iterations: 0,1,2

```

```
694   obs operator:
695     <<: *crtmdry
696     obs options:
697       <<: *crtmopts
698       Sensor_ID: mhs_n19
699   get values:
700     interpolation type: unstructured
701 - obs space:
702   name: MHS-NOAA18
703   obsdatain:
704     obsfile: Data/mhs_n18_obs_2018041500.h5
705   obsdataout:
706     obsfile: Data/obsout_omboma_mhs_n18.h5
707   simulated variables: [brightness_temperature]
708   channels: 3-5
709   obs error:
710     covariance model: diagonal
711   obs filters:
712 - filter: PreQC
713   maxvalue: 0
714   apply at iterations: 0,1,2
715 - filter: Background Check
716   threshold: 3
717   apply at iterations: 0,1,2
718   obs operator:
719     <<: *crtmdry
720     obs options:
721       <<: *crtmopts
722       Sensor_ID: mhs_n18
723   get values:
724     interpolation type: unstructured
725 - obs space:
726   name: MHS-METOP-A
727   obsdatain:
728     obsfile: Data/mhs_metop-a_obs_2018041500.h5
729   obsdataout:
730     obsfile: Data/obsout_omboma_mhs_metop-a.h5
731   simulated variables: [brightness_temperature]
732   channels: 3-5
733   obs error:
734     covariance model: diagonal
735   obs filters:
736 - filter: PreQC
737   maxvalue: 0
738   apply at iterations: 0,1,2
739 - filter: Background Check
740   threshold: 3
741   apply at iterations: 0,1,2
742   obs operator:
743     <<: *crtmdry
```



```

744     obs options:
745         <<: *crtmopts
746         Sensor_ID: mhs_metop-a
747     get values:
748         interpolation type: unstructured
749 - obs space:
750     name: MHS-METOP-B
751     obsdatain:
752         obsfile: Data/mhs_metop-b_obs_2018041500.h5
753     obsdataout:
754         obsfile: Data/obsout_omboma_mhs_metop-b.h5
755     simulated variables: [brightness_temperature]
756     channels: 3-5
757     obs error:
758         covariance model: diagonal
759     obs filters:
760     - filter: PreQC
761         maxvalue: 0
762         apply at iterations: 0,1,2
763     - filter: Background Check
764         threshold: 3
765         apply at iterations: 0,1,2
766     obs operator:
767         <<: *crtmdry
768         obs options:
769             <<: *crtmopts
770             Sensor_ID: mhs_metop-b
771     get values:
772         interpolation type: unstructured
773 output:
774     filename: "./analysis.$Y-$M-$D_$h.$m.$s.nc"
775 variational:
776     minimizer:
777         algorithm: DRIPCG
778     iterations:
779     - geometry:
780         nml_file: "./namelist.atmosphere_60km"
781         streams_file: "./streams.atmosphere_60km"
782         deallocate non-da fields: true
783         interpolation type: unstructured
784     ninner: '60'
785     gradient norm reduction: 1e-10
786     test: 'on'
787     diagnostics:
788         departures: depbg
789     - geometry:
790         nml_file: "./namelist.atmosphere_60km"
791         streams_file: "./streams.atmosphere_60km"
792         deallocate non-da fields: true
793         interpolation type: unstructured

```

```
794     ninner: '60'  
795     gradient norm reduction: 1e-10  
796     test: 'on'  
797     diagnostics:  
798         departures: depbg2  
799 final:  
800     diagnostics:  
801         departures: depan  
802
```