UNIVERSITY OF CAMBRIDGE

ACITES Atmospheric Chemistry In The Earth System

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

Getting Started with UKCA
The UKCA Tutorials

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Centre *for* **Atmospheric Science**

Outline

- What is UKCA and what can I do with it?
- Why should I use it?
- What resources are available?
- Feedback

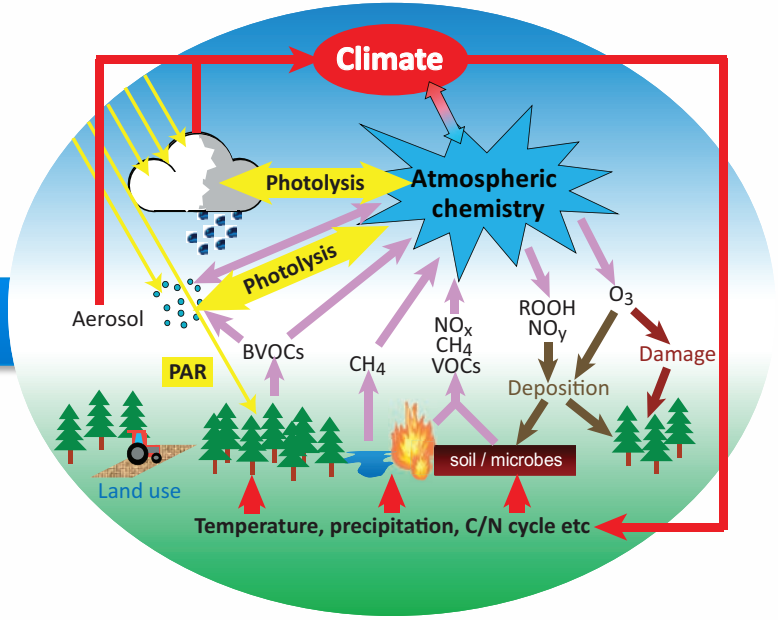
- UKCA Tutorials

- STASH

What is UKCA?

- UKCA is a Climate-Chemistry-Aerosol model, built as a sub-model of the Met Office's Unified Model (UM).
- UKCA is not a *particular* collection of chemistry and aerosol schemes, but is a **framework** for putting chemistry and aerosol schemes into the UM.

Unified Model



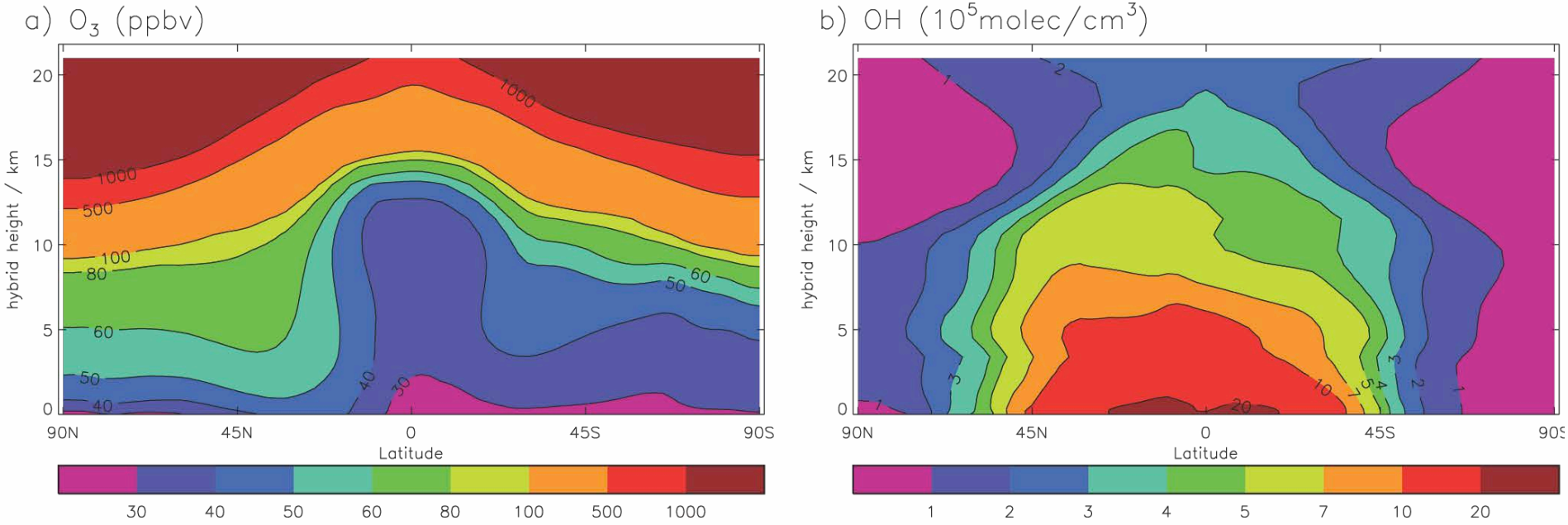
UKCA

What can I do with UKCA?

- UKCA was originally designed to run for long integrations covering decadal to centennial timescales, but it can also be used for air-quality forecasts
- A number of different chemistry schemes currently exist in the model, covering the troposphere and the stratosphere
  - These schemes are provided because the UKCA developers have wanted to use them for a particular purpose. If they don't suit your needs then you can add to or change them.
  - One aim of the UKCA Tutorials was to teach new UKCA users how to do this

What is UKCA used for?

UKCA was included in HadGEM2-ES

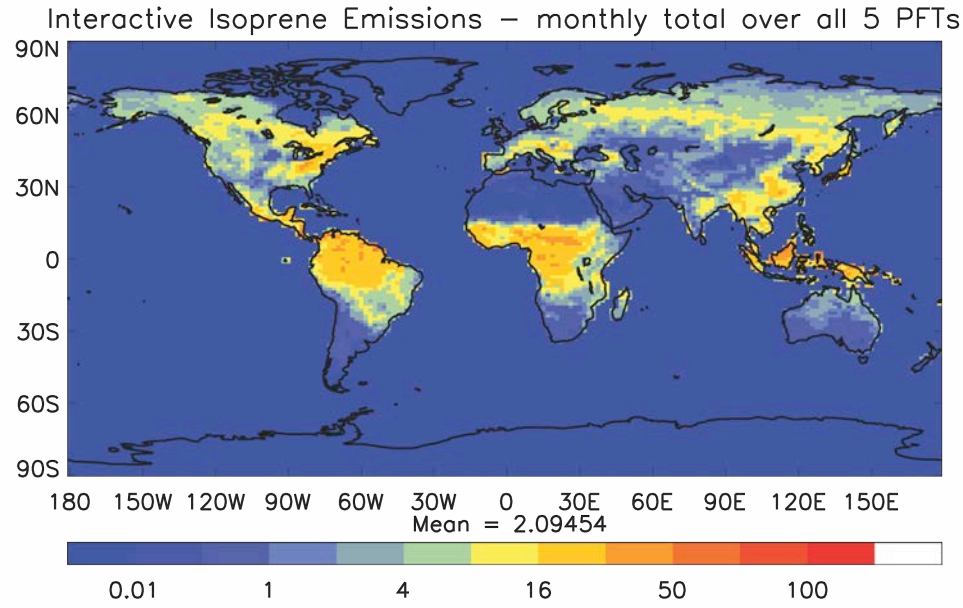


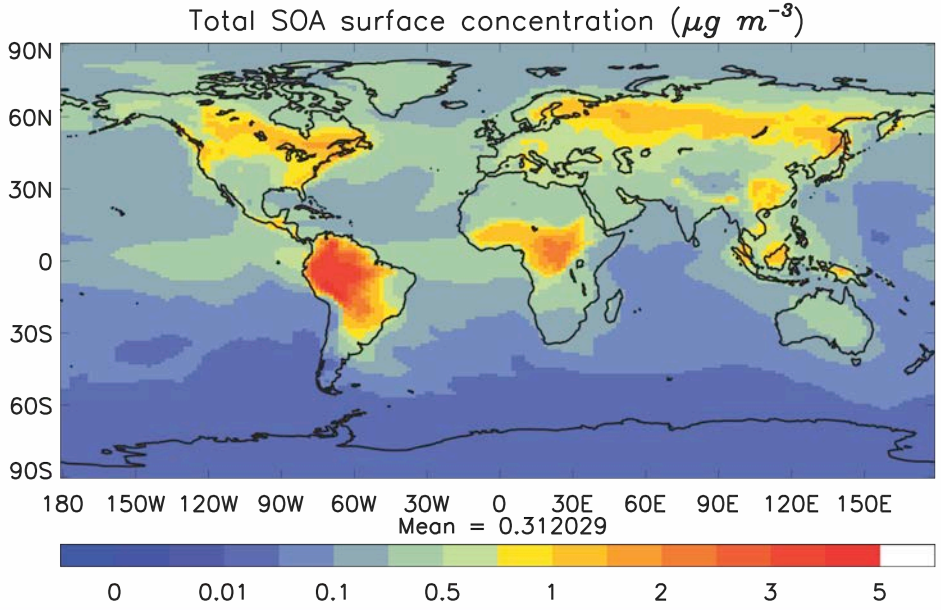
Simple scheme designed to simulate tropospheric O3 on centennial timescales to investigate feedbacks.

What is UKCA used for?

An extended version of the simple scheme was also included

Designed to look at feedbacks from the land-surface in shorter *timeslice* simulations.

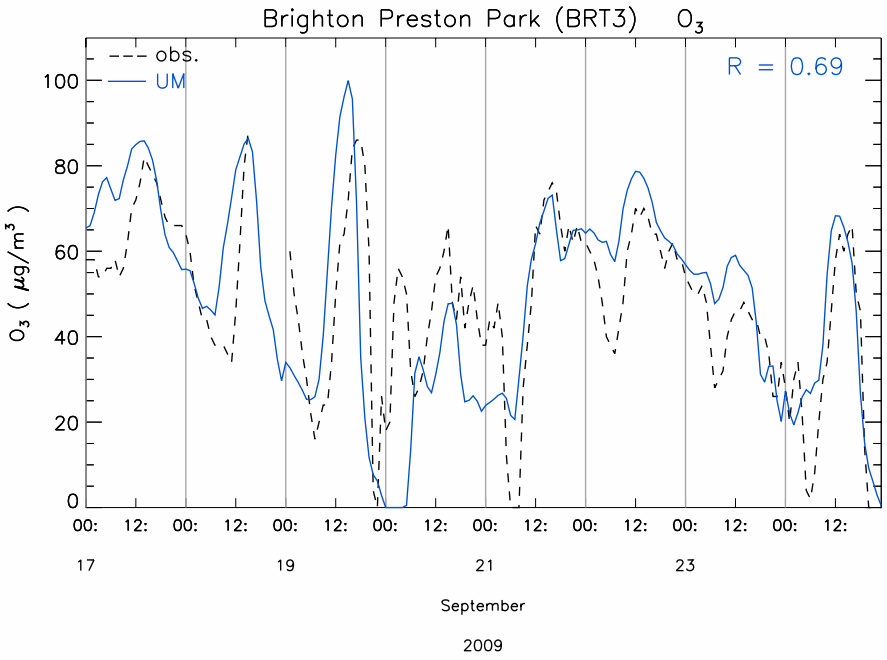


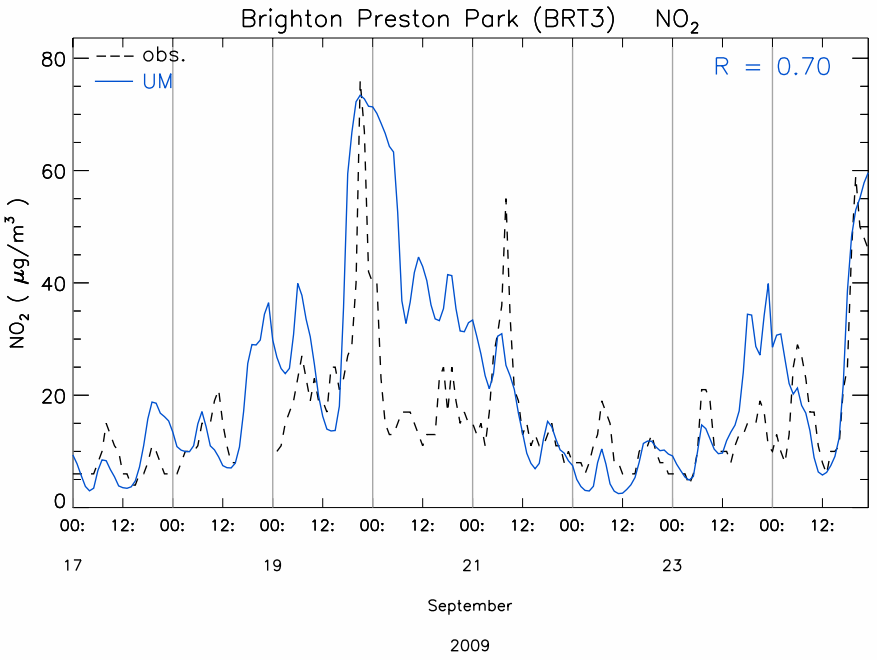


What is UKCA used for?

UKCA also runs in the UM Operational (Forecast) Suite

This is used to provide air-quality forecasts



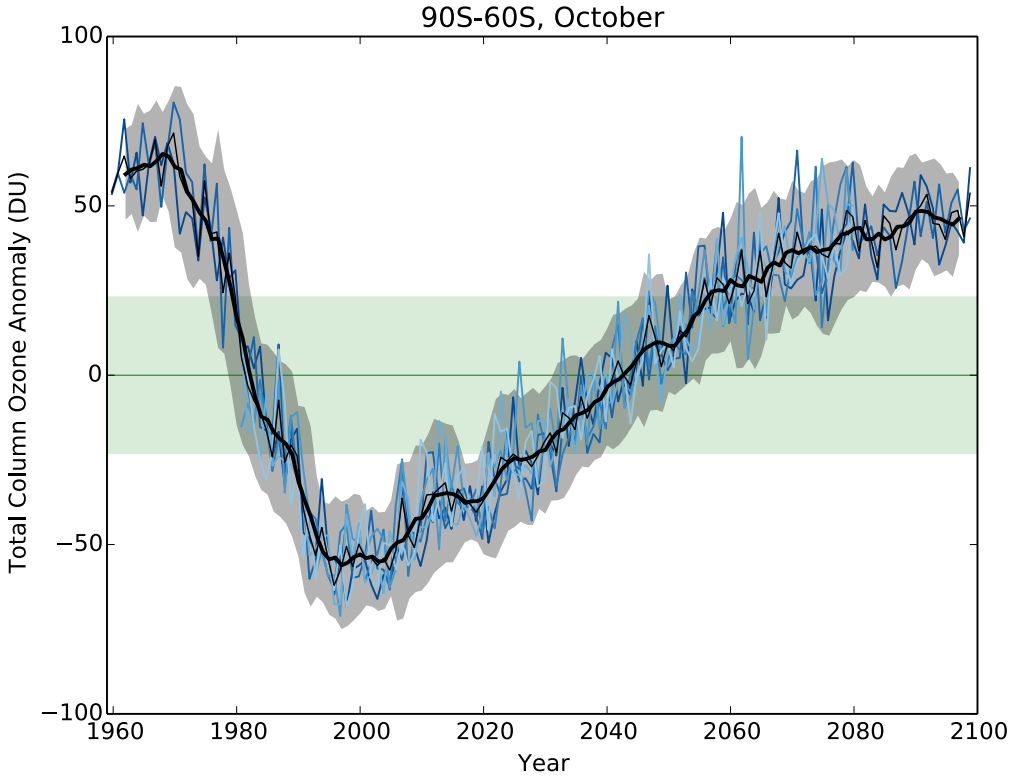


What is UKCA used for?

UKCA tracer fields can be made to interact with the UM radiation scheme, allowing chemistry-climate feedbacks to be investigated

UKCA was used in the SPARC CCMVal-2 and Lifetime Assessments.

Several modelling groups from the UK, Australia, and New Zealand will submit UKCA data to CCMI



What is UKCA used for?

UKCA can be used to ask “what if…”-type questions –

e.g. How many skin cancers have been avoided by the introduction of the Montreal Protocol?

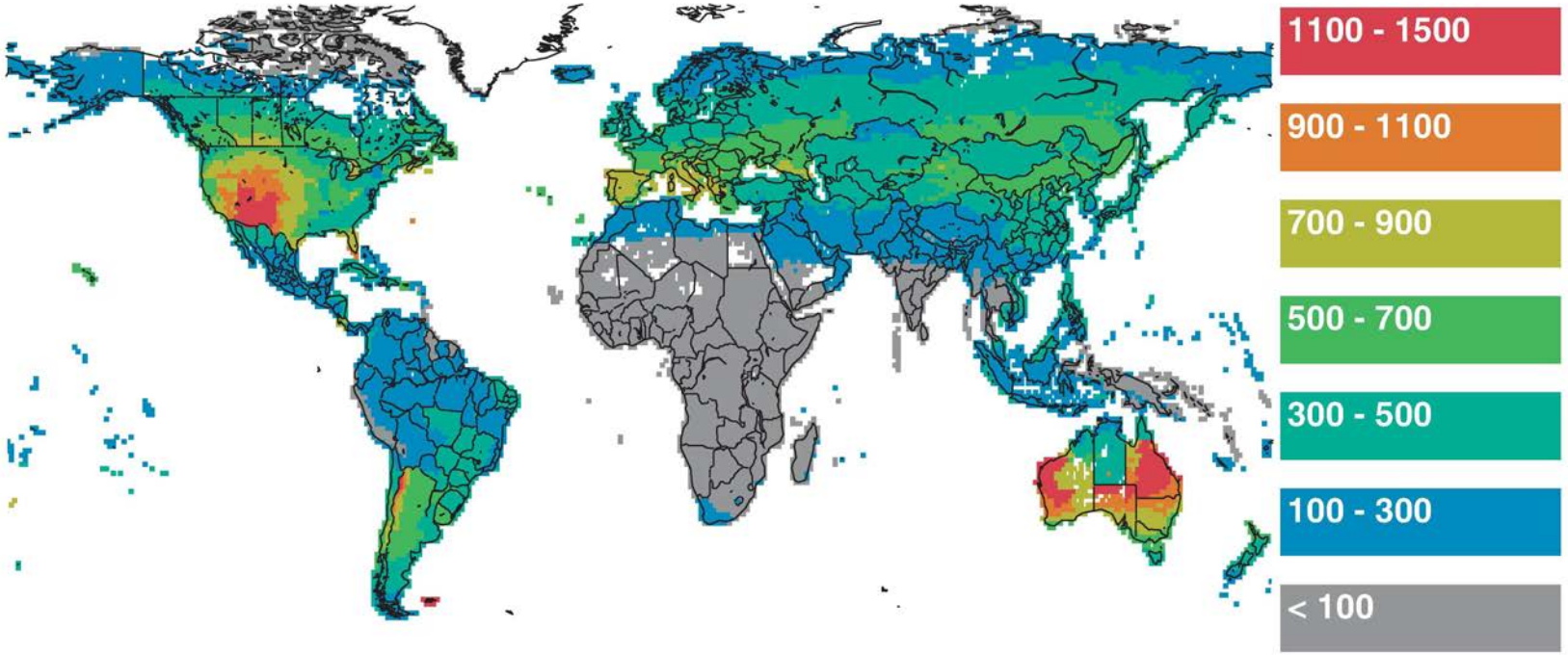


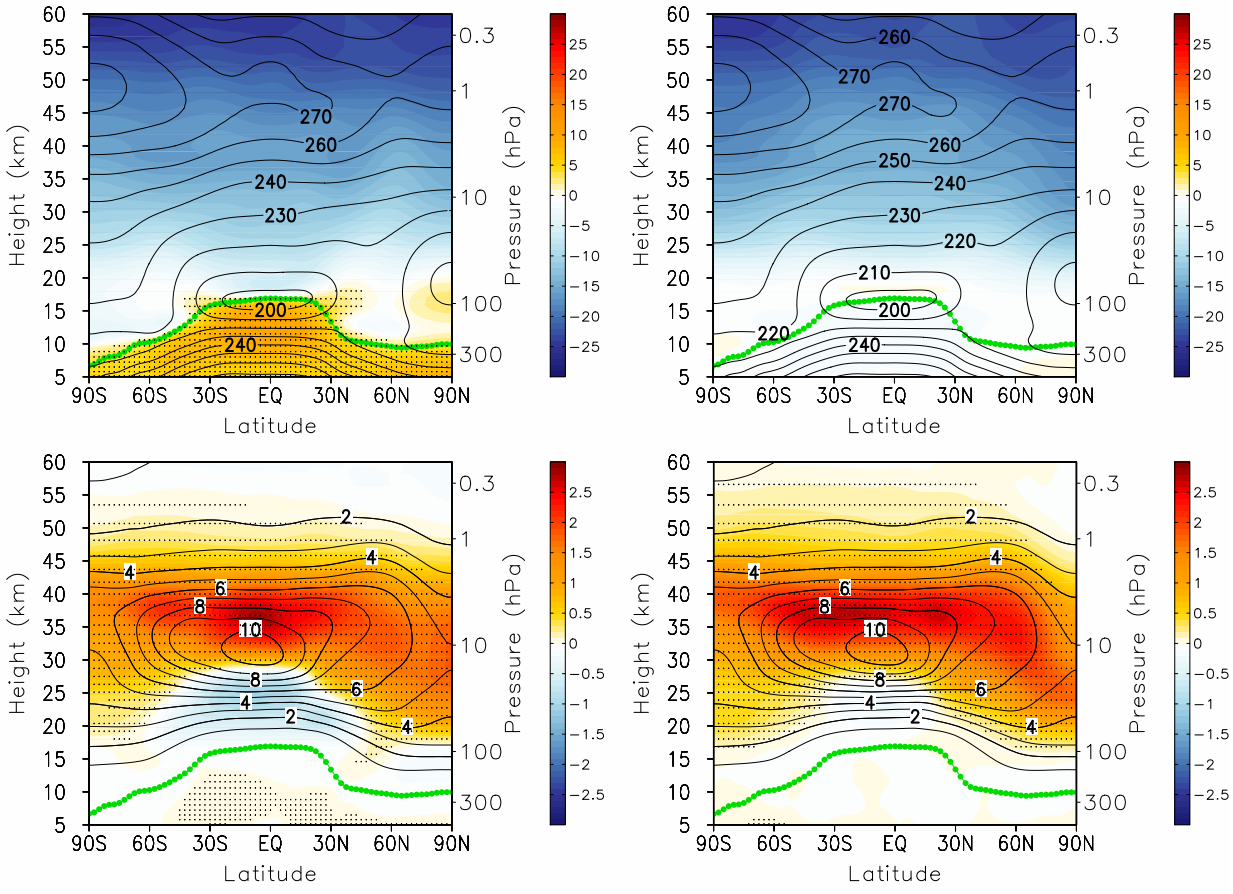
Figure 9. Total numbers of new cases of skin cancer per million people per year avoided by the Montreal Protocol in the year 2030.

van Dijk et al 2013

What is UKCA used for?

The UM atmosphere model can also be coupled to the NEMO ocean model, and UKCA can be run in this configuration

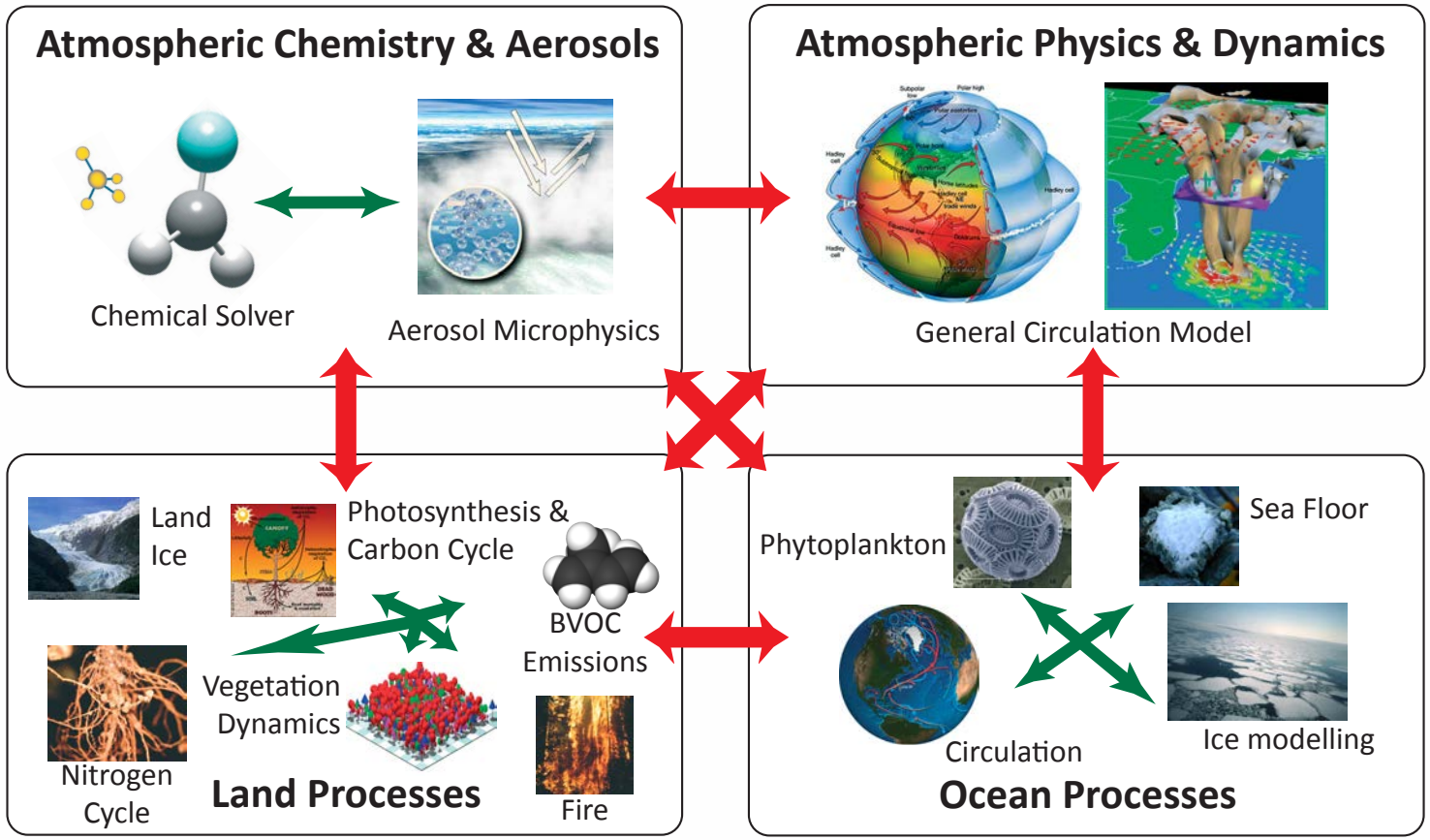
This model is currently being used to perform geoengineering studies in the GeoMIP framework



What is UKCA used for?

Earth-System Modelling

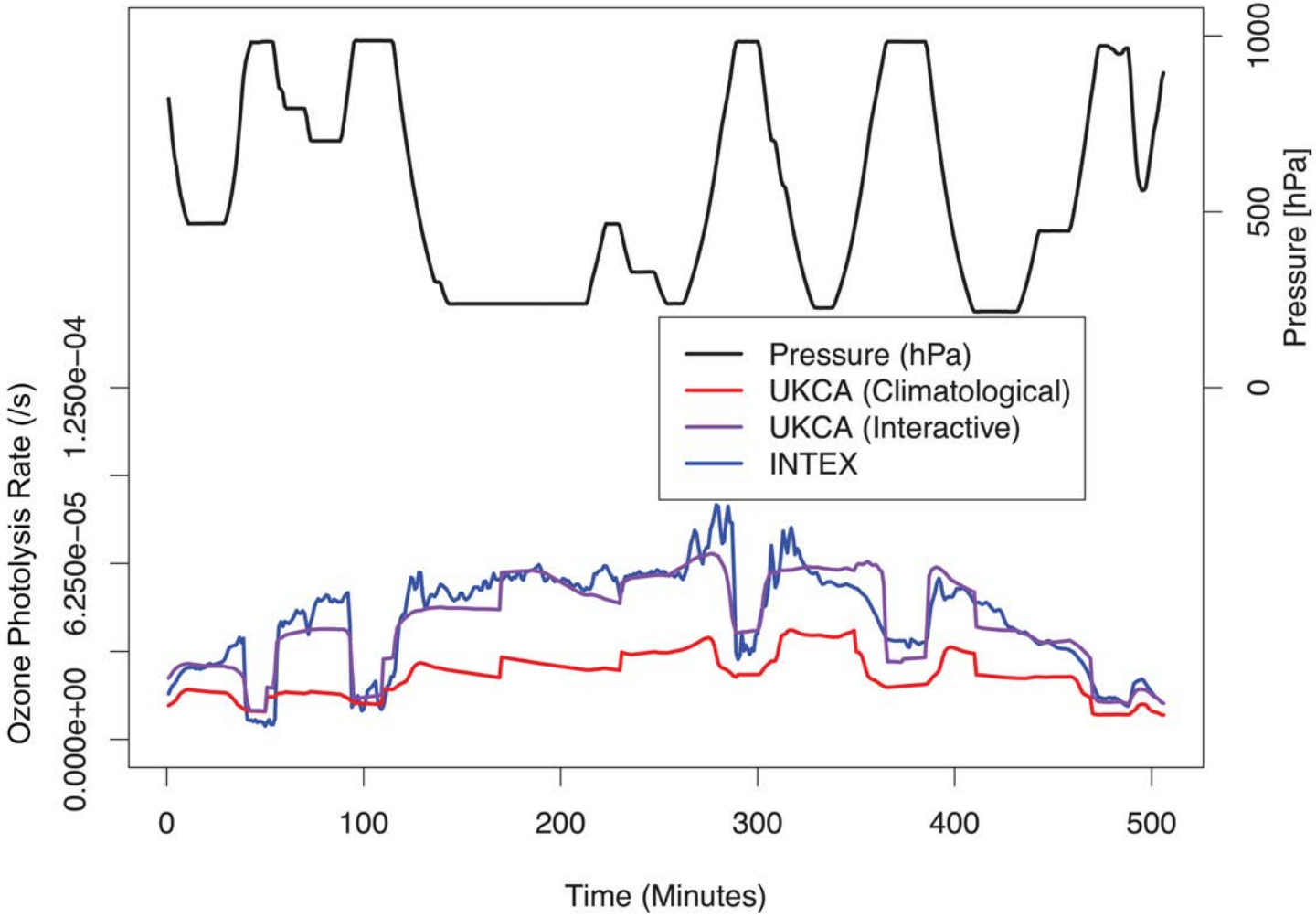
UKCA will form the chemistry and aerosol components of the joint Met Office – NERC joint Earth System Model UK-ESM1



Why should I use UKCA?

- Some of the reasons that you should use UKCA are…
  - You want to investigate chemistry-climate or aerosol-climate feedbacks
  - You want to investigate chemistry and aerosol feedbacks on the land-surface or on ocean biogeochemistry
  - You need to make use of the the functionality or diagnostics provided when using UM/UKCA, e.g.
    - Physical parameterisations
    - Nesting and high resolution
    - UKCA satellite emulator, flight-track simulator, double-call aerosol diagnostics, other on-line diagnostics…
  - You want to make use of the large amount of UKCA data available e.g. CMIP5, ACCMIP, CCMVal-2, CCMI…

Flight track simulator



What Resources are Available?

- So – you've decided to use UKCA, but if you are the only person at your institution using it it can be difficult to get up and running. It can also be very difficult to over-come and solve model problems.
- The UKCA Tutorials have been developed to address this first problem
  - There are also several UKCA standard jobs which are provided on PUMA under the **`ukca`** user
  - A UKCA Evaluation Suite is currently under development and is available on MONSooN
- The second issue is addressed by the NCAS Computational Modelling Services team based in Reading
  - `http://cms.ncas.ac.uk/`

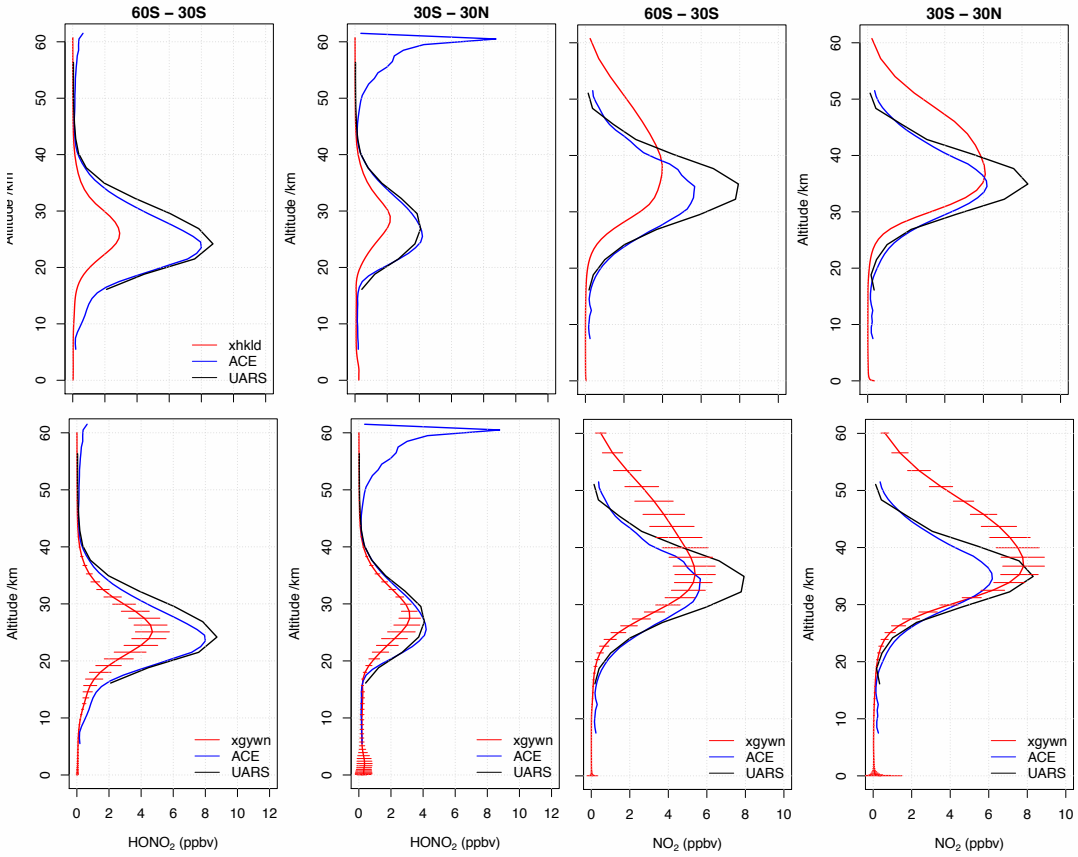
UKCA Evaluation Suite

- A UKCA Evaluation suite is being developed by Mohit Dalvi at the Met Office
- Takes existing scripts developed by the different groups developing UKCA and combines them in a single package
- UKCA jobs output a set of standard diagnostics which are then read by the suite to produce a series of plots to aid model evaluation
- As this contains some IDL programs it is only currently available on MONSooN, but will soon be available on JASMIN
- This suite is also designed to inform the UKCA developers whether or not a candidate job is scientifically suitable for release
  - Future UKCA release jobs will designed to be used for both chemistry and aerosol studies, and so must be suitable for both

UKCA Evaluation Suite

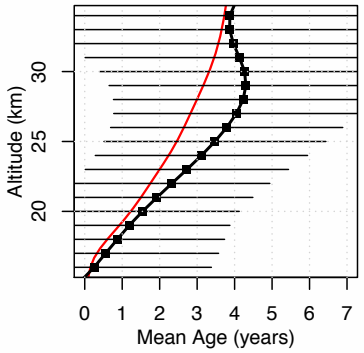
NOy

UM8.2 Release candidate

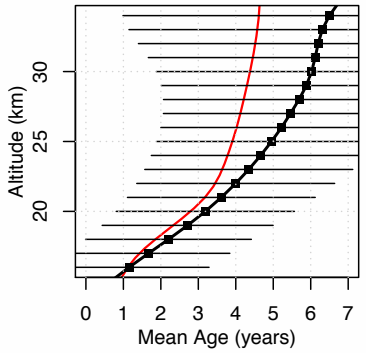


UM7.3 N48L60 CheST

Tropical Mean Age Profile

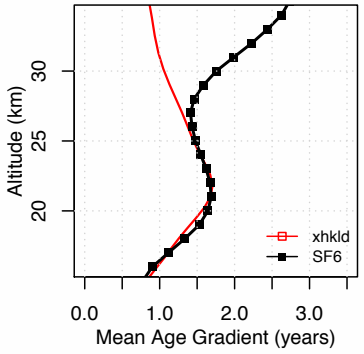


Midlatitude Mean Age Profil

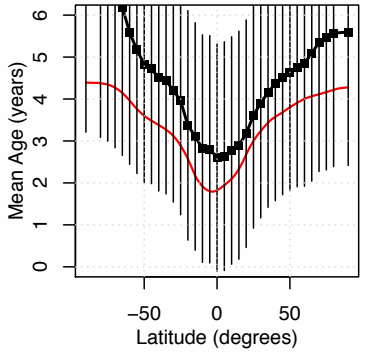


UM8.2 Release candidate

Trop–Midlat Mean Age Gradient Prof

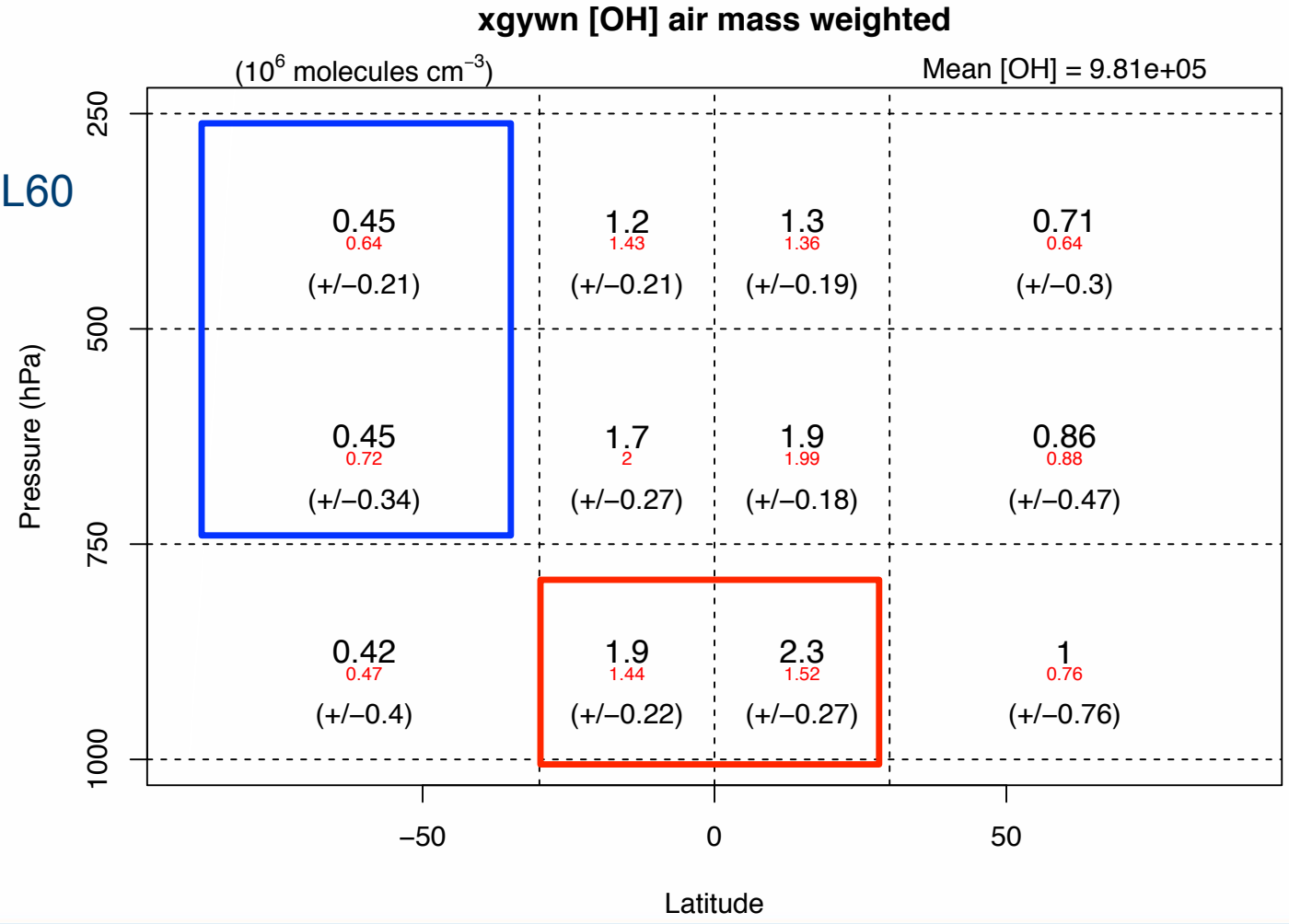


Mean Age, 23km (~50hPa)



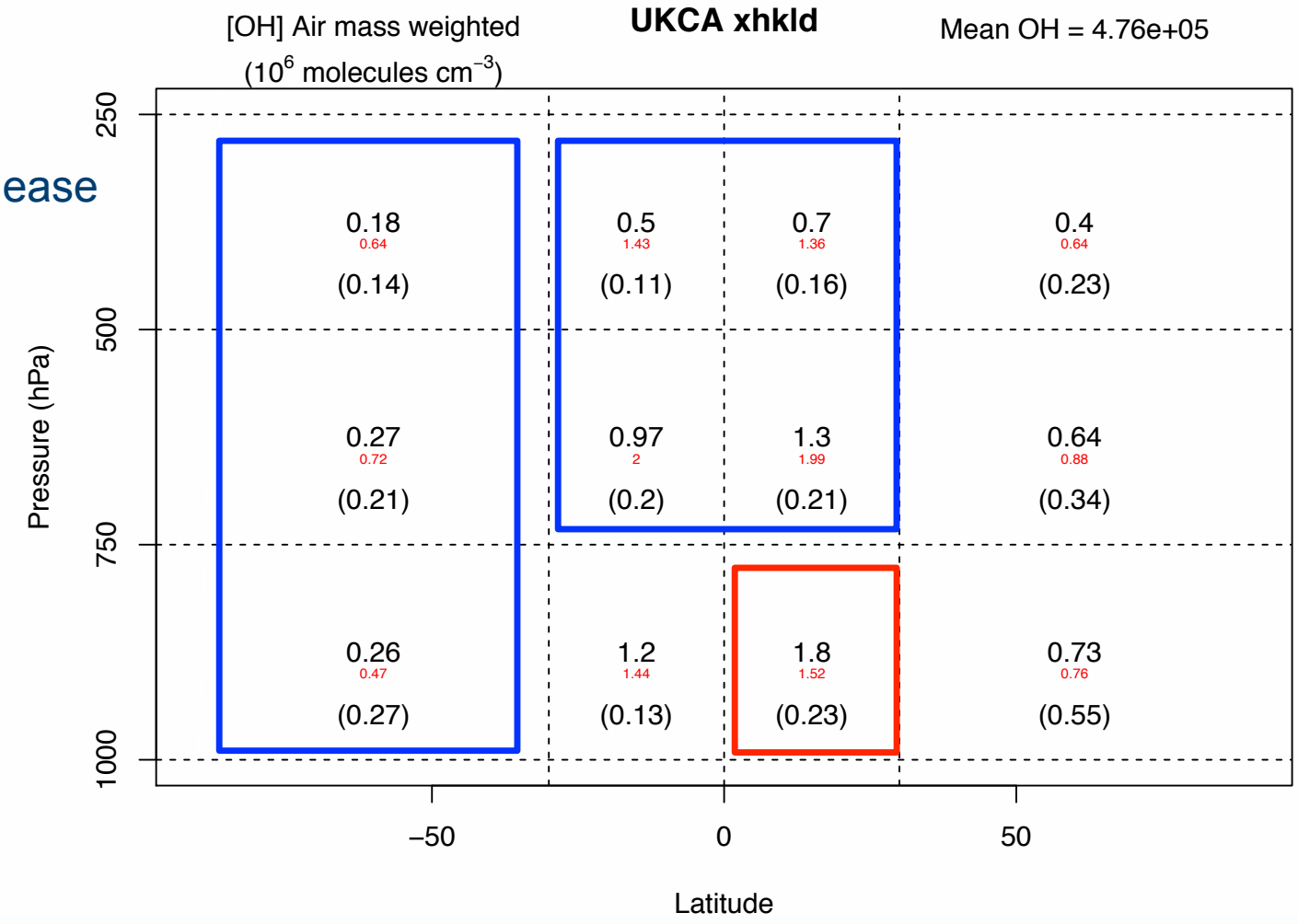
UKCA Evaluation Suite

UM7.3 N48L60
CheST



UKCA Evaluation Suite

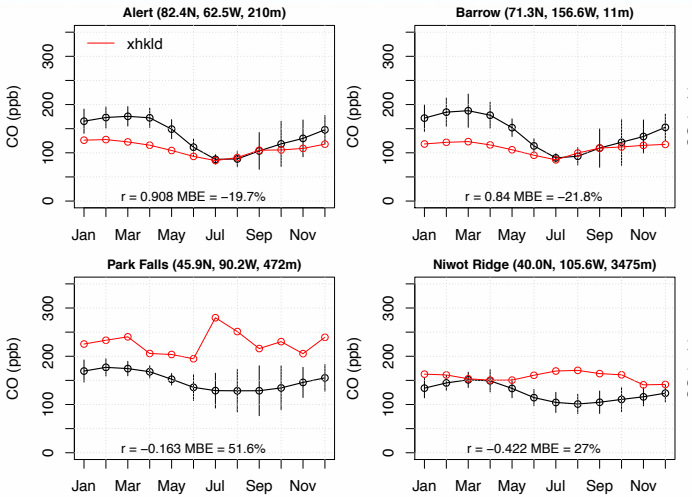
UM8.2 Release candidate

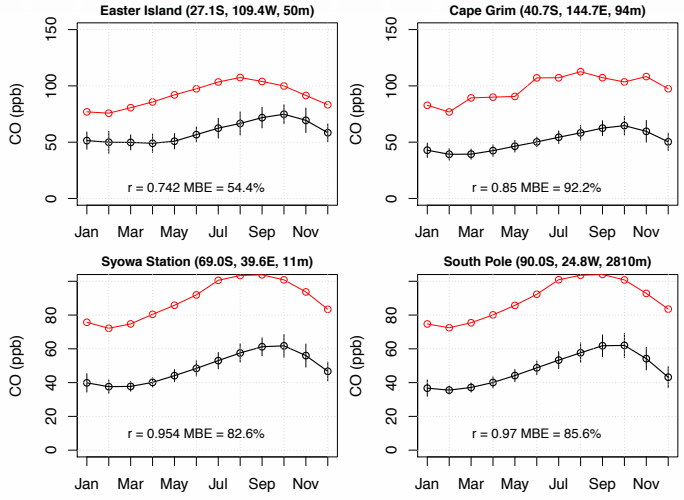


UKCA Evaluation Suite

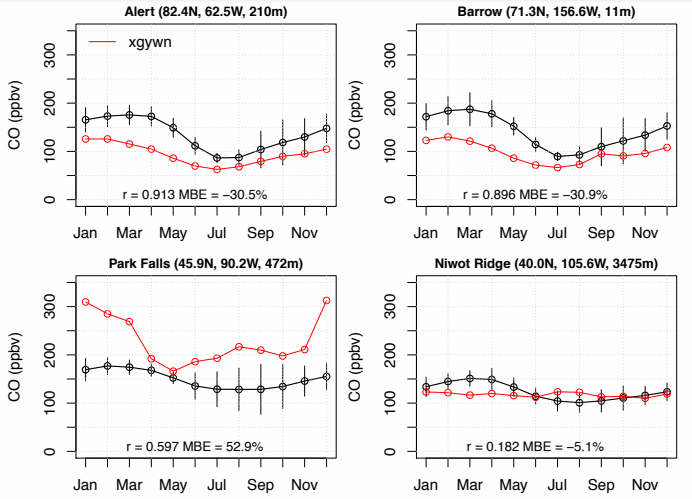
Surface CO

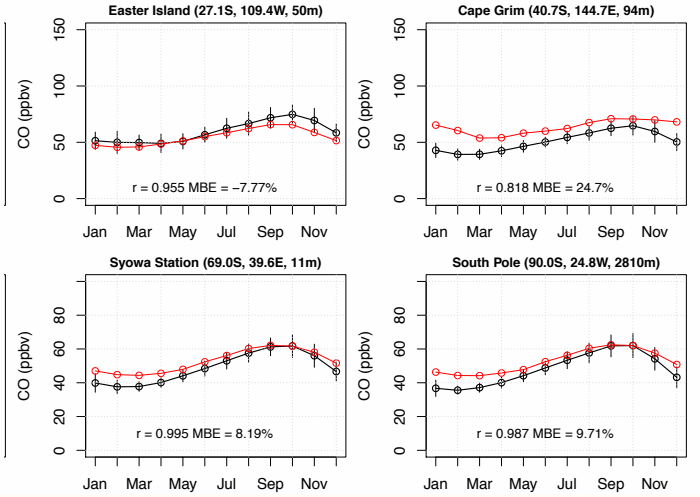
UM8.2 Release candidate





UM7.3 N48L60 CheST

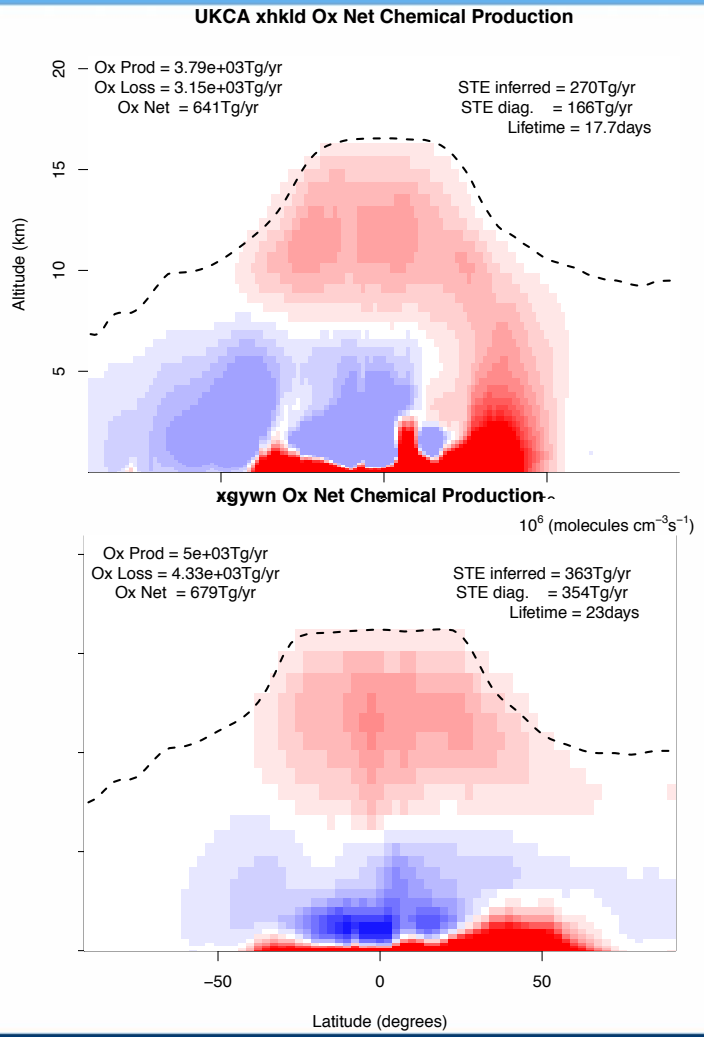




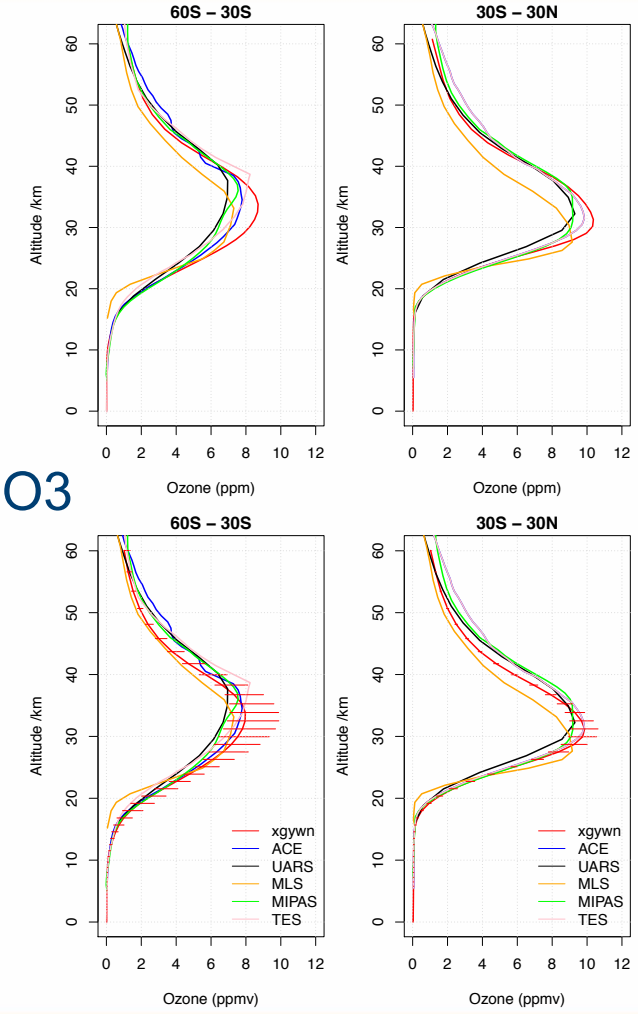
UKCA Evaluation Suite

UM8.2 Release candidate

UM7.3 N48L60 CheST



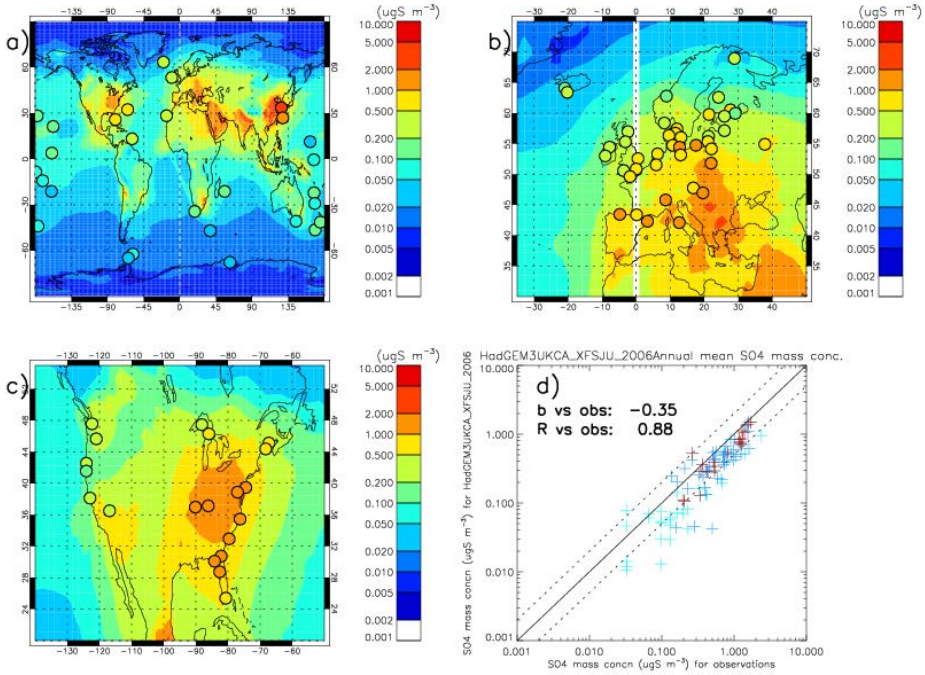
O3

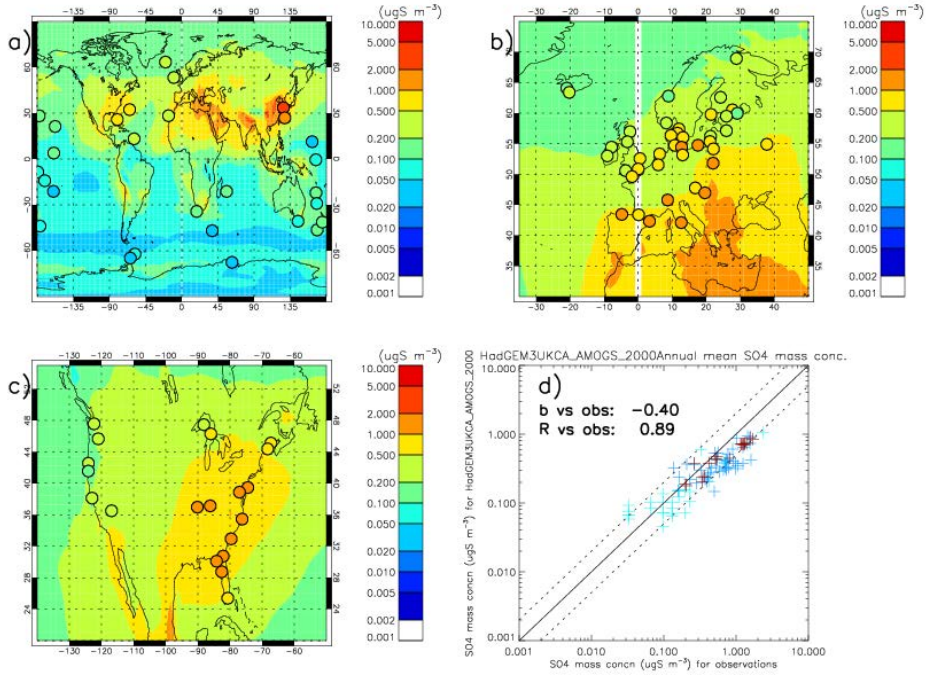


UKCA Evaluation Suite

UM7.3N96L63 CheT+GLOMAP

UM8.2 Release candidate





Mean SO4 mass concentration

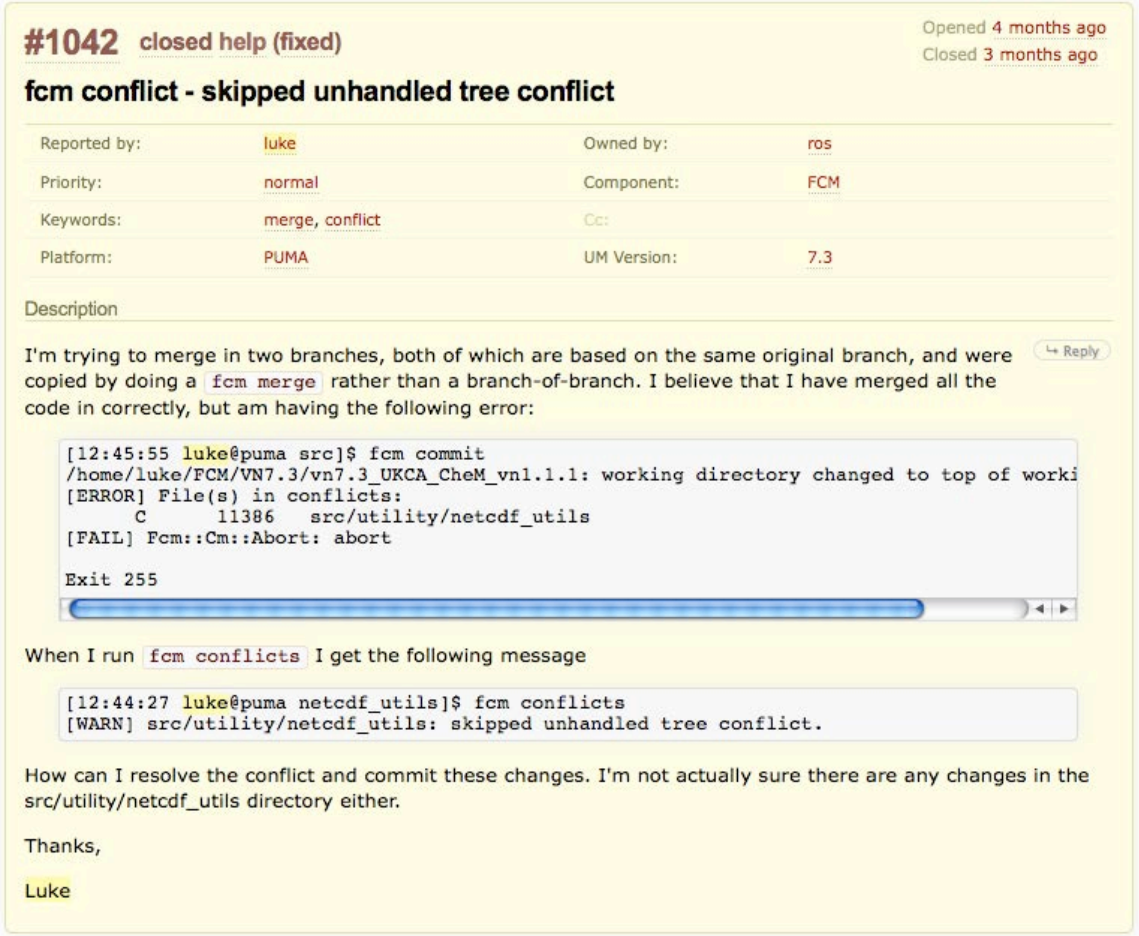
What do CMS do?

- CMS provide the PUMA service. This runs the UMUI server which is used to submit UM jobs to ARCHER and MONSooN
  - This means that everyone in the UK (including scientists at the Met Office) can develop and share UM/UKCA jobs from a single code-base
  - CMS port and test UM release jobs from the Met Office on these supercomputers
- They provide UM training, both as an on-line FCM tutorial, and as a 2-day workshop
- They provide tools, such as Xconv and Xancil, and the cf-python library
- They provide the **CMS Helpdesk**

Helpdesk

Ticket	Summary	Component	Version	Type	Owner	Status	Created
#1105	Segmentation fault when using the PC2 cloud scheme	UM Model	6.6.3	help	willie	accepted	24/07/13
#1104	UM4.5.1 on HECToR (July 2013)	UM Model	4.5	help	um_support	new	19/07/13
#1103	Error in umui	UMUI	<select version>	help	um_support	new	19/07/13
#1101	PS31 MOGREPS on MONSooN	UM Model	8.2	enhancement	willie	new	12/07/13
#1100	MOGREPS-R data request	Data	<select version>	task	um_support	new	12/07/13
#1098	large drift in HadGEM2 concides with change to phase2b..	UM Model	6.6.3	help	ros	accepted	10/07/13
#1097	Sending files straight to local computer	UM Model	None	help	ros	new	10/07/13
#1095	Running the UM with SST anomalies	UM Model	7.3	help	willie	accepted	08/07/13
#1092	Radiation diagnostics on different timestep to other variables?	UM Model	6.6.3	help	um_support	new	27/06/13
#1091	problems using sea ice and sst ancillaries	UM Model	6.6.3	help	jeff	accepted	27/06/13
#1088	PS31 Euro4 on MONSooN	UM Model	8.2	help	willie	new	21/06/13
#1087	Ensembles on MONSooN	UM Model	8.2	help	willie	new	21/06/13
#1081	Unknown problem in .leave file when submitting job	UM Model	6.6.3	help	um_support	new	11/06/13
#1071	UKCA O3-NOy daily output run failed	UM Model	7.3	help	luke	accepted	20/05/13
#1070	running HadCEM at Bristol	UM Model	4.5	help	jeff	new	16/05/13
#1067	Failure of model run using IAU scheme - segmentation fault	UM Model	6.6.3	help	um_support	assigned	13/05/13
#1064	Sporadic problems submitting to MONSOON (error msg: "system has no more ptys"	UM Model	7.3	help	um_support	new	07/05/13
#1061	segmentation fault when running HadCEM	UM Model	4.5	error	um_support	new	03/05/13
#1059	ssh_exchange_identification: Connection closed by remote host	UM Model	<select version>	help	um_support	new	01/05/13
#1053	Model instability	UM Model	7.3	help	luke	accepted	15/04/13
#1051	UKCA NOy stash diagnostics&NOx emissions	UM Model	7.3	help	luke	accepted	10/04/13
#1035	xancil - error	UM Model	6.1	help	jeff	accepted	08/03/13
#988	Network timeout submitting jobs to MONSooN	MONSooN	7.3	error	ros	reopened	06/12/12
#981	Sea ice ancillary file causing model crash	UM Model	7.3	help	jeff	accepted	03/12/12
#892	Error when reconfiguring a minimal start dump without physics	UM Model	8.2	help	annette	reopened	16/08/12
#769	Error when attempting to run an ensemble	UM Model	7.8	error	simon	assigned	10/01/12
#648	UM version 4.5.3 (FAMOUS) compilation problem	FAMOUS	4.5	error	robin	accepted	11/07/11
#583	12-hour and 6-hour means	UMUI	<select version>	help	lois	assigned	16/02/11

Helpdesk



#1042 closed help (fixed)

Opened 4 months ago
Closed 3 months ago

fcm conflict - skipped unhandled tree conflict

Reported by:	luke	Owned by:	ros
Priority:	normal	Component:	FCM
Keywords:	merge, conflict	Cc:	
Platform:	PUMA	UM Version:	7.3

Description

Reply

I'm trying to merge in two branches, both of which are based on the same original branch, and were copied by doing a `fcm merge` rather than a branch-of-branch. I believe that I have merged all the code in correctly, but am having the following error:

```
[12:45:55 luke@puma src]$ fcm commit
/home/luke/FCM/VN7.3/vn7.3_UKCA_CheM_vn1.1.1: working directory changed to top of worki
[ERROR] File(s) in conflicts:
      C      11386   src/utility/netcdf_utils
[FAIL] Fcm::Cm::Abort: abort

Exit 255
```

When I run `fcm conflicts` I get the following message

```
[12:44:27 luke@puma netcdf_utils]$ fcm conflicts
[WARN] src/utility/netcdf_utils: skipped unhandled tree conflict.
```

How can I resolve the conflict and commit these changes. I'm not actually sure there are any changes in the src/utility/netcdf_utils directory either.

Thanks,

Luke

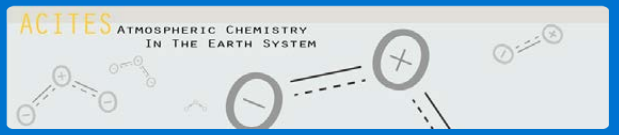
Solved in 5 comments

The Helpdesk is searchable, so if you have a problem the first thing to do is to search for past tickets with the same problem.

If you cannot find a solution open a new ticket. This will be emailed round to all of the CMS team

UKCA tickets will be answered by me.

Tutorials



- The UKCA Tutorials are being developed as part of the ACITES atmospheric chemistry modelling network
  - The tutorials focusing on chemistry are complete, and the tutorials focusing on aerosols will be completed within the next few weeks.

- Premise:

  What are the most common things that a PhD student or Research Associate will need to know how to do when they start using UKCA?

Starting to use UKCA

- Often you will want to use UKCA to answer questions like these:
  - *What happens when I add in reaction A to form new species B?*
  - *What is the effect of changing the emissions of C?*
  - *How does the deposition of D affect process E?*
  - *How do my changes affect the aerosol properties?*
  - *What is the budget of F?*
    - *Output the fluxes of reactions G, H, and I to diagnose it.*
- When you have completed the UKCA Tutorials you should have a basic understanding how to make the required changes needed to answer these questions

Tutorial Tasks

- Through-out the tutorial you are asked to perform a series of tasks. In fact, these are part of one big task which is:

Create two new species, ALICE and BOB, then add in emissions of ALICE and the reaction

ALICE + OH ➔ BOB + Secondary Organic Compound (Sec_Org)

before adding in the dry deposition of ALICE and the wet deposition of BOB. You should also output the fluxes through the reaction and deposition processes. You will then make changes to the GLOMAP-mode aerosol scheme and diagnose the impact of this reaction on the aerosol microphysics.

Tutorial Tasks

- Despite seeming to be straight-forward, this is actually quite a big task as it involves
  - UMUI changes
    - Creation of hand-edits
    - Creation of STASHmaster (diagnostic definition) files
    - Changes to STASH (diagnostic) output
  - UKCA code changes
    - New species
    - New emissions
    - New reactions/depositions
    - Changing the aerosol configuration
  - Creating of new input files
    - Regridding input data

Tutorial Tasks

- When working with UKCA it is important to

1. Break the tasks down into manageable chunks
   - This is why the task is split across several tutorials

2. Remember that UKCA sits within the UM framework
   - When making changes to UKCA that will also involve changes to the UM, you should (where possible) make the UM changes ***first***
   - If the UKCA changes are made first you will probably not be able to compile or run, but making the UM changes first means that you can check that the infrastructure is in place for the changes you will make to UKCA

Tutorial Tasks

- The Tutorials are broken down into three sections

1. General use of UKCA and the UMUI
    - These three tutorials cover the basics of the UMUI, copying and running a UKCA job, and STASH
2. UKCA Chemistry
    - These tutorials break down the chemistry task into 6 smaller chunks
        - Adding tracers, adding emissions, adding reactions, adding dry and wet deposition, and adding diagnostics
3. UKCA Aerosols
    - The 3 aerosol tutorials cover changing the aerosol configuration, looking into how your changes have affected the aerosol optical depth, and diagnosing the radiative effect of aerosols

Tutorial Tasks

- These tutorials have been designed so that you can go through them in your own pace and in your own time
- This is partly because, due to the number of steps that may need to be completed, it may take longer than 2 days to complete all the tutorials
- Do not worry if you are not able to complete a section – you can pick-up a worked solution and carry on from there

Feedback

I hope that you will find the UKCA Tutorials both enjoyable and useful.

It would be very helpful for me if you could fill in the UKCA feedback form which is linked to from the Tutorial front page.

More detailed comments can be emailed to me at

luke.abraham@atm.ch.cam.ac.uk

Any and all feedback given will be used to improve the Tutorials for future users.

The Tutorials

Tutorial 1:
Running an existing UKCA job

Tutorial 1: Running an existing UKCA job

- This tutorial is designed to make you more familiar with the use of Xconv to view UKCA output, and to convert the UM fields-file format to netCDF
- It also covers the text-file output – the **`.leave`** files
  - If your job has an error, either in the compilation step or the run-step, then you may get useful information in these files
  - During run-time, further information is also held in the **`jobid.fort6.peX`** files
- In this tutorial you are asked to run your copy of the Tutorial base job, and examine the output

ARCHER: **xjrna**

Tutorial 1: Running an existing UKCA job

You should now work through the

Running an existing UKCA job

tutorial

Tutorial 1: Running an existing UKCA job

- Points to remember

  1. You can check the progress of a running job by looking at the output in the `jobid.fort6.peX` files
  2. Xconv can be used to take a quick look at UM/UKCA output, as well as converting this output to other formats, e.g. netCDF
  3. Warning and error messages are held in the output `.leave` files

Tutorial 2:
Exploring the UMUI

Tutorial 2: Exploring the UMUI

- This task is designed to make you more familiar with the UMUI
- On many levels, the having the functionality given by the UMUI is a big plus for the UM
  - It provides a well organised method of editing the very complex scripts used to run the UM
  - It provides a certain level of consistency checking
  - Most UMUI panels have some level of help text available

Tutorial 2: Exploring the UMUI

- However, the UMUI is currently **not** searchable
  - This tutorial was designed to provide a useful point of reference for many of the UMUI panels that you may need to use when using UKCA
  - You may also find it useful to make your own notes as to what each panel does
- In this tutorial you are asked to browse through the UMUI panels

Tutorial 2: Exploring the UMUI

You should now work through the

Exploring the UMUI

tutorial

Tutorial 2: Exploring the UMUI

- Points to remember

    1. The UMUI is a very useful way to manage UM/UKCA jobs, however, it has no search function and so it can be quite difficult to find exactly what you want

    2. Remember that there may be help text available for a panel

    3. If you are unsure what you are looking for, browse through the UMUI panels, and make changes to see which options appear. However, you should remember to **abandon** any unwanted changes rather than close (and save) the panel

    4. You may find it useful to make notes about which panels do what.

Tutorial 3:
STASH

Tutorial 3: STASH

- This tutorial is designed to give you an overview of the STASH panel and options
- Some further details to do with STASH, such as making new STASH specification files, are covered in later tutorials
- You are also asked to add some high-frequency output and check that this is being done correctly

Tutorial 3: STASH

You should now work through the

What is STASH?

tutorial

Tutorial 3: STASH

- From this tutorial I hope that you have more of an understanding of what STASH can and can't do, as well as things to try if you are having problems
- Points to remember
    1. If you are unsure the best thing to do is to **take a copy of your job** and play around with settings until you get the desired effect
        - You can always **abandon** any unwanted changes
    2. Remember to **verify** your diagnostics after any changes, as this will flag any issues

Tutorial 4:
Adding new UKCA tracers

Tutorial 4: Adding new UKCA tracers

- This tutorial begins the process of adding in the new tracers, emission, reaction, depositions, and diagnostics
- It also requires you to make a new FCM branch and merge-in an existing UKCA branch
  - While a lot of UKCA developments were put back into the trunk at UM8.2, you may still find that you need to do this merging step, and it is useful to know how to do this
  - If you want to use another UM/UKCA version (e.g. UM7.3) then you will need to know how do this
- You are asked to add in two tracers, ALICE and BOB
  - This task is a good example of needing to add in the UM/UMUI changes **first**, before making any changes to the UKCA code itself

Tutorial 4: Adding new UKCA tracers

You should now work through the

Adding new chemical tracers

tutorial

Tutorial 4: Adding new UKCA tracers

- Points to remember for the UM/UMUI changes:
  1. Pick your tracer slot(s) from the UKCA code
  2. Make a STASHmaster file for these, and add them to the UMUI
     - Remember to initialise the tracer as well as output it
  3. Make your hand-edit to turn on these slots

- Once you have done these, you can make your UKCA changes

Tutorial 4: Adding new UKCA tracers

- Points to remember for the UKCA changes:
  1. The number of tracers UKCA thinks it has will be different from the number of tracers the UM/UMUI thinks UKCA has
     - The UM/UMUI is concerned with how many tracers are transported in section 34
     - UKCA is concerned with how many species, which are involved in the chemical mechanism, are transported
     - This means that the UKCA diagnostic tracers, e.g. age of air appear in the UM/UMUI but not the UKCA species list, and H2O appears in the UKCA species list but not the UM/UMUI (as it is not transported in section 34).
  2. As the UM outputs tracers in mass-mixing ratio, but UKCA performs the chemistry in volume-mixing ratio, you will need to define a conversion factor for your new tracers

Tutorial 5:
Adding new emissions

Tutorial 5: Adding new emissions

- In this tutorial you are taught about
  - How to regrid emissions to the correct UM grid using Xconv
  - How to use Xancil to produce a new emissions file
  - How to make the necessary changes to UKCA

- You are asked to take an emissions dataset for ALICE and regrid it to N96 resolution, then make up a new ancillary file and then use this in UKCA

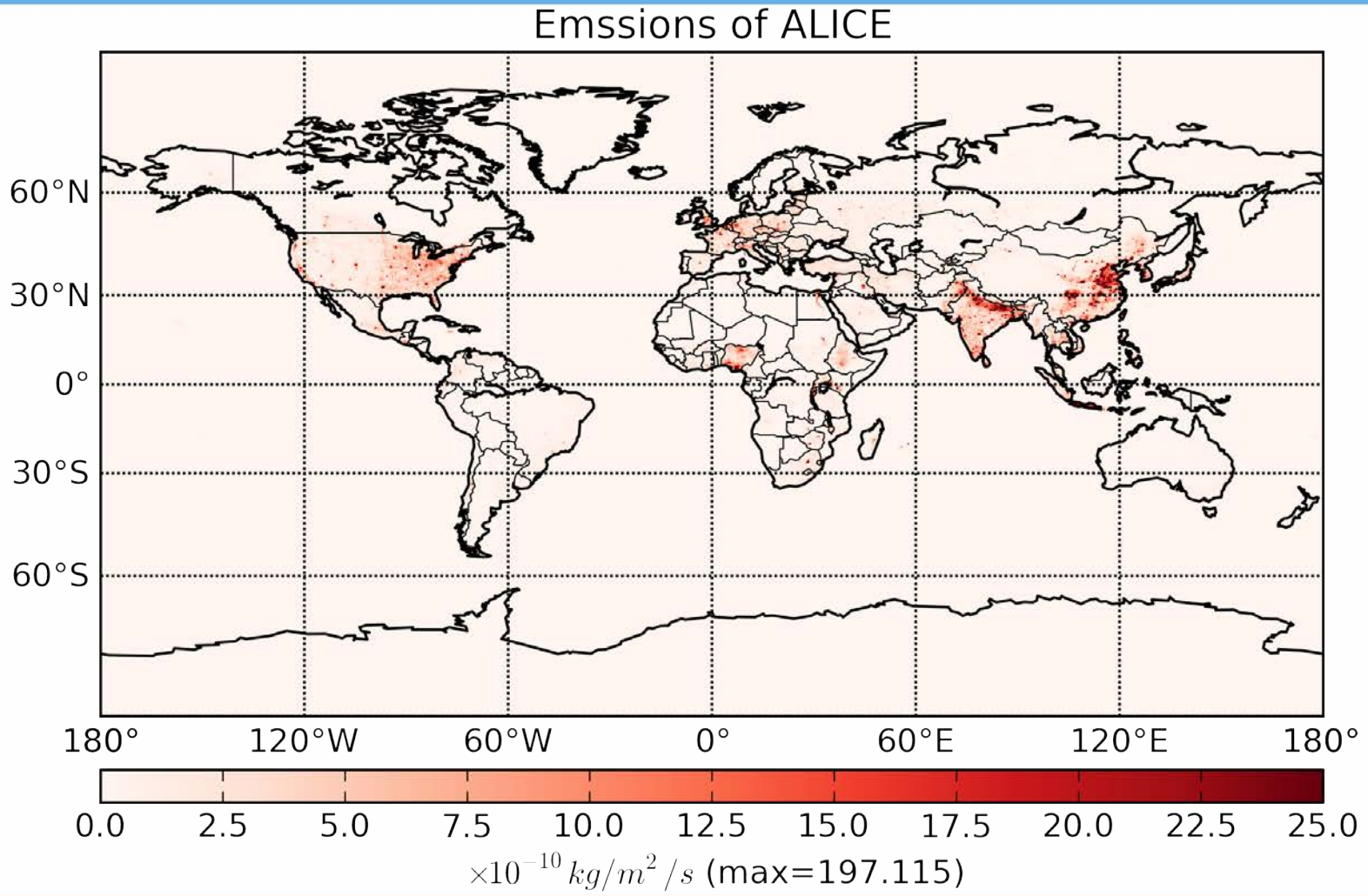
Tutorial 5: Adding new emissions

You should now work through the

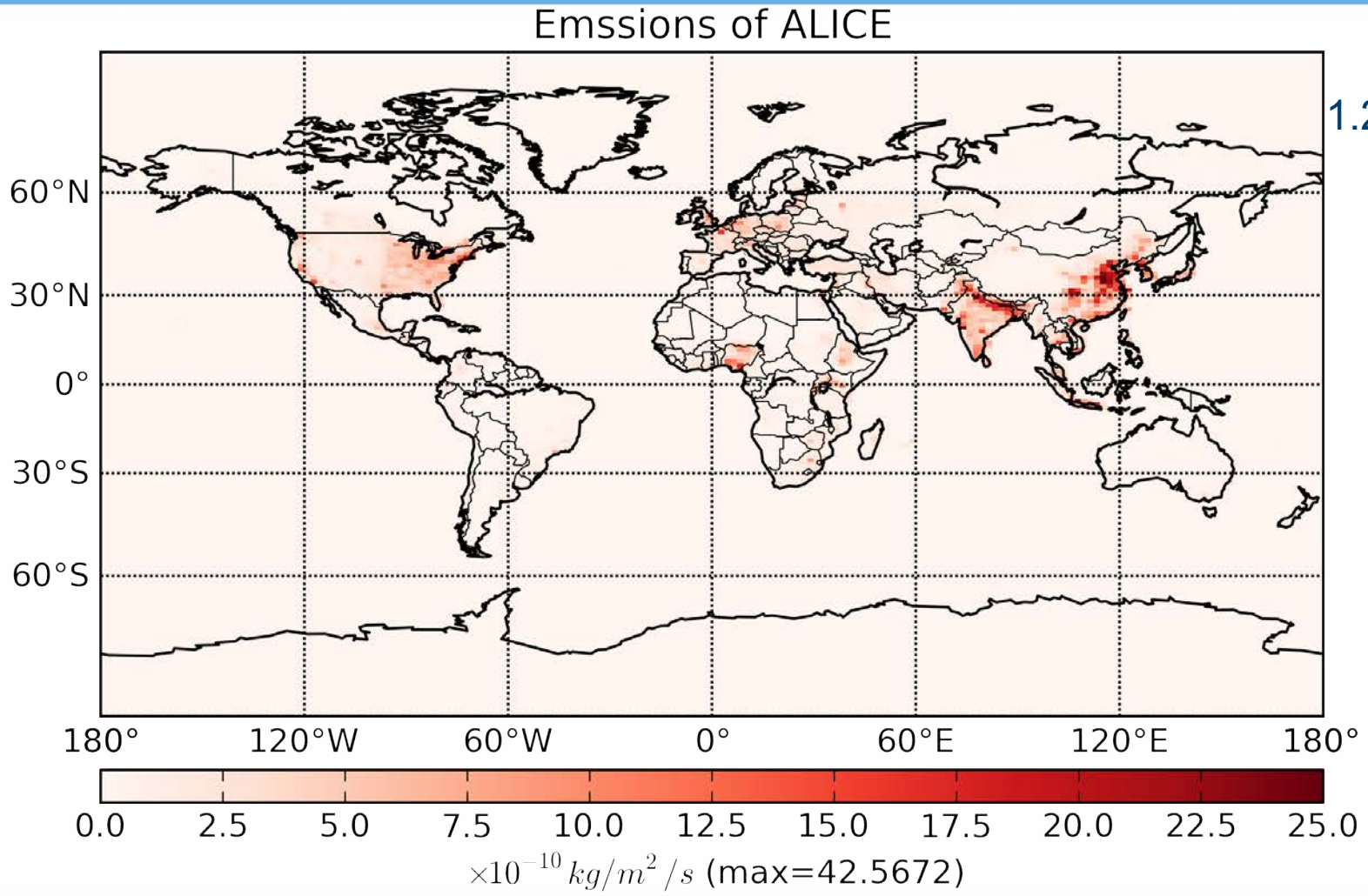
Adding new emissions

tutorial

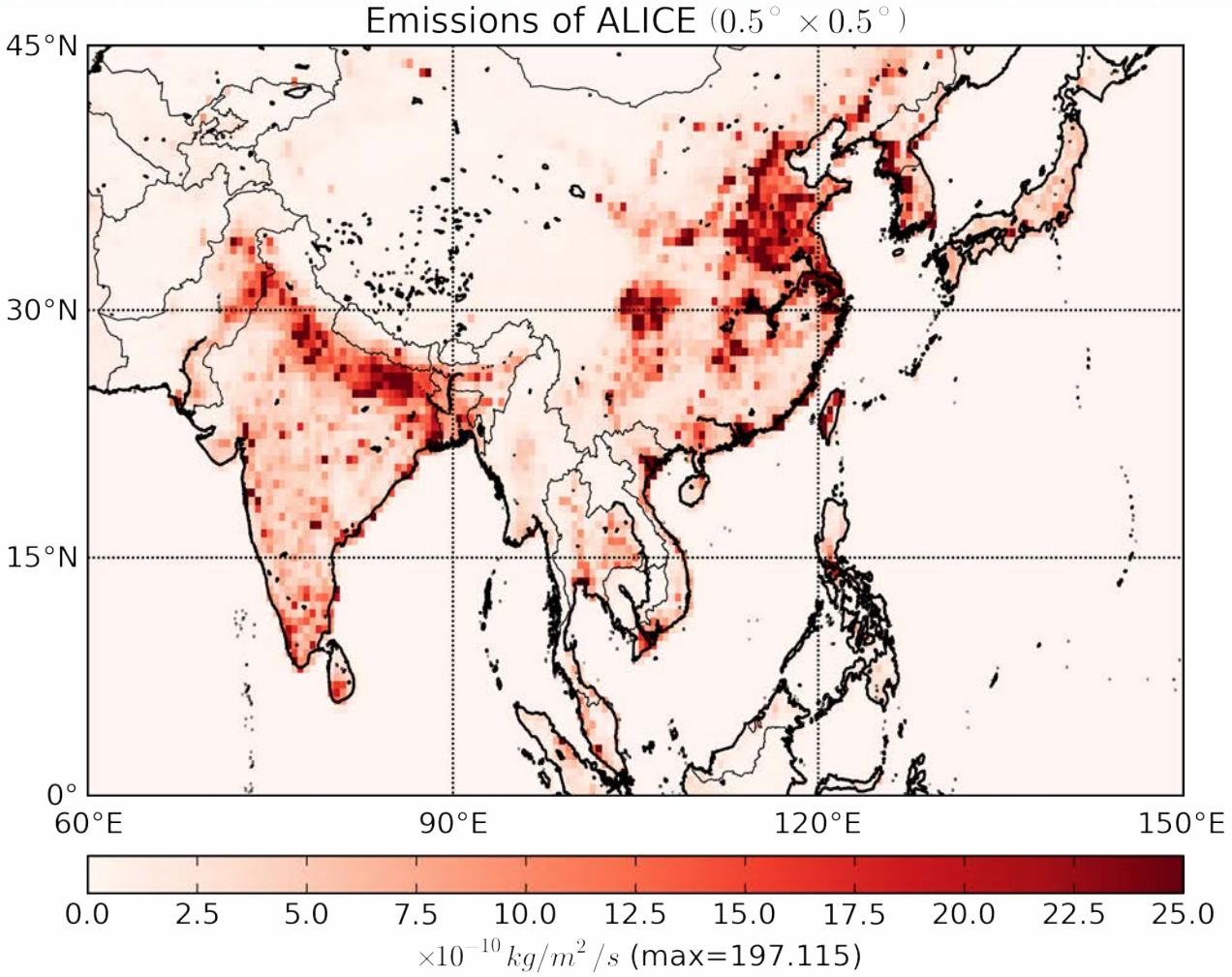
Tutorial 5: Adding new emissions



Tutorial 5: Adding new emissions

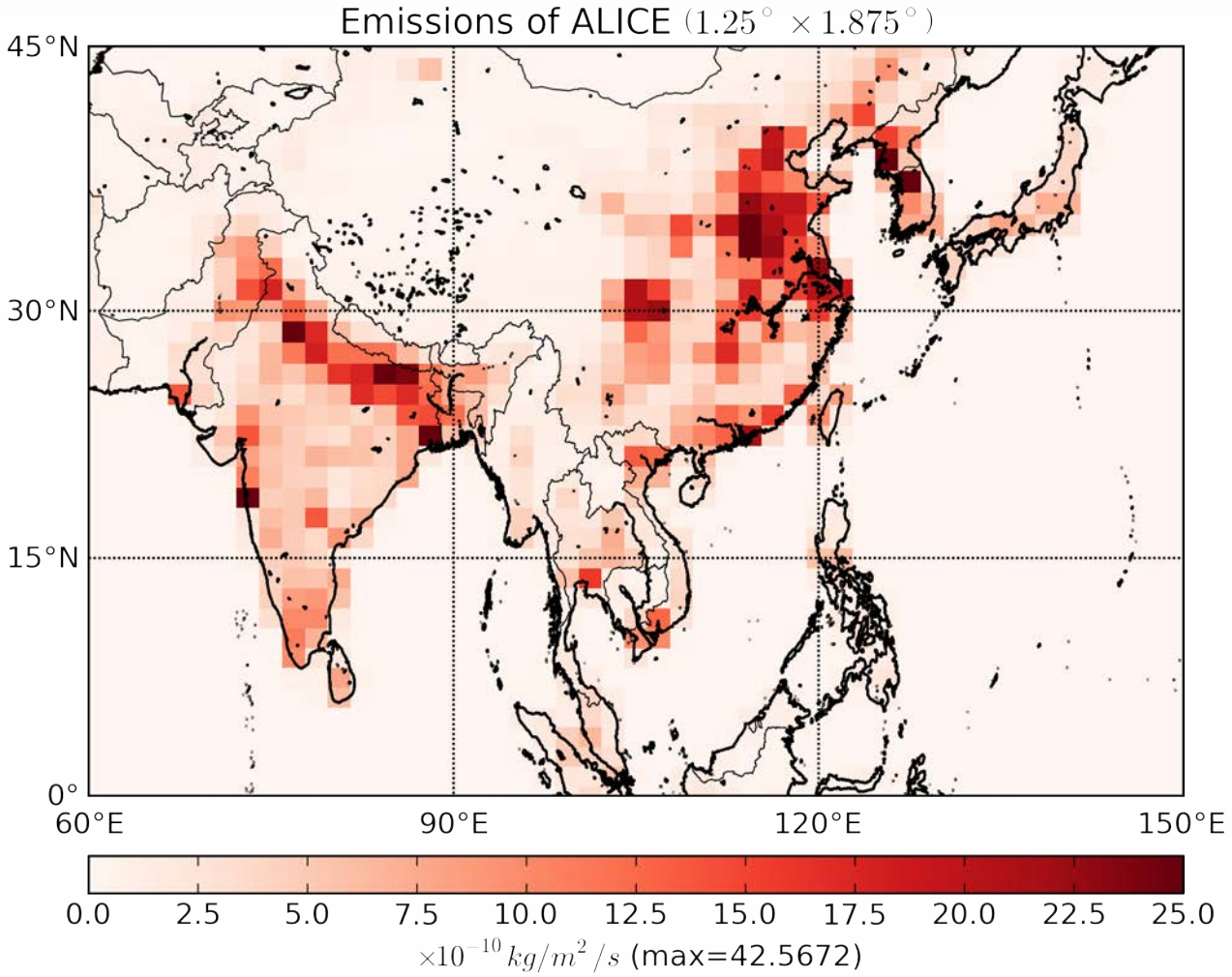


Tutorial 5: Adding new emissions



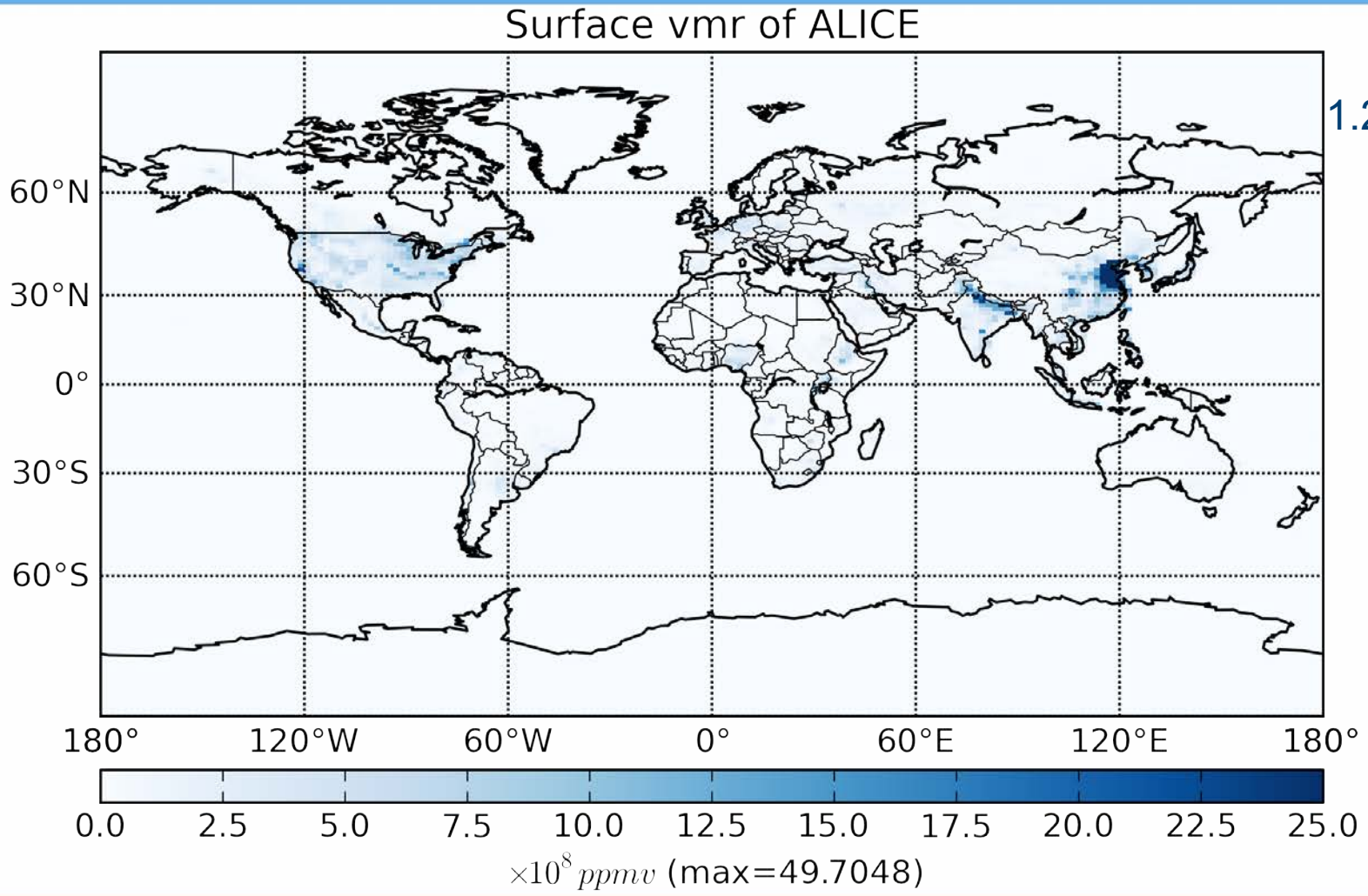
0.5x05

Tutorial 5: Adding new emissions



N96
1.25x1.875

Tutorial 5: Adding new emissions



Tutorial 5: Adding new emissions

- Points to remember:

    1. You should always regrid your emissions using **area-weighted** interpolation to ensure that the same mass is emitted at the new resolution

    2. The UM/UMUI can only read-in one single-level (and one multi-level) emissions user ancillary file, so you must also include all the other emissions already in use in your new emissions file

    3. In UKCA you will need to specify the STASH number of these emissions

    4. You will also need to define the molar mass of the species being emitted into

Tutorial 6:
Adding new reactions

Tutorial 6: Adding new reactions

- In this tutorial you are taught about
  - The different types of reactions UKCA considers
    a) Bimolecular reactions
    b) Termolecular reactions
    c) Heterogeneous reactions
    d) Photolysis reactions
  - The format of how these reactions are defined within the UKCA chemistry scheme specification module are very similar
    - However, special code may need to be added for some reactions

Tutorial 6: Adding new reactions

- In this tutorial you are asked to add the following bimolecular reaction

  ALICE + OH ➔ BOB + Secondary Organic Compound (Sec_Org)

  using the following rate coeffients $k_0 = 2.70 \times 10^{-11}$

  $\alpha = 0.00$

  $\beta = -390.0$

- You should:
  - Make your changes to the UKCA chemistry specification module and change the number of reactions using a hand-edit

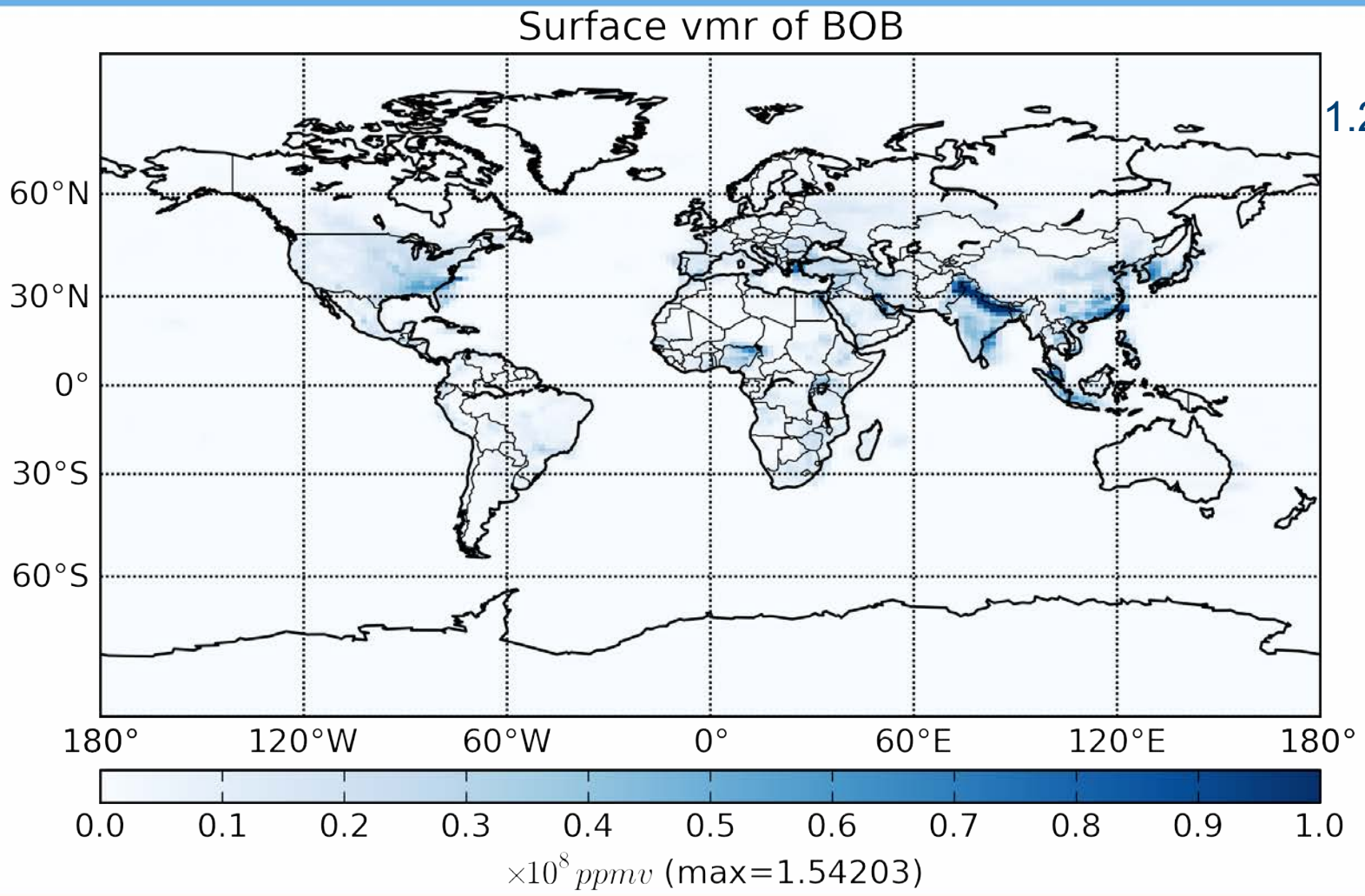
Tutorial 6: Adding new reactions

You should now work through the

Adding new chemical reactions

tutorial

Tutorial 6: Adding new reactions



Tutorial 6: Adding new reactions

- Points to remember

    1. Check that you have your array sizes correct – it can be difficult to keep track

    2. As well as increasing the number of (e.g.) bimolecular reactions you will also need to increment the total number of reactions

Tutorial 7:
Adding dry deposition

Tutorial 7: Adding dry deposition

- There are two dry deposition schemes that UKCA uses
  1. A simple 2-dimensional scheme
  2. An interactive parameterisation, based on the Wesely scheme, which deposits from throughout the boundary layer

- The 2D scheme only requires changes to the UKCA chemistry scheme specification module, as well as a hand-edit
- The Interactive scheme also requires changes to two UKCA routines
  - You may also need to define the molar mass of the dry deposited species

Tutorial 7: Adding dry deposition

- In this tutorial you are asked to add-in the dry deposition of ALICE (which deposits in the same in the same way as CO)
- The values for the 2D scheme are

	Summer (day)	*Summer (night)*	*Summer (24h av)*	*Winter (day)*	*Winter (night)*	*Winter (24h av)*
Water	0.0	0.0	0.0	0.0	0.0	0.0
Forest	0.3	0.3	0.3	0.3	0.3	0.3
Grass	0.3	0.3	0.3	0.3	0.3	0.3
Desert	0.3	0.3	0.3	0.3	0.3	0.3
Ice	0.0	0.0	0.0	0.0	0.0	0.0

- The values for the interactive scheme should be taken from how CO is treated in **`ukca_aerod`** and **`ukca_surfddr`**, taking the different molecular mass of ALICE into account

Tutorial 7: Adding dry deposition

You should now work through the

Adding dry deposition of chemical species

tutorial

Tutorial 7: Adding dry deposition

- Points to remember

  1. Even if you are using the Interactive scheme, you will also need to make changes to the 2D scheme

  2. The order of values in the 2D scheme **`depvel_defs`** array is important – you should ensure that this matches the order of the species in the **`chch_defs`** array

     - You may need to re-order your tracer list here

  3. When adding species to the Interactive scheme you may also need to define the molar mass of the deposited species

Tutorial 8:
Adding wet deposition

Tutorial 8: Adding wet deposition

- There is only one wet deposition scheme used in UKCA
- You will need to define the Henry's Law coefficients for each species that is wet deposited
- To add in new wet deposition you will only need to make changes to the chemistry scheme specification module, as well as a hand-edit

In this tutorial you are asked to add-in wet deposition of BOB using the following values

$$k(298) = 0.21 \times 10^{6}$$

$$-(\Delta H/R) = 0.87 \times 10^{4}$$

$$k(298)_{1stDissociation} = 0.2 \times 10^{2}$$

$$-(\Delta H/R)_{1stDissociation} = 0.0$$

$$k(298)_{2ndDissociation} = 0.0$$

$$-(\Delta H/R)_{2ndDissociation} = 0.0$$

Tutorial 8: Adding wet deposition

You should now work through the

Adding wet deposition of chemical species

tutorial

Tutorial 8: Adding wet deposition

- Points to remember

    1. The order of the **`henry_defs`** array is important, and (as with the 2D dry deposition scheme) should match the order of species in the **`chch_defs`** array

Tutorial 9:
Adding new UKCA diagnostics

Tutorial 9: Adding new UKCA diagnostics

- While the STASH system provides a nice GUI system for requesting output, it does introduce complexity within the code (and in the user-STASHmaster file format)
- UKCA has a diagnostic system which deals with the STASH-handling, meaning that it is straight-forward to add-in new diagnostic requests
  - The code which deals with the diagnostics is in **`asad_chem_flux_diags`**
    - You should not need to edit this module unless you want to make a new type of diagnostic
  - The specification of the diagnostics is done in the **`asad_flux_dat`** module

Tutorial 9: Adding new UKCA diagnostics

- Currently UKCA can output the following types of diagnostics
  - The flux through, or rate of, chemical reactions
  - The flux through deposition processes
  - Emission fluxes, both surface (2D) and 3D (e.g. lightning, aircraft etc.)
  - The net chemical and dynamical tendencies of tracers
  - The atmospheric mass
  - PSC diagnostic information
  - A dynamic ‘tropospheric mask’, useful for post-processing
  - Tracer concentrations (which can be masked to only include tropospheric values)
- Most diagnostics have units of moles/gridcell/s

Tutorial 9: Adding new UKCA diagnostics

- 2D user-STASHmaster file diagnostic specification

```
#
1|     1 |    34 |   321 |Ox BUDGET: O3 DRY DEPOSITION (2D)    |
2|     0 |     0 |     1 |     1 |     5 |    -1 |    -1 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 00000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |   129 |     0 |     0 |     0 |     0 |     0 |
#
```

- 3D user-STASHmaster file diagnostic specification

```
#
1|     1 |    34 |   321 |Ox BUDGET: O3 DRY DEPOSITION (3D)    |
2|     0 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 00000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
```

Tutorial 9: Adding new UKCA diagnostics

- To add new diagnostics you will need to
  1. Define your diagnostic request in the **`asad_flux_dat`** module
  2. Create a new user-STASHmaster file for this diagnostic
     - Care should be taken if the diagnostic is 2D or 3D
  3. Request this diagnostic in the UMUI STASH panel
     - Care should be taken about the sampling time, as the UKCA chemistry timestep is one hour
- You can also use this diagnostic system to sum diagnostics on-line
  - Multiple diagnostics sent to the same STASH code will be summed (useful for budgeting)

Tutorial 9: Adding new UKCA diagnostics

- In this tutorial you are asked to

  1. output the flux through the

     ALICE + OH ➔ BOB + Secondary Organic Compound (Sec_Org)

     reaction to STASH code 34461

  2. Output the dry deposition of ALICE to STASH code 34462

  3. Output the wet deposition of BOB to STASH code 34463

  These should be daily means to the **`pa/UPA`** output stream.

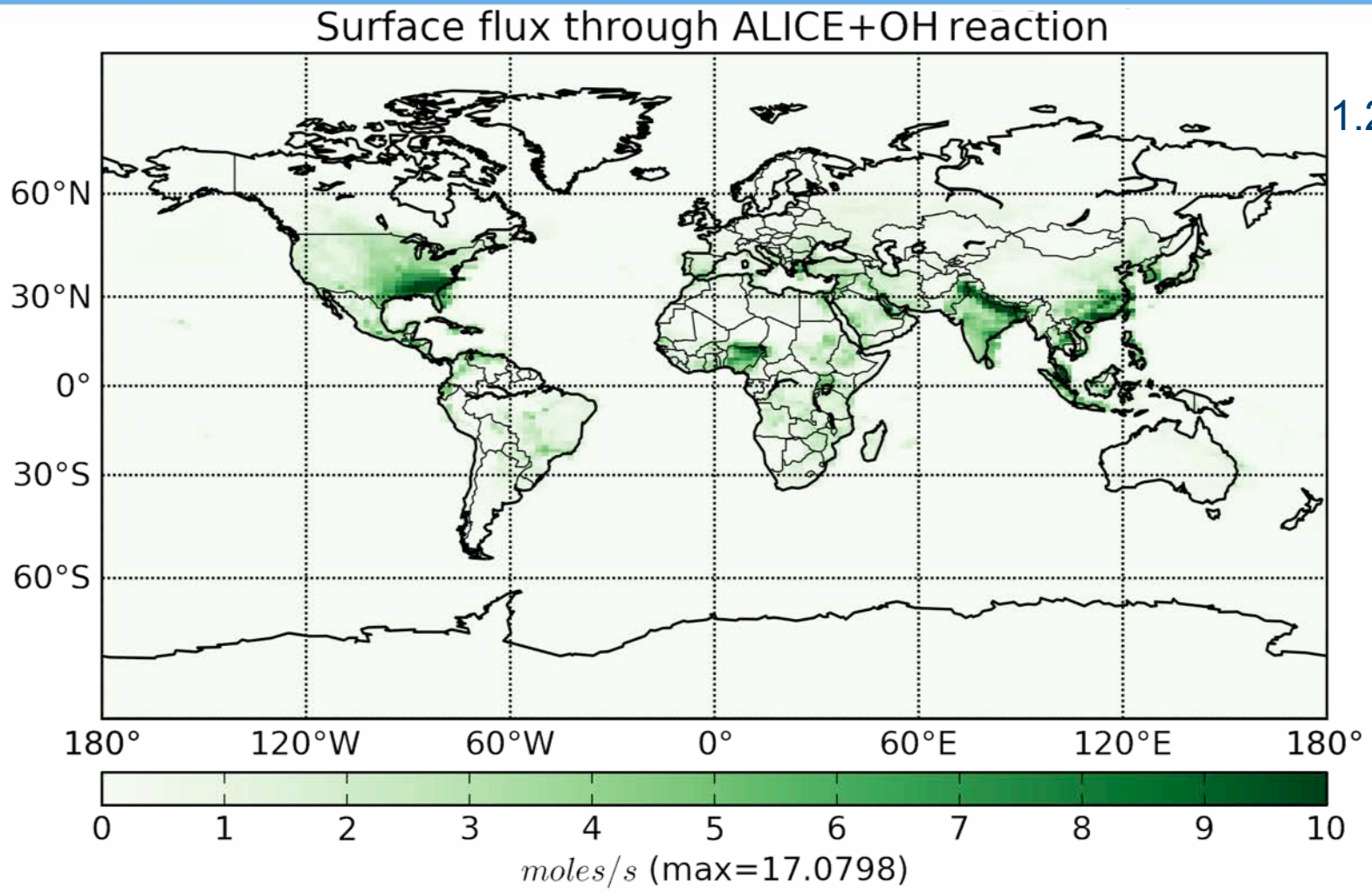
Tutorial 9: Adding new UKCA diagnostics

You should now work through the

Adding new UKCA diagnostics

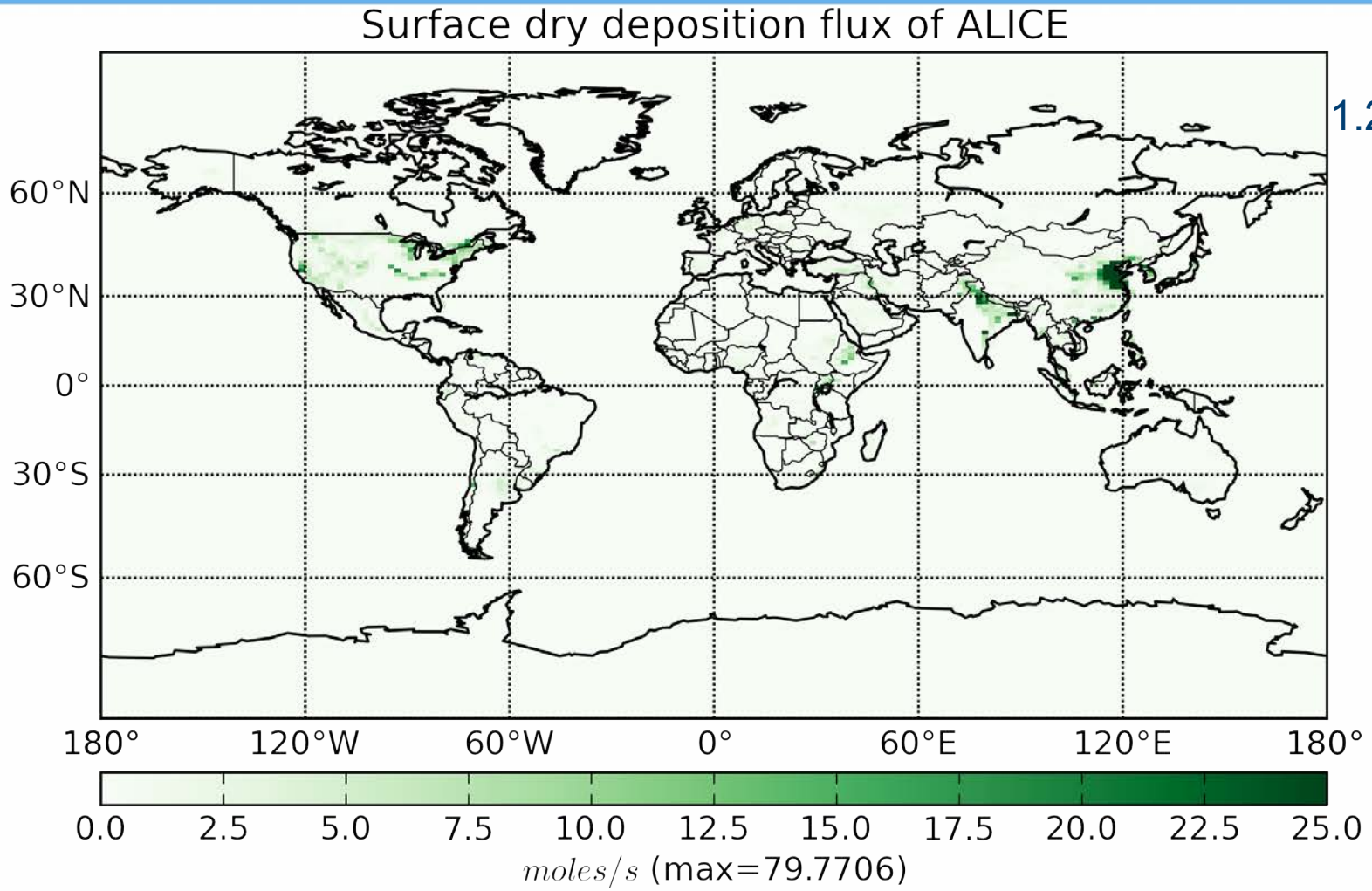
tutorial

Tutorial 9: Adding new UKCA diagnostics

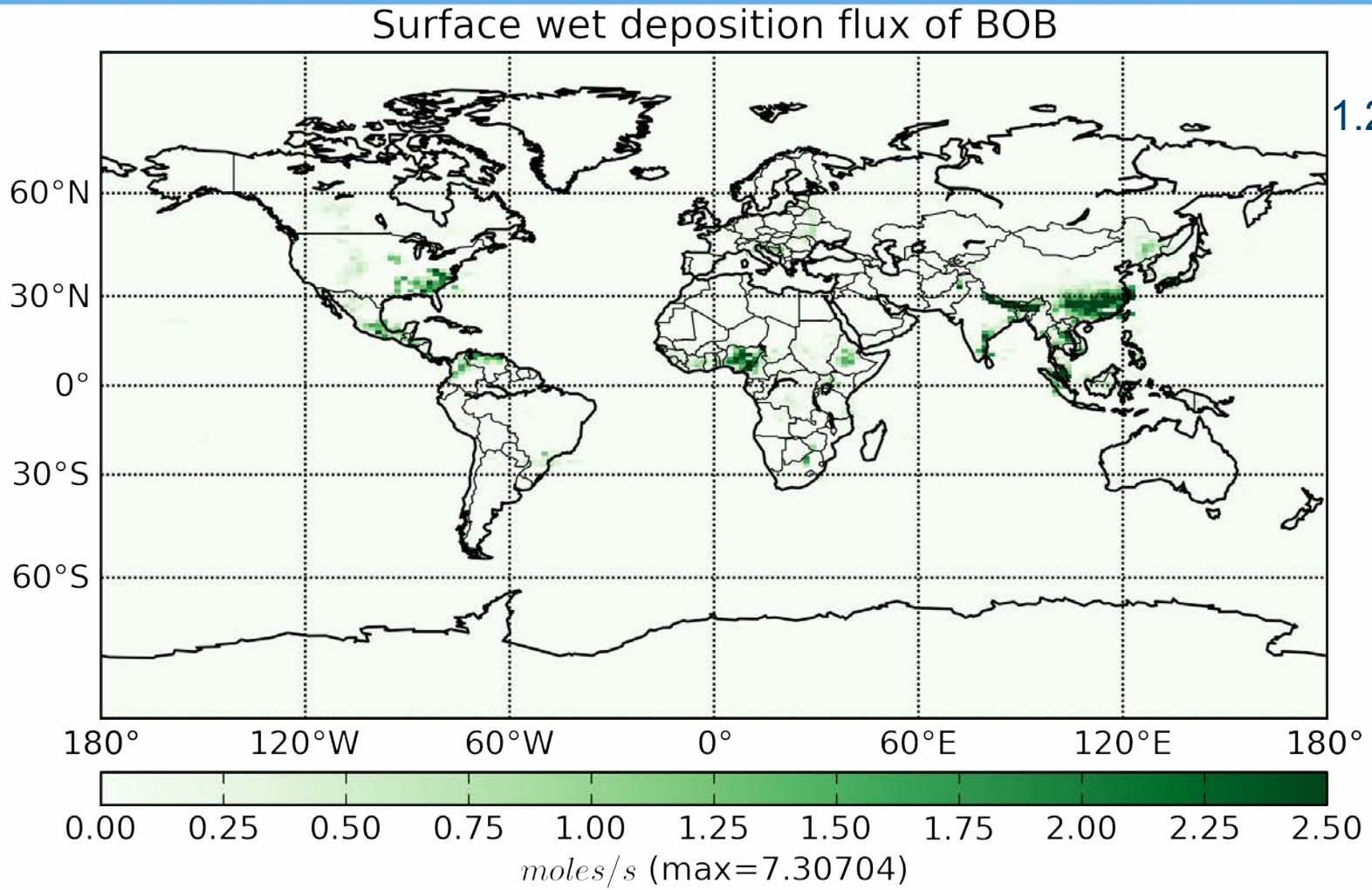


N96
1.25x1.875

Tutorial 9: Adding new UKCA diagnostics



Tutorial 9: Adding new UKCA diagnostics



Tutorial 9: Adding new UKCA diagnostics

- Points to remember

1. When requesting these new diagnostics in STASH, you should be careful of the time sampling used

   - The UKCA chemical timestep is only every hour, so reaction and deposition fluxes are only valid on these timesteps

2. Be careful which STASH numbers you choose

   - The UKCA diagnostics are configured to sum multiple diagnostics to a single STASH number if defined this way

3. If you are unsure if you should use a 2D or 3D user-STASHmaster file specification for your new diagnostic(s), you can always use a 3D one

What should you now be able to do with UKCA?

- After doing these tutorials you should
  - Be more confident using the UMUI
  - Be able to copy an existing UKCA, run it, and be able to process the output
  - Be familiar with STASH
  - Be able to add new UKCA tracers
  - Be able to create and add emissions into UKCA
  - Be able to define new chemical reactions
  - Be able to define new dry and wet deposition of species
  - Be able to output new UKCA diagnostics
  - Be able to change the aerosol configuration
  - Be able to examine the aerosol optical depth
  - Be able to diagnose the radiative effect of aerosols

Feedback

I hope that you will found the UKCA Tutorials both enjoyable and useful.

It would be very helpful for me if you could fill in the UKCA feedback form which is linked to from the Tutorial front page.

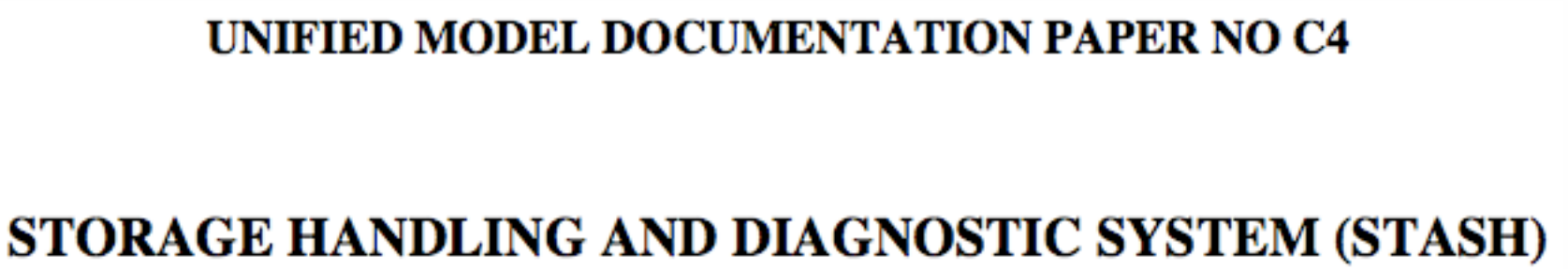
More detailed comments can be emailed to me at

luke.abraham@atm.ch.cam.ac.uk

Any and all feedback given will be used to improve the Tutorials for future users.

What is STASH?

- STASH is the Unified Model's **Storage Handling and Diagnostic System** ("Spatial and Temporal Averaging and Storage Handling")

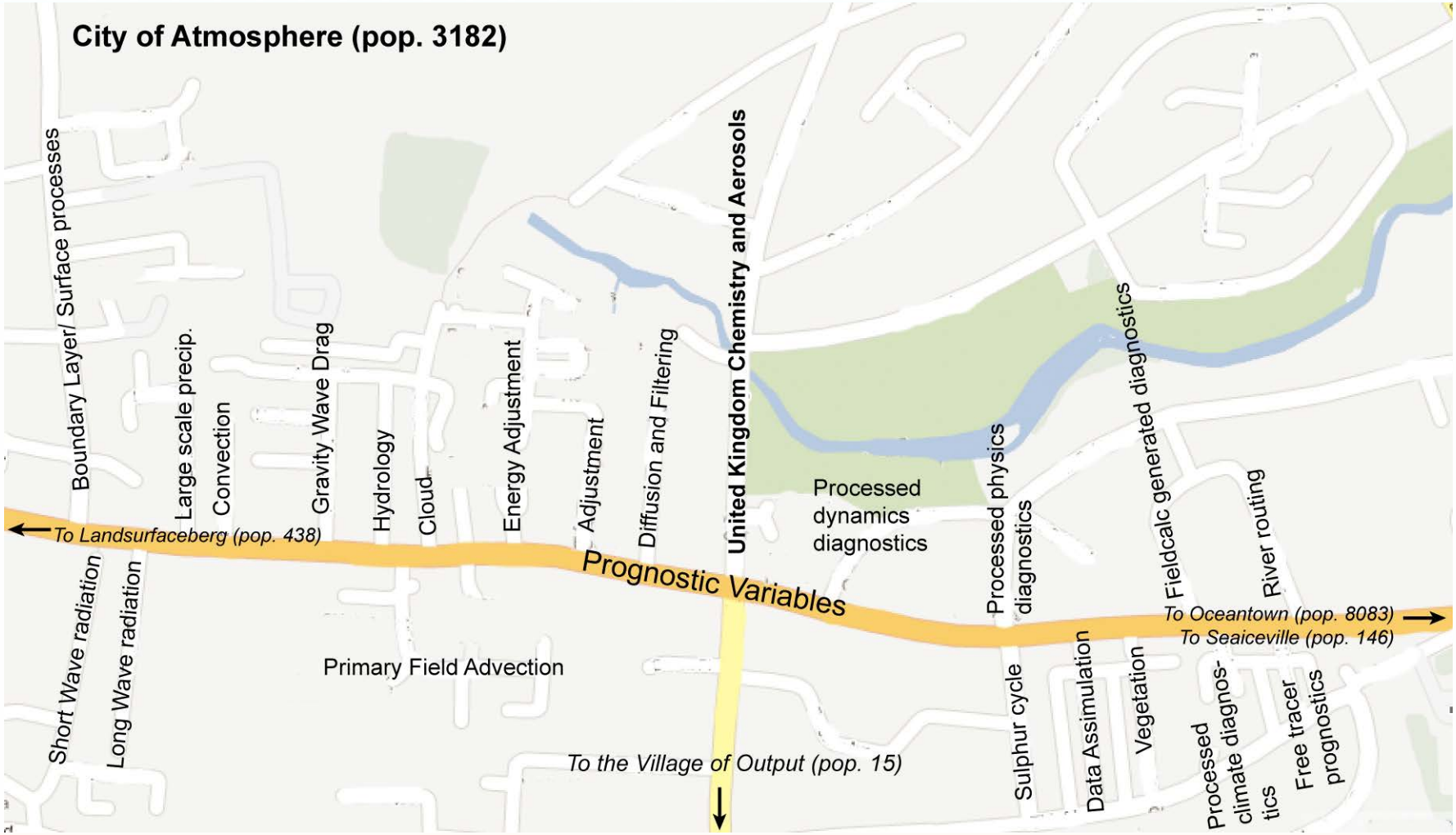


UNIFIED MODEL DOCUMENTATION PAPER NO C4

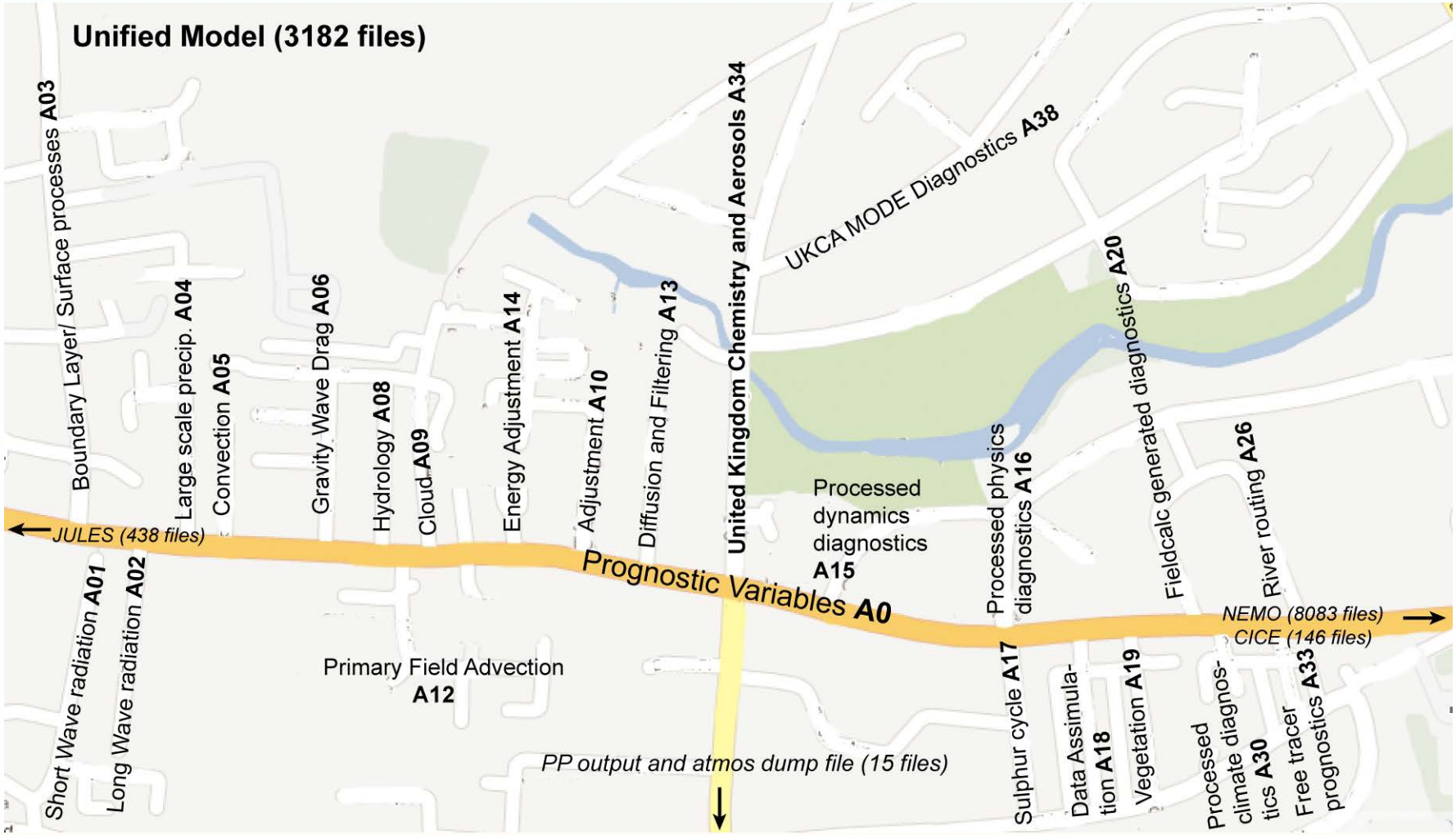
STORAGE HANDLING AND DIAGNOSTIC SYSTEM (STASH)

- It is designed to cope with the many different configurations that the UM can be used in, but still provide output in a consistent and standard way
- The basic building block of STASH is the *horizontal* field
  - It uniquely labels prognostic, ancillary, and diagnostic fields
- Calls to STASH are made every timestep to allow it to extract, process, and output data

Model Sections



STASH Sections



STASH sections, STASH items

- While it is easy to make variables within the UM, if you want to output this variable cleanly, it must be defined within STASH.
- Each STASH code is made up of 5 numbers, giving the address of the prognostic or diagnostic within the model.
  - The first two numbers are the **section**
  - The last three numbers are the **item**
  - There can only be **512 items** per section
- e.g.
  - UKCA N2O has STASH code 34049
  - Specific humidity has STASH code 10 (00010 = section 00, item 010)

Prognostics

- Prognostic variables are those that the code requires to derive all other quantities
  - e.g. u, v, q etc.
  - tracers are also prognostic quantities
- Prognostics are outputted in UM dump files (***jobid*****a.da********)
- In the code these prognostics are held within a master array called **`D1`**

Diagnostics

- Diagnostics are all variables which are not prognostics (i.e. the model does not need these to restart, since it can calculate these from prognostic variables)
  - e.g. pressure on model levels, UKCA reaction fluxes etc
- Diagnostics are not held within **`D1`**, they are copied into STASH directly
- In the code this is done with a call to **`copydiag`** to put the diagnostic into the **`STASHwork`** array, before it is passed via a call to `STASH`
- For most UKCA diagnostics, these steps are already done for you using the **`asad_chem_flux_diags`** module

STASH treatment of variables

- The STASH system also provides a GUI in the UMUI for managing all model output
- Diagnostic and prognostic variables are treated equally when outputting to data files
- There is a high level of control over:
  - The time domain the variables are sampled and processed over
  - The spatial domain the variables are sampled and processed over
- The variables can output through different output streams (fields-files or ‘PP files’) or passed through to the climate meaning stream

pre-STASHmaster files

- If STASH sections are analogous to streets in a city, then STASH items are analogous to houses on each street
- In order to output the variable correctly then you need to get the address right
- This is done with the use of a pre-STASHmaster file
  - This defines the STASH section and item numbers, the levels it is valid for, if it is a prognostic or not, and many others
  - It can also be used to remove unwanted variables from a model dump
  - A full description can be found in UMDP C4 (ask me for a copy or see the collaboration Twiki)

Examples

```
#
1|     1 |    34 |     7 |HONO2 MASS MIXING RATIO AFTER TSTEP |
2|     2 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000007 | 0000000000000000001 |     1 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1861 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
1|     1 |    34 |   483 |NOy: DRY DEP OF NO              (2D) |
2|     0 |     0 |     1 |     1 |     5 |    -1 |    -1 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 0000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |   129 |     0 |     0 |     0 |     0 |     0 |
#
1|     1 |    34 |   489 |NOy: WET DEP OF NO3                  |
2|     0 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 0000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
```

Examples

```
#
1|     1 |    34 |     7 |HONO2 MASS MIXING RATIO AFTER TSTEP |
2|     2 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000007 | 0000000000000000001 |     1 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1861 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
1|     1 |    34 |   483 |NOy: DRY DEP OF NO              (2D) |
2|     0 |     0 |     1 |     1 |     5 |    -1 |    -1 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 0000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |   129 |     0 |     0 |     0 |     0 |     0 |
#
1|     1 |    34 |   489 |NOy: WET DEP OF NO3                  |
2|     0 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 0000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
```

Examples

```
#
1|     1 |    34 |     7 |HONO2 MASS MIXING RATIO AFTER TSTEP |
2|     2 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000007 | 00000000000000000001 |     1 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1861 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
1|     1 |    34 |   483 |NOy: DRY DEP OF NO              (2D) |
2|     0 |     0 |     1 |     1 |     5 |    -1 |    -1 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000 | 00000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |   129 |     0 |     0 |     0 |     0 |     0 |
#
1|     1 |    34 |   489 |NOy: WET DEP OF NO3                  |
2|     0 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000 | 00000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
```

Examples

```
#
1|     1 |    34 |     7 |HONO2 MASS MIXING RATIO AFTER TSTEP |
2|     2 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000007 | 0000000000000000001 |     1 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1861 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
1|     1 |    34 |   483 |NOy: DRY DEP OF NO              (2D) |
2|     0 |     0 |     1 |     1 |     5 |    -1 |    -1 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 0000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |   129 |     0 |     0 |     0 |     0 |     0 |
#
1|     1 |    34 |   489 |NOy: WET DEP OF NO3                   |
2|     0 |     0 |     1 |     1 |     2 |    10 |    11 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 0000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |  1871 |     1 |    65 |     0 |     0 |     0 |     0 |     0 |
#
```

Removing a field from a UM dump

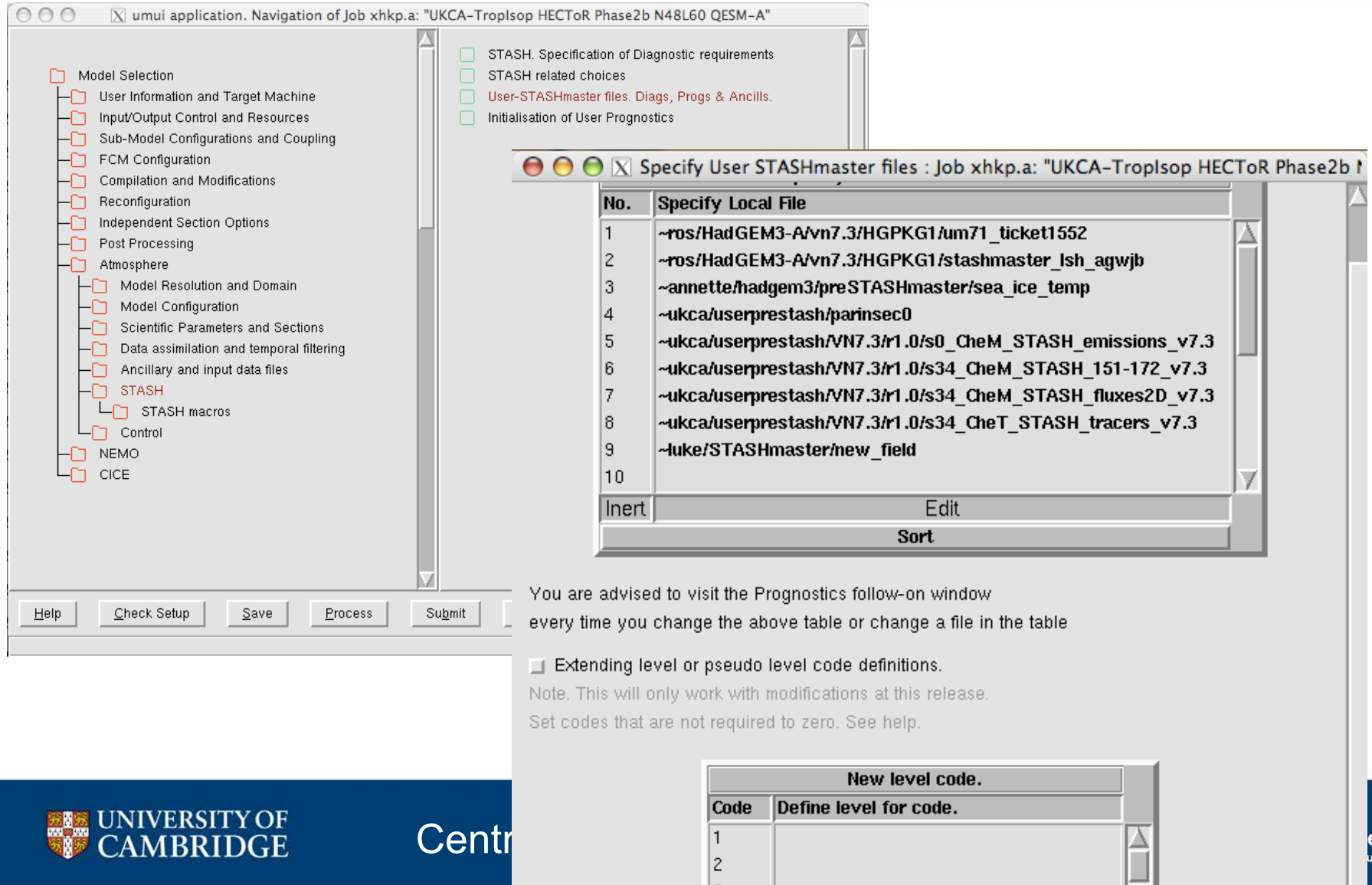
```
#
1|     1 |     0 |   309 |C5H8 surf emissions                    |
2|     2 |     0 |     1 |     1 |     5 |   -1 |   -1 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 0000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |   539 |     0 |   129 |     0 |     0 |     0 |     0 |     0 |
#

#
1|     1 |     0 |   309 |C5H8 surf emissions                    |
2|    10 |     0 |     1 |     1 |     5 |   -1 |   -1 |     0 |     0 |     0 |     0 |
3| 00000000000000000000000000000000 | 0000000000000000001 |     3 |
4|     1 |     0 | -99   -99   -99   -99   -99   -99   -99   -99   -99   -99 |
5|     0 |   539 |     0 |   129 |     0 |     0 |     0 |     0 |     0 |
#
```

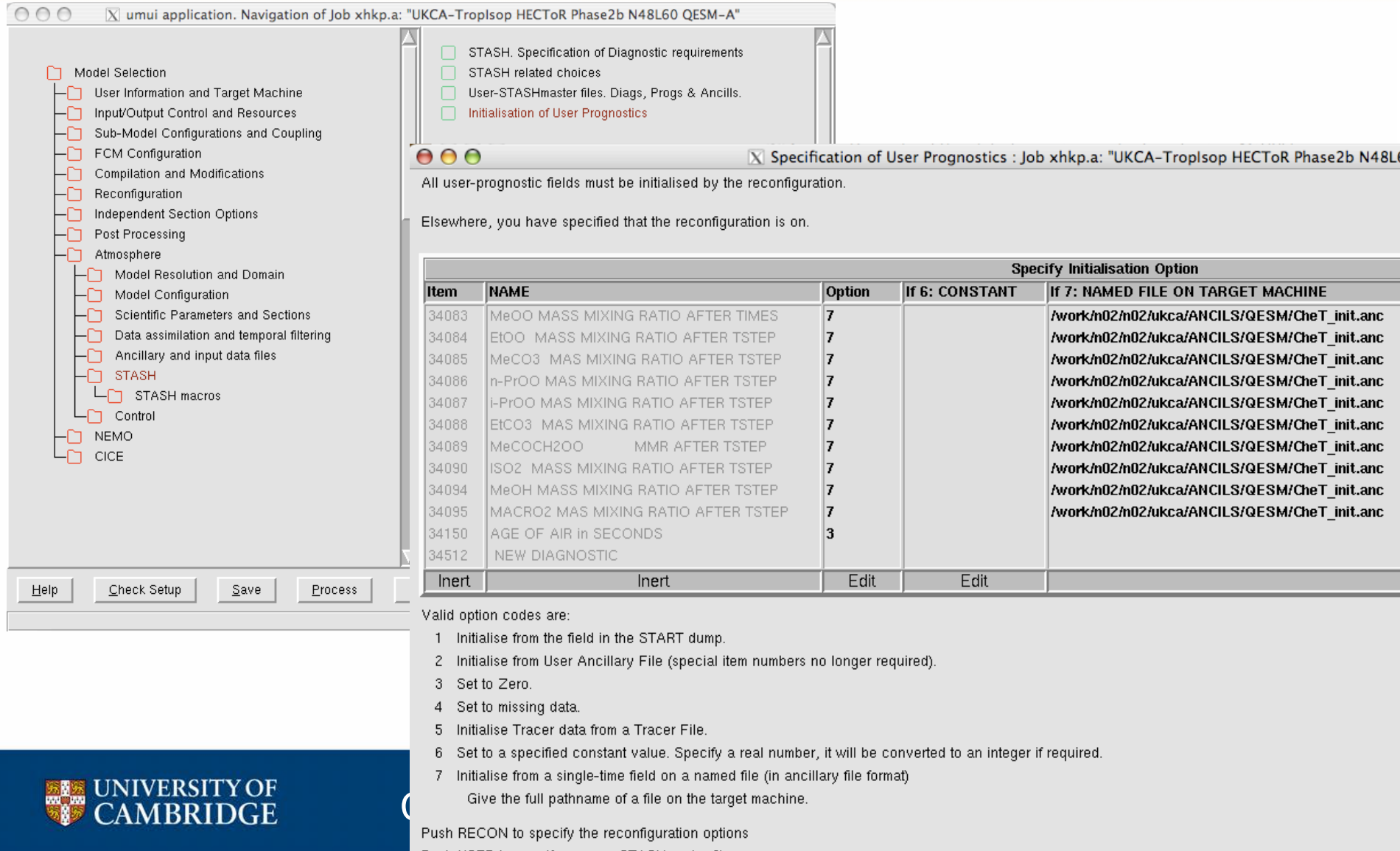
Adding your diagnostic to the UMUI

```
H1| SUBMODEL_NUMBER=1
H2| SUBMODEL_NAME=ATMOS
H3| UM_VERSION=7.3
#
#|Model |Sectn | Item |Name                                  |
#|Space |Point | Time | Grid |LevelT|LevelF|LevelL|PseudT|PseudF|PseudL|LevCom|
#| Option Codes         | Version Mask          | Halo |
#|DataT |DumpP | PC1  PC2  PC3  PC4  PC5  PC6  PC7  PC8  PC9  PCA |
#|Rotate| PPFC | USER | LBVC | BLEV | TLEV |RBLEVV| CFLL | CFFF |
#
1|    1 |   34 |  512 | NEW DIAGNOSTIC                       |
2|    0 |    0 |    1 |    1 |    2 |   10 |   11 |    0 |    0 |    0 |    0 |
3| 00000000000000000000000000000000 | 00000000000000000001 |    3 |
4|    1 |    0 | -99  -99  -99  -99  -99  -99  -99  -99  -99  -99 |
5|    0 | 1871 |    1 |   65 |    0 |    0 |    0 |    0 |    0 |
#
1|   -1 |   -1 |   -1 |END OF FILE MARK                      |
2|    0 |    0 |    0 |    0 |    0 |    0 |    0 |    0 |    0 |    0 |    0 |
3| 00000000000000000000000000000000 | 00000000000000000000 |    0 |
4|    0 |    0 | -99  -99  -99  -99  -30  -99  -99  -99  -99  -99 |
5|    0 |    0 |    0 |    0 |    0 |    0 |    0 |    0 |    0 |
#
```

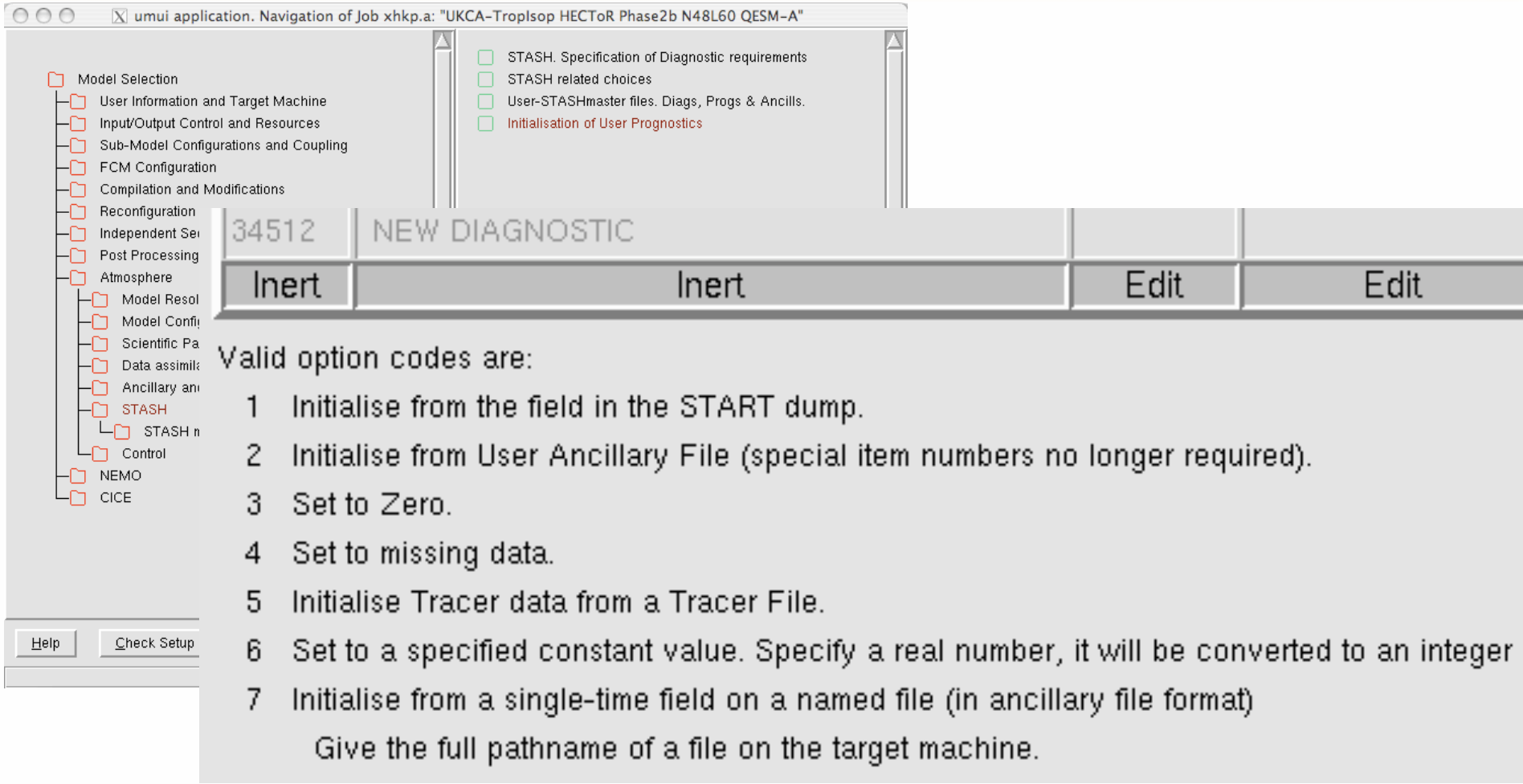
Adding your diagnostic to the UMUI



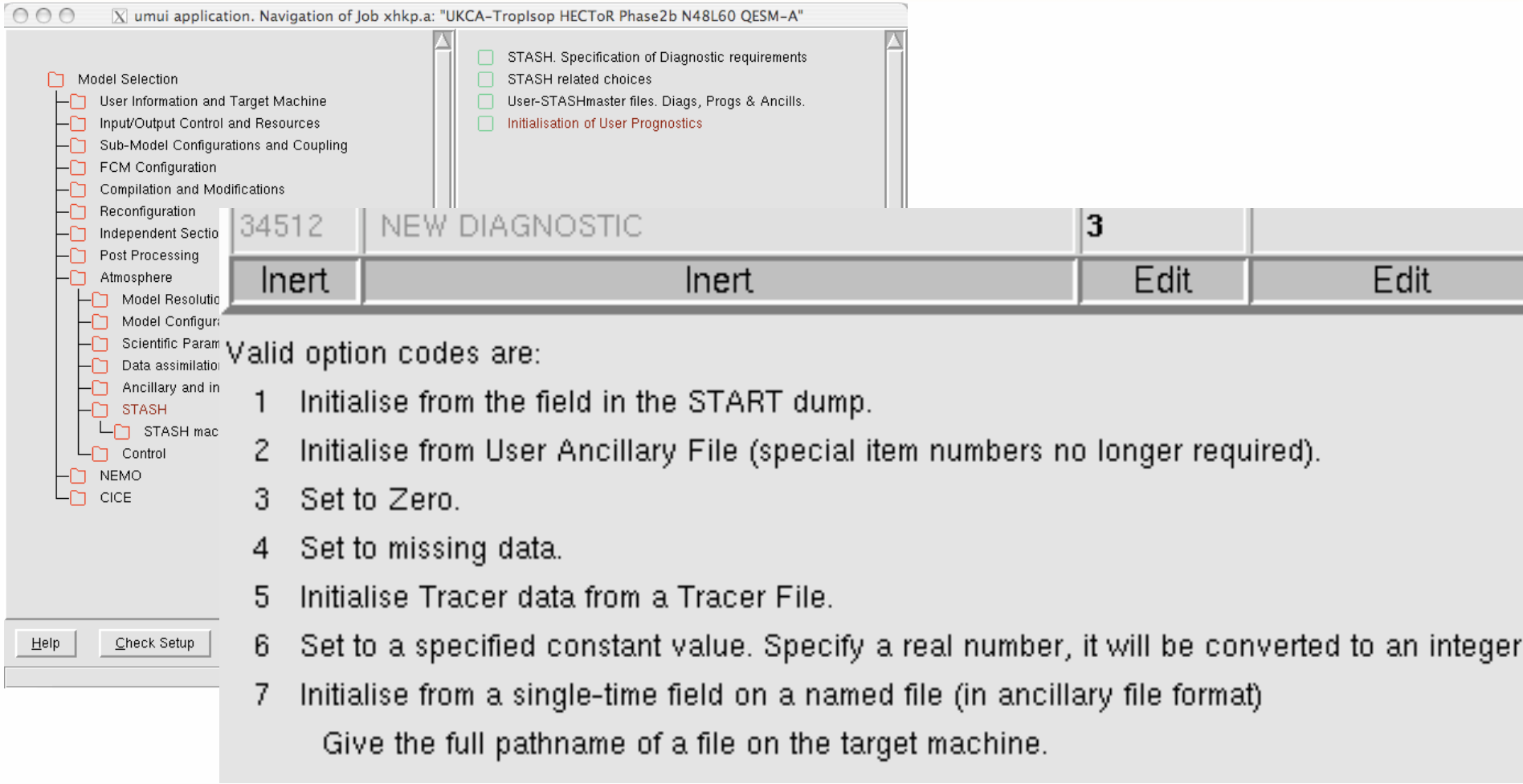
Adding your diagnostic to the UMUI



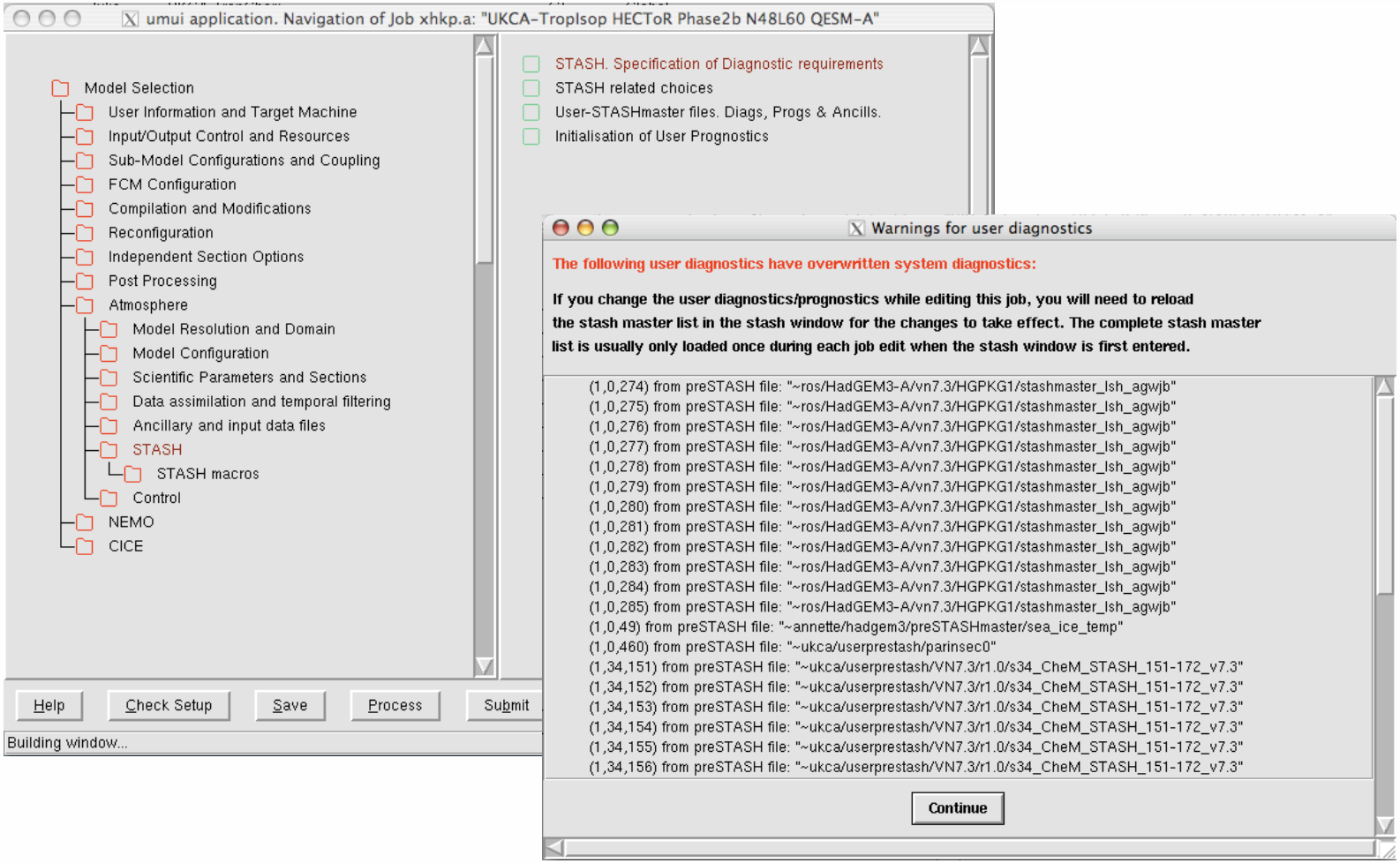
Adding your diagnostic to the UMUI



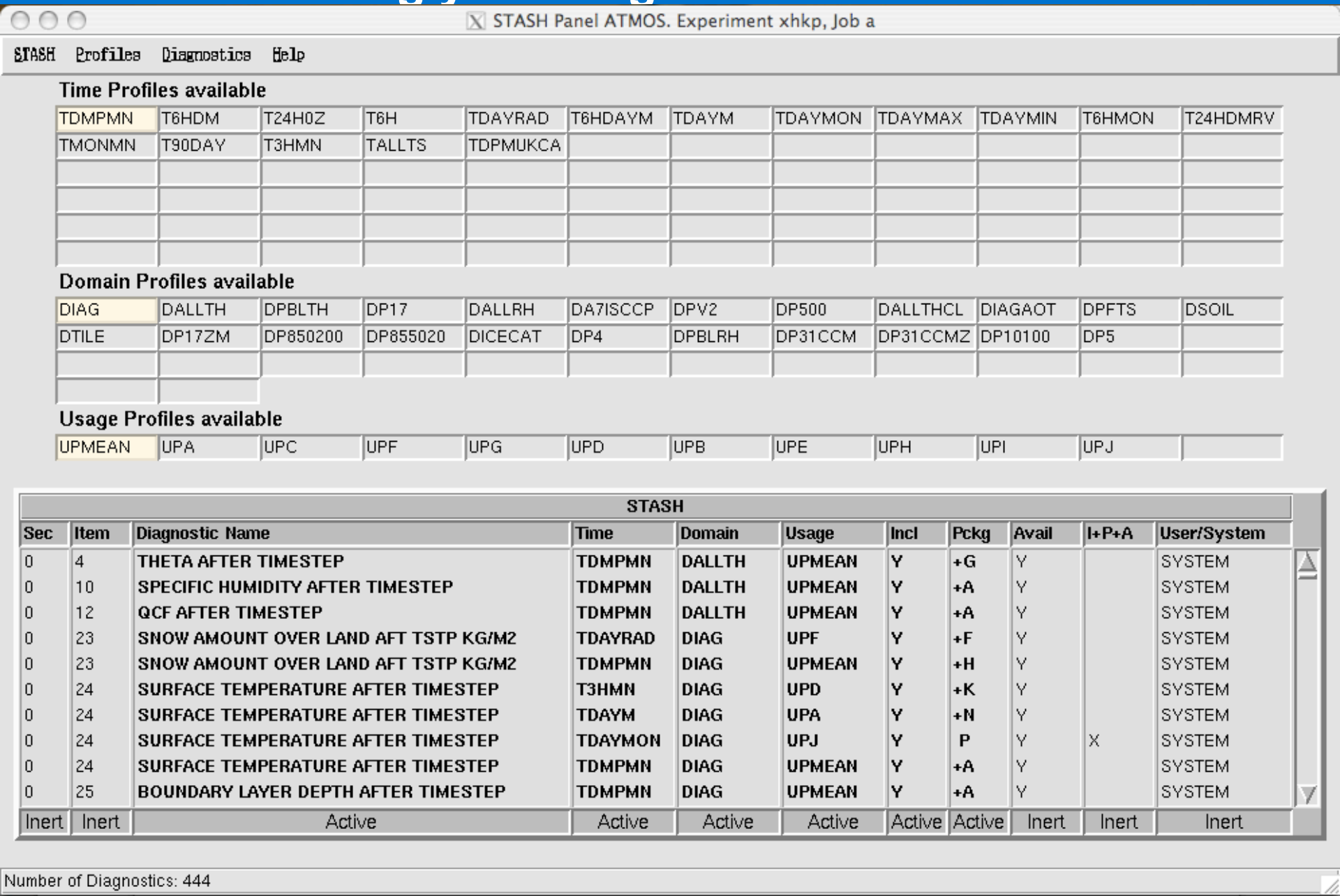
Adding your diagnostic to the UMUI



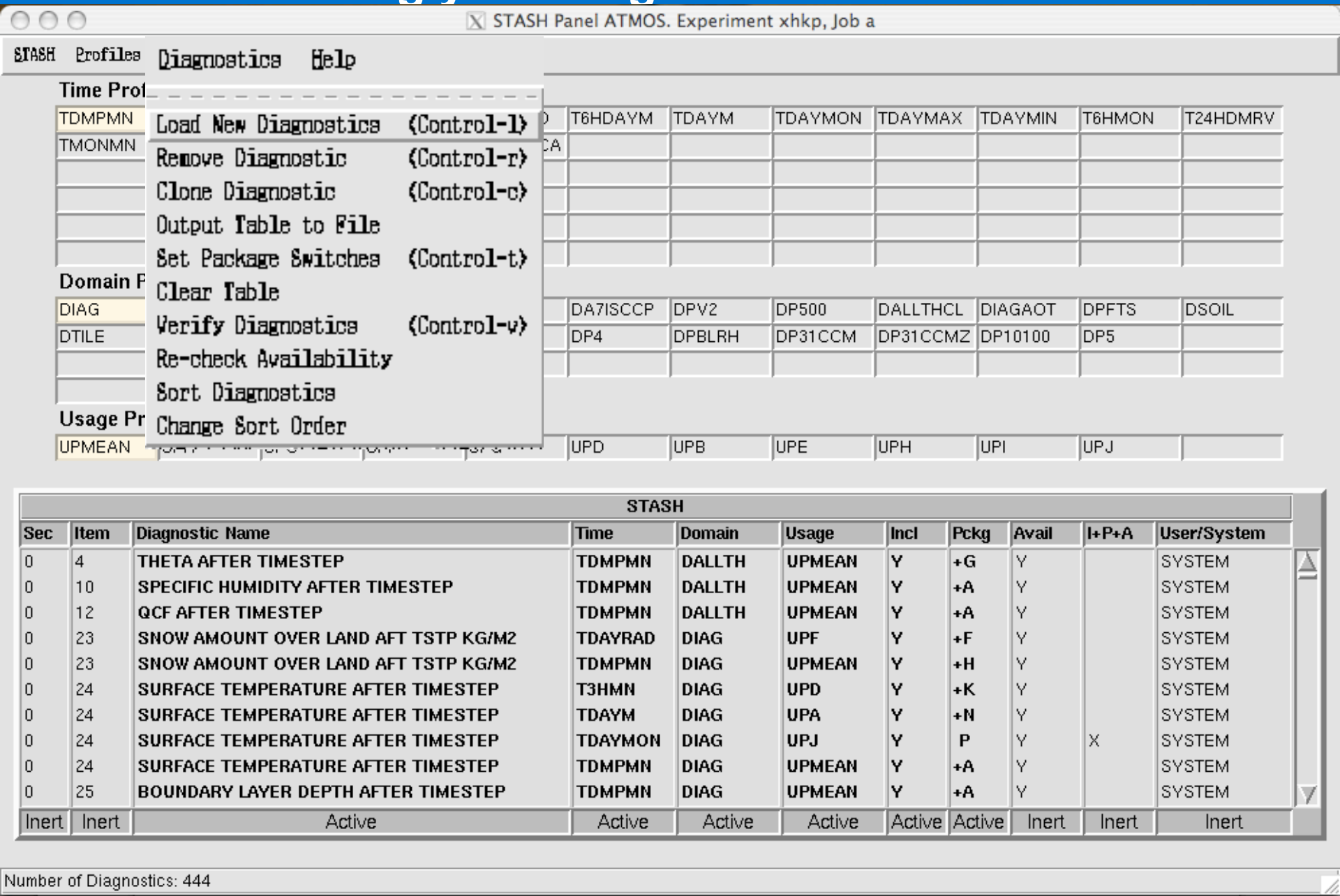
Adding your diagnostic to the UMUI



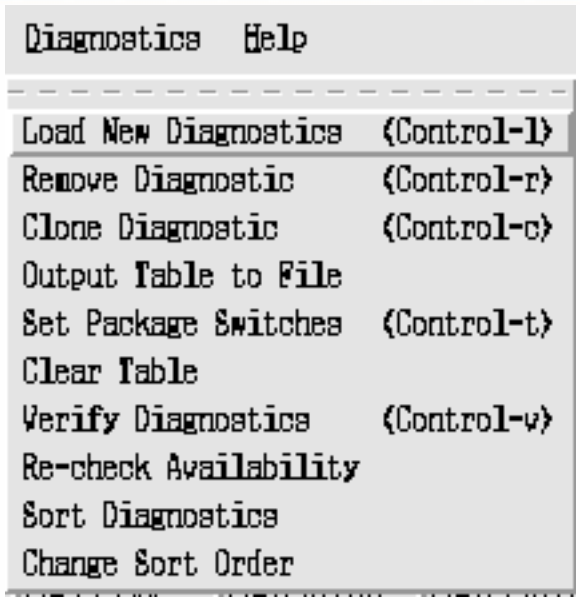
Adding your diagnostic to the UMUI



Adding your diagnostic to the UMUI



Adding your diagnostic to the UMUI



New Diagnostics.

Cancel

Select Section Number (Double Click)

Section Number	Section Name
12	Primary field advection.
13	Diffusion and filtering.
14	Energy adjustment.
15	Processed dynamics diags.
16	Processed physics diags.
17	Sulphur Cycle.
18	Data assimilation.
19	Vegetation.
20	Field Calc Diagnostic
26	River Routing
30	Processed Climate diagnostics
31	LBC fields for input (ie. by a LAM model)
32	LBC fields for output.
33	Atmospheric Tracers
34	UKCA Chemistry
Inert	Active

Select Diagnostic to Add.

Section	Item	Diagnostic Name. Double click to add	Help Available ?	Available	User/System
34	30	MACR MASS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	31	MACROOH MS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	32	MPAN MASS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	33	HACET MASS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	34	MGLY MASS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	35	NALD MASS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	36	HCOOH MASS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	37	MeCO3H MAS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	38	MeCO2H MAS MIXING RATIO AFTER TSTEP	No help	Y	USER
34	59	O3P MASS MIXING RATIO AFTER TSTEP	No help	N	USER
34	90	ISO2 MASS MIXING RATIO AFTER TSTEP	No help	N	USER
34	94	MeOH MASS MIXING RATIO AFTER TSTEP	No help	N	USER
34	95	MACRO2 MAS MIXING RATIO AFTER TSTEP	No help	N	USER
34	150	AGE OF AIR in SECONDS	No help	N	USER
34	512	NEW DIAGNOSTIC	No help	Y	USER
Inert	Inert	Active	Active	Inert	Inert

Adding your diagnostic to the UMUI

STASH Panel ATMOS. Experiment xhkp, Job a

STASH Profiles Diagnostics Help

Time Profiles available

TDMPMN	T6HDM	T24H0Z	T6H	TDAYRAD	T6HDAYM	TDAYM	TDAYMON	TDAYMAX	TDAYMIN	T6HMON	T24HDMRV
TMONMN	T90DAY	T3HMN	TALLTS	TDPMUKCA							

Domain Profiles available

DIAG	DALLTH	DPBLTH	DP17	DALLRH	DA7ISCCP	DPV2	DP500	DALLTHCL	DIAGAOT	DPFTS	DSOIL
DTILE	DP17ZM	DP850200	DP855020	DICECAT	DP4	DPBLRH	DP31CCM	DP31CCMZ	DP10100	DP5	

Usage Profiles available

UPMEAN	UPA	UPC	UPF	UPG	UPD	UPB	UPE	UPH	UPI	UPJ	

STASH

Sec	Item	Diagnostic Name	Time	Domain	Usage	Incl	Pckg	Avail	I+P+A	User/System
34	512	NEW DIAGNOSTIC				Y	+	Y		USER
0	4	THETA AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+G	Y		SYSTEM
0	10	SPECIFIC HUMIDITY AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	12	QCF AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDAYRAD	DIAG	UPF	Y	+F	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDMPMN	DIAG	UPMEAN	Y	+H	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	T3HMN	DIAG	UPD	Y	+K	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYM	DIAG	UPA	Y	+N	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYMON	DIAG	UPJ	Y	P	Y	X	SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDMPMN	DIAG	UPMEAN	Y	+A	Y		SYSTEM
Inert	Inert	Active	Active	Active	Active	Active	Active	Inert	Inert	Inert

Number of Diagnostics: 445

Adding your diagnostic to the UMUI

STASH Panel ATMOS. Experiment xhkp, Job a

STASH Profiles Diagnostics Help

Time Profiles available

TDMPMN	T6HDM	T24H0Z	T6H	TDAYRAD	T6HDAYM	TDAYM	TDAYMON	TDAYMAX	TDAYMIN	T6HMON	T24HDMRV
TMONMN	T90DAY	T3HMN	TALLTS	TDPMUKCA							

Domain Profiles available

DIAG	DALLTH	DPBLTH	DP17	DALLRH	DA7ISCCP	DPV2	DP500	DALLTHCL	DIAGAOT	DPFTS	DSOIL
DTILE	DP17ZM	DP850200	DP855020	DICECAT	DP4	DPBLRH	DP31CCM	DP31CCMZ	DP10100	DP5	

Usage Profiles available

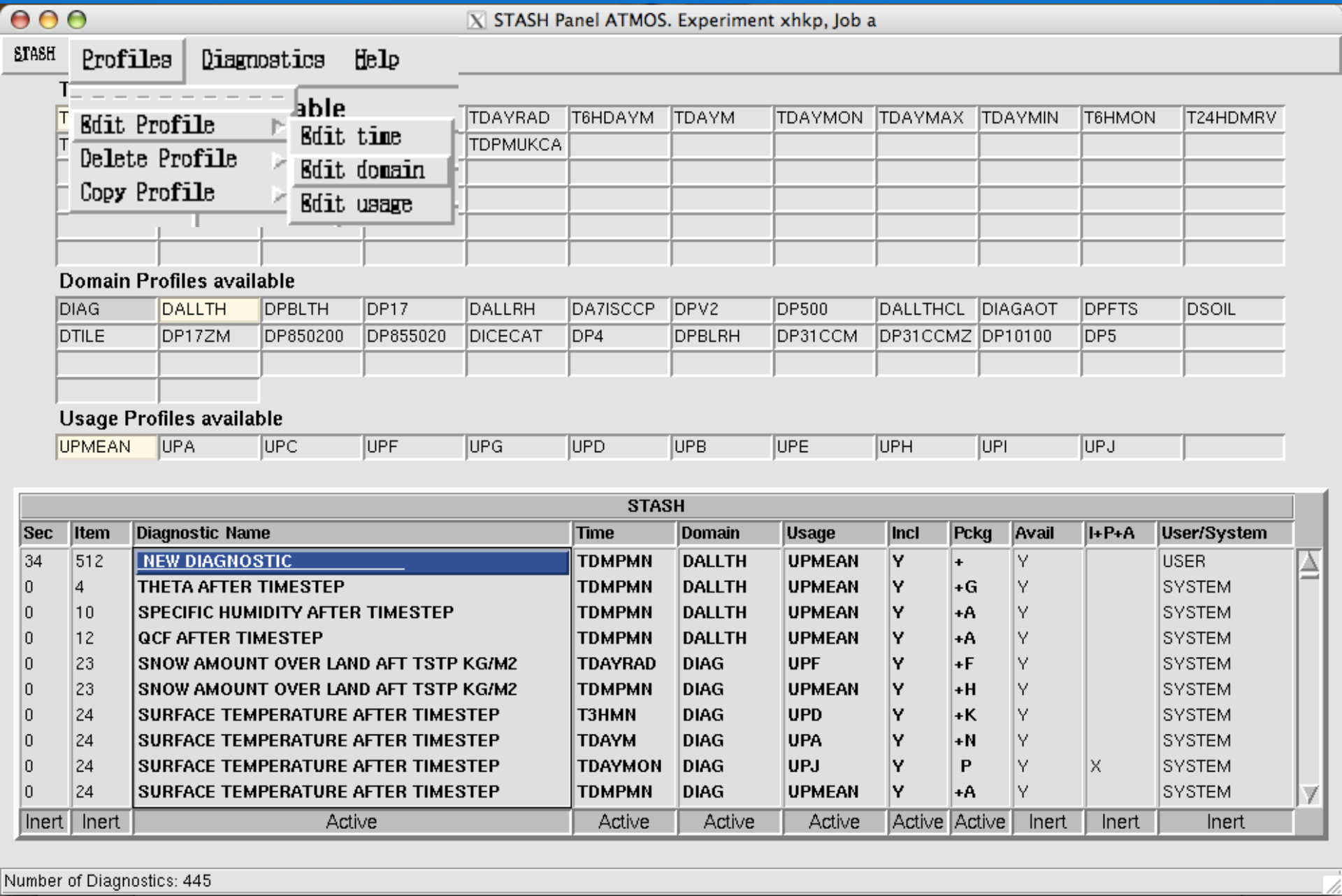
UPMEAN	UPA	UPC	UPF	UPG	UPD	UPB	UPE	UPH	UPI	UPJ	

STASH

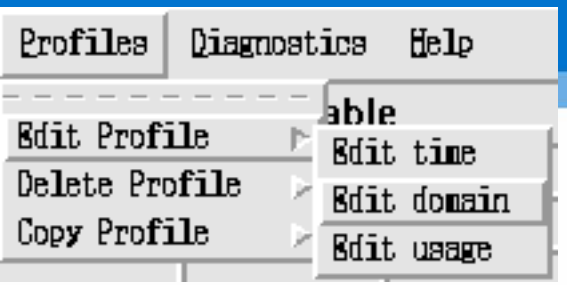
Sec	Item	Diagnostic Name	Time	Domain	Usage	Incl	Pckg	Avail	I+P+A	User/System
34	512	NEW DIAGNOSTIC	TDMPMN	DALLTH	UPMEAN	Y	+	Y		USER
0	4	THETA AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+G	Y		SYSTEM
0	10	SPECIFIC HUMIDITY AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	12	QCF AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDAYRAD	DIAG	UPF	Y	+F	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDMPMN	DIAG	UPMEAN	Y	+H	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	T3HMN	DIAG	UPD	Y	+K	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYM	DIAG	UPA	Y	+N	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYMON	DIAG	UPJ	Y	P	Y	X	SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDMPMN	DIAG	UPMEAN	Y	+A	Y		SYSTEM
Inert	Inert	Active	Active	Active	Active	Active	Active	Inert	Inert	Inert

Number of Diagnostics: 445

Domain Profile



Domain Profile



Domain profile specification (Levels) : Job xhkp.a: "UKCA-TropIsop HECToR Phase2b N48L60 QESM-A"

Domain profile name: DALLTH

Select vertical level type:
- Variables derived on a single or unspecified level
- Variables derived on model rho levels (Charney-Philips grid)
- Variables derived on model theta levels (Charney-Philips grid)
- Variables on deep soil levels
- Variables on pressure levels (hPa)
- Variables on geometric height levels (m)
- Variables on constant theta surfaces (K)
- Variables on potential vorticity levels
- Variables on cloud threshold levels (octas)

Specification of levels by:
- Range of model levels
- List of selected model levels

Range starting at (see Level Names Help): ATMOS_BOTTOM — Converts to: 1

Range ending at (see Level Names Help): ATMOS_TOP — Converts to: 60

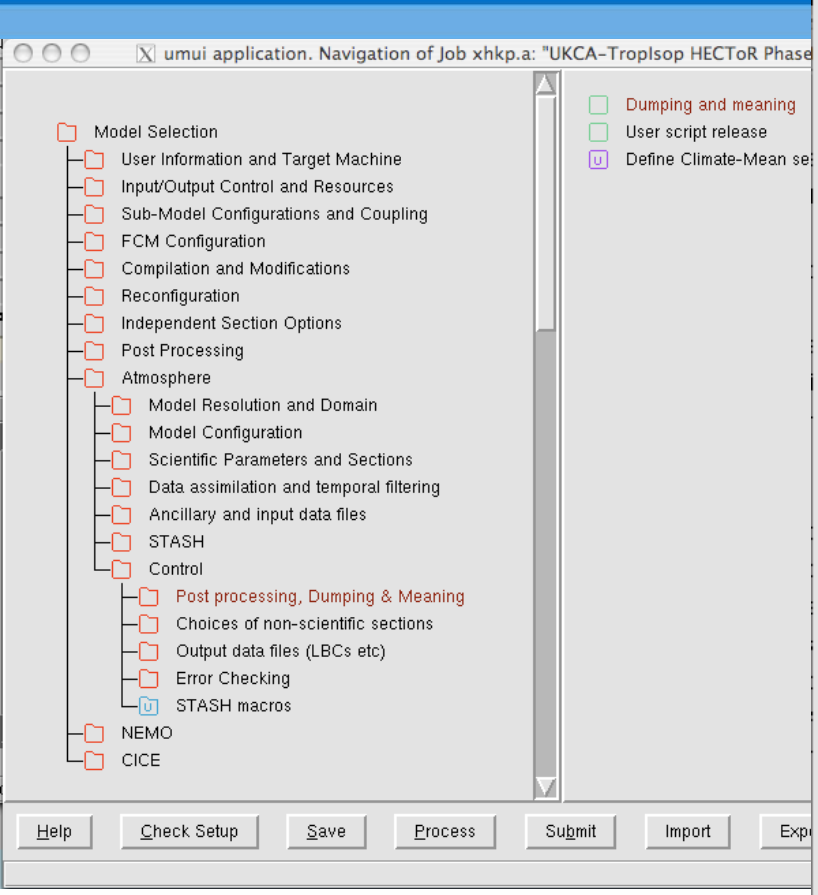
Level Names Help | Help | Abandon changes | Close | PSEUDO | HORIZ | TSERIES

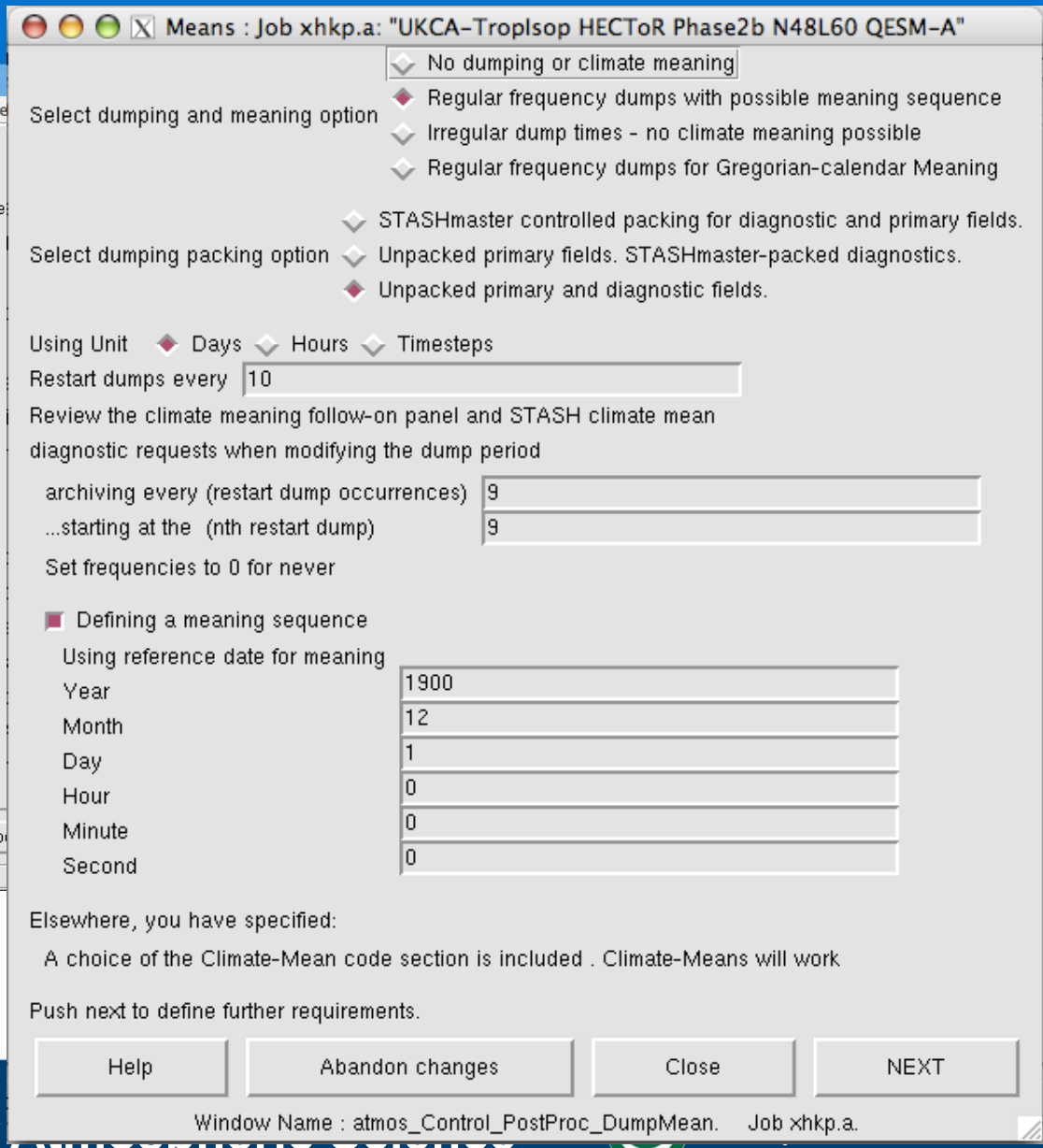
Window Name : atmos_STASH_Domain. Job xhkp.a.

Climate Meaning

- We have passed this diagnostic through to **UPMEAN**, but what does this mean?
- There are 12 streams in the UM that lead to output files. I will cover the first 11 later, but the 12th is the climate meaning stream
  - This stream works slightly differently to the other streams, where "what you see is what you get"
  - The behaviour of the climate meaning stream is controlled elsewhere in the UMUI

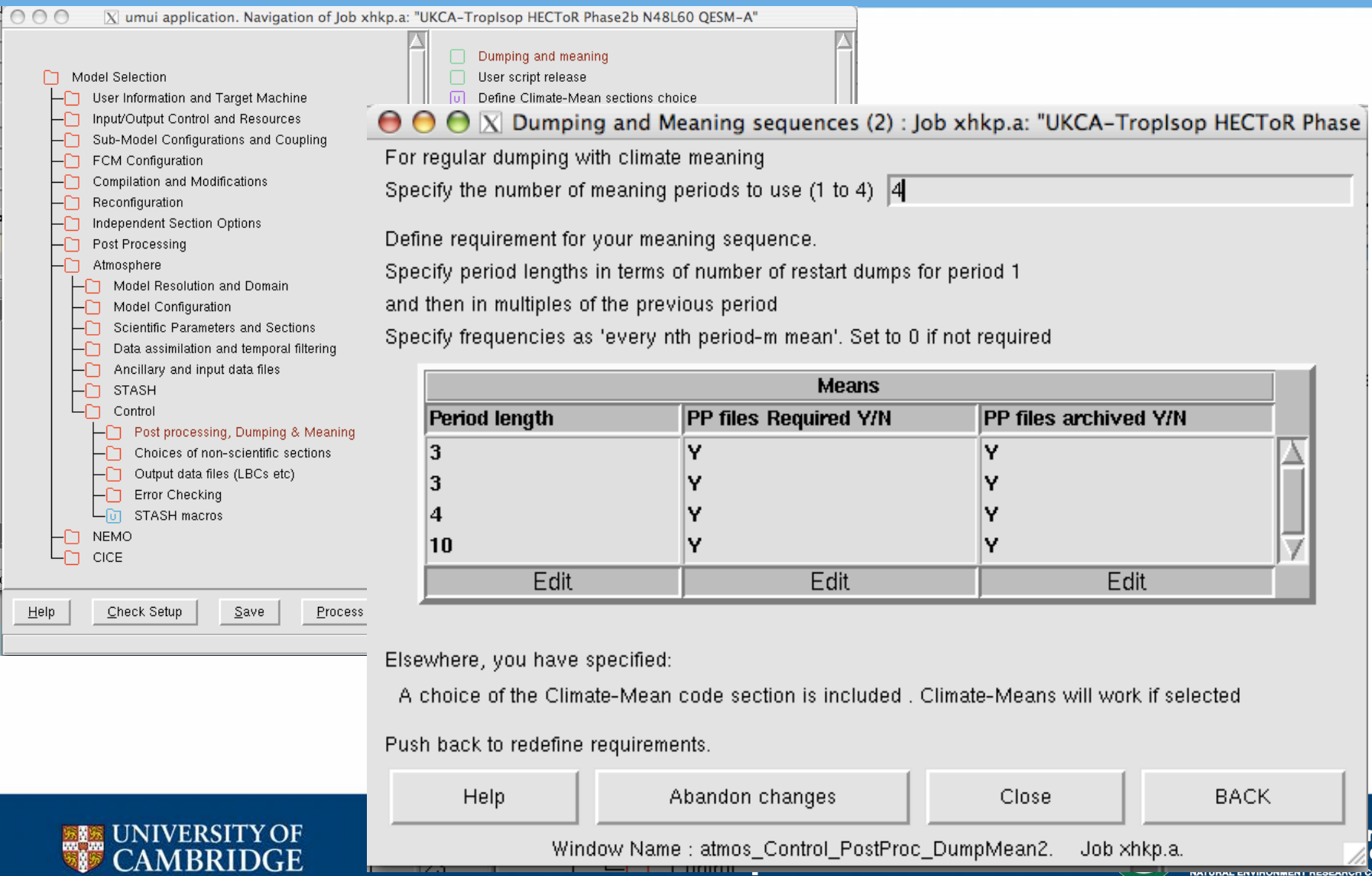
Climate Meaning



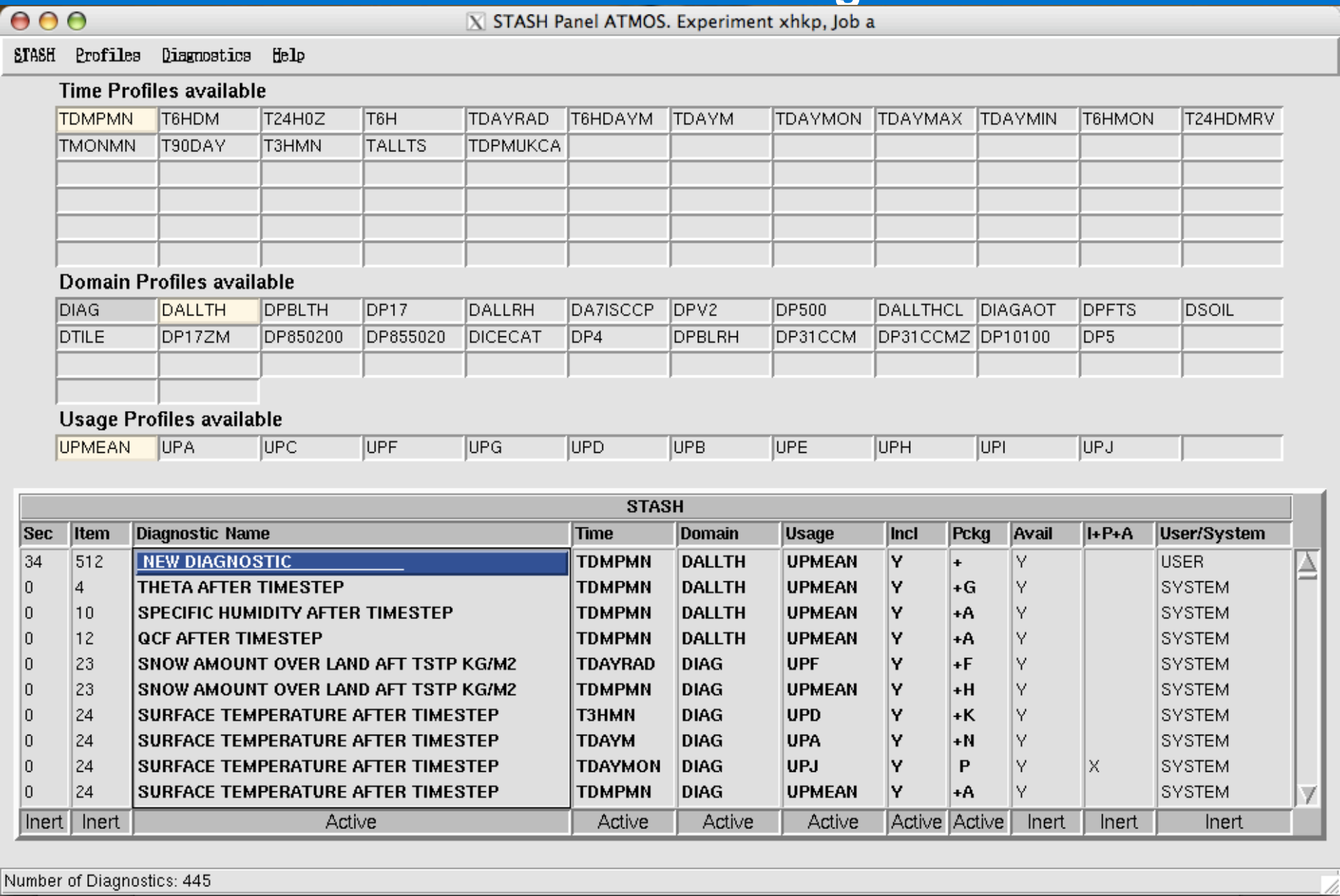


Climate Meaning

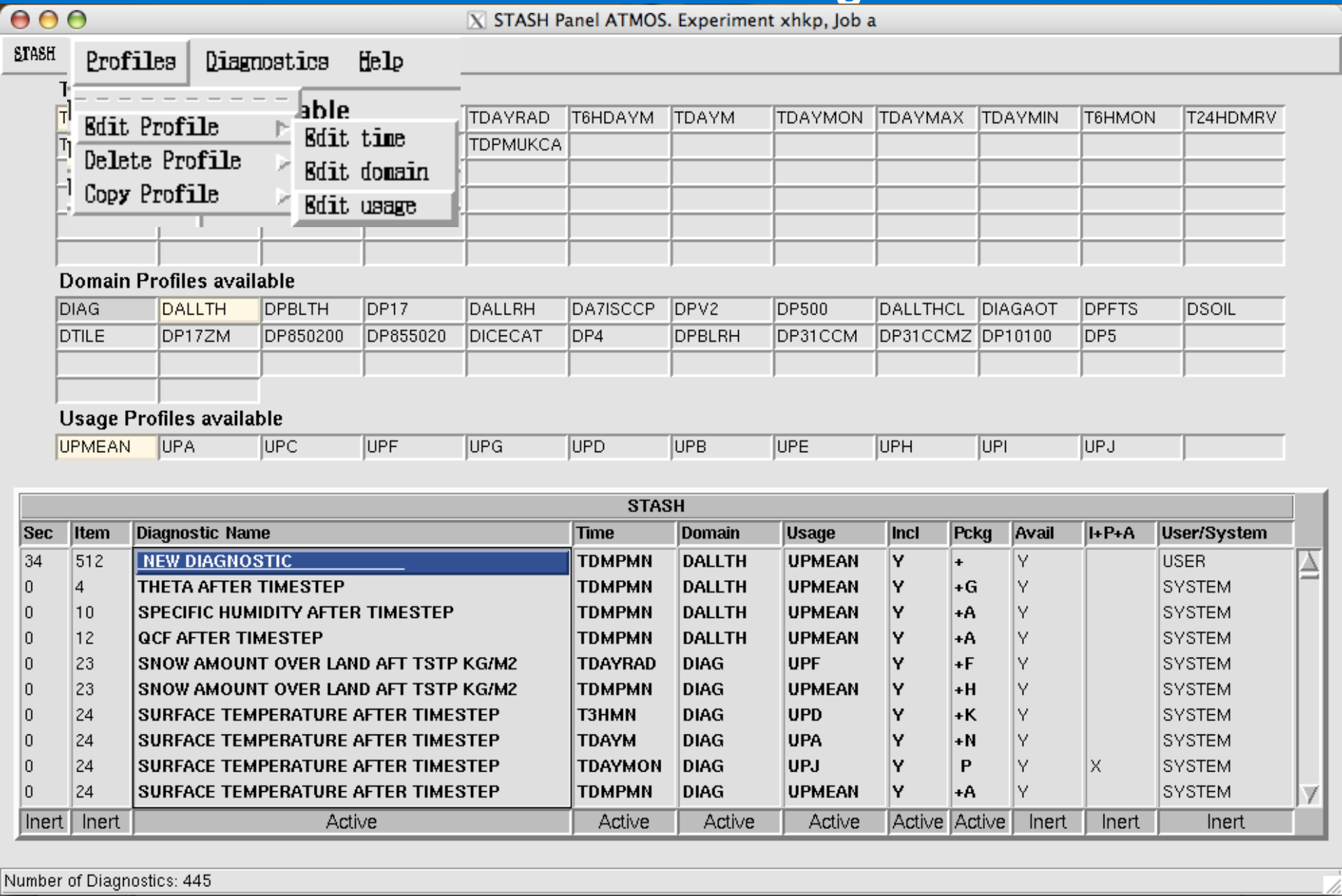
pm (monthly mean)
ps (seasonal mean)
py (annual mean)
px (decadal mean)
files will be produced



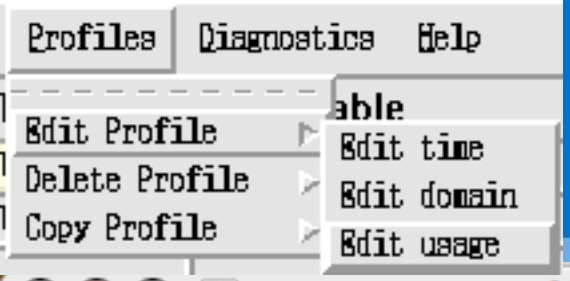
Climate Meaning



Climate Meaning



Climate Meaning



STASH Usage profile. : Job xhkp.a: "UKCA-TropIsop HECToR Phase2b N48L60 QESM-A"

Usage profile name: UPMEAN

Specify the final destination of the diagnostic

- Dump store with user specified TAG, specify tag below.
- Secondary store with user specified TAG, specify tag below.
- **Dump store with climate mean TAG. Specify meaning periods below**
- PP-file. Specify stream below
- Send mean diagnostic direct to mean PP-file (climate mean sections only)

- Tagged for climate mean period 1
- Tagged for climate mean period 2
- Tagged for climate mean period 3
- Tagged for climate mean period 4

Elsewhere you have set up climate meaning as follows:

Climate meaning is specified

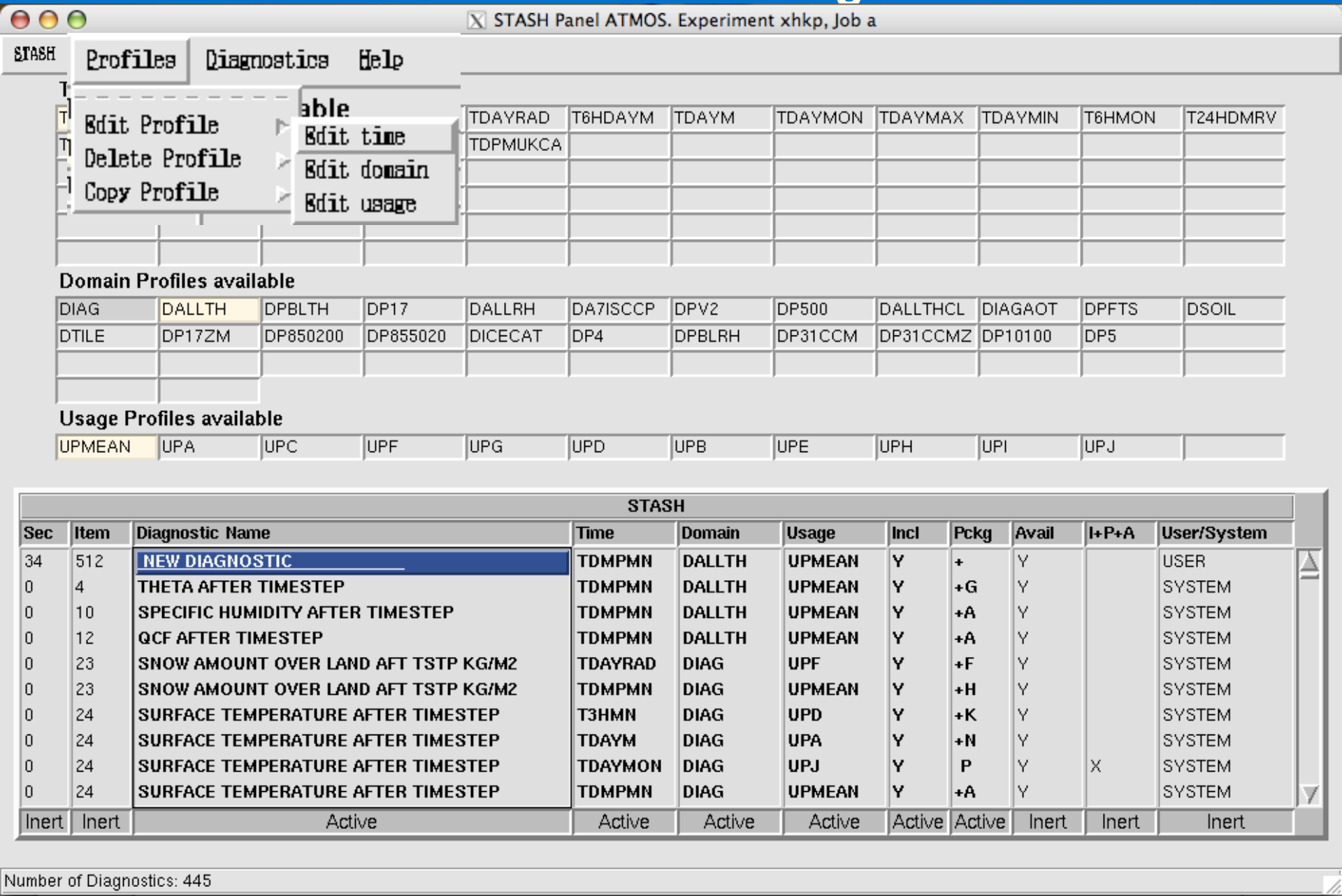
Number of climate mean periods: 4

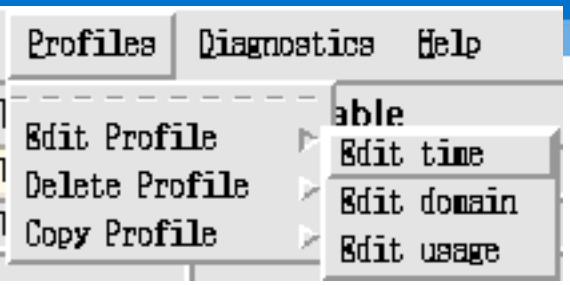
Push FILES to see settings of PP-files to sub-models and reinitialisation.

Help | Abandon changes | Close | FILES

Window Name : atmos_STASH_Usage. Job xhkp.a.

Climate Meaning





Time profile name: TDMPMN

Specify time processing required:
- No time processing. Field valid at output timesteps.
- Time accumulation, specify accumulation period and sampling frequency below
- Time mean, specify meaning period and sampling frequency below
- Time series, specify recycling period and sampling frequency below
- Special daily-mean time series. Specify recycling period below.
- Maximum value in a period, specify period and sampling frequency below
- Minimum value in a period, specify period and sampling frequency below

Define the meaning period:

Time units: Days / Hours / Dump periods / Timesteps

Sampling period: 1

Define the sampling frequency to make up the above:

Time units: Days / Hours / Dump periods / Timesteps

Frequency (every): 1

Sampling offset (0 for no offset): 0

Specify the output times for the diagnostic

Specification type: Regular intervals / Specified List

Time units: Days / Hours / Dump periods / Timesteps

Starting: 1

Ending: -1

Frequency (every): 1

Set ending to -1 for the whole run

Number of times in the list:

Output time list	
No.	Values need to be sorted
Inert	Inert

Climate Meaning

- **Points to remember:**
  - All fields sent to **`UPMEAN` must use `TDMPMN`** or a derivative (e.g. offset in temporal sampling of data c.f. **`TDMNUKCA`**)
  - If e.g. **`TMONMN`** (monthly mean) is used then the data will be sampled incorrectly leading to problems with the values in the **`.pm`** files.

- If you are having problems outputting fields through climate meaning the solution is to send the data to another output stream

Other output streams

umui application. Navigation of Job xhkp.a: "UKCA-TropIsop HECToR Phase2b N48L60 QESM-A"

- Model Selection
  - User Information and Target Machine
  - Input/Output Control and Resources
  - Sub-Model Configurations and Coupling
  - FCM Configuration
  - Compilation and Modifications
  - Reconfiguration
  - Independent Section Options
  - Post Processing

Main Switch + General Questions

Initialization and processing of mean & standard PP files

Select packing profile for mean PP files

- Unpacked, profile 0
- Packed as required for operational output streams, profile 1
- Packed as required for standard climate output, profile 2
- Packed as required for stratosphere model output, profile 4
- New standard climate packing, profile 5
- Simple GRIB packing, profile 6

GRIB format mean PP files

Define processing and post-processing requirements for the PP output streams.

Define periodic re-initialization for those files which require automatic post processing.

PP Files										
Basics					For re-initialised PP files, also specify					
PP File/Unit	Packing profile	Override size	GRIB FORMAT (Y/N)	Periodic Re-init	Period	Starting	Ending	Time Unit	Sub Model	Archiving
PP0/PA/60	5	16000	N	Y	30	0	-1	DA	A	Y
PP1/PB/61	5	0	N	Y	1	0	-1	DA	A	Y
PP2/PC/62	5	16000	N	Y	90	0	-1	DA	A	Y
PP3/PD/63	5	16000	N	Y	30	0	-1	DA	A	Y
PP4/PE/64	5	16000	N	Y	30	0	-1	DA	A	Y
PP5/PF/65	5	0	N	Y	90	0	-1	DA	A	Y
PP6/PG/66	5	0	N	Y	90	0	-1	DA	A	Y
PP7/PH/67	5	0	N	Y	30	0	-1	DA	A	N
PP8/PI/68	5	0	N	Y	90	0	-1	DA	A	Y
PP9/PJ/69	5	0	N	Y	90	0	-1	DA	A	Y
PP10/PK/151	5	16000	N	Y	30	0	-1	DA	A	N
Inert	Edit	Edit	Edit	Edit	Edit	Edit	Edit	Edit	Edit	Edit

Time units are: DA=days, H=hours, T=timesteps, RM=real months.

Packing profiles numbers are as defined for mean PP file.

A (Atmosphere) is currently the only valid sub-model.

Help | Abandon changes | Close

Window Name : subindep_PostProc_PPInit. Job xipf.a.

Other output streams

STASH Panel ATMOS. Experiment xhkp, Job a

STASH Profiles Diagnostics Help

Time Profiles available

TDMPMN	T6HDM	T24H0Z	T6H	TDAYRAD	T6HDAYM	TDAYM	TDAYMON	TDAYMAX	TDAYMIN	T6HMON	T24HDMRV
TMONMN	T90DAY	T3HMN	TALLTS	TDPMUKCA							

Domain Profiles available

DIAG	DALLTH	DPBLTH	DP17	DALLRH	DA7ISCCP	DPV2	DP500	DALLTHCL	DIAGAOT	DPFTS	DSOIL
DTILE	DP17ZM	DP850200	DP855020	DICECAT	DP4	DPBLRH	DP31CCM	DP31CCMZ	DP10100	DP5	

Usage Profiles available

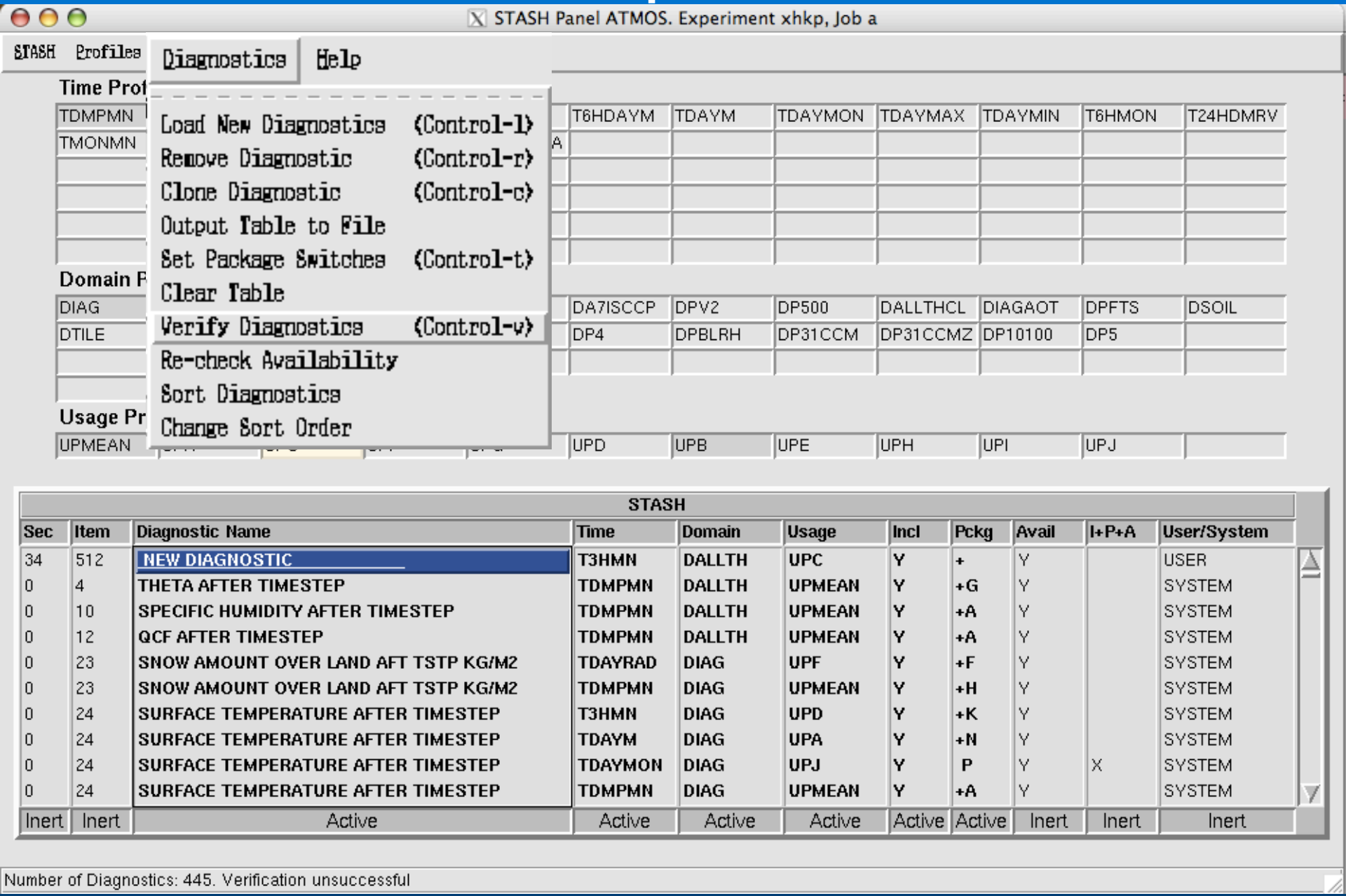
UPMEAN	UPA	UPC	UPF	UPG	UPD	UPB	UPE	UPH	UPI	UPJ	

STASH

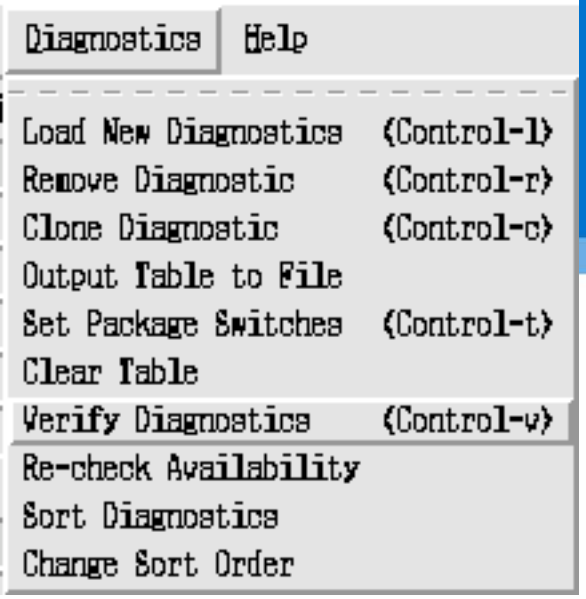
Sec	Item	Diagnostic Name	Time	Domain	Usage	Incl	Pckg	Avail	I+P+A	User/System
34	512	NEW DIAGNOSTIC	T3HMN	DALLTH	UPC	Y	+	Y		USER
0	4	THETA AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+G	Y		SYSTEM
0	10	SPECIFIC HUMIDITY AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	12	QCF AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDAYRAD	DIAG	UPF	Y	+F	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDMPMN	DIAG	UPMEAN	Y	+H	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	T3HMN	DIAG	UPD	Y	+K	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYM	DIAG	UPA	Y	+N	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYMON	DIAG	UPJ	Y	P	Y	X	SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDMPMN	DIAG	UPMEAN	Y	+A	Y		SYSTEM
Inert	Inert	Active	Active	Active	Active	Active	Active	Inert	Inert	Inert

Number of Diagnostics: 445. Verification unsuccessful

Other output streams



Other output streams



Warning:
You may exceed the maximum number of PP fields per file

Estimated number of PP files to be written:

17190 fields in stream 62
5761 fields in Climate mean Period_1
5761 fields in Climate mean Period_2
5761 fields in Climate mean Period_3
5761 fields in Climate mean Period_4

Maximum allowed is 4096 fields per stream.

Note: ‘field’ is a 2D horizontal field

Other output streams

umui application. Navigation of Job xhkp.a: "UKCA-TropIsop HECToR Phase2b N48L60 QESM-A"

- Model Selection
  - User Information and Target Machine
  - Input/Output Control and Resources
  - Sub-Model Configurations and Coupling
  - FCM Configuration
  - Compilation and Modifications
  - Reconfiguration
  - Independent Section Options
  - Post Processing

Main Switch + General Questions

Initialization and processing of mean & standard PP files

Select packing profile for mean PP files

- Unpacked, profile 0
- Packed as required for operational output streams, profile 1
- Packed as required for standard climate output, profile 2
- Packed as required for stratosphere model output, profile 4
- New standard climate packing, profile 5
- Simple GRIB packing, profile 6

GRIB format mean PP files

Define processing and post-processing requirements for the PP output streams.

Define periodic re-initialization for those files which require automatic post processing.

PP Files										
Basics					For re-initialised PP files, also specify					
PP File/Unit	Packing profile	Override size	GRIB FORMAT (Y/N)	Periodic Re-init	Period	Starting	Ending	Time Unit	Sub Model	Archiving
PP0/PA/60	5	16000	N	Y	30	0	-1	DA	A	Y
PP1/PB/61	5	0	N	Y	1	0	-1	DA	A	Y
PP2/PC/62	5	16000	N	Y	90	0	-1	DA	A	Y
PP3/PD/63	5	16000	N	Y	30	0	-1	DA	A	Y
PP4/PE/64	5	16000	N	Y	30	0	-1	DA	A	Y
PP5/PF/65	5	0	N	Y	90	0	-1	DA	A	Y
PP6/PG/66	5	0	N	Y	90	0	-1	DA	A	Y
PP7/PH/67	5	0	N	Y	30	0	-1	DA	A	N
PP8/PI/68	5	0	N	Y	90	0	-1	DA	A	Y
PP9/PJ/69	5	0	N	Y	90	0	-1	DA	A	Y
PP10/PK/151	5	16000	N	Y	30	0	-1	DA	A	N
Inert	Edit	Edit	Edit	Edit	Edit	Edit	Edit	Edit	Edit	Edit

Time units are: DA=days, H=hours, T=timesteps, RM=real months.

Packing profiles numbers are as defined for mean PP file.

A (Atmosphere) is currently the only valid sub-model.

Help | Abandon changes | Close

Window Name : subindep_PostProc_PPInit. Job xipf.a.

Other output streams

STASH Panel ATMOS. Experiment xhkp, Job a

STASH Profiles Diagnostics Help

Time Profiles available

TDMPMN	T6HDM	T24H0Z	T6H	TDAYRAD	T6HDAYM	TDAYM	TDAYMON	TDAYMAX	TDAYMIN	T6HMON	T24HDMRV
TMONMN	T90DAY	T3HMN	TALLTS	TDPMUKCA							

Domain Profiles available

DIAG	DALLTH	DPBLTH	DP17	DALLRH	DA7ISCCP	DPV2	DP500	DALLTHCL	DIAGAOT	DPFTS	DSOIL
DTILE	DP17ZM	DP850200	DP855020	DICECAT	DP4	DPBLRH	DP31CCM	DP31CCMZ	DP10100	DP5	

Usage Profiles available

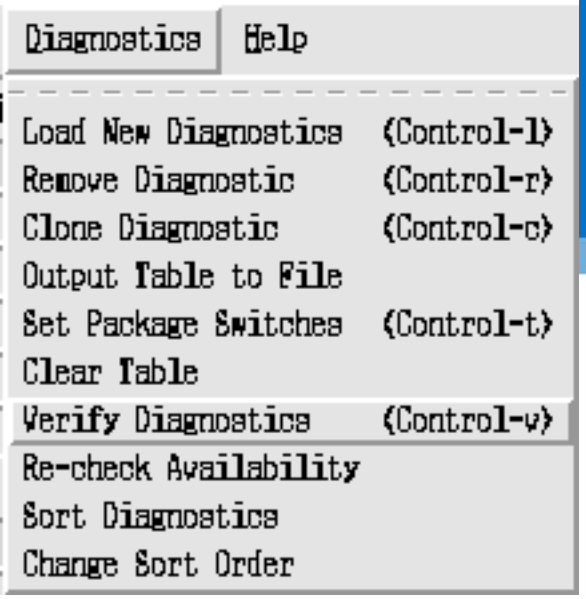
UPMEAN	UPA	UPC	UPF	UPG	UPD	UPB	UPE	UPH	UPI	UPJ	

STASH

Sec	Item	Diagnostic Name	Time	Domain	Usage	Incl	Pckg	Avail	I+P+A	User/System
34	512	NEW DIAGNOSTIC	T3HMN	DALLTH	UPB	Y	+	Y		USER
0	4	THETA AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+G	Y		SYSTEM
0	10	SPECIFIC HUMIDITY AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	12	QCF AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDAYRAD	DIAG	UPF	Y	+F	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDMPMN	DIAG	UPMEAN	Y	+H	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	T3HMN	DIAG	UPD	Y	+K	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYM	DIAG	UPA	Y	+N	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYMON	DIAG	UPJ	Y	P	Y	X	SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDMPMN	DIAG	UPMEAN	Y	+A	Y		SYSTEM
Inert	Inert	Active	Active	Active	Active	Active	Active	Inert	Inert	Inert

Number of Diagnostics: 445. Verification unsuccessful

Other output streams



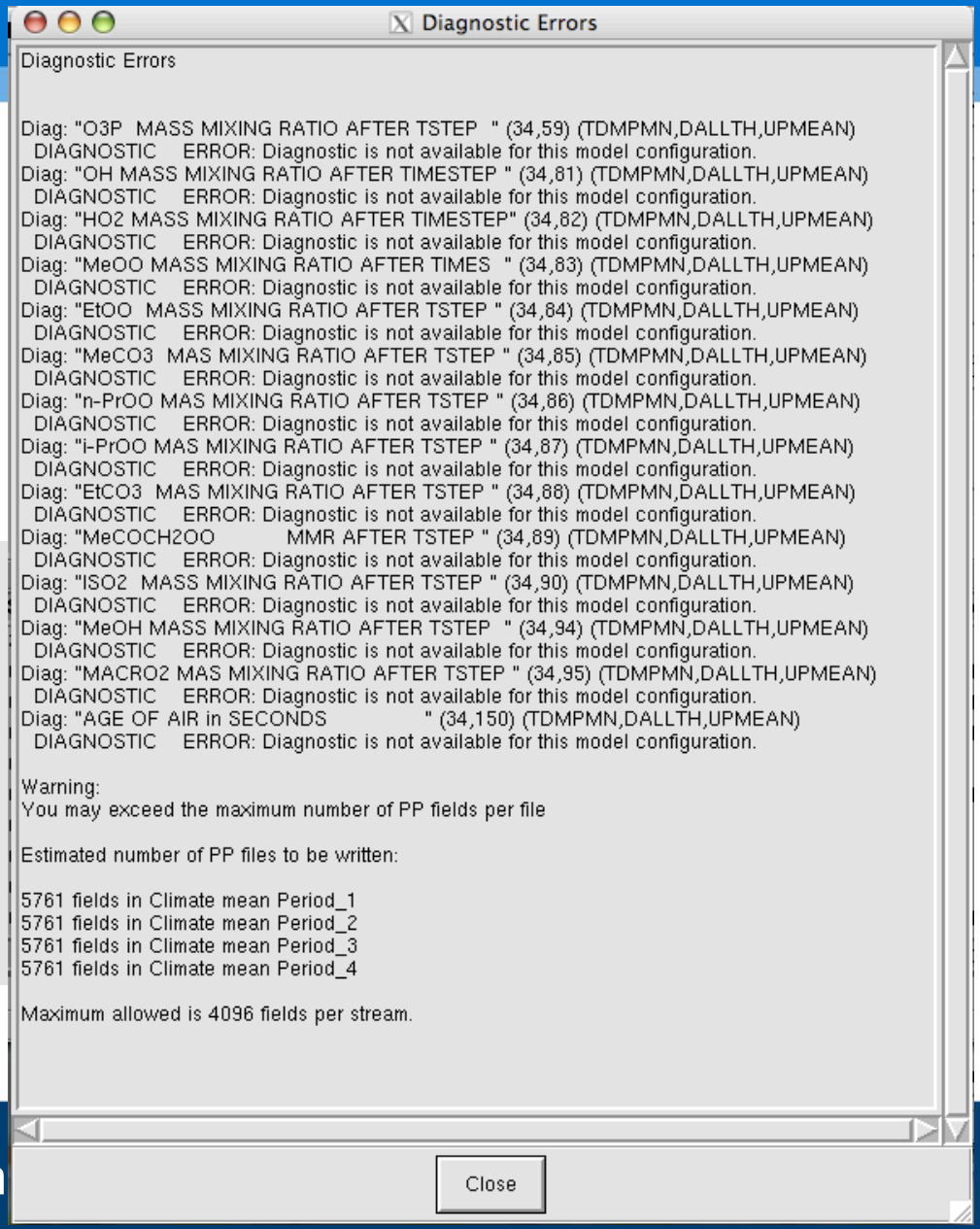
Warning:
You may exceed the maximum number of PP fields per file

Estimated number of PP files to be written:

5761 fields in Climate mean Period_1
5761 fields in Climate mean Period_2
5761 fields in Climate mean Period_3
5761 fields in Climate mean Period_4

Maximum allowed is 4096 fields per stream.

Note: 'field' is a 2D horizontal field



Other output streams

- **Points to remember:**
  - When verifying diagnostics the climate meaning stream can usually take more than the 4096 specified (but not a massive amount more)
  - If you have asked for many more fields for **`UPMEAN`** then you may need to move these fields to one of the PP-streams (**`UPA`**, **`UPB`**, etc.)
    - In these streams you will need to use **`TMONMN`** for a monthly mean etc.
- You may also need/want to make up your own temporal (and/or domain) profiles
  - These could be used in either the PP- or climate meaning streams

Diag: " NEW DIAGNOSTIC " (34,512) (T3HMN,DALLRH,UPB)
DOMAIN PROF ERROR: Use profile on model theta-levels.

Which levels?

STASH Panel ATMOS. Experiment xhkp, Job a

STASH Profiles Diagnostics Help

Time Profiles available

TDMPMN	T6HDM	T24H0Z	T6H	TDAYRAD	T6HDAYM	TDAYM	TDAYMON	TDAYMAX	TDAYMIN	T6HMON	T24HDMRV
TMONMN	T90DAY	T3HMN	TALLTS	TDPMUKCA							

Domain Profiles available

DIAG	DALLTH	DPBLTH	DP17	DALLRH	DA7ISCCP	DPV2	DP500	DALLTHCL	DIAGAOT	DPFTS	DSOIL
DTILE	DP17ZM	DP850200	DP855020	DICECAT	DP4	DPBLRH	DP31CCM	DP31CCMZ	DP10100	DP5	

Usage Profiles available

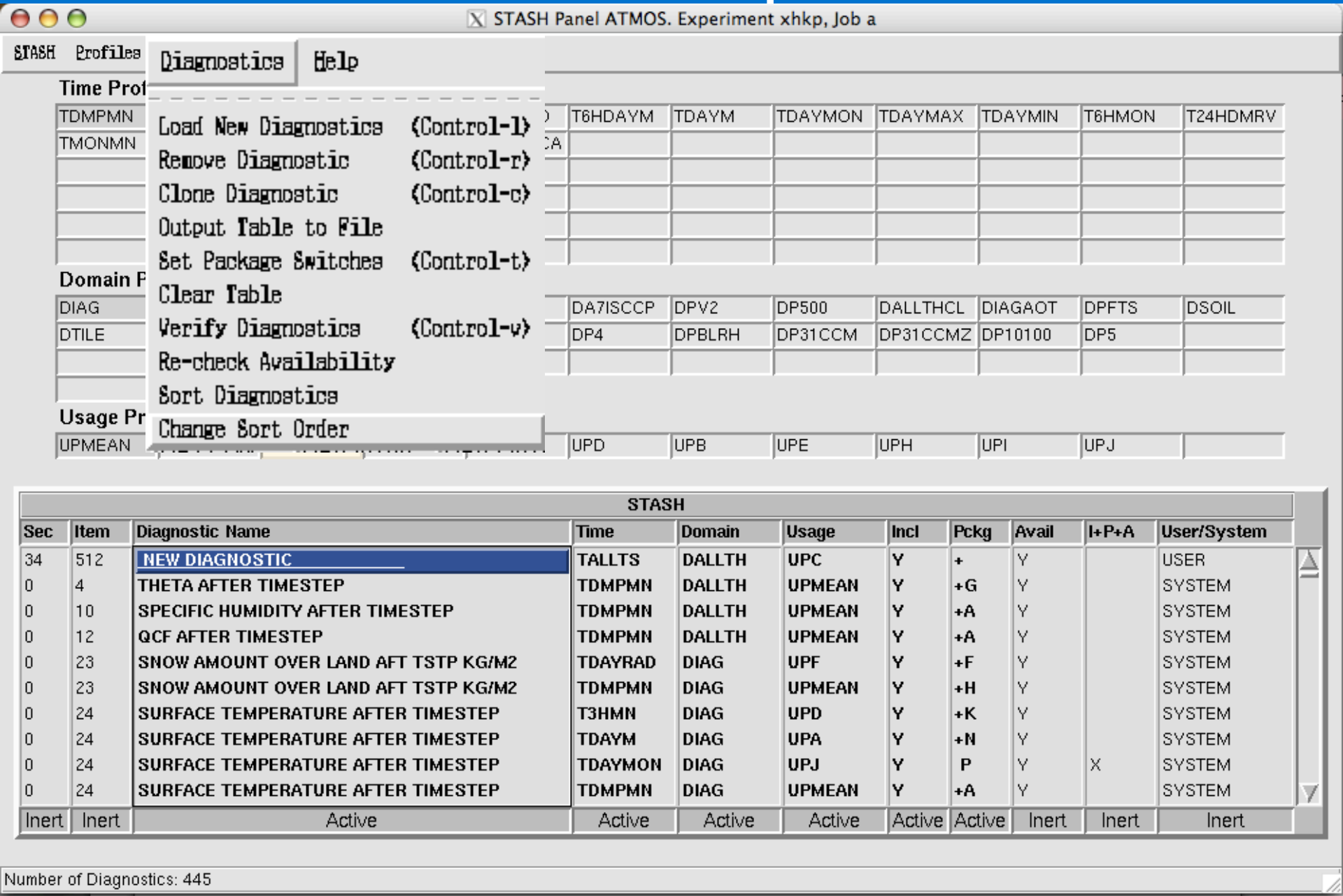
UPMEAN	UPA	UPC	UPF	UPG	UPD	UPB	UPE	UPH	UPI	UPJ	

STASH

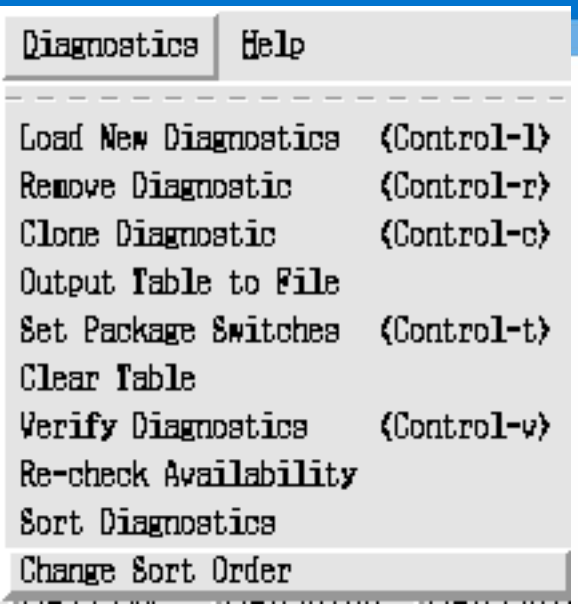
Sec	Item	Diagnostic Name	Time	Domain	Usage	Incl	Pckg	Avail	I+P+A	User/System
34	512	NEW DIAGNOSTIC	T3HMN	DALLRH	UPB	Y	+	Y		USER
0	4	THETA AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+G	Y		SYSTEM
0	10	SPECIFIC HUMIDITY AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	12	QCF AFTER TIMESTEP	TDMPMN	DALLTH	UPMEAN	Y	+A	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDAYRAD	DIAG	UPF	Y	+F	Y		SYSTEM
0	23	SNOW AMOUNT OVER LAND AFT TSTP KG/M2	TDMPMN	DIAG	UPMEAN	Y	+H	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	T3HMN	DIAG	UPD	Y	+K	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYM	DIAG	UPA	Y	+N	Y		SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDAYMON	DIAG	UPJ	Y	P	Y	X	SYSTEM
0	24	SURFACE TEMPERATURE AFTER TIMESTEP	TDMPMN	DIAG	UPMEAN	Y	+A	Y		SYSTEM
Inert	Inert	Active	Active	Active	Active	Active	Active	Inert	Inert	Inert

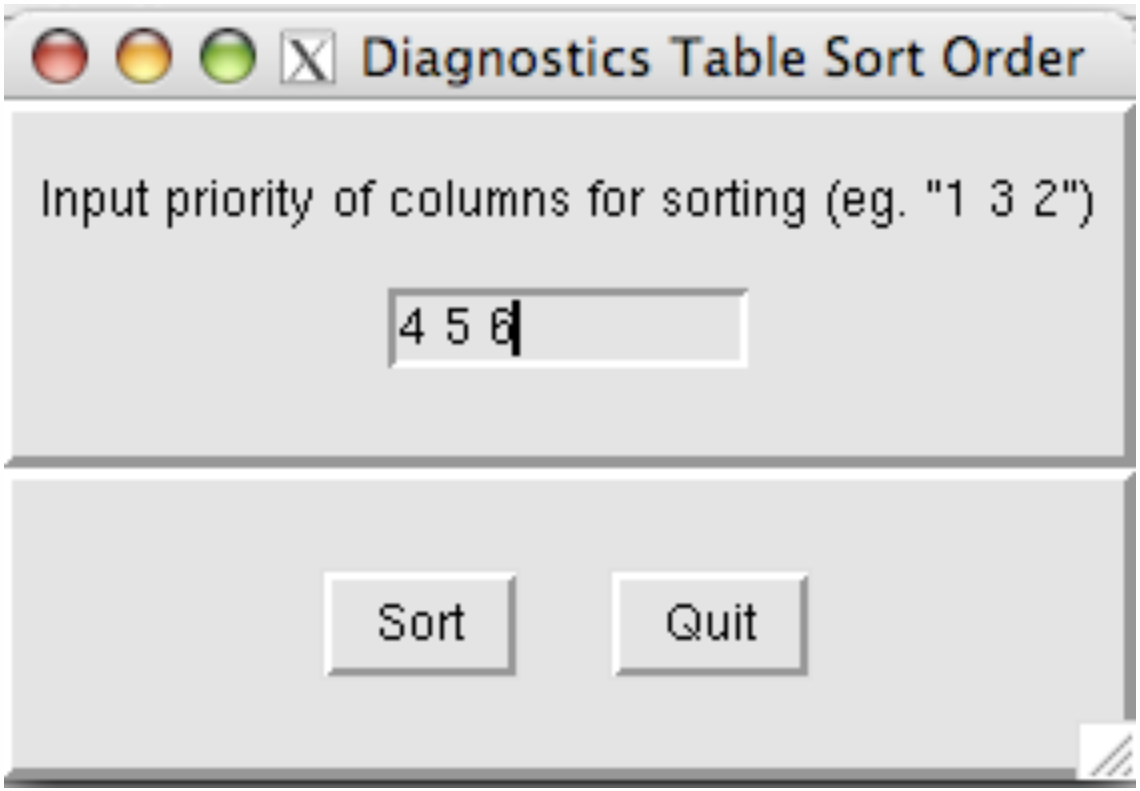
Number of Diagnostics: 445. Verification unsuccessful

Other useful options

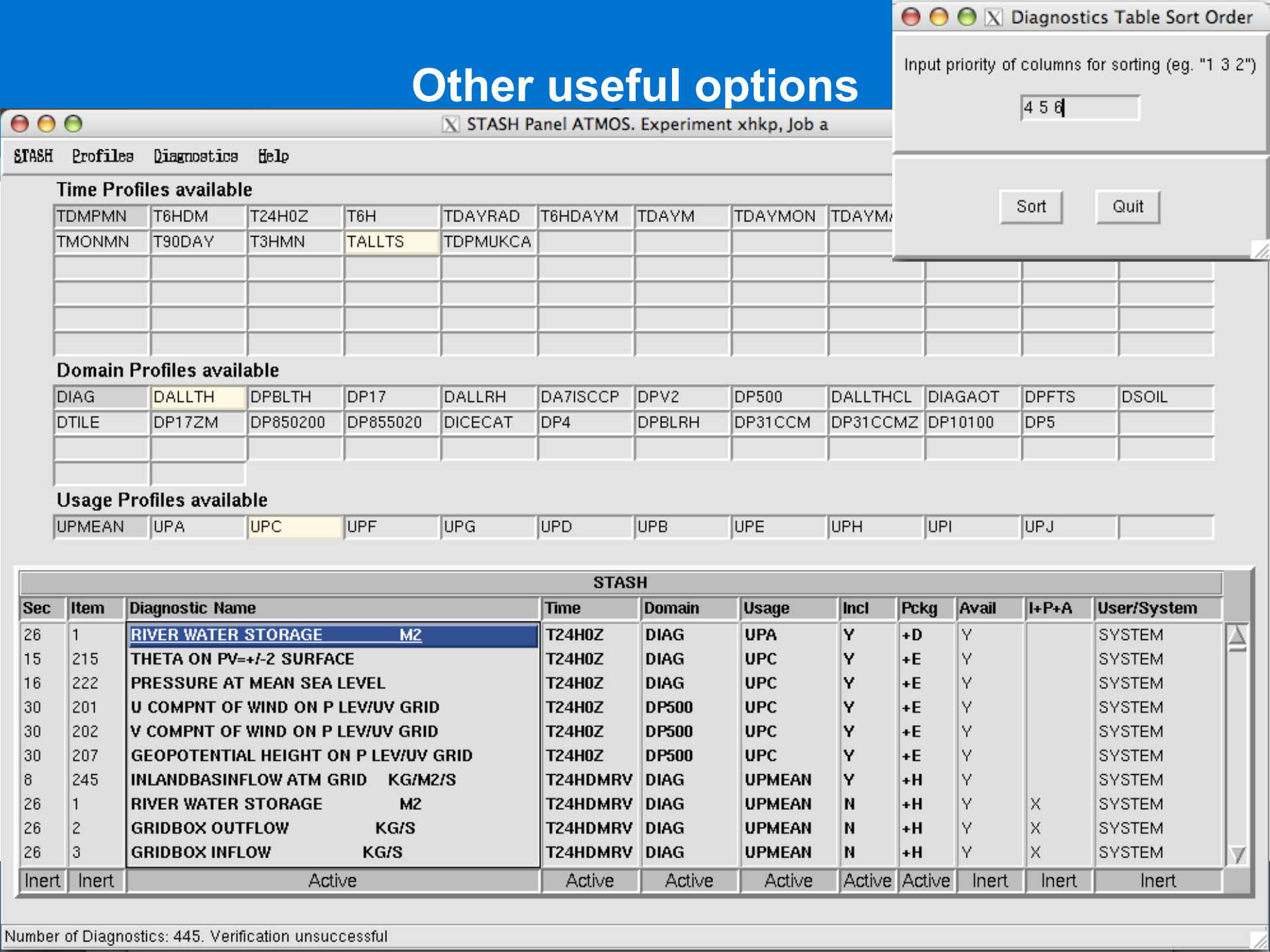


Other useful options

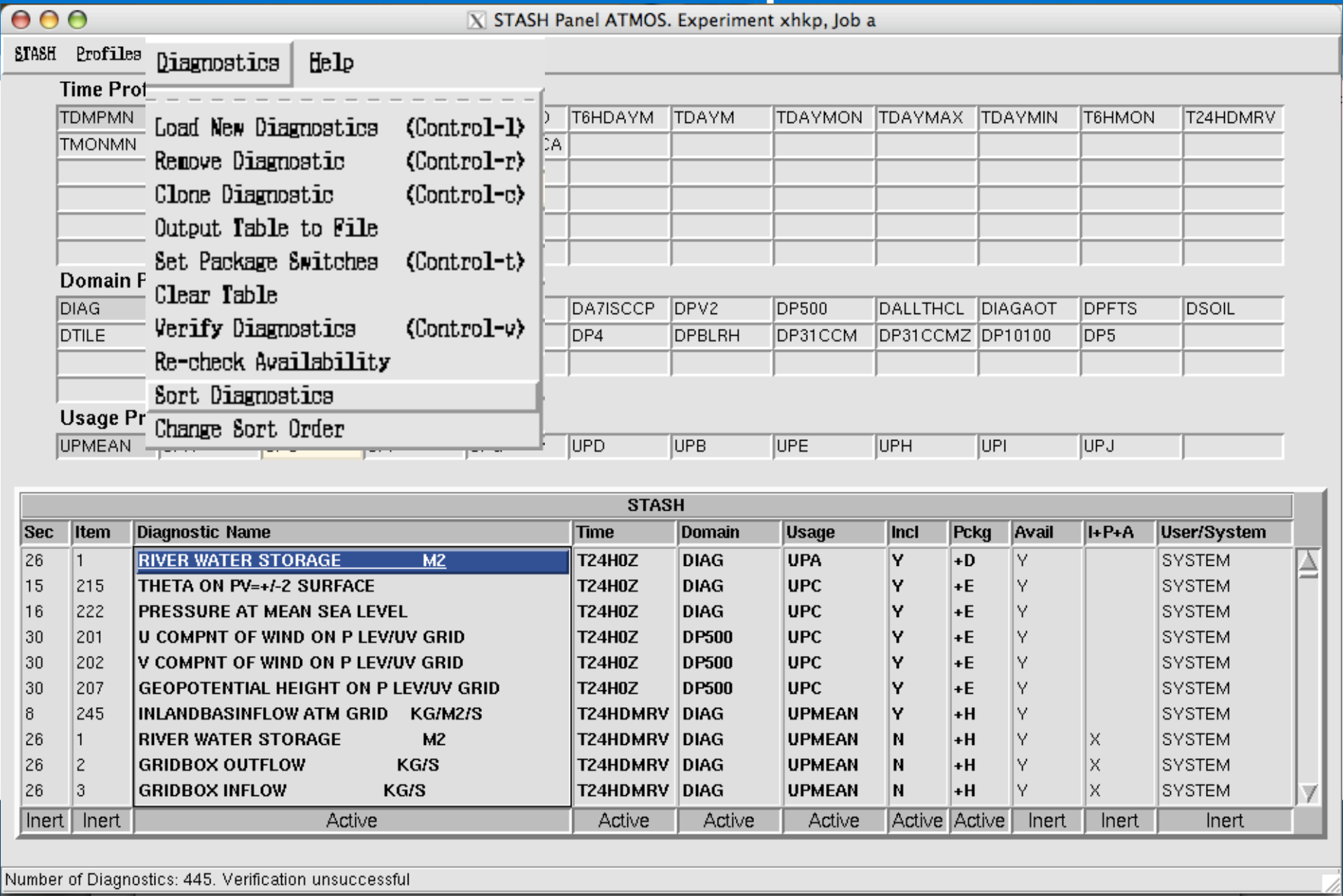




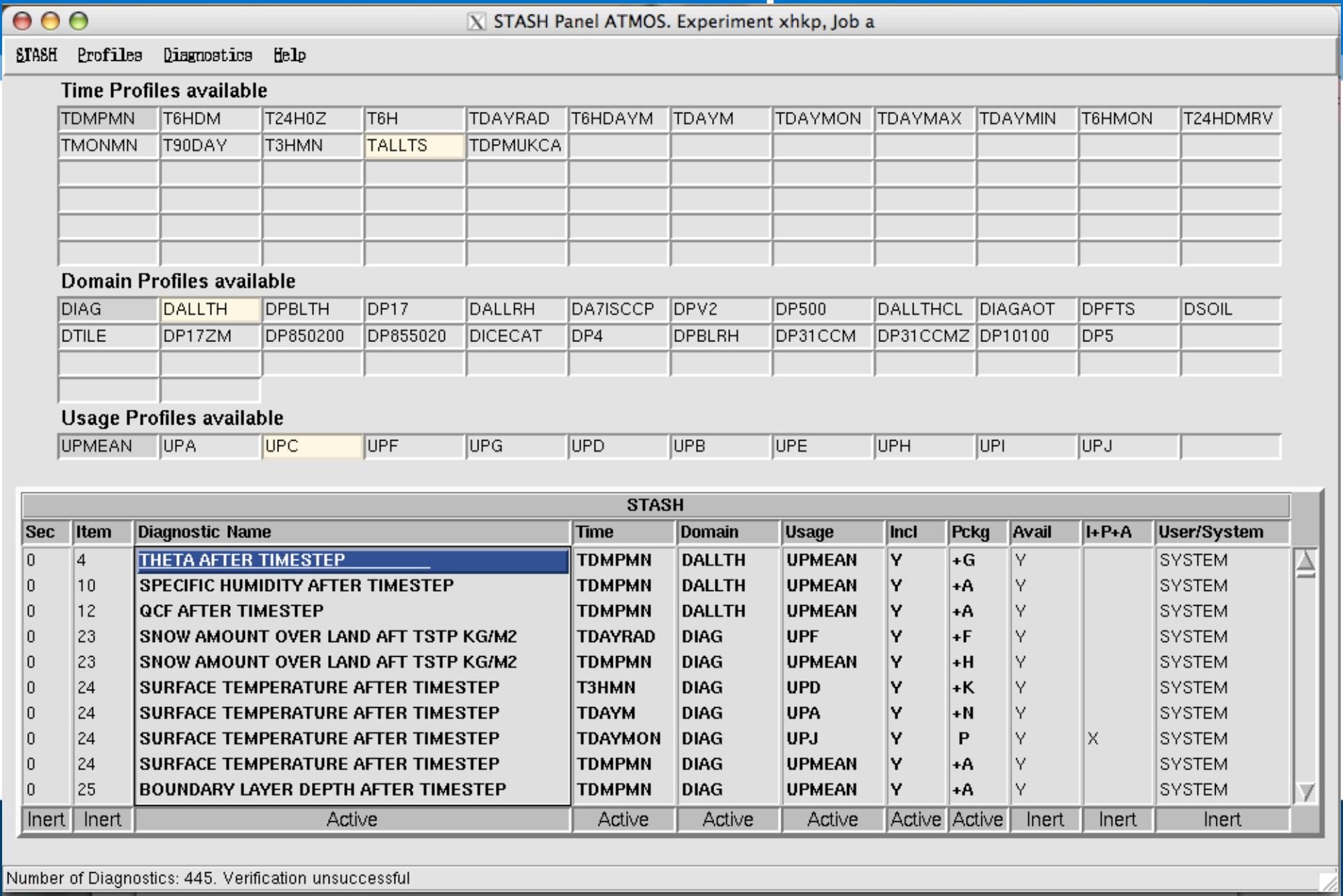
Other useful options



Other useful options

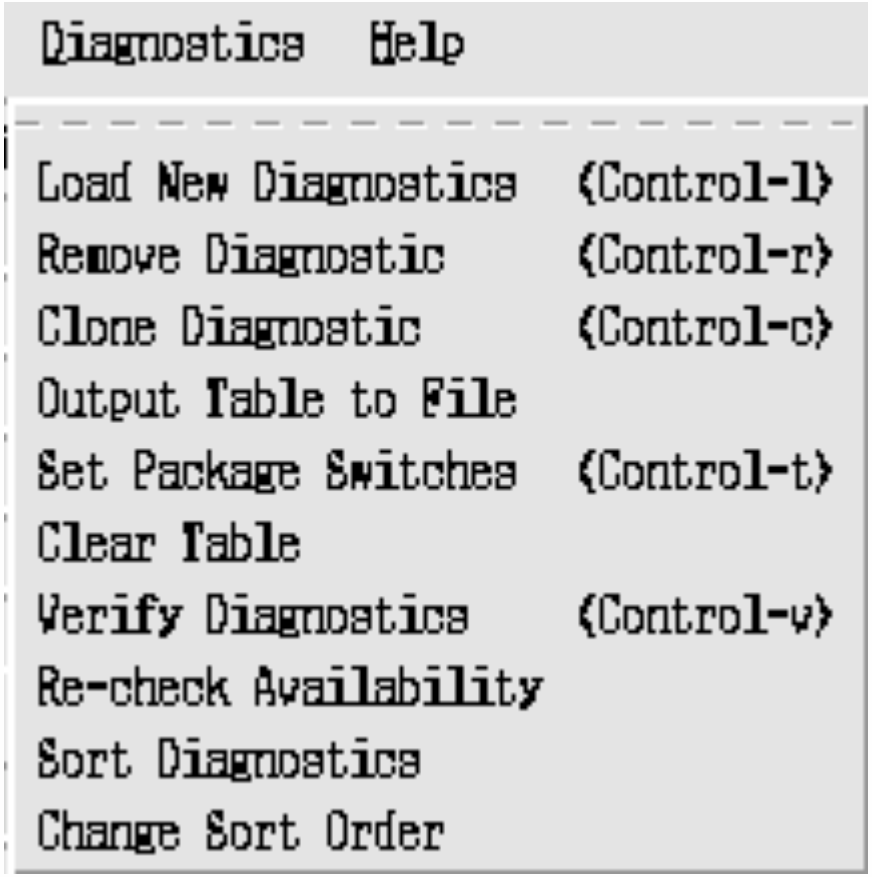


Other useful options

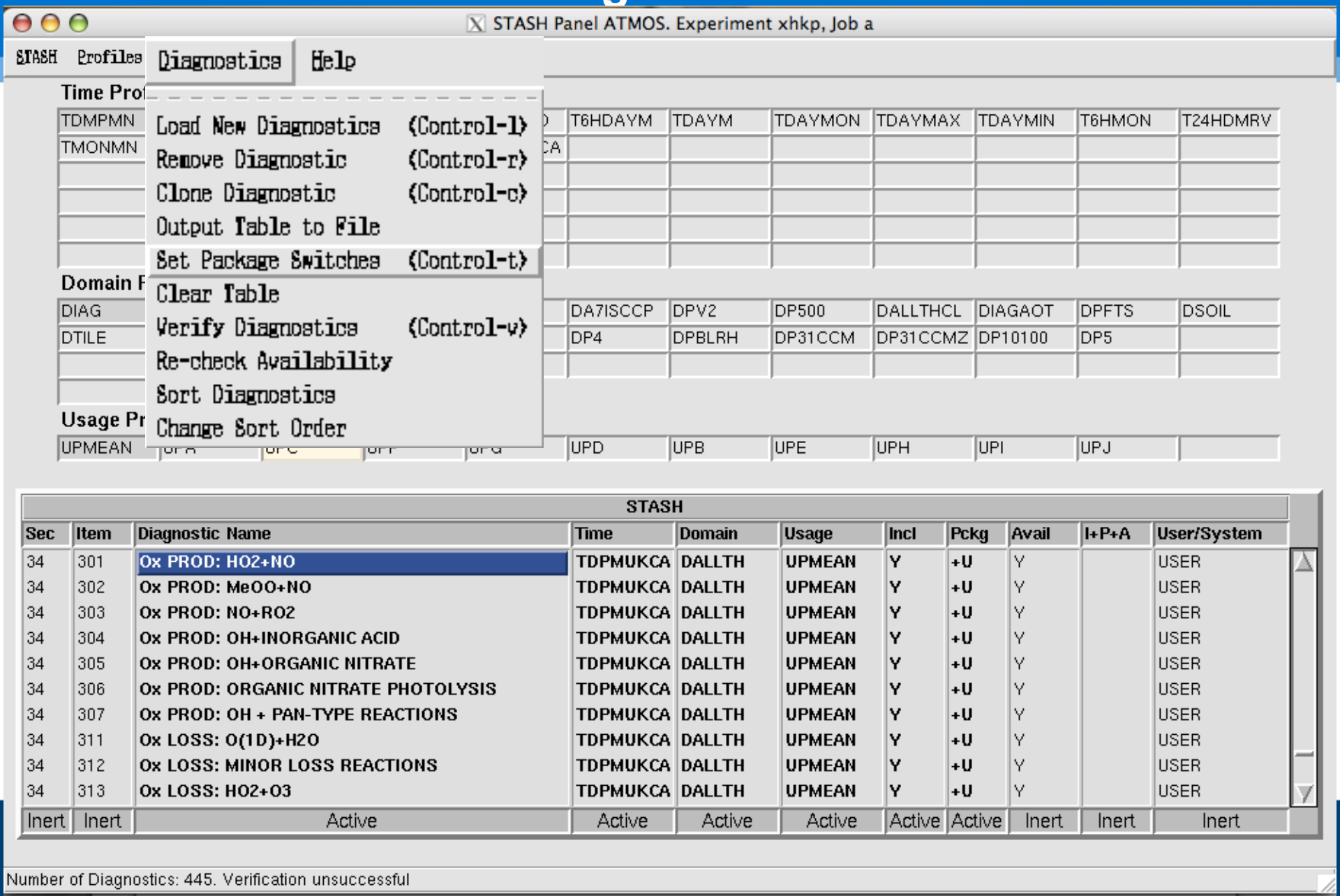


Other useful options

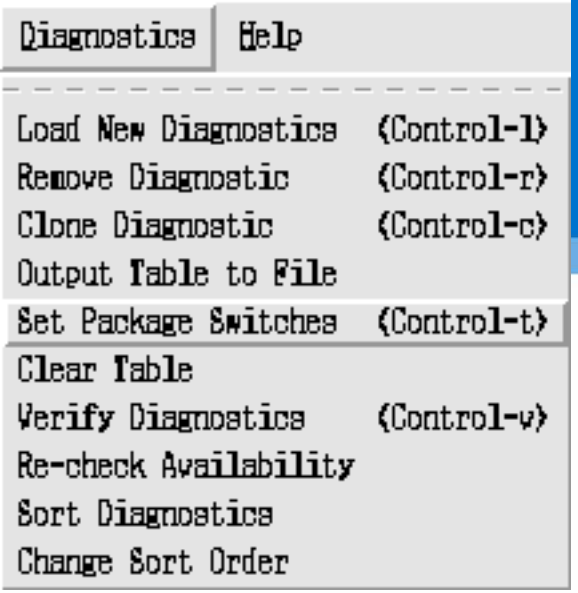
- You can also:
  - Output table to file (very useful for comparing STASH between jobs)
  - Set package switches
    - A set of diagnostics can be grouped together and turned on or off from the package table

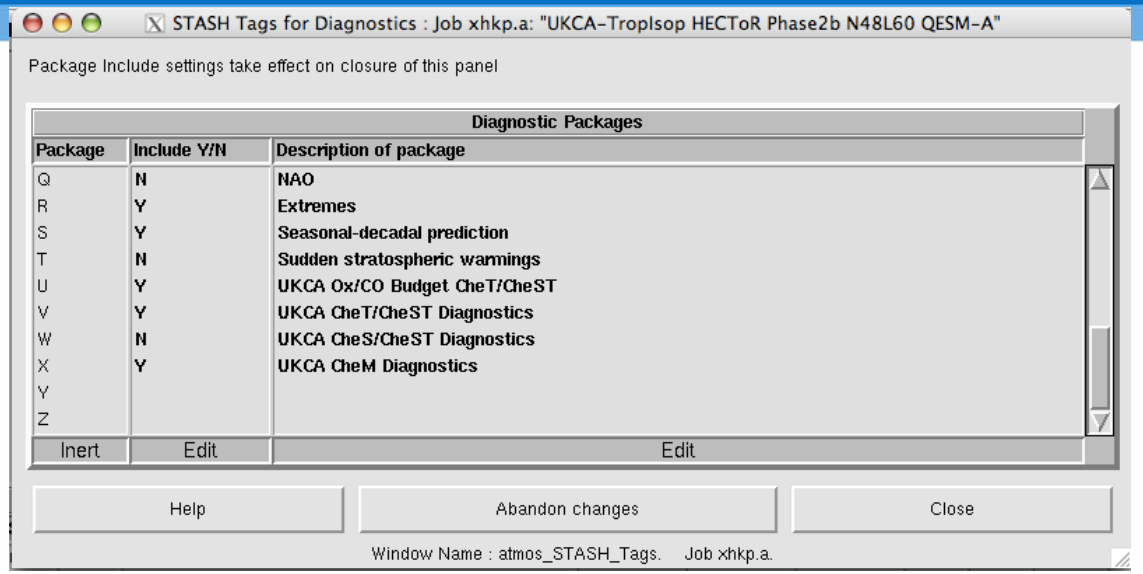


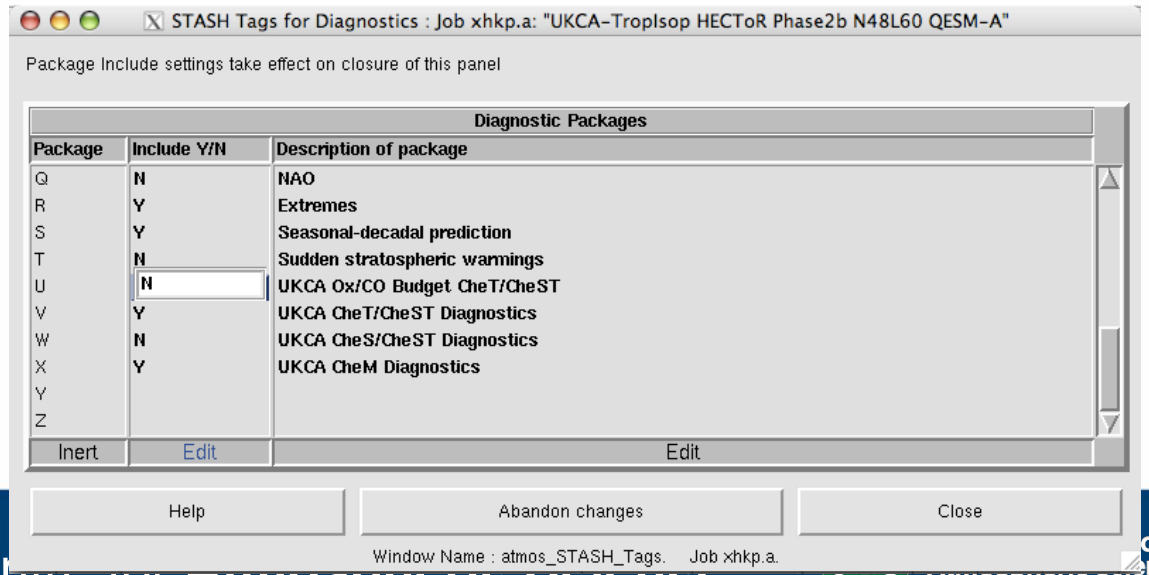
Package Switches



Package Switches







Package Switches

Note: May need to close STASH window and re-open!

STASH Panel ATMOS. Experiment xhkp, Job a

STASH Profiles Diagnostics Help

Time Profiles available

TDMPMN	T6HDM	T24H0Z	T6H	TDAYRAD	T6HDAYM	TDAYM	TDAYMON	TDAYMAX	TDAYMIN	T6HMON	T24HDMRV
TMONMN	T90DAY	T3HMN	TALLTS	TDPMUKCA							

Domain Profiles available

DIAG	DALLTH	DPBLTH	DP17	DALLRH	DA7ISCCP	DPV2	DP500	DALLTHCL	DIAGAOT	DPFTS	DSOIL
DTILE	DP17ZM	DP850200	DP855020	DICECAT	DP4	DPBLRH	DP31CCM	DP31CCMZ	DP10100	DP5	

Usage Profiles available

UPMEAN	UPA	UPC	UPF	UPG	UPD	UPB	UPE	UPH	UPI	UPJ	

STASH

Sec	Item	Diagnostic Name	Time	Domain	Usage	Incl	Pckg	Avail	I+P+A	User/System
34	301	Ox PROD: HO2+NO	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	302	Ox PROD: MeOO+NO	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	303	Ox PROD: NO+RO2	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	304	Ox PROD: OH+INORGANIC ACID	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	305	Ox PROD: OH+ORGANIC NITRATE	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	306	Ox PROD: ORGANIC NITRATE PHOTOLYSIS	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	307	Ox PROD: OH + PAN-TYPE REACTIONS	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	311	Ox LOSS: O(1D)+H2O	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	312	Ox LOSS: MINOR LOSS REACTIONS	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
34	313	Ox LOSS: HO2+O3	TDPMUKCA	DALLTH	UPMEAN	Y	U	Y	X	USER
Inert	Inert	Active	Active	Active	Active	Active	Active	Inert	Inert	Inert

Number of Diagnostics: 445