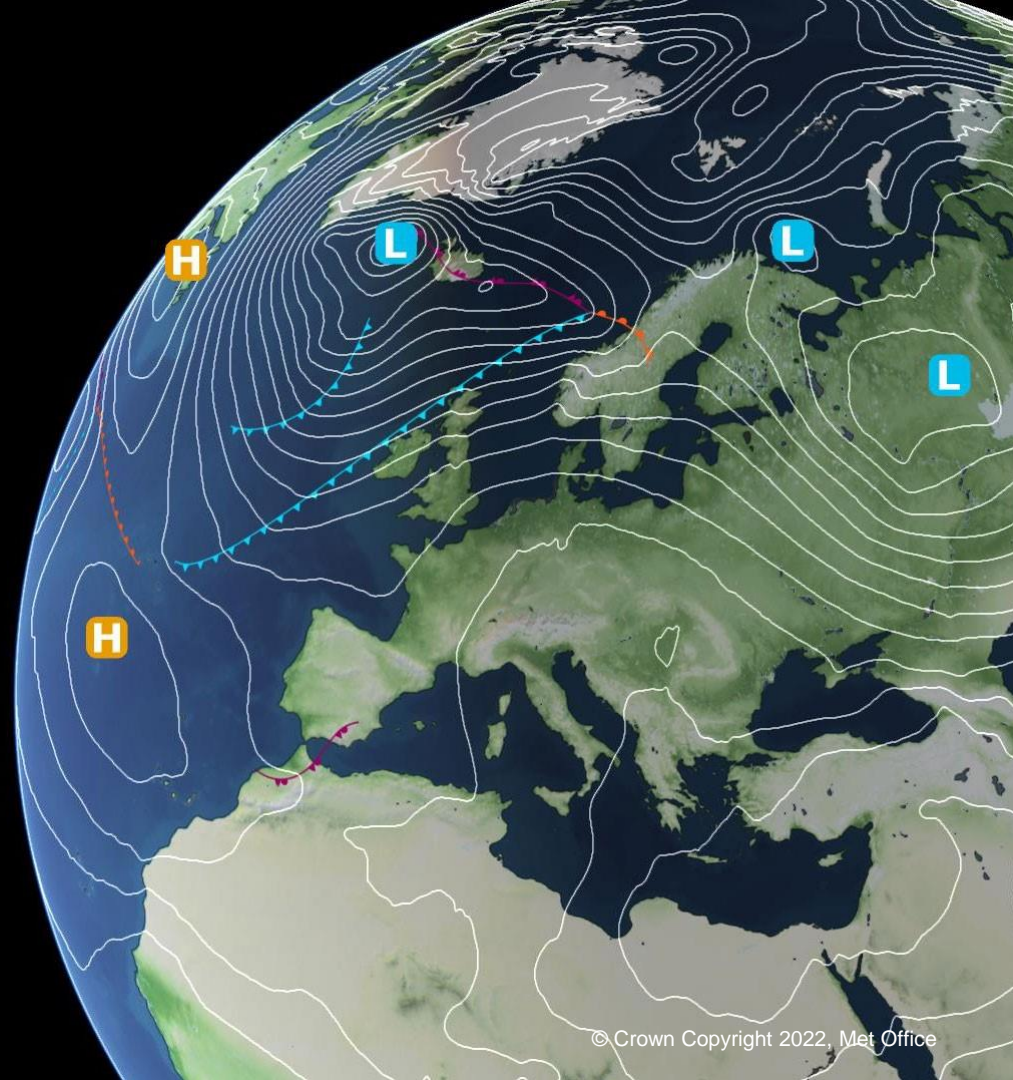


# Filter ordering: what you see is what you get

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# Current treatment of obs filters

observations:

- obs space: ...

  - obs operator: ...

  - obs filters:**

    - filter: Background Check

    - filter: Variable Assignment

    - filter: ...

- Filters are run in order according to the data they request:
  - Pre filter: before GetValues. GeoVaLs and H(x) unavailable.
  - Prior filter: after GetValues, before obs operator. GeoVaLs available, H(x) unavailable.
  - Post filter: after obs operator. GeoVaLs and H(x) available.
  - defer to post option moves an operator into the list of post filters.
- yaml files with many filters can be difficult to follow, particularly given defer to post

# WYSIWYG filter ordering

observations:

- obs space: ...
  - obs operator: ...
  - obs pre filters:**
    - filter: ...
  - obs prior filters:**
    - filter: ...
  - obs post filters:**
    - filter: ...

- Guard against filters requesting nonexistent data
- ufo ObsFilters test and oops Observer class are fully backwards compatible (i.e. obs filters can still be used)

# Existing filter code

- Treatment of filters occurs in both ufo and oops
- Key classes in oops
  - `src/oops/base/ObsFilter.h`, `src/oops/generic/ObsFilterBase.h`,  
`src/oops/interface/ObsFilterBase.h`
  - `src/oops/base/ObsFilters.h`
  - `src/oops/base/Observer.h`, `src/oops/base/Observers.h`
- Key classes in ufo
  - `src/ufo/filters/ObsProcessorBase.{h,cc}`
  - `test/ufo/ObsFilters.h`

# Major code modifications

- `postFilter` now accepts `GeoVaLs`:

```
void ObsProcessorBase::postFilter(const GeoVaLs & gv,  
                                  const ioda::ObsVector & hofx,  
                                  const ioda::ObsVector & bias,  
                                  const ObsDiagnostics & diags)
```

- Ensures `GeoVaLs` are always associated with `ObsFilterData` when present
- New routine `checkFilterData` ensures that `ObsFilterData` contains quantities requested in each filter (by adding to `allvars_` in the filter constructor)
  - e.g. if a filter expects to use `GeoVaLs` it cannot be added to the `obs_pre_filters` list

# Status

- oops PR [#1604](#)
- ufo PR [#1793](#)
- All reviews very welcome
- See also Print Filter Data utility which can be used to print contents of ObsFilterData at any stage
  - `ufo/test/print_filter_data.yaml` has some examples
  - Documentation to follow