# UFO tutorial: implement an observation operator

# The exercise for today is:

Implement radiosonde temperature observation operator.

# Things that need to be implemented:

- `ufo_radiosonde_mod.F90`:
  - subroutine `ufo_radiosonde_t_eqv` to calculate $H(x)$
- `ufo_radiosonde_tlad_mod.F90`:
  - `ufo_radiosonde_tlad` data type (for saving whatever you may need from "trajectory")
  - subroutine `ufo_radiosonde_tlad_settraj` to set trajectory and fill in the above data type
  - subroutine `ufo_radiosonde_tlad_t_eqv_tl` to calculate TL (using trajectory from the data type and the $dx$ geovals on input)
  - subroutine `ufo_radiosonde_tlad_t_eqv_ad` to calculate AD (using trajectory from the data type and the $dy$ obsvector on input)
  - subroutine `ufo_radiosonde_tlad_delete` to destruct ufo_radiosonde_tlad data type if needed

# Some comments

- $H(x)$ here is vertical interpolation (linear in log pressure) of virtual temperature.

- GeoVaLs should contain "atmosphere_ln_pressure_coordinate" and "virtual_temperature" (see ObsRadiosonde.h and ObsRadiosondeTLAD.h)

- Observation files should have pressure of the observations ("Pressure")

- Note: different units of pressure are used in geovals and obs (this is to be fixed). For now one has to divide obs pressure by 10 to be in the same units

- You may use vertical interpolation routines from ufo/src/ufo/atmosphere/utils/vert_interp.F90

# Tests

- The tests are already added to ufo tests, see test/Cmakelists.txt, tests test_ufo_radiosonde and test_ufo_obsop_rsonde_tlad.

- Those tests will invoke tests from oops:

- ObsOperator: https://github.com/JCSDA/oops/blob/develop-nicas/src/test/interface/ObsOperator.h

- LinearObsOperator: https://github.com/JCSDA/oops/blob/develop-nicas/src/test/interface/LinearObsOperator.h