

6 Appendix A - GRASP Settings

6.1 Case 1

```
# test1.sd.sp.hp.6wl.full_retrieval_settings_example_polder_hp_w6_SinglePixel
retrieval:
  convergence:
    stop_before_performing_retrieval: false
    minimization_convention: logarithm
    threshold_for_stopping: 1.0e-3
    maximum_iterations_for_stopping: 15
    maximum_iterations_of_Levenberg-Marquardt: 15
    threshold_for_stopping_Q_iterations: 1.0e-12
    scale_for_finite_difference: 1.0e-3
    normal_system_solver: sparse_matrix_solver
    shift_for_applying_logarithm_to_negative_values: 1.1

  regime_of_measurement_fitting:
    polarization: relative_polarization_components

  product_configuration:
    wavelength_indices_for_angstrom: [4, 5]
    wavelength_indices_for_ndvi: [4, 5]
    aerosol_particulate_matter_diameter: [2.5, 10]

  regime_of_multipixel_constraints:
    inversion_regime: single_pixel

  noises:
    noise[1]:
      standard_deviation_synthetic: 0.0
      error_type: relative
      standard_deviation: 0.03
      measurement_type[1]:
        type: I
        index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    noise[2]:
      standard_deviation_synthetic: 0.0
      error_type: absolute
      standard_deviation: 0.005
      measurement_type[1]:
        type: Q
        index_of_wavelength_involved: [ 2, 4, 5 ]
      measurement_type[2]:
        type: U
        index_of_wavelength_involved: [ 2, 4, 5 ]

  radiative_transfer:
    number_of_layers: [50,50]
    aerosol_profile_vertical_type: exponential
    absolute_error_rt_calculations: 0.0001
    reference_plane_for_polarization: meridian
    simulating_observation:
      order_of_scattering: multiple_scattering
      number_of_gaussian_quadratures_for_expansion_coefficients: 21
      number_of_gaussian_quadratures_for_fourier_expansion_coefficients: 10
      number_of_fourier_expansion_coefficients: 10
    simulating_derivatives:
      order_of_scattering: derivatives
      number_of_gaussian_quadratures_for_expansion_coefficients: 15
      number_of_gaussian_quadratures_for_fourier_expansion_coefficients: 7
      number_of_fourier_expansion_coefficients: 10

  phase_matrix:
    size_binning_method_for_triangle_bins: logarithm
    number_of_elements: 4
    kernels_folder: "parasol_ang35_bin5_w16"
```

```
radius:
  mode[1]:
    bins: [ 0.1, 0.1732, 0.3, 1., 2.9 ]

products:
  aerosol:
    chemistry: false
    lidar: true
    optical_properties: true
    phase_matrix: false
    refractive_index: true
    theoretical_bimodal_extinction: true
    theoretical_bimodal_parameters: true
  error_estimation:
    aerosol:
      lidar: false
      optical_properties: false
      parameters: false
  forcing:
    broadband_flux: false
    forcing: false
  retrieval:
    fitting: false
    parameters: true
    residual: true
  surface: true

debug:
  verbose: false
  additional_information: false

constraints:
  characteristic[1]:
    type: size_distribution_precalculated_lognormal
    retrieved: true
    mode[1]:
      initial_guess:
        value: [0.01, 0.01, 0.01, 0.01, 0.01 ]
        min: [0.000005, 0.000005, 0.000005, 0.000005, 0.000005 ]
        max: [5.0, 5.0, 5.0, 5.0, 5.0 ]
        index_of_wavelength_involved: [0, 0, 0, 0, 0 ]

      single_pixel:
        smoothness_constraints:
          difference_order: 2
          lagrange_multiplier: 5.0e-3
      multi_pixel:
        smoothness_constraints:
          derivative_order_of_X_variability: 1
          lagrange_multiplier_of_X_variability: 1.0e-2
          derivative_order_of_Y_variability: 1
          lagrange_multiplier_of_Y_variability: 1.0e-2
          derivative_order_of_T_variability: 1
          lagrange_multiplier_of_T_variability: 5.0e-4

  characteristic[2]:
    type: real_part_of_refractive_index_spectral_dependent
    retrieved: true
    mode[1]:
      initial_guess:
        value: [1.46, 1.46, 1.46, 1.46, 1.46, 1.46]
        min: [1.33,1.33,1.33,1.33,1.33,1.33]
        max: [1.6, 1.6, 1.6, 1.6, 1.6, 1.6]
        index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
      single_pixel:
        smoothness_constraints:
          difference_order: 1
          lagrange_multiplier: 1.0e+1
      multi_pixel:
        smoothness_constraints:
```

```
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-2
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-2
    derivative_order_of_T_variability: 0
    lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[3]:
  type: imaginary_part_of_refractive_index_spectral_dependent
  retrieved: true
  mode[1]:
    initial_guess:
      value: [ 0.005, 0.005, 0.005, 0.005, 0.005, 0.005 ]
      min: [ 0.00005, 0.00005, 0.00005, 0.00005, 0.00005, 0.00005 ]
      max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 5.0e-2
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 0
        lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[4]:
  type: sphere_fraction
  retrieved: true
  mode[1]:
    initial_guess:
      value: [0.9]
      min: [0.005]
      max: [0.9999]
      index_of_wavelength_involved: [0]
    single_pixel:
      smoothness_constraints:
        difference_order: 0
        lagrange_multiplier: 0.0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[5]:
  type: vertical_profile_parameter_height
  retrieved: true
  mode[1]:
    initial_guess:
      value: [2000.0 ]
      min: [10.0 ]
      max: [5000.0 ]
      index_of_wavelength_involved: [0 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 0
        lagrange_multiplier: 0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 1
```

```
lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[6]:
  type: surface_land_brdf_ross_li
  retrieved: true
  mode[1]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
      max: [ 1.1, 1.1, 1.1, 1.1, 1.1, 1.1 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 1.0e-4
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0

  mode[2]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.001, 0.001, 0.001, 0.001, 0.001, 0.001 ]
      max: [ 2.0, 2.0, 2.0, 2.0, 2.0, 2.0 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 10.0e-0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0

  mode[3]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
      max: [ 1.0, 1.0, 1.0, 1.0, 1.0, 1.0 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 10.0e-0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0

characteristic[7]:
  type: surface_land_polarized_maignan_breon
  retrieved: true
  mode[1]:
    initial_guess:
      value: [ 2.1, 2.1, 2.1, 2.1, 2.1, 2.1 ]
      min: [ 0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
      max: [ 15.03, 15.03, 15.03, 15.03, 15.03, 15.03 ]
```

```
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 10.0e-0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 8.0e-0

characteristic[8]:
  type: surface_water_cox_munk_iso
  retrieved: true
mode[1]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.005, 0.005, 0.005 ]
    min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
    max: [ 0.05, 0.05, 0.05, 0.05, 0.05, 0.05 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 1.0e-3
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 1.0e-3

mode[2]:
  initial_guess:
    value: [ 0.900, 0.900, 0.900, 0.900, 0.900, 0.900 ]
    min: [ 0.60, 0.60, 0.60, 0.60, 0.60, 0.60 ]
    max: [ 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 10.0e-0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 0
    lagrange_multiplier_of_T_variability: 1.0e-3

mode[3]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    min: [ 0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015 ]
    max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 10.0e-0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 1
```

```
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 0
    lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[9]:
  type: vertical_profile_parameter_standard_deviation
  retrieved: false
  mode[1]:
    initial_guess:
      value: [ 530.33 ]
      min: [ 530.23 ]
      max: [ 530.43 ]
      index_of_wavelength_involved: [0]
    single_pixel:
      smoothness_constraints:
        difference_order: 0
        lagrange_multiplier: 0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 1.0e-3
```

6.2 Case 2

```
# test2.sd.mp.opt.6wl.full_retrieval_settings_example_polder_opt_w6_5layers
retrieval:
  convergence:
    stop_before_performing_retrieval: false
    minimization_convention: logarithm
    threshold_for_stopping: 1.0e-3
    maximum_iterations_for_stopping: 7
    maximum_iterations_of_Levenberg-Marquardt: 15
    threshold_for_stopping_Q_iterations: 1.0e-12
    scale_for_finite_difference: 1.0e-3
    normal_system_solver: sparse_matrix_solver
    shift_for_applying_logarithm_to_negative_values: 1.1

  regime_of_measurement_fitting:
    polarization: relative_polarization_components

  product_configuration:
    wavelength_indices_for_angstrom: [4, 5]
    wavelength_indices_for_ndvi: [4, 5]
    aerosol_particulate_matter_diameter: [2.5, 10]

  regime_of_multipixel_constraints:
    inversion_regime: multi_pixel

  noises:
    noise[1]:
      standard_deviation_synthetic: 0.0
      error_type: relative
      standard_deviation: 0.03
      measurement_type[1]:
        type: I
        index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    noise[2]:
      standard_deviation_synthetic: 0.0
      error_type: absolute
      standard_deviation: 0.005
      measurement_type[1]:
        type: Q
        index_of_wavelength_involved: [ 2, 4, 5 ]
      measurement_type[2]:
```

```
    type: U
    index_of_wavelength_involved: [ 2, 4, 5 ]

radiative_transfer:
  number_of_layers: [5,50]
  aerosol_profile_vertical_type: exponential
  absolute_error_rt_calculations: 0.0005
  reference_plane_for_polarization: meridian
  simulating_observation:
    order_of_scattering: multiple_scattering
    number_of_gaussian_quadratures_for_expansion_coefficients: 15
    number_of_gaussian_quadratures_for_fourier_expansion_coefficients: 5
    number_of_fourier_expansion_coefficients: 4
  simulating_derivatives:
    order_of_scattering: derivatives
    number_of_gaussian_quadratures_for_expansion_coefficients: 15
    number_of_gaussian_quadratures_for_fourier_expansion_coefficients: 4
    number_of_fourier_expansion_coefficients: 4

phase_matrix:
  size_binning_method_for_triangle_bins: logarithm
  number_of_elements: 4
  kernels_folder: "parasol_ang35_bin5_wl6"
  radius:
    mode[1]:

      bins: [ 0.1, 0.1732, 0.3, 1., 2.9 ]

products:
  aerosol:
    chemistry: false
    lidar: true
    optical_properties: true
    phase_matrix: false
    refractive_index: true
    theoretical_bimodal_extinction: true
    theoretical_bimodal_parameters: true
  error_estimation:
    aerosol:
      lidar: false
      optical_properties: false
      parameters: false
  forcing:
    broadband_flux: false
    forcing: false
  retrieval:
    fitting: false
    parameters: true
    residual: true
  surface: true

debug:
  verbose: false
  additional_information: false

constraints:
  characteristic[1]:
    type: size_distribution_precalculated_lognormal
    retrieved: true
    mode[1]:
      initial_guess:
        value: [0.01, 0.01, 0.01, 0.01, 0.01 ]
        min: [0.000005, 0.000005, 0.000005, 0.000005, 0.000005 ]
        max: [5.0, 5.0, 5.0, 5.0, 5.0 ]
        index_of_wavelength_involved: [0, 0, 0, 0, 0 ]

      single_pixel:
        smoothness_constraints:
          difference_order: 2
          lagrange_multiplier: 5.0e-3
      multi_pixel:
```

```
smoothness_constraints:
  derivative_order_of_X_variability: 1
  lagrange_multiplier_of_X_variability: 1.0e-2
  derivative_order_of_Y_variability: 1
  lagrange_multiplier_of_Y_variability: 1.0e-2
  derivative_order_of_T_variability: 1
  lagrange_multiplier_of_T_variability: 5.0e-4

characteristic[2]:
  type: real_part_of_refractive_index_spectral_dependent
  retrieved: true
  mode[1]:
    initial_guess:
      value: [1.46, 1.46, 1.46, 1.46, 1.46, 1.46]
      min: [1.33,1.33,1.33,1.33,1.33,1.33]
      max: [1.6, 1.6, 1.6, 1.6, 1.6, 1.6]
      index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 1.0e+1
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 0
        lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[3]:
  type: imaginary_part_of_refractive_index_spectral_dependent
  retrieved: true
  mode[1]:
    initial_guess:
      value: [ 0.005, 0.005, 0.005, 0.005, 0.005, 0.005 ]
      min: [ 0.00005,0.00005,0.00005,0.00005,0.00005,0.00005 ]
      max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 5.0e-2
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 0
        lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[4]:
  type: sphere_fraction
  retrieved: true
  mode[1]:
    initial_guess:
      value: [0.9]
      min: [0.005]
      max: [0.9999]
      index_of_wavelength_involved: [0]
    single_pixel:
      smoothness_constraints:
        difference_order: 0
        lagrange_multiplier: 0.0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
```

```

        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[5]:
  type: vertical_profile_parameter_height
  retrieved: true
  mode[1]:
    initial_guess:
      value: [2000.0 ]
      min: [10.0 ]
      max: [5000.0 ]
      index_of_wavelength_involved: [0 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 0
        lagrange_multiplier: 0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[6]:
  type: surface_land_brdf_ross_li
  retrieved: true
  mode[1]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
      max: [ 1.1, 1.1, 1.1, 1.1, 1.1, 1.1 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 1.0e-4
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0

  mode[2]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.001, 0.001, 0.001, 0.001, 0.001, 0.001 ]
      max: [ 2.0, 2.0, 2.0, 2.0, 2.0, 2.0 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]

    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 10.0e-0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0

  mode[3]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]

```

```
max: [ 1.0, 1.0, 1.0, 1.0, 1.0, 1.0 ]
index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 10.0e-0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 0
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 0
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 8.0e-0

characteristic[7]:
  type: surface_land_polarized_maignan_breon
  retrieved: true
mode[1]:
  initial_guess:
    value: [ 2.1, 2.1, 2.1, 2.1, 2.1, 2.1 ]
    min: [ 0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    max: [ 15.03, 15.03, 15.03, 15.03, 15.03, 15.03 ]
    index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 8.0e-0

characteristic[8]:
  type: surface_water_cox_munk_iso
  retrieved: true
mode[1]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.005, 0.005, 0.005 ]
    min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
    max: [ 0.05, 0.05, 0.05, 0.05, 0.05, 0.05 ]
    index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 1.0e-3
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3

mode[2]:
  initial_guess:
    value: [ 0.900, 0.900, 0.900, 0.900, 0.900, 0.900 ]
    min: [ 0.60, 0.60, 0.60, 0.60, 0.60, 0.60 ]
    max: [ 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000 ]
    index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
```

```

smoothness_constraints:
  derivative_order_of_X_variability: 1
  lagrange_multiplier_of_X_variability: 1.0e-3
  derivative_order_of_Y_variability: 1
  lagrange_multiplier_of_Y_variability: 1.0e-3
  derivative_order_of_T_variability: 0
  lagrange_multiplier_of_T_variability: 1.0e-3

mode[3]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    min: [ 0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015 ]
    max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 0
      lagrange_multiplier_of_T_variability: 1.0e-3

```

6.3 Case 3

```
# test3.sd.mp.models.6wl.fix_surf_settings_polder_models5_6wl_surffix
```

```
retrieval:
```

```
convergence:
```

```

stop_before_performing_retrieval: false
minimization_convention: logarithm
threshold_for_stopping: 1.0e-3
maximum_iterations_for_stopping: 7
maximum_iterations_of_Levenberg-Marquardt: 15
threshold_for_stopping_Q_iterations: 1.0e-12
scale_for_finite_difference: 1.0e-2
normal_system_solver: sparse_matrix_solver
shift_for_applying_logarithm_to_negative_values: 1.1

```

```
regime_of_measurement_fitting:
```

```
polarization: relative_polarization_components
```

```
product_configuration:
```

```

wavelength_indices_for_angstrom: [4, 5]
wavelength_indices_for_ndvi: [4, 5]

```

```
regime_of_multipixel_constraints:
```

```
inversion_regime: multi_pixel
```

```
noises:
```

```
noise[1]:
```

```

standard_deviation_synthetic: 0.0
error_type: relative
standard_deviation: 0.03
measurement_type[1]:
  type: I
  index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]

```

```
noise[2]:
```

```

standard_deviation_synthetic: 0.0
error_type: absolute
standard_deviation: 0.005
measurement_type[1]:
  type: Q
  index_of_wavelength_involved: [ 2, 4, 5 ]
measurement_type[2]:
  type: U

```

```
    index_of_wavelength_involved: [ 2, 4, 5 ]

radiative_transfer:
  number_of_layers: [5,50]
  aerosol_profile_vertical_type: exponential
  absolute_error_rt_calculations: 0.0005
  reference_plane_for_polarization: meridian
  simulating_observation:
    order_of_scattering: multiple_scattering
    number_of_gaussian_quadratures_for_expansion_coefficients: 15
    number_of_guassian_quadratures_for_fourier_expansion_coefficients: 5
    number_of_fourier_expansion_coefficients: 4
  simulating_derivatives:
    order_of_scattering: derivatives
    number_of_gaussian_quadratures_for_expansion_coefficients: 15
    number_of_guassian_quadratures_for_fourier_expansion_coefficients: 4
    number_of_fourier_expansion_coefficients: 4

phase_matrix:
  size_binning_method_for_triangle_bins: logarithm
  number_of_elements: 4
  use_models: true
  kernels_folder: "models_ang35_wl22_optimized"
  radius:
    mode[1]:
      bins: [ 1., 2., 3., 4., 5. ]

products:
  aerosol:
    chemistry: false
    lidar: true
    optical_properties: true
    phase_matrix: false
    refractive_index: true
    theoretical_bimodal_extinction: false
    theoretical_bimodal_parameters: false
  error_estimation:
    aerosol:
      lidar: false
      optical_properties: false
      parameters: false
  forcing:
    broadband_flux: false
    forcing: false
  retrieval:
    fitting: true
    parameters: true
    residual: true
  surface: true

debug:
  verbose: false
  additional_information: false

constraints:
  characteristic[1]:
    type: size_distribution_precalculated_lognormal
    retrieved: true
    mode[1]:
      initial_guess:
        value: [0.01, 0.01, 0.01, 0.01, 0.01 ]
        min: [0.000005, 0.000005, 0.000005, 0.000005, 0.000005 ]
        max: [5.0, 5.0, 5.0, 5.0, 5.0 ]
      index_of_wavelength_involved: [0, 0, 0, 0, 0 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 2
      lagrange_multiplier: 0.0e-3
  multi_pixel:
    smoothness_constraints:
```

```
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-0
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-0
    derivative_order_of_T_variability: 2
    lagrange_multiplier_of_T_variability: 1.0e-1

characteristic[2]:
  type: vertical_profile_parameter_height
  retrieved: true
  mode[1]:
    initial_guess:
      value: [2000.0 ]
      min: [10.0 ]
      max: [5000.0 ]
      index_of_wavelength_involved: [0 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 0
        lagrange_multiplier: 0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[3]:
  type: surface_land_brdf_ross_li
  retrieved: false
  mode[1]:
    initial_guess:
      value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [0.001, 0.001, 0.001, 0.001, 0.001, 0.001 ]
      max: [1.1, 1.1, 1.1, 1.1, 1.1, 1.1 ]
      index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 1.0e-4
      a_priori_estimates:
        lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0

  mode[2]:
    initial_guess:
      value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
      max: [2.0, 2.0, 2.0, 2.0, 2.0, 2.0 ]
      index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]

    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 10.0e-2
      a_priori_estimates:
        lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
```

```
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 0
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 8.0e-0

mode[3]:
  initial_guess:
    value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]

    min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    max: [1.0, 1.0, 1.0, 1.0, 1.0, 1.0 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-2
    a_priori_estimates:
      lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 0
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 0
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 8.0e-0

characteristic[4]:
  type: surface_land_polarized_maignan_breon
  retrieved: false
mode[1]:
  initial_guess:
    value: [2.1, 2.1, 2.1, 2.1, 2.1, 2.1 ]

    min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    max: [10.03, 10.03, 10.03, 10.03, 10.03, 10.03 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
    a_priori_estimates:
      lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 8.0e-0

characteristic[5]:
  type: surface_water_cox_munk_iso
  retrieved: false
mode[1]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.005, 0.005, 0.01 ]

    min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
    max: [ 0.05, 0.05, 0.05, 0.05, 0.05, 0.05 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 1.0e-3
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
```

```
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 1.0e-3

mode[2]:
  initial_guess:
    value: [ 0.900, 0.900, 0.900, 0.900, 0.900, 0.900 ]

    min: [ 0.30, 0.30, 0.30, 0.30, 0.30, 0.30 ]
    max: [ 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3

mode[3]:
  initial_guess:
    value: [ 0.02, 0.02, 0.02, 0.02, 0.02, 0.02 ]

    min: [ 0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015 ]
    max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[6]:
  type: real_part_of_refractive_index_constant
  retrieved: false
mode[1]:
  initial_guess:
    value: [1.5 ]
    min: [1.3 ]
    max: [1.6 ]
    index_of_wavelength_involved: [0 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 0
      lagrange_multiplier: 0.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-0
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-0
      derivative_order_of_T_variability: 0
      lagrange_multiplier_of_T_variability: 1.0e-4

characteristic[7]:
  type: imaginary_part_of_refractive_index_constant
  retrieved: false
mode[1]:
```

```

initial_guess:
  value:          [0.005 ]
  min:            [0.003 ]
  max:            [0.006 ]
  index_of_wavelength_involved: [0 ]
single_pixel:
  smoothness_constraints:
    difference_order: 0
    lagrange_multiplier: 0.0e-0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-0
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-0
    derivative_order_of_T_variability: 0
    lagrange_multiplier_of_T_variability: 1.0e-4

characteristic[8]:
  type: sphere_fraction
  retrieved: false
mode[1]:
  initial_guess:
    value:          [0.9]
    min:            [0.005]
    max:            [0.9999]
    index_of_wavelength_involved: [0]
  single_pixel:
    smoothness_constraints:
      difference_order: 0
      lagrange_multiplier: 0.0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-2
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-2
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3

```

6.4 Case 4

```

# test4.sd.mp.models.6wl.apri_surf_settings_polder_models5_6wl_surfpapri
retrieval:
  convergence:
    stop_before_performing_retrieval: false
    minimization_convention: logarithm
    threshold_for_stopping: 1.0e-3
    maximum_iterations_for_stopping: 7
    maximum_iterations_of_Levenberg-Marquardt: 15
    threshold_for_stopping_Q_iterations: 1.0e-12
    scale_for_finite_difference: 1.0e-2
    normal_system_solver: sparse_matrix_solver
    shift_for_applying_logarithm_to_negative_values: 1.1

  regime_of_measurement_fitting:
    polarization: relative_polarization_components

  product_configuration:
    wavelength_indices_for_angstrom: [4, 5]
    wavelength_indices_for_ndvi: [4, 5]
  regime_of_multipixel_constraints:
    inversion_regime: multi_pixel

  noises:
    noise[1]:
      standard_deviation_synthetic: 0.0
      error_type: relative
      standard_deviation: 0.03

```

```
measurement_type[1]:
  type: I
  index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
noise[2]:
  standard_deviation_synthetic: 0.0
  error_type: absolute
  standard_deviation: 0.005
  measurement_type[1]:
    type: Q
    index_of_wavelength_involved: [ 2, 4, 5 ]
  measurement_type[2]:
    type: U
    index_of_wavelength_involved: [ 2, 4, 5 ]
radiative_transfer:
  number_of_layers: [5,50]
  aerosol_profile_vertical_type: exponential
  absolute_error_rt_calculations: 0.0005
  reference_plane_for_polarization: meridian
  simulating_observation:
    order_of_scattering: multiple_scattering
    number_of_gaussian_quadratures_for_expansion_coefficients: 15
    number_of_guassian_quadratures_for_fourier_expansion_coefficients: 5
    number_of_fourier_expansion_coefficients: 4
  simulating_derivatives:
    order_of_scattering: derivatives
    number_of_gaussian_quadratures_for_expansion_coefficients: 15
    number_of_guassian_quadratures_for_fourier_expansion_coefficients: 4
    number_of_fourier_expansion_coefficients: 4
phase_matrix:
  size_binning_method_for_triangle_bins: logarithm
  number_of_elements: 4
  use_models: true
  kernels_folder: "models_ang35_wl22_optimized"
  radius:
    mode[1]:
      bins: [ 1., 2., 3., 4., 5. ]

products:
  aerosol:
    chemistry: false
    lidar: true
    optical_properties: true
    phase_matrix: false
    refractive_index: true
    theoretical_bimodal_extinction: false
    theoretical_bimodal_parameters: false
  error_estimation:
    aerosol:
      lidar: false
      optical_properties: false
      parameters: false
  forcing:
    broadband_flux: false
    forcing: false
  retrieval:
    fitting: true
    parameters: true
    residual: true
  surface: true
debug:
  verbose: false
  additional_information: false
constraints:
  characteristic[1]:
    type: size_distribution_precalculated_lognormal
    retrieved: true
    mode[1]:
      initial_guess:
        value: [0.01, 0.01, 0.01, 0.01, 0.01 ]
        min: [0.000005, 0.000005, 0.000005, 0.000005, 0.000005 ]
        max: [5.0, 5.0, 5.0, 5.0, 5.0 ]
```

```

    index_of_wavelength_involved: [0, 0, 0, 0, 0 ]
single_pixel:
  smoothness_constraints:
    difference_order: 2
    lagrange_multiplier: 0.0e-3
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-0
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-0
    derivative_order_of_T_variability: 2
    lagrange_multiplier_of_T_variability: 1.0e-1

characteristic[2]:
  type: vertical_profile_parameter_height
  retrieved: true
mode[1]:
  initial_guess:
    value: [2000.0 ]
    min: [10.0 ]
    max: [5000.0 ]
    index_of_wavelength_involved: [0 ]
single_pixel:
  smoothness_constraints:
    difference_order: 0
    lagrange_multiplier: 0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-2
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-2
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[3]:
  type: surface_land_brdf_ross_li
  retrieved: true
mode[1]:
  initial_guess:
    value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    min: [0.001, 0.001, 0.001, 0.001, 0.001, 0.001 ]
    max: [1.1, 1.1, 1.1, 1.1, 1.1, 1.1 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 1.0e-4
  a_priori_estimates:
    lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 0
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 0
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 8.0e-0
mode[2]:
  initial_guess:
    value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    max: [2.0, 2.0, 2.0, 2.0, 2.0, 2.0 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 10.0e-2
  a_priori_estimates:
    lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]

```

```
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 0
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 0
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 8.0e-0
mode[3]:
  initial_guess:
    value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    max: [1.0, 1.0, 1.0, 1.0, 1.0, 1.0 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-2
    a_priori_estimates:
      lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 0
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 0
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 8.0e-0
characteristic[4]:
  type: surface_land_polarized_maignan_breon
  retrieved: true
mode[1]:
  initial_guess:
    value: [2.1, 2.1, 2.1, 2.1, 2.1, 2.1 ]
    min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    max: [10.03, 10.03, 10.03, 10.03, 10.03, 10.03 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
    a_priori_estimates:
      lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 8.0e-0
characteristic[5]:
  type: surface_water_cox_munk_iso
  retrieved: true
mode[1]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.005, 0.005, 0.01 ]
    min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
    max: [ 0.05, 0.05, 0.05, 0.05, 0.05, 0.05 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 1.0e-3
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
```

```
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 1.0e-3
mode[2]:
  initial_guess:
    value: [ 0.900, 0.900, 0.900, 0.900, 0.900, 0.900 ]
    min: [ 0.30, 0.30, 0.30, 0.30, 0.30, 0.30 ]
    max: [ 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3
mode[3]:
  initial_guess:
    value: [ 0.02, 0.02, 0.02, 0.02, 0.02, 0.02 ]
    min: [ 0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015 ]
    max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3
characteristic[6]:
  type: real_part_of_refractive_index_constant
  retrieved: false
mode[1]:
  initial_guess:
    value: [1.5 ]
    min: [1.3 ]
    max: [1.6 ]
    index_of_wavelength_involved: [0 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 0
      lagrange_multiplier: 0.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-0
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-0
      derivative_order_of_T_variability: 0
      lagrange_multiplier_of_T_variability: 1.0e-4
characteristic[7]:
  type: imaginary_part_of_refractive_index_constant
  retrieved: false
mode[1]:
  initial_guess:
    value: [0.005 ]
    min: [0.003 ]
    max: [0.006 ]
    index_of_wavelength_involved: [0 ]
  single_pixel:
    smoothness_constraints:
```

```

        difference_order: 0
        lagrange_multiplier: 0.0e-0
    multi_pixel:
        smoothness_constraints:
            derivative_order_of_X_variability: 1
            lagrange_multiplier_of_X_variability: 1.0e-0
            derivative_order_of_Y_variability: 1
            lagrange_multiplier_of_Y_variability: 1.0e-0
            derivative_order_of_T_variability: 0
            lagrange_multiplier_of_T_variability: 1.0e-4
characteristic[8]:
    type: sphere_fraction
    retrieved: false
mode[1]:
    initial_guess:
        value: [0.9]
        min: [0.005]
        max: [0.9999]
        index_of_wavelength_involved: [0]
    single_pixel:
        smoothness_constraints:
            difference_order: 0
            lagrange_multiplier: 0.0
    multi_pixel:
        smoothness_constraints:
            derivative_order_of_X_variability: 1
            lagrange_multiplier_of_X_variability: 1.0e-2
            derivative_order_of_Y_variability: 1
            lagrange_multiplier_of_Y_variability: 1.0e-2
            derivative_order_of_T_variability: 1
            lagrange_multiplier_of_T_variability: 1.0e-3

```

6.5 Case 5

```
# test5.sd.mp.models.6wl.full_retrieval_settings_polder_models5_6wl
```

```

retrieval:
    convergence:
        stop_before_performing_retrieval: false
        minimization_convention: logarithm
        threshold_for_stopping: 1.0e-3
        maximum_iterations_for_stopping: 7
        maximum_iterations_of_Levenberg-Marquardt: 15
        threshold_for_stopping_0_iterations: 1.0e-12
        scale_for_finite_difference: 1.0e-2
        normal_system_solver: sparse_matrix_solver
        shift_for_applying_logarithm_to_negative_values: 1.1

    regime_of_measurement_fitting:
        polarization: relative_polarization_components

    product_configuration:
        wavelength_indices_for_angstrom: [4, 5]
        wavelength_indices_for_ndvi: [4, 5]
    regime_of_multipixel_constraints:
        inversion_regime: multi_pixel

    noises:
        noise[1]:
            standard_deviation_synthetic: 0.0
            error_type: relative
            standard_deviation: 0.03
            measurement_type[1]:
                type: I
                index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
        noise[2]:
            standard_deviation_synthetic: 0.0
            error_type: absolute
            standard_deviation: 0.005
            measurement_type[1]:

```

```

    type: Q
    index_of_wavelength_involved: [ 2, 4, 5 ]
  measurement_type[2]:
    type: U
    index_of_wavelength_involved: [ 2, 4, 5 ]
  radiative_transfer:
    number_of_layers: [5,50]
    aerosol_profile_vertical_type: exponential
    absolute_error_rt_calculations: 0.0005
    reference_plane_for_polarization: meridian
    simulating_observation:
      order_of_scattering: multiple_scattering
      number_of_gaussian_quadratures_for_expansion_coefficients: 15
      number_of_gaussian_quadratures_for_fourier_expansion_coefficients: 5
      number_of_fourier_expansion_coefficients: 4
    simulating_derivatives:
      order_of_scattering: derivatives
      number_of_gaussian_quadratures_for_expansion_coefficients: 15
      number_of_gaussian_quadratures_for_fourier_expansion_coefficients: 4
      number_of_fourier_expansion_coefficients: 4
  phase_matrix:
    size_binning_method_for_triangle_bins: logarithm
    number_of_elements: 4
    use_models: true
    kernels_folder: "models_ang35_wl22_optimized"
    radius:
      mode[1]:
        bins: [ 1., 2., 3., 4., 5. ]

  products:
    aerosol:
      chemistry: false
      lidar: true
      optical_properties: true
      phase_matrix: false
      refractive_index: true
      theoretical_bimodal_extinction: false
      theoretical_bimodal_parameters: false
    error_estimation:
      aerosol:
        lidar: false
        optical_properties: false
        parameters: false
    forcing:
      broadband_flux: false
      forcing: false
    retrieval:
      fitting: true
      parameters: true
      residual: true
    surface: true
  debug:
    verbose: false
    additional_information: false

  constraints:
    characteristic[1]:
      type: size_distribution_precalculated_lognormal
      retrieved: true
      mode[1]:
        initial_guess:
          value: [0.01, 0.01, 0.01, 0.01, 0.01 ]
          min: [0.000005, 0.000005, 0.000005, 0.000005, 0.000005 ]
          max: [5.0, 5.0, 5.0, 5.0, 5.0 ]
          index_of_wavelength_involved: [0, 0, 0, 0, 0 ]
        single_pixel:
          smoothness_constraints:
            difference_order: 2
            lagrange_multiplier: 0.0e-3
        multi_pixel:
          smoothness_constraints:

```

```

    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-0
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-0
    derivative_order_of_T_variability: 2
    lagrange_multiplier_of_T_variability: 1.0e-1

characteristic[2]:
  type: vertical_profile_parameter_height
  retrieved: true
  mode[1]:
    initial_guess:
      value: [2000.0 ]
      min: [10.0 ]
      max: [5000.0 ]
      index_of_wavelength_involved: [0 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 0
        lagrange_multiplier: 0
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 1
        lagrange_multiplier_of_X_variability: 1.0e-2
        derivative_order_of_Y_variability: 1
        lagrange_multiplier_of_Y_variability: 1.0e-2
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[3]:
  type: surface_land_brdf_ross_li
  retrieved: true
  mode[1]:
    initial_guess:
      value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [0.001, 0.001, 0.001, 0.001, 0.001, 0.001 ]
      max: [1.1, 1.1, 1.1, 1.1, 1.1, 1.1 ]
      index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 1.0e-4
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0
  mode[2]:
    initial_guess:
      value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
      max: [2.0, 2.0, 2.0, 2.0, 2.0, 2.0 ]
      index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 10.0e-2
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0
  mode[3]:
    initial_guess:
      value: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]

```

```
min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
max: [1.0, 1.0, 1.0, 1.0, 1.0, 1.0 ]
index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 10.0e-2
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 0
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 0
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 8.0e-0
characteristic[4]:
  type: surface_land_polarized_maignan_breon
  retrieved: true
mode[1]:
  initial_guess:
    value: [2.1, 2.1, 2.1, 2.1, 2.1, 2.1 ]
    min: [0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    max: [10.03, 10.03, 10.03, 10.03, 10.03, 10.03 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 8.0e-0
characteristic[5]:
  type: surface_water_cox_munk_iso
  retrieved: true
mode[1]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.005, 0.005, 0.01 ]
    min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
    max: [ 0.05, 0.05, 0.05, 0.05, 0.05, 0.05 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 1.0e-3
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3
mode[2]:
  initial_guess:
    value: [ 0.900, 0.900, 0.900, 0.900, 0.900, 0.900 ]
    min: [ 0.30, 0.30, 0.30, 0.30, 0.30, 0.30 ]
    max: [ 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
```

```
    lagrange_multiplier_of_X_variability: 1.0e-3
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-3
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 1.0e-3
mode[3]:
  initial_guess:
    value: [ 0.02, 0.02, 0.02, 0.02, 0.02, 0.02 ]
    min: [ 0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015 ]
    max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[6]:
  type: real_part_of_refractive_index_constant
  retrieved: false
mode[1]:
  initial_guess:
    value: [1.5 ]
    min: [1.3 ]
    max: [1.6 ]
    index_of_wavelength_involved: [0 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 0
      lagrange_multiplier: 0.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-0
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-0
      derivative_order_of_T_variability: 0
      lagrange_multiplier_of_T_variability: 1.0e-4

characteristic[7]:
  type: imaginary_part_of_refractive_index_constant
  retrieved: false
mode[1]:
  initial_guess:
    value: [0.005 ]
    min: [0.003 ]
    max: [0.006 ]
    index_of_wavelength_involved: [0 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 0
      lagrange_multiplier: 0.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-0
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-0
      derivative_order_of_T_variability: 0
      lagrange_multiplier_of_T_variability: 1.0e-4

characteristic[8]:
  type: sphere_fraction
  retrieved: false
mode[1]:
  initial_guess:
```

```

value: [0.9]
min: [0.005]
max: [0.9999]
index_of_wavelength_involved: [0]
single_pixel:
  smoothness_constraints:
    difference_order: 0
    lagrange_multiplier: 0.0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-2
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-2
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 1.0e-3

```

6.6 Case 6

```
# test6.sd.mp.opt.6wl.apri_surf_settings_example_polder_opt_w6_5layers
```

```

retrieval:
  convergence:
    stop_before_performing_retrieval: false
    minimization_convention: logarithm
    threshold_for_stopping: 1.0e-3
    maximum_iterations_for_stopping: 7
    maximum_iterations_of_Levenberg-Marquardt: 15
    threshold_for_stopping_Q_iterations: 1.0e-12
    scale_for_finite_difference: 1.0e-3
    normal_system_solver: sparse_matrix_solver
    shift_for_applying_logarithm_to_negative_values: 1.1

  regime_of_measurement_fitting:
    polarization: relative_polarization_components

  product_configuration:
    wavelength_indices_for_angstrom: [4, 5]
    wavelength_indices_for_ndvi: [4, 5]
    aerosol_particulate_matter_diameter: [2.5, 10]

  regime_of_multipixel_constraints:
    inversion_regime: multi_pixel

  noises:
    noise[1]:
      standard_deviation_synthetic: 0.0
      error_type: relative
      standard_deviation: 0.03
      measurement_type[1]:
        type: I
        index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    noise[2]:
      standard_deviation_synthetic: 0.0
      error_type: absolute
      standard_deviation: 0.005
      measurement_type[1]:
        type: Q
        index_of_wavelength_involved: [ 2, 4, 5 ]
      measurement_type[2]:
        type: U
        index_of_wavelength_involved: [ 2, 4, 5 ]

  radiative_transfer:
    number_of_layers: [5,50]
    aerosol_profile_vertical_type: exponential
    absolute_error_rt_calculations: 0.0005
    reference_plane_for_polarization: meridian
    simulating_observation:
      order_of_scattering: multiple_scattering
      number_of_gaussian_quadratures_for_expansion_coefficients: 15
      number_of_gaussian_quadratures_for_fourier_expansion_coefficients: 5

```

```
    number_of_fourier_expansion_coefficients: 4
simulating_derivatives:
  order_of_scattering: derivatives
  number_of_gaussian_quadratures_for_expansion_coefficients: 15
  number_of_gaussian_quadratures_for_fourier_expansion_coefficients: 4
  number_of_fourier_expansion_coefficients: 4
phase_matrix:
  size_binning_method_for_triangle_bins: logarithm
  number_of_elements: 4
  kernels_folder: "parasol_ang35_bin5_wl6"
  radius:
    mode[1]:
      bins: [ 0.1, 0.1732, 0.3, 1., 2.9 ]

products:
  aerosol:
    chemistry: false
    lidar: true
    optical_properties: true
    phase_matrix: false
    refractive_index: true
    theoretical_bimodal_extinction: true
    theoretical_bimodal_parameters: true
  error_estimation:
    aerosol:
      lidar: false
      optical_properties: false
      parameters: false
  forcing:
    broadband_flux: false
    forcing: false
  retrieval:
    fitting: false
    parameters: true
    residual: true
  surface: true
debug:
  verbose: false
  additional_information: false
constraints:
  characteristic[1]:
    type: size_distribution_precalculated_lognormal
    retrieved: true
    mode[1]:
      initial_guess:
        value: [0.01, 0.01, 0.01, 0.01, 0.01 ]
        min: [0.000005, 0.000005, 0.000005, 0.000005, 0.000005 ]
        max: [5.0, 5.0, 5.0, 5.0, 5.0 ]
        index_of_wavelength_involved: [0, 0, 0, 0, 0 ]
      single_pixel:
        smoothness_constraints:
          difference_order: 2
          lagrange_multiplier: 5.0e-3
      multi_pixel:
        smoothness_constraints:
          derivative_order_of_X_variability: 1
          lagrange_multiplier_of_X_variability: 1.0e-2
          derivative_order_of_Y_variability: 1
          lagrange_multiplier_of_Y_variability: 1.0e-2
          derivative_order_of_T_variability: 1
          lagrange_multiplier_of_T_variability: 5.0e-4

  characteristic[2]:
    type: real_part_of_refractive_index_spectral_dependent
    retrieved: true
    mode[1]:
      initial_guess:
        value: [1.46, 1.46, 1.46, 1.46, 1.46, 1.46]
        min: [1.33, 1.33, 1.33, 1.33, 1.33, 1.33]
        max: [1.6, 1.6, 1.6, 1.6, 1.6, 1.6]
        index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
```

```
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 1.0e+1
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-2
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-2
    derivative_order_of_T_variability: 0
    lagrange_multiplier_of_T_variability: 1.0e-3
characteristic[3]:
  type: imaginary_part_of_refractive_index_spectral_dependent
  retrieved: true
mode[1]:
  initial_guess:
    value: [ 0.005, 0.005, 0.005, 0.005, 0.005, 0.005 ]
    min: [ 0.00005, 0.00005, 0.00005, 0.00005, 0.00005, 0.00005 ]
    max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
single_pixel:
  smoothness_constraints:
    difference_order: 1
    lagrange_multiplier: 5.0e-2
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-2
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-2
    derivative_order_of_T_variability: 0
    lagrange_multiplier_of_T_variability: 1.0e-3
characteristic[4]:
  type: sphere_fraction
  retrieved: true
mode[1]:
  initial_guess:
    value: [0.9]
    min: [0.005]
    max: [0.9999]
    index_of_wavelength_involved: [0]
single_pixel:
  smoothness_constraints:
    difference_order: 0
    lagrange_multiplier: 0.0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-2
    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-2
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 1.0e-3
characteristic[5]:
  type: vertical_profile_parameter_height
  retrieved: true
mode[1]:
  initial_guess:
    value: [2000.0 ]
    min: [10.0 ]
    max: [5000.0 ]
    index_of_wavelength_involved: [0 ]
single_pixel:
  smoothness_constraints:
    difference_order: 0
    lagrange_multiplier: 0
multi_pixel:
  smoothness_constraints:
    derivative_order_of_X_variability: 1
    lagrange_multiplier_of_X_variability: 1.0e-2
```

```

    derivative_order_of_Y_variability: 1
    lagrange_multiplier_of_Y_variability: 1.0e-2
    derivative_order_of_T_variability: 1
    lagrange_multiplier_of_T_variability: 1.0e-3

characteristic[6]:
  type: surface_land_brdf_ross_li
  retrieved: true
  mode[1]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
      max: [ 1.1, 1.1, 1.1, 1.1, 1.1, 1.1 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 1.0e-4
      a_priori_estimates:
        lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0
  mode[2]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.001, 0.001, 0.001, 0.001, 0.001, 0.001 ]
      max: [ 2.0, 2.0, 2.0, 2.0, 2.0, 2.0 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 10.0e-0
      a_priori_estimates:
        lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0
  mode[3]:
    initial_guess:
      value: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
      min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
      max: [ 1.0, 1.0, 1.0, 1.0, 1.0, 1.0 ]
      index_of_wavelength_involved: [ 1, 2, 3, 4, 5, 6 ]
    single_pixel:
      smoothness_constraints:
        difference_order: 1
        lagrange_multiplier: 10.0e-0
      a_priori_estimates:
        lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
    multi_pixel:
      smoothness_constraints:
        derivative_order_of_X_variability: 0
        lagrange_multiplier_of_X_variability: 1.0e-3
        derivative_order_of_Y_variability: 0
        lagrange_multiplier_of_Y_variability: 1.0e-3
        derivative_order_of_T_variability: 1
        lagrange_multiplier_of_T_variability: 8.0e-0
characteristic[7]:
  type: surface_land_polarized_maignan_breon
  retrieved: true

```

```
mode[1]:
  initial_guess:
    value: [ 2.1, 2.1, 2.1, 2.1, 2.1, 2.1 ]
    min: [ 0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    max: [ 15.03, 15.03, 15.03, 15.03, 15.03, 15.03 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
    a_priori_estimates:
      lagrange_multiplier: [0.1, 0.1, 0.1, 0.1, 0.1, 0.1]
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 8.0e-0

characteristic[8]:
  type: surface_water_cox_munk_iso
  retrieved: true
mode[1]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.005, 0.005, 0.005 ]
    min: [ 0.0001, 0.0001, 0.0001, 0.0001, 0.0001, 0.0001 ]
    max: [ 0.05, 0.05, 0.05, 0.05, 0.05, 0.05 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 1.0e-3
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 1
      lagrange_multiplier_of_T_variability: 1.0e-3

mode[2]:
  initial_guess:
    value: [ 0.900, 0.900, 0.900, 0.900, 0.900, 0.900 ]
    min: [ 0.60, 0.60, 0.60, 0.60, 0.60, 0.60 ]
    max: [ 1.0000, 1.0000, 1.0000, 1.0000, 1.0000, 1.0000 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
    smoothness_constraints:
      derivative_order_of_X_variability: 1
      lagrange_multiplier_of_X_variability: 1.0e-3
      derivative_order_of_Y_variability: 1
      lagrange_multiplier_of_Y_variability: 1.0e-3
      derivative_order_of_T_variability: 0
      lagrange_multiplier_of_T_variability: 1.0e-3

mode[3]:
  initial_guess:
    value: [ 0.01, 0.01, 0.01, 0.01, 0.01, 0.01 ]
    min: [ 0.0015, 0.0015, 0.0015, 0.0015, 0.0015, 0.0015 ]
    max: [ 0.1, 0.1, 0.1, 0.1, 0.1, 0.1 ]
    index_of_wavelength_involved: [1, 2, 3, 4, 5, 6 ]
  single_pixel:
    smoothness_constraints:
      difference_order: 1
      lagrange_multiplier: 10.0e-0
  multi_pixel:
```

```
smoothness_constraints:  
  derivative_order_of_X_variability: 1  
  lagrange_multiplier_of_X_variability: 1.0e-3  
  derivative_order_of_Y_variability: 1  
  lagrange_multiplier_of_Y_variability: 1.0e-3  
  derivative_order_of_T_variability: 0  
  lagrange_multiplier_of_T_variability: 1.0e-3
```