NH_3 Deposition Workflow

IASI → Dry & Wet Fluxes → Natura-2000 Reserves

Zhonghua Ma

1 Column → Mass

$$m(\mathbf{x},t) = \frac{N(\mathbf{x},t)\;10^{16}\ \mathrm{cm}^{-2}}{N_A}\;\frac{M_{\mathrm{NH_3}}}{1000} \quad \left[\mathrm{kg\,m^{-2}}\right] \tag{1}$$

N = IASI column $\quad N_A = 6.022\,140\,76 \times 10^{23}\,\mathrm{mol}^{-1}, \quad M_{\mathrm{NH_3}} = 17.031\,\mathrm{g\,mol}^{-1}$

2 Dry Deposition Velocity (V_d)

$$V_d(\mathbf{x},t) = A_d + B_d\,u_*(\mathbf{x},t) \quad \left[\mathrm{m\,s^{-1}}\right] \tag{2}$$

with $A_d = 0.001$ and $B_d = 0.005$ (equivalent to $0.1 + 0.5\,u_*$ in $\mathrm{cm\,s^{-1}}$).

3 Surface Concentration inside the Mixed Layer

$$C_{\mathrm{surf}}(\mathbf{x},t) = \frac{m(\mathbf{x},t)}{\mathrm{BLH}(\mathbf{x},t)} \quad \left[\mathrm{kg\,m^{-3}}\right] \tag{3}$$

4 Dry Flux per Month

$$F_{\mathrm{dry}}(\mathbf{x},t) = V_d(\mathbf{x},t)\;C_{\mathrm{surf}}(\mathbf{x},t)\;\Delta t(t) \quad \left[\mathrm{kg\,m^{-2}\,month^{-1}}\right] \tag{4}$$

5 Rain Rate from ERA5 `tp`

$$P(\mathbf{x},t) = \mathrm{tp}(\mathbf{x},t)\;3600\;1000 \quad \left[\mathrm{mm\,h^{-1}}\right] \tag{5}$$

6 Below-Cloud Scavenging Coefficient

$$\lambda_p(\mathbf{x},t) = \Lambda\,P(\mathbf{x},t), \qquad \Lambda = 4 \times 10^{-5}\ \mathrm{s^{-1}}\,(\mathrm{mm\,h^{-1}})^{-1} \tag{6}$$

7 Wet Flux per Month

$$F_{\mathrm{wet}}(\mathbf{x},t) = \lambda_p(\mathbf{x},t)\;m(\mathbf{x},t)\;\Delta t(t) \quad \left[\mathrm{kg\,m^{-2}\,month^{-1}}\right] \tag{7}$$

8 Reserve-Integrated Flux

$$\mathcal{F}_r(t) = \sum_{i,j} \left[F_{\mathrm{dry}} + F_{\mathrm{wet}}\right]_{i,j,t} A_{ij}\;f_{ij,r} \quad \left[\mathrm{kg\,month^{-1}}\right] \tag{8}$$

A_{ij} is the spherical-rectangle cell area, $A_{ij} = R^2\,\Delta\phi\,\Delta\lambda\cos\phi_i$, and $f_{ij,r} \in [0,1]$ is the supersampled fractional overlap of grid-cell (i,j) with reserve r.

Notes

- Δt equals `days_in_month` $\times$ 86400.
- Negative F_{dry} values correspond to upward NH_3 emission when the compensation point exceeds the ambient concentration.
- Supersampling factor 10×10 (1 km effective) is used to compute $f_{ij,r}$ with `rasterio.features.rasterize`