Geo-sensory time series
- Sensors deployed in different geospatial locations
- Constantly reporting readings of different measurements
- Examples
- Forecasting them is of great importance to our daily lives

Challenges
- Dynamic spatio-temporal correlation
- External factors (e.g., meteorology)

Methodology

Preliminary
- Suppose there are $N_s$ sensors
- Each sensor generates $N_i$ kinds of readings about different measurements
- Predict the target series of a given sensor over the next $T$ hours

Framework
- Multi-level attention network
  - Spatial attention
  - Temporal attention
  - External factors fusion module

Temporal Attention
- Select relevant historical time slots to make predictions
  \[ \hat{y}_i^t = \text{tanh}(\theta \cdot W \cdot (d_{i,t-1}) + W_h h_0 + b_i) \]

Spatial Attention
- Local spatial attention: select relevant local features
- Global spatial attention: select relevant sensors

External Factors Fusion
- New encoder input
  \[ \tilde{x}_i = [x_{local} ; x_{global}] \]
- Update decoder hidden state
  \[ \tilde{y}^t = \text{tanh}(W_m [c_t ; d_t] + b_m) + b_y \]
- Output generation
  \[ y^t = \text{softmax}(W_y (\tilde{y}^t) + b_y) \]

Model Training
- GeoMAN is smooth and differentiable
- Loss function
  \[ L(\theta) = \| \hat{y} - y \|_2^2 \]
- Optimizer: Adam

Results

Attention Visualization